LK220 Series

Programmable Logic Controller System Manual

Intelligence For Excellence

HollySys Group

Beijing HollySys Intelligent Technologies Co., Ltd.

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Address: Di Sheng Middle Road, No.2,
Economic-Technological Development Area, 100176, Beijing, China
Tel: +86 010-5898 1588
Consulting Hotline: 4008-111-999
Technology Request: +86 010-58981514
Fax: +86 010-5898 1558
Web: http://www.hollysys.com
Email: PLC@hollysys.com
Sina weibo: http://weibo.com/hollysysplc

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Chapter 1 About This Document

1.1 What's New

Version	Description	Date
V1.0	New	June.2016
V1.1	Add LK234	April.2017
V1.2	1. Update temperature and humidity 2. Update module name: LK610, LK710, LK441, LK511 3. Add LK410, LK510, LK620	January.2018
V1.3	Update Chapter 3.2.3.3 Terminal Matching Resistor Settings	March. 2018
V1.4	Add LK250 and LE5406	March. 2019
V1.0	Modify range of the operating temperature to -20 ℃~70 ℃ and storage temperature to -40℃ ~80℃ (Except LK910 and LKA102), update Copyright information	June. 2019
V1.1	LK220 as a master station can configure two IP addresses LK250 configures mode IO IO configuration mode of LK250 is improved	November. 2019
V1.2	Add LK222/LK224/LK132/LK133/LK922 module Update Hardware Product List	April. 2020
V1.3	LK250 supports 30 slave stations	September. 2020
V1.4	Add LK631/LK246/LK241/LK235 /SP100-2FP4T-SFP module	November. 2020
V1.5	Add LK512 controller Add optical module in Chapter 2.3 Update company information	Match. 2021
V1.6	Add LK238 and SP010-1FP1T-SFP module	December. 2021
V1.7	Add LK621/LK622/LK220T1 module	August. 2022
V1.8	Add LK271/LK272 module LK250 supports LK616/LK716/LK432 modules LK250 supports confguring Watchdog Time Support free protocol	January. 2023
V1.9	Modify LK922 power wiring Support free protocol	January. 2024
V2.0	Update description of LK720	February. 2024
V2.1	Add the configuration of LK235M、LK241M Added module: LKC131, LKC171, LK231 Delete the relevant instructions for LK410, LK411, LK412, LK430, LK441, LK442, LK510, LK511 calibration operation indicator lamps LK512 increase current/voltage output capacity indicator LK220/LK222/LK224/LK220T1 Increase of 10 KB in power-down hold data area M LK220/LK222/LK224 Integrated Ethernet Communication Rate Update Type Selection and Planning Add TCP/IP,OPC UA,Modbus TCP	August . 2024
V2.2	The applicable range of LK410 has been updated from 10V/0~10V/0~5V to -10V~10V/0~10V/0~5V, and the maximum measurable range has been updated from 10.25V/0~10.25V/0~5.125V to -10.25V~10.25V/0~10.25V/0~5.125V.	September. 2024

Version	Description	Date
	Update the connection diagram for LK235M. The AC voltage range of LK720 has been modified to 10~265V. The number of Modbus TCP connections for LK224 has been modified to 32. Revise the LK250 optical fiber cascading diagram and the DP and optical fiber combination cascading diagram.	
V2.3	Add import of PN devices. Add controller LK216 and IO module LK619. Update LK271 to view PN device diagnostic information. Update configuration for master station polling: increase total periodic polling time and add periodic data polling time. Update the wiring description for LK104 and LK107. Adjustment of Installation Dimension Schematic for LK118 Backplane. Add communication specifications to the LK512/LK442 technical specifications table.	December. 2024

1.2 Purpose

This Manual mainly introduces the operational principle, major functions, wiring instructions, configuration settings, technical specifications and so on of LK series programmable control system. It helps users to use the product properly.

1.3 Intended audience

This document is intended for engineers and salesmen who have a basic knowledge of automation.

1.4 Important information

The following marks are used in this manual for identifying appropriate information:

Danger: This symbol indicates a dangerous situation that could cause death or injury if not avoided.

Electric shock: This symbol indicates a dangerous situation of electric shock if not avoided.

Warning: This symbol indicates a dangerous situation that could cause property or environment damage if not avoided.

Notes: This symbol indicates useful tips or recommendations for efficient operation.

SEE ALSO This symbol indicates information for reference.

1.5 Related documentation

HollySys Programmable Logic Control System Instruction Manual

AutoThink V3.1 User Manual_Project Configuration

LK220 Series Programmable Logic Controller System Manual

1.6 Terminology

Terminology	Description
Profibus –DP	Standard bus protocol
MRAM	Magnetic random access memory, a nonvolatile memory
Modbus	A serial interface industrial bus protocol, used for communication between electron devices
PHY	PHY refers to the physical layer, the lowest level of OSI. It is the medium access control and medium interface of the data link layer
PCIe	Peripheral Component Interface Express, a quick and peripheral interconnection standard

1.7 Abbreviations

Abbreviations	Full Name
AT	AutoThink
I/O	Input / Output
DC	Direct Current
FPGA	Field Programmable Gate Array
TCP/IP	Transmission Control Protocol/Internet Protocol
Profibus	Process Field Bus
AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
TC	Thermocouple Assembly
HSC	High Speed Counting
RTD	Resistance Temperature Detector
RTC	Real-Time Clock
HMI	Human Machine Interface
STP	Shielded Twisted Pair

Chapter 2 Overview

LK control system has high reliability, high performance, and fast response characteristics, can be widely used in a variety of application scenarios, such as subway, water treatment, high-end equipment. The redundant system is composed of the controller, IO and programming software, which can realize the functions of data acquisition, logic calculation, output execution, human-computer interaction, data exchange and so on, realizing automation and intelligence.

2.1 Hardware Components

LK system hardware includes main control unit and IO unit.

The main control unit adopts dual-stand redundancy structure, which is divided into A-Frame

and B-Frame. Each set of control unit includes main control backplane, power module, controller module, communication module and synchronous module.

IO unit collects field data and expands IO modules. It mainly includes extension backplane, communication interface module and I / O module.

Controller Unit of 6-slot Backplane

2.1.1 Controller Unit

- Main control backplane

  You can install control unit modules in the main control backplane. The main control modules communicate with each other through the backplane bus.

  Main control backplane includes LK130, LK132 and LK133 .

  - LK130: 4-slot backplane, one power supply slot, one controller slot, two communication module slots.
  - LK132: 6-slot backplane, one power supply slot, one controller slot, four communication module slots.
  - LK133: 7-slot backplane, two redundant power supply slots, one controller slot, four communication module slots.

- Power supply module

  It is installed in the power supply slot to provide 24VDC power for main control module in backplane. At present, LK921 and LK922 are supported, and the power supply model can be selected flexibly according to the main control backplane used.

- LK921: DC power supply adapter module, which can be configured separately.
- LK922: Redundancy DC power supply module, which can be configured separately or redundantly.

- Controller module

It is installed in the controller slot, with dual Ethernet ports. The controller supports Modbus TCP, HolliTCP and TCP/IP free port . Connect AT, HMI and third-party upper software upward, and extend I / O module downward.

According to the specification, it can be divided into four models: LK216, LK220, LK222, LK224 and LK220T1. It can be selected according to the actual needs. See Technical Specifications.

- Communication module

It is installed in the communication extension slot for system expansion and third-party equipment communication. At present, it includes LK240, LK249, LK246, LK241 and LK241M modules.

LK240: Redundancy synchronization module is used for data synchronization and interaction of master-slave controller.

LK249: Profibus-DP master station communication module is used to expand IO slave station.

LK246: Ethernet communication processor module (High-performance) provides two Ethernet ports. Connect AT, HMI and third-party upper software upward. Support for Modbus TCP protocol, OPC UA server.

LK241: POWERLINK master station communication module, supporting ring network redundancy, is used to expand IO slave station.

LK241M: HolliTCP master station communication module is used to expand IO slave station.

2.1.2 IO Unit

- Extension backplane

Install communication interface module and I / O module in extension backplane. The extension backplane includes one communication slot and several I / O slots, and multiple slots are optional. Provide 24VDC power interface, Profibus-DP communication interface, address dial switch and IO terminal. The extension backplane connects the main control backplane upward and allows multiple backplanes to cascade downward. The backplane can be distributed remotely to realize the remote I / O access.

At present,LK117 (11 slots) and LK118 (5 slots) are supported.

- Communication interface module

Installed in the first slot of the extension backplane, as the interface of system bus communication, it can realize bus daisy chain, star and other topologies.

Through the interface module, the bus signal can be received and amplified, or the bus can be divided into multiple network segments. Improve system bus signal quality and system scale.

■ I/O module

Install in the I / O slot of the extension backplane. It mainly includes DI, DO, AI, AO, RTD, TC, HSC, SOE,SSI and third-party modules.

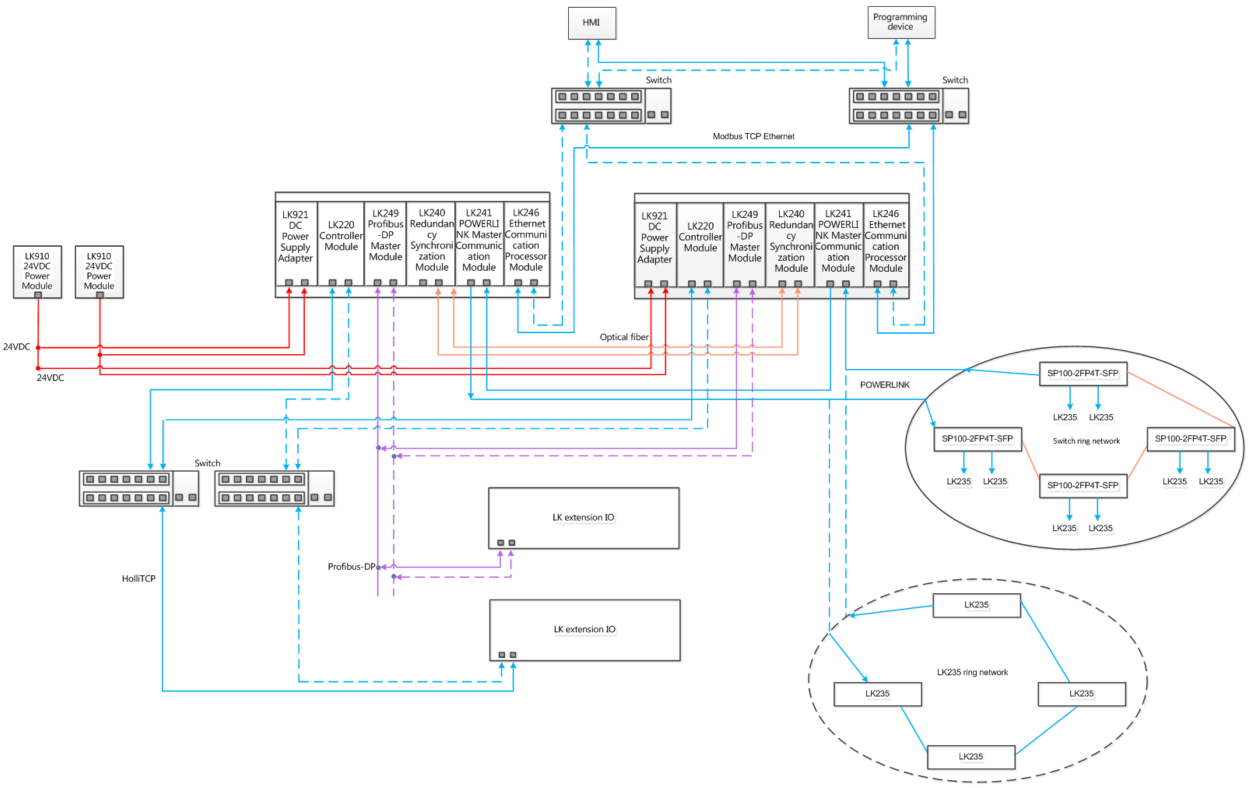
2.2 Network Topology Structure

LK system provides various types of backplane and communication modules to build different hardware structures.

Network structure:

- Profibus-DP bus network, a maximum of 124 I / O slaves are supported.
- ModbusTCP Ethernet, supporting redundancy. can be configured through controller and LK246. Connect AT, HMI and third-party upper software upward.
- HoliTCP network, supporting redundancy, Connect AT, HMI and third-party upper software upward.
- POWERLINK Industrial Ethernet can be configured through LK235 or SP100-2FP4T-SFP.
- Support single rack and redundant rack.

The following figure shows the typical network configuration of LK system.



Network Topology of LK system

2.3 Hardware Product List

The LK series programmable logical control system hardware products mainly include master control modules, communication modules, I/O modules, backplanes and power modules. Wherein, the I/O modules fall into multiple types, as shown in table.

LK System Hardware Product List

Module Type	Model	Specifications
Master controller Unit	LK130	4-slot, local backplane, 235×166×44.3 mm, with 4 CPCI pin interfaces
	LK132	6-slot, local backplane, 325×166×44.3 mm, with 6 CPCI pin interfaces
	LK133	7-slot, local backplane, 387.7×166×44.3 mm, with 7 CPCI pin interfaces
	LK921	24V DC power supply adapter module, converting two 24VDC inputs into a 24VDC output. Input voltage: 12~30 VDC, with independently pluggable input terminals
	LK922	Redundancy 24V DC power supply adapter module, supporting single module or redundancy configuration, 24VDC input and dry contact output
	LK216	600 MHz, power-lose retentive memory (R area): 64KB, M area power-lose retentive size : 4KB, supporting single machine
	LK220	600 MHz, power-lose retentive memory (R area): 64KB, M area power-lose retentive size : 4KB, supporting redundancy
	LK222	667MHz, power-lose retentive memory (R area): 96KB, M area power-lose retentive size : 6KB, supporting redundancy
	LK224	766MHz, power-lose retentive memory (R area): 128KB, M area power-lose retentive size : 8KB, supporting redundancy
	LK220T1	600 MHz, power-lose retentive memory (R area): 192KB, M area power-lose retentive size : 10KB, supporting redundancy, supporting security and trusted function
	LK249	Profibus-DP master station communication module, two road DB9 receptacle, supporting hot swapping
	LK240	Redundancy synchronization module, dual optical fiber communication interface of LC type
	LK246	Ethernet communication processor module, double Ethernet ports, High-performance
	LK241	POWERLINK/PL-LINK master station communication module, double Ethernet ports, supporting ring network redundancy
	LK241M	HolliTCP master module, 2 Redundant Ethernet Interfaces
	LK141	Master back plate empty slot module
Power supply	LK910	24 VDC power module, input voltage:110VAC/220VAC, output voltage: 24 VDC, power: 120 W, DIN rail mounting
Extension Backplane	LK117	Local backplane, 11-slot, 385×166×55.5 mm, with DB9 hole receptacles applied to Profibus-DP interfaces, provided pluggable with I/O terminals
	LK118	Local backplane, 5-slot, 210×166×55.5 mm, with DB9 hole receptacles applied to Profibus-DP interfaces, provided with pluggable I/O terminals
Communication module	LK231	Profibus-DP communication switching module, providing terminal matching resistance for the bus
	LK232	Profibus-DP bus repeater, with terminal resistance switches
	LK233	Profibus-DP bus optoelectronic transceiver
	LK234	Ethernet interface module
	LK238	Serial Communication Module
	LK239	Modbus master/slave communication extension module, RS232/RS485 interface
	LK250	Profibus-DP network extension module

Module Type	Model	Specifications
	LE5406	Profibus-DP to LE bus communication extension module
	LK235	POWERLINK/PL-LINK interface module, double Ethernet ports, supporting ring network redundancy
	LK235M	HolliTCP interface module
	LK271	PROFINET communication module
	LK272	PROFINET interface module
Switch	SP100-2FP4T-SFP	POWERLINK Industrial Ethernet switch, 2 optical ports, 4 Ethernet ports
	SP010-1FP1T-SFP	Photoelectric conversion module, 1 optical ports, 1 Ethernet ports
DI	LK610	16-channel leaking type digital input module
	LK616	32-channel 24VDC leaky digital input module
	LK619	16-Channel 230VAC Digital Input Module
DO	LK710	16-channel source type digital output module, MOSFET output, capacity: 0.5 A, 10~30 VDC
	LK716	32-channel transistor type digital output module
	LK720	10~265VAC/5~125VDC 8-way normally open relay output module
AI	LK410	8-channel voltage type analog input module, ±10V/0~5V/0~10V
	LK411	8-channel current type analog input module, 0~20 mA/4~20 mA
	LK412	6-channel isolation analog input module, 0~20 mA/4~20 mA/±10 V/0~5 V/0~10 V
	LK430	6-channel thermal resistance analog input module, PT100/200/500/1000, Ni100/120/200/500, Cu10/50
	LK432	8-channel thermal resistance analog input module, PT100/200/500/1000, Ni100/120/200/500, Cu10/50
	LK441	8-channel thermocouple analog input module, B/C/E/J/K/N/R/S/T type thermocouple, -12 mV~+32 mV (+78 mV)
	LK442	6-channel isolated thermocouple analog input module, B/C/E/J/K/N/R/S/T type thermocouple, -12 mV~+32 mV (+78 mV)
High-speed counting module	LK620	2-channel counting module, 2 counters, each one has 3-way pulse inputs and 2-way MOSFET outputs
AO	LK510	4-channel inter-channel isolated voltage type analog output module, ±10.25V/0~5.125V/0~10.25V
	LK511	4-channel inter-channel isolated current type analog output module, 0~21 mA/4~20 mA
SOE	LK631	24VDC 14-channel SOE module
SSI	LK621	2-channel SSI absolute value encoder module
Frequency measurement	LK622	6-channel high precision frequency measurement module
Slot Module	LKC131	IO Back Slot Module
Attachment	LKA101	Profibus-DP bus connector module
	LKA102	Battery power box module
	LKA103	Capacitance power box module
	LKA104	Profibus-DP bus connector module
	LKA107	Profibus-DP bus connector module
	LKA105	Optical fiber, length is 5 meters
	LKA106	Optical fiber, length is 1 meter
	SFP-FS-LC	Single-mode transceiver, Distance 20km
	SFP-FM-LC	Multi-mode transceiver, Distance 2km
	GACS-1312-20ID	Single-mode transceiver, Distance 20km
	GACS-8512-02ID	Multi-mode transceiver, Distance 550m

Module Type	Model	Specifications
	LKC171	Terminal Cover Plate

2.4 Model Selection and Planning

2.4.1 Power Capacity Calculation and Configuration

For the sake of security, it is suggested that the total power consumption of all the modules shall not exceed 70% of the selected power supply. Refer to the following table for the power consumption of the modules. The table only represents the LK system power capacity. The field power capacity of the LK Series (that is, power supply to switch, load, field devices including transmitter, etc.), shall be determined according to the specific load of each I/O channel. Refer to each I/O module section.

- In order to ensure the electrical isolation between the field and the system, the field power should be configured separately from the system power, otherwise the field side short circuit will lead to system hardware damage.
- The system power module must be CE certified.

Power Consumption of Hardware Modules

Module Type	Model	Rated Voltage	Current (max.)	Power consumption
Master control module	LK216	24 VDC	400 mA	9.6 W
	LK220	24 VDC	400 mA	9.6 W
	LK222	24 VDC	400 mA	9.6 W
	LK224	24 VDC	400 mA	9.6 W
	LK220T1	24 VDC	400 mA	9.6 W
AI	LK410	24VDC	100 mA	2.4 W
	LK411	24 VDC	60 mA	1.44 W
	LK412	24 VDC	150 mA	3.6 W
RTD	LK430	24 VDC	65 mA	1.56 W
	LK432	24 VDC	60mA	1.44 W
TC	LK441	24 VDC	60 mA	1.44 W
	LK442	24 VDC	120 mA	1.44 W
AO	LK511	24 VDC	180 mA	4.32 W
	LK512	24 VDC	100 mA	2.4 W
High-speed counting module	LK620	24VDC	80 mA	1.92W
DI	LK610	24 VDC	50 mA	1.2 W
	LK616	24 VDC	60mA	1.44W
	LK619	24 VDC	50 mA	1.2 W
DO	LK710	24 VDC	130 mA	3.12 W
	LK716	24 VDC	60mA	1.44W
	LK720	24 VDC	140 mA	3.36 W
SOE	LK631	24VDC	100 mA	2.4 W
SSI	LK621	24 VDC	150 mA	3.6 W

Module Type	Model	Rated Voltage	Current (max.)	Power consumption
Frequency measurement	LK622	24VDC	80 mA	1.92W
Communication module	LK231	24 VDC	50 mA	1.2W
	LK232	24 VDC	60 mA	1.44 W
	LK233	24 VDC	80 mA	1.92 W
	LK234	24 VDC	180 mA	4.32 W
	LK238	24VDC	80 mA	1.92W
	LK239	24VDC	80 mA	1.92W
	LK240	24 VDC	250 mA	6 W
	LK249	24 VDC	200 mA	4.8 W
	LK250	24 VDC	300 mA	7.2 W
	LE5406	24 VDC	83 mA	2 W
	LK246	24 VDC	300 mA	7.2 W
	LK241	24 VDC	300 mA	7.2 W
	LK241M	24 VDC	300 mA	7.2 W
	LK235	24 VDC	180 mA	4.32 W
	LK235M	24 VDC	180 mA	4.32 W
	LK271	24 VDC	180 mA	4.32 W
	LK272	24 VDC	180 mA	4.32 W

2.4.2 Ethernet Connection

Controller module and LK246 provides two Ethernet interfaces, using the standard RJ45 interface and shielded cable as the transmission medium.

Ethernet is in redundant mode, one is in normal communication and the other is in hot standby redundancy status. When communication fails, it will automatically switch to the other.

ETHERNET1 interface default as network segment 128, ETHERNET2 interface default as network segment 129, see the following table for the default IP. For network reliability, network segments 128 and 129 shall use different switch.

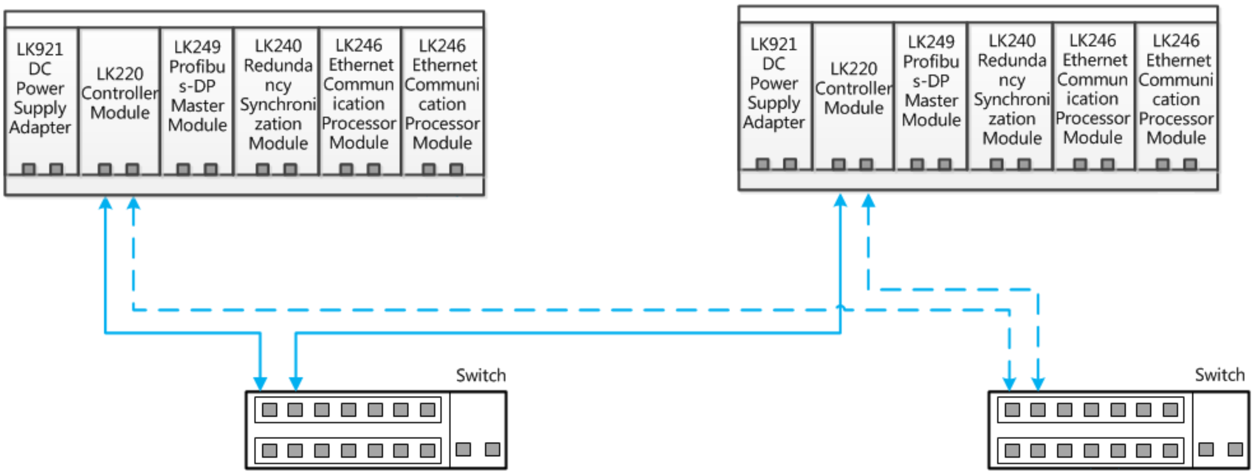
Network port communication rate and default IP

Ethernet interface	Communication rate	Default IP
Controller Ethernet interface	10M/100M/1000 Mbps self-adapting	ETHERNET1:128.0.0.250 ETHERNET2:129.0.0.250
LK246 Ethernet interface	10M/100M/1000 Mbps self-adapting	ETHERNET1:128.0.X-1.250 ETHERNET2:128.0.X-1.250 X is device address of module, the device address of controller slot is default 1 , and the device address of slot on the right side of the controller is added 1 in turn

Controller module and LK246 module support TCP/IP free port protocol, OPC UA protocol, Modbus TCP protocol to communicate with external devices, please see the details of each module.

TCP/IP Connection

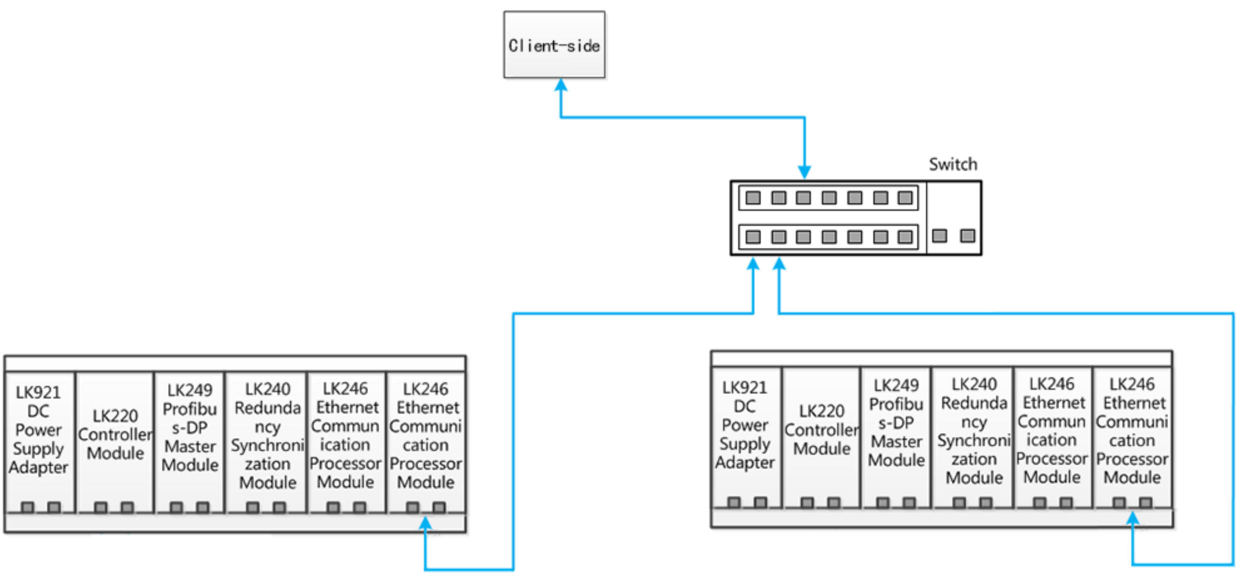
Two Ethernet interfaces inside the controller module support TCP/IP free port protocol for data communication, including transmitting data only, receiving data only, sending and receiving data.



TCP/IP network connection diagram

OPC UA Connection LK246 module integrates OPC UA protocol functions.

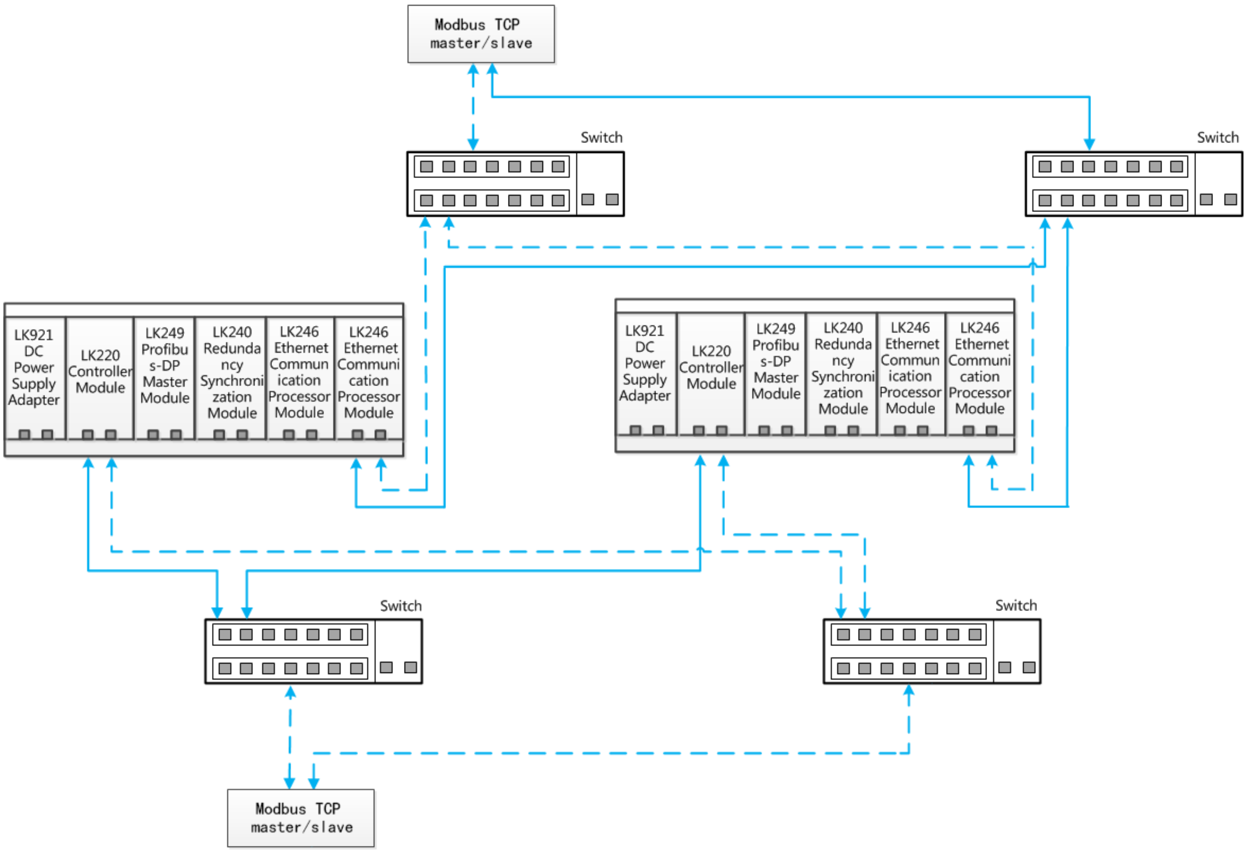
- Only one OPCA-A _ Server protocol can be configured for the entire project, and only one LK246 module can be configured for a single port. The LK246 veneer supports up to 16 channels (Modbus master + Modbus slave + OPCAA _ Server).
- The number of configurable OPC UA variables is subject to the size of bytes occupied by all variables and up to 20000 bytes for all configured OPC UA variables.
- When dual racks are switched between the master and the standby, the OPC UA server will actively disconnect the link, and the current subscription resources of the client cannot be released by the server according to the agreement, and can not be released actively until the end of the subscription cycle (note: the subscription cycle is the client configuration parameter). If, before the end of the subscription cycle, the OPC UA server disconnects multiple times, causing clients to request multiple subscriptions to the server limit, new subscription resources cannot be added.



OPC UA network connection diagram

2.4.2.1 Modbus TCP Connection

Both the controller and the LK246 module support the Modbus TCP protocol and can be configured as master or slave. ModbusTCP requires a maximum number of master-slave connections, refer to Maximum Number of Master-Slave Connections.



Modbus TCP network connection diagram

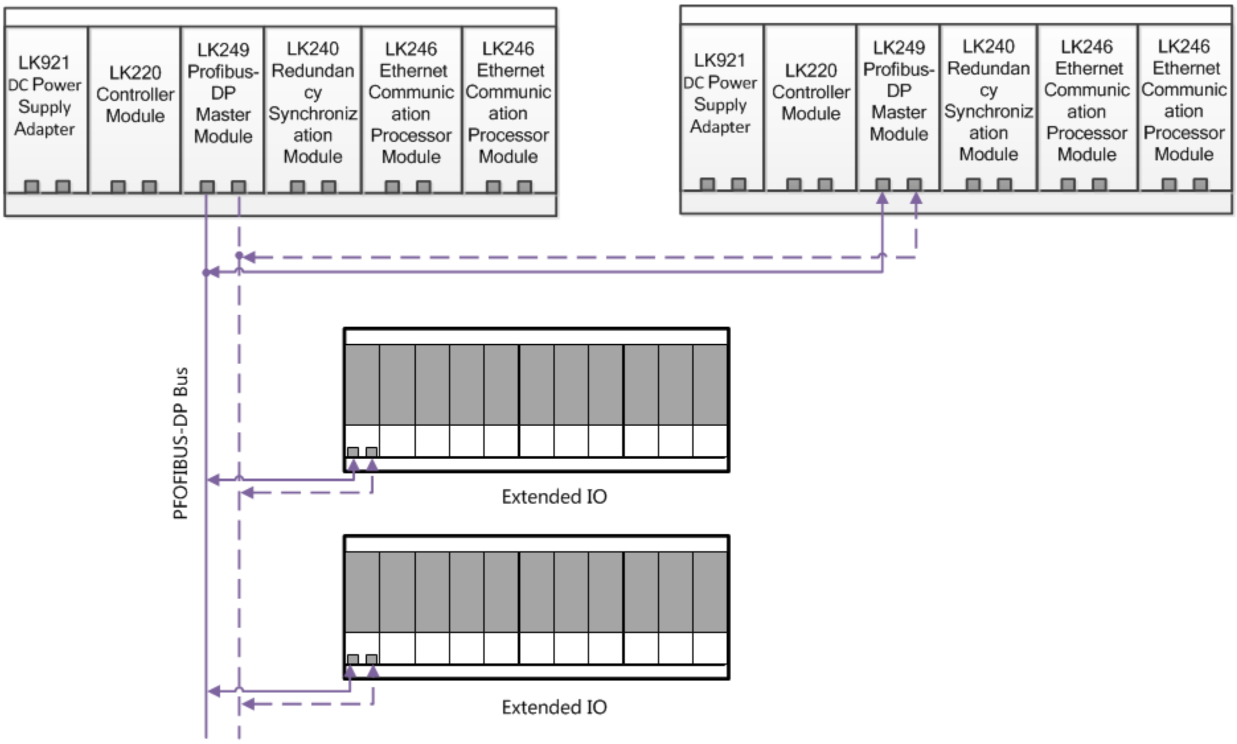
2.4.3 Profibus-DP Network Connection and Calculation

As shown in figure, it can cascade multiple extension backplanes to increase I/O via the redundant Profibus-DP bus interface (DP1, DP2) on LK249 module. It shall adopt two LKA104 modules to connect DP interface between LK249 module and extension backplane, with the communication rate 187.5kbps, 500 kbps, 1.5M bps, 3Mbps, 6Mbps, optional and the transmission medium of RS485 shielded twisted pair.

For the I/O passing through Profibus-DP extension backplane, it shall carefully calculate its node capacity before configuring the LK series programmable logical control system, estimating whether all the I/O bus scanning period can meet the specific project requirements.

Capacity of node: IO slave station up to 124 on Profibus-DP segment, node address from 2 to 125. 1 is fixed to the address of the master controller, with 2~125 are for the I/O modules.

Calculation of bus scanning period: even when it is feasible to calculate the capacities of node, to meet the speed requirement of a specific engineering project, it finally shall still calculate the bus scanning period.



Schematic Diagram of Profibus-DP Network Connection

2.4.4 Profibus-DP Bus Scanning Period

When configuring the DP slave scale, the entire DP polling cycle should not exceed 150ms. Refer to table for roughly estimating DP polling cycle in current DP scale (Note: table as a reference value of polling cycle for single slave station).

DP polling cycle is the total time to poll all slave stations.

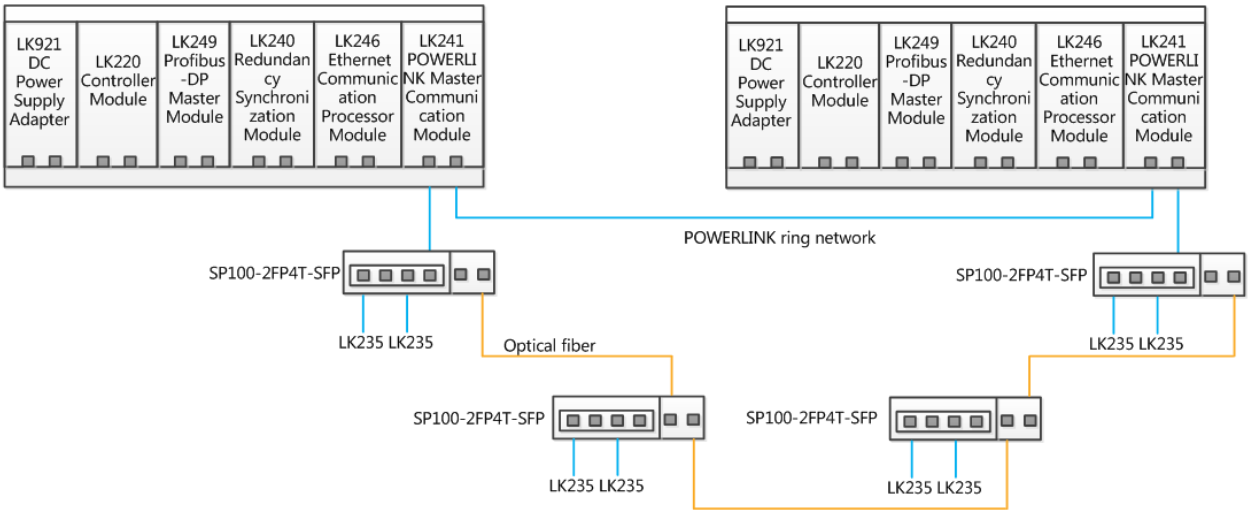
Polling Cycle for Single Slave Station

Baud rate	LK239 module requires time (ms, the maximum number of configured module)	Non-LK239 module requires time (ms)
187.5kbps	34	2.2
500kbps and above which	14	1

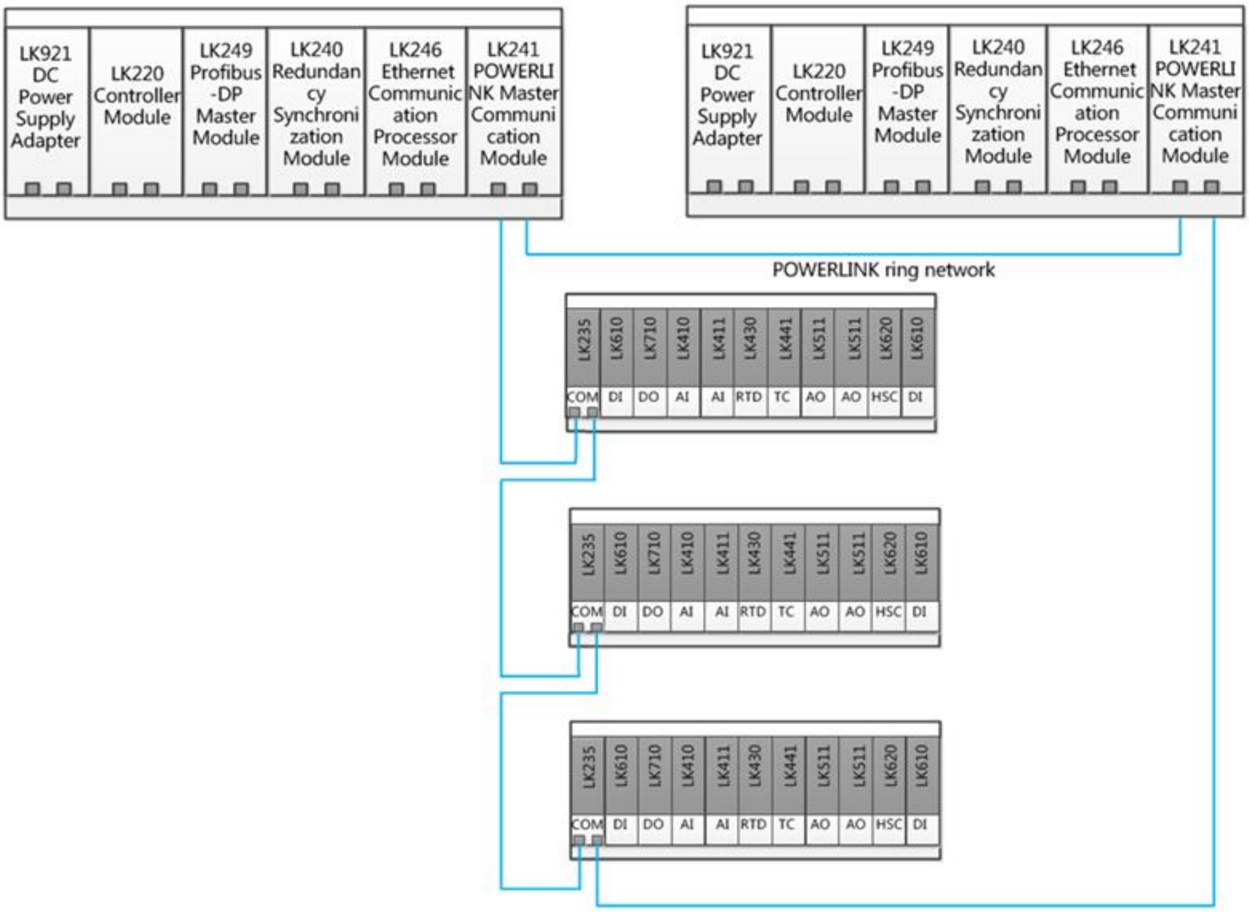
2.4.5 POWERLINK Network Connection

When LK extends the IO rack through POWERLINK connection, LK241, LK235 and SP100-2FP4T-SFP switches can form a ring network. Through the SP100-2FP4T-SFP switch to configure ring network, main ring network can support up to 32 switches, and each switch can support up to 4 LK235 POWERLINK interface modules. Through LK235 to configure ring network, it can support up to 40 LK235

POWERLINK interface modules.



SP100-2FP4T-SFP Ring Network Connection



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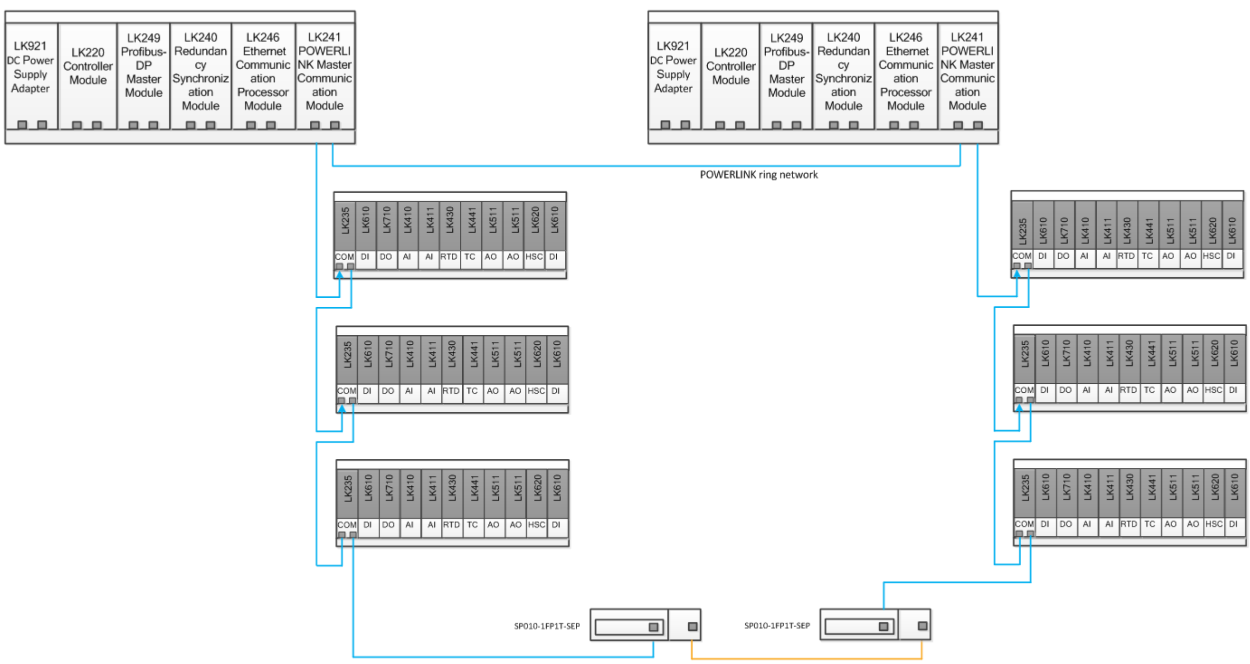

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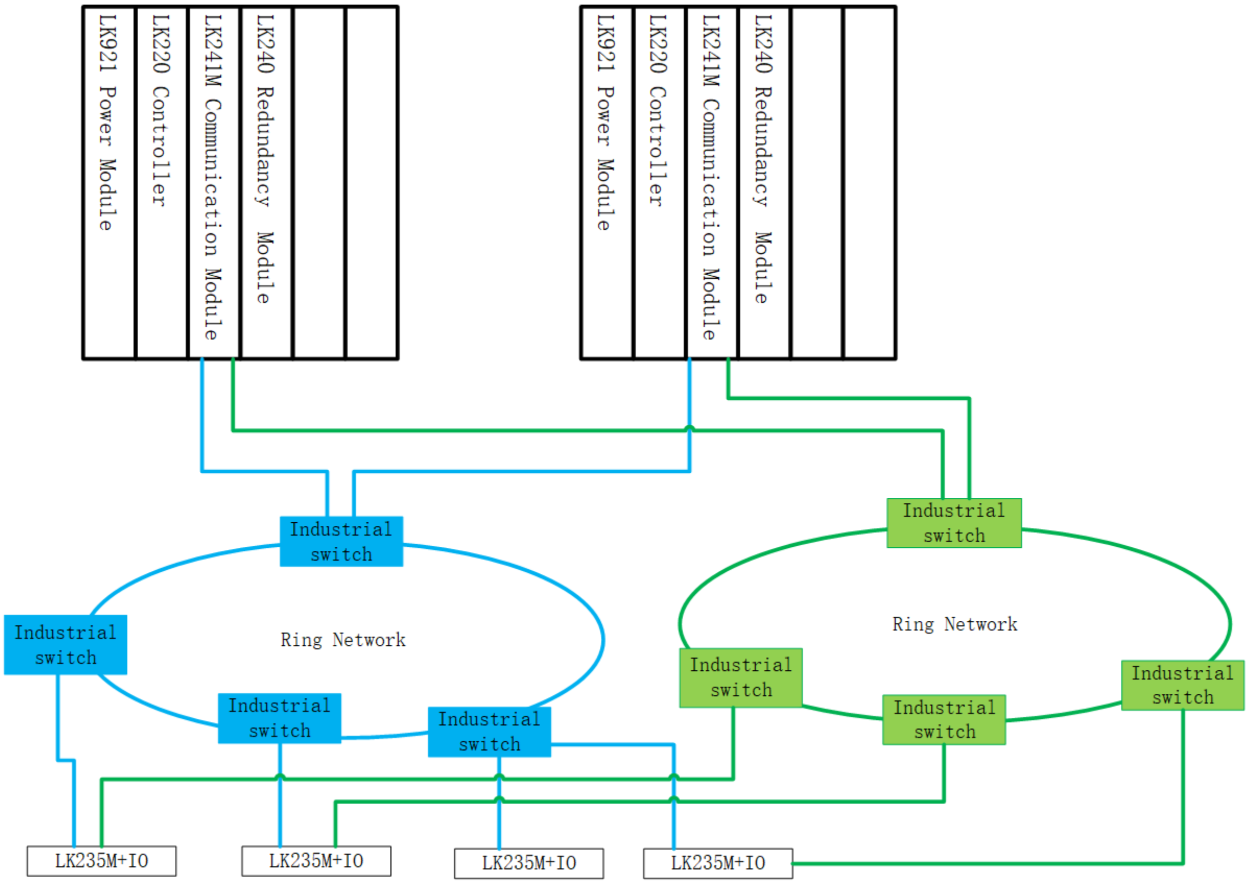
LK235 Ring Network Connection

2.4.6 HolliTCP Network Connection

The HolliTCP protocol is a proprietary control bus protocol based on TCP/IP protocol, which can be extended by controller or LK241M module networking. LK220/LK222/LK224/LK241M and LK235M, industrial switch control network, can support up to 64 LK235M module.



HolliTCP Ring Network Diagram

- Support single network and dual network mode.
- When the switch is a linear network (non-ring network), it can work normally.
- Cascading switch will affect the real-time data refresh, serious cases will occur packet loss.

2.5 System Specification

General Technical Specifications for LK Series Programmable Logical Control System

General Technical specifications for LK Series Programmable Logical Control System			
System Power	24 VDC	Supply voltage	24VDC (-15%, +20%)

General Technical specifications for LK Series Programmable Logical Control System			
		Ripple	<5%
		Polarity-reverse protection	Supported
Electromagnetic Compatibility	Anti noise	Electrostatic discharge	IEC61000-4-2 contact discharge 6 kV, air discharge 8 kV
		Radiated immunity of radio frequency field	IEC61000-4-3 20 V/m (80 ~1000 MHz)
		Electrical fast transient	IEC61000-4-4 2 kV
		Surge immunity	IEC61000-4-5 2 kV
		Conducted immunity of radio frequency field	IEC61000-4-6 10 V
		Power frequency magnetic field immunity	IEC61000-4-8 magnetic field strength of stable and continuous magnetic field test 30 A/m
	Electromagnetic radiation	Radiated interference	IEC61131-2 30~230 MHz, the quasi-peak value less than 40 dB (μV/m) 230~1000 MHz, the quasi-peak value less than 47 dB (μV/m) 1~3 GHz, the quasi-peak value less than 70dB(μV/m), with the average value less 56 dB(μV) 3~6 GHz, the quasi-peak value less than 80dB（μV/m）, with the average value less 60 dB（μV）
		Conducted interference	IEC61131-2 0.15~0.5 MHz, with the quasi-peak value less than 79 dB (μV), with the average value less than 66 dB (μV) 0.5~30 MHz, with the quasi-peak value less than 73 dB (μV), with the average value less than 60 dB(μV)
Environmental adaptability	Climatic environment	Operating temperature	-20℃~70℃（Operating temperature of LKA102 is 0℃~50℃,and LK245 is -20℃~60℃）
		Operating humidity	5%~95%, with no condensation
		Operating altitude	0~2000 m
		Storage temperature	-40℃~80℃(Storage temperature of LKA102 is 0℃~+35℃)
		Storage humidity	5%~95%, with no condensation
	Mechanical environment	Vibration	IEC61131-2-4: 5Hz ≤ f ≤ 8.4Hz, 3.5mm displacement; 9Hz ≤ f ≤ 150Hz, 1.0g, constant acceleration
		Impact	IEC61131-2-4: 15 g, duration: 11 ms
	Enclosure protection	Enclosure protection rating	IEC60529 IP20 (preventing the entry of foreign matters with a size over 12 mm, non-watertight)

2.6 Product Storage and Transport

2.6.1 Storage

To hold the performance of the LK hardware during storage, the LK Series must be placed indoors. It is forbidden to place the devices in open air. See the following for the optimal storage environment:

(1) Storage temperature: 0℃~+40℃.

(2) Relative humidity: 40%~80%, without condensation.

(3) It shall not allow storing various flammable, explosive, corrosive gases and articles indoors.

(4) It shall be free of fierce mechanical vibration, impact and strong magnetic field indoors.

(5) The packing box shall be elevated no less than 100 mm away from the ground, at least 500 mm away from the wall, heat source, cold source, window or air ventilation port.

2.6.2 Transport

It shall strictly follow the following when transporting the LK hardware products:

(1) Protective measures shall be taken during transport. The packing box shall be kept away from rain, snow or drip washing of liquid substance and mechanical damage. During long-distance transport, the products shall not be loaded onto an open cabin and compartment. During transshipment, the products shall not be placed in an open warehouse.

(2) The packing box shall meet the Level-II stipulations of GB9813 concerning vibration, collision and impact adaptability.

(3) When handling the packing box, it shall strictly forbid strenuous vibration, collision and falloff.

(4) Product weight: refer to following table.

LK Hardware Module Weight List

Model	Module Name	Weight
LK117	11-slot extension backplane	1740 g
LK118	5-slot extension backplane	880 g
LK130	4-slot backplane module	939 g
LK132	6-slot backplane module	1332 g
LK133	7-slot backplane module	1576 g
LK216	Master control module (single machine)	382 g
LK220	Master control module (redundancy)	382 g
LK222	Master control module (redundancy)	382 g

Model	Module Name	Weight
LK224	Master control module (redundancy)	382 g
LK220T1	Static trusted controller module	382 g
LK921	24V DC power supply adapter module	371 g
LK922	Redundancy 24V DC power supply adapter module	508 g
LK910	24VDC power module	790 g
LK231	Profibus-DP Communication Transfer Module	170 g
LK232	Profibus-DP bus repeater module	170 g
LK233	Profibus-DP bus optoelectronic transceiver	170 g
LK238	Serial Communication Module	180g
LK239	Modbus master/slave communication extension module, RS232/RS485 interface	180 g
LK240	Redundancy Synchronization Module	365 g
LK249	Profibus-DP master station communication module	365 g
LK234	Ethernet Interface Module	300 g
LK250	Profibus-DP network extension module	185 g
LE5406	Profibus-DP to LE bus communication extension module	300 g
LK246	Ethernet communication processor module	365 g
LK241	POWERLINK master station communication module	365 g
LK241M	HolliTCP master module	380 g
LK235	POWERLINK interface module	190 g
LK235M	HolliTCP interface module	190 g
LK271	PROFINET communication module, POWERLINK converted to DP or PN master	190 g
LK272	PROFINET interface module, PROFINET converted to DP	190 g
SP100-2FP4T-SFP	POWERLINK Industrial Ethernet switch	300 g
SP010-1FP1T-SFP	Photoelectric conversion module	300 g
LK410	8-channel voltage type analog input module	190 g
LK411	8-channel current type analog input module	190 g
LK412	6-channel isolation analog input module	190 g
LK430	6-channel thermal resistance analog input module	180 g
LK432	8-channel thermal resistance analog input module	205 g
LK441	8-channel thermocouple analog input module	180 g
LK442	6-channel isolated thermocouple analog input module	180 g
LK510	4-channel inter-channel isolated voltage type analog output module	180 g
LK511	4-channel inter-channel isolated current type analog output module	200 g
LK512	8-channel current voltage analog output module	200 g
LK610	16-channel leaking type digital input module	180 g

Model	Module Name	Weight
LK616	32-channel 24VDC leaky digital input module	200 g
LK619	16-Channel 230VAC Digital Input Module	320 g
LK620	2-channel counting module	185 g
LK621	2-channel SSI absolute value encoder module	185 g
LK622	6-channel high precision frequency measurement module	185 g
LK631	24VDC 14-channel SOE module	180 g
LK710	16-channel source type digital output module	200 g
LK716	32-channel transistor type digital output module	200 g
LK720	10~265VAC/5~125VDC 8-way normally open relay output module	210 g
LKA101	Profibus-DP bus connector	30 g
LKA102	Battery power box module	22 g
LKA103	Capacitance power box module	16 g
LKA104	Profibus-DP bus connector	30 g
LKA107	Profibus-DP bus connector	30 g

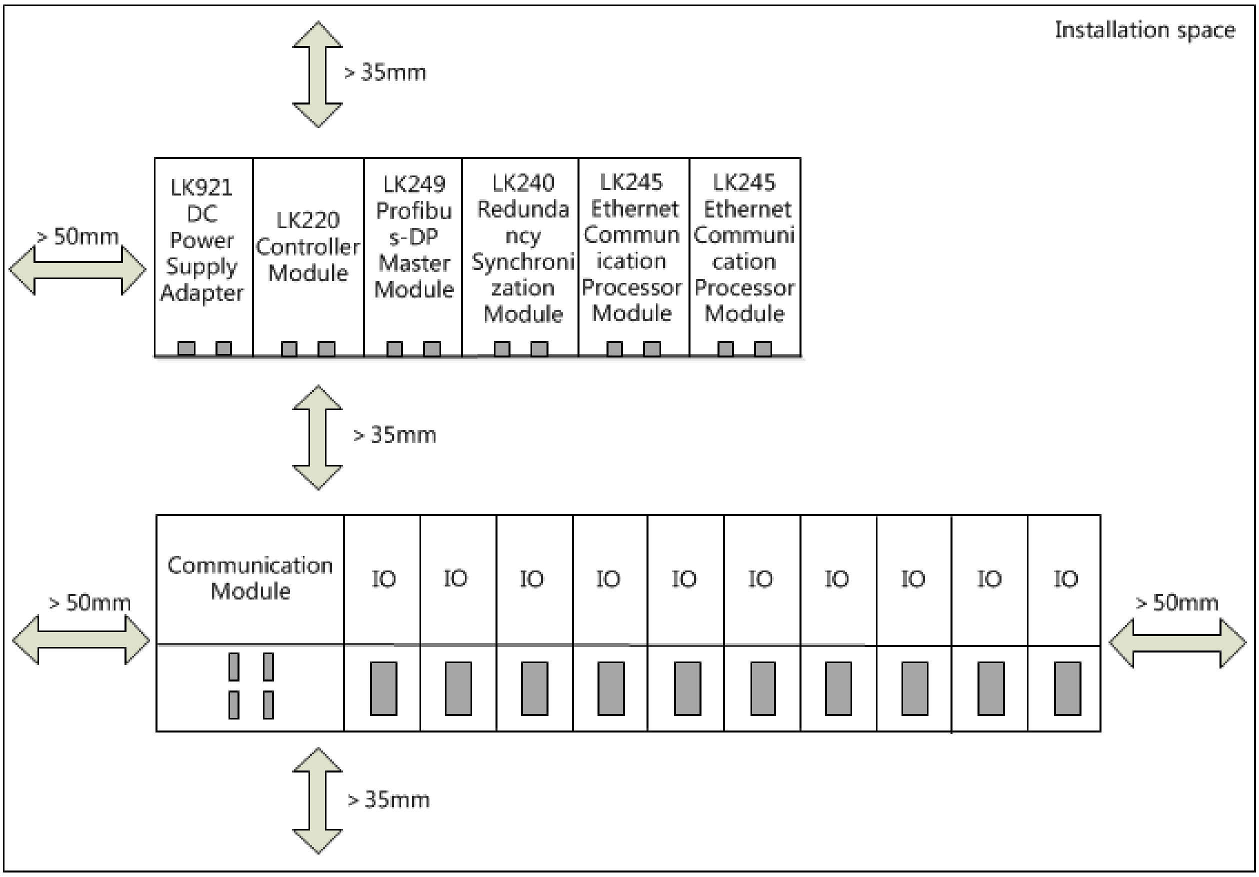
Chapter 3 Installation and Wiring

3.1 Layout Planning and Installation

Based on power capacity planning, network planning and node capacity planning mentioned in the previous chapter, by giving full consideration to all factors, it can consider the layout and installation of the modules on the backplane after having determined the quantities and configurations of master control modules, I/O modules and backplanes.

3.1.1 Space Layout

When placing a LK backplane, it shall consider keeping enough room for ventilation, which can also facilitate the engineering personnel in terms of successful wiring, routing and installation, etc.



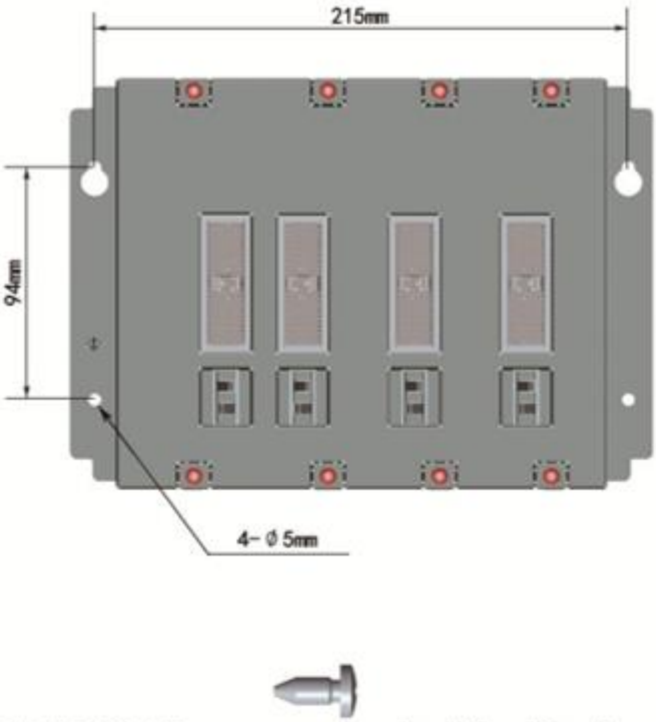
Spatial Layout Requirements Relating to LK Backplane Installation

3.1.2 Backplane Installation

3.1.2.1 Installation of Master Control Backplane

The local backplane is surface mounted. A pair of mounting holes is provided at both ends, fastened to the mounting surface with M5 screws. The mounting surface shall be smooth, clean and even.

Take LK130 as an example for installation, refer to figure for the hole size (Unit: mm).



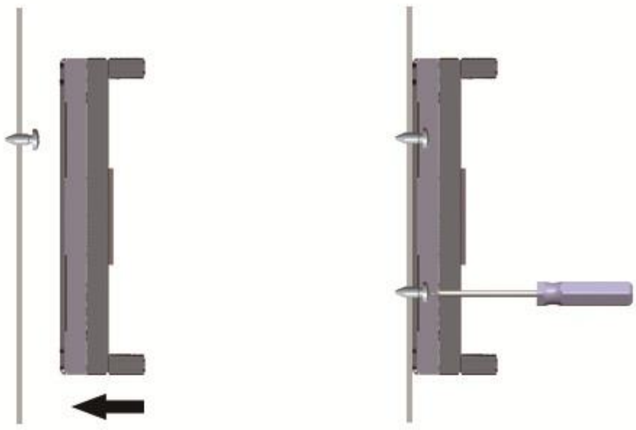
GB/T6560 M5 × 10 cross recessed pan head thread forming screws

Hole Size on Master Control Backplane

The local backplane is fixed by screws. Firstly drill 4 mounting holes on the mounting surface according to the hole size, with an aperture of 5 ± 0.5 mm. The specific installation steps as following:

(1) Select a M5 cross recessed head screw and screw it into the mounting hole for about 2/3 of the threads, keeping a clearance between the screw and the mounting surface.

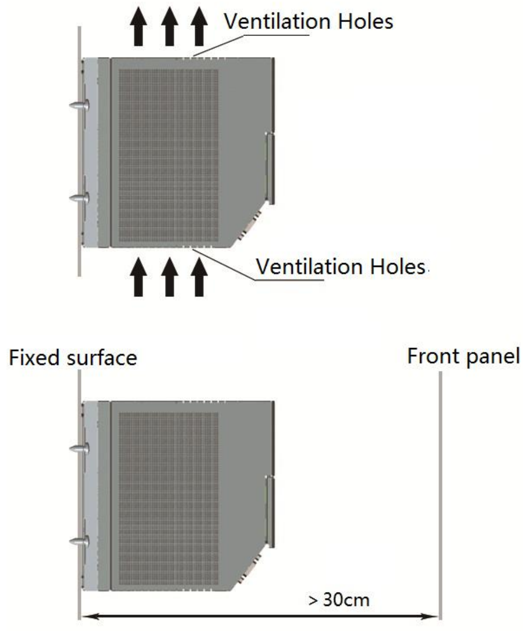
(2) Put the master control backplane mounting hole in alignment with the screw, slightly push down to fix the screw into the mounting hole tightly, then fasten the screw.



Installation Diagram of Master Control Backplane

Since the service life of all the electrical equipment continuously working with a higher ambient temperature is shortened, the ventilation of the electrical equipment must be considered carefully.

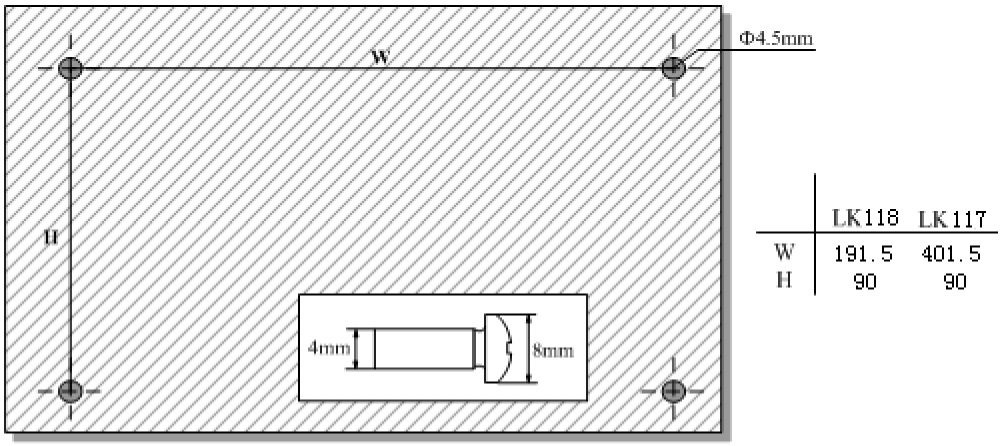
The LK series programmable logical control system adopts radiation through natural convection. Therefore, some requirements are put forward for the installation mode and the placement space of backplanes, thus ensuring that the system equipment is sound in ventilation and radiation.



Correct Installation of The Backplane

3.1.2.2 Installation of Extension Backplane

The LK extension backplane is surface mounted. A pair of mounting holes is provided at both ends, fastened to the mounting surface with M4 screws. The mounting surface shall be smooth, clean and even. Refer to figure for the hole size (Unit: mm).

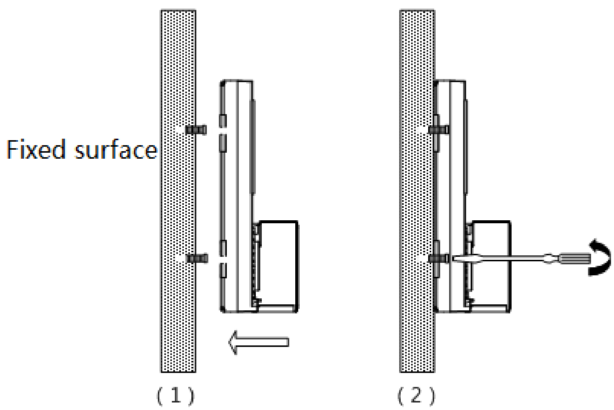


Hole Size on Extension Backplane

The extension backplane is fixed by screws. Firstly drill 4 mounting holes on the mounting surface according to the opening size, with an aperture of 4.5±0.5 mm. The specific installation steps as following:

(1) Select a M4 cross recessed head screw and screw it into the mounting hole for about 2/3 of the threads, keeping a clearance between the screw and the mounting surface.

(2) Put the extension backplane mounting hole in alignment with the screw, slightly push down to fix the screw into the mounting hole tightly, then fasten the screw.



Installation Diagram of Extension Backplane

3.1.3 Protection Key

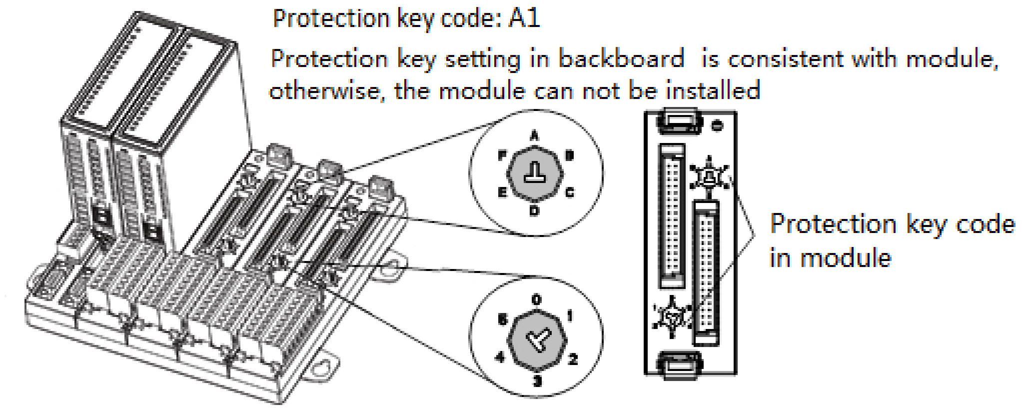
The I/O wiring is in the extension backplane, not in the module, so it must provide a coded protection key to prevent the module from being damaged when being plugged into an improper slot.

The protection key of the LK Series is located on the module and extension backplane. The code of a protection key for the LK Series includes two digits. One digit is letter from A to F, and other digit is number from 0 to 5. The combination of these two digits can provide 36 code positions (A0~F5).

Only IO module and communication module can set protection key code, specific modules and protection key code refer to Installation and Disassembly of IO Module.

The protection key on the module is of a female mold. Each type of electrically compatible module is allocated with a unique code, which is fixed and unable to modify upon delivery. The protection key on the extension backplane is of a male mold, able to rotate to fit into the plugged module.

Taking LK411 for example, the protection key code of the module is A1. When installing the module, rotate the protection key for the corresponding slot on the backplane to A1, which corresponds to the protection key position of the module, then plug in the LK411 module, as shown in figure.



Set Protection Keys for LK Module

3.1.4 Installation and Removal of Control Module

The main control modules are installed on the control backplane. The module slot refers to actual installed backplane model.

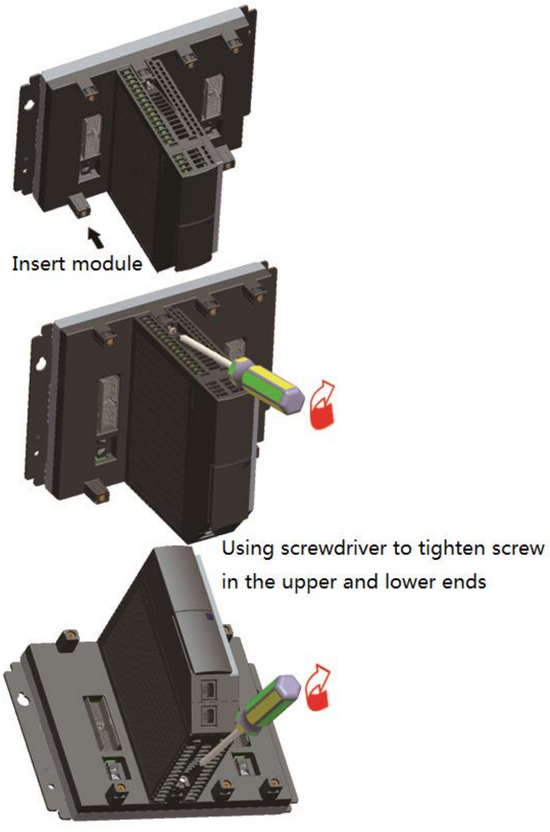
- Installation attention:
  - □ The main control unit module shall be installed in the cabinet.
  - □ The main control unit module is designed for pollution level 2.
  - □ The installation position of the modules on the master-slave rack must be consistent.
  - □ The main control module shall be installed in the metal cabinet, and the IP level of the cabinet shall not be lower than IP41.
  - □ First, optical fiber is inserted to module, and then install the module into the backplane when LK240 module is installed with electricity.

3.1.4.1 Installation

Follow these steps to install:

(1) After importing hole on the module and importing column on upper and lower ends of the slot are aligned, insert the module level, until completely into the bottom in slot.

(2) Using screwdriver to tighten screws at the upper & lower ends.



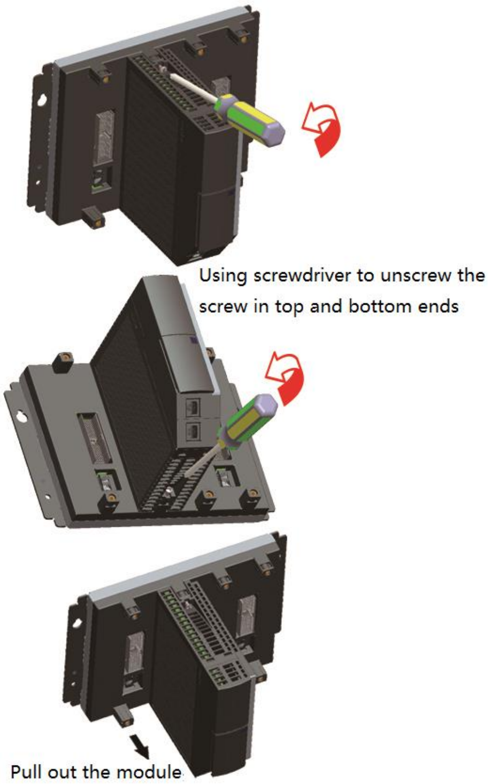
Install Module

3.1.4.2 Removal

Follow these steps to remove:

(1) Use a screwdriver to loosen the screw in top and bottom ends of the module.

(2) Pull out the module level.



Removal Module

3.1.5 Installation and Removal of IO Module

The IO modules are installed on the extension backplane. The communication module is installed in first slot and the IO module is installed in other slots.

When installing the IO module, the protection key in the installation slot matches with module.

Protection Key code of IO Module

Module Type	Model	Protection Key
Communication module	LK232	A5
	LK233	A5
	LK234	A5
	LK239	F1
	LK250	B5
	LK235	A5
	LK271	A5
	LK272	A5
DI	LK610	D0
	LK616	D1

Module Type	Model	Protection Key
	LK619	A4
DO	LK710	E0
	LK716	E1
	LK720	D3
AI	LK410	A0
	LK411	A1
	LK412	A0
	LK430	A2
	LK432	A3
	LK441	B1
	LK442	B2
High-speed counting module	LK620	F2
AO	LK510	C0
	LK511	C1
SOE	LK631	D0

3.1.5.1 Installation

Follow these steps to install:

(1) According to the protection key of module to set protection key in installation slot.

(2) After the guide hole on the module is aligned with the guide column on the backplane, insert the module horizontally to the bottom of the slot.

When the "click" sound is heard, the module is installed in place.

(3) Put the M3 × 20 screws into the screw mounting hole at the top of the module and tighten the screw.

Pay attention that movement shall not be too much when tightening the screw, so as to avoid damaging the module.

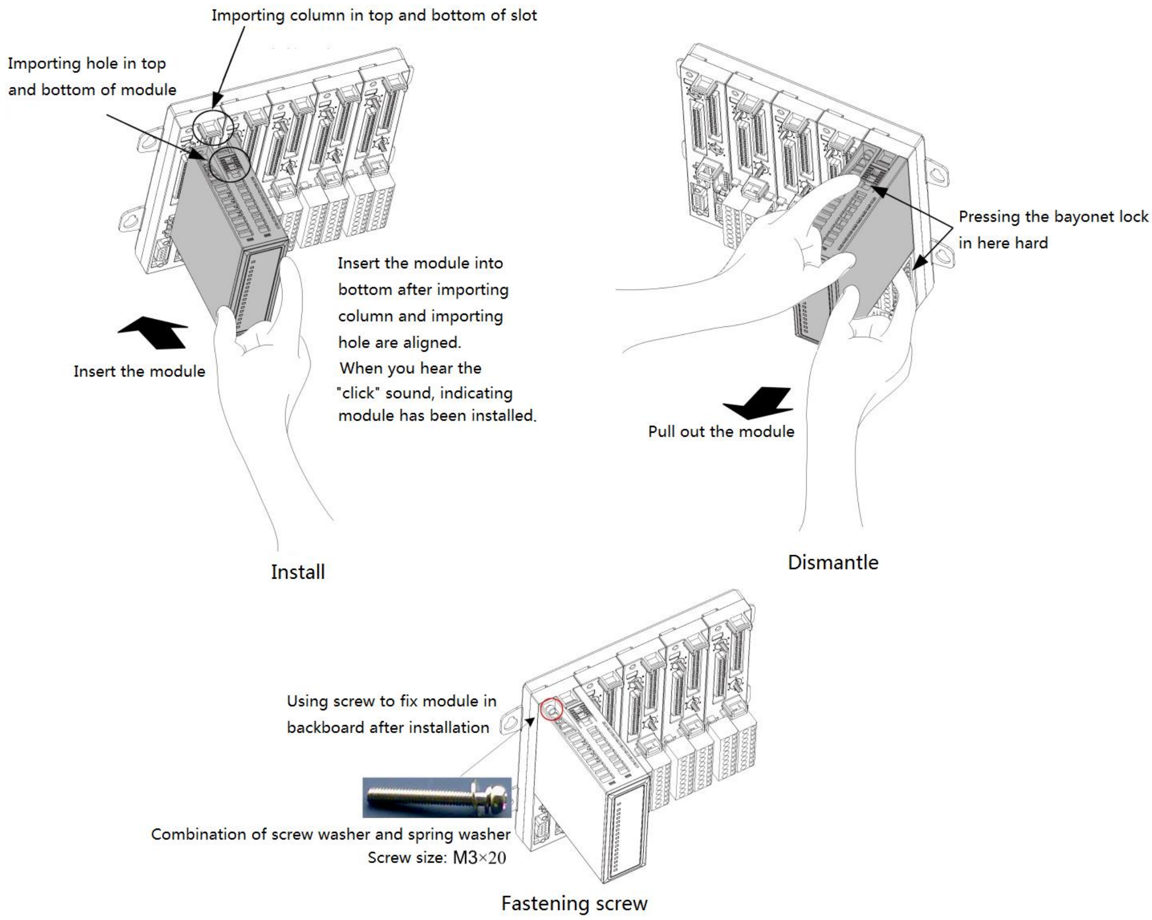
3.1.5.2 Removal

Follow these steps to remove:

(1) Use a screwdriver to loosen the fixing screws at the top of the module.

(2) Press clips at the upper and lower ends of the module.

(3) Pull out the module horizontally.



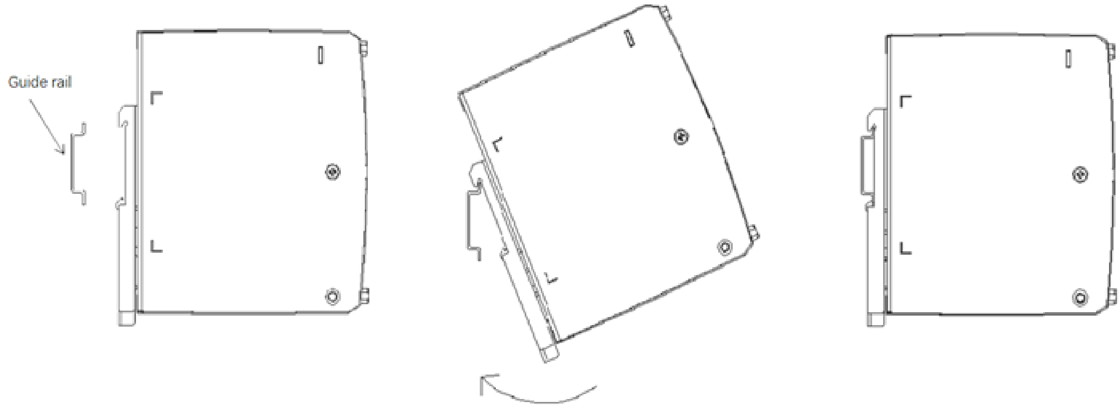
Installation and Disassembly of IO Modules

3.1.6 Installation of LK910

The Lk910 power module adopts standard DIN rail installation:

(1) Tilt the module so that the upper card slot of the module catches the edge of the DIN rail.

(2) Gently push the module to snap the lower slot into the edge of the DIN rail. When you hear a "click", it indicates that the module has been installed in place.



LK910 Installation

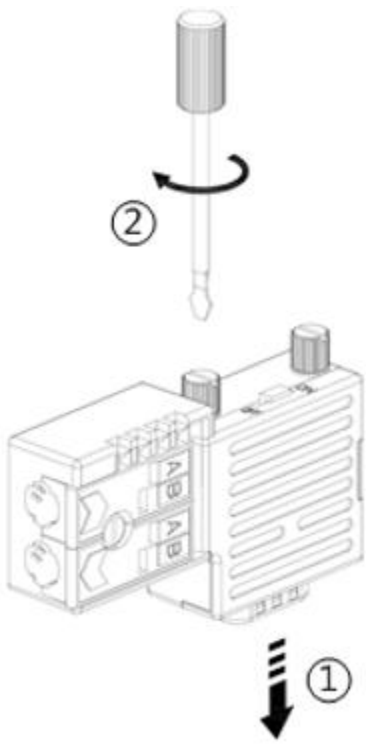
3.1.7 Installation of LKA104

LKA104 connector is used to connect DP signal between LK backplane.

You can insert the LKA104 connector into installation position. The installation steps are as follows:

(1) Insert the DB9 male connector into female socket in the backplane or in LK249 module.

(2) Tighten the fastening screws of the DB9 with a flat-head screwdriver.



LKA104 Installation Schematic Diagram

3.1.8 Installation of Power Supply Box

Battery slot on the front panel of controller module that can be used to install LKA102 battery power supply box or LKA103 capacitor power supply box. The installation steps are as follows:

(1) The module is inserted into battery slot horizontally, with holding the top and bottom edges from the front of the module.

(2) Push the battery into the battery compartment bottom at an end, and complete installation after fastener is buckled.

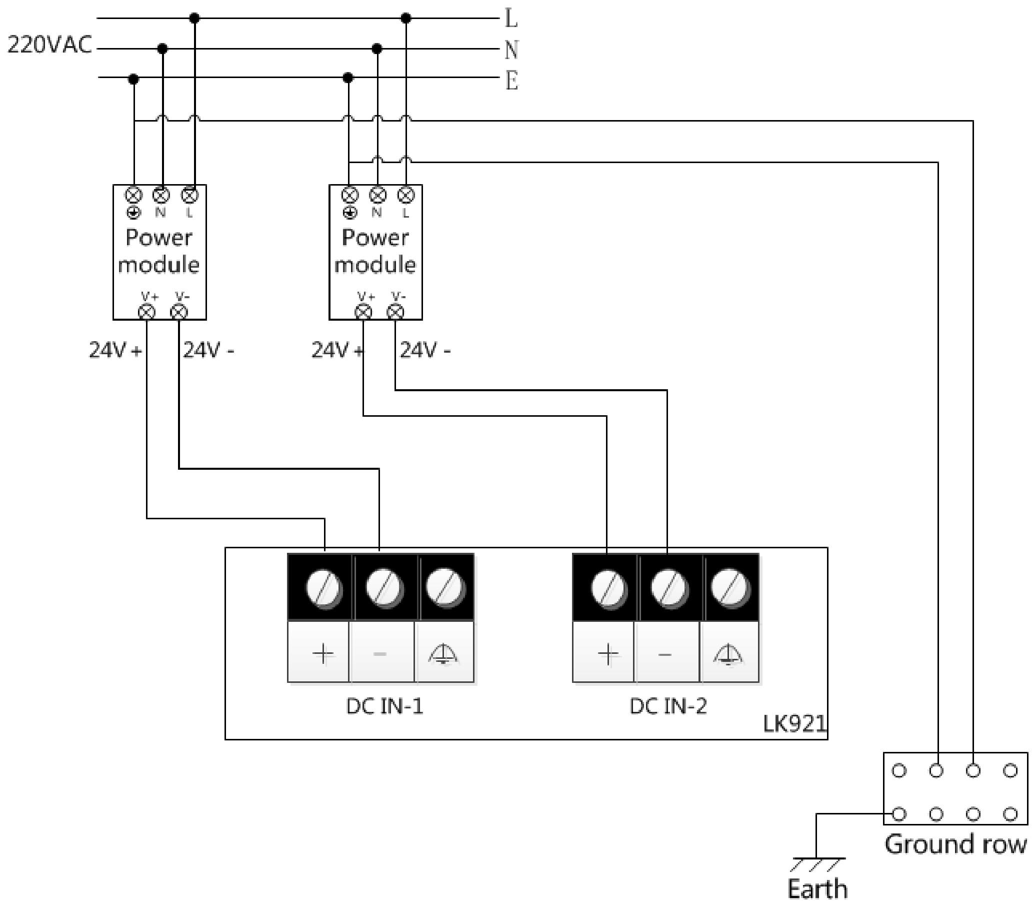
Installation Schematic Diagram of Power Supply Box

3.2 System Wiring

3.2.1 LK921 Power Wiring

The LK921 DC power supply adapter module has 2 sets input terminals. Three positions are provided in each terminal for 24V+, 24V- and system ground wire. System power wiring as shown in figure.

Note: Symbol ⏚ is functional ground of the system, to discharge electromagnetic interference. When wiring , the grounding terminal of LK921 cannot be connected to the ground row.



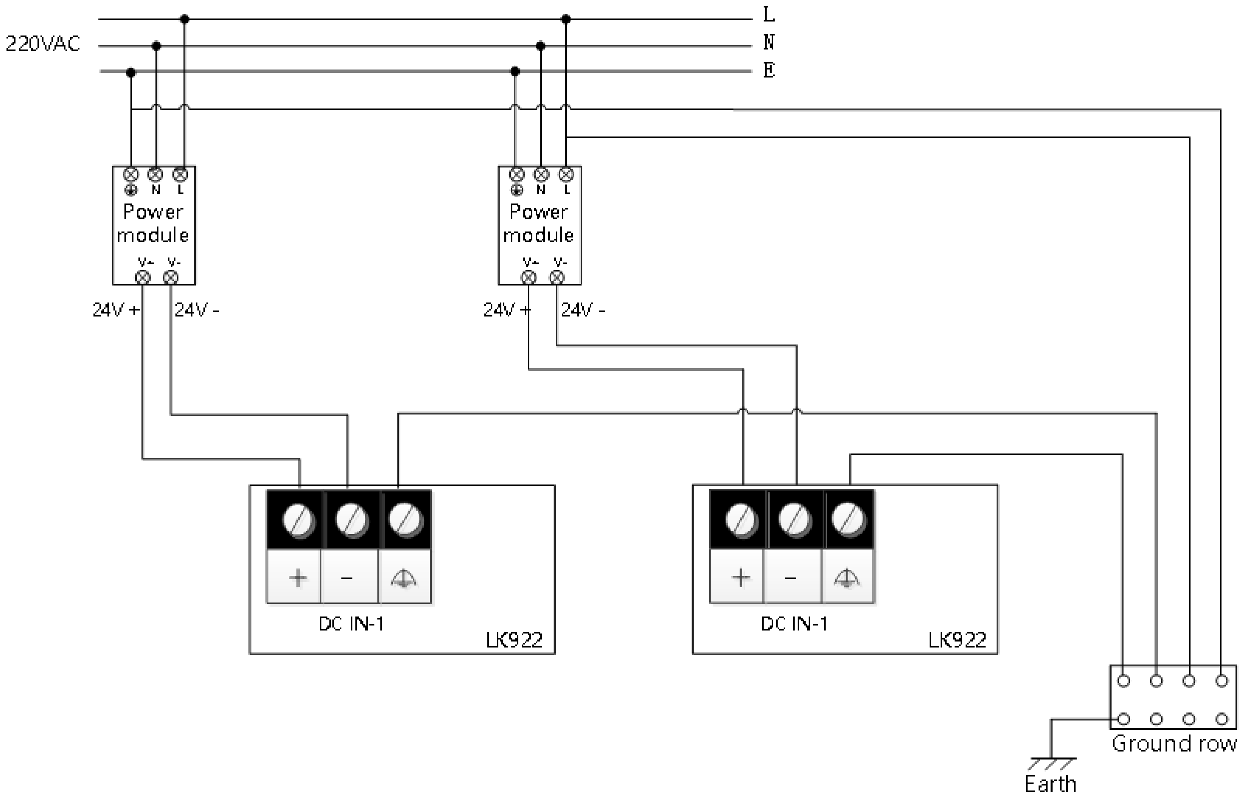
System Power Wiring

3.2.2 LK922 Power Wiring

The LK922 power supply module has one input terminal. Three positions are provided in terminal for 24V+, 24V- and system ground wire.

LK922 supports redundant configuration, system power wiring as shown in figure.

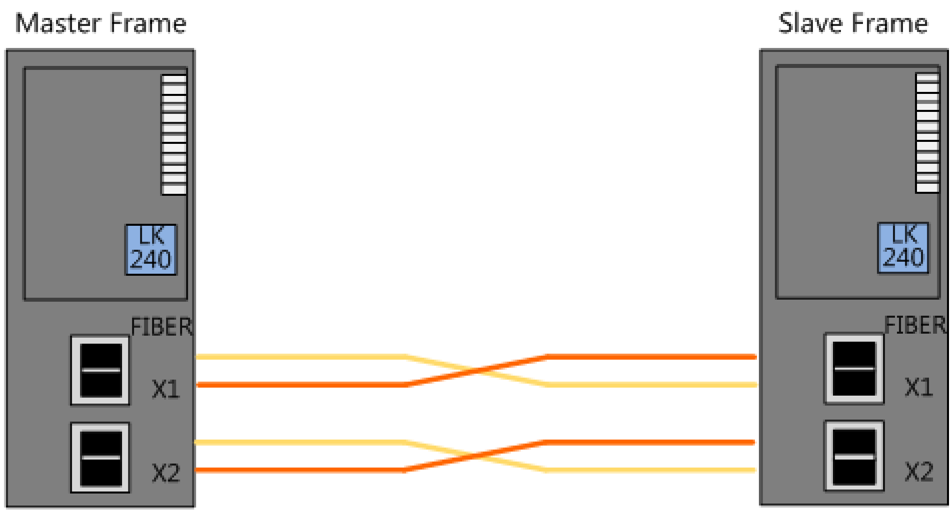
Note: Symbol ⏚ is functional ground of the system, to discharge electromagnetic interference. When wiring , the grounding terminal of LK922 can be connected to the ground row or not.



System Power Wiring

3.2.3 Redundancy Communication Wiring

The LC plug of LKA105 optical fiber is inserted into FIBER X1 ports in the LK240 modules which located in master/slave frame, respectively. Another group optical fiber is inserted into FIBER X2 ports.



Redundancy Synchronization Module Wiring

3.2.4 Profibus-DP Wiring

3.2.4.1 Cable Requirements

With a view to the network transmission technology of LK series control system hardware, it shall adopt RS485 twisted-pair cable or optical fiber. Taking engineering applications (construction difficulty, maintainability and economy efficiency, etc.) and the actual circumstances in the product application fields into consideration, STP (Type A) is always used as transmission medium.

Such two conductors as Types A (STP) and B (UTP) can be selected as the transmission medium of RS485 twisted-pair cable. A refers to shielded twisted pair and B refers to unshielded twisted pair, as shown in table. The characteristic impedance of bus cable ranges from 100 Ω to 165 Ω. The cable capacitance is less than 60 pF/m. The cross section area of conductor is more than or equal to 0.22 mm^2.

Technical specifications for Cables

Cable Parameter	Type A	Type B
Impedance	135~165 Ω	100~130 Ω
Capacitance	＜30 pF/m	＜60 pF/m
Resistance	＜110 Ω/km	Not provided
Cross Section Area of Conductor	≥0.34 mm^2 (22AWG)	≥0.22 mm^2(24 AWG)

The following rules shall be followed when laying the cables:

- Do not twist the cables.
- Do not stretch the cables.
- Do not extrude the cables.
- Follow the basic restrictions (d= outer diameter of cable) listed in table when installing the house cable.

Basic Restrictions for Cable Installation

Characteristics	Restrictions
Bending radius of a individual bending	≥80 mm (10×d)
Bending radius of repeated bending	≥160 mm (20×d)
Allowed installation temperature range	-20℃~70℃
Allowed operating temperature range	-20℃~70℃

3.2.4.2 Total Cable Length

The total cable length (Max. transmission distance) relies on transmission speed. The transmission distance of a signal is different for various media and baud rates.There are at most 32 DP slave modules in DP section (depending on the specification of field wiring). If there are more than 32, LK232 relay module is required for relay. The maximum number of relay modules allowed: when the baud rate is > 187.5 Kbps, the number of relay modules is 3, and when the baud rate is ≤ 187.5 Kbps, the number of relay modules is 5.

The combination mode of LK232 + LKA104 is adopted by default on site. When the communication distance exceeds the values in the table below, the combination mode of LK232 + LKA101 can be used to extend the communication distance.

When DP station > 124, LK250 DP interface expansion module can be used to expand the number of IO.

When the communication distance exceeds twice the values in the table below, LK233 DP optical fiber transceiver module can be used to extend the communication distance.

Apart from extending the network length, the bus repeater can also realize electrical isolation between various network segments, for example, isolation is required when connecting equipment with a different ground potential.

ⓘThe total cable length refers to the distance from the first node to the last node of the bus network segment.

Max. Cable Length Based on Different Transmission Rates for Twisted-pair Cables (with no repeaters)

Content Item	Units	Value							
Data rate	kbps	9.6	19.2	93.75	187.5	500	1500	3000	6000
Cable Type A	m	1200	1200	1200	1000	400	200	100	100
Cable Type B	m	1200	1200	1200	600	200	70	Not recommended	Not recommended

3.2.4.3 Terminal Matching Resistor Settings

The terminal matching resistor must be set at both ends of the Profibus-DP. The setting principle is as follows:

- The terminal matching resistor is set at the end of each of the Profibus-DP segment.
- The terminal matching resistance at each end of Profibus-DP network segment can be provided by connector or communication module, but it can only be set at one place and cannot be set repeatedly. It is recommended to use the matching resistance on communication module.

ⓘ

Terminal matching resistor setting precautions:

- Understand the first and end of each segment in order to accurately set the terminal matching resistor.

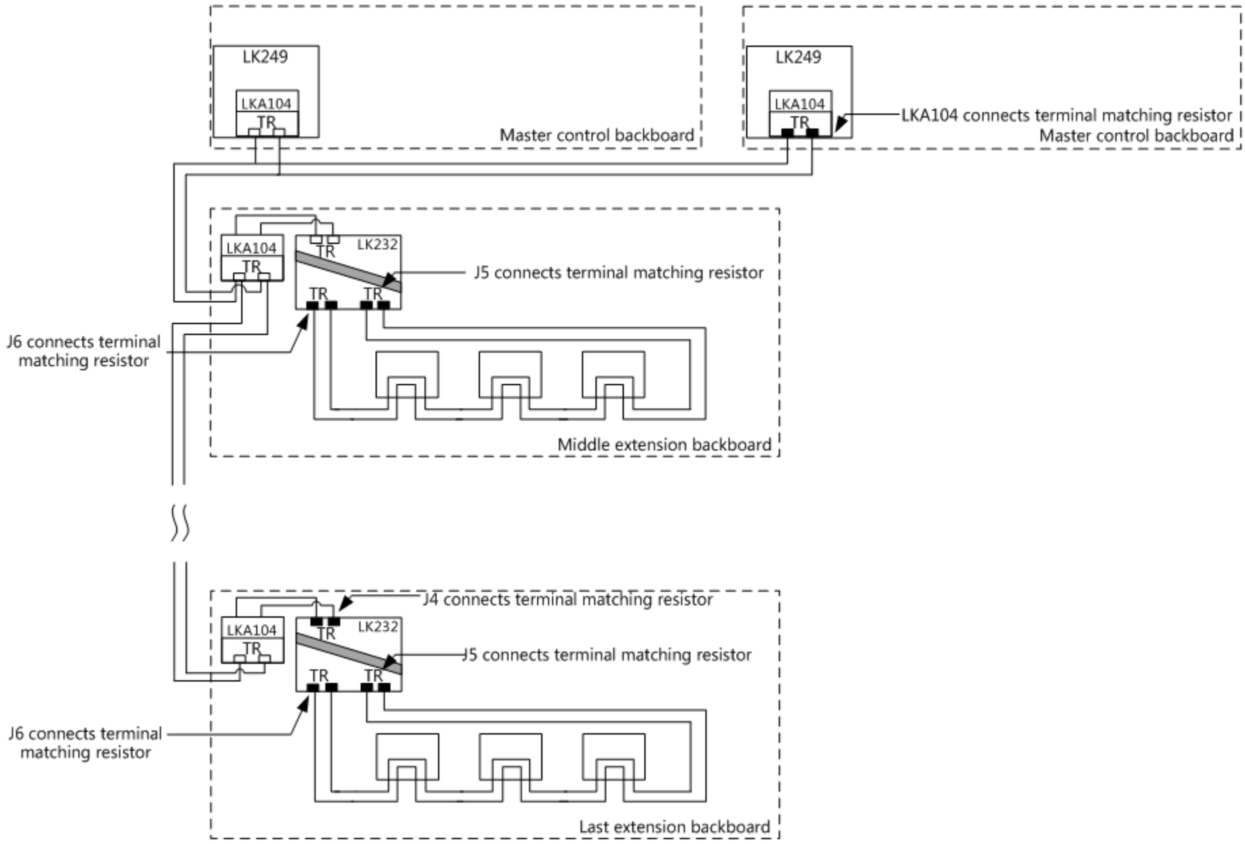
The setting of the terminal matching resistor is illustrated by the following Profibus-DP expansion scenarios.

1. Scenario 1: LK232 and LKA104 are used together to extend the Profibus-DP

For tree topology, LK232 in tree backbone network does not have relay function. The distance between the first expansion backplane and the last expansion backplane depends on DP baud rate and field wiring specification. LK232 acts as fault isolation in branch network.

For the backbone DP network segment, the start terminal matching resistor is provided by the

LKA104 (select the one far from the main and standby racks), the dialing switch is set to ON, the end terminal matching resistor is provided by the LK232 on the last extension backplane, and the J4 is set to ON. In the branch DP network section,the terminal matching resistor at both ends of the Profibus-DP in extended backplane is provided by LK232, and J5, J6 are set to ON (factory default). As shown in figure.



Terminal Matching Resistance Settings

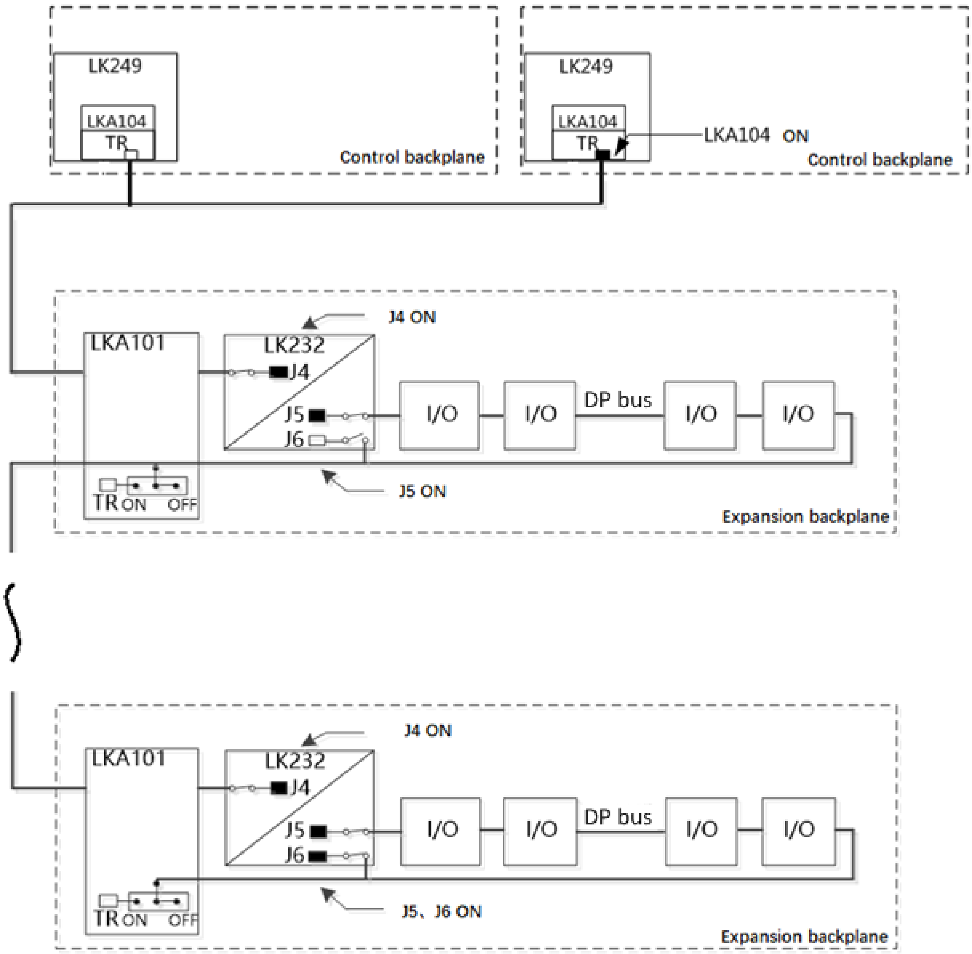
ⓘOnly LK232 is illustrated in the figure, and the setting of LK250 is completely consistent with that of LK232.

2. Scenario 2: LK232 and LKA101 are used together to extend the Profibus-DP

For bus topology, LK232 has relay function, and the relay distance depends on DP baud rate and field wiring specification. LK232 can not isolate faults in bus network.

In the trunk DP network segment, the matching resistance at the beginning is provided by LKA104 (select the one far from the main and standby racks), the dial switch is turned to ON, and other terminals are matched in LK232 module, but LKA101 module is not set.

Dual link redundancy is supported. In order to facilitate marking terminal matching, it is represented by single link in the figure below.



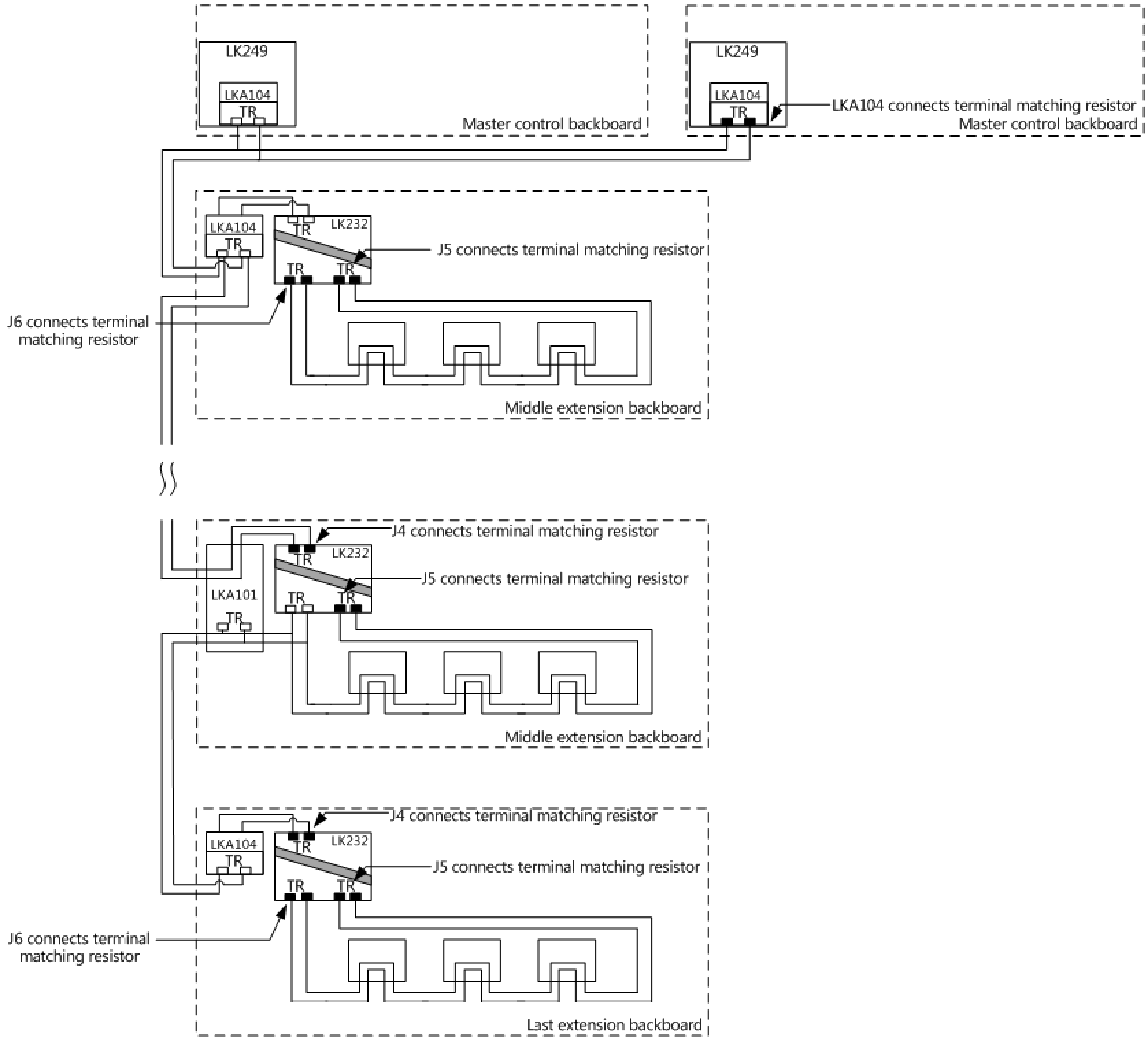
Terminal Matching Resistor Settings

3. Scenario 3: LK232 and LKA101 and LKA104 are used together to extend the Profibus-DP

For hybrid topology, considering the characteristics of tree topology and bus topology, it is not recommended to use it in order to avoid complex field construction (LKA101 and LKA104 are mixed).In the trunk DP network section, the matching resistance at the beginning is provided by LKA104 (select the one far from the main and standby racks), the dial switch is turned to ON, the matching of other terminals is set in LK232 module, and LKA101 / LKA104 module is not set.

LKA101 is generally used as a relay. This terminal is in the middle of the whole DP network. In this position, if LKA101 terminal is used, J4 and J5 of LK232 need to be turned ON, and the last LK232 needs to turn J4, J5 and J6 ON.

When using LKA104 terminal, it is necessary to turn J5 and J6 of LK232 ON, and J4, J5 and J6 of the last LK232 ON.



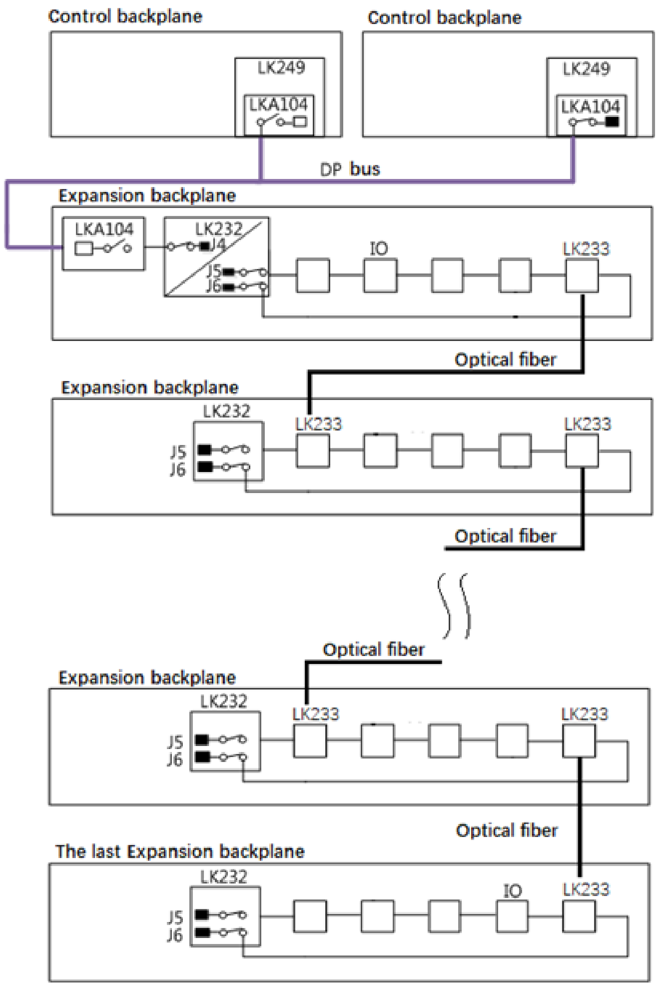
Terminal Matching Resistor Settings

4. Scenario 4: LK232 and LK233 are used continuous optical fiber together to extend the Profibus-DP

The start terminal matching resistor is provided by the LKA104 in Profibus-DP between master control backplane and the first extended backplane(select the one far from the main and standby racks), the dialing switch is set to ON. The end terminal matching resistor is provided by the LK232, and the J4 is set to ON. The terminal matching resistor at both ends of the Profibus-DP in extended backplane is provided by LK232, and J5, J6 are set to ON. As shown in figure.

ⓘ

1. When continuous optical fiber connection is adopted, it is recommended to install in the last slot when there is only one LK233 module on the IO backplane. When there are two LK233 modules on the IO backplane, it is recommended to install two LK233 modules in the first and last IO slots respectively.
2. LK233 module supports multi-mode expansion without setting terminal matching.

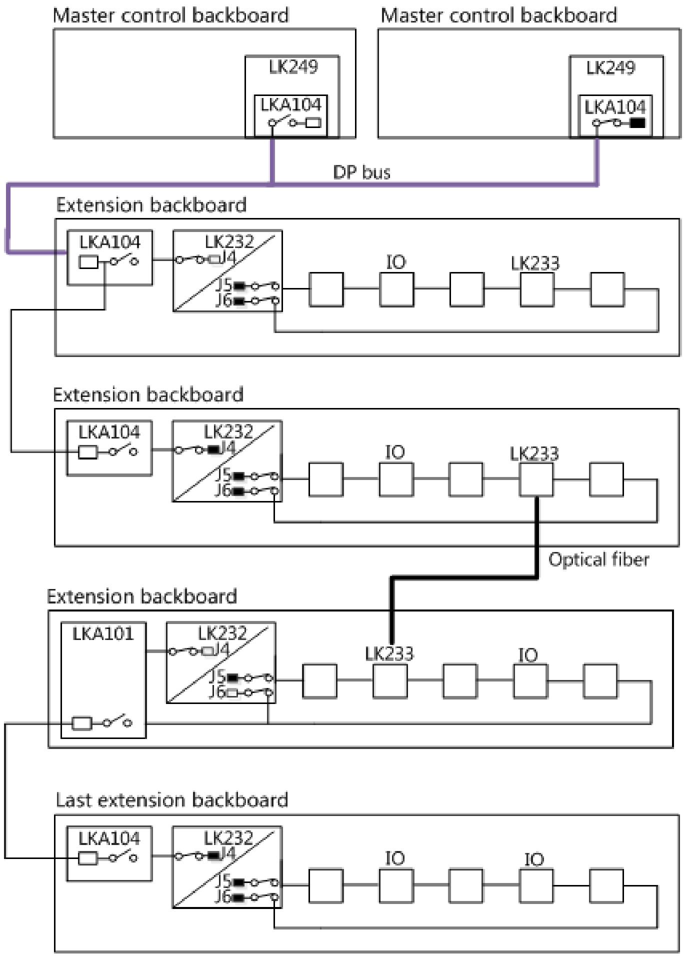


Terminal Matching Resistor Settings

5. Scenario 5: LK232 and LK233 and LKA101 and LKA104 are used together to extend the Profibus-DP

In the trunk DP network section, the matching resistance at the beginning is provided by LKA104 (select the one far from the main and standby racks), the dial switch is turned to ON, the matching of other terminals is set in LK232 module, and LKA101 / LKA104 module is not set.

The connection mode of optical fiber before DP is adopted. When LK233 is used for DP signal cascade, LK232 behind LK233 uses LKA101 for network topology, and LKA104 cannot be used to expand to the next backplane. J5 of LK232 module is turned ON, J6 is turned OFF, and J5 of LK233 module is not turned ON.



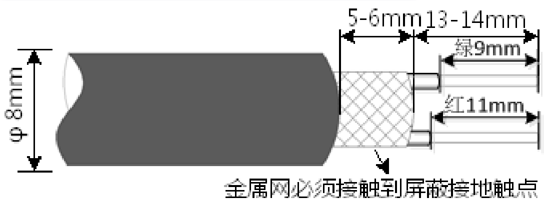
Terminal Matching Resistor Settings

ⓘNotice:

1. When LKA104 and LKA101 are mixed, LKA104 red and green lines are connected normally and LKA101 red and green lines are connected upside down.
2. The wiring of DP connector is standard. The red and green wire shall be stripped off and connected with metal wire, and the cable shielding network shall be connected to the grounding contact.
3. After changing the IO backplane address (the IO backplane address dials ON = 0), the backplane needs to be powered off and restarted.
4. The terminal resistance of the head end LK249 is turned on LKA104, and the other DP connectors are turned off.
5. When LKA104 is used for DP cable connection, LK232 and LK250 modules on the middle backplane are set to J5 and J6 (factory default), and LK232 and LK250 modules at the tail end are set to J4, J5 and J6.
6. When LKA101 is used for DP cable connection, LK232 modules on the middle backplane are switched to J4 and J5, and J6 is switched to off, and LK232 modules at the tail end are switched to J4, J5 and J6.

3.2.4.4 LKA104 wiring

The cable processing requirements of the bus connector are shown in figure. The outer diameter of cable is no more than 8 mm. Otherwise it cannot be put into the cable interface of the connector.



Requirements of DP Cables

Wiring of the bus cable:

(1) Unscrew the fastening screw of the wiring bracket and lift the wiring bracket up.

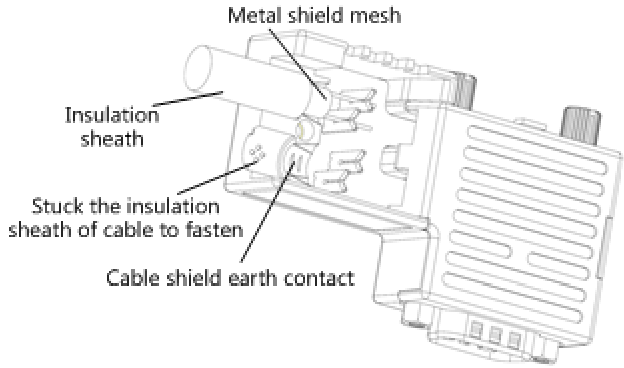
(2) Allow the appropriate length of shielding and core for wiring according to the standard of cable processing, peel off the skin of the green core wire about 9mm, and the skin of the red core wire about 11mm to expose the metal wire.

(3) Insert the red wire into the B hole of the wiring bracket and insert the green wire into the A hole.

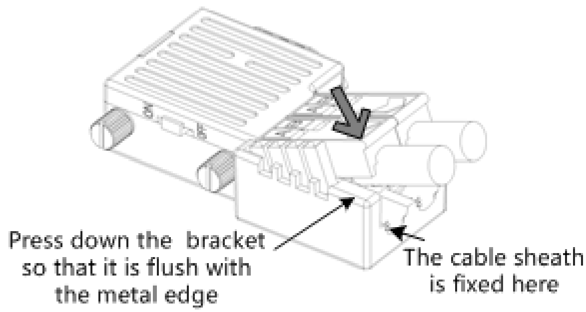
(4) The shield layer and the grounding contact are reliably connected, and the cable sheath is fastened.

(5) Press the wiring bracket downwards, so that the bracket is flush with the metal edge of the lower cover. Note: when pressing, press the wiring bracket on the inlet side first, then press the wiring bracket on the outlet side, otherwise it will damage the screw installation hole.

(6) Tighten the fasten screws.



(1)



(2)

LKA104 Wiring Schematic Diagram

3.2.5 I/O Cable

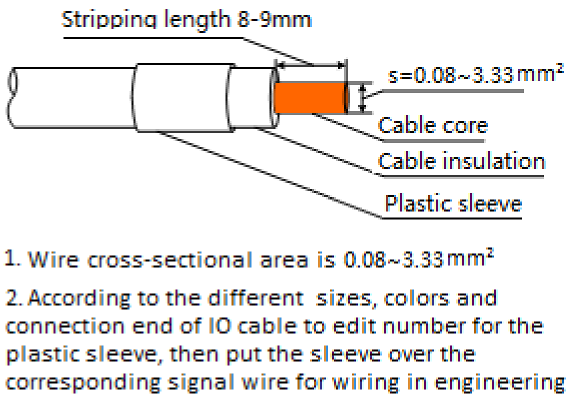
The field I/O signals are generally divided into analog signals and digital signals.

- The analog signals include AI and AO signals. Such a type of signals is connected with STP.
- The digital signals include DI and DO signals. The low-level switching signal is connected with STP. The high-level (or heavy-current) digital input/output signal is connected with UTP, however, separated from the analog signal and the low-level switching signal in an individual cable tray.
- When used for process control, the field I/O signal cable is laid in a special covered cable tray. The cable tray and the cover plate are well-grounded.
- It shall better apply a copper tape shield or aluminum foil shield to the cable shielding layer. The bonding principle is to ground on one side. It is recommended to ground the shielded cable on the controller module side (system side) for LK series programmable logical control system.

3.2.5.1 I/O Cable Processing

The aperture of backplane terminal is 5mm/0.197in. It adapts to a cable diameter of AWG28~AWG12/0.08~3.33 mm^2. The strip length is 8~9 mm/0.33in.

Firstly define the corresponding relationship between the field device signal and the terminal according to the wiring of I/O module. Then determine the cable type according to the signal type, determine the cable length according to the field device location. Finally prepare the signal cable according to the processing requirements, as shown in figure.



I/O Cable Processing Requirements

3.2.5.2 I/O Wiring

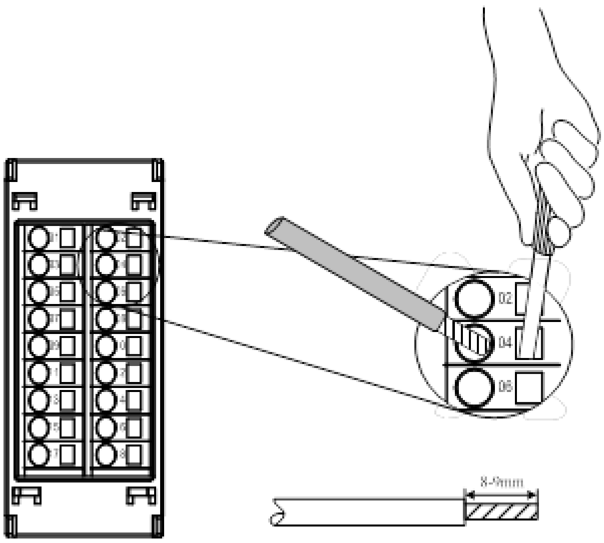
For LK117/LK118 backplane, the terminal is fixed on the backplane, located right beneath the module installation location, adopting new-type two-row 18-position pressure-cindicatored terminals. The pressure-cindicatored terminal (spring terminal) is more convenient for wiring as compared to a conventional screw terminal.

Wiring steps:

(1) Press a LK-dedicated screwdriver vertically into the square hole on the right of the terminal, opening the spring piece in the circular hole on the left of the terminal.

(2) Plug the processed signal line into the circular terminal. Plug out the screwdriver after being plugged in completely, with the spring piece cindicatored the cable.

(3) Check whether the cable is connected properly. Do not hold the naked line exposed in order to avoid a short-circuit hazard.



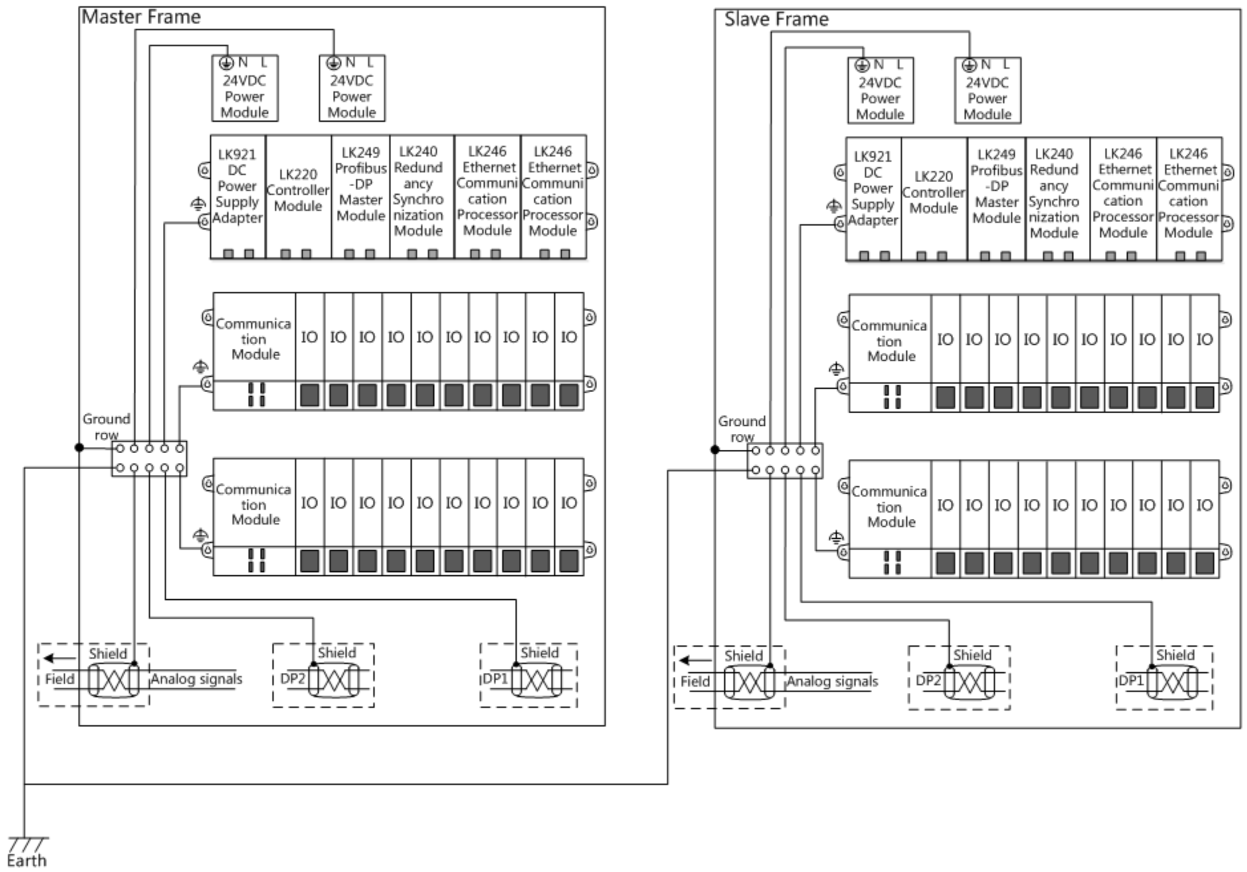
Wiring of I/O Terminals

3.3 Grounding

In common cases, the grounding system mainly includes protective grounding and shield grounding:

- Protective grounding: Protective grounding is a protection measure taken to prevent device enclosure from electrostatic charge accumulation and avoid personal injuries.
- Shield grounding: it means to screen out the interference during signal transmission in order to improve the signal quality. The shielded cable shall be grounded on the PLC system side for an analog signal. The backplane enclosure shall be grounded. The DP cable shielding layer shall be grounded.

The control system must be grounded separately. Never to ground the system ground wire indirectly via other devices. The ground wire size shall be maximized, at least no less than 2.5 mm^2 (10 AWG). The ground resistance is generally less than 4Ω.



Grounding of LK Series Programmable Logical Control System

Chapter 4 System Configuration

Controller exchanges data with the controlled object or device via the input and output modules. The input module collects data from the controlled object and the output module controls the device for the controlled object. After installing and wiring the hardware, to realize the input, output and control of controller module, it shall configure the LK series programmable logical control system hardware accordingly via the programming software according to the hardware architecture of the actual project, including configuring the I/O module on the Profibus-DP bus, parameter settings, Modbus master/slave station and communication settings.

Start the AutoTink programming software and create a new project to configure the basic items of the project. These items include task configuration, creating program, hardware configuration, etc. Refer to the manual *AutoThink V3.1 User Manual_Project Configuration* for specific configuration. Only hardware-related configuration items are discussed here.

4.1 Hardware Configuration

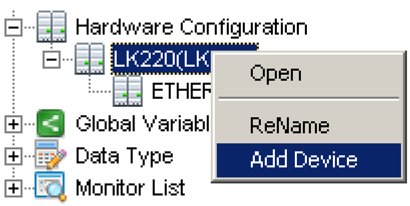
When a new LK project is created, A controller module is added by default with redundancy configuration. The entire hardware configuration will be completed in controller node.

4.1.1 Configure DP Devices

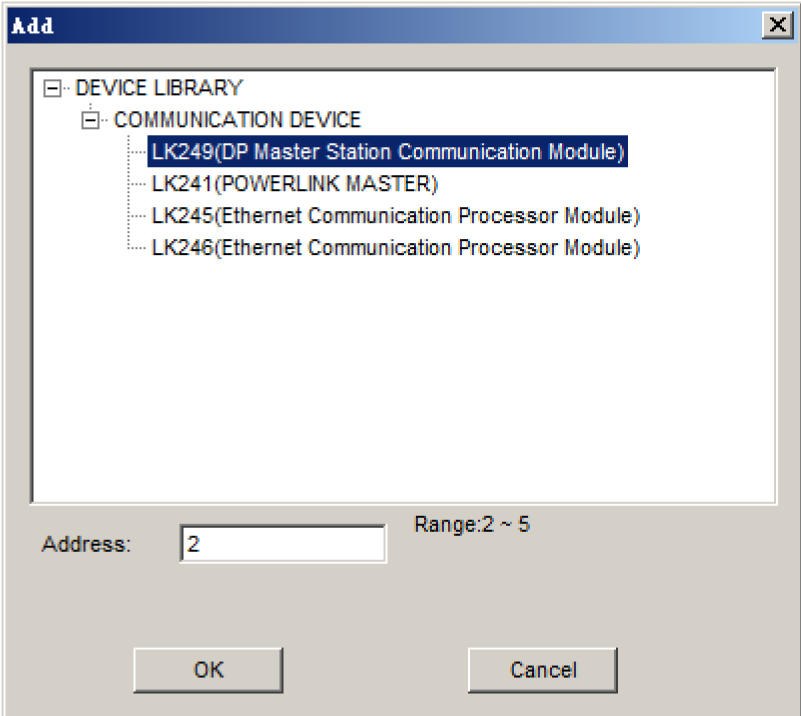
IO slave station configuration method is as shown in follows, when IO modules are connected by DP bus.

4.1.1.1 Add the DP Device

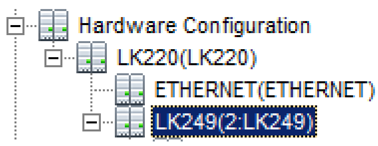
Ethernet Adapter is added under the controller by default. DP Master Station Communication Module is added through the [Add Device] command. As shown in figure.



(a)



(b)



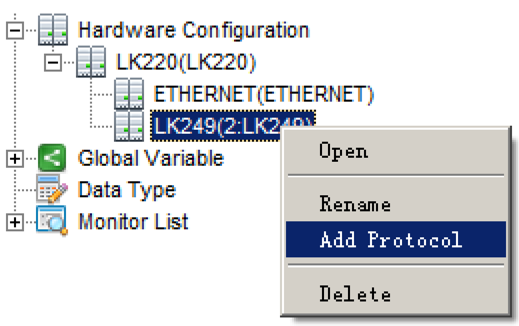
(c)

Add DP Communication Devices

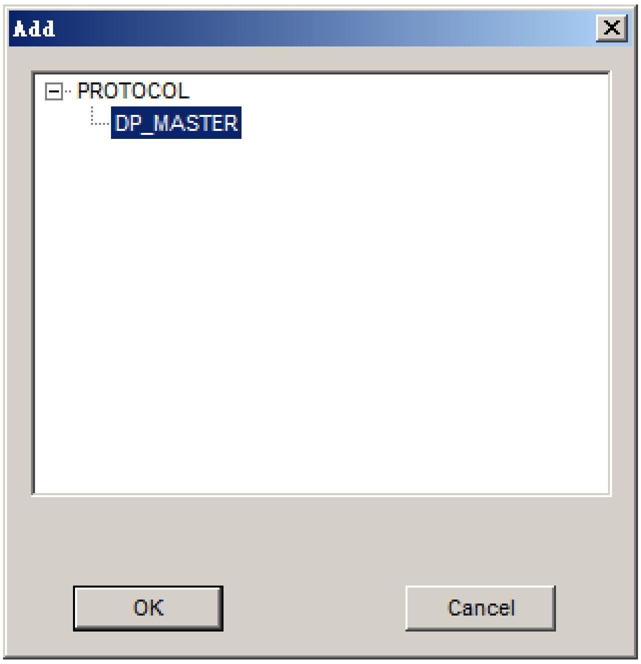
IO devices are configured through the LK249 module, and Modbus communication is configured through the Ethernet Adapter.

4.1.1.2 Add the Profibus-DP Protocol

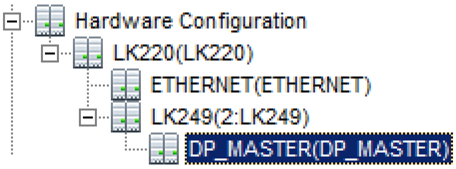
The controller supports Profibus-DP and Modbus TCP, user can add protocol in corresponding communication device. As shown in figure, select [Add Protocol] command in right click menu of LK249 module to add DP protocol.



(a)



(b)

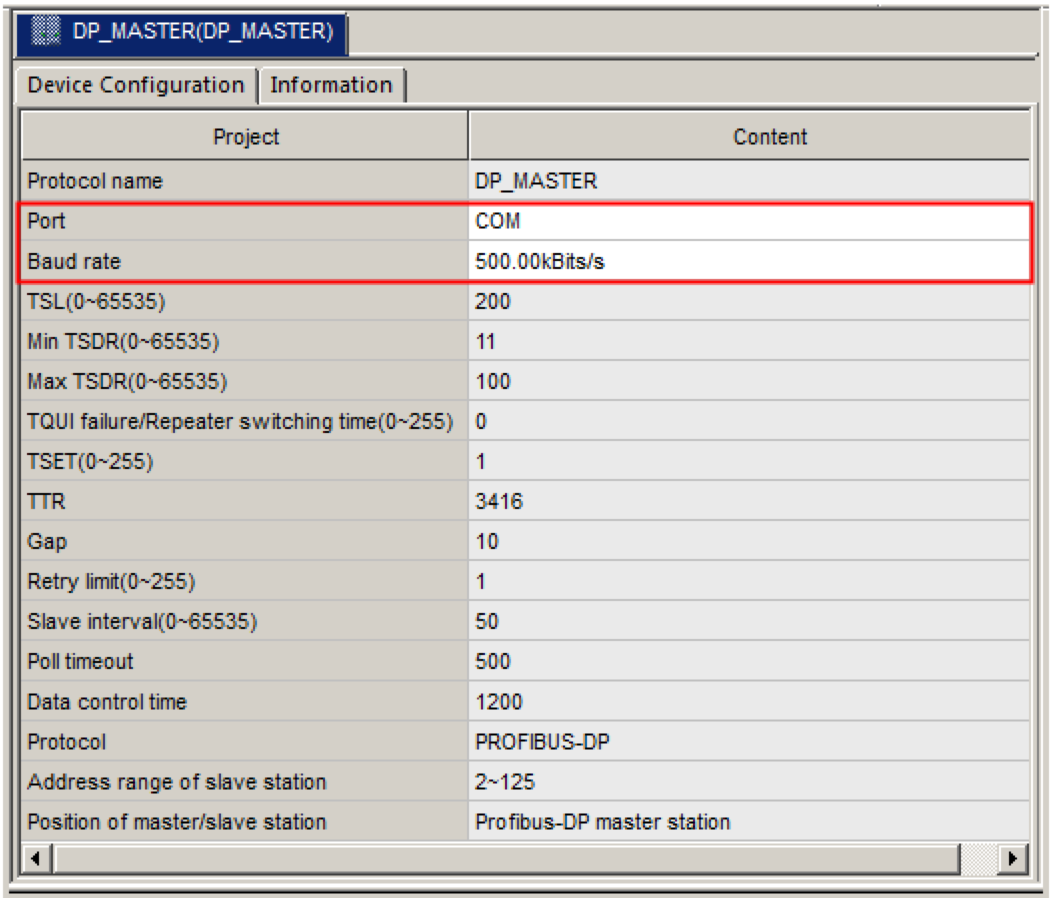


(c)

Add the Profibus-DP Protocol

■ Set the Port and Baud Rate

Select [Open] command, or double-click the DP MASTER node to open the device information window in the right area, as shown in figure.



DP_MASTER(DP_MASTER)

Device Configuration | Information

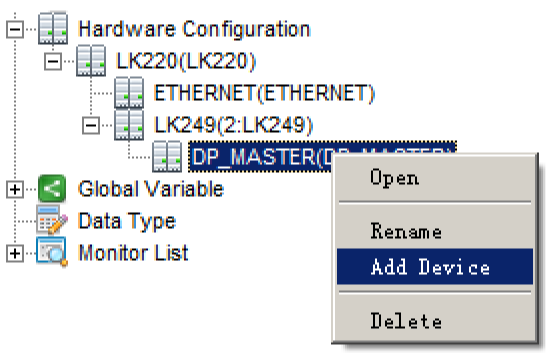
Project	Content
Protocol name	DP_MASTER
Port	COM
Baud rate	500.00kBits/s
TSL(0~65535)	200
Min TSDR(0~65535)	11
Max TSDR(0~65535)	100
TQUI failure/Repeater switching time(0~255)	0
TSET(0~255)	1
TTR	3416
Gap	10
Retry limit(0~255)	1
Slave interval(0~65535)	50
Poll timeout	500
Data control time	1200
Protocol	PROFIBUS-DP
Address range of slave station	2~125
Position of master/slave station	Profibus-DP master station

Set the Port and Baud Rate

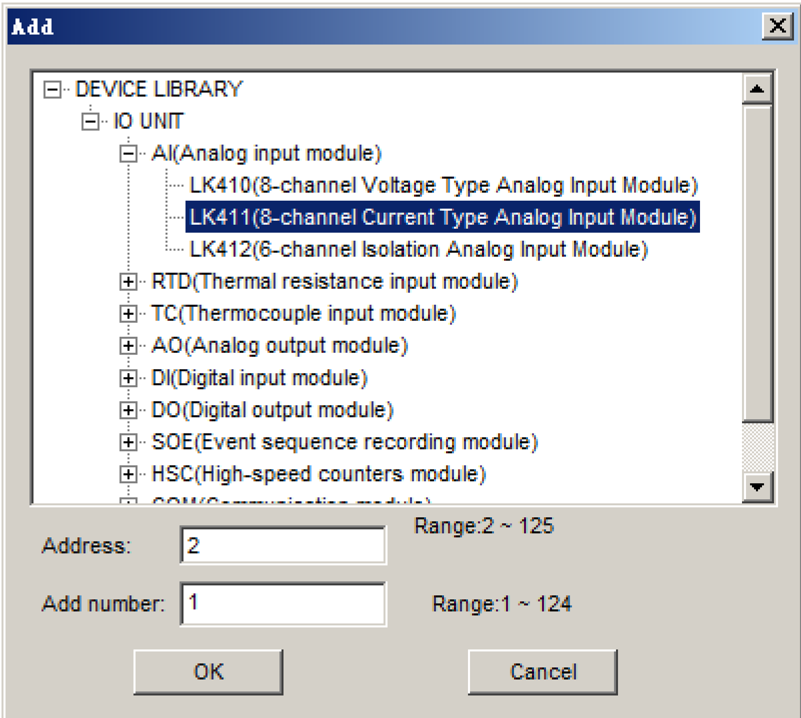
Port is set as **COM1**. Selecting different baud rate with other bus parameters switch to best value automatically when the baud rate is set.

4.1.1.3 Add DP Slave Module

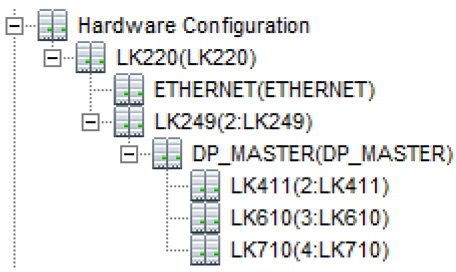
Select [Add Device] command to add the slave station, operate as shown in figure.



(a)



(b)



(c)

Add Slave Device

Select the slave module, enter the address and add number of slave station, click **OK**, then newly added module is generated in the DP_MASTER node.

4.1.1.4 IO Module Parameter

Select [Open] command, or double-click on the slave module to open the device information window of the module, as shown in figure.

LK239_MASTER(2:LK239-MASTER)

Device Configuration | Channel | Information

Project	Content
Module Type	LK239-MASTER
GSD File Name	LK239-MASTER.gsd
Description	ModbusRTU Master Station Communication Module
Device Address	2(Double-click Configuration)
Redundancy	NO
Input Starting Address	IB0
Output Starting Address	QB0
Device Property	Double-click Configuration
Protocol	DP Communication:Profibus-DP Protocol,MODBUS Communication:M
Maximum power consumption	80mA@24VDC
Operating ambient temperature	0~60 degrees centigrade

Module Device Information Window

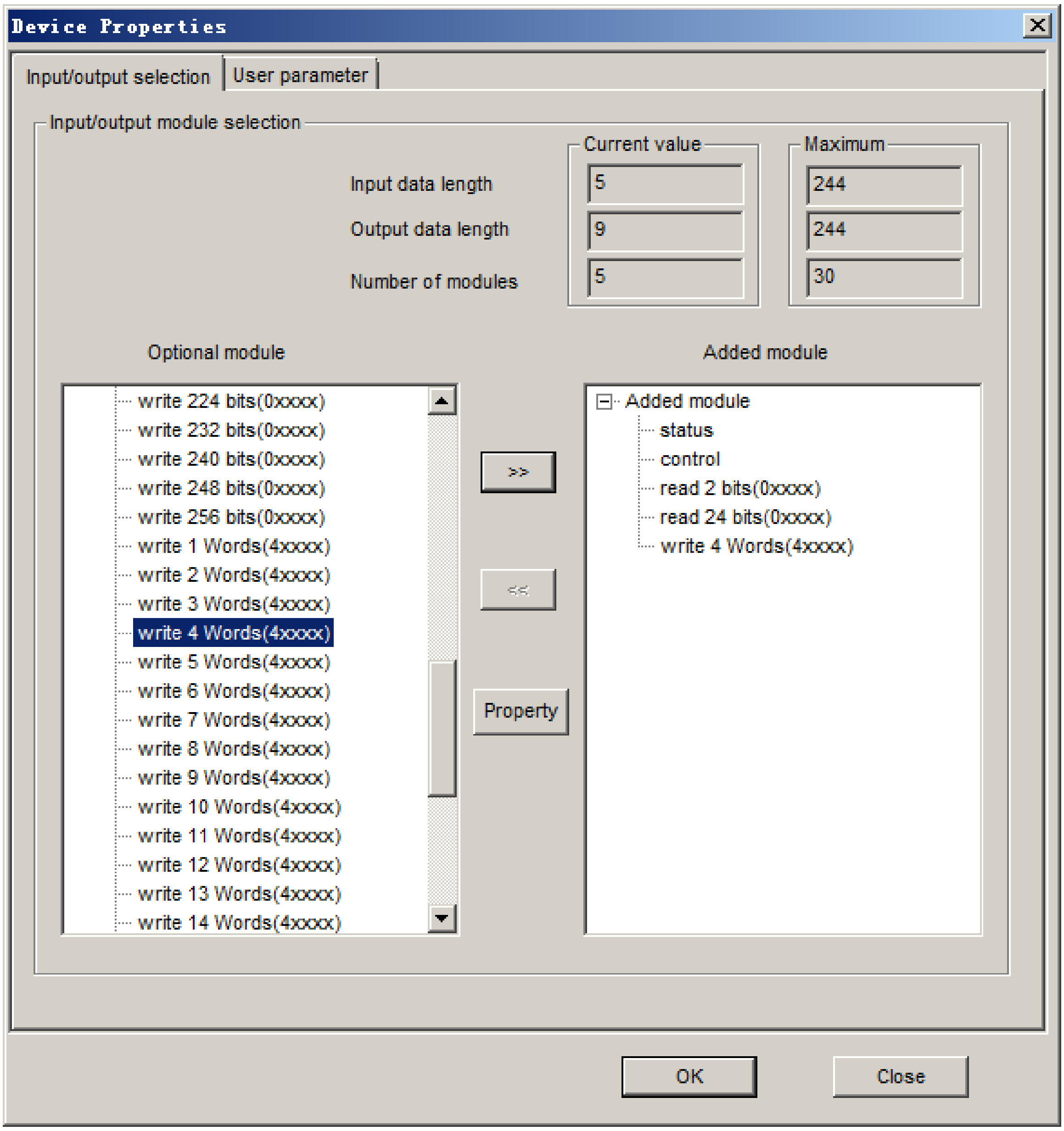
Double-click blue area in **Device Address** to modify address, refer to *Hardware Configuration* in fifth chapter in the manual *AutoThink V3.1 User Manual_Project Configuration* for details.

Double-click the blue area in the **Device property** to set IO parameter. The **Device property** dialog is as shown in figure.

The dialog contains [Input / output selection] tab and [User parameter] tab.

4.1.1.4.1 Input/output selection

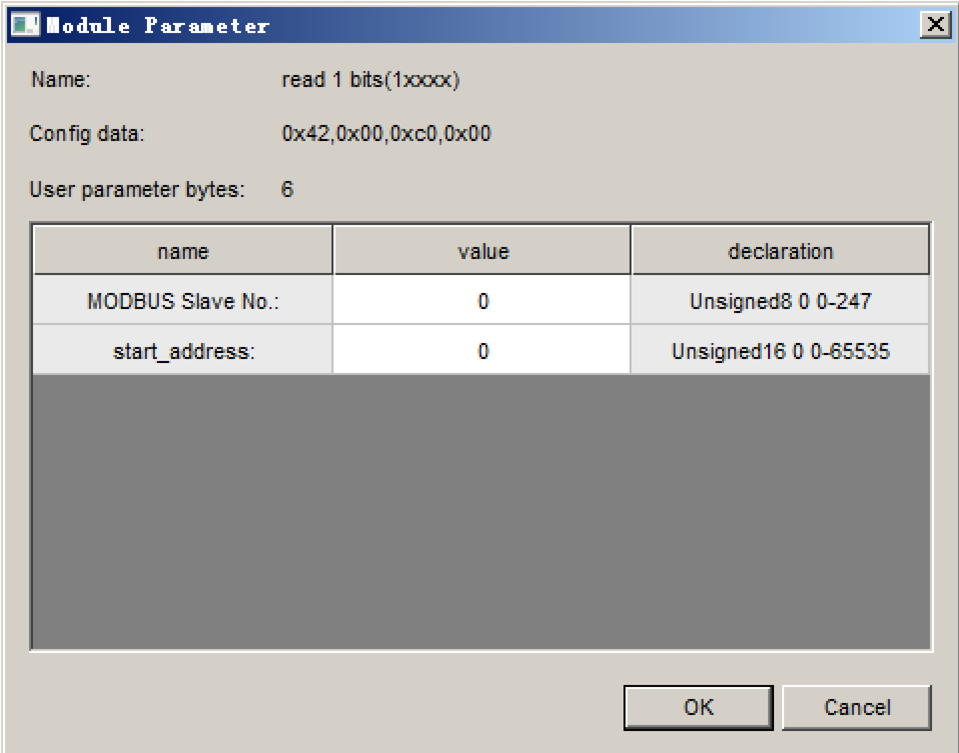
Select the module in [Optional module] list box, click the button >>, and the selected module shall be added to the node of [Added module].Only communication modules and third-party devices can implement the operation that add and delete the sub-module in [Input / output selection] tab. The produced module can only view.



Add the Sub-module

4.1.1.4.2 Set Sub-module Parameter

Select the module in the node of [Added module], click the button of **Property**, pop up **Module Parameter** dialog, as shown in figure. The parameter value can be modified.

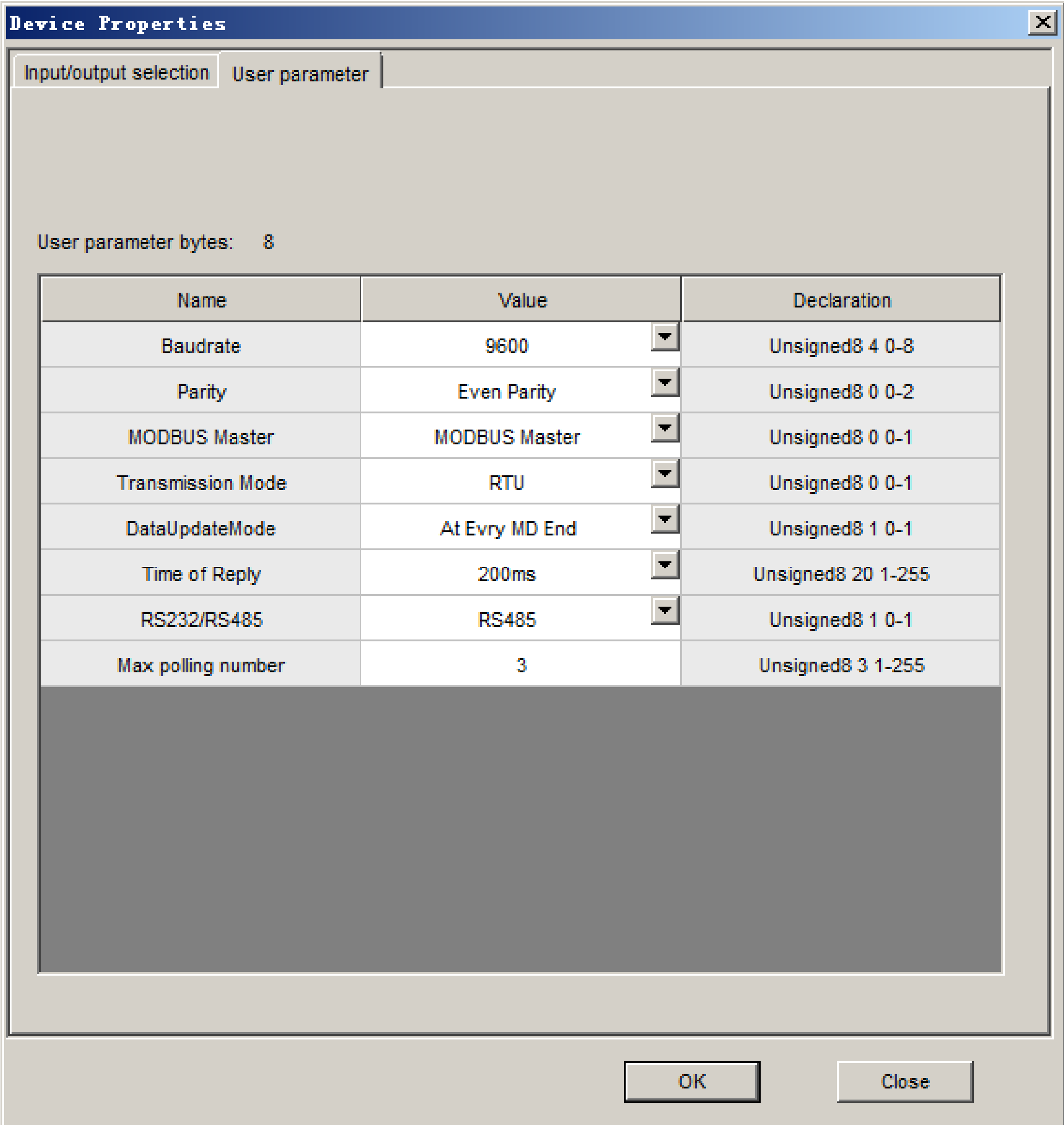


Sub-module Property Dialog

4.1.1.4.3 User Parameter

The user parameter be used to set working mode of module, with writing into controller module when the user program is downloaded.

Each parameter has the default value and value range, and you can modify value according to the engineering requirements. The engineering need to be full downloaded after modifying the parameter value.



Set User Parameters

4.1.2 Configure POWERLINK

4.1.2.1 Add POWERLINK Master

4.1.2.1.1 Concept

When configuring POWERLINK network, a POWERLINK master station communication module is needed to communicate with the POWERLINK interface module. The master station module is installed in the communication slot of the main control backplane. At the same time, the master station parameters need to be added and configured.

The LK216/LK220/LK220T1 controller can configure one POWERLINK master station module at most. The LK222 / LK224 controller can configure two POWERLINK master station modules at most.

4.1.2.1.2 Requirements

Module has been installed

4.1.2.1.3 Steps

To add POWERLINK master station, follow these steps:

(1) In the right-click menu of controller tree node, select "Add Device" command.

The "Add" dialog box will pop up.

(2) Select "LK241(POWERLINK/PL-LINK Master Station Communication Module)".

(3) Enter the device address according to the slot of LK241 module on the main control backplane.

The device address of the controller slot is 1 by default, and the address of the extended slot device address is increased by 1 in turn.

(4) Click the **OK** button.

The LK241 module is added under the controller.

4.1.2.2 Add POWERLINK Master Protocol

4.1.2.2.1 Concept

The master station module communicates with the slave station through the POWERLINK protocol, which needs to be configured for the master station module.

4.1.2.2.2 Requirements

Master station module has been added

4.1.2.2.3 Steps

To add POWERLINK protocol, follow these steps:

(1) In the right-click menu of master station module, select "Add Protocol" command.

The "Add" dialog box will pop up.

(2) Select "POWERLINK_MASTER".

(3) Click the **OK** button.

The POWERLINK_MASTER protocol is added under the master station module.

4.1.2.2.4 Next Step

Add POWERLINK interface module.

4.1.2.2.5 Reference

Add POWERLINK Master

Add POWERLINK Interface Module

4.1.2.3 Add POWERLINK interface module

4.1.2.3.1 Concept

POWERLINK communication interface module reports the IO slave data information to the upper master station, and sends the data from the controller to the lower IO slave station. The LK235 \ LK271 communication interface module needs to be installed in the communication slot of the extension backplane, and the parameters of the communication interface module need to be added and configured.

Each POWERLINK master protocol can configure 128 communication interface modules at most.

4.1.2.3.2 Requirements

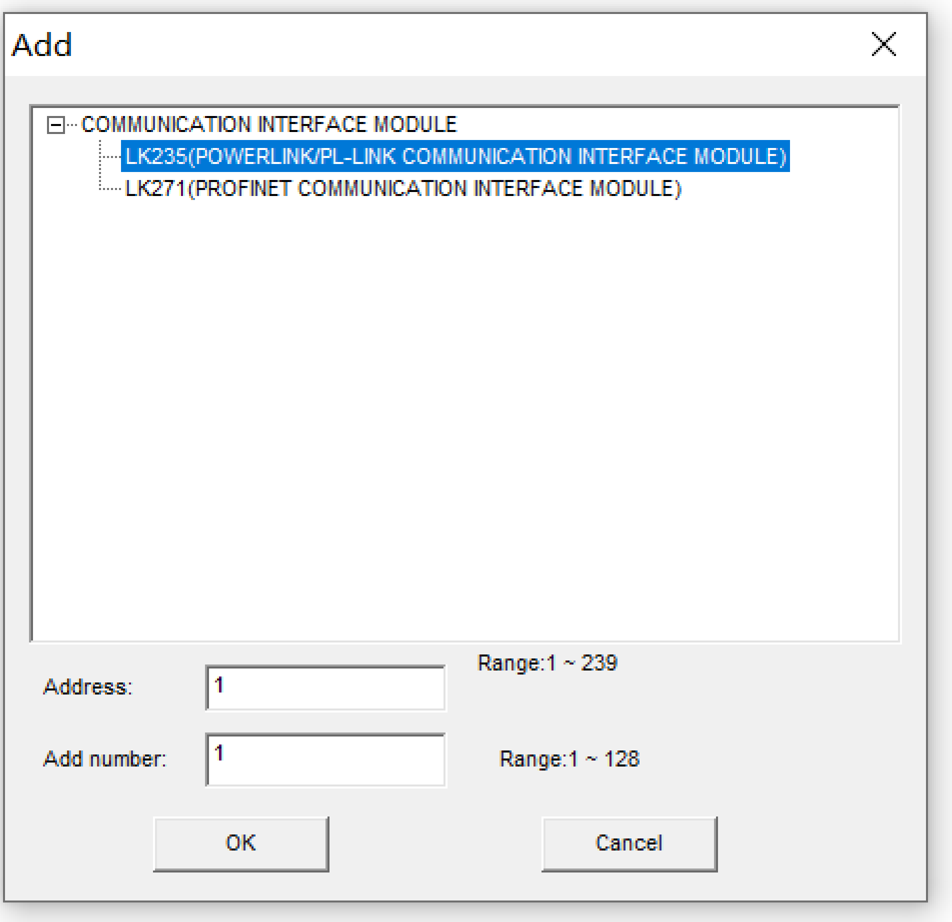
- "POWERLINK_MASTER "protocol has been added
- LK235 \ LK271 has been installed and the station address has been set

4.1.2.3.3 Steps

To add communication interface module, follow these steps:

(1) In the right-click menu of POWERLINK_MASTER node, select "Add Device" command.

The "Add" dialog box will pop up.



Add Communication Interface Module

(2) Select "LK235 (POWERLINK/PL-LINK COMMUNICATION INTERFACE MODULE)" or "LK271(PROFINET COMMUNICATION INTERFACE MODULE)"

(3) Enter the device Address and Add number.

Set the address according to dial switch on the module.

(4) Click the **OK** button.

The module is added under the POWERLINK_MASTER.

4.1.2.3.4 Next Step

Add POWERLINK slave protocol.

4.1.2.3.5 Reference

[Add POWERLINK Master Protocol]

[Add POWERLINK Slave Protocol]

4.1.2.4 Add POWERLINK Slave Protocol

4.1.2.4.1 Concept

The slave I / O module communicates with the master station through the POWERLINK slave protocol, so it is necessary to configure the POWERLINK slave protocol for POWERLINK communication interface module.

4.1.2.4.2 Requirements

POWERLINK communication interface module has been added

4.1.2.4.3 Steps

To add POWERLINK slave protocol, follow these steps:

(1) In the right-click menu of LK235/LK271 module, select "Add Protocol" command.

The "Add" dialog box will pop up.

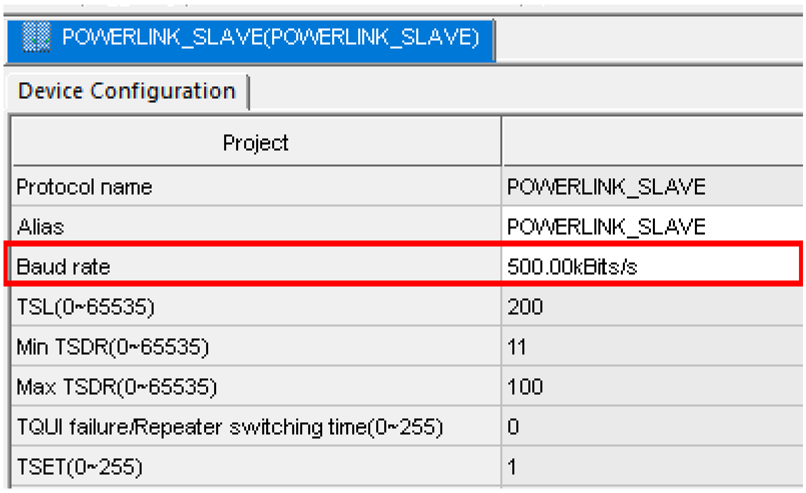
(2) Select "POWERLINK_SLAVE".

(3) Click the **OK** button.

The POWERLINK_SLAVE protocol is added under LK235/LK271 communication interface module.

(4) Double click on the "POWERLINK_SLAVE" protocol tree node and set the baud rate in the "Device Configuration" window on the right.

Step (4) is only supported by LK235 module. When configured at 187.5kbps, a maximum of 12 IO modules can be configured. If a third-party IO module is configured, the number of modules needs to be adjusted based on the response time of the third-party IO module.



Set Baud Rate

4.1.2.4.4 Next Step

Add I/O module.

4.1.2.4.5 Reference

[Add POWERLINK Interface Module]

[Add I/O Module]

4.1.2.5 Add I/O Module

4.1.2.5.1 Concept

The I / O slave station modules are attached to the LK235 /LK271 communication interface module. According to the installation sequence of IO modules in the extension backplane, I / O modules are added in turn. It is recommended that the number of IO added under each LK235/LK271 should not exceed 10, otherwise the communication speed will be affected.

4.1.2.5.2 Requirements

"POWERLINK_SLAVE "protocol has been added

4.1.2.5.3 Steps

To add I/O module, follow these steps:

(1) In the right-click menu of POWERLINK_SLAVE node, select "Add Device" command.

The "Add" dialog box will pop up.

(2) Select a slave module.

(3) Enter the device Address and Add number.

Device address of IO module is related to module installation slot and backplane base address. See LK extension backplane Communication Address for details.

(4) Click the **OK** button.

The slave module is added under the POWERLINK_SLAVE.

4.1.2.5.4 Reference

Add POWERLINK Slave Protocol

4.1.2.6 Configure Polling Period

4.1.2.6.1 Concept

The data between POWERLINK master station and LK235/LK271 slave station periodically interacts. The master station periodically polls each slave station in order to transmit the data to the slave station or receive the data from the slave station. Polling all the slave stations once is a polling period. The polling period parameter needs to be configured for the master station.

POWERLINK polling cycle (unit: us) = cycle data transmission time + non cycle data transmission time.

- The cycle data transmission time is the sum of polling time of each slave station.
- The non cycle data transmission time: 350us.

Each slave polling time includes input data sending time and output data sending time.

Input data sending time = input data transmission time + forwarding delay (via SP100 or LK235/LK271 slave station) + path transmission delay.

Output data sending time = output data transmission time + forwarding delay (via SP100 or LK235/LK271 slave station) + path transmission delay.

explain:

- Input / output data transmission time = (input / output data of IO module under each LK235/LK271 module + 28 byte frame header) / 12.5 bytes (unit: us) + 6 us (data processing time)
- One SP100 or LK235/LK271 forwarding delay: 0.68us.
- Path transmission delay: The connection length of Ethernet twisted pair is less than 100 meters, and the path transmission delay is too small to be ignored; the delay time of optical signal transmission per kilometer is 5 us.

Example: 40 LK235/LK271 constitute ring network, each LK235/LK271 has 5 DI(LK610) and 5 DO

(LK710), and the path transmission delay is ignored.

Input data length of LK610 is 2 bytes, the input data length and the output data length of LK710 are 2 bytes respectively, the data transmission time of a slave station is:

Input data transmission time = (5 * 2 + 5 * 2 + 28) / 12.5 + 6 = 9.84us

Output data transmission time = (5 * 2 + 28) / 12.5 + 6 = 9.04us

The total time of 40 slave stations is:

Total data transmission time = 40 * (9.84 + 9.04) = 755.2us

Total forwarding delay = 0.68 * (1 + 2 + 3 +...) .39)=0.68*(39+39*38/2)=530.4us

Cycle data polling time=755.2+530.4=1285.6us

Total polling time =(1285.6+350)*1.1=1799.16us

4.1.2.6.2 Requirements

"POWERLINK_MASTER "protocol window has been opened

4.1.2.6.3 Steps

To configure the polling period of the master station, follow these steps:

(1) In the "Device Configuration" tab, double-click the "polling period" edit box to enter value.

4.1.2.7 Configure Parameters of Communication Interface Module

4.1.2.7.1 Concept

After adding LK235/LK271 POWERLINK interface module, communication parameters need to be configured.

4.1.2.7.2 Requirements

LK235/LK271 module window has been opened

4.1.2.7.3 Steps

To configure parameters of communication interface module, follow these steps:

(1) In the LK235/LK271 "Device Configuration" tab, configure the following parameters.

Parameter name	Description
Alias	Rename module
Device Address	The device address is related to address set by module rotary code switch . See

Parameter name	Description
	Set_Device_Address for details
Input Starting Byte Offset	Set to default value
Communication Failure Mode	In case of communication failure, I / O modules configured in LK235/LK271 are offline or remains online value Reset: Communication failure between LK235/LK271 and LK241, all the I / O modules are offline Hold: Communication failure between LK235/LK271 and LK241, all the I / O module remains online
Response Time	The time to wait for the communication interface module to respond after the POWERLINK master station sends the request. The setting range is 300 ~ 1000us, 750 as a default value. Response time = (input data sending time + output data sending time) * 10. Please refer to Configure Polling Period
PN Input length	only supported by LK271, default to 100 bytes
PN Output length	only supported by LK271, default to 100 bytes

4.1.3 Configure PL-LINK

4.1.3.1 Add PL-LINK Master

4.1.3.1.1 Concept

When configuring PL-LINK network, a PL-LINK master station module is needed to communicate with the PL-LINK slave station module. The master station module is installed in the communication slot of the main control backplane. At the same time, the master station parameters need to be added and configured.

The LK216/LK220/LK220T1 controller can configure one PL-LINK master station module at most. The LK222 / LK224 controller can configure two PL-LINK master station modules at most.

4.1.3.1.2 Requirements

Module has been installed

4.1.3.1.3 Steps

To add PL-LINK master station, follow these steps:

(1) In the right-click menu of controller tree node, select "Add Device" command.

The "Add" dialog box will pop up.

(2) Select "LK241(POWERLINK/PL-LINK Master Station Communication Module)".

(3) Enter the device address according to the slot of LK241 module on the main control backplane.

The device address of the controller slot is 1 by default, and the address of the extended slot device address is increased by 1 in turn.

(4) Click the **OK** button.

The LK241 module is added under the controller.

4.1.3.1.4 Next Step

Add PL-LINK master protocol.

4.1.3.1.5 Reference

Add PL-LINK Master Protocol

4.1.3.2 Add PL-LINK Master Protocol

4.1.3.2.1 Concept

The master station module communicates with the slave station through the PL-LINK protocol, which needs to be configured for the master station module.

4.1.3.2.2 Requirements

Master station module has been added

4.1.3.2.3 Steps

To add PL-LINK protocol, follow these steps:

(1) In the right-click menu of master station module, select "Add Protocol" command.

The "Add" dialog box will pop up.

(2) Select "PL_LINK_MASTER".

(3) Click the **OK** button.

The PL_LINK_MASTER protocol is added under the master station module.

4.1.3.2.4 Next Step

Add PL-LINK communication interface module.

4.1.3.2.5 Reference

Add PL-LINK Master

Add PL-LINK Communication Interface Module

4.1.3.3 Add PL-LINK Communication Interface Module

4.1.3.3.1 Concept

PL-LINK communication interface module reports the IO slave data information to the upper master station, and sends the data from the controller to the lower IO slave station. The LK235 / LK271 communication interface module needs to be installed in the communication slot of the extension backplane, and the parameters of the communication interface module need to be added and configured.

Each PL-LINK master protocol can configure 128 LK235 / LK271 communication interface modules at most.

4.1.3.3.2 Requirements

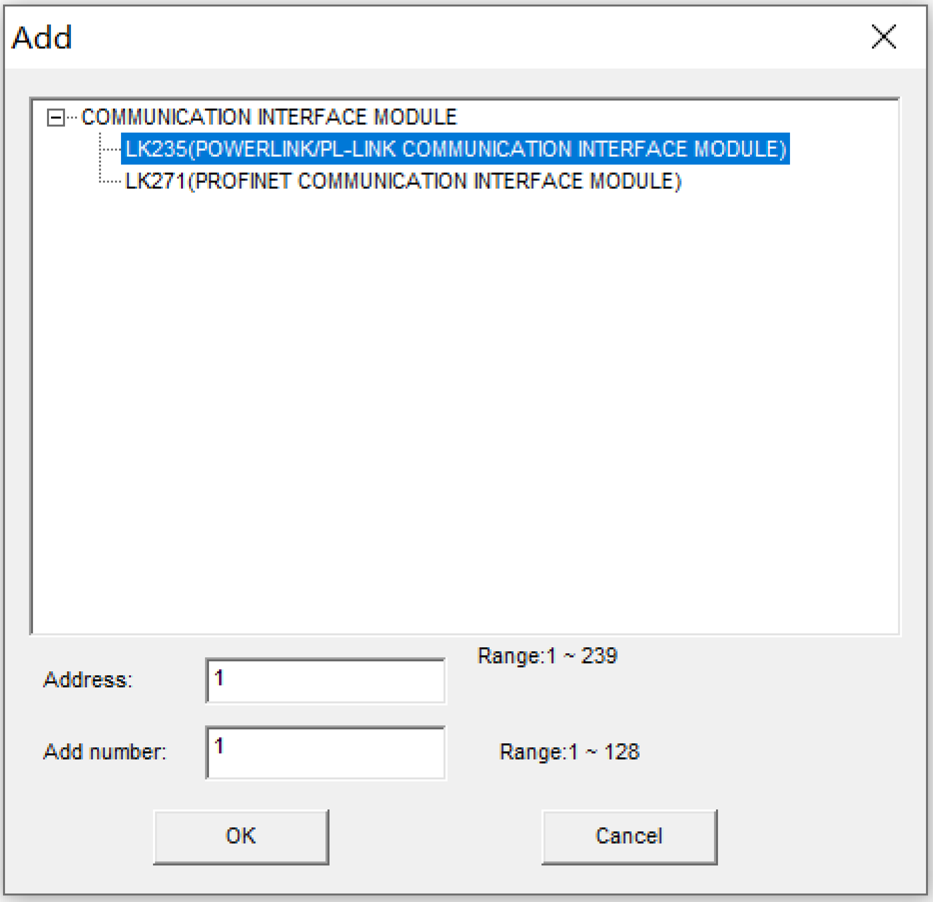
- "PL_LINK_MASTER "protocol has been added
- LK235 / LK271 has been installed and the station address has been set

4.1.3.3.3 Steps

To add communication interface module, follow these steps:

(1) In the right-click menu of PL_LINK_MASTER node, select "Add Device" command.

The "Add" dialog box will pop up.



Add Communication Interface Module

(2) Select "LK235 (POWERLINK/PL-LINK COMMUNICATION INTERFACE MODULE)" or "LK271(PROFINET COMMUNICATION INTERFACE MODULE)"

(3) Enter the device Address and Add number.

Set the address according to dial switch on the module.

(4) Click the **OK** button.

The module is added under the PL_LINK_MASTER.

4.1.3.3.4 Next Step

Add PL-LINK slave protocol.

4.1.3.3.5 Reference

Add PL-LINK Master Protocol

Add PL-LINK Slave Protocol

4.1.3.4 Add PL-LINK Slave Protocol

4.1.3.4.1 Concept

The slave I / O module communicates with the master station through the PL-LINK slave protocol, so it is necessary to configure the PL-LINK slave protocol for PL-LINK communication interface module.

4.1.3.4.2 Requirements

PL-LINK communication interface module has been added

4.1.3.4.3 Steps

To add PL-LINK slave protocol, follow these steps:

(1) In the right-click menu of LK235/LK271 module, select "Add Protocol" command.

The "Add" dialog box will pop up.

(2) Select "PL_LINK_SLAVE".

(3) Click the **OK** button.

The PL_LINK_SLAVE protocol is added under LK235/LK271 communication interface module.

(4) Double click on the "PL_LINK_SLAVE" protocol tree node and set the baud rate in the "Device Configuration" window on the right.

Step (4) is only supported by LK235 module. When configured at 187.5kbps, a maximum of 12 IO modules can be configured. If a third-party IO module is configured, the number of modules needs to be adjusted based on the response time of the third-party IO module.

PL_LINK_SLAVE(PL_LINK_SLAVE)

Device Configuration

Project	Content
Protocol name	PL_LINK_SLAVE
Alias	PL_LINK_SLAVE
Baud rate	1500.00kBits/s
TSL(0~65535)	400
Min TSDR(0~65535)	11
Max TSDR(0~65535)	150
TQUI failure/Repeater switching time(0~255)	0
TSET(0~255)	1
TTR	4449
Gap	10
Retry limit(0~255)	2
Slave interval(0~65535)	50
Poll timeout	500
Data control time	1200

Set Baud Rate

4.1.3.4.4 Next Step

Add I/O module.

4.1.3.4.5 Reference

[Add PL-LINK Communication Interface Module]

[Add I/O Module]

4.1.3.5 Add I/O Module

4.1.3.5.1 Concept

The I / O slave station modules are attached to the LK235 /LK271 communication interface module. According to the installation sequence of IO modules in the extension backplane, I / O modules are added in turn. It is recommended that the number of IO added under each LK235/LK271 should not exceed 10, otherwise the communication speed will be affected.

4.1.3.5.2 Requirements

"PL_LINK_SLAVE "protocol has been added

4.1.3.5.3 Steps

To add I/O module, follow these steps:

(1) In the right-click menu of PL_LINK_SLAVE node, select "Add Device" command.

The "Add" dialog box will pop up.

(2) Select a slave module.

(3) Enter the device Address and Add number.

Device address of IO module is related to module installation slot and backplane base address. See LK extension backplane Communication Address for details.

(4) Click the **OK** button.

The slave module is added under the PL_LINK_SLAVE.

4.1.3.5.4 Reference

Add PL-LINK Slave Protocol

4.1.3.6 Configure Polling Period

4.1.3.6.1 Concept

The data between PL-LINK master station and LK235/LK271 slave station periodically interacts. The master station periodically polls each slave station in order to transmit the data to the slave station or receive the data from the slave station. Polling all the slave stations once is a polling period. The polling period parameter needs to be configured for the master station.

PL-LINK polling cycle (unit: us) = cycle data transmission time + non cycle data transmission time.

- The cycle data transmission time is the sum of polling time of each slave station.
- The non cycle data transmission time: 350us.

Each slave polling time includes input data sending time and output data sending time.

Input data sending time = input data transmission time + forwarding delay (via SP100 or LK235/LK271 slave station) + path transmission delay.

Output data sending time = output data transmission time + forwarding delay (via SP100 or LK235/LK271 slave station) + path transmission delay.

explain:

- Input / output data transmission time = (input / output data of IO module under each LK235/LK271 module + 28 byte frame header) / 12.5 bytes (unit: us) + 6 us (data processing time)
- One SP100 or LK235/LK271 forwarding delay: 0.68us.

- Path transmission delay: The connection length of Ethernet twisted pair is less than 100 meters, and the path transmission delay is too small to be ignored; the delay time of optical signal transmission per kilometer is 5 us.

Example: 40 LK235/LK271 constitute ring network, each LK235/LK271 has 5 DI(LK610) and 5 DO (LK710), and the path transmission delay is ignored.

Input data length of LK610 is 2 bytes, the input data length and the output data length of LK710 are 2 bytes respectively, the data transmission time of a slave station is:

Input data transmission time = (5 * 2 + 5 * 2 + 28) / 12.5 + 6 = 9.84us

Output data transmission time = (5 * 2 + 28) / 12.5 + 6 = 9.04us

The total time of 40 slave stations is:

Total data transmission time = 40 * (9.84 + 9.04) = 755.2us

Total forwarding delay = 0.68 * (1 + 2 + 3 +...) .39)=0.68*(39+39*38/2)=530.4us

Cycle data polling time=755.2+530.4=1285.6us

Total polling time =(1285.6+350)*1.1=1799.16us

4.1.3.6.2 Requirements

"PL_LINK_MASTER "protocol window has been opened

4.1.3.6.3 Steps

To configure the polling period of the master station, follow these steps:

(1) In the "Device Configuration" tab, double-click the "polling period" edit box to enter value.

4.1.3.7 Configure Parameters of Communication Interface Module

4.1.3.7.1 Concept

After adding LK235/LK271 communication interface module, communication parameters need to be configured.

4.1.3.7.2 Requirements

LK235/LK271 module window has been opened

4.1.3.7.3 Steps

To configure parameters of communication interface module, follow these steps:

(1) In the LK235/LK271 "Device Configuration" tab, configure the following parameters.

Parameter name	Description
Alias	Rename module
Device Address	The device address is related to address set by module rotary code switch
Input Starting Byte Offset	Set to default value
Communication Failure Mode	In case of communication failure, I / O modules configured in LK235/LK271 are offline or remains online value Reset: Communication failure between LK235/LK271 and LK241, all the I / O modules are offline Hold: Communication failure between LK235/LK271 and LK241, all the I / O module remains online
Response Time	The time to wait for the communication interface module to respond after the PL-LINK master station sends the request. The setting range is 300 ~ 1000us, 750 as a default value. Response time = (input data sending time + output data sending time) * 10. Please refer to Configure Polling Period
PN Input length	only supported by LK271, default to 100 bytes
PN Output length	only supported by LK271, default to 100 bytes

4.1.4 Configure HolliTCP

4.1.4.1 Configure HolliTCP MASTER Protocol

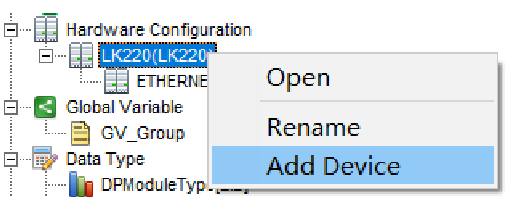
The controller and LK241M, as the HolliTCP communication master, are responsible for the data communication connection between the controller and the HolliTCP _ Master protocol slave. In data communication, the master station sends communication instructions from the controller to the HolliTCP slave station LK235M, and receives IO data uploaded by LK235M to the controller.

- The limit for the HolliTCP _ Master protocol addition in the system is 1.

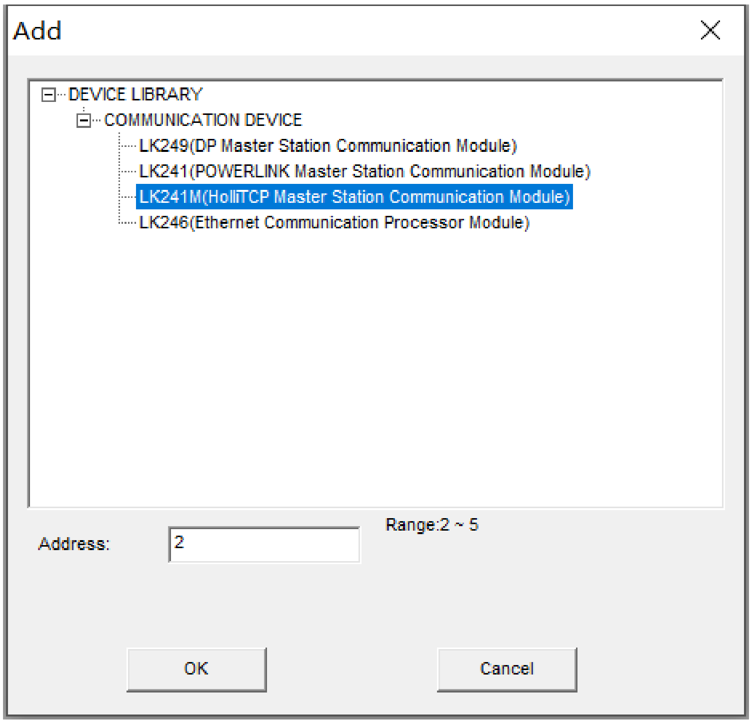
4.1.4.1.1 Add LK241M

Controller and LK241M add HolliTCP master method is the same, below to LK241M example.

On the right-click menu of the controller node, click the "Add Device" command, bring up the "Add" dialog box, as shown in Figure (b), select [LK241M (HolliTCP master station communication module)] and click OK to add LK241M under the controller node.



(a)

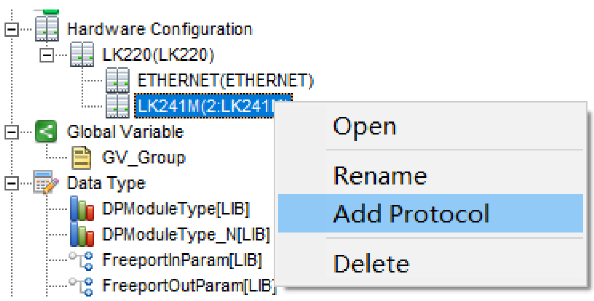


(b)

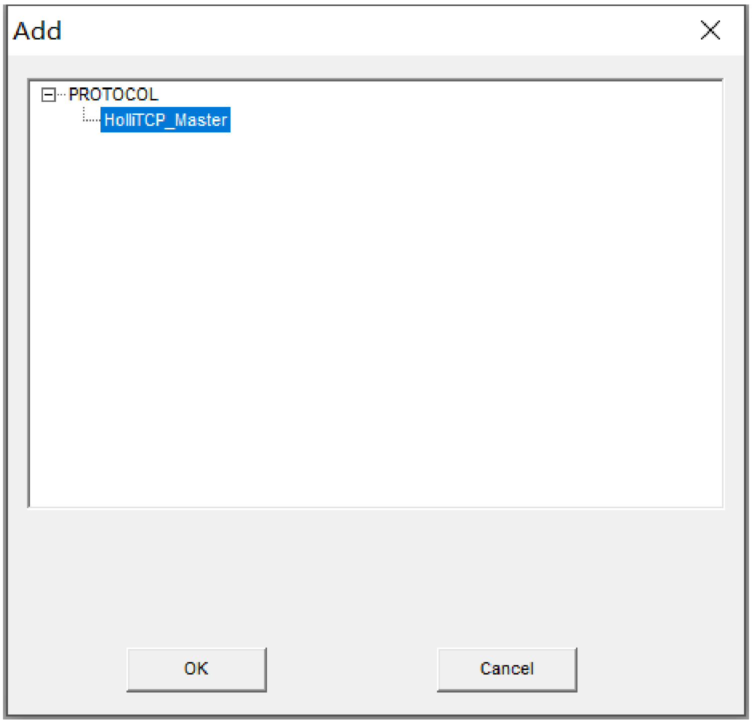
Add LK241M Module

4.1.4.1.2 Add HolliTCP_Master

In the right-click menu of the [LK241M] node, select the [Add Protocol] command, which will pop up the 'Add' dialog box, as shown in figure .



(c)

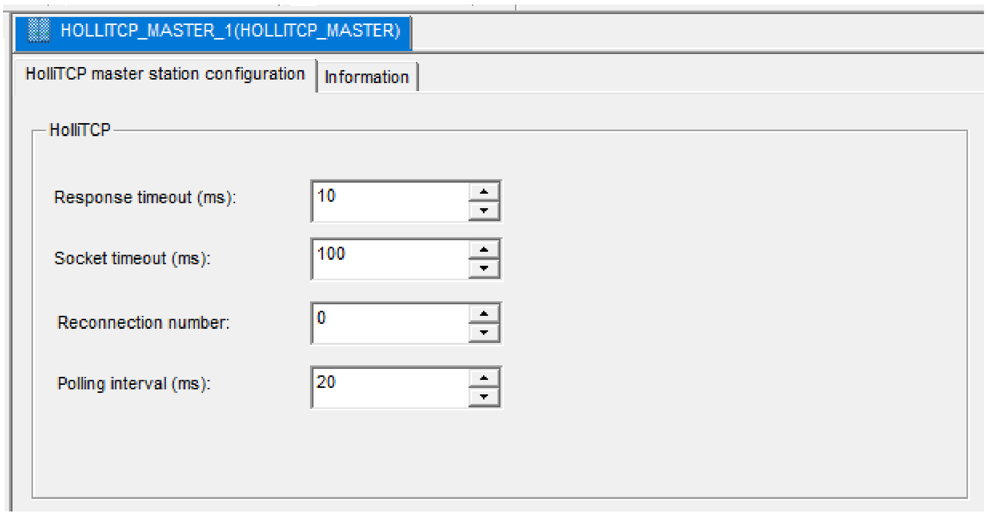


(d)

Add HolliTCP_Master protocol

4.1.4.1.3 Configure Master Station of HolliTCP MASTER Protocol

Double click the **HolliTCP_Master** node, open the parameter configuration window of master station, as shown in figure.



HolliTCP MASTER Parameter Configuration Window

HolliTCP _ MASTER Protocol Parameter

Parameter	Parameter value	Initial value	Illustration
The time of	10~2,147,483,000	10	HolliTCP_Master Slave station response time allowed after the

Parameter	Parameter value	Initial value	Illustration
response timeout （ms）			master sends the request frame
The time of socket timeout （ms）	1~2,147,483,000	100	The time of HolliTCP connect socket timeout
Number of retries	0~10	0	Number of times the master station resend a request after a slave reply exception
Polling interval （ms）	0~2,147,483,000 (LK235M)	20	The interval between HolliTCP_Master receiving a slave reply frame and sending the next request frame. If the last slave reply timed out, the master can ignore the interval and send the request frame directly

4.1.4.1.4 Configure LK235M Module

Refer to the Configure LK235M Module.

4.1.4.2 Configure LK235M

LK235M module is responsible for reporting IO slave data to HolliTCP master station and sending controller data to IO slave station.

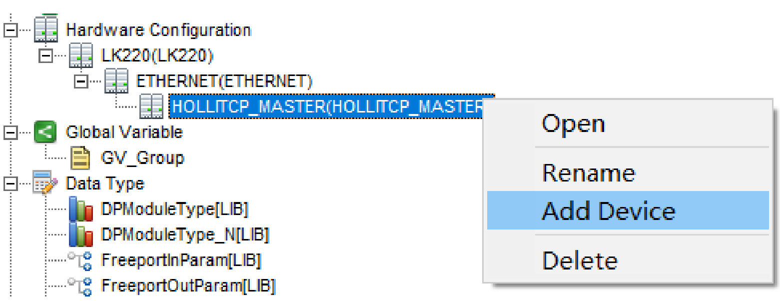
The HolliTCP protocol can support up to 64 LK235M modules.

4.1.4.2.1 Requirements

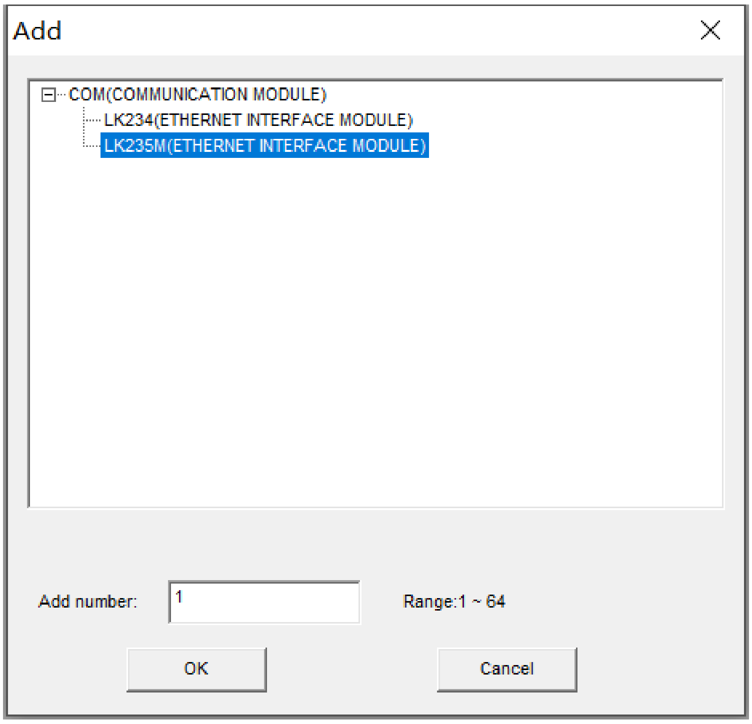
- Added 'HolliTCP' protocol
- LK235M Installed and Set Station Address

4.1.4.2.2 Configure LK235M Module

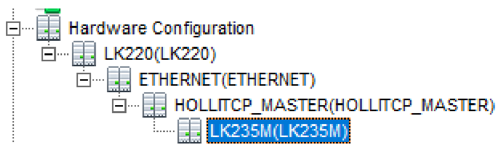
Right-click on [Add Device] command under [HolliTCP_Master] node, bring up the "Add" dialog as shown in Figure (b), select [LK235M (Ethernet Interface Extension Module)] and click OK to add LK235M to the HolliTCP node. Adding LK235M is only supported under LK241M.



(a)



(b)



(c)

Add LK235M module

The range of additions in figure (b) above is the maximum number that can be added currently. The add scope is automatically adjusted based on the number of modules that have been added. Enter more than this range or no LK235M module selected, then **make sure** the button is not available.

The composition of Added LK235M: if the equipment name (equipment model) is duplicated, the default equipment name when added is "LK235M _ serial number".

- Parameter setting

Double-click the LK235M node to open the device information window, as shown in the figure.

LK235M(LK235M)

Device Configuration | Information

Project	Content
Module Type	LK235M
Alias	LK235M
Description	Ethernet Interface Module
Baud rate	500.00kBits/s
TSL(0~65535)	200
Min TSDR(0~65535)	11
Max TSDR(0~65535)	100
TQUI failure/Repeater switching time(0~255)	0
TSET(0~255)	1
TTR	3416
Gap	10
Retry limit(0~255)	1
Slave interval(0~65535)	50
Poll timeout	500
Data control time	1200
Operating mode	Double network
Ethernet1	128.0.0.249
Ethernet2	129.0.0.249
Port number	503
Response timeouts(0~2147483000)	0

LK235M Device Information Window

- Alias:LK235M/LK234.
- Baud rate: 500 Kbps, 187.5 Kbps, 1.5 Mbps (DP side).
- TSL (0 ~ 65535): The DP polling time of a slave station; that is, retry or poll the next station if no response is received after this period of time.
- Min TSDR (0 ~ 65535):Minimum slave latency; The minimum delay from master request to the slave reply.
- Max TSDR (0 ~ 65535):Maximum slave latency; The maximum delay from the master request to the slave reply.
- TQUI failure/Repeater switching time(0~255):The switch time of DP send failed to next resend.
- TSET(0~255):DP connection establishment time.
- TTR:Maximum time available for token delivery.
- Gap:Number of token turns.
- Retry limit(0~255):Maximum number of retries after DP reply timeout.
- Slave interval(0 ~ 65535):The time interval of polling the same slave twice cannot be less than this parameter, otherwise the slave may not be processed in time.
- Poll timeout:Maximum polling time for a token between master stations.
- Data control time:The maximum time for a master station to update all its slave stations, typically set to 1200ms.
- Operating mode: dual network(Single network is supported in practice).
- EtherNet1: Configure the IP address of LK235M's first Ethernet port to match the actual IP address.
- EtherNet2: Configure the IP address of LK235M's second Ethernet port to match the actual IP address.
- Port number: HolliTCP _ MASTER protocol port number. The default is 503.

- Response timeouts: Slave latency response time allowed after the HolliTCP _ MASTER master master sends the request frame. The default value is 0, which sets the range from 0 to 2,147,483,000.

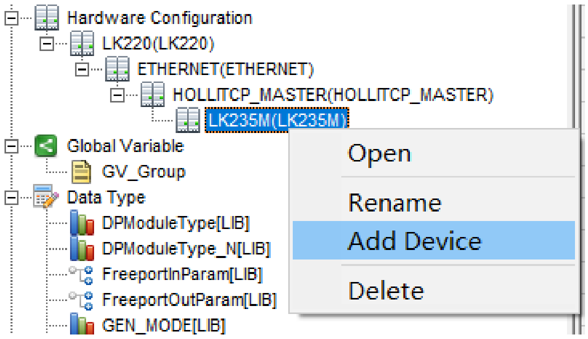
- Diagnostic information

Refer to theLK235M Diagnosis.

4.1.4.2.3 Configure DP Slave

Right-click on the LK235M module and select Add Device to add the IO module. As shown in the figure.

The method of adding IO slave under LK235M is the same as that under LK249 module. Please see the content of Add I/O Slave Station for details.



Add IO Module

4.1.4.2.4 Operation of the IO module

Refer to the Operation of Modules.

4.1.4.3 Configure HolliTCP Slave Devices

LK234 is replaced by LK235M compatible, configuration of LK234 IO slave can refer to Configure LK235M HolliTCP Slave Devices.

4.1.5 Configure IO Device Address

Each IO module has a unique device address, which is determined by the base address of the backplane where the module is located and the module installation slot. The base address is the device address of the first IO slot of the expansion backplane, which is set by the 7-bit dial switch. After that, the device address of the slot is incremented by 1 from left to right. After adding the IO module in AutoThink software, you need to configure the device address.

4.1.5.1 Requirement

You need to set the base address of the expansion backplane where the IO module is located first. See Communication Address.

4.1.5.2 Step

Configuration IO module device address, please follow the steps below:

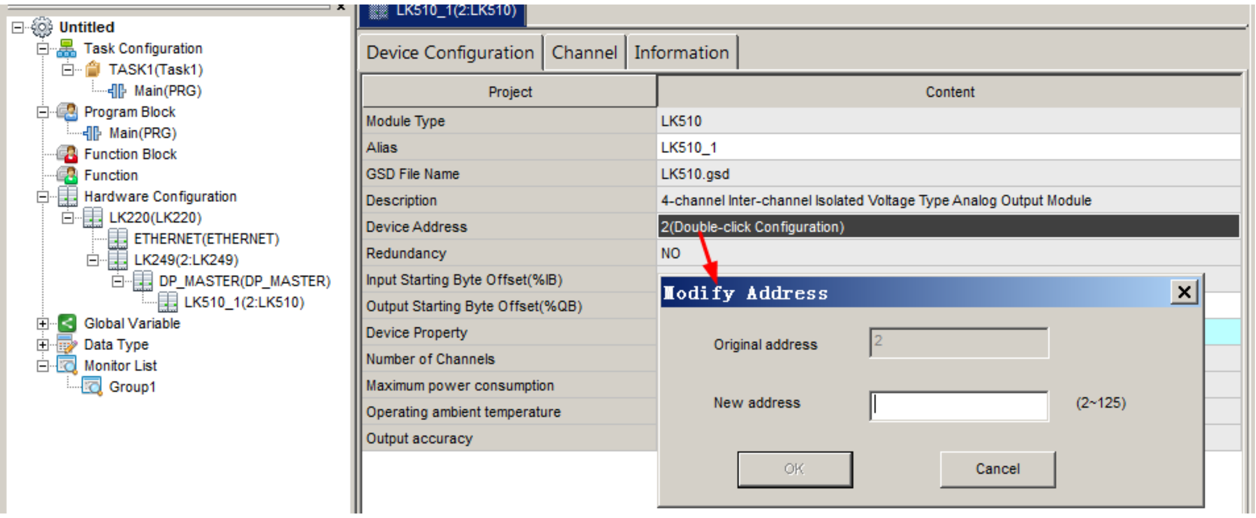
(1) Double click the IO module under the "Hardware configuration" node to open the "Device Configuration" window;

(2) Double click the "Device Address" item to open the "Modify Address" dialog box;

(3) Enter the calculated IO device address in the "New Address" edit box.

(4) Compile and download, and the address will take effect.

After the base address is set, calculate the device address in turn according to the slot position of each module, and configure the device address of each module in the software.



Set IO Device Address

4.1.6 Configure Modbus TCP Protocol

The controller and LK246 supports Modbus TCP protocol and can be configured as master station or slave station. LK246 module can independently execute Modbus TCP protocol .

The number of Modbus TCP master-salve connection has a limit, which exceeds the total number of connections and AT will report a compilation error.

Maximum Number of Master-Slave Connections

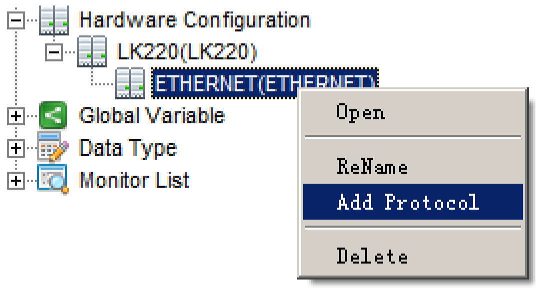
Module	Maximum number of master-slave concurrent connections
LK216/LK220/LK220T1	16 for master-slave in each

Module	Maximum number of master-slave concurrent connections
LK222	32 for master, 16 for slave
LK224	32 for master-slave in each
LK246	64 for master-slave in each

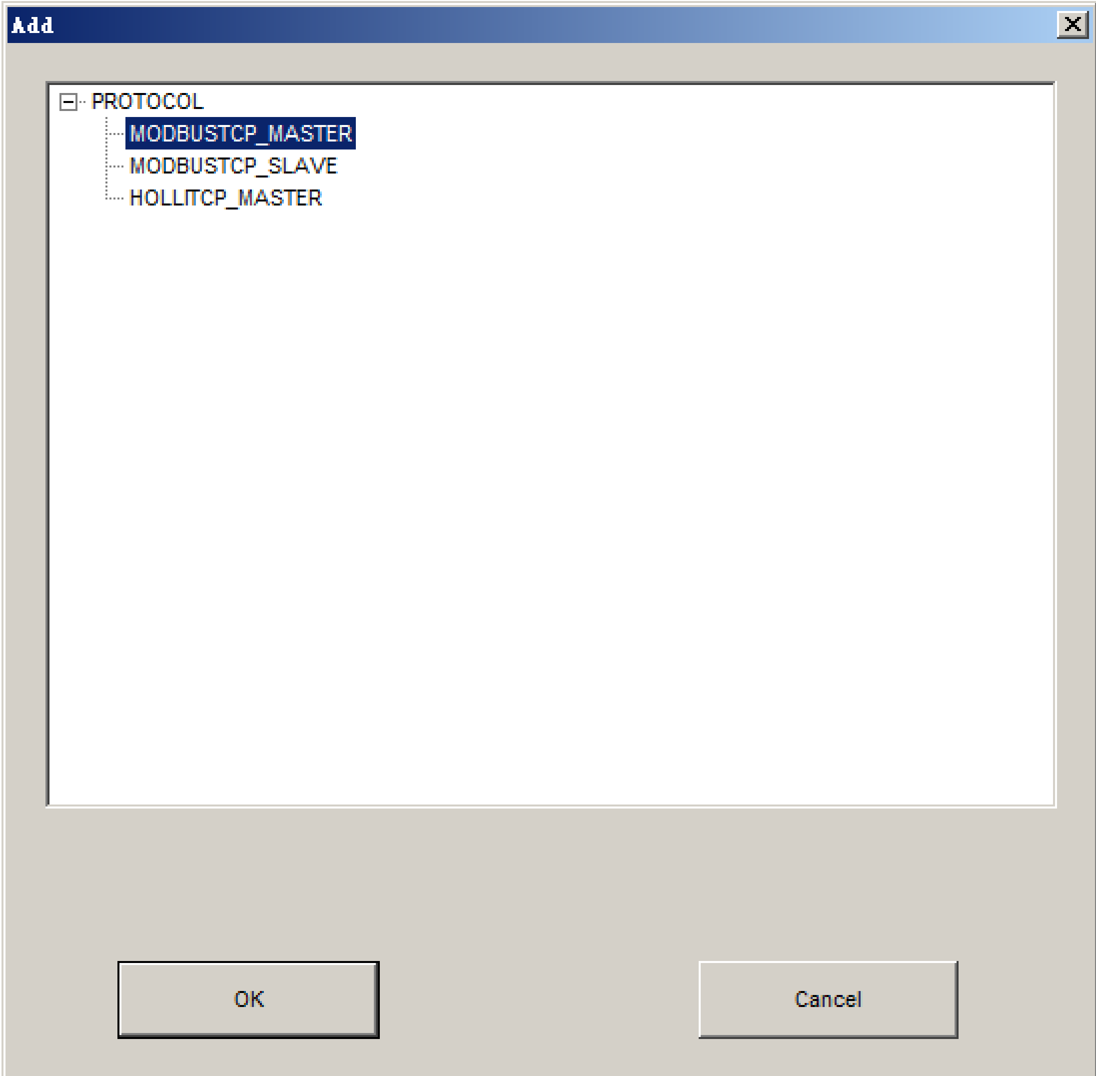
Configuration of Modbus TCP protocol is the same in the controller and LK246, take the controller as an example to describe.

The controller and LK246 are configured in the same way as Modbus TCP protocol. Here, take the controller as an example.

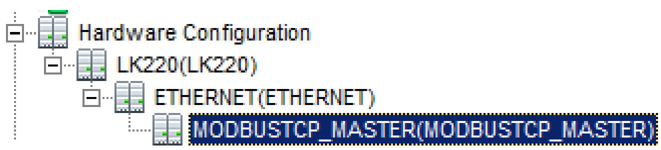
Select [Add Protocol] command in right click menu of the [ETHERNET] node, then pop up the **Add** dialog, as shown in figure(b). When the current controller module is the master station, select the ModbusTCP_MASTER master station protocol. When the current controller module is the slave station, select the ModbusTCP_SLAVE slave station protocol. Click **OK** after selecting the protocol type. The protocol is added, as shown in figure (c).



(a)



(b)

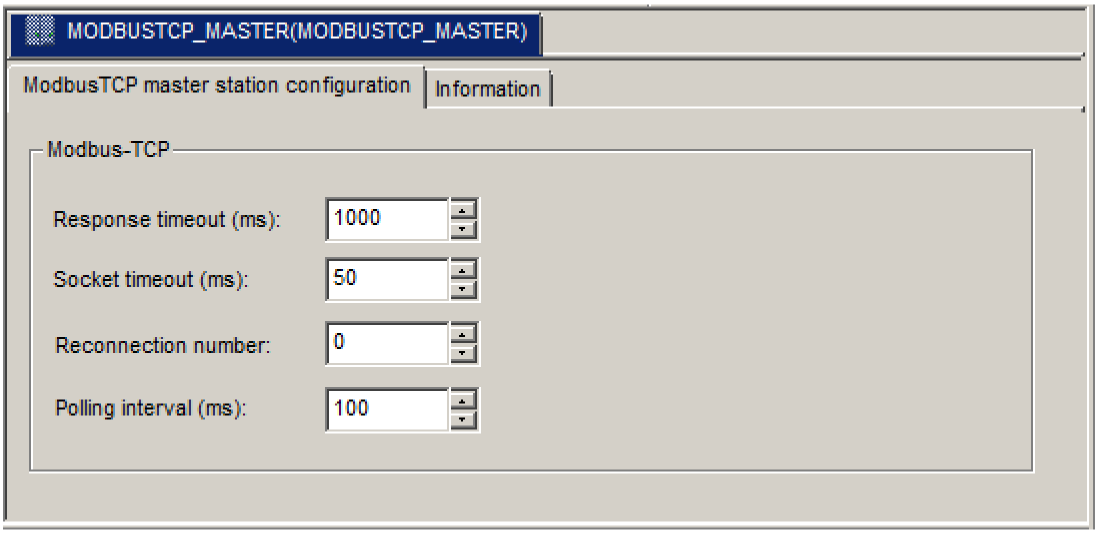


(c)

Add Modbus TCP Protocol

4.1.6.1 Configure Modbus TCP Master Station Protocol

Enter the master station configuration window by double clicking the ModbusTCP MASTER node or selecting [Open] command in the right click menu, as shown in figure. Configurable Modbus TCP master protocol parameters are displayed, and the user can modify the parameter values.



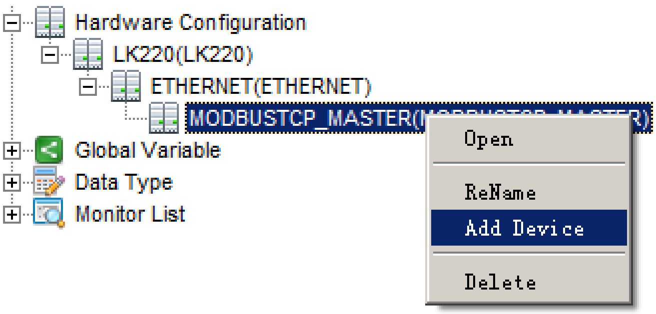
Master Station Configuration Window of Modbus TCP

Parameter settings refer to Modbus Communication Settings for details.

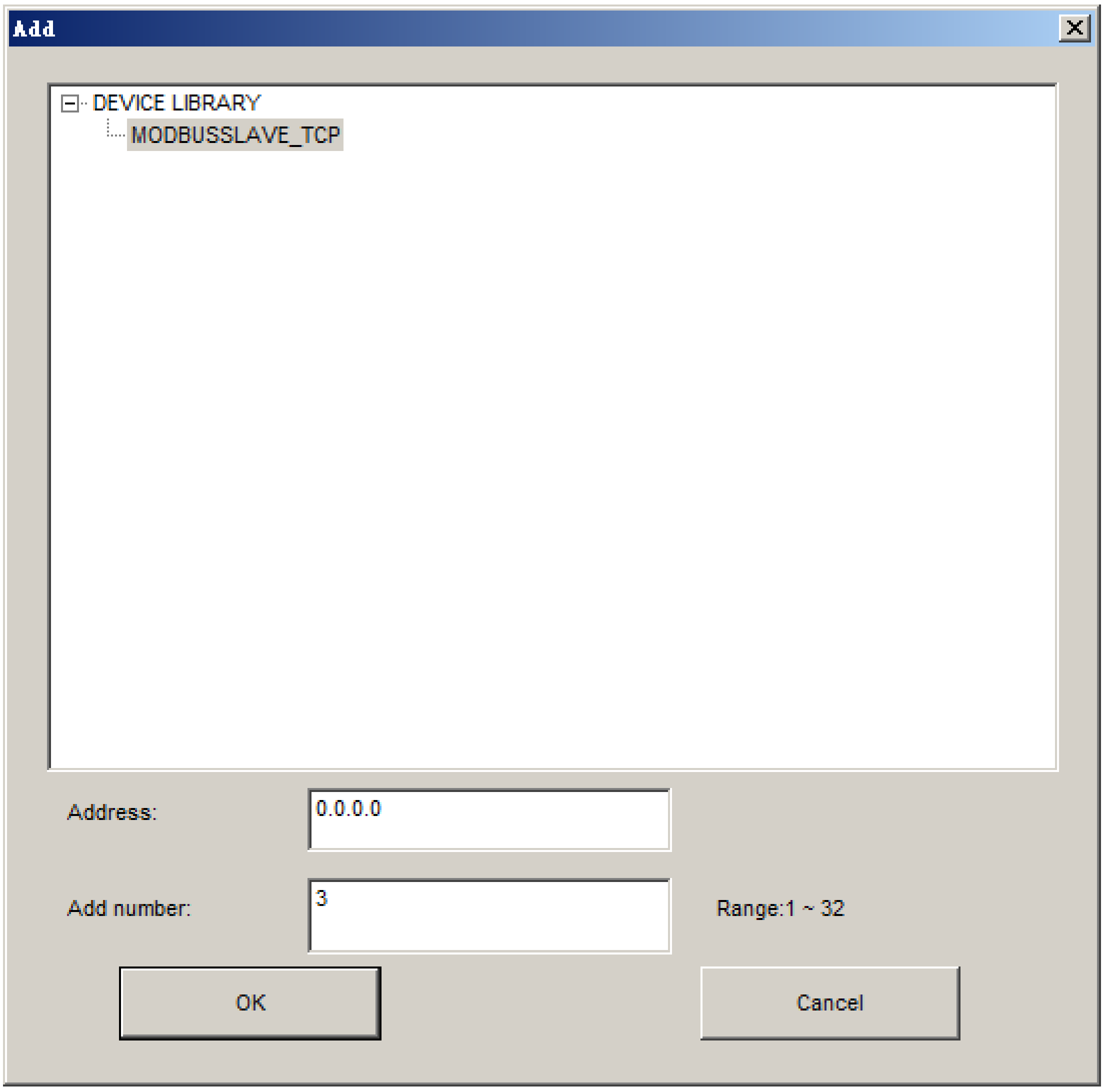
4.1.6.2 Configured Slave Station of Modbus Master Station Protocol

When the current controller as a master station, it can configure one or more slave stations for data communication.

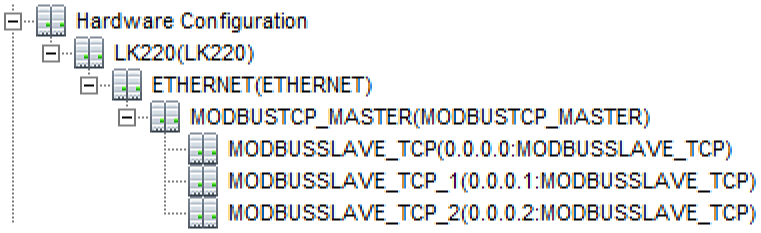
Select [Add Device] in the right click menu in the ModbusTCP_MASTER node to add slave station, as shown in figure.



(a)



(b)



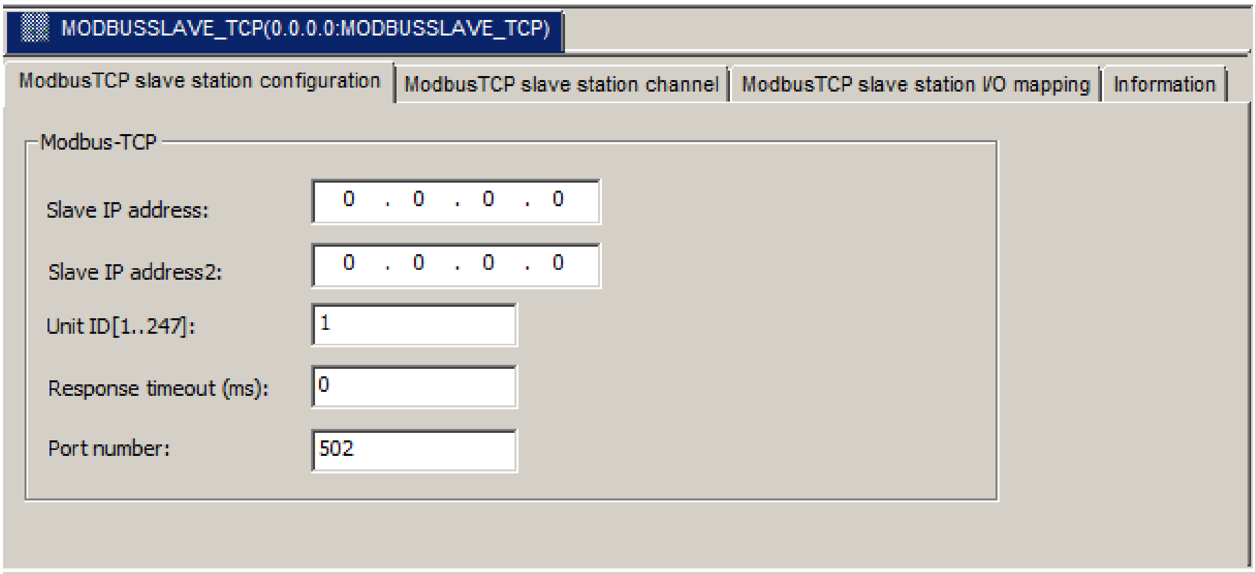
(c)

ModbusTCP Master Configure Slave Station

- Configure instruction for Modbus Slave Station

Open the ModbusSLAVE_TCP configuration window by double clicking the ModbusSLAVE_TCP node or selecting [Open] command in the right click menu, as shown in figure.

Controller as a master station, two IP addresses can be configured.Select one way to connect and the other way as standby. If the first IP is not successful, try to connect second IP.

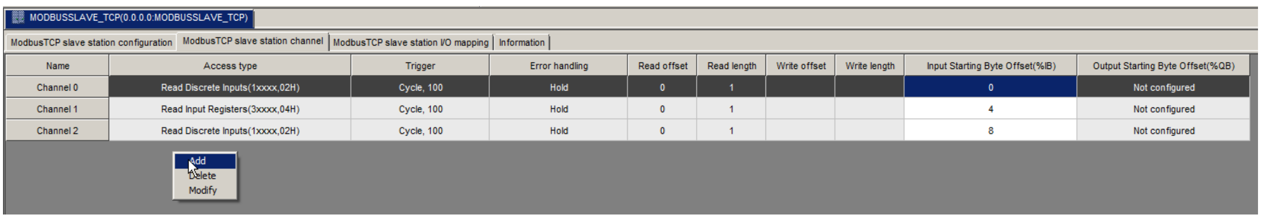


Configuration Window of Modbus TCP Slave Station

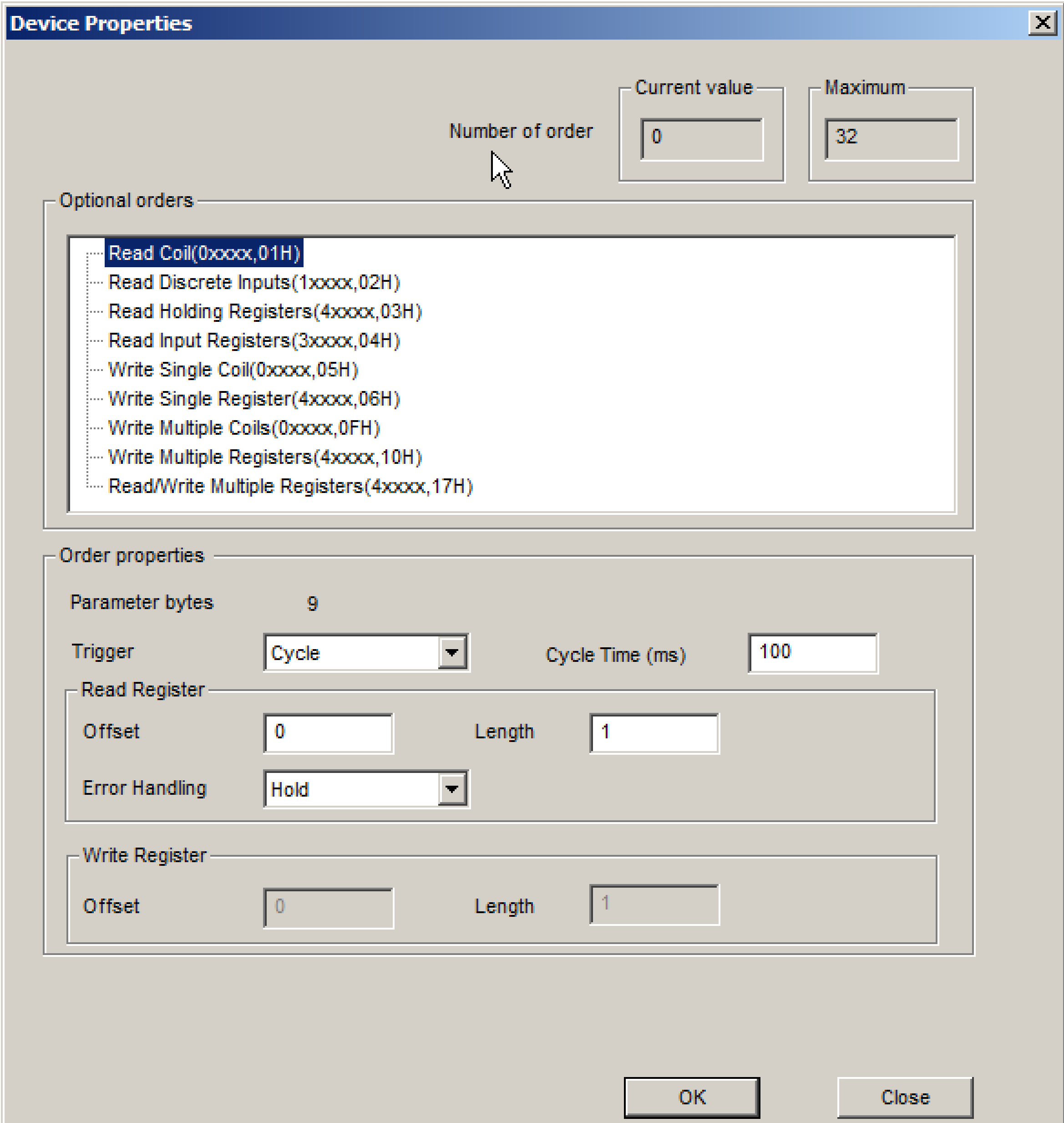
Parameter settings refer to Modbus Communication Settings for details.

- Configure slave station orders

In the [ModbusTCP slave station channel] tab, you can add orders to the slave station through the [Add] command in the right-click menu, as shown in figure.



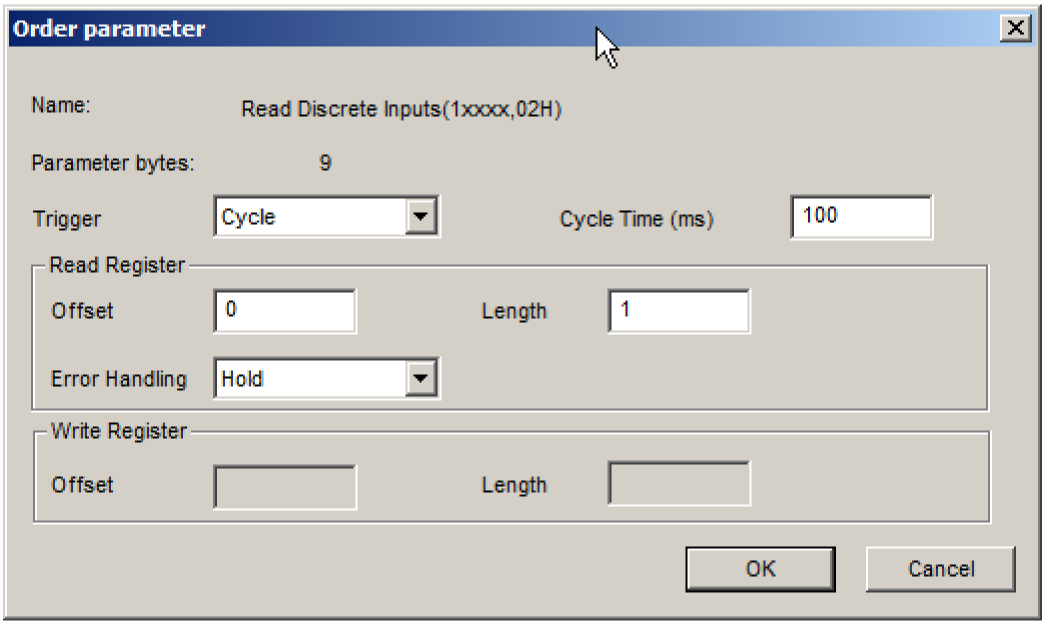
(a)



(b)

Add Slave Station Orders

Choose the instructions in **Optional Orders** list with parameters displayed in **Order properties** list. set parameters and click **OK** to complete adding. You can add up to 32 instructions.



Instruction Parameter Settings of Modbus TCP Slave Station

- Slave station I/O mapping

After configuring the orders, the corresponding I/O channels are mapped in the [ModbusTCP slave station I/O mapping] tab.

MODBUSSLAVE_TCP(0.0.0.0:MODBUSSLAVE_TCP)

ModbusTCP slave station configuration | ModbusTCP slave station channel | ModbusTCP slave station I/O mapping | Information

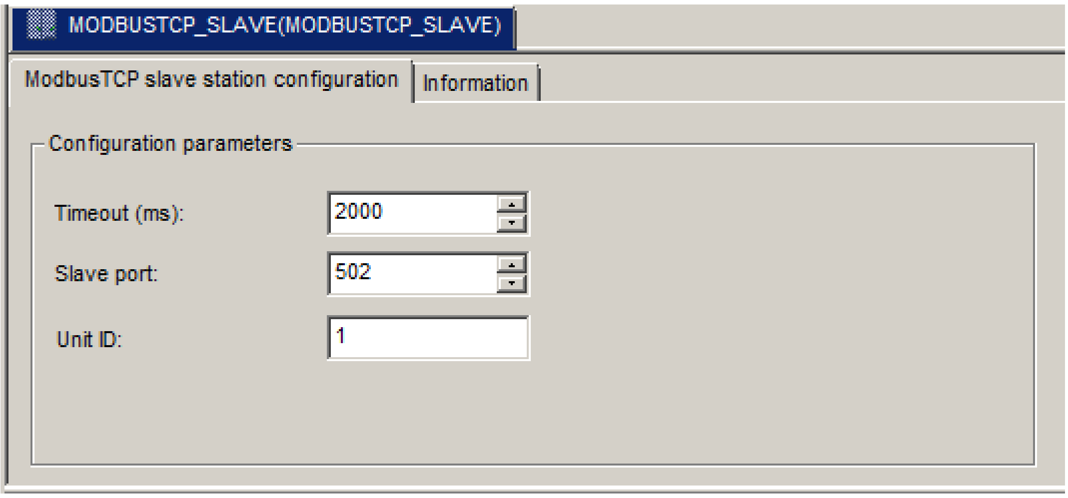
Channel Number	Modbus Address	Channel Name	Channel Type	Channel Address	Channel Description
Channel 0					
1	000001	TCPIO_1_1_0_0_0_0_1	BOOL	%IX0.0	Read Coil(0xxxx,01H)
2	000002	TCPIO_1_1_0_0_0_0_2_1	BOOL	%IX0.1	Read Coil(0xxxx,01H)
3	000003	TCPIO_1_1_0_0_0_0_3_1	BOOL	%IX0.2	Read Coil(0xxxx,01H)
Channel 1					
4	400001	TCPIO_1_1_0_0_0_0_2	WORD	%MW4	Read Holding Registers(4xxxx,03H)
5	400002	TCPIO_1_1_0_0_0_0_3	WORD	%MW6	Read Holding Registers(4xxxx,03H)
6	400003	TCPIO_1_1_0_0_0_0_4	WORD	%MW8	Read Holding Registers(4xxxx,03H)
7	400004	TCPIO_1_1_0_0_0_0_5	WORD	%MW10	Read Holding Registers(4xxxx,03H)
Channel 2					
8	300001	TCPIO_1_1_0_0_0_0_8	WORD	%MW12	Read Input Registers(3xxxx,04H)
9	300002	TCPIO_1_1_0_0_0_0_9	WORD	%MW14	Read Input Registers(3xxxx,04H)
10	300003	TCPIO_1_1_0_0_0_0_10	WORD	%MW16	Read Input Registers(3xxxx,04H)

I/O Channels of Slave Station

4.1.6.3 Configure Modbus Slave Station Protocol

Controller as a salve station, you need to add ModbusTCP_SLAVE protocol, reference to Configure_Modbus_TCP_Master_Station_Protocol.

Double-click ModbusTCP_SLAVE node to open the slave station configuration window of Modbus TCP, as shown in figure.



ModbusTCP_SLAVE Configuration Window

Configurable Modbus TCP slave protocol parameters are displayed in ModbusTCP_SLAVE window, and the user can modify the parameter values.

Parameter settings refer to Modbus Communication Settings for details.

4.1.7 Configure OPC UA Protocol

LK216 supports one LK246 module, LK220 /LK220T1/ LK222 supports two LK246 modules, and LK224 supports four LK246 modules.LK246 module integrates OPC UA protocol function.

- Only one OPCUA_Server protocol can be configured in the project, only one networkport can be configured under the LK246 module. The LK246 supports up to 16 protocols(Modbus master + Modbus slave + OPCUA_Server).
- Configurable number of OPC UA variables is subject to the byte size of all variables,
- and all configured OPC UA variables occupy up to 20000 bytes.
- When the capacity of OPC UA variables exceeds the limit, please insert SD card to extend. When switching between active and standby in dual racks, the OPC UA server will actively disconnect the link. At this time, the current subscription resources of the client cannot be released by the server according to the protocol, and can only be actively released after the subscription cycle ends (note: the subscription cycle is a client configuration parameter). If the OPC UA server disconnects and reconnects multiple times before the end of the subscription cycle, causing the client to apply for subscription resources multiple times and reach the server limit, it will not be possible to add new subscription resources.

4.1.7.1 Configuration method

Please refer to the LK246 OPC UA configuration section of <*AutoThink V3.1 User Manual_Project Configuration*> for the specific configuration method.

4.1.8 Configure LK246

4.1.8.1 Overview

Controller supports LK246 communication module. LK220 /LK220T1/ LK222 supports two LK246 modules, and LK224 supports four LK246 modules.

- Reference

Configure MODBUS TCP Protocol

4.1.8.2 Configure Failover Mode

4.1.8.2.1 Concept

When LK246 module has a network interface fault, You can configure the conditions of the master-slave switch through the configuration software. When the configuration conditions in the software are met, the master-slave switch is triggered.

The configurable failover mode are as follows:

- No switching
- Network port 1 failure
- Network port 2 failure
- Network port 1 or network port 2 failure
- Network port 1 and network port 2 failure

4.1.8.2.2 Requirements

LK246 module has been added under the controller

4.1.8.2.3 Steps

To configure failover mode, follow these steps:

(1) Double click the LK246 module under the controller tree node.

The LK246 configuration window will open.

LK246(2:LK246)

Device Configuration | Information

Project	Content
Module Type	LK246
Alias	LK246
Description	Ethernet Communication Processor Module
Device Address	2(Double-click Configuration)
Failover mode	No switching
Input voltage	19.2V~30VDC
Module dissipation(max)	300mA@24V
PCIe bus transmission speed	512MB/s
Module hot swap supported	Yes
Module size(W*D*H)	44.7mm*166mm*152mm
Operating ambient temperature	-20~70 degrees centigrade
Installation	Backplane slot

LK246 Device Configuration Window

(2) In the "Device Configuration" tab, click the "Failover mode" drop-down button to select a fault for switching.

4.1.9 IP Can Instructions

Through the IP scanning tool, you can find and modify the IP address of all controllers in the LAN. At the same time, the IP equipment can be identified by lighting.

Precautions for use:

- IP scanning does not support routing. If the router is connected to the LAN, the devices connected by the router cannot be scanned.
- If the PC has multiple network adapters, you need to check the network adapter model connected to network before scanning, and configure it in the Assistant Tool to ensure that the communication port is correct.
- When using the IP scanning tool, when the Windows system pops up a prompt, you need to check the network type connected to the PLC system in the actual usage scenario correctly. For example, if you define a network connected to a PLC system as a public networks, you need to check the public networks. If you cannot judge the currently defined network type, please check all of them. Otherwise, some functions of IP scan may be abnormal due to windows firewall filtering mechanism.

4.2 System Running

4.2.1 Required Devices

The basic hardware of a control system: master control backplane, extension backplane, power supply module, master control module, communication module, I/O module, connecting cable.

A PC installed with the professional programming software AutoThink and provided with the RJ45 network port.

4.2.2 Device Wiring

- I / O module signal wiring: the wiring of each module is different, please refer to the wiring instructions of each module.
- Wiring of the 24VDC system power supply: positive terminal of 24VDC power supply connected to DC IN+, negative terminal connected to DC IN－ of DC power supply adapter module.
- Network wiring: you need a RJ45 network cable, one end is connected to the network interface of the PC and the other end is connected to ETHERNET ports of the controller.
- Profibus-DP wiring: via the LKA104 to connect the LK249 module in master chassis and slave chassis, then connect to DP port of the backplane. Also DP can be expanded by LK233.
- Redundancy communication wiring: two fiber cable LKA105 are separately connected to the FIBER X1, FIBER X2 in LK240 module in master-slave frame.

Configure redundancy system, the suggested steps as following:

(1) Network cable, DP cable, fiber cable are connected well (to ensure correct wiring method).

(2) Power -on for a single frame and you need to wait for some time until it becomes the master frame.

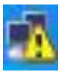
(3) Power -on for other frame and you need to wait for some time until it becomes the slave frame.

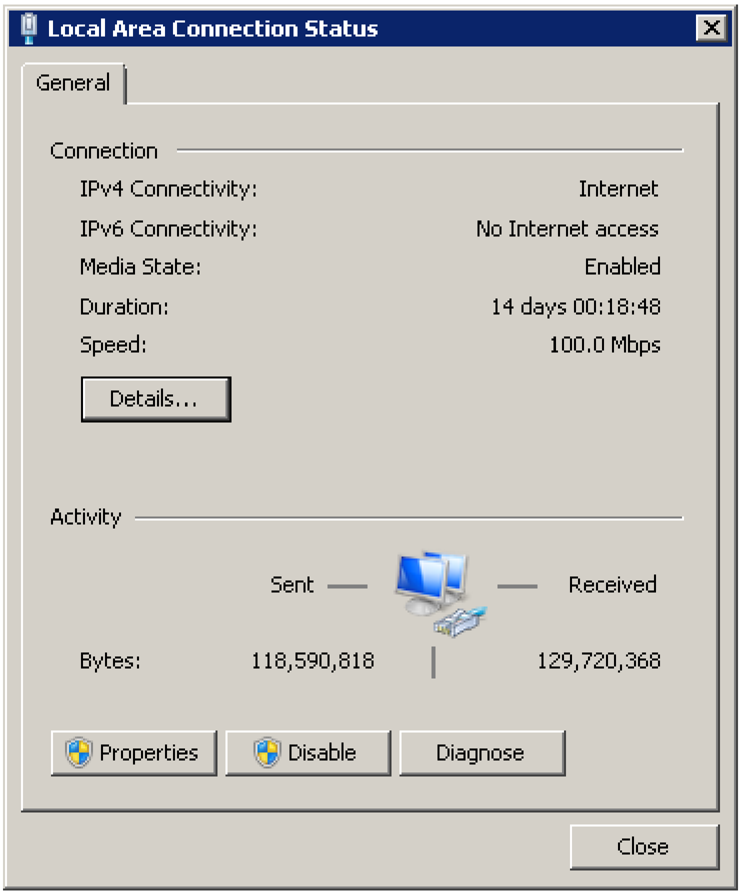
⚠It is not suggested that the fiber cable is inserted into module to compose the redundancy system when both frames are master with running normally.

4.2.3 Network Connection

After completing various configuration items, use any of the four programming languages provided by the software to write and compile the program, finally download the compiled user program to the controller module and run it. Only by doing so can achieve the control goal.

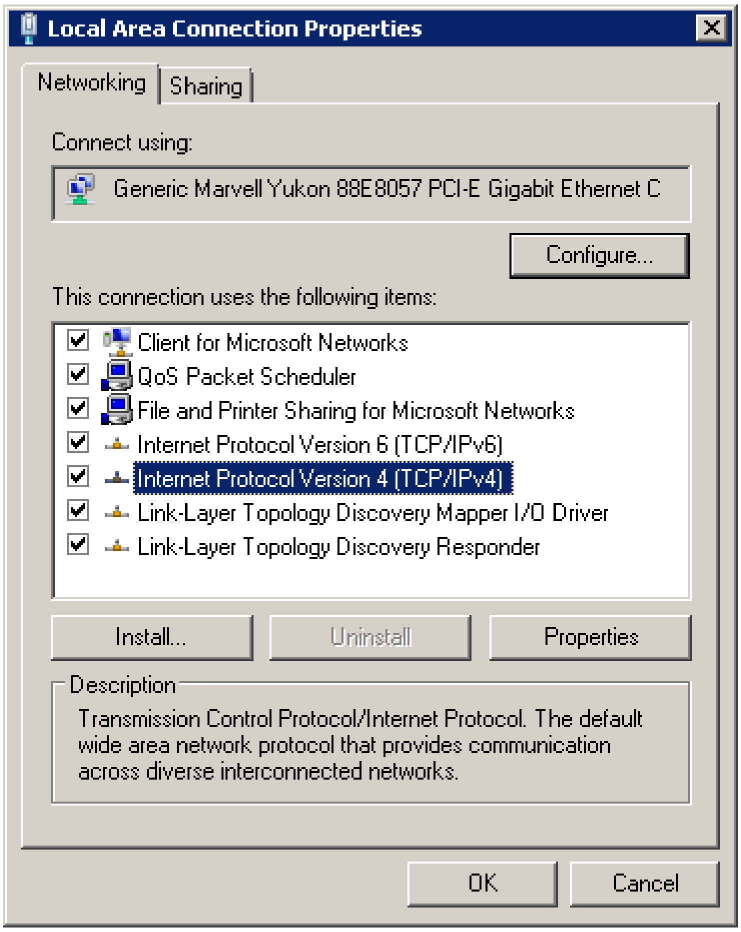
The controller module and the programming device (PC) are connected via the industrial Ethernet, with the connection steps given below:

(1) Double click the icon  of **Local Area Connection** in the taskbar to pop up the **Local Area Connection Status** window, as shown in figure.



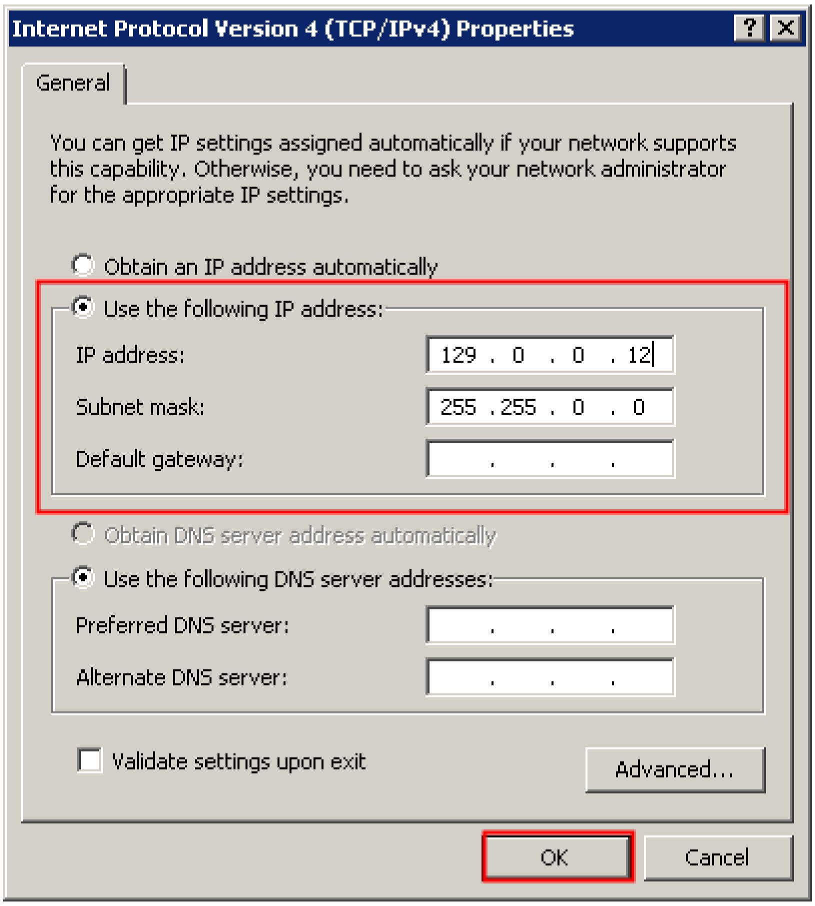
Local Connection Status

(2) Click the **Properties** button to pop up the **Local Area Connection properties** window, as shown in figure.



Local Area Connection Properties

(3) Select the **Internet Protocol Version 4 (TCP/IPv4)**, click the **Properties** to pop up the Internet Protocol Version 4 (TCP/IPv4) Properties window.

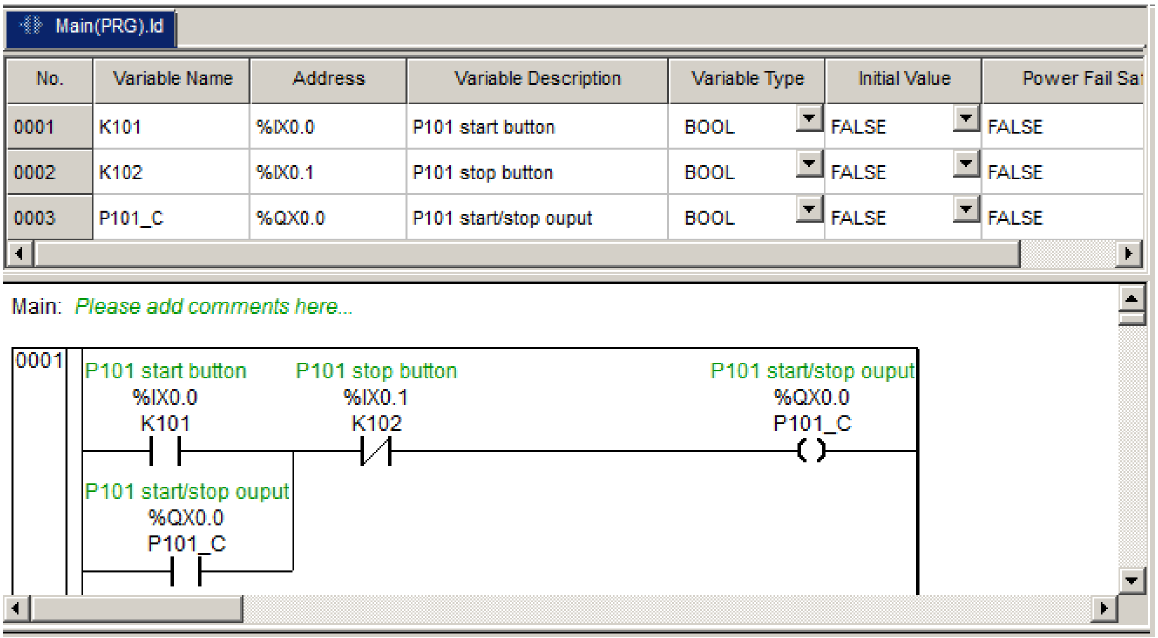


Dialog Box of Internet Protocol (TCP/IP) Properties

Select **Use the following IP address** and fill in IP address of PC in the **IP address** field. Notably, The first three IP addresses are the same as IP addresses of the controller module or Ethernet communication module to be connected to the PC (controller default 128.0.0 and 129.0.0). The final digit shall be any number, only of there is no address conflicts with the controller module or other devices, such as 129.0.0.12. Click the **Subnet mask** bar to automatically pop up 255.255.0.0, as shown in figure 50. Click **OK** to Close the dialog box, the **Local Area Connection** network icon in the task bar shall change into , which indicates successful network connection.

4.2.4 Example Project

Configure the pump P101's logic of starting, keeping and stopping. Pump P101 starts when start button K101 is pressed, while stops when stop button K102 is pressed.

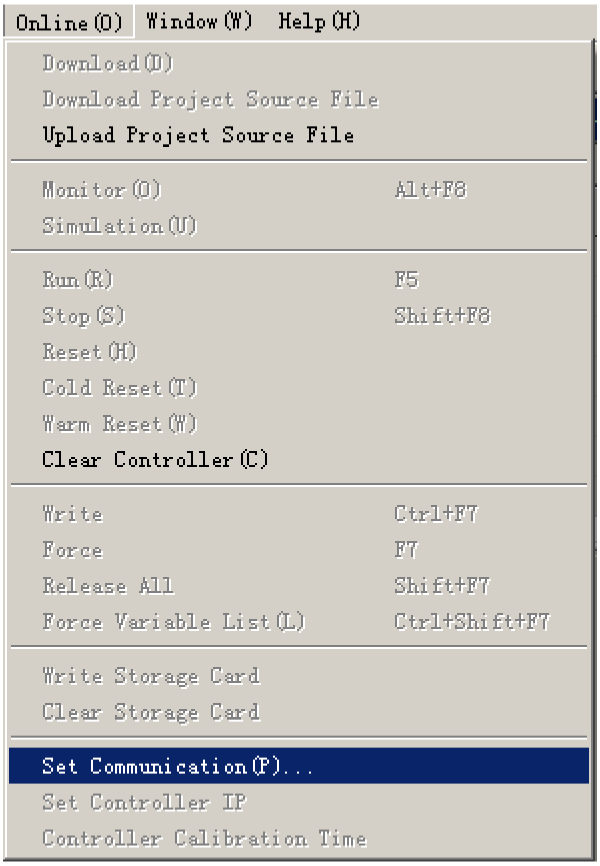


Example for Program Configuration

4.2.5 Download Project

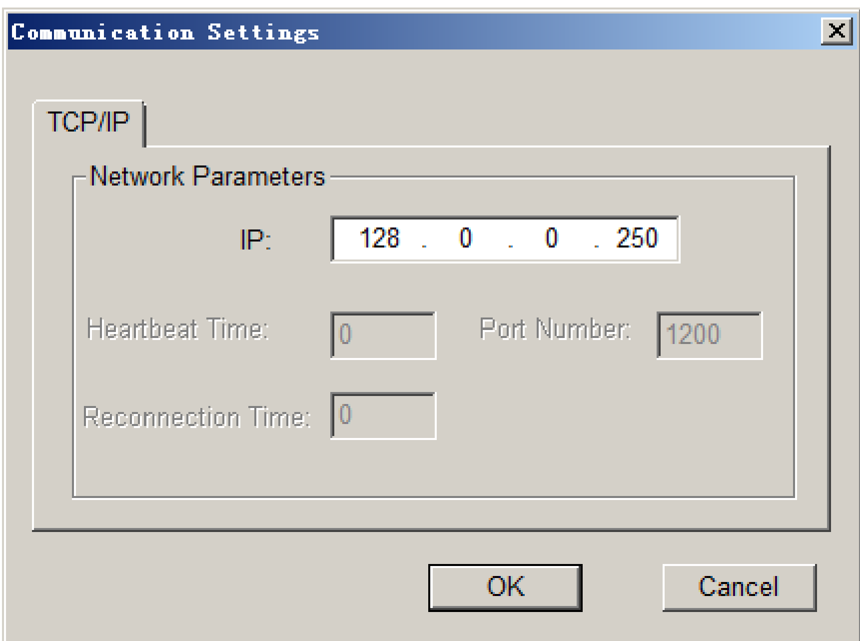
After establishing the network connection, it can download the engineering from the programming device to the controller module. See the following for the main operation steps:

(1) Select [Online]-[Set Communication] in the menu bar of AutoThink software, as shown in figure.



Online Menu

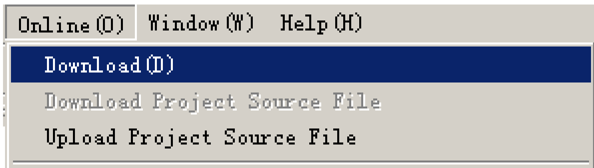
(2) Enter the IP address of the controller module in the **Communication Settings** window, such as 128.0.0.250, as shown in figure.



Communication Parameters Settings

(3) Set the key switch in the controller panel as **PRG** or **REM**, and Select [Online]-[Download] in

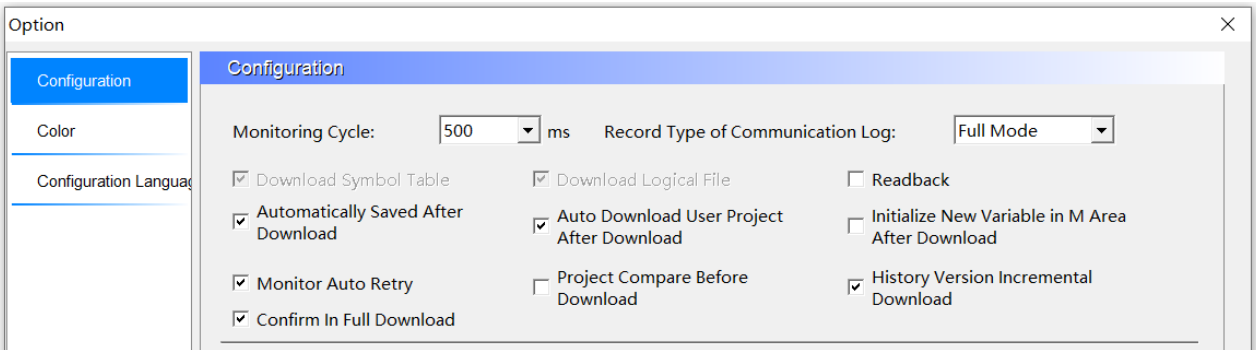
the menu bar, as shown in figure.



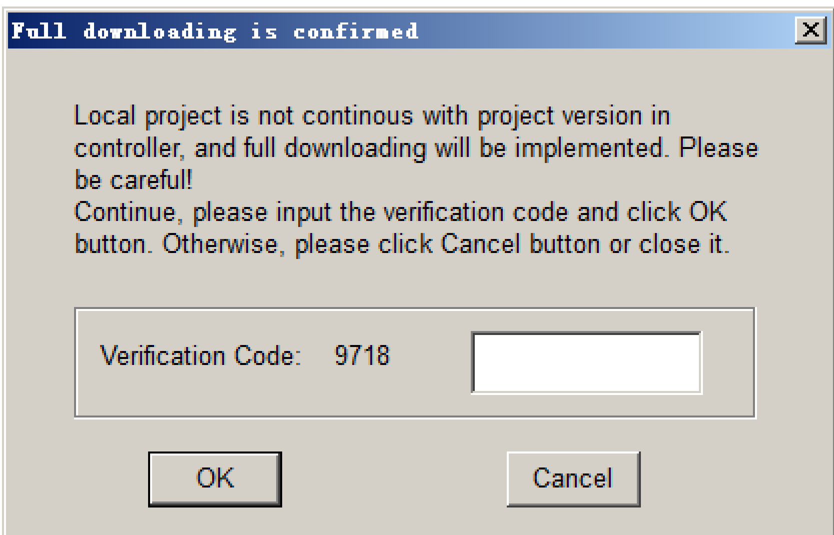
Select the Download Command

The project of "Download" is the project of current AT software compiling and running, and the project files of "Download User Project" and "Upload User Project" are called User Project, and the suffix is. hpf. The running project and the user project all carry on the power-down protection automatically. Make sure the user project has been downloaded before uploading it.

By default, the user project can be downloaded together with the running project. The user can choose whether to download the user project according to the actual situation.



(4) Pop up an information window prompting full download as shown in figure, click **OK** to download the project. In this case, ensure good communication connection between the programming device and the controller module. Otherwise, an error message shall be prompted.



Message Prompting Full Download

4.2.6 Program Run

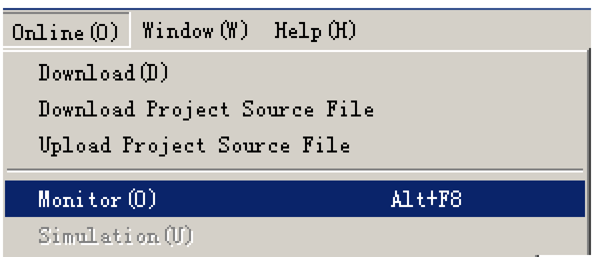
After downloading, the project is in a stopped status.

Start the project, with the methods making it run as following:

Method 1: The controller can be run or stopped via AutoThink when the key switch is in REM position. Turn the key switch on the controller module panel to **REM**, select [Online]-[Monitor] to run the project, as shown in figure. For **Start Type** is manual, you need to click [Online]-[Run] to make task run. The project run based on the **REM** mode is not completely out of the control of the programming software. It is allowed that forcing variable, increment download, full download, running, stopping. Select [Online]-[Stop] to stop the running project, And then you can modify the project and download again.

Prior to officially run, this method can be used to debug the project online. After the project run normally, to ensure that the project is not modified accidentally, it shall turn the key switch to **RUN** and pull it out, with any operation forbidden.

Method 2: Control project via key switch, that is in RUN position for running and in PRG position for stopping. Turn the key switch on the controller module panel to **RUN**, with the controller module starting to run the project. In this case, it can neither stop the project via the programming software, nor modify the project.



Online Operation

Chapter 5 Master Control Unit

5.1 Backplane

5.1.1 LK130 4-slot Backplane Module

LK130 is a 4-slot main control backplane, with power slot, controller slot, extension slot0 and extension slot1.The device address of the controller slot is default 1, and the device address of the extension slot is added 1 in turn, such as 2-3.

Supporting modules:

- Supported power modules: LK921, LK922
- Supported controller: LK216, LK220, LK222, LK224, LK220T1
- Supported extension modules: LK249, LK240, LK246, LK241,LK241M

5.1.1.1 Appearance

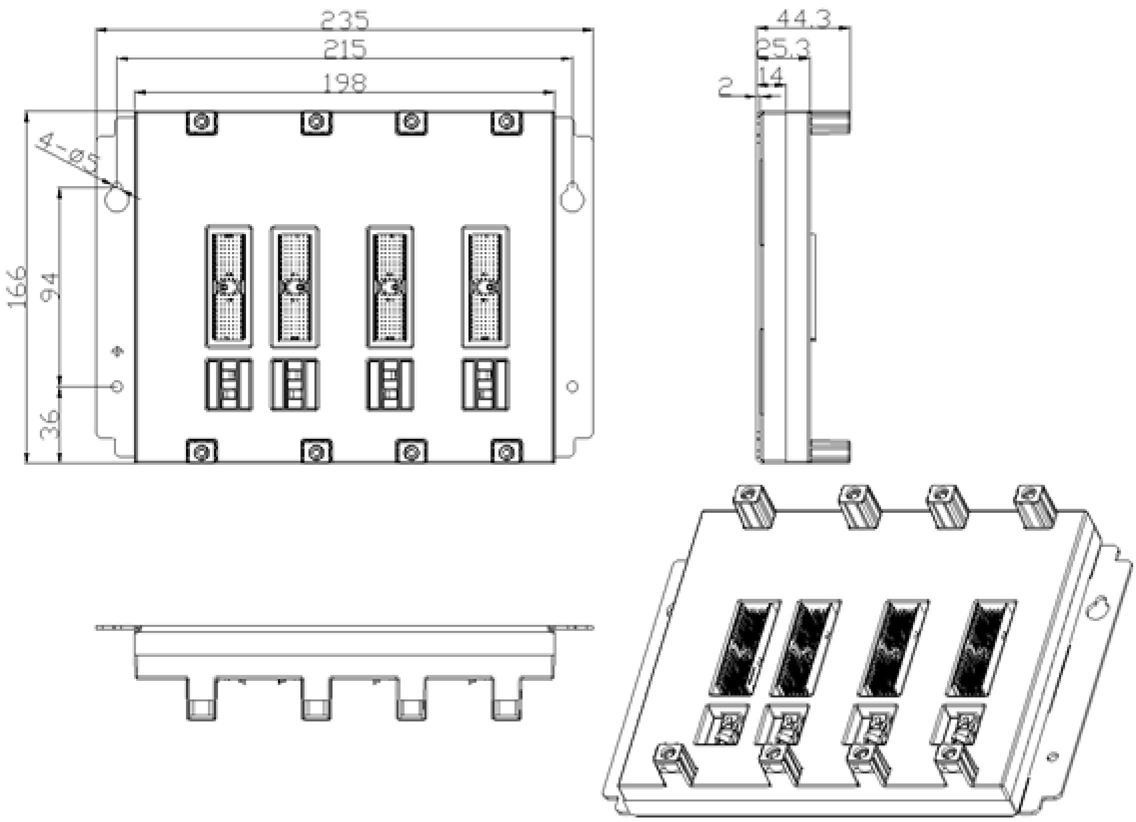
See figure for the external structure of the LK130 module.

LK130 Backplane Schematic Diagram

Interface Specification

Interface	Description
Module screw fixing hole	Fix main controller modules
Mounting hole	Intall backplane to mounting plane through the mounting holes
Backplane screw fixing hole	After the backplane is installed, fix it with screws
Power slot	Install power module LK921 and LK922
Controller slot	Install controller LK216, LK220, LK222, LK224, LK220T1
Extension slot	SLOT0~SLOT1 , install communication expansion module LK249, LK240, LK246, LK241,LK241M

5.1.1.2 Installation Dimension



LK130 Backplane Dimension

5.1.1.3 Technical Specifications

LK130 4-slot Backplane Module	
Interface	
Number of Slots	4
Physical Property	
Installation Pattern	Install via a screw hole

Module Dimension (W*H*D)	235 mm *166 mm*44.3 mm
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

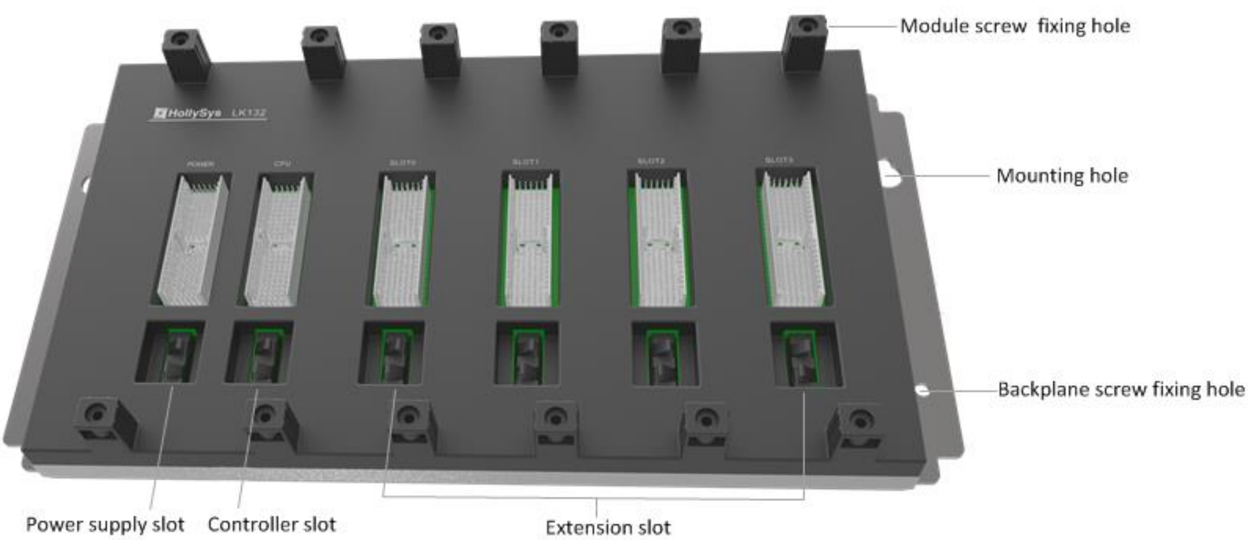
5.1.2 LK132

LK132 is a 6-slot main control backplane, with power slot, controller slot, extension slot0 and extension slot3.The device address of the controller slot is default 1, and the device address of the extension slot is added 1 in turn, such as 2-5.

Supporting modules:

- Supported power modules: LK921, LK922
- Supported controller: LK216, LK220, LK222, LK224, LK220T1
- Supported extension modules: LK249, LK240, LK246, LK241, LK241M

5.1.2.1 Appearance



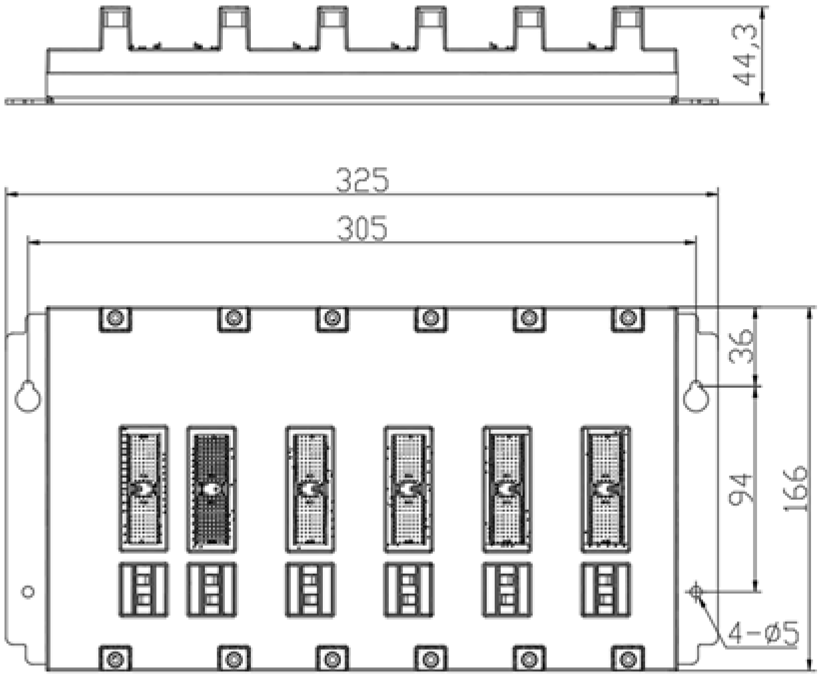
LK132 Backplane Schematic Diagram

Interface Specification

Interface	Description
Module screw fixing hole	Fix main controller modules
Mounting holes	Intall backplane to mounting plane through the mounting holes
Backplane screw fixing hole	After the backplane is installed, fix it with screws
Power slot	Install power module LK921 and LK922

Controller slot	Install controller LK216, LK220, LK222, LK224, LK220T1
Extension slot	SLOT0~SLOT3， install communication expansion module LK249, LK240, LK246, LK241, LK241M

5.1.2.2 Installation Dimension



LK132 Backplane Dimension

5.1.2.3 Technical Specifications

LK132 6-slot Backplane Module	
Interface	
Number of Slots	6
Physical Property	
Installation Pattern	Install via a screw hole
Module Dimension (W*H*D)	325 mm*166 mm*44.3 mm±0.5mm
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

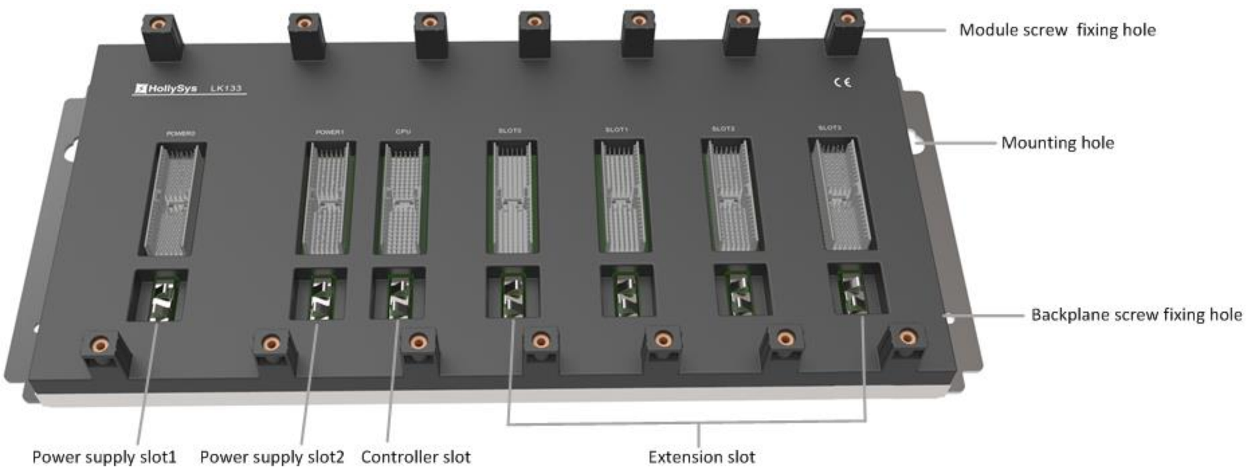
5.1.3 LK133

LK133 is a 7-slot main control backplane, with power slot1, power slot2, controller slot, extension slot0 and extension slot3.The device address of the controller slot is default 1, and the device address of the extension slot is added 1 in turn, such as 2-5.

Supporting modules:

- Supported power modules: LK922
- Supported controller: LK216, LK220, LK222, LK224, LK220T1
- Supported extension modules: LK249, LK240, LK246, LK241, LK241M

5.1.3.1 Appearance

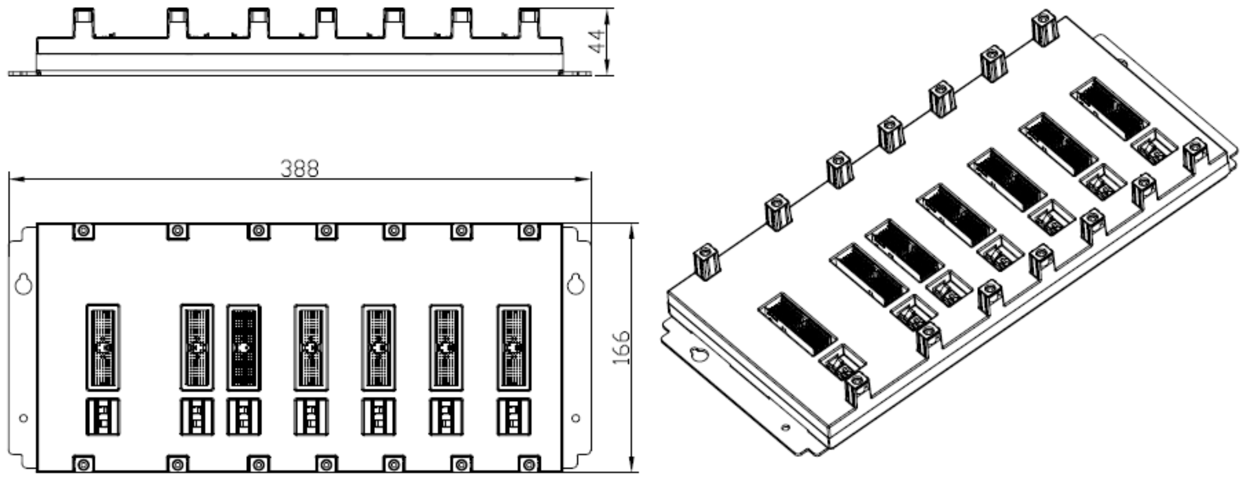


LK133 Backplane Schematic Diagram

Interface Specification

Interface	Description
Module screw fixing hole	Fix main controller modules
Mounting holes	Intall backboard to mounting plane through the mounting holes
Backplane screw fixing hole	After the backplane is installed, fix it with screws
Power slot 1/2	Install redundancy power module LK922
Controller slot	Install controller LK216, LK220, LK222, LK224, LK220T1
Extension slot	SLOT0~SLOT3, install communication expansion module LK249, LK240, LK246, LK241, LK241M

5.1.3.2 Installation Dimension



LK133 Backplane Dimension

5.1.3.3 Technical Specifications

LK133 7-slot Backplane Module	
Interface	
Number of Slots	7
Physical Property	
Installation Pattern	Install via a screw hole
Module Dimension (W*H*D)	387.7 mm*166 mm*44.3 mm±0.5mm
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

5.2 Power Supply Module

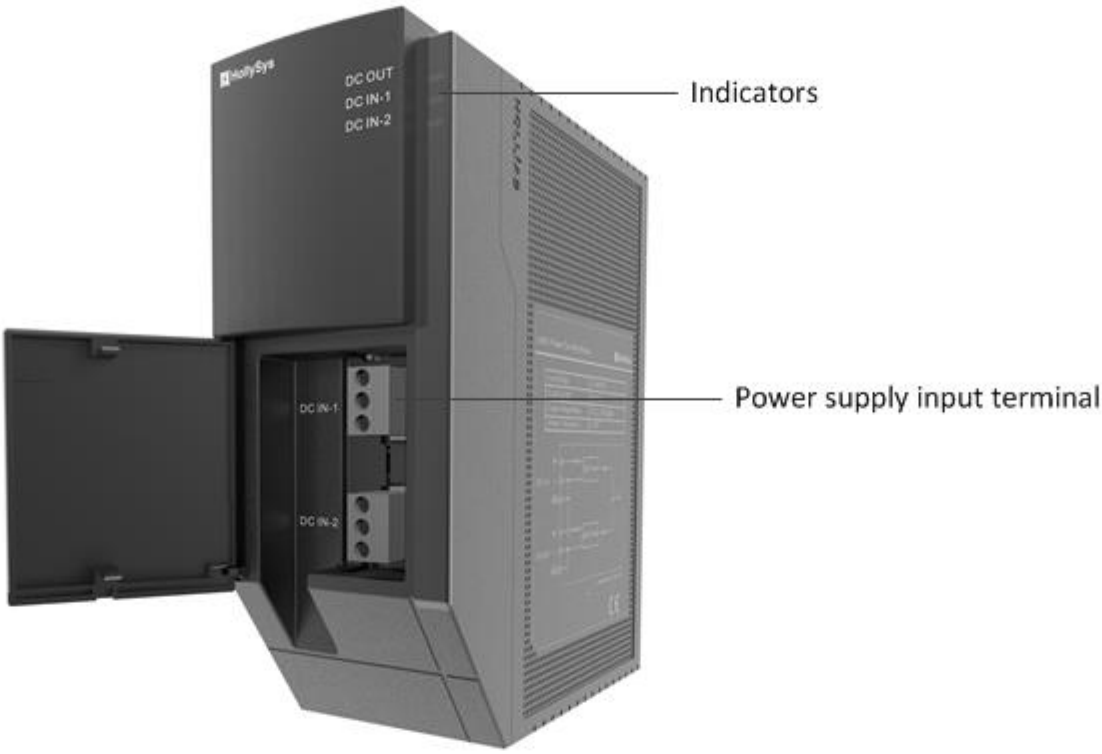
5.2.1 LK921 DC Power Supply Adapter Module

The LK921 module is a redundancy power module of the new-generation programmable logical control system. It can convert two 24VDC inputs into a 24VDC output. It is installed in the power supply slot of the main control backplane and supplies power to the main control unit module through the backplane.

LK921 can be installed in the power module slot. Supports LK130, LK132 backplane.

5.2.1.1 Features

- Input voltage: 19.2V~30VDC
- Input short circuit protection
- Hot swapping
- Support anti-reverse insert



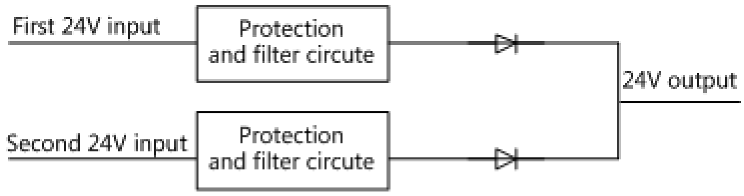
LK921 Module Schematic Diagram

Interface Specification

Interface	Description
Indicators	Three LED indicators, indicating the power status of input and output
Power supply input terminal	Two power supply inputs connect 24VDC power signal

5.2.1.2 Circuit Diagram

The two 24VDC power supplies input by LK921, forms a protective circuit via the slow-break fuse and the varistor to provide short circuit protection and overvoltage protection. It outputs a 24VDC power supply after eliminating the interfering signal via the filter circuit. After an input circuit fails, it switches to the other one without affecting the output voltage. Thus it can realize a safe and reliable redundancy power supply mode.



Power Supply Switching Module Block Diagram

5.2.1.3 Wiring

See Power Wiring.

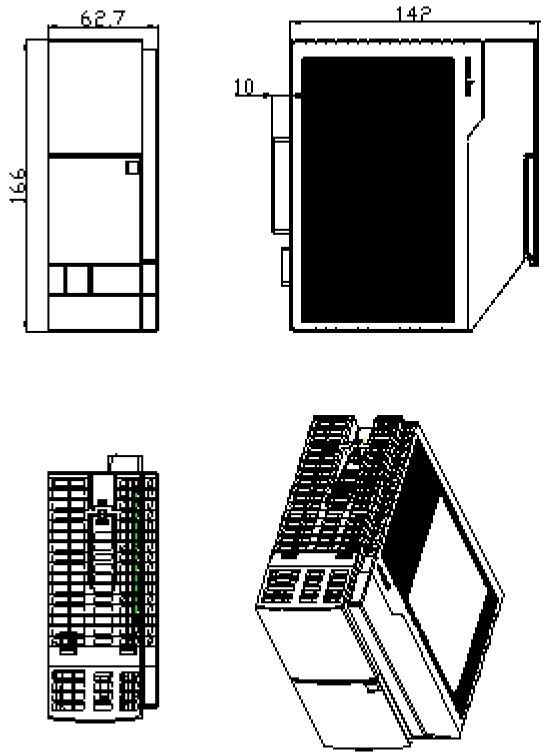
⚠Please note that operating temperature of wire should higher than 70℃.

5.2.1.4 Indicators

Instructions to LK922 Indicators

Name	Function	Color	Status	Description
DCIN-1	Indication of Input Power Supply 1	Yellow	On	Input Power Supply 1 works regularly.
			Off	Input Power Supply 1 fails.
DCIN-2	Indication of Input Power Supply 2	Yellow	On	Input Power Supply 2 works regularly.
			Off	Input Power Supply 2 fails.
DCOUT	Indication of output supply power	Green	On	The output supply power works regularly.
			Off	The output supply power fails.

5.2.1.5 Installation Dimension



LK921 dimension figure

5.2.1.6 Technical Specifications

LK921 DC Power Supply Adapter Module	
Power Input	
Quantity	2
Input Voltage	19.2V~30VDC
Input Current	2A Max
Power Output	
Quantity	1
Input/Output Voltage Drop	1V ± 0.2V (based on a single -channel current of 2A)
Physical Property	
Installation Pattern	Backplane slot
Protection key position	None
Module Dimension (W*H*D)	62.7 mm *166 mm *152 mm ± 0.5 mm
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃

LK921 DC Power Supply Adapter Module	
Storage Humidity	5%~95%, with no condensation
Conditions of acceptability	• The equipment is intended for building in and shall be provided with a suitable enclosure in the end assembly

5.2.2 LK922 Redundancy DC Power Supply Module

LK922 is a 24VDC power module, which supports single power supply and redundant power supply configuration. In redundant configuration, two input power supplies are converted to 24VDC single power supply to provide working power for modules on backplane.

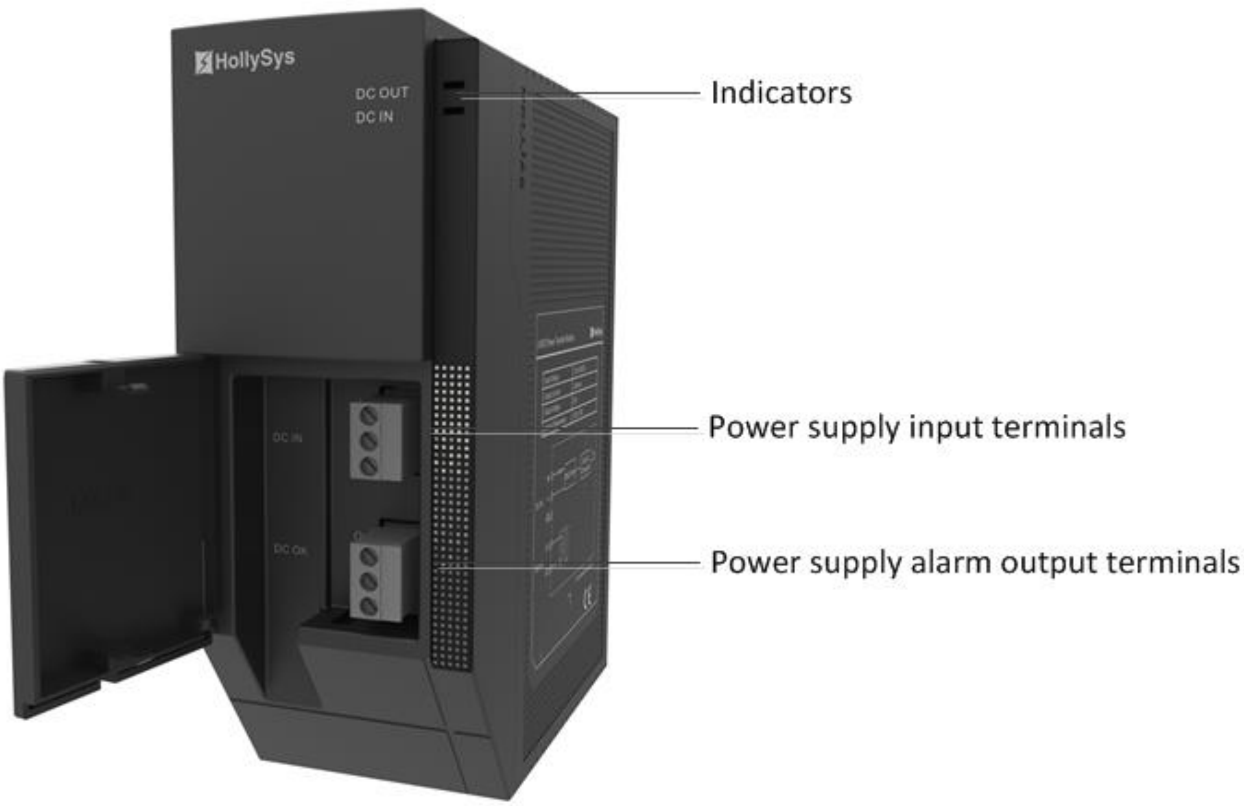
LK922 detects whether 24VDC output signal is normal through indicator status and output contact. In case of power failure, the output contact is opened and the output power indicator is off.

LK922 can be installed in the power module slot. Supports LK130, LK132 and LK133 backplane.

5.2.2.1 Features

- Input voltage: 19.5~60VDC
- Redundant configuration
- Hot swapping
- Support anti-reverse insert

5.2.2.2 Appearance



LK922 Module Schematic Diagram

Interface Specification

Interface	Description
Indicators	Two LED indicators, indicating the power status of input and output
Power supply input terminals	One power supply input connects 24VDC power signal
Power supply alarm output terminals	Dry contact indicates the status of output power supply ON: Output power is normal OFF: Output power failure

5.2.2.3 Wiring

LK922 provides one input terminal and one power supply alarm output terminal, the wiring refers to LK922 Power Wiring.

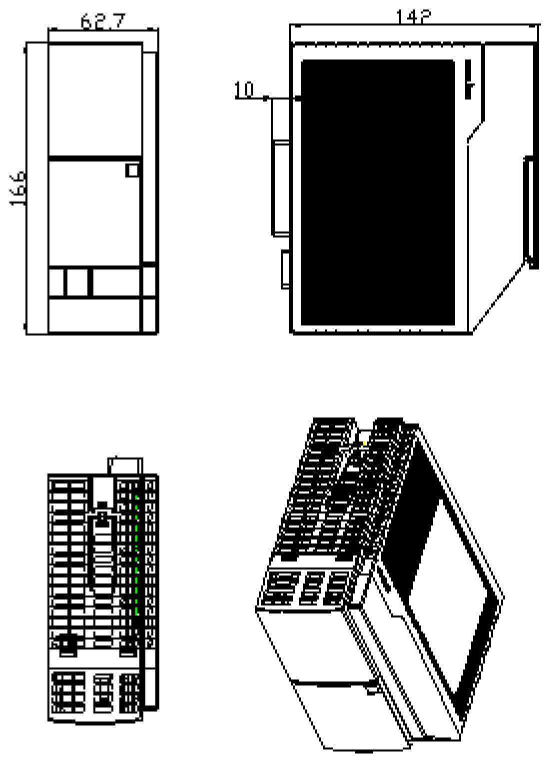
5.2.2.4 Indicators

Instructions to LK922 Indicators

Name	Function	Color	Status	Description
DCIN	Indication of Input power supply	Yellow	On	Input power supply is normal
			Off	Input power supply is faulty
DCOUT	Indication of output supply power	Green	On	The output supply power is normal, and DC OK contact is closed

Name	Function	Color	Status	Description
			Off	The output supply power is faulty, and DC OK contact is opened

5.2.2.5 Installation Dimension



LK922 Dimension Diagram

5.2.2.6 Technical Specifications

LK922 Redundancy DC Power Supply Module	
Power Input	
Input Voltage	19.5~60VDC
Power Output	
Output Voltage	24VDC
Output voltage range	23~25.5VDC
Output Current	2A(max)
Hot Swapping	Supported
Solation Voltage between Input and Output	500VAC
Physical Property	
Installation Pattern	Backplane slot
Module Dimension (W*H*D)	62.7 mm *166 mm *152 mm ± 0.5 mm
Environmental Adaptability	
Operating Temperature	-20℃~70℃

LK922 Redundancy DC Power Supply Module	
Operating Humidity	10%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	10%~95%, with no condensation

5.3 Controller

5.3.1 Overview

5.3.1.1 Controller Features

LK series controller includes LK216, LK220, LK222, LK224 , and LK220T1. The controller provides double Ethernet ports, which are connected with configuration software to download project. It can also be used as a master / slave of Modbus TCP to communicate with other devices.

All controllers support single configuration and redundant configuration (LK216 not supported). The basic functions of each controller are the same, and the processing speed, communication resources and data area size are different. See Technical Specifications for details.

- LK216 does not support Profibus-DP protocol, HolliTCP protocol, or redundant configuration.

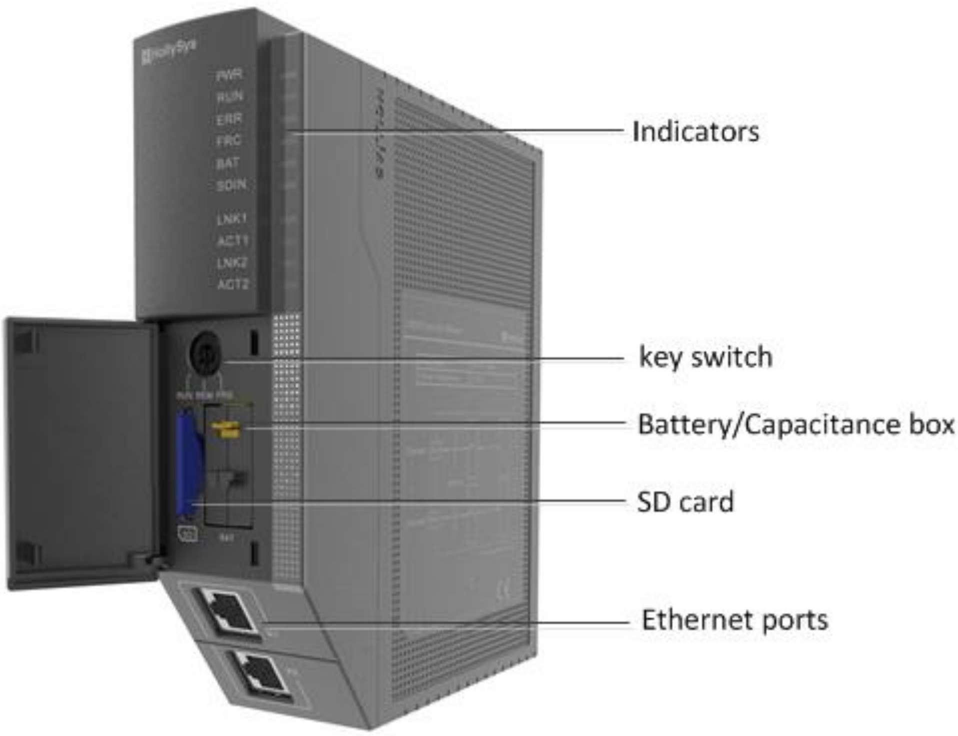
5.3.1.1.1 Basic Features

- Support storage via Flash and SD card
- Support dual Ethernet ports
- Support Modbus TCP, HolliTCP (LK216 not supported), Free protocol and AT communication protocol
- Support the backplane bus
- Hot swapping
- Support SD updating
- Support power fail safeguard
- Support Ethernet port expansion
- Support timing function
- Support security and trusted function (LK220T1)

5.3.1.1.2 Hot Swap Instructions

When using LK216-A01, LK220-G01, LK222-D01, LK224-D01 and later versions of controllers in single rack system, modules in main control backplane not support hot swapping.

5.3.1.2 Appearance

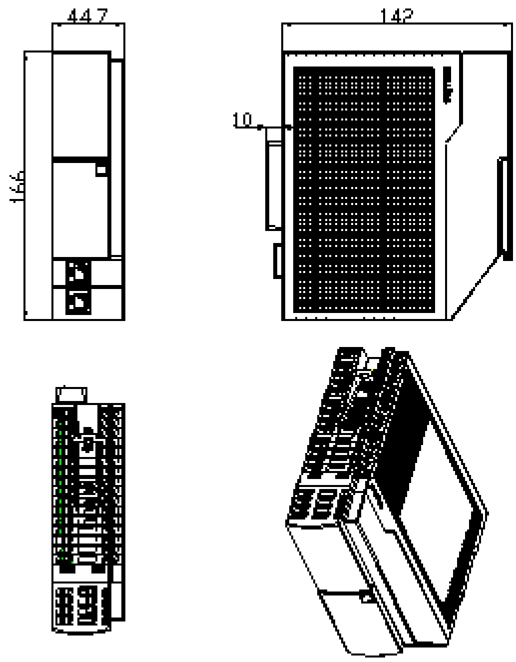


Appearance of Controller

Interface Specification

Interface	Description
Indicators	Ten LED indicators, indicating the running status of the controller module in real time.
Key switch	Switch the working mode of the controller (RUN, PRG, REM).
Battery/Capacitance box	The battery / capacitance box is used as a backup battery to provide power-lose retentive function for real-time clock data. When the controller is powered off, the real-time clock data can still be maintained. The max. power fail safeguard period for battery power supply is 1 year. The max. power fail safeguard period for capacitance power supply is 7 days.
SD card	Upgrade controller and store user files through SD card.
Ethernet ports	Connect programming computer to doanload project, communicate with other devices

5.3.1.3 Installation Dimension



Controller Dimension

5.3.1.4 Technical Specifications

Technical Specifications		**LK216**	**LK220**	**LK222**	**LK224**	**LK220T1 (Static trust)**
Operation Speed	Controller frequency	600MHz		667MHz	766MHz	600MHz
Instruction Execution Time	Bit operation	15ns		10ns	7ns	15ns
	Integer type operation	15ns		10ns	7ns	15ns
	Floating-point operation	25ns		18ns	12ns	25ns
Memory	System memory	512MB				
	Integrated memory (program + data)	24MB		32MB	64MB	> 20MB
	Power-loss retentive memory	R area: 64KB; M area: 14KB		R area: 96KB; M area: 16KB	R area: 128KB; M area: 18KB	R area: 192KB; M area: 20KB
Ethernet		10M/100M/1000M	10M/100M/1000M (1000M for LK220-G01/LK222-D01/LK224-D01 and above)			10M/100M/1000M
		Dual network port, supports Modbus TCP, HolliTCP and communication with AT (LK216 not support HolliTCP)				

<table>
<tr><th colspan="2">Technical Specifications</th><th>LK216</th><th>LK220</th><th>LK222</th><th>LK224</th><th>LK220T1 (Static trust)</th></tr>
<tr><td rowspan="3">Communication Connection Limit</td><td>Modbus TCP</td><td colspan="2">Maximum number of master-slave concurrent connections is 16 in each</td><td>Maximum number of master connections is 32, maximum number of slave connections is 16</td><td>Maximum number of master-slave concurrent connections is 32 in each</td><td></td></tr>
<tr><td>Profibus-DP</td><td>Not support</td><td>Maximum 124 slave station</td><td>Maximum 124 slave station</td><td>Maximum 124 slave station</td><td>Maximum 124 slave station</td></tr>
<tr><td>Ethernet Port Free Protocol（Free Protocol）</td><td colspan="4">Maximum 16 connections, each connection can send and receive 8K bytes data at most</td><td>Not supported</td></tr>
<tr><td rowspan="3">Configuration scale of communication module</td><td>LK241 POWERLINK master station communication module</td><td>1</td><td>1</td><td>2</td><td>2</td><td>1</td></tr>
<tr><td>LK246 Ethernet communication processor module</td><td>1</td><td>2</td><td>2</td><td>4</td><td>2</td></tr>
<tr><td colspan="6">Note: the number of LK246 configured under LK220 /LK220T1/ LK222 is no more than 2, The quantity of LK246 configured for LK216 is 1</td></tr>
<tr><td rowspan="2">Real-time Clock</td><td>Data format</td><td colspan="5">YY:MM:DD:HH:MM:SS, BCD code</td></tr>
<tr><td>Clock precision</td><td colspan="5">No more than 1 minute/month @25℃</td></tr>
<tr><td rowspan="2">PCIe Bus</td><td>Communication speed</td><td colspan="5">Meet PCIe interface, 2.5Gb/S</td></tr>
<tr><td>Load capacity</td><td colspan="5">4-channel×1</td></tr>
<tr><td rowspan="5">Configuration Capacity</td><td>Input variable area (Area I)</td><td colspan="2">The max. space is 32KB</td><td>The max. space is 64KB</td><td>The max. space is 128KB</td><td>The max. space is 32KB</td></tr>
<tr><td>Output variable area (Area Q)</td><td colspan="2">The max. space is 32KB</td><td>The max. space is 64KB</td><td>The max. space is 128KB</td><td>The max. space is 32KB</td></tr>
<tr><td>Global variable area (Area G)</td><td colspan="2">1MB</td><td>4MB</td><td>6MB</td><td>8MB</td></tr>
<tr><td>Free variable area (Area M)</td><td colspan="2">1MB</td><td>2MB</td><td>4MB</td><td>6MB</td></tr>
<tr><td>Retain area (Area R)</td><td colspan="2">Max. 64KB</td><td>Max. 96KB</td><td>Max. 128KB</td><td>Max. 192KB</td></tr>
<tr><td rowspan="2">Power Supply</td><td>Input voltage</td><td colspan="5">19.2V~30VDC</td></tr>
<tr><td>Module dissipation (max.)</td><td colspan="5">400mA@24VDC</td></tr>
<tr><td colspan="2">Backup battery</td><td colspan="5">Based on battery/capacitance power supply</td></tr>
<tr><td colspan="2">SOE storage capacity of controller</td><td colspan="5">6000</td></tr>
<tr><td colspan="2">Dual-rack redundancy</td><td colspan="5">Supported</td></tr>
<tr><td colspan="2">Protection rating</td><td colspan="5">IP20</td></tr>
</table>

Technical Specifications		**LK216**	**LK220**	**LK222**	**LK224**	**LK220T1 (Static trust)**
Starting Time	Time from the moment when the module is powered on to the moment when the project begins	≤60 s				≤90 s
Physical Property	Installation pattern	Backplane slot				
	Module dimension (W*H*D)	44.7 mm*166 mm*152 mm ±0.5mm				
Environmental Adaptability						
Operating Temperature		-20℃~70℃(LK224 is -20℃~60℃)				
Operating Humidity		5%~95%, with no condensation				
Storage Temperature		-40℃~80℃				
Storage Humidity		5%~95%, with no condensation				
Online tracking		In a single trace, 16 variables are tracked at the same time in a sampling group. After AT is offline, the maximum number of 4W samples can be saved.				Not supported

5.3.2 Basic Function

5.3.2.1 Indicators

Instructions to Indicators

Name	**Function**	**Color**	**Status**	**Description**	**Combined Indication of Indicator indicators**
PWR	Indication of power supply	Yellow	On	The power supply is normal	
			Off	The power supply fails or no power.	
RUN	Indication of operating pattern	Green	On	There is a project but not run.	
			Slow flashing	There is a project and running.	
			Off	There is no projects.	
ERR	Indication of module failure	Red	On	The module fails.	
			Slow flashing	The module is powered up or restarted, in initialization.	
			Off	There is no failures	
FRC	Forced indication	Green	On	With force data	All indicators flash slowly: updating the firmware All indicators flash quickly: restoring factory settings
			Off	With no force data	
BAT	Indication of battery status	Yellow	On	The battery is not installed or the battery capacity is lower than 90% of the ratings, thus requiring replacement	
			Off	The battery capacity is full, in normal operation	
SDIN	Indication of SD cards	Green	On	The SD card has been inserted	

Name	Function	Color	Status	Description	Combined Indication of Indicator indicators
			Slow flashing	Reading/writing the data on SD cards	
			Off	No SD cards has been inserted	
LNK1	Indication of connecting Ethernet Interface 1	Green	On	Ethernet Interface 1 has been connected successfully	
			Off	Ethernet Interface 1 has not been connected yet	
ACT1	Indication of receiving and sending data via Ethernet Interface 1	Yellow	Slow flashing	Ethernet Interface 1 is receiving and sending data	
			Off	Ethernet Interface 1 is not receiving and sending data	
LNK2	Indication of connecting Ethernet Interface 2	Green	On	Ethernet Interface 2 has been connected successfully	
			Off	Ethernet Interface 2 has not been connected yet	
ACT2	Indication of receiving and sending data via Ethernet Interface 2	Yellow	Slow flashing	Ethernet Interface 2 is receiving and sending data	
			Off	Ethernet Interface 2 is not receiving and sending data	

5.3.2.2 Key Switch

It can set the controller operation pattern via the key switch. The controller has three working patterns: RUN, PRG and REM patterns. It can select the REM pattern as the default by make a selection via the key switch. The key switch can be pulled out in RUN, REM, PRG patterns.

Definition of Key Switch

Key Position	Mode Type	Definition
RUN	Running Mode	controller can execute the project, but cannot modify it nor operate it via AutoThink.
REM (remote)	Remote control pattern	A user can control the project to run and stop, modify the project and conduct operations including Force, Reset and Write-in, etc.
PRG (program)	Program Mode	controller can stop executing the project and cannot run the project via the software. It can modify the project and conduct operations including Force, Reset and Write-in, etc.

The three working patterns are specified in details below:

RUN: to run the user project, unable to stop the project via the programming software, nor to modify the project.

- Enable output.
- The controller module executes I/O scanning and operation.
- Cannot be forced.
- The human-machine interface software (that is, HMI) can write variables. The programming software (AutoThink) cannot write variables.

- Cannot reset and clear.
- Cannot change the operating mode of the controller module remotely via the programming software.

PRG (Programming): the project is stopped and cannot be enabled via the programming software. It is capable of full download and increment download.

- Output the program mode settings.
- The controller module does not execute the (scanning) task.
- Create, modify and delete the task, program and routine.
- Download the project or user project.
- Reset and clear.
- Cannot change the operating mode of the controller module remotely via the programming software.

REM: (Remote) to control the project to run and stop via the programming software. However, the agreed initial status is that: switch from RUN to REM, with the project keeping its running; switch from RPG to REM, with the project keeping its original stopped status. In the key is positioned at REM before enabling the controller module, after starting the system project, the running status stays the same to that before power off or resetting. In REM mode, it can download the project, including full download (full download can be conducted only after stopping the running of the project) and increment download (can be conducted when the project is running or stopped).

- Force variables.
- Write variables.
- Reset and clear.
- Project download.
- Change the operating mode of the controller module remotely via the programming software.

The controller changes the controller IEC running status by toggling the key switch, with the IEC running status of the slave controller keeping pace with that of the controller. For example, when toggling the key switch of the controller to the PRG position and IEC operation stops, IEC operation of the slave controller also stops even if the key switch of the controller is not at the PRG position.

ⓘThe key switch is not allowed during the download.

5.3.2.3 Reset

Reset: operate the key switch in the sequence of REM→RUN→REM→RUN→REM (that is, start from the REM position, switch twice toward the RUN position and then go back to the REM position). If the operation is completed in 1.5s, the controller module can reset the hardware.

It can reset the project via the programming software, including the following reset methods.

■ Reset: except the power fail safeguard data (that is, to hold the retain variable), all the data shall be recovered to their starting values.

■ Cold reset: all the data including the power fail safeguard data shall be recovered to their starting values.

■ Warm reset: all the data stays in the status before resetting.

■ Clear the controller: it shall delete all the projects and recover all the variables to their starting values.

Click the "Online" menu and choose a reset command. The reset commands are shown in the figure below.

Reset Command of Online Menu

⚠

- System running , prohibit resetting master controller !

- In redundancy mode, reset by key switch is only effective for current controller. If master controller is reset, it will cause master-slave switching. AutoThink reset does not cause a master-slave switch.

5.3.2.4 Restore Factory Defaults

Restore factory defaults: operate the key switch in the sequence of REM→PRG→REM→PRG→REM. If the operation is done in 1.5s, controller can be recovered to factory defaults. In this process, the FRC indicator and the BAT indicator flash alternately. After the factory defaults are recovered, the FRC indicator and the BAT indicator stop flashing. It shall initialize the user data, clear the user files, user logic source projects, static routing lists and control locks, etc.

By restoring the factory defaults to resolve this issue when you forget the IP address of the controller.

- Cautions

External connection must be disconnected when you restore factory defaults.

⚠Restoring factory defaults must ensure that the controller had no effect to the field.

5.3.2.5 Upgraded Controller in stopped state

For redundant systems, it is recommended to upgrade the firmware when the controller is in stopped state. If the controller is configured as a stand-alone system, the firmware must be upgraded when the controller is in stopped state.

When upgrading the redundant system, it is recommended to upgrade the master controller first. After the master controller is upgraded successfully, the system will automatically switch master-slave controller, and then continue to upgrade the new master controller (old slave controller).

Users can upgrade controller firmware through SD card or AutoThink. The local controller can be upgraded through SD card, and the remote controller can be upgraded through AutoThink.

5.3.2.5.1 SD card to Upgraded

5.3.2.5.1.1 Requirements

Turn key switch of master controller to PRG mode, or stop the task through autotink when key switch is in REM mode.

5.3.2.5.1.2 Steps

To upgrade through SD card, please follow the following steps:

(1) Copy all files from the released CD to SD card.

Files includes: mcs.conf , crc.txt and .bin file.

(2) Insert the SD card into the SD card slot in the master controller.

(3) Power off to restart the master controller or reset the controller through the key switch.

At this time, the master-slave state is switched. The firmware will be upgraded automatically and the ERR indicator will flash slowly. When the ERR indicator is off, the firmware upgrade is completed.

(4) Repeat steps (2) ~ (3) to upgrade the new master controller.

For stand-alone system, please operate steps (2) ~ (3) to upgrade.

5.3.2.5.2 AutoThink to Upgraded

5.3.2.5.2.1 Requirements

Turn key switch of master controller to PRG mode, or stop the task through autotink when key switch is in REM mode.

5.3.2.5.2.2 Steps

To upgrade through AutoThink, please follow the following steps:

(1) Click [Tool]- [Assistant tool] - [Controller Operation].

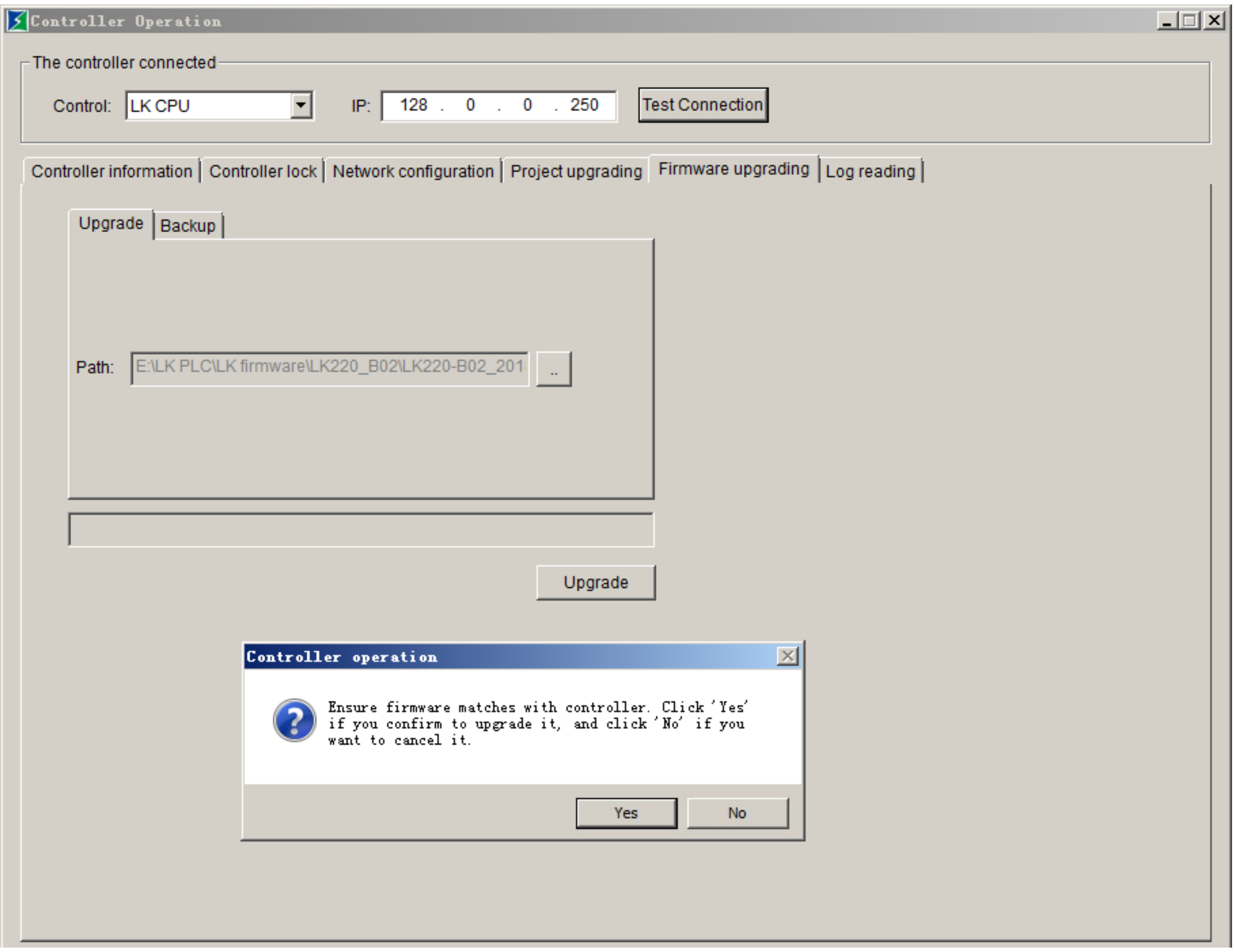
The Controller Operation window will be opened as shown in the following figure.

(2) Enter the IP address of master controller.

(3) In the [Firmware Upgrading] tab, click .. in the Path field to select the .bin file of controller firmware.

(4) Click the **Upgrade** button.

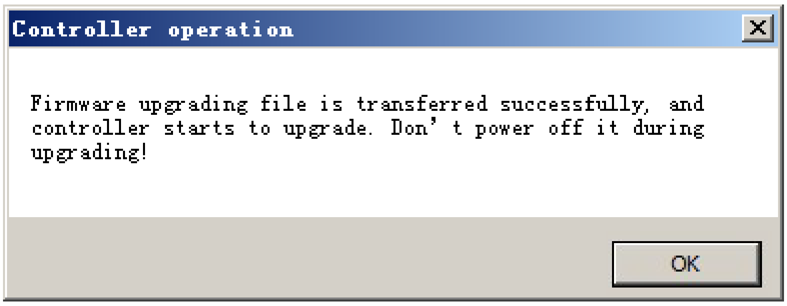
An upgrade confirmation prompt box will pop up.



Firmware Upgrading Tools for AutoThink

(5) Click **Yes** and the firmware file is uploaded to the controller.

Do not do anything during firmware is transfered. After the firmware file is transferred successfully, the following prompt will pop up.



The Prompt box for transmission of firmware file

(6) Click **OK** to upgrade.

At this time, FRC indicator and BAT indicator flash slowly at the same time. When FRC indicator and BAT indicator are off, ERR indicator starts to flash slowly. When ERR indicator is off, the firmware upgrade is completed.

You can confirm whether firmware version is correct by reading the controller version information.

Master-slave state is switched when the controller is upgraded successfully.

(7) Repeat steps (2) ~ (6) to upgrade the new master controller.

For stand-alone system, please operate steps (2) ~ (6) to upgrade.

5.3.2.6 Upgraded Controller in Running State

Redundant systems also can upgrade firmware when the controller is in running state.During upgrading, the master controller runs normally, and slave controller upgrades the firmware. After the upgrade is completed, you need to manually switch the master-slave state and continue upgrading the new slave controller (old master controller).

Users can upgrade controller firmware through SD card or AutoThink. The local controller can be upgraded through SD card, and the remote controller can be upgraded through AutoThink.

In two upgrading methods, the master-slave state is switched by the following operations:

- When upgrading through AutoThink, after the slave controller is upgraded successfully, you can use the master-slave switch instruction "sysmasterswitchtoslave" to manually switch master controller to slave controller.
- When upgrading through SD card, after the slave controller is upgraded successfully, you can reset the master controller to salve controller through the key switch.

5.3.2.6.1 SD card to Upgraded

5.3.2.6.1.1 Steps

To upgrade through SD card, please follow the following steps:

(1) Copy all files from the released CD to SD card.

Files includes: mcs.conf , crc.txt and .bin file.

(2) Insert the SD card into the SD card slot in the slave controller.

(3) Power off to restart the salve controller or reset the controller through the key switch.

The firmware will be upgraded automatically. At this time, the ERR indicator will flash slowly. When the ERR indicator is off, the firmware upgrade is completed.

After the upgrade is completed, the STDB indicator of LK240 module in slave system turns on, at this time, master-slave state has been reestablished. Please go to step (4).

(4) Reset the master controller through the key switch to trigger the master-slave switch.

See Reset for key switch reset operation.

(5) Repeat steps (2) ~ (3) to upgrade the new salve controller.

For stand-alone system, please operate steps (2) ~ (3) to upgrade.

5.3.2.6.2 AutoThink to Upgraded

5.3.2.6.2.1 Requirements

The master-slave switch instruction should be configured in the project.

5.3.2.6.2.2 Steps

To upgrade through AutoThink, please follow the following steps:

(1) Click [Tool]- [Assistant tool] - [Controller Operation].

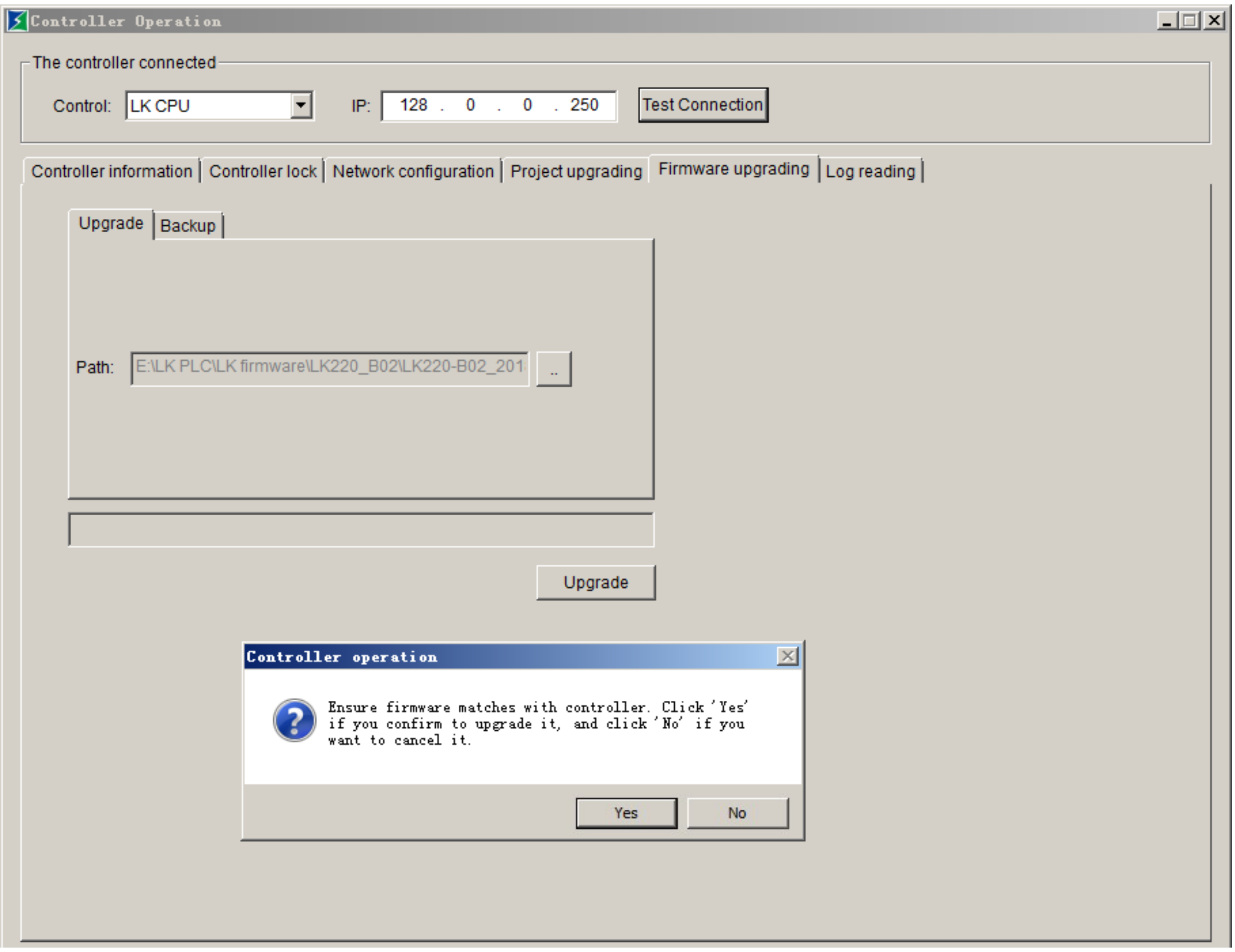
The Controller Operation window will be opened as shown in the following figure.

(2) Enter the IP address of slave controller.

(3) In the [Firmware Upgrading] tab, click .. in the Path field to select the .bin file of controller firmware.

(4) Click the **Upgrade** button.

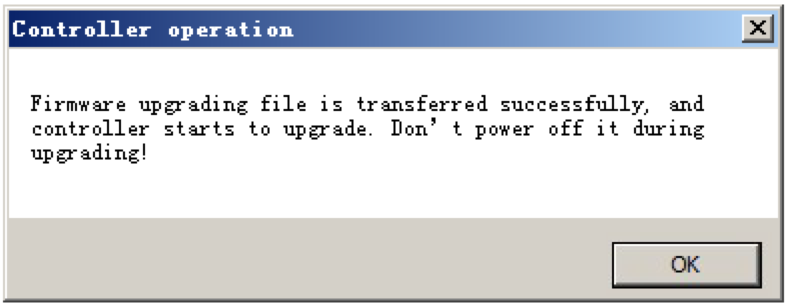
An upgrade confirmation prompt box will pop up.



Firmware Upgrading Tools for AutoThink

(5) Click **Yes** and the firmware file is uploaded to the controller.

Do not do anything during firmware is transfered. After the firmware file is transferred successfully, the following prompt will pop up.



The Prompt box for transmission of firmware file

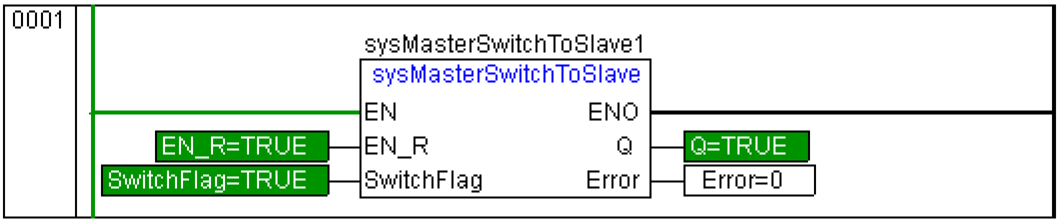
(6) Click **OK** to upgrade.

At this time, FRC indicator and BAT indicator flash slowly at the same time. When FRC indicator and BAT indicator are off, ERR indicator starts to flash slowly. When ERR indicator is off, the firmware upgrade is completed.

You can confirm whether firmware version is correct by reading the controller version information.

After the upgrade is completed, the STDB indicator of LK240 module in slave system turns on, at this time, master-slave state has been reestablished. Please go to step (7).

(7) Monitor master controller through AutoTink, execute the "sysmasterswitchtoslave" instruction to switch the master controller to the slave controller.



Trigger instruction to execute

(8) Repeat steps (2) ~ (6) to upgrade the new salve controller.

For stand-alone system, please operate steps (2) ~ (6) to upgrade.

5.3.2.7 Backup Battery

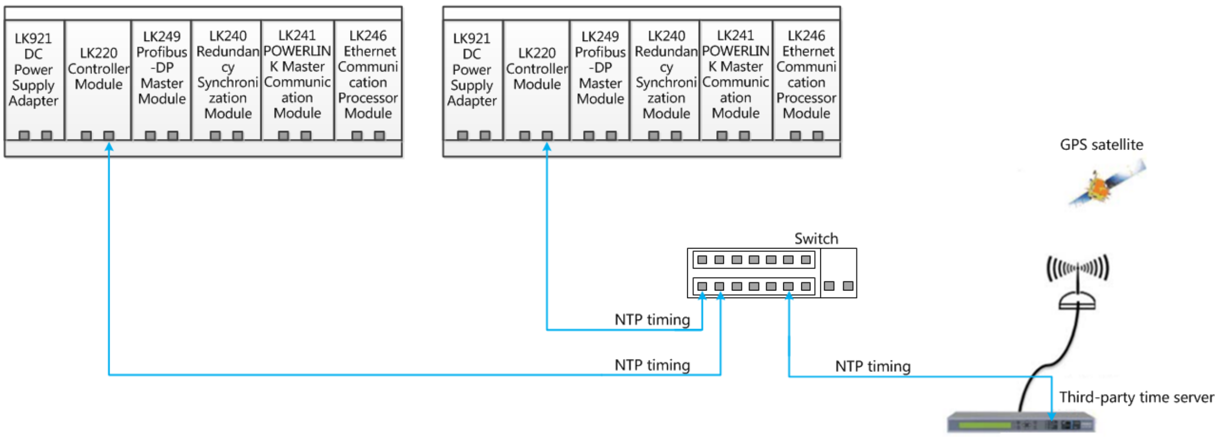
The front panel of controller is provided with a backup battery slot. The user can choose to insert the LK102 battery power box or the LK103 capacitance power box. The backup battery can provide power fail safeguard for the real-time clock data. Upon the power loss of the controller, the real-time clock data can still be kept. The max. power fail safeguard period for battery power supply is 1 year. The max. power fail safeguard period for capacitance power supply is 7 days.

In case of low battery, BAT indicator shall give an alarm. Check the battery regularly and replace it timely, ensuring that power fail safeguard can work well. See LK102 and LK103 Modules for battery replacement.

5.3.2.8 Timing Function

5.3.2.8.1 NTP timing

In the main and standby systems, the controllers need to be connected to the timing server. The controller establishes the time calibration connection through the IP address of the time calibration server and sends the timing request periodically to keep time synchronized with the clock source of the server.



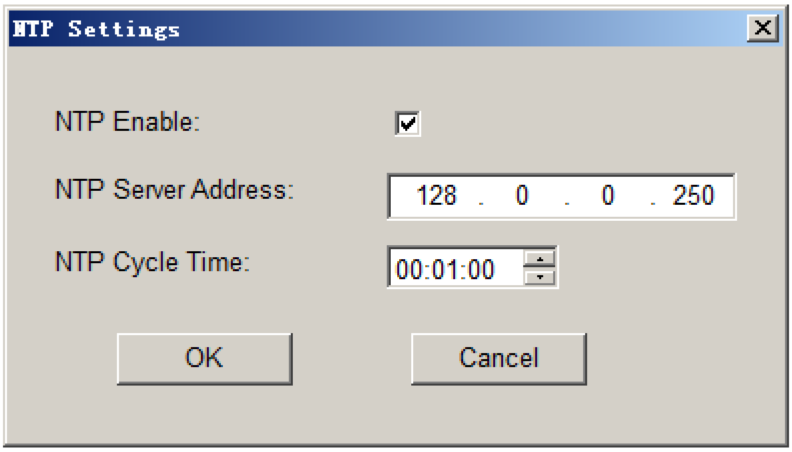
NTP Timing of Controller

5.3.2.8.2 Configuration Settings

(1) Click Online menu.

(2) Select [NTP settings] command.

The settings dialog box will pop up.



NTP Settings

(3) Check the "NTP Enable" option.

(4) Enter the IP address of the NTP timing server.

(5) Please select a time value of hour, minute or second, and click the adjust button to increase or decrease the value.

You can also enter the time value manually. It can be set from 00:01:00 to 23:59:59.

NTP Cycle Time must be set to UTC time.

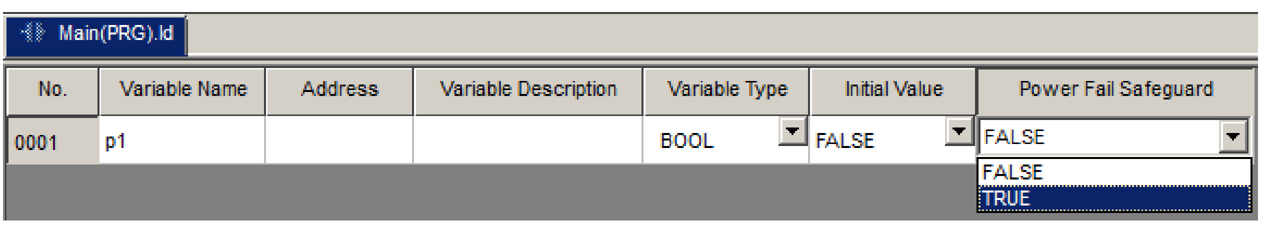
(6) After setting NTP parameters, please download project to the controller.

At this time, NTP timing function takes effect.

5.3.2.9 Power Fail Safeguard

The MRAM memory of controller provides power fail safeguard. When controller module is running, the MRAM memory will backup and save the data from the SRAM memory periodically. It can still keep the data after the controller module is power off.

In case the user sets **Power Fail Safeguard** when defining the variables in the AutoThink programming software, the controller can provide power fail safeguard for the real-time numerical of the retain-type variables in the user program. After restarting the power-failed controller module, the retain-type variables can be recovered to the values before power loss, with other variables recovered to their initial values.



Setting Power Failure Retention

R area and a segment of address in M area supports power fail safeguard, and the size of data area supported by each controller is different, as shown in the table below.

Power Fail Safeguard Area

Power fail safeguard area	LK216	LK220	LK220T1	LK222	LK224
R area	64KB	64KB	192KB	96KB	128KB
M area	%MB0~%MB4095(4KB) %MB100000~%MB110239(10KB)	%MB0~%MB4095(4KB) %MB100000~%MB110239(10KB)	%MB0~%MB10239(10KB) %MB100000~%MB110239(10KB)	%MB0~%MB6143(6KB) %MB100000~%MB110239(10KB)	%MB0~%MB8191(8KB) %MB100000~%MB110239(10KB)

5.3.2.10 Redundancy Data Area

The task cycle is set to 50 ms, the maximum matching redundancy data is 512KB. The redundancy data increases each 100KB with the task cycle increasing10 ms. That is, task cycle corresponding to the 612KB redundancy data is 60ms. Redundancy data includes all data which in N area, R area, I area, Q area, between %MB0 and maximum variable address defined in M area. Among them, the direct address used directly in M area and address accessed by Modbus TCP does not belong to redundant data when using the M area address, the maximum variable address represents the size of the entire M area. If only the address% MB999 is used between address% MB0 ~% MB1000, the all address between % MB0 ~%999 are redundant. You should pay attention to avoid that overmuch data area is wasted and effect redundancy rate when you define a variable in M area.

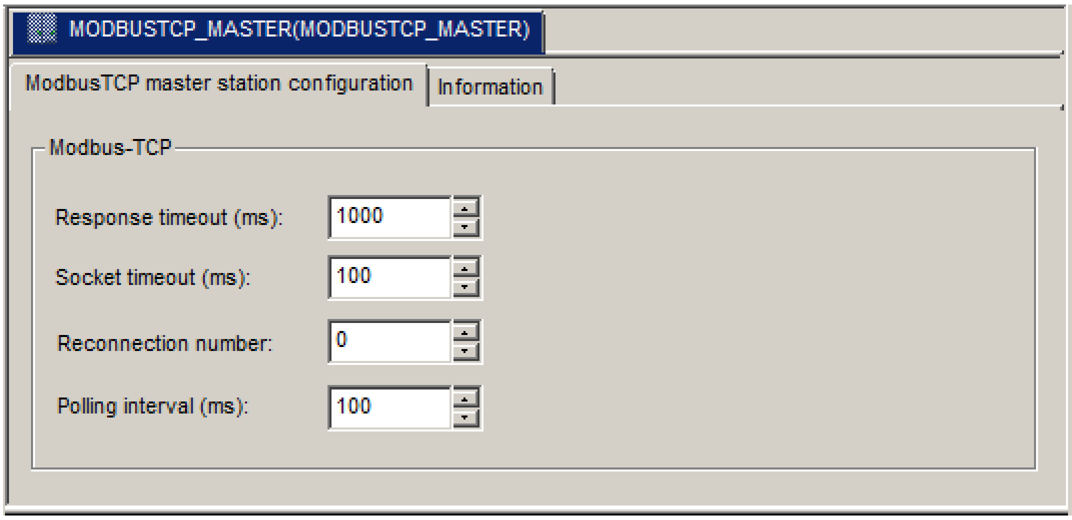
Variables which have been deleted in N and R area are not released, and you can execute full compilation to reduce the memory occupied by variables.

Stop data redundancy between master and slave frame when IEC running cycle not matches with the size of the engineering data area configured. The function block sysGetRedState report the error code 130.

5.3.2.11 Modbus Communication Settings

5.3.2.11.1 Configure Modbus TCP MASTER

You can set parameters for the slave station modules and Modbus TCP master station communication. In the AutoThink programming software, double click the created [ModbusTCP_MASTER] master station node under the controller tree node, open the master station configuration window, as shown in figure.



Master Station Communication Parameter Settings

- Response timeout (ms): the allowed delay response time after the ModbusTCP master station sends a request frame. The default value is 1000, with a range of 10~2,147,483,000.
- Socket timeout (ms): TCP/IP connection Socket timeout. Default value is 100, with a range of 10~2,147,483,000.
- Reconnection number count: number of times that the master station re-sends the request upon an abnormal response made by the slave station. The default value is 0, with a range of 0~ 10.
- Polling interval: the time interval from the moment when the ModbusTCP master station receives the response frame from the slave station to the moment when it sends the next request frame (LK246 polling interval is the interval time between two request frames). If the response made by the slave station is timed out for the last frame, then the master station can ignore the time interval and send the request frame directly. The default value is 100, with a range of 100~2,147,483,000.

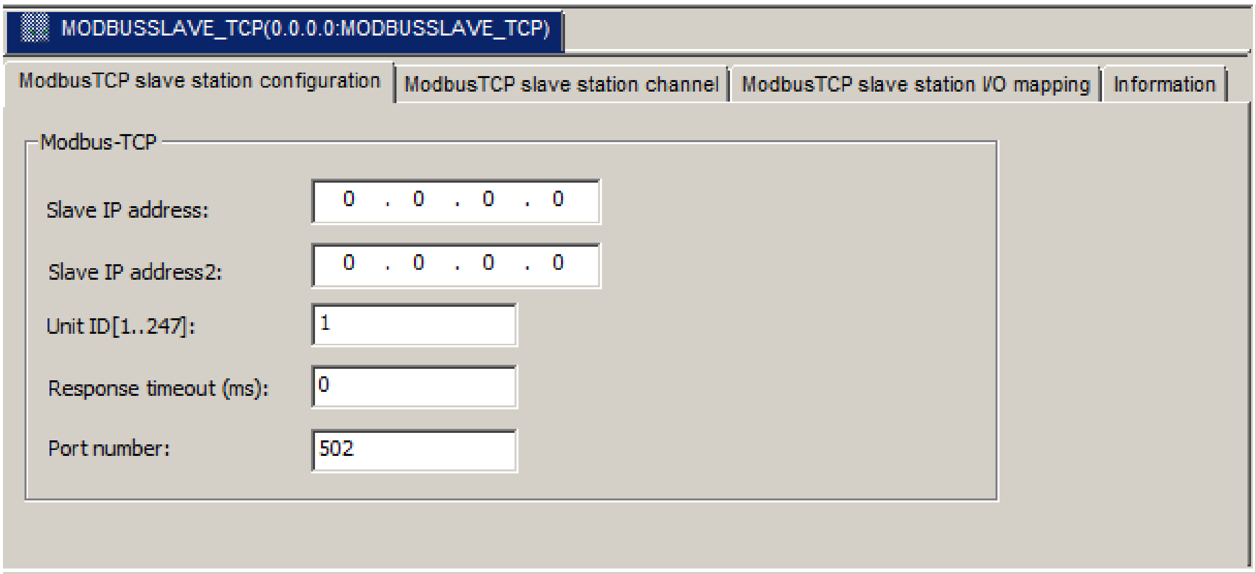
For cycle instruction, the Polling interval does not take effect, and the Cycle Time is used as the polling interval.

To ensure the validity of the polling interval, you should note the following points in configuration:

- It is suggested that you need to use less instructions to read data from slave station, in other words, each read instruction to read more data.
- If slave station has been configured, please ensure that communication link is normal between the master and slave, and slave stations run fine. If the slave station does not exist, to delete the configuration of slave station.
- Theoretical calculation formula of polling interval in worst case: 80ms * the number of instruction configured in slave station (Note: if all slaves run fine, the worst value is not reached).

5.3.2.11.1.1 MODBUS TCP Slave Station Configuration

Right click the slave station that is added under the [ModbusTCP_MASTER] node, open the ModbusSLAVE_TCP window, as shown in figure.



ModbusSLAVE_TCP Slave Station Configuration Window

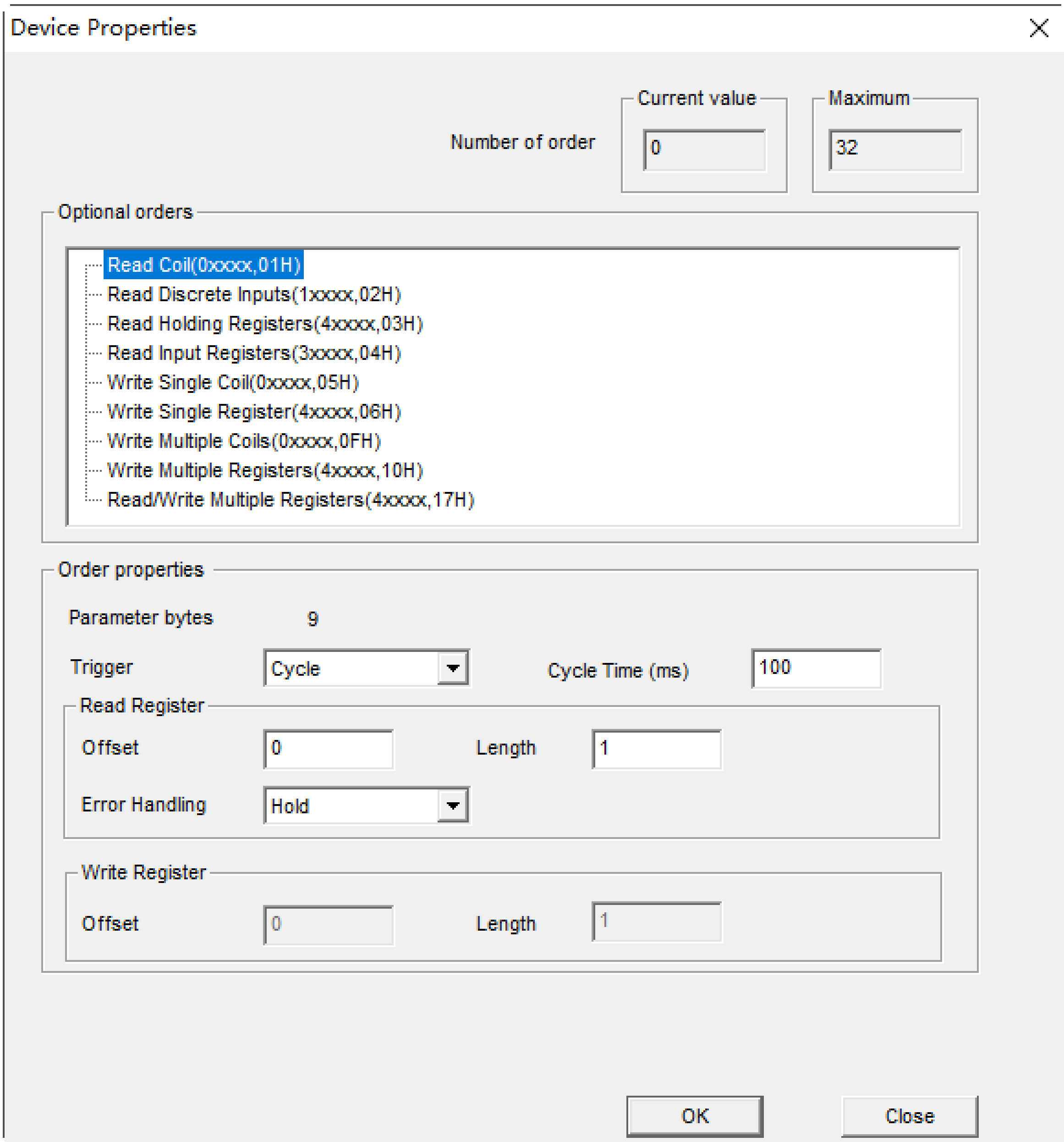
- Slave IP address: IP address of the slave station requested by master station, which is set according to the actual IP address of slave station. Two IP addresses can be configured. Select one way to connect and the other way as standby. If the first IP is not successful, try to connect second IP.
- Unit ID: Modbus TCP Protocol Unit ID. The default value is 1, with a range of 1~247.
- Response timeout (ms): the allowed delay response time after the ModbusTCP master station sends a request frame. The default value is 0, with a range of 0~2,147,483,000.
- Port number: Modbus TCP protocol port number. The default value is 502, with a range of 1~65,535.

5.3.2.11.1.2 Add Command Parameter

In the Modbus master communication mode, the maximum number of slave station connected to each controller model is different, as shown in follows table. Each slave stations can be configured with up to 32 orders.

Maximum Number of Master-Slave Connections

Module	Maximum number of master-slave concurrent connections
LK216/LK220/ LK220T1	16 for master-slave in each
LK222	32 for master, 16 for slave
LK224	32 for master-slave in each
LK246	64 for master-slave in each



Optional Command List of Slave Station

Choose the instructions in **Optional Orders** list, and set parameters, click **OK** to complete adding.

Functional Code

Function Code	Data Area	Function
Read Coil (0xxxx, 01H)	0xxxx	Read the status (ON/OFF) of 1~2000 (0x07D0) continuous logic coils from a remote device
Read Discrete Inputs (1xxxx, 02H)	1xxxx	Read the status (ON/OFF) of 1~2000 (0x07D0) continuous discrete inputs from a remote device
Read Holding Registers (4xxxx, 03H)	4xxxx	Read the binary values for 1~125 (0x007D) continuous holding registers from a remote device
Read Input Registers (3xxxx, 04H)	3xxxx	Read the binary values for 1~125 (0x007D) continuous input registers from a remote device

Function Code	Data Area	Function
Write Single Coil (0xxxx, 05H)	0xxxx	Force to set a single coil output as ON or OFF in a remote device
Write Single Register (4xxxx, 06H)	4xxxx	Force to write a binary value into a single holding register in a remote device
Write Multiple Coils (0xxxx, 0FH)	0xxxx	Force to set each single coil in a group of coils (1~1968 pcs) as ON or OFF in a remote device
Write Multiple Registers (4xxxx, 10H)	4xxxx	Force to write a binary value into a continuous register (1~123 pcs) in a remote device
Read/Write Multiple Registers (4xxxx, 17H)	4xxxx	Read or Write a binary value from a continuous register (1~118 pcs) in a remote device

- The channel value for a coil and discrete command is digital. The channel value for a register is analog.

Instruction Parameters

Parameter Name	Parameter Value	Default	Description	Name of Commands Having This Parameter
Trigger	Cycle,Rising Edge,High Level	Cycle	Period: The master station polls the slave station periodically, sending and receiving command data Rising edge: When the rising edge trigger is selected, the BOOL type trigger variable is automatically generated under the corresponding channel of [ModbusTCP Slave I/O Mapping]. When the variable has a rising edge, the master station polls the slave station to send and receive instruction data.The user needs to configure the logic triggered by the rising edge, and set the high and low time reasonably according to the number of configured instructions and the set instruction timeout time, otherwise the rising edge will not be detected High level: When high level trigger is selected, the BOOL type trigger variable is automatically generated under the corresponding channel of [ModbusTCP Slave I/O Mapping]. When the variable is high level, the master station polls the slave station and sends and receives command data	
Cycle Time	0~65,535	100	The cycle time for the master station to poll the slave station, which can be set when the trigger is "period".The cycle time must be set as an integral multiple of task cycle, for controllers, the value must be ≥100. For LK246, the value must be ≥10. For cycle instruction, the Polling interval does not take effect, and the Cycle Time is used as the polling interval	
Error handing	Hold, Clear	Hold	Hold: keep the current data upon an abnormal response Clear: clear the current data upon an abnormal response	
Read and write start address	0~65,535	0	The Modbus Initial Address corresponding to the slave station	
Read and write switch length	1~2000	1	Number of channels corresponding to the slave stations relating to the length value	Read Coil Read Discrete Input Write Multiple Coils
Read and write analog	1~125	1	Number of channels corresponding to the slave stations relating to the length value	Read Holding Register Read Input Register

Parameter Name	Parameter Value	Default	Description	Name of Commands Having This Parameter
length				Write Multiple Register
Read start address	0~65,535	0	The Modbus Initial Address of Read Memory Area Corresponding to the slave station	Read/Write Multiple Register
Write start address	0~65,535	0	The Modbus Initial Address of Write Memory Area Corresponding to the slave station	
Read analog length	1~118	1	Number of Channels Reading Analog Data	
Write analog length	1~118	1	Number of Channels Writing Analog Data	

- Read: Master station data memory area I and M.
- Write: Master station data memory area Q and M.

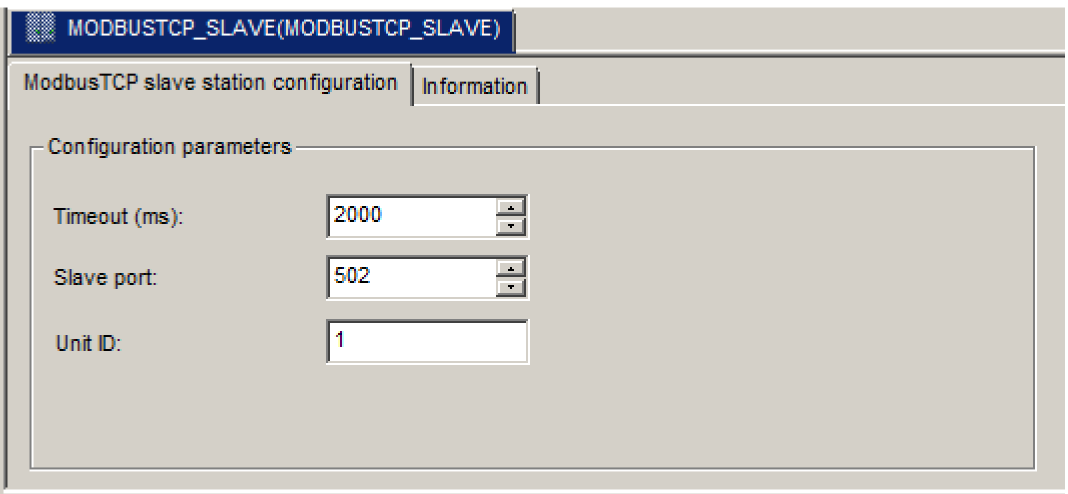
Modbus start address= first address in command data area + Read and write start address, Modbus end address=zero address in command data area +Read and write start address+Read and write length.

Taking the Read Discrete inputs (1xxxx,02H) command for instance, Read and write start address is set as 10, Read and write switch length is set as 20, then Modbus start address is 10,001+10, that is, 10011. Modbus end address is 10,000+10+20, with the address range of 10,011~10,030.

5.3.2.11.2 Configure Modbus TCP SLAVE

You can configure Modbus TCP communication parameters.

In the AutoThink programming software, double click the created [ModbusTCP_SLAVE]slave station node under the controller tree node, open the ModbusTCP_SLAVE slave station configuration window, as shown in figure.



Open Configuration Window for ModbusTCP_SLAVE Slave Station

- Timeout (ms): the time interval in which the slave station has not received the data sent by the master station. If the set time is exceeded, the slave station disconnects the communication link to the master station. The default value is 2000ms, with a range of 0~2,147,483,000.
- Slave port: Modbus TCP protocol port number. The default value is 502, with a range of 1~65,535,

where 1200 is used to communicate with AT, not be configured to slave port.

- Unit ID:Modbus TCP Protocol Unit ID. The default value is 1, with a range of 1~247.

Data areas which is accessed by Modbus TCP slave protocol include that input area (I area), output area (Q area), middle area （M area).

The three data areas are accessed by BOOL data or WORD data. Mapping relations between the data areas and Modbus TCP slave protocol is as shown in table.

Mapping Relations between the Data Areas and Modbus Address

Data area		Type	Address range	Modbus address	Mapping Relation	X （register type） selection
I area	%IX	BOOL	%IX0.0,… %IX0.7 %IX1.0,… %IX1.7 …%IX374.7	X0000,…X0007 X0008,…X0015 …X2999	IXm.n：m*8+n	Read-only, X selects 1
	%IW	WORD	%IW0, %IW2,…%IW5998	X0000, X0001,…X2999	IWm: m/2	Read-only, X selects 3
Q area	%QX	BOOL	%QX0.0,…%QX0.7 %QX1.0,…%QX1.7 …%QX374.7	X0000,…X0007 X0008,…X0015 …X2999	QXm.n: m*8+n	Read and Write, X selects 0
	%QW	WORD	%QW0, %QW2,…%QW5998	X0000, X0001,…X2999	QWm: m/2	Read and Write, X selects 4
M area	%MX	BOOL	%MX0.0,…%MX0.7 %MX1.0,…%MX1.7 …%MX7816.7	X3000,…X3007 X3008,…X3015 …X65535	MXm.n: m*8+n+3000	Read-only, X selects 1 Read and Write, X selects 0
	%MW	WORD	%MW0, %MW2,…%MW125070	X3000,X3001,…X65535	MWm: m/2+3000	Read-only, X selectes 3 Read and Write, X selects 4

The following four cases describe the mapping relationship through examples :

- Read switch data in I area (or write Q area): such as reading a piece of data beginning from % IX2.6 (or writing % QX2.6),you need to reference mapping formula for BOOL type data in I area (or Q area), reading (or writing) slave start address in the master station to fill should be: 2 * 8 + 6 = 22.

- Read analog data in I area (or write Q area): such as reading a piece of data beginning from % IW8 (or writing % QW8),you need to reference mapping formula for WORD type data in I area (or Q area), reading (or writing) slave start address in the master station to fill should be: 8 / 2 = 4.

- Read and write switch data in M area: such as reading and writing a piece of data beginning from % MX2.6, you need to reference mapping formula for BOOL type data in M area, reading and writing slave start address in the master station to fill should be: 2 * 8 + 6 + 3000 = 3022.

- Read and write analog data in M area: such as reading and writing a piece of data beginning from % MW1000, you need to reference mapping formula for WORD type data in M area, reading and writing slave start address in the master station to fill should be 1000/2 + 3000 = 3500.

ⓘ

- The read and write start address add the data length no greater than 3000 byte when the I area or Q area is accessed in slave station.

- When data in input area of the IO slave station is used, the slave is online as the prerequisite (the information is obtained from the S area) and the diagnosis information of the slave station is viewed (online state and diagnosis information of the IO slave stations under the LK249 are obtained via the function block), to ensure that the read data is normal.

5.4 Extension Module

5.4.1 LK249 Profibus-DP Master Station Communication Module

LK249 is a Profibus-DP master station communication module of programmable logical control system of the new-generation LK Series. The module has 2 DB9 communication interfaces, supporting Hollysys Profibus-DP master station communication protocol. It can be connected to up to 124 slave stations. It is connected to the main control backplane via the bus connector.

5.4.1.1 Features

- Support the Profibus-DP master station communication protocol
- Two DB9 interfaces

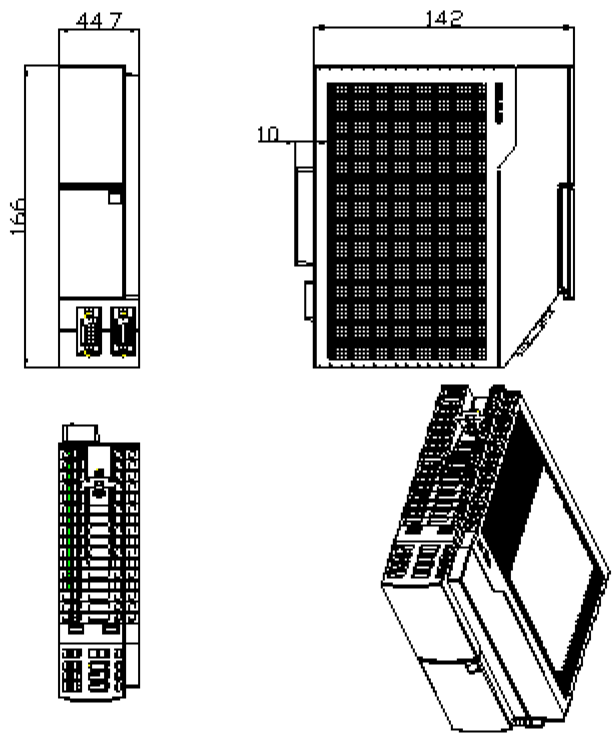
5.4.1.2 Appearance

LK249 Module Schematic Diagram

Interface Specification

Interface	Description
Indicators	Five LED indicators, indicating the running status of the LK249 module in real time
DB9 ports	Two DB9 ports, connecting two redundant Profibus-DP bus

5.4.1.3 Installation Dimension



LK249 Module Dimension

5.4.1.4 Indicators

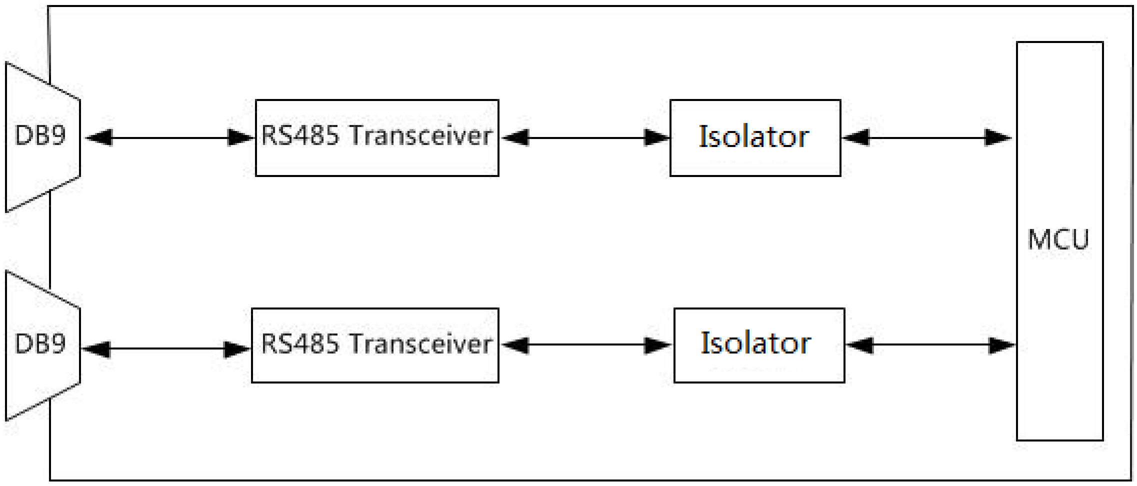
Instructions to Indicators

Name	Function	Color	Status	Description
PWR	Indication of power supply	Yellow	On	The power supply works regularly.
			Off	The power fails/not powered on
RUN	Indication of operating pattern	Green	Slow flashing	The module is working properly.
			On/Off	The module fails.
ERR	Indication of module failure	Red	On	The module appearance fails.
			Off	The module is free of failures.
DP1	Indication of data sending/receiving via DP Communication Interface 1	Green	Slow flashing	DP Communication Interface 1 is sending/receiving data
			On/Off	DP Communication Interface 1 does not send/receive data
DP2	Indication of data sending/receiving via DP Communication Interface 2	Green	Slow flashing	DP Communication Interface 2 is sending/receiving data
			On/Off	DP Communication Interface 2 does not send/receive data

- Slow flashing: with a frequency of 1Hz
- Quick flashing: with a frequency of 4Hz

5.4.1.5 Operating Principle

The DB9 interface of the LK249 module receives the data sent from the I/O device. Upon conversion via RS485, the signal is converted into a signal supported by the bottom protocol, with the interfering signal coming from the field eliminated via an isolator. The signal is transmitted to MUC for processing.

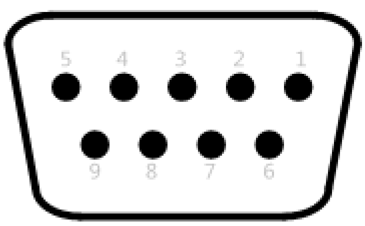


LK249 Internal Schematic Diagram

The DP master station in the mainframe is in operation. The DP master station in the slave frame is in the listening mode. The data is synchronized periodically between the DP master stations. When the controller switches between the master and slave machines, the DP master station also switches accordingly.

5.4.1.6 Terminal Definition

The LK249 module has two DB9 interfaces with each redundancy, which used to connect the IO devices and DP master station communication module in the redundancy cabinet.



DB9 Interface Schematic Diagram

DB9 Pin Signal Definition

Pin	Signal Definition	Description
1/4/9	NC	Not used
2、3	DP+	DP signal positive
5	DP1_GND	Signal grounding
6	DP1_5V	5VDC power supply
7, 8	DP1-	DP signal negative

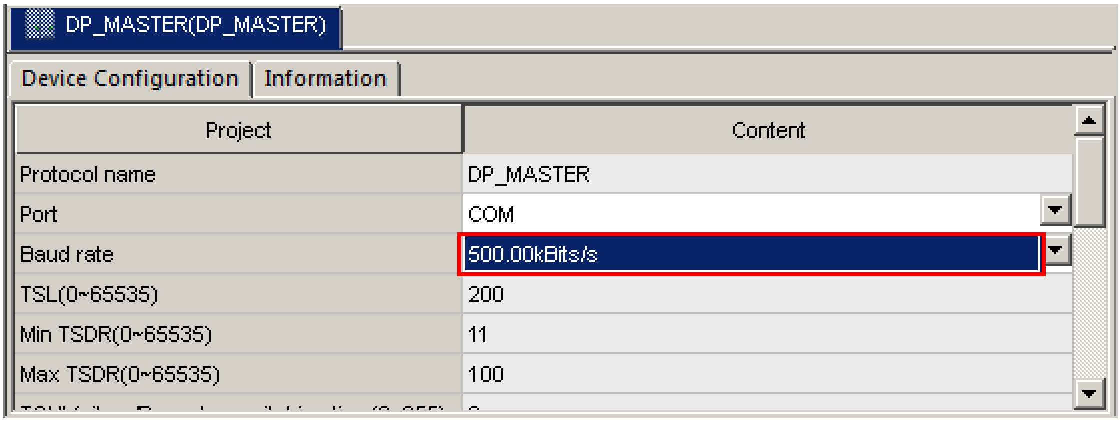
5.4.1.7 Diagnosis

- LK249 can diagnose the following functions: module status diagnosis (module failure).
- Internal module failure (FPGA failure, PCIe link failure).
- Dual DP link break failure.

5.4.1.8 Set Baud Rate

In the AutoThink software, double click the configured DP_MASTER node under the [Hardware Configuration] node, open the device information window, as shown in figure to set the Baud rate.

The Baud rate is the communication rate between the controller and the IO device. It can be set as 187.5, 500, 1500, 3000 and 6000 (unit: Kbps).



DP_MASTER Device Information Window

5.4.1.9 Technical Specifications

LK249 DP Master Station Communication Module	
System power supply	
Input Voltage	19.2V~30VDC
Consumption(max)	200mA@24VDC
DP bus	
Number of Channels	2
Physical Interface	1 double-layer DB9 receptacle
Communication Rate	187.5kbps, 500 kbps, 1.5M bps, 3Mbps, 6Mbps
PCIe Bus	
Communication Speed	Meet PCIe interface, 2.5GT/s
with a load capacity	1-channel X1
Protection Rating	
Protection Rating	IP20
Hot-swappable	
Hot Plug	Supported

LK249 DP Master Station Communication Module	
Dual-network Redundancy	
Dual-network Redundancy	The DP bus supports redundancy
Starting Time	
Time from the moment when the module is powered on to the moment when initialization is done	≤10 s
Physical Property	
Installation Pattern	Backplane slot
Module Dimension (W*H*D)	44.7mm*166mm*152mm±0.5 mm
Weight	365 g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

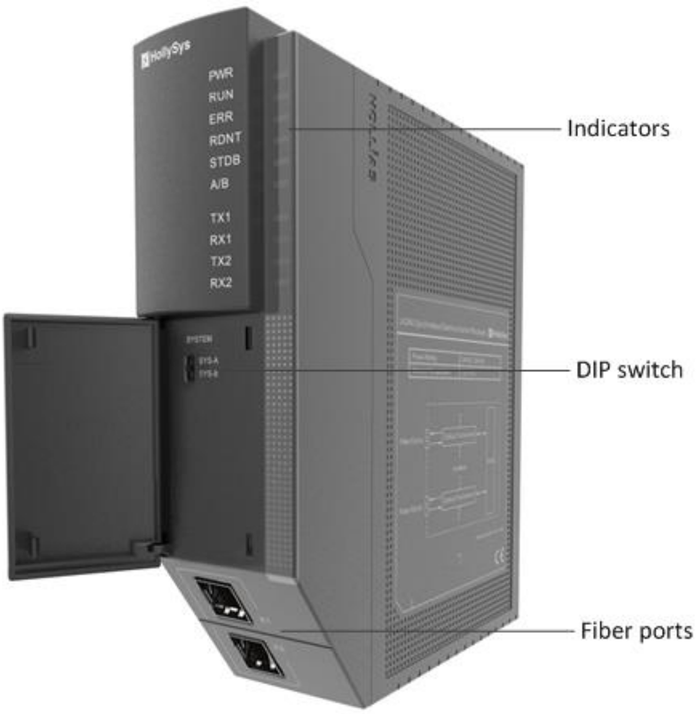
5.4.2 LK240 Redundancy Synchronization Module

LK240 is the redundancy synchronization module in the large-scale PLC redundancy system. It is the dedicated module for data synchronization between the main frame and the slave frame in the redundancy system. Redundancy communication between the main frame and the slave frame can be realized via respective redundancy synchronization modules by taking optical fiber as the medium. It is connected to the main control backplane via the bus connector.

5.4.2.1 Features

- Determine the master/slave mechanism
- Support gigabit optical fiber communication
- Support 2-channel fiber interfaces
- Support anti-reverse insert

5.4.2.2 Appearance

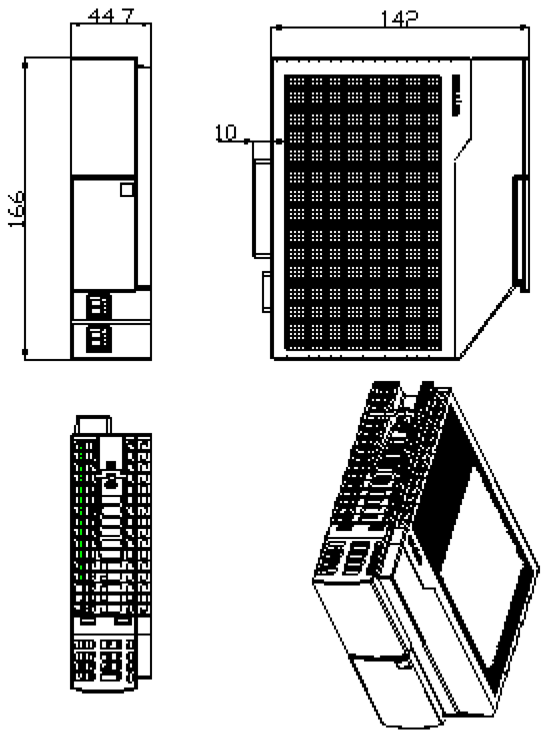


LK240 Module Schematic Diagram

Interface Specification

Interface	Description
Indicators	Ten LED indicators, indicating the running status of the LK240 module in real time
DIP switch	Set controller as A rack or B rack
Fiber ports	Two redundant optical fiber ports for redundant data communication between master and slave racks

5.4.2.3 Installation Dimension



LK240 Module Dimension

5.4.2.4 Indicators

Instructions to Indicators

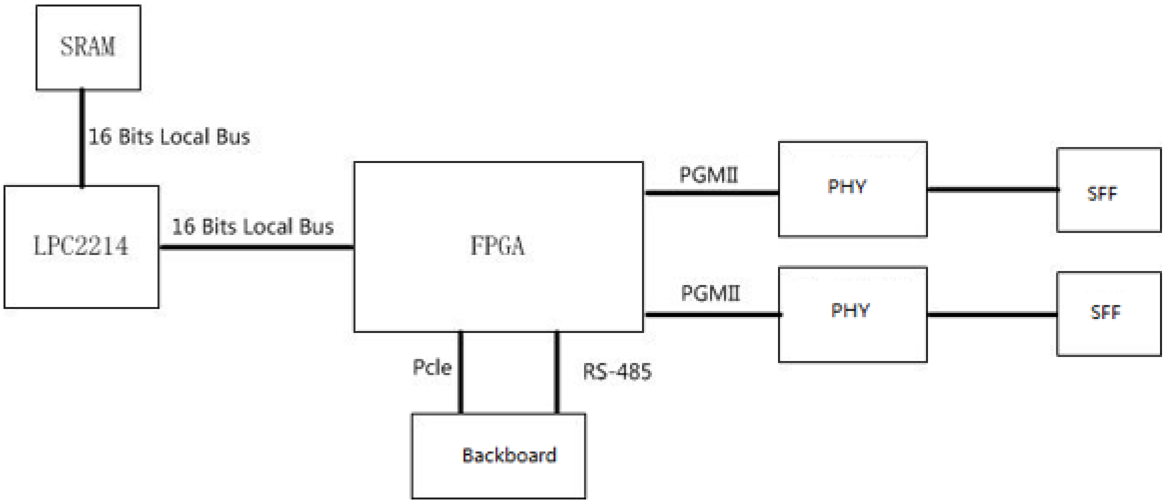
Name	Function	Color	Status	Description
PWR	Indication of power supply	Yellow	On	The power supply is normal
			Off	The power supply fails.
RUN	Indication of operating pattern	Green	On/Off	The firmware does not work regularly.
			Slow flashing	The firmware works regularly.
ERR	Indication of module failure	Red	On	The module fails.
			Off	The module is free of failures.
RDNT	Indication of redundancy communication	Green	On/Off	Redundancy communication fails.
			Slow flashing	Redundancy communication work regularly.
STDB	Indication of master-slave status of controllers	Green	On	The current controller is in standby mode
			Off	The current controller is in operating mode
			Slow flashing	The master-slave status is not determined.
A/B	Indication of Machine A/B	Green	On	The current controller is Machine A

Name	Function	Color	Status	Description
			Off	The current controller is Machine B
TX1	Indication of data sent via Fiber Interface 1	Green	Slow flashing	Fiber Interface 1 is sending data
RX1	Indication of data received via Fiber Interface 1	Green	Slow flashing	Fiber Interface 1 is receiving data
TX2	Indication of data sent via Fiber Interface 2	Green	Slow flashing	Fiber Interface 2 is sending data
RX2	Indication of data received via Fiber Interface 2	Green	Slow flashing	Fiber Interface 2 is receiving data

- Slow flashing: with a frequency of 1Hz
- Quick flashing: with a frequency of 4Hz

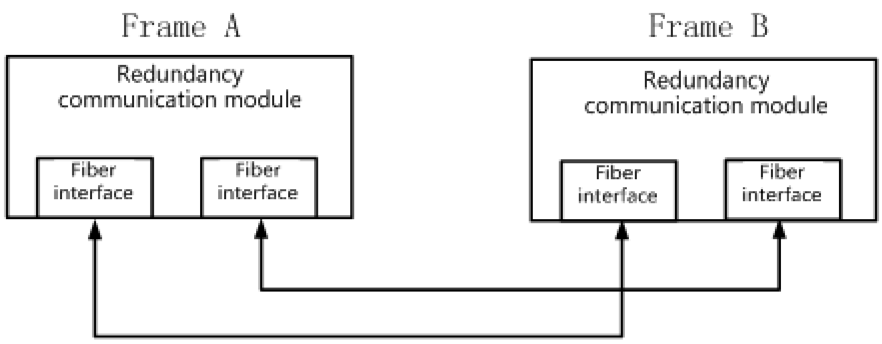
5.4.2.5 Operating Principle

Upon signal conversion via the Ethernet transceiver, the data from the fiber interface is transmitted to FPGA for logical processing, which is then transmitted to the controller module via the PCIe backplane bus.



LK240 Module Block Diagram

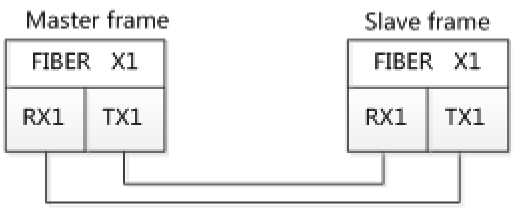
Optical fiber interface in two redundant communication modules is connected by special optical cable to data communication. The two links work redundantly. When a link failure and another link without fault, it can switch to normal link automatically with the switching time no more than 10ms, thus improving the reliability of continuous system operation.



Redundancy Communication Schematic Diagram

5.4.2.6 Wiring

The LK240 redundancy synchronization module has two optical fiber communication interfaces, both of which are standard LC fiber interfaces, based on a communication rate of 1Gbps and above. Each fiber interface includes one TX and one RX, which are cross connected to the redundancy synchronization module of another frame, with one as the sender and the other as the receiver. Take a fiber interface for instance, as shown in figure.



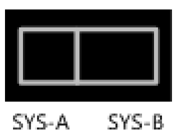
LK240 Optical Fiber Connection

Definitions of LK240 Cable Ports

Port Identifier	Meaning
TX1	Transmitting end, Channel 1
RX1	Receiving end, Channel 1
TX2	Transmitting end, Channel 2
RX2	Receiving end, Channel 2

5.4.2.7 Set A/B Frame

It can set the current controller as Machines A or B via the two-bit DIP switch on the front panel.



Series A/B DIP Switch Schematic Diagram

- Switch to the SYS-A position, set the current controller as Machine A.

- Switch to the SYS-B position, set the current controller as Machine B.

  You need to restart the controller in current frame to make settings effective after the A/B DIP switch was modified.

5.4.2.8 Master-slave Determination

When the redundancy synchronization module is powered on with no fault in current, it can determine whether the module that is newly powered on is the master or the slave machine according to the following principle. The master-slave determination principle (with a descending priority) is:

- The last running status of the controller. When the last redundancy is regular, then the master-slave status is kept unchanged.
- The module involved in a project is the master one.
- When a dual-machine project and the last running status are same, then Machine A is the master one.

ⓘIt is recommended that, in case of dual frame operation, it shall firstly power up the mainframe, then power up the slave frame after the mainframe works regularly.

5.4.2.9 Conditions of Master-slave Switchover

In the following cases, master switches to slave when the slave station works normally. The switching process is non disturbance, which will not affect the output of the control process.

- Conditions of triggering master-slave switchover
  - Power failure (One controller module is power off).
  - Major failure in the controller (PCIe link failure, FPGA failure).
  - Plug and pull the module on the backplane.
  - Any module failure on the backplane.
  - Communication link failure in the DP master station module (dual-DP link break failure, PCIe link break failure in the DP module, FPGA failure).
  - Dual Ethernet connection is broken.
  - Call the sysMasterSwitchToSlave (master-slave switchover) command in AutoThink to make a switchover.

RTC of master and slave controllers are redundant. Configure SET_ RTC function block to calibrate RTC of master controller, the RTC is automatically redundant to the slave controller. Refer to SET_RTC function block.

5.4.2.10 Technical Specifications

LK240 Redundancy Synchronization Module	
System power supply	
Input Voltage	19.2V~30VDC
Consumption(max)	250mA@24VDC
Fiber Interface	
Number of Channels	2
Interface Type	LC type
Media Redundancy	Supported
PCIe Bus	
Communication Speed	Meet PCIe interface, 2.5GT/s
with a load capacity	1-channel X1
Protection Rating	IP20
Hot Plug	Supported
Starting Time	
Time from the moment when the module is powered on to the moment when initialization is done	≤10 s
Physical Property	
Installation Pattern	Backplane slot
Module Dimension (W*H*D)	44.7 mm*166 mm*152 mm ± 0.5 mm
Weight	365 g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

5.4.3 LK241 POWERLINK/PL-LINK Master Station Communication Module

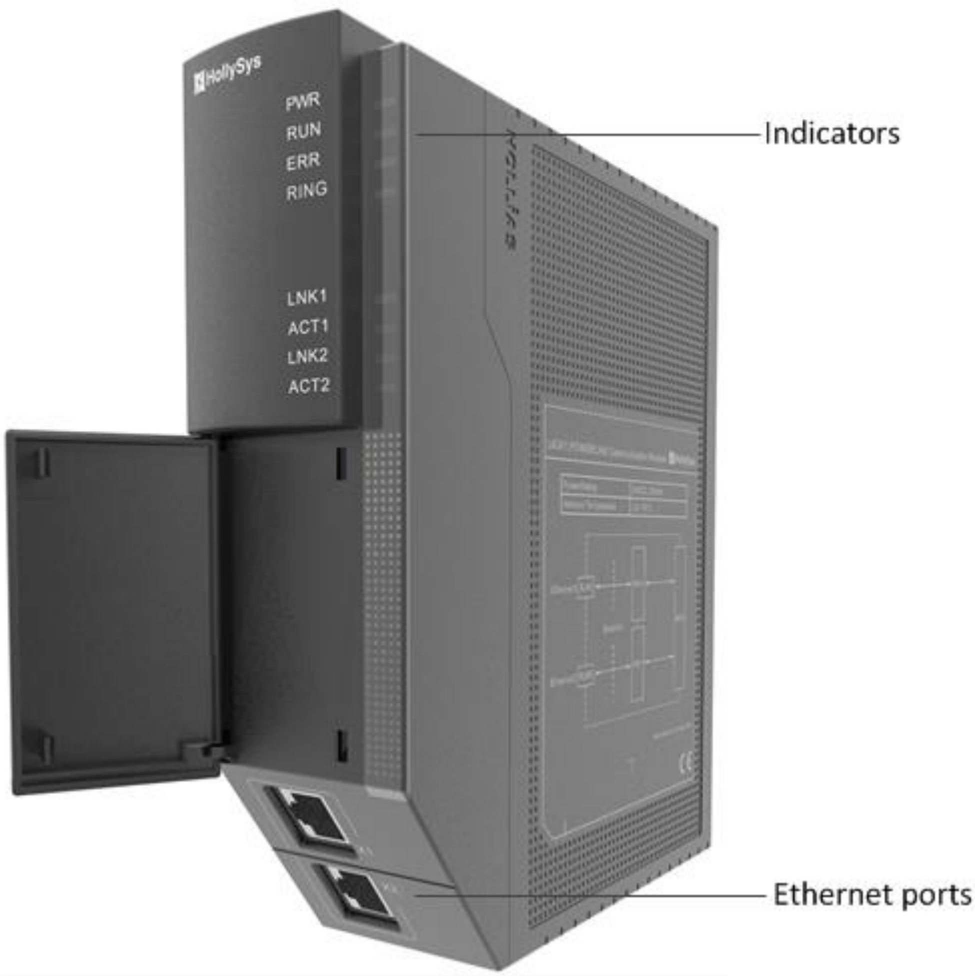
LK241 is a POWERLINK/PL-LINK master station communication module, which exchanges data with the controller through the high-speed backplane bus. The POWERLINK/PL-LINK master station periodically polls the POWERLINK/PL-LINK slave station, reads the input data from the slave station, and writes the output data issued by the controller. POWERLINK/PL-LINK network supports ring network redundancy mode.

LK241 can realize POWERLINK/PL-LINK ring network through SP100-2FP4T-SFP switch or LK235 module. When configuring the SP100-2FP4T-SFP switch ring network, it can support up to 32 switches, and each switch supports connectiing 4 LK235 POWERLINK/PL-LINK interface modules. When configuring the LK235 ring network, it can support up to 40 LK235 POWERLINK/PL-LINK interface modules.

5.4.3.1 Features

- 2 POWERLINK/PL-LINK Ethernet interfaces
- POWERLINK/PL-LINK master station communication protocol
- Support ring network redundancy mode

5.4.3.2 Appearance



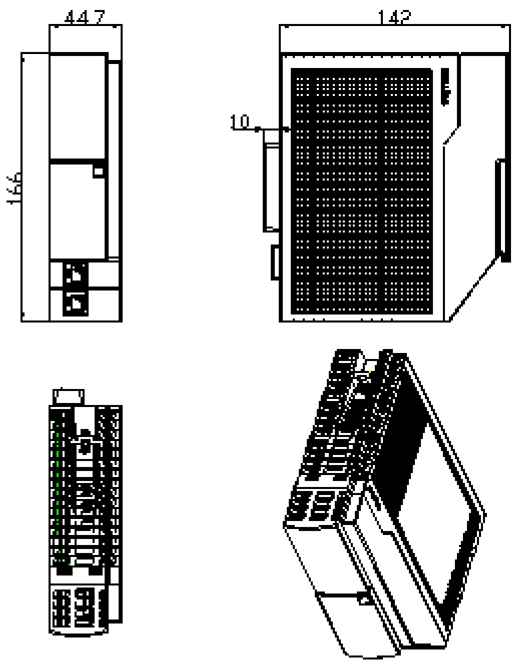
LK241 Module Schematic Diagram

Interface Specification

Interface	Description
Indicators	8 LED indicators, indicating the running status of the LK241 module in real time
Ethernet	2 POWERLINK/PL-LINK Ethernet interfaces for connecting POWERLINK/PL-LINK slave stations or

Interface	Description
ports	switches

5.4.3.3 Installation Dimension



LK241 Module Dimension

5.4.3.4 Indicators

Instructions to Indicators

Name	Function	Color	Status	Description
PWR	Indication of power supply	Yellow	On	The power supply is normal
			Off	Power failure
RUN	Indication of operating pattern	Green	Flashing	The module is normal
			On	Module configuration is unsuccessful or communication is abnormal
			Off	Firmware failure
ERR	Indication of module failure	Red	On	Module failure
			Off	No fault detected
RING	Indication of POWERLINK/PL-LINK link ring network status	Green	On/Off	Local equipment state: On: indicating that the POWERLINK/PL-LINK ring network is closed Off: indicating that the POWERLINK/PL-LINK ring network is open Opposite equipment state: The indicator is always on
LNK1	Indication of connecting POWERLINK/PL-LINK Ethernet interface 1	Green	On	Ethernet interface 1 has been successfully connected
			Off	Ethernet interface 1 is not connected

Name	Function	Color	Status	Description
ACT1	Indication of receiving and sending data via POWERLINK/PL-LINK Ethernet interface 1	Yellow	On	Ethernet interface 1 is sending and receiving data
			Off	Ethernet interface 1 does not send or receive data
LNK2	Indication of connecting POWERLINK/PL-LINK Ethernet interface 2	Green	On	Ethernet interface 2 has been successfully connected
			Off	Ethernet interface 2 is not connected
ACT2	Indication of receiving and sending data via POWERLINK/PL-LINK Ethernet interface 2	Yellow	On	Ethernet interface 2 is sending and receiving data
			Off	Ethernet interface 2 does not send or receive data

5.4.3.5 Technical Specifications

LK241 POWERLINK/PL-LINK master station communication module		
System Power Supply		
Input Voltage	19.2V~30VDC	
Module Power Consumption (max)	300mA @24VDC	
Ethernet		
Number of Channels	2 way	
Physical Interface	Shield RJ45	
Communication Rate	100Mbps	
Protocol	POWERLINK/PL-LINK industrial Ethernet protocol, support ring network redundancy	
Allowable Cable Length	≤100 m	
Number of Connected Slaves		
LK235 Ring Network	Up to 40 LK235 POWERLINK/PL-LINK interface modules	
SP100-2FP4T-SFP Ring Network	Up to 128 LK235 POWERLINK/PL-LINK interface modules	
Polling Period		
Number of Slave Stations	Polling period(ms)	Self healing time of ring network(ms)
40 (ring network without switch)	3	Take the larger value of 3 polling cycles and 3 response time
128 (switch ring network)	7	Take the larger value of 3 polling cycles and 3 response time
PCIe Bus		
Communication Speed	Meet PCIe interface, 2.5GT/s	
Load Capacity	1 X1	
Module Hot Swap	Supported	
Diagnostic Demand		
Redundant Switching Time	≤100 ms	
Start Time		
Time from module power on to completion of initialization	≤20 s	
Physical Characteristics		
Installation Location	Main control backplane expansion module slot	
Module Size (W*H*D)	44.7 mm*166 mm*152 mm±0.5 mm	

5.4.4 LK241M HolliTCP Master Module

LK241M is the communication module of HolliTCP master station, which interacts with the controller through high-speed backplane bus. The HolliTCP master station periodically polls the HolliTCP slave station, reads the slave station input data, and writes the output data sent by the controller.

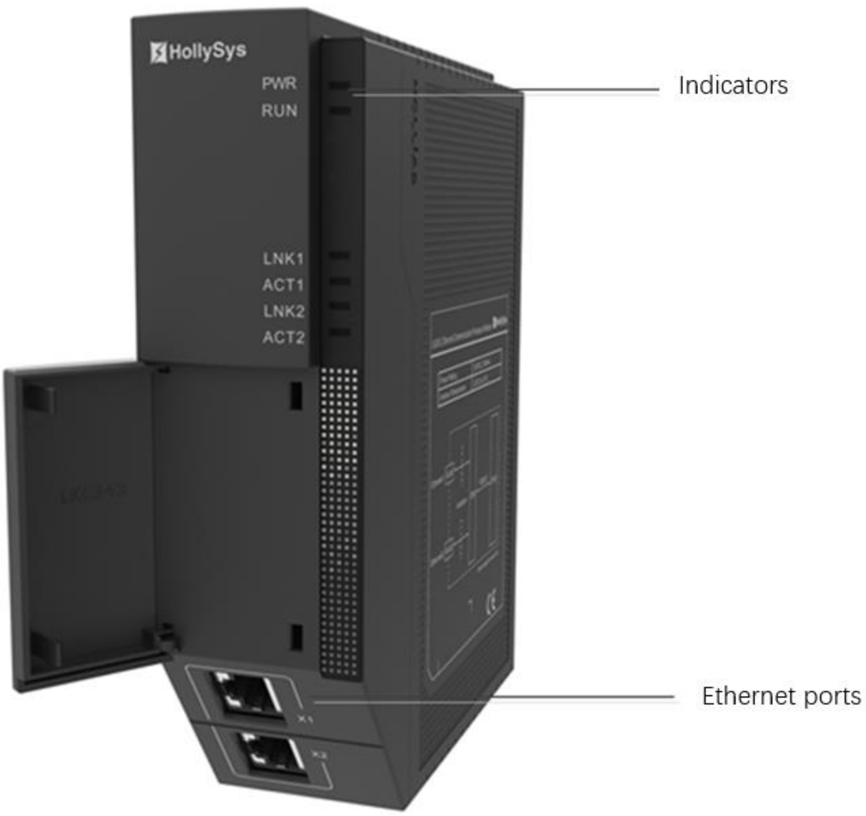
The LK241M provides two redundant 100Mbps Ethernet ports, forms a control network with LK235M, industrial switches, and supports up to 64 LK235M modules.

Module installed in the main control back communication expansion slot, support up to 1 LK241M.

5.4.4.1 Features

- 100 Mbps Ethernet Portal
- Support for the HolliTCP master protocol
- Port support redundancy

5.4.4.2 Appearance

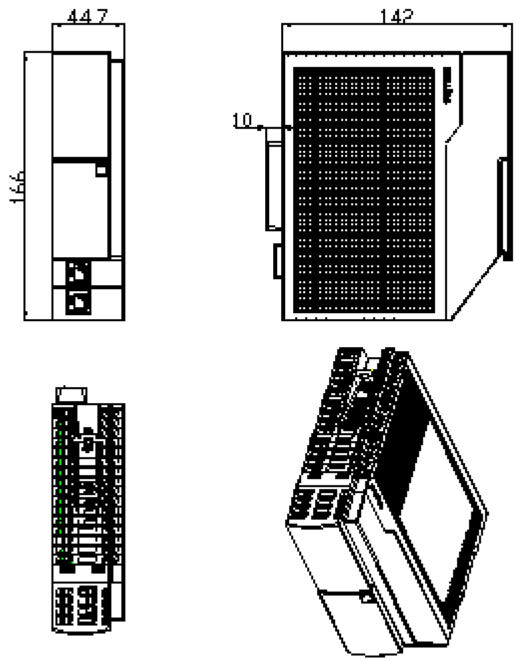


LK241M Module Schematic Diagram

Interface Specification

Interface	Description
Indicators	8 LED indicators, indicating the running status of the LK241M module in real time
Ethernet ports	2-way HolliTCP Ethernet interface for connecting to HolliTCP slave or switch

5.4.4.3 Installation Dimension



LK241M Module Dimension

5.4.4.4 Indicators

Instructions to Indicators

Name	Function	Color	Status	Description
PWR	Indication of power supply	Yellow	On	The power supply is normal
			Off	Power failure
RUN	Indication of operating pattern	Green	Flashing	The module is normal
			Off	Module to controller communication is exception
LNK1	Indication of connecting POWERLINK Ethernet interface 1	Green	On	Ethernet interface has been successfully connected
			Off	Ethernet

Name	Function	Color	Status	Description
				interface is not connected
ACT1	Indication of receiving and sending data via POWERLINK Ethernet interface 1	Yellow	On	Ethernet interface is sending and receiving data
			Off	Ethernet interface does not send or receive data
LNK2	Indication of connecting POWERLINK Ethernet interface 2	Green	On	Ethernet interface has been successfully connected
			Off	Ethernet interface is not connected
ACT2	Indication of receiving and sending data via POWERLINK Ethernet interface 2	Yellow	On	Ethernet interface is sending and receiving data
			Off	Ethernet interface does not send or receive data

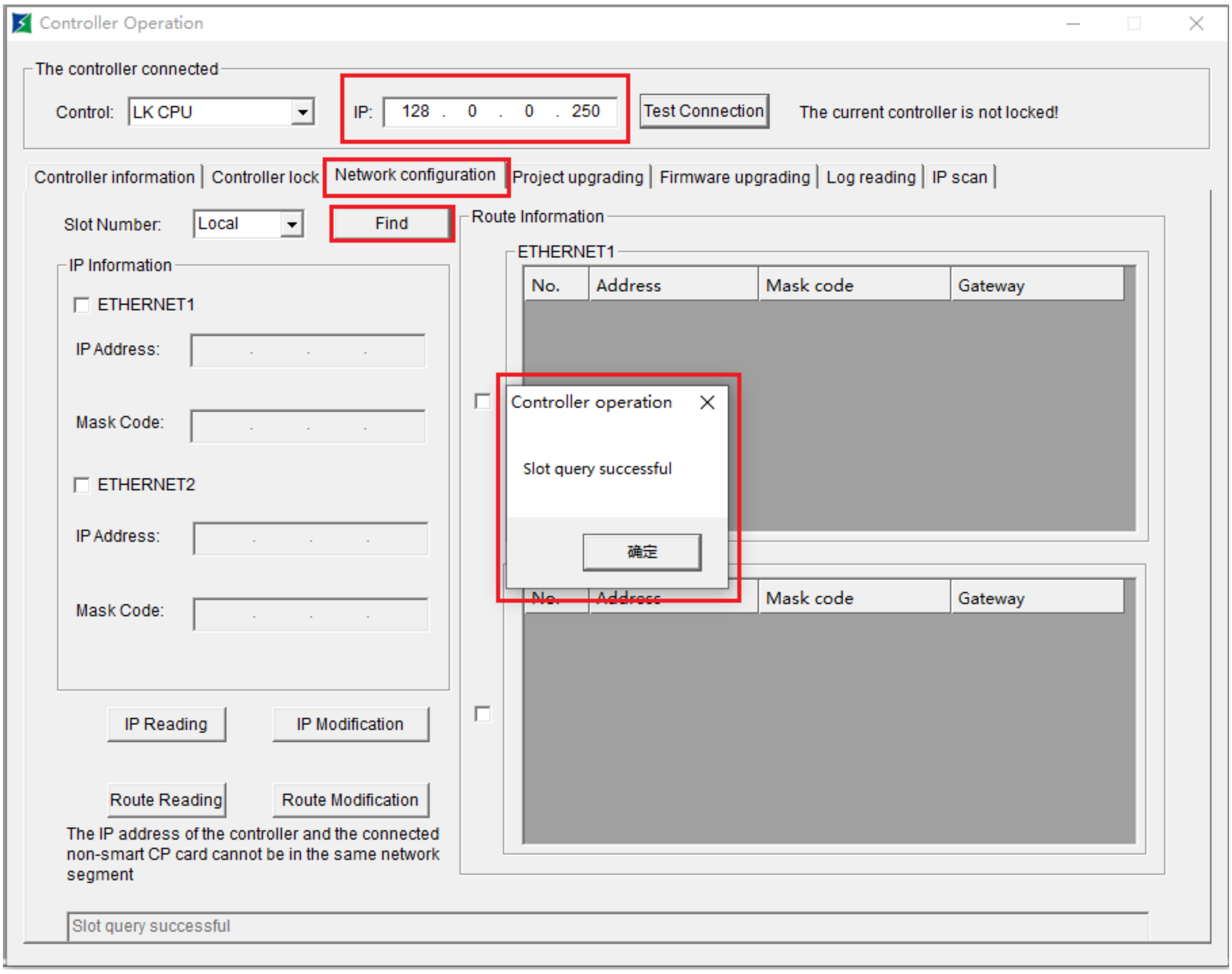
5.4.4.5 IP address settings

5.4.4.5.1 Default IP

The default IP addresses are: 128.0.x.250 and 129.0.x.250, x minus 1 for the module slot number.

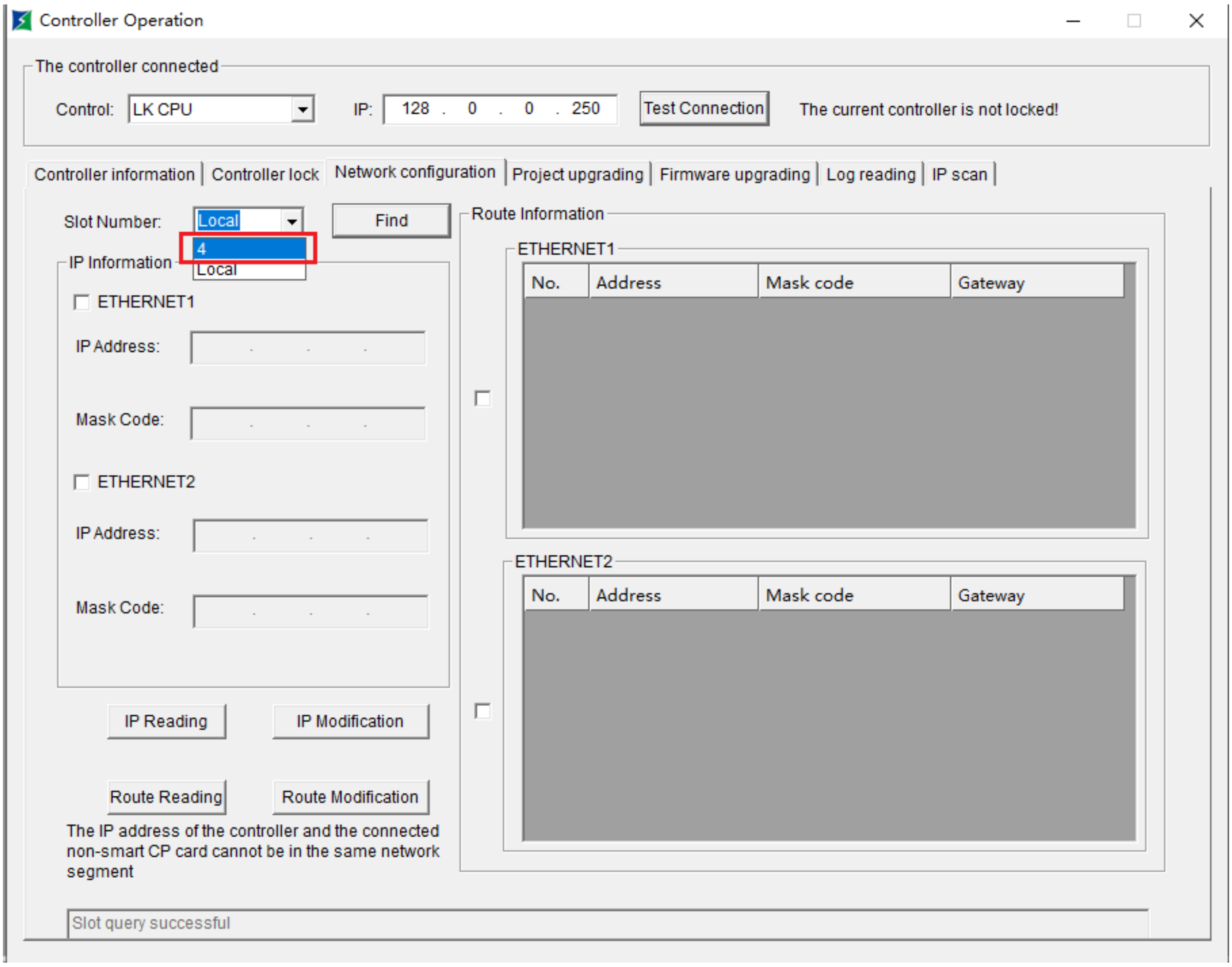
5.4.4.5.2 Configure IP

(1) After the master connection, set the controller IP address, the default address is 128.0.0.250 or 129.0.0.250. The IP address of the LK241M is set by the gadget in the Auto Think programming software, click the Find button to find the slot number of the master LK241M module.



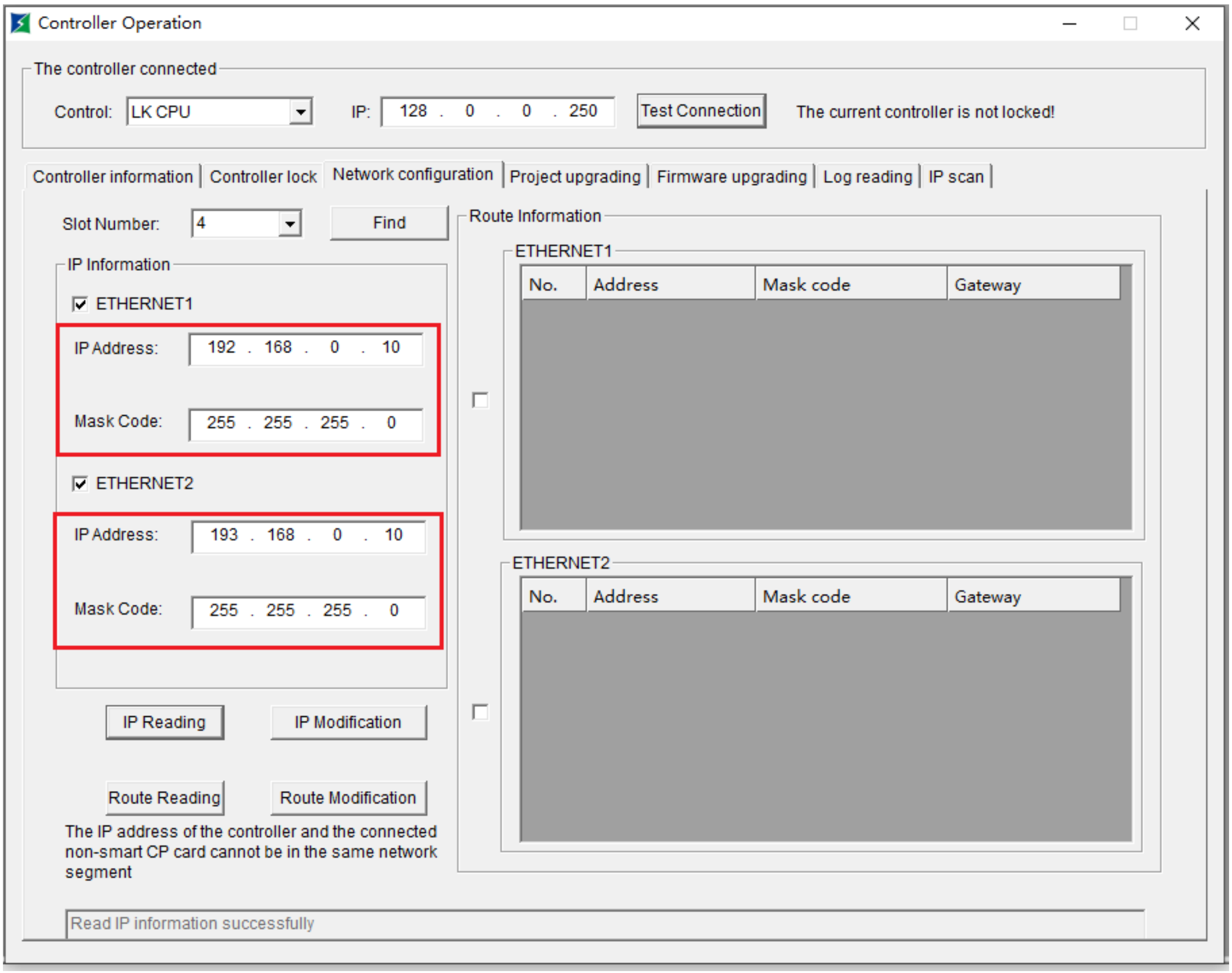
Lookup slot number

(2) Click the slot number drop-down box and select LK241M slot number.



Elect LK241M slot number

(3) Click the IP read button, "IP information" box shows two network port IP and mask. Check the network port, enter the new IP address and mask, click the IP modify button, will modify the LK241M IP address, as shown in the following figure.



LK241M IP address configuration

- The first three fields of the LK241M IP address cannot be the same as the other modules on the backplane, otherwise the module information will be read incorrectly.

5.4.4.6 LK241M Diagnosis

LK241M HolliTCP master communication module diagnostic information includes module activity status identification and network status diagnosis. When both Ethernet interfaces of the LK241M fail, the primary and secondary switches are triggered.

Double-click the LK241M tree node to view it in the Diagnostics tab of the module information page.The [diagnostic information] tab is displayed after the project is compiled.

LK241M(2:LK241M)

Device Configuration | Diagnostic Information | Information

No.	Variable Name	Address	Variable Description	Variable Type	Initial Value	Power Fail Safeguard
0001	AT_LK241MActive4_Local	%SB65536	Local module activity status identification-0:Hot-Standby 1:Activity	BYTE	0	FALSE
0002	AT_LK241MActive4_Remote	%SB66536	Opposite module activity status identification-0:Hot-Standby 1:Activity	BYTE	0	FALSE
0003	AT_LK241MNet1Status4_Local	%SB65537	Local module first network status-0:Normal 1:Disconnected	BYTE	0	FALSE
0004	AT_LK241MNet1Status4_Remote	%SB66537	Opposite module first network status-0:Normal 1:Disconnected	BYTE	0	FALSE
0005	AT_LK241MNet2Status4_Local	%SB65538	Local module second network status-0:Normal 1:Disconnected	BYTE	0	FALSE
0006	AT_LK241MNet2Status4_Remote	%SB66538	Opposite module second network status-0:Normal 1:Disconnected	BYTE	0	FALSE

LK241M Diagnosis Variable

5.4.4.7 Technical Specifications

LK241M HolliTCP master module	
System Power Supply	
Input Voltage	19.2V~30VDC
Module Power Consumption (max)	300mA @24VDC
Ethernet	
Number of Channels	2 way
Physical Interface	Shield RJ45
Connecting cable	Shielded cable CAT5e、CAT6、CAT6e
Allowable Cable Length	≤100 m
Communication Rate	100 Mbps
Communication protocol	Supports the HolliTCP master protocol with up to 64 LK235M connections
Redundancy	Supporte
PCIe Bus	
Communication Speed	Meet PCIe interface, 2.5GT/s
Physical Characteristics	
Installation Location	Main control backplane expansion module slot
Module Size (W*H*D)	44.7 mm*166 mm*152 mm±0.5 mm

5.4.5 LK246 Ethernet Communication Processor Module

LK246 is an Ethernet communication processor module that provides 2 10M/100M/1000Mbps Ethernet ports to connect to AT, HMI or third-party upper software.

The LK246 module supports Modbus TCP master protocol and Modbus TCP slave protocol, supporting a total of 16 master/slave protocols. The master and slave each support 64 connections, and each connection has a maximum of 32 instructions.

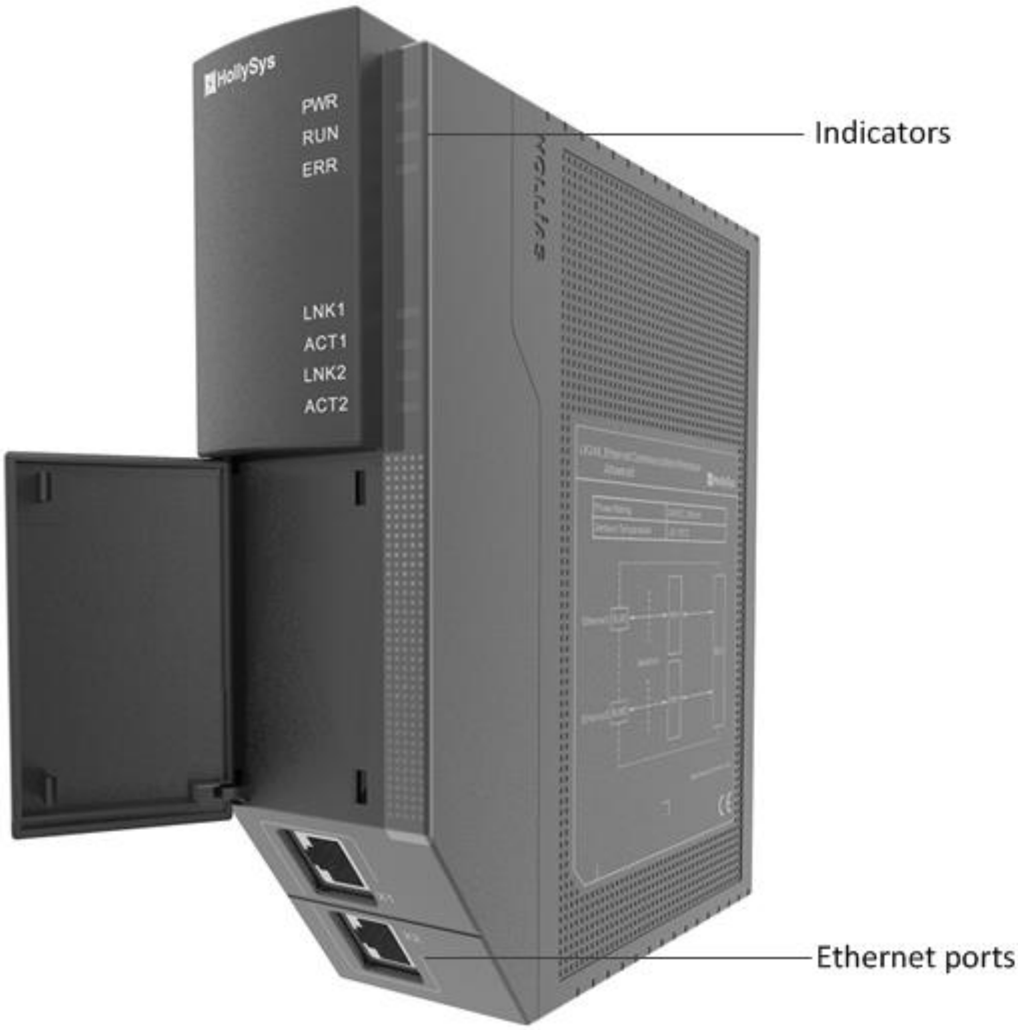
The module is installed in the communication expansion slot of the main control backplane. The maximum configuration quantity is related to the controller model. Please refer to the controller Technical Specifications.

5.4.5.1 Features

- 10M/100M/1000Mbps Ethernet port

- Support Modbus TCP master-slave protocol
- Support AT downloading project
- Support OPC UA

5.4.5.2 Appearance

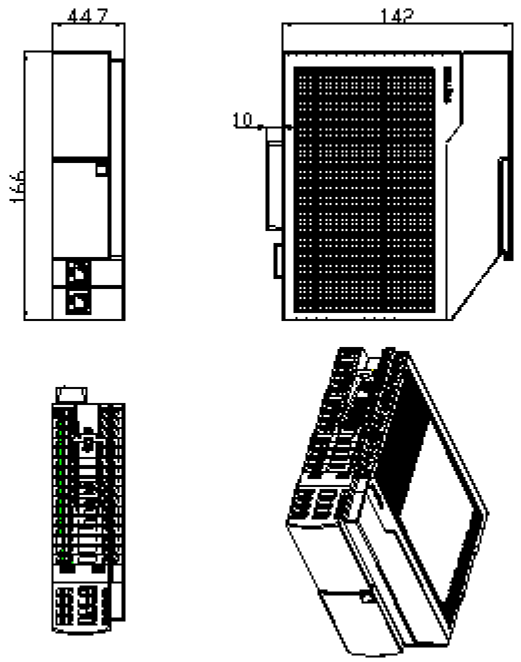


LK246 Module Schematic Diagram

Interface Specification

Interface	Description
Indicators	7 LED indicators, indicating the running status of the LK246 module in real time
Ethernet ports	Connect the programming computer, download the project; as a Modbus TCP master/slave station to communicate with other devices. Two network ports have independent MAC addresses for independent use The default addresses are: 128.0.x.250 and 129.0.x.250, where x is the module slot number -1. Add 1 to the IP address of the LK246 module of the standby rack

5.4.5.3 Installation Dimension



LK246 Module Dimension

5.4.5.4 Indicators

Instructions to Indicators

Name	Function	Color	Status	Description
PWR	Indication of power supply	Yellow	On	The power supply is normal
			Off	Power failure or no power
RUN	Indication of operating pattern	Green	Slow flashing	The module is normal
			On	Module failure (module configuration is unsuccessful or communication is abnormal)
			Off	Module failure (faulty firmware)
ERR	Indication of module failure	Red	On	The module has a configured network port failure
			Off	No fault detected
LNK1	Indication of connecting Ethernet Interface 1	Green	On	Ethernet interface has been successfully connected
			Off	Ethernet interface is not connected
ACT1	Indication of receiving and sending data via Ethernet Interface 1	Yellow	On	Ethernet interface is sending and receiving data
			Off	Ethernet interface does not send or receive data
LNK2	Indication of connecting Ethernet Interface 2	Green	On	Ethernet interface has been successfully connected
			Off	Ethernet interface is not connected
ACT2	Indication of receiving and sending data via Ethernet Interface 2	Yellow	On	Ethernet interface is sending and receiving data
			Off	Ethernet interface does not send or receive data

5.4.5.5 Technical Specifications

LK246 Ethernet communication processor module	
System Power Supply	
Input Voltage	19.2V~30VDC
Consumption(max)	300mA @24VDC
Ethernet Connection	
Number of Interfaces	2
Physical Interface	Shield RJ45
Cable	Shield above CAT5
Cable Length	≤100m
Communication Rate	10M/100M/1000 Mbps self-adaption
Protocol	Support Modbus TCP master/slave protocol
PCIe Bus	
Communication Speed	Meet PCIe interface, 2.5GT/s
Load Capacity	1 x1
Start Time	
Time from module power on to completion of initialization	≤50 s
Physical Characteristics	
Installation Method	Backplane slot
Module Dimension (W*H*D)	44.7 x 166 x 152 mm±0.5 mm

5.4.6 LK141 Master Back Plate Empty Slot Module

LK141 is an empty module of LK series controller, which only has a structure part, without circuit board, and be used to cover unused empty slots on the backplane.

LK141 Master Back Plate Empty Slot Module

5.5 Switch

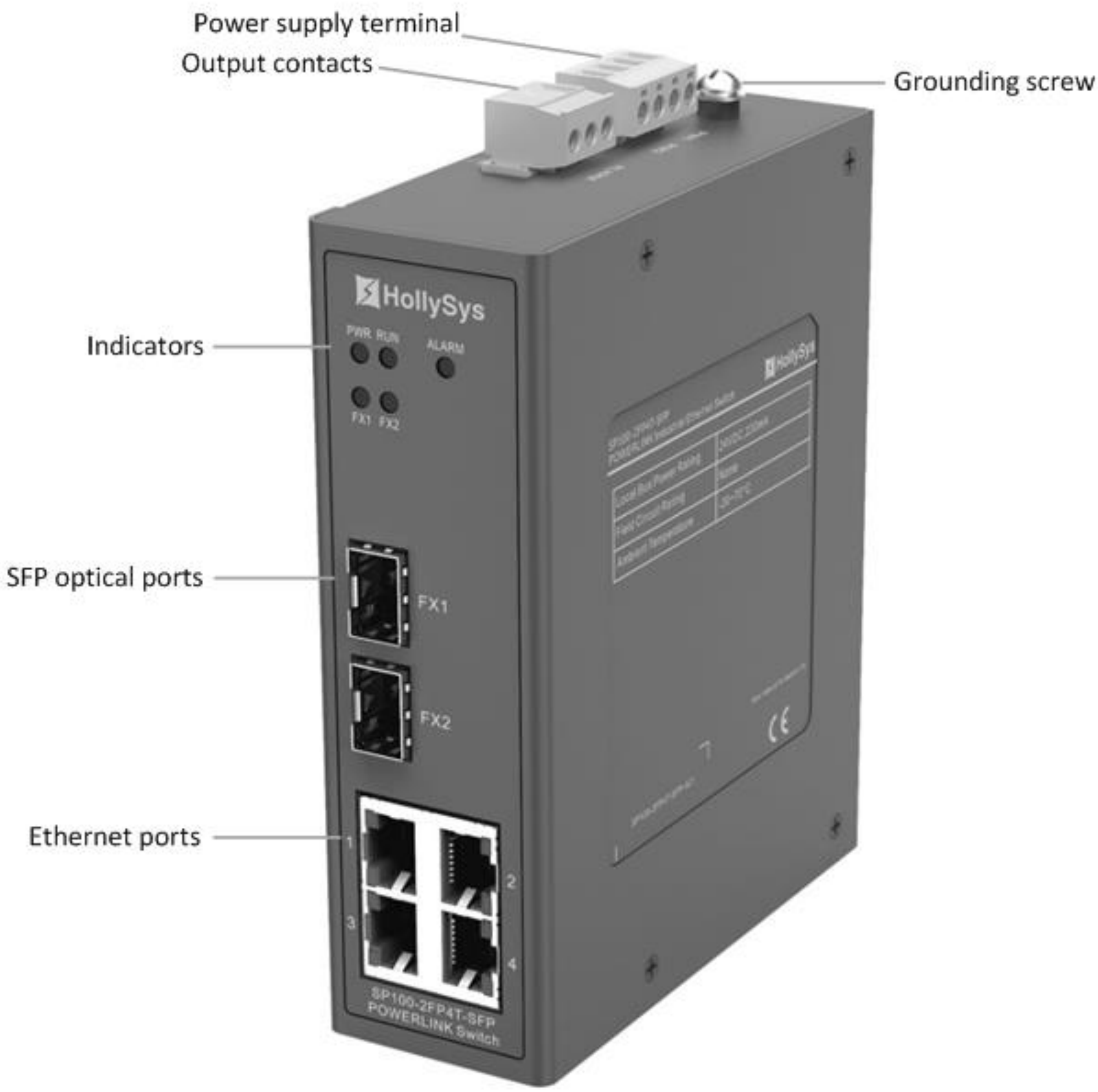
5.5.1 SP100-2FP4T-SFP POWERLINK Industrial Ethernet Switch

SP100-2FP4T-SFP POWERLINK Industrial Ethernet switch is used for LK system ring network, supporting optical port ring network and electrical port ring network. The POWERLINK ring network supports redundancy. When a link in the network fails, the system continues to work, and when both links fail, a node will be separated from the network.

5.5.1.1 Features

- Support ring network redundancy
- 2 SFP optical ports
- 4 Ethernet ports
- Network communication conflict detection

5.5.1.2 Appearance



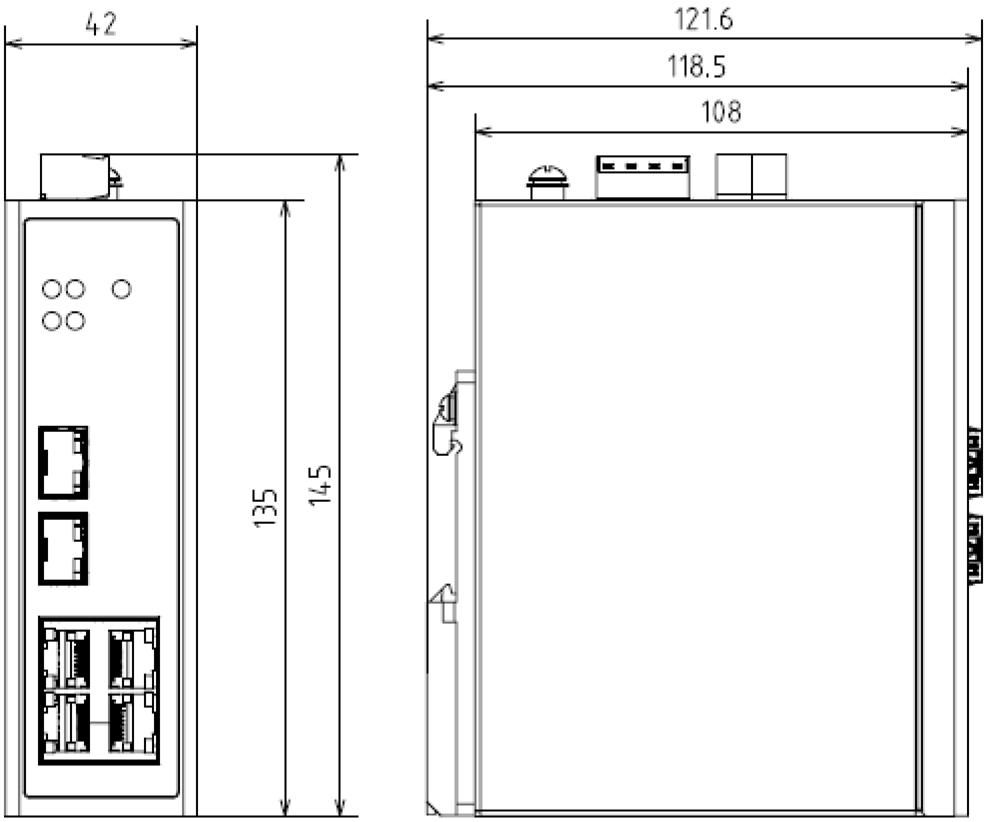
SP100-2FP4T-SFP Module Schematic Diagram

Interface Specification

Interface	Description
Power supply terminal	Connect an external 24VDC power supply to provide working power for the switch
Output contacts	Dry contact output contact, when the network port communication conflicts, the normally open contact is closed and the normally closed contact is disconnected
Indicators	A total of 5 status indicators, including power indicator, running indicator, communication status indicator and 2 optical port indicators
SFP optical ports	2 optical ports for interconnection communication between switches. The optical module should be inserted to connect the optical fiber. Recommended optical module models: SFP-FM-LC multimode

Interface	Description
	and SFP-FS-LC single mode. Please refer to Optical Module
Ethernet ports	4 Ethernet ports, 100Mbps, It can be used to connect the master and slave stations of POWERLINK and it can also be used for ring network communication between switches
Grounding screw	Crimp one end of the ground wire with the cold-pressed terminal and fix it with a ground screw, and connect the other end to the cabinet ground bar

5.5.1.3 Installation Dimension

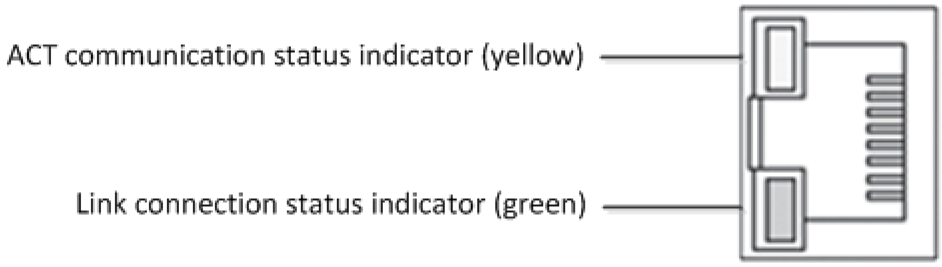


SP100-2FP4T-SFP Module Dimension

5.5.1.4 Indicators

There are 5 indicators on the front panel of the switch, which indicate power supply, operation, fault detection, and fiber connection status. The module's RJ45 network port has its own communication status indicator, and each network port has an ACT light and a LINK light to indicate the data communication status and connection status of the network port.

Refer to the module appearance diagram for the front panel indicator. The network port status indicator diagram is as follows, taking Ethernet port 1 as an example.



Network Port Status Indicators

Definition of SP100-2FP4T-SFP Indicator

Indicator	Name	Color	Status	Description
Module front panel indicators	PWR	Green	On	Power supply is normal
			Off	The module is not powered on or the module is damaged
	RUN	Green	On	The module is normal
			Off	Module failure
	ALARM	Yellow	On	Network port communication failure
			Off	No fault detected
	FX1	Green	On	Fiber 1 is connected normally
			Off	Fiber 1 is not connected
			Flashing	Fiber 1 is exchanging data
	FX2	Green	On	Fiber 2 is connected normally
			Off	Fiber 2 is not connected
			Flashing	Fiber 2 is exchanging data
Network port status indicators	ACK	Yellow	On	Data exchange
			Off	No data interaction
	LINK	Green	On	Network cable inserted link
			Off	The network cable is not plugged in

5.5.1.5 Power Supply Terminal

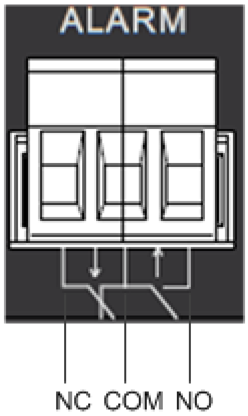
The power terminal is located on the upper cover of the module, and the 24VDC power supply is connected to the module through the power terminal. Supports redundant power input. When one of the power supplies fails, the module can operate normally without interruption to ensure the reliability of network operation.

PWI/PW2 Power Terminal Definition

Terminal	Description
P1+	Positive of first 24VDC power input
P1-	Negative of first 24VDC power input
P2+	Positive of second 24VDC power input
P2-	Negative of second 24VDC power input

5.5.1.6 Output Contacts

The output contact terminal is located on the upper cover of the module and provides two output contacts, normally open and normally closed. When there is a conflict in network port communication, the normally open contact is closed and the normally closed contact is disconnected. At the same time, the ALARM indicator lights up.



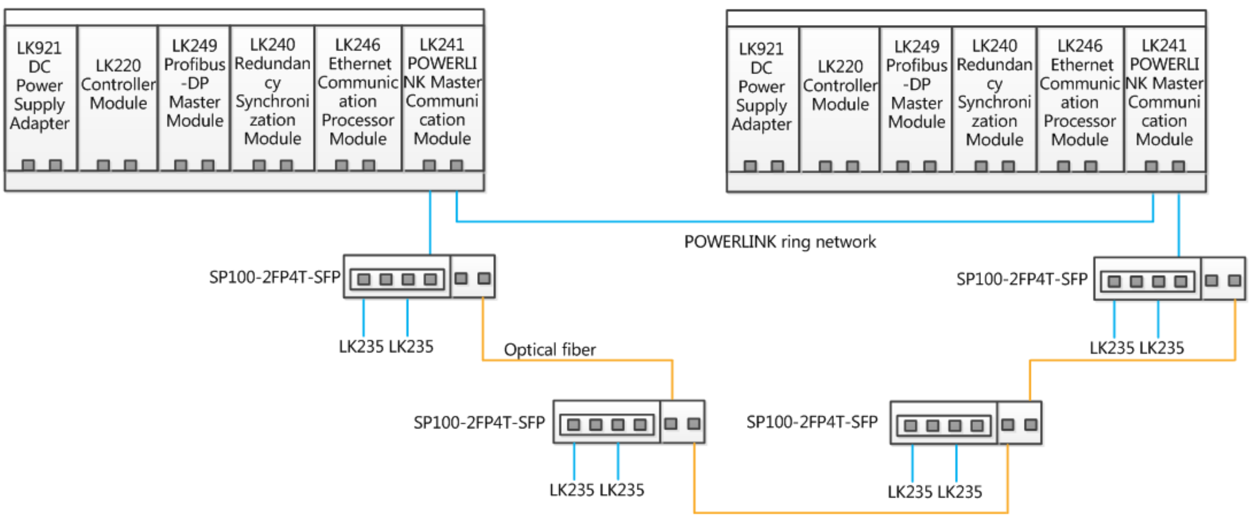
ALARM Terminals

ALARM Contact Terminal Definition

Terminal number	Description
NO	Normally open contact terminal
NC	Normally closed contact terminal
COM	Common terminal

5.5.1.7 Switch Ring Network

The schematic diagram of the switch ring network is shown below. The switches are connected by optical fibers to form a ring network. The switch is connected to the LK235 POWERLINK interface module or the LK241 POWERLINK master station communication module through the Ethernet port.



Network Connection

5.5.1.8 Precautions for Optical Port

- When an optical port is connected to an optical fiber jumper, the optical module must be inserted first. Recommended optical module models: SFP-FM-LC multi-mode and SFP-FS-LC single-mode.
- When the optical module is not in use, cover the dust cap to prevent foreign objects from falling into it.
- Before using the optical module, check whether the conductive metal of the gold finger is damaged or missing, and whether the color is bright enough.
- Standardize insertion and removal to ensure that it is inserted tightly and the card lock is in place to avoid instantaneous disconnection and loosening of the optical module in the event of vibration or collision.
- Use standard optical fiber jumpers. If they are not used for a long time, the optical fiber jumpers must be equipped with dust caps to prevent optical port pollution when the optical fiber jumpers are connected to the optical module.
- Before inserting the optical fiber jumper into the optical module, fix the lever of the optical module first.
- When removing the optical module, be sure to pull out the pull rod first, and then use the pull rod to remove the optical module. Forbidden to remove it.

5.5.1.9 Technical Specifications

SP100-2FP4T-SFP POWERLINK Industrial Ethernet switch	
Input Voltage	24VDC (-15 to +20%)
Power Consumption (max)	230mA @24VDC
Power Redundancy	Supported
Electrical isolation	RJ45 interface and system isolation
Ethernet Port	
Number of Interfaces	4
Physical Interface	Shield RJ45
Connect the Cable	Shield five categories and above
Allowable Cable Length	≤100m
Communication Rate	100Mbps
Protocol	Support POWERLINK protocol
Fiber Port	
Optical Port	Comply with IEEE802.3u 100Base-F(X) standard
Number of Interfaces	2 个
Transceiver Interface	SFP, LC type duplex connector
Optical Fiber Specifications	Multi-mode, the maximum distance is 2km Single mode, the maximum distance is 15km
Physical Properties	
Module Size (W*H*D)	42*145*121.6 ±0.5mm
Installation Method	Rail installation

5.5.2 SP010-1FP1T-SFP (Photoelectric conversion module)

SP010-1FP1T-SFP photoelectric conversion module is used for LK system ring network, supporting optical port ring network and electrical port ring network. The POWERLINK ring network supports redundancy. When a link in the network fails, the system continues to work, and when both links fail, a node will be separated from the network.

5.5.2.1 Features

- Support ring network redundancy
- 1 SFP optical ports
- 1 Ethernet ports

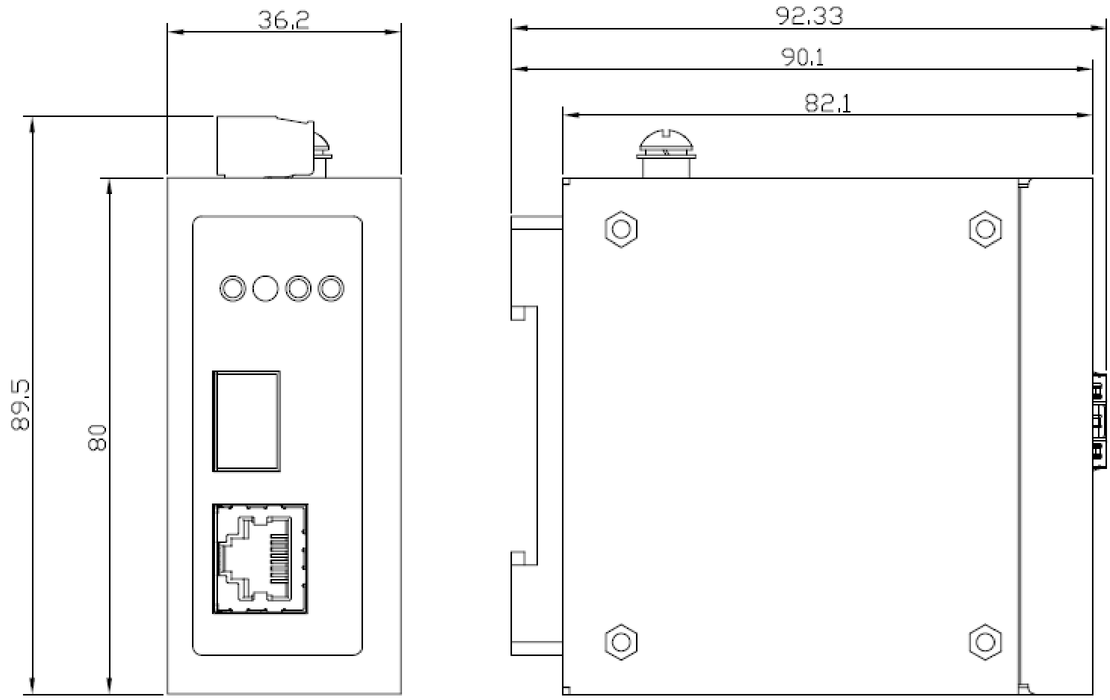
5.5.2.2 Appearance

SP010-1FP1T-SFP Schematic Diagram

Interface Specification

Interface	Description
Power supply terminal	Connect an external 24VDC power supply to provide working power for the switch
Indicators	3 status indicators, including power indicator, communication connection, communication status indicator
SFP optical ports	1 optical ports for interconnection communication between switches. The optical module should be inserted to connect the optical fiber,Recommended optical module models: SFP-FM-LC multimode and SFP-FS-LC single mode. Please refer to Optical Module
Ethernet ports	1 Ethernet ports, 100Mbps, It can be used to connect the master and slave stations of POWERLINK
Grounding screw	Crimp one end of the ground wire with the cold-pressed terminal and fix it with a ground screw, and connect the other end to the cabinet ground bar

5.5.2.3 Installation Dimension



SP010-1FP1T-SFP Module Dimension

5.5.2.4 Indicators

There are 3 indicators on the front panel of the switch, which indicate power supply, connection status of ring network and communication status of ring network.

Definition of SP010-1FP1T-SFP Indicator

Indicator	Color	Status	Description
PWR	Green	On	Power supply is normal
		Off	The module is not powered on or the module is damaged
ACK	Yellow	On	Ring network communication is normal
		Off	Ring network communication is abnormal

Indicator	Color	Status	Description
LINK	Green	On	Communication connection of ring network is normal
		Off	Communication connection of ring network is abnormal

5.5.2.5 Power Supply Terminal

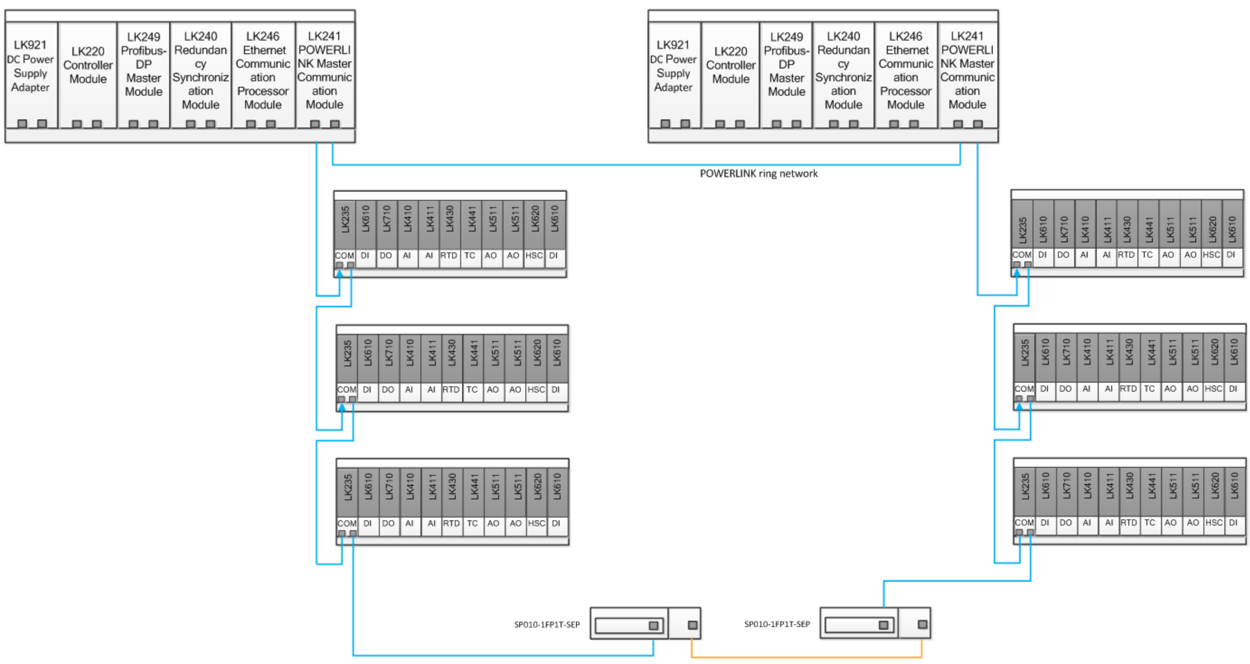
The power terminal is located on the upper cover of the module, and the 24VDC power supply is connected to the module through the power terminal. Supports redundant power input. When one of the power supplies fails, the module can operate normally without interruption to ensure the reliability of network operation.

PWI/PW2 Power Terminal Definition

Terminal	Description
P1+	Positive of first 24VDC power input
P1-	Negative of first 24VDC power input
P2+	Positive of second 24VDC power input
P2-	Negative of second 24VDC power input

5.5.2.6 Switch Ring Network

The schematic diagram of the switch ring network is shown below. The modules are connected by optical fibers to form a ring network. The module is connected to the LK235 POWERLINK interface module or the LK241 POWERLINK master station communication module through the Ethernet port.



Network Connection

5.5.2.7 Precautions for Optical Port

- When an optical port is connected to an optical fiber jumper, the optical module must be inserted first. Recommended optical module models: SFP-FM-LC multi-mode and SFP-FS-LC single-mode.
- When the optical module is not in use, cover the dust cap to prevent foreign objects from falling into it.
- Before using the optical module, check whether the conductive metal of the gold finger is damaged or missing, and whether the color is bright enough.
- Standardize insertion and removal to ensure that it is inserted tightly and the card lock is in place to avoid instantaneous disconnection and loosening of the optical module in the event of vibration or collision.
- Use standard optical fiber jumpers. If they are not used for a long time, the optical fiber jumpers must be equipped with dust caps to prevent optical port pollution when the optical fiber jumpers are connected to the optical module.
- Before inserting the optical fiber jumper into the optical module, fix the lever of the optical module first.
- When removing the optical module, be sure to pull out the pull rod first, and then use the pull rod to remove the optical module. Forbidden to remove it.

5.5.2.8 Technical Specifications

SP010-1FP1T-SFP Photoelectric conversion module	
Input Voltage	24VDC (-20 to +20%)
Power Consumption (max)	100mA @24VDC
Power Redundancy	Supported
Reverse Protection	Supported
Electrical isolation	RJ45 interface and system isolation
Ethernet Port	
Number of Interfaces	1
Physical Interface	Shield RJ45
Connect the Cable	Shield five categories and above
Allowable Cable Length	≤100m
Communication Rate	100Mbps
Protocol	Support POWERLINK protocol
Fiber Port	
Optical Port	Comply with IEEE802.3u 100Base-F(X) standard
Number of Interfaces	1
Transceiver Interface	SFP, LC type duplex connector
Optical Fiber Specifications	Multi-mode, the maximum distance is 2km Single mode, the maximum distance is 15km
Physical Properties	
Module Size (W*H*D)	36.2*80*92.33 ±0.5mm
Installation Method	Rail installation

Chapter 6 IO Unit

6.1 Power Module

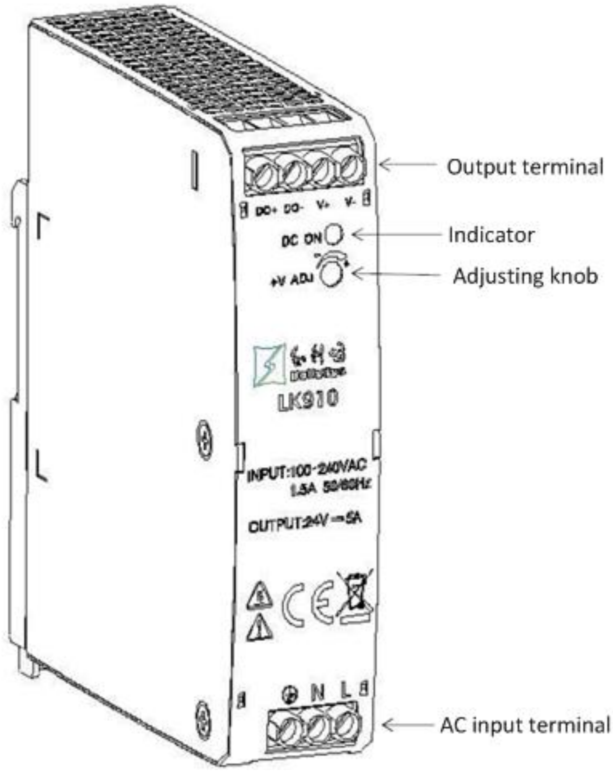
6.1.1 LK910 24VDC Power Module

6.1.1.1 Basic Features

- Input voltage: 100VAC~ 240VAC, switch selection
- Output voltage: 24VDC
- Input-output isolation
- Rated power: 120W
- 1 + 1 redundancy
- Output short circuit protection
- Output over-temperature protection
- Output overload
- Output status inquiry

LK910 achieve 100VAC~ 240VAC to 24VDC DC conversion, input and output isolation, output rated power 120W. LK910 has output short circuit protection & automatic recovery after the power fault is eliminated. An output status inquiry function, state switch is turned on when the power output is normal, Otherwise off. Provide the interface for remote diagnosis power state.

LK910 has modular design with overall structure of aluminum material, strong anti-seismic & anti – interference ability.

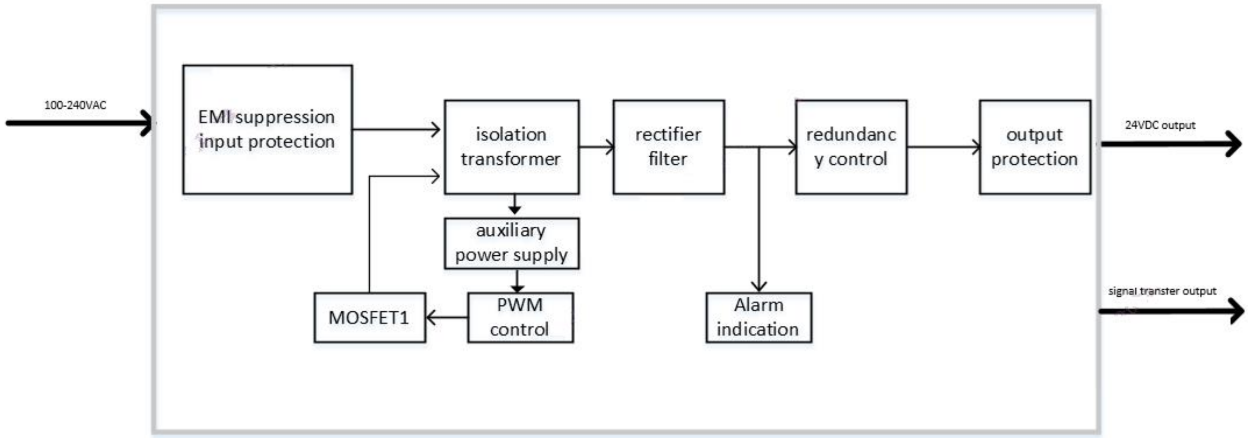


LK910 Wiring Terminals and Indicator

6.1.1.2 Operating Principle

LK910 power input 100VAC~ 240VAC, and output 24VDC after EMI suppression and rectifier circuit.

AC input part in LK910 includes the input protection, input rectifier, noise filtering circuit to complete AC power rectification and filtering, while suppressing electromagnetic interference coming from the electrical network to ensure that the AC input is not be interfered by electromagnetic. Then, control circuitry outputs 24VDC after overvoltage protection, current-limiting protection. And display the working status of the power module by the alarm output terminal "DO +", "DO-". Alarm output circuit is achieved by the optical coupling devices, the optocoupler is turn on when the power supply is normal, while output indicators is on. The optocoupler is turn off when the output is owed-voltage, while the output lights is off.



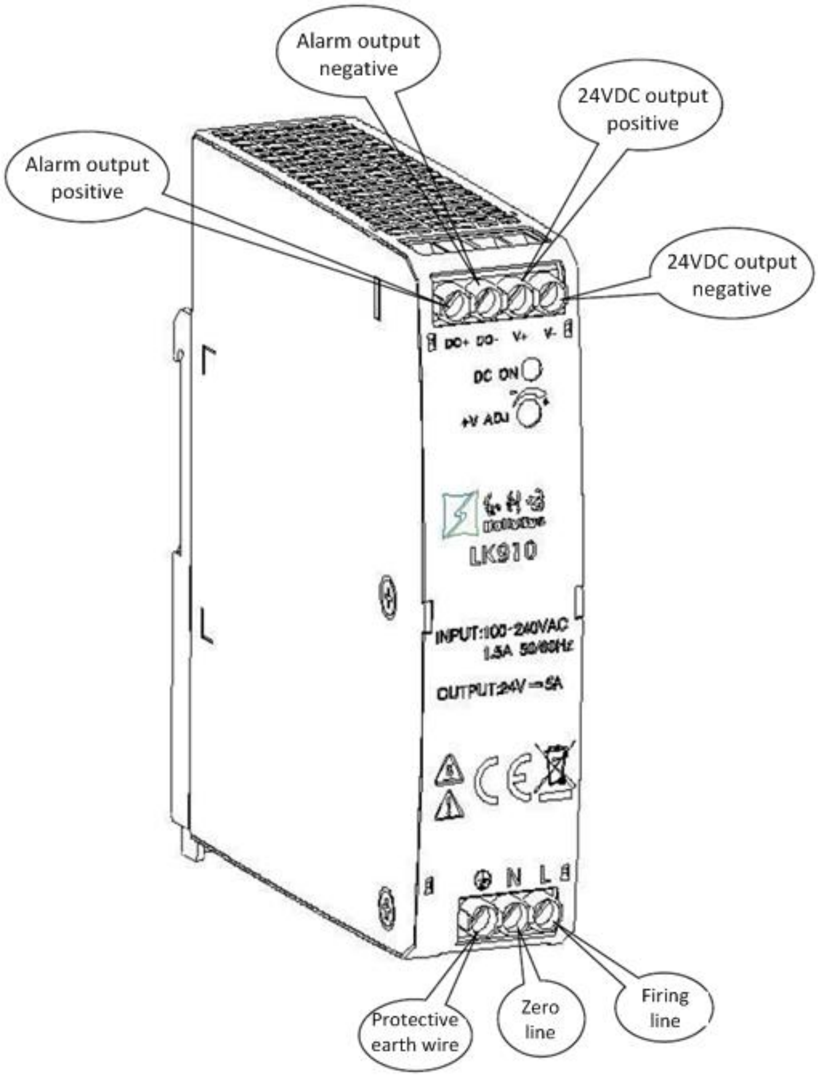
LK910 Schematic Diagram

6.1.1.3 Instructions for using

6.1.1.3.1 Indicator and Terminal

After the module power up, the green LED indicator on the front panel displays the current working state. The indicator light is on when power supply is normal.

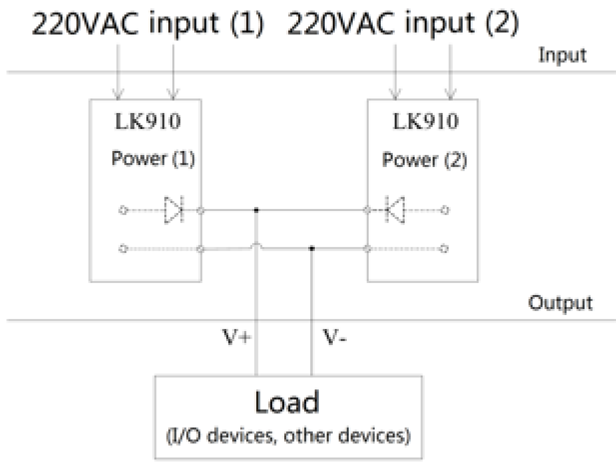
Terminals are located in upper and lower ends on the module. The 24VDC output terminals and the alarm output terminals in the upper end, the AC input terminals in the lower end. The specifically definition is shown in Figure.



LK910 Wiring Terminals Instruction

6.1.1.3.2 Parallel redundancy

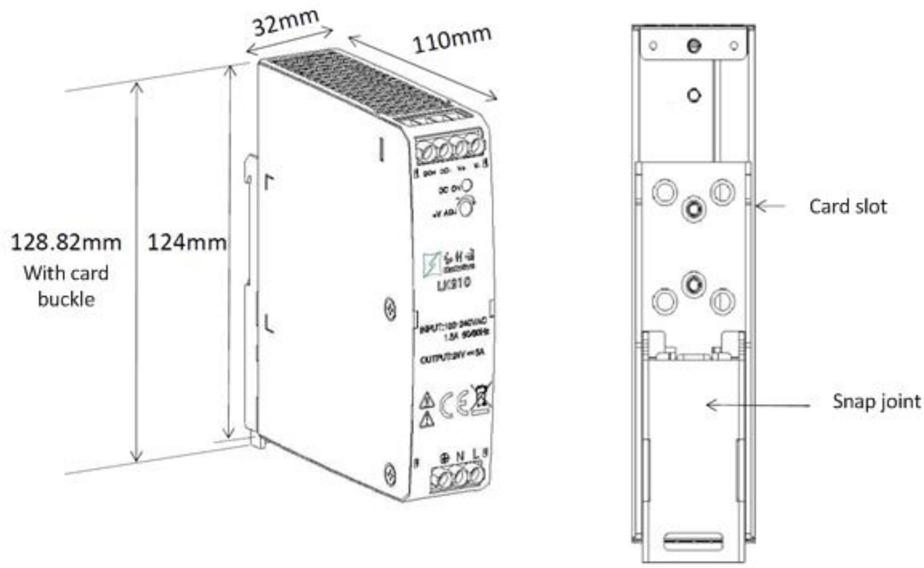
For improving the reliability of the system, LK910 power supply can be configured as two or more parallel operation to reduce the fault caused by the power supply. Dual redundancy power is achieved by using rectifier diodes. The undisturbed switching and replacing of the power is achieved in the 1 + 1 mode, redundancy power supply configuration is shown in Figure.



LK910 Power Redundancy Configuration

6.1.1.4 Installation Dimension

The LK910 power module adopt standard rail mounting, with mounting slot on the back, installation dimensions as shown in Figure 90.



LK910 Appearance Dimension Diagram

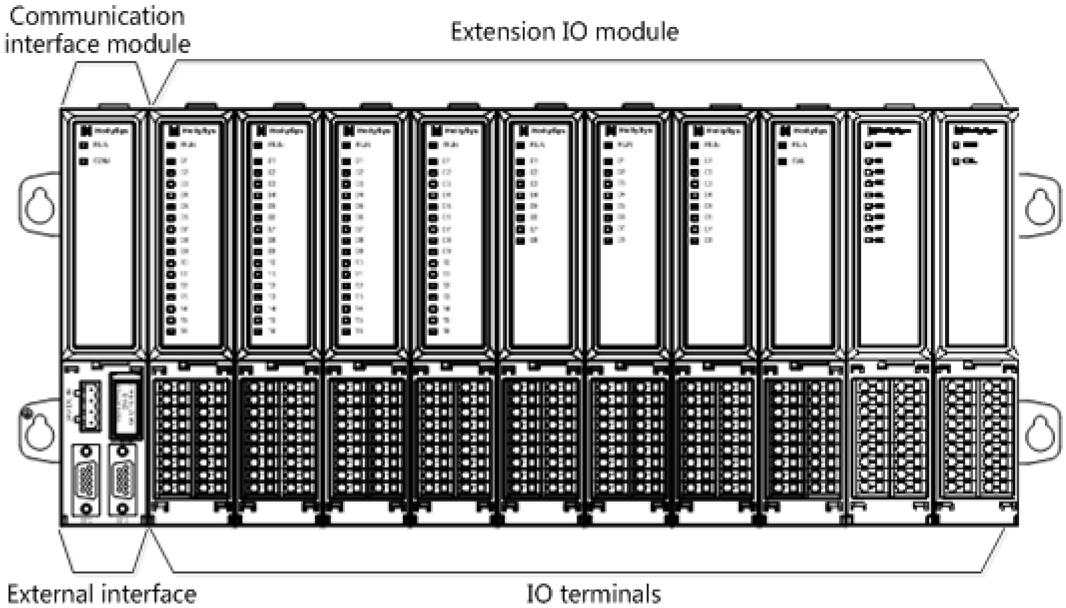
6.1.1.5 Technical Specifications

LK910 24VDC Power Module	
Input	
Maximum input voltage range	85VAC～264VAC
input voltage range	100 VAC~240 VAC
Input frequency range	47 Hz~63 Hz
Output	

LK910 24VDC Power Module	
Rated output	24 VDC±2%
Rated output current	5 A
rated power	120 W
Ripple (Including noise)	<120mV
Load adjusting rate	<±2%
Voltage adjusting rate	<±2%
Temperature drift coefficient	<±0.03%℃
Conversion efficiency	>80%
Power down holding time	>30mS
Cooling method	Natural cooling
1+1 parallel redundancy	Supported
Output short circuit protection	Long term short circuit and self recovery
Power fault state output	The state switch is turned on when power is normal, otherwise off. state switch is isolated with power
Ouput state indicate	Indicators is on when ouput is normal
insulation	
Insulation resistance	Input and shell: 500 VDC, >100 MΩ Input and output: 500 VDC, >100 MΩ Output and shell: 500 VDC, >100 MΩ
Dielectric Voltage withstan	Input and shell:1500 Vrms, 1 min., leakage current<10 mA Input and output: 3000 Vrms, 1 min., leakage current <10 mA Output and shell: 500 Vrms, 1 min., leakage current <20 mA
Environmental Condition	
Ambient Temperature for Operation	-20℃~+70℃, and full-load output in 70℃
Storage Temperature	-40℃~+85℃
RH	5%~95%, with no condensation
Physical Property	
Module Dimension (W*H*D)	32mm x124mm x110mm （Without buckle）
Installation Pattern	Standard rail mounting
Standards and Certification	
Safety certification	IEC 61010-1, IEC 61010-2-201
EMC	EN61000-4-2
	EN61000-4-3
	EN61000-4-4
	EN61000-4-5
	EN61000-4-6
	EN61000-4-8
	EN61000-4-10
	EN61000-4-11
	EN61000-4-12
	EN55032 Class A
	EN61000-3-2 Class A

6.2 Extension Backplane

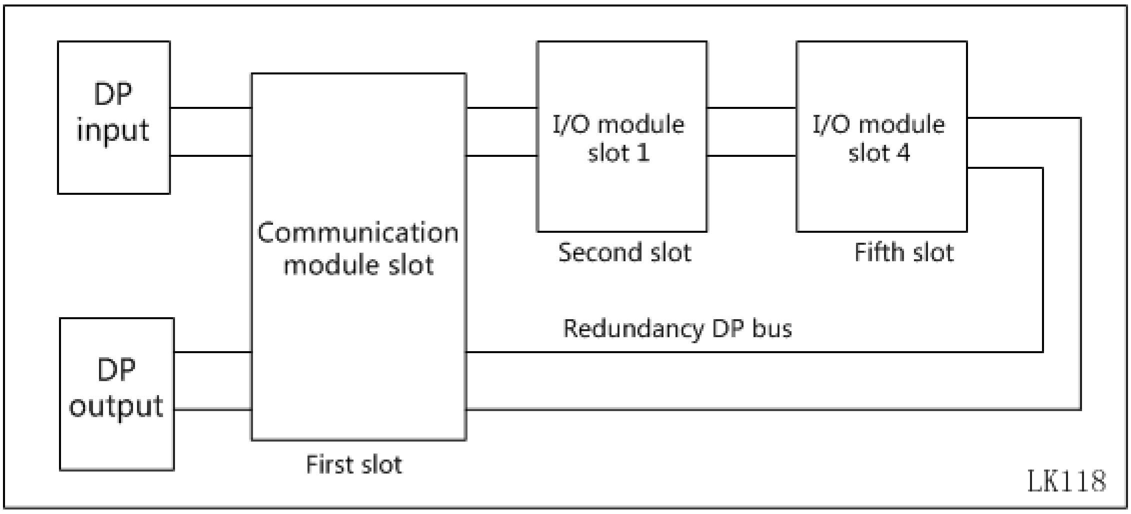
The extension backplane can only install IO module. E.g. LK117 for example, as shown in figure, Slot 1 is the communication module slot. Slots 2~11 are I/O module slot. Each terminal block corresponds to an I/O module, directly connecting to the field signal via an I/O cable.



Structure of LK117 Backplane

As shown in figure, the extension backplane supports the redundant DP bus. It provides the DP bus input and output interfaces and connects to the local backplane for extending the I/O points. In case of multiple extension backplane cascade connection, it shall better adopt serial connection, not allowed to connect multiple extension backplanes to a local backplane.

The extension backplane does not provide the terminal matching resistance for the DP bus, with the matching resistance provided by the communication module.



Internal Structure of Extension Backplane

6.2.1 Interface Specification

The extension backplane interfaces can be divided into power supply interface and communication interface.

6.2.1.1 24 VDC Power Supply Interface

The 24VDC working power supply for the hardware module on the backplane is led in from the power supply interface of the backplane.

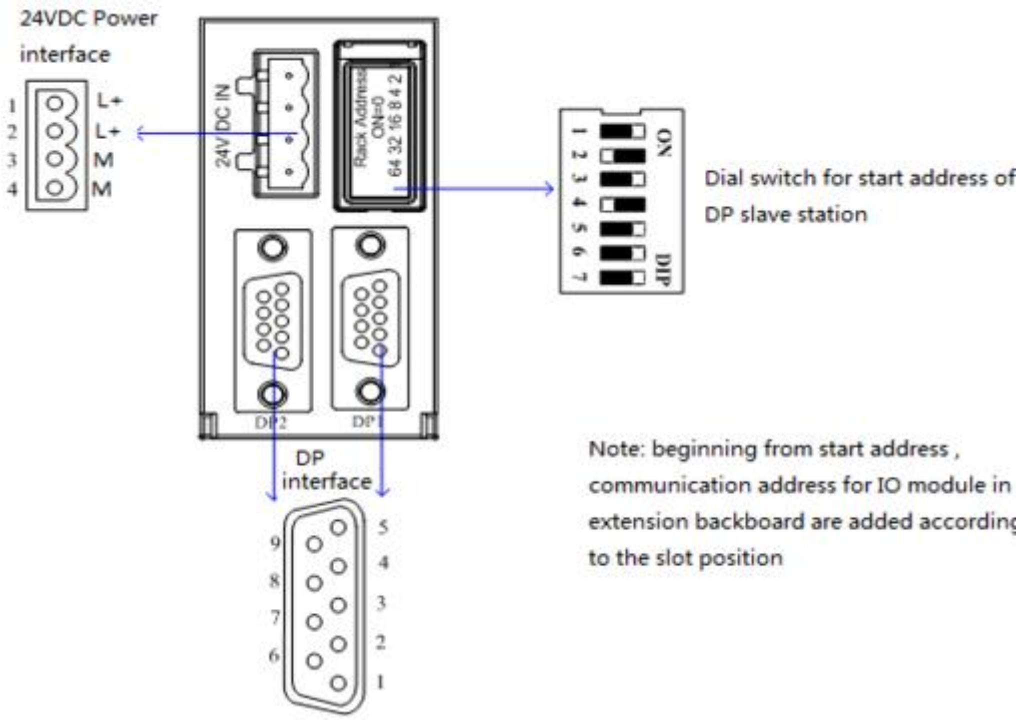
When the power supply is configured as redundant power supply, it needs to support the redundancy function.

Signal Definition of Power Connectors on Extension Backplane

Pin No.	Terminal Identifier	Meaning
1	L+	24V+
2	L+	24V+
3	M	GND
4	M	GND

6.2.1.2 Communication Interface

The I/O module on the extension backplane communicates and exchanges data with the controller module on the local backplane via the Profibus-DP bus interface. The DP bus interface is a DB9 hole receptacle.



Power and Communication Interfaces of LK117 and LK118 Backplanes

6.2.1.3 Profibus-DP Bus Interface

The DP bus interface realizes the communication between the I/O module on the backplane and the controller on the local board, adopting two DB9 hole receptacle connectors.

ⓘDuring wiring, it can work with the LKA104 Profibus-DP bus connector, leading in and out the DP cable via LKA104.

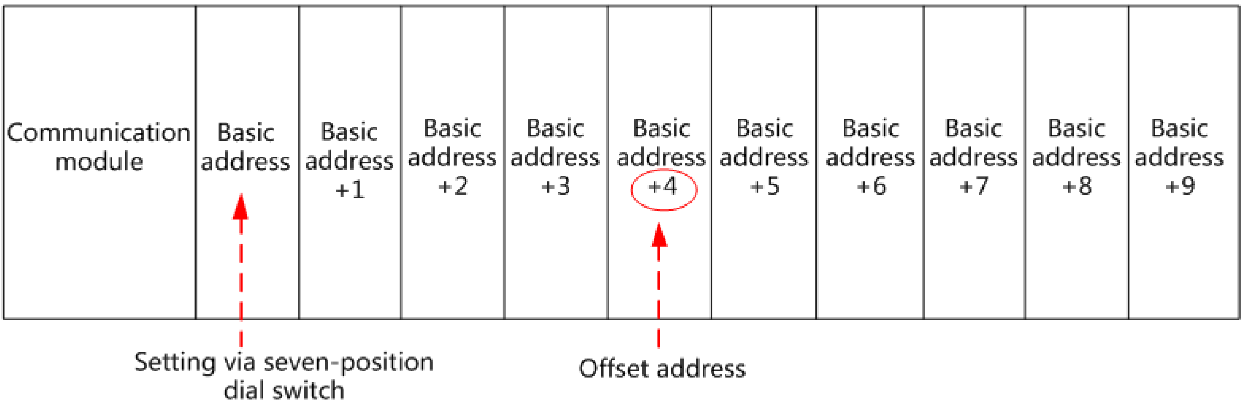
Signal Definition of DP Connectors on LK117 Backplane

Pin No.	Signal Name	Meaning
1	Null	Null
2	DPIN+	DP incoming line, signal positive
3	DPOUT+	DP outgoing line, signal positive
4	Null	Null
5	GND	GND
6	+5V	5VDC, provided by the communication module
7	DPIN-	DP incoming line, signal negative
8	DPOUT-	DP outgoing line, signal negative
9	Null	Null

6.2.2 Communication Address

The communication address of the I/O module consists of the backplane base address and the backplane offset address.

Taking LK117 for example, the base address is the communication address of the first I/O module from the left, which is set via the 7-bit dial code DIP switch on the backplane; the backplane offset addresses of the 2nd~11th I/O slave station modules are 1~10, as shown in figure.



Communication Address Allocation of I/O Module on LK117 Backplane

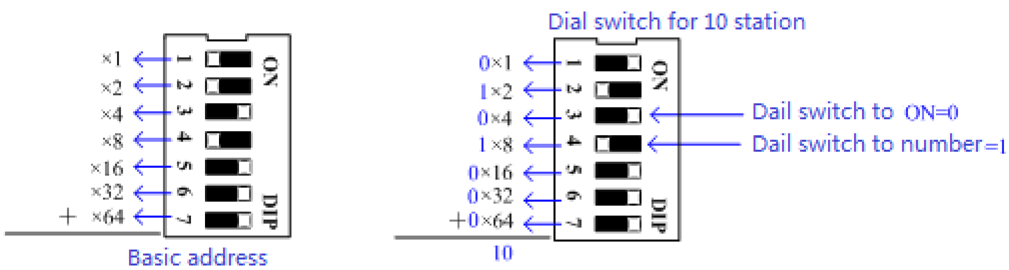
When certain bit of the dial code on the DIP switch is turned to the **ON** side, the bit is 0; when turned to the numeric side, the bit is 1. The 7-bit dial codes are combined into a binary number from high to low. Its corresponding decimal number is the base address of the backplane.

See the following for the conversion:

Base Address=64×K7+32×K6+16×K5+8×K4+4×K3+2×K2+1×K1

Notably, Ki (i=1~7) indicates the status of the 1th dial code

For example, the DIP switch is set successively from high to low as 0001010, the corresponding decimal number 10 is the base address of the extension backplane, and then the communication addresses of the I/O modules on the LK117 backplane are successively: 10, 11, 12, 13... 19.



Setup of Backplane Base Address

- In case of multiple backplane cascade connection, it cannot set the communication addresses repeatedly.
- When LK232 module is installed in communication slot, the base address cannot be set to 0.

6.2.3 LK117 11-slot Extension Backplane

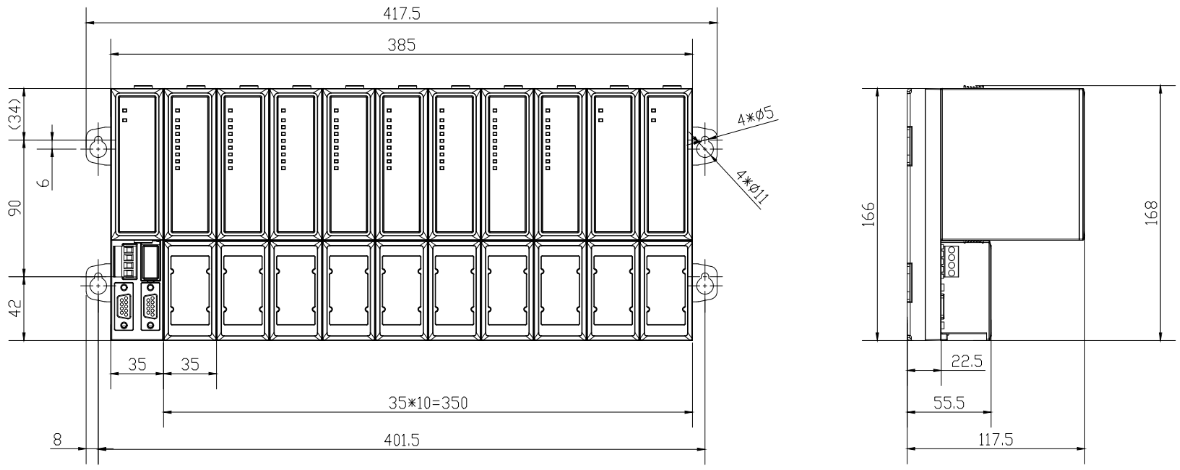
6.2.3.1 Composition

- communication slot, 10 I/O slots
- Dial code of the base address of the slave station
- Redundant PROFIBUS-DP bus interface, DB9 hole receptacle
- To support the cascade connection of the extension backplane
- 24 VDC system power supply interface, 4-pin receptacle
- Shrapnel terminals, pluggable

6.2.3.2 Installation Dimension

Apart from power supply, all other LK hardware modules are installed on the backplane.The LK backplane is surface mounted, fastened to the mounting surface with M4 screws.

All the module widths on the extension backplane are 35 mm. Therefore, for a LK117 backplane, the horizontal spacing between the crew hole centers on both sides is (35×11+16.5) mm = 401.5 mm, with the vertical spacing between the screw hole centers on the same side of 90 mm, as shown in figure.



Installation Dimension of LK117 Backplane

6.2.3.3 Technical Specifications

LK117 11-slot Extension Backplane
Slot and Interface

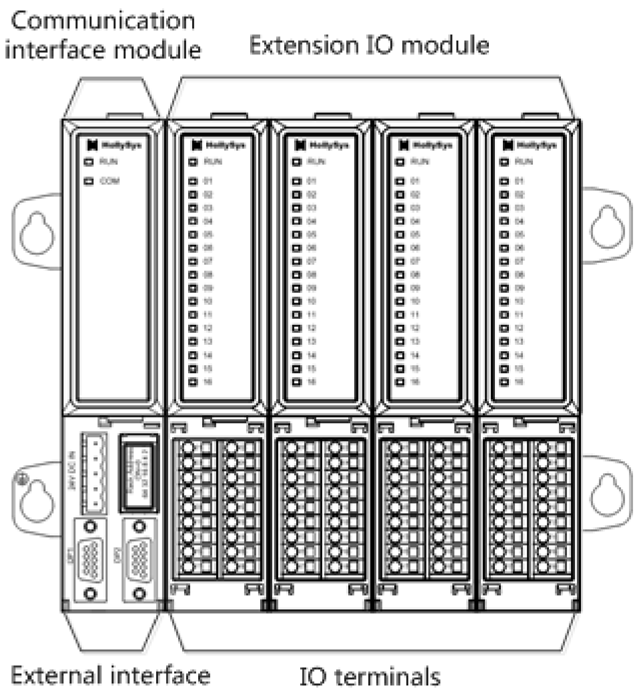
LK117 11-slot Extension Backplane	
Number of Slots	11 slots (1 communication slot, 10 I/O slots)
PROFIBUS-DP Interface	DB9, hole receptacle, receptacle duplex
System Power Supply Interface	4-pin receptacle, connected to 24 VDC system power supply
Isolated and voltage withstand	
Channel-to-channel	≥ 1000 VAC@1 min, leakage current: 5 mA
Channel-to-system	≥ 1000VAC@ 1min, leakage current: 5 mA
Electrical Specification	
Input voltage	24 VDC (-15%~+20%)
Terminal Matching Resistance	None, can be provided by the communication module
Physical Property	
Installation Mode	Plane installation
Module Dimension (W*H*D)	385 mm×166 mm×55.5 mm
Enclosure Protection Rating	IEC60529 IP20
Weight	1740 g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.2.4 LK118 5-slot Extension Backplane

6.2.4.1 Composition

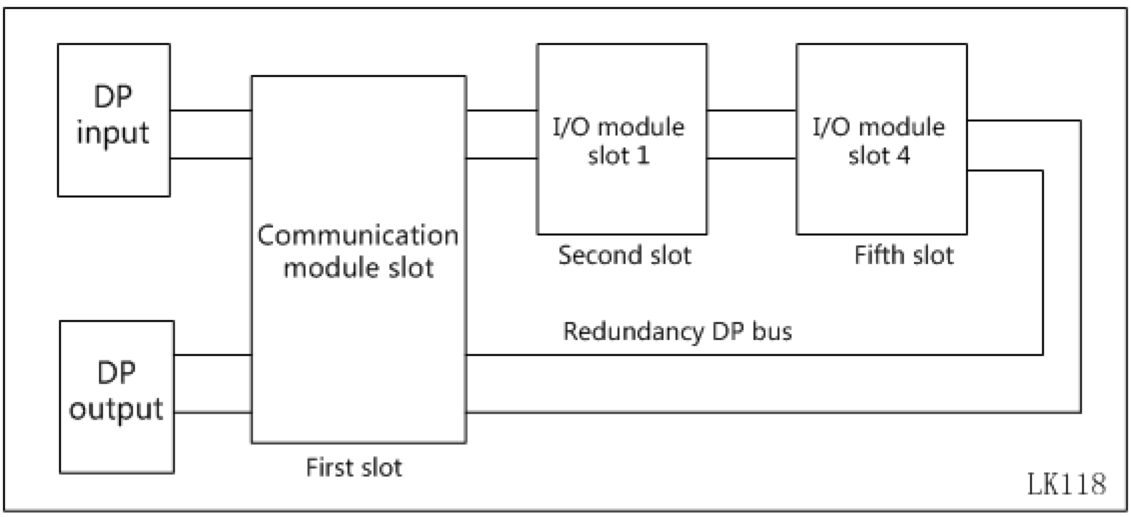
- 1 communication slot, 4 I/O slots
- Dial code of the base address of the slave station
- Redundant PROFIBUS-DP bus interface, 9-pin Type-D receptacle
- 24VDC system power supply interface, 4-pin receptacle
- To support the cascade connection of the extension backplane
- Pluggable & Shrapnel I/O terminals

LK118 is a 5-slot extension backplane, as shown in figure, from the left, Slot 1 is a communication module slot, installed with a communication module. Slots 2~5 are I/O module slots, installed with 4 I/O modules of the DP bus interface. The corresponding terminal beneath the I/O module slot is used to connect the field I/O module.



Structure of LK118 Backplane

Refer to figure for the internal structure of the LK118 extension backplane.

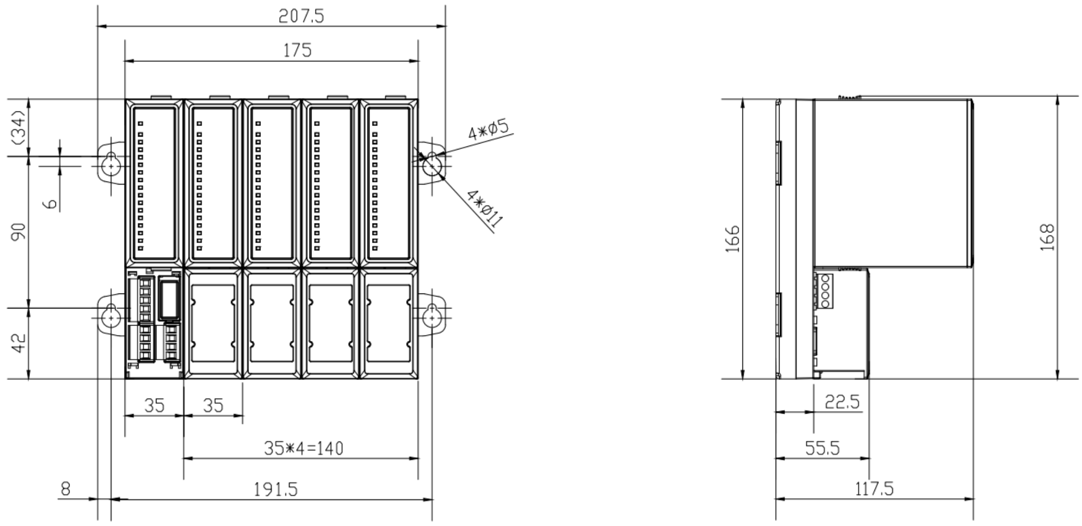


Internal Structure of Extension Backplane

6.2.4.2 Installation Dimension

Apart from power supply, all other LK hardware modules are installed on the backplane. The LK backplane is surface mounted, fastened to the mounting surface with M4 screws.

All the module widths on the extension backplane are 35 mm. Therefore, for a LK118 backplane, the horizontal spacing between the crew hole centers on both sides is (35×5+16.5) mm= 191.5 mm, with the vertical spacing between the screw hole centers on the same side of 90 mm, as shown in figure.



Installation Dimension of LK118 Backplane

6.2.4.3 Technical Specifications

LK118 5-slot Extension Backplane	
Number of Slots	
Number of Slots	5 slots (1 communication slot, 4 I/O slots)
PROFIBUS-DP Interface	DB9, hole receptacle, receptacle duplex
System Power Supply Interface	4-pin receptacle, connected to 24 VDC system power supply
Isolated and voltage withstand	
Channel-to-channel	≥500 VAC@1 min@5 mA
Channel-to-system	≥500 VAC@1 min@5 mA
Electrical Specification	
Input voltage	24 VDC (-15%~20%)
Terminal Matching Resistance	None, can be provided by the communication module
Physical Property	
Installation Mode	Plane installation
Module Dimension (W*H*D)	210 mm×166 mm×55.5 mm
Enclosure Protection Rating	IEC60529 IP20
Weight	880 g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.3 Communication Module

6.3.1 LK231 Profibus-DP Communication Transfer Module

6.3.1.1 Basic Features

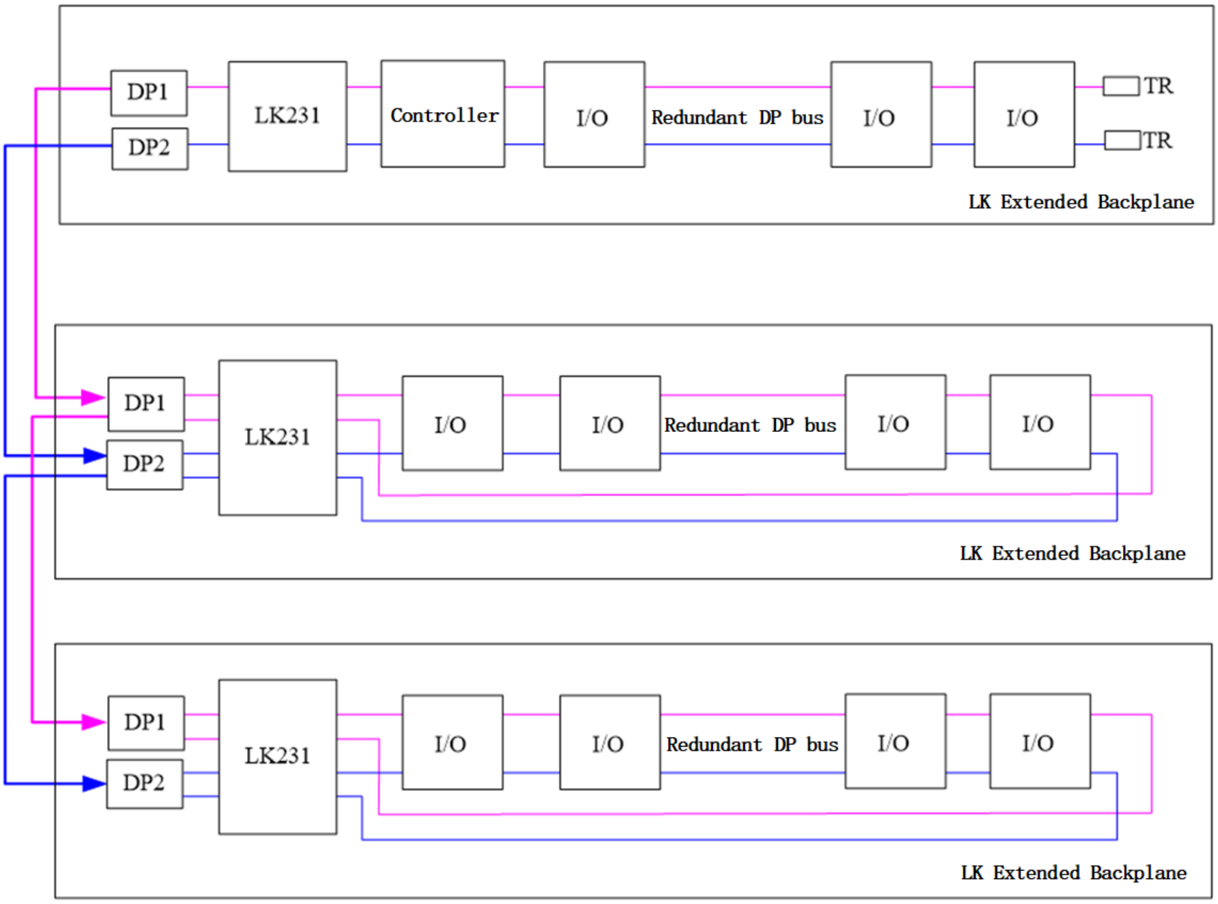
- Provides terminal matching resistors for the Profibus-DP bus
- Switch the Profibus-DP bus to the next backplane
- Mount on the left side of the local backplane and extended backplane slot 1
- Support hot-swap

LK231 is the Profibus-DP communication transfer module, the main function is to convert the system 24VDC to 5VDC, provide Profibus-DP and high-speed local backplane bus active terminal match the required power supply, and transfer the DP signal of the last backplane to the next extended backplane. There are jumpers inside the module, which can be used to set whether the active matching resistance network is configured for the DP bus.

The LK231 module does not require configuration.

6.3.1.2 Operating Principle

The DP bus of the local backplane is connected to the LK231 module of the extended backplane through a terminal connector, and then transferred to the DP bus of the extended backplane through the LK231 module, thereby establishing communication between the controller and the extended I/O module.



Switch the DP bus to the extended backplane

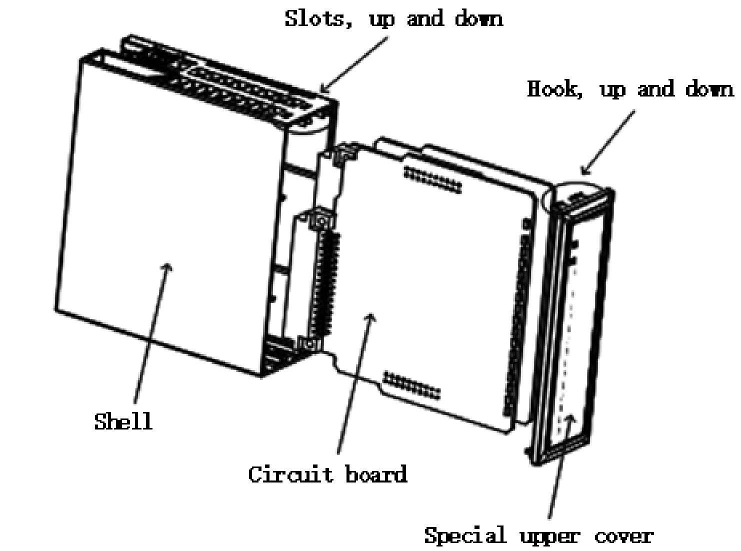
6.3.1.3 Terminal Matching

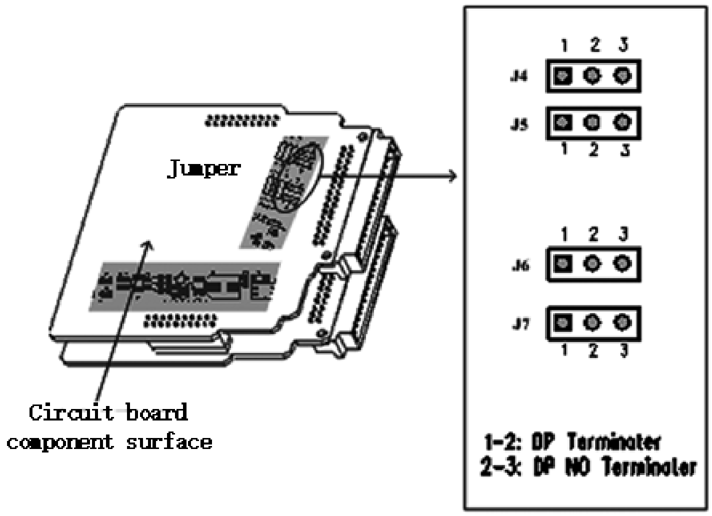
LK231 module through the internal jumper settings, you can choose whether to provide active DP bus terminal resistance network. The jumper is set to no terminal matching resistance by default. User can set it according to the site situation. Jumper 1, 2 short, the terminal matching connection; jumper 2, 3 short, the terminal matching is invalid.

The jumper is located on the printed circuit board inside the LK231 module and by default does not connect the terminal matching resistor. To reset the jumper, remove the top cover of the LK231 module and remove the printed circuit board.

- ⚠Note: Do not touch the IC chip and the PCB surface during the process of removing the PCB, setting the jumper wire and putting it back to the PCB to prevent electrostatic damage. If possible, it is best to take anti-static gloves or other anti-static measures, unconditional careful operation, can only use hand to hold the board board edge operation.

The upper end and the lower end of the upper cover of the module are respectively provided with a pair of hooks, which are embedded in the card groove of the corresponding position of the module shell. When disassembly, first use a screwdriver to tilt the hook from the card slot, remove the upper cover, and then pull out the printed circuit board.



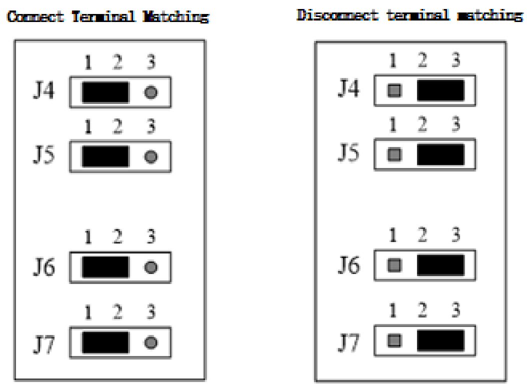


The jumper is on a circuit board inside LK231

There are four groups of jumpers, J4, J5, J6, J7, set to the same state.

1、2 Short connection, connect terminal matching resistance.

2、3 Short connection, disconnect terminal matching resistance (default).



Connection and disconnection of LK231 jumper

6.3.1.4 Indicators

The indicator lamp definition for the LK231 module is shown in the table. RUN and COM lights up when the controller sends normal packets.

Definitions of LK231 Indicators

RUN (green)	COM (yellow)	Description
Off	Off	The module is no power or damaged.
Flash	Off	Incoming communication not established or communication error
On	On	Communication set up and DP network is working

6.3.1.5 Technical Specifications

LK231 Profibus-DP Bus Repeater Module	
Backplane Power Supply	
Operating Voltage	24VDC (-15%~+20%)
Power consumption	50 mA @24 VDC
Signal channel	
Data format	For physical layer forwarding and matching Profibus-DP only, do not send any data to DP bus
Communication	
Protocol	PROFIBUS-DP slave, IEC61158-3/EN50170
Hot standby redundancy of communication medium	Supported
Communication rate	9.6 Kbps, 19.2 Kbps, 31.25 Kbps, 45.45 Kbps, 93.75 Kbps, 187.5 Kbps, 500 Kbps, 1.5 Mbps, 3 Mbps, 6 Mbps self-adapting
Physical Property	
Installation Mode	Slot Installation
Installation Position	Communication slots of extension backplane
Protection Key	A5
Module Dimension (W*H*D)	35 mm×100 mm×100 mm
Hot Swapping	Supported
Environmental Adaptability	

LK231 Profibus-DP Bus Repeater Module	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.3.2 LK232 Profibus-DP Bus Repeater Module

6.3.2.1 Basic Features

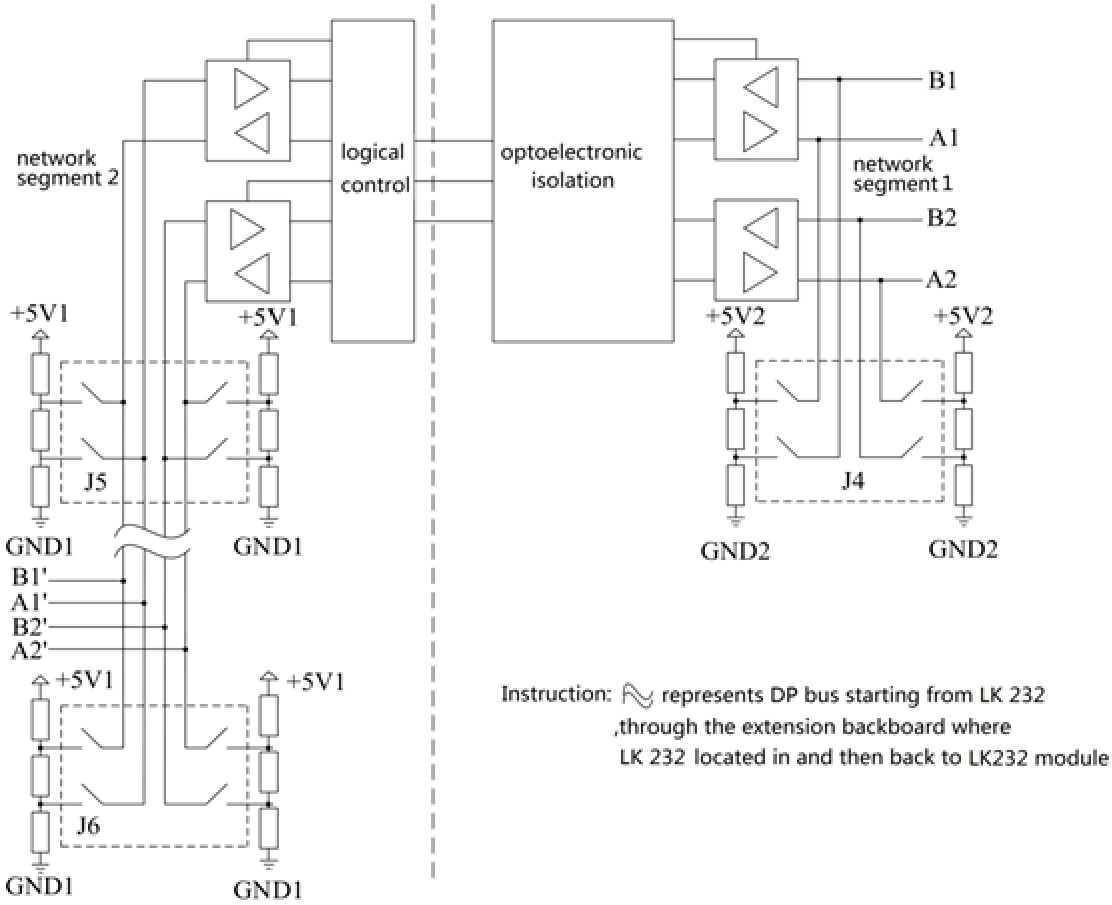
- To extend the physical length of the Profibus-DP bus
- To isolate the two Profibus-DP buses
- Installed on the extension backplane
- To provide the terminal matching resistance for the Profibus-DP bus
- Hot swapping

LK232 Module Schematic Diagram

6.3.2.2 Operating Principle

LK232 is the repeater module of the Profibus-DP bus, installed on the first slot on the left of the extension backplane.

If the transmission distance is too long or load is too high, it can result in weak of transmitted signal on twisted pair. LK232 outputs two DP signals after selecting a normally working one for shaping and amplification from two redundant DP signals, as shown in figure.



Bus Transition Diagram of LK232

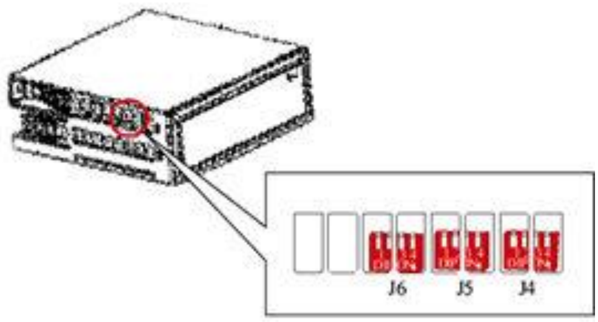
To avoid the interference on the bus from spreading along the whole bus, it can isolate the two segments of the DP bus via the DP bus repeater.

The LK232 module is installed in the far left communication slot of the extension backplane. The protection keys is coded as A5.

DP bus is extended by LK232 with using LKA104 connector together.

6.3.2.3 Terminal Matching

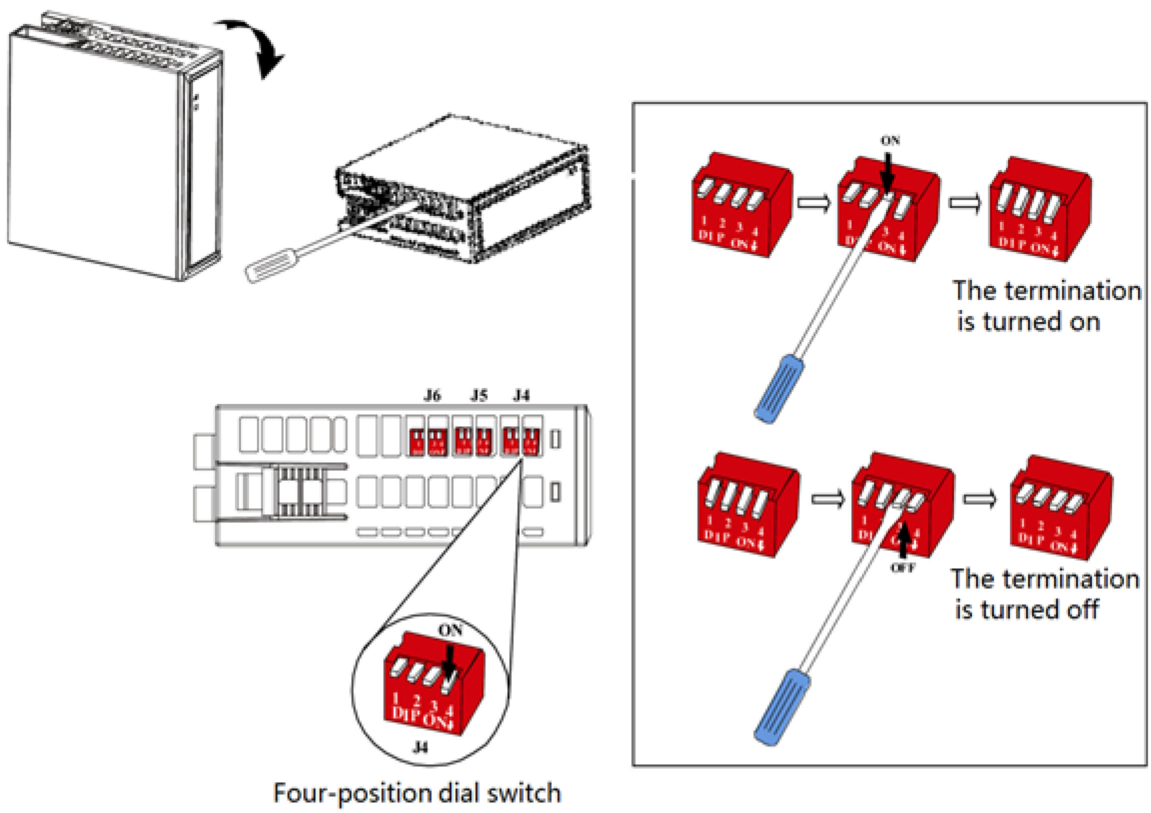
For the built-in terminal matching DIP switch (J4, J5, J6) of LK232, as shown in figure. It can set whether to connect the DP bus with source matching resistor network. The factory setting default is that J4 disconnects terminal matching resistor, J5 and J6 connect the terminal matching resistor .



Position of LK232 Terminal Matching DIP Switch

The DIP switch is located inside the module, it is not required to disassemble the enclosure when changing the position of the switch. Via the heat emission hole of the enclosure, it can conveniently set the position by using a small **flathead** screwdriver, as shown in figure.

The four keys of each DIP switch are turned consistently when setting. When the four keys are dialed downward at the same time, which is in **ON** status, the terminal matching resistance is connected. When the four keys are dialed upward at the same time, which is in **OFF** status, the terminal matching resistance is disconnected.



Setting LK232 Terminal Matching DIP Switch

6.3.2.4 Indicators

The definitions for the Indicators of the LK232 module are shown in table, the **RUN** indicates the communication link between LK232 and the controller module; the **COM** indicator indicates the communication link between LK232 and the extension I/O module.

Definitions of LK232 Indicators

Name	Status	Description
RUN (green)	Flash	No data transmission between LK232 and controller.
	On	Data is being transferredby Profibus-DP bus between LK232 and controller.
	Off	The module is no power or damaged.
COM (yellow)	Flash	Data is being transferred by Profibus-DP bus between LK232 and IO modules . The greater the data volume , the higher the flashing frequency.
	Off	No data transmission between LK232 and IO modules.

- Flashing frequency of the RUN indicator: on for 125ms and off for 125 ms.
- Flashing frequency of the COM indicator: flash once when transmitting 30 data packages each time.

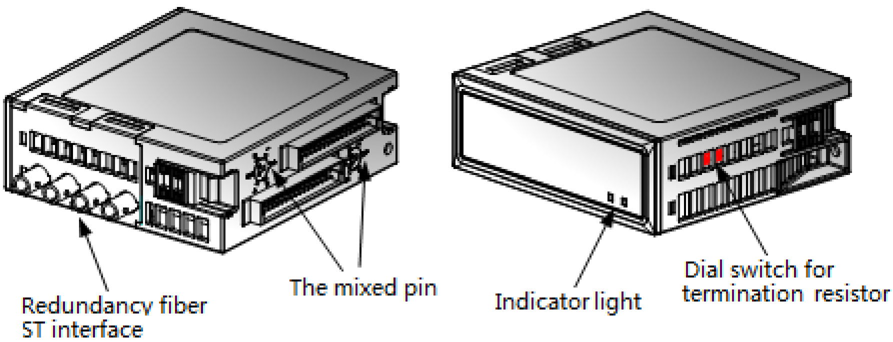
6.3.2.5 Technical Specifications

LK232 Profibus-DP Bus Repeater Module	
Backplane Power Supply	
Operating Voltage	24VDC（-15%~+15%）
Power consumption	60 mA max.@24 VDC
Isolation Voltage	
Network Segments 1 and 2	To test for 1 minute based on 500 VAC, with a leaking current 5 mA
Communication	
Protocol	Profibus-DP
Dual-network Redundancy	Supported
Communication rate	9.6 Kbps, 19.2 Kbps, 31.25 Kbps, 45.45 Kbps, 93.75 Kbps, 187.5 Kbps, 500 Kbps, 1.5 Mbps, 3 Mbps, 6 Mbps self-adapting
Physical Property	
Installation Mode	Slot Installation
Installation Position	Communication slots of extension backplane
Protection Key	A5
Module Dimension (W*H*D)	35 mm×100 mm×100 mm
Hot Swapping	Supported
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.3.3 LK233 Profibus-DP Bus Optoelectronic Transceiver

6.3.3.1 Basic Features

- To extend the transmission distance of the Profibus-DP bus
- Dual redundant transmission
- To support multi-mode glass fiber (6.25/150 um or 50/150 um), ST interface
- To provide the terminal matching resistance
- Installed in the I/O slot of local backplane or the extension backplane
- Hot swapping



External View of LK233 Module

LK233 is the optoelectronic transceiver module of the Profibus-DP bus. It is applied to special engineering fields requiring protection against electromagnetic interference, lightning, chemical corrosion and long-distance transmission, etc. LK233 interconverts the opto-electronic transmission media of the DP bus network in the physical layer, extends the physical length of the DP bus, thus ensuring the security and validity of data transmission.

LK233 provides two optical fiber channels, which can realize the redundant transmission of DP optical fibers.

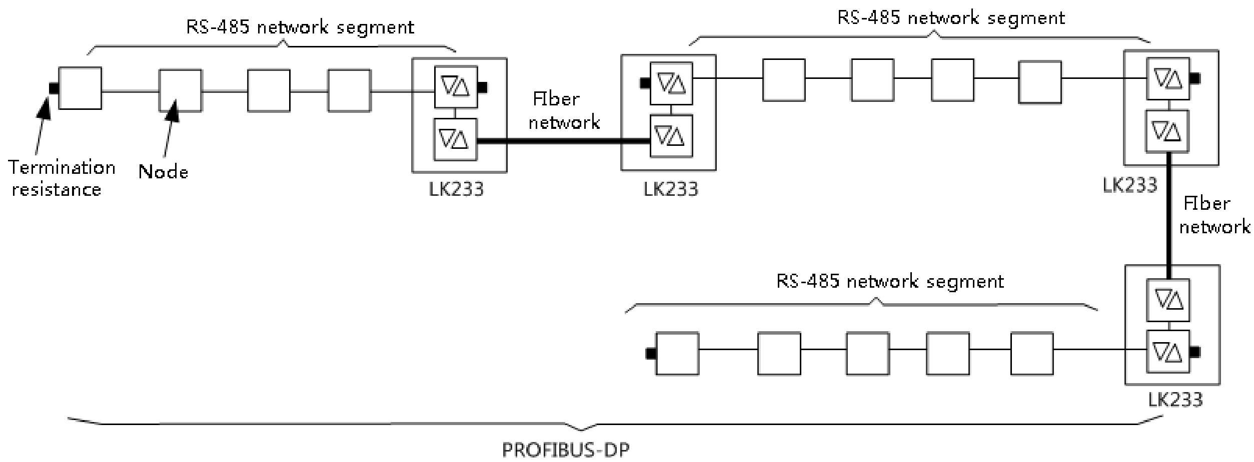
LK233 is installed in the I/O slot of the extension backplane, with the protection key coded as A5. The LK232 repeater module is installed in the communication slot of the backplane, used jointly with LK233.

The LK233 modules are used in pairs, realizing data exchange and communication between the controller module and the remote I/O module. The near-end LK233 module converts the electrical signal of the controller module into an optical signal, then sends it to the far-end LK233 module via optical fiber. The far-end LK233 module restores the received optical signal into an electrical signal, then sends it to the I/O module. Inversely, the far-end LK233 module converts the electrical signal of the I/O module into an optical signal, then sends it to the near-end LK233 module via optical fiber. The near-end LK233 module converts it into an electrical signal and then uploads it to the controller module.

In the network system, upon each access of a LK233 module pair, a new network segment or link is created. LK233 can divide the Profibus-DP bus into multiple network segments. Refer to figure for the basic network topology structure. Both ends of the electrical signal network segment transmitted by each RS-485 are connected to a terminal resistance. The terminal resistance at one end is connected (defaulted to be disconnected) via the DIP switch inside LK233. The terminal resistance at the other end is provided by the communication module (defaulted to be disconnected).

A LK233 module can drive multi-mode glass fiber for up to 5km. It can support up to a 4-segment cascade connection, with 4-pair (8) LK233 modules connected to 5 backplanes, based on the max. extension communication distance 4×5 km＝20 km.

The optoelectronic transceiver module of the LK233 module requires no configuration. It can be used directly and occupies one I/O slot. It occupies one node in terms of electrical specification, without occupying a logic node. However, since the slave station addresses of the backplane are allocated in sequence, the LK233 module still occupies a slave station address.



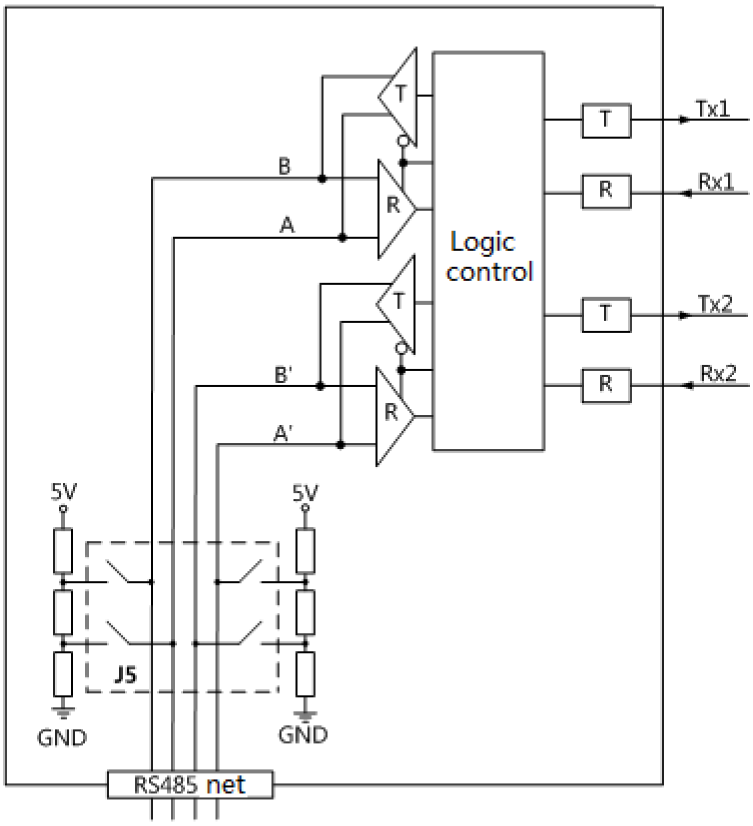
Network Topology Structure Connected with Optical Fiber

6.3.3.2 Operating Principle

As shown in figure, LK233 outputs two DP optical signals after selecting a normally working one for photoelectric conversion from two redundant DP electrical signals.

When sending data, the DP electrical signal is transmitted from the DP bus on the backplane. It is converted into an optical signal and transmitted via optical fiber. When receiving data, the DP optical signal is transmitted from the optical fiber receiver. It is converted into an electrical signal and then transmitted to other I/O modules via the DP bus on the backplane.

DIP Switch J5 is used to connect the terminal matching resistance, defaulted to be disconnected.



Internal Structure Diagram of LK233

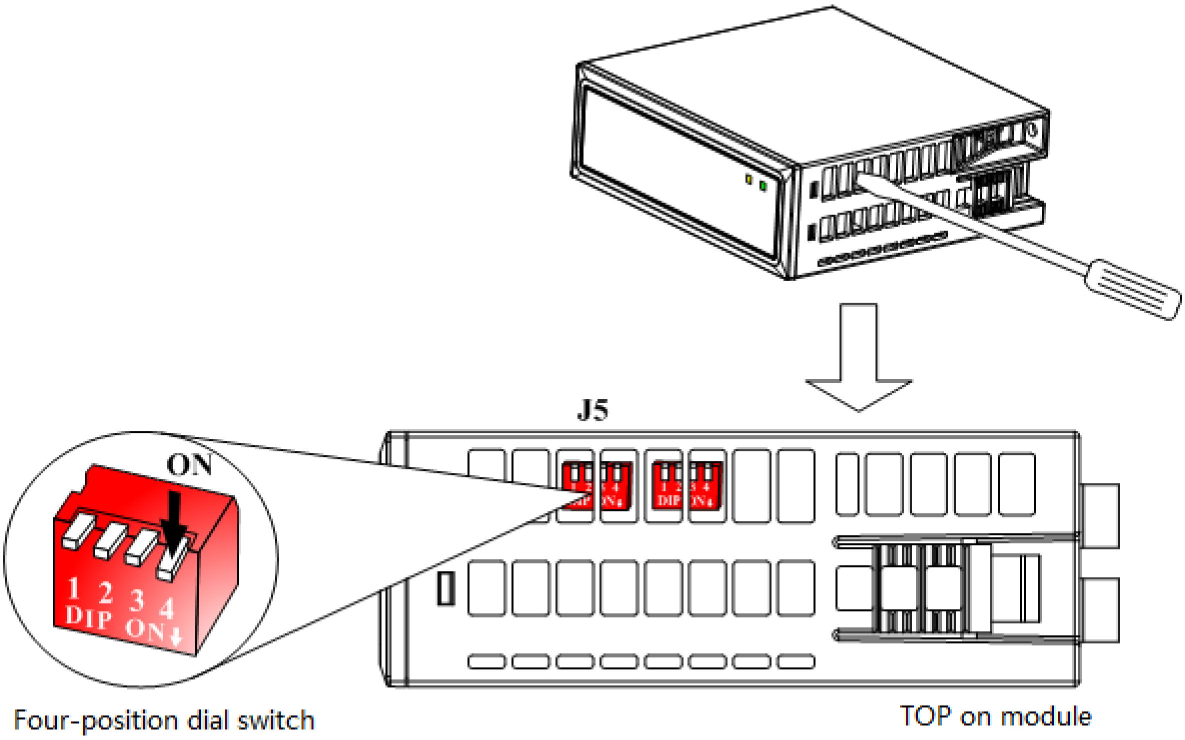
6.3.3.3 Terminal Matching

For the built-in terminal matching DIP switch (J5) of LK233, it can select whether to connect the Profibus-DP bus with an active matching resistance network or not.

The DIP switch is located in the module, defaulted as not to be connected with the terminal matching resistance. It is unnecessary to disassemble the enclosure when changing the position of the switch. Via the heat emission hole at the top enclosure of the module, it can conveniently set the position by using a small flathead screwdriver.

The four keys of the DIP switch are turned consistently when setting. When the 4 keys are dialed downward at the same time, which is in **ON** status, the terminal matching resistance is connected. When the 4 keys are dialed upward at the same time, which is in **OFF** status (default), the terminal matching resistance is disconnected.

DIP Switch J6 on the right of DIP Switch J5 is a reserved switch and requires no settings. It can just hold the default status.



Position of LK233 DIP Switch

6.3.3.4 Indicators

Refer to table for the definitions of the Indicators of the LK233 modules. The **RUN** indicator indicates the communication link between LK233 and the controller module. The **COM** indicator indicates the communication link between LK233 and the extension I/O module.

Definition of Indicators of LK233

indicator Name	Status	Meaning
RUN (green)	Flash	No data transmission is available for the Profibus-DP bus between LK233 and the controller module
	On	Data transmission is available for the Profibus-DP bus between LK233 and the controller module
	Off	The module is not powered up or damaged.
COM (yellow)	Flash	Data transmission is available to the Profibus-DP bus of between LK233 and the I/O module. The greater the data volume is, the higher the flashing frequency is.
	Off	No data transmission is available for the Profibus-DP bus between LK233 and the I/O module

- Flashing frequency of the RUN indicator: on for 125ms and off for 125 ms.
- Flashing frequency of the COM indicator: flash once when transmitting 30 data packages each time.

6.3.3.5 Wirings

ⓘThe optical fiber port of LK233 is located at the bottom of the module. Wiring cannot be applied to the I/O terminal block under the module slot.

The LK233 module can be used with 62.5/125 or 50/125 um multi-mode glass fiber, as well as plastic or ceramic ST type connectors, with a wave length of 1300 nm. The max. length of an optical cable section is 5km, supporting multi-section cascade connection.

The optical fiber type is selected by the user according to the network environment. It can determine the optimal optical fiber type for specifically applied environmental conditions by consulting professional installation personnel.

The optical fiber cables are cross-connected between the two modules, with one end used for transmitting and the other end used for receiving. The transmitting end (TX) is connected to the receiving end of another LK233 module (RX). And vice versa, as shown in figure.

See the following for the steps to connect optical fiber:

(1) Dismantle the protective cap of the module port and keep the protective cap properly for future application.

(2) Plug the optical cable connector into the port by aligning the knob of the optical cable connector with the groove of the module port.

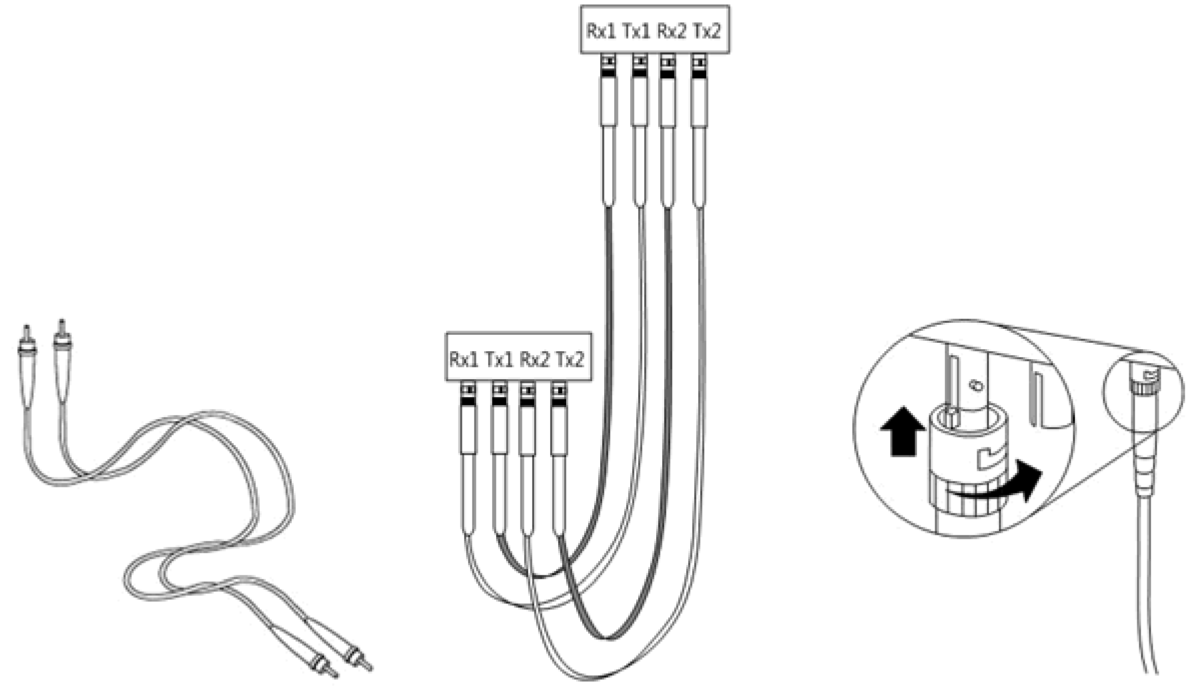
(3) Tighten the optical cable connector till the bayonet socket lug is locked into place.

(4) Keep the protective cap of a port that is not used on the port to avoid dust.

Definitions of LK233 Cable Ports

Port Identifier	Meaning
TX1	Transmitting end, Channel 1
RX1	Receiving end, Channel 1
TX2	Transmitting end, Channel 2
RX2	Receiving end, Channel 2

The Profibus-DP communication link between two LK backplanes cannot be connected to optical fiber and STP at the same time. When the communication link is changed from STP to optical fiber, the switchover sequence when powered up is: firstly to plug out the STP, disconnect the DP communication, then install the LK233 module to switch to the optical fiber mode successfully.



Optical Fiber Connection of LK233

6.3.3.6 Technical Specifications

LK233 Profibus-DP Bus Optoelectronic Transceiver	
System Power	
Operating Voltage	24VDC (-15%~+15%)
Backplane Current	80 mA max.@24 VDC
Port Characteristics	
Connector Type	ST (ceramic or plastic)
Optical Fiber Type	62.5/125 um or 50/125 um multi-mode glass fiber
Operating Wavelength	1300 nm
Transmission Distance	0~5 km
Drive Capability	
Load Capacity of Optic Terminals	To drive multi-mode glass fiber for up to 5km.
Load Capacity of Electric Terminals	To drive up to 256 LK I/O modules
Number of Cascade Connections	4-segment cascade connection (8 LK 233 modules in total, with a data delay of 1.2 us for every 2 LK233 modules)
Communication	
Protocol	Profibus-DP
Dual-network Redundancy	Supported
Communication rate	9.6 Kbps, 19.2 Kbps, 31.25 Kbps, 45.45 Kbps, 93.75 Kbps, 187. 5 Kbps, 500 Kbps, 1.5 Mbps self-adapting
Physical Property	
Fiber Interface	4 ST connectors
Installation Mode	Slot Installation
Installation Position	I/O slots on the extension backplane

LK233 Profibus-DP Bus Optoelectronic Transceiver	
Protection Key	A5
Module Dimension (W*H*D)	35 mm×100 mm×100 mm
Hot Swapping	Supported
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.3.4 LK234 Ethernet interface module

LK234 is replaced by LK235M compatible. See LK235M for functional description and specifications.

6.3.5 LK235 POWERLINK/PL-LINK interface module

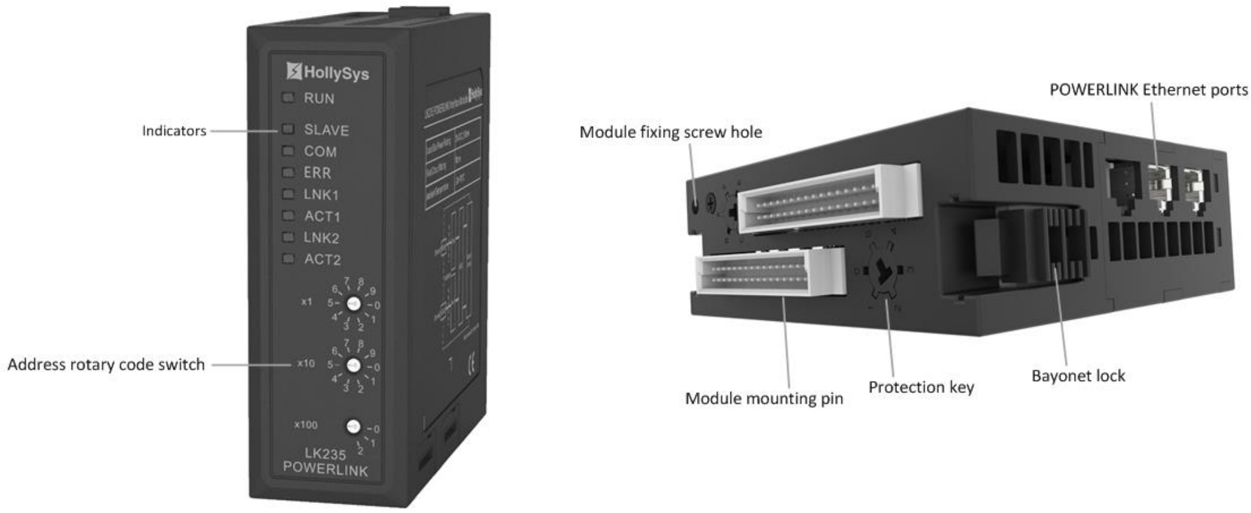
LK235 is a POWERLINK/PL-LINK interface module, used for data forwarding and communication conversion between POWERLINK/PL-LINK master station and I/O slave station. Support POWERLINK/PL-LINK slave protocol. The data interaction between the controller and the I/O module is realized through POWERLINK/PL-LINK Ethernet.

LK235 is installed in the expansion backplane communication slot, It is recommended that the number of LK IO added under each LK235 should not exceed 10, otherwise the communication speed will be affected.

6.3.5.1 Features

- 2 POWERLINK/PL-LINK Ethernet interfaces
- POWERLINK/PL-LINK slave station communication protocol
- Support hot swap
- POWERLINK/PL-LINK bus supports ring network redundancy

6.3.5.2 Appearance



LK235 Module Schematic Diagram

Interface Specification

Interface	Description
Indicators	Indicate module working status
Address rotary code switch	Two 10-bit rotary code switches and 1 3-bit rotary code switch are used to set the address of the LK235 device
Module fixing screw hole	After the module is installed, fix it with screws
POWERLINK/PL-LINK Ethernet Ports	2 POWERLINK/PL-LINK Ethernet ports, used to connect POWERLINK/PL-LINK master station or switch
Module installation pin	Insert into the slot jack of the expansion backplane
Protection key	The unique code set to prevent the module from being damaged by incorrect insertion is fixed at the factory and cannot be changed. The protection key code on the slot must be consistent with the module protection key code
Bayonet lock	One on top and one on bottom. After the module is installed in the slot, the bayonet and expansion backplane buckle are automatically locked When disassembling, you need to press the upper and lower bayonets at the same time to pull out the module

6.3.5.3 Indicators

Instructions to Indicators

Name	Function	Color	Status	Description
RUN	Indication of operating pattern	Green	On	The module is normal
			Off	The module is not powered on or the module is damaged
SLAVE	Communication status indication with POWERLINK/PL-LINK master station	Green	On	The communication between the module and the POWERLINK/PL-LINK master station is normal
			Slow flashing	Abnormal communication between module and POWERLINK/PL-LINK master station
COM	Communication status indication with I/O slave	Yellow	On	Normal communication with all I/O modules
			Fast	Communication with one of the I/O is abnormal, at this time, at least one I/O module is offline

Name	Function	Color	Status	Description
			flashing	
			Slow flashing	DP side configuration data is not received
			Off	Receive DP side configuration data, but communication with all I/O is abnormal, at this time all I/O modules are offline
ERR	Fault status indication	Red	On	2 POWERLINK/PL-LINK Ethernet or 2 DP cannot communicate
			Off	No failure of the module
LNK1	Indication of connecting POWERLINK/PL-LINK Ethernet interface 1	Green	On	POWERLINK/PL-LINK Ethernet interface has been successfully connected
			Off	POWERLINK/PL-LINK Ethernet interface is not connected
ACT1	Indication of receiving and sending data via POWERLINK/PL-LINK Ethernet interface 1	Yellow	On	POWERLINK/PL-LINK Ethernet interface is sending and receiving data
			Off	POWERLINK/PL-LINK Ethernet interface does not send or receive data
LNK2	Indication of connecting POWERLINK/PL-LINK Ethernet interface 2	Green	On	POWERLINK/PL-LINK Ethernet interface has been successfully connected
			Off	POWERLINK/PL-LINK Ethernet interface is not connected
ACT2	Indication of receiving and sending data via POWERLINK/PL-LINK Ethernet interface 2	Yellow	On	POWERLINK/PL-LINK Ethernet interface is sending and receiving data
			Off	POWERLINK/PL-LINK Ethernet interface does not send or receive data

- Fast flashing: 4 Hz, on for 125 ms, and off for 125 ms.
- Slow flashing: 1Hz, on for 500ms, and off for 500ms.

6.3.5.4 Set Device Address

6.3.5.4.1 Concept

Set the device address through the 3 rotary switches on the front panel of the LK235 POWERLINK/PL-LINK interface module. The ones place and tens place are 10-bit rotary code switches, and the hundreds place is 3-bit rotary code switches. Device address=100×setting value of hundreds place rotary code switch+10×setting value of tens place rotary code switch+setting value of ones place rotary code switch, the setting range is 1~239.

When configuring the LK235 device address in the AutoThink software, please keep it consistent with the actual dialing value.

Please set the device address before powering on the module. If you set the rotary code switch address when the module is powered on, you need to restart the module to make the address take effect.

6.3.5.4.2 Requirements

- The LK235 module has been installed

■ Prepare a flat-blade screwdriver

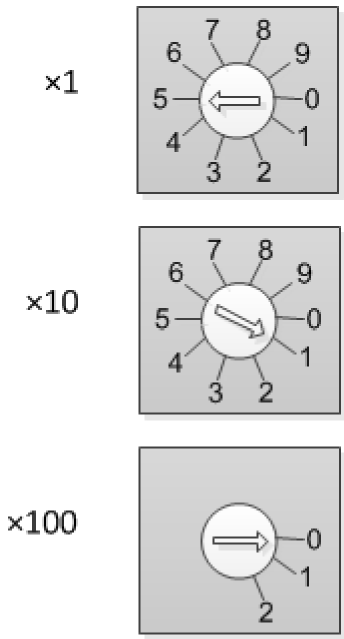
6.3.5.4.3 Steps

To set the LK235 device address, please follow the steps below:

(1) Using a screwdriver, turn the three rotary code switches ×1, ×10, and ×100 to the required device address.

6.3.5.4.4 Example

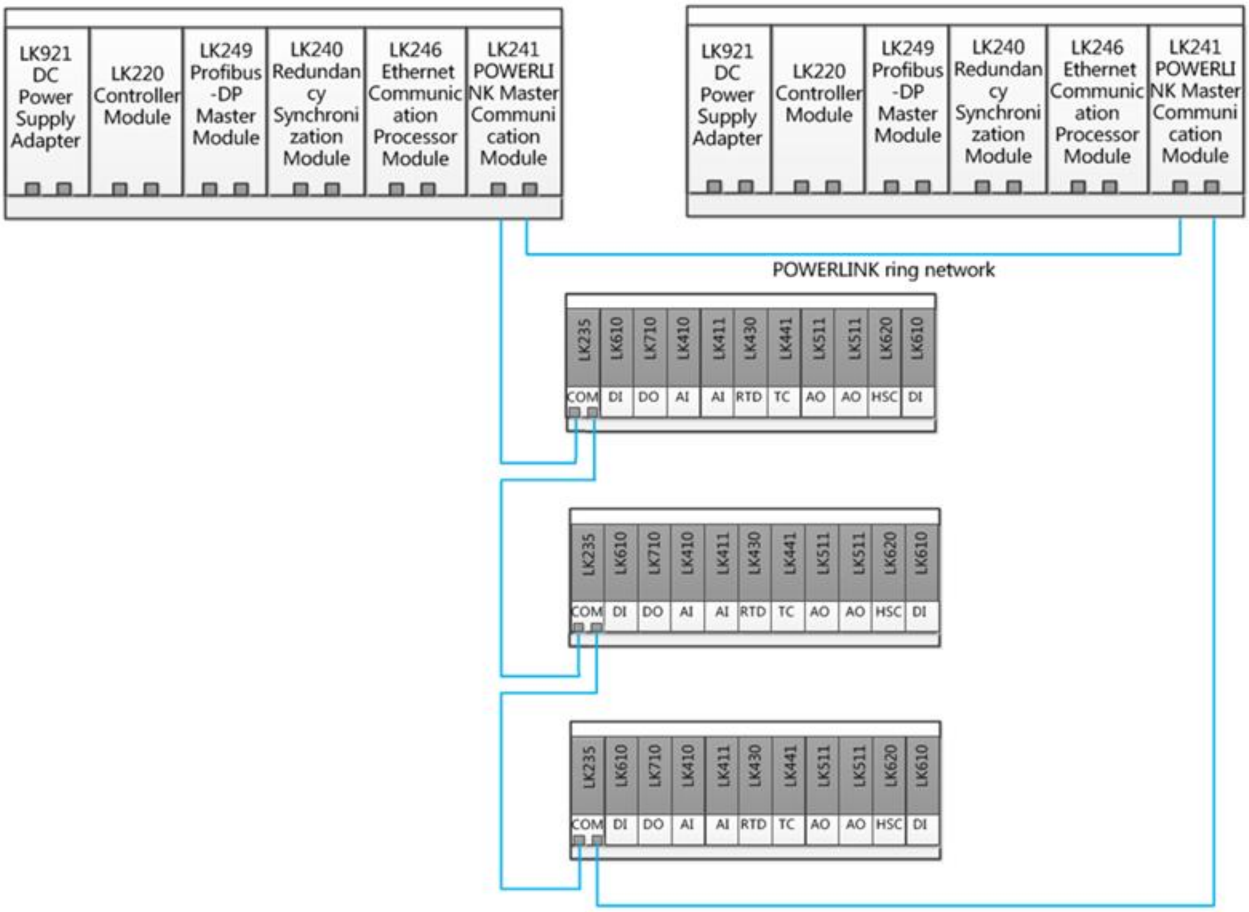
For example: Set the station address to 15, then turn the hundreds place rotary code switch to 0, the tens place rotary code switch to 1, and the ones place rotary code switch to 5, as shown in the figure below.



Set Device Address

6.3.5.5 LK235 Ring Network

When the POWERLINK/PL-LINK network is configured by the LK235 ring network, the schematic diagram is shown below. LK241 supports the connection of 40 LK235, and It is recommended that the number of IO added under each LK235 should not exceed 10.



Network Connection

6.3.5.6 Technical Specifications

LK235 POWERLINK/PL-LINK interface module	
Ethernet	
Number of Communication Ports	2 way
Redundant Function	Support POWERLINK/PL-LINK ring network redundancy
Level standard	IEEE 802.3
Communication port type	Shield RJ45
Communication rate (bps)	100Mbps
Protocol	POWERLINK/PL-LINK protocol
Hot Wap	
Module hot swap	Supported
Power Supply	
Input Voltage	24VDC（-15%~+20%)
Module Power Consumption (max)	180mA@24VDC
Rated Voltage	24.0VDC
Start Time	
Time from module power on to completion of initialization	≤20s
Physical Properties	
Installation Location	Expansion backplane communication slot

LK235 POWERLINK/PL-LINK interface module	
Module Size (W*H*D)	35 mm*100 mm*100 mm ±0.5 mm
Operate humidity	5%~95%with no condensation

6.3.6 LK235M HolliTCP Interface Module

6.3.6.1 Basic Features

- 2-way redundant Ethernet interface (100Mbps)
- HolliTCP slave communication protocol
- Hot swapping

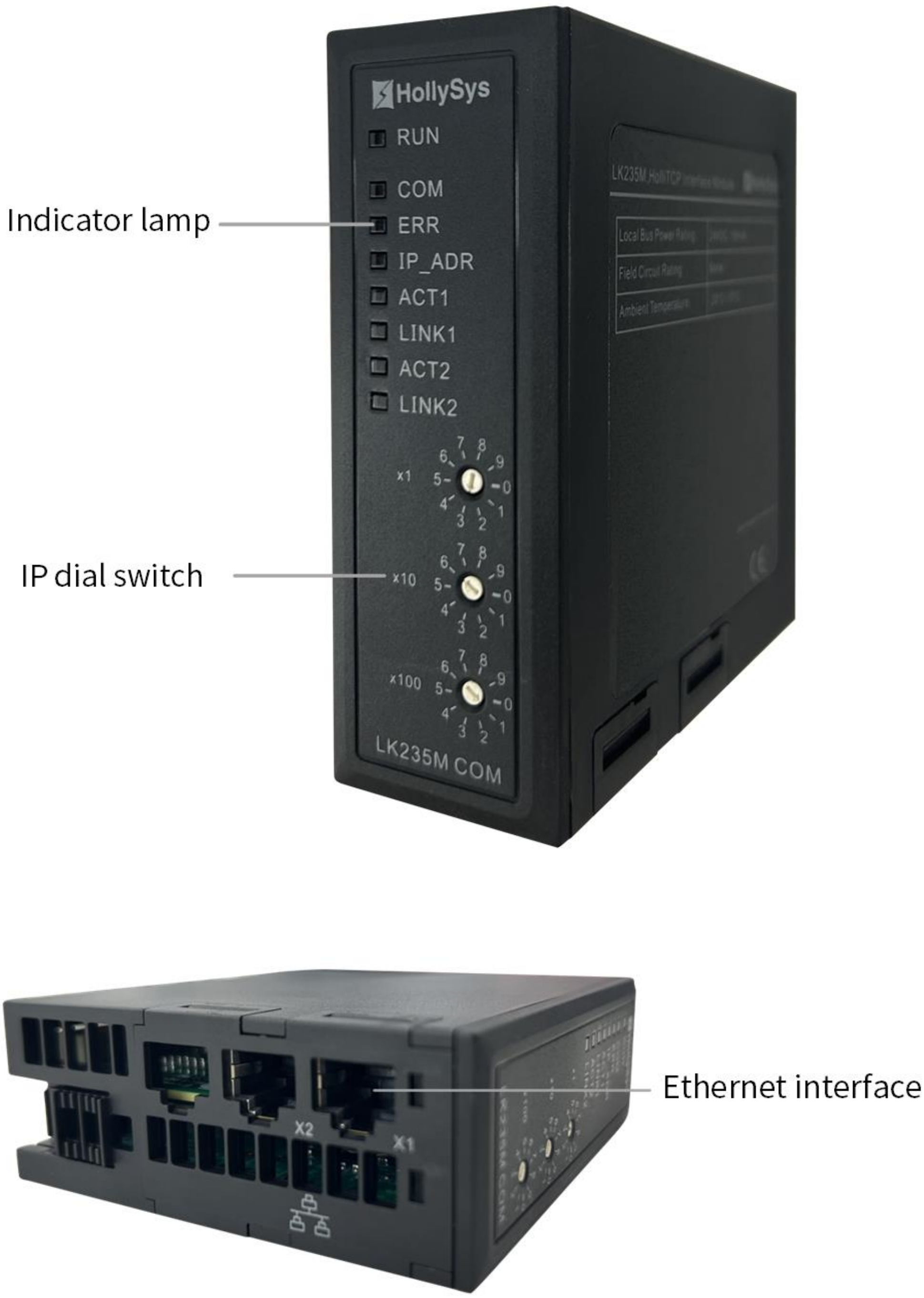
6.3.6.2 Function

LK235M is a communication module which converts HolliTCP to DP, and it is used to connect expansion IO modules of LK series for LK controller.

LK235M module communicates with the controller through two-way redundant HolliTCP, and communicates with DP slave through two-way redundant Profibus-DP. LK235M module as a slave station in the HolliTCP protocol side and as the master in the Profibus-DP protocol side.

- LK620、LK621、LK622、LK631 is not supported under LK235M module.

6.3.6.3 Interface



LK235M Module Schematic Diagram

6.3.6.4 Indicators

LK235M has 8 indicators, the specific meaning as shown in table.

Definition of Indicators

Indicator Type	Color	State	Meaning
RUN (Running indicator)	Green	On	The LK235M module has loaded the configuration file and is running normally
		Fast flashing	The LK235M module has loaded the configuration file but is not running (communication with the controller is not successful)
		Slow flashing	The LK235M module does not load the configuration file
		Off	No power or the module is damaged
COM (Communication indicator)	Yellow	On	Establish communication with at least one DP slave
		Off	No communication is established with any DP slaves
ERR (Abnormal indicator)	Red	On	Module failure (eg configuration file loading error; DP master works abnormally)
		Slow flashing	The module is starting up
		Off	The module is no fault
IP_ADR (IP address indicator)	Green	On	The IP address of the software configuration takes effect
		Slow flashing	The default IP address takes effect
		Off	No power or the module is damaged
ACT1 (Ethernet 1 Data interaction indicator)	Yellow	Flashing	The Ethernet 1 interface is sending and receiving data
		Off	No data is received or sent in Ethernet 1
LINK1 (Ethernet 1 link indicator)	Green	On	Ethernet 1 interface has been connected successfully
		Off	The Ethernet 1 interface is not connected
ACT2 (Ethernet 2 Data interaction indicator)	Yellow	Flashing	The Ethernet 2 interface is sending and receiving data
		Off	No data is received or sent in Ethernet 2
LINK2 (Ethernet 2 link indicator)	Green	On	Ethernet 2 interface has been connected successfully
		Off	The Ethernet 2 interface is not connected

- Fast flashing: 4 Hz, 125 ms is on, 125 ms is off.
- Slow flashing: 1 Hz, 500 ms is on, 500 ms is off.
- When the firmware is upgraded, the RUN indicator will be off and the COM, ERR and IP_ADR indicators will flash slowly.
- Flashing frequency of the ACT indicator is related to the amount of communication data on the current network, ACT indicator is On when the amount of data on the network is high.

6.3.6.5 IP Address Settings

The fourth field of the LK235M IP address can be set via the three 10-position IP dial switches on the front panel. Fourth field IP address = 100 × dial switch setting value + 10 × dial switch setting value + dial switch setting value.

If the IP address of the LK235M is set to X.X.X.51, turn the hundred-digit dial switch to 0, the ten-digit dial switch to 5, and the single-digit dial switch to 1.

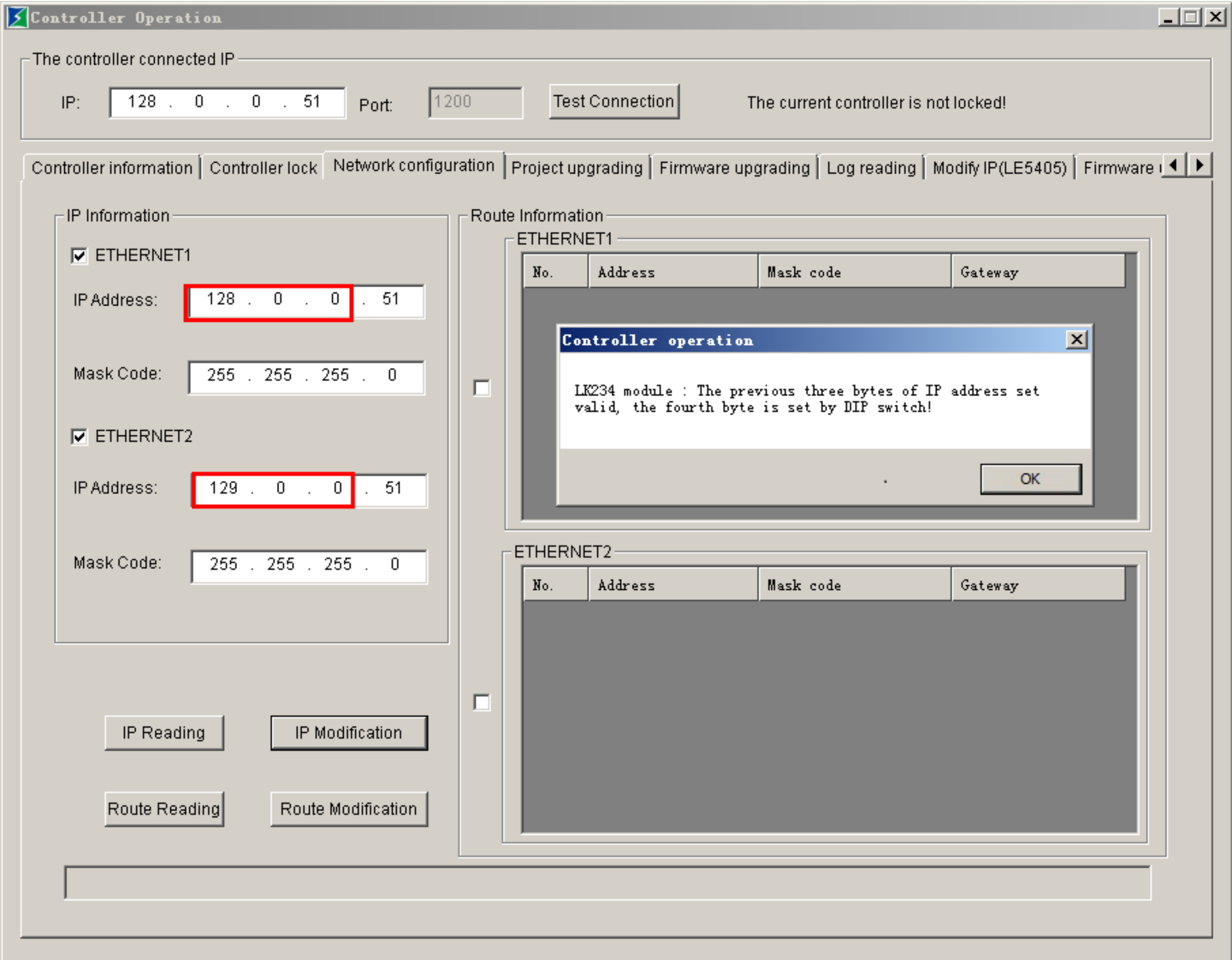
Refer to following table for the meaning of the IP setting value when the IP address in fourth field is set by DIP switch.

Description of IP Address Settings in Fourth Field

IP Address	Dial Switch Setting Value	Meaning	Function Description	Note
x.x.x.0	0	IP reset	When dial switch is set as 0, IP address of LK235M is reset to default value 128.0.0.249, 129.0.0.249	
x.x.x.1	1	Gateway address		Setting is not recommended
x.x.x.255	255	Broadcast address		Setting is not recommended
x.x.x.249	256~999	IP address in fourth field is as a default value	When dial switch is set as 256~999, IP address in fourth field is 249	The dial switch is in 999, the LK235M configuration file will be deleted automatically when power on

The IP address in the first three fields of the LK235M is set by the [Network Configuration] tool in the AutoThink configuration software, as shown in following figure.

After connecting to the LK235M successfully, the IP address can be read from the LK235M by **IP Reading**. Address set by the dial switch is shown in the fourth field and can not be modified. Enter IP address of the first three fields to be modified in the **IP Address** box, click **IP Modification**, IP address is set to complete.



The First Three Fields Settings of LK235M IP Address

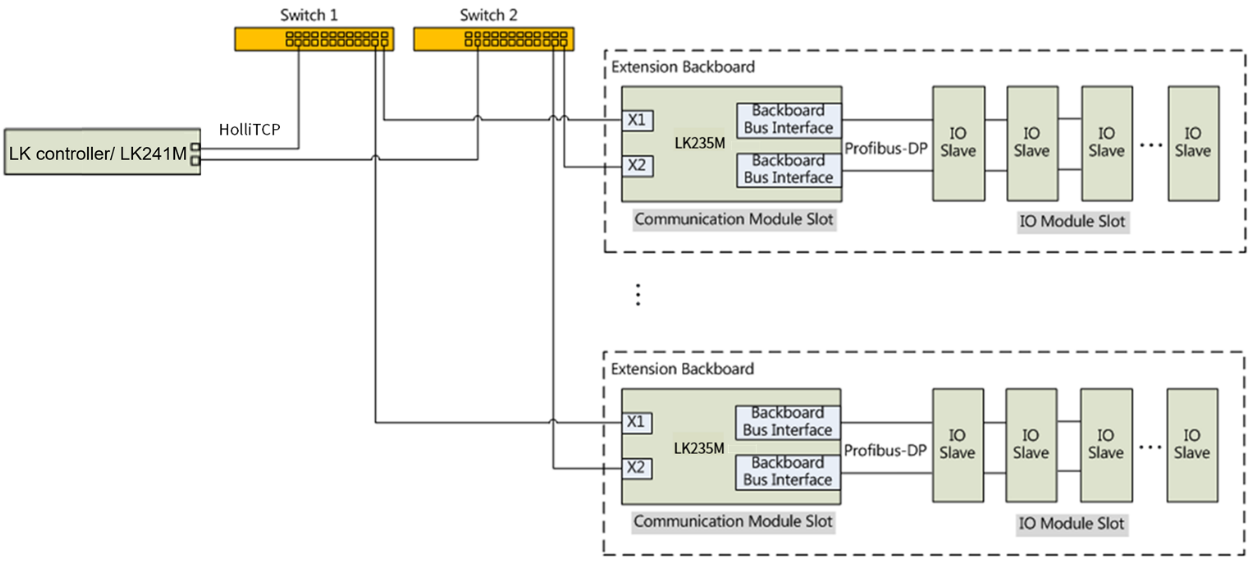
LK235M configuration refers to Configure HolliTCP MASTER Protocol.

6.3.6.6 Wirings

The LK235M module is installed in the first slot on the left side of the expansion backplane and The protection key is coded as A5.

LK235M module is connected with the LK controller or LK241M through the switch, and connected with the LK expansion IO modules through the backplane bus.

Currently, on an extended backplane, the LK235M module supports up to 10 IO modules.



LK235M Connection Schematic Diagram

- It is recommended that you do not use the routing function when using the LK235M.
- Users should ensure that the LK235M communication network is normal and avoid that the high network load caused by the external modules, the long network transmission time caused by the network configuration, a lot of useless packets (such as network storm) in the network.

6.3.6.7 Diagnosis

Diagnosis information of LK235M module and its attached DP slave modules is viewed in [Diagnostic Information] of each module in AutoThink programming software.

When the LK235M module is configured in the LK project, the diagnosis variables are generated in [Diagnostic Information] after compilation, The length of diagnostic variable is 5 bytes, as shown in following figure.

LK235M(LK235M)

Device Configuration | Diagnostic Information | Information

No.	Variable Name	Address	Variable Description	Variable Type	Online Value	Power Fail Safeguard
0001	AT_LK235MState20	%SB67536	Whether the configuration is...	BYTE	0	FALSE
0002	AT_EthernetState20	%SB67537	Ethernet communication stat...	BYTE	0	FALSE
0003	AT_DPState20	%SB67538	Whether DP is ready	BYTE	0	FALSE
0004	AT_DPRunState20	%SB67539	Whether DP is running	BYTE	0	FALSE
0005	AT_ConnectDP20	%SB67540	At least one DP slave statio...	BYTE	0	FALSE

LK235M Diagnosis Variable

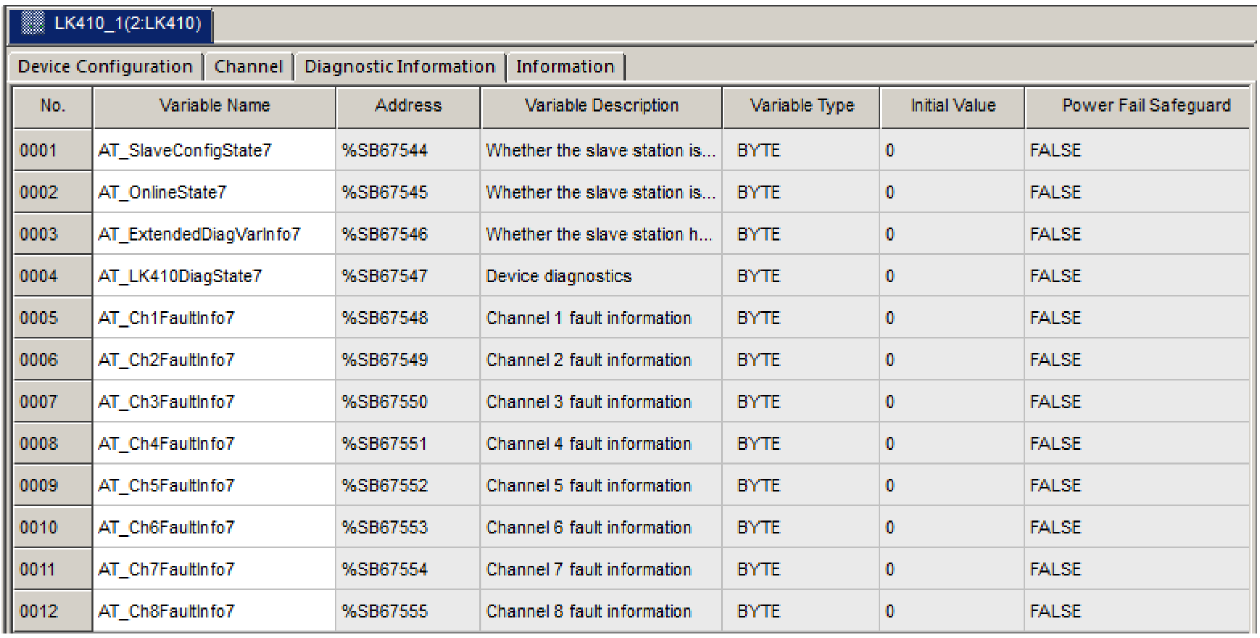
Diagnostic Information Description

Diagnosis Information	Diagnostic Description	Diagnostic Value Description
LK235M diagnosis information	Whether LK235M is configured successfully	0: Unsuccessful 1: Successful
	LK235M Ethernet communication status	0: Not connected

Diagnosis Information	Diagnostic Description	Diagnostic Value Description
		Non-zero: Normal running
	Whether LK235M DP is ready	0: Not ready 1: Ready
	Whether the LK235M DP is running	0: Not running 1: Running
	The LK235M establishes communication with at least one DP slave	0: No 1: Yes

After the I / O module is added to LK235M, the compilation is passed, and the diagnostic variables can be viewed in the [Diagnostic Information] tab of module. If the version is switched to the version before V3.1.7B2, the LK235M diagnostic variables and the diagnostic variables of I / O connected with LK235M are reported by the LK235MDiagGroup variable group.

The diagnosis information of each DP slave module consists of three parts: the first three bytes are the module status diagnosis information, the fourth byte is the device diagnosis information, and the following bytes are the channel Diagnosis information, as shown in figure.


LK410_1(2:LK410)

Device Configuration | Channel | Diagnostic Information | Information

No.	Variable Name	Address	Variable Description	Variable Type	Initial Value	Power Fail Safeguard
0001	AT_SlaveConfigState7	%SB67544	Whether the slave station is...	BYTE	0	FALSE
0002	AT_OnlineState7	%SB67545	Whether the slave station is...	BYTE	0	FALSE
0003	AT_ExtendedDiagVarInfo7	%SB67546	Whether the slave station h...	BYTE	0	FALSE
0004	AT_LK410DiagState7	%SB67547	Device diagnostics	BYTE	0	FALSE
0005	AT_Ch1FaultInfo7	%SB67548	Channel 1 fault information	BYTE	0	FALSE
0006	AT_Ch2FaultInfo7	%SB67549	Channel 2 fault information	BYTE	0	FALSE
0007	AT_Ch3FaultInfo7	%SB67550	Channel 3 fault information	BYTE	0	FALSE
0008	AT_Ch4FaultInfo7	%SB67551	Channel 4 fault information	BYTE	0	FALSE
0009	AT_Ch5FaultInfo7	%SB67552	Channel 5 fault information	BYTE	0	FALSE
0010	AT_Ch6FaultInfo7	%SB67553	Channel 6 fault information	BYTE	0	FALSE
0011	AT_Ch7FaultInfo7	%SB67554	Channel 7 fault information	BYTE	0	FALSE
0012	AT_Ch8FaultInfo7	%SB67555	Channel 8 fault information	BYTE	0	FALSE

Diagnosis Information of I/O Slave Module

Diagnostic Byte Description

Diagnosis Information	Diagnostic Description	Diagnostic Value Description	Note
State diagnosis information of DP slave	Whether DP slave is configured	0: Not configured 1: Configured	
	Whether DP slave is online	0: Offline 1: Online	
	Whether the DP slave has extended diagnosis information	0: none 1: Yes	
Device diagnosis information of DP slave	Device diagnostics	The device diagnosis of each module is different. Refer to device diagnosis information of each module	No device diagnostic for LK239

Diagnosis Information	Diagnostic Description	Diagnostic Value Description	Note
Channel diagnosis information of DP slave	Channel fault information	The channel diagnosis of each module is different. Refer to channel diagnosis information of each module	No channel fault information for LK610, LK710 and LK239

- When data in input area of the IO slave station is used, the slave is online as the prerequisite (the information is obtained from the S area) and the diagnosis information of the slave station is viewed, to ensure that the read data is normal.
- All the diagnosis information will be cleared after 20s when LK235M was in offline.

6.3.6.8 Technical Specifications

LK235M HolliTCP interface module	
Ethernet	
Number of Communication Ports	2 way
Redundant Function	Support for redundancy with no more than 50ms netting time
Level standard	IEEE 802.3
Communication port type	Standard RJ45
Communication rate (bps)	100Mbps
Protocol	HolliTCP protocol
Protection level	
Module protection level	IP20
Hot Wap	
Module hot swap	Supported
Power Supply	
Input Voltage	24VDC (-15%~+20%)
Module Power Consumption (max)	180mA@24VDC
Rated Voltage	24.0VDC
Start Time	
Time from module power on to completion of initialization	≤40s
Physical Properties	
Installation mode	Backplane slot mounting
Installation Location	Expansion backplane communication slot
Antimixing position	A5
Module Size (W*H*D)	35 mm*100 mm*100 mm ±0.5 mm
Weight	300g

6.3.7 LK238 Serial Communication Module

6.3.7.1 Basic Features

- Support the PROFIBUS-DP slave protocol
- Support the MODBUS master /slave protocol
- Connect the controller to an external Modbus master/slave
- Installed in the I/O slot
- 4-way RS485 interface
- Support hot swap

LK238 module is Modbus master-slave communication expansion module, supports Profibus-DP bus protocol and Modbus protocol, and realizes data communication from external Modbus station to controller.

The LK238 module can only be used as a DP slave on the Profibus-DP side to exchange parameters and data with the controller to realize the DP slave function.

The LK238 module can be used as a Modbus master station or a Modbus slave station on the Modbus side to obtain or send Modbus data. It supports function codes 01, 02, 03, 04, 05, 06, 15, 16.

The maximum length of input data and output data in Modbus data area of LK238 module is 236 bytes each. As a Modbus master station, the maximum number of slave stations supported must meet the two constraints that the total length of input (output) data each does not exceed 236 bytes and the number of instructions does not exceed 32.

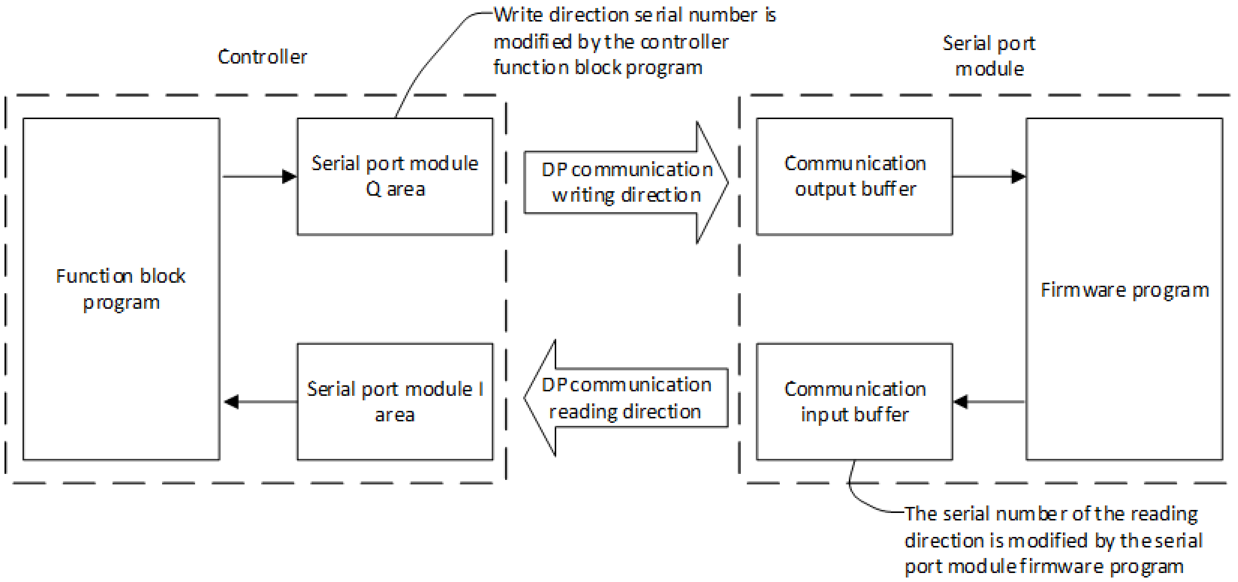
Modbus communication adopts the response method: the master station sends a command to a slave station, and then waits for the response from the slave station. After receiving the command from the master station, the slave station executes the command and returns the execution result to the master station as a response, and then waits for the next command.

Modbus physical layer interface RS485, the transmission rate can reach 115.2 Kbps, RTU transmission mode.

6.3.7.2 Principle Description

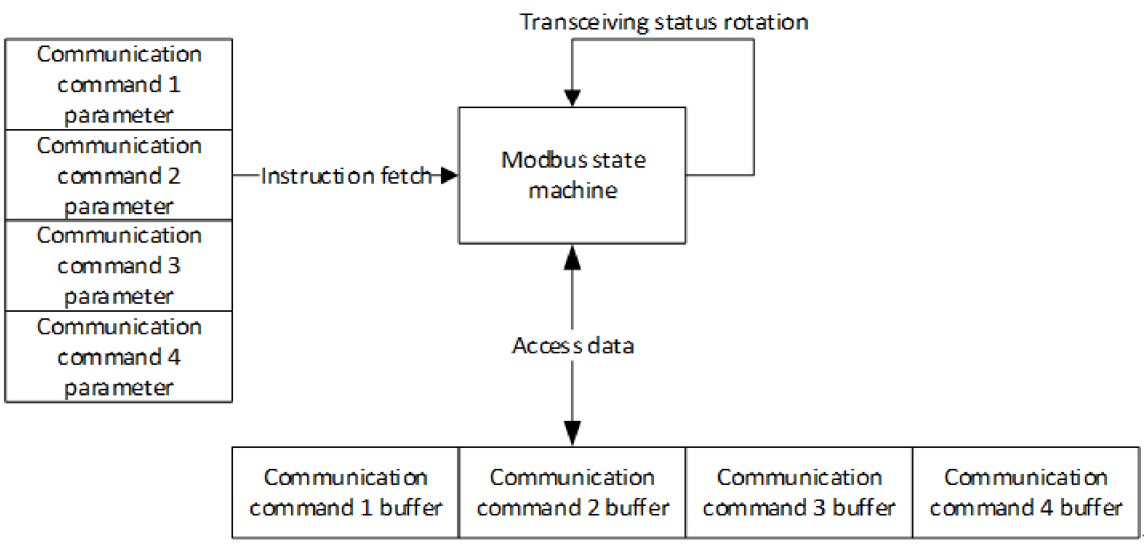
The data is periodically refreshed between the controller and the serial port module through DP communication, which can be divided into two directions: read and write, as shown in the figure below. The configuration process of communication command parameters is one-time and trigger mode. Therefore, it is necessary to implement a message-based interaction mechanism in the periodic communication data. The control initiative adopts the master-slave mode, where the controller acts as the master and the serial port module acts as the slave.

The controller and the serial port module are the sender and receiver each other. For the sender, adding a field in the periodic data area indicates that the data has been updated, rather than repeated data, and the receiver will process it when it finds that the data is updated, otherwise it will be considered as repeated data and not processed. For example, add the serial number of the command and response, modify the serial number when sending the command, and use the same serial number when replying to the response.



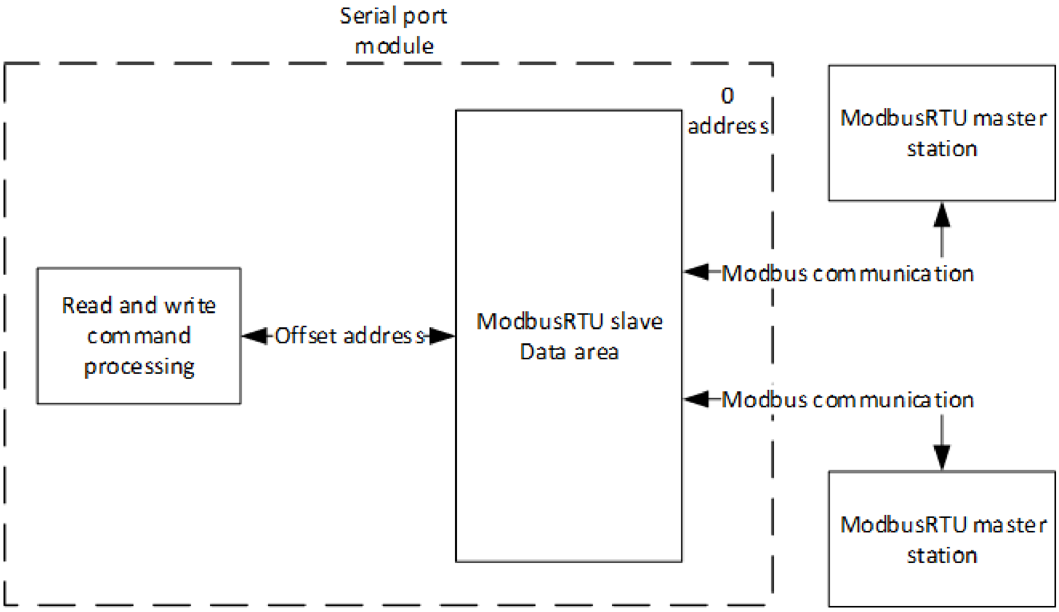
DP Communication Interaction Schematic Diagram

The Modbus master station protocol creates a command data buffer pool for each command according to the configured command ID as the index. The command of the protocol state machine to read the function code (01/02/03/04) will copy the data read from the slave station into this In the data buffer pool of the instruction; for the instruction data buffer pool of the write function code (05/06/15/16), the write data of the instruction obtained from the DP cycle communication is issued to the slave station through the Modbus protocol.



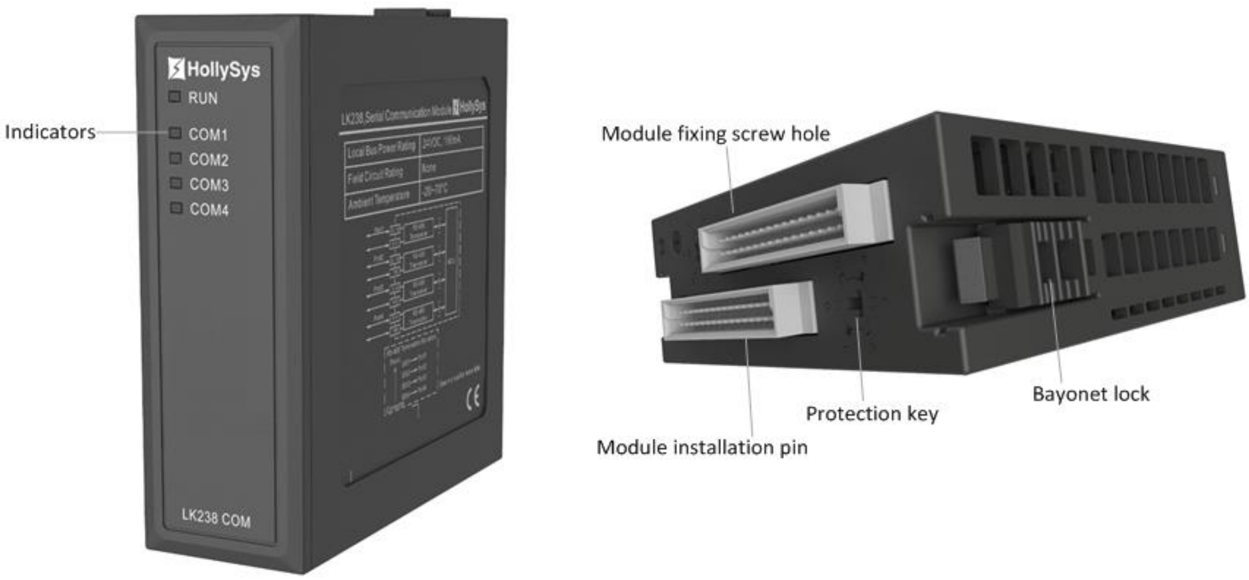
Serial Port Module Communication Command Polling Schematic Diagram

The Modbus slave protocol creates a common data buffer for multiple Modbus slaves. When the protocol state machine receives the request message of the Modbus master to read the function code (01/02/03/04), it will follow the read offset address from the slave. When the data buffer is read, the data is filled into the Modbus slave response message; when the request message of the Modbus master write function code (05/06/15/16) is received, the data will be written into the data buffer according to the write offset address Corresponding position. Through the read and write communication data commands in the DP cycle communication, the offset address can be specified to read and write data in the Modbus slave data buffer.



Modbus Slave Data Area Access Schematic Diagram

6.3.7.3 Module Appearance



LK238 Module Appearance Diagram

Interface Description

Interface definition	Instructions for use
Indicator light	Indicate module working status and channel status
Module fixing screw hole	Insert into the slot jack of the expansion backplane
Module installation pins	Insert into the slot jack of the expansion backplane
Anti-mixing female mold	The unique code set to prevent the module from being damaged by incorrect insertion is fixed at the factory and cannot be changed. The anti-mixing code on the slot must be the same as the module anti-mixing code
Bayonet	One upper and lower one. After the module is installed in the slot, the bayonet and the expansion backplane buckle are automatically locked When disassembling, you need to press the upper and lower pins at the same time to pull out the module

6.3.7.4 Status Indicator

The definition of the indicator lights of the LK238 module is shown in the table. The RUN light shows the communication connection status with the controller; the COM light shows the Modbus communication connection status.

LK238 Module Status Indicator Definition

Name	Colorn	State	Description
RUN	Green	Flashing	Communication is being established just after power-on, or communication error between LK238 and LK CPU module
		On	The communication between LK238 and LK's DP master module is normal
		Off	The module is not powered on or the module is broken
COM1	yellow	On	The first serial port communication is enabled and works normally
		Fast flashing	Modbus master / slave communication error occurs in the first serial port communication; Free port protocol communication error.
		Slow flashing	When the first serial port communication is configured as Modbus master protocol communication, no Modbus slave is configured for LK238; The free port protocol does not start communication; This state is not available when the Modbus slave protocol is configured
		Off	The first channel is prohibited or not enabled
COM2	yellow	On	The second serial port communication is enabled and works normally
		Fast flashing	Modbus master / slave communication error occurs in the second serial port communication; Free port protocol communication error.
		Slow flashing	When the second serial port communication is configured as Modbus master protocol communication, no Modbus slave is configured for LK238; The free port protocol does not start communication; This state is not available when the Modbus slave protocol is configured
		Off	The second channel is prohibited or not enabled
COM3	yellow	On	The third serial port communication is enabled and works normally
		Fast flashing	Modbus master / slave communication error occurs in the third serial port communication; Free port protocol communication error.
		Slow flashing	When the third serial port communication is configured as Modbus master protocol communication, no Modbus slave is configured for LK238; The free port protocol does not start communication; This state is not available when the Modbus slave protocol is configured
		Off	The third channel is prohibited or not enabled

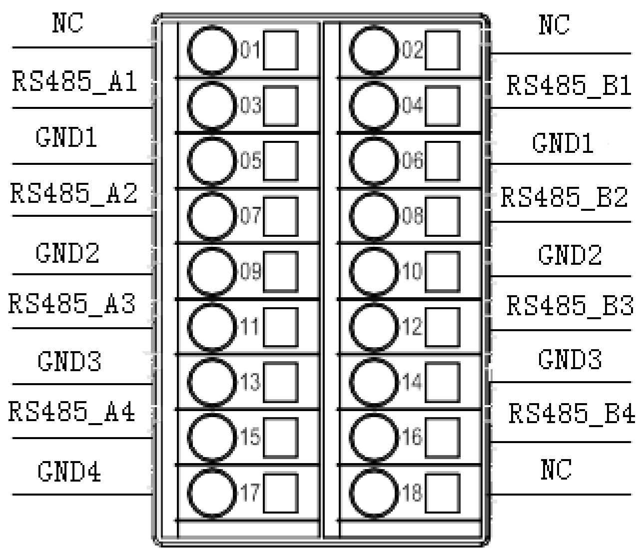
Name	Colorn	State	Description
COM4	yellow	On	The fourth serial port communication is enabled and works normally
		Fast flashing	Modbus master / slave communication error occurs in the fourth serial port communication; Free port protocol communication error.
		Slow flashing	When the fourth serial port communication is configured as Modbus master protocol communication, no Modbus slave is configured for LK238; The free port protocol does not start communication; This state is not available when the Modbus slave protocol is configured
		Off	The fourth channel is prohibited or not enabled

- Fast flashing: 4Hz, on for 125ms, off for 125ms.
- Slow flashing: 1Hz, on for 500ms, off for 500ms.

6.3.7.5 Wiring Instructions

The serial port input channel of LK238 is wired out from the backplane, and there is no need to externally external 24 VDC field power supply to supply power to the module. Definition of external connectors or wiring terminals for electrical isolation between serial channels.

The terminal definition on the back panel is shown in the figure below.



Wiring Diagram

Signal Definition

Terminal number	Cable specifications	Terminal number	DB9 signal definition
1	NC	2	NC
3	RS485_A1	4	RS485_B1
5	GND1	6	GND1
7	RS485_A2	8	RS485_B2
9	GND2	10	GND2
11	RS485_A3	12	RS485_B3

Terminal number	Cable specifications	Terminal number	DB9 signal definition
13	GND3	14	GND3
15	RS485_A4	16	RS485_B4
17	GND4	18	NC

6.3.7.6 Diagnostic Instructions

The diagnostic information of LK238 only contains 3-byte device-related diagnostics.

When adding the LK238 module through the DP protocol under the LK249 DP communication module, the diagnosis needs to be checked through the function block. After calling the DP slave diagnostic function block (sysGetDPSlaveState), the diagnostic data is stored in the output parameter DiagData array.

LK238 Diagnostic Information Description

Diagnostic information	Diagnostic byte	Value
Device diagnostic information	DiagData[0]	0x03: Device diagnosis header byte
	DiagData[1]	Bit0: COM1 communication fault diagnosis 1: Indicates communication failure 0: indicates that the communication is not faulty
		Bit1: COM2 communication fault diagnosis 1: Indicates communication failure 0: indicates that the communication is not faulty
		Bit1: COM3 communication fault diagnosis 1: Indicates communication failure 0: indicates that the communication is not faulty
		Bit1: COM4 communication fault diagnosis 1: Indicates communication failure 0: indicates that the communication is not faulty
		Bit4~Bit5: reserved
		Bit6~Bit7: DP network fault diagnosis 0: indicates no fault 1: Indicates that the DP1 network is faulty 2: Indicates that the DP2 network is faulty
	DiagData[2]	Bit0~Bit7: Module MCU firmware version information

When adding the LK238 module through the POWERLINK protocol under the LK241 POWERLINK communication module, after compiling, you can directly view the diagnostic information on the diagnostic page.

The LK238 module is configured in the AutoThink configuration software, and the module diagnosis information page is generated after compilation, and the obtained diagnosis is stored in the system S area. The diagnostic information of LK238 only contains 3 bytes of device-related diagnostics, as shown in the figure:

Variable Name	Variable Type
AT_LK238SlaveState1_8	BYTE
AT_LK238SlaveID_H8	BYTE
AT_LK238SlaveID_L8	BYTE
AT_LK238COM1Fault8	BOOL
AT_LK238COM2Fault8	BOOL
AT_LK238COM3Fault8	BOOL
AT_LK238COM4Fault8	BOOL
AT_LK238DP1NetFault8	BOOL
AT_LK238DP2NetFault8	BOOL
AT_LK238MCUVern8	BYTE

LK238 Diagnostic Information Description

ⓘOnly when the COM port is configured as Modbus master protocol or Modbus slave protocol can com report the port fault status, free port protocol has no diagnostic function.

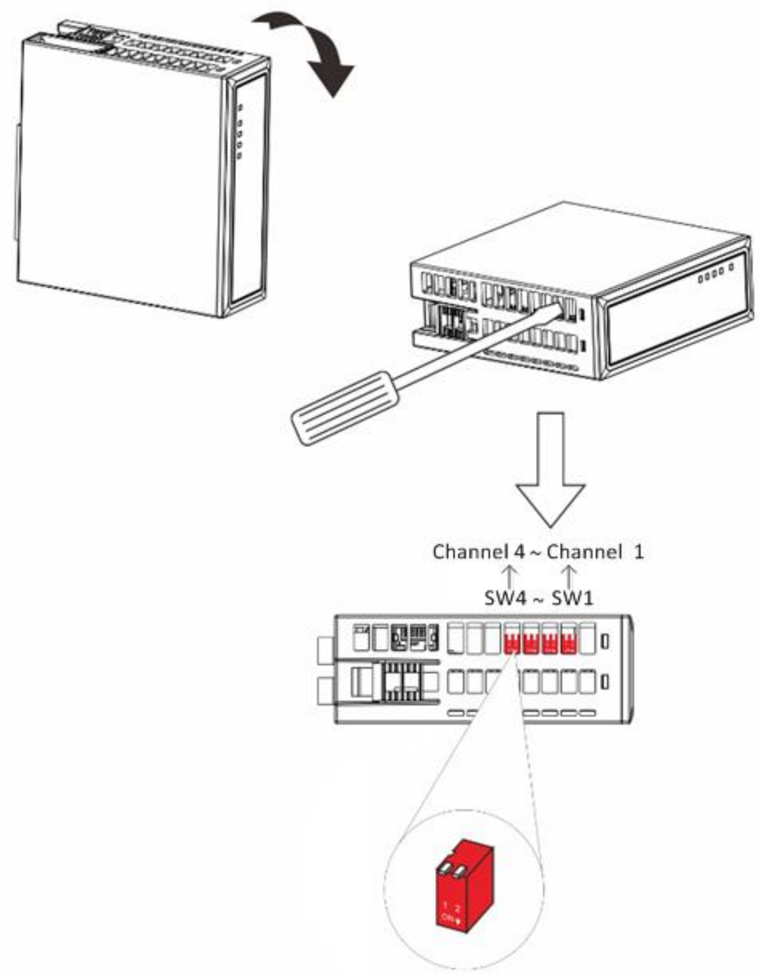
6.3.7.7 Matching Resistance

The matching resistance dial switch is located inside the module, with four groups, corresponding to channels 1 ~ 4 respectively. Each channel can set the matching resistance independently. Each group has two keys, which are not connected by default. As shown in the figure, there is no need to disassemble the shell when changing the switch position. Through the heat dissipation hole of the shell on the top of the module, it can be easily set with a small screwdriver.

When setting, the two-digit keys of the DIP switch should be dialed in the same way. Dial the 2-digit button downwards at the same time to turn on the terminal matching resistance; Dial the 2-digit button upwards at the same time to turn off the terminal matching resistance.

Matching resistors must be connected in the following scenarios:

- When the module channel is used as the ModbusRTU master station and is located at the beginning of the serial port network, it is necessary to turn on the corresponding matching resistance switch.
- When the module channel is used as a ModbusRTU slave station and is located at the end of the serial port network, it is necessary to turn on the corresponding matching resistance switch.



Setting of LK238 DIP Switch

6.3.7.8 Modbus Communication Information Description

The Modbus communication protocol is a master/slave communication protocol. The master station sends a message, and only the slave station with the same call address in the message sent by the master station sends a reply message to the master station.

The slave address range of the LK238 module is 1 (default) ~ 247, the 0 address in the protocol is the broadcast message sending mode, and the LK238 module does not support the 0 address function.

The function code is used by the Modbus master station to inform the Modbus slave station what action should be performed. The slave station sends the same function code to the master station as a response, indicating that it has responded to the master station for operation.

The following table lists the Modbus function codes supported by LK238 as a Modbus master station. For function codes not listed in the table, LK238 does not respond.

If the highest bit of the function code sent by the slave station is 1 (the function code is greater than 127), it indicates that the slave station has not responded to the operation or sent an error.

Supported Function Code Definition

Function code	Data type	Meaning	Function
01	BIT	Read the open state (DO read back)	Read back the current state of a group of switch output (not supporting broadcast mode)
02	BIT	Read input status (DI)	Get the current state of a group of digital inputs (not supporting broadcast mode)
03	WORD	Read back the current state of a group of analog output (not supporting broadcast mode)	Read back the current state of a group of analog output (not supporting broadcast mode)
04	WORD	Read the state of the module (AI)	Get the current state of a group of analog inputs (not supporting broadcast mode)
05	BIT	Forced single out (single DO)	Mandatory setting of the output value of a certain switch (not supporting broadcast mode)
06	WORD	Mandatory single-channel mode output (single-channel AO)	Mandatory setting of the output value of an analog quantity (not supporting broadcast mode)
15	BIT	Forced multi-channel out (multi-channel DO)	Mandatory setting of the output values of several continuous switching values of the slave station (not supporting broadcast mode)
16	WORD	Mandatory multi-channel mode output (multi-channel AO)	Mandatory setting of the output values of several continuous analog quantities from the slave station (not supporting broadcast mode)

6.3.7.9 LK238 as a Modbus Master

When using LK238 as a Modbus master station for communication, communication parameters and read-write data functions can be configured by calling relevant function blocks. When configuring, corresponding function blocks can be selected based on actual application scenarios.

- When the Modbus communication trigger mode is cycle triggered or event triggered, COMM_SET_CONFIG(Set LK238 Communication Instruction Param), COMM_CTL_MODULE(LK238 Module Control Function Block) and COMM_RW_MODBUS_MASTER(LK238 Modbus Master Read and Write Communication Data) can be called to configure Modbus communication. Please refer to the following chapters for specific configurations.
- When the Modbus communication trigger mode is event triggered, you can also call LK238_ModbusMaster(LK238 Modbus Master Configure Read and Write) to configure Modbus communication. Please refer to LK238_ModbusMaster(LK238 Modbus Master Configure Read and Write).

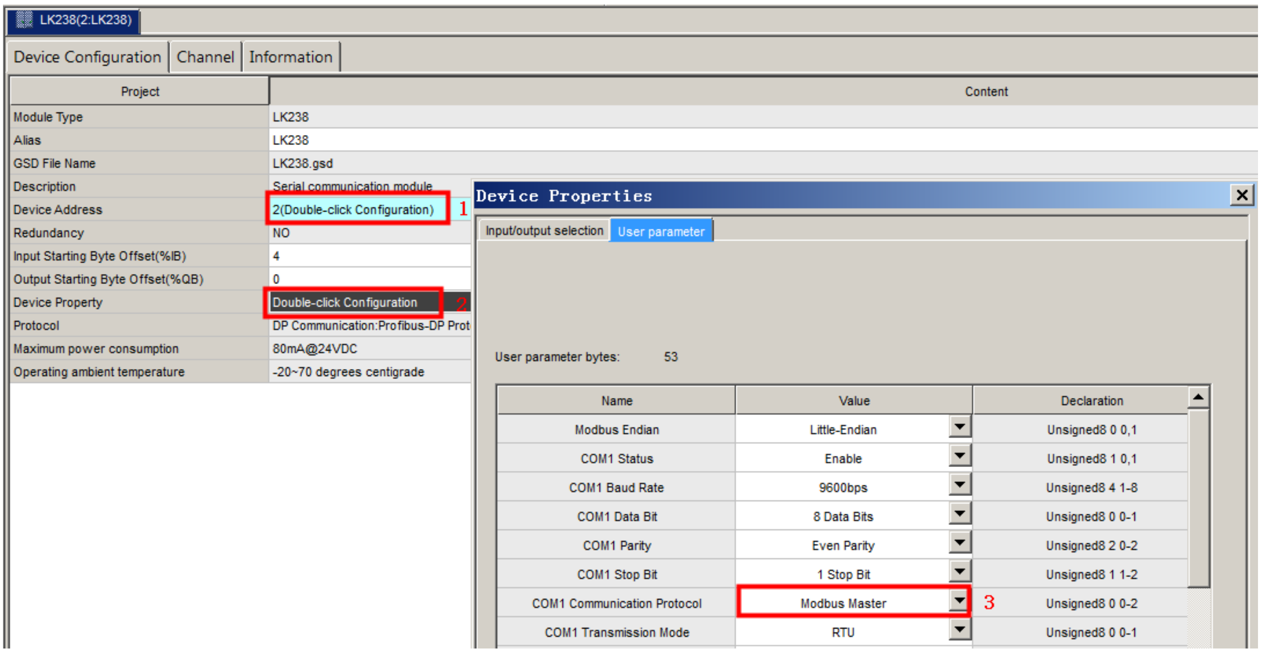
6.3.7.9.1 User parameter select Modbus master

(1) Configure the correct device address

(2) Select Modbus master for protocol type

(3) Modbus Endian: byte order processing, which is used to adapt to the size end of the controller. The data reading format of the controller is little endian and the default value here is "Little

Endian".



Select Modbus Master

6.3.7.9.2 Add Input and Output Modules

[Input/Output Selection] The tab page is used to configure the data space on the Modbus side of the LK238 module to realize the data transmission between the LK238 and the external Modbus station.

The data length in the module is limited, the maximum length of input data is 236 bytes, and the maximum length of output data is 236 bytes. When the added data exceeds the limited length, an error message will pop up.

As shown in the figure below, all optional input and output data are displayed in the optional module list box on the left, select the data that needs to be added, Click the button >> , Add the data to the added module list box on the right.

The number of input modules actually added is determined by the maximum input byte length among the following factors, and the data size of the input module (56 bytes × Number of additions) must be greater than the following maximum input byte length. Otherwise, the corresponding function block will report an error.

- Number of configuration instructions (InstructionNum) in COMM_GET_CONFIG (Read LK238 Communication Instruction Param) × The length of an instruction (12 bytes) is the required input byte length.
- Instruction parameters corresponding to the instruction ID number (InstructionIDs) in COMM_RW_MODBUS_MASTER (LK238 Modbus Master Read and Write Communication Data), the "datalength" corresponding to the (01 / 02 / 03 / 04) read function code is the required

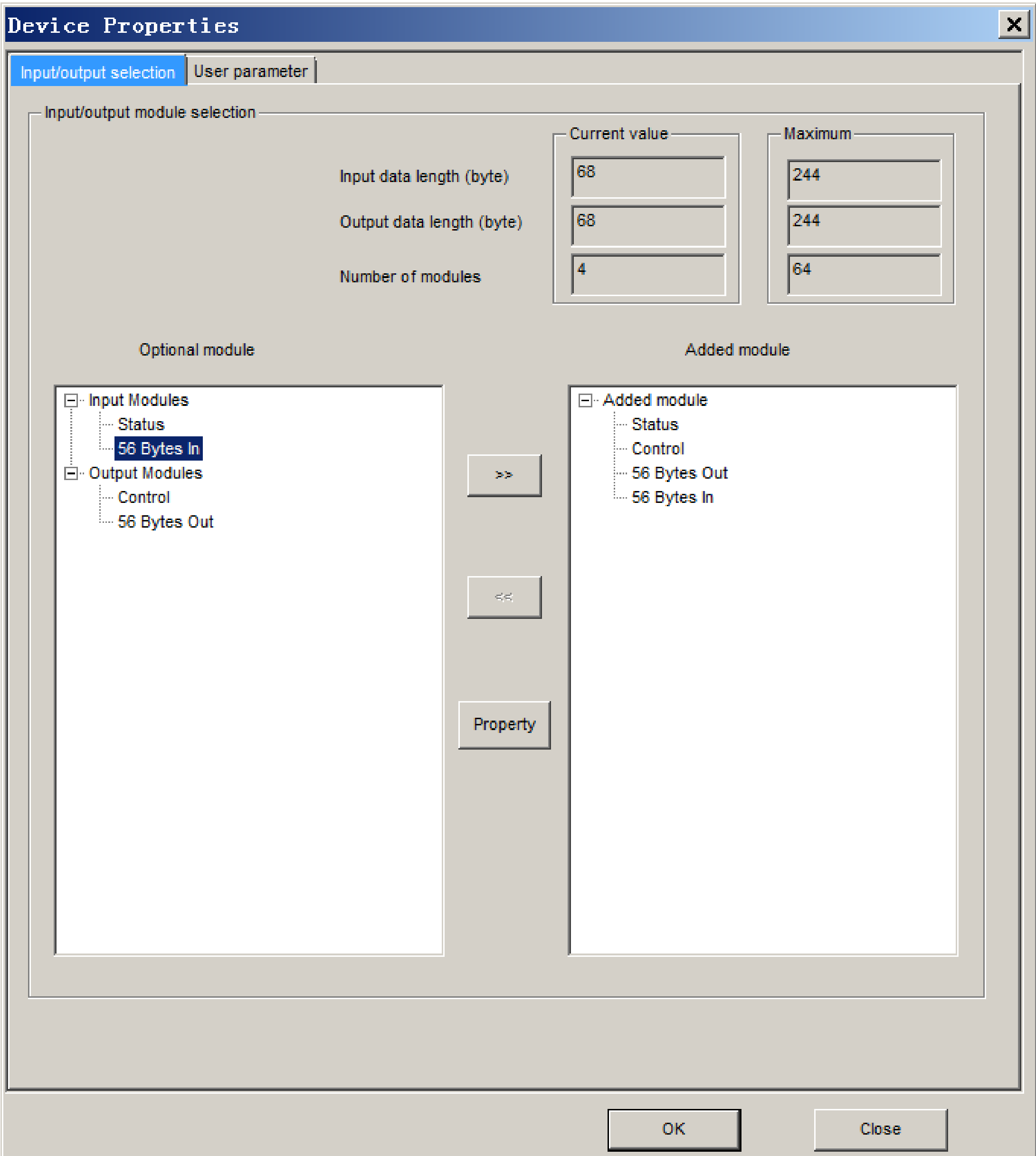
input byte length.

- When the read / write direction (RW) in COMM_RW_MODBUS_SLAVE (LK238 Modbus Slave Read and Write Communication Data) is read data, "read / write data length" (DataLength) is the required input byte length.
- In COMM_RW_FREEPORT (LK238 Free Protocol Read and Write Communication Data), the length of RecvLen in the input parameter FreeportIn+ 7byte (header length) is the required input byte length.

The number of output modules actually added is determined by the maximum output byte length among the following factors, and the data size of the output module (56 bytes × Number of additions) must be greater than the following maximum output byte length.

- Number of configuration instructions (InstructionNum) in COMM_SET_CONFIG (Read LK238 Communication Instruction Param) × The length of an instruction (12 bytes) is the required output byte length.
- Instruction parameters corresponding to the instruction ID number (InstructionIDs) in COMM_RW_MODBUS_MASTER (LK238 Modbus Master Read and Write Communication Data), the "datalength" corresponding to the (05/06/15/16) write function code is the required output byte length.
- When the read / write direction (RW) in COMM_RW_MODBUS_SLAVE (LK238 Modbus Slave Read and Write Communication Data) is write data, "read / write data length" (DataLength) is the required output byte length.
- In COMM_RW_FREEPORT (LK238 Free Protocol Read and Write Communication Data), the length of SendLength in the input parameter FreeportIn+ 10byte (header length) is the required output byte length.

The number of I / O modules can also be dynamically adjusted according to the byte requirements of the currently running instruction function block to release the communication data volume of DP link.



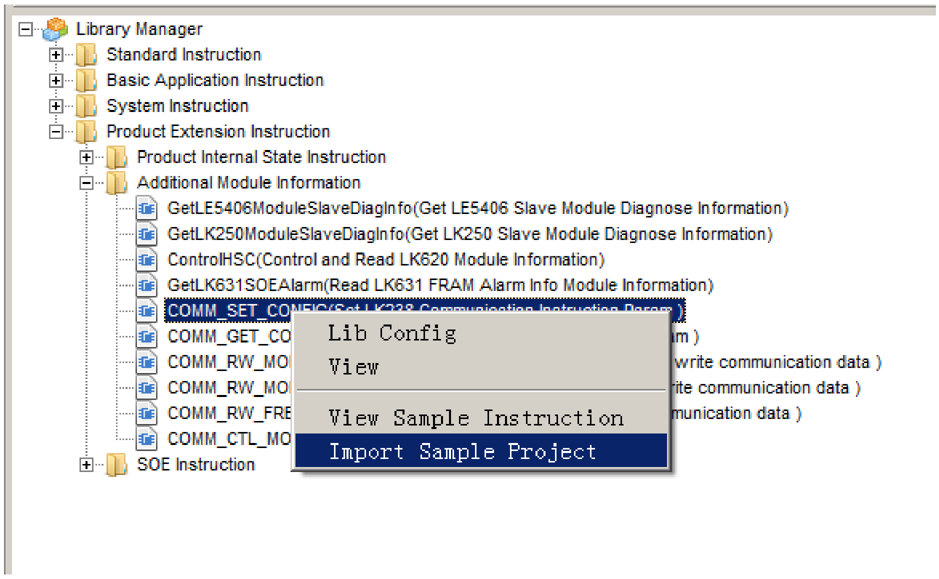
Input and Output Module of Modbus Master Sation

Note: the status and control fields must be added, and the status is before and the control is after. The control field and the configured Q area data (56 bytes out) are prohibited from direct operation and can be accessed through the function block.

6.3.7.9.3 Import the sample project through the library manager

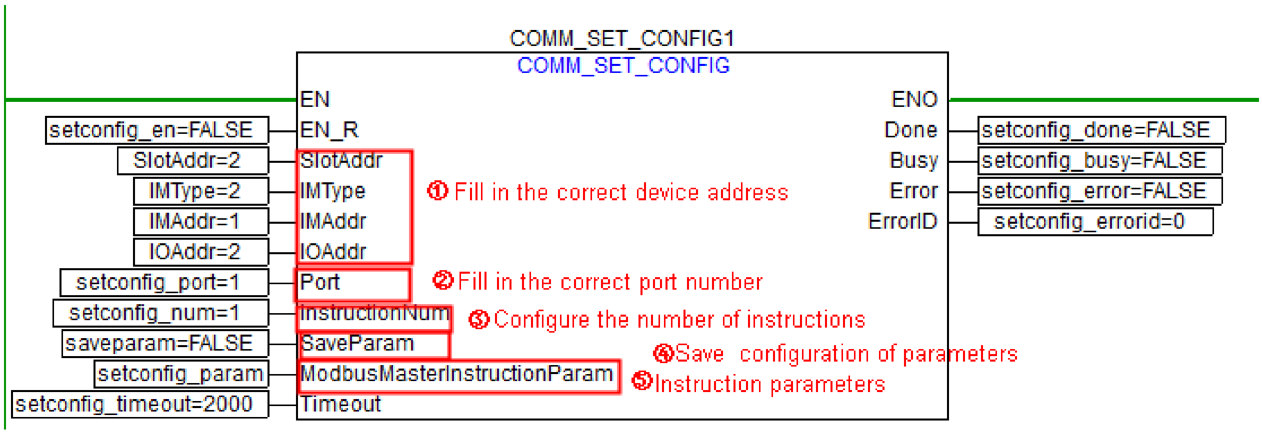
Through the library manager, find the required function block and right-click to import the sample project, as shown in the following figure.

The function blocks are imported in the form of POU. The variables of the imported example function blocks have been defined. You only need to configure the function block parameters according to the needs of the project.



Import the Sample Project

6.3.7.9.4 Use the configuration function block to configure the master parameters



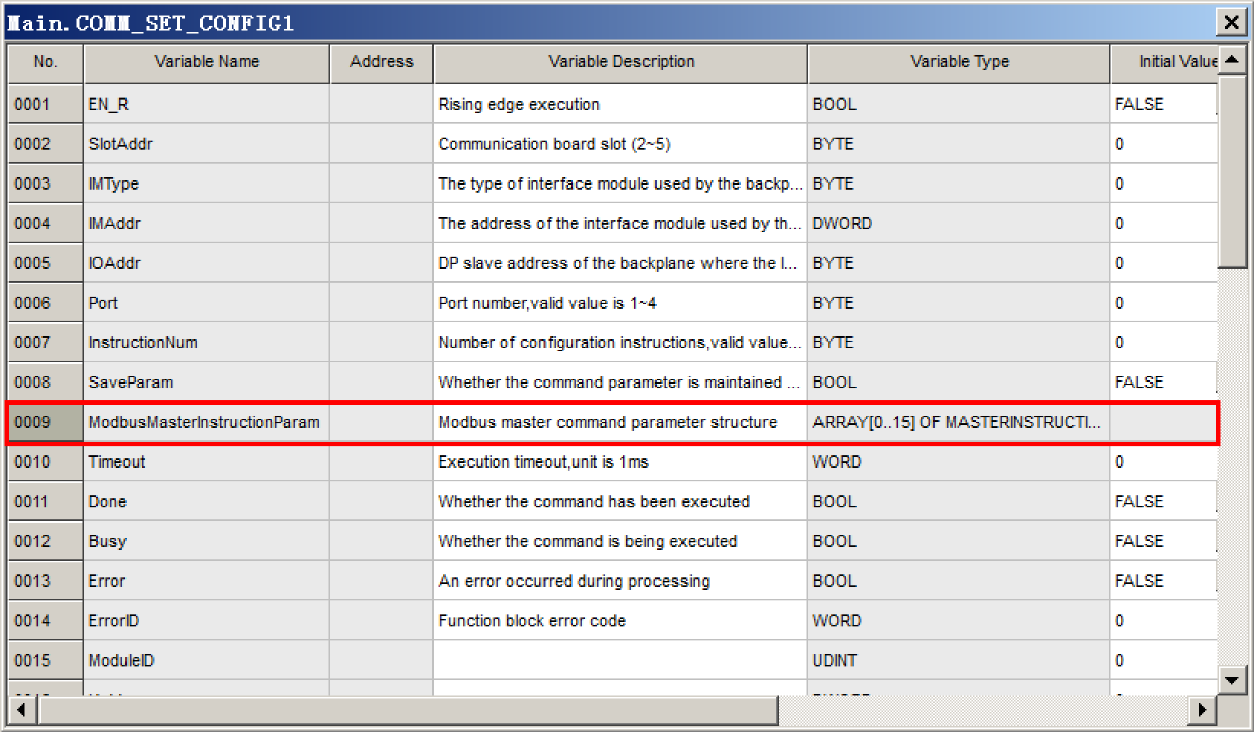
Configure the Master Parameters

(1) Fill in the correct device address. . SlotAddr shall fill in the slot number of the communication board on the master backplane, IMType shall fill in the type of interface module on the expansion backplane, IMAddr shall fill in the address of the interface module on the expansion backplane, and IOAddr shall fill in the slave address of LK238 module. See parameter description of COMM_SET_CONFIG(Set LK238 Communication Instruction Param) in instruction manual.

(2) Fill in the correct port number. LK238 has 4 serial ports. If the first serial port is used, fill in 1 for port.

(3) Configure the number of instructions. This function block can only be configured with 16 instructions at most at a time, and LK238 can support the configuration of 32 instruction parameters at most. If 32 instructions need to be configured, you need to fill in different parameters and call them twice, or call two comm_set_config function blocks for parameter configuration twice.

(4) When SaveParam is true, the configuration input parameter ModbusMasterInstructionParam remains when LK238 is powered off. If SaveParam is false, the parameter configuration is lostafter LK238 power down and needs to be reconfigured.



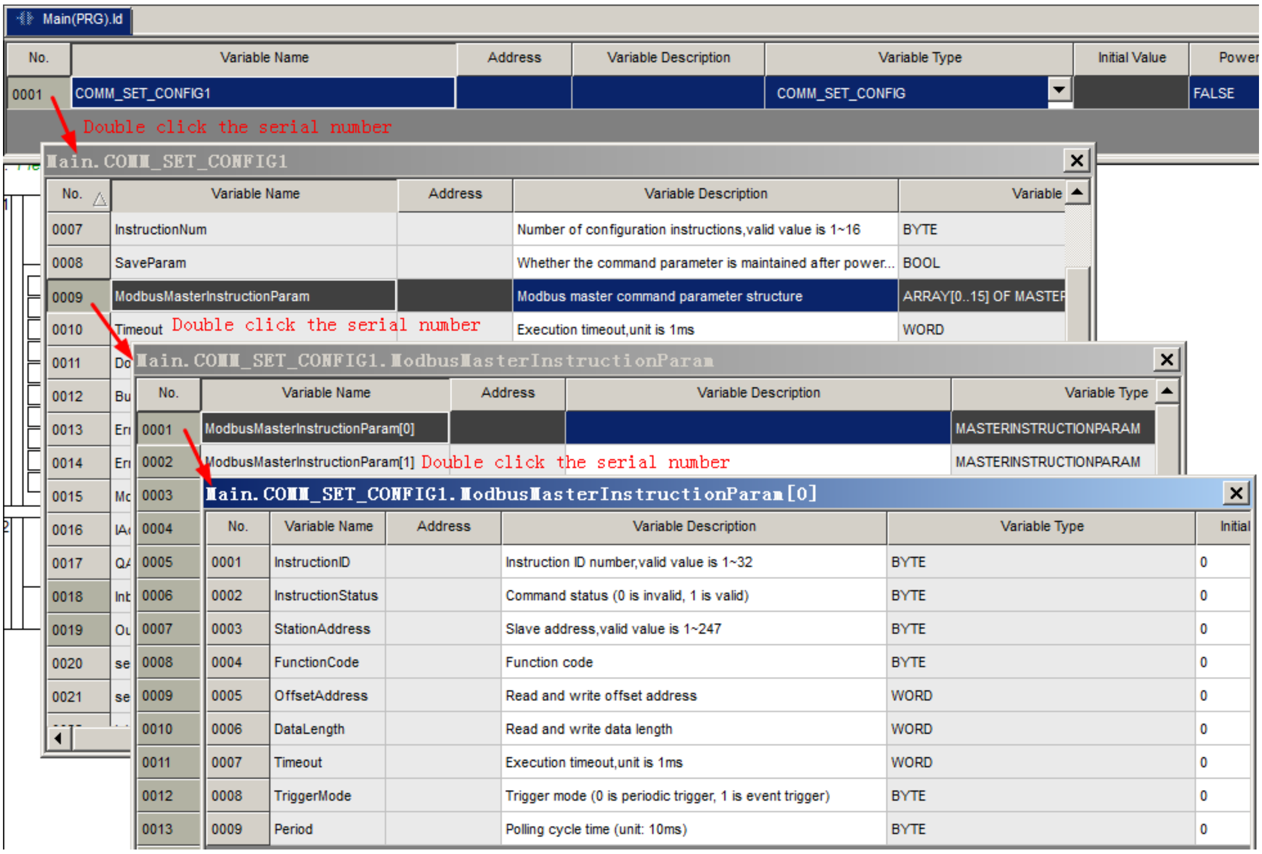
No.	Variable Name	Address	Variable Description	Variable Type	Initial Value
0001	EN_R		Rising edge execution	BOOL	FALSE
0002	SlotAddr		Communication board slot (2~5)	BYTE	0
0003	IMType		The type of interface module used by the backp...	BYTE	0
0004	IMAddr		The address of the interface module used by th...	DWORD	0
0005	IOAddr		DP slave address of the backplane where the I...	BYTE	0
0006	Port		Port number,valid value is 1~4	BYTE	0
0007	InstructionNum		Number of configuration instructions,valid value...	BYTE	0
0008	SaveParam		Whether the command parameter is maintained ...	BOOL	FALSE
0009	ModbusMasterInstructionParam		Modbus master command parameter structure	ARRAY[0..15] OF MASTERINSTRUCTI...	
0010	Timeout		Execution timeout,unit is 1ms	WORD	0
0011	Done		Whether the command has been executed	BOOL	FALSE
0012	Busy		Whether the command is being executed	BOOL	FALSE
0013	Error		An error occurred during processing	BOOL	FALSE
0014	ErrorID		Function block error code	WORD	0
0015	ModuleID			UDINT	0

Power Down Hold Parameters

(5) Here, take the configuration of an instruction as an example. The parameters contained in an instruction are shown in the table below. When the Modbus master station is configured with the following parameters, the preparation for communication has been completed.

Note: The controller downloading will not affect the communication configuration of the serial port module. When the controller project changes and the new project does not match the current communication configuration, it is necessary to reconfigure the communication command parameters of the serial port module.

When configuring communication command parameters, please open the command parameter list as shown in the following figure:



Open the Command Parameter Configuration Interface

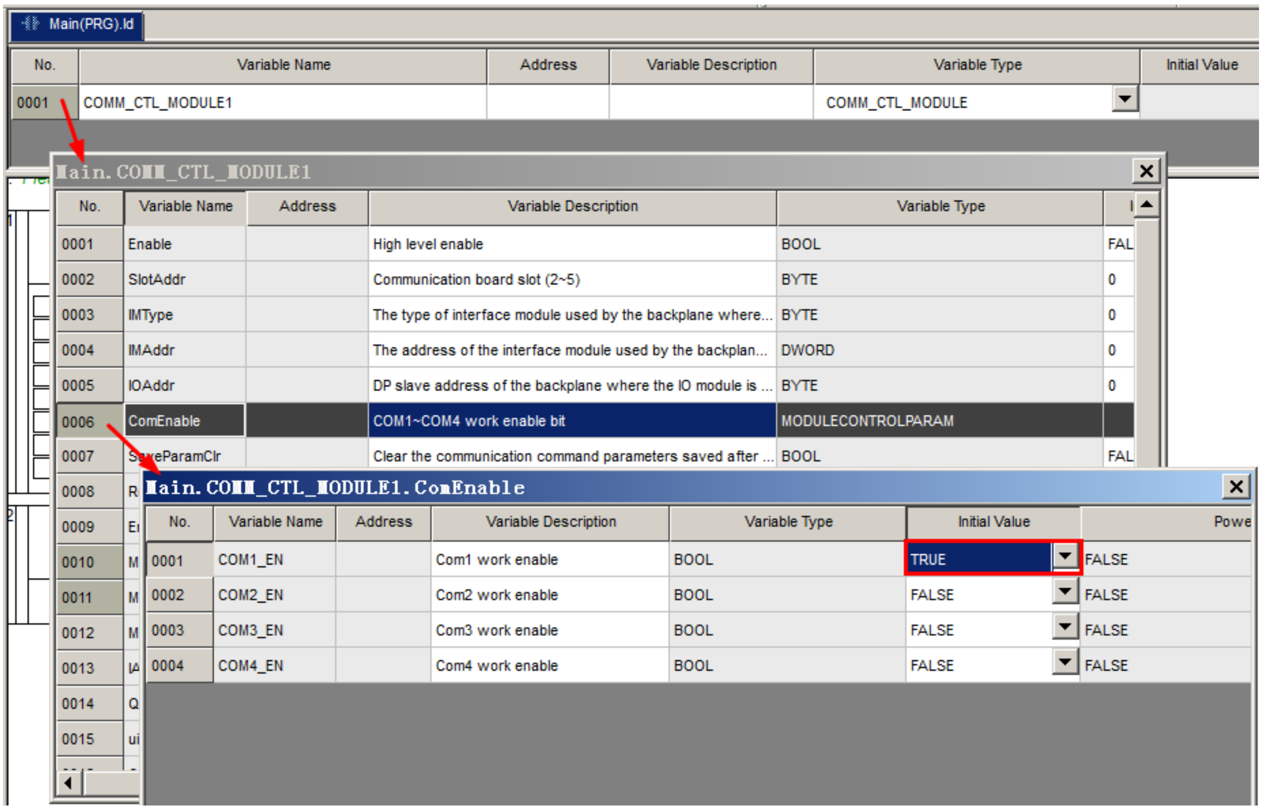
Instruction Parameters Description

Member variable	Data type	Parameter description
InstructionID	BYTE	Instruction ID number (1 ~ 32)
InstructionStatus	BYTE	Instruction status (0: invalid instruction, 1: effective instruction)
StationAddress	BYTE	Slave address (1 ~ 247)
FunctionCode	BYTE	0x01 (read coil), 0x02 (read discrete input), 0x03 (read hold register), 0x04 (read input register), 0x05 (write single coil), 0x06 (write single register), 0x0f (write multiple coils), 0x10 (write multiple registers)
OffsetAddress	WORD	Read / write offset address
DataLength	WORD	Read / write switching value / analog data length Switching value: 1 ~ 1600 Analog quantity: 1 ~ 100
Timeout	WORD	Execution timeout (unit: 1ms), When it is set to 0, the default value is 1000
TriggerMode	BYTE	Trigger mode 0: cycle trigger, When the parameter configuration is successful and the protocol port is enabled, MODBUS starts communication according to the polling cycle set by period 1: event trigger, when the parameter configuration is successful and the protocol port is enabled, through rising edge of EN_R of COMM_RW_MODBUS_MASTER (LK238 Modbus Master Read and Write Communication Data)_ triggers Modbus communication once
Period	BYTE	Polling cycle time (unit: 10ms),when set to 0, the default polling mode is dead pocket type

6.3.7.9.5 Enable protocol port

The COMM_CTL_MODULE function block is required here. Enable the corresponding port. When enabled, you can see that the light of the corresponding port starts to flash.

When enable the port, operate as shown in the figure below, double-click the serial number label in front of the variable to open the configuration window, and set the working enabling of the corresponding port to true.

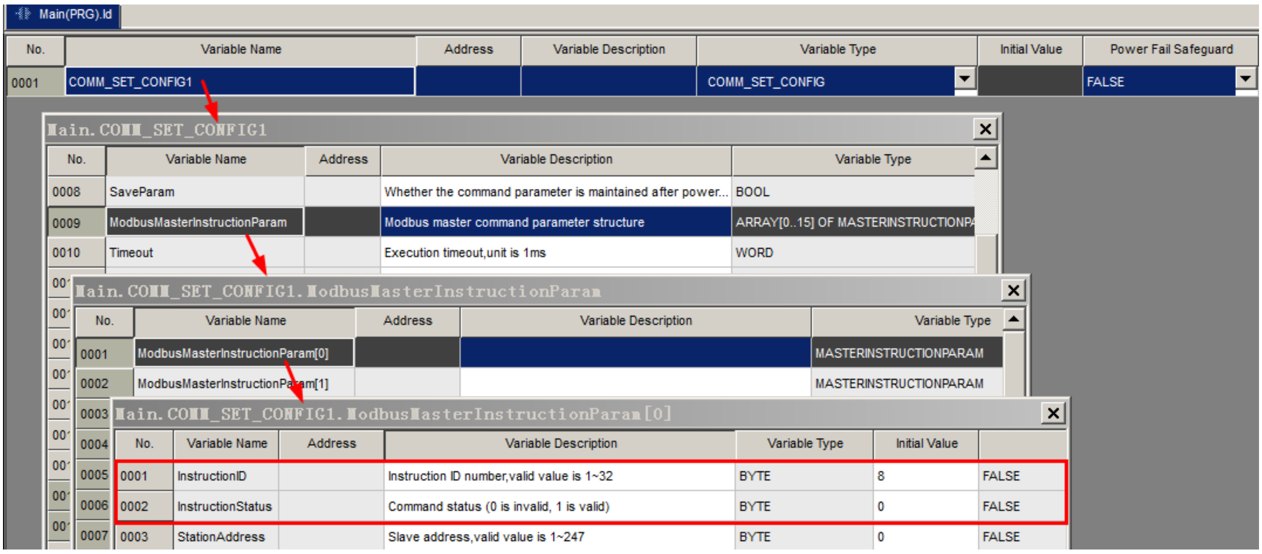


COMM_CTL_MODULE Function Block

6.3.7.9.6 Clear MODBUS Master Command Parameters

The Modbus master station command parameters of non power down hold are cleared:

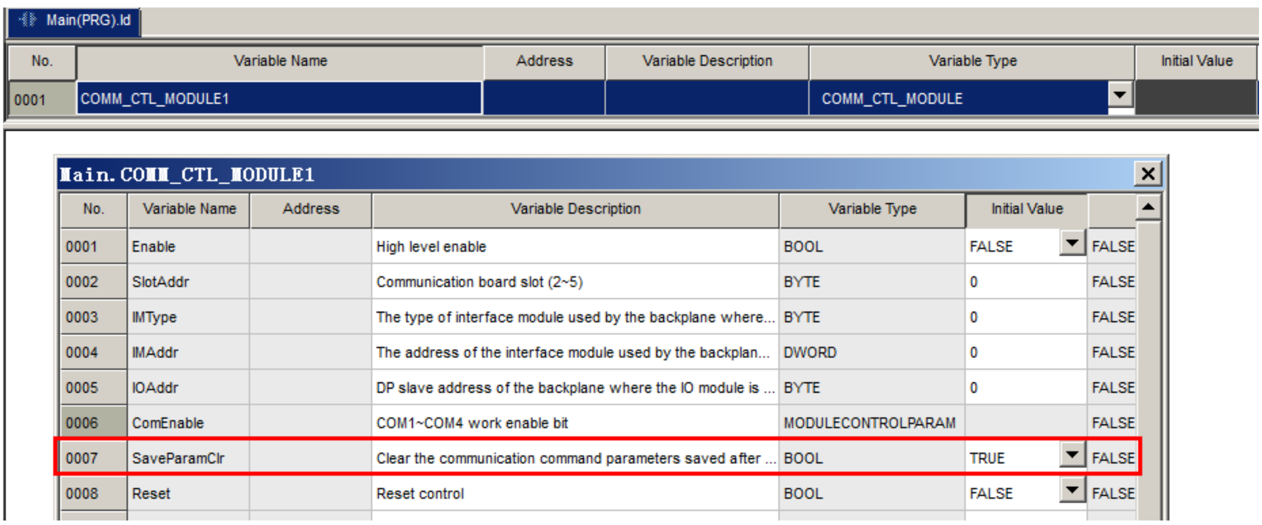
Delete the specified instruction parameters by calling COMM_SET_CONFIG function block, the instruction parameter structure of Modbus master station specifies the instruction ID to be deleted, and specifies that the instruction status is 0, which means that the instruction ID is an invalid instruction.



Delete Specified Instruction

In case of hot start or cold start of the module, all the command parameters of Modbus master station not maintained by power down will be cleared. For example, when the DP baud rate is switched, it will cause the module to be hot started, or after the module is powered off and cold started, it will cause all the command parameters of the Modbus master station that are not powered off and held to be cleared.

The Modbus master command parameter of power down hold can be cleared only by calling COMM_CTL_MODULE function block, set the saveparamclr pin to true to realize all the command parameters of the Modbus master station maintained by power failure of the four COM ports.



Delete Power Down Hold Command Parameters

6.3.7.9.7 Read and write data to MODBUS master station

The parameters SlotAddr/IMType/IMAddr/IOAddr/Port are filled in the same way as those in the comm. they will not be repeated here. The following parameters will be emphasized.

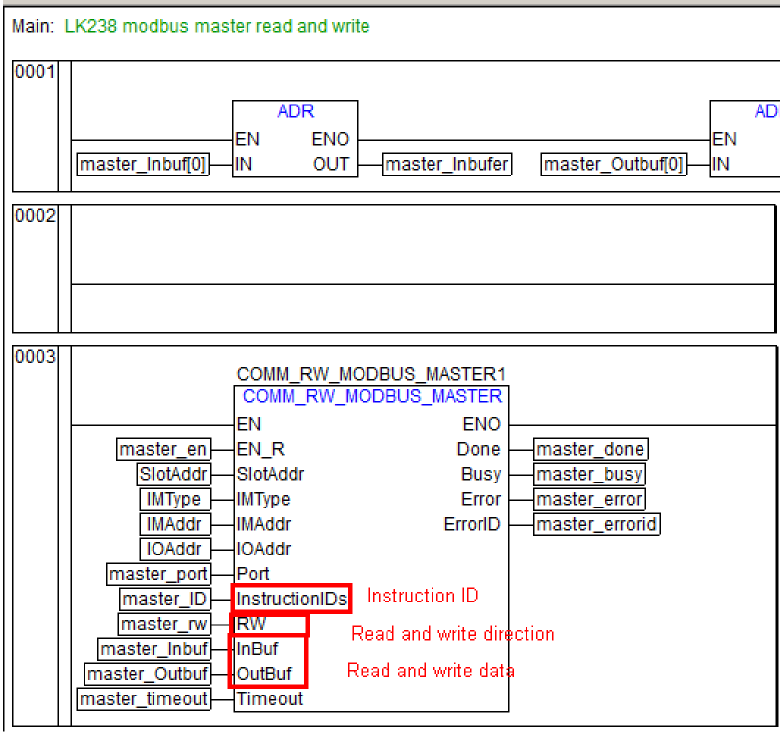
(1)InstructionIDs is the instruction ID successfully configured through

Use_the_configuration_function_block_to_configure_the_master_parameters . when LK238 is configured with 32 instructions (1 ~ 32), fill in the ID number here and read and write the data of the corresponding ID.

(2) When RW is 1, write data to Modbus master station; when RW is 0, read Modbus master station data.

(3) As shown in the figure below, the read data is put into the Inbuf buffer, and the written data is put into the OutBuf buffer.

No.	Variable Name	Address	Variable Description	Variable Type	Initial Value	Power F
0001	COMM_RW_MODBUS_MASTER1			COMM_RW_MODBUS_MASTER		FALSE
0002	master_en			BOOL	FALSE	FALSE
0003	SlotAddr		Slot(2~5)	BYTE	0	FALSE
0004	IMType		module type	BYTE	0	FALSE
0005	IMAddr		module address	DWORD	0	FALSE
0006	IOAddr		module slave address	BYTE	0	FALSE
0007	master_port		port(1~4)	BYTE	0	FALSE
0008	master_ID		instruction ID(1 ~ 32)	BYTE	0	FALSE
0009	master_rw		Read and write direction	BOOL	FALSE	FALSE
0010	master_Inbuf	Read data to modbus master station	Input data buffer	ARRAY[0..223] OF BYTE		FALSE
0011	master_Outbuf	Write data to modbus master station	Output data buffer	ARRAY[0..223] OF BYTE		FALSE



Configure Parameters

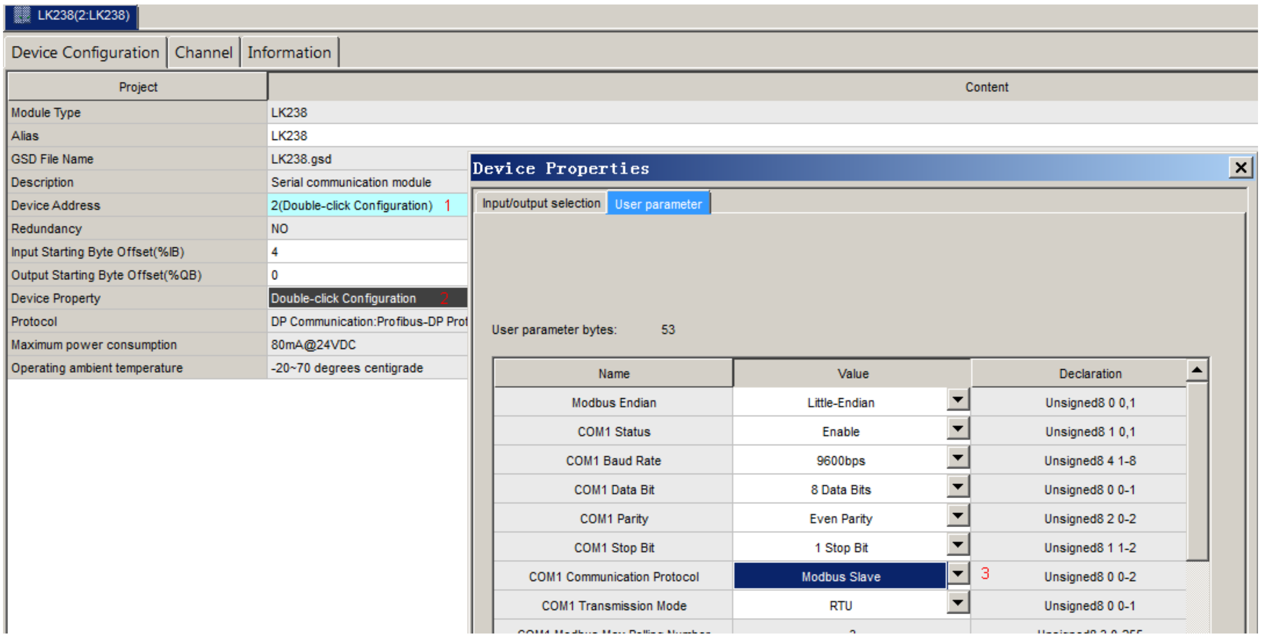
6.3.7.10 LK238 as a Modbus Slave

6.3.7.10.1 User parameter select Modbus slave

(1) Configure the correct device address

(2) Select Modbus slave for protocol type

(3) Modbus Endian: byte order processing, which is used to adapt to the size end of the controller. The data reading format of the controller is little endian and the default value here is "Little Endian".



Select Modbus Slave

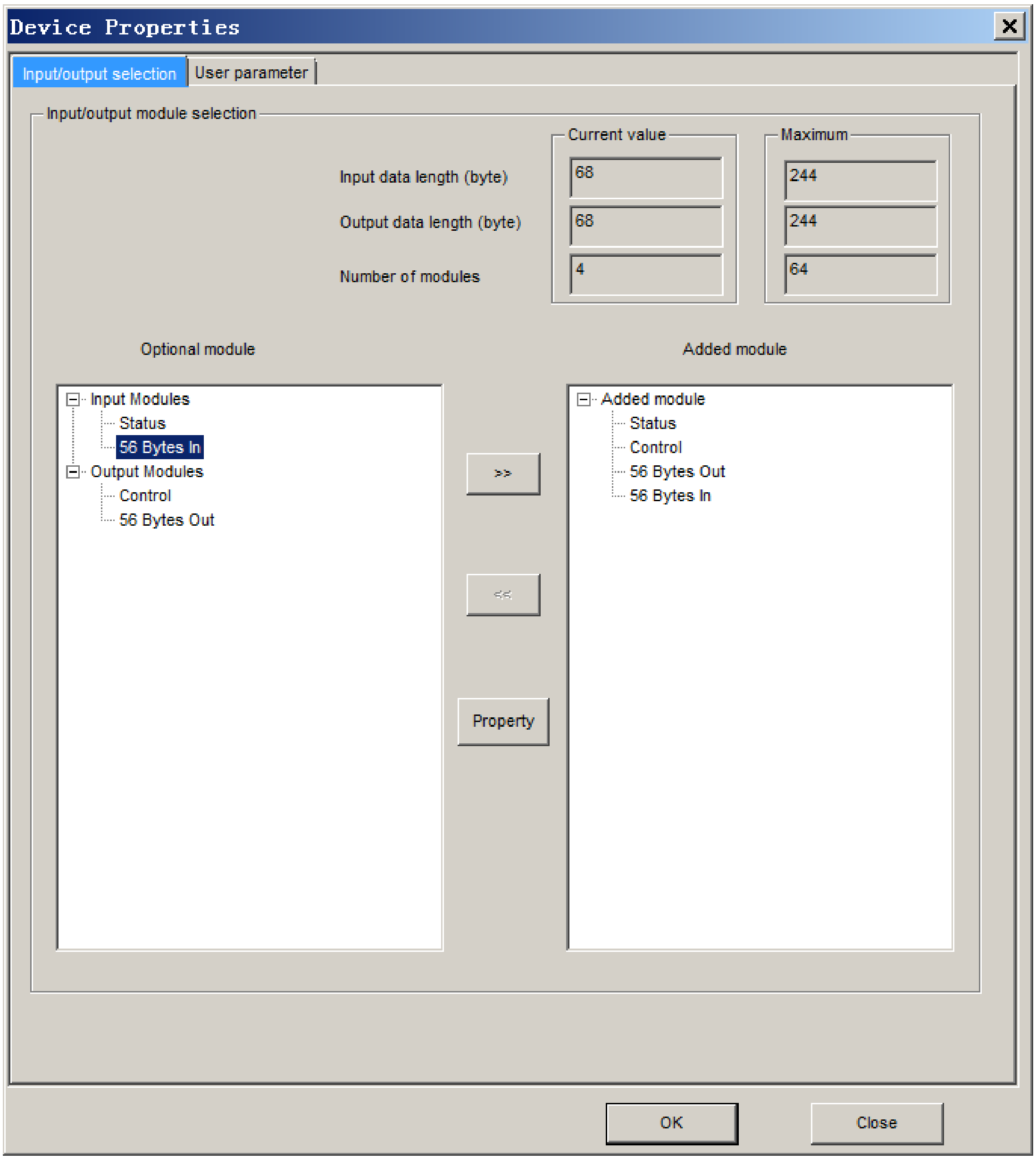
6.3.7.10.2 Add Input and Output Modules

[Input/Output Selection] The tab page is used to configure the data space on the Modbus side of the LK238 module to realize the data transmission between the LK238 and the external Modbus station.

The data length in the module is limited, the maximum length of input data is 236 bytes, and the maximum length of output data is 236 bytes. When the added data exceeds the limited length, an error message will pop up.

As shown in the figure below, all optional input and output data are displayed in the optional module list box on the left, select the data that needs to be added, Click the button >> , Add the data to the added module list box on the right.

See Add_Input_and_Output_Modules for the number of input and output modules actually added.



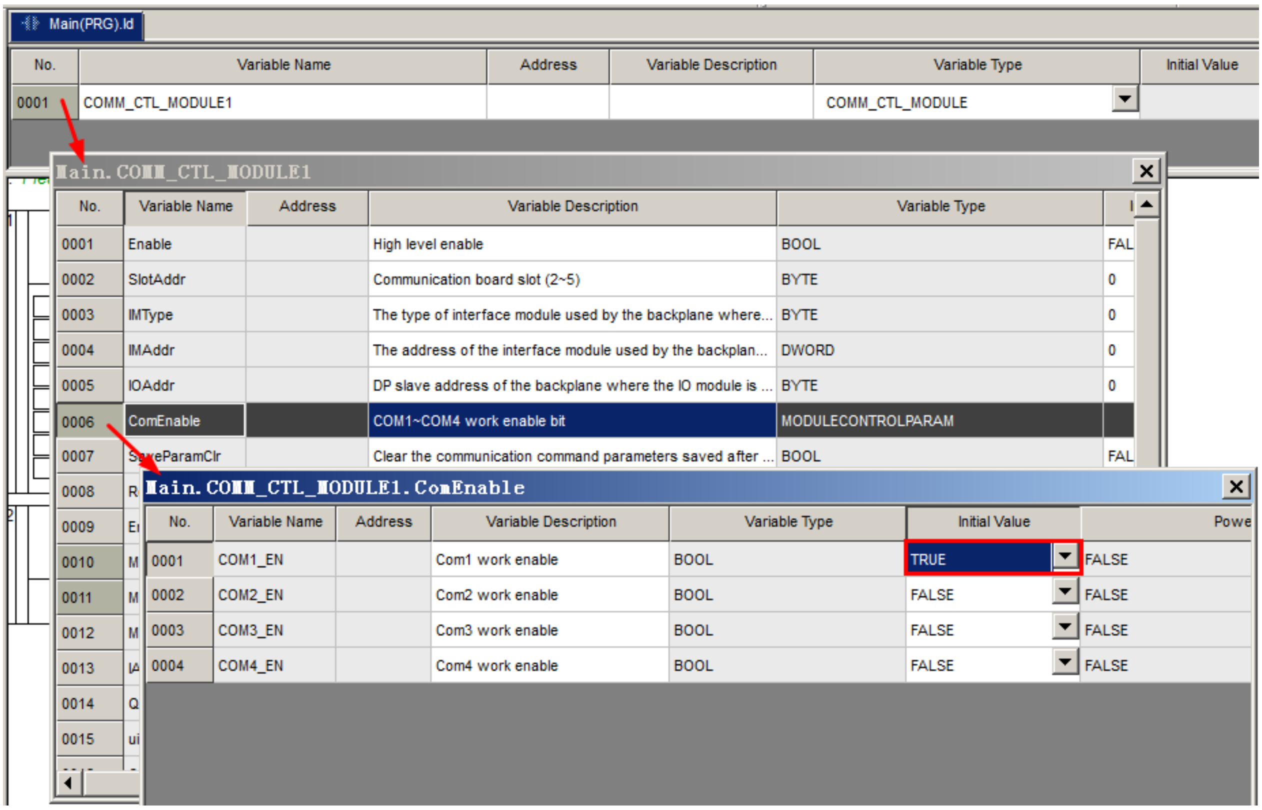
Input and Output Module of Modbus Master Sation

Note: the status and control fields must be added, and the status is before and the control is after. The control field and the configured Q area data (56 bytes out) are prohibited from direct operation and can be accessed through the function block.

6.3.7.10.3 Enable protocol port

The COMM_CTL_MODULE function block is required here. Enable the corresponding port. When enabled, you can see that the light of the corresponding port starts to flash.

When enable the port, operate as shown in the figure below, double-click the serial number label in front of the variable to open the configuration window, and set the working enabling of the corresponding port to true.

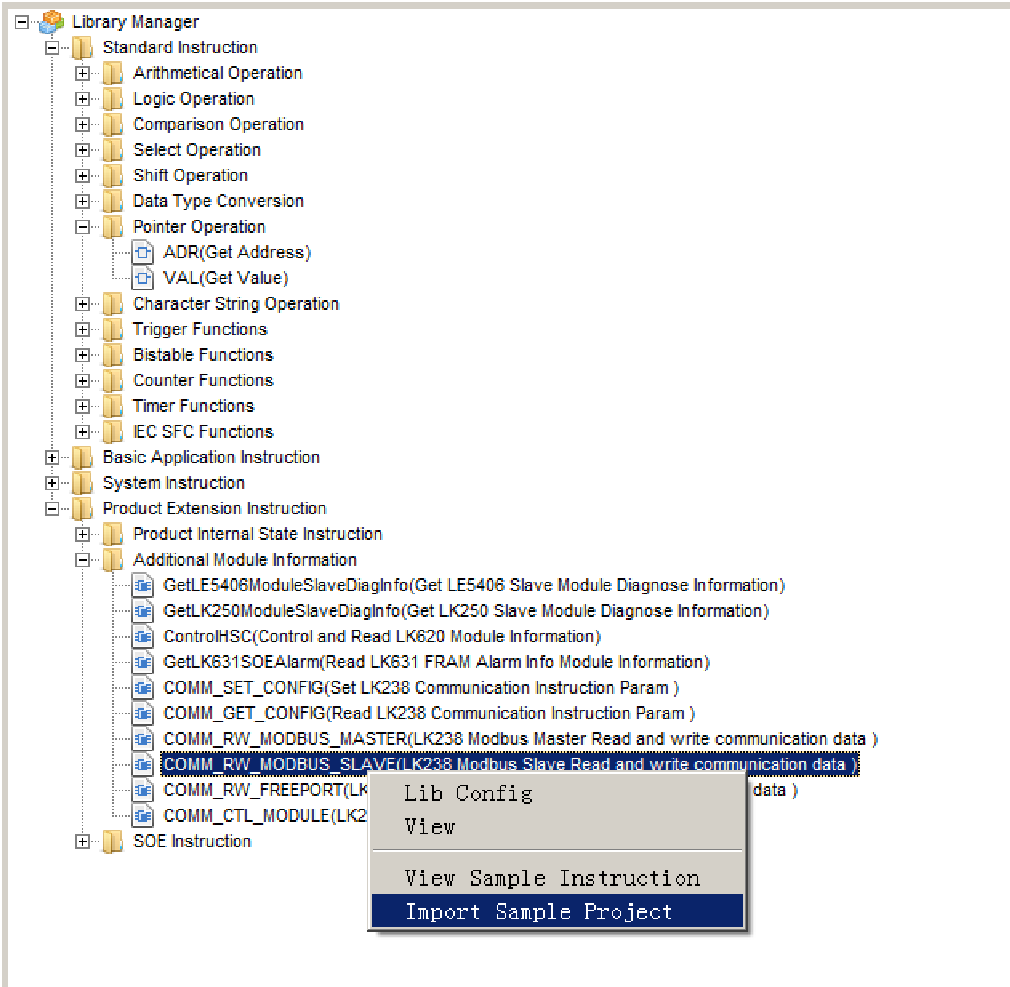


COMM_CTL_MODULE Function Block

6.3.7.10.4 Import the sample project through the library manager

Through the library manager, find the required function block and right-click to import the sample project, as shown in the following figure.

The function blocks are imported in the form of POU. The variables of the imported example function blocks have been defined. You only need to configure the function block parameters according to the needs of the project.



Import the Sample Project

6.3.7.10.5 Read and write data to MODBUS slave station

(1) Fill in the correct device address. SlotAddr shall fill in the slot number of the communication board on the master backplane, IMType shall fill in the type of interface module on the expansion backplane, IMAddr shall fill in the address of the interface module on the expansion backplane, and IOAdd shall fill in the slave address of LK238 module. See parameter description of COMM_SET_CONFIG(Set LK238 Communication Instruction Param) in instruction manual.

(2) Fill in the correct port number. LK238 has 4 serial ports. If the first serial port is used, fill in 1 for port.

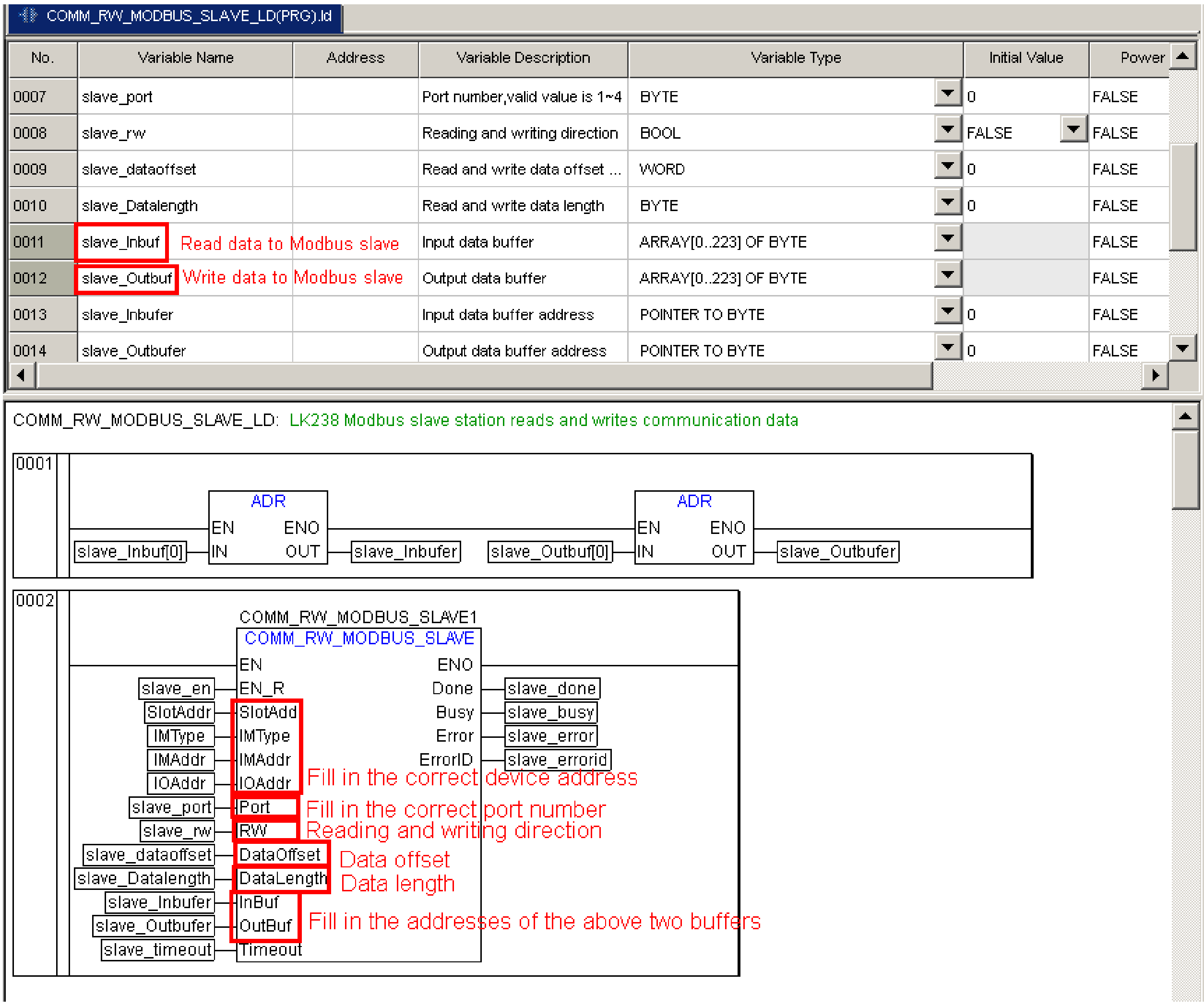
(3) When RW is 1, write data to Modbus slave, and when RW is 0, read Modbus slave data.

(4) Dataoffset is the read / write data offset address, which indicates that the data is read from the address of the Modbus slave station

(5) Datalength is the read data length, indicating that the data of datalength length is read from this position (dataoffset).

(6) Read the data from Modbus slave station with DataLength and DataOffset address and put it into

the inbuf buffer, and put the data that written to Modbus slave station with DataLength and DataOffset address into the OutBuf.



Parameter Configuration

In the Modbus slave protocol, four serial ports jointly maintain a Modbus slave data area. The Modbus master station reads and writes the data in the data area by specifying the read-write address as the access offset address of the data area.

6.3.7.11 LK238 as a Free Port

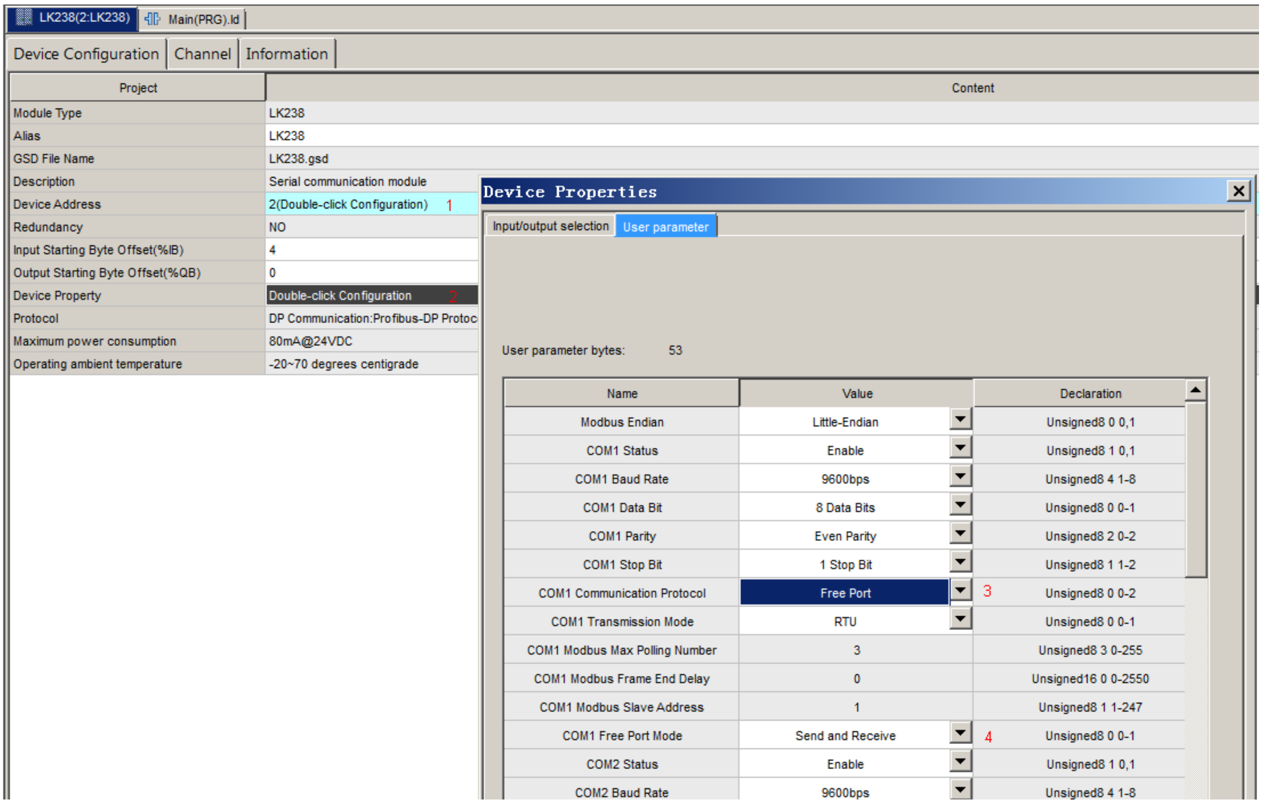
6.3.7.11.1 User parameter select free port

(1) Configure the correct device address

(2) Select free port for protocol type

(3) Select the free port protocol type mode, which is divided into receive only mode and send receive mode. If the user only uses LK238 to receive external serial port data and does not send

data out through LK238, please select only receive mode.



Select Free Port

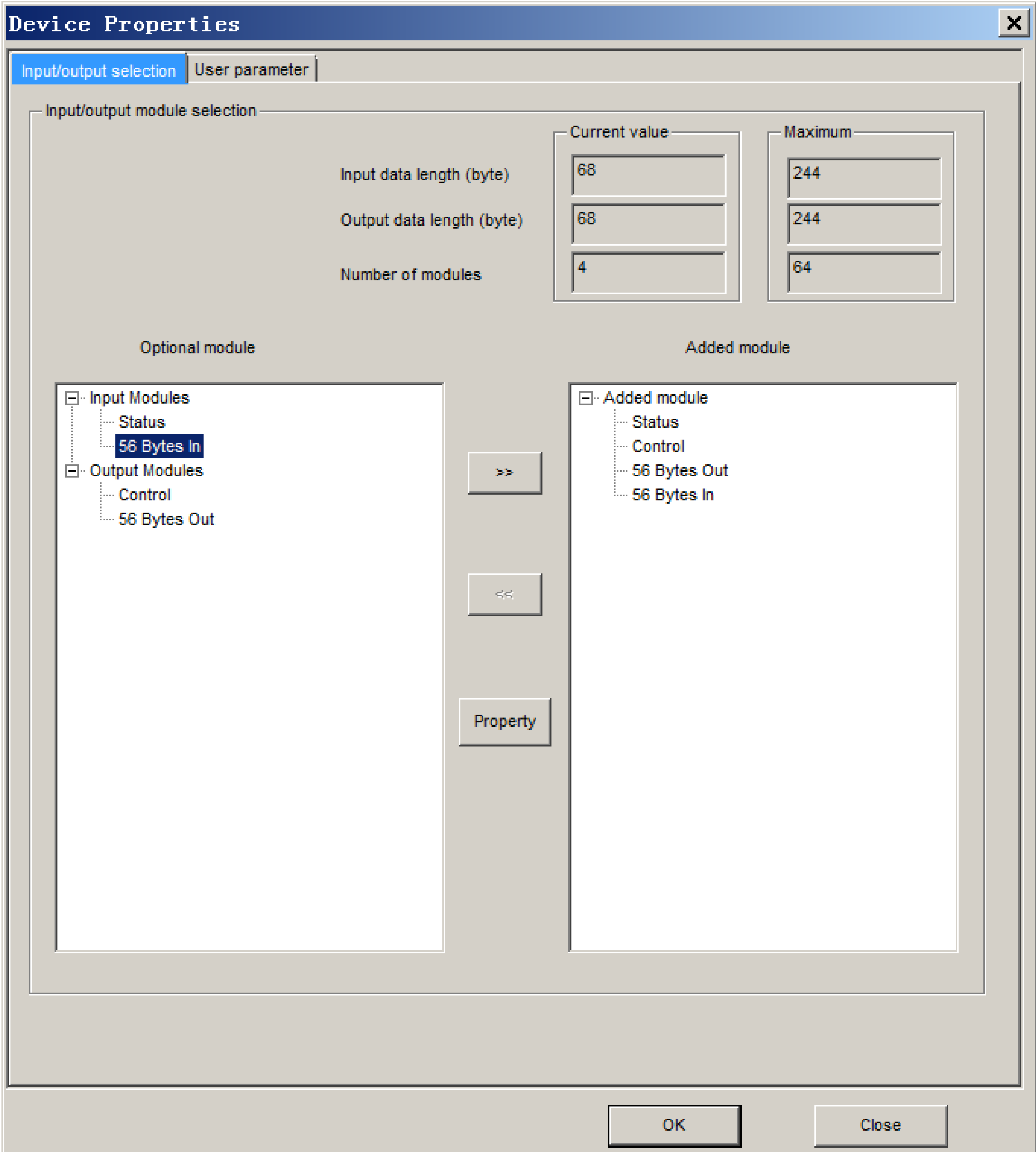
6.3.7.11.2 Add Input and Output Modules

[Input/Output Selection] The tab page is used to configure the data space on the Modbus side of the LK238 module to realize the data transmission between the LK238 and the external Modbus station.

The data length in the module is limited, the maximum length of input data is 236 bytes, and the maximum length of output data is 236 bytes. When the added data exceeds the limited length, an error message will pop up.

As shown in the figure below, all optional input and output data are displayed in the optional module list box on the left, select the data that needs to be added, Click the button >> , Add the data to the added module list box on the right.

See Add_Input_and_Output_Modules for the number of input and output modules actually added.



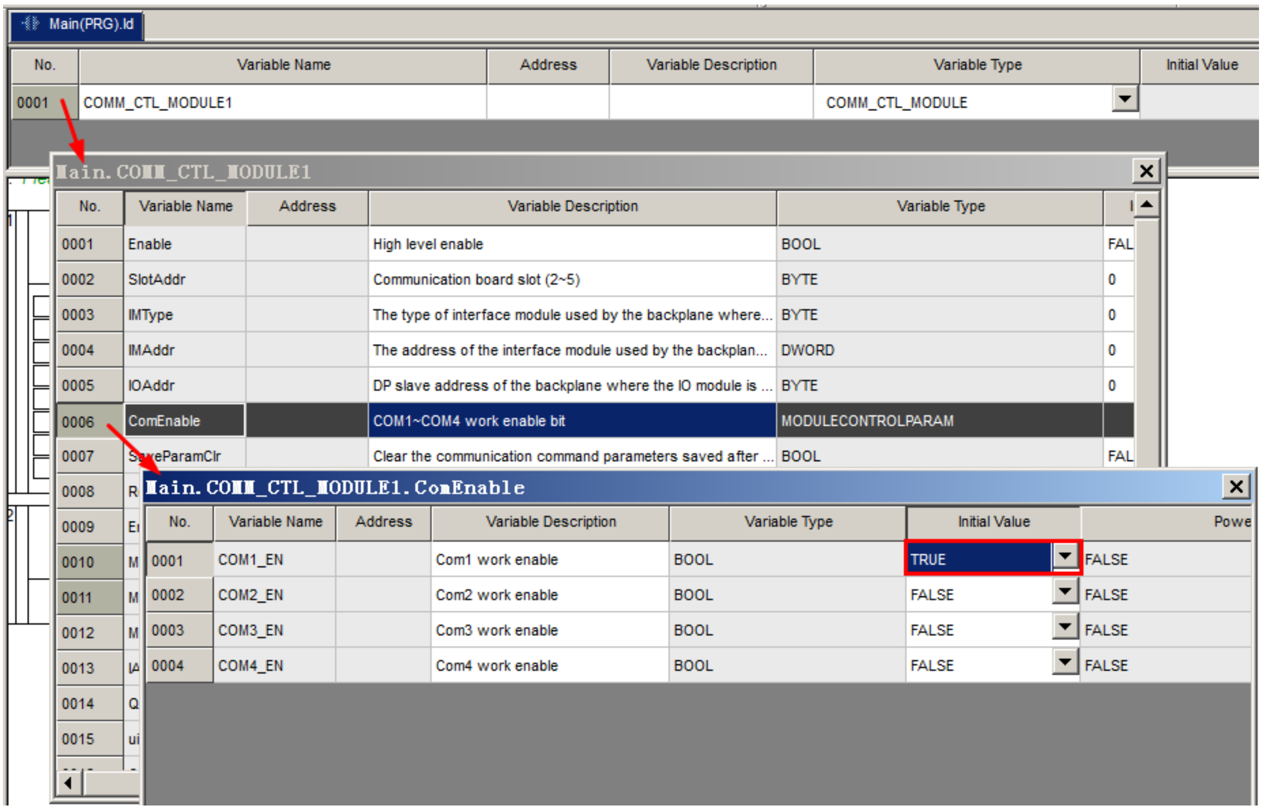
Input and Output Module of Modbus Master Sation

Note: the status and control fields must be added, and the status is before and the control is after. The control field and the configured Q area data (56 bytes out) are prohibited from direct operation and can be accessed through the function block.

6.3.7.11.3 Enable protocol port

The COMM_CTL_MODULE function block is required here. Enable the corresponding port. When enabled, you can see that the light of the corresponding port starts to flash.

When enable the port, operate as shown in the figure below, double-click the serial number label in front of the variable to open the configuration window, and set the working enabling of the corresponding port to true.

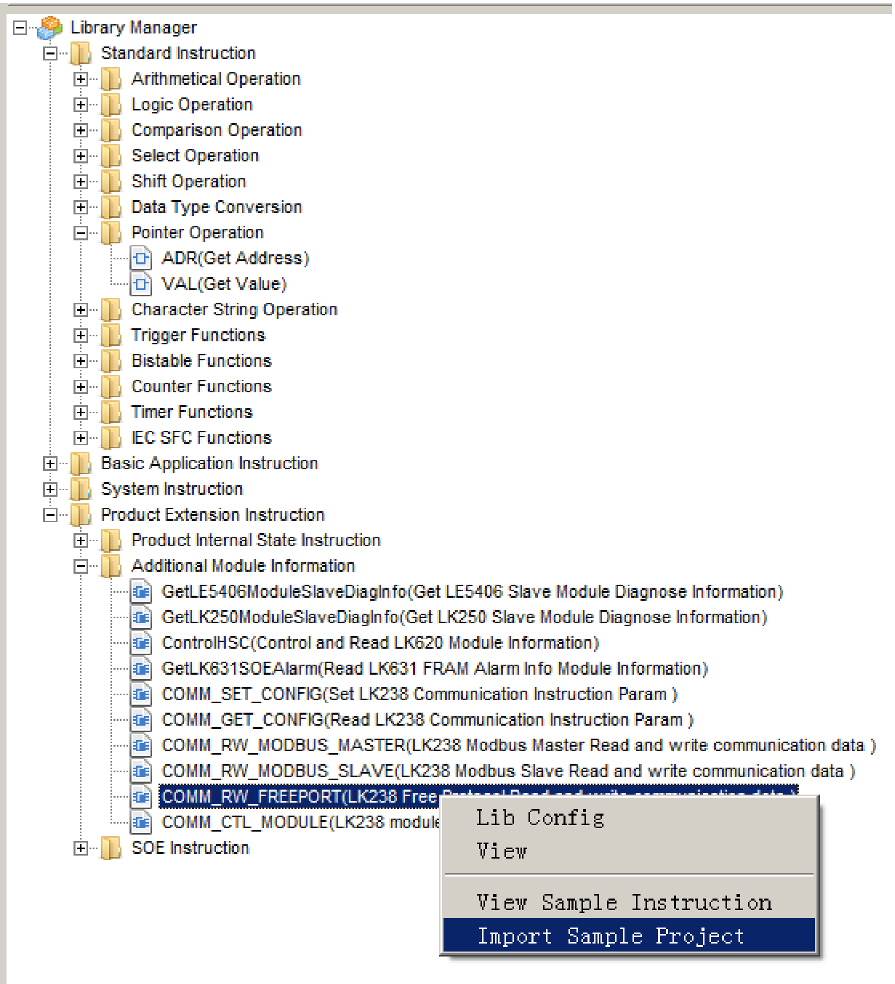


COMM_CTL_MODULE Function Block

6.3.7.11.4 Import the sample project through the library manager

Through the library manager, find the required function block and right-click to import the sample project, as shown in the following figure.

The function blocks are imported in the form of POU. The variables of the imported example function blocks have been defined. You only need to configure the function block parameters according to the needs of the project.



Import the Sample Project

6.3.7.11.5 Use the free port to receive and send data

If the user only uses LK238 to receive external serial port data and does not send data out through LK238, please select Only Receive mode.

In Only Receive mode, FreeportIn.RecvEn (the rising edge is enabled, and the high level continues to receive data). If the configuration parameter FreeportIn.RecvEn is true, LK238 will enter the automatic data receiving state when the EN_R of the function block COMM_RW_FREEPORT is enabled; if the configuration parameter FreeportIn.RecvEn is false, when the EN_R of the function block COMM_RW_FREEPORT is enabled, the free port will initialize and clear the previously received data.

Note: after receiving length / receiving character / receiving mode and other parameters are modified, to take effect, you need to send Rising edge to FreeportIn.RecvEn again.

If the start character is enabled, the data will be received from the start character. If the start character is not received, the data will be discarded; If the start character is prohibited, the length and end character must be enabled, otherwise an error will be reported; If the reception length is set to 0, the start and end characters must be enabled.

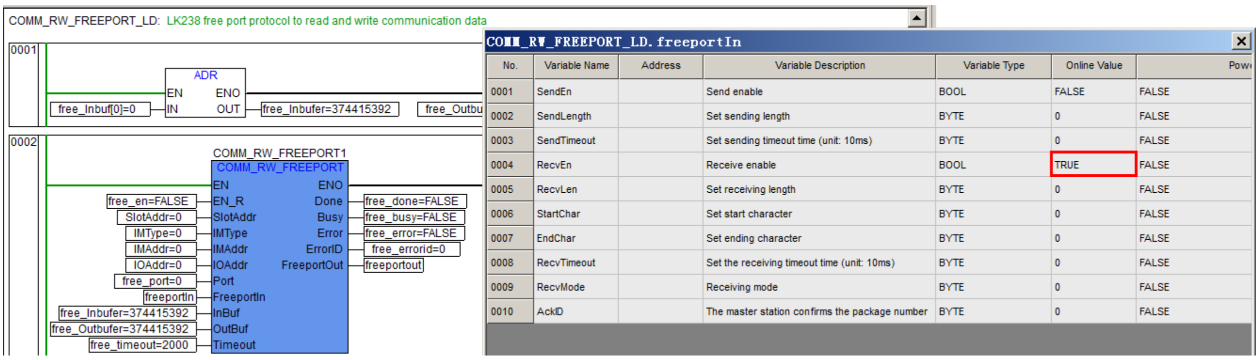
When receiving data, if the end character is enabled, stop receiving this packet with the end character and continue to receive the next packet; If the end character is prohibited, the start character is enabled, and the enable length will end the reception after the specified data length with the start character as the header is filled. Only receive mode has a cache, which will put the data sent by the peripheral into the buffer (32 * 64 bytes can cache 64 packets of data in total, each packet is 32bytes, and the part less than 32bytes will be calculated as one packet. If more than 64 packets of data are not taken away in time, the new data will overwrite the old data), and then add the ID to submit it to the master in order.

Use steps:

When the sender has not sent data

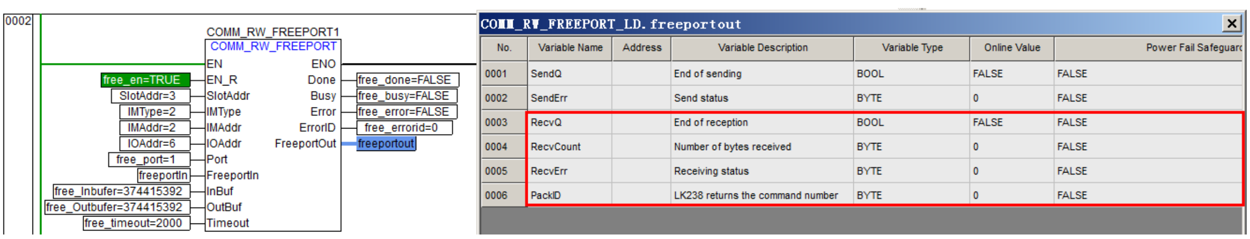
a. Enable reception

Here, take the enable length as an example



Enable Length

b. Enable function block pin EN_ R



Enable Function Block Pin

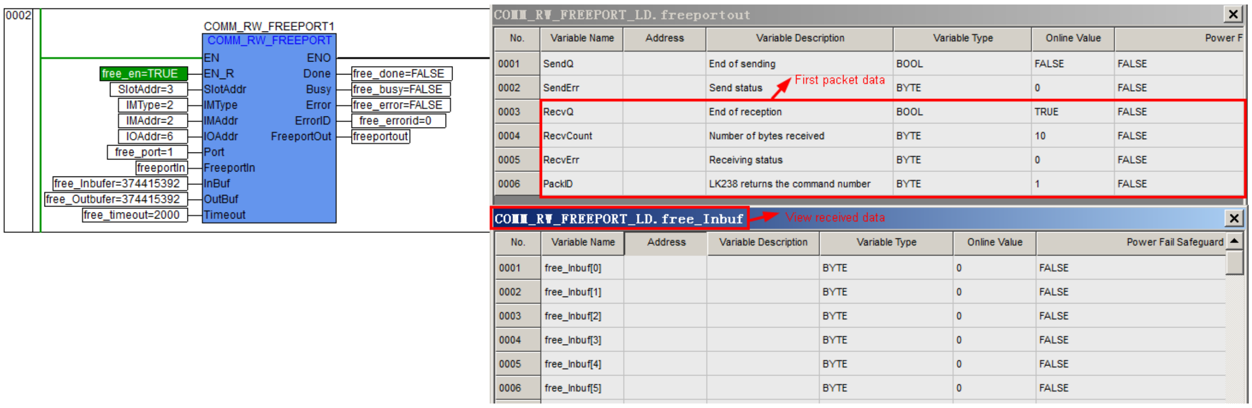
When the sender sends data

c. Give rising edge to EN_R again

Two situations may occur at this time

When PackID is 1, the first packet of data is received

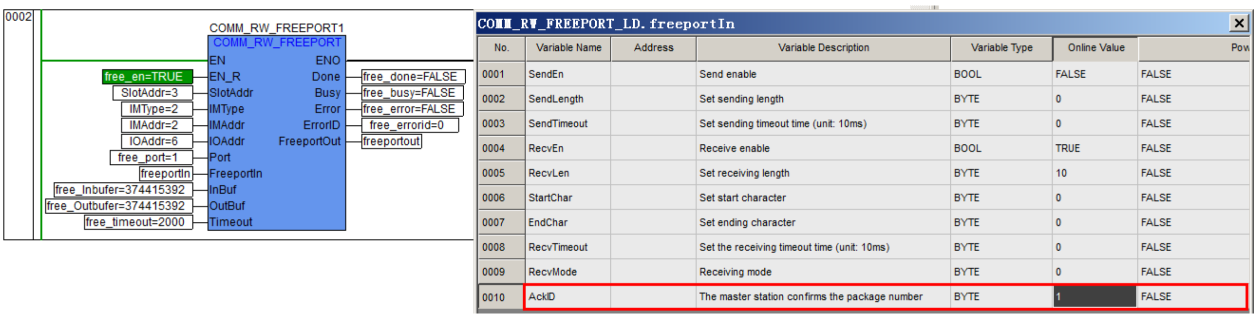
When PackID is still 0, it means that the first packet of data has not been received. At this time, it needs to sent rising edge to function block EN_R again.



Send Data

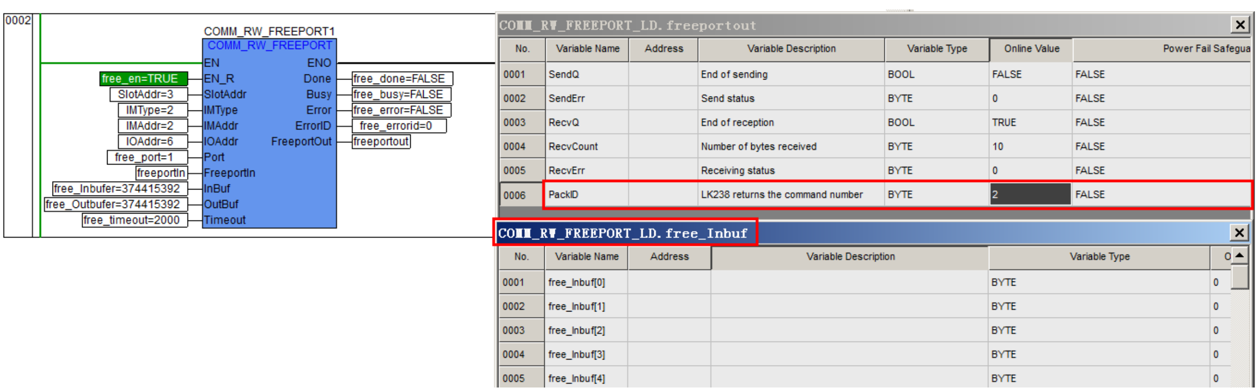
d. After receiving the first packet of data

At this time, it should be noted that the PackID value is assigned to the AckID. The current PackID is 1, so the AckID is 1; After changing the value of AckID, it needs to sent rising edge to function block EN_R again



Receive Data

e. Repeat steps c and d

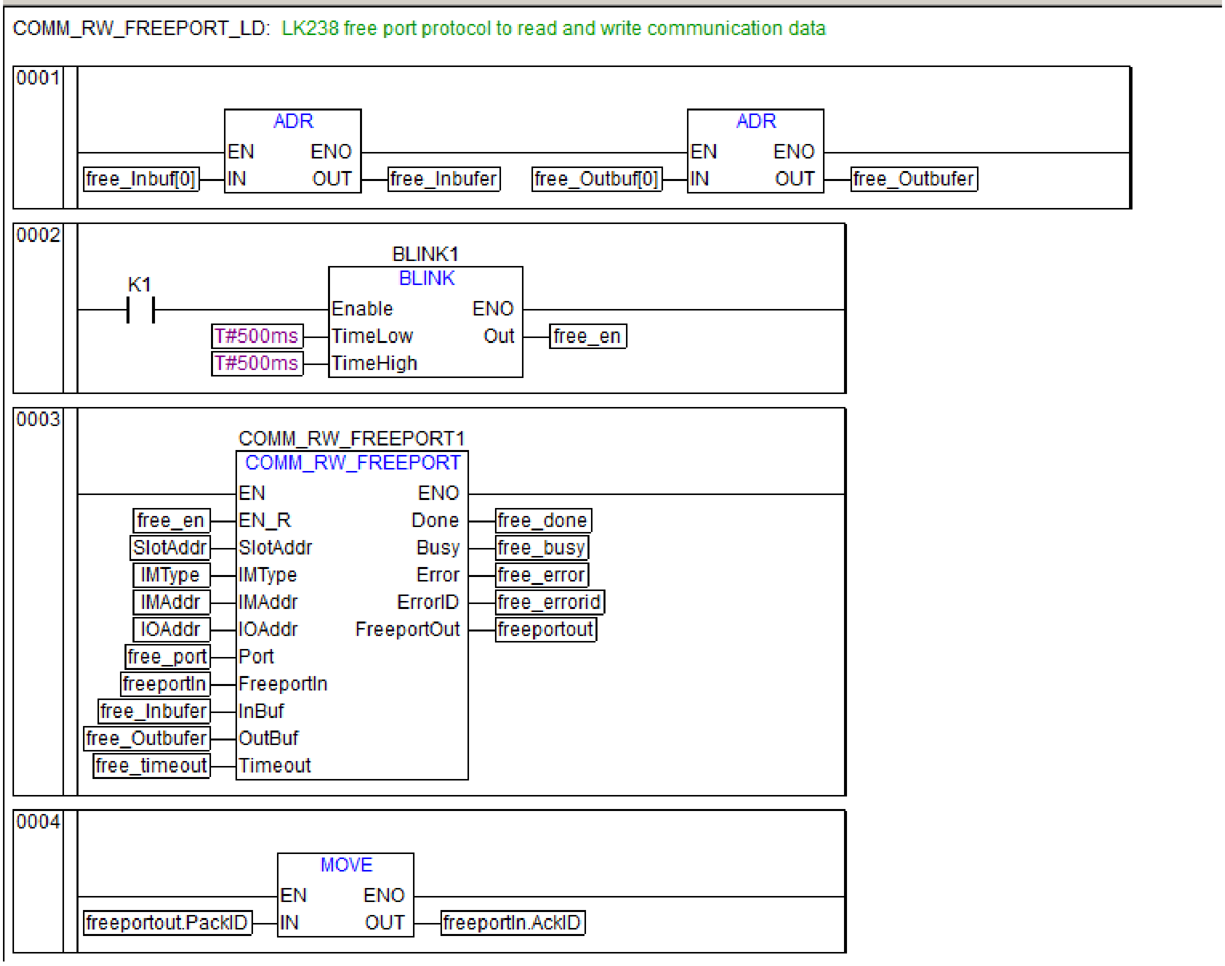


Send-Receive Data

The configuration example is shown in the figure below:

COMM_RW_FREEPORT_LD(PRG).ld

No.	Variable Name	Address	Variable Description	
0004	IMType		The type of interface module used by the backplane where the I...	BYTE
0005	IMAddr		The address of the interface module used by the backplane wh...	DWORD
0006	IOAddr		DP slave address of the backplane where the IO module is locat...	BYTE
0007	free_port		Port number,valid value is 1~4	BYTE
0008	freeportIn		Freeport protocol input data	FREEPORTINPARAM



Configuration Example

LK238 will report the next packet of data only after confirming the data reported by LK238 this time. Error messages can be sent through freeportOut.RecvErr bytes obtained. When receiving data, the system will report the received data packet (including start character and / or end character) to the input data area.

(2) Transceiver mode

If the user uses LK238 to send data through the serial port or receive data from the peripheral after sending data, please select Send and Receive mode. In the Send and Receive mode, when the rising edge of the function block is input, LK238 recognizes it as a trigger according to FreeportIn.SendEn and FreeportIn.RecvEn, both of which are high-level enabled, identifies whether transmission and reception are enabled.

When receiving data, if the end character is enabled, the receiving of this packet ends with the end character and continues to receive the next packet. Otherwise, continue to receive until the specified data length is met; If the end character is prohibited, the start character is enabled, and the enabling length will end the reception after the specified data length with the start character as the header. If the receiving length is set to 0, the start and end characters must be enabled.

To sum up, the start character and / or end character must be correctly set and consistent at the sending end and receiving end at the same time in order to correctly receive data.

Use steps

a. Enable receive and enable send

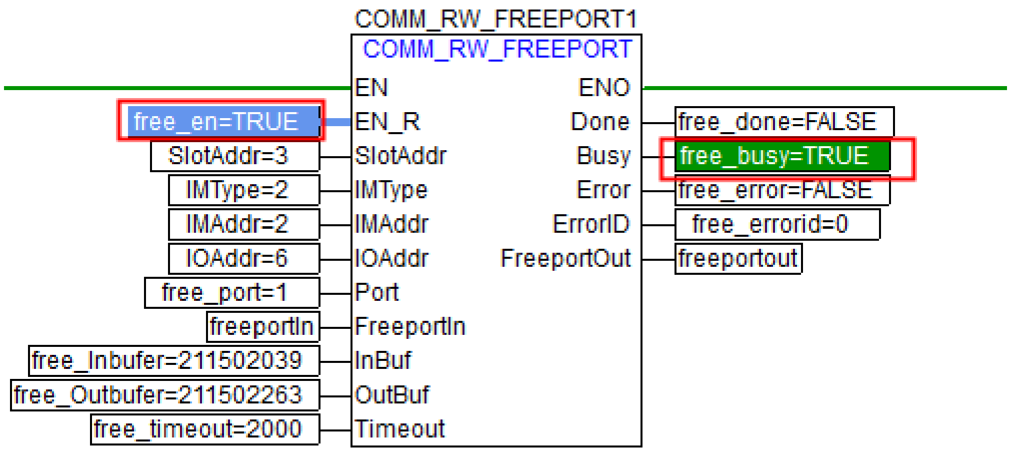
COMM_RW_FREEPORT_LD.freeportIn

No.	Variable Name	Address	Variable Description	Variable Type	Online Value	Pow
0001	SendEn		Send enable	BOOL	TRUE	FALSE
0002	SendLength		Set sending length	BYTE	10	FALSE
0003	SendTimeout		Set sending timeout time (unit: 10ms)	BYTE	0	FALSE
0004	RecvEn		Receive enable	BOOL	TRUE	FALSE
0005	RecvLen		Set receiving length	BYTE	10	FALSE
0006	StartChar		Set start character	BYTE	0	FALSE
0007	EndChar		Set ending character	BYTE	0	FALSE
0008	RecvTimeout		Set the receiving timeout time (unit: 10ms)	BYTE	0	FALSE
0009	RecvMode		Receiving mode	BYTE	0	FALSE
0010	AckID		The master station confirms the package num...	BYTE	0	FALSE

Enable Receive and Enable Send

b. Enable function block pin en_ R

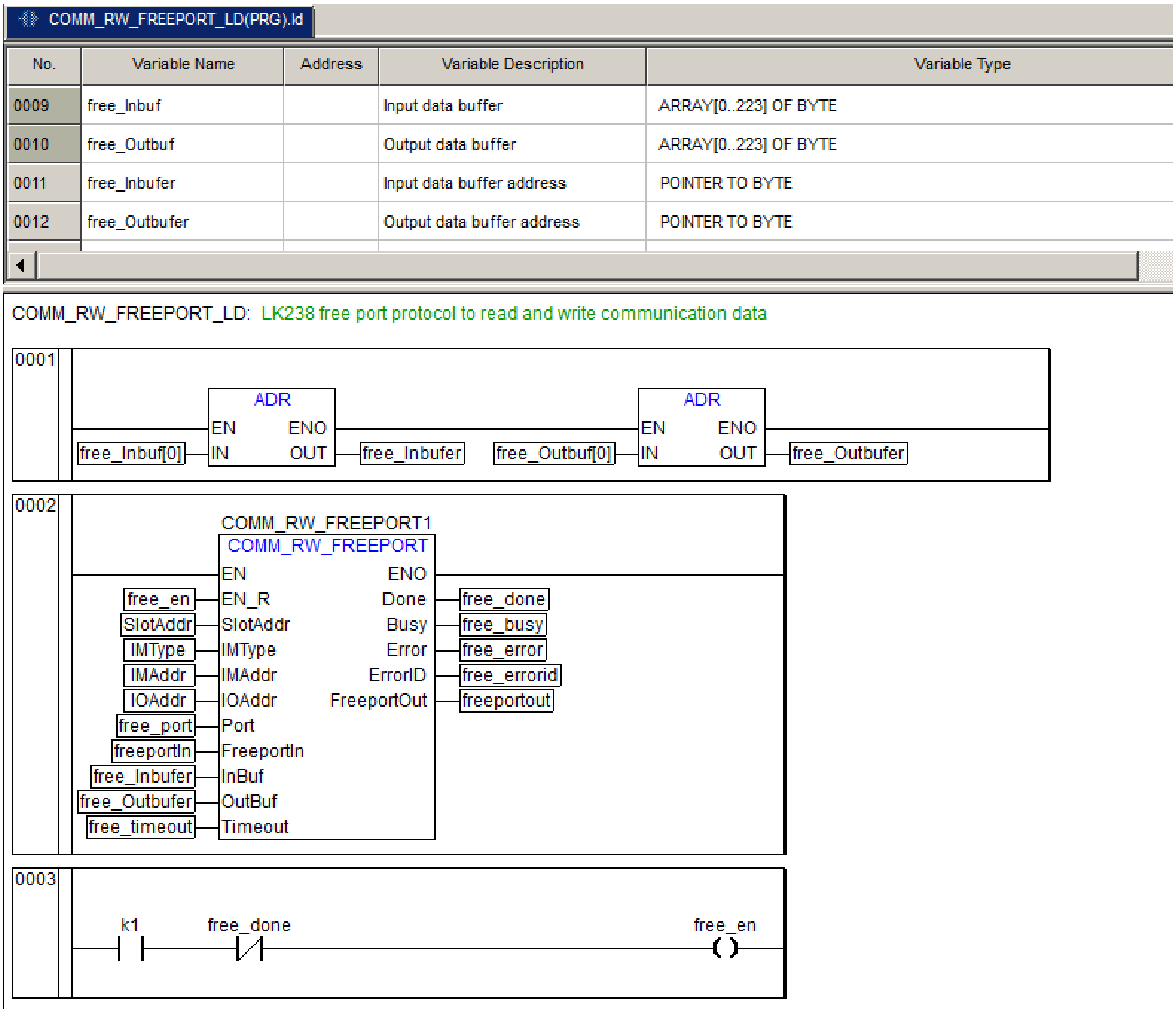
Taking the above parameters as an example, FreeportIn.SendEn and FreeportIn.RecvEn is enabled (the sending and receiving functions can be used separately). The rising edge of the function block is triggered. After the function block sends the data, it will wait for the data to be received. If there is no data, the function block will always be in the busy state; each time the function block is triggered, it will send and receive once.



Enable EN_ R Pin

Note: because the reception here is only based on the length, when the data is not received, the function block will always be in the busy state. At this time, other function blocks are not available. When the data is received, the function will complete the reception operation, and other function blocks can continue to execute. (to avoid being busy all the time, you can enable the receiving timeout. If the required data is not received within the timeout period, the function block will end this operation).

The configuration example project is shown in the figure below:



Configuration Example Project

6.3.7.12 Technical Specifications

LK238 Serial Communication Module	
Power supply	
Input voltage	24VDC (-20% ~ +20%)
Power consumption (max.)	Max.80mA @24V
DP bus communication	
protocol	Profibus-DP Bus protocol
Slave identification number	0x0522
Number of channels	2 channels
redundancy	Dual network redundancy
Physical layer interface	RS-485
Isolation characteristics	Not isolated
Support communication baud rate	9.6Kbps, 19.2Kbps, 31.25Kbps, 45.45Kbps, 93.75Kbps, 187.5Kbps, 500Kbps, 1.5Mbps, 3Mbps are optional, adaptive.

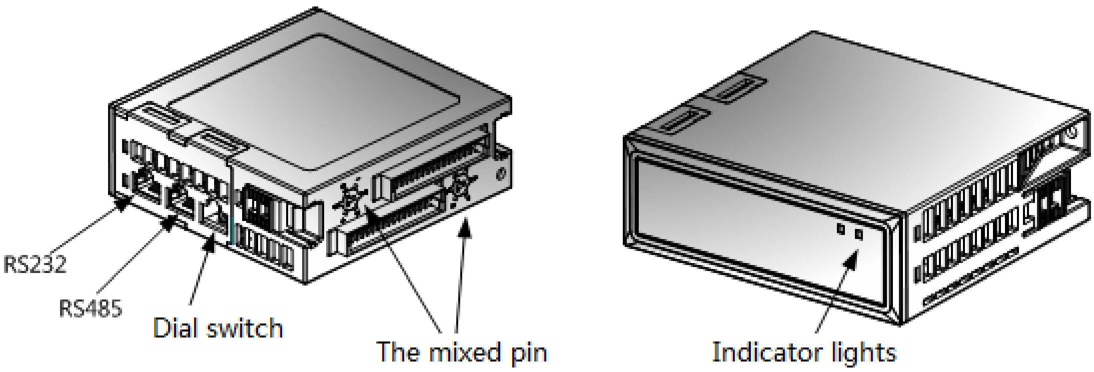
LK238 Serial Communication Module	
Serial communication	
Number of channels	4 channels
Physical layer interface	4 channels support RS-485 interface mode (backplane terminal)
Isolation characteristics	RS485 interface: the serial communication interface side is isolated from the system side Each channel is isolated from each other
Isolation withstand voltage	The system is isolated from the serial communication interface side Isolation between channels Isolation voltage is not less than 500VAC/1min (leakage current 5mA)
Terminal match	The module body provides a serial port communication interface and a serial port terminal matching dial switch
protocol	ModbusRTU (master/slave), free port, four channels can choose the protocol type independently.
Channel enable	The enable state can be configured, enable/disable.
Communication parameter configuration	Communication baud rate, parity bit, stop bit communication parameters 4 channels can be independently configured
Communication rate	User software configuration 1200bps, 2400bps, 4800bps, 9600bps (default), 19.2kbps, 38.4kbps, 57.6kbps, 115.2kbps
Check method	User software configuration byte verification mode Odd parity, even parity (default), no parity
Stop bit	User software configures the number of stop bits 1 digit/2 digits
Single channel input/output data length	Up to 220 bytes each
Modbus protocol communication	
Function codes supported by Modbus	The user can realize the command configuration through the configuration function block 0x01 (read coil), 0x02 (read discrete input), 0x03 (read holding register), 0x04 (read input register), 0x05 (write single coil), 0x06 (write single register), 0x0F (write multiple coils), 0x10 (write multiple registers)
Modbus supports the maximum number of instructions	32
Modbus master polling the number of retransmissions after the slave communication fails	User software configuration 0~255, 3 times by default
Modbus master/slave station message end delay	User software configuration 0ms~2550ms
Modbus master polling slave timeout time setting	User configurable through function blocks 1ms~65535ms
Modbus master polling slave station interval time setting	User configurable through function blocks 10ms~2500ms
Modbus master command mode	It can be configured by the user through the function block, and supports the periodic instruction mode or the event trigger instruction mode.
Modbus master station command parameter power-down retention function	It can be configured by the user through the function block, and whether to instruct the parameter to keep after power-off can be set.
Modbus slave address	User software configuration 1 (default)~247
Free agreement mode	
Free protocol receiving mode	Transceiver mode and receive only mode
Free protocol sending timeout time setting	Support three modes of timeout reception, end character enable reception, and start character enable
Free protocol receiving timeout time setting	User configurable through function blocks

LK238 Serial Communication Module	
Free agreement sending length	10ms~2500ms
Free agreement receiving length	User configurable through function blocks
Free agreement mode	10ms~2500ms
Module failure	
communication fail	DP network (DP1, DP2) failure COM port communication failure
Configuration failure	Configuration errors such as mismatch between the configuration parameters and the selected protocol type.Port not working error
Physical characteristics	
Installation method	Backplane slot installation
Module size (W*H*D)	35mm*100mm*100mm
Anti-mixing pin position	F1
Environmental conditions	
Working temperature	-20℃~70℃
Relative humidity of working environment	5%~95%, no condensation
Storage temperature	-40℃~70℃
Relative humidity of storage environment	5%~95%, no condensation
Altitude	< 2000m
Pollution degree	Level 2
Whether three anti-coating	Yes

6.3.8 LK239 MODBUS Master/Slave Communication Extension Module

6.3.8.1 Basic Features

- Support the PROFIBUS-DP slave protocol
- To support the MODBUS master /slave protocol
- To connect the LK controller module and the external MODBUS master /slave station
- Installed in the I/O slot
- RS485 or RS232 interface (2 option 1)
- Hot swapping



External View of LK239 Module

The LK239 module is the MODBUS master/slave communication extension module, supporting the PROFIBUS-DP bus protocol and the MODBUS protocol, realizing the data communication from the external MODBUS station to the LK controller module.

The LK239 module on the PROFIBUS-DP side can only be used as the DP slave station and exchanges the parameters and data with the LK controller module, thus realizing the functions of the DP slave station.

The LK239 module on the MODBUS side can be used as the MODBUS master station, or as the MODBUS slave station, to obtain or send the MODBUS data, with function codes 01, 02, 03, 04, 05, 06, 15, 16 supported.

The max. input and output data lengths for the MODBUS data area of the LK239 module are up to 244 bytes separately. As the MODBUS master station, the max. number of the supported slave stations must meet two restrictions of up to 244 bytes in total input (output) data length and up to 28 slave stations at the same time.

ⓘWhether the slave station or the master station, the LK239 module cannot transmit the REAL data directly by configuring the input/output data. It shall do this with the help of Zone M, with the high-low byte sequence exchanged.

The LK239 module is installed in the I/O slot of the LK backplane. The module itself provides the MODBUS communication interface and the MODBUS terminal matching DIP switch, as shown in figure.

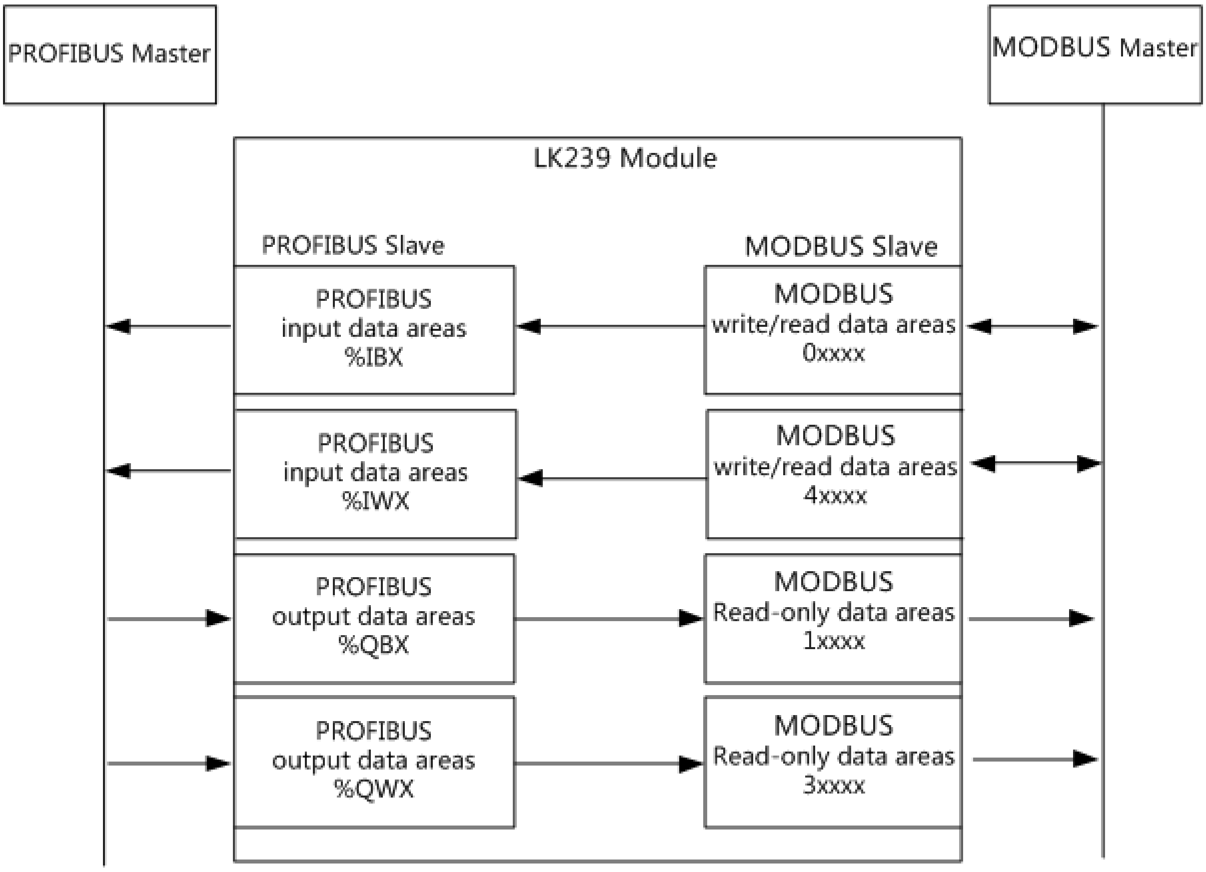
The MODBUS communication adopts a response mode: the master station sends command to one slave station, and wait for the response from slave station. After receiving the instruction from the master station, the slave station executes the instruction and feedback the execution results to the master station, then wait for the next instruction. The time interval from the moment that the master station gives an instruction to the moment that the slave station responds data is received is the time-out value, which can be set via the user parameter **Time of Replay**.

For the RS485 or RS232 (select one from the two) interfaces for the MODBUS physical layer, the transmission speed can be 115.2 kbps in the RTU transmission mode.

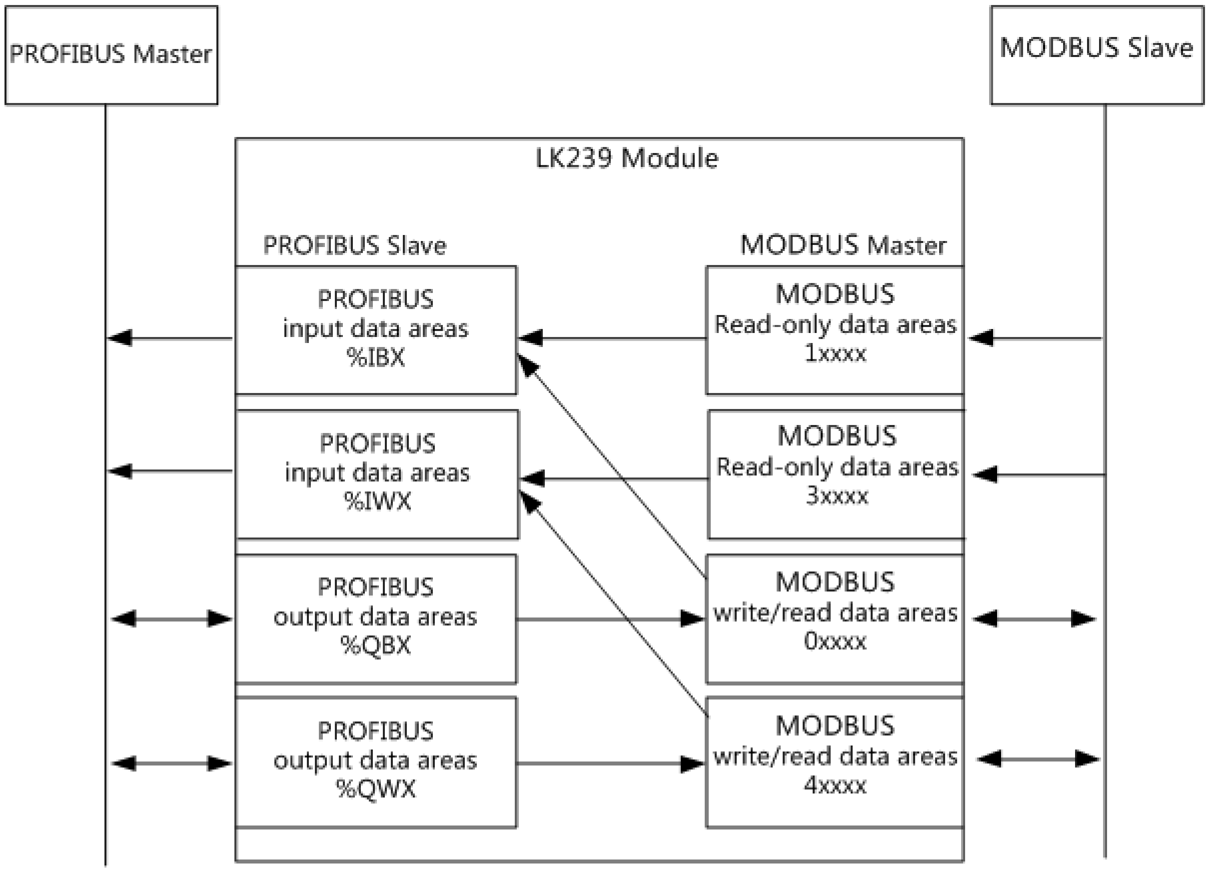
6.3.8.2 Operating Principle

The LK239 module creates the PROFIBUS-DP data area and the MODBUS data area in the data memory, exchanges the data between the two data storage areas periodically, thus realizing the data communication from MODBUS to PROFIBUS-DP.

The communication data of the PROFIBUS-DP master station (the controller module) and LK239 is saved in the PROFIBUS-DP data area. The communication data of the external MODBUS master station slave station and LK239 is saved into the MODBUS data area. Upon the completion of the PROFIBUS-DP data communication each time, it shall exchange the data of the two data storage areas once according to the corresponding relationship between the PROFIBUS-DP address and the MODBUS address.



Schematic Diagram of Data Exchange Realization of LK239 Module as Slave



Schematic Diagram of Data Exchange Realization of LK239 Module as Master

6.3.8.3 Indicators

Refer to table for the definitions of the indicators of the LK239 module, the **RUN** indicator indicates the communication link with the LK controller module. The **COM** indicator indicates the MODBUS communication link.

Definition of LK239 Indicators

Name	Status	Description
RUN (green)	On	The communication between LK239 and the LK controller module is normal
	Flash	It is just powered up and establishing the communication, or a communication error occurs between LK239 and the LK controller module, or the module is disabled
	Off	The module is not powered up or damaged.
COM (yellow)	On	The MODBUS communication is normal
	Flash	It is just powered up and establishing the communication, or a MODBUS communication error occurs, or no MODBUS slave station is available to LK239
	Off	The module is not powered up or damaged.

ⓘFlashing frequency: 4 Hz.

6.3.8.4 Wirings

The MODBUS communication interface is located at the bottom of the module, supporting the RS232 and RS485 modes, adopting two RJ45 outlets. It can use a customized cable to convert the RJ45 interface into the Type-D 9-pin plug. Refer to table for the cable information.

MODBUS Connecting Cable

Cable Name	Cable Specification	Definition of RJ45 Signal	Definition of DB9 Signal
RS485 wiring mode, MODBUS communication cable	Shielded cable with a magnet ring. 3m, with one end of a RJ45 interface and the other end of a DB9 plug (RS485)	4—RS485+ 5—RS485- 8—GND	5—RS485+ 9—RS485- 1—GND
RS232 wiring mode, MODBUS communication cable	Shielded cable with a magnet ring. 3m, with one end of a RJ45 interface and the other end of a DB9 plug (RS232)	1—TXD (LK239 send) 2—RXD (LK239 receive) 8—GND	2—TXD (LK239 send) 3—RXD (LK239 receive) 5—GND

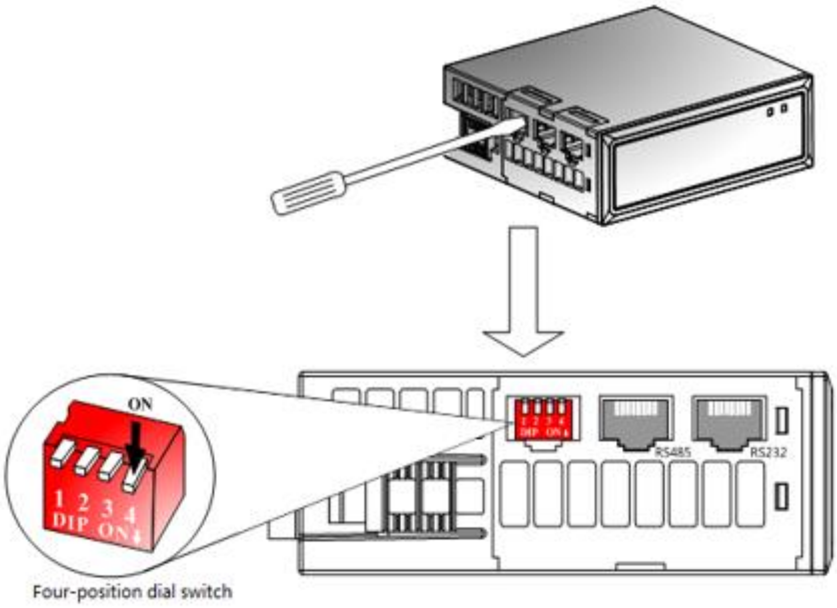
ⓘWiring cannot be applied to the I/O terminal block under the LK239 module slot.

6.3.8.5 Terminal Matching

On the MODBUS bus, when selecting a RS485 interface, if the LK239 module is located at the initial terminal or end terminal of the bus, it is connected to a matching resistance.

The terminal matching DIP switch is located in the module, defaulted as disconnected. As shown in figure, it is unnecessary to disassemble the enclosure when changing the position of the switch. Via the heat emission hole at the top enclosure of the module, it can conveniently set the position by using a small flathead screwdriver.

The four keys of the DIP switch are turned consistently when setting. When the 4 keys are dialed downward at the same time, which is in **ON** status, the terminal matching resistance is connected. When the 4 keys are dialed upward at the same time, which is in **OFF** status (default), the terminal matching resistance is disconnected.



Setup of LK239 DIP Switch

6.3.8.6 MODBUS Communication Messages

The MODBUS communication protocol is the master/slave communication protocol. The master station sends the message. Only a slave station with an address same to the calling address in the message sent from the master station can send a response message.

The slave station address range of the LK239 module is 1~247. The 0 address in the protocol refers to the messaging mode of the broadcasting message. The LK239 module does not support the 0 address.

6.3.8.6.1 MODBUS Storage Area

The device storage area relating to MODBUS is identified with 0xxxx, 1xxxx, 3xxxx and 4xxxx, as shown in table.

Specifications for MODBUS Storage Area

MODBUS Storage Area	Type	Write/Read	Name	Storage Unit Address
0xxxx	Bit	Write and read	Coil	00001~0xxxx
1xxxx	Bit	Read only	Input of discrete magnitude	10001~1xxxx
3xxxx	Word	Read only	Input register	30001~3xxxx
4xxxx	Word	Write and read	Holding register	40001~4xxxx

MODBUS address form is used in this system. If register address form is used, corresponding address subtracts 1.

6.3.8.6.2 Definition of Function Code

The function code is used by the MODBUS master station to notify the MODBUS slave station of the operation to be executed. As a response, the slave station sends the same function code to the master station, indicating that it has responded to the master station by executing the operation.

Table showns the MODBUS function codes supported when taking LK239 as the MODBUS master station. For a function code excluded in the list, LK239 gives no responses.

If the most significant bit of the function code sent from the slave station is 1 (with the function code more than 127), it indicates that the slave station does not make any response or a sending error occurs.

Definition of Supported Function Code

Function Code	Data Type	Meaning	Role
01	BIT	To read the DO status (DO readback)	To read back the current status of a group of digital outputs (not supporting the broadcast mode)
02	BIT	To read the DI status (DI)	To obtain the current status of a group of digital inputs (not supporting the broadcast mode)
03	WORD	To read the AO status (AO readback)	To read back the current status of a group of analog output (not supporting the broadcast mode)
04	WORD	To read the AI status (AI)	To obtain the current status of a group of analog inputs (not supporting the broadcast mode)
05	BIT	To force single-channel digital outputs (single-channel DO)	To force to set a certain digital output value (not supporting the broadcast mode)
06	WORD	Force single-channel analog outputs (single-channel AO)	To force to set a certain analog output value (not supporting the broadcast mode)
15	BIT	Force multiple-channel digital outputs (multiple-channel DO)	To force to set several continuous digital output values of the slave station (not supporting the broadcast mode)
16	WORD	Force multi-channel analog outputs (multi-channel AO)	To force to set several continuous analog output values of the slave station (not supporting the broadcast mode)

6.3.8.6.3 Diagnosis Message Code

When a request message error in the master station is detected, the slave station sets the most significant bit (bit 7) of the function code as 1 in the response message, with a one-byte error code sent at the same time. Error codes 1~7 separately represents various error types, as shown in table.

Upon receiving an error code, it can take responsive measures according to the error type and re-send a request.

Supported Diagnosis Message Code

Error Code	Meaning	Cause
1	An illegal function code	The slave station does not support such a function code
2	An illegal data address	The initial data address is set improperly
3	Data area overflow	The data length is set improperly
4	An error in the interconnecting device	The slave device fails
5	Confirming the receipt of the request	It takes a rather long time for the slave device to process, therefore, it can confirm the receipt first
6	Busy now, with the request refused	The slave device is busy
7	Request received without no confirmation	The request is not executed

6.3.8.7 Diagnosis

As an I / O slave of HolliTCP protocol, refer to Diagnosis for diagnostic information.

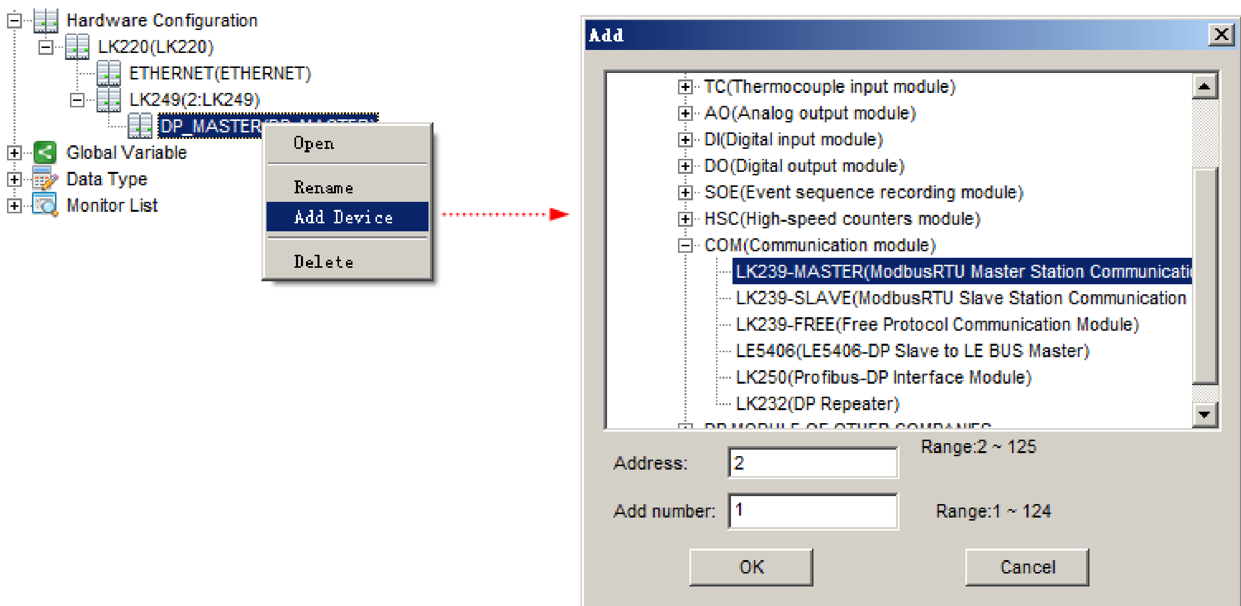
As an I / O slave of POWERLINK protocol, refer to Overview of Diagnosis Information for diagnostic information.

6.3.8.8 GSD File

On the MODBUS side, LK239 can not only be used as the master station, but also a slave station, with different GSD files selected during configuration, as shown in figure.

When LK239 is used as a master station, add a LK239-MASTER module.

When LK239 is used as a slave station, add a LK239-SLAVE module.

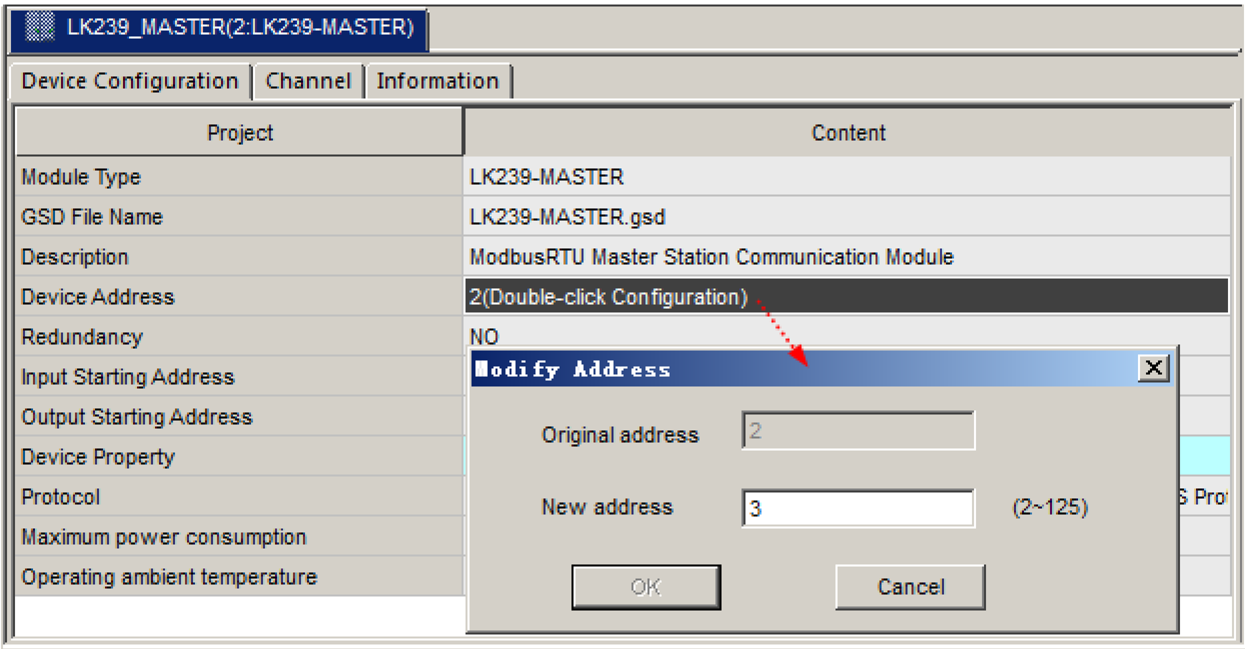


Adding a LK239 Module

6.3.8.9 Configuration for LK239 as MODBUS Master

6.3.8.9.1 Set Station Address

In PROFIBUS-DP side, LK239 supports PROFIBUS-DP slave protocol, and address uniquely identified by a backplane number and a slot number. During configuration, double-click the **Device Address** item, as shown in figure. Enter a physical communication address in **New** address, and click **OK**.



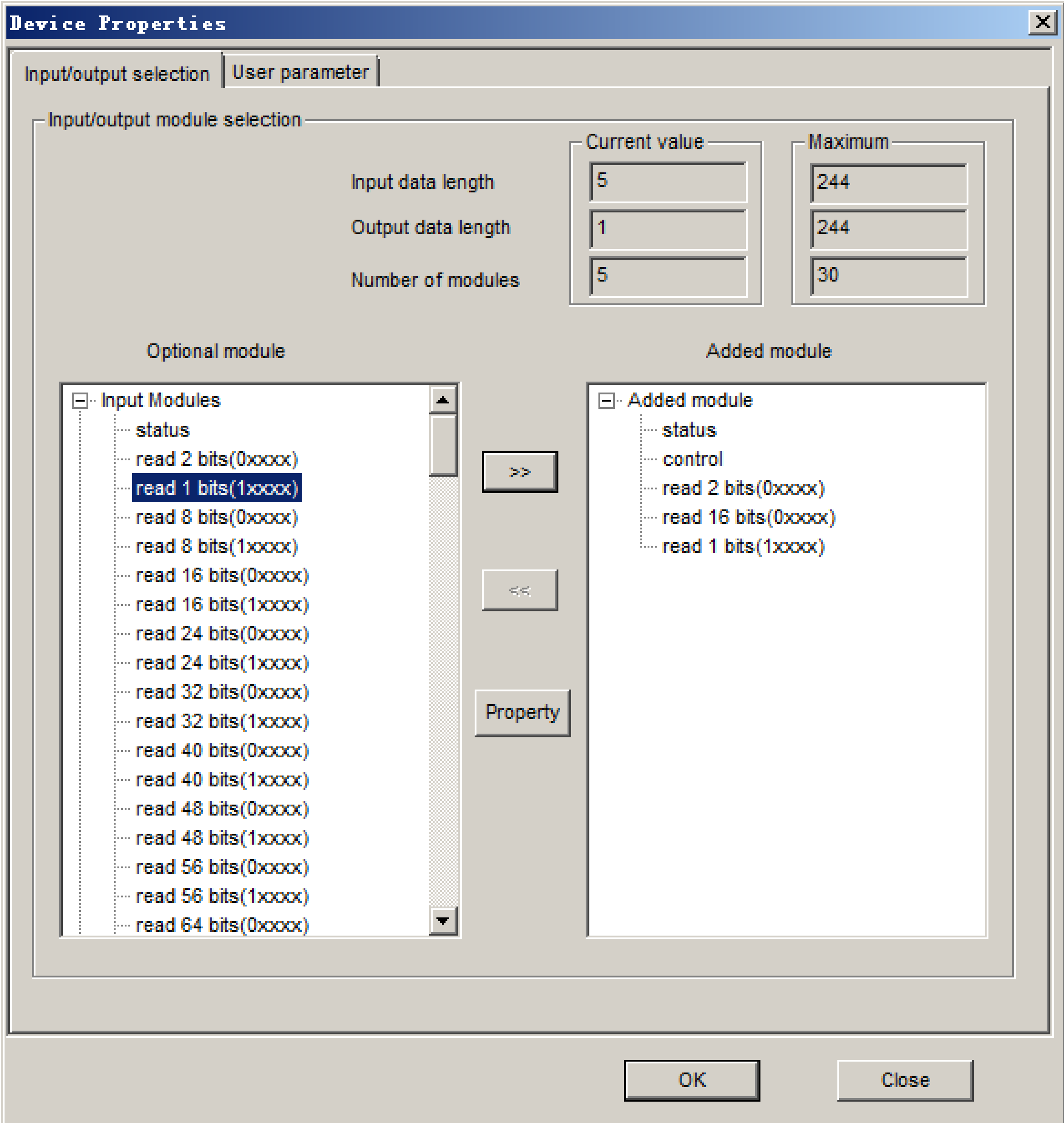
Set Station Address

6.3.8.9.2 Input/output Selection

The [Input/output selection] are used to configure the data space on the MODBUS side of the LK239 module, realizing the data transmission between LK239 and the external MODBUS station.

The data length in the module is limited. The max. length of input data is 244 bytes. The max. output data length is 244 bytes. When the length of the added data goes beyond the limit, an error prompt is popped up.

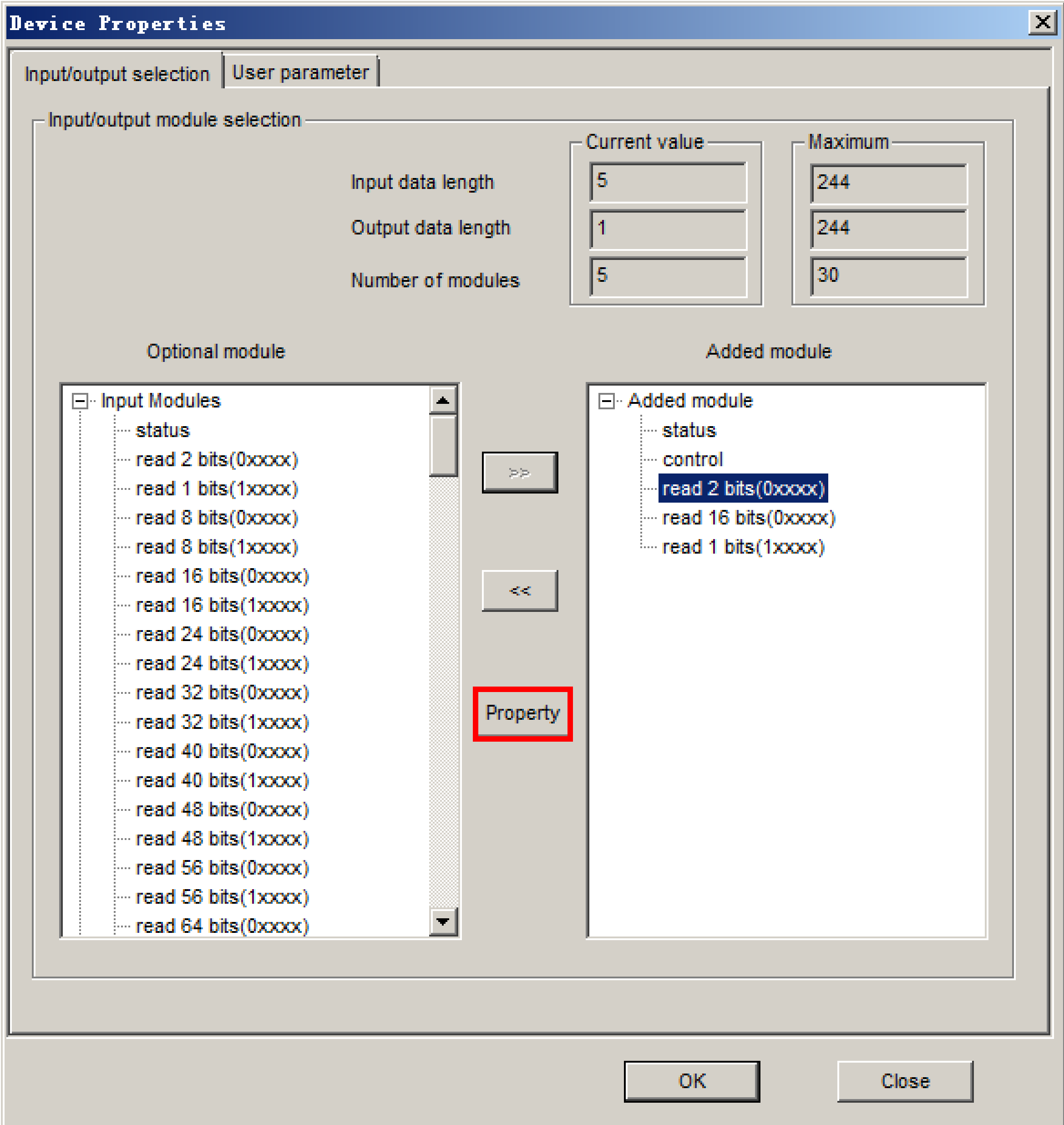
As shown in figure, all the input /output data selected is displayed in **Optional module** list box, you can select data to be added, and click button >> to add data to **Added module** list box. You can view the parameters of current slave station after selecting the data added to click **Property**.



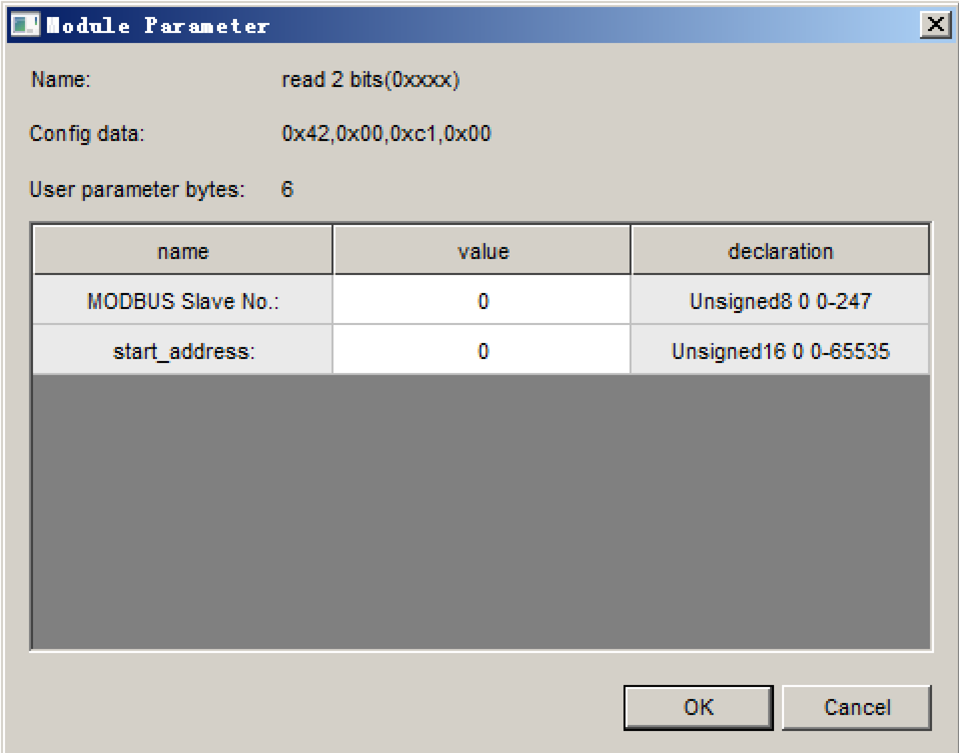
Input/output Module of MODBUS Master Station

When taking LK239 as the master station, the MODBUS data area includes Input Modules and Output Modules, as shown in figure. Each module indicates a function code that is supported by MODBUS. It can select the module according to the MODBUS slave station device property. Notably, Status and Control are added by default. Refer to Status_and_Control_Byte for the specific meanings.

When LK239 is used as the MODBUS master station, apart from selecting a correct input/output module, for each MODBUS slave station, it is also required to specify the slave station address and the start address to realize the reading and writing of the slave station data. Refer to figure for the specific flow, the **Module Parameter** dialog is opened via selecting the module added to click **Property**, and you can set parameters.


Device Properties
Input/output selection
User parameter
Input/output module selection
Current value
Maximum
Input data length
5
244
Output data length
1
244
Number of modules
5
30
Optional module
Added module
Input Modules
status
read 2 bits(0xxxx)
read 1 bits(1xxxx)
read 8 bits(0xxxx)
read 8 bits(1xxxx)
read 16 bits(0xxxx)
read 16 bits(1xxxx)
read 24 bits(0xxxx)
read 24 bits(1xxxx)
read 32 bits(0xxxx)
read 32 bits(1xxxx)
read 40 bits(0xxxx)
read 40 bits(1xxxx)
read 48 bits(0xxxx)
read 48 bits(1xxxx)
read 56 bits(0xxxx)
read 56 bits(1xxxx)
read 64 bits(0xxxx)
>>
<<
Property
Added module
status
control
read 2 bits(0xxxx)
read 16 bits(0xxxx)
read 1 bits(1xxxx)
OK
Close

(a)



(b)

Slave Station Parameter Setup

Specification for MODBUS Slave Station Parameters

Parameter Name	Parameters	Value
MODBUS Slave No.	Slave station address	0~247
Start_address	Initial data address	0~65,535

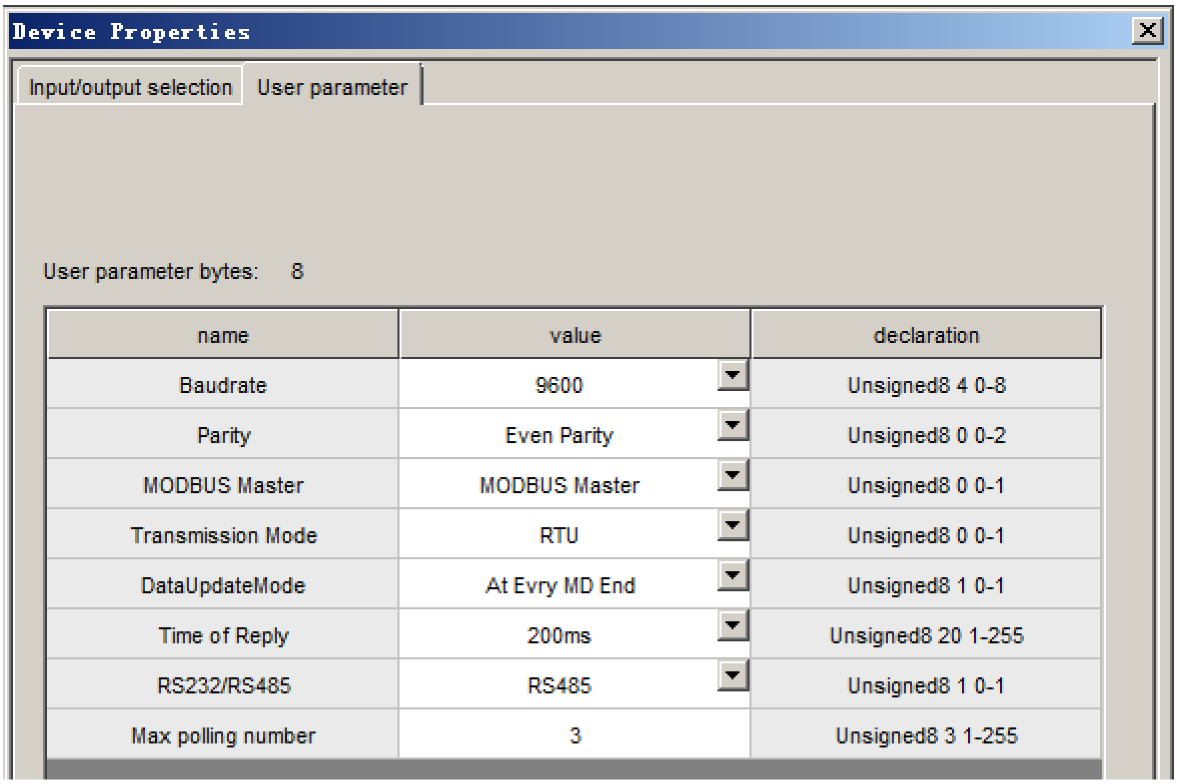
6.3.8.9.3 User Parameter

When LK239 is used as the MODBUS master station, the user parameter length is 8 bytes. Refer to table for the meaning.

User Parameter List of MODBUS Master Station

Parameter Name	**Meaning**	**Value**
Baud rate	To select the baud rate for MODBUS communication	1200 bps, 2400 bps, 4800 bps, 9600 bps (default), 19.2 kbps, 38.4 kbps, 57.6 kbps, 115.2 kbps
Parity	To select the verification mode	=Even Parity, even-parity check (default) = Odd Parity, odd-parity check =No Parity, no check
MODBUS Master	To select the MODBUS master and slave stations	=MODBUS Master, master station
Transmission Mode	MODBUS data transmission mode	= RTU, RTU transmission mode
Data Update Mode	MODBUS data update mode	=At MD_scan End, to updated upon the completion of all the MODBUS instructions

Parameter Name	Meaning	Value
		=At Evry MD End (default), to update upon the completion of the MODBUS instruction each time
Time of Reply	Time-out setup	The value is selected by drop-down menu, and 200 ms (default) When setting ,the timeout time must meet: Time of Reply > Tran_Byte/(Baud rate/(8*1000))ms, Tran_Byte is the total length of input/output bytes and Baud rate is the set Modbus communication baud rate
RS232/RS485	To select RS232 /RS485 communication interface	= RS232 = RS485 (default)
Max. polling number	The response that is made from the slave station is timed out, the max. re-sending times for the master station includes the first time that the master station sends.	1~255, defaulted to 3 times



name	value	declaration
Baudrate	9600	Unsigned8 4 0-8
Parity	Even Parity	Unsigned8 0 0-2
MODBUS Master	MODBUS Master	Unsigned8 0 0-1
Transmission Mode	RTU	Unsigned8 0 0-1
DataUpdateMode	At Evry MD End	Unsigned8 1 0-1
Time of Reply	200ms	Unsigned8 20 1-255
RS232/RS485	RS485	Unsigned8 1 0-1
Max polling number	3	Unsigned8 3 1-255

User Parameters for MODBUS Master Station

6.3.8.9.4 Status and Control Byte

Definitions of the Status (device status) byte and the Control (device control) byte when LK239 is used as the MODBUS master station.

- Definition of the Status (device status) byte
  - Bit0: indicates whether the MODBUS slave station is offline or not. Bit0=0 indicates no slave stations are offline. When the response that is made from the slave station is timed out and the max. re-sending times are met, Bit0=1 indicates that a slave station is offline.

- ◻ Bit4~Bit1: indicates a diagnosis message code. When multiple MODBUS slave station are abnormal, the code is displayed in a scrolling manner.
- ◻ Bit5: indicates the running status of the master station, with 1 set in normal services.
- ◻ Bit6: with 1 set to indicate an error in data verification.

■ Definition of the Control (device control) byte

- ◻ Bit0: with 1 set to indicate the startup of the MODBUS device. In case of zero clearing, it indicates to forbid the MODBUS device.
- ◻ Bit7~Bit1: hold.

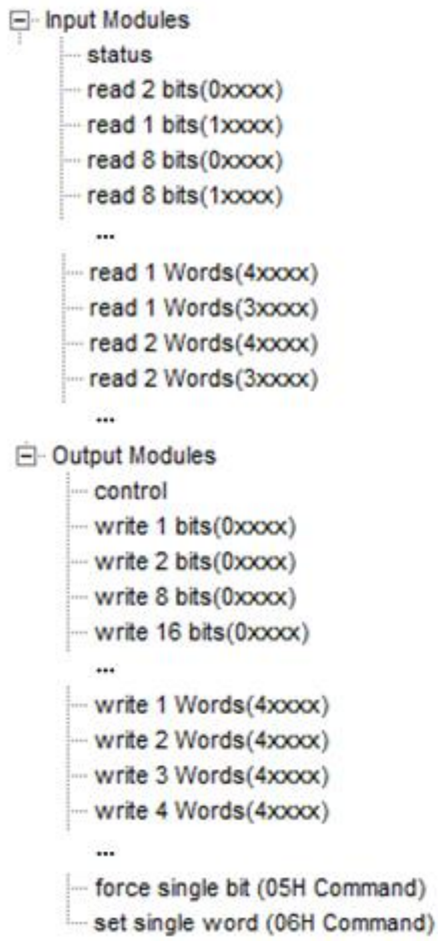
Special attention: in order to maintain the effectiveness and continuity of data , first, DP communication connection between controller and LK239 should be established, and then start MODBUS device (Control byte is set to 1). When communication connection is disconnected, prohibit MODBUS device (Control byte is cleared), when communication is restored, restart MODBUS device.

6.3.8.9.5 Data Communication

After adding the data in [Input/output selection] tab for LK239, corresponding input/output data is displayed in the data list, including input data of up to 244 bytes and output data of up to 244 bytes, notably, **Status** and **Control** are required.

ⓘThe LK239 module cannot transmit the REAL data directly by configuring the input/output data. It shall do this with the help of Zone M, with the high-low byte sequence exchanged.

When LK239 is used as the master station, each module in the MODBUS data area indicates one function code supported by MODBUS. Refer to table for the function codes represented by each module.



MODBUS Master Station Data Area

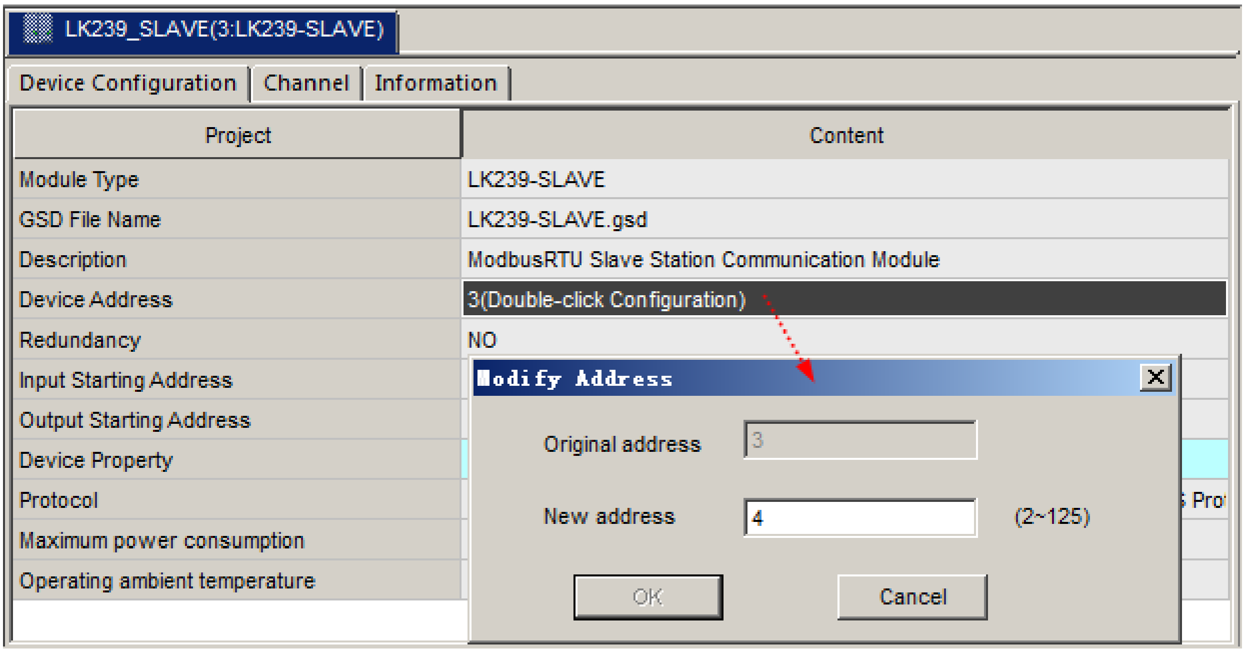
Function Codes Represented by Each Module

Module Types	MODBUS Storage Area	Function Codes
Input module	0xxxx	01 (DO read-back)
	1xxxx	02 (read DI)
	4xxxx	03 (AO read-back)
	3xxxx	04 (read AI)
Output module	0xxxx	15 (multiple DO)
	4xxxx	16 (multiple AO)
	05H Command	05 (single DO)
	06H Command	06 (single AO)

6.3.8.10 Configuration for LK239 as MODBUS Slave

6.3.8.10.1 Set Station Address

In PROFIBUS-DP side, LK239 supports PROFIBUS-DP slave protocol, and address uniquely identified by a backplane number and a slot number. During configuration, double-click the **Device Address** item, as shown in figure. Enter a physical communication address in **New** address, and click **OK**.

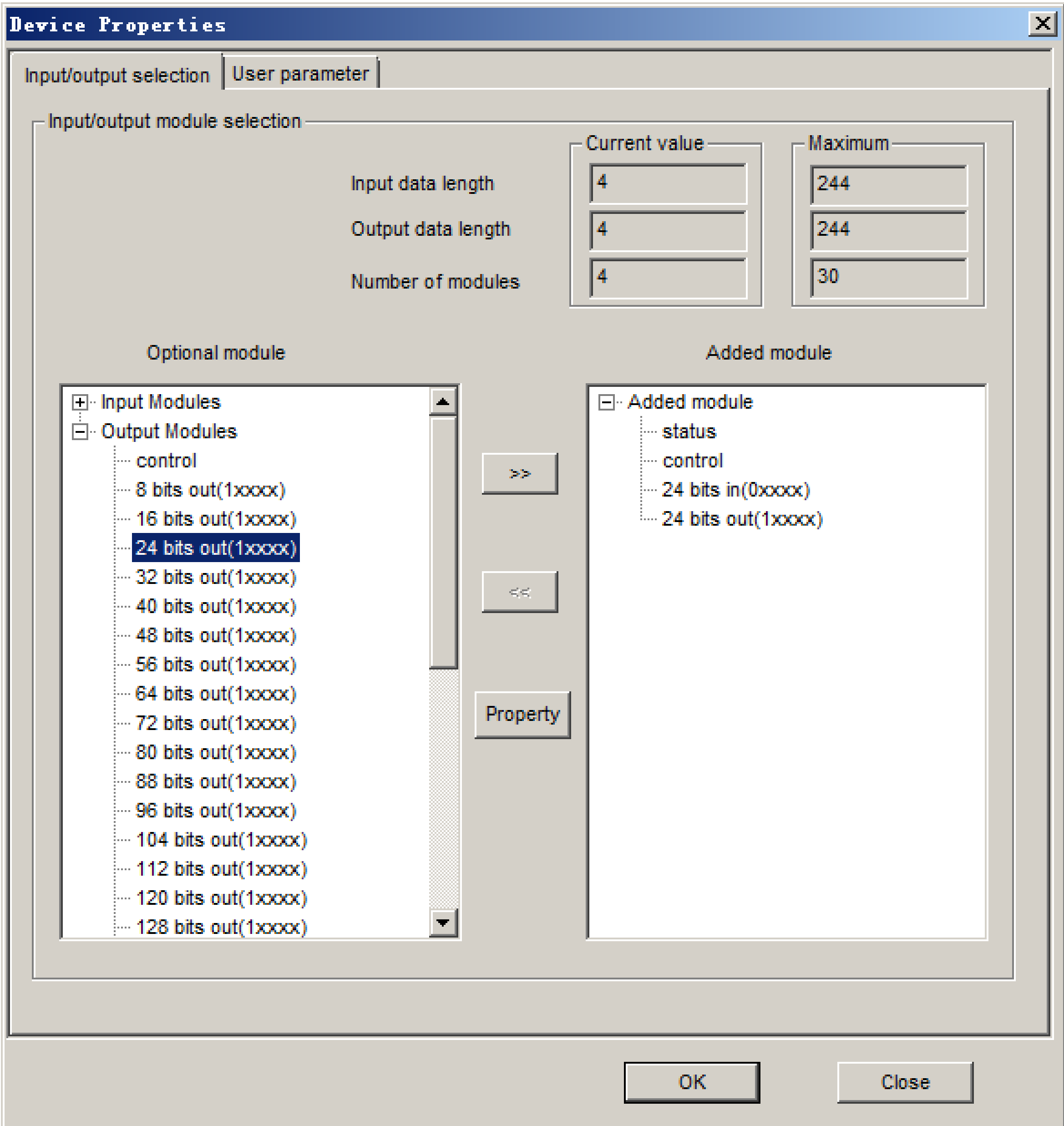


Set Station Address

6.3.8.10.2 Input/output Parameters

When LK239 is used as the slave station, as shown in figure, the MODBUS data area includes Input Modules and Output Modules. The data length of each module is different. Notably, **Status** and **Control** are added by default.

All the input /output data selected is displayed in **Optional module** list box. you can select data to be added, and click button >> to add data to **Added module** list box.

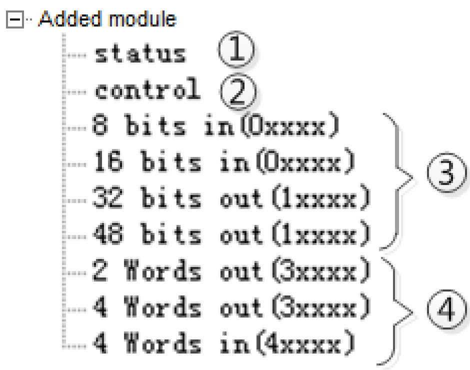


Input/output Module of MODBUS Slave Station

ⓘWhen taking LK239 as the Modbus slave station, it shall add strictly in the following sequence. Otherwise, the module cannot work normally.

(1) Status first, then Control and finally Data. Status and control are added by default.

(2) Add **bits** into the data first, then add **Words**.



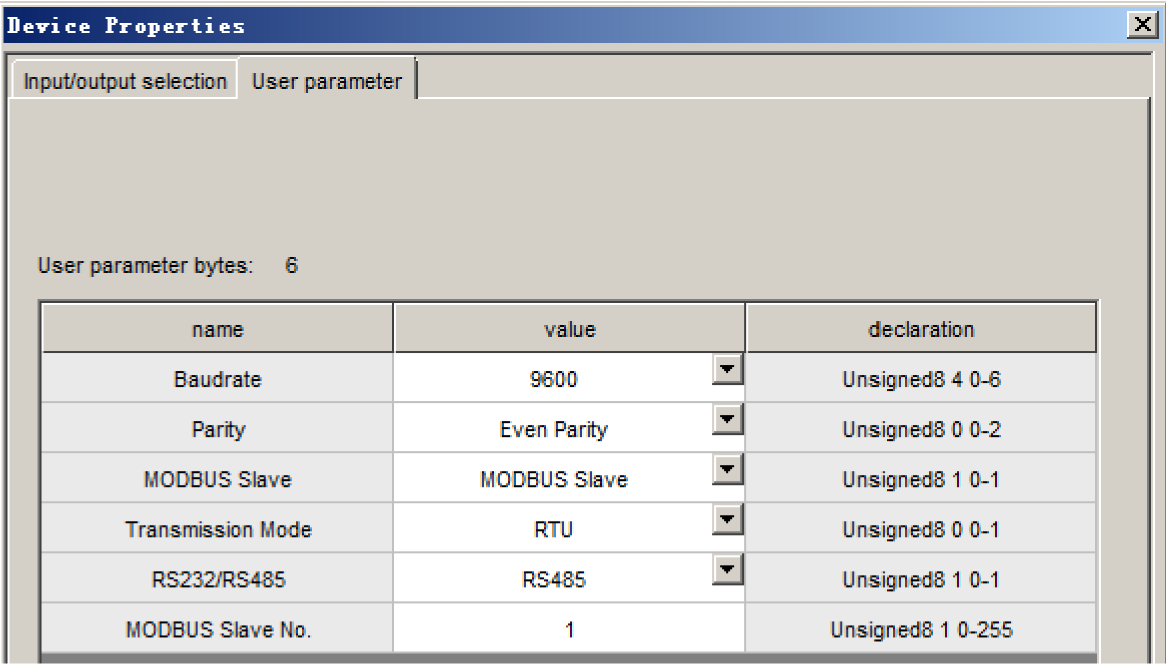
Sequence of Adding MODBUS Slave Station Data

6.3.8.10.3 User Parameter

When LK239 is used as the MODBUS slave station, the user parameter length is 6 bytes. Refer to table for the meaning.

User Parameter List of MODBUS Slave Station

Parameter Name	Meaning	Value
Baud rate	To select the baud rate for MODBUS communication	1200 bps, 2400 bps, 4800 bps, 9600 bps (default), 19.2 kbps, 38.4 kbps
Parity	To select the verification mode	=Even Parity, even-parity check (default) = Odd Parity, odd-parity check =No Parity, no check
MODBUS Master	To select the MODBUS master and slave stations	=MODBUS Slave, slave station
Transmission Mode	MODBUS data transmission mode	= RTU, RTU transmission mode
RS232/RS485	To select RS232 /RS485 communication interface	=RS232 = RS485 (default)
MODBUS Slave No.	Slave station address	1 (fault) ~ 247



name	value	declaration
Baudrate	9600	Unsigned8 4 0-6
Parity	Even Parity	Unsigned8 0 0-2
MODBUS Slave	MODBUS Slave	Unsigned8 1 0-1
Transmission Mode	RTU	Unsigned8 0 0-1
RS232/RS485	RS485	Unsigned8 1 0-1
MODBUS Slave No.	1	Unsigned8 1 0-255

User Parameters for MODBUS Slave Station

6.3.8.10.4 Status and Control Byte

Definitions of the Status (device status) byte and the Control (device control) byte when LK239 is used as the MODBUS slave station.

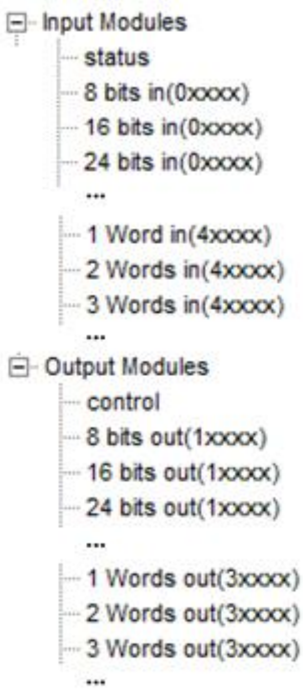
- Definition of the Status (device status) byte
  - Bit0: hold.
  - Bit4~Bit1: diagnosis message code.
  - Bit5: indicates the running status of the slave station, with 1 set in normal services.
  - Bit6: with 1 set to indicate CRC or LRC verification error.
  - Bit7: with 1 set to indicate an error in parity check error.
- Definition of the Control (device control) byte
  - Bit0: with 1 set to indicate the startup of the MODBUS device. In case of zero clearing, it indicates to forbid the MODBUS device.
  - Bit7~ Bit0: hold.

6.3.8.10.5 Data Communication

After adding the data in [Input/output selection] tab for LK239, corresponding input/output data is displayed in the data list, including input data of up to 244 bytes and output data of up to 244 bytes, notably, **Status** and **Control** are required.

ⓘThe LK239 module cannot transmit the REAL data directly by configuring the input/output data. It shall do this with the help of Zone M, with the high-low byte sequence exchanged.

When LK239 is used as the slave station, each module in the MODBUS data area indicates the MODBUS slave station data, with the module name intuitively indicating the data length and type of each module, as shown in figure.

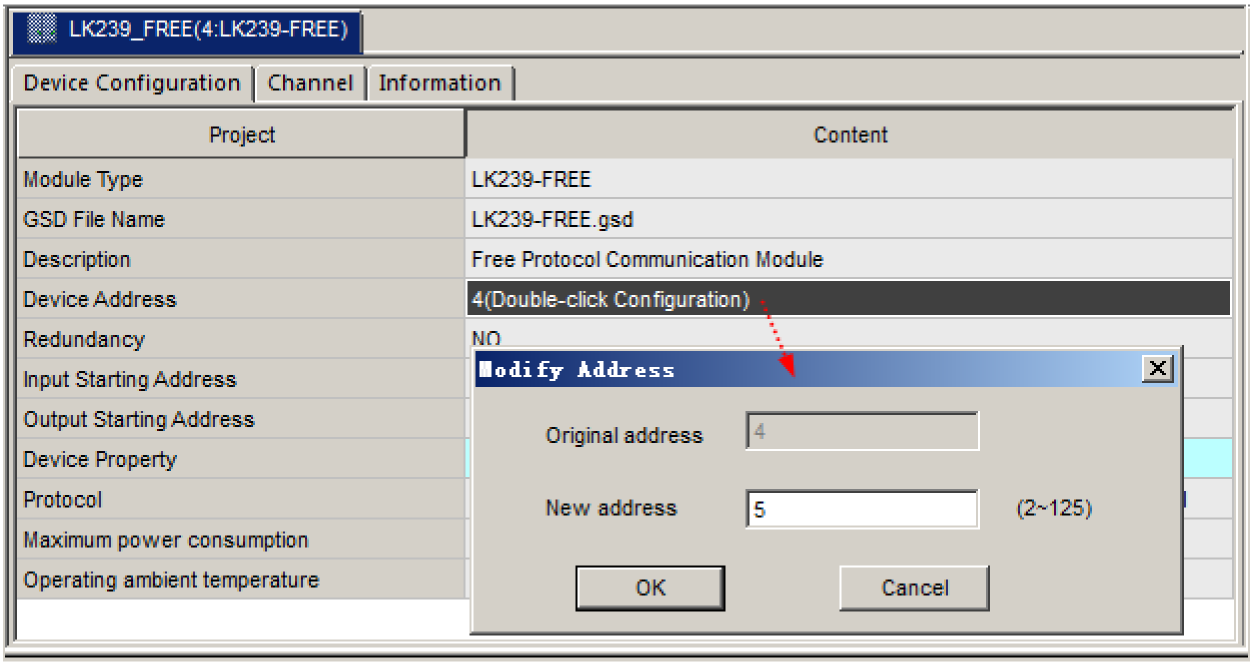


MODUBS Slave Station Data Area

6.3.8.11 Configuration for LK239 as Free Protocol

6.3.8.11.1 Set Station Address

In PROFIBUS-DP side, LK239 supports PROFIBUS-DP slave protocol, and address uniquely identified by a backplane number and a slot number. During configuration, double-click the **Device Address** item, as shown in figure. Enter a physical communication address in **New** address, and click **OK**.

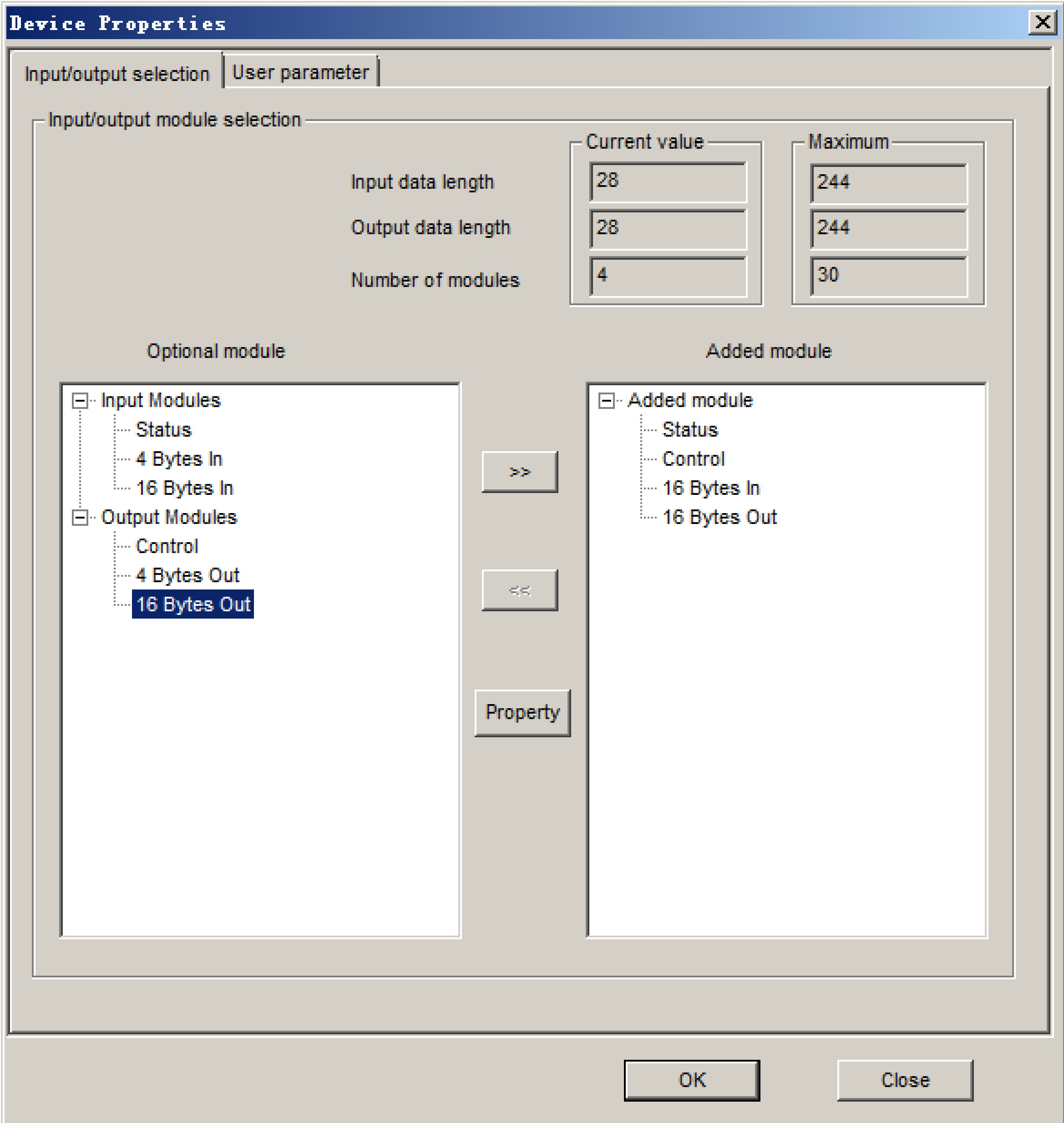


et Station Address

6.3.8.11.2 Input/output Parameters

When LK239 is used as the free protocol station, as shown in figure, the data area includes **Input Modules** and **Output Modules**. The data length of each module is different, and the maximum data length is 244 bytes (including the Control and Status).

Input modules can be added when **Free** parameter is configured as **Only Receive**, and input, output modules can be added when **Free** parameter is configured as **Send and Receive**. **Status** and **Control** are required in two modes.



Input/output Module of Free Protocol

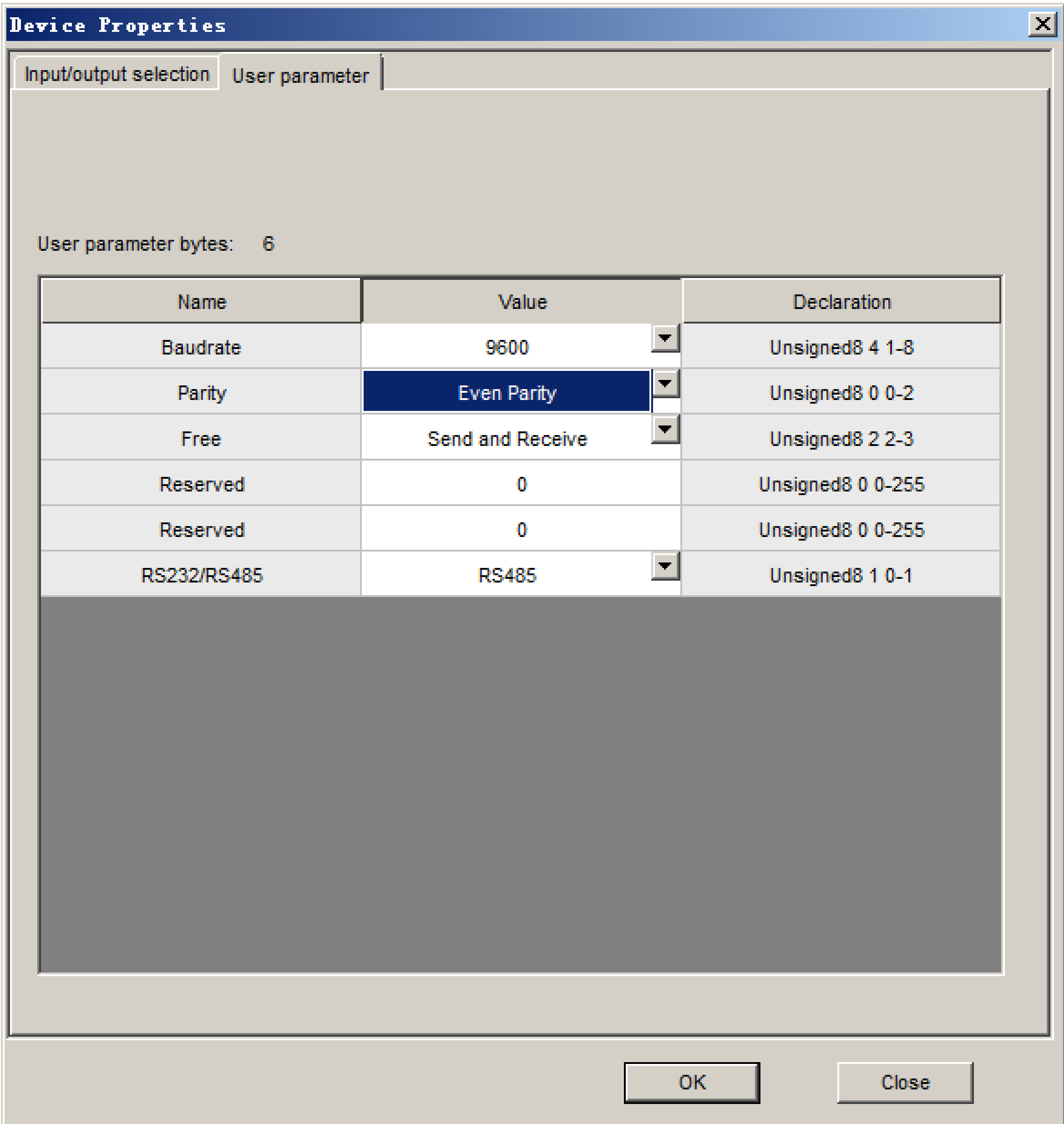
6.3.8.11.3 User Parameter

When LK239 is used as Free protocol, the user parameter length is 6 bytes. Refer to table for the specific meaning.

User Parameter List of Free Protocol

Parameter Name	Meaning	Value
Baud rate	To select the baud rate for Free protocol	1200, 2400, 4800, 9600 (default), 19.2 K, 38.4 K , unit: bps
Parity	To select the verification mode	=Even Parity, even-parity check (default)

Parameter Name	Meaning	Value
		= Odd Parity, odd-parity check =No Parity, no check
Free	To select the Only Receive mode and Send and Receive mode	=Only Receive, only receive data =Send and Receive, send and receive data (default)
Reserved	Ignore	Ignore
Reserved	Ignore	Ignore
RS232/RS485	To select RS232 /RS485 communication interface	=RS232 = RS485 (default)



User Parameters for Free Protocol

6.3.8.11.4 Status and Control Byte

(1) Free protocol Only Receive mode

Only Receive in **Free** parameter be selected when free protocol as only receive mode.

In only receive mode, definitions of the Control (device control) byte as shown in table .

Control Byte of Free Protocol in Only Receive Mode

Control	Name	Meaning
Byte0	—	—
Byte1	—	—
Byte2	—	—
Byte3	—	—
Byte4	RecvEn	Receive data is enabled, high level for receiving data, low level disabled
Byte5	RecvLen	Data length received
Byte6	StartCahar	Set the starting character received
Byte7	EndChar	Set the ending character received
Byte8	RecvTimeout	Set receiving timeout (unit: 10ms)
Byte9	RecvMode	bit0: Timeout enabled bit1: Ignore bit2: Ending character enabled bit3: Starting character enabled bit4~7: Ignore
Byte10	—	—
Byte11	AckID	ID acknowledged by master station

The Status byte (device control) is defined as shown in table when LK239 adopts the **Only Receive** mode of free protocol.

Status Byte of Free Protocol in Only Receive Mode

Status	Name	meaning
Byte0	—	—
Byte1	—	—
Byte2	—	—
Byte3	—	—
Byte4	RecvQ	1: receiving end 0: receiving
Byte5	RecvCount	Data length received
Byte6	RecvErr	Receiving error: =0: Correct =1: Data length error =2: Data storage address out of bound =3: Enable starting character, but no setting =4: Enable ending character, but no setting =5: Timeout is set too low =6: Failed to obtain user space pointers =7: Receive timeout =8: No selecting the free protocol =9: Calling multiple function blocks =21: In this case, en neither 0 nor 1 =22: Read starting character error (fpga receiving error)

Status	Name	meaning
		=24: Serial port to receive data error =26: Ending character not found =27: Length parameter error
Byte7	—	—
Byte8	—	—
Byte9	—	—
Byte10	—	—
Byte11	RecvSN	LK239 return the command number

(2) Free protocol Send and Receive mode

Send and Receive in **Free** parameter be selected when free protocol as send and receive mode.

In send and receive mode, definitions of the Control (device control) byte as shown in table.

Control Byte of Free Protocol in Send and Receive Mode

Control	Name	Meaning
Byte0	SendEn	Sending data is enabled (Sending data with rising edge, high level for holding)
Byte1	SendLength	Set sending length
Byte2	Sendtimeout	Set sending timeout (unit: 10ms)
Byte3	SendSN	Command number
Byte4	RecvEn	Receiving data is enabled, receiving with rising edge, high level for holding
Byte5	RecvLen	Data length received
Byte6	StartCahar	Set the starting character received
Byte7	EndChar	Set the ending character received
Byte8	RecvTimeout	Set receiving timeout (unit: 10ms)
Byte9	RecvMode	bit0: Timeout enabled bit1: Ignore bit2: Ending character enabled bit3: Starting character enabled bit4-7: Ignore
Byte10	—	—
Byte11	AckID	ID acknowledged by master station

The Status byte (device control) is defined as shown in table when LK239 adopts the **Send and Receive** mode of free protocol.

Status Byte of Free Protocol in Send and Receive Mode

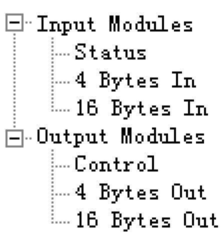
Status	Name	meaning
Byte0	SendQ	1: Sending end 0: Sending
Byte1	SendErr	Sending error: =0: Correct =1: Data length error =2: Data storage address out of bound =3: Failed to obtain user space pointers =4: Send timeout =5: No selecting the free protocol =6: Calling multiple function blocks =20: System abnormal =21: In this case, en neither 0 nor 1

Status	Name	meaning
		=27: Length parameter error
Byte2	—	—
Byte3	SendSN	The sending command number returned
Byte4	RecvQ	1: receiving end 0: receiving
Byte5	RecvCount	Data length received
Byte6	RecvErr	Receiving error: =0: Correct =1: Data length error =2: Data storage address out of bound =3: Enable starting character, but no setting =4: Enable ending character, but no setting =5: Timeout is set too low =6: Failed to obtain user space pointers =7: Receive timeout =8: No selecting the free protocol =9: Calling multiple function blocks =21: In this case, en neither 0 nor 1 =22: Read starting character error (fpga receiving error) =24: Serial port to receive data error =26: Ending character not found =27: Length parameter error
Byte7	—	—
Byte8	—	—
Byte9	—	—
Byte10	—	—
Byte11	RecvSN	LK239 return the command number

6.3.8.11.5 Data Communication

As shown in figure, the name of each data visually marked out its length and data type in data area of free protocol, according to the need to add.

Input and output data accumulated no more than 244 bytes (including the Control and Status).



Optional Data Type of Free protocol

Corresponding input data or output data is displayed in [Channel] tab after data is added for LK239 in [Input/output selection] tab, with Status and Control data must be selected. As shown in figure.

LK239_FREE(4:LK239-FREE)

Device Configuration | Channel | Information

0_Status | 1_Control | 2_4 Bytes In | 3_4 Bytes Out | 4_16 Bytes In | 5_16 Bytes Out

Channel Number	Channel Name	Channel Type	Channel Address	Channel Description
1	DPIO_2_1_4_1_1	BYTE	%IB4	
2	DPIO_2_1_4_2_1	BYTE	%IB5	
3	DPIO_2_1_4_3	BYTE	%IB6	
4	DPIO_2_1_4_4	BYTE	%IB7	
5	DPIO_2_1_4_5	BYTE	%IB8	
6	DPIO_2_1_4_6	BYTE	%IB9	
7	DPIO_2_1_4_7	BYTE	%IB10	
8	DPIO_2_1_4_8	BYTE	%IB11	
9	DPIO_2_1_4_9	BYTE	%IB12	
10	DPIO_2_1_4_10	BYTE	%IB13	
11	DPIO_2_1_4_11	BYTE	%IB14	
12	DPIO_2_1_4_12	BYTE	%IB15	

the Data Added

(1) Free protocol Only Receive mode

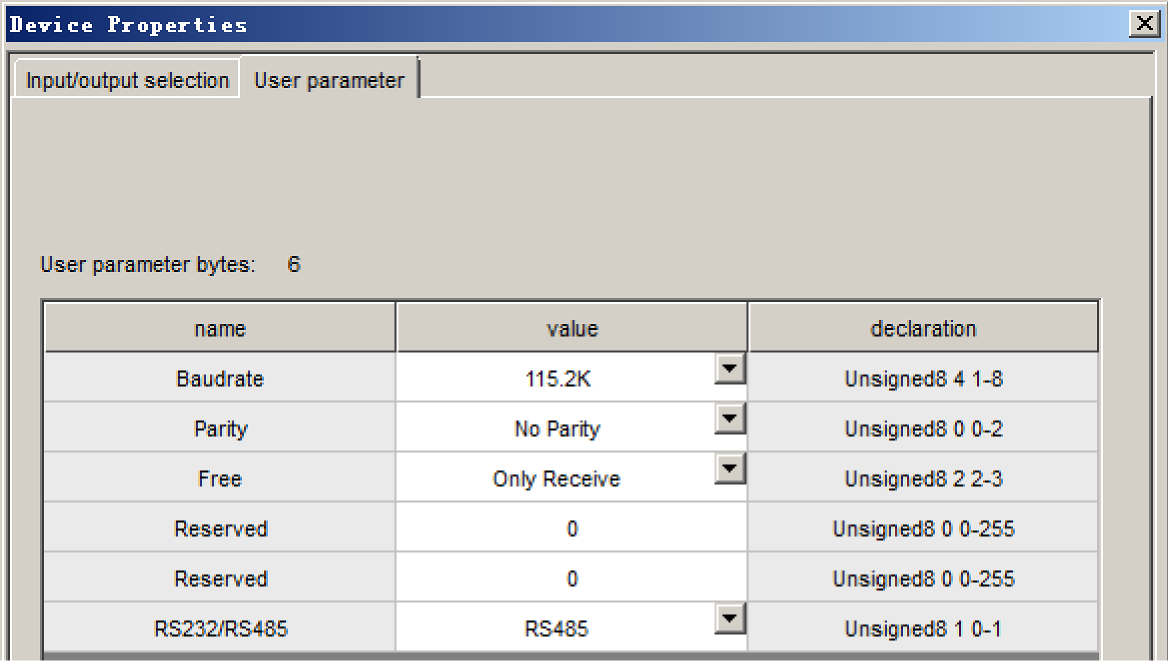
Only Receive mode is selected if the user just use LK239 receiving external serial data and no sending. In **Only Receive** mode, enable RecvEn (rising edge enable, continue to receive data in high levels), LK239 will automatically enter the receiving data state. When enable the starting character, which as a starting point to begin receiving data. The data will be discarded If the starting character not be received. If the starting characters are forbidden, you must enable the length and ending characters, otherwise it will be error. If the receiving length is set as 0, the starting and ending characters must be enabled.

When data is received, if enable the ending characters, which as ending to end the current packet and continue receiving the next packet, then receiving until the specified data length is met. If disenable the ending character, enable the starting character and length, stop receiving when the specified data length which to begin for starting character is met. LK239 free protocol Only Receive mode with cache which is used to store data from external device (25 * 64 Byte cache for a total of 64 data packets, each packet 25 Byte, less than 25 Byte part as a packet, the data more than 64 packets, which not be promptly removed, it will be overwritten by the new data), and then sequentially send to LK master control module after adding the ID.

In summary, the starting characters and / or ending character must be set correctly and be consistent in sending and receiving ends for receiving data correctly.

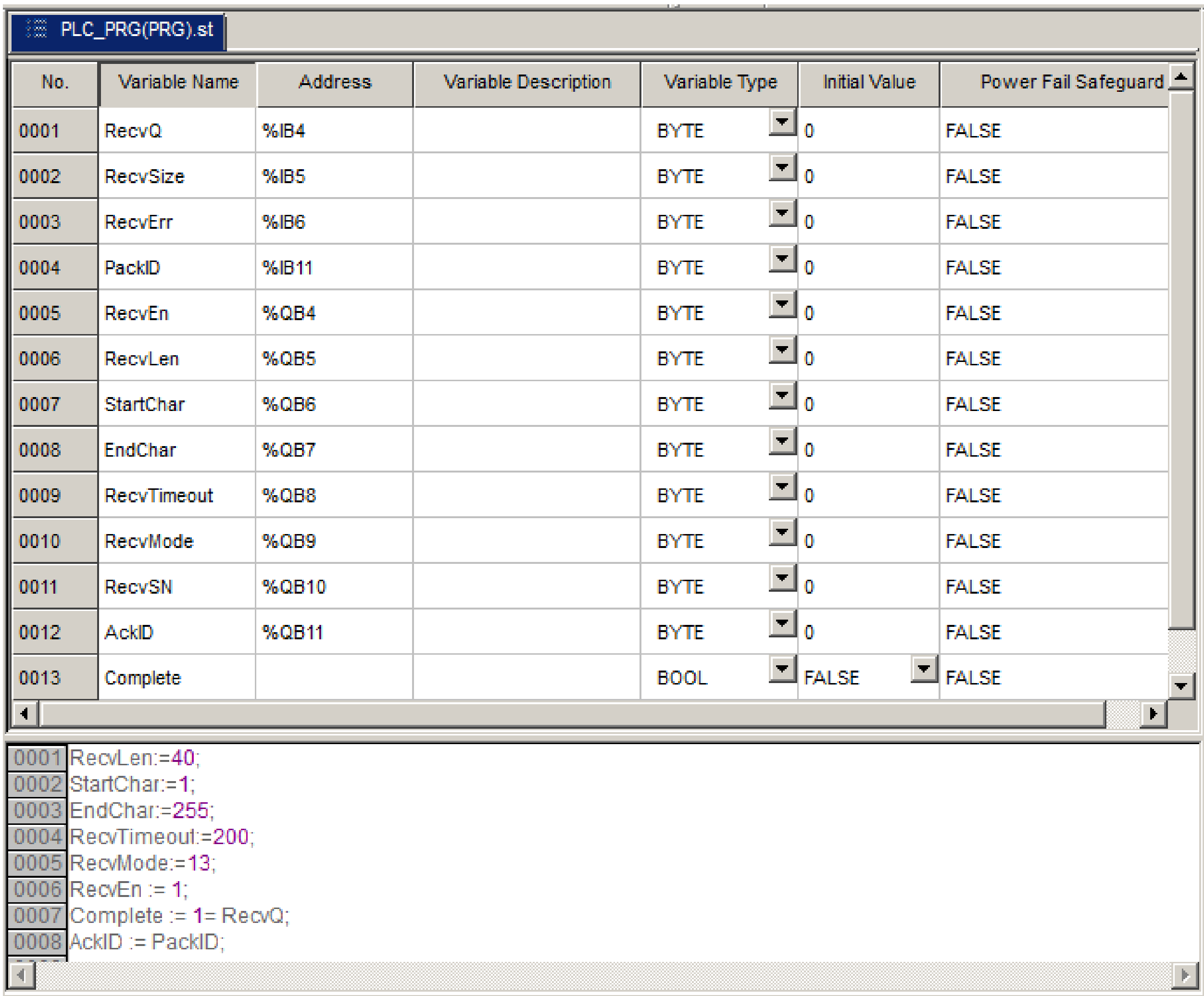
Free protocol in only receive mode for example as following:

As shown in figure, after data is added, you can set **Only Receive** mode and configure the baud rate (The description use RS485 as an example, please select baud rate according to the actual project) as shown in figure.



LK239 configured as Only Receive Mode

Engineering configuration is as shown in figure.



PLC_PRG(PRG).st

No.	Variable Name	Address	Variable Description	Variable Type	Initial Value	Power Fail Safeguard
0001	RecvQ	%IB4		BYTE	0	FALSE
0002	RecvSize	%IB5		BYTE	0	FALSE
0003	RecvErr	%IB6		BYTE	0	FALSE
0004	PackID	%IB11		BYTE	0	FALSE
0005	RecvEn	%QB4		BYTE	0	FALSE
0006	RecvLen	%QB5		BYTE	0	FALSE
0007	StartChar	%QB6		BYTE	0	FALSE
0008	EndChar	%QB7		BYTE	0	FALSE
0009	RecvTimeout	%QB8		BYTE	0	FALSE
0010	RecvMode	%QB9		BYTE	0	FALSE
0011	RecvSN	%QB10		BYTE	0	FALSE
0012	AckID	%QB11		BYTE	0	FALSE
0013	Complete			BOOL	FALSE	FALSE

```
0001 RecvLen:=40;
0002 StartChar:=1;
0003 EndChar:=255;
0004 RecvTimeout:=200;
0005 RecvMode:=13;
0006 RecvEn := 1;
0007 Complete := 1= RecvQ;
0008 AckID := PackID;
```

Configuration for Only Receive Mode

Only confirming the data reported by LK239, then the next packet data will be reported. Error information can be obtained by% IB6 bytes. Test the starting characters and / or ending character, when LK239 is configured as only receive data, starting characters and / or ending characters need to be enabled in Control byte, starting characters and / or ending characters must be filled correctly and be consistent with settings in sending for receiving data correctly. When receiving data, the system will send packet received (including the starting characters and / or ending characters) to input data area.

(2) Free protocol Send and Receive mode

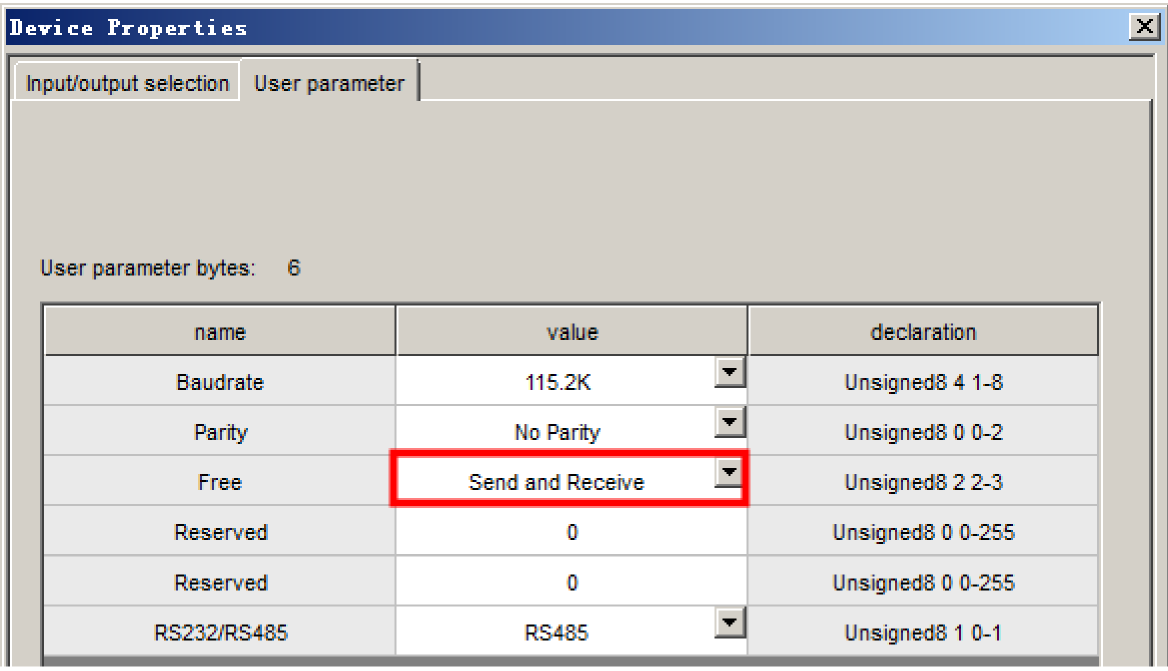
If LK239 both send data through the serial port and receive data from external device, you will select **Send and Receive** mode. In **Send and Receive** mode, enable the SendEn (rising edge enable and high level is effective, the data is sent once in each rising edge). LK239 will send valid data in output area, if the device returns data to the LK239, the users should enable RecvEn with sending enabled (rising edge enable, high level for holding, the data is received once in each rising edge). receiving process is similar with the Only Receive mode (no cache for receiving in Send and Receive mode).

When data is received, if enable the ending characters, which as ending to end the current packet and continue receiving the next packet, then receiving until the specified data length is met. If disenable the ending character, enable the starting character and length, end receiving when the specified data length which to begin for starting character is met. If the receiving length is set as 0, the starting and ending characters must be enabled.

In summary, the starting characters and / or ending character must be set correctly and be consistent in sending and receiving ends for receiving data correctly.

Free protocol in **Send and Receive** mode for example as following:

As shown in figure, after data is added, you can set **Send and Receive** mode and configure the baud rate (The description use RS485 as an example, please select baud rate according to the actual project) as shown in figure.



LK239 configured as Send and Receive Mode

Engineering configuration is shown in figure.

PLC_PRG(PRG).st

No.	Variable Name	Address	Variable Description	Variable Type	Initial Value	Power Fail Safegua
0001	RecvQ	%IB4		BYTE	0	FALSE
0002	RecvSize	%IB5		BYTE	0	FALSE
0003	RecvErr	%IB6		BYTE	0	FALSE
0004	PackID	%IB11		BYTE	0	FALSE
0005	RecvEn	%QB4		BYTE	0	FALSE
0006	RecvLen	%QB5		BYTE	0	FALSE
0007	StartChar	%QB6		BYTE	0	FALSE
0008	EndChar	%QB7		BYTE	0	FALSE
0009	RecvTimeout	%QB8		BYTE	0	FALSE
0010	RecvMode	%QB9		BYTE	0	FALSE
0011	RecvSN	%QB10		BYTE	0	FALSE
0012	AckID	%QB11		BYTE	0	FALSE
0013	Complete			BYTE	0	FALSE
0014	SendQ	%IB0		BYTE	0	FALSE
0015	SendEn	%QB0		BYTE	0	FALSE
0016	SendLength	%QB1		BYTE	0	FALSE
0017	SendTimeout	%QB2		BYTE	0	FALSE
0018	SendSN	%QB3		BYTE	0	FALSE
0019	CompleteSend			BOOL	FALSE	FALSE

```
RecvLen:=40;
StartChar:=1;
EndChar:=255;
RecvTimeout:=200;
RecvMode:=13;
SendLength:=40;
SendTimeout:=1;
SendEn:=1;
CompleteSend:= 1= SendQ;
```

Configuration for Send and Receive Mode

Here simply to show the data sending and receiving process is similar with the Only Receive mode.

ⓘThe LK239 module cannot transmit the REAL data directly by configuring the input/output data. It shall do this with the help of Zone M, with the high-low byte sequence exchanged.

6.3.8.12 Technical Specifications

LK239 Modbus Master/Slave Communication Extension Module		
System Power		
Operating Voltage		24VDC (-15%~+15%)
Backplane Current		80mA max.@24VDC
DP Communication Bus		
Protocol		Profibus-DP slave station protocol
Dual-network Redundancy		Support
Communication rate		9.6 kbps, 19.2 kbps, 45.45 kbps, 93.75 kbps, 187. 5 kbps, 500 kbps, 1.5 Mbps self-adapting
Medium		Led out to the backplane via an European connector
Modbus Communication		
Protocol		Modbus protocol
Transmission Mode and Frame Format		RTU
Physical Layer Interface		RS485 interface (RJ-45), RS232 interface (RJ-45), configuration selection
Function code supported		01, 02, 03, 04, 05, 06, 15, 16 (decimal)
Max. Number of Supported Slave Stations		28
Input/Output Data Length		Up to 244 bytes
Communication Rate		1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps (configuration selection)
Verification Mode		Odd parity check, even parity check, no check (configuration selection)
Master Slave Mode		To support the master and slave stations (configuration selection)
Isolation Voltage betwen System and Communication Interface		≥500 VAC@1 min, leakage current: 5 mA
Free Protocol		
Protocol		Free protocol, send and receive at the same time
Communication Rate		1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps (configuration selection)
Physical interface		Choose one in RS485 or RS232
Verification Mode		Odd parity check, even parity check, no check (configuration selection)
Input/Output Data Length		The input / output data length is up to 244 bytes each
Start byte		One byte, data range: 0~255, Occupies starting address
End byte		One byte, data range: 0~255, Occupies end address
Isolation Voltage between System and Communication Interface		≥500 VAC@1 min, leakage current: 5 mA
Physical Property		
indicator	RUN (green)	indicator for Profibus-DP bus communication
	COM (yellow)	Modbus communication /Free protocol indicator
Installation Mode		Slot Installation
Installation Position		I/O slot on the extension backplane
Protection Key		F1
Module Dimension (W*H*D)		35 mm×100 mm×100 mm
Hot Plugging		Support
Weight		180 g
Environmental Adaptability		
Operating Temperature		-20℃~70℃
Operating Humidity		5%~95%, with no condensation
Storage Temperature		-40℃~80℃
Storage Humidity		5%~95%, with no condensation

6.3.9 LK250 Profibus-DP Network Extension Module

6.3.9.1 Basic Features

- Interconnect Profibus-DP slave stations to Profibus-DP master stations
- Used to reduce the number of Profibus-DP slave station nodes in the network segment where the controller resides
- Connect at most 30 Profibus-DP slave station modules
- Can only be installed on expansion backplanes
- Provide termination resistors for Profibus-DP
- Support hot swap

LK250 Module Schematic Diagram

6.3.9.2 Principle Description

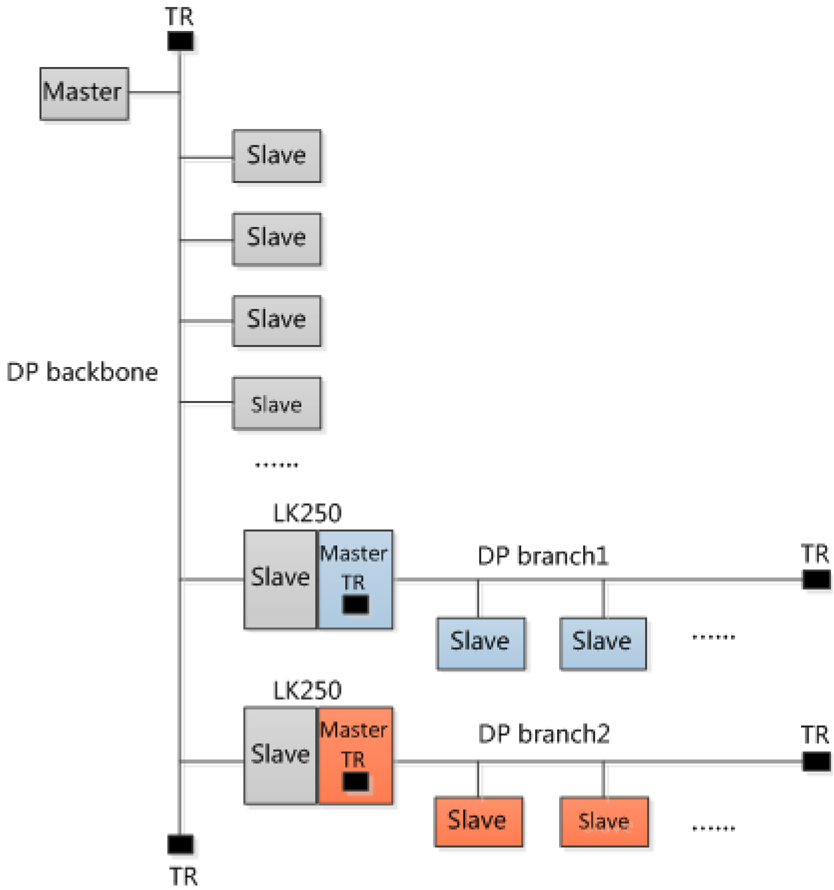
The LK250 is a Profibus-DP network extension module that interconnect Profibus-DP slave stations to Profibus-DP master stations. It works as a Profibus-DP slave station in the upper network segment and as a Profibus-DP master station in the lower network segment.

Since a logical Profibus-DP network segment supports at most 124 nodes address (node addresses range from 2 to 125), the controller in the LK system occupies addresses 0 and 1, and the DP slave station node address range from 2 to 125, which means it can connect at most 124 DP slave stations. When the number of DP slave station to be configured exceeds 124, LK250 module can be used to extend the network segment.

Logically speaking, LK250 uses the DP slave station protocol to connect to the controller and occupies only one DP node address as seen by the controller, and at same time it uses the DP master station protocol for extended I/O. Each LK250 may carry at most 30 DP slave station I/O,which form a DP logical network segment. The LK250 extended I/O modules exchanges data with the controller through the LK250 module. All extended I/O modules are only one DP node as seen by the controller.

The DP backbone segment of the controller can be connected to multiple LK250. Each LK250 expands one DP branch, and the DP branches are independent of each other, as shown in figure.

LK250 modules are installed in the left-most communication slots of the expansion backplanes, and the mechanic key is B5.



LK250 Extended slave stations

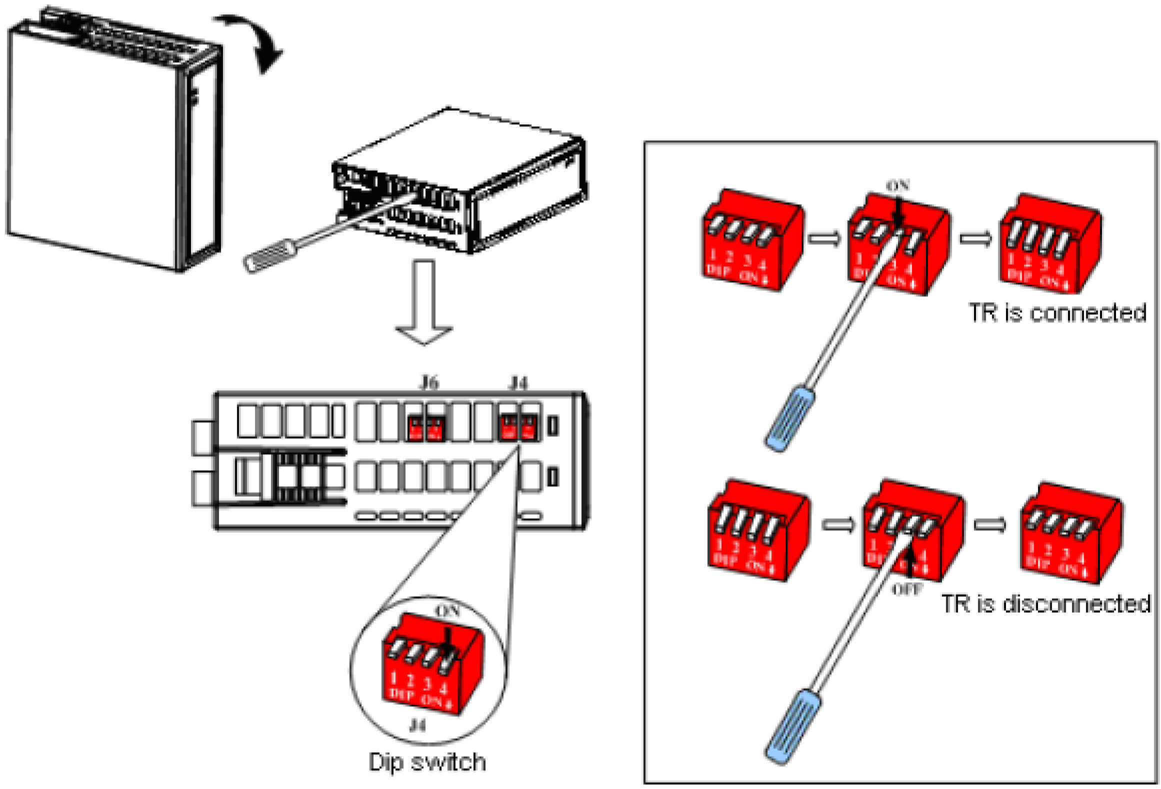
6.3.9.3 Terminal Matching

There are three dip switches J4, J5 and J6 on LK250, and through the dip switches it can be configured whether or not to provide active termination resistor networks for DP bus.

- J4: Used to set termination resistor of main DP bus. Default is not connected.
- J5: Used to set the termination resistor at the start of the LK250 extended DP branch, Default is connected.
- J6: Used to set the termination resistor at the end of the LK250 extended DP branch, Default is connected.

The dip switches are located inside the modules, to change the switch position, it is not necessary to dissemble the casing, instead, use a small flathead screw driver to set the dip switches through the heat dissipation holes, as shown in figure.

When setting the switches, the four keys of each switch must be set consistently. When the four keys are down, the state is "ON", and the termination resistor is connected. When the four keys are up, the state is "OFF", and the termination resistor is disconnected.



Configuration of DIP switches of LK250

6.3.9.4 Indicator Definition of LK250

The indicator of LK250 modules are defined as in table, where the RUN indicator shows the communication between LK250 and the controller, and the COM indicator shows the communication between LK250 and the expansion I/O modules.

Definition of LK250 indicator

Indicator	Color	Status	Description
RUN indicator	Green	ON	Communication between LK250 and the controller is normal
		Flashing quickly	Communication between LK250 and the controller is abnormal
		OFF	Not powered on or power failure
COM indicator	Yellow	ON	LK250 is communicating normally with all I/O
		Flashing quickly	LK250 is communicating abnormally with one or more I/O
		OFF	LK250 is communicating abnormally with all I/O

Note: When the firmware is upgraded, the RUN and COM indicators are flashing slowly. After the firmware upgrade is completed, the two indicators are off.

6.3.9.5 LK250 Extends I / O

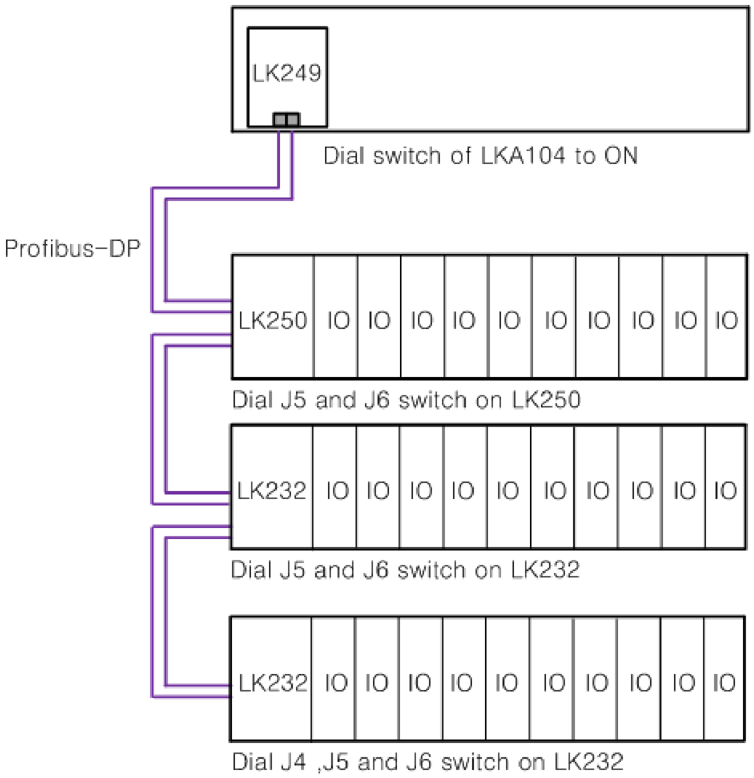
LK250 can connect 30 IO slave stations, which can be used with LK232 module and LK233 module to connect extension backplane in DP network segment under the LK250. The extension backplane cascade mainly includes DP cascade, optical fiber cascade and DP with optical fiber cascade.

Attentions for I / O extension :

- When 30 I/O modules are extended by LK250, LK250 can only be as a last slave station of DP backbone .
- The extension backplane where the LK250 is located uses LKA101 Profibus-DP bus connector to connect DP cable.
- The initial matching resistor of Profibus-DP backbone is set by LKA104, and the ending terminal matching resistor is set by LK250.
- In order to ensure the continuity of the slave address under LK250, when the backplane is cascaded, the dial switch address of the next extension backplane should be continuous with the address of the previous extension backplane.
- If optical fiber is used to connect extension backplane, in order to ensure the continuity of the slave address, the LK233 modules are installed in the last IO slots. LK233 only occupies electrical nodes, not logical nodes.

6.3.9.5.1 DP cascade

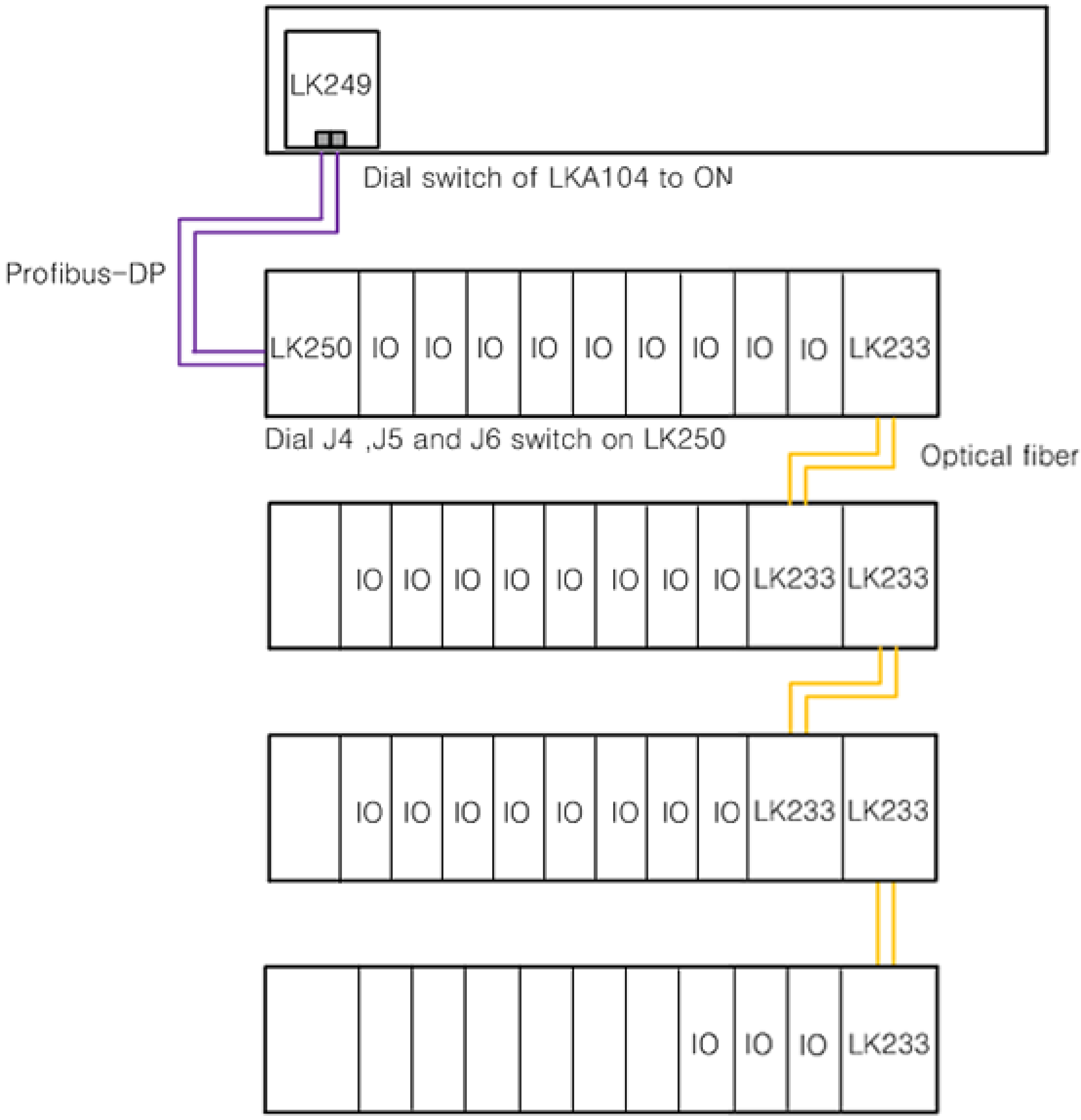
The extension backplanes are cascaded by Profibus-DP bus, and use LK232 module to extend with connector LKA104. The connection diagram is as follows.



DP Cascade Diagram

6.3.9.5.2 Optical fiber cascade

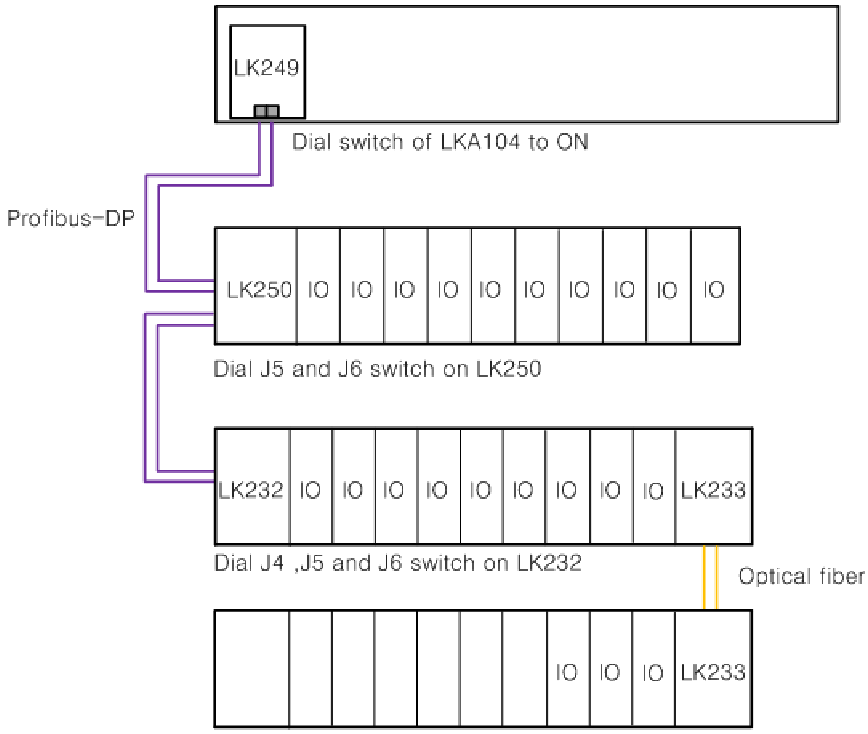
The extension backplanes are cascaded by optical fiber, and use LK233 module to extend with connector LKA104. The connection diagram is as follows.



Optical Fiber Cascade Diagram

6.3.9.5.3 DP with optical fiber cascade

The extension backplanes are cascaded by optical fiber, and use LK233 module to extend. The connection diagram is as follows.



DP with Optical Fiber Cascade Diagram

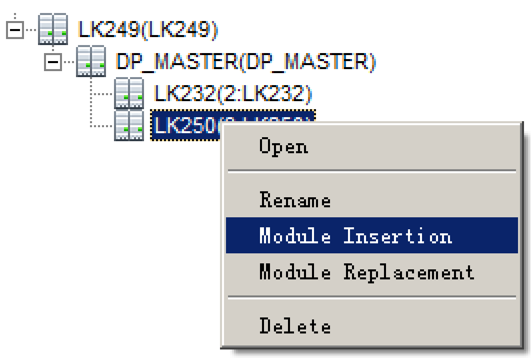
6.3.9.6 Parameter Description

6.3.9.6.1 Add IO slave station

The LK250 can connect at most 30 Profibus-DP slave station modules. You need to add IO modules according according to the actual installation slot of the IO module on the expansion backplane.

To expand IO modules, follow these steps:

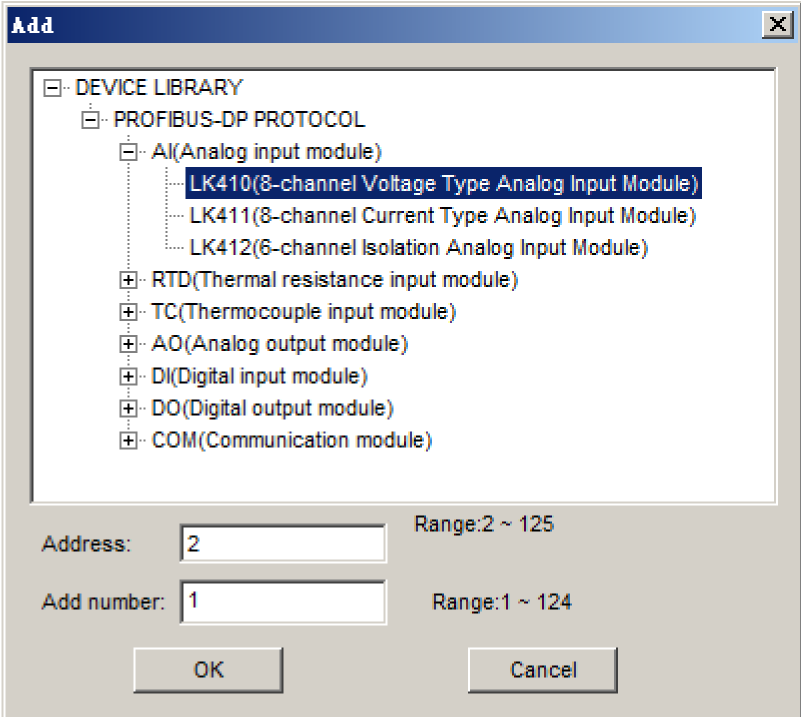
(1) In the right-click menu of communication module, select "Module Insertion".



Select Add Command

The "Add" dialog box pops up.

(2) Select a module to add.



Select a Module

(3) Enter module address and number.

(4) Click the **OK** button.

I / O module is added to the communication module node.

6.3.9.6.2 Set station address

You need to configure station address of LK250 and IO module. LK250 address is set by the dip switches of the expansion backplane.The IO module address consists of the DIP switch and the backplane offset address of module, please see Communication Address.

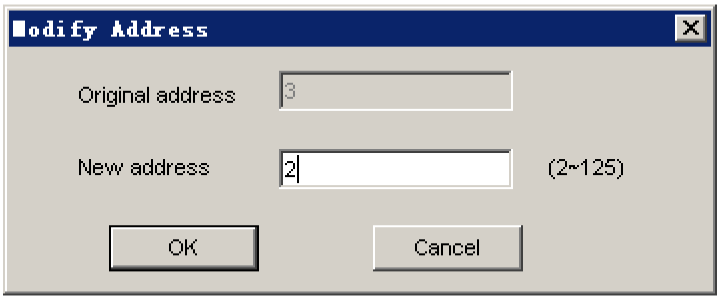
(1) Double click the module name to open the module properties window.

(2) On the "Device Configuration" tab, double-click the "Device Address" parameter.

The "Modify Address" dialog box will pop up.

(3) Enter station address.

(4) Click the **OK** button.

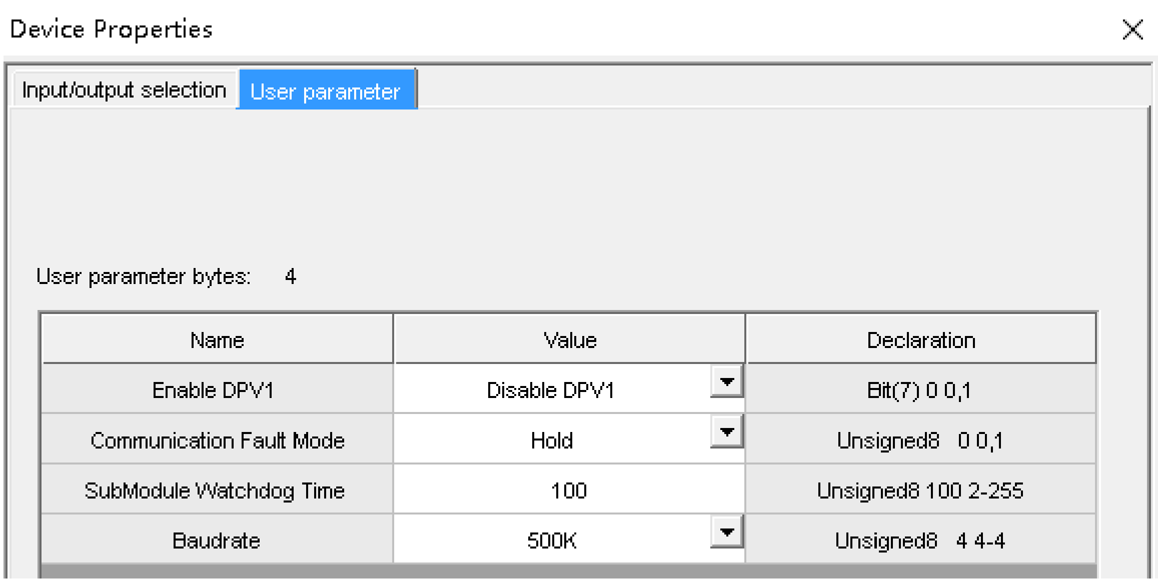


LK250 DP Slave Station Address Setting

6.3.9.6.3 Setting user parameter

In the User Parameters tab, the following parameters need to be configured.

- Enable DPV1: DPV1 protocol is not supported at present, and remain the default value.
- Communication Fault Mode: Communication fault mode can be set to hold and reset. Hold: When LK250 is offline, slave station IO module remains online; Reset: When LK is offline, slave station IO module is offline.
- SubModule Watchdog Time: Watchdog time of LK250, unit:ms, Watchdog time=settings value *10ms.For example, SubModule Watchdog Time is set to 4, then Watchdog time is 40ms. Generally, the default value is used. If an I/O module is offline, please increase the parameter value.
- Baudrate: Baud rate, default 500 Kbps.



User Parameters Setting

6.3.9.7 Diagnosis

LK250 reports the 20 bytes diagnosis information, wherein 3 bytes are device-related diagnosis, 17 bytes are identification diagnosis information. Call the function block sysGetDPSlaveState (Get Diagnosis of DP Slave), diagnosis data reported are saved into the output parameter **DiagData**.

Diagnosis Information of DiagData array

Output parameters	**Data type**	**Diagnosis information**	**Description of diagnosis byte**
DiagData[0]	BYTE	Device diagnosis	Length of device diagnosis information, 3 bytes
DiagData[1]	BYTE		The bit6 and bit7 report DP1 , DP2 networks fault status of slave station 00: The network is normal 01: DP1 network fault 10: DP2 network fault
DiagData[2]	BYTE		The bit6 and bit7 report DP1 , DP2 networks fault status of master station 00: The network is normal 01: DP1 network fault 10: DP2 network fault 11: DP1 and DP2 network fault
DiagData[3]	BYTE	Identification diagnosis	Length of identification diagnosis information, the decimal value of bit0-bit4 report the diagnosis length, and bit5-bit7 is fixed value 010
DiagData[4]~DiagData[19]	BYTE		DiagData [4]~DiagData [19] 16 bytes, bit2-bit125 bitwise displays the online status of slave IO module 2-125, 1:module online, 0:module offline

Diagnosis information of IO slave station connected by LK250, please refer to diagnosis function block of LK250.

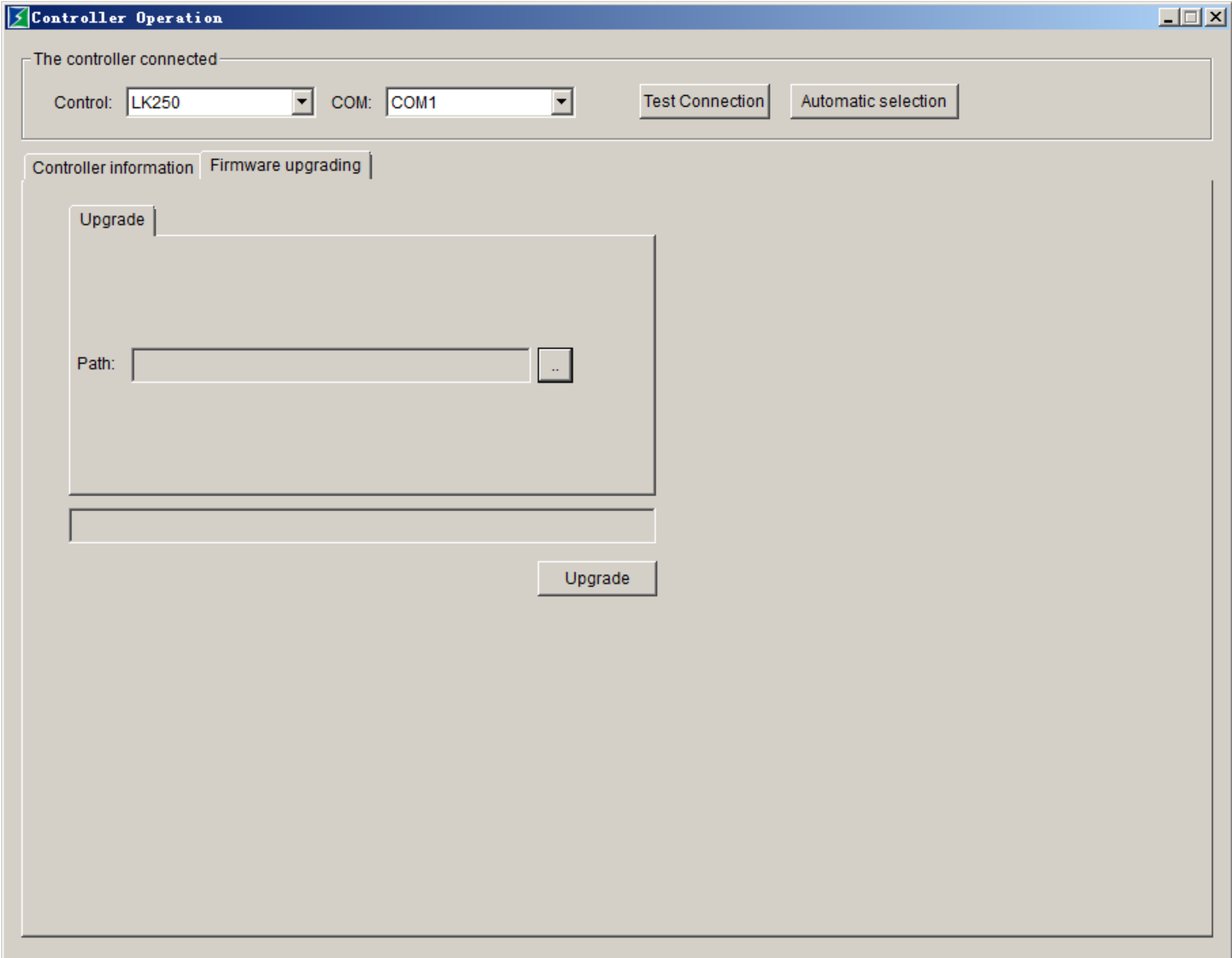
6.3.9.8 Update Firmware

Upgrade module by following steps:

(1) Address dip switch of the LK250 is set to 0, plug and pull module, the RUN and COM indicators are off.

(2) Click the menu [Tool]- [Assistant tool]- [Controller Operation] in AutoThink.

The Controller Operations dialog box will be opened.



Firmware Upgrading Dialog Box

(3) Select LK250 as a Controller , and COM1 as serial port .

(4) Click the Path button to select the. bin firmware file.

(5) Click the **Upgrade** button.

During upgrading, the RUN and COM indicators are flashing.

(6) After upgrading, the RUN and COM indicators are off and modify address.

(7) Plug and pull module, module can work normally.

6.3.9.9 Technical Specifications

LK250 Profibus-DP Network Extension Module		
System Power Supply		
Voltage		24VDC (-15%~+20%)
Power Consumption		100mA@24VDC
Processor and Memory		
controller		32 bit micro processor
Memory	RAM	192KB

LK250 Profibus-DP Network Extension Module		
	FLASH	1024KB
Communication Bus		
Protocol		Profibus-DP
Communication Rate	DP slave protocol	187.5kbps, 500kbps, 1.5Mbps, 3Mbps, 6Mbps
	DP master protocol	500kbps
Physical Features		
Installation Method		Slot installation
Installation Location		Communication slots on expansion backplane
Mechanic Keys that Prevent Incorrect Insertion		B5
Hot Swap		Supported
Dimensions（W*H*D）		35mm*100mm*100mm
Casing Protection Level		IEC60529 IP20
Weight		185g
Environmental Adaptability		
Operating Temperature		-20℃~70℃
Operating Humidity		5%~95%, with no condensation
Storage Temperature		-40℃~80℃
Storage Humidity		5%~95%, with no condensation

6.3.10 LK271

6.3.10.1 LK271 PROFINET Communication Module

The LK271 PROFINET Communication module belongs to the communication module between the PL to DP master and PN master, used to support the LK controller to connect to the LK series expansion IO module, third-party DP slave, and third-party PN slave.

The LK271 module has two PL communication interfaces, one PN communication interface, and two redundant DP. It is the master module for the PN protocol and the master module for the DP protocol.

LK271 is only responsible for the IO slave station of the local expansion communication backplane. An LK271 connects with a maximum of 32 IO modules.

LK271 supports mainstream brand switches such as Siemens, MOXA, Excellence, Dongtu, and TP Link.

6.3.10.2 Basic Features

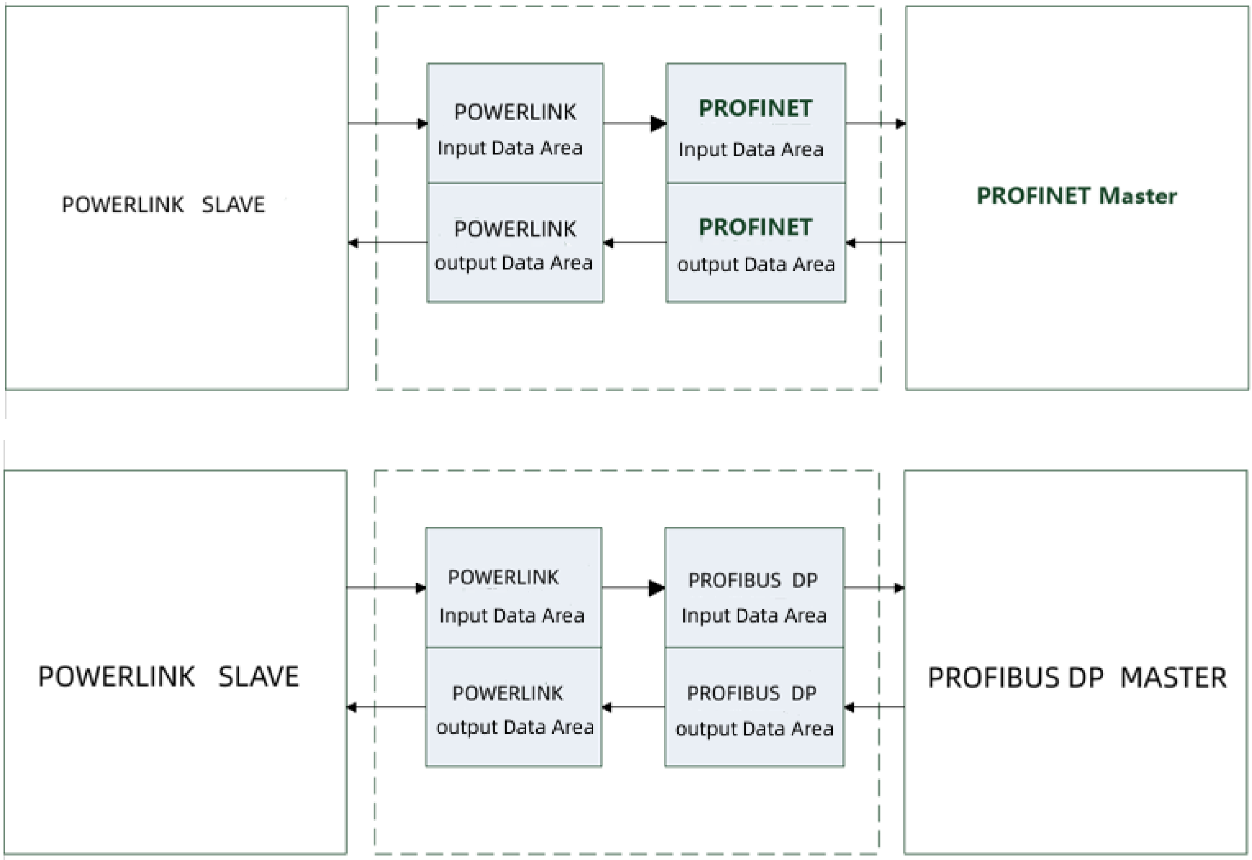
- 3-way Ethernet interface
- PROFINET master station communication protocol
- Support for hot swapping

■ Provide two redundant RS485 backplane communication channels (Profibus DP)

6.3.10.3 Principle of Data Mapping

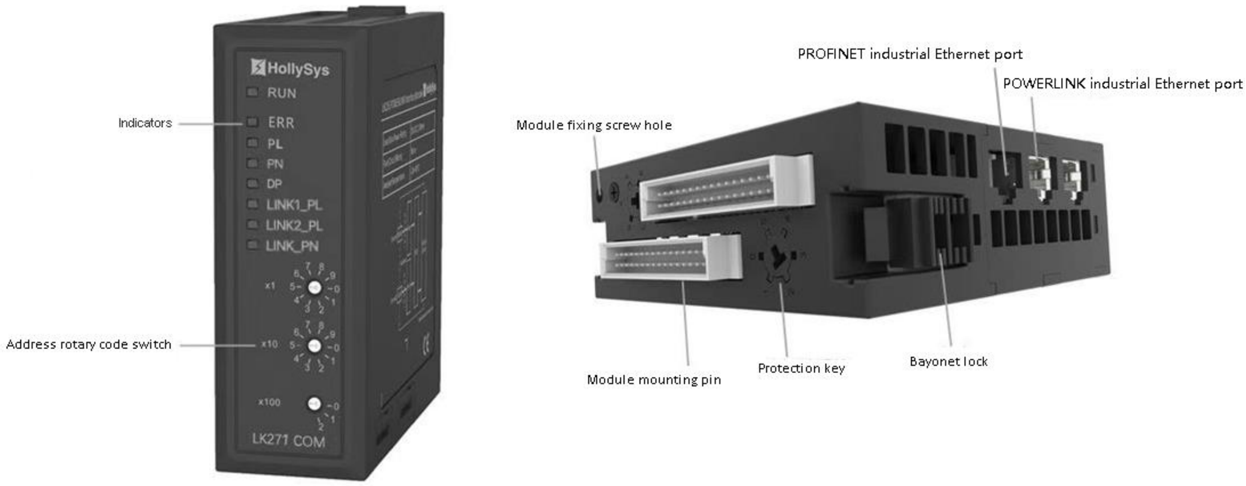
The LK271 as a gateway for connecting the communication modules of PL to DP master and PN master. It internally establishes a mapping relationship between PowerLink data, PROFIBUS DP data, and PROFINET data, and exchanges data according to this mapping relationship.

There are two data buffers in the gateway device, one is the input buffer. The PROFIBUS DP master station reads the data from the PROFIBUS DP slave station and stores it in the PROFIBUS input data area. The internal data exchange buffer is the PROFINET input data area, which is read by the PROFINET master station through the function block; The other block is the output buffer, where the PROFINET master station writes data to the PROFINET output data area through the function block, and then caches the data to the PROFIBUS output data area after data exchange. Until mapped to the PROFIBUS DP slave station.



Module Work Mapping Principle

6.3.10.4 Appearance



LK271 Module Schematic Diagram

Interface Description

Interface	Description
Indicators	Indicate module working status
Address rotary code switch	Two 10-bit rotary code switches and 1 3-bit rotary code switch are used to set the address of the LK271 device
Module fixing screw hole	After the module is installed, fix it with screws
PROFINET industrial Ethernet port	1- way PROFINET Ethernet interface, used to connect PROFINET slave stations or switches
POWERLINK industrial Ethernet port	2-way POWERLINK Ethernet interface, used to connect to POWERLINK master station or switch
Module installation pin	Insert into the slot jack of the expansion backplane
Protection key	The unique code set to prevent the module from being damaged by incorrect insertion is fixed at the factory and cannot be changed. The protection key code on the slot must be consistent with the module protection key code
Bayonet lock	One on top and one on bottom. After the module is installed in the slot, the bayonet and expansion backplane buckle are automatically locked When disassembling, you need to press the upper and lower bayonets at the same time to pull out the module

6.3.10.5 Indicators

Instructions to Indicators

Name	Function	Color	Status	Description
RUN	Indication of operating pattern	Green	On	Module is running normally
			Slow flashing	Module did not load configuration/ during firmware upgrade
			Off	Module not powered on or damaged

Name	Function	Color	Status	Description
ERR	Fault status indication	Red	On	Module has malfunctioned
			Slow flashing	Module is starting
			Off	Module has no faults
PL	Communication indication with POWERLINK master station	Yellow	On	Communication with POWERLINK master stations is normal
			Slow flashing	Communication with POWERLINK master stations is abnormality
PN	Communication status indication with PROFINET slave station	Yellow	On	Communication between all PN slave stations is normal
			Slow flashing	At least one slave station has normal communication, but some slave stations have not established communication
			Off	No communication established with any slave stations
DP	Indication of communication status with DP slave station	Red	On	Communication between all DP slave stations is normal
			Slow flashing	At least one slave station has normal communication, but some slave stations have not established communication
			Off	No communication established with any slave stations
LNK1_PL	Connecting indication of POWERLINK Ethernet interface Port1	Green	On	Port is successfully connected
			Off	Port is not connected
LNK2_PL	Connecting indication of POWERLINK Ethernet interface Port2	Green	On	Port is successfully connected
			Off	Port is not connected
LNK_PN	Connecting indication of PROFINET interface Port	Green	On	Port is successfully connected
			Off	Port is not connected

Note:

- Fast flashing: 4Hz, 125ms on, 125ms off;
- Slow flashing: 1Hz, 500ms on, 500ms off.
- When upgrading firmware, the RUN light is off, ERR, PL, DP and PN lights are Fast flashing.

6.3.10.6 Set Device Address

6.3.10.6.1 Concept

Set the device address through the 3 rotary switches on the front panel of the module. The ones place and tens place are 10-bit rotary code switches, and the hundreds place is 3-bit rotary code switches. Device address=100×setting value of hundreds place rotary code switch+10×setting value of tens place rotary code switch+setting value of ones place rotary code switch, the setting range is 1~239.

When configuring the device address in the AutoThink software, please keep it consistent with the actual dialing value.

Please set the device address before powering on the module. If you set the rotary code switch address when the module is powered on, you need to restart the module to make the address take effect.

6.3.10.6.2 Requirements

- The module has been installed
- Prepare a flat-blade screwdriver

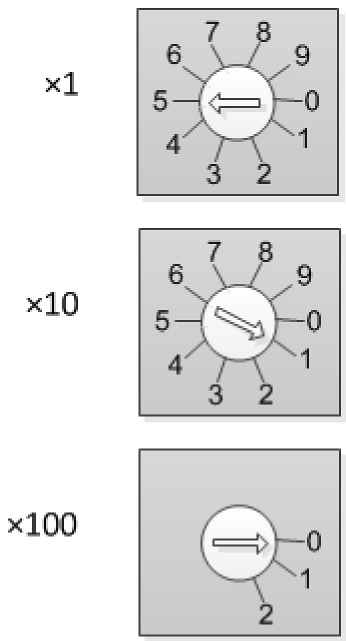
6.3.10.6.3 Steps

To set the device address, please follow the steps below:

(1) Using a screwdriver, turn the three rotary code switches ×1, ×10, and ×100 to the required device address.

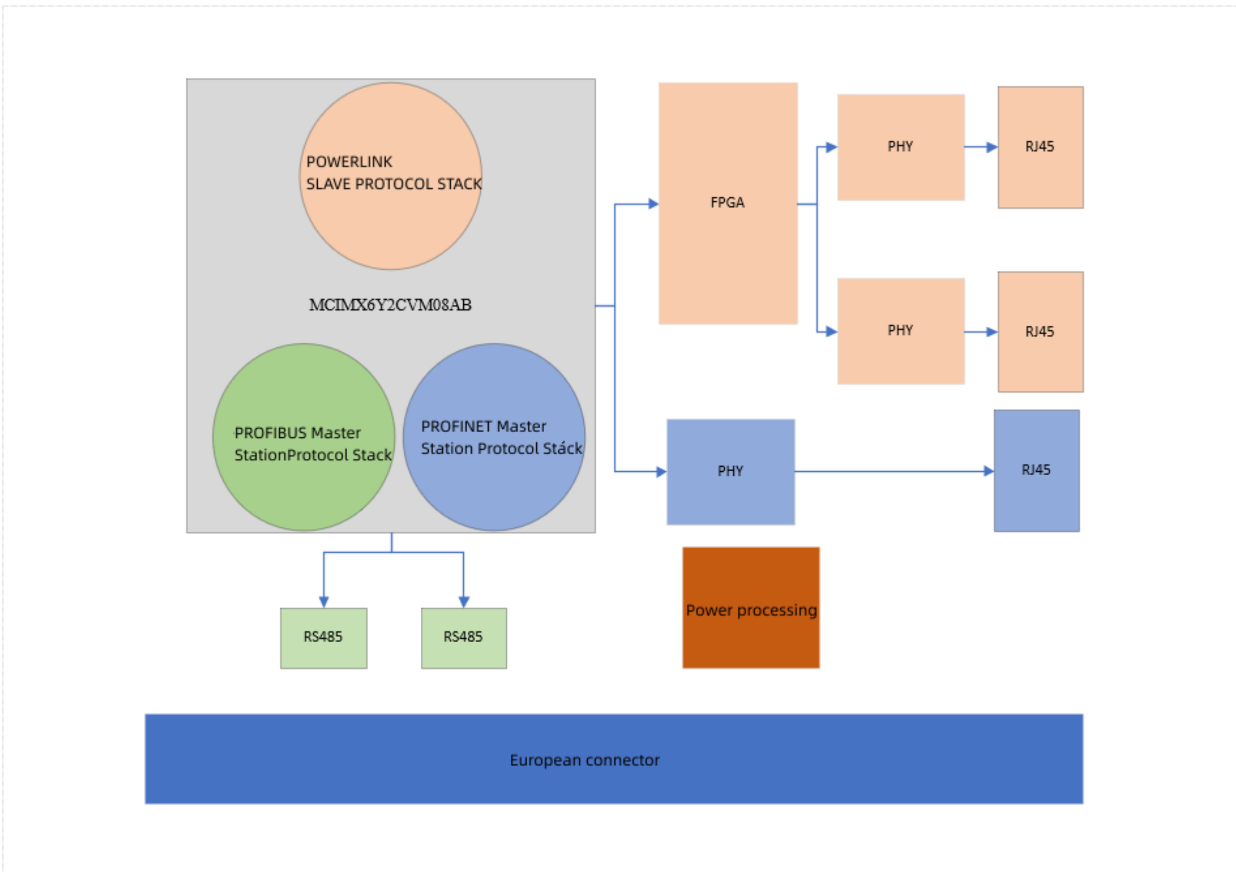
6.3.10.6.4 Example

For example: Set the station address to 15, then turn the hundreds place rotary code switch to 0, the tens place rotary code switch to 1, and the ones place rotary code switch to 5, as shown in the figure below.



Set Device Address

6.3.10.7 LK271 System Block Diagram



LK271 System Block Diagram

6.3.10.8 Technical Specifications

LK271 PROFINET interface module		
MCU characteristics		
CPU Model	MCIMX6Y2CVM08AB	
Storage	32G	SD 卡
	256M	DDR3
DP bus		
Number of Communication Ports	2-ways	
Redundancy Function	supports redundancy	
Level Standard	EIA/TIA-485	
Communication Port Type	Backplane Communication	
(bps) Communication Rate	187.5Kbps,500Kbps,1.5Mbps	
Communication Protocol	HollySys DP master station	
Electrical Isolation	No isolation between channels and system No isolation between two RS485 channels	
PN Bus		
Number of Communication Ports	1-way	

LK271 PROFINET interface module	
Level standard	802.3
Communication Port Type	Standard RJ45
Communication Rate(bps)	100Mbps
Communication Protocol	PROFINET
PL Bus	
Number of Communication Ports	2-ways
Level standard	802.3
Communication Port Type	Standard RJ45
Communication Rate(bps)	100Mbps
Communication Protocol	POWERLINK
Protection Level	
Module Protection Level	IP20
Hot Swapping	
Module Hot Swapping	Supported
Power Supply	
Input Voltage	20.4VDC ~ 28.8VDC(24.0VDC -15%~+20%)
Module Power Consumption (max)	180mA@24VDC
Rated Voltage	24.0VDC
Start Time	
The time from power-up to initialization of the module	≤30S

6.3.10.9 Configuration

6.3.10.9.1 Add Module

6.3.10.9.1.1 Concept

The LK271 PROFINET interface module acts as a POWERLINK slave upwards, reports IO slave data information to the upper POWERLINK master, acts as a DP master or PN master downwards, and sends data from the controller to the lower IO slave. The LK271 communication interface module needs to be installed in the communication slot of the extension backplane, and the parameters of the communication interface module need to be added and configured.

Each POWERLINK master protocol can configure 64 LK271 modules at most.

6.3.10.9.1.2 Requirements

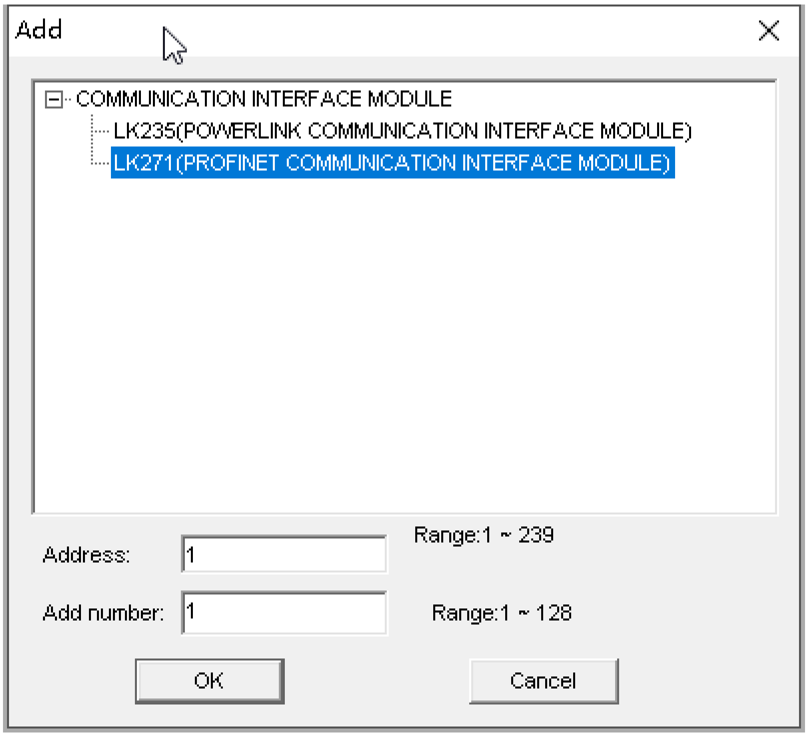
- "POWERLINK_MASTER "protocol has been added
- LK271 has been installed and the station address has been set

6.3.10.9.1.3 Steps

To add communication interface module, follow these steps:

In the right-click menu of POWERLINK_MASTER node, select "Add Device" command.

(1) The "Add" dialog box will pop up.



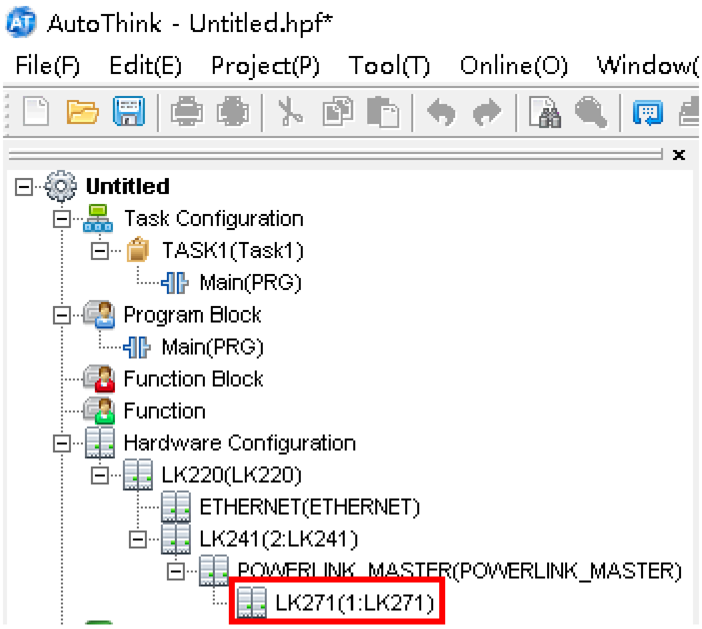
(2) Select "LK271 (PROFINET COMMUNICATION INTERFACE MODULE)".

(3) Enter the device Address and Add number.

Set the address according to dial switch on the module.

(4) Click the OK button.

The module is added under the POWERLINK_MASTER.



6.3.10.9.1.4 Next Step

Add POWERLINK slave protocol.

6.3.10.9.1.5 Reference

Add POWERLINK Master Protocol

Add POWERLINK Slave Protocol

6.3.10.9.2 Configuration Module

(1) Connect the power supply correctly, connect LK271 to the PC through the Ethernet port, and power up LK271;

(2) Open the configuration software and configure it according to the requirements, including DP master station, slave station attribute parameters, etc;

(3) Click the "Online" and "Download" buttons in the toolbar to download the configuration to LK271;

(4) Configure the corresponding configuration in AutoThink, including the module, the IP address and device name of the target device (LK271);

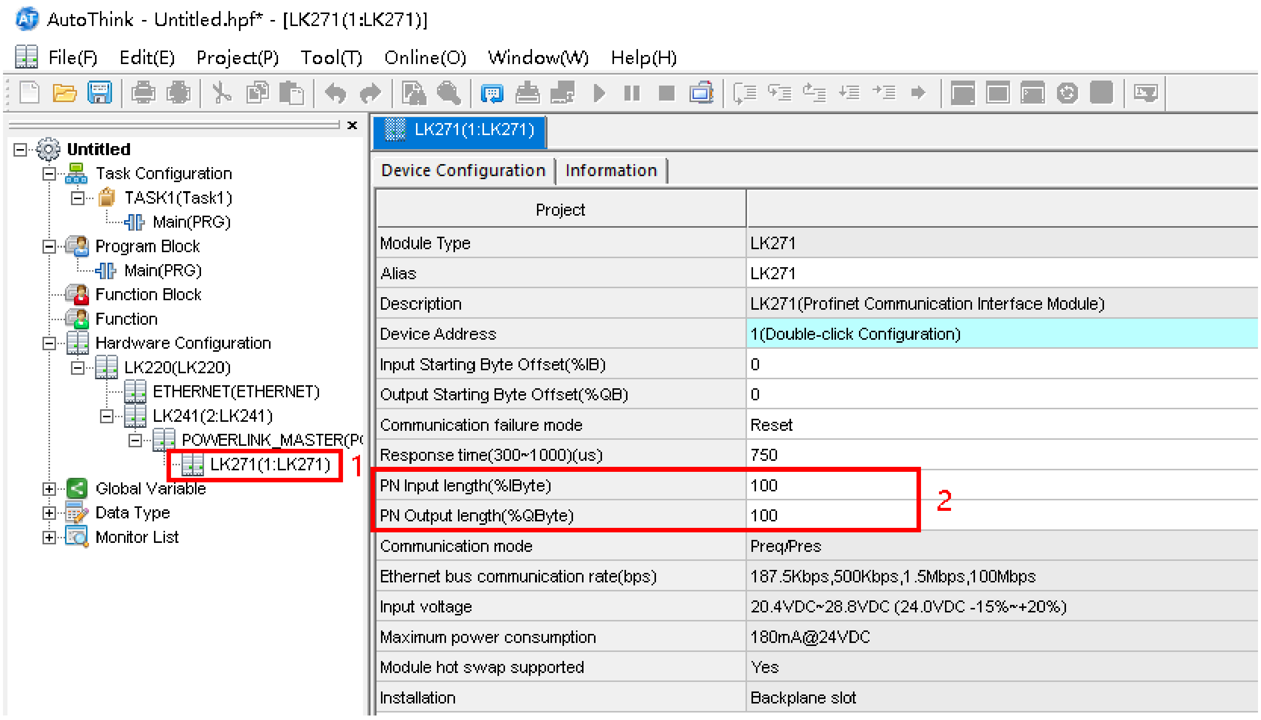
(5) Download the configuration of AutoThink to LK271.

Note: LK271 is used in PROFINET Config software, please refer to corresponding help manual for the configuration.

6.3.10.9.3 Software Configuration Engineering Corresponds to LK271 Data

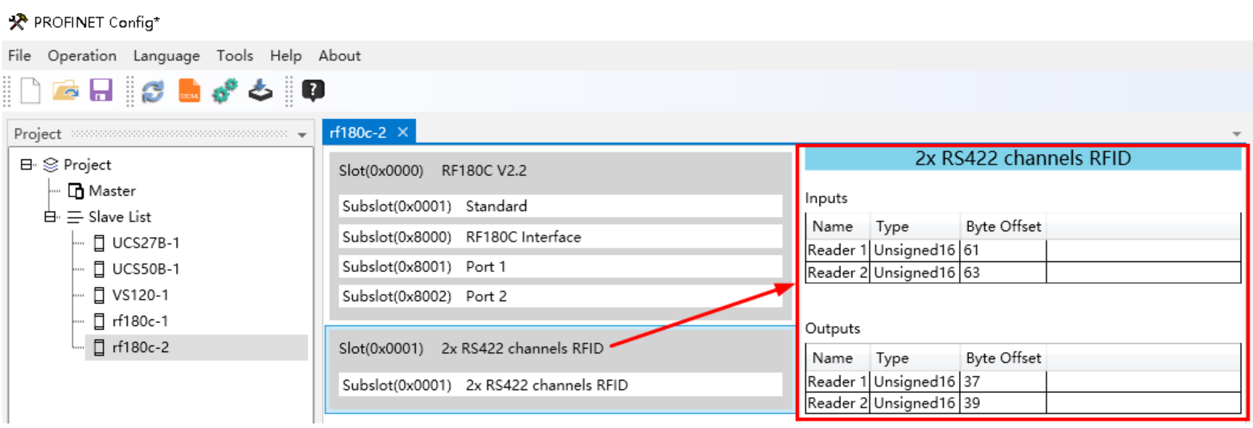
When using AutoThink software version V3.1.11B1Patch2 or higher, you can skip the " Software Configuration Engineering Corresponds to LK271 Data" step and proceed directly to importing the PN device.

(1)Open AutoThink, follow the steps above to configure LK271, double-click LK271, as shown in the following figure:



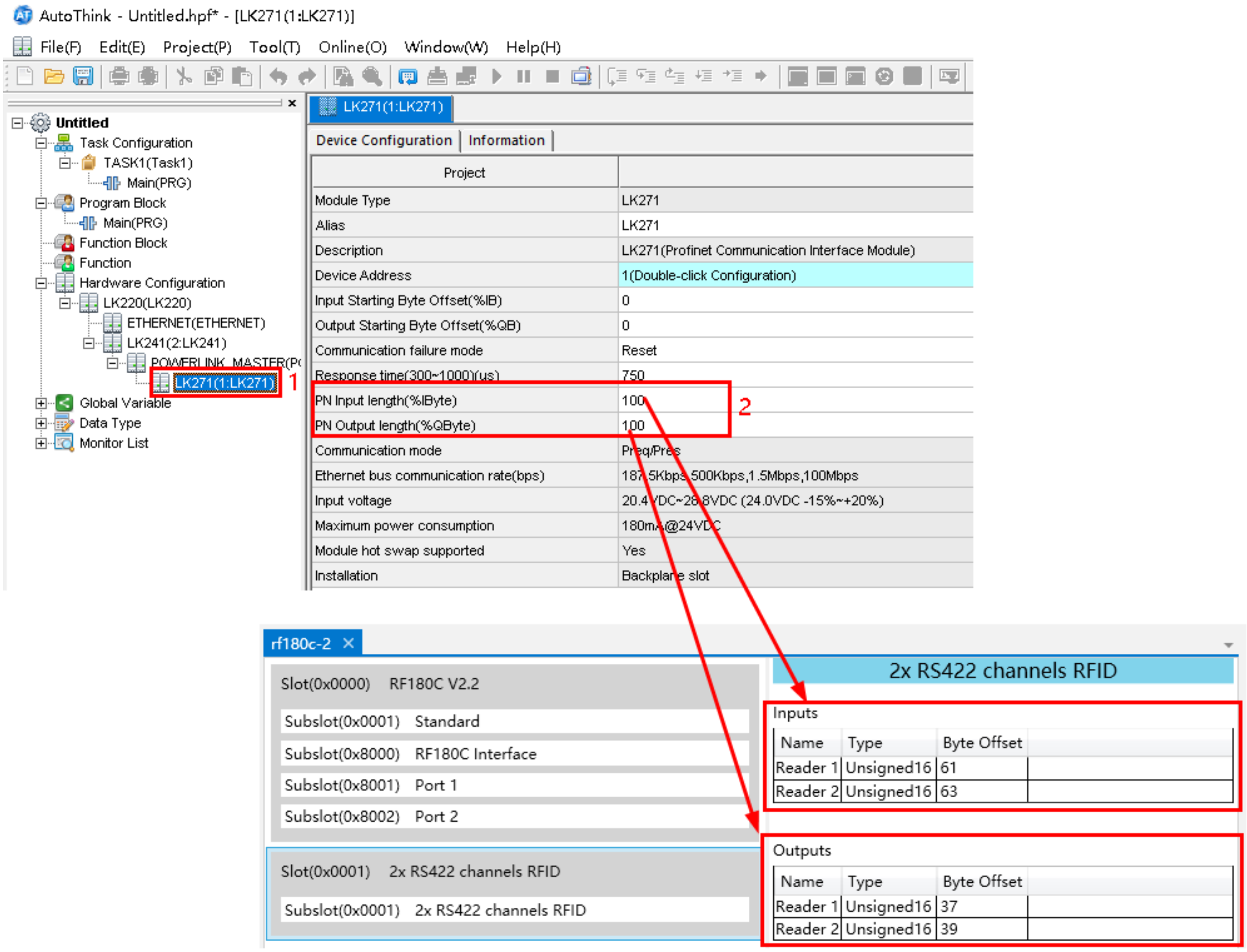
LK271 PN Input Output Byte Length

(2)As shown in the above figure, the length of the PN input channel is 100, and the length of the PN output channel is 100. Open the PROFINET CONFIG configuration software and take rf180c-2 as an example. The specific data offset is shown in the following figure:



Byte Length of Slave Input and Output

(3)The specific correspondence between the PROFINET CONFIG configuration software data and the AutoThink configuration software is shown in the following figure:



Correspondence between Input and Output Bytes of Master and Slave Stations

- PN Input length:32 bytes diagnosis length + byte length of all slave input data.
- PN Output length:byte length of all slave output data.
- The length satisfies four-byte alignment.

6.3.10.9.4 Import PN Device

6.3.10.9.4.1 PROFINET configuration

Add a third-party PN device to Auto Think via LK271.

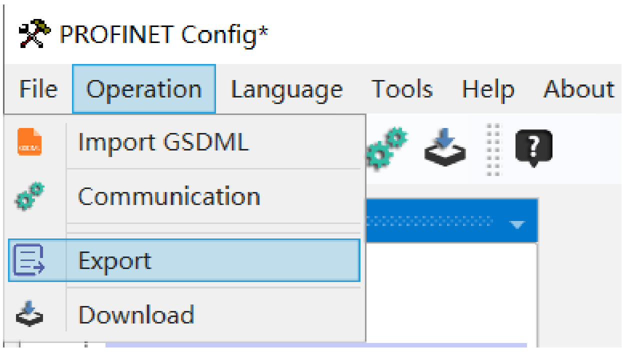
- Note: Please refer to the help manual of PROFINET Config for the network configuration of PN side.

6.3.10.9.4.2 Import PN Profile

1. In the PROFINET Config software, export configuration files by:

Export the configuration file on the PN side of the LK271 module through the toolbar, as shown below.

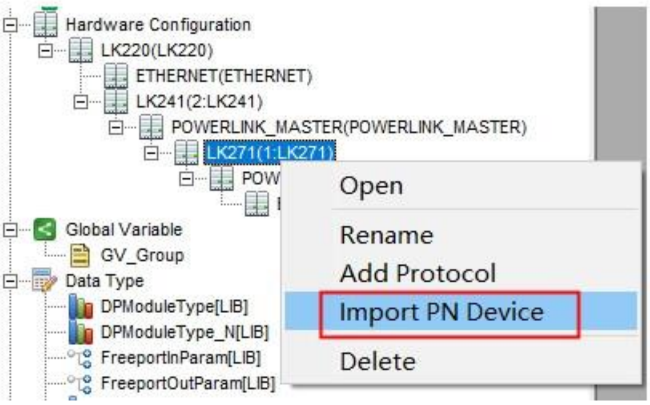
Make sure the file is saved before exporting.



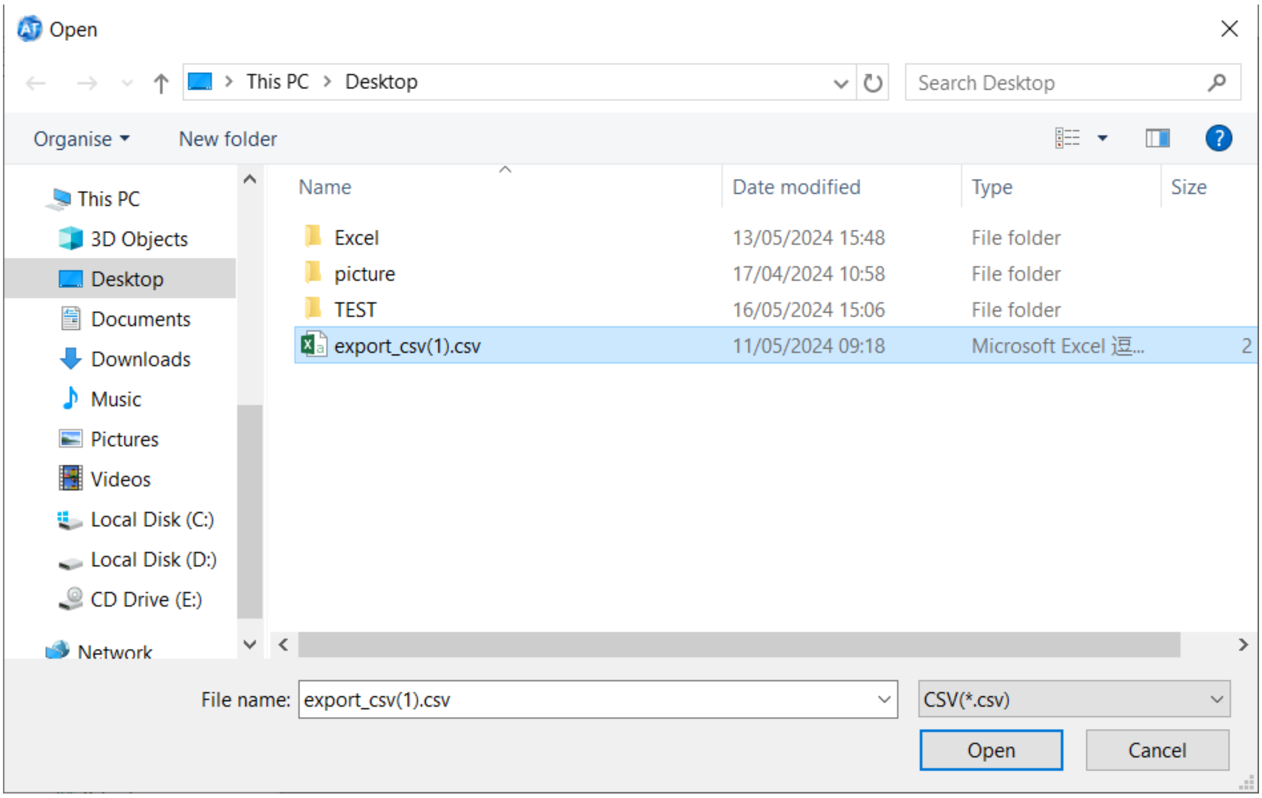
- Note:Please refer to the software's help manual for exporting configuration files.

2. Import PN devices from AutoThink software as follows:

(1) Under the LK271 module, add the "POWERLINK _ SLAVE protocol" firstly and then, on the right-click menu, click the [Import PN Device] command, as shown in figure (a), and select the configuration file exported by PROFINET Config, as shown in figure (b).



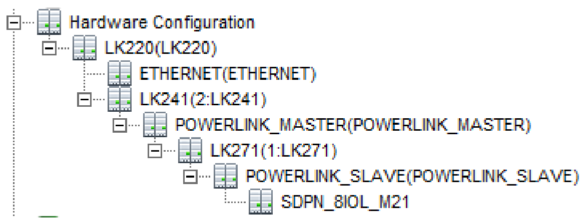
(a)



(b)

Import PN Device

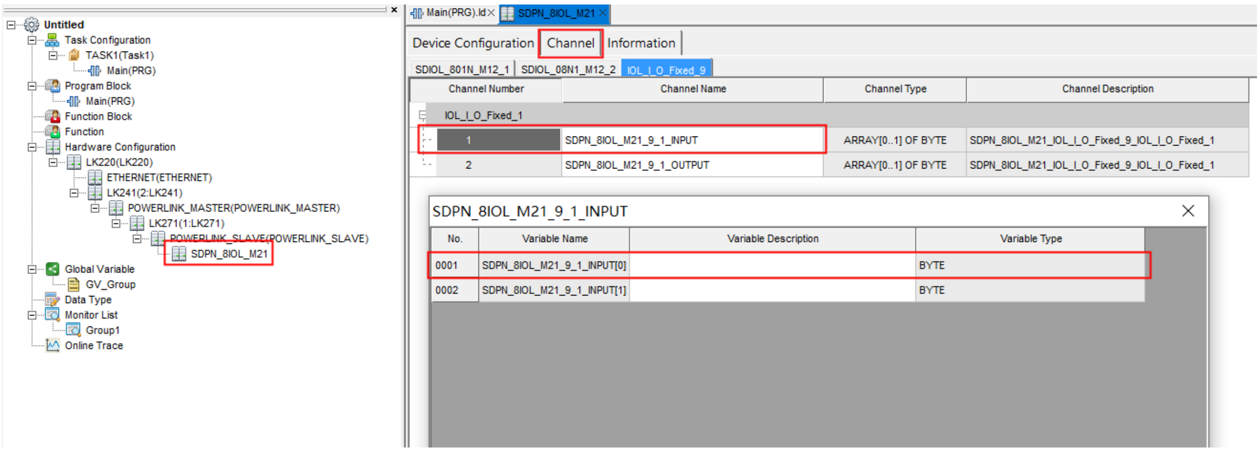
(2) The PN device was successfully added under POWERLINK _ SLAVE.



If the same profile is imported under a different LK271, the AutoThink internal rename check indicates that the import failed.

6.3.10.9.4.3 Channel information description

The input or output channels of the imported device are usually displayed as BYTE arrays; when the channel length is 1 byte, the channel type is displayed as BYTE.



Import Device Channel Information

(3) The rules for calculating the length of LK271 PN test input/output channel are as follows:

- PN input length = 32 bytes (PN diagnostics) + total actual length of PN input (AutoThink automatically aligns 4 bytes).
- PN output length = PN output actual length sum(AutoThink automatically aligns 4 bytes).

(4) Channel presentation content: "Channel Number", "Channel Name", "Channel Type", "Channel Description".

- Only channel names can be modified and are not retained after reimport.

(5) Channel naming rule: Device name_slot number_subslot number_Input/Output.

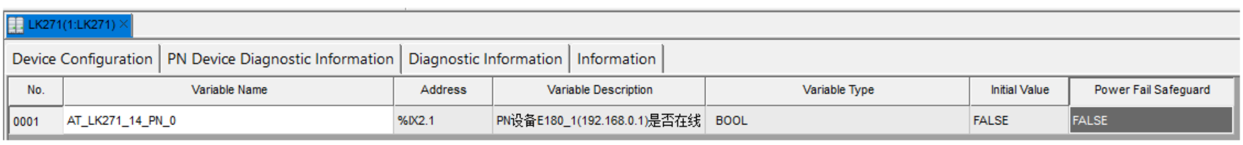
6.3.10.9.4.4 Compilation

Once the import is complete, a project compilation check is recommended. The input/output area length under LK271 will be checked at compile time. When the input/output area length of DP + PN device exceeds 1490, the error prompt and compilation will fail.

6.3.10.9.5 Diagnosis of PN and DP

6.3.10.9.5.1 Diagnostic information of PN

After the project is compiled, the PN device diagnostic information can view by double-clicking LK271.



PN Diagnostic Information

(1) The first 32 bytes of PN input data contain data representing all slave diagnostic information, with each bit representing online/offline information of a slave. Bit=0 represents offline, and bit=1 represents online.

(2) The IP address of the device x.x.x.IP (0-255) corresponds to 256bit, IP/8+1 (rounded to an integer) represents which byte the diagnostic information of the device is in, and the remainder

of IP/8 represents which bit corresponds to that byte.

(3) Examples are as follows:

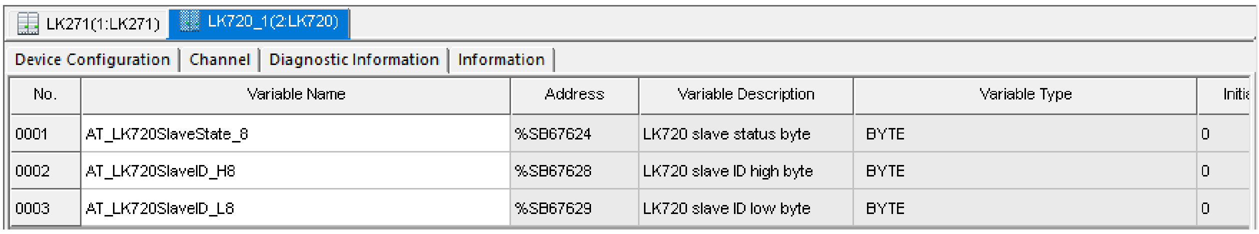
LK271 Input start byte offset: 0, PN device IP: x.x.x.10, address% IX 3.2.

(4) Precautions:

The starting position of PN diagnostic information is related to the length of system information bytes occupied by AutoThink software. For example, if the system information occupies the first two bytes of input data (% IB0,% IB1), then the starting byte of PN diagnostic information starts from the third byte (% IB2); The length of system information changes, and the starting bit of PN diagnostic information changes accordingly.

6.3.10.9.5.2 Diagnostic information of DP

(1)Open AutoThink, add LK241 device, then add POWERLINK master protocol, then add LK271 device, then add POWERLINK slave protocol, and add any device. Double click the device to enter the device information page, as shown in the following figure with LK720;



No.	Variable Name	Address	Variable Description	Variable Type	Initi
0001	AT_LK720SlaveState_8	%SB67624	LK720 slave status byte	BYTE	0
0002	AT_LK720SlaveID_H8	%SB67628	LK720 slave ID high byte	BYTE	0
0003	AT_LK720SlaveID_L8	%SB67629	LK720 slave ID low byte	BYTE	0

AutoThink Diagnostic Information

(2) AT_ LK720SlaveState 16 represents the slave LK720 state, with 0 being offline and 1 being online.

(3) AT_ LK720SlaveID_ H16 and AT_ LK720SlaveID_ L16 represents the high and low bytes of the slave station LK720 ID.

6.3.11 LK272

6.3.11.1 LK272 PROFINET Interface Module

LK272 is a PROFINET interface module used for data forwarding and communication conversion between the PROFINET master and I/O slave stations. Supports PROFINET slave protocol. Realize data exchange between the PROFINET master station and the I/O module through PROFINET Ethernet.

LK272 is installed in the communication slot of the expansion backplane, and each LK272 supports up to 10 I/O.

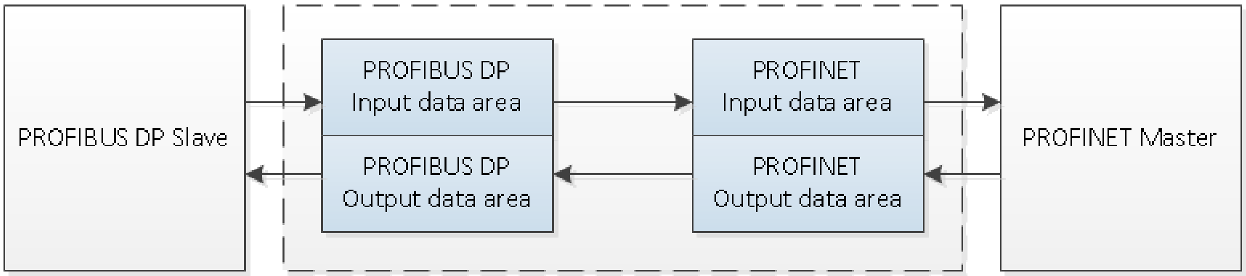
6.3.11.2 Basic Features

- 2-way PROFINET Ethernet interfaces
- PROFINET slave communication protocol
- Support for hot swapping
- PROFINET bus supports ring network redundancy

6.3.11.3 Principle of Data Mapping

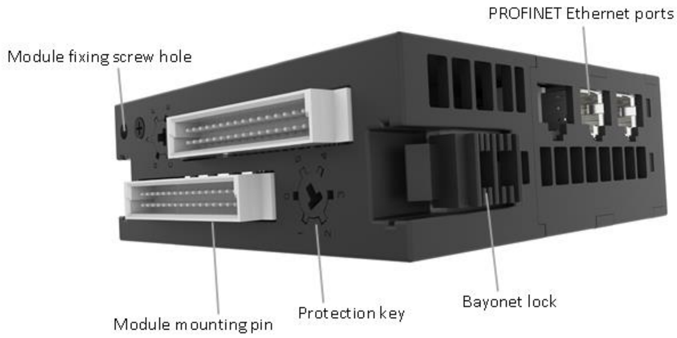
The LK272 device serves as a gateway connecting the PROFIBUS DP bus and the PROFINET network, establishing a mapping relationship between PROFINET data and PROFIBUS data internally, and exchanging data according to this mapping relationship.

There are two data buffers in the gateway device, one is the input buffer. The PROFIBUS DP master station reads the data from the PROFIBUS DP slave station and stores it in the PROFIBUS input data area. The internal data exchange buffer is the PROFINET input data area, which is read by the PROFINET master station through the function block; The other block is the output buffer, where the PROFINET master station writes data to the PROFINET output data area through the function block, and then caches the data to the PROFIBUS output data area after data exchange. Until mapped to the PROFIBUS DP slave station.



Principle of Data Mapping

6.3.11.4 Appearance



Appearance diagram of LK272 module

Interface Description

Interface	Description
Indicators	Indicate module working status
Module fixing screw hole	After the module is installed, fix it with screws
PROFINET industrial Ethernet port	2-way PROFINET Ethernet interface, used to connect PROFINET master stations or switches
Module installation pin	Insert into the slot jack of the expansion backplane
Protection key	The unique code set to prevent the module from being damaged by incorrect insertion is fixed at the factory and cannot be changed. The protection key code on the slot must be consistent with the module protection key code
Bayonet lock	One on top and one on bottom. After the module is installed in the slot, the bayonet and expansion backplane buckle are automatically locked When disassembling, you need to press the upper and lower bayonets at the same time to pull out the module

6.3.11.5 Indicators

Instructions to Indicators

Name	Function	Color	Status	Description
RUN	Indication of operating pattern	Green	On	Module loading configuration and running normally
			Slow flashing	Module did not load configuration
			Off	Module not powered on or damaged
ERR	Fault status indication	Red	On	Module has malfunctioned
			Slow flashing	Module is starting
			Off	Module has no faults

Name	Function	Color	Status	Description
PN	Communication status indication with PROFINET master station	Yellow	On	PN communication is normal
			Off	PN communication abnormality
DP	Communication status indication with I/O slave station	Red	On	Communication between all DP slave stations is normal
			Slow flashing	At least one slave station has normal communication, but some slave stations have not established communication
			Off	No communication established with any slave stations
LNK1	Indication of connecting PROFINET Ethernet interface1	Green	On	Port1 successfully connected
			Off	Port1 not connected
ACT1	Indication of receiving and sending data via the PROFINET Ethernet interface1	Yellow	Flashing	Port1 is sending and receiving data
			Off	Port1 has no sending or receiving data
LNK2	Indication of connecting PROFINET Ethernet interface2	Green	On	Port2 successfully connected
			Off	Port2 not connected
ACT2	Indication of receiving and sending data via the PROFINET Ethernet interface2	Yellow	Flashing	Port2 is sending and receiving data
			Off	Port2 has no sending or receiving data

- Fast flashing Flash: 4Hz, 125ms on, 125ms off.
- Slow flashing: 1Hz, 500ms on, 500ms off.

6.3.11.6 Set Device Address

6.3.11.6.1 Concept

Set the device address through the 3 rotary switches on the front panel of the module. The ones place and tens place are 10-bit rotary code switches, and the hundreds place is 3-bit rotary code switches. Device address=100×setting value of hundreds place rotary code switch+10×setting value of tens place rotary code switch+setting value of ones place rotary code switch, the setting range is 1~239.

When configuring the device address in the AutoThink software, please keep it consistent with the actual dialing value.

Please set the device address before powering on the module. If you set the rotary code switch address when the module is powered on, you need to restart the module to make the address take effect.

6.3.11.6.2 Requirements

- The module has been installed
- Prepare a flat-blade screwdriver

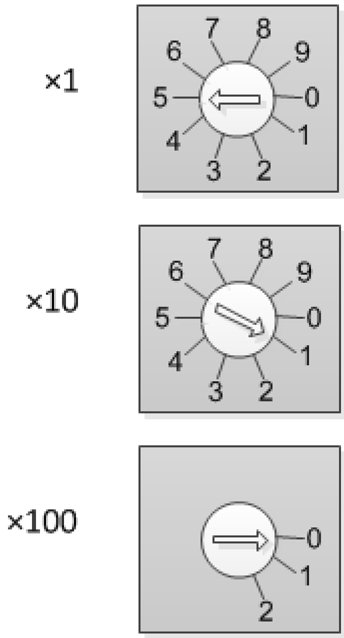
6.3.11.6.3 Steps

To set the device address, please follow the steps below:

(1) Using a screwdriver, turn the three rotary code switches ×1, ×10, and ×100 to the required device address.

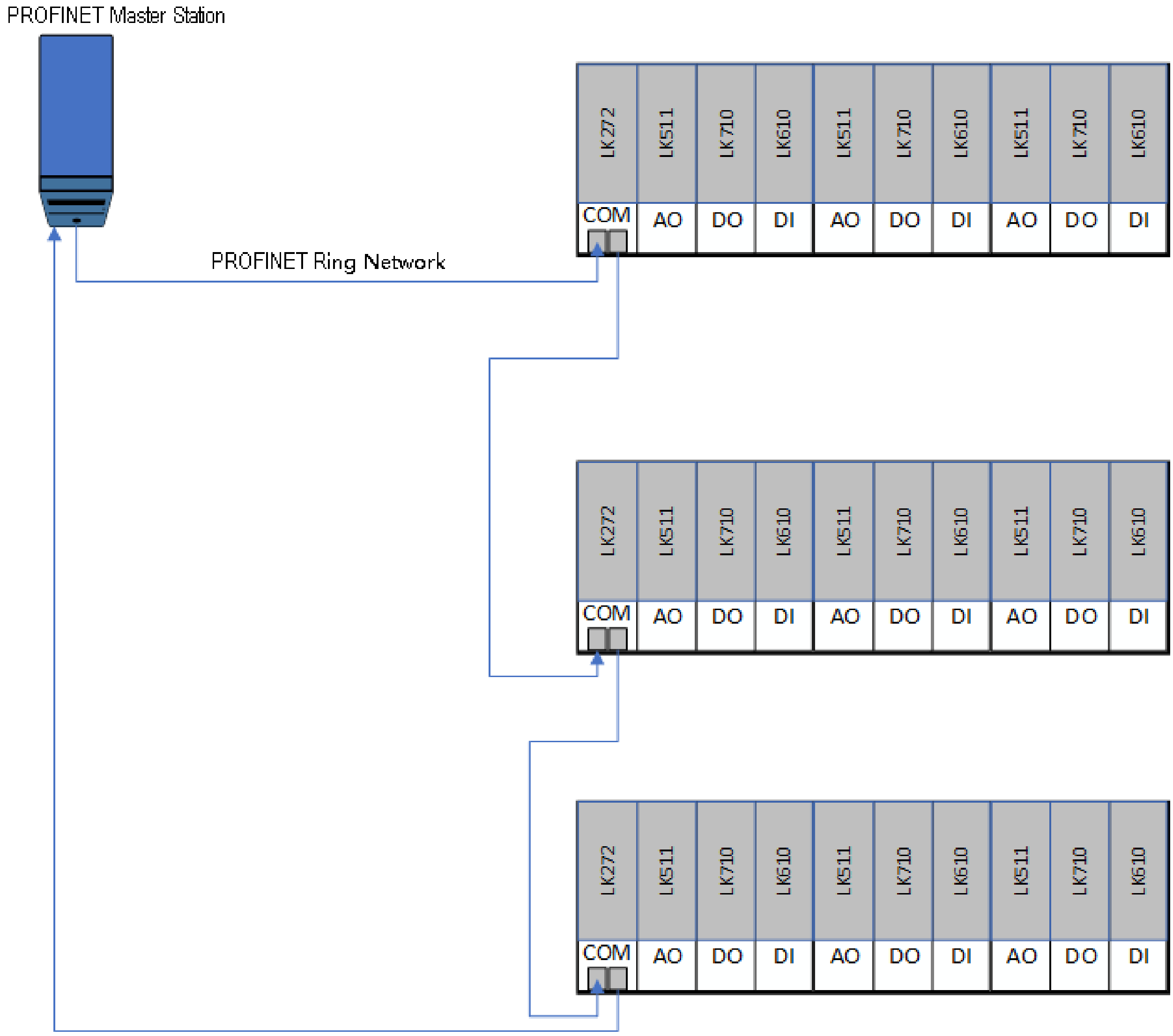
6.3.11.6.4 Example

For example: Set the station address to 15, then turn the hundreds place rotary code switch to 0, the tens place rotary code switch to 1, and the ones place rotary code switch to 5, as shown in the figure below.



Set Device Address

6.3.11.7 Schematic Diagram of LK272 Ring Network



Network Connection Diagram

6.3.11.8 Configuration Module

Please refer to help manual of DP Config for the configuration of LK272.

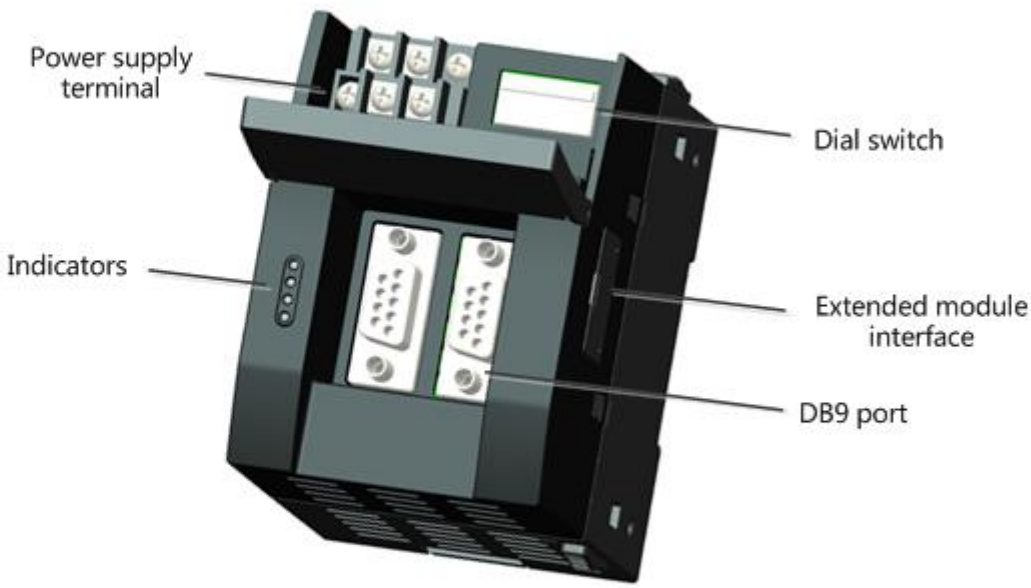
6.3.11.9 Technical Specifications

LK272 PROFINET interface module	
Ethernet	
Number of Communication ports	2-way

LK272 PROFINET interface module	
Redundant Function	Support for PROFINET ring network redundancy
Level Standard	IEEE 802.3
Communication Port Type	Shield RJ45
Communication Rate (bps)	100Mbps
Communication Protocol	PROFINET protocol
Hot Swapping	
Module hot swapping	Supported
Power Supply	
Input Voltage	24VDC（-15%~+20%）
Module Power Consumption (max)	180mA@24VDC
Rated Voltage	24.0VDC
Start Time	
The time from module power on to initialization completion	≤30S
Physical Property	
Installation Position	Expansion backplane communication slot
Module size (W * H * D)	35 mm*100 mm*100 mm ±0.5 mm

6.3.12 LE5406 Profibus-DP to LE Bus Communication Extension Module

LE5406 is a gateway module that based on transferring Profibus-DP to LE-Bus, which is used to extend LE IO module for LK series controller .



LE5406 Module Schematic Diagram

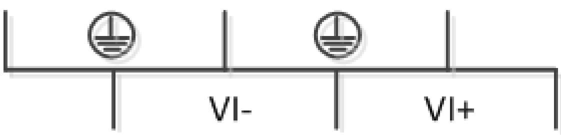
6.3.12.1 Indicators

Type	Color	Status	Description
POWER (Power supply indicator)	Green	ON	The power supply is normal
		OFF	Not powered on or power failure
RUN/ERR (Run/Error indicator)	Green	ON	Communication between LE5406 and all LE IO modulesis normal
	Red	ON	There are several situations: Communication in DP side is abnormal The project has no configuration of LE IO modules or the configuration of LE IO modules is error, such as module model. inconsistency, offline LE master station is abnormal Failured to load configuration data of DP or LE
DP_COM (DP communication indicator)	Yellow	ON	Communication of DP is normal
		Flashing quickly	Communication of DP is abnormal or communication is not build
LE_COM (LE-BUS communication indicator)	Yellow	ON	Communication of LE IO modules is normal.
		Flashing quickly	At least one LE IO module is configured failured or offline
		OFF	All LE IO modules are offline

Note: When the firmware is upgraded, the RUN/ERR, DP_COM and LE_COM indicators are flashing slowly. After the firmware upgrade is completed, the three indicators are off.

6.3.12.2 Interface Description

1. Power Supply Terminal



Power Supply Terminal

Terminals

Terminals	Description
VI+	Positive terminal of 24VDC input
VI-	Negative terminal of 24VDC input
⏚	Grounding
⏚	Grounding

2. DB9 port

There are two DB9 Interfaces, which are used to connect the Profibus-DP bus connector module.

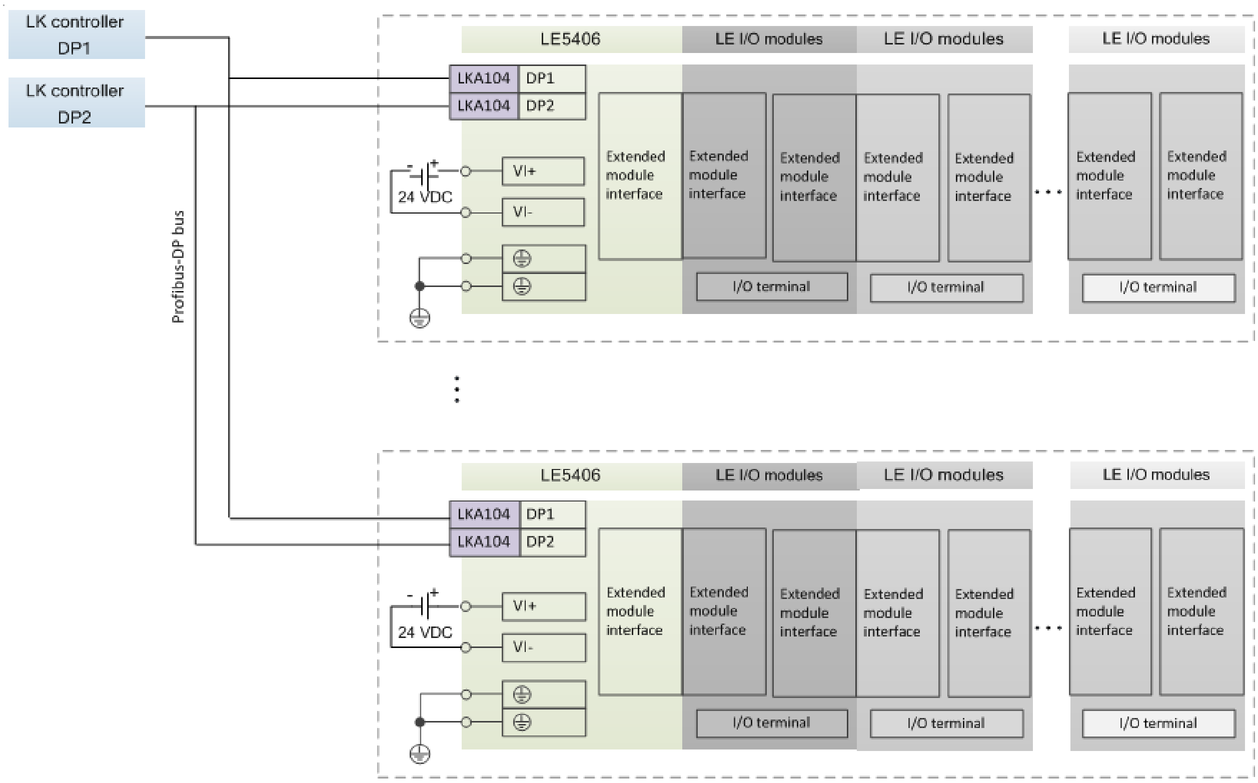
The detailed interface definition are shown in Terminal_Definition.

3. Extended module interface

Used to connect the extended LE IO modules.

6.3.12.3 Description of Wiring

The following figure is the interface wiring of LE5406 module.

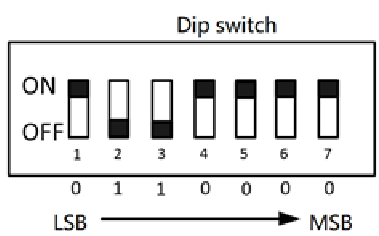


Wiring Schematic Diagram

6.3.12.4 DIP Switch

The dial switch is used to set the device address of LE5406 module. The device address of Auto Think must be set as same as the station of the dial switch.

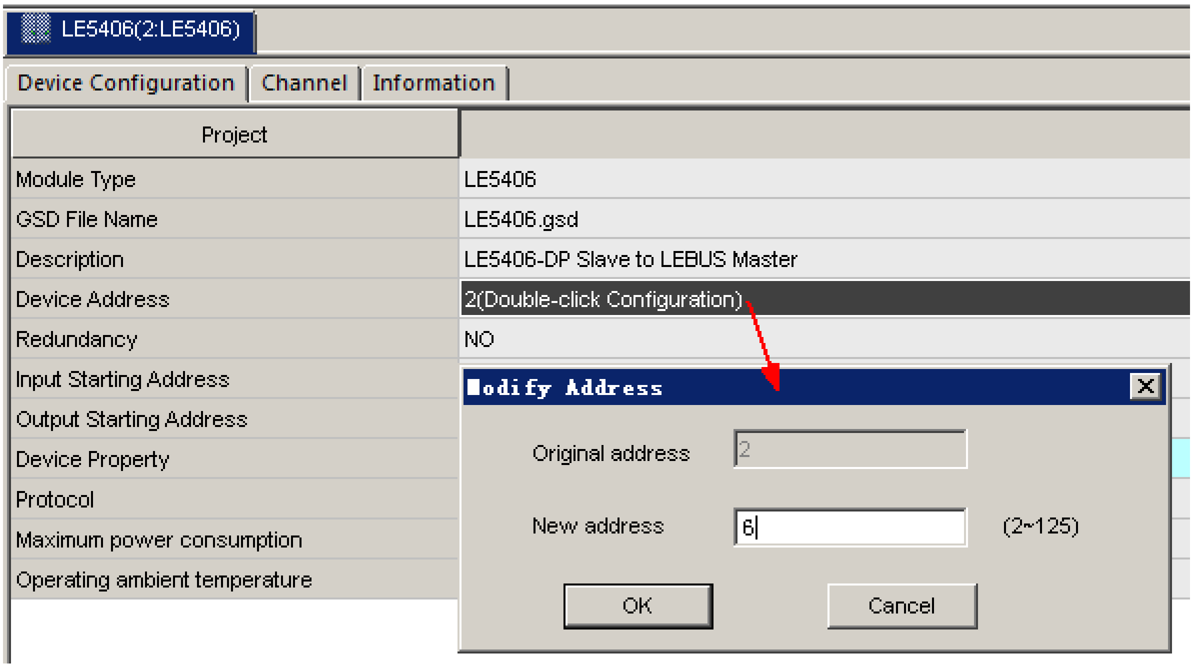
The dial switch has a total of 7 bits, and the address is represented by a binary code of 1~7 digits, as shown in following figure.



DIP Switch Schematic Diagram

- ON position means 0.
- OFF position means 1.

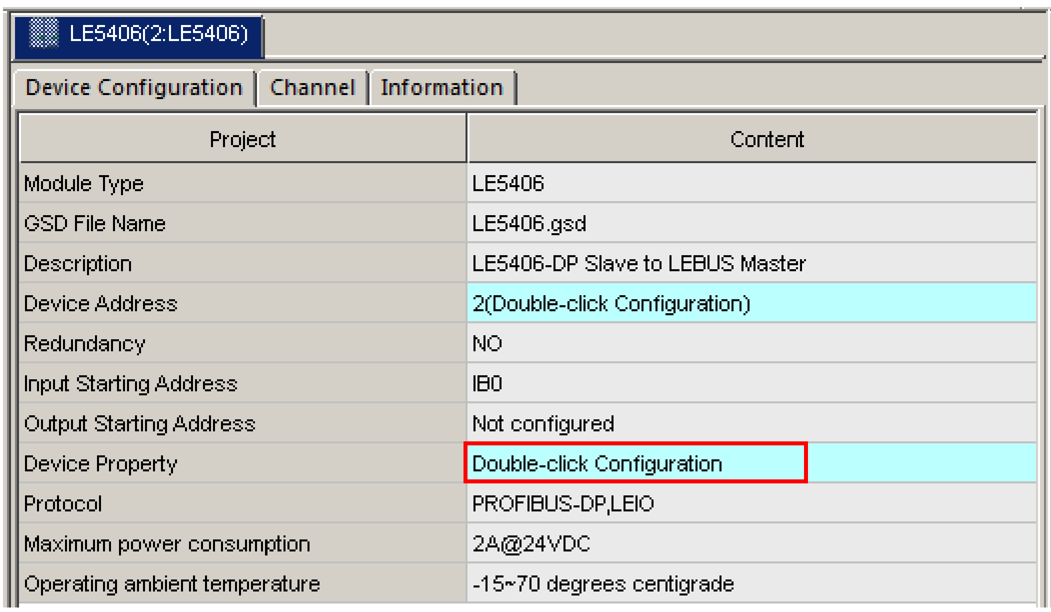
The dial switch address in the figure is 0110000, and the decimal is 6.



Configure Device Address

6.3.12.5 Configuration of LE IO

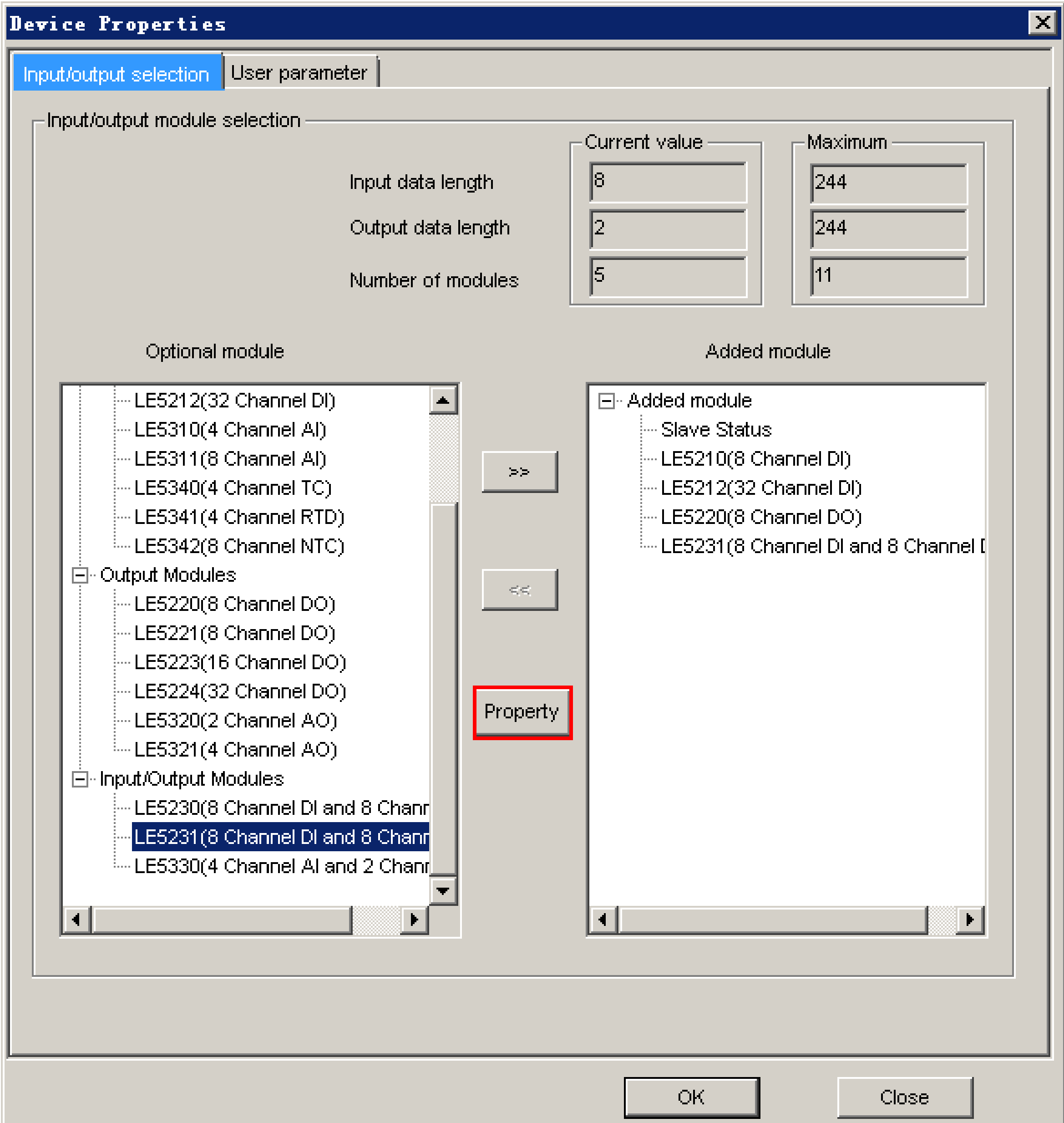
Configure LE IO modules according to the actual connected module.



Configure LE IO

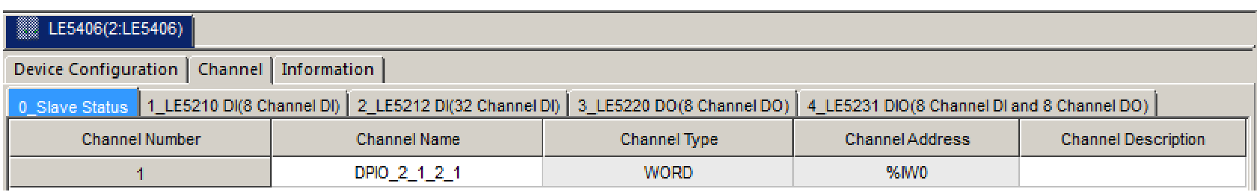
Double-click the Device Property to open the IO configuration dialog, as shown in following figure. Select the module according to the actual model and add it according to the installation location.

Select the added module and click the properties button to configure the module parameters. Please refer to the manual of each module for detailed parameter description.



Configure LE IO module parameters

The added module is displayed in the channel tab, and click module name to view the channel information. Among them, 2-byte Slave Status displays the bitwise online status of LE IO module. When LE5406 is online, Slave Status status and input values of each module are valid.



Channel Information

6.3.12.6 Diagnosis

LE5406 reports the 6 bytes diagnosis information, wherein 3 bytes are device-related diagnosis, 3 bytes are identification diagnosis information. Call the function block sysGetDPSlaveState (Get Diagnosis of DP Slave), diagnosis data reported are saved into the output parameter **DiagData**.

Diagnosis Information of DiagData array

Output parameters	Data type	Diagnosis information	Description of diagnosis byte
DiagData[0]	BYTE	Device diagnosis	Length of device diagnosis information, 3 bytes
DiagData[1]	BYTE		The bit6 and bit7 of this byte diagnose the fault status of DP1 and DP2 networks respectively 00: The network is normal 01: DP1 network fault 10: DP2 network fault
DiagData[2]	BYTE		Reserved
DiagData[3]	BYTE	Identification diagnosis	Length of identification diagnosis information, 3 bytes
DiagData[4]	BYTE		DiagData [4]~DiagData [5]: 2 bytes show the online status of LE IO slave module , bit0=0, bit1-bit15 show the bitwise online status of the module starting from station 1
DiagData[5]	BYTE		

Diagnosis information of IO slave station connected by LE5406, please refer to diagnosis function block of LE5406.

6.3.12.7 Update firmware

See Update_firmware of LK250 module.

6.3.12.8 Description of usage

- Maximum number of LE5406 module supported in single LK series controller is 124.
- Maximum number of LE IO modules supported by single LE5406 can't be more than 10.
- Upon satisfying the above requirements, please configure the LE IO according to the output power load capacity of the LE5406 module .

  The load capacity is determined by the 5 VDC and 24 VDC output power consumption. The calculation formula as follows.

  N1*DIO module+N2*AI module+ N3*AO module(N1, N2, N3 is number of LE IO modules)

6.3.12.9 List of LE IO

The extended LE IO module lists

Module Type	Product Model	Specifications Description	Extended Bus Consumption	
			24VDC	5VDC
DI	LE5210	8-channel digital input module, DI 8×24 VDC	0mA	50mA
	LE5211	16-channel digital input module, DI 16×24 VDC	0mA	65mA
	LE5212	32-channel digital input module, DI 32×24 VDC	0mA	105mA
DO	LE5220	8-channel digital output module, DO 8×transistor output, Rated current of output channel is 1 A	0mA	90mA
	LE5221	8-channel digital output module, DO 8×relay output, Rated current of output channel is 2 A	60mA	50mA
	LE5223	16-channel digital output module, DO 16×relay output, Rated current of output channel is 2 A	120mA	135mA
	LE5224	32-channel digital output module, DO 32×transistor output, Rated current of output channel is 1 A	0mA	265mA
AI	LE5310	4-channel analog input module(4～20mA/0～20mA/0～10V), differential input, 12 bit	15mA	95mA
	LE5311	8-channel analog input module(4～20mA/0～20mA/0～10V), single-ended input, 12 bit	0mA	75mA
	LE5340	4-channel thermocouple input module -80mV～+80mV, B/E/J/K/N/R/S/T Floating thermocouple, 24 bits	0mA	135mA
	LE5341	4-channel RTD input module Cu50, Ni100, Ni120, Ni200, Ni500, Ni1000, Pt100, Pt200, Pt 500, Pt1000, 16 bits	0mA	80mA
	LE5342	8-channel thermistor input module	0mA	130mA
AO	LE5320	2-channel analog output module(4～20mA/0～20mA/0～10V), 12 bits	0mA	90mA
	LE5321	4-channel analog output module(4～20mA/0～20mA/0～10V),12 bits	0mA	45mA
AI/AO	LE5330	4-channel analog input /2-channel analog output (4～20mA/0～20mA/0～10V),12 bits	0mA	35mA

6.3.12.10 Technical Parameters

LE5406 Profibus-DP to LE bus communication extension module		
Power Supply Specifications		
Power Supply	Operating voltage	24VDC (-15%~+20%)
	Rated voltage	24VDC
	Power consumption	< 2W (The consumption of module)
Module Output Power Supply	Output voltage	24VDC(-15%~+20%) input-output voltage drop,1V ±0.2V
		5VDC±5%
	Load capacity	2A@24VDC
		2.9A@5VDC
Physical Interface		
DP(RS-485)	Number of communication interface	2
	Interface type	DB9
	Communication rate (bps)	187.5Kbps, 500Kbps, 1.5Mbps, 3Mbps, 6Mbps

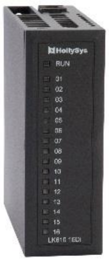
LE5406 Profibus-DP to LE bus communication extension module		
	Communication protocol	Profibus–DP
	Isolation method	Coupling isolation
	Isolation withstand voltage	500V AC test 1 min., leakage current < 5mA
LE-BUS(RS485)	Number of communication interface	1 channel
	Level standard	EIA/TIA-485
	Baud rates (bps)	1.125Mbps
	Communication protocol	LE-IO backplane protocol
Power Interface	24VDC power supply	
Reliability		
Hot Swap	Not supported	
Insulation Resistor	Inter-terminal isolation resistor≥5MΩ(General experimental conditions) Inter-terminal isolation resistor≥1MΩ(Damp heat condition)	
Mechanical Protection Level	IP20	
Physical Characteristics		
Installation Method	DIN rail mounting or screw mounting	
Dimensions(W*H*D)	63mm×89mm×90mm±0.5mm	
Weight	300g	
Environmental Adaptability		
Operating Temperature	-20℃~70℃	
Operating Humidity	5%~95%, with no condensation	
Storage Temperature	-40℃~80℃	
Storage Humidity	5%~95%, with no condensation	

6.4 IO Module

6.4.1 LK610 16-channel Leaking Type Digital Input Module

6.4.1.1 Basic Features

- 16-contact leaking type input
- Field supply voltage: 10 VDC~31.2 VDC
- Field power loss detection
- Reverse supply protection
- Isolation between each field channel and the system
- Support the Profibus-DP slave station protocol
- Hot swapping



LK610 Module Schematic Diagram

6.4.1.2 Operating Principle

Threshold level of LK610:

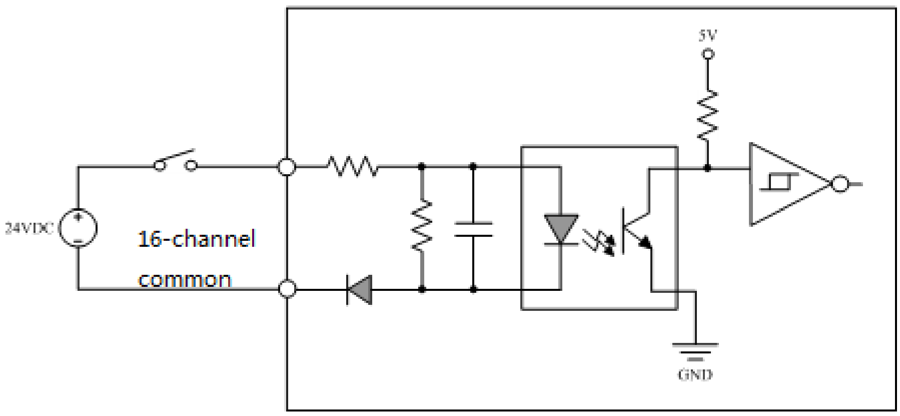
Logic 1: voltage range: 10~31.2 VDC, current: 2 mA (10 VDC)~10 mA (31.2 VDC).

Logic 0: Max. Voltage: 5 VDC, Max. Current: 1.5 mA.

As shown in figure, LK610 adopts the leaking type input, with the negative pole of the field power supply connected to the 16-channel common terminal. The one end of the switch is connected to the positive pole of the field power supply, with the other end connected to the input terminal of the DI channel. When the switch is turned off, the current flows into the optocoupler from the input terminal, and then flows out of the common terminal and back to the negative pole of the field power supply.

When the input voltage is 10~31.2 VDC, the LED side of the optocoupler is turned on, providing a high level output. When the input voltage is no more than 5VDC or the input voltage is more than 1.5 mA LED side of the optocoupler is cut off, providing a low level output.

The RC filter circuit filters the input voltage to remove dithering, with the LED playing a role in reserve protection.



LK610 Channel Interface Circuit Diagram

6.4.1.3 Indicators

Definition of LK610 Indicators

Name	Status	Description
RUN indicator (green)	On	The communication is established, and the module works well
	Flash	The communication is not established or incorrect.
	Off	The module is not powered on or module is fault.
01~16-channel indicator (yellow)	On	The channel is connected.
	Off	The channel is disconnected.

See the following for the specific description of the green RUN indicator:

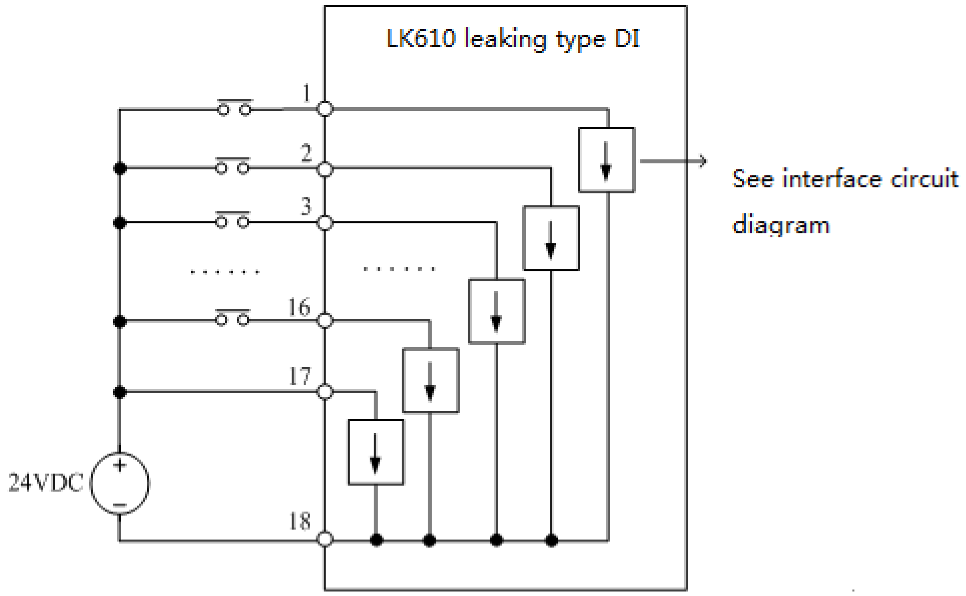
- Immediately after being powered on, the green indicator flashes to wait for the initialized data, with a flashing frequency of 4 times/second.
- Upon the completion of initialization, the green indicator is turned normally on, which indicates that the module works well. In case of any error in the initialized data, communication cannot be established and the green indicator keeps flashing. Check whether the communication parameters (slave station address, etc.) are set correctly.
- When the communication is normal, the green indicator is normally on; when the communication is disconnected, the green indicator flashes; when the communication is established again, the green indicator is turned on again.

6.4.1.4 Wirings

LK610 receives the 16-channel wet contact signal. The 16-channel circuit supply is provided by the external 24 VDC power supply. To ensure the isolation between the field and the system, the field 24 VDC power supply shall be configured separately and cannot be commonly used as the power supply for the backplane.

LK610 is installed on the extension backplane.

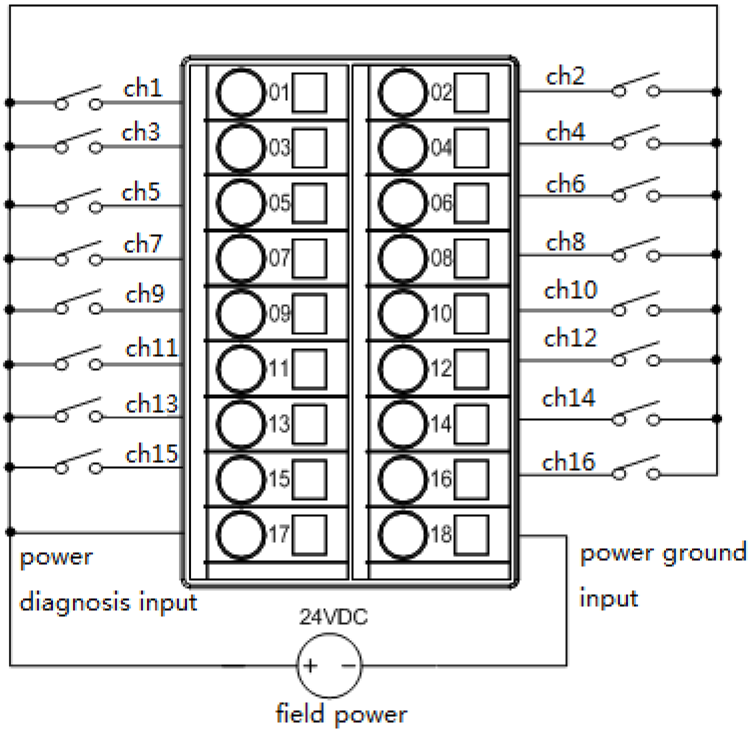
The one ends of the 16-channel contacts are separately connected to the terminals of corresponding channels (01~16), with all the other ends shorted to the positive terminal of the field power supply, as shown in figure.



LK610 16-channel DI Channel DI Interface Block Diagram

LK610 goes through the corresponding terminal connections under the mounting groove of the backplane, as shown in figure. Following points need attention during wiring:

- It is required to connect a separate 24 VDC field power supply externally for LK610 (that is: the field power supply cannot use the 24 VDC power supply on the backplane). Only in this way can ensure the electrical isolation between the field and the system.
- The 16 channels use the 24 VDC field power supply commonly.
- Terminals 1~16 are digital input terminals for Channels 1~16.
- Terminal 17 is the diagnosis input of the field power supply, connected to the positive terminal of the field power supply and used for field power loss detection.
- Terminal 18 is the negative terminal of the field power input, and also the common terminal inside the module for Channels 1~16.
- Do not crimp multiple cables on the same terminal. It can realize multipoint connection via conversion terminal.



Corresponding Backplane Terminal Wiring Diagram

6.4.1.5 Reverse supply protection

The LK610 module is connected to a diode in series at the negative terminal of the power input for reverse protection. By doing so, it can avoid preventing the polarity of the external power supply improperly, which can damage the module.

Max. reverse withstand voltage: 60 VDC.

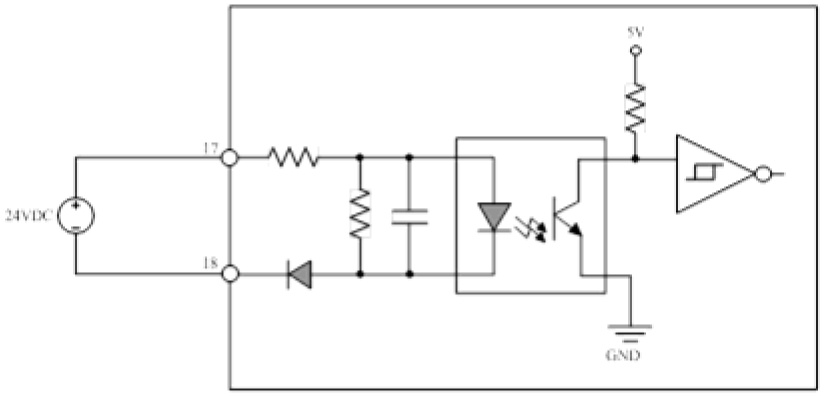
6.4.1.6 Diagnosis

LK610 can conduct field power loss detection. Such a diagnosis is a device diagnosis.

Whether to enable power loss detection can be selected via the user parameter **Field Power Loss Detection**, which is defaulted to Enable. The modification takes effect only upon full download.

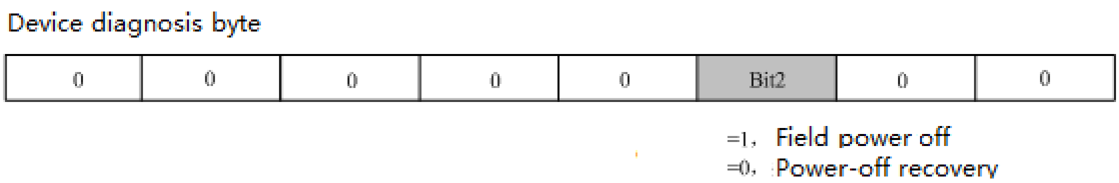
As shown in figure, Terminal 17 is connected to the positive terminal of the field power supply, with Terminal 18 to the negative terminal. LK610 conducts power loss diagnosis by detecting the changes in the input voltages between the two terminals. In case of a failure, report the fault status in form of diagnosis data to the controller module.

In case, the field power supply voltage is between 10 and 31.2 VDC, when the optocoupler switch of the power loss detection channel is in "ON" status, it is determined that the field power supply works well. When the field power supply is less than 5 DVC, the optocoupler switch of the power loss detection channel is in "OFF" status, it is determined that the field power supply fails. In case, the field power supply voltage is between 5 and 10 VDC, the status of the optocoupler switch of the power loss detection channel cannot be determined.



Electrical Schematic Diagram of LK610 Field Power Loss Detection

- When the 24 VDC field power supply is disconnected (the line is broken or the power output voltage is less than 5 VDC), the diagnosis data 0x04 (in the diagnosis bytes, Bit2=1) is generated in the device diagnosis data area of LK610. The diagnosis data is reported to the controller module upon the arrival of the next scanning period.
- After the 24 VDC field power supply is recover to its normal status (output voltage: 10~31.2V DC), the new diagnosis data 0x00 is generated in the device diagnosis area of LK610 (in the diagnosis bytes, Bit2=1). The diagnosis data is reported to the controller module upon the arrival of the next scanning period.
- LK610 only reports the diagnosis data once separately when a failure occurs and the fault recovered.



Diagnosis Byte of LK610

Field power loss detection is device diagnosis, refer to above figure for the definition of diagnosis bytes. After calling the function block Get Diagnosis of DP slave (sysGetDPSlaveState), the diagnosis data reported by LK610 is saved into output parameter **DiagData** in the function block, as shown in table..

Specifications for LK610 Diagnosis Information

Device diagnosis	Value	Meaning
DiagData[0]: DiagData[1]	0x02: 0x04	Field power loss
	0x02: 0x00	The failure is recovered or there is no diagnosis data

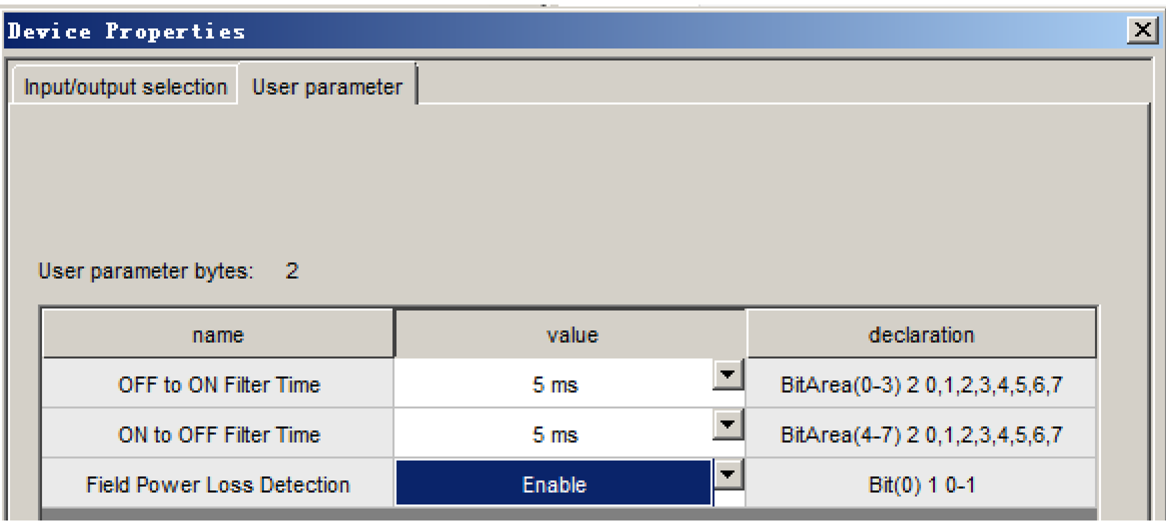
As an I / O slave of HolliTCP protocol, excepte above diagnostic information, refer to LK234_Diagnosis for more diagnostic information.

As an I / O slave of POWERLINK protocol, excepte above diagnostic information, refer to Overview of Diagnosis Information for more diagnostic information.

6.4.1.7 Parameters

The [User parameter] is used to set the operation mode of the module. The controller module written when downloading the project may not be read in each scanning period. Each parameter has a default value, able to modify the parameter value according to the project requirements. After modifying the parameter value, it requires full download before taking effect.

Double-click the added LK610 module in the DP_MASTER node to open the dialog of **Device Properties** in AutoThink, as shown in figure, there are 2 bytes in LK610 user parameter.



LK610 User Parameter Setting

Definition of LK610 User Parameter

Parameter Name	Meaning	Value
OFF to ON Filter Time	OFF—>ON filter time	0=1 ms 1=3 ms 2=5 ms (default) 3=10 ms 4=15 ms 5=20 ms 6=25 ms 7=30 ms
ON to OFF Filter Time	ON-> OFF filter time	
Field Power Loss Detection	To enable field power loss detection	0=Disable, disable 1=Enable enable (default)

6.4.1.8 Technical Specifications

LK610 16-channel Leaking Type Digital Input Module	
System Power	
Operating Voltage	24VDC (-15%~+15%)
System Power Consumption	50 mA max.@24 VDC, excluding field power consumption
Input channel	
Number of channels	16
Contact Type	Dry contact, leaking type input

LK610 16-channel Leaking Type Digital Input Module		
Rated Voltage of Field Power Supply		24 VDC
Threshold Level	ON	10 VDC (2 mA) ~31.2 VDC (10 mA)
	OFF	0~5 VDC (1.5 mA)
Dithering-removing Filter Time OFF→ON ON→OFF		1 ms, 3 ms, 5 ms, 10 ms, 15 ms, 20 ms, 25 ms, 30 ms optional for configuration 1 ms, 3 ms, 5 ms, 10 ms, 15 ms, 20 ms, 25 ms, 30 ms optional for configuration
Reverse Protection		Max. reverse withstand voltage: 60 VDC.
Isolation Voltage between Field and System		500 VAC@1 min, leaking current: 5 mA
Failure Diagnosis and Hot Plug		
Field Power Loss Diagnosis		Bit2 in the diagnosis bytes (Bit0~Bit7) reported to the module is used to indicate the information on field power supply detection. When Bit2=1 indicates field power loss, then Bit2=0 indicates field power recovery. The field power failure diagnosis only reports once separately when a failure occurs and the fault recovered.
Hot Swapping		Supported
Communication Bus		
Protocol		Profibus-DP
Baud Rate		1.5Mbps, 500Kbps, 187.5Kbps , 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps adaptive
Media		Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Property		
Protection Key		D0
Installation Position		Extension backplane
Module Dimension (W*H*D)		35 mm×100 mm×100 mm
Enclosure Protection Rating		IEC60529 IP20
Weight		180g
Environmental Adaptability		
Operating Temperature		-20℃~70℃
Operating Humidity		5%~95%, with no condensation
Storage Temperature		-40℃~80℃
Storage Humidity		5%~95%, with no condensation

6.4.2 LK616 32-channel 24VDC leaky digital input module

6.4.2.1 Basic Features

- 32 channel drain input
- Field power supply voltage range: 19.2v to 28.8v
- Module field side and system side isolation
- Field power supply fault diagnosis

- DP dual network fault diagnosis
- Support channel overvoltage protection
- Support PROFIBUS DP slave protocol
- Support hot plug

Appearance drawing of LK616 module

6.4.2.2 Operating Principle

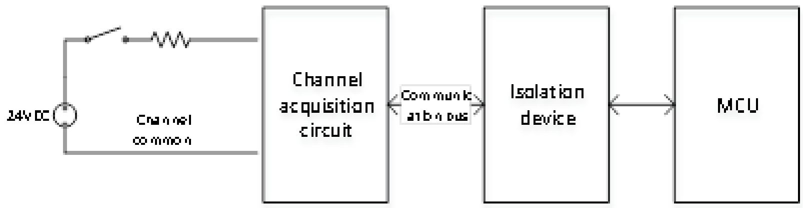
LK616 threshold level

Logic 1: voltage range 15 ~ 30VDC, current 3mA @ 24V @ single channel.

Logic 0: maximum voltage 5 VDC, maximum current 1.5 ma.

As shown in the figure, LK616 adopts drain input, and the negative pole of field power supply is connected to the common end of 32 channels. One end of the switch is connected to the positive pole of the field power supply, and one end is connected to the input end of the di channel. When the switch is closed, the current flows into the channel acquisition circuit from the input end, flows out from the common end and returns to the negative pole of the field power supply.

When the input voltage is 15 ~ 30 VDC, the output of the channel acquisition chip is high, and the value is saved in the register; When the input voltage is less than or equal to 5 VDC, the channel acquisition chip outputs low, saves the value in the register, and reports the channel value to the microprocessor through the bus.



LK616 module channel interface circuit diagram

6.4.2.3 Indicators

Definition of LK616 Indicators

Name		Status	Description
RUN/ERR indicator	green	On	The communication is established, and the module works well
		Flash	The communication is not established or incorrect.
		Off	The module is not powered on or module is fault.
	red	On	The communication has been established, and at least one group of field power failure, system power failure and at least one chip failure of the module
		Flash	Communication not established or communication error and system power failure
		Off	The module is working properly
01~32-channel indicator	yellow	On	The field power supply is normal and the channel input is high
		Off	Field power loss, channel input low level / channel not enabled

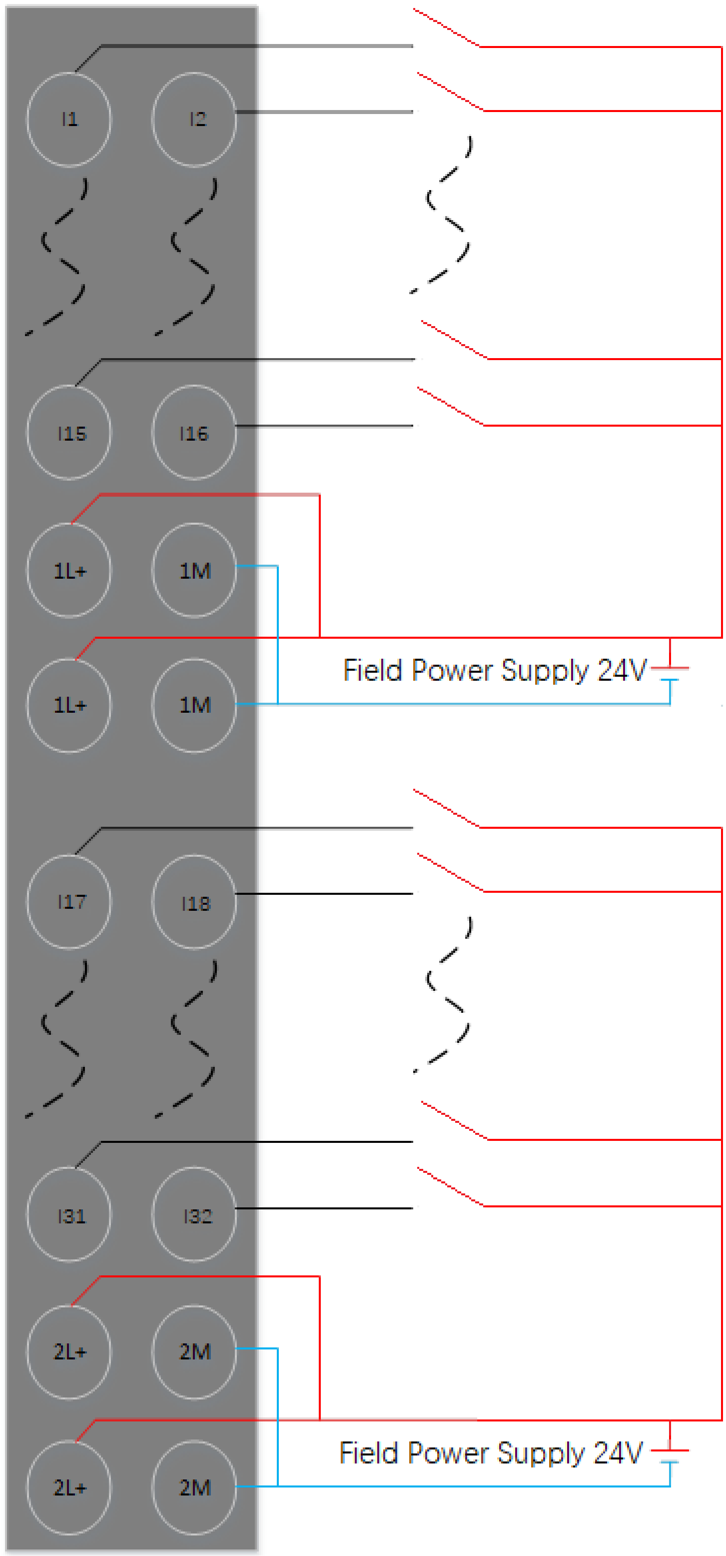
6.4.2.4 Wirings

The field signal is connected to LK616 module through LKX1030 prefabricated cable connector. The prefabricated cable is 40 core copper wire, which connects the field signal and power supply. In order to ensure the isolation between the site and the system, the site 24VDC power supply shall be configured separately and cannot be shared with the backplane power supply.

1 ~ 16 channels share one group of field power supply, and 17 ~ 32 channels share one group of field power supply. Each group of field power supply has 4 wires, 2 positive and 2 negative, and connected to two groups of power signal terminals

LK616 signal line color definition

Channel number	Cable core color	Channel number	Cable core color
Channel 1	Red on white	Channel 17	Red on green
Channel 2	Yellow on white	Channel 18	Yellow on green
Channel 3	Green on white	Channel 19	Green
Channel 4	Blue on white	Channel 20	Blue on green
Channel 5	Pink on white	Channel 21	Pink on green
Channel 6	Grey on white	Channel 22	Grey on green
Channel 7	Black on white	Channel 23	Black on green
Channel 8	White	Channel 24	White on green
Channel 9	Red on yellow	Channel 25	Red on blue
Channel 10	yellow	Channel 26	Yellow on blue
Channel 11	Green on yellow	Channel 27	Green on blue
Channel 12	Blue on yellow	Channel 28	Blue
Channel 13	Pink on yellow	Channel 29	Pink on blue
Channel 14	Grey on yellow	Channel 30	Grey on blue
Channel 15	Black on yellow	Channel 31	Black on blue
Channel 16	White on yellow	Channel 32	White on blue
On-site power source 1+	Brown on red	On-site power source 2+	Red
On-site power source 1+	Brown on pink	On-site power source 2+	Pink
On-site power source 1-	Brown on black	On-site power source 2-	Black
On-site power source 1-	Brown on violet	On-site power source 2-	Orange



Wiring diagram of LK616 module

6.4.2.5 Diagnosis

The diagnostic information of LK616 only contains 4-byte device related diagnostics.

When LK616 module is added through DP protocol under LK249 DP communication module, the diagnosis needs to be viewed through the function block.

After calling to obtain the DP slave station diagnosis function block (sysGetDPSlaveStateExt), the diagnosis data is stored in the output parameter DiagData array.

Description of diagnostic information for LK616 module

Diagnostic information	Diagnostic byte	Value
Device diagnostic information	DiagData[0]	0x04：Device diagnostic header byte
	DiagData[1]	Bit0：Chip fault diagnosis 1：Chip failure 0：No chip failure Bit2: System power failure 1: failure 0:No failure
	DiagData[2]	Bit2：Field power 1 diagnostics 1：Indicates the power failure of the field power supply 0：No fault
		Bit3：Field power 2 diagnostics 1：Indicates the power failure of the field power supply 0：No fault
		Bit6~Bit7：DP network fault diagnosis 0：No fault 1：DP1 fault 2：DP2 fault
	DiagData[3]	Bit0~Bit7：Module MCU firmware version information

When LK616 module is added under LK241 Powerlink communication module through Powerlink protocol, after compilation, you can directly view the diagnosis information on the diagnosis page.

Configure LK616 module in autothink programming software, generate module diagnosis information page after compilation, and store the obtained diagnosis in s area of the system. The diagnosis information of LK616 only contains 4-byte equipment related diagnosis. The diagnosis information is shown in the figure:

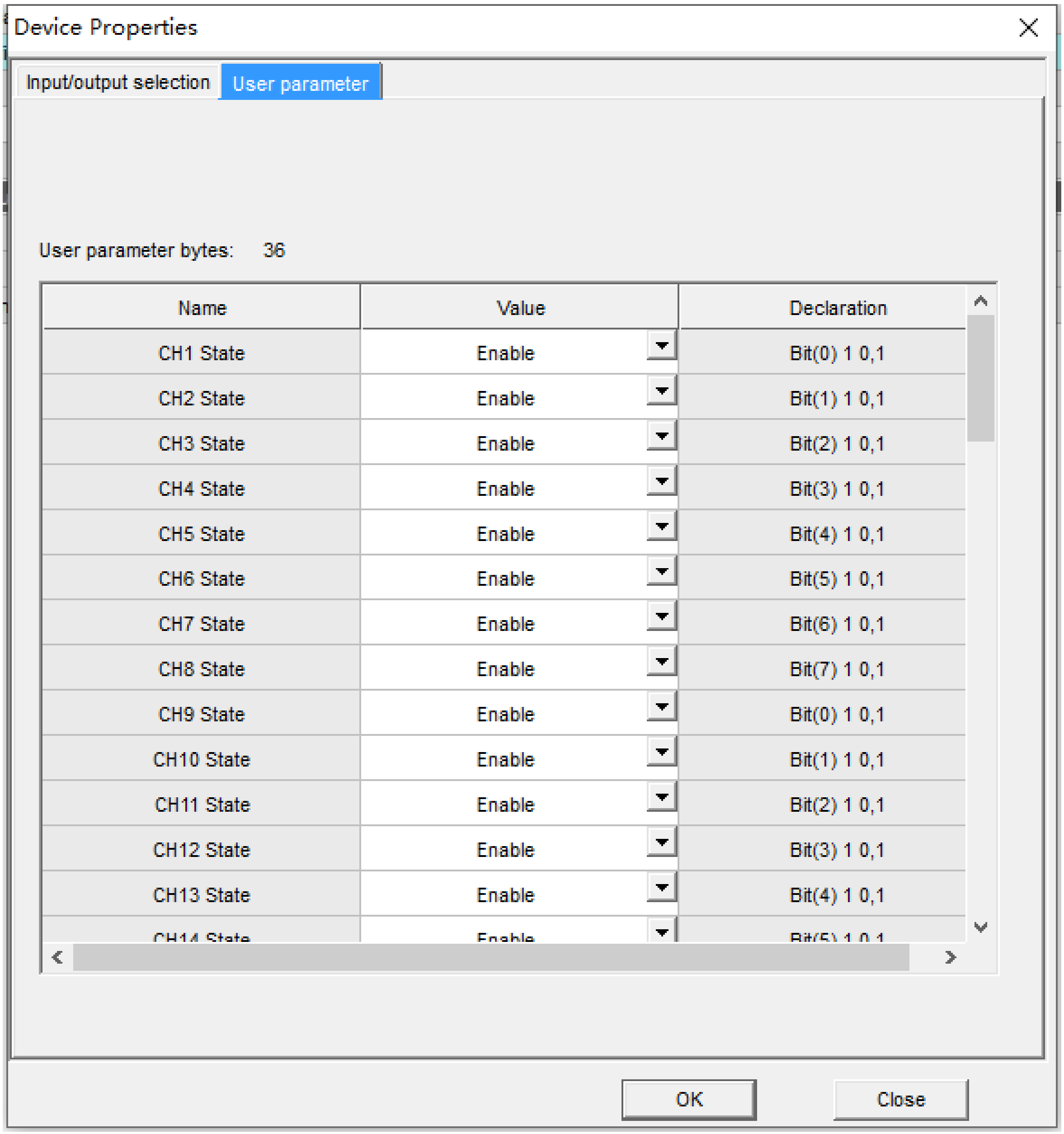
Variable Name	Variable Type
AT_LK616SlaveState1_8	BYTE
AT_LK616SlaveID_H8	BYTE
AT_LK616SlaveID_L8	BYTE
AT_LK616_Chip_Fault8	BOOL
AT_LK616_SysPower_Fault8	BOOL
AT_LK616Field1PowerFault8	BOOL
AT_LK616Field2PowerFault8	BOOL
AT_LK616DP1NetFault8	BOOL
AT_LK616DP2NetFault8	BOOL
AT_LK616MCUVern8	BYTE

LK616 module diagnostic information description

6.4.2.6 Parameters

The user parameter is used to set the working mode of the module. It is written to the controller when the project is loaded. It is not read every scanning cycle. Each parameter has a default value (default), which can be changed according to project requirements. After the parameter value is changed, you need to download it all to take effect

In autothink configuration software, double-click the LK616 tree node under hardware configuration to open the "device properties" dialog box. As shown in the figure, the LK616 user parameter has 36 bytes.



LK616 user parameter setting

LK616 definition of user parameters

Parameter name	**Parameter meaning**	**Parameter value**
CHn State(n=1~32)	Channel status	Enable Disable
CHn Filter Time(n=1~32)	Channel filtering time	0ms、1ms、3ms、10ms、20ms（默认值）、200ms、500ms

6.4.2.7 Technical Specifications

LK616 32 channel 24VDC leaky digital input module

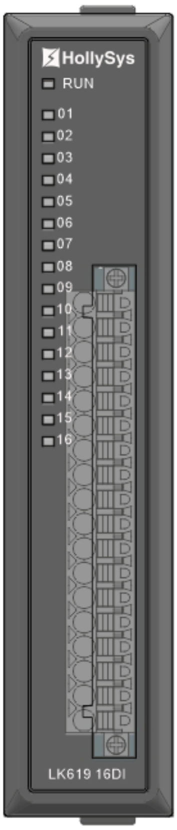
<table>
<tr><td colspan="4">LK616 32 channel 24VDC leaky digital input module</td></tr>
<tr><td colspan="4">System Power</td></tr>
<tr><td colspan="2">Operating Voltage</td><td colspan="2">24VDC(-20%~+20%)</td></tr>
<tr><td colspan="2">System Power Consumption（Max）</td><td colspan="2">60mA@ 24VDC(-20%~+20%)</td></tr>
<tr><td colspan="4">Rated Voltage of Field Power Supply</td></tr>
<tr><td colspan="2">working voltage</td><td colspan="2">24VDC(-20%~+20%)</td></tr>
<tr><td colspan="2">power dissipation（Max）</td><td colspan="2">100mA @24VDC(-20%~+20%)</td></tr>
<tr><td colspan="4">Channel performance index</td></tr>
<tr><td colspan="2">Number of channels</td><td colspan="2">32</td></tr>
<tr><td colspan="2">Channel Type</td><td colspan="2">Leaking type input</td></tr>
<tr><td colspan="2">Rated Voltage of Field Power Supply</td><td colspan="2">24VDC</td></tr>
<tr><td colspan="2">Field voltage range</td><td colspan="2">19.2V~28.8VDC</td></tr>
<tr><td colspan="2">Field current</td><td colspan="2">3mA @24V@ Channel</td></tr>
<tr><td colspan="2">ON、OFF</td><td>Leaking</td><td>ON : 15V～30V； OFF : 0～5V</td></tr>
<tr><td colspan="2" rowspan="2">Single channel parameters</td><td>Debounce time</td><td>0ms、2ms、4ms、 10ms、20ms（default）、200ms、500ms
When setting the de chattering time, the module channel value reporting will be delayed during cold and hot start,
Whether the channel value is valid can be identified by the channel quality bit.</td></tr>
<tr><td>Channel status settings</td><td>1、Any channel can be configured with or without enabling
2、When the channel is not enabled, the channel reports 0
3、The default is channel enable
4、Channel quality bit: normal is 1, abnormal is 0
Field power diagnosis: normal is 0, and abnormal field power is 1
Chip communication diagnosis: 0 for normal and 1 for abnormal chip communication
DP communication diagnosis: normal is 0, DP communication exception is 1</td></tr>
<tr><td>Channel protection</td><td>Overvoltage protection</td><td colspan="2">The channel is wrongly connected to 40VDC, which will not damage this module and Affect the normal operation of other modules</td></tr>
<tr><td rowspan="2">Field power protection</td><td>Anti reverse connection</td><td colspan="2">Support</td></tr>
<tr><td>Short circuit protection</td><td colspan="2">Support，Short circuit current greater than 3A</td></tr>
</table>

LK616 32 channel 24VDC leaky digital input module		
System power protection	Anti reverse connection	Support
	Short circuit protection	Support，Short circuit current greater than 1.6A
Full channel scan time		2ms/32 channels
Channel on-off minimum pulse width		0.5ms
Channel off-on minimum pulse width		0.5ms
Hot plug		Support
Isolation Voltage		
Channel to system		1000VAC@1min@5mA
Between groups: Channels 1-16 are group 1; Channels 17-32 are group 1		500VAC@1min@5mA
Communication Bus		
Protocol		Profibus-DP
Dual network redundancy		Support
Baud Rate		3Mbps、1.5Mbps、500Kbps、187.5Kbps、93.75Kbps、45.45Kbps、31.25Kbps、19.2Kbps、9.6Kbps。
Module failure		
Fault isolation		1.Fault isolation between channels and groups
		2.Fault isolation between modules
Module failure		1.DP1 fault or DP2 fault
		2.Field power failure
		3.System power failure
Field power failure threshold		17V±1V（2 ways)
System power failure threshold		17V±1V
Physical Property		
Installation Position		Extension backplane
Protection Key		D1
Enclosure Protection Rating		IP20
Module Dimension (W*H*D)		35mm×107mm×100mm
Weight		200g
Environmental Adaptability		
Operating Temperature		-20～70°C
Operating Humidity		5%~95%, with no condensation
Storage Temperature		-40～70°C
Storage Humidity		5%~95%, with no condensation

6.4.3 LK619 16-Channel 230VAC Digital Input Module

6.4.3.1 Basic Features

- 16-channel contact input
- Field power supply voltage range: 159VAC ~ 265VAC
- Field power failure detection
- Isolation between system and field
- Supports PROFIBUS-DP protocol
- Hot swapping



Appearance drawing of LK619 module

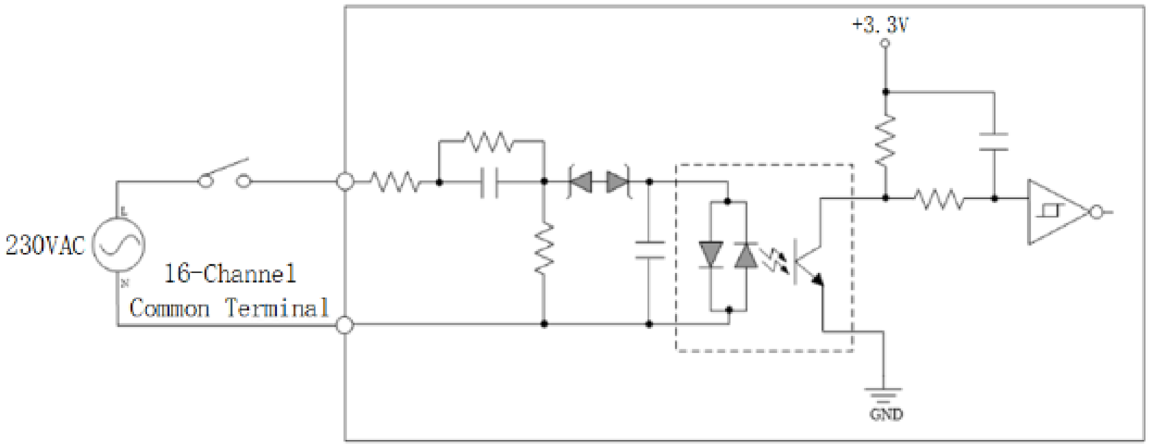
6.4.3.2 Operating Principle

Threshold Levels for LK619:

Logic 1: Voltage Range 159VAC to 265VAC (47-63Hz); Current: 4mA@159VAC (47Hz) to 12mA@265VAC (63Hz)

Logic 0: Voltage Range 0 to 40VAC (47-63Hz); Maximum Current: 2.5mA@40VAC 63Hz)

As shown in the diagram, one end of the switch is connected to the L terminal of the field power supply, and the other end is connected to the LK619. When the input voltage is between 159VAC and 265VAC, the LED side of the optocoupler conducts, and the inverter outputs a high level. When the input voltage is less than or equal to 40VAC or the input current is less than or equal to 0.5mA, the LED side of the optocoupler turns off, and the inverter outputs a low level.



LK619 module channel interface circuit diagram

6.4.3.3 Indicators

Definition of LK619 Indicators

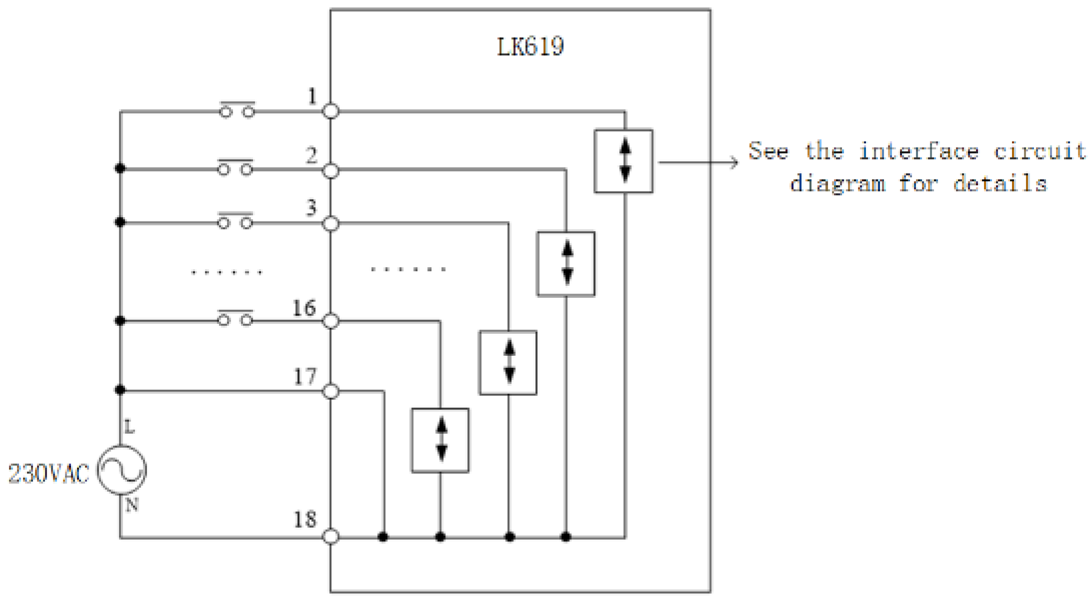
Name	Status	Description
RUN operation indicator (dual-color red and green)	Green light on	The communication is established, and the module works well
	Green light flashing	The communication is not established or incorrect.
	Green light off	Module not powered or module fault
	Red light on	Communication has been established, on-site power diagnosis is enabled, and there is an on-site power fault.
01~16-channel indicator (yellow)	On	The channel is on.
	Flash	The channel is off.

The LED blinking cycle is 250ms (on for 125ms, off for 125ms).

6.4.3.4 Wirings

A field power supply is required for the DI contact to power the optocoupler. The field power supply uses a 230VAC source.

The LK619 is installed on the expansion backplane.

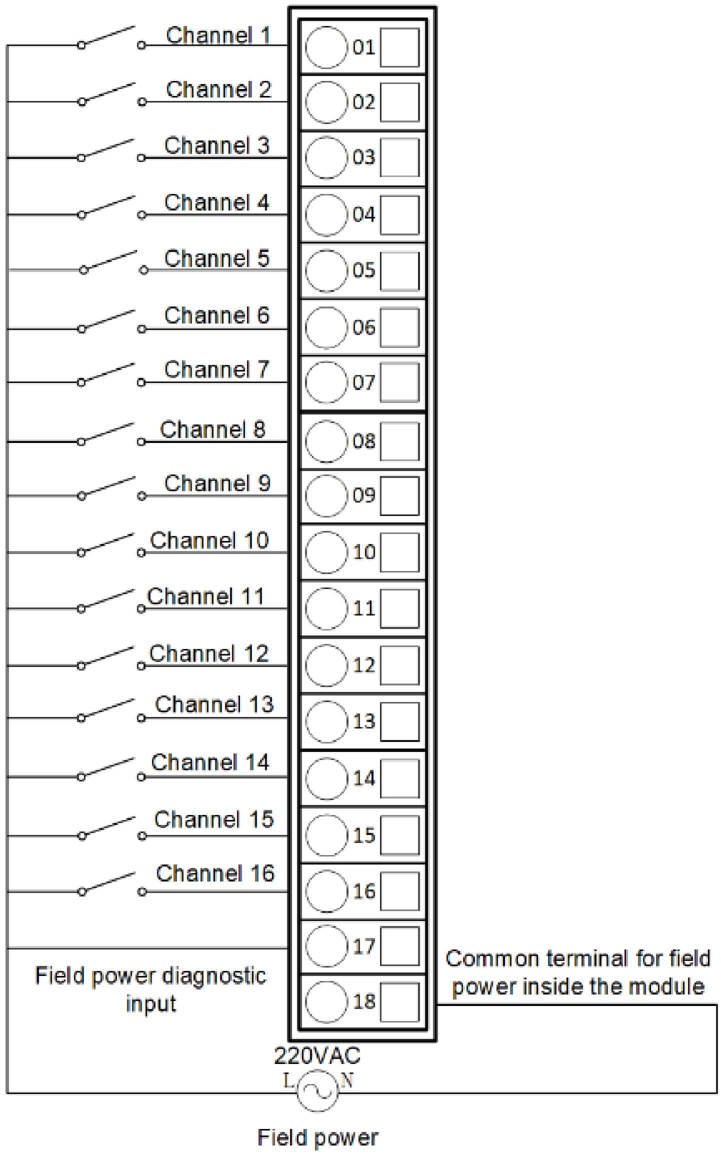


LK619 16-Channel DI interface block diagram

The LK619 is connected through standard terminal block of the module. The relationship between each channel and the terminal is shown in the figure below. One end of the 16 contact points is connected to the corresponding channel terminal (01~16), while the other end is shorted to the L terminal of the field power supply.

When wiring, note the following points:

- Use an external, separate 230VAC field power supply.
- Terminals "1~16" are the switch input terminals for channels 1 to 16.
- Terminal "17" is the field power diagnostic input, connected to the field power input terminal (usually the live wire) for detecting field power loss.
- Terminal "18" is the field power return terminal, typically connected to the neutral wire, which serves as the common terminal for channels 1 to 16 inside the module.
- Do not connect multiple wires to the same terminal; use transition terminal blocks to achieve multi-point connections.



Corresponding backplane terminal wiring diagram

Field Power Supply Live Wire Fault (Open Circuit): Does not affect the channel signal; the channel signal will follow the external signal.

Field Power Supply Neutral Wire Fault (Open Circuit): The channel circuit is open, resulting in no voltage.

6.4.3.5 Diagnosis

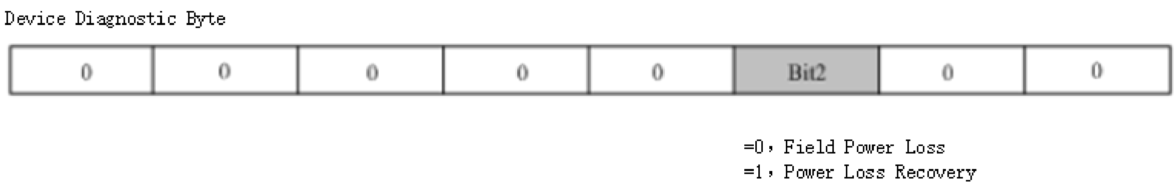
Translation:The LK619 can perform field power loss detection, which falls under device diagnostics.

Whether to enable power loss detection is selected through the user parameter “Field Power Loss Detection,” which is enabled by default (Enable). After modification, a full download is required for the changes to take effect.

Terminal “17” is connected to the L terminal of the field power supply.Terminal “18” is connected to the N terminal of the field power supply.The LK619 detects power loss by monitoring changes in the input voltage between these two terminals. If a fault occurs, the fault status is reported to the controller as diagnostic data.

When the 230VAC field power supply is disconnected (due to a broken wire or output voltage less than 40VAC), the LK619 generates diagnostic data “0x04” (Bit2 = 1 in the diagnostic byte). This diagnostic data is reported to the controller during the next scan cycle.

When the 230VAC field power supply is restored (output voltage between 159VAC and 265VAC), the LK619 generates new diagnostic data “0x00” (Bit2 = 0 in the diagnostic byte). This diagnostic data is reported to the controller during the next scan cycle.The LK619 reports diagnostic data only once when a fault occurs and once when the fault is resolved.



Diagnostic Byte of LK619

Field power loss detection belongs to device diagnostics, with the diagnostic byte defined as shown in the figure above. After calling the function block to get the DP slave diagnosis (sysGetDPSlaveState), the diagnostic data reported by the LK619 is stored in the function block's output parameter DiagData, as shown in the table.

Explanation of LK619 diagnostic information

Device Diagnostic	Value	Description
DiagData[0]: DiagData[1]	0x02:0x04	Power Failure Fault
	0x02:0x00	Fault Recovery or No Diagnostic Data

When the module operates as an I/O slave for the HolliTCP protocol, in addition to reporting the aforementioned diagnostic information, refer to the LK235M fault diagnosis for other diagnostic information.

When the module operates as an I/O slave for the POWERLINK protocol, in addition to reporting the aforementioned diagnostic information, refer to the overview of slave diagnostic information for other diagnostic information.

6.4.3.6 Parameters

User parameters are used to set the operating mode of the module and are written into the controller when the user program is downloaded. These parameters are not read during every scan cycle. Each parameter has a default value (Default) which can be changed according to project requirements. After changing the parameter values, a full download is required for the changes to take effect.The user parameters for the LK619 include software filter time selection and field power loss detection enable. The meanings of these parameters are listed in the table below.

Definition of LK619 User Parameters.

Parameter name	Parameter meaning	Parameter value
OFF to ON Filter Time	OFF - >ON Filter Time	9ms (default), 18ms
ON to OFF Filter Time	ON - >OFF Filter Time	9ms (default), 18ms
Field Power Loss Detection	Field power loss detection enable	0=Disable， disable 1=Enable， enable（default)

6.4.3.7 Technical Specifications

LK619 16-Channel 230VAC Digital Input Module		
System Power		
System Power Voltage		24VDC（-15%~+20%)
System Power Consumption		50mA max.@24VDC, excluding Field Power Consumption.
Input Channel		
Number of Channels		16
Rated Voltage of Field Power Supply		230VAC (Maximum 265VAC)
Threshold Level	ON	ON: 159～265V AC（47-63Hz） Max ON: 4mA@159VAC,47HZ Min ON: 12mA@265VAC,63Hz
	OFF	OFF: 0～40V AC（47-63Hz） Max OFF: 2.5mA@40VAC,63Hz
Debounce Filter Time OFF→ON ON→OFF		Software Filtering： 9ms, 18ms， Configuration Option； Hardware Delay： 15ms max. Software Filtering： 9ms, 18ms， Configuration Option； Hardware Delay： 10ms max.
Isolation Voltage from Field to System		1000VAC@1min.， leakage Current 5mA
Fault Diagnosis and Hot Swapping		
Field Power Failure Diagnosis		Bit2 in the diagnostic byte (Bit0~Bit7) reported by the module is used to indicate the field power detection information. When Bit2=1, it indicates a field power failure; when Bit2=0, it indicates the recovery of the field power. The fault diagnosis for the field power is reported only once at the time of fault occurrence and once again upon recovery.
Module hot swap		Support
Communication Bus		
Protocol		PROFIBUS-DP
Baud Rate		Optional baud rate： 3Mbps, 1.5Mbps, 500Kbps, 187.5Kbps
Medium		The communication bus is routed to the backplane via Euro connectors, with redundant communication media in hot standby.
Physical Property		

LK619 16-Channel 230VAC Digital Input Module	
Protection Key	A4
Installation Position	Extension backplane
Module Dimension (W*D*H)	34.7mm*166mm*90.7mm
Enclosure Protection Rating	IEC60529 IP20 (prevent objects larger than 12mm from entering; not waterproof)
Weight	≤320g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.4.4 LK620 2-channel counting module

The LK620 is an ordinary counting module that can be mounted on an expansion backplane.

6.4.4.1 Basic Features

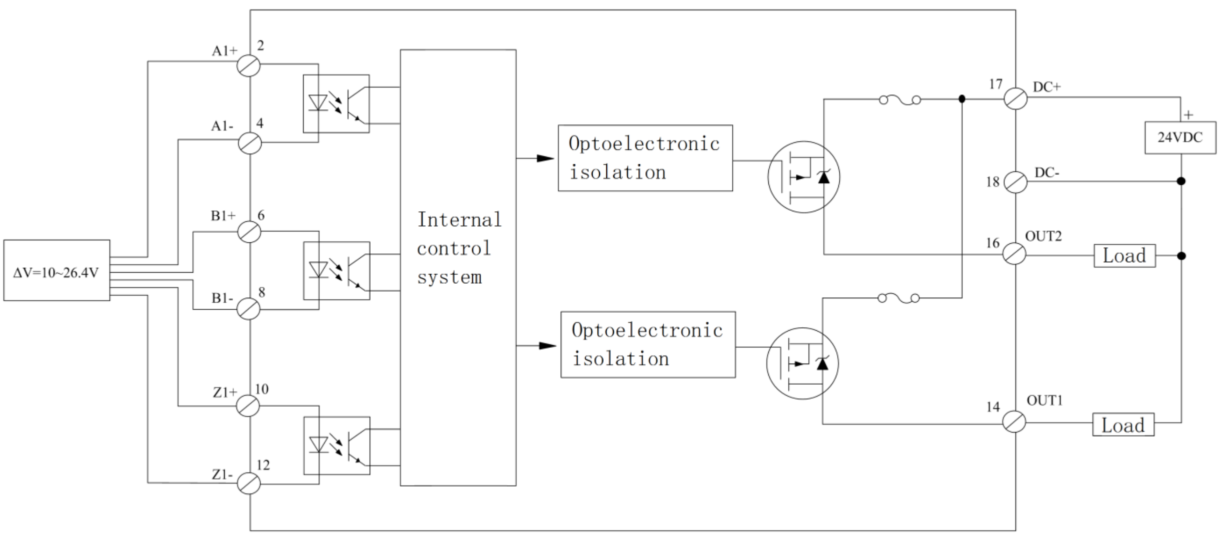
- Double circuit counters
- Two-way counting, frequency measurement
- Z signal inversion
- Function of store count value
- Debounce filtering
- Function of disable counter
- Fault mode output
- Field power failure detection
- System and field isolation
- Support for Profibus-DP slave station protocol
- Hot swapping

LK620 Module Schematic Diagram

6.4.4.2 Operating Principle

The dual channel counting module has two independent counters, each with three-way inputs (A, B, Z) and two-way digital outputs.

Input signal effective voltage range is 10 ~ 26.4VDC, the current range is 2.2mA (10VDC) ~ 7mA (26.4VDC). As shown in figure, the output channel is common to the module power supply. After the MOSFET electronic switch is closed, the current flows from the switch to the load.

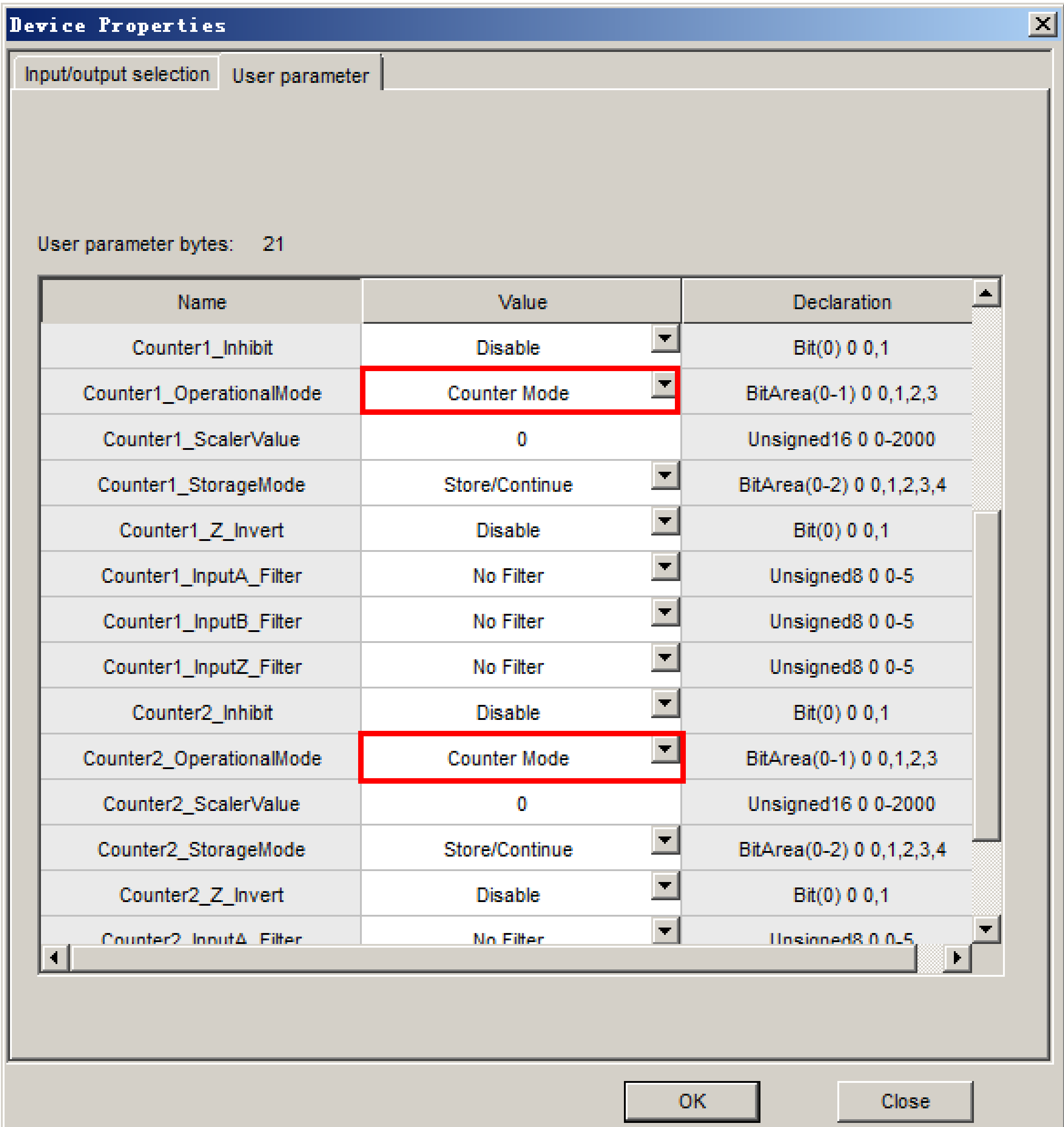


Channel Interface Circuit Diagram (counter 1 as an example)

6.4.4.3 Operating Mode

The counting module is mainly used for pulse input measurement of photoelectric encoders and proximity sensors. There are four modes of operation, counter mode, encoder × 1 mode, encoder × 4 mode and frequency measurement mode. Among them, the frequency measurement mode can implement frequency measurement for 0.1Hz ~ 1MHz signal.

The operating mode of counter 1 is selected by parameter **Counter1_OperationalMode**; the operating mode of counter 2 is selected by parameter **Counter2_OperationalMode** and the default selection is counter mode.



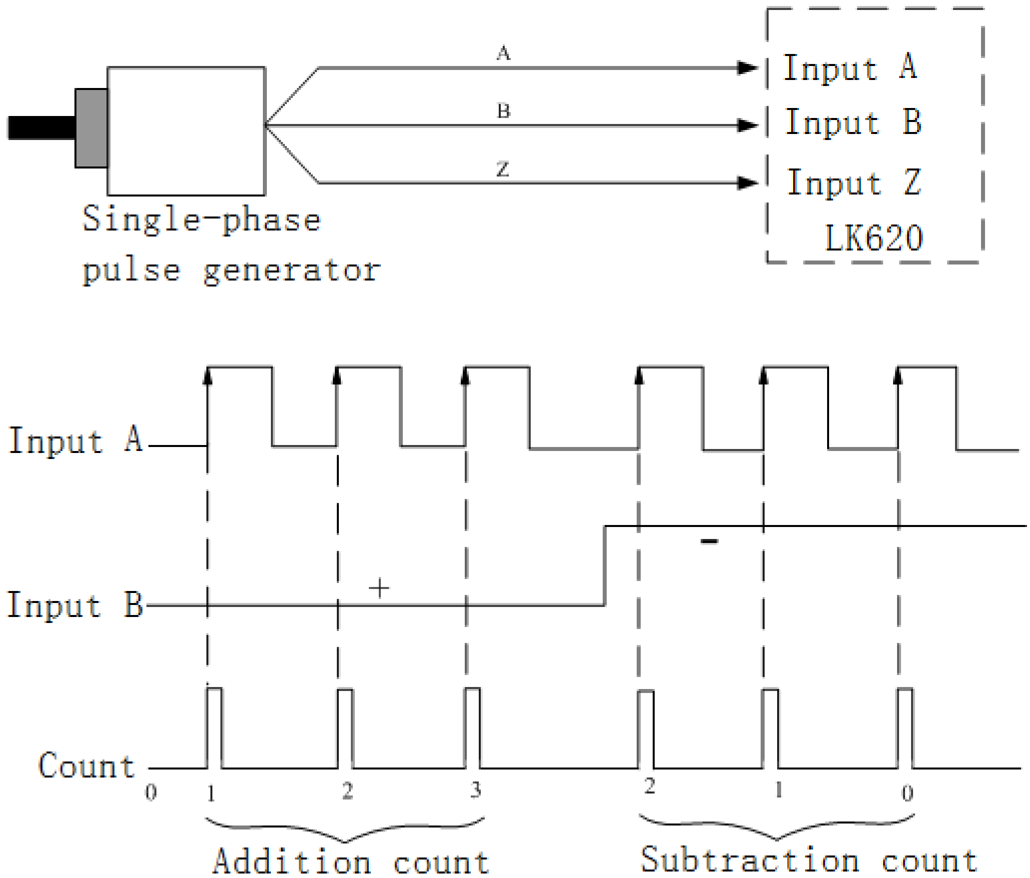
Counting Module Operation Mode Selection

6.4.4.3.1 Counter mode

Under counter mode, the A-end input pulse signal and allowed the maximum input signal frequency is 1MHz. B-end input direction signal. The counter counts when the rising edge of the A-end signal arrives, and the counting direction depends on the B-end signal. B-end signal is low level, addition count; B-end signal is high level, subtraction count.

The Counting Direction in Counter Mode

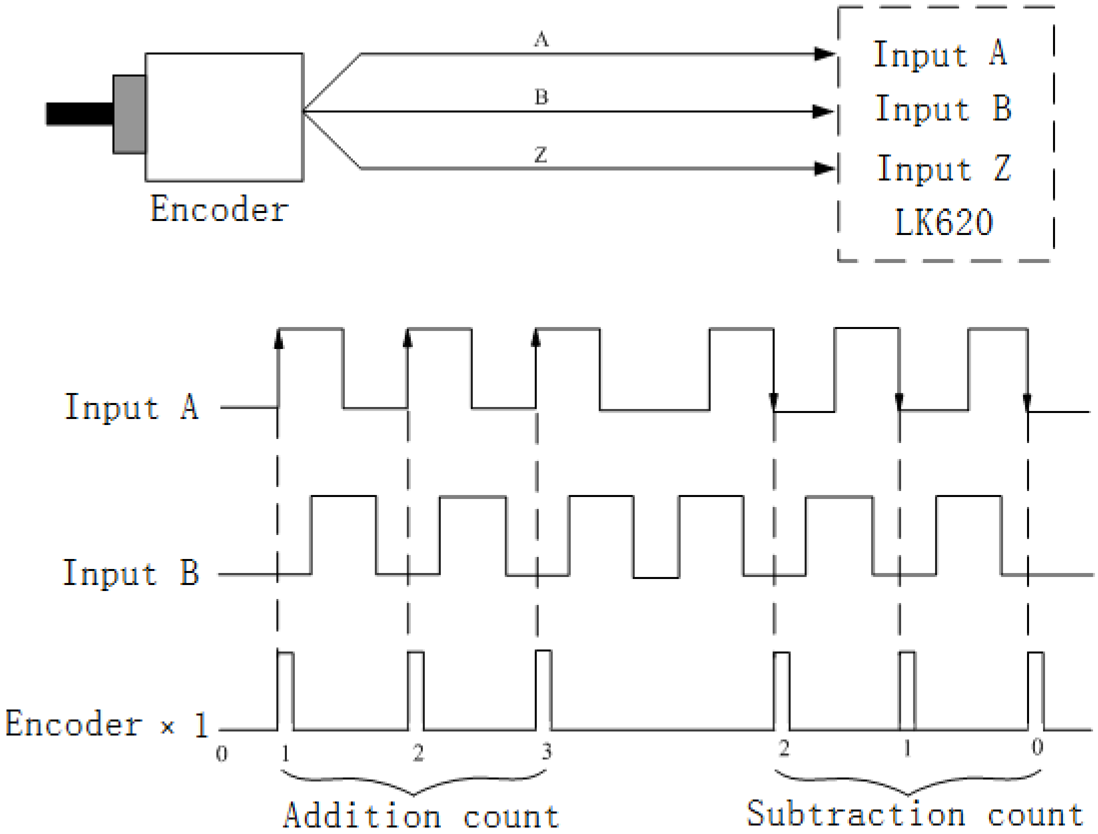
B-end	Counting Direction
High level	Subtraction count
Low level(or disconnection)	Addition count



Counter Mode

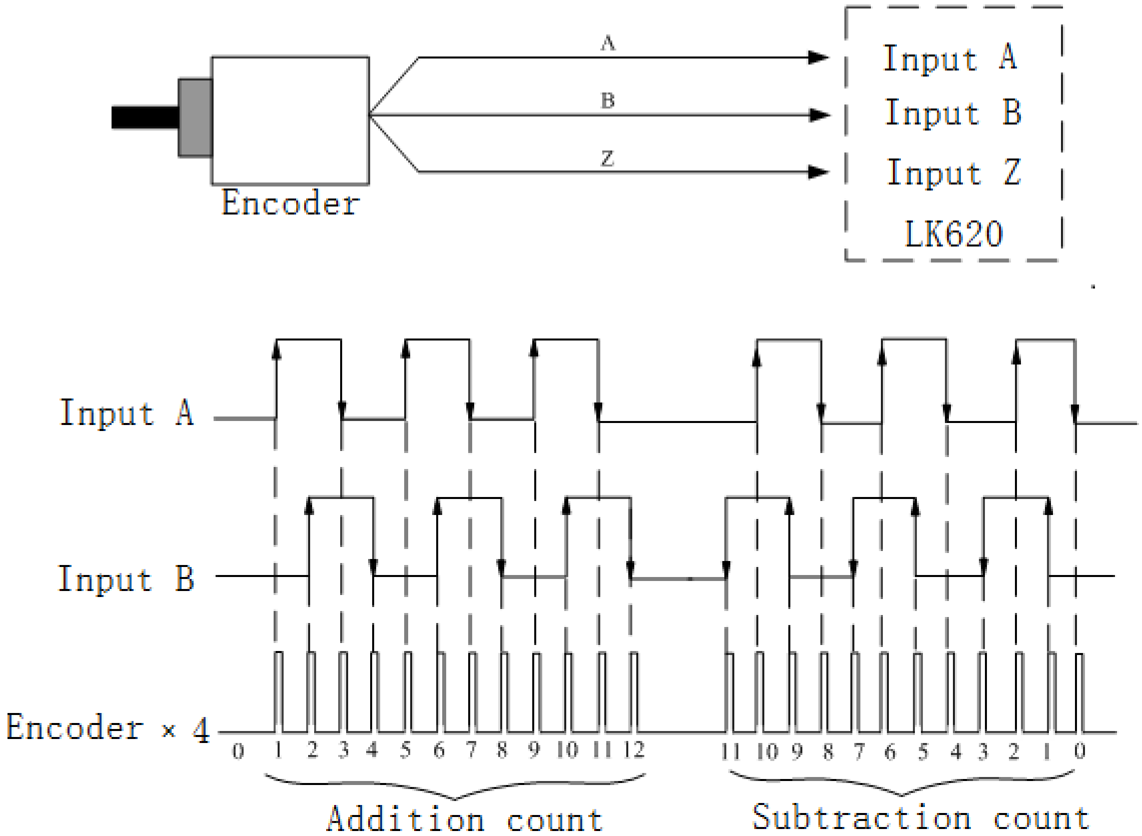
6.4.4.3.2 Encoder × 1 Mode

In encoder × 1 mode, A-end and B-end input signal maximum allowable frequency are 1MHz with 90° phase difference. When the A-end is ahead of the B-end, addition count and counts when the rising edge of the A-end signal arrives. When the B-end signal is 90°ahead of the A-end signal, subtraction count and counts when the falling edge of the A-end signal arrives.



Encoder × 1 Mode of the Counting Module

6.4.4.3.3 Encoder × 4 Mode



Encoder × 4 Mode of the Counting Module

In encoder × 4 mode, A-end and B-end input signal maximum allowable frequency are 1MHz with 90° phase difference. Using the frequency multiplication can achieves double edge the count, and count when the A-end signal rising edge, falling edge and B-end signal rising edge and the falling edge arrive.

When the A-end is 90° ahead of the B-end, addition count. When the B-end is 90°ahead of the A-end, subtraction count.

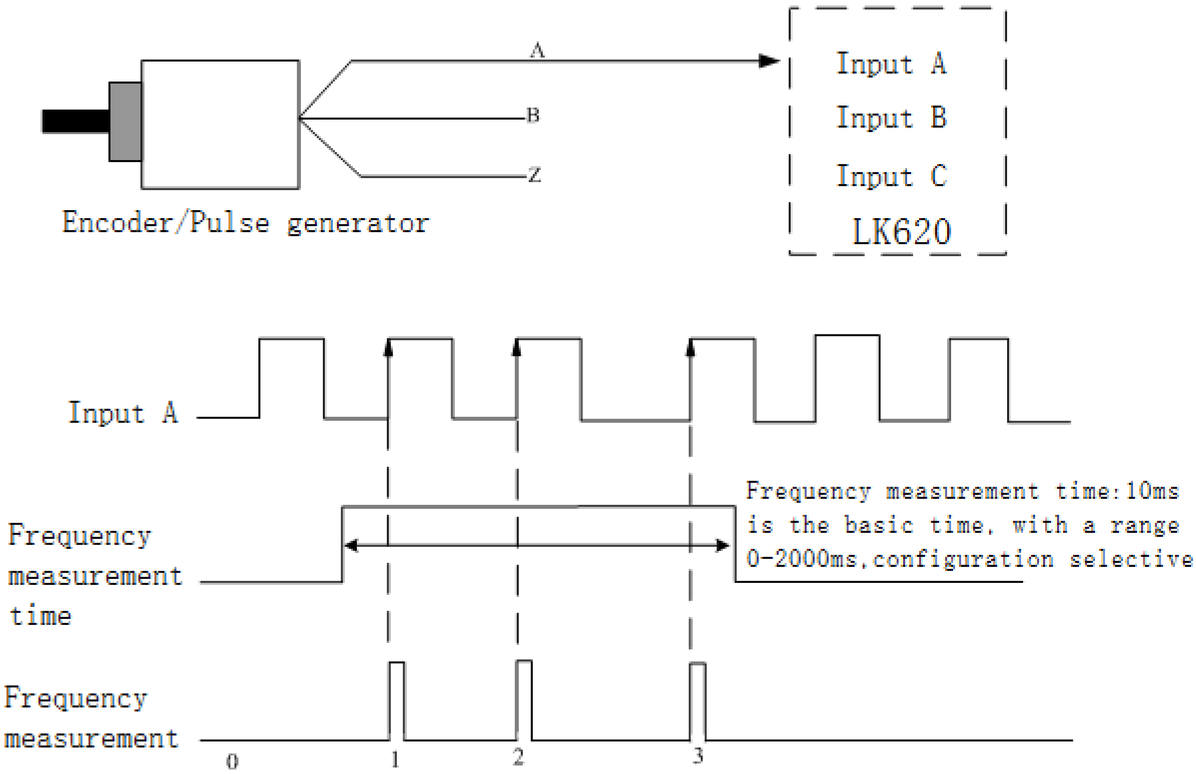
6.4.4.3.4 Frequency Measurement Mode

In frequency measurement mode, A-end input frequency signal, B-end and Z-end do not. The counter records the number of pulses of the A-end frequency signal within a given frequency measurement period and report to the controller as the current count value. In the configuration, the pulse frequency is calculated by the frequency count value and the frequency measurement time.

The frequency measurement time is specified by the user. With 10ms as the reference time unit, the values of the parameters **Counter1_ScalerValue** and **Counter2_ScalerValue** indicate how many time bases within frequency measurement time. For example, if **Counter1_ScalerValue** is set as 4, the frequency measurement time of the counter 1 is 4 × 10ms = 40ms. Assuming that the counter 1 receives three pulses in the 40ms frequency measurement time and the pulse frequency = 3 / 40ms = 75Hz obtained from configuration with division operation.

The maximum time for the frequency measurement can be set as 20s. Correspondingly, the maximum value of the parameters **Counter1_ScalerValue** and **Counter2_ScalerValue** is 2000. The frequency measurement time should not be set as zero.

In frequency measurement mode, the maximum measurable frequency is 1MHz, the minimum measurable frequency is 0.1Hz.



Frequency Measurement Mode of the Counting Module

6.4.4.4 Indicators

LK620 Indicators Definition

Type	Status	Description
RUN	On	The module is working normally
	Flash	Communication is not established
	Off	No powered on or module fault
CH1.1	On	The first output channel of counter 1 is cloesd
	Off	The first output channel of counter 1 is disconnected
CH1.2	On	The second output channel of counter 1 is cloesd
	Off	The second output channel of counter 1 is disconnected
CNT1	On	Counter 1 works in counter mode
Freq1	On	Counter 1 works in frequency measurement mode
CH2.1	On	The first output channel of counter 2 is cloesd
	Off	The first output channel of counter 2 is disconnected
CH2.2	On	The second output channel of counter 2 is cloesd
	Off	The second output channel of counter 2 is disconnected
CNT2	On	Counter 2 works in counter mode

Type	Status	Description
Freq2	On	Counter 2 works in frequency measurement mode

Details of RUN Green indicator is as follows:

- When powered on, the green indicator flashes to wait for the initialization data, the flashing frequency is 4 times / s.
- After initialization, the green indicator is on, which indicates that the module is running normally. If the initialization data is incorrect, the communication cannot be established and the green indicator will remain flashing. Checking whether the address of the communication station is set correctly.
- Communication is normal, the green indicator is on; communication is interrupted and the green indicator is flashing; after the communication is reestablished, the green indicator will turn on again.

6.4.4.5 Wirings

Counting module is installed on the extension backplane.

The counting module is connected to the terminal via the backplane mounting slot. The relationship between each channel and the terminal is shown in table. A1 + / A1-, B1 + / B1-, Z1 + / Z1- are the three inputs of the counter 1, OUT1 and OUT2 are the two outputs of the counter 1; A2 + / A2-, B2 + / B2-, Z2 + / Z2- are three inputs of counter 2, OUT3 and OUT4 are the two outputs of counter 2.

Definition of Backplane Terminals

Signal Type		Counter 2		Cunter 1	
		Signal definition	Terminal number	Signal definition	Terminal number
Input	A+	A2+	01	A1+	02
	A-	A2-	03	A1-	04
	B+	B2+	05	B1+	06
	B-	B2-	07	B1-	08
	Z+	Z2+	09	Z1+	10
	Z-	Z2-	11	Z1-	12
Output	The first route	OUT3	13	OUT1	14
	The second route	OUT4	15	OUT2	16
10~31.2VDC power supply	DC+	17			
	DC-	18			

When wiring, pay special attention to the following:

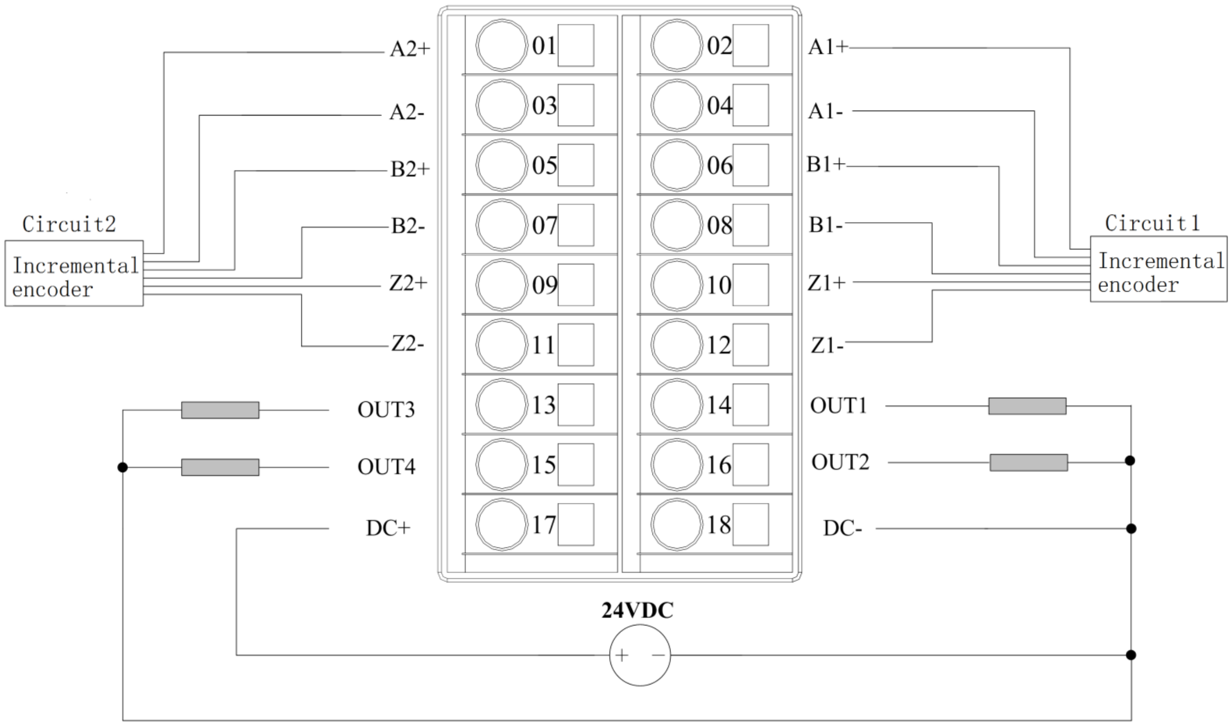
- Each counter has 2-way switching outputs.
- External independent 10 ~ 31.2VDC field power supply, to ensure that the field and the system are isolated.
- 4-way DO outputs circuit share a 10 ~ 31.2VDC field power supply.
- The output channel does not have reverse voltage protection, and if the wiring is wrong, it may burn the internal circuit.
- Terminal "17" is connected to the positive end of the field power supply.
- Terminal "18" is connected to the negative end of the field power supply, and used for field power down detection.

- Do not connect multiple cables on the same terminal at the same time. You can achieve multipoint connection via conversion terminal.

The following three examples of typical field devices describe the wiring mode of counting module. Input the range of signal voltage difference: 10-26.4V, that is, for differential signal, (U +) - (U -) = 10 ~ 26.4V; for single-end signal, U = 10 ~ 26.4V. Output channel connect externally DC supply voltage range: 10 ~ 31.2VDC.

6.4.4.5.1 Connection with Incremental Encoder

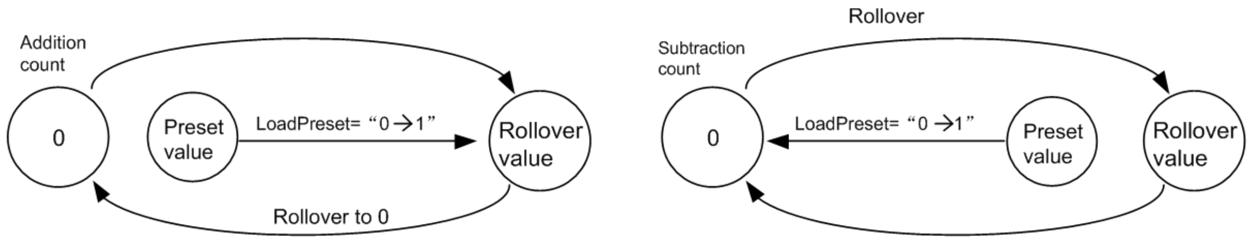
As shown in the following figure, the corresponding relationship between output of the incremental encoder and the input of the counting module: A—A, B—B, 0—Z.



Connection of the Counting Module with the Incremental Encoder

6.4.4.5.2 Connection to Photoelectric Sensor

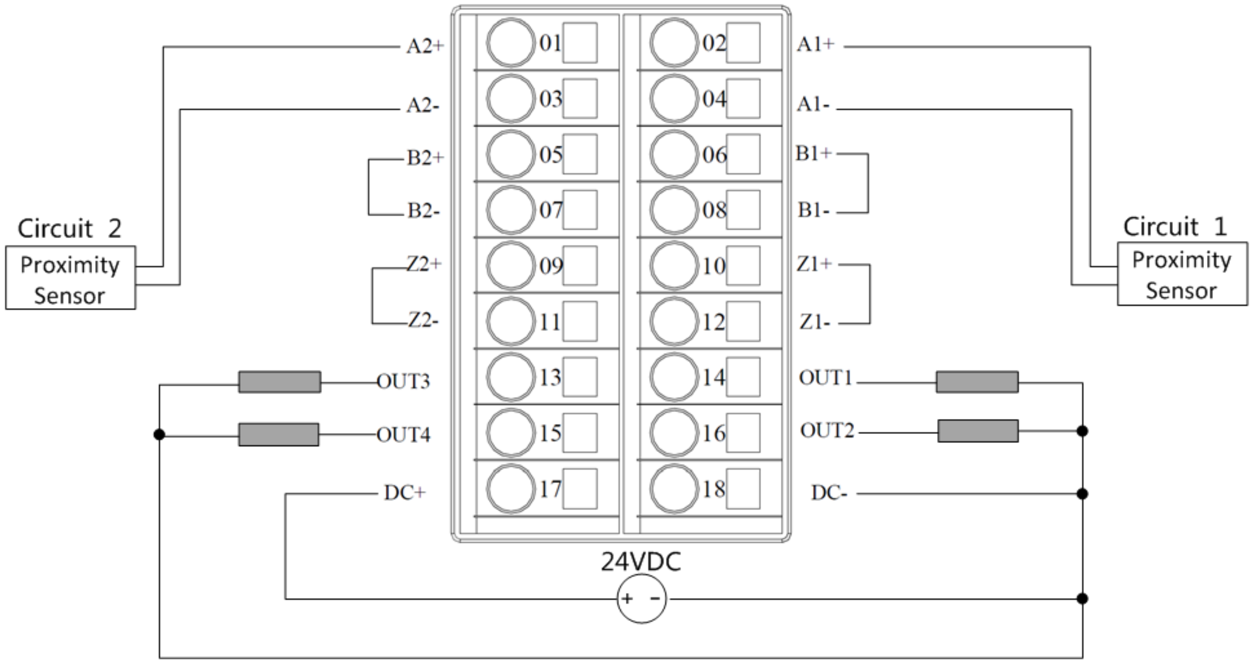
As shown in the following figure, the output of the photoelectric sensor is connected to the A and Z input end of the counting module respectively, B-end short circuit.



Connection of the Counting Module with the Photoelectric Sensor

6.4.4.5.3 Connection to Proximity Sensor

As shown in the following figure, the input of proximity sensor connect to the A input end, B-end, Z-end short circuit.



Connection of the Counting Module with the Proximity Sensor

6.4.4.6 Function Description

6.4.4.6.1 Rollover Value

In counter mode, you need to set a rollover value for the counter as the upper limit of the count with a range 1 to 4,294,967,295.

During the counting process, when the count value = (rollover value -1), the counter returns to 0 and restarts counting. If the set rollover value is 1500, the counting order is: ... 1498, 1499, 0, 1, 2 ....

The rollover value of counter 1 is set by the output data **Counter1_RolloverValue**, and the rollover value of counter 2 is set by the output data **Counter2_RolloverValue**.

The Rolled mark in the input data (Counter_Rolled) indicates whether the counter has reached the rollover value and rolled over. If Counter 1 has been rolled, **Counter1_Rolled** = 0x01; if it is not rolled or the mark is cleared, **Counter1_Rolled** = 0x00.

The user can clear the rolled flag through the clear rolled flag (Counter_ClearRolledFlag) in the output data to record the next rollover.

Details of relevant data see Data_Area.

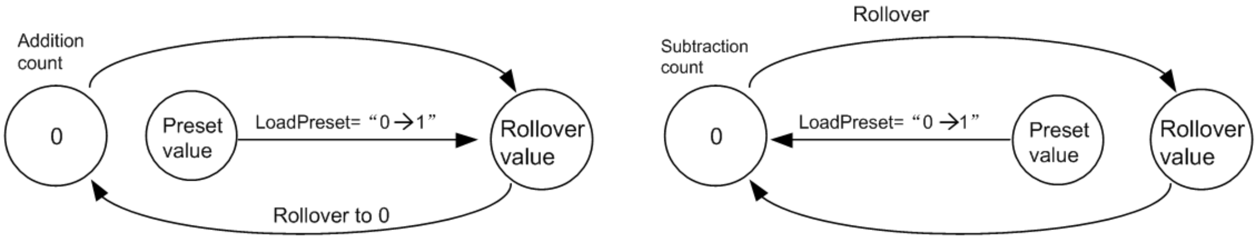
In frequency measurement mode, rollover value should be set as 0.

6.4.4.6.2 Preset Value

In counter mode, you can set a preset value for the counter and make counter counts from that value. Preset value's range is 0 to 4,294,967,295. In frequency measurement mode, the preset value is meaningless.

The preset value must be less than the rollover value. If the value is greater than the rollover value, count error will occur.

It is important to note that when the current count value reaches the rollover value, the counter roll back to zero and restarts counting from 0, not starting from the preset value, as shown in the following figure.



Counter Preset and Rollover Value

Whether or not the counter loads the preset value and counts from the preset value is controlled by the output data **Counter_LoadPreset**. Writing into the rising edge signal (0 → 1), the counter loads the preset value and starts counting from the preset value.

Whether or not to reset the counter is controlled by the output data **Counter_Reset**. Writing into the rising edge signal (0 → 1), the counter is reset and counts from zero. When **Counter_Reset** = 1, the two output channels of the counter are output OFF and are not output according to the configuration settings.

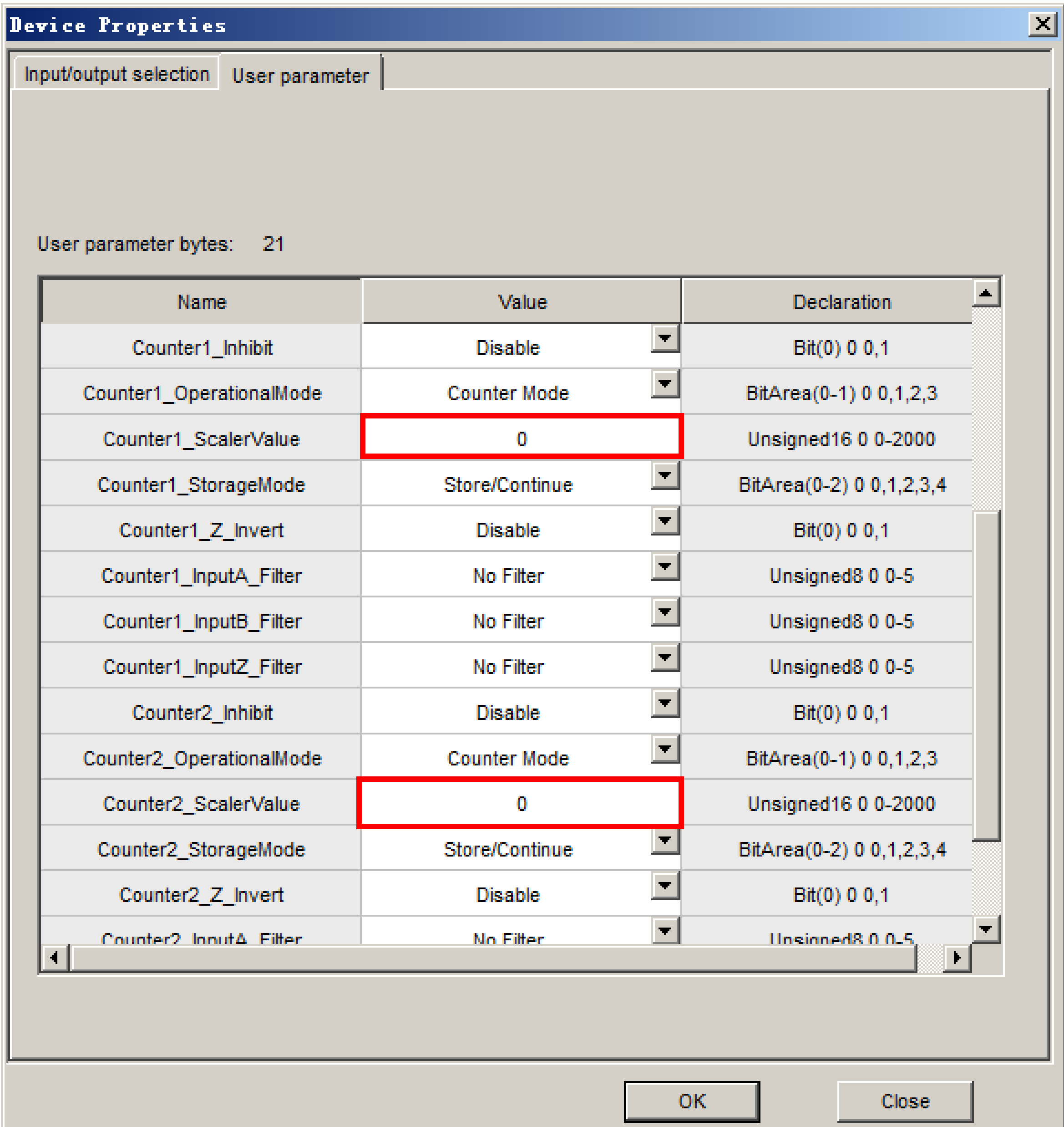
If **Counter_Reset** and **Counter_LoadPreset** are simultaneously written to the rising edge signal, the counter loads the preset value and counts from the preset value.

The preset value of counter 1 is set by the output data of **Counter1_PresetValue**, and the preset value of counter 2 is set by the output data of **Counter2_PresetValue**.

Details of relevant data see Data_Area.

6.4.4.6.3 Frequency Measurement Time

In frequency measurement mode, you need to set a frequency measurement time, called the frequency measurement time. The counter will count the number of pulses received within the specified frequency measurement time.



Counter Frequency Measurement Time Setting

The two counter frequency measurement time is set respectively by the parameters **Counter1_ScalerValue** and **Counter2_ScalerValue**, the default is 0, the value range: 0 ~ 2000, which indicates that how many time base in the frequency measurement time (10ms). For example: counter 1 works in frequency measurement mode, parameter Counter1_ScalerValue = 6, then the counter 1 frequency measurement time = 6 × 10ms = 60ms. Assuming that the counter 1 receives six pulses in the frequency measurement time, the pulse frequency = 6 / 60ms = 100 Hz.

If the counter is not operating in the frequency measurement mode, the parameter should be set as 0.

Maximum parameter value= 2000, that is, the maximum allowable frequency measurement time = 2000 × 10ms = 20s.

6.4.4.6.4 Output ON

You can set a count value for each output. When the current count value of the counter reaches this value, the output channel is ON (the channel is closed). This value is called the output ON trigger value (Output_ON_Value).

The output ON trigger value of each output (OUT1 / OUT2 / OUT3 / OUT4) is set by the parameters **Output1_ON_Value**, **Output2_ON_Value**, **Output3_ON_Value** and **Output4_ON_Value** respectively, and double word variable (DWord) with a range of 0 ~ 4,294,967,295.

The output ON trigger value should be less than the rollover value. If the output ON trigger value is no less than rollover value, the count value cannot reach the output ON trigger value, the output channel will not output ON.

The output data **Output_Control** is used to control the status of the counter's outputs. For example, setting **Output1_Control** = 0x03, indicates that the current output value of the modified output channel 1 (OUT1) is "ON" and the forced channel 1 is closed, regardless of whether the current count value of counter 1 reaches the output ON trigger value (Output1_ON_Value) and output channel 1 output and remain "ON" status. Setting Output1_Control = 0x00, indicates that output is based on the count result, and output channel 1 will output ON when the ON trigger value of counter 1 arrives.

Details of relevant data see Data_Area.

6.4.4.6.5 Output OFF

When powered on, the output channel remains in its original status. After output enable, the status of the user program is output. When restarted, the output channel outputs OFF. After establish the communication and re-download the parameters, output a configured status.

A count value can be set for each output. When the current count value of the counter reaches this value, the output channel outputs OFF (the channel is disconnected and the output is stopped). This value is called the output OFF trigger value (Output_OFF_Value).

The output OFF trigger value should be less than the rollover value. If the output OFF trigger values are no less than rollover value, the count value cannot reach the output OFF trigger value, the output channel will not output OFF.

The output OFF trigger values of each output(OUT1 / OUT2 / OUT3 / OUT4) are set by the parameters **Output1_OFF_Value**, **Output2_OFF_Value**, **Output3_OFF_Value** and **Output4_OFF_Value** respectively, DWORD, with a range of 0 to 4,294,967,295.

The output data **Output_Control** is used to control the status of the counter's outputs. For example, setting **Output3_Control** = 0x02, indicates that the current output value of the modified output channel 3

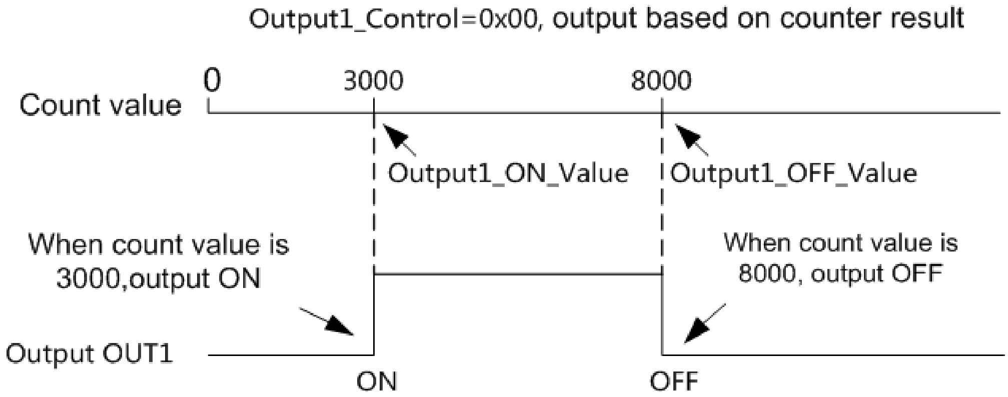
(OUT3) is "OFF" and the forced channel 3 is disconnected, regardless of whether the current count value of counter 2 reaches the output OFF trigger value or not (Output3_OFF_Value). Output channel 3 outputs and remains "OFF". Setting **Output1_Control** = 0x00, indicates that output is based on the count result, and output channel 3 will output OFF when OFF value of counter 2 arrives.

Details of relevant data see Data_Area.

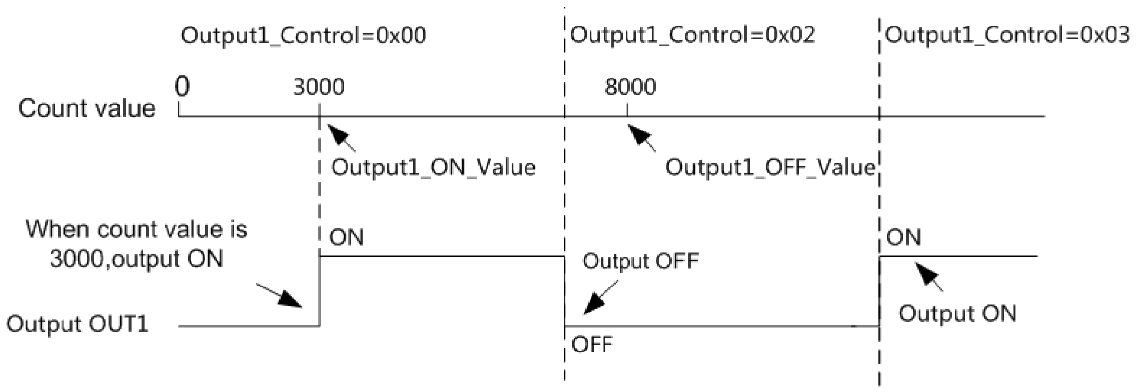
It outputs OFF when output OFF trigger value equals to output ON trigger value.

Channel Output Priority: Fault Mode Value> Force Output ON / OFF> Output OFF Trigger Value> Output ON Trigger Value.

Take OUT1 of counter1 as example, when **Output1Control** = 0x00 (output based on counting result), **Output1_ON_Value** = 3000, **Output1_OFF_Value** = 8000, the output status of output point OUT1 is shown in the figure. If **Output1Control** = 0x02 (modify OUT1 output value is OFF) or = 0x03 (modify OUT1 output value is ON), **Output1_ON_Value** = 3000, **Output1_OFF_Value** = 8000, the output status of output point OUT1 is shown in the following figure.



Output Timing of OUT1 When Output According to the Count Result



Output Timing of the OUT1 after the Output Value is Forcefully Modified

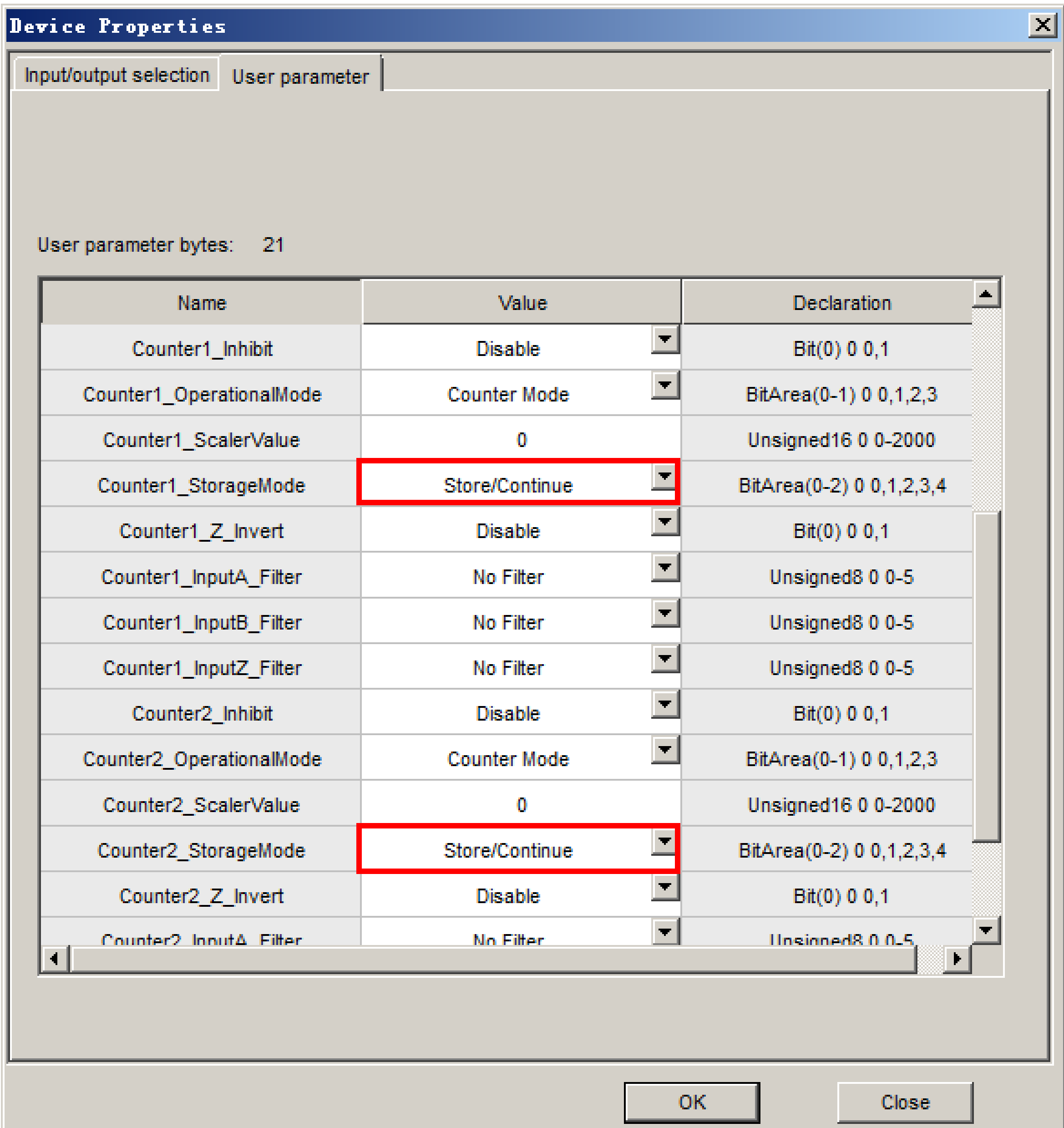
6.4.4.6.6 Store the count value

When the Z signal (the default rising edge is valid, when the "Z Inversion" function is enabled, the falling edge is valid), the counter can store the current count value until the next Z signal arrives, storing the new count value and covering the old value.

Whether or not to store the count value and select which kind of storage mode for counter 1, counter 2 depends on the parameters **Counter1_StorageMode** and **Counter2_StorageMode** set, the default **Store / Continue**. The count status of the counter in different memory modes is described below.

Selecting a storage mode means that the stored count value function is enabled and the counter will store the current count value in that mode when the Z signal arrives. Select **No Store Mode**, store count value function is disenabled.

When the store count value function is enabled, the counter module not only reports the current counter value of the two counters (Counter_PresentValue) in the input data, but also reports the stored count value (Counter_StoredValue).

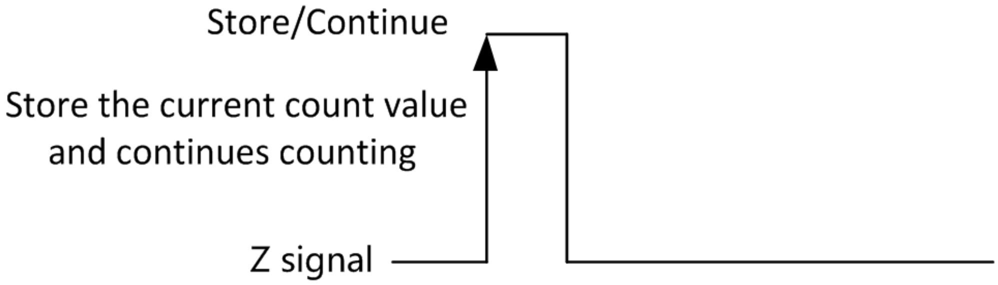


Counting Module Storage Mode Setting

6.4.4.6.7 Storage mode

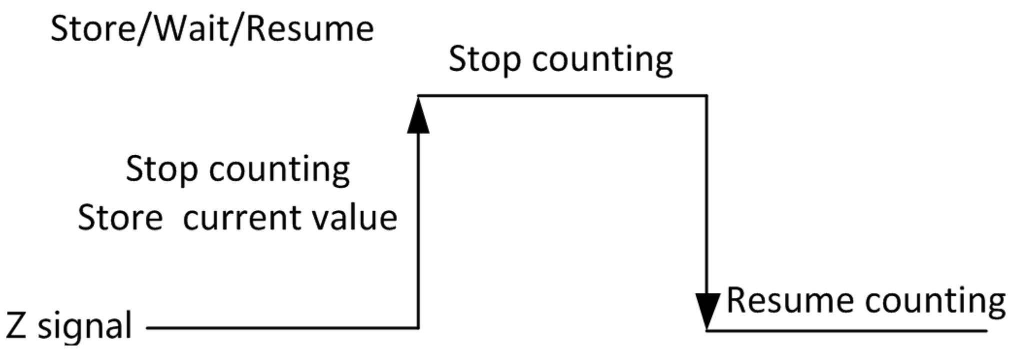
When the counter stores count values, four different memory modes are supported:

- Store/Continue (default): The counter stores the current count value and continues counting.



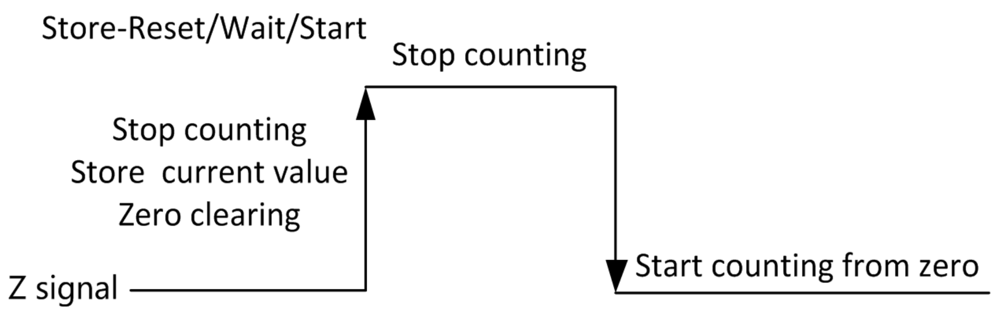
Counting Module Store/Continue Mode

- Store/Wait/Resume: The counter stores the current count value and stops counting. Until the Z signal falling edge arrives, it continues to count.



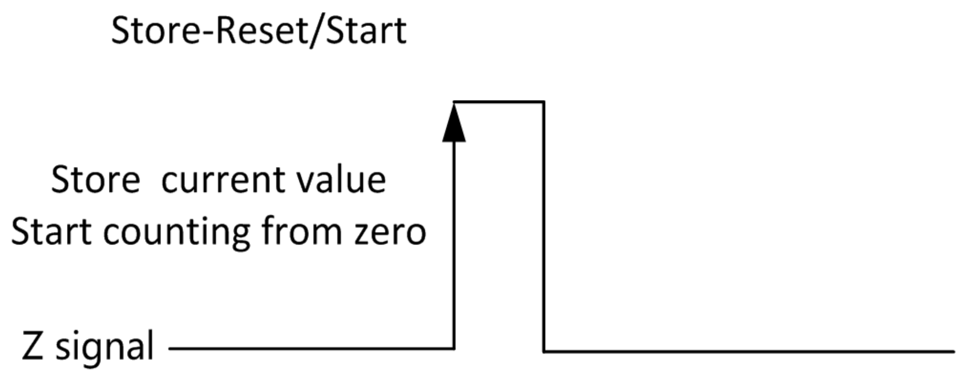
Counting Module Store/Wait/ Resume Mode

- Store-Reset/Wait/Start: The counter stores the current count value, zero clearing, and stops counting. Until the Z signal falling edge arrives, it starts counting from zero.



Counting Module Store-Reset /Wait/ Start Mode

- Store-Reset/Start: The counter stores the current count value, zero clearing, and recounts from 0.

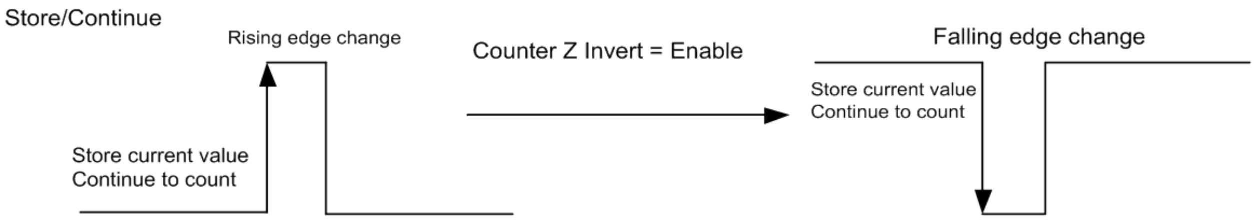


Counting Module Store-reset / start Mode

6.4.4.6.8 Z Signal inversion

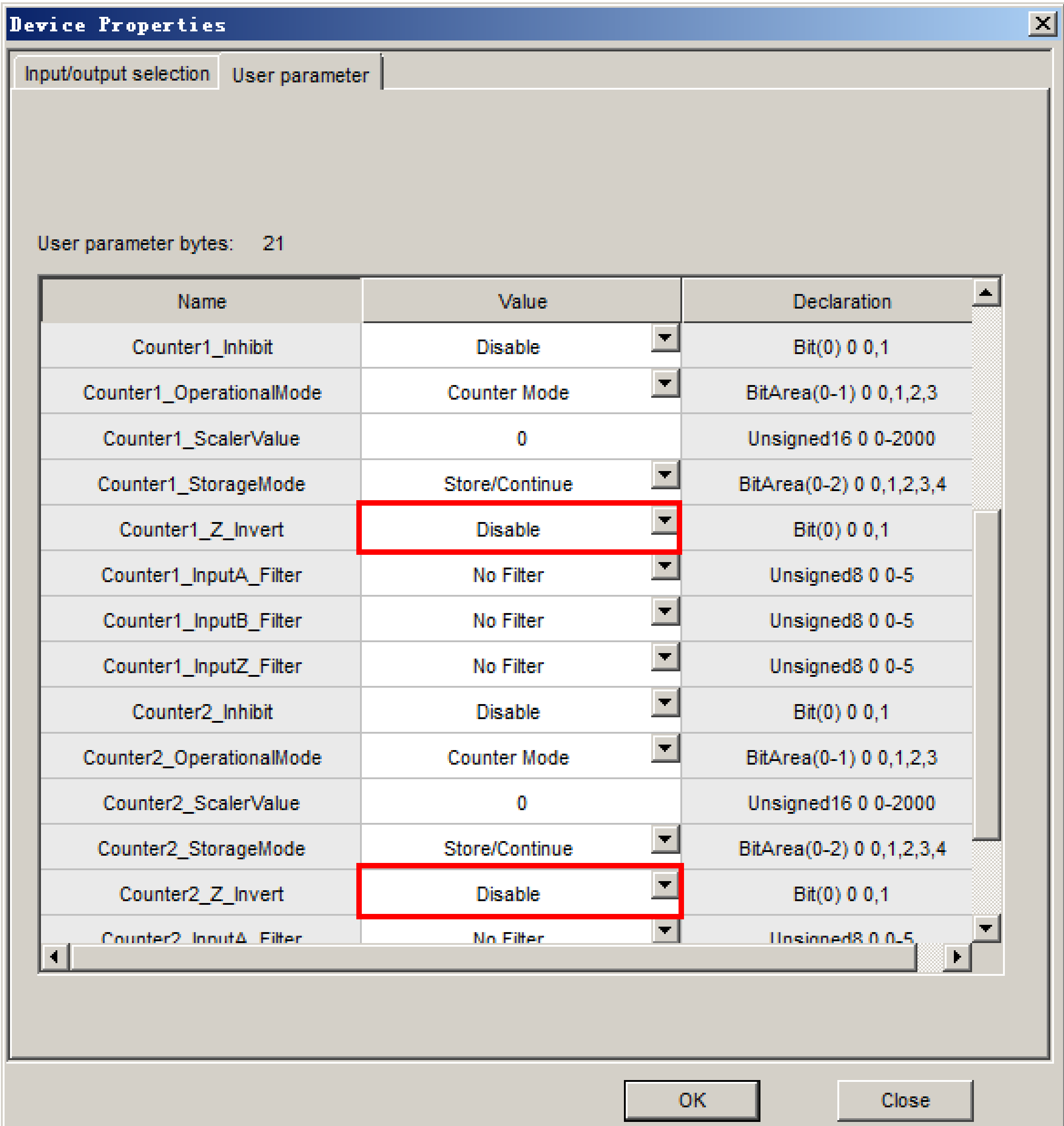
By default, the rising edge of the Z signal input is valid. The Z signal inversion function can be selected so that the Z signal input falling edge will be effective, the Z interrupt will be triggered when the falling edge of the Z signal arrives, and the count value is stored when the falling edge of the Z signal arrives.

After the Z signal inversion enable, the trigger condition for storing the count value is shown in the following figure.



Z Signal Inversion of the Counting Module

Whether or not the Z signal of counter 1 inverted is set by parameter **Counter_Z_Invert**. Whether or not the Z signal of counter 2 inverted is set by parameter **Counter2_Z_Invert**. The default set is Disable.



Counting Module Z Signal Inversion Enable Setting

6.4.4.6.9 Communication Failure

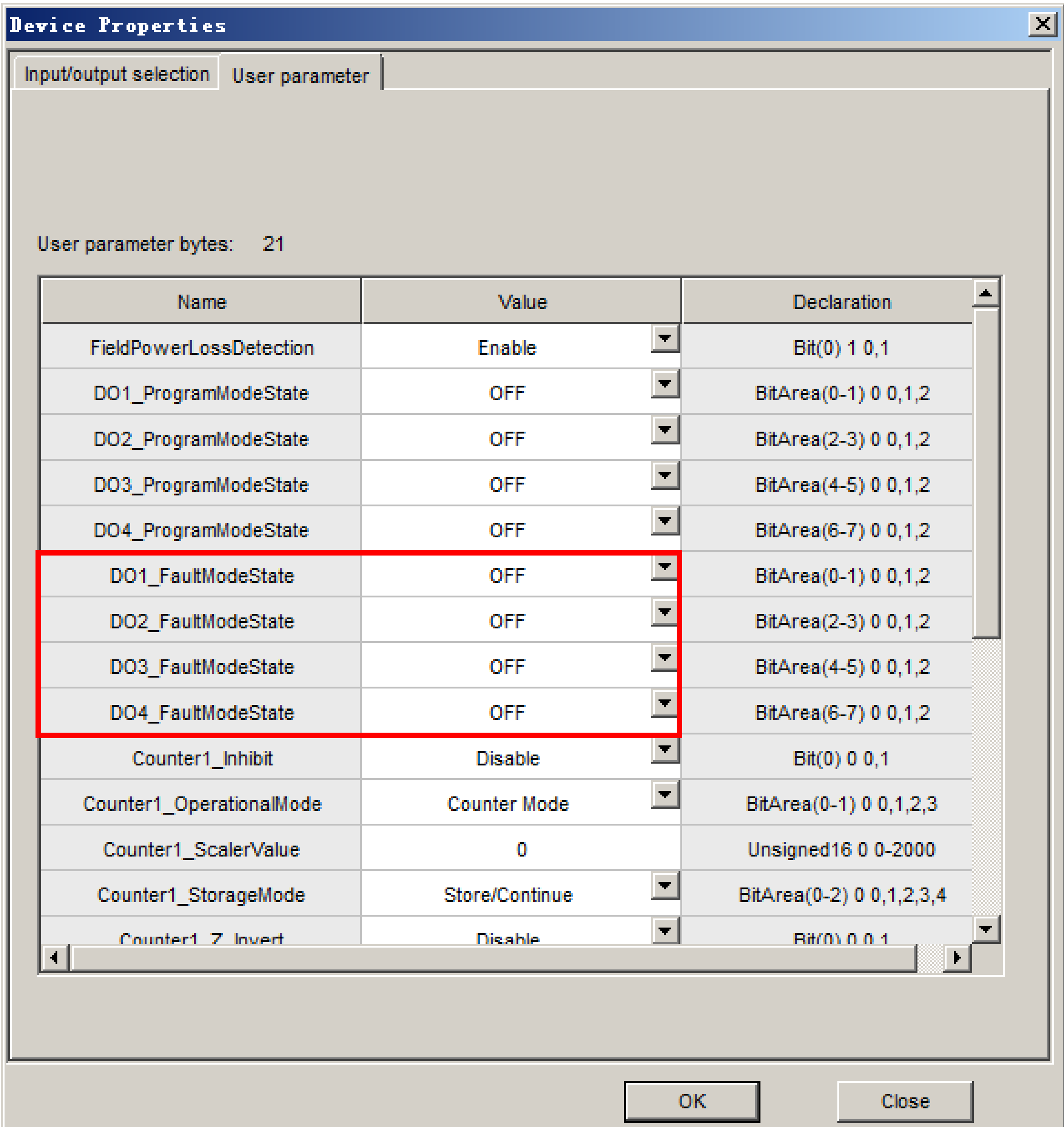
When the communication is normal, the LK620 exchanges data with the controller via the Profibus-DP bus. The output points (OUT1 / OUT2 / OUT3 / OUT4) are output according to the control commands issued by the controller.

In the event of a communication failure, communication between the module and the controller is interrupted and the "RUN" light flashes.

When the module is powered on, the module automatically enters the fault mode when any communication fault occurs and outputs a status (fault value) configured in advance: output holding (Hold

Last Status) or the output fault mode setting value (Fault Mode Status, ON or OFF).

In fault mode, the output holding or the output fault mode setting value is selected by the user parameter **Fault Mode Output** and the default output is held. The fault mode setting value is set by the user parameter **Fault Mode Status** and the default output is OFF (disconnected).



LK620 Output Point's Output Value in Failure Mode

6.4.4.6.10 Disable Counter

After the counter is disabled, it is not counted and reports the count value before disabled. Whether or not to disable the counter 1 depends on the parameter **Counter1_Inhibit**, and whether or not to disable the counter 2 depends on the parameter **Counter2_Inhibit**, the default value is Disable.

When a counter is disabled, it does not affect the output channel of the counter, only the counter does not work.

Name	Value	Declaration
Counter1_Inhibit	Disable	Bit(0) 0 0,1
Counter1_OperationalMode	Counter Mode	BitArea(0-1) 0 0,1,2,3
Counter1_ScalerValue	0	Unsigned16 0 0-2000
Counter1_StorageMode	Store/Continue	BitArea(0-2) 0 0,1,2,3,4
Counter1_Z_Invert	Disable	Bit(0) 0 0,1
Counter1_InputA_Filter	No Filter	Unsigned8 0 0-5
Counter1_InputB_Filter	No Filter	Unsigned8 0 0-5
Counter1_InputZ_Filter	No Filter	Unsigned8 0 0-5
Counter2_Inhibit	Disable	Bit(0) 0 0,1
Counter2_OperationalMode	Counter Mode	BitArea(0-1) 0 0,1,2,3
Counter2_ScalerValue	0	Unsigned16 0 0-2000
Counter2_StorageMode	Store/Continue	BitArea(0-2) 0 0,1,2,3,4
Counter2_Z_Invert	Disable	Bit(0) 0 0,1
Counter2_InputA_Filter	No Filter	Unsigned8 0 0-5

Counter Inhibit Setting

6.4.4.7 Diagnosis

LK620 can implement field power loss detection, the diagnosis belongs to the device diagnosis.

Whether or not to enable power-down detection is selected by the user parameter **FieldPowerLoss Detection**. The default value is Enable. After modification, you need to fully download to take effect.

Device Properties

Input/output selection | User parameter

User parameter bytes: 21

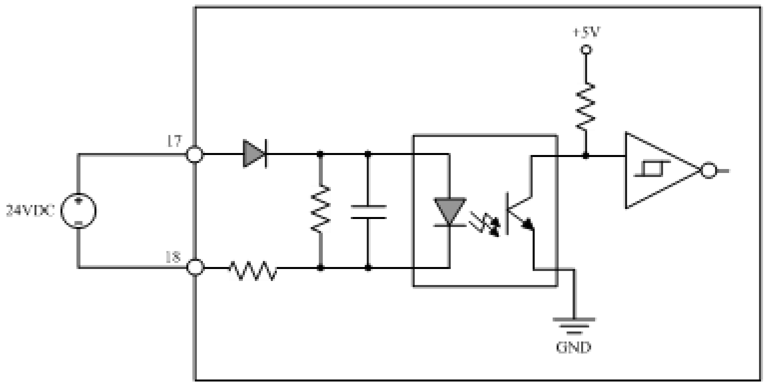
Name	Value	Declaration
FieldPowerLossDetection	Enable	Bit(0) 1 0,1

LK620 Power Loss Detection Enable Selection

As shown in the following figure, the "17" terminal is connected to the positive terminal of the field power supply and the "18" terminal is connected to the negative terminal of the field power supply. The

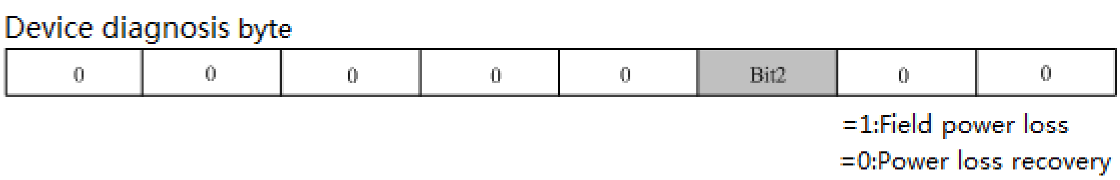
LK620 performs power loss diagnosis by detecting changes of the input voltage between the two terminals. If there is a fault, the fault status is reported to the controller in the form of diagnostic data.

The field power supply voltage is between 10 ~ 31.2VDC, the optocoupler switch of the power loss detection channel is ON, and it is judged that the field power supply is normal. When the field power supply voltage is less than 5VDC, the optocoupler switch of the power loss detection channel is OFF, and it is judged that the field power supply is in power loss status. the field power supply voltage is between 5 ~ 10VDC, the power failure detection channel of the optocoupler switch status is uncertain.



LK620 Field Power Loss Detection Circuit Diagram

- When the 24VDC power supply is disconnected (disconnection or power supply output voltage is less than 5VDC), the device diagnostic data area of the LK620 generates the diagnostic data "0x04" (Bit2 = 1 in the diagnostic byte). When the next scan cycle arrives, it is reported to the controller.
- When the 24VDC power supply is restored to normal (output voltage 10 ~ 31.2VDC), LK620 device diagnostic area generates a new diagnostic data "0x00" (Bit2 = 0 in the diagnostic byte), when the next scan cycle arrives, it is reported to the controller.
- Only in the event of failure and fault recovery, the diagnostic data of LK620 is reported once respectively.



LK620 Diagnostic Byte

Field power loss detection belongs to device diagnosis, diagnostic byte definition is shown in the above figure. After calling the function block sysGetDPSlaveState (Get Diagnosis of DP Slave), diagnosis data reported by LK620 are saved into the output parameter **DiagData** in the function block. as shown in the following table.

LK620 Diagnostic Information

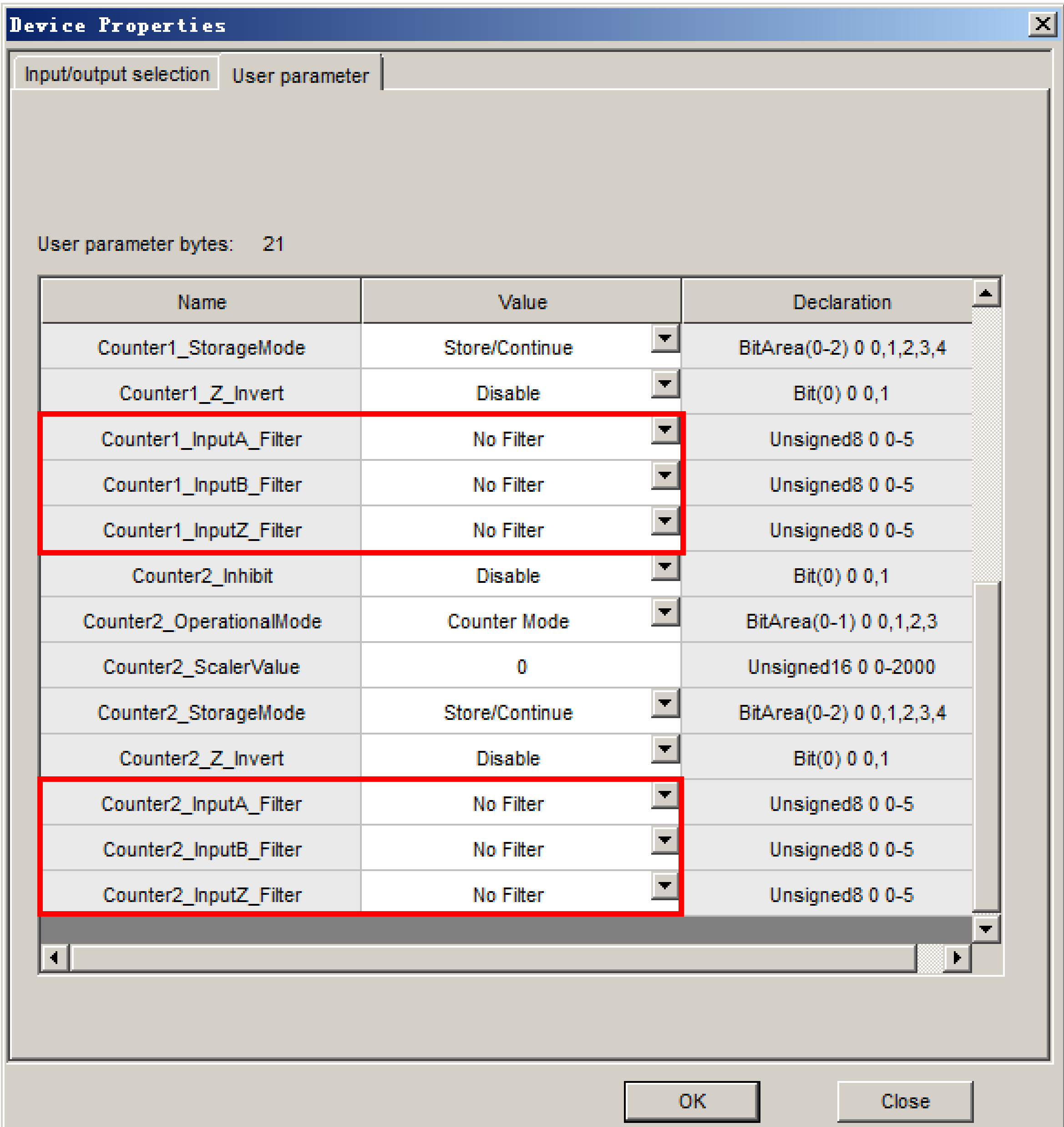
Device diagnosis	Value	Description
DiagData [0]:DiagData [1]	0x02:0x04	Field power loss
	0x02:0x00	Fault recovery or no diagnostic data

As an I / O slave of POWERLINK protocol, excepte above diagnostic information, refer to Overview of Diagnosis Information for more diagnostic information.

6.4.4.8 Debounce Filtering

The module has a debounce filter function, which can effectively filter out the edge jitter and clutter interference of the input pulse. It provides multi-file filter frequency of 460kHz, 230kHz, 115kHz, 57kHz and 28kHz. After selecting a filter frequency, the input signal greater than the frequency will be filtered out.

Whether or not to filter out the input signal of counter1, 2, is set by **Counter1_InputA (B/Z)_Filter** and **Counter2_InputA(B/Z)_Filter**. The default mode is no filter (No Filter).



LK620 Debounce Filter Enable Setting

6.4.4.9 Parameter Specifications

The user parameter is used to determine the module operation mode and is written into controller when downloading, and it is not read by every scan cycle. Each module parameter has a default value, which can be changed according to the engineering requirements. When the parameter value is changed, user parameter needs to be fully downloaded to take effect.

The length of the user parameter is 21 bytes. Details are shown in the following table.

LK620 User Parameter List

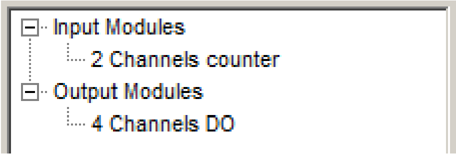
Parameter name	Parameter description
FieldPowerLossDetection	Field power loss detection or not =Enable (default) =Disable
DO1_FaultModeState DO2_FaultModeState DO3_FaultModeState DO4_FaultModeState	Output channel 1 ~ channel 4 fault mode output settings: =OFF, output channel disconnected (default) =ON, output channel closed =Depend on the counter value
Counter1_Inhibit	Inhibit counter 1 or not =Disable, counter 1 allowed (default) =Enable, counter 2 inhibited
Counter1_OperationalMode	Counter 1 operational mode =Counter mode (default) =Encoder×1 Mode =Encoder×4 Mode =Frequency Mode
Counter1_ScalerValue	Frequency time of Counter 1 is selectd from the range of 0 ~ 2000, 10ms is the reference unit. If it is not working in frequency mode, the value is set to 0
Counter1_StorageMode	Counter 1 storage mode =Store/Continue =Store/Wait/Resume =Store-Reset/Wait/Start =Store-Reset/Start =No Store Mode,no value stored
Counter1_Z_Invert	Counter1 Z value Invert enabled =Disable (default) =Enable
Counter1_InputA_Filter	Counter 1 input A Fliter set = No Filter (default) = 460kHz = 230kHz = 115kHz = 57kHz = 28kHz
Counter1_InputB_Filter	Counter 1 input B fliter set = No Filter (default) = 460kHz = 230kHz = 115kHz = 57kHz = 28kHz

Parameter name	Parameter description
Counter1_InputZ_Filter	Counter 1 input Z filter set = No Filter (default) = 460kHz = 230kHz = 115kHz = 57kHz = 28kHz
Counter2_Inhibit	Inhibit counter 2 or not =Disable, counter 2 allowed (default) =Enable, counter 2 inhibited
Counter2_OperationalMode	Counter 2 operating mode =Counter Mode (default) =Encoder×1 Mode =Encoder×4 Mode =Frequency Mode
Counter2_ScalerValue	Frequency time of Counter 2 is selectd from the range of 0 ~ 2000, 10ms is the reference unit. If it is not working under frequency mode, the value is set to 0
Counter2_StorageMode	Storage mode of counter 2 =Store/Continue =Store/Wait/Resume =Store-Reset/Wait/Start =Store-Reset/Start =No Store Mode, no value stored
Counter2_Z_Invert	Counter 2 Z value reversal enabled =Disable =Enable
Counter2_InputA_Filter	Counter 2 input A flitering set = No Filter (default) = 460kHz = 230kHz = 115kHz = 57kHz = 28kHz
Counter2_InputB_Filter	Counter 2 input B flitering set = No Filter (default) = 460kHz = 230kHz = 115kHz = 57kHz = 28kHz
Counter2_InputZ_Filter	Counter 2 input Z flitering set = No Filter (default) = 460kHz = 230kHz = 115kHz = 57kHz = 28kHz

6.4.4.10 Data Area

The data area stores data that is updated for each scan cycle and exists as a variable in the project.

The input data is the LK620 data uploaded to the controller's counter record, including the current count value, the stored value and the status backward read of output channel. The output data is the configuration and control commands issued by the controller to the LK620, including the preset value, the rollover value, the channel output force mark and the rollover clearing mark. When the project is running, the input data and the output data are updated once in each scan cycle.



LK620 Input and Output Data Area

6.4.4.10.1 Input data

As shown in the following table, the input data occupies 11 words (22 bytes). The output status of each output point is sent back to the controller (Output1to2_State, Output3to4_State), available for user programming.

LK620 Input Data Specification

Data type	Address offset(byte)	Data name	Data description
DWORD	0~3	Counter1_PresentValue	Counter 1 current count value(0~4,294,967,295)
DWORD	4~7	Counter1_StoredValue	Counter 1 stored count value(0~4,294,967,295)
DWORD	8~11	Counter2_PresentValue	Counter 2 current count value(0~4,294,967,295)
DWORD	12~15	Counter2_StoredValue	Counter 2 stored count value(0~4,294,967,295)
WORD	16	Output1to2_State	Bit0: output 1 status backward read =1, ON (channel closed) =0, OFF (channel disconnected) Bit1: output 2 status backward read =1, ON (channel closed) =0, OFF (channel disconnected)
	17	Output3to4_State	Bit0:output 3 status backward read =1, ON (channel closed) =0, OFF (channel disconnected) Bit1: output 4 status backward read =1, ON (channel closed) =0, OFF (channel disconnected)
WORD	18	Channel1_Z_State	Bit0:counter 1 Z status =0, low level =1, high level
	19	Channel2_Z_State	Bit0: counter 2 Z status =0, low level =1, high level
WORD	20	Counter1_Rolled	Bit0: counter 1 has reached the rollover value and rollover or not =0, not rollover =1, rollovered
	21	Counter2_Rolled	Bit0: counter 2 has reached the rollover value and rollovered

Data type	Address offset(byte)	Data name	Data description
			or not =0, not rollover =1, rollovered

6.4.4.10.2 Output data

As shown in the following table, the output data occupies 29 words (58 bytes).

LK620 Input and Output Data List

Data Type	Address Offset (byte)	Data Name	Instructions
DWORD	0~3	Counter1_PresetValue	Counter 1 preset value (0~4,294,967,295), the value must be less than the rollover value
DWORD	4~7	Counter1_RolloverValue	Counter 1 rollover value (0~4,294,967,295),frequency measurement mode, rollover value is 0.
WORD	8	Counter1_Reset	Counter 1 is reset and starts counting 0x00→0x01: Reset counter 1, counting from zero =0x01: Output channel OUT1 / OUT2 output OFF Other: no action
	9	Counter1_LoadPreset	counter 1 loading the preset value and starting counting or not 0x00→0x01: loading the preset value and counting from the preset value Other: no action
WORD	10	Output1_Control	Output 1 current output value is modified =0x00, output according to the counting result =0x02, change OUT1 output value to OFF =0x03, change OUT1 output value to ON
	11	Output2_Control	Output 2 current output value is modified =0x00, output according to the counting result =0x02, change OUT2 output value to OFF =0x03, change OUT2 output value to ON
DWORD	12~15	Output1_ON_Value	Output 1 Output ON trigger value (0~4,294,967,295)
DWORD	16~19	Output1_OFF_Value	Output 1 Output OFF trigger value (0~4,294,967,295)
DWORD	20~23	Output2_ON_Value	Output 2 Output ON trigger value (0~4,294,967,295)
DWORD	24~27	Output2_OFF_Value	Output 2 Output OFF trigger value (0~4,294,967,295)
DWORD	28~31	Counter2_PresetValue	Counter 2 preset value (0~4,294,967,295), the value must be less than the rollover value
DWORD	32~35	Counter2_RolloverValue	Counter 2 rollover value (0~4,294,967,295), frequency measurement mode, rollover value is 0.
WORD	36	Counter2_Reset	Counter 2 is reset and starts counting 0x00→0x01: Reset counter 2, counting from zero =0x01: Output channel OUT3 / OUT4 output OFF Other: no action
	37	Counter2_LoadPreset	counter 2 loading the preset value and starting counting or not 0x00→0x01: loading the preset value and counting from the preset value Other: no action
WORD	38	Output3_Control	Output 3 current output value is modified =0x00, outputing according to the result of the count =0x02 , change out 3 output value to OFF =0x03, change OUT 3 output value to ON
	39	Output4_Control	Output 4 The current output value is modified =0x00, outputing according to the result of the count =0x02, change OUT 4 output value to OFF

Data Type	Address Offset (byte)	Data Name	Instructions
			=0x03, change OUT 4 output value to ON
DWORD	40~43	Output3_ON_Value	Output 3 Output ON trigger value (0~4,294,967,295)
DWORD	44~47	Output3_OFF_Value	Output 3 Output OFF trigger value (0~4,294,967,295)
DWORD	48~51	Output4_ON_Value	Output 4 Output ON trigger value (0~4,294,967,295)
DWORD	52~55	Output4_OFF_Value	Output 4 Output OFF trigger value (0~4,294,967,295)
WORD	56	Counter1_ClearRolledFlag	Counter 1 clearing rollover mark 0x00→0x01: remove the rollover mark Other: no action
	57	Counter2_ClearRolledFlag	Counter 2 remove the rollover mark 0x00→0x01: remove the rollover mark Other: no action

LK620 module can be controlled and monitored by calling the function block ControlLK620

6.4.4.11 Technical specifications

LK620 2-Channel Counting Module	
System power supply	
Voltage	24VDC (-15%~+20%)
Power consumption	80mA@24VDC
counter	
Counter quantity	2
Counting range	0~4,294,967,295 (32 bits)
Counting error	±1counting code value
Counter input channel number	Each counter has 3-way voltage pulse signal (A, B, Z), a total of 6 pulse input
Counter output channel number	Each channel has 2-way source MOSFET output, a total of 4 DO output (OUT1 ~ OUT4)
Counter input (A1,B1,Z1,A2,B2,Z2)	
High level pulse rated voltage	24VDC
High level pulse (ON) voltage range	10~26.4VDC
High level pulse current range	2mA~7mA
Low level pulse (OFF) voltage range	0~2VDC
Low level pulse leakage current	250μA max.
Maximum input frequency	1MHz (Do not use debounce filtering)
Counter output (OUT1~OUT4)	
Output type	Source type
Output voltage range	10VDC~31.2VDC
Maximum output current	1.0A@10VDC~31.2VDC
Minimum load current	40mA/per point
Maximum on-state voltage drop	550mV
Maximum off-state leakage current	300μA/per point
Output delay time OFF→ON ON→OFF	 20μs (nomal), 50μs (longest) 60μs (nomal), 300μs (longest)

LK620 2-Channel Counting Module	
Over-current protection	Each current is protected by (Self-) Resettable fuse.
Reverse voltage protection	none, if the wiring is wrong, the output may be damaged
Isolation voltage	
Input channel and system	500VAC@1min., leakage current 5mA
Output channel and system	500VAC@1min., leakage current 5mA
Fault diagnosis and hot swapping	
Field power failure detection	Field power down: device diagnostic byte reports 0x04; recovery, reportes 0x00
Hot swapping	Yes
Comunication bus	
Protocol	Profibus-DP
Baud Rate	1.5Mbps, 500Kbps, 187.5Kbps , 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps adaptive
Medium	Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical characteristics	
The mixed pin	F2
Installation position	Expansion backplane
Module Dimension (W*H*D)	35mm×100mm×100mm
Enclosure protection class	IEC60529 IP20
Weight	185g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.4.5 LK621 2-channel SSI Absolute Value Encoder Module

LK621 is an encoder interface module, which is connected to the absolute value encoder through SSI interface and uploads the current position of the encoder to the controller through PROFIBUS-DP bus.

Support preset function (optional configuration). When the count value is equal to the preset value, the current encoder coordinate position is marked as preset value, and the count value will start counting from the preset value.

Support field power failure detection, remote alarm by reporting equipment diagnostic value, and field alarm by channel indicator. Among them, the report diagnosis supports two configuration modes, and the user can choose any one according to the situation.

Support encoder speed measurement (optional configuration), with 5 time intervals to adapt to different speed inputs and improve speed measurement accuracy. Generally, the faster the speed, the smaller the time interval; On the contrary, the slower the speed, the greater the time interval.

LK621 module can support baud rate: 1M, 500K, 200K (default), 100K (depending on whether the encoder supports it).

6.4.5.1 Basic Features

- SSI encoder (gray code / binary)
- Resolution of SSI encoder: 8 ~ 31bit
- Encoder speed measurement
- Encoder preset zeroing
- Field Power Loss Detection
- System-to-Field Isolation
- Support PROFIBUS-DP slave station protocol
- Supports hot swap

LK621 Module Schematic Diagram

6.4.5.2 Indicators

LK621 provides four indicators: RUN, COM, CH1 and CH2. Different state combinations of indicators represent the operation state of the module under different conditions.

Definition of LK621 Indicators

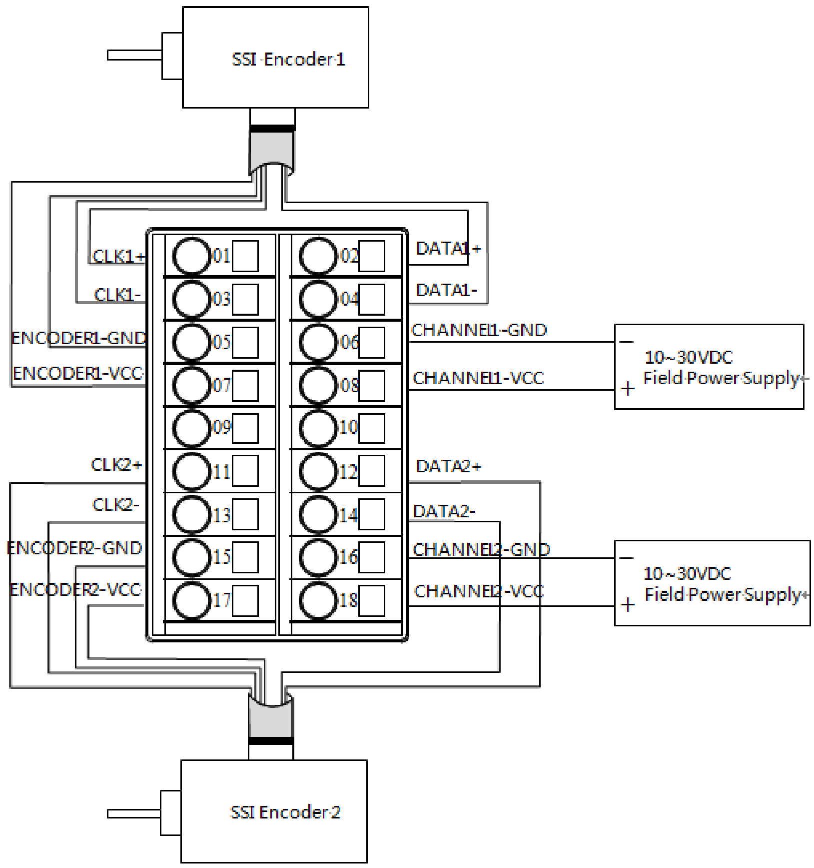
RUN（Module status indicator）	COM（Communication status indicator）	CH1（Channel status indicator）	CH2 Channel status indicator）	Description
Off	——	——	——	Module power loss or other serious faults
Flash	Off	Off	Off	The backplane of the module is not connected to the DP signal or the module hardware is faulty
Flash	Flash	——	——	DP communication is not normal
On	On	On	On	DP communication is normal; Channels 1 and Channels 2 are normal
On	Flash	On	Flash	DP communication is normal; Channel 1 is normal; Channel 2 is not powered on
On	Flash	Flash	On	DP communication is normal; Channel 2 is normal; Channel 1 is not powered on
On	Flash	Flash	Flash	DP communication is normal; Channels 1 and Channels 2 are not powered on

6.4.5.3 Wirings

LK621 is connected through the terminal under the backplane mounting slot. The corresponding relationship between each channel and the terminal is shown in the following table. The module has the function of field power failure detection. When the 10 ~ 30VDC field power supply is not connected, the cable is disconnected, the cable is in poor contact, and the encoder cannot be normally powered, the module will report the diagnosis information.

Definition of Backplane Terminal Wiring

Signal type		Encoder 1		Encoder 2	
		Signal definition	Terminal	Signal definition	Terminal
Output	CLK（Clock）	CLK1+	01	CLK2+	11
		CLK1-	03	CLK2-	13
	Encoder power supply（10~30VDC）	ENCODER1-GND	05	ENCODER2-GND	15
		ENCODER1-VCC	07	ENCODER2-VCC	17
Input	DATA	DATA1+	02	DATA2+	12
		DATA1-	04	DATA2-	14
	Channel power supply（10~30VDC）	CHANNEL1-GND	06	CHANNEL2-GND	16
		CHANNEL1-VCC	08	CHANNEL2-VCC	18



Connection between LK621 and SSI Encoder

6.4.5.4 Diagnosis

The diagnosis information of LK621 contains 3 bytes device diagnosis information and 3 bytes version information.

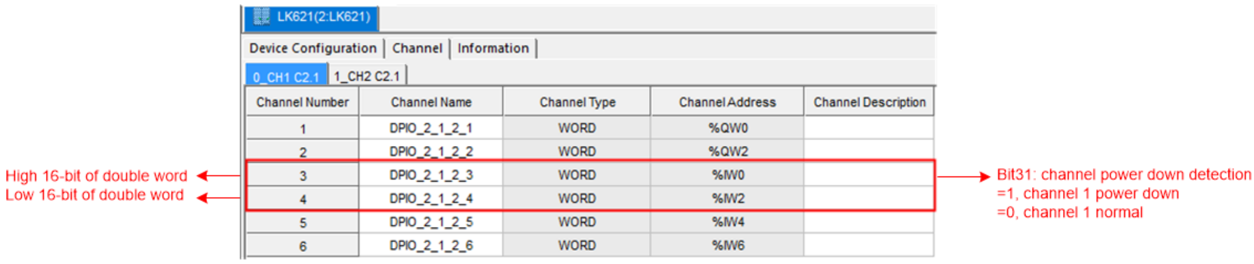
After calling the function block sysGetDPSlaveState (Get Diagnosis of DP Slave), the diagnosis data is saved into the output parameter DiagData of the function block.

LK621 Diagnosis Information Description

Diagnosis information	Diagnosis byte	Value
Device diagnosis information	DiagData[0]	0x03 Device diagnostic header byte
	DiagData[1]	Bit2: Field power supply 1 diagnosis 1: The power failure of the field power supply 0: No fault
	DiagData[2]	Bit2：Field power supply 2 diagnosis 1: The power failure of the field power supply 0: No fault
Version information	DiagData[3]	MCU version number: the version number of the first release is 1, and the version number of each subsequent upgrade is + 1
	DiagData[4]	FPGA version number: the version number of the first release is 1, and the

Diagnosis information	Diagnosis byte	Value
		version number of each subsequent upgrade is + 1
	DiagData[5]	Hardware version number: the version number of the first release is 1, and the version number of each subsequent upgrade is + 1

The field power failure can also be reported through the input data. The user can also perform power failure diagnosis by reading the power failure diagnosis bit (the highest bit bit31) in the input data, as shown in the following figure.

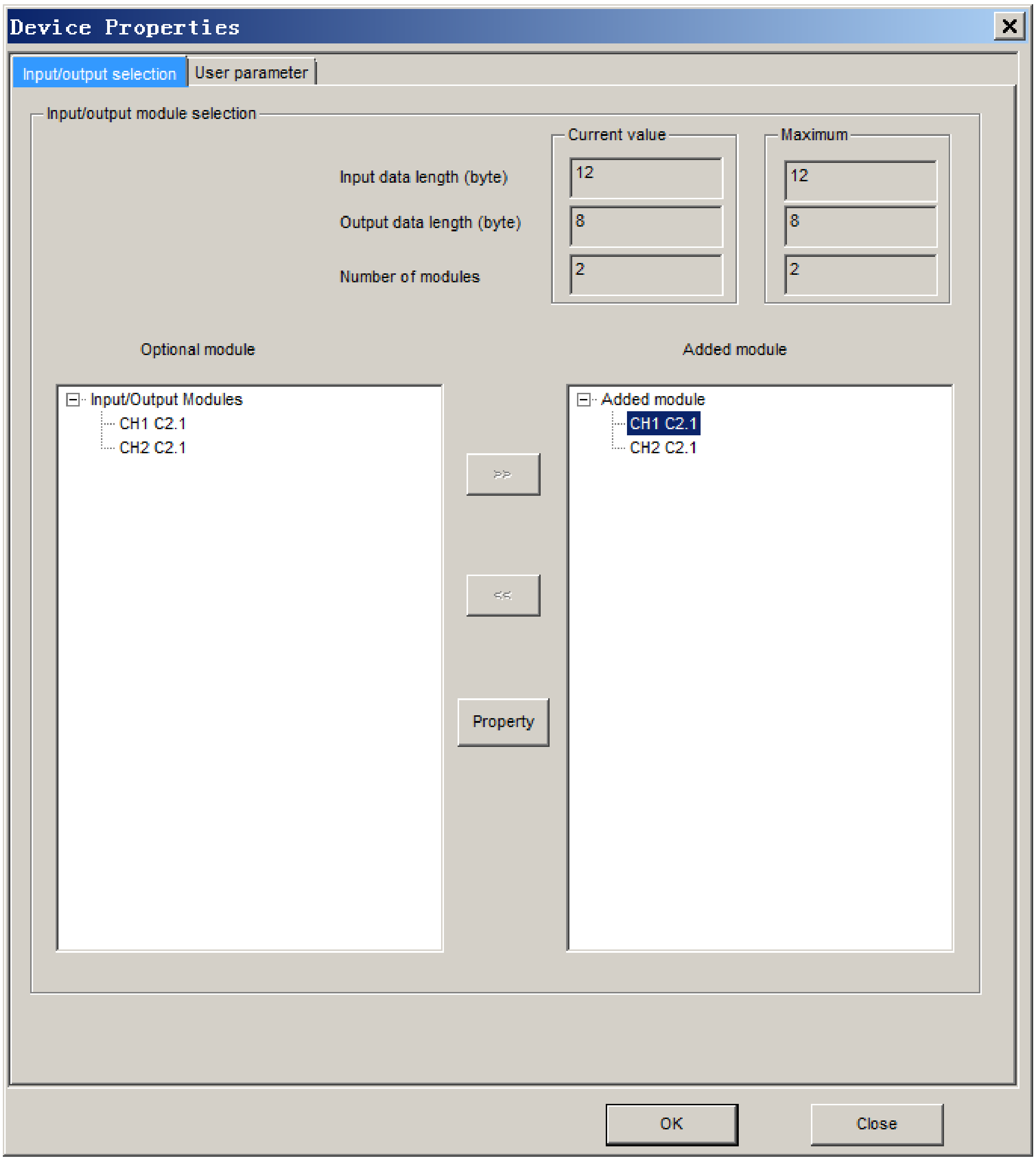


Power Failure Diagnosis Bit in Input Data

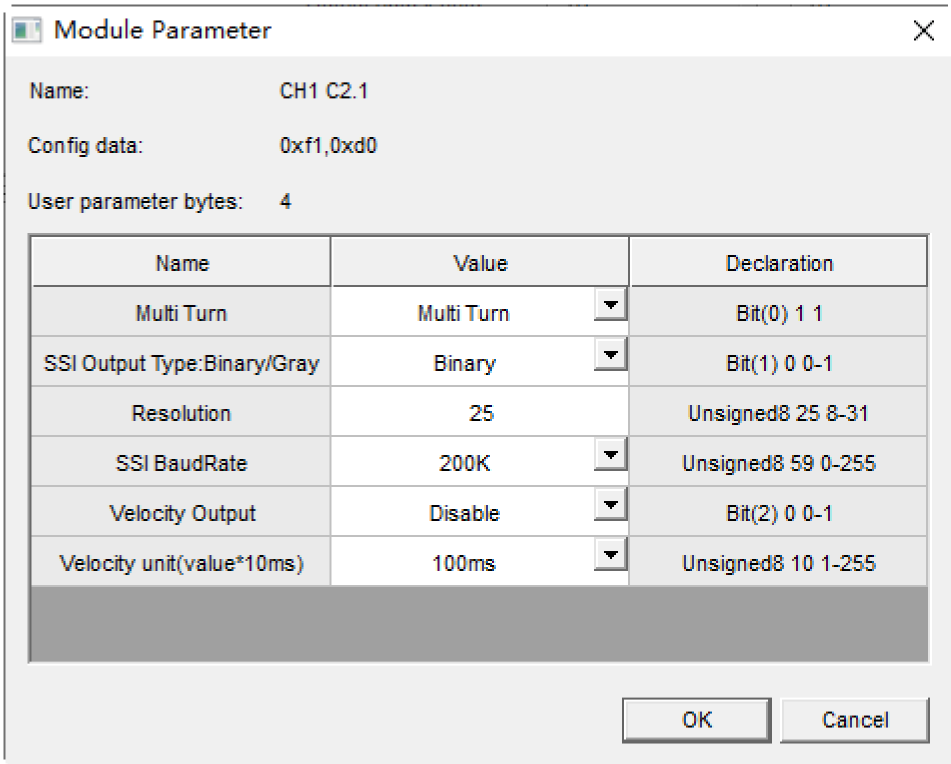
6.4.5.5 Parameters

LK621 module needs to configure correct channel parameters before establishing communication connection with controller and encoder.

Module channels are added by default. You need to select the corresponding channel for parameter configuration. As shown in the following figure, first select the channel to be set in the right box, and then click "Property" button. The parameter setting dialog box of the corresponding channel will pop up.



Channel Configuration Interface



Channel Parameter Setting Dialog Box

The description of channel parameters is shown in the following table. It should be noted that the parameter value must be consistent with the parameter index of the SSI encoder connected to the channel.

Channel Parameter Definition

Parameter Name	Parameter Meaning	Parameter Value
Multi Turn	SSI encoder type, default multi turn encoder	Multi Turn (default value)
SSI Output Type: Binary/Gray	Output code of SSI encoder	=Binary (default value) =Gray
Resolution	Resolution of SSI encoder	8~31bit, default value is 25bit
SSI Baud Rate	Communication baud rate of SSI encoder	=1M =500K =200K (default value) =100K
Velocity Output	Speed measurement function enable	=Disable (default value) =Enable
Velocity Unit （value*10ms）	Selection of time interval for speed measurement; After enabling the speed measurement function, the module reports the coordinate difference of the encoder within the time interval	=10ms =20ms =50ms =100ms (default value) =1000ms

6.4.5.6 Data Area

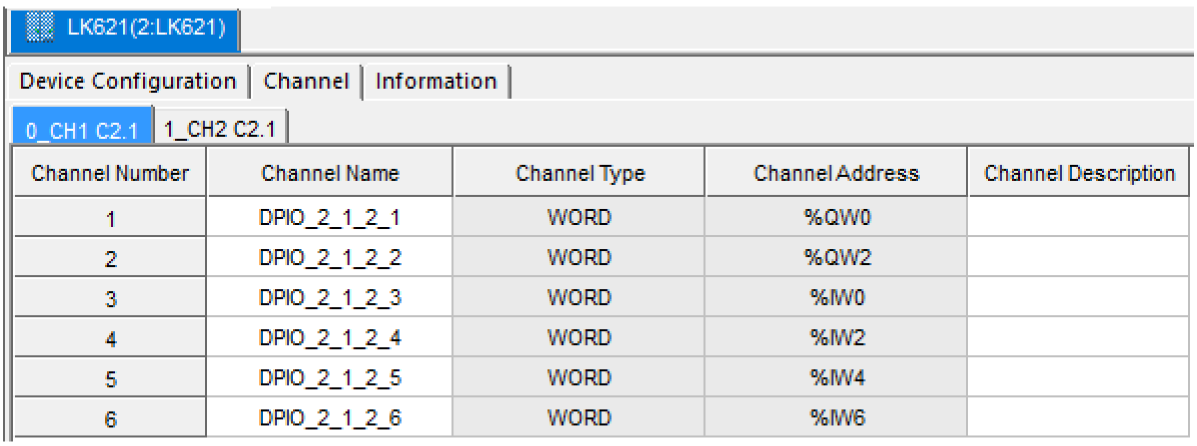
LK621 occupies 6 words per channel, including 2 words of output data and 4 words of input data. When the project is running, the input data and output data are updated once every scanning cycle.

As shown in the figure, input data (IW) is various data uploaded to the controller by LK621 module, including:

- One double word data: power loss detection diagnosis bit (bit31) + encoder coordinate data (bit0 ~ 30).
- One double word data: speed measurement data - encoder coordinate difference. This data is reported (0 ~ 2147483647) after the speed measurement function is enabled. It is used to record the encoder coordinate difference within a certain time interval. The time interval is set in the channel parameters.

The output data (QW) is sent from the controller to the LK621 module, including:

- One double word data: preset function enable bit (bit31) + preset value (bit0 ~ 30). After the preset function is enabled, set the current coordinate as the preset value.



Channel Number	Channel Name	Channel Type	Channel Address	Channel Description
1	DPIO_2_1_2_1	WORD	%QW0	
2	DPIO_2_1_2_2	WORD	%QW2	
3	DPIO_2_1_2_3	WORD	%IW0	
4	DPIO_2_1_2_4	WORD	%IW2	
5	DPIO_2_1_2_5	WORD	%IW4	
6	DPIO_2_1_2_6	WORD	%IW6	

LK621 Channel Data

Channel Data List

Channel	Area definition	Data type	Data bit	Meaning
Channel 1	Output data (%QW)	WORD	Bit16~Bit31	Double word data Bit0~Bit30: Preset value of channel 1, The preset value range is related to the encoder resolution, see Configure_Preset_Value Bit31: Channel 1 preset function enabled, = 1: enabled, = 0: disenabled
		WORD	Bit0~Bit15	
	Input data (%IW)	WORD	Bit16~Bit31	Double word data Bit0~Bit30: Input data of channel 1, counting range 0~2147483647 Bit31: Channel 1 power down detection signal, = 1: channel power down, = 0: channel normal
		WORD	Bit0~Bit15	
		WORD	Bit16~Bit31	Double word data Speed measurement of channel 1, 0~2147483647, the data is the code value difference within the time interval. The encoder speed is calculated from this data, and the formula is as follows: $\text{Angular velocity}=\frac{\text{Channel value}\times 360°}{\text{Single-ring code value}\times\text{Time interval}}$
		WORD	Bit0~Bit15	

Channel	Area definition	Data type	Data bit	Meaning
				(Unit: ° /ms) Channel value: It is code value difference within time interval Single-ring code value: The code value corresponding to one ring of the encoder is determined according to the actual connected encoder specification Time interval: Set by user parameter "Velocity Unit"
Channel 2	Output data (%QW)	WORD	Bit16~Bit31	Double word data
		WORD	Bit0~Bit15	Bit0~Bit30: Preset value of channel 2, The preset value range is related to the encoder resolution, see Configure_Preset_Value Bit31: Channel 2 preset function enabled, = 1: enabled, = 0: disenabled
	Input data (%IW)	WORD	Bit16~Bit31	Double word data
		WORD	Bit0~Bit15	Bit0~Bit30: Input data of channel 2, counting range 0~2147483647 Bit31: Channel 2 power down detection signal, = 1: channel power down, = 0: channel normal
		WORD	Bit16~Bit31	Double word data
		WORD	Bit0~Bit15	Speed measurement of channel 2, 0~2147483647, the data is the code value difference within the time interval. The encoder speed is calculated from this data, and the formula is as follows: $\text{Angular velocity}=\frac{\text{Channel value}\times 360°}{\text{Single-ring code value}\times\text{Time interval}}$ *(Unit: ° /ms)* Channel value: It is code value difference within time interval Single-ring code value: The code value corresponding to one ring of the encoder is determined according to the actual connected encoder specification Time interval: Set by user parameter "Velocity Unit"

6.4.5.7 Configure Preset Value

LK621 supports preset value. You can mark an encoder position to any value within preset value range and start counting again. You need to enable the preset function and write the preset value at the same time. Once the preset function is enabled, it will always be effective. At this time, the count value = preset value, and the current encoder coordinate position is marked as preset value. When the enable is turned off, the count value will start counting from the preset value.

The preset value range is related to the encoder resolution. The LK621 supports a resolution of 8 bits to 31 bits. If the resolution is 8 bits, the preset value range is 0 to 2^8. If the resolution is 25 bits, the preset value range is 0 to 2^{25}. If the resolution is 31 bits, the preset value range is 0 to 2147483647.

The most common function of preset value setting is to clear the count. You can mark an encoder position as zero, and the count value will be counted again from zero.

The preset value function can also set a position as a non zero point. When the preset value is set as a non zero point, the current position will be marked as the corresponding preset value after enabling. As shown in the following figure, the current count value displays 5461. If you need to recount with100 as a new zero point, please follow the following steps:

LK621(2:LK621)

Device Configuration | Channel | Information

0_CH1 C2.1 | 1_CH2 C2.1

Channel Number	Channel Name	Channel Type	Online Value	Channel Address	Channel Description
1	DPIO_2_1_2_1_1	WORD	0	%QW0	
2	DPIO_2_1_2_2_1	WORD	0	%QW2	
3	DPIO_2_1_2_3_1	WORD	0	%IW0	
4	DPIO_2_1_2_4_1	WORD	5461	%IW2	
5	DPIO_2_1_2_5_1	WORD	0	%IW4	
6	DPIO_2_1_2_6_1	WORD	0	%IW6	

Preset Value Setting Example

(1) %QW2 enter the preset value of 100.

LK621(2:LK621)

Device Configuration | Channel | Information

0_CH1 C2.1 | 1_CH2 C2.1

Channel Number	Channel Name	Channel Type	Online Value	Channel Address	Channel Description
1	DPIO_2_1_2_1_1	WORD	0	%QW0	
2	DPIO_2_1_2_2_1	WORD	100	%QW2	
3	DPIO_2_1_2_3_1	WORD	0	%IW0	
4	DPIO_2_1_2_4_1	WORD	5461	%IW2	
5	DPIO_2_1_2_5_1	WORD	0	%IW4	
6	DPIO_2_1_2_6_1	WORD	0	%IW6	

Set Preset Value

(2) Set the enable to 0, that is,% QW0 to 32768. At this time, the count value (% IW2) = the preset value (% QW2) = 100. If the enable bit is not turned off, the count value is always equal to the preset value.

LK621(2:LK621)

Device Configuration | Channel | Information

0_CH1 C2.1 | 1_CH2 C2.1

Channel Number	Channel Name	Channel Type	Online Value	Channel Address	Channel Description
1	DPIO_2_1_2_1_1	WORD	32768	%QW0	
2	DPIO_2_1_2_2_1	WORD	100	%QW2	
3	DPIO_2_1_2_3_1	WORD	0	%IW0	
4	DPIO_2_1_2_4_1	WORD	100	%IW2	
5	DPIO_2_1_2_5_1	WORD	0	%IW4	
6	DPIO_2_1_2_6_1	WORD	0	%IW6	

Set Enable

(3) Enable is 0, the encoder starts counting from 100.

6.4.5.8 Technical Specifications

LK621 2-channel SSI absolute value encoder module					
Channel performance index					
Number of channels	2 channel				
Signal type	485 differential signal				
Communication protocol	SSI				
Baud rate	1M, 500K, 200K (efault), 100K (Depending on whether the encoder supports)				
Length of communication cable	Baud rate	1M	500K	200K	100K
	Length	<20m	<70m	<180m	<350m
Encoder types supported	SSI interface Bit width: 8bis~31bits Code：gray/binaray				
Inter channel isolation voltage	500V@1min, leakage current 5mA				
Channel power supply	10~30V DC				
Encoder power supply	10~30V DC				
Field power failure detection	Remote alarm by reporting equipment diagnostic value, and on-site alarm by channel indicator				
Coding compliance	Absolute pair encoder 24V model with standard SSI interface (tolerance: 10-30VDC)				
Support preset function	When the count value is equal to the preset value, and the current encoder coordinate position is marked as preset value. Generally, preset value is set to 0 , the encoder returns to zero				
Support encoder speed measurement	Max: 800rps, min: 0.001rps (for 4096 * 8192 encoder); There are 5 time intervals to adapt to different speed inputs and improve speed measurement accuracy.				
Channel power consumption (max)	40mA@24VDC，Encoder not included				
Power supply					
Input voltage	24V DC（-15% ~ +20%）				
Power consumption（max）	150mA@24VDC				
Communication					
Protocol	Profibus-DP				
Dual network redundancy	Supported				
Diagnosis — Equipment diagnosis	Supported				
Communication rate	12Mbps, 6Mbps, 3Mbps, 1.5Mbps, 500kbps, 187.5kbps, 93.75kbps, 45.45kbps, 19.2kbps, 9.6kbps				
Physical Property					
Installation position	I/O slot in expansion backplane				
Module Dimension (W*H*D)	35mm*100mm*100mm				

6.4.6 LK622 6-channel High Precision Frequency Measurement Module

LK622 6-channel high-precision frequency measurement module realizes the frequency measurement function in industrial control applications. It can measure the frequency of signals from 1Hz to 100KHz, and the response time of signal measurement is 40ms.

6.4.6.1 Basic Features

- Frequency measurement, 45-55Hz, accuracy: 0.001Hz
- Field Power Loss Detection
- System-to-Field Isolation
- Support PROFIBUS-DP slave station protocol
- Supports hot swap

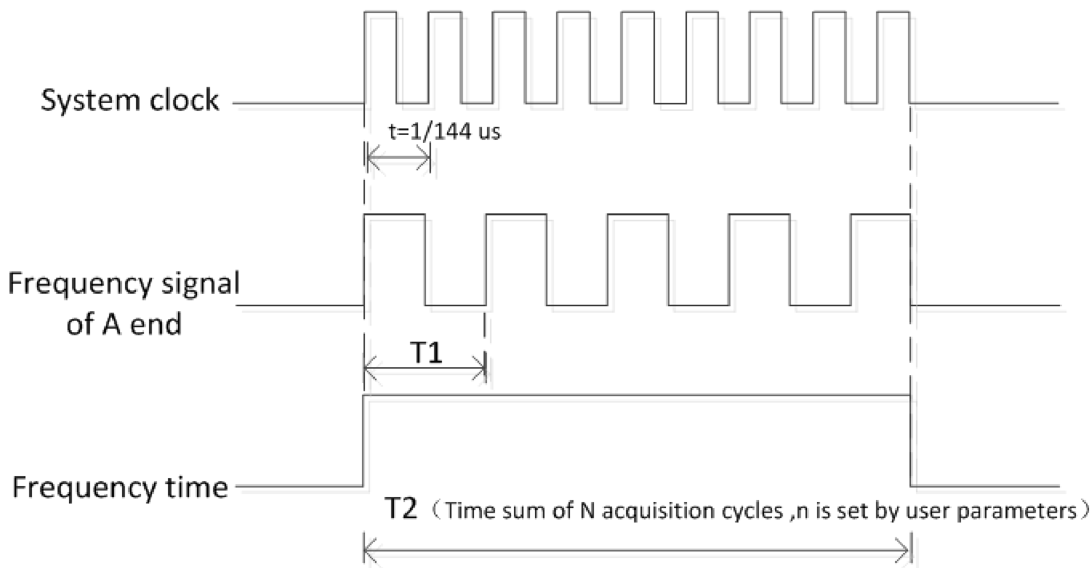
LK622 Module Schematic Diagram

6.4.6.2 Frequency Measurement Method

During frequency measurement, frequency signal is input at terminal A. The counter records the number of system clocks of the frequency signal at terminal A in N cycles and reports it to the controller as the current count value. The total time of N cycles is calculated by the count value and the cycle time of the system clock. N is set by the user parameter, ranging from 1 to 20, and the pulse frequency is calculated by the frequency measurement time and the number of cycles.

- Cycle time of system clock: t is shown in Figure below, one cycle is 1 / 144 microseconds.
- Frequency count value: the count value reported to the controller, that is, the channel value.
- Time sum of N cycles: T2 is shown in Figure below, T2 = frequency count value (channel value) × t。

- Frequency signal cycle time: T1 is shown in Figure below, T1 = T2 / N, so as to calculate the pulse frequency.



Frequency Measurement Method

6.4.6.3 Indicators

LK622 provides one module status indicator and six channel indicators. Different status combinations of the indicator represent the operation status of the module under different conditions.

Definition of LK622 Indicators

RUN (Module status indicator)	CHn (Channel status indicator)	Description
On	On	Channel input signal is within the frequency range
On	Off	Channel input signal is not within the frequency range
Flash	——	Module offline
Off	——	The module is not powered on or the module is broken

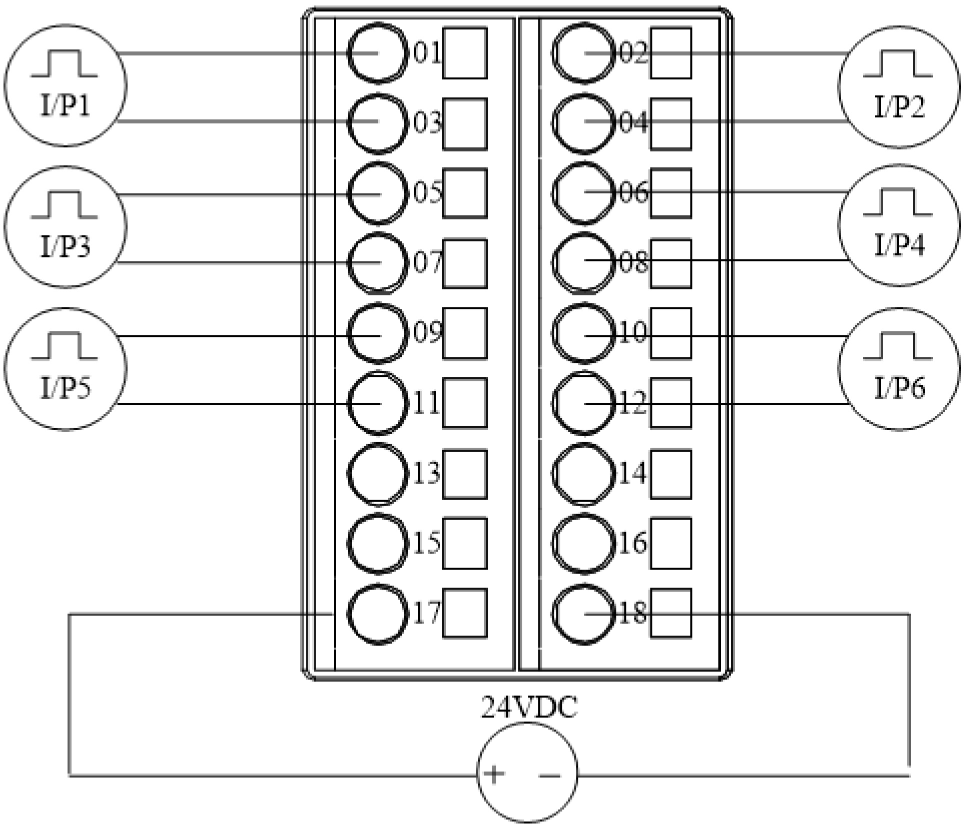
6.4.6.4 Wirings

See the following table for the definition of LK622 backplane wiring terminal.

Definition of Backplane Terminal Wiring

Channel	Terminal number	
	Voltage input positive terminal	Voltage input negative terminal
Channel 1	01	03
Channel 2	02	04
Channel 3	05	07
Channel 4	06	08
Channel 5	09	11

Channel	Terminal number	
	Voltage input positive terminal	Voltage input negative terminal
Channel 6	10	12
24VDC Channel power supply	Positive end of power supply	Negative end of power supply
	17	18



Connection between LK622 and Pulse Generator / Encoder

6.4.6.5 Diagnosis

The diagnosis information of LK622 contains 2 bytes device diagnosis information and 3 bytes version information.

After calling the function block sysGetDPSlaveState (Get Diagnosis of DP Slave), the diagnosis data is saved into the output parameter DiagData of the function block.

LK622 Diagnosis Information Description

Diagnosis information	Diagnosis byte	Value
Device diagnosis information	DiagData[0]	0x02: Device diagnostic header byte
	DiagData[1]	Bit2: Switching value field power failure 1: Power failure 0: Power supply is normal
Version information	DiagData[2]	MCU version number: the version number of the first release is 1, and the

Diagnosis information	Diagnosis byte	Value
		version number of each subsequent upgrade is + 1
	DiagData[3]	FPGA version number: the version number of the first release is 1, and the version number of each subsequent upgrade is + 1
	DiagData[4]	Hardware version number: the version number of the first release is 1, and the version number of each subsequent upgrade is + 1

6.4.6.6 Parameters

The [User parameter] is used to set the operation mode of the module. The controller module written when downloading the project may not be read in each scanning period. Each parameter has a default value, able to modify the parameter value according to the project requirements. After modifying the parameter value, it requires full download before taking effect.

See the following table for LK622 user parameters.

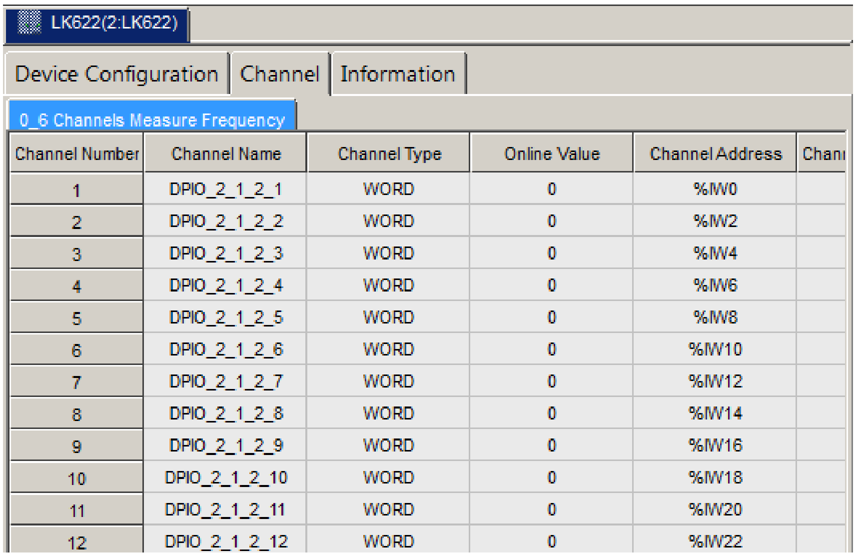
LK622 User Parameter Definition

Parameter name	Parameter meaning	Parameter meaning
CHn State(n=1~6)	Channel status	Enable Disable
CHn AcquisitionCycle	Number of acquisition cycles	Settable range: 1 ~ 20 The channel collects frequency signals. When the number of acquisition cycles is 1, cycle value is: channel value *(1 / 144). When the number of acquisition cycles is set to N, the time value reported by the channel is the total time of N cycles, then cycle value is: channel value / 144N

6.4.6.7 Data Area

LK622 input data occupies 12 words, and 6 channels of data are collected respectively, each channel occupies 2 words.

The channel reports the total time of N acquisition cycles (N is set by user parameters). Taking 1 / 144 microseconds as the reference time unit, the channel collect the number of reference times in N cycle times, then the sum of acquisition times reported by each channel = channel value * (1 / 144) microseconds. If the acquisition cycle is set to N, the time of one cycle = channel value / (144N). Then frequency = 1 / cycle time.



LK622(2:LK622)

Device Configuration | Channel | Information

0_6 Channels Measure Frequency

Channel Number	Channel Name	Channel Type	Online Value	Channel Address	Chan
1	DPIO_2_1_2_1	WORD	0	%IW0	
2	DPIO_2_1_2_2	WORD	0	%IW2	
3	DPIO_2_1_2_3	WORD	0	%IW4	
4	DPIO_2_1_2_4	WORD	0	%IW6	
5	DPIO_2_1_2_5	WORD	0	%IW8	
6	DPIO_2_1_2_6	WORD	0	%IW10	
7	DPIO_2_1_2_7	WORD	0	%IW12	
8	DPIO_2_1_2_8	WORD	0	%IW14	
9	DPIO_2_1_2_9	WORD	0	%IW16	
10	DPIO_2_1_2_10	WORD	0	%IW18	
11	DPIO_2_1_2_11	WORD	0	%IW20	
12	DPIO_2_1_2_12	WORD	0	%IW22	

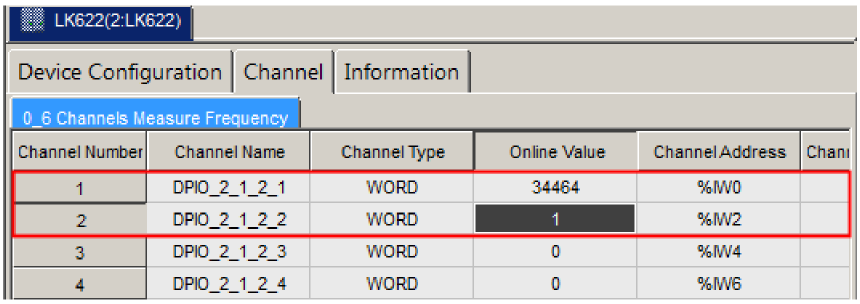
LK622 Channel Data

Channel Data List

Area definition	Data type	Data bit	Meaning
Input data (%IW)	WORD	Bit0~Bit15	Input data from channel 1 to channel 6, and each channel occupies 2 word. The first word is low 16 bits and the second word is high 16 bits

Example: the data words of channel 1 are% IW0 and% IW2. Wherein, the current value of %IW0 is 34464, and the current value of %IW2 is 1. The number of acquisition cycles set in the configuration is N = 5

Then the data value of channel 1 is a 32-bit data value composed of% IW2 as high 16 bits and%IW0 as low 16 bits. The channel value = 34464 + 65536 = 100000, the total of reported acquisition cycles = 100000 * (1 / 144) microseconds, the time of one cycle = 100000 / (144 * 5) microseconds = 1 / 7200 seconds, and the frequency = 7200Hz.



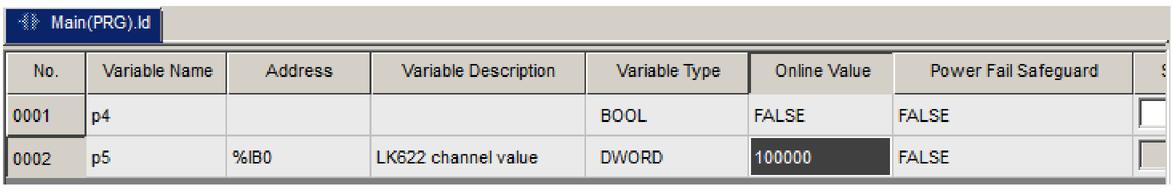
LK622(2:LK622)

Device Configuration | Channel | Information

0_6 Channels Measure Frequency

Channel Number	Channel Name	Channel Type	Online Value	Channel Address	Chan
1	DPIO_2_1_2_1	WORD	34464	%IW0	
2	DPIO_2_1_2_2	WORD	1	%IW2	
3	DPIO_2_1_2_3	WORD	0	%IW4	
4	DPIO_2_1_2_4	WORD	0	%IW6	

Online Value of High and Low Words of Channel 1



Main(PRG).ld

No.	Variable Name	Address	Variable Description	Variable Type	Online Value	Power Fail Safeguard	S
0001	p4			BOOL	FALSE	FALSE	
0002	p5	%IB0	LK622 channel value	DWORD	100000	FALSE	

Data Value of Channel 1

6.4.6.8 Technical Specifications

LK622 6 Channel high precision frequency measurement module	
Backplane power supply	
Supply voltage	24V DC±10%
Power dissipation	80mA @24V dc（Max）
I/O point	
Number of channels	6
Switching value input	
Working voltage	24V DC
ON voltage range	10~26.4V DC
Input ON current Ordinary Minimum	 7 mA 2 mA
Maximum OFF voltage	2V
Maximum OFF leakage current	250 μA
Maximum input frequency	1 MHz (when input filtering is not used)
Counter	
Frequency measurement range	1Hz-100KHz (including: 45-55Hz, accuracy: 0.001Hz.. The response time of signal measurement shall not exceed 40ms)
Frequency measurement accuracy	±75Hz
Isolation voltage	
Channel to system	1min at 1000V DC / 1min at 500V DC (effective value)
Communication	
Protocol	Profibus-DP
Dual network redundancy	Supported
Communication rate	9.6Kbps, 19.2Kbps, 31.25Kbps, 45.45Kbps, 93.75Kbps, 187. 5Kbps, 500Kbps, 1.5Mbps
Physical Property	
Installation position	I/O slot in expansion backplane
Module Dimension (W*H*D)	35mm*100mm*100mm

6.4.7 LK631 24VDC 14-channel SOE Module

6.4.7.1 Basic Features

- 14-contact leaking type input
- Field supply voltage: 20.4~28.8 VDC
- Support SOE events
- Support NTP and IRIG-B timing
- Isolation between field and system
- Support channel line broken detection
- Support field power loss detection

- Support channel overvoltage protection
- Support the Profibus-DP slave station protocol
- Hot swapping

6.4.7.2 SOE Features

- Event resolution: 1 ms
- Support NTP timing and IRIG-B timing
- Event storage: 3072
- Support SOE event storage overlimit alarm

LK631 Module Schematic Diagram

6.4.7.3 Operating Principle

LK631 module adopts leakage type input, and collects 14 on-off switch signal. When the switch is closed, current flows into the input channel. When the input voltage is 15V-30V, the channel collects the high level; when the voltage is less than 5V, the channel collects the low level. When the collected digital signal jumps from high to low or from low to high, the module will record a SOE event. When the number of SOE event storage exceeds 70% of the maximum storage, an overlimit warning will be reported. When the number of SOE event storage exceeds 100% of the maximum storage, an overflow warning will be reported.

SOE events can be cleared by full down loading, cold reset, calling external library and changing module slot.

The module calibrates SOE timing accuracy through the NTP source and IRIG-B source, and the time calibration mode can be configured in AutoTink software. For NTP timing, LK631 module calibrates time through the NTP source from the controller. For IRIG-B timing, the module calibrates time through the external clock source.

6.4.7.4 Indicators

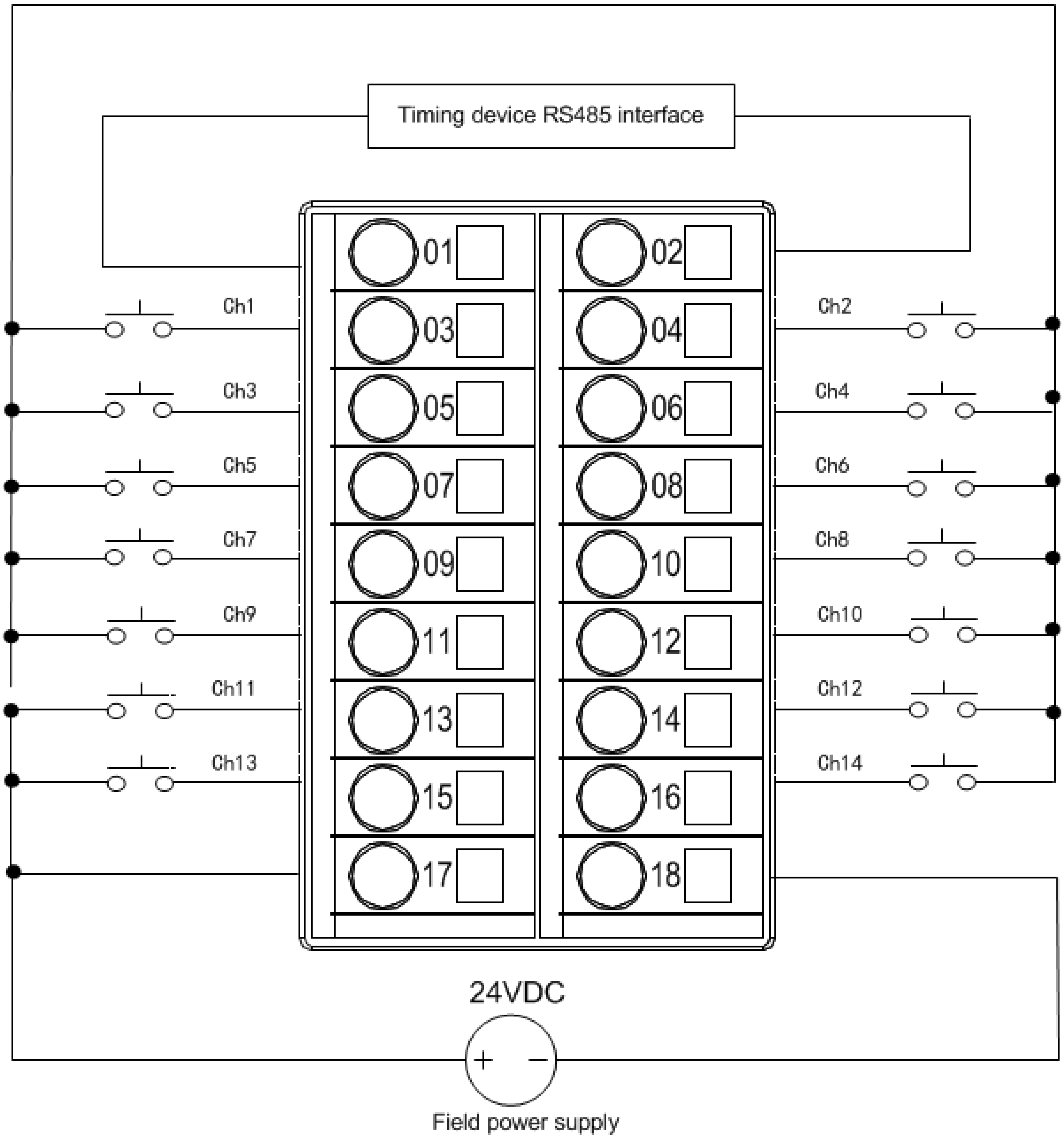
Definition of LK631 Indicators

Name	Color	Status	Description
RUN indicator	Green	On	The communication is established, and the module works well
		Flash	The communication is not established or incorrect
		Off	The module is not powered on or power supply is abnormal
ERR indicator	Red	On	Module has a fault
		Off	The module is working properly
T timing indicator	Green	On	The module is synchronized with the IRIG-B timing source
		Off	No timing source
01~14 channel indicator	Yellow	On	Channel is normal with high level
		Off	Channel is normal with low level
	Red	On	The channel is line broken
		Off	The channel is normal

6.4.7.5 Wirings

LK631 receives the 14-channel leakage type input signal and a timing signal. The 14-channel circuit supply is provided by the external 24 VDC power supply. To ensure the isolation between the field and the system, the field 24 VDC power supply shall be configured separately and cannot be commonly used as the power supply for the backplane.

LK631 is installed on the extension backplane, and input signal is connected through the corresponding terminals under the backplane installation slot.



LK631 Terminal Wiring Diagram

Following points need attention during wiring:

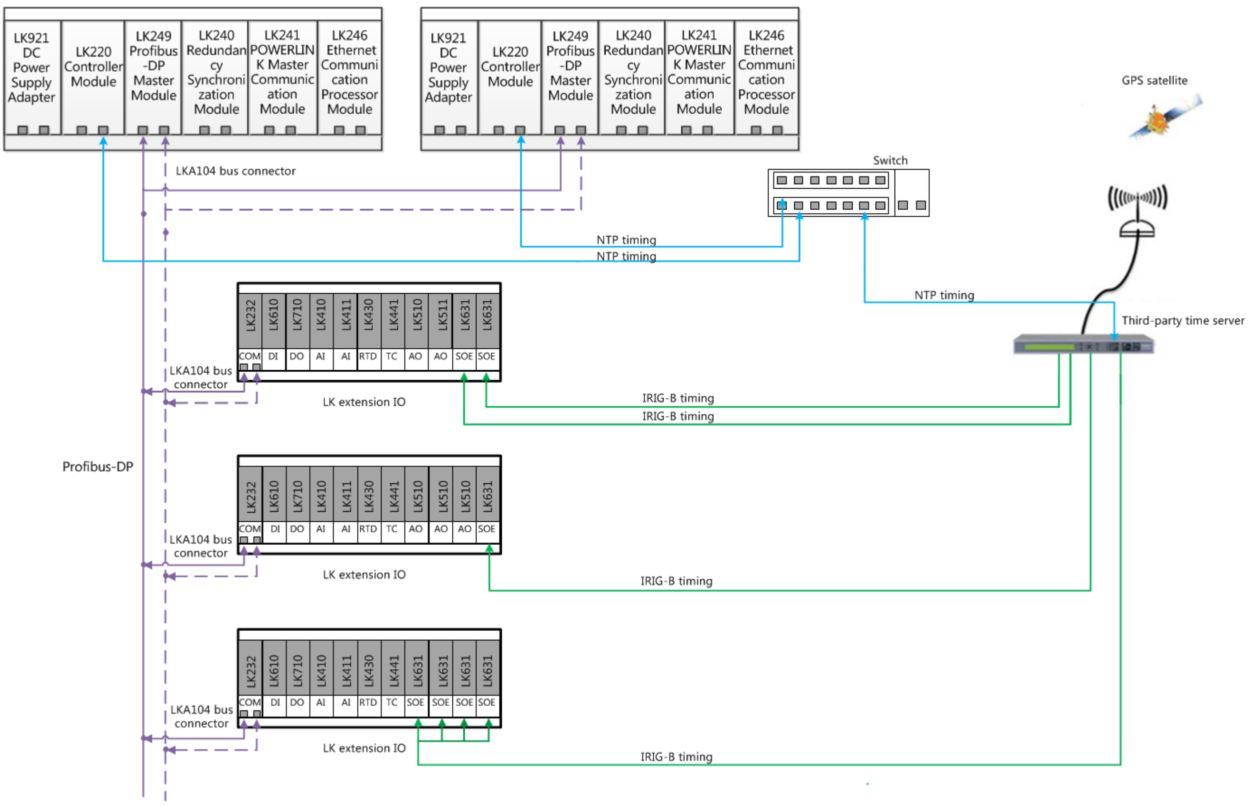
- It is required to connect a separate 24 VDC field power supply externally for LK631 (that is: the field power supply cannot use the 24 VDC power supply on the backplane). Only in this way can ensure the electrical isolation between the field and the system.
- The 14 channels use the 24 VDC field power supply commonly.
- Terminals 01 ~ 02 are respectively connected with RS485_ A and RS485_ B of timing source device.
- Terminals 03~16 are digital input terminals for Channels 1~14.

- Terminal 17 is the diagnosis input of the field power supply, connected to the positive terminal of the field power supply and used for field power loss detection.
- Terminal 18 is the negative terminal of the field power input, and also the common terminal inside the module for Channels 03~16.
- When collecting the broken wire diagnosis function, you need to enable the channel diagnosis function, and connect a resistance at both ends of the user's switch signal, with the resistance range of 39K Ω ~ 43K Ω @ 24VDC.

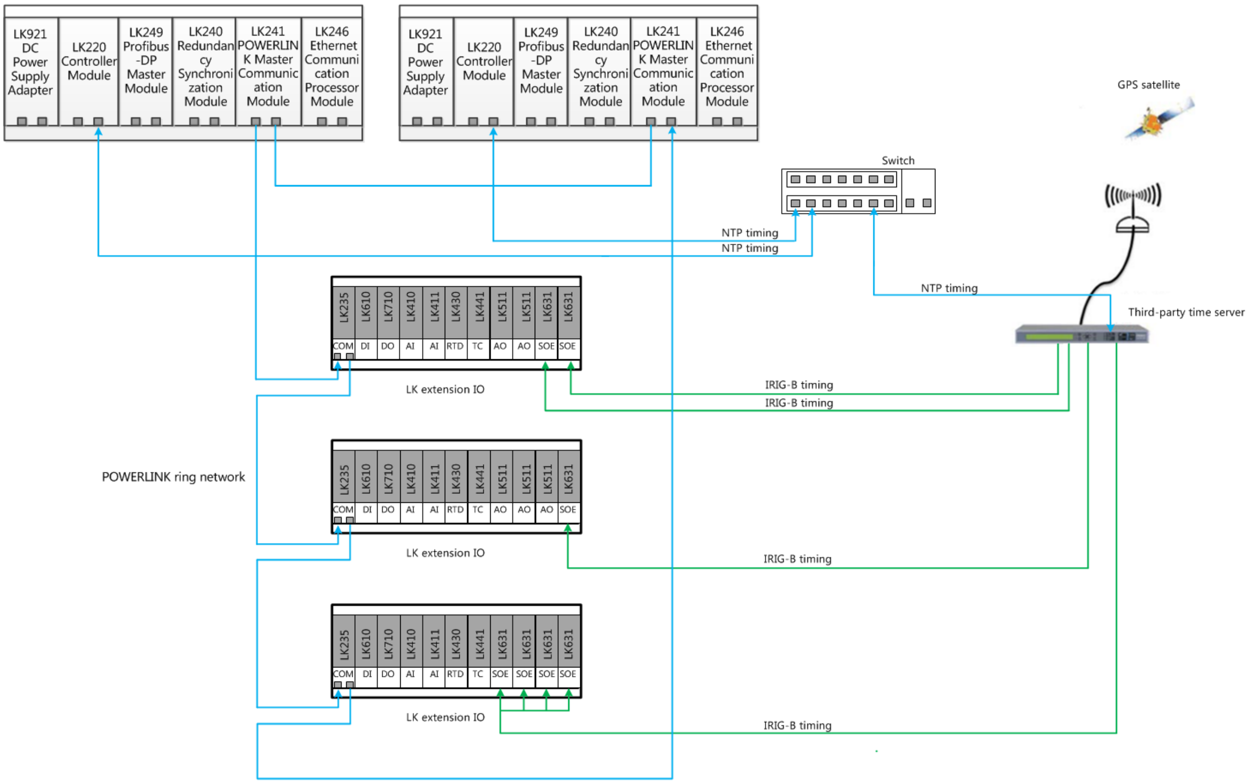
6.4.7.6 Timing Topology Structure

Through IRIG-B timing, LK631 module needs to connect with external timing source device, and the module time accuracy is calibrated by IRIG-B source. Through NTP timing, the NTP of controller is sent to LK631 module through Profibus-DP bus or POWERLINK bus. During the module timing, the timing mode is selected by programming software.

The network topology supports star connection and daisy chain connection, the schematic diagram of timing source connection is shown below.



Schematic Diagram of Timing Source Connection (Profibus-DP)



Schematic Diagram of Timing Source Connection (POWERLINK)

6.4.7.7 Diagnosis

The diagnosis information of LK631 contains 56 bytes. wherein 3 bytes are device related diagnosis, 2 bytes are identification diagnosis, 42 bytes are channel diagnosis, 6 bytes are SOE alarm time and 3 bytes are version information. LK631 has 14 channels, each channel has 3 bytes diagnosis information.

After calling the function block sysGetDPSlaveStateExt (Get Diagnosis of DP Slave), the diagnosis data is saved into the output parameter **DiagData** of the function block.

Call function block getLK631SoeAlarm(Read LK631 FRAM Alarm Info Module Information) to view detailed information of SOE alarm diagnosis.

Diagnosis information of LK631

Diagnosis information	Diagnosis byte	Value
Device related diagnosis	DiagData[0]	0x03: Head-byte of device diagnosis
	DiagData[1]	Bit0: Chip fault diagnosis 1: Chip failure 0: No fault
		Bit1: SOE 70% alarm diagnosis 1: Has a 70% alarm diagnosis 0: No 70% alarm
		Bit2: SOE 100% alarm diagnosis 1: Has a 100% alarm diagnosis 0: No100% alarm

Diagnosis information	Diagnosis byte	Value
	DiagData[2]	Bit0: Channel fault diagnosis 1: Channel failure 0: No fault
		Bit2: Field power supply diagnosis 1: Power failure of the field power supply 0: No fault
		Bit6~Bit7: DP network fault diagnosis 0: No fault 1: Network A failure 2: Network B failure 3: A/B network failure
Version information	DiagData[3]~DiagData[5]	3 bytes, version information of module
SOE alarm time	DiagData[6]~DiagData[11]	6 bytes, including 4 bytes second time, 2 bytes millisecond time
Identification diagnosis	DiagData[12]	0x42: Head-byte of dentification diagnosis
	DiagData[13]	0x00: No channel fault 0x01: There is a channel fault
Channel diagnosis	DiagData[14]~DiagData[55]	Each channel has three bytes diagnosis The first byte is 0x80: Header byte of channel diagnosis The second byte is channel number: 0x40 and channel number (0 ~ 13) The third byte is channel data type / fault diagnosis type: 0x20 (32) and line broken fault (6) See the following table "LK631 Channel Diagnosis Information"

LK631 Channel Diagnosis Information

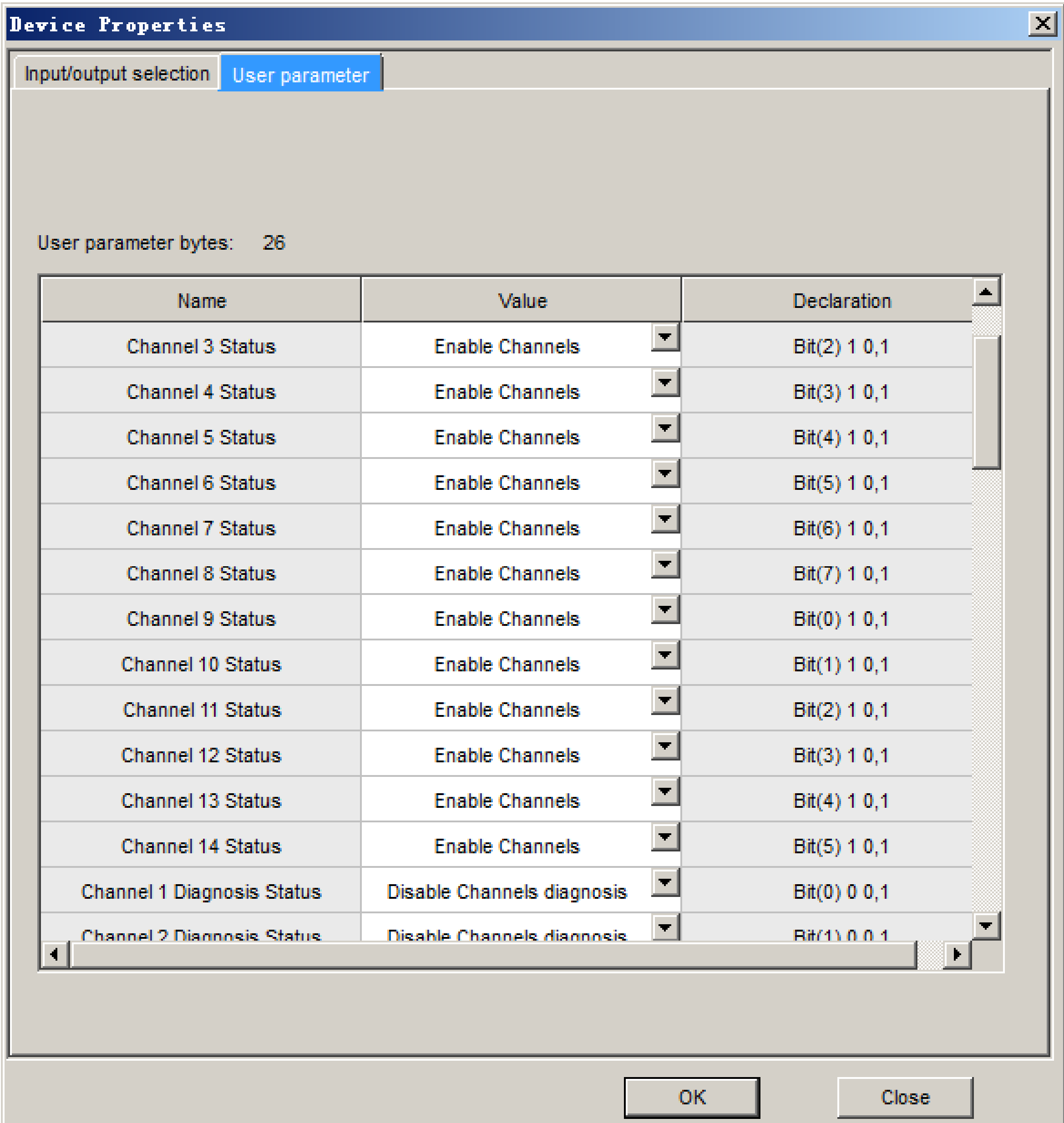
Diagnosis Information						Meaning
Bit		Bit7	Bit6	Bit5	Bit4~ Bit0	
The first byte	Head	0x80				Decimal online value 128
The second byte	I/O type/channel	01 (Input)		(Channel)		Fault channel no. 1~14 Decimal online value 64~77
The third byte	Channel data type/fault type	10 (BOOL)			6	Line broken, Decimal online value is 38
					0	Channel fault recovery, Decimal online value is 32

As an I / O slave of POWERLINK protocol, excepte above diagnostic information, refer to Overview of Diagnosis Information for more diagnostic information.

6.4.7.8 Parameters

The [User parameter] is used to set the operation mode of the module. The controller module written when downloading the project may not be read in each scanning period. Each parameter has a default value, able to modify the parameter value according to the project requirements. After modifying the parameter value, it requires full download before taking effect.

There are 26 bytes in LK631 user parameter, see the "User parameters" tab in the Device Properties dialog.



LK631 User Parameter Setting

Definition of LK631 User Parameter

Parameter Name	Meaning	Value
Time Mode	Configurable timing mode	NTP Synchronization: timing by NTP IRIG-B Synchronization: timing by IRIG-B(default)
Channel n Status(n=1~14)	Channel status	Enable Channels (default) Disable Channels
Channel n Diagnosis Status(n=1~14)	Channel diagnostic status	Enable Channels diagnosis Disable Channels diagnosis(default)
Channel n Filter Time(n=1~14)	Channel filtering time	When Channel n Function Selection is set to DI, you can choose 0ms (default), 2ms, 4ms, 10ms, ,20ms, 200ms, 500ms When Channel n Function Selection is set to SOE, you can choose 0ms (default), 2ms, 4ms, 10ms, 20ms
Channel n Function Selection(n=1~14)	Channel SOE status	DI: Channel acquisition DI signal SOE: Channel acquisition DI signals with SOE event recording(default)

6.4.7.9 Technical Specifications

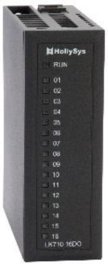
LK631 24VDC 14-channel SOE Module	
Number of channels	14
Contact Type	Leakage type (wet contact)
Field power supply voltage	24VDC(External connection)
Field power supply range	15V~30VDC
Field power supply current	4mA @24V@single channel
ON、OFF condition	ON : 15V～30V OFF : 0～5V
Over voltage protection	When field power supply is wrongly connected to ±30VDC, module and the other modules will not be affected. After the fault is eliminated, the module will automatically return to normal
	When channel is wrongly connected to ± 30VDC, the other channels and the other modules will not be affected; after the fault is eliminated, the channel will automatically return to normal
Hot swapping	Supported
SOE performance	
SOE time source	IRIG-B timing (support B004 / 005 / 006 / 007), the timing source must select UTC time NTP timing, the timing source must select UTC time
IRIG-B timing source interface	RS-485 level
IRIG-B timing source isolation	Isolation from system and field side
SOE event resolution	1ms
SOE storage(power down hold)	3072 events
timing mode	NTP timing and IRIG-B timing are supported. IRIG-B timing is the default
SOE event memory overlimit alarm	SOE events is over 70%(2150) to alarm SOE events is over 100%(3072) to alarm When SOE events are less than 2050, the alarm is cleared
Clear SOE event	AT full download Cold reset Call external library Plug in and out the module and replace different slots
Isolation and withstand voltage	
Between channel and system	500VAC@1min@5mA
Insulation resistance	More than 10MW under normal condition (temperature + 25 ℃ ± 2 ℃, relative humidity 30% ± 5%, no condensation)
Power supply	
System power supply	max.100mA@ 24VDC(-15%~+20%)
Field power supply	max.160mA @24VDC(-15%~+20%)
Communication Bus	
Protocol	Profibus-DP
Baud Rate	187.5Kbps, 500Kbps, 1.5Mbps, 3Mbps, 6Mbps adaptive
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media
Network fault detection	DP network (DP1, DP2) failure
Module failure	

<table>
<tr><th colspan="3">LK631 24VDC 14-channel SOE Module</th></tr>
<tr><td>Fault isolation</td><td colspan="2">Support module card fault isolation and channel fault isolation</td></tr>
<tr><td rowspan="2">Module failure</td><td colspan="2">DP network (DP1, DP2) failure</td></tr>
<tr><td colspan="2">Field power failure</td></tr>
<tr><td rowspan="2">Channel failure</td><td rowspan="2">Broken wire fault diagnosis: it is necessary to enable the disconnection diagnosis function and connect resistance at both ends of user switch(Resistance: 39K ~ 24V Ω)</td><td>Broken wire alarm current range: < 280uA</td></tr>
<tr><td>Normal inquiry current range: ≥4mA</td></tr>
<tr><th colspan="3">Physical Property</th></tr>
<tr><td>Protection Key</td><td colspan="2">D0</td></tr>
<tr><td>Installation Position</td><td colspan="2">Extension backplane</td></tr>
<tr><td>Module Dimension (W*H*D)</td><td colspan="2">35 mm×100 mm×100 mm</td></tr>
<tr><td>Enclosure Protection Rating</td><td colspan="2">IEC60529 IP20</td></tr>
<tr><td>Weight</td><td colspan="2">180g</td></tr>
</table>

6.4.8 LK710 16-channel Source Type Digital Output Module

6.4.8.1 Basic Features

- 16-channel MOSFET source type output
- Output voltage range: 10 VDC~31.2 VDC
- Output read-back diagnosis
- Field power loss detection
- Over Current Protection
- Fault mode output
- Isolation between the system and the field
- Hot swapping



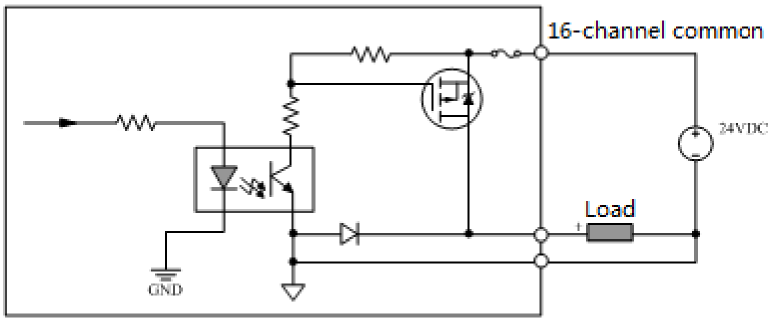
LK710 Module Schematic Diagram

6.4.8.2 Operating Principle

As shown in figure, one end of the load is connected to the negative pole of the field power supply, with the other end connected to LK710. After the MOSFET electronic switch is turn on, the current flowing from the switch is supplied to the load, with the 16-channel switches used the power supply commonly in the module.

The controller module writes the output data and the preset time into the LK710 data storage area via the high-speed bus. The data controls the instructions to turn on or off the MOSFET electronic switch output. When the control signal is a high level, the diode side of the optocoupler is conducted, and the electronic switch is turn on to drive the load, thus realizing digital output.

The diode plays a role of follow current. When the external load is inductive, it can be the channel to discharge the induced current upon the moment of power failure.



Circuit Diagram of LK710 Channel Interface

6.4.8.3 Indicators

Definition of LK710 Indicators

Name	Status	Description
RUN indicator (green)	On	The communication is established, the module works well
	Flash	The communication is not established or incorrect.
	Off	The module is not powered on.
01~16-channel indicator (yellow)	On	The channel is conducted.
	Off	The channel is disconnected.

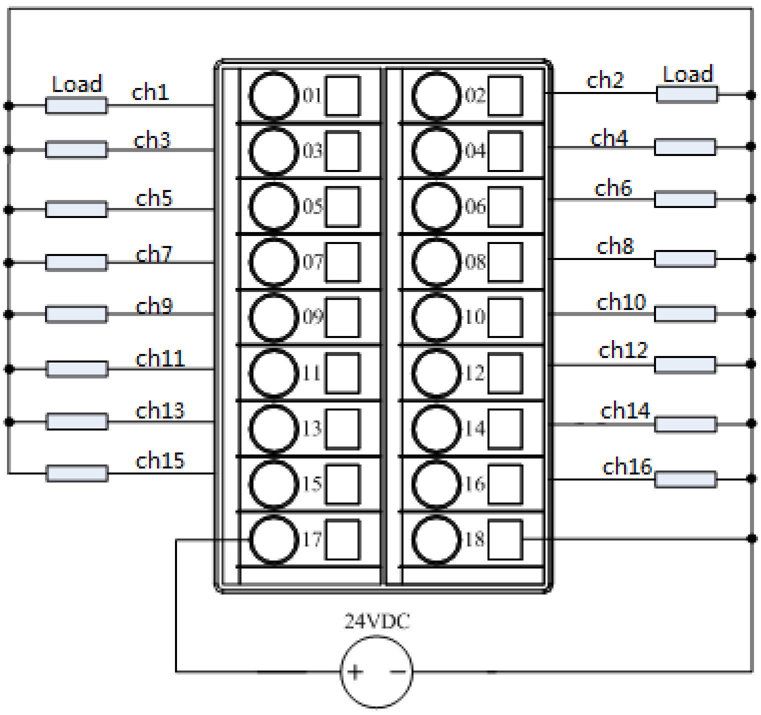
See the following for the specific description of the green RUN indicator:

- Immediately after being powered on, the green indicator flashes to wait for the initialized data, with a flashing frequency of 4 times/second.
- Upon the completion of initialization, the green indicator is turned normally on, which indicates that the module works well. In case of any error in the initialized data, communication cannot be established and the green indicator keeps flashing. Check whether the communication parameters are set correctly.
- When the communication is normal, the green indicator is normally on; when the communication is disconnected, the green indicator flashes. In this case, the module enters the fault mode automatically, outputting the value of the fault mode. When the communication is established again, the green indicator is turned on again. The module automatically exits from the fault mode.

6.4.8.4 Wirings

The LK710 output contact is of a dry type, which can drive the output of the electronic switch only when connected to the field power supply. The field power supply is a 10~30 VDC DC power supply.

LK710 is installed on the extension backplane.



Wiring Diagram of Backplane Terminals Corresponding to LK710

Refer to figur for the corresponding relationship between each channel and the terminal. Pay attention to the following during wiring:

- The module is not provided with reverse voltage protection. **In case of improper wiring, it may burn down the internal circuit**.
- To ensure the isolation between the field and the system, the field power supply shall be configured separately and cannot be commonly used as the power supply for the backplane.

- The 16 channels use the 24 VDC field power supply commonly.
- Terminals 1~16 are separately the digital outputs for Channels 1~16.
- Terminal 17 is the positive terminal of the field power input commonly used by the DO signal of Channel 16.
- Terminal 18 is used for field power loss diagnosis and connected to the negative terminal of the field power supply.
- Do not crimp multiple cables on the same terminal. It can realize multipoint connection via conversion terminal.

6.4.8.5 Functions

6.4.8.6 Output Enable

After the output module is powered on, if the output instruction given from the controller module is not received, then it is in the initial status, with no output. For a module in the initial status, the output cannot be enabled. In this case, it holds its initial status even when in the fault modes.

After running the project, the controller module sends the output instruction to the module via the Profibus-DP bus. The module receives the control instruction and outputs. Once the instruction given from the controller module is output, output is then enabled for the slave station module. When in the fault modes, the output enabled module outputs the values for the fault modes.

In summary, whether output has been enabled after powering on the output module, shall affect the output status in the fault modes.

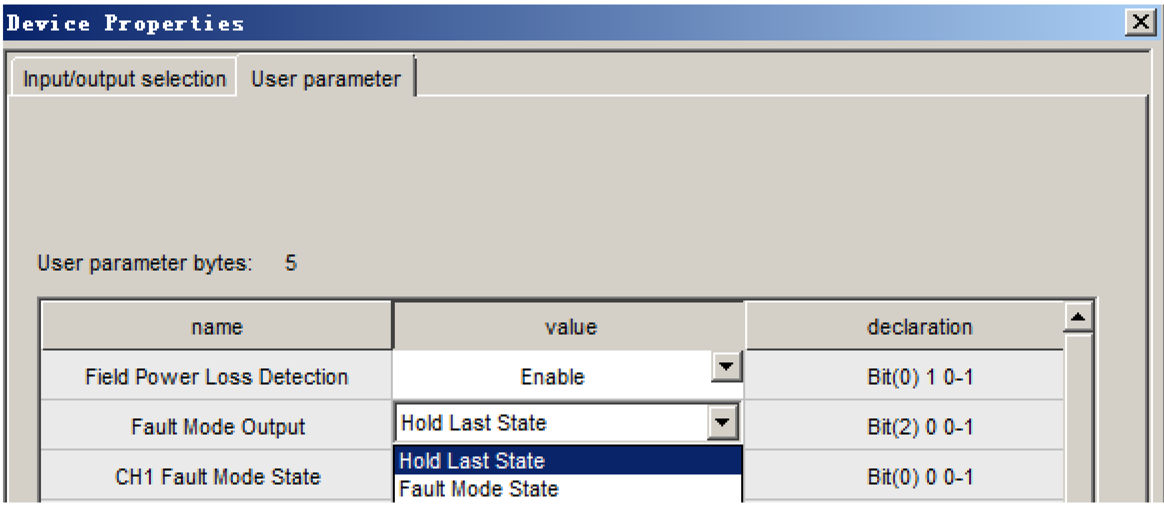
After the output is enabled, the module enters the plug module or is powered up again upon power failure. The module returns to the initial status, with the output disabled. After receiving the output instruction of the controller module, the output is re-enabled.

6.4.8.6.1 Communication Fault

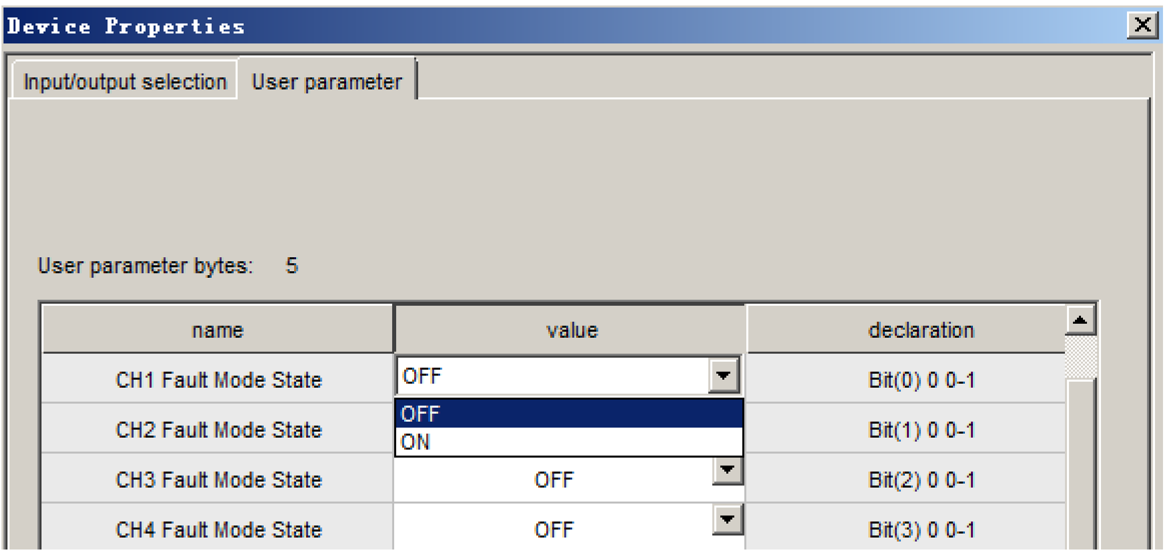
In case of a communication fault, the communication between the module and the controller module is disconnected, with "RUN" indicator flashing. In case of a communication fault, the module status can be divided into the following cases:

- After the module is powered on, it cannot communicate with the controller module. The module is in the initial status and the output is disabled.
- When a communication fault (offline) occurs during running: output Hold (Hold Last State) or output certain status (ON or OFF) that is specified in the configuration in advance, which is known as the fault mode settings (Fault Mode State). In case of a communication fault, Output Hold or Output Fault Mode Settings can be selected in the configuration.
- If the output has not been enabled, then it cannot output the fault mode status even in case of a communication fault.

In the fault mode, it can set Output Hold or Output Fault Mode Settings via the user parameter **Fault Mode Output**, defaulted to Output Hold. The fault mode settings are set via the user parameter **Fault Mode State**, defaulted to output OFF status (disconnected).



(a)

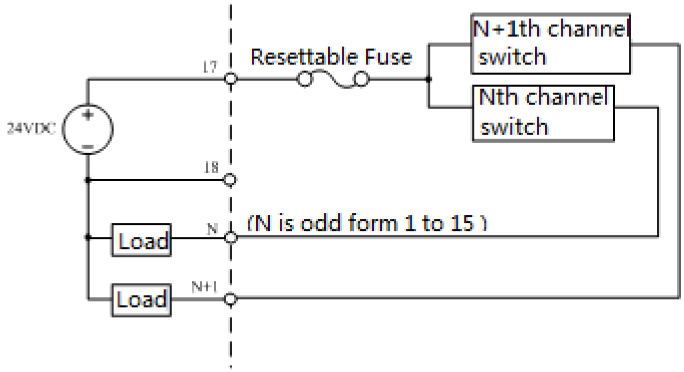


(b)

Output Setting of LK710 Fault Mode

6.4.8.6.2 Over Current Protection

The LK710 module is provided with over-current protection. It can protect the module in case the instant current is too great, such as output short circuit, etc. Over current protection can be realized by connecting to a self-recovery fuse in series in the loop, with each two points sharing a self-recovery fuse.

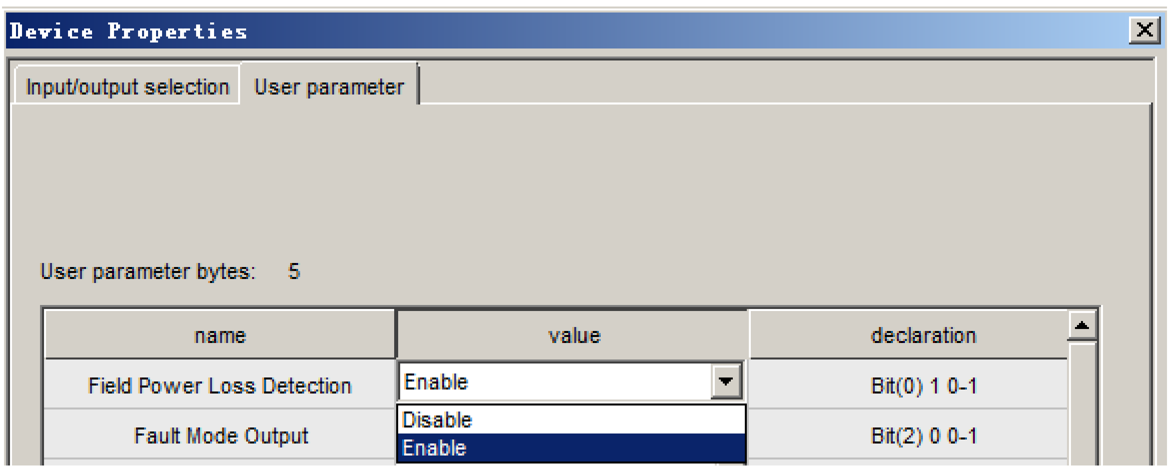


Electrical Schematic Diagram of LK710 Channel over Current Protection

6.4.8.7 Diagnosis

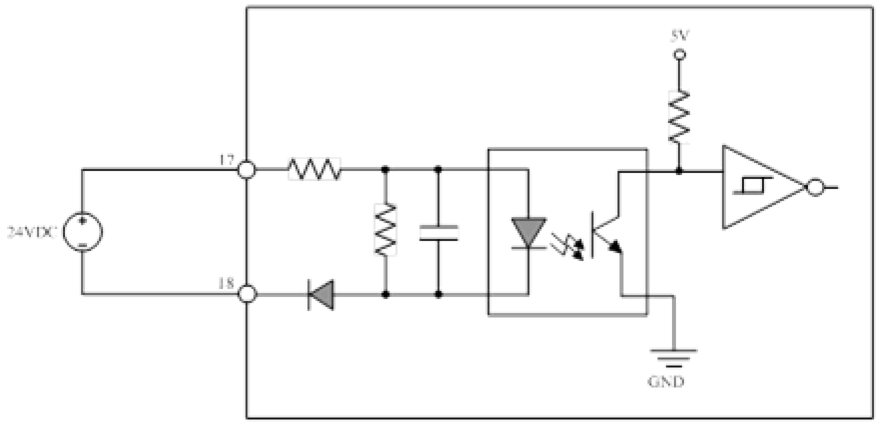
LK710 can conduct field power loss detection. Such a diagnosis is a device diagnosis.

Whether to enable power loss detection can be selected via the user parameter **Field Power Loss Detection**, which is defaulted to Enable. The modification takes effect only upon full download.



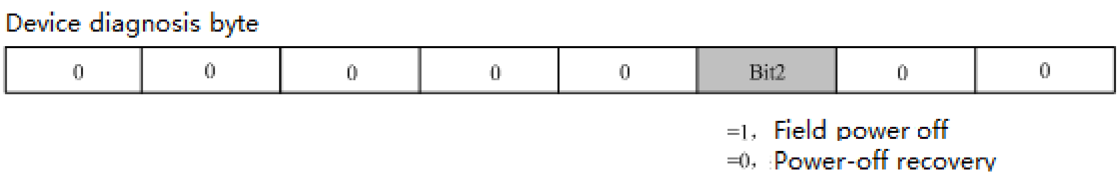
Setting The LK710 Field Power Loss Detection

As shown in figure, Terminal 17 is connected to the positive terminal of the field power supply, with Terminal 18 to the negative terminal. LK710 conducts power loss diagnosis by detecting the changes in the input voltages between the two terminals. In case of a failure, report the fault status in form of diagnosis data to the controller module.



Electrical Schematic Diagram of LK710 Field Power Loss Detection

- When the 24 VDC field power supply is disconnected (the line is broken or the power output voltage is less than 5 VDC), the diagnosis data "0x04" (in the diagnosis bytes, Bit2=1) is generated in the device diagnosis data area of LK710. The diagnosis data is reported to the controller module upon the arrival of the next scanning period.
- After the 24 VDC field power supply is recover to its normal status (output voltage: 10~31.2V DC), the new diagnosis data "0x00" is generated in the device diagnosis area of LK710 (in the diagnosis bytes, Bit2=1). The diagnosis data is reported to the controller module upon the arrival of the next scanning period.
- LK710 only reports the diagnosis data once separately when a failure occurs and the fault recovered.



Diagnosis Byte of LK710

Field power loss detection is device diagnosis, refer to above figure for the definition of diagnosis bytes. After calling the function block Get Diagnosis of DP slave (sysGetDPSlaveState), the diagnosis data reported by LK710 is saved into output parameter **DiagData** in the the function block, as shown in table.

Specifications for LK710 Diagnosis Information

Device diagnosis	Value	Meaning
DiagData[0]: DiagData[1]	0x02:0x04	Field power loss
	0x02:0x00	The failure is recovered or there is no diagnosis data (If the power failure has never happened, the diagnosis information is 0x00:0x00)

As an I / O slave of HolliTCP protocol, excepte above diagnostic information, refer to LK234_Diagnosis for more diagnostic information.

As an I / O slave of POWERLINK protocol, excepte above diagnostic information, refer to Overview of Diagnosis Information for more diagnostic information.

6.4.8.8 Parameters

The [User parameter] is used to set the operation mode of the module. The controller module written when downloading the project may not be read in each scanning period. Each parameter has a default, able to modify the parameter value according to the project requirements. The user parameter does not support online modification. The modification takes effect only upon full download.

The user parameter length of the LK710 module is up to 5 bytes.

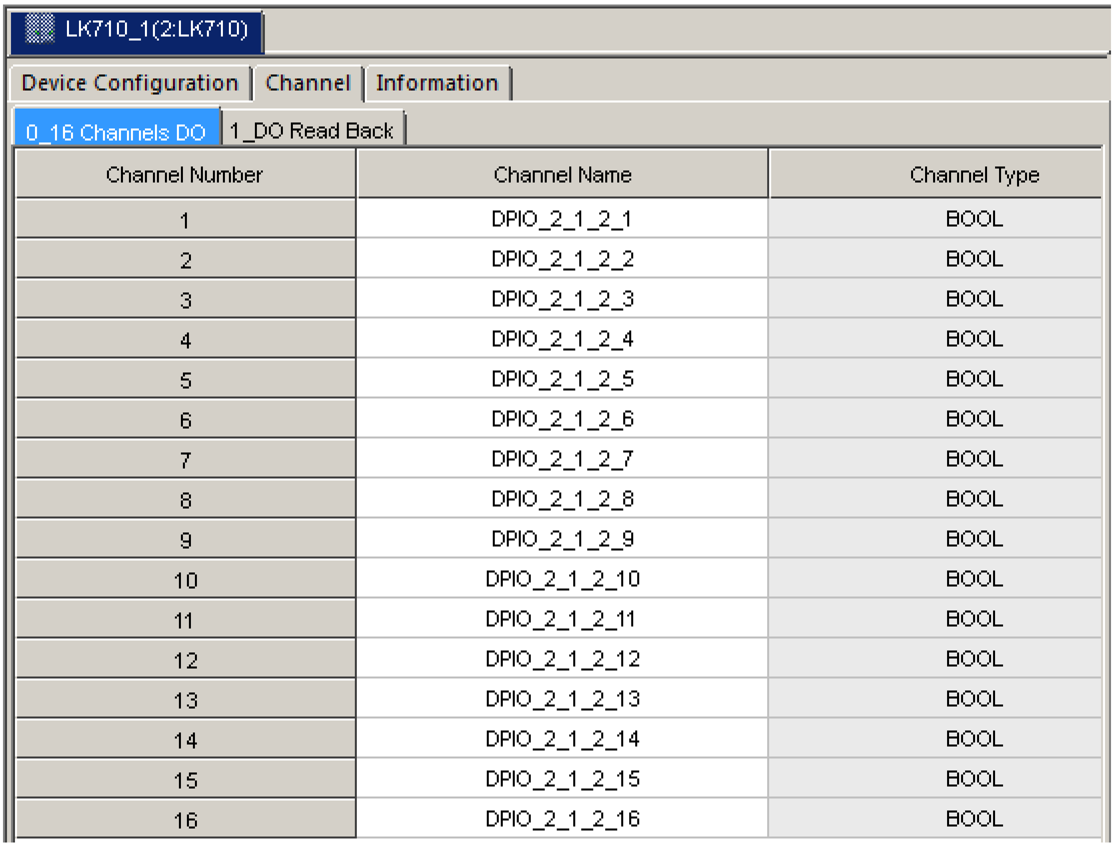
table of LK710 User Parameters

Parameter Name	Meaning	Value
Field Power Loss Detection	To enable power loss detection	0: Disable; 1: Enable (default)
Fault Mode Output	Fault mode output setting	0: Output Hold (default) 1: Output the failure mode settings
CH1~16 Fault Mode State	Fault mode settings for channels 1~16	0: OFF (default); 1: ON

6.4.8.9 Data Area

The input data is the one that is updated data that is uploaded from the slave station in each scanning period. The output data is the one that is sent by the controller module to the slave station in each scanning period, which can be modified online when running the project.

LK710 contains 16 channels BOOL output data and 16 channels BOOL input data. Channels 1 ~16 as output data control the close and open of channels. Channel 17~32 as the input data feed back current state of channel.The channel read-back data returns the channel output status to the controller module for programming.


LK710_1(2:LK710)

Device Configuration | Channel | Information

0_16 Channels DO | 1_DO Read Back

Channel Number	Channel Name	Channel Type
1	DPIO_2_1_2_1	BOOL
2	DPIO_2_1_2_2	BOOL
3	DPIO_2_1_2_3	BOOL
4	DPIO_2_1_2_4	BOOL
5	DPIO_2_1_2_5	BOOL
6	DPIO_2_1_2_6	BOOL
7	DPIO_2_1_2_7	BOOL
8	DPIO_2_1_2_8	BOOL
9	DPIO_2_1_2_9	BOOL
10	DPIO_2_1_2_10	BOOL
11	DPIO_2_1_2_11	BOOL
12	DPIO_2_1_2_12	BOOL
13	DPIO_2_1_2_13	BOOL
14	DPIO_2_1_2_14	BOOL
15	DPIO_2_1_2_15	BOOL
16	DPIO_2_1_2_16	BOOL

Input /Output data

6.4.8.10 Technical Specifications

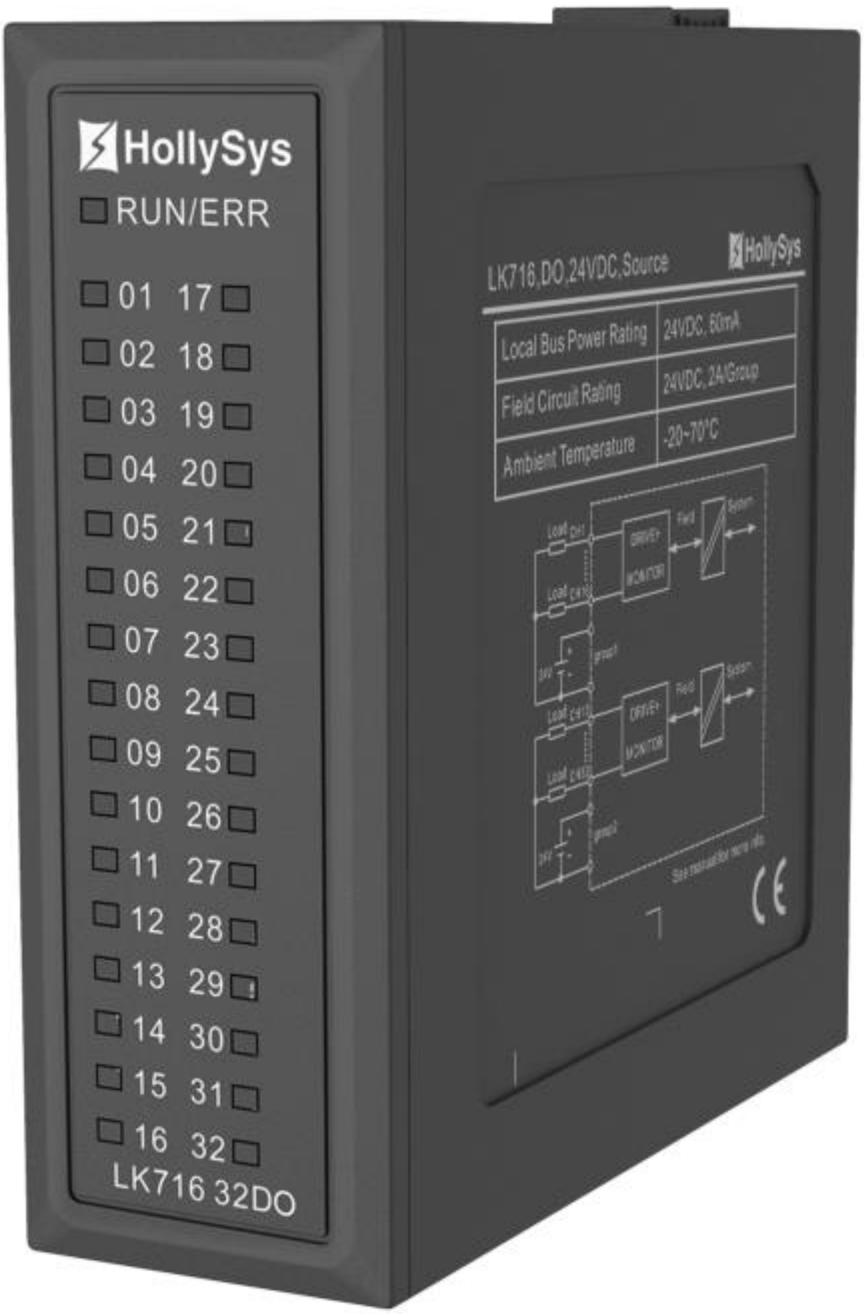
LK710 16-channel Source Type Digital Output Module	
System Power	
Operating Voltage	24VDC (-15%~+20%)
Backplane Current	130mA max.@24VDC
Output channel	
Number of channels	16-channel
Output Switch	MOSFET
Isolation Voltage	500 VAC@1 min. between the system and the field, leaking current: 5 mA
Rated Output Voltage	24 VDC
Output Voltage Range	10 VDC~31.2 VDC
Rated output current Each Point Each Module	0.5 A@40℃&0.4 A@60℃ (linear decrease) 8 A@40℃& 6.4 A@60℃ (linear decrease)
Surge Current at Each Point	1 A, duration: 10 ms, period: 2 s@60℃
Over Current Protection	A self-recovery fuse protection device is shared for every two points
Min. Load Current	3 mA/Each Point
Max. On-status Voltage Drop	150 mV@0.5 A
Max. Off-status Leakage Current	1 mA/Each Point
Output Delay Time OFF→ON	1 ms (max.) 1 ms (max.)

LK710 16-channel Source Type Digital Output Module	
ON→OFF	
Independent Configurable Fault Mode Output Value for Each Point	Output hold (default) Default mode settings:ON or OFF
Failure Diagnosis and Hot Plug	
Field power loss detection	Field power loss: device diagnostic sampling word reporting 0x04; power loss recovery: reporting 0x00
Hot Plugging	Supported
Communication Bus	
Protocol	Profibus-DP
Baud Rate	1.5Mbps, 500Kbps, 187.5Kbps , 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps adaptive
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Property	
Protection Key	E0
Installation	Extension backplane
Module Dimension (W*H*D)	35 mm×100 mm×100 mm
Enclosure Protection Rating	IEC60529 IP20
Weight	200 g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.4.9 LK716 32-channel Source Type Digital Output Module

6.4.9.1 Basic Features

- 32 channel transistor output
- Field power supply voltage: 19.2 VDC ~ 28.8 VDC
- Reverse voltage protection
- Field power supply fault diagnosis
- Short circuit protection
- Isolation between channel and system
- Support fail safe mode output
- Support hot plug

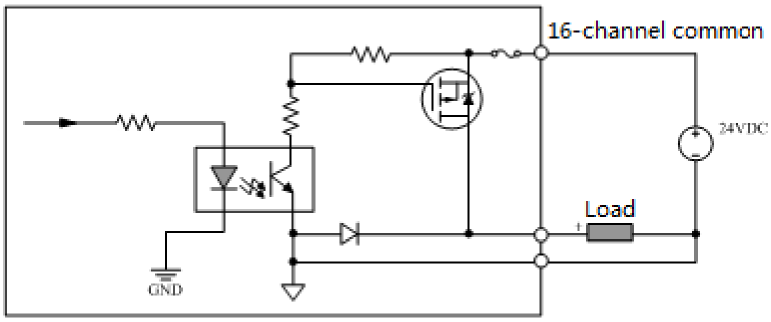


Appearance drawing of LK716 module

6.4.9.2 Operating Principle

As shown in the figure, one end of the load is connected to the negative pole of the field power supply, and one end is connected to the LK716 output channel. After the MOSFET electronic switch is closed, the current flowing from the switch supplies power to the load. 16 channels are a group, a total of two groups, and each group shares the power supply inside the module.

The controller module writes the output data and preset time into the data storage area of LK716 through the high-speed bus. This data controls the MOSFET electronic switch output close or open command. When the control signal is high level, the disconnector drives the load to realize digital output.



LK716 channel interface circuit diagram

6.4.9.3 Indicators

Definition of LK716 Indicators

Name		Status	Description
RUN/ERR indicator	green	On	The communication is established, and the module works well
		Flash	The communication is not established or incorrect.
		Off	The module is not powered on or module is fault.
	red	On	The communication has been established, and at least one group of field power failure, system power failure and at least one chip failure of the module
		Flash	Communication not established or communication error and system power failure
		Off	The module is working properly
01~32-channel indicator	yellow	On	Channel output high level
		Off	Channel output low no output / channel not enabled

6.4.9.4 Wirings

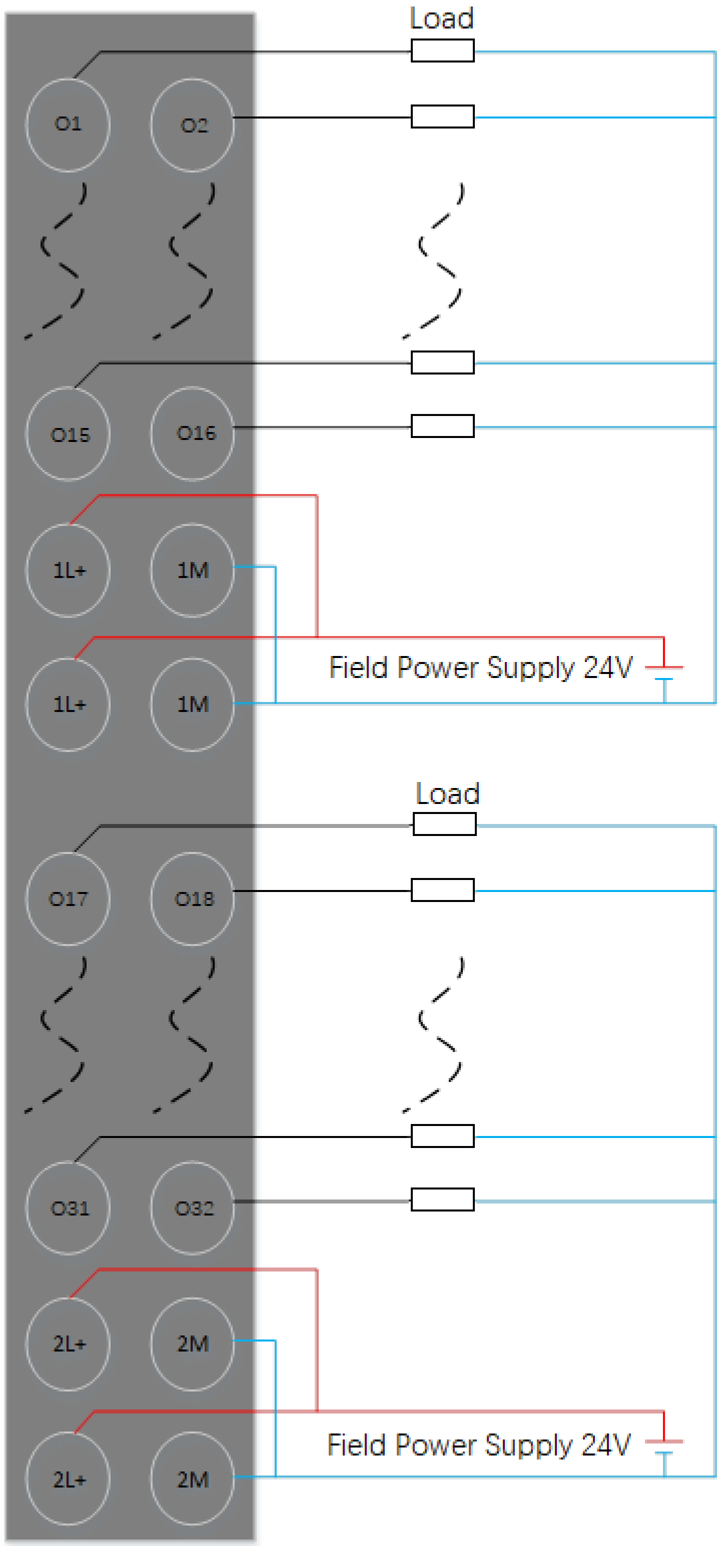
The field signal is connected to LK716 module through LKX1030 prefabricated cable connector. The prefabricated cable is 40 core copper wire, which connects the field signal and power supply. In order to ensure the isolation between the site and the system, the site 24VDC power supply shall be configured separately and cannot be shared with the backplane power supply.

1 ~ 16 channels share one group of field power supply, and 17 ~ 32 channels share one group of field power supply. Each group of field power supply has 4 wires, 2 positive and 2 negative, and connected to two groups of power signal terminals

LK716 signal line color definition

Channel number	Cable core color	Channel number	Cable core color
Channel 1	Red on white	Channel 17	Red on green

Channel number	Cable core color	Channel number	Cable core color
Channel 2	Yellow on white	Channel 18	Yellow on green
Channel 3	Green on white	Channel 19	Green
Channel 4	Blue on white	Channel 20	Blue on green
Channel 5	Pink on white	Channel 21	Pink on green
Channel 6	Grey on white	Channel 22	Grey on green
Channel 7	Black on white	Channel 23	Black on green
Channel 8	White	Channel 24	White on green
Channel 9	Red on yellow	Channel 25	Red on blue
Channel 10	yellow	Channel 26	Yellow on blue
Channel 11	Green on yellow	Channel 27	Green on blue
Channel 12	Blue on yellow	Channel 28	Blue
Channel 13	Pink on yellow	Channel 29	Pink on blue
Channel 14	Grey on yellow	Channel 30	Grey on blue
Channel 15	Black on yellow	Channel 31	Black on blue
Channel 16	White on yellow	Channel 32	White on blue
On-site power source 1+	Brown on red	On-site power source 2+	Red
On-site power source 1+	Brown on pink	On-site power source 2+	Pink
On-site power source 1-	Brown on black	On-site power source 2-	Black
On-site power source 1-	Brown on violet	On-site power source 2-	Orange



Wiring diagram of LK716 module

6.4.9.5 Diagnosis

The diagnostic information of LK716 only contains 4-byte device related diagnostics.

When LK716 module is added through DP protocol under LK249 DP communication module, the diagnosis needs to be viewed through the function block.

After calling to obtain the DP slave station diagnosis function block (sysGetDPSlaveStateExt), the diagnosis data is stored in the output parameter DiagData array.

Description of diagnostic information for LK716 module

Diagnostic information	Diagnostic byte	Value
Device diagnostic information	DiagData[0]	0x04：Device diagnostic header byte
	DiagData[1]	Bit0：Chip fault diagnosis 1：Chip failure 0：No chip failure Bit2: System power failure 1: failure 0:No failure
	DiagData[2]	Bit2：Field power 1 diagnostics 1：Indicates the power failure of the field power supply 0：No fault
		Bit3：Field power 2 diagnostics 1：Indicates the power failure of the field power supply 0：No fault
		Bit6~Bit7：DP network fault diagnosis 0：No fault 1：DP1 fault 2：DP2 fault
	DiagData[3]	Bit0~Bit7：Module MCU firmware version information

When LK716 module is added under LK241 Powerlink communication module through Powerlink protocol, after compilation, you can directly view the diagnosis information on the diagnosis page.

Configure LK716 module in autothink programming software, generate module diagnosis information page after compilation, and store the obtained diagnosis in s area of the system. The diagnosis information of LK716 only contains 4-byte equipment related diagnosis. The diagnosis information is shown in the figure:

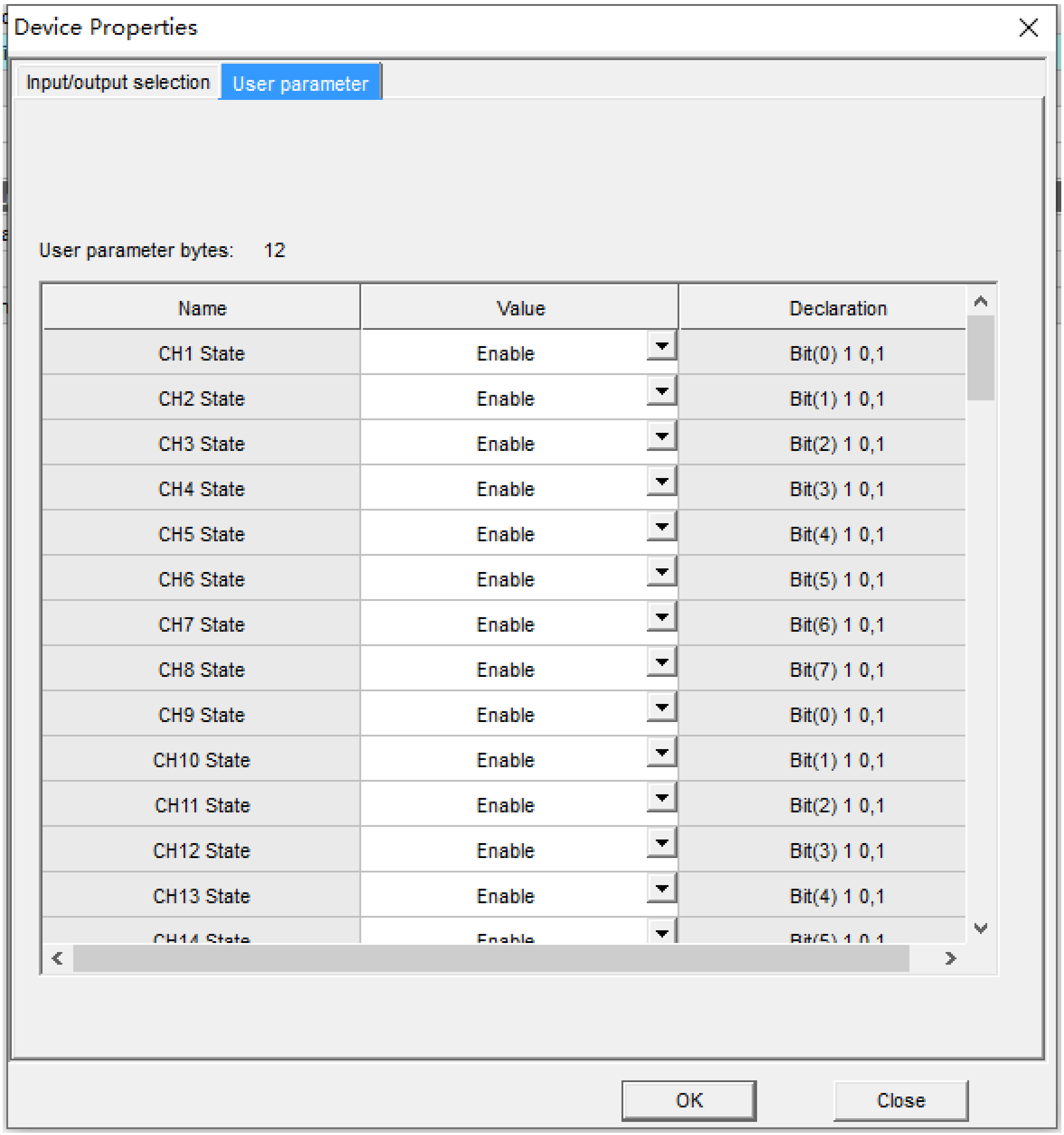
Variable Name	Variable Type
AT_LK716SlaveState1_9	BYTE
AT_LK716SlaveID_H9	BYTE
AT_LK716SlaveID_L9	BYTE
AT_LK716_Chip_Fault9	BOOL
AT_LK716_SysPower_Fault9	BOOL
AT_LK716Field1PowerFault9	BOOL
AT_LK716Field2PowerFault9	BOOL
AT_LK716DP1NetFault9	BOOL
AT_LK716DP2NetFault9	BOOL
AT_LK716MCUVern9	BYTE

LK716 module diagnostic information description

6.4.9.6 Parameters

The user parameter is used to set the working mode of the module. It is written to the controller when the project is loaded. It is not read every scanning cycle. Each parameter has a default value (default), which can be changed according to project requirements. After the parameter value is changed, you need to download it all to take effect.

In autothink configuration software, double-click the LK716 tree node under hardware configuration to open the "device properties" dialog box. As shown in the figure, LK716 user parameters have 12 bytes.



User parameter setting of LK716 module

Definition of user parameters of LK716 module

Parameter name	**Parameter meaning**	**Parameter value**
CHn State(n=1~32)	Channel status	Enable：(default) Disable
CHn Fault Mode State(n=1~32)	Set the failure mode of the channel	Hold Last State：(default) Fault Mode State
CHn Fault Mode Output(n=1~32)	Channel failure mode setpoint	OFF：(default) ON：close

6.4.9.7 Technical Specifications

LK716 32 channel transistor type digital output module	
System power supply	
Operating Voltage	24VDC（-20%~+20%)
System Power Consumption（Max	60mA@24VDC
Reverse connection protection	Support system power reverse connection protection
Rated Voltage of Field Power Supply	
working voltage	24VDC（-20%~+20%），2-way independent field power supply
Reverse connection protection	Support on-site power reverse connection protection
Channel output	
Number of channels	32 channels (16 channels in one group, 2 groups in total)
Channel enable	1. Any channel can be configured with or without enabling 2. When the channel is not enabled, the channel remains disconnected 3. The default is channel enable
Channel Type	MOS
Output mode	Source
Load capacity	0.5A single channel (resistive load))
ommon end overcurrent capacity	2A each group
Leakage current in off state	0.5 mA single channel
Channel conduction voltage drop	<1.5V
Maximum switching frequency	Resistive load ≤ 50Hz
	Inductive load ≤ 0.5Hz
	Lamp load ≤ 5Hz
Output delay time OFF→ON ON→OFF	1 ms（Max) 1 ms（Max)
Hot plug	Support
Module data output mode	
Module cold start	Initialize value
During module hot start	Output hold
After module configuration change	Output hold
System power failure	Fault preset / hold
Communication was interrupted and returned to normal	Normal output
Module communication lost	Fault preset / hold
Load type	
Load type	Resistance, inductance

LK716 32 channel transistor type digital output module	
Module failure	
Fault isolation	1. Fault isolation between channels and groups 2. Fault isolation between modules
Module fault type	1、PROFIBUS DP network single DP1 network or single DP2 network fault 2、Channel field power failure 3、System power failure
Field power failure threshold	17V±1V (2-way)
System power failure threshold	17V±1V
Channel short circuit protection	Support, (short circuit current threshold: 1.8A)
Isolation voltage	
Field to system	500V AC test for 1min, leakage current 5mA
communication	
DP master card model	LK235 LK234 LK249 LK202 LK205 LK207 LK210
agreement	Profibus-DP
Dual network redundancy	Support
Baud rate	3Mbps、1.5Mbps、500Kbps、187.5Kbps、93.75Kbps、45.45Kbps、31.25Kbps、19.2Kbps、9.6Kbps。
physical characteristics	
Installation Position	Extension backplane
Protection Key	E1
Enclosure Protection	IP20
Module Dimension (W*H*D)	35mm×107mm×100mm
Weight	200g
Environmental Adaptability	
Operating Temperature	-20～70°C
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40～70°C
Storage Humidity	5%~95%, with no condensation

6.4.10 LK720 10~265VAC/5~125VDC 8-way Normally Open Relay Output Module

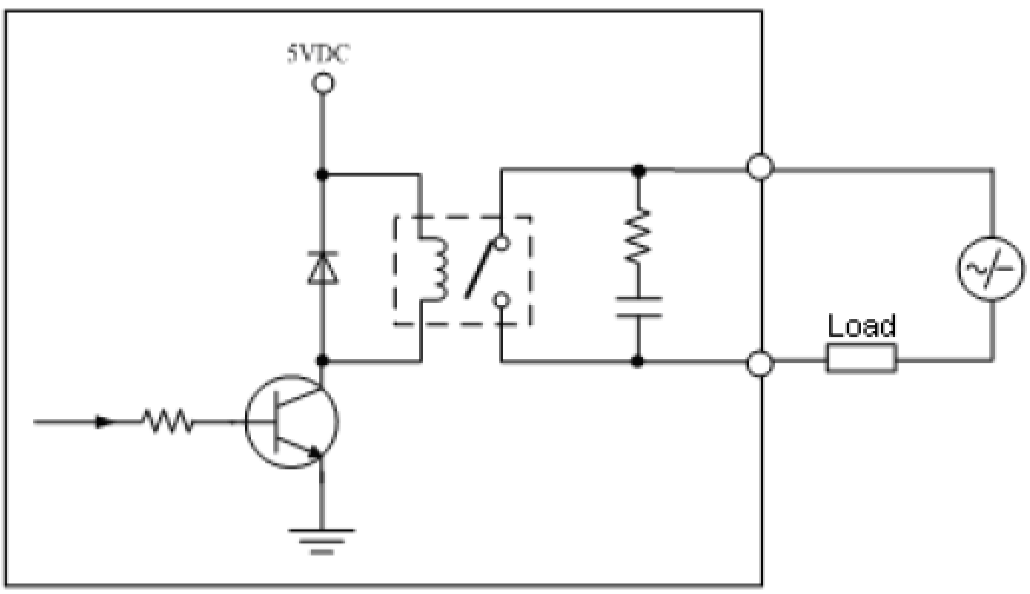
6.4.10.1 Basic Features

- 8 channels of relay outputs, non source open contact
- DC voltage range: 5~125VDC
- AC voltage range: 10~265VAC@47~63Hz
- Support Profibus-DP slave station protocol
- Fault mode safety Output
- Output readback diagnosis
- Inter-channel isolation
- System-to-field Isolation
- Supports hot swap

6.4.10.2 Operation Principles

The controller writes the output data into the memory of LK720 through Profibus-DP bus. These data control the drive circuit closing or opening the relay contact to drive the load in the output circuit.

As shown in figure, the relay is in a constantly open status.



LK720 Channel Interface Circuit

6.4.10.3 Indicators

Definition of LK720 Indicators

Name	Status	Description
RUN indicator (green)	On	The communication is established, the module works well
	Flash	Communication is not established or communication error
	Off	The module is not powered on
01~08 channel indicators (yellow)	On	The channel is conducted
	Off	The channel is disconnected

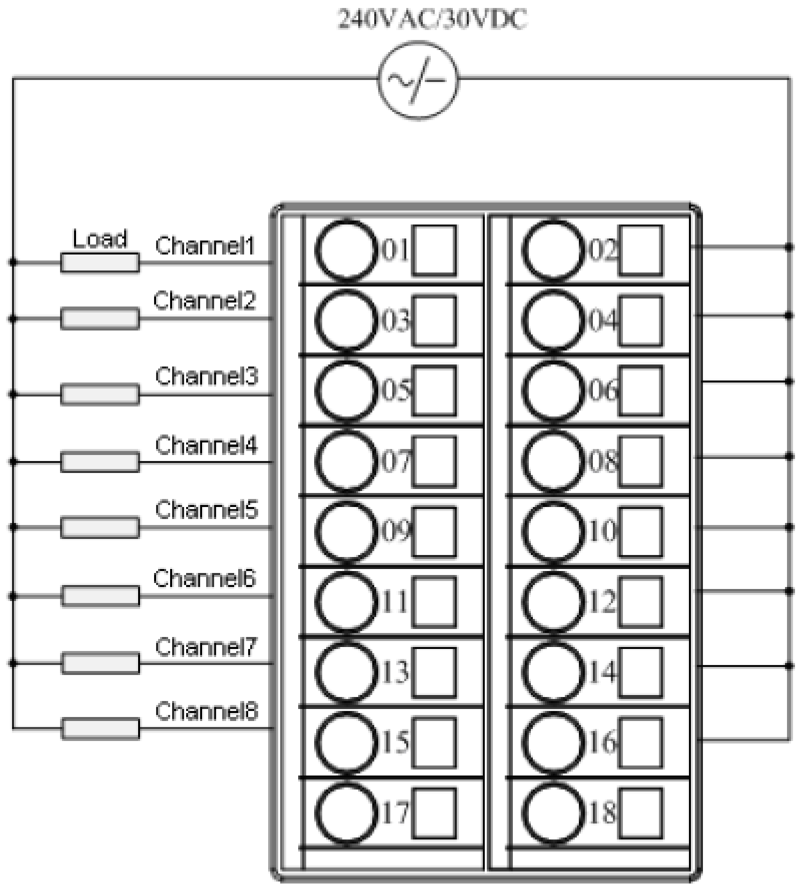
Specifications of RUN green light are as follows:

- After the power is on, the module waits for initialization data while the green light flashes with a frequency of 4 times per second.
- After the initialization is completed, the green light is constantly on to indicate the module in normal operation; if any error occurs in the initialization, then the communication is not established and the green light keeps flashing. Then, communication parameter settings shall be checked.
- In normal communications, green light is constantly on; when communication breaks, green light flashes while the module automatically enters fault mode; when communication is re-established, the green light is constantly on again and the module automatically exits fault mode.

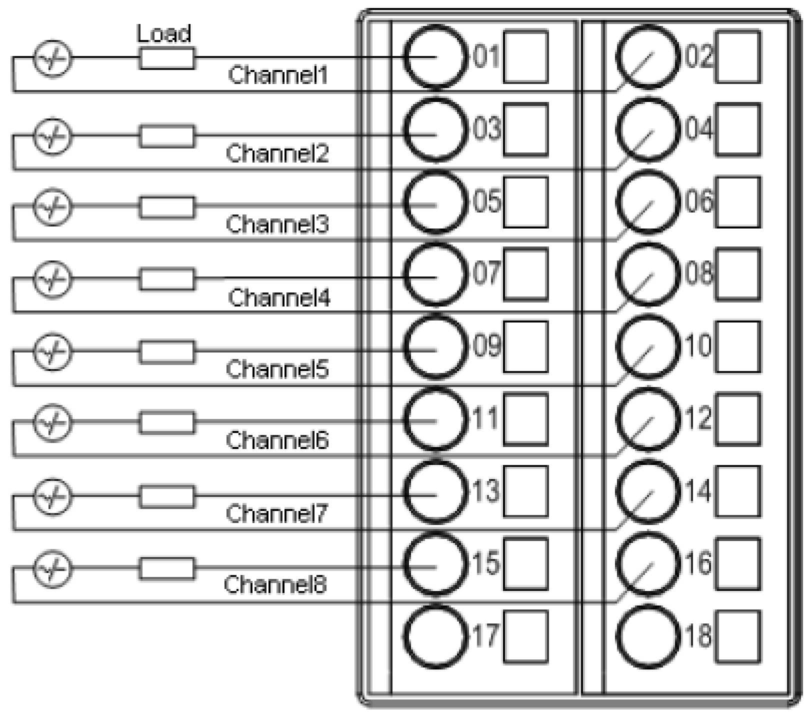
6.4.10.4 Wirings

LK720 output contact points are dry contacts; hence it requires field power supply to drive optical coupler output. The field power supply can be a 5~125VDC power or a 10~265VAC power, which is selected according to different types of the load.

LK720 module is installed on LK series backplanes. LK720 module is wired through the correspondence terminals under the local backplane installation slot. The relationship between each channel and terminal is shown in figure. The 8 channel outputs can share a field power supply when there is no isolation between channels. They can also connect to separate field power supplies when the channels are isolated from each other.



Wiring of LK720 Backplane Terminals with Single Power Supply



Wiring of LK720 Backplane Terminals with Multiple Power Supply

In the wiring, the following shall be noted:

- The field power supply can use both DC power and AC power.
- Signals of each channel are connected to the wiring terminals through 2 cables without distinguish between positive and negative.
- When module employs single power supply, there is no isolation between channels; when module employs multiple power supplies, there is isolation between channels using different power supplies.
- A single terminal shall not be connected to many wires; therefore multiple-point connection can be established through transferring terminal board.
- Terminal 17 and 18 shall not be connected in the wiring.

6.4.10.5 Functions

6.4.10.5.1 Output Enable

Please see Output_Enable of LK710.

6.4.10.5.2 Communication Failure

Please see Communication_Fault of LK710.

6.4.10.6 Diagnosis

As an I / O slave of HolliTCP protocol, refer to LK234_Diagnosis for diagnostic information.

As an I / O slave of POWERLINK protocol, refer to Overview of Diagnosis Information for diagnostic information.

6.4.10.7 Parameters

User parameters are used to configure the module's operating mode. They are written into the controller during the download of user program and will not be read in every scanning circle. Each parameter has a default value that can be changed according to requirements of the project. User parameters do not support online modification; therefore they can only be effective after the full download.

LK720 user parameter has 3 bytes (Byte0~Byte2):

table of LK720 User Parameters

Parameter Name	Meaning	Value
Fault Mode Output	Fault mode output setting	0: Output Hold (default) 1: Output the failure mode settings
CH1 Fault Mode State~CH8 Fault Mode State	Fault mode settings for Channels 1~8	0: OFF (default) 1: ON

6.4.10.8 Data Area

The input data is the one that is updated data that is uploaded from the slave station in each scanning period. The output data is the one that is sent by the controller module to the slave station in each scanning period, which can be modified online when running the user program.

LK720 contains 8 channels BOOL output data and 8 channels BOOL input data. Channels 1 ~8 as output data control the close and open of channels. Channel 9~16 as the input data feed back current state of channel.The channel read-back data returns the channel output status to the controller module for programming.

6.4.10.9 Technical Specifications

LK720 10~265VAC/5~125VDC 8-way Normally Open Relay Output Module		
System Power Supply		
Power Supply Voltage	24VDC(-10%~+10%)	
Power consumption	140mA max.@24VDC	
Output Channel		
Number of Channels	8 channels	
Signal Type	Non source open contact	
Valid load voltage range	10~265VAC@47~63Hz/5~125VDC	
Load voltage range (load control)	Resistance load	
	5~30VDC@2A	
	48VDC@0.5A	
	100VDC@0.2A	
	125VAC@2A	
	240VAC@2A	
Rated output current (stable status)	Resistance load	Inductive load
	2A@5~30VDC	2A@5~30VDC
	0.5A@48VDC	0.5A@48VDC
	0.2A@100VDC	0.2A@100VDC
	2A@125VAC	2A@125VAC
	2A@240VAC	2A@240VAC
Rated power (stable status)	Resistance load	Inductive load
	125VAC,250W max.	125VAC,250W max.
	240VAC,480W max.	240VAC,480W max.
	30VDC,60W max.	30VDC,60W max.
	48VDC,24W max.	48VDC,24W max.
	100VDC,20W max.	100VDC,20W max.
Minimum load current	10mA/point	
Maximum OFF-state Current Leak	1.5mA	
Initial contact resistance	30mΩ	
Maximum connection frequency at rated load	6 times / minute	
Minimum connection frequency at rated load	1200 times / minute	
Bounce time	1ms	
Operating time	5ms	

LK720 10~265VAC/5~125VDC 8-way Normally Open Relay Output Module	
Release time	1ms
Relay contact life span Resistance load Inductive load	 200, 000 times 30, 000 times
Maximum Output Delay Time OFF→ON ON→OFF	 10ms 10ms
Configurable fault mode output state of each point	Hold Last State (default); ON of OFF
Isolation Voltage Field to System Channel to channel	 1000VAC@1min, Current Leak 5mA 1000VAC@1min, Current Leak 5mA
Hot Swap	
Hot Swap	Supported
Communication Bus	
Protocol	Profibus-DP
Baud Rate	1.5Mbps, 500Kbps, 187.5Kbps , 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps adaptive
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Features	
Mechanic Keys to Prevent Incorrect Insertion	D3
Installation	Expansion backplane
Dimension	Width × Height × Depth = 35mm×100mm×100mm
Casing Protection Level	IEC60529 IP20
Weight	210g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.4.11 LK410 8-Channel Voltage Type Analog Input Module

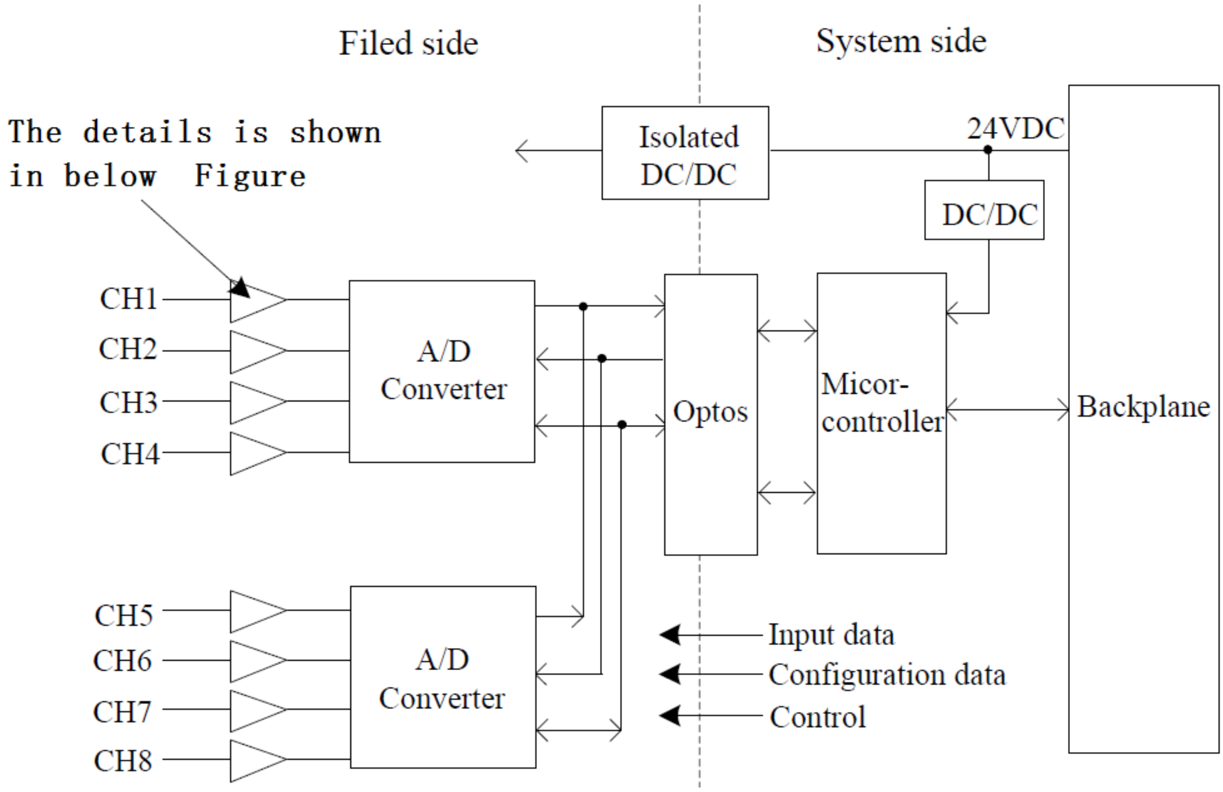
6.4.11.1 Basic Features

- 8-channel voltage inputs
- Applicable range:-10V~10V/0~10V/0V~5V
- Max. measurable range:-10.25V~10.25V/0V~10.25V/0~5.125V
- Over-limit alarm
- Over range alarm
- Line broken detection

- Support Profibus-DP slave station protocol
- Isolation between the system and the field channel
- Field calibration function
- Hot swapping

LK410 Module Schematic Diagram

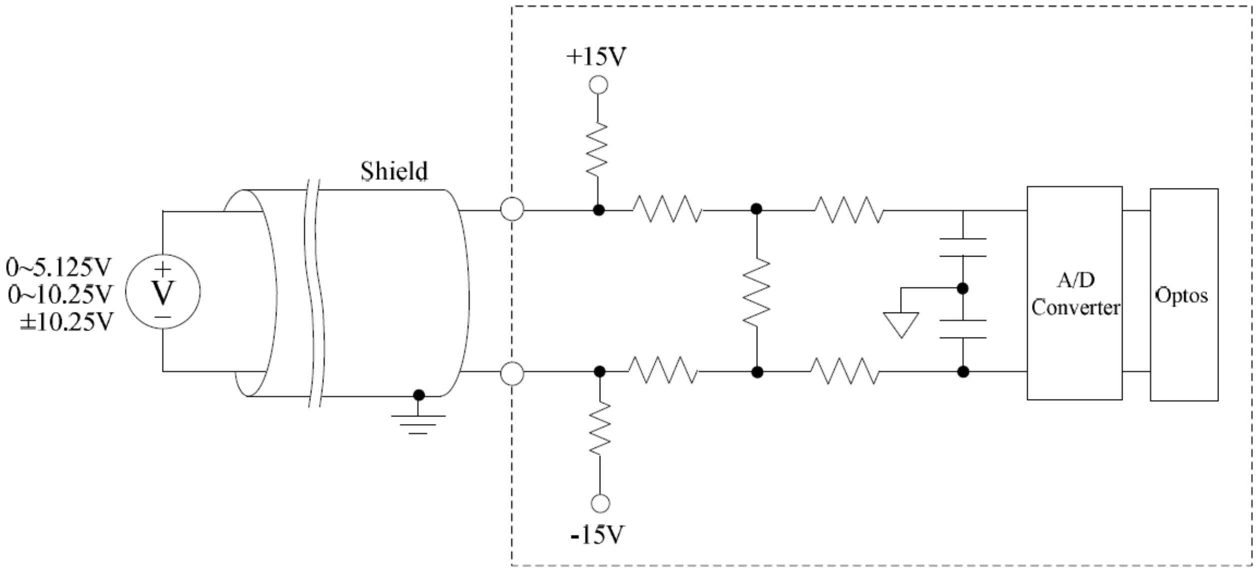
6.4.11.2 Operating Principle



LK410 Input Circuit Block Diagram

The module is powered by 24VDC voltage which is converted to ±15VDC by isolated DC/DC converter.

As shown in the following figure, the module converts an analog voltage into a digital value via voltage conversion, filtering, A/D, and signal is read by the module's microprocessor after photoelectric isolation, and sent to the controller via Profibus-DP bus.



LK410 Input Simplified Circuit

6.4.11.3 Indicators

There are two status indicators on the front panel of the module: the green indicator RUN and the yellow indicator CAL. The RUN indicator indicates the communication status between the module and the controller. CAL indicator indicates the calibration process of the module(Calibration model is not introduced in this article, please contact HollySys service agencies if necessary).

Definition of LK410 Indicators

Type	Status	Instructions
RUN indicator (Green)	On	communication has been established and module working properly
	Flash	Communication has not been established or communication error
	Off	Module is not powered on or module's faulty
CAL indicator (Yellow)	On	In calibration mode, in the process of calibration
	Flash	In calibration mode, but calibration is not conducted
	Off	No power on or no communication established or the module does not in calibration mode

- Running mode
  - When powered on, the module waits for initialization data, the green indicator flashes, and the flashing frequency is 4 times per second.
  - When the initialization is complete, the module is running normally and the green indicator is on. If the initialization data is incorrect, the communication cannot be established and the green indicator will remain flashing. Inspect that if the DP connection is correct and the communication parameters (communication rate, communication station number) are set correctly.
  - When the module is working normally, the green indicator is on; while the communication is interrupted and the green indicator flashes. After the communication is reestablished, the green indicator will turn on again.
  - When the module is in running status, the yellow light is off.

Definition of LK410 Indicators in Running Mode

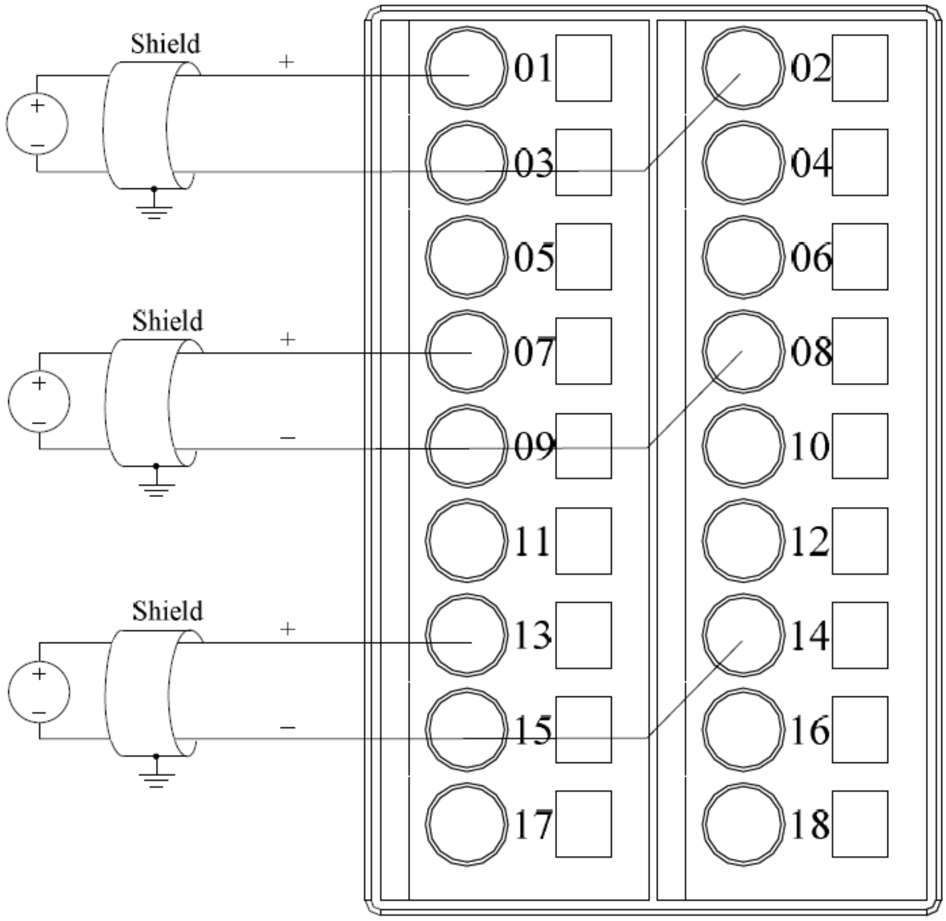
	RUN light	CAL light	Description
Run mode	Off	Off	Not powered on
	Flash	Off	Communication is not established or communication error
	On	Off	The communication has been established and the module is working properly

6.4.11.4 Wirings

The LK410 module is mounted on the expansion backplane.

Definition of LK410 Backplane Terminals

Channel number	Terminal number	
	Positive terminal	Negative terminal
1	01	02
2	03	04
3	05	06
4	07	08
5	09	10
6	11	12
7	13	14
8	15	16



Backboard Terminal Wiring Schematic Diagram

When wiring, pay special attention to the following:

- Two-row 18 terminals are fixed on the backplane, just below the LK410 module's mounting position.
- Odd terminals are connected to the positive terminal of the voltage signal; even terminals are connected to the negative terminal of voltage signal.
- Each AI signal of field circuit is connected to the terminal with two wires (shielded cable).
- The terminal "17" and "18" are not use, which prohibited wiring.

6.4.11.5 Measured data output format

As shown in the following table, the measurement data of the AI channel reported by the LK410 is represented by 2-byte positive integer digital code (decimal 0 to 65535). The range (-10.25 ~ +10.25V) is divided into two sections, and positive voltage (0 ~ 10.25V) corresponds to the decimal digital code (0 ~ 32767), the negative voltage (-10.25V ~ 0) corresponds to the decimal digital code (32768 ~ 65535).

Corresponding Relationship between LK410 Input Voltage and Digital Code

Max. measurable range		Decimal digital code
-10.25~+10.25V	0~10.25V	0~32767

Max. measurable range	Decimal digital code
-10.25V~0V	32768~65535
0~10.25V	0~65535
0~5.125V	0~65535

The conversion formula between the measurement data of the range (-10.25 ~ + 10.25V) and the physical quantity is as follows:

Positive voltage 0 ~ + 10.25V: voltage value (V) = measurement data / 32767 × 10.25

Negative voltage -10.25 ~ 0V: Voltage value (V) = (measurement data -65535) /32767 × 10.25

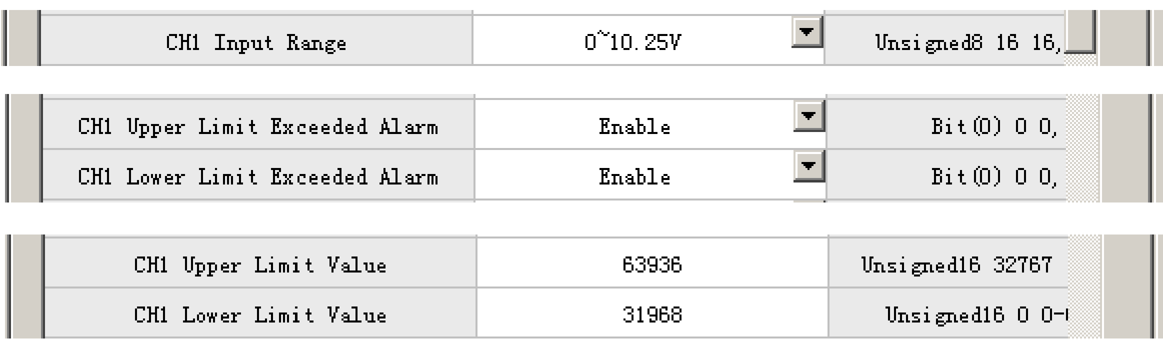
By calling the function block HEX_ENGIN of the Analog signal Processing Functions library in the programming software AutoThink, it can convert the 2-byte measured data into the engineering data. Refer to HEX_ENGIN for the specific application of the function blocks.

When setting the upper alarm limit and lower alarm limit in the user parameter, it is needed to convert the voltage signal into decimal digital code and then fill in. Different ranges correspond to different conversion method of digital code.

- For the range of 0 ~ 10.25V, 0 ~ 5.125V, conversion formula of corresponding value of signal:

  Corresponding code value = voltage signal × 65535 / full scale value.

  For example, the channel 1, if the range "0 ~ 10.25V" is selected and over-limit enables, the user defines the upper limit voltage as 10V, the lower limit voltage as 5V, then the alarm upper limit = 10 × 65535 / 10.25 = 63936, the alarm lower limit = 5 × 65535 / 10.25=31968, the relevant user parameter settings are shown in the following figure.



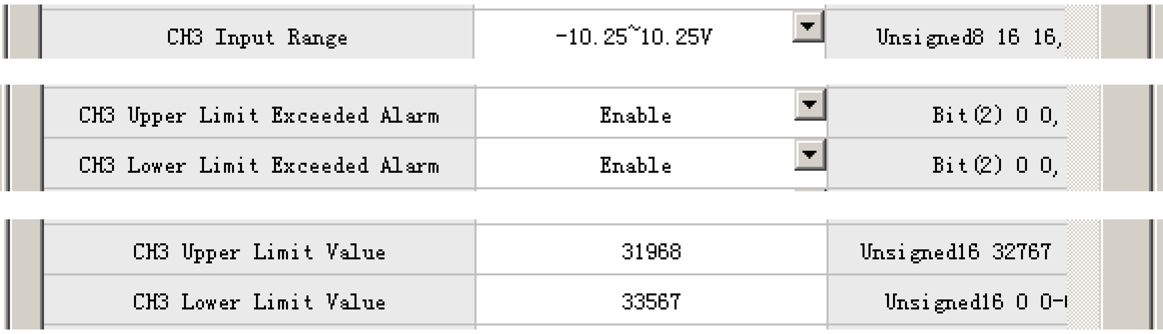
Example of Parameter Setting of Over-limit Alarm with Selected Range

- For range of -10.25 ~ +10.25V, the conversion formula of signal corresponding code value:

  Positive voltage range (0 ~ 10.25V): Corresponding code value = Positive voltage signal × 32767 / 10.25.

  Negative voltage range (-10.25 ~ 0V): Corresponding code value = 65535 + (negative voltage signal × 32767 / 10.25).

  For example, the channel 3, if the range of "-10.25 ~ +10.25V" is selected and the over-limit alarm enables, the user defines the upper limit voltage 10V, the lower limit voltage -10V, then the alarm upper limit = 10 × 32767 / 10.25 = 31968, the alarm lower limit = 65535 + (- 10 × 32767 / 10.25) V = 33567, the relevant user parameter settings are shown in the following figure.



Example of Parameter Setting of Over-limit Alarm with Selected Range

6.4.11.6 Diagnosis

The input channel of LK410 can detect over range, over-limit and line broken, which are channel diagnosis features. Power input channel can implement field power down detection, which is device diagnosis. After calling the function block sysGetDPSlaveState (Get Diagnosis of DP Slave), the channel diagnosis data and the device diagnosis data reported by LK410 are saved into the output parameter **DiagData** in the function block.

Diagnostic information of LK410 up to 28 bytes, wherein 2 bytes are device-related diagnosis, 2 bytes are identification diagnosis and 24 bytes are channel diagnosis. For eight channel of LK410, The diagnosis information for each channel is 3 bytes.

■ Device diagnosis information

The device diagnosis data is 0x02,0x00 indicates that there is no fault on the current device.

The device diagnosis data is 0x02, 0x01 indicates that the current device has channel fault.

Device diagnostic data of 0x02, 0x03 indicates that the current device has a channel failure and an error.

■ Identification number diagnostic information

When there is diagnosis information reported, the 2-byte identification number diagnosis information is 0x42, 0x01.

■ Channel diagnosis information

The channel diagnosis information is shown in the following table.

Specifications for LK410 Channel Diagnosis Information

<table>
<tr><th colspan="6">Diagnosis Information</th><th>Meaning</th></tr>
<tr><td colspan="2">Bit</td><td>Bit7</td><td>Bit6</td><td>Bit5</td><td>Bit4~
Bit0</td><td></td></tr>
<tr><td>The first byte</td><td>Head</td><td colspan="4">0x80</td><td>Decimal online value 128</td></tr>
<tr><td>The second byte</td><td>I/O type/channel</td><td colspan="2">01
(Input)</td><td colspan="2">(Channel)</td><td>Fault channel no. 1~8
Decimal online value 64~71</td></tr>
<tr><td rowspan="3">The third byte</td><td rowspan="3">Channel data type/fault type</td><td colspan="3" rowspan="3">101 (Word)</td><td>2</td><td>Under range, Decimal online value is 162</td></tr>
<tr><td>3</td><td>Over range, Decimal online value is 163</td></tr>
<tr><td>6</td><td>Line broken, Decimal online value is 166</td></tr>
</table>

Diagnosis Information				Meaning
			7	Upper limit exceeded, Decimal online value is 167
			8	Lower limit exceeded, Decimal online value is 168
			0	Channel fault recovery, Decimal online value is 160

Example:

Channel diagnosis data 0x80, 0x42, 0xA6 indicates that channel 3 has line broken alarm. Corresponding online value is 128, 66, 166.

As an I / O slave of HolliTCP protocol, excepte above diagnostic information, refer to LK234_Diagnosis for more diagnostic information.

As an I / O slave of POWERLINK protocol, excepte above diagnostic information, refer to Overview of Diagnosis Information for more diagnostic information.

6.4.11.7 Over Range Alarm

The LK410 module has the function of over range alarm. When the input signal is out of the selected range, the channel diagnostics area will report over range. When the signal is restored within the range, it reports fault recovery.

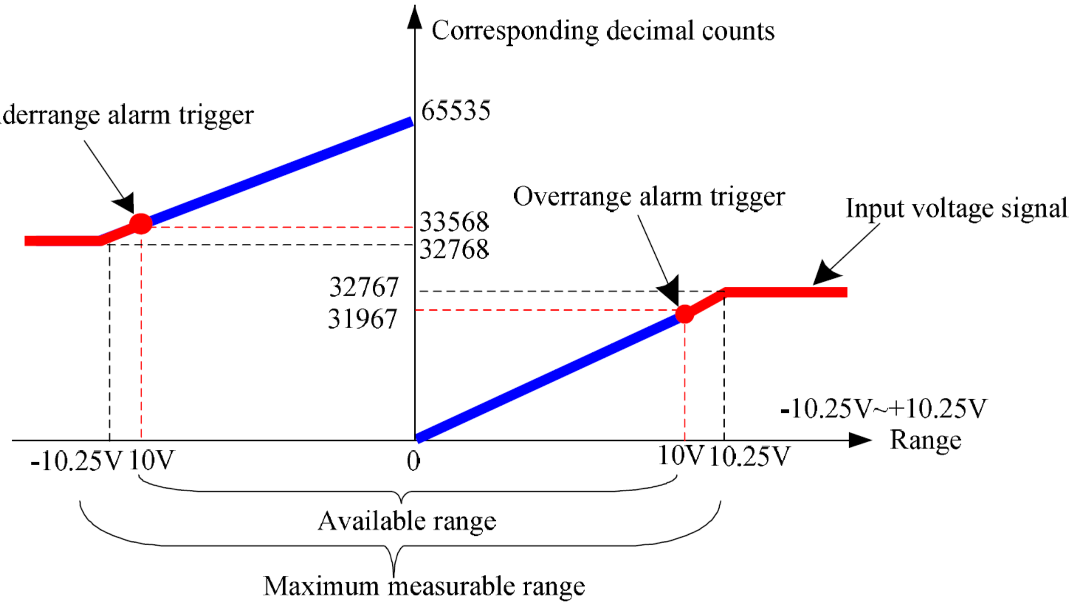
The LK410 module reports diagnostic data only when over range occurs and recovery.

It is important to note that for the LK410 module, the effective range is not the maximum measurable range. When the input signal is out of range, it does not necessarily exceed the maximum measurable range.

When over the range, if not beyond the maximum measurable range, the channel measurement data reports the current signal corresponding code value; If beyond the maximum measurable voltage, the channel measurement data reports the maximum measurable voltage corresponding code value within the range; if lower than the minimum measurable voltage, the channel measurement data reports the minimum measurable voltage corresponding code value within the range.

Definition of LK410 Over Range

Range	Overrange	
	Over Range	Underrange
-10v~10v	> 10v	< -10v
0~10v	> 10v	< 0v
0~5v	> 5v	< 0v



LK410 Over Range Alarm Diagram

As the selected range is different, the diagnostic processing of the modules is different when over range occurred, as shown in table. When the signal is recovered to the normal range, the channel diagnosis byte reports 0xA0.

Processing Method of LK410 Over Range Alarm under Different Ranges

Maximum measurable range	Effective range	Overrange type	Overrange processing
-10.25V~10.25V	-10V~10V	Over range	The channel diagnostic byte reports 0xA3 10 ~ 10.25V, channel measurement data reports the corresponding code value 31967 ~ 32767 > 10.25V, channel measurement data reports 32767
		Underrange	The channel diagnostic byte reports 0xA2 -10.25V ~ -10V, the channel measurement data reports the corresponding code value 32768 ~ 33568 <-10.25V, channel measurement data reports 32768
0~10.25V	0~10V	Over range	The channel diagnostic byte reports 0xA3 10 ~ 10.25V, channel measurement data reports the corresponding code value 63937 ~ 65535 > 10.25V, channel measurement data reports 65535
		Underrange	The channel diagnostic byte reports 0xA2 Channel measurement data reports 0
0~5.125V	0~5V	Over range	The channel diagnostic byte reports 0xA3 5 ~ 5.125V, the channel measurement data reports the corresponding code value 63937 ~ 65535 > 5.125V, channel measurement data reports 65535
		Under range	The channel diagnostic byte reports 0xA2 Channel measurement data reports 0

6.4.11.8 Over-limit Alarm

LK410 module has the function of over-limit alarm. Within the selected range, the user can set the upper and lower alarm limits of the input signal. When the input signal is out of the limited range, that is, higher than the alarm upper limit or lower than the alarm lower limit, the channel diagnostic byte reports over-limit; When the signal is recovered to the limit range, it then reports fault recovery.

The LK410 module reports the diagnostic data once only when the over-limit occurred and recovery of over-limit . As shown in table, the alarm upper limit voltage must be greater than the lower limit voltage; otherwise the LK410 module cannot correctly report the diagnostic information.

Value Range of LK410 Over-limit Alarm

Range	Alarm Signal
-10v~10 V	10 V > Upper Limit Voltage > Lower Limit Voltage > -10 V
0~10 V	10 V > Upper Limit Voltage > Lower Limit Voltage > 0 V
0~5 V	5 V > Upper Limit Voltage > Lower Limit Voltage > 0 V

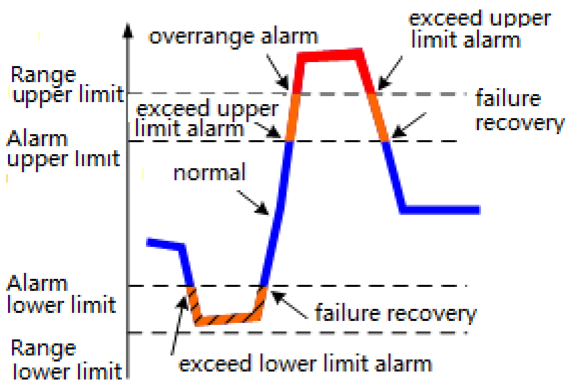
The alarm value in the configuration is the digital code corresponding to the measured signal within the selected range, indicated by a two-byte positive integer code (decimal 0 to 65535). The value range of upper limit of alarm: 1 ~ 65535, the default 32767, the value range of lower limit of alarm: 0 ~ 65534, the default 0, the calculation formula as shown in table.

LK410 Alarm Digital Code Calculation

<table>
<tr><th colspan="2">Range</th><th>Alarm upper limit(decimal)</th><th>Alarm lower limit (decimal)</th></tr>
<tr><td rowspan="2">±10.25V</td><td>-10.25~0V</td><td>65535+(Upper limit voltage×32767/10.25)</td><td>65535+(Lower limit voltage×32767/10.25)</td></tr>
<tr><td>0~10.25V</td><td>Upper limit voltage×32767/10.25</td><td>Lower limit voltage×32767/10.25</td></tr>
<tr><td colspan="2">0~10.25V</td><td>Upper limit voltage×65535/10.25</td><td>Lower limit voltage×65535/10.25</td></tr>
<tr><td colspan="2">0~5.125V</td><td>Upper limit voltage×65535/5.125</td><td>Lower limit voltage×65535/5.125</td></tr>
</table>

Whether the over lower limit alarm function can be set by parameter CH1 ~ CH8 Lower Limit Exceeded Alarm and whether the over upper limit alarm function can be set by parameter CH1 ~ CH8 Upper Limit Exceeded Alarm, and default is disable. After the alarm is enabled, alarm lower limit and alarm upper limit are set by parameter CH1 ~ CH8 Lower Limit Value and CH1 ~ CH8 Upper Limit Value.

Over-limit alarm enable, alarm upper limit, alarm lower limit of 8 input channels shall be set respectively without interfere with each other. If the over-limit alarm enabled and over range occurred at the same time, LK410 reports over range.



LK410 Over-limit Alarm Diagram

When an input channel signal beyond the limit:

- Beyond upper limit, channel diagnostic byte reports 0xA7
- Beyond lower limit, channel the diagnostic byte reports 0xA8

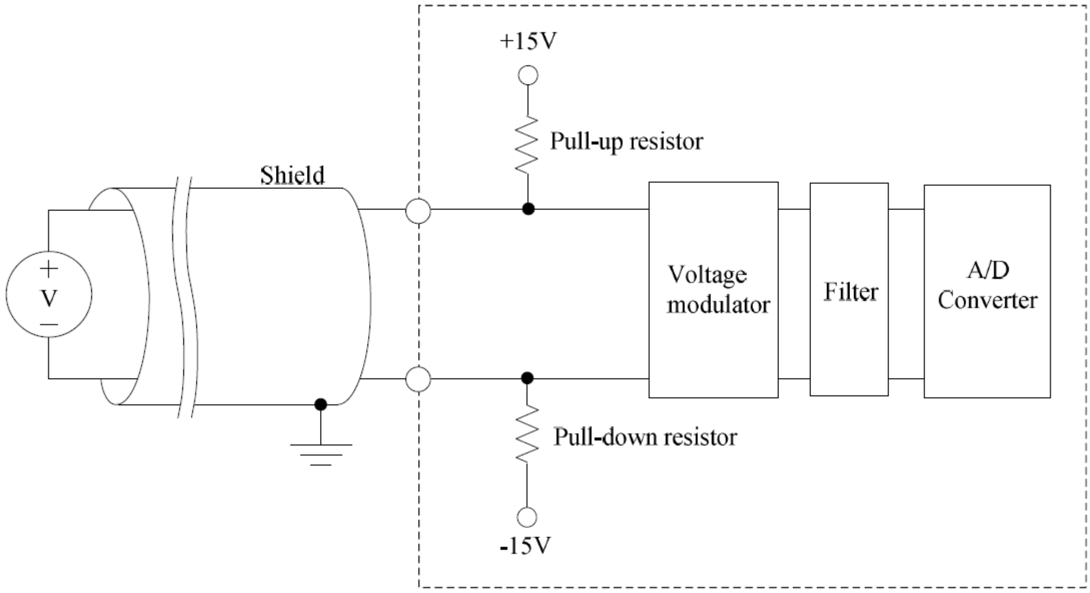
- The channel measurement data reports the current signal corresponding code value
- The signal is recovered to the normal range and the channel diagnostic byte reports 0xA0.

6.4.11.9 Line Broken Detection

The LK410 module has a line broken detection function.

As shown in figure, the signal channel is connected with a 10MΩ pull-up resistor. The LK410 conduct the line broken diagnosis by detecting changes of input voltage between the two wiring terminals. If there is a fault, the fault status is reported to the controller in the form of diagnostic data.

When line broken occurs in the input channel, the positive voltage of the channel is pulled up to + 15V, the negative end of the channel is pulled down to -15V, the voltage difference at the input end of the AD converter reaches the maximum value, and the channel diagnostic byte reports line broken; after line broken recovery, it reports Fault recovery.



LK410 Line Broken detection schematic diagram

The LK410 module reports the diagnostic data only once when line broken occurred and line broken recovery. Whether conduct line broken alarm, configuration optional and the default is disable. If the input channel is not wired, it is considered as line broken. It is recommended to disable line broken alarm function for channel not used, that is, the default value of the Line Break Alarm is maintained and forbidden to modify.

When a channel is broken:

Channel diagnostic byte reports line broken value 0xA6

Channel measurement data reports 65535 or 32768 (-10.25 ~ 10.25V range)

After the line broken is recovered, the channel diagnostic byte reports 0xA0

6.4.11.10 Parameters

The user parameter is used to set the mode of operation of the module and is written into the controller when the project is downloaded. It is not read by each scan cycle. Each parameter has a default value, which can be changed according to the engineering requirements. User parameters do not support online modification, modification takes effect only by full download.

The LK410 module has a total of 46 bytes of user parameters.

LK410 User Parameter List

Parameter Name	Parameter Description	Parameter Value
Filter Mode	Digital filter mode selection parameters	0=No Filter, No filtering is performed 1=10Hz Filter, Interference filtering on 10Hz 2=50Hz Filter, Interference filtering on 50Hz(default) 3=60Hz Filter, Interference filtering on 60Hz 4=400Hz Filter, Interference filtering on 400Hz
Sample Rate	Sample rate selection	0: Fast, the fastest sample rate 1: Normal, Drift inhibit function enable, but the internal sampling time is doubled (default)
CH1 Input Range	CH1 Range Selection	16=-10.25~10.25V range(default) 17=0~10.25V range 18=0~5.125V range
CH2 Input Range	CH2 Range Selection	
CH3 Input Range	CH3 Range Selection	
CH4 Input Range	CH4 Range Selection	
CH5 Input Range	CH5 Range Selection	
CH6 Input Range	CH6 Range Selection	
CH7 Input Range	CH7 Range Selection	
CH8 Input Range	CH8 Range Selection	
CH1 Digital Filter	CH1 Software Filtering Selection	0 = None, no software filtering (default) 1 = 4 Points, Choosing the latest four historical data 2 = 8 Points, Choosing the latest eight historical data 3 = 16 Points, Choosing the latest sixteen historical data
CH2 Digital Filter	CH2 Software Filtering Selection	
CH3 Digital Filter	CH3 Software Filtering Selection	
CH4 Digital Filter	CH4 Software Filtering Selection	
CH5 Digital Filter	CH5 Software Filtering Selection	
CH6 Digital Filter	CH6 Software Filtering Selection	
CH7 Digital Filter	CH7 Software Filtering Selection	
CH8 Digital Filter	CH8 Software Filtering Selection	
CH1 Upper Limit Exceeded Alarm	CH1 Upper Limit Exceeded Alarm Enable	0:Disable,(default) 1:Enable
CH1 Lower Limit Exceeded Alarm	CH1 Lower Limit Exceeded Alarm Enable	
CH2 Upper Limit Exceeded Alarm	CH2 Upper Limit Exceeded Alarm Enable	
CH2 Lower Limit Exceeded Alarm	CH2 Lower Limit Exceeded Alarm Enable	
CH3 Upper Limit Exceeded Alarm	CH3 Upper Limit Exceeded Alarm Enable	
CH3 Lower Limit	CH3 Lower Limit Exceeded	

Parameter Name	Parameter Description	Parameter Value
Exceeded Alarm	Alarm Enable	
CH4 Upper Limit Exceeded Alarm	CH4 Upper Limit Exceeded Alarm Enable	
CH4 Lower Limit Exceeded Alarm	CH4 Lower Limit Exceeded Alarm Enable	
CH5 Upper Limit Exceeded Alarm	CH5 Upper Limit Exceeded Alarm Enable	
CH5 Lower Limit Exceeded Alarm	CH5 Lower Limit Exceeded Alarm Enable	
CH6 Upper Limit Exceeded Alarm	CH6 Upper Limit Exceeded Alarm Enable	
CH6 Lower Limit Exceeded Alarm	CH6 Lower Limit Exceeded Alarm Enable	
CH7 Upper Limit Exceeded Alarm	CH7 Upper Limit Exceeded Alarm Enable	
CH7 Lower Limit Exceeded Alarm	CH7 Lower Limit Exceeded Alarm Enable	
CH8 Upper Limit Exceeded Alarm	CH8 Upper Limit Exceeded Alarm Enable	
CH8 Lower Limit Exceeded Alarm	CH9 Lower Limit Exceeded Alarm Enable	
CH1 Upper Limit Value	CH1 Alarm Upper Limit Setting	Alarm lower limit range:0~65534 Alarm upper limit range:1~65535 Alarm lower limit :0 Alarm upper limit:32767 The calculation method is shown in Measured_Data_Output_Format
CH1 Lower Limit Value	CH1 Alarm Lower Limit Setting	
CH2 Upper Limit Value	CH2 Alarm Upper Limit Setting	
CH2 Lower Limit Value	CH2 Alarm Lower Limit Setting	
CH3 Upper Limit Value	CH3 Alarm Upper Limit Setting	
CH3 Lower Limit Value	CH3 Alarm Lower Limit Setting	
CH4 Upper Limit Value	CH4 Alarm Upper Limit Setting	
CH4 Lower Limit Value	CH4 Alarm Lower Limit Setting	
CH5 Upper Limit Value	CH5 Alarm Upper Limit Setting	
CH5 Lower Limit Value	CH5 Alarm Lower Limit Setting	
CH6 Upper Limit Value	CH6 Alarm Upper Limit Setting	
CH6 Lower Limit Value	CH6 Alarm Lower Limit Setting	
CH7 Upper Limit Value	CH7 Alarm Upper Limit Setting	
CH7 Lower Limit Value	CH7 Alarm Lower Limit Setting	
CH8 Upper Limit Value	CH8 Alarm Upper Limit Setting	
CH8 Lower Limit Value	CH8 Alarm Lower Limit Setting	
CH1 Line Break Alarm	CH1 Line Break Alarm Enable	0:Disable,(default) 1:Enable

Parameter Name	Parameter Description	Parameter Value
CH2 Line Break Alarm	CH2 Line Break Alarm Enable	
CH3 Line Break Alarm	CH3 Line Break Alarm Enable	
CH4 Line Break Alarm	CH4 Line Break Alarm Enable	
CH5 Line Break Alarm	CH5 Line Break Alarm Enable	
CH6 Line Break Alarm	CH6 Line Break Alarm Enable	
CH7 Line Break Alarm	CH7 Line Break Alarm Enable	
CH8 Line Break Alarm	CH8 Line Break Alarm Enable	

6.4.11.11 Technical Specifications

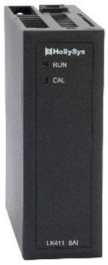
LK410 8-Channel Voltage Type Analog Input Module				
System power supply				
Supply Voltage	24VDC(-10%~+10%)			
Power consumption	100mA@24VDC			
Input channel				
Channel number	8			
Range code	16		17	18
Maximum measurable range	-10.25~0V	0~10.25V	0~10.25V	0~5.125V
Reported data format	32768~65535	0~32767	0~65535	0~65535
ADC resolution rate	16 bits			
Sampling period (full channel scan time)	<480ms(No software filtering)			
Input resistance	>1MΩ			
Step response	It takes less than 1s to reach the 90% of the target value.			
Differential mode rejection ratio	80dB			
Common mode rejection ratio	100dB			
Measurement accuracy	0.1% F.S.@25℃			
Calibration accuracy	0.03% F.S.@25℃			
Temperature drift	±25ppm/℃			
Field and system isolation voltage	500VAC@1min, leaking current 5mA			
Fault diagnosis and hot swapping				
Overrange alarm	The signal range is exceed the upper limit of the range or the lower limit of the range. The diagnostic byte reports 0xA3 / 0xA2.			
Over-limit alarm	The signal range exceeds the alarm upper limit / alarm limit and the diagnostic byte reports 0xA7 / 0xA8.			
Disconnection detection	Fault occurs, diagnostic byte reports 0xA6, channel measurement data reports 65535 or 32767			
Hot swapping	Supported			
Communication bus				
Protocol	Profibus-DP			

LK410 8-Channel Voltage Type Analog Input Module	
Baud rate	1.5Mbps, 500Kbps, 187.5Kbps , 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps adaptive
Medium	Communication bus is connected to the backplane through euro connector, hot redundant communication media.
Physical characteristics	
Protection Key	A0
Installation position	Expansion backplane
Module Dimension (W*H*D)	35mm×100mm×100mm
Enclosure protection class	IEC60529 IP20
Weight	190g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.4.12 LK411 8-channel Current Type Analog Input Module

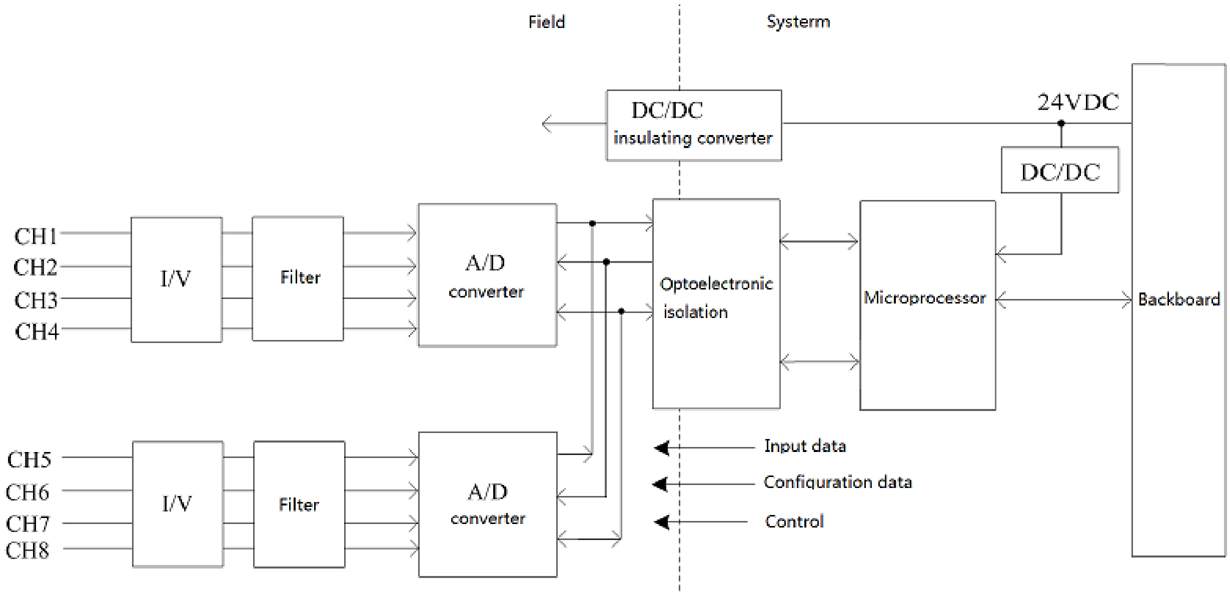
6.4.12.1 Basic Features

- 8-channel current input
- Applicable range: 0~20 mA/4~20 mA
- Max. measurable value: 0~20.58 mA/4~20.58 mA
- Field calibration
- Over-limit alarm
- Over range alarm
- Line broken detection
- Isolation between the system and the field channel
- Hot swapping



LK411 Module Schematic Diagram

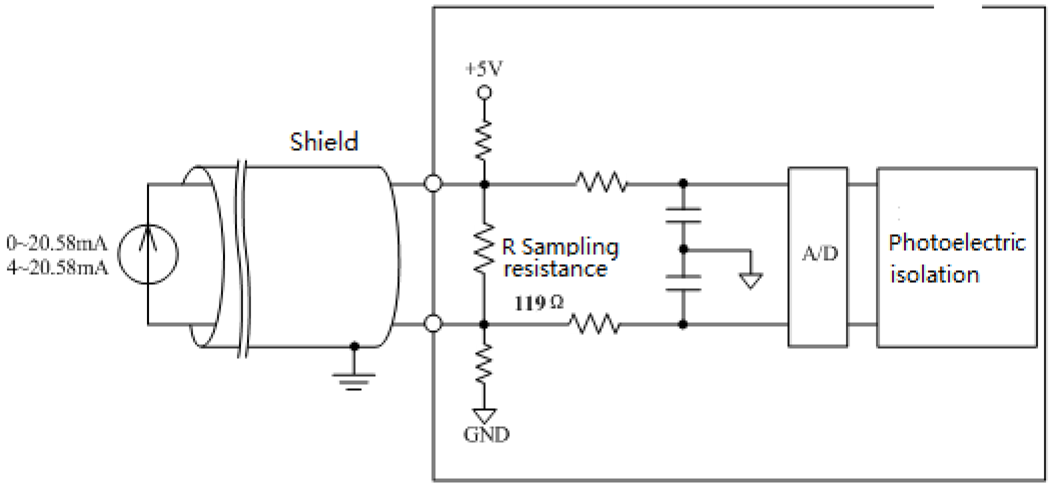
6.4.12.2 Operating Principle



Internal Structure Block Diagram of LK411

The 24 VDC system power supply of the LK411 module supplies the power to the field interface circuit by outputting 5 VDC via isolated DC/DC. The interface circuit is connected to other circuits by using opto-isolators, thus realizing the isolation between the field circuit and the system.

For the channel interface as shown in figure, the current signal is converted into a digital signal via current/voltage conversion, filtering and A/D conversion. Via optoelectronic isolation, it is read by the microprocessor of the module, then uploaded to the controller module via the DP bus.



LK411Channel Interface Circuit Diagram

6.4.12.3 Indicators

There are two status indicators on the front panel of the module: the green RUN indicator and the yellow CAL indicator. The RUN indicator is the run indicator indicator, indicating the communication status between the module and the controller module. The CAL indicator is the calibration indicator, indicating the calibration process(Calibration model is not introduced in this article, please contact HollySys service agencies if necessary).

Definition of LK411 Indicators

Name	Status	Description
RUN indicator (green)	On	The communication is established, and the module works well
	Flash	The communication is not established or incorrect.
	Off	The module is not powered on or fault.
CAL Calibration indicator (yellow)	On	In the calibration and detection mode, undergoing calibration and detection
	Flash	In the calibration no detection mode, but undergoing no calibration and detection
	Off	It is not powered up or the communication is not established or the module does not in the calibration and detection mode

■ Running Mode

□ Immediately after being powered on, the module waits for the initialized data, with a green indicator flashing based on a frequency of 4 times/second.

□ Upon the completion of initialization, the green indicator is turned normally on, which indicates that the module works well. In case of any error in the initialized data, communication cannot be established and the green indicator keeps flashing. Check whether the DP is connected properly and the communication parameters (communication rate, communication station No.) are set properly.

□ When the module works well, the green indicator is normally on; when the communication is disconnected, the green indicator flashes; when the communication is established again, the green indicator is turned normally on again.

□ The yellow indicator is normally off when the module is in the running mode.

Definition of LK411 Indicators in Running Mode

	RUN indicator	CAL indicator	Meaning
Running Mode	Off	Off	Not powered up
	Flash	Off	The communication is not established or incorrect.
	On	Off	The communication is established, the module works well

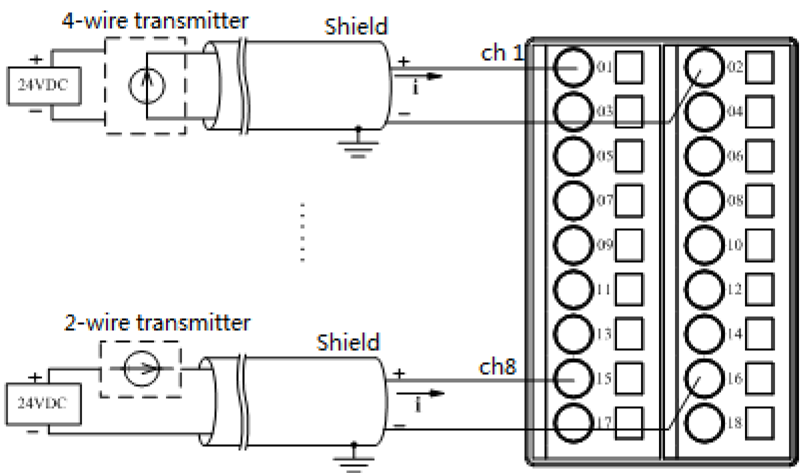
6.4.12.4 Wirings

The output channel of LK411 does not supply power externally. When connected to a transmitter based on the two-wire system, a separate 24 DC field power supply is provided separately externally to the transmitter. To ensure the isolation between the field and the system, the field power supply shall be configured separately and cannot be commonly used as the power supply for the backplane.

The LK411 module is installed on the extension backplane.

Definition of LK411 Backplane Terminals

Channel No.	Sequence of Terminals	
	Positive Terminal of Power input	Negative terminal of Power input
1	01	02
2	03	04
3	05	06
4	07	08
5	09	10
6	11	12
7	13	14
8	15	16



Backplane Terminal Wiring Schematic Diagram

Pay attention to the following during wiring:

- The two-row 18-channel terminals are fixed on the backplane, right located under the installation position of the LK411 module.
- Each AI signal is separately connected to the terminals via two conductors (shielded cable) in the field.
- The output channel does not supply power to the transmitter. When connected to a transmitter based

on the two-wire system, a separate 24 DC field power supply is provided separately to the transmitter.

- To ensure the isolation between the field and the system, the field power supply shall be configured separately and cannot be commonly used as the power supply for the backplane.
- Terminals 17 and 18 are not used, with wiring forbidden.

6.4.12.5 Measured data output format

As shown in table, the measured data on the AI channel that is reported by the LK411 module, is expressed in form of 2-byte positive integer (decimal: 0~65,535) digital code.

Corresponding Relationship between LK411 Input Current and Digital Code

Max. Measurable Range	Corresponding Decimal Digital Code
4~20.58 mA	0~65,535
0~20.58 mA	0~65,535

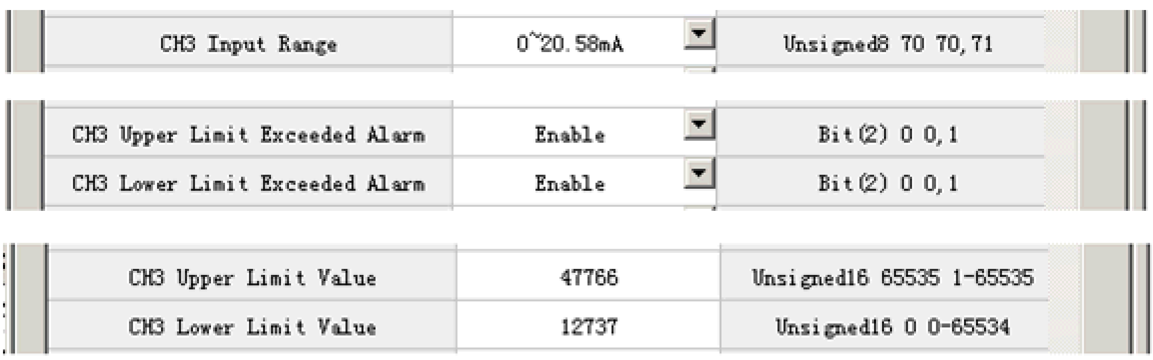
By calling the function block HEX_ENGIN of the Analog signal Processing Functions library in the programming software AutoThink, it can convert the 2-byte measured data into the engineering data. Refer to the HEX_ENGIN for the specific application of the function blocks.

Set the alarm upper limit and alarm lower limit in the [User parameters] in accordance with the formula set in table, the current signal is converted to a decimal digital code to fill in.

Data Conversion Formula of LK411 Module

Max. Measurable Range	Formula of Corresponding Digital Code
4≤I≤20.58 mA	(I—4) ×65,535/16.58 (I—4) ×65,535/16.58
0≤I≤20.58 mA	I×65,535/20.58

Example: for Channel 3, in case the range is selected as 0~20.58mA, over-limit enabled, user defined upper current limit: 15mA, lower current limit: 4mA, then Upper Limit Value for Channel 3 =15×65,535/20.58=47766, Lower Limit Value for Channel 3 =4×65,535/20.58=12,737. Refer to figure for the relevant user parameter settings.

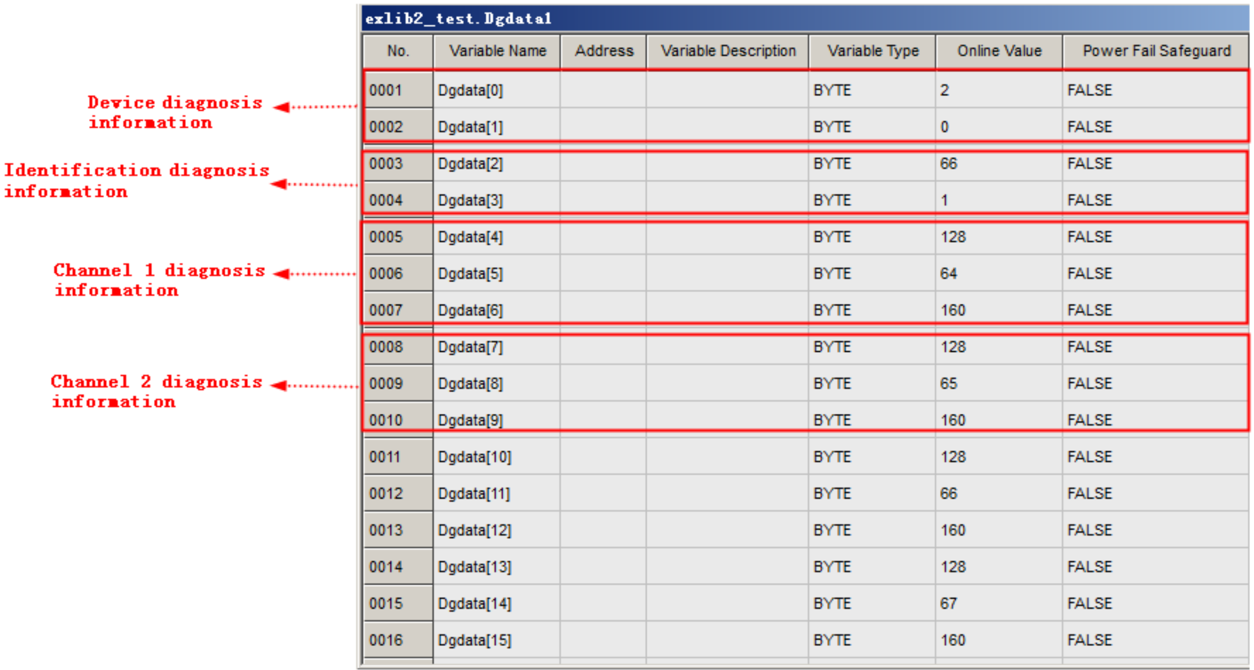


Examples of Over-limit Alarm Parameter Settings Based on Selected Range

6.4.12.6 Diagnosis

The input channel of LK411 can detect over range, over-limit and line broken, which are channel diagnosis features. The power input channel is capable of field power loss detection, which is of a device diagnosis. After calling the function block Get Diagnosis of DP slave (sysGetDPSlaveState), the diagnosis data and the device diagnosis data reported by LK411 are saved into the output parameter **DiagData** in the function block.

Diagnostic information of LK411 up to 28 bytes, wherein 2 bytes are device-related diagnosis, 2 bytes are identification diagnosis and 24 bytes are channel diagnosis. For eight channel of LK411, The diagnosis information for each channel is 3 bytes.



No.	Variable Name	Address	Variable Description	Variable Type	Online Value	Power Fail Safeguard
0001	Dgdata[0]			BYTE	2	FALSE
0002	Dgdata[1]			BYTE	0	FALSE
0003	Dgdata[2]			BYTE	66	FALSE
0004	Dgdata[3]			BYTE	1	FALSE
0005	Dgdata[4]			BYTE	128	FALSE
0006	Dgdata[5]			BYTE	64	FALSE
0007	Dgdata[6]			BYTE	160	FALSE
0008	Dgdata[7]			BYTE	128	FALSE
0009	Dgdata[8]			BYTE	65	FALSE
0010	Dgdata[9]			BYTE	160	FALSE
0011	Dgdata[10]			BYTE	128	FALSE
0012	Dgdata[11]			BYTE	66	FALSE
0013	Dgdata[12]			BYTE	160	FALSE
0014	Dgdata[13]			BYTE	128	FALSE
0015	Dgdata[14]			BYTE	67	FALSE
0016	Dgdata[15]			BYTE	160	FALSE

Diagnosis Information diagram

- Device diagnosis information

  Device diagnosis data 0x02,0x00 indicates the current device without any fault.

  Device diagnosis data 0x02,0x01 indicates that the current device has channel fault.

- Identification diagnosis information

  The 2-byte identification diagnosis information is 0x42,0x01 when diagnosis information is reported.

- Channel diagnosis information

  Channel diagnosis information as shown in table.

Specifications for LK411 Channel Diagnosis Information

Diagnosis Information						Meaning
Bit		Bit7	Bit6	Bit5	Bit4~Bit0	
The first byte	Head	0x80				Decimal online value 128

The second byte	I/O type/channel	01 (Input)	（Channel）	Failed channel no 1~8 Decimal online value 64~71
The third byte	Channel data type/fault type	101 (Word)	2	Under range, Decimal online value is 162
			3	Over range, Decimal online value is 163
			6	Line Broken Decimal online value is 166
			7	Upper limit exceeded, Decimal online value is 167
			8	Lower limit exceeded, Decimal online value is 168
			0	Channel fault recovery, Decimal online value is 160

Example:

Channel diagnosis data 0x80, 0x42, 0xA6 indicates that channel 3 has line broken alarm. Corresponding online value is 128, 66, 166.

As an I / O slave of HolliTCP protocol, excepte above diagnostic information, refer to LK234_Diagnosis for more diagnostic information.

As an I / O slave of POWERLINK protocol, excepte above diagnostic information, refer to Overview of Diagnosis Information for more diagnostic information.

6.4.12.7 Over Range Alarm

The LK411 module is capable of over range alarm. When the signal goes beyond the selected range, the channel diagnosis byte reports over range, when the signal is recovered, it then reports fault recovery.

The LK411 module only reports the diagnosis data once separately when over range occurs and is recovered.

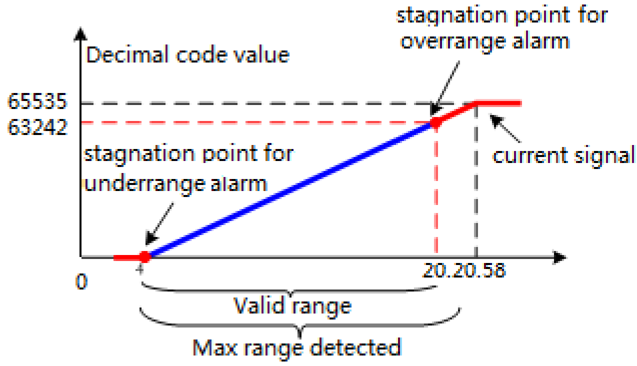
ⓘFor the LK411 module, the effective range is the max. measurable range. When the output signal exceeding the range, it may not exceed the Max. Measurable range.

In case of over range while within the Max. Measurable range, the measured channel data then reports the code value corresponding to the current signal; if more than the Max. Measurable current, the measured channel data then reports the full range code value 0xFFFF; if less than the Min. measured current, the measured channel data then reports the code value 0x0000.

Over Range Definition of LK411

Range	**Over Range**	
	Over Range	Under Range
0~20 mA	＞20 mA	-
4~20 mA	＞20 mA	0＜…＜4mA

ⓘNo Under Range Alarm is available in the range of 0~20 mA, with an line broken reported when the current is less than 0.



LK411 Over Range Alarm Schematic Diagram

Due to the different ranges selected, the diagnosis handling methods of the module may also differ in case of over range, as shown in table. When the signal is recovered to the normal range, the channel diagnosis byte then reports 0xA0.

Handling of LK411 Over Range Alarm Based on Different Ranges

Max. Measurable Range	Effective Range	Type of Over Range	Handling of Over Range
0~20.58mA	0~20mA	Over Range	The channel diagnosis byte reports 0xA3 20~20.58 mA, the measured channel data reports the code value ranging 63,688~65,535 of the current signal ＞20.58 mA, the measured channel data reports 65,535
4~20.58mA	4~20mA	Over Range	The channel diagnosis byte reports 0xA3 20~20.58 mA, the measured channel data reports the code value ranging 63,242~65,535 of the current signal >20.58 mA, the measured channel data reports 65,535
		Under Range	The channel diagnosis byte reports 0xA2 The measured channel data reports 0

6.4.12.8 Over-limit Alarm

The LK411 module is capable of over-limit alarm. In the selected range, the user can set Upper Limit Value and Lower Limit Value of the input signal by his or her own. When the input signal goes beyond the limit range, that is, higher than Upper Limit Value or lower than Lower Limit Value, the channel diagnosis byte then reports over-limit. When the signal is recovered to the limit range, it then reports fault recovery**.**

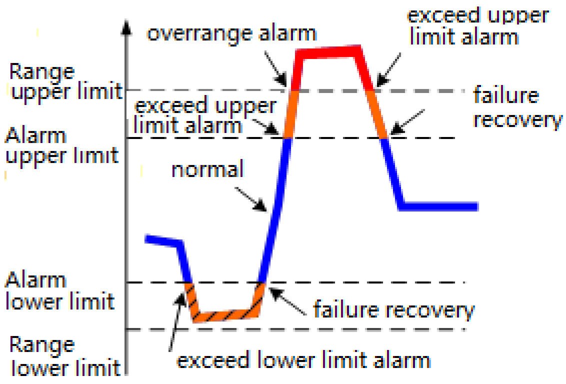
The LK411 module only reports the diagnosis data once separately when over-limit occurs and is recovered. It can select whether to give an over-limit alarm during configuration, defaulted to disabled. Upper Limit Value and Lower Limit Value for each channel are customized. The upper limit current must be more than the lower limit current. Otherwise, the LK411 module cannot report the diagnosis message properly.

If over-limit and over range occur simultaneously, only over range is reported.

Range of LK411 Over-limit Alarm Values

Range	Alarm Signal
0~20 mA	20 mA＞Upper Limit Current＞Lower Limit Current＞0 mA
4~20 mA	20 mA>Upper Limit Current>Lower Limit Current> 4 mA

The alarm value in the configuration is the digital code value corresponding to the measured signal in the selected range, expressed in a two-byte decimal digital code (0~65,535). Range of upper limit value: 1~65,535, defaulted to 65,535; range of lower limit value values: 0~65,534, defaulted to 0. Refer to Measured_Data_Output_Format for the specific calculation methods.



Over-limit Alarm Schematic Diagram

When certain input channel signal over-limits:

- If going beyond the upper limit, the channel diagnosis byte then reports 0xA7.
- If going beyond the lower limit, the channel diagnosis byte then reports 0xA8.
- The measured channel data reports the code value corresponding to the current signal.
- If the signal is recovered to the normal range, the channel diagnosis byte then reports 0x0A0.

6.4.12.9 Line Broken Detection

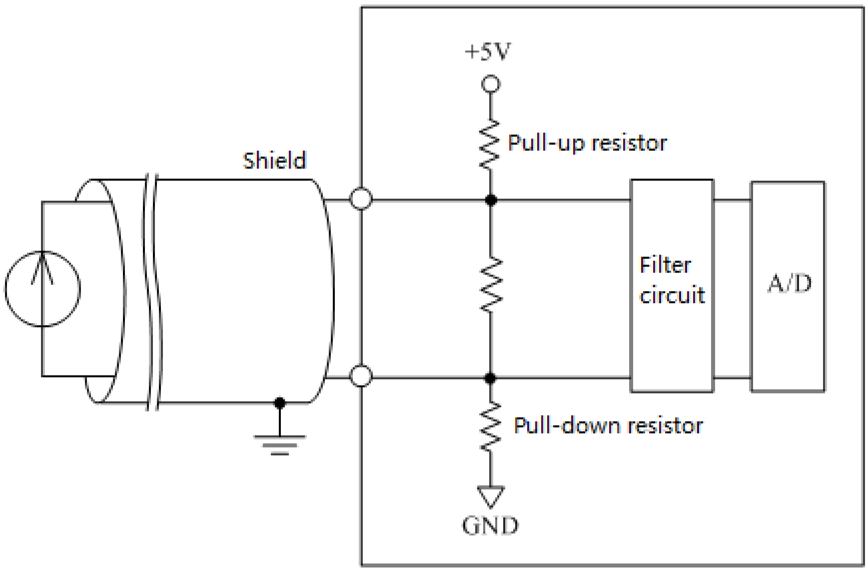
The LK411 module is capable of line broken detection.

As shown in figure, the signal channel is connected to a 10 MΩ pull-up resistor. The LK411 makes an line broken diagnosis according to the input voltage change between the two terminals. In case of a failure, report the fault status in form of diagnosis data to the controller module. When the input channel signal connection is broken, the voltage at the positive terminal of the channel is pulled up to +5V, the negative terminal of the channel is pulled down to GND, with the voltage difference at the input terminal of the AD converter reaching to the max. value. The channel diagnosis byte then reports line broken. After the line broken is recovered, the channel diagnosis area then reports fault recovery.

The LK411 module only reports the diagnosis data once separately when a line break occurs and is recovered. It can select whether to give an line broken alarm during configuration, defaulted to disabled. If the input channel is not connected or connected reversely (with negative current), it can be considered as broken. It is suggested to disable line broken alarm for channels that are not used, that is, to hold the default parameter line break Alarm unchanged.

When certain channel is broken:

- The channel diagnosis byte reports line broken fault value 0xA6.
- The measured channel data reports the code value 0x0000.
- After the line broken is recovered, the channel diagnosis byte reports 0xA0.



LK411 Line Broken Detection Schematic Diagram

6.4.12.10 LK411 Parameters

The user parameter is used to set the operation mode of the module. The controller module written when downloading the user program may not be read in each scanning period. Each parameter has a default, able to modify the parameter value according to the project requirements. The user parameter does not support online modification. The modification takes effect only upon full download.

The user parameter of the LK411 module occupies 46 bytes.

LK411 User Parameters

<table>
<tr><th>Parameter Name</th><th>Meaning</th><th>Value</th></tr>
<tr><td>Filter Mode</td><td>Parameter for selecting a digital filtering mode</td><td>0=No Filter, not to filter
1=10 Hz Filter, to filter the 10 Hz interference
2=50 Hz Filter, to filter 50 Hz interference (default)
3=60 Hz Filter, to filter the 60 Hz interference
4=400 Hz Filter, to filter the 400 Hz interference</td></tr>
<tr><td>Sample Rate</td><td>To select the sampling rate</td><td>0=Fast, fastest sampling rate
1=Normal (default, drift suppression enabled, but with the internal sampling time doubled)</td></tr>
<tr><td>CH1 Input Range</td><td>To select the range of Channel 1</td><td rowspan="7">70=0~20.58 mA (default)
71=4~20.58 mA</td></tr>
<tr><td>CH2 Input Range</td><td>To select the range of Channel 2</td></tr>
<tr><td>CH3 Input Range</td><td>To select the range of Channel 3</td></tr>
<tr><td>CH4 Input Range</td><td>To select the range of Channel 4</td></tr>
<tr><td>CH5 Input Range</td><td>To select the range of Channel 5</td></tr>
<tr><td>CH6 Input Range</td><td>To select the range of Channel 6</td></tr>
<tr><td>CH7 Input Range</td><td>To select the range of Channel 7</td></tr>
</table>

Parameter Name	Meaning	Value
CH8 Input Range	To select the range of Channel 8	
CH1 Digital Filter	To select software filtering of Channel 1	0=None, without software filtering (default) 1=4 Points, to select the latest 4 historical data 2=8 Points, to select the latest 8 historical data 3=16 Points, to select the latest 16 historical data
CH2 Digital Filter	To select software filtering of Channel 2	
CH3 Digital Filter	To select software filtering of Channel 3	
CH4 Digital Filter	To select software filtering of Channel 4	
CH5 Digital Filter	To select software filtering of Channel 5	
CH6 Digital Filter	To select software filtering of Channel 6	
CH7 Digital Filter	To select software filtering of Channel 7	
CH8 Digital Filter	To select software filtering of Channel 8	
CH1 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 1	0: Disable (default) 1: Enable
CH1 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 1	
CH2 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 2	
CH2 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 2	
CH3 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 3	
CH3 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 3	
CH4 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 4	
CH4 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 4	
CH5 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 5	
CH5 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 5	
CH6 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 6	
CH6 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 6	
CH7 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 7	
CH7 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 7	
CH8 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 8	
CH8 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 8	
CH1 Upper Limit Value	To set Upper Limit Value of Channel 1	Range of Lower Limit Values: 0~65,534 Range of Upper Limit Values: 1~ 65,535 Default of lower limit value: 0 Default of upper limit value: 65,535 Refer to Measured_Data_Output_Format for the calculation method.
CH1 Lower Limit Value	To set Upper Limit Value of Channel 1	
CH2 Upper Limit Value	To set Upper Limit Value of Channel 2	

Parameter Name	Meaning	Value
CH2 Lower Limit Value	To set Upper Limit Value of Channel 2	
CH3 Upper Limit Value	To set Upper Limit Value of Channel 3	
CH3 Lower Limit Value	To set Upper Limit Value of Channel 3	
CH4 Upper Limit Value	To set Upper Limit Value of Channel 4	
CH4 Lower Limit Value	To set Upper Limit Value of Channel 4	
CH5 Upper Limit Value	To set Upper Limit Value of Channel 5	
CH5 Lower Limit Value	To set Upper Limit Value of Channel 5	
CH6 Upper Limit Value	To set Upper Limit Value of Channel 6	
CH6 Lower Limit Value	To set Upper Limit Value of Channel 6	
CH7 Upper Limit Value	To set Upper Limit Value of Channel 7	
CH7 Lower Limit Value	To set Upper Limit Value of Channel 7	
CH8 Upper Limit Value	To set Upper Limit Value of Channel 8	
CH8 Lower Limit Value	To set Upper Limit Value of Channel 8	
CH1 Line Break Alarm	To enable Line Break Alarm of Channel 1	0: Disable (default) 1: Enable
CH2 Line Break Alarm	To enable Line Break Alarm of Channel 2	
CH3 Line Break Alarm	To enable Line Break Alarm of Channel 3	
CH4 Line Break Alarm	To enable Line Break Alarm of Channel 4	
CH5 Line Break Alarm	To enable Line Break Alarm of Channel 5	
CH6 Line Break Alarm	To enable Line Break Alarm of Channel 6	
CH7 Line Break Alarm	To enable Line Break Alarm of Channel 7	
CH8 Line Break Alarm	To enable Line Break Alarm of Channel 8	

6.4.12.11 Technical Specifications

LK411 8-channel Current Type Analog Input Module		
System Power		
Power Voltage	24VDC (-15%~+20%)	
Power consumption	60 mA@24 VDC	
Input channel		
Number of channels	8	
Range Code	70	71
Max. Measurable Range	0-20.58 mA	4-20.58 mA

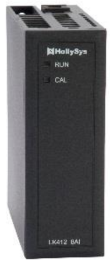
LK411 8-channel Current Type Analog Input Module		
Reported Data Format	0x0000~0xFFFF	0x0000~0xFFFF
ADC Resolution	16-bit	
Sampling Period (Full-channel Scanning Time)	<480 ms (with no software filtering)	
Input Impedance	243 ±7Ω	
Step Response Time	The time reaching to 90% of the target value is better than 1s	
Differential Mode Rejection Ratio	80 dB	
Common Mode Rejection Ratio	100 dB	
Measurement Accuracy	0.1% F.S.@25℃	
Calibration Accuracy	<0.03% F.S.@25℃	
Temperature drift	±25 ppm/℃	
Isolation Voltage between Field and System	500 VAC@1 min, leaking current: 5 mA	
Failure Diagnosis and Hot Plug		
Over Range Alarm	When the signal exceeds the upper/lower limit of the range, the diagnosis byte then reports 0xA3/0xA2	
Over-limit Alarm	When the signal range exceeds the upper/lower limit of the alarm, the diagnosis byte then reports 0xA7/0xA8	
Line Break Detection	When the channel is broken, the diagnosis then reports 0xA6; when the fault recovered, it then reports 0xA0	
Hot Plugging	Supported	
Communication Bus		
Protocol	Profibus-DP	
Baud Rate	1.5Mbps, 500Kbps, 187.5Kbps , 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps adaptive	
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media	
Physical Property		
Protection Key	A1	
Installation Position	Extension backplane	
Module Dimension (W*H*D)	35 mm×100 mm×100 mm	
Enclosure Protection Rating	IEC60529 IP20	
Weight	190 g	
Environmental Adaptability		
Operating Temperature	-20℃~70℃	
Operating Humidity	5%~95%, with no condensation	
Storage Temperature	-40℃~80℃	
Storage Humidity	5%~95%, with no condensation	

6.4.13 LK412 6-channel Isolation Analog Input Module

6.4.13.1 Basic Features

- 6-channel analog input, inter-channel isolation
- Applicable ranges: 0~20 mA/4~20 mA/-10 V~10 V/0~10 V/0~5 V

- Max. measurable range: 0~20.58 mA/4~20.58 mA/-10.25 V~10.25 V/0~10.25 V/0~5.125 V
- Field calibration
- Over-limit alarm
- Over range alarm
- Line broken detection
- Isolation between the system and the field channel
- Hot swapping

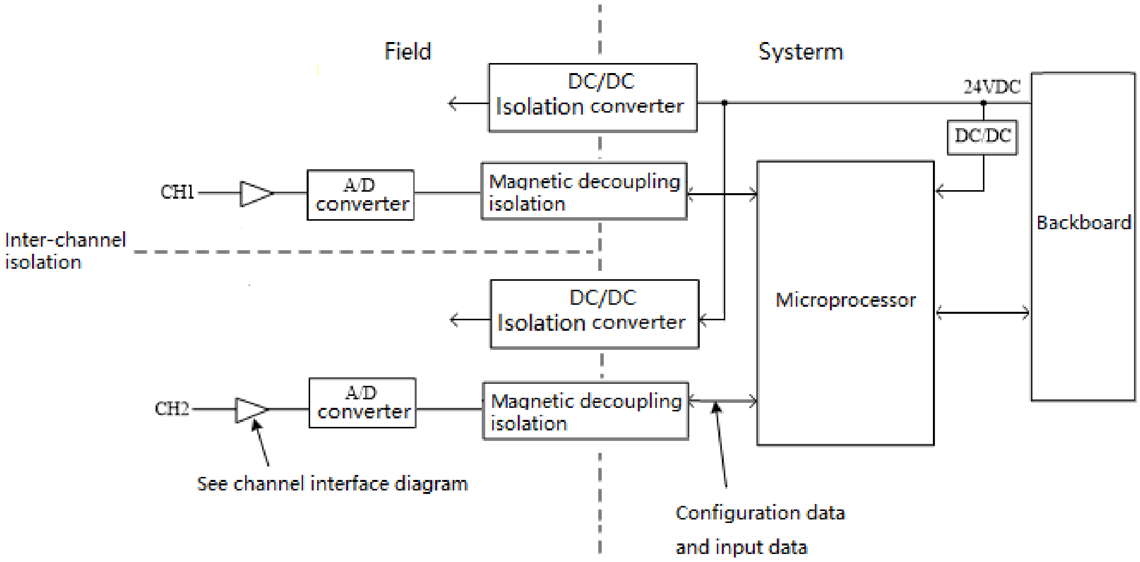


LK412 Module Schematic Diagram

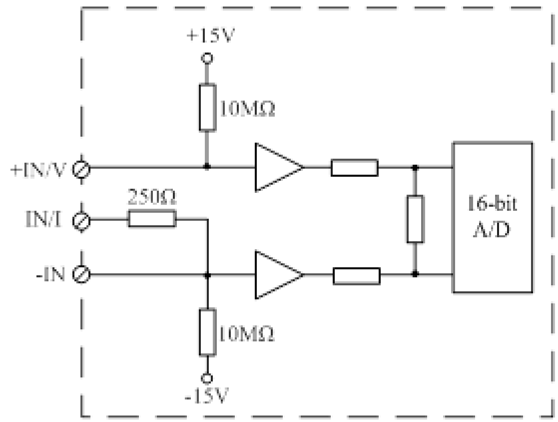
6.4.13.2 Operating Principle

The LK412 adopts a 24 VDC power supply as the input power supply. The 24V DC power supply output ±15 VDC via isolated DC/DC to power supply separately to the interface circuit of each channel (field circuit), based on inter-channel electrical isolation. The interface circuit is connected via magnetic coupling with other circuits, thus realizing the isolation between the field and the system.

The current signal is converted into a digital signal via I/V, filtering, A/D, uploaded to the controller module via the DP bus. The voltage signal is converted into a digital signal via voltage conversion, filtering and A/D, uploaded to the controller module via the DP bus.



Internal Structure Block Diagram of LK412



Channel Interface Circuit of LK412 Module

6.4.13.3 Indicators

There are two status indicator on the front panel of the module: the green **RUN** indicator and the yellow **CAL** indicator. The **RUN** indicator is the run indicator indicator, indicating the communication status between the module and the controller module. The **CAL** indicator is the calibration indicator, indicating the calibration process(Calibration model is not introduced in this article, please contact HollySys service agencies if necessary).

Definition of LK412 Indicators

Name	Status	Description
RUN indicator (green)	On	The communication is established, and the module works well
	Flash	The communication is not established or incorrect.
	Off	The module is not powered on or fault.
CAL Calibration indicator	On	In the calibration and detection mode, undergoing calibration and detection
	Flash	In the calibration no detection mode, but undergoing no calibration and detection

Name	Status	Description
(yellow)	Off	It is not powered up or the communication is not established or the module does not in the calibration and detection mode

■ Running Mode

□ Immediately after being powered on, the module waits for the initialized data, with the green indicator flashing based on a frequency of 4 times/second.

□ Upon the completion of initialization, the green indicator is turned normally on, which indicates that the module works well. In case of any error in the initialized data, communication cannot be established and the green indicator keeps flashing. Check whether the DP is connected properly and the communication parameters are set properly.

□ When the module works well, the green indicator is normally on; when the communication is disconnected, the green indicator flashes; when the communication is established again, the green indicator is turned normally on again.

□ The yellow indicator is normally off when the module is in the running mode.

Definition of LK412 Indicators in Running Mode

	RUN indicator	CAL indicator	Meaning
Running Mode	Off	Off	Not powered up
	Flash	Off	The communication is not established or incorrect.
	On	Off	The communication is established, the module works well

6.4.13.4 Wirings

The LK412 module is connected with a transmitter based on the two-wire system, and it does not supply power externally. Each input channel is required to supply a separate external 24 VDC field power supply to the transmitter. To ensure the isolation between the field and the system, the field power supply shall be configured separately and cannot be commonly used as the power supply for the backplane.

The LK412 module is installed on the extension backplane.

Definition of LK412 Backplane Terminals

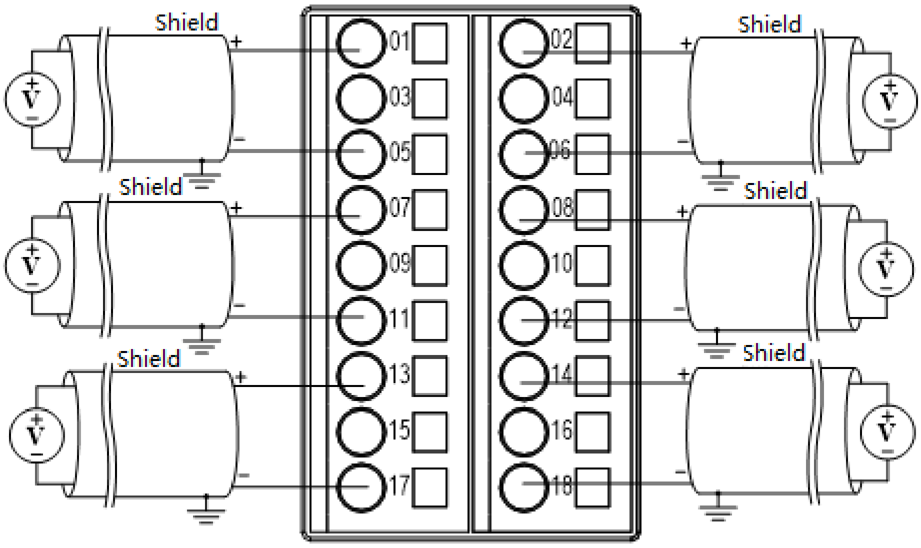
Channel No.	Terminal No.		
	Positive Terminal of Voltage Input (+IN/V) (+IN/V)	Current Input Terminal (+IN/I)	Common Negative Terminal (-In)
1	01	03/01	05
2	02	04/02	06
3	07	09/07	11
4	08	10/08	12
5	13	15/13	17
6	14	16/14	18

Pay attention to the following during wiring:

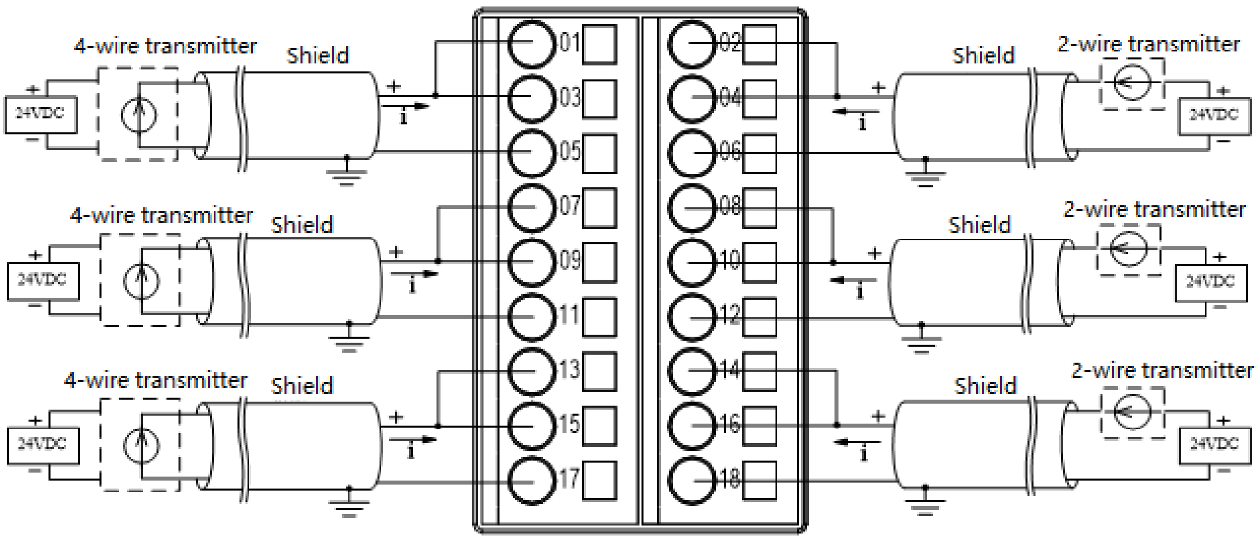
■ The two-row 18-channel terminals are fixed on the backplane, right located under the installation position of the LK412 module.

■ It is non-interfering when selecting each channel range, with an access to both a voltage signal and a current signal.

- For a current signal, Terminals 03 and 01 is short-circuited as the current input terminal of Channel 1, with Terminals 04 and 02 short-circuited as the current input terminal of Channel 2, and so on.
- Each AI signal is separately connected to the terminals via two conductors (shielded cable) in the field.
- The output channel does not supply power to the transmitter. When connected to a transmitter based on the two-wire system,, a separately 24 DC field power supply is provided separately to the transmitter.
- Upon the wiring, check whether the cable is connected properly. Do not hold the naked line exposed in order to avoid a short-circuit hazard.



LK412 Voltage Channel Terminal Wiring Diagram



LK412 Current Channel Terminal Wiring Diagram

6.4.13.5 Measured data output format

As shown in table, the measured data on the AI channel that is reported by the LK412 module, is expressed in form of 2-byte positive integer (decimal: 0~65,535) digital code. Notably, the voltage range (-10.25~+10.25 V) has two segments, including the positive voltage (0~10.25 V) corresponding to the decimal digital code (0~32,767) and the negative voltage (-10.25 V~0) corresponding to the decimal digital code (32,768~65,535).

Corresponding Relationship between LK412 Input Signal and Digital Code

Max. Measurable Range		Corresponding Decimal Digital Code
-10.25~+10.25 V	0~10.25 V	0~32,767
	-10.25~0 V	32,768~65,535
0~10.25 V		0~65,535
0~5.125 V		0~65,535
0~20.58 mA		0~65,535
4~20.58 mA		0~65,535

See the following for the conversion formula between the measured data and the physical quantity of the voltage range (-10.25~10.25V):

Positive voltage: 0~+10.25 V: Voltage (V) =measured data/32,767×10.25

Negative voltage: -10.25~0 V: Voltage (V) = (measured data －65,535)/32,767×10.25

By calling the function block HEX_ENGIN of the Analog signal Processing Functions library in the programming software AutoThink, it can convert the 2-byte measured data into the engineering data. Refer to the HEX_ENGIN for the specific application of the function blocks.

When setting Upper Limit Value and Lower Limit Value in the user parameters, according to the formula listed in table, convert the electrical signal (voltage or current) into a decimal digital code and then input it. For different ranges, the digital code may be converted in different ways.

Data Conversion Formula of LK412 Module

Max. Measurable Range		Formula of Corresponding Digital Code
-10.25~+10.25 V	0 V≤U≤10.25 V	U×32,767/10.25
	-10.25V≤U≤0 V	65,535＋ (U×32,767/10.25) 65,535＋ (U×32,767/10.25)
0 V≤U≤10.25 V		U×65,535/10.25
0 V≤U≤5.125 V		U×65,535/5.125
4 mA≤I≤20.58 mA		(I－4) ×65,535/16.58(I-4) ×65,535/16.58
0 mA≤I≤20.58 mA		I×65,535/20.58

Example 1: for Channel 1, in case the range is selected as 0~10.25 V, over-limit enabled, user-defined upper voltage limit: 10 V, lower voltage limit: 5 V, then Upper Limit Value for Channel 1 =10×65,535/10.25=63,936, Lower Limit Value for Channel 1 ＝5×65,535/10.25=31,968. Refer to figure for the relevant user parameter settings.

CH1 Input Range	0~10.25V	Unsigned8 16 16,17,18,

CH1 Upper Limit Exceeded Alarm	Enable	Bit(0) 0 0,1
CH1 Lower Limit Exceeded Alarm	Enable	Bit(0) 0 0,1

CH1 Upper Limit Value	63936	Unsigned16 32767 1-65535
CH1 Lower Limit Value	31968	Unsigned16 0 0-65534

Examples of Over-limit Alarm Parameter Settings Based on Selected Range

Example 2: for Channel 3, in case the range is selected as -10.25~+10.25 V, Over-limit enabled, user-defined upper voltage limit: 10 V, lower voltage limit: -10 V, then Upper Limit Value for Channel 1 =10×32,767/10.25=31,968, Lower Limit Value for Channel 1 =65,535+ (-10×32,767/10.25)V=33,567. Refer to figure for the relevant user parameter settings.

CH3 Input Range	-10.25~10.25V	Unsigned8 16 16,17,18,70,71

CH3 Upper Limit Exceeded Alarm	Enable	Bit(2) 0 0,1
CH3 Lower Limit Exceeded Alarm	Enable	Bit(2) 0 0,1

CH3 Upper Limit Value	31968	Unsigned16 32767 1-65535
CH3 Lower Limit Value	33567	Unsigned16 0 0-65534

Examples of Over-limit Alarm Parameter Settings Based on Selected Range

6.4.13.6 Diagnosis

LK412 can conduct calibration data error diagnosis. Such a diagnosis is a device diagnosis. LK412 can also detect over range, over-limit and open circuit, which are channel diagnosis. After calling the function block Get Diagnosis of DP slave (sysGetDPSlaveState), the diagnosis data and the device diagnosis data reported by LK412 are saved into the output parameter **DiagData** in the function block.

Diagnostic information of LK412 up to 22 bytes, wherein 2 bytes are device-related diagnosis, 2 bytes are identification diagnosis and 18 bytes are channel diagnosis. For six channel of LK412, the diagnosis information of each channel is 3 bytes. Diagnosis information diagram refer to figure Diagnosis_Information_diagram.

- Device diagnosis information

Device diagnosis data 0x02, 0x00 indicates the current device without any fault.

Device diagnosis data 0x02, 0x01 indicates that the current device has channel fault.

Device diagnostic data of 0x02, 0x02 indicates that the current device has errors.

Device diagnostic data of 0x02, 0x03 indicates that the current device has a channel failure and an error.

- Identification diagnosis information

The 2-byte identification diagnosis information is 0x42,0x01 when diagnosis information is reported.

- Channel diagnosis information

Channel diagnosis information as shown in table.

Specifications for LK412 Channel Diagnosis Information

Diagnosis Information						Meaning
Bit		Bit7	Bit6	Bit5	Bit4~ Bit0	
The first byte	Head	0x80				Decimal online value 128
The second byte	I/O type/channel	01 (Input)		（Channel）		Failed channel no 1~6 Decimal online value 64~69
The third byte	Channel data type/fault type	101 (Word)			2	Under range, Decimal online value is 162
					3	Over range, Decimal online value is 163
					6	Line Broken, Decimal online value is 166
					7	Upper limit exceeded, Decimal online value is 167
					8	Lower limit exceeded, Decimal online value is 168
					0	Channel fault recovery, Decimal online value is 160

Example:

Channel diagnosis data 0x80, 0x42, 0xA6 indicates that channel 1 has line broken alarm.

Channel diagnosis data 0x80, 0x42, 0xA7 indicates that channel 1 has upper limit exceeded alarm.

Channel diagnosis data 0x80, 0x42, 0xA8 indicates that channel 1 has lower limit exceeded alarm.

As an I / O slave of HolliTCP protocol, excepte above diagnostic information, refer to LK234_Diagnosis for more diagnostic information.

As an I / O slave of POWERLINK protocol, excepte above diagnostic information, refer to Overview of Diagnosis Information for more diagnostic information.

6.4.13.6.1 Over Range alarm

The LK412 module is capable of over range alarm. When the signal goes beyond the selected range, the channel diagnosis byte reports over range, when the signal is recovered, it then reports fault recovery.

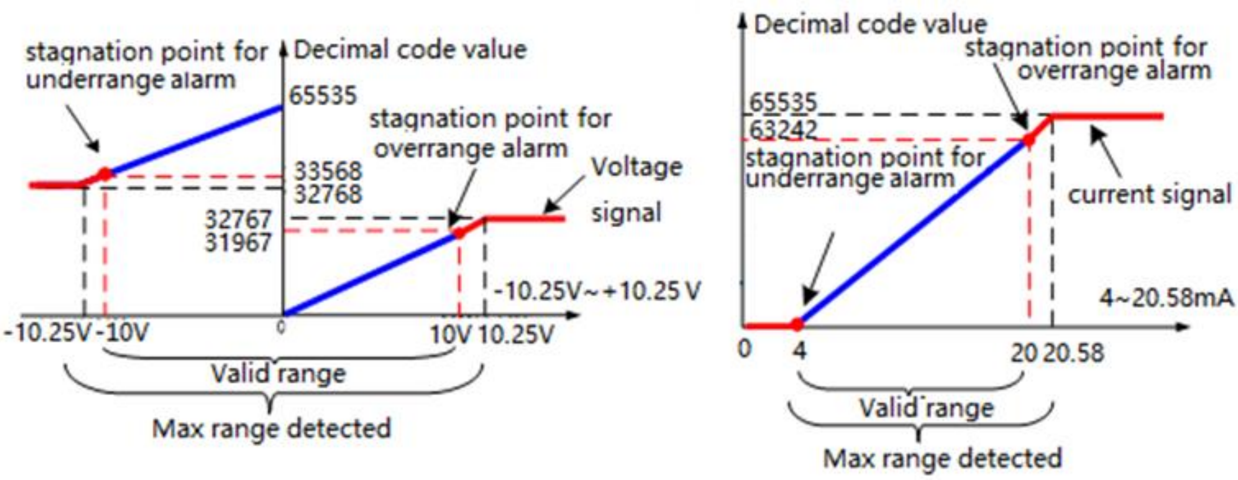
The LK412 module only reports the diagnosis data once separately when over range occurs and is recovered.

ⓘFor the LK412 module, the effective range is not the max. measurable range. When the output signal exceeding the range, it may not exceed the Max. Measurable range.

Channel data then reports the code value corresponding to the max. measurable signal in the range; if less than the Min. measured current, the measured channel data then reports the code value corresponding to the Min. measurable signal in the range.

Over Range Definition of LK412

Range	Over Range	
	Over Range	Under Range
0~20 mA	＞20 mA	＜0 mA
4~20 mA	＞20 mA	＜4 mA
-10 V~10 V	＞10 V	＜-10 V
0~10 V	＞10 V	＜0 V
0~5 V	＞5 V	＜0 V



LK412 Over Range Alarm Schematic Diagram

Due to the different ranges selected, the diagnosis handling methods of the module may also differ in case of over range, as shown in table. When the signal is recovered to the normal range, the channel diagnosis byte then reports 0xA0.

Handling of LK412 Over Range Alarm Based on Different Ranges

Max. Measurable Range	Range	Type of Over Range	Handling of Over Range
0~20.58 mA	0~20 mA	Over Range	The channel diagnosis byte reports 0xA3 20~20.58mA, the measured channel data reports the corresponding code value ranging 63,688~65,535 >20.58mA, the measured channel data reports 65,535
		Under Range	The channel diagnosis byte reports 0xA2 The measured channel data reports 0
4~20.58 mA	4~20 mA	Over Range	The channel diagnosis byte reports 0xA3 20~20.58mA, the measured channel data reports the corresponding code value ranging 63,242~65,535 >20.58mA, the measured channel data reports 65,535
		Under Range	The channel diagnosis byte reports 0xA2 The measured channel data reports 0
-10.25 V~10.25 V	10 V~10 V	Over Range	The channel diagnosis byte reports 0xA3 10~10.25 V, the measured channel data reports the corresponding code value ranging 31,967~32,767 ＞10.25V, the channel reports 32,767
		Under Range	The channel diagnosis byte reports 0xA2 -10.25V~-10V, the measured channel data reports the corresponding code value ranging 32,768~33568

Max. Measurable Range	Range	Type of Over Range	Handling of Over Range
			＜-10.25V, the measured channel data reports 32,768
0~10.25 V	0~10 V	Over Range	The channel diagnosis byte reports 0xA3 10~10.25 V, the measured channel data reports the corresponding code value ranging 63,937~ 65,535 ＞10.25V, the measured channel data reports 65,535
		Under Range	The channel diagnosis byte reports 0xA2 The measured channel data reports 0
0~5.125 V	0~5 V	Over Range	The channel diagnosis byte reports 0xA3 5~ 5.125 V, the measured channel data reports the corresponding code value ranging 63,937~ 65,535 > 5.125V, the measured channel data reports 65,535
		Under Range	The channel diagnosis byte reports 0xA2 The measured channel data reports 0

6.4.13.6.2 Over-limit Alarm

The LK412 module is capable of over-limit alarm. When the input signal goes beyond the limit range, that is, higher than Upper Limit Value or lower than Lower Limit Value, the channel diagnosis byte then reports over-limit. When the signal is recovered to the limit range, it then reports fault recovery.

The LK412 module only reports the diagnosis data once separately when over-limit occurs and is recovered.

Upper Limit Value must be more than Lower Limit Value. Otherwise, the LK412 module cannot report the diagnosis message properly.

If over-limit and over range occur simultaneously, only over range is reported.

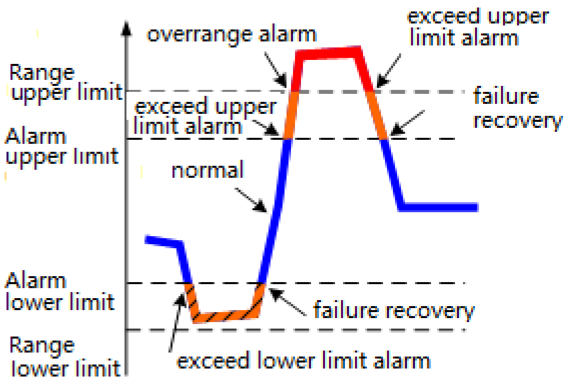
Range of LK412 Over-limit Alarm Value

Range	Alarm Value Settings
0~20 mA	20 mA>Upper Limit for Current>Lower Limit for Current>0 mA
4~20 mA	20 mA>Upper Limit for Current>Lower Limit for Current> 4 mA
-10 V~10 V	10 V>Upper Limit for voltage>Lower Limit for Voltage> -10 V
0~10 V	10 V>Upper Limit for voltage>Lower Limit for Voltage> 0 V
0~5 V	5 V>Upper Limit for voltage>Lower Limit for Voltage> 0 V

The alarm value in the configuration is the digital code corresponding to the measured signal in the selected range, expressed in a two-byte decimal digital code (0~65,535). Range of upper limit value: 1~65,535, defaulted to 32,767; range of lower limit value: 0~65,534, defaulted to 0. The formula of the digital code value corresponding to the electrical signal is shown in following table.

Calculation of LK412 Alarm Limit Digital Code

Input Signal		Upper Limit Value Digital Code (Decimal)	Lower Limit Digital Code (Decimal)
0~20.58 mA		Upper limit current ×65,535/20.58	Lower limit current×65,535/20.58
4~20.58 mA		(Upper limit current-4)×65,535/16.58	(Lower limit current-4) ×65,535/16.58
-10.25~10.25 V	-10.25~0 V	65,535+(Lower Limit voltage × 32,767/ 10.25)	65,535+(Lower Limit voltage×32,767/10.25)
	0~10.25 V	Upper limit voltage × 32,767/ 10.25	Upper limit voltage × 32,767/ 10.25
0~10.25 V		Upper limit voltage × 65,535/ 10.25	Lower limit voltage×65,535/10.25
0~5.125V		Upper limit voltage × 65,535/ 5.125	Lower limit voltage×65,535/5.125



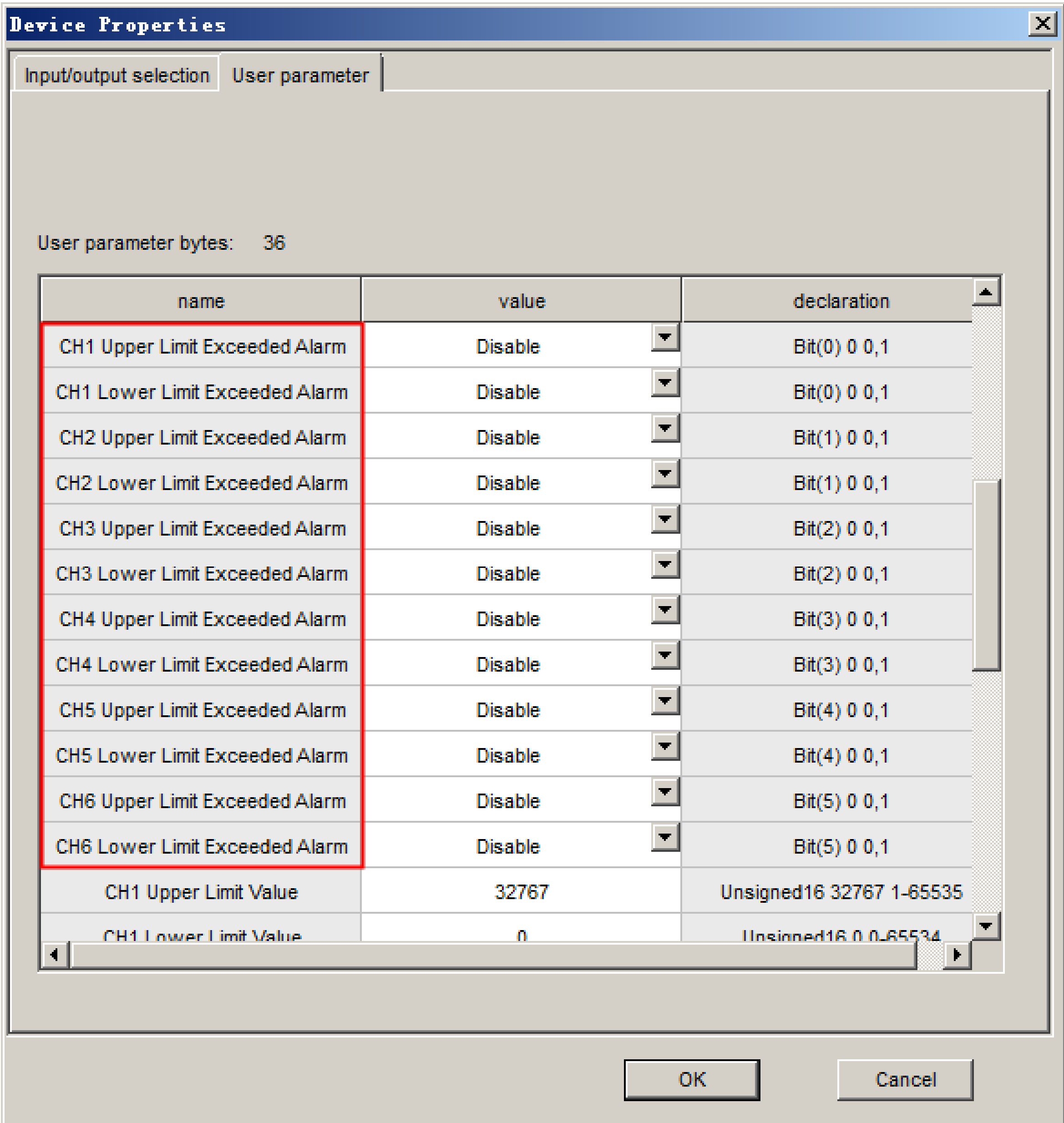
LK412 Over-limit Alarm Diagnosis

When certain input channel signal over-limits:

- If going beyond the upper limit, the channel diagnosis byte then reports 0xA7.
- If going beyond the lower limit, the channel diagnosis byte then reports 0xA8.
- The measured channel data reports the digital code corresponding to the current signal.
- If the signal is recovered to the normal range, the channel diagnosis byte then reports 0xA0.

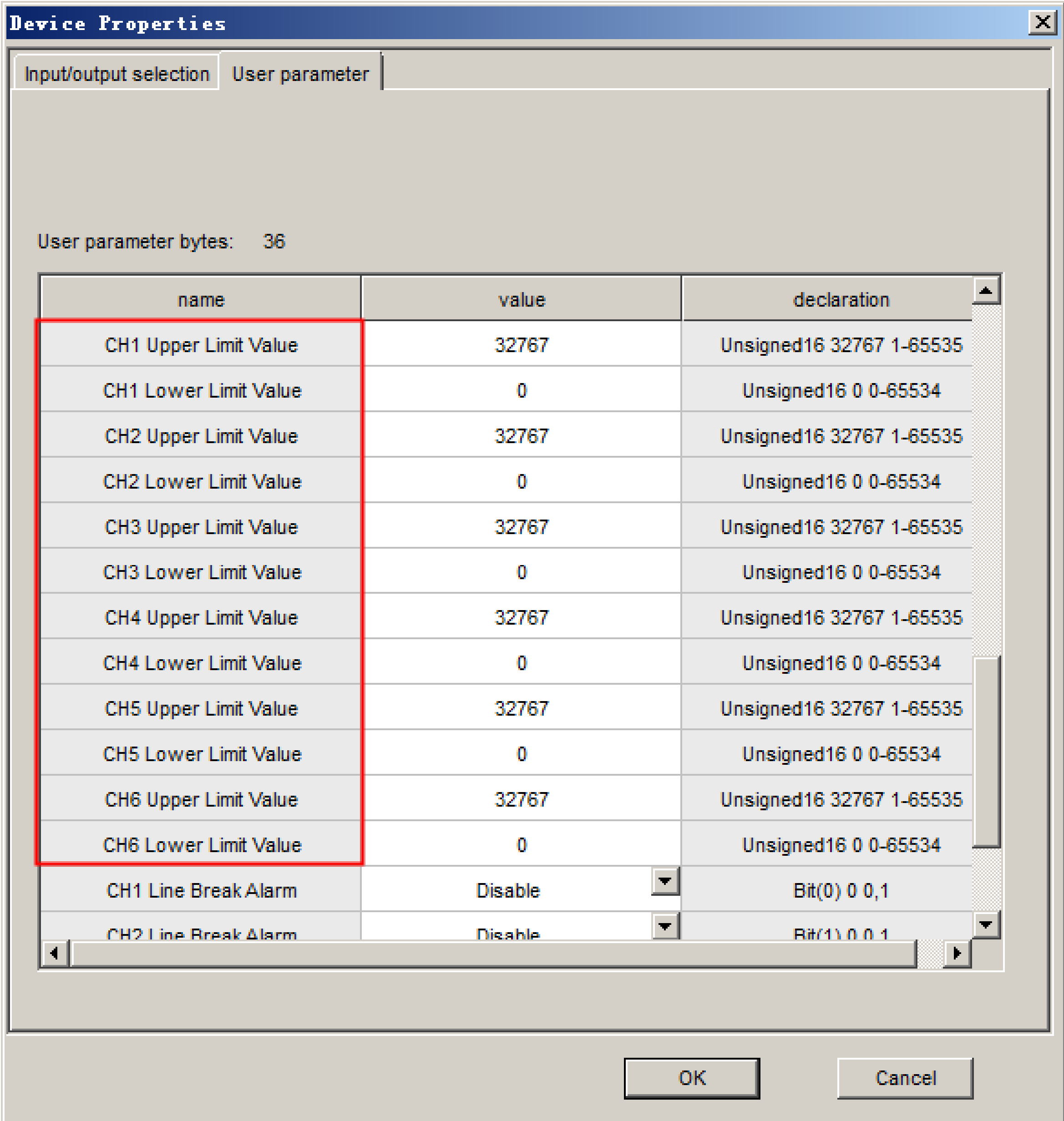
Whether Lower Limit Exceeded Alarm Enable is set by the parameter CH1~CH6 Lower Limit Exceeded Alarm, whether Upper Limit Exceeded Alarm Enable is set by the parameter CH1~CH6 Upper Limit Exceeded Alarm, defaulted to disabled. After enabling the alarm, set Lower Limit Value and Upper Limit Value according to the parameters CH1~CH6 Lower Limit Value and CH1~CH6 Upper Limit Value.

Over-limit Alarm Enable, Upper Limit Value and Lower Limit Value of the 6 channels are set separately, without interfering each other.



name	value	declaration
CH1 Upper Limit Exceeded Alarm	Disable	Bit(0) 0 0,1
CH1 Lower Limit Exceeded Alarm	Disable	Bit(0) 0 0,1
CH2 Upper Limit Exceeded Alarm	Disable	Bit(1) 0 0,1
CH2 Lower Limit Exceeded Alarm	Disable	Bit(1) 0 0,1
CH3 Upper Limit Exceeded Alarm	Disable	Bit(2) 0 0,1
CH3 Lower Limit Exceeded Alarm	Disable	Bit(2) 0 0,1
CH4 Upper Limit Exceeded Alarm	Disable	Bit(3) 0 0,1
CH4 Lower Limit Exceeded Alarm	Disable	Bit(3) 0 0,1
CH5 Upper Limit Exceeded Alarm	Disable	Bit(4) 0 0,1
CH5 Lower Limit Exceeded Alarm	Disable	Bit(4) 0 0,1
CH6 Upper Limit Exceeded Alarm	Disable	Bit(5) 0 0,1
CH6 Lower Limit Exceeded Alarm	Disable	Bit(5) 0 0,1
CH1 Upper Limit Value	32767	Unsigned16 32767 1-65535
CH1 Lower Limit Value	0	Unsigned16 0 0-65534

(a)



(b)

LK412 Over-limit Alarm Parameters

6.4.13.6.3 Line break detection

The LK412 module is capable of line broken detection.

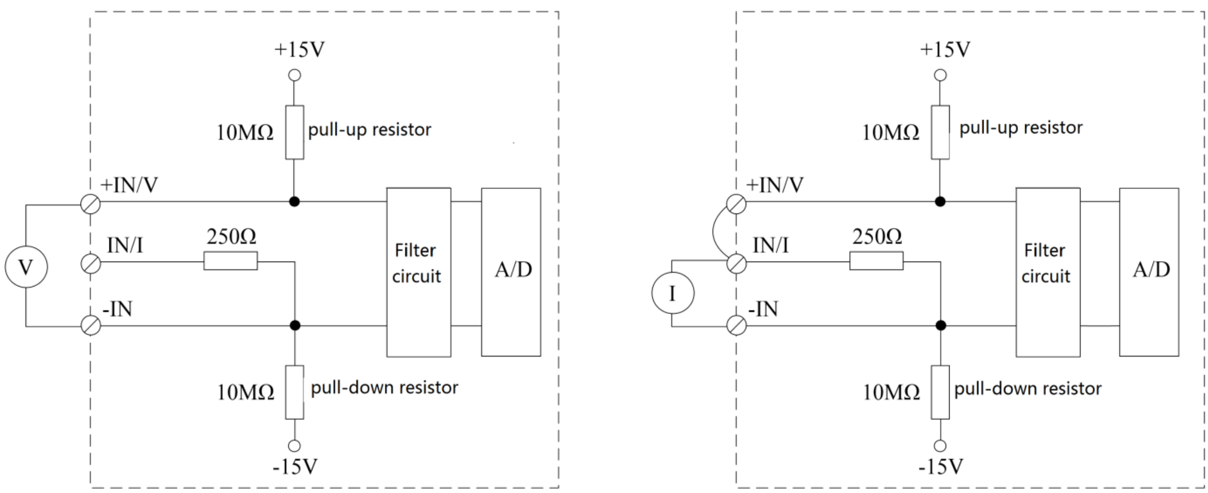
As shown in figure, the signal channel is connected to a 10 MΩ pull-up resistor. The LK412 detect the line broken diagnosis according to the input voltage change between the two terminals. In case of a failure, report the fault status in form of diagnosis data to the controller module. When the input channel signal connection is broken, the voltage at the positive terminal of the channel is pulled up to +15V, the negative terminal of the channel is pulled down to -15 V, with the voltage difference at the input terminal of the AD converter reaching to the max. value, the channel diagnosis byte reports line broken. After the line broken is recovered, the channel diagnosis byte reports **f**ault recovery**.**

The LK412 module only reports the diagnosis data once separately when a line break occurs and is recovered. It can select whether to give an line broken alarm during configuration, defaulted to disabled. If the input channel is not connected, it can be considered as broken. It is suggested to disable line broken alarm for channels that are not used, that is, to hold the default parameter unchanged.

When certain channel is broken, refer to table for the diagnosis and handling of various signal types. After the line broken is recovered, the channel diagnosis byte reports 0xA0.

Handling of Broken LK412 of Various Types

Signal Type	Type of Line Broken	Handling of Line Broken
Current signal	The short line (+IN/V) is broken.	The channel diagnosis byte reports line broken fault value 0xA6. The measured channel data reports 65,535
	The field signal line (+IN/I, -IN) is broken	The channel diagnosis byte reports line broken fault value 0xA6. The measured channel data reports 0
Voltage Signal	The field signal line (+IN/V, -IN) is broken.	The channel diagnosis byte reports line broken fault value 0xA6. The measured channel data reports 65,535 or 32,767 (with a range of -10.25~10.25 V)



LK412 Channel Line Broken Detection Circuit Diagram

6.4.13.7 Parameters

The user parameter is used to set the operation mode of the module. The controller module written when downloading the user program may not be read in each scanning period. Each parameter has a default, able to modify the parameter value according to the project requirements. The user parameter does not support online modification. The modification takes effect only upon full download.

The user parameter length of the LK412 module is up to 36 bytes.

table of LK412 User Parameters

Parameter Name	Meaning	Value
Filter Mode	To select the digital filtering mode	0=50 Hz Filter, to filter 50 Hz interference (default) 1=60 Hz Filter, to filter the 60 Hz interference
CH1 Input Range	To select the range of	16=-10.25~10.25 V (default)

Parameter Name	Meaning	Value
	Channel 1	17=0~10.25 V 18=0~5.125 V 70=0~20.58 mA 71=4~20.58 mA
CH2 Input Range	To select the range of Channel 2	
CH3 Input Range	To select the range of Channel 3	
CH4 Input Range	To select the range of Channel 4	
CH5 Input Range	To select the range of Channel 5	
CH6 Input Range	To select the range of Channel 6	
CH1 Digital Filter	To set software filtering of Channel 1	0=None, without software filtering (default) 1=4 Points, to select the latest 4 historical data 2=8 Points, to select the latest 8 historical data 3=16 Points, to select the latest 16 historical data
CH2 Digital Filter	To set software filtering of Channel 2	
CH3 Digital Filter	To set software filtering of Channel 3	
CH4 Digital Filter	To set software filtering of Channel 4	
CH5 Digital Filter	To set software filtering of Channel 5	
CH6 Digital Filter	To set software filtering of Channel 6	
CH1 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 1	0=Disable, disabled (default) 1=Enable, enabled
CH1 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 1	
CH2 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 2	
CH2 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 2	
CH3 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 3	
CH3 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 3	
CH4 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 4	
CH4 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 4	
CH5 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 5	
CH5 Lower Limit Exceeded Alarm	To enable Lower Limit Exceeded Alarm of Channel 5	
CH6 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm of Channel 6	

<table>
<tr><th>Parameter Name</th><th>Meaning</th><th>Value</th></tr>
<tr><td>CH6 Lower Limit Exceeded Alarm</td><td>To enable Lower Limit Exceeded Alarm of Channel 6</td><td></td></tr>
<tr><td>CH1 Upper Limit Value</td><td>To set Upper Limit Value of Channel 1</td><td rowspan="12">Range of Lower Limit Values: 0~65,534
Range of Upper Limit Values: 1~ 65,535
Default of lower limit value: 0
Default of upper limit value: 32,767
Refer to Specifications_for_Measured_Data_Output_Format for the calculation method.</td></tr>
<tr><td>CH1 Lower Limit Value</td><td>To set Upper Limit Value of Channel 1</td></tr>
<tr><td>CH2 Upper Limit Value</td><td>To set Upper Limit Value of Channel 2</td></tr>
<tr><td>CH2 Lower Limit Value</td><td>To set Upper Limit Value of Channel 2</td></tr>
<tr><td>CH3 Upper Limit Value</td><td>To set Upper Limit Value of Channel 3</td></tr>
<tr><td>CH3 Lower Limit Value</td><td>To set Upper Limit Value of Channel 3</td></tr>
<tr><td>CH4 Upper Limit Value</td><td>To set Upper Limit Value of Channel 4</td></tr>
<tr><td>CH4 Lower Limit Value</td><td>To set Upper Limit Value of Channel 4</td></tr>
<tr><td>CH5 Upper Limit Value</td><td>To set Upper Limit Value of Channel 5</td></tr>
<tr><td>CH5 Lower Limit Value</td><td>To set Upper Limit Value of Channel 5</td></tr>
<tr><td>CH6 Upper Limit Value</td><td>To set Upper Limit Value of Channel 6</td></tr>
<tr><td>CH6 Lower Limit Value</td><td>To set Upper Limit Value of Channel 6</td></tr>
<tr><td>CH1 Line Break Alarm</td><td>To enable Line Break Alarm of Channel 1</td><td rowspan="6">0=Disable
1=Enable</td></tr>
<tr><td>CH2 Line Break Alarm</td><td>To enable Line Break Alarm of Channel 2</td></tr>
<tr><td>CH3 Line Break Alarm</td><td>To enable Line Break Alarm of Channel 3</td></tr>
<tr><td>CH4 Line Break Alarm</td><td>To enable Line Break Alarm of Channel 4</td></tr>
<tr><td>CH5 Line Break Alarm</td><td>To enable Line Break Alarm of Channel 5</td></tr>
<tr><td>CH6 Line Break Alarm</td><td>To enable Line Break Alarm of Channel 6</td></tr>
</table>

- The selection of each channel range does not interfere with each other and can be different ranges separately.
- The software filtering of each channel does not interfere with each other and can be different modes separately.

6.4.13.8 Technical Specifications

LK412 6-channel Isolation Analog Input Module

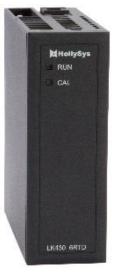
LK412 6-channel Isolation Analog Input Module					
Power supply					
Operating Voltage		24VDC (-15%~+20%)			
Power Consumption (max.)		150 mA@24 VDC			
Input channel					
Number of channels		6			
Range Code		16		17	18
Max. Measurable Range	Voltage Signal	-10.25~0 V	0~10.25 V	0~10.25 V	0~5.125 V
	Data Format	32768~65,535	0~32,767	0~65,535	0~65,535
Range Code		70		71	
Max. Measurable Range	Current signal	0~20.58 mA		4~20.58 mA	
	Data Format	0~65,535		0~65,535	
Input Impedance	Voltage Signal	＞1 MΩ			
	Current signal	250 Ω			
ADC Resolution		16-bit			
Full-channel Scanning Time (with no software filtering)		＜50 ms (with no software filtering)			
Differential Mode Rejection Ratio		＞60 dB			
Common Mode Rejection Ratio		＞90 dB			
Measurement Accuracy		0.1% F.S.@25℃			
Repeatability precision		0.02% F.S.@25℃			
Calibration Accuracy (25℃)		0.03% F.S.@25℃			
Step Response		The time reaching to 90% of the target value is better than 1 s			
Temperature Drift		±25 ppm/℃			
Failure Diagnosis and Hot Plug					
Device Detection		When powered on, if the device is wrong, the device diagnosis byte then reports 0xA2; if the data is correct, it then does not report			
Over range alarm		When the signal exceeds the upper/lower limit of the range, the diagnosis byte then reports 0xA3/0xA2			
Over-limit alarm		When the signal exceeds the upper/lower limit of the alarm, channel the diagnosis byte then reports 0xA7/0xA8			
Line break detection		When the channel is broken, the channel diagnosis byte then reports 0xA6; when the fault recovered, it then reports 0xA0			
Hot Plugging		Supported			
Isolated and voltage withstand					
Channel-to-system		To test for 1 minute based on 500 VAC, with a leaking current 5 mA			
Channel-to-channel		To test for 1 minute based on 500 VAC, with a leaking current 5 mA			
Communication Bus					
Protocol		Profibus-DP			
Baud Rate		1.5Mbps, 500Kbps, 187.5Kbps , 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps adaptive			
Media		Communication bus is connected to the backplane through euro connector, hot redundant communication media			
Physical Property					
Protection Key		A0			
Installation Position		Extension backplane			
Module Dimension (W*H*D)		35 mm×100 mm×100 mm			
Enclosure Protection Rating		IEC60529 IP20			

LK412 6-channel Isolation Analog Input Module	
Weight	190 g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.4.14 LK430 6-channel Thermal Resistance Analog Input Module

6.4.14.1 Basic Features

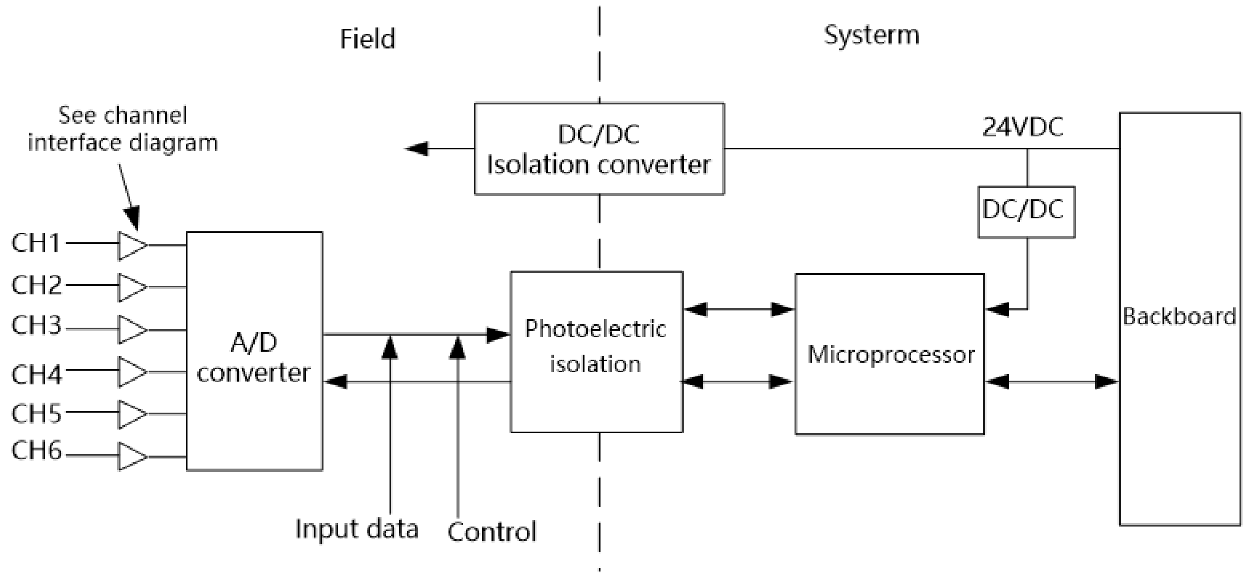
- 6-channel RTD input, in form of constant current source
- RTD measurement can report the temperature or resistance value
- RTD Type: Copper427, Chinese_Cu, Nikel618, Nikel672, Platinum385, Platinum3916
- Resistance measurement range： 1~4020 Ω
- Upper Limit Exceeded Alarm
- Lower Limit Exceeded Alarm
- Line broken detection
- Isolation between the system and the field
- Hot swapping
- Field calibration



LK430 Module Schematic Diagram

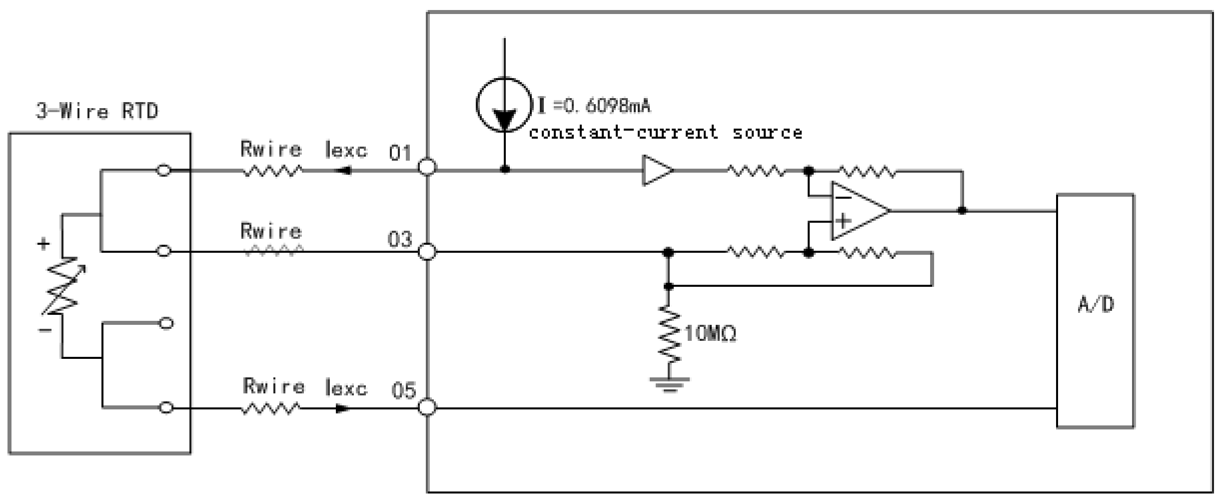
6.4.14.2 Operating Principle

The 24 VDC system power supply of the LK412 module supplies the power to the interface circuit by outputting 5 VDC via isolated DC/DC. An opto-isolator is between the interface circuit and the system, thus realizing the electrical isolation between the system and the field channel.



Internal Structure Block Diagram of LK430

LK430 adopts a measurement method based on constant current source excitation. As compared to the conventional bridge measurement, it can eliminate the impact exerted by the line resistance of the long RTD conductor on measurement accuracy in case of imbalanced electric bridge. Of course, no matter of constant current source measurement or bridge measurement, the line resistance values of the three RTD conductors are equal. Otherwise, the conductor resistance deviation may affect measurement accuracy. Refer to figure for the interface circuit.



LK430 Channel Interface Circuit Diagram (taking Channel 1 for example)

6.4.14.3 Indicators

There are two status indicator on the front panel of the module: the green RUN indicator and the yellow CAL indicator. The RUN indicator is the run indicator, indicating the communication status between the module and the controller module. The CAL indicator is the calibration indicator, indicating the calibration process(Calibration model is not introduced in this article, please contact HollySys service agencies if necessary).

Definition of LK430 Indicators

Name	Status	Description
RUN indicator (green)	On	The communication is established
	Flash	The communication is not established or incorrect.
	Off	The module is not powered on.
CAL Calibration Indicator (yellow)	On	In the calibration and detection mode, undergoing calibration and detection
	Flash	In the calibration no detection mode, but undergoing no calibration and detection
	Off	It is not powered up or the communication is not established or the module does not in the calibration and detection mode

- Running Mode
  - Immediately after being powered on, the module waits for the initialized data, with the green indicator flashing based on a frequency of 4 times/second.
  - Upon the completion of initialization, the green indicator is turned normally on, which indicates that the module works well. In case of any error in the initialized data, communication cannot be established and the green indicator keeps flashing. Check whether the DP is connected properly and the communication parameters (communication rate, communication station No.) are set properly.
  - When the module works well, the green indicator is normally on; when the communication is disconnected, the green indicator flashes; when the communication is established again, the green indicator is turned normally on again.
  - The yellow indicator is normally off when the module is in the running mode.

Definition of LK430 Indicators in Running Mode

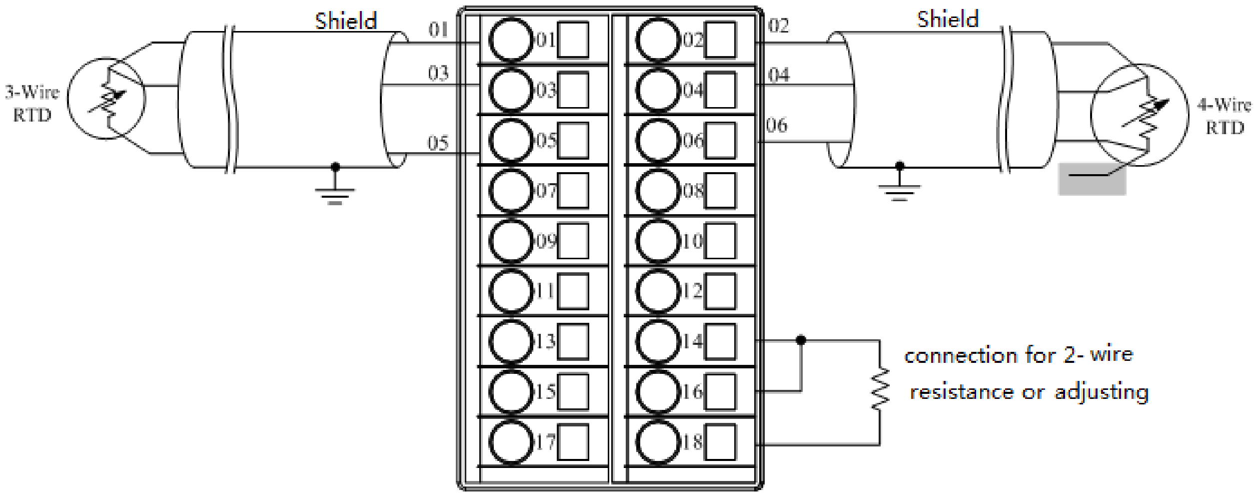
	RUN indicator	CAL indicator	Meaning
Running Mode	Off	Off	Not powered up
	Flash	Off	The communication is not established or incorrect.
	On	Off	The communication is established, the module works well

6.4.14.4 Wirings

The LK430 module is installed on the extension backplane.

Definition of LK430 Backplane Terminals

Channel No.	Sequence of Terminals		
1	01	03	05
2	02	04	06
3	07	09	11
4	08	10	12
5	13	15	17
6	14	16	18



LK430 Backplane Terminal Wiring Diagram

Pay attention to the following during wiring:

- The two-row 18-channel terminals are fixed on the backplane, located right under the installation position of the LK430 module.
- Each RTD Number in the field is separately connected to the terminals via three conductors (shielded cable) in the field.
- Do not crimp multiple cables on the same terminal. It can realize multipoint connection via conversion terminal.

6.4.14.5 Functions

6.4.14.5.1 Measured Data Output Format

The measured data of each channel of the LK430 module is expressed in a 2-byte positive integer (decimal: 0~65,535). There are two output formats available for configuration: the output resistance digital code or the output temperature digital code. See the following for the formula of conversion between the measured data and the physical quantity:

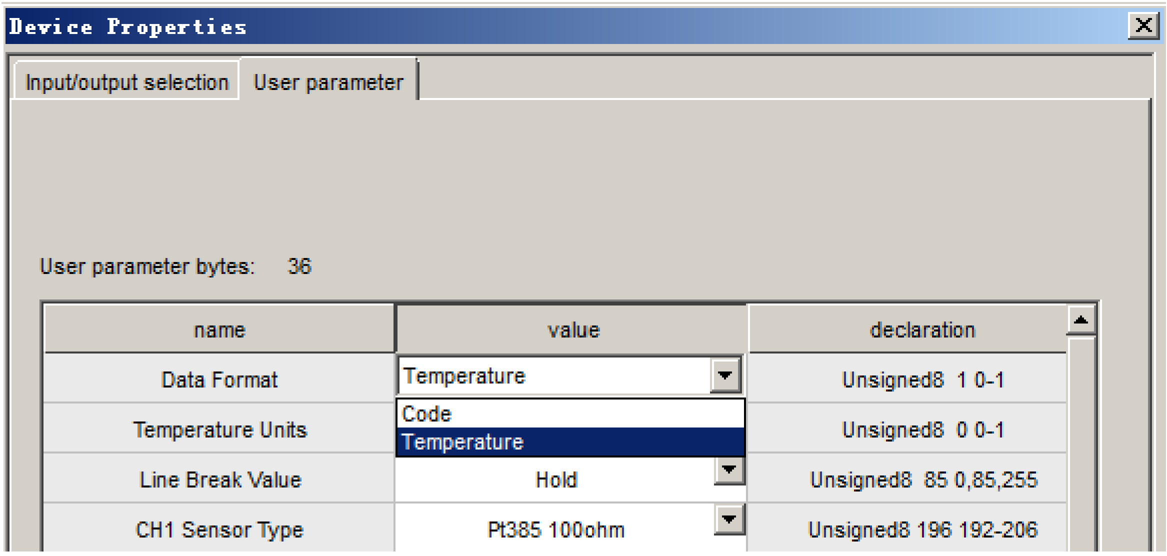
- Output resistance value for configuration selection:

Resistance Value (Ω)=(Resistance Digital Code/65,535)× Full Range Resistance Value +Min. Measurable Resistance Value in Range, notably, the full range resistance value is equal to the value obtained by subtracting the Min. measurable resistance with the max. measurable resistance. For example, in tabletable_of_LK430-supported_Standard_Thermal_Resistances_and_Their_Measurement_Ranges, the max. measurable resistance range for Cu50 is 1~121.75 Ω, then the full range resistance value=121.75-1=120.75.

- Output temperature value for configuration selection:

Temperature Value (℃/℉)=(Temperature Digital Code-10000)/10

Select the output format of the measured data according to the parameter Data Format, with default temperature digital code. The user can obtain the actual field temperature value or resistance value upon simple operation according to the conversion formula in the programming software AutoThink.



LK430 Output Data Format Selection

6.4.14.5.2 Measurement range

Refer to table for various standard LK430-supported thermal resistances and their measurement ranges.

table of LK430-supported Standard Thermal Resistances and Their Measurement Ranges

Type of Thermal Resistance	Thermal Resistance Temperature Measurement Range (℃)	Corresponding Resistance Value Range of Thermal Resistance (Ω)	Range Code	Max. Measurable Resistance Range (Ω)
Copper427 10 Ω	-200℃~260℃	3.69980~21.1574	192	1~121.75
Chinese_Cu 50 Ω	-50℃~150℃	39.243~82.136	193	
Nikel618 100 Ω	-60℃~250℃	69.5204~343.584	194	1~487
Nikel618 120 Ω	-60℃~250℃	83.4245~412.301	195	
Platinum385 100 Ω	-200℃~870℃	18.5201~396.311	196	
Platinum3916 100 Ω	-200℃~630℃	16.9960~327.744	197	
Nikel618 200 Ω	-60℃~250℃	139.041~687.168	198	2~1000
Nikel672 120 Ω	-80℃~320℃	66.6000~568.407	199	
Platinum385 200 Ω	-200℃~870℃	37.0402~792.622	200	
Platinum3916 200 Ω	-200℃~630℃	33.992~655.488	201	
Nikel618 500 Ω	-60℃~250℃	347.602~1717.92	202	4~2000
Platnium385 500 Ω	-200℃~870℃	92.6005~1981.56	203	
Platnium3916 500 Ω	-200℃~630℃	84.98~1638.72	204	
Platnium385 1000 Ω	-200℃~870℃	185.201~3963.11	205	8~4020
Platnium3916 1000	-200℃~630℃	169.960~3277.44	206	

Ω				

ⓘWhen using a special resistance not listed in the above list, it can be measured by selecting Measured Data Output Format as Resistance Value. In case of range configuration, select from the above table a standard thermal resistance close to the value range of the special resistance as a substitution range. For example, when measuring a 350Ω resistance, it can select one from Ni618 100Ω, Ni618 120Ω, Pt385 100Ω or Pt3916 100Ω as the substitution range.

6.4.14.6 Diagnosis

The LK430 module can also diagnose over-limit and line broken, which are channel diagnosis. After calling the function block Get Diagnosis of DP slave (sysGetDPSlaveState), the channel diagnosis data reported is sent into the output parameter **DiagData**.

Diagnostic information of LK430 up to 22 bytes, wherein 2 bytes are device-related diagnosis, 2 bytes are identification diagnosis and 18 bytes are channel diagnosis. For six channels LK430, the diagnosis information of each channel is 3 bytes. Diagnosis information diagram refer to figure Diagnosis_Information_diagram.

- Device diagnosis information

Device diagnosis data 0x02,0x00 indicates the current device without any fault.

Device diagnosis data 0x02,0x01 indicates that the current device has channel fault.

Device diagnostic data of 0x02, 0x02 indicates that the current device has errors.

Device diagnostic data of 0x02, 0x03 indicates that the current device has a channel failure and an error.

- Identification diagnosis information

The 2-byte identification diagnosis information is 0x42, 0x01 when diagnosis information is reported.

- Channel diagnosis information

Channel diagnosis information as shown in table.

Specifications for LK430 Channel Diagnosis Message

Diagnosis Information						Meaning
Bit		Bit7	Bit6	Bit5	Bit4~ Bit0	
The first byte	Head	0x80				Decimal online value 128
The second byte	I/O type/channel	01 (Input)		（Channel）		Failed channel no 1~6 Decimal online value 64~69
The third byte	Channel data type/fault type	101 (Word)			6	Line Broken, Decimal online value is 166
					7	Upper limit exceeded, Decimal online value is 167
					8	Lower limit exceeded, Decimal online value is 168
					0	Channel fault recovery, Decimal online value is 160

Example:

Channel diagnosis data 0x80, 0x41, 0xA6 indicates that channel 2 has line broken alarm.

Channel diagnosis data 0x80, 0x45, 0xA7 indicates that channel 6 has upper limit exceeded alarm.

Channel diagnosis data 0x80, 0x42, 0xA8 indicates that channel 3 has lower limit exceeded alarm.

Channel diagnosis data 0x80, 0x43, 0xA0 indicates that channel 4 fault recovery.

As an I / O slave of HolliTCP protocol, excepte above diagnostic information, refer to LK234_Diagnosis for more diagnostic information.

As an I / O slave of POWERLINK protocol, excepte above diagnostic information, refer to Overview of Diagnosis Information for more diagnostic information.

6.4.14.6.1 Over-limit Alarm

The LK430 module is capable of over-limit alarm. In the selected range, the user can set Upper Limit Value and Lower Limit Value of the input signal by his or her own. When the input signal goes beyond the limit range, that is, higher than Upper Limit Value or lower than Lower Limit Value, the channel diagnosis byte then reports over-limit. When the signal is recovered to the limit range, it then reports fault recovery.

For various standard thermal resistances that can be measured by LK430, as shown in table_of_LK430-supported_Standard_Thermal_Resistances_and_Their_Measurement_Ranges, LK430 can support over-limit alarm. For other special non-standard thermal resistances or resistance measurement, LK430 does not support over-limit alarm.

For a standard thermal resistance, no matter whether the output data format of LK430 is of a temperature value or a resistance value, Upper Limit Value and Lower Limit Value for an over-limit alarm are set to be a positive integer digital code, with the formula for the temperature digital code of upper and lower limits given below:

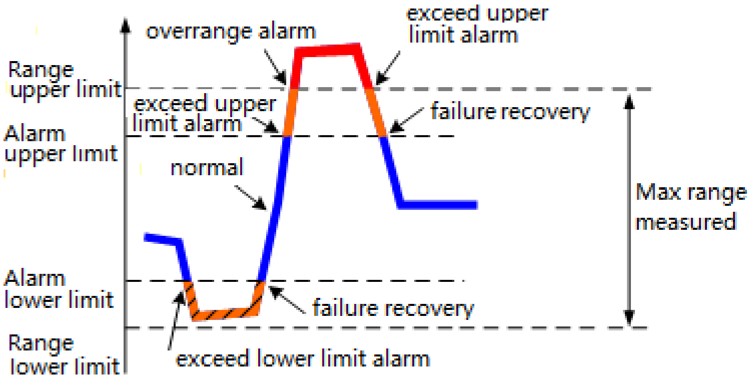
Upper Limit Digital Code=Upper Limit Value Temperature Value×10+10000

Lower Limit Digital Code= Lower Limit Value Temperature Value×10+10000

The temperature unit of Upper Limit Value Temperature and Lower Limit Value Temperature (℃ or ℉), conform to the temperature unit selected for the module (to select via the parameter Temperature Units, defaulted to ℃)

The set range of Upper Limit Value and Lower Limit Value: 6720~25,980. Upper Limit Value must be more than Lower Limit Value. Otherwise, the LK430 cannot report the diagnosis message properly.

The LK430 module only reports the diagnosis data once separately when over-limit occurs and is recovered. Whether the LK430 module can give an overall alarm, Upper Limit Value and Lower Limit Value of each channel can be selected during configuration.



LK430 Overran Alarm Schematic Diagram

Due to the different measured data formats for LK430 configuration, the diagnosis and handling methods for the module in case of over-limit may also differ, as shown in table . When the signal is recovered to the normal range, the channel diagnosis area then reports 0xA0.

Handling of LK430 Over Range Alarm

Measured Data Format	Type of Over-limit	Handling of Over-limit
Output Temperature Value	Upper limit exceeded	The channel diagnosis area reports the fault value 0xA7 ≤Upper Range Limit, the measured channel data reports the current temperature digital code ＞Upper Range Limit, the measured channel data reports the max. measurable temperature value code allowed in the range
	Lower limit exceeded	The channel diagnosis area reports the fault value 0xA8 ≥ Lower Range Limit, the measured channel data reports the current temperature digital code ＜Lower Range Limit, the measured channel data reports the Min. measurable temperature value code allowed in the range
Output Resistance Value	Upper limit exceeded	The channel diagnosis area reports the fault value 0xA7 ≤Upper Range Limit, the measured channel data reports the current resistance digital code > Upper Range Limit, the measured channel data reports 0xFFFF
	Lower limit exceeded	The channel diagnosis area reports the fault value 0xA8 ≥ Lower Range Limit, the measured channel data reports the current resistance digital code ＜ Lower Range Limit, the measured channel data reports 0x0000

6.4.14.6.2 Line Broken Detection

The LK430 module is capable of line broken detection. When any signal cable of the input channel falls off, the module then gives an line broken alarm to the controller module.

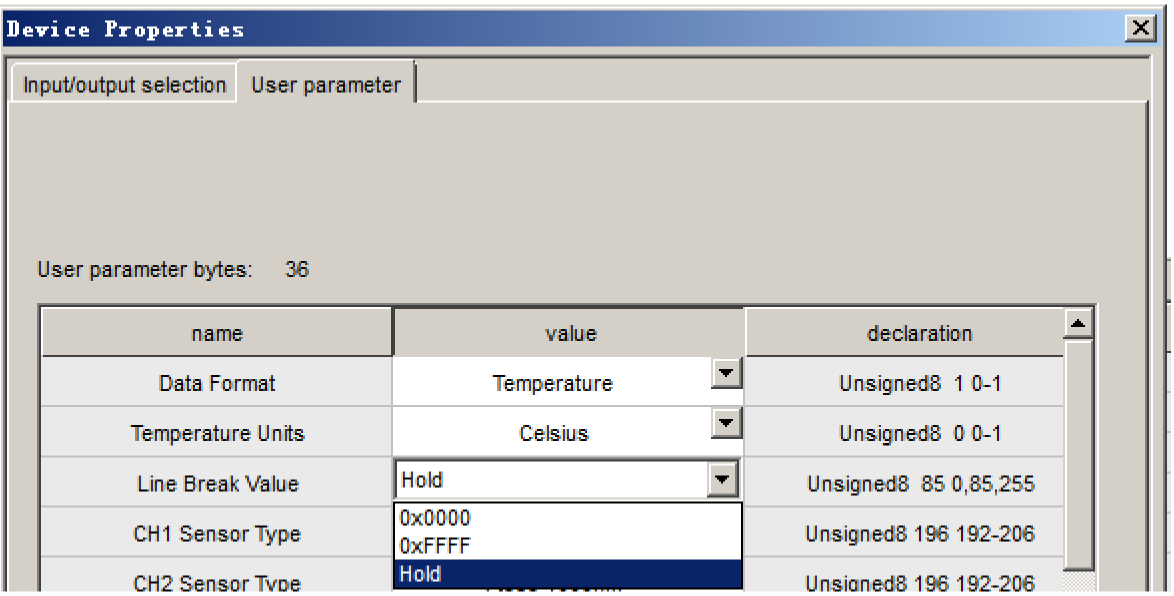
When certain channel is broken:

- The channel diagnosis area reports the fault value 0xA6.
- The measured channel data reports the selected value for configuration. Due to different selected data formats, the measured channel data to be reported in case of an line broken may differ, as shown in following table.

After the line broken is recovered, the channel diagnosis area reports 0xA0. The LK430 module only reports the diagnosis data once separately when an line broken occurs and is recovered.

Specifications for Reported Channel Data in Case of Line Broken

User Parameter		Specifications for Measured Data
Data Format (data format)	Line Break Value (reported line broken value)	
Code	0x0000	The measured channel data reports 0x0000
	0xFFFF	The measured channel data reports 0xFFFF
	Hold (default)	The measured channel data hold the normal data prior to the line break
Temperature	0x0000	Take Channel 1 for example, Terminals 1, 3 and 5: When an line broken occurs to Terminal 1 or/and Terminal 3, the channel measurement reports the Min. temperature code value in the range When an line broken occurs to Terminal 5, the measured channel data reports the Max. temperature code value in the range
	0xFFFF	
	Hold (default)	The measured channel data hold the normal data prior to the line break



LK430 Line Broken Detection Settings

6.4.14.7 Parameters

The user parameter length of the LK430 module is up to 36 bytes.

table of LK430 User Parameters

Parameter Name	Meaning	Value	Default
Data Format	To select the 6-channel measured channel data output format of the module	0=Code, to report the resistance code value 1=Temperature, to report the temperature code value	1
Temperature Units	To select the temperature scale for the measured temperature of the module	0=Celsius, Celsius temperature scale 1=Fahrenheit, Fahrenheit scale	0
Line broken Value	To select the code value to be reported by the line broken alarm channel data	0=0x0000 85=Hold, to hold the line broken 255=0xFFFF Refer to Line_Broken_Detection for the	85

Parameter Name	Meaning	Value	Default
		detailed specifications.	
CH1 Sensor Type	To select thermal resistance type for Channels 1~6	192=Cu427:10 Ω 193=Chinese_Cu:50 Ω 194=Ni618:100 Ω 195=Ni618:120 Ω 196=Pt385:100 Ω 197=Pt3916:100 Ω 198=Ni618:200 Ω 199=Ni672:120 Ω 200=Pt385:200 Ω 201=Pt3916:200 Ω 202=Ni618:500 Ω 203=Pt385:500 Ω 204=Pt3916:500 Ω 205=Pt385:1000 Ω 206=Pt3916:1000 Ω	196
CH2 Sensor Type			
CH3 Sensor Type			
CH4 Sensor Type			
CH5 Sensor Type			
CH6 Sensor Type			
CH1 Digital Filter	To enable digital filtering	0=None, no filtering 1=8 Points, filtering (to select the latest 8 historical data)	0
CH2 Digital Filter			
CH3 Digital Filter			
CH4 Digital Filter			
CH5 Digital Filter			
CH6 Digital Filter			
CH1 Upper Limit Exceeded Alarm	To enable Upper Limit Exceeded Alarm, Low Limit Exceeded Alarm for Channels 1~6	0=Disable 1=Enable	0
CH1 Lower Limit Exceeded Alarm			
CH2 Upper Limit Exceeded Alarm			
CH2 Lower Limit Exceeded Alarm			
CH3 Upper Limit Exceeded Alarm			
CH3 Lower Limit Exceeded Alarm			
CH4 Upper Limit Exceeded Alarm			
CH4 Lower Limit Exceeded Alarm			
CH5 Upper Limit Exceeded Alarm			
CH5 Lower Limit Exceeded Alarm			
CH6 Upper Limit Exceeded Alarm			
CH6 Lower Limit Exceeded Alarm			
CH1 Upper Limit Value	To set Upper Limit Value and Lower Limit Value for Channels 1~6	Range of Lower Limit Values: 6720~ 25,980 Range of Upper Limit Values: 6720~ 25,980 Refer to Over-limit_Alarm for setting and calculating the alarm limits	Lower Limit Value: 8000 Upper Limit Value: 18700
CH1 Lower Limit Value			
CH2 Upper Limit Value			
CH2 Lower Limit Value			
CH3 Upper Limit Value			

Parameter Name	Meaning	Value	Default
CH3 Lower Limit Value			
CH4 Upper Limit Value			
CH4 Lower Limit Value			
CH5 Upper Limit Value			
CH5 Lower Limit Value			
CH6 Upper Limit Value			
CH6 Lower Limit Value			
CH7 Upper Limit Value			
CH7 Lower Limit Value			
CH8 Upper Limit Value			
CH8 Lower Limit Value			
CH1 Line Break Alarm	To enable the line broken alarm for Channels 1~6	0=Disable 1=Enable	0
CH2 Line Break Alarm			
CH3 Line Break Alarm			
CH4 Line Break Alarm			
CH5 Line Break Alarm			
CH6 Line Break Alarm			
CH7 Line Break Alarm			
CH8 Line Break Alarm			

ⓘThe temperature conversion value adopts the temperature scale selected for module configuration. Upper Limit Value must be more than Lower Limit Value.

6.4.14.8 Technical Specifications

LK430 6-channel Thermal Resistance Type Analog Input Module	
System Power	
Power Voltage	24VDC (-10%~+10%)
Power consumption	65mA max.@24VDC
Input channel	
Number of channels	6-channel
Measurement Method	3-wire thermal resistance input, three-wire connection, constant current source measurement

LK430 6-channel Thermal Resistance Type Analog Input Module			
Thermal Resistance Type and Temperature Measurement Accuracy	Thermal Resistance Type Code	Temperature Measurement Range	Absolute Error
	Copper427：10 Ω Copper427: 10 Ω	-200℃~260℃	1.4℃
	Chinese_Cu：50 Ω Chinese_Cu: 50 Ω	-50℃~150℃	0.6℃
	Nickel618： 100 Ω/120 Ω/200 Ω/500 Ω Nickel618: 100 Ω/120 Ω/200 Ω/500 Ω	-60℃~250℃	0.9℃
	Nickel672：120 Ω Nickel672: 120 Ω	-80℃~320℃	1.4℃
	Platinum385：100 Ω/200 Ω/500 Ω/1000 Ω Platinum385: 100 Ω/200 Ω/500 Ω/1000 Ω	-200℃~870℃	1.3℃
	Platinum3916：100 Ω/200 Ω/500 Ω/1000 Ω Platinum3916: 100 Ω/200 Ω/500 Ω/1000 Ω	-200℃~630℃	1.3℃
Resistance Measurement Range	1~4020 Ω		
Resistance Measurement Accuracy	0.1% F.S.@25℃		
Sampling Period (Full-channel Scanning Time) The measured data is a resistance value The measured data is a temperature value	Max.: 1.5 s Max.: 2 s		
Differential Mode Rejection Ratio	60 dB		
Common Mode Rejection Ratio	100 dB		
Temperature drift	±50 ppm/℃		
Calibration Accuracy	0.05% of resistance, full range		
Calibration Period	12 months		
Isolation Voltage between Field and System	500 VAC@1 min, leaking current: 5 mA		
(0~65,535) Upload Data Format (0~65,535)			
Uploaded Resistance for Configuration Selection	65,535×(resistance value-Min. measurable resistance value in the range)/full range resistance value		
Uploaded Temperature for Configuration Selection	Acquisition temperature ×10+10,000		
Failure Diagnosis and Hot Plug			
Diagnosis Line break detection Over-limit alarm	When an line broken occurs, the diagnosis byte reports 0xA6, with the value reported by the measured channel data optional for configuration When the signal range exceeds Upper Limit Value/Lower Limit Value, the diagnosis byte then reports 0xA7/0xA8		
Hot Plugging	Supported		
Communication Bus			
Protocol	Profibus-DP		
Baud Rate	1.5Mbps, 500Kbps, 187.5Kbps , 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps adaptive		
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media		
Physical Property			
Protection Key	A2		

LK430 6-channel Thermal Resistance Type Analog Input Module	
Installation	Extension backplane
Module Dimension (W*H*D)	35 mm×100 mm×100 mm
Enclosure Protection Rating	IEC60529 IP20
Weight	180 g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.4.15 LK432 8-channel Thermal Resistance Analog Input Module

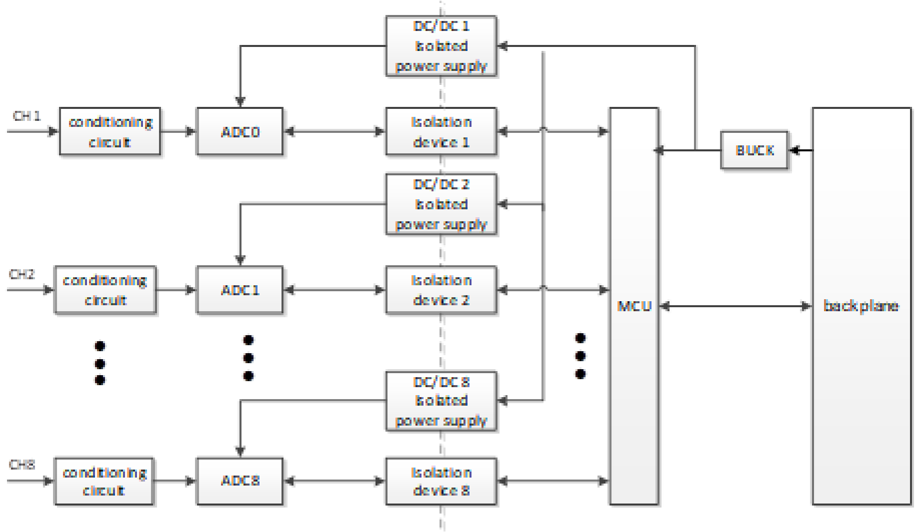
6.4.15.1 Basic Features

- 8-channel RTD input, in form of constant current source
- RTD measurement can report the temperature or resistance value or code value
- RTD Type: Copper427, Chinese_Cu, Nickel618, Nickel672, Platinum385, Platinum3916
- Resistance measurement range：Upper limit of sensor standard resistance range ≤ 402 Ω: 1 ~ 402 Ω; Upper limit of sensor standard resistance range > 402 Ω: 1 ~ 4020 Ω
- Upper Limit Exceeded Alarm
- Lower Limit Exceeded Alarm
- Line broken detection
- Isolation between the system and the field
- Hot swapping

Appearance drawing of LK432 module

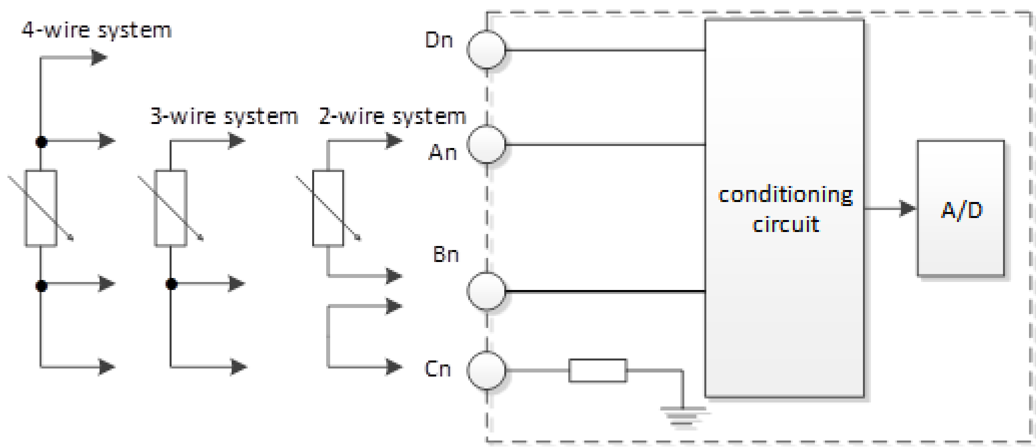
6.4.15.2 Operating Principle

The 24VDC system power supply of LK432 module outputs 3.3vdc through isolated DC / DC to supply power to the interface circuit. The interface circuit and the system are isolated by magnetic coupling, so as to realize the electrical isolation of the system from the field channels, and each channel is isolated from each other.



Internal structure block diagram of LK432 module

LK432 adopts the measurement method excited by constant current source. Compared with the traditional bridge measurement method, it can more effectively eliminate the influence of the line resistance of RTD long conductor on the measurement accuracy when the bridge is unbalanced. The module supports 2-wire, 3-wire and 4-wire connection methods. In the 3-wire connection method, the line resistance values of three RTD wires are required to be equal, otherwise the deviation of wire resistance will affect the measurement accuracy. The interface circuit is shown in the figure.



Interface circuit of LK432 module

6.4.15.3 Indicators

Definition of LK432 Indicators

Name		Status	Description
RUN/ERR indicator	green	On	The communication is established, and the module works well
		Flash	The communication is not established or incorrect.
		Off	The module is not powered on

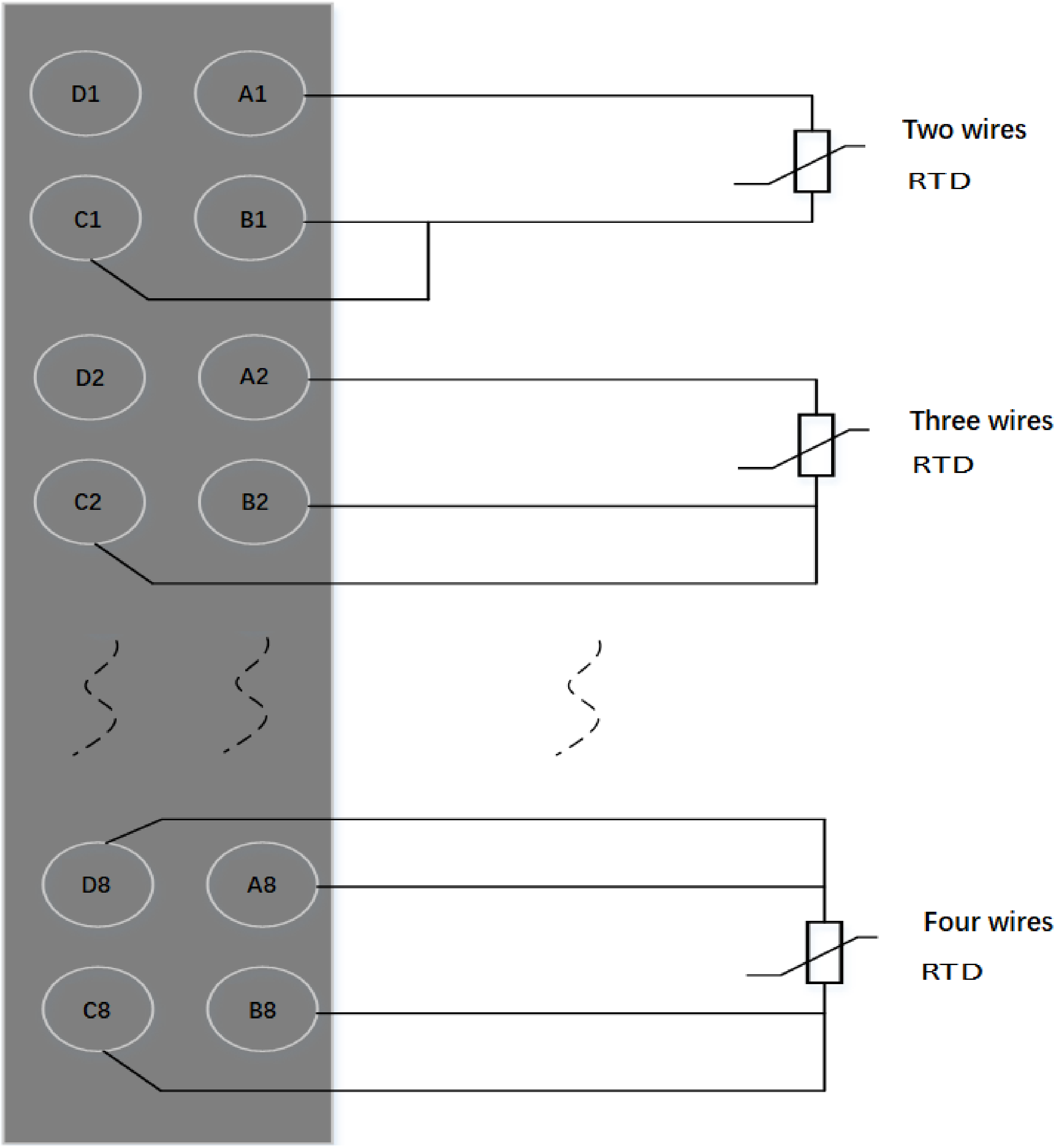
Name		Status	Description
	red	On	System power failure, system power supply voltage is lower than 18.2v. Chip failure, that is, ADC chip failure occurs in all 8 channels.
		Flash	Communication not established or communication error and system power failure
		Off	The module is working properly
01~08-channel indicator	yellow	On	channel OK
		Off	Channel failure / channel not enabled
	red	On	Channel failure (disconnection, over upper and lower limits, over range, channel failure).
		Off	Channel failure is not enabled or channel is normal

6.4.15.4 Wirings

The field signal is connected to LK432 module through LKX1130 prefabricated cable connector. The prefabricated cable is 36 core copper wire to connect the field signal. Among them, 32 cores are connected with 4-wire 8-channel thermal resistance analog input signal, and the other 4 cores are reserved without connection, and the wire head is insulated.

Color definition of signal line of LK432 module

Channel number	Cable core color	Channel number	Cable core color
Channel 1:A	Red on white	Channel 5:A	Red on green
Channel 1:B	Yellow on white	Channel 5:B	Yellow on green
Channel 1:C	Green on white	Channel 5:C	Green
Channel 1:D	Blue on white	Channel 5:D	Blue on green
Channel 2:A	Pink on white	Channel 6:A	Pink on green
Channel 2:B	Grey on white	Channel 6:B	Grey on green
Channel 2:C	Black on white	Channel 6:C	Black on green
Channel 2:D	White	Channel 6:D	White on green
Channel 3:A	Red on yellow	Channel 7:A	Red on blue
Channel 3:B	yellow	Channel 7:B	Yellow on blue
Channel 3:C	Green on yellow	Channel 7:C	Green on blue
Channel 3:D	Blue on yellow	Channel 7:D	Blue
Channel 4:A	Pink on yellow	Channel 8:A	Pink on blue
Channel 4:B	Grey on yellow	Channel 8:B	Grey on blue
Channel 4:C	Black on yellow	Channel 8:C	Black on blue
Channel 4:D	White on yellow	Channel 8:D	White on blue
NC1:	Brown on red	NC3:	Red
NC2:	Brown on pink	NC4:	Black



Wiring diagram of LK432 module

6.4.15.5 Diagnosis

The diagnostic information of LK432 contains 30 bytes. Among them, 4-byte equipment related diagnosis, 2-byte identification number diagnosis and 24 byte channel diagnosis. LK432 has 8 channels, and each channel has 3 bytes of diagnostic information.

When LK432 module is added through DP protocol under LK249 DP communication module, the diagnosis needs to be viewed through the function block.

After calling to obtain the DP slave station diagnosis function block (sysGetDPSlaveStateExt), the diagnosis data is stored in the output parameter DiagData array.

Description of diagnostic information for LK432 module

Diagnostic information	Diagnostic byte	Value
Device diagnostic information	DiagData[0]	0x04：Device diagnostic header byte
	DiagData[1]	Bit0：Chip fault diagnosis 1：Chip failure 0：No chip failure Bit2: System power failure 1: failure 0:No failure
	DiagData[2]	Bit0: channel fault diagnosis 1: failure 0:No failure
		Bit6~Bit7：DP network fault diagnosis 0：No fault 1：DP1 fault 2：DP2 fault
	DiagData[3]	Bit0~Bit7：Module MCU firmware version information
Diagnostic information for identification number	DiagData[4]	0x42: ID diagnostic header byte
	DiagData[5]	0x00: no channel failure 0x01: channel failure
Channel diagnostic information	DiagData[6]~DiagData[29]	3 bytes per channel The first byte is the channel diagnostic header byte The second byte is the channel number data The third byte is the channel data type / fault diagnosis type See the following table "LK432 channel diagnostic information"

Specifications for LK432 Channel Diagnosis Message

Diagnostic information						meaning
Bit		Bit7	Bit6	Bit5	Bit4~ Bit0	
First byte	head	0x80				Decimal online value 128
Second byte	I / O type / channel number	01 (input)		(Channel number)		Failed channel numbers 1~8 Decimal online value 64~71
Third byte	Channel data type / fault type	101 (Word)			2	Under range fault, decimal online value 162
					3	Overrange fault, decimal online value 163
					6	Disconnection, decimal online value 166
					7	Over upper limit fault, decimal online value 167
					8	Out of lower limit fault, decimal online

Diagnostic information				meaning
				value 168
			9	Channel ADC chip failure, decimal online value 169
			0	Channel fault recovery, decimal online value 160

When LK432 module is added under LK241 Powerlink communication module through Powerlink protocol, after compilation, you can directly view the diagnosis information on the diagnosis page.

Configure LK432 module in autothink programming software, generate module diagnosis information page after compilation, and store the obtained diagnosis in s area of the system. The diagnostic information of LK432 is shown in the figure.

Variable Name	Variable Type
AT_LK432SlaveState_10	BYTE
AT_LK432SlaveID_H10	BYTE
AT_LK432SlaveID_L10	BYTE
AT_LK432_Chip_Fault10	BOOL
AT_LK432_SysPower_Fault10	BOOL
AT_LK432ChannelFault10	BOOL
AT_LK432DP1NetFault10	BOOL
AT_LK432DP2NetFault10	BOOL
AT_LK432MCUVern10	BYTE
AT_LK432ModuleDiag10	BOOL
AT_LK432Channel1DataFault10	BYTE
AT_LK432Channel2DataFault10	BYTE
AT_LK432Channel3DataFault10	BYTE
AT_LK432Channel4DataFault10	BYTE
AT_LK432Channel5DataFault10	BYTE
AT_LK432Channel6DataFault10	BYTE
AT_LK432Channel7DataFault10	BYTE
AT_LK432Channel8DataFault10	BYTE

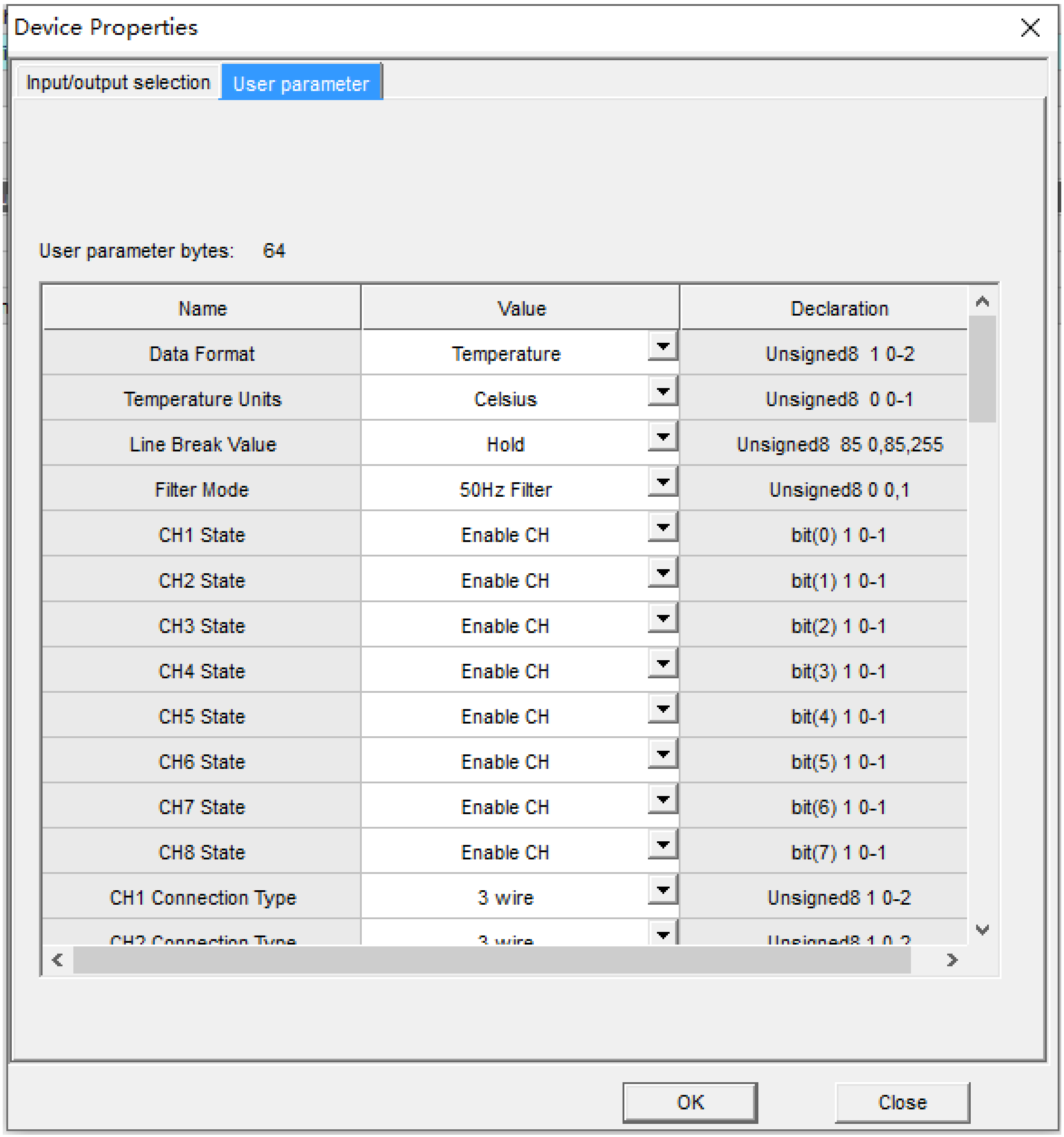
The diagnostic information of LK432

ⓘUnder LK202, LK205, LK207 and LK210, LK432 module channel diagnosis is not supported.

6.4.15.6 Parameters

The user parameter is used to set the working mode of the module. It is written to the controller when the project is loaded. It is not read every scanning cycle. Each parameter has a default value (default), which can be changed according to project requirements. After the parameter value is changed, you need to download it all to take effect.

In autothink programming software, double-click the LK432 tree node under hardware configuration to open the "device properties" dialog box. As shown in the figure, the LK432 user parameter has 64 bytes.



LK432 user parameter setting

Table of LK432 User Parameters

Parameter Name	Meaning	Value
Data Format	Channel measurement data output format selection	Code：Report the resistance code value Temperature：Report the temperature code value (default) Resistance：Report the resistance value
Temperature Units	Selection of temperature scale for module temperature measurement	Celsius Fahrenheit
Line Break Value	Data reporting code value selection of disconnection alarm channel	0x0000：according to the configured data format output format, the channel reports the corresponding code value offline limit or resistance value offline limit or lower temperature limit Hold：the channel measurement data maintains the normal data before disconnection (default) 0xFFFF：according to the configured data format output format, the channel reports the corresponding code value on-line limit or resistance value on-line or temperature upper limit
Filter Mode	digital filtering mode selection	50 Hz Filter：filter 50 Hz interference (default) 60 Hz Filter：filter 60 Hz interference
CHn State(n=1~8)	Channel status	Enable CH：(default) Disable CH
CHn Connection Type(n=1~8)	Channel wiring type selection	2 wire：connect 2-wire input signal 3 wire：connect 3-wire input signal (default) 4 wire：connect 4-wire input signal
CHn Sensor Type(n=1~8)	Channel thermal resistance type selection	Cu427:10 Ω Chinese_Cu:50 Ω Ni618:100 Ω Ni618:120 Ω Pt385:100 Ω(default) Pt3916:100 Ω Ni618:200 Ω Ni672:120 Ω Pt385:200 Ω Pt3916:200 Ω Ni618:500 Ω Pt385:500 Ω Pt3916:500 Ω Pt385:1000 Ω Pt3916:1000 Ω
CHn Digital Filter(n=1~8)	Digital filter enable	None：(default) 4 Points：(select the latest 4 historical data) 16 Points：(select the latest 16 historical data) 32 Points：filtering (select the latest 32 historical data)
CHn Upper Limit Exceeded	Channel over limit alarm	Disable：(default) Enable

Parameter Name	Meaning	Value
Alarm(n=1~8)	enable	
CHn Lower Limit Exceeded Alarm(n=1~8)	Channel over lower limit alarm enable	Disable：(default) Enable
CHn Upper Limit Value(n=1~8)	Channel alarm upper limit setting	Alarm upper limit range: 6720 ~ 25980, default value: 18700
CHn Lower Limit Value(n=1~8)	Channel alarm lower limit setting	Alarm lower limit range: 6720 ~ 25980, default value: 8000
CHn Line Break Alarm(n=1~8)	Channel disconnection alarm enable	Disable Enable：(default)

6.4.15.7 Technical Specifications

LK432 8-channel Thermal Resistance Analog Input Module			
Input channel performance index			
Number of channels	8		
Measurement Method	Current source measurement		
Connection method of thermal resistance	2 / 3 / 4-wire thermal resistance input, you can select "2-wire system, 3-wire system, 4-wire system" through at. The default is 3-wire system		
Temperature Measurement Accuracy	Thermal Resistance Type Code	Temperature Measurement Range	Absolute Error
	Copper427：10 Ω	-200℃~260℃	4℃
	Chinese_Cu：50 Ω	-50℃~150℃	1.0℃
	Nickel618：100 Ω/120 Ω/200 Ω/500 Ω	-60℃~250℃	0.9℃
	Nickel672：120 Ω	-80℃~320℃	1.4℃
	Platinum385：100 Ω/200 Ω/500 Ω/1000 Ω	-200℃~870℃	1. 2℃
	Platinum3916：100 Ω/200 Ω/500 Ω/1000 Ω	-200℃~630℃	1.0℃
Temperature scale selection	Celsius scale or Fahrenheit scale		
Resistance Measurement Range	1~4020 Ω		
Resistance Measurement Accuracy	±0.1% F.S.@25℃		

LK432 8-channel Thermal Resistance Analog Input Module	
Full channel scan time	Max. 1s (no filtering)
Channel enable function	It has channel enabling function. When the channel is not enabled, the code value is displayed as 0
Hot plug	Support
Filter parameters	No filtering, 4-point filtering, 16 point filtering and 32 point filtering. No filtering by default
Interference frequency suppression	50Hz or 60Hz, 50Hz by default
Differential Mode Rejection Ratio	60 dB
Common Mode Rejection Ratio	100 dB
Temperature drift	±20 ppm/℃
Channel withstand voltage	≤12VDC
Maximum cable impedance	≤25Ω(2 / 3 wires)； ≤50Ω(4 wires)

Thermal resistance input range			
Range code	Type of thermal resistance	Input range (unit: Ω)	
		Standard resistance range	Measurable range
0xC0	Cu427 10Ω	3.69980 ~ 21.1574	1 ~ 402
0xC1	Chinese_Cu 50Ω	39.243 ~ 82.136	1 ~ 402
0xC2	Ni618 100Ω	69.5204 ~ 343.584	1 ~ 402
0xC3	Ni618 120Ω	83.4245 ~ 412.301	1 ~ 4020
0xC4	Pt385 100Ω	18.5201 ~ 396.311	1 ~ 402
0xC5	Pt3916 100Ω	16.9960 ~ 327.744	1 ~ 402
0xC6	Ni618 200Ω	139.041 ~ 687.168	1 ~ 4020
0xC7	Ni672 120Ω	66.6000 ~ 568.407	1 ~ 4020
0xC8	Pt385 200Ω	37.0402 ~ 792.622	1 ~ 4020
0xC9	Pt3916 200Ω	33.992 ~ 655.488	1 ~ 4020
0xCA	Ni618 500Ω	347.602 ~ 1717.92	1 ~ 4020
0xCB	Pt385 500Ω	92.6005 ~ 1981.56	1 ~ 4020

LK432 8-channel Thermal Resistance Analog Input Module			
0xCC	Pt3916 500Ω	84.98～1638.72	1～4020
0xCD	Pt385 1000Ω	185.201～3963.11	1～4020
0xCE	Pt3916 1000Ω	169.960～3277.44	1～4020
Upload data format (0~65535)			
Configuration selection upload code value	The upper limit of the standard resistance range of the sensor is ≤ 402 Ω, indicating the resistance value: code value × (402/65535)Ω; The upper limit of the standard resistance range of the sensor is ＞ 402 Ω, indicating the resistance value: code value × (4020/65535)Ω; When the resistance value is less than 1 Ω, it can still be measured, but the accuracy cannot be guaranteed.		
Configuration selection upload temperature	Acquisition temperature × 10+10,000		
Configuration upload resistance	Upper limit of sensor standard resistance range ≤ 402 Ω: resistance value × 100; Upper limit of sensor standard resistance range ＞ 402 Ω: resistance value × 10; Note 1: if the input resistance value is ＞ 402 ohms, the displayed resistance value is 40200 and the display code value is 65535; Note 2: if the input resistance value is ＞ 4020 ohms, the displayed resistance value is 40200 and the display code value is 65535		
Periodic data			
Periodic data composition	Channel data	17 bytes. Single channel: 2-byte channel acquisition value and 1-bit channel quality bit	
Periodic data reporting method	Module cold start	The reported data is the actual collected value, and the reported zero value. After one acquisition (within 400ms), the resistance value and temperature value have no filtered real-time value until the data acquisition is completed. Whether the data is valid is marked by the quality bit. Report the actual value after the data is ready, and the data preparation time is less than 300ms × Configuration filtering times + 400	
	Module hot start	The reported data is the actual collected value, and the reported zero value. After one acquisition (within 400ms), the resistance value and temperature value have no filtered real-time value until the data acquisition is completed. Whether the data is valid is marked by the quality bit. Report the actual value after the data is ready, and the data preparation time is less than 300ms × Configuration filtering times + 400	
	Module configuration parameters change after downloading	The reported data is the actual collected value	

LK432 8-channel Thermal Resistance Analog Input Module			
	The module is not reset and the communication is interrupted and returns to normal	The data reported in the first shot is the actual collected value The cumulative number of samples does not reach before the filtering parameters	
	The cumulative number of samples does not reach before the filtering parameters	The reported data shall be the results of smooth filtering of the previous few beats, and the sampling results without filtering shall be reported until the cumulative times reach the filtering times	
Aperiodic data			
Diagnostic data	Routine diagnosis	6 bytes	
	Extended diagnosis	Equipment diagnosis	5 bytes, including chip fault, DP 1 / DP 2 network fault, channel fault, MCU version number, FPGA version number and other diagnostic information
		Identification number diagnosis	2 bytes
		Channel diagnosis	24 bytes, which contains the channel diagnostic status of 8 channels
	Reporting method	Module cold start	Report once extended diagnosis module reports once extended diagnosis after the data is accurate, and the data preparation time is less than 300ms × Configuration filtering times + 400
		Module hot start	Report once extended diagnosis module reports once extended diagnosis after the data is accurate, and the data preparation time is less than 300ms × Configuration filtering times + 400 Module configuration parameters change after downloading Report an extended diagnosis module. After the configuration parameters change, report an

LK432 8-channel Thermal Resistance Analog Input Module			
			extended diagnosis after the configuration is completed
		Module configuration parameters change after downloading	After the configuration parameters are changed, the module reports an extended diagnosis after the configuration is completed
		After the module is not reset and the communication is interrupted and re established	Report an extended diagnosis
		The cumulative number of samples does not reach before the filtering parameters	The channel diagnosis report sets the diagnosis results before filtering, and the delay time of diagnosis report is less than 300ms × Configuration filtering times
Isolation withstand voltage			
Channel to system	1000VAC@1min，≤5mA		
Between channels	500VAC@1min，≤5mA		
System Power			
Power Voltage	19.2V~28.8V		
Power consumption	60mA@ 24VDC		
Communication Bus			
DP master card model	LK235 LK234 LK249 LK202 LK205 LK207 LK210		
Protocol	Profibus-DP		
Dual network redundancy	Support		
Baud Rate	3Mbps、1.5Mbps、500Kbps、187.5Kbps、93.75Kbps、45.45Kbps、31.25Kbps、19.2Kbps、9.6Kbps。		
Module failure			
Fault isolation	The channel failure of the module does not affect the operation of other channels, and the channel failure does not spread to other channels		
Module fault type	Communication failure	DP network (DP1, DP2) failure	
	Channel failure	The channel is disconnected (which line cannot be diagnosed), and there is an enable bit control	

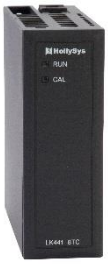
LK432 8-channel Thermal Resistance Analog Input Module		
		Channel overrun fault, with enable bit control; The overrun threshold can be set. The over limit threshold setting needs to be within the over range. If the two exist at the same time, the over range fault will be reported first. Overrun threshold in any reporting format, only temperature units can be selected. The unit follows the configuration to select the temperature unit. In case of over range fault, the channel input resistance exceeds the "measurable range" of the channel.
Physical Property		
Installation	Extension backplane	
Protection Key	A3	
Enclosure Protection Rating	IP20	
Module Dimension (W*H*D)	35mm×107mm×100mm	
Weight	205g	
Environmental Adaptability		
Operating Temperature	-20～70°C	
Operating Humidity	5%~95%, with no condensation	
Storage Temperature	-40～70°C	
Storage Humidity	5%~95%, with no condensation	

6.4.16 LK441 8-channel Thermocouple Analog Input Module

6.4.16.1 Basic Features

- 8-channel thermocouple or millivolt input
- Thermocouple type: B, E, J, K, R, S, T, N, C
- Range of millivolt signals: -12~32mV/-12~78mV
- Directly reported temperature value of a thermocouple signal type

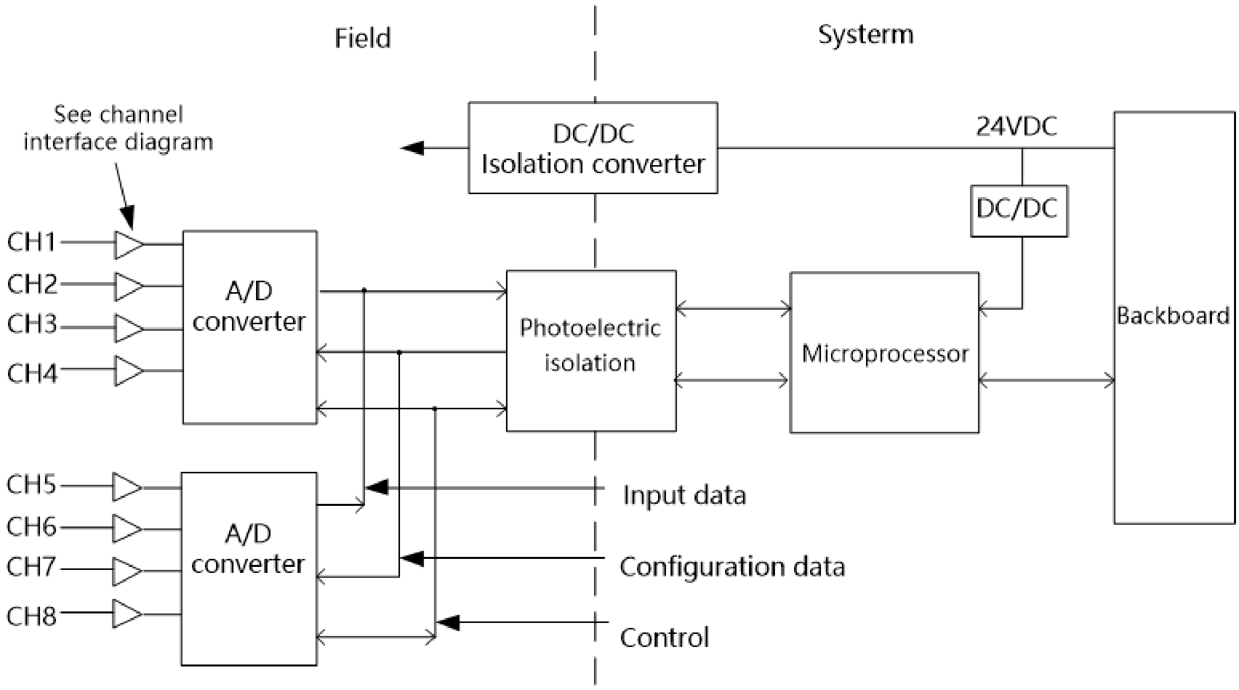
- RTD cold junction temperature compensation
- Over-limit alarm
- Over range alarm
- Line broken alarm
- Isolation between the system and the field
- Field calibration
- Hot swapping



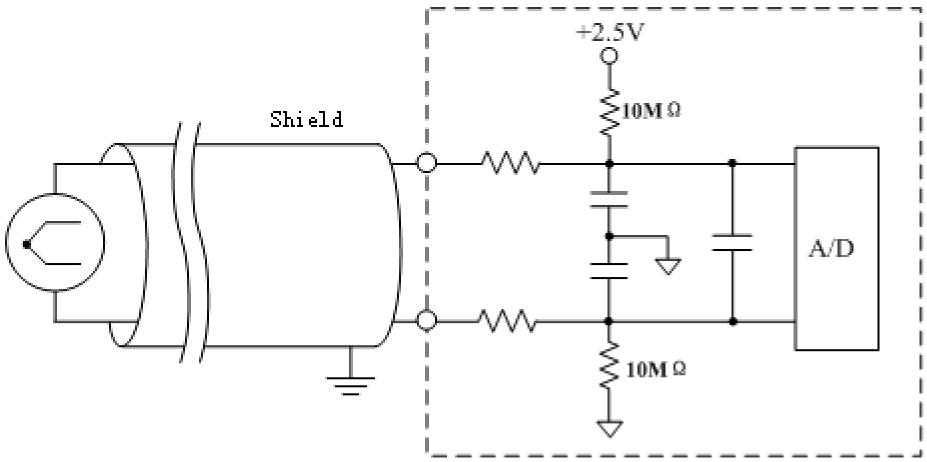
LK441 Module Schematic Diagram

6.4.16.2 Operating Principle

The 24 VDC system power supply of the LK441 module supplies the power to the interface circuit by outputting 2.5 VDC via isolated DC/DC. An opto-isolator is between the interface circuit and the system, realizing the electrical isolation between the system and the field channel. The field signal is converted into a digital signal via an A/D converter. Via optoelectronic isolation, it is read by the microprocessor in the module, then uploaded to the controller module via the Profibus-DP bus.



Internal Structure Block Diagram of LK441



LK441 Channel Interface Circuit Diagram

6.4.16.3 Indicators

There are two status indicators on the front panel of the module: the green RUN indicator and the yellow CAL indicator. The RUN indicator is the run indicator, indicating the communication status between the module and the controller module. The CAL indicator is the calibration indicator, indicating the calibration process(Calibration model is not introduced in this article, please contact HollySys service agencies if necessary).

Definition of LK441 Indicators

Name	Status	Description
RUN indicator (green)	On	The communication is established, and the module works well
	Flash	The communication is not established or incorrect.
	Off	The module is not powered on.
CAL Calibration Indicator (yellow)	On	In the calibration and detection mode, undergoing calibration and detection
	Flash	In the calibration no detection mode, but undergoing no calibration and detection
	Off	It is not powered up or the communication is not established or the module does not in the calibration and detection mode

- Running Mode
  - Immediately after being powered on, the module waits for the initialized data, with the green indicator flashing based on a frequency of 4 times/second.
  - Upon the completion of initialization, the green indicator is turned normally on, which indicates that the module works well. In case of any error in the initialized data, communication cannot be established and the green indicator keeps flashing. Check whether the DP is connected properly and the communication parameters are set properly.
  - When the module works well, the green indicator is normally on; when the communication is disconnected, the green indicator flashes; when the communication is established again, the green indicator is turned normally on again.
  - The yellow indicator is normally off when the module is in the running mode.

Definition of LK441 Indicators in Running Mode

Name	Status	Description
RUN indicator (green)	On	The communication is established
	Flash	The communication is not established or incorrect.
	Off	The module is not powered on.
CAL Calibration Indicator (yellow)	On	In the calibration and detection mode, undergoing calibration and detection
	Flash	In the calibration no detection mode, but undergoing no calibration and detection
	Off	It is not powered up or the communication is not established or the module does not in the calibration and detection mode

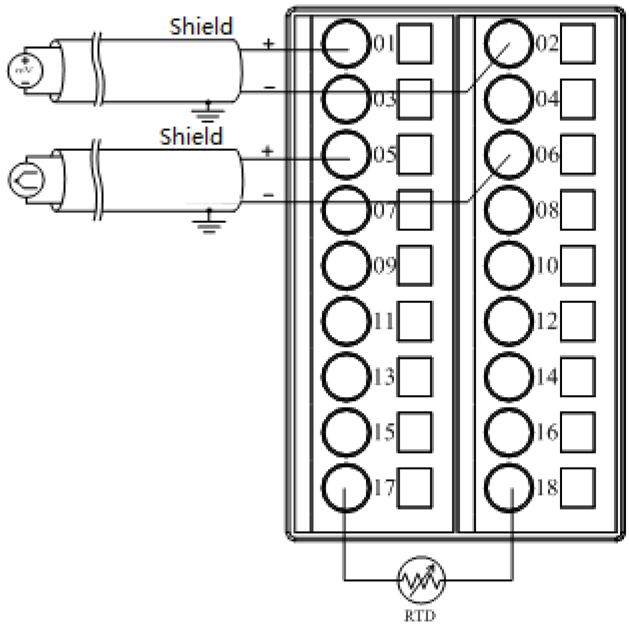
6.4.16.4 Wirings

The LK441 module is installed on the extension backplane.

Definition of LK441 Backplane Terminals

Channel No.	Sequence of Terminals	
	Positive Terminal of TC/Millivolt Signal Input	Negative terminal of TC/Millivolt Signal Input
1	01	02
2	03	04
3	05	06
4	07	08
5	09	10
6	11	12
7	13	14

Channel No.	Sequence of Terminals	
	Positive Terminal of TC/Millivolt Signal Input	Negative terminal of TC/Millivolt Signal Input
8	15	16
Cold junction compensation channel	To connect the RTD temperature measurement element	
9	17	18



LK441 Backplane Terminal Wiring Diagram

Pay attention to the following during wiring:

- The two-row 18-channel terminals are fixed on the backplane, right located under the installation position of the LK441 module.
- Each thermocouple or millivolt signal is separately connected to the terminals via two conductors (shielded cable) in the field.
- The odd terminal is connected to the positive terminal of thermocouple/millivolt signal; the even terminal is connected to the negative terminal of the thermocouple/millivolt signal.
- When adopting set cold junction temperature compensation, Terminals 71 and 18 cannot be used.

6.4.16.5 Functions

6.4.16.5.1 Measured Data Output Format

LK441 can be connected to a thermocouple element of B, E, J, K, R, S, T, N and C type to acquire the field temperature signal, or it can acquire the millivolt voltage signal within a range of -12~78 mV or -12~+32 mV.

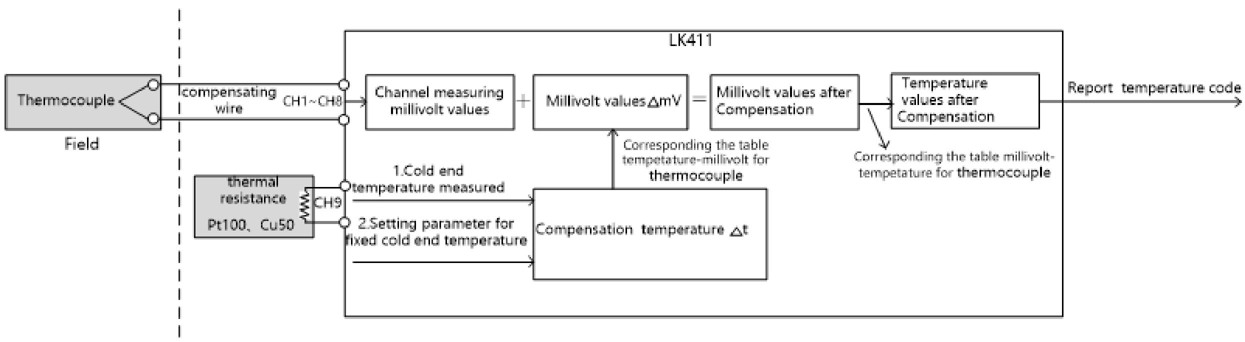
The measured data on each channel that is reported by LK441, is expressed in form of 2-byte positive integer (decimal: 0~65,535) digital code. For different ranges, the output format of measured data may differ. The millivolt range outputs the millivolt digital code corresponding to the field signal. The thermocouple range outputs the temperature digital code corresponding to the field signal. See the following for the formula of conversion between the measured data and the physical quantity:

- Millivolt range of configuration selection: Millivolt Value mV＝(Millivolt digital code/65,535)×Range-12, notably, for -12~78 mV, Range＝90 mV, for -12~32 mV, Range＝44 mV.
- Thermocouple Range of configuration selection: Temperature Value (℃/℉) ＝(Temperature digital code-10,000)/10.

For a millivolt range, by calling the function block HEX_ENGIN of the Analog signal Processing Functions library in the programming software AutoThink, it can convert the 2-byte millivolt code value into the engineering data.For a thermocouple range, it can obtain the actual temperature value upon simple operation according to the above formula.

6.4.16.6 Cold-conjunction Compensation

LK441 can adopt the following two methods for cold junction compensation. Both methods require configuring LK441 with a thermocouple range, with the measured data reported to the controller module representing a temperature value (that is, to report the temperature digital code).



LK441 Cold-conjunction Temperature Compensation Block Diagram

- RTD measured cold junction temperature compensation

Each LK441 uses a RTD temperature measurement element to measure the actual temperature at the cold junction of thermocouple, via the "temperature→millivolt" table corresponding to thermocouple, automatically verifies the millivolt value corresponding to the cold junction temperature value. Then it sums up such a cold junction millivolt value and the measured channel millivolt value of LK441 to obtain the actual compensation millivolt value, further by looking up in "millivolt-temperature" table according to the compensation millivolt value to obtain the actual temperature value at the field terminal of thermocouple, finally reporting the measured temperature code to the controller module. The specific compensation algorithm is completed automatically in LK441. The controller module obtains the compensation temperature directly.

The external RTD temperature measurement element of LK441 occupies Channel 9 that is inside. The RTD allows using such three thermal resistances as Chinese_Cu50 ohm, Pt385 100 ohm and Pt3916 100 ohm, with the cold junction temperature compensation ranging 0~60℃. It is recommended of using Pt385 100 ohm or Pt3916 100 ohm. The installation position of thermal resistance is close to the cold junction of the thermocouple as closely as possible (that is, close to the outgoing terminal of LK441).

See the following for the steps to adopt RTD temperature measurement to configure automatic cold junction compensation:

(1) The cold junction compensation of a corresponding channel enables to select Enable for the parameter CHn Cold Junction Compensation, thus enabling cold junction temperature compensation of the channel.

(2) Select RTD for the cold junction compensation mode parameter Cold Junction Comp.Source.

(3) Select the connected thermal resistance type as Chinese_Cu 50 ohm, Pt385 100 ohm or Pt3916 100 ohm for the RTD temperature measurement element parameter Cold Junction Comp.RTType-D.

Select whether the RTD temperature measurement channel is capable of line broken detection according to the parameter **RTD Line Break Alarm**, defaulted to Disable. After enabling line broken detection, if an line broken occurs to the RTD temperature measurement channel (Channel 9), the channel data holds the normal data prior to the line broken, with the channel diagnosis reporting the line broken fault value 0xA6.

- Set cold junction temperature compensation

When the dynamic compensation accuracy requirement is low or the cold junction ambient temperature changes slightly, the cold junction temperature can also be pre-input in the configuration and kept unchanged. LK441 compensates according to the set cold junction temperature.

Each LK441 via the "temperature→millivolt" table corresponding to thermocouple, automatically verifies the millivolt value corresponding to the cold junction temperature. Then it sums up such a cold junction millivolt value and the measured channel millivolt value of LK441 to obtain the actual compensation millivolt value, further by looking up in "millivolt-temperature" table according to the compensation millivolt value to obtain the actual temperature value at the field terminal of thermocouple, finally reporting the measured temperature digital code to the controller module. The specific compensation algorithm is completed automatically in LK441. The controller module obtains the compensation temperature directly.

See the following for the steps to adopt a set cold junction temperature to configure cold junction compensation:

(4) The cold junction compensation of a corresponding channel enables to select Enable for the parameter CHn Cold Junction Compensation, thus enabling cold junction temperature compensation of the channel.

(5) Select Cold Junction Compensation for the cold junction compensation mode parameter Cold Junction Comp.Source.

(6) Input the temperature compensation value in the cold junction temperature compensation value parameter Cold Junction Compensation Value, with temperature compensation value=compensation temperature ×10.

The temperature scale of the compensation temperature conforms to the temperature scale (Temperature Units) selected by the LK441. When the temperature scale is of a degree Celsius, the cold junction temperature compensation ranges 0~60℃, with the corresponding temperature compensation value of 0~600. When the temperature scale is of a degree Fahrenheit, the cold junction temperature compensation ranges 32~ 140℉, with the corresponding temperature patch compensation value of 320~1400.

6.4.16.7 Diagnosis

The LK441 module can diagnose over range, over-limit and line broken, which are of a channel diagnosis. After calling the function block Get Diagnosis of DP slave (sysGetDPSlaveState), the channel diagnosis data reported is sent into the output parameter **DiagData** in the function block.

Diagnostic information of LK441 up to 31 bytes, wherein 2 bytes are device-related diagnosis, 2 bytes are identification diagnosis and 27 bytes are channel diagnosis. nine channels in LK441, wherein, the forward 8-channel as thermocouple or millivolt signal input, channel 9 for the cold junction compensation terminal. the diagnosis information for each channel 3 bytes. Diagnosis information diagram refer to figure Diagnosis_Information_diagram.

- Device diagnosis information

Device diagnosis data 0x02,0x00 indicates the current device without any fault.

Device diagnosis data 0x02,0x01 indicates that the current device has channel fault.

Device diagnosis data 0x02,0x02 indicates that the current device has checksum fault.

Device diagnosis data 0x02,0x03 indicates that the current device have both channel fault and checksum fault.

- Identification diagnosis information

The 2-byte identification diagnosis information is 0x42,0x01 when diagnosis information is reported.

- Channel diagnosis information

Channel diagnosis information as shown in table.

Specifications for LK441 Channel Diagnosis Information

<table>
<tr><th colspan="6">Diagnosis Information</th><th>Meaning</th></tr>
<tr><td colspan="2">Bit</td><td>Bit7</td><td>Bit6</td><td>Bit5</td><td>Bit4~
Bit0</td><td></td></tr>
<tr><td>The first byte</td><td>Head</td><td colspan="4">0x80</td><td>Decimal online value 128</td></tr>
<tr><td>The second byte</td><td>I/O type/channel</td><td colspan="2">01
(Input)</td><td colspan="2">（Channel）</td><td>Failed channel no 1~8
Decimal online value 64~72</td></tr>
<tr><td rowspan="6">The third byte</td><td rowspan="6">Channel data type/fault type</td><td colspan="3" rowspan="6">101 (Word)</td><td>2</td><td>Under range, Decimal online value is 162</td></tr>
<tr><td>3</td><td>Over range, Decimal online value is 163</td></tr>
<tr><td>6</td><td>Line broken, Decimal online value is 166</td></tr>
<tr><td>7</td><td>Upper limit exceeded, Decimal online value is 167</td></tr>
<tr><td>8</td><td>Lower limit exceeded, Decimal online value is 168</td></tr>
<tr><td>0</td><td>Channel fault recovery, Decimal online value is 160</td></tr>
</table>

Example:

Channel diagnosis data 0x80, 0x40, 0xA2 indicates that channel 1 has under range alarm.

Channel diagnosis data 0x80, 0x41, 0xA3 indicates that channel 2 has over range alarm.

Channel diagnosis data 0x80, 0x42, 0xA6 indicates that channel 3 has line broken alarm.

Channel diagnosis data 0x80, 0x43, 0xA7 indicates that channel 4 has upper limit exceeded alarm.

As an I / O slave of HolliTCP protocol, excepte above diagnostic information, refer to LK234_Diagnosis for more diagnostic information.

As an I / O slave of POWERLINK protocol, excepte above diagnostic information, refer to Overview of Diagnosis Information for more diagnostic information.

6.4.16.7.1 Optional Alarms

The alarms that are provided by each range for the LK441 module are different, as shown in table.

LK441 Alarm List Based on Different Ranges

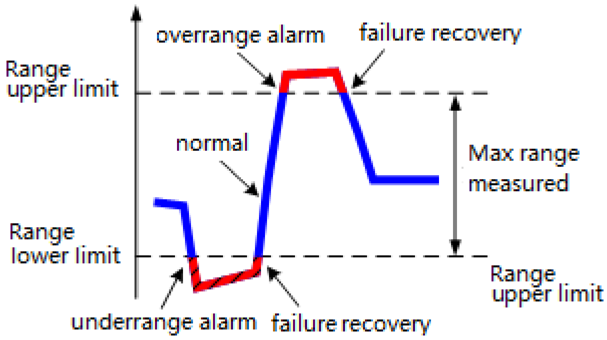
Range Limit	Thermocouple Type	Internal Range Code	Alarm Type
-12 mV~78 mV	—	13	Over-limit alarm, over range alarm
-12 mV~32 mV	—	14	Over-limit alarm, over range alarm
300~1820°C	Type B	207	Over-limit alarm, line broken alarm
0~1725°C	Type C	208	Over-limit alarm, over range alarm
0~2315°C	Type C	209	Over-limit alarm, line broken alarm
-270~415°C	Type E	210	Over-limit alarm, over range alarm
-270~1000°C	Type E	211	Over-limit alarm, line broken alarm
-210~550°C	Type J	212	Over-limit alarm, over range alarm
-210~1200°C	Type J	213	Over-limit alarm, line broken alarm
-270~725°C	Type K	214	Over-limit alarm, over range alarm
-270~1372°C	Type K	215	Over-limit alarm, line broken alarm
-270~840°C	Type N	216	Over-limit alarm, over range alarm
-270~1300°C	Type N	217	Over-limit alarm, line broken alarm
-50~1768°C	Type R	218	Over-limit alarm, line broken alarm
-50~1768°C	Type S	219	Over-limit alarm, line broken alarm
-270~400°C	Type T	220	Over-limit alarm, line broken alarm

Note: when using a thermocouple range, if thermocouples of a same type has two temperature ranges available, for example, for Type C thermocouples, the two ranges are 0~1725℃ and 0~2315℃. When configuring in a smaller temperature range, for example, if a Type C thermocouple selects a range of 0~1725℃, the module does not provide line broken detection directly. However, if a broken thermocouple occurs, the channel consequently gives an over range alarm. That is, in such a case, if an over range alarm is received, the channel may really go beyond the range, or it may be resulted in a broken thermocouple.

6.4.16.7.2 Over Range Alarm

The LK441 module is capable of over range alarm. When an input signal exceeds the selected range, for a thermocouple, it means to exceed the millivolt value corresponding to the temperature range selected by thermocouple. The channel diagnosis byte reports over range. When the signal is recovered, it reports fault recovery.

For the LK441, not all the ranges are capable of over range alarm. Each range supports different alarm types. Refer to Optional_Alarms .



LK441 Over Range Alarm Schematic Diagram

Due to the different ranges selected, the diagnosis handling methods of the module may also differ in case of over range, as shown in table. When the signal is recovered to the normal range, the channel diagnosis byte then reports 0xA0.

The LK441 module only reports the diagnosis data once separately when over range occurs and is recovered.

Handling of LK441 Over Range Alarm

Range Type	Type of Over Range	Handling of Over Range
Thermocouple	Over Range	1. The channel diagnosis area reports the fault value 0xA3 2. The measured channel data reports the max. temperature code value in the range
	Under Range	1. The channel diagnosis area reports the fault value 0xA2 2. The measured channel data reports the Min. temperature code value in the range
Millivolt Signal	Over Range	1. The channel diagnosis area reports the fault value 0xA3 2. The measured channel data reports 0xFFFF
	Under Range	1. The channel diagnosis area reports the fault value 0xA2 2. The measured channel data reports 0x0000

6.4.16.7.3 Over-limit Alarm

The LK441 module is capable of over-limit alarm. It can set the alarm boundary line flexibly according to different industrial fields, detects field temperature signal changes, and timely gives an over-limit alarm, thus well improving security in industrial control.

In the selected range, the user can set Upper Limit Value and Lower Limit Value of the input signal by his or her own. When the input signal goes beyond the limit range, that is, higher than Upper Limit Value or lower than Lower Limit Value, the channel diagnosis byte then reports over-limit. When the signal is recovered to the limit range, it then reports fault recovery.

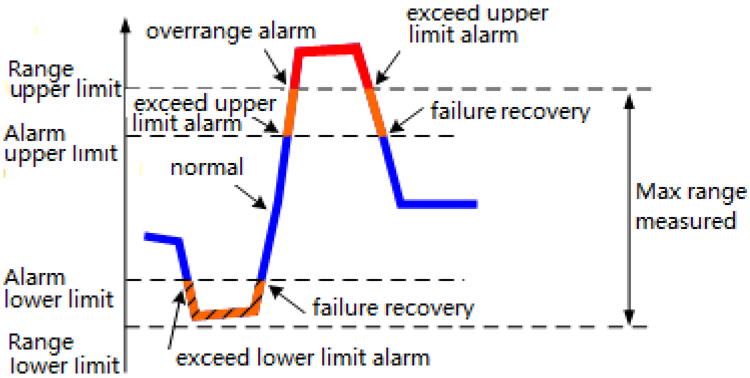
Whether the LK441 module can give an overall alarm, Upper Limit Value and Lower Limit Value of each channel can be selected during configuration, defaulted to Over-limit Alarm Disable. The alarm limit set in the user parameter is a 16-bit positive integer digital code, which is divided into a temperature digital code (when thermocouple is selected for the range) and a millivolt digital code (when millivolt is selected for the range). Refer to table for the conversion formula.

Calculation of LK441 Alarm Limit Digital Code

Range Type	Upper Limit Value (Decimal)	Lower Limit Value (Decimal)
Thermocouple	Upper Limit Temperature value ×10+10000	Lower Limit Temperature value ×10+10000
-12 mV~78 mV	65,535×(Upper Millivolt Value+12)/90	65,535×(Lower Millivolt Value+12)/90
-12 mV~32 mV	65,535×(Upper Millivolt Value+12)/ 44	65,535×(Lower Millivolt Value+12)/ 44

For a thermocouple signal, the temperature units for Upper Limit Value Temperature and Lower Limit Value Temperature (℃ or ℉) conform to those selected for the module (to select via the parameter **Temperature Units**, defaulted to ℃)

Range of Lower Limit Values 0~65534, defaulted to 0; Range of Upper Limit Values: 1~ 65,535, defaulted to 65,535. Upper Limit Value must be more than Lower Limit Value. Otherwise, the LK441 module cannot report the diagnosis message properly.



LK441 Overran Alarm Schematic Diagram

Due to the different ranges selected, the diagnosis handling methods of the module may also differ in case of over-limit, as shown in table. When the signal is recovered to the normal range, the channel diagnosis area then reports 0xA0.

The LK441 module only reports the diagnosis data once separately when occurrence over-limit occurs and is recovered.

Handling of LK441 Over Range Alarm

Range Type	Type of Over-limit	Handling of Over-limit
Thermocouple	Upper limit exceeded	1. The channel diagnosis area reports the fault value 0xA7 2.The measured channel data reports the current temperature digital code
	Lower limit exceeded	1. The channel diagnosis area reports the fault value 0xA8 2. The measured channel data reports the current temperature digital code
Millivolt Signal	Upper limit exceeded	1. The channel diagnosis area reports the fault value 0xA7 2. The measured channel data reports the current millivolt digital code
	Lower limit exceeded	1. The channel diagnosis area reports the fault value 0xA8 2. The measured channel data reports the current millivolt digital code

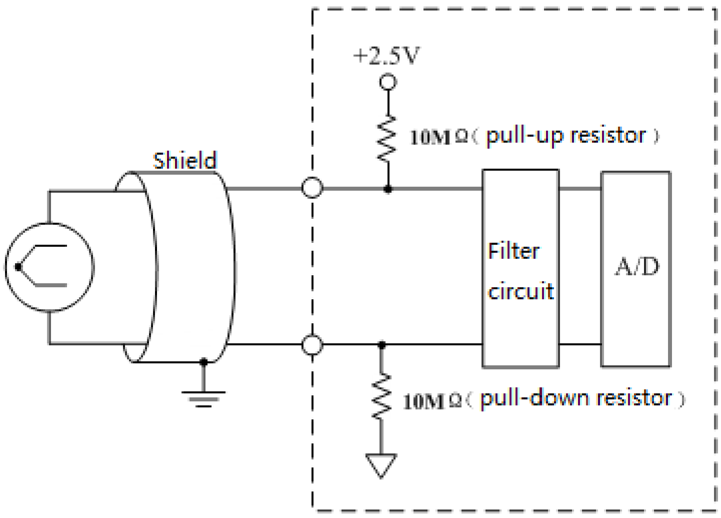
For a range with both over range alarm and over-limit alarm, when over-limit is enabled and occurs in synchronism with the over range, the LK441 module then reports the over range.

6.4.16.7.4 Line Broken Detection

The LK441 module is connected to a 10 MΩ pull-up resistor at the signal input terminal, used to detect an line broken to the channel.

When the input channel signal connection is broken, the voltage at the positive terminal of the channel is pulled up to +2.5 V, the negative terminal voltage of the channel is pulled down to GND, with the voltage difference at the input terminal of the AD converter reaching to the max. value. The channel diagnosis area then reports line broken. After the line broken is recovered, the channel diagnosis area then reports Fault Recovery.

For a thermocouple range, not all the ranges are capable of line broken detection. Refer to Optional_Alarms. For a millivolt signal range, the LK441 module does not support line broken detection.



LK441 Line Broken Detection Schematic Diagram

When certain measured channel thermocouple signal is broken:

- The channel diagnosis area reports line broken fault value 0xA6.
- The measured channel data holds the data prior to the line broken or reports the max. temperature code value in the range, which is optional for configuration.
- After the line broken is recovered, the channel diagnosis area reports 0xA0.
- When the RTD temperature measurement channel is broken:
- Channel 9 diagnosis area (ChDiag.Module.Channel[9].Error) reports line broken fault value 0xA6.
- The temperature measurement channel holds the data prior to the line broken.
- After the line broken is recovered, Channel 9 diagnosis area reports 0xA0.

6.4.16.8 Parameters

The user parameter is used to set the operation mode of the module. The controller module written when downloading the project may not be read in each scanning period. Each parameter has a default, which can be modified according to the project requirements. The user parameter does not support online modification. The modification takes effect only upon full download.

The user parameter length LK441 is up to 49 bytes.

LK441 User Parameters

Parameter Name	Meaning	Value
Temperature Units	To select the temperature scale of thermocouple	0: Celsius, celsius temperature scale (default) 1: Fahrenheit, fahrenheit scale
Filter Mode	To select the hardware filtering mode	0: No Filter , with no filtering (Full-channel Scanning Time: 85 ms) 1: 10Hz Filter, 10 with no filtering (Full-channel Scanning Time: 1500 ms) 2: 50Hz Filter, 50 Hz filtering, , Full-channel Scanning Time: 490 ms (default) 3: 60Hz Filter, 60 Hz filtering, Full-channel Scanning Time: 420 ms 4: 400H Filter, 400 Hz filtering, Full-channel Scanning Time: 85 ms
TC Line Broken Value	To select the value to be reported by thermocouple line broken channel	0: Hold, to report the normal value prior to the line broken (default) 1: Rang Maximum Value, to report the Max. value in the range
CH1 Input Range	To select the range of Channel 1	13: -12 mV~+78 mV (default) 14: -12 mV~+32 mV 207: Type B thermocouple, 300~1820°C 208: Type C thermocouple, 0~ 1725°C 209: Type C thermocouple, 0~ 2315°C 210: Type E thermocouple, -270~415°C 211: Type E thermocouple, -270~1000°C 212: Type J thermocouple, -210~550°C 213: Type J thermocouple, -210~1200°C 214: Type K thermocouple,-270~725°C 215 Type K thermocouple, -270~1372°C 216: Type N thermocouple, -270~840°C 217: Type N thermocouple, -270~1300°C 218: Type R thermocouple,-50~1768°C 219: Type S thermocouple,-50~1768°C 220: Type T thermocouple,-270~400°C
CH2 Input Range	To select the range of Channel 2	
CH3 Input Range	To select the range of Channel 3	
CH4 Input Range	To select the range of Channel 4	
CH5 Input Range	To select the range of Channel 5	
CH6 Input Range	To select the range of Channel 6	
CH7 Input Range	To select the range of Channel 7	
CH8 Input Range	To select the range of Channel 8	
CH1 Cold Junction Compensation	To enable cold junction compensation for Channel 1	0: Disable (default) 1: Enable
CH2 Cold Junction Compensation	To enable cold junction compensation for Channel 2	
CH3 Cold Junction Compensation	To enable cold junction compensation for Channel 3	
CH4 Cold Junction Compensation	To enable cold junction compensation for Channel 4	
CH5 Cold Junction Compensation	To enable cold junction compensation for Channel 5	
CH6 Cold Junction Compensation	To enable cold junction compensation for Channel 6	
CH7 Cold Junction Compensation	To enable cold junction compensation for Channel 7	
CH8 Cold Junction Compensation	To enable cold junction compensation for Channel 8	
Cold Junction Comp. Source	To select the cold junction compensation mode	0: RTD, RTD measured cold junction temperature compensation for Channel 9 (default)

Parameter Name	Meaning	Value
		1: Cold Junction Compensation：fixed cold junction temperature compensation
Cold Junction Comp. RTD Type	To select the RTD temperature measurement element type	0: To select Chinese_Cu50 ohm (default) 1: To select Pt385 100 ohm 2: To select Pt3916 100 ohm
RTD Line Broken Alarm	To enable RTD line broken alarm	0: Disable (default) 1: Enable
Cold Junction Compensation Value	To set the cold junction temperature compensation value	The temperature scale is of a degree celsius, with a range of 0~600 (representing 0℃~60℃) The temperature scale is of a degree fahrenheit, with a range of 320~ 1400 (representing 32℃~ 140℃) Compensation=Compensation Temperature×10, defaulted to 0
CH1 Digital Filter	To select software filtering of Channel 1	0: None, without software filtering (default) 1: 3 Points, to select the latest 3 historical data for software filtering 2: 5 Points, to select the latest 5 historical data for software filtering 3: 7 Points, to select the latest 7 historical data for software filtering
CH2 Digital Filter	To select software filtering of Channel 2	
CH3 Digital Filter	To select software filtering of Channel 3	
CH4 Digital Filter	To select software filtering of Channel 4	
CH5 Digital Filter	To select software filtering of Channel 5	
CH6 Digital Filter	To select software filtering of Channel 6	
CH7 Digital Filter	To select software filtering of Channel 7	
CH8 Digital Filter	To select software filtering of Channel 8	
CH1 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 1	0: Disable (default) 1: Enable
CH1 Lower Limit Exceeded Alarm	To enable Lower Limit Value for Channel 1	
CH2 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 2	
CH2 Lower Limit Exceeded Alarm	To enable Lower Limit Value for Channel 2	
CH3 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 3	
CH3 Lower Limit Exceeded Alarm	To enable Lower Limit Value for Channel 3	
CH4 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 4	
CH4 Lower Limit Exceeded Alarm	Channel 4	
CH5 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 5	
CH5 Lower Limit Exceeded Alarm	To enable Lower Limit Value for Channel 5	
CH6 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 6	
CH6 Lower Limit Exceeded Alarm	To enable Lower Limit Value for Channel 6	
CH7 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 7	
CH7 Lower Limit	To enable Lower Limit Value for	

Parameter Name	Meaning	Value
Exceeded Alarm	Channel 7	
CH8 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 8	
CH8 Lower Limit Exceeded Alarm	To enable Lower Limit Value for Channel 8	
CH1 Upper Limit Value	To set Upper Limit Value of Channel 1	Range of Lower Limit Value: 0 (default)~65534 Range of Upper Limit Value: 1~ 65,535 (default) Millivolt Voltage Ranges 13 and 14: Alarm Limit＝65,535×(Millivolt Value + 12)/Range, notably, for -12 mV~78 mV, Range＝90 mV, for -12 mV~+32 mV, Range＝44 mV Thermocouple range 207~220: Alarm Limit＝ Temperature Value ×10+10000
CH1 Lower Limit Value	To set Upper Limit Value of Channel 1	
CH2 Upper Limit Value	To set Upper Limit Value of Channel 2	
CH2 Lower Limit Value	To set Upper Limit Value of Channel 2	
CH3 Upper Limit Value	To set Upper Limit Value of Channel 3	
CH3 Lower Limit Value	To set Upper Limit Value of Channel 3	
CH4 Upper Limit Value	To set Upper Limit Value of Channel 4	
CH4 Lower Limit Value	To set Upper Limit Value of Channel 4	
CH5 Upper Limit Value	To set Upper Limit Value of Channel 5	
CH5 Lower Limit Value	To set Upper Limit Value of Channel 5	
CH6 Upper Limit Value	To set Upper Limit Value of Channel 6	
CH6 Lower Limit Value	To set Upper Limit Value of Channel 6	
CH7 Upper Limit Value	To set Upper Limit Value of Channel 7	
CH7 Lower Limit Value	To set Upper Limit Value of Channel 7	
CH8 Upper Limit Value	To set Upper Limit Value of Channel 8	
CH8 Lower Limit Value	To set Upper Limit Value of Channel 8	

ⓘ

- The selection of each channel range does not interfere with each other and can be different ranges separately. A voltage range refers to a code value corresponding to the millivolt signal reported by the channel; a temperature range refers to a code value corresponding to the current thermocouple temperature reported by the channel.
- After enabling cold junction compensation, when selecting a compensation mode subsequently, whether adopting fixed value compensation or external RTD temperature measurement compensation? In case of RTD compensation, it shall select the temperature measurement element, whether Cu50 or Pt100; in case of fixed temperature compensation, it shall set the cold junction temperature compensation value.
- The software filtering of each channel does not interfere with each other and can be different modes separately.

6.4.16.9 Technical Specifications

LK441 8-channel Thermocouple Analog Input Module		
System Power		
Operating Voltage	24VDC (-15%~+15%)	
Power consumption	60 mA max. @ 24 VDC	
Input channel		
Number of Input Channels	9 (8-channel thermocouple or millivolt signals, plus 1-channel RTD cold junction compensation)	
Signal type	B, C, E, J, K, N, R, S, T thermocouple or -12 mV~78 mV / -12 mV~32 mV	
Thermocouple Temperature Range	-12 mV~+78 mV Range	-12 mV~+ 32 mV Range
Type B		300~1820°C(572~3308°F)
Type C	0~2315°C(32~4199°F)	0~1725°C(32~3137°F)
Type E	-270~1000°C(-454~1832°F)	-270~415°C(-454~779°F)
Type J	-210~1200°C(-346~2192°F)	-210~550°C(-346~1022°F)
Type K	-270~1372°C(-454~2502°F)	-270~725°C(-454~1337°F)
Type N	-270~1300°C(-454~2372°F)	-270~840°C(-454~1544°F)
Type R		-50~1768°C(-58~3215°F)
Type S		-50~1768°C(-58~3215°F)
Type T		-270~400°C(-454~752°F)
Temperature Resolution of Thermocouple (B, C, E, J, K, N, R, S, T)	0.05°C (0.09°F)	0.03°C (0.05°F)
A/D Converter Resolution	16-bit	
Voltage Measurement Accuracy	0.1% F.S. @ 25℃	
Temperature Drift	±15 ppm/℃	
Differential Mode Rejection Ratio	60 dB	
Common Mode Rejection Ratio	100 dB	
Input Impedance	10 MΩ min.	
Sampling Period (Full-channel Scanning Time)	85 ms, 420 ms, 490 ms, 1500 ms, optional for configuration	
Setting Time for full-scall 1%	1 s max., in the ±1% error range of the full-scall	
Channel Bandwidth	15 Hz	
Voltage Calibration Accuracy	<0.04% F.S.@ 25℃	
Isolation Voltage between Field and System	500 VAC@1 min, leaking current: 5 mA	
Uploaded Data Format (0~65,535)		
Millivolt Range	65,535×(Millivolt Voltage+12)/Range	
Thermocouple range	Acquisition temperature ×10+10000	
Cold-conjunction Compensation Channel		
Implementation Method	To acquire the cold junction temperature of thermal resistance (RTD)	
Type of Thermal Resistance	Chinese_Cu 50 ohm, Pt385 100 ohm, Pt3916 100 ohm Chinese_Cu 50 ohm, Pt385 100 ohm, Pt3916 100 ohm	
Temperature Value Accuracy in Working Range (0°C~60°C)	Chinese_Cu 50 ohm	The absolute deviation is ±0.3℃
	Pt385 100 ohm	The absolute deviation is ± 0.3℃
	Pt3916 100 ohm	The absolute deviation is ± 0.3℃
Line broken detection	RTD line broken alarm	

LK441 8-channel Thermocouple Analog Input Module	
Failure Diagnosis and Hot Plug	
Over range alarm	When the signal exceeds the upper/lower limit of the range, the diagnosis byte then reports 0xA3/0xA2
Over-limit alarm	When the signal exceeds Upper Limit Value/Lower Limit Value that is set in the configuration, the diagnosis byte then reports 0xA7/0xA8
Line broken detection	When an line broken occurs, the diagnosis byte reports 0xA6. The measured channel data reports the full-range valule or the normal value prior to the line broken
Line broken detection of Cold Junction Compensation Thermal Resistance	When an line broken occurs to the RTD temperature compensation channel, Channel 9 diagnosis byte reports 0xA6, taking the normal value prior to the line brea as the compensated value
Hot Plugging	Supported
Communication Bus	
Protocol	Profibus-DP
Baud Rate	1.5Mbps, 500Kbps, 187.5Kbps , 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps adaptive
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media
Physical Property	
Protection Key	B1
Installation Position	Extension backplane
Module Dimension (W*H*D)	35 mm×100 mm×100 mm
Enclosure Protection Rating	IEC60529 IP20
Weight	180 g
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation

6.4.17 LK442 6-channel Thermocouple Analog Input Module

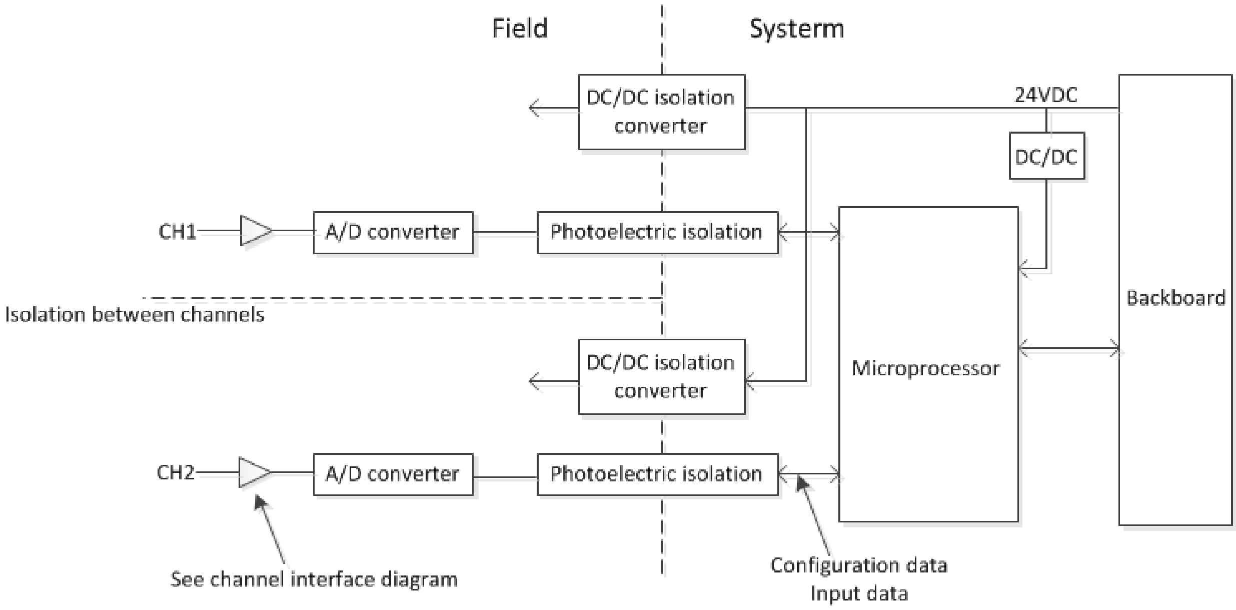
6.4.17.1 Basic Features

- 6-channel thermocouple or millivolt input, isolation between channels
- Thermocouple type: B, E, J, K, R, S, T, N, C
- Range of millivolt signals: -12~32mV/-12~78mV
- Directly reported temperature value of a thermocouple signal type
- Support Profibus-DP protocol, maximum baud rate 12Mbps
- Field calibration
- RTD cold junction temperature compensation
- Over-limit alarm

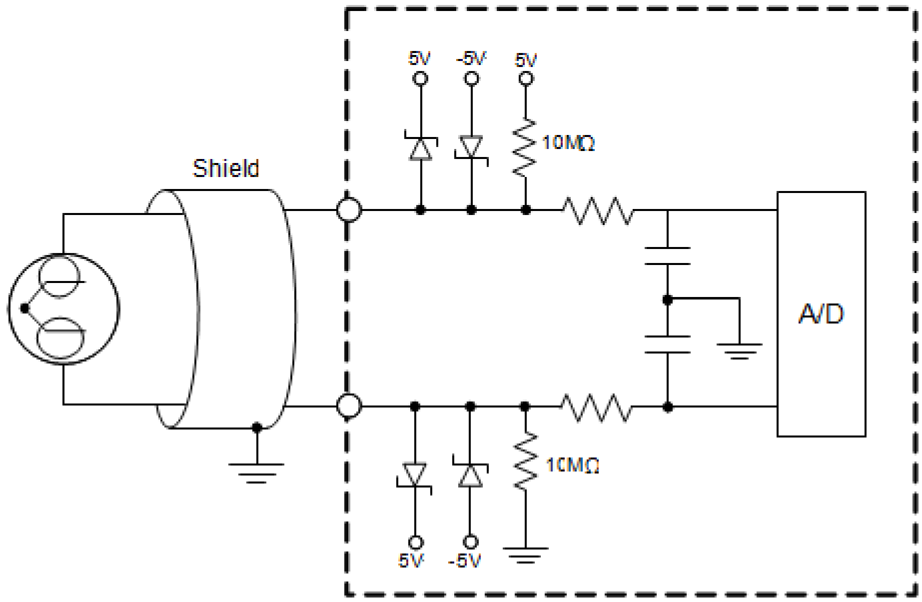
- Over range alarm
- Line broken alarm
- Isolation between the system and the field
- Hot swapping

6.4.17.2 Operating Principle

The 24 VDC system power supply of the LK442 module supplies the power to the interface circuit by outputting 5 VDC via isolated DC/DC. An opto-isolator is between the interface circuit and the system, realizing the electrical isolation between the system and the field channel. The field signal is converted into a digital signal via an A/D converter, and then it is read by the microprocessor in the module, then uploaded to the controller module via the Profibus-DP bus.



Internal Structure Block Diagram of LK442



LK442 Channel Interface Circuit Diagram

6.4.17.3 Indicators

There are two status indicators on the front panel of the module: the green RUN indicator and the yellow CAL indicator. The RUN indicator is the run indicator, indicating the communication status between the module and the controller module. The CAL indicator is the calibration indicator, indicating the calibration process (Calibration model is not introduced in this article, please contact HollySys service agencies if necessary).

Definition of LK442 Indicators

Name	Status	Description
RUN indicator (green)	On	The communication is established, and the module works well
	Flash	The communication is not established or incorrect.
	Off	The module is not powered on.
CAL Calibration Indicator (yellow)	On	In the calibration and detection mode, undergoing calibration and detection
	Flash	In the calibration no detection mode, but undergoing no calibration and detection
	Off	It is not powered up or the communication is not established or the module does not in the calibration and detection mode

- Running Mode
  - Immediately after being powered on, the module waits for the initialized data, with the green indicator flashing based on a frequency of 4 times/second.
  - Upon the completion of initialization, the green indicator is turned normally on, which indicates that the module works well. In case of any error in the initialized data, communication cannot be established and the green indicator keeps flashing. Check whether the DP is connected properly and the communication parameters are set properly.
  - When the module works well, the green indicator is normally on; when the communication is disconnected, the green indicator flashes; when the communication is established again, the

green indicator is turned normally on again.

- The yellow indicator is normally off when the module is in the running mode.

Definition of LK442 Indicators in Running Mode

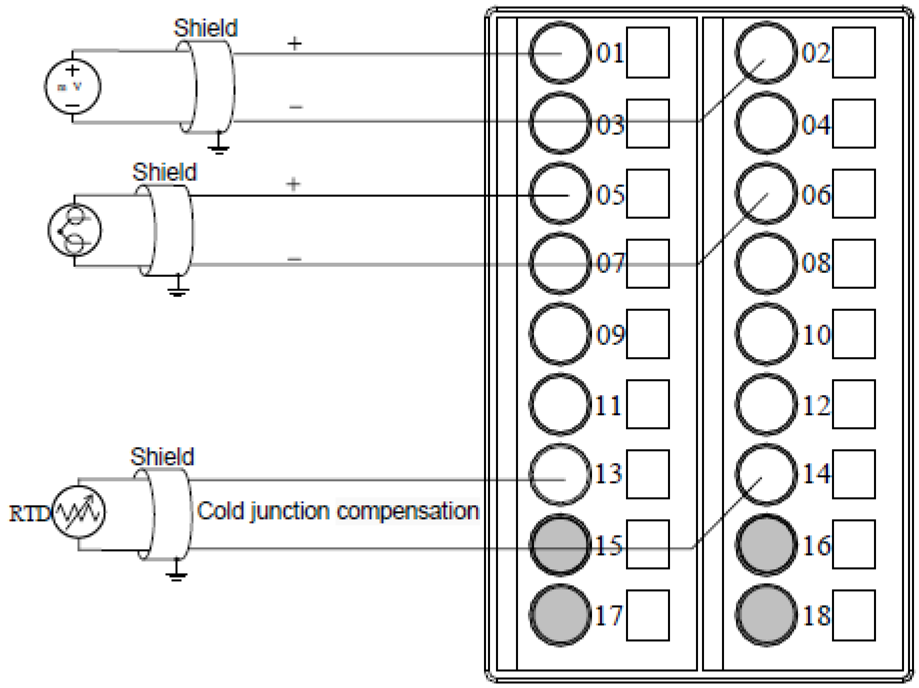
Name	Status	Description
RUN indicator (green)	On	The communication is established
	Flash	The communication is not established or incorrect.
	Off	The module is not powered on.
CAL Calibration Indicator (yellow)	On	In the calibration and detection mode, undergoing calibration and detection
	Flash	In the calibration no detection mode, but undergoing no calibration and detection
	Off	It is not powered up or the communication is not established or the module does not in the calibration and detection mode

6.4.17.4 Wirings

The LK442 module is installed on the extension backplane.

Definition of LK442 Backplane Terminals

Channel No.	Sequence of Terminals	
	Positive Terminal of TC/Millivolt Signal Input	Negative terminal of TC/Millivolt Signal Input
1	01	02
2	03	04
3	05	06
4	07	08
5	09	10
6	11	12
Cold junction compensation channel	To connect the RTD temperature measurement element	
7	13	14



LK442 Backplane Terminal Wiring Diagram

Pay attention to the following during wiring:

- Each thermocouple or millivolt signal is separately connected to the terminals via two conductors (shielded cable) in the field.Copper wire is used as connecting wire.
- Terminals 1-12 are field thermocouple or millivolt signal channels. The odd terminal is connected to the positive terminal of thermocouple/millivolt signal; the even terminal is connected to the negative terminal of the thermocouple/millivolt signal.
- Terminals 13 and 14 are cold junction compensation channels.
- Terminals 15, 16, 17 and 18 are not used. When adopting set cold junction temperature compensation, Terminals 13 and 14 cannot be used.

6.4.17.5 Functions

6.4.17.5.1 Measured Data Output Format

LK442 can be connected to a thermocouple element of B, E, J, K, R, S, T, N and C type to acquire the field temperature signal, or it can acquire the millivolt voltage signal within a range of -12~78 mV or -12~+32 mV.

The measured data on each channel that is reported by LK442, is expressed in form of 2-byte positive integer (decimal: 0~65,535) digital code. For different ranges, the output format of measured data may differ. The millivolt range outputs the millivolt digital code corresponding to the field signal. The thermocouple range outputs the temperature digital code corresponding to the field signal. See the following for the formula of conversion between the measured data and the physical quantity:

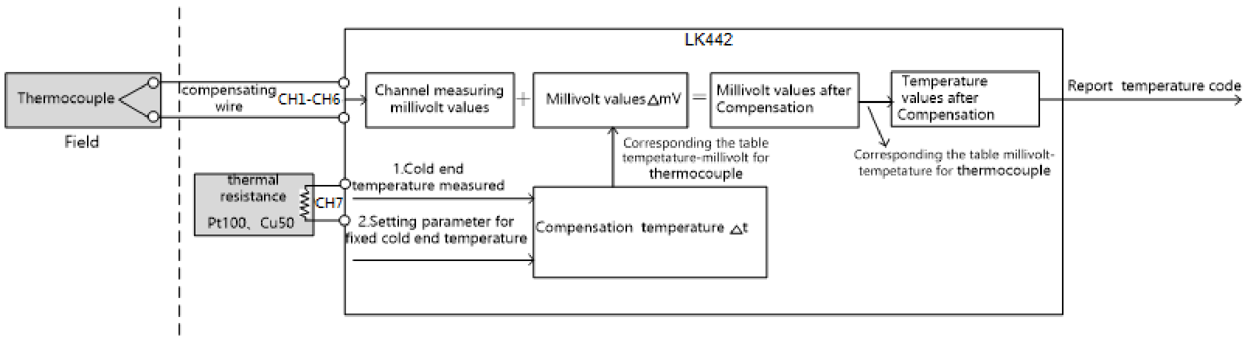
■ Millivolt range of configuration selection: Millivolt Value mV＝(Millivolt digital code/65,535)×Range-12, notably, for -12~78 mV, Range＝90 mV, for -12~32 mV, Range＝44 mV.

■ Thermocouple Range of configuration selection: Temperature Value (℃/℉) ＝(Temperature digital code-10,000)/10.

For a millivolt range, by calling the function block HEX_ENGIN of the Analog signal Processing Functions library in the programming software AutoThink, it can convert the 2-byte millivolt code value into the engineering data.For a thermocouple range, it can obtain the actual temperature value upon simple operation according to the above formula.

6.4.17.6 Cold-conjunction Compensation

LK442 can adopt the following two methods for cold junction compensation. Both methods require configuring LK442 with a thermocouple range, with the measured data reported to the controller module representing a temperature value (that is, to report the temperature digital code).



LK442 Cold-conjunction Temperature Compensation Block Diagram

6.4.17.7 RTD Measured Cold Junction Temperature Compensation

Each LK442 uses a RTD temperature measurement element to measure the actual temperature at the cold junction of thermocouple, via the "temperature→millivolt" table corresponding to thermocouple, automatically verifies the millivolt value corresponding to the cold junction temperature value. Then it sums up such a cold junction millivolt value and the measured channel millivolt value of LK442 to obtain the actual compensation millivolt value, further by looking up in "millivolt-temperature" table according to the compensation millivolt value to obtain the actual temperature value at the field terminal of thermocouple, finally reporting the measured temperature code to the controller module. The specific compensation algorithm is completed automatically in LK442. The controller module obtains the compensation temperature directly.

The external RTD temperature measurement element of LK442 occupies Channel 7 that is inside. The RTD allows using such three thermal resistances as Chinese_Cu50 ohm, Pt385 100 ohm and Pt3916 100 ohm, with the cold junction temperature compensation ranging 0~60℃. It is recommended of using Pt385 100 ohm or Pt3916 100 ohm. The installation position of thermal resistance is close to the cold junction of the thermocouple as closely as possible (that is, close to the outgoing terminal of LK442).

See the following for the steps to adopt RTD temperature measurement to configure automatic cold junction compensation:

(1) The cold junction compensation of a corresponding channel enables to select Enable for the parameter CHn Cold Junction Compensation, thus enabling cold junction temperature compensation of the channel.

(2) Select RTD for the cold junction compensation mode parameter Cold Junction Comp.Source.

(3) Select the connected thermal resistance type as Chinese_Cu 50 ohm, Pt385 100 ohm or Pt3916 100 ohm for the RTD temperature measurement element parameter Cold Junction Comp.RTType-D.

Select whether the RTD temperature measurement channel is capable of line broken detection according to the parameter **RTD Line Break Alarm**, defaulted to Disable. After enabling line broken detection, if an line broken occurs to the RTD temperature measurement channel (Channel 7), the channel data holds the normal data prior to the line broken, with the channel diagnosis reporting the line broken fault value 0xA6.

6.4.17.8 Set Cold Junction Temperature Compensation

When the dynamic compensation accuracy requirement is low or the cold junction ambient temperature changes slightly, the cold junction temperature can also be pre-input in the configuration and kept unchanged. LK442 compensates according to the set cold junction temperature.

Each LK442 via the "temperature→millivolt" table corresponding to thermocouple, automatically verifies the millivolt value corresponding to the cold junction temperature. Then it sums up such a cold junction millivolt value and the measured channel millivolt value of LK442 to obtain the actual compensation millivolt value, further by looking up in "millivolt-temperature" table according to the compensation millivolt value to obtain the actual temperature value at the field terminal of thermocouple, finally reporting the measured temperature digital code to the controller module. The specific compensation algorithm is completed automatically in LK442. The controller module obtains the compensation temperature directly.

See the following for the steps to adopt a set cold junction temperature to configure cold junction compensation:

(1) The cold junction compensation of a corresponding channel enables to select Enable for the parameter CHn Cold Junction Compensation, thus enabling cold junction temperature compensation of the channel.

(2) Select Cold Junction Offset for the cold junction compensation mode parameter Cold Junction Comp.Source.

(3) Input the temperature compensation value in the cold junction temperature compensation value parameter Cold Junction Compensation Value, with temperature compensation value=compensation temperature ×10.

The temperature scale of the compensation temperature conforms to the temperature scale (Temperature Units) selected by the LK442. When the temperature scale is of a degree Celsius, the cold junction temperature compensation ranges 0~60℃, with the corresponding temperature compensation value of 0~600. When the temperature scale is of a degree Fahrenheit, the cold junction temperature compensation ranges 32~ 140℉, with the corresponding temperature patch compensation value of 320~1400.

6.4.17.9 Diagnosis

The LK442 module can diagnose over range, over-limit and line broken, which are of a channel diagnosis. After calling the function block Get Diagnosis of DP slave (sysGetDPSlaveState), the channel diagnosis data reported is sent into the output parameter **DiagData** in the function block.

Diagnostic information of LK442 up to 25 bytes, wherein 2 bytes are device-related diagnosis, 2 bytes are identification diagnosis and 21 bytes are channel diagnosis. 7 channels in LK442, wherein, the forward 6-channel as thermocouple or millivolt signal input, channel 7 for the cold junction compensation terminal. the diagnosis information for each channel 3 bytes. Diagnosis information diagram refer to figure Diagnosis_Information_diagram.

- Device diagnosis information

Device diagnosis data 0x02,0x00 indicates the current device without any fault.

Device diagnosis data 0x02,0x01 indicates that the current device has channel fault.

Device diagnostic data of 0x02, 0x02 indicates that the current device has errors.

Device diagnostic data of 0x02, 0x03 indicates that the current device has a channel failure and an error.

- Identification diagnosis information

The 2-byte identification diagnosis information is 0x42,0x01 when diagnosis information is reported.

- Channel diagnosis information

Channel diagnosis information as shown in table.

Specifications for LK442 Channel Diagnosis Information

Diagnosis Information						Meaning
Bit		Bit7	Bit6	Bit5	Bit4~ Bit0	
The first byte	Head	0x80				Decimal online value 128
The second byte	I/O type/channel	01 (Input)		（Channel）		Failed channel no 1~7 Decimal online value 64~70
The third byte	Channel data type/fault type	101 (Word)			2	Under range, Decimal online value is 162
					3	Over range, Decimal online value is 163
					6	Line broken, Decimal online value is 166
					7	Upper limit exceeded, Decimal online value is 167
					8	Lower limit exceeded, Decimal online value is 168
					0	Channel fault recovery, Decimal online value is 160

Example:

Channel diagnosis data 0x80, 0x40, 0xA2 indicates that channel 1 has under range alarm.

Channel diagnosis data 0x80, 0x41, 0xA3 indicates that channel 2 has over range alarm.

Channel diagnosis data 0x80, 0x42, 0xA6 indicates that channel 3 has line broken alarm.

Channel diagnosis data 0x80, 0x43, 0xA7 indicates that channel 4 has upper limit exceeded alarm.

As an I / O slave of HolliTCP protocol, excepte above diagnostic information, refer to LK234_Diagnosis for more diagnostic information.

As an I / O slave of POWERLINK protocol, excepte above diagnostic information, refer to Overview of Diagnosis Information for more diagnostic information.

6.4.17.9.1 Optional Alarms

The alarms that are provided by each range for the LK442 module are different, as shown in table.

LK442 Alarm List Based on Different Ranges

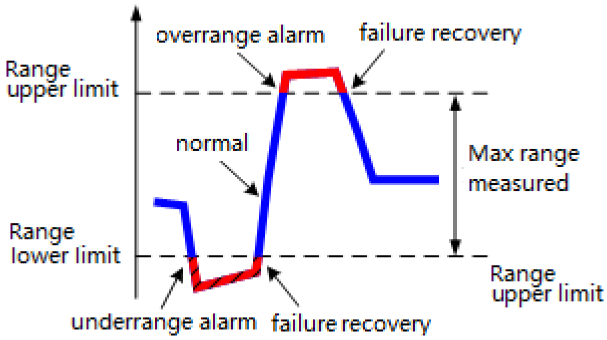
Range Limit	Thermocouple Type	Internal Range Code	Alarm Type
-12 mV~78 mV	—	13	Over-limit alarm, over range alarm
-12 mV~32 mV	—	14	Over-limit alarm, over range alarm
300~1820°C	Type B	207	Over-limit alarm, line broken alarm
0~1725°C	Type C	208	Over-limit alarm, over range alarm
0~2315°C	Type C	209	Over-limit alarm, line broken alarm
-270~415°C	Type E	210	Over-limit alarm, over range alarm
-270~1000°C	Type E	211	Over-limit alarm, line broken alarm
-210~550°C	Type J	212	Over-limit alarm, over range alarm
-210~1200°C	Type J	213	Over-limit alarm, line broken alarm
-270~725°C	Type K	214	Over-limit alarm, over range alarm
-270~1372°C	Type K	215	Over-limit alarm, line broken alarm
-270~840°C	Type N	216	Over-limit alarm, over range alarm
-270~1300°C	Type N	217	Over-limit alarm, line broken alarm
-50~1768°C	Type R	218	Over-limit alarm, line broken alarm
-50~1768°C	Type S	219	Over-limit alarm, line broken alarm
-270~400°C	Type T	220	Over-limit alarm, line broken alarm

Note: when using a thermocouple range, if thermocouples of a same type has two temperature ranges available, for example, for Type C thermocouples, the two ranges are 0~1725℃ and 0~2315℃. When configuring in a smaller temperature range, for example, if a Type C thermocouple selects a range of 0~1725℃, the module does not provide line broken detection directly. However, if a broken thermocouple occurs, the channel consequently gives an over range alarm. That is, in such a case, if an over range alarm is received, the channel may really go beyond the range, or it may be resulted in a broken thermocouple.

6.4.17.9.2 Over Range Alarm

The LK442 module is capable of over range alarm. When an input signal exceeds the selected range, for a thermocouple, it means to exceed the millivolt value corresponding to the temperature range selected by thermocouple. The channel diagnosis byte reports over range. When the signal is recovered, it reports fault recovery.

For the LK442, not all the ranges are capable of over range alarm. Each range supports different alarm types. Refer to Optional_Alarms.



LK442 Over Range Alarm Schematic Diagram

Due to the different ranges selected, the diagnosis handling methods of the module may also differ in case of over range, as shown in table. When the signal is recovered to the normal range, the channel diagnosis byte then reports 0xA0.

The LK442 module only reports the diagnosis data once separately when over range occurs and is recovered.

Handling of LK442 Over Range Alarm

Range Type	Type of Over Range	Handling of Over Range
Thermocouple	Over Range	1. The channel diagnosis area reports the fault value 0xA3 2. The measured channel data reports the max. temperature code value in the range
	Under Range	1. The channel diagnosis area reports the fault value 0xA2 2. The measured channel data reports the Min. temperature code value in the range
Millivolt Signal	Over Range	1. The channel diagnosis area reports the fault value 0xA3 2. The measured channel data reports 0xFFFF
	Under Range	1. The channel diagnosis area reports the fault value 0xA2 2. The measured channel data reports 0x0000

6.4.17.9.3 Over-limit Alarm

The LK442 module is capable of over-limit alarm. It can set the alarm boundary line flexibly according to different industrial fields, detects field temperature signal changes, and timely gives an over-limit alarm, thus well improving security in industrial control.

In the selected range, the user can set Upper Limit Value and Lower Limit Value of the input signal by his or her own. When the input signal goes beyond the limit range, that is, higher than Upper Limit Value or lower than Lower Limit Value, the channel diagnosis byte then reports over-limit. When the signal is recovered to the limit range, it then reports fault recovery.

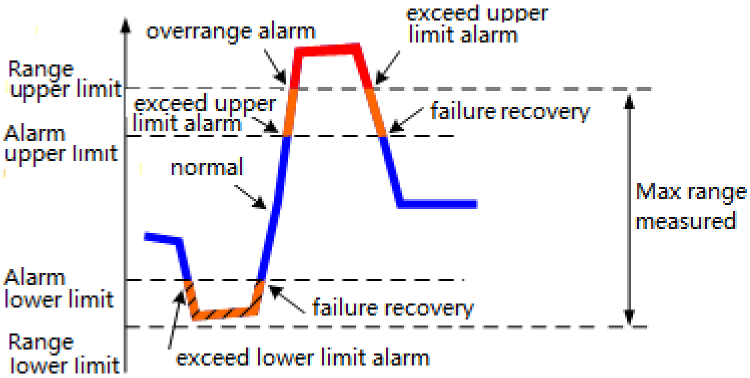
Whether the LK442 module can give an overall alarm, Upper Limit Value and Lower Limit Value of each channel can be selected during configuration, defaulted to Over-limit Alarm Disable. The alarm limit set in the user parameter is a 16-bit positive integer digital code, which is divided into a temperature digital code (when thermocouple is selected for the range) and a millivolt digital code (when millivolt is selected for the range). Refer to table for the conversion formula.

Calculation of LK442 Alarm Limit Digital Code

Range Type	Upper Limit Value (Decimal)	Lower Limit Value (Decimal)
Thermocouple	Upper Limit Temperature value ×10+10000	Lower Limit Temperature value ×10+10000
-12 mV~78 mV	65,535×(Upper Millivolt Value+12)/90	65,535×(Lower Millivolt Value+12)/90
-12 mV~32 mV	65,535×(Upper Millivolt Value+12)/ 44	65,535×(Lower Millivolt Value+12)/ 44

For a thermocouple signal, the temperature units for Upper Limit Value Temperature and Lower Limit Value Temperature (℃ or ℉) conform to those selected for the module (to select via the parameter **Temperature Units**, defaulted to ℃)

Range of Lower Limit Values 0~65534, defaulted to 0; Range of Upper Limit Values: 1~ 65,535, defaulted to 65,535. Upper Limit Value must be more than Lower Limit Value. Otherwise, the LK442 module cannot report the diagnosis message properly.



LK442 Overran Alarm Schematic Diagram

Due to the different ranges selected, the diagnosis handling methods of the module may also differ in case of over-limit, as shown in table. When the signal is recovered to the normal range, the channel diagnosis area then reports 0xA0.

The LK442 module only reports the diagnosis data once separately when occurrence over-limit occurs and is recovered.

Handling of LK442 Over Range Alarm

Range Type	Type of Over-limit	Handling of Over-limit
Thermocouple	Upper limit exceeded	1. The channel diagnosis area reports the fault value 0xA7 2.The measured channel data reports the current temperature digital code
	Lower limit exceeded	1. The channel diagnosis area reports the fault value 0xA8 2. The measured channel data reports the current temperature digital code
Millivolt Signal	Upper limit exceeded	1. The channel diagnosis area reports the fault value 0xA7 2. The measured channel data reports the current millivolt digital code
	Lower limit exceeded	1. The channel diagnosis area reports the fault value 0xA8 2. The measured channel data reports the current millivolt digital code

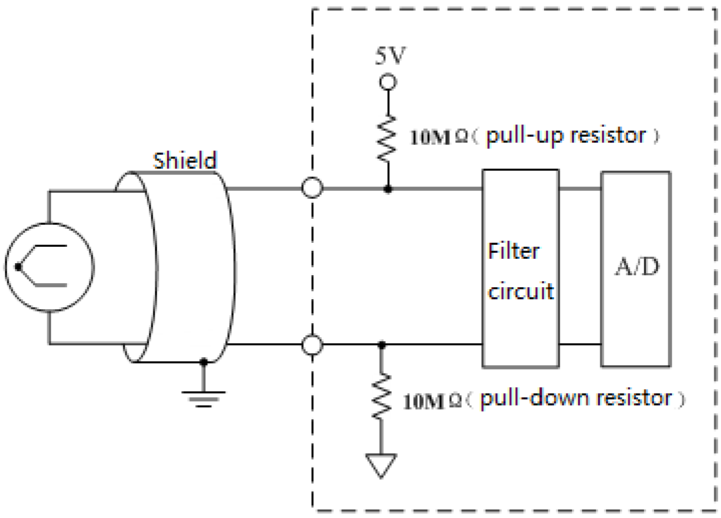
For a range with both over range alarm and over-limit alarm, when over-limit is enabled and occurs in synchronism with the over range, the LK442 module then reports the over range.

6.4.17.9.4 Line Broken Detection

The LK442 module is connected to a 10 MΩ pull-up resistor at the signal input terminal, used to detect an line broken to the channel.

When the input channel signal connection is broken, the voltage at the positive terminal of the channel is pulled up to 5 V, the negative terminal voltage of the channel is pulled down to GND, with the voltage difference at the input terminal of the AD converter reaching to the max. value. The channel diagnosis area then reports line broken. After the line broken is recovered, the channel diagnosis area then reports Fault Recovery.

For a thermocouple range, not all the ranges are capable of line broken detection. Refer to Optional_Alarms. For a millivolt signal range, the LK442 module does not support line broken detection.



LK442 Line Broken Detection Schematic Diagram

When certain measured channel thermocouple signal is broken:

- The channel diagnosis area reports line broken fault value 0xA6.
- The measured channel data holds the data prior to the line broken or reports the max. temperature code value in the range, which is optional for configuration.
- After the line broken is recovered, the channel diagnosis area reports 0xA0.

When the RTD temperature measurement channel is broken:

- Channel 7 diagnosis area (ChDiag.Module.Channel[7].Error) reports line broken fault value 0xA6.
- The temperature measurement channel holds the data prior to the line broken.
- After the line broken is recovered, Channel 7 diagnosis area reports 0xA0.

6.4.17.10 Parameters

The user parameter is used to set the operation mode of the module. The controller module written when downloading the project may not be read in each scanning period. Each parameter has a default, which can be modified according to the project requirements. The user parameter does not support online modification. The modification takes effect only upon full download.

The user parameter length LK442 is up to 39 bytes.

LK442 User Parameters

Parameter Name	Meaning	Value
Temperature Units	To select the temperature scale of thermocouple	0: Celsius, celsius temperature scale (default) 1: Fahrenheit, fahrenheit scale
Filter Mode	To select the hardware filtering mode	0: 50Hz Filter, 50 Hz filtering, , Full-channel Scanning Time < 50 ms (default) 1: 60Hz Filter, 60 Hz filtering, Full-channel Scanning Time < 50 ms
TC Line Broken Value	To select the value to be reported by thermocouple line broken channel	0: Hold, to report the normal value prior to the line broken (default) 1: Rang Maximum Value, to report the Max. value in the range
CH1 Input Range	To select the range of Channel 1	13: -12 mV~+78 mV (default) 14: -12 mV~+32 mV 207: Type B thermocouple, 300~1820°C 208: Type C thermocouple, 0~ 1725°C 209: Type C thermocouple, 0~ 2315°C 210: Type E thermocouple, -270~415°C 211: Type E thermocouple, -270~1000°C 212: Type J thermocouple, -210~550°C 213: Type J thermocouple, -210~1200°C 214: Type K thermocouple,-270~725°C 215 Type K thermocouple, -270~1372°C 216: Type N thermocouple, -270~840°C 217: Type N thermocouple, -270~1300°C 218: Type R thermocouple,-50~1768°C 219: Type S thermocouple,-50~1768°C 220: Type T thermocouple,-270~400°C
CH2 Input Range	To select the range of Channel 2	
CH3 Input Range	To select the range of Channel 3	
CH4 Input Range	To select the range of Channel 4	
CH5 Input Range	To select the range of Channel 5	
CH6 Input Range	To select the range of Channel 6	
CH1 Cold Junction Compensation	To enable cold junction compensation for Channel 1	0: Disable (default) 1: Enable
CH2 Cold Junction Compensation	To enable cold junction compensation for Channel 2	
CH3 Cold Junction Compensation	To enable cold junction compensation for Channel 3	
CH4 Cold Junction Compensation	To enable cold junction compensation for Channel 4	
CH5 Cold Junction Compensation	To enable cold junction compensation for Channel 5	
CH6 Cold Junction Compensation	To enable cold junction compensation for Channel 6	
Cold Junction Comp. Source	To select the cold junction compensation mode	0: RTD, RTD measured cold junction temperature compensation for Channel 9 (default) 1: Cold Junction Compensation： fixed cold junction temperature compensation
Cold Junction Comp. RTD Type	To select the RTD temperature measurement element type	0: To select Chinese_Cu50 ohm (default) 1: To select Pt385 100 ohm 2: To select Pt3916 100 ohm
RTD Line Broken Alarm	To enable RTD line broken alarm	0: Disable (default) 1: Enable
Cold Junction Compensation Value	To set the cold junction temperature compensation	The temperature scale is of a degree celsius, with a range of 0~600 (representing 0℃~60℃)

Parameter Name	Meaning	Value
	value	The temperature scale is of a degree fahrenheit, with a range of 320~ 1400 (representing 32 ℉~ 140 ℉) Compensation=Compensation Temperature×10, defaulted to 0
CH1 Digital Filter	To select software filtering of Channel 1	0: None, without software filtering (default) 1: 4Points, to select the latest 4 historical data for software filtering 2: 8 Points, to select the latest 8 historical data for software filtering 3: 16 Points, to select the latest 16 historical data for software filtering
CH2 Digital Filter	To select software filtering of Channel 2	
CH3 Digital Filter	To select software filtering of Channel 3	
CH4 Digital Filter	To select software filtering of Channel 4	
CH5 Digital Filter	To select software filtering of Channel 5	
CH6 Digital Filter	To select software filtering of Channel 6	
CH1 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 1	0: Disable (default) 1: Enable
CH1 Lower Limit Exceeded Alarm	To enable Lower Limit Value for Channel 1	
CH2 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 2	
CH2 Lower Limit Exceeded Alarm	To enable Lower Limit Value for Channel 2	
CH3 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 3	
CH3 Lower Limit Exceeded Alarm	To enable Lower Limit Value for Channel 3	
CH4 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 4	
CH4 Lower Limit Exceeded Alarm	Channel 4	
CH5 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 5	
CH5 Lower Limit Exceeded Alarm	To enable Lower Limit Value for Channel 5	
CH6 Upper Limit Exceeded Alarm	To enable Upper Limit Value for Channel 6	
CH6 Lower Limit Exceeded Alarm	To enable Lower Limit Value for Channel 6	
CH1 Upper Limit Value	To set Upper Limit Value of Channel 1	Range of Lower Limit Value: 0 (default)~65534 Range of Upper Limit Value: 1~ 65,535 (default) Millivolt Voltage Ranges 13 and 14: Alarm Limit＝65,535×(Millivolt Value + 12)/Range, notably, for -12 mV~78 mV, Range＝90 mV, for -12 mV~+32 mV, Range＝44 mV Thermocouple range 207~220: Alarm Limit＝ Temperature Value ×10+10000
CH1 Lower Limit Value	To set Upper Limit Value of Channel 1	
CH2 Upper Limit Value	To set Upper Limit Value of Channel 2	
CH2 Lower Limit Value	To set Upper Limit Value of Channel 2	
CH3 Upper Limit Value	To set Upper Limit Value of Channel 3	
CH3 Lower Limit Value	To set Upper Limit Value of Channel 3	
CH4 Upper Limit Value	To set Upper Limit Value of Channel 4	
CH4 Lower Limit Value	To set Upper Limit Value of Channel 4	

Parameter Name	Meaning	Value
CH5 Upper Limit Value	To set Upper Limit Value of Channel 5	
CH5 Lower Limit Value	To set Upper Limit Value of Channel 5	
CH6 Upper Limit Value	To set Upper Limit Value of Channel 6	
CH6 Lower Limit Value	To set Upper Limit Value of Channel 6	

6.4.17.11 Technical Specifications

LK442 6-channel isolated thermocouple analog input module		
System Power		
Operating Voltage	24VDC（-15%~+15%）	
Power consumption	120 mA max. @ 24 VDC	
Input channel		
Number of Input Channels	7 (6-channel thermocouple or millivolt signals, 1-channel RTD cold junction compensation)	
Signal type	B, C, E, J, K, N, R, S, T	
Thermocouple Temperature Range	-12 mV~+78 mV Range	-12 mV~+ 32 mV Range
Type B		300~1820°C(572~3308°F)
Type C	0~2315°C(32~4199°F)	0~1725°C(32~3137°F)
Type E	-270~1000°C(-454~1832°F)	-270~415°C(-454~779°F)
Type J	-210~1200°C(-346~2192°F)	-210~550°C(-346~1022°F)
Type K	-270~1372°C(-454~2502°F)	-270~725°C(-454~1337°F)
Type N	-270~1300°C(-454~2372°F)	-270~840°C(-454~1544°F)
Type R		-50~1768°C(-58~3215°F)
Type S		-50~1768°C(-58~3215°F)
Type T		-270~400°C(-454~752°F)
Temperature Resolution of Thermocouple (B, C, E, J, K, N, R, S, T)	0.05°C (0.09°F)	0.03°C (0.05°F)
A/D Converter Resolution	16-bit	
Temperature Drift	±15 ppm/℃	
Differential Mode Rejection Ratio	60 dB	
Common Mode Rejection Ratio	100 dB	
Input Impedance	10 MΩ min.	
Sampling Period (Full-channel Scanning Time)	＜50ms	
Setting Time for full-scall 1%	1 s max., in the ±1% error range of the full-scall	
Channel Bandwidth	15 Hz	
Calibration Accuracy	<0.06%	
Isolation Voltage between Channel	500 VAC@1 min, leaking current: 5 mA	
Isolation Voltage between Field and System	500 VAC@1 min, leaking current: 5 mA	
Uploaded Data Format (0~65,535)		
Millivolt Range	65,535×(Millivolt Voltage+12)/Range	

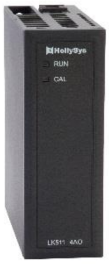
LK442 6-channel isolated thermocouple analog input module		
Thermocouple range	Acquisition temperature ×10+10000	
Cold-conjunction Compensation Channel		
Implementation Method	To acquire the cold junction temperature of thermal resistance (RTD)	
Type of Thermal Resistance	Chinese_Cu 50 ohm, Pt385 100 ohm, Pt3916 100 ohm	
Temperature Value Accuracy in Working Range (0°C~60°C)	Chinese_Cu 50 ohm	The absolute deviation is ±1.1℃
	Pt385 100 ohm	The absolute deviation is ± 0.7℃
	Pt3916 100 ohm	The absolute deviation is ± 0.8℃
Line broken detection	RTD line broken alarm	
Failure Diagnosis and Hot Plug		
Over range alarm	When the signal exceeds the upper/lower limit of the range, the diagnosis byte then reports 0xA3/0xA2	
Over-limit alarm	When the signal exceeds Upper Limit Value/Lower Limit Value that is set in the configuration, the diagnosis byte then reports 0xA7/0xA8	
Line broken detection	When an line broken occurs, the diagnosis byte reports 0xA6. The measured channel data reports the full-range valule or the normal value prior to the line broken	
Line broken detection of Cold Junction Compensation Thermal Resistance	When an line broken occurs to the RTD temperature compensation channel, Channel 9 diagnosis byte reports 0xA6, taking the normal value prior to the line brea as the compensated value	
Hot Plugging	Supported	
Communication Bus		
Protocol	Profibus-DP	
Baud Rate	1.5Mbps, 500Kbps, 187.5Kbps , 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps adaptive	
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media	
Physical Property		
Protection Key	B2	
Installation Position	Extension backplane	
Module Dimension (W*H*D)	35 mm×100 mm×100 mm	
Weight	180 g	
Environmental Adaptability		
Operating Temperature	-20℃~70℃	
Operating Humidity	5%~95%, with no condensation	
Storage Temperature	-40℃~80℃	
Storage Humidity	5%~95%, with no condensation	

6.4.18 LK511 4-channel Inter-channel Isolated Current Type Analog Output Module

6.4.18.1 Basic Features

- 4-channel current output, inter-channel isolation
- Output signal range: 4~20 mA/0~21 mA

- Electrical isolation between the channel and the system
- Fault mode output
- Self-diagnosis of the output read-back channel
- Line broken detection
- Field calibration
- Hot swapping

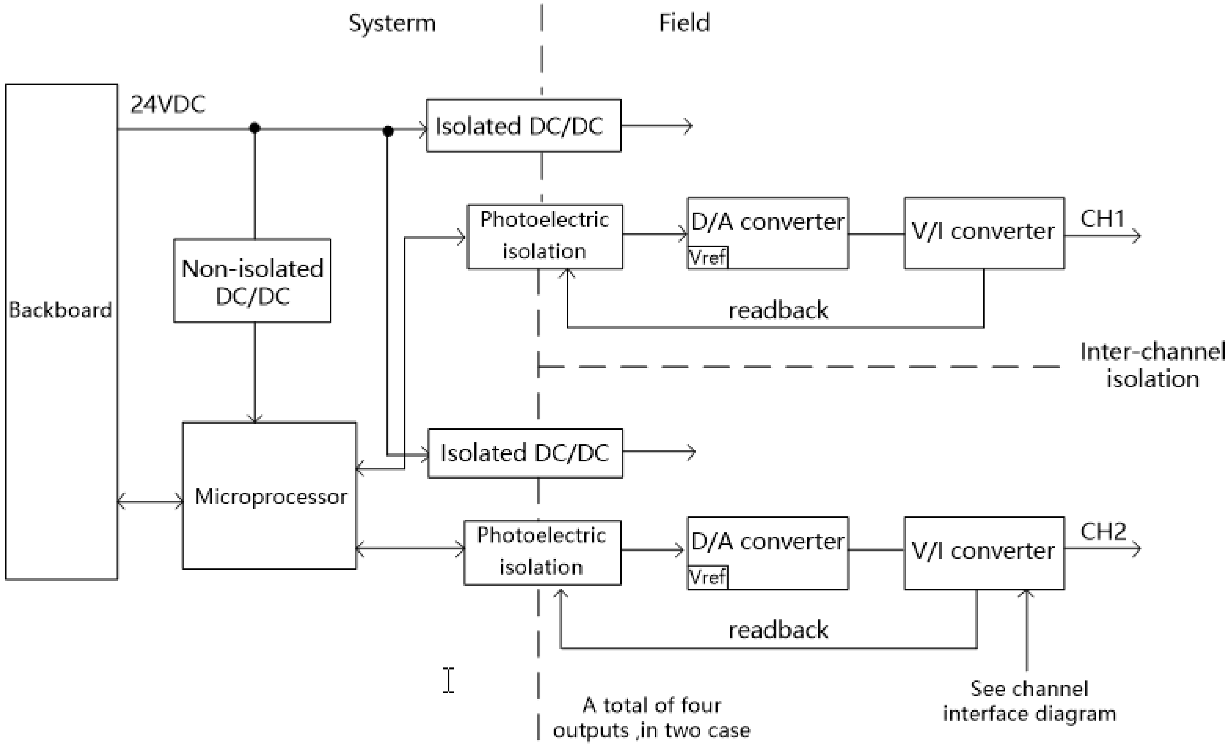


LK511 Module Schematic Diagram

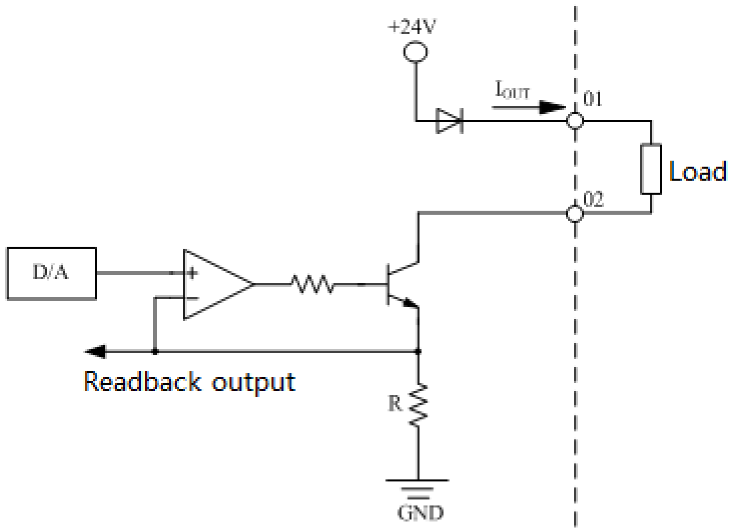
6.4.18.2 Operating Principle

The controller module sends the output data to LK511 via the Profibus-DP bus, which is converted into a voltage signal via DAC. The drive circuit receives the voltage signal output from DAC and then output it after voltage-current conversion and regulation to control the operation of the field actuator.

Electrical isolation is provided between the output channels. The 24 VDC power supply supplies power to each channel separately upon isolated DC/DC conversion. In the meantime, the interface circuit of each channel is connected via opto-isolators with other circuits, thus realizing the isolation between the field and the system.



Internal Structure Block Diagram of LK511



LK511 Channel Interface Circuit Diagram

6.4.18.3 Indicators

There are two status indicators on the front panel of the module: the green RUN indicator and the yellow CAL indicator. The RUN indicator is the run indicator, indicating the communication status between the module and the controller module. The CAL indicator is the calibration indicator, indicating the calibration process (Calibration model is not introduced in this article, please contact HollySys service agencies if necessary).

- Running Mode
  - Immediately after being powered on, the module waits for the initialized data, with the green indicator flashing based on a frequency of 4 times/second.
  - Upon the completion of initialization, the green indicator is turned normally on, which indicates that the module works well. In case of any error in the initialized data, communication cannot be established and the green indicator keeps flashing. Check whether the communication parameters are set correctly.
  - When the communication is normal, the green indicator is normally on; when the communication is disconnected, the green indicator flashes; when the communication is established again, the green indicator is turned on again.
  - The yellow indicator is normally off when in the running mode.

Definition of LK511 Indicators in Running Mode

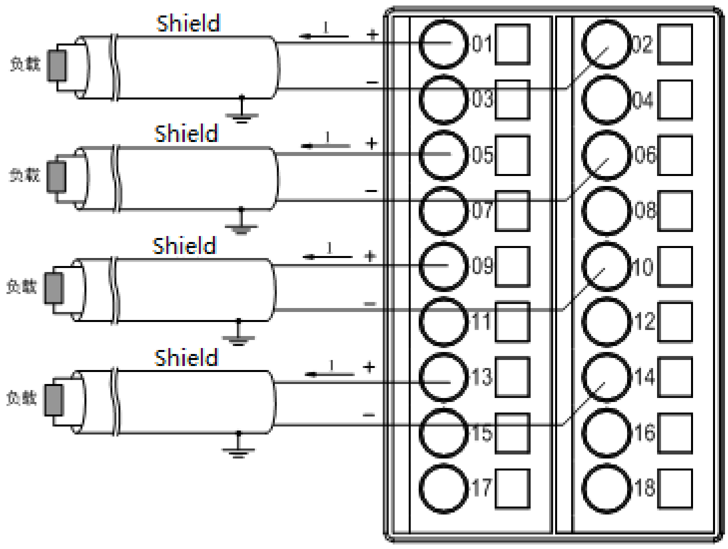
Running Mode	RUN indicator	CAL indicator	Meaning
	Off	Off	Not powered up
	Flash	Off	The communication is not established or incorrect.
	On	Off	The communication is established, the module works well

6.4.18.4 Wirings

The LK511 module is installed on the extension backplane.

Definition of LK511 Backplane Terminals

Channel No.	Sequence of Terminals	
	Current Output Terminal (Positive)	Current Input Terminal (Negative)
1	01	02
2	05	06
3	09	10
4	13	14



LK511 Backplane Terminal Wiring Schematic Diagram

Pay attention to the following during wiring:

- The two-row 18-channel terminals are fixed on the backplane, right located under the installation position of the LK511 module.
- The terminals that are not listed in the above table cannot be used, with wiring forbidden.
- The 4-channel current type AO only uses the 4 terminal pairs as shown in figure, with other terminals not used and wiring forbidden.
- Each signal is separately connected to the field device via two conductors (shielded cable).
- Upon the wiring, check whether the cable is connected properly. Do not hold the naked line exposed in order to avoid a short-circuit hazard.

6.4.18.5 Data Format

As shown in table, the AO channel output data that is sent by the controller module to LK411, is expressed in form of 2-byte positive integer (decimal: 0~65,535) digital code.

Corresponding Relationship between LK511 Output Current and Digital Code

Output Range	Corresponding Decimal Digital Code
4~20mA	0~65,535
0~21mA	0~65,535

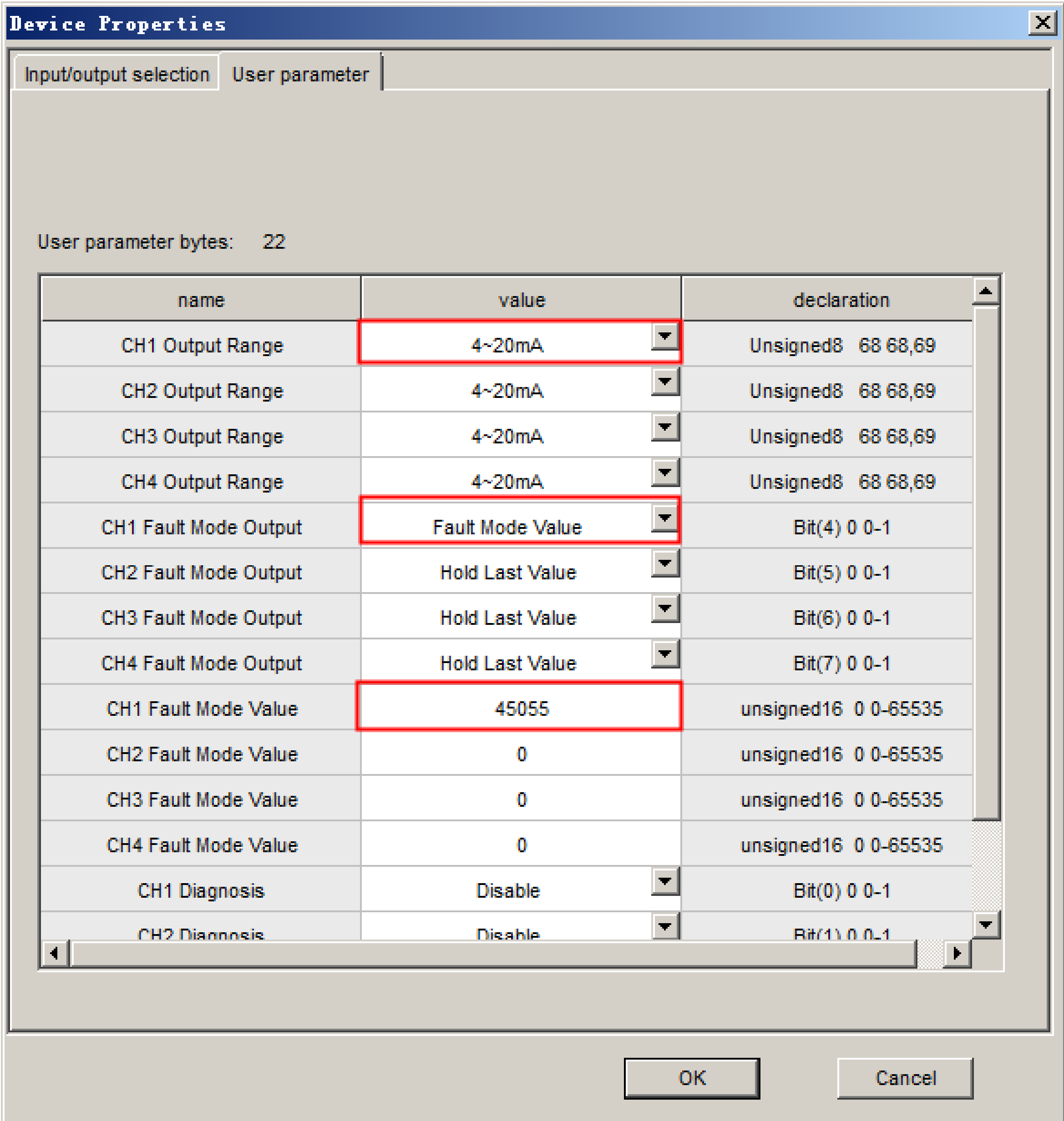
By calling the function block ENGIN_ HEX of the Analog signal Processing Functions library in the programming software AutoThink, it can convert the engineering data into the 2-byte code value data. Refer to the function block ENGIN_ HEX for the specific application.

When setting the fault mode and the program mode in the [User parameters], input the current after converting it into a decimal digital code according to the formula listed in table.

Data Conversion Formula LK511 Module

Output Range	Formula of Corresponding Code Values
4 mA≤I≤20 mA	(I－4) ×65,535/16(I-4) ×65,535/ 16
0 mA≤I≤21 mA	I×65,535/21

Example 1: for Channel 1, in case the range is selected as 4~ 20 mA, the user-defined fault mode outputs 15mA, then the Channel 1 Fault Mode Output setting=(15-4)×65,535/16=45,055. Refer to figure for the relevant user parameter settings.



Examples of Fault Mode Parameter Settings Based on Selected Range

6.4.18.6 Functions

6.4.18.6.1 Output Enable

After the output module is powered on, if the output instruction given from the controller module is not received, then it is in the initial status, with no output. For a module in the initial status, the output cannot be enabled. In this case, it holds its initial status even when in the fault modes.

After running the project, the controller module sends the output instruction to the module via the Profibus-DP bus. The module receives the control instruction and outputs. Once the instruction given from the controller module is output, output is then enabled for the slave station module. When in the fault modes, the output enabled module outputs the values for the fault modes.

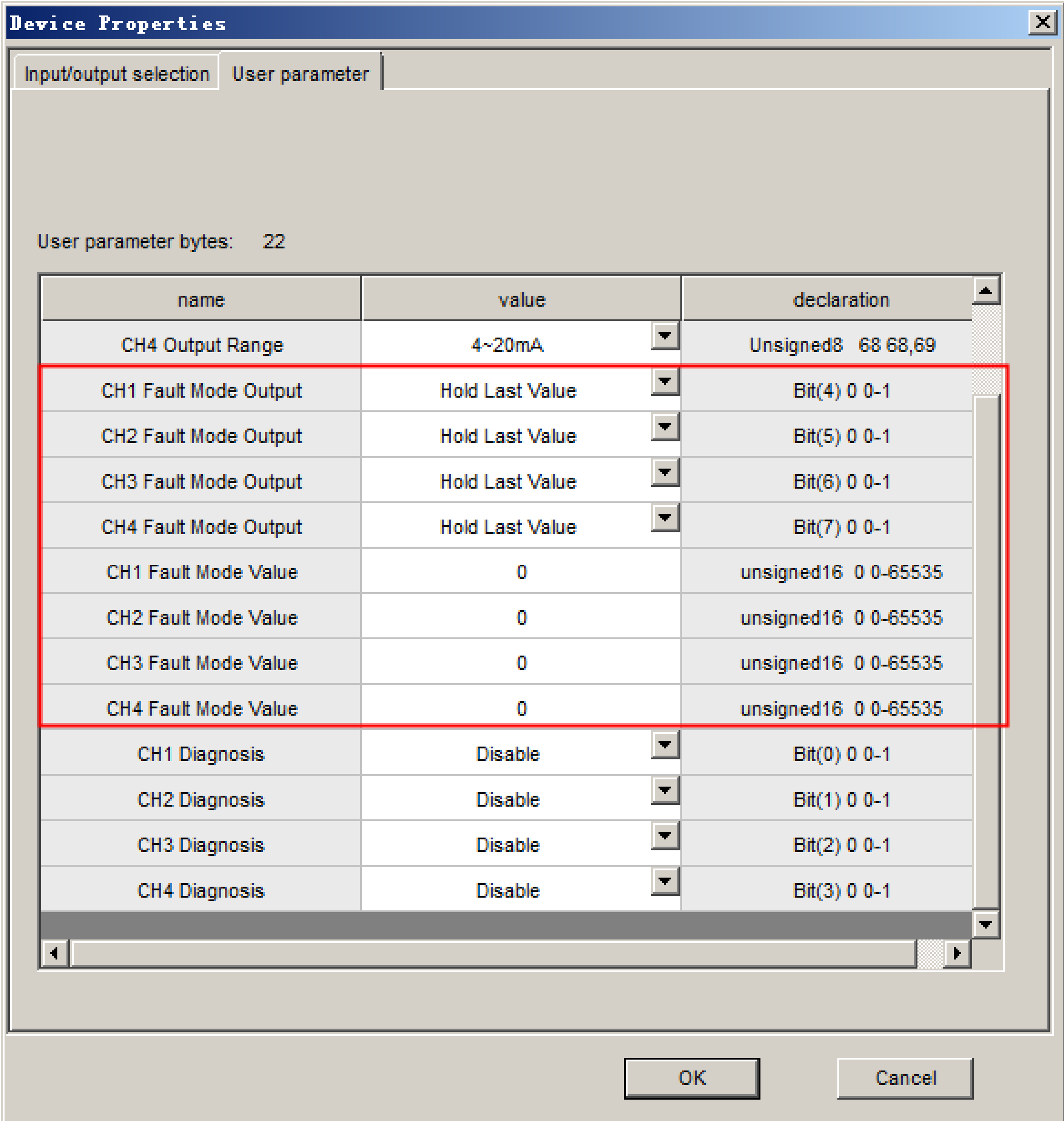
In summary, whether output has been enabled after powering on the output module, shall affect the output status in the fault modes.

After the output is enabled, the module goes on with the plug module or is powered up again upon power failure. The module returns to the initial status, with the output disabled. After receiving the output instruction of the controller module, the output is re-enabled.

6.4.18.6.2 Communication Fault

In case of a communication fault, the communication between the module and the controller module is disconnected, with the **RUN** indicator flashing.

After the module is powered up, whenever a communication fault occurs, the module then enters the fault mode automatically, outputting certain status (default value) pre-set in the configuration: Output Hold (Hold Last State) or the output fault mode settings (Fault Mode State).



Fault Mode Output Settings

In the fault mode, it can select Output Hold or Output Program Fault Mode Settings via the user parameter **Fault Mode Output**, defaulted to Output Hold (Hold Last Value). The fault mode settings are set via the user parameter **Fault Mode Value**, defaulted to Output 0 V. Refer to Data_Format for the fault mode settings.

Each channel parameter is set separately, without interfering each other. The modification takes effect only upon full download.

6.4.18.7 Diagnosis

The output channel of LK511 module is capable of line broken diagnosis and channel output fault diagnosis, which are of a channel diagnosis. After calling the function block sysGetDPSlaveState (Get Diagnosis of DP Slave), the channel diagnosis data reported by LK511 is saved into the output parameter **DiagData** in the function block.

Diagnostic information of LK511 up to 16 bytes, wherein 2 bytes are device-related diagnosis, 2 bytes are identification diagnosis and 12 bytes are channel diagnosis. The four channels in LK511, the diagnosis information for each channel 3 bytes. Diagnosis information diagram refer to figure Diagnosis_Information_diagram.

- Device diagnosis information

Device diagnosis data 0x02,0x00 indicates the current device without any fault.

Device diagnosis data 0x02,0x01 indicates that the current device has channel fault.

Device diagnostic data of 0x02, 0x02 indicates that the current device has errors.

Device diagnostic data of 0x02, 0x03 indicates that the current device has a channel failure and an error.

- Identification diagnosis information

The 2-byte identification diagnosis information is 0x42, 0x01 when diagnosis information is reported.

- Channel diagnosis information

Channel diagnosis information as shown in table.

Specifications for LK511 Channel Diagnosis Information

Diagnosis Information						Meaning
Bit		Bit7	Bit6	Bit5	Bit4~Bit0	
The first byte	Head	0x80				Decimal online value 128
The second byte	I/O type/channel	10 (Output)		（Channel）		Failed channel no 1~4 Decimal online value 128~131
The third byte	Channel data type/fault type	101 (Word)			6	Line broken, Decimal online value is 166
					18	Channel output fault, Decimal online value is 178
					0	Channel fault recovery, Decimal online value is 160
					10	The module readback diagnosis function fails, and the current output of the channel is 0~4mA. Decimal online value is 170. Diagnosis information is only repored when output range is 0~21mA

Example:

Channel diagnosis data 0x80, 0x82, 0xA6 indicates that channel 3 is line broken.

The LK511 module is designed for a channel read-back diagnosis circuit for its hardware. The channel output data is uploaded to the controller module by means of read-back. The user can access to and check the output signal at any time, thus further improving the reliability in AO control. In the meantime, the LK511 module automatically detects the output status of the channel via the read-back data, realizing fault diagnosis.

For a 4~20 mA range, read-back diagnosis holds valid in the full range.

The LK511 can conduct line broken and output fault diagnosis to the output channel via the read-back value. The controller module compares the read-back value and theoretical readback value, diagnoses the channel status and reports the diagnosis data. The rules are given below:

- Theoretical readback value: Output value from AT is taken as the theoretical readback value.
- When the read-back current is ＜4 mA, the output loop is disconnected, the channel is broken and the channel diagnosis byte reports line broken.
- When the error between the read-back value and theoretical readback value is more than 5% of the full range, the channel diagnosis byte reports channel output fault.
- When all the faults of the channel are recovered, the channel diagnosis byte reports fault recovery.
- When the channel is not loaded, it is considered as that the channel is broken, with line broken reported.

For the 0~21 mA range, 0~4 mA range of each channel is the read-back circuit dead zone. The current in the 0~4 mA range, the read-back diagnosis of the module becomes invalid automatically.

The LK511 module only reports the diagnosis data once separately when a fault occurs and is recovered. Due to the different output ranges selected by the user, the handling methods of the module may also differ in case of a fault, as shown in table. When all the channel faults are recovered and outputs normally, the channel diagnosis byte reports 0xA0.

Channel Fault Handling Based on Different Ranges

Output Range	Effective Diagnosis Range	Fault Type	Handling, Read-back Data and Diagnosis Byte
4~20 mA	4~20 mA	Line broken	The channel read-back data reports 0xA0 The channel diagnosis byte reports the line broken fault value 0xA6.
		Output fault	1. The error between the actual read-back value and theoretical readback value is more than 5% of the full range 2. The channel diagnosis byte reports the output fault value 0xB2.
0~21 mA	4~21 mA	Line broken	1. The code value reported by the channel read-back data is ≈ 0x22 (that is, not zero) 2. The channel diagnosis byte reports the line broken fault value 0xA6.
		Output fault	1. The error between the actual read-back value and theoretical readback value is more than 5% of the full range 2. The channel diagnosis byte reports the output fault value 0xB2.
	0~4 mA	Readback diagnosis function fails	The channel diagnosis byte reports the output fault value 0xAA.

It can select whether to conduct line broken diagnosis and output fault diagnosis in the configuration, defaulted to disable. If the channel is not connected, it can be considered as broken. It is suggested to disable the diagnosis function for channels that are not used, that is, to hold the default parameter diagnosis unchanged.

As an I / O slave of HolliTCP protocol, excepte above diagnostic information, refer to LK234_Diagnosis for more diagnostic information.

As an I / O slave of POWERLINK protocol, excepte above diagnostic information, refer to Overview of Diagnosis Information for more diagnostic information.

6.4.18.8 Parameters

The [User parameter] is used to set the operation mode of the module. The controller module written when downloading the user program may not be read in each scanning period. Each parameter has a default, which can be modified according to the project requirements. The user parameter does not support online modification. The modification takes effect only upon full download.

The user parameter length of the LK511 module is up to 22 bytes, used to set change range, fault mode output and fault mode output value, channel diagnosis enable.

table of LK511 User Parameters

Parameter Name	Meaning	Value
CH1 Output Range	To select the range of Channel 1	68: 4~ 20 mA (default) 69: 0~21 mA
CH2 Output Range	To select the range of Channel 2	
CH3 Output Range	To select the range of Channel 3	
CH4 Output Range	To select the range of Channel 4	
CH1 Fault Mode Output	Fault mode output value for Channel 1	0: Hold Last Value, Output Hold (default) 1: Fault Mode Value, Output fault Mode Settings.
CH2 Fault Mode Output	Fault mode output value for Channel 2	
CH3 Fault Mode Output	Fault mode output value for Channel 3	
CH4 Fault Mode Output	Fault mode output value for Channel 4	
CH1 Fault Mode Value	Fault mode settings for Channel 1	0 (fault) ~65,535 Refer to Data_Format for the calculation method.
CH2 Fault Mode Value	Fault mode settings for Channel 2	
CH3 Fault Mode Value	Fault mode settings for Channel 3	
CH4 Fault Mode Value	Fault mode settings for Channel 4	
CH1 Diagnosis	To enable Channel 1 diagnosis	0: Disable (default) 1: Enable
CH2 Diagnosis	To enable Channel 2 diagnosis	
CH3 Diagnosis	To enable Channel 3 diagnosis	
CH4 Diagnosis	To enable Channel 4 diagnosis	

ⓘChannel Diagnosis Enable includes Channel Line Break Diagnosis Enable and Output Fault Diagnosis Enable.

6.4.18.9 Data Area

The LK511 data area is divided for input data and output data. The output data is the current signal that is sent by the controller module to the LK511 output channel, which occupies four character variables, with each character variable (0~65,535) corresponding to one channel output data. The input data is the channel read-back data uploaded to the controller module via LK511, which occupies four character variables, with each character variable (0~255) corresponding to one channel read-back data.

table of LK511 Input/output Data

Definition of Areas	Data Length	Data Definition	Value Range	Corresponding Current Value
Output Data	1WORD	Output data for Channel 1	0x0000~0xFFFF	0x0000 corresponds to 4 mA or 0 mA

	1WORD	Output data for Channel 2	0x0000~0xFFFF	0xFFFF corresponds to 20 mA or 21 mA
	1WORD	Output data for Channel 3	0x0000~0xFFFF	
	1WORD	Output data for Channel 4	0x0000~0xFFFF	
Input Data	1BYTE	Read-back data for Channel 1	0x00~0xFF	0x00 corresponds to 4 mA or 0 mA 0xFF corresponds to 20 mA or 21 mA
	1BYTE	Read-back data for Channel 2	0x00~0xFF	
	1BYTE	Read-back data for Channel 3	0x00~0xFF	
	1BYTE	Read-back data for Channel 4	0x00~0xFF	

6.4.18.10 Technical Specifications

LK511 4-channel Inter-channel Isolated Current Type Analog Output Module				
System Power				
Operating Voltage			24VDC (-15%~+20%)	
Power			180 mA max.@24 VDC (that is, all the 4 channels output based on 20 mA)	
Output channel				
Number of channels			4	
Range Code			68	69
Output Range			4~20 mA	0~21 mA
Output Data Format			0x0000~0xFFFF	0x0000~0xFFFF
Read-back Data Format			0x00~0xFF	0x00~0xFF
Output Setup Time			＜2 ms	
Load Capacity			750 Ω max.	
DAC Resolution			12-bit	
Read-back ADC Resolution			8-bit	
Channel Output Temperature Drift			±50 ppm/℃	
Isolation Voltage between Channel and System			500 VAC@1 min, leaking current: 5 mA	
Isolation Voltage between Channels			500 VAC@1 min, leaking current: 5 mA	
Reset Output	Power On Reset (cold start)		0 mA	
	Charged Reset (warm start)		Output Hold	
Accuracy	Output	0~4 mA Range	0.6% F.S.@25℃	
		4~21 mA Range	0.3% F.S.@25℃	
	Read-back		In the 4~21 mA range; the 0~4 mA range is the readback dead zone, with the readback data in the range approximating to 4 mA	
Stability	Output		0.05% F.S.@25℃	
	Read-back		2.5% F.S.@25℃	
Failure Diagnosis and Hot Plug				
Line broken detection			When the channel is broken (Configure Enable), the diagnosis then reports 0xA6; when the fault recovered, it then reports 0xA0	
Output Fault Detection			In case of a channel output fault (Configure Enable), the diagnosis then reports 0xB2; when the fault recovered, it then reports 0xA0	
Hot Plugging			Supported	
Physical Property				

LK511 4-channel Inter-channel Isolated Current Type Analog Output Module	
Protection Key	C1
Installation Position	Extension backplane
Module Dimension (W*H*D)	35 mm×100 mm×100 mm
Enclosure Protection Rating	IEC60529 IP20
Communication Bus	
Protocol	Profibus-DP
Baud Rate	1.5Mbps, 500Kbps, 187.5Kbps , 93.75Kbps, 45.45Kbps, 31.25Kbps, 19.2Kbps, 9.6Kbps adaptive
Media	Communication bus is connected to the backplane through euro connector, hot redundant communication media
Environmental Adaptability	
Operating Temperature	-20℃~70℃
Operating Humidity	5%~95%, with no condensation
Storage Temperature	-40℃~80℃
Storage Humidity	5%~95%, with no condensation
Weight	180 g

6.4.19 LK512 8-channel Current Voltage Analog Output Module

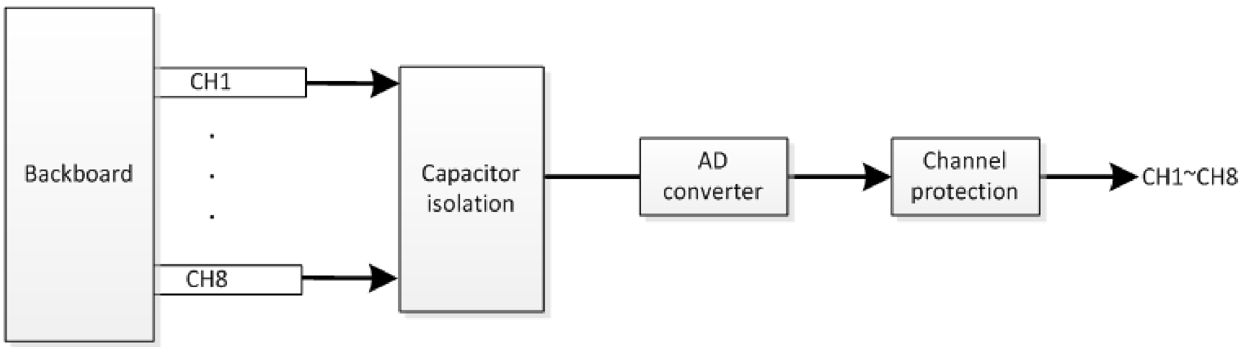
6.4.19.1 Basic Features

- 8-channel current / voltage output
- Output signal range: 0 ~ 20mA / 4 ~ 20mA / 0 ~ 5V / 0 ~ 10V / 1 ~ 5V / - 5 ~ 5V / - 10 ~ 10V
- Fault safe output
- Short circuit detection
- Line broken detection
- Field power supply fault detection
- Electrical isolation between the channel and the system
- Hot swapping

LK512 Module Schematic Diagram

6.4.19.2 Operating Principle

The controller sends the output data to LK512 through Profibus-DP bus, and every four channels are a group. The output is isolated by capacitor chip, and converted into voltage or current signal output through ADC converter. The channel supports short circuit detection and line broken detection functions. At the same time, the module can detect field power failure, DP network failure and module chip failure. In case of channel fault or module fault, the fault information is reported to the controller, the corresponding status indicator is triggered, and the preset safety mode value is output.



Internal Structure Block Diagram of LK512

6.4.19.3 Indicators

LK512 provides 1-way module status indicator and 8-channel status indicator, and each indicator is double color indicator.

Definition of LK512 Indicators

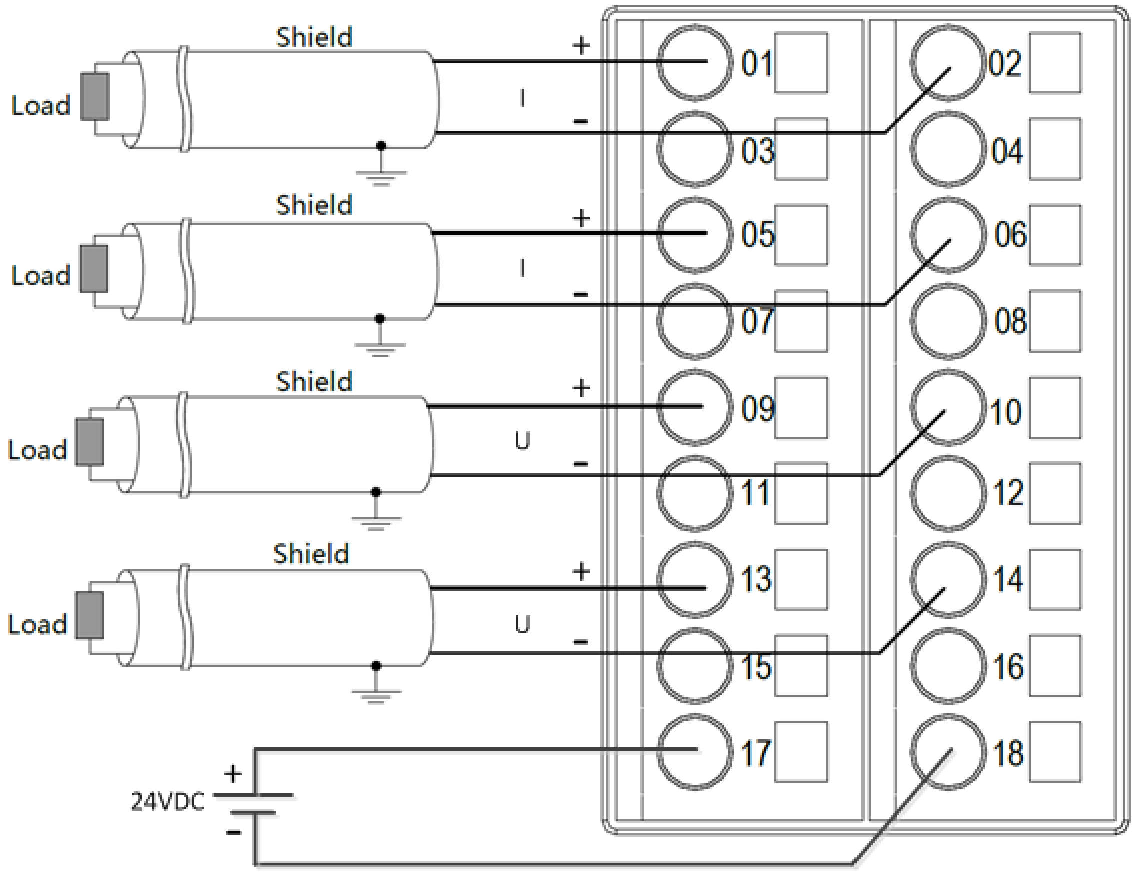
Name	Color	Status	Description
Channel indicator (Red and yellow)	Yellow	On	The channel is normal
		Flash	Undefined
	Red	On	The channel output failure
		Flash	Undefined
	——	Off	Channel is disenabled or no output
RUN/ERR indicator (Red and green)	Green	On	The communication has been established and the module works normally
		Flash	Communication not established
	Red	On	Module has a fault
		Flash	Undefined
	——	Off	The module is not powered on

6.4.19.4 Wirings

The definition of LK512 backplane terminal is shown in the table below. The working voltage of 24 VDC is provided to 1 ~ 8 channels through terminals 17 and 18.

Definition of LK512 Backplane Terminals

Channel No.	Sequence of Terminals	
	Current / voltage Output Terminal (Positive)	Current / voltage Output Terminal (Negative)
1	01	02
2	03	04
3	05	06
4	07	08
5	09	10
6	11	12
7	13	14
8	15	16
24 VDC channel power supply	Power supply positive	Power supply negative
	17	18



LK512 Backplane Terminal Wiring Schematic Diagram

Pay attention to the following during wiring:

- Each AO signal is connected to the terminal with two wires (shielded cable).
- Odd terminal is the positive end of the output signal, and the even terminal is the negative end of the output signal.
- Do not connect multiple cables on the same terminal at the same time. You can achieve multipoint connection via conversion terminal.

6.4.19.5 Diagnosis

LK512 module supports line broken detection in current output and supports short circuit detection in voltage output. These diagnoses belong to channel diagnosis. After calling the function block sysGetDPSlaveState (Get Diagnosis of DP Slave), the diagnosis data is saved into the output parameter **DiagData** of the function block.

The diagnosis information of LK512 contains 32 bytes. Wherein 3 bytes are device related diagnosis, 2 bytes are identification diagnosis, 24 bytes are channel diagnosis, and 3 bytes are version information. LK512 has 8 channels, each channel has 3 bytes diagnosis information. Diagnosis information diagram refer to figure Diagnosis_Information_diagram.

Diagnosis information of LK512

Diagnosis information	Diagnosis byte	Value
Device related diagnosis	DiagData[0]	0x03: Head-byte of device diagnosis
	DiagData[1]	Bit0: Chip fault diagnosis 1: Chip failure 0: No fault
	DiagData[2]	Bit0: Channel fault diagnosis 1: Channel failure 0: No fault
		Bit2: Field power supply diagnosis 1: Power failure of the field power supply 0: No fault
		Bit6~Bit7: DP network fault diagnosis 0: No fault 1: Network A failure 2: Network B failure
Identification diagnosis	DiagData[3]	0x42: Head-byte of dentification diagnosis
	DiagData[4]	0x00: No channel fault 0x01: There is a channel fault
Channel diagnosis	DiagData[5]~DiagData[28]	Each channel has three bytes diagnosis, see following table
Version information	DiagData[29]~DiagData[31]	3 bytes, version information of module First byte: MCU version number Second byte: FPGA version number Third byte: Hardware version number

LK512 Channel Diagnosis Information

Diagnosis Information						Meaning
Bit		Bit7	Bit6	Bit5	Bit4~ Bit0	
The first byte	Head	0x80				Decimal online value 128
The second byte	I/O type/channel	10(Output)		（Channel）		Fault channel no Decimal online value 128~135
The third byte	Channel data type/fault type	101 (WORD)			1	Short circuit, decimal online value is161
					6	Line broken, decimal online value is 166
					0	Channel fault recovery, decimal online value is 160

6.4.19.6 Parameters

The [User parameter] is used to set the operation mode of the module. The controller module written when downloading the user program may not be read in each scanning period. Each parameter has a default, which can be modified according to the project requirements. The user parameter does not support online modification. The modification takes effect only upon full download.

The user parameter length of the LK512 module is up to 32 bytes, used to set channel enable, channel range, fault output mode and safety preset value, channel diagnosis enable.

Table of LK512 User Parameters

Parameter Name	Meaning	Value
CH1 State ~CH8 State	Enable channel	Disable CH Enable CH
CH1 Range ~CH8 Range	Set range of channel	0~20mA/4~20mA/0~5 V/1~5 V /0~10V /-5~5 V/-10~10V
CH1 Fault Mode Output~ CH8 Fault	Set fault mode output for	Hold

Parameter Name	Meaning	Value
Mode Output	channel	Safe Preset Value
CH1 Safe Preset Value~ CH8 Safe Preset Value	Set preset value for channel	0(default), -32768~32767
CH1 Diag.State~ CH8 Diag.State	Enable channel diagnosis	Disable (default) Enable

6.4.19.7 Technical Specifications

<table>
<tr><th colspan="9">LK512 8-channel Current Voltage Analog Output Module</th></tr>
<tr><td colspan="9">System power supply</td></tr>
<tr><td colspan="2">Operating voltage</td><td colspan="7">24VDC(-15%~20%)</td></tr>
<tr><td colspan="2">Power consumption (Max)</td><td colspan="7">100mA@24VDC</td></tr>
<tr><td colspan="9">Field power supply</td></tr>
<tr><td colspan="2">Operating voltage</td><td colspan="7">24VDC(-15%~20%)</td></tr>
<tr><td colspan="2">Power consumption (Max)</td><td colspan="7">260mA @24VDC</td></tr>
<tr><td colspan="9">Output channel</td></tr>
<tr><td colspan="2">Number of channels</td><td colspan="7">8</td></tr>
<tr><td colspan="2">Output load</td><td colspan="7">Voltage and current</td></tr>
<tr><td colspan="2">Current output carrying capacity</td><td colspan="7">≤750Ω</td></tr>
<tr><td colspan="2">Voltage output carrying capacity</td><td colspan="7">≥1.5KΩ</td></tr>
<tr><td colspan="9">Output signal range</td></tr>
<tr><td colspan="2">Standard signal</td><td>0~20mA</td><td>4~20mA</td><td>0~5V</td><td>1~5V</td><td>0~10V</td><td>-5V~+5V</td><td>-10V~+10V</td></tr>
<tr><td colspan="2">Corresponding code value</td><td>0~27648</td><td>0~27648</td><td>0~27648</td><td>0~27648</td><td>0~27648</td><td>-27648~27648</td><td>-27648~27648</td></tr>
<tr><td colspan="2">Full-scall</td><td>0~23.69mA</td><td>4~22.96mA</td><td>0~5.92V</td><td>1~5.74V</td><td>0~11.85V</td><td>-5.92~5.92V</td><td>-11.85~11.85V</td></tr>
<tr><td colspan="2">Corresponding code value</td><td>0~32767</td><td>0~32767</td><td>0~32767</td><td>0~32767</td><td>0~32767</td><td>-32768~32767</td><td>-32768~32767</td></tr>
<tr><td colspan="2">Stability</td><td colspan="7">±0.08% F.S.@25℃</td></tr>
<tr><td colspan="2">Resolution</td><td colspan="7">16-bit</td></tr>
<tr><td colspan="2">Isolation voltage between channel and system</td><td colspan="7">500VAC@1min , leaking current: 5mA</td></tr>
<tr><td rowspan="2">Reset Output</td><td>Power on reset (cold start)</td><td colspan="7">0mA</td></tr>
<tr><td>Charged reset (warm start)</td><td colspan="7">Output Hold</td></tr>
<tr><td colspan="2">Accuracy</td><td colspan="7">±0.2% F.S.@25℃
±0.5% F.S@(-20～70℃)</td></tr>
<tr><td colspan="9">Failure diagnosis and hot plug</td></tr>
<tr><td colspan="2">Short circuit detection</td><td colspan="7">Detected in voltage output</td></tr>
<tr><td colspan="2">Line broken detection</td><td colspan="7">Detected in current output</td></tr>
<tr><td colspan="2">Field power supply fault detection</td><td colspan="7">Supported</td></tr>
<tr><td colspan="2">Hot plugging</td><td colspan="7">Supported</td></tr>
<tr><td colspan="9">Communication</td></tr>
<tr><td colspan="2">Protocol</td><td colspan="7">Profibus-DP</td></tr>
<tr><td colspan="2">Baud Rate</td><td colspan="7">187.5Kbps、500Kbps、1.5Mbps、3Mbps、6Mbps、12Mbps adaptive</td></tr>
<tr><td colspan="2">Media</td><td colspan="7">Communication bus is connected to the backplane through euro connector, hot redundant communication media</td></tr>
<tr><td colspan="9">Physical property</td></tr>
<tr><td colspan="2">Installation position</td><td colspan="7">Extension backplane</td></tr>
</table>

LK512 8-channel Current Voltage Analog Output Module	
Module dimension(W*H*D)	35mm×100mm×100mm

6.4.20 LKC131 IO Back Slot Module

The LKC131 is the LK Series IO Back Slot Module, with only structural components and no formwork to cover unused back slots.

LKC131 IO Back Slot Module Exterior

Chapter 7 Attachment

7.1 LKA101 Profibus-DP Bus Connector

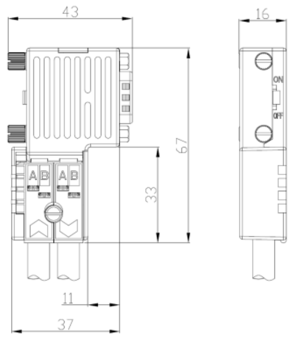
LKA101 is the PROFIBUS-DP bus connector. It switches the redundancy DP signal of the previous backboard to the next one. In the meantime, it also provides the active terminal matching resistance for the PROFIBUS-DP bus. The matching resistance is selected via the DIP switch. If the connector is at the end point of the bus, it must be connected to the matching resistance.

The DB9 plug of LKA101 matches the DB9 receptacle on the backboard that is used as the DP communication extension interface. Each LKA101 is installed with one receptacle.

7.1.1 Appearance

External View of LKA101

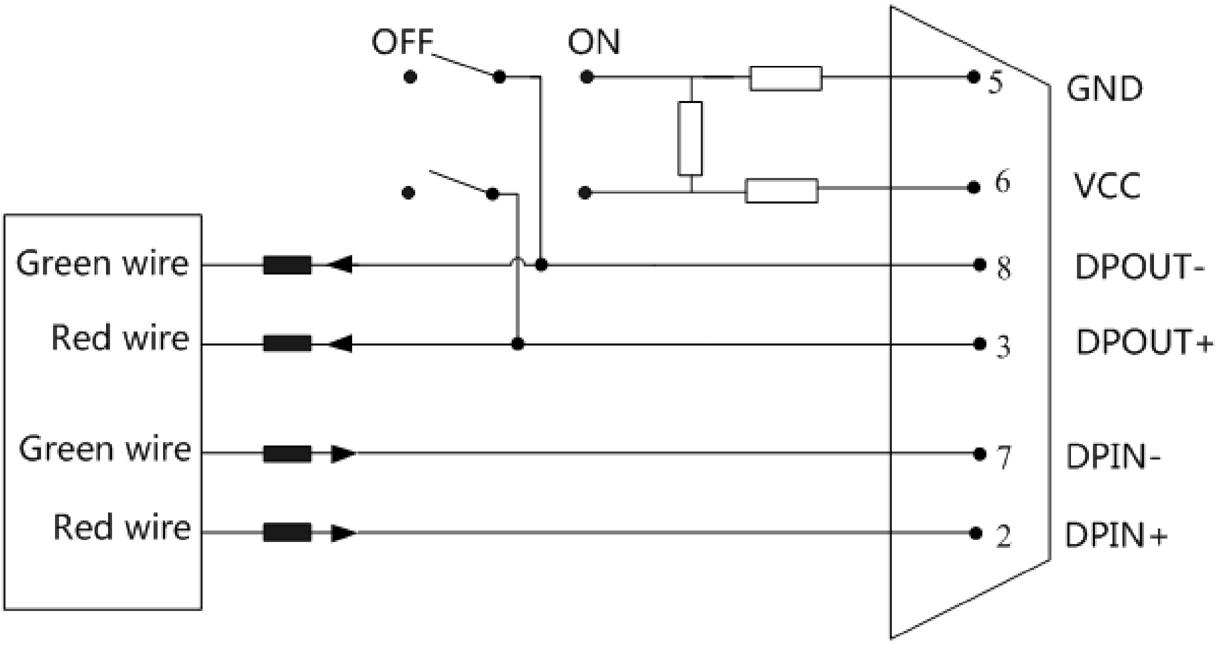
7.1.2 Installation Dimension



Dimension Figure

7.1.3 Operating Principle

The LKA101 bus connector is as shown in Figure. The DP input signal is input to the backboard via the DPIN pin. The DP output signal is output via the DPOUT pin, and connected to the next backboard. You can set whether to connect matched resistors by selecting positions ON, OFF of dial switch.



LKA101 Profibus-DP Bus Connector Schematic Diagram

7.1.4 Terminal Matching Resistance

At the terminal node of the DP bus, a matched resistance is bridged over for impedance matching. The node in the middle cannot be connected with a matched resistance.

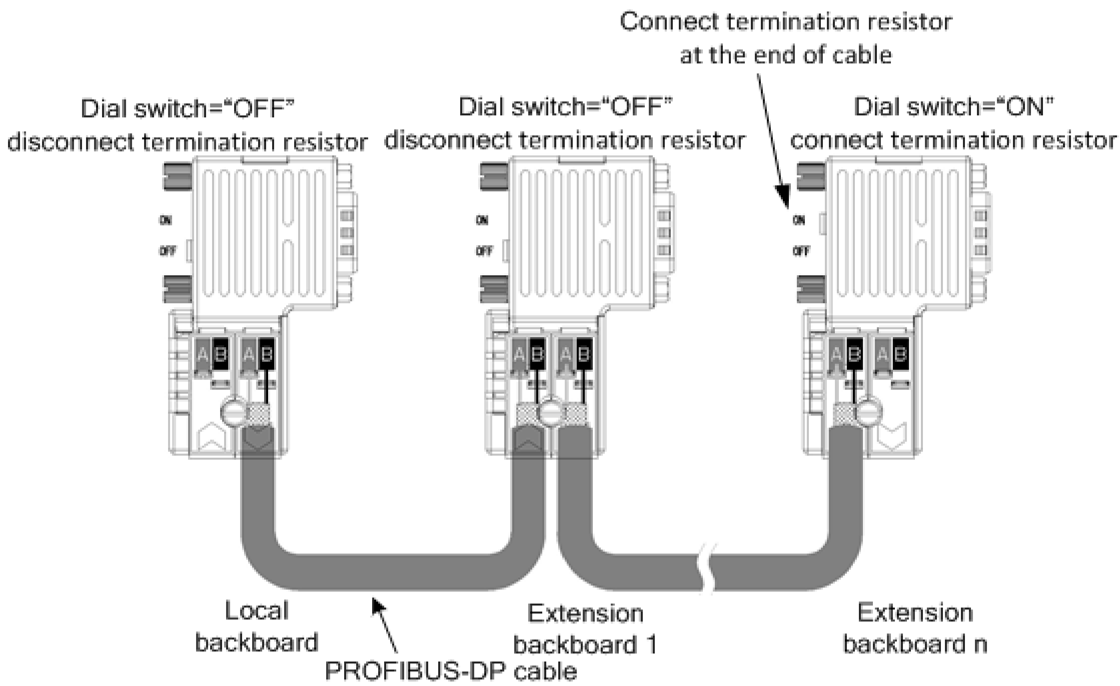
For the LK system, the matched resistance at one end of the DP bus is provided by the local backboard with no user settings. The matched resistance of the other end can be provided by the LKA101 connector or the communication module, which can be set by the user according to the actual situation.

It can connect only one terminal resistance on LKA101 or the communication module, with no repeated settings allowed. To facilitate operation, it is recommended of using the matched resistance on the LKA101 connector.

Select the matched resistance on LKA101 by dial switch, which has two positions such as ON, OFF, as shown in Figure.

DIP Switch Schematic Diagram

- Switched to ON: connect the matched resistance
- Switched to OFF: disconnect the matched resistance



DIP Switch Settings for Backboard Cascade Connection

7.1.5 Wiring

Signal definition of LKA101 as follows:

DP Signal Definition

Cable Identification		Signal Definition
Input wire	Green wire A	DP negative (DPIN-)
	Red wire B	DP positive (DPIN+)

Cable Identification		Signal Definition
Output wire	Green wire A	DP negative (DPOUT-)
	Red wire B	DP positive (DPOUT+)

See Wiring for the cable requirements and wiring steps.

When multiple LKA101 connectors realize cascade connection between backboards, it shall observe the following rules:

- When located on the master control backboard and dial switch in OFF, there are only outgoing lines.
- When located on the extension backboard in the middle and dial switch in OFF, there are both incoming and outgoing lines.
- When located on the last extension backboard and dial switch in ON, there are only incoming lines.

7.1.6 Installation

See Installation.

7.1.7 Technical Specifications

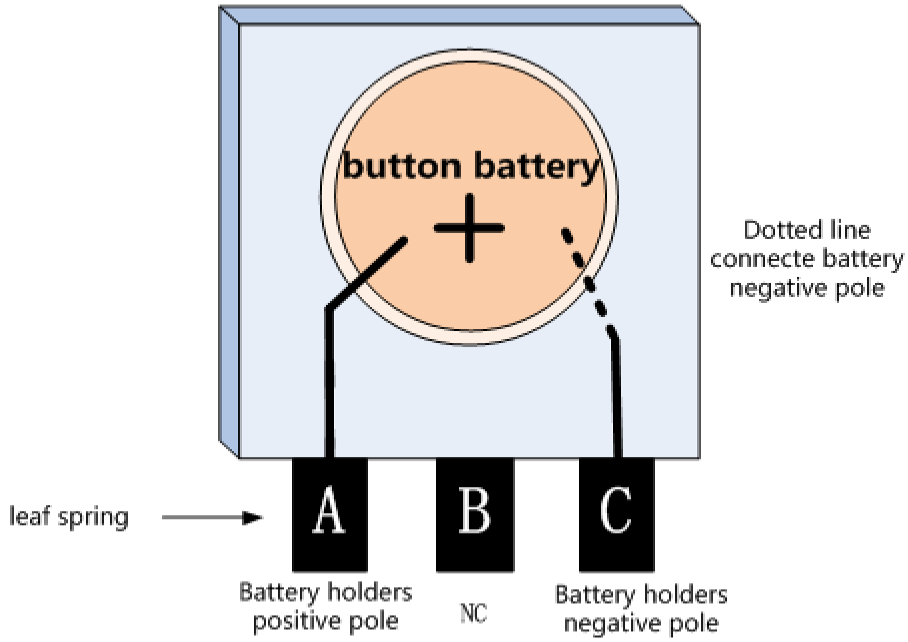
LKA101 PROFIBUS-DP Bus Connector Module		
Connector	D-sub 9 pin	
Cable outer diameter	8mm±0.4mm	
Screw specification	Shell screw	M3, mechanical screw
	DB9 screw	4-40UNC-2A
	Wiring bracket screw	M3, mechanical tooth free screw
Maximum torque（Nm）	Shell screw	0.5Nm
	DB9 screw	0.4Nm
	Wiring bracket screw	0.22~0.25Nm
Cross-sectional area of core	Rigid wire	0.14~1.5mm2
	Flexible wire	0.14~1mm2
AWG	26~16	
Termination resistance	220Ω	
Module Dimension (W*H*D)	43mm×67mm×16mm	
Protection class	EN60529 IP20	

7.2 LKA102 Battery Power Box Module.

LKA102 provides the backup battery for RTC of the controller module. After the system is powered off, it is powered by the backup battery to ensure that the controller program is not lost

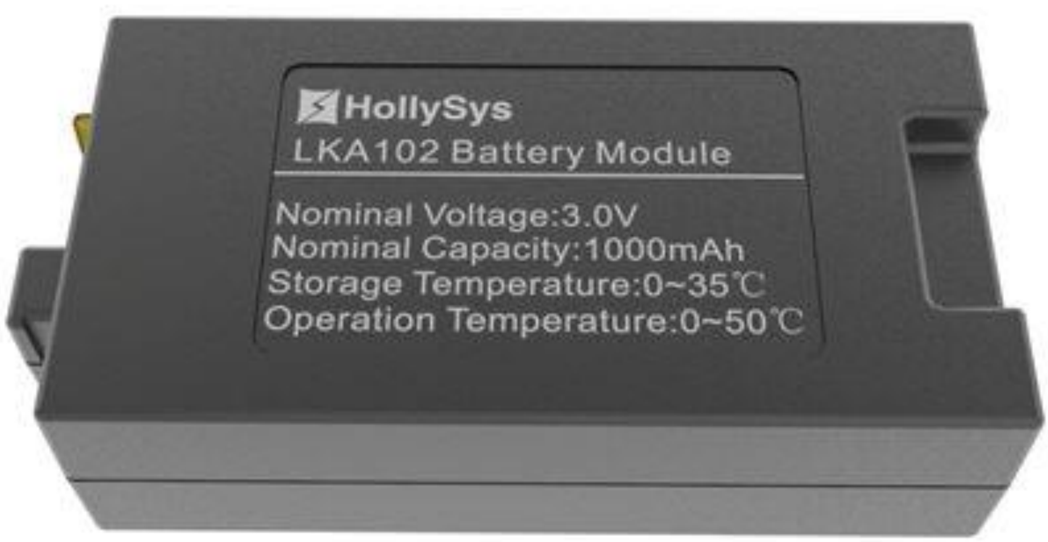
When controller is powered off, LKA102 supplies power to RTC via Springs A and C to keep RTC in the standby mode. The battery voltage is 3.0 V, the capacity is 1,000mAh, which can keep the typical standby value of RTC for 1 year.

Note: LKA102 is a standard product of hollysys, you can only buy it from hollysys.



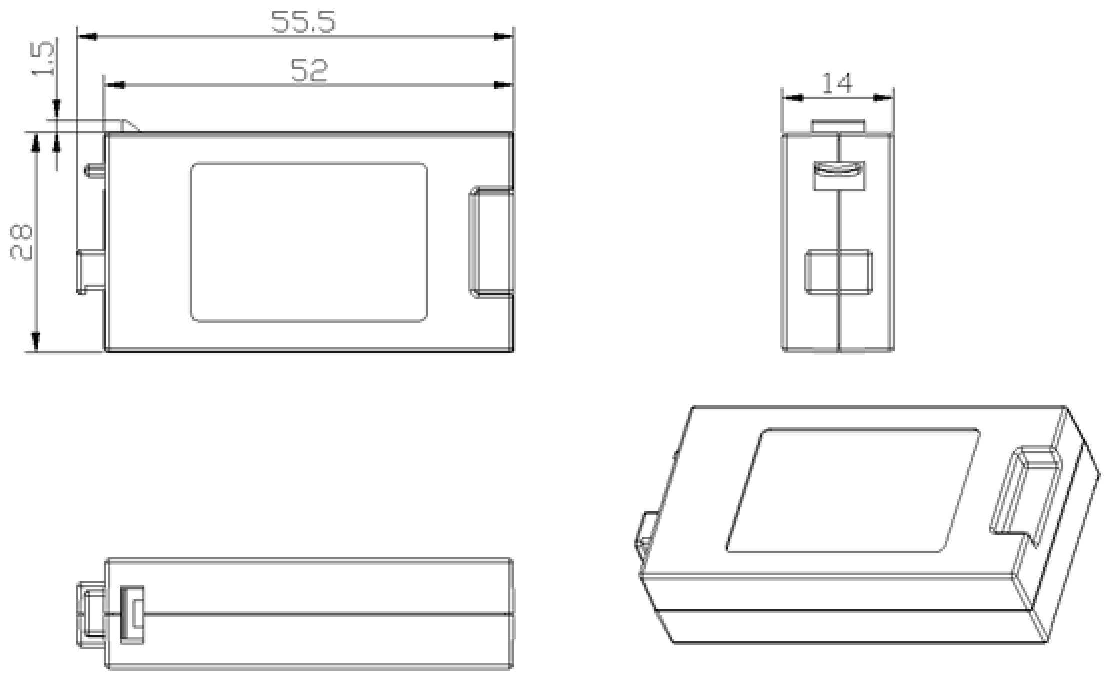
LKA102 Battery Power Box Schematic Diagram

7.2.1 Appearance



LKA102 Module Schematic Diagram

7.2.2 Installation Dimension



Installation Dimension of LKA102 Module

7.2.3 Battery Replacement

When the BAT indicator indicator on the controller module panel is ON, it shall replace the battery module.

Steps to replace the battery are as follows:

- Take the used battery out from the battery slot of the controller module.
- Hold the upper and lower edges from the front of the module, insert into the battery in the indicated direction.
- After being inserted, the BAT indicator turns OFF and the battery is replaced.

7.2.4 Installation

See Installation of Power Supply Box.

7.2.5 Technical Specifications

LKA102 Battery Power Box Module	
Physical Property	
Installation Pattern	Clip
Protection key position	Rear right
Module Dimension (W*H*D)	55.5 mm*28 mm*14 mm

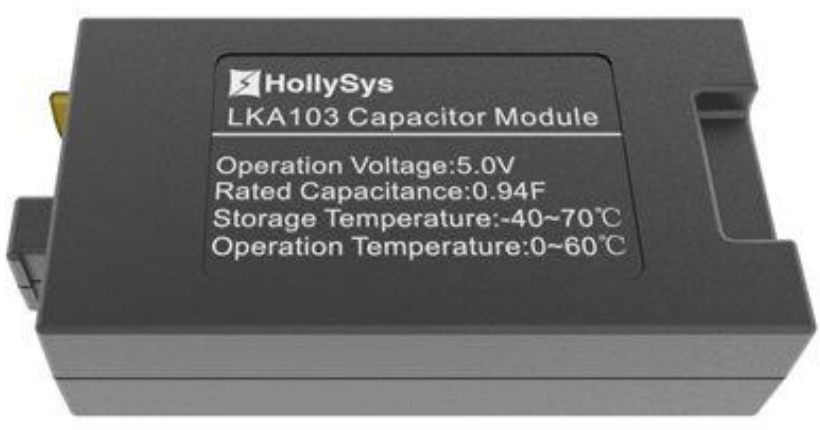
7.3 LKA103 Capacitance Power Box Module

LKA103 provides the backup battery for RTC of the module. After the system is powered off, it is powered by the backup battery to ensure that the controller program is not lost

When is powered off, LKA103 supplies power to RTC via Springs A and C to keep RTC in the standby mode. The max. voltage for capacitance charging is 5.0V and the capacity is 0.94F. It can keep RTC in the standby mode for about 7 days when fully charged once.

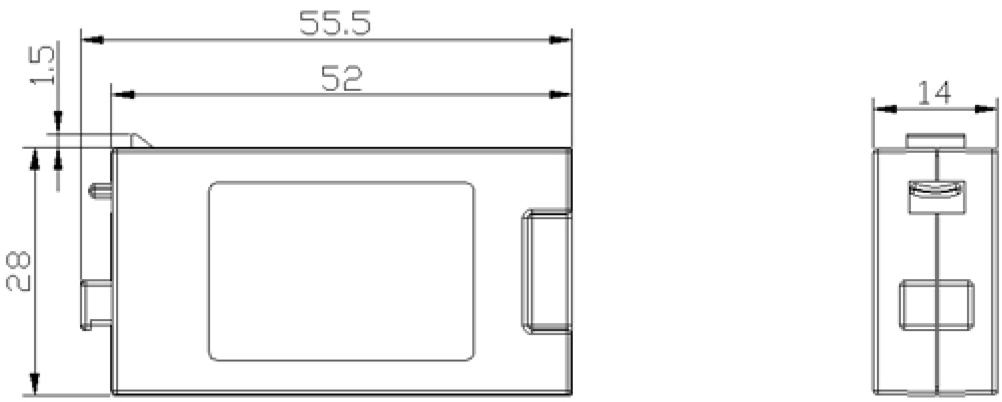
Note: LKA103 is a standard product of hollysys, you can only buy it from hollysys.

7.3.1 Appearance



LKA103 Module Schematic Diagram

7.3.2 Installation Dimension



Installation Dimension of LKA103 Module

7.3.3 Installation

See Installation of Power Supply Box.

7.3.4 Battery Replacement

See Battery_Replacement.

7.3.5 Technical Specifications

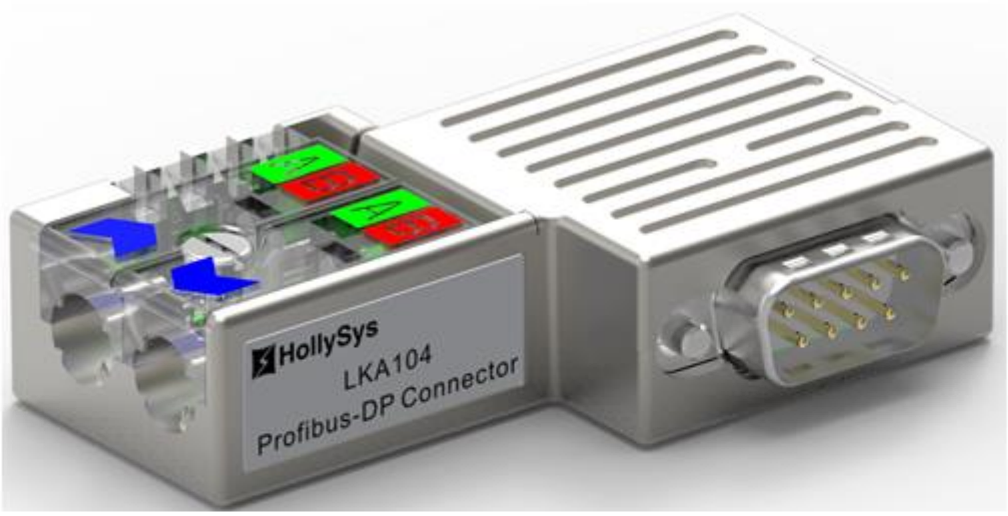
LKA103 Capacitance Power Box Module	
Physical Property	
Installation Pattern	Clip
Protection key position	Rear right
Module Dimension (W*H*D)	55.5 mm*28 mm*14 mm
Environmental Condition	
Ambient Temperature for Operation	0℃～60℃
Storage Temperature	-40℃～70℃
Ambient RH for Operation	10%~95%, with no condensation
Storage RH	10%~95%, with no condensation

7.4 LKA104 Profibus-DP Bus Connector

LKA104 is a Profibus-DP bus connector. It switches the redundancy DP signal of the previous backplane to the next one. It provides the terminal matching resistance for the Profibus-DP bus. The matching resistance is selected via the DIP switch. If the connector is at the both ends of the bus, it must be connected to the matching resistance.

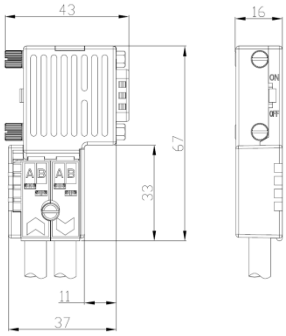
The DB9 plug of LKA104 matches the DB9 receptacle on the DP communication extension interface of the backplane and the communication module. Each LKA104 is installed with one receptacle. The LKA104 modules are connected via the DP cable, and DP cable is inserted into wiring holes and pressed.

7.4.1 Appearance



External View of LKA104

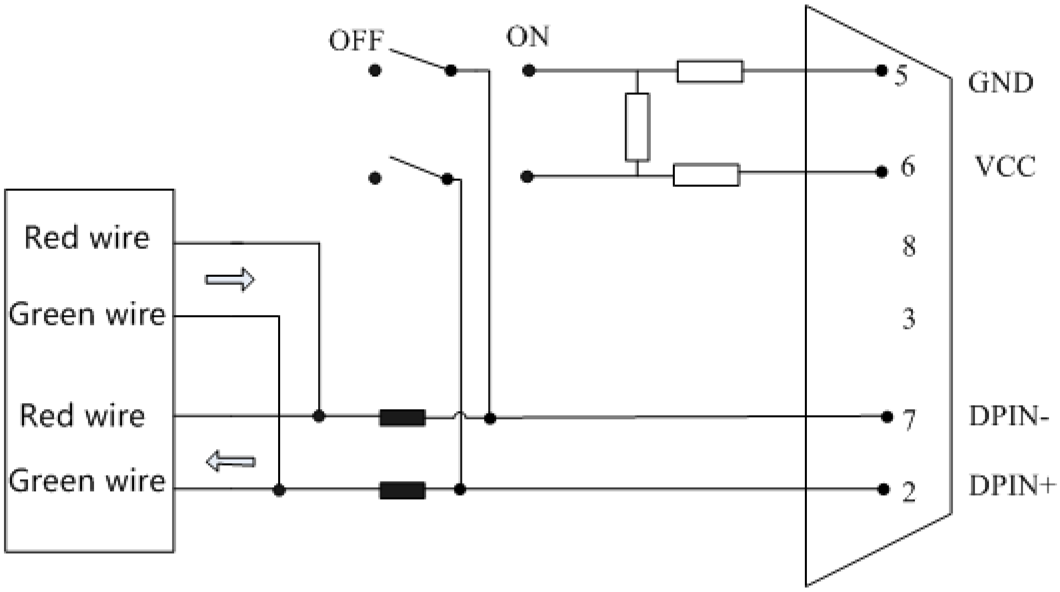
7.4.2 Installation Dimension



Dimension figure of LKA104

7.4.3 Operating Principle

The LKA104 bus connector is shown in figure. The DP input signal is input to the backplane via the DPIN pin. In the meantime, the DP signal is connected to the next backplane. You can set whether to connect matched resistors by selecting positions ON, OFF of dial switch.



LKA104 Schematic Diagram

7.4.4 Terminal matching resistance

At the terminal node of the DP bus, a matching resistance is bridged over for impedance matching. The node in the middle cannot be connected with a matching resistance.

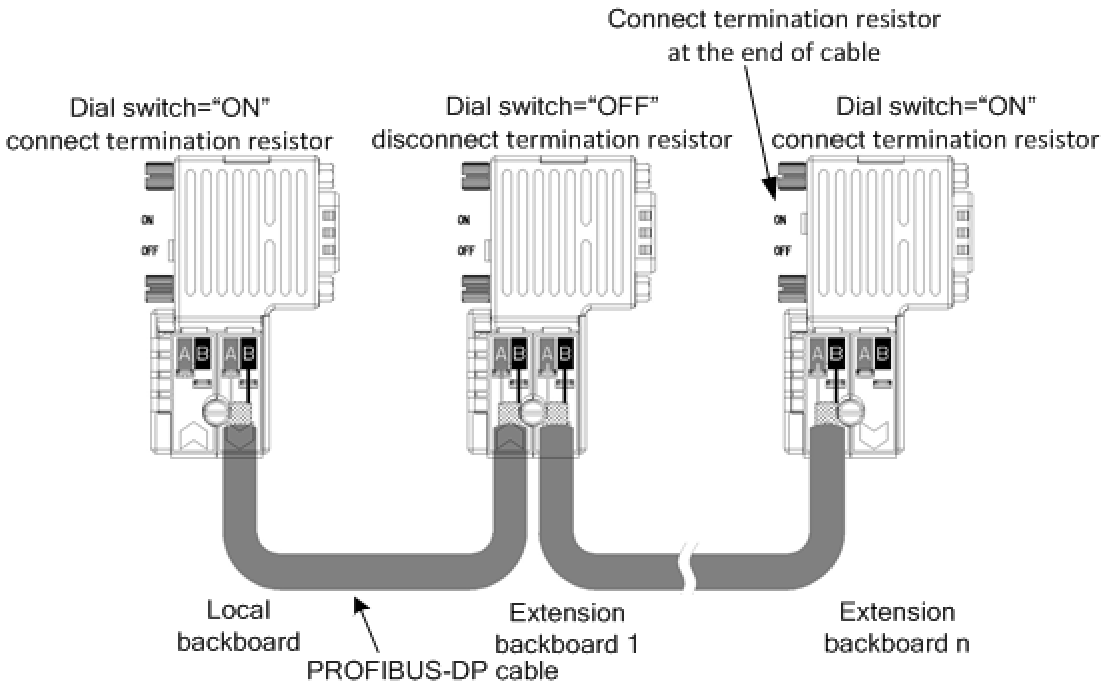
For the LK system, the matching resistance at one end of the DP bus is provided by LKA104. The matching resistance of the other end can be provided by the LKA104 connector or the communication module, which can be set by the user according to the actual situation.

It can connect only one terminal resistance on LKA104 or the communication module, with no repeated settings allowed. To facilitate operation, it is recommended to used the matching resistance on the module.

Select the matching resistance on LKA104 by dial switch, which has two positions such as ON, OFF, as shown in figure.

DIP Switch Schematic Diagram

- Switched to ON: connect the matching resistance
- Switched to OFF: disconnect the matching resistance



DIP Switch Settings for Backplane Cascade Connection

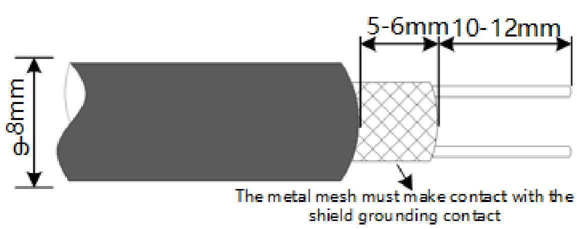
7.4.5 Wiring

Signal definition of LKA104 as follows:

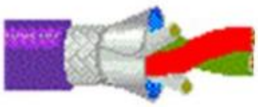
DP Signal Definition

Cable Identification		Signal Definition
Input wire	Green wire A	DP positive（DPIN+）
	Red wire B	DP negative（DPIN-）
Output wire	Green wire A	DP positive（DPOUT+）
	Red wire B	DP negative（DPOUT-）

The cable processing requirements for the bus connector are as shown in the figure. The outer diameter of the cable must not exceed 8 mm, otherwise it will not fit into the cable port of the connector.



(a)



(b)

The processing requirements for DP cables

Cable requirements and wiring steps:

(1) Loosen the fixing screws of the wiring bracket and lift the wiring bracket upwards.

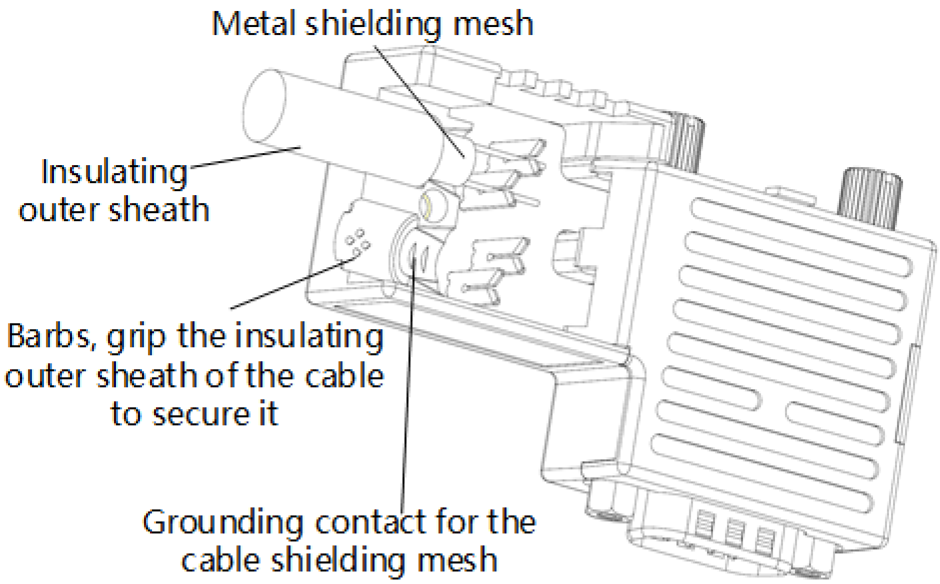
(2) According to the cable processing standards, leave an appropriate length of the shielding layer and conductors.

(3) Insert the red conductor into the B terminal hole of the wiring bracket, and the green conductor into the A terminal hole.

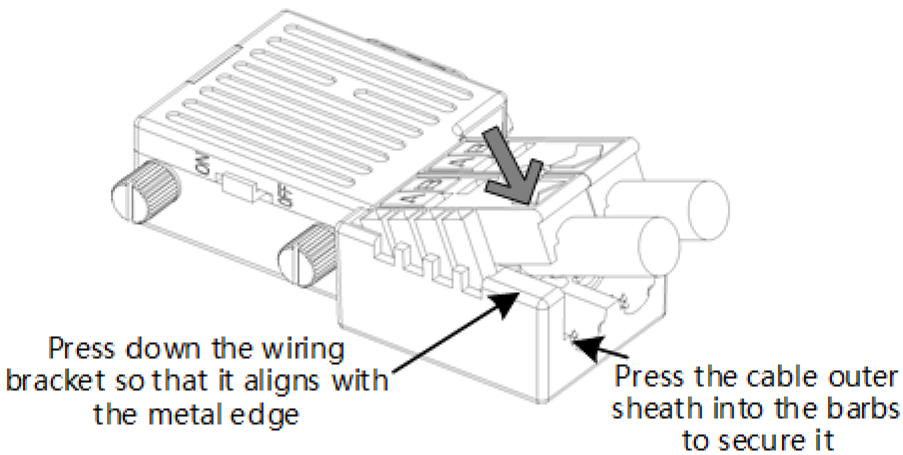
(4) Ensure a reliable connection between the shielding layer and the grounding contact, and secure the cable outer sheath.

(5) Press down the wiring bracket so that it aligns with the metal edge of the lower cover. Note: When pressing down, tighten the inlet side wiring bracket first, then the outlet side wiring bracket, otherwise, the screw mounting holes may be damaged.

(6) Tighten the fixing screws of the bracket.



(1)



(2)

LKA104 Wiring Diagram

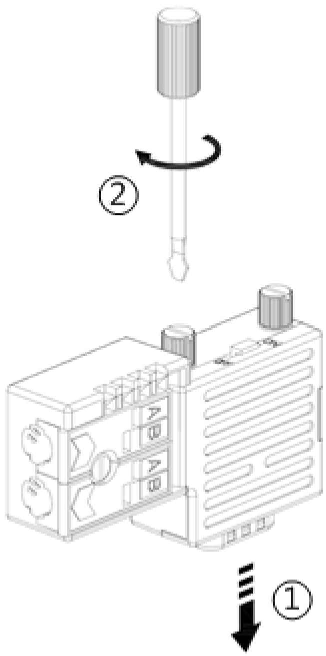
7.4.6 Installation

The LKA104 connector is used to achieve DP signal connections between LK backplanes.

To install the LKA104 connector, follow these steps:

(1) Insert the DB9 plug into the corresponding DB9 socket on the backplane or LK249 module.

(2) Tighten the securing screws on the DB9 plug using a small screwdriver.



LKA104 Installation Diagram

7.4.7 Technical specifications

LKA104 Profibus-DP Bus Connector Module		
Connector	D-sub 9 pin	
Cable outer diameter	8mm±0.4mm	
Screw specification	Shell screw	M3, mechanical screw
	DB9 screw	4-40UNC-2A
	Wiring bracket screw	M3, mechanical tooth free screw
Maximum torque（Nm）	Shell screw	0.5Nm
	DB9 screw	0.4Nm
	Wiring bracket screw	0.22~0.25Nm
Cross-sectional area of core	Rigid wire	0.14~1.5mm2
	Flexible wire	0.14~1mm2
AWG	26~16	
Termination resistance	220Ω	
Module Dimension (W*H*D)	43mm×67mm×16mm	
Protection class	EN60529 IP20	

7.5 LKA107 Profibus-DP Bus Connector

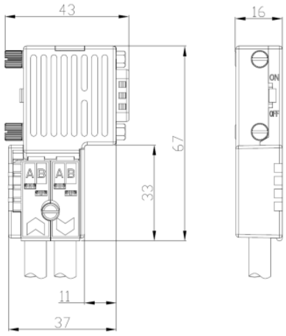
LKA107 is a Profibus-DP bus connector, which transfers the DP signal from the previous backplane to the next backplane, and provides the terminal matching resistance of Profibus-DP bus. Matching resistance is selected by DIP switch. LKA107 is usually used with LK255 module to realize DP signal cascade between main control backplanes.

The DB9 of LKA107 is inserted into LK255 module. DP cable connects two LKA107.

7.5.1 Appearance

External View of LKA107

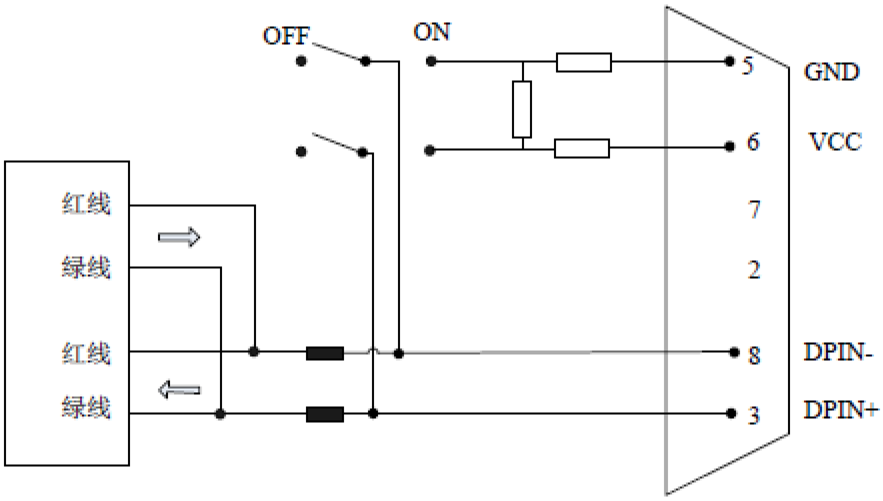
7.5.2 Installation Dimension



Dimension figure of LKA107

7.5.3 Operating Principle

LKA107 is installed on LK255 module and connected with each main control backplane through Profibus-DP bus. The connector selects whether to connect to the terminal matching resistance through the dial switch. One channel of DP input signal is connect to LK255 module through 3 and 8 pins, and the other as output is connected to the next backplane.



LKA107 Schematic Diagram

7.5.4 Terminal matching resistance

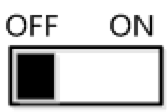
At the terminal node of the DP bus, a matching resistance is bridged over for impedance matching. The node in the middle cannot be connected with a matching resistance.

LK main control backplane side, matching resistance can be provided by LKA107 or LK255 module. The setting principles are as follows:

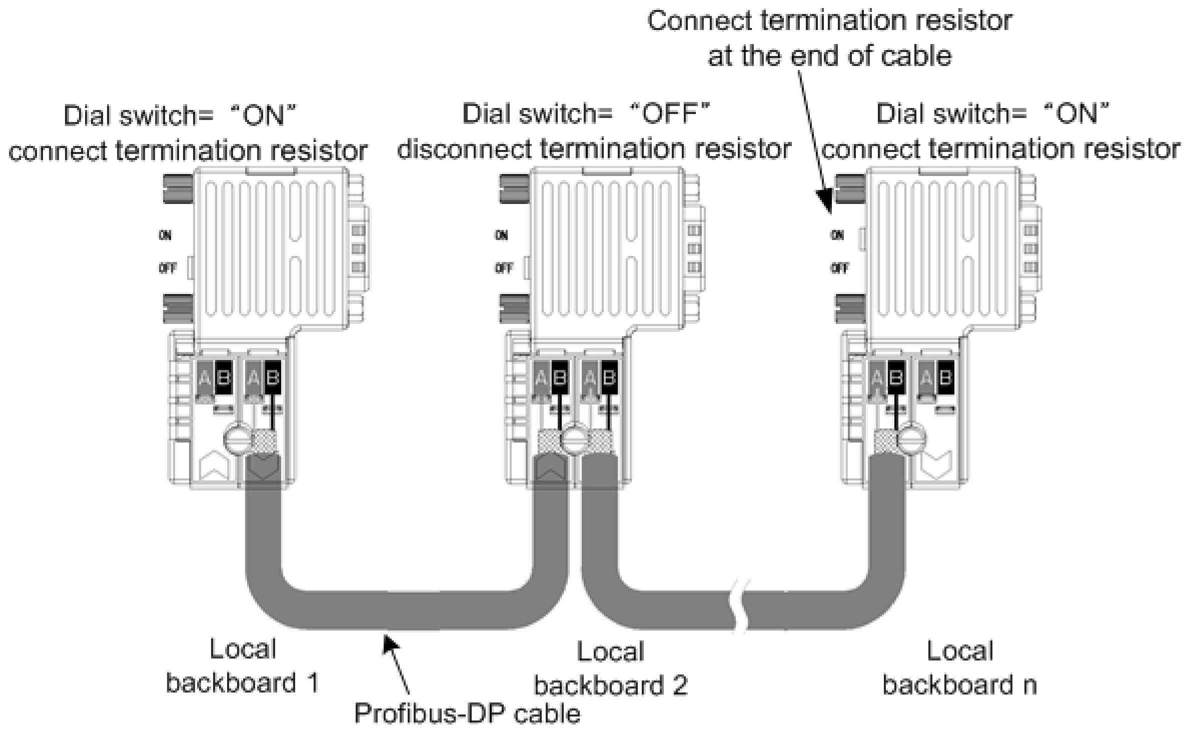
- When the module is located at both ends of DP bus, terminal resistance needs to be set.
- The terminal resistance can not be set repeatedly.

The matching resistance on LKA107 is selected by the DIP switch, which has two positions: ON and OFF, and the default is OFF.

- ON: Connect the matching resistor.
- OFF: Disconnect the matching resistor.



DIP Switch Schematic Diagram



DIP Switch Settings for Backplane Cascade Connection

7.5.5 Wiring

Signal definition of LKA107 as follows:

DP Signal Definition

Cable Identification		Signal Definition
Input wire	Green wire A	DP positive（DPIN+）
	Red wire B	DP negative（DPIN-）
Output wire	Green wire A	DP positive（DPOUT+）
	Red wire B	DP negative（DPOUT-）

See LKA104_wiring for the cable requirements and wiring steps.

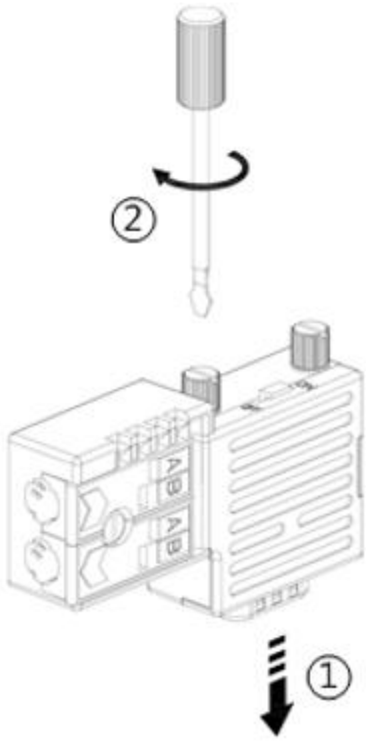
7.5.6 Installation

LKA107 connector is used to realize DP signal cascade between main control backplanes.

The installation steps are as follows:

(1) Insert the DB9 male of LKA107 connector into female socket in the LK255 module.

(2) Tighten the fastening screws of the DB9 with a flat-head screwdriver.



LKA107 Installation Schematic Diagram

7.5.7 Technical specifications

LKA107 Profibus-DP Bus Connector Module		
Connector	D-sub 9 pin	
Cable outer diameter	8mm±0.4mm	
Screw specification	Shell screw	M3, mechanical screw
	DB9 screw	4-40UNC-2A
	Wiring bracket screw	M3, mechanical tooth free screw
Maximum torque（Nm）	Shell screw	0.5Nm
	DB9 screw	0.4Nm
	Wiring bracket screw	0.22~0.25Nm
Cross-sectional area of core	Rigid wire	0.14~1.5mm2
	Flexible wire	0.14~1mm2
AWG	26~16	
Termination resistance	220Ω	
Module Dimension (W*H*D)	43mm×67mm×16mm	
Protection class	EN60529 IP20	

7.6 Optical Fiber

Optical fiber is used to connect the redundancy synchronization module in master/slave frame, two types are provided, length of LKA105 is 5 meters and length of LKA106 is 1 mester, optical fiber schematic diagram as shown in figure.

LKA105 Optical Fiber Diagram

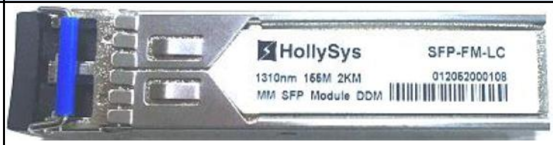
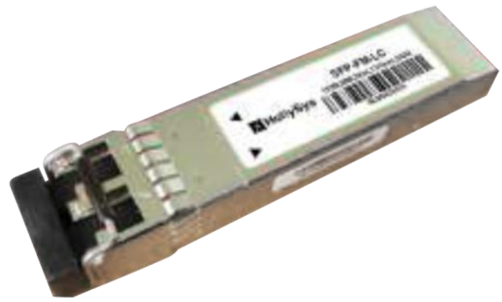
The detailed using refer to Wiring.

7.7 Optical Module

The optical module is installed on optical port of the switch. It is recommended to use the recommended optical module model.

Supported Optical Module Models and Specifications

Optical Module Models	Specifications	Diagram
SFP-FS-LC	Single-mode transceiver ■ Operating data rate up to 155Mbps ■ Wavelength of 1310nm ■ Distance 20km ■ Hot-pluggable	

Optical Module Models	Specifications	Diagram
SFP-FM-LC	Multi-mode transceiver ■ Operating data rate up to 155Mbps ■ Wavelength of 1310nm ■ Distance 2km ■ Hot-pluggable	 
GACS-1312-20ID	Single-mode transceiver ■ Operating data rate up to 1.25Gbps ■ Wavelength of 1310nm ■ Distance 20km ■ Hot-pluggable	
GACS-8512-02ID	Multi-mode transceiver ■ Operating data rate up to 1.25Gbps ■ Wavelength of 850nm ■ Distance 550m ■ Hot-pluggable	

7.8 Prefabricated cable

7.8.1 LKX1030 High density DIO module prefabricated cable

7.8.1.1 Basic feature

LKX1030 is a prefabricated cable for high-density DIO module. One end of the prefabricated cable is a black SCSI plug, which is connected to the IO signal connector interface of the DIO module, and the other end is a 40 core loose wire, which is connected to the field wiring term

Basic feature:

- Applicable to LK616 and LK716 modules
- The cross-sectional area of the internal cable shall comply with AWG24
- The cable sheath is made of grey PVC material with Hollysys logo
- The cable has 40 cores inside and is marked with color ring. The outside is provided with tin foil shielding layer and guide wire
- Net cable length 3000±50mm
- The connector housing is labeled with the cable model number

LKX1030 Cable Diagram

7.8.1.2 Cable color comparison table

1 ~ 16 channels share one group of field power supply, and 17 ~ 32 channels share one group of field power supply. Each group of field power supply has 4 wires, 2 positive and 2 negative, and connected to two groups of power signal terminals.

Comparison table of DIO channel signal and cable core color

Channel number	Cable core color	Channel number	Cable core color
Channel 1	Red on white	Channel 17	Red on green
Channel 2	Yellow on white	Channel 18	Yellow on green
Channel 3	Green on white	Channel 19	Green
Channel 4	Blue on white	Channel 20	Blue on green
Channel 5	Pink on white	Channel 21	Pink on green

Channel number	Cable core color	Channel number	Cable core color
Channel 6	Grey on white	Channel 22	Grey on green
Channel 7	Black on white	Channel 23	Black on green
Channel 8	White	Channel 24	White on green
Channel 9	Red on yellow	Channel 25	Red on blue
Channel 10	yellow	Channel 26	Yellow on blue
Channel 11	Green on yellow	Channel 27	Green on blue
Channel 12	Blue on yellow	Channel 28	Blue
Channel 13	Pink on yellow	Channel 29	Pink on blue
Channel 14	Grey on yellow	Channel 30	Grey on blue
Channel 15	Black on yellow	Channel 31	Black on blue
Channel 16	White on yellow	Channel 32	White on blue
On-site power source 1+	Brown on red	On-site power source 2+	Red
On-site power source 1+	Brown on pink	On-site power source 2+	Pink
On-site power source 1-	Brown on black	On-site power source 2-	Black
On-site power source 1-	Brown on violet	On-site power source 2-	Orange

7.8.2 LKX1130 RTD Modular prefabricated cable

7.8.2.1 Basic feature

LKX1130 is prefabricated cable for RTD module. One end of the prefabricated cable is a black SCSI plug, which is connected to the IO signal connector interface of RTD module, and the other end is a 36 core loose wire, of which 32 cores are connected to the field wiring terminal, and the other 4 cores are reserved and do not need to be connected, and the wire head is insulated.

Basic feature:

- Applicable to LK432 modules
- The cross-sectional area of the internal cable shall comply with AWG24
- The cable sheath is made of grey PVC material with Hollysys logo
- There are 36 cores inside the cable, which are marked with color rings, and there is a woven mesh shielding layer outside
- Net cable length 3000±50mm
- The connector housing is labeled with the cable model number

LKX1130 Cable Diagram

7.8.2.2 Cable color comparison table

The prefabricated cable is 36 core copper wire, of which 32 cores are connected with 4-wire 8-channel thermal resistance analog input signal, and the other 4 cores are reserved without connection, and the wire ends are insulated.

Comparison table of RTD channel signal and cable core color

Channel number	Cable core color	Channel number	Cable core color
Channel 1:A	Red on white	Channel 5:A	Red on green
Channel 1:B	Yellow on white	Channel 5:B	Yellow on green
Channel 1:C	Green on white	Channel 5:C	Green
Channel 1:D	Blue on white	Channel 5:D	Blue on green
Channel 2:A	Pink on white	Channel 6:A	Pink on green
Channel 2:B	Grey on white	Channel 6:B	Grey on green
Channel 2:C	Black on white	Channel 6:C	Black on green
Channel 2:D	White	Channel 6:D	White on green
Channel 3:A	Red on yellow	Channel 7:A	Red on blue
Channel 3:B	yellow	Channel 7:B	Yellow on blue
Channel 3:C	Green on yellow	Channel 7:C	Green on blue
Channel 3:D	Blue on yellow	Channel 7:D	Blue
Channel 4:A	Pink on yellow	Channel 8:A	Pink on blue
Channel 4:B	Grey on yellow	Channel 8:B	Grey on blue
Channel 4:C	Black on yellow	Channel 8:C	Black on blue

Channel number	Cable core color	Channel number	Cable core color
Channel 4:D	White on yellow	Channel 8:D	White on blue
NC1：	Brown on red	NC3：	Red
NC2：	Brown on pink	NC4：	Black

7.8.3 LKX1030L High density DIO module prefabricated cable

7.8.3.1 Basic feature

LKX1030L is a prefabricated cable for high-density DIO module. One end of the prefabricated cable is a black SCSI plug, which is connected to the IO signal connector interface of the DIO module, and the other end is a 40 core cold pressed terminal and number tube, which is connected to the field wiring terminal.

Basic feature:

- Applicable to LK616 and LK716 modules
- The cross-sectional area of the internal cable shall comply with AWG24
- The cable sheath is made of grey PVC material with Hollysys logo
- The cable has 40 cores inside and is marked with color ring. The outside is provided with tin foil shielding layer and guide wire
- Net cable length 3000±50mm
- The connector housing is labeled with the cable model number

LKX1030L Cable Diagram

7.8.3.2 Cable color comparison table

1 ~ 16 channels share one group of field power supply, and 17 ~ 32 channels share one group of field power supply. Each group of field power supply has 4 wires, 2 positive and 2 negative, and connected to two groups of power signal terminals.

Comparison table of DIO channel signal and cable core color

Channel number	Cable core color	Channel number	Cable core color
Channel 1	Yellow CH1	Channel 17	Blue CH17
Channel 2	Yellow CH2	Channel 18	Blue CH18
Channel 3	Yellow CH3	Channel 19	Blue CH19
Channel 4	Yellow CH4	Channel 20	Blue CH20
Channel 5	Yellow CH5	Channel 21	Blue CH21
Channel 6	Yellow CH6	Channel 22	Blue CH22
Channel 7	Yellow CH7	Channel 23	Blue CH23
Channel 8	Yellow CH8	Channel 24	Blue CH24
Channel 9	Yellow CH9	Channel 25	Blue CH25
Channel 10	Yellow CH10	Channel 26	Blue CH26
Channel 11	Yellow CH11	Channel 27	Blue CH27
Channel 12	Yellow CH12	Channel 28	Blue CH28
Channel 13	Yellow CH13	Channel 29	Blue CH29
Channel 14	Yellow CH14	Channel 30	Blue CH30
Channel 15	Yellow CH15	Channel 31	Blue CH31
Channel 16	Yellow CH16	Channel 32	Blue CH32
On-site power source 1+	Red PWR1	On-site power source 2+	Red PWR3
On-site power source 1+	Red PWR2	On-site power source 2+	Red PWR4
On-site power source 1-	Black GND1	On-site power source 2-	Black GND3
On-site power source 1-	Black GND2	On-site power source 2-	Black GND4

7.8.4 LKX1130L RTD Modular prefabricated cable

7.8.4.1 Basic feature

LKX1130L is prefabricated cable for RTD module. One end of the prefabricated cable is a black SCSI plug, which is connected to the IO signal connector interface of RTD module, and the other end is a 36 core cold pressed terminal and number tube, of which 32 cores are connected to the field wiring terminal, and the other 4 cores are reserved and do not need to be connected, and the wire head is insulated.

Basic feature:

- Applicable to LK432 modules
- The cross-sectional area of the internal cable shall comply with AWG24
- The cable sheath is made of grey PVC material with Hollysys logo
- There are 36 cores inside the cable, which are marked with color rings, and there is a woven mesh

shielding layer outside

- Net cable length 3000±50mm
- The connector housing is labeled with the cable model number

LKX1130L Cable Diagram

7.8.4.2 Cable color comparison table

The prefabricated cable is 36 core copper wire, of which 32 cores are connected with 4-wire 8-channel thermal resistance analog input signal, and the other 4 cores are reserved without connection, and the wire ends are insulated.

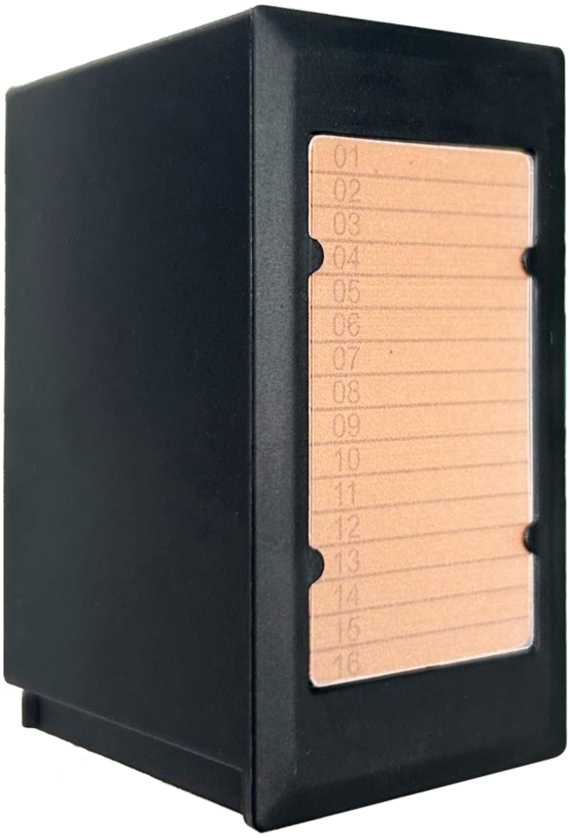
Comparison table of RTD channel signal and cable core color

Channel number	Cable core color	Channel number	Cable core color
Channel 1:A	Black A1	Channel 5:A	Black A5
Channel 1:B	Black B1	Channel 5:B	Black B5
Channel 1:C	Black C1	Channel 5:C	Black C5
Channel 1:D	Black D1	Channel 5:D	Black D5
Channel 2:A	Black A2	Channel 6:A	Black A6
Channel 2:B	Black B2	Channel 6:B	Black B6
Channel 2:C	Black C2	Channel 6:C	Black C6
Channel 2:D	Black D2	Channel 6:D	Black D6
Channel 3:A	Black A3	Channel 7:A	Black A7
Channel 3:B	Black B3	Channel 7:B	Black B7
Channel 3:C	Black C3	Channel 7:C	Black C7
Channel 3:D	Black D3	Channel 7:D	Black D7
Channel 4:A	Black A4	Channel 8:A	Black A8
Channel 4:B	Black B4	Channel 8:B	Black B8
Channel 4:C	Black C4	Channel 8:C	Black C8
Channel 4:D	Black D4	Channel 8:D	Black D8

Channel number	Cable core color	Channel number	Cable core color
NC1：	Black CJ+	NC3：	Black CJ EX+
NC2：	Black CJ-	NC4：	Black CJ EX-

7.9 LKC171 Terminal Cover Plate

The LKC171 is the LK Series Plate Terminal Cover, with only structural members, without templates, for shielding terminals.



LKC171 Terminal Cover Diagram

Chapter 8 Fault and Treatment

8.1 Fault Mechanism

8.1.1 Serious Failures

1. Controller fault

■ Ethernet fault

Dual Ethernet fault causes master-slave switching. During this, fault diagnosis information is reported.

2. System fault

■ Backplane communication fault

When the backplane communication between the master control module and the communication module (except the LK240) is broken, it will cause master-slave switching. During this, the ERR indicator on each module are on, and fault diagnosis information is reported.

■ Pull out the module

Any module in master control backplane is pulled out to cause master-slave switching. This moment, master and slave equipment state is error.

If a master control module is pulled out, first, the master and slave equipment state is error state, then initial state.

■ System power off

Power in master frame is off that will cause master-slave switching.

3. LK249 fault

■ DP link fault

This fault is triggered when all polled slave stations have no response to LK249 in master frame. During this, the ERR indicator on LK249 module are on, and fault diagnosis information is reported. The fault will cause master-slave switching.

4. Power fault

■ LK921 fault

The dual power in LK921 are fault that will cause master-slave switching.

■ Power module fault

Both redundancy power modules are fault to cause master-slave switching.

Suggestion:

This fault can be diagnosed through that the switch output terminal DO +, DO- in the power module is connected to DI module.

5. LK246

■ Ethernet fault

When the network port fault that has been configured in the software occurs, the master-slave switch will be caused, and the ERR indicator will be ON.

6. LK241:

■ Ethernet fault

Dual Ethernet fault causes master-slave switching. During this, fault diagnosis information is reported.

ⓘMaster-slave switching must be carried out in the opposite equipment without serious fault.

8.1.2 General Failures

1. Battery / Capacitance fault

This fault occurs if power in battery/capacitor is low or battery/Capacitor box is not plugged. You need to replace the battery when BAT light in controller module is on.

You need to configure function block sysGetBatteryAlarm (Get Battery Alarm) to obtain the alarm information. Function block refer to the manual *HollySys Programmable Logic Control System Instruction Manual* for details.

2. Power fault

It will not cause master-slave switching that the one power in LK921 is fault. This moment, the one power light is off.

3. Controller fault

■ Ethernet fault

Single Ethernet fault will not cause master-slave switching. This moment, fault diagnosis information is reported.

4. LK249 fault

■ DP link fault

Single DP link fault only reports the diagnosis information, and will not turn off the indicators and master-slave switching.

DP diagnosis information of slave station is not detected.

5. LK240 fault

■ Redundancy fiber fault

This fault occurs if dual fiber are broken and fiber are cross connected. During this, the ERR light on LK240 module is on, and fault diagnosis information is reported. The value of Error pin in the function block sysGetRedState outputs error code at the same time.

When the single fiber is broken, the function block sysGetRedState reports the error code and the ERR light on LK240 module is off.

- A/B switch conflict

It will trigger this fault that LK240 A, B Dail switch is consistent, and the controller is restarted. At this time, the ERR indicator light on LK240 module is on, the two controllers are in a failed state without running.

A/B switch conflict show the different phenomenon in following case.

- □ Slave restart

The ERR indicator on LK240 module which in master and slave frame are red.

This moment, the slave equipment state is fault.

Output parameter ExtDiag [0] in diagnosis function block sysGetComModleDiagInfo (Get Diagnosis of Communication Module) is 1.

- □ Master and slave restart

The ERR indicator on LK240 module which in master and slave frame are red.

This moment, both the master and slave equipment state are fault.

This moment, the master controller is in failed state, unable to view the function block diagnostic information.

6. Data is out of sync between the master and slave

Stop data redundancy between master and slave frame when IEC running cycle not matches with the size of the engineering data area configured. This moment, slave ERR light is on, while, the Error pin in function block sysGetRedState outputs error code.

7. LK241:

- Ethernet fault

Single POWERLINK fault only reports the diagnosis information, and will not cause master-slave switching.

8.2 Troubleshooting Way

When error occurs in LK series redundancy system, you can troubleshoot faults in three ways:

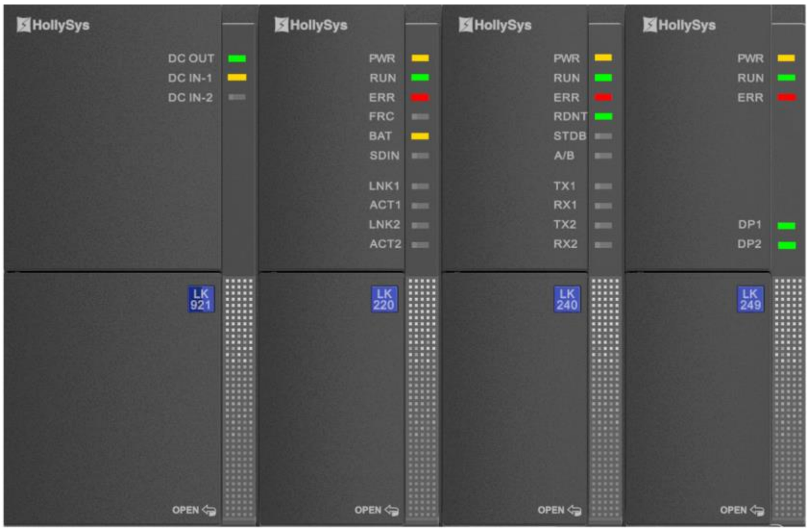
- Check status indicator on the module.
- See the tool [Controller Operation] in AutoThink.

- See the diagnosis information in AutoThink.

8.2.1 Indicator

Check the module status indicator to determine the faulty module when error occurs in redundancy system.

If the ERR indicator is red in any module, you can obtain detailed diagnosis information through viewing the diagnosis function block.



Abnormal Indicator Diagram

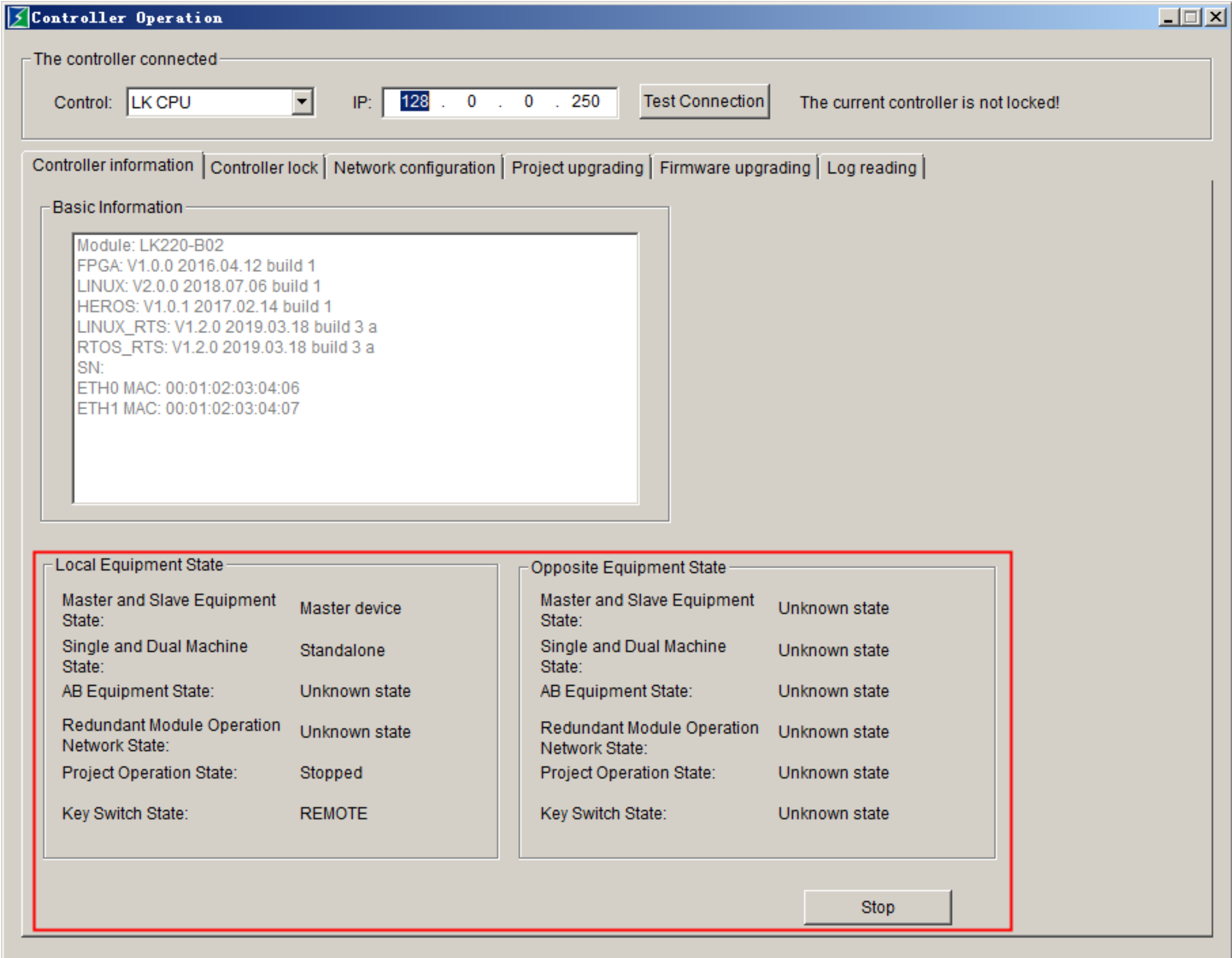
Indicator meaning refer to the specific definition of each module indicators.

8.2.2 View Tool Information

- Tool bar: Click [Tool]-[Assistant tool]-[Controller Operation].

Display the related information of master and slave equipment in [Controller information] tab.

The detailed state information refers to tool in fifth chapter in manual *AutoThink V3.1 User Manual_Project Configuration.*



Master and Slave State

The system is abnormal when the local or opposite equipment appear the following state.

- Master and slave equipment state: Fault state
- Master and slave equipment state: Error state
- Master and slave equipment state: unqualified host
- Any state appears Unknown state or Unknown

8.2.3 View Diagnosis Information

To determine the detailed fault causes of module by diagnosis information and users need to configure the diagnosis function block of each module in the AutoThink.

LK system diagnostic function blocks are divided into the master control module diagnosis, communication module diagnosis and DP slave extension diagnosis. Detailed diagnostic information sees the manual *HollySys Programmable Logic Controller PLC Instruction Manual*.

For diagnosis information of module under LK241, refer to AutoThink diagnostic variable area.

Configurable Diagnosis Function Block

Function Block	Function
sysGetcontrollerDiagInfo (Get Diagnosis of controller)	You can view diagnosis information of master control module .such as ethernet fault information, internal communication link fault information, etc.
sysGetComModleDiagInfo (Get Diagnosis of Communication Module)	You can view diagnosis information of communication module LK249, LK240. Such as fiber disconnection, AB switch conflict, DP link disconnection, etc.
sysGetDPSlaveState (Get Diagnosis of DP Slave)	You can view the diagnosis information of IO slave station. Such as line broken, exceed range, exceed limit,etc.
sysGetDPMasterState (Get Current State of DP Master)	You can view running state of DP master station.
sysGetRedState (Get Redundant State of System)	You can view redundant state between master and slave frame.

8.2.4 Example for Troubleshooting

The following example illustrates the troubleshooting procedure when system is abnormal.

Phenomenon: display that the slave equipment is error state.

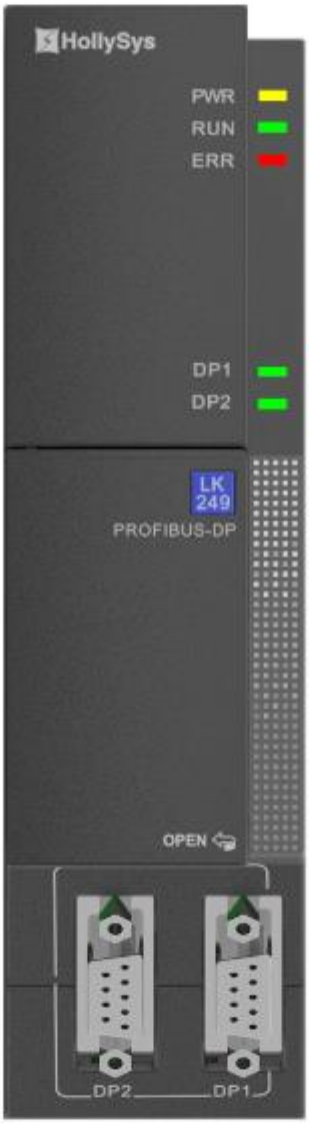
1. View the tool in AutoThink

Via the tool in AutoThink to view and find that master equipment state is normal and slave equipment state is error state, single and dual state is normal, network state is normal, AB equipment state is normal, key switch state is normal, but project operation state of master equipment is running and project operation state of slave equipment is stopping.

2. Check the indicator

Check if there is an abnormal indicator in cabinet.

In master frame, the lights on each module are normal and RUN light on controller is flashing. In slave frame, the ERR light on LK249 is on and RUN light on controller is on, the other lights are normal. Therefore, you can determine that LK249 module were broken.

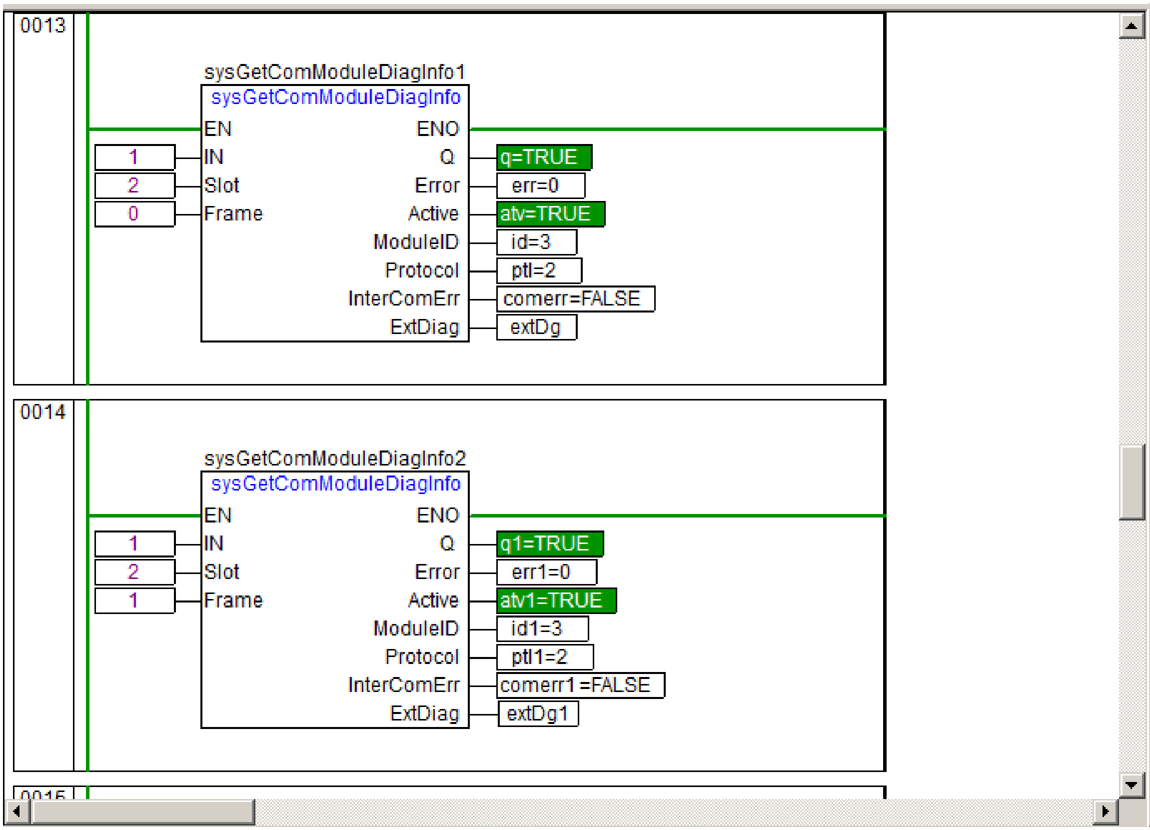


LK249 Status Indicator

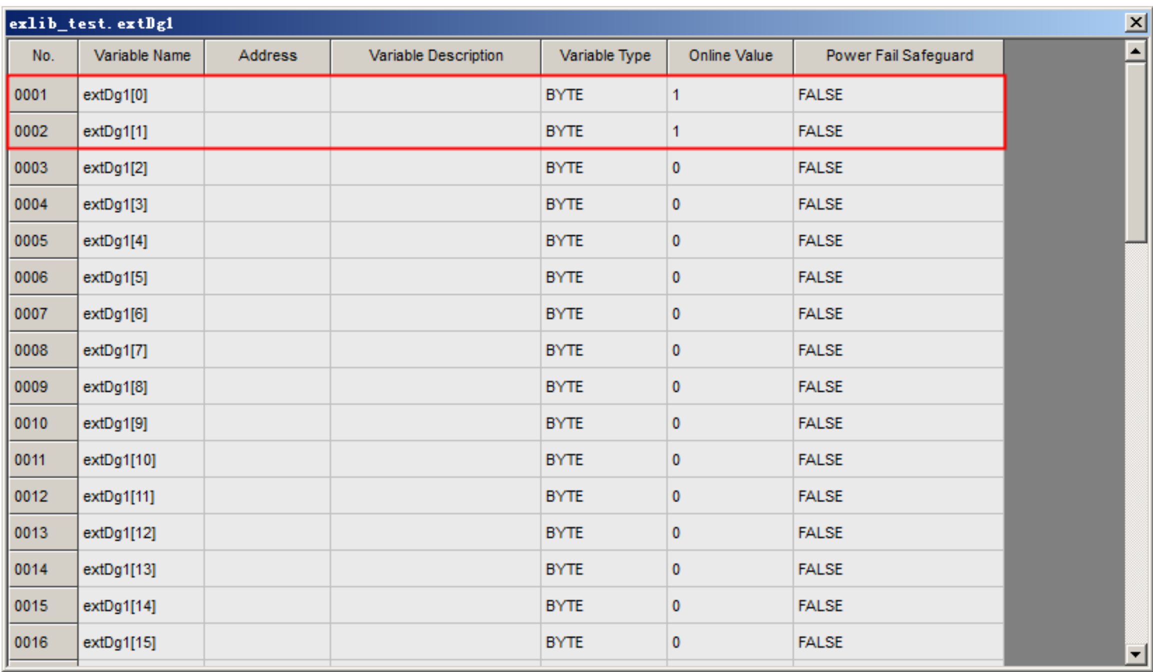
3. View the diagnosis information in AutoThink

Open the AutoThink to view function block sysGetcontrollerDiagInfo (Get Diagnosis of controller) of master/slave controller,and master station function block sysGetDPMasterState (Gets DP master card status), diagnosis output values are normal. Function blocks sysGetDPSlaveState corresponding to each slave station are normal, and communication between master controller and slave controller are normal.

View the function block sysGetComModuleDiagInfo (Get Diagnosis of Communication Module), wherein, Error is 0 to indicate that the block executes and feedback actual results. Active is True to indicate that module is operating normally. ModuleID is 3 to indicate that current module is LK249. Protocol is 2 to indicate that current protocol is DP. InterComErr is 0 to indicate that communication between controller and LK249 is normal. Online values of the forward two bytes in the array variable ExtDiag are 1 to indicate that dual DP links of LK249 in slave frame are broken.



(a)


exlib_test.extDg1

No.	Variable Name	Address	Variable Description	Variable Type	Online Value	Power Fail Safeguard
0001	extDg1[0]			BYTE	1	FALSE
0002	extDg1[1]			BYTE	1	FALSE
0003	extDg1[2]			BYTE	0	FALSE
0004	extDg1[3]			BYTE	0	FALSE
0005	extDg1[4]			BYTE	0	FALSE
0006	extDg1[5]			BYTE	0	FALSE
0007	extDg1[6]			BYTE	0	FALSE
0008	extDg1[7]			BYTE	0	FALSE
0009	extDg1[8]			BYTE	0	FALSE
0010	extDg1[9]			BYTE	0	FALSE
0011	extDg1[10]			BYTE	0	FALSE
0012	extDg1[11]			BYTE	0	FALSE
0013	extDg1[12]			BYTE	0	FALSE
0014	extDg1[13]			BYTE	0	FALSE
0015	extDg1[14]			BYTE	0	FALSE
0016	extDg1[15]			BYTE	0	FALSE

(b)

SysGetComModleDiagInfo Function Block

4. Troubleshooting

(1) Check if the DP cable is plugged well

(2) Check if the DP cable is broken, and replace it

8.3 Fault Phenomenon and Causes

The following are some fault symptoms, possible causes and correction measures.

Fault Symptoms and Possible Causes

Fault symptoms	Causes	Treatment measures
The ERR light of master control module is on	History state is not run : the IEC of master controller was stopping state, and key switch of slave controller in RUN, then the fault is touched off after slave rise to master controller	Dial switch to PRG position
	History state is not run : when the single controller runs normally, and key switch is in RUN, then you pull out the LK240 and plug it again, at this time, ERR lights are on	Dial switch to PRG position
	Internal communication link fault in master control module	Replace the module
	Redundancy link is abnormal	Replace the module and check if redundancy link is normal
The BAT light of master control module is on	Low power	Replace the battery / capacitance box
	The battery / capacitance box is not be plugged in	Check if the battery / capacitance box is plugged well
The ERR light of Slave controller is on	IEC running cycle not matches with the size of the engineering data area configured	1. Increasing task cycle in AutoThink 2. Delete the unused variables to reduce the used data area
The ERR light of LK240 module is on	A、B dial switch conflict	Set the A/B dial switch again
	The dual fiber link is disconnected	1. Check if the fiber is plugged well 2. Check if the fiber is broken 3. Check if the optical fiber plug is intact Re-connect the fiber according to the correct way
	Redundancy fiber is cross-connected	Reconnect the fiber in correct way
	Internal communication link fault in redundancy synchronization module	Replace the module
The ERR light of LK249 module is on	The dual DP link is disconnected	1. Check if the DP cable is plugged well 2. Check if LKA104 Incoming wire, the outgoing wire is well connected 3. Check if the slave address dail switch is correct 4. Check if the DP cable is broken, and replace it
	Internal communication link fault in LK249 module	Replace the module
The ERR light of LK246 module is on	The module has a network port fault	Check whether the network cable connection is normal
The ERR light of LK241 module is on	The module has double network port fault	Check whether the network cable connection is normal

Fault symptoms	Causes	Treatment measures
		Check whether LK235 address rotary code switch is correct Check whether the LK235 network cable connection is normal
The all modules no power in chassis	LK910 power fault	Replace the power module
	Fuse fault	Replace the fuse in power module
	Dual input power is broken in LK921	1. Check if the wiring is connected 2. Check if the cables is broken
The engineering does not run after power up	History without running fault: the IEC of master controller was stopping state, and key switch of slave controller in RUN, then the fault is touched off after slave rise to master controller.	The key switch dial to PRG position
The controller has been in engineering redundancy state	Without engineering in master controller	Re-download the project
	Flash space in controller is insufficient	Clear the flash or contact the factory The power must be turned off to restart after clearing the flash
The controller is error state in tool	The dual DP link is disconnected	Refer to treatment measures about "The ERR lights of LK249 module is on "
	Dual Ethernet disconnection	1. Check if the Ethernet cable is plugged well 2. Check if the Ethernet cable is disconnected
	Backplane communication fault between the master control module and the communication module	Replace the module
	Any module in master control backplane is pulled out	Check whether module is plugged well
The controller is fault state in tool	A/B switch conflict	Set the A/B dial switch again
The master equipment state is normal, and slave equipment state is fault state	The dual fiber link is disconnected	Refer to treatment measures about "The ERR lights of LK240 module is on" This moment, you need to view state information of master equipment or slave equipment separately in AutoThink
The controller is unknown state in tool	Redundancy fiber communication is disconnected	1. Check if the fiber is plugged well 2. Check if the fiber is broken and replace
The controller is unqualified master equipment in tool	Controller that redundancy was not completed last time is unqualified master equipment after power up	1. Reset by the key switch 2. Click **Clear** button in AutoThink assistant tool-[Controller Operation]–[Controller information] tab 3. Restart
DP slave station is offline	Configuration in software not match with hardware configuration	View if the slave station address configured is consistent with the actual hardware address
	DP link fault	Refer to treatment measures about "The ERR lights of LK249 module is on"
	No master controller in current system	Refer to treatment measures about controller is error state, controller is fault state
	Communication switching module fault	Replace the module
Master –slave switching	Dual Ethernet disconnection	Refer to treatment measures about "The ERR lights of master control

Fault symptoms	Causes	Treatment measures
		module is on"
	The dual DP link is broken	Refer to treatment measures about "The ERR lights of LK249 module is on "
	Power fault	1. Check if the power fuse in LK910 is normal 2. Check if two-input wire of LK921 is connected well
	Any module is pulled out in backplane	The module is plugged again
	Redundancy LK910 module fault	Replace the power module
	Backplane communication fault	Replace the module
RTC time is restored to the default value after power up	The power of the battery / capacitance box is low	Refer to treatment measures about "The BAT lights of master control module is on"
	The battery / capacitance box is not be plugged in	
Unable to establish an Ethernet communication connection	Without restarting after setting IP address	Restart the controller to make IP settings effective
	Ethernet link fault	1. Check if the Ethernet cable is plugged well 2. Check if the Ethernet cable is disconnected
Unable to download the controller	Ethernet communication connection fault	Refer to treatment measures about "Unable to establish a Ethernet communication connection"
	Assistant tool is running	Exit from the assistant tool
Unable to establish a ModbusTCP communication connection	Slave controller is connect to Modbus communication	IP address is modified to IP address of master controller

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Beijing HollySys Intelligent Technologies Co., Ltd..

Di Sheng Middle Road, No.2

Economic-Technological Development Area

100176 Beijing, China

Tel: 010-5898 1588

Hotline: 4008111999

Fax: 010-5898 1558

http://www.hollysys.com