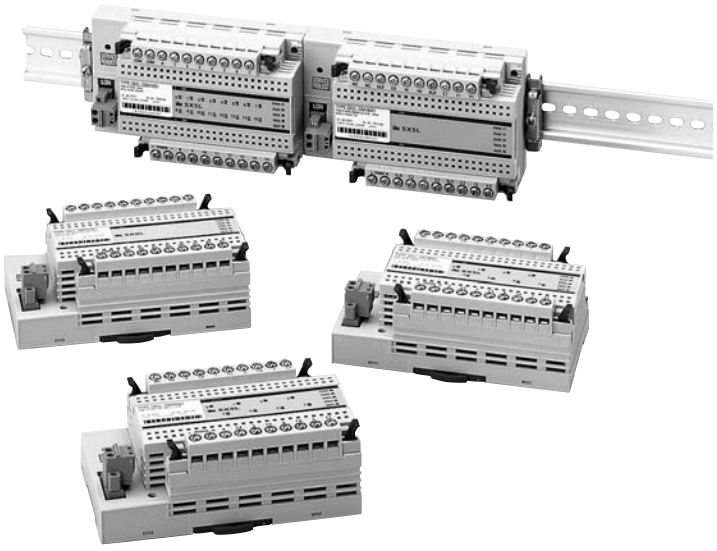
SX9Z-B801-01

SX5L SERIES

LONWORKS®
Communication Terminals

LONMARK® PARTNER

User's Manual



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SAFETY PRECAUTIONS

- Read this user's manual to make sure of correct operation before starting installation, wiring, operation, maintenance, and inspection of the SX5L communication terminals.
- All SX5L modules are manufactured under IDEC's rigorous quality control system, but users must add a backup or failsafe provision to the control system using the SX5L in applications where heavy damage or personal injury may be caused in case the SX5L should fail.
- In this user's manual, safety precautions are categorized in order of importance to Warning and Caution:

⚠ Warning **Warning notices are used to emphasize that improper operation may cause severe personal injury or death.**

- Turn off the power to the SX5L before starting installation, removal, wiring, maintenance, and inspection of the SX5L. Failure to turn power off may cause electrical shocks or fire hazard.
- Special expertise is required to install, wire, program, and operate the SX5L. People without such expertise must not use the SX5L.
- Emergency stop and interlocking circuits must be configured outside the SX5L. If such a circuit is configured inside the SX5L, failure of the SX5L may cause disorder of the control system, damage, or accidents.

⚠ Caution **Caution notices are used where inattention might cause personal injury or damage to equipment.**

- Install the SX5L according to the instructions described in this user's manual. Improper installation will result in falling, failure, or malfunction of the SX5L.
- The SX5L is designed for installation in a cabinet. Do not install the SX5L outside a cabinet.
- Install the SX5L in environments described in this user's manual. If the SX5L is used in places where the SX5L is subjected to high-temperature, high-humidity, condensation, corrosive gases, excessive vibrations, and excessive shocks, then electrical shocks, fire hazard, or malfunction will result.
- The environment for using the SX5L is "Pollution degree 2." Use the SX5L in environments of pollution degree 2 (according to IEC 60664-1).
- Prevent the SX5L from falling while moving or transporting the SX5L, otherwise damage or malfunction of the SX5L will result.
- Prevent metal fragments and pieces of wire from dropping inside the SX5L housing. Put a cover on the SX5L modules during installation and wiring. Ingress of such fragments and chips may cause fire hazard, damage, or malfunction.
- Make sure of safety before starting and stopping the SX5L or when operating the SX5L to force outputs on or off. Incorrect operation on the SX5L may cause machine damage or accidents.
- Connect a protective ground to the cabinet containing the SX5L using a wire of UL1007 AWG16 (grounding resistance 100Ω maximum).
- Do not disassemble, repair, or modify the SX5L modules.
- When disposing of the SX5L, do so as an industrial waste.

IMPORTANT INFORMATION

Under no circumstances shall IDEC Corporation be held liable or responsible for indirect or consequential damages resulting from the use of or the application of IDEC SX5L communication terminals, individually or in combination with other equipment.

All persons using these components must be willing to accept responsibility for choosing the correct component to suit their application and for choosing an application appropriate for the component, individually or in combination with other equipment.

All diagrams and examples in this manual are for illustrative purposes only. In no way does including these diagrams and examples in this manual constitute a guarantee as to their suitability for any specific application. To test and approve all programs, prior to installation, is the responsibility of the end user.

About This Manual

This user's manual primarily describes hardware and software specifications of the SX5L communication terminals, installation and wiring methods, and troubleshooting procedures.

CHAPTER 1: GENERAL INFORMATION

General information about the LONWORKS network system and the features and functions of the SX5L communication terminals.

CHAPTER 2: HARDWARE SPECIFICATIONS

Hardware specifications of the SX5L communication terminals.

CHAPTER 3: INSTALLATION AND WIRING

Methods and precautions for installing and wiring the SX5L communication terminals.

CHAPTER 4: SOFTWARE SPECIFICATIONS

Software specifications of the SX5L communication terminals. Designing a LONWORKS network requires complete understanding of the functional blocks available on each SX5L communication terminal. Before starting system configuration, read this chapter to understand available functional blocks.

CHAPTER 5: TROUBLESHOOTING

Procedure to determine the cause of trouble and actions to be taken when any trouble occurs while operating the SX5L communication terminals.

APPENDIX

Type numbers of the SX5L communication terminals and accessories, and a glossary of major terms related to LONWORKS.

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Alphabetical listing of key words.

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CHAPTER 5: TROUBLESHOOTING

APPENDIX

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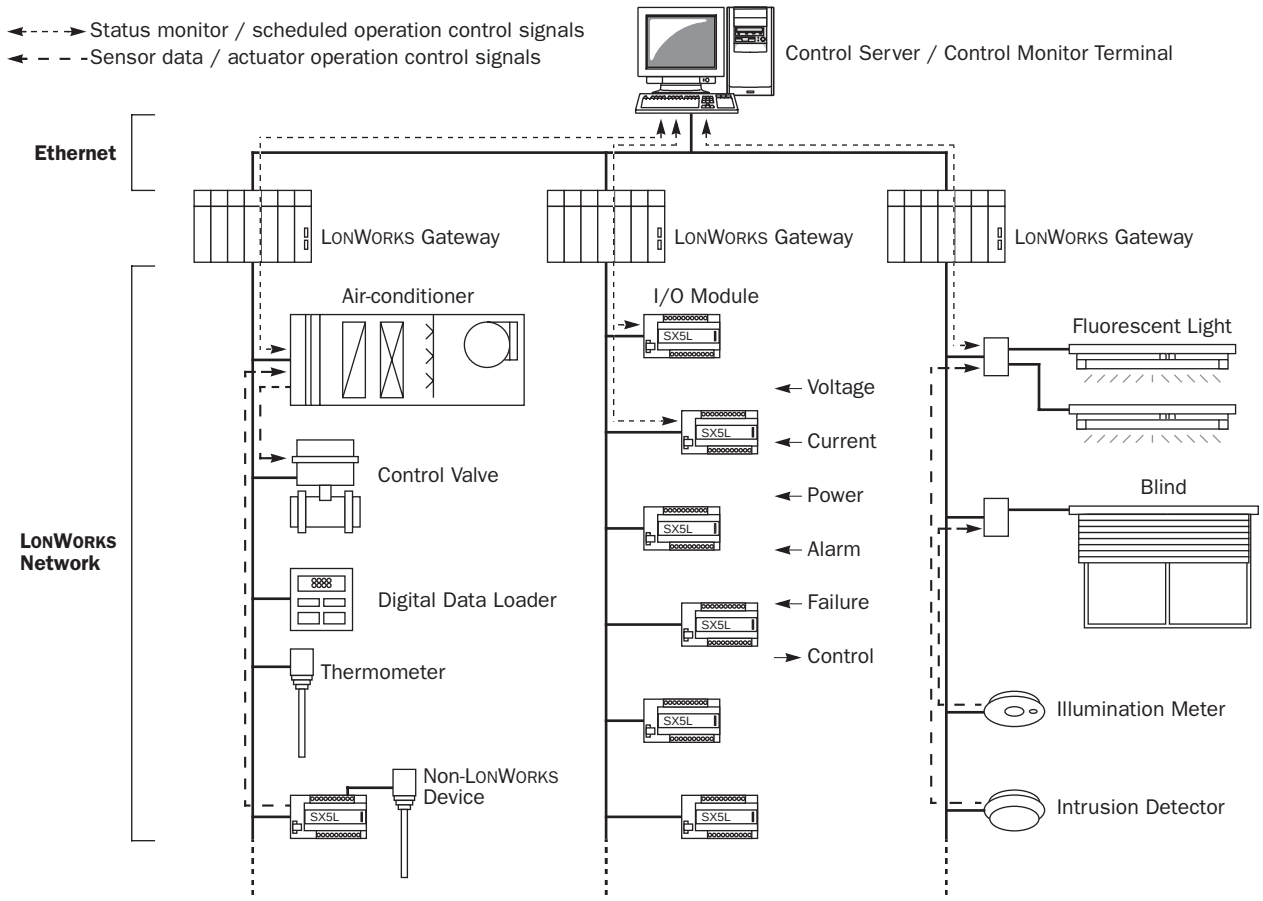
1: GENERAL INFORMATION

Introduction

This chapter describes general information about the LONWORKS network system and provides the features and functions of the SX5L communication terminals.

LONWORKS Network

LONWORKS refers to the whole multi-purpose network technology developed by Echelon Corporation to provide solutions for building and home automation, industrial, transportation, and public utility control networks. LONWORKS is a field-level open network that enables to build open, multi-vendor control systems of the peer-to-peer distributed control configuration.



Example of LONWORKS Network for Building Automation (BA)

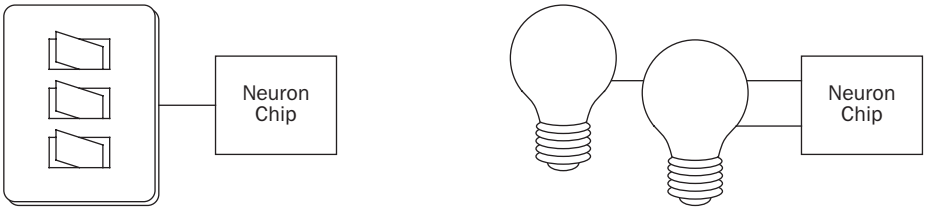
In the above control system, LONWORKS devices are connected to the LONWORKS network, such as air-conditioner, control valve, digital data loader, thermometer, fluorescent light, blind, illumination meter, intrusion detector as well as SX5L communication terminals. These LONWORKS devices contain a microprocessor called Neuron Chip and a LONWORKS transceiver to communicate with other devices using the LonTalk protocol.

In the centralized control system, the network consists of one host controller, such as a PLC or computer, and multiple terminals, such as sensors and actuators, connected in the 1:N configuration. The host takes care of almost all processing for intended control operations while terminals work as instructed by the host through the network communication. Therefore, the host alone contains the control program and network settings.

In contrast to the centralized control system, LONWORKS is a distributed control system with each device containing an application program. Operation of each device can be programmed by changing configuration parameters. The destination and contents of communication can be designated for each device using a network management tool.

LONWORKS Device and Functional Block

The following figure illustrates examples of LONWORKS devices. Device A consists of switches to send the ON/OFF status signals of three switches to the network when they are operated. Device B consists of two lamps which go on or off when receiving ON/OFF signals from the network.

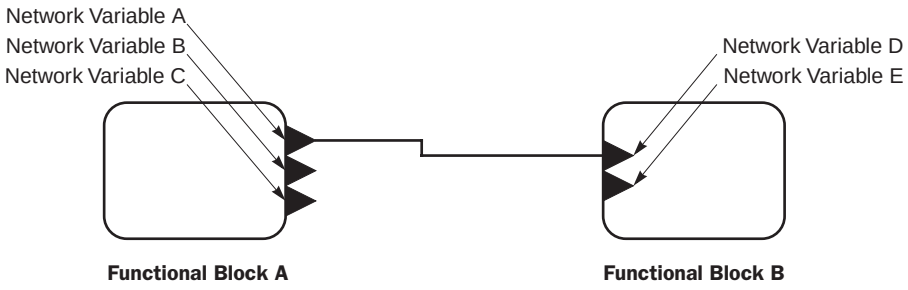


Example of LONWORKS Devices

The intended operation programmed in the LONWORKS device is represented by a functional block. The interface with the network to send the operation results and receive commands is the network variable.

In the next figure, the operation performed by device A is represented by functional block A, which contains three network variables to send the statuses of three switches. The operation performed by device B is represented by functional block B, which has two network variables to receive commands to turn on and off the lamps. Network variables to send data are called output network variables, and those to receive data are input network variables.

When network variable D is designated as the destination of network variable A, it is made possible for the device A switches to turn on or off the device B lamps. This procedure is called binding.



Example of Functional Blocks

Standard Network Variable Type and Standard Configuration Property Type

As shown in the figure of the example of LONWORKS Network on the preceding page, the LONWORKS network can deal with various types of data in addition to ON/OFF statuses, such as angle, temperature, illuminance, voltage, and current. Unlike other field-level networks which transmit data without physical units, LONWORKS can send data with physical units. The LONMARK Interoperability Association defines Standard Network Variable Types (SNVTs) to facilitate interoperability by providing a well-defined interface for communication between devices made by different manufacturers. The association also defines Standard Configuration Property Types (SCPTs) to further facilitate interoperability by providing a well-defined compact mechanism for handling large amounts of configuration information on a device

Address and Table

The LonTalk protocol usually uses a combination of domain ID, subnet ID, and node ID to identify the address of the receiving device. Each LONWORKS device has a domain table to store its address (source address) and an address table to store the addresses to send data to (destination addresses). All SX5L communication terminals can store 2 addresses in the domain table and 15 addresses in the address table, or the maximum quantities allowed for a LONWORKS device.

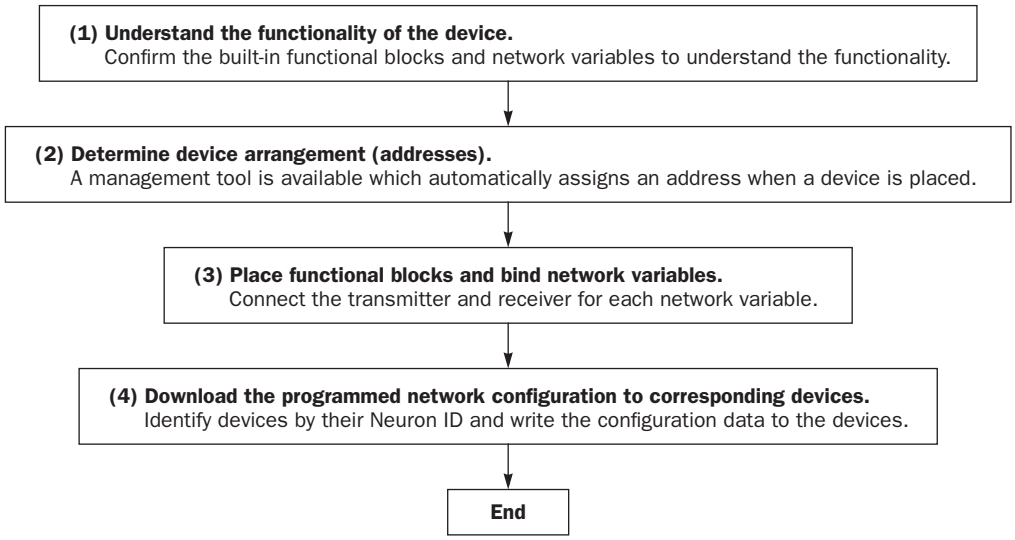
To identify each network variable contained in a LONWORKS device, each network variable is assigned an address called selector address. Mutually bound network variables are assigned the same selector address. When the value of a network variable is sent to multiple network variables, the network variable of the transmitting device sometimes require another

place, called an alias table, to store the second and subsequent selector addresses. The allowable quantity of selector address entries for the alias table depends on the type of the device. The maximum quantity is 62 according to the LONWORKS specifications. For the quantity of address table entries of the SX5L, see page 4-1.

When using the LonMaker Integration Tool for binding, the tool automatically assigns the selector addresses. Therefore, users do not have to consider the selector addresses. However, if the device use up the alias table and more binding is attempted, the tool indicates an error. The network must be designed to keep the selector address quantity within the alias table entry capacity.

Network Building Procedures

A network management tool is needed to build a LONWORKS network. The most widely used tool is the LonMaker Integration Tool from Echelon. The basic procedures are illustrated below. For detailed procedures, see the user's manual for each tool you use.



Network Building Procedures

(1) Understand the functionality of the device.

Before proceeding with building the network, it is necessary to understand the types and quantities of functional blocks contained in the device you are using, the details of the functionality, and the network variables. For details about the functional blocks contained in the SX5L, see Chapter 4: Software Specifications.

(2) Determine device arrangement (addresses).

From this step, a network management tool is used. The LONWORKS network identifies the logical location of a device by its domain ID, subnet ID, and node ID. The LonMaker Integration Tool automatically assigns these three IDs when a device symbol is placed on the data base. For step (2) and after, the information about the device must be sent to the network management tool. One method is using a XIF file, and another is uploading from the device through the network.

(3) Place functional blocks and bind network variables.

As shown in the figure of functional blocks on the preceding page, bind network variables as many as required for the entire network. Generally, steps (2) and (3) are performed offline.

(4) Download the programmed network configuration to corresponding devices.

Connect the network management tool to the network, and download the information concerning addresses and binding specified in steps (2) and (3) to each LONWORKS device through the network. Then use the Neuron ID (hexadecimal 12-digit number) contained in the Neuron Chip to identify the download destination device. The SX5L communication terminal is attached with a label indicating the Neuron ID. The Neuron ID can also be sent to the network by pressing the SERVICE REQUEST button on the SX5L.

SX5L Communication Terminal Models and Features

The SX5L is a terminal block type LONWORKS I/O device available in a variety of models designed for multi-vendor building automation and industrial control networks.

All SX5L communication terminals contain Standard Network Variable Types (SNVTs) defined by the LONMARK Interoperability Association.

Output network variables can be made to be sent only when the input status changes in order to reduce the network traffic, and also can be made to be sent at regular intervals (heartbeat) while the input status does not change.

When the network is powered up, each node sends the initial values of the output network variables at different timing.

Digital Input, Output, and I/O Modules

- 16 inputs, 16 outputs, or 8 in/8 out
- Start/stop control module is also available with 8 inputs and 8 outputs.
- Contains virtual I/O functional blocks which can be used for Boolean operation (AND, OR, NOT) on bit data and for enabling/disabling output network variables.
- Power voltage 24V DC

Analog Input Module

- 4 analog input channels for 1 to 5V and 4 to 20 mA DC inputs
- Network variable types can be changed to meet the unit of analog input data.
- Power voltage 24V AC/DC

Pt100Ω Input Module

- 4 input channels for room temperature control (0 to +50°C)
- 4 input channels for water temperature control (–20 to +80°C)
- Power voltage 24V AC/DC

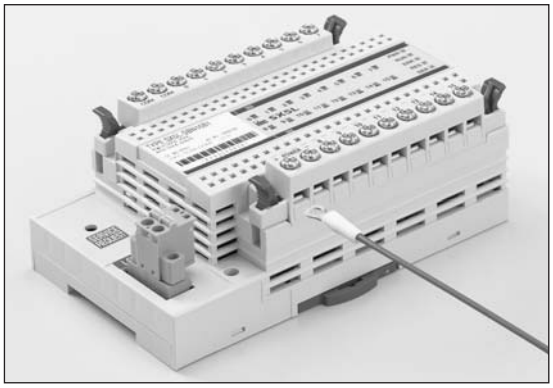
Pulse Input Module

- 8 inputs for counting input pulses of minimum pulse width 50 ms
- Maintains counter current values when power is interrupted.
- Counter current values can be changed by input variable.
- Power voltage 24V AC/DC

Remote-control Relay Control Module

- Controls 8 remote control relays for fluorescent lamps.
- Remote-control relays on existing illumination system can also be controlled.
- Power voltage 24V AC

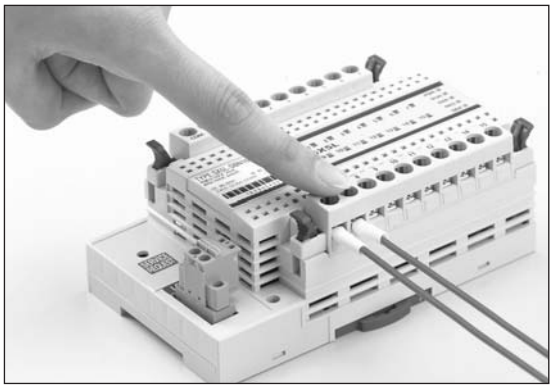
Finger-safe Spring-up Terminal Block Features



Time saving

The innovative terminals on the SX5L series use special, spring-loaded screws. This makes installation as easy as pushing down and turning with a screwdriver. Installation time is cut in half since the screws do not need to be backed out to install wiring.

Screw terminals accept bare wire or ring or spade connectors.

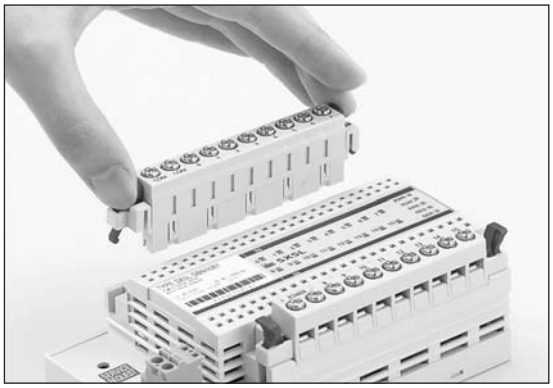


Finger-safe

The screws are held captive once installed and are 100% finger-safe.

1. Insert the wire connector into the slot in the side of the terminal block.
2. Using a Phillips screwdriver, push down and turn the screw.

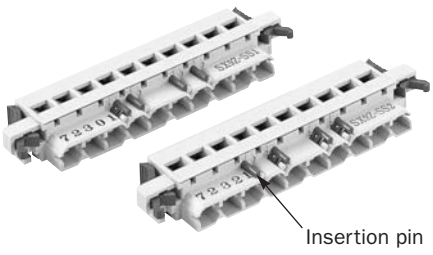
The wire is now connected, and the screw terminal is finger-safe.



Detachable

The terminal block can be removed simply by squeezing both latches on top of the block inward to unlock the block from the socket. To reattach the terminal block, place the block in the socket with the latches opened and press the block until it bottoms in the socket, then the latches snap outward to lock the terminal block.

Wiring can be done with the terminal block removed, so installation in narrow areas is quite easy. When replacing the SX5L modules, simply remove the terminal blocks and reinstall the terminal blocks into the new SX5L module, without disconnecting wires.



Insertion pins

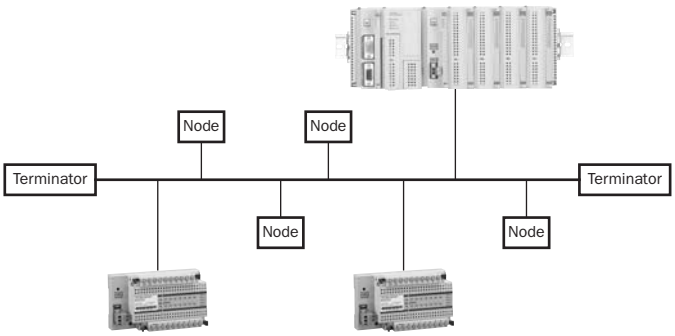
Insertion pins are positioned on the base of the terminal block and inside the socket to prevent insertion of invalid terminal blocks into the socket. The pins are keyed to make sure of correct matching of terminal block and socket, and to prevent swapping of upper and lower terminal block.

System Setup Examples

Bus Topology

Nodes are connected to one trunk line. The trunk line can be extended up to 1,400 meters.

Terminators are needed at both ends of the network.

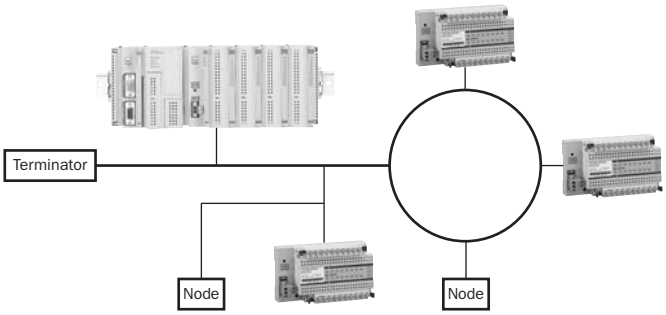


Maximum trunk cable length: 1,400 meters

Free Topology

The network can also be connected in star, loop, bus, and combination of these configurations. The network can be expanded and modified flexibly.

One terminator is needed at any place on the network.

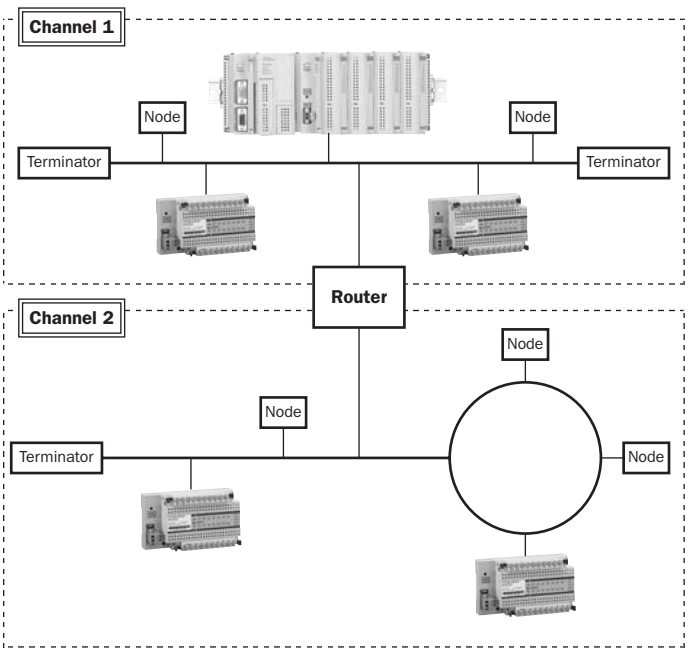


Maximum total cable length: 500 meters
Maximum distance between nodes: 400 meters

Quantity of Nodes (FTT-10A Transceiver Nodes)

A maximum of 64 nodes can be connected to one channel. When connecting more than 64 nodes, a router or repeater is needed.

One router is regarded as one node. Consequently, when using one router, the maximum number of nodes connected to one channel will reduce to 63.

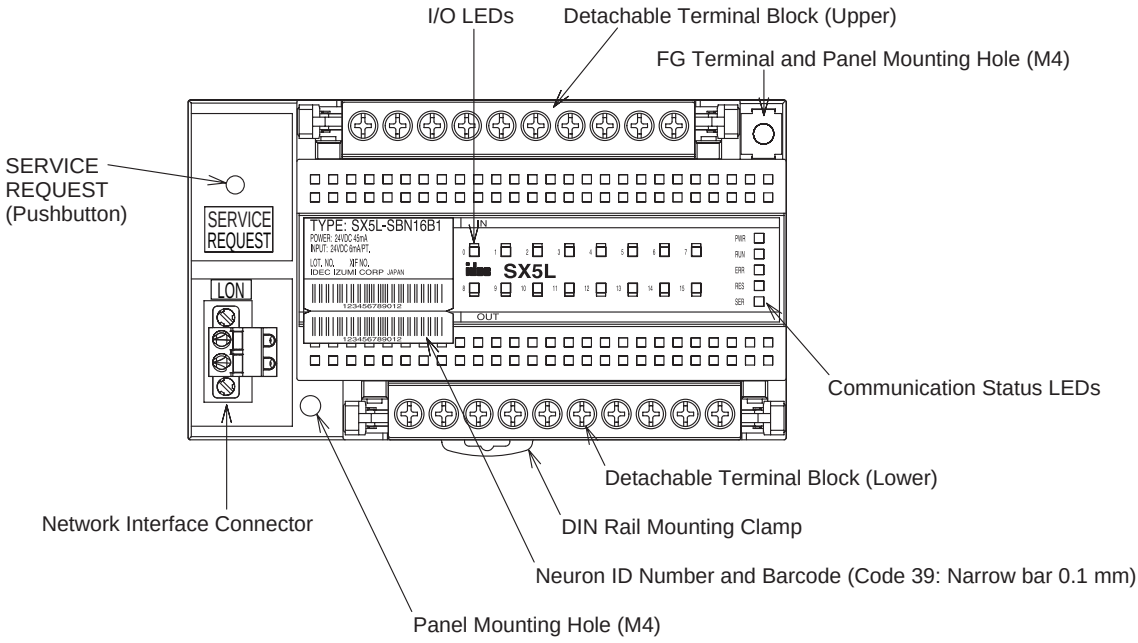


2: HARDWARE SPECIFICATIONS

Introduction

This chapter describes hardware specifications of the SX5L communication terminals.

Parts Description

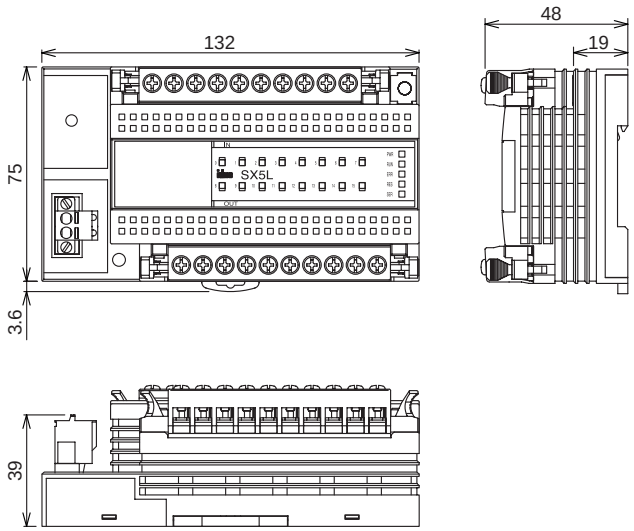


Communication Status LEDs

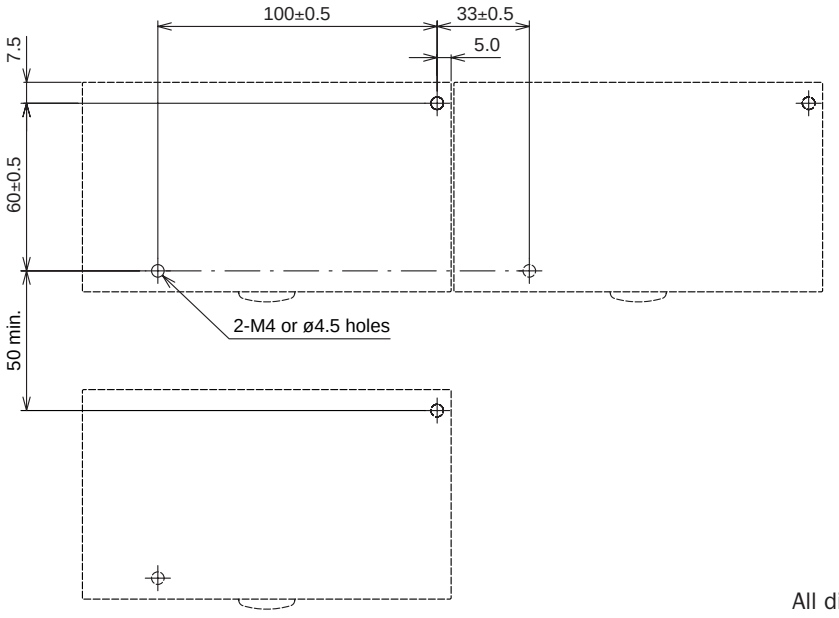
Name	Color	Description
PWR	Green	Remains on while power is supplied.
RUN	Green	Goes on when, after powerup, self-diagnosis has completed and application starts.
ERR	Red	Goes on when, after application has started, output network variable update failed. Goes off when output network variable is updated successfully.
RES	—	Reserved (does not go on)
SER	Yellow	Goes on when application program is not configured yet. Flashes when network information is not configured yet.

Dimensions

All SX5L modules has the same external demensions.



Mounting Hole Layout



All dimensions in mm.

Hardware Common Specifications

Communication Specifications

Communication System		LON® system
Transceiver		FTT-10A
Connection Topology		Bus topology, free topology
Transmission Speed		78 Kbps
Transmission Distance	Bus Topology	1,400m (when using only FTT-10A transceivers) (Level 4, AWG22 cable)
	Free Topology	500m total, 400m between nodes (Level 4, AWG22 cable)
Neuron Chip		TMPN3120FE5M (Toshiba)

Detachable Finger-safe Terminal Block

Rated Insulation Voltage	250V
Terminal Screw	M3 (on 7.62-mm centers)
No. of Poles	10 poles
Rated Thermal Current	7A
Insertion/Removal Durability	100 times

Network Interface Connector

	Receptacle in Module Housing	Connector for Cable
Phoenix Contact Type No.	MSTBV2.5/2-GF-5.08	FKC2.5/2-STF-5.08
IDEC Type No.	—	SX9Z-CN23
Insertion/Removal Durability	100 times	

Digital Input Module SX5L-SBN16B1

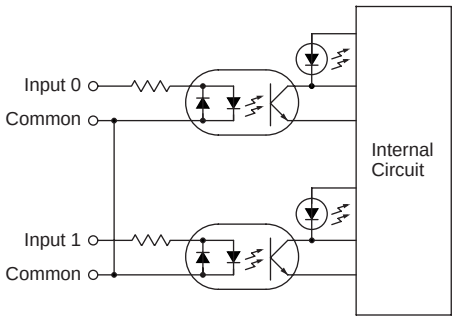
General Specifications

Rated Power Voltage	24V DC
Power Voltage Range	21.6 to 26.4V DC (including 5% ripple)
Power Consumption	1.0W (24V DC)
Power Inrush Current	3A maximum (24V DC)
Allowable Momentary Power Interruption	10 ms minimum (at the rated power voltage)
Dielectric Strength	1,000V AC, 1 minute between power and FG terminals
Insulation Resistance	100 MΩ minimum between power and FG terminals (500V DC megger)
Operating Temperature	0 to 55°C (no freezing)
Operating Humidity	30 to 90% RH (non-condensing)
Storage Temperature	–20 to +75°C (no freezing)
Storage Humidity	30 to 90% RH (non-condensing)
Pollution Degree	2 (IEC 60664)
Corrosion Immunity	Atmosphere free from corrosive gases
Altitude	Operation: 0 to 2,000m Transport: 0 to 3,000m
Vibration Resistance	10 to 57 Hz amplitude 0.075 mm, 57 to 150 Hz acceleration 9.8 m/s^2 2 hours per axis on each of three mutually perpendicular axes
Shock Resistance	294 m/s^2, 11-ms sinusoidal half-wave pulse
Mounting	35-mm-wide DIN rail, direct panel mounting (M4 mounting screws)
Weight (approx.)	240g

Digital Input Specifications

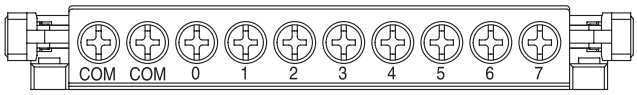
Input Points	16 points
Input Type	No-voltage input (DC 2-wire sensor, 3-wire sensor, no-voltage contact)
Rated Input Voltage	24V DC
Input Voltage Range	0 to 26.4V DC
Input Impedance	Approx. 4.0 kΩ
Input Current	6 mA/point (24V DC)
No. of Common Circuits	1
Input Common Polarity	Plus and minus common compatible
Input Delay Time	250 ms
Input Turn ON Voltage	15V minimum (between input and COM terminals)
Input Turn OFF Voltage	5V maximum (between input and COM terminals)
Input OFF Current	1 mA maximum
Isolation from Power Line	Photocoupler isolation
Dielectric Strength	500V AC, 1 minute between input and FG terminals 500V AC, 1 minute between input and power terminals
Insulation Resistance	100 MΩ minimum between input and FG terminals (500V DC megger) 100 MΩ minimum between input and power terminals (500V DC megger)

Input Internal Circuit

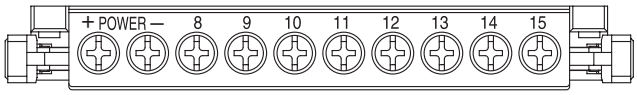


Terminal Arrangement

• Upper Terminal Block (SX9Z-SS10)

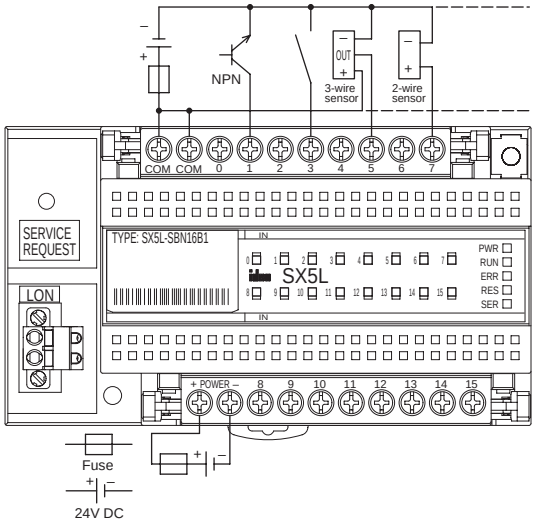
Marking	COM	COM	0	1	2	3	4	5	6	7
Name	Input Common		Input 0	Input 1	Input 2	Input 3	Input 4	Input 5	Input 6	Input 7
Front View										

• Lower Terminal Block (SX9Z-SS2)

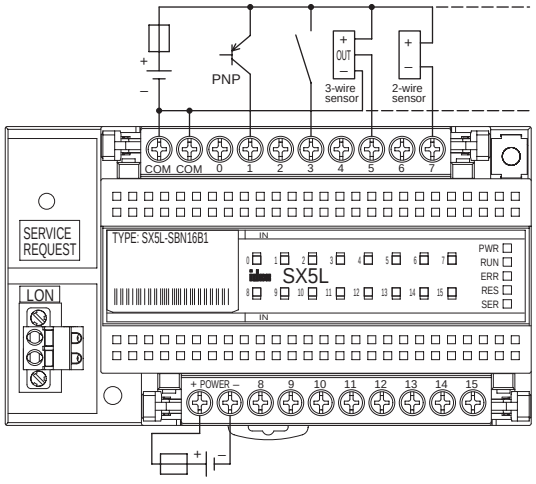
Marking	POWER +	POWER –	8	9	10	11	12	13	14	15
Name	Power Voltage		Input 8	Input 9	Input 10	Input 11	Input 12	Input 13	Input 14	Input 15
	24V DC	0V								
Front View										

Wiring Examples

• Minus Common Wiring



• Plus Common Wiring



Note: The internal circuit and input circuit can be powered by the same power supply. Two COM terminals are connected together internally.

Digital Output Modules SX5L-SBT16K1 / SX5L-SBT16S1

General Specifications

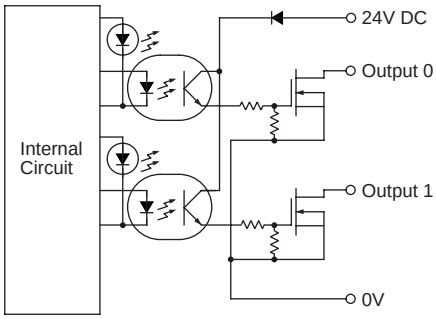
Rated Power Voltage	24V DC
Power Voltage Range	21.6 to 26.4V DC (including 5% ripple)
Power Consumption	1.2W (24V DC)
Power Inrush Current	3A maximum (24V DC)
Allowable Momentary Power Interruption	10 ms minimum (at the rated power voltage)
Dielectric Strength	1,000V AC, 1 minute between power and FG terminals
Insulation Resistance	100 MΩ minimum between power and FG terminals (500V DC megger)
Operating Temperature	0 to 55°C (no freezing)
Operating Humidity	30 to 90% RH (non-condensing)
Storage Temperature	–20 to +75°C (no freezing)
Storage Humidity	30 to 90% RH (non-condensing)
Pollution Degree	2 (IEC 60664)
Corrosion Immunity	Atmosphere free from corrosive gases
Altitude	Operation: 0 to 2,000m Transport: 0 to 3,000m
Vibration Resistance	10 to 57 Hz amplitude 0.075 mm, 57 to 150 Hz acceleration 9.8 m/s^2 2 hours per axis on each of three mutually perpendicular axes
Shock Resistance	294 m/s^2, 11-ms sinusoidal half-wave pulse
Mounting	35-mm-wide DIN rail, direct panel mounting (M4 mounting screws)
Weight (approx.)	240g

Transistor Output Specifications

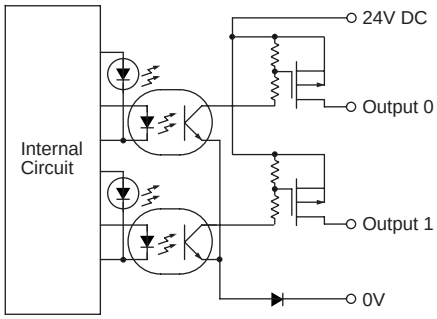
Type No.	SX5L-SBT16K1	SX5L-SBT16S1
Output Points	16 points	
Output Type	N-MOS open drain (NPN transistor output)	P-MOS open drain (PNP transistor output)
Rated Load Voltage	24V DC	
Load Voltage Range	21.6 to 26.4V DC	
Maximum Load Current	500 mA per point 6A per common line	
Output Common Polarity	Plus common	Minus common
Voltage Drop (ON Voltage)	0.8V maximum (voltage between the power – terminal and output terminals when output is on)	0.8V maximum (voltage between the power + terminal and output terminals when output is on)
Leakage Current	1 mA maximum	
Isolation from Power Line	Photocoupler isolation	
Dielectric Strength	500V AC, 1 minute between output and FG terminals 500V AC, 1 minute between output and power terminals	
Insulation Resistance	100 MΩ minimum between output and FG terminals (500V DC megger) 100 MΩ minimum between output and power terminals (500V DC megger)	

Output Internal Circuit

• SX5L-SBT16K1

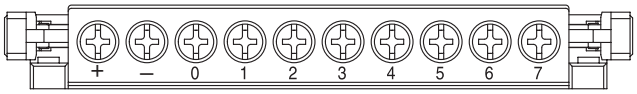


• SX5L-SBT16S1

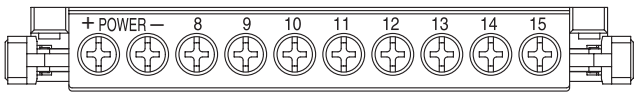


Terminal Arrangement

• Upper Terminal Block (SX9Z-SS1)

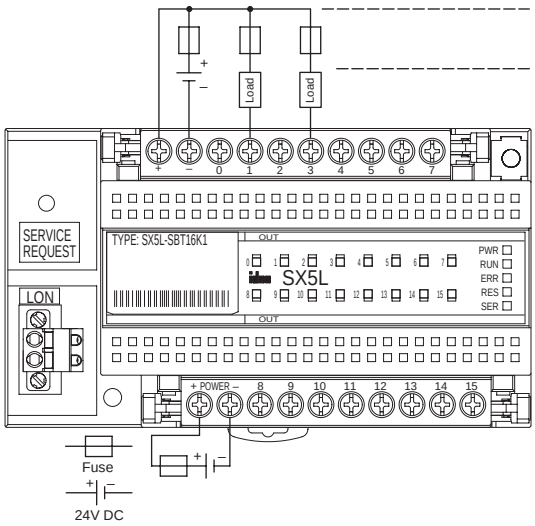
Marking	+	–	0	1	2	3	4	5	6	7
Name	Load Power		Output 0	Output 1	Output 2	Output 3	Output 4	Output 5	Output 6	Output 7
	24V DC	0V								
Front View										

• Lower Terminal Block (SX9Z-SS2)

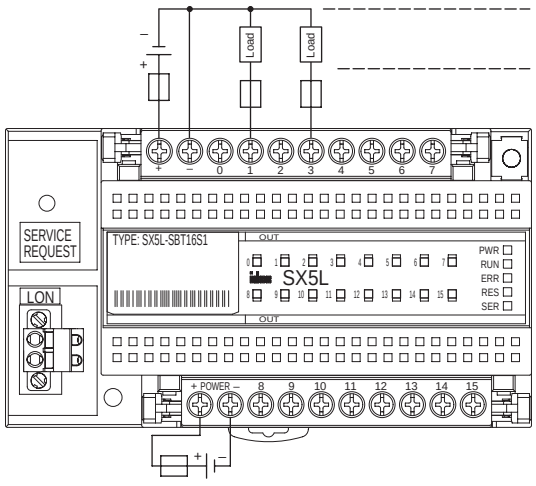
Marking	POWER +	POWER –	8	9	10	11	12	13	14	15
Name	Power Voltage		Output 8	Output 9	Output 10	Output 11	Output 12	Output 13	Output 14	Output 15
	24V DC	0V								
Front View										

Wiring Examples

• SX5L-SBT16K1 (Plus Common Wiring)



• SX5L-SBT16S1 (Minus Common Wiring)



Note: The internal circuit and output circuit can be powered by the same power supply.

Digital I/O Modules SX5L-SBM16K1, -SBM16K2, -SBM16S1, -SBM16S2

General Specifications

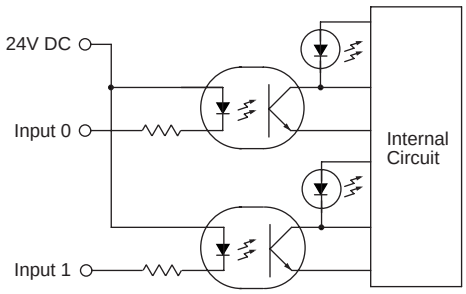
Rated Power Voltage	24V DC
Power Voltage Range	21.6 to 26.4V DC (including 5% ripple)
Power Consumption	1.2W (24V DC)
Power Inrush Current	3A maximum (24V DC)
Allowable Momentary Power Interruption	10 ms minimum (at the rated power voltage)
Dielectric Strength	1,000V AC, 1 minute between power and FG terminals
Insulation Resistance	100 MΩ minimum between power and FG terminals (500V DC megger)
Operating Temperature	0 to 55°C (no freezing)
Operating Humidity	30 to 90% RH (non-condensing)
Storage Temperature	–20 to +75°C (no freezing)
Storage Humidity	30 to 90% RH (non-condensing)
Pollution Degree	2 (IEC 60664)
Corrosion Immunity	Atmosphere free from corrosive gases
Altitude	Operation: 0 to 2,000m Transport: 0 to 3,000m
Vibration Resistance	10 to 57 Hz amplitude 0.075 mm, 57 to 150 Hz acceleration 9.8 m/s^2 2 hours per axis on each of three mutually perpendicular axes
Shock Resistance	294 m/s^2, 11-ms sinusoidal half-wave pulse
Mounting	35-mm-wide DIN rail, direct panel mounting (M4 mounting screws)
Weight (approx.)	240g

Digital Input Specifications

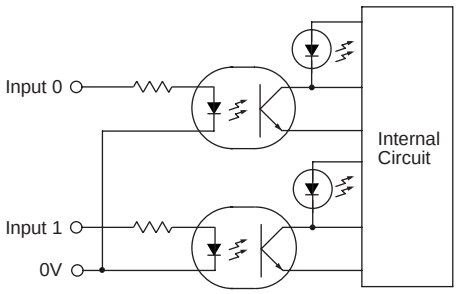
Type No.	**SX5L-SBM16K1 / SX5L-SBM16K2**	**SX5L-SBM16S1 / SX5L-SBM16S2**
Input Points	8 points	
Input Type	NPN input type No-voltage input (DC 2-wire sensor, NPN 3-wire sensor, no-voltage contact)	PNP input type No-voltage input (DC 2-wire sensor, PNP 3-wire sensor, no-voltage contact)
Rated Input Voltage	24V DC	
Input Voltage Range	0 to 26.4V DC	
Input Impedance	Approx. 4.0 kΩ	
Input Current	6 mA/point (24V DC)	
No. of Common Circuits	1	
Input Common Polarity	Minus common	Plus common
Input Delay Time	250 ms	
Input Turn ON Voltage	15V minimum (between input and COM terminals)	
Input Turn OFF Voltage	5V maximum (between input and COM terminals)	
Input OFF Current	1 mA maximum	
Isolation from Power Line	Photocoupler isolation	
Dielectric Strength	500V AC, 1 minute between input and FG terminals 500V AC, 1 minute between input and power terminals	
Insulation Resistance	100 MΩ minimum between input and FG terminals (500V DC megger) 100 MΩ minimum between input and power terminals (500V DC megger)	

Input Internal Circuit

• **SX5L-SBM16K1 / SX5L-SBM16K2**



• **SX5L-SBM16S1 / SX5L-SBM16S2**

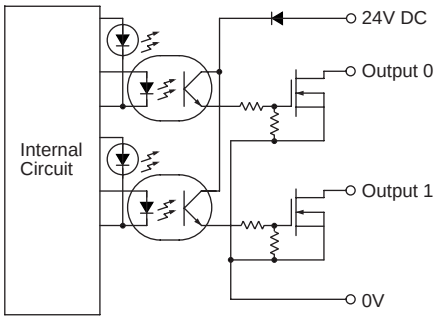


Transistor Output Specifications

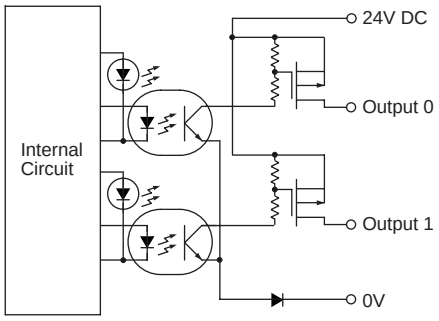
Type No.	SX5L-SBM16K1 / SX5L-SBM16K2	SX5L-SBM16S1 / SX5L-SBM16S2
Output Points	8 points	
Output Type	N-MOS open drain (NPN transistor output)	P-MOS open drain (PNP transistor output)
Rated Load Voltage	24V DC	
Load Voltage Range	21.6 to 26.4V DC	
Maximum Load Current	500 mA per point 4A per common line	
Output Common Polarity	Plus common	Minus common
Voltage Drop (ON Voltage)	0.8V maximum (voltage between the power – terminal and output terminals when output is on)	0.8V maximum (voltage between the power + terminal and output terminals when output is on)
Leakage Current	1 mA maximum	
Isolation from Power Line	Photocoupler isolation	
Dielectric Strength	500V AC, 1 minute between output and FG terminals 500V AC, 1 minute between output and power terminals	
Insulation Resistance	100 MΩ minimum between output and FG terminals (500V DC megger) 100 MΩ minimum between output and power terminals (500V DC megger)	

Output Internal Circuit

• **SX5L-SBM16K1 / SX5L-SBM16K2**

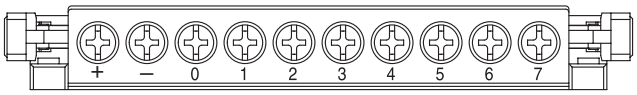


• **SX5L-SBM16S1 / SX5L-SBM16S2**



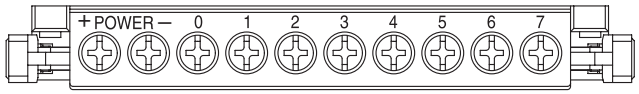
Terminal Arrangement (SX5L-SBM16K1 / SX5L-SBM16S1)

• Upper Terminal Block (SX9Z-SS1)

Marking	+	–	0	1	2	3	4	5	6	7
Name	Input Common/ Load Power		Input 0	Input 1	Input 2	Input 3	Input 4	Input 5	Input 6	Input 7
	24V DC*1	0V*2								
Front View										

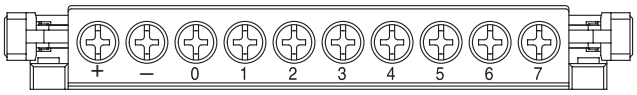
*1: Common terminal for SX5L-SBM16S1 inputs
*2: Common terminal for SX5L-SBM16K1 inputs

• Lower Terminal Block (SX9Z-SS3)

Marking	POWER +	POWER –	0	1	2	3	4	5	6	7
Name	Power Voltage		Output 0	Output 1	Output 2	Output 3	Output 4	Output 5	Output 6	Output 7
	24V DC	0V								
Front View										

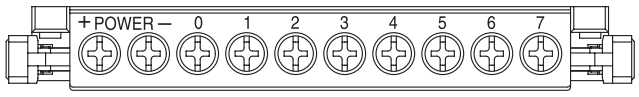
Terminal Arrangement (SX5L-SBM16K2 / SX5L-SBM16S2)

• Upper Terminal Block (SX9Z-SS1)

Marking	+	–	0	1	2	3	4	5	6	7
Name	Input Common/ Load Power		Status 0	Alarm 0	Status 1	Alarm 1	Status 2	Alarm 2	Status 3	Alarm 3
	24V DC*1	0V*2								
Front View										

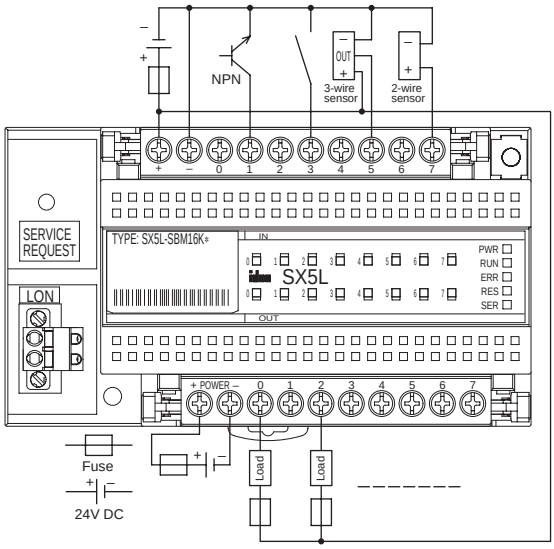
*1: Common terminal for SX5L-SBM16S2 inputs
*2: Common terminal for SX5L-SBM16K2 inputs

• Lower Terminal Block (SX9Z-SS3)

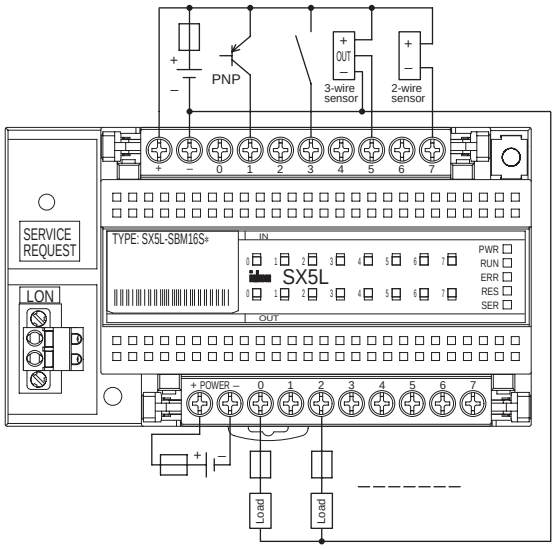
Marking	POWER +	POWER –	0	1	2	3	4	5	6	7
Name	Power Voltage		Start 0	Stop 0	Start 1	Stop 1	Start 2	Stop 2	Start 3	Stop 3
	24V DC	0V								
Front View										

Wiring Examples

- **SX5L-SBM16K1 / SX5L-SBM16K2**
  (Input: Minus Common Wiring)
  (Output: Plus Common Wiring)



- **SX5L-SBM16S1 / SX5L-SBM16S2**
  (Input: Plus Common Wiring)
  (Output: Minus Common Wiring)



Note: The internal circuit, input circuit, and output circuit can be powered by the same power supply.

Analog Input Module SX5L-SBAN041

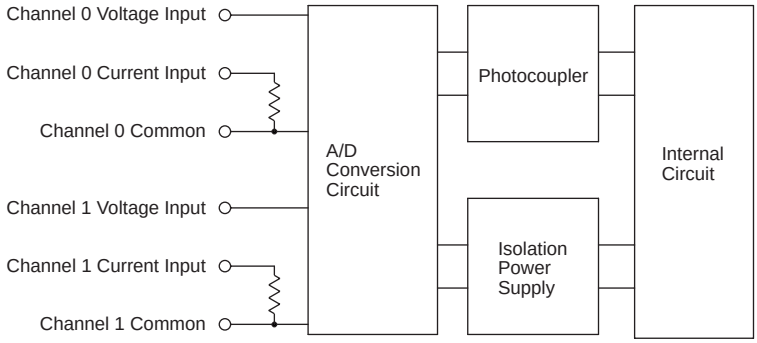
General Specifications

Rated Power Voltage	24V AC (50/60Hz) / 24V DC compatible
Power Voltage Range	21.6 to 26.4V AC/DC (including 5% ripple)
Power Consumption	3.0 VA (24V AC), 1.8W (24V DC)
Power Inrush Current	15A maximum (24V AC/DC)
Allowable Momentary Power Interruption	10 ms minimum (at the rated power voltage)
Dielectric Strength	1,000V AC, 1 minute between power and FG terminals
Insulation Resistance	100 MΩ minimum between power and FG terminals (500V DC megger)
Operating Temperature	0 to 55°C (no freezing)
Operating Humidity	30 to 90% RH (non-condensing)
Storage Temperature	–20 to +75°C (no freezing)
Storage Humidity	30 to 90% RH (non-condensing)
Pollution Degree	2 (IEC 60664)
Corrosion Immunity	Atmosphere free from corrosive gases
Altitude	Operation: 0 to 2,000m Transport: 0 to 3,000m
Vibration Resistance	10 to 57 Hz amplitude 0.075 mm, 57 to 150 Hz acceleration 9.8 m/s^2 2 hours per axis on each of three mutually perpendicular axes
Shock Resistance	294 m/s^2, 11-ms sinusoidal half-wave pulse
Mounting	35-mm-wide DIN rail, direct panel mounting (M4 mounting screws)
Weight (approx.)	250g

Analog Input Specifications

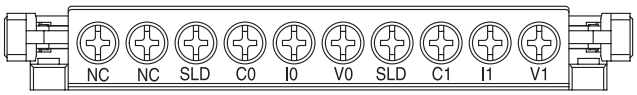
Input Points	4 points
Input Type	Voltage input: 1 to 5V DC Current input: 4 to 20 mA DC
Input Impedance	Voltage input: 1 MΩ Current input: 250Ω
Digital Resolution	12 bits
A/D Conversion Time	80 ms per point
Sample Duration Time	300 ms per point
Error	±0.6% (at 25°C) ±1.0% (over the operating temperature range)
Isolation between Input Channels	No isolation
Dielectric Strength	500V AC, 1 minute between input and FG terminals 500V AC, 1 minute between input and power terminals
Insulation Resistance	100 MΩ minimum between input and FG terminals (500V DC megger) 100 MΩ minimum between input and power terminals (500V DC megger)

Input Internal Circuit

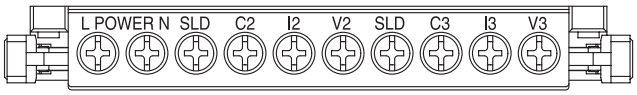


Terminal Arrangement

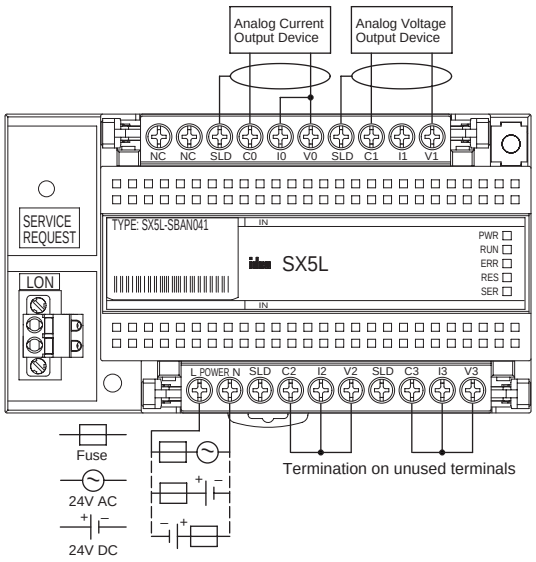
• Upper Terminal Block (SX9Z-SS12)

Marking	NC	NC	SLD	C0	I0	V0	SLD	C1	I1	V1
Name	No Connection		Shield	Channel 0			Shield	Channel 1		
				Common	Current Input	Voltage Input		Common	Current Input	Voltage Input
Front View										

• Lower Terminal Block (SX9Z-SS9)

Marking	POWER L	POWER N	SLD	C2	I2	V2	SLD	C3	I3	V3
Name	Power Voltage		Shield	Channel 2			Shield	Channel 3		
				Common	Current Input	Voltage Input		Common	Current Input	Voltage Input
Front View										

Wiring Examples



Note: Connect together the terminals of an unused channel using an optional jumper BPJ-26B (ring type) or BPJ-26FB (spade type) or using wires.

Pt100Ω Input Modules SX5L-SBPT04X1 / SX5L-SBPT04Y1

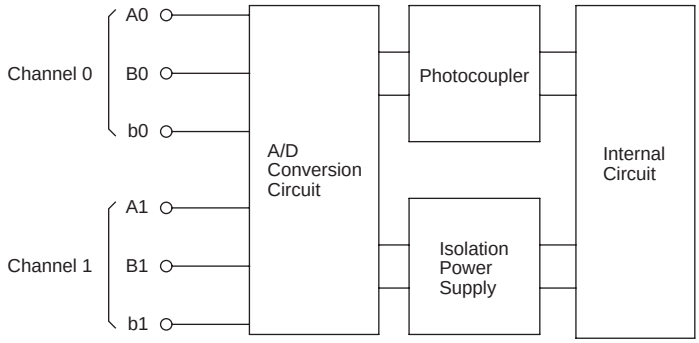
General Specifications

Rated Power Voltage	24V AC (50/60Hz) / 24V DC compatible
Power Voltage Range	21.6 to 26.4V AC/DC (including 5% ripple)
Power Consumption	3.0 VA (24V AC), 1.8W (24V DC)
Power Inrush Current	15A maximum (24V AC/DC)
Allowable Momentary Power Interruption	10 ms minimum (at the rated power voltage)
Dielectric Strength	1,000V AC, 1 minute between power and FG terminals
Insulation Resistance	100 MΩ minimum between power and FG terminals (500V DC megger)
Operating Temperature	0 to 55°C (no freezing)
Operating Humidity	30 to 90% RH (non-condensing)
Storage Temperature	–20 to +75°C (no freezing)
Storage Humidity	30 to 90% RH (non-condensing)
Pollution Degree	2 (IEC 60664)
Corrosion Immunity	Atmosphere free from corrosive gases
Altitude	Operation: 0 to 2,000m Transport: 0 to 3,000m
Vibration Resistance	10 to 57 Hz amplitude 0.075 mm, 57 to 150 Hz acceleration 9.8 m/s^2 2 hours per axis on each of three mutually perpendicular axes
Shock Resistance	294 m/s^2, 11-ms sinusoidal half-wave pulse
Mounting	35-mm-wide DIN rail, direct panel mounting (M4 mounting screws)
Weight (approx.)	250g

Pt100Ω Input Specifications

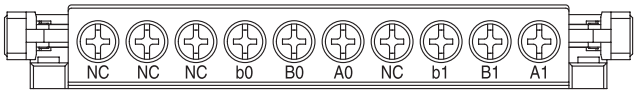
Type No.	**SX5L-SBPT04X1**	**SX5L-SBPT04Y1**
Input Points	4 points	
Input Type	3-wire Pt100Ω resistance thermometer	
Temperature Measurement Range	0 to +50°C	–20 to +80°C
Digital Resolution	12 bits	
Input Detection Current	1.0 mA maximum	
A/D Conversion Time	80 ms per point	
Sample Duration Time	1 sec	
Allowable Conductor Resistance	100Ω maximum (3 wires must have the same resistance)	
Burnout	Yes (data: +327.67°C)	
Error	±0.4% FS	
Isolation between Input Channels	No isolation	
Dielectric Strength	500V AC, 1 minute between input and FG terminals 500V AC, 1 minute between input and power terminals	
Insulation Resistance	100 MΩ minimum between input and FG terminals (500V DC megger) 100 MΩ minimum between input and power terminals (500V DC megger)	

Input Internal Circuit

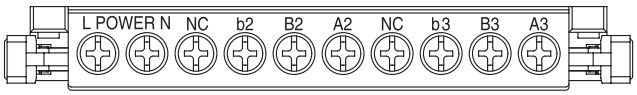


Terminal Arrangement

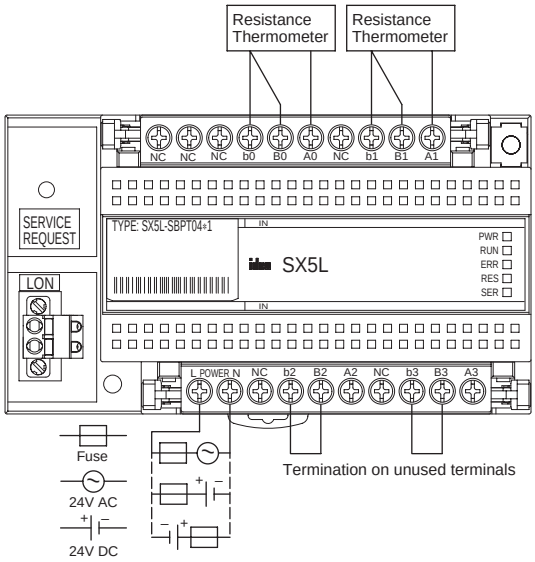
• Upper Terminal Block (SX9Z-SS13)

Marking	NC	NC	NC	b0	B0	A0	NC	b1	B1	A1
Name	No Connection			Channel 0 Pt100Ω Input			No Connection	Channel 1 Pt100Ω Input		
Front View										

• Lower Terminal Block (SX9Z-SS14)

Marking	POWER L	POWER N	NC	b2	B2	A2	NC	b3	B3	A3
Name	Power Voltage		No Connection	Channel 2 Pt100Ω Input			No connection	Channel 3 Pt100Ω Input		
Front View										

Wiring Examples



Note: Connect together the terminals of an unused channel using an optional jumper BPJ-26B (ring type) or BPJ-26FB (spade type) or using wires.

Pulse Input Module SX5L-SBCN081

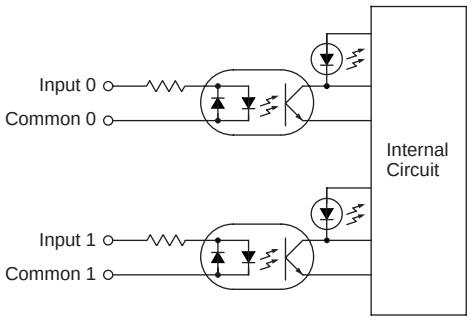
General Specifications

Rated Power Voltage	24V AC (50/60Hz) / 24V DC compatible
Power Voltage Range	21.6 to 26.4V AC/DC (including 5% ripple)
Power Consumption	2.0 VA (24V AC), 1.0W (24V DC)
Power Inrush Current	15A maximum (24V AC/DC)
Allowable Momentary Power Interruption	10 ms minimum (at the rated power voltage)
Dielectric Strength	1,000V AC, 1 minute between power and FG terminals
Insulation Resistance	100 MΩ minimum between power and FG terminals (500V DC megger)
Operating Temperature	0 to 55°C (no freezing)
Operating Humidity	30 to 90% RH (non-condensing)
Storage Temperature	–20 to +75°C (no freezing)
Storage Humidity	30 to 90% RH (non-condensing)
Pollution Degree	2 (IEC 60664)
Corrosion Immunity	Atmosphere free from corrosive gases
Altitude	Operation: 0 to 2,000m Transport: 0 to 3,000m
Vibration Resistance	10 to 57 Hz amplitude 0.075 mm, 57 to 150 Hz acceleration 9.8 m/s^2 2 hours per axis on each of three mutually perpendicular axes
Shock Resistance	294 m/s^2, 11-ms sinusoidal half-wave pulse
Mounting	35-mm-wide DIN rail, direct panel mounting (M4 mounting screws)
Weight (approx.)	250g

Pulse Input Specifications

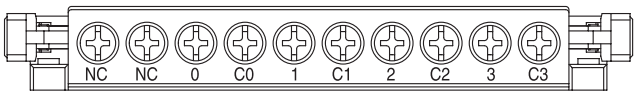
Input Points	8 points
Rated Input Voltage	24V DC
Input Voltage Range	0 to 26.4V DC
Minimum Pulse Width	ON duration: 50 ms OFF duration: 50 ms
Maximum Frequency Response	8 Hz
Input Impedance	Approx. 3.4 kΩ
Input Current	7 mA/point (24V DC)
No. of Common Circuits	1 common circuit/point
Input Common Polarity	Plus and minus common compatible
Input Turn ON Voltage	15V minimum (between input and COM terminals)
Input Turn OFF Voltage	5V maximum (between input and COM terminals)
Isolation from Power Line	Photocoupler isolation
Dielectric Strength	500V AC, 1 minute between input and FG terminals 500V AC, 1 minute between input and power terminals 500V AC, 1 minute between input terminals
Insulation Resistance	100 MΩ minimum between input and FG terminals (500V DC megger) 100 MΩ minimum between input and power terminals (500V DC megger) 100 MΩ minimum between input terminals (500V DC megger)
Current Value Backup Times	10,000 times of current value storage into the built-in EEPROM during power interruption

Input Internal Circuit

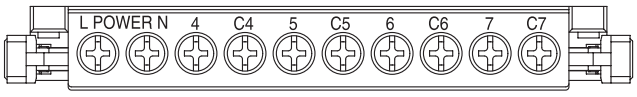


Terminal Arrangement

• Upper Terminal Block (SX9Z-SS11)

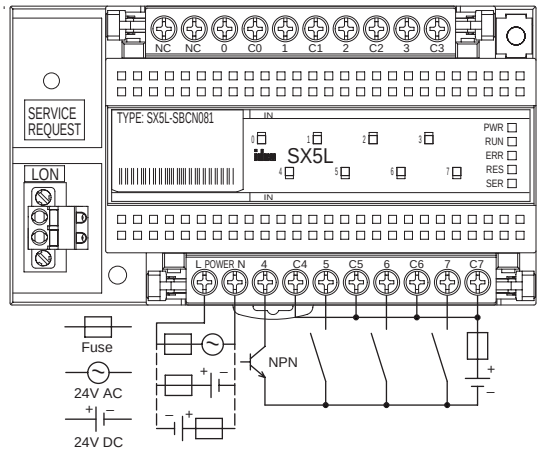
Marking	NC	NC	0	C0	1	C1	2	C2	3	C3
Name	No Connection		Input 0	Common 0	Input 1	Common 1	Input 2	Common 2	Input 3	Common 3
Front View										

• Lower Terminal Block (SX9Z-SS7)

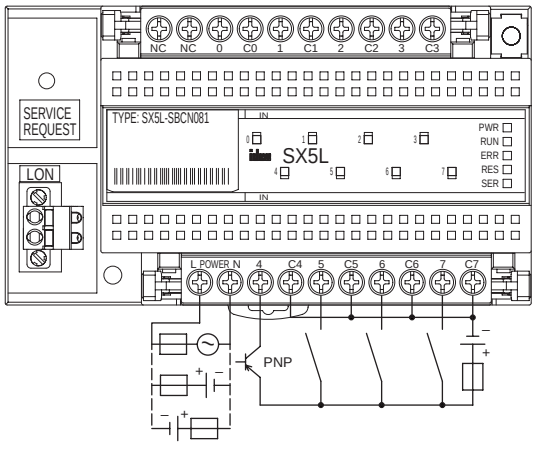
Marking	POWER L	POWER N	4	C4	5	C5	6	C6	7	C7
Name	Power Voltage		Input 4	Common 4	Input 5	Common 5	Input 6	Common 6	Input 7	Common 7
Front View										

Wiring Examples

• Minus Common Wiring



• Plus Common Wiring



Note: Besides common wiring, input circuits can also be connected separately.
When using a DC power supply, the internal circuit and pulse input circuit can be powered by the same power supply.
When using an AC power supply for the internal circuit, the same power supply cannot be used for the pulse input circuit.

Remote-control Relay Control Module SX5L-SBRR081

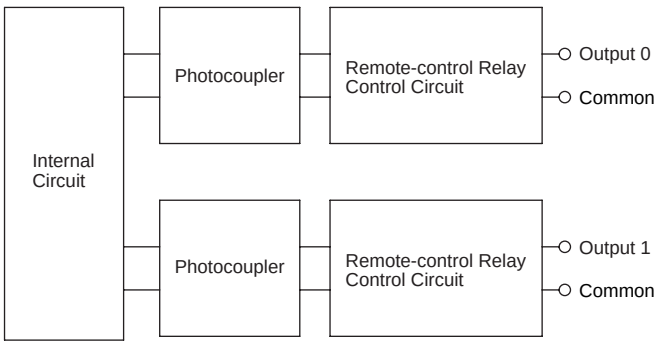
General Specifications

Rated Power Voltage	24V AC (50/60Hz) supplied from a remote-control transformer
Power Voltage Range	21.6 to 26.4V AC (including 5% ripple)
Power Consumption	1.8 VA (24V AC) not including power consumption by remote-control relays
Power Inrush Current	15A maximum (24V AC)
Allowable Momentary Power Interruption	10 ms minimum (at the rated power voltage)
Dielectric Strength	1,000V AC, 1 minute between power and FG terminals
Insulation Resistance	100 MΩ minimum between power and FG terminals (500V DC megger)
Operating Temperature	0 to 55°C (no freezing)
Operating Humidity	30 to 90% RH (non-condensing)
Storage Temperature	–20 to +75°C (no freezing)
Storage Humidity	30 to 90% RH (non-condensing)
Pollution Degree	2 (IEC 60664)
Corrosion Immunity	Atmosphere free from corrosive gases
Altitude	Operation: 0 to 2,000m Transport: 0 to 3,000m
Vibration Resistance	10 to 57 Hz amplitude 0.075 mm, 57 to 150 Hz acceleration 9.8 m/s^2 2 hours per axis on each of three mutually perpendicular axes
Shock Resistance	294 m/s^2, 11-ms sinusoidal half-wave pulse
Mounting	35-mm-wide DIN rail, direct panel mounting (M4 mounting screws)
Weight (approx.)	250g

Remote-control Relay Control Specifications

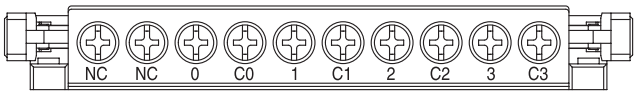
Input Points		8 points
Input Type		Feedback input from remote control relays through output signal lines
Output Type		Remote-control relay output
Output Pulse ON Width		100 ms
No. of Common Circuits		1 common circuit for 8 points
Applicable Devices	**Remote-control Relay**	BR-12D, BR-22D, BR-1 (Mitsubishi Electric) WR6165 (Matsushita Electric Works)
	Remote-control Transformer	BRT-10B, BRT-20B, BRT-1 (Mitsubishi Electric) WR2301 (Matsushita Electric Works)
Isolation from Power Line		Photocoupler isolation
Dielectric Strength		500V AC, 1 minute between remote-control relay control and FG terminals
Insulation Resistance		100 MΩ minimum between remote-control relay control and FG terminals (500V DC megger)

Input Internal Circuit

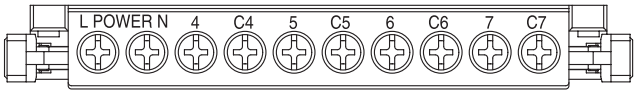


Terminal Arrangement

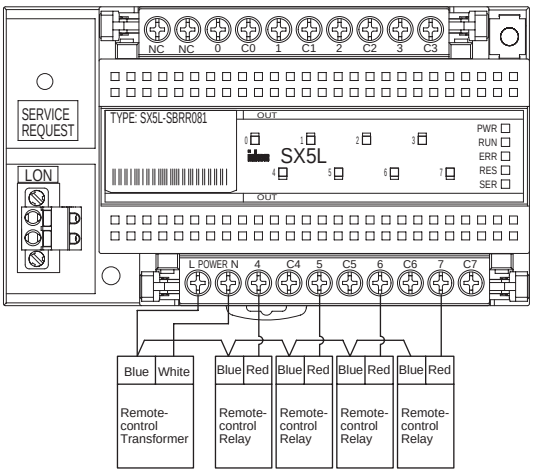
• Upper Terminal Block (SX9Z-SS11)

Marking	NC	NC	0	C0	1	C1	2	C2	3	C3
Name	No Connection		Output 0	Common	Output 1	Common	Output 2	Common	Output 3	Common
Front View										

• Lower Terminal Block (SX9Z-SS7)

Marking	POWER L	POWER N	4	C4	5	C5	6	C6	7	C7
Name	Power Voltage		Output 4	Common	Output 5	Common	Output 6	Common	Output 7	Common
Front View										

Wiring Examples



Note: Common terminals C0 through C7 and the POWER N terminal are connected together internally.

Only one remote-control relay can be connected to each output circuit.

3: INSTALLATION AND WIRING

Introduction

This chapter describes the methods and precautions for installing and wiring the SX5L communication terminals.

Before starting installation and wiring, be sure to read "Safety Precautions" in the beginning of this manual and understand precautions described under Warning and Caution.

Mounting on DIN Rail

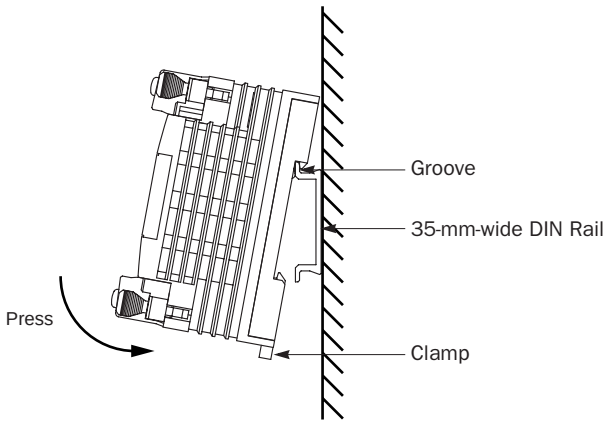
⚠ Warning

- Turn off the power to the SX5L before mounting and removing. Failure to turn power off may cause electrical shocks or fire hazard.

⚠ Caution

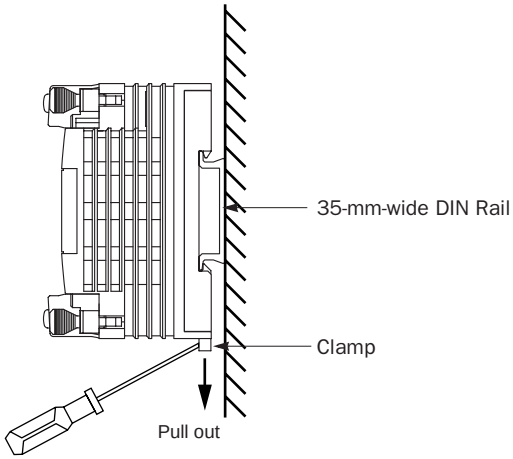
- Install the SX5L modules according to instructions described in this user's manual. Improper installation will result in falling, failure, or malfunction of the SX5L.
- Mount the SX5L modules on a 35-mm-wide DIN rail or a panel surface.
  Applicable DIN rail: IDEC's BAA1000NP or BAP1000NP (1000mm/39.4" long)

1. Fasten the DIN rail to a panel using screws firmly.
2. Pull out the clamp from the SX5L module, and put the groove of the module on the DIN rail. Press the module towards the DIN rail and push in the clamp as shown on the right.
3. Use BNL6P mounting clips on both sides of the SX5L module to prevent moving sideways.



Removing from DIN Rail

1. Insert a flat screwdriver into the slot in the clamp.
2. Pull out the clamp from the SX5L module.
3. Turn the SX5L module bottom out.



Mounting on Panel

The SX5L modules can also be mounted directly on a panel surface using M4 mounting screws. For the mounting hole layout, see page 2-2.

I/O Wiring

⚠ Warning

- Turn off the power to the SX5L before wiring the I/O and network cable. Failure to turn power off may cause electrical shocks or fire hazard.

⚠ Caution

- Prevent metal fragments and pieces of wire from dropping inside the SX5L housing. Put a cover on the SX5L module during wiring the I/O and network cable. Ingress of such fragments and chips may cause fire hazard, damage, or malfunction.
- Run the power supply wiring as far away possible from motor lines to prevent malfunction.
- Use wires of an appropriate size to meet the voltage and current requirements. Using inappropriate wires may cause overheat, resulting in possible fire hazard.
- Make sure of correct connection. Incorrect connection may cause overheat, resulting in possible fire hazard.
- Do not run the I/O wiring in parallel with or in the vicinity of motor lines. Keep the I/O wiring away from noise sources. Check for loose connection periodically. Loose connection may cause overheat, resulting in possible fire hazard.
- Keep the power voltage and frequency within the rated values, otherwise the SX5L may be damaged.
- Keep the input signal within the rated values, otherwise the SX5L may be damaged.

Applicable Wires

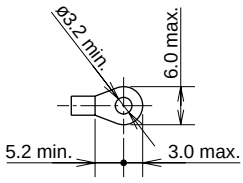
For power and input wiring, use AWG18 or AWG16 (0.75 to 1.25 mm^2) solid or stranded wires. When connecting two wires together, use wires of the same size.

Terminal Tightening Torque

Tighten the I/O terminals to a toque of 0.6 to 1.0 N·m. Also tighten unused I/O terminals.

Wire Termination

When using crimping terminals for wire termination, be sure to use an insulation tube on the crimping terminal. One or two crimping terminals can be connected to one screw terminal. Dimensions of an applicable crimping terminal are shown at right.



When wiring without using crimping terminals, strip the wire as long as the terminal clamp plate (approx. 6 mm), and insert the wire until the wire insulation touches the end of the terminal clamp plate.

Optional Jumper

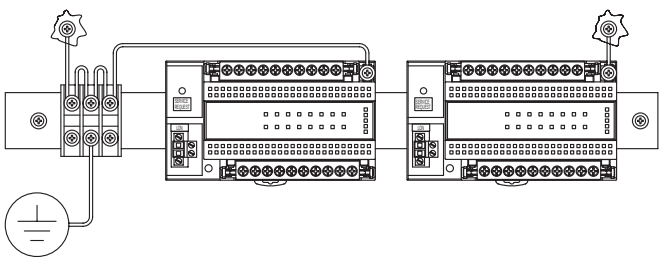
When using the analog input module or Pt100Ω input module, be sure to interconnect input terminals of each unused channel using a wire or optional ring or spade type jumper. Otherwise an error may exceeds the rated value.

Grounding

The upper-right mounting hole has a FG terminal. Connect the FG terminal and control box as shown in the figure below. Use a UL1007 AWG16 wire to connect the FG terminal to the ground (grounding resistance 100Ω at the maximum).

The FG terminal is supplied with an M4 screw and an embedded nut for ground connection when mounting on a DIN rail. When mounting the SX5L directly on a panel, prepare a proper screw for grounding.

Remove paint from the panel surface for grounding to make sure of electrical connection.



Network Cable Wiring

Caution

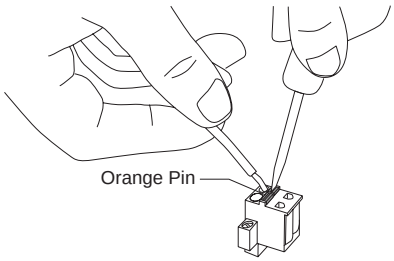
- Do not run the network cable in parallel with or in the vicinity of power, output, or motor lines. Keep the network cable away from noise sources. Check for loose connection periodically. Loose connection may cause overheat, resulting in possible fire hazard.

Applicable Cables

Use twisted pair cable with core wires of AWG24 to AWG14 (0.2 to 2.5 mm^2) applicable to the LONWORKS network. One or two wires can be connected to one network interface connector. When connecting two wires together, use wires of the same size, AWG24 to AWG16 (0.2 to 1.5 mm^2). Whether connecting one or two wires, always use ferrules to terminate the wires for connection to the network interface connector.

Network Interface Connector

The network interface connector features spring-clamp terminals. Push in the orange pin to open the cable hole using a flat screwdriver, and insert a ferrule into the cable hole. The LONWORKS network cable can be connected to the two terminals in either polarity.



For tightening the mounting screws of the network interface connector, use a flat screwdriver with a straight shank at the tip.

Recommended Screwdriver: Phoenix Type No. SZS 0,6 x 3,5
(Order No.: 12 05 05 3)

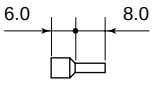
Tightening Torque

Tighten the network interface connector mounting screws to a torque of 0.3 to 0.5 N·m.

Applicable Ferrules

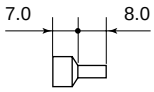
Wire Thickness		Phoenix Type (Order No.)	
AWG	Cross Section (mm^2)	For 1-cable connection	For 2-cable connection
24	0.25	AI 0,25-8 YE (32 00 85 2)	—
20	0.5	AI 0,5-8 WH (32 00 01 4)	AI-TWIN 2 x 0,5-8 WH (32 00 93 3)
18	0.75	AI 0,75-8 GY (32 00 51 9)	AI-TWIN 2 x 0,75-8 GY (32 00 80 7)
18	1.0	AI 1-8 RD (32 00 03 0)	AI-TWIN 2 x 1-8 RD (32 00 81 0)
16	1.5	AI 1,5-8 BK (32 00 04 3)	AI-TWIN 2 x 1,5-8 BK (32 00 82 3)
14	2.5	AI 2,5-8 BU (32 00 52 2)	—

For 1-cable connection



AI 1-8 RD

For 2-cable connection



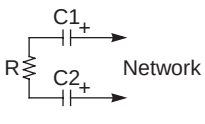
AI-TWIN 2 x 1-8 RD

To crimp the ferrules, use a special crimping tool.

Crimping Tool: Phoenix Type No. CRIMPFOX ZA 3
(Order No.: 12 01 88 2)

Terminators

LONWORKS networks require terminators. Connect terminators consisting of one resistor and two capacitors shown at right (note the polarity of capacitors).



The bus topology requires two terminators at both ends of the network, and the free topology can connect a terminator at any position in the network.

Topology	Bus Topology	Free Topology
R	105Ω±1%, 1/8W	52.3Ω±1%, 1/8W
C1 and C2	100 µF, ≥50V	100 µF, ≥50V
Connect Position	Terminators at both ends of the network	One terminator at any position in the network
Applicable Terminator	Echelon 44101	Echelon 44100

Removing the Detachable Terminal Block

Warning • Turn off the power to the SX5L before removing and installing the detachable terminal block. Failure to turn power off may cause electrical shocks or fire hazard.

To remove the detachable terminal block from the SX5L module, squeeze both latches on top of the terminal block inward to unlock the terminal block from the socket.

Installing the Detachable Terminal Block

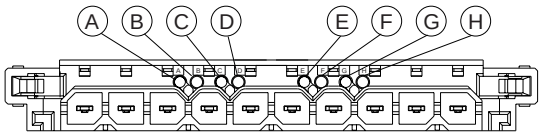
Place the terminal block in the socket with the latches opened and press the terminal block until it bottoms in the socket.

Insertion Pin Positions

Insertion pins are positioned on the base of the terminal block and inside the socket to prevent insertion of invalid terminal blocks into the socket. The pins are keyed to make sure of correct matching of terminal block and socket, and prevent swapping of upper and lower terminal blocks.

When the terminal block does not fit into the socket properly, check to see if the pin positions on the terminal block agree with the pin-slot arrangement in the socket. If the pins and the pin slots are in matching positions, check for any chips and obstacles in the socket.

When purchasing terminal blocks separately, set the insertion pins as shown below.



Terminal Block Bottom View

Applicable Terminal Blocks and Insertion Pin Positions

Module Name	Type No.	Terminal Block Position	Terminal Block Type No.	Insertion Pin Positions
Digital Input	SX5L-SBN16B1	Upper	SX9Z-SS10	B D F H
		Lower	SX9Z-SS2	A C F H
Digital Output	SX5L-SBT16K1 SX5L-SBT16S1	Upper	SX9Z-SS1	B C E G
		Lower	SX9Z-SS2	A D F H
Digital I/O	SX5L-SBM16K1 SX5L-SBM16K2 SX5L-SBM16S1 SX5L-SBM16S2	Upper	SX9Z-SS1	B C F H
		Lower	SX9Z-SS3	A D E G
Analog Input	SX5L-SBAN041	Upper	SX9Z-SS12	A D E H
		Lower	SX9Z-SS9	B C F G
Pt100Ω Input	SX5L-SBPT04X1 SX5L-SBPT04Y1	Upper	SX9Z-SS13	B D E H
		Lower	SX9Z-SS14	A C F G
Pulse Input	SX5L-SBCN081	Upper	SX9Z-SS11	A C E H
		Lower	SX9Z-SS7	B C E H
Remote-control Relay Control	SX5L-SBRR081	Upper	SX9Z-SS11	B D F G
		Lower	SX9Z-SS7	A D F G

4: SOFTWARE SPECIFICATIONS

Introduction

This chapter describes the software specifications of the SX5L communication terminals. Designing a LONWORKS network requires complete understanding of the functional blocks available on each SX5L communication terminal. Before starting system configuration, read this chapter to understand available functional blocks.

General

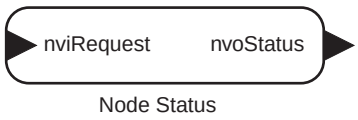
The SX5L communication terminals contain an application program installed before shipment from factory. The functions of application programs are configured in units of functional blocks. More than one functional block is installed in one SX5L communication terminal. Available functional blocks are listed in the table below.

To set up a LONWORKS network, every device on the network, including the SX5L modules, must be commissioned individually to assign an address using a network management tool. A Neuron ID is needed to identify each LONWORKS module. While commissioning the SX5L using a network management tool, either enter the 12-digit alphanumeric Neuron ID printed on the label on the SX5L manually, or press the SERVICE REQUEST button on the SX5L module to send the service pin message.

Available Functional Blocks

Functional Block	Input Module	Output Module	I/O Module	I/O Start/Stop	Analog Input	Pt100Ω Input	Pulse Input	Remote-control	Page
	SBN16B1	SBT16K1 SBT16S1	SBM16K1 SBM16S1	SBM16K2 SBM16S2	SBAN041	SBPT04X1 SBPT04Y1	SBCN081	SBRR081	
Node Object	x	x	x	x	x	x	x	x	4-2
Digital Input	x		x						4-3
Digital Output		x	x						4-4
Virtual I/O		x	x						4-5
Shot Output/Digital Input				x					4-8
Analog Input					x				4-10
Pt100Ω Input						x			4-13
Pulse Count							x		4-15
Remote-control Relay Control								x	4-17
Quantity of Alias Table Entries	62	62	62	16	8	8	16	16	

Node Object Functional Block



The Node Object functional block is installed in all SX5L modules. When receiving an input to nviRequest, this functional block sends out nvoStatus in reply. This functionality makes it possible for the network to confirm that the responding node is in on-line status.

I/O	Name	Type	Description
Input Network Variable	nviRequest	SNVT_obj_request	For node objects
Output Network Variable	nvoStatus	SNVT_obj_status	For node objects
Configuration Property	nciPwrup	SCPTpwrUpDelay	Delay in sending nvoStatus immediately after powerup (factory setting: 0 seconds)
	nciMaxStsSendT	SCPTmaxSndT	nvoStatus heartbeat transmission interval (factory setting: 3 minutes)

Initial Status Transmission

This functional block sends output network variable nvoStatus to the network within 3 seconds after powerup. The delay depends on a random number based on the Neuron ID, and differs on each node.

The sending time can be delayed by changing the nciPwrup value. At system startup, if the SX5L sends nvoStatus before the addressee device is ready to receive communication, set the nciPwrup to a larger value.

The preset value for nciPwrup can be between 0 and 60 seconds (0.1-sec increments). The sending time is determined by the sum of the nciPwrup value and a random number.

Event-driven Transmission

When receiving nviRequest, this functional block sends output network variable nvoStatus to the network.

Heartbeat Transmission (Periodical Transmission)

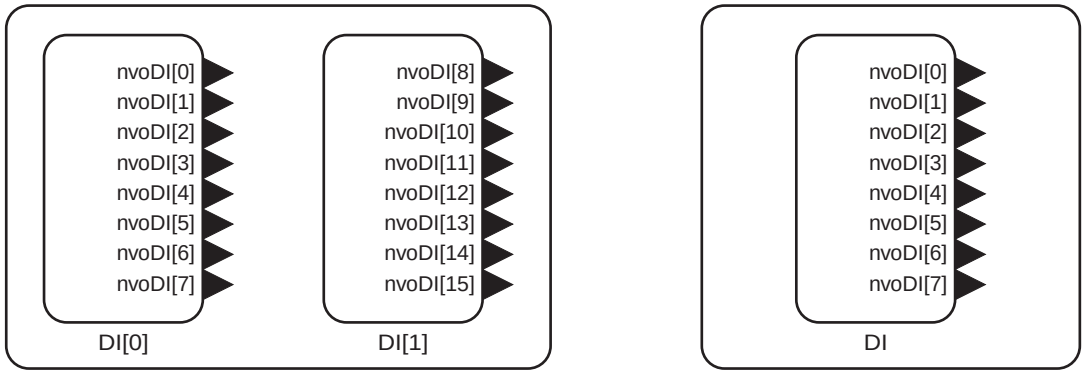
After the first transmission of output network variable nvoStatus, this functional block sends nvoStatus repeatedly at intervals designated by nciMaxStsSendT. When the nciMaxStsSendT value is 0, the heartbeat transmission is disabled.

The configuration type of nciMaxStsSendT is SNVT_elapsed_tm (day, hour, minute, second, millisecond). When a value over 12 hours is set, the interval is designated as 12 hours 00 minutes 00 seconds. The millisecond value has no effect.

Presets

When sending input network variable nviRequest to the SX5L, set all values to 0. The SX5L always sends output network variable nvoStatus with all values set to 0.

Digital Input Functional Block



Digital input terminals 0 through 15 correspond to output network variables nvoDI[0] through nvoDI[15], respectively. When the status at any input terminal changes, the Digital Input functional block sends a corresponding output network variable to the network.

I/O	Name	Type	Description
Output Network Variable	nvoDI[0] to [15]	SNVT_switch	Correspond to inputs 0 through 15
Configuration Property	nciMaxStsSendT1 [0] to [15]	SCPTmaxSndT	nvoDI[0] to [15] heartbeat transmission interval (factory setting: 3 minutes)

Initial Status Transmission

This functional block sends output network variables nvoDI[0] through nvoDI[15] to the network within 3 seconds after powerup. The delay depends on a random number based on the Neuron ID, and differs on each node.

The sending time can be delayed by changing the nciPwrup value designated in the Node Object functional block. At system startup, if the SX5L sends output network variables before the addressee device is ready to receive communication, set the nciPwrup to a larger value.

The preset value for nciPwrup can be between 0 and 60 seconds (0.1-sec increments). The sending time is determined by the sum of the nciPwrup value and a random number.

Event-driven Transmission

When the status at any input terminal changes or when receiving a request (polling) from the network, this functional block sends a corresponding output network variable to the network.

Heartbeat Transmission (Periodical Transmission)

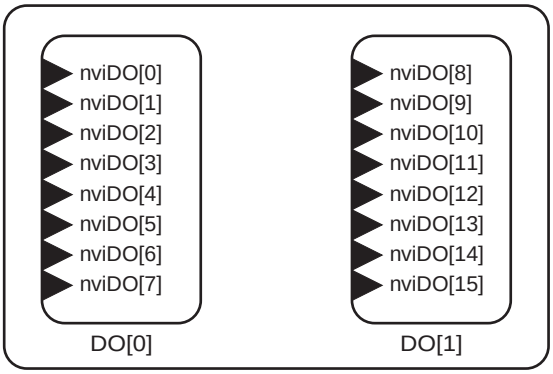
When the status at any input terminal does not change, this functional block sends the output network variable repeatedly at intervals designated by nciMaxStsSendT1[0] to [15]. When the nciMaxStsSendT1[0] to [15] value is 0, the heartbeat transmission is disabled.

The configuration type of nciMaxStsSendT1[0] to [15] is SNVT_elapsed_tm (day, hour, minute, second, millisecond). When a value over 12 hours is set, the interval is designated as 12 hours 00 minutes 00 seconds. The millisecond value has no effect.

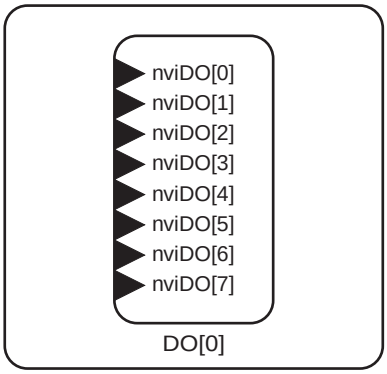
Input Terminal Status vs. Output Network Variable

Input Terminal Status	Output Network Variable
ON	(state) = 1, (value) = 100.0%
OFF	(state) = 0, (value) = 0.0%

Digital Output Functional Block



SX5L-SBT16K1 / SX5L-SBT16S1



SX5L-SBM16K1 / SX5L-SBM16S1

Digital output terminals 0 through 15 correspond to input network variables nviDO[0] through nviDO[15], respectively. When any of these input network variables receives a new value, the value effects the ON/OFF status of a corresponding output terminal.

I/O	Name	Type	Description
Input Network Variable	nviDO[0] to [15]	SNVT_switch	Correspond to outputs 0 through 15

Input Network Variable vs. Output Terminal Status

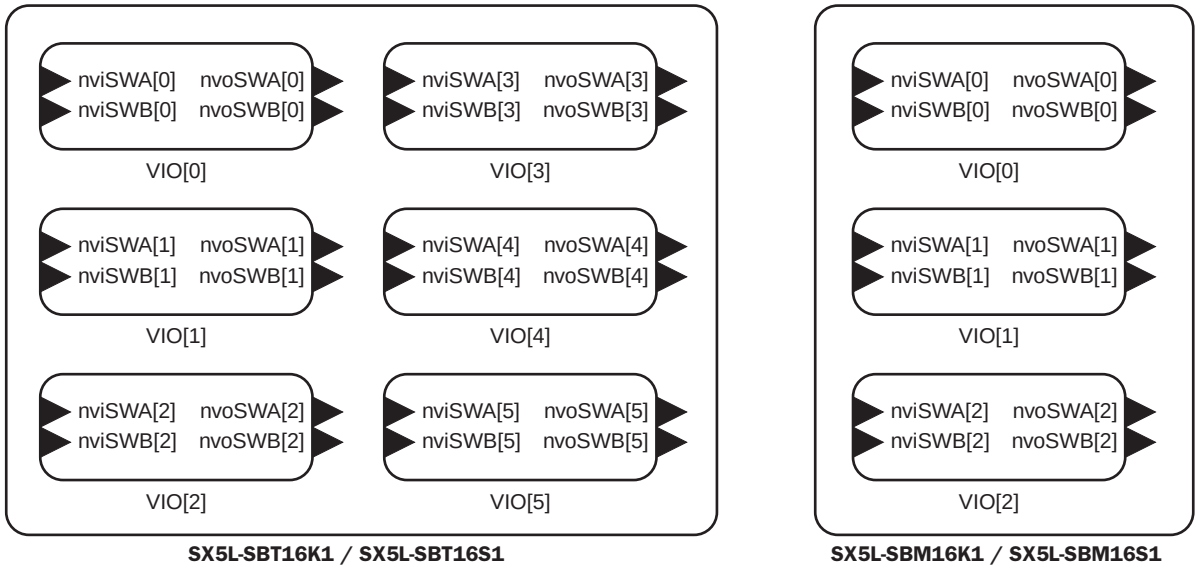
Each time the input network variable is updated, a corresponding output terminal status is updated according to the received data.

The existing output terminal status is maintained until the input network variable is updated.

When receiving a reset command or when power is cycled, all outputs are initialized to OFF.

Input Network Variable	Output Terminal Status
(state) = 1, (value) = no effect	ON
(state) = 0, (value) = no effect	OFF

Virtual I/O Functional Block



The Virtual I/O functional block is not designed for a particular hardware type, but can be used to configure required circuits. For example, the Virtual I/O functional block can be used to link alarm signals to digital output functional blocks, and configure a simple interlocking circuit by combining multiple Virtual I/O functional blocks.

I/O	Name	Type	Description
Input Network Variable	nviSWA[0] to [5]	SNVT_switch	Value to be sent from nvoSWA[0] to [5]
	nviSWB[0] to [5]	SNVT_switch	Forces to change the nvoSWA and nvoSWB output values. When receiving (state) = 1, nvoSWA sends 0 and nvoSWB sends 1.
Output Network Variable	nvoSWA[0] to [5]	SNVT_switch	Sends the received nviSWA[0] to [5] values without change.
	nvoSWB[0] to [5]	SNVT_switch	Inverts the received nviSWA[0] to [5] values and sends the inverted values (logical NOT).
Configuration Property	nciAndOr[0] to [5]	SCPTdefltBehave	Designates Boolean operation for functional blocks. When (state) = 0, as shown above. When (state) = 1 is set, the following output is sent: nvoSWA sends logical AND of nviSWA and nviSWB. nvoSWB sends logical OR of nviSWA and nviSWB.

Initial Status Transmission

When receiving the reset command at powerup, input network variables nviSWA and nviSWB are initialized to (value, state) = (0, 0). Based on these values, output network variables nvoSWA and nvoSWB are sent to the network.

Event-driven Transmission

Each time nviSWA or nviSWB is received, nvoSWA and nvoSWB are sent.

SNVT and SCPT Truth Table

Input Network Variable			Output Network Variable	
nviSWA[0] (state)	**nviSWB[0] (state)**	**nciAndOr[0] (state)**	**nvoSWA[0]**	**nvoSWB[0]**
0	0	0	OFF	ON
1	0	0	ON	OFF
1 or 0	1	0	OFF	ON
0	0	1	OFF	OFF
0	1	1	OFF	ON
1	0	1	OFF	ON
1	1	1	ON	ON

ON: (state) = 1, (value) = 100.0%
OFF: (state) = 0, (value) = 0.0%

Presets

The configuration type of nciAndOr is SNVT_switch (value, state). Its value has no effect.

When nciAndOr is changed, the result takes effect after the node has been reset or after either nviSWA or nviSWB has received an input.

⚠ Caution

- Do not make a binding such that output network variables (nvoSWA[0] to [5], nvoSWB[0] to [5]) are directly fed back to input network variables (nviSWA[0] to [5], nviSWB[0] to [5]). If send and receive signals make a loop, data transmission continues infinitely and the network can not perform correct communication. The same consideration is needed to prevent multiple Virtual I/O functional blocks from making a loop.

Example 1: Using Virtual I/O functional block VIO[0] for Boolean operation (Inversion/Buffer)

1. Set configuration property nciAndOr[0] (state) to 0.
2. Set input network variable nviSWB[0] (state) to 0.
3. Make input network variable nviSWA[0] (state) to receive 0 or 1.

When nviSWA[0] (state) receives 0:

nvoSWA[0] sends the same value as nviSWA[0], that is (state = 0, value = 0.0%).
nvoSWB[0] sends the inverted value of nviSWA[0], that is (state = 1, value = 100.0%).

When nviSWA[0] (state) receives 1:

nvoSWA[0] sends the same value as nviSWA[0], that is (state = 1, value = 100.0%).
nvoSWB[0] sends the inverted value of nviSWA[0], that is (state = 0, value = 0.0%).

Example 2: Using Virtual I/O functional block VIO[0] for forced stop

1. Set configuration property nciAndOr[0] (state) to 0.
2. Make input network variable nviSWB[0] (state) to receive 1.

Then, regardless of nviSWA[0] (state), nvoSWA[0] sends OFF (state = 0, value = 0.0%), and nvoSWB[0] sends ON (state = 1, value = 100.0%).

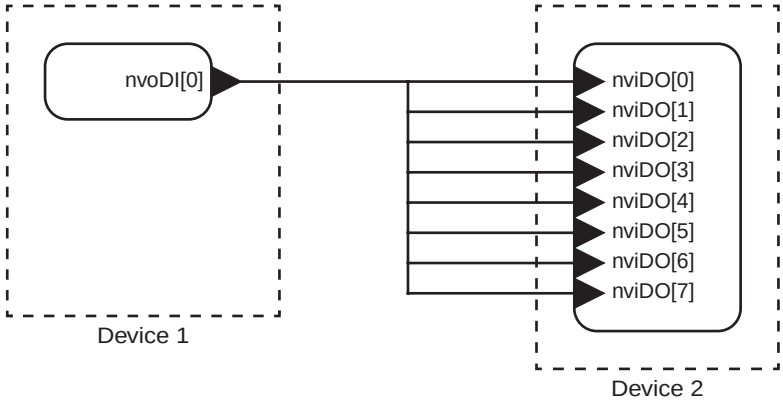
Example 3: Using Virtual I/O functional block VIO[0] for Boolean operation (AND/OR)

1. Set configuration property nciAndOr[0] (state) to 1.
2. Make input network variables nviSWA[0] (state) and nviSWB[0] (state) to receive 0 or 1.

Then, nvoSWA[0] sends the logical AND result of nviSWA[0] (state) and nviSWB[0] (state). Similarly, nvoSWB[0] sends the logical OR result of nviSWA[0] (state) and nviSWB[0] (state).

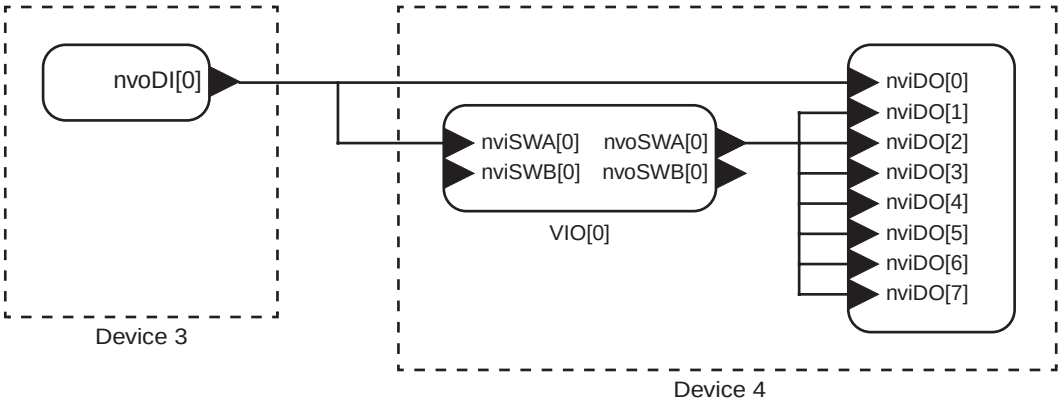
Example 4: Using Virtual I/O functional block VIO[0] to communicate with multiple input network variables

The figure below illustrates a network consisting of Device 1 with one output network variable and Device 2 with eight input network variables. In this network configuration, Device 1 uses seven alias tables, because binding more than one network variable on one device requires additional alias tables.



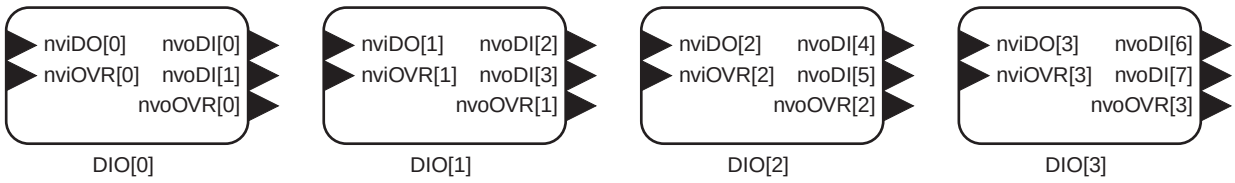
Network Consisting of Digital Input and Digital Output Functional Blocks

The next example shows a network consisting of Device 3 with one output network variable and Device 4 with eight input network variables and a Virtual I/O functional block. In this network configuration, Device 3 uses only one alias table. Using virtual I/O functional blocks, Device 3 can communicate with more input network variables as many as six alias tables.



Network Containing Virtual I/O Functional Block

Shot Output/Digital Input Functional Block



The Shot Output/Digital Input functional block is designed for start/stop control. The output pulse signals can be used to turn on and off external keep relays. While input variable nviOVR is off, input variable nviDO can be used to generate a start or stop signal. For example on DIO[0], when nviDO[0] receives an ON signal, output terminal 0 outputs a start pulse. When nviDO[0] receives an OFF signal, output terminal 1 outputs a stop pulse. When input variable nviOVR[0] turns on, output terminal 1 outputs a stop pulse and subsequent nviDO[0] signals are ignored.

This functional block also has input terminals to receive the operation status and alarm inputs, which are reflected on output network variables nvoDI to be sent to the network. The output network variables have the same function as the Digital Input functional block, and have no relationship with output pulse signals sent from output terminals.

I/O	Name	Type	Description
Input Network Variable	nviDO[0]	SNVT_switch	Sends start/stop pulses from Start 0 and Stop 0 (output terminals 0 and 1)
	nviDO[1]	SNVT_switch	Sends start/stop pulses from Start 1 and Stop 1 (output terminals 2 and 3)
	nviDO[2]	SNVT_switch	Sends start/stop pulses from Start 2 and Stop 2 (output terminals 4 and 5)
	nviDO[3]	SNVT_switch	Sends start/stop pulses from Start 3 and Stop 3 (output terminals 6 and 7)
	nviOVR[0] to [3]	SNVT_switch	Sends stop pulses from Stop 0 to Stop 3 (output terminals 1, 3, 5, 7), and disables nviDO[0] to [3]
Output Network Variable	nvoDI[0], [2], [4], [6]	SNVT_switch	Sends Status 0, 1, 2, and 3 to the network
	nvoDI[1], [3], [5], [7]	SNVT_switch	Sends Alarm 0, 1, 2, and 3 to the network
	nvoOVR[0] to [3]	SNVT_switch	Sends the received nviOVR[0] to [3] values to the network
Configuration Property	nciMaxStsSendT1[0]	SCPTmaxSndT	nvoDI[0] and [1] heartbeat transmission interval (factory setting: 3 minutes)
	nciMaxStsSendT1[1]	SCPTmaxSndT	nvoDI[2] and [3] heartbeat transmission interval (factory setting: 3 minutes)
	nciMaxStsSendT1[2]	SCPTmaxSndT	nvoDI[4] and [5] heartbeat transmission interval (factory setting: 3 minutes)
	nciMaxStsSendT1[3]	SCPTmaxSndT	nvoDI[6] and [7] heartbeat transmission interval (factory setting: 3 minutes)

Initial Status Transmission

This functional block sends output network variables within 3 seconds to the network after powerup. The delay depends on a random number based on the Neuron ID, and differs on each node.

The sending time can be delayed by changing the nciPwrup value designated in the Node Object functional block. At system startup, if the SX5L sends output network variables before the addressee device is ready to receive communication, set the nciPwrup to a larger value.

The preset value for nciPwrup can be between 0 and 60 seconds (0.1-sec increments). The sending time is determined by the sum of the nciPwrup value and a random number.

Event-driven Transmission

When the status at any input terminal changes or when receiving a request (polling) from the network, this functional block sends a corresponding output network variable.

Heartbeat Transmission (Periodical Transmission)

When the status at any input terminal does not change, this functional block sends the output network variable repeatedly at intervals designated by nciMaxStsSendT1[0] to [3]. When the nciMaxStsSendT1[0] to [3] value is 0, the heartbeat transmission is disabled.

The configuration type of nciMaxStsSendT1[0] to [3] is SNVT_elapsed_tm (day, hour, minute, second, millisecond). When a value over 12 hours is set, the interval is designated as 12 hours 00 minutes 00 seconds. The millisecond value has no effect.

Input Network Variables vs. Output Pulse

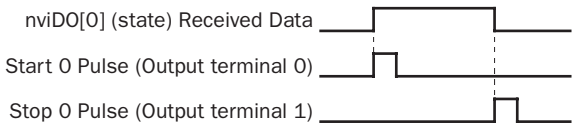
Depending on the statuses of input variables nviDO and nviOVR, a start or stop output pulse is generated or suppressed. For DIO[0], the following tables summarize the relationships of input variables nviDO[0] and nviOVR[0] with start or stop output pulse generation from output terminal 0 or 1, respectively. For DIO[1] through DIO[3], start and stop output pulses are generated from output terminals 2 through 7 similarly.

nviOVR[0] Status	nviDO[0] Received Data	Pulse Output
OFF	Receive ON signal	Sends a start 0 pulse from output terminal 0
	Receive OFF signal	Sends a stop 0 pulse from output terminal 1
ON	Receive either ON or OFF signal	No output

nviOVR[0] Received Data	nviDO[0] Status	Pulse Output
Receive ON signal	Either ON or OFF	Sends a stop 0 pulse from output terminal 1
Receive OFF signal	ON	Sends a start 0 pulse from output terminal 0
	OFF	Sends a stop 0 pulse from output terminal 1

(1) While nviOVR[0] is off

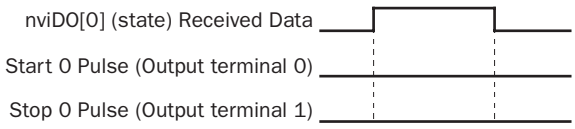
When nviDO[0] receives an ON signal while nviOVR[0] is off, this functional block sends a start 0 pulse (pulse width approximately 1 second) from output terminal 0. When nviDO[0] receives an OFF signal, this functional block sends a stop 0 pulse (pulse width approximately 1 second) from output terminal 1.



Note: Once nviOVR[0] has received an OFF (or ON) signal, the internal nviOVR[0] status remains off (or on) until nviOVR[0] receives an ON (or OFF) signal. Similarly, once nviDO[0] has received an OFF (or ON) signal, the internal nviDO[0] status remains off (or on) until nviDO[0] receives an ON (or OFF) signal.

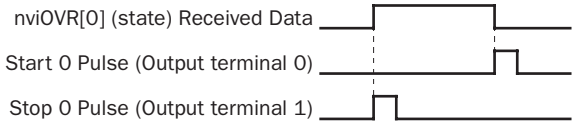
(2) While nviOVR[0] is on

While nviOVR[0] is on, nviOVR[0] overrides nviDO[0]. Consequently, this functional block does not send a start or stop pulse even when nviDO[0] receives an ON or OFF signal while nviOVR[0] is on.



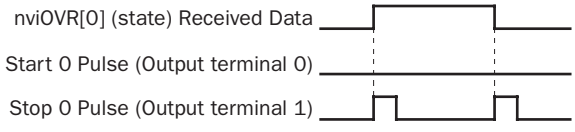
(3) While nviDO[0] is on

When nviOVR[0] receives an ON signal while nviDO[0] is on, this functional block sends a stop pulse (pulse width approximately 1 second) from output terminal 1. When nviOVR[0] receives an OFF signal, this functional block sends a start pulse (pulse width approximately 1 second) from output terminal 0.

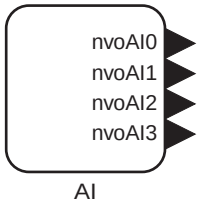


(4) While nviDO[0] is off

When nviOVR[0] receives either an ON or OFF signal while nviDO[0] is off, this functional block sends a stop pulse (pulse width approximately 1 second) from output terminal 1.



Analog Input Functional Block



Analog input channels 0 through 3 correspond to nvoAI0 through nvoAI3, respectively. At the factory settings, analog input signals of 1 to 5V or 4 to 20 mA are converted to 1 through 100%, and the result is sent to the network.

The output network variable type of the Analog Input functional block can be changed to various SNVTs as shown on page 4-11.

I/O	Name	Type	Description
Output Network Variable	nvoAI0	SNVT_lev_percent	Corresponds to channel 0
	nvoAI1	SNVT_lev_percent	Corresponds to channel 1
	nvoAI2	SNVT_lev_percent	Corresponds to channel 2
	nvoAI3	SNVT_lev_percent	Corresponds to channel 3
Configuration Property	nciMaxStsSendT1	SCPTmaxSndT	nvoAI0 to nvoAI3 heartbeat transmission interval (factory setting: 3 minutes)
	nciMinSendT1	SCPTminSndT	nvoAI0 to nvoAI3 minimum transmission interval (factory setting: 1 second)
	nciMaxRng[0]	SCPTmaxRnge	Designates nvoAI0 maximum value (factory setting: 100%)
	nciMaxRng[1]	SCPTmaxRnge	Designates nvoAI1 maximum value (factory setting: 100%)
	nciMaxRng[2]	SCPTmaxRnge	Designates nvoAI2 maximum value (factory setting: 100%)
	nciMaxRng[3]	SCPTmaxRnge	Designates nvoAI3 maximum value (factory setting: 100%)
	nciMinRng[0]	SCPTminRnge	Designates nvoAI0 minimum value (factory setting: 0%)
	nciMinRng[1]	SCPTminRnge	Designates nvoAI1 minimum value (factory setting: 0%)
	nciMinRng[2]	SCPTminRnge	Designates nvoAI2 minimum value (factory setting: 0%)
	nciMinRng[3]	SCPTminRnge	Designates nvoAI3 minimum value (factory setting: 0%)
	nciMinDelta[0]	SCPTsndDelta	Minimum change to send nvoAI0 (factory setting: 0%) valid for every input level
	nciMinDelta[1]	SCPTsndDelta	Minimum change to send nvoAI1 (factory setting: 0%) valid for every input level
	nciMinDelta[2]	SCPTsndDelta	Minimum change to send nvoAI2 (factory setting: 0%) valid for every input level
	nciMinDelta[3]	SCPTsndDelta	Minimum change to send nvoAI3 (factory setting: 0%) valid for every input level

Initial Status Transmission

This functional block sends output network variables to the network within 3 seconds after powerup. The delay depends on a random number based on the Neuron ID, and differs on each node.

The sending time can be delayed by changing the nciPwrup value designated in the Node Object functional block. At system startup, if the SX5L sends output network variables before the addressee device is ready to receive communication, set the nciPwrup to a larger value.

The preset value for nciPwrup can be between 0 and 60 seconds (0.1-sec increments). The sending time is determined by the sum of the nciPwrup value and a random number.

Event-driven Transmission

When receiving a request (polling) from the network or when detecting a change larger than the value designated by nciMinDelta[0] through nciMinDelta[3], this functional block sends a corresponding output network variable.

Heartbeat Transmission (Periodical Transmission)

When the analog input value at any input terminal does not change, this functional block sends the output network variable of the analog input value repeatedly at intervals designated by nciMaxStsSendT1. When the nciMaxStsSendT1 value is 0, the heartbeat transmission is disabled.

The configuration type of nciMaxStsSendT1 is SNVT_elapsed_tm (day, hour, minute, second, millisecond). When a value over 12 hours is set, the interval is designated as 12 hours 00 minutes 00 seconds. The millisecond value has no effect.

Scaling and Sampling Intervals

The input data of 1 to 5V or 4 to 20 mA DC received by channel 0 is converted to a value in the range between nciMinRng[0] and nciMaxRng[0], and the resultant output network variable nvoAI0 is sent to the network. Similarly, for channels 1 through 3, network variables nvoAI1 through nvoAI3 are sent to the network.

When the input value drops below 1V or 4 mA DC or exceeds 5V or 20 mA DC, an input in the range between –4% and +104% is converted and the resultant output network variable is sent to the network. When the input value further drops or exceeds, output network variable 7FFF is sent as input error data.

The configuration type of nciMinSendT1 to designate the minimum transmission interval is SNVT_elapsed_tm (day, hour, minute, second, millisecond). When a value over 60 seconds is set, the interval is designated as 60 seconds.

Changing SVNT Type

The type of output network variables nvoAI0 through nvoAI3 can be changed. To change the type of the output network variable, use the LonMaker Browser. Right-click on the network variable you want to change, and from the short-cut menu, select [Change Type]. The changeable network variable types are listed in the table below, with the SNVT index approved by the LONMARK Interoperability Association.

Index	Type	Index	Type	Index	Type	Index	Type
1	SVNT_amp	20	SVNT_length_mil	41	SVNT_vol	100	SVNT_density
2	SVNT_amp_mil	23	SVNT_mass	42	SVNT_vol_kilo	102	SVNT_rpm
3	SVNT_angle	24	SVNT_mass_kilo	43	SVNT_vol_mil	104	SVNT_angle_deg
4	SVNT_angle_vel	25	SVNT_mass_mega	44	SVNT_volt	105	SVNT_temp_p
5	SVNT_btu_kilo	26	SVNT_mass_mil	45	SVNT_volt_dbmv	107	SVNT_time_sec
6	SVNT_btu_mega	27	SVNT_power	46	SVNT_volt_kilo	110	SVNT_area
8	SVNT_count	28	SVNT_power_kilo	47	SVNT_volt_mil	113	SVNT_press_p
9	SVNT_count_inc	29	SVNT_ppm	71	SVNT_grammage	123	SVNT_time_min
13	SVNT_elec_kwh	30	SVNT_press	76	SVNT_freq_hz	124	SVNT_time_hour
14	SVNT_elec_whr	31	SVNT_res	77	SVNT_freq_kilohz	125	SVNT_ph
15	SVNT_flow	32	SVNT_res_kilo	78	SVNT_freq_milhz	129	SVNT_smo_obscur
16	SVNT_flow_mil	33	SVNT_sound_db	79	SVNT_lux	131	SVNT_temp_ror
17	SVNT_length	34	SVNT_speed	81	SVNT_lev_percent	138	SVNT_volt_ac
18	SVNT_length_kilo	35	SVNT_speed_mil	82	SVNT_multiplier	139	SVNT_amp_ac
19	SVNT_length_micr	39	SVNT_temp	98	SVNT_pwr_fact		

Example: Connect a pressure sensor to channel 0 of an analog input module and change the SNVT type

Sensor specifications

Measurement Range	20 to 100 kPa
Analog Output Value	4 to 20 mA

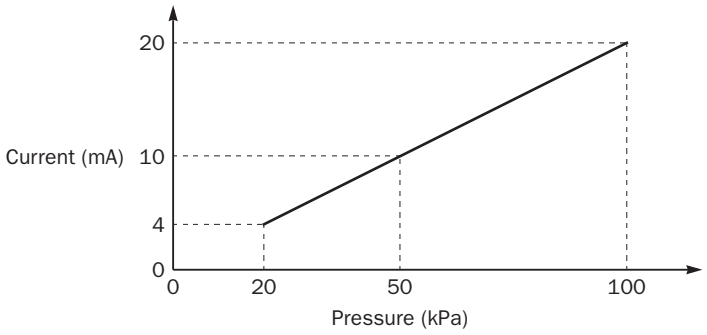
1. Use the LonMaker Browser to change the SNVT type of nvoAI0.

On the LonMaker Browser screen, right-click on the network variable line. From the short-cut menu, select [Change Type], then select "SNVT_press."

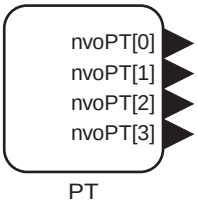
2. Set the nciMinRng[0] and nciMaxRng[0] values as shown below.

nciMinRng[0]	20
nciMaxRng[0]	100

When the analog input module receives an analog value of 20 kPa (4 mA), the analog input module sends nvoAI0 data representing 20 kPa to the network. Similarly, when receiving 50 kPa (10 mA), the analog input module sends nvoAI0 data representing 50 kPa.



Pt100Ω Input Functional Block



Four input channels 0 through 3 of Pt100Ω resistance thermometers correspond to output variables nvoPT[0] through nvoPT[3], respectively. When detecting any change in measured temperature, this functional block sends a corresponding output network variable to the network.

I/O	Name	Type	Description
Output Network Variable	nvoPT[0]	SNVT_temp_p	Corresponds to channel 0
	nvoPT[1]	SNVT_temp_p	Corresponds to channel 1
	nvoPT[2]	SNVT_temp_p	Corresponds to channel 2
	nvoPT[3]	SNVT_temp_p	Corresponds to channel 3
Configuration Property	nciMaxStsSendT1	SCPTmaxSndT	nvoPT[0] to nvoPT[3] heartbeat transmission interval (factory setting: 3 minutes)
	nciMinSendT1	SCPTminSndT	nvoPT[0] to nvoPT[3] minimum transmission interval (factory setting: 1 second)
	nciMinDelta[0]	SCPTsndDelta	Minimum change to send nvoPT[0] (factory setting: 0°C) valid for every input level
	nciMinDelta[1]	SCPTsndDelta	Minimum change to send nvoPT[1] (factory setting: 0°C) valid for every input level
	nciMinDelta[2]	SCPTsndDelta	Minimum change to send nvoPT[2] (factory setting: 0°C) valid for every input level
	nciMinDelta[3]	SCPTsndDelta	Minimum change to send nvoPT[3] (factory setting: 0°C) valid for every input level

Initial Status Transmission

This functional block sends output network variables to the network within 3 seconds after powerup. The delay depends on a random number based on the Neuron ID, and differs on each node.

The sending time can be delayed by changing the nciPwrup value designated in the Node Object functional block. At system startup, if the SX5L sends output network variables before the addressee device is ready to receive communication, set the nciPwrup to a larger value.

The preset value for nciPwrup can be between 0 and 60 seconds (0.1-sec increments). The sending time is determined by the sum of the nciPwrup value and a random number.

Event-driven Transmission

When receiving a request (polling) from the network or when detecting a change larger than the value designated by nciMinDelta[0] through nciMinDelta[3], this functional block sends a corresponding output network variable.

The resistance value of the Pt100Ω resistance thermometer connected to channel 0 is converted to a value between 0 and +50°C (SX5L-SBPT04X1) or between –20 and +80°C (SX5L-SBPT04Y1), and the resultant output network variable nvoPT[0] is sent to the network. Channels 1 through 3 work similarly with nvoPT[1] through nvoPT[3].

Heartbeat Transmission (Periodical Transmission)

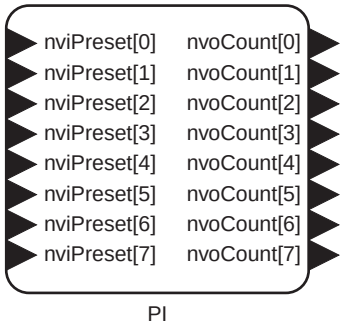
When the input value at any input terminal does not change, this functional block sends output network variables nvoPT[0] through nvoPT[3] repeatedly at intervals designated by nciMaxStsSendT1. When the nciMaxStsSendT1 value is 0, the heartbeat transmission is disabled.

The configuration type of nciMaxStsSendT1 is SNVT_elapsed_tm (day, hour, minute, second, millisecond). When a value over 12 hours is set, the interval is designated as 12 hours 00 minutes 00 seconds. The millisecond value has no effect.

Sampling Intervals

The configuration type of nciMinSendT1 to designate the minimum transmission interval is SNVT_elapsed_tm (day, hour, minute, second, millisecond). When a value over 60 seconds is set, the interval is designated as 60 seconds.

Pulse Count Functional Block



The Pulse Count functional block counts input pulses to each terminal. Pulse input terminals 0 through 7 correspond to output network variables nvoCount[0] through nvoCount[7], respectively. When the node power is turned off, the Pulse Count functional block maintains the current value, and continues counting when power is restored.

I/O	Name	Type	Description
Input Network Variable	nviPreset[0] to [7]	SNVT_count_f	Receives adding counter new current value
Output Network Variable	nvoCount[0] to [7]	SNVT_switch	Sends adding counter current value
Configuration Property	nciMaxStsSendT1	SCPTmaxSndT	nvoCount[0] to [7] heartbeat transmission interval (factory setting: 3 minutes)
	nciMinSendT1	SCPTminSndT	nvoCount[0] to [7] minimum transmission interval (factory setting: 1 second)
	nciDefaults	SCPTdefltBehave	Enable nvoCount[0] to [7] event-driven transmission (factory setting: enable)
	nciMaxRng [0] to [7]	SCPTmaxRnge	Maximum value of nvoCount[0] to [7] counters (factory setting: 9,999,999)

Adding Counter Specifications

The Pulse Count functional block has eight adding counters assigned to input terminals 0 through 7, and sends output network variables nvoCount[0] through nvoCount[7] of the counter current values to the network.

When power is turned off, the current values are stored to the EEPROM in the Neuron Chip. Data storage can be repeated a maximum of 10,000 times according to the Neuron Chip specifications.

When the pulse input module is started, the current values stored in the EEPROM are restored to nvoCount[0] through nvoCount[7]. The current values can be changed by sending new values to nviPreset[0] through nviPreset[7] from the network.

The maximum current values of nvoCount[0] through nvoCount[7] can be designated using nciMaxRng[0] through nciMaxRng[7]. Valid values are between 0 and 9,999,999. After the current value reaches the maximum value, the current value changes to 0 on the next count up, and the counter repeats another counting cycle.

Initial Status Transmission

This functional block sends output network variables to the network within 3 seconds after powerup. The delay depends on a random number based on the Neuron ID, and differs on each node.

The sending time can be delayed by changing the nciPwrup value designated in the Node Object functional block. At system startup, if the SX5L sends output network variables before the addressee device is ready to receive communication, set the nciPwrup to a larger value.

The preset value for nciPwrup can be between 0 and 60 seconds (0.1-sec increments). The sending time is determined by the sum of the nciPwrup value and a random number.

Event-driven Transmission

Event-driven transmission is enabled or disabled by setting the nciDefaults state as shown below.

nciDefaults	Event-driven Transmission
(state) = 1, (value) = no effect	Enable event-driven transmission. Output network variables nvoCount[0] through nvoCount[7] are sent immediately when any change occurs in these values. (factory setting)
(state) = 0, (value) = no effect	Disable event-driven transmission.

Whether event-driven transmission is enabled or not, nvoCount[0] through nvoCount[7] are sent when receiving a request (polling) from the network or at regular intervals designated by nciMaxStsSendT1.

Heartbeat Transmission (Periodical Transmission)

This functional block sends nvoCount[0] through nvoCount[7] repeatedly at intervals designated by nciMaxStsSendT1.

The configuration type of nciMaxStsSendT1 is SNVT_elapsed_tm (day, hour, minute, second, millisecond). When a value over 12 hours is set, the interval is designated as 12 hours 00 minutes 00 seconds. The millisecond value has no effect.

When the nciMaxStsSendT1 value is 0, the heartbeat transmission is disabled.

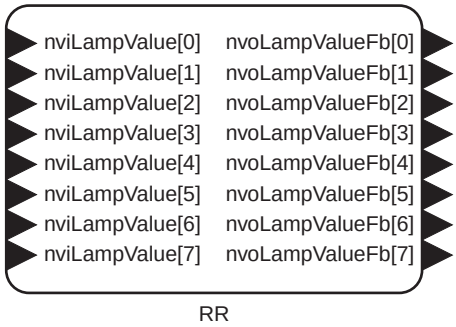
Sampling Intervals

The nciMinSendT1 designates the minimum interval of sending nvoCount[0] through nvoCount[7].

The configuration type of nciMinSendT1 is SNVT_elapsed_tm (day, hour, minute, second, millisecond). When a value over 12 hours is set, the interval is designated as 12 hours 00 minutes 00 seconds. The millisecond value has no effect.

When the nciMinSendT1 value is 0, the minimum transmission interval is disabled.

Remote-control Relay Control Functional Block



Remote-control relay control terminals 0 through 7 correspond to input network variables nviLampValue[0] through nviLampValue[7] and output network variables nvoLampValueFb[0] through nvoLampValueFb[7], respectively. When nviLampValue receives an ON or OFF signal, this functional block sends a signal to directly control the remote-control relay. This functional block also monitors the remote-control relay, and sends nvoLampValueFb to the network when detecting a change in the ON/OFF status of the remote-control relay.

I/O	Name	Type	Description
Input Network Variable	nviLampValue[0] to [7]	SNVT_switch	Controls remote-control relay
Output Network Variable	nvoLampValueFb[0] to [7]	SNVT_switch	Sends feedback signal
Configuration Property	nciMaxStsSendT1	SCPTmaxSndT	nvoLampValueFb[0] to [7] heartbeat transmission interval (factory setting: 3 minutes)
	nciDefaults	SCPTdefltBehave	Enable nvoLampValueFb[0] to [7] event-driven transmission (factory setting: enable)

Input Network Variable vs. Remote-control Relay Status

When input variables nviLampValue[0] through nviLampValue[7] receive the following signal, this functional block turns on or off the remote control relay.

Input Network Variable	Remote-control Relay
(state) = 1, (value) = no effect	ON
(state) = 0, (value) = no effect	OFF

Each time receiving an input variable, this functional block controls one remote-control relay so that more than one remote-control relay does not turn on simultaneously.

Initial Status Transmission

This functional block sends output network variables to the network within 3 seconds after powerup. The delay depends on a random number based on the Neuron ID, and differs on each node.

The sending time can be delayed by changing the nciPwrup value designated in the Node Object functional block. At system startup, if the SX5L sends output network variables before the addressee device is ready to receive communication, set the nciPwrup to a larger value.

The preset value for nciPwrup can be between 0 and 60 seconds (0.1-sec increments). The sending time is determined by the sum of the nciPwrup value and a random number.

Event-driven Transmission

Event-driven transmission is enabled or disabled by setting the nciDefaults state as shown below.

nciDefaults	Event-driven Transmission
(state) = 0, (value) = no effect	Enable event-driven transmission. Output network variables nvoLampValueFb[0] through nvoLampValueFb[7] are sent immediately when any change occurs in these values. (factory setting)
(state) = 1, (value) = no effect	Disable event-driven transmission.

Whether event-driven transmission is enabled or not, nvoLampValueFb[0] through nvoLampValueFb[7] are sent when receiving a request (polling) from the network or at regular intervals designated by nciMaxStsSendT1.

Heartbeat Transmission (Periodical Transmission)

This functional block sends nvoLampValueFb[0] through nvoLampValueFb[7] repeatedly at intervals designated by nciMaxStsSendT1.

The configuration type of nciMaxStsSendT1 is SNVT_elapsed_tm (day, hour, minute, second, millisecond). When a value over 12 hours is set, the interval is designated as 12 hours 00 minutes 00 seconds. The millisecond value has no effect.

When the output network variable has been sent upon receiving a status change signal from the remote-control relay, the heartbeat transmission timer is reset and restarts to time down.

Output Network Variable Data

Depending on the remote-control relay status, output network variables nvoLampValueFb[0] through nvoLampValueFb[7] send the following data to the network:

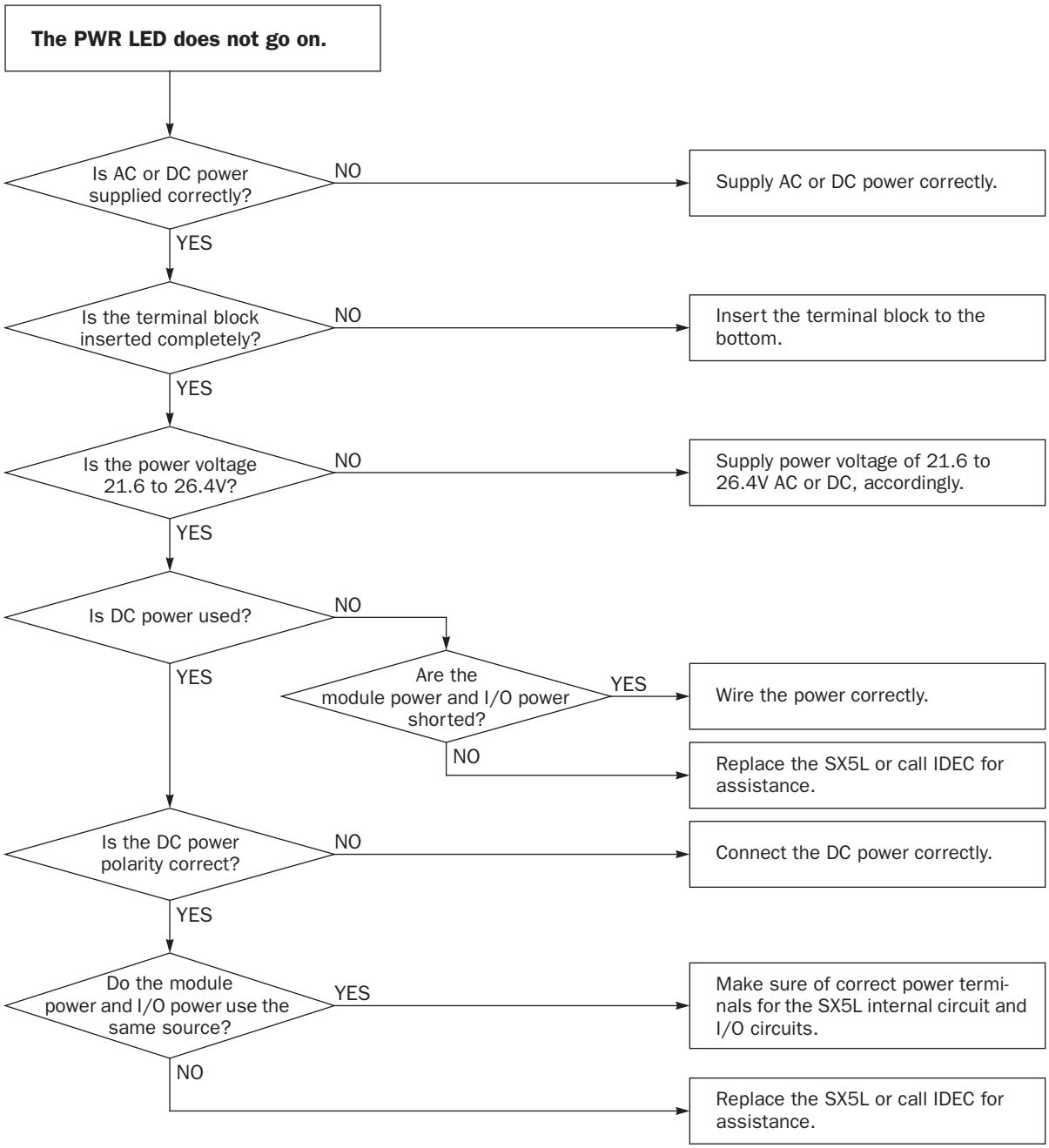
Remote-control Relay	Output Network Variable
ON	(state) = 1, (value) = 100.0%
OFF	(state) = 0, (value) = 0.0%

5: TROUBLESHOOTING

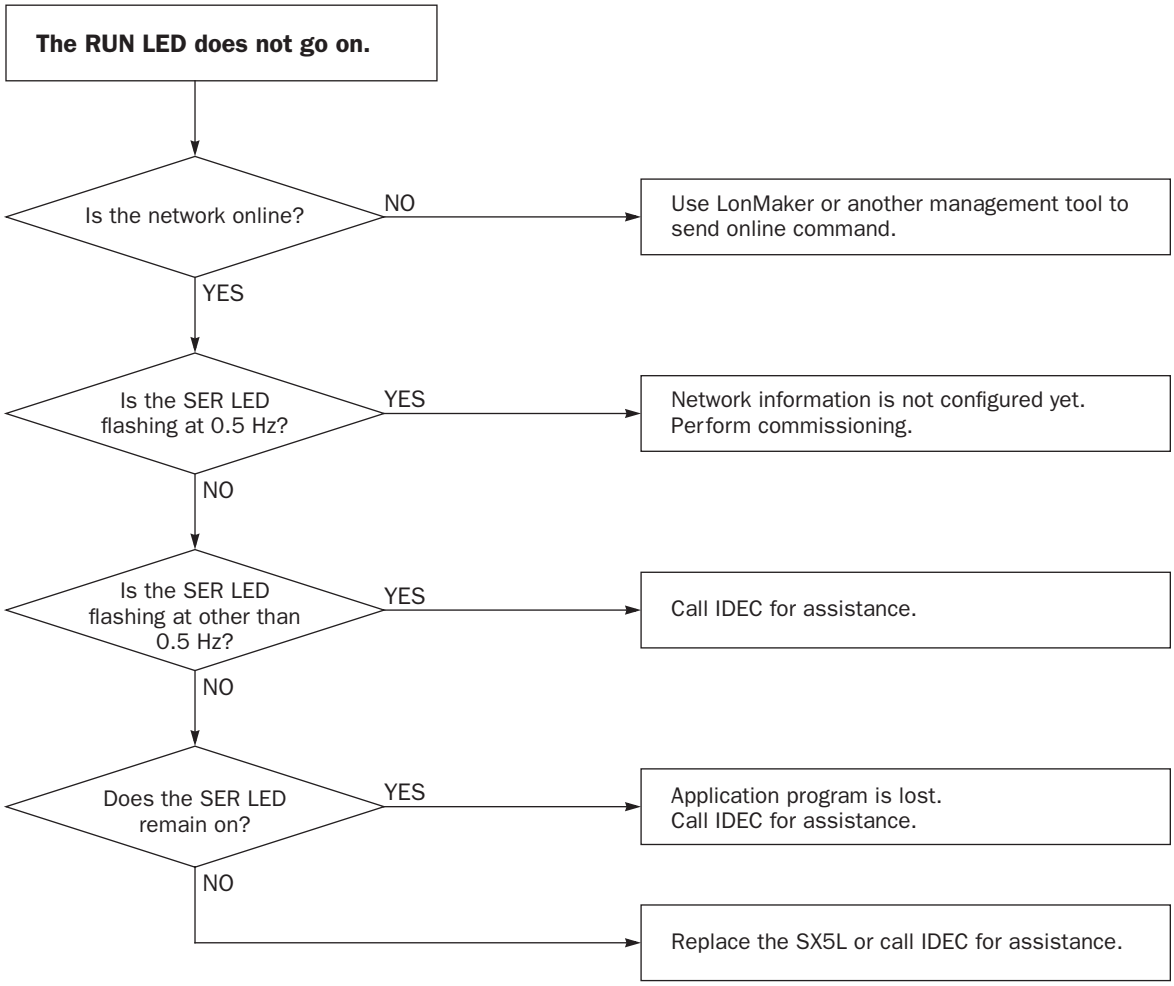
Introduction

This chapter describes the procedure to determine the cause of trouble and actions to be taken when any trouble occurs while operating the SX5L communication terminals.

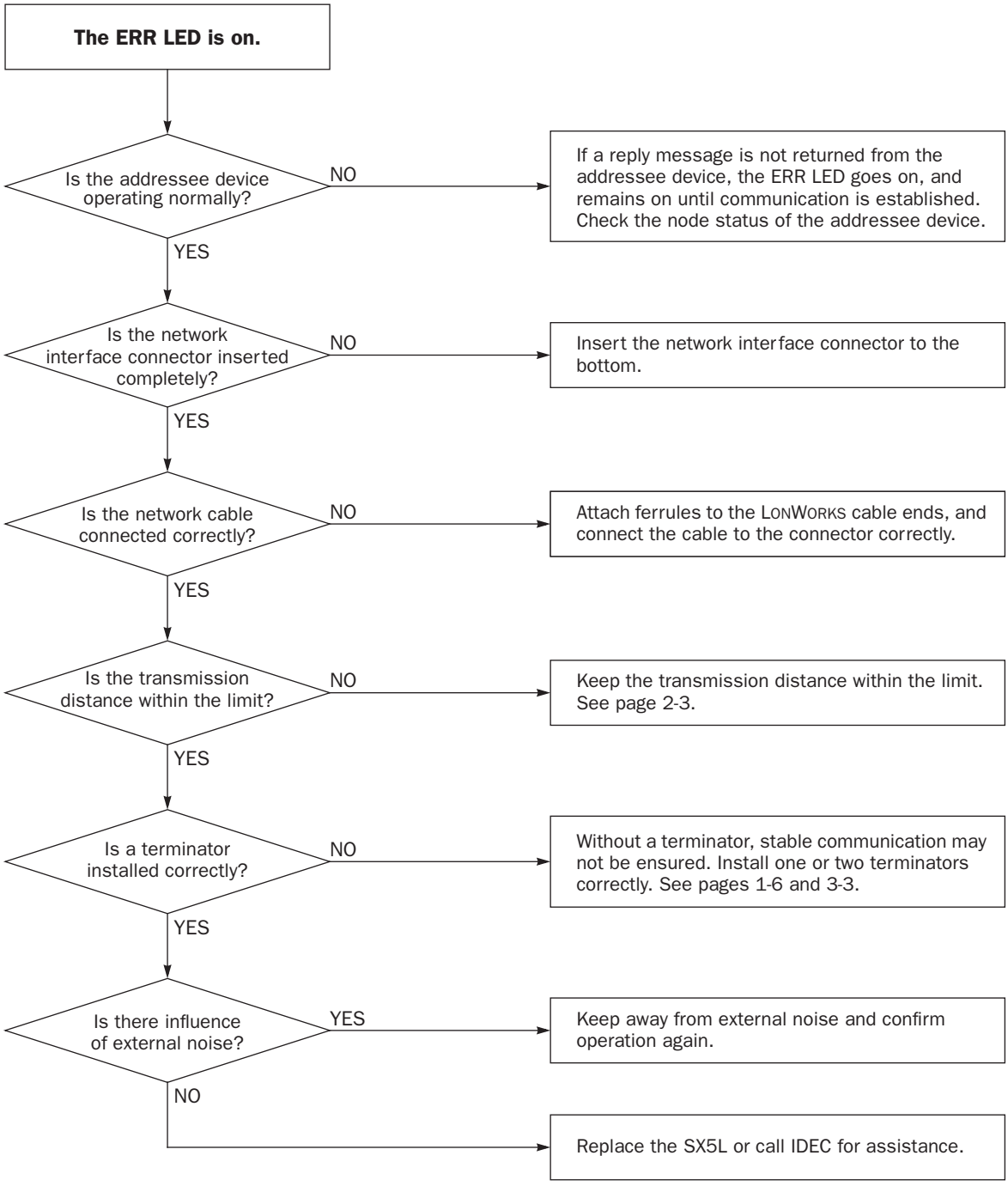
Troubleshooting Diagram 1



Troubleshooting Diagram 2

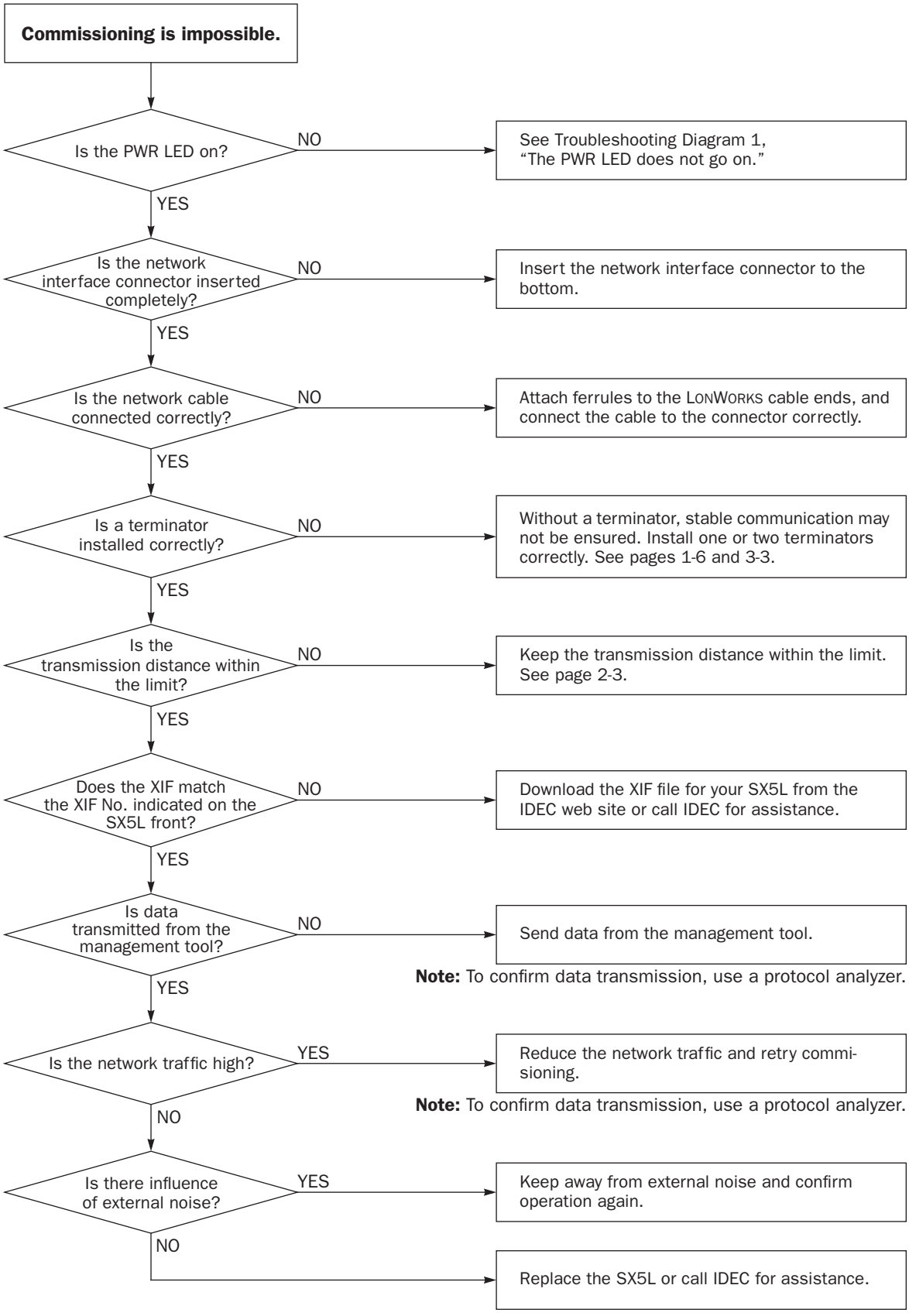


Troubleshooting Diagram 3

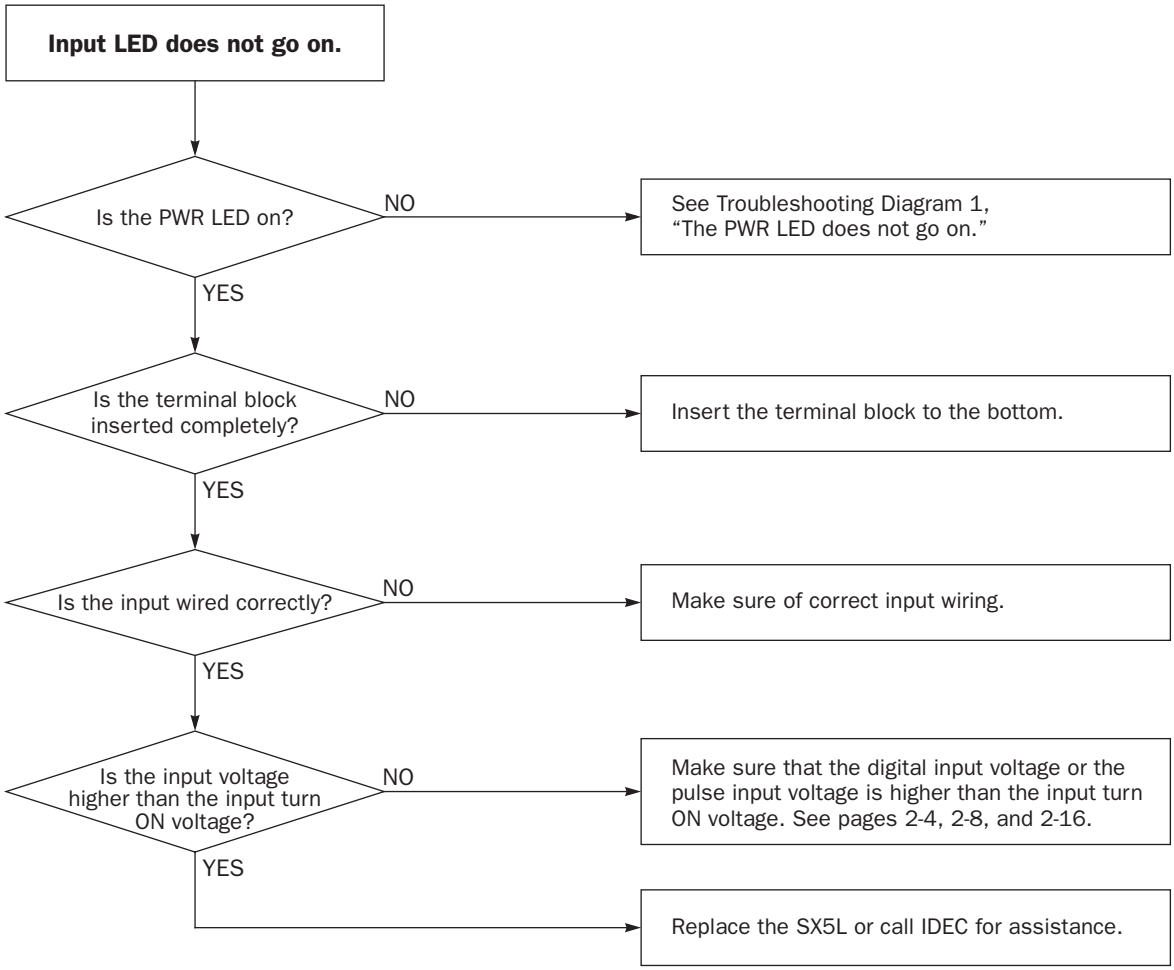


Note: If the ERR LED goes on repeatedly, see "Communication seems incomplete" on page 5-8.

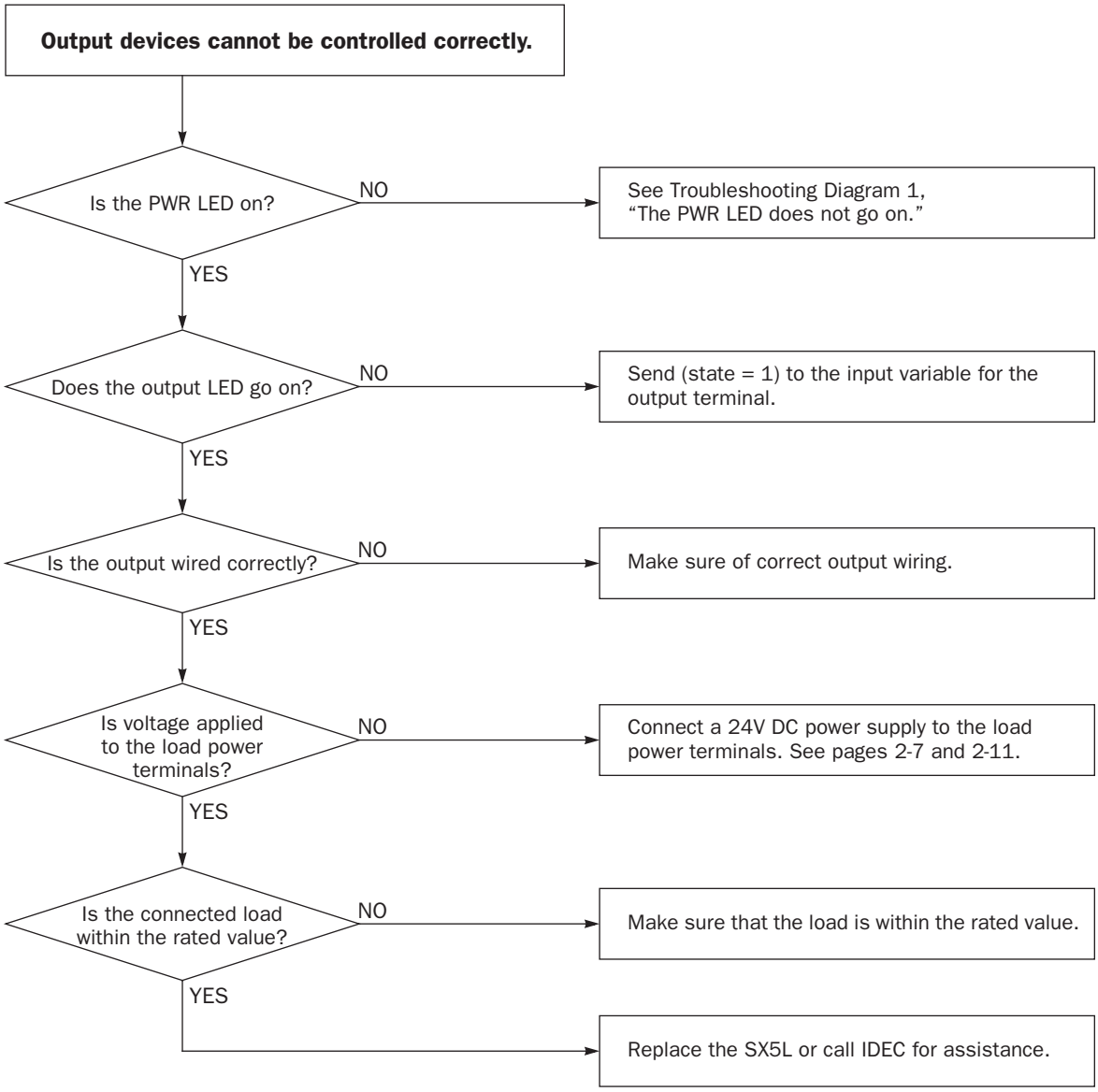
Troubleshooting Diagram 4



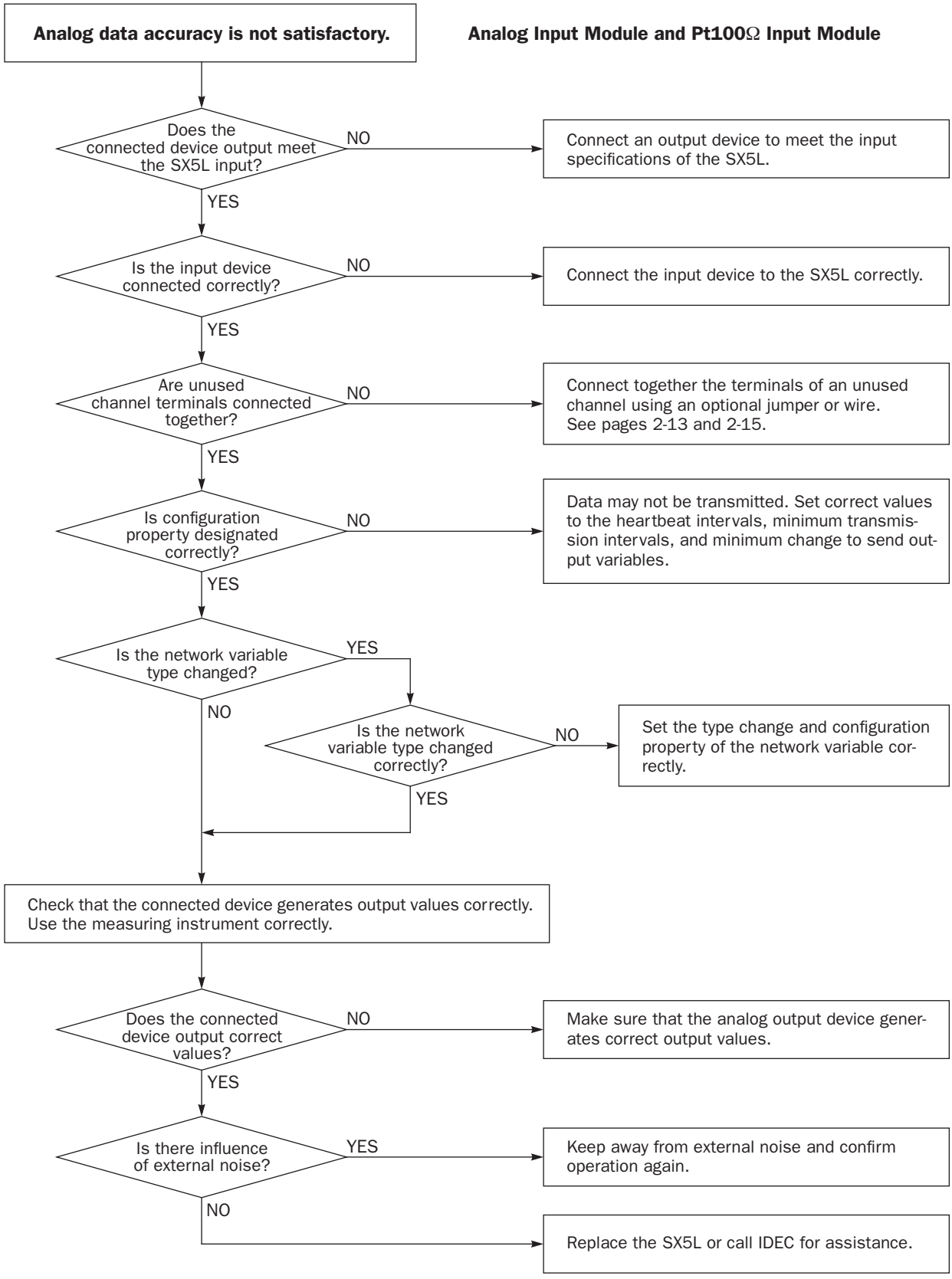
Troubleshooting Diagram 5



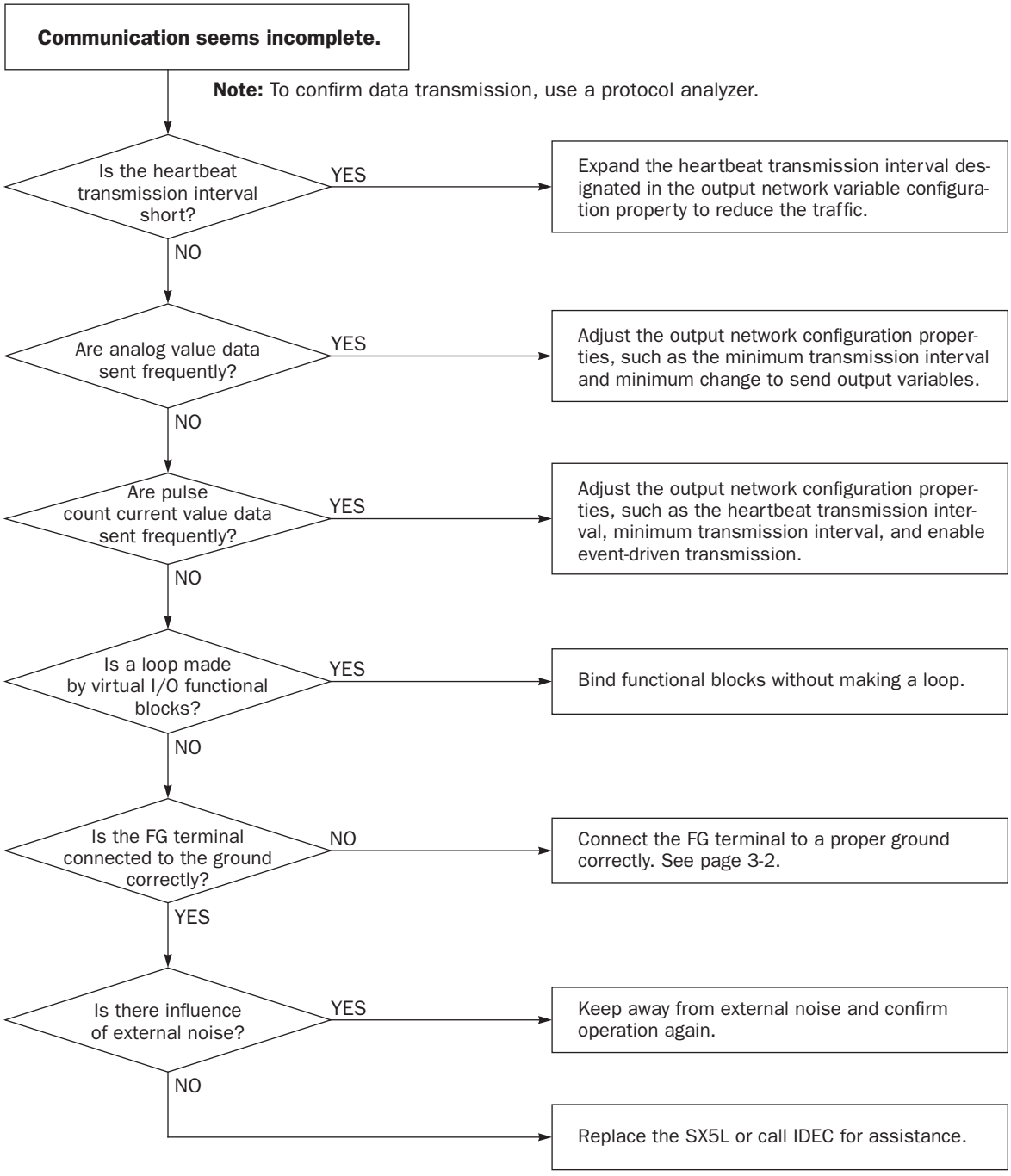
Troubleshooting Diagram 6



Troubleshooting Diagram 7



Troubleshooting Diagram 8



APPENDIX

Introduction

This chapter describes type numbers of the SX5L communication terminals and accessories, and also provides a glossary of major terms related to LONWORKS.

Type List

SX5L Communication Terminal Type Number

Module Name	Power Voltage	I/O Points	Type No.
Digital Input	24V DC	16-point source/sink input, plus/minus common compatible	SX5L-SBN16B1
Digital Output	24V DC	16-point transistor sink output, plus common	SX5L-SBT16K1
		16-point transistor source output, minus common	SX5L-SBT16S1
Digital I/O	24V DC	8-point source input, minus common 8-point transistor sink output, plus common	SX5L-SBM16K1
		8-point source input, minus common 8-point transistor sink output, plus common (start/stop control)	SX5L-SBM16K2
		8-point sink input, plus common 8-point transistor source output, minus common	SX5L-SBM16S1
		8-point sink input, plus common 8-point transistor source output, minus common (start/stop control)	SX5L-SBM16S2
Analog Input	24V AC/DC	4-point, 1 to 5V, 4 to 20 mA	SX5L-SBAN041
Pt100Ω Input	24V AC/DC	4-point, 3-wire Pt100Ω resistance thermometer, 0 to 50°C	SX5L-SBPT04X1
		4-point, 3-wire Pt100Ω resistance thermometer, –20 to +80°C	SX5L-SBPT04Y1
Pulse Input	24V AC/DC	8-point pulse input, plus/minus common compatible	SX5L-SBCN081
Remote-control Relay Control	24V AC	8-point, remote-control relay control	SX5L-SBRR081

Accessories

Name		Type No.	Ordering Type No.	Package Quantity
Terminal Block 1		SX9Z-SS1	SX9Z-SS1	1
Terminal Block 2		SX9Z-SS2	SX9Z-SS2	1
Terminal Block 3		SX9Z-SS3	SX9Z-SS3	1
Terminal Block 7		SX9Z-SS7	SX9Z-SS7	1
Terminal Block 9		SX9Z-SS9	SX9Z-SS9	1
Terminal Block 10		SX9Z-SS10	SX9Z-SS10	1
Terminal Block 11		SX9Z-SS11	SX9Z-SS11	1
Terminal Block 12		SX9Z-SS12	SX9Z-SS12	1
Terminal Block 13		SX9Z-SS13	SX9Z-SS13	1
Terminal Block 14		SX9Z-SS14	SX9Z-SS14	1
DIN Rail	Aluminum (1m long)	BAA1000	BAA1000PN10	10
	Steel (1m long)	BAP1000	BAP1000PN10	10
Mounting Clip		BNL5	BNL5PN10	10
Network Interface Connector		SX9Z-CN23	SX9Z-CN23PN02	2
Jumper (Note)	Ring	BPJ-26B	BPJ-26BPN10	10
	Spade	BPJ-26FB	BPJ-26FBPN10	10

Note: For connecting terminals of an unused channel on analog input and Pt100Ω input modules

Glossary

Alias

When binding network variables, binding may not be completed due to the limitations on selector numbers which are automatically assigned by the management tool. Alias is a technique used to virtually divide one network variable into several variables.

Application program

A program for the application layer in the OSI reference model, written in Neuron C which is derived from ANSI C. Since IDEC has created and installed an application program into the SX5L, users do not have to create a user program.

Binding

A task to define a sender and receiver(s) of a network variable.

Commission

A task to identify the LONWORKS device by the Neuron ID and write configuration information into the device.

Configuration property

A data value used to determine initial values and parameters, such as maximum value, minimum value, and time, for a particular LONWORKS device.

Domain ID

The first layer of the device address.

Functional block

A symbolic representation of an individual function to be performed by the application program installed in a LONWORKS device. Every SX5L module contains more than one functional block.

Gateway

A hardware or software provision to connect networks that communicate in different protocols.

LonMaker integration tool

A tool supplied by Echelon to perform network management.

LONMARK Interoperability Association (http://www.lonmark.org/)

An organization that was established to promote the easy integration of multi-vendor systems based on LONWORKS networks using standard tools and components. Today over 300 companies around the world are members of the association, including device manufacturers, integrators, and end users.

LonTalk protocol

A complete seven-layer protocol in compliance with the Open System Interconnection (OSI) defined by the International Standard Organization (ISO). Also known as LONWORKS protocol.

LONWORKS device

A device in which a Neuron Chip and LONWORKS transceiver are installed to communicate with other devices using the LonTalk protocol.

LONWORKS transceiver

A LONWORKS transceiver contains an FTT-10A (free topology transceiver).

The FTT-10A transceiver is of a transformer-coupled type and has the following specifications:

Name	Communication Medium	Transmission Speed	Transmission Distance (Note)
FTT-10A	Twisted-pair cable	78 kbps	Bus topology: 1,400m Free topology: 500m

Note: The transmission distance is the values when using Level 4 AWG22 cable and proper terminators.

Network management

A task to install network configuration information (addressing and binding) into LONWORKS devices. Network management must be done when setting up a LONWORKS network system.

Network management tool

A tool used to perform network management.

Network variable

A data item that a particular device application program expects to get from other device on a network (an input network variable) or expects to make available to other devices on a network (an output network variable). Examples are a temperature, switch value, and actuator position setting.

Neuron Chip

A microprocessor that supports LonTalk protocol. The SX5L uses Toshiba TMPN3120FE5M with a 10-MHz clock quartz oscillator.

Neuron ID

Every LONWORKS device has a unique 48-bit identifier called the Neuron ID. The Neuron ID is typically assigned when a device is manufactured and used for network management.

Node ID

The third layer of the device address. Node ID identifies an individual device within a subnet. Up to 127 devices can be defined within a single subnet.

Protocol analyzer

Software or hardware that enables to monitor the data transmitted through the network.

SCPT

An acronym for Standard Configuration Property Type. SNVTs are standardized definitions of the units, scaling, encoding, and meaning of the contents of configuration properties.

SNVT

An acronym for Standard Network Variable Type. SNVTs are standardized definitions of the units, scaling, and encoding of the contents of network variables.

SNVT_elapsed_tm

SNVT index 87, used to measure elapsed time. The SX5L uses SNVT_elepsed_tm for configuration property nciMaxStsSendT to determine the heartbeat transmission intervals.

Measurement	Type Size and Structure	Size	Valid Type Range	Note

Elapsed Time	7 bytes
	`typedef struct {`
	`  unsigned long  day;`
	`  unsigned short  hour;`
	`  unsigned short  minute;`
	`  unsigned short  second;`
	`  unsigned long  millisecond;`
	`} SNVT_elapsed_tm;`
		day	0 .. 65,534	65,535: null elapsed

		hour	0 .. 23	—
		minute	0 .. 59	—
		second	0 .. 59	—
		millisecond	0 .. 999	—

SNVT_lev_percent

SNVT index 81, used to represent data in percent. The SX5L uses SNVT_lev_percent for output network variables nvoAI0 through nvoAI3 of the Analog Input functional block. When the measured value exceeds the limit, 0x7FFF is sent.

Measurement	Type Size and Category	Valid Type Range	Type Resolution	Note
Percentage Level	2 bytes (signed long)	–163.840% .. 163.830%	0.005% or 50 ppm	0x7FFF: invalid data

SNVT_switch

SNVT index 95. The SX5L uses SNVT_switch mainly for digital input and output statuses. When the input variable has (state) = 1, digital output is on. When (state) = 0, digital output is off. When the digital input is on, an output network variable is sent with (state) = 1, (value) = 1. When the digital input is off, an output network variable is sent with (state) = 0, (value) = 0.

Measurement	Type Size and Structure	Valid Type Range	Note

Switch	2 bytes
	`typedef struct {`
	`  unsigned  value;`
	`  signed  state;`
	`} SNVT_switch;`
		0 .. 100%	Resolution: 0.5%

		0 .. 1, 0xFF	0: off 1: on 0xFF: undefined

SNVT_temp_p

SNVT index 105, used for heating, ventilation, and air-conditioning (HVAC) applications. The SX5L uses SNVT_temp_p for output network variables nvoPT[0] through nvoPT[3] of the Pt100Ω Input functional block. When the measured temperature value exceeds the limit, 0x7FFF is sent.

Measurement	Type Size and Category	Valid Type Range	Type Resolution	Note
Temperature	2 bytes (signed long)	–273.17 .. +327.66 degrees C	0.01 degree C	0x7FFF: invalid data

SNVT_time_sec

SNVT index 107, used to measure elapsed time. The SX5L uses SNVT_time_sec for configuration property nciPwrup to determine the transmission delay immediately after powerup.

Measurement	Type Size and Category	Valid Type Range	Type Resolution	Note
Elapsed Time	2 bytes (unsigned long)	0.0 .. 6553.4 sec	0.1 sec	0xFFFF: invalid data

Subnet ID

The second layer of the device address. Up to 255 subnets can be defined within a single domain.

Topology

The physical arrangement of devices in a communication network, such as bus, ring, and star topology.

XIF

An acronym for External Interface File, whose filename has extension XIF. A XIF file contains network variable information, a part of hardware parameter, and communication parameter concerning a particular node. The XIF file is mainly supplied from a manufacturer, and can also be imported from the device depending on the type of management tool.

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