Panasonic®

PROGRAMMABLE CONTROLLER

PHLS System
User's Manual

Safety Precautions

Observe the following notices to ensure personal safety or to prevent accidents.
To ensure that you use this product correctly, read this User's Manual thoroughly before use.
Make sure that you fully understand the product and information on safety.
This manual uses two safety flags to indicate different levels of danger.

WARNING

If critical situations that could lead to user's death or serious injury is assumed by mishandling of the product.
-Always take precautions to ensure the overall safety of your system, so that the whole system remains safe in the event of failure of this product or other external factor.
-Do not use this product in areas with inflammable gas. It could lead to an explosion.
-Exposing this product to excessive heat or open flames could cause damage to the lithium battery or other electronic parts.

CAUTION

If critical situations that could lead to user's injury or only property damage is assumed by mishandling of the product.
-To prevent excessive exothermic heat or smoke generation, use this product at the values less than the maximum of the characteristics and performance that are assured in these specifications.
-Do not dismantle or remodel the product. It could cause excessive exothermic heat or smoke generation.
-Do not touch the terminal while turning on electricity. It could lead to an electric shock.
-Use the external devices to function the emergency stop and interlock circuit.
-Connect the wires or connectors securely.
The loose connection could cause excessive exothermic heat or smoke generation.
-Do not allow foreign matters such as liquid, flammable materials, metals to go into the inside of the product. It could cause excessive exothermic heat or smoke generation.
-Do not undertake construction (such as connection and disconnection) while the power supply is on. It could lead to an electric shock.

Copyright / Trademarks

-This manual and its contents are copyrighted.
-You may not copy this manual, in whole or part, without written consent of Panasonic Industrial Devices SUNX Co., Ltd.
-Windows is a registered trademark of Microsoft Corporation in the United States and other countries.
-All other company names and product names are trademarks or registered trademarks of their respective owners.

PLC_ORG

Introduction

Thank you for buying a Panasonic product. Before you use the product, please carefully read the installation instructions and the users manual, and understand their contents in detail to use the product properly.

Types of Manual

- There are different types of users manual for the FP7 series, as listed below. Please refer to a relevant manual for the unit and purpose of your use.
- The manuals can be downloaded on our website.

Unit name or purpose of use		Manual name	Manual code
FP7 Power Supply Unit		FP7 CPU Unit Users Manual (Hardware)	WUME-FP7CPUH
FP7 CPU Unit			
	Instructions for Built-in COM Port FP7 Extension (Communication) Cassette	FP7 CPU Unit Users Manual (COM Port Communication)	WUME- FP7COM
	Instructions for Built-in LAN Port	FP7 CPU Unit Users Manual (LAN Port Communication)	WUME-FP7LAN
FP7 Digital Input/Output Unit		FP7 Digital Input/Output Unit Users Manual	WUME-FP7DIO
FP7 Analog Input Unit		FP7 Analog Input Unit Users Manual	WUME-FP7AIH
FP7 Analog Output Unit		FP7 Analog Output Unit Users Manual	WUME-FP7AOH
FP7 Positioning Unit		FP7 Positioning Unit Users Manual	WUME-FP7POSP
PHLS System		PHLS System Users Manual	WUME-PHLS
Programming Software FPWIN GR7		FPWIN GR7 Introduction Guidance	WUME-FPWINGR7

Table of Contents

1

System Configuration and Restrictions on Combination

1.1 Overview of the PHLS System

1.1.1 Function and Operation of the PHLS System

■ Functions of the PHLS System

- The PHLS system is a high-speed remote I/O system that can be connected to the FP7 series. Input/output units connected to the network can be controlled by way of the shielded twisted pair cable, thereby relieving work for input/output wiring and saving space.
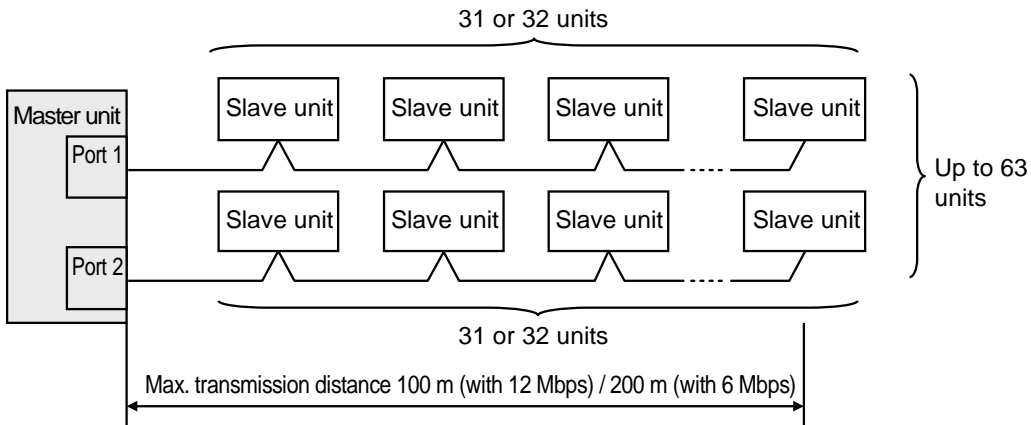
- The PHLS system can be handled as an ordinary I/O on the FP7 CPU unit, thereby dispensing with complicated programming.

- A fixed-time communication method is used. This retains a constant scan time even when a transmission error occurs.

• Key specifications of PHLS

Items	Description
Transmission line	Shielded twisted pair cable
Baud rate	12 Mbps/ 6 Mbps (Use the switch on the body)
Transmission scan time	0.03 ms/ 1 slave, 1.86 ms/ 63slave (with Baud rate 12 Mbps)
Max. transmission distance	100 m (with 12 Mbps) , 200 m (with 6 Mbps)
Controllable I/O points	Max. 1,008 points (per master unit)
Slave units	Max. 63 units (per master unit)

(Note) The figure above indicates performance using a recommended cable. The indicated performance may not be available if a recommended cable is not used.

1.2 List of System Component Devices

1.2.1 List of Units

■ Master unit

Used in combination with the FP7 CPU unit.
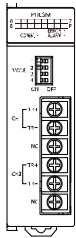
AFP7PHLSM

■ Slave unit terminal block type

• Both I/O and transmission line can be connected using MP3 screws.
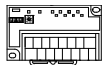
AFPRP1X8D2
Input: 8 points

AFPRP1X16D2
Input: 16 points

AFPRP1Y16T
Output: 16 transistor points

AFPRP1XY16D2T
Input: 8 points, Output: 8 transistor points

■ Slave unit compact type

• Space-saving size of W59.5mm × H57.5mm × D40mm)

• An e-CON type input is also available. This saves work for wiring.

AFPRP2X16D2
Input: 16 points

AFPRP2Y16T
Output: 16 points

AFPRP2XY16D2T
Input: 8 points,
Output: 8 transistor points

AFPRP2X08D2E
Input: 8 points

AFPRP2Y04R
Output: 4 relay points

1.2.2 List of Component Units

■ **Master unit**

Product name	Description	Model no.
FP7 PHLS master unit	Interface unit to connect FP7 to the PHLS system. Controllable I/O points per master unit: 1,008	AFP7PHLSM

■ **Slave unit**

Type	Connection method	No. of I/O points	Output type	Model no.
Terminal Block Type	Screw terminal block (M3)	Input: 8 points	–	AFPRP1X08D2
		Input: 16 points	–	AFPRP1X16D2
		Input: 8 points / Output: 8points	Transistor (sink type)	AFPRP1XY16D2T
		Output: 16 points	Transistor (sink type)	AFPRP1Y16T
Compact type	e-CON connector	Input: 8 points	–	AFPRP2X08D2E
	Connector terminal block	Input: 16 points	–	AFPRP2X16D2
		Input: 8 points / Output: 8 points	Transistor (sink type)	AFPRP2XY16D2T
		Output: 16 points	Transistor (sink type)	AFPRP2Y16T
	Relay output	Output: 4 points	Relay output	AFPRP2Y04R

1.2.3 Selection of Cables

Use a two-wire shielded twisted pair cable indicated below.

■ **Recommended cables**

Manufacturer	Product
Shinko Seisen Industry Co. Ltd.	ZHY221PS

(Note) The indicated performance (e.g. Max. transmission distance, Max. slave units) may not be available if a recommended cable is not used.

1.3 Restrictions on Combination

1.3.1 Restrictions on Transmission Lines

■ How to connect transmission lines

Connect the lines so that there is no branch. Avoid T-letter wiring or octopus wiring.

Example of correct connection
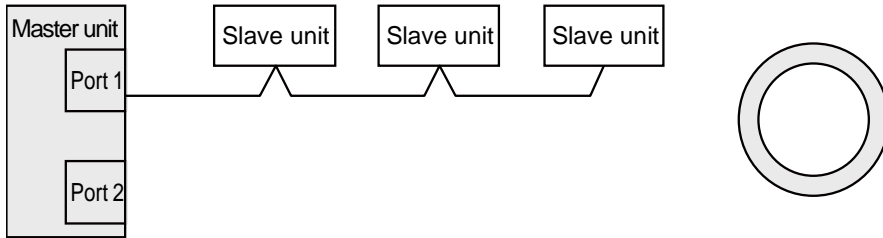
Example of T-letter wiring and octopus wiring
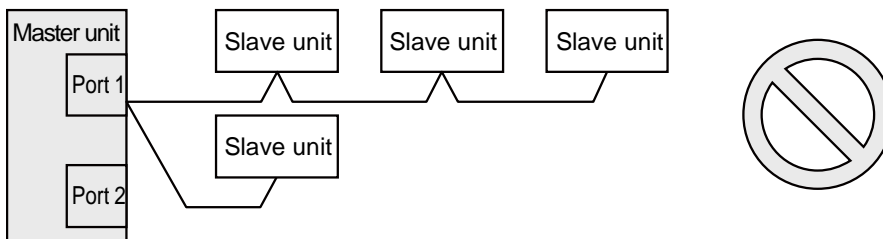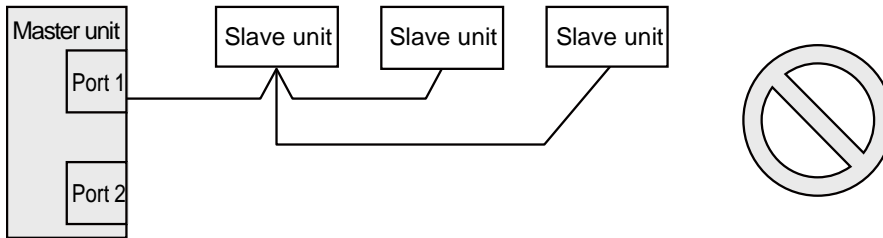
1.3.2   Restrictions on Terminal Units

- A master unit has two ports. For both ports, the master unit should always be a terminal unit. A master unit cannot be connected in the middle of a transmission line.

Correct connection (Example using Port 1)

Terminal unit   Terminal unit

| Master unit | Slave unit | Slave unit |
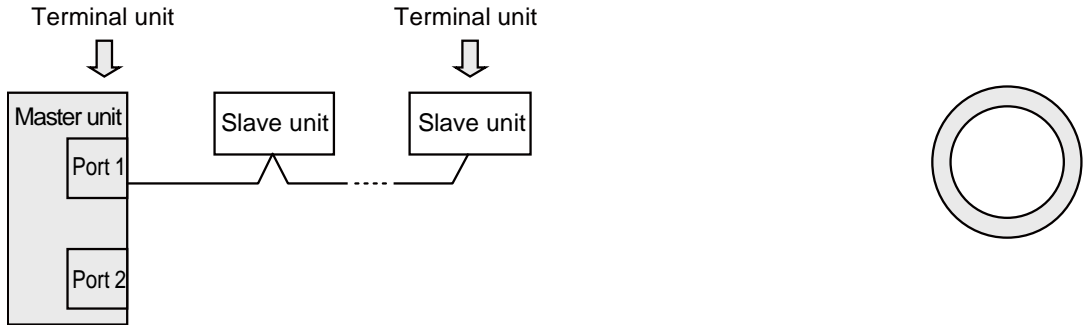
Port 1

Port 2

Correct connection (Example using Port 1 and Port 2)

Terminal unit   Terminal unit   Terminal unit

| Slave unit | Slave unit | Master unit | Slave unit | Slave unit |

Port 1

Port 2
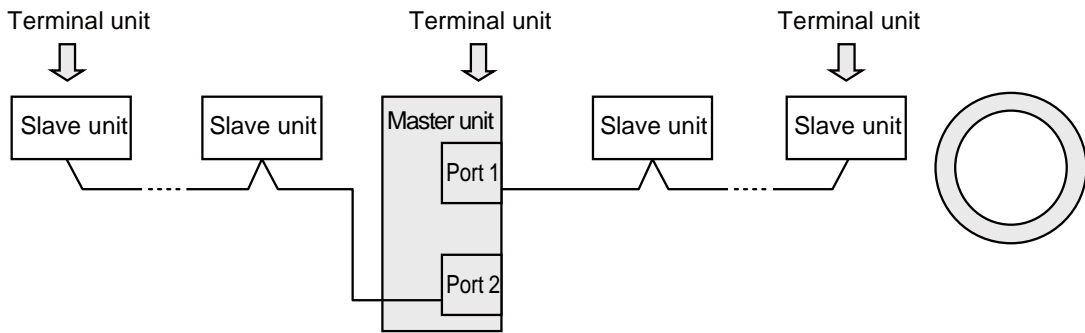
Connection where the master unit is not a terminal unit

Terminal unit   Terminal unit

| Slave unit | Slave unit | Master unit | Slave unit | Slave unit |

Port 1

Port 2
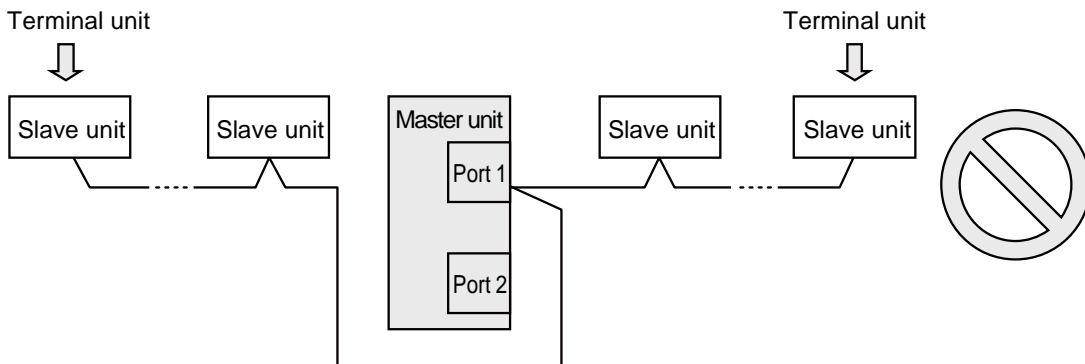
1.3.3   Restrictions on Transmission Distance

"Transmission distance" refers to the length of a single transmission line.
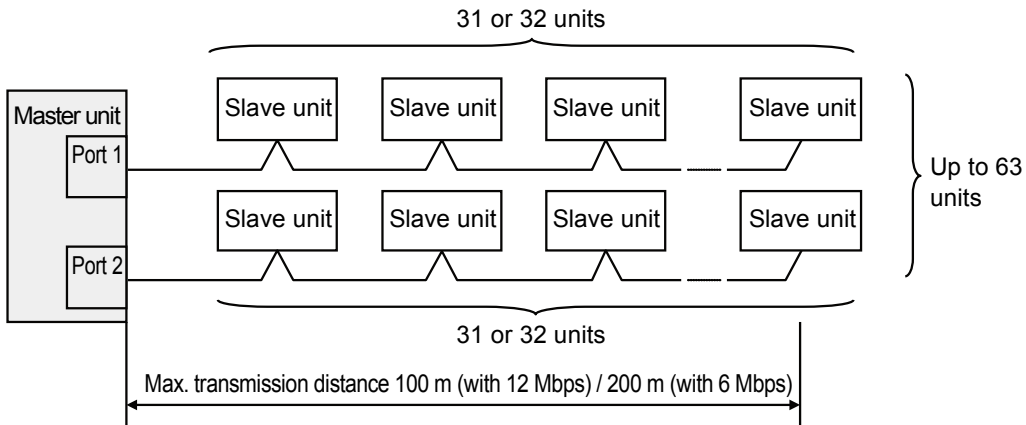
1.3.4   Restrictions on Slave Units

■ Max. number of connectable slave units

• Up to 63 slave units can be connected to one master unit.

• Up to 32 slave units can be connected to one transmission line.

1.3.5   Restrictions on Installation of Master Units

■ Max. number of installable master units

Up to 16 FP7 PHLS master units can be controlled by the FP7 CPU unit.

■ Restrictions based on current consumption

Internal current consumption by a unit is as indicated below. Make sure that the total
consumption including other units is within the power supply capacity to be used.

Name	Model no.	Current consumption
FP7 PHLS master unit	AFP7PHLSM	85 mA or less

2

Names and Functions of Parts

2.1 FP7 PHLS Master Unit

2.1.1 Names and Functions of Parts
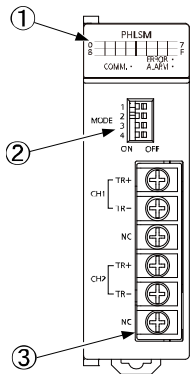
■ Names and functions of parts

(1) Operation monitor LEDs

Shows communication conditions and error occurrence.

(2) Operation mode switch

Used for setting Baud rate and indications of operation monitor LEDs.

(3) Terminal block for connection to the transmission line

Used for connecting transmission cables. From each of the two ports, one transmission line can be connected.

2.1.2 Operation Monitor LEDs

■ LED indications and their meanings

Signs and LED colors		Description
PWR	Blue	Turns on when the power is ON.
1 × n - 16 × n	Green	Indicates the setting status or the communication status of each slave unit. Depending on settings of the operation mode switch, the slave number to be monitored varies.
COMM.	Green	Turns on while communicating with the slave.
ERR	Red	Turns on when an error occurs in communication with the specified slave.
ALM	Red	Turns on when an error in communication with the specified slave does not recover after retry.
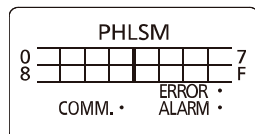
2.1.3 Operation Mode Switch

■ Settings of switches

Switch no.	Settings	
SW1	Status monitored by operation monitor LEDs	ON: The slave number, as specified in the "Select a connected slave" dialog box under the configuration menu of FPWIN GR7, turns on. OFF: The slave number that is currently communicating turns on. Slave numbers larger than the Max. slave number does not turn on. Switching becomes possible while the power supply is ON.
SW2 SW3	Slave unit monitored by operation monitor LEDs	Used for setting slave numbers to be monitored by operation monitor LEDs. Switching becomes possible while the power supply is ON. When SW2: OFF and SW3: OFF, Slave No.1 to No.15 When SW2: OFF and SW3: ON, Slave No.16 to No.31 When SW2: ON and SW3: OFF, Slave No.32 to No.47 When SW2: ON and SW3: ON, Slave No.48 to No.63
SW4	Baud rate	Used for switching Baud rate. While the power is ON, switching is invalid. Settings become valid during the power supply OFF → ON. ON: 12 Mbps, OFF: 6 Mbps
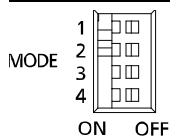
2.2 PHLS Slave Unit, Terminal Block Type

2.2.1 Names and Functions of Parts
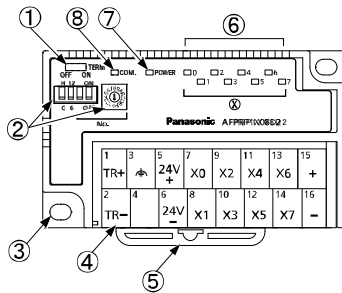
AFPRP1X08D2
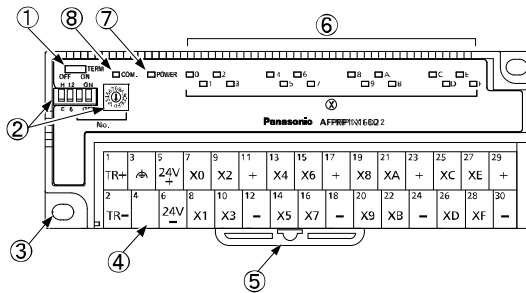
AFPRP1X16D2
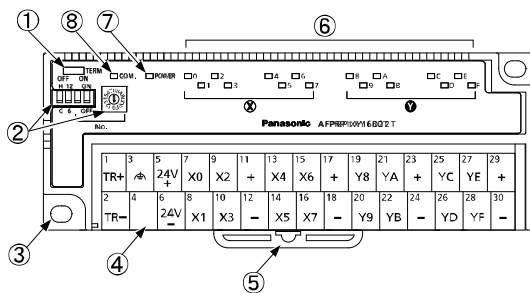
AFPRP1XY16D2T
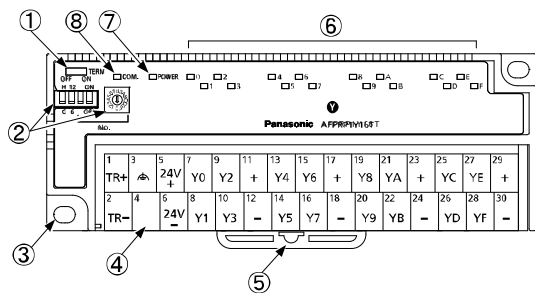
AFPRP1Y16T

■ Names and functions of parts

(1) Termination resistance selector switch

Set to ON when the slave becomes a terminal unit of the transmission line.

(2) Operation mode setting switches

Used for setting slave numbers, Baud rate and output status during error.

(3) Unit mounting hole

Used for mounting with screws.

(4) Power supply and I/O terminal block

Used for connecting transmission cables, power supply for unit driving, and I/O devices.

(5) DIN rail attachment hook

Used for attachment to the DIN rail.

(6) I/O circuit operation monitor LEDs

Shows ON/OFF status of the input circuit or the output circuit.

(7) POWER LED

Turns on when the slave unit power is ON.

(8) Communication status LED

Shows the status of communication with the master unit.

2.2.2　Operation Mode Setting Switches

Turn off the power supply before making settings or changes.
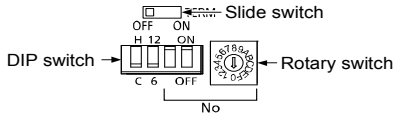
■ Settings of DIP switches
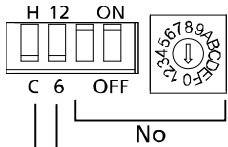
Switch part sign	Settings
No.	Set slave numbers by a combination of the settings of the rotary switch. Refer to the table below.
12 6	Set Baud rate. 12: 12 Mbps 6: 6 Mbps
H C	Set the output status when a transmission error occurs. H: Hold: Outputs are retained. C: Clear: All outputs are turned off.

■ Switch settings and slave numbers

DIP switch ON / OFF		Rotary switch settings and allocated slave numbers															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
ON	ON	—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ON	OFF	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
OFF	ON	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
OFF	OFF	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63

(Note) Slave No.0 cannot be used.

2.3 PHLS Slave Unit Compact Type

2.3.1 Names and Functions of Parts
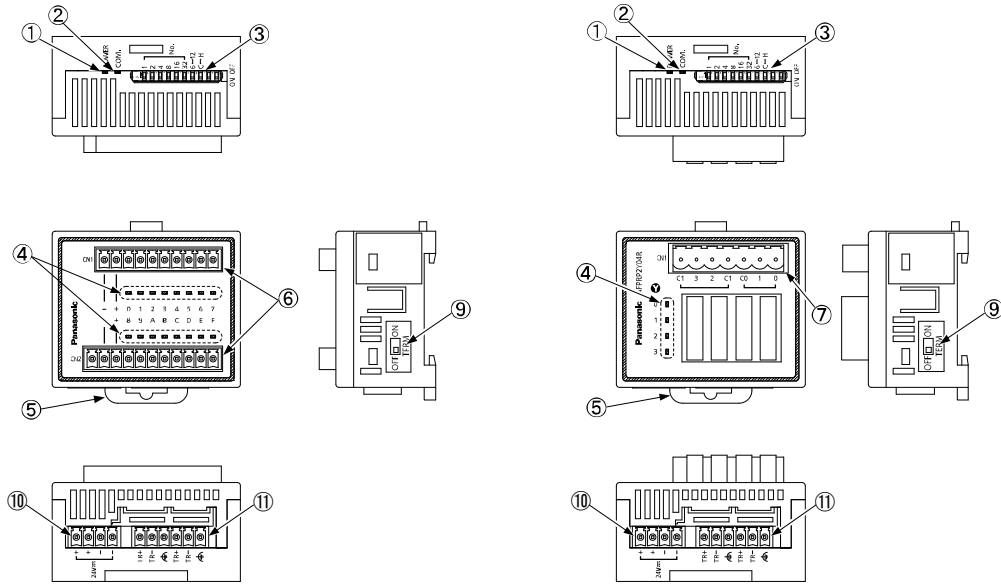
Connector-Type
Terminal Block

Relay Output type
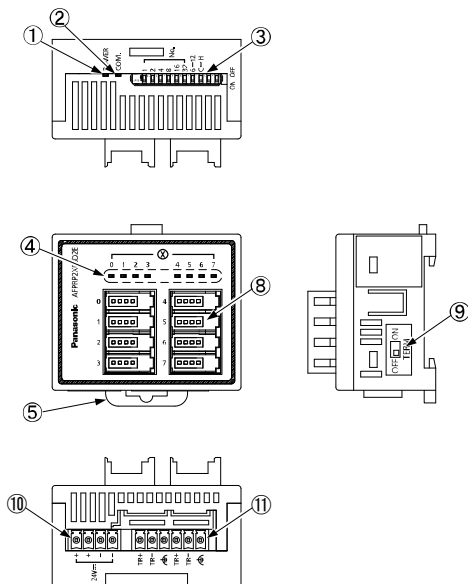
e-CON type

■ **Names and functions of parts**

(1) POWER LED

Turns on when the slave unit power is ON.

(2) Communication status LED

Shows the status of communication with the master unit.

(3) Mode selector switches

Used for setting slave numbers, Baud rate and output status during error.

(4) I/O circuit operation monitor LEDs

Shows ON/OFF status of the input circuit or the output circuit.

(5) DIN rail attachment hook

Used for attachment to the DIN rail.

(6) Terminal block for connection of the I/O circuit (CN1: 10P, CN2: 11P)

Used for connecting I/O devices.

(7) Terminal block for connection of the relay output circuit (7P)

Used for connecting output devices.

(8) e-CON socket for connection of the input circuit (4P×8)

Used for connecting input devices. e-CON should be used for connection.

(9) Termination resistance selector switch

Set to ON when the slave becomes a terminal unit of the transmission line.

(10) Terminal block for power supply

Used for connecting a unit driving power supply 24 V.

(11) Terminal block for connection to the transmission line

Used for connecting transmission cables. The two TR+ terminals, TR- terminals, and earth terminals are respectively connected inside.

2.3.2 Operation Mode Setting Switches

Turn off the power supply before making settings or changes.

■ Settings of switches

Switch no.	Switch part sign		Settings
	(OFF)	(ON)	
5/6/7/8/9/10	–	1 2 4 8 16 32	Set slave numbers in accordance with the sum of the five dip switches (1 to 63). For example, in order to set the total slave number to 10, make settings as follows. 1: OFF, 2: ON, 4: OFF, 8: ON, 16: OFF, 32: OFF
4	6	12	Used for switching Baud rate. ON: 12 M bps, OFF: 6 M bps
3	C	H	Set the output status when a transmission error occurs. C (Clear): All outputs are turned off. H (Hold): Outputs are retained.
1/2	–	–	Not used
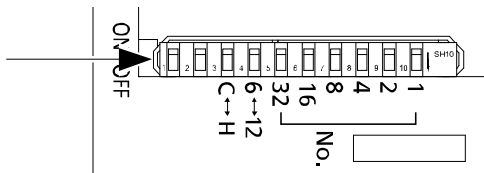
3

Installation and Wiring

3.1 Installation Environment and Handling of Environment

■ **Ambient environment**

Use the unit within the range of the general specifications when installing

• Ambient temperatures: 0 to +55°C

• Ambient humidity: 10 to 95%RH (at 25°C, no-condensing)

• Altitude: up to 2,000 m

• Location: Inside the control board

• For use in pollution Degree 2 environment.

Do not use it in the following environments.

• Direct sunlight — Sudden temperature changes causing condensation.

• Inflammable or corrosive gas.

• Excessive airborne dust, metal particles or saline matter.

• Benzine, paint thinner, alcohol or other organic solvents or strong alkaline solutions such as ammonia or caustic soda.

• Direct vibration, shock or direct drop of water.

• Influence from power transmission lines, high voltage equipment, power cables, power equipment, radio transmitters, or any other equipment that would generate high switching surges. (100 mm or more)

■ **Handling**

Do not touch connector pins directly to prevent static electricity from causing damage.

Always rid yourself of any static electricity before handling this product.

3.2 Installation and Wiring of the Master Unit

3.2.1 Installation

For installation of the master unit, please see the FP7 CPU Unit Users Manual (Hardware).

3.2.2 Wiring

Respectively connect TR+ and TR- of the PHLS master unit with TR+ and TR- of the PHLS slave unit.

Connect the shielded wire of the transmission cable to the functional earth terminal of the slave unit.
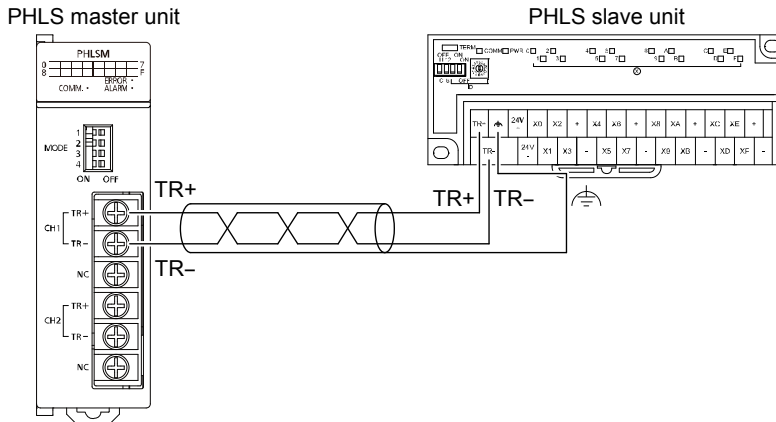
3.2.3 Hard Wiring

■ **Suitable transmission cable (Recommended product)**
Shinko Seisen Industry Co., Ltd.: ZHY221PS

■ **Suitable solderless terminal**
M3 terminal screws are used for the solderless terminal. Use the solderless terminal specified below.
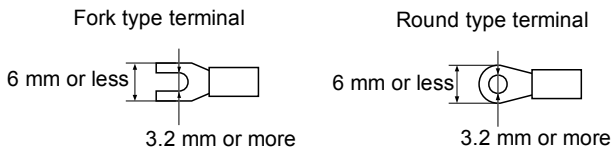
Manufacturer	Shape	Part no.	Suitable wires
J.S.T. Mfg Co.,Ltd	Fork type	1.25-B3A	0.25 to 1.65 mm^2
	Round type	1.25-MS3	

■ **Screwing torque for the terminal block**
0.5 to 0.6 N·m

3.3 Handling of a Slave Unit, Standard Type

3.3.1 Clearance

■ Measures regarding heat discharge

• In order to secure clearance for ventilation, ensure that the top, bottom and sides of the unit are at least 10 mm away from other devices, wiring ducts, etc.
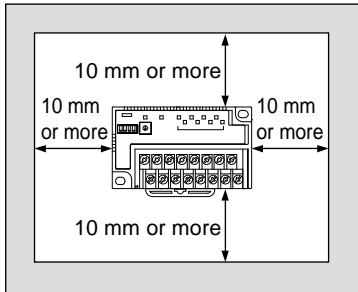
• Do not install the unit above devices which generate heat such as heaters, transformers or large scale resistors.

• See the figure below for direction of unit attachment.

Vertically installed   Horizontally installed   Installed in vertically reversed orientation

• In order to eliminate any effects from noise emission, power wires and electromagnetic devices should be kept at a sufficient distance from the surfaces of the unit.

3.3.2　Attachment Methods

■　**Attachment to the DIN rail**

1. Hang the slave unit over the DIN rail.

2. Press in the unit.

■　**Removal from the DIN rail**

1. Pull out the attachment lever using a flathead screwdriver.

2. While pulling up the unit, remove it from the DIN rail.
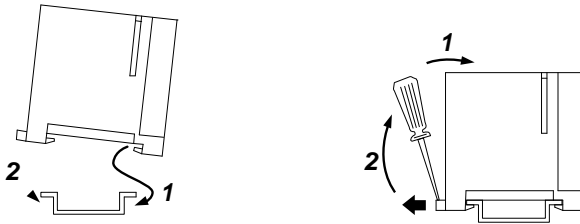
■　**Installation with screws**

M4 washer built-in screw
(Washer size: ø9mm or less)
  • Tightening torque: 0.6 to 1.08N•m
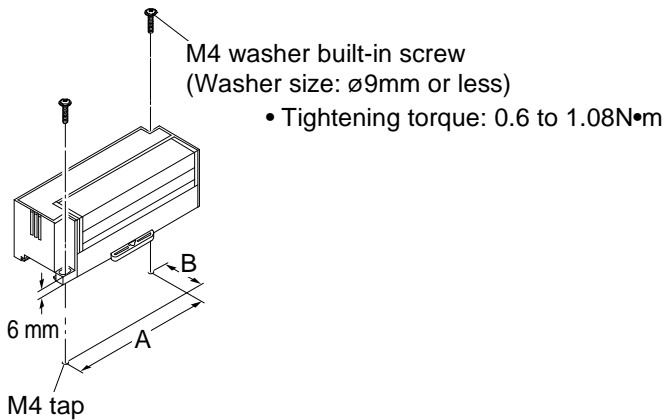
Model no.	A (mm)	B (mm)
AFPRP1X08D2	75 ± 0.4	41 ± 0.4
AFPRP1X16D2	128 ± 0.4	41 ± 0.4
AFPRP1Y16T		
AFPRP1XY16D2T		

3.3.3 Precautions for Wiring a Slave Unit, Standard Type

■ **Internal circuit diagram**
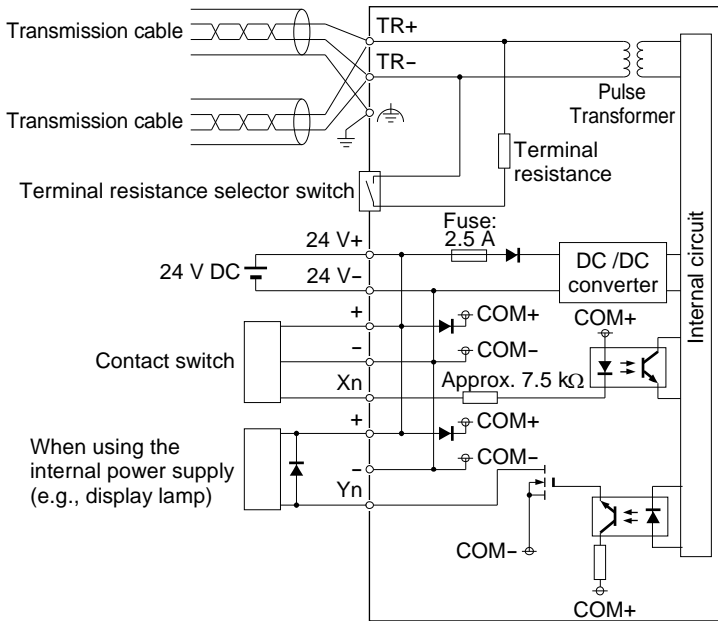
■ **Wiring the power supply**

For the purpose of internal circuit driving, supply 24 V DC from outside to the 24 V+ and 24 V- terminals. These are connected to the + terminals and - terminals inside, and power is supplied to I/O devices.

■ **Wiring of the input circuit**

In the case of contact input or no-voltage input, connect to the respective input terminals and - terminals. In the case of an input device that requires power supply (e.g. sensor), + terminals can be used.

■ **Wiring of the output circuit**

In the case of rated 24 V DC load, connect to the respective output terminals and + terminals. As a DC type inductive load, attach a counter EMF absorption diode.

■ **Wiring of transmission Lines**

Terminals for connection to the transmission line (TR+, TR- and earth terminals) should be connected in a daisy chain wiring. Avoid T-letter wiring or octopus wiring. In order to avoid influence of noise, connect the shielded wire of the transmission cable on one side to the functional earth terminal, and make sure to ground the functional earth terminal.

◆ **KEY POINTS**

- **Do not supply power from outside to the + terminals and the - terminals.**

- **In the input circuit or the output circuit, the maximum current that can be withdrawn from the internal circuit (24 V DC) is 2 A.**

◆ REFERENCE

In the internal circuit diagram on the previous page, a typical example of the mixed input/output unit AFPRP1XY16D2T is indicated. For specifications of individual slave unit, please see 7.3 Internal Circuit Diagram, Terminal Layout .

3.3.4　Hard Wiring

■ **Suitable wires (copper strand wire)**

- **Recommended transmission cable**

  Shinko Seisen Industry Co. Ltd., ZHY221PS

- **Power supply cables and input/output cables**

  Size: AWG22 to 14, Rated temperature: 60 to 75°C

■ **Suitable solderless terminal**

M3 terminal screws are used for the terminal. The following suitable solderless terminals are recommended for wiring to the terminals.

Manufacturer	Shape	Part no.	Suitable wires
J.S.T. Mfg Co.,Ltd	Round type	1.25-MS3	0.25 to 1.65 mm^2
	Fork type	1.25-B3A	
	Round type	2-MS3	1.04 to 2.63 mm^2
	Fork type	2-N3A	

■ **Screwing torque for the terminal block**

0.6 to 0.8N·m
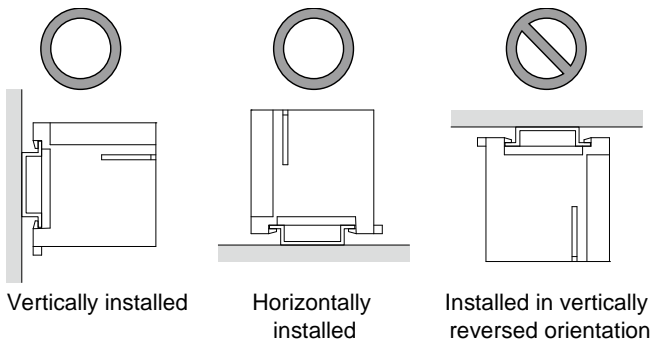
3.4 Handling of a Slave Unit Compact Type

3.4.1 Clearance

■ Measures regarding heat discharge

• In order to secure clearance for ventilation, ensure that the top and sides of the unit are at least 10 mm away from other devices, wiring ducts, etc. In order to secure clearance for power supply and transmission cables, ensure that the bottom of the unit is at least 50 mm away from other devices.
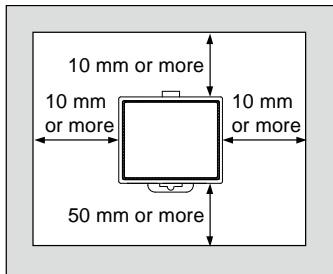
• Do not install the unit above devices which generate heat such as heaters, transformers or large scale resistors.

• See the figure below for direction of unit attachment.
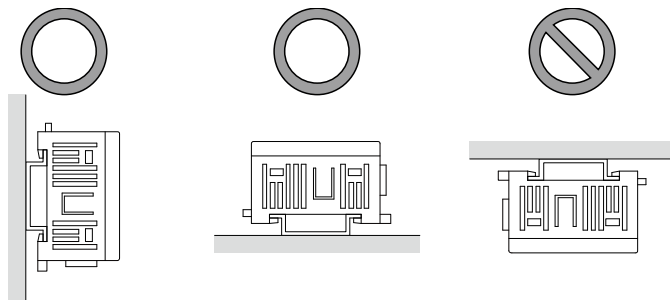
Vertically installed   Horizontally installed   Installed in vertically
                                                   reversed orientation

• In order to eliminate any effects from noise emission, power wires and electromagnetic devices should be kept at a sufficient distance from the surfaces of the unit.

3.4.2   Attachment Methods

■ Attachment to the DIN rail

1. Hang the slave unit over the DIN rail.

2. Press in the unit.
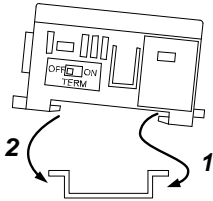
■ Removal from the DIN rail

1. Pull out the attachment lever using a flathead screwdriver. Alternatively, press the lever from the opposite side.

2. While pulling up the unit, remove it from the DIN rail.
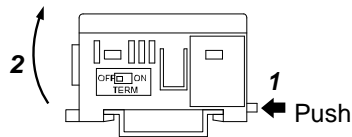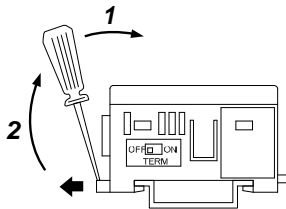
3.4.3   Precautions for Wiring

■ **Internal circuit diagram (Examples of the mixed input/output unit AFPRP2XY16D2T)**
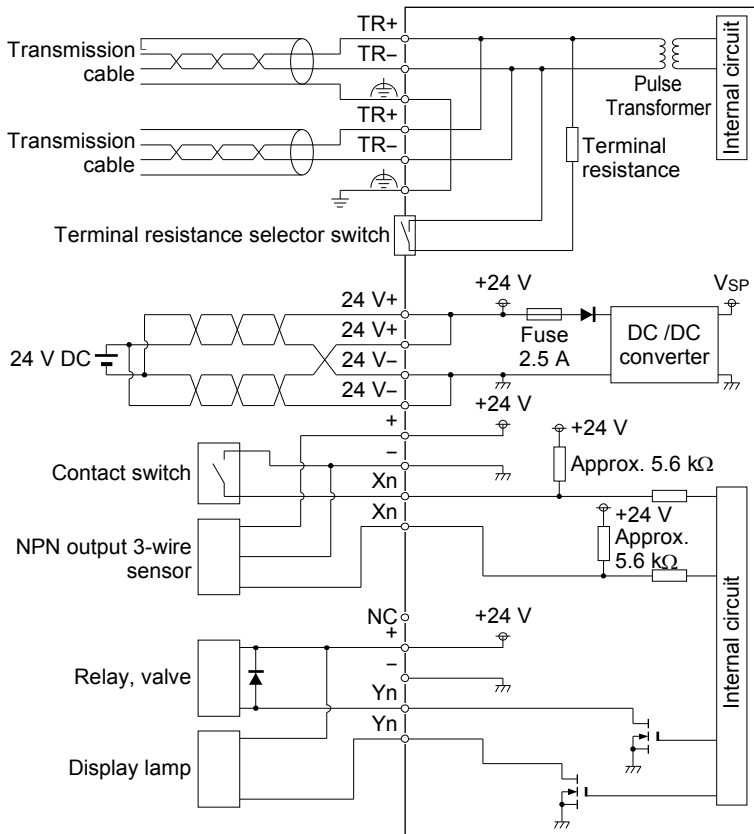
■ **Wiring the power supply**

For the purpose of internal circuit driving, supply 24 V DC from outside to the 24 V+ and 24 V- terminals. These are connected to the + terminals and - terminals inside, and power is supplied to I/O devices.

■ **Wiring of the input circuit**

In the case of contact input or no-voltage input, connect to the respective input terminals and - terminals. In the case of an input device that requires power supply (e.g. sensor), + terminals can be used.

■ **Wiring of the output circuit**

In the case of rated 24 V DC load, connect to the respective output terminals and + terminals. In the case of relay output AFPRP2Y04R, power supply for load driving is required. As a DC type inductive load, attach a counter EMF absorption diode.

■ **Wiring of transmission Lines**

Terminals for connection to the transmission line (TR+, TR- and earth terminals) should be connected in a daisy chain wiring. Avoid T-letter wiring or octopus wiring. In order to avoid influence of noise, connect the shielded wire of the transmission cable to the functional earth terminal on one side, and make sure to ground the functional earth terminal on the other side.

influence of noise, connect the shielded wire of the transmission cable to the functional earth terminal on one side, and make sure to ground the functional earth terminal on the other side.

♦ **KEY POINTS**

- **Do not supply power from outside to the + terminals and the - terminals.**

- **In the input circuit or the output circuit, the maximum current that can be withdrawn from the internal circuit (24 V DC) is 2 A.**

♦ **REFERENCE**

In the internal circuit diagram on the previous page, a typical example of the mixed input/output unit AFPRP2XY16D2T is indicated. For specifications of individual slave unit, please see 7.3 Internal Circuit Diagram, Terminal Layout .

3.4.4   Hard Wiring for Terminal Blocks

■ Suitable wires and screwing torque

Unit type and wiring position		Suitable wire	Tightening torque
Compact type (Common)	Communication terminal block	Recommended transmission cable Manufactured by Shinko Seisen Industry Co., Ltd.: ZHY221PS	0.22 to 0.25 N·m
	Power supply terminal block	AWG 24 to 16 (copper strand wire), Rated temperature: 60 to 75°C	0.22 to 0.25 N·m
Compact connector terminal block type	I/O terminal block	AWG 24 to 16 (copper strand wire), Rated temperature: 60 to 75°C	0.22 to 0.25 N·m
Compact relay output type	Output terminal block	AWG 22 to 14 (copper strand wire), Rated temperature: 60 to 75°C	0.5 to 0.6 N·m
Compact e-CON connector type	I/O terminal block	Refer to "3.4.5 Hard Wiring for e-CON Type".	

■ Wiring method

1. Remove a potion of the wire's insulation.

7 mm
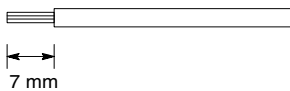
2. Insert wire into terminal hole until it stops. Tighten screw clockwise to fix wire in place.
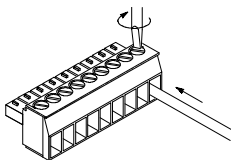
■ Precautions on wiring

The following precautions should be observed, to avoid broken or disconnected wires.

• When removing the wire's insulation, be careful not to scratch the core wire.

• Do not twist the wires to connect them.

• Do not solder the wires to connect them. The solder may break due to vibration.

• After wiring, make sure stress is not applied to the wire.

• In the terminal block socket construction, if the wire is fastened upon counter-clockwise rotation of the screw, the connection is faulty. Disconnect the wire, check the terminal hole, and then re-connect the wire.

Clockwise   Counter clockwise
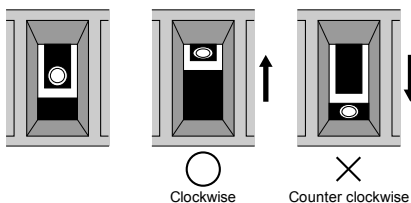
3.4.5   Hard Wiring for e-CON Connector

■ Recommended connector and suitable wires

Use a connector as prescribed below.

Panasonic Industrial Devices SUNX Co. Ltd.

Cover color	Model	Suitable wires		
		AWG	Nominal cross-sectional area	Finished outside diameter
Yellow	CN-EP2	27 to 20	0.1 to 0.5 mm^2	ϕ1.0 to ϕ1.15 mm
Orange	CN-EP3			ϕ0.6 to ϕ0.9 mm

Tyco Electronics Japan G.K.

Cover color	Part no.	Suitable wires		
		AWG	Nominal cross-sectional area	Finished outside diameter
Green	4-1473562-4	28 to 20	0.08 to 0.6 mm^2	ϕ1.35 to ϕ1.6 mm
Blue	2-1473562-4			ϕ1.15 to ϕ1.35 mm
Yellow	1473562-4			ϕ1.0 to ϕ1.15 mm
Red	1-1473562-4			ϕ0.9 to ϕ1.0 mm
Orange	3-1473562-4			ϕ0.6 to ϕ0.9 mm

■ Terminal layout for the connector part

4 3 2 1
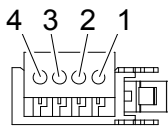
Terminal no.	Terminal name
1	+
2	NC
3	-
4	Input

■ Connection method

1. Prepare the cable as illustrated below. Do not remove the wire's insulation.
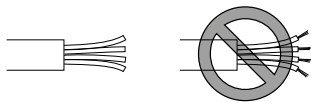
2. Insert the wire into the wire inlet of the connector until the end of the wire hits the inner wall.

3. Pressure-weld the connector using pliers, etc.
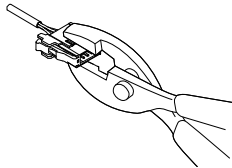
4. Gently pull the wire to check that the wire has been securely welded.

■ **Attachment to the slave unit**

Straightly insert the connector into the input connector part of the unit.
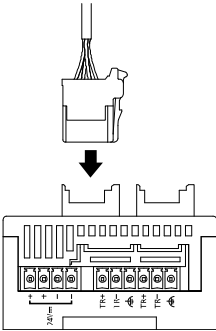
■ **Removal from the slave unit**

While pressing down the lock release lever on the connector body, pull out the connector.
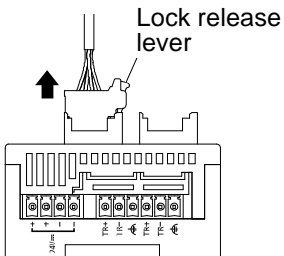
4

Unit Settings and Configuration

4.1 Switch Settings for Slave Units

4.1.1 Slave No. Settings

Slave numbers are used by the master unit to identify slave units. For each of the slave units connected to the same master unit, specify a unique number between 1 and 63.

■ How to set slave numbers for a standard type

Specify slave numbers using a combination of DIP switch and rotary switch.
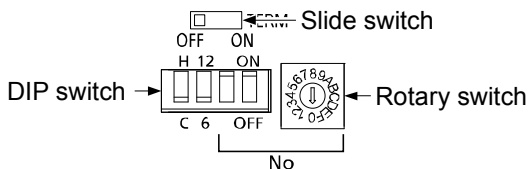
DIP switch		Rotary switch settings and allocated slave numbers															
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**A**	**B**	**C**	**D**	**E**	**F**
ON	ON	–	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ON	OFF	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
OFF	ON	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
OFF	OFF	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63

(Note) Slave No.0 cannot be used.

■ How to set slave numbers for a compact type

To each slave number to be allocated, an address is provided by adding corresponding bit figures from 1, 2, 4, 8, 16, and 32. Switches for the relevant figures are turned on the slave unit.

E.g. When a slave number is set to "5", 1 and 2 are turned on, and the other figures are turned off.
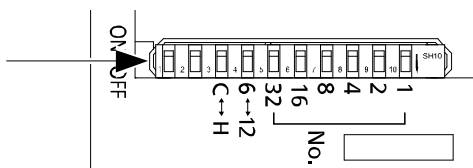
◆ **KEY POINTS**

- **It is recommended to allocate slave numbers using consecutive numbers starting with 1.**

- **Because the PHLS master unit does not communicate with slaves that have numbers larger than the Max. slave number, it is recommended to set the Max. slave number as small as possible to enable speedy scanning.**

4.1.2 Setting Baud Rate

Baud rate of the PHLS system should be set using the operation mode switches on the master unit and the slave unit. Make sure that Baud rates of the master unit and all the slave units are consistent.

Switch position	Baud rate
12	12 Mbps
6	6 Mbps

4.1.3 Output Hold/Clear Settings during Transmission Error

Specify how to handle output at the time of system transmission error.

Switch position	Output operation at the time of transmission error
H	Hold: Output status before the transmission error occurred is retained.
C	Clear: The OFF signal is output.

♦ **REFERENCE**

- **Turn off the power supply before making settings or changes.**

- **For settings of the operation mode switch on the master unit, please see 2.1.3 Operation Mode Switch.**

- **For settings of the operation mode switch on the Slave unit, Standard type, please see 2.2.2 Operation Mode Setting Switches.**

- **For settings of the operation mode switch on the Slave unit, Compact type, please see 2.3.2 Operation Mode Setting Switches.**

4.2 I/O No. Allocation

4.2.1 Allocation of the Master Unit in the I/O Map

The PHLS master unit should be allocated in the I/O map using the tool software FPWIN GR7.

■ **How to allocate the master unit**

◆ **PROCEDURE**

1. **From the menu bar, select "Option" → "FP7 Configuration".**

2. **In the left pane, select "I/O Map".**

3. **Double click a slot to which the PHLS master unit is to be installed.**

    The "Unit selection" dialog box is displayed.

4. **In the field for selection of units to be used, select "Communications" and "PHLS master unit".**
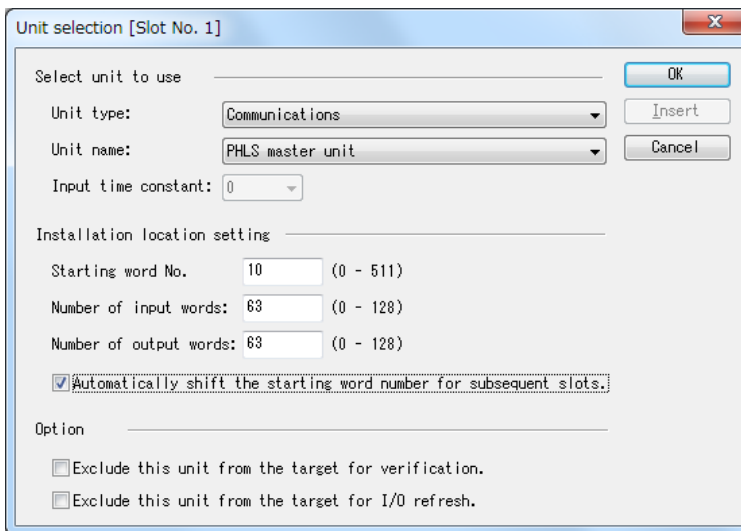
5. **For input words and output words, enter the same value as "End slave no.".**

6. **Press [OK] button.**

◆ **KEY POINTS**

- **In the PHLS system, each slave occupies I/O numbers for 16 points.**

4.2.2 I/O Number Allocated to Slaves

I/O numbers allocated to slaves of the PHLS system are determined based on the initial word number of the connected master unit and the slave number.

■ Slave types and allocated I/O numbers

I/O numbers listed below indicate cases where the initial word number is "10" and the slave number is "1".

Item number for the standard type	Item number for the compact type	No. of I/O points	I/O No.	
			Input	**Output**
AFPRP1X08D2	AFPRP2X08D2E (e-CON)	Input: 8 points	X100 to X107	–
AFPRP1X16D2	AFPRP2X16D2	Input: 16 points	X100 to X10F	–
AFPRP1XY16D2T	AFPRP2XY16D2T	Input: 8 points / Output: 8 points	X100 to X107	Y108 to Y10F
AFPRP1Y16T	AFPRP2Y16T	Output: 16 points	–	Y100 to Y10F
–	AFPRP2Y04R (Relay)	Output: 4 points	Y100 to Y103	–

■ Order of allocated I/O numbers

I/O numbers for slaves are allocated in the order of slave numbers specified by the switch on the relevant slave units.
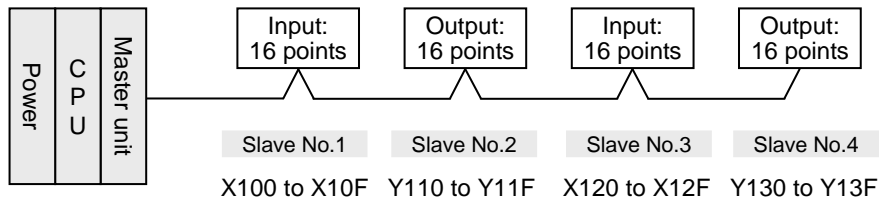
I/O numbers for slaves are allocated in the order of slave numbers, regardless of the order of connection of the relevant slave units.
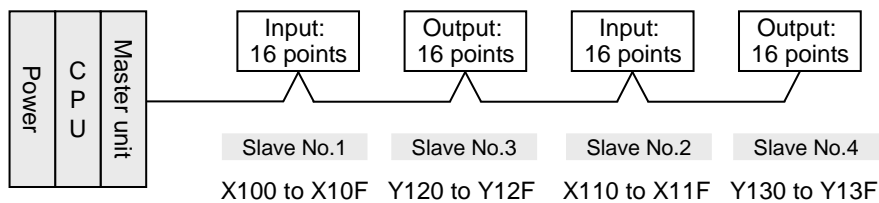
■ I/O numbers allocated to slaves of the mixed input/output type

In the case of the mixed input/output type, consecutive numbers are allocated in the order of Input → Output.

E.g. In the case of a slave with 8 input points and 8 output points, X100 to X107 are allocated to Input, and Y108 to Y10F are allocated to Output.
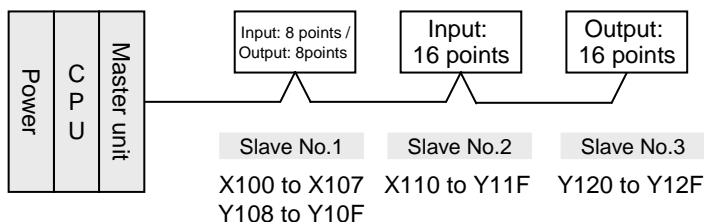
(The example above indicates a case where the initial word number allocated to the master unit is "10".)

■ I/O numbers allocated when 4-point type and 8-point type are mixed

Because numbers for 16 points are allocated whether the unit is 4-point type or 8-point type, numbers from the final allocated I/O number to the subsequent slave number become dead.

E.g. If X100 to X107 are allocated to a slave No. 1 of 8-point type, X108 to X10F become dead numbers. I/O numbers for Slave No. 2 start with X110 or Y110.
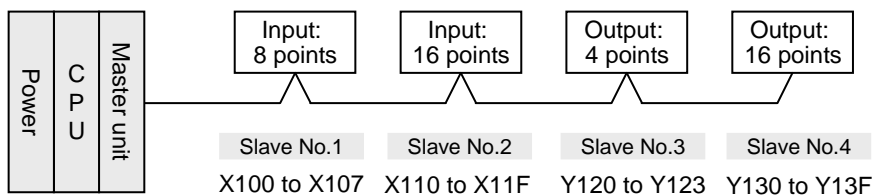
(The example above indicates a case where the initial word number allocated to the master unit is "10".)

■ I/O numbers allocated when slave numbers are not consecutive

Dead numbers also occur in cases where slave numbers allocated to the connected slaves are not consecutive.

E.g. If Slaves No.1 and No.3 are allocated and No.2 does not exist, X110 to X11F and Y110 to Y11F become dead numbers.
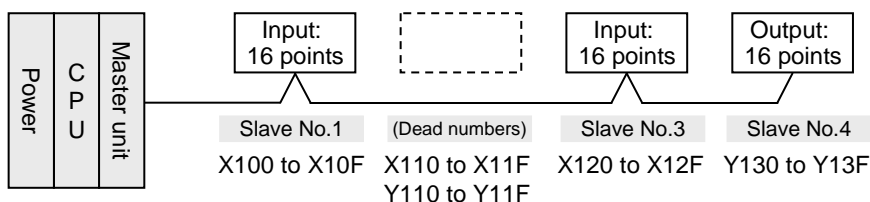
(The example above indicates a case where the initial word number allocated to the master unit is "10".)

◆ **KEY POINTS**

- **The initial word number of a slave unit should be calculated as follows.**

- **[Initial word No.] + [Slave No.] - 1 = Slave word No.**

E.g. If the initial word number allocated to the master unit is "10", and the slave number is "5", the I/O word number allocated to the relevant slave is "14".

Item number for the standard type	Item number for the compact type	No. of I/O points	I/O No.	
			Input	**Output**
AFPRP1X08D2	AFPRP2X08D2E (e-CON)	Input: 8 points	X140 to X147	–
AFPRP1X16D2	AFPRP2X16D2	Input: 16 points	X140 to X14F	–
AFPRP1XY16D2T	AFPRP2XY16D2T	Input: 8 points / Output: 8 points	X140 to X147	Y148 to Y14F
AFPRP1Y16T	AFPRP2Y16T	Output: 16 points	–	Y140 to Y14F
–	AFPRP2Y04R (Relay)	Output: 4 points	Y140 to Y143	–

4.3 Configuration Concerning PHLS

4.3.1 Settings Using Tool Software FPWIN GR7

Parameters to be used in the PHLS system (e.g. slave unit registration, connection waiting time) should be set in the tool software FPWIN GR7.

■ Setting method

In the following procedure, it is assumed that the PHLS master unit is already allocated in the I/O map under the configuration menu.

◆ **PROCEDURE**

1. **From the menu bar, select "Option" → "FP7 Configuration".**

2. **In the left pane, select "I/O Map".**

3. **Select the slot where the PHLS master unit is registered, and press the [Advanced] button.**

   The "PHLS master unit settings" dialog box is displayed.

4. **Enter the slave final address, communication retry times, and PHLS slave communication waiting time.**

5. **Select the slave to be connected.**

6. **Press [OK] button.**

   The set values become valid when the mode is switched to "RUN" after downloading the values in a project together with the program.

■ **Setting item**

Items	Default	Setting range	Settings
End slave No.	63	1 to 63	Among the slave units to be connected, specify the slave number that has the largest value. The master unit does not communicate with slaves that have larger values than the above.
Communications retry count	3	3 to 7	・Specify retry times in the case where communication cannot be established between the master unit and the slave unit. An error is detected if communication with the slave cannot be established after retry has been made for the specified times. ・Even if a communication error is recorded, communication is automatically restarted once the cause of the error is removed. When this happens, the Error LED remains in the same status.
PHLS slave connection waiting time	0	0 to 300 (sec)	・Specify waiting time before communication is established with the slave unit selected in the "Select slaves to be connected" field, following power-up. ・The above is valid not only following power-up, but also when the mode is switched from PROG to RUN after downloadeding the FP7 configuration or project. ・While waiting for communication with the slave unit, the PROG LED on the CPU unit flashes. While this LED is flashing, the RUN mode cannot be used. ・Once communication with the slave unit is established within this time, the CPU unit becomes ready for transition to the RUN mode. (The unit automatically transits to the RUN mode if power is turned on in the RUN mode, or when the mode is switched from PROG to RUN.) ・If communication with the slave unit cannot be established within this time, the master unit reports an error. ・If the time is set to "0", the master unit continues waiting until communication with the slave unit is established. (No error is reported.) ・Whether the master unit allows transition to the RUN mode, while an error is being reported, depends on settings under "Select operation when a self-test error occurs → A unit error occurred" in the CPU configuration.
Select slaves to be connected	No check	01 to 63	・Turn on the check box for the number of slave to be connected. ・If the slave of the specified number is not connected, an error is reported after "PHLS slave connection waiting time" has passed.

4.3.2 Final Slave No. and Settings and Operations Concerning "Select Slaves to be Connected"

• The master unit does not communicate with slave units that have slave numbers larger than the specified final slave number. Among the slave units to be connected, specify the slave number that has the largest value for the final slave number.

• The master unit also communicates with units whose check boxes in "Select slaves to be connected" are not turned on, as long as their slave numbers are smaller than the specified final slave number. No connection waiting check is conducted for such commutation. No error is reported, either, even if the relevant units are not connected.

♦ KEY POINTS

- **Among the slave units to be connected, specify the slave number that has the largest value for the final slave number. If this value is excessively large, the transmission time will be longer.**

♦ NOTE

- **Please note that slave units are activated even if their check boxes in "Select slaves to be connected" are not turned on, as long as their slave numbers are smaller than the final slave number. Operation is continued without detecting an error, even if such slave units are turned on or off during the RUN mode.**

4.3.3   Settings and Operations of PHLS Slave Connection Waiting Time

Depending on settings of PHLS slave connection waiting time, operations following power-up, or when the mode is switched from PROG to RUN after downloading the FP7 configuration or project, as follows.

■ Operation when the connection waiting time is set to "0"

- The master unit continues waiting until the slave unit selected in "Select slaves to be connected" is started up. While waiting, the PROG. LED on the CPU unit flashes. During this time, the RUN mode cannot be used.

- The mode is set to RUN when the slave is started up, following power-up in the RUN mode, or when the mode is switched from PROG to RUN.

■ Operation when the connection waiting time is set to "1 to 300 seconds"

- The master unit continues waiting within the specified range of waiting time, until the slave unit selected in "Select slaves to be connected" is started up. During this time, the PROG. LED on the CPU unit flashes. During this time, the RUN mode cannot be used.

- The mode is set to RUN when the registered slave is started up within the specified waiting time. (The mode can be switched to RUN.) The mode is automatically set to RUN, following power-up in the RUN mode, or when the mode is switched from PROG to RUN.

- An error is reported if the time before the slave unit selected in "Select slaves to be connected" is started up exceeds the specified connection waiting time. In this case, the ERROR LED on the PHLS master unit turns on.

- The operation mode of the CPU unit at the time of error varies depending on settings of CPU configuration ("Select operation when a self-test error occurs → A unit error occurred").

Select operation when a self-test error occurs → A unit error occurred	Operation when the time before the slave unit selected in "Select slaves to be connected" is started up exceeds the specified connection waiting time
Stop operation	A unit error is reported. The CPU unit remains in the PROG. mode.
Continue operation	A unit error is reported. The CPU unit is switched to the RUN mode.
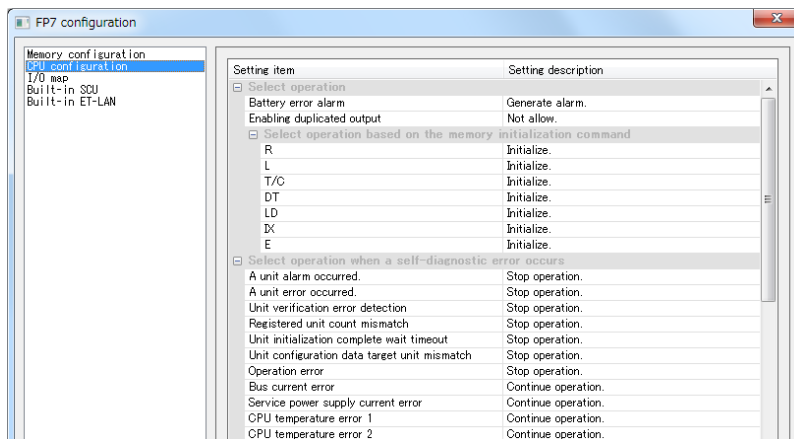
CPU configuration menu

5

Startup and Operation of the PHLS System

5.1 Startup of the PHLS System

5.1.1 Check Before Turning On the Power

In order to prevent malfunctions and accidents, check the following items before starting up the system.

■ **Items to be checked**

1. Check to make sure the various devices have been connected as indicated by the design.

2. Make sure settings have been entered so that power supplies will be turned on according to the procedure outlined in section "Procedure for Turning On the Power".

3. Ensure that the CPU unit is started up in the PROG. mode by default.

5.1.2 Procedure for Turning On/Off the Power

In order to prevent malfunctions at the time of system startup or stop, observe the following procedure to start up the PHLS system.

■ **Procedure for turning on the power**

1. Power on I/O devices connected to the PHLS slave unit.

2. Power on the PLHS slave unit.

3. Power on FP7 where the PHLS master unit is installed.

■ **Procedure for turning off the power**

1. Power off FP7 where the PHLS master unit is installed.

2. Power off the PLHS slave unit.

3. Power off I/O devices connected to the PHLS slave unit.

5.2 Pre-Operation Checks (Before Switching to the RUN Mode)

5.2.1 Check of Communication Status

- While the slave unit and the master unit are communicating normally, the COMM. LED flashes. The numbers of the connected slaves can be confirmed by checking the operation monitor LEDs of the master unit.

- Check that the COMM. LEDs on the master unit and all the slave units are turned on. Subsequently, check that the numbers of the connected slaves are correct, by checking the operation monitor LEDs of the master unit.

◆ **REFERENCE**

- **For the operation monitor LEDs of the master unit, please see 6.2 What to Do If an Error Occurs.**

- **If there is abnormality (e.g. ERR. LED or ALARM LED is turned on), please see 6.2 What to Do If an Error Occurs.**

5.2.2 Check of Output Status

The output status of the PHLS system can be checked using the tool software FPWIN GR7.

■ Setting method

In the following procedure, it is assumed that the tool software FPWIN GR7 has already been started up, and the PHLS master unit is already allocated in the I/O map.

◆ **PROCEDURE**

1. **From the menu bar, select "Debug" → "Force I/O functions".**

   The "Force I/O" dialog box is displayed.
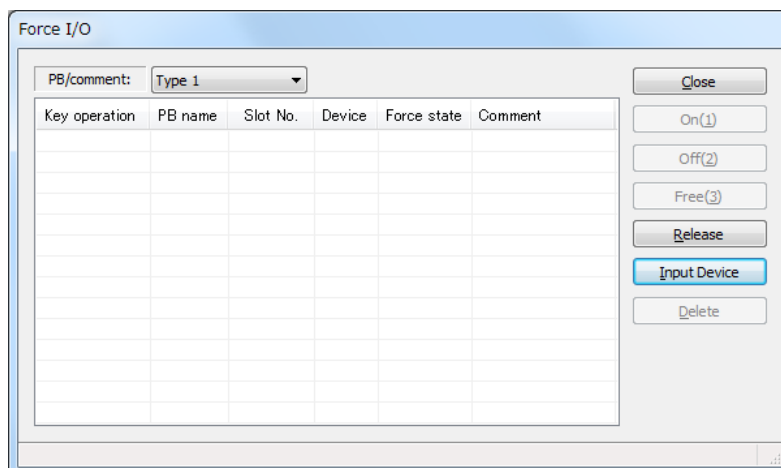
2. **Press the [Input device] button.**

    The "Force I/O devices" dialog box is displayed.

3. **Enter the device type and no., slot no., and number of consecutive registrations, and press the [OK] button.**

Setting item	Setting method
Device type	Select "OT (direct output)".
No.	In accordance with the I/O allocation, specify the numbers. Note that the initial word number is "0". Specify a value subtracting 1 from the relevant slave number.
Slot No.	Enter the slot number where the master unit is installed.
No. of continuous registrations	Enter the number of input/output points to be registered. Enter "16" to enable registrations for one slave.

    The registered settings are indicated.

4. **Select "Output", and press the [ON] or [OFF] button.**

    The settings are output to the specified slave unit. The process above can also be carried out by pressing <Ctrl> key + Number key.

5. **In order to cancel the force input/output, press the [Release] button.**

5.3 Response Times in the PHLS System

5.3.1   Input/Output Response Times

- The PHLS system undertakes input/output processing asynchronously from the I/O refresh operation by the CPU unit.

- Input/output response times during use of the PHLS system are specified as follows, depending on settings of Baud rate, final slave No., and scan time of the CPU unit.

■ Input response time
Response time before input signals received by the slave unit are incorporated, through input/output refresh by the CPU unit, is calculated by the following equation.

Input response time = (1) + (2) + (3) + (4)

(1)	Input response time of the slave unit	1 ms or less
(2)	Transmission time of the PHLS system	Baud rate: When 12 Mbps, 29.5 μs × Final slave No. Baud rate: When 6 Mbps + 59.0 μs × Final slave No.
(3)	Scan time of the master unit	220 μs + 13.75 μs × Final slave No.
(4)	Scan time of the CPU unit	Varies by the program, settings and time.

Example of calculation: When Baud rate 12 Mbps, Final slave No.10, and CPU scan time 1 ms

Input response time = 1 ms + (29.5 μs × 10) + (220 μs + 13.75 μs × 10) + 1 ms = 2.653 ms.

■ Output response time
Response time before signals output through input/output refresh by the CPU unit, are output from the slave unit, are calculated by the following equation.

Output response time = (1) + (2) + (3)

(1)	Output response time of the slave unit	Models excluding the relay output type: 0.5 ms or less
		Relay output type: OFF → ON: 10 ms or less, ON → OFF: 5 ms or less
(2)	Transmission time of the PHLS system	Baud rate: When 12 Mbps, 29.5 μs × Final slave No. Baud rate: When 6 Mbps, 59.0 μs × Final slave No.
(3)	Scan time of the master unit	220 μs + 13.75 μs × Final slave No

6

Troubleshooting

6.1 Self-Diagnosis Function

6.1.1 Operation If an Error Occurs

In order to prevent malfunctions at the time of system startup or stop, observe the following procedure to start up the PHLS system.

■ Operation of the CPU unit at the time of transmission error

Operation mode of the CPU unit at the time of PHLS system transmission error can be set (Continue or Stop) in the "FP7 Configuration" menu of the tool software FPWIN GR7.

■ Output of the slave unit at the time of transmission error

Output of the slave unit can be switched using the operation mode switch on the relevant slave unit.

♦ **REFERENCE**

For details of settings, please see 4.1.3 Output Hold/Clear Settings during Transmission Error.

6.2 What to Do If an Error Occurs

6.2.1 ALM LED Turns On on the Master Unit

■ Situation

It is probable that an error has occurred on the master unit.

■ Solution

◆ PROCEDURE

1. **Set the CPU unit to the PROG. mode, and turn off the power supply and then on again on the FP7 system where the master unit is installed.**

    If the ALM LED lights again, there may be a problem with the unit. If the ALARM LED goes out after the power supply is turned off and then on again, the problem may have been caused by noise or another temporary phenomenon.

6.2.2 ERR LED Turns On on the Master Unit

■ Situation

It is probable that there is an error in the settings of the master unit, slave unit, and/or tool software FPWIN GR7.

■ Solution

Confirm the status in the following procedure.

◆ PROCEDURE

1. **Check the operation mode switches on the master unit and the slave unit, and confirm that the Baud rate settings are consistent.**

2. **Check the "FP7 configuration" menu in FPWIN GR7, and confirm that the slave numbers of the slave units to be used are consistent with design.**

3. **Check the operation mode switch on the slave unit, and confirm that the slave numbers are specified correctly.**

6.2.3 PWR LED Does Not Turn On on the Slave Unit

■ Situation

It is possible that sufficient power is not supplied.

■ Solution

Confirm the status in the following procedure.

◆ **PROCEDURE**

1. **Power off the slave unit and double-check the wiring status (e.g. Is there any loose terminal?)**

2. **Disconnect the power supply wiring to the other devices if the power supplied to the unit is shared with them.**

   If LED on the slave unit turns on following the above step, undercapacity of power supply is possible. Review the power supply design.

6.2.4 If Expected Output Is Not Available

■ Situation

Both hardware reasons (e.g. wiring, power supply) and software reasons (e.g. program, I/O allocation) are possible.

■ Solution (check of the output side)

Proceed from the check of the output side to the check of the input side.

◆ **PROCEDURE**

1. **Check if output indication LED on the slave unit is on.**

   If it is on, proceed to the next step. If it is not, proceed to Step 4.

2. **Check the wiring of the load (e.g. Is there any loose terminal?)**

   If LED on the slave unit turns on following the above step, undercapacity of power supply is possible. Review the power supply design.

3. **Check if the power is properly supplied to both ends of the load.**

   If the power is properly supplied to the load, there is probably an abnormality in the load. If the power is not supplied to the load, there is probably an abnormality in the unit's output part.

4. **Monitor the output status using the tool software FPWIN GR7.**

   If the output monitored is turned on, there is probably a duplicated output error, etc.

5. **Forcibly turn on and off the relevant output using the forced input/output functions of the tool software FPWIN GR7.**

    If the output indicator LED of the slave unit is turned on, go to input condition check. If the output indicator LED remains off, there is probably an abnormality in the unit's output part.

■ **Solution (check of the input side)**

Clarify the situation in the following procedure.

◆ **PROCEDURE**

1. **Check if input indication LED on the slave unit is on.**

    If it is off, proceed to the next step. If it is on, proceed to Step 3.

2. **Check the wiring of the input device (e.g. Is there any loose terminal?)**

    If LED on the slave unit turns on following the above step, undercapacity of power supply is possible. Review the power supply design.

3. **Check that the power is properly supplied to the input terminals.**

    If the power is properly supplied to the input terminals, there is probably an abnormality in the unit's input part.
    If the power is not supplied to the input terminal, there is probably an abnormality in the power supply or the input device.

4. **Monitor the input status using the tool software FPWIN GR7.**

    If the input monitored is off, there is probably an abnormality with the unit's input part.
    Modify the program if the input monitored is on. If the input device is a two-wire sensor, influence of leaked current is possible.

◆ **KEY POINTS**

• **When the program is to be reviewed, check the following points.**
    1. Check if output specifications are rewritten (e.g. duplicated output use)

    2.   Check if the program flow has been changed due to an MCR command, JMP command or other control commands.

    3. Check if the I/O map allocation agrees with the actual mount status.

7
Specifications

7.1 Common Specifications

7.1.1 General Specifications

| Items | PHLS master unit | PHLS slave unit standard type | | |
| | | Input type | Output type | Mixed I/O type |
	AFP7PHLSM	AFPRP1X08D2 AFPRP1X16D2	AFPRP1Y16T	AFPRP1XY16D2T
Internal current consumption (with 24 V)	85 mA or less	–		
Current consumption	–	100 mA or less	150 mA or less	75 mA or less	120 mA or less
Rated voltage	–	24V DC		
Operating voltage range	–	20.4 to 28.8 V DC		
Operating ambient temperature	0 to +55°C			
Storage ambient temperature	−40 to +70°C			
Operating ambient humidity	10 to 95%RH (at 25°C, no-condensing)			
Storage ambient humidity	10 to 95%RH (at 25°C, no-condensing)			
Breakdown voltage	<PHLS Master unit> 500 V AC, 1 minute (Note 1) ・Between Communication channel 1 and power supply terminals; Functional earth terminals (Note 2) ・Between Communication channel 2 and power supply terminals; Functional earth terminals (Note 2) ・Between Communication channel 1 and Communication channel 2 <PHLS - Slave unit> 500V AC, 1 minute (Note 1) ・I/O terminals; Between power supply terminals and functional earth terminals ・I/O terminals; Between power supply terminals and communication terminals ・Between communication terminals and functional earth terminals			

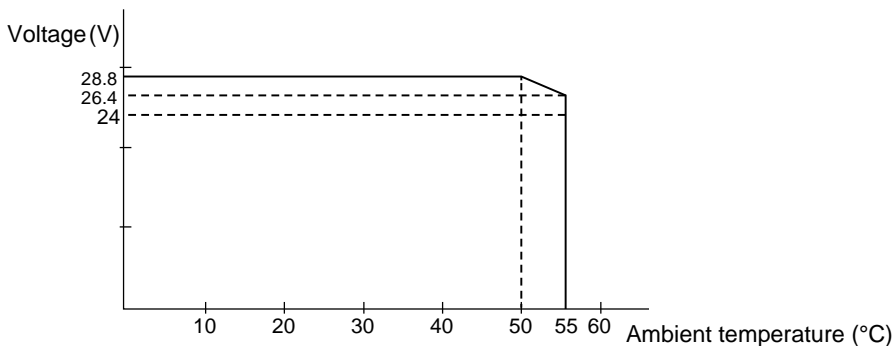| Items	PHLS master unit	PHLS slave unit standard type			
		Input type		Output type	Mixed I/O type
	AFP7PHLSM	AFPRP1X08D2	AFPRP1X16D2	AFPRP1Y16T	AFPRP1XY16D2T
Insulation resistance (Test voltage: 500 V DC)	<PHLS Master unit> 100 MΩ or more ・Between Communication channel 1 and power supply terminals; Functional earth terminals (Note 2) ・Between Communication channel 2 and power supply terminals; Functional earth terminals (Note 2) ・Between Communication channel 1 and Communication channel 2 <PHLS - Slave unit> 100 MΩ or more ・I/O terminals; Between power supply terminals and functional earth terminals ・I/O terminals; Between power supply terminals and communication terminals ・Between communication terminals and functional earth terminals				
Vibration resistance	Based on JIS B 3502 and IEC 61131-2: 5 to 8.4 Hz, half amplitude 3.5 mm 8.4 to 150 Hz, constant acceleration 9.8 m/s^2 X, Y and Z axes, 10 sweeps each (1 octave/mm)				
Shock resistance	Based on JIS B 3502 and IEC 61131-2: 147 m/s^{2}or more, X, Y and Z axes, 3 sweeps each				
Noise resistance	1,000V P-P with pulse widths of 50 ns or 1 μs				
Environment	Free from corrosive gases and excessive dust.				
EU Directive applicable standard	EMC Directive: EN 61131-2u				
Overvoltage category	Category II or lower				
Pollution degree	Pollution degree 2 or lower				
Weight (main unit)	Approx. 110 g	Approx. 140 g		Approx. 210 g	

(Note 1): Cutoff current 5 mA. This excludes the protective varistor (Factory default setting).
(Note 2): Power supply terminal and functional earth terminal of the control unit.

Items	PHLS Slave unit compact type				
	Connector terminal block			e-CON	Relay output
	Input type	Output type	Mixed I/O type		
	AFPRP2X16D2	AFPRP2Y16T	AFPRP2XY16D2T	AFPRP2X08D2E	AFPRP2Y04R
Current consumption	170 mA or less	40 mA or less	110 mA or less	100 mA or less	85 mA or less
Rated voltage	−	24V DC			
Operating voltage range	−	20.4 to 28.8 V DC			
Operating ambient temperature	0 to +55°C				
Storage ambient temperature	−40 to +70°C				
Operating ambient humidity	10 to 95%RH (at 25°C, no-condensing)				
Storage ambient humidity	10 to 95%RH (at 25°C, no-condensing)				
Breakdown voltage	<Connector terminal block, e-CON> 500V AC, 1 minute (Note 1) ・I/O terminals; Between power supply terminals and functional earth terminals ・I/O terminals; Between power supply terminals and communication terminals ・Between communication terminals and functional earth terminals <Relay output> 2,300V AC, 1 minute (Note 1) ・Between output terminals and power supply terminals ・Between output terminals and functional earth terminals ・Between output terminals and communication terminals ・Between power supply terminals and functional earth terminals ・Between power supply terminals and communication terminals ・Between functional earth terminals and communication terminals ・Between output terminals and output terminals (between different commons)				

(Note): AFPRP2X16D2 should be used within the following voltage range depending on the ambient temperature.

Items	PHLS Slave unit compact type				
	Connector terminal block			e-CON	Relay output
	Input type	Output type	Mixed I/O type		
	AFPRP2X16D2	AFPRP2Y16T	AFPRP2XY16D2T	AFPRP2X08D2E	AFPRP2Y04R
Insulation resistance (Test voltage: 500 V DC)	<Connector terminal block, e-CON> 100 MΩ or more ・I/O terminals, Between power supply terminals and functional earth terminal ・I/O terminals; Between power supply terminals and communication terminals ・Between communication terminals and functional earth terminal <Relay output> 100 MΩ or more ・Between output terminals and power supply terminals ・Between output terminals and functional earth terminals ・Between output terminals and communication terminals ・Between power supply terminals and functional earth terminals ・Between power supply terminals and communication terminals ・Between functional earth terminals and communication terminals ・Between output terminals and output terminals (between different commons)				
Vibration resistance	Based on JIS B 3502 and IEC 61131-2: 5 to 8.4 Hz, half amplitude 3.5 mm 8.4 to 150 Hz, constant acceleration 9.8 m/s^2 X, Y and Z axes, 10 sweeps each (1 octave/mm)				
Shock resistance	Based on JIS B 3502 and IEC 61131-2: 147 m/s^{2}or more, X, Y and Zaxes, 3 sweeps each				
Noise resistance	<Connector terminal block, e-CON> 1,000V P-P with pulse widths of 50 ns or 1 μs <Relay output> 1,500V P-P with pulse widths of 50 ns or 1 μs				
Environment	Free from corrosive gases and excessive dust.				
EU Directive applicable standard	EMC Directive: EN 61131-2				
Overvoltage category	Category II or lower				
Pollution degree	Pollution degree 2 or lower				
Weight (main unit)	Approx. 75g				

(Note 1): Cutoff current 5 mA. This excludes the protective varistor (Factory default setting).
(Note 2): Power supply terminal and functional earth terminal of the control unit.

7.1.2 Performance Specifications

Items	Description
Transmission system	Two-wire half-duplex communication
Insulation system	Pulse transformer insulation
Baud rate	6 Mbps/ 12 Mbps
Synchronous method	Bit synchronization
Error detection	CRC-12
Transmission distance	Total length: 200 m (6 Mbps) / 100 m (12 Mbps) (Note 1)
Connection method	Multi-drop method
Impedance	100Ω
Terminal resistance	Mounted on the product
External interface	Master unit: Terminal block (2 CH)
	Slave unit (terminal block type): Terminal block
	Slave unit (compact type): Connector terminal block

(Note 1): The performance values assume the use of a recommended cable. The indicated performance (e.g. Max. transmission distance, Max. slave units) may not be available if a recommended cable is not used.

7.2 Common Specifications of Slave Units

7.2.1 Input Specifications

Items		Standard type			Compact type		
					Connector terminal block		e-CON
		Input		Mixed I/O	Input	Mixed I/O	Input
		AFPRP1X08D2	AFPRP1X16D2	AFPRP1XY16D2T	AFPRP2X16D2	AFPRP2XY16D2T	AFPRP2X08D2E
Insulation system		Optical coupler			Non-isolated		
Rated input voltage		24V DC					
Rated input current		Approx. 3 mA			Approx. 4.3 mA		
Input impedance		Approx. 7.5 kΩ			Approx. 5.6 kΩ		
Operating voltage range		20.4 to 28.8 V DC					
Min. ON voltage / Min. ON current		15 V / 2 mA			17V / 2 mA		
Max. OFF voltage / Max. OFF current		5V / 0.5 mA					
Response time	OFF → ON	1 ms or less					
	ON → OFF	1 ms or less					

7.2.2 Output Specifications (Excluding the Relay Output Type)

Items	Standard type		Compact type	
			Connector terminal block	
	Output	Mixed I/O	Output	Mixed I/O
	AFPRP1X08D2	AFPRP1XY16D2T	AFPRP2X16D2	AFPRP2XY16D2T
Insulation system	Optical coupler		Non-isolated	
Output type	Sink type, open collector output			
Rated load voltage	20.4 to 28.8 V DC			
Max. restricted capacity	0.1 A / point			
Restrictions on commons	0.5 A	0.8 A	1.6 A	0.8 A
Max. inrush current	0.5 A			
Off state leakage current	0.1 mA or less			
On state voltage drop	0.5V			
Response time OFF → ON	0.05 ms or less			
Response time ON → OFF	0.5 ms or less			
Surge absorber	Zener diode			
Short circuit protection	Off			

7.2.3 Output Specifications (Relay Output Type)

	Compact type
	Relay output
	Output
	AFPRP2X16D2
Insulation system	Relay insulation
Rated control capacity	1 A 250 V AC resistance load (250 VA) (2 A/Common) 1 A 30 V DC resistance load (30 W) (2 A/Common) Min. load 0.1 mA, 100 mV (resistance load)
Response time OFF → ON	10 ms or less
Response time ON → OFF	5 ms or less
Life Mechanical lifetime	Min. 20,000,000 operations
Life Electrical lifetime	100,000 times or more (Frequency of switching: 20 times/min.)
Surge absorber	No
Relay socket	No

7.3 Internal Circuit Diagram, Terminal Layout

7.3.1 Slave Unit, Standard Type (Item No. AFPRP1 Series)

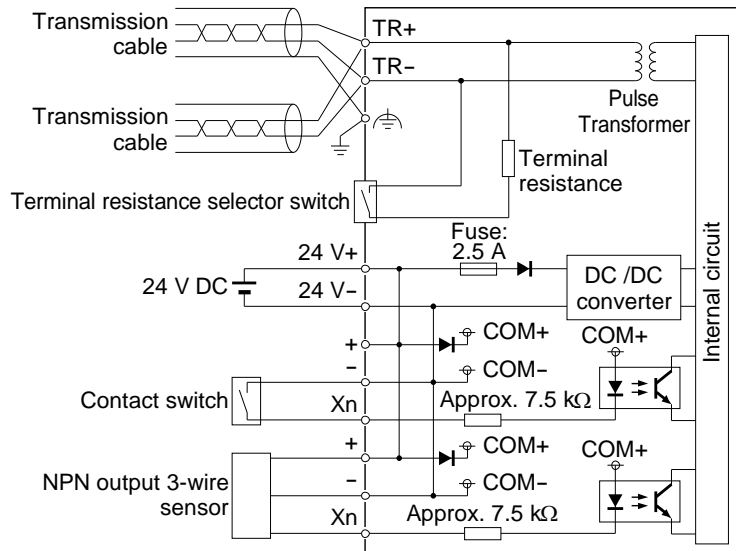### ■ Input type: AFPRP1X08D2, AFPRP1X16D2

Terminal layout

AFPRP1X08D2

1 TR+	3 ⏚	5 24V +	7 X0	9 X2	11 X4	13 X6	15 +
2 TR−	4	6 24V −	8 X1	10 X3	12 X5	14 X7	16 −

AFPRP1X16D2

1 TR+	3 ⏚	5 24V +	7 X0	9 X2	11 +	13 X4	15 X6	17 +	19 X8	21 XA	23 +	25 XC	27 XE	29 +
2 TR−	4	6 24V −	8 X1	10 X3	12 −	14 X5	16 X7	18 −	20 X9	22 XB	24 −	26 XD	28 XF	30 −

Internal circuit diagram

(Note 1): In order to avoid influence of noise, connect the shielded wire of the transmission cable on one side to the functional earth terminal, and make sure to ground the functional earth terminal.
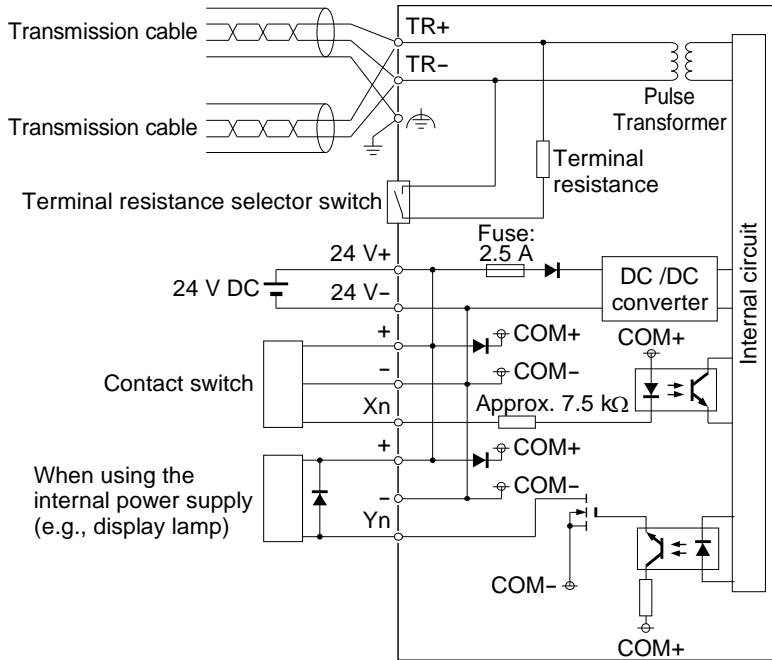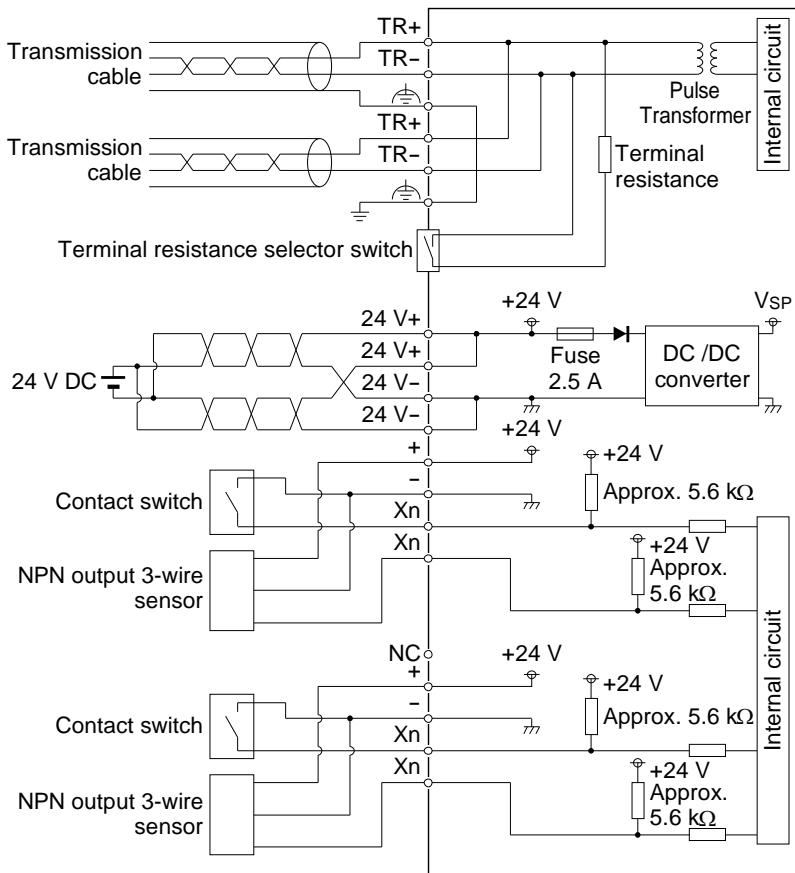
■ Output type: AFPRP1Y16T

Terminal layout

1 TR+	3 ⏚	5 24V +	7 Y0	9 Y2	11 +	13 Y4	15 Y6	17 +	19 Y8	21 YA	23 +	25 YC	27 YE	29 +
2 TR−	4	6 24V −	8 Y1	10 Y3	12 −	14 Y5	16 Y7	18 −	20 Y9	22 YB	24 −	26 YD	28 YF	30 −

Internal circuit diagram
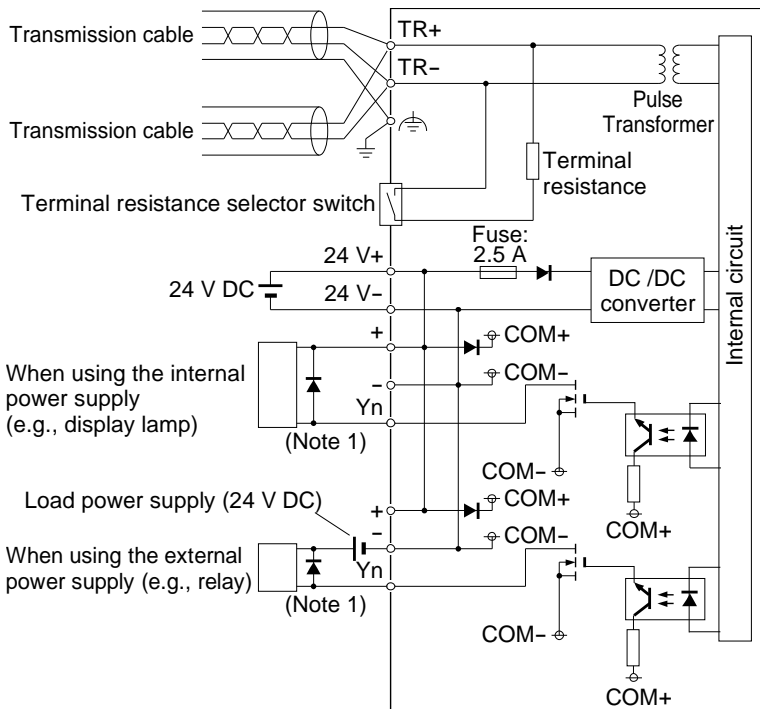
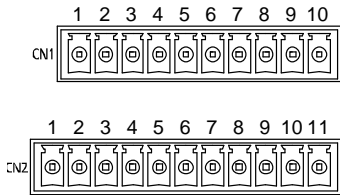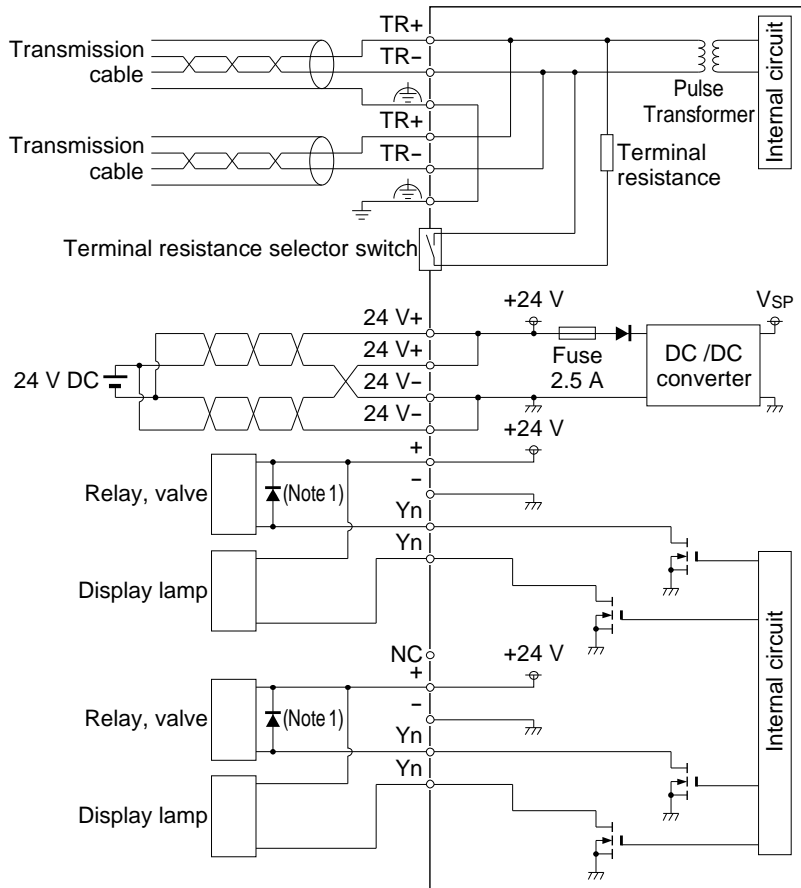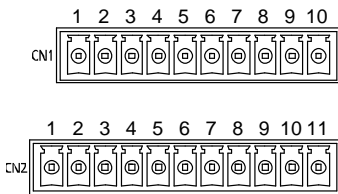(Note 1): As an inductive load, attach a counter EMF absorption diode.
(Note 2): In order to avoid influence of noise, connect the shielded wire of the transmission cable on one side to the functional earth terminal, and make sure to ground the functional earth terminal.

■ Mixed I/O type: AFPRP1XY16D2T

Terminal layout

1 TR+	3 ⏚	5 24V +	7 X0	9 X2	11 +	13 X4	15 X6	17 +	19 Y8	21 YA	23 +	25 YC	27 YE	29 +
2 TR−	4	6 24V	8 X1	10 X3	12 −	14 X5	16 X7	18 −	20 Y9	22 YB	24 −	26 YD	28 YF	30 −

Internal circuit diagram

(Note 1): As a DC type inductive load, attach a counter EMF absorption diode.

(Note 2): In order to avoid influence of noise, connect the shielded wire of the transmission cable on one side to the functional earth terminal, and make sure to ground the functional earth terminal.

7.3.2 Slave Unit, Compact Type (Connector Terminal Block) (Item No. AFPRP2 Series)

■ Input type: AFPRP2X16D2

Terminal layout
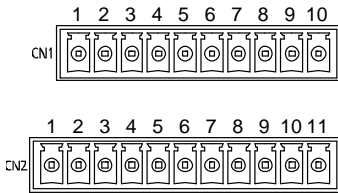
Internal circuit diagram

(Note): In order to avoid influence of noise, connect the shielded wire of the transmission cable to the functional earth terminal on one side, and make sure to ground the functional earth terminal on the other side.
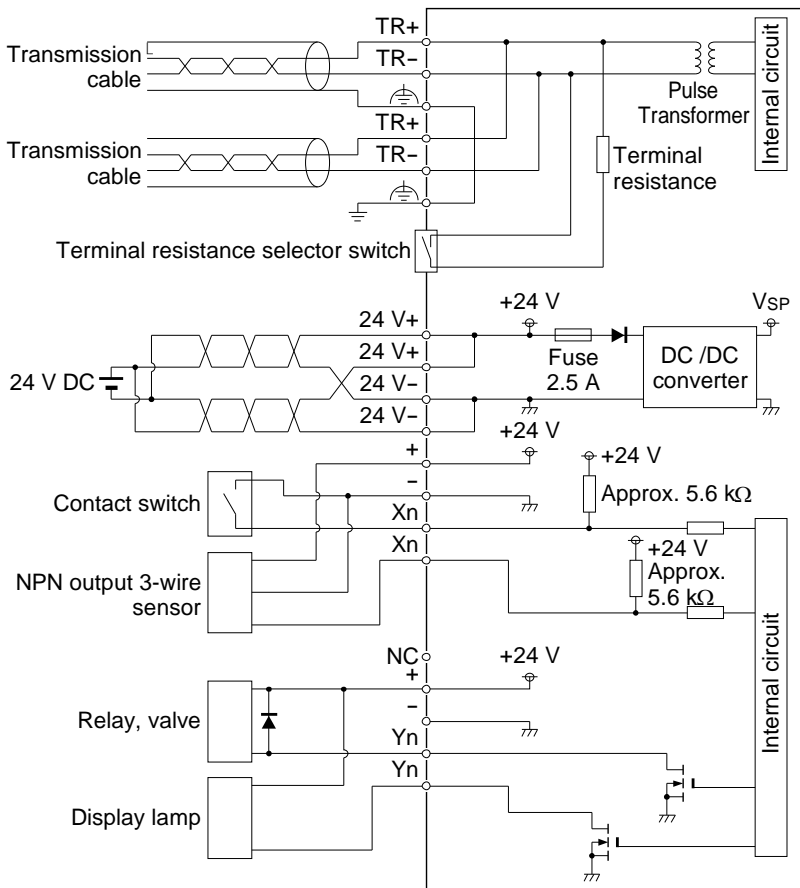
■ **Output type: AFPRP2Y16T**

Terminal layout
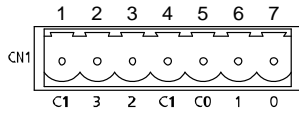

Internal circuit diagram

(Note 1): As an inductive load, attach a counter EMF absorption diode.

(Note 2): In order to avoid influence of noise, connect the shielded wire of the transmission cable to the functional earth terminal on one side, and make sure to ground the functional earth terminal on the other side.

■ Mixed I/O type: AFPRP2XY16D2T

Terminal layout

```
      1  2  3  4  5  6  7  8  9 10
CN1 [⊙⊙⊙⊙⊙⊙⊙⊙⊙⊙]

      1  2  3  4  5  6  7  8  9 10 11
CN2 [⊙⊙⊙⊙⊙⊙⊙⊙⊙⊙⊙]
```

Internal circuit diagram

(Note 1): As an inductive load, attach a counter EMF absorption diode.

(Note 2): In order to avoid influence of noise, connect the shielded wire of the transmission cable to the functional earth terminal on one side, and make sure to ground the functional earth terminal on the other side.

7.3.3   Slave Unit, Compact Type (Relay Output) (Item No. AFPRP2Y04R Series)

■ **When commons are connected separately**

Terminal layout
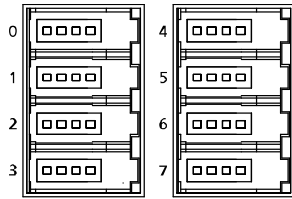

Internal circuit diagram
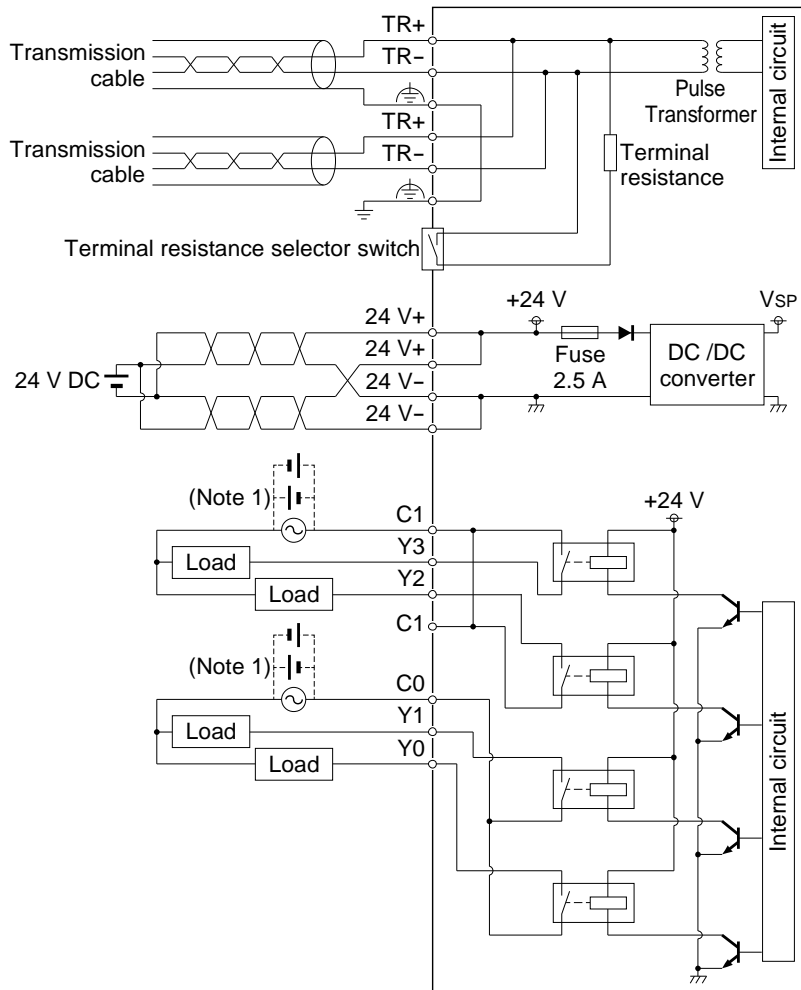
(Note 1): In the case of an AC inductive load, attach a surge absorber (AC load) to either end of the load. In the case of a DC inductive load, attach a diode (DC load) to either end of the load.

(Note 2): In order to avoid influence of noise, connect the shielded wire of the transmission cable to the functional earth terminal on one side, and make sure to ground the functional earth terminal on the other side.

■ **When commons are connected together**

Terminal layout
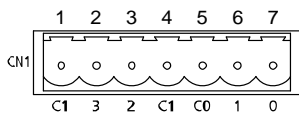
Internal circuit diagram
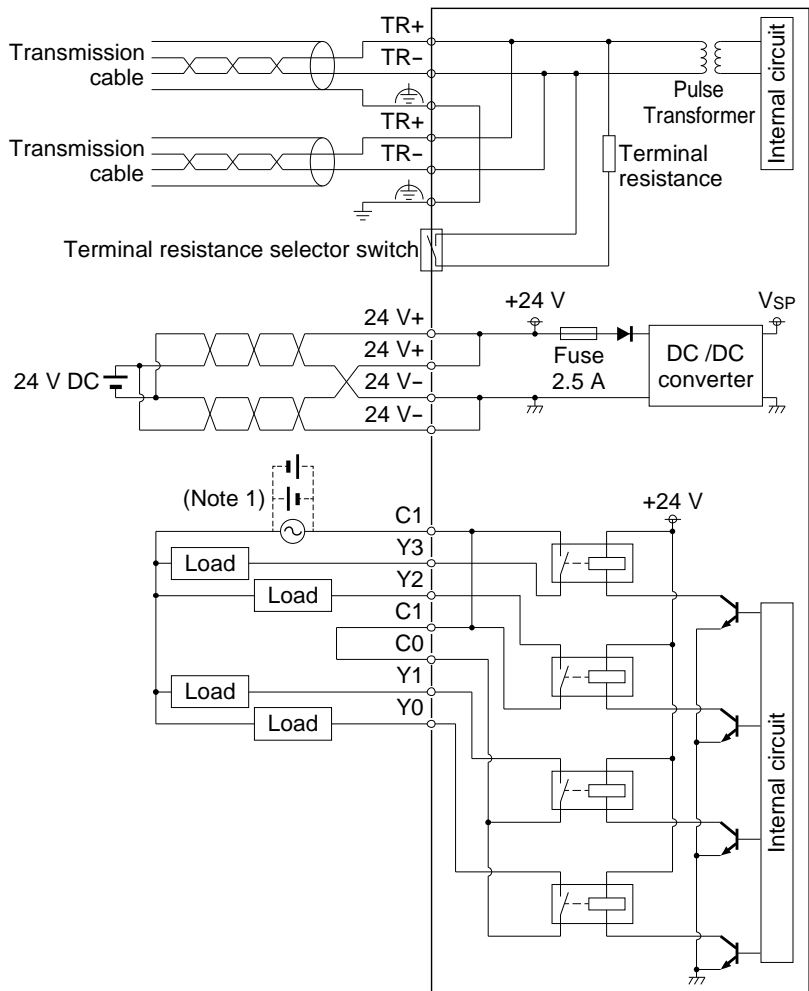
(Note 1): In the case of an AC inductive load, attach a surge absorber (AC load) to either end of the load. In the case of a DC inductive load, attach a diode (DC load) to either end of the load.

(Note 2): In order to avoid influence of noise, connect the shielded wire of the transmission cable to the functional earth terminal on one side, and make sure to ground the functional earth terminal on the other side.

7.3.4 Slave Unit, Compact Type (e-CON) (Item No. AFPRP2X08D2E Series)

■ AFPRP2X08D

Terminal layout

Internal circuit diagram
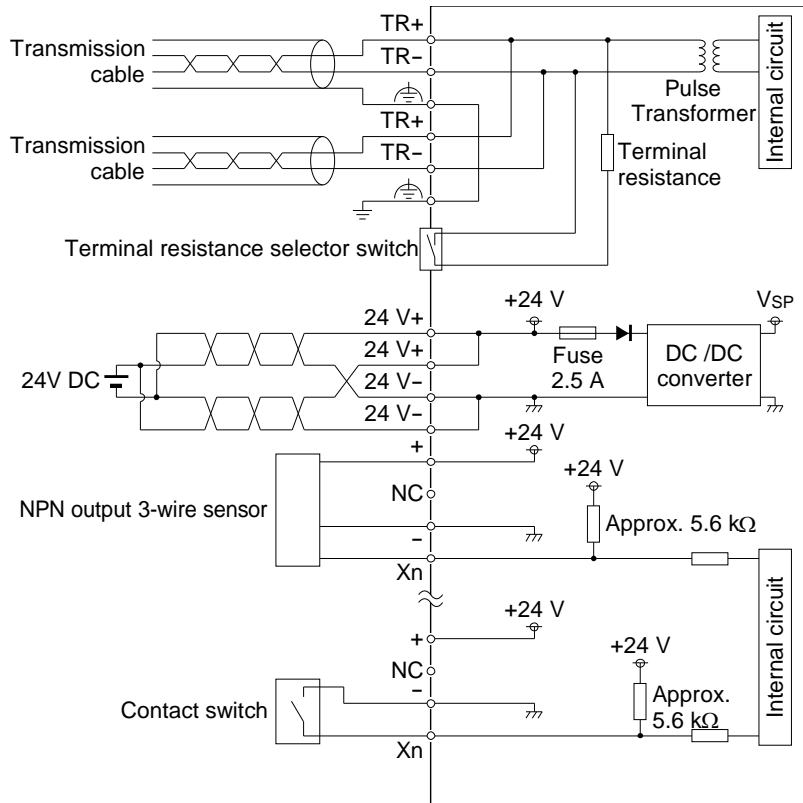
(Note): In order to avoid influence of noise, connect the shielded wire of the transmission cable to the functional earth terminal on one side, and make sure to ground the functional earth terminal on the other side.
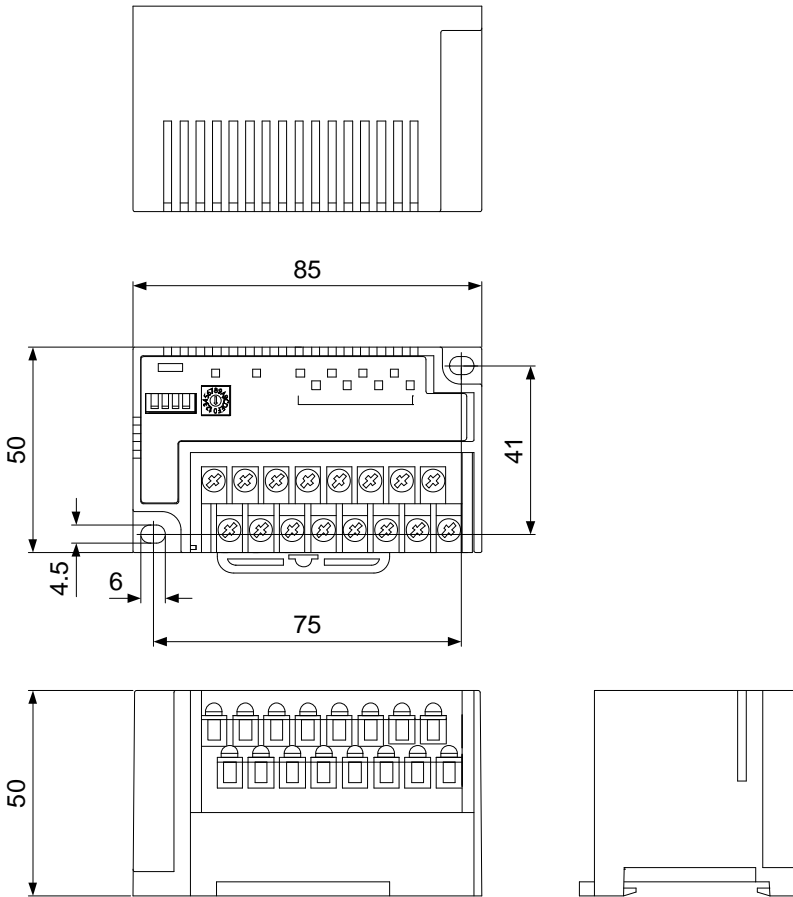
7.4 Dimension Diagram

7.4.1 Slave Unit, Standard Type (Item No. AFPRP1 Series)

■ **Dimensions**
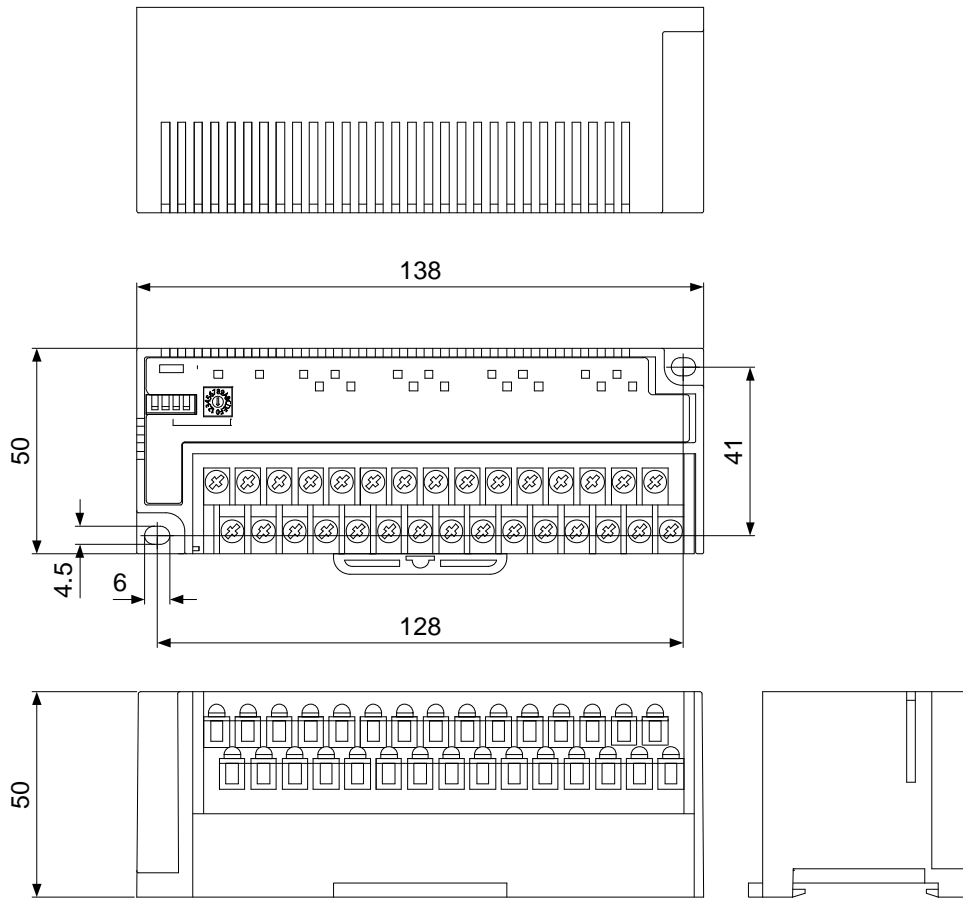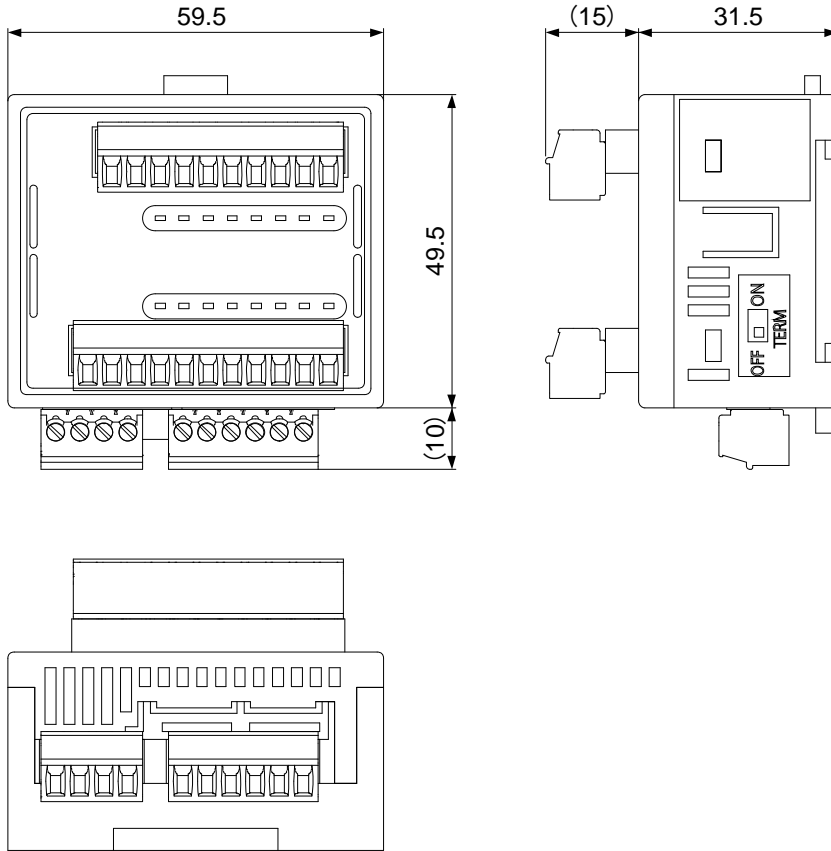**AFPRP1X08D2**

(Unit: mm)

AFPRP1X16D2

138

50

41

4.5

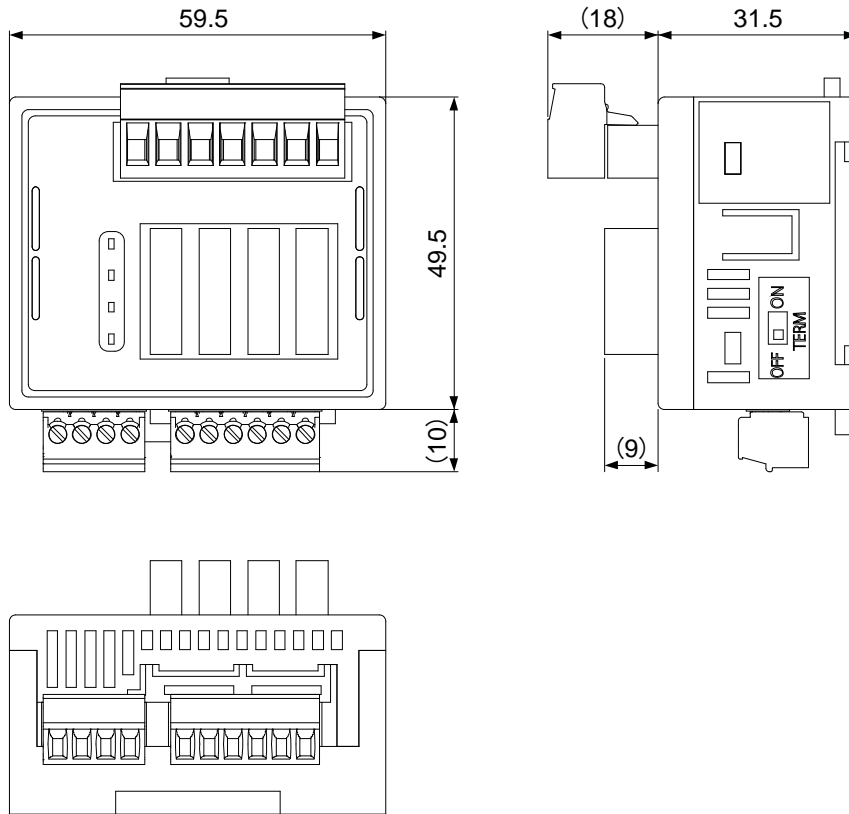6

128

50

(Unit: mm)

7.4.2 Slave Unit, Compact Type (Connector Terminal Block) (Item No. AFPRP2 Series)
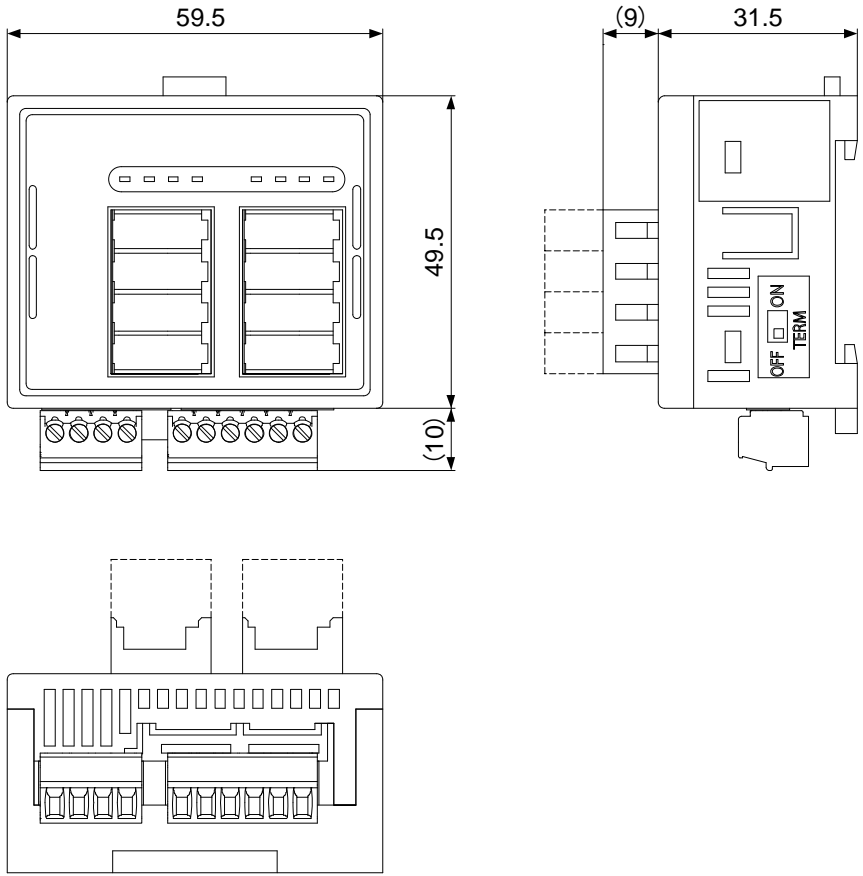
■ Dimensions
AFPRP2X16D2

(Unit: mm)

7.4.3 Slave Unit, Compact Type (Relay Output) (Item No. AFPRP2Y04R Series)

■ **Dimensions**
AFPRP2Y04R

(Unit: mm)

7.4.4   Slave Unit, Compact Type (e-CON) (Item No. AFPRP2X08D2E Series)

■ Dimensions
AFPRP2X08D2E

59.5

(9)   31.5

49.5

(10)

TERM
ON
OFF

(Unit: mm)

Record of changes

Manual No.	Date	Record of Changes
WUME-PHLS-01	Mar.2013	First Edition
WUME-PHLS-02	Jun.2013	Second Edition - Correction in settings of master unit SW2 and SW3 - Correction in settings of slave unit dip switch - Error correction