

General Specifications (AS-Interface Module)

Operating Temperature	0 to 55°C (operating ambient temperature, no freezing)
Storage Temperature	-25 to +70°C (no freezing)
Relative Humidity	Level RH1, 30 to 95% (non-condensing)
Pollution Degree	2 (IEC 60664)
Degree of Protection	IP20
Corrosion Immunity	Free from corrosive gases
Altitude	Operation: 0 to 2,000m (0 to 6,565 feet) Transport: 0 to 3,000m (0 to 9,840 feet)
Vibration Resistance	When mounted on a DIN rail: 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 When mounted on a panel surface: 2 to 25 Hz amplitude 1.6 mm, 25 to 100 Hz acceleration 39.2 m/s ² 90 minutes per axis on each of three mutually perpendicular axes
Shock Resistance	147 m/s ² , 11 ms duration, 3 shocks per axis, on three mutually perpendicular axes (IEC 61131)
External Power Supply	AS-Interface power supply, 29.5 to 31.6V DC
AS-Interface Current Draw	65 mA (normal operation) 110 mA maximum
Effect of Improper Input Connection	No damage
Connector on Mother Board	MSTB2.5/3-GF-5.08BK (Phoenix Contact)
Connector Insertion/Removal Durability	100 times minimum
Internal Current Draw	80 mA (5V DC) 0 mA (24V DC)
AS-Interface Master Module Power Consumption	540 mW
Weight	85g

Communication Specifications (AS-Interface Module)

Maximum Bus Cycle	When 1 through 19 slaves are connected: 3 ms When 20 through 62 slaves are connected: $0.156 \times (1 + N)$ ms where N is the number of active slaves 5 ms maximum when 31 standard or A/B slaves are connected 10 ms maximum when 62 A/B slaves are connected	
Maximum Slaves (Note)	Standard slaves: 31 A/B slaves: 62	When using a mix of standard slaves and A/B slaves together, the standard slaves can only use addresses 1(A) through 31(A). Also, when a standard slave takes a certain address, the B address of the same number cannot be used for A/B slaves.
Maximum I/O Points (Note)	Standard slaves: 248 total (124 inputs + 124 outputs) A/B slaves: 434 total (248 inputs + 186 outputs)	
Maximum Cable Length	AS-Interface cable 2-wire flat cable Single wires	When using no repeater or extender: 100m When using a total of 2 repeaters or extenders: 300m 200 mm
Rated Bus Voltage	30V DC	

Note: When using two AS-Interface modules, these quantities are doubled.

2: MODULE SPECIFICATIONS

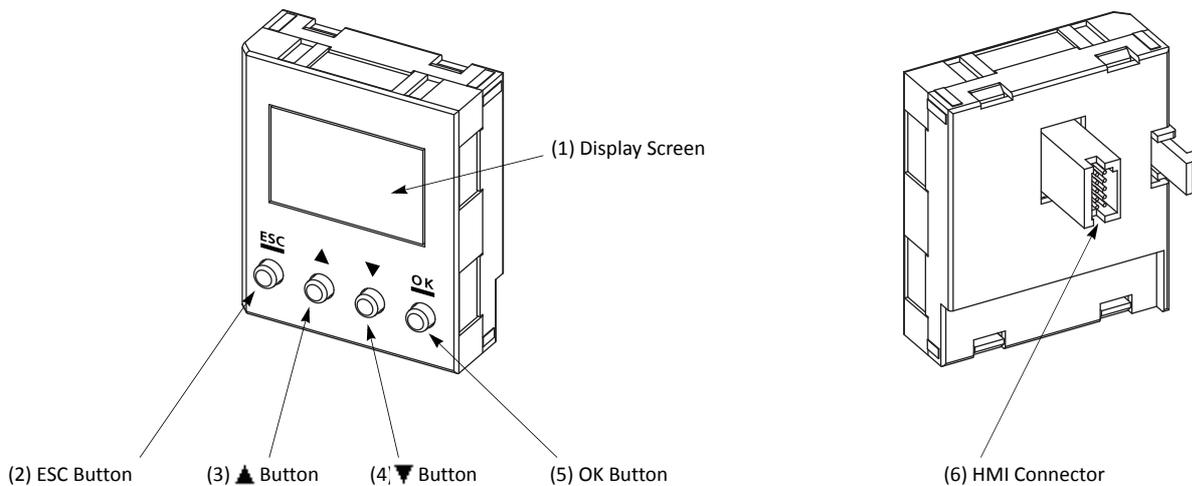
HMI Module

The optional HMI module can mount on any all-in-one type CPU module, and also on the HMI base module mounted next to any slim type CPU module. The HMI module makes it possible to manipulate the RAM data in the CPU module without using the Online menu options in WindLDR. For details about operating the HMI module, see page 5-60. For installing and removing the HMI module, see pages 3-3 and 3-4.

HMI Module Type Number

Module Name	Type No.
HMI Module	FC4A-PH1

Parts Description



- | | |
|---------------------------|--|
| (1) Display Screen | The liquid crystal display shows menus, devices, and data. |
| (2) ESC Button | Cancels the current operation, and returns to the immediately preceding operation. |
| (3) ▲ Button | Scrolls up the menu, or increments the selected device address or value. |
| (4) ▼ Button | Scrolls down the menu, or decrements the selected device address or value. |
| (5) OK Button | Goes into each control screen, or enters the current operation. |
| (6) HMI Connector | Connects to the all-in-one CPU module or HMI base module. |

HMI Module Specifications

Type No.	FC4A-PH1
Power Voltage	5V DC (supplied from the CPU module)
Internal Current Draw	200 mA DC
Weight	20g



Caution

- Turn off the power to the MicroSmart before installing or removing the HMI module to prevent electrical shocks and damage to the HMI module.
- Do not touch the connector pins with hand, otherwise contact characteristics of the connector may be impaired.

HMI Base Module

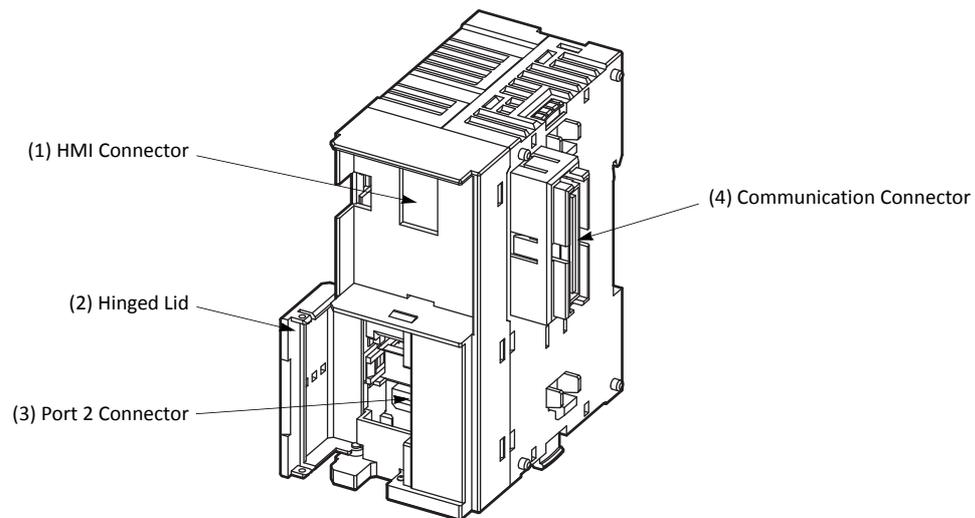
The HMI base module is used to install the HMI module when using the slim type CPU module. The HMI base module also has a port 2 connector to attach an optional RS232C or RS485 communication adapter.

When using the all-in-one type CPU module, the HMI base module is not needed to install the HMI module.

HMI Base Module Type Number

Module Name	Type No.
HMI Base Module	FC4A-HPH1

Parts Description



- | | |
|------------------------------------|---|
| (1) HMI Connector | For installing the HMI module. |
| (2) Hinged Lid | Open the lid to gain access to the port 2 connector. |
| (3) Port 2 Connector | For installing an optional RS232C or RS485 communication adapter. |
| (4) Communication Connector | Connects to the slim type CPU module. |

Communication Adapters and Communication Modules

All MicroSmart CPU modules have communication port 1 for RS232C communication. In addition, all-in-one type CPU modules have a port 2 connector. An optional communication adapter can be installed on the port 2 connector for RS232C or RS485 communication.

A communication module can be attached to any slim type CPU module to use port 2 for additional RS232C or RS485 communication. When the HMI base module is attached to a slim type CPU module, a communication adapter can be installed to the port 2 connector on the HMI base module.

When using the RS232C communication adapter or communication module for port 2, maintenance communication, user communication, and modem communication are made possible. With the RS485 communication adapter or communication module installed, maintenance communication, user communication, data link communication, and Modbus master and slave communication can be used on port 2.

Communication Adapter and Communication Module Type Numbers

Name	Termination	Type No.
RS232C Communication Adapter	Mini DIN connector	FC4A-PC1
RS485 Communication Adapter	Mini DIN connector	FC4A-PC2
	Screw Terminal Block	FC4A-PC3
RS232C Communication Module	Mini DIN connector	FC4A-HPC1
RS485 Communication Module	Mini DIN connector	FC4A-HPC2
	Screw Terminal Block	FC4A-HPC3

Communication Adapter and Communication Module Specifications

Type No.	FC4A-PC1 FC4A-HPC1	FC4A-PC2 FC4A-HPC2	FC4A-PC3 FC4A-HPC3
Standards	EIA RS232C	EIA RS485	EIA RS485
Communication Method	Asynchronous	Asynchronous	Asynchronous
Port No.	2	2	2
Maximum Connectable Quantity	1	1	1
Maximum Baud Rate	115,200 bps (Note 1)	115,200 bps (Note 1)	115,200 bps (Note 1)
Maintenance Communication (Computer Link)	Possible	Possible	Possible
User Communication	Possible	Possible	Possible
Modem Communication	Possible	—	—
Data Link Communication	—	Possible (31 slaves max.) (Note 2)	Possible (31 slaves max.) (Note 2)
Modbus ASCII/RTU Communication	Possible	Possible	Possible
Modbus TCP Communication (Note 3)	Possible	Possible	Possible
Maximum Cable Length	Special cable (Note 4)	Special cable (Note 4)	200m (Note 5)
Isolation between Internal Circuit and Communication Port	Not isolated	Not isolated	Not isolated

Note 1: Maximum baud rate is 57,600 bps when using CPU modules apart from for FC5A-D12K1E/S1E.

Note 2: Maximum baud rate when using data link communication is 57,600 bps.

Note 3: Though Modbus TCP communication cannot be used on port 2 of FC5A-D12K1E and FC5A-D12S1E, it can be used on the built-in Ethernet port.

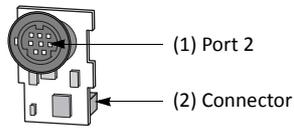
Note 4: For special cables, see page A-12.

Note 5: Recommended cable for RS485: Twisted-pair shielded cable with a minimum core wire of 0.3 mm².
Conductor resistance 85 Ω/km maximum, shield resistance 20 Ω/km maximum.

The proper tightening torque of the terminal screws on the RS485 communication adapter and RS485 communication module is 0.22 to 0.25 N·m. For tightening the screws, use screwdriver SZS 0,4 x 2,5 (Phoenix Contact).

Parts Description

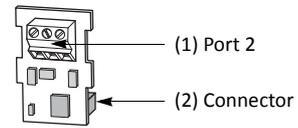
RS232C Communication Adapter (Mini DIN)
RS485 Communication Adapter (Mini DIN)



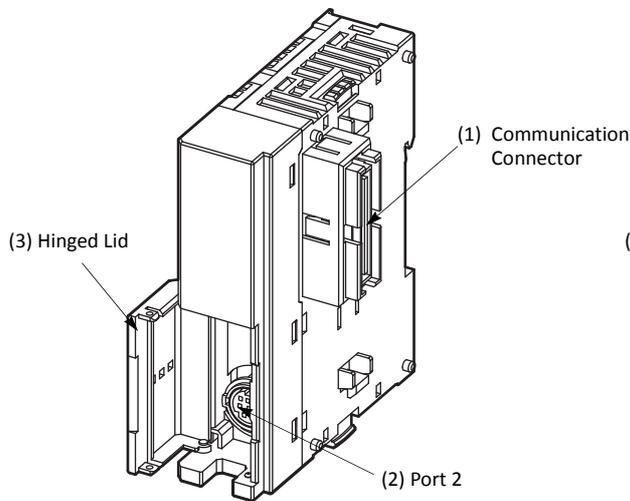
(1) Port 2
(2) Connector

RS232C or RS485 communication port 2.
Connects to the port 2 connector on the all-in-one type CPU module or HMI base module.

RS485 Communication Adapter (Screw Terminal)



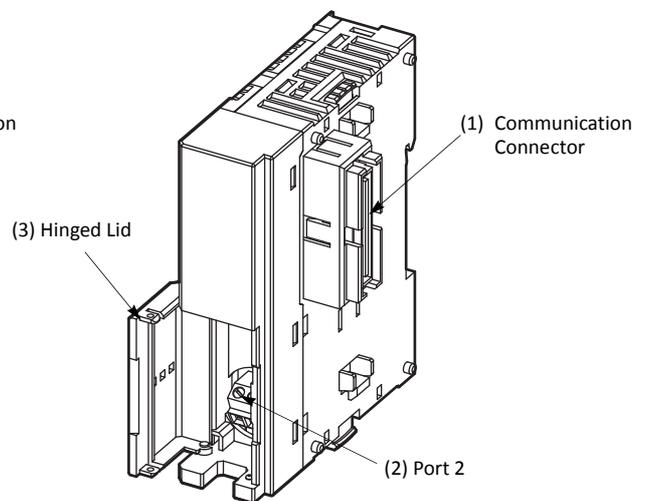
RS232C Communication Module (Mini DIN)
RS485 Communication Module (Mini DIN)



(1) Communication Connector
(2) Port 2
(3) Hinged Lid

Connects to the slim type CPU module.
RS232C or RS485 communication port 2.
Open the lid to gain access to port 2.

RS485 Communication Module (Screw Terminal)

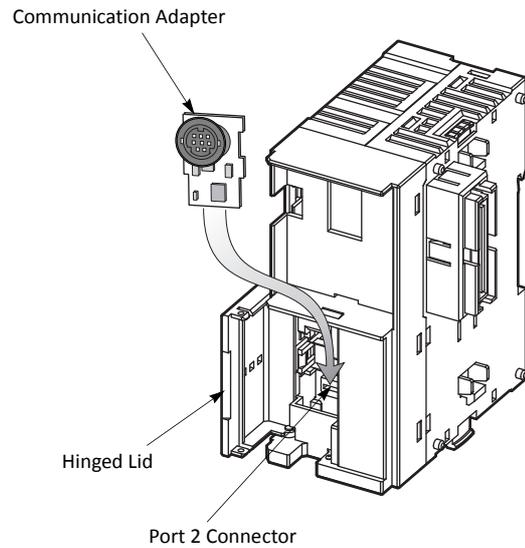
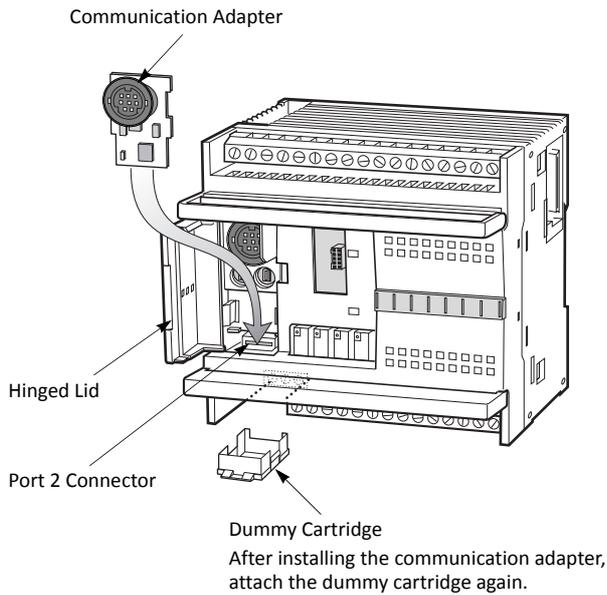


Installing the Communication Adapter and Communication Module

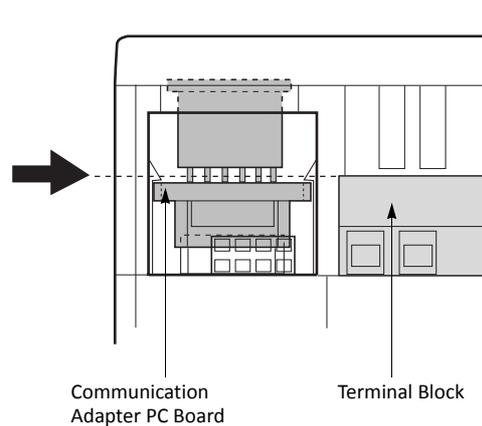
Caution • Before installing the communication adapter or communication module, turn off the power to the MicroSmart CPU module. Otherwise, the communication adapter or CPU module may be damaged, or the MicroSmart may not operate correctly.

Communication Adapter

To install the communication adapter on the all-in-one type CPU module, open the hinged lid and remove the dummy cartridge. Push the communication adapter into the port 2 connector from the front until it bottoms and is secured by the latches. Similarly, when installing the communication adapter on the HMI base module, open the hinged lid, and push the communication adapter into the port 2 connector from the front until it bottoms and is secured by the latches.



After installing the communication adapter on an all-in-one type CPU module, view the communication adapter through the dummy cartridge opening, and check to see that the PC board of the communication adapter is in a lower level than the top of the terminal block.

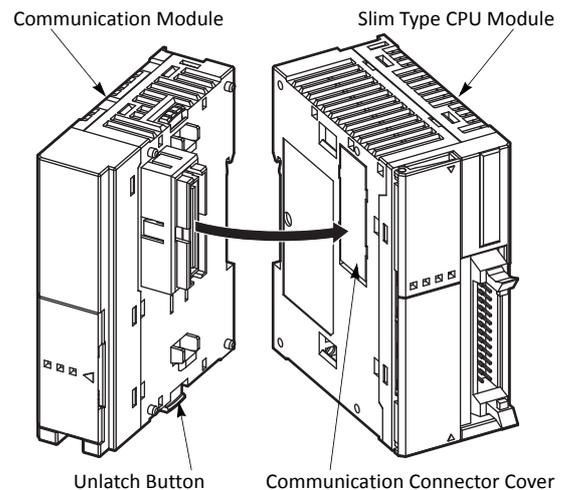


Communication Module

When installing a communication module on the slim type CPU module, remove the communication connector cover from the slim type CPU module. See page 3-7.

Place the communication module and CPU module side by side. Put the communication connectors together for easy alignment.

With the communication connectors aligned correctly and the blue unlatch button in the down position, press the communication module and CPU module together until the latches click to attach the modules together firmly. If the unlatch button is in the up position, push down the button to engage the latches.



Removing the Communication Adapter and Communication Module



Caution

- Before removing the communication adapter or communication module, turn off the power to the MicroSmart CPU module. Otherwise, the communication adapter or CPU module may be damaged, or the MicroSmart may not operate correctly.

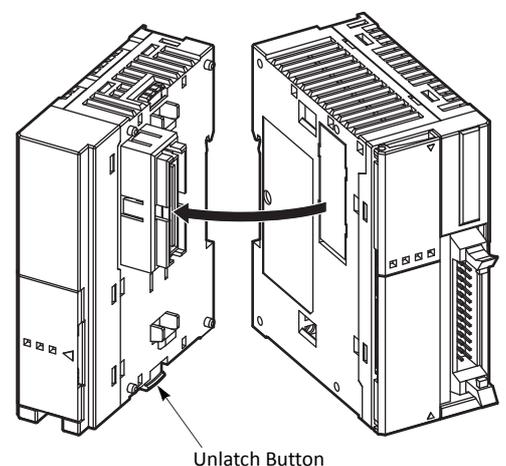
Communication Adapter

To remove the communication adapter from the all-in-one type CPU module, first remove the dummy cartridge. While pushing up the communication adapter PC board with a finger through the dummy cartridge opening, disengage the latches from the communication adapter using a flat screwdriver. Pull out the communication adapter from the port 2 connector. When removing the communication adapter from the HMI module, take similar steps.

Communication Module

If the modules are mounted on a DIN rail, first remove the modules from the DIN rail as described on page 3-8.

Push up the blue unlatch button to disengage the latches, and pull the modules apart as shown on the right.

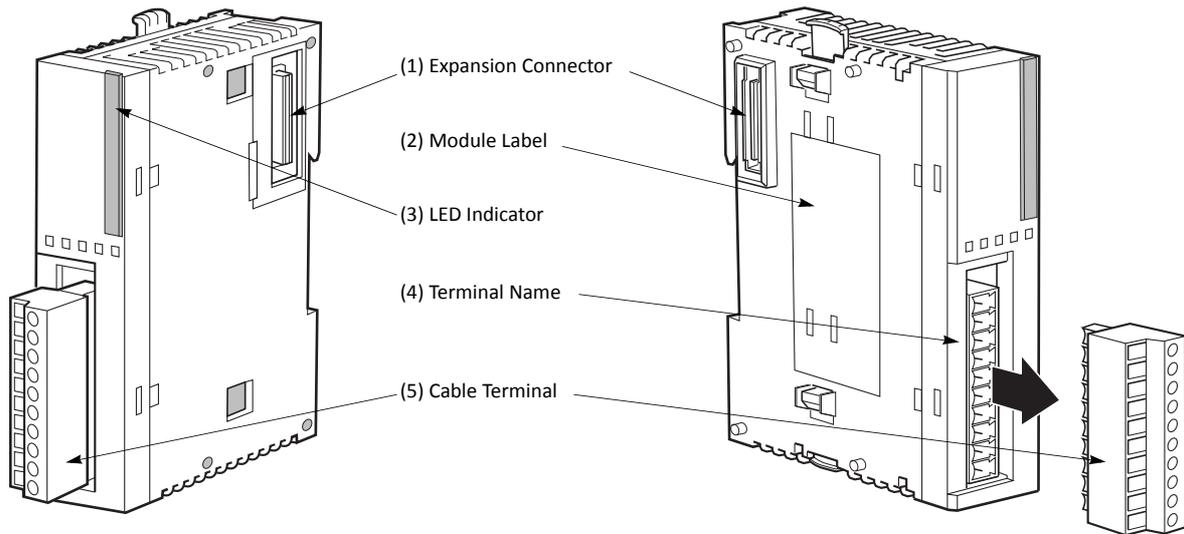


Expansion RS232C/RS485 Communication Modules

The expansion RS232C/RS485 communication modules can be attached to the CPU modules to add RS232C or RS485 communication port 3 through port 7. The FC5A-SIF2 expansion RS232C communication module is an expansion module used with CPU modules system program version 110 or higher. The FC5A-SIF4 expansion RS485 communication module is an expansion module used with CPU modules system program version 220 or higher.

For details about expansion RS232C/RS485 communication, see page 25-1 (Advanced Vol.).

Parts Description



(1) Expansion Connector

Connects to the CPU and other I/O modules.
(All-in-one 10- and 16-I/O type CPU modules cannot be connected.)

(2) Module Label

Indicates the expansion RS232C/RS485 communication module Type No. and specifications. Expansion RS232C/RS485 communication modules have the version number indicated on the module label attached to the side of the module. Confirm the version number because some specifications differ depending on the version number. For the position of the version number printed on the module label, see page 2-56.

(3) LED Indicators

PWR	<input type="checkbox"/>
SD	<input type="checkbox"/>
RD	<input type="checkbox"/>

PWR: Turns on when this module is powered up.
Flashes when the power supply to FC5A-SIF4 is insufficient.
SD: Turns on when this module is sending data.
RD: Turns on when this module is receiving data.

(4) Terminal Name

Indicates terminal names.

(5) Cable Terminal

Screw terminals for wiring.

Expansion RS232C/RS485 Communication Module Specifications

General Specifications

Type No.	FC5A-SIF2	FC5A-SIF4	
Quantity of Channels	1		
Synchronization	Start-stop synchronization		
Electrical Characteristics	EIA RS232C compliant	EIA RS485 compliant	
Terminal Arrangement	See page 2-89.	See page 2-90.	
Operating Temperature	0 to 55°C		
Relative Humidity	10 to 95% (no condensation)		
Cable Specifications	Cable Type	Shielded multi-core cable 24AWG x 6	Shielded twisted-pair cable with a minimum core wire of 0.3 mm ² (AWG22)
	Dielectric strength	2000 V/min	700V AC/min
	Insulation resistance	100 MΩ/km	
Maximum Cable Length	3m	1200m	
Maximum Nodes	2 (1:1 Communication)	32	
Connector on Mother Board	MC1.5/10-G-3.81BK (Phoenix Contact) Applicable terminal block:FC4A-PMT10P		
Connector Insertion/Removal Durability	100 times minimum		
Isolation from Internal Circuit	Transformer isolated		
Effect of Improper Input Connection	Incorrect Wiring	Malfunction may be caused.	
	Improper Voltage	If any input exceeding the rated value is applied, permanent damage may be caused.	
Dielectric Strength	Between communication terminals and internal circuit: 500V AC, 1 minute		
Quantity of Applicable Expansion RS232C/RS485 Communication Modules	All-in-one 24-I/O type CPU module:3 maximum Slim type CPU module:5 maximum		
Internal Current Draw	40 mA [85 mA](5V DC) 40 mA [0 mA] (24V DC)	40 mA (5V DC) 40 mA (24V DC)	
Weight	100g		

Notes:

- The quantity of expansion RS232C/RS485 communication modules is the total number of FC5A-SIF2 and FC5A-SIF4 connected to the CPU module.
- The stability of communication depends on the quantity of the connected expansion RS232C/RS485 communication modules, the cable length, and the communication speed. If communication is unstable, confirm and adjust those factors.
- Values indicated in square brackets represent FC5A-SIF2 earlier than version 200.

2: MODULE SPECIFICATIONS

Communication Specifications

Type No.		FC5A-SIF2	FC5A-SIF4
Communication Parameters	Baud Rate (bps)	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 (Note 1)	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
	Data Bits	7 or 8	
	Parity	Even, Odd, None	
	Stop Bits	1 or 2	
Protocol (Note 3)	Maintenance Communication	Possible (Note 2)	Possible (Note 2)
	User Communication	Possible	Possible
	Data Link	—	Possible
	Modbus Communication	Possible (Note 4)	Possible
	Modem Communication	—	—

Note 1: 57600 and 115200 bps are supported with version 200 or higher.

Note 2: Transfer mode must be set to ASCII to download or upload user program. Run-time program download cannot be used.

Note 3: The communication protocols that can be used depend on the system program version of the CPU module and the version of the connected expansion RS232C/RS485 communication modules. For the combination of the version numbers and supported protocols, see page A-17.

Note 4: Modbus communication is supported with version 200 or higher.

Data Communication Processing Time

The CPU module processes data communication with expansion RS232C/RS485 communication modules in the END processing every scan. The CPU module also processes data communication during the scan when COMRF instructions are executed or every 10 ms when “Every 10 ms” under “Communication Refresh for Port 3 through port 7” is selected in the Function Area Settings dialog.

One expansion RS232C/RS485 communication module requires a communication processing time shown in the table below. Therefore, when an expansion RS232C/RS485 communication module sends or receives communication, the scan time extends accordingly.

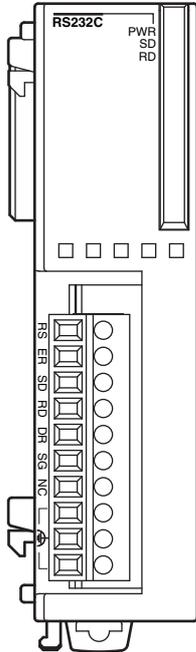
CPU Module system program version	Expansion RS232C/RS485 Communication Module version	Maximum Delay in One Scan (Note 1)
Earlier than 220	Earlier than 200	Approx. 4 ms
	200 or higher	
220 or higher	Earlier than 200	
	200 or higher	

Note 1: The values are the maximum delay of scan time when one expansion RS232C/RS485 communication module performs communication. When multiple expansion RS232C/RS485 communication modules perform communication at the same time, the delay is multiplied by the quantity of the expansion RS232C/RS485 communication modules.

Expansion RS232C Communication Module Terminal Arrangement and Wiring Diagrams

FC5A-SIF2 — Screw Terminal Type

Applicable Terminal Block: FC4A-PMT10P (supplied with the expansion RS232C communication module)



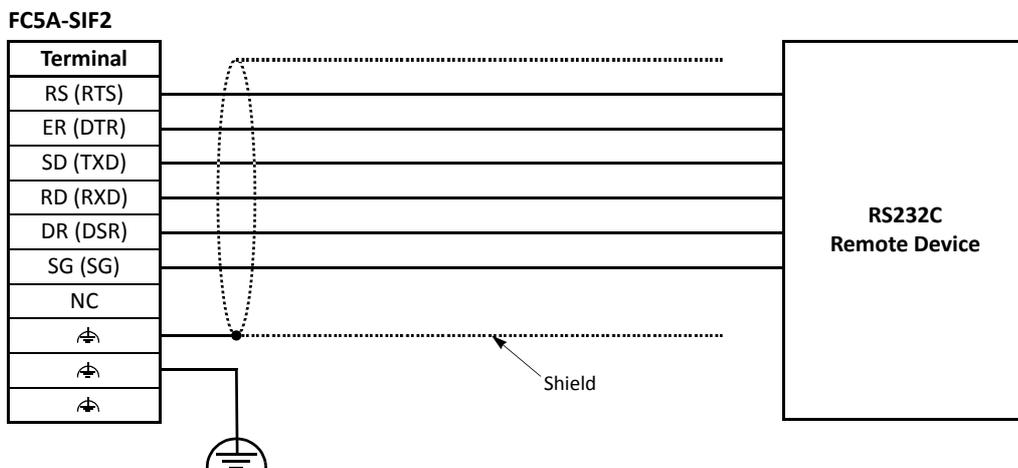
Terminal	I/O	Description
RS (RTS)	Output	Request to Send (constant voltage terminal)
ER (DTR)	Output	Data Terminal Ready
SD (TXD)	Output	Transmit Data
RD (RXD)	Input	Receive Data
DR (DSR)	Input	Data Set Ready
SG (SG)	—	Signal Ground
NC	—	—
⚡	—	Functional ground
⚡	—	Functional ground
⚡	—	Functional ground

Note: The ⚡ terminals can be used as junction terminals of functional ground.

Wiring Example

Caution

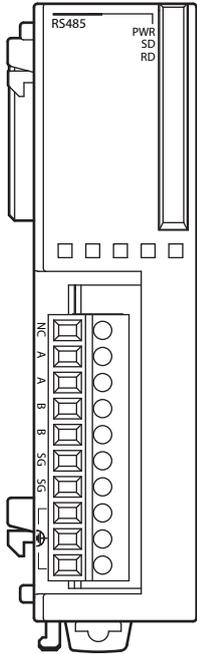
- Use a recommended cable or a similar shielded cable for wiring the expansion RS232C communication terminals. For the recommended cable, see page 2-87 and prepare the cable.
- When the expansion RS232C communication module may malfunction due to external noise, connect the shield of the cable to a proper ground.
- Before wiring, read the user’s manual for the remote device connected to the expansion RS232C communication module.



Expansion RS485 Communication Module Terminal Arrangement and Wiring Diagrams

FC5A-SIF4 — Screw Terminal Type

Applicable Terminal Block: FC4A-PMT10P (supplied with the expansion RS485 communication module)



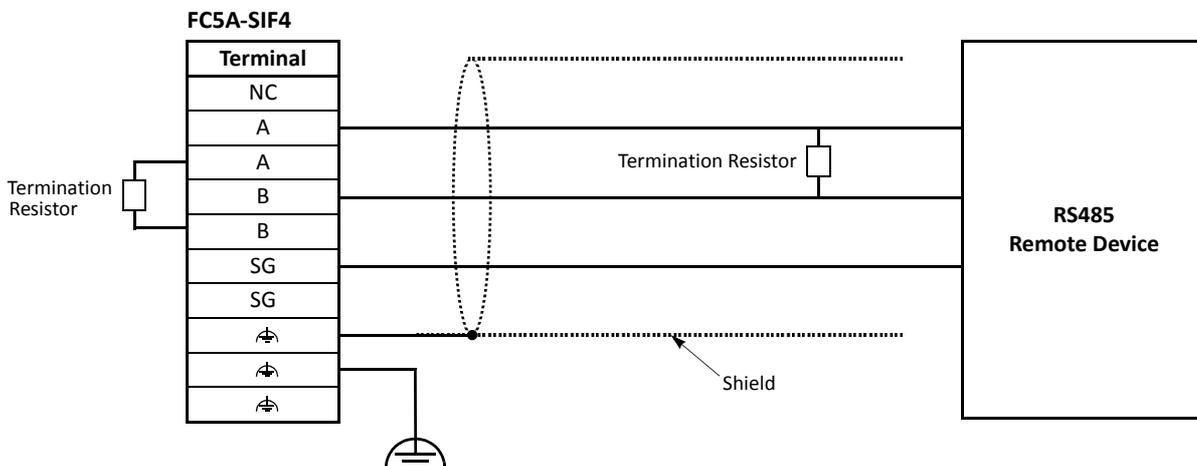
Terminal	I/O	Description
NC	—	—
A	Input and Output	Data A
A	Input and Output	Data A
B	Input and Output	Data B
B	Input and Output	Data B
SG	—	Signal Ground
SG	—	Signal Ground
⚡	—	Functional ground
⚡	—	Functional ground
⚡	—	Functional ground

- Two A terminals are interconnected.
- Two B terminals are interconnected.
- Two SG terminals are interconnected.
- Three ⚡ terminals are interconnected. The ⚡ terminals can be used as junction terminals of functional ground.

Wiring Example

⚠ Caution

- Use a recommended cable or a similar shielded cable for wiring the expansion RS485 communication terminals. For the recommended cable, see page 2-87 and prepare the cable.
- When the expansion RS485 communication module may malfunction due to external noise, connect the shield of the cable to a proper ground.
- Before wiring, read the user’s manual for the remote device connected to the expansion RS485 communication module.
- Insert appropriate termination resistors matched to the characteristic impedance of the cable. When the recommended cable is used, insert 100Ω 1/2W resistors.



Memory Cartridge

A user program can be stored on an optional memory cartridge installed on a MicroSmart CPU module from a computer running WindLDR, and the memory cartridge can be installed on another MicroSmart CPU module of the same type. Using a memory cartridge, the CPU module can exchange user programs without using a computer.

User programs can be uploaded and downloaded between a memory cartridge and WindLDR, and downloaded from a memory cartridge to the CPU module. These features are available on all models of FC5A CPU modules.

In addition, a use program can be uploaded from the CPU module to a memory cartridge. This feature is available on CPU modules with system program version 200 or higher.

Memory Cartridge Type Number

Module Name	Type No.
32KB Memory Cartridge	FC4A-PM32
64KB Memory Cartridge	FC4A-PM64
128KB Memory Cartridge	FC4A-PM128

User Program Execution Priority

Depending whether a memory cartridge is installed on the MicroSmart CPU module or not, a user program stored on the memory cartridge or on the CPU module EEPROM is executed, respectively.

Memory Cartridge	User Program Execution Priority
Installed on the CPU Module	When a memory cartridge is installed on the CPU module, the user program stored in the memory cartridge is executed. The memory cartridge download function makes it possible to download the user program in the memory cartridge to the CPU module. The memory cartridge upload function makes it possible to upload the user program from the CPU module and store it in the memory cartridge.
Not installed on the CPU Module	The user program stored on the EEPROM in the CPU module is executed.

Memory Cartridge Specifications

Type No.	FC4A-PM32	FC4A-PM64	FC4A-PM128
Memory Type	EEPROM		
Accessible Memory Capacity	32 KB	64 KB	128 KB
Hardware for Storing Data	CPU module		
Software for Storing Data	WindLDR		
Quantity of Stored Programs	One user program can be stored on one memory cartridge.		

Note: The optional clock cartridge (FC4A-PT1) and the memory cartridge cannot be used together on the all-in-one type CPU module. The clock cartridge and the memory cartridge can be used together on the slim type CPU module.

User Program Compatibility

The CPU module can execute only user programs created for the same CPU module type. When installing a memory cartridge, make sure that the user program stored on the memory cartridge matches the CPU module type. If the user program is not for the same CPU module type, a user program syntax error occurs and the CPU module cannot run the user program.



Caution

• **Compatibility of User Program with CPU Modules**

When a memory cartridge contains a user program for higher functionality, do not install the memory cartridge into CPU modules with lower functionality, otherwise the user program is not executed correctly. Make sure that the user program in the memory cartridge is compatible with the CPU module.

Downloading and Uploading User Program to and from Memory Cartridge Using WindLDR

When a memory cartridge is installed on the CPU module, a user program is downloaded to and uploaded from the memory cartridge using WindLDR on a computer. When a memory cartridge is not installed on the CPU module, a user program is downloaded to and uploaded from the CPU module. For the procedures to download a user program from WindLDR on a computer, see page 4-11.

With a memory cartridge installed on a CPU module, if the user program stored on the memory cartridge does not match the CPU module type, downloading is possible, but uploading is not possible. To upload a user program, make sure that the existing user program stored on the memory cartridge matches the CPU module type. Downloading is always possible to new blank memory cartridges installed on any type of CPU modules.

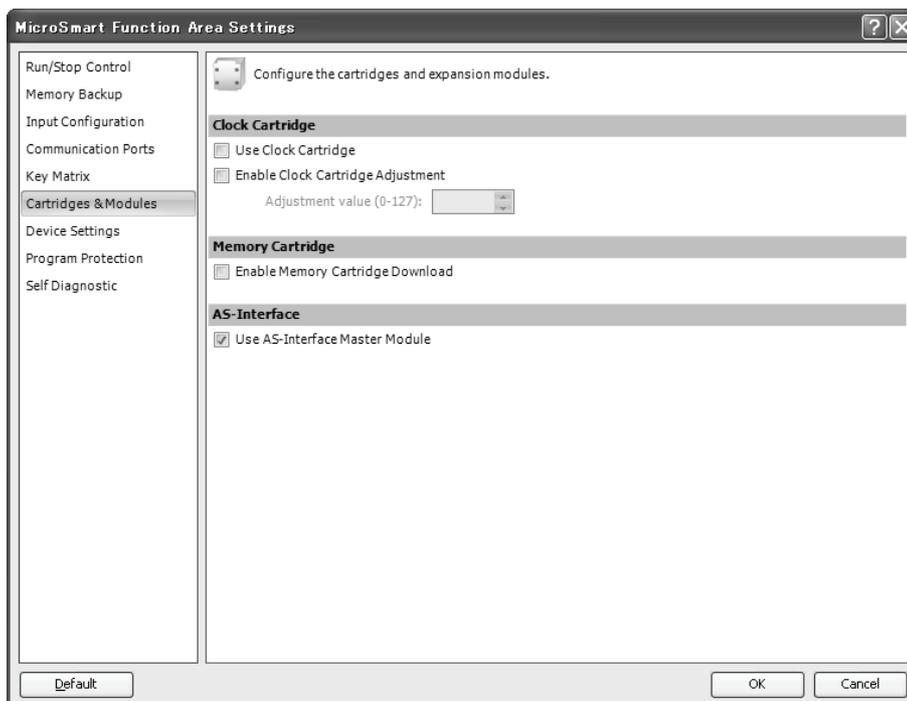
Downloading User Program from Memory Cartridge to the CPU Module

To designate user program download from the memory cartridge, install a memory cartridge on the CPU module connected to a PC, and power up the CPU module.

Programming WindLDR

1. From the WindLDR menu bar, select **Configuration > Cartridges & Modules**.

The Function Area Settings dialog box for Cartridges & Modules appears.



2. Under **Memory Cartridge**, click the check box to the left of **Enable Memory Cartridge Download**.

Checked: The user program is downloaded from the memory cartridge to the CPU module.

Unchecked: The user program is not downloaded from the memory cartridge to the CPU module.

3. Click the **OK** button.

4. Download the user program to the memory cartridge to complete the designation in the memory cartridge.

5. Shut down the CPU module and remove the memory cartridge. Install the memory cartridge on another CPU module. Power up the CPU module, then the user program is downloaded from the memory cartridge to the CPU module.

If the user program in the CPU module is write-protected or read/write-protected, the user program can be downloaded only when the password in the memory cartridge matches the password in the CPU module. For user program protection password, see page 5-44.

Memory Cartridge Upload

The user program in the MicroSmart CPU module can be uploaded and stored to a memory cartridge installed on the CPU module. In order to enable user program upload, the memory cartridge has to be configured using WindLDR. When the configured memory cartridge is installed on the CPU module and the CPU module is powered up, the user program is uploaded from the CPU module and stored to the memory cartridge.

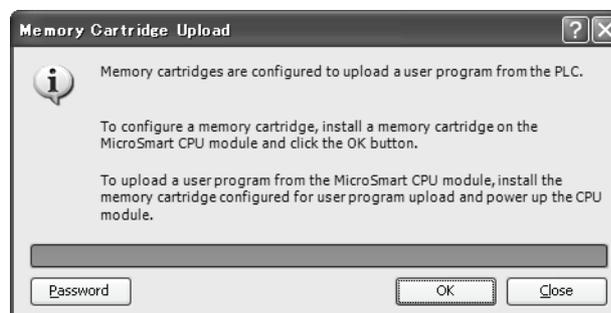
The configured memory cartridge can upload a user program only once because the user program upload configuration of the memory cartridge is cleared when the memory cartridge stores the uploaded user program.

Memory cartridge upload can be used on CPU modules with system program version 200 or higher.

Programming WindLDR

1. Install a memory cartridge on a CPU module. Connect the CPU module to the PC and power up the CPU module.
2. From the WindLDR menu bar, select **Online > Upload > Memory Cartridge Upload**.

The Memory Cartridge Upload dialog box appears.



3. If the user program to upload from the CPU module is read-protected with a password, click the **Password** button.

The Password Setting dialog box appears. Enter the same password. When finished, press the **OK** button and return to the Memory Cartridge Upload dialog box.



4. On the Memory Cartridge Upload dialog box, click the **OK** button to configure the memory cartridge for user program upload. Then, the user program stored on the memory cartridge is cleared.
5. Turn off the power to the CPU module and remove the memory cartridge from the CPU module. The memory cartridge has been configured for user program upload.
6. Install the memory cartridge to a CPU module of the same type and power up the CPU module. The user program in the CPU module is uploaded and stored to the memory cartridge.

Notes:

User program writing error occurs and the user program is not uploaded to the memory cartridge, turning on the ERR LED on the CPU module and stopping the CPU operation in the following cases:

- If the configured memory cartridge is installed on a different type of CPU module or installed on a CPU module with system program version lower than 200, user program writing error occurs when the CPU module is powered up. System program version 200 or higher is needed for configuring memory cartridges and uploading user programs.
- If the configured memory cartridge is a 32KB memory cartridge (FC4A-PM32) and is installed on a CPU module containing a user program of larger than 30,000 bytes, user program writing error occurs when the CPU module is powered up. A 32KB memory cartridge can upload a user program of 30,000 bytes maximum.
- If the user program in the CPU module is read-prohibited, the user program cannot be uploaded to the memory cartridge. If the user program in the CPU module is read-protected and the passwords do not match between the user programs in the memory cartridge and the CPU module, user program writing error occurs when the CPU module is powered up. For the user program protection, see page 5-44.

Installing and Removing the Memory Cartridge



Caution

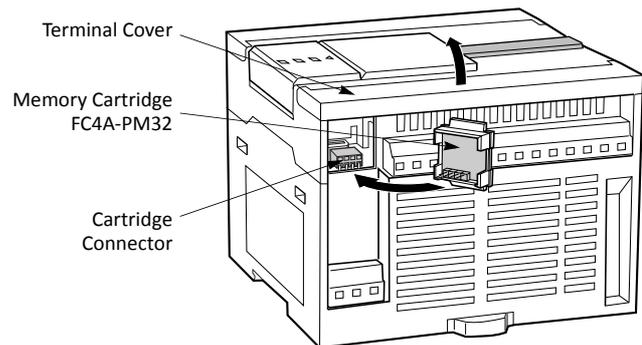
- Before installing or removing the memory cartridge, turn off the power to the MicroSmart CPU module. Otherwise, the memory cartridge or CPU module may be damaged, or the MicroSmart may not operate correctly.
- Do not touch the connector pins with hand, otherwise electrostatic discharge may damage the internal elements.

All-in-One Type CPU Module

The cartridge connector is normally closed with a dummy cartridge. To install the memory cartridge, open the terminal cover and remove the dummy cartridge from the CPU module. Make sure of correct orientation of the memory cartridge. Insert the memory cartridge into the cartridge connector until it bottoms. Do not insert the memory cartridge diagonally, otherwise the terminal pins will be deformed.

After installing the memory cartridge, close the terminal cover.

To remove the memory cartridge, hold both edges of the memory cartridge and pull it out.

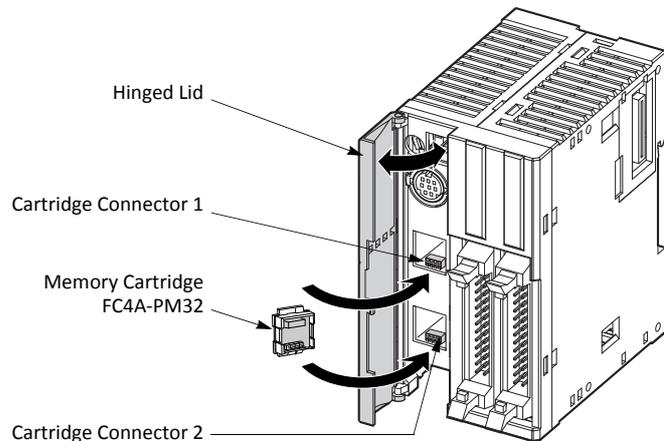


Slim Type CPU Module

Cartridge connectors 1 and 2 are normally closed with a dummy cartridge. To install the memory cartridge, open the hinged lid and remove the dummy cartridge from the CPU module. Make sure of correct orientation of the memory cartridge, and insert the memory cartridge into cartridge connector 1 or 2 until it bottoms. After installing the memory cartridge, close the hinged lid.

Only one memory cartridge can be installed to either cartridge connector 1 or 2 on the slim type CPU module. A memory cartridge and a clock cartridge can be installed at the same time.

To remove the memory cartridge, hold both edges of the memory cartridge and pull it out.



Clock Cartridge

With the optional clock cartridge installed on any type of MicroSmart CPU modules, the MicroSmart can be used for time-scheduled control such as illumination and air conditioners. For setting the calendar/clock, see page 9-6 (Advanced Vol.).

Clock Cartridge Type Number

Module Name	Type No.
Clock Cartridge	FC4A-PT1

Clock Cartridge Specifications

Accuracy	±30 sec/month (typical) at 25°C
Backup Duration	Approx. 30 days (typical) at 25°C after backup battery fully charged
Battery	Lithium secondary battery
Charging Time	Approx. 10 hours for charging from 0% to 90% of full charge
Battery Life	Approx. 100 recharge cycles after discharging down to 10% of full charge
Replaceability	Not possible to replace battery

The optional memory cartridge (FC4A-PM32) and the clock cartridge cannot be used together on the all-in-one type CPU module. The memory cartridge and the clock cartridge can be used together on the slim type CPU module.

Installing and Removing the Clock Cartridge



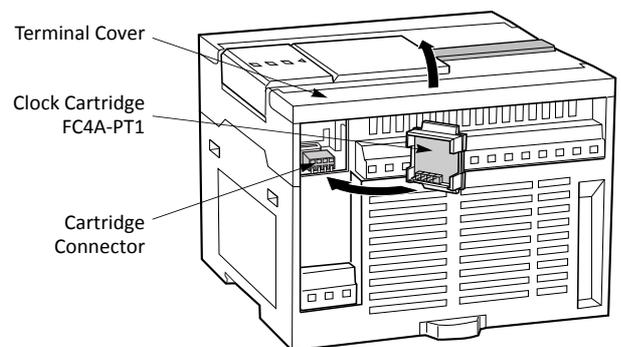
Caution

- Before installing or removing the clock cartridge, turn off the power to the MicroSmart CPU module. Otherwise, the clock cartridge or CPU module may be damaged, or the MicroSmart may not operate correctly.
- After installing the clock cartridge, set the calendar/clock using WindLDR. If the calendar/clock is set before installing the clock cartridge, clock IC error occurs, turning on the ERR LED.

All-in-One Type CPU Module

The cartridge connector is normally closed with a dummy cartridge. To install the clock cartridge, open the terminal cover and remove the dummy cartridge from the CPU module. Make sure of correct orientation of the clock cartridge. Insert the clock cartridge into the cartridge connector until it bottoms. Do not insert the clock cartridge diagonally, otherwise the terminal pins will be deformed. After installing the clock cartridge, close the terminal cover.

To remove the clock cartridge, hold both edges of the clock cartridge and pull it out.

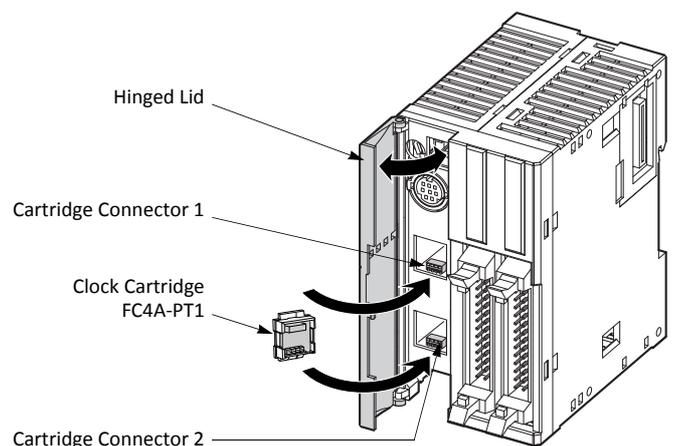


Slim Type CPU Module

To install the clock cartridge, open the hinged lid and remove the dummy cartridge from the CPU module. Make sure of correct orientation of the clock cartridge, and insert the clock cartridge into cartridge connector 1 or 2 until it bottoms. After installing the clock cartridge, close the hinged lid.

Only one clock cartridge can be installed to either cartridge connector 1 or 2 on the slim type CPU module. A clock cartridge and a memory cartridge can be installed at the same time.

To remove the clock cartridge, hold both edges of the clock cartridge and pull it out.



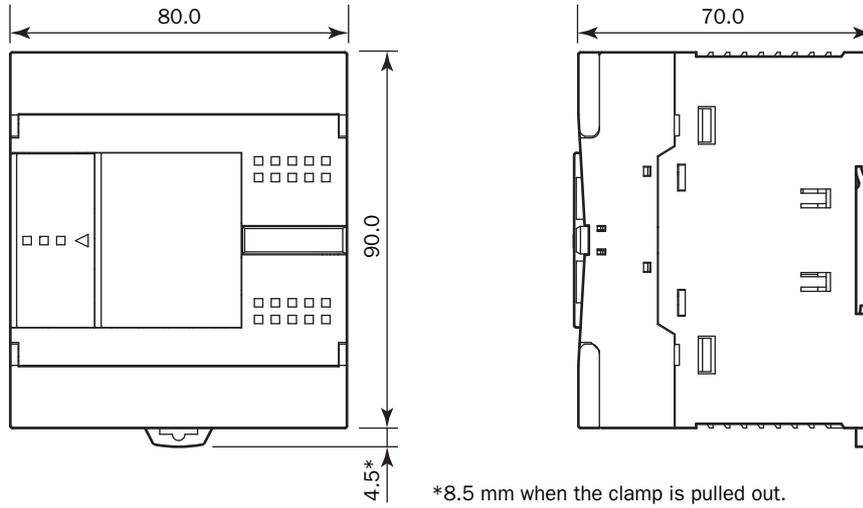
2: MODULE SPECIFICATIONS

Dimensions

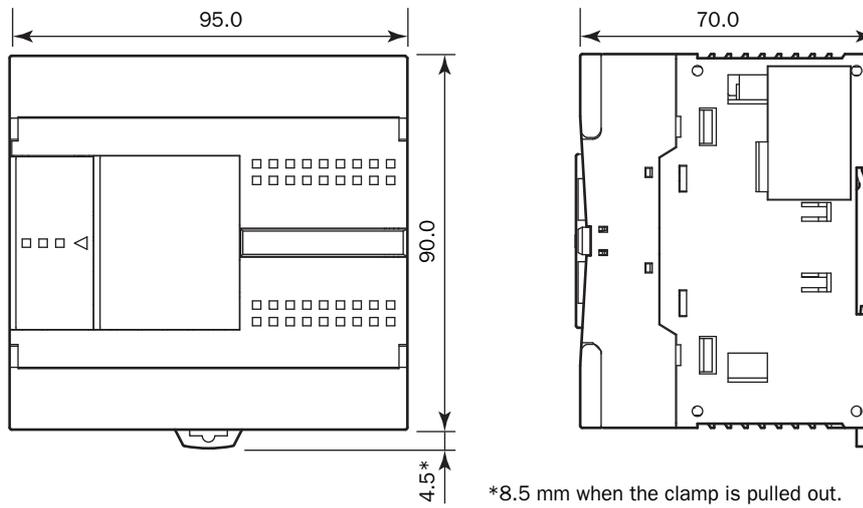
All MicroSmart modules have the same profile for consistent mounting on a DIN rail.

CPU Modules

FC5A-C10R2, FC5A-C10R2C, FC5A-C10R2D, FC5A-C16R2, FC5A-C16R2C, FC5A-C16R2D

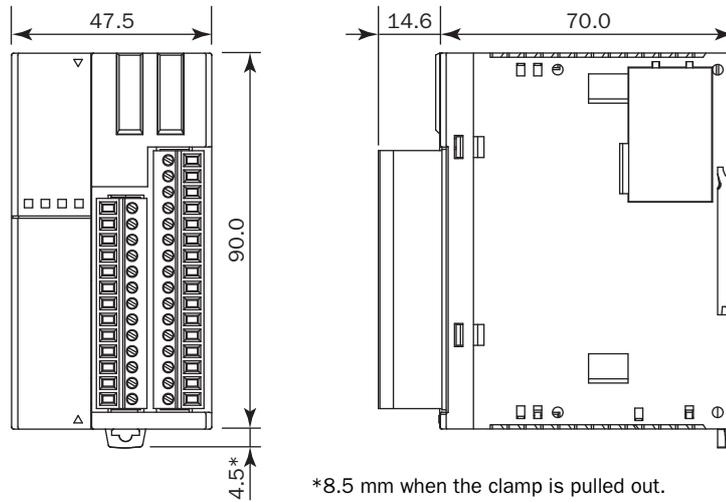


FC5A-C24R2, FC5A-C24R2C, FC5A-C24R2D

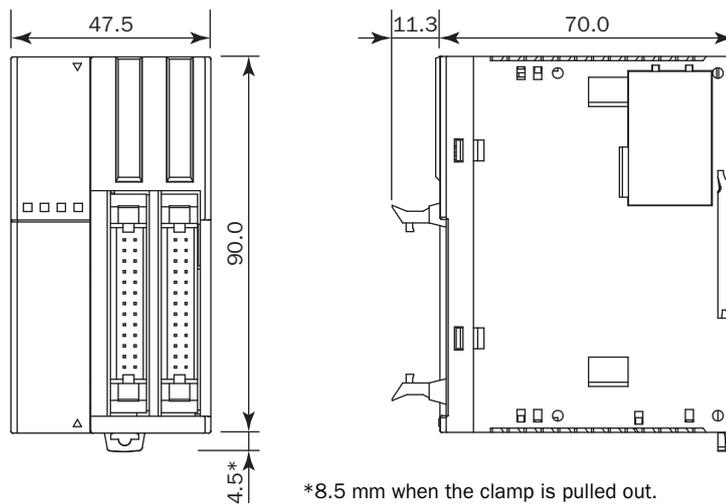


All dimensions in mm.

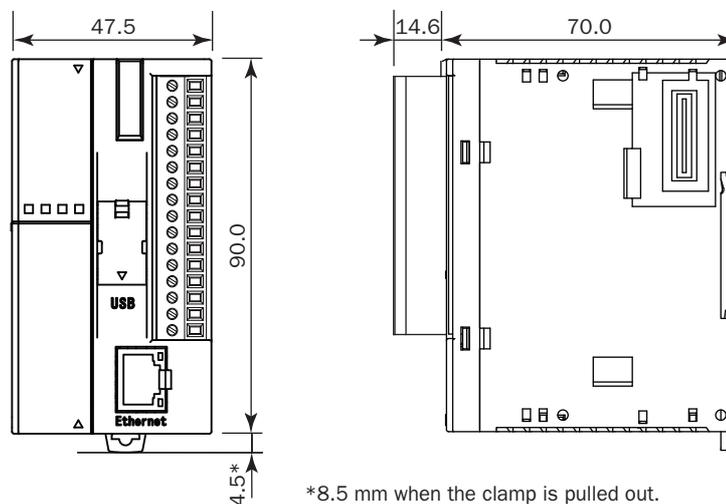
FC5A-D16RK1, FC5A-D16RS1



FC5A-D32K3, FC5A-D32S3



FC5A-D12K1E, FC5A-D12S1E

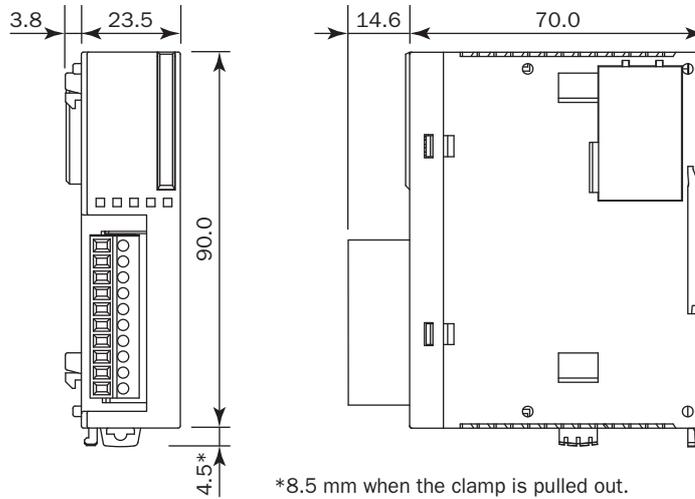


All dimensions in mm.

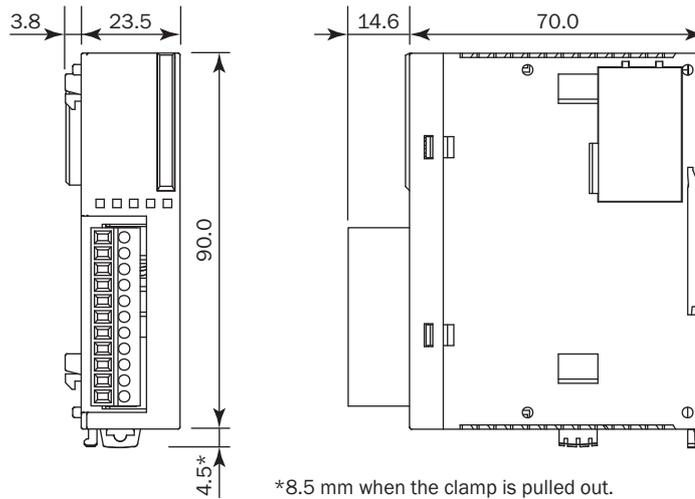
2: MODULE SPECIFICATIONS

I/O Modules

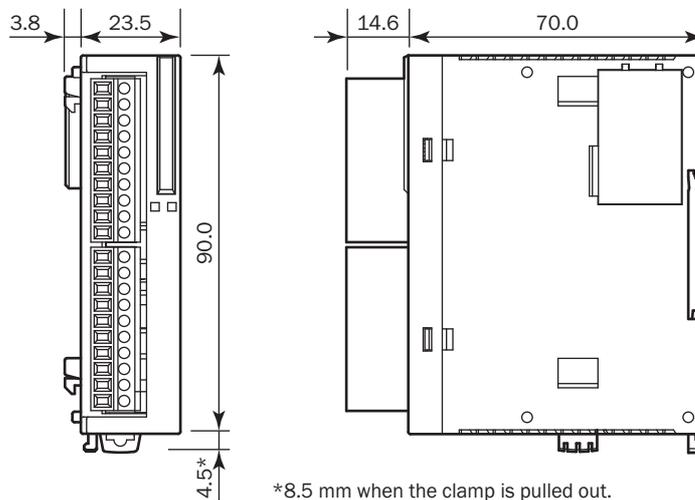
FC4A-N08B1, FC4A-T08K1, FC4A-T08S1, FC5A-SIF2, FC5A-SIF4, FC4A-K2C1



**FC4A-N08A11, FC4A-R081, FC4A-M08BR1,
FC4A-L03A1, FC4A-L03AP1, FC4A-J2A1, FC4A-K1A1, FC4A-K4A1**

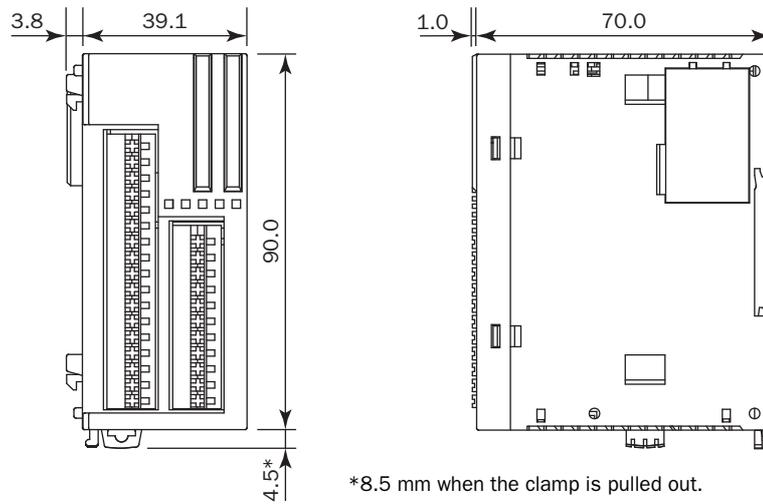


FC4A-N16B1, FC4A-R161, FC4A-J4CN1, FC4A-J8C1, FC4A-J8AT1

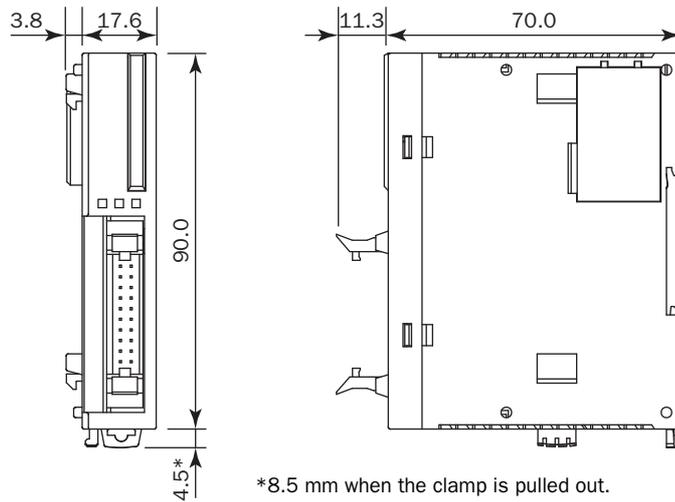


All dimensions in mm.

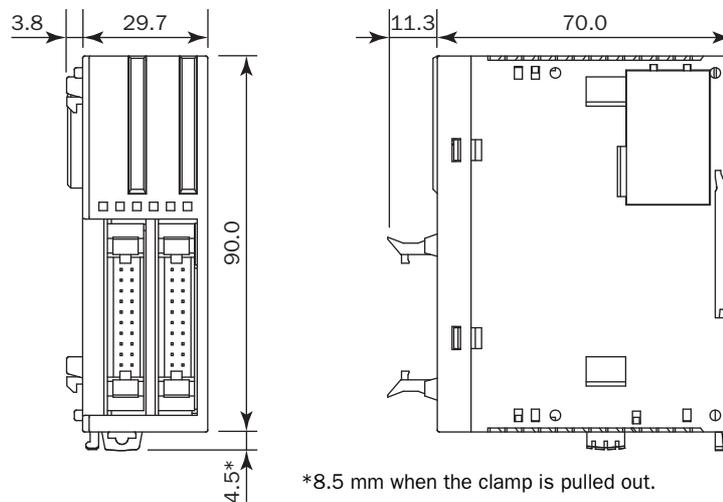
FC4A-M24BR2



FC4A-N16B3, FC4A-T16K3, FC4A-T16S3



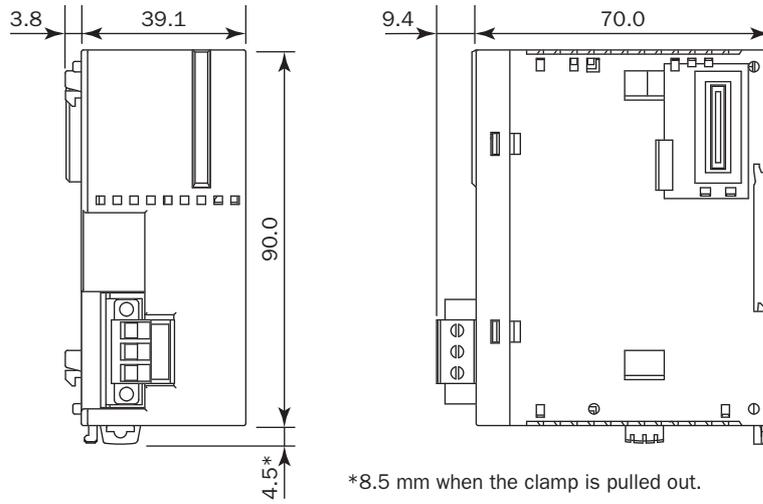
FC4A-N32B3, FC4A-T32K3, FC4A-T32S3



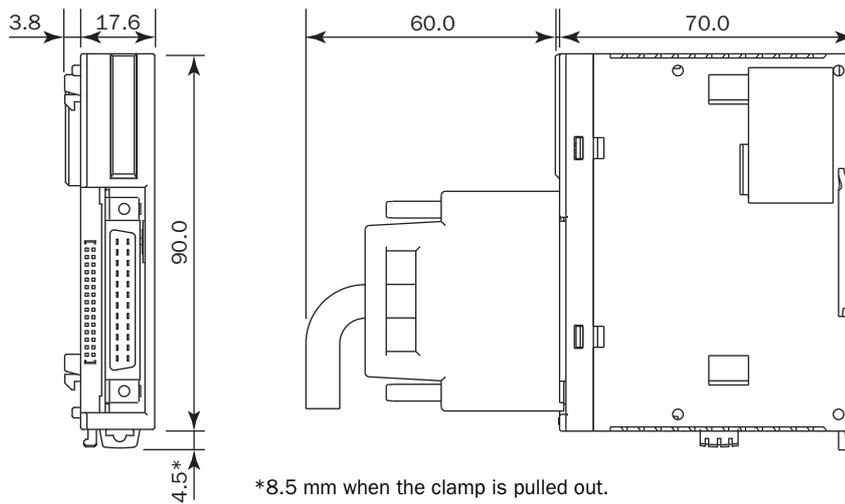
All dimensions in mm.

2: MODULE SPECIFICATIONS

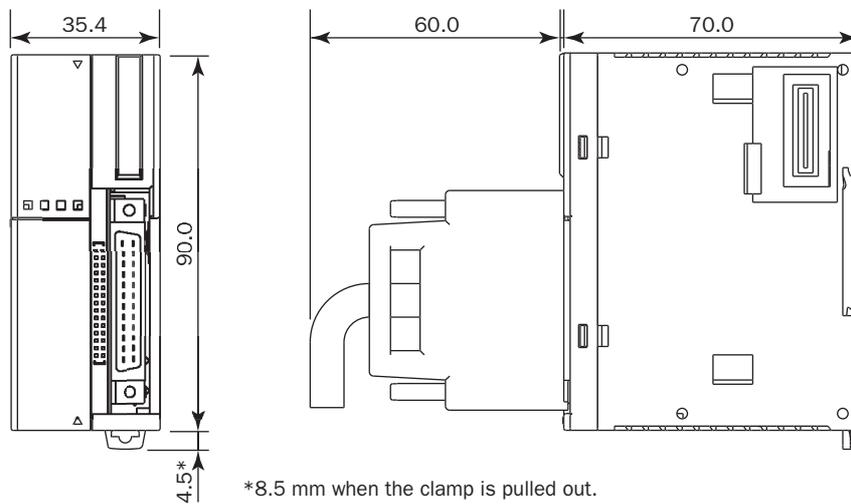
Expansion Interface Module FC5A-EXM2



Expansion Interface Master Module FC5A-EXM1M

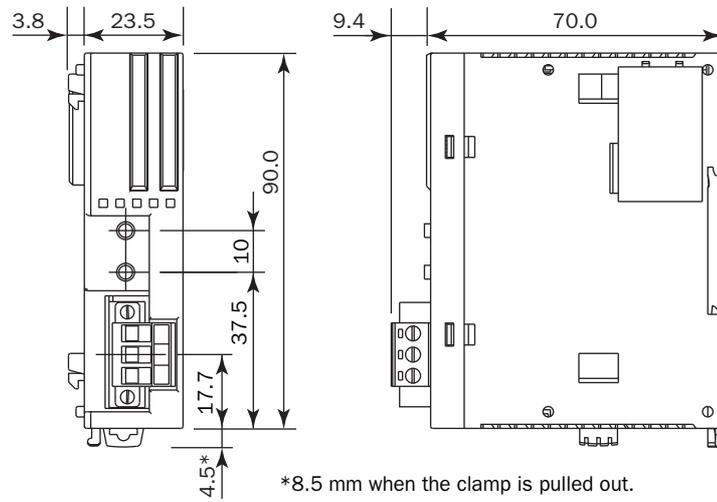


Expansion Interface Slave Module FC5A-EXM1S

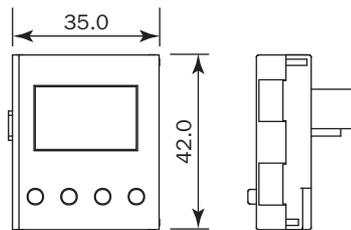


All dimensions in mm.

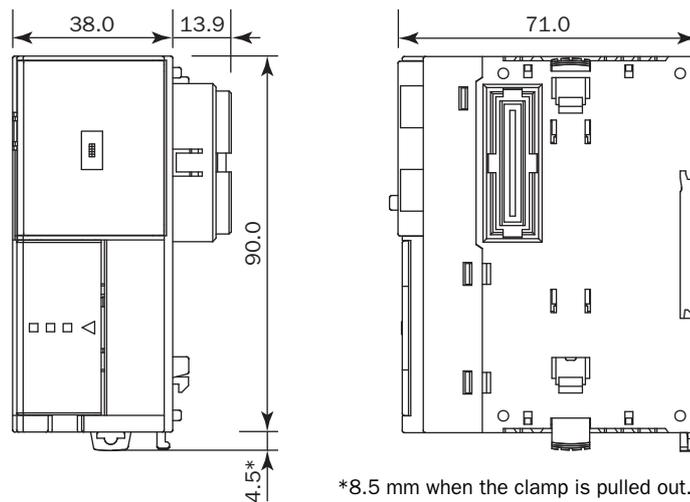
AS-Interface Module FC4A-AS62M



HMI Module FC4A-PH1



HMI Base Module FC4A-HPH1

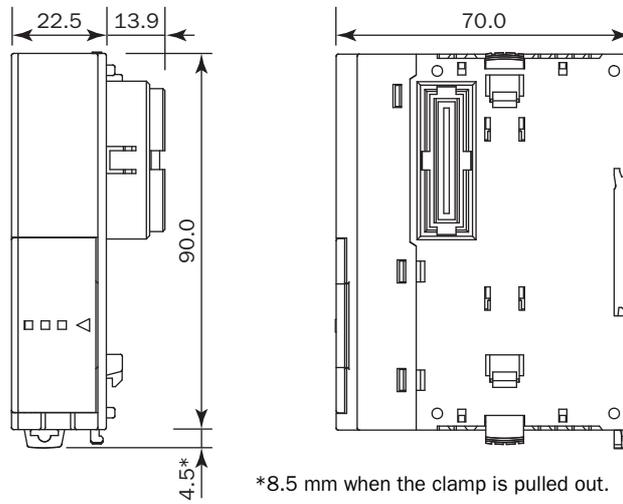


All dimensions in mm.

2: MODULE SPECIFICATIONS

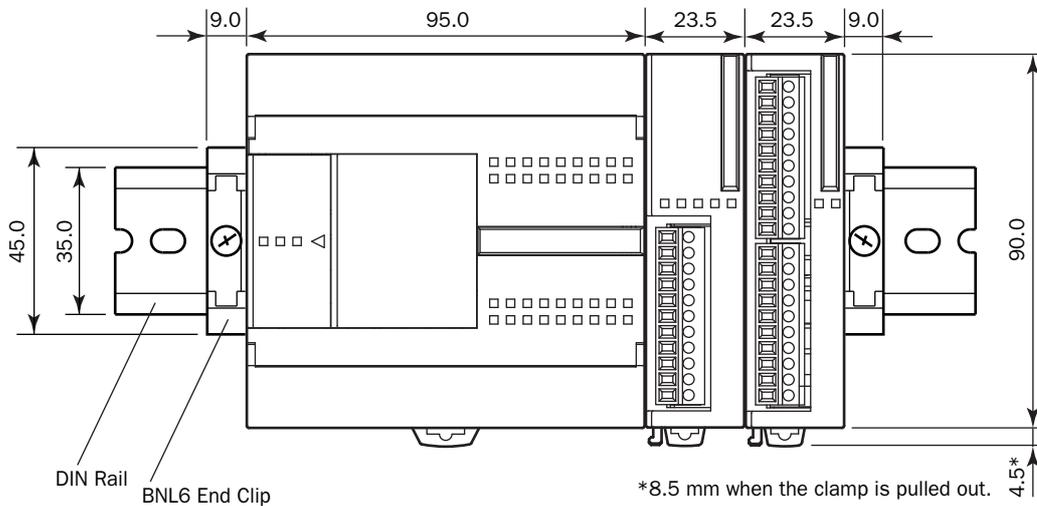
Communication Modules

FC4A-HPC1, FC4A-HPC2, FC4A-HPC3



Example:

The following figure illustrates a system setup consisting of the all-in-one 24-I/O type CPU module, an 8-point relay output module, and a 16-point DC input module mounted on a 35-mm-wide DIN rail using BNL6 end clips.



All dimensions in mm.

3: INSTALLATION AND WIRING

Introduction

This chapter describes the methods and precautions for installing and wiring MicroSmart modules.

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.



Warning

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



Caution

- Prevent metal fragments and pieces of wire from dropping inside the MicroSmart housing. Put a cover on the MicroSmart modules during installation and wiring. Ingress of such fragments and chips may cause fire hazard, damage, or malfunction.
- Do not touch the connector pins with hand, otherwise electrostatic discharge may damage the internal elements.
- Keep the MicroSmart wiring away from motor lines.

Installation Location

The MicroSmart must be installed correctly for optimum performance.

The MicroSmart is designed for installation in a cabinet. Do not install the MicroSmart outside a cabinet.

The environment for using the MicroSmart is "Pollution degree 2." Use the MicroSmart in environments of pollution degree 2 (according to IEC 60664-1).

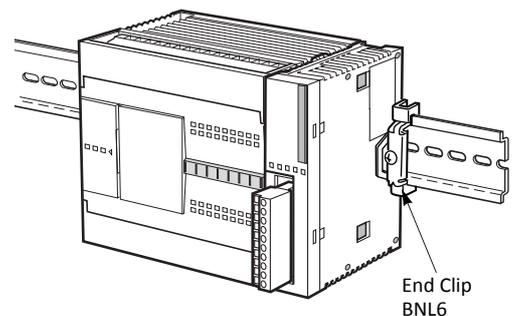
Make sure that the operating temperature does not drop below 0°C or exceed 55°C. If the temperature does exceed 55°C, use a fan or cooler.

Mount the MicroSmart on a vertical plane as shown at right.

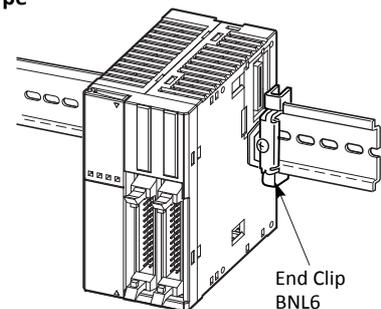
To eliminate excessive temperature build-up, provide ample ventilation. Do not install the MicroSmart near, and especially above, any device which generates considerable heat, such as a heater, transformer, or large-capacity resistor. The relative humidity should be above 30% and below 95%.

The MicroSmart should not be exposed to excessive dust, dirt, salt, direct sunlight, vibrations, or shocks. Do not use the MicroSmart in an area where corrosive chemicals or flammable gases are present. The modules should not be exposed to chemical, oil, or water splashes.

All-in-One Type



Slim Type

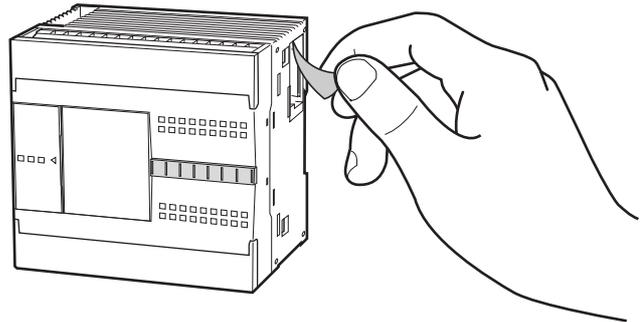


Assembling Modules

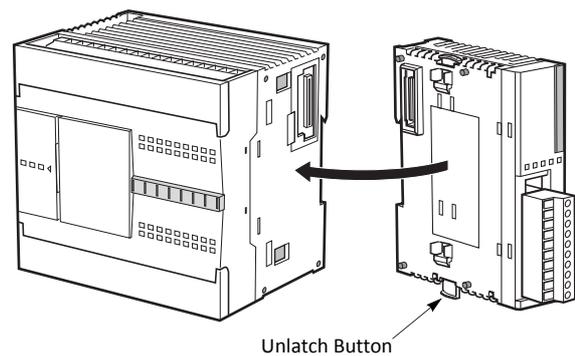
 Caution	<ul style="list-style-type: none">• Assemble MicroSmart modules together before mounting the modules onto a DIN rail. Attempt to assemble modules on a DIN rail may cause damage to the modules.• Turn off the power to the MicroSmart before assembling the modules. Failure to turn power off may cause electrical shocks.
--	---

The following example demonstrates the procedure for assembling the all-in-one 24-I/O type CPU module and an I/O module together. When assembling slim type CPU modules, take the same procedure.

1. When assembling an input or output module, remove the expansion connector seal from the 24-I/O type CPU module.



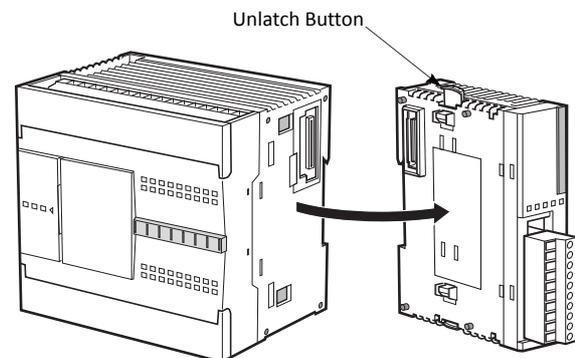
2. Place the CPU module and I/O module side by side. Put the expansion connectors together for easy alignment.
3. With the expansion connectors aligned correctly and the blue unlatch button in the down position, press the CPU module and I/O module together until the latches click to attach the modules together firmly. If the unlatch button is in the up position, push down the button to engage the latches.



Disassembling Modules

 Caution	<ul style="list-style-type: none">• Remove the MicroSmart modules from the DIN rail before disassembling the modules. Attempt to disassemble modules on a DIN rail may cause damage to the modules.• Turn off the power to the MicroSmart before disassembling the modules. Failure to turn power off may cause electrical shocks.
--	---

1. If the modules are mounted on a DIN rail, first remove the modules from the DIN rail as described on page 3-8.
2. Push up the blue unlatch button to disengage the latches, and pull the modules apart as shown. When disassembling slim type CPU modules, take the same procedure.



Installing the HMI Module



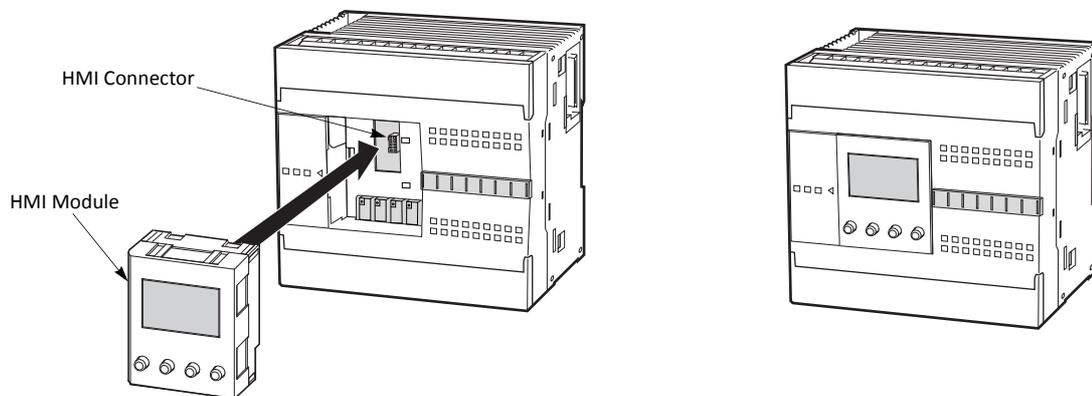
Caution

- Turn off the power to the MicroSmart before installing or removing the HMI module to prevent electrical shocks.
- Do not touch the connector pins with hand, otherwise electrostatic discharge may damage the internal elements.

The optional HMI module (FC4A-PH1) can mount on any all-in-one type CPU module, and also on the HMI base module mounted next to any slim type CPU module. For specifications of the HMI module, see page 2-80. For details about operating the HMI module, see page 5-60.

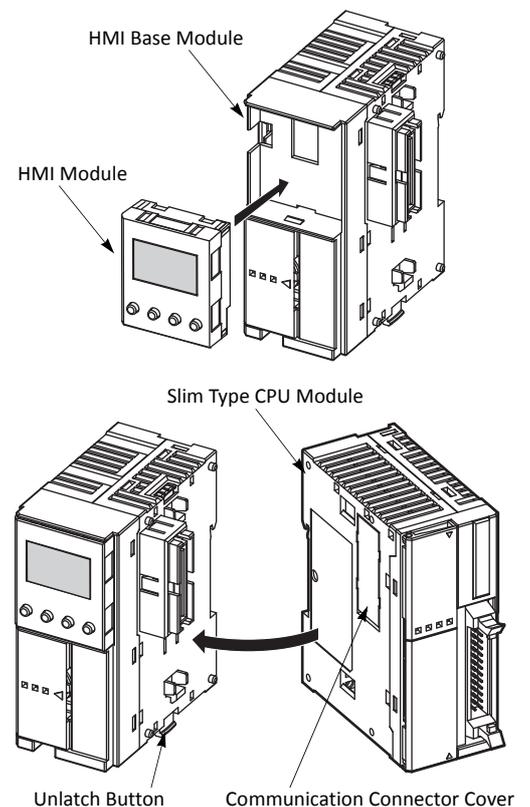
All-in-One Type

1. Remove the HMI connector cover from the CPU module. Locate the HMI connector inside the CPU module.
2. Push the HMI module into the HMI module connector in the CPU module until the latch clicks.



Slim Type

1. When using the HMI module with the slim type CPU module, prepare the optional HMI base module (FC4A-HPH1). See page 2-81.
2. Locate the HMI connector inside the HMI base module. Push the HMI module into the HMI connector in the HMI base module until the latch clicks.
3. Remove the communication connector cover from the slim type CPU module. See page 3-7.
4. Place the HMI base module and CPU module side by side. With the communication connectors aligned correctly and the blue unlatch button in the down position, press the HMI base module and CPU module together until the latches click to attach the modules together firmly. If the unlatch button is in the up position, push down the button to engage the latches.

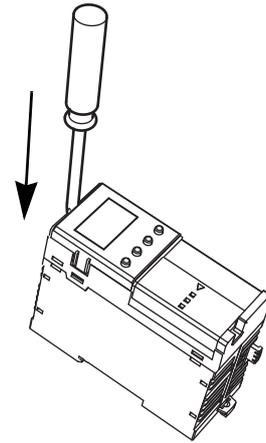


Removing the HMI Module

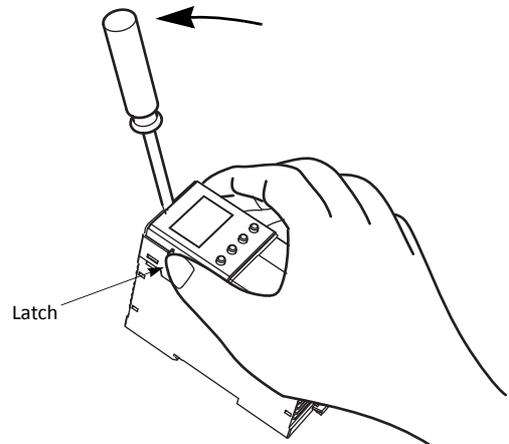
	Caution	• Turn off the power to the MicroSmart before installing or removing the HMI module to prevent electrical shocks.
		• Do not touch the connector pins with hand, otherwise electrostatic discharge may damage the internal elements.

This section describes the procedures for removing the HMI module from the optional HMI base module mounted next to any slim type CPU module.

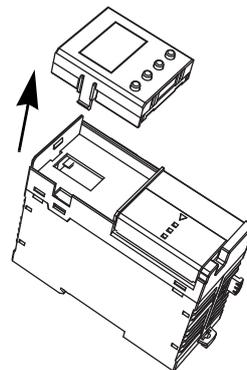
1. Insert a thin flat screwdriver (ø3.0 mm maximum) between the gap on top of the HMI module until the tip of the screwdriver bottoms.



2. While turning the screwdriver in the direction as shown, disengage the latch on the HMI module and pull out the HMI module.



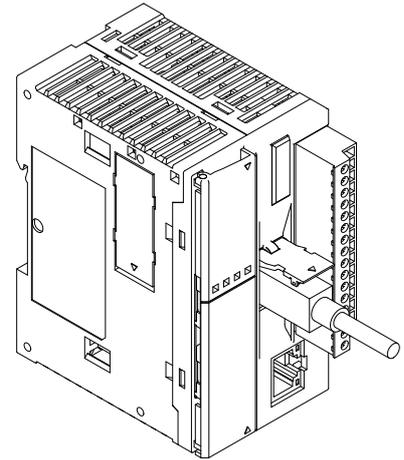
3. Remove the HMI module from the HMI base module.



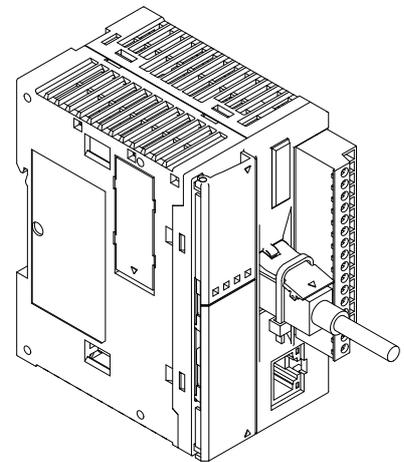
Securing USB Extension Cable Using Cable Tie

When FC5A-D12K1E/S1E is installed in a control panel, it is possible to extend the USB Mini-B port of the PLC to the panel surface using a USB extension cable (Note 1). When using the USB extension cable, it is recommended that the USB extension cable is secured to the USB port cover of the PLC using a cable tie (Note 2) so that the USB extension cable does not come loose from the USB port of the PLC. This section describes the procedure to secure the USB extension cable to the USB port cover using the cable tie.

1. Open the USB port cover and insert the USB extension cable into the USB port.



2. Pass a cable tie around the USB cable cover and the USB extension cable, taking care to route the cable tie through the notches on the USB cover.
3. Insert the tip of the cable tie through the locking section to make a loop. Tighten the loop until it is the suitable size and trim the excess cable tie using wire cutters.



Note 1: IDEC USB extension cable for USB Mini-B (HG9Z-XCE21) is recommended.

Note 2: HellermanTyton cable tie T18R-1000 is recommended.

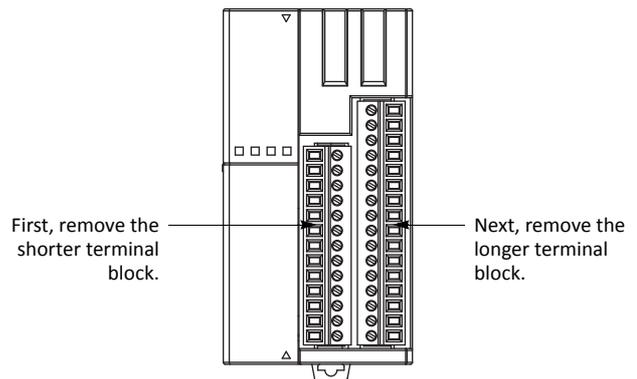
Removing the Terminal Blocks

 Caution	<ul style="list-style-type: none">• Turn off the power to the MicroSmart before installing or removing the terminal blocks to prevent electrical shocks.• Use the correct procedures to remove the terminal blocks, otherwise the terminal blocks may be damaged.
--	--

This section describes the procedures for removing the terminal blocks from slim type CPU modules FC5A-D16RK1, FC5A-D16RS1, FC5A-D12K1E and FC5A-D12S1E.

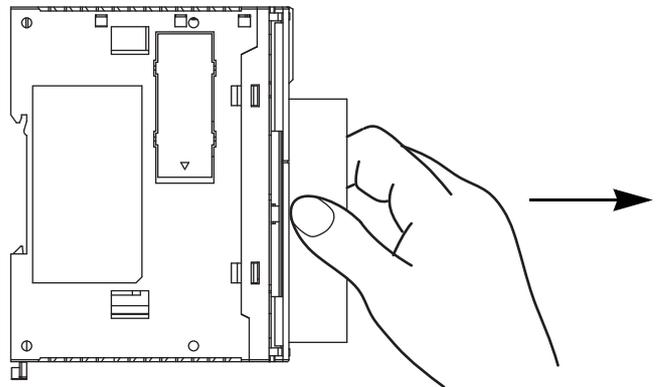
1. Before removing the terminal blocks, disconnect all wires from the terminal blocks.

Remove the shorter terminal block on the left first, then remove the longer one on the right.

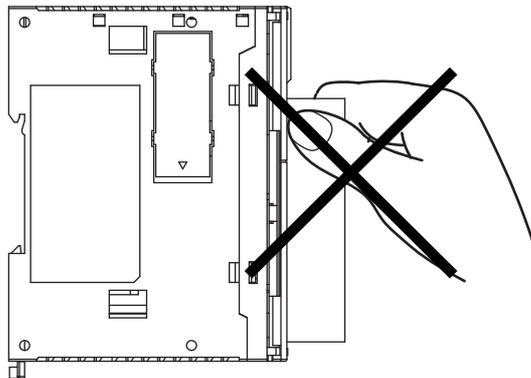


FC5A-D16RK1, FC5A-D16RS1, FC5A-D12K1E and FC5A-D12S1E

2. When removing the longer terminal block, hold the center of the terminal block, and pull it out straight.



3. Do not pull one end of the longer terminal block, otherwise the terminal block may be damaged.



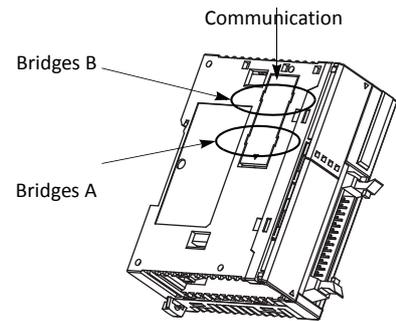
Removing the Communication Connector Cover



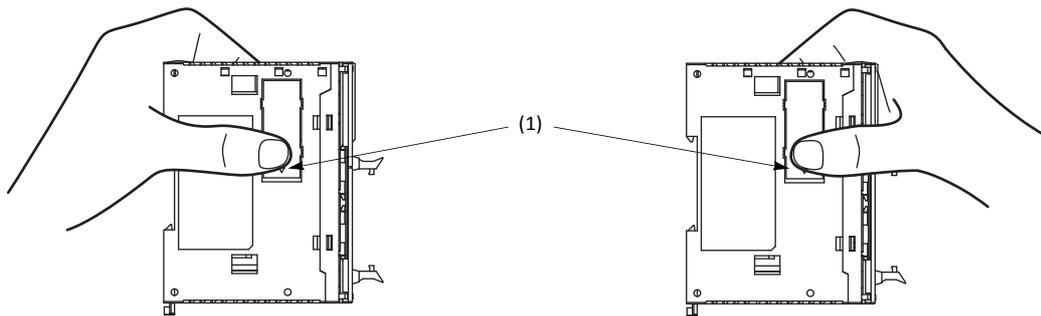
Caution

- When using a thin screwdriver to pull out the communication connector cover, insert the screwdriver carefully and do not damage the electronic parts inside the CPU module.
- When first pushing in the communication connector cover to break, take care not to injure your finger.

Before mounting a communication module or HMI base module next to the slim type CPU module, the communication connector cover must be removed from the CPU module. Break the communication connector cover on the slim type CPU module as described below.

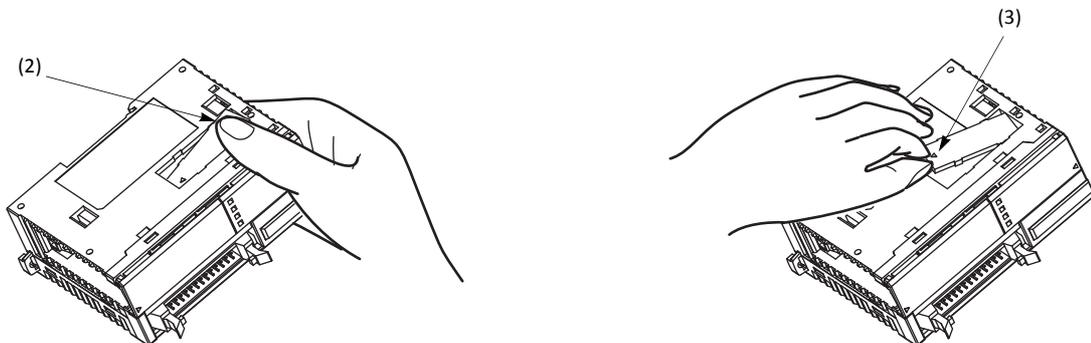


1. Carefully push in the communication connector cover at position (1) to break bridges A as shown in either figure below.



2. The other end (2) of the communication connector cover will come out as shown at left below. Push in this end.
3. Then, the opposite end (3) will come out. If the end does not come out, insert a thin screwdriver into the gap and pull out the end (3).

Hold the communication connector cover at (3), and pull off the communication connector cover to break bridges B.



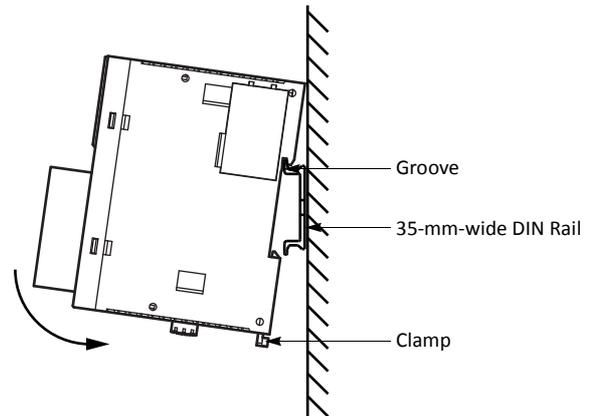
Mounting on DIN Rail



Caution

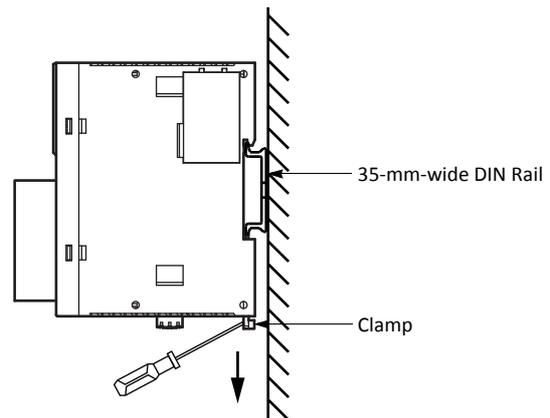
- Install the MicroSmart modules according to instructions described in this user's manual. Improper installation will result in falling, failure, or malfunction of the MicroSmart.
- Mount the MicroSmart modules on a 35-mm-wide DIN rail or a panel surface.
Applicable DIN rail: IDEC's BAA1000PN10 or BAP1000PN10 (1000mm/39.4" long)

1. Fasten the DIN rail to a panel using screws firmly.
2. Pull out the clamp from each MicroSmart module, and put the groove of the module on the DIN rail. Press the modules towards the DIN rail and push in the clamps as shown on the right.
3. Use BNL6 end clips on both sides of the MicroSmart modules to prevent moving sideways.



Removing from DIN Rail

1. Insert a flat screwdriver into the slot in the clamp.
2. Pull out the clamps from the modules.
3. Turn the MicroSmart modules bottom out.

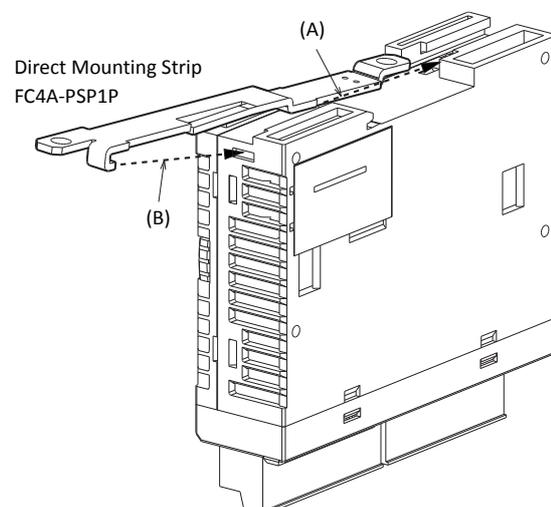


Direct Mounting on Panel Surface

MicroSmart modules can also be mounted on a panel surface inside a console. When mounting a slim type CPU module, digital I/O module, analog I/O module, HMI base module, or communication module, use optional direct mounting strip FC4A-PSP1P as described below.

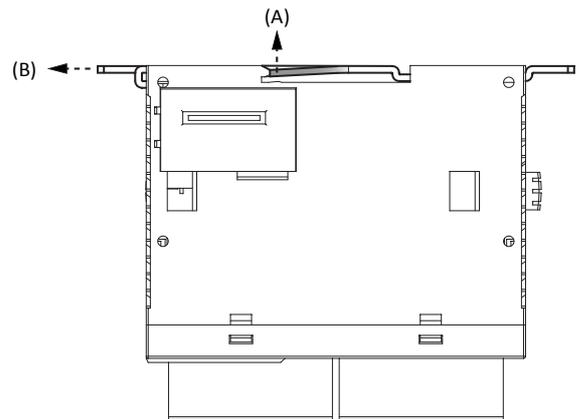
Installing the Direct Mounting Strip

1. Remove the clamp from the module by pushing the clamp inward.
2. Insert the direct mounting strip into the slot where the clamp has been removed (A). Further insert the direct mounting strip until the hook enters into the recess in the module (B).



Removing the Direct Mounting Strip

1. Insert a flat screwdriver under the latch of the direct mounting strip to release the latch (A).
2. Pull out the direct mounting strip (B).



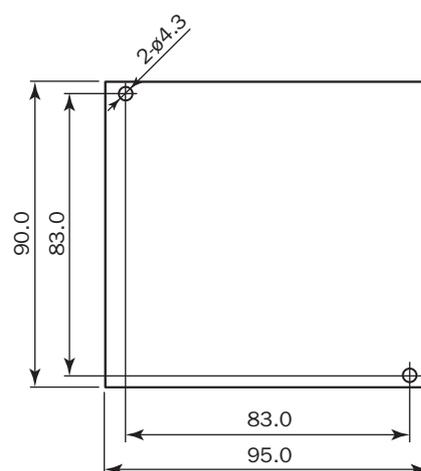
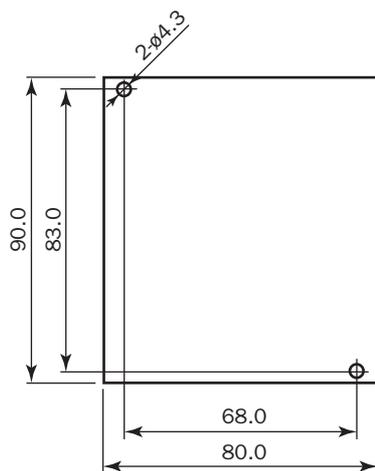
Mounting Hole Layout for Direct Mounting on Panel Surface

Make mounting holes of $\phi 4.3$ mm as shown below and use M4 screws (6 or 8 mm long) to mount the MicroSmart modules on the panel surface.

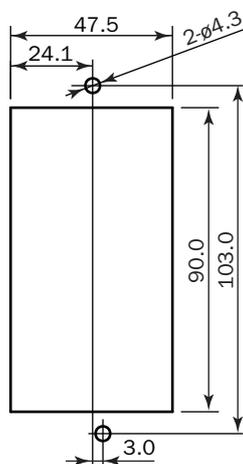
• CPU Modules

FC5A-C10R2, FC5A-C10R2C, FC5A-C10R2D,
FC5A-C16R2, FC5A-C16R2C, FC5A-C16R2D

FC5A-C24R2, FC5A-C24R2C, FC5A-C24R2D



FC5A-D16RK1, FC5A-D16RS1, FC5A-D32K3, FC5A-D32S3,
FC5A-D12K1E, FC5A-D12S1E



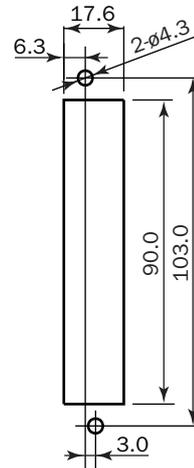
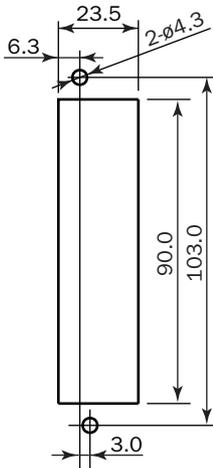
All dimensions in mm.

3: INSTALLATION AND WIRING

• I/O Modules

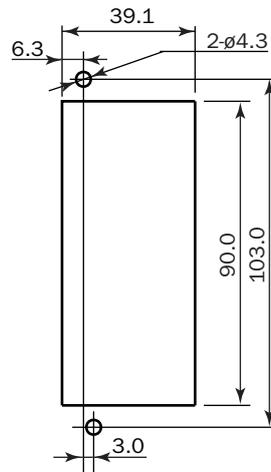
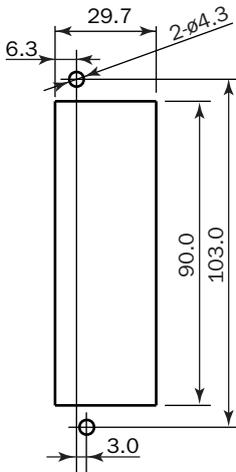
FC4A-N08B1, FC4A-N16B1, FC4A-N08A11, FC4A-R081,
FC4A-R161, FC4A-T08K1, FC4A-T08S1, FC4A-M08BR1,
FC4A-L03A1, FC4A-L03AP1, FC4A-J2A1, FC4A-J4CN1,
FC4A-J8C1, FC4A-J8AT1, FC4A-K1A1, FC4A-K2C1, FC4A-K4A1,
FC5A-SIF2, FC5A-SIF4

FC4A-N16B3, FC4A-T16K3, FC4A-T16S3



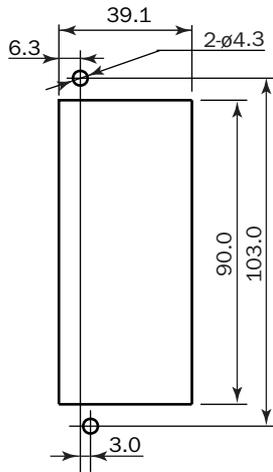
FC4A-N32B3, FC4A-T32K3, FC4A-T32S3

FC4A-M24BR2

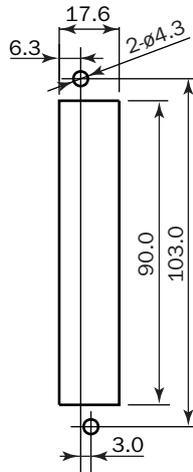


All dimensions in mm.

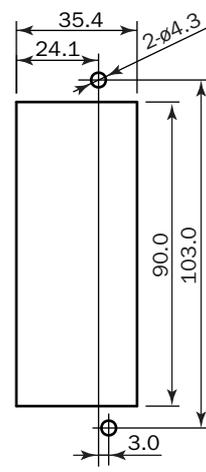
• Expansion Interface Module
FC5A-EXM2



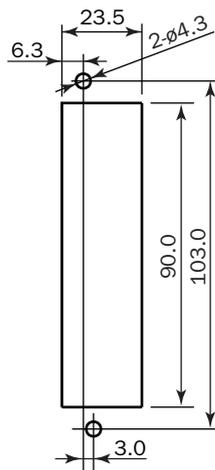
• Expansion Interface Master Module
FC5A-EXM1M



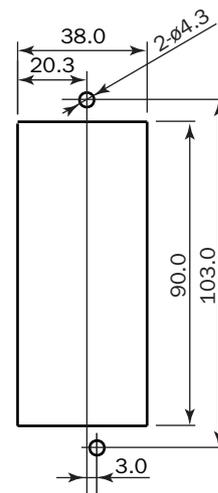
• Expansion Interface Slave Module
FC5A-EXM1S



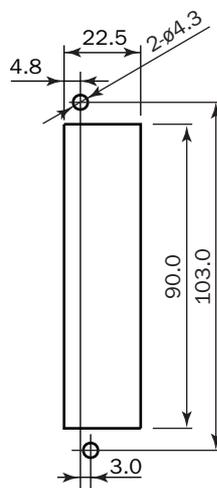
• AS-Interface Module
FC4A-AS62M



• HMI Base Module
FC4A-HPH1



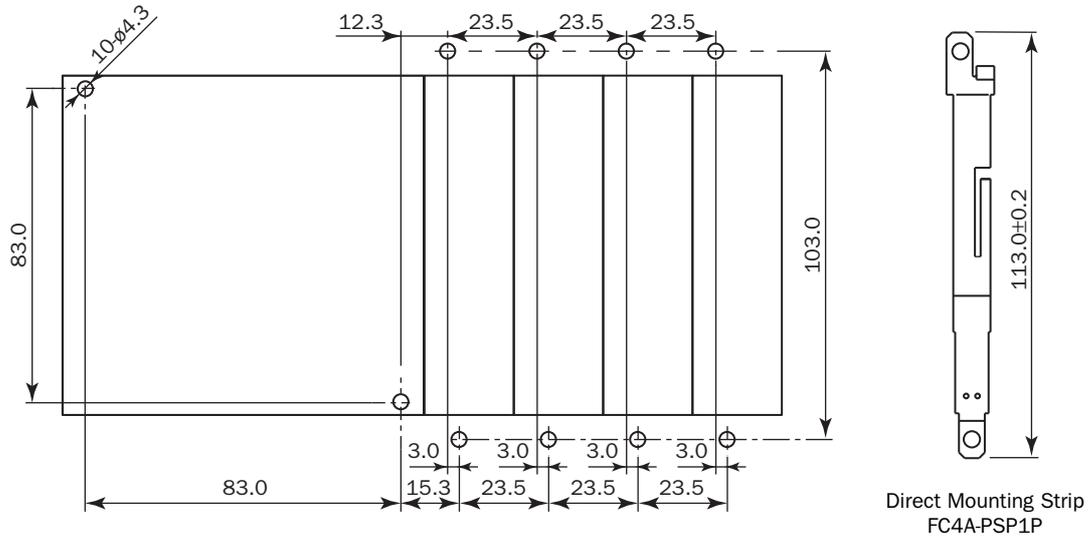
• Communication Modules
FC4A-HPC1, FC4A-HPC2, FC4A-HPC3



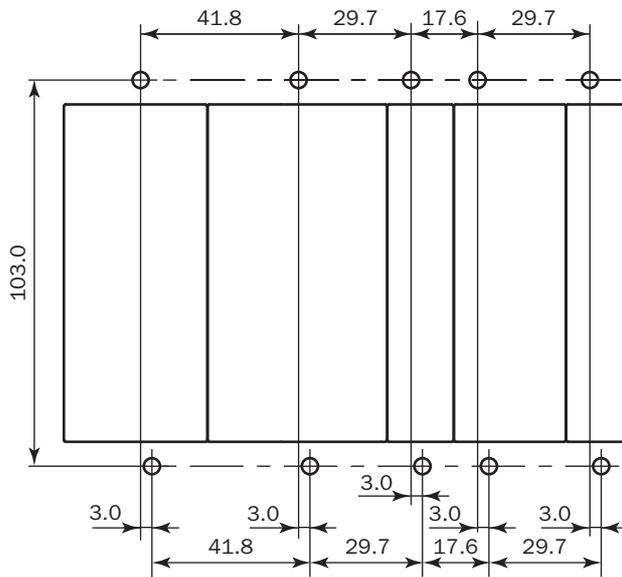
All dimensions in mm.

3: INSTALLATION AND WIRING

Example 1: Mounting hole layout for FC5A-C24R2 and 23.5-mm-wide I/O modules



Example 2: Mounting hole layout for, from left, FC4A-HPH1, FC5A-D16RK1, FC4A-N16B3, FC4A-N32B3, and FC4A-M24R2 modules



All dimensions in mm.

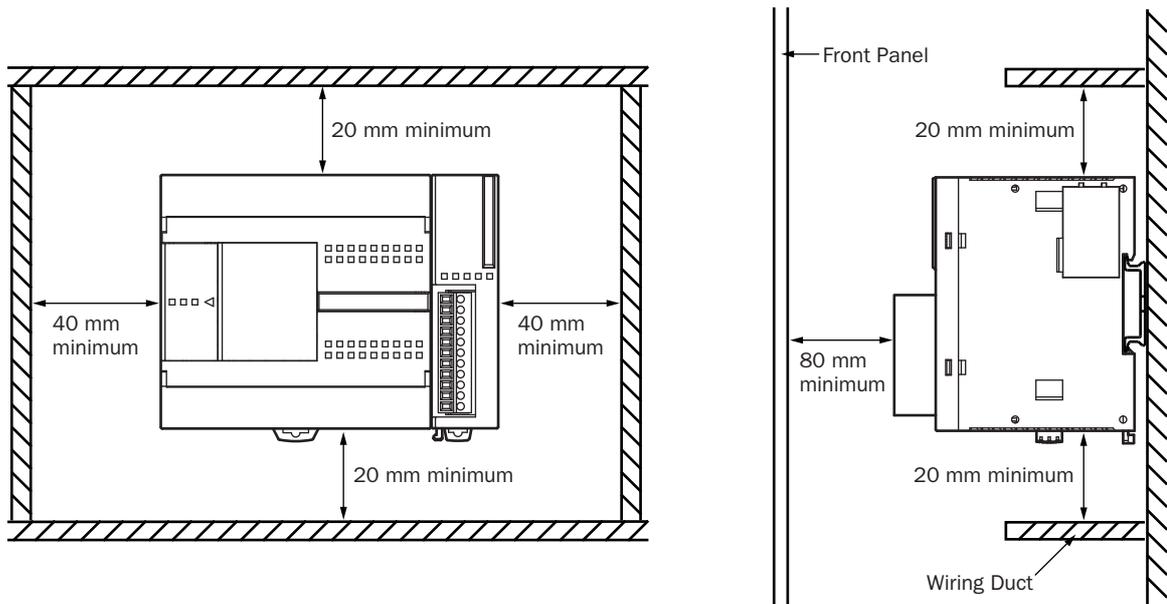
Installation in Control Panel

The MicroSmart modules are designed for installation in a cabinet. Do not install the MicroSmart modules outside a cabinet.

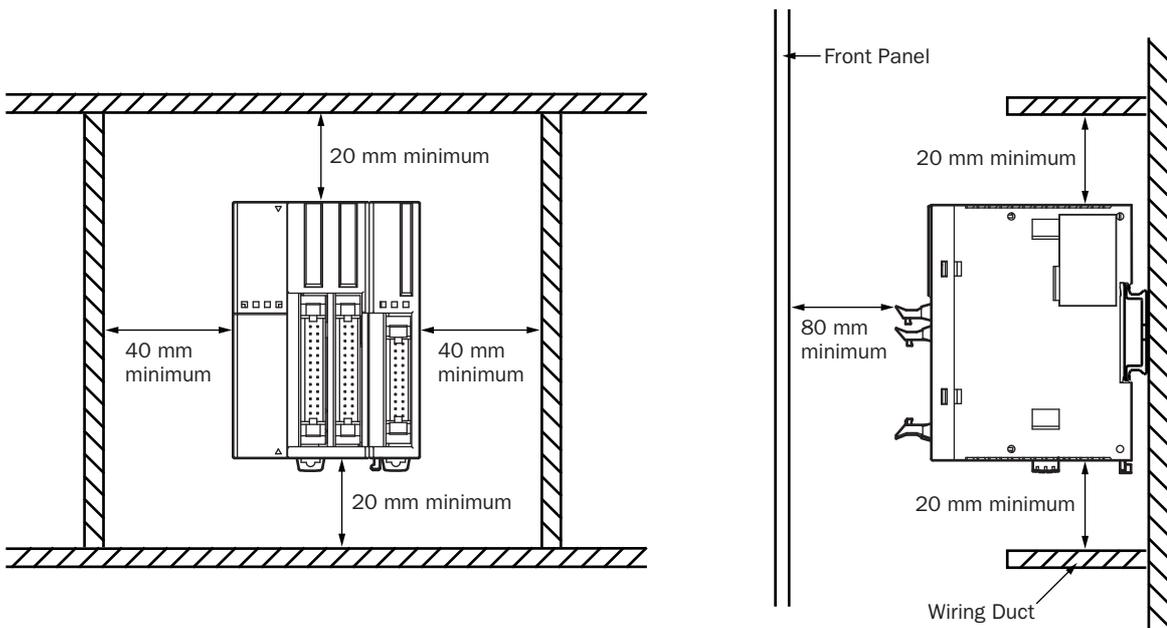
The environment for using the MicroSmart is "Pollution degree 2." Use the MicroSmart in environments of pollution degree 2 (according to IEC 60664-1).

When installing the MicroSmart modules in a control panel, take the convenience of operation and maintenance, and resistance against environments into consideration.

All-in-One Type CPU Module



Slim Type CPU Module

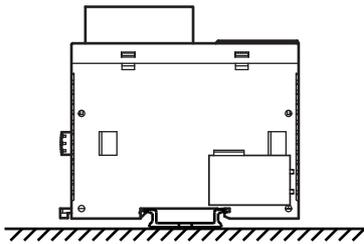


Mounting Direction

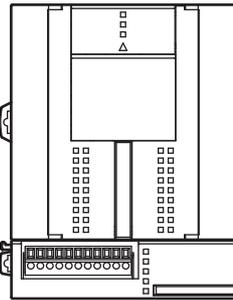
Mount the MicroSmart modules horizontally on a vertical plane as shown on the preceding page. Keep a sufficient spacing around the MicroSmart modules to ensure proper ventilation and keep the ambient temperature between 0°C and 55°C.

All-in-One Type CPU Module

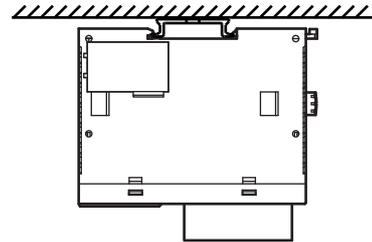
When the ambient temperature is 35°C or below, the all-in-one type CPU modules can also be mounted upright on a horizontal plane as shown at left below. When the ambient temperature is 40°C or below, the all-in-one type CPU modules can also be mounted sideways on a vertical plane as shown in the middle below.



Allowable Mounting Direction at 35°C or below



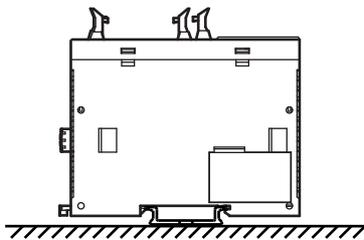
Allowable Mounting Direction at 40°C or below



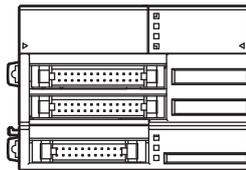
Incorrect Mounting Direction

Slim Type CPU Module

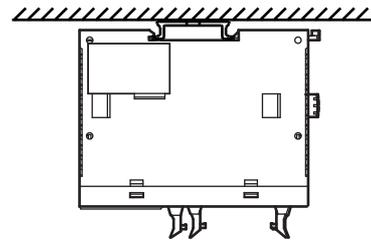
Always mount the slim type CPU modules horizontally on a vertical plane as shown on the preceding page. Any other mounting directions are not allowed.



Incorrect Mounting Direction



Incorrect Mounting Direction



Incorrect Mounting Direction

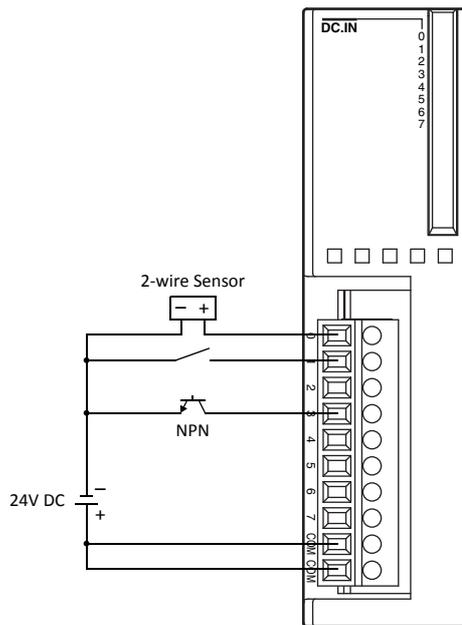
Input Wiring



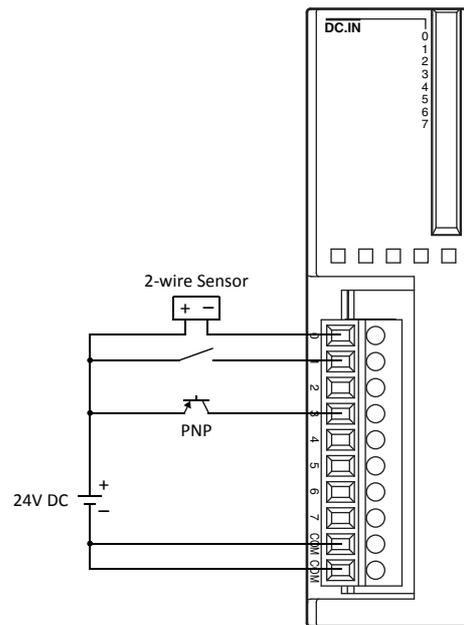
Caution

- Separate the input wiring from the output line, power line, and motor line.
- Use proper wires for input wiring.
 All-in-one type CPU modules: UL1015 AWG22 or UL1007 AWG18
 Slim type CPU and I/O modules: UL1015 AWG22

DC Source Input



DC Sink Input

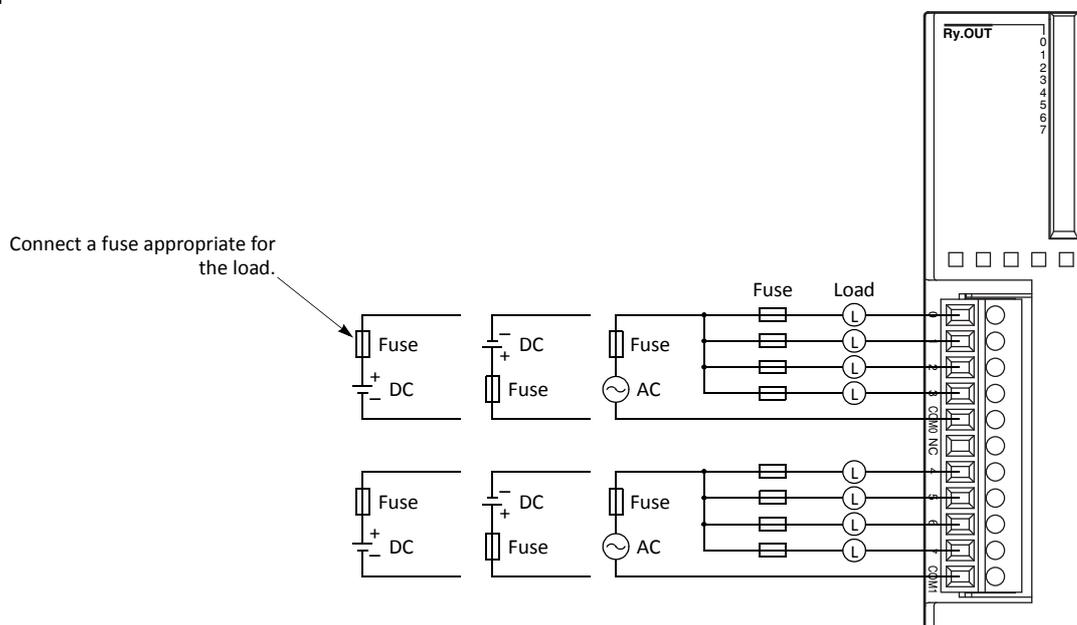


Output Wiring

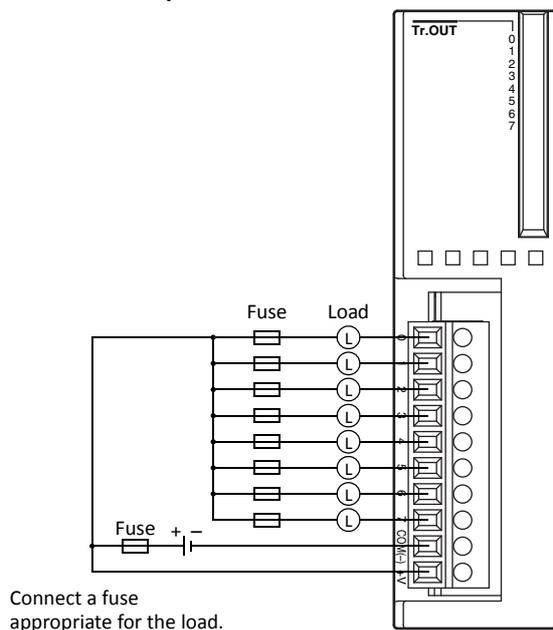
Caution

- If output relays or transistors in the MicroSmart CPU or output modules should fail, outputs may remain on or off. For output signals which may cause heavy accidents, provide a monitor circuit outside the MicroSmart.
- Connect a fuse to the output module, selecting a fuse appropriate for the load.
- Use proper wires for output wiring.
 All-in-one type CPU modules: UL1015 AWG22 or UL1007 AWG18
 Slim type CPU and I/O modules: UL1015 AWG22
- When equipment containing the MicroSmart is intended for use in European countries, insert an IEC 60127-approved fuse to each output of every module for protection against overload or short-circuit. This is required when equipment containing the MicroSmart is destined for Europe.

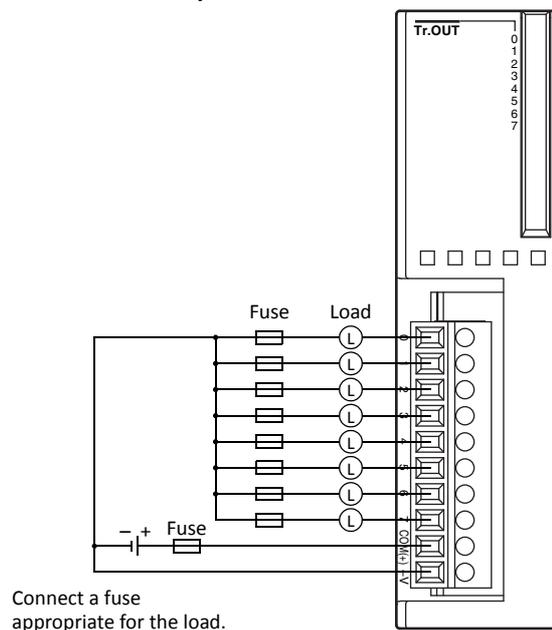
Relay Output



Transistor Sink Output



Transistor Source Output

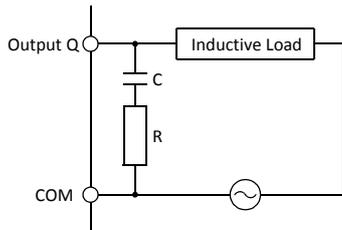


Contact Protection Circuit for Relay and Transistor Outputs

Depending on the load, a protection circuit may be needed for the relay output of the MicroSmart modules. Choose a protection circuit from A through D shown below according to the power supply and connect the protection circuit to the outside of the CPU or relay output module.

For protection of the transistor output of the MicroSmart modules, connect protection circuit C shown below to the transistor output circuit.

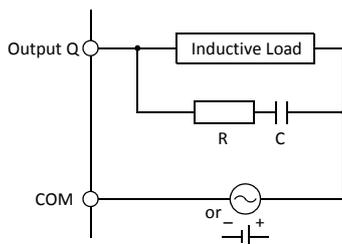
Protection Circuit A



This protection circuit can be used when the load impedance is smaller than the RC impedance in an AC load power circuit.

R: Resistor of approximately the same resistance value as the load
C: 0.1 to 1 μ F

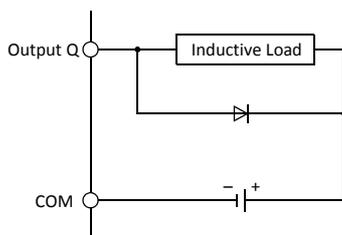
Protection Circuit B



This protection circuit can be used for both AC and DC load power circuits.

R: Resistor of approximately the same resistance value as the load
C: 0.1 to 1 μ F

Protection Circuit C

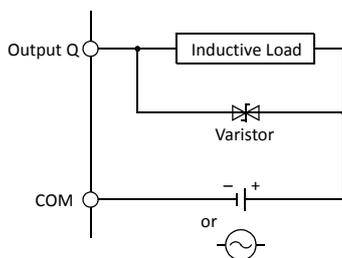


This protection circuit can be used for DC load power circuits.

Use a diode with the following ratings.

Reverse withstand voltage: Power voltage of the load circuit \times 10
Forward current: More than the load current

Protection Circuit D



This protection circuit can be used for both AC and DC load power circuits.

Power Supply

All-in-One Type CPU Module (AC and DC Power)



Caution

- Use a power supply of the rated value. Use of a wrong power supply may cause fire hazard.
- The allowable power voltage range is 85 to 264V AC for the AC power type CPU module, 20.4 to 28.8V DC for the 24V DC power type CPU module, and 10.2 to 18.0V DC for the 12V DC power type CPU module. Do not use the MicroSmart CPU module on any other voltage.
- On the AC power type CPU module, if the power voltage turns on or off very slowly between 15 and 50V AC, the CPU module may run and stop repeatedly between these voltages.
- On the 12V DC power type CPU module, if the power voltage changes very slowly to turn on or off, the CPU module may run and stop repeatedly.
- When MicroSmart I/O signals are connected to a device which may cause a major accident in case of an error, take a measure to secure safety, such as providing a voltage monitoring circuit outside the MicroSmart.
- Use an IEC 60127-approved fuse on the power line outside the MicroSmart. This is required when equipment containing the MicroSmart is destined for Europe.

Power Supply Voltage

The allowable power voltage range for the all-in-one type MicroSmart CPU module is 85 to 264V AC (AC power type), 20.4 to 28.8V DC (24V DC power type), and 10.2 to 18.0V DC (12V DC power type). Do not use the MicroSmart CPU module on any other voltage.

Power failure detection voltage depends on the quantity of used input and output points. Basically, power failure is detected when the power voltage drops below 85V AC (AC power type), 20.4V DC (24V DC power type), and 10.2V DC (12V DC power type), stopping operation to prevent malfunction.

On AC power type CPU modules, a momentary power interruption for 10 ms or less is not recognized as a power failure at the rated voltage of 100 to 240V AC.

On DC power type CPU modules, a momentary power interruption for 10 ms or less is not recognized as a power failure at the rated voltage of 24 or 12V DC.

Inrush Current at Powerup

When the all-in-one AC or 24V DC power type CPU module is powered up, an inrush current of a maximum of 35A (10- and 16-I/O type CPU modules) or 40A (24-I/O type CPU module) flows.

When the 12V DC power type CPU module is powered up, an inrush current of a maximum of 20A flows.

Power Supply Wiring

Use a stranded wire of UL1015 AWG22 or UL1007 AWG18 for power supply wiring. Make the power supply wiring as short as possible.

Run the power supply wiring as far away as possible from motor lines.

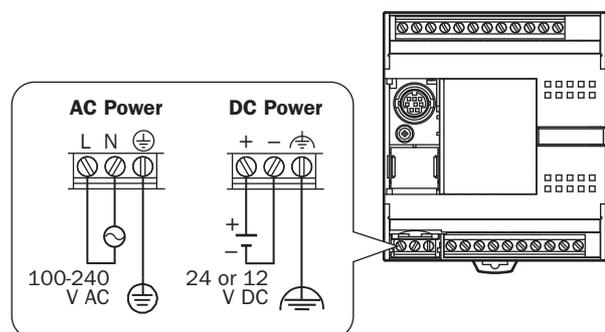
Grounding

To prevent electrical shocks, connect the \oplus or \ominus terminal to a proper ground using a wire of UL1007 AWG16. The grounding also prevents malfunctioning due to noise.

Do not connect the grounding wire in common with the grounding wire of motor equipment.

Separate the grounding wires of the MicroSmart and external devices which can be a possible noise source.

Use a thick wire for grounding the MicroSmart and make the grounding wire as short as possible to make sure that noises from external devices can be conducted to the ground effectively.



Slim Type CPU Module and Expansion Interface Module (DC Power)



Caution

- Use a power supply of the rated value. Use of a wrong power supply may cause fire hazard.
- The allowable power voltage range for the slim type MicroSmart CPU module, expansion interface module FC5A-EXM2, and expansion interface slave module FC5A-EXM1S is 20.4 to 26.4V DC. Do not use the MicroSmart on any other voltage.
- If the power voltage turns on or off very slowly, the MicroSmart may run and stop repeatedly or I/O operation may fluctuate at a voltage lower than the rated voltage.
- When MicroSmart I/O signals are connected to a device which may cause a major accident in case of an error, take a measure to secure safety, such as providing a voltage monitoring circuit outside the MicroSmart.
- Use one power supply to power the CPU module and the expansion interface module or expansion interface slave module.
- When using a separate power supply, power up the expansion interface module or expansion interface slave module first, followed by the CPU module, otherwise the CPU module causes an error and cannot start and stop operation.
- Use an IEC 60127-approved fuse on the power line outside the MicroSmart. This is required when equipment containing the MicroSmart is destined for Europe.

Power Supply Voltage

The allowable power voltage range for the slim type MicroSmart CPU module is 20.4 to 26.4V DC.

Power failure detection voltage depends on the quantity of used input and output points. Basically, power failure is detected when the power voltage drops below 20.4V DC, stopping operation to prevent malfunction.

A momentary power interruption for 10 ms or less is not recognized as a power failure at the rated voltage of 24V DC.

Inrush Current at Powerup

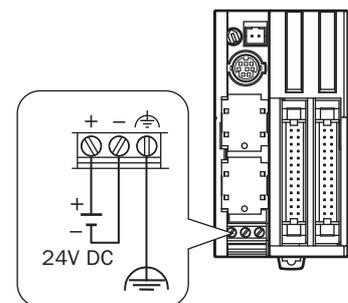
When the slim type CPU module, expansion interface module, or expansion interface slave module is powered up, an inrush current of a maximum of 50A flows.

Power Supply Wiring

Use a stranded wire of UL1015 AWG22 or UL1007 AWG18 for power supply wiring. Make the power supply wiring as short as possible.

Run the power supply wiring as far away as possible from motor lines.

For a power supply wiring example of expansion interface modules, see page 2-77.



Grounding

To prevent electrical shocks, connect the ⚡ terminal to a proper ground using a wire of UL1015 AWG22 or UL1007 AWG18. The grounding also prevents malfunctioning due to noise.

Do not connect the grounding wire in common with the grounding wire of motor equipment.

Separate the grounding wires of the MicroSmart and external devices which can be a possible noise source.

Use a thick wire for grounding the MicroSmart and make the grounding wire as short as possible to make sure that noises from external devices can be conducted to the ground effectively.

AS-Interface Master Module

The AS-Interface bus uses a dedicated 30V DC power supply (AS-Interface power supply). For AS-Interface power supply and power supply wiring, see pages 24-3 and 24-7 (Advanced Vol.).

Precautions for Connecting Communication Devices

When connecting communication devices to the MicroSmart, take possible external noise sources into consideration.

In a communication network consisting of a MicroSmart and an external device (a communication device which has a functional ground and a signal ground connected together internally [for example, IDEC's HG3F and HG4F operator interfaces]), if all devices are powered by a common AC or DC power source, noise generated by the external device may affect the internal circuits of the MicroSmart and the communication device. Take the following measures depending on the operating environment.

- Use a separate power supply for the external device generating noises so that a loop circuit to induce noises can not be formed.
- Disconnect the functional ground terminal of the communication device from the ground line. This measure may result in deterioration of EMC characteristics. When taking this measure, make sure that the EMC characteristics of the entire system are satisfactory.
- Connect the functional ground terminal of the communication device to the 0V line of the power supply so that the noises from the external device do not flow through the communication line.
- Connect an isolator to the communication line so that a loop circuit to induce noises can not be formed.

Maximum Quantity of Applicable Expansion Modules

This section describes precautions for installing the expansion RS232C communication module in connection with the internal current draw by other expansion modules.

The all-in-one 24-I/O type CPU module (except 12V DC power type) can mount a maximum of three expansion RS232C communication modules. The slim type CPU module can mount a maximum of five expansion RS232C communication modules.

Including expansion RS232C communication modules and other expansion modules, the all-in-one type CPU module can mount a maximum of four expansion modules, and the slim type CPU module can mount a maximum of seven expansion modules, unless the total internal current draw by all connected expansion modules exceeds the allowable current draw of the CPU module. Make sure that the total internal current draw does not exceed the current capacity of the CPU module.

Allowable Total Internal Current Draw

CPU Module	Quantity of Expansion RS232C Communication Modules	Quantity of Expansion Modules	Total Internal Current Draw (5V DC)
All-in-one 24-I/O Type CPU Module	3 maximum (Note)	4 maximum	260 mA maximum
Slim Type CPU Module	5 maximum	7 maximum	455 mA maximum

Note: The all-in-one 24-I/O type CPU module cannot use the expansion RS232C/RS485 communication module in combination with function modules listed below. When using the expansion RS232C/RS485 communication module and these function modules, use the slim type CPU module.

Function Module	Type No.
Analog I/O Module	FC4A-L03A1, FC4A-L03AP1, FC4A-J2A1, FC4A-J4CN1, FC4A-J8C1, FC4A-J8AT1, FC4A-K1A1, FC4A-K2C1, FC4A-K4A1
AS-Interface Master Module	FC4A-AS62M

Internal Current Draw by Expansion Modules

Module	Type No.	Internal Current Draw (5V DC)	Module	Type No.	Internal Current Draw (5V DC)
Input Module	FC4A-N08B1	25 mA maximum	Mixed I/O Module	FC4A-M08BR1	25 mA maximum
	FC4A-N16B1	40 mA maximum		FC4A-M24BR2	65 mA maximum
	FC4A-N16B3	35 mA maximum	Analog I/O Module	FC4A-L03A1	50 mA maximum
	FC4A-N32B3	65 mA maximum		FC4A-L03AP1	50 mA maximum
	FC4A-N08A11	60 mA maximum		Analog Input Module	FC4A-J2A1
Relay Output Module	FC4A-R081	30 mA maximum	FC4A-J4CN1		50 mA maximum
	FC4A-R161	45 mA maximum	FC4A-J8C1		40 mA maximum
Transistor Output Module	FC4A-T08K1	10 mA maximum	FC4A-J8AT1		45 mA maximum
	FC4A-T08S1	10 mA maximum	Analog Output Module	FC4A-K1A1	50 mA maximum
	FC4A-T16K3	10 mA maximum		FC4A-K2C1	60 mA maximum
	FC4A-T16S3	10 mA maximum		FC4A-K4A1	65 mA maximum
	FC4A-T32K3	20 mA maximum			
	FC4A-T32S3	20 mA maximum			
AS-Interface Master Module (Note 1)				FC4A-AS62M	80 mA maximum
Expansion RS232C Communication Module				FC5A-SIF2	40 mA [85 mA] maximum (Note 2)
Expansion RS485 Communication Module				FC5A-SIF4	40 mA maximum
PID Module (Note 3)				FC5A-F2MR2	65 mA maximum
				FC5A-F2M2	65 mA maximum

Note 1: A maximum of two AS-Interface master modules can be mounted even if the total current draw is within the limits.

Only one expansion interface module or expansion interface master module can be mounted to a CPU module, and is not included in the calculation of the total current draw by expansion modules.

Note 2: Values indicated in square brackets represent FC5A-SIF2 earlier than version 200.

Note 3: For details about the PID module, see FC5A Series PID Module User's Manual.

3: INSTALLATION AND WIRING

Example: Installing five expansion RS232C communication modules to the slim type CPU module

Module	Type No.	Quantity	Internal Current Draw (5V DC)	Total Internal Current Draw
Expansion RS232C Communication Module	FC5A-SIF2 (Earlier than V200)	5	85 mA	425 mA
Maximum Applicable Expansion Modules (Slim CPU)		7	—	455 mA
Balance		2	—	30 mA

In the above example, two more expansion modules can be added, with a maximum total current draw of 30 mA. The following table shows an example of installing the maximum quantity of expansion modules.

Module	Type No.	Quantity	Internal Current Draw (5V DC)	Total Internal Current Draw
Expansion RS232C Communication Module	FC5A-SIF2 (Earlier than V200)	5	85 mA	425 mA
Transistor Output Module	FC4A-T08S1	1	10 mA	10 mA
	FC4A-T32K3	1	20 mA	20 mA
Total		7	—	455 mA

Example: Installing an expansion interface module and RS232C communication modules

When using an expansion interface module, the current draw by the expansion interface module is not included in the total of internal current draw the current capacity of the CPU module as shown in the example below.

Area	Module	Type No.	Quantity	Internal Current Draw (5V DC)	Total Internal Current Draw
Expansion	Expansion RS232C Communication Module	FC5A-SIF2 (Earlier than V200)	5	85 mA	425 mA
	Total		5	—	425 mA
Expansion Interface Module		FC5A-EXM2 or FC5A-EXM1M + FC5A-EXM1S			
Additional	Input Module	FC4A-N32B3	4	65 mA	260 mA
	Transistor Output Module	FC4A-T32K3	4	20 mA	80 mA
	Total		8	—	340 mA

In the additional area on the right of the expansion interface module (FC5A-EXM2, FC5A-EXM1M, and FC5A-EXM1S), a maximum of eight digital I/O modules can be mounted regardless of the internal current draw of the digital I/O modules.

Expansion RS232C communication modules cannot be mounted on the right of expansion interface module.

For details about the expansion interface modules, see page 2-72.



Warning

- This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only.
- Explosion hazard — Substitution of components may impair suitability for Class I, Division 2.
- Explosion hazard — Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.



Caution

- Make sure that the total internal current draw by all connected expansion modules does not exceed the allowable current draw of the CPU module. Otherwise the CPU and other modules do not operate correctly. The CPU module does not detect the excessive current draw.
- The expansion RS232C communication module cannot be mounted on the right of expansion interface modules (FC5A-EXM2, FC5A-EXM1M, and FC5A-EXM1S). Expansion interface modules can be mounted on the right of the expansion RS232C communication module.

Terminal Connection



Caution

- Make sure that the operating conditions and environments are within the specification values.
- Be sure to connect the grounding wire to a proper ground, otherwise electrical shocks may be caused.
- Do not touch live terminals, otherwise electrical shocks may be caused.
- Do not touch terminals immediately after power is turned off, otherwise electrical shocks may be caused.
- When using ferrules, insert a wire to the bottom of the ferrule and crimp the ferrule.
- When connecting a stranded wire or multiple solid wires to a screw terminal block, use a ferrule. Otherwise the wire may slip off the screw terminal block.

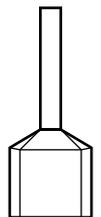
Ferrules, Crimping Tool, and Screwdriver for Phoenix Terminal Blocks

The screw terminal block can be wired with or without using ferrules on the end of cable. Applicable ferrules for the Phoenix terminal blocks and crimping tool for the ferrules are listed below. The screwdriver is used for tightening the screw terminals on the MicroSmart modules. These ferrules, crimping tool, and screwdriver are made by Phoenix Contact and are available from Phoenix Contact.

Type numbers of the ferrules, crimping tool, and screwdriver listed below are the type numbers of Phoenix Contact. When ordering these products from Phoenix Contact, specify the Order No. and quantity listed below.

Ferrule Order No.

Quantity of Cables	Cable Size	Phoenix Type	Order No.	Pcs./Pkt.
For 1-wire connection	UL1007 AWG16	AI 1,5-8 BK	32 00 04 3	100
	UL1007 AWG18	AI 1-8 RD	32 00 03 0	100
	UL1015 AWG22	AI 0,5-8 WH	32 00 01 4	100
	UL2464 AWG24	AI 0,25-8 YE	32 03 03 7	100
For 2-wire connection	UL1007 AWG18	AI-TWIN 2 x 0,75-8 GY	32 00 80 7	100
	UL1015 AWG22	AI-TWIN 2 x 0,5-8 WH	32 00 93 3	100



Crimping Tool and Screwdriver Order No.

Tool Name		Phoenix Type	Order No.	Pcs./Pkt.
Crimping Tool		CRIMPFOX ZA 3	12 01 88 2	1
Screwdriver	For power supply terminals	SZS 0,6 x 3,5	12 05 05 3	10
	For I/O modules, communication adapter, communication module, expansion RS232C/RS485 communication modules	SZS 0,4 x 2,5	12 05 03 7	10

Screw Terminal Tightening Torque	CPU modules	0.5 N·m
	I/O modules Communication adapter Communication module Expansion RS232C/RS485 communication modules	0.22 to 0.25 N·m

4: OPERATION BASICS

Introduction

This chapter describes general information about setting up the basic MicroSmart system for programming, starting and stopping MicroSmart operation, and introduces simple operating procedures from creating a user program using WindLDR on a PC to monitoring the MicroSmart operation.

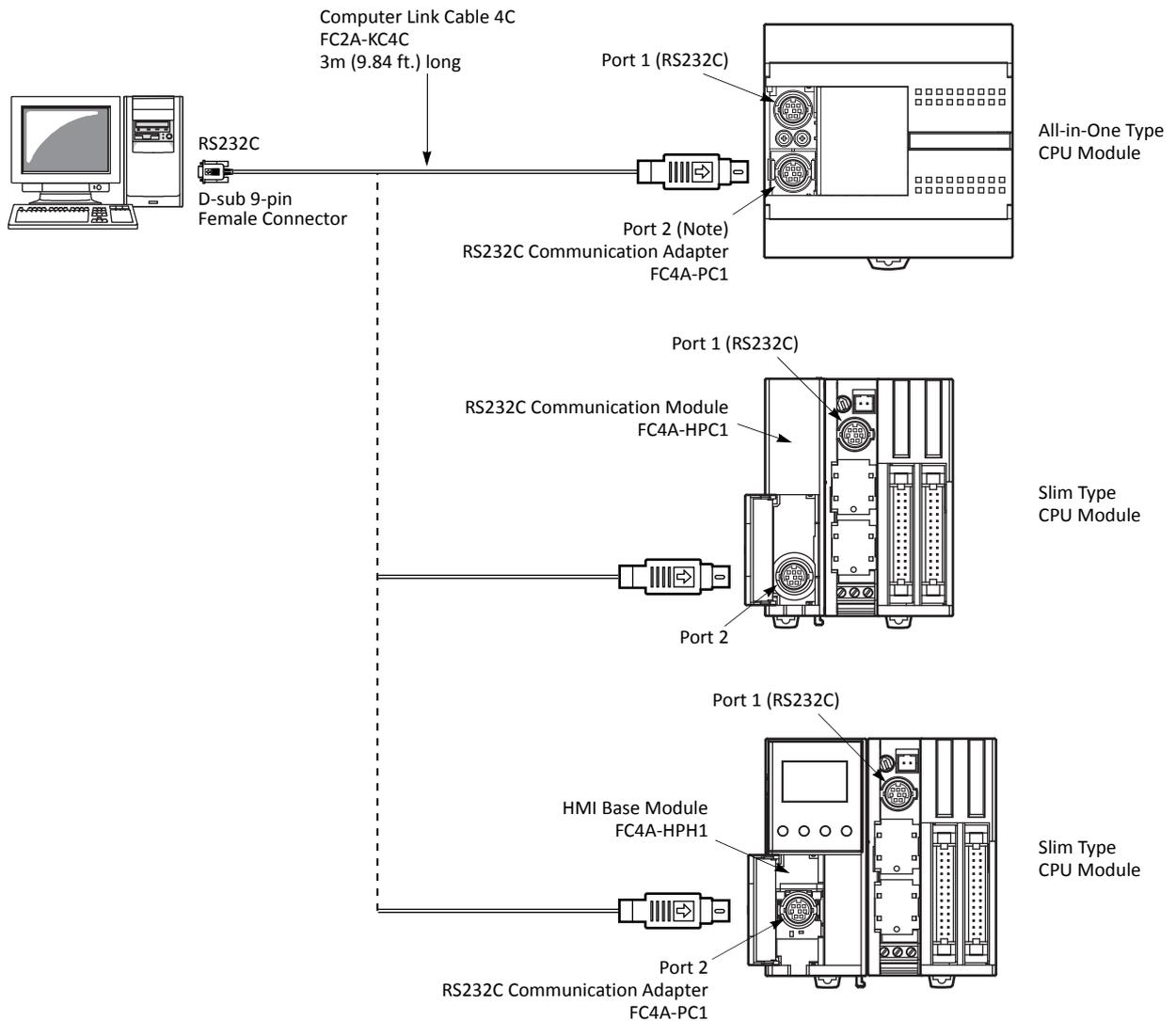
Connecting MicroSmart to PC (1:1 Computer Link System)

The MicroSmart can be connected to a Windows PC in two ways.

Computer Link through Port 1 or Port 2 (RS232C)

When connecting a Windows PC to the RS232C port 1 or port 2 on the MicroSmart CPU module, enable the maintenance protocol for the RS232C port using the Function Area Settings in WindLDR. See page 21-2 (Advanced Vol.).

To set up a 1:1 computer link system, connect a PC to the CPU module using the computer link cable 4C (FC2A-KC4C). The computer link cable 4C can be connected to port 1 directly. When connecting the cable to port 2 on the all-in-one type CPU module, install an optional RS232C communication adapter (FC4A-PC1) to the port 2 connector. When connecting to port 2 on the slim type CPU module, an optional RS232C communication module (FC4A-HPC1) is needed. The RS232C communication adapter can also be installed on the HMI base module (FC4A-HPH1).



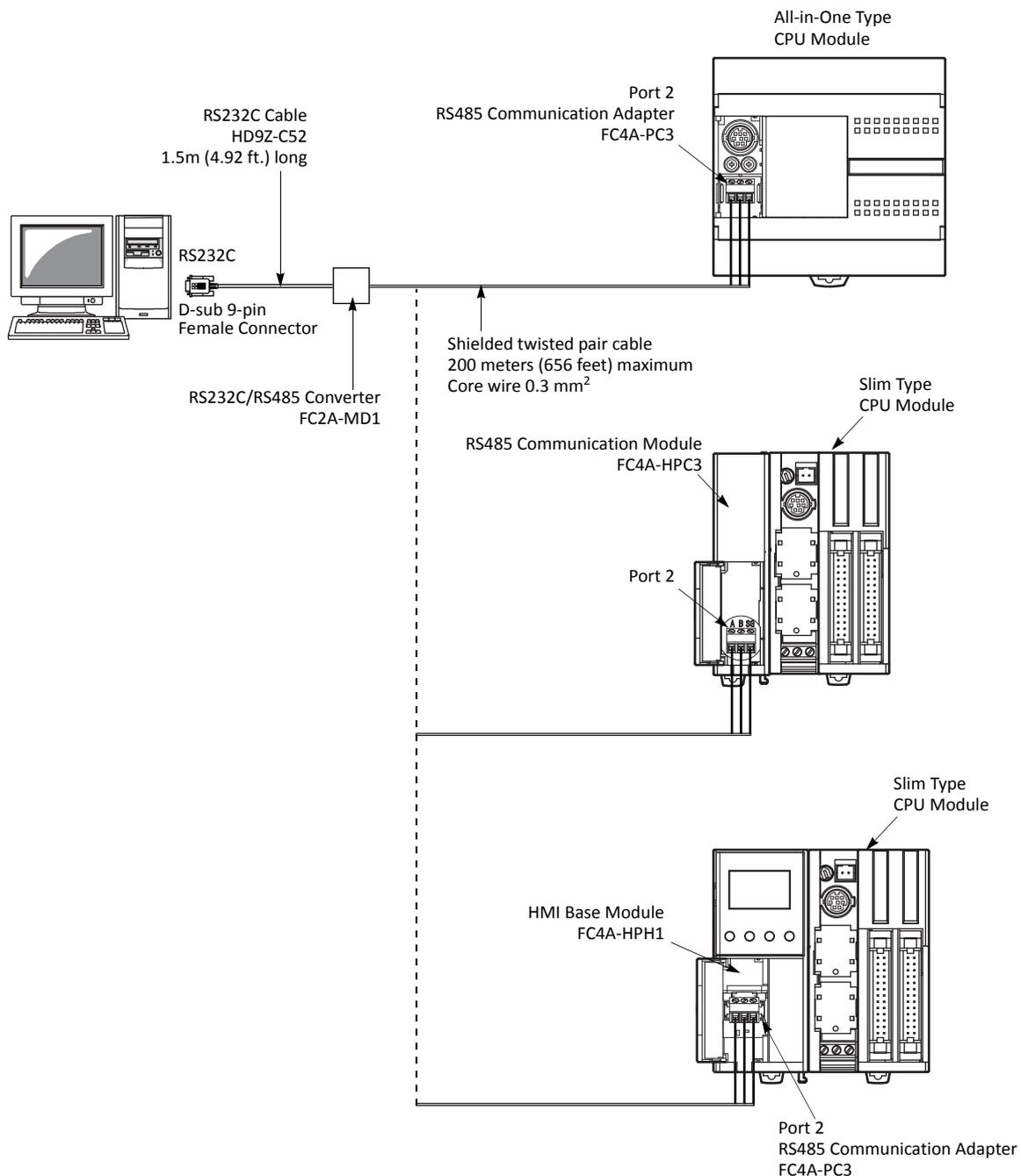
Computer Link through Port 2 (RS485)

When connecting a Windows PC to port 2 on the all-in-one type CPU module or slim type CPU module, enable the maintenance protocol for port 2 using the Function Area Settings in WindLDR. See page 21-2 (Advanced Vol.).

To set up a 1:1 computer link system using the all-in-one type CPU module, install an optional RS485 communication adapter (FC4A-PC3) to the port 2 connector. Connect a PC to the RS232C/RS485 converter (FC2A-MD1) using the RS232C cable (HD9Z-C52). Connect the RS232C/RS485 converter to the CPU module using a shielded twisted pair cable. The RS232C/RS485 converter is powered by a 24V DC source or an AC adapter with 9V DC output. For details about the RS232C/RS485 converter, see page 21-4 (Advanced Vol.).

To set up a 1:1 computer link system using the slim type CPU module, an optional RS485 communication module (FC4A-HPC3) is needed. The RS485 communication adapter can also be installed on the HMI base module (FC4A-HPH1).

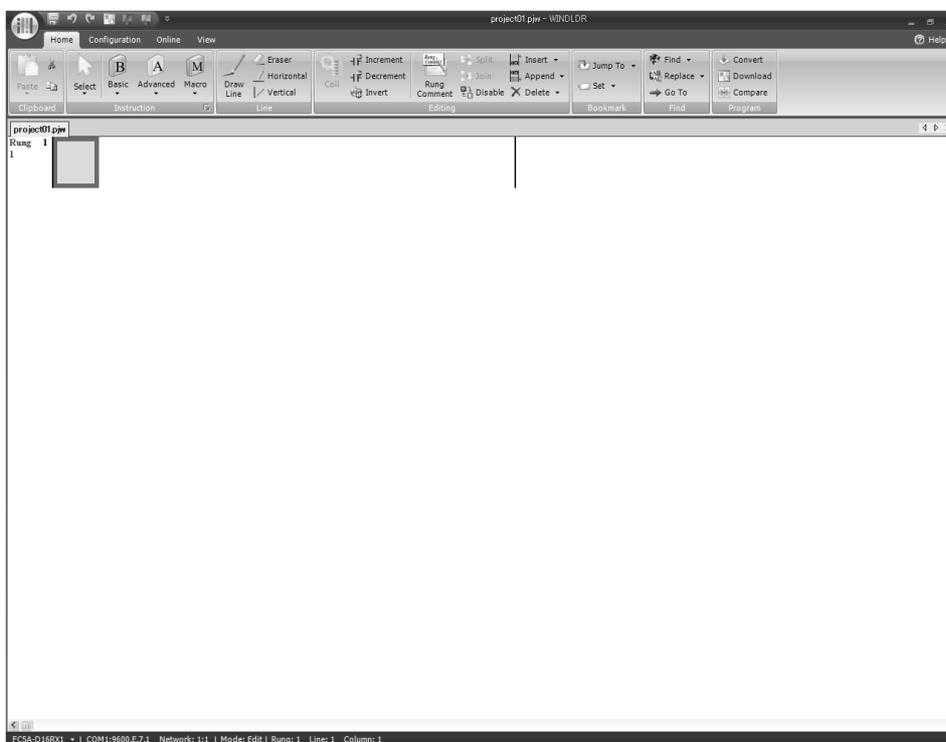
For setting up a 1:N computer link system, see page 21-1 (Advanced Vol.).



Start WindLDR

From the Start menu of Windows, select **Programs > Automation Organizer > WindLDR > WindLDR**.

WindLDR starts and a blank ladder editing screen appears with menus and tool bars shown on top of the screen.

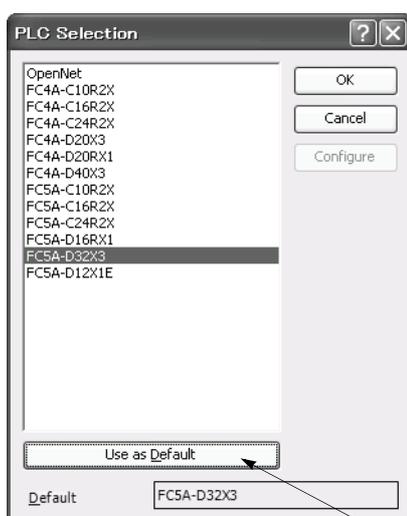


PLC Selection

Before programming a user program on WindLDR, select a PLC type.

1. Select **Configuration** from the WindLDR menu bar, then select **PLC Type**.

The PLC Selection dialog box appears.



PLC Selection Option	MicroSmart CPU Module Type No.
FC5A-C10R2X	FC5A-C10R2 FC5A-C10R2C FC5A-C10R2D
FC5A-C16R2X	FC5A-C16R2 FC5A-C16R2C FC5A-C16R2D
FC5A-C24R2X	FC5A-C24R2 FC5A-C24R2C FC5A-C24R2D
FC5A-D16RX1	FC5A-D16RK1 FC5A-D16RS1
FC5A-D32X3	FC5A-D32K3 FC5A-D32S3
FC5A-D12X1E	FC5A-D12K1E FC5A-D12S1E

2. Select a PLC type in the selection box.
Click **OK** to save the changes.

Press this button, then the same PLC will be selected as default when WindLDR is started next time.

Communication Port Settings for the PC

Depending on the communication port used, select the correct port in WindLDR.

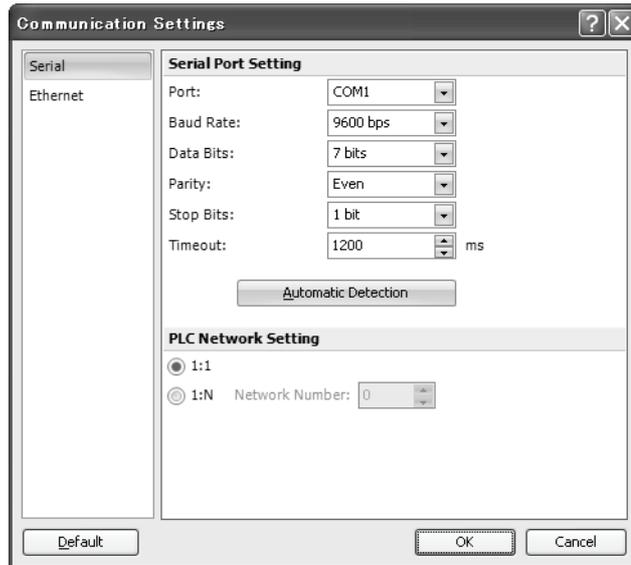
1. Select **Online** from the WindLDR menu bar, then select **Set Up**.

The Communication Settings dialog box appears.

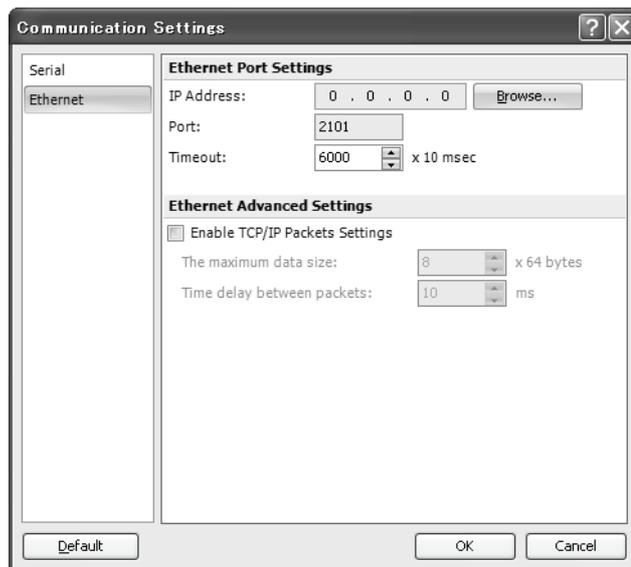
2. Select Serial Port in the Port selection box and click the **Automatic Detection** button.

Click **OK** to save the changes.

- **When Using a COM**



- **When Using Ethernet**



For details about the Ethernet communication settings, see the Web Server user's manual.

Start/Stop Operation

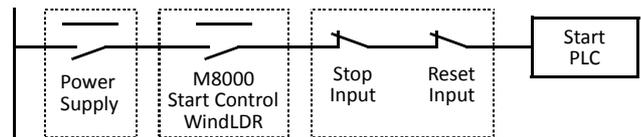
This section describes operations to start and stop the MicroSmart and to use the stop and reset inputs.



Caution • Make sure of safety before starting and stopping the MicroSmart. Incorrect operation on the MicroSmart may cause machine damage or accidents.

Start/Stop Schematic

The start/stop circuit of the MicroSmart consists of three blocks; power supply, M8000 (start control special internal relay), and stop/reset inputs. Each block can be used to start and stop the MicroSmart while the other two blocks are set to run the MicroSmart.



Start/Stop Operation Using WindLDR

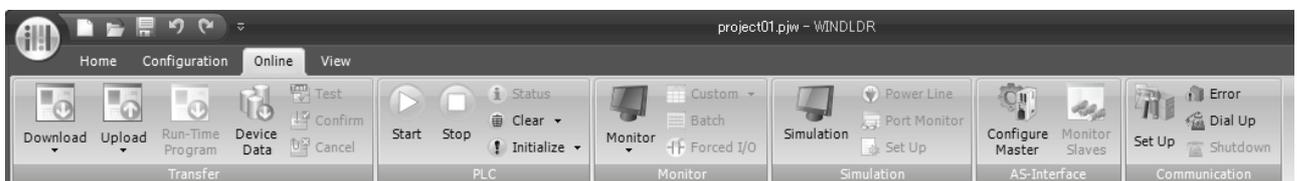
The MicroSmart can be started and stopped using WindLDR run on a Windows PC connected to the MicroSmart CPU module. When the **Start** button is pressed in the menu bar shown below, start control special internal relay M8000 is turned on to start the MicroSmart. When the **Stop** button is pressed, M8000 is turned off to stop the MicroSmart.

1. Connect the PC to the MicroSmart, start WindLDR, and power up the MicroSmart. See page 4-1.
2. Check that a stop input is not designated using **Configuration > Run/Stop Control > Stop and Reset Inputs**. See page 5-2.

Note: When a stop input is designated, the MicroSmart cannot be started or stopped by turning start control special internal relay M8000 on or off.

3. Select **Online** from the WindLDR menu bar.

The Online tab appears.



4. Click the **Start** button to start operation, then the start control special internal relay M8000 is turned on.
5. Click the **Stop** button to stop operation, then the start control special internal relay M8000 is turned off.

The PLC operation can also be started and stopped while WindLDR is in the monitor mode. Select **Online > Monitor > Monitor** and click the **Start** or **Stop** button.

Note: Special internal relay M8000 is a keep type internal relay and stores the status when power is turned off. M8000 retains its previous status when power is turned on again. However, when the backup battery is dead, M8000 loses the stored status, and can be turned on or off as programmed when the MicroSmart is powered up. The selection is made in **Configuration > Run/Stop Control > Run/Stop Selection at Memory Backup Error**. See page 5-3.

The backup duration is approximately 30 days (typical) at 25°C after the backup battery is fully charged.

Start/Stop Operation Using the Power Supply

The MicroSmart can be started and stopped by turning power on and off.

1. Power up the MicroSmart to start operation. See page 4-1.
2. If the MicroSmart does not start, check that start control special internal relay M8000 is on using WindLDR. If M8000 is off, turn it on. See page 4-5.
3. Turn power on and off to start and stop operation.

Note: If M8000 is off, the MicroSmart does not start operation when power is turned on. To start operation, turn power on, and turn M8000 on by clicking the **Start** button in WindLDR.

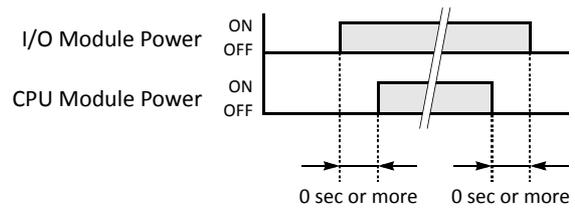
The response time of the MicroSmart at powerup depends on such factors as the contents of the user program, data link usage, and system setup. The table below shows an approximate time delay before starting operation after powerup.

Response time when no data link is used:

Program Size	After powerup, the CPU starts operation in
4,800 bytes (800 steps)	Approx. 0.5 second
15,000 bytes (2,500 steps)	Approx. 1.2 seconds
27,000 bytes (4,500 steps)	Approx. 2 seconds
62,400 bytes (10,400 steps)	Approx. 5 seconds

Order of Powerup and Powerdown

To ensure I/O data transfer, power up the I/O modules first, followed by the CPU module, or power up the CPU and I/O modules at the same time. When shutting down the system, power down the CPU first, followed by I/O modules, or power down the CPU and I/O modules at the same time.



Start/Stop Operation Using Stop Input and Reset Input

Any input terminal available on the CPU module can be designated as a stop or reset input using the Function Area Settings. The procedure for selecting stop and reset inputs is described on page 5-2.

Note: When using a stop and/or reset input to start and stop operation, make sure that start control special internal relay M8000 is on. If M8000 is off, the CPU does not start operation when the stop or reset input is turned off. M8000 is not turned on or off when the stop and/or reset input is turned on or off.

When a stop or reset input is turned on during program operation, the CPU stops operation, the RUN LED is turned off, and all outputs are turned off.

The reset input has priority over the stop input.

System Statuses at Stop, Reset, and Restart

The system statuses during running, stop, reset, and restart after stopping are listed below:

Mode	Output	Internal Relay, Shift Register, Counter, Data Register, Expansion DR, Extra DR		Timer Current Value
		Keep Type	Clear Type	
Run	Operating	Operating	Operating	Operating
Stop (Stop input ON)	OFF	Unchanged	Unchanged	Unchanged
Reset (Reset input ON)	OFF	OFF/Reset to zero	OFF/Reset to zero	Reset to zero
Restart	Unchanged	Unchanged	OFF/Reset to zero	Reset to preset

Note: Expansion data registers are available on slim type CPU modules. All expansion data registers are keep types.

Simple Operation

This section describes how to edit a simple program using WindLDR on a PC, transfer the program from the PC to the MicroSmart, run the program, and monitor the operation on the WindLDR screen.

Connect the MicroSmart to the PC as described on page 4-1.

Sample User Program

Create a simple program using WindLDR. The sample program performs the following operation:

When only input I0 is turned on, output Q0 is turned on.

When only input I1 is turned on, output Q1 is turned on.

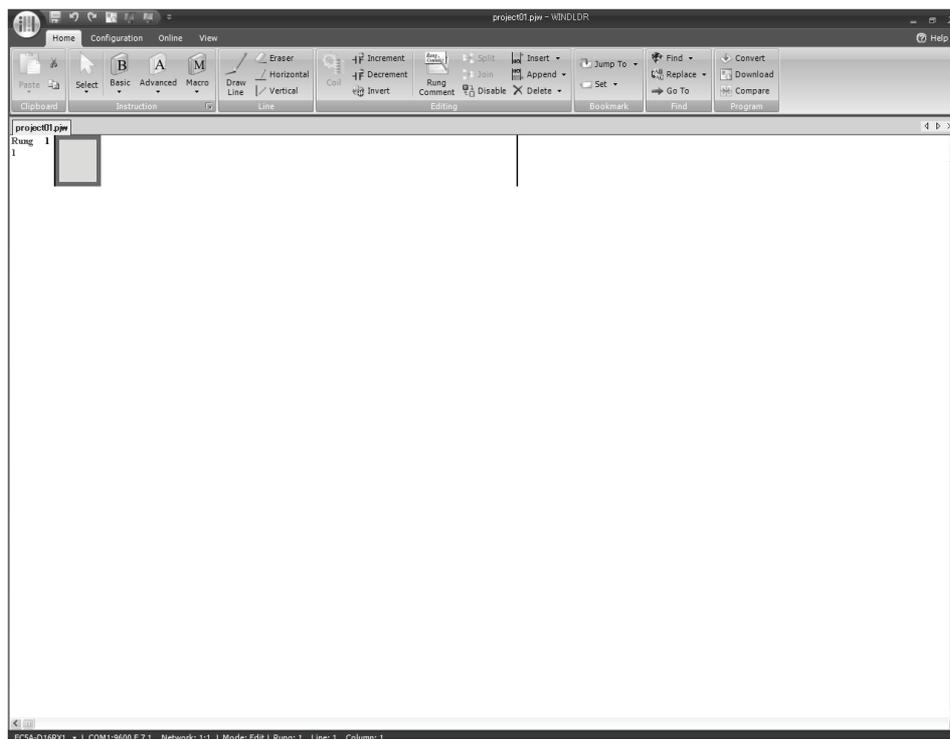
When both inputs I0 and I1 are turned on, output Q2 flashes in 1-sec increments.

Rung No.	Input I0	Input I1	Output Operation
1	ON	OFF	Output Q0 is turned ON.
2	OFF	ON	Output Q1 is turned ON.
3	ON	ON	Output Q2 flashes in 1-sec increments.

Start WindLDR

From the Start menu of Windows, select **Programs > Automation Organizer > WindLDR > WindLDR**.

WindLDR starts and a blank ladder editing screen appears with menus and tool bars shown on top of the screen.

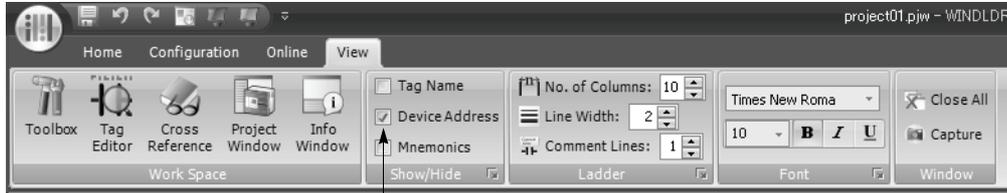


4: OPERATION BASICS

Disable Tag Function

The following example describes a simple procedure without using the tag function.

From the WindLDR menu bar, select **View**, then click the check box of Device Address.

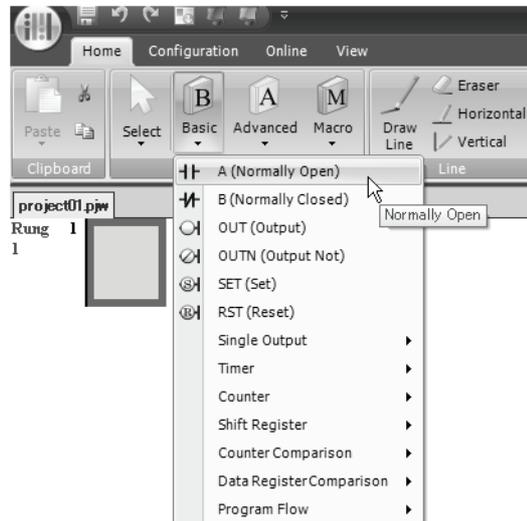


Check the Device Address check box.

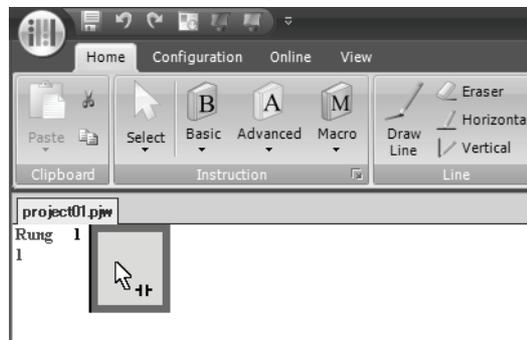
Edit User Program Rung by Rung

Start the user program with the LOD instruction by inserting a NO contact of input I0.

1. From the WindLDR menu bar, select **Home > Basic > A (Normally Open)**.



2. Move the mouse pointer to the first column of the first line where you want to insert a NO contact, and click the left mouse button.



Note: Another method to insert a NO (or NC) contact is to move the mouse pointer where you want to insert the contact, and type A (or B).

The Normally Open dialog box appears.

3. Enter **I0** in the Tag Name field, and click **OK**.



A NO contact of input I0 is programmed in the first column of the first ladder line.

Next, program the ANDN instruction by inserting a NC contact of input I1.

4. From the WindLDR menu bar, select **Home > Basic > B (Normally Closed)**.

5. Move the mouse pointer to the second column of the first ladder line where you want to insert a NC contact, and click the left mouse button.

The Normally Closed dialog box appears.

6. Enter **I1** in the Tag Name field, and click **OK**.

A NC contact of input I1 is programmed in the second column of the first ladder line.

At the end of the first ladder line, program the OUT instruction by inserting a NO coil of output Q0.

7. From the WindLDR menu bar, select **Home > Basic > OUT (Output)**.

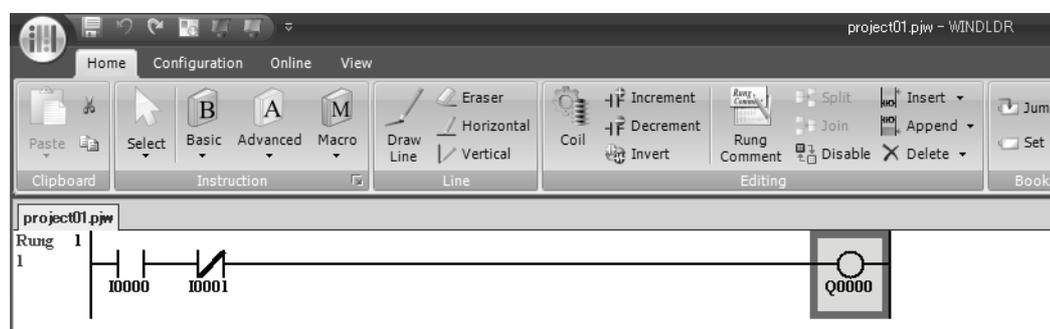
8. Move the mouse pointer to the third column of the first ladder line where you want to insert an output coil, and click the left mouse button.

Note: Another method to insert an instruction (either basic or advanced) is to type the instruction symbol, OUT, where you want to insert the instruction.

The Output dialog box appears.

9. Enter **Q0** in the Tag Name field, and click **OK**.

A NO output coil of output Q0 is programmed in the right-most column of the first ladder line. This completes programming for rung 1.

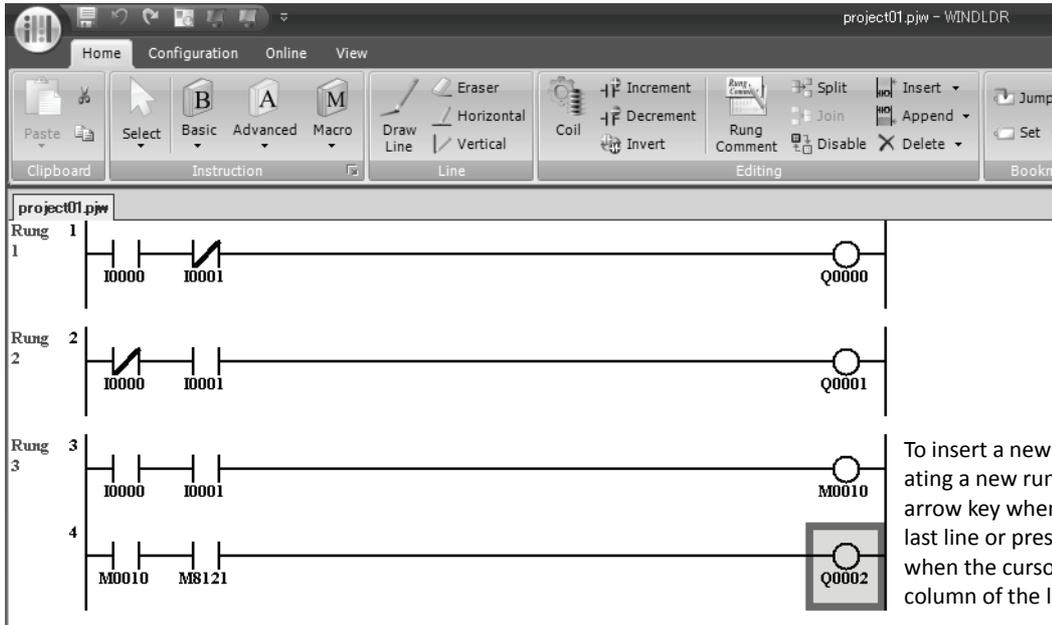


Continue programming for rungs 2 and 3 by repeating similar procedures.

A new rung is inserted by pressing the **Enter** key while the cursor is on the preceding rung. A new rung can also be inserted by selecting **Home > Append > Append a Rung**.

4: OPERATION BASICS

When completed, the ladder program looks like below.



The ladder program can be checked whether it contains any user program syntax error.

10. From the menu bar, select Home > Convert (above Program).

When the instruction symbols are connected correctly, conversion is completed successfully. If any error is found, the errors are listed on the screen. Then, make corrections as necessary.

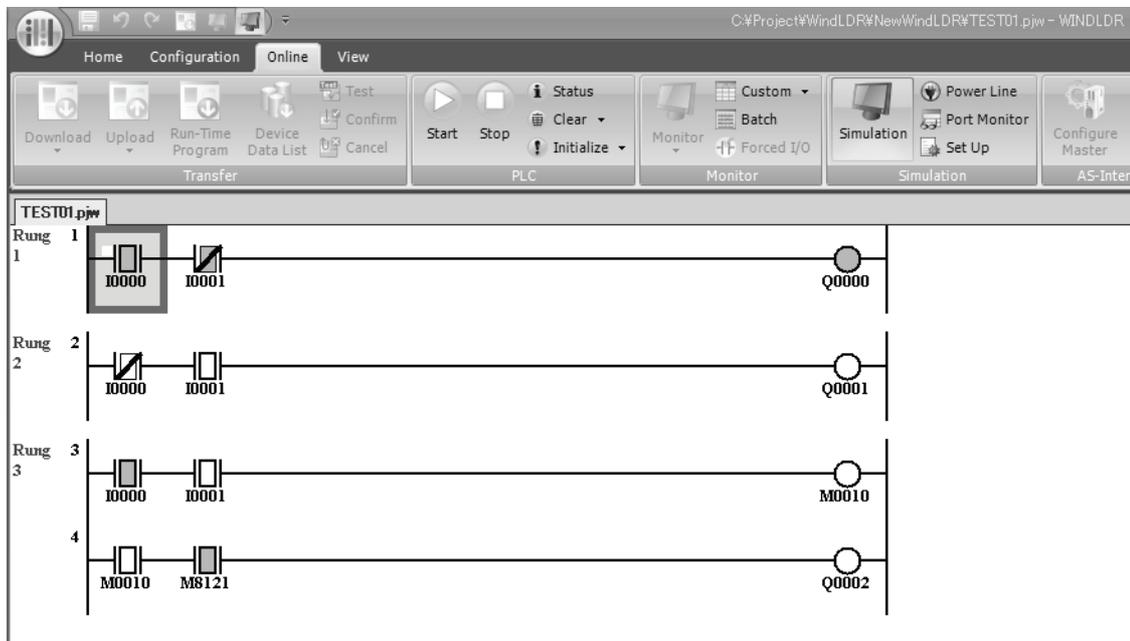
Now, save the file with a new name.

11. Select the WindLDR application button at the upper-left corner of the WindLDR screen, followed by Save, and type TEST01 in the File Name field. Change the Folder or Drive as necessary.

Simulate Operation

Before downloading the user program, you can simulate the operation on the WindLDR screen without connecting the MicroSmart.

From the WindLDR menu bar, select **Online > Simulation**. The Simulation screen appears.



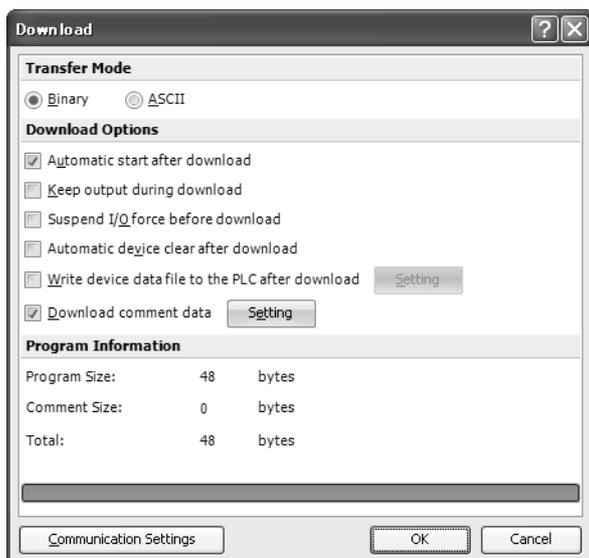
To change an input status, place the mouse pointer on the input and right-click the mouse. In the pop-up menu, select Set or Reset to set or reset the input.

To quit simulation, from the WindLDR menu bar, select **Online > Simulation**.

Download Program

You can download the user program from WindLDR running on a PC to the MicroSmart.

From the WindLDR menu bar, select **Online > Download**. The Download Dialog appears, then click the **OK** button. The user program is downloaded to the MicroSmart.



Note: The Download Dialog is also shown by selecting **Home > Download**.

Note: When downloading a user program, all values and selections in the Function Area Settings are also downloaded to the MicroSmart. For Function Area Settings, see pages 5-1 through 5-44.

Monitor Operation

Another powerful function of WindLDR is to monitor the PLC operation on the PC. The input and output statuses of the sample program can be monitored in the ladder diagram.

From the WindLDR menu bar, select **Online > Monitor > Monitor**.

When both inputs I0 and I1 are on, the ladder diagram on the monitor screen looks as follows:

Rung 1:
When both inputs I0 and I1 are on, output Q0 is turned off.

Rung 2:
When both inputs I0 and I1 are on, output Q1 is turned off.

Rung 3:
When both input I0 and I1 are on, internal relay M10 is turned on.
M8121 is the 1-sec clock special internal relay.
While M10 is on, output Q2 flashes in 1-sec increments.

Quit WindLDR

When you have completed monitoring, you can quit WindLDR either directly from the monitor screen or from the editing screen. In both cases, from the WindLDR application button, click **Exit WindLDR**.

5: SPECIAL FUNCTIONS

Introduction

The MicroSmart features special functions such as stop/reset inputs, run/stop selection at memory backup error, keep designation for internal relays, shift registers, counters, and data registers. These functions are programmed using the Function Area Settings menu. Also included in the Function Area Settings are high-speed counter, catch input, interrupt input, communication protocol selection for port 1 through port 7, input filter, and user program read/write protection.

This chapter describes these special functions. Clock function, analog potentiometer function, memory cartridge, and constant scan features are also described in this chapter.

The Function Area Settings for communication functions are detailed in chapters 10 through 12 (Basic Vol.) and 21 through 25 (Advanced Vol.).

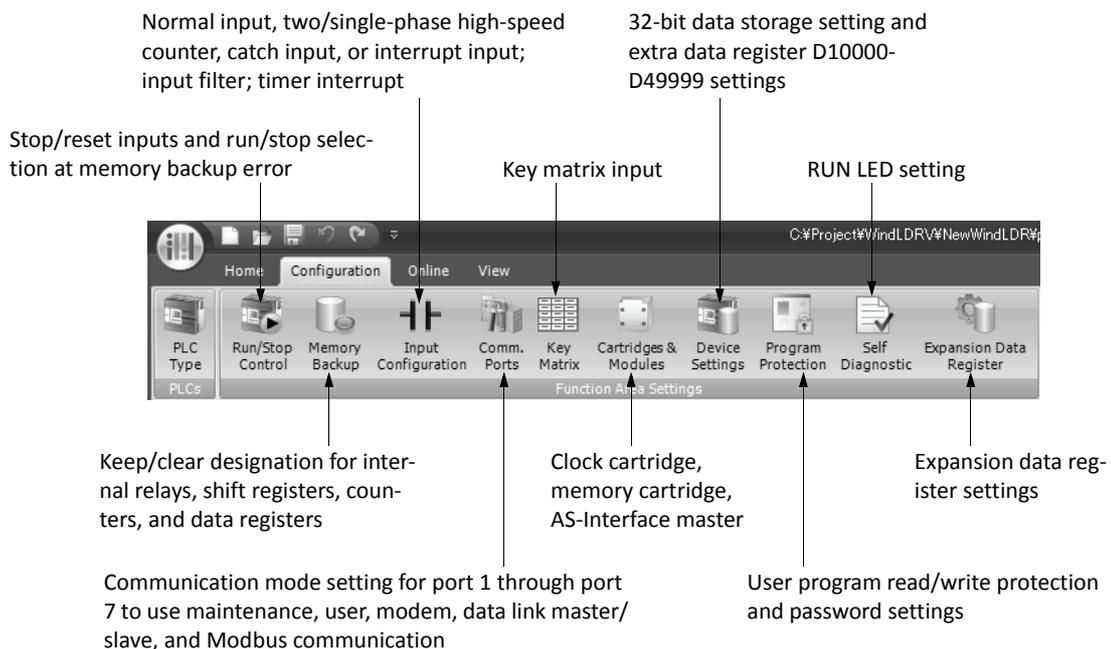


Caution

- Since all Function Area Settings relate to the user program, the user program must be downloaded to the MicroSmart after changing any of these settings.

Function Area Settings

Various special functions are programmed in the Function Area Settings. To call the Function Area Settings dialog box, start WindLDR on a Windows PC. From the WindLDR menu bar, select **Configuration**, then the Function Area Settings menu appears.



Detailed information is described on the following pages.

Stop Input and Reset Input

As described on page 4-5, the MicroSmart can be started and stopped using a stop input or reset input, which can be designated from the Function Area Settings menu. When the designated stop or reset input is turned on, the MicroSmart stops operation. For the system statuses in the stop and reset modes, see page 4-6.

Since these settings relate to the user program, the user program must be downloaded to the MicroSmart after changing any of these settings.

Programming WindLDR

1. From the WindLDR menu bar, select **Configuration > Run/Stop Control**.

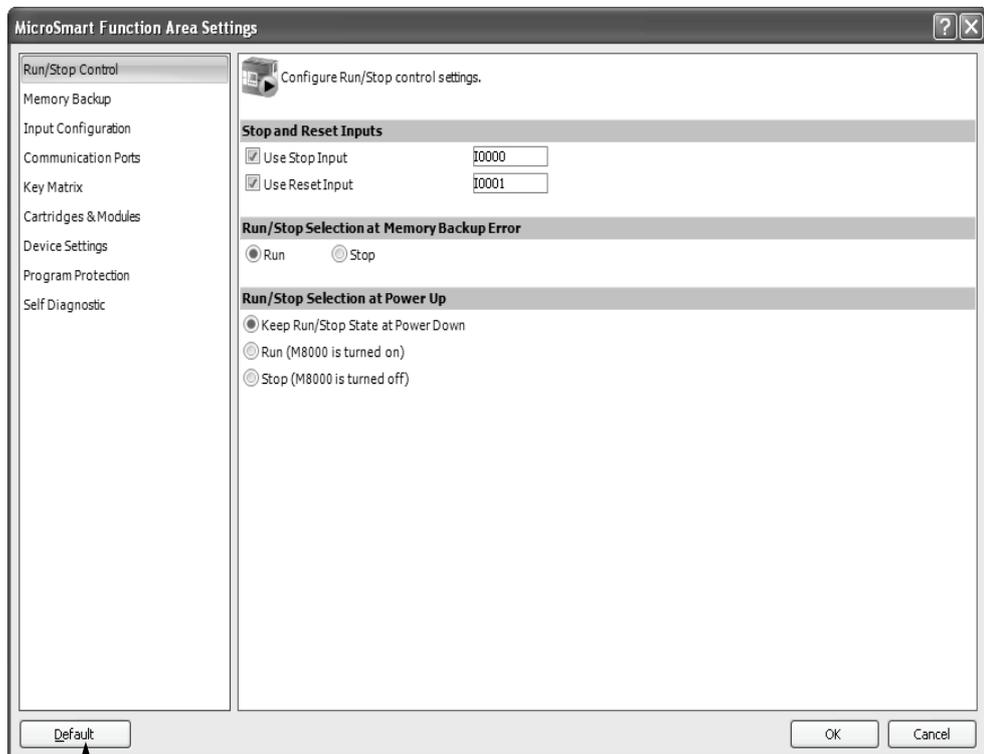
The Function Area Settings dialog box for Run/Stop Control appears.

2. Click the check box under the Stop and Reset Inputs.

Stop Input: Click the check box on the left of Use Stop Input and type a desired input number available on the CPU module in the Stop Input field.

Reset Input: Click the check box on the left of Use Reset Input and type a desired reset number available on the CPU module in the Reset Input field.

This example designates input I0 as a stop input and input I1 as a reset input.



Resets all Function Area Settings values to defaults.

Default: No stop and reset inputs are designated.

3. Click the **OK** button.

Run/Stop Selection at Memory Backup Error

Start control special internal relay M8000 maintains its status when the CPU is powered down. After the CPU has been off for a period longer than the battery backup duration, the data designated to be maintained during power failure is broken. The Run/Stop Selection at Memory Backup Error dialog box is used to select whether to start or stop the CPU when attempting to restart operation after the “keep” data in the CPU RAM has been lost.

When memory backup error occurs, Run/Stop Selection at Memory Backup Error is preferred than Run/Stop Selection at Power Up.

When a built-in lithium battery is fully charged, data of internal relays, shift registers, counters, and data registers stored in the RAM are maintained for approximately 30 days.

Since this setting relates to the user program, the user program must be downloaded to the MicroSmart after changing this setting.

Programming WindLDR

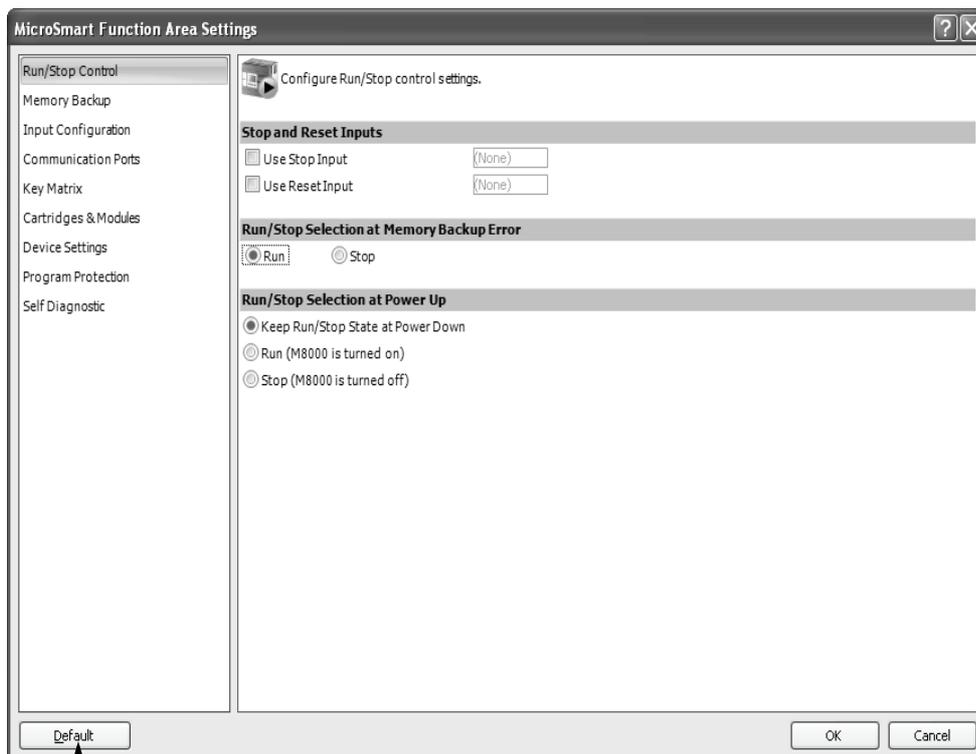
1. From the WindLDR menu bar, select **Configuration > Run/Stop Control**.

The Function Area Settings dialog box for Run/Stop Control appears.

2. Click the Run or Stop button.

Run (Default): Click the button on the left to start the CPU at memory backup error.

Stop: Click the button on the right to stop the CPU when attempting to start at memory backup error. When the CPU does not start because of the Stop selection, the CPU can not be started alone, then the CPU can still be started by sending a start command from WindLDR to turn on start control special internal relay M8000. For start/stop operation, see page 4-5.



Resets all Function Area Settings values to defaults.

3. Click the **OK** button.

Run/Stop Selection at Power Up

Start control special internal relay M8000 maintains its status when the CPU module is powered down. When powered up, the CPU module is started or stopped according to the M8000 status. The Run/Stop Selection at Power Up is used to select whether to start or stop the CPU module regardless of the M8000 status when the CPU is powered up.

When a memory cartridge is installed on a CPU module, the CPU module is started or stopped according to the M8000 status of the CPU module. The CPU module can always be started regardless of the M8000 status by using Run/Stop Selection at Power Up. WindLDR software is not needed to start the CPU module.

Stop and Reset inputs have priority over start control special internal relay M8000. When the memory backup error occurs, the CPU module is started or stopped according to Run/Stop Selection at Memory Backup Error regardless of Run/Stop Selection at Power Up. For start/stop operation, see page 4-5.

Since this settings relate to the user program, the user program must be downloaded to the MicroSmart after changing this settings.

The Run/Stop Selection at Power Up can be used with the CPU module system program version 220 or higher.

Programming WindLDR

1. From the WindLDR menu bar, select **Configuration > Run/Stop Control**.

The Function Area Settings dialog box for Run/Stop Control appears.

2. Click the button under Run/Stop Selection at Power Up.

Keep Run/Stop State at Power Down (Default)

Click this button to keep the run/stop status at power down when the CPU module is powered up.

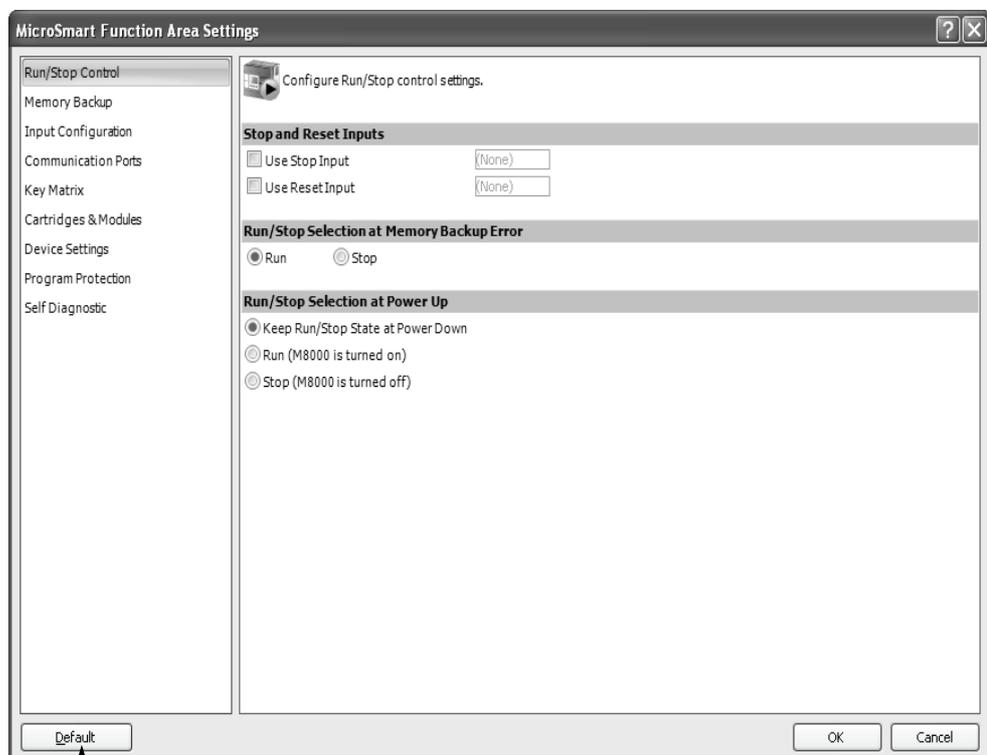
Run (M8000 is turned on):

Click this button to always start the CPU module when the CPU module is powered up.

Stop (M8000 is turned off):

Click this button to always stop the CPU module when the CPU module is powered up.

This example designates Keep Run/Stop Status at Power Down.



Resets all Function Area Settings values to defaults.

3. Click the **OK** button.

Keep Designation for Internal Relays, Shift Registers, Counters, and Data Registers

The statuses of internal relays and shift register bits are usually cleared at startup. It is also possible to designate all or a block of consecutive internal relays or shift register bits as “keep” types. Counter current values and data register values are usually maintained at powerup. It is also possible to designate all or a block of consecutive counters and data registers as “clear” types.

When the CPU is stopped, these statuses and values are maintained. When the CPU is reset by turning on a designated reset input, these statuses and values are cleared despite the settings in the Configure Keep/Clear Settings dialog box shown below. The keep/clear settings in this dialog box have effect when restarting the CPU.

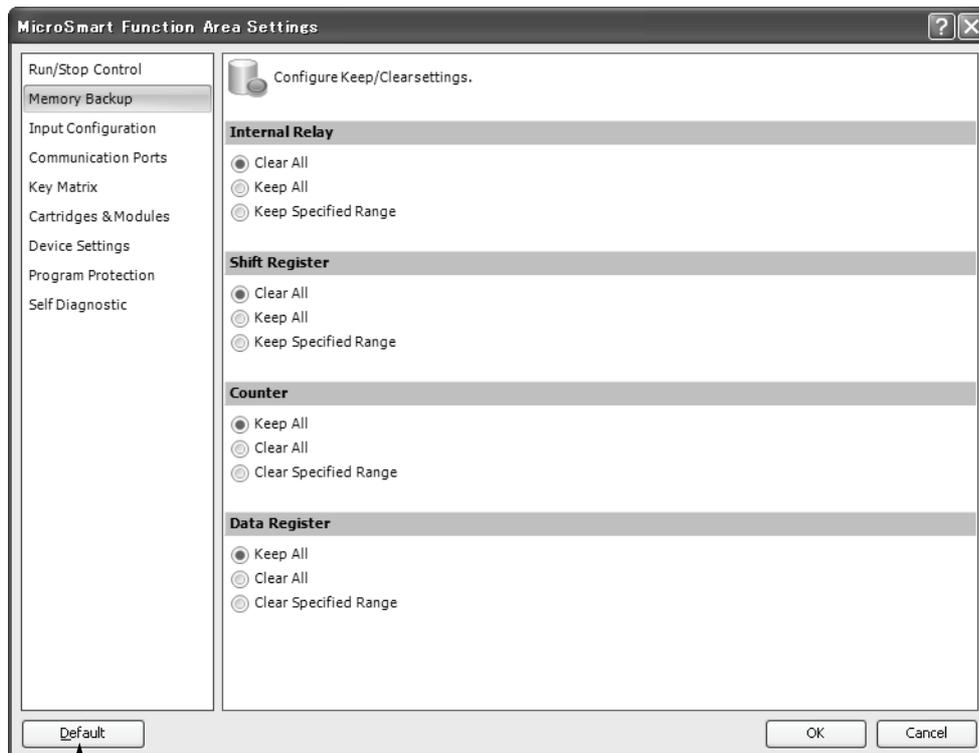
Since these settings relate to the user program, the user program must be downloaded to the MicroSmart after changing any of these settings.

Programming WindLDR

1. From the WindLDR menu bar, select **Configuration > Memory Backup**.

The Function Area Settings dialog box for Configure Keep/Clear Settings appears.

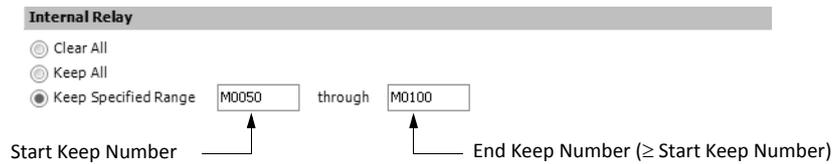
2. Click the buttons under Internal Relay, Shift Register, Counter, and Data Register to clear all, keep all, or keep/clear specified range as required.



Resets all Function Area Settings values to defaults.

Internal Relay ‘Keep’ Designation

- Clear All:** All internal relay statuses are cleared at startup (default).
- Keep All:** All internal relay statuses are maintained at startup.
- Keep Specified Range:** A specified range of internal relays are maintained at startup. Enter the start “keep” number in the left field and the end “keep” number in the right field. The start “keep” number must be smaller than or equal to the end “keep” number.
Valid internal relay numbers are M0 through M2557. Special internal relays cannot be designated.



When a range of M50 through M100 is designated as shown in the example above, M50 through M100 are keep types, M0 through M47 and M101 through M2557 are clear types.

Shift Register ‘Keep’ Designation

- Clear All:** All shift register bit statuses are cleared at startup (default).
- Keep All:** All shift register bit statuses are maintained at startup.
- Keep Specified Range:** A specified range of shift register bits are maintained at startup. Enter the start “keep” number in the left field and the end “keep” number in the right field. The start “keep” number must be smaller than or equal to the end “keep” number.
Valid shift register bit numbers are R0 through R255.
When a range of R17 through R32 is designated, R17 through R32 are keep types, R0 through R16 and R33 through R255 are clear types.

Counter ‘Clear’ Designation

- Keep All:** All counter current values are maintained at startup (default).
- Clear All:** All counter current values are cleared at startup.
- Clear Specified Range:** A specified range of counter current values are cleared at startup. Enter the start “clear” number in the left field and the end “clear” number in the right field. The start “clear” number must be smaller than or equal to the end “clear” number.
Valid counter numbers are C0 through C255.
When a range of C0 through C10 is designated, C0 through C10 are clear types, and C11 through C255 are keep types.

Data Register ‘Clear’ Designation

- Keep All:** All data register values are maintained at startup (default).
- Clear All:** All data register values are cleared at startup.
- Clear Specified Range:** A specified range of data register values are cleared at startup. Enter the start “clear” number in the left field and the end “clear” number in the right field. The start “clear” number must be smaller than or equal to the end “clear” number.
Valid data register numbers are D0 through D1999. Special data registers and expansion data registers cannot be designated. All expansion data registers are keep types.
On slim type CPU modules, extra data registers D10000 through D49999 can be enabled in the Function Area Settings. All extra data registers are keep types.
When a range of D100 through D1999 is designated, D0 through D99 are keep types, and D100 through D1999 are clear types.

High-speed Counter

This section describes the high-speed counter function to count many pulse inputs within one scan. Using the built-in 16-bit high-speed counter, the all-in-one type CPU module counts up to 65,535 high-speed pulses. Using the built-in 32-bit high-speed counter, the slim type CPU module counts up to 4,294,967,295 pulses.

The high-speed counter counts input pulses from a rotary encoder or proximity switch without regard to the scan time, compares the current value with a preset value, and turns on the output when the current value reaches the preset value. This function can be used for simple motor control or to measure lengths of objects.

The all-in-one type CPU modules and slim type CPU modules have different high-speed counter configurations.

CPU Module	All-in One Type CPU Module		
High-speed Counter No.	HSC1		HSC2, HSC3, HSC4
Operation Mode	Single-phase	Two-phase	Single-phase
Counting Mode	Adding counter	1-edge count	Adding counter
Maximum Counting Frequency	50 kHz		5 kHz
Counting Range	0 to 65,535 (16 bits)		
Current Value Comparison	Preset value	Overflow Underflow	Preset value
Comparison Action	Comparison output		
Reset Input	With		Without
Reset Special Internal Relay	With		
Current Value after Reset	0	Reset value	0

CPU Module	Slim Type CPU Module		
High-speed Counter No.	HSC1, HSC4		HSC2, HSC3
Operation Mode	Single-phase	Two-phase	Single-phase
Counting Mode	Adding counter Dual-pulse reversible Up/down selection reversible	1-edge count 2-edge count 4-edge count	Adding counter
Maximum Counting Frequency	100 kHz	1-edge count: 100 kHz 2-edge count: 50 kHz 4-edge count: 25 kHz	100 kHz
Counting Range	0 to 4,294,967,295 (32 bits)		
Current Value Comparison	Preset value 1 Preset value 2 Overflow Underflow		Preset value
Comparison Action	Comparison output Interrupt program		
Reset Input	With		Without
Reset Special Internal Relay	With		
Current Value after Reset	Reset value		0

High-speed counters are programmed in the Function Area Settings in WindLDR and allocated to input terminals I0 through I5 (all-in-one type CPU module) or I7 (slim type CPU module) in four groups. When high-speed counters are used, input terminals in the same group cannot be used for ordinary inputs, catch inputs, or interrupt inputs.

5: SPECIAL FUNCTIONS

High-speed Counters on All-in-One Type CPU Modules

All-in-one type CPU modules have four 16-bit high-speed counters; HSC1 through HSC4, which can count up to 65,535. HSC1 can be used as a single-phase or two-phase 50-kHz high-speed counter. HSC2 through HSC4 are single-phase 5-kHz high-speed counters. All high-speed counter functions are selected using the Function Area Settings in WindLDR.

High-speed Counter Operation Modes and Input Terminals (All-in-One Type CPU Modules)

High-speed counters HSC1 through HSC4 are allocated input terminals as listed in the following table.

High-speed Counter No.	HSC1			HSC2	HSC3	HSC4
Input Terminal (Note 1)	I0	I1	I2	I3	I4	I5
Single-phase High-speed Counter	(Note 2)	Pulse Input	Reset Input (Note 3)	Pulse Input	Pulse Input	Pulse Input
Two-phase High-speed Counter	Phase A	Phase B	Reset Input (Phase Z) (Note 3)	—	—	—

Note 1: When the voltage difference between the input terminal and the COM terminal is 24V DC, the input turns on. Both positive and negative input voltages are accepted.

Note 2: Input I0 can be used as an ordinary input terminal.

Note 3: When a reset input is not used, input I2 can be used as an ordinary input terminal.

Single-phase High-speed Counters HSC1 through HSC4 (All-in-One Type CPU Modules)

HSC1 can be used as a single-phase high-speed counter as well as HSC2 through HSC4. The four single-phase high-speed counters count input pulses to the input terminal allocated to each high-speed counter. When the preset value is reached, a designated comparison output turns on, and the current value is reset to 0 to count subsequent input pulses.

Five special internal relays and two special data registers are assigned to control and monitor each single-phase high-speed counter operation. The current value is stored in a special data register (current value) and is updated every scan. The value stored in another special data register (preset value) is used as a preset value. When a reset input special internal relay is turned on, the current value is reset to 0.

The single-phase high-speed counter is enabled while a gate input special internal relay is on and is disabled while the gate input is off. When the current value reaches the preset value, a special internal relay (comparison ON status) turns on in the next scan. At this point, the current value is reset to 0, and the value stored in a preset value special data register takes effect for the subsequent counting cycle. When a comparison output reset special internal relay is turned on, the designated comparison output is turned off.

In addition, only the single-phase high-speed counter HSC1 has reset input I2 and reset status special internal relay M8130. When reset input I2 is turned on to reset the current value to 0, reset status special internal relay M8130 turns on in the next scan. When reset input special internal relay M8032 is turned on, M8130 does not turn on. See page 5-9.

Special Internal Relays for Single-phase High-speed Counters (All-in-One Type CPU Modules)

Description	High-speed Counter No.				ON	Read/Write
	HSC1	HSC2	HSC3	HSC4		
Comparison Output Reset	M8030	M8034	M8040	M8044	Turns off comparison output	R/W
Gate Input	M8031	M8035	M8041	M8045	Enables counting	R/W
Reset Input	M8032	M8036	M8042	M8046	Resets the current value	R/W
Reset Status	M8130	—	—	—	Current value reset by I2	Read only
Comparison ON Status	M8131	M8133	M8134	M8136	Preset value reached	Read only

Note: Special internal relays M8130, M8131, M8133, M8134, and M8136 go on for only one scan.

Special Data Registers for Single-phase High-speed Counters (All-in-One Type CPU Modules)

Description	High-speed Counter No.				Updated	Read/Write
	HSC1	HSC2	HSC3	HSC4		
High-speed Counter Current Value	D8045	D8047	D8049	D8051	Every scan	Read only
High-speed Counter Preset Value	D8046	D8048	D8050	D8052	—	R/W

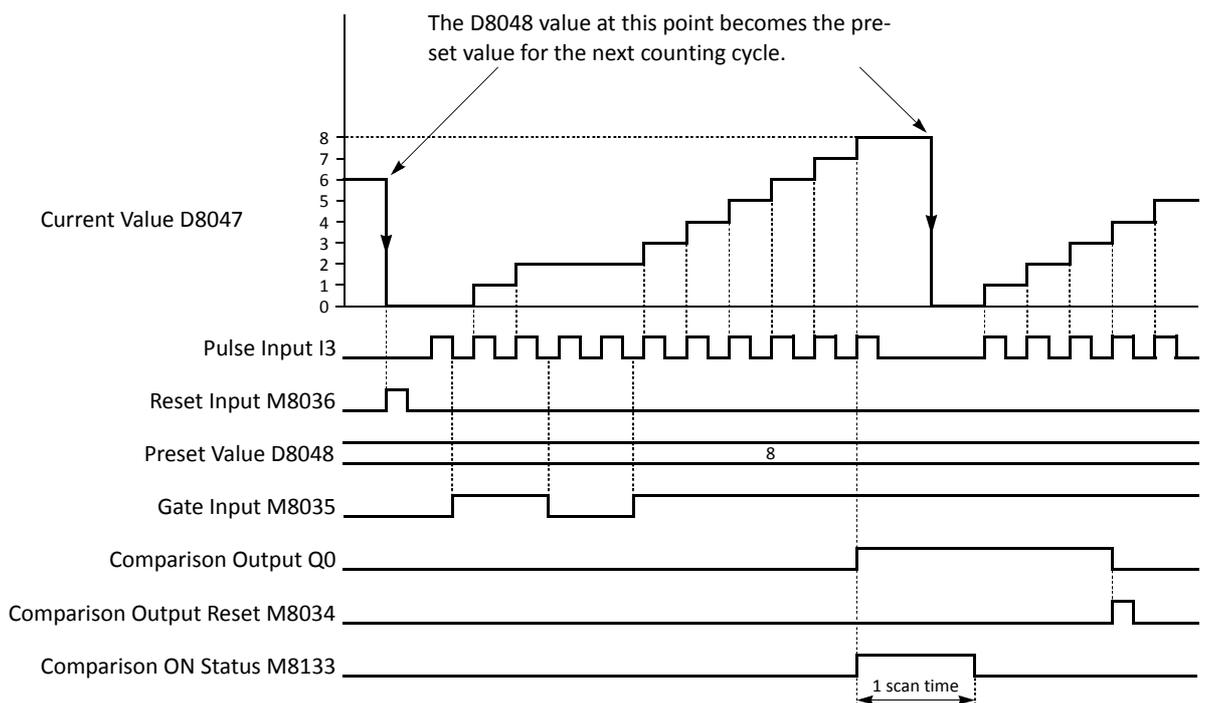
Single-phase High-speed Counter Functions (All-in-One Type CPU Modules)

Counting Mode	Adding counter
Maximum Counting Frequency	HSC1: 50 kHz HSC2 through HSC4: 5 kHz
Counting Range	0 to 65535 (16 bits)
Gate Control	Enable/disable counting
Current Value Reset	Current value is reset to 0 when the current value reaches the preset value or when reset input I2 (HSC1 only) or a reset input special internal relay is turned on.
Status Relays	Special internal relays for indicating high-speed counter statuses.
Comparison Output	Any output number available on the CPU module can be designated as a comparison output which turns on when the current value reaches the preset value. Output numbers on expansion output or mixed I/O modules cannot be designated as a comparison output.

Single-phase High-speed Counter Timing Chart

Example: Single-phase high-speed counter HSC2

Preset value is 8. Q0 is designated as a comparison output.



- When reset input M8036 is turned on, the D8047 current value is cleared to 0, then the D8048 preset value takes effect for the next counting cycle.
- While gate input M8035 is on, single-phase high-speed counter HSC2 counts pulse inputs to input I3.
- The D8047 current value is updated every scan.
- When the D8047 current value reaches the D8048 preset value, comparison ON status M8133 goes on for one scan. At the same time, comparison output Q0 turns on and remains on until comparison output reset M8034 is turned on.
- When the D8047 current value reaches the D8048 preset value, the D8048 preset value at that point takes effect for the next counting cycle.

5: SPECIAL FUNCTIONS

Two-phase High-speed Counter HSC1 (All-in-One Type CPU Modules)

Two-phase high-speed counter HSC1 operates in the rotary encoder mode, and counts up or down input pulses to input terminals I0 (phase A) and I1 (phase B). When the current value overflows 65535 or underflows 0, a designated comparison output turns on. Any output terminal available on the CPU module can be designated as a comparison output. When input I2 (reset input) is turned on, the current value is reset to a predetermined reset value, and the two-phase high-speed counter counts subsequent input pulses starting at the reset value.

Six special internal relays and two special data registers are assigned to control and monitor the two-phase high-speed counter operation. The current value is stored in data register D8045 (current value) and is updated every scan. The value stored in D8046 (reset value) is used as a reset value. When a high-speed counter reset input (I2 or M8032) is turned on, the current value in D8045 is reset to the value stored in D8046.

The two-phase high-speed counter is enabled while gate input special internal relay M8031 is on and is disabled while M8031 is off. When current value overflow or underflow occurs while counting up or down, special internal relay M8131 or M8132 turns on in the next scan, respectively. At this point, the D8045 current value is reset to the D8046 reset value for the subsequent counting cycle. When comparison output reset special internal relay M8030 is turned on, the designated comparison output is turned off. When reset input I2 is turned on to reset the current value, reset status special internal relay M8130 turns on in the next scan. When reset input special internal relay M8032 is turned on, M8130 does not turn on. See page 5-11.

Special Internal Relays for Two-phase High-speed Counter (All-in-One Type CPU Modules)

Description	High-speed Counter No.				ON	Read/Write
	HSC1	HSC2	HSC3	HSC4		
Comparison Output Reset	M8030	—	—	—	Turns off comparison output	R/W
Gate Input	M8031	—	—	—	Enables counting	R/W
Reset Input	M8032	—	—	—	Resets the current value	R/W
Reset Status	M8130	—	—	—	Current value reset by I2	Read only
Current Value Overflow	M8131	—	—	—	Overflow occurred	Read only
Current Value Underflow	M8132	—	—	—	Underflow occurred	Read only

Note: Special internal relays M8130 through M8132 go on for only one scan.

Special Data Registers for Two-phase High-speed Counter (All-in-One Type CPU Modules)

Description	High-speed Counter No.				Updated	Read/Write
	HSC1	HSC2	HSC3	HSC4		
High-speed Counter Current Value	D8045	—	—	—	Every scan	Read only
High-speed Counter Reset Value	D8046	—	—	—	—	R/W

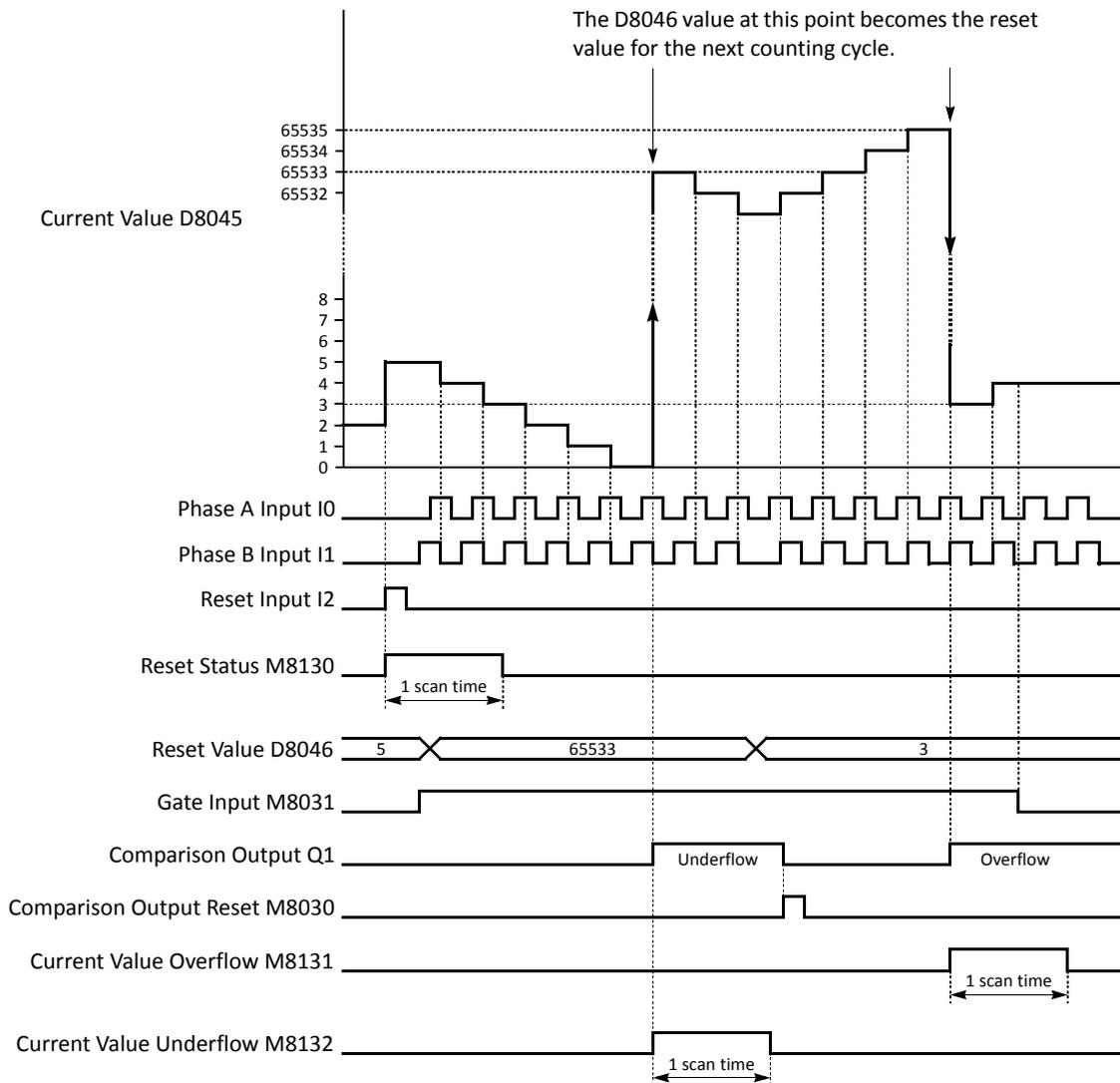
Two-phase High-speed Counter Functions (All-in-One Type CPU Modules)

Counting Mode	1-edge count (phases A, B, Z)
Maximum Counting Frequency	50 kHz
Counting Range	0 to 65535 (16 bits)
Gate Control	Enable/disable counting
Current Value Reset	Current value is reset to a given value when the current value overflows 65535 or underflows 0, or when reset input I2 or reset input special internal relay M8032 is turned on.
Control/Status Relays	Special internal relays are provided to control and monitor the high-speed counter operation.
Comparison Output	Any output number available on the CPU module can be designated as a comparison output which turns on when current value overflow or underflow occurs. Output numbers on expansion output or mixed I/O modules cannot be designated as a comparison output.

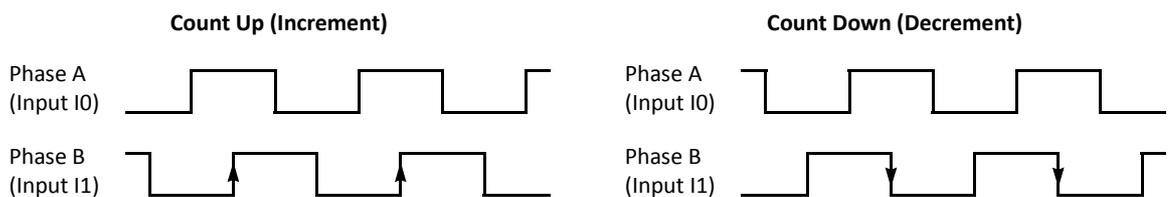
Two-phase High-speed Counter Timing Chart

Example: Two-phase high-speed counter HSC1

Reset input I2 is used. Q1 is designated as a comparison output.



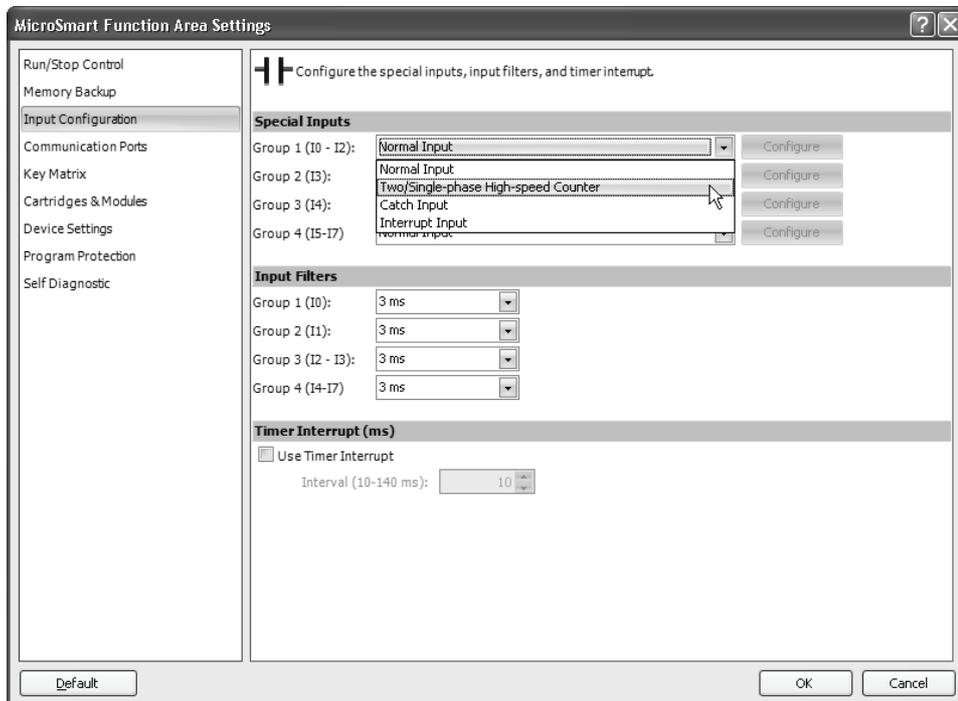
- When reset input I2 is turned on, the D8046 reset value is set to the D8045 current value, then reset status M8130 turns on for one scan. If reset input M8032 is turned on, reset status M8130 does not turn on.
- While gate input M8031 is on, the two-phase high-speed counter counts up or down depending on the phase difference between phase A (input I0) and phase B (input I1).



Programming WindLDR (All-in-One Type CPU Modules)

1. From the WindLDR menu bar, select **Configuration > Input Configuration**.

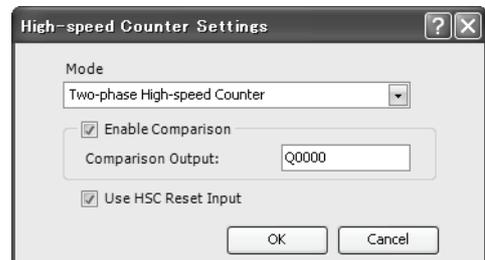
The Function Area Settings dialog box for Input Configuration appears.



2. When using high-speed counter HSC1, select **Two/Single-phase High-speed Counter** in the Group 1 pull-down list box.

When using high-speed counters HSC2 through HSC4, select **Single-phase High-speed Counter** in the Groups 2 through 4 pull-down list boxes.

The High-speed Counter Settings dialog box appears.



Mode

Select **Two-phase High-speed Counter** or **Single-phase High-speed Counter** for HSC1. Only Single-phase High-speed Counter is available for HSC2 through HSC4.

Enable Comparison

Click the check box to enable the high-speed counter comparison output, and specify an output number available on the CPU module in the **Comparison Output** field. When the preset value is reached (single-phase high-speed counter) or when current value overflow or underflow occurs (two-phase high-speed counter), the specified comparison output is turned on and remains on until a comparison output reset special internal relay (M8030, M8034, M8040, or M8044) is turned on.

Use HSC Reset Input

Click the check box to enable high-speed counter reset input I2 for HSC1 only. When input I2 is turned on, the current value in D8045 is reset depending on the high-speed counter mode.

CPU Module	Comparison Output
FC5A-C10R2/C/D	Q0 to Q3
FC5A-C16R2/C/D	Q0 to Q6
FC5A-C24R2/C/D	Q0 to Q7, Q10 to Q11

Single-phase	The current value is reset to 0. The value stored in D8046 (high-speed counter preset value) at this point takes effect for the subsequent counting cycle.
Two-phase	The current value is reset to the value stored in D8046 (high-speed counter reset value). The two-phase high-speed counter counts subsequent input pulses starting at the reset value.

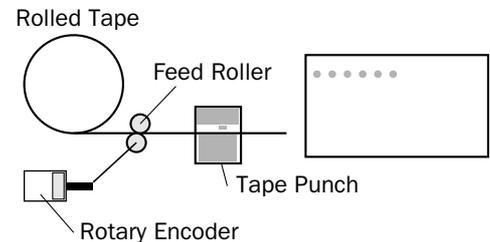
Since these settings relate to the user program, the user program must be downloaded to the MicroSmart after changing any of these settings.

Example: Two-phase High-speed Counter on All-in-One Type CPU Module

This example demonstrates a program for two-phase high-speed counter HSC1 to punch holes in a paper tape at regular intervals.

Description of Operation

A rotary encoder is linked to the tape feed roller directly, and the output pulses from the rotary encoder are counted by the two-phase high-speed counter in the MicroSmart CPU module. When the high-speed counter counts 2,700 pulses, the comparison output is turned on. When the comparison output is turned on, the high-speed counter continues another cycle of counting. The comparison output remains on for 0.5 second to punch holes in the tape, and is turned off before the high-speed counter counts 2,700 pulses again.

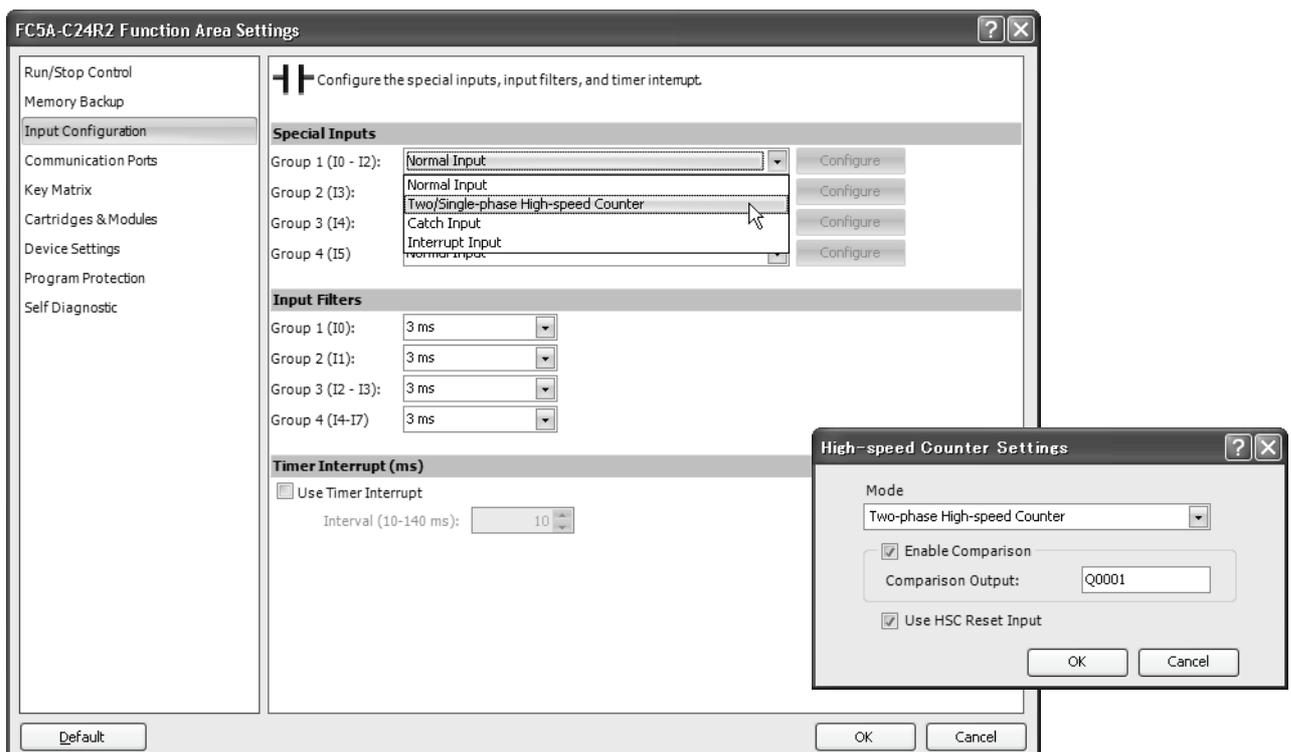


Program Parameters

PLC Selection	FC5A-C24R2
Group 1 (I0 - I2)	Two/Single-phase High-speed Counter
High-speed Counter Settings	Two-phase High-speed Counter
Enable Comparison	Yes
Comparison Output	Q1
Use HSC Reset Input (I2)	No
HSC Reset Value (D8046)	To cause current value overflow every 2700 pulses, store 62836 to D8046 (65535 - 2700 + 1 = 62836)
Timer Preset Value	0.5 sec (needed for punching) programmed in TIM instruction

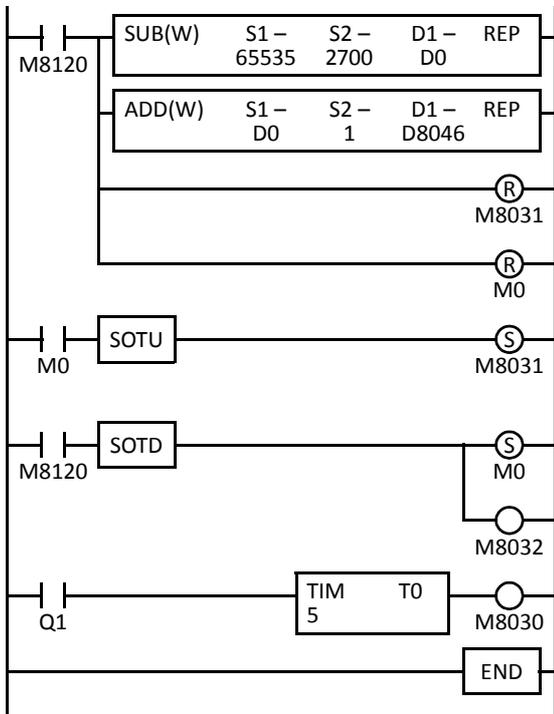
Note: This example does not use the phase Z signal (input I2).

Programming WindLDR



Ladder Diagram

When the MicroSmart starts operation, reset value 62836 is stored to reset value special data register D8046. Gate input special internal relay M8031 is turned on at the end of the third scan to start the high-speed counter to count input pulses.



M8120 is the initialize pulse special internal relay.

1st scan

SUB and ADD instructions are used to store a reset value of 62836 (65535 - 2700 + 1) to D8046 (reset value).

M8031 (gate input) is turned off.

M0 is turned off.

3rd scan

At the rising edge of M0, M8031 (gate input) is turned on. After the END processing of the third scan, HSC1 starts counting.

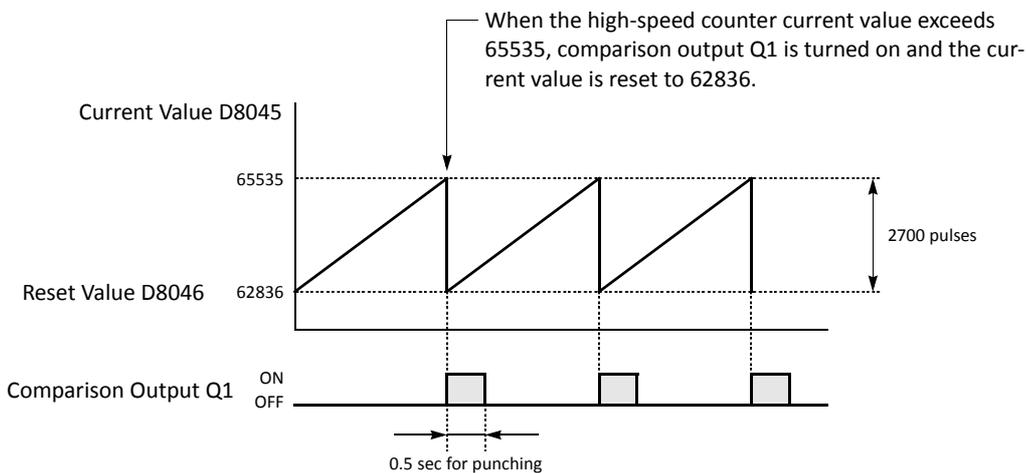
2nd scan

At the falling edge of M8120 (initialize pulse), M0 is turned on. M8032 (reset input) is turned on to initialize HSC1 in the END processing of the second scan.

When HSC1 overflows 65535, output Q1 (comparison output) is turned on to start timer T0. HSC1 starts to repeat counting.

When the timer times out 0.5 sec, M8030 (comparison output reset) is turned on to turn off output Q1.

Timing Chart



High-speed Counters on Slim Type CPU Modules

Slim type CPU modules have four 32-bit high-speed counters, HSC1 through HSC4, which can count up to 4,294,967,295 pulses. HSC1 and HSC4 can be used as a single-phase or two-phase high-speed counter. HSC2 and HSC3 are single-phase high-speed counters. All high-speed counter functions are selected using the Function Area Settings in WindLDR.

High-speed Counter Operation Modes and Input Terminals (Slim Type CPU Modules)

HSC No.	HSC1			HSC2	HSC3	HSC4		
Input Terminal (Note 1)	I0	I1	I2	I3	I4	I5	I6	I7
Single-phase High-speed Counter								
Adding Counter	(Note 2)	Pulse Input	Reset Input (Note 3)	Pulse Input	Pulse Input	Reset Input (Note 3)	(Note 2)	Pulse Input
Dual-pulse Reversible Counter	Down Pulse	Up Pulse	Reset Input (Note 3)	—	—	Reset Input (Note 3)	Down Pulse	Up Pulse
Up/down Selection Reversible Counter	U/D Selection	Pulse Input	Reset Input (Note 3)	—	—	Reset Input (Note 3)	U/D Selection	Pulse Input
Two-phase High-speed Counter								
1-edge Count 2-edge Count 4-edge Count	Phase A	Phase B	Reset Input (Phase Z) (Note 3)	—	—	Reset Input (Phase Z) (Note 3)	Phase A	Phase B

Note 1: When the voltage difference between the input terminal and the COM terminal is 24V DC, the input turns on. Both positive and negative input voltages are accepted.

Note 2: In the single-phase high-speed counter, inputs I0 and I6 are used for dual-pulse reversible counters and up/down selection reversible counters. When adding counter is selected, inputs I0 and I6 can be used as ordinary input terminals.

Note 3: When a reset input is not used, inputs I2 and I5 can be used as an ordinary input terminal.

Single-phase High-speed Counters HSC1 through HSC4 (Slim Type CPU Modules)

Single-phase counters include three modes; adding counter, dual-pulse reversible counter, and up/down selection reversible counter. All high-speed counters HSC1 through HSC4 can be used as adding counters. HSC1 and HSC4 can also be used as a dual-pulse reversible counter and an up/down selection reversible counter.

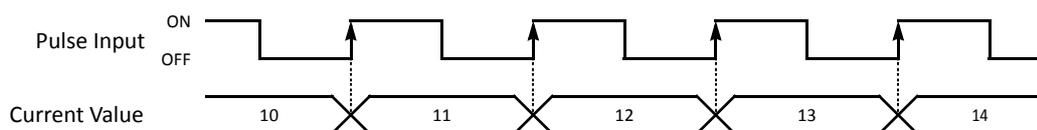
Adding Counter

The four adding counters count input pulses to the input terminal allocated to each high-speed counter.

HSC1 and HSC4 can designate two preset values: preset value 1 and preset value 2. When the current value reaches preset value 1, a designated comparison output turns on or program execution jumps to a designated tag. At this point, the current value can be designated to keep counting subsequent input pulses or to be reset to the reset value and restart another counting cycle. When “Keep Current Value” is designated, the current value continues to increase up to preset value 2, then another comparison output can be turned on or program execution jumps to a designated tag. Similarly, when “Keep Current Value” is designated for preset value 2, the current value continues to increase up to 4,294,967,295. At this point, another comparison output can be turned on or program execution jumps to a designated tag, and the current value is reset to the reset value.

HSC2 and HSC3 can designate one preset value. When the preset value is reached, a designated comparison output turns on or program execution jumps to a designated tag, and the current value is reset to 0 to start another counting cycle.

• Single-phase Adding Counter Operation Chart



When the pulse input turns on, the current value increments.

Dual-pulse Reversible Counter

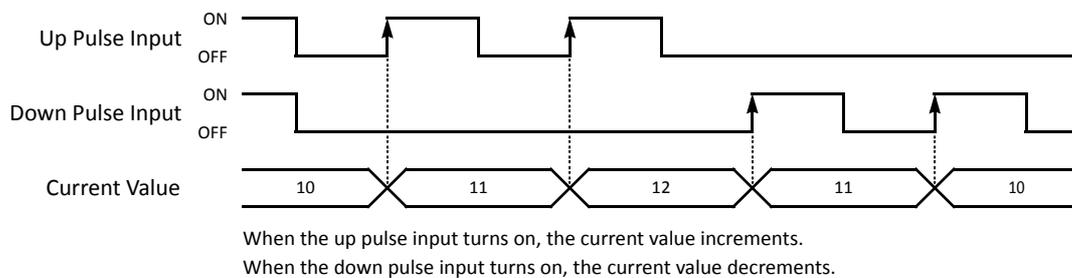
HSC1 and HSC4 can also be used as dual-pulse reversible counters to increment or decrement the current value when receiving input pulses to the up pulse input terminal or the down pulse input terminal, respectively.

5: SPECIAL FUNCTIONS

Current value comparison and comparison actions are similar to the HSC1 and HSC4 adding counters. In addition, the dual pulse reversible counters have another comparison of the current value to 0. When the current value decreases down to 0, another comparison output can be turned on or program execution jumps to a designated tag, and the current value is reset to the reset value.

When the current value decrements and reaches preset value 1 or 2, the comparison action occurs similarly, turning on the comparison output or jumping to a designated tag.

• Single-phase Dual-pulse Reversible Counter Operation Chart

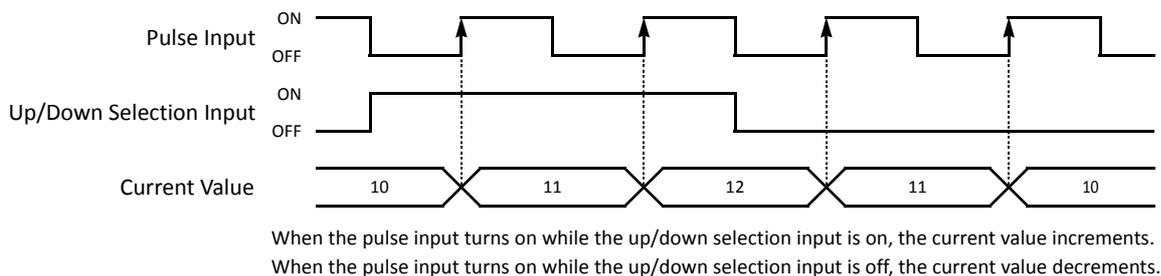


Up/down Selection Reversible Counter

HSC1 and HSC4 can also be used as up/down selection reversible counters to increment or decrement the current value when receiving input pulses to the pulse input terminal depending on the up/down selection input status.

Current value comparison and comparison actions are the same as the HSC1 and HSC4 dual-pulse reversible counters.

• Single-phase Up/down Selection Reversible Counter Operation Chart



Eight special internal relays and eight special data registers are assigned to control and monitor each single-phase high-speed counter operation. The current value is stored in two special data registers (current value) and is updated every scan. The value stored in another two special data registers (preset value) is used as a preset value. When a reset input special internal relay is turned on, the current value is reset to the reset value (HSC1 and HSC4) or 0 (HSC2 and HSC3). HSC1 and HSC4 can set two preset values.

The single-phase high-speed counter is enabled while a gate input special internal relay is on and is disabled while the gate input is off. When the current value reaches the preset value, a special internal relay (comparison ON status) turns on in the next scan. At this point, the current value is reset to the reset value (HSC1 and HSC4) or 0 (HSC2 and HSC3), and the value stored in preset value special data registers takes effect for the subsequent counting cycle. If HSC1 or HSC4 is set to keep the current value when the current value reaches the first preset value, HSC1 or HSC4 continues counting until the current value reaches the second preset value. When a comparison output reset special internal relay is turned on, the designated comparison output is turned off.

In addition, only the single-phase high-speed counter HSC1 or HSC4 has reset input I2 or I5 and reset status special internal relay M8130 or M8135. When reset input I2 or I5 is turned on to reset the current value, reset status special internal relay M8130 or M8135 turns on in the next scan. When reset input special internal relay M8032 or M8046 is turned on, M8130 or M8135 does not turn on. See page 5-18.

Special Internal Relays for Single-phase High-speed Counters (Slim Type CPU Modules)

Description	High-speed Counter No.				ON	Read/Write
	HSC1	HSC2	HSC3	HSC4		
Comparison Output Reset	M8030	M8034	M8040	M8044	Turns off comparison output	R/W
Gate Input	M8031	M8035	M8041	M8045	Enables counting	R/W
Reset Input	M8032	M8036	M8042	M8046	Resets the current value	R/W
Reset Status	M8130	—	—	M8135	Current value reset by I2 or I5	Read only
Comparison 1 ON Status	M8131	M8133	M8134	M8136	Preset value 1 reached	Read only
Comparison 2 ON Status	M8132	—	—	M8137	Preset value 2 reached	Read only
Current Value Overflow	M8161	—	—	M8163	Overflow occurred	Read only
Current Value Underflow	M8162	—	—	M8164	Underflow occurred	Read only

Note: Special internal relays M8130 through M8137 and M8161 through M8164 go on for only one scan.

Special Data Registers for Single-phase High-speed Counters (Slim Type CPU Modules)

Description	High-speed Counter No.				Updated	Read/Write
	HSC1	HSC2	HSC3	HSC4		
Current Value (High Word)	D8210	D8218	D8222	D8226	Every scan	Read only
Current Value (Low Word)	D8211	D8219	D8223	D8227	Every scan	Read only
Preset Value 1 (High Word)	D8212	D8220	D8224	D8228	—	R/W
Preset Value 1 (Low Word)	D8213	D8221	D8225	D8229	—	R/W
Preset Value 2 (High Word)	D8214	—	—	D8230	—	R/W
Preset Value 2 (Low Word)	D8215	—	—	D8231	—	R/W
Reset Value (High Word)	D8216	—	—	D8232	—	R/W
Reset Value (Low Word)	D8217	—	—	D8233	—	R/W

Note: When using the current value, preset value 1, preset value 2, and reset value in advanced instructions, select the data type of double word (D).

Single-phase High-speed Counter Functions (Slim Type CPU Modules)

Counting Mode	HSC1 to HSC4	Adding counter
	HSC1 HSC4	Dual-pulse reversible counter Up/down selection reversible counter
Maximum Counting Frequency	100 kHz	
Counting Range	0 to 4,294,967,295 (32 bits)	
Gate Control	Enable/disable counting	
Current Value Reset	HSC1 HSC4	Current value is reset to the reset value when reset input I2 (HSC1) or I5 (HSC4) is turned on or when a reset input special internal relay M8032 (HSC1) or M8046 (HSC4) is turned on. In addition, when any of current value comparison (preset value 1, preset value 2, overflow, or underflow) is true, the current value can be reset to the reset value. The current value comparison is designated in the Function Area Settings.
	HSC2 HSC3	Current value is reset to 0 when a reset input special internal relay M8036 (HSC2) or M8042 (HSC3) is turned on. In addition, when the current value reaches the preset value, the current value is reset to 0.
Current Value Keep	HSC1 HSC4	When current value comparison for preset value 1 or preset value 2 is true, the current value can also be kept to count subsequent input pulses, without resetting the current value to the reset value.
Status Relays	Special internal relays for indicating high-speed counter statuses.	

5: SPECIAL FUNCTIONS

Comparison Action	Comparison Output	A comparison output turns on when any of current value comparison (preset value 1, preset value 2, overflow, or underflow) is true. Any output number available on the CPU module can be designated as a comparison output. Output numbers on expansion output or mixed I/O modules cannot be designated as a comparison output.
	Interrupt Program	Program execution jumps to a tag when any of current value comparison (preset value 1, preset value 2, overflow, or underflow) is true.

Single-phase High-speed Counter Timing Chart

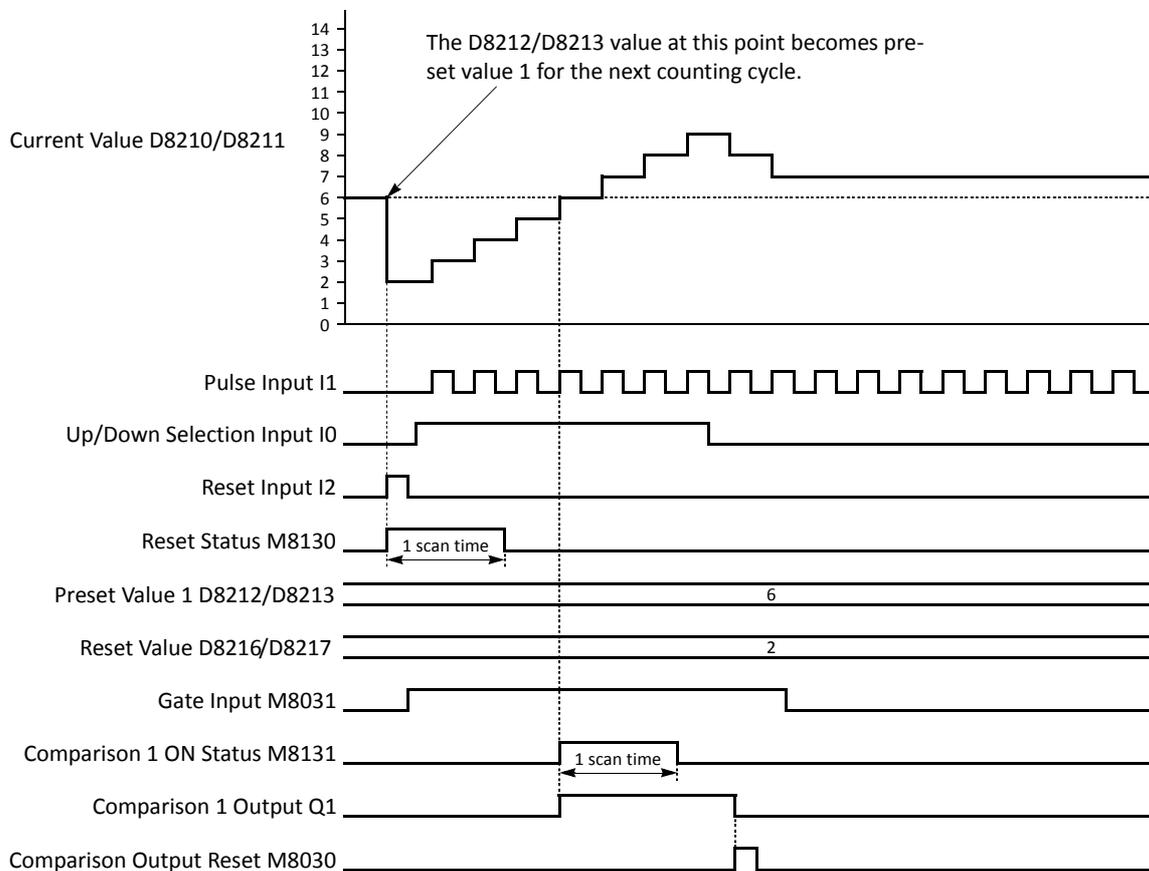
Example: Single-phase high-speed counter HSC1

Operation mode: Up/down selection reversible counter

Preset value 1 is 6.

Q1 is designated as the comparison 1 output.

The current value is maintained when preset value 1 is reached.



- When reset input I2 is turned on, the D8210/D8211 current value is reset to the D8216/D8217 reset value, then the D8212/D8213 preset value 1 takes effect for the next counting cycle.
- While gate input M8031 is on, up/down selection reversible counter HSC1 counts pulse inputs to input I1. While up/down selection input I0 is on, the current value increments. While up/down selection input I0 is off, the current value decrements.
- The current value is updated every scan.
- When the current value reaches the preset value, comparison 1 ON status M8131 goes on for one scan. At the same time, comparison 1 output Q1 turns on and remains on until comparison output reset M8030 is turned on.
- After the current value has reached the preset value, the current value is maintained and the high-speed counter continues to count input pulses as long as the gate input is on.

Two-phase High-speed Counters HSC1 and HSC4 (Slim Type CPU Modules)

Two-phase high-speed counters HSC1 and HSC4 operates in the rotary encoder mode, and counts up or down input pulses to input terminals I0 or I6 (phase A) and I1 or I7 (phase B), respectively.

HSC1 and HSC4 can designate two preset values: preset value 1 and preset value 2. When the current value reaches preset value 1, a designated comparison output turns on or program execution jumps to a designated tag. At this point, the current value can be designated to keep counting subsequent input pulses or to be reset to the reset value and restart another counting cycle. When "Keep Current Value" is designated, the current value continues to increase up to preset value 2, then another comparison output can be turned on or program execution jumps to a designated tag. Similarly, when "Keep Current Value" is designated for preset value 2, the current value continues to increase up to 4,294,967,295. At this point, another comparison output can be turned on or program execution jumps to a designated tag, and the current value is reset to the reset value.

In addition, the two-phase high-speed counters have another comparison of the current value to 0. When the current value decreases down to 0, another comparison output can be turned on or program execution jumps to a designated tag, and the current value is reset to the reset value.

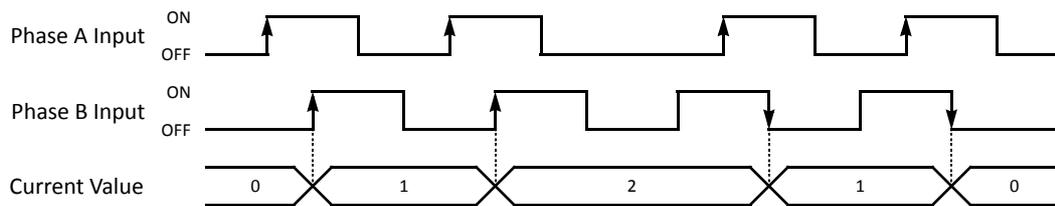
When the current value decrements and reaches preset value 1 or 2, the comparison action occurs similarly, turning on the comparison output or jumping to a designated tag.

The two-phase high-speed counters have three counting modes: 1-edge count, 2-edge count, and 4-edge count.

1-edge Count

The current value increments or decrements at the rising or falling edge of the phase B input after the phase A input has turned on.

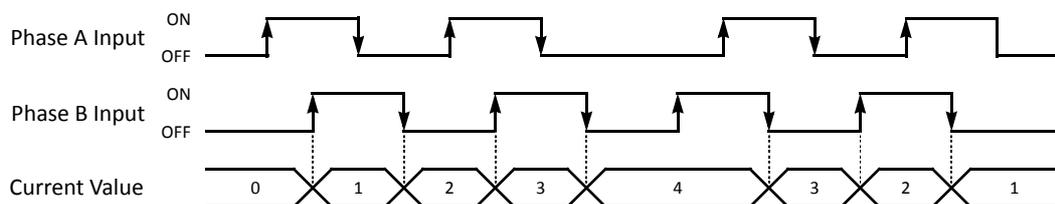
• 1-edge Count Operation Chart



2-edge Count

The current value increments or decrements at the rising or falling edge of the phase B input after the phase A input has turned on or off.

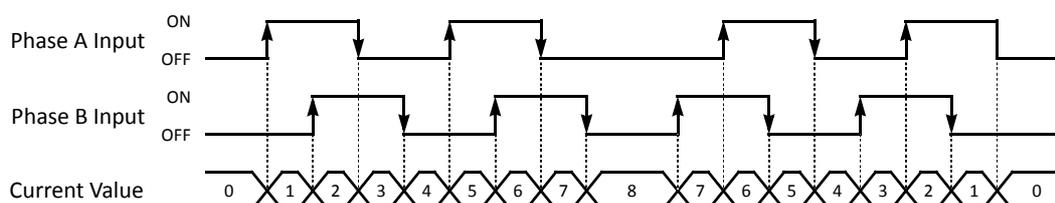
• 2-edge Count Operation Chart



4-edge Count

The current value increments or decrements at the rising or falling edges of the phase A and B inputs.

• 4-edge Count Operation Chart



5: SPECIAL FUNCTIONS

Eight special internal relays and eight special data registers are assigned to control and monitor each two-phase high-speed counter operation. The current value is stored in two special data registers (current value) and is updated every scan. The value stored in another two special data registers (preset value) is used as a preset value. When a reset input special internal relay is turned on, the current value is reset to the reset value. HSC1 and HSC4 can set two preset values.

The two-phase high-speed counter is enabled while a gate input special internal relay is on and is disabled while the gate input is off. When the current value reaches the preset value, a special internal relay (comparison ON status) turns on in the next scan. At this point, the current value is reset to the reset value, and the value stored in preset value special data registers takes effect for the subsequent counting cycle. If HSC1 or HSC4 is set to keep the current value when the current value reaches the first preset value, HSC1 or HSC4 continues counting until the current value reaches the second preset value. When a comparison output reset special internal relay is turned on, the designated comparison output is turned off.

In addition, HSC1 or HSC4 has reset input I2 or I5 and reset status special internal relay M8130 or M8135. When reset input I2 or I5 is turned on to reset the current value, reset status special internal relay M8130 or M8135 turns on in the next scan. When reset input special internal relay M8032 or M8046 is turned on, M8130 or M8135 does not turn on. See page 5-22.

Special Internal Relays for Two-phase High-speed Counters (Slim Type CPU Modules)

Description	High-speed Counter No.				ON	Read/Write
	HSC1	HSC2	HSC3	HSC4		
Comparison Output Reset	M8030	—	—	M8044	Turns off comparison output	R/W
Gate Input	M8031	—	—	M8045	Enables counting	R/W
Reset Input	M8032	—	—	M8046	Resets the current value	R/W
Reset Status	M8130	—	—	M8135	Current value reset by I2 or I5	Read only
Comparison 1 ON Status	M8131	—	—	M8136	Preset value 1 reached	Read only
Comparison 2 ON Status	M8132	—	—	M8137	Preset value 2 reached	Read only
Current Value Overflow	M8161	—	—	M8163	Overflow occurred	Read only
Current Value Underflow	M8162	—	—	M8164	Underflow occurred	Read only

Note: Special internal relays M8130 to M8132, M8135 to M8137, and M8161 to M8164 go on for only one scan.

Special Data Registers for Two-phase High-speed Counters (Slim Type CPU Modules)

Description	High-speed Counter No.				Updated	Read/Write
	HSC1	HSC2	HSC3	HSC4		
Current Value (High Word)	D8210	—	—	D8226	Every scan	Read only
Current Value (Low Word)	D8211	—	—	D8227	Every scan	Read only
Preset Value 1 (High Word)	D8212	—	—	D8228	—	R/W
Preset Value 1 (Low Word)	D8213	—	—	D8229	—	R/W
Preset Value 2 (High Word)	D8214	—	—	D8230	—	R/W
Preset Value 2 (Low Word)	D8215	—	—	D8231	—	R/W
Reset Value (High Word)	D8216	—	—	D8232	—	R/W
Reset Value (Low Word)	D8217	—	—	D8233	—	R/W

Note: When using the current value, preset value 1, preset value 2, and reset value in advanced instructions, select the data type of double word (D).

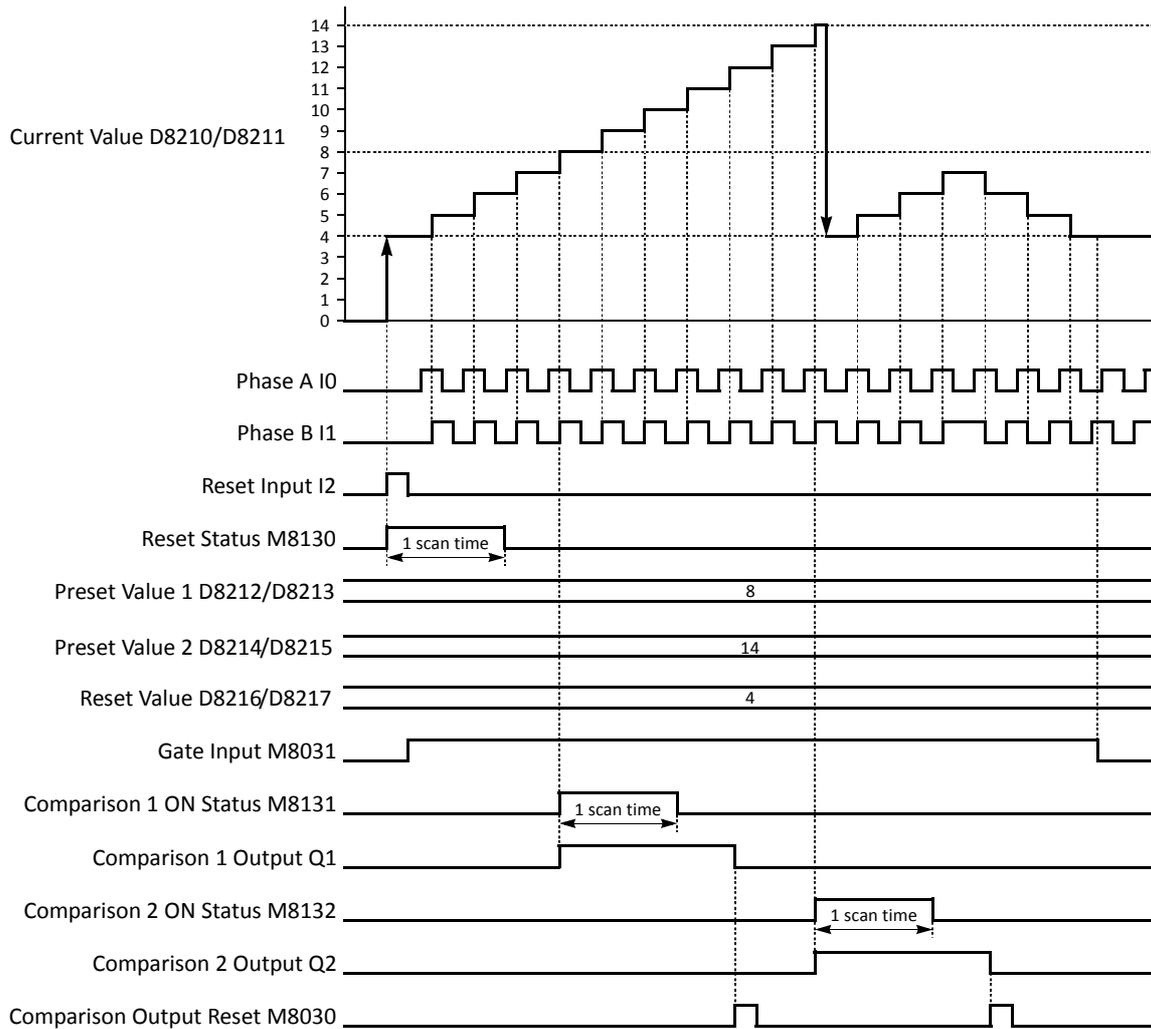
Two-phase High-speed Counter Functions (Slim Type CPU Modules)

Counting Mode and Maximum Counting Frequency	1-edge count: 100 kHz 2-edge count: 50 kHz 4-edge count: 25 kHz
Counting Range	0 to 4,294,967,295 (32 bits)
Gate Control	Enable/disable counting
Current Value Reset	Current value is reset to the reset value when reset input I2 (HSC1) or I5 (HSC4) is turned on or when a reset input special internal relay M8032 (HSC1) or M8046 (HSC4) is turned on. In addition, when any of current value comparison (preset value 1, preset value 2, overflow, or underflow) is true, the current value can be reset to the reset value. The current value comparison is designated in the Function Area Settings.
Current Value Keep	When current value comparison for preset value 1 or preset value 2 is true, the current value can also be kept to count subsequent input pulses, without resetting the current value to the reset value.
Status Relays	Special internal relays for indicating high-speed counter statuses.
Comparison Action	Comparison Output A comparison output turns on when any of current value comparison (preset value 1, preset value 2, overflow, or underflow) is true. Any output number available on the CPU module can be designated as a comparison output. Output numbers on expansion output or mixed I/O modules cannot be designated as a comparison output.
	Interrupt Program Program execution jumps to a tag when any of current value comparison (preset value 1, preset value 2, overflow, or underflow) is true.

Two-phase High-speed Counter Timing Chart

Example: Two-phase high-speed counter HSC1

- 1-edge count, preset value 1 is 8.
- I2 is designated as the reset input.
- Q1 is designated as the comparison 1 output.
- The current value is maintained when preset value 1 is reached.
- Q2 is designated as the comparison 2 output.
- The current value is not maintained when preset value 2 is reached.
- Overflow and underflow actions are not used.



- When reset input I2 is turned on, the D8210/D8211 current value is reset to the D8216/D8217 reset value, then the D8212/D8213 preset value 1 and D8214/D8215 preset value 2 take effect for the next counting cycle.
- While gate input M8031 is on, two-phase HSC1 counts pulse inputs to phase B input I1 because of the 1-edge count mode. While phase A input I0 is leading phase B input I1, the current value increments. While phase A input I0 is trailing phase B input I1, the current value decrements.
- The current value is updated every scan.
- When the current value reaches the preset value 1, comparison 1 ON status M8131 goes on for one scan. At the same time, comparison 1 output Q1 turns on and remains on until comparison output reset M8030 is turned on. The current value is maintained and the high-speed counter continues to count input pulses.
- When the current value reaches the preset value 2, comparison 2 ON status M8132 goes on for one scan. At the same time, comparison 2 output Q2 turns on and remains on until comparison output reset M8030 is turned on. The current value is reset to the reset value and the high-speed counter continues to count input pulses.

Clearing High-speed Counter Current Value

The high-speed counter current value is reset to the reset value (two-phase high-speed counter) or to zero (single-phase high-speed counters) in five ways:

- when the CPU is powered up,
- when a user program is downloaded to the CPU,
- when reset input I2 (HSC1) or I5 (HSC4 on slim type CPU only) is turned on,
- when current value overflow or underflow occurs (two-phase) or when the preset value is reached (single-phase when Keep Current Value is not selected), or
- when the reset input (*not* the high-speed counter reset input) designated in the Function Area Settings is turned on.

Precautions for Downloading High-speed Counter Program

When downloading a user program containing a high-speed counter, turn off the gate input before downloading the user program.

If a user program containing a high-speed counter is downloaded while the gate input is on, the high-speed counter is disabled. Then, to enable counting, stop and restart the MicroSmart. Or, turn off the gate input, and 3 scans later turn on the gate input again. For ladder programs to delay the gate input 3 scans, see pages 5-27 and 5-29.

Preset Values 1 and 2

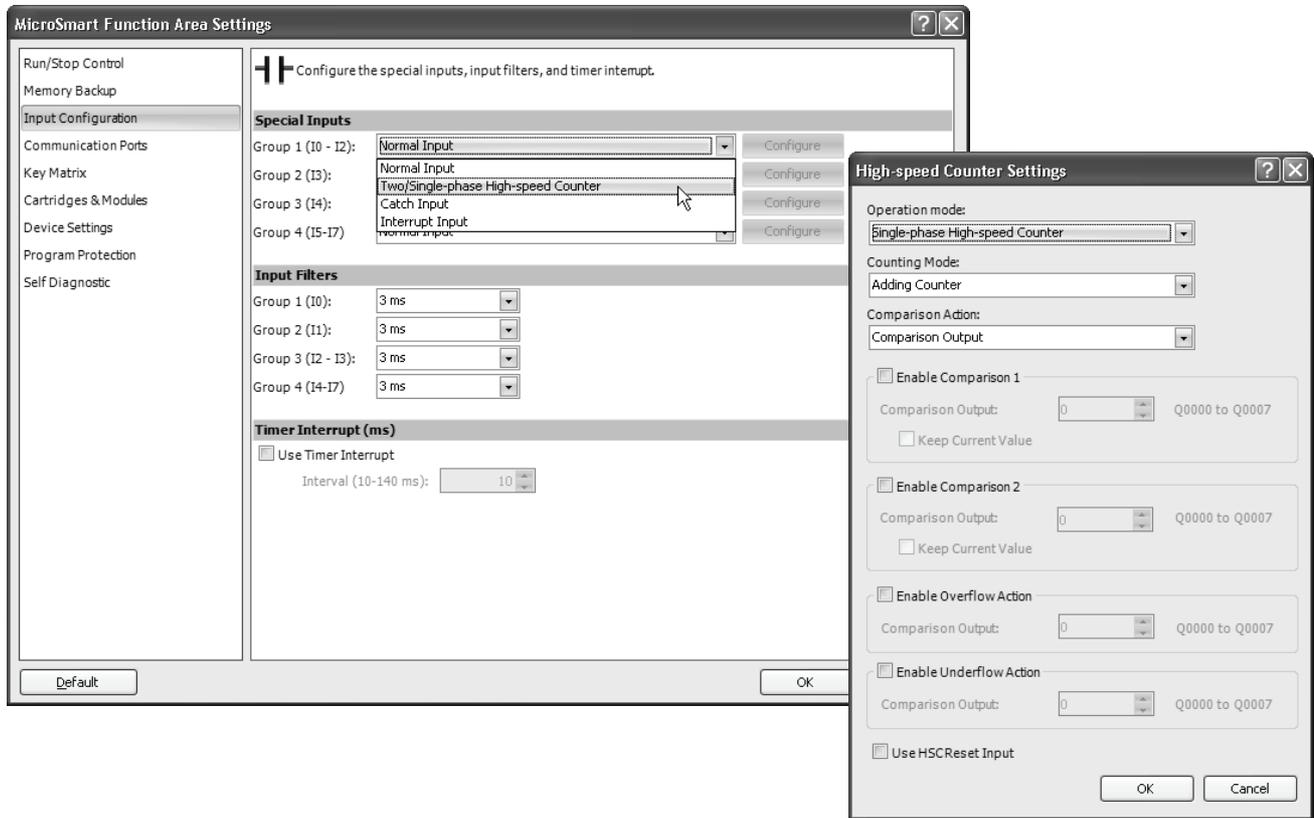
Preset values 1 and 2 take effect in the END processing at the end of the second scan after starting the CPU module. Use initialize pulse special internal relay M8120 to store preset values to appropriate data registers.

If preset value 1 or 2 has been changed during high-speed counter operation, the new preset value takes effect when the current value reaches the previous preset value. To change preset values easily, store new preset values in an interrupt program and call the new preset values when the current value reaches the previous preset value.

Programming WindLDR (Slim Type CPU Modules)

1. From the WindLDR menu bar, select **Configuration > Input Configuration**.

The Function Area Settings dialog box for Input Configuration appears.



2. When using high-speed counter HSC1 or HSC4, select **Two/Single-phase High-speed Counter** in the Group 1 or 4 pull-down list box.

When using high-speed counters HSC2 or HSC3, select **Single-phase High-speed Counter** in the Group 2 or 3 pull-down list box.

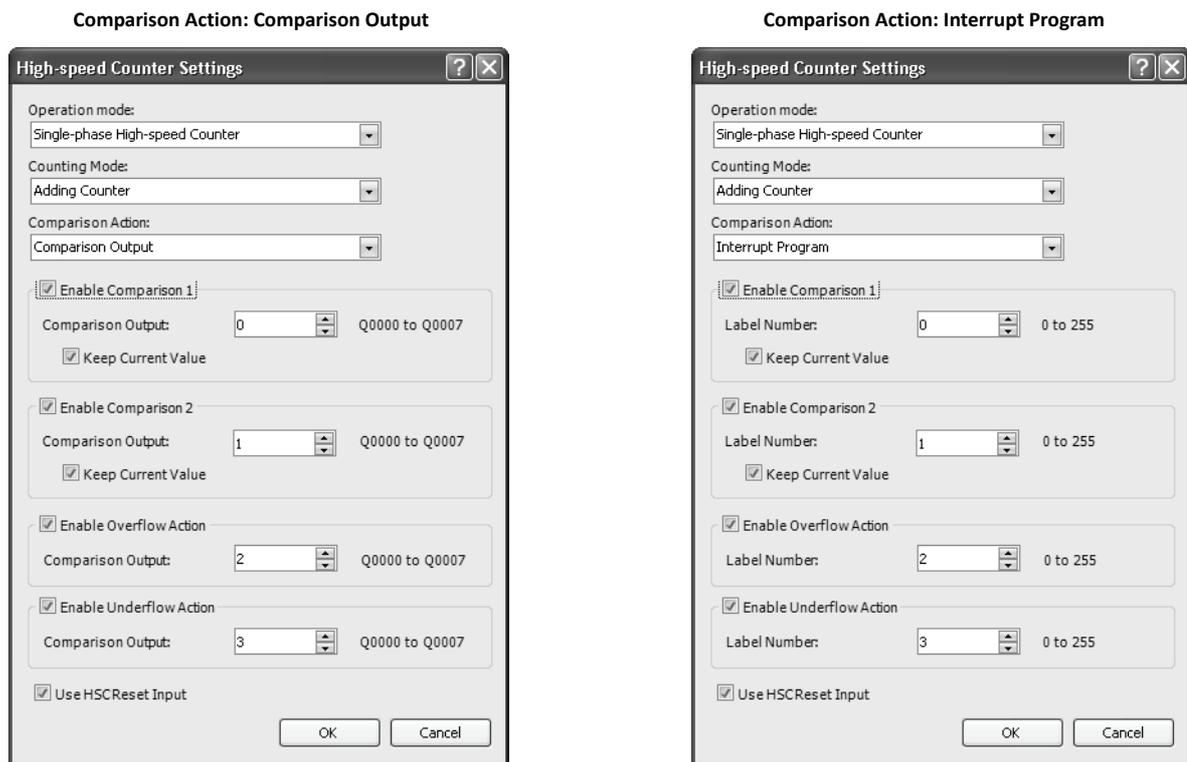
The High-speed Counter Settings dialog box appears.

3. In the High-speed Counter Settings dialog box, select the following options.

High-speed Counter No.	HSC1, HSC4		HSC2, HSC3
Operation Mode	Single-phase	Two-phase	Single-phase
Counting Mode	Adding counter Dual-pulse reversible Up/down selection reversible	1-edge count 2-edge count 4-edge count	Adding counter
Comparison Action	Comparison output Interrupt program		Comparison output Interrupt program
Current Value Comparison	Preset value 1 Preset value 2 Overflow Underflow		Preset value

Comparison Action

For the HSC1 through HSC4, comparison action can be selected from comparison output or interrupt program. Depending on the selection in the Comparison Action field, different options for the comparison action are shown.



4. Select comparison output number or label number for each enabled comparison.

Comparison Output

When comparison output is selected for the comparison action, specify an output number available on the CPU module in the **Comparison Output** field. When the preset value is reached (single-phase and two-phase high-speed counters) or current value overflow or underflow occurs (two-phase high-speed counter), the specified comparison output is turned on and remains on until a comparison output reset special internal relay (M8030, M8034, M8040, or M8044) is turned on.

Label Number

When interrupt program is selected for the comparison action, specify a label number to jump to. When the preset value is reached (single-phase and two-phase high-speed counters) or current value overflow or underflow occurs (two-phase high-speed counter), program execution jumps to the specified label number in the subroutine program.

5. Select to keep current value or not.

For the HSC1 and HSC4, the current value can be kept when reaching preset value 1 and preset value 2 to enable another comparison. To keep the current value, check the box. When this box is not checked, the current value in D8210/D8211 or D8226/D8227 is reset to the reset value to start another counting cycle.

6. Select to use the HSC reset input or not.

Click the check box to enable high-speed counter reset input I2 for HSC1 or I5 for HSC4 only. When input I2 or I5 is turned on, the current value is reset to the reset value to start another counting cycle.

HSC1	The current value is reset to the value stored in D8216/D8217 (high-speed counter reset value). High-speed counter HSC1 counts subsequent input pulses starting at the reset value.
HSC4	The current value is reset to the value stored in D8232/D8233 (high-speed counter reset value). High-speed counter HSC4 counts subsequent input pulses starting at the reset value.

Since these settings relate to the user program, the user program must be downloaded to the MicroSmart after changing any of these settings.

5: SPECIAL FUNCTIONS

Example: Single-phase High-speed Counter (Slim Type CPU Module)

This example demonstrates a program for single-phase high-speed counter HSC2 to count input pulses and turn on output Q2 every 1000 pulses.

Program Parameters

PLC Selection		FC5A-D32
Function Area Settings	Group 2 (I3)	Single-phase High-speed Counter
	Enable Comparison 1	Yes
	Comparison Output	Q2
	Enable Comparison 2	No
	Enable Overflow Action	No
Special Data Registers	Enable Underflow Action	No
	HSC Preset Value 1 High Word (D8220)	0
	HSC Preset Value 1 Low Word (D8221)	1000

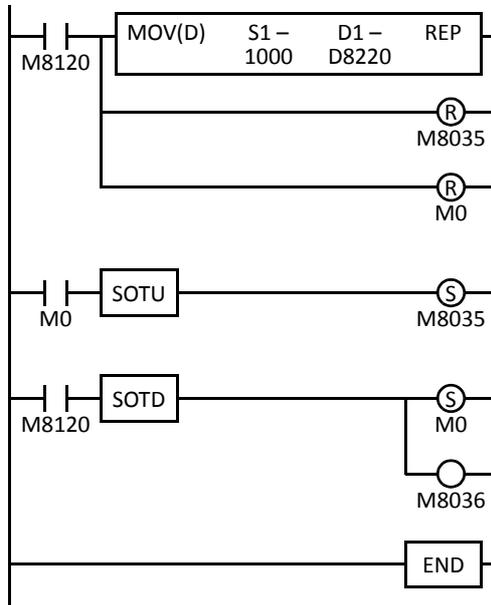
Programming WindLDR

The image shows two screenshots from the WindLDR software. The main window is 'MicroSmart Function Area Settings', which is used to configure special inputs, input filters, and timer interrupts. In the 'Special Inputs' section, Group 3 (I4) is configured as a 'Single-phase High-speed Counter'. The 'Input Filters' section shows that all four input groups (I0-I3) have a 3 ms filter. The 'Timer Interrupt (ms)' section shows that the timer interrupt is enabled with an interval of 10 ms.

The 'High-speed Counter Settings' dialog box is also shown, which provides detailed configuration for the selected counter. The 'Operation mode' is set to 'Single-phase High-speed Counter'. The 'Counting Mode' is 'Adding Counter'. The 'Comparison Action' is 'Comparison Output'. 'Enable Comparison 1' is checked, and its 'Comparison Output' is set to '2' (Q0000 to Q0007). 'Keep Current Value' is unchecked. 'Enable Comparison 2', 'Enable Overflow Action', and 'Enable Underflow Action' are all unchecked. 'Use HSCReset Input' is also unchecked. The 'OK' and 'Cancel' buttons are visible at the bottom.

Ladder Diagram

When the MicroSmart starts operation, preset value 1000 is stored to preset value special data registers D8220 and D8221. Gate input special internal relay M8035 is turned on at the end of the third scan to start the high-speed counter to count input pulses.



M8120 is the initialize pulse special internal relay.

1st scan

MOV instruction stores a preset value of 1000 to D8220/D8221 (preset value).

M8035 (gate input) is turned off.

M0 is turned off.

3rd scan

At the rising edge of M0, M8035 (gate input) is turned on. After the END processing of the third scan, HSC2 starts counting.

2nd scan

At the falling edge of M8120 (initialize pulse), M0 is turned on.

M8036 (reset input) is also turned on to initialize HSC2 in the END processing of the second scan.

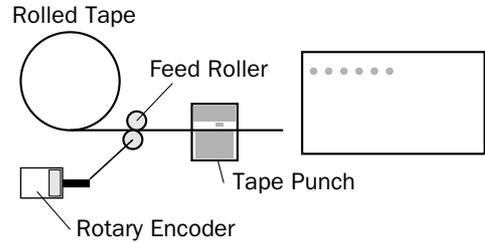
When HSC2 current value reaches 1000, output Q2 (comparison output) is turned on, and HSC2 starts to repeat counting from zero.

Example: Two-phase High-speed Counter (Slim Type CPU Module)

This example demonstrates a program for two-phase high-speed counter HSC1 to punch holes in a paper tape at regular intervals.

Description of Operation

A rotary encoder is linked to the tape feed roller directly, and the output pulses from the rotary encoder are counted by the two-phase high-speed counter in the MicroSmart CPU module. When the high-speed counter counts 2,700 pulses, the comparison output is turned on. When the comparison output is turned on, the high-speed counter continues another cycle of counting. The comparison output remains on for 0.5 second to punch holes in the tape, and is turned off before the high-speed counter counts 2,700 pulses again.



Program Parameters

PLC Selection		FC5A-D32
Function Area Settings	Group 1 (I0-I2)	Two/Single-phase High-speed Counter
	Enable Comparison 1	Yes
	Comparison Output	Q1
	Keep Current Value	No
	Enable Comparison 2	No
	Enable Overflow Action	No
	Enable Underflow Action	No
Special Data Registers	HSC Preset Value 1 High Word (D8212)	0
	HSC Preset Value 1 Low Word (D8213)	2700
	HSC Reset Value High Word (D8216)	0
	HSC Reset Value Low Word (D8217)	0

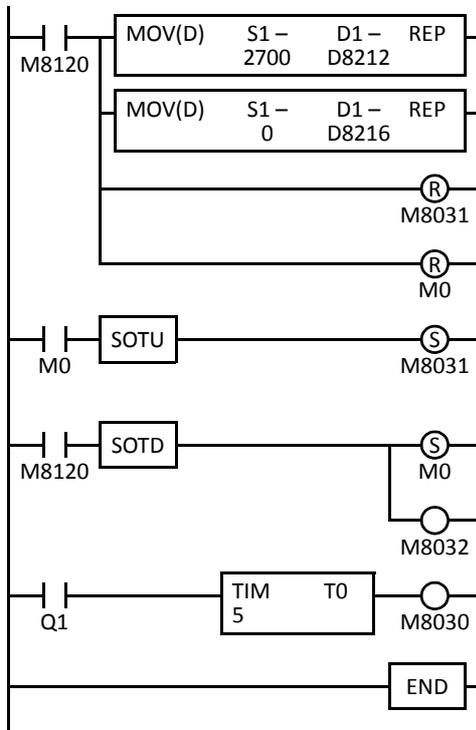
Note: This example does not use the phase Z signal (input I2).

Programming WindLDR

The screenshot shows two overlapping software windows. The background window is 'MicroSmart Function Area Settings', which has a sidebar with options like 'Input Configuration', 'Communication Ports', etc. The main area shows 'Special Inputs' for Group 1 (I0-I2) set to 'Normal Input', Group 2 (I3) set to 'Two/Single-phase High-speed Counter', Group 3 (I4) set to 'Catch Input', and Group 4 (I5-I7) set to 'Interrupt Input'. Below this are 'Input Filters' (all set to 3 ms) and 'Timer Interrupt' (set to 10 ms). The foreground window is 'High-speed Counter Settings'. It shows 'Operation mode' as 'Two-phase High-speed Counter', 'Counting Mode' as '1 Edge Count', and 'Comparison Action' as 'Comparison Output'. It has three sections for 'Enable Comparison 1', 'Enable Comparison 2', and 'Enable Overflow Action', each with a 'Comparison Output' field set to '0' and a 'Keep Current Value' checkbox. There is also a 'Use HSC Reset Input' checkbox.

Ladder Diagram

When the MicroSmart starts operation, preset value 2700 is stored to preset value special data registers D8212 and D8213. Gate input special internal relay M8031 is turned on at the end of the third scan to start the high-speed counter to count input pulses.



M8120 is the initialize pulse special internal relay.

1st scan
 MOV instruction stores a preset value of 2700 to D8212/D8213 (preset value 1).
 MOV instruction stores a reset value of 0 to D8216/D8217 (reset value).
 M8031 (gate input) is turned off.
 M0 is turned off.

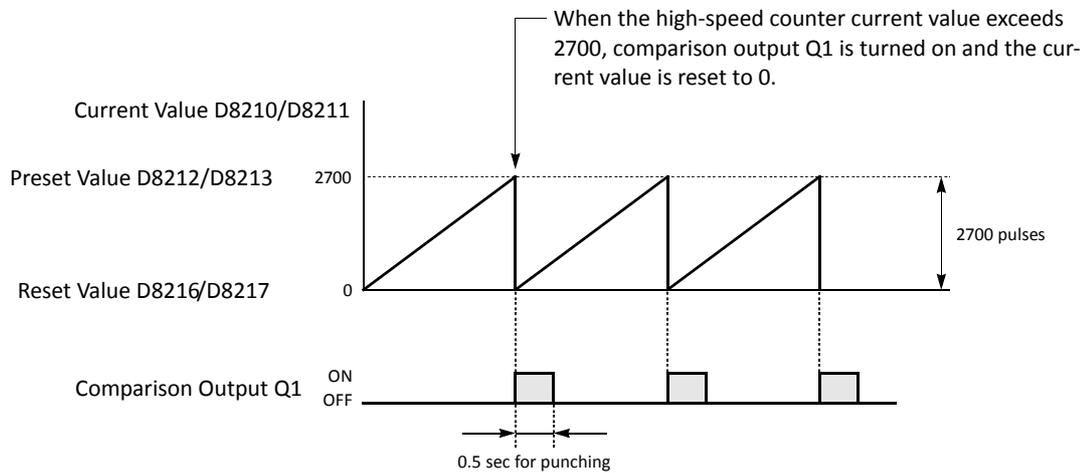
3rd scan
 At the rising edge of M0, M8031 (gate input) is turned on. After the END processing of the third scan, HSC1 starts counting.

2nd scan
 At the falling edge of M8120 (initialize pulse), M0 is turned on.
 M8032 (reset input) is also turned on to initialize HSC1 in the END processing of the second scan.

When HSC1 current value reaches 2700, output Q1 (comparison output) is turned on to start timer T0. HSC1 starts to repeat counting.

When the timer times out 0.5 sec, M8030 (comparison output reset) is turned on to turn off output Q1.

Timing Chart



Frequency Measurement

The pulse frequency of input signals to input terminals I1, I3, I4, and I5 (all-in-one) or I7 (slim) can be counted using the high-speed counter function. The high-speed counter counts input pulses within a given period, calculates input pulse frequency, and stores the result to a special data register.

The all-in-one type CPU modules and slim type CPU modules have different frequency measurement configurations.

Frequency Measurement Devices for All-in-One Type CPU Modules

Description	High-speed Counter No.			
	HSC1	HSC2	HSC3	HSC4
Input Terminal	I1	I3	I4	I5
Gate Input	M8031	M8035	M8041	M8045
Frequency Measurement Value	D8060	D8062	D8064	D8066
Frequency Measurement Range	4 Hz to 50 kHz		4 Hz to 5 kHz	
Measurement Error	4 Hz to 4 kHz: ±10% maximum 4 kHz and above: ±0.1% maximum			
Calculation Period	Below 4 kHz: 1 sec maximum 4 kHz and above: 250 ms maximum			

Frequency Measurement Devices for Slim Type CPU Modules

Description		High-speed Counter No.			
		HSC1	HSC2	HSC3	HSC4
Input Terminal		I1	I3	I4	I7
Gate Input		M8031	M8035	M8041	M8045
Frequency Measurement Value	High Word	D8060	D8062	D8064	D8066
	Low Word	D8061	D8063	D8065	D8067
Frequency Measurement Range		4 Hz to 100 kHz			
Measurement Error		4 Hz to 4 kHz: ±10% maximum 4 kHz and above: ±0.1% maximum			
Calculation Period		Below 4 kHz: 1 sec maximum 4 kHz and above: 250 ms maximum			

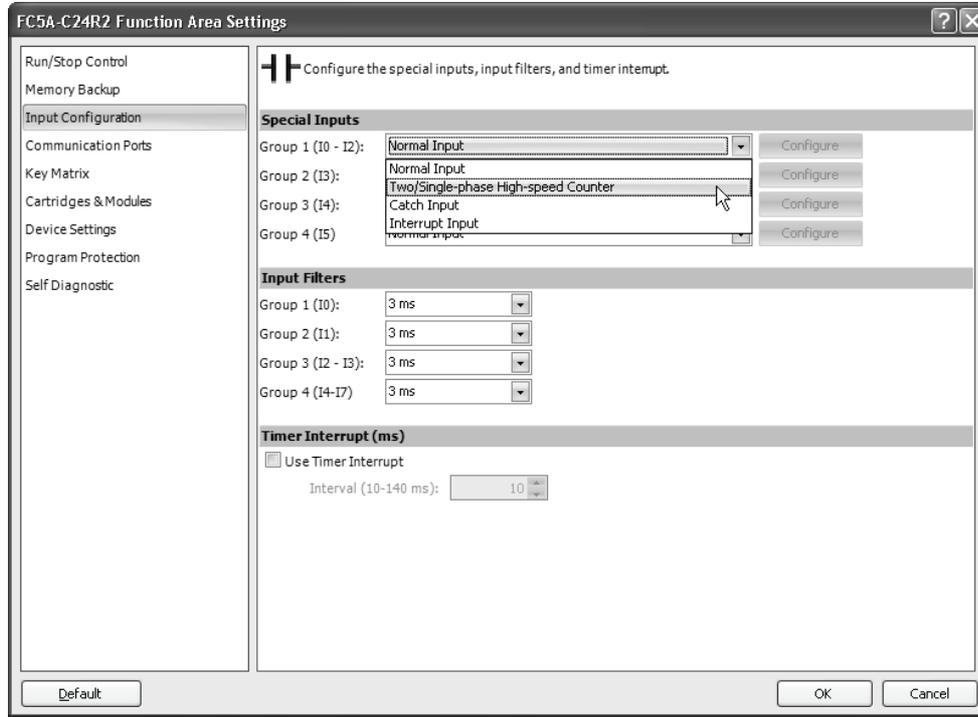
Precautions for Using Frequency Measurement Function

- High-speed counters cannot be used for the group in which frequency measurement is used.
- While the gate input is on, the input pulse frequency is measured. To restart frequency measurement, turn off and on the gate input, or stop and run the CPU module.
- Before downloading a user program to the CPU module, turn off the gate input. If a user program is downloaded while the gate input is on, frequency measurement stops.
- Before the measured results are stored in the special data registers, it takes a maximum of calculation period plus one scan time. Using the FRQRF (frequency measurement refresh) instruction in the ladder diagram, the latest value of the frequency measurement can be read out within 250 ms regardless of the input frequency. For the FRQRF instruction, see page 11-12 (Advanced Vol.).
- For wiring the frequency measurement input signals, use a twisted-pair shielded cable.

Programming WindLDR (All-in-One Type CPU Modules)

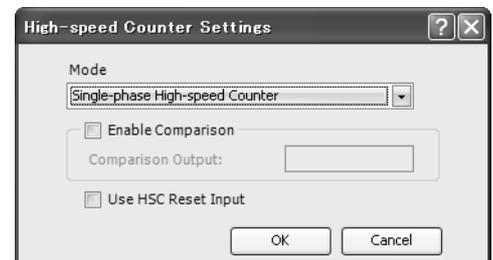
1. From the WindLDR menu bar, select **Configuration > Input Configuration**.

The Function Area Settings dialog box for Input Configuration appears.



2. When using frequency measurement, select **Single-phase High-speed Counter** in the Groups 1 through 4 pull-down list boxes.

Do not make other changes.



Catch Input

The catch input function is used to receive short pulses from sensor outputs regardless of the scan time. Input pulses shorter than one scan time can be received. Four inputs I2 through I5 can be designated to catch a rising or falling edge of short input pulses, and the catch input statuses are stored to special internal relays M8154 through M8157, respectively. The Function Area Settings dialog box is used to designate inputs I2 through I5 as a catch input.

Normal input signals to input terminals are read when the END instruction is executed at the end of a scan.

Since these settings relate to the user program, the user program must be downloaded to the MicroSmart after changing any of these settings.

Catch Input Specifications

Minimum Turn ON Pulse Width	All-in-one type: 40 μs	Slim type: 5 μs (I3, I4), 40 μs (I2, I5)
Minimum Turn OFF Pulse Width	All-in-one type: 150 μs	Slim type: 5 μs (I3, I4), 150 μs (I2, I5)

Note: Input filter settings have no effect on the catch inputs. For the input filter function, see page 5-42.

Catch Input Terminals and Special Internal Relays for Catch Inputs

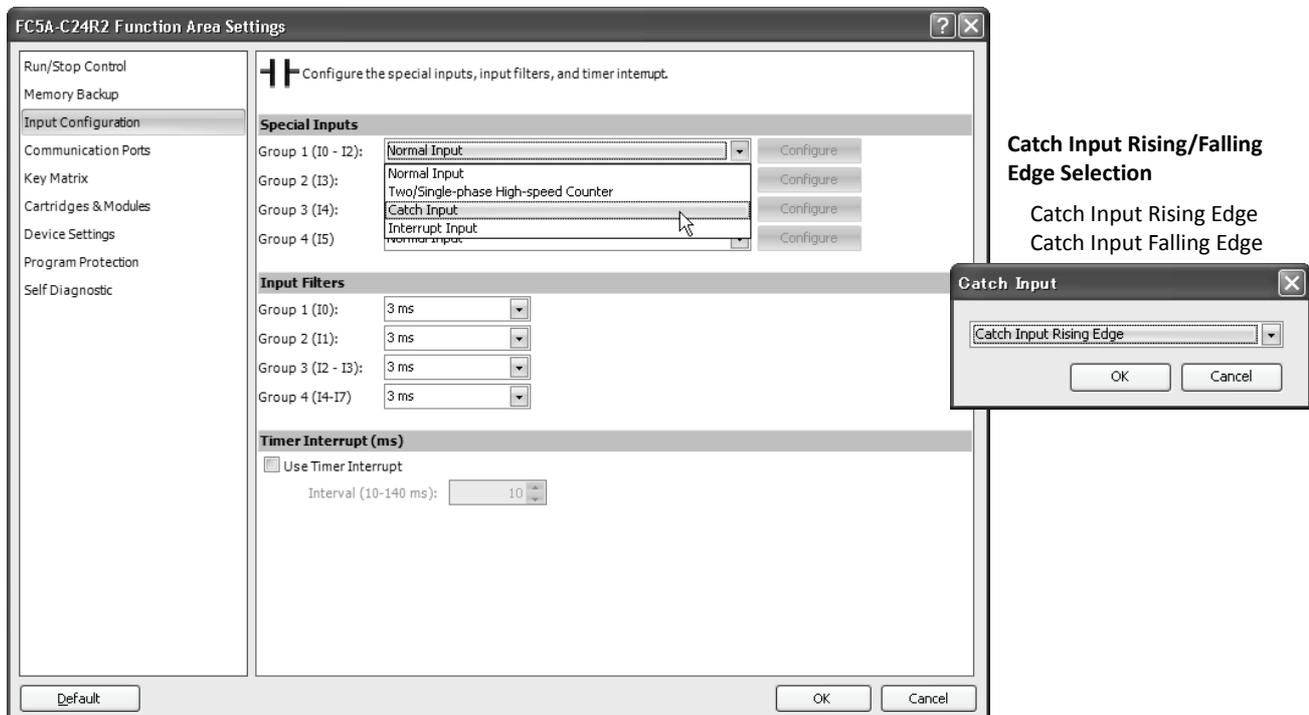
Group	Catch Input No.	Special Internal Relay for Catch Input
Group 1	I2	M8154
Group 2	I3	M8155
Group 3	I4	M8156
Group 4	I5	M8157

Note: For wiring the catch input signals, use a twisted-pair shielded cable.

Programming WindLDR

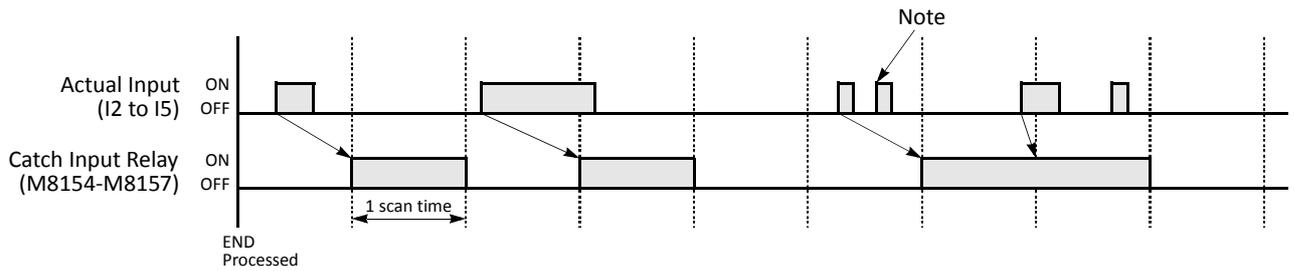
- From the WindLDR menu bar, select **Configuration > Input Configuration**.

The Function Area Settings dialog box for Input Configuration appears.

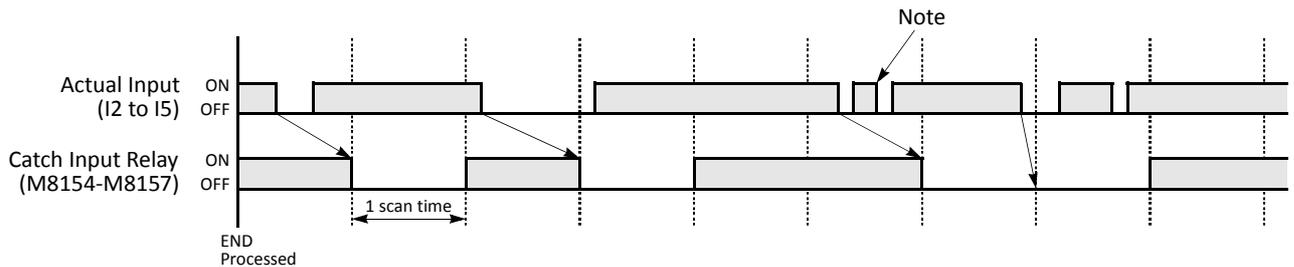


- Select **Catch Input** in the Groups 1 through 4 pull-down list boxes. The Catch Input dialog box appears.
- Select **Catch Input Rising Edge** or **Catch Input Falling Edge** in the pull-down list.

Catching Rising Edge of Input Pulse



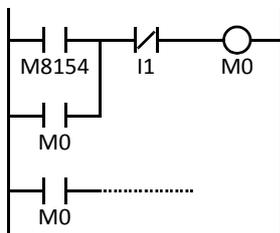
Catching Falling Edge of Input Pulse



Note: When two or more pulses enter within one scan, subsequent pulses are ignored.

Example: Maintaining Catch Input

When a catch input is received, the catch input relay assigned to a catch input is turned on for only one scan. This example demonstrates a program to maintain a catch input status for more than one scan.



Input I2 is designated as a catch input using the Function Area Settings.

When input I2 is turned on, special internal relay M8154 is turned on, and M0 is maintained in the self-holding circuit.

When NC input I1 is turned off, the self-holding circuit is unlatched, and M0 is turned off.

M0 is used as an input condition for the subsequent program instructions.

Interrupt Input

All MicroSmart CPU modules have an interrupt input function. When a quick response to an external input is required, such as positioning control, the interrupt input can call a subroutine to execute an interrupt program.

Four inputs I2 through I5 can be designated to execute interrupt at a rising and/or falling edge of input pulses. When an interrupt is initiated by inputs I2 through I5, program execution immediately jumps to a predetermined label number stored in special data registers D8032 through D8035, respectively. The Function Area Settings dialog box is used to designate inputs I2 through I5 as an interrupt input, normal input, high-speed counter input, or catch input.

Normal input signals to input terminals are read when the END instruction is executed at the end of a scan.

Since these settings relate to the user program, the user program must be downloaded to the MicroSmart after changing any of these settings.

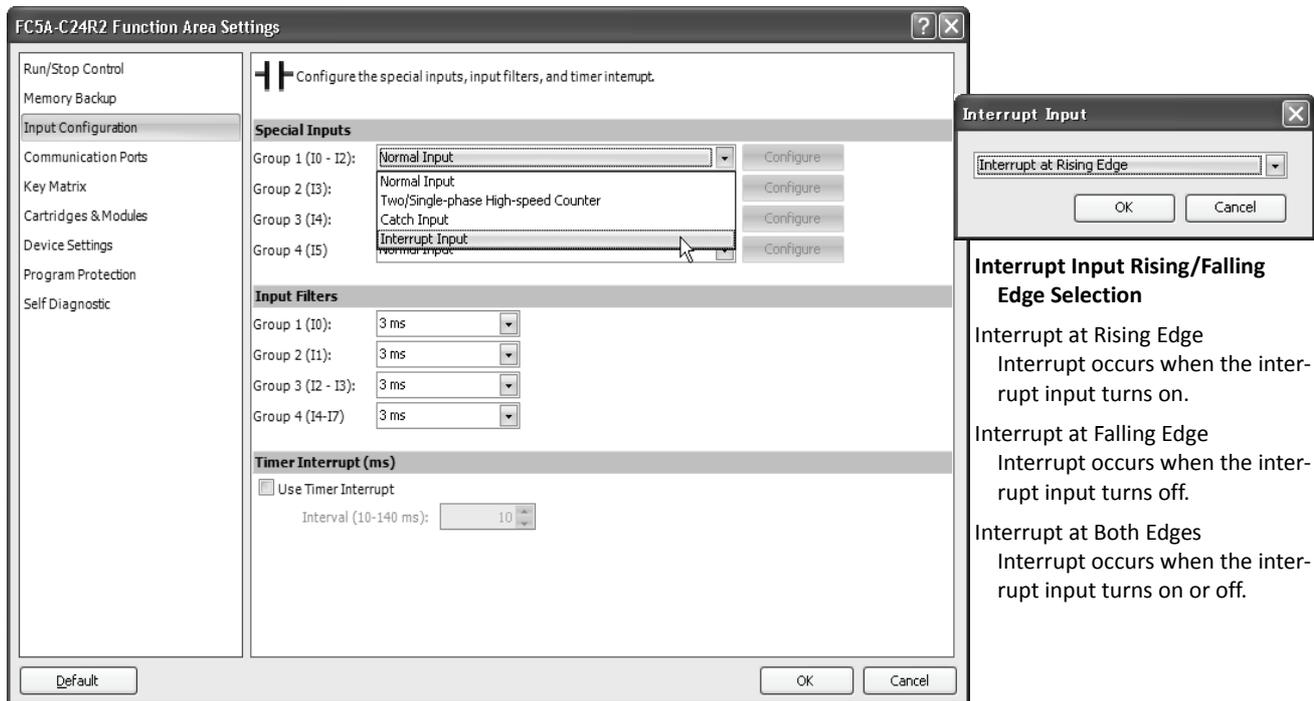
Interrupt Input Terminals, Special Data Registers, and Special Internal Relays for Interrupt Inputs

Group	Interrupt Input No.	Interrupt Input Jump Destination Label No.	Interrupt Input Status
Group 1	I2	D8032	M8140
Group 2	I3	D8033	M8141
Group 3	I4	D8034	M8142
Group 4	I5	D8035	M8143

Programming WindLDR

- From the WindLDR menu bar, select **Configuration > Input Configuration**.

The Function Area Settings dialog box for Input Configuration appears.



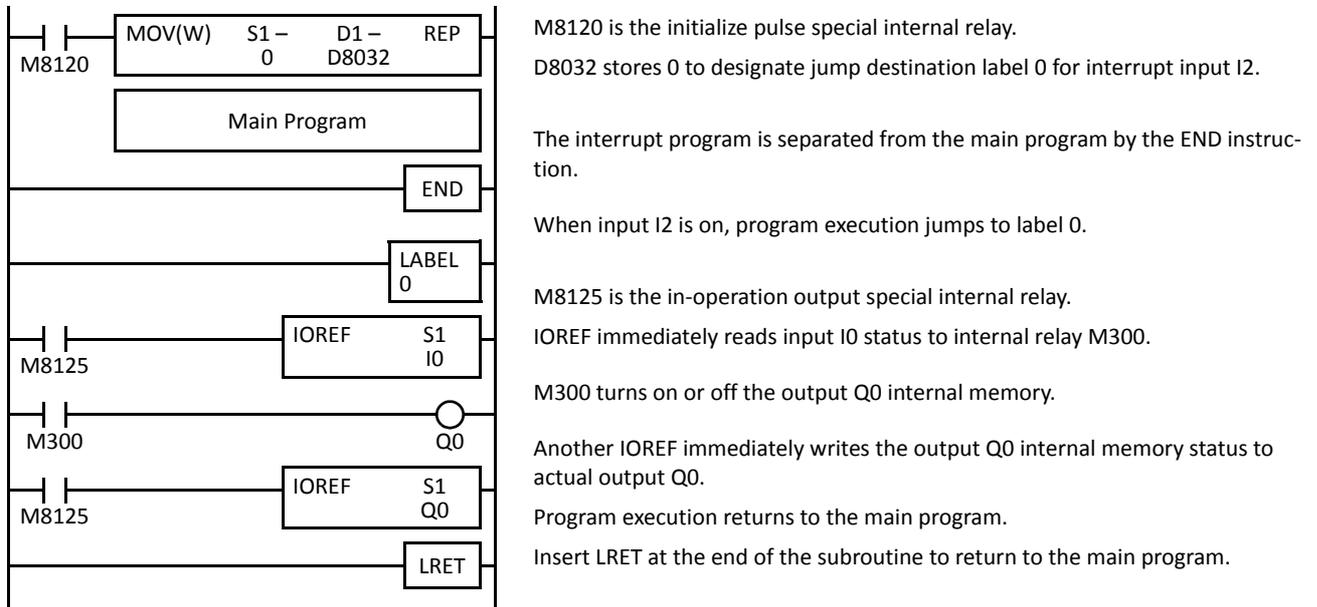
- Select **Interrupt Input** in the Groups 1 through 4 pull-down list boxes. the Interrupt Input dialog box appears.
- Select an interrupt edge in the pull-down list for each group.

Disable and Enable Interrupts

The interrupt inputs I2 through I5 and timer interrupt are normally enabled while the CPU is running, and can also be individually disabled using the DI instruction or enabled using the EI instruction. When interrupt inputs I2 through I5 are enabled, special internal relay M8140 through M8143 are turned on, respectively. See page 11-7 (Advanced Vol.).

Example: Interrupt Input

The following example demonstrates a program of using the interrupt input function, with input I2 designated as an interrupt input. When the interrupt input is turned on, the input I0 status is immediately transferred to output Q0 using the IOREF (I/O refresh) instruction before the END instruction is executed. For the IOREF instruction, see page 11-9 (Advanced Vol.).

**Notes for Using Interrupt Inputs and Timer Interrupt:**

- When using an interrupt input or timer interrupt, separate the interrupt program from the main program using the END instruction at the end of the main program.
- When an interrupt program calls another subroutine, a maximum of 3 subroutine calls can be nested. If more than 3 calls are nested, a user program execution error occurs, turning on special internal relay M8004 and the ERR LED.
- When using an interrupt input or timer interrupt, include the label number of the interrupt program to be executed when an interrupt occurs. The label numbers stored in data registers D8032 through D8036 specify the interrupt programs for interrupt inputs I2 through I5 and timer interrupt, respectively.
- When more than one interrupt input is turned on at the same time, interrupt program execution is given priority to inputs I2, I3, I4, and I5, in that order. If an interrupt is initiated while another interrupt program is executed, the subsequent interrupt program is executed after the prior interrupt is completed. Multiple interrupt programs cannot be executed simultaneously.
- Make sure that the execution time of the interrupt program is shorter than interrupt intervals sufficiently.
- Interrupt programs cannot use the following instructions: SOTU, SOTD, TML, TIM, TMH, TMS, CNT, CDP, CUD, SFR, SFRN, WKTIM, WKTBL, DISP, DGRD, TXD1/2, RXD1/2, DI, EI, XYFS, CVXTY, CVYTX, PULS1/2/3, PWM1/2/3, RAMP1/2, ZRN1/2/3, PID, DTML, DTIM, DTMH, DTMS, TTIM, RUNA, and STPA.
- For wiring the interrupt input signals, use a twisted-pair shielded cable.

Timer Interrupt

In addition to the interrupt input as described in the preceding section, all CPU modules have a timer interrupt function. When a repetitive operation is required, the timer interrupt can be used to call a subroutine repeatedly at predetermined intervals of 10 through 140 ms.

The Function Area Settings dialog box is used to enable the timer interrupt and to specify the interval, from 10 to 140 ms, to execute the timer interrupt. When the timer interrupt is enabled, the program execution jumps to the jump destination label number stored in special data register D8036 repeatedly while the CPU is running. When the interrupt program is completed, the program execution returns to the main program at the address where the interrupt occurred.

Since these settings relate to the user program, the user program must be downloaded to the CPU module after changing any of these settings.

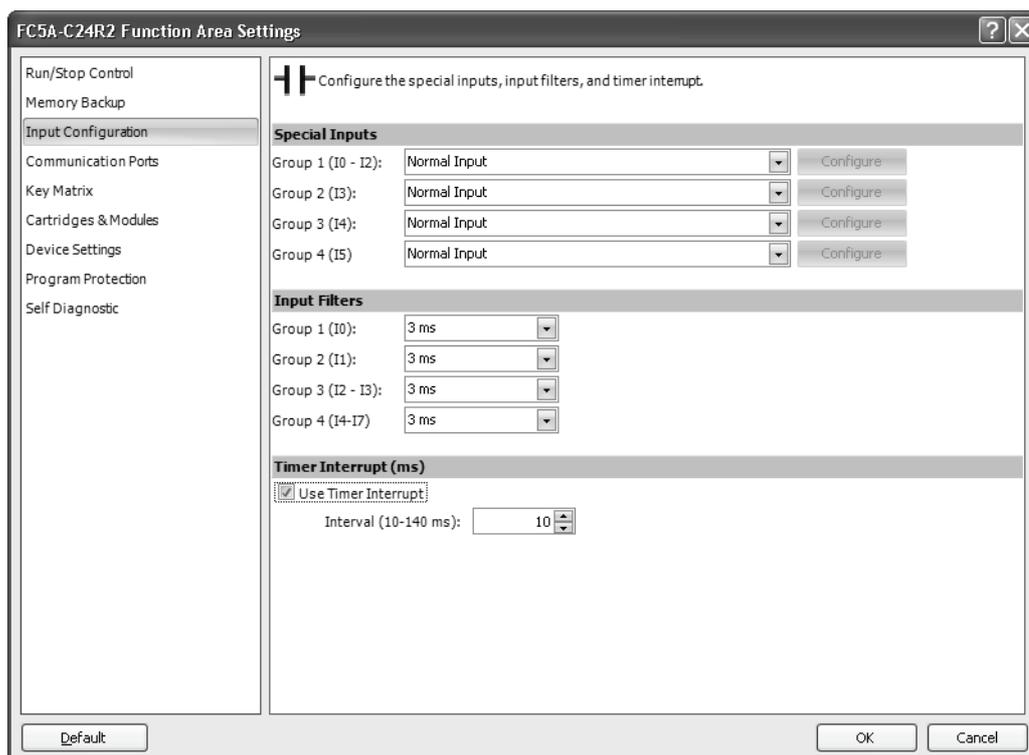
Special Data Register and Special Internal Relay for Timer Interrupt

Interrupt	Special Data Register for Timer Interrupt Jump Destination Label No.	Special Internal Relay for Timer Interrupt Status
Timer Interrupt	D8036	M8144

Programming WindLDR

1. From the WindLDR menu bar, select **Configuration > Input Configuration**.

The Function Area Settings dialog box for Input Configuration appears.



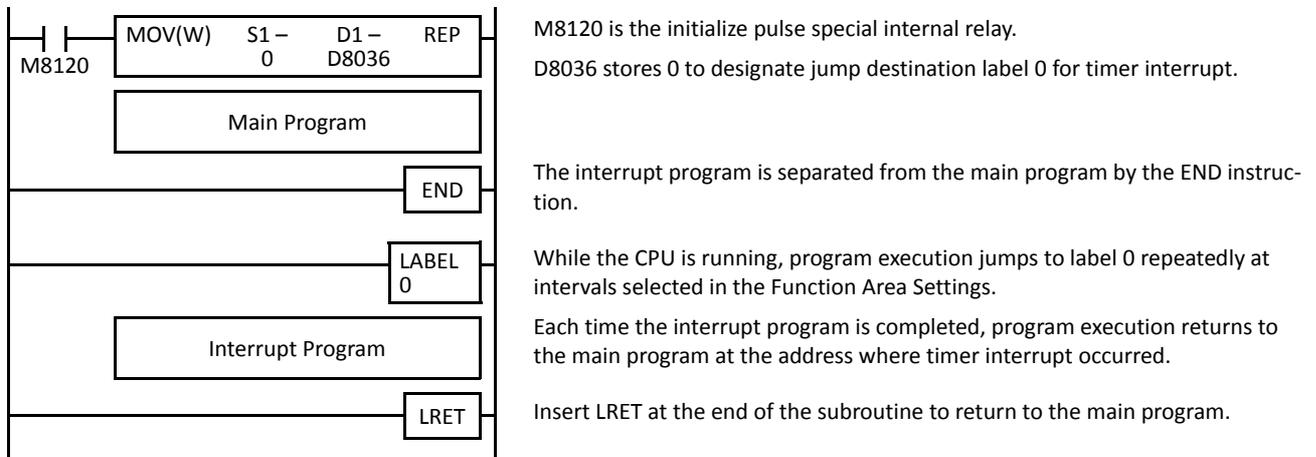
2. Under the Timer Interrupt, click the check box to use the timer interrupt function.
3. Select an interval to execute the timer interrupt, from 10 to 140 ms.

Disable and Enable Interrupts

The timer interrupt and interrupt inputs I2 through I5 are normally enabled while the CPU is running, and can also be individually disabled using the DI instruction or enabled using the EI instruction. When timer interrupt is enabled, M8144 is turned on. When disabled, M8144 is turned off. See page 11-7 (Advanced Vol.).

Example: Timer Interrupt

The following example demonstrates a program of using the timer interrupt function. The Function Area Settings must also be completed to use the timer interrupt function as described on the preceding page.

**Notes for Using Timer Interrupt and Interrupt Inputs:**

- When using a timer interrupt or interrupt input, separate the interrupt program from the main program using the END instruction at the end of the main program.
- When an interrupt program calls another subroutine, a maximum of 3 subroutine calls can be nested. If more than 3 calls are nested, a user program execution error occurs, turning on special internal relay M8004 and the ERR LED.
- When using a timer interrupt or interrupt input, include the label number of the interrupt program to be executed when an interrupt occurs. The label numbers stored in data registers D8032 through D8036 specify the interrupt programs for interrupt inputs I2 through I5 and timer interrupt, respectively.
- If an interrupt is initiated while another interrupt program is executed, the subsequent interrupt program is executed after the prior interrupt is completed. Multiple interrupt programs cannot be executed simultaneously.
- Make sure that the execution time of the interrupt program is shorter than interrupt intervals sufficiently.
- Interrupt programs cannot use the following instructions: SOTU, SOTD, TML, TIM, TMH, TMS, CNT, CDP, CUD, SFR, SFRN, WKTIM, WKTBL, DISP, DGRD, TXD1/2, RXD1/2, DI, EI, XYFS, CVXTY, CVYTX, PULS1/2/3, PWM1/2/3, RAMP1/2, ZRN1/2/3, PID, DTML, DTIM, DTMH, DTMS, TTIM, RUNA, and STPA.

Key Matrix Input

The key matrix input can be programmed using the Function Area Settings in WindLDR to form a matrix with 1 to 16 input points and 2 to 16 output points to multiply input capability. A key matrix with 8 inputs and 4 outputs would equal 32 inputs, for example. The maximum, 16 inputs and 16 outputs, would result in 256 input points. A maximum of 5 sets of key matrix inputs can be programmed for one user program, therefore a maximum of 1280 inputs can be read to the FC5A MicroSmart CPU module.

The input information is stored in consecutive internal relays as many as the quantity of input points multiplied by the quantity of output points, starting at the first internal relay number programmed in the Function Area Settings.

The key matrix input function is available on upgraded CPU modules with system program version 210 or higher.

When using the key matrix input function, DC inputs and transistor outputs must be used.

Since these settings relate to the user program, the user program must be downloaded to the CPU module after changing any of these settings.

 **Caution** • To read key matrix inputs, use transistor outputs of either CPU module or transistor output module. If relay outputs are connected to configure the key matrix, the CPU module cannot read the inputs.

Applicable Modules for Inputs and Outputs

To configure a key matrix, use DC inputs and transistor outputs. Applicable CPU and I/O modules are listed in the table below.

Module	For Inputs		For Outputs	
FC5A MicroSmart CPU Modules	FC5A-C24R2 FC5A-D16RK1 FC5A-D32K3 FC5A-D12K1E	FC5A-C24R2C FC5A-D16RS1 FC5A-D32S3 FC5A-D12S1E	FC5A-D16RK1 FC5A-D32K3 FC5A-D12K1E	FC5A-D16RS1 FC5A-D32S3 FC5A-D12S1E
I/O Modules	FC4A-N08B1 FC4A-N16B3 FC4A-M08BR1	FC4A-N16B1 FC4A-N32B3 FC4A-M24BR2	FC4A-T08K1 FC4A-T16K3 FC4A-T32K3	FC4A-T08S1 FC4A-T16S3 FC4A-T32S3

Valid Device Ranges

A maximum of 1280 points (16 inputs × 16 outputs × 5 key matrices) can be read using the key matrix input function. The valid device range depends on the CPU module.

CPU Module	Inputs	Outputs	Internal Relays
FC5A-C10R2, FC5A-C10R2C, FC5A-C10R2D	—	—	—
FC5A-C16R2, FC5A-C16R2C, FC5A-C16R2D	—	—	—
FC5A-C24R2D	—	—	—
FC5A-C24R2, FC5A-C24R2C	I0 - I15, I30 - I107	Q30 - Q107	M0 - M2557
FC5A-D16RK1, FC5A-D16RS1	I0 - I7, I30 - I627	Q0 - Q1, Q30 - Q627	
FC5A-D32K3, FC5A-D32S3	I0 - I17, I30 - I627	Q0 - Q17, Q30 - Q627	
FC5A-D12K1E, FC5A-D12S1E	I0 - I7, I30 - I627	Q0 - Q3, Q30 - Q627	

A maximum of 16 inputs and 16 outputs can be designated. Use inputs or outputs of a CPU module or I/O module separately. Do not straddle a CPU module and an I/O module to designate input or output devices for a key matrix. For example, when the FC5A-D32K3 CPU module is used and input I10 is designated as the first input number, then 16 cannot be designated as the quantity of inputs. When input I10 is designated as the first input number, a maximum of 8 inputs can be used, I10 through I17.

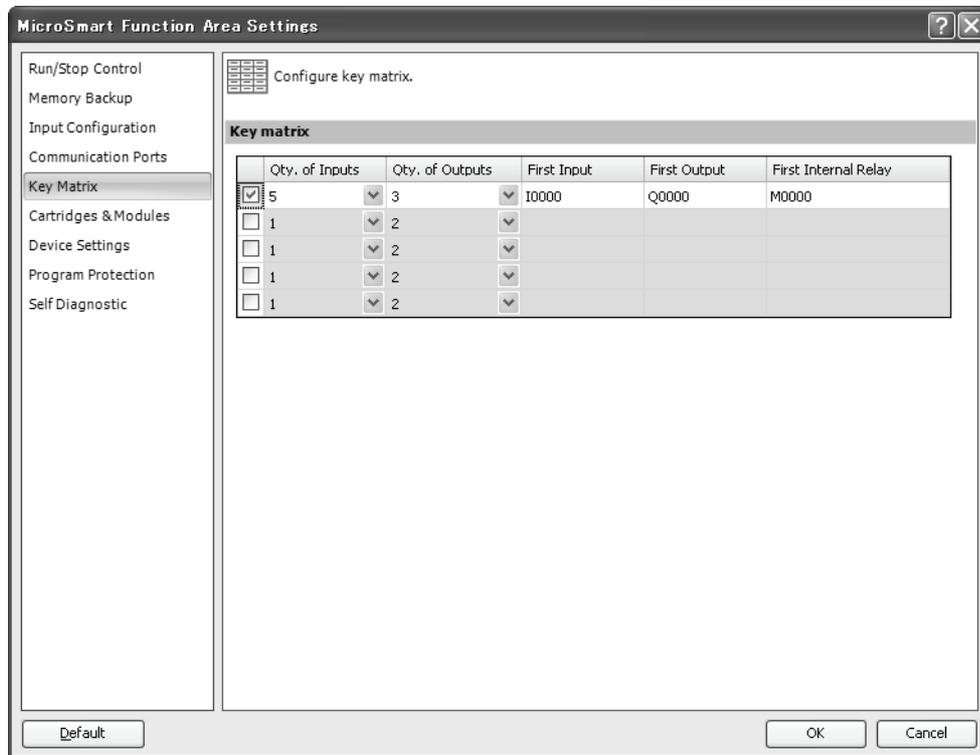
Key matrix input information is stored to internal relays starting with the designated internal relay number. Internal relays as many as input points × output points must be reserved for the key matrix.

Programming WindLDR

1. From the WindLDR menu bar, select **Configuration > Key Matrix**.

The Function Area Settings dialog box for Key Matrix appears.

A maximum of five key matrices can be programmed.



2. Click the check box on the left and enter required data in the fields shown below.

Field	Description
First Input	Enter the first input number used for the key matrix.
Qty of Inputs	Enter the quantity of input points used for the key matrix. Valid range: 1 to 16
First Output	Enter the first output number used for the key matrix.
Qty of Outputs	Enter the quantity of output points used for the key matrix. Valid range: 2 to 16
First Internal Relay	Enter the first internal relay number used for storing key matrix input information. Internal relays as many as input points × output points must be reserved.

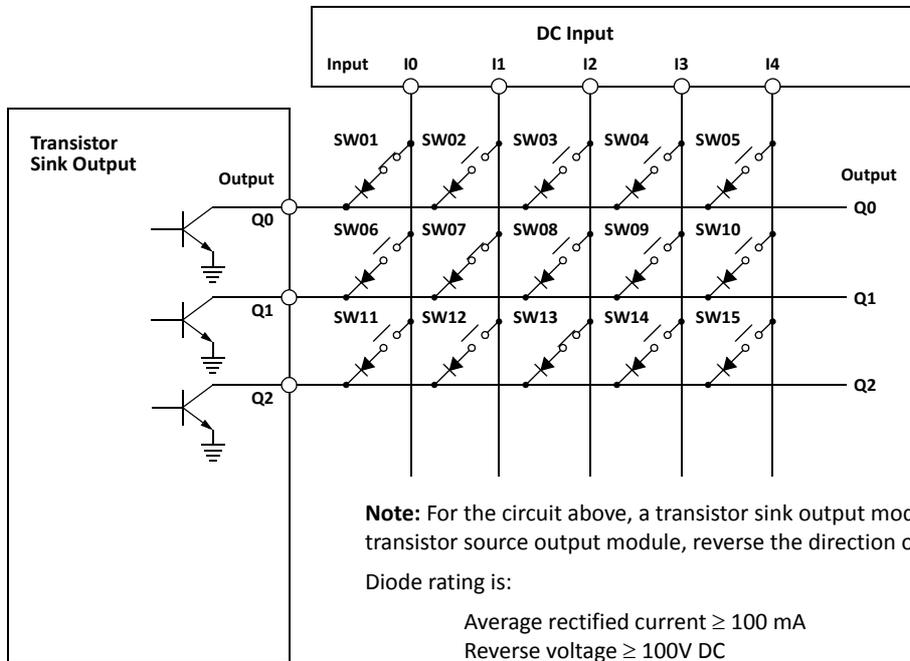
3. Click the **OK** button.
4. Download the user program to the CPU module.

Key Matrix Dialog Box

The screen display shown above is an example to configure a key matrix of 5 input points and 3 output points, starting with input I0 and output Q0. The key matrix information is stored to 15 internal relays starting with M0.

Key Matrix Circuit

The key matrix structure includes sequentially-numbered input points along the top and sequentially-numbered output points along the side. The I/O connecting blocks include a diode and a switch. The following diagram illustrates an example of key matrix circuit consisting of 5 inputs and 3 outputs.



Internal Relay Allocation

The example of a key matrix configuration shown on page 5-39 stores input information to 15 internal relays starting with internal relay M0. The switches are assigned to internal relays as shown below:

Outputs	Inputs				
	I0	I1	I2	I3	I4
Q0	M0 (SW01)	M1 (SW02)	M2 (SW03)	M3 (SW04)	M4 (SW05)
Q1	M5 (SW06)	M6 (SW07)	M7 (SW08)	M10 (SW09)	M11 (SW10)
Q2	M12 (SW11)	M13 (SW12)	M14 (SW13)	M15 (SW14)	M16 (SW15)

Maximum Input Read Time

The maximum period of time required to read input signals in the key matrix circuit is called the maximum input read time, which can be calculated using the following formula. When the input ON duration is shorter than the maximum input read time, the input may not be read.

$$\text{Maximum Input Read Time} = \text{Output Points} \times \left(\left[\frac{\text{I/O Delay Time}}{\text{Scan Time}} + 1 \right] + 1 \right) \times \text{Scan Time}$$

- The scan time can be confirmed using special data register D8023 (scan time current value in ms).
- The I/O delay time depends on the modules used for inputs of the key matrix. The I/O delay time for CPU modules and I/O modules are listed in the table below.
- The value of [X] in the above formula represents the maximum integer value less than or equal to X. For example, [0.23] represents 0, and [2.5] represents 2.

Module Used for Key Matrix Inputs	CPU Module		I/O Module	
	FC5A-C24R2	FC5A-C24R2C	FC4A-N08B1	FC4A-N16B1
FC5A-D16RK1	FC5A-D16RS1	FC4A-N16B3	FC4A-N32B3	
FC5A-D32K3	FC5A-D32S3	FC4A-M08BR1	FC4A-M24BR2	
FC5A-D12K1E	FC5A-D12S1E			
I/O Delay Time	Approx. 5 ms + Input filter value (Note 1)		Approx. 10 ms (Note 2)	

Note 1: The input filter can be selected using WindLDR. From the WindLDR menu bar, select **Configuration > Input Configuration > Input Filters**. Different input filter values can be selected for inputs I0 through I7 in four groups. When the inputs used for the key matrix contain different input filter values, the largest input filter value takes effect for the I/O delay time.

Note 2: When using expansion interface modules (FC5A-EXM2 or FC5A-EXM1M and FC5A-EXM1S) for key matrix inputs or outputs, the I/O delay time is approximately 22 ms.

Example: Calculating Maximum Input Read Time

This example calculates the maximum input read time for a key matrix consisting of 4 inputs and 16 outputs to read 64 points of input signals.

Conditions	MicroSmart System Setup		FC5A-D16RK1 + FC4A-T16K3
	Function Area Settings	Key Matrix Input	I4 to I7 (4 inputs)
		Key Matrix Output	Q30 to Q47 (16 outputs)
		Input Filter (Group 4)	3 ms
	Scan Time	10 ms (D8023 value)	
I/O Delay Time	5 ms + Input filter value (3 ms) = 8 ms		
Calculation Formula	$\begin{aligned} & \text{Output Points} \times \left(\left[\frac{\text{I/O Delay Time}}{\text{Scan Time}} + 1 \right] + 1 \right) \times \text{Scan Time} \\ & = 16 \times \left(\left[\frac{8 \text{ ms}}{10 \text{ ms}} + 1 \right] + 1 \right) \times 10 \text{ ms} \\ & = 16 \times ([1.8] + 1) \times 10 \text{ ms} \\ & = 16 \times (1 + 1) \times 10 \text{ ms} \end{aligned}$		
Maximum Input Read Time	320 ms		

Input Filter

The input filter function is used to reject input noises. The catch input function described in the preceding section is used to read short input pulses to special internal relays. On the contrary, the input filter rejects short input pulses when the MicroSmart is used with input signals containing noises.

Different input filter values can be selected for inputs I0 through I7 in four groups using the Function Area Settings. Selectable input filter values to pass input signals are 0 ms, and 3 through 15 ms in 1-ms increments. Default value is 3 ms for all inputs I0 through I7. Inputs I10 and above on 16- and 24-I/O all-in-one type CPU modules and 32-I/O slim type CPU modules are provided with a fixed filter of 3 ms. Inputs I30 and above on all expansion input modules have a fixed filter of 4 ms. The input filter rejects inputs shorter than the selected input filter value minus 2 ms.

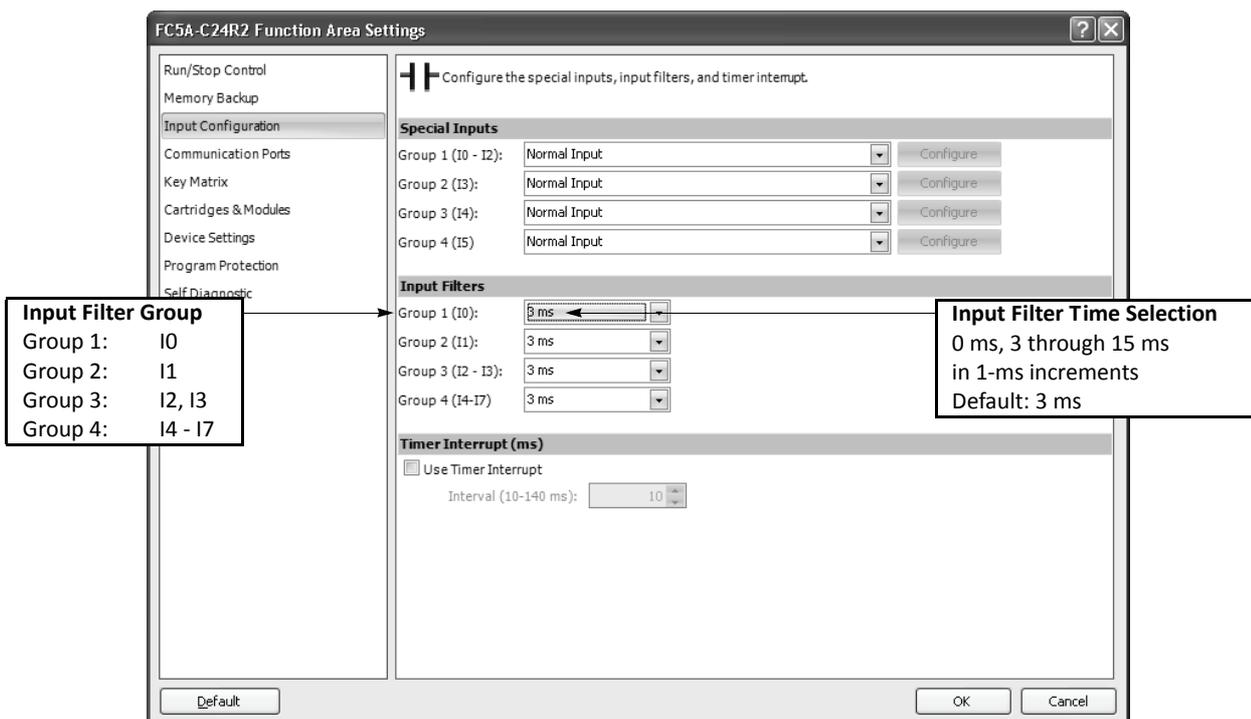
Normal inputs require a pulse width of the filter value plus one scan time to receive input signals. When using the input filter function, select **Normal Input** under Special Inputs on the Input Configuration dialog box in the Function Area Settings.

Since these settings relate to the user program, the user program must be downloaded to the MicroSmart after changing any of these settings.

Programming WindLDR

1. From the WindLDR menu bar, select **Configuration > Input Configuration**.

The Function Area Settings dialog box for Input Configuration appears.



2. Select an input filter value for each group of inputs.

Input Filter Values and Input Operation

Depending on the selected values, the input filter has three response areas to reject or pass input signals.

- Reject area:** Input signals do not pass the filter (selected filter value minus 2 ms).
- Indefinite area:** Input signals may be rejected or passed.
- Pass area:** Input signals pass the filter (selected filter value).

Example: Input Filter 8 ms

To reject input pulses of 6 ms or less, select input filter value of 8 ms. Then input pulses of 8 ms plus one scan time are accepted correctly at the END processing.

	6 ms	8 ms + 1 scan	
Input	Rejected	Indefinite	Accepted

Communication Refresh for Port 3 through Port 7

The expansion communication buffers for port 3 through port 7 are refreshed in the END processing. Communication refresh option for port 3 through port 7 can be used to refresh the buffers every 10 ms during the scan. When the buffers are refreshed, the send data in the buffers are sent out and the receive data in the buffer are processed immediately.

COMRF instructions can also be programmed to refresh the communication buffers for port 3 through port 7 in any place in the ladder program where you want to refresh the buffers. When “Every 10 ms” under “Communication Refresh for Port 3 through Port 7” is selected in the Function Area Settings dialog box, COMRF instructions programmed in the ladder program have no effects. For COMRF instruction, see page 11-13 (Advanced Vol.).

Regardless of the communication refresh option for port 3 through port 7, the expansion communication buffers for port 3 through port 7 are always refreshed in the END processing.

Since these settings relate to the user program, the user program must be downloaded to the MicroSmart after changing this setting.

Communication Refresh for Port 3 through port 7 can be used with the CPU module system program version 220 or higher.

Programming WindLDR

1. From the WindLDR menu bar, select **Configuration > Comm. Ports**.

The Function Area Settings dialog box for Communication Ports appears.

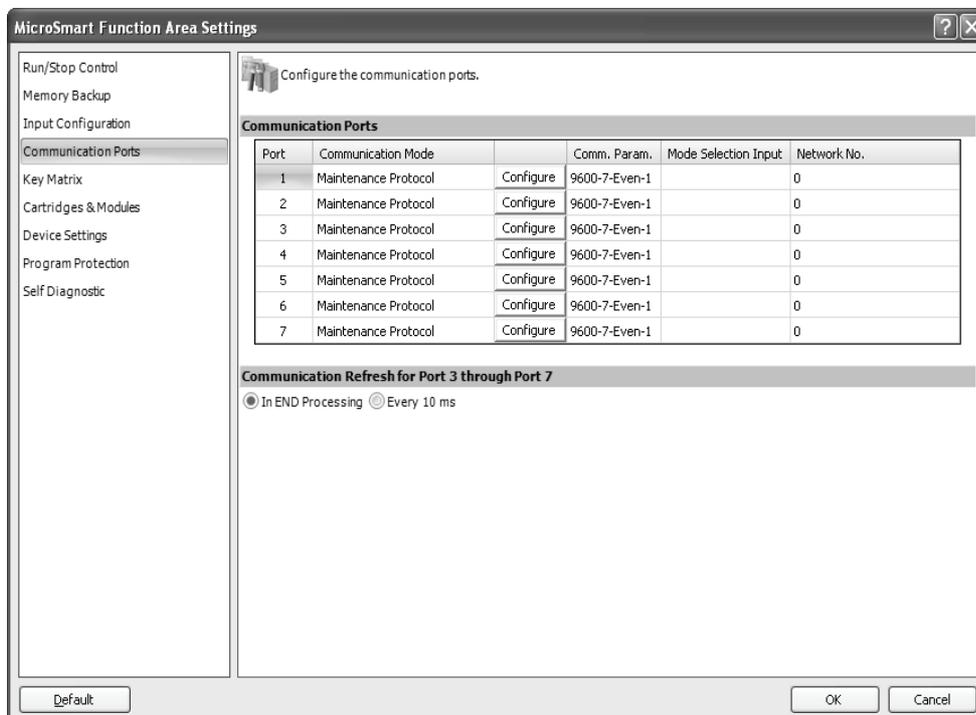
2. Click the In END Processing or Every 10 ms button.

In END Processing (Default):

Click this button to refresh the expansion communication buffers for port 3 through port 7 in the END processing.

Every 10 ms:

Click this button to refresh the expansion communication buffers for port 3 through port 7 every 10 ms during the scan.



3. Click the **OK** button.

User Program Protection

The user program in the MicroSmart CPU module can be protected from reading, writing, or both using the Function Area Settings in WindLDR.

Upgraded CPU modules with system program version 210 or higher have an option for read protection without a password, making it possible to inhibit reading completely.

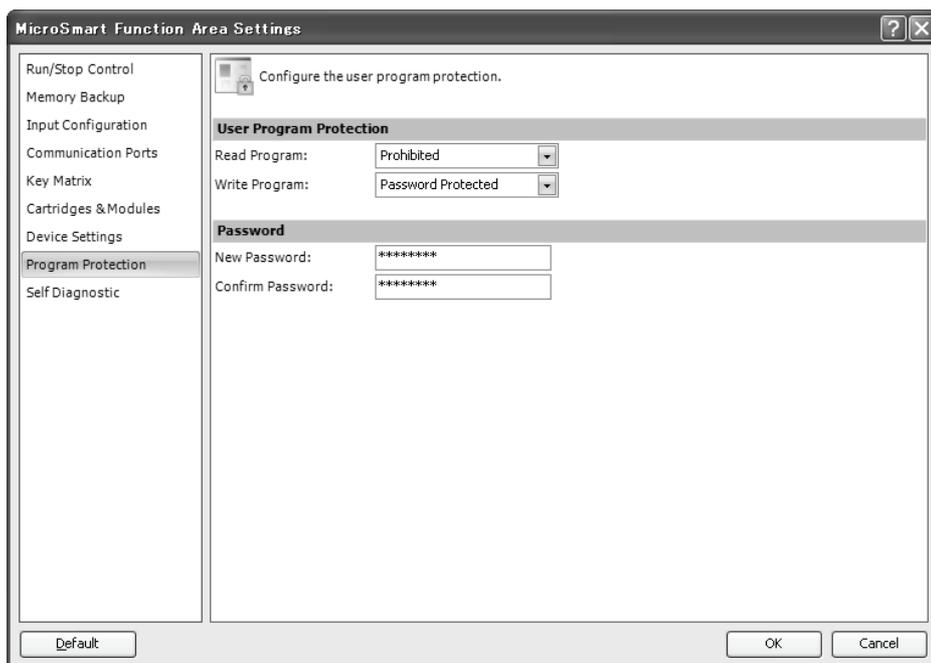
Warning • Before proceeding with the following steps, make sure to note the protect code, which is needed to disable the user program protection. If the user program in the MicroSmart CPU module is write- or read/write-protected, the user program cannot be changed without the protect code.

Caution • If the user program is read-protected without using a password, the read protection cannot be temporarily disabled using the password, thus the user program cannot be read out by any means. To disable the read protection, download another user program without user program protection.

Programming WindLDR

1. From the WindLDR menu bar, select **Configuration > Program Protection**.

The Function Area Settings dialog box for Program Protection appears.



2. Under **User Program Protection**, select required protect modes for **Read Program** and **Write Program** in the pull-down list.

- Unprotected:** The user program in the CPU module can be read and written without a password.
- Password Protected:** Prevents unauthorized copying or inadvertent replacement of the user program. The protection can be temporarily disabled using a predetermined password.
- Prohibited:** Prevents copying of the user program completely. This option is available for read protection only and can not be temporarily disabled using a password. To select this option, use a CPU module with system program ver. 210 or higher and WindLDR ver 5.31 or higher

3. After selecting a required protect mode, enter a password of 1 through 8 ASCII characters from the key board in the **New Password** field, and enter the same password in the **Confirm Password** field.
4. Click the **OK** button and download the user program to the MicroSmart after changing any of these settings.

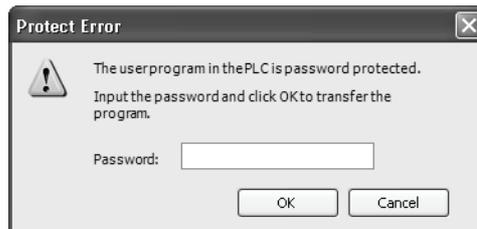
Disabling Protection

When the user program is password-protected against read and/or write, the protection can be temporarily disabled using WindLDR.

If the user program is read-prohibited, the read protection cannot be disabled, thus the user program cannot be read out by any means. To disable the read protection, download another user program without user program protection.

1. From the WindLDR menu bar, select **Online > Download or Upload**.

When the user program in the CPU module is read and/or write protected, the Protect Error dialog box appears. When program verification or online edit is attempted, the Protect Error dialog box appears.



2. Enter the password and click the **OK** button.

The user program protection is disabled only temporarily. When the CPU module is powered up again, the protection designated in the user program takes effect again.

To disable or change the protection permanently, change the protection settings and download the user program.

32-bit Data Storage Setting

When the double-word, long, or float data type is selected for the source or destination device, the data is loaded from or stored to two consecutive data registers. The order of two devices can be selected from the following two settings in the Function Area Settings.

This setting can be used on CPU modules with system program version 110 or higher.

Setting	Description
From Upper Word	When a data register, timer, or counter is used as a double-word device, the high-word data is loaded from or stored to the first device selected. The low-word data is loaded from or stored to the subsequent device. This is identical with the 32-bit data storage of OpenNet Controller and FC4A MicroSmart, and is the default setting of the FC5A MicroSmart.
From Lower Word	When a data register, timer, or counter is used as a double-word device, the low-word data is loaded from or stored to the first device selected. The high-word data is loaded from or stored to the subsequent device. This is identical with the 32-bit data storage of IDEC FA Series PLCs.

Devices

When the devices listed below are used as a double-word device, two consecutive devices are processed according to the 32-bit data storage settings.

Device	Device Address
Data Register	D0 - D1999
Expansion Data Register	D2000 - D7999
Special Data Register	D8000 - D8499
Extra Data Register	D10000 - D49999
Timer	T0 - T255
Counter	C0 - C255

Instructions

The 32-bit data storage setting has the effect on the following instructions: CNTD, CDPD, CUDD, MOV, MOVN, IMOV, IMOVN, NSET, NRS, TCCST, CMP=, CMP<>, CMP<, CMP>, CMP<=, CMP>=, ICMP>=, LC=, LC<>, LC<, LC>, LC<=, LC>=, ADD, SUB, MUL, DIV, ROOT, ANDW, ORW, XORW, BCDLS, ROTL, ROTR, HTOB, BTOH, BTOA, ATOB, CVDT, AVRG, PULS, PWM, RAMP, RAD, DEG, SIN, COS, TAN, ASIN, ACOS, ATAN, LOGE, LOG10, EXP, and POW.

Data Register Allocation

The 32-bit data storage setting has the effect on data register allocation of the following functions: PULS, PWM, and RAMP instructions, frequency measurement, and high-speed counter. All of these functions can be used on the slim type CPU modules only.

Control Registers for PULS or PWM Instruction

Device Address	Description	From Upper Word	From Lower Word
S1+3	Preset Value 1 to 100,000,000 (05F5E100h)	High Word	Low Word
S1+4		Low Word	High Word
S1+5	Current Value 1 to 100,000,000 (05F5E100h) (PULS1, PULS3, PWM1, and PWM3 only)	High Word	Low Word
S1+6		Low Word	High Word

Control Registers for RAMP Instruction

Device Address	Description	From Upper Word	From Lower Word
S1+6	Preset Value 1 to 100,000,000 (05F5E100h)	High Word	Low Word
S1+7		Low Word	High Word
S1+8	Current Value 1 to 100,000,000 (05F5E100h)	High Word	Low Word
S1+9		Low Word	High Word

Special Data Registers for Frequency Measurement

Device Address	Description	From Upper Word	From Lower Word
D8060	Frequency Measurement Value I1	High Word	Low Word
D8061		Low Word	High Word
D8062	Frequency Measurement Value I3	High Word	Low Word
D8063		Low Word	High Word
D8064	Frequency Measurement Value I4	High Word	Low Word
D8065		Low Word	High Word
D8066	Frequency Measurement Value I7	High Word	Low Word
D8067		Low Word	High Word

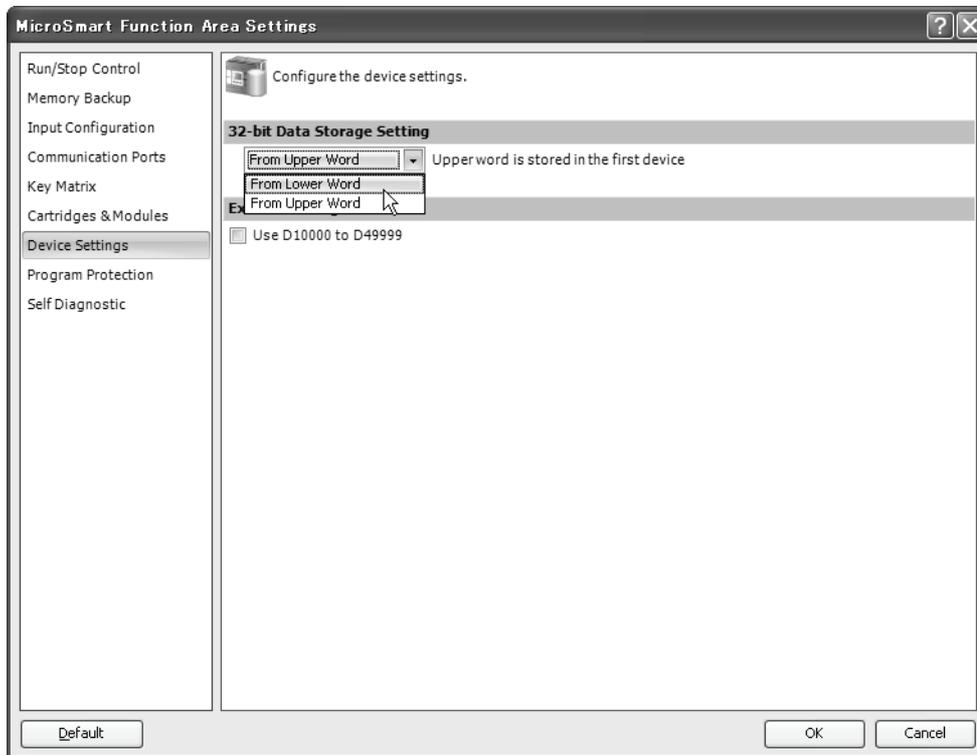
Special Data Registers for High-speed Counters

Device Address	Description	From Upper Word	From Lower Word
D8210	High-speed Counter 1 (I0-I2) Current Value	High Word	Low Word
D8211		Low Word	High Word
D8212	High-speed Counter 1 (I0-I2) Preset Value 1	High Word	Low Word
D8213		Low Word	High Word
D8214	High-speed Counter 1 (I0-I2) Preset Value 2	High Word	Low Word
D8215		Low Word	High Word
D8216	High-speed Counter 1 (I0-I2) Reset Value	High Word	Low Word
D8217		Low Word	High Word
D8218	High-speed Counter 2 (I3) Current Value	High Word	Low Word
D8219		Low Word	High Word
D8220	High-speed Counter 2 (I3) Preset Value	High Word	Low Word
D8221		Low Word	High Word
D8222	High-speed Counter 3 (I4) Current Value	High Word	Low Word
D8223		Low Word	High Word
D8224	High-speed Counter 3 (I4) Preset Value	High Word	Low Word
D8225		Low Word	High Word
D8226	High-speed Counter 4 (I5-I7) Current Value	High Word	Low Word
D8227		Low Word	High Word
D8228	High-speed Counter 4 (I5-I7) Preset Value 1	High Word	Low Word
D8229		Low Word	High Word
D8230	High-speed Counter 4 (I5-I7) Preset Value 2	High Word	Low Word
D8231		Low Word	High Word
D8232	High-speed Counter 4 (I5-I7) Reset Value	High Word	Low Word
D8233		Low Word	High Word

Programming WindLDR

1. From the WindLDR menu bar, select **Configuration > Device Settings**.

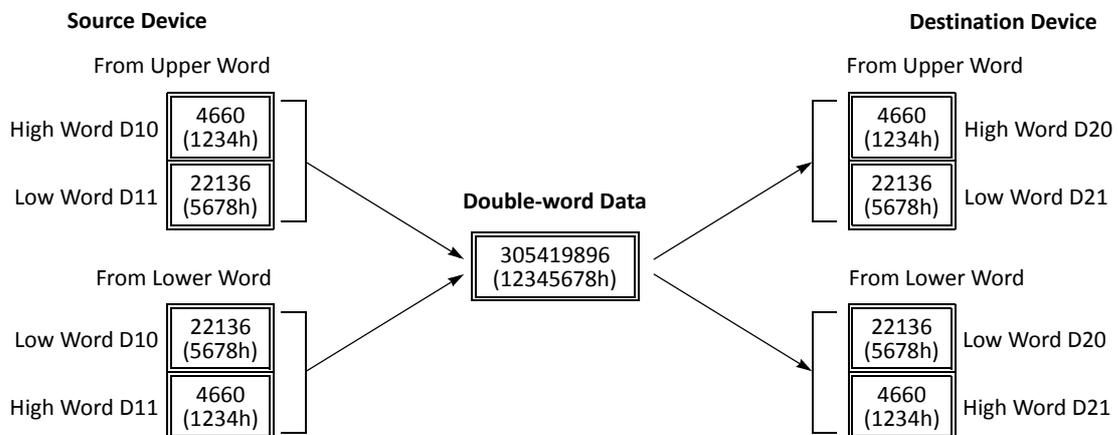
The Function Area Settings dialog box for Device Settings appears.



2. Under **32-bit Data Storage Setting**, select **From Upper Word** or **From Lower Word** in the pull-down list.

Example: 32-bit Data Storage Setting

When data register D10 is designated as a double-word source device and data register D20 is designated as a double word destination device, the data is loaded from or stored to two consecutive devices according the 32-bit data storage setting as illustrated below.



RUN LED Flashing Mode

The RUN LED flashing mode has been added to the MicroSmart CPU modules. The internal status of the MicroSmart CPU module can be seen with the flashing status of the RUN LED. The RUN LED flashes slowly or quickly according to the status of the MicroSmart as shown below.

The RUN LED flashing mode can be used with the CPU module system program version 200 or higher. This setting is always enabled in the FC5A-D12K1E and D12S1E.

RUN LED status	Description
Slow Flash (1-sec interval)	Test program has been downloaded to the MicroSmart but not been confirmed nor canceled during the online editing.
	Timer/counter preset values have been changed but not been confirmed nor canceled.
Quick Flash (100-ms interval)	During the user program in the RAM of the MicroSmart is written to the EEPROM.

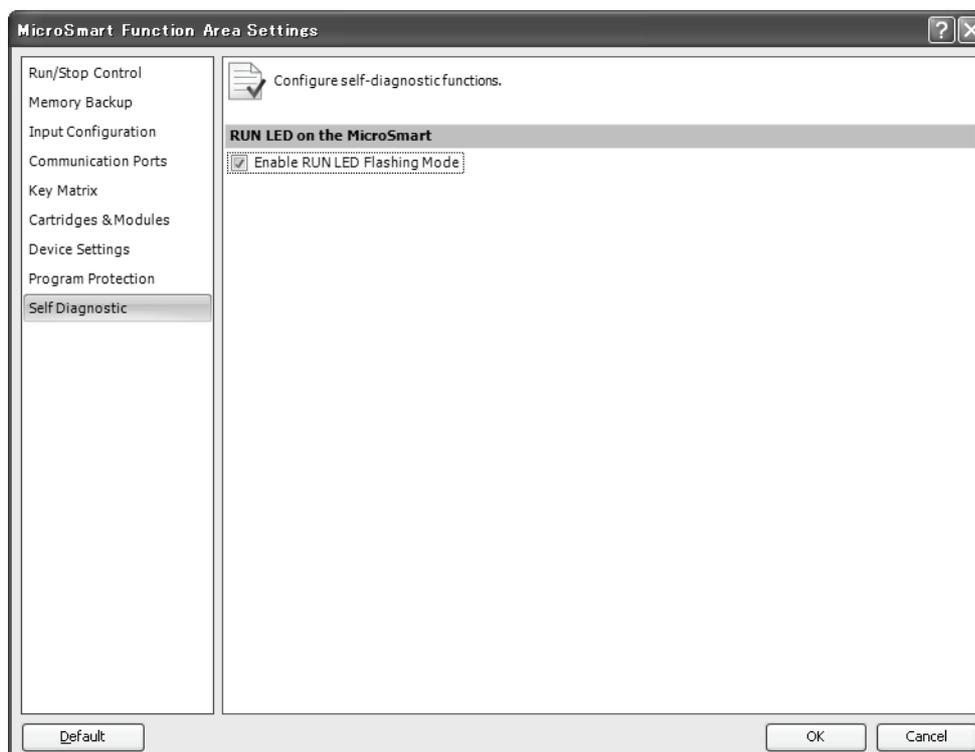
Notes:

- RUN LED flashes when inputs/outputs are forced on/off regardless of the RUN LED flashing mode setting. See page 5-72.
- While RUN LED flashes quickly, do not shut down the CPU module. Otherwise, a fatal error may occur such as user program writing error.

Programming WindLDR

1. From the WindLDR menu bar, select **Configuration > Self Diagnostic**.

The Function Area Settings dialog box for Self Diagnostic appears.



2. Click the check box to enable the RUN LED flashing mode.

Constant Scan Time

The scan time may vary whether basic and advanced instructions are executed or not depending on input conditions to these instructions. The scan time can be made constant by entering a required scan time preset value into special data register D8022 reserved for constant scan time. When performing accurate repetitive control, make the scan time constant using this function. The constant scan time preset value can be between 1 and 1,000 ms.

The scan time error is ±1 ms of the preset value normally. When the data link or other communication functions are used, the scan time error may be increased to several milliseconds.

When the actual scan time is longer than the scan time preset value, the scan time cannot be reduced to the constant value.

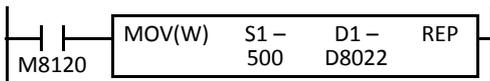
Special Data Registers for Scan Time

In addition to D8022, three more special data registers are reserved to indicate current, maximum, and minimum scan time values.

D8022	Constant Scan Time Preset Value (1 to 1,000 ms)
D8023	Scan Time Current Value (ms)
D8024	Scan Time Maximum Value (ms)
D8025	Scan Time Minimum Value (ms)

Example: Constant Scan Time

This example sets the scan time to a constant value of 500 ms.



M8120 is the initialize pulse special internal relay.

When the CPU starts operation, the MOV (move) instruction stores 500 to special data register D8022.

The scan time is set to a constant value of 500 ms.

Online Edit, Run-Time Program Download, and Test Program Download

Normally, the CPU module has to be stopped before downloading a user program. Using WindLDR 5.0 or higher, the FC5A MicroSmart CPU modules have online edit capabilities which allow to make small modifications to the user program while monitoring the CPU module operation on the WindLDR screen either in the 1:1 or 1:N computer link system.

While monitoring on the WindLDR screen, the modified user program can be downloaded in two ways: run-time program download and test program download.

When executing run-time program download, the modified user program is downloaded to the EEPROM in the CPU module and replaces the original user program permanently. When download is completed, the modified program is executed and monitored on the WindLDR screen.

The test program download replaces the user program in the RAM only and does not overwrite the EEPROM immediately. When test program download is completed, the modified program is executed while the original user program still remains in the EEPROM. Before quitting the test program download, you are asked whether to store the modified user program in the EEPROM or discard the modified program.

Before performing the online edit, a user program has to be downloaded to the CPU module using the ordinary program download. Add or delete a part of the same user program, or make small changes to the same user program, and download the modified user program using the run-time program download or test program download while the CPU is running to confirm the changes online.

Another method of using this feature is: upload the user program from the CPU module to WindLDR, make changes, and download the modified user program while the CPU is running.

Online Edit

Before starting the online edit using WindLDR, download a user program to the CPU module or upload a user program from the CPU module using the ordinary program download or upload. If user programs do not match between WindLDR and the CPU module, the online edit cannot be used.

Online edit can not change Function Area Settings and Expansion Data Register values. Only ladder diagrams can be edited.

When TIM/CNT preset values have been changed as a result of advanced instructions or through communication, confirm or clear the changes before starting the online edit. See page 7-18.

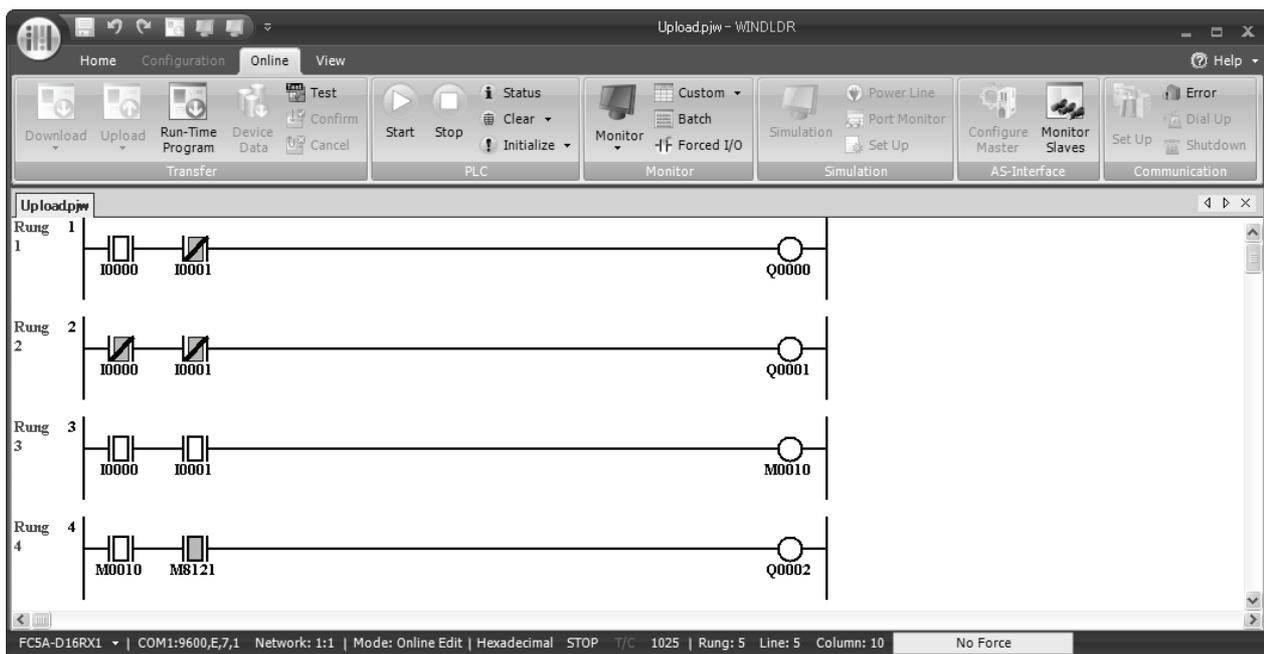
If you do not want to clear the new preset values during the run-time program download or test program download, you can import the new preset values to the user program. Access the PLC Status dialog box from the Online menu in the monitoring mode. Then click the **Confirm** button in the TIM/CNT Change Status field. (The displayed status will switch from **Changed** to **Unchanged**.) Upload the user program, which has new preset values in place of the original preset values. Make changes to the uploaded user program, then perform the run-time program download or test program download. Note that the **Confirm** button has effect on both timer and counter preset values.

Note: When “Enable D10000 to D49999” has been selected in the Function Area Settings for the slim type CPU module, the online edit cannot be used. To use the online edit, deselect the use of extra data registers D10000 to D49999. See page 6-2.

Programming WindLDR

1. From the WindLDR menu bar, select **Online > Monitor > Online Edit** while the CPU module is running.

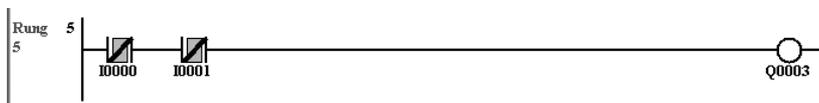
WindLDR enters Online Edit mode where the user program can be modified while monitoring the CPU module operation.



2. Edit the user program.

In this example, a rung is inserted, two NC contacts are programmed in series and connected to an output.

The added program is monitored immediately.



Run-Time Program Download



Caution

- The run-time program download may cause unexpected operation of the MicroSmart. Before starting the run-time program download, make sure of safety after understanding the function correctly.
- If many changes are made to a user program, the possibility of unexpected operation increases. Keep changes to a minimum in one modification and download the user program to make sure of safety.
- If a user program syntax error or user program writing error occurs during the run-time program download, the CPU module is stopped and all outputs are turned off, which may cause hazards depending on the application.
- Immediately when program download is completed, the new user program is executed. It takes a maximum of 60 seconds to store the downloaded program to the ROM. In this period, the scan time is extended by about 10 to 130 ms per scan.
- While executing the run-time program download, do not shut down the CPU module or disconnect the communication cable. Otherwise, a fatal error may occur such as user program writing error, which may cause hazards depending on the application.
- When executing the run-time program download, output statuses are maintained. When an OUT/OUTN instruction is deleted or an output device address has been changed, the output status is maintained after executing the run-time program download. This may cause hazards depending on the application.

Note: For FC5A-D12K1E and FC5A-D12S1E, it is possible to select whether to use a program capacity of 62,400 bytes or 127,800 bytes. If 127,800 bytes is selected, the run-time program download cannot be used.

The run-time program download function is used to download a modified user program to the EEPROM in the CPU module while the CPU is running. When program download is complete, the CPU module executes the new program in the next scan.

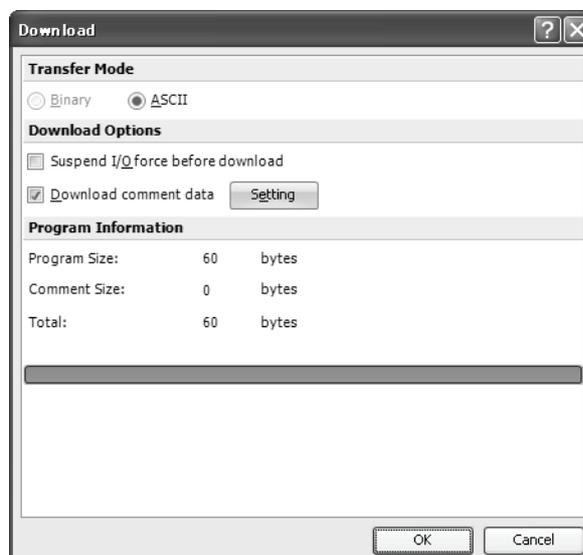
When run-time program download is completed, outputs, internal relays, shift registers, timer/counter current values, and data registers maintain the previous statuses. Timer/counter preset values are replaced by the new values.

Programming WindLDR

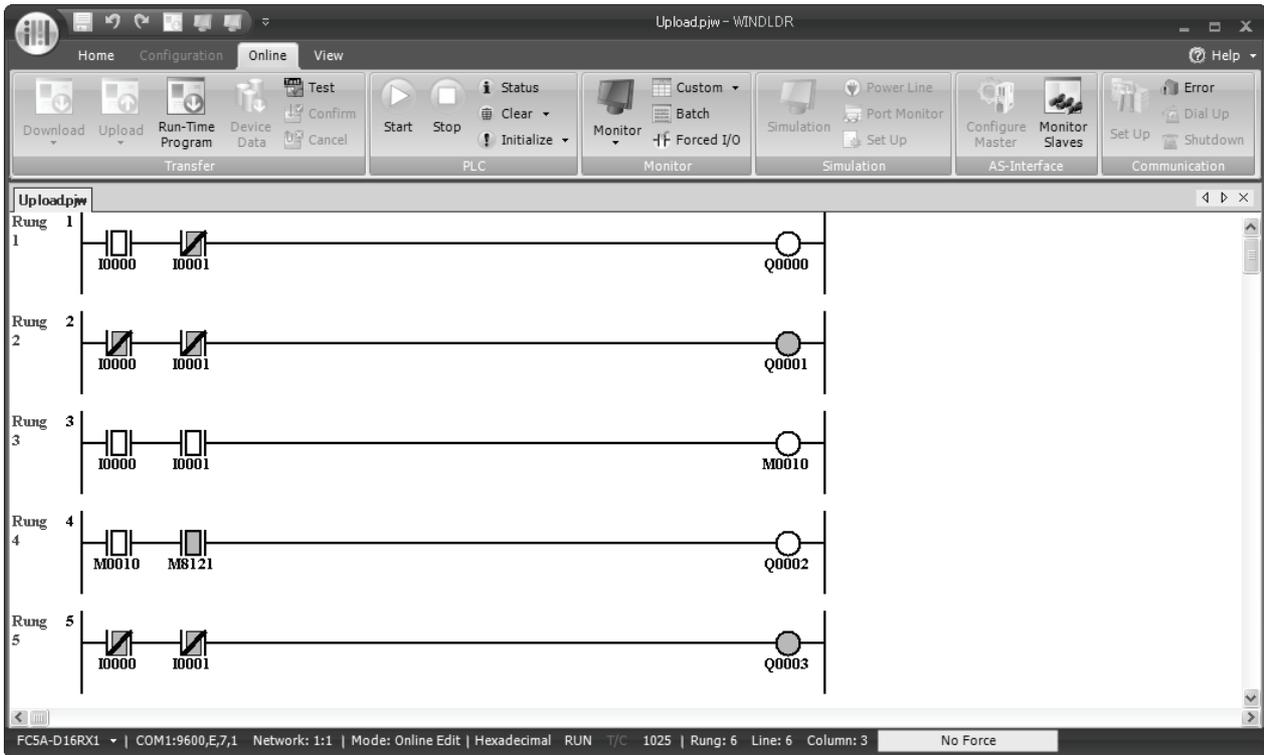
1. To execute run-time program download, select **Online > Run-Time Program**.

The Download Program Dialog appears.

2. Click the **OK** button to start downloading the user program to the EEPROM in the CPU module.



3. Monitor the downloaded program.



4. To quit the online edit mode, select **Online > Online Edit**.

Notes for Using Run-Time Program Download:

- When DISP, DGRD, AVRG, PULS, PWM, RAMP, ZRN, or PID instructions have been added or edited, the input to these instructions needs to remain off for one scan time to initialize these inputs.
- SOTU/SOTD instructions are initialized in the first scan after the run-time program download is completed.
- Function Area Settings and Expansion Data Register values cannot be changed using the online edit. To change these settings, download the user program using the ordinary program download procedure.
- When the communication buffer for TXD/RXD/ETXD/ERXD instructions still holds the instruction data, the run-time program download does not overwrite the data in the communication buffer immediately. After the communication has been completed according to the existing data in the buffer, the new data for TXD/RXD/ETXD/ERXD instructions takes effect. To clear the receive buffer for the RXD instruction, turn on the special internal relay for user communication receive instruction cancel flag, such as M8022 for port 1 or M8023 for port 2. See the example on page 5-57.
- If communication is interrupted during run-time program download, disparity between user programs in the RAM and ROM occurs. If this is the case, quit the online edit and download the user program to the CPU module using the ordinary program download procedure.

Test Program Download



Caution

- The test program download may cause unexpected operation of the MicroSmart. Before starting the test program download, make sure of safety after understanding the function correctly.
- If many changes are made to a user program, the possibility of unexpected operation increases. Keep changes to a minimum in one modification and download the user program to make sure of safety.
- If a user program syntax error or user program writing error occurs during the test program download, the CPU module is stopped and all outputs are turned off, which may cause hazards depending on the application.
- Before quitting the test program download, confirm or cancel the test program to select whether to store the modified user program to the ROM or discard the changes. Before executing the confirming procedure, the ROM stores the original user program. If the CPU module is shut down before confirming, the modified user program is lost.
- When cancelling the test program after making changes to the user program, only the original user program is restored and device values are not restored.
- While executing the test program download, do not shut down the CPU module or disconnect the communication cable. Otherwise, a fatal error may occur such as user program writing error, which may cause hazards depending on the application.
- When executing the test program download, output statuses are maintained. When an OUT/OUTN instruction is deleted or an output device address has been changed, the output status is maintained after executing the test program download. This may cause hazards depending on the application.
- When executing the Cancel Test Program, the original user program in the ROM is restored, but device values are maintained and are not restored.

The test program download replaces the user program in the RAM only and does not overwrite the ROM immediately. When test program download is completed, the modified program is executed while the original user program still remains in the ROM. Before quitting the test program download, you are asked whether to store the modified user program to the ROM or discard the modified program.

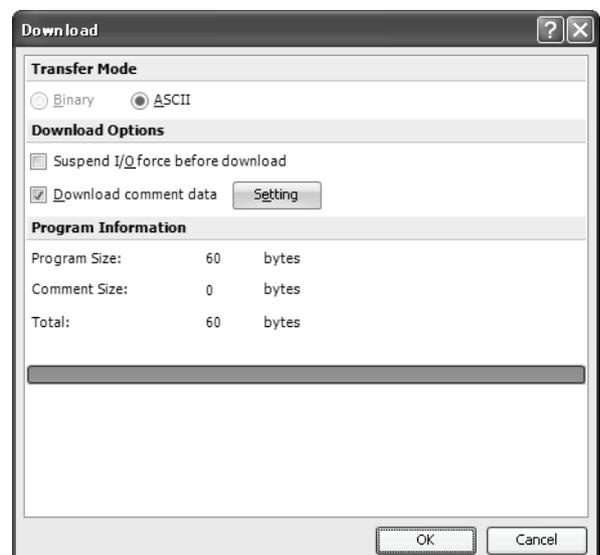
When test program download is completed, outputs, internal relays, shift registers, timer/counter current values, and data registers maintain the previous statuses. Timer/counter preset values are replaced by the new values.

Programming WindLDR

1. To execute test program download, select **Online > Test**.

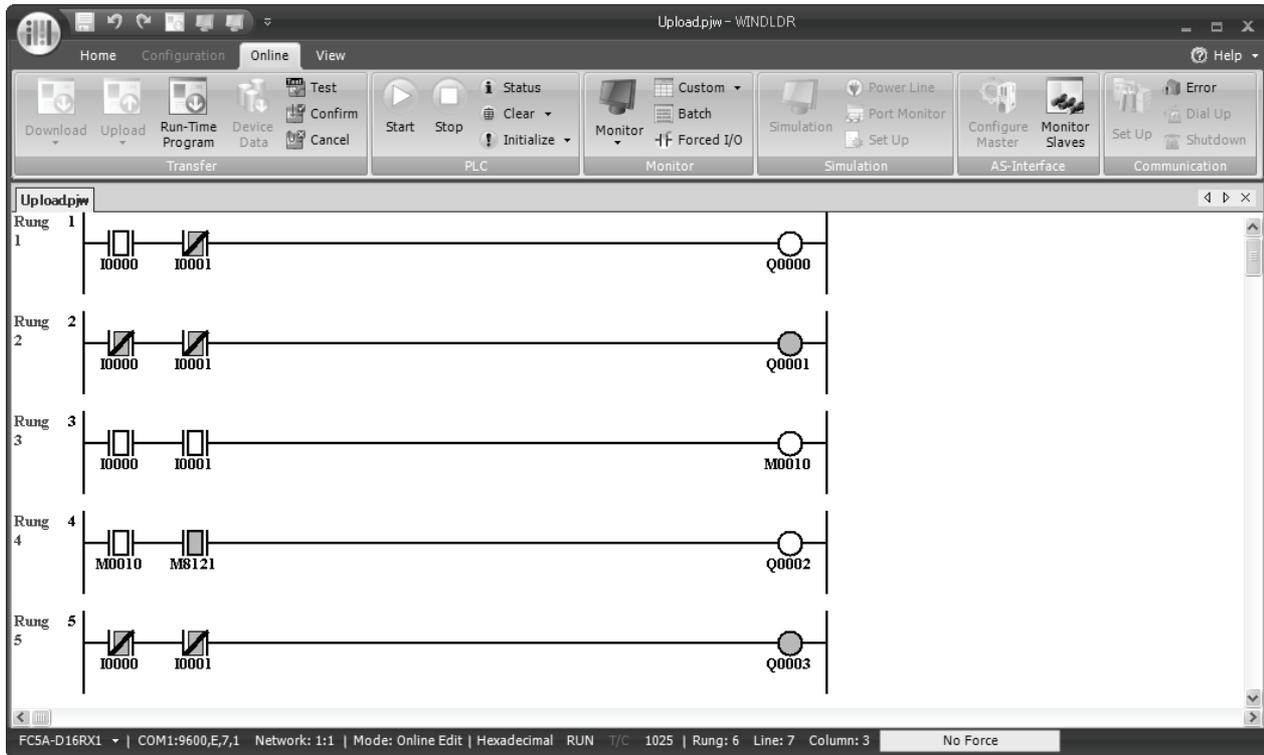
The Download Program Dialog appears.

2. Click the **OK** button to start downloading the user program to the RAM in the CPU module.



5: SPECIAL FUNCTIONS

3. Monitor the downloaded program.



Before quitting the test program download, you have to store the modified user program to the ROM or discard the modified program.

4-1. To store the downloaded program to the ROM, select **Online > Confirm**.

When a confirmation box appears, click **Yes** to store the downloaded program to the ROM.

The modified program is stored from the RAM to the ROM and can still be monitored.

4-2. To discard the downloaded program, select **Online > Cancel**.

When a confirmation box appears, click **Yes** to discard the downloaded program

The original user program stored in the ROM is restored and loaded to the RAM.

Note: If an output status is changed because of the test program download, the output status is maintained after discarding the downloaded program. In the above example, output Q3 is turned on after executing the test program download, and remains on after discarding the downloaded program. This may cause hazards depending on the application.

5. To quit the online edit mode, select **Online > Monitor > Online Edit**.

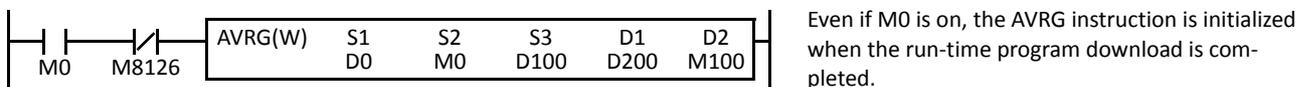
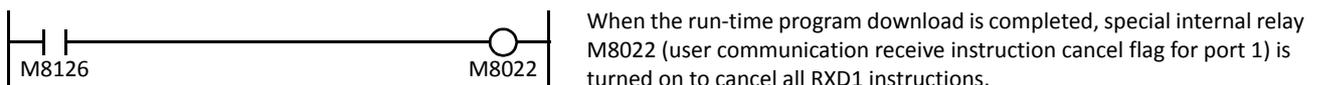
Note: To quit the online edit mode after executing the test program download, execute either Confirm, Cancel, or Run-Time Program Download, otherwise the online edit mode cannot be quit.

Notes for Using Test Program Download:

- Immediately when test program download is complete, the new user program is executed.
- When executing the Confirm Test Program, it takes a maximum of 60 seconds to store the downloaded program to the ROM. In this period, the scan time is extended by about 10 to 130 ms per scan.
- When the Download Test Program (to RAM) or Cancel Test Program is completed, special internal relay M8126 turns on for one scan time.
- When DISP, DGRD, AVRG, PULS, PWM, RAMP, ZRN, or PID instructions have been added or edited, the input to these instructions needs to remain off for one scan time to initialize these inputs.
- SOTU/SOTD instructions are initialized in the first scan after the Download Test Program (to RAM) or Cancel Test Program is completed.
- Function Area Settings and Expansion Data Register values cannot be changed using the online edit. To change these settings, download the user program using the ordinary program download procedure.
- When the communication buffer for TXD/RXD/ETXD/ERXD instructions still holds the instruction data, the Download Test Program (to RAM) or Cancel Test Program operation does not overwrite the data in the communication buffer immediately. After the communication has been completed according to the existing data in the buffer, the new data for TXD/RXD/ETXD/ERXD instructions takes effect. To clear the receive buffer for the RXD instruction, turn on the special internal relay for user communication receive instruction cancel flag, such as M8022 for port 1 or M8023 for port 2. See the example on page 5-57.
- If communication is interrupted during test program download, disparity between user programs in the RAM and ROM occurs. If this is the case, quit the online edit and download the user program to the CPU module using the ordinary program download procedure.

M8126 Run-Time Program Download Completion (ON for 1 scan)

After the run-time program download has been completed, special internal relay M8126 turns on for one scan time when the CPU starts to run. During the test program download, M8126 also turns on for one scan time when the Download Test Program (to RAM) or Cancel Test Program is completed. This special internal relay is useful for initializing instructions.

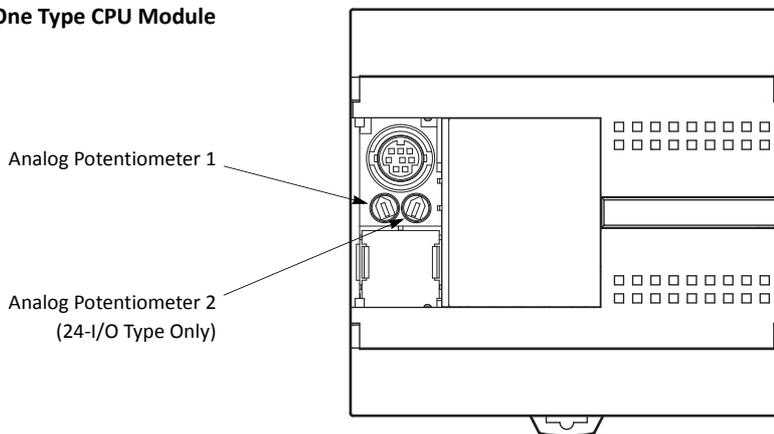
Example: Initialize the AVRG instruction after Run-Time Program Download**Example: Cancel all RXD instructions after Run-Time Program Download**

Analog Potentiometers

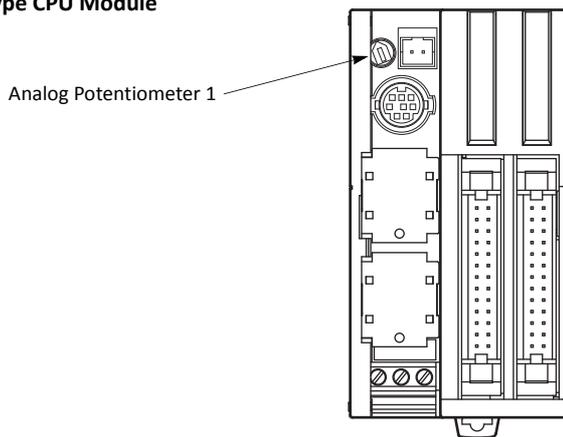
The all-in-one 10- and 16-I/O type CPU modules and every slim type CPU module have one analog potentiometer. Only the 24-I/O type CPU module has two analog potentiometers. The values (0 through 255) set with analog potentiometers 1 and 2 are stored to data registers D8057 and D8058, respectively, and updated in every scan.

The analog potentiometer can be used to change the preset value for a timer or counter.

All-in-One Type CPU Module



Slim Type CPU Module

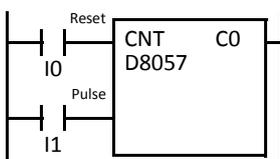


Special Data Registers for Analog Potentiometers

CPU Module	Analog Potentiometer 1	Analog Potentiometer 2
FC5A-C24R2 and FC5A-C24R2C	D8057	D8058
Other CPU Modules	D8057	—

Example: Changing Counter Preset Value Using Analog Potentiometer

This example demonstrates a program to change a counter preset value using analog potentiometer 1.



Analog potentiometer 1 value is stored to data register D8057, which is used as a preset value for counter C0.

The preset value is changed between 0 and 255 using the potentiometer.

Analog Voltage Input

Every slim type CPU module has an analog voltage input connector. When an analog voltage of 0 through 10V DC is applied to the analog voltage input connector, the signal is converted to a digital value of 0 through 255 and stored to special data register D8058. The data is updated in every scan.

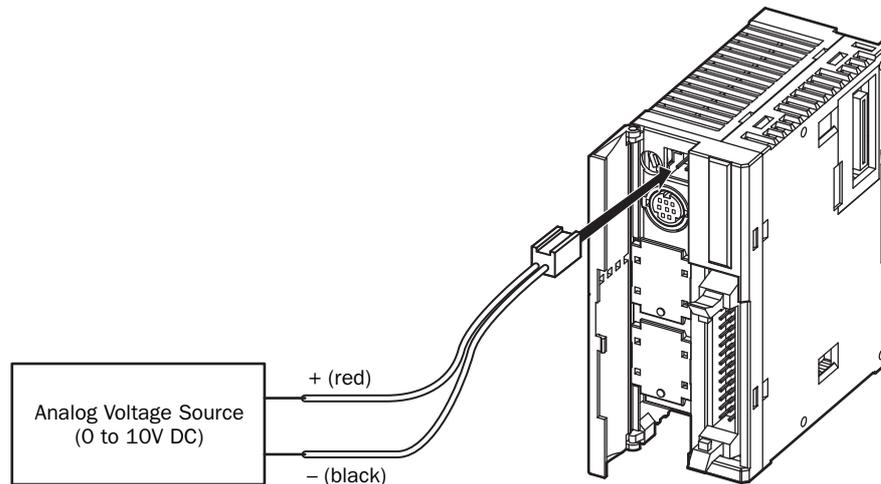
Special Data Register for Analog Voltage Input

CPU Module	Analog Voltage Input Data
Slim Type CPU Modules	D8058

To connect an external analog source, use the attached cable.

The cable is also available optionally.

Cable Name	Type No.
Analog Voltage Input Cable (1m/3.28 ft. long)	FC4A-PMAC2P (package quantity 2)



Caution

- Do not apply a voltage exceeding 10V DC to the analog voltage input, otherwise the CPU module may be damaged.

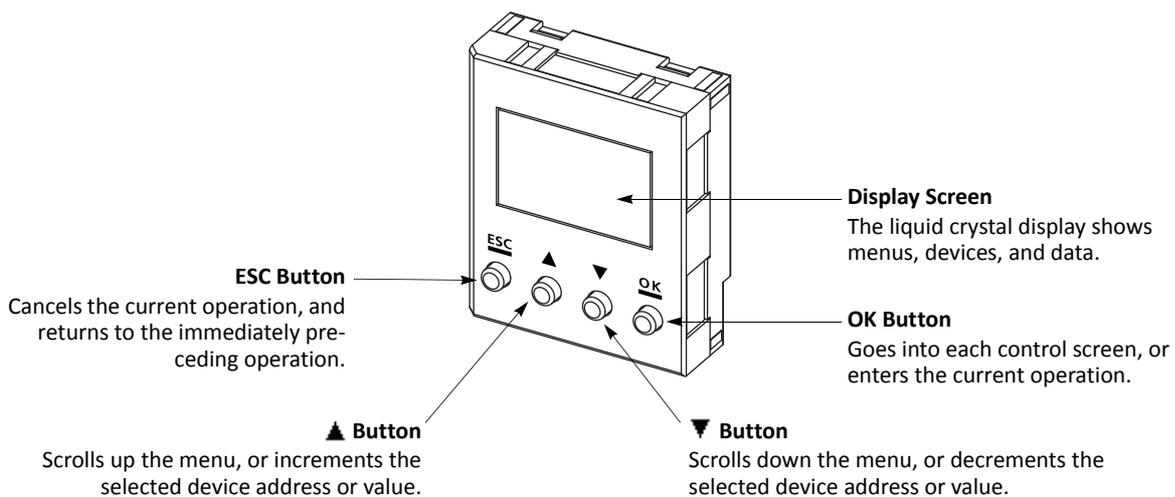
HMI Module

This section describes the functions and operation of the optional HMI module (FC4A-PH1). The HMI module can be installed on any all-in-one type CPU module, and also on the HMI base module mounted next to any slim type CPU module. The HMI module makes it possible to manipulate the RAM data in the CPU module without using the Online menu options in WindLDR. For details about the specifications of the HMI module, see page 2-80.

HMI module functions include:

- Displaying timer/counter current values and changing timer/counter preset values
- Displaying and changing data register values
- Setting and resetting bit device statuses, such as inputs, outputs, internal relays, and shift register bits
- Displaying and clearing error data
- Starting and stopping the PLC
- Displaying and changing calendar/clock data (only when using the clock cartridge)
- Confirming changed timer/counter preset values

Parts Description

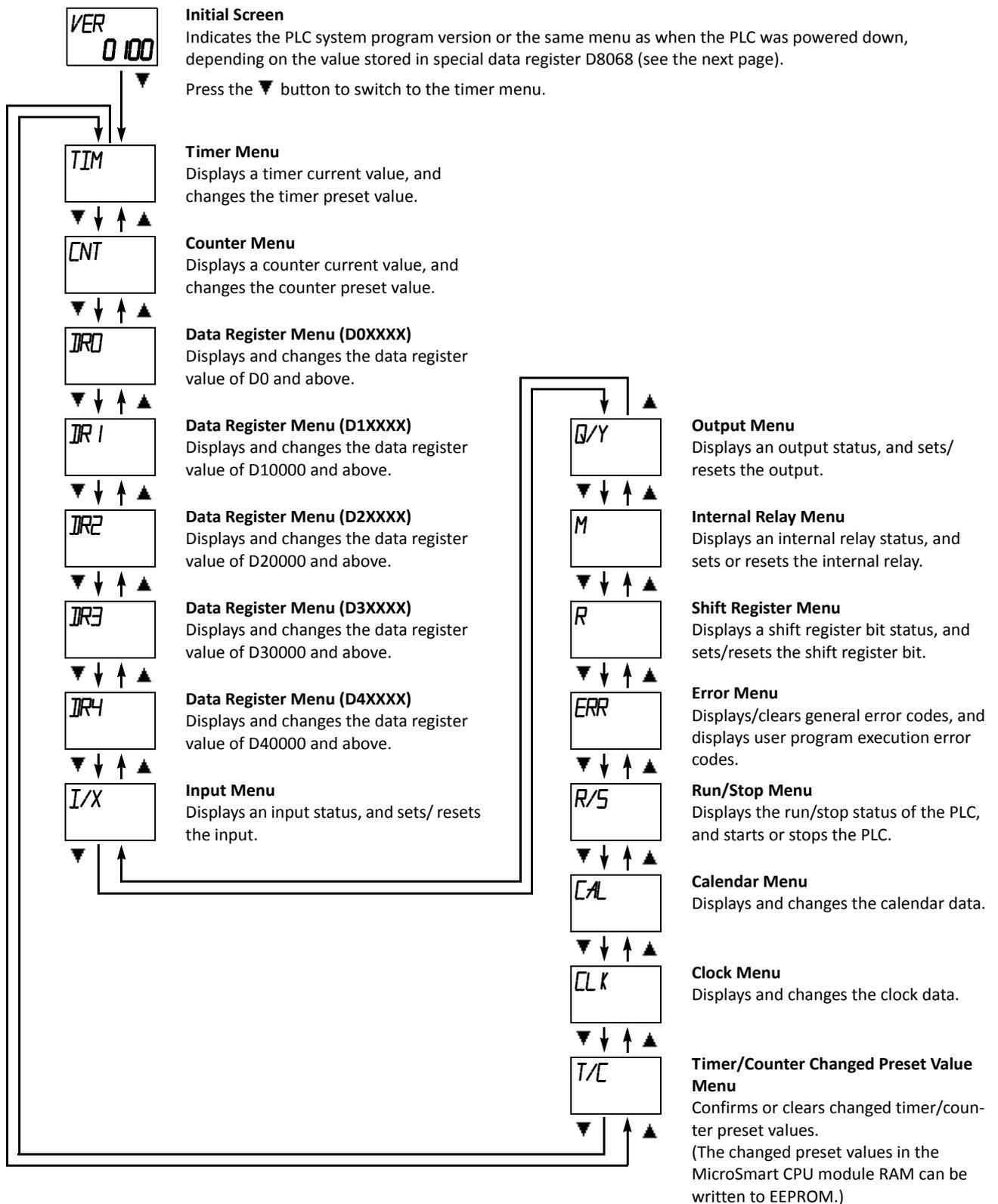


Caution

- Power up the MicroSmart CPU module after installing the HMI module. If the HMI module is installed or removed while the MicroSmart is powered up, the HMI module may fail to operate correctly.
- If an invalid device or a value over 65535 is entered, the display screen flashes to signal an error. When an error screen displays, press the **ESC** button and repeat the correct key operation.

Key Operation for Scrolling Menus after Power-up

The chart below shows the sequence of scrolling menus using the ▲ and ▼ buttons on the HMI module after power-up. While a menu screen is shown, press the **OK** button to enter into each control screen where device addresses and values are selected. For details of each operation, see the following pages.



5: SPECIAL FUNCTIONS

Special Internal Relays for HMI Module

Two special internal relays are provided protect the HMI operation.

Internal Relay	Name	Description
M8011	HMI Write Prohibit Flag	When M8011 is turned on, the HMI module is disabled from writing data to prevent unauthorized modifications, such as direct set/reset, changing timer/counter preset values, and entering data into data registers.
M8012	HMI Operation Prohibit Flag	When M8012 is turned on, the HMI module is disabled from all operations, reducing the scan time. To turn off M8012, power down and up the CPU, or use the Point Write on WindLDR.

Selection of HMI Module Initial Screen

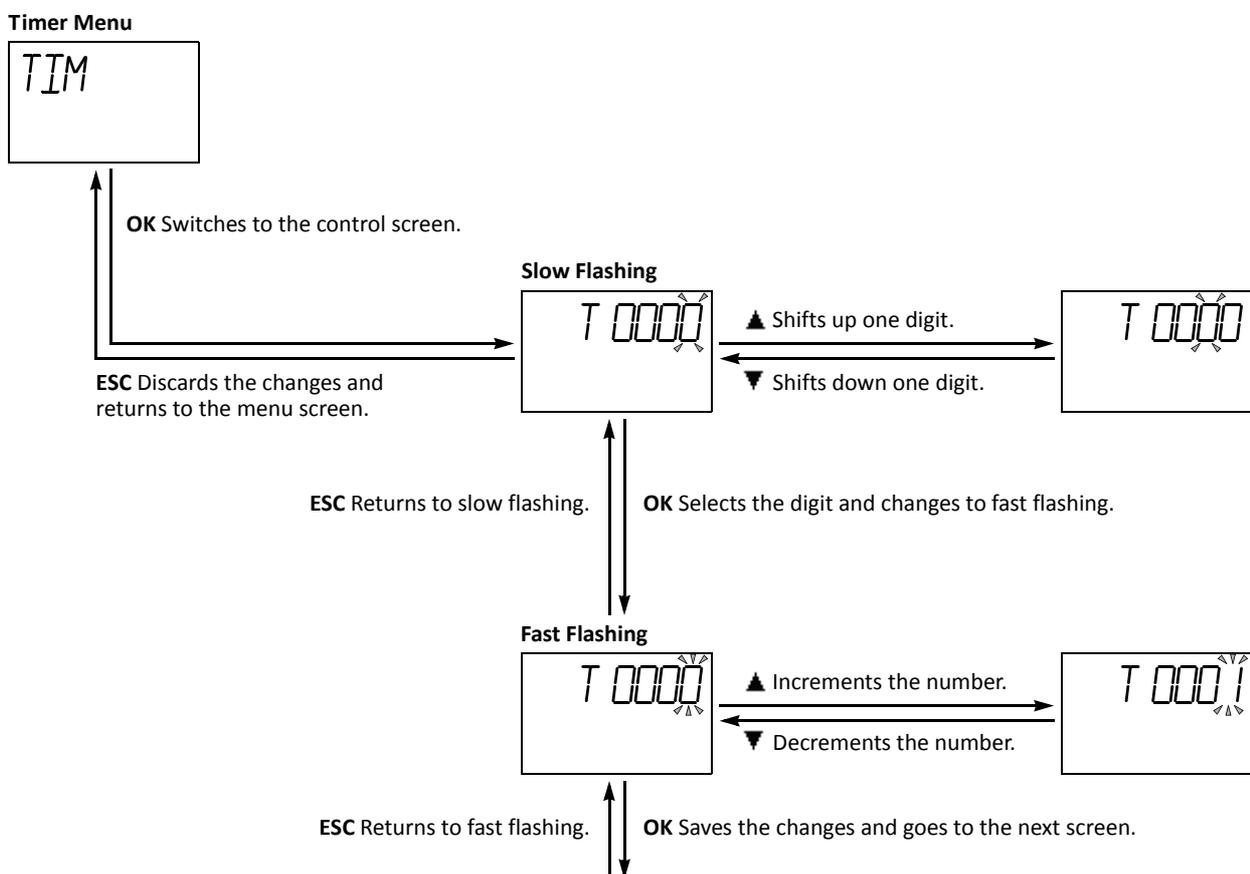
D8068 can be used to select the initial screen display of the HMI module when the CPU module is powered up.

Data Register	Value	Description
D8068	0, 2 through 65535	Mode 1: Indicates the PLC program version each time the PLC is powered up.
	1	Mode 2: Indicates the same menu as when the PLC was shut down.

When a keep data error occurs, mode 1 is enabled regardless of the value stored in data register D8068.

Key Operation for Selecting device address

When the **OK** button is pressed while a menu screen is shown, the screen switches to the control screen of the menu. For example, while the timer menu is on the display, pressing the **OK** button switches the screen to the timer control screen, where device addresses and values are selected. For operation examples, see the following pages.



Displaying Timer/Counter Current Values and Changing Timer/Counter Preset Values

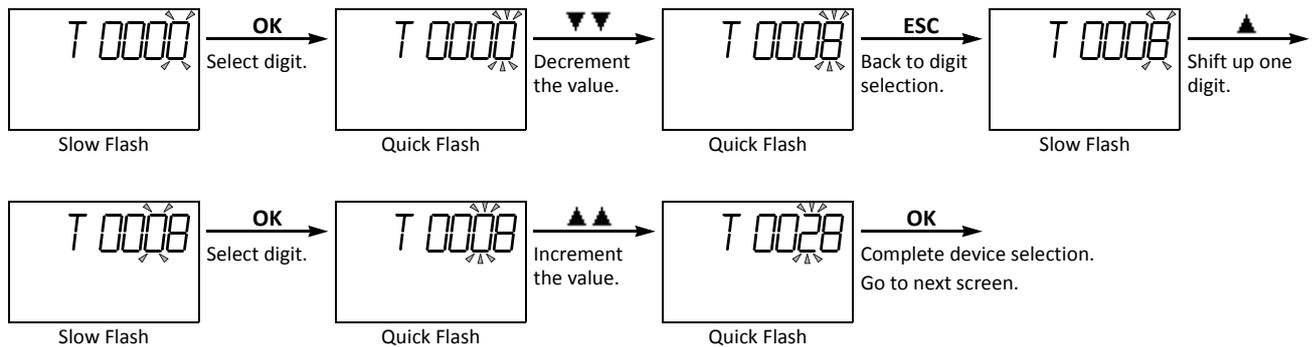
This section describes the procedure for displaying a timer current value and for changing the timer preset value for an example. The same procedure applies to counter current values and preset values.

Example: Change timer T28 preset value 820 to 900

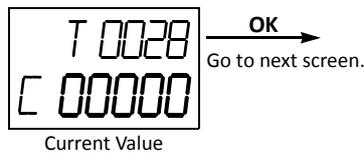
1. Select the Timer menu.



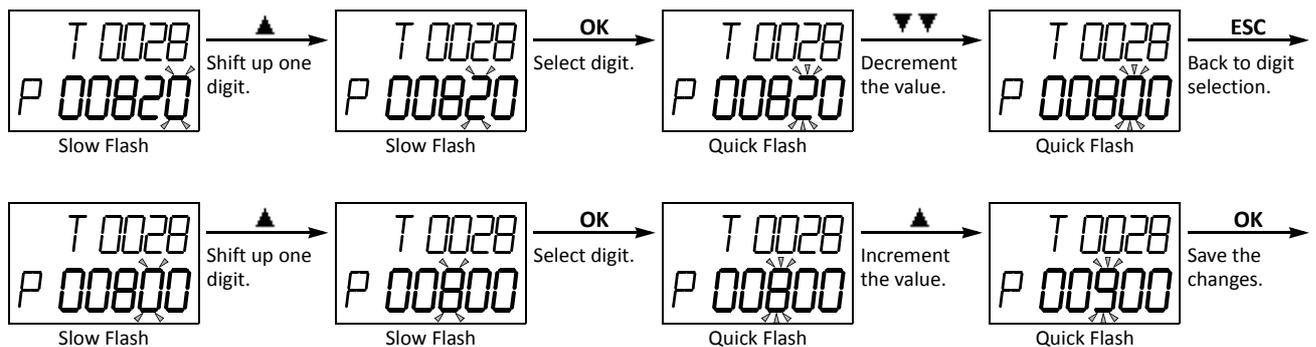
2. Select the device address.



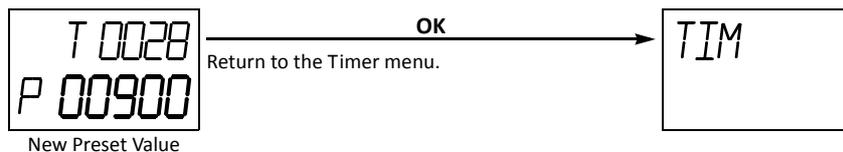
3. The current value of the selected timer number is displayed.



4. The preset value of the selected timer number is displayed. Change the preset value to 900 as described below.



5. The changed preset value is displayed without flashing.



Note: The changed timer/counter preset values are stored in the MicroSmart CPU module RAM and backed up for 30 days by a lithium backup battery. If required, the changed preset values can be written from the MicroSmart CPU module RAM to the ROM using the Timer/Counter Changed Preset Value Confirm menu described on page 5-65. For the data movement in the CPU module, see page 7-18.