CQM1-CPU11 | CQM1-CPU21 | CQM1-CPU41 | CQM1-CPU42 | CQM1-CPU43 | CQM1-CPU44 | CQM1-CPU45

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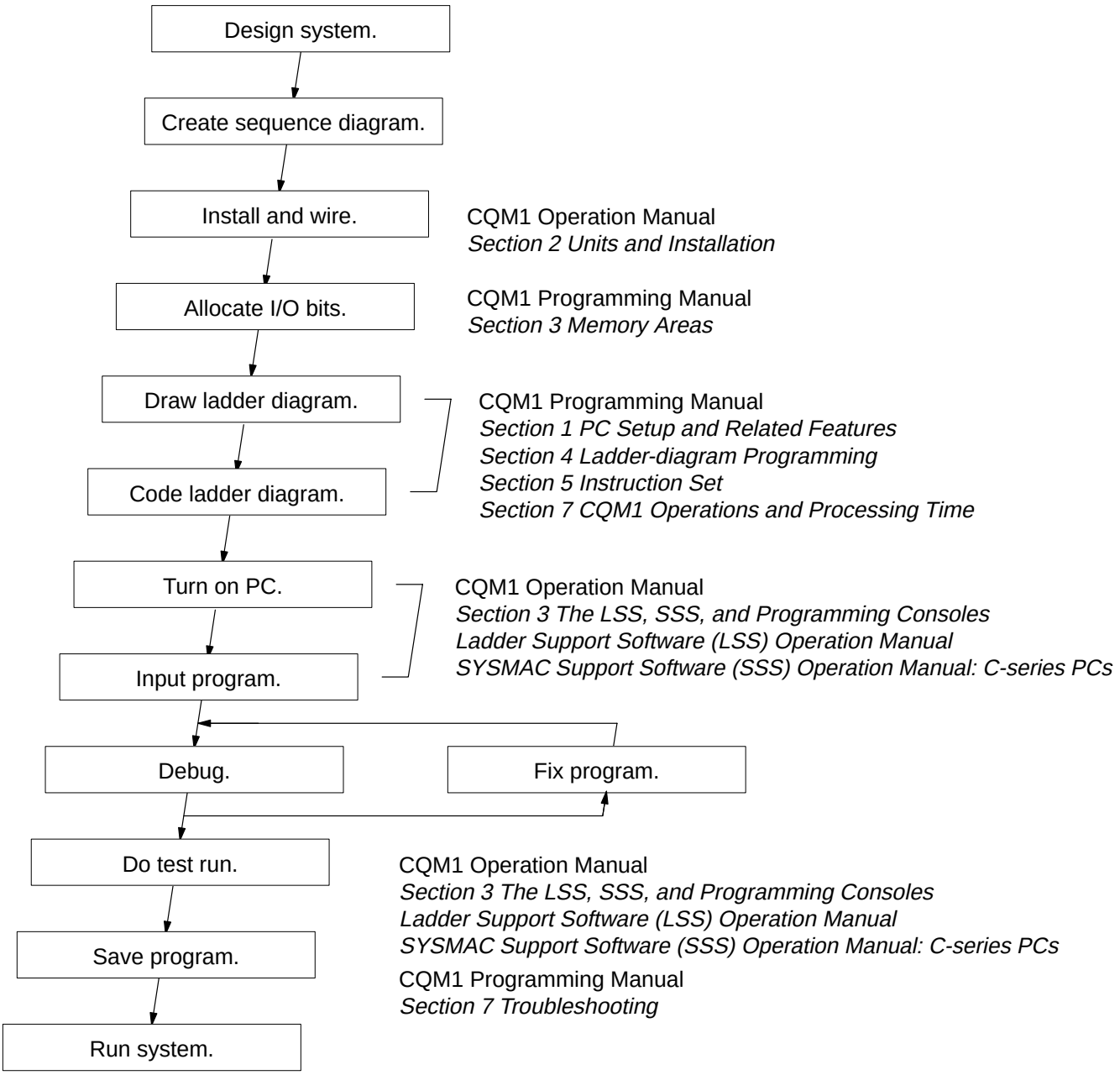
1-1 Overview

The following diagram shows the steps involved in setting up and operating a CQM1 System and the sections in this and the *CQM1 Programming Manual* that will be most useful at each step.

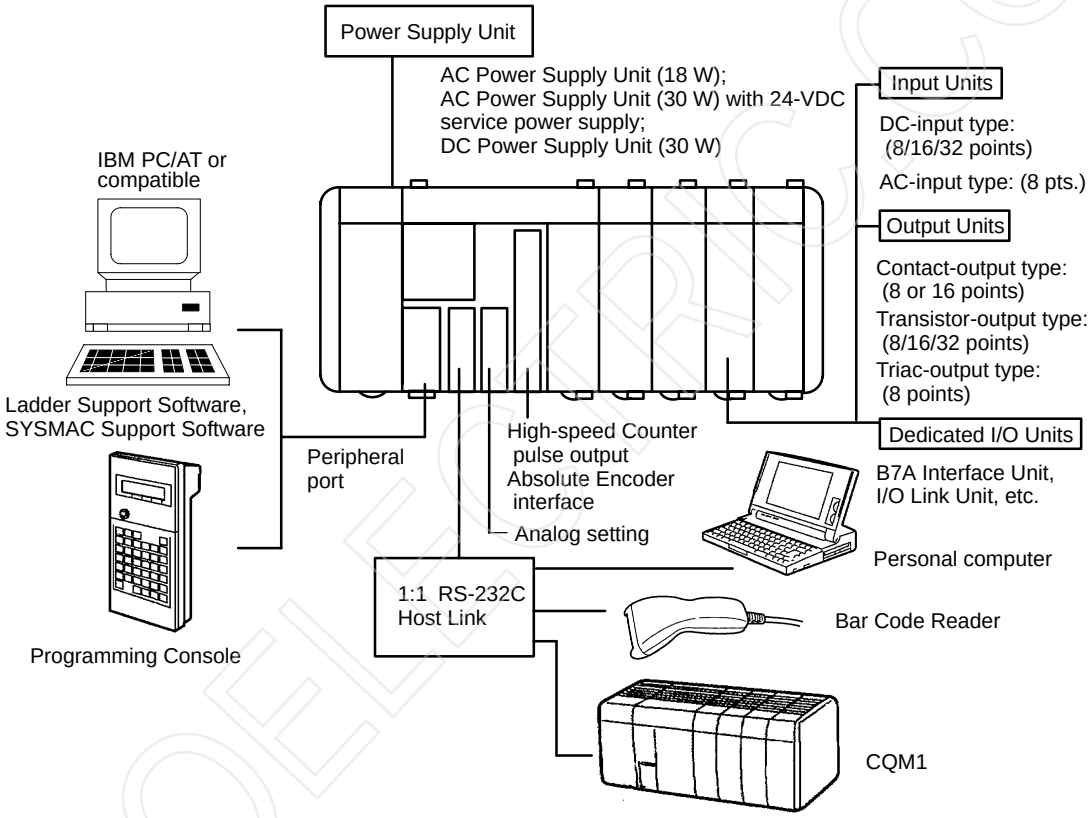


1-2 System Configuration

The CQM1 is a compact, high-speed PC composed of a Power Supply Unit, a CPU Unit, and I/O Units. All of these Units connect at the sides to form a single PC, which is normally mounted to a DIN track.

All CQM1 CPU Units, except for the CQM1-CPU11-E, are equipped with an RS-232C port that can be connected directly to a host computer, another CQM1, or other serial devices.

The following diagram shows the system configurations possible with the CQM1. Refer to *Section 2 Hardware Considerations* for more details on system components and specifications.



1-3 CQM1 Features

Main Features

The CQM1 provides many advanced features, including the following:

- The CPU Unit provides 16 built-in input terminals.
- I/O Units can be added to increase I/O capacity.
- The CQM1 is much faster: about 20 times faster than P-type PCs.
- High-speed timers and counters are built in.
- Outputs are processed when instructions are executed (direct outputs).

Interrupts

The CQM1 supports three types of interrupts:

- Input Interrupts

  Input interrupts are used to process input signals from an external device that are shorter than the program execution time. Input signals with a pulse width as short as 0.1 ms can be used.

- Scheduled Interrupts

  Scheduled interrupts can be performed using a high-speed interval timer.

- High-speed Counter Interrupts

  Single-phase pulses up to 5 kHz and two-phase pulses up to 2.5 kHz can be input. High-speed counter interrupts can be combined with pulse outputs for applications such as motor control. The CQM1-CPU43-EV1 and CQM1-CPU44-EV1 can accept single-phase pulses up to 50 kHz and two-phase pulses up to 25 kHz. The high-speed counter (absolute encoder input for the CPU44-EV1) has two points added.

Pulse Output Function

Pulses up to 1 kHz can be output from Output Unit contacts. The CQM1-CPU43-EV1 has two dedicated ports for outputting 50 kHz pulses.

Communications

A peripheral port and RS-232C port are available and are used to communicate with external devices using the following methods.

- Host Link

  The CQM1 using the host link can communicate with a personal computer and Programmable Terminal using host link commands.

- RS-232C

  The CQM1 using the RS-232C can read data from a bar code reader or measurement device and output data to a printer.

- 1-to-1 Link

  A data link can be created with a data area in another CQM1 to monitor the other PC's status and synchronize processes controlled by the PCs.

Analog Setting Function

The CQM1-CPU42-EV1 provides volume controls with four channels for adjusting analog settings.

Convenient I/O Instructions

A single instruction can be used to input or output data, simplifying the program.

- The TEN KEY INPUT instruction can be used to read 8-digit BCD data input from a ten-key.
- The HEXADECIMAL KEY INPUT instruction can be used to read 8-digit hexadecimal key input data from I/O Units.
- The DIGITAL SWITCH instruction can be used to read 4 or 8-digit BCD data from digital switches.
- The 7-SEGMENT DISPLAY OUTPUT instruction can be used to output 4 or 8-digit data to 7-segment displays.

Macros

The MACRO instruction can be used to call and execute subroutines, designating the I/O word for the subroutine as an argument. Using an argument to specify a subroutine I/O words allows subroutines to be used more easily in different locations, simplifying the program.

Differentiation Monitoring

Up to now, differentiation monitoring was available only in top-of-the-line PCs. Differentiation monitoring indicates when a bit goes from OFF to ON or from ON to OFF. It can be used to monitor the status of inputs or bits that turn on and off in very short intervals.

SECTION 2
Units and Installation

This section describes the Units that go together to create a CQM1 PC and provides information on switch settings, installation, and hardware maintenance. Technical specifications of the Units are also provided.

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- 2-1-1 CPU Unit Components
- 2-1-2 DIP Switch
- 2-1-3 Indicators
- 2-1-4 PC Modes
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- 2-1-7 Battery Replacement
- 2-1-8 Programmable Controller Power Interruptions
- 2-1-9 Analog Setting Function
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- 2-2-2 Dimensions
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- 2-6-2 CPU Unit Specifications
- 2-6-3 Pulse Input Port (CQM1-CPU43-EV1)
- 2-6-4 ABS Interface Port (CQM1-CPU44-EV1)
- 2-6-5 24-VDC Inputs (Built into CPU Unit)
- 2-6-6 12-VDC Input Units
- 2-6-7 12 to 24-VDC and 24-VDC Input Units
- 2-6-8 24-VDC Input Units
- 2-6-9 AC Input Units
- 2-6-10 Contact Output Units
- 2-6-11 Transistor Output Units

2-1 CPU Unit

The CQM1 is a compact, high-speed PC made up of a CPU Unit, Power Supply Unit, and I/O Units that together provide up to 256 total I/O points. These components lock together at the sides, allowing simple changes in the size and capacity of the PC. There are six types of CPU Unit, shown in the table below. All of the CPU Units except for the CQM1-CPU11-E have a built-in RS-232C interface.

Model	Maximum I/O points	Program capacity (words)	DM capacity (Words)	RS-232C port	Analog setting	Pulse I/O	ABS interface	AD/DA conversion
CQM1-CPU11-E	128 pts (7 Units max.)	3.2K	1K	---	---	---	---	---
CQM1-CPU21-E				Yes	---	---	---	---
CQM1-CPU41-EV1	256 pts (11 Units max.)	7.2K	6K		---	---	---	---
CQM1-CPU42-EV1					Yes	---	---	---
CQM1-CPU43-EV1					---	Yes	---	---
CQM1-CPU44-EV1					---	---	Yes	---

CQM1-CPU11-E and CQM1-CPU21-E CPU Units

CQM1-CPU11-E and CQM1-CPU21-E CPU Units provide a maximum of 128 I/O points. The only difference between the two models is the RS-232C port that is added to the CQM1-CPU21-E.

Built-in Analog Setting Function

The CQM1-CPU42-EV1 CPU Unit provides a built-in analog setting function. It has four dedicated volume controls, and their respective values (0 to 200 BCD) appear in words 220 to 223. This function can be used for operations such as changing timer and counter set values during operation.

Built-in Pulse I/O Function

The CQM1-CPU43-EV1 CPU Unit provides a built-in pulse input and output function. It has two dedicated ports for high-speed counting of up to 25-kHz two-phase pulse inputs from a device such as a rotary encoder and outputting up to 50-kHz pulses to a device such as a stepping motor.

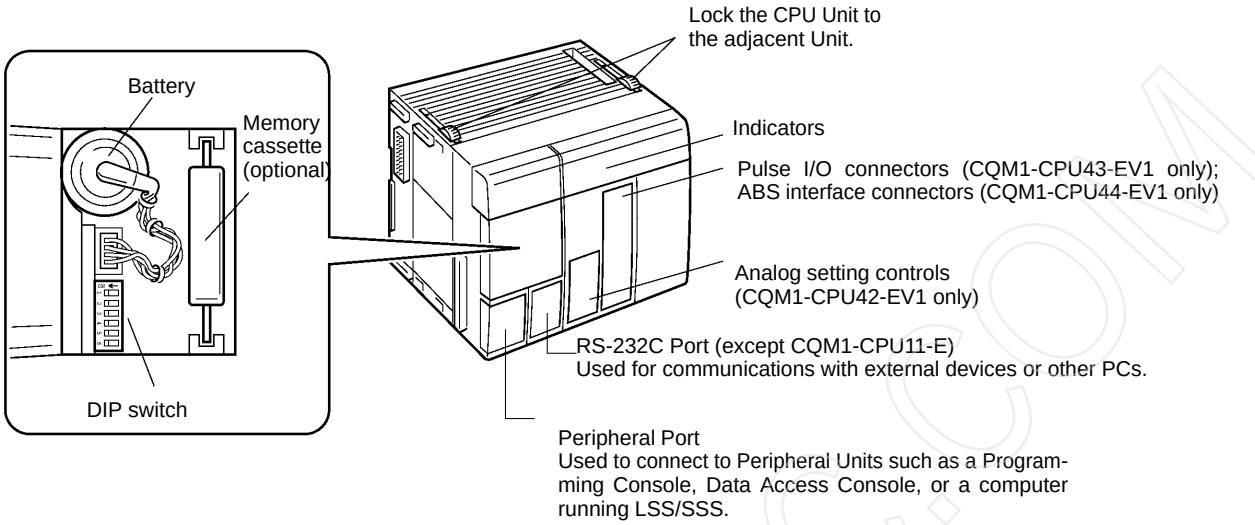
Built-in ABS Interface Function

The CQM1-CPU44-EV1 has two ABS interfaces (absolute encoder interfaces) that can directly receive inputs from absolute-type rotary encoders.

Note In this manual, CQM1-CPU11-E/21-E CPU Units are referred to as “standard CPU Units,” and CQM1-CPU41-EV1/42-EV1/43-EV1/44-EV1 CPU Units are referred to as “highly functional, large-capacity CPU Units.”

2-1-1 CPU Unit Components

The following diagram shows the basic components of the CPU Unit that are used in general operation of the PC.



2-1-2 DIP Switch

The DIP switch is located under a cover on the front of the CPU Unit as shown in *2-1-1 CPU Unit Components*. The setting of these switches is described in the following table.

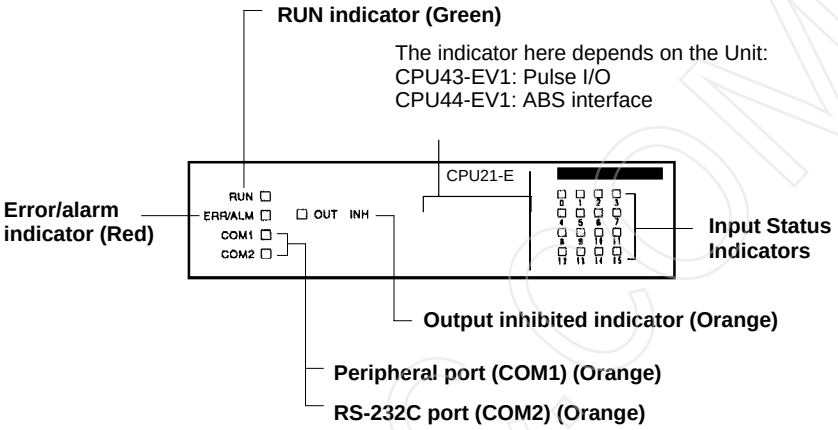
Pin	Setting	Function
1	ON	Program Memory and read-only DM (DM 6144 to DM 6655) data cannot be overwritten from a Peripheral Device.
	OFF	Program Memory and read-only DM (DM 6144 to DM 6655) data can be overwritten from a Peripheral Device.
2	ON	Auto-boot enabled. The contents of Memory Cassette will be transferred to the CPU Unit automatically at start-up.
	OFF	Auto-boot disabled.
3	ON	Programming Console messages will be displayed in English.
	OFF	Programming Console messages will be displayed in the language stored in system ROM. (Messages will be displayed in Japanese with the Japanese version of system ROM.)
4	ON	Expansion instructions set by user. Normally ON when using a host computer for programming/monitoring.
	OFF	Expansion instructions set to defaults.
5	ON	Standard communications parameters (see note 2) will be set for the following serial communications ports. • Built-in RS-232C port • Peripheral port (only when a CQM1-CIF01/-CIF02 Cable is connected. Does not apply to Programming Console.) **Note** 1. Standard communications parameters are as follows: Serial communications mode: Host Link or peripheral bus; start bits: 1; data length: 7 bits; parity: even; stop bits: 2; baud rate: 9,600 bps 2. The CX-Programmer running on a personal computer can be connected to the peripheral port via the peripheral bus using the above standard communications parameters.
	OFF	The communications parameters for the following serial communications ports will be set in PC Setup as follows: • Built-in RS-232C port: DM 6645 and DM 6646 • Peripheral port: DM 6650 and DM 6651 **Note** When the CX-Programmer is connected to the peripheral port with the peripheral bus, either set bits 00 to 03 of DM 6650 to 0 Hex (for standard parameters), or set bits 12 to 15 of DM 6650 to 0 Hex and bits 00 to 03 of DM 6650 to 1 Hex (for Host Link or peripheral bus) separately.
6	ON	The setting of pin 6 determines the ON/OFF status of AR 0712. If pin 6 is ON, AR 0712 will be ON and if pin 6 is OFF, AR 0712 will be OFF. (See note 3.)
	OFF	

Note

1. All DIP switch pins except pin 3 are turned OFF at the factory.
2. The above settings apply to CPU Units manufactured from July 1995 (lot number □□75 for July 1995). For CPU Units manufactured before July 1995 (lot number □□65 for June 1995), only 1 stop bit will be set and the baud rate will be 2,400 bps.
3. Pin 6 can be used to control the status of AR 0712 in memory to provide optional control of program execution.

2-1-3 Indicators

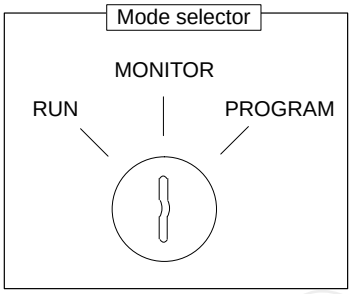
CPU Unit indicators provide visual information on the general operation of the PC. Although not substitutes for proper error programming using the flags and other error indicators provided in the data areas of memory, these indicators provide ready confirmation of proper operation. CPU Unit indicators are shown below and are described in the following table.



Indicator	Name	Function
RUN	RUN indicator	Lights when the CPU Unit is operating normally.
ERR/ALM	Error/Alarm indicator	Flashes when there is a non-fatal error. The CPU Unit will continue operating. Lit when there is a fatal error. When this indicator lights, the RUN indicator will go off, CPU Unit operation will be stopped, and all outputs will be turned OFF.
COM1	Peripheral port indicator	Flashes then the CPU Unit is communicating with another device via the peripheral port.
COM2	RS-232C port indicator	Flashes when the CPU Unit is communicating with another device via the RS-232C port. (CQM1-CPU21-E only)
OUT INH	Output inhibited indicator	Lights when the Output OFF Bit, SR 25215, is turned ON. All PC outputs will be turned OFF.
0, 1, 2 . . .	Input status indicators	Indicate the ON and OFF status of input bits in IR 000.

2-1-4 PC Modes

The CQM1 PCs have three operating modes: PROGRAM, MONITOR, and RUN. The PC mode can be changed from the mode selector on the Programming Console.



The key cannot be removed when the mode selector is set to PROGRAM.

Note Some Programming Devices (e.g., the Programming Console) will clear the current display and display the new operating mode when the mode selector is changed. You can change the mode without changing the display by first pressing the SHIFT Key and then changing the setting of the mode selector.

The function of each mode is described briefly below.

PROGRAM Mode

PROGRAM mode is used when making basic changes to the PC program or settings, such as transferring, writing, editing, or checking the program, or changing the PC Setup. The program cannot be executed in PROGRAM mode. Output points at Output Units will remain OFF, even when the corresponding output bit is ON.

MONITOR Mode

MONITOR mode is used when monitoring program execution, such as making a trial run of a program. The program is executed just as it is in RUN mode, but bit status, timer and counter SV/PV, and the data content of most words can be changed online. Output points at Output Units will be turned ON when the corresponding output bit is ON.

RUN Mode

RUN mode is used when operating the PC in normal control conditions. Bit status cannot be force set or reset, and SVs, PVs, and data cannot be changed online.

Note When a program section is displayed on the Programming Console and the PC is in RUN or MONITOR Mode, the ON/OFF status of bits in that program section will be displayed in the upper-right corner of the display.

Mode Changes

The factors that determine the initial operating mode of the PC (the mode when the PC is turned on) are listed below in order of importance.

1, 2, 3...

1. No Devices mounted:

   If no Peripheral Devices are mounted to the PC, the PC will enter RUN mode when turned ON unless the startup mode setting in the PC Setup (DM 6600) has been set to MONITOR or PROGRAM Mode.

2. Programming Console mounted:

   If the Programming Console is connected to the PC when PC power is applied, the PC will enter the mode set on the Programming Console's mode selector.

3. Other Peripheral Device mounted:

   If a Programming Console is not mounted to the PC, but another Peripheral Device is connected to the PC, the PC will enter PROGRAM mode.

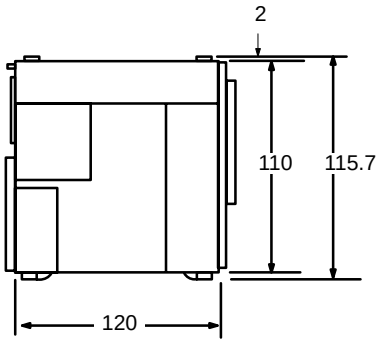
If the PC power supply is already turned on when a Peripheral Device is attached to the PC, the PC will stay in the same mode it was in before the peripheral device was attached. If the Programming Console is connected, the PC will enter the mode set on the Programming Console's mode selector once the password has been entered.

2-1-5 Dimensions and Weights

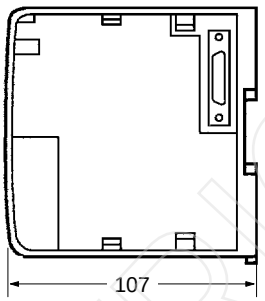
Dimensions

The following diagrams show the dimensions of the CPU Unit and right End Cover, which covers the Unit at the far right side of the PC. All dimensions are in millimeters.

CPU Unit Front View



CPU Unit Side View



End Cover Front View

Note The depth is the same for all Units.

Weights

The CQM1-CPU11-E weighs 520 g max.; the CQM1-CPU21-E and CQM1-CPU41-EV1, 530 g max. All the other CPU Units weigh 600 g max.

2-1-6 Memory Cassette

Four Memory Cassettes are available as accessories to store the program or PC Setup. When pin 2 of the CPU Unit's DIP switch is ON, the contents of the Memory Cassette will be transferred to the CPU Unit automatically at start-up.

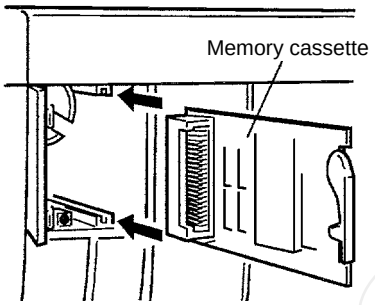
Memory	Clock Function	Model	Comments
EEPROM	No	CQM1-ME04K	The Programming Console is used to write to EEPROM. (4K words)
	Yes	CQM1-ME04R	
	No	CQM1-ME08K	The Programming Console is used to write to EEPROM. (8K words)
	Yes	CQM1-ME08R	
EPROM	No	CQM1-MP08K	A PROM Writer is used to write to EPROM.
	Yes	CQM1-MP08R	

Memory Cassette Installation Follow the procedure below to install a Memory Cassette in the CPU Unit.

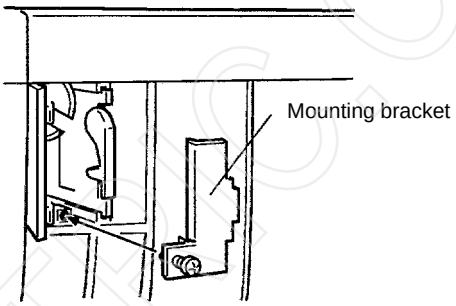
⚠ Caution Always turn off power to the CQM1 before installing or removing a Memory Cassette.

1, 2, 3... 1. Remove the mounting bracket from inside the memory cassette compartment.

2. Slide the Memory Cassette into the CPU Unit on the tracks provided. Press the Memory Cassette in so that the connectors fit securely.



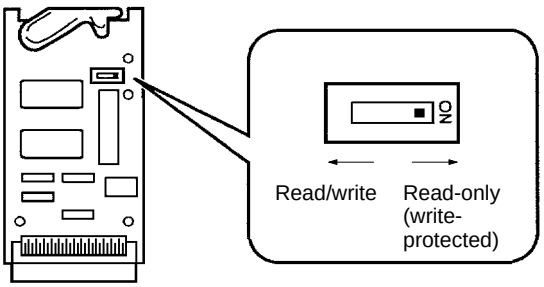
3. Replace the bracket as shown below and tighten the screw.



EEPROM Write Protection

Turn on the write-protect switch on the EEPROM Memory Cassette to prevent the program or PC Setup from being deleted accidentally. Turn the switch off when writing to the Memory Cassette.

⚠ Caution Always turn off the CQM1 and remove the Memory Cassette when changing the write-protect switch setting.



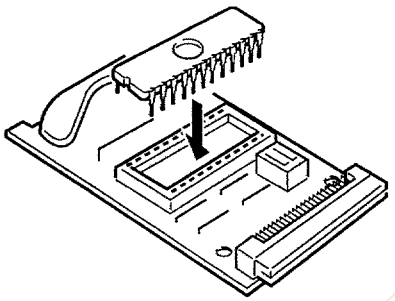
Note Flag AR 1302 will be ON when the write-protect switch is ON.

EPROM Version

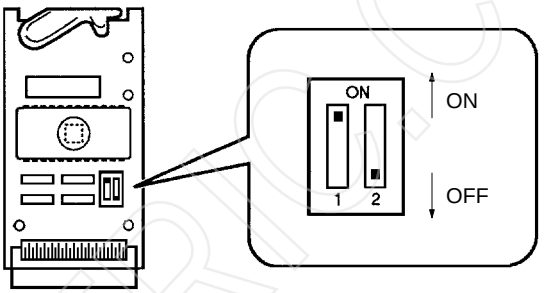
The four EPROM chips listed below can be used in the Memory Cassettes.

EPROM Version	Capacity	Access Speed	Model Number
27128	8K words	150 ns	ROM-ID-B
27256	16K words	150 ns	ROM-JD-B
27512	32K words	150 ns	ROM-KD-B

Install an EPROM chip onto the memory cassette as shown in the following diagram.



Be sure that the EPROM version set with the switch on the Memory Cassette agrees with the EPROM version of the installed chip. Refer to the following diagram and table for the location of the switch and its settings.



EPROM Version	Pin 1 Setting	Pin 2 Setting
27128	OFF	OFF
27256	ON	OFF
27512	ON	ON

2-1-7 Battery Replacement

CQM1 CPU Units contain a 3G2A9-BAT08 Battery Set, which must be replaced when its effective life has expired. The effective life under normal conditions is approximately 5 years. The effective life will be reduced at higher temperatures. Refer to *Appendix B Battery Service Life* for more details.

A battery error will occur when the voltage of the battery starts to drop, causing the ALARM/ERROR indicator to flash, causing SR 25308 to turn ON, and generating a battery error message readable from Programming Devices. The battery must be replaced within one week after a battery error is indicated.

⚠ Caution Replace the battery within one week after the first indication that the battery requires replacement. Always keep a spare Battery Set on hand. It will be highly unlikely that you will be able to obtain a replacement Battery Set in time otherwise. If the battery is not replaced in time, the user program and other data may be lost.

Use the following procedure to replace the battery. You must complete this procedure within five minutes after turning off the power to the CQM1 to ensure memory backup.

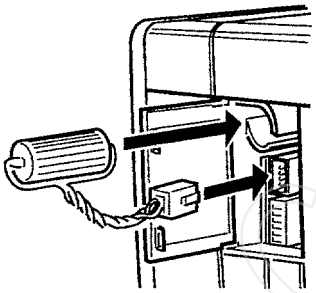
1, 2, 3... 1. Turn off the power to the CQM1.

or If the CQM1 is not turned on, turn it on for at least one minute and then turn it off.

Note If power is not turned on for at least one minute before replacing the battery, the capacitor that backs up memory when the battery is

removed will not be fully charged and memory may be lost before the new battery is inserted.

2. Open the compartment on the upper left of the CPU Unit and carefully draw out the battery.
3. Remove the battery connector.
4. Connect the new battery, place it into the compartment, and close the cover.



The battery error will automatically be cleared when a new battery is inserted.

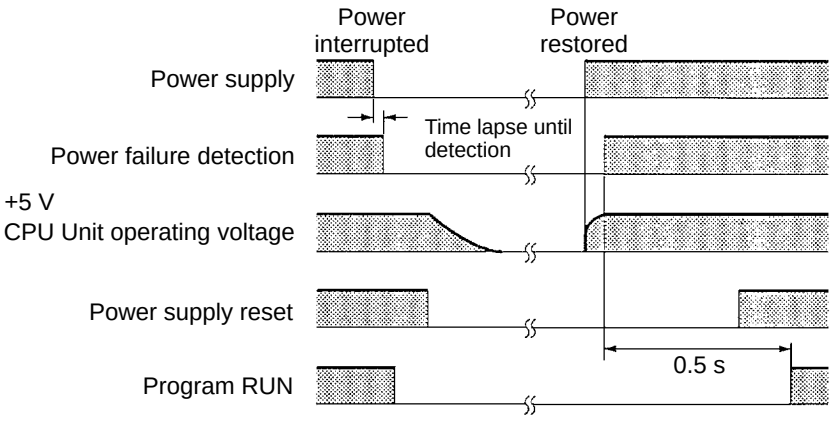
⚠ WARNING Never short-circuit the battery terminals; never charge the battery; never disassemble the battery; and never heat or incinerate the battery. Doing any of these may cause the battery to leak, burn, or rupturing resulting in injury, fire, and possible loss of life or property.

2-1-8 Programmable Controller Power Interruptions

A sequential circuit is built into the PC to handle power interruptions. This circuit prevents malfunctions due to momentary power loss or voltage drops. A timing diagram for the operation of this circuit is shown below.

The PC ignores all momentary power failures if the interruption lasts no longer than 10 ms. If the interruption lasts between 10 and 25 ms, the interruption may or may not be detected. If the supply voltage drops below 85% of the rated voltage for longer that 25 ms (less for the DC Power Supply), the PC will stop operating and the external outputs will be automatically turned OFF.

Operation is resumed automatically when the voltage is restored to more than 85% of the rated value. The diagram below shows the timing of PC operation and stopping during a power interruption. The time it takes to detect the power failure is 5 ms when the power supply is DC.

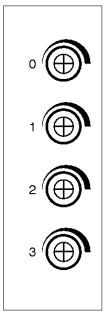


2-1-9 Analog Setting Function

The CQM1-CPU42-EV1 has four volume controls. By adjusting these controls, the contents of words 220 through 223 can be changed within a range of 0000 to 0200 (in four digits BCD). This is called the “analog setting function.”

A commercially available mini-screwdriver can be used to turn the volume controls. The value increases as they are turned in a clockwise direction.

If words 220 through 223 are designated as the SV for instructions such as TIM, they cannot be used as the analog timer. With CPU Unit models other than the CQM1-CPU42-EV1, there is no particular use for words 220 through 223, and they can be use as IR words.



The value for this control is stored in word 220.

The value for this control is stored in word 221.

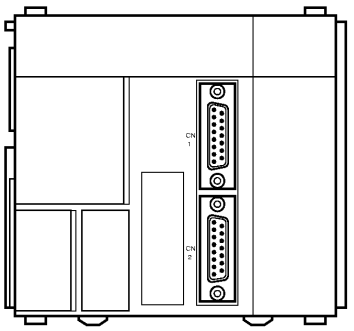
The value for this control is stored in word 222.

The value for this control is stored in word 223.

⚠ Caution While the power is turned on for CQM1-CPU42-EV1 CPU Units, words 220 through 223 are constantly refreshed with the values from these volume controls. Be sure that writing is not executed within this range by the program or peripheral devices.

2-1-10 Pulse I/O Function

The CQM1-CPU43-EV1 has two dedicated ports (CN1 and CN2) that can input and output high-speed pulses.



These two ports can be used to perform the functions described below.

Pulse Output

Pulses from 10 Hz to 50 kHz can be output. In comparison with pulse output from a contact, wide-frequency band pulses can be output more smoothly while changing frequencies.

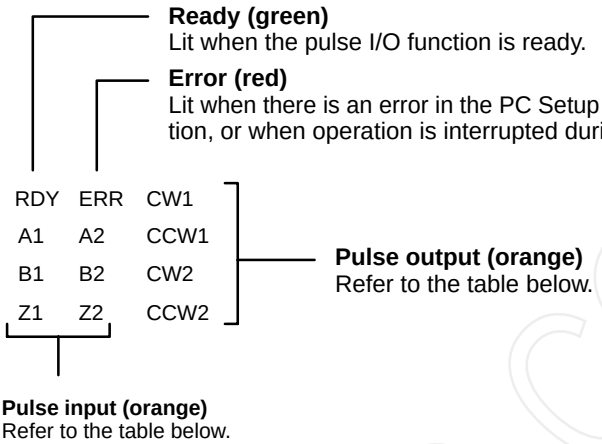
High-Speed Counter Interrupts

High-speed pulses input to the port (up to 50 kHz for single phase and 25 kHz for two-phase) can be counted, and processing can be executed according to the count. There are three kinds of count mode:

- Phase-difference pulse input mode
- Pulse and direction input mode
- Increment/Decrement input mode

Caution The following instructions cannot be used when the CQM1-CPU43-EV1 is set to high-speed counter mode by PC Setup (DM 6611): PLS2 and ACC mode 0.

LED Indicators



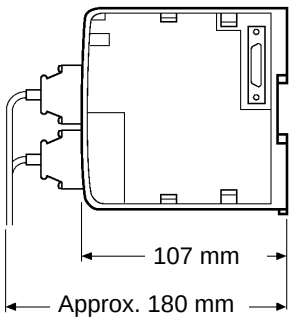
Pulse Output Indicators

Indicator	Port	Function
CW1	Port 1	Lit during pulse output to port 1 CW.
CCW1		Lit during pulse output to port 1 CCW.
CW2	Port 2	Lit during pulse output to port 2 CW.
CCW2		Lit during pulse output to port 2 CCW.

Pulse Input Indicators

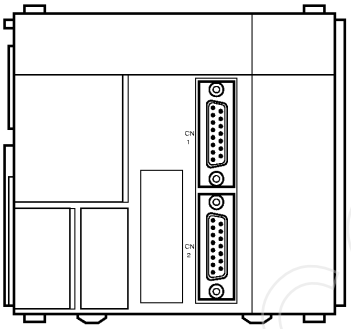
Port 1	Port 2	Function
A1	A2	Lit when pulse input is ON at phase A for each port.
B1	B2	Lit when pulse input is ON at phase B for each port.
Z1	Z2	Lit when pulse input is ON at phase Z for each port.

Dimensions With Connectors Mounted



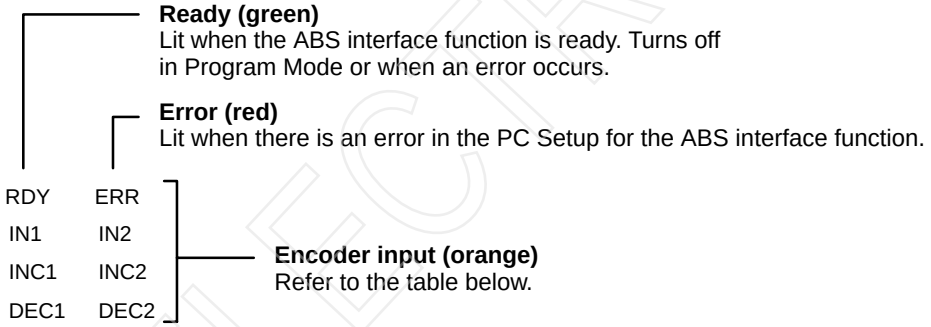
2-1-11 ABS Interface Function

The CQM1-CPU44-EV1 has two dedicated ports (CN1 and CN2) for receiving grey codes from an absolute-type rotary encoder.



These two ports can be used to carry out absolute-type high-speed counter interrupts. Grey codes input to the ports can be received at a computation speed of up to 4 kHz, and processing can be executed according to that value.

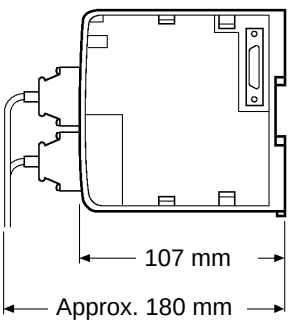
LED Indicators



Encoder Input Indicators

Port 1	Port 2	Function
IN1	IN2	Lit when input bit 0 of each port is ON.
INC1	INC2	Lit when value input for each port is incremented.
DEC1	DEC2	Lit when value input for each port is decremented.

Dimensions With Connectors Mounted



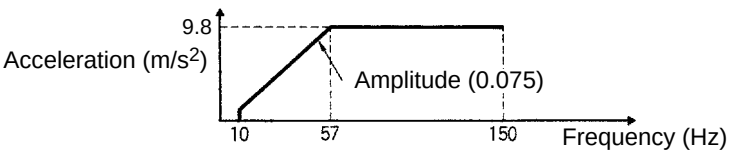
2-6 Unit Specifications

2-6-1 Power Supply Units

Item	CQM1-PA203	CQM1-PA206	CQM1-PA216	CQM1-PD026
Supply voltage	100 to 240 VAC, 50/60 Hz		100 or 230 VAC (selectable), 50/60 Hz	24 VDC
Operating voltage range	85 to 264 VAC		85 to 132 VAC or 170 to 264 VAC	20 to 28 VDC
Operating frequency range	47 to 63 Hz			---
Power consumption	60 VA max.	120 VA max.		50 W max.
Inrush current	30 A max.			
Output capacity	5 VDC: 3.6 A (18 W)	5 VDC: 6 A 24 VDC: 0.5 A (30 W total)		5 VDC: 6 A (30 W)
Insulation resistance	20 MΩ min. (at 500 VDC) between AC external terminals and GR terminals (see note 1)			20 MΩ min. (at 500 VDC) between AC external terminals and GR terminals (see note 1)
Dielectric strength	2,300 VAC 50/60 Hz for 1 min between AC external and GR terminals, (see note 1) leakage current: 10 mA max. 1,000 VAC 50/60 Hz for 1 min between DC external and GR terminals, (see note 1) leakage current: 20 mA max.			
Noise immunity	1,500 Vp-p, pulse width: 100 ns to 1 μs, rise time: 1 ns (via noise simulation)			
Vibration resistance	10 to 57 Hz, 0.075-mm amplitude, 57 to 150 Hz, acceleration: 9.8 m/s^2 (see note 2) in X, Y, and Z directions for 80 minutes each (Time coefficient; 8 minutes × coefficient factor 10 = total time 80 minutes)			
Shock resistance	147 m/s^2 (21.8 m/s^2 for Contact Output Units) 3 times each in X, Y, and Z directions			
Ambient temperature	Operating: 0° to 55°C Storage: –20° to 75°C (except battery)			
Humidity	10% to 90% (with no condensation)			
Atmosphere	Must be free from corrosive gasses			
Grounding	Less than 100 Ω			
Enclosure rating	Mounted in a panel			
Weight	5 kilograms max.			
Dimensions (without cables)	219 to 443 × 110 × 107 mm (W×H×D)			

Note 1. Disconnect the LG terminal of the Power Supply Unit from the GR terminal when performing insulation and dielectric strength tests. If the tests are repeatedly performed with the LG and GR terminals short-circuited, the internal components may be damaged.

2.

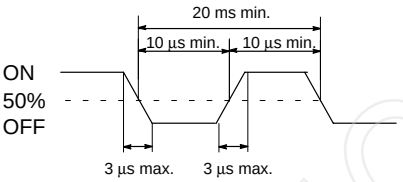
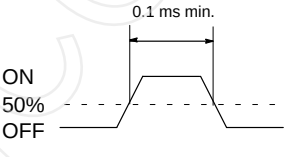
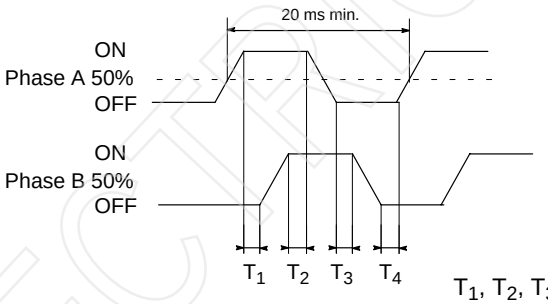


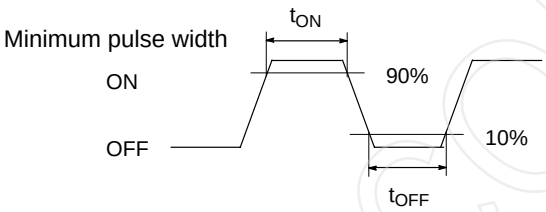
2-6-2 CPU Unit Specifications

Item	CQM1-CPU11-E/21-E	CQM1-CPU41 -EV1	CQM1-CPU42 -EV1	CQM1-CPU43-EV1 /44-EV1
Control method	Stored program method			
I/O control method	Cyclic scan with direct output; immediate interrupt processing			
Programming language	Ladder diagram			

Item	CQM1-CPU11-E/21-E	CQM1-CPU41 -EV1	CQM1-CPU42 -EV1	CQM1-CPU43-EV1 /44-EV1
Instruction length	1 step per instruction, 1 to 4 words per instruction			
Types of instructions	117 instructions (14 basic types)	137 instructions (14 basic types)		
Execution time	Basic instructions: 0.50 to 1.50 μs Special instructions: 24 μs (MOV instruction)			
Program capacity	3.2K words	7.2K words		
Input bits	00000 to 01115	I/O total within 128 points (8 words)	I/O total within 256 points (12 words)	
Output bits	10000 to 11115			
	Bits not used as I/O bits can be used as work bits.			
Work bits	2720 bits min. 01200 to 09515 11200 to 19515 21600 to 21915 22400 to 22915			
Function expansion bits	20000 to 21515: Used as work bits.			
	22000 to 22315: Used as work bits.		Analog SV area	Used as work bits.
	23200 to 23515: Used as work bits.			High-speed Counter 1,2 PV
	23600 to 23915: Used as work bits.			Pulse output 1, 2 volume (CPU43-EV1 only)
	24000 to 24315: Used as work bits.			
MACRO instruction bits	Inputs: 64 bits (IR 09600 to IR 09915) Outputs: 64 bits (IR 19600 to IR 19915)			
High-speed Counter 0 PV	32 bits (IR 23000 to IR 23115)			
Special bits (SR area)	192 bits (IR 24400 to IR 25515)			
Temporary bits (TR area)	8 bits (TR0 to TR7)			
Holding bits (HR area)	1,600 bits (HR 0000 to HR 9915)			
Auxiliary bits (AR area)	448 bits (AR0000 to AR 2715)			
Link bits (LR area)	1,024 bits (LR 0000 to LR6315)			
Timers/counters	512 timers/counters (TIM/CNT 000 to TIM/CNT 511).Interrupt refreshing possible for TIM 000 to TIM 015 (high-speed timer only).Interval timers 0 to 2 (interval timer 2 is used with the high-speed counter 0). High-speed counter input.			In addition to the specifications on the left, high-speed counter 1, 2 inputs (2 pts.)
Data memory	1,024 words (DM 0000 to DM 1023) plus DM 6144 to DM 6655 (read-only)	6,144 words (DM 0000 to DM 6143) plus DM 6144 to DM 6655 (read-only)		
Interrupt processing	External interrupts: 4 Scheduled interrupts: 3 (one of which can be used as a high-speed counter interrupt and one of which can be used as pulse output)			In addition to the specifications on the left, high-speed counter 1, 2 interrupts (2 pts.)
Memory protection	HR, AR, and DM area contents; counter values; and clock (RTC) values maintained during power interruptions.			
Memory backup	Battery life is 5 years regardless of presence or absence of clock (RTC). Backup time varies with ambient temperature. If BAT ERR indicator lights, replace the battery with a new one within 1 week. Connect new battery within 5 min of removing battery.			
Self-diagnostic functions	CPU Unit failure (watchdog timer), I/O bus error, memory failure, battery error, and host link error			
Program checks	No END instruction, programming errors (continuously checked during operation)			

2-6-3 Pulse Input Port (CQM1-CPU43-EV1)

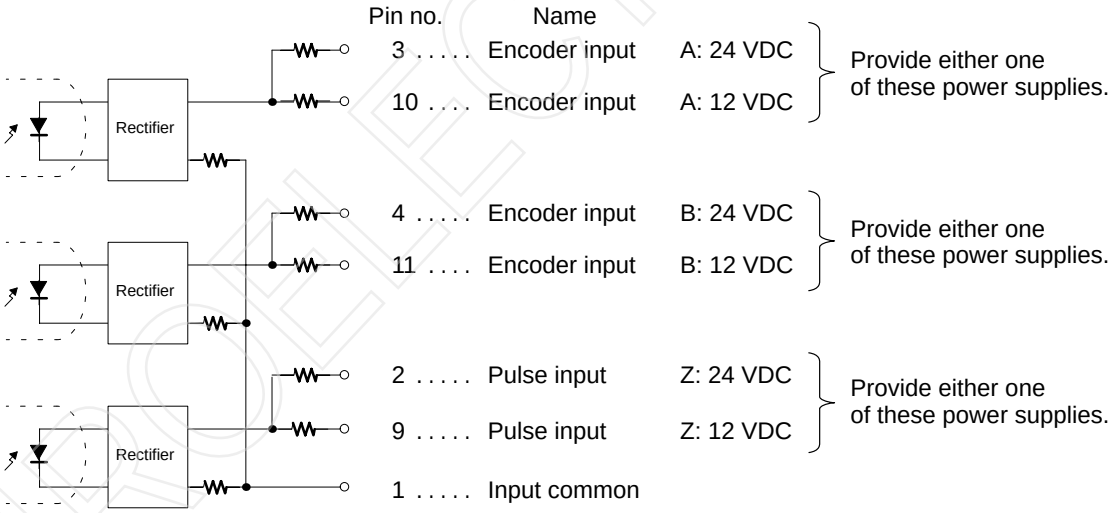
Item		Specifications	
Name		[Pulse I/O] CQM1-CPU43-EV1 (Built-in pulse function type)	
Pulse input	Signals	Encoder inputs A, B; pulse input Z	
	Input voltage	12 VDC ± 10%	24 VDC ± 10%
	Input current	A, B: 5 mA, TYP Z: 12 mA, TYP	
	ON voltage	10.2 VDC min.	20.4 VDC min.
	OFF voltage	3.0 VDC max.	4.0 VDC max.
	Computation speed	Single-phase: 50 kHz, two-phase: 25 kHz	
	Minimum response pulse	Encoder input A, B: Encoder input A, B waveform Input rising/falling time: 3 μs max. 50-kHz duty ratio: 50% pulse  Pulse input Z: A minimum pulse width of 0.1 ms is required.  Relation between phases A and B when phase-difference inputs are used.  T_1, T_2, T_3, T_4: 4.5 μs max. A minimum of 4.5 μs must be allowed for changing between phase A and phase B.	

Item		Specifications
Pulse output	Signals	Pulse output CW, CCW
	Output frequency	50 kHz (20 kHz max. when stepping motor is connected)
	Max. switching capacity	NPN open collector, 30 mA, 5 to 24 VDC ± 10%
	Min. switching capacity	NPN open collector, 7 mA, 5 to 24 VDC ± 10%
	Leakage current	0.1 mA max.
	Residual voltage	0.4 V max.
	External power supply	5 VDC ± 10%, 30 mA min. 24 VDC $^{+10\%}/_{-15\%}$, 30 mA min.
	Pulse output specifications	

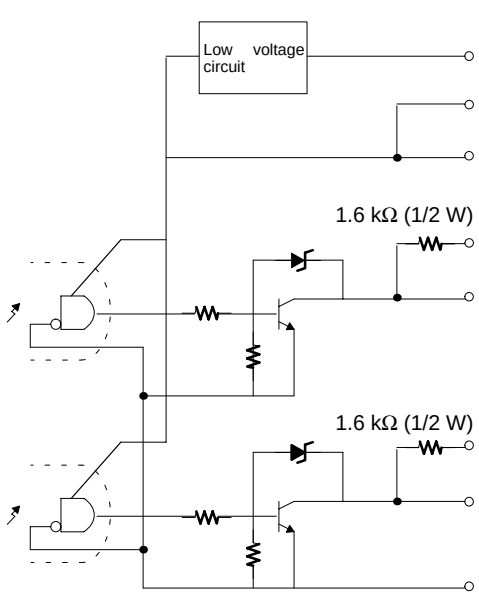
Pulse frequency	Switching current/Load power supply voltage			
	7 to 30 mA/5 VDC ±10%		7 to 30 mA/24 VDC $^{+10}/_{-15}$%	
	t ON	t OFF	t ON	t OFF
10 kpps max.	49.5 μs min.	48.5 μs min.	49.6 μs min.	46.0 μs min.
30 kpps max.	19.5 μs min.	18.5 μs min.	19.6 μs min.	16.0 μs min.
50 kpps max.	9.5 μs min.	8.5 μs min.	9.6 μs min.	6.0 μs min.

Internal Circuit Configuration

- **Pulse Input Section**



• Pulse Output Section



Pin no. Name

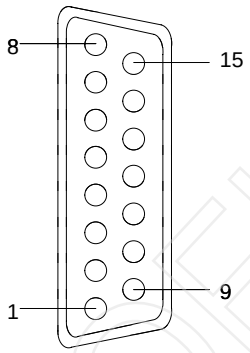
15 . . . . Power supply input for output 24 VDC
7 . . . . . Power supply input for output 5 VDC
8 . . . . . Power supply input for output 5 VDC

Provide either one of these power supplies. Do not provide both, or the circuits will be damaged.

13 . . . . CCW pulse output (with 1.6-kΩ resistance)
5 . . . . . CCW pulse output
14 . . . . CW pulse output / PWM output (with 1.6-kΩ resistance)
6 . . . . . CW pulse output / PWM output
12 . . . . Output common (0 V)

Note Ports 1 and 2 are the same.

Connector Pin Arrangement



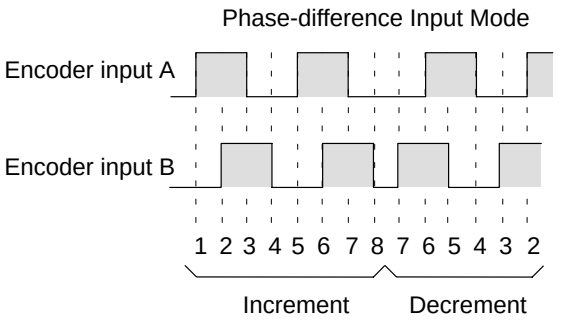
Pin no.	Signals
1	Input common
2	Pulse input Z: 24 VDC
3	Encoder input A: 24 VDC
4	Encoder input B: 24 VDC
5	CCW pulse output
6	CW pulse output / PWM output
7	Power supply input for output: 5 VDC
8	Power supply input for output: 5 VDC
9	Pulse input Z: 12 VDC
10	Encoder input A: 12 VDC
11	Encoder input B: 12 VDC
12	Output common (0 V)
13	CCW pulse output (with 1.6-Ω resistance)
14	CW pulse output / PWM output (with 1.6-Ω resistance)
15	Power supply input for output: 24 VDC

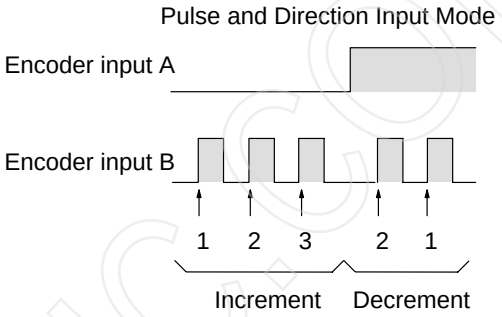
Wiring Examples

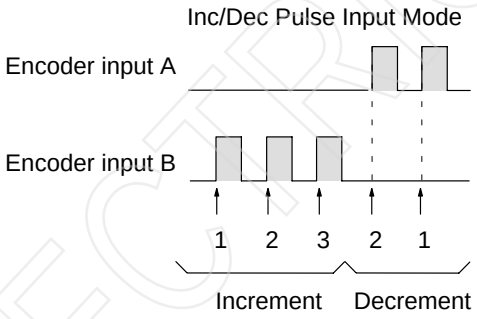
1) Pulse Input Connection

Depending on the count mode, the outputs from the encoder are connected to Port 1 and Port 2 as shown below.

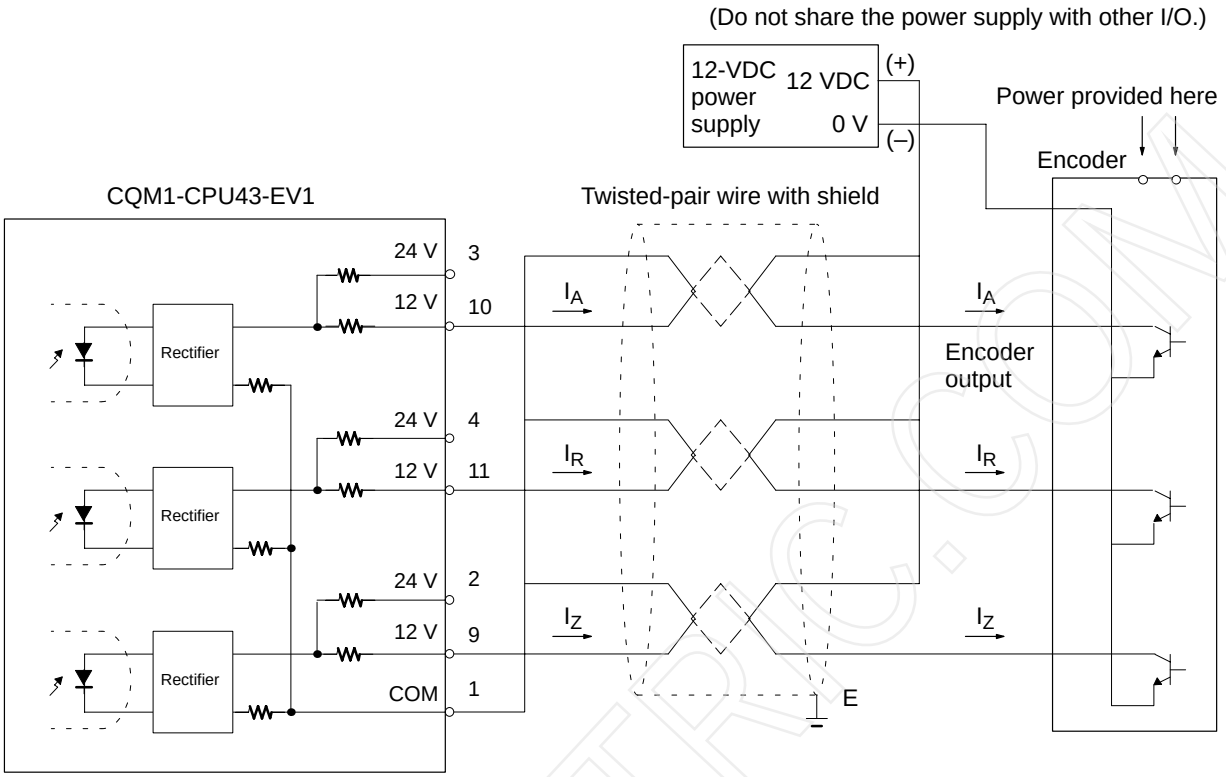
Ports 1 and 2		Encoder outputs		
Pin no.	Signal name	Phase-difference input mode	Pulse + direction input mode	Inc/Dec pulse input mode
3, 10	Encoder input A	Encoder phase A output	Direction signal output	Decrement pulse output
4, 11	Encoder input B	Encoder phase B output	Pulse output	Increment pulse output







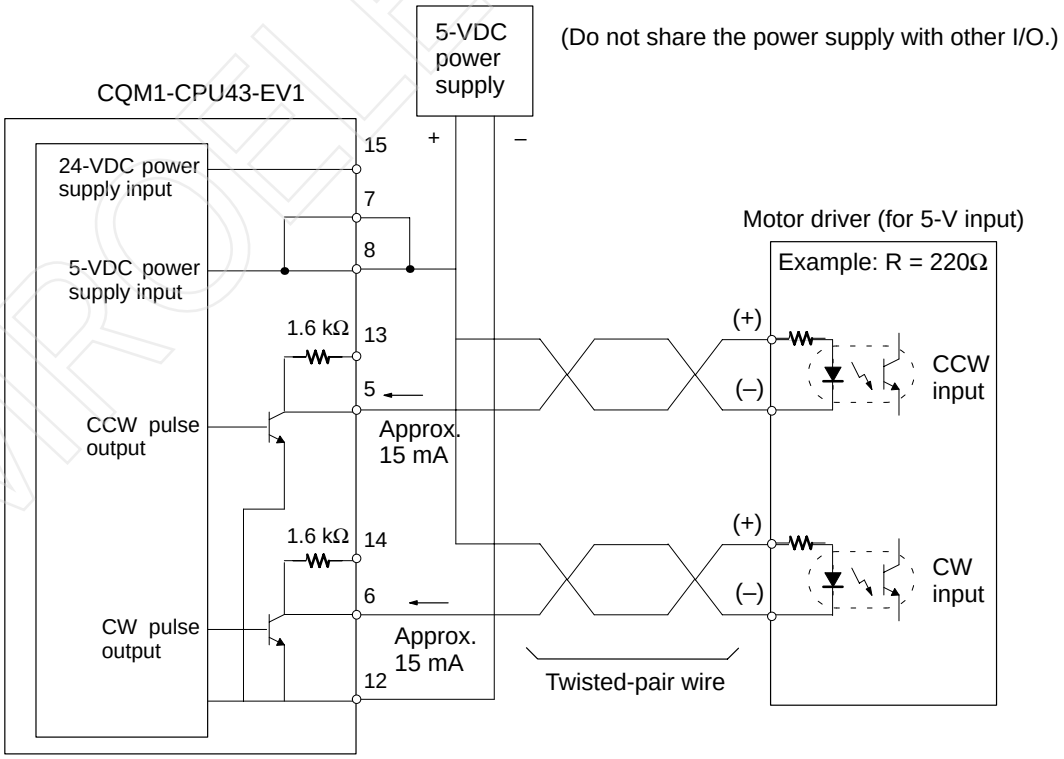
For example, the following diagram shows the connection of an encoder with phases A, B, and C.



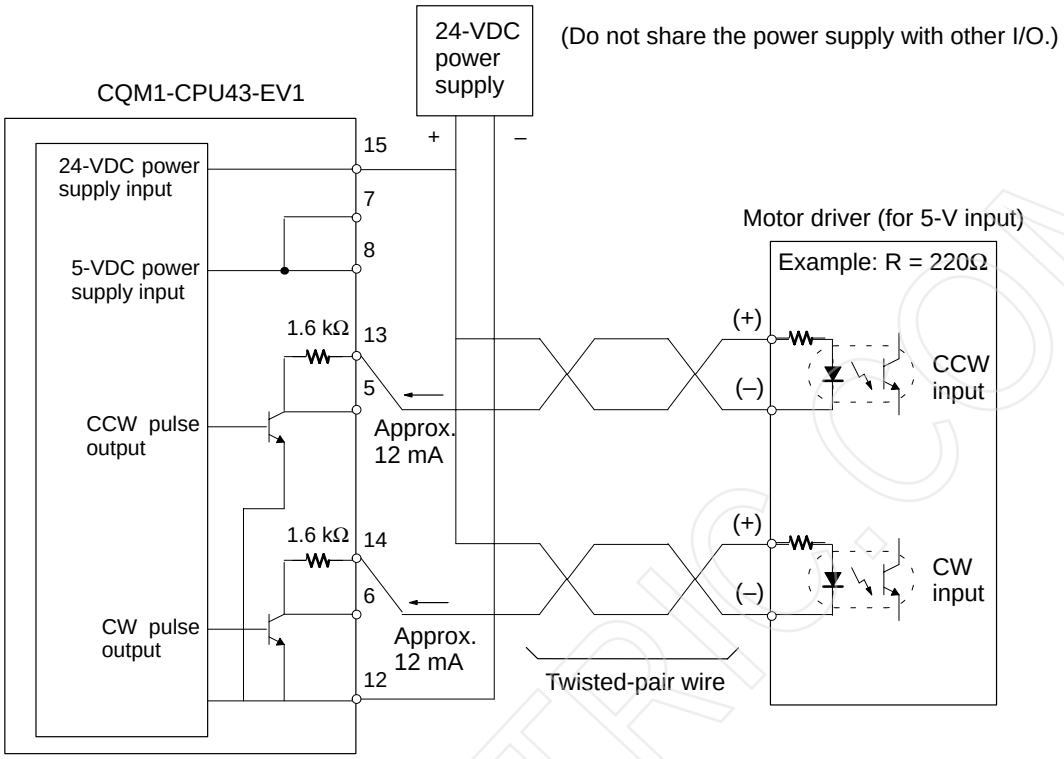
2) Pulse Output Connection

In these two example diagrams, the CQM1-CPU43-EV1 is connected to a 5-V input motor driver.

- **When a 5-VDC Power Supply is Used**



• When a 24-VDC Power Supply is Used



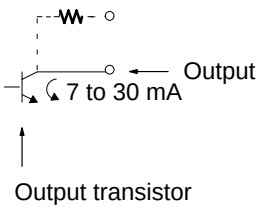
Note In this example, in order to use a 5-V input motor driver with a 24-VDC power supply, the CQM1 internal resistance (1.6 kΩ) is used. Be careful with regard to the drive current at the motor driver.

⚠ Caution Be careful when connecting the power supply inputs for the output section. If both 5-VDC and 24-VDC power supplies are provided, and if they are accidentally reversed, the CPU Unit and the power supply may be damaged.

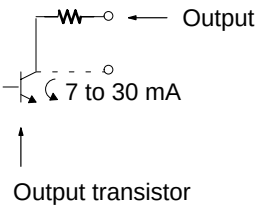
For the pulse output, connect a 7-mA to 30-mA load. (If using a load smaller than 7 mA, install a bypass resistor.)

Two 1.6-kΩ (1/2 W) resistors are built into the internal circuitry (pin numbers 13 and 14) for the pulse output. Use either one of the following outputs, to conform with the power supply, motor driver, and so on, that are used.

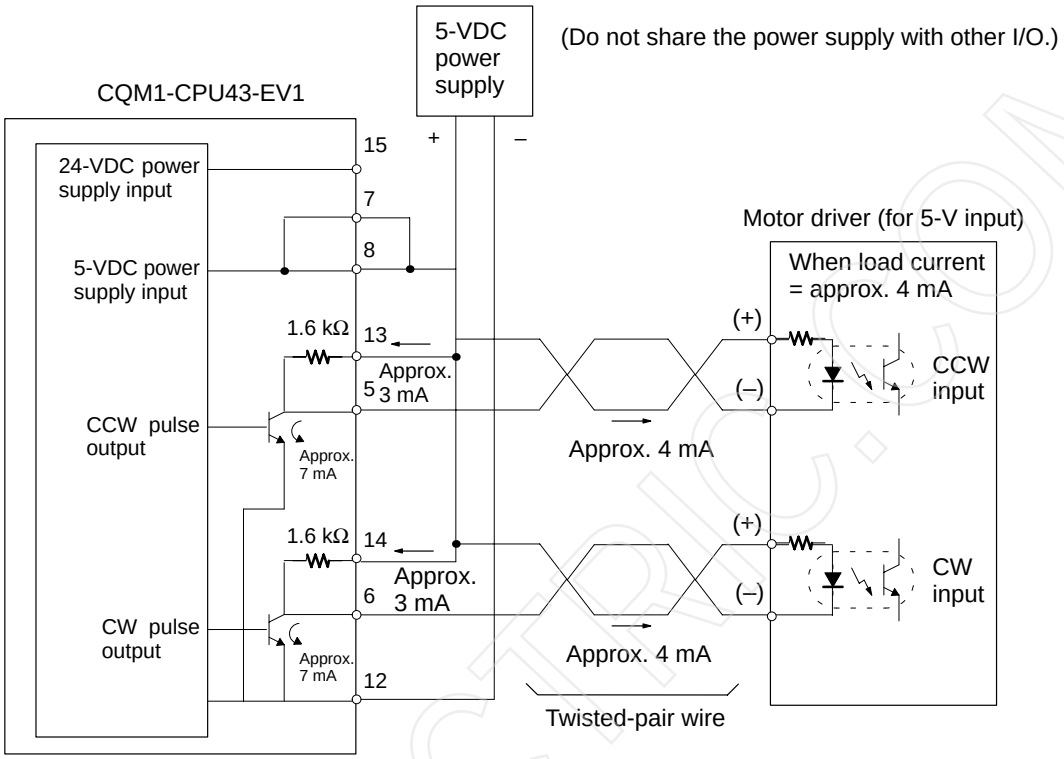
Open Collector Output



Open Collector Output with 1.6-kΩ Series Resistance



The built-in 1.6-kΩ resistors can be used as bypass resistors as shown in the example diagram below. In this example, the output-section transistor current of 7 mA equals the load current of 4 mA plus the bypass current of 3 mA.

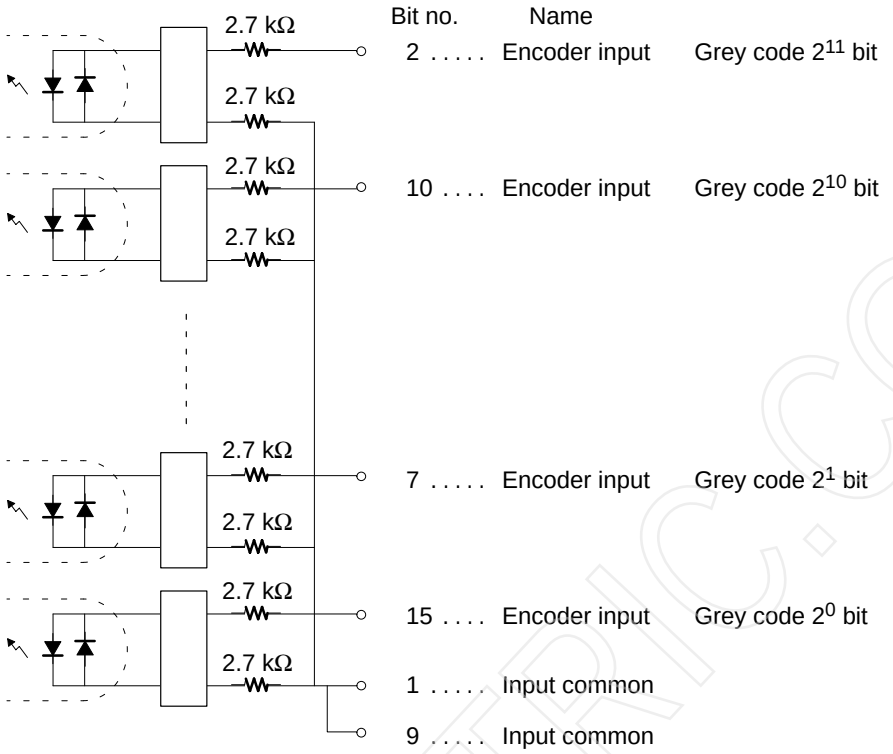


The pulse output section's internal circuit transistor is off while pulse output is stopped.

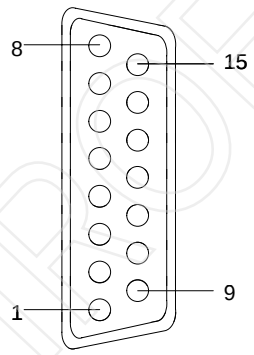
2-6-4 ABS Interface Port (CQM1-CPU44-EV1)

Item	Specifications
Name	[ABS interface] CQM1-CPU44-EV1 (built-in ABS interface type)
Input Voltage	24 VDC $^{+10\%}/_{-15\%}$
Input Impedance	5.4 kΩ
Input Current	4 mA typical
ON Voltage	16.8 VDC min.
OFF Voltage	3.0 VDC max.
Computation speed	4 kHz max.
Input code	Grey, binary (8, 10, 12 bits)

Internal Circuit Configuration



Connector Pin Arrangement

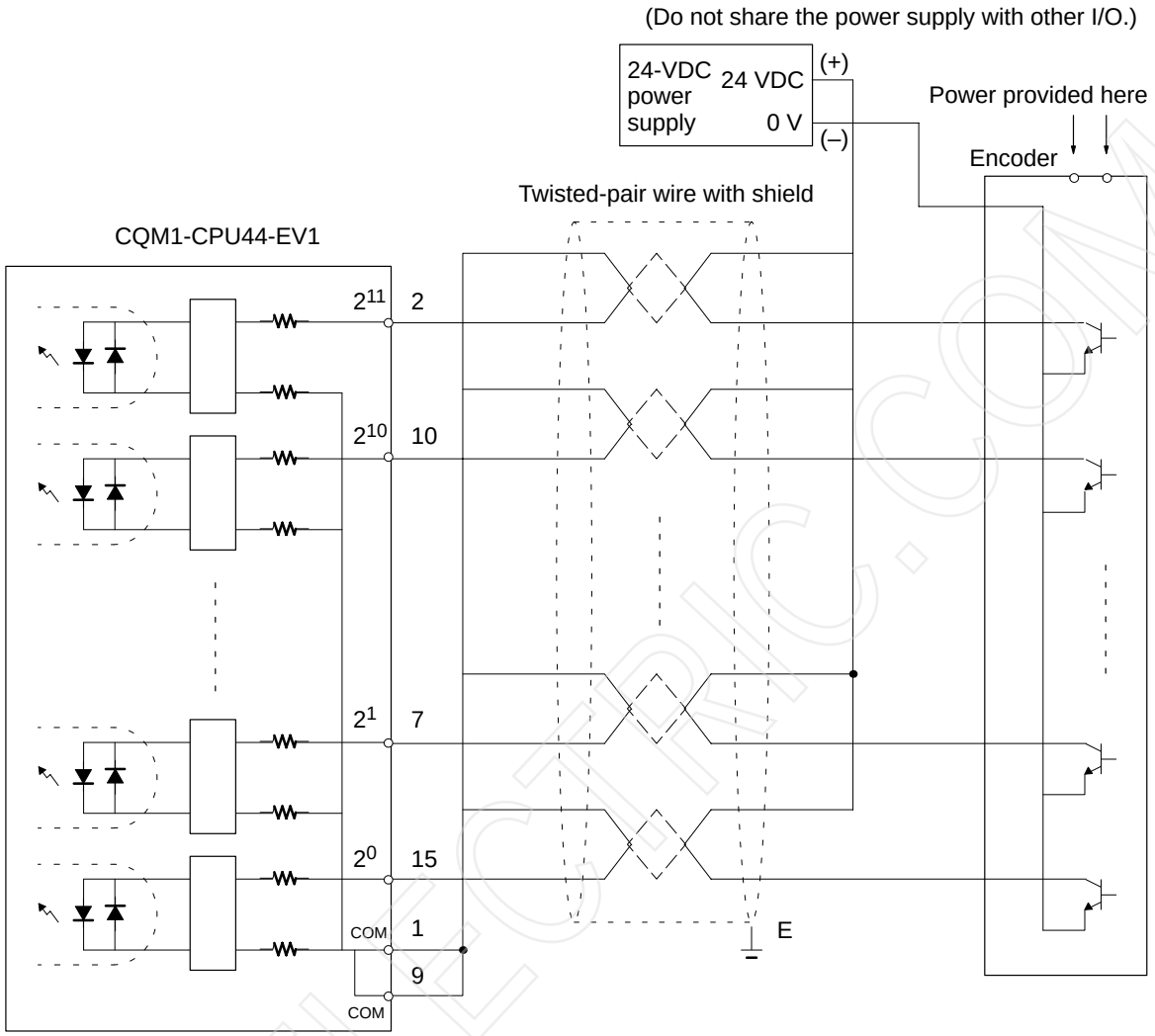


Pin no.	Signals
1	Input common
2	Encoder input, grey code 2^{11} bit
3	Encoder input, grey code 2^{9} bit
4	Encoder input, grey code 2^{7} bit
5	Encoder input, grey code 2^{5} bit
6	Encoder input, grey code 2^{3} bit
7	Encoder input, grey code 2^{1} bit
8	NC
9	Input common
10	Encoder input, grey code 2^{10} bit
11	Encoder input, grey code 2^{8} bit
12	Encoder input, grey code 2^{6} bit
13	Encoder input, grey code 2^{4} bit
14	Encoder input, grey code 2^{2} bit
15	Encoder input, grey code 2^{0} bit

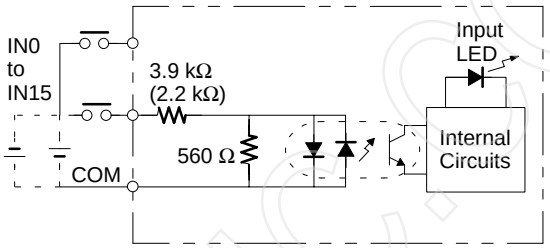
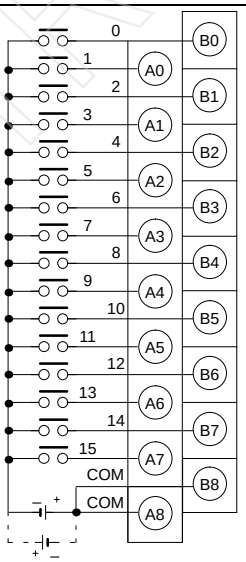
Note Ports 1 and 2 are the same.

⚠ Caution The only absolute-type encoder that can be connected is the grey binary code output type.

Wiring Example



2-6-5 24-VDC Inputs (Built into CPU Unit)

Item	CQM1-CPU11-E/21-E/41-EV1/42-EV1/43-EV1/44-EV1
Input Voltage	24 VDC $^{+10\%}/_{-15\%}$
Input Impedance	IN4 and IN5: 2.2 kΩ; other inputs: 3.9 kΩ
Input Current	IN4 and IN5: 10 mA typical; other inputs: 6 mA typical (at 24 VDC)
ON Voltage	14.4 VDC min.
OFF Voltage	5.0 VDC max.
ON Delay	Default: 8 ms max. (can be set between 1 and 128 ms in PC Setup; see note)
OFF Delay	Default: 8 ms max. (can be set between 1 and 128 ms in PC Setup; see note)
No. of Inputs	16 points (16 inputs/common, 1 circuits)
Circuit Configuration	 **Note** Figures in parentheses are for IN4 and IN5. The input power supply polarity may be connected in either direction.
Terminal Connections	

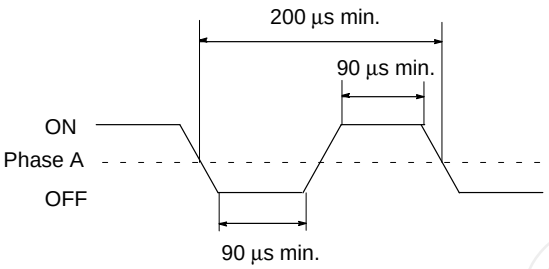
Note IN0 through IN3 can be set for use as input interrupts in the PC Setup. The ON and OFF delays for input interrupts are fixed at 0.1 ms max. and 0.5 ms max., respectively. IN4 through IN6 can be set for use as high-speed counter interrupts. The delays for high-speed counter interrupts are shown in the following table.

Input	Increment input mode	Differential phase mode
IN4 (A)	5 KHz	2.5 KHz
IN5 (B)	Normal input	
IN6 (Z)	ON: 100 μs min. required; OFF delay: 500 μs min. required	

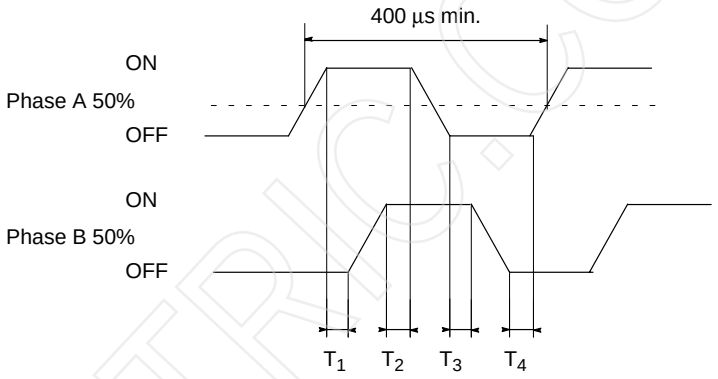
The minimum response pulses will be as follows:

Input A (IN4), Input B (IN5)

Increment Mode (5 kHz max.)

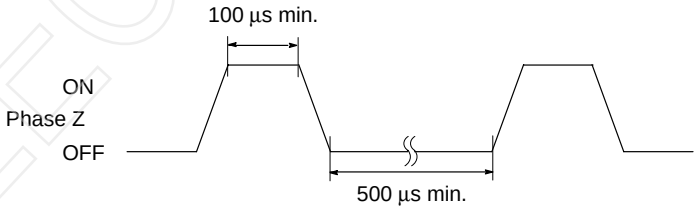


Phase-input Difference Mode (2.5 kHz max.)

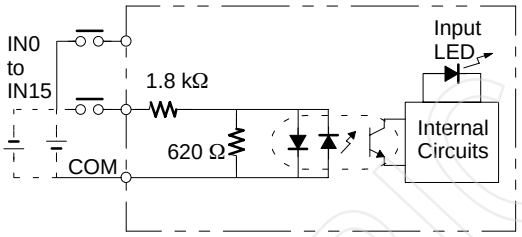
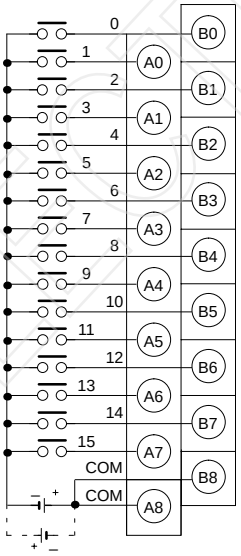


T_1, T_2, T_3, T_4: 90 μs min.

Input Z (IN6)



2-6-6 12-VDC Input Units

Item	CQM1-ID111
Input Voltage	12 VDC $^{+10\%}/_{-15\%}$
Input Impedance	1.8 kΩ
Input Current	6 mA typical (at 12 VDC)
ON Voltage	8.0 VDC min.
OFF Voltage	3.0 VDC max.
ON Delay	Default: 8 ms max. (can be set between 1 and 128 ms in PC Setup, see note)
OFF Delay	Default: 8 ms max. (can be set between 1 and 128 ms in PC Setup, see note)
No. of Inputs	16 points (16 points/common, 1 circuit)
Internal Current Consumption	85 mA max. at 5 VDC
Weight	180 grams max.
Circuit Configuration	 **Note** The input power supply polarity may be connected in either direction.
Terminal Connections	

Note Refer to *3-1-1 Offline Operations*.