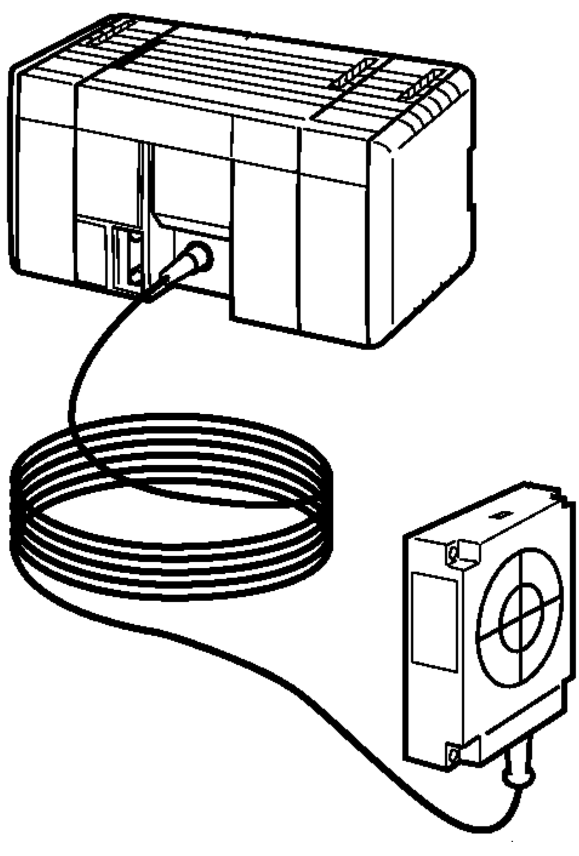
IDSC-C1DR/C1DT-A-E
ID Controller

User's Manual

Revised December 2004



Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to the product.

⚠ DANGER Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ Caution Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

OMRON Product References

All OMRON products are capitalized in this manual. The word "Unit" is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation "Ch," which appears in some displays and on some OMRON products, often means "word" and is abbreviated "Wd" in documentation in this sense.

The abbreviation "PC" means Programmable Controller and is not used as an abbreviation for anything else.

Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

Note Indicates information of particular interest for efficient and convenient operation of the product.

1, 2, 3... 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

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TABLE OF CONTENTS

About this Manual:

This manual describes the installation and operation of the IDSC-C1DR-AE and IDSC-C1DT-AE ID Controllers and includes the sections described below. These ID Controllers provide complete Programmable Controller (PC) functionality and use a electromagnetic coupling system to enable construction of non-contact information recognition (IDentification) systems.

Although this is the only manual provided specially for the ID Controllers, the following manuals must be referenced as required when setting up, programming, installing, and operating an ID Controller System.

Information on	Manual
Constructing ID Systems, including information on Read/Write Heads, Data Carriers, etc.	*V600 FA ID Sensor Serial Interface Operation Manual (Z44)* *V600 FA ID Sensor Parallel Interface Operation Manual (Z45)*
Programmable Controllers	*CQM1 Programmable Controller Programming Manual (W228)*
Inputting programs or operating PCs	*SYSMAC C-Series PC Ladder Support Software Operation Manual (W237)*

Please read this manual and the related manuals carefully and be sure you understand the information provided before attempting to install and operate an ID Controller.

Section 1 describes the features of an ID Controller and the types of system configuration in which it can be used.

Section 2 describes the components that make up an ID Controller and the procedures necessary to install and mount an ID Controller.

Section 3 describes the Programming Console, Ladder Support Software (LSS) Operations, and SYSMAC Support Software (SSS) Operations used with an ID Controller System.

Section 4 describes the structure and use of the data areas used by the ID Controller.

Section 5 describes the functions of the ID Controller and the Setup that can be used to control those functions.

Section 6 describes some of the ladder-diagram programming used to program the ID Controller. Refer to the *CQM1 Programming Manual* for more information on ladder-diagram programming.

Section 7 provides four programming examples using ID communications instructions.

Section 8 described the processing that takes place within the ID Controller and explains how to calculate the time required for program execution and related processing (called the scan time).

Section 9 describes how to diagnose and correct the hardware and software errors that can occur during ID Controller operation and how to create user errors based on program execution.

The **Appendices** provide information on standard models, specifications, dimensions, SR and AR Area allocations, and extended ASCII.

> **⚠WARNING** Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

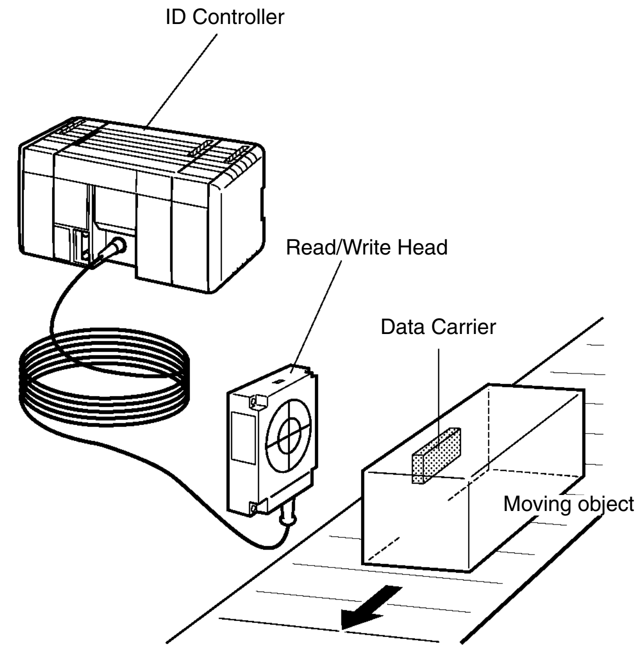
SECTION 1
Features and System Configuration

This section describes the features of an ID Controller and the types of system configuration in which it can be used.

1-1 ID Controller Features

1-1-1 Overview

An ID Controller can be used to create a non-contact information system and is equipped the complete functionality of a compact, high-speed Programmable Controller (PC). Data is transferred between a Read/Write Head and Data Carriers in systems like the one shown in the following illustration.



Refer to the following page numbers for specific information.

- Hardware
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  - Transistor Outputs: Page 23
  - Contact Outputs: Page 24
  - Power Supply Wiring: Page 30
  - Read/Write Head Connections: Page 31
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  - DC WRITE/AUTOWRITE: Page 80
  - DC CLEAR: Page 82
  - DC MANAGE DATA: Page 83
  - All the Above Instructions: Page 134
- Advanced I/O Instructions: Page 86
- Interrupts: Page 94
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1-1-2 ID Controller Features

- The ID Controller is equipped with an interface for electromagnetic-coupling ID Sensors and one Read/Write Head can be connected. Communications (content read/write) with Data Carriers featuring this interface is performed by sequential programming commands.
- Interrupt functions are provided, and specific subroutines can be executed in response to ID communications.
- The ID Controller can be used for various types of communications, such as host links, NT links to PT, 1:1 links, and RS-232C.
- The controller is equipped with 32 I/O points (16 input points and 16 output points).
- The details of up to 30 errors generated during communications with the Data Carrier can be logged in response to errors in ID communication commands. Other functions, such as online communications test, are available to test communications with Data Carriers.

1-1-3 ID Controller Functions

ID Communications Instructions

The following instructions are provided specifically for ID communications to control data reception between the ID Controller and Data Carriers (DC).

Code	Mnemonic	Name	Function
61	IDRD	DC READ	Reads data from memory in the Data Carrier.
62	IDWT	DC WRITE	Writes data to memory in the Data Carrier.
63	IDAR	DC AUTOREAD	Waits for approach of a Data Carrier and then reads data.
64	IDAW	DC AUTOWRITE	Waits for approach of a Data Carrier and then writes data.
65	IDCA	DC CLEAR	Initializes memory in the Data Carrier with the specified data.
66	IDMD	DC MANAGE DATA	Checks memory in the Data Carrier. Also manages the write life in EEPROM Data Carriers.

ID Interrupts

The ID Controller is equipped with the following interrupt functions.

- ID communications response interrupt for ID communications responses.
- Input interrupts for external input signals
- Interval timer interrupts for internal timers
- High-speed counter interrupts for an internal counter

Communication Functions

Equipped with both a peripheral and an RS232 port, the ID Controller can communicate with external devices using the following methods

Host Link Communications or NT Links
Communications by Host Link commands is enabled by connecting the ID Controller to a Programmable Terminal (PT), personal computer or other device.

RS-232C Devices
Data can be read from bar code readers, measuring instruments, and other devices and data can be output to a printer.

1:1 Link Systems
Data areas can be linked by connecting the ID Controller to other ID Controller. In this setup, operating status can be synchronized while the status of other equipment can be monitored.

32 I/O Points

- Outputs: 16 contact outputs or 16 transistor outputs
- Inputs: 16 24-VDC inputs

ID Error Log

The log of errors generated during ID communication is stored in the DM area in the order generated (serial error log) or as statistical data by error type (error statistics log). The time that an error was generated can also be stored in memory if a Memory Cassette equipped with clock functions is provided.

Serial and error statistics logs can be checked from a Programming Console connected to the ID Controller.

ID Communication Errors

Error code	Programming Console message	Meaning
70	COM. DC E	Data Carrier communications error.
71	VERIFY E	Data mismatch.
72	NO DC E	Data Carrier missing.
7A	ADRS E	Data Carrier address error.
7C	R/WD E	Read/Write Head not connected.
7D	PROTCT E	Protection error.

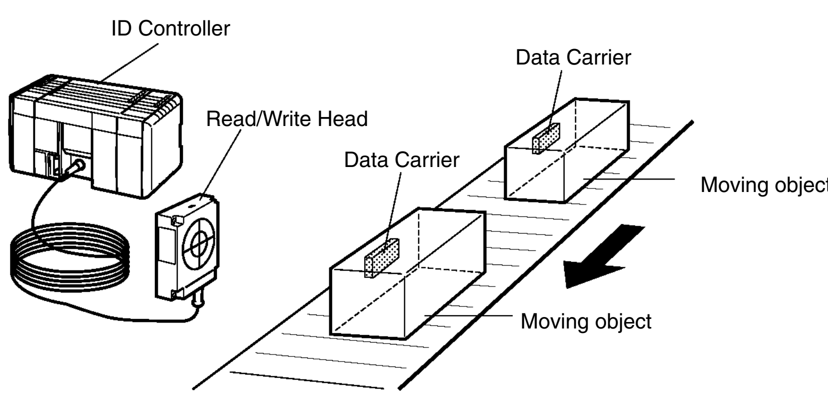
PC Functions

I/O and communication functions can be controlled with the ladder-diagram program in the PC. Advanced I/O instructions that input and output data with a single instructions, macro instructions to call up subroutines, and differential monitoring to monitor changes (via LSS/SSS) in signals are also provided to help simplify programming and operation.

Note Refer to the *CQM1 Programming* and *Operation Manuals* for details on PC functions.

1-1-4 ID Controller Applications

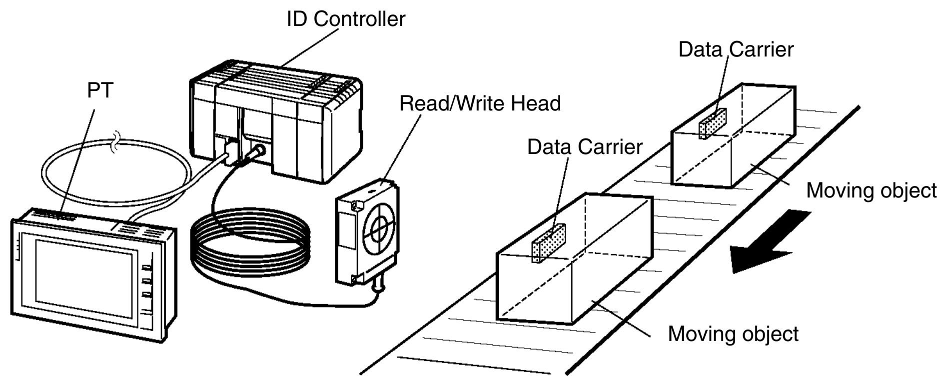
The ID Controller facilitates the construction of non-contact ID systems that recognize data using and electromagnetic induction and can process the data using Programmable Controller (PC) functions. The contents of Data Carrier memory can be read without direct connections or contact with Data Carriers mounted on moving objects simply by connecting a Read/Write (R/W) Head to the ID Controller, as shown in the following illustration.



As a result, products or other articles can be distributed, and specific products can be extracted automatically. (Refer to *7-4 Controlling Workpiece Flow*.)

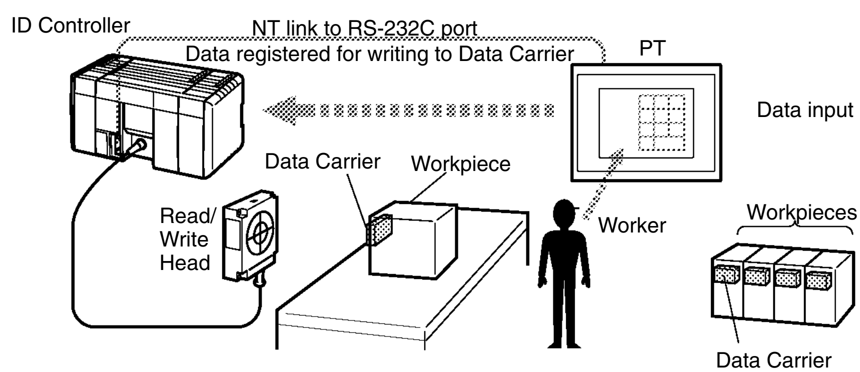
And since the ID Controller can write to Data Carriers, information such as whether work was completed or work results can be recorded at any stage to the Data Carrier of moving objects. (Refer to *7-1 Recording Data* and *7-3 Managing Production Histories*.)

Connecting Programmable Terminals (PTs), shown in the following illustration, to a ID Controller enables data confirmation, displays for work details applicable in the ID system and other capabilities. (Refer to *7-2 Displaying Worker Instructions*.)



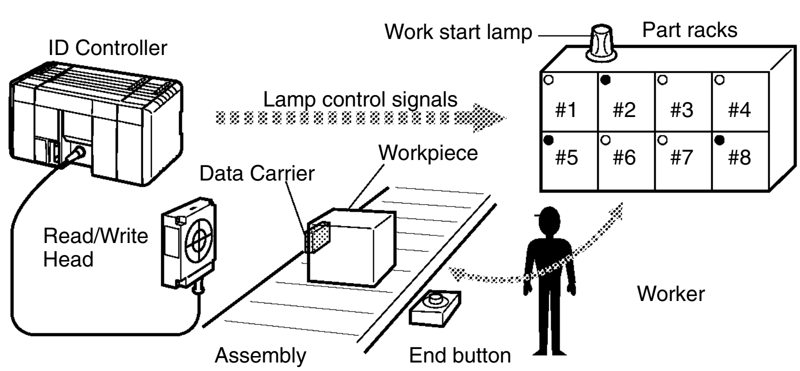
Data Recording

The ID Controller and Programmable Terminal can also be used to record data in the Data Carrier. Workers can record data in the Data Carrier with a few simple operations while confirming data details on a Programmable Terminal (PT) fnscreen.



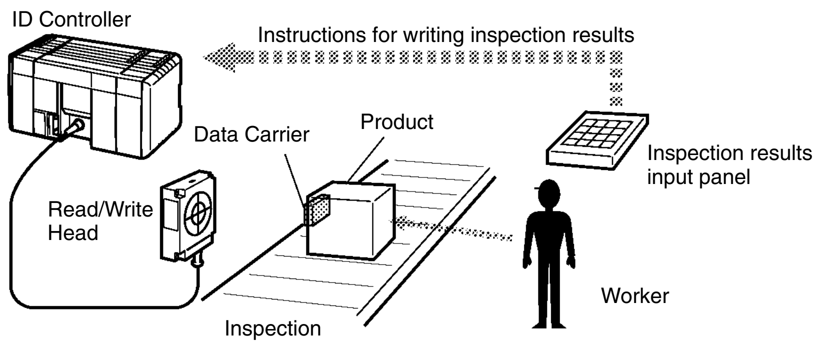
Worker Instructions

The ID Controller can read work data from Data Carriers and display the results on lamp to direct line workers.



Production History Control

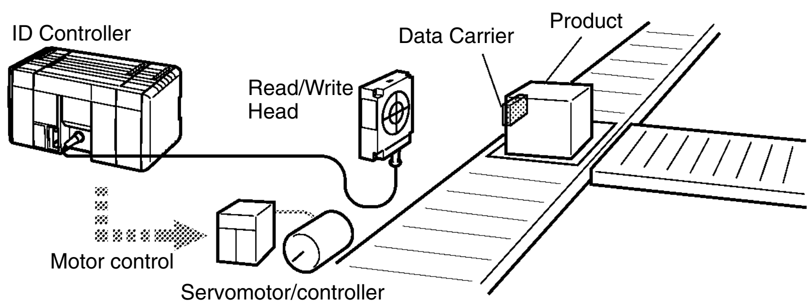
The production history of products can be controlled in extreme detail at each process by writing assembly and inspection results together with other information, such as time and line workers, to the Data Carriers. Clock functions can be provided for time data if a clock-equipped Memory Cassette is used.



Distribution

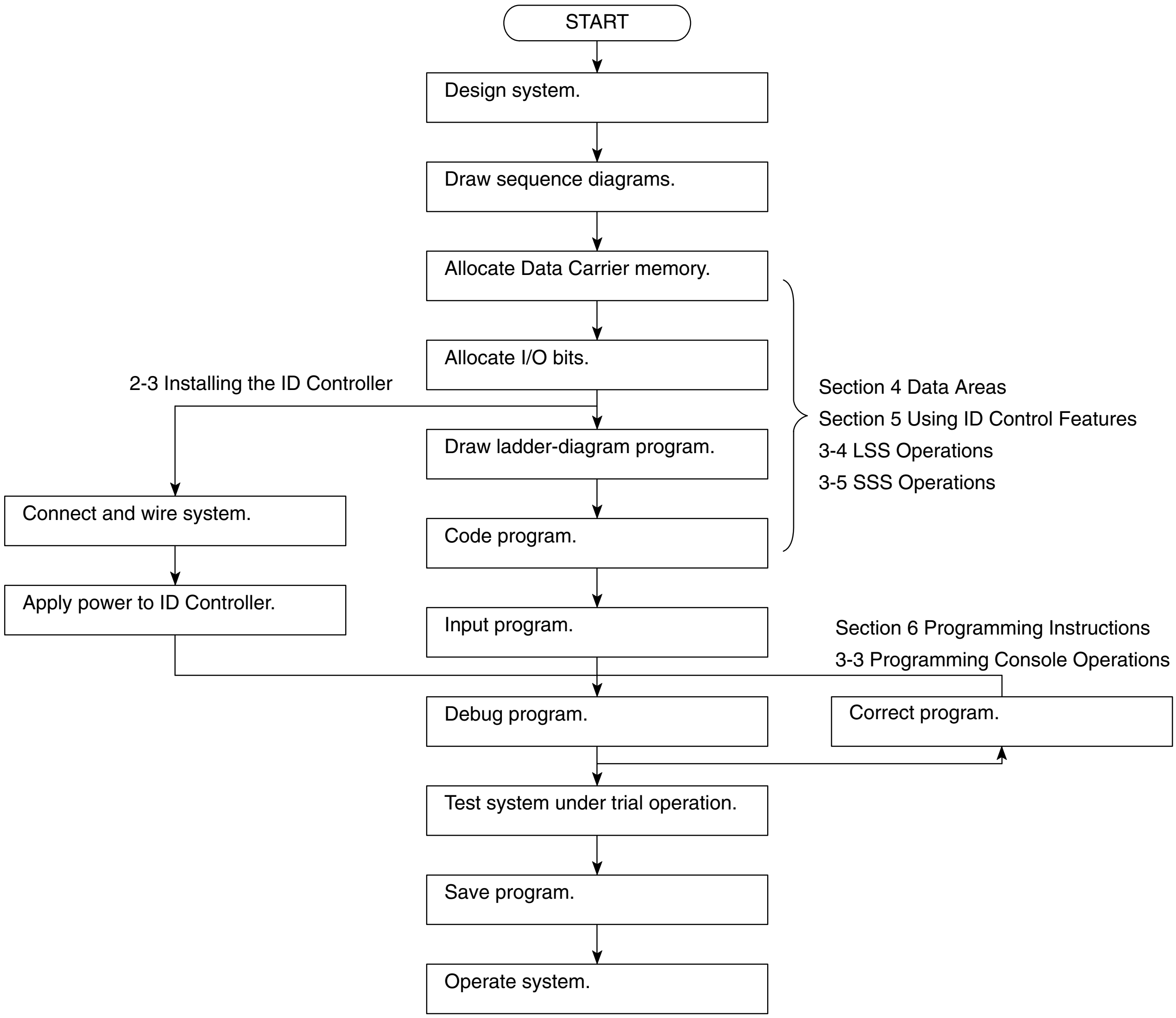
The ID Controller can be used to distribute (route to another line by destination, for example) articles on a conveyor.

In addition to distribution control with a simple mechanism like a pusher, the ID Controller is also ideally suited to advanced distribution control using devices that demand complex processing by servomotors and other equipment.



1-2 Overall ID Controller Procedure

The following flowchart illustrates the overall flow of using an ID Controller.

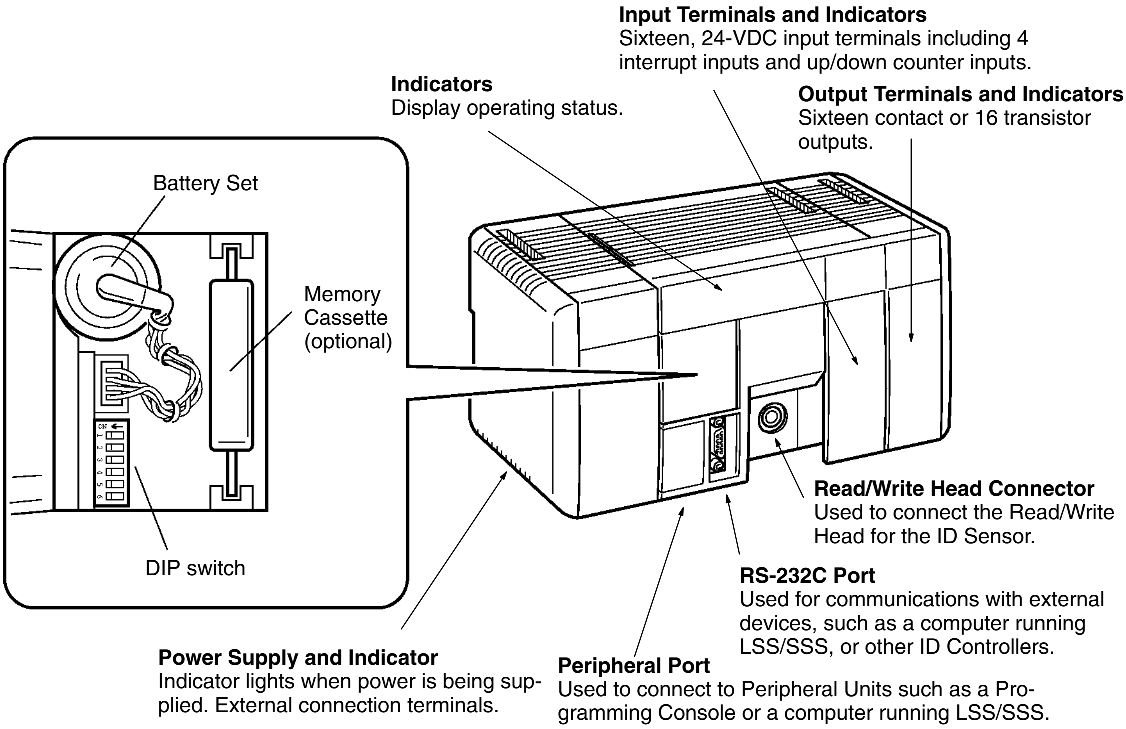


SECTION 2
Hardware Components and Installation

This section describes the components that make up an ID Controller and the procedures necessary to install and mount an ID Controller.

2-1 Component Names and Functions

The following diagram shows the basic components that are used in general operation of the ID Controller.



2-1-1 DIP Switch

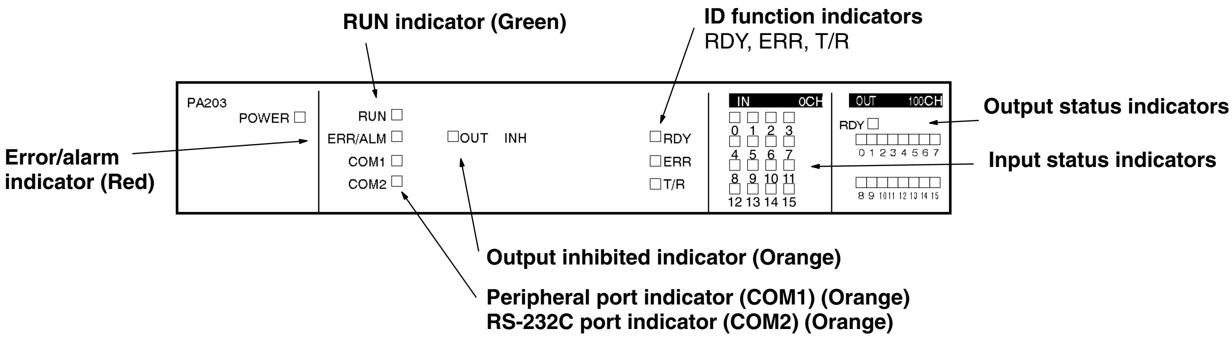
The DIP switch is located under a cover on the front of the ID Controller as shown above. The setting of these switches is described in the following table.

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	Autoboot enabled. The contents of Memory Cassette will be transferred to the ID Controller automatically at start-up.
	OFF	Autoboot 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	RS-232C communications governed by default settings. (1 start bit, even parity, 7-bit data, 1 stop bit, 2,400 bps)
	OFF	RS-232C communications not governed by default settings.
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.
	OFF	

Note All DIP switch pins except pin 3 are turned OFF at the factory.

2-1-2 Indicators

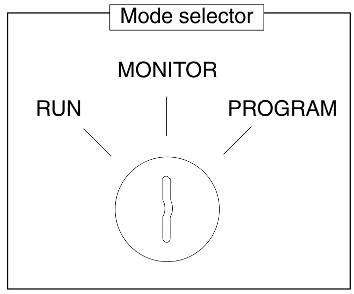
ID Controller indicators provide visual information on the general operation of the ID Controller. Although not substitutes for proper error programming using the flags and other error indicators provided in the data areas of memory, these indicators provide ready confirmation of proper operation. ID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



Indicator	Name	Function
RUN (Green)	RUN indicator	Lights when the ID Controller is operating normally.
ERR/ALM (Red)	Error/Alarm indicator	Flashes when there is a non-fatal error. The ID Controller will continue operating. Lit when there is a fatal error. When this indicator lights, the RUN indicator will go off, ID Controller operation will be stopped, and all outputs will be turned OFF.
COM1 (Orange)	Peripheral port indicator	Flashes then the ID Controller is communicating with another device via the peripheral port.
COM2 (Orange)	RS-232C port indicator	Flashes when the ID Controller is communicating with another device via the RS-232C port.
OUT INH (Orange)	Output inhibited indicator	Lights when the Output OFF Bit, SR 25215, is turned ON. All ID Controller outputs will be turned OFF.
0, 1, 2 . . .	Input status indicators	Indicate the ON and OFF status of input bits in IR 000.
0, 1, 2 . . .	Output status indicators	Indicate the ON and OFF status of output bits in IR 100.
ID Function Indicators		
RDY (Green)	Operation Ready	Lit when ID functions are possible.
ERR (Red)	Error/Alarm	Lit when there is an error in the ID Controller Setup or when operation stops during communications. Flashes when there is an error in ID communications.
T/R (Orange)	ID Communications	Lit when communications are taking place with the Read/Write Head.

2-1-3 ID Controller Operating Modes

ID Controllers have three operating modes: PROGRAM, MONITOR, and RUN. The ID Controller 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. When changing between RUN and PROGRAM mode, press the SHIFT Key once and change to MONITOR mode and then press the SHIFT Key again before switching to the final mode.

RUN Mode

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

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 will be turned ON when the corresponding output bit is ON.

PROGRAM Mode

PROGRAM mode is used when making basic changes to the ID Controller program or settings, such as transferring, writing, editing, or checking the program, or changing the ID Controller Setup. The program is not executed in PROGRAM mode.

Mode Changes

The factors that determine the initial operating mode of the ID Controller (the mode when the ID Controller is turned on) are listed below.

1, 2, 3...

1. No Devices mounted: RUN mode

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

2. Programming Console mounted:

   If the Programming Console is connected to the ID Controller when ID Controller power is applied, the ID Controller 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 ID Controller, but another Peripheral Device is connected to the ID Controller, the ID Controller will enter PROGRAM mode.

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

2-1-4 Memory Cassettes

Six Memory Cassettes are available as accessories to store the program or ID Controller Setup. The following CQM1 Memory Cassettes are used for ID Controllers.

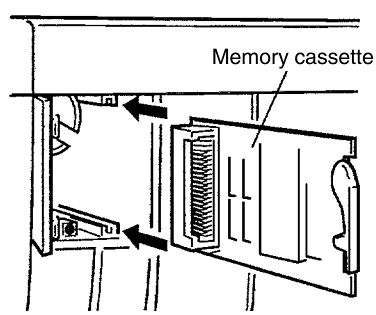
Note When pin 2 of the ID Controller's DIP switch is ON, the contents of the Memory Cassette will be transferred to the ID Controller automatically at start-up.

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	

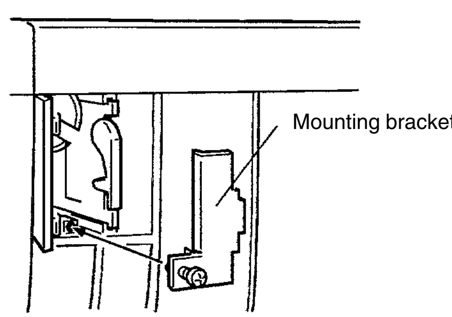
Memory Cassette Installation Follow the procedure below to install a Memory Cassette in the ID Controller.

⚠ **Caution** Always turn off power to the ID Controller 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 ID Controller on the tracks provided. Press the Memory Cassette in so that the connectors fit securely.



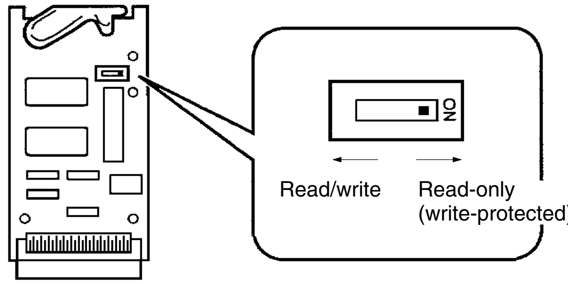
3. Replace the bracket as shown below and tighten the screw.



EEPROM Write Protection

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

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



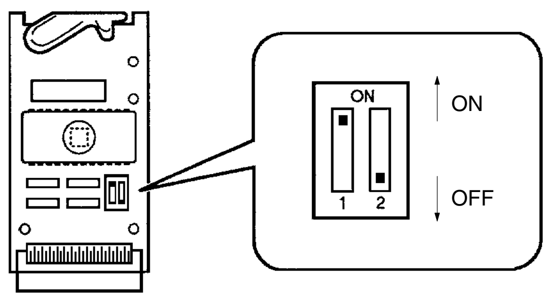
Note Flag AR 1302 will be ON when the write-protect switch is ON.

EPROM Version

The three EPROM Chips listed below can be used in the Memory Cassettes. These Chips are made by OMRON.

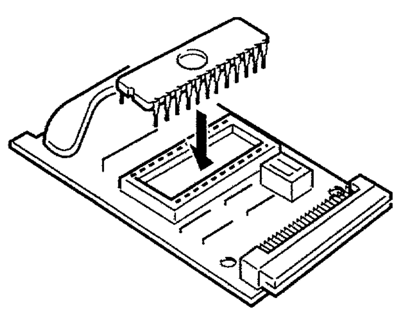
EPROM version	Capacity	Access speed	Model number
27128	8K words	150 ns	ROM-ID-B
27256	16K words	150 ns	ROM-JD-B
27512	32K words	150 ns	ROM-KD-B

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

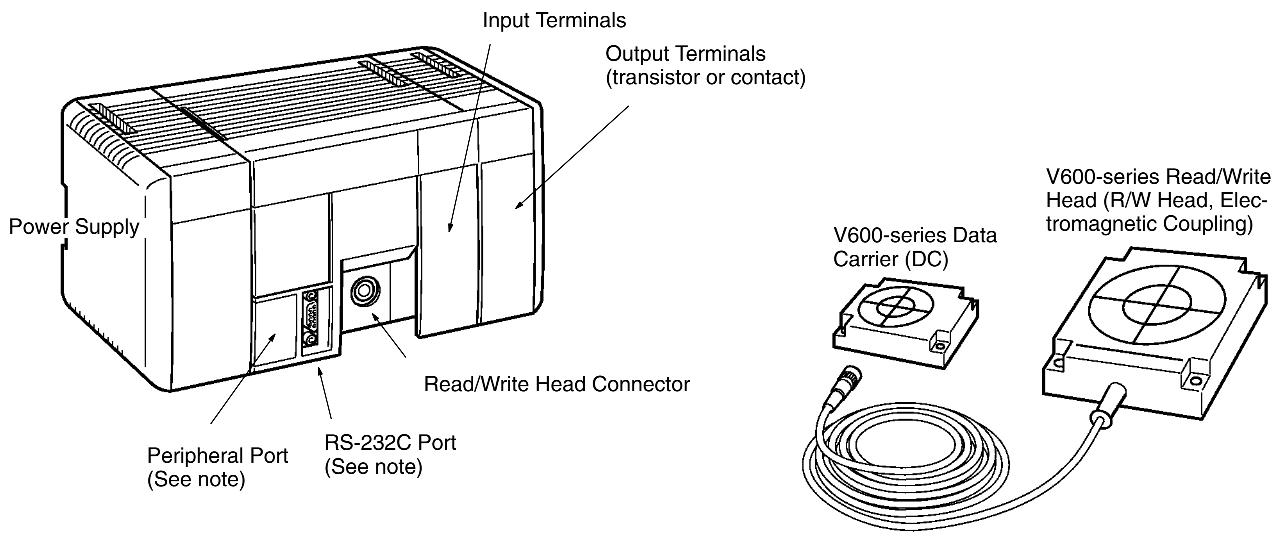
Install an EPROM chip onto the Memory Cassette as shown in the following diagram.



2-2 System Configuration and Installation

2-2-1 Basic Configuration

The basic components of an ID Controller System are shown in the following illustration.



Note These ports can be connected to a Programming Console (CQM1-PRO01-E or C200H-PRO27-E) or to an IBM PC/AT or compatible computer (running Ladder Support Software or SYSMAC Support Software).

ID Controller

I/O points:	32
Program capacity:	3.2K words
Data memory:	6K words

ID Communications

Connectable R/W Heads:	1
Data transmission capacity:	256 bytes max.
Communications instructions:	Six for ID communications

Power Supply

Voltage:	100 to 240 VAC
Power supply capacity:	3.6 A (18 W) at 5 VDC

Input Terminals

Number of inputs:	16
Voltage:	24 V

Output Terminals

See following table.

Item	Transistor outputs	Contact outputs
Number of outputs	16	16
Voltage	4.5 to 26.4 V	250 VAC/24 VDC
Max. switching capacity	0.3 A	2 A (8 A total)

2-2-2 Installation Precautions

This section provides precautions for installing the ID Controller.

⚠ Caution Static electricity can damage ID Controller components. Your body can carry an electrostatic charge, especially when the humidity is low. Before touching the ID Controller, be sure to first touch a grounded metallic object, such as a metal water pipe, in order to discharge any static build-up.

Ambient Conditions

Do not install the ID Controller in any of the following locations. Doing so will affect ID Controller life and may affect operating performance.

- Locations subject to ambient temperatures lower than 0°C or higher than 55°C, or 0°C to 45°C when a Programming Console is used.
- Locations subject to drastic temperature changes or condensation.
- Locations subject to ambient humidity lower than 10% or higher than 90%.
- Locations subject to corrosive or flammable gases.
- Locations subject to excessive dust (especially iron dust) or chloride.
- Locations that would subject the ID Controller to direct shock or vibration.
- Locations that would subject the ID Controller to water, oil, or chemical reagents.
- Locations exposed to direct sunlight.
- Do not install the ID Controller over heaters, transformers, high-capacity resistors, or other devices that generate heat.

High-voltage Equipment

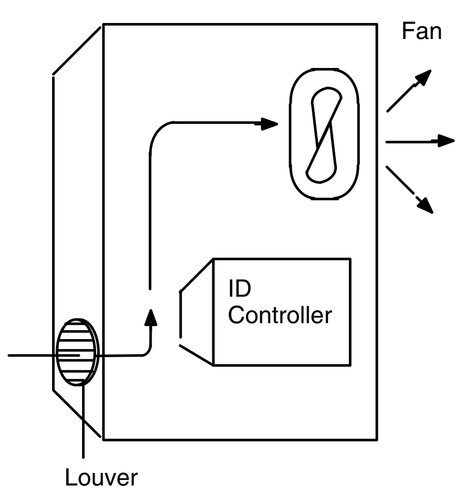
To maintain safe operating conditions, locate the ID Controller as far away from high-voltage equipment as possible.

Clearance

The ID Controller needs to have sufficient room to allow for I/O wiring, and additional room to ensure that the I/O wiring does not hamper cooling or does not strike the cover to the control panel when it is closed. As a general rule, allow at least 20 mm above and below the ID Controller.

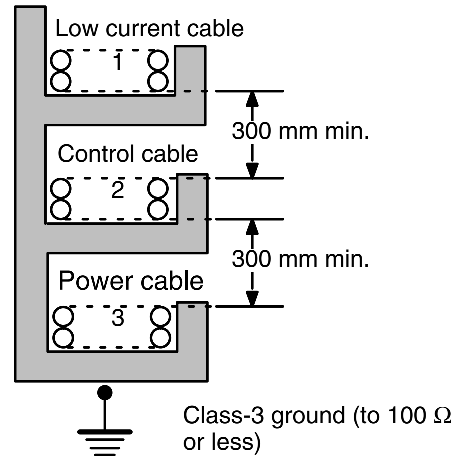
Cooling Fan

A cooling fan is not always necessary, but may be needed in some installations. Try to avoid mounting the ID Controller in a warm area or over a source of heat. A cooling fan is needed if the ambient temperature may become higher than that specified. If the ID Controller is mounted in an enclosure, install a cooling fan, as shown in the following diagram, to maintain the ambient temperature within specifications.



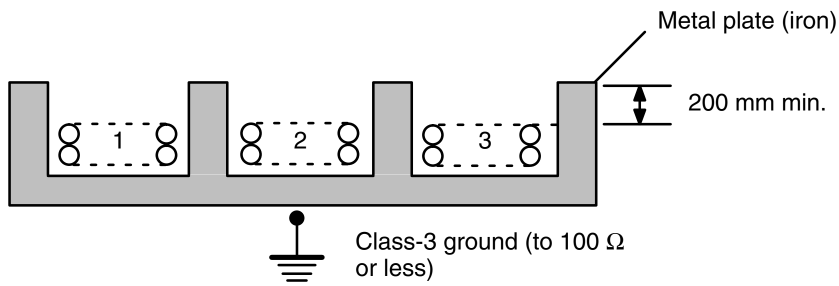
External Wiring

If power cables must be run alongside the I/O wiring (that is, in parallel with it), at least 300 mm must be left between the power cables and the I/O wiring as shown below. This applies to all cables carrying 10 A or less at 400 V or 20 A or less at 220 V.



Where: 1 = I/O wiring
2 = General control wiring
3 = Power cables

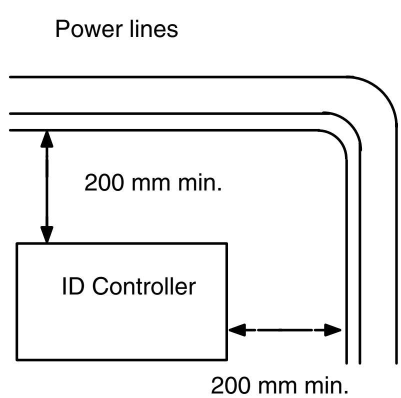
If the I/O wiring and power cables must be placed in the same duct (for example, where they are connected to the equipment), they must be shielded from each other using grounded metal plates.



Where: 1 = I/O wiring
2 = General control wiring
3 = Power cables

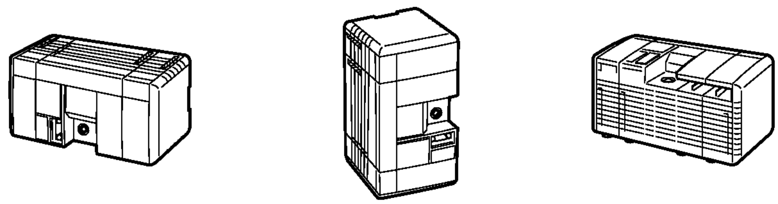
Noise

Do not mount the ID Controller in a control panel in which high-power equipment is installed,. To avoid noise, make sure the point of installation is at least 200 mm away from power lines as shown in the following diagram. Ensure that the plate to which the ID Controller is mounted is grounded.



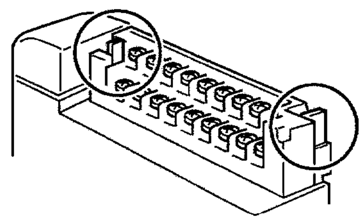
Mounting Direction

Always mount the ID Controller with the cooling vents facing up. Never mount it on it's side or end.

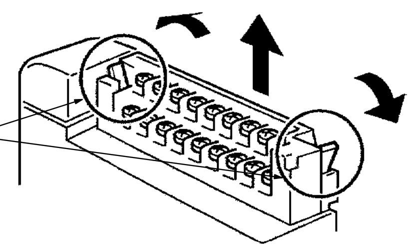


2-2-3 Terminal Blocks

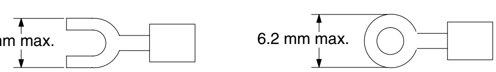
The I/O Controller's terminal blocks are removable. Be sure that the connector tabs are in the locked position, as shown in the following diagram.



To remove the terminal block, push the connector tabs to the sides and lift the terminal block off of the connector, as shown in the following diagram.



Crimp connectors for I/O wiring should be less than 6.2 mm wide (M3).



⚠ Caution Forked crimp connectors are required by UL and CSA standards.

2-2-4 I/O Wiring Precautions

The following must be considered when connecting electrical devices to I/O terminals: leakage currents, inrush currents, noise, and inductive loads

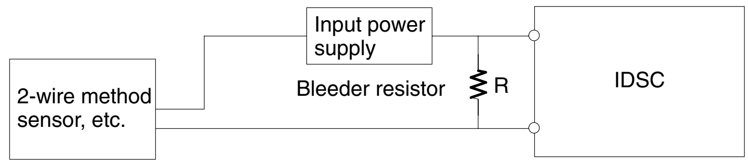
⚠ Caution Tighten the terminal screws to a torque of 0.5 to 0.6 Nm.

⚠ WARNING Do not apply voltages exceeding the maximum permissible input voltage to inputs nor voltages exceeding the switching capacity to output. Doing so may result in damage or destruction of the ID Controller or may result in fire.

Leakage Current (24 VDC)

A leakage current can cause false inputs when using 2-wire sensors (proximity switches or photoelectric switches) or limit switches with LEDs on 24-VDC inputs.

If the leakage current exceeds 1.3 mA, insert a bleeder resistor in the circuit to reduce the input impedance, as shown in the following diagram.



R = 7.2/(2.4I–3) kΩ max. I: Device's leakage current (mA)
R: Bleeder resistance (kΩ)
W = 2.3/R W min. W: Bleeder resistor's power rating (W)

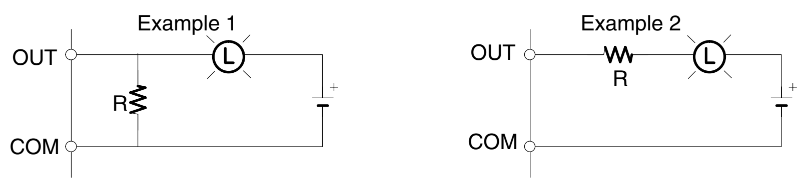
The equations above were derived from the following equation:

$$I \times \frac{R \times \frac{\text{Input voltage (24)}}{\text{Input current (10)}}}{R + \frac{\text{Input voltage (24)}}{\text{Input current (10)}}} \leq \text{OFF voltage (3)}$$

$$W \geq \text{Input voltage (24)}/R \times \text{Input voltage (24)} \times \text{tolerance (4)}$$

Inrush Current (Transistor)

The following diagram shows two methods that can be used to reduce the large inrush current caused by certain loads, such as incandescent light bulbs, when connected to transistor outputs



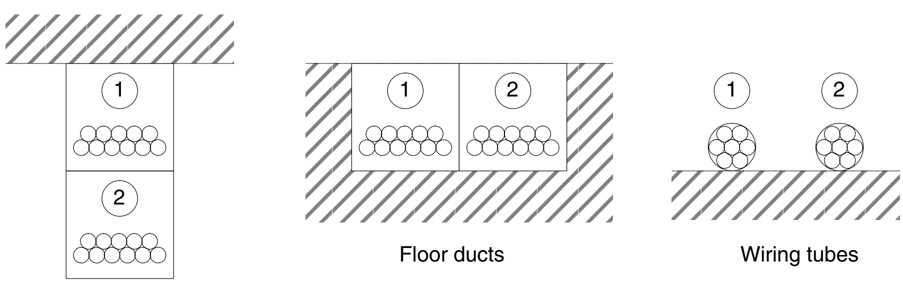
Generating a dark current (about 1/3 of the rated current) through the incandescent bulb.

Inserting a regulating resistance.

Be careful not to damage the output transistor.

Noise on Input Signal Lines

I/O cables must be placed in separate ducts or wiring tubes both inside and outside of the control panel, as shown in the following diagram.



Suspended ducts

Floor ducts

Wiring tubes

(1): I/O Cables
(2): Power lines

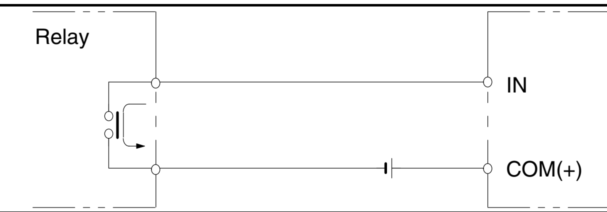
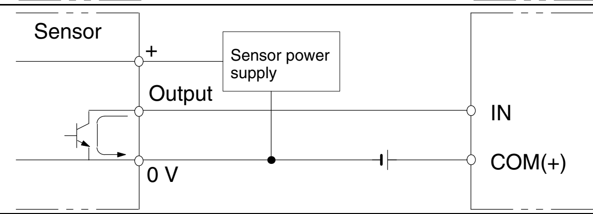
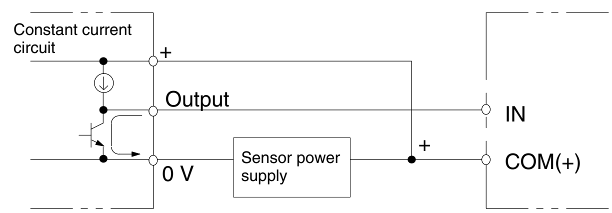
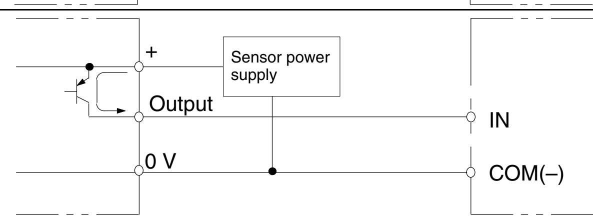
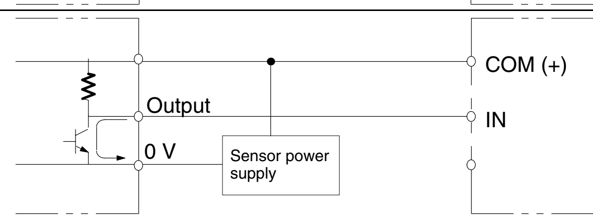
Inductive Loads

When connecting an inductive load to an I/O terminal, connect a diode in parallel with the load. The diode should satisfy the following requirements:

1, 2, 3...
1. Peak reverse-breakdown voltage must be at least 3 times the load voltage.
2. Average rectified current must be 1 A.

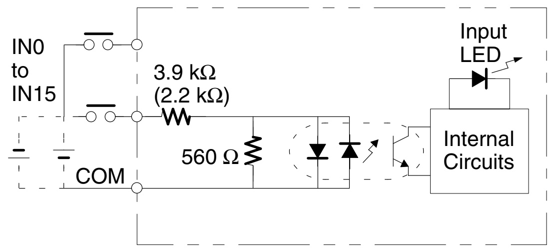
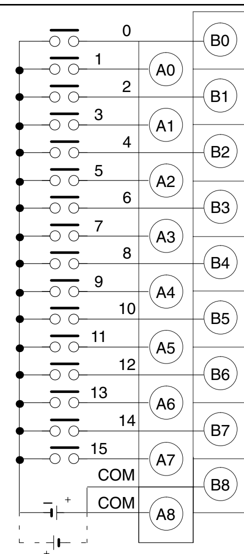
Wiring I/O Terminal

When connecting an external device with a DC output to a DC input terminal, wire the device as shown in the following table.

Device output type	Circuit Diagram (External device on left; input terminals on right
Contact output	
NPN open collector	
NPN current output	Use the same power supply for the input and sensor. 
PNP current output	
Voltage output	

2-2-5 I/O Specifications

24-VDC Inputs (16 pts)

Item	Specification
Model	IDSC-C1D□-A-E
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 ID Controller Setup; see note)
OFF Delay	Default: 8 ms max. (can be set between 1 and 128 ms in ID Controller Setup; see note)
No. of Inputs	16 points (16 inputs/common, 1 circuit)
Circuit Configuration	 **Note** Figures in parentheses are for IN4 and IN5. The input power supply polarity may be connected in either direction.
Terminal Connections	

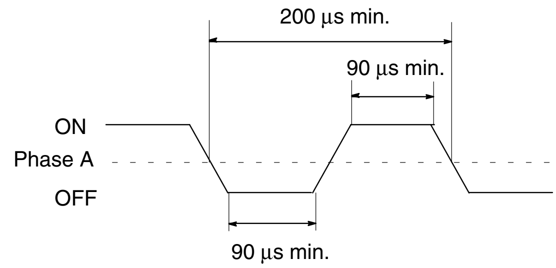
Note IN0 through IN3 can be set for use as input interrupts in the ID Controller Setup. The ON and OFF delays for input interrupts are fixed at 0.1 ms max. and 0.5 ms max., respectively. IN4 through IN6 can be set for use as high-speed counter interrupts. The delays for high-speed counter interrupts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

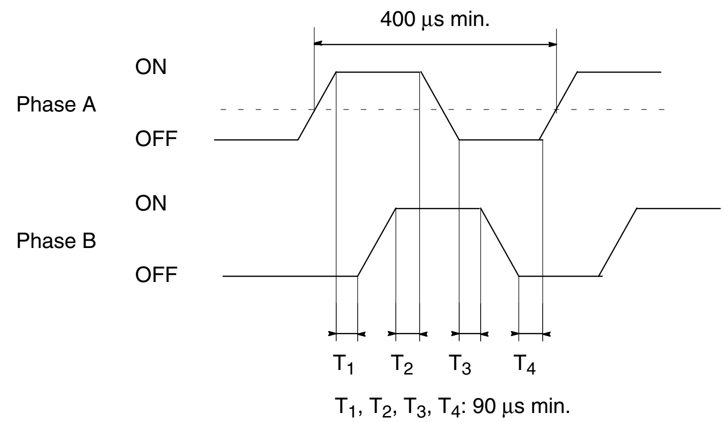
The minimum response pulses will be as follows:

Input A (IN4), Input B (IN5)

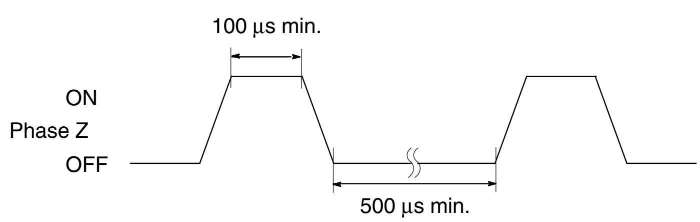
Increment Mode (5 kHz max.)



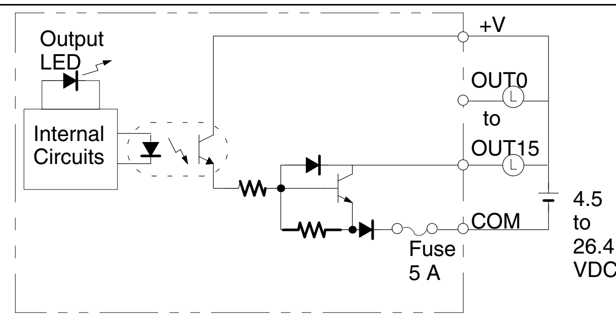
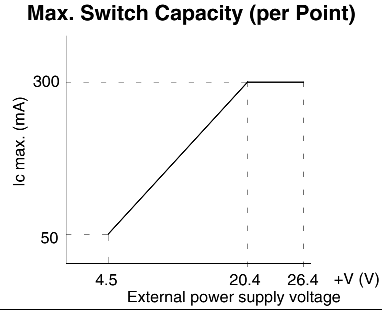
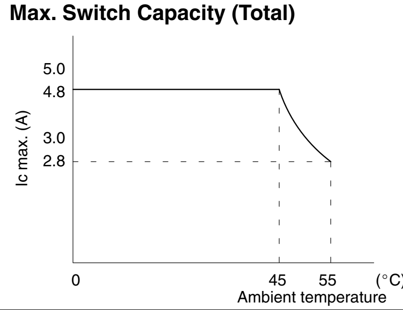
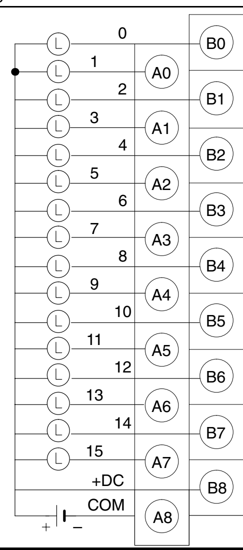
Phase-input Difference Mode (2.5 kHz max.)



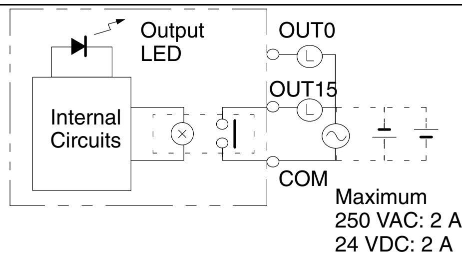
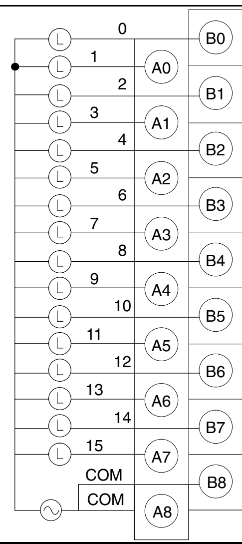
Input Z (IN6)



Transistor Outputs (16 pts)

Item	Specification
Model	IDSC-C1DT-A-E
Max. Switching Capacity	50 mA at 4.5 VDC to 300 mA at 26.4 V (see diagram below)
Leakage Current	0.1 mA max.
Residual Voltage	0.8 V max.
ON Delay	0.1 ms max.
OFF Delay	0.4 ms max.
No. of Outputs	16 points (16 points/common, 1 circuit)
Internal Current Consumption	170 mA max. at 5 VDC
Fuse	5 A (one per common), one only (Fuse is not user replaceable.)
Service Power Supply	40 mA min. at 5 to 24 VDC ±10% (2.5 mA × number of ON points)
Circuit Configuration	 **Max. Switch Capacity (per Point)**  **Max. Switch Capacity (Total)** 
Terminal Connections	

Contact Outputs (16 pts)

Item	Specification
Model	IDSC-C1DR-A-E
Max. Switching Capacity	2 A, 250 VAC (cosϕ= 1) 2 A, 250 VAC (cosϕ= 0.4) 2 A, 24 VDC (8 A total)
Min. Switching Capacity	10 mA, 5 VDC
Relay	G6D-1A
Service Life of Relay	Electrical: 300,000 operations (resistive load) 100,000 operations (inductive load) Mechanical: 20,000,000 operations
ON Delay	10 ms max.
OFF Delay	5 ms max.
No. of Outputs	16 points (16 points/common, 1 circuit))
Internal Current Consumption	850 mA max. at 5 VDC
Circuit Configuration	
Terminal Connections	

2-2-6 Connectable Devices

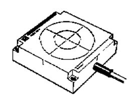
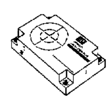
Memory Cassettes

Memory	Model	Clock	Capacity
EEPROM	CQM1-ME04K	No	4K words
	CQM1-ME04R	Yes	
	CQM1-ME08K	No	8K words
	CQM1-ME08R	Yes	
EPROM (socket only)	CQM1-MP08K	No	8K words
	CQM1-MP08R	Yes	

Battery Set

Name	Model
Battery Set	3G2A9-BAT08

Read/Write Heads and Data Carriers

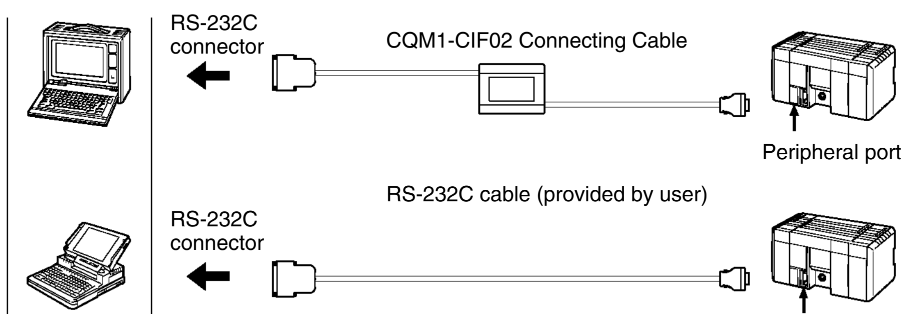
Name	Model	Comments
Read/Write Head 	V600-H07	30.5 m max.
	V600-H11/H51/H52	50.5 m max.
Data Carrier 	V600-D□□R□□	Built-in lithium battery
	V600-D□□P□□	No battery

Note Not all combinations of Data Carrier and Read/Write Head are possible. Refer to the following manuals for details: *V600 FA ID Sensor Serial Interface Operation Manual (Z44-E1-2)* and *V600 FA ID Sensor Parallel Interface Operation Manual (Z45-E1-2)*.

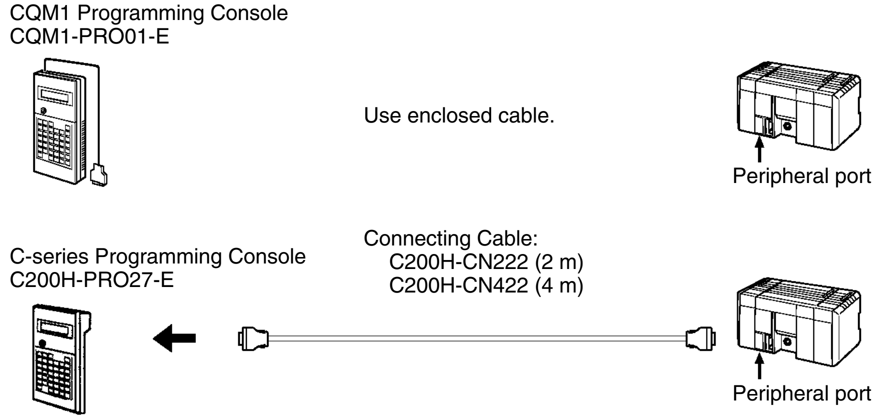
Programming Devices

The ID Controller can be programmed and operated either from an IBM PC/AT or compatible running the LSS/SSS or from a Programming Console.

Connect the computer using the illustrated cables. The computer must run the Ladder Support Software (LSS) version 3 or later (on 3.5” floppy disks: C500-SF312-EV3; on 5” floppy disks: C500-SF711-EV3), or SYSMAC Support Software (SSS) (C500-ZL3AT1-E).

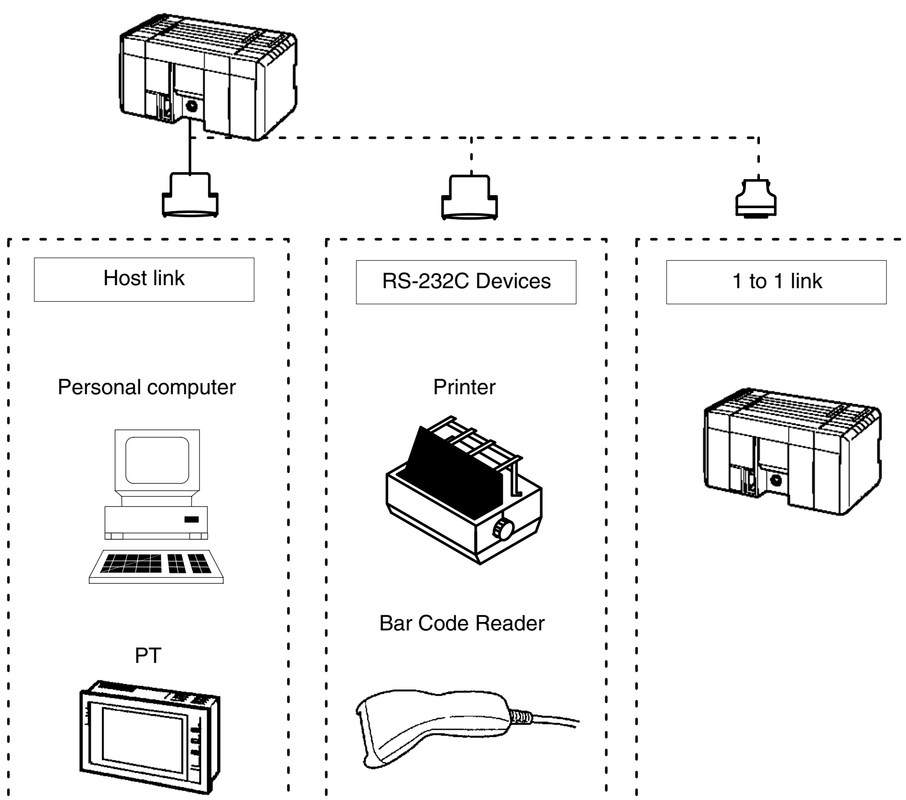


Connect the Programming Console using the illustrated cables.



2-2-7 Connecting External Devices via RS-232C Port

Various types of devices can be connected to the ID Controller via the RS-232C. A few examples are shown in the following illustration.

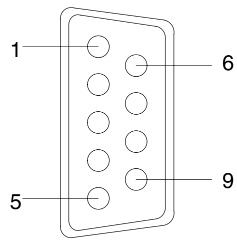


RS-232C Port Specifications

The specifications for the RS-232C port are given below. Devices that meet these specifications can be connected.

Connector Pin Assignments

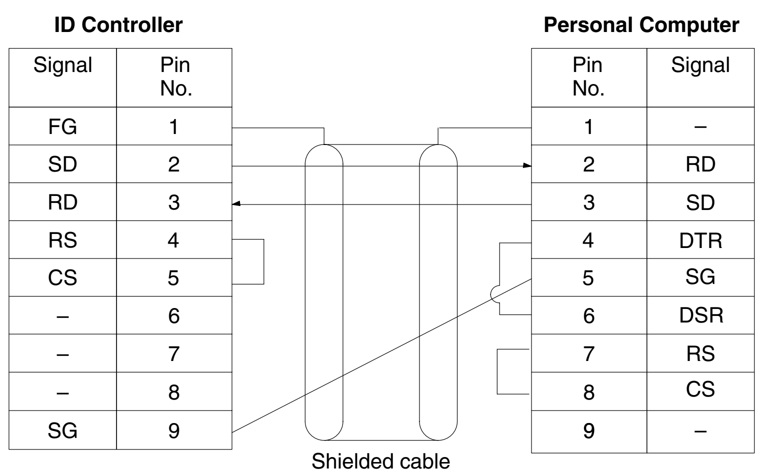
Pin assignments for the RS-232C port are given in the following table.



Pin	Abbreviation	Name	Direction
1	FG	Field ground	---
2	SD (TXD)	Send data	Output
3	RD (RXD)	Receive data	Input
4	RS (RTS)	Request to send	Output
5	CS (CTS)	Clear to send	Input
6	---	Not used.	---
7	---	Not used.	---
8	---	Not used.	---
9	SG	Signal ground	---
Connector fitting	FG	Field ground	---

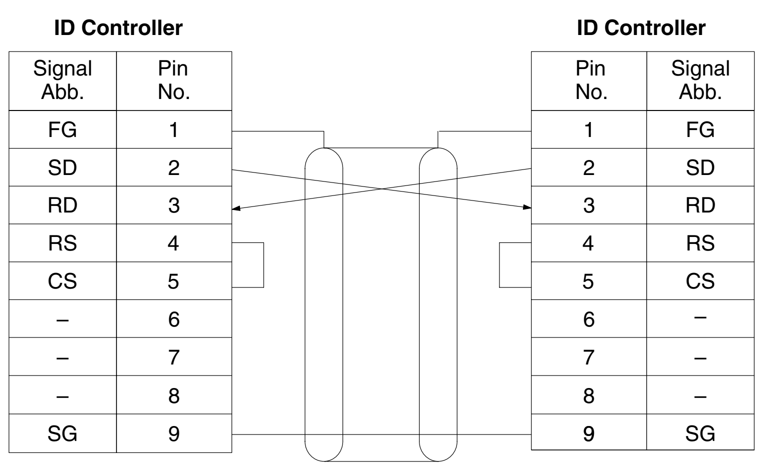
Personal Computer

The connections between the ID Controller and a personal computer are illustrated below as an example.



One-to-one Link Connections

The RS-232C port can be connected to the same port on another ID Controller to create a data link. Wire the cable as shown in the diagram below.



Ground the FG terminals of ID Controller at a resistance of less than 100 Ω.

Applicable Connectors

The following connectors are applicable. One plug and one hood are included with the ID Controller.

Plug: XM2A-0901 (OMRON) or equivalent
Hood: XM2S-0901 (OMRON) or equivalent

Port Specifications

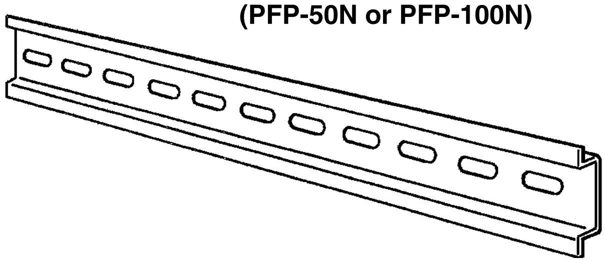
Item	Specification
Communications method	Half duplex
Sync	Start-stop
Baud rate	1,200, 2,400, 4,800, 9,600, or 19,200 bps
Transmission method	Point to point
Transmission distance	15 m max.
Interface	EIA RS-232C

2-3 Installing the ID Controller

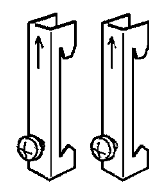
2-3-1 Mounting the ID Controller

An ID Controller must be installed on DIN Track and secured with the DIN Track Brackets shown below.

DIN Track (PFP-50N or PFP-100N)



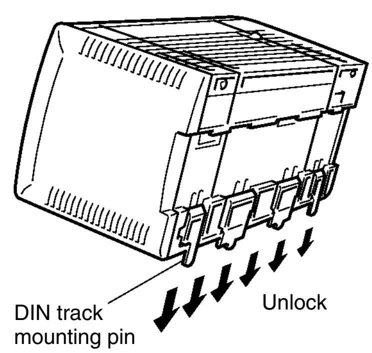
DIN Track Brackets (PFP-M)



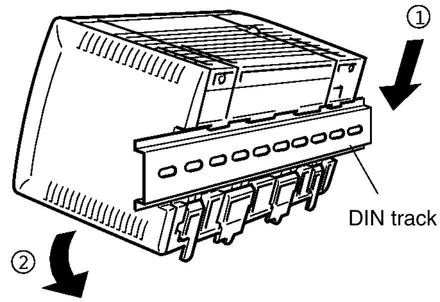
Use the following procedure to install an ID Controller on DIN Track.

1, 2, 3...

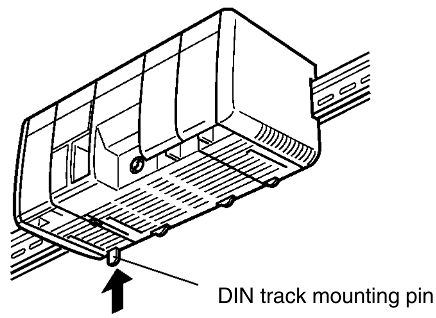
1. Mount the DIN Track securely to the control board or inside the control panel using screws in at least 3 separate locations.
2. Release the pins on the backs of the ID Controller. These pins lock the ID Controller to the DIN Track.



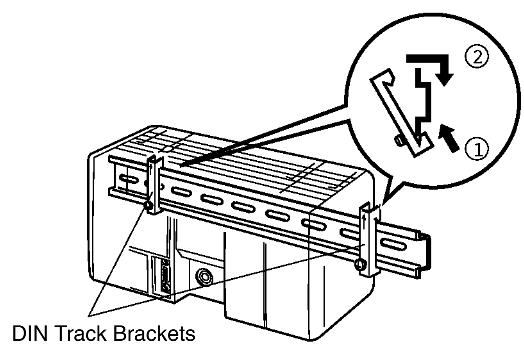
3. Fit the back of the ID Controller onto the DIN Track by inserting the top of the track and then pressing in at the bottom of the ID Controller, as shown below.



4. Lock the pins on the backs of the ID Controller.

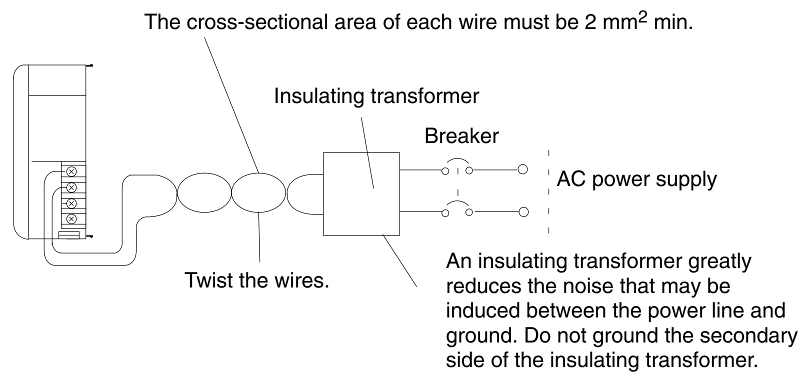


5. Install a DIN Track Bracket on each side of the ID Controller. To install a bracket, hook the bottom of the Bracket on the bottom of the track, rotate the Bracket to hook the top of the Bracket on the top of the track, and then tighten the screw to lock the Bracket in place.



2-3-2 Wiring the Power Supply

The following diagram shows the proper connection to an AC power supply. The AC voltage should be between 100 and 240 VAC with an allowable range of 85 to 264 VAC.



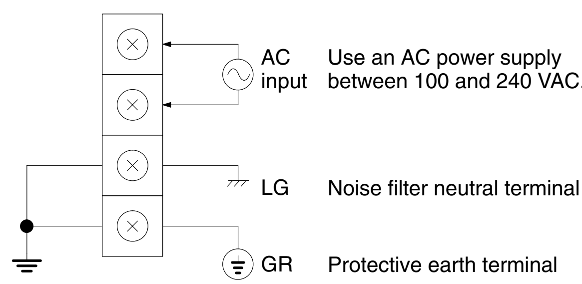
⚠ Caution Be sure that the AC power supply voltage remains within the allowed fluctuation range of 85 to 264 VAC. Exceeding this range may destroy the ID Controller.

Wiring Precautions for Ground Wires

Wire the grounding wires according to the diagram shown below. The ID Controller with the lot number □□Z5 manufactured in December 1995 and later is provided with the LG-GR short-circuit bar and the DIN-track cable.

Terminal Block for External Connections

The following diagram shows the terminal blocks for the external power supply.

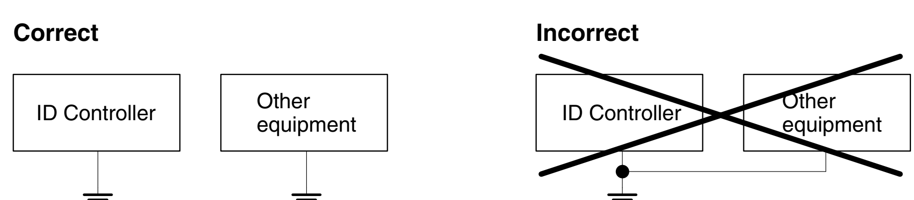


The wire used should be at least 2 mm^2. Provide the grounding point as close to the ID Controller as possible.

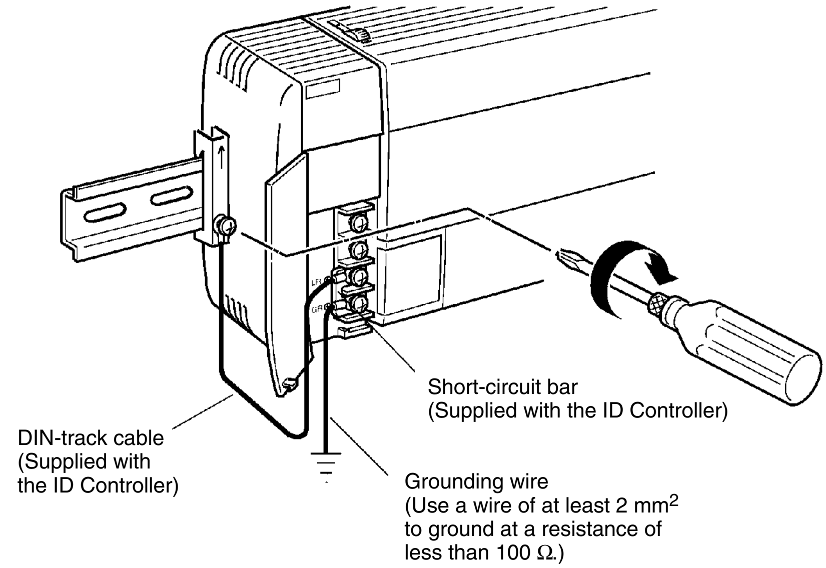
⚠ WARNING LG:
Noise filter neutral terminal. Short-circuit the LG terminal and GR terminals using the attached short-circuit bar and ground them at a resistance of less than 100 Ω to reduce noise and prevent electric shock.

⚠ WARNING GR:
Protective earth terminal. Connect to a separate ground wire of at least 2 mm^2 to ground the terminal at a resistance of less than 100 Ω to prevent electric shock.

⚠ Caution Avoid sharing the grounding wire with other equipment or attaching to the beam of a building, otherwise it may cause an adverse effect.



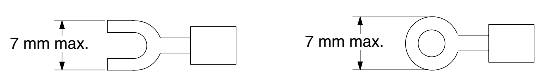
In order to improve the Electro Magnetic Compatibility (EMC), connect the LG terminal to the screw on the end plate using the supplied DIN-track connecting cable.



Note Definition of EMC:
The EMC refers to the capacity of equipment represented in terms of emission, which indicates the degree to which electromagnetic waves produced by equipment do not affect other communications equipment, and also in terms of immunity, which indicates the degree of resistance against electromagnetic disturbance.

Crimp Connectors

Crimp connectors for the power supply should be less than 7 mm wide (M3.5).



⚠ **Caution** Forked crimp connectors are required by UL and CSA standards.

2-3-3 Connecting the Read/Write Head

Connection

Use the following procedure to connect the Read/Write Head.

1, 2, 3...

1. Hold on to the rubber molding at the connector of the Read/Write Head and align it with the keyed slot on the connector on the ID Controller.
2. Press in firmly on the connector until it clicks into place.

Removal

To remove the connector, hold onto the ring on the connector and pull straight out.

⚠ **Caution** Do not pull on the rubber molding. The Read/Write Head connector cable cannot be removed by pulling out on the rubber molding; you must hold onto the sliding ring. If you pull on the rubber molding, you may damage the connector or break connections inside the cable.

Note Refer to the following manuals for details on installing Read/Write Heads and Data Carriers: *V600 FA ID Sensor Serial Interface Operation Manual (Z44-E1-2)* and *V600 FA ID Sensor Parallel Interface Operation Manual (Z45-E1-2)*

SECTION 3
Programming Device Operations

This section describes the Programming Console, Ladder Support Software (LSS) Operations, and SYSMAC Support Software (SSS) Operations used with an ID Controller System.

3-1 Applicable Programming Devices

The following Programming Devices can be used with an ID Controller System.

Programming Consoles

CQM1-PRO01-E or C200H-PRO27-E

Ladder Support Software

Version 3 or later running on an IBM PC/AT or compatible:
C500-SF312-EV3 (on 3.5” floppy disks)
C500-SF711-EV3 (on 5” floppy disks)

Note Be sure to perform the operations listed in *3-4 LSS Operations* before using the LSS or *3-5 SSS Operations* before using the SSS for an ID Controller.

3-2 Programming Console Preparations

This and the following section provide an introduction to the main operations possible on a Programming Console, although there are other operations that can also be used for an ID Controller System. Refer to the *CQM1 Programmable Controller Operation Manual* (W226-E1-2A) for details on other possible operations.

Key Sequences

Graphic key sequences are provided for Programming Console operations. Just press the keys in the order they are shown. Many of the keys show example data they should be replace with actual data during operation.

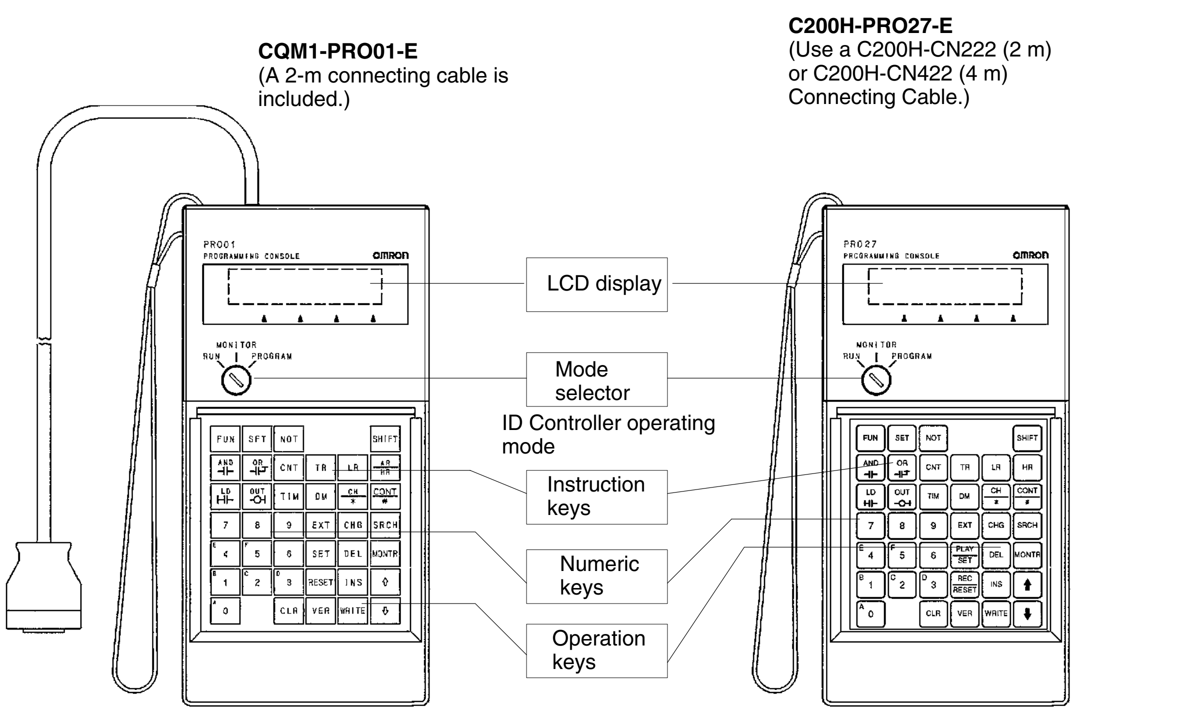
Initial Display

Most key sequences are given assuming that the Programming Console is showing the initial display. If the initial display is not on the Programming Console when you want to start a new operation, just press the CLEAR Key repeatedly until you reach the initial display.

Components and Functions

There are two Programming Consoles that can be used with the ID Controller: the CQM1-PRO01-E and the C200H-PRO27-E. The key functions for these Programming Consoles are identical.

Press the Shift Key to input a letter shown in the upper-left corner of the key or the upper function of a key that has two functions. For example, the CQM1-PRO01-E’s AR/HR key can specify either the AR or HR Area; press and release the Shift Key and then press the AR/HR Key to specify the AR Area.



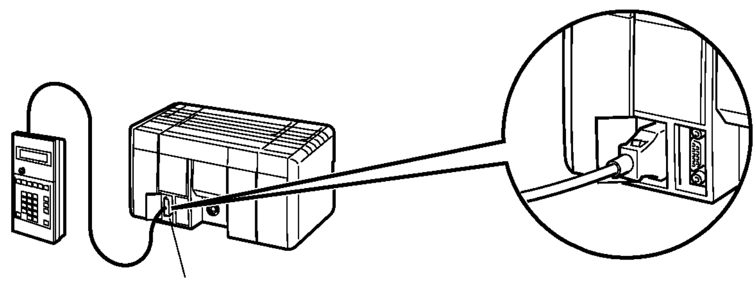
⚠ Caution When turning on the ID Controller, set it to PROGRAM mode using the mode selector as described in *2-1-3 ID Controller Operating Modes* unless you have a specific reason to use another mode. If the ID Controller is set to RUN or MONITOR mode, the program will be executed when it is turned on, possibly causing a ID Controller-controlled system to begin operation.

Note The following three sets of keys are labeled differently on the CQM1-PRO01-E and the C200H-PRO27-E. The operation of the two keys in each pair are identical.

CQM1-PRO01-E	C200H-PRO27-E
AR/HR	HR
SET	PLAY/SET
RESET	REC/RESET

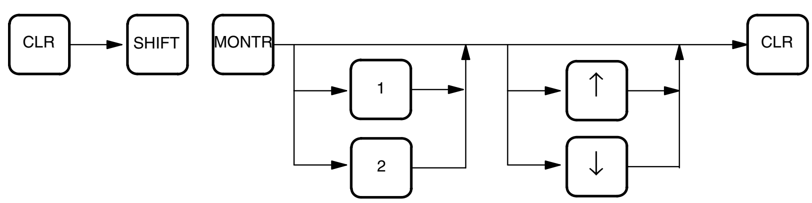
Connecting the Programming Console

Connect the Programming Console's connecting cable to the ID Controller's peripheral port, as shown below. Refer to *2-2-6 Connectable Devices* for details on connections.



Monitoring Errors

The following key sequence can be used to read the ID communications error log any time during ID Controller operation. The ID Controller may be in any operating mode.



ID Function Test

The Programming Console can be used to test ID communications. The ID Controller must be in PROGRAM mode for this set to be carried out.

1, 2, 3...

1. Turn bits SR 23208 and SR 23209 ON and then OFF from the Programming Console to execute the test.

   Data will be written and read from specific addresses in the Data Carrier at 1-second intervals and any errors occurring during the test will be recorded in word SR 234.
2. Read the contents of SR 234 to check the results of the test.

Other Operations

Refer to the next section for other operations or to the *CQM1 Programmable Controller Operation Manual*.

Preparatory Operations

The basic operations required to prepare for programming are listed below.

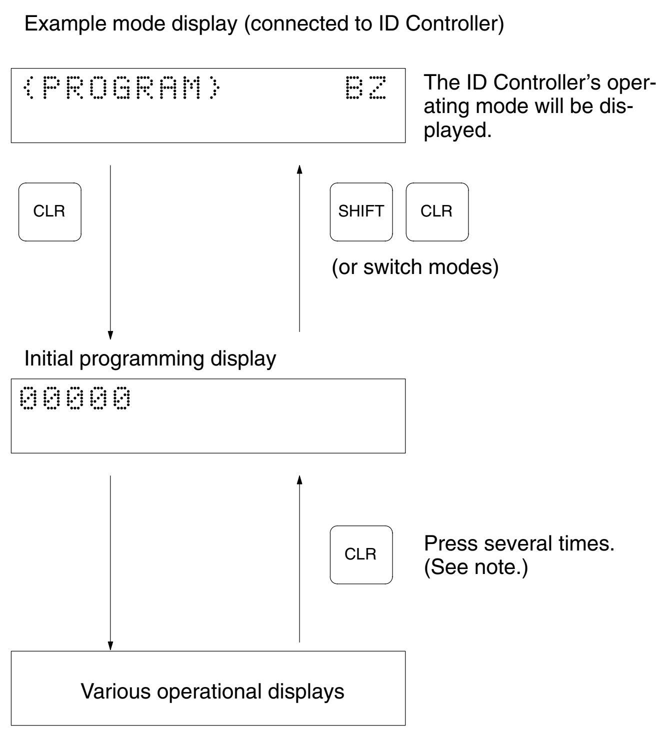
1, 2, 3...

1. Set the Programming Console's mode selector to PROGRAM mode.
2. Enter the password by pressing the CLR and then the MONTR Key.

   At this point, the SHIFT and then the 1 key can be pressed to turn on and off the Programming Console's buzzer. Refer to page 41.
3. If you are going to input a new program, clear the ID Controller's memory by pressing the CLR, SET, NOT, RESET, and then the MONTR Key. Refer to page 39.
4. Display and clear any error messages by pressing the CLR, FUN, and then the MONTR Key. Continue pressing the MONTR Key until all error messages have been cleared. Refer to page 40.
5. Press the CLR Key to bring up the initial programming display (program address 00000).

Changing Displays

The following diagram shows which keys to press in order to change Programming Console displays.



Note When cancelling an operation or beginning operation, press the CLR Key several times to return to the initial display.

After the SHIFT Key is pressed, changing the mode by means of the mode-change switch will cause the mode to change while retaining the current display.

When switching between RUN and PROGRAM, first go into MONITOR and press the SHIFT Key again.

3-3 Programming Console Operations

3-3-1 Testing ID Communications

This operation can be used to show the status of errors generated by executing either a read or a write communications operation repeatedly every second for a specific Data Carrier address. In the read test, one byte is read from the Data Carrier repeatedly, while in the write test one byte is written to the Data Carrier repeatedly. This operation is possible in PROGRAM mode only.

RUN	MONITOR	PROGRAM
No	No	OK

Note Data contained in the Data Carrier will not be overwritten, so the test can be used for checks and other operations at system startup. At the same time, this function can also perform various adjustment tests, such as on-site adjustment of the distance between the Data Carriers and the Read/Write Head.

1, 2, 3...

1. Monitor the content of word SR 234 in the ID controller.

   SHIFT CH/*

   C 2 D 3 E 4 MONTR

   ```
   c234
   0000
   ```

2. Display bit SR 23209, and select the test mode (read or write) by turning SR 23209 ON or OFF with the Set or Reset Key. (A read test is specified in the following example.)

   Read test: Turn OFF SR 23209.

   Write test: Turn ON SR 23209.

   SHIFT CONT/# C 2 D 3 C 2 A 0 9 MONTR

   REC/RESET

   ```
   23209 c234
     OFF 0000
   ```

3. Display bit SR 23208 and turn it ON to start the test.

   SHIFT CONT/# C 2 D 3 C 2 A 0 8 MONTR

   PLAY/SET

   ```
   23208 23209 c234
      ON   OFF FFFF
   ```

   During the test, the T/R indicator for the ID function will flash, and the test results will be placed in word SR 234, as shown below.

   FFFF: ID communication in progress

   0x00: Normal end

   0xxx: Error end

4. Refer to *ID Communications Errors* on page 178 for the meaning of error messages and error codes.
5. When the next communication is executed normally, the error display will automatically leave the screen.
6. Turn off bit 23208 to cancel the test or before shifting to the another operation. The following display shows a normal ending for the test.

   REC/RESET

   ```
   23208 23209 c234
     OFF   OFF 0100
   ```

⚠ Caution Do not change ID Controller operating mode while the test function is being executed (i.e., while SR 23208 is ON).

3-3-2 Reading the ID Error Log

When the ID Controller is running in the operating mode, information on various types of errors is stored in the DM area in the ID Error Log and in the ID Error Statistics Log. This information can be displayed on the Programming Console as error messages.

ID Error Log The last 30 errors are displayed in order of the error log data number.

ID Error Statistics Log The numbers of ID communications errors generated are displayed by the type of error.

Note The ID Error Log and ID Error Statistics Log may or may not be stored in memory depending on ID Controller Setup. ID error log information is stored in one of two ways, leaving either the newest error or the first 30 errors. Refer to *5-1 ID Controller Setup* for details.

Displaying ID Error Log Records

1, 2, 3...

1. Press the Shift Key and the Monitor Key to display ID error menu.

   SHIFT MONTR
   ```
   ID ERRORS CHK
   1:LAT. 2:STA.
   ```
2. Press the 1 Key to display the ID communications error log.

   B 1
   ```
   LAT. 05 10:14:20
   NO1 RD  COM.DC E
   ```
   The different portions of the display are given in the following table, using the data in the above example display.

Displayed data	Meaning
05	The date that the error was generated.
10:14:20	The time that an error was generated. If the Memory Cassette used is not equipped with a clock function, the date and time will be displayed as all zeros.
NO1	The error log data number. Here, N30 is the most recent, and N01 is the oldest error.
RD	The command that generated the error. In this case, it is IDRD. The following displays will appear for ID communications instructions: RD: IDRD WT: IDWT MD: IDMD AR: IDAR AW: IDAW CA: IDCA
COM.DC E	The error message. Refer to *1-1-3 ID Controller Functions* for the meaning of error messages.

3. Press the Down Cursor Key shifts the display from the current position to the next most recent error.

   ↓
   ```
   LAT. 04 15:19:31
   NO2 WT  R/WH   E
   ```
   Pressing the Up Cursor Key shifts the display from the current position to the oldest error.

   Pressing the Up Cursor Key with N01 data displayed, displays N30 data, and pressing the Down Cursor Key with N30 data displayed, displays N01 data.
4. Press the Clear Key to leave the ID error log display, and returns to the initial display.

The following display will appear when there are no ID error logs.

```
LAT. ERRORS INF.
        NO ERROR
```

The following display will appear while reading the ID communications error log and the display has been moved past the last recorded error.

```
LAT. 00 00:00:00
NO3     NO ERROR
```

ID errors are displayed by pressing the shift key and the monitor key in that order.

Displaying ID Error Statistics Log

1, 2, 3...

1. Press the Shift Key and the Monitor Key to display ID error menu.

   SHIFT MONTR

   ```
   ID ERRORS CHK
   1:LAT.  2:STA.
   ```

2. Press the 2 Key to display the ID error statistics log.

   C 2

   ```
   STA. ERRORS INF.
   S0004   COM.DC E
   ```

   The different portions of the display are given in the following table, using the data in the above example display.

Displayed data	Meaning
0004	The number of times the specified type of error has occurred.
COM.DC E	The error message. Refer to *1-1-3 ID Controller Functions* for the meaning of error messages.

3. Press the Down Cursor Key to display the number of times an error was generated for the next error code number.

   ↓

   ```
   STA. ERRORS INF.
   S0000   VERIFY E
   ```

   Pressing the Up Cursor Key displays the number of times an error was generated for the previous error code number.

4. Press the Clear Key to quit the ID Error Statistics Log display and return to the initial screen.

3-3-3 Clearing Memory

This operation is used to clear all or part of the Program Memory and any data areas that are not read-only. This operation is possible in PROGRAM mode only.

RUN	MONITOR	PROGRAM
No	No	OK

⚠ **Caution** The ID Controller Setup (DM 6600 through DM 6655) will be cleared along with the rest of the DM area if the DM area is specified for clearing. The error log, however, will not be cleared.

All Clear

The following procedure is used to clear memory completely.

1, 2, 3...

1. Bring up the initial display by pressing the CLR key repeatedly.
2. Press the SET, NOT, and then the RESET Key to begin the operation.

   SET NOT RESET

   ```
   00000 MEM CLR ?
       HR   CNT DM
   ```

3. Press the MONTR Key to clear memory completely.

   MONTR

   ```
   00000 MEM CLR
   END HR   CNT DM
   ```

Partial Clear

It is possible to retain the data in specified areas or part of the Program Memory. To retain the data in the HR, TC, or DM Areas, press the appropriate key after pressing SET, NOT, and RESET. Any data area that still appears on the display will be cleared when the MONTR Key is pressed.

The HR Key is used to specify both the AR and HR Areas, the CNT Key is used to specify the entire timer/counter area, and the DM Key is used to specify the DM Area.

It is also possible to retain a portion of the Program Memory from the first memory address to a specified address. After designating the data areas to be retained, specify the first Program Memory address to be cleared. For example, input 030 to leave addresses 000 to 029 untouched, but to clear addresses from 030 to the end of Program Memory.

Example

As an example, follow the procedure below to retain the timer/counter area and Program Memory addresses 000 through 122:

1, 2, 3...

1. Bring up the initial display.
2. Press the SET, NOT, and then the RESET Key to begin the operation.
3. Press the CNT Key to remove the timer/counter area from the data areas shown on the display.

   CNT
   ```
   00000 MEM CLR ?
       HR       DM
   ```
4. Press 123 to specify 123 as the starting program address.

   B 1 C 2 D 3
   ```
   00123 MEM CLR ?
       HR       DM
   ```
5. Press the MONTR Key to clear the specified regions of memory.

   MONTR
   ```
   00000 MEM CLR
   END HR       DM
   ```

3-3-4 Reading/Clearing Error Messages

This operation is used to display and clear error messages. It is possible to display and clear non-fatal errors and MESSAGE instruction messages in any mode, but fatal errors can be displayed and cleared in PROGRAM mode only.

RUN	MONITOR	PROGRAM
OK	OK	OK

Before inputting a new program, any error messages recorded in memory should be cleared. It is assumed here that the causes of any of the errors for which error messages appear have already been taken care of. If the buzzer sounds when an attempt is made to clear an error message, eliminate the cause of the error, and then clear the error message.

Key Sequence

Follow the procedure below to display and clear messages.

1, 2, 3...

1. Bring up the initial display.
2. Press the FUN and then the MONTR Key to begin the operation. If there are no messages, the following display will appear:

   FUN MONTR
   ```
   00000ERR CHK
   OK
   ```

   If there are messages, the most serious message will be displayed when the MONTR Key is pressed. Pressing MONTR again will clear the present message and display the next most serious error message. Continue pressing MONTR until all messages have been cleared. These are some examples of error messages:

A fatal error:

MONTR

```
MEMORY ERR
```

A non-fatal error:

MONTR

```
SYS FAIL FAL01
```

All messages cleared:

MONTR

```
ERR/MSG CHK OK
```

3-3-5 Buzzer Operation

This operation is used to turn on and off the buzzer that sounds when Programming Console keys are pressed. This buzzer will also sound whenever an error occurs during ID Controller operation. Buzzer operation for errors is not affected by this setting.

This operation is possible in any mode.

RUN	MONITOR	PROGRAM
OK	OK	OK

Key Sequence

Follow the procedure below to turn the key-input buzzer on and off.

1, 2, 3...

1. Press the CLR, SHIFT, and then the CLR Key to bring up the mode display. In this case the ID Controller is in PROGRAM mode and the buzzer is on.

```
<PROGRAM>     BZ
```

2. Press the SHIFT and then the 1 Key to turn off the buzzer.

SHIFT B 1

```
<PROGRAM>
```

3. Press the SHIFT and then the 1 Key again to turn the buzzer back on.

SHIFT B 1

```
<PROGRAM>     BZ
```

Note It is possible to adjust the buzzer volume on the C200H-PRO27-E using the volume control lever on the side of the Programming Console.

3-3-6 Reading and Changing Expansion Instructions

This operation is used to read and change the function codes assigned to certain instructions. It is possible to read the function code assignments in any mode, but the assignments can be changed in PROGRAM mode only.

Operation	RUN	MONITOR	PROGRAM
Reading	OK	OK	OK
Changing	No	No	OK

⚠ **Caution** Be sure to change function code assignments before inputting the program. The ID Controller will not operate properly if the function codes in the program are assigned incorrectly.

Note

1. Two function codes cannot be assigned to a single instruction.
2. Be sure that pin 4 of the ID Controller's DIP switch is ON when changing function codes.

Reading Function Codes

Follow the procedure below to read out function code assignments.

1, 2, 3...

1. Bring up the initial display.
2. Press the EXT Key.

[EXT]
```
INST TBL  READ
 FUN17:ASFT
```

3. Use the Up and Down Cursor Keys to scroll through the function codes and read their corresponding instructions.

[↓] [↑]
```
INST TBL  READ
 FUN18:TKY
```

Changing Function Codes

Follow the procedure below to change function code assignments. The assignments can be changed in PROGRAM mode only.

1, 2, 3...

1. Follow the procedure above to read out the function code which will be changed.
2. Press the CHG Key. The following display will appear.

[CHG]
```
INST TBL   CHG?
 FUN18:TKY →????
```

3. Use the Up and Down Cursor Keys to scroll through the available instructions.

[↓]
```
INST TBL   CHG?
 FUN18:TKY →HKY
```

4. When the desired instruction is displayed, press the WRITE Key to change the function code assignment. The following display will appear if the selected instruction has not been assigned to another function code.

[WRITE]
```
INST TBL  READ
 FUN18:HKY
```

Note It is not possible to change to an instruction which is already assigned to a different function code.

3-3-7 Reading and Changing the Clock

This operation is used to read and change the clock in ID Controllers that have a Memory Cassette equipped with a clock. It is possible to read the clock in any mode, but the clock can be changed in MONITOR or PROGRAM mode only.

Operation	RUN	MONITOR	PROGRAM
Reading	OK	OK	OK
Changing	No	OK	OK

Reading the Clock

Follow the procedure below to read the clock.

1, 2, 3...

1. Bring up the initial display.
2. Press the FUN, SHIFT, and then the MONTR Key. The current clock setting will be displayed.

[FUN] [SHIFT] [MONTR]
```
TIM      93-03-17
10:56:36   TUE(2)
```

Changing the Clock

Follow the procedure below to change the clock setting. The clock setting cannot be changed in RUN mode.

1, 2, 3...

1. Follow the procedure above to display the current clock setting.
2. Press the CHG Key. The following display will appear.

[CHG]
```
TIM CHG?→3-03-17
10:57:00   TUE(2)
```

3. Use the Up and Down Cursor Keys to move the cursor to the unit that will be changed. In this case, the day of the week is being changed.

```
[↓] [↑]    TIM CHG?93-03-17
           10:58:00 TUE(→)
```

4. Input the new value and press the WRITE Key. The new setting will appear on the display.

```
[D 3] [WRITE]    TIM      93-03-17
                 10:58:30  WED(3)
```

Note The days of the week correspond to the following numbers: Sun.=0, Mon.=1, Tue.=2, Wed.=3, Thu.=4, Fri.=5, and Sat.=6.

3-3-8 Setting and Reading a Program Memory Address

This operation is used to display the specified program memory address and is possible in any mode.

RUN	MONITOR	PROGRAM
OK	OK	OK

When inputting a program for the first time, it is generally written to Program Memory starting from address 00000. Because this address appears when the display is cleared, it is not necessary to specify it.

When inputting a program starting from other than 00000 or to read or modify a program that already exists in memory, the desired address must be designated.

1, 2, 3...

1. Bring up the initial display.
2. Input the desired address. It is not necessary to input leading zeroes.

```
[C 2] [A 0] [A 0]    00200
```

3. Press the Down Cursor Key.

```
[↓]    00200READ     OFF
       LD          00000
```

Note The ON/OFF status of any displayed bit will be shown if the ID Controller is in RUN or MONITOR mode.

4. Press the Up and Down Cursor Keys to scroll through the program.

```
[↓]    00201READ      ON
       AND         00001

[↑]    00200READ     OFF
       LD          00000
```

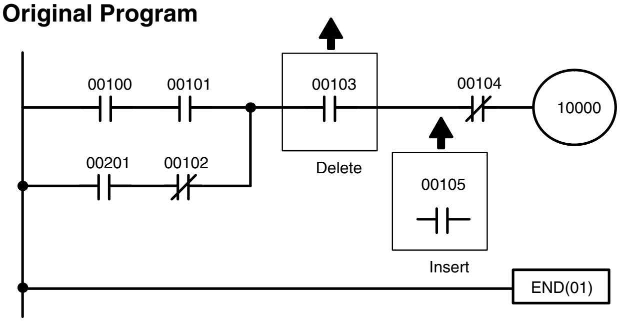
3-3-9 Inserting and Deleting Instructions

This operation is used to insert or delete instructions from the program. It is possible in PROGRAM mode only.

RUN	MONITOR	PROGRAM
No	No	OK

To demonstrate this operation, an IR 00105 NO condition will be inserted at program address 00206 and an IR 00103 NO condition deleted from address 00205, as shown in the following diagram.

Original Program



Delete ←

Address	Instruction	Operands
:	:	:
00205	AND	00103
00206	AND NOT	00104
00207	OUT	10000
00208	END(01)	-

← Insert

Insertion

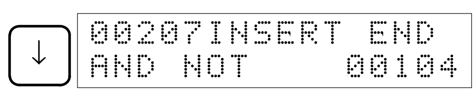
Follow the procedure below to insert the IR 00105 NO condition at address 00206.

1, 2, 3...
1. Bring up the initial display.
2. Input the address where the NO condition will be inserted and press the Down Cursor Key. It is not necessary to input leading zeroes.

3. Input the new instruction and press the INS Key.

4. Press the Down Cursor Key to insert the new instruction.

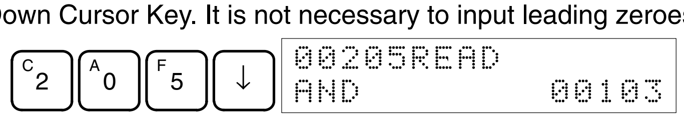
Note For instructions that require more operands, input the operands and then press the WRITE Key.



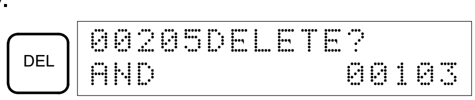
Deletion

Follow the procedure below to delete the IR 00103 NO condition at address 00205.

1, 2, 3...
1. Bring up the initial display.
2. Input the address where the NO condition will be deleted and press the Down Cursor Key. It is not necessary to input leading zeroes.

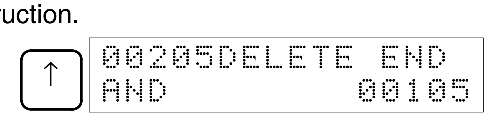


3. Press the DEL Key.



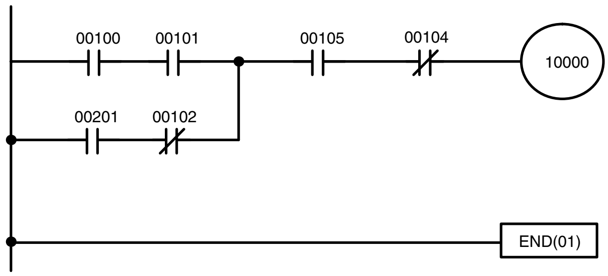
4. Press the Up Cursor Key to delete the specified instruction.

   If the instruction has more operands, the operands will be deleted automatically with the instruction.



After completing the insertion and deletion procedures, use the Up and Down Cursor Keys to scroll through the program and verify that it has been changed correctly, as shown in the following diagram.

Corrected Program



Address	Instruction	Operands
⋮	⋮	⋮
00205	AND	00105
00206	AND NOT	00104
00207	OUT	10000
00208	END(01)	-

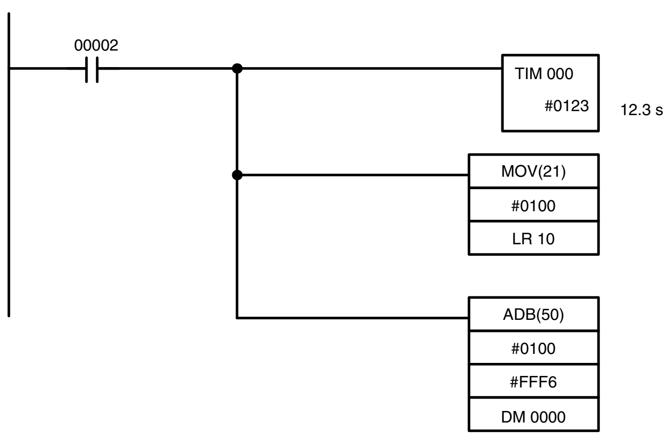
3-3-10 Entering or Editing Programs

This operation is used enter or edit programs. It is possible in PROGRAM mode only.

RUN	MONITOR	PROGRAM
No	No	OK

The same procedure is used to either input a program for the first time or to change a program that already exists. In either case, the current contents of Program Memory is overwritten.

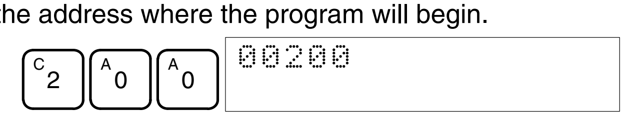
The program shown in the following diagram will be entered to demonstrate this operation.



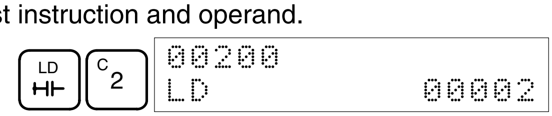
Address	Instruction	Operands	
00200	LD	IR	00002
00201	TIM		000
			0123
00202	MOV(21)		
			#0100
		LR	10
00203	ADB(50)		
			#0100
			#FFF6
			DM 0000

1, 2, 3...

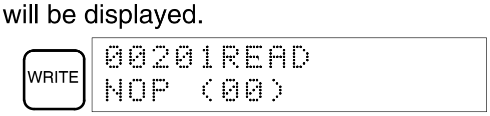
1. Bring up the initial display.
2. Input the address where the program will begin.



3. Input the first instruction and operand.



4. Press the WRITE Key to write the instruction to Program Memory. The next program address will be displayed.



If a mistake was made inputting the instruction, press the Up Cursor Key to return to the previous program address and input the instruction again. The mistaken instruction will be overwritten.

5. Input the second instruction and operand. (In this case it isn't necessary to enter the timer number, because it's 000.) Press the WRITE Key to write the instruction to Program Memory.

   TIM *Timer number* WRITE

   ```
   00201 TIM DATA
              #0000
   ```

6. Input the SV as the second operand (123 to specify 12.3 seconds) and press the WRITE Key. The next program address will be displayed.

   B 1 | C 2 | D 3 | WRITE

   ```
   00202READ
   NOP (00)
   ```

   If a mistake was made inputting the operand, press the Up Cursor Key to return to display the mistaken operand, press the CONT/# Key and 123 again. The mistaken operand will be overwritten.

   Note Counters are input in the same basic way as timers except the CNT Key is pressed instead of the TIM Key.

7. Input the third instruction and its operands. First input the instruction by pressing the FUN Key and then the function code (21 in this case).

   FUN | C 2 | B 1

   ```
   00202
   MOV (21)
   ```

   Note To input a differentiated instruction, press the NOT Key after entering the function code. The "@" symbol will be displayed next to differentiated instructions. Press the NOT Key again to change back the instruction back to a non-differentiated instruction. The "@" symbol will disappear. To change an instruction after it has been entered, simply scroll through the program until the desired instruction is displayed and press the NOT Key. The "@" symbol should be displayed next to the instruction.

8. Press the WRITE Key to write the instruction to Program Memory. The input display for the first operand will be displayed.

   WRITE

   ```
   00202 MOV DATA A
                000
   ```

• **Writing Hexadecimal, BCD Constants**

9. Input the first operand and press the WRITE Key to write the instruction to Program Memory. The input display for the second operand will appear.

   CONT/# | B 1 | A 0 | A 0 | WRITE

   ```
   00202 MOV DATA B
              #0000
   ```

• **Writing Word Addresses**

10. Input the second operand and press the WRITE Key to write the instruction to Program Memory. The next program address will be displayed.

    LR | B 1 | A 0 | WRITE

    ```
    00203READ
    NOP (00)
    ```

    Note When an instruction operand is input, the designation the operand as a bit or word can be abbreviated.

11. Write the application instruction.

    FUN | F 5 | A 0 | WRITE

    ```
    00202 ADB DATA A
               #0000
    ```

3-3-11 Checking the Program

Once a program has been entered or edited, its syntax should be checked to be sure that no programming rules have been violated.

This operation checks for programming errors and displays the program address and error when errors are found. It is possible in PROGRAM mode only.

RUN	MONITOR	PROGRAM
No	No	OK

1, 2, 3...

1. Bring up the initial display.
2. Press the SRCH Key. An input prompt will appear requesting the desired check level.

[SRCH]
```
00000PROG CHK
CHKLEVEL  (0-2)?
```

3. Input the desired check level (0, 1, or 2). The program check will begin when the check level is input, and the first error found will be displayed.

[A 0]
```
00178CIRCUIT ERR
OUT         00200
```

Note Refer to *9-3 Programming Errors* for details on check levels.

4. Press the SRCH Key to continue the search. The next error will be displayed. Continue pressing the SRCH Key to continue the search.

   The search will continue until an END(01) instruction or the end of Program Memory is reached. A display like this will appear if the end of Program Memory is reached and END(01) is not found:

[SRCH]
```
03000NO END INST
END
```

A display like this will appear if an END instruction is reached:

```
03000PROG CHK
END (01)(03.2KW)
```

Note The search can be cancelled at any time by pressing the CLR Key.

3-3-12 Bit, Digit, Word Monitor

This operation is used to monitor the status of up to 16 bits and words, although only 3 can be shown on the display at any one time. Operation is possible in any mode.

RUN	MONITOR	PROGRAM
OK	OK	OK

Program Read then Monitor

When a program address is being displayed, the status of the bit or word in that address can be monitored by pressing the MONTR Key.

1, 2, 3...

1. Bring up the initial display.
2. Input the desired program address and press the Down Cursor Key.

[B 1] [A 0] [A 0] [↓]
```
00100READ
TIM           000
```

3. Press the MONTR Key to begin monitoring.

[MONTR]
```
T000
1234
```

If the status of a bit is being monitored, that bit's status can be changed using the Force Set/Reset operation. Refer to page 49 for details.

If the status of a word is being monitored, that word's value can be changed using the Hexadecimal/BCD Data Modification operation. Refer to page 51 for details.

4. Press the CLR Key to end monitoring.

[CLR]

```
00100
TIM                000
```

Bit Monitor

Follow the procedure below to monitor the status of a particular bit.

1, 2, 3...

1. Bring up the initial display.
2. Input the bit address of the desired bit and press the MONTR Key.

[SHIFT] [CONT/#] [B 1] [MONTR]

```
00001
^   ON
```

Note a) If the ID Controller is in PROGRAM or MONITOR mode, the displayed bit's status can be changed using the Force Set/Reset operation. Refer to page 49 for details.

b) Bit IR 00001 can also be specified by pressing the LD and 1 Keys, reducing the number of keystrokes.

3. The Up or Down Cursor Key can be pressed to display the status of the previous or next bit.

[↓]

```
00002
^   OFF
```

4. Press the CLR Key to end monitoring.

[CLR]

```
00100
CONT             00002
```

Word Monitor

Follow the procedure below to monitor the status of a particular word.

1, 2, 3...

1. Bring up the initial display.
2. Input the word address of the desired word.

[SHIFT] [CH/*] [LR] [B 1]

```
00000
channel LR        01
```

Note a) If the ID Controller is in PROGRAM or MONITOR mode, the displayed word's status can be changed using the Hexadecimal/BCD Data Modification operation. Refer to page 51 for details.

b) The status of SR 25503 to SR 25507 and TR 00 to TR 07 cannot be monitored.

3. Press the MONTR Key to begin monitoring.

[MONTR]

```
cL01
FFFF
```

The Up or Down Cursor Key can be pressed to display the status of the previous or next word.

4. Press the CLR Key to end monitoring.

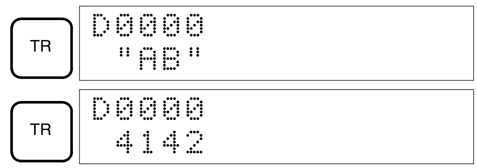
3-3-13 Hex-ASCII Display Change

This operation is used to convert word data displays back and forth between 4-digit hexadecimal data and ASCII. It is possible in any mode.

RUN	MONITOR	PROGRAM
OK	OK	OK

1, 2, 3...

1. Monitor the status of the desired word according to the procedure described in *3-3-12 Bit, Digit, Word Monitor*. If two or more words are being monitored, the desired word should be leftmost on the display.
2. Press the TR Key to switch to ASCII display. The display will toggle between hexadecimal and ASCII displays each time the TR Key is pressed.



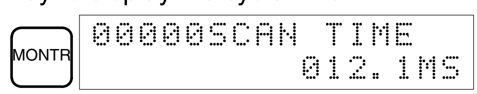
3-3-14 Displaying the Cycle Time

This operation is used to display the current average cycle time (scan time). It is possible only in RUN or MONITOR mode while the program is being executed.

RUN	MONITOR	PROGRAM
OK	OK	No

1, 2, 3...

1. Bring up the initial display.
2. Press the MONTR Key to display the cycle time.



There might be differences in displayed values when the MONTR Key is pressed repeatedly. These differences are caused by changing execution conditions.

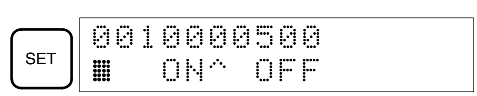
3-3-15 Force Set, Reset

This operation is used to force bits ON (force set) or OFF (force reset) and is useful when debugging the program or checking output wiring. It is possible in MONITOR or PROGRAM mode only.

RUN	MONITOR	PROGRAM
No	OK	OK

1, 2, 3...

1. Monitor the status of the desired bit according to the procedure described in *3-3-12 Bit, Digit, Word Monitor*. If two or more words are being monitored, the desired bit should be leftmost on the display.
2. Press the SET Key to force the bit ON or press the RESET Key to turn the bit OFF.



The cursor in the lower left corner of the display indicates that the force set/reset is in progress. Bit status will remain ON or OFF only as long as the key is held down; the original status will return one cycle after the key is released.

If a timer or counter is force reset in MONITOR mode, it will begin operation again after completion if its input is on and will stop when the time is up.

3. Press the SHIFT+SET or SHIFT+RESET Keys to maintain the status of the bit after the key is released. In this case, the force-set status is indicated by an “S” and the force-reset status is indicated by an “R.”

   To return the bit to its original status, press the NOT key or perform the Clear Force Set/Reset operation. (Refer to *3-3-16 Clear Force Set/Reset* for details.) Forced status will also be cleared when the ID Controller’s operating mode is changed (unless SR 25211 is ON, in which case forced status will not be cleared when changing from PROGRAM to MONITOR mode) or when operation stops as the result of an error or power interruption.

3-3-16 Clear Force Set/Reset

This operation is used to restore the status of all bits which have been force set or reset. It is possible in MONITOR or PROGRAM mode only.

RUN	MONITOR	PROGRAM
No	OK	OK

1, 2, 3...

1. Bring up the initial display.
2. Press the SET and then the RESET Key. A confirmation message will appear.

   SET RESET
   ```
   00000FORCE RELE?
   ```

   Note If you mistakenly press the wrong key, press CLR and start again from the beginning.

3. Press the NOT Key to clear the force-set/reset status of bits in all data areas.

   NOT
   ```
   00000FORCE RELE
   END
   ```

Note Forced status will also be cleared when the ID Controller’s operating mode is changed (unless SR 25211 is ON, in which case forced status will not be cleared when changing from PROGRAM to MONITOR mode) or when operation stops as the result of an error or power interruption.

3-3-17 Binary Monitor

This operation is used to monitor the ON/OFF status of any word’s 16 bits. It is possible in any mode.

RUN	MONITOR	PROGRAM
OK	OK	OK

1, 2, 3...

1. Monitor the status of the desired word according to the procedure described in *3-3-12 Bit, Digit, Word Monitor*. The desired word should be leftmost on the display if 2 or more words are being monitored.
2. Press the SHIFT and then the MONTR Key to begin binary monitoring. The ON/OFF status of the selected word’s 16 bits will be shown along the bottom of the display. A 1 indicates a bit is on, and a 0 indicates it is off.

   SHIFT MONTR
   ```
        C100 MONTR
   1111111111111111
   ```

   The status of force-set bits is indicated by “S,” and the status of a force-reset bits is indicated by “R,” as shown below.

   ```
       C100 MONTR
   0000S0100R0110SR
   ```

   Force-set bit   Force-reset bit

Note a) The status of displayed bits can be changed at this point. Refer to *3-3-19 Binary Data Modification* for details.

b) The Up or Down Cursor Key can be pressed to display the status of the previous or next word's bits.

3. Press the CLR Key to end binary monitoring and return to the normal monitoring display.

   Press the SHIFT+CLR Keys to end monitoring altogether.

3-3-18 Hexadecimal, BCD Data Modification

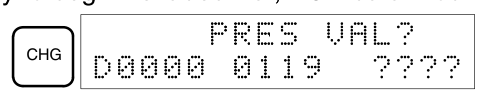
This operation is used to change the BCD or hexadecimal value of a word being monitored using the procedure described in *3-3-12 Bit, Digit, Word Monitor*. It is possible in MONITOR or PROGRAM mode only.

RUN	MONITOR	PROGRAM
No	OK	OK

Words SR 253 to SR 255 cannot be changed.

1, 2, 3...

1. Monitor the status of the desired word according to the procedure described in *3-3-12 Bit, Digit, Word Monitor*. If two or more words are being monitored, the desired word should be leftmost on the display.
2. Press the CHG Key to begin hexadecimal, BCD data modification.

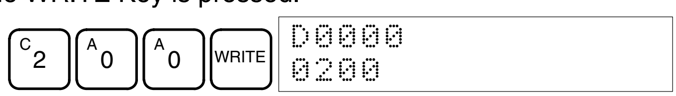


   If a timer or counter is leftmost on the display, its PV will be displayed and will be the value changed.

   In MONITOR mode, the timer's PV will be counting down if the timer is on.

3. Input the new PV and press the WRITE Key to change the PV. Be sure to input timer or counter PVs in BCD only.

   The operation will end and the normal monitoring display will return when the WRITE Key is pressed.



   The timer's PV will continue counting down from the new PV if the timer is on.

3-3-19 Binary Data Modification

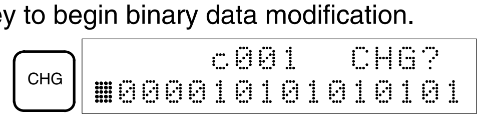
This operation is used to change the status of a word's bits when the word is monitored using the procedure described in *3-3-17 Binary Monitor*. It is possible in MONITOR or PROGRAM mode only.

RUN	MONITOR	PROGRAM
No	OK	OK

Bits SR 25300 to SR 25507 cannot be changed.

1, 2, 3...

1. Monitor the status of the desired word according to the procedure described *3-3-17 Binary Monitor*.
2. Press the CHG Key to begin binary data modification.



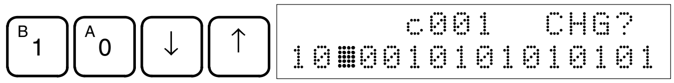
   A flashing cursor will appear over bit 15. The cursor indicates which bit can be changed.

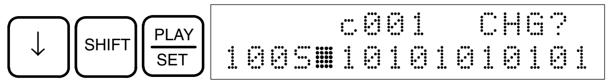
3. Three sets of keys are used to move the cursor and change bit status:

   a) Use the Up and Down Cursor Keys to move the cursor to the left and right.

b) Use the 1 and 0 keys to change a bit's status to on or off. The cursor will move one bit to the right after one of these keys is pressed.

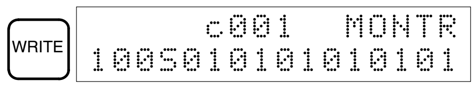
c) Use the SHIFT+SET and SHIFT+RESET Keys to force-set or force-reset a bit's status. The cursor will move one bit to the right after one of these keys is pressed. The NOT Key will clear force-set or force-reset status.





Note Bits in the DM Area cannot be force-set or force-reset.

4. Press the WRITE Key to write the changes in memory.



3-4 LSS Operations

This section describes LSS operations required for communications with the ID Controller and settings in the LSS's System Setup necessary for the ID Controller. Perform these operations before using the LSS for the ID Controller.

⚠ Caution Be sure to set the correct PC model (ID Controller) before using the LSS. All LSS data will be cleared if the PC model specified in the LSS System Setup is changed from one PC group to another. (Even if the PC model is changed within the same group, the I/O table, I/O comments, time chart data, data trace data, and step trace data are deleted.)

PC Model for ID Controller

Set the PC model to the CQM1 when using the LSS for the ID Controller. Press the K Key on the System Setup Menu to specify the PC model setting and then press the E Key to specify the CQM1. (The LSS treats the ID Controller as a CQM1 PC.)

Expansion Instructions

Go to online LSS operations and transfer the expansion instructions from the ID Controller to the LSS. Press the A Key from the online Utility Menu and then confirm the operation on the prompt that appears next.

Program Transfer

When transferring the program from the ID Controller to the computer running the LSS, specify "E:SEND TO END." This will ensure that the expansion instructions table will transferred to the computer after transfer of the program has been completed.

Note To avoid having to go online with the ID Controller to transfer the expansion instructions each time you use the LSS for the ID Controller, you can transfer them to the LSS once and then save them to disk using the A:RETRIEVE/SAVE INSTRUCTIONS operation on the offline Utility Menu. Once the expansion instructions have been saved to disk, the A:RETRIEVE/SAVE INSTRUCTIONS operation can be used to retrieve them to use the LSS offline for the ID Controller.

3-5 SSS Operations

This section describes SSS operations required for communications with the ID Controller and settings in the SSS's System Setup necessary for the ID Controller. Perform these operations before using the SSS for the ID Controller.

⚠ Caution Be sure to set the correct PC model (ID Controller) before using the SSS. All SSS data will be cleared if the PC model specified in the SSS System Setup is changed from one PC group to another. (Even if the PC model is changed within the same group, the I/O comment, I/O table, time chart data, data trace data, and step trace data are deleted.)

PC Model for ID Controller

Set the PC model to the CQM1 when using the SSS for the ID Controller. Press the K Key on the System Setup Menu to specify the PC model setting and then press the H Key to specify the CQM1. (The SSS treats the ID Controller as a CQM1 PC.)

Expansion Instructions

The expansion instructions for the ID Controller are already registered in the SSS. It is thus not necessary to transfer the expansion instructions when using the SSS; just be sure to transfer the instructions table.

Program Transfer

When transferring the program from the ID Controller to the computer running the SSS, specify "E:SEND TO END." This will ensure that the expansion instructions table will transferred to the computer after transfer of the program has been completed.

SECTION 4
Data Areas

This section describes the structure and use of the data areas used by the ID Controller.

4-1 Data Area Structure

The following memory areas can be used with the ID Controller.

Data Area		Size	Words	Bits	Function
IR area[1]	Input area	32 bits	IR 000 to IR 015	IR 00000 to IR 01515	Allocated to I/O terminals.
	Output area		IR 100 to IR 115	IR 10000 to IR 11515	
	Work areas	3,584 bits min.	IR 001 to IR 095	IR 00100 to IR 09515	Work bits do not have any specific function, and they can be freely used within the program.
			IR 101 to IR 195	IR 10100 to IR 19515	
			IR 200 to IR 229	IR 20000 to IR 22915	
			IR 240 to IR 243	IR 24000 to IR 24315	
MACRO operand area[1]	Input area	64 bits	IR 096 to IR 099	IR 09600 to IR 09915	Used when the MACRO instruction, MCRO(99), is used. When the MACRO instruction is not used, these bits may be used as work bits.
	Output area	64 bits	IR 196 to IR 199	IR 19600 to IR 19915	
High-speed Counter PV[1]		32 bits	IR 230 to IR 231	IR 23000 to IR 23115	Used to store the present values of the high-speed counter.
ID Controller area	**Read/Write**	16 bits	SR 232	SR 23200 to SR 23215	Used for ID communications. Refer to *4-3 ID Controller Area* and *5-3 ID Communications* for details.
	Read-only	112 bits	SR 233 to SR 239	SR 23300 to SR 23915	
SR area	Read/Write	144 bits	SR 244 to SR 252	SR 24400 to SR 25215	These bits serve specific functions such as flags and control bits.
	Read-only	48 bits	SR 253 to SR 255	SR 25300 to SR 25515	Can be used as work bits, but not as holding bits.
TR area		8 bits	---	TR 0 to TR 7	These bits are used to temporarily store ON/OFF status at program branches.
HR area		1,600 bits	HR 00 to HR 99	HR 0000 to HR 9915	These bits store data and retain their ON/OFF status when power is turned off.
AR area		448 bits	AR 00 to AR 27	AR 0000 to AR 2715	These bits serve specific functions such as flags and control bits.
LR area[1]		1,024 bits	LR 00 to LR 63	LR 0000 to LR 6315	Used for 1:1 data link through the RS-232 port.
Timer/Counter area[2]		512 bits	TC 000 to TC 511 (timer/counter numbers)		The same numbers are used for both timers and counters.
DM area	Read/write	6,144 words	DM 0000 to DM 6143	DM area data can be accessed in word units only. Word values are retained when the power is turned off.	
	Read-only	512 words	DM 6144 to DM 6655	Cannot be overwritten from program. DM 6450 to DM 6540 (91 words): ID Error Log DM 6541 to DM 6546 (6 words): ID Error Statistics Log DM 6569 to DM 6599: Error History Area DM 6600 to DM 6655: ID Controller Setup	
User program area (UM area)		3,200 words	---		Used to store the program. Retained when the power is turned off.

Note

1. IR and LR bits that are not used for their allocated functions can be used as work bits.
2. When accessing a PV, TC numbers are used as word data; when accessing Completion Flags, they are used as bit data.

4-2 Data Area Functions

The functions of the various data areas are explained below.

IR Area

IR area bits are allocated to I/O terminals. They reflect the ON/OFF status of input and output signals. Input bits run from IR 00000 to IR 00015, and output bits run from IR 10000 to IR 10015.

Note Input bits cannot be used in output instructions. Do not use the same output bit in more than one OUT and/or OUT NOT instruction, or the program will not execute properly.

Work Bit Area

Any of the bits between IR 001 and IR 229 and IR 240 to IR 243 not used for specific functions can be used as work bits.

The work bits can be used freely within the program. They can only be used within the program, however, and not for direct external I/O. Work bits are reset (i.e., turned OFF) when the ID Controller power supply is turned off or when operation begins or stops.

The bits in the ranges shown below have specific functions, but can still be used as work bits when their specific functions are not being used.

Range	Function
IR 096 to IR 099	When the MACRO instruction is used, these bits serve as operand input bits.
IR 196 to IR 199	When the MACRO instruction is used, these bits serve as operand output bits.
IR 230 to IR 231	When high-speed counter is used, these bits are used to store its present value.

LR 00 to LR 63 are used as link bits, but they can also be used as work bits when not linked to another ID Controller. Refer to the *CQM1 Programming Manual* for details on using link bits in 1-to-1 communications.

SR Area

These bits mainly serve as flags related to ID Controller operation. For details on the various bit functions, refer to *Appendix D AR and SR Area Allocations*.

SR 244 to SR 247 can also be used as work bits, when input interrupts are not used in Counter Mode.

TR Area

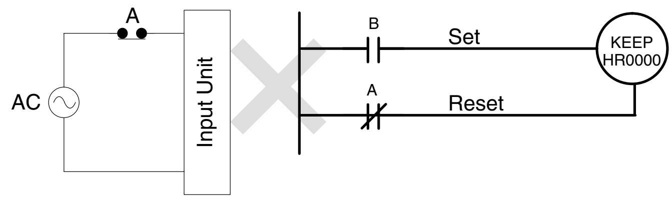
When a complex ladder diagram cannot be programmed in mnemonic code just as it is, these bits are used to temporarily store ON/OFF execution conditions at program branches. They are used only for mnemonic code. When programming directly with ladder diagrams using the Ladder Support Software (LSS) or SYSMAC Support Software (SSS), TR bits are automatically processed for you.

The same TR bits cannot be used more than once within the same instruction block, but can be used again in different instruction blocks. The ON/OFF status of TR bits cannot be monitored from a Peripheral Device.

HR Area

These bits retain their ON/OFF status even after the ID Controller power supply has been turned off or when operation begins or stops. They are used in the same way as work bits.

⚠ Caution Never use an input bit in a NC condition on the reset (R) for KEEP(11) when the input device uses an AC power supply (see diagram below). The delay in shutting down the ID Controller's DC power supply relative to the AC power supply to the input device can cause the designate bit of KEEP(11) to be reset.



AR Area

These bits mainly serve as flags related to ID Controller operation. For details on the various bit functions, refer to relevant sections in this manual or to *Appendix D AR and SR Area Allocations*.

LR Area

When the ID Controller is linked one to one with another ID Controller, these bits are used to share data. Refer to the *CQM1 Programming Manual* for details on using link bits in 1-to-1 communications.

LR bits can be used as work bits when not used for data links.

Timers/Counters Area

This area is used to manage timers and counters created with TIM, TIMH(15), CNT, and CNTR(12). The same numbers are used for both timers and counters and each number can be used only once in the user program. Do not use the same TC number twice even for different instructions.

TC number are used to create timers and counters, as well as to access Completion Flags and present values (PVs). If a TC number is designated for word data, it will access the present value (PV); if it is used for bit data, it access the Completion Flag for the timer/counter.

The Completion Flag turns ON when the PV of the timer/counter that is being used goes to 0.

Refer to the *CQM1 Programming Manual* for details on timers and counters.

Note

1. TC numbers 000 through 015 and interrupt processing should be used for TIMH(15) whenever the cycle time is longer than 10 ms. Using other timer/counter numbers or not using interrupt processing will lead to inaccuracy in the high-speed timers. Interrupt processing can be set in DM 6629 of the ID Controller Setup.
2. When the input condition turns OFF for TIM or TIMH(15), the PV is reset and returns to the set value. The PV is also reset at the beginning of program execution or when the interlock condition goes OFF in a interlocked program section (IL–ILC). The PV for CNT or CNTR(12) is not reset like one for the timer instruction, but rather is reset only when the reset input goes ON.

DM Area

Data is accessed in word units. As shown below, the DM area contains both an area that can be freely used and areas with specific functions.

Start word	Area	Description
DM 0000		This area has no specific functions and can be used freely. Both reading and writing are possible from the program.
DM 6144	Fixed DM (See note 1)	This area cannot be written from the program. It is used for storing information that is not to be changed. Writing can be executed by means of peripheral devices only.
DM 6450	ID error log	This area is used to store errors that occur in ID communications. This area cannot be written by the user.
DM 6541	ID Error Statistics Log	This area records the number of various types of errors that occur in ID communications. This area cannot be written by the user.
DM 6569	Error History	This area stores the error log. This area cannot be written by the user.
DM 6600	ID Controller Setup	This area stores information related to ID Controller operation. The settings are made by means of peripheral devices.
DM 6655		

Note
1. Turning ON pin 1 of the DIP switch on the ID Controller will prevent writing even by means of peripheral devices.
2. Fixed DM contents, the ID Controller Setup, the user program, and the instructions table can all be saved to and loaded from a Memory Cassette as a single unit.

UM Area

The UM area stores the user's program. UM area contents can be read and written only as program data, and not as words. The UM Area can contain up to 3.2K words of programming.

4-3 ID Controller Area

The following table lists the dedicated bits used for the ID Controller.

Word	Bit(s)	Name	Function	
SR 232 (Read/Write)	00	AUTOREAD/WRITE Cancel Bit	ON: Autoread/write canceled (RUN mode only) OFF: Autoread/write enabled.	
	01	Flag Reset Bit	ON: SR 233 flags reset except (ID Ready Flag). OFF: SR 233 flags operative.	
	02 to 07	Reserved	Do not use.	
	08	Test Bit	ON: Test executed (PROGRAM mode only) OFF: Test stopped.	
	09	Test Read/Write Bit	ON: Write test. OFF: Read test.	
	10	ID Error Log Clear Bit	ON: Error log cleared. (RUN or PROGRAM mode only) Will automatically turn back OFF.	
	11	ID Error Statistics Log Clear Bit		
	12 to 15	Reserved	Do not use.	
SR 233 (Read-only)	00	ID Ready Flag	Turns ON when ID communications instruction is issued, turns OFF as soon as instruction is executed, and turns back ON when communications are completed.	
	01	ID Completed Flag	Turns ON as soon as processing for communications with Data Carrier via ID communications instruction has been completed.	
	02	ID Communications Error Flag	Turns ON when an error occurs in communications (ON when any flag between SR 23308 and SR 23313 is ON). Turns OFF when error is cleared and ID communications instruction is executed.	
	03 to 05	Reserved	Do not use.	
	06	DC Battery Warning Flag	Turns ON when the voltage of the battery built into the Data Carrier is low, indicating the battery has passed its service life.	
	07	ID Check Warning Flag	Turns ON when an error is detected for the IDMD (66) (ID CHECK) instruction.	
	08	DC Missing Error Flag	Turn ON when corresponding error is detected, Turn OFF when SR 23201 (Flag Reset Bit) turns ON. Turn OFF when ID communications instruction is executed.	
	09	Write Protected Error Flag		
	10	DC Communications Error Flag		
	11	Address Error Flag		
	12	Verification Error Flag		
	13	No Head Error Flag		
	14, 15	Reserved	Do not use.	
SR 234 (Read-only)	00 to 07	Error Code	70 to 7D	ID communications in progress: FFFF Normal end: Instruction code + "00" Error end: Instruction code + error code
	08 to 11	Instruction Code	1 to 6	
	12 to 15	Reserved	Do not use.	
SR 235 to SR 239	00 to 15	Reserved	Do not use.	

Note When the Flag Reset Bit (SR 23201) is turned ON, all flags in SR 233 except the ID Ready Flag (SR 23300) will turn OFF and the Error Code and Instruction Code in SR 234 will be cleared.

4-3-1 ID Flags Timing

ID Controller Bits in SR 232 are refreshed once each scan during overseeing processing. The setting for the refresh method in DM 6611, bits 03 to 07 does not affect the refreshing of these flags

ID Controller Flags and Data in SR 233 and SR 234 are refreshed according to the setting for the refresh method in DM 6611, bits 03 to 07 and can be set either for cyclic or interrupt processing.

Cyclic processing refreshes memory only once each scan. Interrupt processing causes an interrupt to be generated when ID communications have been completed, refreshing SR 233 and SR 234 immediately after communications.

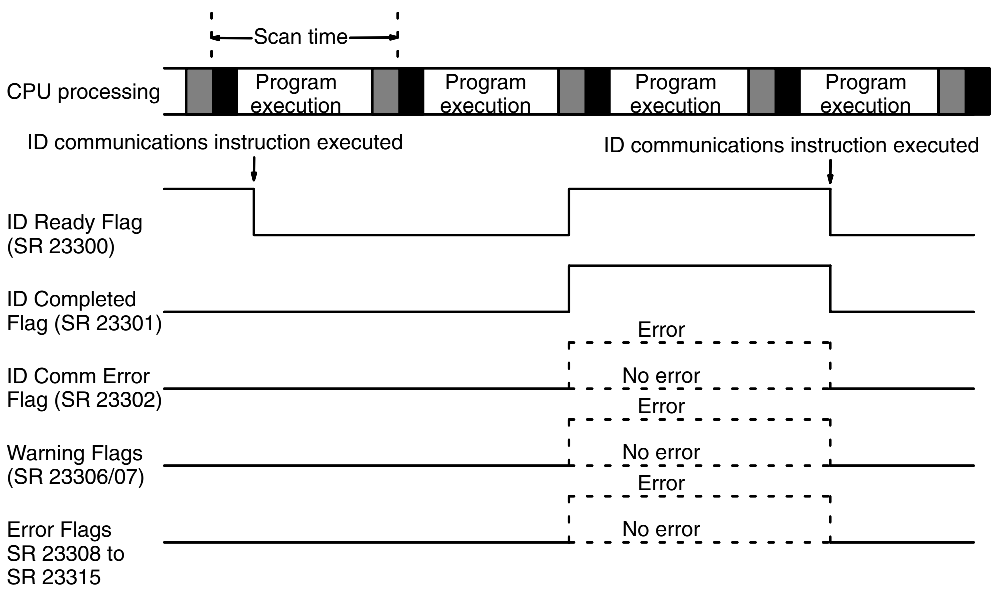
If the Error Flag (SR 25503) is not ON, the contents of SR 233 and SR 234 will be as shown below immediately after an ID communications instruction has been issued, prevent other ID communications instructions from being executed.

SR 233: $0000
SR 234: $FFFF

When ID communications have been completed, the ID Ready Flag (SR 23300) will turn ON, again enabling execution of ID communications instructions.

Note If the Flag Reset Bit (SR 23201) is ON when ID communications are completed, the content of SR 233 and SR 234 will be refreshed normally once, and then their content will be reset during the next overseeing processing stage.

The following timing chart illustrates the operation of the ID Controller Bits and Flags.



4-3-2 Autoread/Write Flags

The ID Ready Flag (SR 23300) will turn OFF when the AUTOREAD (IDAR) or AUTOWRITE (IDAW) instruction is executed. If the Data Carrier cannot be detected within a specified period of time (i.e., if the ID Ready Flag does not come ON for a specified period of time), the Autoread/Write Cancel Bit (SR 23200) can be turned ON to cancel the read/write instruction. The status of the ID Controller Flags will be as follows after the instruction has been cancelled:

ID Ready Flag (SR 23300): ON
Other Flags (SR 23301 to SR 23315): OFF

The Autoread/Write Cancel Bit (SR 23200) will not be effective, however, if it is turned ON after a Data Carrier has been detected. In this case, execution of the AUTOREAD (IDAR) or AUTOWRITE (IDAW) instruction will be continued normally.

Note
1. Make sure that the ID Ready Flag (SR 23300) is OFF when you turn on the Autoread/Write Cancel Bit (SR 23200).
2. Data at the write destination for the AUTOREAD (IDAR) or AUTOWRITE (IDAW) instruction will not be changed if the instruction is cancelled.

SECTION 5
ID Controller Functions and Setup

This section describes the functions of the ID Controller and the Setup that can be used to control those functions.

5-1 ID Controller Setup

The ID Controller Setup comprises various operating parameters that control ID Controller operation. In order to make the maximum use of ID Controller functionality when using interrupt processing and communications functions, the ID Controller Setup may be customized according to operating conditions.

At the time of shipping, the defaults are set for general operating conditions, so that the ID Controller can be used without having to change the settings. You are, however, advised to check the default values before operation.

The ID Controller Setup is broadly divided into three categories: 1) Settings related to basic ID Controller operation and I/O processes, 2) Settings related to interrupts, and 3) Settings related to communications. This section will explain the settings according to these classifications.

The following table shows the setting in order in the DM area. For details, refer to the page numbers shown.

Word(s)	Bit(s)	Function	Page
Startup Processing (DM 6600 to DM 6614) The following settings are effective after transfer to the ID Controller only after the ID Controller is restarted.			
DM 6600	00 to 07	Startup mode (effective when bits 08 to 15 are set to 02). 00: PROGRAM; 01: MONITOR 02: RUN	69
	08 to 15	Startup mode designation 00: Programming Console switch (default; RUN mode when not connected) 01: Continue operating mode last used before power was turned off 02: Setting in 00 to 07	
DM 6601	00 to 07	Reserved (Set to 00.)	
	08 to 11	IOM Hold Bit (SR 25212) Status 0: Reset (default); 1: Maintain	69
	12 to 15	Forced Status Hold Bit (SR 25211) Status 0: Reset (default); 1: Maintain	
DM 6602 to DM 6610	00 to 15	Reserved	
DM 6611	00 to 03	ID Communications Mode (effective when Data Carrier is EEPROM) 0: Communications distance given priority; 1: baud rate given priority	73
	04 to 07	ID Communications Response Refresh Method 0: Cyclic refresh; 1: Interrupt refresh (can trigger interrupt subroutines 04 to 09)	
	08 to 15	Reserved (Set to 00.)	
DM 6612 to DM 6614	00 to 15	Reserved.	
Port Settings (DM 6615 to DM 6619) The following settings are effective after transfer to the ID Controller the next time operation is started.			
DM 6615	00 to 15	Reserved.	
DM 6616	00 to 07	Servicing time for RS-232C port (effective when bits 08 to 15 are set to 01) 00 to 99 (BCD): Percentage of cycle time used to service RS-232C port.	69
	08 to 15	RS-232C port servicing setting enable 00: Do not set service time (5% of scan time; default) 01: Use time in 00 to 07.	
DM 6617	00 to 07	Servicing time for peripheral port (effective when bits 08 to 15 are set to 01) 00 to 99 (BCD): Percentage of cycle time used to service peripheral.	
	08 to 15	Peripheral port servicing setting enable 00: Do not set service time (120 ms; default) 01: Use time in 00 to 07.	

Word(s)	Bit(s)	Function	Page
DM 6618	00 to 07	Cycle monitor time (effective when bits 08 to 15 are set to 01, 02, or 03) 00 to 99 (BCD): Setting (see 08 to 15)	71
	08 to 15	Cycle monitor enable (Setting in 00 to 07 x unit; 99 s max.) 00: 120 ms (default; setting in bits 00 to 07 disabled) 01: Setting unit: 10 ms 02: Setting unit: 100 ms 03: Setting unit: 1 s	
DM 6619	00 to 15	Cycle time 0000: Variable (default; no minimum) 0001 to 9999 (BCD): Minimum time in ms	70
Interrupt Processing (DM 6620 to DM 6639) The following settings are effective after transfer to the ID Controller the next time operation is started.			
DM 6620	00 to 03	Input constant for IR 00000 to IR 00007 0: 8 ms; 1: 1 ms; 2: 2 ms; 3: 4 ms; 4: 8 ms; 5: 16 ms; 6: 32 ms; 7: 64 ms; 8: 128 ms	70
	04 to 07	Input constant for IR 00008 to IR 00015 (Setting same as bits 00 to 03)	
	08 to 15	Reserved.	
DM 6621 to DM 6627	00 to 15	Reserved	
DM 6628	00 to 03	Interrupt enable for IR 00000 (0: Normal input; 1: Interrupt input)	97
	04 to 07	Interrupt enable for IR 00001 (0: Normal input; 1: Interrupt input)	
	08 to 11	Interrupt enable for IR 00002 (0: Normal input; 1: Interrupt input)	
	12 to 15	Interrupt enable for IR 00003 (0: Normal input; 1: Interrupt input)	
DM 6629	00 to 07	Number of high-speed timers for interrupt refreshing 00 to 15 (BCD; e.g., set 15 for 00 to 14)	70
	08 to 15	High-speed timer interrupt refresh enable 00: 16 timers (default; setting in bits 00 to 07 disabled) 01: Use setting in 00 to 07	
DM 6630	00 to 07	Set to 00.	97
	08 to 15	Input Refresh Setting for input interrupt 0: 00: Refresh; 01: Don't refresh	
DM 6631	00 to 07	Set to 00.	
	08 to 15	Input Refresh Setting for input interrupt 1: 00: Refresh; 01: Don't refresh	
DM 6632	00 to 07	Set to 00.	
	08 to 15	Input Refresh Setting for input interrupt 2: 00: Refresh; 01: Don't refresh	
DM 6633	00 to 07	Set to 00.	
	08 to 15	Input Refresh Setting for input interrupt 3: 00: Refresh; 01: Don't refresh	
DM 6634	00 to 07	Set to 00.	
	08 to 15	Input Refresh Setting for ID communications response interrupt: 00: Refresh; 01: Don't refresh	
DM 6635	00 to 15	Reserved	
DM 6636	00 to 07	Set to 00.	102, 106
	08 to 15	Input Refresh Setting for interval timer 0: 00: Refresh; 01: Don't refresh	
DM 6637	00 to 07	Set to 00.	
	08 to 15	Input Refresh Setting for interval timer 1: 00: Refresh; 01: Don't refresh	
DM 6638	00 to 07	Set to 00.	
	08 to 15	Input Refresh Setting for interval timer 2 (also used for high-speed counter): 00: Re-fresh; 01: Don't refresh	
DM 6639	00 to 07	Output refresh method 00: Cyclic (default); 01: Direct	71, 163
	08 to 15	Number of digits for DIGITAL SWITCH (DSW) instruction 00: 4 digits (default); 01: 8 digits	71, 89

Word(s)	Bit(s)	Function	Page
High-speed Counter Settings (DM 6640 to DM 6644) The following settings are effective after transfer to the ID Controller the next time operation is started.			
DM 6640 to DM 6641	00 to 15	Reserved	
DM 6642	00 to 03	High-speed counter mode 0: Up/down counter mode 4: Incremental counter mode	106
	04 to 07	High-speed counter reset mode 0: Z phase and software reset 1: Software reset only	
	08 to 15	High-speed counter enable 00: Do not use high-speed counter 01: Use high-speed counter with settings in 00 to 07	
DM 6643	00 to 15	Data Carrier standby time (for autoread/write execution). 0000: No limit 0001 to 9999: 0.1 to 999.9 s	74
DM 6644	00 to 15	Reserved	
RS-232C Port Settings The following settings are effective after transfer to the ID Controller.			
DM 6645	00 to 07	Port settings 00: Standard (1 start bit, 7-bit data, even parity, 2 stop bits, 9,600 bps) 01: Settings in DM 6646	111
	08 to 11	Link words for 1:1 link 0: LR 00 to LR 63; 1: LR 00 to LR 31; 2: LR 00 to LR 15	
	12 to 15	Communications mode 0: Host link; 1: RS-232C (no protocol); 2: 1:1 data link slave; 3: 1:1 data link master; 4: NT link	
DM 6646	00 to 07	Baud rate 00: 1.2K, 01: 2.4K, 02: 4.8K, 03: 9.6K, 04: 19.2K	
	08 to 15	Frame format Start / Length / Stop / Parity 00: 1 bit / 7 bits / 1 bit / Even 01: 1 bit / 7 bits / 1 bit / Odd 02: 1 bit / 7 bits / 1 bit / None 03: 1 bit / 7 bits / 2 bit / Even 04: 1 bit / 7 bits / 2 bit / Odd 05: 1 bit / 7 bits / 2 bit / None 06: 1 bit / 8 bits / 1 bit / Even 07: 1 bit / 8 bits / 1 bit / Odd 08: 1 bit / 8 bits / 1 bit / None 09: 1 bit / 8 bits / 2 bit / Even 10: 1 bit / 8 bits / 2 bit / Odd 11: 1 bit / 8 bits / 2 bit / None	
DM 6647	00 to 15	Transmission delay (Host Link) 0000 to 9999 (BCD): Set in units of 10 ms, e.g., setting of 0001 equals 10 ms	
DM 6648	00 to 07	Node number (Host link) 00 to 31 (BCD; default: 00))	
	08 to 11	Start code enable (RS-232C) 0: Disable (default); 1: Set	
	12 to 15	End code enable (RS-232C) 0: Disable (default; number of bytes received) 1: Set (specified end code) 2: CR, LF	

Word(s)	Bit(s)	Function	Page
DM 6649	00 to 07	Start code (RS-232C) 00 to FF (binary)	111
	08 to 15	12 to 15 of DM 6648 set to 0: Number of bytes received 00: Default setting (256 bytes) 01 to FF: 1 to 255 bytes 12 to 15 of DM 6648 set to 1: End code (RS-232C) 00 to FF (binary)	
Peripheral Port Settings The following settings are effective after transfer to the ID Controller.			
DM 6650	00 to 07	Port settings 00: Standard (1 start bit, 7-bit data, even parity, 2 stop bits, 9,600 bps) 01: Settings in DM 6651	111
	08 to 11	Reserved	
	12 to 15	Communications mode 0: Host link; 1: RS-232C	111
DM 6651	00 to 07	Baud rate 00: 1.2K, 01: 2.4K, 02: 4.8K, 03: 9.6K, 04: 19.2K	
	08 to 15	Frame format Start / Length / Stop / Parity 00: 1 bit, 7 bits, 1 bit, Even 01: 1 bit, 7 bits, 1 bit, Odd 02: 1 bit, 7 bits, 1 bit, None 03: 1 bit, 7 bits, 2 bit, Even 04: 1 bit, 7 bits, 2 bit, Odd 05: 1 bit, 7 bits, 2 bit, None 06: 1 bit, 8 bits, 1 bit, Even 07: 1 bit, 8 bits, 1 bit, Odd 08: 1 bit, 8 bits, 1 bit, None 09: 1 bit, 8 bits, 2 bit, Even 10: 1 bit, 8 bits, 2 bit, Odd 11: 1 bit, 8 bits, 2 bit, None	
DM 6652	00 to 15	Transmission delay (Host Link) 0000 to 9999: In ms.	
DM 6653	00 to 07	Node number (Host link) 00 to 31 (BCD; default: 00)	
	08 to 11	Start code enable (RS-232C) 0: Disable; 1: Set	
	12 to 15	End code enable (RS-232C) 0: Disable (number of bytes received) 1: Set (specified end code) 2: CR, LF	
DM 6654	00 to 07	Start code (RS-232C) 00 to FF (binary)	
	08 to 15	12 to 15 of DM 6653 set to 0: Number of bytes received 00: Default setting (256 bytes) 01 to FF: 1 to 255 bytes 12 to 15 of DM 6653 set to 1: End code (RS-232C) 00 to FF (binary)	

Word(s)	Bit(s)	Function	Page
Error Log Settings (DM 6655) The following settings are effective after transfer to the ID Controller.			
DM 6655	00 to 03	Error Log Style 0: Shift after 10 records have been stored (default) 1: Store only first 10 records (no shifting) 2 to F: Do not store records	72
	04 to 07	ID Error Log Style 0: Shift after 30 records have been stored (default) 1: Store only first 30 records (no shifting) 2 to F: Do not store records	72
	08 to 11	Cycle time monitor enable 0: Detect long cycles as non-fatal errors (default) 1: Do not detect long cycles	72
	12 to 15	Low battery error enable 0: Detect low battery voltage as non-fatal error (default) 1: Do not detect low batter voltage	

Default Values

The default values for the ID Controller Setup are 0000 for all words. The default values can be reset at any time by turning ON SR 25210.

⚠ Caution When data memory (DM) is cleared from a Programming Device, the ID Controller Setup settings will also be cleared to all zeros.

Changing the Setup

Changes in ID Controller Setup settings are effective and will affect ID Controller operation at various times depending on the setting, as described below.

DM 6600 to DM 6614: Effective when ID Controller power supply is turned on.
DM 6615 to DM 6644: Effective when program execution begins.
DM 6645 to DM 6655: Effective any time that ID Controller power is on.
(DM 6611 and DM 6643 are read once when power is turned on and once when program execution begins.)

Note Changes in the ID Controller Setup are effective only at the times given above. Be sure to take the proper measures to make changes effective before continuing operation.

Although the ID Controller Setup is stored in DM 6600 to DM 6655, settings can be made and changed only from a Programming Device (e.g., LSS, SSS, or Programming Console). DM 6600 to DM 6644 can be set or changed only while in PROGRAM mode. DM 6645 to DM 6655 can be set or changed while in either PROGRAM mode or MONITOR mode.

Note The ID Controller Setup can be read, but not written into, from the user program. Writing can only be done by means of a Programming Device.

If a ID Controller Setup setting is improper, then a non-fatal error (error code 9B) will be generated when the ID Controller reads that setting, and the appropriate bit between AR 2400 and AR 2402 will turn ON. (The erroneous setting will be read at the default value.)

The following settings can be made in PROGRAM mode from the LSS/SSS using menu operations. All other settings must be made using the hexadecimal setting operation.

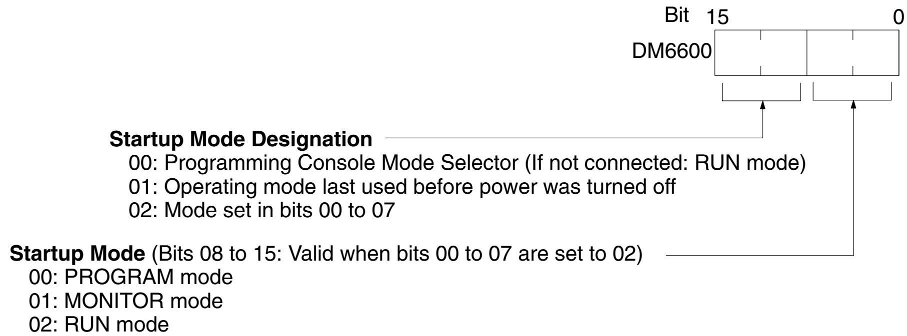
Startup Mode (DM 6600)
I/O Hold Bit Status and Forced Status Hold Bit Status (DM 6601)
Cycle Monitor Time (DM 6618)
Cycle Time (DM 6619)
RS-232C Port Settings (DM 6645 to DM 6649)

5-2 Basic Operations and I/O Processes

This section explains the ID Controller Setup settings related to basic ID Controller operation and I/O processes.

Startup Mode (DM 6600)

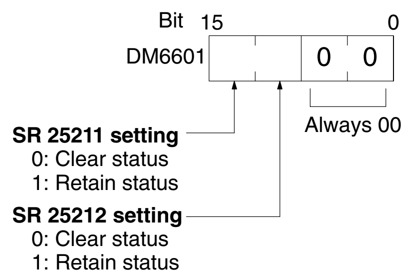
The operation mode the ID Controller will start in when power is turned on can be set as shown below.



Default: Programming Console Mode Selector or RUN mode when Programming Console is not connected.

Hold BIt Status (DM 6601)

Make the settings shown below to determine whether, when the power supply is turned on, the Forced Status Hold Bit (SR 25211) and/or IOM Hold Bit (SR 25212) will retain the status that was in effect when the power was last turned off, or whether the previous status will be cleared.



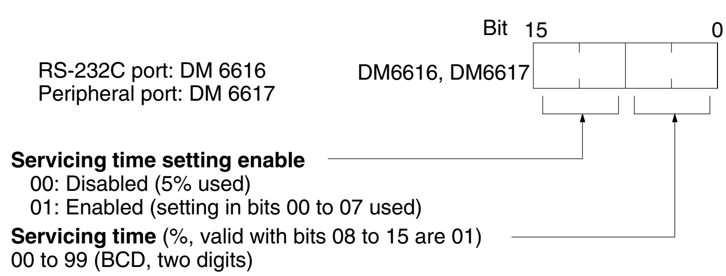
Default: Clear both.

The Forced Status Hold Bit (SR 25211) determines whether or not the forced set/reset status is retained when changing from PROGRAM mode to MONITOR mode.

The IOM Hold Bit (SR 25212) determines whether or not the status of IR bits and LR bits is retained when ID Controller operation is started and stopped.

RS-232C and Peripheral Port Servicing Times (DM 6616 and DM 6617)

The following settings are used to determine the percentage of the cycle time devoted to servicing the RS-232C port and the percentage devoted to the peripheral port.



Default: 5% of cycle time

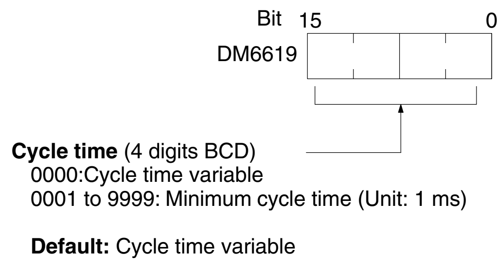
Example: If DM 6616 is set to 0110, the RS-232C port will be serviced for 10% of the cycle time. If DM 6617 is set to 0115, the peripheral port will be serviced for 15% of the cycle time.

The servicing time will be 0.34 ms minimum even if a lower time is set.

The entire servicing time will not be used unless processing requests exist.

Cycle Time (DM 6619)

Make the settings shown below to standardize the cycle time and to eliminate variations in I/O response time by setting a minimum cycle time.

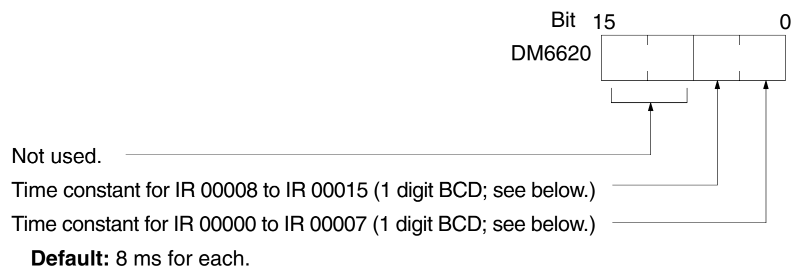


If the actual cycle time is shorter than the minimum cycle time, execution will wait until the minimum time has expired. If the actual cycle time is longer than the minimum cycle time, then operation will proceed according to the actual cycle time. AR 2405 will turn ON if the minimum cycle time is exceeded.

Input Time Constants (DM 6620)

Make the settings shown below to set the time from when the actual inputs are turned ON or OFF until the corresponding input bits are updated (i.e., until their ON/OFF status is changed). Make these settings when you want to adjust the time until inputs stabilize.

Input Time Constants for IR 000

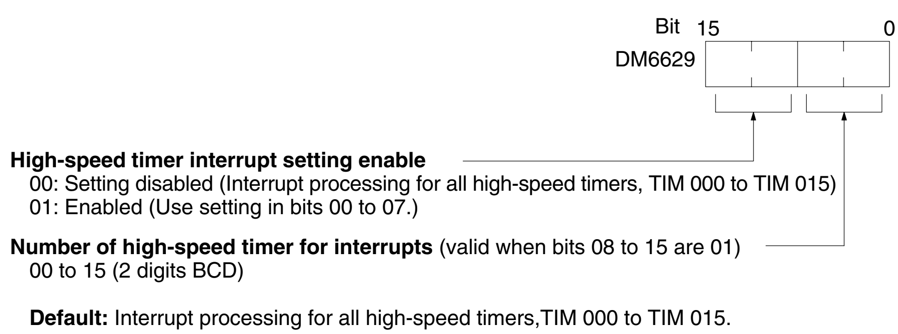


The nine possible settings for the input time constant are shown below.

0: 8 ms	1: 1 ms	2: 2 ms	3: 4 ms	4: 8 ms
5: 16 ms	6: 32 ms	7: 64 ms	8: 128 ms	

High-speed Timers (DM 6629)

Make the settings shown below to set the number of high-speed timers created with TIMH(15) that will use interrupt processing.



The setting indicates the number of timers that will use interrupt processing beginning with TIM 000. For example, if "0108" is specified, then eight timers, TIM 000 to TIM 007 will use interrupt processing.

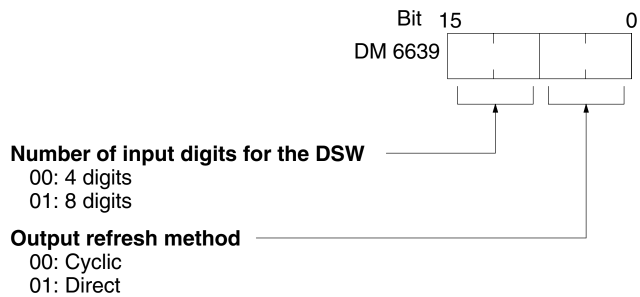
Note High-speed timers will not be accurate without interrupt processing unless the cycle time is 10 ms or less.

Interrupt response time for other interrupts will be improved if interrupt processing is set to 00 when high-speed timer processing is not required. This includes any time the cycle time is less than 10 ms.

Note If the SPED(––) instruction is used and pulses are output at a frequency of 500 Hz or greater, then set the number of high-speed timers with interrupt processing to four or less. Refer to information on the SPED(––) instruction in the *CQM1 Programming Manual* for details.

DSW Input Digits and Output Refresh Method (DM 6639)

Make the settings shown below to set the number of input digits the DSW(––) instruction, and to set the output refresh method.



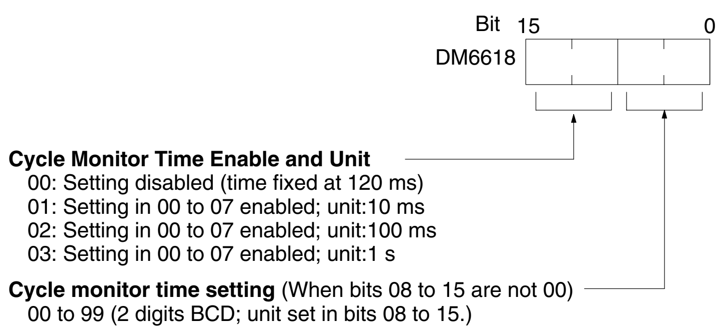
Default: The number of input digits for the DSW instruction is set to “4” and the output refresh method is cyclic.

Refer to the *CQM1 Programming Manual* for details on the DSW instruction and for details on I/O refresh methods.

Error Log Settings

Make the settings shown below for detecting errors and storing the error log.

Cycle Monitor Time (DM 6618)



Default: 120 ms.

The cycle monitor time is used for checking for extremely long cycle times, as can happen when the program goes into an infinite loop. If the cycle time exceeds the cycle monitor setting, a fatal error (FALS 9F) will be generated.

Note
1. The unit used for the maximum and current cycle times recorded in AR 26 and AR 27 will change according to the unit set for the cycle monitor time as shown below.

Bits 08 to 15 set to 00 or 01:	0.1 ms
Bits 08 to 15 set to 02:	1 ms
Bits 08 to 15 set to 03:	10 ms

2. When bits 08 to 15 are set to 02 or 03, the cycle time read from Programming Devices will not exceed 999.9 ms even if the cycle time is 1 s or longer. The correct maximum and current cycle times will be recorded in AR 26 and AR 27.

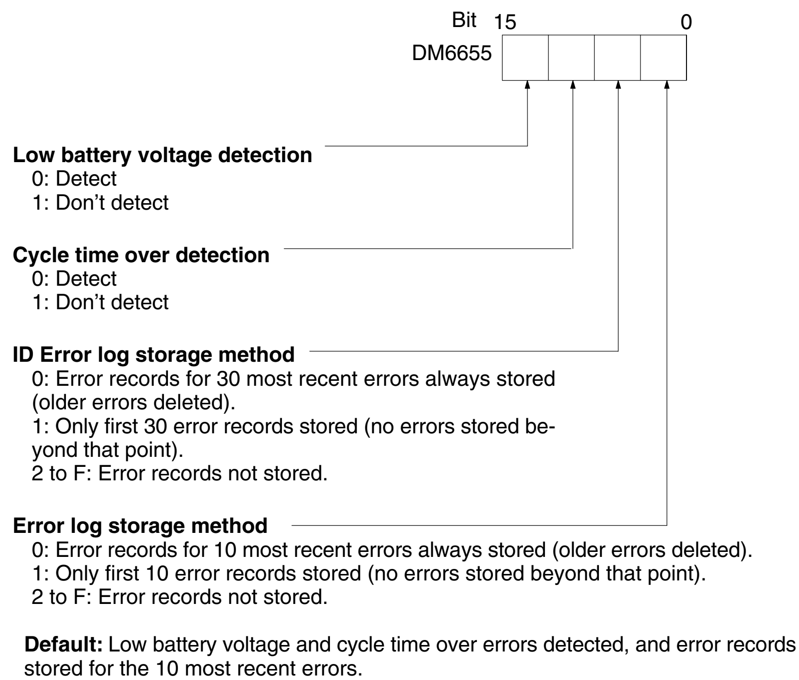
Example

If 0230 is set in DM 6618, an FALS 9F error will not occur until the cycle time exceeds 3 s. If the actual cycle time is 2.59 s, AR 27 will contain 2590 (ms), but the cycle time read from a Programming Device will be 999.9 ms.

A "cycle time over" error (non-fatal) will be generated when the cycle time exceeds 100 ms unless detection of long cycle times is disable using the setting in DM 6655.

Error Detection and Error Log Operation (DM 6655)

Make the settings shown below to determine whether or not a non-fatal error is to be generated when the cycle time exceeds 100 ms or when the voltage of the built-in battery drops, and to set the method for storing records in the error log when errors occur.



Battery errors and cycle time overrun errors are non-fatal errors.

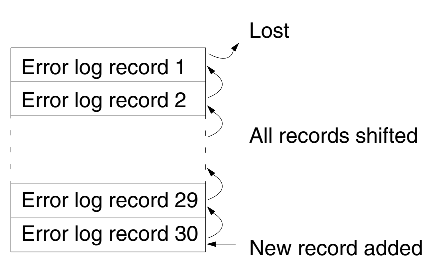
For details on the normal error log, refer to the *CQM1 Programming Manual*. For details on the ID error log, refer to *9-8 ID Error Logs*.

ID Error Log Storage Method

The ID error log storage method is set in the ID Controller Setup (DM 6655). Set any of the following methods.

1, 2, 3...

1. You can store the most recent 30 ID error log records and discard older records. This is achieved by shifting the records as shown below so that the oldest record (record 1) is lost whenever a new record is generated.



2. You can store only the first 30 ID error log records, and ignore any subsequent errors beyond those 30 (setting = 1).
3. You can disable the log so that no records are stored (setting = 2 to F).

The default setting is the first method. Refer to *ID Error Log Settings* on page 71 for details on the ID Controller Setup for the error log.

If a Memory Cassette without a clock is mounted, the date and time will be all zeros.

Error records will be stored even if pin 1 on the ID Controller's DIP switch is turned ON to protect DM 6144 to DM 6655.

For further details on the ID error log, refer to *9-8 ID Error Logs*.

5-3 ID Communications

Follow the procedures below to use the ID communication functions of the ID Controller.

1, 2, 3...

1. Set the parameters in the ID Controller Setup related to ID communications, including the ID communications mode and the ID communication response refresh method.
2. Setup the Data Carrier parameters.
3. Execute the ladder-diagram program containing the required ID communications instructions. References to these are shown in the following list.

DC READ/AUTOREAD: Page 79
DC WRITE/AUTOWRITE: Page 80
DC CLEAR: Page 82
DC MANAGE DATA: Page 83

5-3-1 ID Communications Mode (DM 6611, Bits 00 to 03)

These settings designate whether the communications distance (setting: 0) or the communications speed (setting: 1) will take precedence in EEPROM Data Carriers (not powered by batteries).

AR 2400 will turn ON if an error is generated by the ID Controller Setup when operation is started (i.e., when power is turned on or after switching to RUN mode).

5-3-2 ID Communication Response Refresh Method (DM 6611, Bits 04 to 07)

This setting specifies one of two ID communication response refresh methods for ID communication instructions.

• Cyclic Refreshes (0)

ID communication response data will be returned once per scan

• Interrupt Refreshes (1)

This setting will cause interrupts to be generated when ID communications response data is returned. Subroutines 004 to 009 in the user program will be executed in response to these interrupts.

IDRD(61):	Subroutine 004
IDWT(62):	Subroutine 005
IDAR(63):	Subroutine 006
IDAW(64):	Subroutine 007
IDCA(65):	Subroutine 008
IDMD(66):	Subroutine 009

AR 2400 will turn ON if an error is generated by the ID Controller Setup when operation is started (i.e., when power is turned on or after switching to RUN mode).

5-3-3 Data Carrier Standby Time (DM 6643)

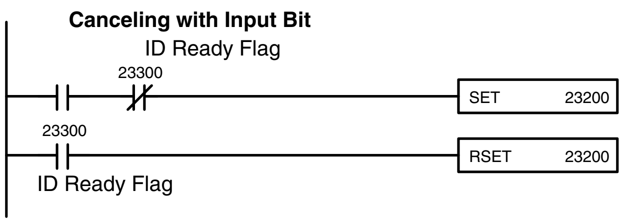
This setting determines the Data Carrier standby time for ID AUTOREAD (IDAR(63)) and ID AUTOWRITE (IDAW(64)). The time is designated between 0001 (0.1 s) to 9999 (999.9 s). Designating 0000, sets continuous standby until a Data Carrier is detected.

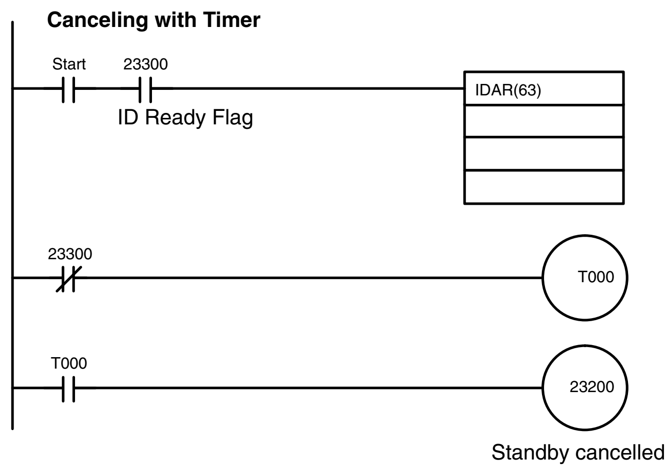
The following error will be generated if an approaching Data Carrier is not detected before the standby time has elapsed.

DC missing error (Error code 72)

AR 2401 will turn ON if an error is generated by the ID Controller Setup when operation is started (i.e., when power is turned on or after switching to RUN mode).

Bit SR 23200 (AUTOREAD/WRITE Cancel Bit) can be manipulated from the program to cancel the standby status when executing CD AUTOREAD/CD AUTOWRITE with a standby setting of 0000 (indefinite standby). The following two examples show two ways this bit can be used.



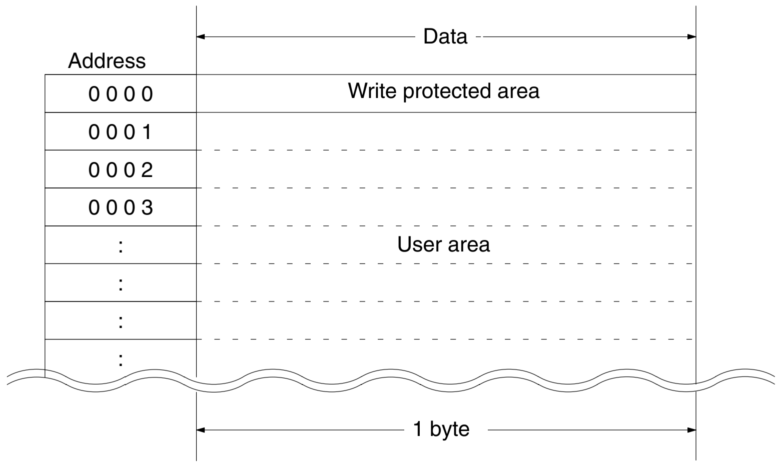


5-3-4 Data Carrier Memory

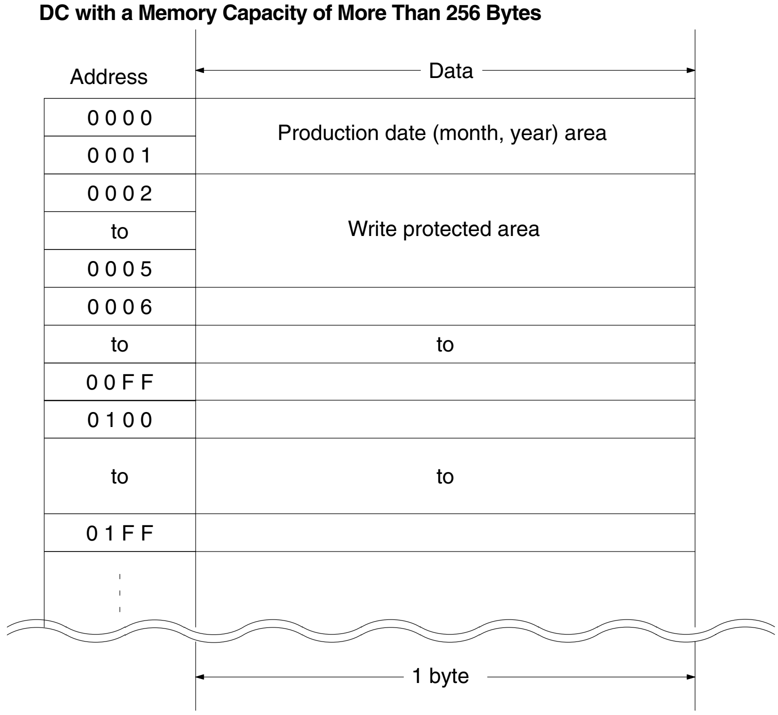
A one byte of data (8 bits) can be written to each address in the Data Carrier.

The way that Data Carrier memory is used depends on its memory capacity. The production month/year area is not available if Data Carrier memory capacity is less than 256 bytes.

DC with a Memory Capacity of 256 Bytes or Less



DC with a Memory Capacity of More Than 256 Bytes



The Data Carrier memory capacities and accessible address ranges are shown in the following table.

Data Carrier	Memory capacity	Address range
V600-D2KR0□	2K bytes	0000 to 07FF
V600-D8KR0□	8K bytes	0000 to 1FFF

Note There are two types of Data Carrier: SRAM Data Carriers, which have built-in batteries, and EEPROM Data Carriers, which do not require batteries. The ID Communications Mode and other settings in the ID Controller Setup depend on the type of Data Carrier being used. The ID Communications Mode in DM 6611 is valid only for EEPROM Data Carriers.

Production Date Area

The production date format is valid for a DC with a memory capacity of more than 256 bytes.

For checking the life of the DC battery, the manufacturer registers the production date in the first two bytes of the memory area immediately prior to shipping the DC from the factory. Data can be read from this area, but cannot be written to it. If a write operation to this area is attempted by mistake, an error message, “7D,” will be issued.

The contents of the production date area is shown in the following table.

Address	Bit							
	7	6	5	4	3	2	1	0
0000	Month, first digit				Month, second digit			
0001	Year, first digit				Year, second digit			

Note 1. The last two digits of the year is used. For example, 92 for 1992.

2. The month is represented by two digits. For example, 03 for March and 10 for October.

Write Protect Function

The write protect function protects important data stored in the memory of the Data Carrier, such as product number and model, from inadvertent write access.

With this function, the data up to a specified memory address can be protected.

Data Carrier capacity	Specification	Write protect setting
256 bytes or less	End address specified.	In 0000 (start address is fixed at 0001)
More than 256 bytes	Start and end address specified.	0002 to 0005

Memory Capacity of 256 Bytes or Less

It is recommended that important data be write-protected as follows:

The write protect function is set in address 0000 of the Data Carrier’s memory. The most significant bit of address 0000 determines whether or not the write protect function is in effect.

Address	Bit							
	7	6	5	4	3	2	1	0
00	YES/ NO	Last 2 digits of end address						

Write protect execution bit (most significant bit of address 0000)
1: Write-protected
0: Not write-protected

The end address can be set between 00 and 7F. Setting the address to 00 protects all bytes from 01 through FD. Setting the address to a value from 01 to 7F protects all bytes from 01 through the specified address. It is not possible to specify an end address between 80 and FF.

Note 1. Address 00 cannot be write-protected.

2. Address 01 is always the starting address of the write-protect area.

Memory Capacity of More Than 256 Bytes
It is recommended that important data be write-protected as follows:

The write protect function is set in addresses 0002 to 0005 of the Data Carrier's memory. The most significant bit of address 0002 determines whether or not the write protect function is in effect.

Address	Bit							
	7	6	5	4	3	2	1	0
0002	YES/ NO	First (leftmost) 2 digits of start address						
0003	Last (rightmost) 2 digits of start address							
0004	First (leftmost) 2 digits of end address							
0005	Last (rightmost) 2 digits of end address							

Write protect execution bit (most significant bit of address 0002)
1: Write-protected
0: Not write-protected

The start address can be set between 0006 and 7FFF. The end address can be set between 0006 and FFFF.

Note
1. If the setting of the end address exceeds the last address in the Data Carrier, protection will still be in effect through the last address.
2. If the start address is larger than the end address, two areas will be protected: from 0006 through the end address and from the start address through the last address in the Data Carrier.

5-3-5 Data Carrier Life Detection Functions

SRAM Data Carriers

A check on the service life of batteries can be executed by reading two bytes of data from an address between 0000 to 0001 of the Data Carrier. After the data is read, the results of the battery check will be reflected in the status of SR 23306 (DC Battery Warning Flag). This flag will be turned ON when the service life of the battery is at an end and will be OFF if the battery is still normal.

The service life of Data Carrier battery is checked by running a fixed current momentarily through the internal circuits of the Data Carrier. The battery thus will be quickly consumed if a service life check of the batteries is executed every time a Data Carrier is accessed. We recommend a routine check once a day in the system program.

⚠ Caution In a service life check on the battery of a Data Carrier that has been sitting around unused for several months, the DC battery service life warning may be ON even if the battery is still serviceable. Therefore, execute a read operation for 10 minutes to activate the batteries before conducting a check on Data Carriers that have been sitting around for an extended amount of time.

EEPROM Data Carriers

The DC MANAGE DATA (IDMD(66)) instruction can be used to determine whether the EEPROM overwrite count has been exceeded.

When the IDMD(66) instruction is executed, the results are reflected in the status of SR 23307 (ID Check Warning Flag).

5-3-6 ID Communications Instructions

The ID communication instructions are shown in the following table.

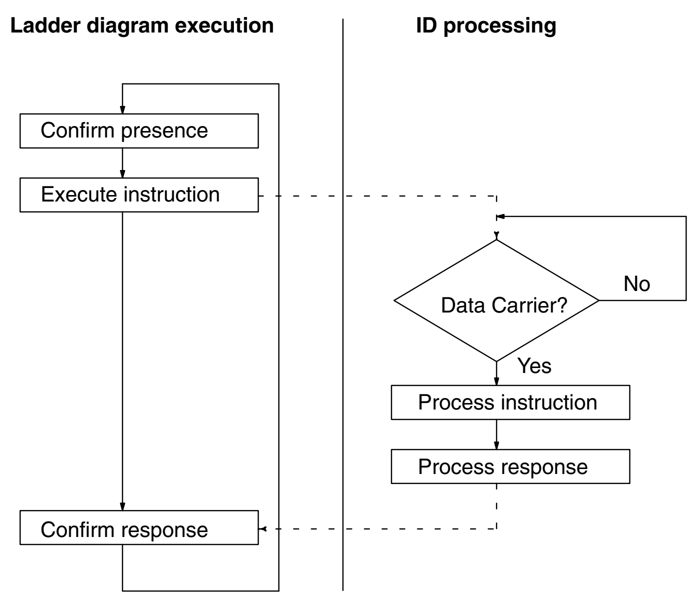
Code	Mnemonic	Name	Function
61	IDRD	DC READ	Reads data from memory in the Data Carrier.
62	IDWT	DC WRITE	Writes data to memory in the Data Carrier.
63	IDAR	DC AUTOREAD	Waits for approach of a Data Carrier and then reads data.
64	IDAW	DC AUTOWRITE	Waits for approach of a Data Carrier and then writes data.
65	IDCA	DC CLEAR	Initializes memory in the Data Carrier with the specified data.
66	IDMD	DC MANAGE DATA	Checks memory in the Data Carrier. Also manages the write life of Data Carriers.

There are two types of ID communications instructions: those executed normally and those executed automatically. These instructions differ in the processing execute start timing for the Data Carrier.

Automatic Execution: IDAR(63) and IDAW(64)

After the instruction is executed, the ID Controller will remain in standby until a Data Carrier is within the communications range of the Read/Write Head, and then processing will be carried out. Execute the instruction before the Data Carrier approaches.

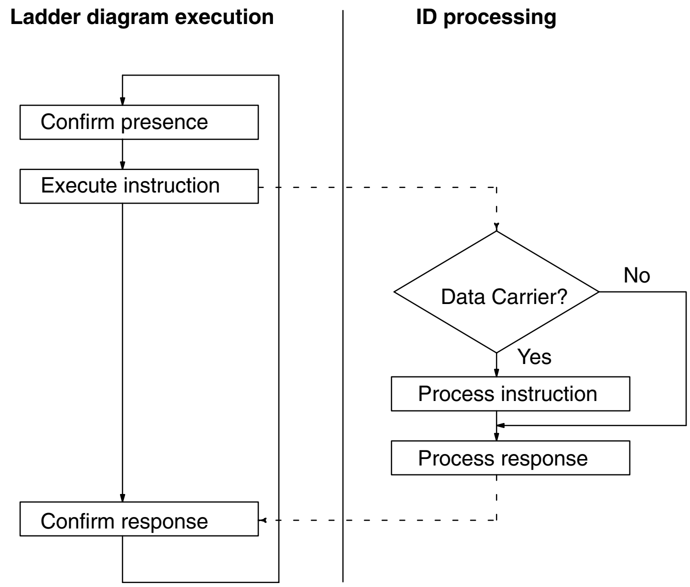
The instruction can be interrupted by turn on the AUTOREAD/WRITE Cancel Flag (SR 23200) when the ID Controller is in the standby mode waiting for a Data Carrier to approach. Standby time can also be set using the Data Carrier Standby Time settings (DM 6643). If a Data Carrier does not approach within the set amount of time, a DC missing error (SR 23308) will be generated.



Automatic execution can be used in systems without synchronized sensors when the Data Carriers do not stop in front of the Read/Write Head.

Normal Execution: IDRD(61), IDWT(62), IDCA(65), and IDMD(66)

When the instruction is executed, processing is carried out only if a Data Carrier is present within the communications range of the Read/Write Head. If no Data Carrier is present, a DC missing error (SR 23308) will be generated. Execute the instruction after making sure that a Data Carrier is present.



Use normal execution when a Data Carrier is stopped in front of the Read/Write Head.

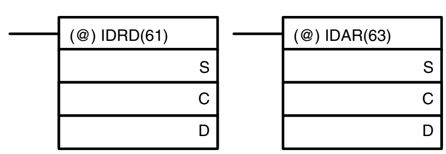
5-3-7 Reading Data Carriers — IDRD(61)/IDAR(63)

The DC READ (IDRD(61)) and DC AUTOREAD (IDAR(63)) instructions are used to read data from a Data Carrier. The maximum amount of data that can be read each time an instruction is executed is 256 bytes.

IDRD(61) reads data from the Data Carrier memory (S: first address) and stores the data in the ID Controller memory (D: first word).

IDAR(63) places execution of the read operation on standby until a Data Carrier is detected. It then reads data from Data Carrier memory and stores the data in the ID Controller.

Using the Instruction



S: First source address in DC (4-digit HEX)
C: Control data (number of bytes)
D: First destination word in ID Controller

Refer to page 134 for further details on control data.

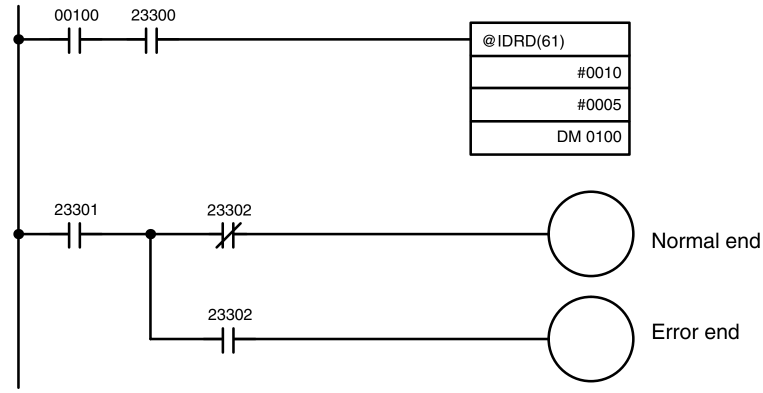
Note Data returned from reads can be processed return once per scan using cyclic refreshes or it can be processed via interrupts generated at the end of communications with the Data Carrier (interrupt refreshes). Set the ID communications response refresh method in DM 6611, bits 04 to 07. With the interrupt refresh method, subroutines 004 to 009 of the user program can be executed.

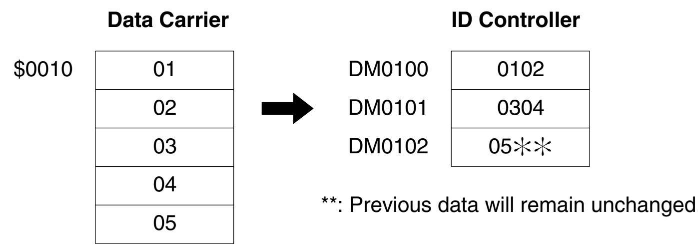
Example

The following example reads five bytes of data starting at address $0010 of the Data Carrier and stores the data starting at DM 0100 in the ID Controller.

If SR 23300 (ID Ready Flag) is ON when input IR 00100 turns ON, 5 bytes of data are read starting from address $0010 to and written starting at DM 0100. The data is stored with the most significant bytes first.

SR 23301 (ID Completed Flag) will turn ON when execution of IDRD(61) has been completed and this will signal either a normal or error end, depending on the status of SR 23302 (ID Communications Error Flag).





5-3-8 Writing Data Carriers — IDWT(62)/IDAW(64)

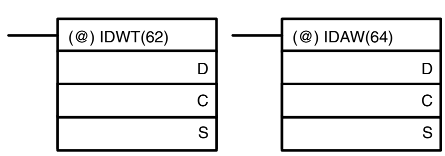
The DC WRITE (IDWT(62)) and DC AUTOWRITE (IDAW(64)) instructions are used to write data to Data Carriers. The maximum amount of data that can be written each time a instruction is executed is 256 bytes.

Data cannot be written to areas that are write-protected. Any attempt to do so will generate a “write protected” error.

IDWT(62) reads data from one or more words (S: first word) of the ID Controller and then writes the data to memory (D: first address) designated in the Data Carrier.

IDAW(64) places execution of the write operation on standby until a Data Carrier is detected. It then reads data from the ID Controller and writes the data to memory in the Data Carrier.

Using the Instruction



D: First destination address in DC (4-digit HEX)
C: Control data (number of bytes)
S: First source word in ID Controller

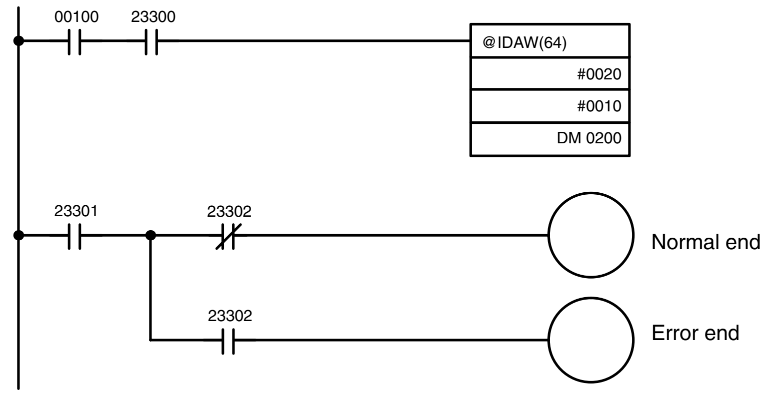
Refer to page 136 for further details on control data.

Example

The following example reads 10 bytes of data between DM 0200 and DM 0204 in the ID Controller and writes the data starting from address $0020 of the Data Carrier.

If SR 23300 (ID Ready Flag) is ON when input IR 00100 turns ON, 10 bytes of data will be read starting from DM 0200 and written to the Data Carrier starting from address $0020. The write operation will be executed when the Data Carrier is detected.

SR 23301 (ID Completed Flag) will turn ON when execution of IDAW(64) has been completed and this will signal either a normal or error end, depending on the status of SR 23302 (ID Communications Error Flag).



ID Controller

DM0200	1122
DM0201	3344
DM0202	5566
DM0203	7788
DM0204	99AA

➡

Data Carrier

$0020	11	$0025	66
$0021	22	$0026	77
$0022	33	$0027	88
$0023	44	$0028	99
$0024	55	$0029	AA

5-3-9 Cancelling DC AUTOREAD and DC AUTOWRITE

The AUTOREAD/WRITE Cancel Bit (SR 23200) is used to cancel read/write operations that are waiting for detection of a Data Carrier when IDAW(64) or IDAR(63) is executed.

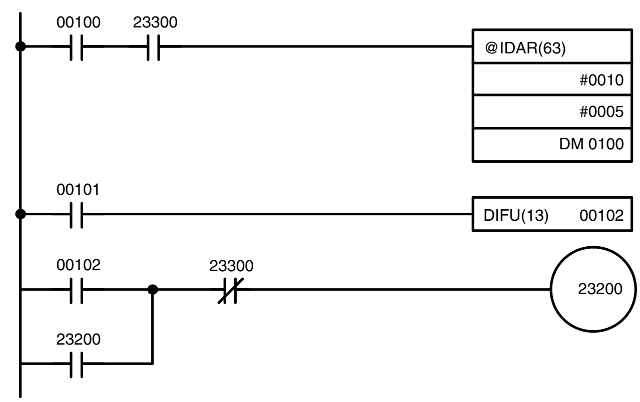
Example

The following example shows how to cancel processing while a read initiated by DC AUTOREAD (IDAR(63)) is in progress for 5 bytes of data starting from address $0010 of the Data Carrier.

If SR 23300 (ID Ready Flag) is ON when input IR 00100 turns ON, IDAR(63) will be executed and execution of the read operation will wait for detection of a Data Carrier.

The AUTOREAD/WRITE Cancel Bit (SR 23200) will turn ON when IR 00101 turns ON, canceling the read operation.

After the read operation is canceled, SR 23300 (ID Ready Flag) will turn ON, turning OFF the AUTOREAD/WRITE Cancel Bit (SR 23200).

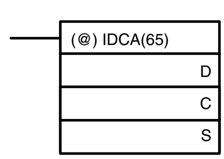


⚠ **Caution** The data at the specified destination word(s) or address(es) will not be overwritten if IDAR(63) or IDAW(64) processing is cancelled.

5-3-10 Clearing Data Carriers — IDCA(65)

The DC CLEAR (IDCA(65)) instruction initializes the memory (D: first address) of the Data Carrier with designated data (S: word or constant). All data in designated user areas will be initialized whether the area is write-protected or not.

Using the Instruction



D: First destination address in DC (4-digit HEX)
C: Control data
(number of bytes; 0000: end of memory)
S: Source word in ID Controller or constant

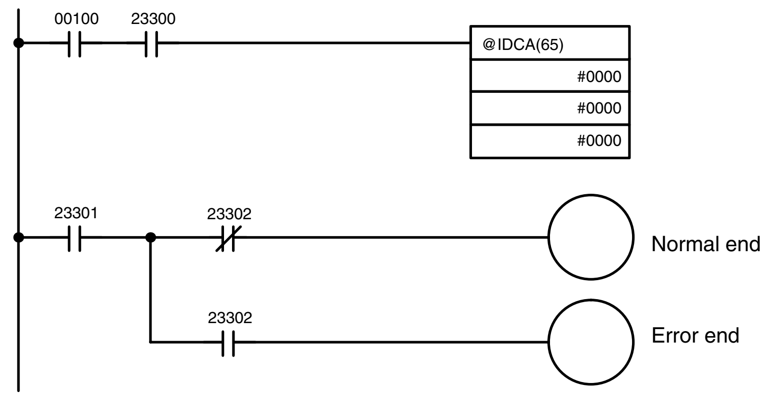
Refer to page 137 for further details on control data.

Example

The following example shows how to initialize all Data Carrier data with $00.

If SR 23300 (ID Ready Flag) is ON when input IR 00100 turns ON, all addresses (i.e., from $0000 to the last address except the production month/year) will be cleared to 00.

SR 23301 (ID Completed Flag) will turn ON when execution of IDCA(65) has been completed and this will signal either a normal or error end, depending on the status of SR 23302 (ID Communications Error Flag).

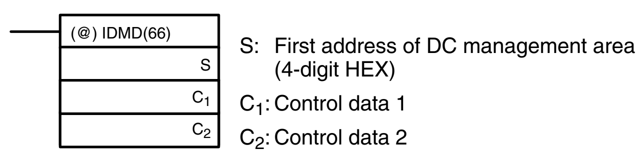


If execution ends normally, all addresses except the production month/year of the Data Carrier will be cleared to 00.

5-3-11 Checking Data Carriers — IDMD(66)

The DC MANAGE DATA (IDMD(66)) instruction has two main functions. It can be used to add a check code to data in the Data Carrier and then again to detect data errors in reading previously written check codes. It can also be used to count the number of times data is written to the Data Carrier in order to manage the writing service life.

Using the Instruction



Refer to page 138 for further details on control data.

Write Count Control

The number of times that data is written to a Data Carrier can be counted in order to manage the writing service life of EEPROM Data Carriers.

IDMD(66) is used to create write count management areas to count the number of times data is written to the most frequently overwritten address in the Data Carrier and is placed immediately after a write instruction for that address. When the instruction is used after writing data several times, the number of times that writing took place can be specified in the control data as an increment to add to the count.

Note With IDMD(66), any overwrite count service life can be managed by setting separate 3-byte write count management areas separate from the area used for the 100,000-cycle overwrite service life.

Counting Modes

The write count mode can be set in the control data. In incremental write count management, the number designated for the incremental/decremental count is added each time IDMD(66) is executed. When the write count management area exceeds 100,000, the ID Check Warning Flag (SR 23307) will turn ON.

In decremental write count management, the write management count is written in the write count management area ahead of time with the write instruction. The number designated by the incremental/decremental count is subtracted each time IDMD(66) is executed. The ID Check Warning Flag (SR 23307) will turn ON when the write count management area reaches 0.

Code Checks

IDMD(66) can also be executed to add a check code to data in the Data Carrier to detect data errors caused by battery service life (SRAM Data Carriers) and overwrite service life (EEPROM Data Carriers). After writing data, IDMD(66) is used to calculate and write check codes after the data.

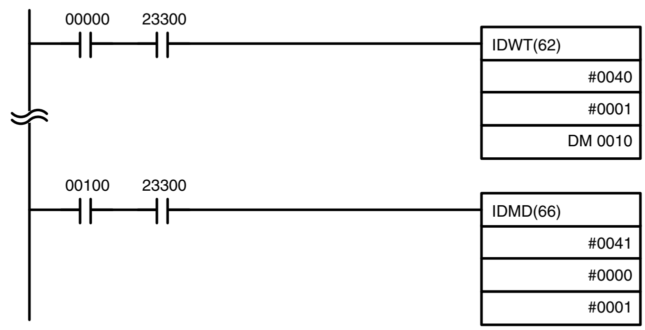
Note The check code is written in the last two bytes of the specified check code calculation area. Do not write data to this area from the user program. CRC ($X^{16} + X^{12} + X^{5} + 1$) is used for error detection.

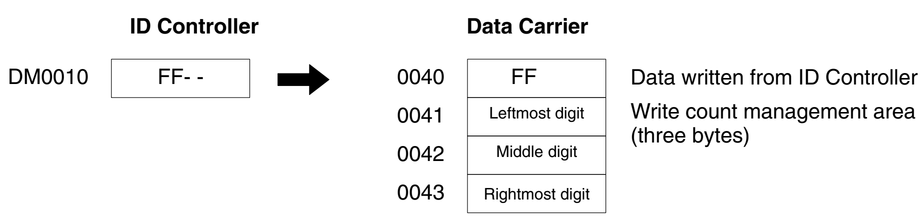
Check codes can be verified before reading previously written data in order to make sure that the data has not been damaged by reaching the service life or other problems. If the check code does not match the one that was written earlier, the ID Check Warning Flag (SR 23307) will turn ON.

Example: Write Count Management

Data is written to DC address $0040 in the Data Carrier.

When IDMD(66) is executed, the count in the address used for write count management ($0041 to $0043) is incremented. When the value in addresses #0041 to $0043 exceeds 100,000, the ID Check Warning Flag (SR 23307) will turn ON.





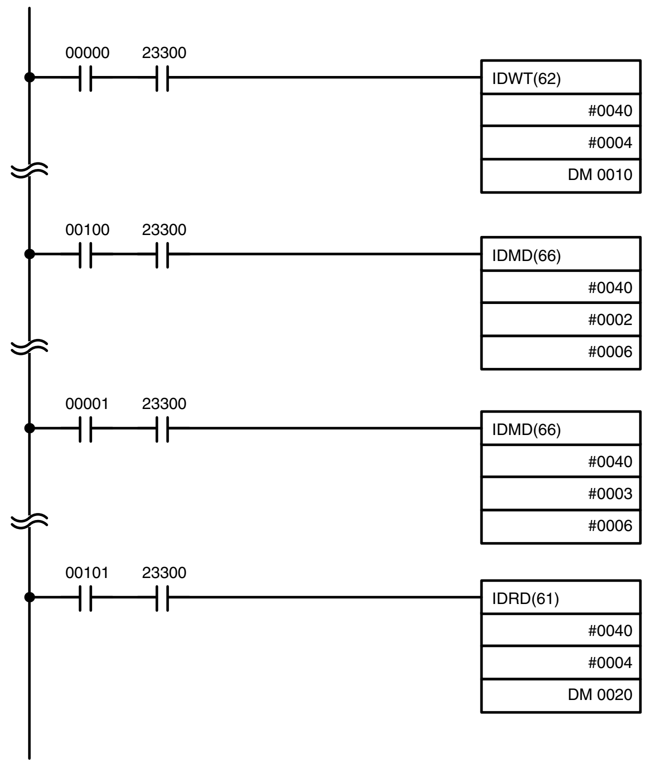
Example: Check Code Verification

Data starting at DM 0010 is written starting at Data Carrier address $0040.

IDMD(66) is executed to calculate the check code for data starting at DC address $0040 (check for 4 bytes written plus 2 bytes for check code) and write the check code to the specified words.

IDMD(66) is then executed again to verify the check code for the 6 bytes starting at $0040 and the last instruction will be executed no errors occur.

Data is read starting from Data Carrier address $0040 and written to DM 0020.



	ID Controller
DM0010	1234
DM0011	5678

➡

	Data Carrier	
$0040	12	Data written from ID Controller (four bytes)
$0041	34	
$0042	56	
$0043	78	
$0043	Leftmost digit	Check code area (two bytes)
$0044	Rightmost digit	

5-3-12 Interrupt Refresh Program

Data returned for ID communications responses resulting from executing ID communications instructions can be processed using interrupts

Example

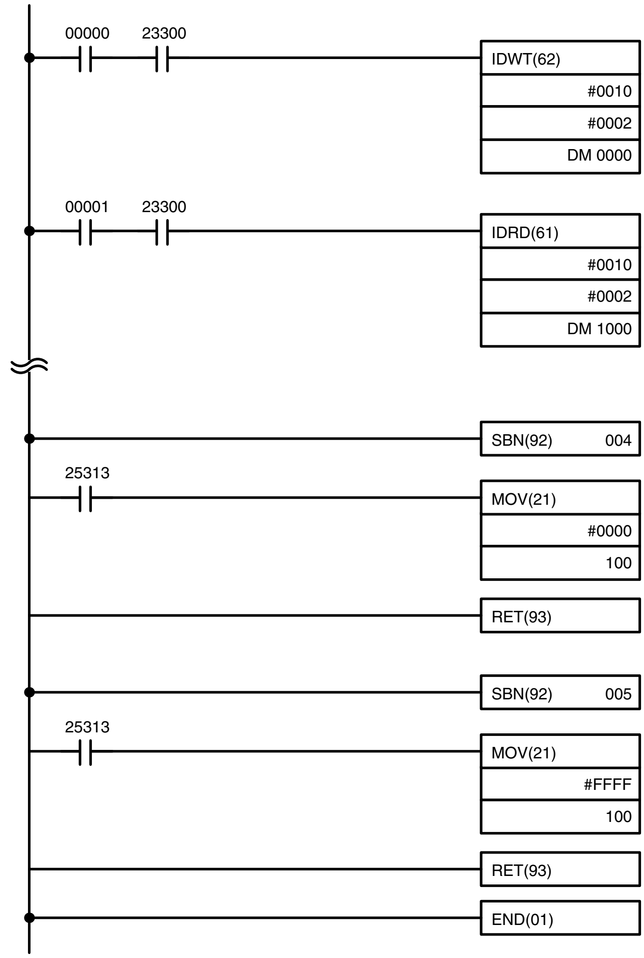
The following example shows how to program interrupts to process data after reading and writing to a Data Carrier.

If SR 23300 (ID Ready Flag) is ON when input IR 00000 turns ON, the IDWT(62) instruction reads two bytes of data starting from DM 0000 and writes it to the Data Carrier starting from address $0010.

If SR 23300 (ID Ready Flag) is ON when input IR 00001 turns ON, two bytes of data are read starting from address $0010 to and written starting at DM 1000.

When the read operation for IDRD(61) has been completed, subroutine 004 (between SBN 004 and the first RET) will be executed.

When the write operation for IDWT(62) has been completed, subroutine 005 (between SBN 005 and the last RET) will be executed.



5-4 Advanced I/O Instructions

Advanced I/O instructions enable control, with a single instruction, of complex operations involving external I/O devices (digital switches, 7-segment displays, etc.). This section introduces advanced I/O instructions. Refer to the *CQM1 Operation Programming Manual* for further details.

There are four advanced I/O instructions, as shown in the following table. All of these are expansion instructions and must be assigned to function codes before they can be used.

Name	Mnemonic	Function
TEN-KEY INPUT	TKY(—)	BCD input from 10-key keypad
HEXADECIMAL KEY INPUT	HKY(—)	Hexadecimal input from 16-key keypad
DIGITAL SWITCH INPUT	DSW(—)	SV input from digital switch
7-SEGMENT DISPLAY OUTPUT	7SEG(—)	BCD output to 7-segment display

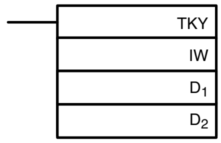
5-4-1 TEN-KEY INPUT – TKY(—)

This instruction inputs 8 digits in BCD from a 10-key keypad and uses 10 input points from 00 though 09.

Hardware

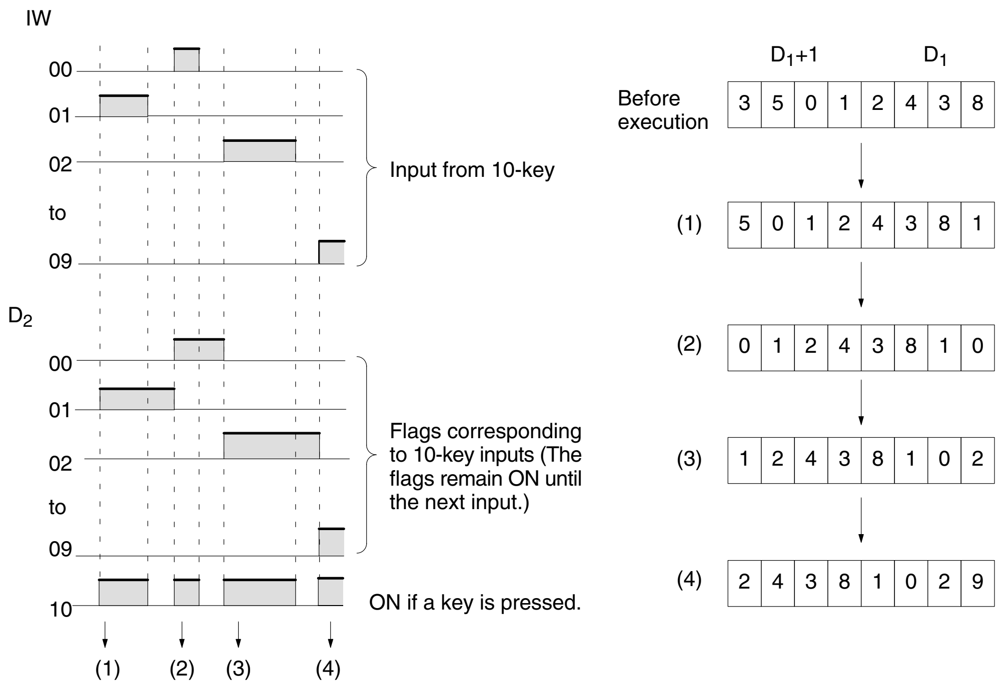
Prepare a 10-key keypad, and connect it so that the switches for numeric keys 0 through 9 are input to points 0 through 9.

Using the Instruction



IW: Input word
D_1: First register word
D_2: Key input word

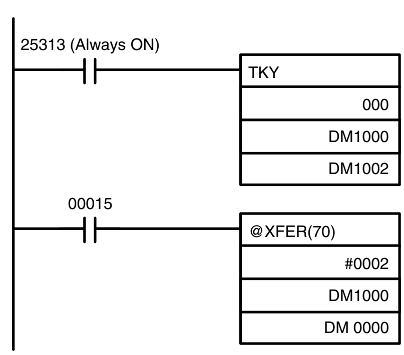
If the input word for connecting the 10-key keypad is specified for IW, then operation will proceed as shown below when the program is executed. (Assume that several numbers have already been entered.)



Note
1. While one key is being pressed, input from other keys will not be accepted.
2. If more than eight digits are input, digits will be deleted beginning with the leftmost digit.
3. Input bits not used here can be used as ordinary input bits.

Application Example

In this example, a program for inputting numbers from the 10-key is shown. Assume that the 10-key is connected to IR 000.



The 10-key information input to IR 000 using TKY(—) is converted to BCD and stored in DM 1000 and DM 1001. Key information is stored in DM 1002.

IR 00015 is used as an “ENTER key,” and when IR 00015 turns ON, the data stored in DM 1000 and DM 1001 will be transferred to DM 0000 and DM 0001.

5-4-2 HEXADECIMAL KEY INPUT – HKY(––)

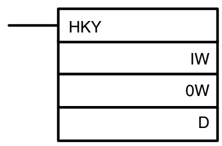
This instruction inputs 8 digits in hexadecimal from a hexadecimal keyboard. It utilizes 5 output bits and 4 input bits of the I/O terminals (sixteen, 24-VDC inputs and sixteen transistor outputs).

⚠ Caution This instruction cannot be used with contact outputs.

Hardware

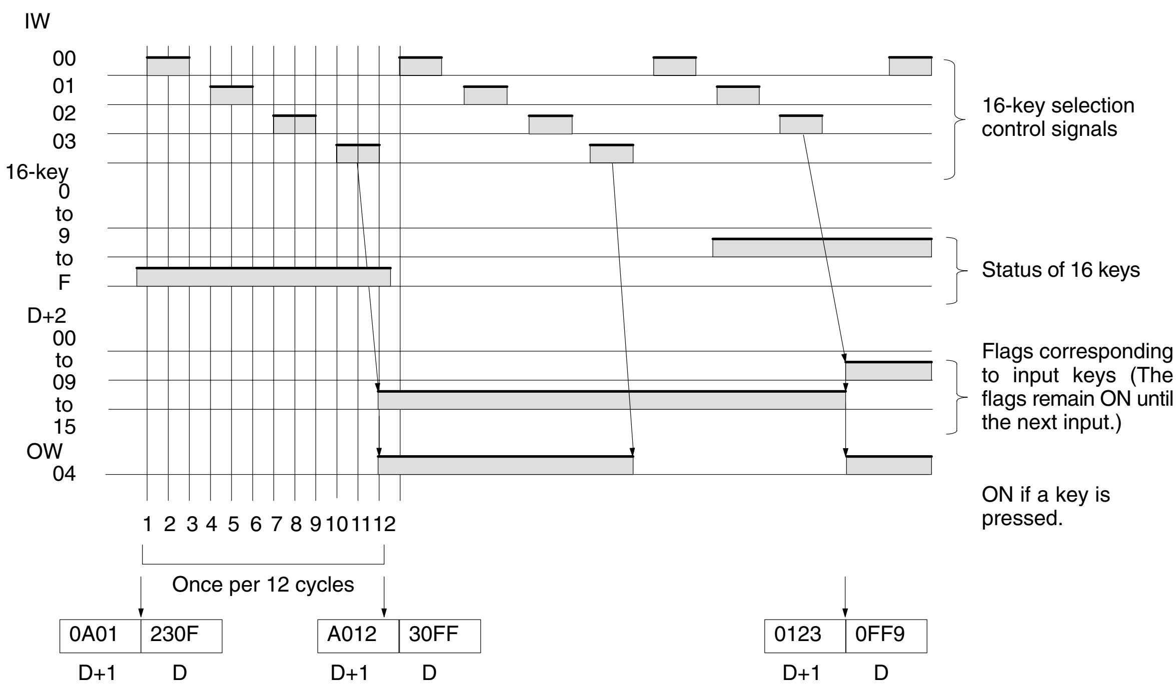
Prepare the hexadecimal keyboard, and connect the 0 to F numeric key switches to input points 0 through 3 and output points 0 through 3. Output point 4 will be turned ON while any key is being pressed, but there is no need to connect it.

Using the Instruction



IW: Input word
OW: Control signal output word
D: First register word

If the input word for connecting the hexadecimal keyboard is specified at IW, and the output word is specified at OW, then operation will proceed as shown below when the program is executed. (Assume that several numbers have already been entered.)



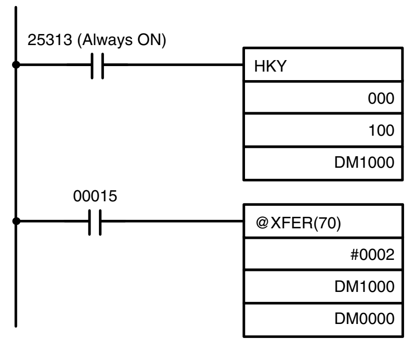
SR 25408 will turn ON while HKY(––) is being executed.

Note
1. Do not use HKY(––) more than once within the same program.
2. When using HKY(––), set the input constant for the relevant input word to less than the cycle time. (Input constants can be changed from DM 6620 onwards.)
3. While one key is being pressed, input from other keys will not be accepted.
4. If more than eight digits are input, digits will be deleted beginning with the leftmost digit.
5. Input and output bits not used here can be used as ordinary input and output bits.

With this instruction, one key input is read in 3 to 12 cycles. More than one cycle is required because the ON keys can only be determined as the outputs are turned ON to test them.

Application Example

This example shows a program for inputting numbers from a hexadecimal keyboard. Assume that the hexadecimal keyboard is connected to IR 000 (input) and IR 100 (output).



The hexadecimal key information that is input to IR 000 by HKY(—) is converted to hexadecimal and stored in words DM1000 and DM1001.

IR 00015 is used as an “ENTER key,” and when IR 00015 turns ON, the numbers stored in DM 1000 and DM 1001 are transferred to DM 0000 and DM 0001.

5-4-3 DIGITAL SWITCH INPUT – DSW(—)

With this instruction, 4-digit or 8-digit set values are read from a digital switch. DSW(—) utilizes 5 output bits and either 4 input bits (for 4 digits) or 8 input bits (for 8 digits) of the I/O terminals (sixteen, 24-VDC inputs and sixteen transistor outputs).

⚠ Caution This instruction cannot be used with contact outputs.

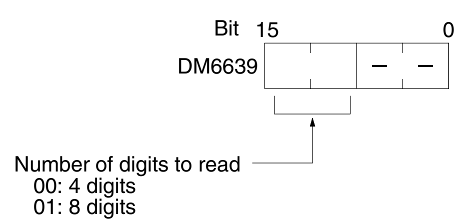
Hardware

Connect the digital switch (e.g., A7E) or thumbwheel switch (e.g., A7B) and I/O terminals. When using a 4-digit input, connect D0 through D3 from the digital switch (least-significant digits) through an interface to input points 0 through 3. When using a 8-digit input, connect D0 through D7 from the digital switch through an interface to input points 0 through 7. The output terminals 0 to 4 are connected to the CS, RD, and similar terminals. In either case, output point 5 will be turned ON when one round of data is read, but there is no need to connect output point 5 unless required for the application.

Preparations

When using DSW(—), make the following setting in the ID Controller Setup in PROGRAM mode before executing the program.

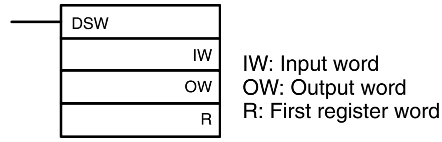
Digital Switch Settings (ID Controller Setup)



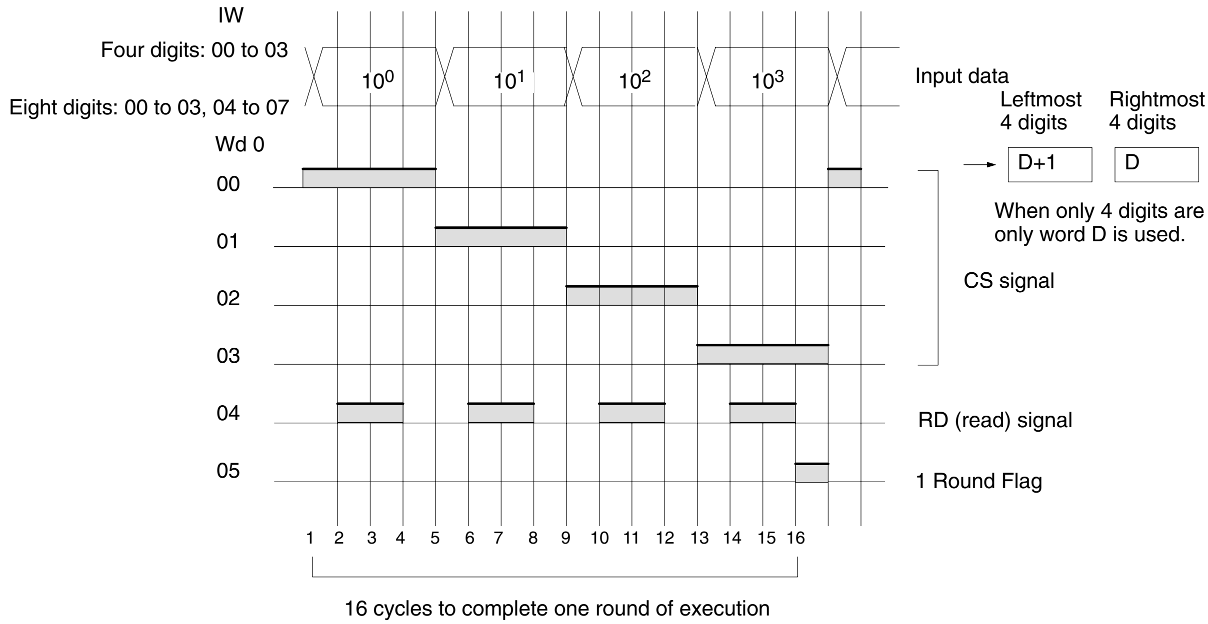
Default: 4 digits

Do not make any changes to bits 0 to 7. They are not related to DSW(—).

Using the Instruction



If the input word for connecting the digital switch is specified at for IW, and the output word is specified for OW, then operation will proceed as shown below when the program is executed.



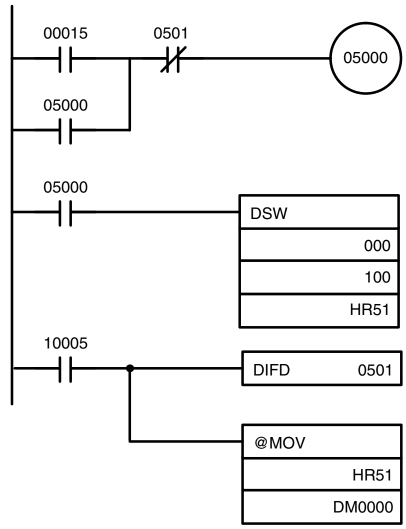
SR 25410 will turn ON while DSW(––) is being executed.

Note
1. Do not use DSW(––) more than once within the same program.
2. When using DSW(––), set the input constant for the relevant input word to less than the cycle time. (Input constants can be changed from DM 6620 onwards.) The characteristics of the digital switch must also be considered in system and program design.
3. Input and output bits not used here can be used as ordinary input and output bits.

With this instruction, 4-digit or 8-digit set values can be read in 16 cycles.

Application Example

This example shows a program for reading 4 digits from the digital switch. Assume that the digital switch is connected to IR 000 (input) and IR 100 (output), and assume the default status for all the ID Controller Setup (4 digits to read).



When IR 00015 turns ON, the IR 05000 will hold itself ON until the One Round Flag (IR 10005) turns ON upon completion of one round of reading by DSW(—).

The data set from the digital switch by DSW(—) is stored in HR 51.

When the One Round Flag (10005) turns ON after reading has been completed, the number stored in HR 51 is transferred to DM 0000.

5-4-4 7-SEGMENT DISPLAY OUTPUT – 7SEG(—)

This instruction outputs word data to a 7-segment display. It utilizes either 8 (for 4 digits) or 12 (for 8 points) output bit of the I/O terminals (sixteen, 24-VDC inputs and sixteen transistor outputs).

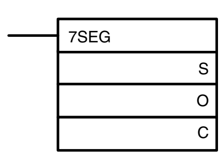
⚠ Caution This instruction cannot be used with contact outputs.

Hardware

The data outputs are connected to output points 0 through 3 for the rightmost four digits and to output points 4 through 7 for the leftmost four digits. The latch outputs are connected to output points 4 through 7 if only four digits are being displayed and to output points 8 through 11 if all eight digits are being displayed. Output point 12 (for 8-digit display) or output point 8 (for 4-digit display) will be turned ON when one round of data is displayed, but there is no need to connect them unless required by the application.

Note Output terminals employ negative logic. The 7-segment display may require either positive or negative logic, depending on the model.

Using the Instruction



S: First source word
O: Output word
C: Control data

If the first word holding the data to be displayed is specified at S, and the output word is specified at O, and the SV taken from the table below is specified at C, then operation will proceed as shown below when the program is executed.

Data Storage Format

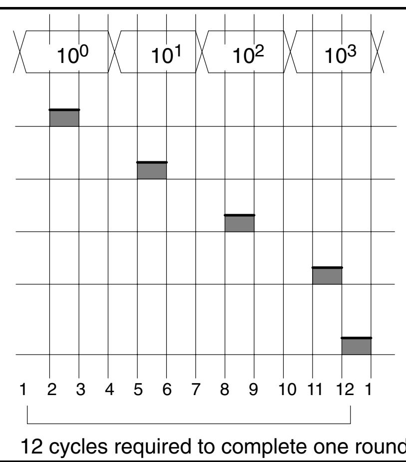
Leftmost 4 digits	Rightmost 4 digits
S+1	S

If only four digits are displayed, then only word S will be used.

Set Values for Selecting Logic and Number of Digits (C)

Number of digits displayed	Display Unit data input and output logic	Display Unit latch input and output logic	C setting data
4 digits (4 digits, 1 block)	Same	Same	000
		Different	001
	Different	Same	002
		Different	003
8 digits (4 digits, 2 blocks)	Same	Same	004
		Different	005
	Different	Same	006
		Different	007

Note Do not set C to values other than 000 to 007.

Function	Bit(s) in O		Output status (Data and latch logic depends on C)
	(4 digits, 1 block)	(4 digits, 2 blocks)	
Data output	00 to 03	00 to 03 04 to 07	 **Note** 0 to 3: Data output for word S 4 to 7: Data output for word S+1
Latch output 0	04	08	
Latch output 1	05	09	
Latch output 2	06	10	
Latch output 3	07	11	
One Round Flag	08	12	

SR 25409 will turn ON while 7SEG(—) is being executed.

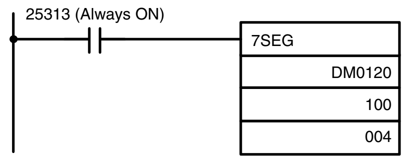
Note
1. Do not use 7SEG(—) more than once within the same program.
2. Consider the cycle time and the characteristics of the 7-segment display when designing the system.
3. Output bits not used here can be used as ordinary output bits.

With this instruction, 4 digits or 8 digits are displayed in 12 cycles.

Operation will proceed from the first execution without regard to the status prior to execution.

Application Example

This example shows a program for displaying the ID Controller's 8-digit BCD numbers at the 7-segment LED display. Assume that the 7-segment display is connected to output word IR 100. Also assume that the output is using negative logic, and that the 7-segment display logic is also negative for data signals and latch signals.



The 8-digit data in DM 0120 (rightmost 4 digits) and DM 0121 (leftmost 4 digits) are always displayed by means of 7SEG(—). When the contents of DM 0120 and DM 0121 change, the display will also change.

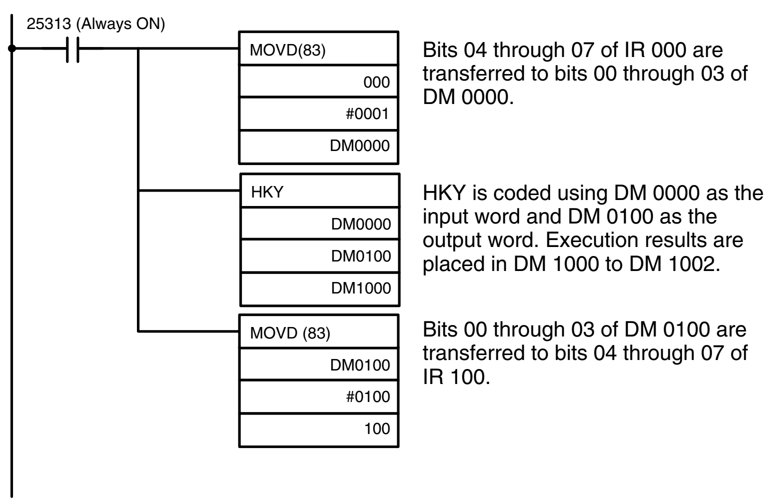
5-4-5 Alternate I/O Bits

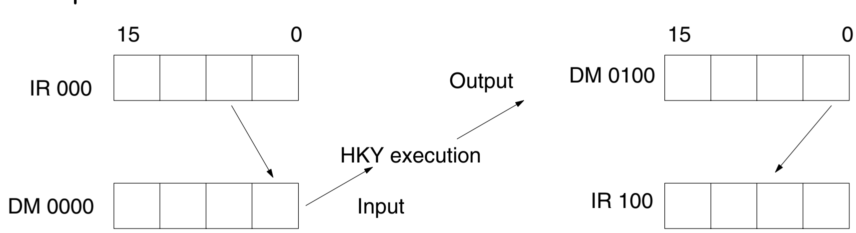
Although the advanced I/O instructions generally using I/O bits starting from bit 00 of the specified words, they can be programmed through intermediate words to use other I/O bits. The following example shows how this can be achieved for HKY(—). Refer to the *CQM1 Programming Manual* for further details.

Example

The following wiring and program examples show how to use input bits IR 00004 through IR 00007 and output bits IR 10004 through IR 10007 to input values from a hexadecimal keypad.

Program





5-5 Using Interrupts

This section explains the settings and methods for using the ID Controller's interrupt functions.

5-5-1 Types of Interrupts

The ID Controller has four types of interrupt processing, as outlined below.

ID Communications Response Interrupts:
Interrupt processing is executed as required to process ID communications.

Input interrupts:
Interrupt processing is executed when an input from an external source turns ON one of ID Controller bits 00000 to 00003.

Interval timer interrupts:
Interrupt processing is executed by an interval timer with a precision of 0.1 ms.

High-speed counter interrupts:
Interrupt processing is executed according to the present value (PV) of a built-in high-speed counter. All ID Controllers are equipped with a high-speed counter, which counts pulse inputs to one of ID Controller bits 00004 to 00006. Two-phase pulses up to 2.5 kHz can be counted.

Interrupt Processing

When an interrupt is generated, the specified interrupt processing routine is executed. Interrupts have the following priority ranking.

1, 2, 3...

1. Input interrupt 0 > Input interrupt 1 > Input interrupt 2 > Input interrupt 3
2. ID communications response interrupt
3. High-speed counter interrupt
4. Interval timer interrupt 0 > Interval timer interrupt 1 > Interval timer interrupt 2 (Interval timer interrupt 2 = high-speed counter interrupt)

When an interrupt with a higher priority is received during interrupt processing, the current processes will be stopped and the newly received interrupt will be processed instead. After that routine has been completely executed, then processing of the previous interrupt will be resumed.

When an interrupt with a lower or equal priority is received during interrupt processing, then the newly received interrupt will be processed as soon as the routine currently being processed has been completely executed.

Just as with ordinary subroutines, interrupt processing routines are defined using SBN(92) and RET(93) at the end of the main program.

When interrupt processing routines are executed, a specified range of input bits can be refreshed.

When an interrupt processing routine is defined, a "no SBS error" will be generated during the program check but execution will proceed normally. If this error occurs, check all normal subroutines to be sure that SBS(91) has been programmed before proceeding.

Pulse Output Instructions and Interrupts

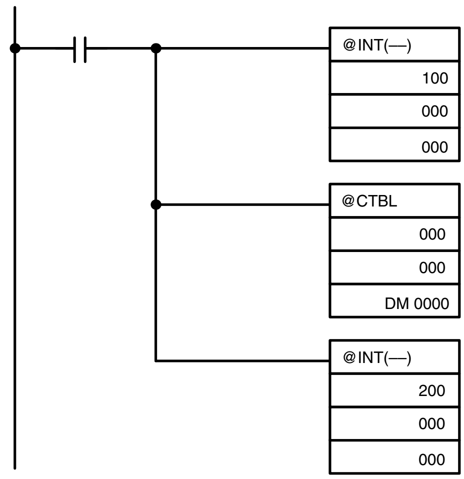
The following instructions will not be executed in an interrupt subroutine when an instruction that controls pulse I/O or high-speed counters is being executed in the main program: (SR 25503 will turn ON)

INI(—), PRV(—), CTBL(—), SPED(—), PULS(—)

The following methods can be used to circumvent this limitation:

Method 1

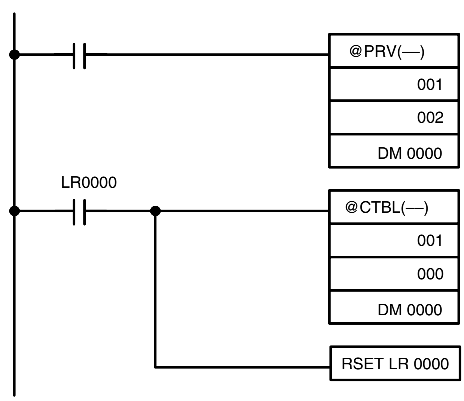
All interrupt processing can be masked while the instruction is being executed.



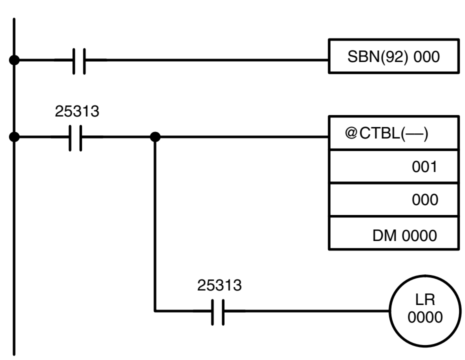
Method 2

Execute the instruction again in the main program.

This is the program section from the main program:



This is the program section from the interrupt subroutine:



5-5-2 ID Communications Response Interrupts

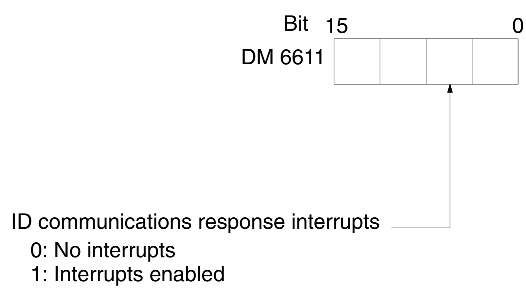
Refreshing interrupts for ID communications responses can be specified in bits 04 to 07 of DM 6611 of the ID Controller Setup to enable the generation of interrupts to process ID communications. Subroutines 004 through 009 are used to process ID communications, with the specific subroutine depending on the instruction that is executed as shown below.

Instruction	Subroutine executed
IDRD(61):	004
IDWT(62):	005
IDAR(63):	006
IDAW(64):	007
IDCA(65):	008
IDMD(66):	009

Using ID communications response interrupts will increase the speed of communications with Data Carriers and will enable executing the appropriate programming (i.e., subroutine) as soon as Data Carrier communications end. This will allow you to process data from Data Carriers immediately using ladder-diagram programming and then write the results back to the Data Carriers without being affected by the scan time of the ID Controller.

ID Controller Setup

To execute subroutines upon completion of ID communications, set the ID communications response refresh method in bit 04 to 07 of DM 6611 to “1.” This setting must be made with the ID Controller in PROGRAM mode before the program is executed. If you do not make this setting, interrupts will not be generated at the completion of ID communications and execution results will be refreshed only once each scan.



Default: No interrupts

Note Subroutines 004 through 009 can be used as normal subroutines if ID communications response interrupts are not being used.

5-5-3 Input Interrupts

The ID Controller’s inputs allocated IR 00000 to IR 00003 can be used for interrupts from external sources. Input interrupts 0 through 3 correspond respectively to these bits and are always used to call the subroutines numbered 000 through 003 respectively. When input interrupts are not used, subroutine numbers 000 to 003 can be used for ordinary subroutines.

Processing

There are two modes for processing input interrupts.

The first is the Input Interrupt Mode, in which the interrupt is carried out in response to an external input. In the Input Interrupt Mode, signals with a length of 100 μs or more can be detected.

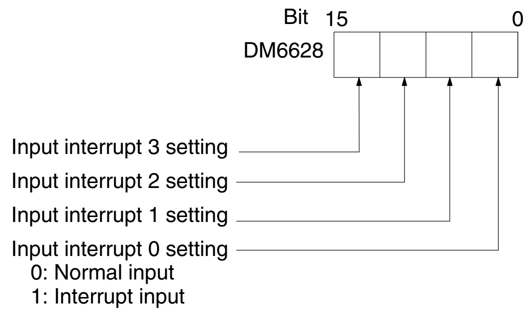
The second is the Counter Mode, in which signals from an external source are counted at high speed, and an interrupt is carried out once for every certain number of signals. In the Counter Mode, signals up to 1 kHz can be counted.

ID Controller Setup

Before executing the program, make the following settings in the ID Controller Setup in PROGRAM mode.

Interrupt Input Settings (DM 6628)

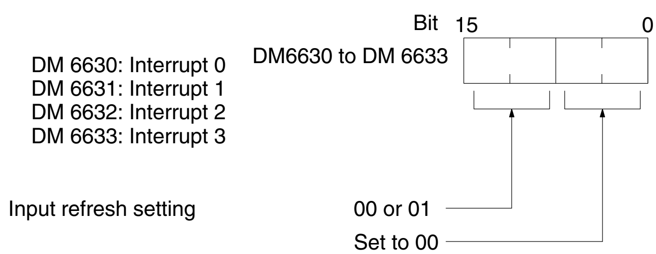
If these settings are not made, interrupts cannot be used in the program.



Default: All normal inputs.

Input Refresh Word Settings (DM 6630 to DM 6633)

Make these settings when it is necessary to refresh inputs.



Default: No input refresh

Example: If DM 6630 is set to 0100, IR 000 will be refreshed when a signal is received for interrupt 0.

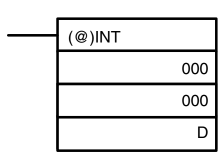
Note If input refreshing is not used, input signal status within the interrupt routine will not be turned ON during execution of the routine. This includes even the status of the interrupt input bit that activated the interrupt. For example, IR 00000 would not be ON in interrupt routine for input interrupt 0 unless it was refreshed (in this case, the Always ON Flag, SR 25313 could be used in place of IR 00000).

Input Interrupt Mode

Use the following instructions to program input interrupts using the Input Interrupt Mode.

Masking of Interrupts

With the INT(—) instruction, set or clear input interrupt masks as required.



Make the settings with the D bits 0 to 3, which correspond to input interrupts 0 to 3.
0: Mask cleared. (Input interrupt permitted.)
1: Mask set. (Input interrupt not permitted.)

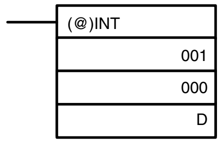
At the beginning of operation, all of the input interrupts are masked and must be unmasked (cleared) to be used.

Clearing Masked Interrupts

If the bit corresponding to an input interrupt turns ON while masked, that input interrupt will be saved in memory and will be executed as soon as the mask is cleared. In order for that input interrupt not to be executed when the mask is cleared, the interrupt must be cleared from memory.

Only one interrupt signal will be saved in memory for each interrupt number.

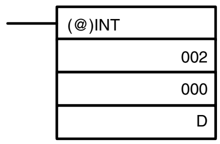
With the INT(—) instruction, clear the input interrupt from memory.



If D bits 0 to 3, which correspond to input interrupts 0 to 3, are set to “1,” then the input interrupts will be cleared from memory.
0: Input interrupt retained.
1: Input interrupt cleared.

Reading Mask Status

With the INT instruction, read the input interrupt mask status.



The status of the rightmost digit of the data stored in word D (bits 0 to 3) show the mask status.
0: Mask cleared. (Input interrupt permitted.)
1: Mask set. (Input interrupt not permitted.)

Counter Mode

Use the following steps to program input interrupts using the Input Interrupt Mode.

Note The SR words used in the Counter Mode (SR 244 to SR 251) all contain binary (hexadecimal) data (not BCD).

1, 2, 3...

1. Write the set values for counter operation to SR words correspond to interrupts 0 to 3. The set values are written between 0000 and FFFF (0 to 65,535). A value of 0000 will disable the count operation until a new value is set and step 2, below, is repeated.

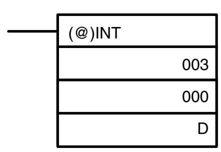
   Note These SR bits are cleared at the beginning of operation, and must be written from the program.

   That maximum input signal that can be counted is 1 kHz.

Interrupt	Word
Input interrupt 0	SR 244
Input interrupt 1	SR 245
Input interrupt 2	SR 246
Input interrupt 3	SR 247

   If the Counter Mode is not used, these SR bits can be used as work bits.

2. With the INT(—) instruction, refresh the Counter Mode set value and enable interrupts.



If D bits 0 to 3, which correspond to input interrupts 0 to 3, are set to “0,” then the set value will be refreshed and interrupts will be permitted.
0: Counter mode set value refreshed and mask cleared.
1: Nothing happens. (Set to 1 the bits for all interrupts that are not being changed.)

The input interrupt for which the set value is refreshed will be enabled in Counter Mode. When the counter reaches the set value, an interrupt will occur, the counter will be reset, and counting/interrupts will continue until the counter is stopped.

Note

1. If the INT(—) instruction is used during counting, the present value (PV) will return to the set value (SV). You must, therefore, use the differentiated form of the instruction or an interrupt may never occur.
2. The set value will be set when the INT(—) instruction is executed. If interrupts are already in operation, then the set value will not be changed just by changing the content of SR 244 to SR 247, i.e., if the contents is changed, the set value must be refreshed by executing the INT(—) instruction again.

Interrupts can be masked using the same process as for the Input Interrupt Mode, but is masked are cleared using the same process, the Counter Mode will not be maintained and the Input Interrupt Mode will be used instead. Interrupt signals received for masked interrupts can also be cleared using the same process as for the Input Interrupt Mode.

Counter PV in Counter Mode

When input interrupts are used in Counter Mode, the counter PV will be stored in the SR word corresponding to input interrupts 0 to 3. Values are 0000 to FFFE (0 to 65,534) and will equal the counter PV minus one.

Interrupt	Word
Input interrupt 0	SR 248
Input interrupt 1	SR 249
Input interrupt 2	SR 250
Input interrupt 3	SR 251

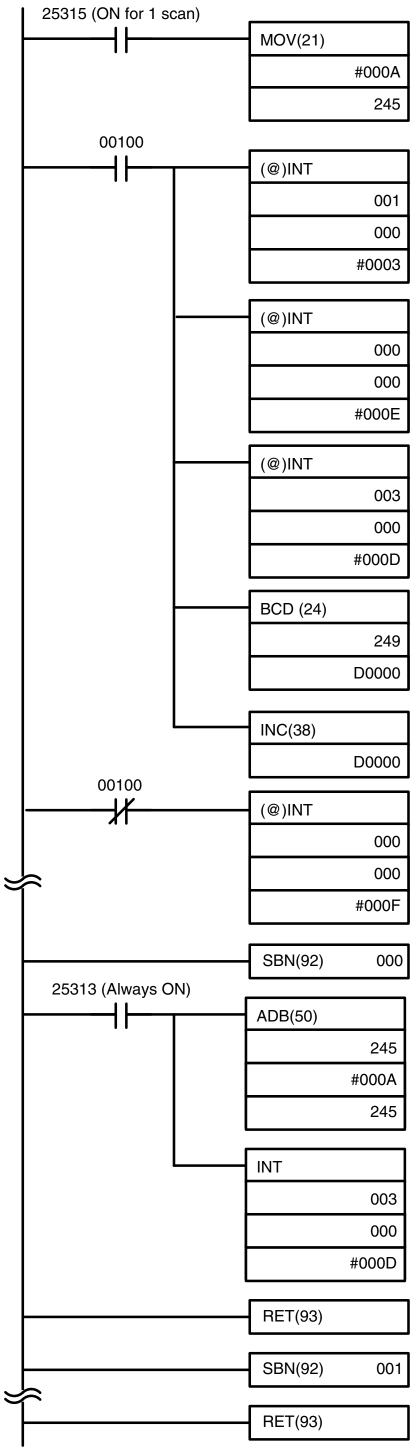
Example: The present value for an interrupt whose set value is 000A will be recorded as 0009 immediately after INT(––) is executed.

Note Even if input interrupts are not used in Counter Mode, these SR bits cannot be used as work bits.

Application Example

In this example, input interrupt 0 is used in Input Interrupt Mode and input interrupt 1 is used in Counter Mode. Before executing the program, check to be sure the ID Controller Setup.

ID Controller Setup: DM 6628: 0011 (IR 00000 and IR 00001 used for input interrupts) The default settings are used for all other ID Controller Setup parameters. (Inputs are not refreshed at the time of interrupt processing.)



Sets 10 as the counter mode SV for input interrupt 1.

When IR 00100 turns ON:
Masked interrupts for input interrupts 0 and 1 are cleared.

Interrupts are enabled in input interrupt mode for interrupt 0.

Interrupts are enabled in counter mode for interrupt 1. (SV: 10)

The contents of SR 249 (PV – 1) are converted to BCD and stored in DM 0000.

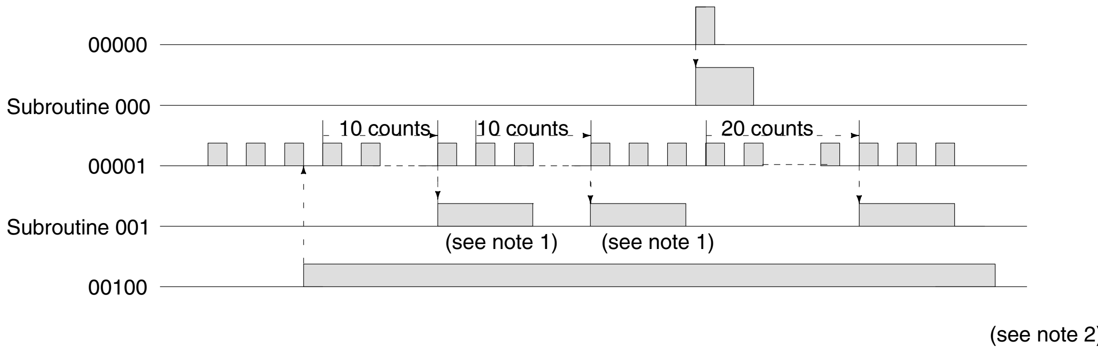
The content to DM 0000 is incremented to the ID Controller.

When IR 00100 turns OFF, input interrupts 0 and 1 are masked and interrupts are prohibited.

When the Input interrupt is executed for interrupt 0, subroutine 000 is called and the counter mode is refreshed with the SV for input interrupt 1 with 10 added (SV = 20)

When the count is reached for the input interrupt 1 counter, subroutine 001 is called and the interrupt processing routine is executed.

When the program is executed, operation will be as shown in the following diagram.



Note
1. The counter will continue operating even while the interrupt routine is being executed.
2. The input interrupt will remained masked.

5-5-4 Masking All Interrupts

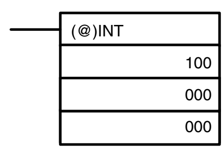
All interrupts, including input interrupts, interval timer interrupts, and high-speed counter interrupts, and ID communications response interrupts, can be masked and unmasked as a group by means of the INT(—) instruction. The mask is in addition to any masks on the individual types of interrupts. Furthermore, clearing the masks for all interrupts does not clear the masks on the individual types of interrupts, but restores them to the masked conditions that existed before INT(—) was executed to mask them as a group.

Do not use INT(—) to mask interrupts unless it is necessary to temporarily mask all interrupts and always use INT(—) instructions in pairs to do so, using the first INT(—) instruction to mask and the second one to unmask interrupts.

INT(—) cannot be used to mask and unmask all interrupts from within interrupt routines.

Masking Interrupts

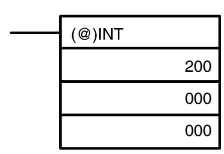
Use the INT instruction to disable all interrupts.



If an interrupt is generated while interrupts are masked, interrupt processing will not be executed but the interrupt will be recorded for the input, interval timer, and high-speed counter interrupts. The interrupts will then be serviced as soon as interrupts are unmasked.

Unmasking Interrupts

Use the INT(—) instruction to unmask interrupts as follows:



5-5-5 Interval Timer Interrupts

High-speed, high-precision timer interrupt processing can be executed using interval timers. The ID Controller provides three interval timers, numbered from 0 to 2.

Note
1. Interval timer 0 cannot be used when pulses are being output by means of the SPED(—) instruction.
2. Interval timer 2 cannot be used at the same time as the high-speed counter.

Processing

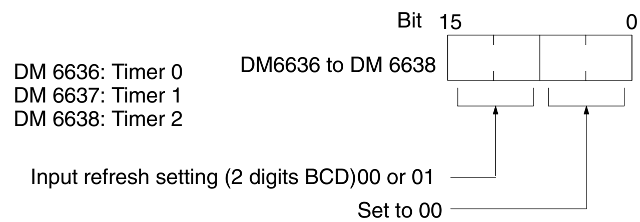
There are two modes for interval timer operation, the One-shot Mode, in which only one interrupt will be executed when time expires, and the Scheduled Interrupt Mode, in which the interrupt is repeated at a fixed interval.

ID Controller Setup

When using interval timer interrupts, make the following settings in the ID Controller Setup in PROGRAM mode before executing the program.

Input Refresh Word Settings (DM 6636 to DM 6638)

Make these settings when it is necessary to refresh inputs.



Default: No input refresh

High-speed Counter Settings (DM 6642)

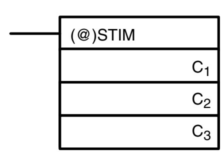
When using interval timer 2, check before beginning operation to be sure that the high-speed counter (ID Controller Setup: DM 6642) is set to the default setting (0000: High-speed counter not used).

Operation

Use the following instruction to activate and control the interval timer.

Starting Up in One-Shot Mode

Use the STIM(—) instruction to start the interval timer in the one-shot mode.



C_1: Interval timer no.

Interval timer 0:	000
Interval timer 1:	001
Interval timer 2:	002

C_2: Timer set value (first word address)

C_3: Subroutine no. (4 digits BCD): 0000 to 0127

C_2: Decrementing counter set value (4 digits BCD): 0000 to 9999
C_2 + 1: Decrementing time interval (4 digits BCD; unit: 0.1 ms): 0005 to 0320 (0.5 ms to 32 ms)

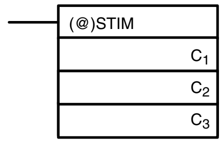
Each time that the interval specified in word C_2 + 1 elapses, the decrementing counter will decrement the present value by one. When the PV reaches 0, the designated subroutine will be called just once and the timer will stop.

The time from when the STIM instruction is executed until time elapses is calculated as follows:
(Contents of word C_2) x (Contents of word C_2 + 1) x 0.1 ms = (0.5 to 319,968 ms)

If a constant is set for C_2, then the set value of the decrementing counter will take that value and the decrementing time interval will be 10 (1 ms). (The set value is expressed in ms.)

Starting Up in Scheduled Interrupt Mode

Use the STIM(—) instruction to start the interval timer in the scheduled interrupt mode.



C_1: Interval timer no.

Interval timer 0:	003
Interval timer 1:	004
Interval timer 2:	005

C_2: Timer set value (leading word no.)

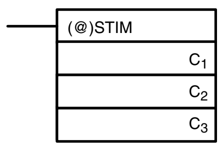
C_3: Subroutine no. (4 digits BCD): 0000 to 0127

C_2: Decrementing counter set value (4 digits BCD): 0000 to 9999
C_2 + 1: Decrementing time interval (4 digits BCD; unit: 0.1 ms): 0005 to 0320 (0.5 ms to 32 ms)

The meanings of the settings are the same as for the one-shot mode, but in the scheduled interrupt mode the timer PV will be reset to the set value and decrementing will begin again after the subroutine has been called. In the scheduled interrupt mode, interrupts will continue to be repeated at fixed intervals until the operation is stopped.

Reading the Timer's Elapsed Time

Use the STIM(—) instruction to read the timer's elapsed time.



C_1: Interval timer no.

Interval timer 0:	006
Interval timer 1:	007
Interval timer 2:	008

C_2: Leading word of parameter 1

C_3: Parameter 2

C_2:	Number of times counter has been decremented (4 digits BCD)
C_2 + 1:	Decrementing counter time interval (4 digits BCD; unit: 0.1 ms)
C_3:	Time since previous decrement (4 digits BCD; unit: 0.1 ms)

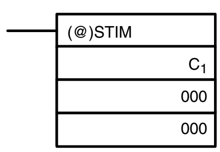
The time from when the interval timer is started until the execution of this instruction is calculated as follows:

{(Contents of word C2) x (Contents of word C2 + 1) + (Contents of word C3)} x 0.1 ms

If the specified interval timer is stopped, then "0000" will be stored.

Stopping Timers

Use the STIM(—) instruction to stop the interval timer.



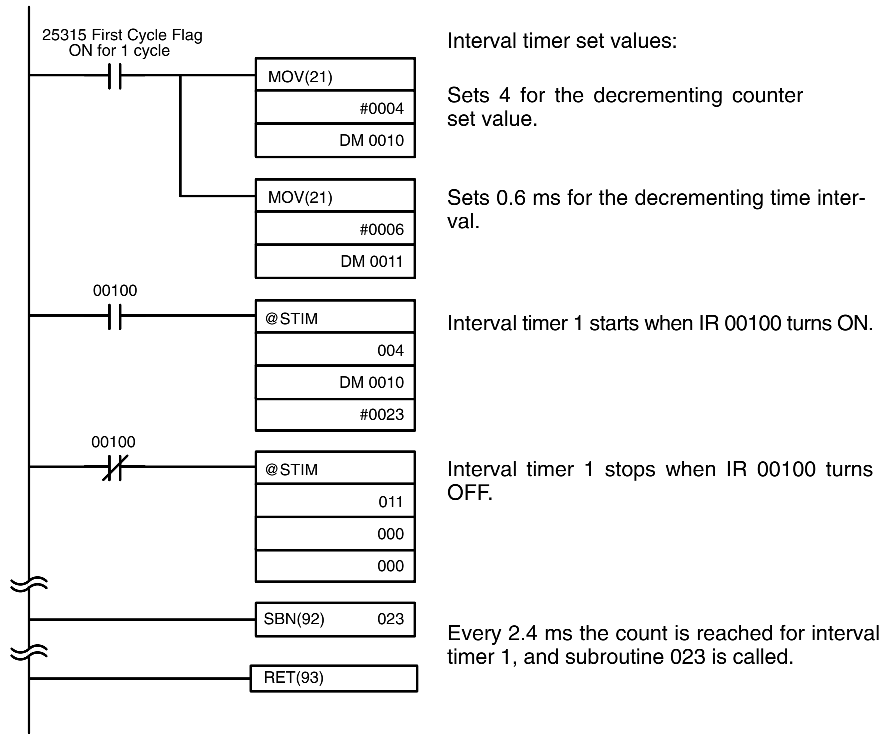
C_1: Interval timer no.

Interval timer 0:	010
Interval timer 1:	011
Interval timer 2:	012

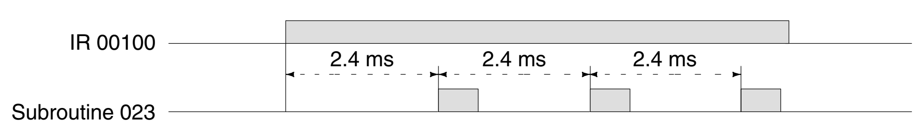
The specified interval timer will stop.

Application Example

In this example, an interrupt is executed every 2.4 ms (0.6 ms x 4) by means of interval timer 1. Assume the default settings for all of the ID Controller Setup. (Inputs are not refreshed for interrupt processing.)



When the program is executed, subroutine 023 will be executed every 2.4 ms while IR 00100 is ON.



5-5-6 High-speed Counter Interrupts

Pulse signals from a pulse encoder to ID Controller bits 00004 through 00006 can be counted at high speed, and interrupt processing can be executed according to the count.

Note Refer to the *CQM1 Programming Manual* for further details on instructions.

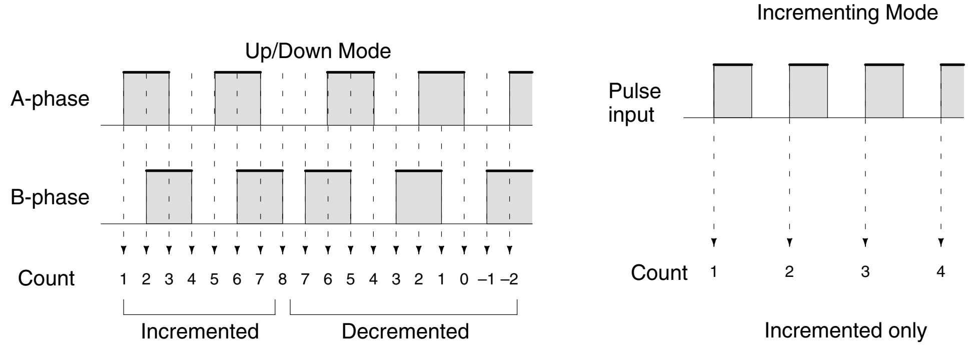
Processing

Input Signal Types and Count Modes

Two types of signals can be input from a pulse encoder. The count mode used for the high-speed counter will depend on the signal type.

Up/Down Mode: A phase-difference 4X two-phase signal (A-phase and B-phase) and a Z-phase signal are used for inputs. The count is incremented or decremented according to differences in the 2-phase signals.

Incrementing mode: One single-phase pulse signal and a count reset signal are used for inputs. The count is incremented according to the single-phase signal.



Note 1. The count will go to 0FFFFFFF for overflows and FFFFFFFF for underflows and counting and comparisons will stop (although comparison table data will remain).

2. One of the methods in the following section should always be used to reset the counter when restarting it. The counter will be automatically reset when program execution is started or stopped.

The following signal transitions are handled as forward (incrementing) pulses: A-phase leading edge to B-phase leading edge to A-phase trailing edge to B-phase trailing edge. The following signal transitions are handled as reverse (decrementing) pulses: B-phase leading edge to A-phase leading edge to B-phase trailing edge to A-phase trailing edge.

The count range is from –32,767 to 32,767 for Up/Down Mode, and from 0 to 65,535 for Incrementing Mode. Pulse signals can be counted at up to 2.5 kHz in Up/Down Mode, and up to 5.0 kHz in Incrementing Mode.

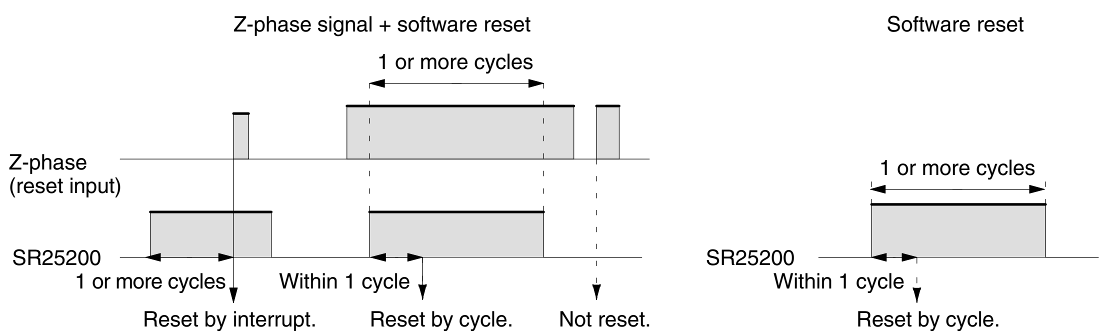
The Up/Down Mode always uses a 4X phase-difference input. The number of counts for each encoder revolution would be 4 times the resolution of the counter. Select the encoder based on the countable ranges.

Reset Methods

Either of the two methods described below may be selected for resetting the PV of the count (i.e., setting it to 0).

Z-phase signal + software reset: The PV is reset when the Z-phase signal (reset input) turns ON after the High-speed Counter Reset Bit (SR 25200) is turned ON.

Software reset: The PV is reset when the High-speed Counter Reset Bit (SR 25200) is turned ON.



Note 1. The High-speed Counter Reset Bit (SR 25200) is refreshed once every cycle, so in order for it to be read reliably it must be ON for at least one cycle.

2. The comparison table, comparison execution status, and range comparison results data will be preserved when the counter is reset, allowing execution to continue from the same condition as before being reset.

The “Z” in “Z-phase” is an abbreviation for “Zero.” It is a signal that shows that the encoder has completed one cycle.

High-speed Counter Interrupt Count

For high-speed counter interrupts, a comparison table is used instead of a “count up.” The count check can be carried out by either of the two methods described below. In the comparison table, comparison conditions (for comparing to the PV) and interrupt routine combinations are saved.

Target value: A maximum of 16 comparison conditions (target values and count directions) and interrupt routine combinations are saved in the comparison table. When the counter PV and the count direction match the comparison conditions, then the specified interrupt routine is executed.

Range comparison: Eight comparison conditions (upper and lower limits) and interrupt routine combinations are saved in the comparison table. When the PV is greater than or equal to the lower limit and less than or equal to the upper limit, then the specified interrupt routine is executed.

Wiring

Depending on the count mode, the input signals from the pulse encoder to the ID Controller’s input terminal are as shown below.

Terminal no.	Up/Down Mode	Incrementing Mode
4	Encoder A-phase	Pulse count input
5	Encoder B-phase	---
6	Encoder Z-phase	Reset input

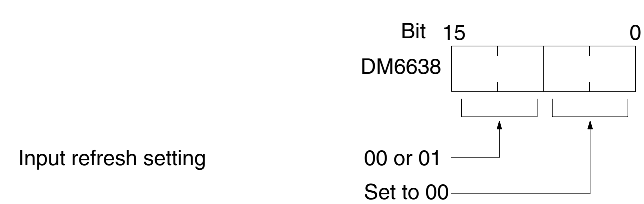
If only the software reset is to be used, terminal 6 can be used as an ordinary input. When in Incrementing Mode, terminal 5 can be used as an ordinary input.

ID Controller Setup

When using high-speed counter interrupts, make the settings in PROGRAM mode shown below before executing the program.

Input Refresh Word Settings (DM 6638)

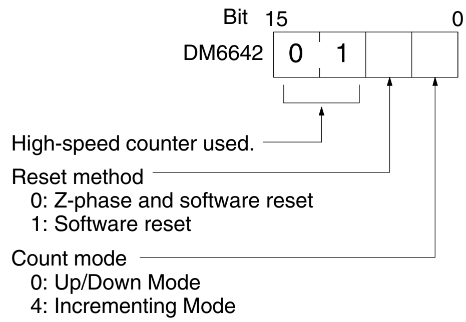
Make these settings when it is necessary to refresh inputs. The setting is the same as that for interval timer 2.



Default: No input refresh

High-speed Counter Settings (DM 6642)

If these settings are not made, the high-speed counter cannot be used in the program.



Default: High-speed counter not used.

Changes in the setting in DM 6642 are effective only when power is turned on or ID Controller program execution is started.

Programming

Use the following steps to program the high-speed counter.

The high-speed counter begins the counting operation when the proper ID Controller Setup settings are made, but comparisons will not be made with the comparison table and interrupts will not be generated unless the CTBL(—) instruction is executed.

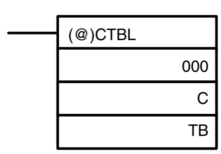
The high-speed counter is reset to “0” when power is turned ON, when operation begins.

The present value of the high-speed counter is maintained in SR 230 and SR 231.

Controlling High-speed Counter Interrupts

1, 2, 3...

1. Use the CTBL(—) instruction to save the comparison table in the ID Controller and begin comparisons.



C: (3 digits BCD)
000: Target table set and comparison begun
001: Range table set and comparison begun
002: Target table set only
003: Range table set only

TB: Beginning word of comparison table

If C is set to 000, then comparisons will be made by the target matching method; if 001, then they will be made by the range comparison method. The comparison table will be saved, and, when the save operation is complete, then comparisons will begin. While comparisons are being executed, high-speed counter interrupts will be executed according to the comparison table.

Note The comparison results are stored in AR 1100 through AR 1107 while the range comparison is being executed.

If C is set to 002, then comparisons will be made by the target matching method; if 003, then they will be made by the range comparison method. For either of these settings, the comparison table will be saved, but comparisons will not begin, and the INI(—) instruction must be used to begin comparisons.

The following diagram shows the structure of a target value comparison table for use with the high-speed counter.

TB	Number of target values (BCD)	0001 to 0016
TB+1	Target value #1, lower 4 digits (BCD)	One target value setting
TB+2	Target value #1, upper 4 digits (BCD)	
TB+3	Subroutine number (See note.)	
⋮	⋮ ⋮ ⋮	

Note The subroutine number can be F000 to F127 to activate the subroutine when decrementing and 0000 to 0127 to activate the subroutine when incrementing.

The following diagram shows the structure of a range comparison table for use with the high-speed counter.

TB	Lower limit #1, lower 4 digits (BCD)	First range setting
TB+1	Lower limit #1, upper 4 digits (BCD)	
TB+2	Upper limit #1, lower 4 digits (BCD)	
TB+3	Upper limit #1, upper 4 digits (BCD)	
TB+4	Subroutine number (See note 1.)	
⋮	⋮ ⋮ ⋮	
TB+35	Lower limit #8, lower 4 digits (BCD)	Eighth range setting
TB+36	Lower limit #8, upper 4 digits (BCD)	
TB+37	Upper limit #8, lower 4 digits (BCD)	
TB+38	Upper limit #8, upper 4 digits (BCD)	
TB+39	Subroutine number (See note.)	

Note The subroutine number can be 0000 to 0127 and the subroutine will be executed as long as the counter's PV is within the specified range. A value of FFFF indicates that no subroutine is to be executed.

2. To stop comparisons, execute the INI(—) instruction as shown below.

(@)INI
000
001
000

To start comparisons again, set the second operand to "000" (execute comparison), and execute the INI(—) instruction.

Once a table has been saved, it will be retained in the ID Controller during operation (i.e., during program execution) as long as no other table is saved.

Reading the PV

There are two ways to read the PV. The first is to read it from SR 230 and SR 231, and the second to use the PRV(—) instruction.

Reading SR 230 and SR 231

The PV of the high-speed counter is stored in SR 230 and SR 231 as shown below. The leftmost bit will be F for negative values.

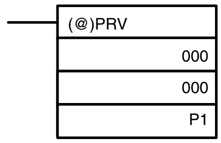
Leftmost 4 digits	Rightmost 4 digits	Up/Down Mode	Incrementing Mode
SR 231	SR 230	F0032767 to 00032767 (–32767)	00000000 to 00065535

Note These words are refreshed only once every cycle, so there may be a difference from the actual PV. The PRV(—) instruction will provide more accurate results.

When the high-speed counter is not being used, the bits in these words can be used as work bits.

Using the PRV(—) Instruction

Read the PV of the high-speed counter by using the PRV(—) instruction.



P1: Leading word of PV

The PV of the high-speed counter is stored as shown below. The leftmost bit will be F for negative values.

Leftmost 4 digits	Rightmost 4 digits	Up/Down Mode	Incrementing Mode
P1+1	P1	F0032767 to 00032767 (–32767)	00000000 to 00065535

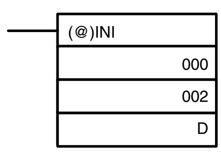
The PV is read when the PRV(—) instruction is actually executed.

Changing the PV

There are two ways to change the PV of the high-speed counter. The first way is to reset it by using the reset methods. (In this case the PV is reset to 0.) The second way is to use the INI(—) instruction.

The method using the INI instruction is explained here. For an explanation of the reset method, refer to the beginning of this description of the high-speed counter.

Change the counter PV by using the INI(—) instruction as shown below.



D: Leading word for storing PV change data

Leftmost 4 digits	Rightmost 4 digits	Up/Down Mode	Incrementing Mode
D+1	D	F0032767 to 00032767	00000000 to 00065535

To specify a negative number, set F in the leftmost digit.

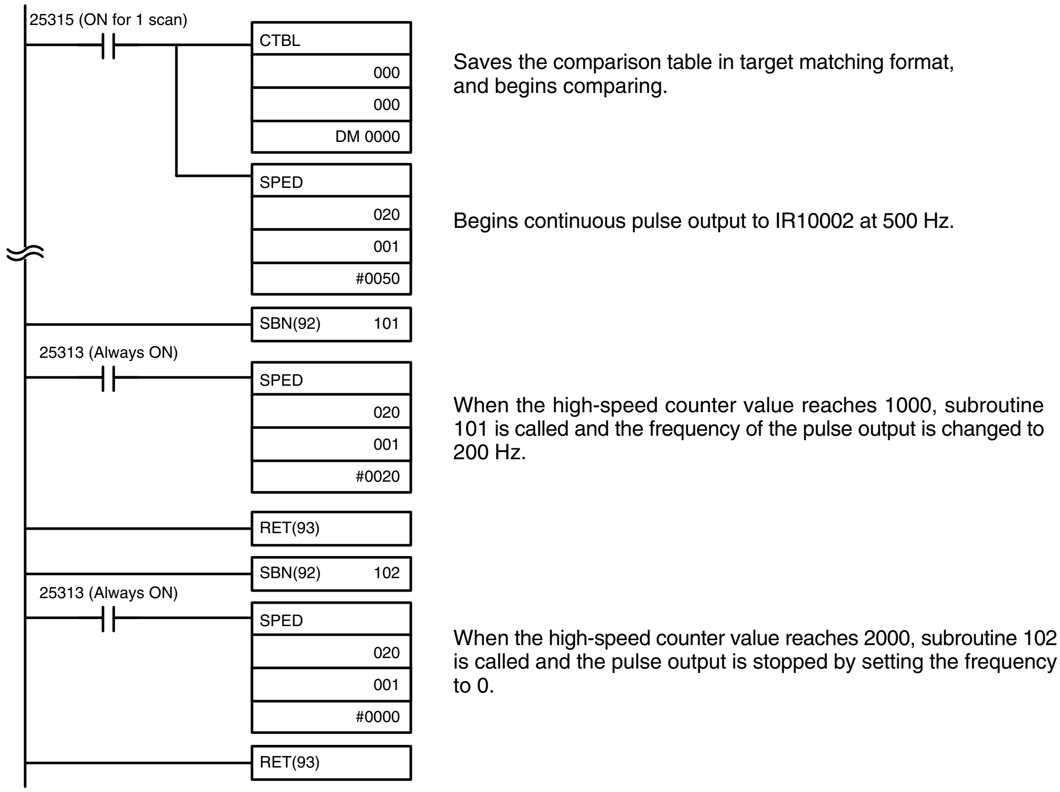
Operation Example

This example shows a program for using the high-speed counter in the Incrementing Mode, making comparisons by means of the target matching method, and changing the frequency of pulse outputs according to the counter's PV. Before executing the program, set the ID Controller Setup as follows:

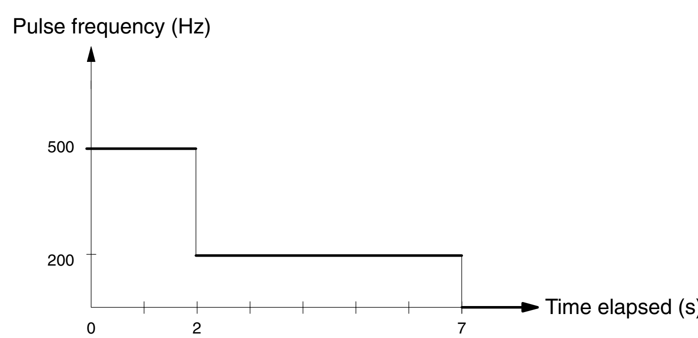
DM 6642: 0114 (high-speed counter used with software reset and Incrementing Mode). For all other ID Controller Setup, use the default settings. (Inputs are not refreshed at the time of interrupt processing, and pulse outputs are executed for IR 100.)

In addition, the following data is stored for the comparison table:

DM 0000	0002	Number of comparison conditions: 2
DM 0001	1000	Target value 1: 1000
DM 0002	0000	
DM 0003	0101	Comparison 1 interrupt processing routine no.: 101
DM 0004	2000	Target value 1: 2000
DM 0005	0000	
DM 0006	0102	Comparison 2 interrupt processing routine no.: 102



When the program is executed, operation will be as follows:



5-6 Communications

The following types of communications can be executed through the ports of the ID Controller.

- Host link communications with a host computer
- RS-232C communications with a computer or other device
- One-to-one link communications with another ID Controller
- NT links with Programmable Terminals

This section explains the required ID Controller Setup and methods for using these types of communications.

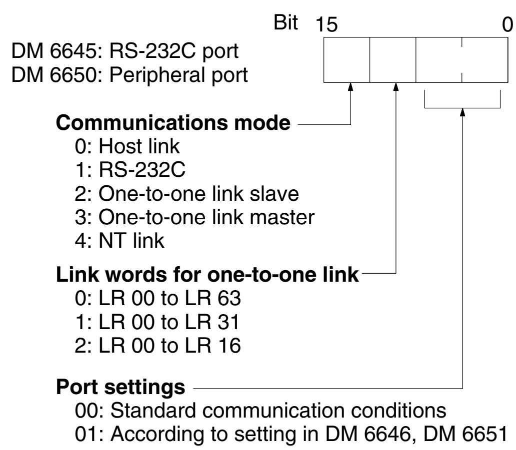
5-6-1 ID Controller Setup

The ID Controller Setup parameters in DM 6645 through DM 6654 are used to set parameters for the communications ports. The parameters for the RS-232C port in DM 6645 through DM 6649 can be set from menu operations using the LSS/SSS.

Note If pin 5 on the ID Controller's DIP switch is turned ON, the ID Controller Setup communications parameters will be ignored and the following parameters will be used.

Mode:	Host link
Node number:	00
Start bits:	1 bit
Data length:	7 bits
Stop bits:	1 bit
Parity:	Even
Baud rate:	2,400 bps
Transmission delay:	None

The settings in DM 6645 and DM 6650 determine the main communications parameters, as shown in the following diagram.



Default: Host link using standard parameters

Note Settings 2 through 4 of the Communications Mode can be used only for the RS-232C port.

5-6-2 Host Link and RS-232C Communications Parameters

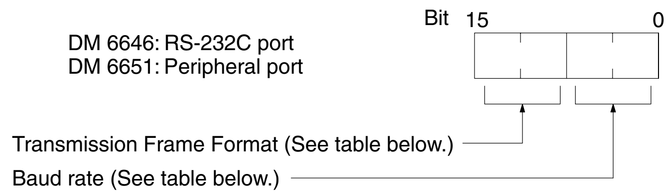
Select either host link or RS-232C communications and then set the communications parameters as described next. Match the communications conditions to the settings at the device with which communications are being carried out.

Standard Communications

If the following settings are satisfactory for these communications conditions, then set the two rightmost digits to 00. The settings in DM 6646 and DM 6651 will be ignored for this setting.

Start bits:	1 bit
Data length:	7 bits
Stop bits:	2 bits
Parity:	Even
Baud rate:	9,600 bps

Setting Communications Conditions



Default: Standard communication conditions.

Transmission Frame Format

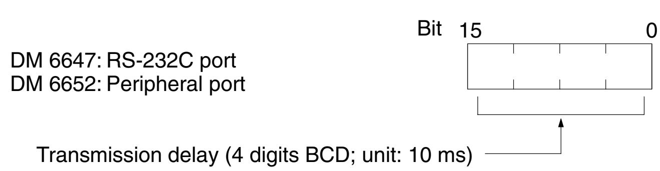
Setting	Stop bits	Data length	Stop bits	Parity
00	1	7	1	Even
01	1	7	1	Odd
02	1	7	1	None
03	1	7	2	Even
04	1	7	2	Odd
05	1	7	2	None
06	1	8	1	Even
07	1	8	1	Odd
08	1	8	1	None
09	1	8	2	Even
10	1	8	2	Odd
11	1	8	2	None

Baud Rate

Setting	Baud rate
00	1,200 bps
01	2,400 bps
02	4,800 bps
03	9,600 bps
04	19,200 bps

Transmission Delay Time

Depending on the devices connected to the RS-232 port, it may be necessary to allow time for transmission. When that is the case, set the transmission delay to regulate the amount of time allowed.



Default: No delay

Resetting Ports

To reset the RS-232C port (i.e., to restore the initial status), turn ON SR 25209. To reset the peripheral port, turn ON SR 25208. These bits will turn OFF automatically after the reset.

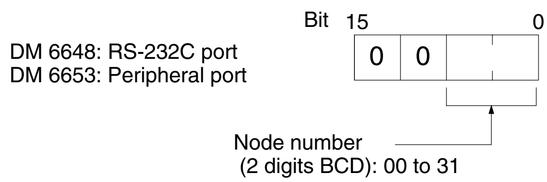
5-6-3 Host Link Communications

Host link communications were developed by OMRON for the purpose of connecting ID Controllers and one or more host computers by RS-232C cable, and controlling ID Controller communications from the host computer. Normally the host computer issues a command to a ID Controller, and the ID Controller automatically sends back a response. Thus the communications are carried out without the ID Controllers being actively involved. The ID Controllers also have the ability to initiate data transmissions when direct involvement is necessary.

In general, there are two means for implementing host link communications. One is based on C-mode commands, and the other on FINS (CV-mode) commands. The ID Controller supports C-mode commands only. For details on host link communications, refer to the *CQM1 Programming Manual*.

Communications Parameters Communications parameters such as the communication conditions, mode, and unit number must be set to use host link communications. Set the ID Controller Setup for host link communications (i.e., set bits 12 to 15 of DM 6645 or DM 6650 to zero) when communicating via host link standards. Always set the same parameters as the other parties in the communications are using.

Host Link Node Number A node number must be set for host link communications to differentiate between nodes when multiple nodes are participating in communications. This setting is required only for host link communications. To use host link communications, the host link must be specified as the communications mode and the communications parameters must be set (see following section).

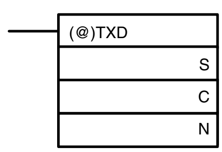


Default: 00

Set the node number to 00 unless multiple nodes are connected in a network.

Communications Procedure This section explains how to use the host link to execute data transmissions from the ID Controller. Using this method enables automatic data transmission from the ID Controller when data is changed, and thus simplifies the communications process by eliminating the need for constant monitoring by the computer.

1, 2, 3...
1. Check to see that AR 0805 (RS-232C Port Transmit Ready Flag) is ON.
2. Use the TXD(—) instruction to transmit the data.



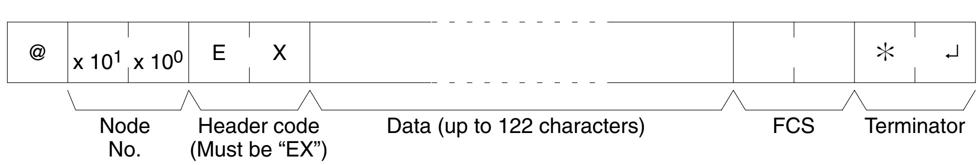
S: Beginning word no. of transmission data

C: Control data
Bits 00 to 11 = 0000
Bits 12 to 15
0: RS-232C port
1: Peripheral port

N: Number of bytes of data to be sent (4 digits BCD)
0000 to 0061

From the time this instruction is executed until the data transmission is complete, AR 0805 (or AR 0813 for the peripheral port) will remain OFF. It will turn ON again upon completion of the data transmission. The TXD(—) instruction does not provide for a response, so in order to receive confirmation that the computer has received the data, the computer's program must be written so that it gives notification when data is written from the ID Controller.

The transmission data frame is as shown below for data transmitted in the Host Link Mode by means of the TXD(—) instruction.

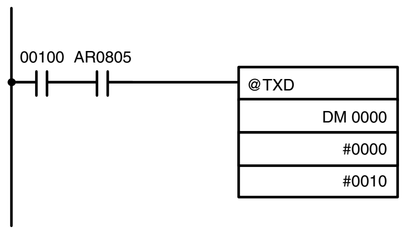


To reset the RS-232C port (i.e., to restore the initial status), turn ON SR 25209. To reset the peripheral port, turn ON SR 25208. These bits will turn OFF automatically after the reset.

If the TXD(—) instruction is executed while the ID Controller is in the middle of responding to a command from the computer, the response transmission will first be completed before the transmission is executed according to the TXD(—) instruction. In all other cases, data transmission based on a TXD(—) instruction will be given first priority.

Application Example

This example shows a program for using the RS-232C port in the Host Link Mode to transmit 10 bytes of data (DM 0000 to DM 0004) to the computer. The default values are assumed for all the ID Controller Setup (i.e., the RS-232C port is used in Host Link Mode, the node number is 00, and the standard communications conditions are used.) From DM 0000 to DM 0004, “1234” is stored in every word. From the computer, execute a program to receive ID Controller data with the standard communications conditions.



If AR 0805 (the Transmit Ready Flag) is ON when IR 00100 turns ON, the ten bytes of data (DM 0000 to DM 0004) will be transmitted.

The following type of program must be prepared in the host computer to receive the data. This program allows the computer to read and display the data received from the ID Controller while a host link read command is being executed to read data from the ID Controller.

```
10 'IDSC SAMPLE PROGRAM FOR EXCEPTION
20 CLOSE 1
30 CLS
40 OPEN "COM:E73" AS #1
50 *KEYIN
60 INPUT "DATA  --------",S$
70 IF S$=""  THEN GOTO 190
80 PRINT "SEND DATA = ";S$
90 ST$=S$
100 INPUT "SEND OK? Y or N?=",B$
110 IF B$="Y" THEN GOTO 130 ELSE GOTO *KEYIN
120 S$=ST$
130 PRINT #1,S$                 'Sends command to ID Controller
140 INPUT #1,R$                 'Receives response from ID Controller
150 PRINT "RECV DATA = ";R$
160 IF MID$(R$,4,2)="EX" THEN GOTO 210 'Identifies command
170 IF RIGHT$(R$,1)<>"*" THEN S$="" :GOTO 130
180 GOTO *KEYIN
190 CLOSE 1
200 END
210 PRINT "EXCEPTION!! DATA"
220 GOTO 140
```

The data received by the computer will be as shown below. (FCS is “59.”)
“@00EX12341234123412341234 59*CR”

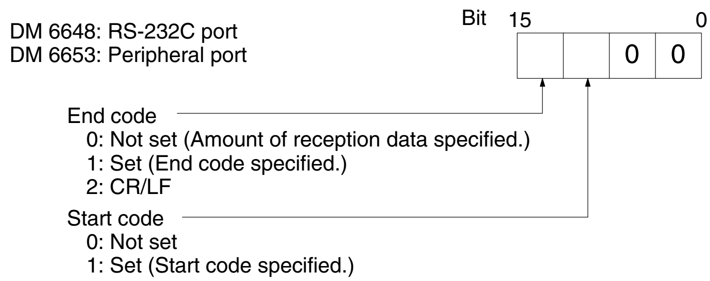
5-6-4 RS-232C Communications

This section explains RS-232C communications. By using RS-232C communications, the data can be printed out by a printer or read by a bar code reader. Handshaking is not supported for RS-232C communications.

Communications Parameters Communications parameters such as the communication conditions, mode, start code, end code, data received, etc. Set the ID Controller Setup for RS-232C communications (i.e., set bits 12 to 15 of DM 6645 or DM 6650 to 1) when communicating via RS-232C standards. Always set the same parameters as the other parties in the communications are using.

RS-232C Start and End Codes and Data Received Start and end codes or the amount of data to be received can be set as shown in the following diagrams if required for RS-232C communications. This setting is required only for RS-232C communications. To use RS-232C communications, the RS-232C must be specified as the communications mode and the communications parameters must be set (see next section).

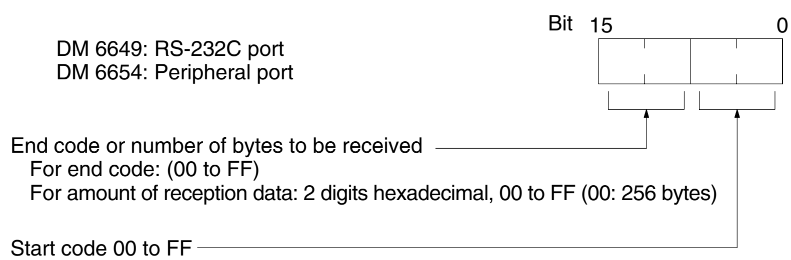
Enabling Start and End Codes



Defaults: No start code; data reception complete at 256 bytes.

Specify whether or not a start code is to be set at the beginning of the data, and whether or not an end code is to be set at the end. Instead of setting the end code, it is possible to specify the number of bytes to be received before the reception operation is completed. Both the codes and the number of bytes of data to be received are set in DM 6649 or DM 6654.

Setting the Start Code, End Code, and Amount of Reception Data

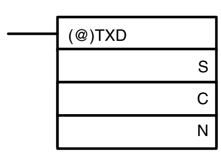


Defaults: No start code; data reception complete at 256 bytes.

Communications Procedure

Transmissions

1, 2, 3...
1. Check to see that AR 0805 (the RS-232C Port Transmit Ready Flag) or AR 0813 (Peripheral Port Transmit Ready Flag) has turned ON.
2. Use the TXD(—) instruction to transmit the data.



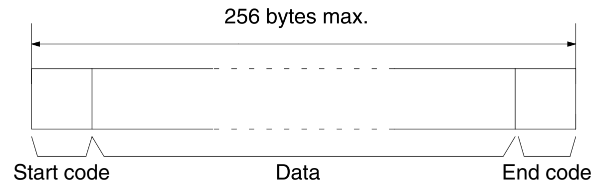
S: Leading word no. of data to be transmitted

C: Control data
  Bits 00 to 03
    0: Leftmost bytes first
    1: Rightmost bytes first
  Bits 12 to 15
    0: RS-232C port
    1: Peripheral port

N: Number of bytes to be transmitted (4 digits BCD), 0000 to 0256

From the time this instruction is executed until the data transmission is complete, AR 0805 (or AR0813 for the peripheral port) will remain OFF. (It will turn ON again upon completion of the data transmission.)

Start and end codes are not included when the number of bytes to be transmitted is specified. The largest transmission that can be sent with or without start and end codes in 256 bytes, N will be between 254 and 256 depending on the designations for start and end codes. If the number of bytes to be sent is set to 0000, only the start and end codes will be sent.

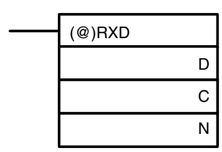


To reset the RS-232C port (i.e., to restore the initial status), turn on SR 25209. To reset the peripheral port, turn on SR 25208. These bits will turn OFF automatically after the reset.

Receptions

1, 2, 3...

1. Confirm that AR 0806 (RS-232C Reception Complete Flag) or AR 0814 (Peripheral Reception Complete Flag) is ON.
2. Use the RXD(—) instruction to receive the data.



D: Leading word no. for storing reception data

C: Control data
- Bits 00 to 03
  - 0: Leftmost bytes first
  - 1: Rightmost bytes first
- Bits 12 to 15
  - 0: RS-232C port
  - 1: Peripheral port

N: Number of bytes stored (4 digits BCD), 0000 to 0256

3. The results of reading the data received will be stored in the AR area. Check to see that the operation was successfully completed. The contents of these bits will be reset each time RXD(—) is executed.

RS-232C port	Peripheral port	Error
AR 0800 to AR 0803	AR 0808 to AR 0811	RS-232C port error code (1 digit BCD) 0: Normal completion 1: Parity error 2: Framing error 3: Overrun error
AR 0804	AR0812	Communications error
AR 0807	AR0815	Reception Overrun Flag (After reception was completed, the subsequent data was received before the data was read by means of the RXD instruction.)
AR 09	AR10	Number of bytes received

To reset the RS-232C port (i.e., to restore the initial status), turn ON SR 25209. To reset the peripheral port, turn ON SR 25208. These bits will turn OFF automatically after the reset.

The start code and end code are not included in AR 09 or AR 10 (number of bytes received).

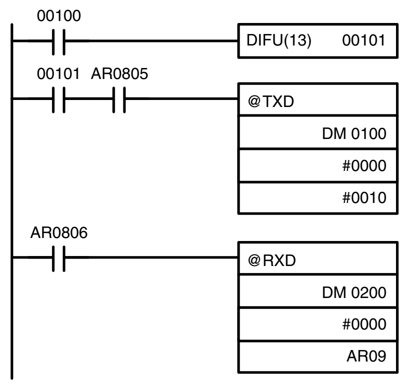
Application Example

This example shows a program for using the RS-232C port in the RS-232C Mode to transmit 10 bytes of data (DM 0100 to DM 0104) to the computer, and to store the data received from the computer in the DM area beginning with DM 0200. Before executing the program, the following ID Controller Setup setting must be made.

DM 6645: 1000 (RS-232C port in RS-232C Mode; standard communications conditions)

DM 6648: 2000 (No start code; end code CR/LF)

The default values are assumed for all other ID Controller Setup settings. From DM 0100 to DM 0104, 3132 is stored in every word. From the computer, execute a program to receive ID Controller data with the standard communications conditions.



If AR 0805 (the Transmit Ready Flag) is ON when IR 00100 turns ON, the ten bytes of data (DM 0100 to DM 0104) will be transmitted, leftmost bytes first.

When AR 0806 (Reception Completed Flag) goes ON, the number of bytes of data specified in AR 09 will be read from the ID Controller's reception buffer and stored in memory starting at DM 0200, leftmost bytes first.

The data will be as follows:
"31323132313231323132<u>CR</u> <u>LF</u>"

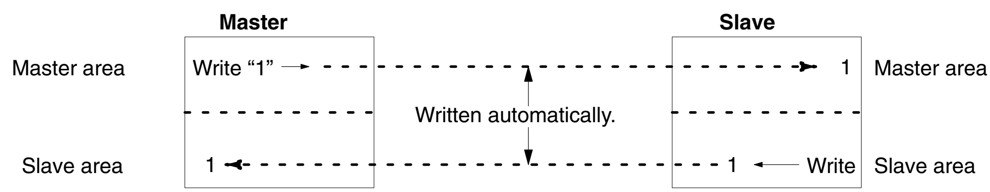
5-6-5 One-to-one Link Communications

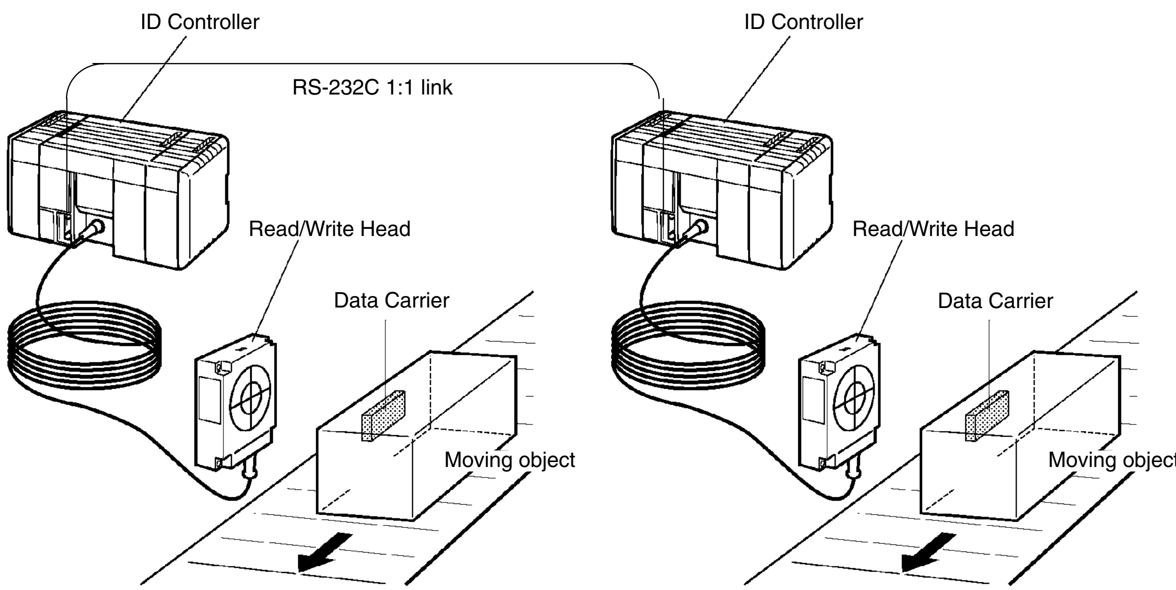
If two ID Controllers are linked one-to-one by connecting them together through their RS-232C ports, they can share common LR areas. When two ID Controllers are linked one-to-one, one of them will serve as the master and the other as the slave.

Note The peripheral port cannot be used for 1:1 links.

One-to-one Links

A one-to-one link allows two ID Controllers to share common data in their LR areas. As shown in the diagram below, when data is written into a word the LR area of one of the linked ID Controllers, it will automatically be written identically into the same word of the other ID Controller. Each ID Controller has specified words to which it can write and specified words that are written to by the other ID Controller. Each can read, but cannot write, the words written by the other ID Controller.





ID Controller Setup

To use a 1:1 link, the only settings necessary are the communications mode and the link words. Set the communications mode for one of the ID Controllers to the 1:1 master and the other to the 1:1 slave, and then set the link words in the ID Controller designated as the master. Bits 08 to 11 are valid only for the master for link one-to-one.

The word used by each ID Controller will be as shown in the following table, according to the settings for the master, slave, and link words.

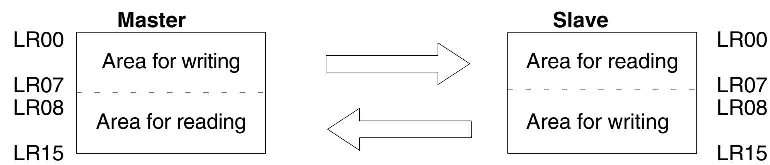
DM 6645 setting	LR 00 to LR 63	LR 00 to LR 31	LR 00 to LR 15
Master words	LR00 to LR31	LR00 to LR15	LR00 to LR07
Slave words	LR32 to LR63	LR16 to LR31	LR08 to LR15

Communications Procedure

If the settings for the master and the slave are made correctly, then the one-to-one link will be automatically started up simply by turning on the power supply to both the ID Controllers and operation will be independent of the ID Controller operating modes.

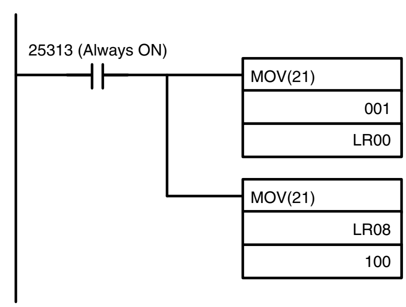
Application Example

This example shows a program for verifying the conditions for executing a one-to-one link using the RS-232C ports. Before executing the program, set the following ID Controller Setup parameters.
Master: DM 6645: 3200 (one-to-one link master; Area used: LR 00 to LR 15)
Slave: DM 6645: 2000 (one-to-one link slave)
The defaults are assumed for all other ID Controller Setup parameters. The words used for the one-to-one link are as shown below.

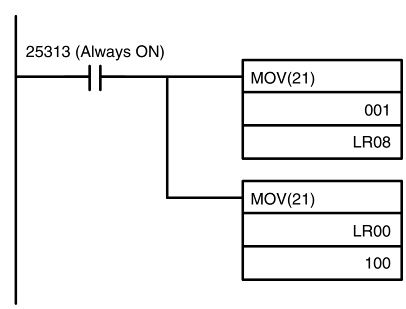


When the program is executed at both the master and the slave, the status of IR 001 of each ID Controller will be reflected in IR 100 of the other ID Controller. Likewise, the status of the other ID Controller's IR 001 will be reflected in IR 100 of each ID Controller. IR 001 is an input word and IR 100 is an output word

In the Master



In the Slave



5-6-6 NT Link Communications

The setting and procedures required to communicate with a Programmable Terminal (PT) connected to the ID Controller via an NT link are described in this section.

An NT link allows you to connect a PT to the RS-232C port via a special cable to allow direct data access between the PT and the ID Controlling using a special communications system developed by OMRON.

Displays on the PT can be generated from ID Controller data and data input from the PT can be written to ID Controller memory. Because the PT can directly access and control bit and word data in the ID controller, it can be connected to the ID Controller without necessarily requiring changes to the ladder-diagram program. This lightens the load on the ID Controller and makes program development far more efficient.

Note NT links are not possible on the peripheral port.

ID Controller Setup

Set bits 12 to 15 of DM 6645 to “4” to specify an NT link for the RS-232C port. Pin 5 on the ID Controller’s DIP switch must be turned OFF to enable this setting.

Communications Procedure

As long as the proper setting is made in the ID Controller Setup and as long as the PT and ID Controller and connected with the proper Connecting Cable, the NT link will be established automatically as soon as power is turned on to the ID Controller and the PT. The PT will then be able to freely read the contents of ID Controller data areas, such as the DM area, IR area, SR area, TIM/CNT area, etc.

SECTION 6
Programming

This section describes some of the ladder-diagram programming used to program the ID Controller. Refer to the *CQM1 Programming Manual* for more information on ladder-diagram programming.

6-1 Instruction Set

The following tables list the instructions that can be used to program the ID Controller. Some programming information is provided later in this section (see page numbers given in the following tables). Refer to the *CQM1 Programing Manual* for information on instructions not described in this manual and for more information on writing ladder-diagram programs.

Code	Mnemonic	Name	Function	Page
—	AND	AND	Logically ANDs status of designated bit with execution condition.	140
—	AND LD	AND LOAD	Logically ANDs results of preceding blocks.	141
—	AND NOT	AND NOT	Logically ANDs inverse of designated bit with execution condition.	140
—	CNT	COUNTER	A decrementing counter.	143
—	LD	LOAD	Used to start instruction line with the status of the designated bit or to define a logic block for use with AND LD and OR LD.	140
—	LD NOT	LOAD NOT	Used to start instruction line with inverse of designated bit.	140
—	OR	OR	Logically ORs status of designated bit with execution condition.	140
—	OR LD	OR LOAD	Logically ORs results of preceding blocks.	141
—	OR NOT	OR NOT	Logically ORs inverse of designated bit with execution condition.	140
—	OUT	OUTPUT	Turns ON operand bit for ON execution condition; turns OFF operand bit for OFF execution condition.	141
—	OUT NOT	OUTPUT NOT	Turns operand bit OFF for ON execution condition; turns operand bit ON for OFF execution condition (i.e., inverts operation).	141
—	RSET	RESET	Turns the operand bit OFF when the execution condition is ON, and does not affect the status of the operand bit when the execution condition is OFF.	142
—	SET	SET	Turns the operand bit ON when the execution condition is ON, and does not affect the status of the operand bit when the execution condition is OFF.	142
—	TIM	TIMER	ON-delay (decrementing) timer operation.	142
00	NOP	NO OPERATION	Nothing is executed and program moves to next instruction.	---
01	END	END	Required at the end of the program.	145
02	IL	INTERLOCK	If interlock condition is OFF, all outputs are turned OFF and all timer PVs reset between this IL(02) and the next ILC(03). Other instructions are treated as NOP; counter PVs are maintained.	---
03	ILC	INTERLOCK CLEAR		---
04	JMP	JUMP	If jump condition is OFF, all instructions between JMP(04) and the corresponding JME(05) are ignored.	---
05	JME	JUMP END		---
06	(@)FAL	FAILURE ALARM AND RESET	Generates a non-fatal error and outputs the designated FAL number to the Programming Console.	---
07	FALS	SEVERE FAILURE ALARM	Generates a fatal error and outputs the designated FALS number to the Programming Console.	---
08	STEP	STEP DEFINE	When used with a control bit, defines the start of a new step and resets the previous step. When used without N, defines the end of step execution.	---
09	SNXT	STEP START	Used with a control bit to indicate the end of the step, reset the step, and start the next step.	---
10	SFT	SHIFT REGISTER	Creates a bit shift register.	---
11	KEEP	KEEP	Defines a bit as a latch controlled by set and reset inputs.	---
12	CNTR	REVERSIBLE COUNTER	Increases or decreases PV by one whenever the increment input or decrement input signals, respectively, go from OFF to ON.	---

Code	Mnemonic	Name	Function	Page
13	DIFU	DIFFERENTIATE UP	Turns ON the designated bit for one cycle on the rising edge of the input signal.	---
14	DIFD	DIFFERENTIATE DOWN	Turns ON the bit for one cycle on the trailing edge.	---
15	TIMH	HIGH-SPEED TIMER	A high-speed, ON-delay (decrementing) timer.	---
16	(@)WSFT	WORD SHIFT	Shifts data between starting and ending words in word units, writing zeros into starting word.	---
17	(@)ASFT	ASYNCHRONOUS SHIFT REGISTER	Creates a shift register that exchanges the contents of adjacent words when one of the words is zero and the other is not.	---
18	(@)SRCH	DATA SEARCH	Searches the specified range of memory for the specified data. Outputs the word address(es) of words in the range that contain the data.	---
19	(@)MCMP	MULTI-WORD COMPARE	Compares a block of 16 consecutive words to another block of 16 consecutive words.	---
20	CMP	COMPARE	Compares the contents of two words and outputs result to GR, EQ, and LE Flags.	145
21	(@)MOV	MOVE	Copies source data (word or constant) to destination word.	146
22	(@)MVN	MOVE NOT	Inverts source data (word or constant) and then copies it to destination word.	---
23	(@)BIN	BCD TO BINARY	Converts four-digit, BCD data in source word into 16-bit binary data, and outputs converted data to result word.	---
24	(@)BCD	BINARY TO BCD	Converts binary data in source word into BCD, and outputs converted data to result word.	---
25	(@)ASL	ARITHMETIC SHIFT LEFT	Shifts each bit in single word of data one bit to left, with CY.	---
26	(@)ASR	ARITHMETIC SHIFT RIGHT	Shifts each bit in single word of data one bit to right, with CY.	---
27	(@)ROL	ROTATE LEFT	Rotates bits in single word of data one bit to left, with CY.	---
28	(@)ROR	ROTATE RIGHT	Rotates bits in single word of data one bit to right, with CY.	---
29	(@)COM	COMPLEMENT	Inverts bit status of one word of data.	---
30	(@)ADD	BCD ADD	Adds two four-digit BCD values and content of CY, and outputs result to specified result word.	---
31	(@)SUB	BCD SUBTRACT	Subtracts a four-digit BCD value and CY from another four-digit BCD value and outputs result to the result word.	---
32	(@)MUL	BCD MULTIPLY	Multiplies two four-digit BCD values and outputs result to specified result words.	---
33	(@)DIV	BCD DIVIDE	Divides four-digit BCD dividend by four-digit BCD divisor and outputs result to specified result words.	---
34	(@)ANDW	LOGICAL AND	Logically ANDs two 16-bit input words and sets corresponding bit in result word if corresponding bits in input words are both ON.	---
35	(@)ORW	LOGICAL OR	Logically ORs two 16-bit input words and sets corresponding bit in result word if one or both of corresponding bits in input data are ON.	---
36	(@)XORW	EXCLUSIVE OR	Exclusively ORs two 16-bit input words and sets bit in result word when corresponding bits in input words differ in status.	---
37	(@)XNRW	EXCLUSIVE NOR	Exclusively NORs two 16-bit input words and sets bit in result word when corresponding bits in input words are same in status.	---
38	(@)INC	BCD INCREMENT	Increments four-digit BCD word by one.	---
39	(@)DEC	BCD DECREMENT	Decrements four-digit BCD word by one.	---
40	(@)STC	SET CARRY	Sets carry flag (i.e., turns CY ON).	---
41	(@)CLC	CLEAR CARRY	Clears carry flag (i.e, turns CY OFF).	---
46	(@)MSG	MESSAGE	Displays a 16-character message on the Programming Console display.	---
47	(@)RXD	RECEIVE	Receives data via a communications port.	150

Code	Mnemonic	Name	Function	Page
48	(@)TXD	TRANSMIT	Sends data via a communications port.	151
50	(@)ADB	BINARY ADD	Adds two four-digit hexadecimal values and content of CY, and outputs result to specified result word.	---
51	(@)SBB	BINARY SUBTRACT	Subtracts a four-digit hexadecimal value and CY from another four-digit hexadecimal value and outputs result to the result word.	---
52	(@)MLB	BINARY MULTIPLY	Multiplies two four-digit hexadecimal values and outputs result to specified result words.	---
53	(@)DVB	BINARY DIVIDE	Divides four-digit hexadecimal dividend by four-digit hexadecimal divisor and outputs result to specified result words.	---
54	(@)ADDL	DOUBLE BCD ADD	Adds two eight-digit values (2 words each) and content of CY, and outputs result to specified result words.	---
55	(@)SUBL	DOUBLE BCD SUBTRACT	Subtracts an eight-digit BCD value and CY from another eight-digit BCD value and outputs result to the result words.	---
56	(@)MULL	DOUBLE BCD MULTIPLY	Multiplies two eight-digit BCD values and outputs result to specified result words.	---
57	(@)DIVL	DOUBLE BCD DIVIDE	Divides eight-digit BCD dividend by eight-digit BCD divisor and outputs result to specified result words.	---
58	(@)BINL	DOUBLE BCD TO DOUBLE BINARY	Converts BCD value in two consecutive source words into binary and outputs converted data to two consecutive result words.	---
59	(@)BCDL	DOUBLE BINARY TO DOUBLE BCD	Converts binary value in two consecutive source words into BCD and outputs converted data to two consecutive result words.	---
60	CMPL	DOUBLE COMPARE	Compares two eight-digit hexadecimal values.	---
61	(@)IDRD	DC READ	Reads data from memory in the Data Carrier.	134
62	(@)IDWT	DC WRITE	Writes data to memory in the Data Carrier.	136
63	(@)IDAR	DC AUTOREAD	Waits for approach of a Data Carrier and then reads data.	134
64	(@)IDAW	DC AUTOWRITE	Waits for approach of a Data Carrier and then writes data.	136
65	(@)IDCA	DC CLEAR	Initializes memory in the Data Carrier with the specified data.	137
66	(@)IDMD	DC MANAGE DATA	Checks memory in the Data Carrier. Also manages the write life of Data Carriers.	138
67	(@)BCNT	BIT COUNTER	Counts the total number of bits that are ON in the specified block of words.	---
68	(@)BCMP	BLOCK COMPARE	Judges whether the value of a word is within 16 ranges (defined by lower and upper limits).	---
69	(@)STIM	INTERVAL TIMER	Controls interval timers used to perform scheduled interrupts.	---
70	(@)XFER	BLOCK TRANSFER	Moves content of several consecutive source words to consecutive destination words.	149
71	(@)BSET	BLOCK SET	Copies content of one word or constant to several consecutive words.	---
72	(@)ROOT	SQUARE ROOT	Computes square root of eight-digit BCD value and outputs truncated four-digit integer result to specified result word.	---
73	(@)XCHG	DATA EXCHANGE	Exchanges contents of two different words.	---
74	(@)SLD	ONE DIGIT SHIFT LEFT	Left shifts data between starting and ending words by one digit (four bits).	---
75	(@)SRD	ONE DIGIT SHIFT RIGHT	Right shifts data between starting and ending words by one digit (four bits).	---
76	(@)MLPX	4-TO-16 DECODER	Converts up to four hexadecimal digits in source word into decimal values from 0 to 15 and turns ON, in result word(s), bit(s) whose position corresponds to converted value.	---
77	(@)DMPX	16-TO-4 ENCODER	Determines position of highest ON bit in source word(s) and turns ON corresponding bit(s) in result word.	---

Code	Mnemonic	Name	Function	Page
78	(@)SDEC	7-SEGMENT DECODER	Converts hexadecimal values from source word to data for seven-segment display.	---
80	(@)DIST	SINGLE WORD DISTRIBUTE	Moves one word of source data to destination word whose address is given by destination base word plus offset. Performs stack push operation.	---
81	(@)COLL	DATA COLLECT	Extracts data from source word and writes it to destination word. Performs stack pull operation.	---
82	(@)MOVB	MOVE BIT	Transfers designated bit of source word or constant to designated bit of destination word.	---
83	(@)MOVD	MOVE DIGIT	Moves hexadecimal content of specified four-bit source digit(s) to specified destination digit(s) for up to four digits.	147
84	(@)SFTR	REVERSIBLE SHIFT REGISTER	Shifts data in specified word or series of words to either left or right.	---
85	(@)TCMP	TABLE COMPARE	Compares four-digit hexadecimal value with values in table consisting of 16 words.	---
86	(@)ASC	ASCII CONVERT	Converts hexadecimal values from the source word to eight-bit ASCII code starting at leftmost or rightmost half of starting destination word.	---
87	(@)HEX	ASCII-TO-HEXADECIMAL	Converts ASCII data to hexadecimal data.	---
88	(@)APR	ARITHMETIC PROCESS	Performs sine, cosine, or linear approximation calculations.	---
89	(@)INT	INTERRUPT CONTROL	Performs interrupt control, such as masking and unmasking the interrupt bits for I/O interrupts.	---
91	(@)SBS	SUBROUTINE ENTRY	Calls and executes subroutine N.	---
92	SBN	SUBROUTINE DEFINE	Marks start of subroutine N.	---
93	RET	RETURN	Marks the end of a subroutine and returns control to main program.	---
97	(@)IORF	I/O REFRESH	Refreshes all I/O words between the start and end words.	---
99	(@)MCRO	MACRO	Calls and executes a subroutine replacing I/O words.	---

Expansion Instructions

The following table shows the instructions that are treated as expansion instructions. These instructions must be allocated function codes before they can be used in programming. Refer to the *CQM1 Programing Manual* for information on using expansion instructions.

Code	Mnemonic	Name	Function	Page
---	7SEG	7-SEGMENT DISPLAY OUTPUT	Converts 4- or 8-digit data to 7-segment display format and then outputs the converted data.	91
---	AVG	AVERAGE VALUE	Adds the specified number of hexadecimal words and computes the mean value. Rounds off to 4 digits past the decimal point.	---
---	(@)COLM	LINE TO COLUMN	Copies the 16 bits from the specified word to a bit column of 16 consecutive words.	---
---	(@)CTBL	COMPARISON TABLE LOAD	Compares counter PVs and generates a direct table or starts operation.	---
---	DSW	DIGITAL SWITCH INPUT	Inputs 4- or 8-digit BCD data from a digital switch.	89
---	(@)FCS	FCS CALCULATE	Computes the FCS to check for errors in data transmitted by a Host Link command.	---
---	HKY	HEXADECIMAL KEY INPUT	Inputs up to 8 digits of hexadecimal data from a 16-key keypad.	88
---	(@)HMS	SECONDS TO HOURS	Converts second data to hour and minute data.	---
---	(@)INI	MODE CONTROL	Starts and stops counter operation, compares and changes counter PVs, and stops pulse output.	---
---	(@)LINE	LINE	Copies a bit column from 16 consecutive words to the specified word.	---

Code	Mnemonic	Name	Function	Page
---	(@)MAX	FIND MAXIMUM	Finds the maximum value in specified data area and outputs that value to another word.	---
---	(@)MIN	FIND MINIMUM	Finds the minimum value in specified data area and outputs that value to another word.	---
---	(@)PRV	HIGH-SPEED COUNTER PV READ	Reads counter PVs and status data for the high-speed counter.	---
---	(@)PULS	SET PULSES	Sets the number of pulses to output.	---
---	(@)SCL	SCALE	Performs a scaling conversion on the calculated value.	---
---	(@)SEC	HOURS TO SECONDS	Converts hour and minute data to second data.	---
---	(@)SPED	SPEED OUTPUT	Outputs pulses at the specified frequency (20 Hz to 1 KHz in 10 Hz units). The output frequency can be changed while pulses are being output.	---
---	(@)SUM	SUM CALCULATE	Computes the sum of the contents of the words in the specified range of memory.	---
---	TKY	TEN KEY INPUT	Inputs 8 digits of BCD data from a 10-key keypad.	86

6-2 Basic Programming Concepts

6-2-1 Notation

All instructions are referred to by their mnemonics. For example, the OUTPUT instruction will be called OUT; the AND LOAD instruction, AND LD.

If an instruction is assigned a function code, it will be given in parentheses after the mnemonic. These function codes, which are 2-digit decimal numbers, are used to input most instructions into the ID Controller. Expansion instructions that are not allocated function codes by default appear with dashes in place of the function code to indicate that they must be allocated function codes before they can be used, for example PULS(—).

An @ before a mnemonic indicates the differentiated version of that instruction. Differentiated instructions are explained in *Section 6-2-6*.

6-2-2 Instruction Format

Most instructions have at least one or more operands associated with them. Operands indicate or provide the data on which an instruction is to be performed. These are sometimes input as the actual numeric values (i.e., as constants), but are usually the addresses of data area words or bits that contain the data to be used. A bit whose address is designated as an operand is called an operand bit; a word whose address is designated as an operand is called an operand word. In some instructions, the word address designated in an instruction indicates the first of multiple words containing the desired data.

Each instruction requires one or more words in Program Memory. The first word is the instruction word, which specifies the instruction and contains any definers (described below) or operand bits required by the instruction. Other operands required by the instruction are contained in following words, one operand per word. Some instructions require up to four words.

A definer is an operand associated with an instruction and contained in the same word as the instruction itself. These operands define the instruction rather than telling what data it is to use. Examples of definers are TC numbers, which are used in timer and counter instructions to create timers and counters, as well as jump numbers (which define which Jump instruction is paired with which Jump End instruction). Bit operands are also contained in the same word as the instruction itself, although these are not considered definers.

Word Structure

Memory areas are divided up into words, each of which consists of 16 bits numbered 00 through 15 from right (least significant) to left (most significant). Words IR 0000 and IR 0001 are shown below with bit numbers. Here, the content of each word is shown as all zeros. Bit 00 is called the rightmost bit; bit 15, the leftmost bit.

The term least significant bit is often used for rightmost bit; the term most significant bit, for leftmost bit.

Bit number	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
IR word 0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IR word 0001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Data in the DM Area, as well as Timer and Counter PVs can be accessed as words only. Timer and Counter Completion Flags can be accessed as bits only. You cannot designate any of these for operands requiring bit data. Data in the IR, AR, SR, HR, LR and other areas is accessible either by word or by bit, depending on the instruction in which the data is being used.

To designate one of these areas by word, all that is necessary is the acronym, if required, and the two-, three-, or four-digit word address. To designate an area by bit, the word address is combined with the bit number as a single four- to six-digit address. The following table shows examples of this. The two rightmost digits of a bit address must be between 00 and 15.

The same timer and counter numbers can be used to designate either the present value (PV) of the timer or counter, or the Completion Flag for the timer or counter.

Area	Word designation	Bit designation
IR	000	00015 (leftmost bit in word IR 000)
SR	252	25200 (rightmost bit in word SR 252)
DM	DM 1250	Not possible
TIM	TIM 215 (designates PV)	TIM 215 (designates Completion Flag)
AR	AR 12	AR 1200

Data Structure

Word data input as decimal values is stored in binary-coded decimal (BCD); word data entered as hexadecimal is stored in binary form. Each four bits of a word represents one digit, either a hexadecimal or decimal digit, numerically equivalent to the value of the binary bits. One word of data thus contains four digits, which are numbered from right to left. These digit numbers and the corresponding bit numbers for one word are shown below.

Digit number	3				2				1				0			
Bit number	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Contents	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

When referring to the entire word, the digit numbered 0 is called the rightmost digit; the one numbered 3, the leftmost digit.

When inputting data, it must be input in the proper form for the intended purpose. Bits are either ON (equivalent to a binary value of 1) or OFF (a binary value of 0). Word data, however, must be input either as decimal (i.e., BCD) or as hexadecimal, depending on what is required by the instruction in which it is being used.

Converting Different Forms of Data

Binary and hexadecimal can be easily converted back and forth because each four bits of a binary number is numerically equivalent to one digit of a hexadecimal number. The binary number 0101 1111 0101 1111 is converted to hexadecimal by considering each set of four bits in order from the right. Binary 1111 is hexadecimal F; binary 0101 is hexadecimal 5. The hexadecimal equivalent would thus be 5F5F, or 24,415 in decimal (16^3 x 5 + 16^2 x 15 + 16 x 5 + 15).

Decimal and BCD are easily converted back and forth. In this case, each BCD digit (i.e., each group of four BCD bits) is numerically equivalent to the corresponding decimal digit. The BCD bits 0101 0111 0101 0111 are converted to decimal by considering each four bits from the right. Binary 0101 is decimal 5; binary 0111 is decimal 7. The decimal equivalent would thus be 5,757. Note that this is not the same numeric value as the hexadecimal equivalent of 0101 0111 0101 0111, which would be 5,757 hexadecimal, or 22,359 in decimal (16^3 x 5 + 16^2 x 7 + 16 x 5 + 7).

Because each four BCD binary bits must be numerically equivalent to a decimal value, any four bit combination numerically greater than 9 cannot be used, e.g., 1011 is not allowed because it is numerically equivalent to 11, which cannot be expressed as a single digit in decimal notation. The binary bits 1011 are allowed in hexadecimal and are equivalent to the hexadecimal digit B.

There are instructions provided to convert data between BCD and hexadecimal.

Decimal Points

Decimal points are used in timers, although they are assumed and not actually input into memory. The least significant digit represents tenths of a second. All arithmetic instructions operate on integers only. When inputting data for use in special applications, be sure to check on the type of data required for the application.

6-2-3 Programming Precautions

The number of conditions that can be used in series or parallel is unlimited as long as the memory capacity of the ID Controller is not exceeded. Therefore, use as many conditions as required to draw a clear diagram.

There must not be any conditions on lines running vertically between two other instruction lines. Diagram A shown below, for example, is not possible, and should be drawn as diagram B. Mnemonic code is provided for diagram B only; coding diagram A would be impossible.

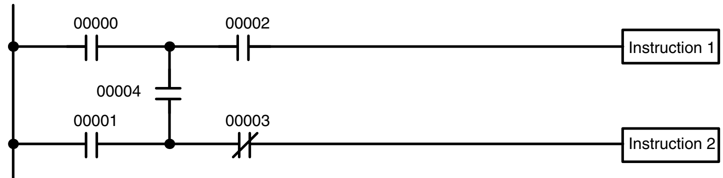


Diagram A: Not Programmable

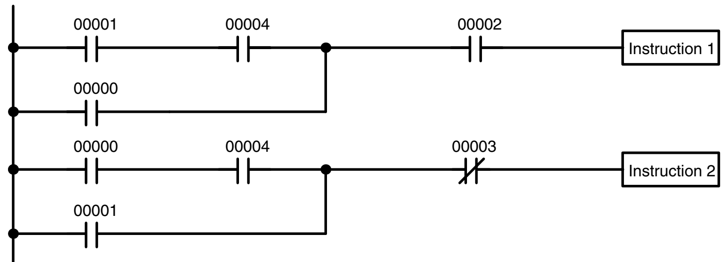


Diagram B: Correct Version

Address	Instruction	Operands
00000	LD	00001
00001	AND	00004
00002	OR	00000
00003	AND	00002
00004	Instruction 1	
00005	LD	00000
00006	AND	00004
00007	OR	00001
00008	AND NOT	00003
00009	Instruction 2	

The number of times any particular bit can be assigned to conditions is not limited, so use them as many times as required to simplify your program. Often, complicated programs are the result of attempts to reduce the number of times a bit is used.

Except for instructions for which conditions are not allowed (e.g., INTERLOCK CLEAR and JUMP END, see below), every instruction line must also have at least one condition on it to determine the execution condition for the instruction at the right. Again, diagram A , below, must be drawn as diagram B. If an instruction must be continuously executed (e.g., if an output must always be kept ON while the program is being executed), the Always ON Flag (SR 25313) in the SR area can be used.

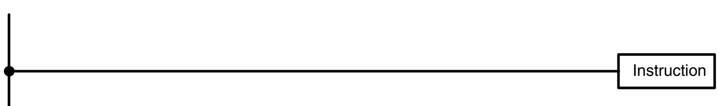


Diagram A: Not Programmable for Most Instructions

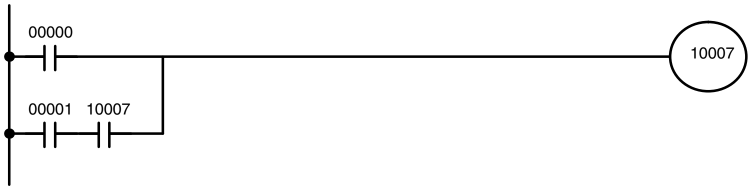
Diagram B: Correct Version

Address	Instruction	Operands
00000	LD	25313
00001	Instruction	

There are a few exceptions to this rule, including the INTERLOCK CLEAR, JUMP END, and step instructions. Each of these instructions is used as the second of a pair of instructions and is controlled by the execution condition of the first of the pair. Conditions should not be placed on the instruction lines leading to these instructions.

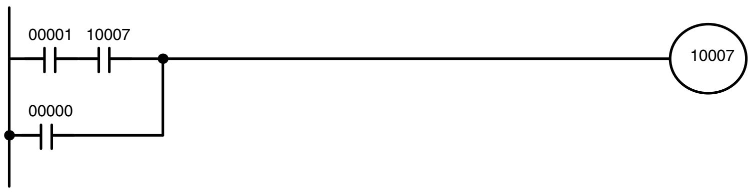
When drawing ladder diagrams, it is important to keep in mind the number of instructions that will be required to input it. In diagram A, below, an OR LOAD instruction will be required to combine the top and bottom instruction lines.

This can be avoided by redrawing as shown in diagram B so that no AND LOAD or OR LOAD instructions are required. Refer to *6-4-2 AND LOAD and OR LOAD* for more details.



Address	Instruction	Operands
00000	LD	00000
00001	LD	00001
00002	AND	10007
00003	OR LD	---
00004	OUT	10007

Diagram A



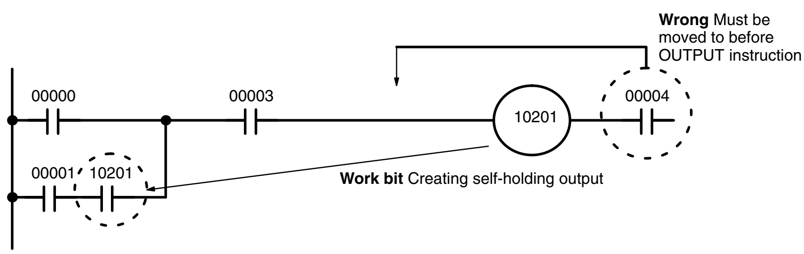
Address	Instruction	Operands
00000	LD	00001
00001	AND	10007
00002	OR	00000
00003	OUT	10007

Diagram B

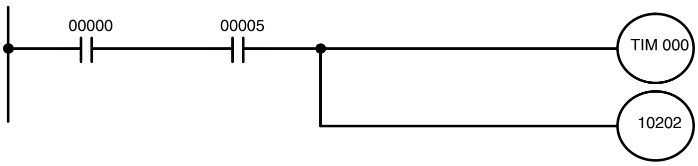
Other Precautions

1, 2, 3...

1. There is no limit to the number of input conditions that can be used in series or in parallel.
2. Instructions can be used not only to control output bit status directly, but also to control the status of other bits in memory (called work bits) that are used to control program execution (e.g., to trigger execution of other instructions). There is no limit to the number of work bits that can be used. In the following example, IR 10201 is used in programming to created a self-holding output.

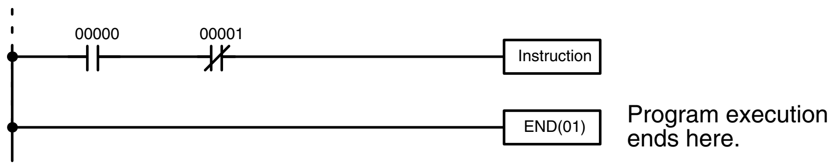


3. You cannot place input conditions to the right of output instructions (i.e., instructions controlling bit status) or special instructions. In the above example, IR 00004 must be moved to before the OUTPUT instruction.
4. Do not use any bit or word addresses not supported by the ID Controller (see *Section 4 Data Areas* for details).
5. Do not control the status of the same output bit with more than one place in the program.
6. Output instructions can be programmed in parallel.



Address	Instruction	Operands	
00000	LD		00000
00001	AND		00005
00002	OUT	TIM	000
00003	OUT		10202

7. The END instruction must be placed at the end of the program. When the CPU scans the program, it executes all instructions up to the first END instruction before returning to the beginning of the program and beginning execution again. Although an END instruction can be placed at any point in a program, which is sometimes done when debugging, no instructions past the first END instruction will be executed until it is removed. The number following the END instruction in the mnemonic code is its function code, which is used when inputted most instruction into the ID Controller. These are described later. The END instruction requires no operands and no conditions can be placed on the same instruction line with it.



Address	Instruction	Operands
00500	LD	00000
00501	AND NOT	00001
00502	Instruction	
00503	END(01)	---

If there is no END instruction anywhere in the program, the program will not be executed at all.

6-2-4 Instruction Classifications

There are four classifications of instructions used with the ID Controller.

- **Basic Instructions:** The most frequently used instructions.
- **Special Instructions:** A wide range of instructions for special purposes.
- **Expansion Instructions:** Additional special instructions requiring allocations of function codes before usage.
- **Advanced I/O Instructions:** Special instructions used to control more complex I/O operations.

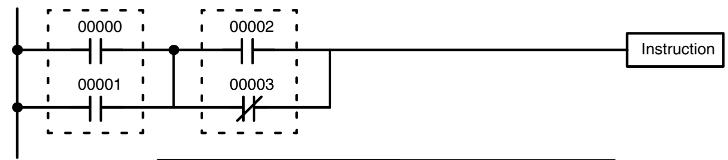
⚠ **Caution** Although ID communications instruction are classified as expansion instructions, you cannot change the function codes allocated to them.

6-2-5 Logic Block Instructions

Logic block instructions do not correspond to specific conditions on the ladder diagram; rather, they describe relationships between logic blocks. The AND LOAD instruction logically ANDs the execution conditions produced by two logic blocks. The OR LOAD instruction logically ORs the execution conditions produced by two logic blocks.

AND LOAD

Although simple in appearance, the diagram below requires an AND LOAD instruction.



Address	Instruction	Operands
00000	LD	00000
00001	OR	00001
00002	LD	00002
00003	OR NOT	00003
00004	AND LD	---
00005	Instruction	---

The two logic blocks are indicated by dotted lines. In this example, an ON execution condition will be produced when: either of the conditions in the left logic block is ON (i.e., when either IR 00000 or IR 00001 is ON), **and** when either of the conditions in the right logic block is ON (i.e., when either IR 00002 is ON or IR 00003 is OFF).

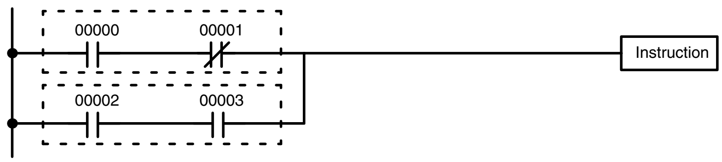
The above ladder diagram cannot, however, be converted to mnemonic code using AND and OR instructions alone. If an AND between IR 00002 and the results of an OR between IR 00000 and IR 00001 is attempted, the OR NOT between IR 00002 and IR 00003 is lost and the OR NOT ends up being an OR NOT between just IR 00003 and the result of an AND between IR 00002 and the first OR. What we need is a way to do the OR (NOT)'s independently and then combine the results.

To do this, we can use the LOAD or LOAD NOT instruction in the middle of an instruction line. When LOAD or LOAD NOT is executed in this way, the current execution condition is saved in special buffers and the logic process is begun over. To combine the results of the current execution condition with that of a previous "unused" execution condition, an AND LOAD or an OR LOAD instruction is used. Here "LOAD" refers to loading the last unused execution condition. An unused execution condition is produced by using the LOAD or LOAD NOT instruction for any but the first condition on an instruction line.

The condition for IR 00000 is a LOAD instruction and the condition below it is an OR instruction between the status of IR 00000 and that of IR 00001. The condition at IR 00002 is another LOAD instruction and the condition below is an OR NOT instruction, i.e., an OR between the status of IR 00002 and the inverse of the status of IR 00003. To arrive at the execution condition for the instruction at the right, the logical AND of the execution conditions resulting from these two blocks would have to be taken. AND LOAD does this. The mnemonic code for the ladder diagram is shown below. The AND LOAD instruction requires no operands of its own, because it operates on previously determined execution conditions. Here too, dashes are used to indicate that no operands needs designated or input.

OR LOAD

The following diagram requires an OR LOAD instruction between the top logic block and the bottom logic block. An ON execution condition would be produced for the instruction at the right either when IR 00000 is ON and IR 00001 is OFF or when IR 00002 and IR 00003 are both ON. The operation of and mnemonic code for the OR LOAD instruction is exactly the same as those for a AND LOAD instruction except that the current execution condition is ORed with the last unused execution condition.



Address	Instruction	Operands
00000	LD	00000
00001	AND NOT	00001
00002	LD	00002
00003	AND	00003
00004	OR LD	---
00005	Instruction	---

Naturally, some diagrams will require both AND LOAD and OR LOAD instructions.

6-2-6 Differentiated Instructions

Most instructions are provided in both differentiated and non-differentiated forms. Differentiated instructions are distinguished by an @ in front of the instruction mnemonic.

A non-differentiated instruction is executed each time it is scanned as long as its execution condition is ON. A differentiated instruction is executed only once after its execution condition goes from OFF to ON. If the execution condition has not changed or has changed from ON to OFF since the last time the instruction was scanned, the instruction will not be executed. The following two examples show how this works with MOV(21) and @MOV(21), which are used to move the data in the address designated by the first operand to the address designated by the second operand.

Diagram A

Address	Instruction	Operands	
00000	LD		00000
00001	MOV(21)		
		HR	10
		DM	0000

Diagram B

Address	Instruction	Operands	
00000	LD		00000
00001	@MOV(21)		
		HR	10
		DM	0000

In diagram A, the non-differentiated MOV(21) will move the content of HR 10 to DM 0000 whenever it is scanned with 00000. If the cycle time is 80 ms and 00000 remains ON for 2.0 seconds, this move operation will be performed 25 times and only the last value moved to DM 0000 will be preserved there.

In diagram B, the differentiated @MOV(21) will move the content of HR 10 to DM 0000 only once after 00000 goes ON. Even if 00000 remains ON for 2.0 seconds with the same 80 ms cycle time, the move operation will be executed only once during the first cycle in which 00000 has changed from OFF to ON. Because the content of HR 10 could very well change during the 2 seconds while 00000 is ON, the final content of DM 0000 after the 2 seconds could be different depending on whether MOV(21) or @MOV(21) was used.

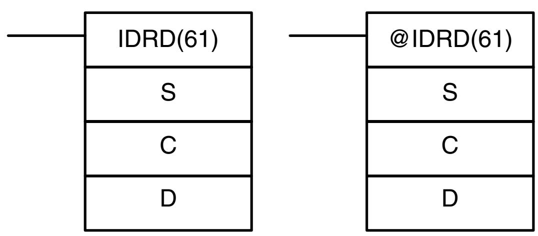
All operands, ladder diagram symbols, and other specifications for instructions are the same regardless of whether the differentiated or non-differentiated form of an instruction is used. When inputting, the same function codes are also used, but NOT is input after the function code to designate the differentiated form of an instruction. Most, but not all, instructions have differentiated forms.

6-3 ID Communications Instructions

6-3-1 DC READ and DC AUTOREAD – IDRD(61)/IDAR(63)

DC READ

Ladder Symbols

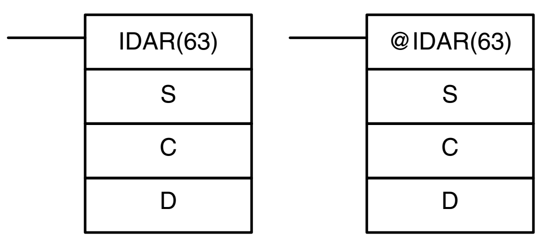


Operand Data Areas

S: First source address (HEX)
IR, SR, AR, DM, HR, TC, LR, #
C: Control data
IR, SR, AR, DM, HR, TC, LR, #
D: First destination word
IR, SR, AR, DM, HR, LR

DC AUTOREAD

Ladder Symbols



Operand Data Areas

S: First source address (HEX)
IR, SR, AR, DM, HR, TC, LR, #
C: Control data
IR, SR, AR, DM, HR, TC, LR, #
D: First destination word
IR, SR, AR, DM, HR, LR

Description

IDRD(61) and IDAR(63) are used to read data from a Data Carrier.

IDRD(61) reads data from the Data Carrier memory (S: first address) and stores the data in the ID Controller memory (D: first word).

IDAR(63) places execution of the read operation on standby until a Data Carrier is detected. It then reads data from Data Carrier memory and stores the data in the ID Controller.

Note Data returned from reads can be processed return once per scan using cyclic refreshes or it can be processed via interrupts generated at the end of communications with the Data Carrier (interrupt refreshes). Set the ID communications response refresh method in DM 6611, bits 04 to 07. With the interrupt refresh method, subroutines 004 to 009 of the user program can be executed.

Control Data

Set the control data (C) as shown in the following table.

Bit(s)	Functions	Values
00 to 11	Number of bytes (addresses) to read	001 to 256 in BCD
12	None	Set to 0.
13	Read data order (in ID Controller)	0: Leftmost byte first 1: Rightmost byte first
14	None	Set to 0.
15	None	Set to 0.

Note Up to 256 bytes can be read with the execution of each instructions. All bytes read with one instruction will be refreshed at the same time.

Precautions

The addresses that can be specified for the first source word (S) depend on the Data Carrier that is being used. Refer to your Data Carrier manual for details.

The content of the control data (C) must be within the specified ranges (see above table).

Flags

ER: The number of bytes to read (bits 00 to 11 in control data) is not BCD or is out of range.

Indirectly addressed DM word is non-existent. (Content of *DM word is not BCD, or the DM area boundary has been exceeded.)

SR 23200 (ID Ready Flag) was OFF or another ID communications instruction was being executed.

23300: OFF while instruction is being executed. ON when executed has been completed.

23301: OFF while instruction is being executed. ON when executed has been completed.

23302: ON when an error has occurred in ID communications.

23306: ON when the end of the service life of the Data Carrier battery has been detected.

23308 to 23313: Indicate error type with 23302 is ON.

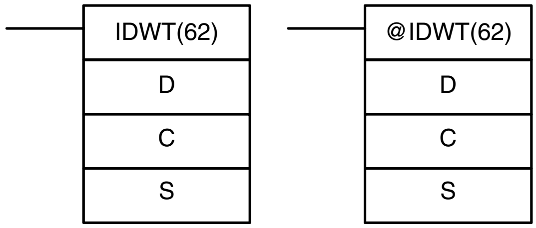
Example

Refer to page 79 for an example.

6-3-2 DC WRITE and DC AUTOWRITE – IDWT(62)/IDAW(64)

DC WRITE

Ladder Symbols



Operand Data Areas

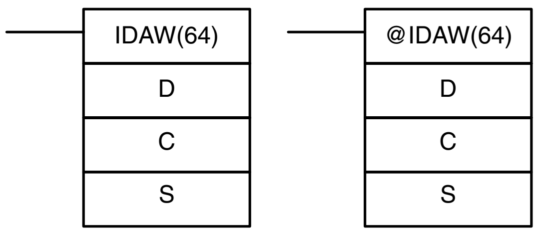
D: First destination address (HEX)
IR, SR, AR, DM, HR, TC, LR, #

C: Control data
IR, SR, AR, DM, HR, TC, LR, #

S: First source word
IR, SR, AR, DM, HR, TC, LR

DC AUTOWRITE

Ladder Symbols



Operand Data Areas

D: First destination address (HEX)
IR, SR, AR, DM, HR, TC, LR, #

C: Control data
IR, SR, AR, DM, HR, TC, LR, #

S: First source word
IR, SR, AR, DM, HR, TC, LR

Description

IDWT(62) and IDAW(64) are used to write data to Data Carriers.

IDWT(62) reads data from one or more words (S: first word) of the ID Controller and then writes the data to memory (D: first address) designated in the Data Carrier.

IDAW(64) places execution of the write operation on standby until a Data Carrier is detected. It then reads data from the ID Controller and writes the data to memory in the Data Carrier.

Control Data

Set the control data (C) as shown in the following table.

Bit(s)	Functions	Values
00 to 11	Number of bytes (addresses) to write	001 to 256 in BCD
12	None	Set to 0.
13	Write data order (in ID Controller)	0: Leftmost byte first 1: Rightmost byte first
14	None	Set to 0.
15	None	Set to 0.

Precautions

The addresses that can be specified for the first destination word (D) depend on the Data Carrier that is being used. Refer to your Data Carrier manual for details.

The content of the control data (C) must be within the specified ranges (see above table).

Data cannot be written to areas that are write-protected. Any attempt to do so will generate a “write protected” error.

Flags

ER: The number of bytes to write (bits 00 to 11 in control data) is not BCD or is out of range.

Indirectly addressed DM word is non-existent. (Content of *DM word is not BCD, or the DM area boundary has been exceeded.)

SR 23200 (ID Ready Flag) was OFF or another ID communications instruction was being executed.

23300: OFF while instruction is being executed. ON when executed has been completed.

23301: OFF while instruction is being executed. ON when executed has been completed.

23302: ON when an error has occurred in ID communications.

23306: ON when the end of the service life of the Data Carrier battery has been detected.

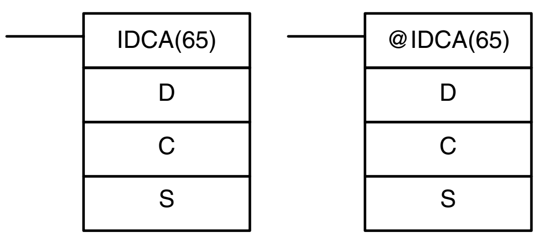
23308 to 23313: Indicate error type with 23302 is ON.

Example

Refer to page 80 for an example.

6-3-3 DC CLEAR – IDCA(65)

Ladder Symbols



Operand Data Areas

D: First destination address (HEX)
IR, SR, AR, DM, HR, TC, LR, #

C: Control data
IR, SR, AR, DM, HR, TC, LR, #

S: Initialization data
IR, SR, AR, DM, HR, TC, LR

Description

IDCA(65) initializes the memory (D: first address) of the Data Carrier with designated data (S: initialization data). All data in designated user areas will be initialized whether the area is write-protected or not.

Control Data

Set the control data (C) as shown in the following table.

Bit(s)	Functions	Values
00 to 11	Number of bytes (addresses) to clear	000: Clear through last address 001 to 256 in BCD
12	None	Set to 0.
13	Write data type (see following explanation for *Initialization Data*)	0: Bytes (Initializes memory with the rightmost digits of specified initialization data) 1: Words (Initializes memory with the both digits of specified initialization data, writing the leftmost byte first)
14	None	Set to 0.
15	None	Set to 0.

Initialization Data

The following table shows the treatment of the content of the initialization data word or constant based on the specification of the write data type in bit 13 of the control data.

Bits		Value	Write data type	
			Byte	Word
00 to 07	Rightmost bits of write data	00 to FF	Data Carrier memory initialized with this data	Initializes Data Carrier memory with first the leftmost and then the rightmost byte. If the number of bytes being cleared is odd, the last byte in Data Carrier memory will be initialized with the leftmost byte of the initialization data.
08 to 15	Leftmost bits of write data	00 to FF	Not used.	

Precautions

The addresses that can be specified for the first destination word (D) depend on the Data Carrier that is being used. Refer to your Data Carrier manual for details.

The content of the control data (C) must be within the specified ranges (see above table).

Flags

ER: The number of bytes to write (bits 00 to 11 in control data) is not BCD or is out of range.

Indirectly addressed DM word is non-existent. (Content of *DM word is not BCD, or the DM area boundary has been exceeded.)

SR 23200 (ID Ready Flag) was OFF or another ID communications instruction was being executed.

23300: OFF while instruction is being executed. ON when executed has been completed.

23301: OFF while instruction is being executed. ON when executed has been completed.

23302: ON when an error has occurred in ID communications.

23306: ON when the end of the service life of the Data Carrier battery has been detected.

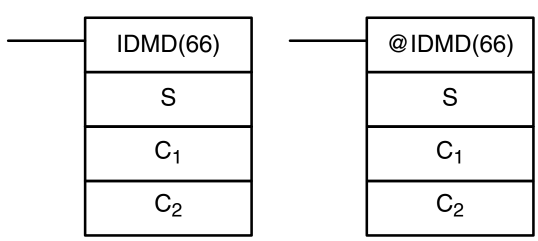
23308 to 23313: Indicate error type with 23302 is ON.

Example

Refer to page 82 for an example.

6-3-4 DC MANAGE DATA – IDMD(66)

Ladder Symbols



Operand Data Areas

S: First management word (HEX)
IR, SR, AR, DM, HR, TC, LR, #

C_1: Control data 1
IR, SR, AR, DM, HR, TC, LR, #

C_2: Control data 2
IR, SR, AR, DM, HR, TC, LR, #

Description

IDMD(66) adds a check code to data in the Data Carrier to detect data errors. It also counts the number of times that data was written to the Data Carrier in order to manage the writing service life.

Control Data 1

Set control data 1 (C_1) as shown in the following table.

Bit(s)	Functions	Values
00 to 04	Management mode	0: Increment write count management (100,000 writes) 1: Decrement write count management 2: Check code calculation 3: Check code verification
04 to 15	None	Set to 0.

Control Data 2

Set control data 2 (C_2) as shown in the following table.

Bit(s)	Function	Values
00 to 15	Write count management	Increment/decrement count: 000 to 255 (BCD)
	Check code calculation/verification	Number of bytes in management area: 003 to 256 (BCD)

Precautions

The addresses that can be specified for the first management word (S) depend on the Data Carrier that is being used. Refer to your Data Carrier manual for details.

The content of the Control data (C_1 and C_2) must be within the specified ranges (see above tables).

Flags

ER: The content of control data 2 is not BCD or is out of range.

The content of control data 1 is out of range.

Indirectly addressed DM word is non-existent. (Content of *DM word is not BCD, or the DM area boundary has been exceeded.)

SR 23200 (ID Ready Flag) was OFF or another ID communications instruction was being executed.

23300: OFF while instruction is being executed. ON when executed has been completed.

23301: OFF while instruction is being executed. ON when executed has been completed.

23302: ON when an error has occurred in ID communications.

23306: ON when the end of the service life of the Data Carrier battery has been detected.

23308 to 23313: Indicate error type with 23302 is ON.

Examples

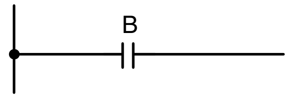
Refer to pages 83 to 85 for examples.

6-4 Basic Instructions

6-4-1 LOAD, LOAD NOT, AND, AND NOT, OR, and OR NOT

Ladder Symbols **Operand Data Areas**

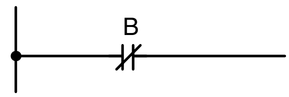
LOAD – LD



B: Bit
IR, SR, AR, HR, TC, LR, TR

Key Sequence LD *bit_address* WRITE

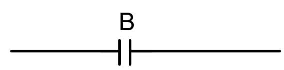
LOAD NOT – LD NOT



B: Bit
IR, SR, AR, HR, TC, LR

Key Sequence LD NOT *bit_address* WRITE

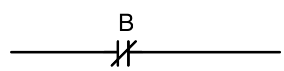
AND – AND



B: Bit
IR, SR, AR, HR, TC, LR

Key Sequence AND *bit_address* WRITE

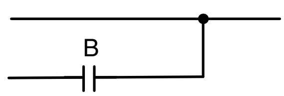
AND NOT – AND NOT



B: Bit
IR, SR, AR, HR, TC, LR

Key Sequence AND NOT *bit_address* WRITE

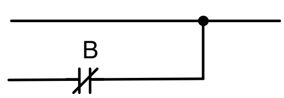
OR – OR



B: Bit
IR, SR, AR, HR, TC, LR

Key Sequence OR *bit_address* WRITE

OR NOT – OR NOT



B: Bit
IR, SR, AR, HR, TC, LR

Key Sequence OR NOT *bit_address* WRITE

Description

These six basic instructions correspond to the conditions on a ladder diagram. The status of the bits assigned to each instruction determines the execution conditions for all other instructions. Each of these instructions and each bit address can be used as many times as required. Each can be used in as many of these instructions as required.

The status of the bit operand (B) assigned to LD or LD NOT determines the first execution condition. Each instruction line connected to the bus bar on the left starts with LD.

AND takes the logical AND between the execution condition and the status of its bit operand; AND NOT, the logical AND between the execution condition and the inverse of the status of its bit operand.

OR takes the logical OR between the execution condition and the status of its bit operand; OR NOT, the logical OR between the execution condition and the inverse of the status of its bit operand.

Precautions

There is no limit to the number of any of these instructions, or restrictions in the order in which they must be used, as long as the memory capacity of the ID Controller is not exceeded.

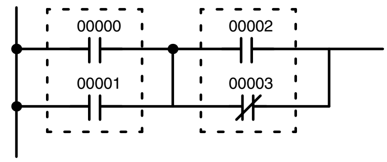
Flags

There are no flags affected by these instructions.

6-4-2 AND LOAD and OR LOAD

AND LOAD – AND LD

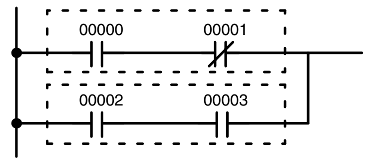
Ladder Symbol



Key Sequence AND LD WRITE

OR LOAD – OR LD

Ladder Symbol



Key Sequence OR LD WRITE

Description

When instructions are combined into blocks that cannot be logically combined using only OR and AND operations, AND LD and OR LD are used. Whereas AND and OR operations logically combine a bit status and an execution condition, AND LD and OR LD logically combine two execution conditions, the current one and the last unused one.

In order to draw ladder diagrams, it is not necessary to use AND LD and OR LD instructions, nor are they necessary when inputting ladder diagrams directly, as is possible from the LSS/SSS. They are required, however, to convert the program to and input it in mnemonic form.

In order to reduce the number of programming instructions required, a basic understanding of logic block instructions is required. For an introduction to logic blocks, refer to *6-2-5 Logic Block Instructions*.

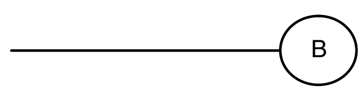
Flags

There are no flags affected by these instructions.

6-4-3 OUTPUT and OUTPUT NOT – OUT and OUT NOT

OUTPUT – OUT

Ladder Symbol



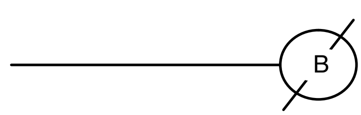
Operand Data Areas

B: Bit
IR, SR, AR, HR, LR, TR

Key Sequence OUT *Bit_address* WRITE

OUTPUT NOT – OUT NOT

Ladder Symbol



Operand Data Areas

B: Bit
IR, SR, AR, HR, LR

Key Sequence OUT NOT *Bit_address* WRITE

Description

OUT and OUT NOT are used to control the status of the designated bit according to the execution condition.

OUT turns ON the designated bit for an ON execution condition, and turns OFF the designated bit for an OFF execution condition.

OUT NOT turns ON the designated bit for a OFF execution condition, and turns OFF the designated bit for an ON execution condition.

OUT and OUT NOT can be used to control execution by turning ON and OFF bits that are assigned to conditions on the ladder diagram, thus determining execution conditions for other instructions. This is particularly helpful and allows a complex set of conditions to be used to control the status of a single work bit, and then that work bit can be used to control other instructions.

The length of time that a bit is ON or OFF can be controlled by combining the OUT or OUT NOT with TIM.

Precautions

Any output bit can generally be used in only one instruction that controls its status.

Flags

There are no flags affected by these instructions.

6-4-4 SET and RESET – SET and RSET

Ladder Symbols

Operand Data Areas

B: Bit
IR, SR, AR, HR, LR

Key Sequence FUN SET *Bit_address* WRITE

B: Bit
IR, SR, AR, HR, LR

Key Sequence FUN RESET *Bit_address* WRITE

Description

SET turns the operand bit ON when the execution condition is ON, and does not affect the status of the operand bit when the execution condition is OFF. RSET turns the operand bit OFF when the execution condition is ON, and does not affect the status of the operand bit when the execution condition is OFF.

The operation of SET differs from that of OUT because the OUT instruction turns the operand bit OFF when its execution condition is OFF. Likewise, RSET differs from OUT NOT because OUT NOT turns the operand bit ON when its execution condition is OFF.

Precautions

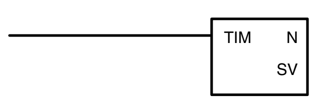
The status of operand bits for SET and RSET programmed between IL(002) and ILC(003) or JMP(004) and JME(005) will not change when the interlock or jump condition is met (i.e., when IL(002) or JMP(004) is executed with an OFF execution condition).

Flags

There are no flags affected by these instructions.

6-4-5 TIMER – TIM

Ladder Symbol



Definer Values

N: TC number
(000 through 511)

Operand Data Areas

SV: Set value (word, BCD)
IR, SR, AR, DM, HR, LR, #

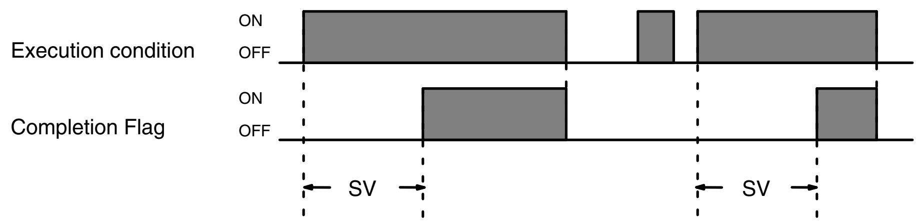
Key Sequence TIM *Timer_number* WRITE *Set_value* WRITE

Description

A timer is activated when its execution condition goes ON and is reset (to SV) when the execution condition goes OFF. Once activated, TIM measures in units of 0.1 second from the SV.

If the execution condition remains ON long enough for TIM to time down to zero, the Completion Flag for the TC number used will turn ON and will remain ON until TIM is reset (i.e., until its execution condition is goes OFF).

The following figure illustrates the relationship between the execution condition for TIM and the Completion Flag assigned to it.



Precautions

SV is between 000.0 and 999.9. The decimal point is not entered.

Each TC number can be used as the definer in only one TIMER or COUNTER instruction.

TC 000 through TC 015 should not be used in TIM if they are required for TIMH(15). (Refer to the *CQM1 Programming Manual* for details.)

Timers in interlocked program sections are reset when the execution condition for IL(02) is OFF. Power interruptions also reset timers. If a timer that is not reset under these conditions is desired, SR area clock pulse bits can be counted to produce timers using CNT. Refer to *6-4-6 COUNTER – CNT* for details.

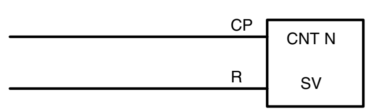
Flags

ER: SV is not in BCD.

Indirectly addressed DM word is non-existent. (Content of *DM word is not BCD, or the DM area boundary has been exceeded.)

6-4-6 COUNTER – CNT

Ladder Symbol



Definer Values

N: TC number
(000 through 511)

Operand Data Areas

SV: Set value (word, BCD)
IR, SR, AR, DM, HR, LR, #

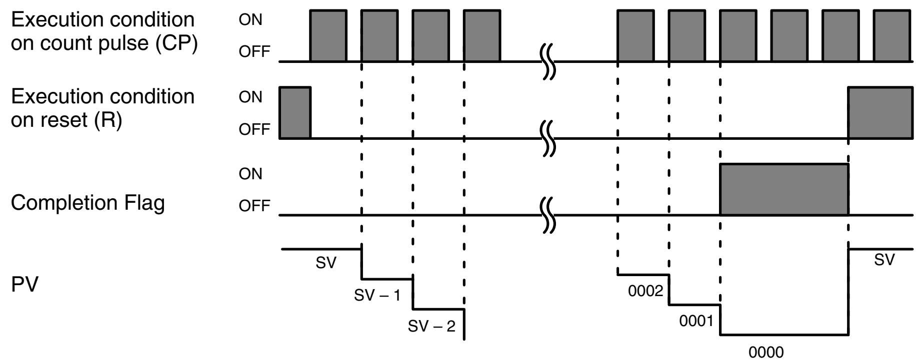
Key Sequence CNT *Counter_number* WRITE *Set_value* WRITE

Description

CNT is used to count down from SV when the execution condition on the count pulse, CP, goes from OFF to ON, i.e., the present value (PV) will be decremented by one whenever CNT is executed with an ON execution condition for CP and the execution condition was OFF for the last execution. If the execution condition has not changed or has changed from ON to OFF, the PV of CNT will not be changed. The Completion Flag for a counter is turned ON when the PV reaches zero and will remain ON until the counter is reset.

CNT is reset with a reset input, R. When R goes from OFF to ON, the PV is reset to SV. The PV will not be decremented while R is ON. Counting down from SV will begin again when R goes OFF. The PV for CNT will not be reset in interlocked program sections or by power interruptions.

Changes in execution conditions, the Completion Flag, and the PV are illustrated below. PV line height is meant only to indicate changes in the PV.



Precautions

Each TC number can be used as the definer in only one TIMER or COUNTER instruction.

Program execution will continue even if a non-BCD SV is used, but the SV will not be correct.

Flags

ER: SV is not in BCD.

Indirectly addressed DM word is non-existent. (Content of *DM word is not BCD, or the DM area boundary has been exceeded.)

Example

In the following example, CNT is used to create extended timers by combining counting SR area clock pulse bits.

CNT 001 counts the number of times the 1-second clock pulse bit (SR 25502) goes from OFF to ON. Here again, IR 00000 is used to control the times when CNT is operating.

Because in this example the SV for CNT 001 is 700, the Completion Flag for CNT 001 turns ON when 1 second x 700 times, or 11 minutes and 40 seconds have expired. This would result in IR 10202 being turned ON.

Address	Instruction	Operands	
00000	LD		00000
00001	AND		25502
00002	LD NOT		00001
00003	CNT		001
		#	0700
00004	LD	CNT	001
00005	OUT		10202

⚠ **Caution** The shorter clock pulses will not necessarily produce accurate timers because their short ON times might not be read accurately during longer cycles. In particular, the 0.02-second and 0.1-second clock pulses should not be used to create timers with CNT instructions.

6-5 Selected Special Instructions

6-5-1 END – END(01)

Ladder Symbol

Description

END(01) is required as the last instruction in any program. If there are subroutines, END(01) is placed after the last subroutine. No instruction written after END(01) will be executed. END(01) can be placed anywhere in the program to execute all instructions up to that point, as is sometimes done to debug a program, but it must be removed to execute the remainder of the program.

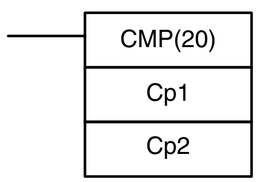
If there is no END(01) in the program, no instructions will be executed and the error message “NO END INST” will appear.

Flags

END(01) turns OFF the ER, CY, GR, EQ, and LE Flags.

6-5-2 COMPARE – CMP(20)

Ladder Symbols



Operand Data Areas

Cp1: First compare word
IR, SR, AR, DM, HR, TC, LR, #

Cp2: Second compare word
IR, SR, AR, DM, HR, TC, LR, #

Description

When the execution condition is OFF, CMP(20) is not executed. When the execution condition is ON, CMP(20) compares Cp1 and Cp2 and outputs the result to the GR, EQ, and LE Flags in the SR area.

Precautions

When comparing a value to the PV of a timer or counter, the value must be in BCD.

Placing other instructions between CMP(20) and the operation which accesses the EQ, LE, and GR Flags may change the status of these flags. Be sure to access them before the desired status is changed.

Flags

ER: Indirectly addressed DM word is non-existent. (Content of *DM word is not BCD, or the DM area boundary has been exceeded.)

EQ: ON if Cp1 equals Cp2.

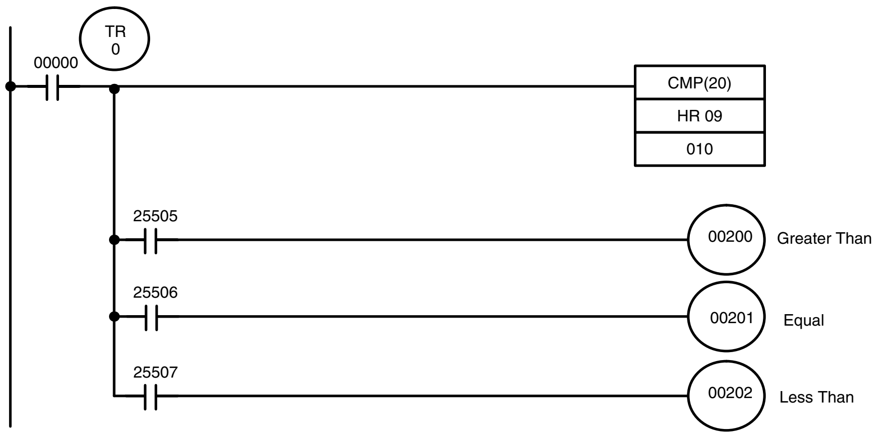
LE: ON if Cp1 is less than Cp2.

GR: ON if Cp1 is greater than Cp2.

Flag	Address	C1 < C2	C1 = C2	C1 > C2
GR	25505	OFF	OFF	ON
EQ	25506	OFF	ON	OFF
LE	25507	ON	OFF	OFF

Example: Saving CMP(20) Results

The following example shows how to save the comparison result immediately. If the content of HR 09 is greater than that of 010, 00200 is turned ON; if the two contents are equal, 00201 is turned ON; if content of HR 09 is less than that of 010, 00202 is turned ON. In some applications, only one of the three OUTs would be necessary, making the use of TR 0 unnecessary. With this type of programming, 00200, 00201, and 00202 are changed only when CMP(20) is executed.

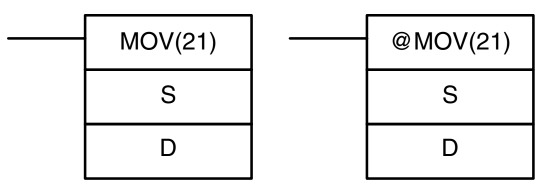


Address	Instruction	Operands	
00000	LD		00000
00001	OUT	TR	0
00002	CMP(20)		
			010
		HR	09
00003	LD	TR	0
00004	AND		25505

Address	Instruction	Operands	
00005	OUT		00200
00006	LD	TR	0
00007	AND		25506
00008	OUT		00201
00009	LD	TR	0
00010	AND		25507
00011	OUT		00202

6-5-3 MOVE – MOV(21)

Ladder Symbols



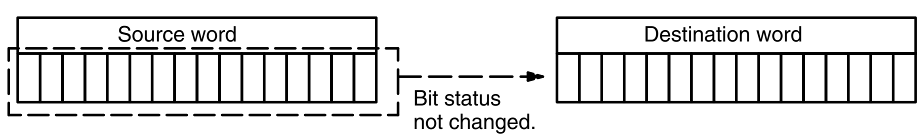
Operand Data Areas

S: Source word
IR, SR, AR, DM, HR, TC, LR, #

D: Destination word
IR, SR, AR, DM, HR, LR

Description

When the execution condition is OFF, MOV(21) is not executed. When the execution condition is ON, MOV(21) copies the content of S to D.



Precautions

DM 6144 to DM 6655 cannot be used for D.

TC numbers cannot be designated as D to change the PV of the timer or counter. You can, however, easily change the PV of a timer or a counter by using BSET(71).

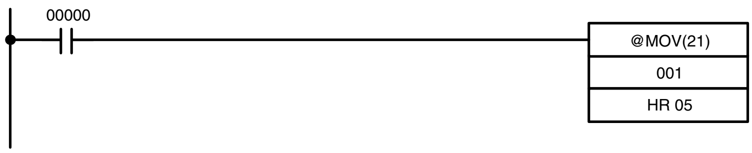
Flags

ER: Indirectly addressed DM word is non-existent. (Content of *DM word is not BCD, or the DM area boundary has been exceeded.)

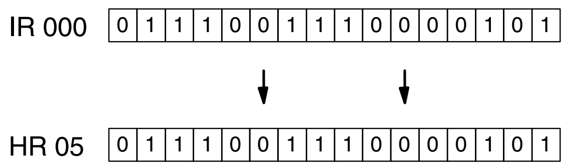
EQ: ON when all zeros are transferred to D.

Example

The following example shows @MOV(21) being used to copy the content of IR 001 to HR 05 when IR 00000 goes from OFF to ON.

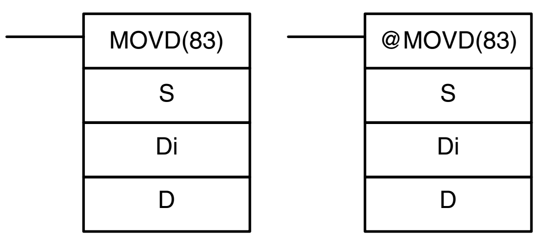


Address	Instruction	Operands	
00000	LD		00000
00001	@MOV(21)		
			001
		HR	05



6-5-4 MOVE DIGIT – MOVD(83)

Ladder Symbols



Operand Data Areas

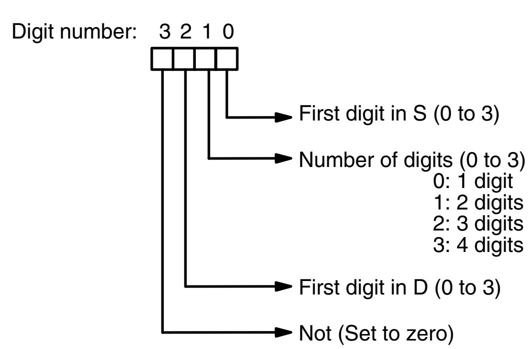
S: Source word
IR, SR, AR, DM, HR, TC, LR, #

Di: Digit designator (BCD)
IR, SR, AR, DM, HR, TC, LR, #

D: Destination word
IR, SR, AR, DM, HR, TC, LR

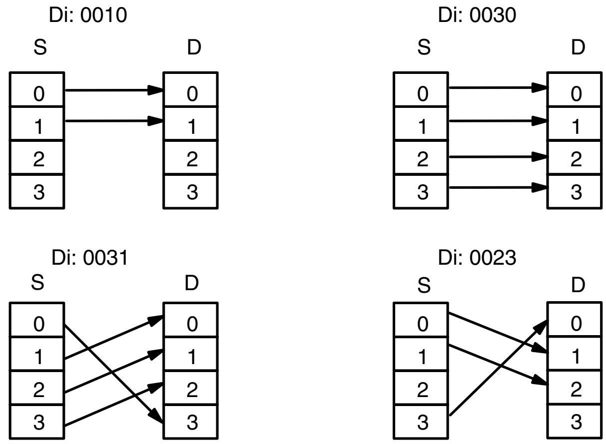
Description

When the execution condition is OFF, MOVD(83) is not executed. When the execution condition is ON, MOVD(83) copies the content of the specified digit(s) in S to the specified digit(s) in D. Up to four digits can be transferred at one time. The first digit to be copied, the number of digits to be copied, and the first digit to receive the copy are designated in Di as shown below. Digits from S will be copied to consecutive digits in D starting from the designated first digit and continued for the designated number of digits. If the last digit is reached in either S or D, further digits are used starting back at digit 0.



Digit Designator

The following show examples of the data movements for various values of Di.



Precautions

The rightmost three digits of Di must each be between 0 and 3.

DM 6144 to DM 6655 cannot be used for Di or D.

Flags

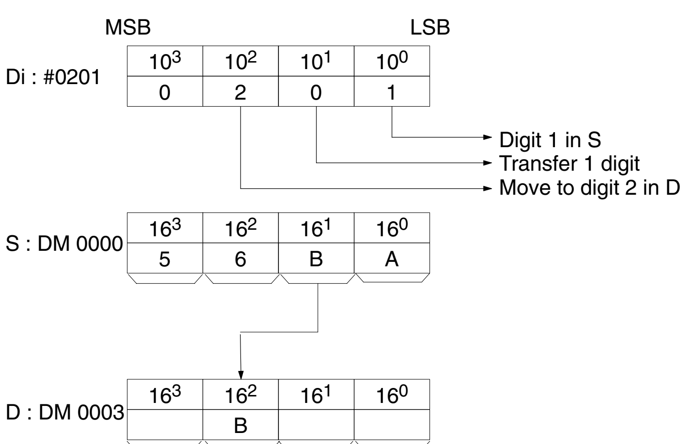
ER: At least one of the rightmost three digits of Di is not between 0 and 3.

Indirectly addressed DM word is non-existent. (Content of ✳DM word is not BCD, or the DM area boundary has been exceeded.)

Example

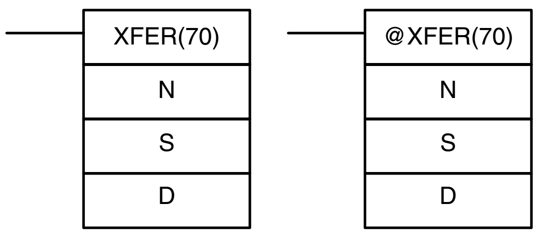
In the following example, MOVD(83) copies the contents of digit 1 (bits 04 to 07) of DM 0000 to digit 2 (bits 08 to 11) of DM 0003 when IR 00000 is ON.

Address	Instruction	Operands
00000	LD	00000
00001	@MOVD(83)	
		DM 0000
		#0201
		DM 0003



6-5-5 BLOCK TRANSFER – XFER(70)

Ladder Symbols



Operand Data Areas

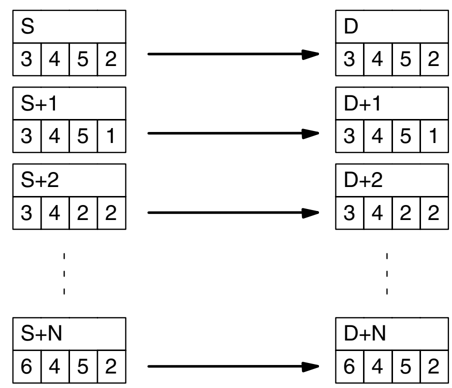
N: Number of words (BCD)
IR, SR, AR, DM, HR, TC, LR, #

S: Starting source word
IR, SR, AR, DM, HR, TC, LR

D: Starting destination word
IR, SR, AR, DM, HR, TC, LR

Description

When the execution condition is OFF, XFER(70) is not executed. When the execution condition is ON, XFER(70) copies the contents of S, S+1, ..., S+N to D, D+1, ..., D+N. XFER(70) can thus be used to shift data in memory.



Precautions

S and S+N must be in the same data area, as must D and D+N.

DM 6144 to DM 6655 cannot be used for D.

Flags

ER: N is not BCD

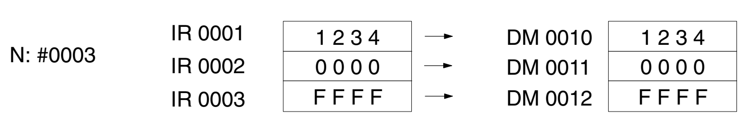
S and S+N or D and D+N are not in the same data area.

Indirectly addressed DM word is non-existent. (Content of *DM word is not BCD, or the DM area boundary has been exceeded.)

Example

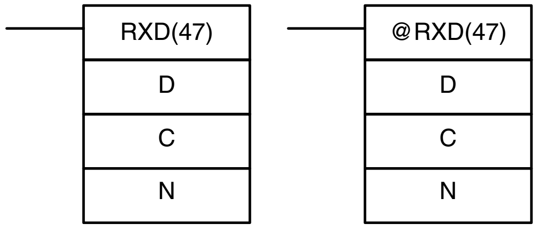
In the following example, XFER(70) copies the contents of IR 0001 through IR 0003 to DM 0010 through DM 0012 when IR 00000 is ON.

Address	Instruction	Operands
00000	LD	00000
00001	@XFER	
		#0003
		001
		DM 0010



6-5-6 RECEIVE – RXD(47)

Ladder Symbols



Operand Data Areas

D: First destination word
IR, SR, AR, DM, HR, TC, LR

C: Control data
#

N: Number of bytes
IR, SR, AR, DM, HR, TC, LR, #

Description

When the execution condition is OFF, RXD(47) is not executed. When the execution condition is ON, RXD(47) reads N bytes of data received at the port specified in the control data, and then writes that data in words D to D+(N÷2)–1. Up to 256 bytes of data can be read at one time.

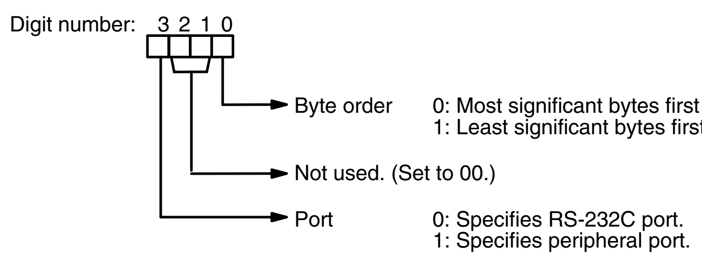
If fewer than N bytes are received, the amount received will be read.

Communications parameters are controlled in part through the ID Controller Setup. Refer to page 110 for details.

⚠ Caution The ID Controller will be incapable of receiving more data once 256 bytes have been received if received data is not read using RXD(47). Read data as soon as possible after the Reception Completed Flag is turned ON (AR 0806 for the RS-232C port, AR 0814 for the peripheral port.)

Control Data

The value of the control data determines the port from which data will be read and the order in which data will be written to memory.



The order in which data is written to memory depends on the value of digit 0 of C. Eight bytes of data 12345678... will be written in the following manner:

Digit 0 = 0

	MSB	LSB
D	1	2
D+1	3	4
D+2	5	6
D+3	7	8
⋮	⋮	⋮

Digit 0 = 1

	MSB	LSB
D	2	1
D+1	4	3
D+2	6	5
D+3	8	7
⋮	⋮	⋮

Precautions

D and D+(N÷2)–1 must be in the same data area.

DM 6144 to DM 6655 cannot be used for D or N.

N must be BCD from #0000 to #0256.

Flags

ER: A device is not connected to the specified port.

There is an error in the communications settings (ID Controller Setup) or the operand settings.

Indirectly addressed DM word is non-existent. (Content of *DM word is not BCD, or the DM area boundary has been exceeded.)

The destination words (D to D+(N÷2)–1) exceed the data area.

AR 08: AR 0806 will be turned ON when data has been received normally at the RS-232C port. Reset when RXD(47) is executed.
AR 0814 will be turned ON when data has been received normally at the peripheral port. Reset when RXD(47) is executed.

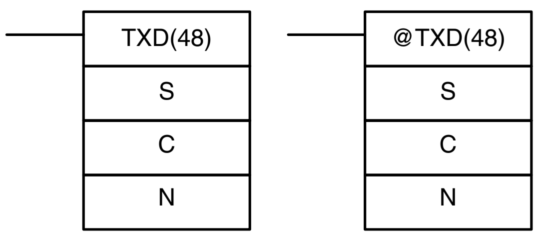
AR 09: Contains the number of bytes received at the RS-232C port. Reset to 0000 when RXD(47) is executed.

AR 10: Contains the number of bytes received at the peripheral port. Reset to 0000 when RXD(47) is executed.

Note Communications flags and counters can be cleared either by specifying 0000 for N or using the Port Reset Bits (SR 25208 for peripheral port and SR 25209 for RS-232C port.)

6-5-7 TRANSMIT – TXD(48)

Ladder Symbols



Operand Data Areas

S: First source word
IR, SR, AR, DM, HR, TC, LR

C: Control data
#

N: Number of bytes
IR, SR, AR, DM, HR, TC, LR, #

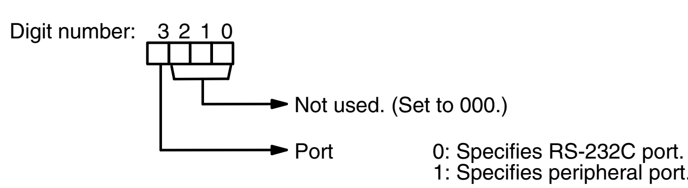
Description

When the execution condition is OFF, TXD(48) is not executed. When the execution condition is ON, TXD(48) reads N bytes of data from words S to S+(N÷2)–1, converts it to ASCII, and outputs the data from the specified port. TXD(48) operates differently in host link mode and RS-232C mode, so these modes are described separately.

Note Flag AR 0805 will be ON when the ID Controller is capable of transmitting data through the RS-232C port and AR 0813 will be ON when the ID Controller is capable of transmitting data through the peripheral port.

Host Link Mode

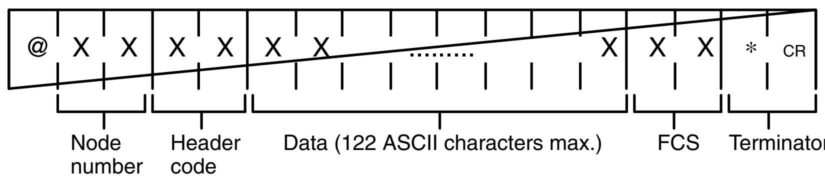
N must be BCD from #0000 to #0061 (i.e., up to 122 bytes of ASCII). The value of the control data determines the port from which data will be output, as shown below.



The specified number of bytes will be read from S through S+(N/2)–1, converted to ASCII, and transmitted through the specified port. The bytes of source data shown below will be transmitted in this order: 12345678...

	MSB	LSB
S	1	2
S+1	3	4
S+2	5	6
S+3	7	8
⋮	⋮	⋮

The following diagram shows the format for host link command (TXD) sent from the ID Controller. The ID Controller automatically attaches the prefixes and suffixes, such as the node number, header, and FCS.

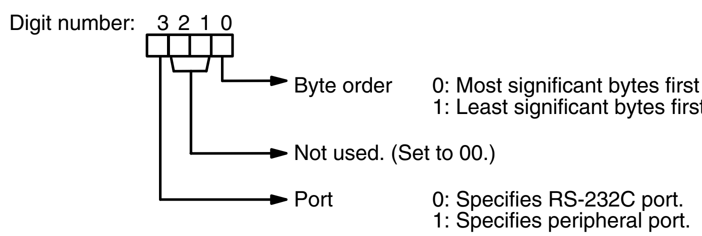


RS-232C Mode

N must be BCD from #0000 to #00256. The value of the control data determines the port from which data will be output and the order in which data will be written to memory.

Control Data

The value of the control data determines the port from which data will be read and the order in which data will be written to memory.



The specified number of bytes will be read from S through S+(NP2)–1 and transmitted through the specified port.

	MSB	LSB
S	1	2
S+1	3	4
S+2	5	6
S+3	7	8
⋮	⋮	⋮

When digit 0 of C is 0, the bytes of source data shown above will be transmitted in this order: 12345678...

When digit 0 of C is 1, the bytes of source data shown above will be transmitted in this order: 21436587...

Note When start and end codes are specified the total data length should be 256 bytes max., including the start and end codes.

Precautions

S and S+(N÷2)–1 must be in the same data area.

DM 6144 to DM 6655 cannot be used for S or N.

N must be BCD from #0000 to #0256. (#0000 to #0061 in host link mode)

Flags

ER: A device is not connected to the peripheral port.

There is an error in the communications settings (ID Controller Setup) or the operand settings.

Indirectly addressed DM word is non-existent. (Content of *DM word is not BCD, or the DM area boundary has been exceeded.)

The source words (S to S+(N÷2)–1) exceed the data area.

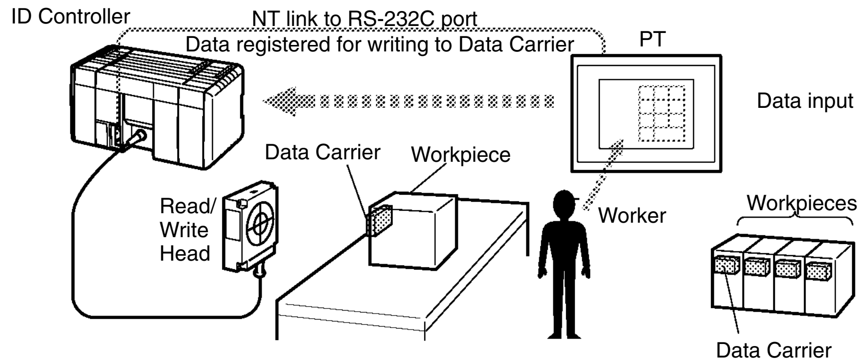
AR 08: AR 0805 will be turned ON when it is possible to transmit through the RS-232C port. AR 0813 will be turned ON when it is possible to transmit through the peripheral port.

SECTION 7
Programming Examples

This section provides four programming examples using ID communications instructions.

7-1 Recording Data

The ID Controller can be used to record data in Data Carriers. Workers can record data in the Data Carrier with a few simple operations from a Programmable Terminal (PT) while confirming data details on a PT's screen.



Process

When a worker inputs the ID number (destination code) of an article, the destination data is displayed on the PT and the ID number is written to the Data Carrier.

Data Carrier Data

The following data is written to the Data Carrier:

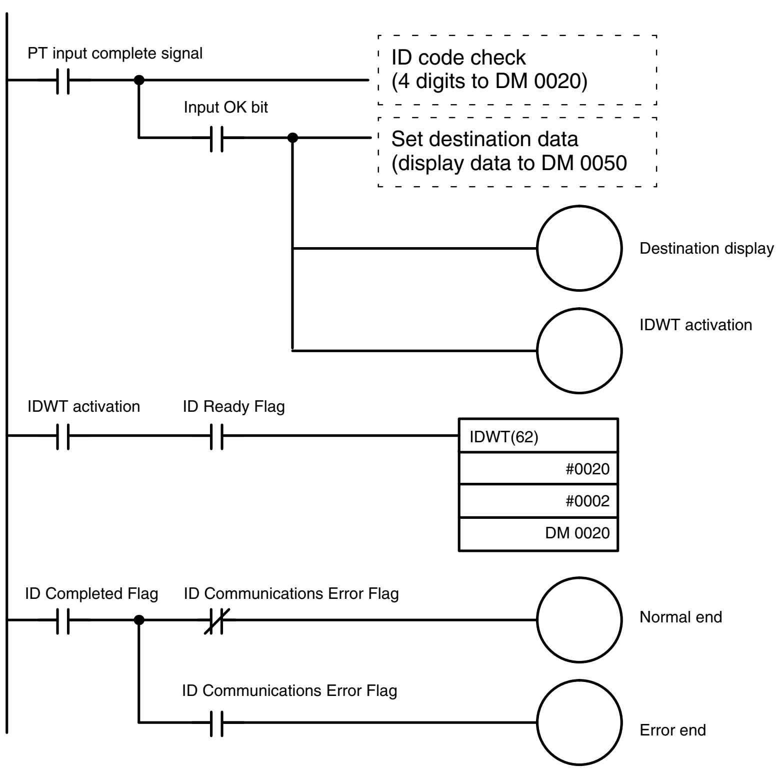
$0020: 12
$0021: 34

PT Settings

Use a ten-key input and set the PT so that the character string stored in DM 0050 is displayed after input.

Program

When the ID number is input, a search is made for messages displayed for the number. The character string is written into DM0050, and written as the ID number to the Data Carrier.



Check validity of 4-digit data input from PT.

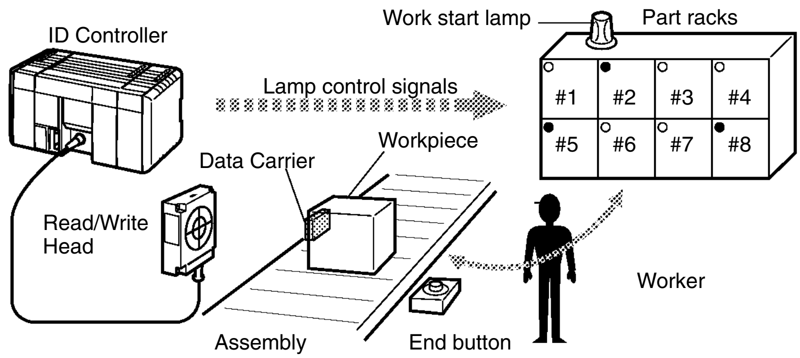
Set display data in DM 0050 is input is valid.

Write 2 bytes of data set in DM 0020 to Data Carrier address $0020.

Check ID Communications Error Flag and set bit to show either normal or error end.

7-2 Displaying Worker Instructions

In this example, the ID Controller reads work data from the Data Carrier for lamp displays to direct line workers.



Process

A lamp display based on data stored in the Data Carrier directs line workers on which part to use.

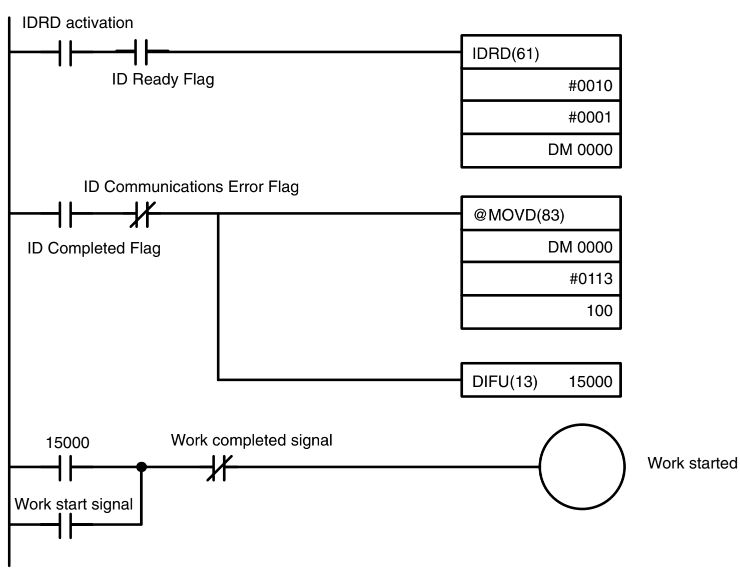
If a line worker presses the work completed button at the end of a job, the process shifts to the next process.

Data Carrier Data

Necessary and unnecessary data for each individual part (here $6D) is written in bit units to address $0010.

Program

Lamp displays are triggered by data that is read. The display turns off when the work completed switch is pressed.



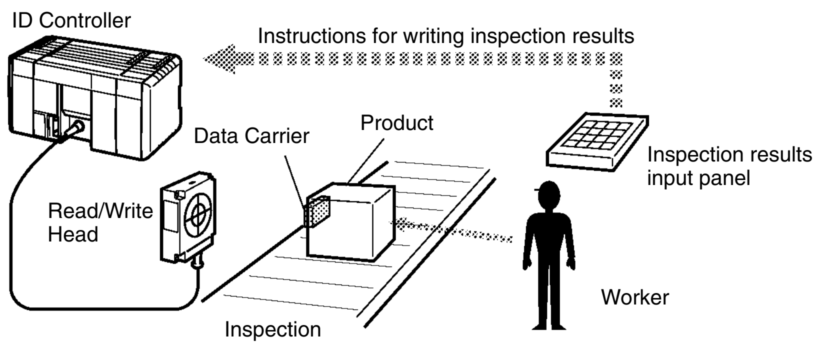
Read 1 byte of data from Data Carrier address $0010

Move rightmost bits of data read above to output word IR 100.

Lit work lamp until the work completed signal is input.

7-3 Managing Production Histories

The production history of products can be controlled in extreme detail at each process by writing assembly and inspection results together with other information, such as time and line workers, to the Data Carrier. Clock functions can be provided for time data when a Memory Cassette equipped with a clock is used.



Process

Once an inspection is completed, data results together with time data are written to the Data Carriers.

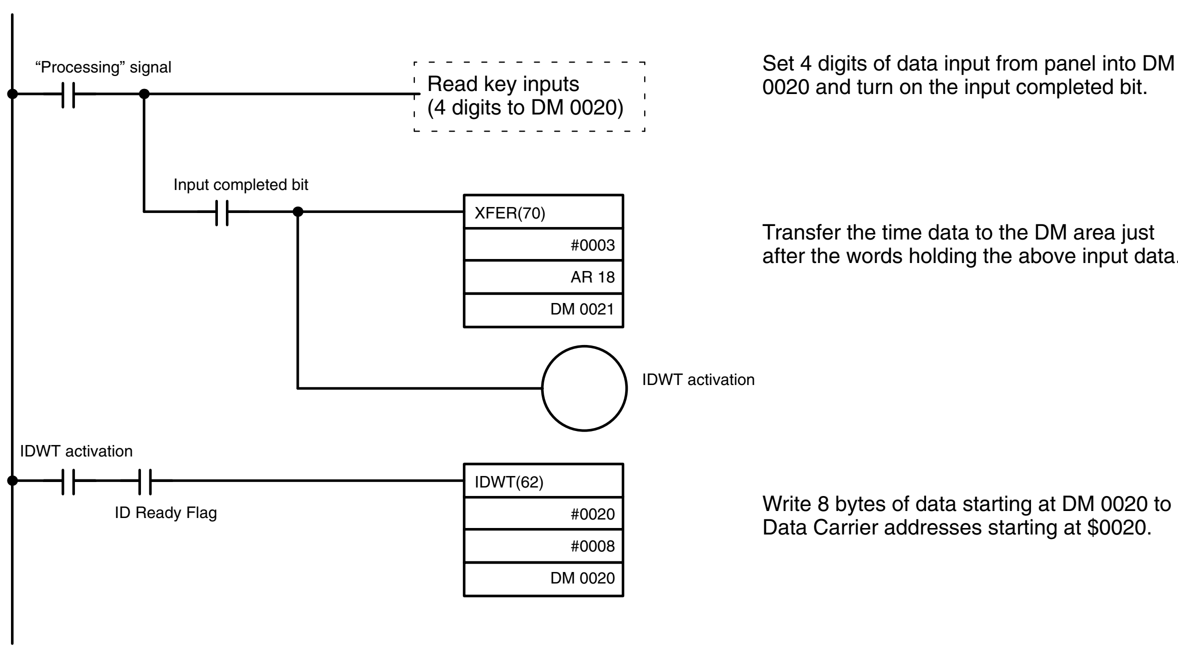
Data Carrier Data

The following data is written to the Data Carriers.

$0020 and $0021 (inspection data):	12	34
$0022 and $0023 (time data):	min.	s
$0024 and $0025 (time data):	date	hr
$0026 and $0027 (time data):	yr.	mo.

Program

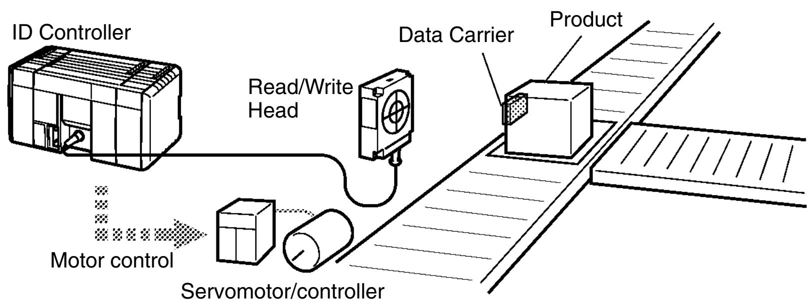
The following program achieves the desired process.



7-4 Controlling Workpiece Flow

In this example, the ID Controller is used to control flow of products on a conveyor line, e.g., to route products to another line by destination.

In addition to flow control with a simple mechanism like a pusher, the ID Controller is also ideally suited to advanced distribution control using devices that demand complex processing by servo motors and other equipment.



Process

When a pallet arrives, it is moved to an alternate destination according to data within the Data Carrier.

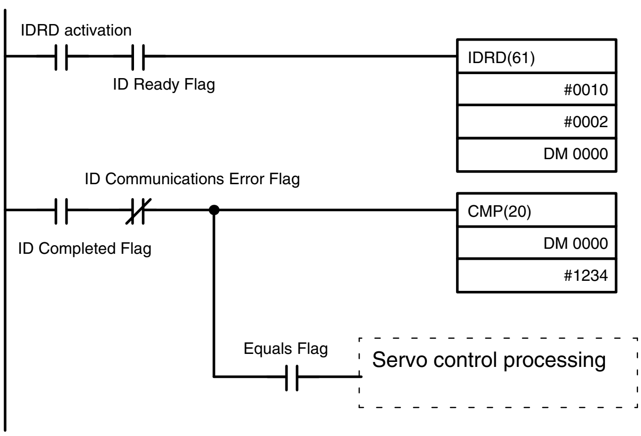
Data Carrier Data

The following data is set in the Data Carrier.

$0010 (destination code):	12
$0011 (destination code):	34

Program

The following program achieves the desired process.



Read 2 bytes of data from Data Carrier addresses $0010 and $0011.

Compare the data read from the Data Carrier to "1234."

If the code in the Data Carrier is "1234," move product to the branch conveyor.

SECTION 8
Internal Processing

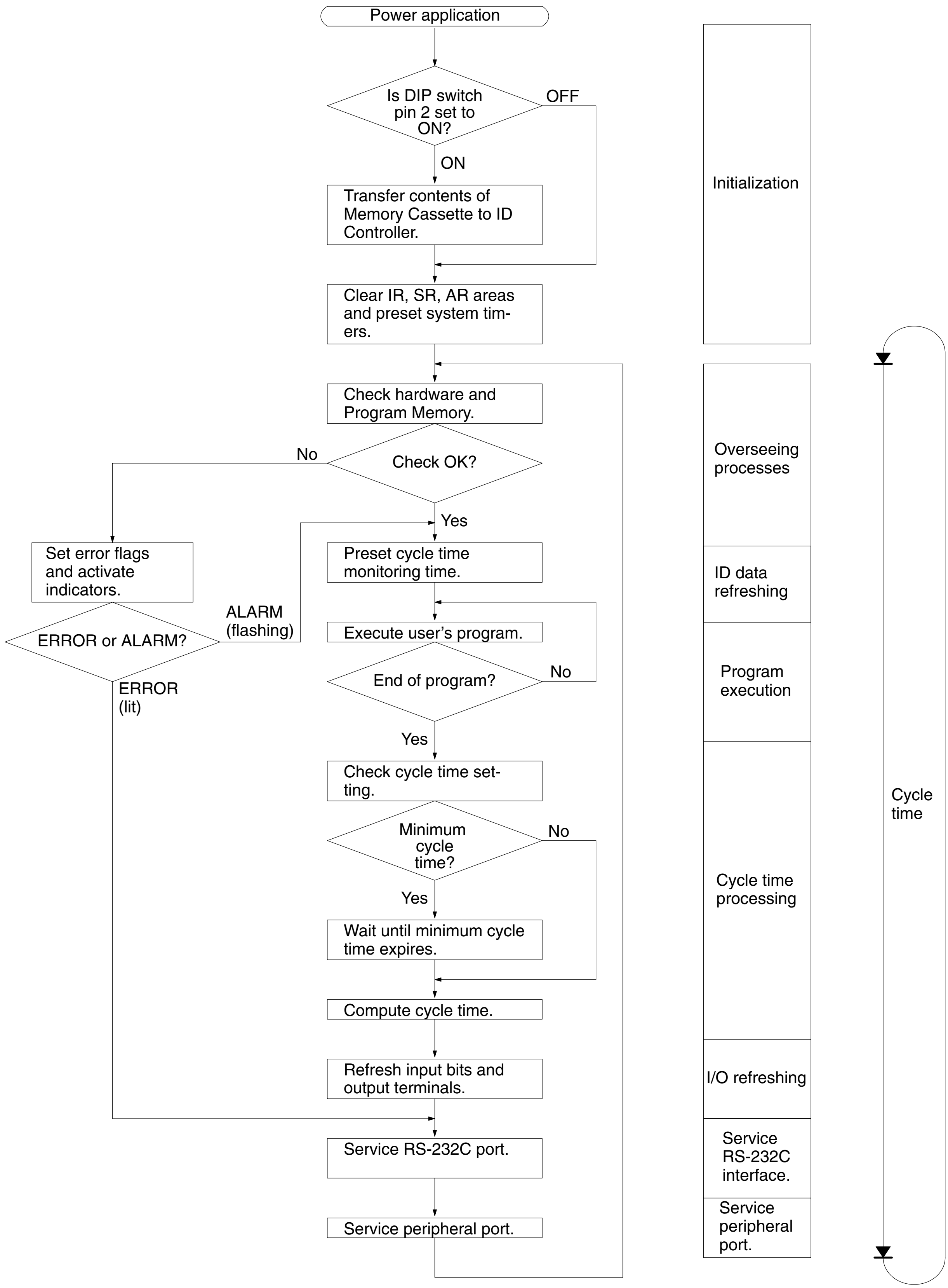
This section described the processing that takes place within the ID Controller and explains how to calculate the time required for program execution and related processing (called the scan time).

8-1 Internal Processing

This section explains ID Controller internal processing.

Operational Flowchart

The overall flow of ID Controller operation is as shown in the following flowchart.



One cycle of ID Controller operation is called a cycle. The time required for one cycle is called the cycle time. (The cycle time is also called the scan time.)

I/O Refresh Methods

ID Controller I/O refresh operations are broadly divided into two categories. The first of these, input refresh, involves reading the ON/OFF status of input points to the input bits. The second, output refresh, involves writing the ON/OFF status after program execution to the output points. The ID Controller I/O refresh methods are as shown in the following table.

Input/Output	I/O refresh method	Function
Input	Cyclic refresh	Input refresh is executed at a set time once per cycle.
	Interrupt input refresh	Input refresh is executed before execution of the interrupt processing routine whenever an input interrupt, interval timer interrupt, or high-speed counter interrupt occurs. (The cyclic refresh is also executed.)
Output	Cyclic refresh	Output refresh is executed at a set time once per cycle.
	Direct refresh	When there is an output from the user's program, that output point is immediately refreshed. (The cyclic refresh is also executed.)

The initial status of the ID Controller I/O refresh is as follows:

Input: Only cyclic refresh executed.
Output: Only cyclic refresh executed.

Cyclic refresh must be executed for both inputs and outputs. If input refresh is to be executed at the time of interrupts, then set the input refresh range in the ID Controller Setup (DM 6630 to DM 6638). Direct refresh can be set in DM 6639 of the ID Controller Setup.

In addition to the methods described above, it is also possible to execute I/O refreshes in the program by means of IORF(97).

Note Refer to the *CQM1 Programming Manual* for information on IORF(97).

8-2 Computing the Cycle Time

This section describes how to calculate ID Controller cycle time.

The processes involved in a single ID Controller cycle are shown in the following table, and their respective processing times are explained.

Process	Content	Time requirements
Overseeing	Setting cycle watchdog timer, I/O bus check, UM check, refreshing clock, refreshing ID data, etc.	0.9 ms (1.0 ms when a Memory Cassette equipped with a clock is mounted) (See note 2.)
Program execution	User program is executed.	Total time for executing instructions. (Varies according to content of user's program.)
Cycle time calculation	Standby until set time, when minimum cycle time is set in DM 6619 of ID Controller Setup. Calculation of cycle time.	Almost instantaneous, except for standby processing.
I/O refresh	Input information is read to input bits.	0.01 ms
	Output information (results of executing program) is written to output points.	0.005 ms
RS-232C port servicing	Devices connected to RS-232C port serviced.	5% or less of cycle time (See note 1.)
Peripheral port servicing	Devices connected to peripheral port serviced.	5% or less of cycle time (See note 1.)

Note 1. The percentages can be changed in the ID Controller Setup (DM 6616, DM 6617).

2. If storing ID errors is specified in the ID Controller Setup, the timer required for overseeing operations increases by 0.2 ms during any cycle where an ID error occurs.

Cycle Time and Operations The affects of the cycle time on ID Controller operations are as shown below.

Cycle time	Operation conditions
10 ms or longer	TIMH(15) may be inaccurate when TC 016 through TC 511 are used (operation will be normal for TC 000 through TC 015) (see note 1).
20 ms or longer	Programming using the 0.02-second Clock Bit (SR 25401) may be inaccurate.
100 ms or longer	Programming using the 0.1-second Clock Bit (SR 25500) may be inaccurate. A CYCLE TIME OVER error is generated (SR 25309 will turn ON) (see note 2).
120 ms or longer	The FALS 9F monitoring time SV is exceeded. A system error (FALS 9F) is generated, and operation stops (see note 3).
200 ms or longer	Programming using the 0.2-second Clock Bit (SR 25501) may be inaccurate.

Note
1. The number of timers to undergo interrupt processing can be set in DM 6629 of the ID Controller Setup. The default setting is for TC 000 through TC 015.
2. The ID Controller Setup (DM 6655) can be used to disable detection of CYCLE TIME OVER error.
3. The FALS 9F cycle monitoring time can be changed by means of the ID Controller Setup (DM 6618).

Cycle Time Example In this example, the cycle time is calculated for the ID Controller. The operating conditions are assumed to be as follows:

User's program: 2,000 instructions (configured of LD and OUT instructions)
Clock: None
RS-232C port: Not used
Cycle time: Variable (no minimum set)

Note The average processing time for a single instruction in the user's program is assumed to be 0.625 µs.

The cycle times are as shown in the following table.

Process	Calculation method	Time with peripheral device
Overseeing	Fixed	0.9 ms (1)
Program execution	0.625 × 2000 (µs)	1.25 ms (2)
Cycle time calculation	Negligible	0 ms (3)
I/O refresh	0.01 + 0.005 (ms)	0.015 ms (4)
RS-232C port servicing	Not used.	0 ms (5)
Peripheral port servicing	Minimum time	0.34 ms (6)
Cycle time	(1) + (2) + (3) + (4) + (5) + (6)	505 ms (2.165 if peripheral port is not used)

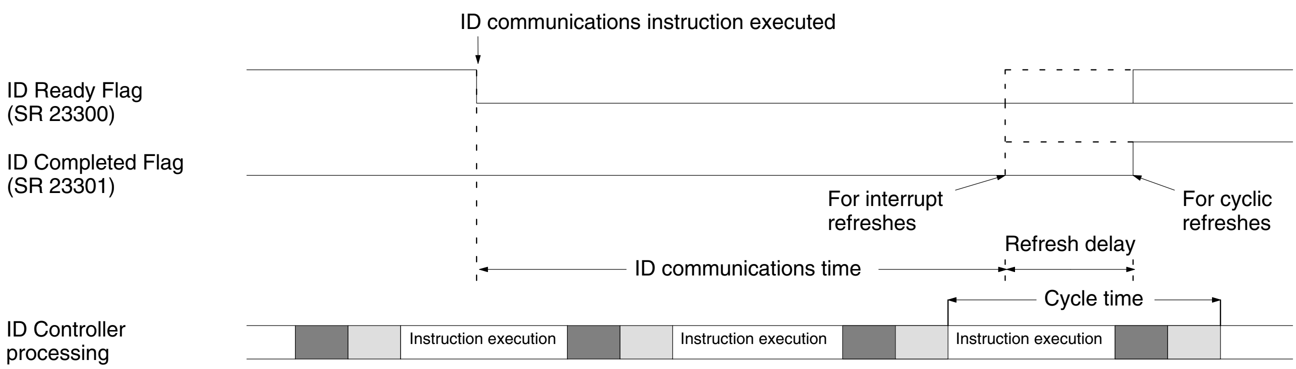
Note
1. The cycle time can be automatically read from the ID Controller via a Peripheral Device.
2. The maximum and current cycle time are stored in AR 26 and AR 27.
3. The cycle time can vary with actual operating conditions and will not necessarily agree precisely with the calculated value.
4. The RS-232C and peripheral port service time will be 0.34 ms minimum, 87 ms maximum.

8-3 Execution Times for ID Communications

This section shows how to calculate the TAT (turn-around time) for ID Controller communications. The TAT is the time from when a communications instruction is executed in the ladder-diagram program until a response is received.

ID Communications

The is always some what of a delay between executing an ID communications instruction, communicating with a Data Carrier, and receiving the results back to the ID Controller. This time, called the TAT, varies with the specifications for the ID communications instruction and the operating conditions of the ID Controller when the instruction is executed. The following diagram illustrates a generalized case.



Calculations for Cycle Refreshes

TAT = Instruction execution time + ID communications time + refresh delay
(Refresh delay = 1 cycle maximum)

Calculations for Interrupt Refreshes Refreshes

TAT = Instruction execution time + ID communications time + interrupt overhead

The interrupt overhead is the time required to activate the interrupt subroutine and is 0.1 ms for any ID communication instructions plus 0.3 ms to store read data for IDRD(61) and IDAR(63)

Instruction Execution Times

This following table lists the execution times for ID communications instructions. The maximum and minimum execution times and the conditions which cause them are given where relevant. When “word” is referred to in the Conditions column, it implies the content of any word except for indirectly addressed DM words. Indirectly addressed DM words, which create longer execution times when used, are indicated by “*DM.”

Refer to the *CQM1 Programming Manual* for execution times for other instructions.

Code	Mnemonic	Execution time (µs)	Conditions (minimum times first; maximum last)
61	IDRD	131.75	Constants for first two operands; word for third.
		135.75	Words for all three operands.
		216.75	*DM for all three operands

Code	Mnemonic	Execution time (µs)	Conditions (minimum times first; maximum last)
62	IDWT	135.75	Constants for first two operands; word for third. Writing one byte, normal order.
		146.75	Words for all three operands. Writing one byte, normal order.
		149.75	Words for all three operands. Writing one byte, reversing order.
		213.75	*DM for all three operands. Writing one byte, normal order.
		146.75	Constants for first two operands; word for third. Writing ten bytes, normal order.
		157.75	Words for all three operands. Writing ten bytes, normal order.
		160.75	Words for all three operands. Writing ten bytes, reversing order.
		224.75	*DM for all three operands. Writing ten bytes, normal order.
		433.75	Constants for first two operands; word for third. Writing 256 bytes, normal order.
		457.75	Words for all three operands. Writing 256 bytes, normal order.
		534.75	Words for all three operands. Writing 256 bytes, reversing order.
		530.75	*DM for all three operands. Writing 256 bytes, normal order.
63	IDAR	131.75	Constants for first two operands; word for third.
		132.75	Words for all three operands.
		212.75	*DM for all three operands
64	IDAW	134.75	Constants for first two operands; word for third. Reading one byte, normal order.
		146.75	Words for all three operands. Reading one byte, normal order.
		149.75	Words for all three operands. Reading one byte, reversing order.
		213.75	*DM for all three operands. Reading one byte, normal order.
		145.75	Constants for first two operands; word for third. Reading ten bytes, normal order.
		156.75	Words for all three operands. Reading ten bytes, normal order.
		160.75	Words for all three operands. Reading ten bytes, reversing order.
		224.75	*DM for all three operands. Reading ten bytes, normal order.
		456.75	Constants for first two operands; word for third. Reading 256 bytes, normal order.
		458.75	Words for all three operands. Reading 256 bytes, normal order.
		536.75	Words for all three operands. Reading 256 bytes, reversing order.
		550.75	*DM for all three operands. Reading 256 bytes, normal order.

Code	Mnemonic	Execution time (µs)	Conditions (minimum times first; maximum last)
65	IDCA	118.75	Constant for all three operands. Clearing part of memory.
		124.75	Words for all three operands. Clearing part of memory.
		202.75	*DM for all three operands. Clearing part of memory.
		115.75	Constant for all three operands. Clearing all of memory.
		125.75	Words for all three operands. Clearing all of memory.
		195.75	*DM for all three operands. Clearing all of memory.
66	IDMD	118.75	Constant for all three operands. Incrementing counter.
		127.75	Words for all three operands. Incrementing counter.
		195.75	*DM for all three operands. Incrementing counter.
		119.75	Constant for all three operands. Decrementing counter.
		133.75	Words for all three operands. Decrementing counter.
		199.75	*DM for all three operands. Decrementing counter.
		119.75	Constant for all three operands. Calculating check code.
		131.75	Words for all three operands. Calculating check code.
		199.75	*DM for all three operands. Calculating check code.
		119.75	Constant for all three operands. Verifying check code.
		127.75	Words for all three operands. Verifying check code.
		199.75	*DM for all three operands. Verifying check code.

Data Carrier Speed

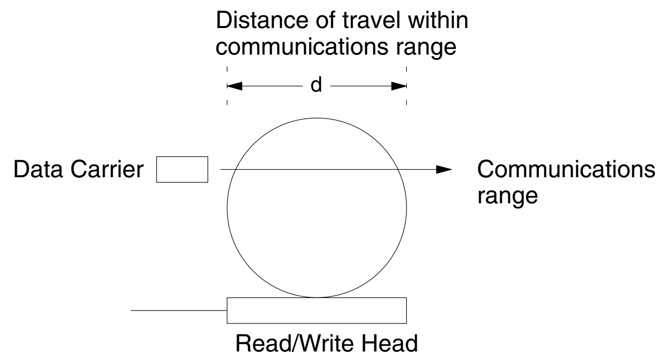
The maximum data carrier speed can be computer by dividing the distance of travel within the communications range by the ID communications time, as shown below: Refer to the following diagrams for

Carrier speed =

Distance within communications range ÷ ID communications time

Refer to the following diagrams for the ID communications time.

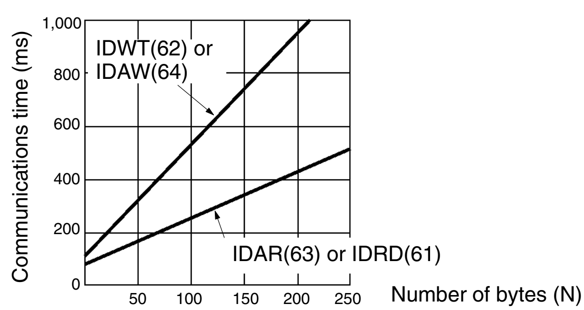
The distance of travel within the communications range varies with the Read/Write Head and the Data Carriers that are used. Refer to you Read/Write Head and Data Carrier manuals for details.



ID Communications Time

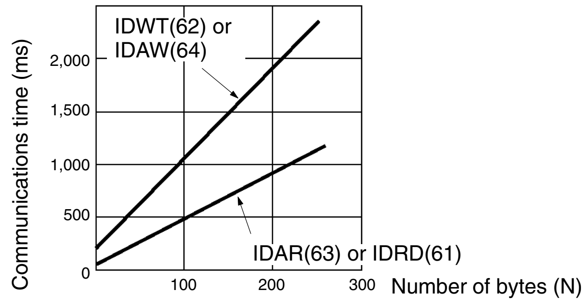
The communications time depends on the type of Data Carrier used: SRAM or EEPROM. The communications time for EEPROM Data Carriers depends on the setting of the ID communications mode in bits 00 through 03 of DM 6611 (communications distance or communications speed given preference). The following examples show the time required for communications between Read/Write Head and a Data Carrier when specific ID communications instructions are used.

SRAM Data Carriers (Reference)



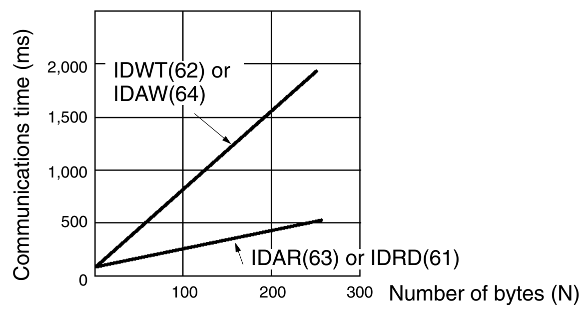
Instruction	ID communications time (ms)
IDAR(63)	T = (1.8 × N) + 48.4
IDAW(64)	T = (4.2 × N) + 86.5

EEPROM Data Carriers, Priority to Communications Distance (Reference)



Instruction	ID communications time (ms)
IDAR(63)	T = (4.3 × N) + 64.6
IDAW(64)	T = (8.7 × N) + 167.1

EEPROM Data Carriers, Priority to Communications Speed (Reference)



Instruction	ID communications time (ms)
IDAR(63)	T = (1.8 × N) + 79.0
IDAW(64)	T = (7.1 × N) + 180.4

SECTION 9
Troubleshooting

This section describes how to diagnose and correct the hardware and software errors that can occur during ID Controller operation and how to create user errors based on program execution.

9-1 Introduction

ID Controller errors can be divided broadly into the following four categories:

1, 2, 3...

1. Program Input Errors

   These errors occur when inputting a program or attempting an operation used to prepare the ID Controller for operation.
2. Programming Errors

   These errors will occur when the program is checked using the Program Check operation.
3. User-defined Errors

   There are three instructions that the user can use to define his own errors or messages. The instructions will be executed when a particular condition (defined by the user) has occurred during operation.
4. Operating Errors

   These errors occur after program execution has been started.

   a) Non-fatal Operating Errors
   ID Controller operation and program execution will continue after one or more of these errors have occurred.

   b) Fatal Operating Errors
   ID Controller operation and program execution will stop and all outputs from the ID Controller will be turned OFF when any of these errors have occurred.

The ID Controller's indicators will indicate when a ID Controller error has occurred and an error message or code will be displayed on the Programming Console or host computer if one is connected. The error code is also contained in SR 25300 to SR 25307.

For the most recent errors, both the type of error and time of occurrence will be recorded in an error log area (DM 6570 to DM 6599). Details are provided starting on page 110.

There are flags and other information provided in the SR and AR Areas that can be used in troubleshooting.

Note Errors can also occur in ID functions and Host Link functions. ID errors can be troubleshot through the ID indicators on the ID Controller or through ID Controller flags in memory. ID errors are described later in this sections. Refer to the *CQM1 Programming Manual* for details on Host Link errors.

9-2 Programming Console Operation Errors

The following error messages may appear when performing operations on the Programming Console. Correct the error as indicated and continue with the operation. The asterisks in the displays shown below will be replaced with numeric data, normally an address, in the actual display. Refer to the operation manual for your programming device or software for errors that may appear for it.

Message	Meaning and appropriate response
REPL ROM	An attempt was made to write to write-protected memory. Set the write-protect switch (pin 1 of the ID Controller's DIP switch) to OFF.
PROG OVER	The instruction at the last address in memory is not NOP(00). Erase all unnecessary instructions at the end of the program.
ADDR OVER	An address was set that is larger than the highest memory address in Program Memory. Input a smaller address.
SETDATA ERR	FALS 00 has been input, and “00” cannot be input. Reinput the data.
I/O NO. ERR	A data area address has been designated that exceeds the limit of the data area, e.g., an address is too large. Confirm the requirements for the instruction and re-enter the address.

9-3 Programming Errors

These errors in program syntax will be detected when the program is checked using the Program Check operation.

Three levels of program checking are available. The desired level must be designated to indicate the type of errors that are to be detected. The following table provides the error types, displays, and explanations of all syntax errors. Check level 0 checks for type A, B, and C errors; check level 1, for type A and B errors; and check level 2, for type A errors only.

Level A Errors

Message	Meaning and appropriate response
?????	The program has been damaged, creating a non-existent function code. Re-enter the program.
CIRCUIT ERR	The number of logic blocks and logic block instructions does not agree, i.e., either LD or LD NOT has been used to start a logic block whose execution condition has not been used by another instruction, or a logic block instruction has been used that does not have the required number of logic blocks. Check your program.
OPERAND ERR	A constant entered for the instruction is not within defined values. Change the constant so that it lies within the proper range.
NO END INSTR	There is no END(01) in the program. Write END(01) at the final address in the program.
LOCN ERR	An instruction is in the wrong place in the program. Check instruction requirements and correct the program.
JME UNDEFD	A JME(04) instruction is missing for a JMP(05) instruction. Correct the jump number or insert the proper JME(04) instruction.
DUPL	The same jump number or subroutine number has been used twice. Correct the program so that the same number is only used once for each.
SBN UNDEFD	The SBS(91) instruction has been programmed for a subroutine number that does not exist. Correct the subroutine number or program the required subroutine.
STEP ERR	STEP(08) with a section number and STEP(08) without a section number have been used incorrectly. Check STEP(08) programming requirements and correct the program.

Level B Errors

Message	Meaning and appropriate response
IL-ILC ERR	IL(02) and ILC(03) are not used in pairs. Correct the program so that each IL(02) has a unique ILC(03). Although this error message will appear if more than one IL(02) is used with the same ILC(03), the program will executed as written. Make sure your program is written as desired before proceeding.
JMP-JME ERR	JMP(04) 00 and JME(05) 00 are not used in pairs. Although this error message will appear if more than one JMP(04) 00 is used with the same JME(05) 00, the program will be executed as written. Make sure your program is written as desired before proceeding.
SBN-RET ERR	If the displayed address is that of SBN(92), two different subroutines have been defined with the same subroutine number. Change one of the subroutine numbers or delete one of the subroutines. If the displayed address is that of RET(93), RET(93) has not been used properly. Check requirements for RET(93) and correct the program.

Level C Errors

Message	Meaning and appropriate response
COIL DUPL	The same bit is being controlled (i.e., turned ON and/or OFF) by more than one instruction (e.g., OUT, OUT NOT, DIFU(13), DIFD(14), KEEP(11), SFT(10)). Although this is allowed for certain instructions, check instruction requirements to confirm that the program is correct or rewrite the program so that each bit is controlled by only one instruction.
JMP UNDEFD	JME(05) has been used with no JMP(04) with the same jump number. Add a JMP(04) with the same number or delete the JME(05) that is not being used.
SBS UNDEFD	A subroutine exists that is not called by SBS(91). Program a subroutine call in the proper place, or delete the subroutine if it is not required.

⚠ Caution Expansion instructions (those assigned to function codes 17, 18, 19, 47, 48, 60 to 69, 87, 88, and 89) are not subject to program checks.

9-4 User-defined Errors

There are three instructions that the user can use to define his own errors or messages. These instructions are used to send messages to the Programming Console connected to the ID Controller and cause a non-fatal or a fatal error.

MESSAGE – MSG(46)

MSG(46) is used to display a message on the Programming Console. The message, which can be up to 16 characters long, is displayed when the instruction's execution condition is ON.

FAILURE ALARM – FAL(06)

FAL(06) is an instruction that causes a non-fatal error. The following will occur when an FAL(06) instruction is executed:

1, 2, 3...
1. The ERR/ALM indicator on the ID Controller will flash. ID Controller operation will continue.
2. The instruction's 2-digit BCD FAL number (01 to 99) will be written to SR 25300 to SR 25307.
3. The FAL number and time of occurrence will be recorded in the ID Controller's error log area if a Memory Cassette with a clock (RTC) is used.

The FAL numbers can be set arbitrarily to indicate particular conditions. The same number cannot be used as both an FAL number and an FALS number.

To clear an FAL error, correct the cause of the error, execute FAL 00, and then clear the error using the Programming Console.

SEVERE FAILURE ALARM – FALS(07)

FALS(07) is an instruction that causes a fatal error. The following will occur when an FALS(07) instruction is executed:

1, 2, 3...
1. Program execution will be stopped and outputs will be turned OFF.

2. The ERR/ALM indicator on the ID Controller will be lit.
3. The instruction's 2-digit BCD FALS number (01 to 99) will be written to SR 25300 to SR 25307.
4. The FALS number and time of occurrence will be recorded in the ID Controller's error log area if a Memory Cassette with a clock (RTC) is used.

The FALS numbers can be set arbitrarily to indicate particular conditions. The same number cannot be used as both an FAL number and an FALS number.

To clear an FALS error, switch the ID Controller to PROGRAM mode, correct the cause of the error, and then clear the error using the Programming Console.

9-5 Operating Errors

There are two kinds of operating errors: non-fatal and fatal. ID Controller operation will continue after a non-fatal error occurs, but operation will be stopped if a fatal error occurs.

⚠ Caution Investigate all errors, whether fatal or not. Remove the cause of the error as soon as possible and restart the ID Controller. After removing the cause of the error, restart the ID Controller or clear the error from the Programming Console or from other Programming Devices.

9-5-1 Non-fatal Errors

ID Controller operation and program execution will continue after one or more of these errors have occurred. Although ID Controller operation will continue, the cause of the error should be corrected and the error cleared as soon as possible.

Indicator Status

When one of these errors occurs, the POWER and RUN indicators will remain lit and the ERR/ALM indicator will flash. ID indicators will be OFF for power interruptions, but are not related to other errors shown here.

Message	FAL No.	Meaning and appropriate response
SYS FAIL FAL**	01 to 99	An FAL(06) instruction has been executed in the program. Check the FAL number to determine conditions that would cause execution, correct the cause, and clear the error.
	9D	An error has occurred during data transmission between the ID Controller and Memory Cassette. Check the status of flags AR 1412 to AR 1415, and correct as directed. AR 1412 ON: Switch to PROGRAM Mode, clear the error, and transfer again. AR 1413 ON: The transfer destination is write-protected. If the ID Controller is the destination, turn off the power to the ID Controller, be sure that pin 1 of the ID Controller's DIP switch is OFF, clear the error, and transfer again. If an EEPROM Memory Cassette is the destination, check whether the power supply is on, clear the error, and transfer again. If an EPROM Memory Cassette is the destination, change to a writeable Memory Cassette (you cannot write to EPROM Memory Cassettes). AR 1414 ON: The destination has insufficient capacity. Check the source's program size in AR 15 and consider using a different Memory Cassette. AR 1415 ON: There is no program in the Memory Cassette or the program contains errors. Check the Memory Cassette.
	9C	An error has occurred in ID functions and SR 25415 will be ON. Refer to page 177 and troubleshoot via the ID indicators.

Message	FAL No.	Meaning and appropriate response
SYS FAIL FAL**	9B	An error has been detected in the ID Controller Setup. Check flags AR 2400 to AR 2402, and correct as directed. AR 2400 ON: An incorrect setting was detected in the ID Controller Setup (DM 6600 to DM 6614) when power was turned on. Correct the settings in PROGRAM Mode and turn on the power again. AR 2401 ON: An incorrect setting was detected in the ID Controller Setup (DM 6615 to DM 6644) when switching to RUN Mode. Correct the settings in PROGRAM Mode and switch to RUN Mode again. AR 2402 ON: An incorrect setting was detected in the ID Controller Setup (DM 6645 to DM 6655) during operation. Correct the settings and clear the error.
SCAN TIME OVER	F8	Watchdog timer has exceeded 100 ms. (SR 25309 will be ON.) This indicates that the program cycle time is longer than recommended. Reduce cycle time if possible or adjust the setting in DM 6655 if necessary.
BATT LOW	F7	Backup battery is missing or its voltage has dropped. (SR 25308 will be ON.) Check the battery and replace if necessary. Check the ID Controller Setup (DM 6655) to see whether a low battery will be detected.

Communication Errors

If an error occurs in communications through the peripheral port or RS-232C port the corresponding indicator (COM1 or COM2) will stop flashing. Check the connecting cables as well as the programs in the ID Controller and host computer.

Reset the communications ports with the Port Reset Bits, SR 25208 and SR 25209.

Output Inhibit

When the OUT INH indicator is lit, the Output Inhibit Bit (SR 25215) is ON and all outputs from the ID Controller will be turned off. If it is not necessary to have all outputs off, turn OFF SR 25215.

9-5-2 Fatal Errors

ID Controller operation and program execution will stop and all outputs from the ID Controller will be turned OFF when any of these errors have occurred.

Indicator Status

All ID Controller indicators will be OFF for the power interruption error. For all other fatal operating errors, the POWER and ERR/ALM indicators will be lit. The RUN indicator will be OFF. ID indicators will be OFF for power interruptions, but are not related to other errors shown here.

Message	FALS No.	Meaning and appropriate response
Power interruption (no message)	None	Power has been interrupted for more than the specified period. Check power supply voltage and power lines. Try to power-up again.
MEMORY ERR	F1	AR 1611 ON: A checksum error has occurred in the ID Controller Setup (DM 6600 to DM 6655). Initialize all of the ID Controller Setup and reinput.
		AR 1612 ON: A checksum error has occurred in the program, indicating an incorrect instruction. Check the program and correct any errors detected.
		AR 1613 ON: A checksum error has occurred in an expansion instruction's data. Initialize all of the expansion instruction settings and reinput.
		AR 1614 ON: Memory Cassette was installed or removed with the power on. Turn the power off, install the Memory Cassette, and turn the power on again.
		AR 1615 ON: The Memory Cassette contents could not be read at start-up. Check flags AR 1412 to AR 1415 to determine the problem, correct it, and turn on the power again.
NO END INST	F0	END(01) is not written anywhere in program. Write END(01) at the final address of the program.
I/O BUS ERR	C0	An error has occurred during data transfer between the CPU and I/O. Determine the location of the problem using flags AR 2408 to AR 2415, turn the power off, check for loose I/O connections or end covers, and turn on the power again.

Message	FALS No.	Meaning and appropriate response
SYS FAIL FALS** (see note)	01 to 99	An FALS(07) instruction has been executed in the program. Check the FALS number to determine the conditions that would cause execution, correct the cause, and clear the error.
	9F	The cycle time has exceeded the FALS 9F Cycle Time Monitoring Time (DM 6618). Check the cycle time and adjust the Cycle Time Monitoring Time if necessary.

9-6 ID Indicators

There are two kinds of ID errors: non-fatal (communications errors) and fatal. ID functions will continue after a non-fatal error occurs, but ID functions will be stopped if a fatal error occurs. ID Controller program execution and other operation will continue even for fatal ID errors.

⚠ Caution Investigate all errors, whether fatal or not. Remove the cause of the error as soon as possible and restart the ID Controller. After removing the cause of the error, restart the ID Controller or clear the error from the Programming Console or from other Programming Devices.

9-6-1 Non-fatal (Communications) Errors

General ID Controller operation and ID functions will continue after one or more of these errors have occurred. Although operation will continue, the cause of the error should be corrected and the error cleared as soon as possible.

ID Function Indicator Status

RDY: Lit
ERR: Flashing
T/R: Not lit
The status of other indicators is not relevant.

Message	FALS No.	Meaning and appropriate response
ID COMM ERR	7□	An error has occurred in communications with the Data Carrier. SR 23302 will be ON and the nature of the error will be indicated in one of the flags between SR 23308 and SR 23313. The program should be written to execute retries. If communications errors continue, there may be problems in the system or system devices. Investigate the error and take appropriate actions.

9-6-2 Fatal Errors

Although general ID Controller operation will continue, ID functions will stop when any of these errors have occurred.

Indicator Status

ERR/ALM: Flashing
RDY: Not lit
The status of other indicators is not relevant.

Message	FAL No.	Meaning and appropriate response
SYS FAIL FAL**	9C	An error has occurred in ID functions and SR 25415 will be ON. If an watchdog timer error occurred, the content of AR 04 will be 01□□. Turn the power to the ID Controller off and then back on.

Indicator Status

ERR/ALM: Flashing
RDY: Lit
The status of other indicators is not relevant.

Message	FAL No.	Meaning and appropriate response
SYS FAIL FAL**	9C	An error has occurred in ID functions and SR 25415 will be ON. If an memory error has occurred, the content of AR 04 will be 02□□. Turn the power to the ID Controller off and then back on.

Indicator Status

ERR/ALM: Flashing
RDY: Lit
ERR: Lit
The status of other indicators is not relevant.

Message	FAL No.	Meaning and appropriate response
SYS FAIL FAL**	9C	**AR 04 = 03□□** There is an error in the ID Controller Setup relating to ID functions. Correct the settings in PROGRAM mode and turn the power to the ID Controller off and then back on. **AR 04 = 04□□** The operating mode was changed while communicating with the Read/Write Head. Turn the power to the ID Controller off and then back on, or clear the error and change the operating mode.

9-7 ID Controller Flags

ID Communications Errors

SR 23302 (ID Communications Error Flag) will turn ON if an error occurs in ID communications. When this happens, the following flags can be used to troubleshoot the cause of the error. The following errors are recorded in the ID Controller and can be read out using a Programming Console.

Bit	Name (code)	ON when	Action
SR 23308	DC Missing Error Flag (72)	There is no Data Carrier in the communications range.	Check the installation distances and program execution timing.
SR 23309	Write Protected Error Flag (7D)	A write was specified for a protected area.	Release the memory protection or change the write address.
SR 23310	DC Communications Error Flag (70)	An error occurred in communications with the Data Carrier.	Check for noise, check the Data Carrier speed, and check installation distances.
SR 23311	Address Error Flag (7A)	An illegal address was specified.	Check the address setting to be sure it is within range. If IDMD(66) is being executed, check address according to instruction specifications.
SR 23312	Verification Error Flag (71)	A write or read operation was not completed normally.	Check for noise.
SR 23313	No Head Error Flag (7C)	A Read/Write Head is not connected.	Connect a Read/Write Head.

ID Communications Warnings

The following flags will turn ON to indicate various warnings even when ID communications have been completed normally. These errors are not recorded in the ID Controller.

Bit	Name	ON when	Action
SR 23306	DC Battery Warning Flag	The voltage of the battery built into the Data Carrier is low, indicating the battery has passed its service life.	Replace the Data Carrier battery or, if the battery is not replaceable, replace the Data Carrier.
SR 23307	ID Check Warning Flag	An error is detected for the IDMD(66) (ID CHECK) instruction.	If write count management was being used, either change the write area or replace the Data Carrier. If a check code was being verified, either the life of the Data Carrier has expired or it is not being used under proper conditions. Check operating conditions and replace the Data Carrier if its life has expired.

Note SR 23307 (ID Check Warning Flag) will also turn ON if the IDMD(66) is not used correctly. Be sure to correctly operands carefully when writing or update the write count, when writing the check code, and when specifying check area words.

9-8 ID Error Logs

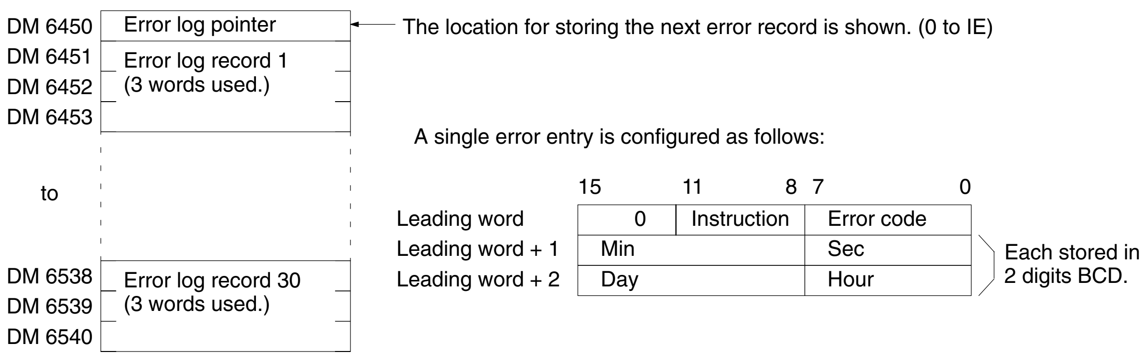
The ID error log function registers the error code of any ID error that occurs in the ID Controller, along with the date and time at which it occurred.

Note There is also an error log for errors in general ID Controller operation. Refer to the *CQM1 Operation Manual* for details.

There are two areas used by the ID error log function. The first area is the ID Error Log, which contains records for up to 30 ID errors, and the second area is the ID Error Statistics Log, which records the number of times each type of ID error has occurred (9,999 max.).

ID Error Log Area

The ID error log is stored in DM 6450 through DM 6540, as shown below.



Item	Contents		
Instruction	A single digit indicates the instruction as follows:		
	1: IDRD(61)	3: IDAR(63)	5: IDCA(65)
	2: IDWT(62)	4: IDAW(64)	6: IDMD(66)
Error code	70 to 7D (see following table)		
Clock date	Date and time in AR 18 and AR 19 used.		

ID Error Statistics Log

DM 6541 through DM 6546 contain the number of errors that have occurred for each error code through a maximum of 9,999 errors for each.

DM 6541	Errors for code 70
DM 6542	Errors for code 71
DM 6543	Errors for code 72
DM 6544	Errors for code 7A
DM 6545	Errors for code 7C
DM 6546	Errors for code 7D

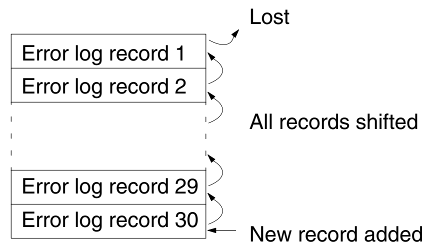
Error code	Error
70	DC communications error
71	Verification error
72	DC missing error
7A	Address error
7C	Read/Write Head missing error
7D	Write protect error

Error Log Storage Methods

The error log storage method is set in the ID Controller Setup (DM 6655). Set any of the following methods.

1, 2, 3...

1. You can store the most recent 30 error log records and discard older records. This is achieved by shifting the records as shown below so that the oldest record (record 1) is lost whenever a new record is generated.



2. You can store only the first 30 error log records, and ignore any subsequent errors beyond those 30.
3. You can disable the log so that no records are stored.

The default setting is the first method. Refer to *Error Log Settings* on page 71 for details on the ID Controller Setup for the error log.

If a Memory Cassette without a clock is mounted, the date and time will be all zeros.

Error records will be stored even if pin 1 on the ID Controller DIP switch is turned ON to protect DM 6144 to DM 6655.

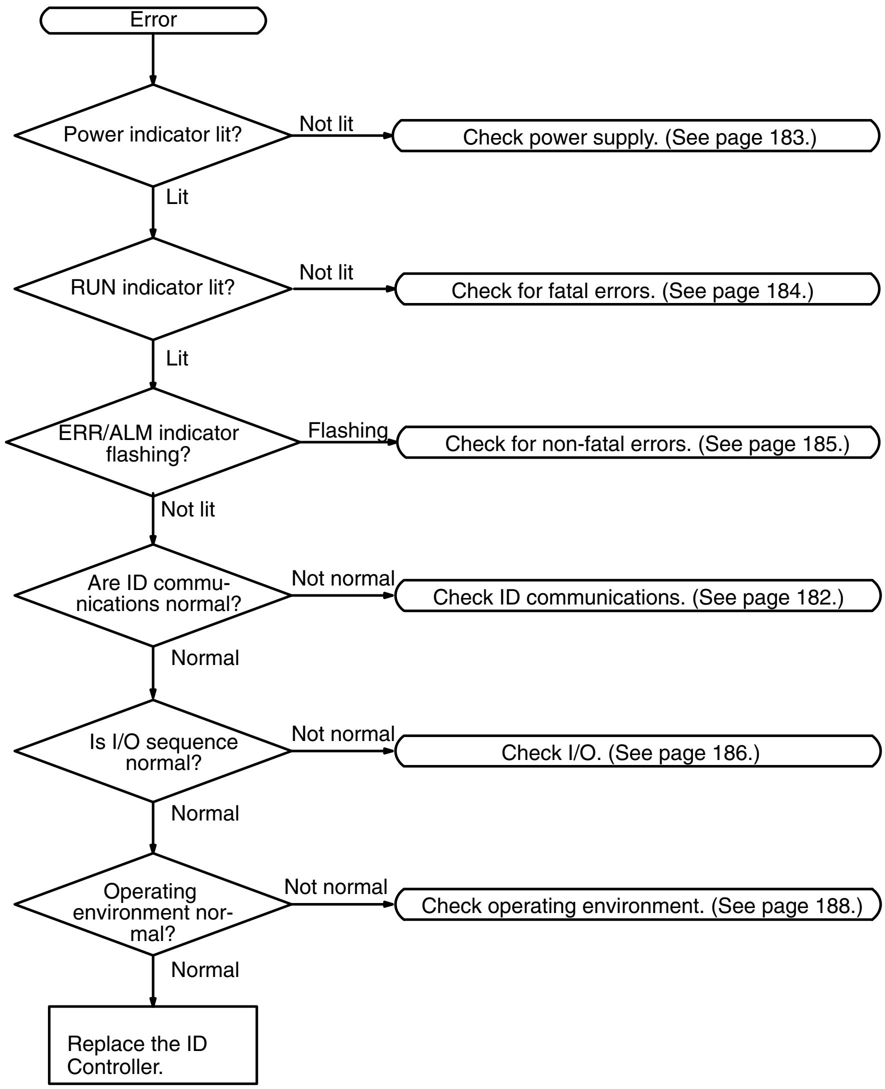
Clearing the Error Log

To clear the entire ID Error Log, turn ON SR 23210 from a peripheral device. To clear the entire ID Error Statistics Log, turn ON SR 23211 from a peripheral device. (After the error log has been cleared, SR 23210 and SR 23211 will turn OFF again automatically.)

9-9 Troubleshooting Flowcharts

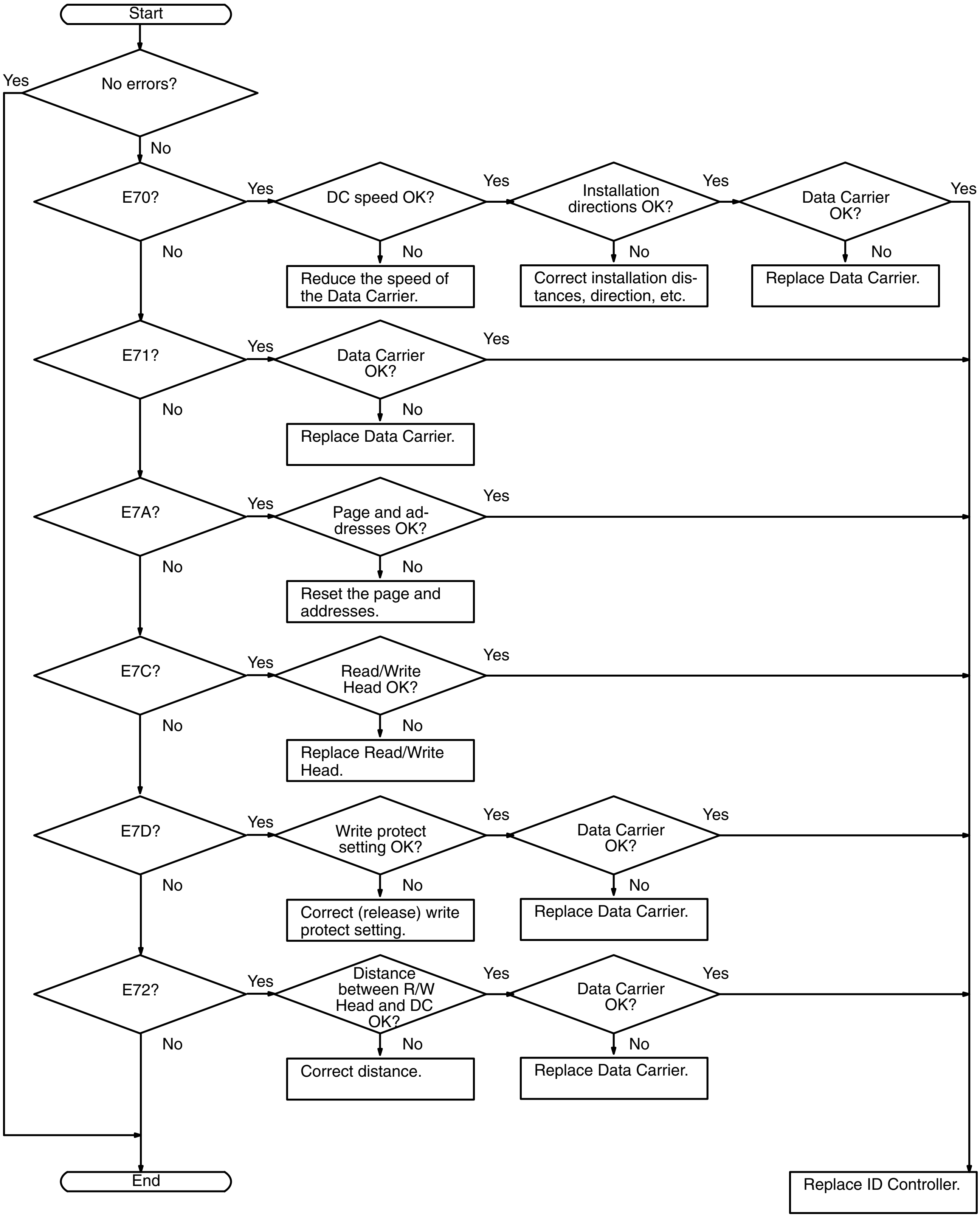
Use the following flowcharts to troubleshoot errors that occur during operation.

Main Check

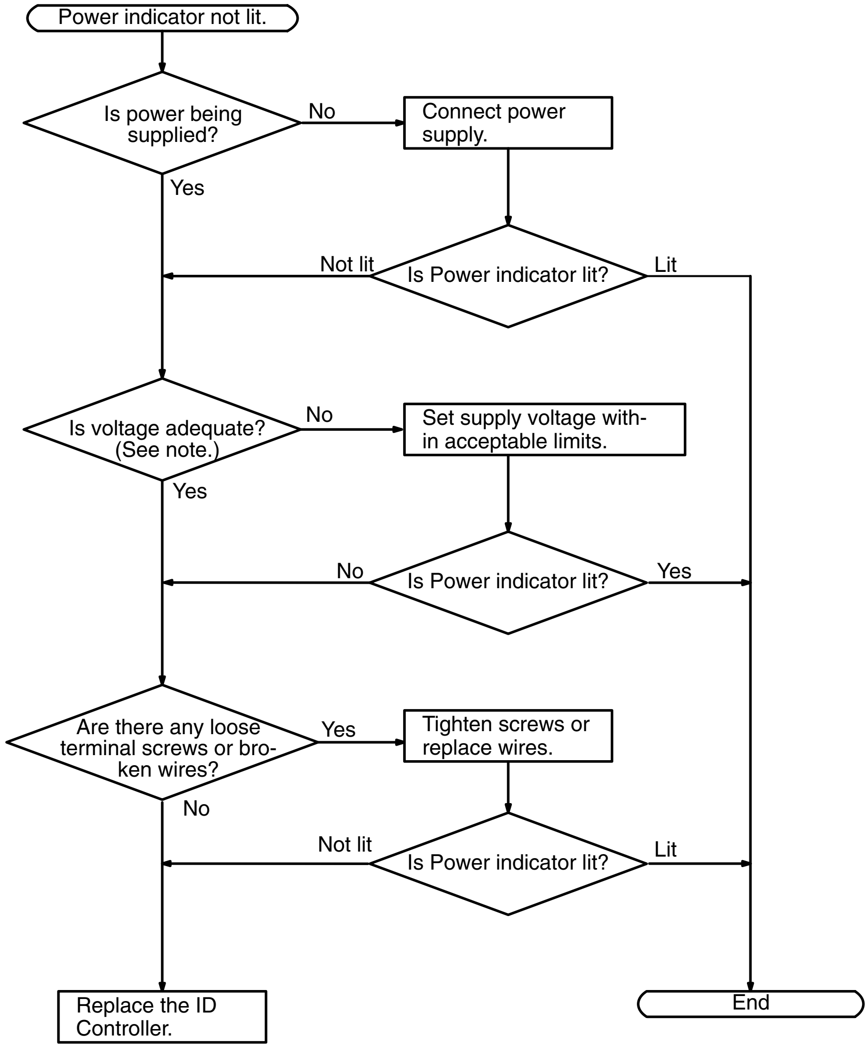


Note Always turn off the power to the ID Controller before replacing batteries, wiring, or cables.

I/O Communications Check Before starting the following flowchart, connect a Programming Console and read the ID error history.



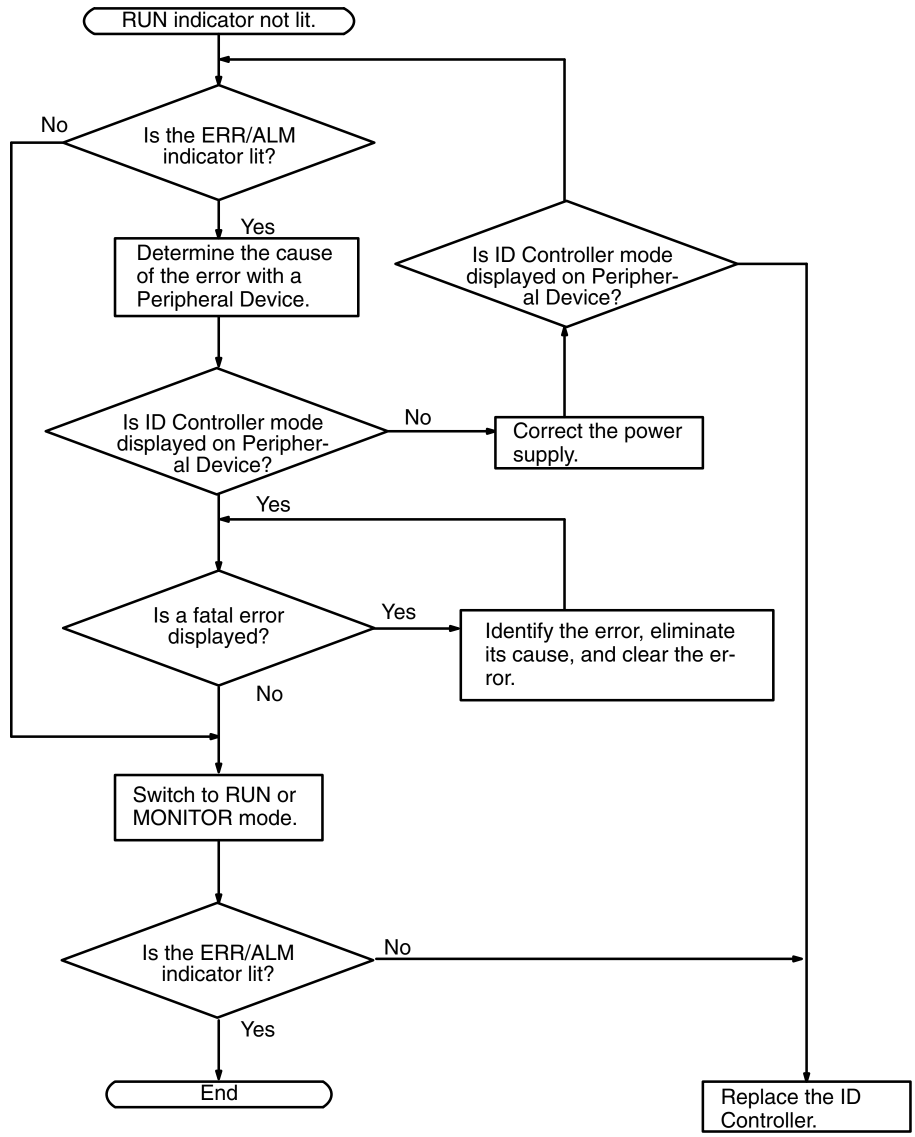
Power Supply Check



Note The allowable voltage range for the ID Controller is 85 to 264 VAC.

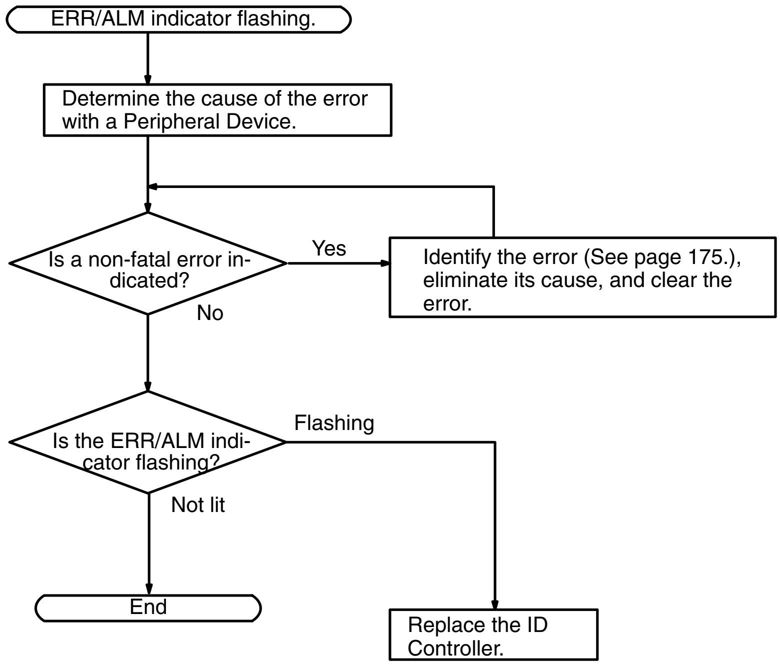
Fatal Error Check

The following flowchart can be used to troubleshoot fatal errors that occur while the Power indicator is lit.



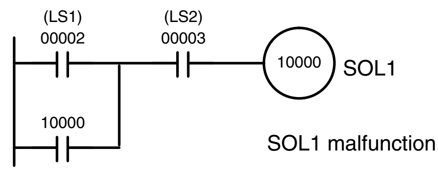
Non-fatal Error Check

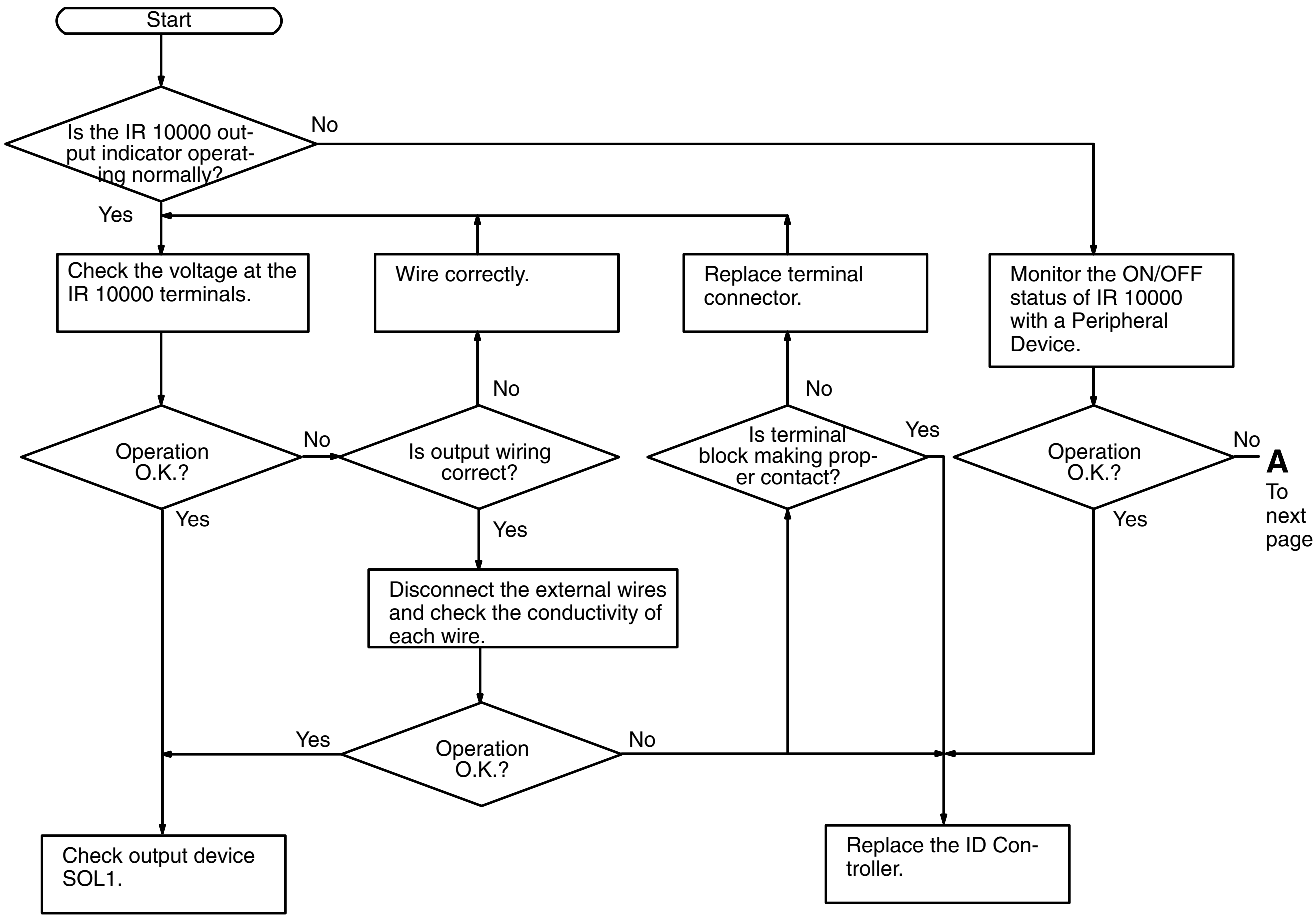
Although the ID Controller will continue operating during non-fatal errors, the cause of the error should be determined and removed as quickly as possible to ensure proper operation. It may to necessary to stop ID Controller operation to remove certain non-fatal errors.

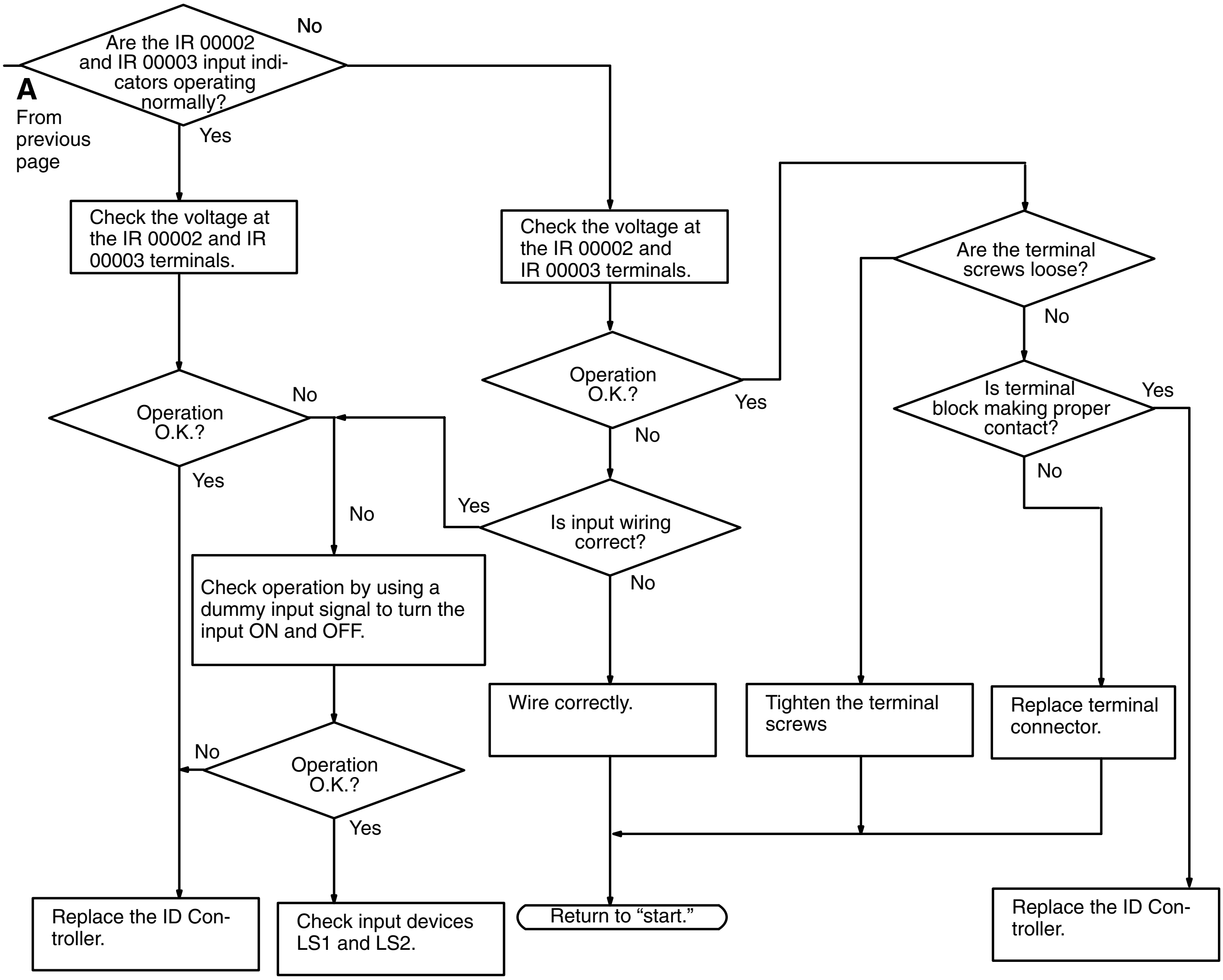


I/O Check

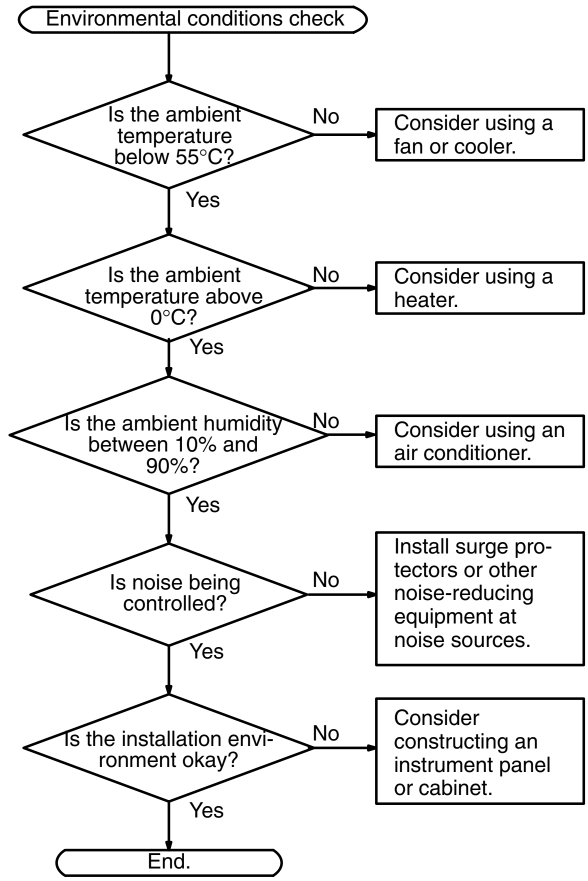
The I/O check flowchart is based on the following ladder diagram section.






A
From previous page
Are the IR 00002 and IR 00003 input indicators operating normally?
No
Yes
Check the voltage at the IR 00002 and IR 00003 terminals.
Check the voltage at the IR 00002 and IR 00003 terminals.
Are the terminal screws loose?
No
Operation O.K.?
No
Operation O.K.?
Yes
Is terminal block making proper contact?
Yes
No
Yes
No
No
Yes
Is input wiring correct?
No
Check operation by using a dummy input signal to turn the input ON and OFF.
Wire correctly.
Tighten the terminal screws
Replace terminal connector.
No
Operation O.K.?
Yes
Replace the ID Controller.
Check input devices LS1 and LS2.
Return to "start."
Replace the ID Controller.

Environmental Conditions Check



Appendix A
Standard Models

ID Controllers

Name	Model Number	Specifications
ID Controller	IDSC-C1DR-A-E	Relay contact outputs
	IDSC-C1DT-A-E	Transistor outputs

Peripheral Devices

Name	Model Number	Specifications
Programming Console	CQM1-PRO01-E	2-m Connecting Cable attached
	C200H-PRO27-E	Hand-held, w/backlight; requires the C200H-CN222 or C200H-CN422, see below
Ladder Support Software	C500-SF312-EV3	3.5", 2HD for IBM PC/AT compatible
	C500-SF711-EV3	5.25", 2D for IBM PC/AT compatible
SYSMAC Support Software	C500-ZL3AT1-E	3.5", 2HD for IBM PC/AT compatible
Connecting Cable	CQM1-CIF02	Connects IBM PC/AT or compatible computers to Peripheral Port
	C200H-CN222	Connects C200H Programming Console to Peripheral Port (2 m)
	C200H-CN422	Connects C200H Programming Console to Peripheral Port (4 m)

Memory Cassettes (Optional)

Model Number	Clock Function	Memory
CQM1-ME04K	No	4K-word EEPROM
CQM1-ME04R	Yes	
CQM1-ME08K	No	8K-word EEPROM
CQM1-ME08R	Yes	
CQM1-MP08K	No	EPROM IC socket only. EPROM chip not included. Refer to the following table for details on available EPROM ICs.
CQM1-MP08R	Yes	

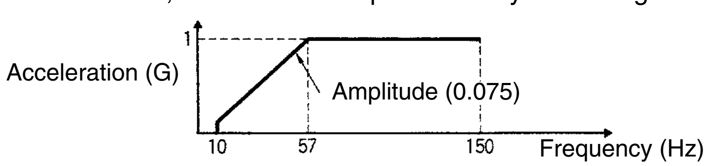
Appendix B
Specifications

General Specifications

Item	Specification
Supply voltage	100 to 240 VAC, 50/60 Hz
Operating voltage range	85 to 264 VAC
Operating frequency range	47 to 63 Hz
Power consumption	60 VA max.
Inrush current	30 A max.
Output capacity	5 VDC: 3.6 A (18 W)
Insulation resistance	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.
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: 1G (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	15G (12G for contact outputs) 3 times each in X, Y, and Z directions
Ambient temperature	Operating: 0°C to 55°C Storage: –20°C 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	1.5 kilograms max.
Dimensions (without cables)	219 × 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.

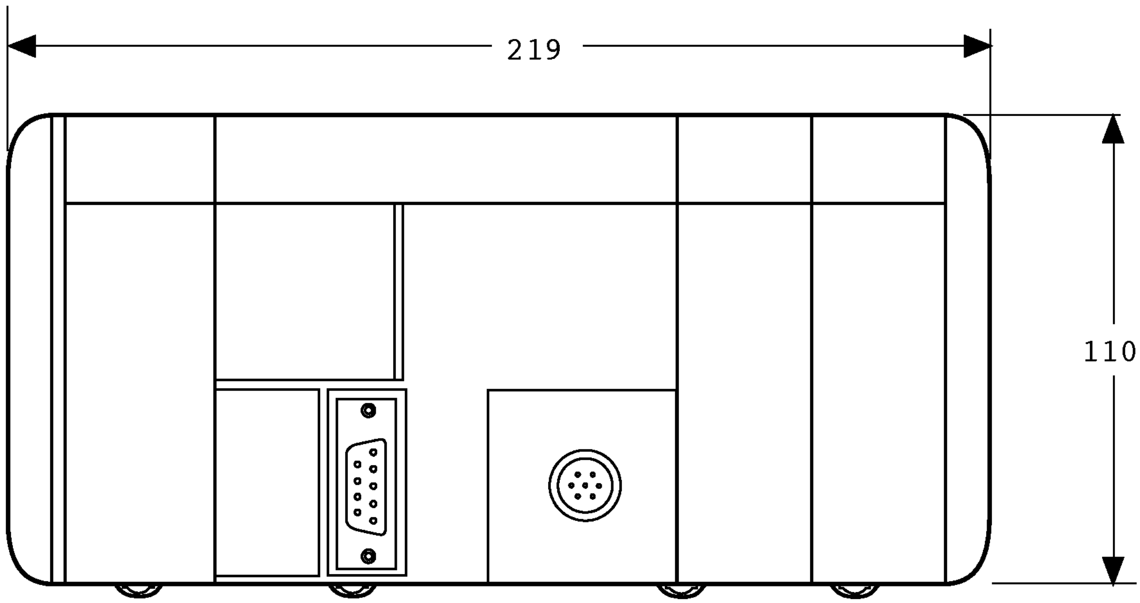


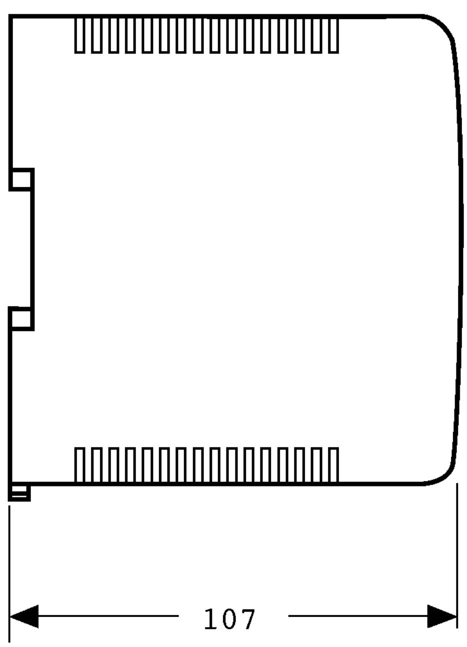
Performance Specifications

Item	Specification	
Control method	Stored program method	
I/O control method	Cyclic scan with direct output; immediate interrupt processing	
Programming language	Ladder diagram	
Instruction length	1 step per instruction, 1 to 4 words per instruction	
Types of instructions	122 instructions (14 basic instructions)	
Execution time	Basic instructions: 0.50 to 1.50 µs	
Program capacity	3.2K words (UM)	
Input bits	16 in IR 000	IR 00000 to IR 00015
Output bits	16 in IR 100	IR 10000 to IR 10015
Work bits	3,584 bits min.	IR 00100 to IR 09515
		IR 10100 to IR 19515
		IR 20000 to IR 22915
		IR 24000 to IR 24315
ID Controller area	16 bits read/ write	SR 23200 to SR 23215 (SR 232 to SR 232)
	112 bits read-only	SR 23300 to SR 23915 (SR 233 to SR 239)
MACRO operand bits	Inputs: 64 bits	IR 09600 to IR 09915 (IR 096 to IR 099)
	Outputs: 64 bits	IR 19600 to IR 19915 (IR 196 to IR 199)
Internal high-speed counter	32 bits	IR 23000 to IR 23115 (IR 230 to IR 231)
Special bits (SR area)	192 bits	SR 24400 to SR 25515 (SR 244 to SR 255)
Temporary bits (TR area)	8 bits	TR0 to TR7
Holding bits (HR area)	1,600 bits	HR 0000 to HR 9915 (HR 00 to HR 99)
Auxiliary bits (AR area)	448 bits	AR 0000 to AR 2715 (AR 00 to AR 27)
Link bits (LR area)	1,024 bits	LR 0000 to LR 6315 (LR 00 to LR 63)
Timers/counters	512 timers/counters	TIM/CNT 000 to TIM/CNT 511 Interrupt refreshing for TIM 000 to TIM 015 (high-speed timer only). Interval timers 0 to 2 (interval timer 2 is used with high-speed counter).
DM area	6,144 words read/write	DM 0000 to DM 6143
	512 words read-only	DM 6144 to DM 6655
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) ID communications response interrupt: 1 (executes subroutines 004 to 009 at end of ID communications instructions)	
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 failure (watchdog timer), I/O bus error, memory failure, battery error, host link error, and ID function errors	
Program checks	No END instruction, programming errors (continuously checked during operation)	
ID functions	One ID sensor (Read/Write Head) interface (electromagnetically coupling)	

Appendix C
Dimensions

The overall dimensions of the ID Controller are 219 × 110 × 107 mm (W×H×D).





Appendix D
SR and AR Area Allocations

SR Area

Word	Bit(s)	Function	Page
SR 244 Read/ Write	01 to 15	**Input Interrupt 0 Counter Mode SV** SV when input interrupt 0 is used in counter mode (4 digits hexadecimal, 0000 to FFFF). (Can be used as work bits when input interrupt 0 is not used in counter mode.)	98
SR 245 Read/ Write	01 to 15	**Input Interrupt 1 Counter Mode SV** SV when input interrupt 1 is used in counter mode (4 digits hexadecimal, 0000 to FFFF). (Can be used as work bits when input interrupt 1 is not used in counter mode.)	
SR 246 Read/ Write	01 to 15	**Input Interrupt 2 Counter Mode SV** SV when input interrupt 2 is used in counter mode (4 digits hexadecimal, 0000 to FFFF). (Can be used as work bits when input interrupt 2 is not used in counter mode.)	
SR 247 Read/ Write	01 to 15	**Input Interrupt 3 Counter Mode SV** SV when input interrupt 3 is used in counter mode (4 digits hexadecimal, 0000 to FFFF). (Can be used as work bits when input interrupt 3 is not used in counter mode.)	
SR 248 Read/ Write	01 to 15	**Input Interrupt 0 Counter Mode PV Minus One** Counter PV-1 when input interrupt 0 is used in counter mode (4 digits hexadecimal).	99
SR 249 Read/ Write	01 to 15	**Input Interrupt 1 Counter Mode PV Minus One** Counter PV-1 when input interrupt 1 is used in counter mode (4 digits hexadecimal).	
SR 250 Read/ Write	01 to 15	**Input Interrupt 2 Counter Mode PV Minus One** Counter PV-1 when input interrupt 2 is used in counter mode (4 digits hexadecimal).	
SR 251 Read/ Write	01 to 15	**Input Interrupt 3 Counter Mode PV Minus One** Counter PV-1 when input interrupt 3 is used in counter mode (4 digits hexadecimal).	
SR 252 Read/ Write	00	**High-speed Counter Reset Bit**	105
	01 to 07	Not used.	
	08	**Peripheral Port Reset Bit** Turn ON to reset peripheral port. (Not valid when peripheral device is connected.) Automatically turns OFF when reset is complete.	113
	09	**RS-232C Port Reset Bit** Turn ON to reset RS-232C port. Automatically turns OFF when reset is complete.	
	10	**ID Controller Setup Reset Bit** Turn ON to initialize ID Controller Setup (DM 6600 through DM 6655). Automatically turns OFF again when reset is complete. Only effective if the ID Controller is in PROGRAM mode.	68
	11	**Forced Status Hold Bit** OFF: Bits that are forced set/reset are cleared when switching from PROGRAM mode to MONITOR mode. ON: The status of bits that are forced set/reset are maintained when switching from PROGRAM mode to MONITOR mode.	69
	12	**I/O Hold Bit** OFF: IR and LR bits are reset when starting or stopping operation. ON: IR and LR bit status is maintained when starting or stopping operation.	69
	13	Not used.	
	14	**Error Log Reset Bit** Turn ON to clear error log (DM6569 through DM6599). Automatically turns OFF again when operation is complete.	180
	15	**Output OFF Bit** OFF: Normal output status. ON: All outputs turned OFF.	---

Word	Bit(s)	Function	Page
SR 253 Read-only	00 to 07	**FAL Error Code** The error code (a 2-digit number) is stored here when an error occurs. The FAL number is stored here when FAL(06) or FALS(07) is executed. This word is reset (to 00) by executing a FAL 00 instruction or by clearing the error from a Peripheral Device.	---
	08	**Low Battery Flag** Turns ON when the ID Controller battery voltage drops.	176
	09	**Cycle Time Overrun Flag** Turns ON when a cycle time overrun occurs (i.e., when the cycle time exceeds 100 ms).	176
	10 to 12	Not used.	
	13	**Always ON Flag**	---
	14	**Always OFF Flag**	---
	15	**First Cycle Flag** Turns ON for 1 cycle at the start of operation.	---
SR 254 Read-only	00	1-minute clock pulse (30 seconds ON; 30 seconds OFF)	---
	01	0.02-second clock pulse (0.01 second ON; 0.01 second OFF)	---
	02 to 03	Not used.	
	04	**Overflow (OF) Flag** Turns ON when the result of a calculation is above the upper limit of signed binary data.	---
	05	**Underflow (UF) Flag** Turns ON when the result of a calculation is below the lower limit of signed binary data.	---
	06	**Differential Monitor Complete Flag** Turns ON when differential monitoring is complete.	56
	07	**STEP(08) Execution Flag** Turns ON for 1 cycle only at the start of process based on STEP(08).	---
	08	**HKY(—) Execution Flag** Turns ON during execution of HKY(—).	---
	09	**7SEG(—) Execution Flag** Turns ON during execution of 7SEG(—).	---
	10	**DSW(—) Execution Flag** Turns ON during execution of DSW(—).	---
	11 to 14	Not used.	
	15	**ID Function Error Flag** Turns ON when there is an error in an ID function.	---
SR 255 Read-only	00	0.1-second clock pulse (0.05 second ON; 0.05 second OFF)	---
	01	0.2-second clock pulse (0.1 second ON; 0.1 second OFF)	---
	02	1.0-second clock pulse (0.5 second ON; 0.5 second OFF)	---
	03	**Instruction Execution Error (ER) Flag** Turns ON when an error occurs during execution of an instruction.	---
	04	**Carry (CY) Flag** Turns ON when there is a carry in the results of an instruction execution.	---
	05	**Greater Than (GR) Flag** Turns ON when the result of a comparison operation is “greater.”	---
	06	**Equals (EQ) Flag** Turns ON when the result of a comparison operation is “equal,” or when the result of an instruction execution is 0.	---
	07	**Less Than (LE) Flag** Turns ON when the result of a comparison operation is “less.”	---
	08 to 15	Not used.	

AR Area

Word	Bit(s)	Function	Page
AR 00 to AR 03	---	Not used.	
AR 04	08 to 15	**ID Function Error code** 00: Normal 01, 02: Hardware error 03: ID Controller Setup error 04: ID Controller stopped during ID communications	---
AR 05 to AR 06	---	Not used.	
AR 07	00 to 11	Not used.	
	12	**DIP Switch Pin 6 Flag** OFF: ID Controller's DIP switch pin no. 6 is OFF. ON: ID Controller's DIP switch pin no. 6 is ON.	---
	13 to 15	Not used.	
AR 08	00 to 03	**RS-232C Communications Error Code** (1-digit number) 0: Normal 1: Parity error 2: Framing error 3: Overrun error	113
	04	**RS-232C Error Flag** Turns ON when an RS-232C communications error occurs.	
	05	**RS-232C Transmission Enabled Flag** Valid only when host link, RS-232C communications are used.	
	06	**RS-232C Reception Completed Flag** Valid only when RS-232C communications are used.	
	07	**RS-232C Reception Overflow Flag** Valid only when RS-232C communications are used.	
	08 to 11	**Peripheral Device Error Code** (1-digit number) The code will be "F" when a computer running LSS/SSS is connected to the Peripheral Port. 0: Normal 1: Parity error 2: Framing error 3: Overrun error	116
	12	**Peripheral Device Error Flag** Turns ON when a peripheral device communications error occurs.	
	13	**Peripheral Device Transmission Enabled Flag** Valid only when host link, RS-232C communications are used.	
	14	**Peripheral Device Reception Completed Flag** Valid only when RS-232C communications are used.	
	15	**Peripheral Device Reception Overflow Flag** Valid only when RS-232C communications are used.	
AR 09	00 to 15	**RS-232C Reception Counter** 4 digits BCD; valid only when RS-232C communications are used.	116
AR 10	00 to 15	**Peripheral Device Reception Counter** 4 digits BCD; valid only when RS-232C communications are used.	116

Word	Bit(s)	Function	Page
AR 11	00 to 07	**High-speed Counter Range Comparison Flags** 00 ON: Counter PV is within comparison range 1 01 ON: Counter PV is within comparison range 2 02 ON: Counter PV is within comparison range 3 03 ON: Counter PV is within comparison range 4 04 ON: Counter PV is within comparison range 5 05 ON: Counter PV is within comparison range 6 06 ON: Counter PV is within comparison range 7 07 ON: Counter PV is within comparison range 8	107
	08 to 14	Not used.	
	15	**Built-in Pulse Output Flag** 0: Output stopped 1: Output ON	---
AR 12	00 to 15	Not used.	
AR 13	00	**Memory Cassette Installed Flag** Turns ON if the Memory Cassette is installed at the time of powering up.	---
	01	**Clock Available Flag** Turns ON if a Memory Cassette equipped with a clock is installed.	---
	02	**Memory Cassette Write-protected Flag** ON when an EEPROM Memory Cassette if mounted and write protected or when an EPROM Memory cassette is mounted.	56
	03	Not used.	
	04 to 07	**Memory Cassette Code** (1-digit number) 0: No Memory Cassette installed. 1: EEPROM, 4K-word Memory Cassette installed. 2: EEPROM, 8K-word Memory Cassette installed. 4: EPROM-type Memory Cassette installed.	---
	08 to 15	Not used.	
AR 14	00	**ID Controller to Memory Cassette Transfer Bit** Turn ON for transfer from the ID Controller to the Memory Cassette. Automatically turns OFF again when operation is complete.	---
	01	**Memory Cassette to ID Controller Transfer Bit** Turn ON for transfer from the Memory Cassette to the ID Controller. Automatically turns OFF again when operation is complete.	---
	02	**Memory Cassette Compare Flag** ON when the contents of the ID Controller and the Memory Cassette are being compared. Turns OFF automatically when comparison has completed.	---
	03	**Memory Cassette Comparison Results Flag** ON: Difference found or comparison not possible OFF: Contents compared and found to be the same.	---
	04 to 11	Not used.	
	12	**PROGRAM Mode Transfer Error Flag** Turns ON when transfer could not be executed due to being in PROGRAM mode.	---
	13	**Write-protect Error Flag** Turns ON when transfer could not be executed due to write-protection.	175
	14	**Insufficient Capacity Flag** Turns ON when transfer could not be executed due to insufficient capacity at the transfer destination.	175
	15	**No Program Flag** Turns ON when transfer could not be executed due to there being no program in the Memory Cassette.	175
AR 15	00 to 07	**Memory Cassette Program Code** Code (2-digit number) indicates the size of the program stored in the Memory Cassette. 00: There is no program, or no Memory Cassette is installed. 04: The program is less than 3.2K words long. 08: The program is less than 7.2K words long.	---
	08 to15	**ID Controller Program Code** Code (2-digit number) indicates the size of the program stored in the ID Controller. 04: The program is less than 3.2K words long.	---

Word	Bit(s)	Function	Page
AR 16	00 to 10	Not used.	
	11	**ID Controller Setup Initialized Flag** Turns ON when a checksum error occurs in the ID Controller Setup area and all settings are initialized back to the default settings.	176
	12	**Program Invalid Flag** Turns ON when a checksum error occurs in the UM area, or when an improper instruction is executed.	176
	13	**Instructions Table Initialized Flag** Turns ON when a checksum error occurs in the instructions table and all settings are initialized back to the default settings.	176
	14	**Memory Cassette Added Flag** Turns ON if the Memory Cassette is installed while the power is on.	176
	15	**Memory Cassette Transfer Error Flag** Turns ON if a transfer cannot be successfully executed when DIP switch pin no. 2 is set to ON (i.e., set to automatically transfer the contents of the Memory Cassette at power-up.)	176
AR 17	00 to 07	"Minutes" portion of the present time, in 2 digits BCD (Valid only when a Memory Cassette with the clock function is installed.)	56
	08 to 15	"Hour" portion of the present time, in 2 digits BCD (Valid only when a Memory Cassette with the clock function is installed.)	
AR 18	00 to 07	"Seconds" portion of the present time, in 2 digits BCD (Valid only when a Memory Cassette with the clock function is installed.)	
	08 to 15	"Minutes" portion of the present time, in 2 digits BCD (Valid only when a Memory Cassette with the clock function is installed.)	
AR 19	00 to 07	"Hour" portion of the present time, in 2 digits BCD (Valid only when a Memory Cassette with the clock function is installed.)	
	08 to 15	"Date" portion of the present time, in 2 digits BCD (Valid only when a Memory Cassette with the clock function is installed.)	
AR 20	00 to 07	"Month" portion of the present time, in 2 digits BCD (Valid only when a Memory Cassette with the clock function is installed.)	
	08 to 15	"Year" portion of the present time, in 2 digits BCD (Valid only when a Memory Cassette with the clock function is installed.)	
AR 21	00 to 07	"Day of week" portion of the present time, in 2 digits BCD [00: Sunday to 06: Saturday] (Valid only when a Memory Cassette with the clock function is installed.)	
	08 to 12	Not used.	
	13	**30-second Adjustment Bit** Valid only when a Memory Cassette with the clock function is installed.	56
	14	**Clock Stop Bit** Valid only when a Memory Cassette with the clock function is installed.	
	15	**Clock Set Bit** Valid only when a Memory Cassette with the clock function is installed.	
AR 22	00 to 15	Not used.	
AR 23	00 to 15	**Power-off Counter** (4 digits BCD) This is the count of the number of times that the power has been turned off. To clear the count, write "0000" from a peripheral device.	---

Word	Bit(s)	Function	Page
AR 24	00	**Power-on ID Controller Setup Error Flag** Turns ON when there is an error in DM 6600 to DM 6614 (the part of the ID Controller Setup area that is read at power-up).	68
	01	**Start-up ID Controller Setup Error Flag** Turns ON when there is an error in DM 6615 to DM 6644 (the part of the ID Controller Setup area that is read at the beginning of operation).	176
	02	**RUN ID Controller Setup Error Flag** Turns ON when there is an error in DM 6645 to DM 6655 (the part of the ID Controller Setup area that is always read).	68
	03, 04	Not used.	
	05	**Long Cycle Time Flag** Turns ON if the actual cycle time is longer than the cycle time set in DM 6619.	---
	06, 07	Not used.	
	08 to 15	Code (2 digits hexadecimal) showing the word number of a detected I/O bus error 00: Corresponds to input word 000. 80: Corresponds to output words 100. FF: End cover cannot be confirmed.	---
AR 25	00 to 15	Not used.	
AR 26	00 to 15	**Maximum Cycle Time** (4 digits BCD) The longest cycle time since the beginning of operation is stored. It is cleared at the beginning, and not at the end, of operation. The unit can be any of the following, depending on the setting of the 9F monitoring time (DM 6618). Default: 0.1 ms; “10 ms” setting: 0.1 ms; “100 ms” setting: 1 ms; “1 s” setting: 10 ms	71
AR 27	00 to 15	**Current Cycle Time** (4 digits BCD) The most recent cycle time during operation is stored. The Current Cycle Time is not cleared when operation stops. The unit can be any of the following, depending on the setting of the 9F monitoring time (DM 6618). Default: 0.1 ms; “10 ms” setting: 0.1 ms; “100 ms” setting: 1 ms; “1 s” setting: 10 ms	

Appendix E
Extended ASCII

The following codes are used to output characters to the Programming Console using MSG(46).

Right digit	Left digit												
	0, 1, 8, 9	**2**	**3**	**4**	**5**	**6**	**7**	**A**	**B**	**C**	**D**	**E**	**F**
0			0	@	P	`	p		-	@	P	`	p
1		!	1	A	Q	a	q	!	1	A	Q	a	q
2		"	2	B	R	b	r	"	2	B	R	b	r
3		#	3	C	S	c	s	#	3	C	S	c	s
4		$	4	D	T	d	t	$	4	D	T	d	t
5		%	5	E	U	e	u	%	5	E	U	e	u
6		&	6	F	V	f	v	&	6	F	V	f	v
7		'	7	G	W	g	w	'	7	G	W	g	w
8		(	8	H	X	h	x	(	8	H	X	h	x
9		)	9	I	Y	i	y	)	9	I	Y	i	y
A		*	:	J	Z	j	z	*	:	J	Z	j	z
B		+	;	K	[	k	{	+	;	K	[	k	{
C		,	<	L	¥	l	|	,	<	L	¥	l	|
D		-	=	M	]	m	}	ｭ	=	M	]	m	}
E		.	>	N	^	n	→	.	>	N	^	n	
F		/	?	O	_	o	←	/	?	O	_	o	→

Glossary

***DM** Indirectly addressed DM area. See *indirect address* and *DM area*.

1:1 link A link created between two ID Controllers to create *common data* in their LR areas.

address A number used to identify the location of data or programming instructions in memory.

AND A logic operation whereby the result is true if and only if both premises are true. In ladder-diagram programming the premises are usually ON/OFF states of bits or the logical combination of such states called execution conditions.

area See *data area* and *memory area*.

area prefix A one or two letter prefix used to identify a memory area in the ID Controller. All memory areas except the IR and SR areas require prefixes to identify addresses in them.

arithmetic shift A shift operation in which the carry flag is included in the shift.

ASCII Short for American Standard Code for Information Interchange. ASCII is used to code characters for output to printers and other external devices.

AR Area A ID Controller data area allocated to flags and control bits.

basic instruction A fundamental instruction used in a ladder diagram. See *special instruction*.

baud rate The data transmission speed between two devices in a system measured in bits per second.

BCD See *binary-coded decimal*.

binary A number system where all numbers are expressed in base 2, i.e., numbers are written using only 0's and 1's. Each group of four binary bits is equivalent to one hexadecimal digit. Binary data in memory is thus often expressed in hexadecimal for convenience.

binary-coded decimal A system used to represent numbers so that every four binary bits is numerically equivalent to one decimal digit.

bit The smallest piece of information that can be represented on a computer. A bit has the value of either zero or one, corresponding to the electrical signals ON and OFF. A bit represents one binary digit. Some bits at particular addresses are allocated to special purposes, such as holding the status of input from external devices, while other bits are available for general use in programming.

bit address The location in memory where a bit of data is stored. A bit address specifies the data area and word that is being addressed as well as the number of the bit within the word.

block See *logic block* and *instruction block*.

bus A communications path used to pass data between any of the devices connected to it.

byte A unit of data equivalent to 8 bits, i.e., half a word.

call A process by which instruction execution shifts from the main program to a subroutine. The subroutine may be called by an instruction or by an interrupt.

Carry Flag A flag that is used with arithmetic operations to hold a carry from an addition or multiplication operation, or to indicate that the result is negative in a subtraction operation. The carry flag is also used with certain types of shift operations.

central processing unit A device that is capable of storing programs and data, and executing the instructions contained in the programs. In a ID Controller System, the central processing unit executes the program, processes I/O signals, communicates with external devices, etc.

CH See *word*.

channel See *word*.

checksum A sum transmitted with a data pack in communications. The checksum can be recalculated from the received data to confirm that the data in the transmission has not been corrupted.

clock pulse A pulse available at specific bits in memory for use in timing operations. Various clock pulses are available with different pulse widths, and therefore different frequencies.

clock pulse bit A bit in memory that supplies a pulse that can be used to time operations. Various clock pulse bits are available with different pulse widths, and therefore different frequencies.

communications cable Cable used to transfer data between components of a control system and conforming to the RS-232C or RS-422 standards.

Completion Flag A flag used with a timer or counter that turns ON when the timer has timed out or the counter has reached its set value.

condition A symbol placed on an instruction line to indicate an instruction that controls the execution condition for the terminal instruction. Each condition is assigned a bit in memory that determines its status. The status of the bit assigned to each condition determines the next execution condition. Conditions correspond to LOAD, LOAD NOT, AND, AND NOT, OR, or OR NOT instructions.

constant An input for an operand in which the actual numeric value is specified. Constants can be input for certain operands in place of memory area addresses. Some operands must be input as constants.

control bit A bit in a memory area that is set either through the program or via a Programming Device to achieve a specific purpose.

control data An operand that specifies how an instruction is to be executed. The control data may specify the part of a word is to be used as the operand, it may specify the destination for a data transfer instructions, it may specify the size of a data table used in an instruction, etc.

control signal A signal sent from the ID Controller to effect the operation of the controlled system.

Control System All of the hardware and software components used to control other devices. A Control System includes the ID Controller System, the ID Controller programs, and all I/O devices that are used to control or obtain feedback from the controlled system.

controlled system The devices that are being controlled by a ID Controller System.

count pulse The signal counted by a counter.

counter A dedicated group of digits or words in memory used to count the number of times a specific process has occurred, or a location in memory accessed through a TIM/CNT bit and used to count the number of times the status of a bit or an execution condition has changed from OFF to ON.

CPU See *central processing unit*.

CTS An acronym for clear-to-send, a signal used in communications between electronic devices to indicate that the receiver is ready to accept incoming data.

CY See *Carry Flag*.

cycle One unit of processing performed by the CPU, including ladder program execution, peripheral servicing, I/O refreshing, etc.

cycle time The time required to complete one cycle of CPU processing.

cyclic interrupt See *scheduled interrupt.*

data area An area in the ID Controller's memory that is designed to hold a specific type of data.

data area boundary The highest address available within a data area. When designating an operand that requires multiple words, it is necessary to ensure that the highest address in the data area is not exceeded.

data length In communications, the number of bits that is to be treated as one unit in data transmissions.

data link area A common data area established through a data link.

data sharing The process in which common data areas or common data words are created between two or more ID Controllers.

data trace A process in which changes in the contents of specific memory locations are recorded during program execution.

data transfer Moving data from one memory location to another, either within the same device or between different devices connected via a communications line or network.

debug A process by which a draft program is corrected until it operates as intended. Debugging includes both the removal of syntax errors, as well as the fine-tuning of timing and coordination of control operations.

decimal A number system where numbers are expressed to the base 10. In a ID Controller all data is ultimately stored in binary form, four binary bits are often used to represent one decimal digit, via a system called binary-coded decimal.

decrement Decreasing a numeric value, usually by 1.

default A value automatically set by the ID Controller when the user does not specifically set another value. Many devices will assume such default conditions upon the application of power.

destination The location where an instruction places the data on which it is operating, as opposed to the location from which data is taken for use in the instruction. The location from which data is taken is called the source.

differentiated instruction An instruction that is executed only once each time its execution condition goes from OFF to ON. Non-differentiated instructions are executed for each scan as long as the execution condition stays ON.

differentiation instruction An instruction used to ensure that the operand bit is never turned ON for more than one scan after the execution condition goes either from OFF to ON for a Differentiate Up instruction or from ON to OFF for a Differentiate Down instruction.

digit A unit of storage in memory that consists of four bits.

DIN track A rail designed to fit into grooves on various devices to allow the devices to be quickly and easily mounted to it.

DIP switch Dual in-line package switch, an array of pins in a signal package that is mounted to a circuit board and is used to set operating parameters.

direct output A method in which program execution results are output immediately to eliminate the affects of the cycle time.

DM area A data area used to hold only word data. Words in the DM area cannot be accessed bit by bit.

DM word A word in the DM area.

EEPROM Electrically erasable programmable read-only memory; a type of ROM in which stored data can be erased and reprogrammed. This is accomplished using a special control lead connected to the EEPROM chip and can be done without having to remove the EEPROM chip from the device in which it is mounted.

electrical noise Random variations of one or more electrical characteristics such as voltage, current, and data, which might interfere with the normal operation of a device.

EPROM Erasable programmable read-only memory; a type of ROM in which stored data can be erased, by ultraviolet light or other means, and reprogrammed.

error code A numeric code generated to indicate that an error exists, and something about the nature of the error. Some error codes are generated by the system; others are defined in the program by the operator.

Error Log Area An area used to store records indicating the time and nature of errors that have occurred in the system.

even parity A communication setting that adjusts the number of ON bits so that it is always even. See *parity*.

event processing Processing that is performed in response to an event, e.g., an interrupt signal.

exclusive NOR A logic operation whereby the result is true if both of the premises are true or both of the premises are false. In ladder-diagram programming, the premises are usually the ON/OFF states of bits, or the logical combination of such states, called execution conditions.

exclusive OR A logic operation whereby the result is true if one, and only one, of the premises is true. In ladder-diagram programming the premises are usually the ON/OFF states of bits, or the logical combination of such states, called execution conditions.

execution condition The ON or OFF status under which an instruction is executed. The execution condition is determined by the logical combination of conditions on the same instruction line and up to the instruction currently being executed.

execution cycle The cycle used to execute all processes required by the CPU, including program execution, I/O refreshing, peripheral servicing, etc.

execution time The time required for the CPU to execute either an individual instruction or an entire program.

extended counter A counter created in a program by using two or more count instructions in succession. Such a counter is capable of counting higher than any of the standard counters provided by the individual instructions.

extended timer A timer created in a program by using two or more timers in succession. Such a timer is capable of timing longer than any of the standard timers provided by the individual instructions.

FAL error An error generated from the user program by execution of an FAL(06) instruction.

FALS error An error generated from the user program by execution of an FALS(07) instruction or an error generated by the system.

fatal error An error that stops ID Controller operation and requires correction before operation can continue.

FCS See *frame checksum*.

flag A dedicated bit in memory that is set by the system to indicate some type of operating status. Some flags, such as the carry flag, can also be set by the operator or via the program.

force reset The process of forcibly turning OFF a bit via a programming device. Bits are usually turned OFF as a result of program execution.

force set The process of forcibly turning ON a bit via a programming device. Bits are usually turned ON as a result of program execution.

forced status The status of bits that have been force reset or force set.

frame checksum The results of exclusive ORing all data within a specified calculation range. The frame checksum can be calculated on both the sending and receiving end of a data transfer to confirm that data was transmitted correctly.

function code A two-digit number used to input an instruction into the ID Controller.

hardware error An error originating in the hardware structure (electronic components) of the ID Controller, as opposed to a software error, which originates in software (i.e., programs).

header code A code in an instruction that specifies what the instruction is to do.

hexadecimal A number system where all numbers are expressed to the base 16. In a ID Controller all data is ultimately stored in binary form, however, displays and inputs on Programming Devices are often expressed in hexadecimal to simplify operation. Each group of four binary bits is numerically equivalent to one hexadecimal digit.

host computer A computer that is used to transfer data to or receive data from a ID Controller in a Host Link system. The host computer is used for data management and overall system control. Host computers are generally small personal or business computers.

host interface An interface that allows communications with a host computer.

host link An interface connecting a ID Controller to a host computer to enable monitoring or program control from the host computer.

HR area A memory area that preserves bit status during power interrupts and used as work bits in programming.

I/O bit A bit in memory used to hold I/O status. Input bits reflect the status of input terminals; output bits hold the status for output terminals.

I/O capacity The number of inputs and outputs that a ID Controller is able to handle. This number ranges from around one hundred for smaller ID Controllers to two thousand for the largest ones.

I/O delay The delay in time from when a signal is sent to an output to when the status of the output is actually in effect or the delay in time from when the status of an input changes until the signal indicating the change in the status is received.

I/O device A device connected to the I/O terminals. I/O devices may be either part of the Control System, if they function to help control other devices, or they may be part of the controlled system.

I/O interrupt An interrupt generated by a signal from I/O.

I/O point The place at which an input signal enters the ID Controller System, or at which an output signal leaves the ID Controller System. In physical terms, I/O points correspond to terminals or connector pins on the ID Controller; in terms of programming, an I/O points correspond to I/O bits in the IR area.

I/O refreshing The process of updating output status sent to external devices so that it agrees with the status of output bits held in memory and of updating input bits in memory so that they agree with the status of inputs from external devices.

I/O response time The time required for an output signal to be sent from the ID Controller in response to an input signal received from an external device.

I/O word A word in the IR area that is allocated in the ID Controller System and is used to hold I/O status.

IBM PC/AT or compatible A computer that has similar architecture to, that is logically compatible with, and that can run software designed for an IBM PC/AT computer.

ID Controller Setup A group of operating parameters set in the ID Controller from a Programming Device to control ID Controller operation.

increment Increasing a numeric value, usually by 1.

indirect address An address whose contents indicates another address. The contents of the second address will be used as the actual operand.

initialization error An error that occurs either in hardware or software during the ID Controller System startup, i.e., during initialization.

initialize Part of the startup process whereby some memory areas are cleared, system setup is checked, and default values are set.

input The signal coming from an external device into the ID Controller. The term input is often used abstractly or collectively to refer to incoming signals.

input bit A bit in the IR area that is allocated to hold the status of an input.

input device An external device that sends signals into the ID Controller System.

input point The point at which an input enters the ID Controller System. Input points correspond physically to terminals or connector pins.

input signal A change in the status of a connection entering the ID Controller. Generally an input signal is said to exist when, for example, a connection point goes from low to high voltage or from a nonconductive to a conductive state.

instruction A direction given in the program that tells the ID Controller of the action to be carried out, and the data to be used in carrying out the action. Instructions can be used to simply turn a bit ON or OFF, or they can perform much more complex actions, such as converting and/or transferring large blocks of data.

instruction block A group of instructions that is logically related in a ladder-diagram program. A logic block includes all of the instruction lines that interconnect with each other from one or more line connecting to the left bus bar to one or more right-hand instructions connecting to the right bus bar.

instruction execution time The time required to execute an instruction. The execution time for any one instruction can vary with the execution conditions for the instruction and the operands used in it.

instruction line A group of conditions that lie together on the same horizontal line of a ladder diagram. Instruction lines can branch apart or join together to form instruction blocks. Also called a rung.

interface An interface is the conceptual boundary between systems or devices and usually involves changes in the way the communicated data is represented. Interface devices perform operations like changing the coding, format, or speed of the data.

interrupt (signal) A signal that stops normal program execution and causes a subroutine to be run or other processing to take place.

interrupt program A program that is executed in response to an interrupt.

inverse condition See *normally closed condition*.

JIS An acronym for Japanese Industrial Standards.

jump A type of programming where execution moves directly from one point in a program to another, without sequentially executing any instructions in between.

jump number A definer used with a jump that defines the points from and to which a jump is to be made.

ladder diagram (program) A form of program arising out of relay-based control systems that uses circuit-type diagrams to represent the logic flow of programming instructions. The appearance of the program is similar to a ladder, and thus the name.

ladder diagram symbol A symbol used in drawing a ladder-diagram program.

ladder instruction An instruction that represents the conditions on a ladder-diagram program. The other instructions in a ladder diagram fall along the right side of the diagram and are called terminal instructions.

Ladder Support Software A software package installed on a IBM PC/AT or compatible computer to function as a Programming Device.

least-significant (bit/word) See *rightmost (bit/word)*.

LED Acronym for light-emitting diode; a device used as for indicators or displays.

leftmost (bit/word) The highest numbered bits of a group of bits, generally of an entire word, or the highest numbered words of a group of words. These bits/words are often called most-significant bits/words.

link A hardware or software connection formed between two devices. “Link” can refer either to a part of the physical connection between two ID Controllers or a software connection created to data existing at another location (e.g., data links).

logic block A group of instructions that is logically related in a ladder-diagram program and that requires logic block instructions to relate it to other instructions or logic blocks.

logic block instruction An instruction used to locally combine the execution condition resulting from a logic block with a current execution condition. The current execution condition could be the result of a single condition, or of another logic block. AND Load and OR Load are the two logic block instructions.

logic instruction Instructions used to logically combine the content of two words and output the logical results to a specified result word. The logic instructions combine all the same-numbered bits in the two words and output the result to the bit of the same number in the specified result word.

LR area A data area that is used in data links.

LSS See *Ladder Support Software*.

main program All of a program except for subroutine and interrupt programs.

mark trace A process in which changes in the contents of specific memory locations are recorded during program execution.

masked bit A bit whose status has been temporarily made ineffective.

masking 'Covering' an interrupt signal so that the interrupt is not effective until the mask is removed.

megabyte A unit of storage equal to one million bytes.

memory area Any of the areas in the ID Controller used to hold data or programs.

message number A number assigned to a message generated with the MESSAGE instruction.

mnemonic code A form of a ladder-diagram program that consists of a sequential list of the instructions without using a ladder diagram.

MONITOR mode A mode of ID Controller operation in which normal program execution is possible, and which allows modification of data held in memory. Used for monitoring or debugging the ID Controller.

most-significant (bit/word) See *leftmost (bit/word).*

NC input An input that is normally closed, i.e., the input signal is considered to be present when the circuit connected to the input opens.

negative delay A delay set for a data trace in which recording data begins before the trace signal by a specified amount.

nesting Programming one loop within another loop, programming a call to a subroutine within another subroutine, or programming one jump within another.

NO input An input that is normally open, i.e., the input signal is considered to be present when the circuit connected to the input closes.

noise interference Disturbances in signals caused by electrical noise.

nonfatal error A hardware or software error that produces a warning but does not stop the ID Controller from operating.

normal condition See *normally open condition*.

normally closed condition A condition that produces an ON execution condition when the bit assigned to it is OFF, and an OFF execution condition when the bit assigned to it is ON.

normally open condition A condition that produces an ON execution condition when the bit assigned to it is ON, and an OFF execution condition when the bit assigned to it is OFF.

NOT A logic operation which inverts the status of the operand. For example, AND NOT indicates an AND operation with the opposite of the actual status of the operand bit.

OFF The status of an input or output when a signal is said not to be present. The OFF state is generally represented by a low voltage or by non-conductivity, but can be defined as the opposite of either.

OFF delay The delay between the time when a signal is switched OFF (e.g., by an input device or ID Controller) and the time when the signal reaches a state readable as an OFF signal (i.e., as no signal) by a receiving party (e.g., output device or ID Controller).

offset A positive or negative value added to a base value such as an address to specify a desired value.

ON The status of an input or output when a signal is said to be present. The ON state is generally represented by a high voltage or by conductivity, but can be defined as the opposite of either.

ON delay The delay between the time when an ON signal is initiated (e.g., by an input device or ID Controller) and the time when the signal reaches a state readable as an ON signal by a receiving party (e.g., output device or ID Controller).

one-to-one link See *1:1 link*.

online edit The process of changed the program directly in the ID Controller from a Programming Device. Online editing is possible in PROGRAM or MONITOR mode. In MONITOR mode, the program can actually be changed while it is being

operand The values designated as the data to be used for an instruction. An operand can be input as a constant expressing the actual numeric value to be used or as an address to express the location in memory of the data to be used.

operand bit A bit designated as an operand for an instruction.

operand word A word designated as an operand for an instruction.

operating modes One of three ID Controller modes: *PROGRAM mode*, *MONITOR mode*, and *RUN mode*.

operating error An error that occurs during actual ID Controller operation as opposed to an initialization error, which occurs before actual operations can begin.

OR A logic operation whereby the result is true if either of two premises is true, or if both are true. In ladder-diagram programming the premises are usually ON/OFF states of bits or the logical combination of such states called execution conditions.

output The signal sent from the ID Controller to an external device. The term output is often used abstractly or collectively to refer to outgoing signals.

output bit A bit in the IR area that is allocated to hold the status to be sent to an output device.

output device An external device that receives signals from the ID Controller System.

output point The point at which an output leaves the ID Controller System. Output points correspond physically to terminals or connector pins.

output signal A signal being sent to an external device. Generally an output signal is said to exist when, for example, a connection point goes from low to high voltage or from a nonconductive to a conductive state.

overflow The state where the capacity of a data storage location has been exceeded.

overseeing Part of the processing performed by the CPU that includes general tasks required to operate the ID Controller.

overwrite Changing the content of a memory location so that the previous content is lost.

parity Adjustment of the number of ON bits in a word or other unit of data so that the total is always an even number or always an odd number. Parity is generally used to check the accuracy of data after being transmitted by confirming that the number of ON bits is still even or still odd.

parity check Checking parity to ensure that transmitted data has not been corrupted.

PC See *Programmable Controller*.

Peripheral Device Devices connected to a ID Controller System to aid in system operation. Peripheral devices include printers, programming devices, external storage media, etc.

peripheral servicing Processing signals to and from peripheral devices, including refreshing, communications processing, interrupts, etc.

port A connector on a ID Controller or computer that serves as a connection to an external device.

positive delay A delay set for a data trace in which recording data begins after the trace signal by a specified amount.

present value The current value registered in a device at any instant during its operation. Present value is abbreviated as PV. The use of this term is generally restricted to timers and counters.

printed circuit board A board onto which electrical circuits are printed for mounting into a computer or electrical device.

PROGRAM mode A mode of operation that allows inputting and debugging of programs to be carried out, but that does not permit normal execution of the program.

Programmable Controller A computerized device that can accept inputs from external devices and generate outputs to external devices according to a program held in memory. Programmable Controllers are used to automate control of external devices. Although single-unit Programmable Controllers are available, building-block Programmable Controllers are constructed from separate components. Such Programmable Controllers are formed only when enough of these separate components are assembled to form a functional assembly.

programmed alarm An alarm given as a result of execution of an instruction designed to generate the alarm in the program, as opposed to one generated by the system.

programmed error An error arising as a result of the execution of an instruction designed to generate the error in the program, as opposed to one generated by the system.

programmed message A message generated as a result of execution of an instruction designed to generate the message in the program, as opposed to one generated by the system.

Programming Console The portable form of Programming Device for a ID Controller.

Programming Device A Peripheral Device used to input a program into a ID Controller or to alter or monitor a program already held in the ID Controller. There are dedicated programming devices, such as Programming Consoles, and there are non-dedicated devices, such as a host computer.

PROM Programmable read-only memory; a type of ROM into which the program or data may be written after manufacture, by a customer, but which is fixed from that time on.

protocol The parameters and procedures that are standardized to enable two devices to communicate or to enable a programmer or operator to communicate with a device.

PV See *present value*.

RAM Random access memory; a data storage media. RAM will not retain data when power is disconnected.

RAS An acronym for reliability, assurance, safety.

read-only area A memory area from which the user can read status but to which data cannot be written.

refresh The process of updating output status sent to external devices so that it agrees with the status of output bits held in memory and of updating input bits in memory so that they agree with the status of inputs from external devices.

relay-based control The forerunner of ID Controllers. In relay-based control, groups of relays are interconnected to form control circuits. In a ID Controller, these are replaced by programmable circuits.

reserved bit A bit that is not available for user application.

reserved word A word in memory that is reserved for a special purpose and cannot be accessed by the user.

reset The process of turning a bit or signal OFF or of changing the present value of a timer or counter to its set value or to zero.

response code A code sent with the response to a data transmission that specifies how the transmitted data was processed.

response format A format specifying the data required in a response to a data transmission.

response monitoring time The time a device will wait for a response to a data transmission before assuming that an error has occurred.

Restart Bit A bit used to restart part of a device or process.

retrieve The processes of copying data either from an external device or from a storage area to an active portion of the system such as a display buffer. Also, an output device connected to the ID Controller is called a load.

retry The process whereby a device will re-transmit data which has resulted in an error message from the receiving device.

return The process by which instruction execution shifts from a subroutine back to the main program (usually the point from which the subroutine was called).

reversible counter A counter that can be both incremented and decremented depending on the specified conditions.

reversible shift register A shift register that can shift data in either direction depending on the specified conditions.

right-hand instruction See *terminal instruction*.

rightmost (bit/word) The lowest numbered bits of a group of bits, generally of an entire word, or the lowest numbered words of a group of words. These bits/words are often called least-significant bits/words.

rising edge The point where a signal actually changes from an OFF to an ON status.

ROM Read only memory; a type of digital storage that cannot be written to. A ROM chip is manufactured with its program or data already stored in it and can never be changed. However, the program or data can be read as many times as desired.

rotate register A shift register in which the data moved out from one end is placed back into the shift register at the other end.

RS-232C interface An industry standard for serial communications.

RUN mode The operating mode used by the ID Controller for normal control operations.

rung See *instruction line*.

scan The process used to execute a ladder-diagram program. The program is examined sequentially from start to finish and each instruction is executed in turn based on execution conditions.

scan time See *cycle time*.

scheduled interrupt An interrupt that is automatically generated by the system at a specific time or program location specified by the operator. Scheduled interrupts result in the execution of specific subroutines that can be used for instructions that must be executed repeatedly at a specified interval of time.

self diagnosis A process whereby the system checks its own operation and generates a warning or error if an abnormality is discovered.

self-maintaining bit A bit that is programmed to maintain either an OFF or ON status until set or reset by specified conditions.

series A wiring method in which devices are wired consecutively in a string.

servicing The process whereby the ID Controller checks an interface or other connection to see if special processing is required.

set The process of turning a bit or signal ON.

set value The value from which a decrementing counter starts counting down or to which an incrementing counter counts up (i.e., the maximum count), or the time from which or for which a timer starts timing. Set value is abbreviated SV.

shift input signal An input signal whose OFF to ON transition causes data to be shifted one bit.

shift register One or more words in which data is shifted a specified number of units to the right or left in bit, digit, or word units. In a rotate register, data shifted out one end is shifted back into the other end. In other shift registers, new data (either specified data, zero(s) or one(s)) is shifted into one end and the data shifted out at the other end is lost.

signed binary A binary value that is stored in memory along with a bit that indicates whether the value is positive or negative.

software error An error that originates in a software program.

source (word) The location from which data is taken for use in an instruction, as opposed to the location to which the result of an instruction is to be written. The latter is called the destination.

special instruction An instruction input with a function code that handles data processing operations within ladder diagrams, as opposed to a basic instruction, which makes up the fundamental portion of a ladder diagram.

SR area A memory area containing flags and other bits/words with specific functions.

SSS See *SYSMAC Support Software*.

subroutine A group of instructions placed separate from the main program and executed only when called from the main program or activated by an interrupt.

subroutine number A definer used to identify the subroutine that a subroutine call or interrupt activates.

SV See *set value*.

switching capacity The maximum voltage/current that a relay can safely switch on and off.

syntax The form of a program statement (as opposed to its meaning).

syntax error An error in the way in which a program is written. Syntax errors can include 'spelling' mistakes (i.e., a function code that does not exist), mistakes in specifying operands within acceptable parameters (e.g., specifying read-only bits as a destination), and mistakes in actual application of instructions (e.g., a call to a subroutine that does not exist).

SYSMAC Support Software A software package installed on a IBM PC/AT or compatible computer to function as a Programming Device.

system configuration The arrangement in which devices in a System are connected. This term refers to the conceptual arrangement and wiring together of all the devices needed to comprise the System.

system error An error generated by the system, as opposed to one resulting from execution of an instruction designed to generate an error.

system error message An error message generated by the system, as opposed to one resulting from execution of an instruction designed to generate a message.

system setup Operating environment settings for a Programming Device, e.g., the LSS.

timer A location in memory accessed through a TIM/CNT bit and used to time down from the timer's set value. Timers are turned ON and reset according to their execution conditions.

TR area A data area used to store execution conditions so that they can be reloaded later for use with other instructions.

TR bit A bit in the TR area.

trace An operation whereby the program is executed and the resulting data is stored to enable step-by-step analysis and debugging.

trace memory A memory area used to store the results of trace operations.

transfer The process of moving data from one location to another within the ID Controller, or between the ID Controller and external devices. When data is transferred, generally a copy of the data is sent to the destination, i.e., the content of the source of the transfer is not changed.

transmission distance The distance that a signal can be transmitted.

trigger A signal used to activate some process, e.g., the execution of a trace operation.

trigger address An address in the program that defines the beginning point for tracing. The actual beginning point can be altered from the trigger by defining either a positive or negative delay.

UM area The memory area used to hold the active program, i.e., the program that is being currently executed.

unmasked bit A bit whose status is effective. See *masked bit*.

unsigned binary A binary value that is stored in memory without any indication of whether it is positive or negative.

uploading The process of transferring a program or data from a lower-level or slave computer to a higher-level or host computer. If a Programming Devices is involved, the Programming Device is considered the host computer.

watchdog timer A timer within the system that ensures that the scan time stays within specified limits. When limits are reached, either warnings are given or ID Controller operation is stopped depending on the particular limit that is reached.

WDT See *watchdog timer*.

word A unit of data storage in memory that consists of 16 bits. All data areas consists of words. Some data areas can be accessed only by words; others, by either words or bits.

word address The location in memory where a word of data is stored. A word address must specify (sometimes by default) the data area and the number of the word that is being addressed.

work area A part of memory containing work words/bits.

work bit A bit in a work word.

work word A word that can be used for data calculation or other manipulation in programming, i.e., a 'work space' in memory. A large portion of the IR area is always reserved for work words. Parts of other areas not required for special purposes may also be used as work words.

write protect switch A switch used to write-protect the contents of a storage device, e.g., a floppy disk. If the hole on the upper left of a floppy disk is open, the information on this floppy disk cannot be altered.

write-protect A state in which the contents of a storage device can be read but cannot be altered.

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Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.

Cat. No. W250-E1-02

Revision code

The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
1	February 1995	Original production
02	December 2004	**Page 25:** Model numbers of Read/Write Heads changed. **Page 30:** *Terminal Block* rewritten and added as *Wiring Precautions for Ground Wires*.