HITACHI

S10mini

S10mini
HARDWARE MANUAL

OPTION

OD.RING

SME-1-102 (D)

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OD.RING

First Edition, November 1998, SME-1-102(A) (out of print)
Second Edition, October 2002, SME-1-102(B) (out of print)
Third Edition, November 2007, SME-1-102(C) (out of print)
Fourth Edition, October 2008, SME-1-102(D)

Printed in Japan.

BI-KB-KO<IC-NS> (FL-MW20, AI8.0)

SAFETY PRECAUTIONS

Be sure to read this manual and all other attached documents carefully before installing, operating inspecting or conducting maintenance on this unit. Always use this unit properly. Be sure to carefully read the information about the device, the safety information and precautions before using this unit. Be sure that the person(s) responsible for maintenance receives and understands this manual completely.

This manual divides the safety precautions into DANGERs and CAUTIONs.

DANGER : Failure to observe these warnings may result in death or serious injury.

CAUTION : Failure to observe these cautions may result in injury or property damage.

Failure to observe any **CAUTION** may lead to serious consequences.

All of these DANGERs and CAUTIONs provide very important precautions and should always be observed.
Additional safety symbols representing a prohibition or a requirement are as follows:

: Prohibition. For example, “Do not disassemble” is represented by:

: Requirement. For example, if a ground is required, the following will be shown:

DANGER

- Devise an emergency stop circuit, interlock circuit, and other similar circuits outside the programmable controller. Disregarding this rule may result in damage to the equipment or cause an accident if the programmable controller fails.
- Keep it in mind that this hardware unit operates on a high voltage. If the user touches a high-voltage terminal inadvertently during connection or disconnection of this hardware unit or its cable, he or she may suffer from an electric shock. Also, this hardware unit may be damaged due to a short circuit or noise. Be sure to switch off the hardware unit before connecting or disconnecting it or its cable.

CAUTION

- This hardware unit may fail if the ambient temperature is too high. The hardware unit may also malfunction due to interference by electromagnetic waves from adjacent hardware. To dissipate heat and reduce electromagnetic interference, provide the specified mount of space between the cubicle and this hardware unit and between the hardware unit and other ones.
- After installing this hardware unit, measure temperatures near the in-cubicle controller and the mount base during operation, and check whether the measurements are within the limits. If the specified amount of space cannot be provided or the measured temperature is too high, use a cooling fan.
- At an extremely high temperature, this hardware unit may fail. Secure the mount base to a vertical surface. If the mount base is secured horizontally, heat does not dissipate efficiently, resulting in an extremely high temperature. This may further cause the hardware unit to fail or its parts to deteriorate.
- This hardware unit may be damaged due to static electricity. Ground yourself before setting switches or connecting or disconnecting cables or connectors with the hardware unit.
- This hardware unit may be damaged during its installation or removal unless the following rules are observed:
  - Check that the connector pins are not damage (bent or broken), are aligned straight and are free from dust.
  - Move the hardware unit along an imaginary vertical surface to the face of the mount base. If the product is inserted or removed slantwise from the connector on the mount base, connector pins may be bent.

REQUIREMENT

Electric shock hazards exist so that you might suffer burns or become electrocuted. Further, the system might malfunction due to noise interference. Therefore, ground the line ground (LG), frame ground (FG), and shield wire (SHD) as directed below:

- Insulate the mount base from the enclosure. To keep the mount base insulated, avoid removing the insulation sheets that are supplied with the mount base.
- The LG is a ground terminal for power supply noise. The FG and SHD are ground terminals for the noise in the communication module and other external interface lines. To avoid interference between the ground terminals, separately ground the LG and FG.
- Ground the module's FG by shorting it to the mount base's FG terminal. Note, however, that the FG terminal for each remote I/O line or JPCN-1 line must be connected separately to a single place on the terminating side.

REQUIREMENT

- A surge voltage may cause hardware units to malfunction or to be damaged. Where a coil such as one in an electromechanical relay is connected to the PCs' OK output circuit, protect the relay with a surge-absorbing diode that is capable of withstanding a peak inverse voltage of at least 10 times the circuit voltage and has a forward current equal to or larger than the load current.
- Excessive accumulation of heat in the cubicle may cause a fire or hardware failure. When the temperature in the cubicle reaches 48°C or higher, the maximum output current of the power supply module is limited. At 55°C, for instance, it is limited to 5.85 A. Where this is very likely, install a cooling fan in the cubicle or reduce the number of modules installed therein.
- If the battery is handled improperly, it may catch fire or explode. Some used batteries may still have a considerable amount of charge. To deliver such used batteries to a waste disposal site safely, follow the general rules for collection, packing, and transportation. For concrete methods of packing and transportation, consult with professionals of your local waste disposal business.

PROHIBITION

If a part in a module is damaged, do not replace the part, but replace the faulty module in its entirety, except when the part is the battery for the CPU.

WARRANTY AND SERVICING

Unless a special warranty contract has been arranged, the following warranty is applicable to this product.

1. Warranty period and scope
   Warranty period
   The warranty period for this product is for one year after the product has been delivered to the specified delivery site.

   Scope
   If a malfunction should occur during the above warranty period while using this product under normal product specification conditions as described in this manual, please deliver the malfunctioning part of the product to the dealer or Hitachi Engineering & Services Co., Ltd. The malfunctioning part will be replaced or repaired free of charge. If the malfunctioning is shipped, however, the shipment charge and packaging expenses must be paid for by the customer.

   This warranty is not applicable if any of the following are true.

   - The malfunction was caused by handling or use of the product in a manner not specified in the product specifications.
   - The malfunction was caused by a unit other than that which was delivered.
   - The malfunction was caused by modifications or repairs made by a vendor other than the vendor that delivered the unit.
   - The malfunction was caused by a relay or other consumable which has passed the end of its service life.
   - The malfunction was caused by a disaster, natural or otherwise, for which the vendor is not responsible.

   The warranty mentioned here means the warranty for the individual product that is delivered. Therefore, we cannot be held responsible for any losses or lost profits that result from the operation of this product or from malfunctions of this product. This warranty is valid only in Japan and is not transferable.

2. Range of services
   The price of the delivered product does not include on-site servicing fees by engineers. Extra fees will be charged for the following:

   - Instruction for installation and adjustments, and witnessing trial operations.
   - Inspections, maintenance and adjustments.
   - Technical instruction, technical training and training schools.
   - Examinations and repairs after the warranty period is concluded.
   - Even if the warranty is valid, examination of malfunctions that are caused by reasons outside the above warranty scope.

This manual provides information for the following hardware product:

<Hardware product>
OD.RING (LQE010/LQE015)

<Changes added to this manual>

Description of added changes	Page
Section 6.5, “Replacing or Adding On the Module” is newly added.	6-9

In addition to the above changes, all the unclear descriptions and typographical errors found are also corrected without prior notice.

Revision record

Revision No.	Revision Record (revision details and reason for revision)	Month, Year	Remarks
A	First Edition	November 1998	
D	Section 6.5, “Replacing or Adding On the Module” is newly added.	October 2008	

PREFACE

We greatly appreciate your purchase of the optical dual ring (OD.RING: Optical Dual RING) module, an option for the CPU. This manual describes the operation of the OD.RING module. We request that you read this manual carefully to assure correct use of this product.

This option module is available in two types: standard model and environmentally resistant model. The environmentally resistant model has thicker platings and coatings than those for the standard model.
The model number of the environmentally resistant model is marked by adding the suffix "-Z" to the model number of the standard model.

(Example)
Standard model: LQE010
Environmentally resistant model: LQE010-Z

This manual is applicable to both the standard model and environmentally resistant models. Although the descriptions contained in this manual are based on the standard model, follow the instructions set forth in this manual for proper use of the product even if you use the environmentally resistant model.

<Trademarks>
Microsoft® Windows® operating system is registered trademarks of Microsoft Corporation in the United States and/or other countries.

NOTE
The OD.RING microprogram is stored in flash memory and no addition software for this module need not be loaded.

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1 BEFORE USE

1.1 CPU Mount Base

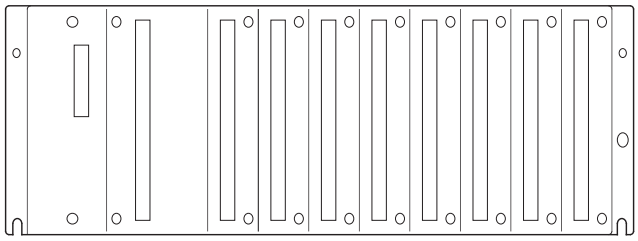


Figure 1-1 CPU Mount Base

Use of optional modules requires a CPU mount base. There are three types of CPU mount bases:

2-slot mount base (model: HSC-1020)
4-slot mount base (model: HSC-1040)
8-slot mount base (model: HSC-1080)

On the 8-slot mount base, for example, up to eight modules can be installed.

1.2 Installing Optional Modules

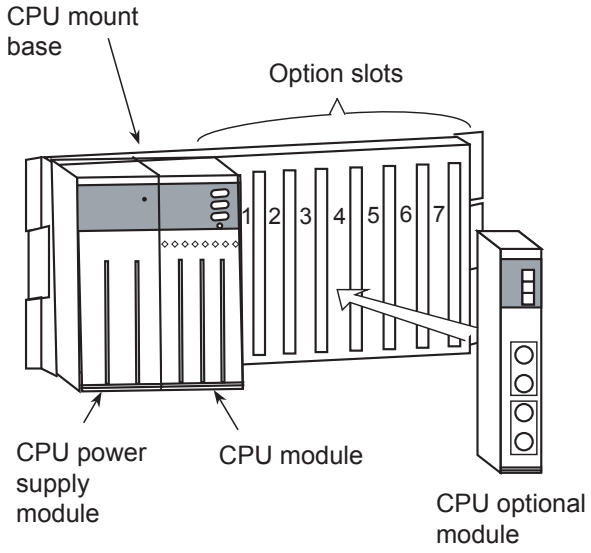


Figure 1-2 Optional Module Insertion Slots

PS slot: A slot into which the CPU power supply (LQV000) module is inserted.
CPU slot: A slot into which the CPU module (LQP000 or LQP010) is inserted.
Slots 0 to 7: Slots into which optional modules are inserted.

⚠ CAUTION

Insert OD.RING modules sequentially into the slots, starting from the leftmost one, without creating any empty slots in between.

Note the following when installing the optional module:

- As shown in Figure 1-3, install the optional module upright on the CPU mount base. Installing the optional module aslant on the mount base may bend a connector pin. If the pin is bent, the optional module may malfunction.

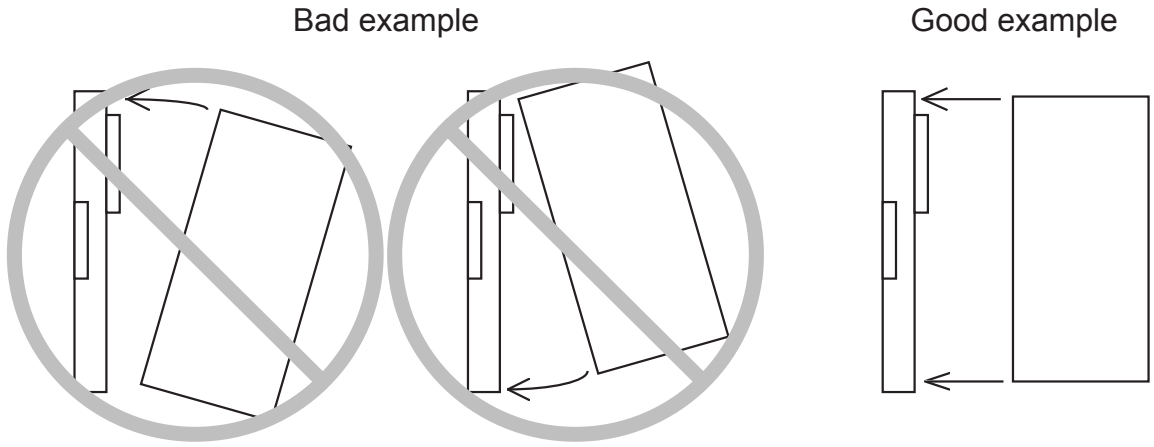
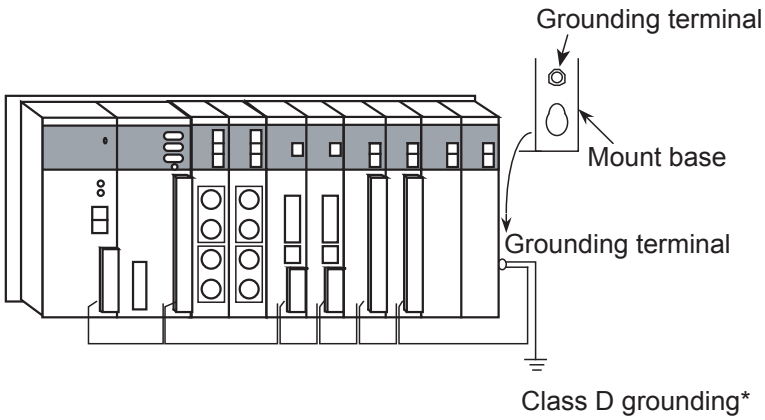


Figure 1-3 Optional Module Mounting Method

CAUTION

When the CPU mount base is located over the head because of the cabinet structure used, take care not to mount the optional modules aslant by using a stepladder or the like.

1.3 Grounding



* Class D grounding is defined in the Technical Standard for Electrical Facilities of Japan. This standard states that the grounding resistance must be 100 ohms for equipment operating on 300 VAC or less, and 500 ohms or less for devices that shut down automatically within 0.5 seconds when shorting occurs in low tension lines.

Figure 1-4 Grounding

REQUIREMENT

- In frame ground (FG) cabling, connect the FG terminal of each module with external terminals to the cubicle ground connection of the mount base. Apply Class D grounding from the cubicle ground connection of the mount base.
- Use a ground wire whose diameter is 2 mm2 or larger.

1.4 Replacing Modules

CAUTION

Be sure to turn off the power supply when replacing the optional module.
Failure to observe this rule may destroy software.

2 SPECIFICATIONS

2.1 Use

The OD.RING module shares data by performing memory transfer between CPUs. For I/O data, the maximum data sharing size is 4,096 points. For word data, the size is 4,096 words.

2.2 Specifications

	Item	Specifications	
		LQE010	LQE015
System	Maximum number of installable modules	2 per CPU	
	Number of lines	2 per module	
	Weight	300 g	
Lines	Network configuration	Dual rings	
	Transmission rate	2 Mbps	
	Maximum transmission distance	4 km between modules 60 km per ring	1 km between modules 60 km per ring
	Maximum number of connectable units	64	
	Maximum data sharing size of the system	I/O data: 4,096 points Word data: 4,096 words	
	Maximum data sharing size of the module	I/O data: 2,048 points/module Word data: 1,024 words/module	
	Data transfer interval	About 13 to 250 ms (depending on the number of modules connected and the amount of data transferred)	
	Wavelength	850 nm	880 nm
Cable	Connector	JIS F01 connector (FC connector)	SMA connector
	Optical fiber	Grated index type	Plastic clad multi-mode type

CAUTION

- For the two types of OD.RING modules (LQE010 and LQE015), up to two modules -- one from each type, or two from one of the two types -- can be connected to the CPU.
- Optical fiber cable cannot be used to connect an LQE010 module and an LQE015 module together. Be sure to connect only LQE010 modules or LQE015 modules using such cable.

3 NAMES AND FUNCTIONS OF EACH PART AND CABLING

3.1 Names and Functions of Each Part

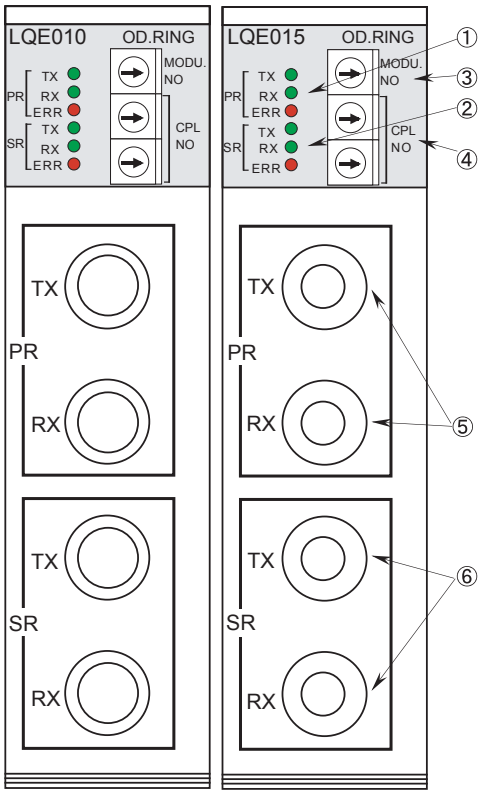


Figure 3-1 Front of OD.RING Module

① LEDs for primary ring (PR)
TX: Starts to blink when data is transferred.
RX: Starts to blink when data is received.
ERR: Comes on when a hardware error is detected.

② LEDs for secondary ring (SR)
The functions of these LEDs are the same as those of LEDs for the primary ring.

③ Module No. switch
Used to select the main module and submodule to be installed. Also, used to select a maintenance function.

Table 3-1 Setting of Module No. Switch

Function	Main module setting No.	Submodule setting No.
33-64 modules connection	0	1
17-32 modules connection	2	3
9-16 modules connection	4	5
1-8 modules connection	6	7
T/M1 (internal loopback)	8	9
T/M2 (external loopback)	A	B
T/M3 (offline loop)	C	D
Prohibition of use	Other setting Nos.	

④ CPL NO. switch
The CPL NO. switch is used to set the number (/00 to /3F) for identifying the module connected to the line.

⑤ Optical module receptacles for primary ring (PR)
TX (transmission): Used to connect the OD.RING module to the primary ring (RX) of the next-stage module.
RX (reception): Used to connect the OD.RING module to the primary ring (TX) of the previous-stage module.

⑥ Optical module receptacles for secondary ring (SR)
TX (transmission): Used to connect the OD.RING module to the secondary ring (RX) of the next-stage module.
RX (reception): Used to connect the OD.RING module to the secondary ring (TX) of the previous-stage module.

CAUTION

When installing both an LQE010 module and an LQE015 module on the same mount base, be sure to set one module as the main module and the other as the submodule using their module No. switches, and limit the total number of OD.RING modules installed to 2.

3.2 Cabling

(1) Primary ring (PR) cabling
As shown in Figure 3-2, connect the TX and RX receptacles of two adjacent OD.RING modules with optical fiber cables to configure the primary ring. Communication data flows from TX to RX in the direction of the arrow.

(2) Secondary ring (SR) cabling
In secondary ring cabling, connect the TX and RX receptacles of two adjacent OD.RING modules with optical cables as in primary ring cabling. In this cabling, however, be sure to connect TX and RX so that communication data flows from RX to TX (i.e., in the direction of the arrow which is the reverse of the direction of the primary ring).

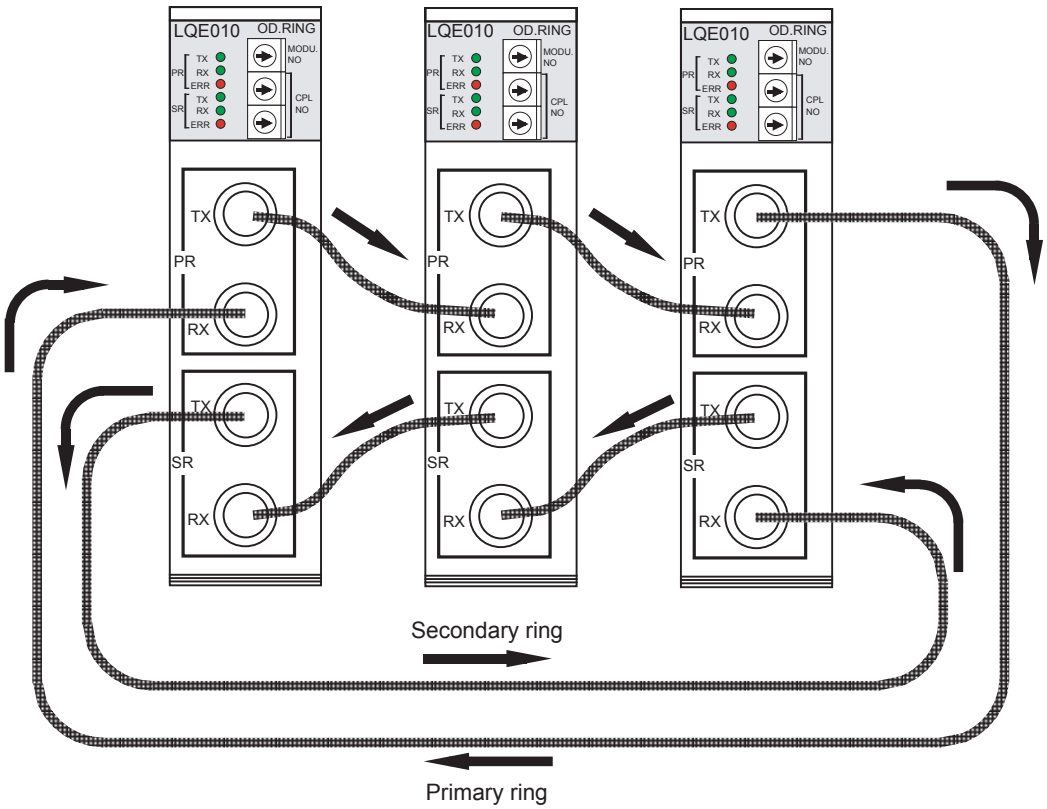


Figure 3-2 Optical Fiber Cable Connection

CAUTION

- Be sure to assign ID numbers to optical fiber cables for identification because cabling errors tend to occur easily.
- Optical fiber cable cannot be used to connect an LQE010 module and an LQE015 module together. Be sure to connect only LQE010 modules or LQE015 modules using such cable.

CAUTION

- As shown in Figure 3-3, insert the cable connector key into the key groove of the optical module, then fasten the key with the attached screw. If the cable connector key does not fit the key groove, do not screw the key forcibly into the groove. Failure to observe this rule may damage the connector or interrupt normal communication. (Applicable only to the LQE010.)
- There is a difference between primary ring cabling and secondary ring cabling. As shown on the previous page, the data flow direction in the primary ring differs from that in the secondary ring, so take care when cabling the rings. Incorrect cabling interrupts normal communication or deteriorates resistance failure performance.
- Fasten an optical fiber cable so that the bend radius is at least 30 mm. If the bend radius is less than 30 mm, the internal cord may be disconnected.
- Be sure to connect cables when the ring is in the dual state. Using an open or broken primary ring or secondary ring or incorrectly connecting them may make failure avoidance or normal communication impossible.
- The screwed part of the cable connector is metallic. For this reason, when the screwed part is touched by hand, static electricity may be discharged from the human body. This may result in a dual ring communication error. To prevent static electricity from being discharged, cover the connectors shown in Figure 3-3 with rubber or an insulating material.
- Electrically insulate the cubicle if it is fastened to the tension member. This insulation is required when a tension member is used in the optical fiber cable. (If cubicles are electrically connected by the tension member, circulating current may flow and generate noise.)

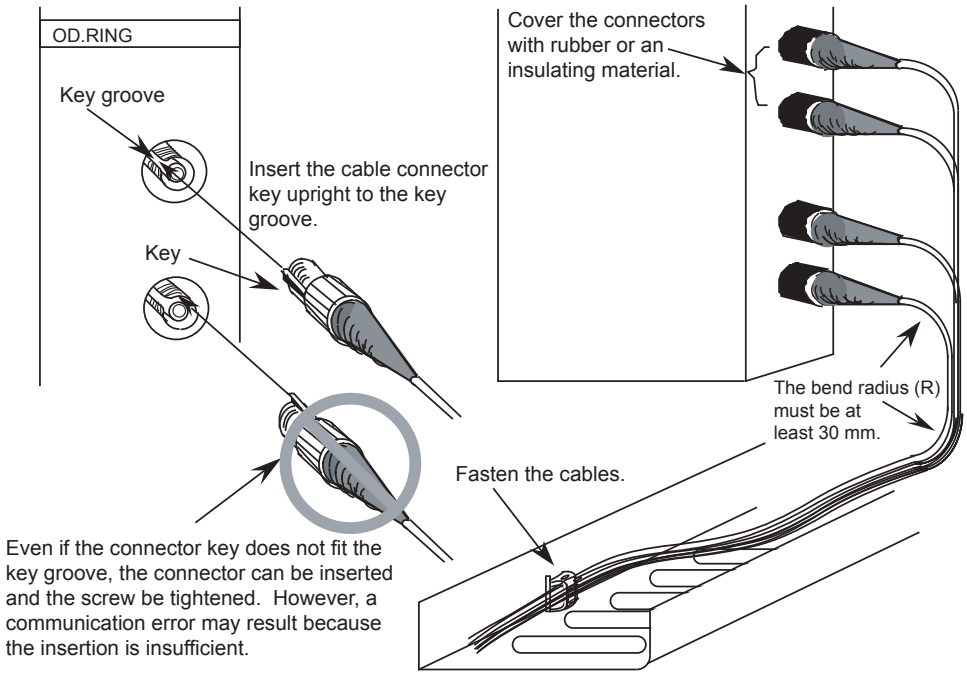


Figure 3-3 Handling Optical Fiber Cables

4 USER GUIDE

4.1 Operation

The OD.RING module transfers data in a set area of memory from one CPU to another.

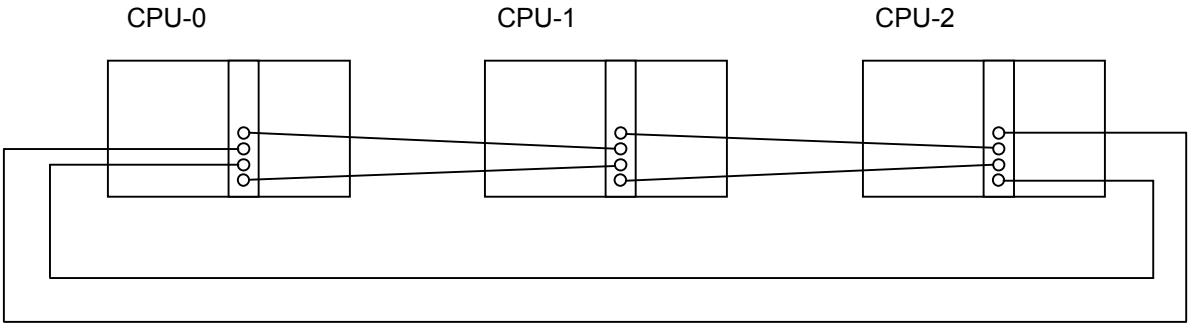


Figure 4-1 Example of System Configuration

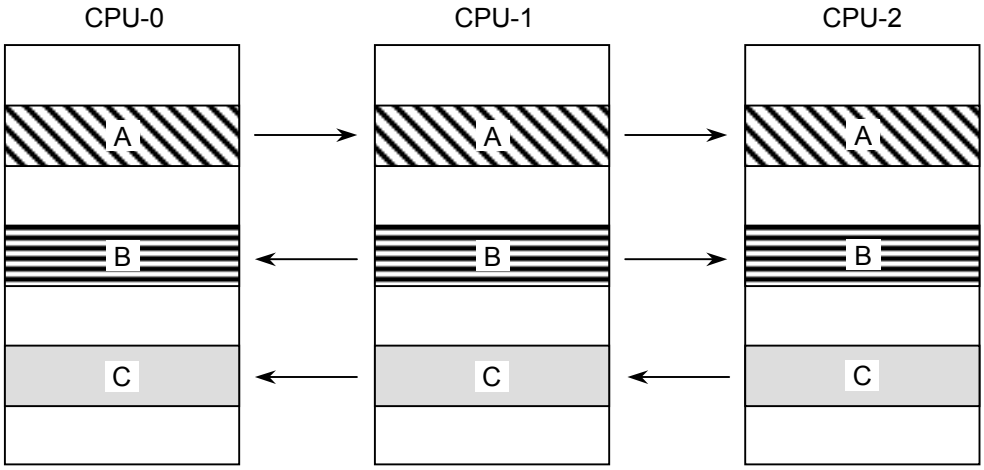


Figure 4-2 Memory Transfer

Figures 4-1 and 4-2 show memory transfer by each CPU.

Step 1: CPU-0 transfers area A to CPU-1 and CPU-2.

Step 2: CPU-1 transfers area B to CPU-0 and CPU-2.

Step 3: CPU-2 transfers area C to CPU-0 and CPU-1.

Step 4: Areas A through C are being shared by CPU-0 through CPU-2. The OD.RING module subsequently returns to Step 1 and repeats sharing.

4.2 Transfer Cycle

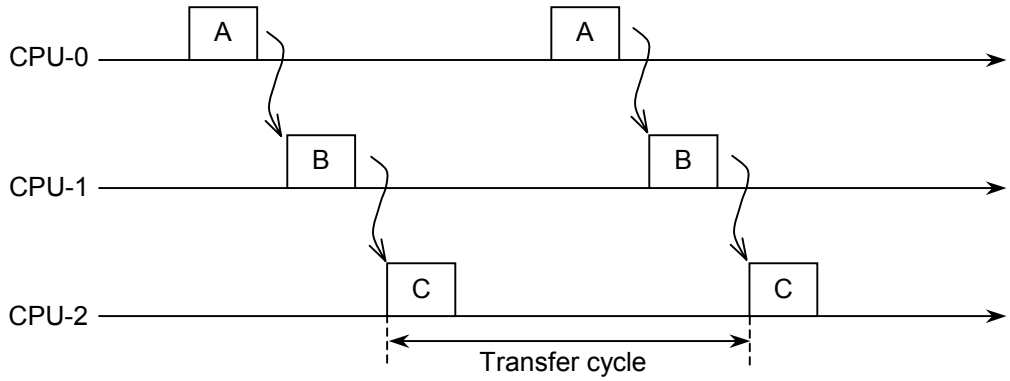


Figure 4-3 Transfer Cycle

Memory transfer explained in Section 4.1 is performed according to the timing chart shown in Figure 4-3. Each horizontal reference line above is a time axis.
Sharing starts when CPU-0 transfers area A and ends when CPU-2 transfers area C. Memory transfer areas are shared by periodically repeating this cycle.
The transfer cycle depends on the module No. switches, the number of modules installed, and the amount of data transferred. This cycle is calculated from the expressions shown in Table 4-1.

Table 4-1 Expressions for Calculating Transfer Cycle

Module No. SW	Expressions for Calculating Transfer Cycle
0, 1	192 - 0.5964X + 0.0146Y + 0.0009Z + 0.005WX (ms)
2, 3	96 - 0.5964X + 0.0146Y + 0.0009Z + 0.005WX (ms)
4, 5	48 - 0.5964X + 0.0146Y + 0.0009Z + 0.005WX (ms)
6, 7	24 - 0.5964X + 0.0146Y + 0.0009Z + 0.005WX (ms)

W: Total ring length (km)
X: Number of operating modules
Y: Amount of word data (words)
Z: Amount of bit data (points)

4.3 Synchronism of Transfer Data

Application software and the OD.RING module may simultaneously access the memory transfer area because they asynchronously access that area. In these cases, note that synchronism of transfer data as a memory transfer area block is lost.
For example, if an application reads the memory transfer area during update by the OD.RING module of that area, the chronological sequence of the data contained is disrupted.
Application software and the OD.RING module, however, assure such sequence in each individual word. Thus, analog data and counter values are transferred normally.

4.4 Memory Transfer Area

As shown in Table 4-2, bit data per module and word data per module can be separately specified as the memory transfer area.

Table 4-2 Memory Transfer Area

Bit data		Word data	
Area	Absolute address	Area	Absolute address
X000 to FFF	/A0000 to /A1FFE	XW000 to FF0	/E0000 to /E01FE
Y000 to FFF	/A4000 to /A5FFE	YW000 to FF0	/E0400 to /E05FE
J000 to FFF	/A2000 to /A3FFE	JW000 to FF0	/E0200 to /E03FE
Q000 to FFF	/A6000 to /A7FFE	QW000 to FF0	/E0600 to /E07FE
G000 to FFF	/A8000 to /A9FFE	GW000 to FF0	/E0800 to /E09FE
R000 to FFF	/AC000 to /ADFFE	RW000 to FF0	/E0C00 to /E0DFE
E400 to FFF	/BC000 to /BDFFE	EW000 to FF0	/E1C00 to /E1DFE
M000 to FFF	/AE000 to /AFFFE	MW000 to FF0	/E0E00 to /E0FFE
—	—	FW000 to BFF	/E2000 to /E37FE
—	—	Memory extension	/100000 to /4FFFFE

As shown in Figure 4-4, the areas set by each module may be non-continuous.

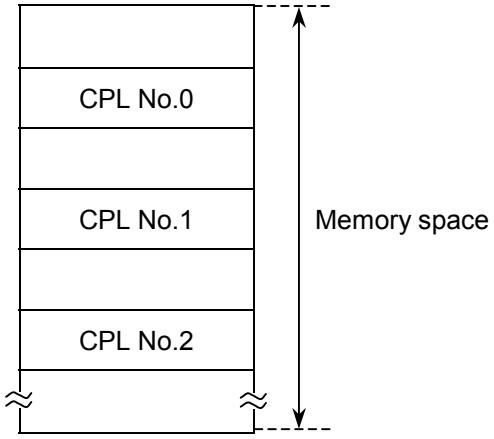


Figure 4-4 Areas Set by Each Module

4.5 Failures and Avoidance

When both the primary ring and secondary ring are communicating normally, each OD.RING module uses primary ring data, not secondary ring data.

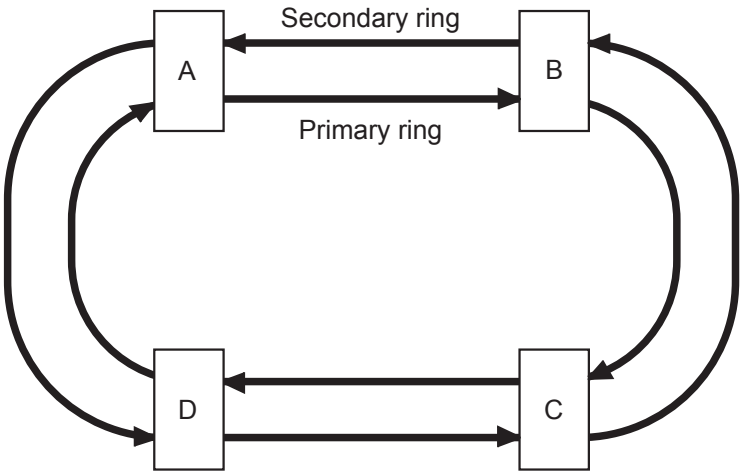


Figure 4-5 Data Flow in Normal Operation of Primary Ring and Secondary Ring

The OD.RING modules use only primary ring data or secondary ring data. Whether they use primary ring data or secondary ring data depends on how data is received.

- When one module is receiving data normally from another via both the primary ring and secondary ring, the primary ring data is used. Primary ring data has priority over secondary ring data.
- When one module is receiving data normally from another via the primary ring, the primary ring data is used.
- When one module is receiving data normally from another via the secondary ring, the secondary ring data is used.

Even if a failure occurs, the OD.RING modules can automatically avoid this to continue communication normally. Examples of failures and their avoidance are given below.

- If the primary ring or secondary ring is disconnected at one place, and data from the ring cannot be received, data from the other ring is used.

In Figure 4-6, for example, modules A, C, and D cannot receive module B data from the primary ring. Module C also cannot receive module A data, module B data, or module D data from the primary ring. In this case, the data received from the secondary ring is used. Primary ring data is used in other cases.

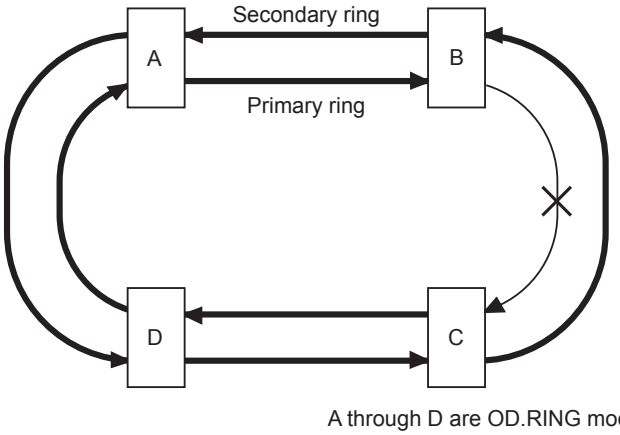


Figure 4-6 When One Ring is Disconnected at One Place

- If one ring is disconnected at several places, data from the other ring is used. In Figure 4-7, for example, modules A, C, and D cannot receive module B data from the primary ring. Modules A, B, and D also cannot receive module C data from the primary ring. In this case, the data received from the secondary ring is used. Primary ring data is used in other cases.

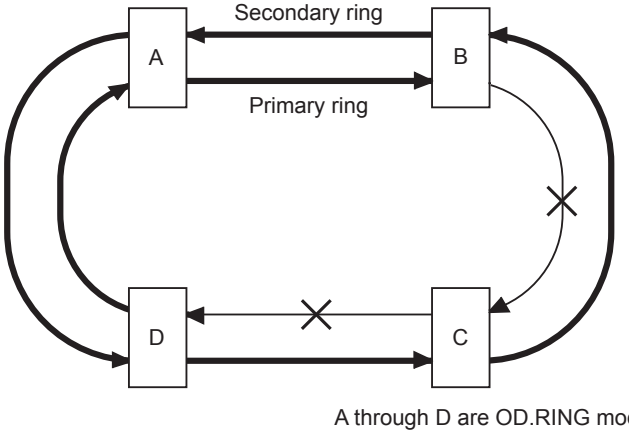


Figure 4-7 When One Ring is Disconnected at Several Places

- If both the primary ring and secondary ring are disconnected at the same place, a connected route is used to continue communication.

In Figure 4-8, for example, modules A, C, and D cannot receive module B data from the primary ring. Module C also cannot receive module A data, module B data, or module D data from the primary ring. In this case, the data received from the secondary ring is used. Primary ring data is used in other cases.

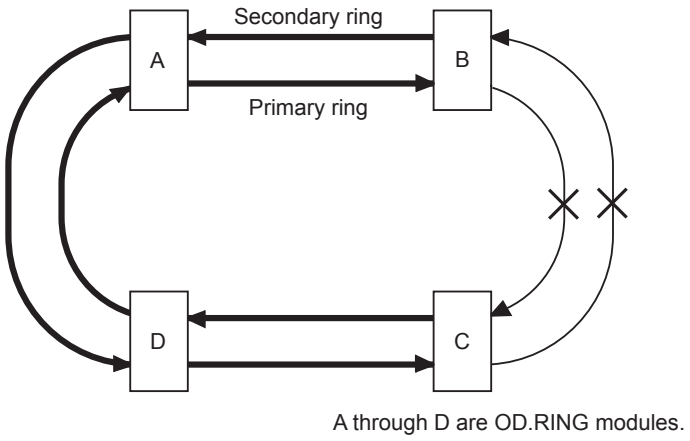


Figure 4-8 When Both Primary Ring and Secondary Ring are Disconnected at Same Place

- If one module stops (power failure), the remaining modules are used to continue communication.

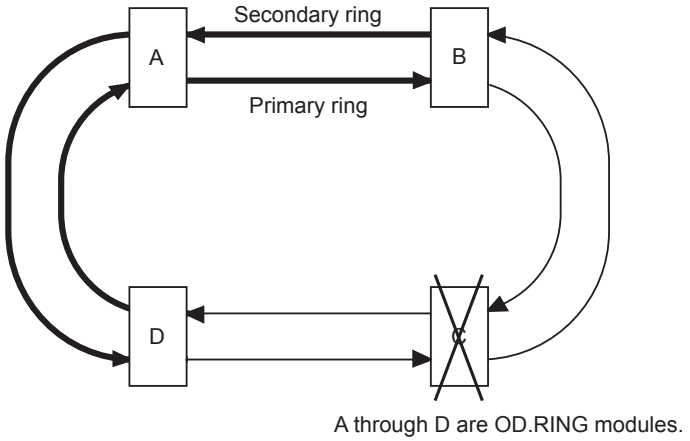


Figure 4-9 When Primary Ring or Secondary Ring is Disconnected at Several Places

- If adjacent modules stop (power failure), the remaining modules are used to continue communication.

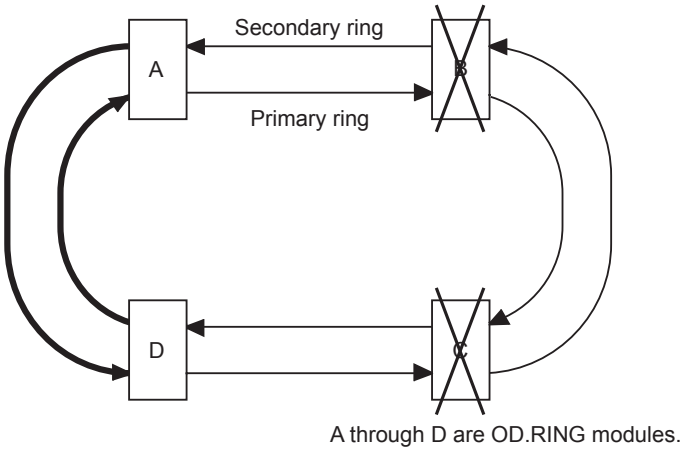


Figure 4-10 When Adjacent Multiple Modules Stop (Power Failure)

- If nonadjacent modules stop (power failure), as shown in Figure 4-11, adjacent modules continue communication.

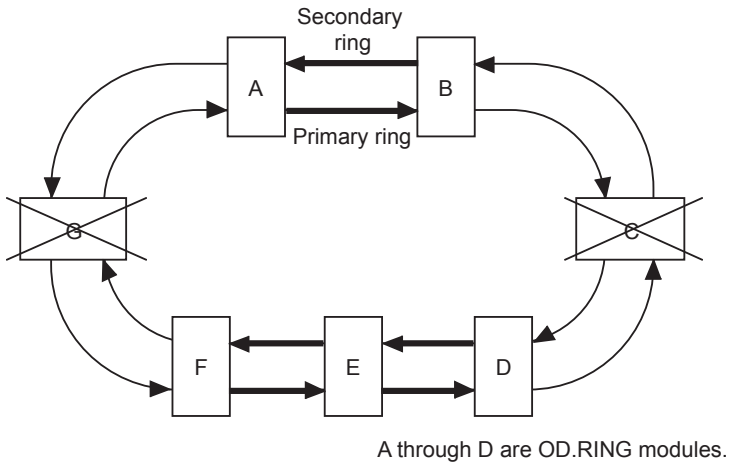


Figure 4-11 When Nonadjacent Multiple Modules Stop (Power Failure)

★ If the primary ring and secondary ring are disconnected at different places (between different modules), normal communication is impossible. (Depending on the number of modules connected, CPL Nos., and number of words transferred, some modules may be unable to transfer data at all. Some modules may also be unable to transfer data intermittently.)

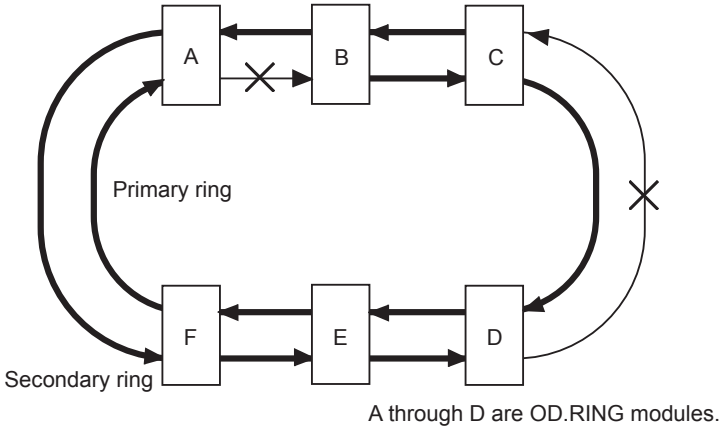
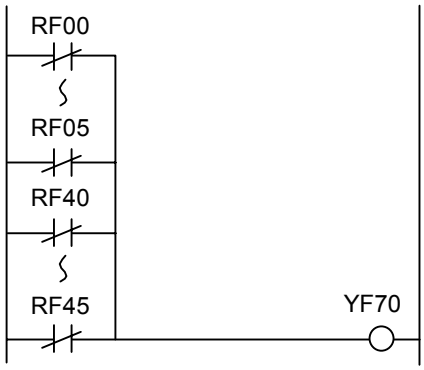


Figure 4-12 When the Primary Ring and Secondary Ring are Disconnected at Different Places

CAUTION

As shown in Figure 4-12, if the primary ring and secondary ring are disconnected at different places (between different modules), normal communication may be impossible. In these cases, be sure not to use the modules.
All the modules should also be programmed so that they can detect an error and issue an alarm when the primary ring or secondary ring is disconnected at one place.
Example: When the CPL No. of the connected OD.RING module is from 0 to 5 and the starting address of the RAS table is set to RWF00. (The figure below shows the case where YF70 is assigned to the coil for alarm issuance.)



4.6 RAS Table

The RAS table contains communication module information. Figure 4-13 shows the structure of the RAS table.

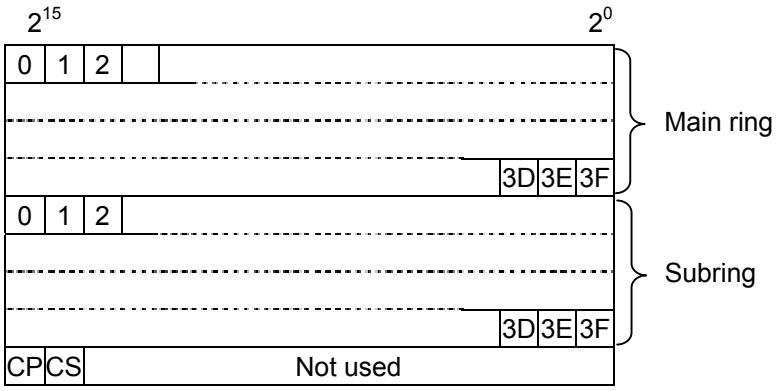


Figure 4-13 Structure of RAS Table

- The figures 0 through 3F correspond to the CPL numbers of the module. A set bit indicates that the module is communicating with another module.
  0: The LADDER switch of the CPU identified with the set CPL number is set to STOP; the cable is broken or not connected; power is not supplied; or the transmission area for the module having the CPL number is not yet set.
  1: Data is being received normally from the module identified with the set CPL number.

- CP indicates detection of primary ring disconnection and CS detection of secondary ring disconnection.
  0: The module immediately preceding the local module is normal.
  1: Disconnection occurred in the module immediately before the local module or the immediately preceding module is inactive or faulty.

The communicating module is monitoring other modules. When the communicating module receives data from another module, it judges that this module is communicating with another and sets the associated bit of the RAS table. If it does not receive data within a fixed time period, the communicating module judges that the other module is inactive and clears the associated bit of the RAS table.
The bit corresponding to the local module indicates the operating status of the module. This bit is set when the local module is operating normally. It is cleared when the module stops abnormally.
The above shows that the failures listed in Table 4-3 can be detected from the RAS table.

Table 4-3 Failures and RAS Table

Failure	RAS table status
Cable disconnection	The bits of all the modules before the place where the associated ring was disconnected are cleared.
Remote module stop (STOP, power failure)	The bits of both the primary ring and secondary ring of the associated module are cleared.
Local module error stop	The bit of the local module is cleared. Since data cannot be received from other modules, all the bits of the primary ring and secondary ring are cleared.

CAUTION

If an FW or an extension area of expanded memory is set as the RAS bit area, any data before resetting may remain there within two seconds after the resetting condition has been cleared. Wait at least for two seconds after resetting, then reference the defined area.

4.7 Hold Operation/Clear Operation

If data is not transmitted from a module that is in communication, this module is judged to have stopped (power failure), a hold or clear (clear to 0) operation is performed for the area to save the data from this module.

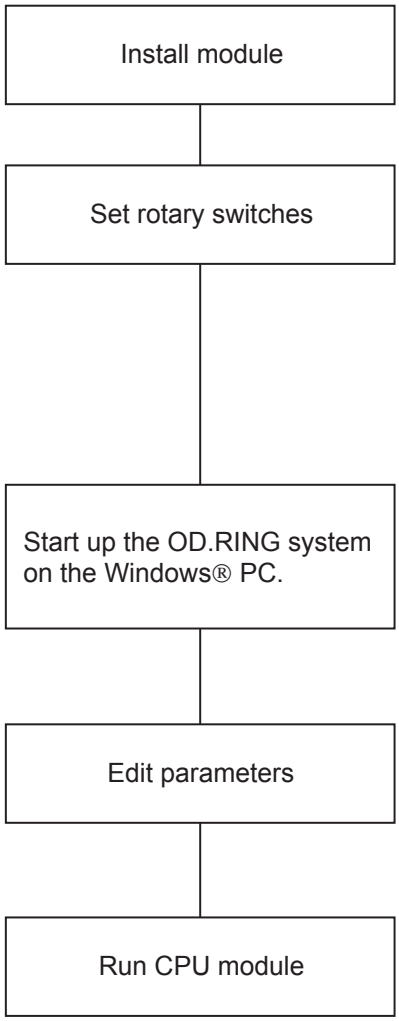
- Hold operation
  Data in the area (e.g., GW) where an inactive module is registered is held (retained) as is. The last data transmitted remains.

- Clear operation
  The area (e.g., GW) in which an inactive module is registered is cleared to 0.

If the inactive module resumes communication, data update for the area in which the module is registered is resumed in hold or clear operations. LQE010 and LQE015 are set to clear operation.

5 OPERATION

5.1 Startup Procedure



① Power down the CPU then install an OD.RING module.

② Use the module No. switch of the OD.RING module to set “primary” or “secondary.” In addition, use the CPL No. switch of the OD.RING module to set the number for identifying the module connected to the line (see Section 5.2).

③ Connect the CPU to the Windows® PC via an interface cable. Then, start up the OD.RING system on the Windows PC (refer to the SOFTWARE MANUAL OPTION OD.RING For Windows® [manual number SAE-3-147]).

④ Edit parameters for OD.RING modules (refer to the SOFTWARE MANUAL OPTION OD.RING For Windows® [manual number SAE-3-147]).

⑤ Set the RUN key switch of the CPU module to “RUN” to start data transmission.

Figure 5-1 Startup Procedure

5.2 Setting Switches

- Module No. switch

  Set the module No. switch to match the number of connected modules (see Section 3.1).

CAUTION

Note that the following setting is prohibited:
- Setting the module No. switch to a number to which no function is assigned (see Section 3.1).

- CPL No. switch
  - Set the CPL No. switch so that all the modules connected to the dual ring are assigned different numbers. Module numbers need not be in sequence.
  - Set the module No. switch and CPL. No. switch according to the number of modules connected, as shown in Table 5-1.

Table 5-1 Setting of Module No. Switch and CPL No. Switch

Number of modules connected	Module No. switch	CPL No. switch
33 to 64 modules	0, 1	Any value from 00 to 3F
17 to 32 modules	2, 3	Any value from 00 to 1F
9 to 16 modules	4, 5	Any value from 00 to 0F
1 to 8 modules	6, 7	Any value from 00 to 07

CAUTION

Note that the following settings are prohibited:
- The module of the same CPL No. exists in the dual ring.
- The CPL No. is set to a value outside the permitted range.

  When module No. switch is set to 0 or 1, an error occurs at CPL No.40 to FF.
  When module No. switch is set to 2 or 3, an error occurs at CPL No.20 to FF.
  When module No. switch is set to 4 or 5, an error occurs at CPL No.10 to FF.
  When module No. switch is set to 6 or 7, an error occurs at CPL No.08 to FF.

5.3 Powering Up

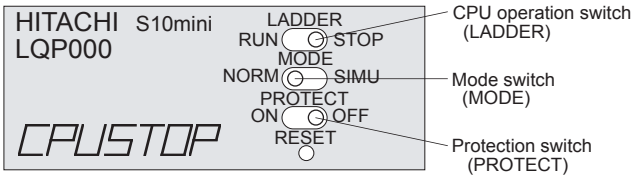


Figure 5-2 Front View of CPU

- Set the LADDER switch to STOP, the MODE switch to NORM, and the PROTECT switch to OFF and leave them in those positions until all necessary operating parameters have been set.
- Turn on the power supply and check that the operating system (OS) for the CPU module is loaded. When the OS is already loaded, the message “CPU STOP” is displayed in the indicator.

(Relationship between the OD.RING module and key switch)

The key switch of the CPU module affects the operation of the OD.RING module.

- STOP
  The OD.RING module receives data from a remote module and updates data in the memory transfer area. It transmits communication control data, not local module data.
- RUN, SIMU RUN
  The OD.RING module transmits and receives data.

5.4 Editing Parameters

5.4.1 Organization of OD.RING support system functions

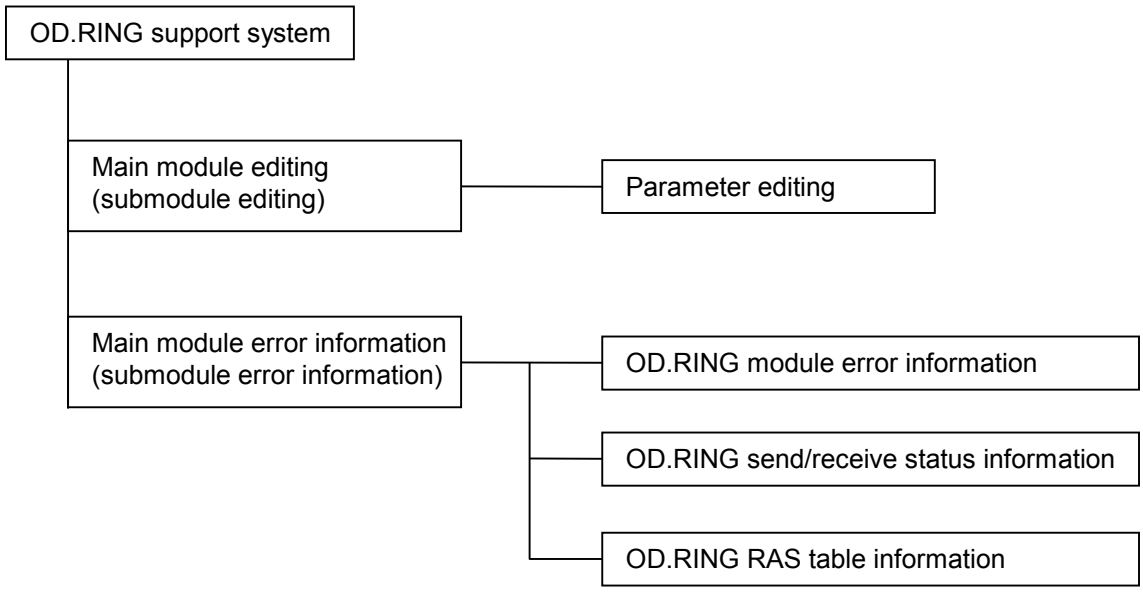


Figure 5-3 Organization of OD.RING Support System Functions

A variety of items are set in parameter editing so that OD.RING operates normally. Set the following items in parameter editing.

- Status setting
  Set the hold/clear operation mode. The hold/clear operation means that when data is not transmitted from another OR.RING module, the transfer area from this module is held or cleared (cleared to 0).
- Bit data address setting
  Set the bit data addresses to be transferred to other modules. For the settable address range, see Table 5-2.
- Word data address setting
  Set the word data addresses to be transferred to other modules. For the settable address range, see Table 5-2.
- RAS table address setting
  Set the RAS table address. The RAS table capacity is 9 words. For the settable address range, see Table 5-2. For the details of the RAS table, see "4.6 RAS Table."

Table 5-2 Settable Address Ranges

Settable address range	Bit data	Word data	RAS table
FW000 to FWBFF	Invalid setting	Valid setting	Valid setting
XW000 to XWFF0	Valid setting		
YW000 to YWFF0			
JW000 to JWFF0			
QW000 to QWFF0			
GW000 to GWFF0			
RW000 to RWFF0			
EW400 to EWFF0			
MW000 to MWFF0			
/100000 to /4FFFFE (memory extension)	Invalid setting		

5.5 Data Transmission

Setting the key switch to RUN starts data transmission.

Figure 5-4 Front View of the CPU (RUN State)

6 MAINTENANCE

6.1 Maintenance and Checking

To use OD.RING modules under the optimum condition, check the items listed in Table 6-1. Perform this check periodically (i.e., twice or more every year).

Table 6-1 Check Items

No.	Item	Check point
1	Appearance of module	Check that the module case is free from cracks, etc. If the case is faulty, the internal circuit may have been damaged. This damage can lead to a system malfunction.
2	LED	Check that the ERR LED of the OD.RING module is not on.
3	Looseness of mounting screws	Check module mounting screws for looseness. If the module mounting screws are loose, tighten them. Loose screws can cause a system malfunction and overheating.
4	Cable covering state	Check the cable covering state. An uncovered cable can cause a system malfunction and electrical shock. It can also cause a fire by shorting.
5	Dirt adhesion state	Check the module for dirt. If dirt is found, remove it with a cleaner. Dirt adhesion to the module can cause the internal circuit to short and start a fire.
6	Module replacement	Replacing the module during hot swap may result in hardware or software destruction. Be sure to turn off the power supply when replacing the module.
7	Conditions of light source and detector surfaces of module	The light source and detector elements of the module are protected by glass caps. If dust and dirt adheres to the glass surface, optical transmission characteristics deteriorate. For this reason, when the optical fiber cable is disconnected from the module receptacle, be sure to cover the receptacle side of the module and the optical connector side of the optical fiber cable with the attached dust-proof cap. If dust and dirt adheres to the glass surface due to frequent connection and disconnection of the connector, blow it off with air or wipe it off lightly with a soft cloth (e.g., gauze) dipped into ethyl alcohol. Do not use a cotton swab, etc., because it may damage the glass surface. If dust and dirt adheres to the end face of the optical fiber cable side, wipe it off with a soft cloth dipped into ethyl alcohol.

6.2 Test/Maintenance Program (T/M)

The test/maintenance program (T/M) is a hardware test program created to simplify the test and maintenance of the OD.RING module. Three T/M routines are already installed in this module. This enables the user to execute the T/M routines through simple operations. Select the T/M routine that you wish to use with the module No. switch. Table 6-2 lists the types and functions of the T/M routines.

Table 6-2 Types and Functions of T/M Routines

T/M	Function	Module No.
T/M1	Internal loopback (main)	8
	Internal loopback (sub)	9
T/M2	External loopback (main)	A
	External loopback (sub)	B
T/M3	Offline loop (main)	C
	Offline loop (sub)	D

CAUTION

T/M1 and T/M2 rewrite the FW area in the CPU. For this reason, save the FW area in advance, and then disconnect T/M1 and T/M2 from the equipment side (i.e., placing them into offline mode).

6.2.1 Executing T/M

The T/M routines can be easily executed as follows:

(1) Reconnecting the optical fiber cable
When you wish to execute T/M1 or T/M2, reconnect the optical fiber cable first. For details on optical cable reconnection, see Subsections 6.2.2 through Subsection 6.2.4.

(2) Setting the rotary switch
Set the rotary switch for T/M routine selection.

(3) Executing the selected T/M routine
The selected T/M routine is executed for the first time when the CPU is reset.

6.2.2 T/M1 (internal loopback test)

- Function
  T/M1 carries out loopback test in the module. It mainly tests the communication part of the module.
- Connecting optical fiber cables
  Optical cables need not be connected externally. Be sure to disconnect all the optical cables.
- Setting switches
  Set the module No. switch to 8 or 9 and the CPL No. switch to /00.
- When the module is operating normally
  The LED (TX LED) for transmission blinks quickly. All other LEDs are off.
- When a communication error occurs
  The error LED (ERR LED) comes on.

6.2.3 T/M2 (external loopback test)

- Function
  T/M2 connects the optical cables to the module (loopback connection) and performs loopback test. It tests the module from the communication part to the connector.
- Connecting optical fiber cables
  As shown in Figure 6-1, connect the TX of the primary ring to the RX of the secondary ring and the TX of the secondary ring to the RX of the primary ring.
- Setting switches
  Set the module No. switch to A or B and the CPL No. switch to /00.
- When the module is operating normally
  The LED (TX LED) for transmission and LED (RX LED) for reception start to blink. All other LEDs are off.
- When a communication error occurs
  The error LED (ERR LED) comes on.

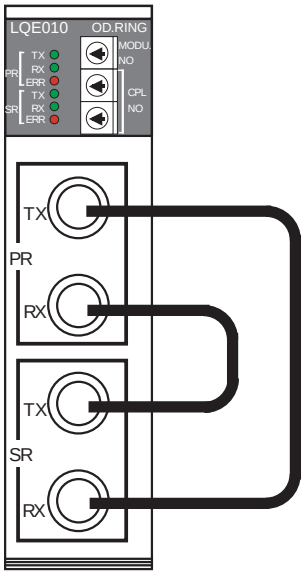


Figure 6-1 Connecting Optical Fiber Cables (T/M2)

6.2.4 T/M3 (offline communication data check)

- Function
  T/M3 uses the dual ring to check communication data. It tests the whole communication function.
- Connecting optical fiber cables
  Connect optical fiber cables in the way they are connected online.
- Setting switches
  Set the module No. switches of all the modules to C or D. The CPL No. switch need not be reset.
- When the module is operating normally
  The LED (TX LED) for transmission and LED (RX LED) for reception start to blink. All other LEDs are off.
- When a communication error occurs
  Even if a communication error occurs, the error LED (ERR LED) does not come on. If the error LED comes on, see Section 7.2.

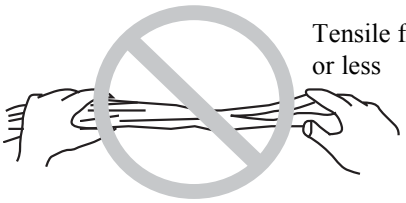
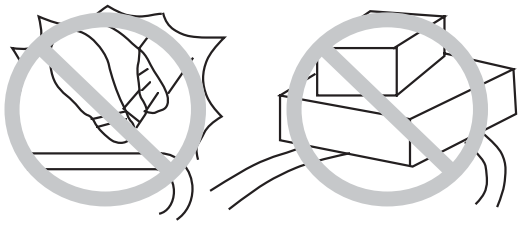
CAUTION

When you wish to execute T/M3, be sure to set the module No. switches of all the modules to C or D. If the module No. switch of even one module is set to a position other than C or D, communication data check will be made incorrectly. Set a CPL No. so that it will not be duplicated.

6.3 Handling an Optical Fiber Cable and Connector

As shown in Table 6-3, handling the optical fiber cable and connector requires sufficient care.

Table 6-3 Notes on Handling

	Item	Description	Remarks
Optical fiber cable	Do not bend!	 The bend radius should be 30 mm or more.	If the bend radius is smaller than the 30 mm, the internal fibers will be broken.
	Do not pull!	 Tensile force = 69 N or less	The fibers may break if the cable is pulled excessively.
	Do not step on the cable!		Do not step on the cable nor place anything on it because the fibers may break, increasing the fiber transfer loss.
	Do not scratch!		Fiber loss increases if the inside of the cable is humid.
Optical connector	Do not forget the dust-proof cap!	Do not remove the dust-proof cap when not using the optical connector.  Dust-proof cap	Same as on the receptacle side
	Optical connector connection	• Before connecting the optical connector, be sure to clean its end face with industrial-use gauze dipped into ethyl alcohol. • Do not insert or extract the optical connector by force, otherwise its end face will be damaged.	The neck of the optical connector is apt to be easily damaged by bending. Insert or extract the optical connector only when necessary.

6.4 Replacing Optical Fiber Cables

The disconnected optical fiber cable of an OD.RING module can be replaced while communication continues online.

DANGER

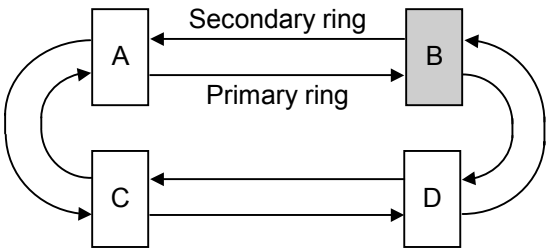
Only optical fiber cables can be replaced online.
Wiring of cables other than optical fiber cables such as power cables and grounding conductors may cause an electrical shock. Be sure to turn off the power supply before wiring such cables.

6.5 Replacing or Adding On the Module

The OD.RING module may be replaced in online mode; that is, its replacement may be performed while communications are in progress with the other existing OD.RING modules.

- What you should get in preparation
  ① Personal computer (with Hitachi's S10 OD.RING/SD.LINK System installed in it)
  ② RS-232C cable (or 10BASE-T cable if the communication module used is an ET.NET module)
  ③ New or add-on OD.RING module (LQE010/015)
  ④ Copies of the parameter values for the module to be replaced. (These copies are prepared for use in cases where the parameters are not accessible for some reason.)
  ⑤ The above-mentioned ET.NET module is an optional module and, if it is mounted in place, may be selected as the type of communication module to be used. For more information, refer to Section 2.1, "Names and Functions of Each Part," and Section 3.2, "Mounting the Module," in the User's Manual, Option ET.NET (LQE520) (manual number SVE-1-103).

- Replacement procedure
  Suppose that your system has a system configuration as shown in Figure 6-2, and that you want to replace module B in the system configuration. Then, perform the replacement procedure described below.



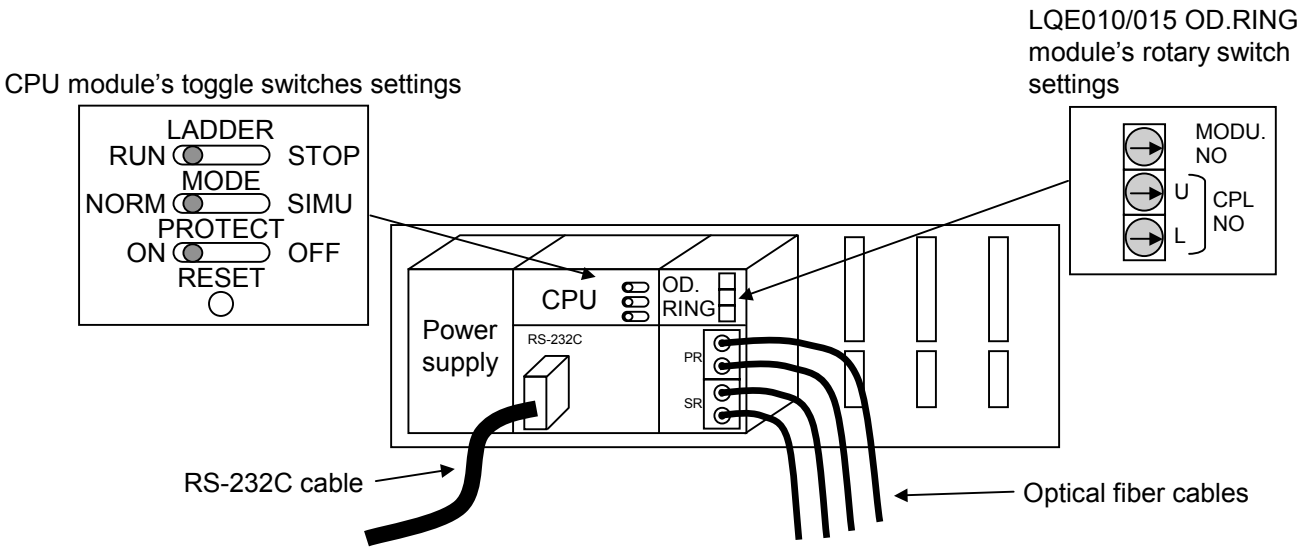
Note: Each of the modules labeled A thru D in this configuration is an OD.RING module.

Figure 6-2 A Sample System Configuration

① Write down, on a piece of paper, the current settings of the rotary switches (MODU.NO, and CPL NO U and L) that are, as shown below, accessible at the front side of module B.

② Write down also the current settings of three switches, labeled LADDER (toggle switch), MODE (toggle switch), and PROTECT (toggle switch), respectively, that are, as shown below, accessible at the front side of the CPU module installed in the same controller unit as module B.

③ Connect the personal computer and the CPU module together with the RS-232C cable.



④ Start Hitachi's S10 OD.RING/SD.LINK System and write down the set values of all the existing parameters on a piece of paper. (If the existing parameters are not accessible for some reason, use the copies of their set values [item ④] that were obtained in preparation.)

⑤ Set the CPU module's LADDER switch in STOP position and turn off the power supply of the controller unit.

⑥ Remove the optical fiber cables from module B. To prevent dust and dirt from getting into the connectors of both the removed optical fiber cables and module B, attach dust-proof caps to those connectors.

⑦ Replace module B with the new one and set the new OD.RING module's rotary switches in the same way as you wrote down in Step ①.

⑧ Turn on the power supply of the controller unit and set the same parameter values as those that were recorded in Step ④, by using the S10 OD.RING/SD.LINK System.

⑨ Check that all the set parameter values are identical to those that were recorded in Step ④.

⑩ Reset the CPU module by pressing the RESET switch at its front.

⑪ Turn off the power supply of the controller unit.

⑫ Remove the RS-232C cable from both the personal computer and CPU module, which were connected together in Step ③.

⑬ Connect the optical fiber cables to the new OD.RING module, the cables that were removed from it in Step ⑥.

⑭ Set the CPU module's LADDER, MODE, and PROTECT switches in the same way as you wrote down in Step ②.

⑮ Turn on the power supply of the controller unit and check that the new OD.RING module is running normally. To accomplish this check, ensure that the new OD.RING module's PR-/SR-RX and PR-/SR-TX LEDs are all lit, but its ERR LED is not.

- Add-on procedure (for adding on a sub-module)

① Write down, on a piece of paper, the current settings of three switches, labeled LADDER (toggle switch), MODE (toggle switch), and PROTECT (toggle switch), respectively, that are accessible at the front side of the CPU module, the one that is installed in the controller unit in which you are adding on an OD.RING module.

② Ensure that your application system has been shut down. Then, set the CPU module's LADDER switch in STOP position and turn off the power supply of the controller unit.

③ Mount the add-on OD.RING module in place according to the instructions given under "1.2 Installing Optional Modules."

④ According to the information provided under "3.1 Names and Functions of Each Part," set the add-on OD.RING module's MODU.NO switch in such a way that a new sub-module No. setting will not duplicate with the current MODU.NO switch setting of the existing main OD.RING module.

⑤ According to the instructions given under "5.2 Setting Switches," set the new OD.RING module's CPL NO U and L switches in such a way that a new number setting will not duplicate with any of the current number settings of the existing OD.RING modules forming the full-duplex ring.

⑥ Connect the personal computer and the CPU module together with the RS-232C cable. Then, turn on the power supply of the controller unit and set parameters for the add-on OD.RING module (sub-module) by using the S10 OD.RING/SD.LINK System.

⑦ Reset the CPU module by pressing the RESET switch at its front.

⑧ Turn off the power supply of the controller unit and connect the optical fiber cables from the ring to the add-on OD.RING module.

⑨ Set the CPU module's LADDER, MODE, and PROTECT switches in the same way as you wrote down in Step ①.

⑩ Turn on the power supply of the controller unit and check that the add-on OD.RING module is running normally. To accomplish this check, ensure that the add-on OD.RING module's PR-/SR-RX and PR-/SR-TX LEDs are all lit, but its ERR LED is not.

DANGER

- Switch off modules before replacing them to avoid electrical shock hazards.
- When replacing modules, do not touch any terminals other than those of optical modules to avoid electrical shock hazards.

- Replace modules one at a time. If optical fiber cables are disconnected at multiple points and the same time, communication might be disabled.
- Before replacing optical modules receptacle, check that the optical fiber cables are not broken. Disconnecting optical fiber cables for replacement while they are broken could disable communication.
- A breakage is detected in the RAS table while replacement work is in progress. If an optical fiber cable is disconnected for replacement, a breakage is detected in the RAS table, but successful communication is carried on.

6.6 Optical Level Measurement

When a fault occurs, the faulty portion can be located by optical level measurement.

6.6.1 Optical receiving level measurement

Measure the optical level on the receiving side of the optical fiber cable as shown in Figure 6-3. Measure it for the primary ring and the secondary ring.
Connect the optical cable to the optical power meter through an applicable connector adapter.
LQE010: FC type connector (JIS C5970 F01 type connector)
LQE015: SMA type connector

Measure the optical level while holding down the RESET switch of the CPU module.

Criterion

- For LQE010: The optical level should be within the range of -15 dBm to -30 dBm.
  (Optical power meter: Wavelength = 850 nm)
- For LQE015: The optical level should be within the range of -14 dBm to -28 dBm.
  (Optical power meter: Wavelength = 880 nm)

If the above criterion is not satisfied, measure the optical level according to “6.6.2 Locating a fault portion” and check the network.

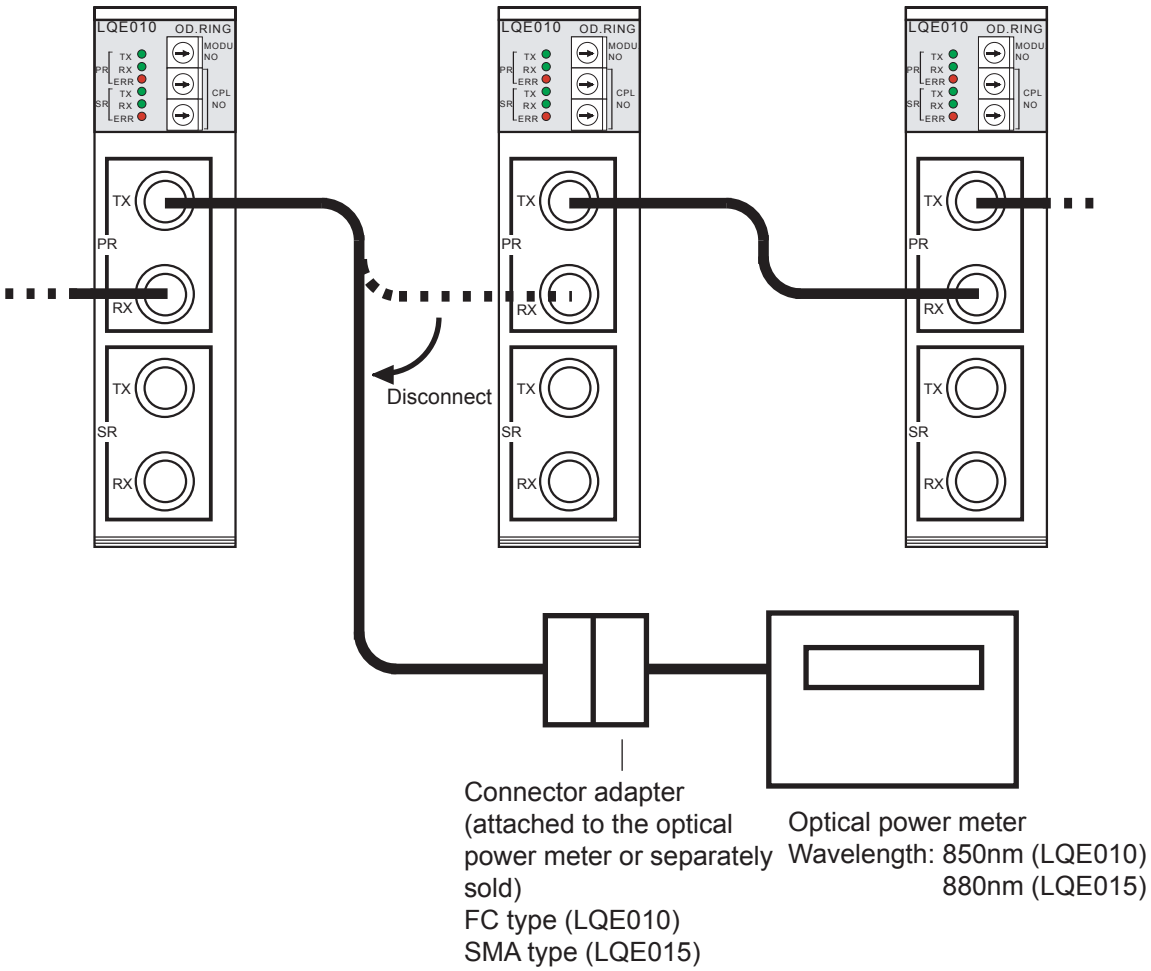
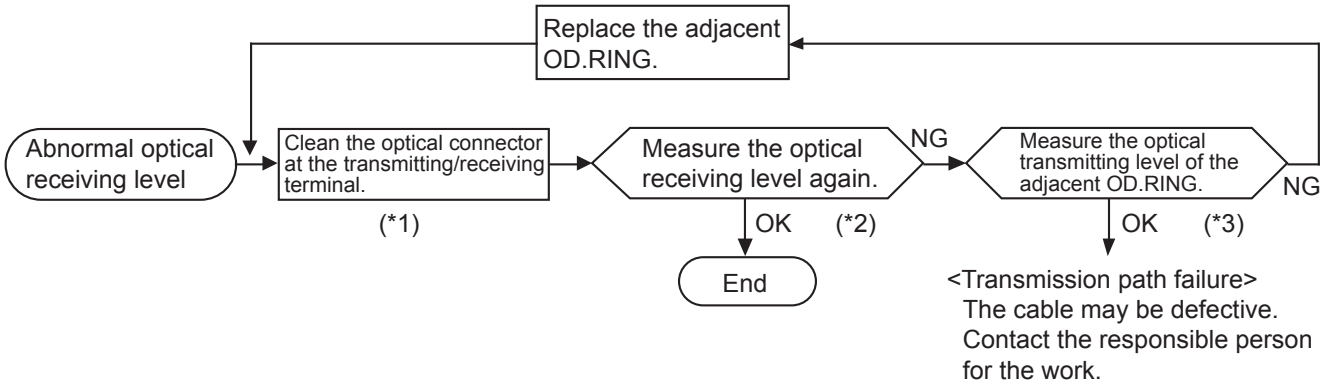


Figure 6-3 Example of Optical Receiving Level Measurement

- Take care when handling the optical fiber cable. In particular, do not make the bend radius smaller than 30 mm, otherwise a wipe breaking may be caused.
- After measurement, clean the optical module and the optical connector.
- Since the optical fiber connector of the OD.RING (LQE010) is the FC type (SMA type for the LQE015), the optical power meter must be applicable to the FC type (or SMA type). Use the connector adapter (attached to the optical power meter or separately sold) for the FC type.

6.6.2 Locating a fault portion



(*1) See “6.3 Handling Optical Fiber Cables.”
(*2) See “6.6.1 Optical receiving level measurement.”
(*3) See “6.6.3 Optical transmitting level measurement.”

Figure 6-4 Locating a Faulty Portion

6.6.3 Optical transmitting level measurement

Measure the optical level on the transmitting side by using a short optical fiber cable with a length of 1 m or less as shown in Figure 6-5.
A transmission path that satisfies the criterion at optical receiving level measurement requires no optical transmitting level measurement.
Connect the optical fiber cable to the optical power meter through an applicable connector adapter.
For LQE010: FC type connector (JIS C5970 F01 type connector)
For LQE015: SMA type connector

Criterion

- For LQE010: The optical level should be within the range of -15 dBm to -18 dBm.
  (Optical power meter: Wavelength = 850 nm)
- For LQE015: The optical level should be within the range of -14 dBm to -18 dBm.
  (Optical power meter: Wavelength = 880 nm)

If the criterion is not satisfied, replace the OD.RING.

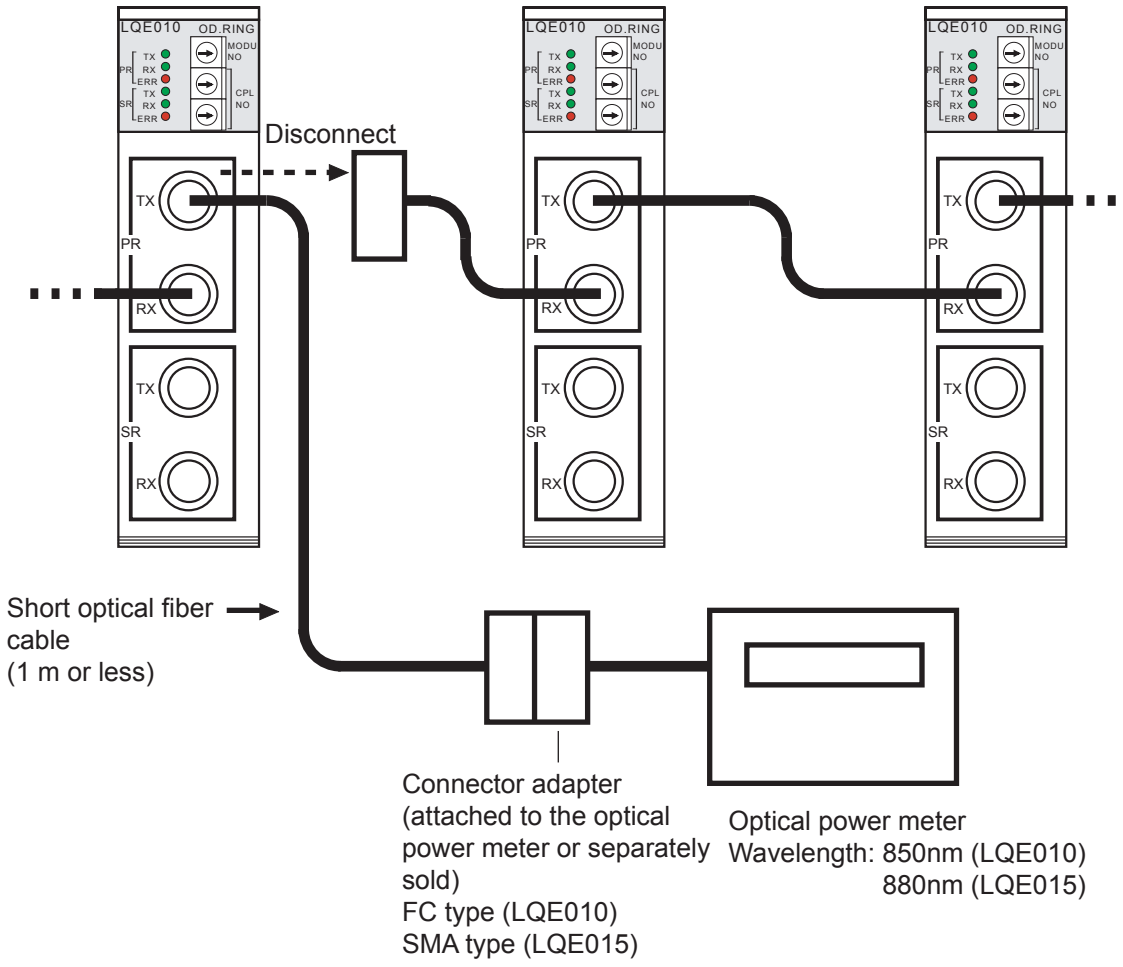


Figure 6-5 Example of Optical Transmitting Level Measurement

- Take care when handling the optical fiber cable. In particular, do not make the bend radius smaller than 30 mm, otherwise a wipe breaking may be caused.
- After measurement, clean the optical module and the optical connector.
- Since the optical fiber connector of the OD.RING (LQE010) is the FC type (SMA type for the LQE015), the optical power meter must be applicable to the FC type (or SMA type). Use the connector adapter (attached to the optical power meter or separately sold) for the FC type (or the SMA type).

7 TROUBLESHOOTING

7.1 Trouble Detection and Solution

- The LED for transmission does not come on.
  - Is the POWER LED of the power module on?
    If the POWER LED is not on, power is not supplied. Turn on the power supply.
  - Is the error LED on?
    The error LED which is on indicates that an error occurred. See Section 7.2.
  - Is the LED for reception on?
    If the LED for reception is on, the module may be faulty. See Section 7.2.

- The LEDs for transmission of all the modules go out and the LEDs for reception come on.
  - Is the optical fiber cable connection correct?
    Check the optical fiber cable connection.
  - Is the optical cable connector inserted properly?
    Check whether the optical cable connector key fits the key groove.

- The LED for reception does not come on.
  - Is the LED for transmission on?
    If the LED for transmission is not on, see the item with the title “The LED for transmission does not come on” above.
  - Is the optical fiber cable connection correct?
    Check whether the cables are wired as described in Section 3.2.
  - Is an optical fiber cable disconnected or bent?
    An optical fiber cable is made up of optical fibers. Communication through optical fibers is disabled if the cable is bent more than the specified bending radius (see Figure 3-3).
  - Is the remote module sending data?
    If the remote module is not sending data, the LED for reception does not come on.

- Data is not sent from the remote module.
  - Is the power supply of the remote module on?
    If the power supply is off, turn it on.
  - Is the remote module sending data?
    If the LED for transmission is not on, see the item with the title “The LED for transmission does not come on” above.
  - Is the key switch of the remote module set to RUN?
    If the key switch is not set to RUN, no memory transfer will take place.

- Is the transmission area of the remote module set correctly?
  If the transmission area is set incorrectly, set it correctly. If the number of words to be sent is set to 0, no data will be sent.
- Are the set module No. and CPL No. correct?
  Check whether the set module No. and CPL No. are correct. Module No. setting and CPL No. setting depend on the number of modules connected (see Section 5.2). If the set value is duplicated, data will be sent incorrectly.

● Data is not sent to the remote module.
- Is the key switch of the local module set to RUN?
  If the key switch is not set to RUN, no memory transfer will take place.
- Is the transmission area of the local module set correctly?
  If the transmission area is set incorrectly, set it correctly. If the number of words to be sent is set to 0, no data will be sent.
- Are the set module No. and CPL No. correct?
  Check whether the set module No. and CPL No. are correct. Module No. setting and CPL No. setting depend on the number of the modules connected (see Section 5.2). If the set value is duplicated, data will be sent incorrectly.

● Transfer area data is lost.
- Is the transmission area of the module currently sending data set correctly?
  If the transmission area is set incorrectly, set it correctly.
- Is a transmission area duplicated in several modules?
  If the transmission area is duplicated, data in the area will be lost.
- Was the transfer area rewritten by the user program?
  If possible, stop the user program and check whether the transfer area was rewritten.

● The sent data was zeroized.
- Is the module currently sending data stopped (power failure)?
  If CLEAR is selected, the content of the transfer area is zeroized when data transmission is suspended.
- Is the key switch of the module currently sending data set to STOP?
  If the key switch is set to STOP, no data will be sent from the transfer area. If CLEAR is selected in hold/clear setting, the transfer area will be zeroized.

7.2 Error Display and Countermeasures

If a fatal error occurs, the error LED on the front of the module comes on. Communication is halted at this point of time. Recovery from this error can be made only by means of resetting the CPU (or powering down). To find the cause of this error (error LED on), check the items below. When the instruction "See Section 7.2" appears in Section 7.1 or when you feel that the operation is unstable, also check them.

- Are the modules mounted on the mount base without leaving any free, permitted slot on the left?
- Are three or more modules mounted?
- Is the module No. switch set correctly?
- Is the CPL No. switch set correctly?
- Are the optical fiber cables as described in the specifications being used? (Too long, etc.)

If no problem is found in these checks, reset the CPU module.

If the same error recurs, turn off the power supply once. If the error condition is not cleared despite this operation, the module may be faulty. Replace the module. If the error LED comes on again although error recovery is made successfully by resetting the CPU (or powering down), the module may be faulty. Replace the module. If the same error still recurs despite module replacement, contact your local sourse.

7.2.1 CPU indicators display messages

Table 7-1 lists the messages to be displayed on the CPU indicators.

Table 7-1 CPU Indicators Display Messages

Message	Explanation	User response
ODM x.x	Normal operation (main)	This message is not an error message. (x.x indicates a version and revision.)
ODS x.x	Normal operation (sub)	
ODM MDSW	Out-of-range MODU No. setting (main)	Set a correct module No.
ODS MDSW	Out-of-range MODU No. setting (sub)	
ODM CPSW	Out-of-range CPL No. setting (main)	Set a correct CPL No.
ODS CPSW	Out-of-range CPL No. setting (sub)	
ODM DPCP	Duplicated CPL No. setting (main)	Set a CPL No. which is not duplicated.
ODS DPCP	Duplicated CPL No. setting (sub)	
ODM BUS	Bus error (main)	Reset the CPU. If the same error message is still displayed, the OD.RING module may be faulty. Replace the module.
ODS BUS	Bus error (sub)	
ODM ADDR	Address error (main)	
ODS ADDR	Address error (sub)	
ODM ILLG	Illegal instruction error (main)	
ODS ILLG	Illegal instruction error (sub)	
ODM ZERO	Division by zero error (main)	
ODS ZERO	Division by zero error (sub)	
ODM PRIV	Privilege violation (main)	
ODS PRIV	Privilege violation (sub)	
ODM WDT	WDT error (main)	
ODS WDT	WDT error (sub)	
ODM FMAT	Format error (main)	
ODS FMAT	Format error (sub)	
ODM SINT	Spurious interrupt (main)	
ODS SINT	Spurious interrupt (sub)	
ODM EXCP	Unused exception (main)	
ODS EXCP	Unused exception (sub)	
ODM PTY	Parity error (main)	
ODS PTY	Parity error (sub)	
ODM ROM1	ROM1 sum error (main)	
ODS ROM1	ROM1 sum error (sub)	
ODM RAM1	RAM1 compare error (main)	
ODS RAM1	RAM1 compare error (sub)	
ODM RAM2	RAM2 compare error (main)	
ODS RAM2	RAM2 compare error (sub)	
ODM ROME	ROM3 erase error (main)	
ODS ROME	ROM3 erase error (sub)	
ODM ROMW	ROM3 write error (main)	
ODS ROMW	ROM3 write error (sub)	
ODM ROM3	ROM3 sum error (main)	
ODS ROM3	ROM3 sum error (sub)	
ODM GR	GR forecast interrupt (main)	
ODS GR	GR forecast interrupt (sub)	
ODM PRME	Parameter error (main)	Specify the parameter again.
ODS PRME	Parameter error (sub)	

7.3 Monitoring a Specific Module

Whether a specific module is communicating with another module is monitored with the following methods:

- The RAS table is checked.
  If the module stops (power failure), both the primary ring bit and secondary ring bit of the RAS table are reset. Whether the module is communicating with another module can be monitored by monitoring these bits.

- In hold/clear setting, CLEAR is selected.
  If the communicating module stops (power failure), the area assigned to the module is cleared. Whether the module is communicating with another module can be monitored by checking this area.

7.4 Error Freeze

When it detects a hardware error, the OD.RING module lights the error LED, saves error freeze information, and stops. Figure 7-1 shows the error freeze information format. For the error codes and stack frame in this format, see the next and subsequent pages.

(Main)	(Sub)	2^{31} —— 2^{16}	2^{15} —— 2^{0}
/940400	/9C0400	Error code	——
		—	
/940410	/9C0410	D0 register	
/940414	/9C0414	D1 register	
/940418	/9C0418	D2 register	
/94041C	/9C041C	D3 register	
/940420	/9C0420	D4 register	
/940424	/9C0424	D5 register	
/940428	/9C0428	D6 register	
/94042C	/9C042C	D7 register	
/940430	/9C0430	A0 register	
/940434	/9C0434	A1 register	
/940438	/9C0438	A2 register	
/94043C	/9C043C	A3 register	
/940440	/9C0440	A4 register	
/940444	/9C0444	A5 register	
/940448	/9C0448	A6 register	
/94044C	/9C044C	A7 register	
/940450	/9C0450	Stack frame (4 words, 6 words, bus error)	

Figure 7-1 Error Freeze Information Format

Error codes

The code “/0000” indicates normal operation.

Table 7-2 Error Codes

Code	Error	User response
/0010	Bus error	The module may be faulty. Replace it.
/0011	Address error	
/0012	Illegal instruction error	
/0013	Division by zero error	
/0014	Privilege violation	
/0015	WDT error	
/0016	Format error	
/0017	Spurious interrupt	
/0018	Unused exception	
/0019	Parity error	
/001A	GR forecast interrupt	
/0100	Module switch setting error	Set the switch correctly.
/0101	CPL switch setting error	
/0102	ROM1 sum error	The module may be faulty. Replace it.
/0103	RAM compare error	
/0105	RAM compare error	
/010B	ROM3 sum error	
/010C	ROM3 micro erase error	
/010D	ROM3 micro write error	
/010E	ROM3 parameter erase error	
/010F	ROM3 parameter write error	
/0111	Duplicated CPL No.	Set a correct CPL No.

Stack frame

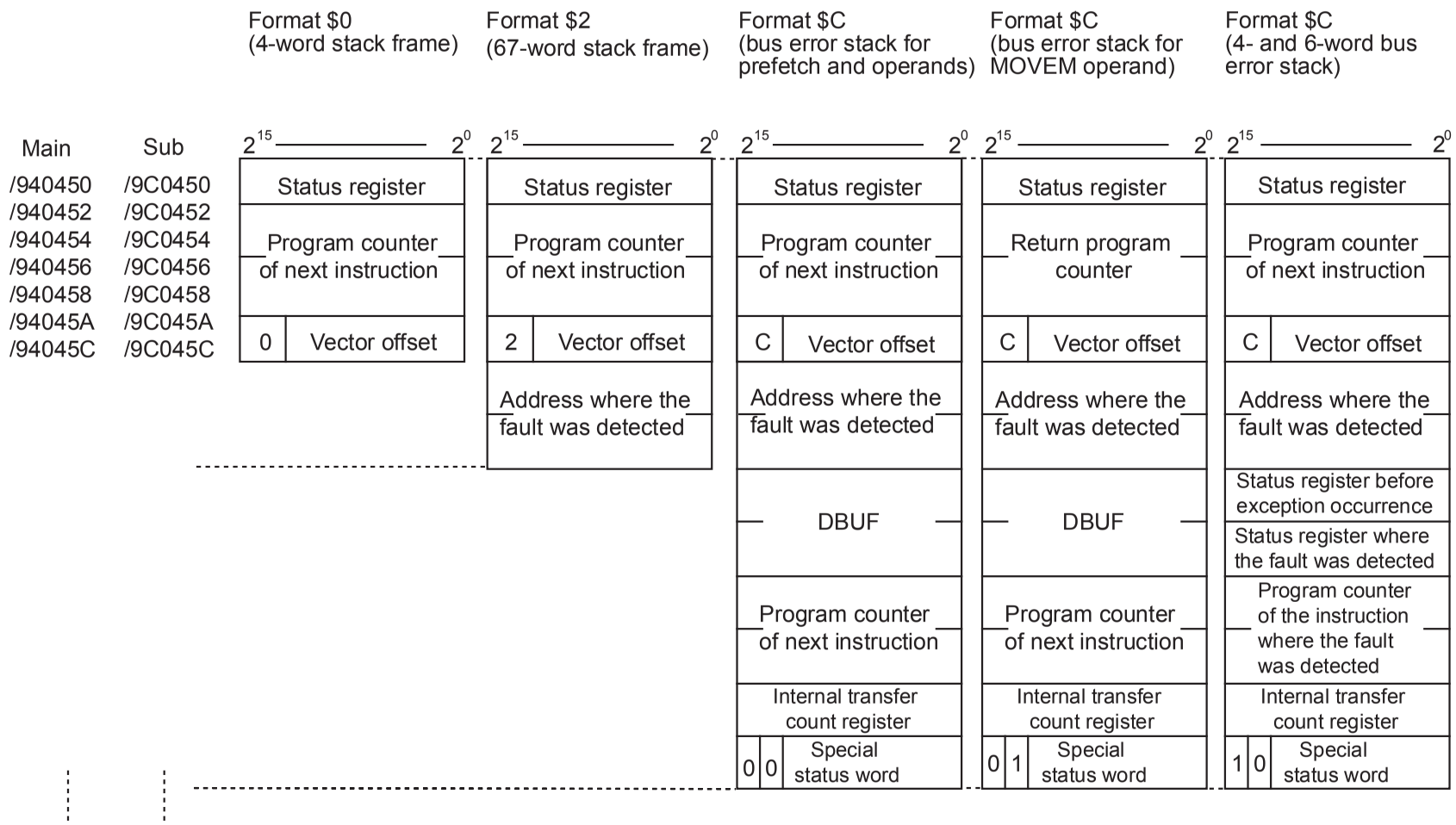


Figure 7-2 Stack Frame Format

7.5 Communication Trace

The OD.RING module has a communication information trace function. This function can be used to create trace data for use in investigation of the causes of faults and take actions for the faults.

7.5.1 Trace buffer structure

A trace buffer consists of an 8-word trace control table and 256-case trace data. Each case consists of 32 words. The OD.RING module cyclically stores trace data according to the pointer.

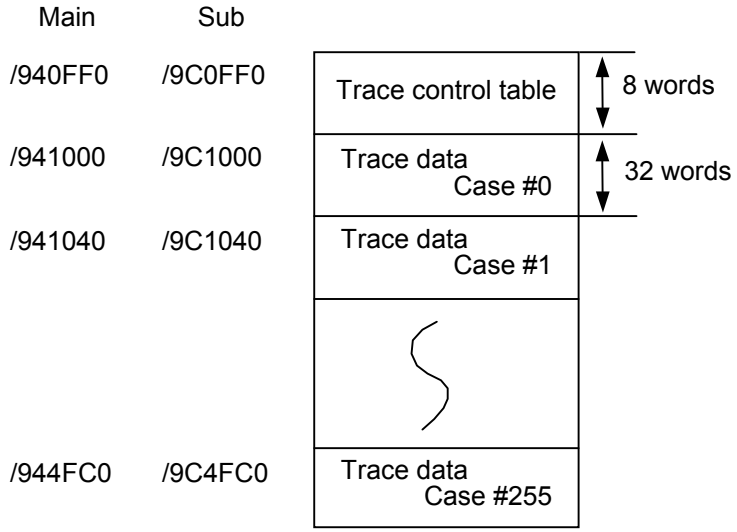


Figure 7-3 Trace Buffer Structure

Trace data is stored in turn, starting from case #0. When trace data is stored in the last case (case #255), the next data is stored in case #0 again.

7.5.2 Structure of trace control table

A trace control table consists of eight words.

Main	Sub	
/940FF0	/9C0FF0	① Execution/stop
/940FF2	/9C0FF2	Unused
/940FF4	/9C0FF4	② Trace target address
/940FF8	/9C0FF8	③ Mask data
/940FFA	/9C0FFA	④ Comparison data
/940FFC	/9C0FFC	⑤ Pointer
/940FFE	/9C0FFE	Unused

Figure 7-4 Structure of Trace Control Table

① Execution/stop

Used to set trace execution or stop.

0: Stop tracing

1: Continue tracing until the trace condition is met.

2: Continue tracing until the trace condition is met or until an error occurs.

When power is recovered or the resetting condition is cleared, a 2 is set. If an error is detected or the trace condition is satisfied, tracing is stopped and a 0 is set.

② Trace target address

Used to set the starting address of the condition trace target area.

③ Mask data

Set mask data for conditional tracing. Of the data bits, only the bit(s) set to 0 are masked off.

④ Comparison data

Set comparison data for conditional tracing. The comparison data is compared with the result obtained by ANDing the trace target address in ② and the mask data. If a match is found, the condition holds.

⑤ Pointer

Used to point to the case in which the next trace data is to be stored. The newest trace data is stored in pointer 1 (for 0, pointer 255).

Example 1

To stop trace when G002 becomes 0, set mask data as shown in Figure 7-5. G002 must always be 1.

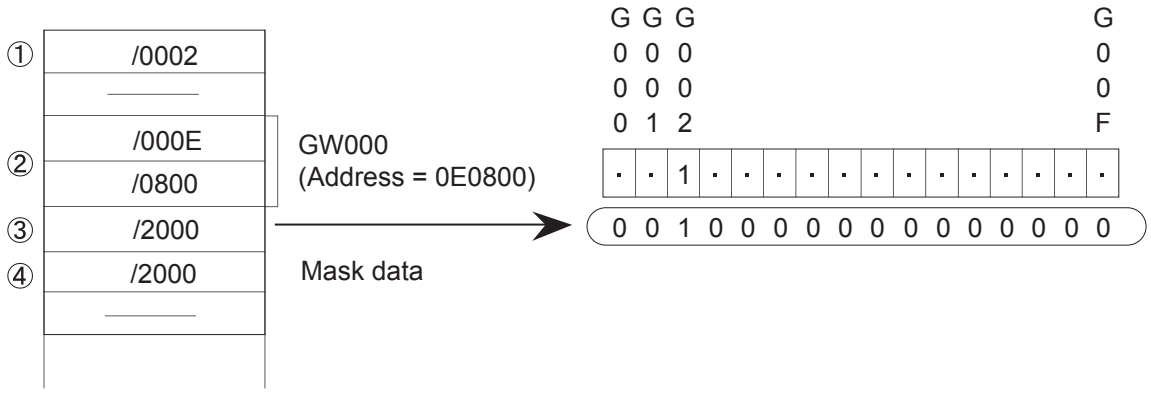


Figure 7-5 Setting Mask Data — Example 1

Example 2

To stop trace when FW000 becomes 1111, set mask data as shown in Figure 7-6. FW000 must be always 1234.

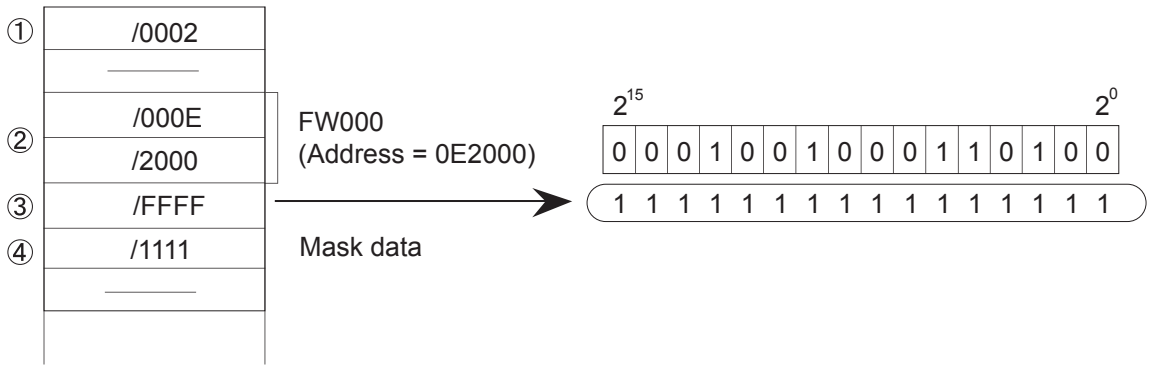


Figure 7-6 Setting Mask Data — Example 2

7.5.3 Trace data structure

Trace data consists of 32 words per case.

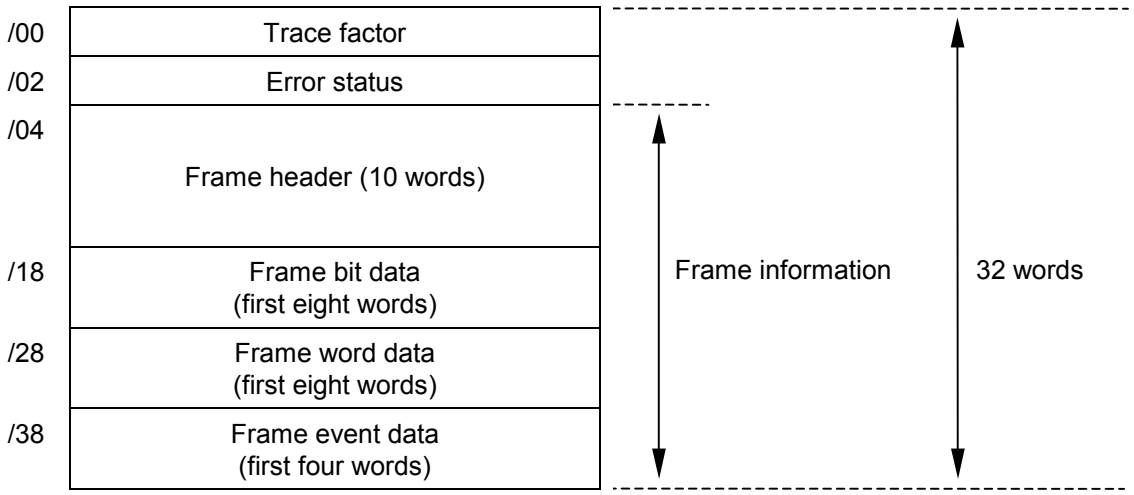


Figure 7-7 Trace Data Structure

Details of frame header

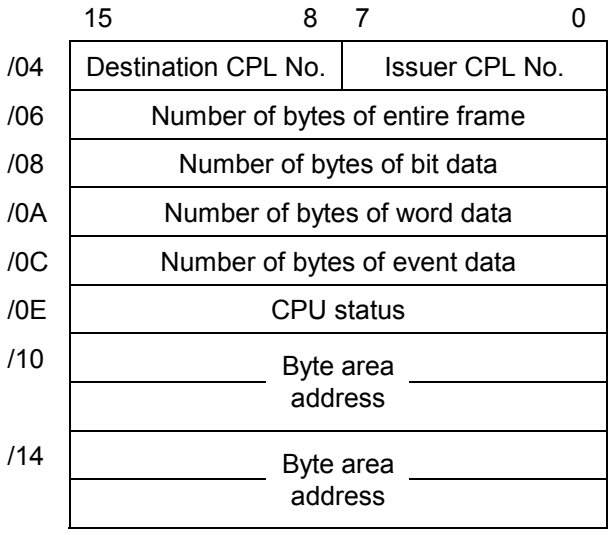


Figure 7-8 Details of Frame Header

7.5.4 Trace events and trace processing

Table 7-3 shows the correspondence between trace events and trace processing.

Table 7-3 Correspondence between Trace Events and Trace Processing

Event	Condition check	Error stop	Trace factor	Error status	Frame information
Transmission start	Done	Not made	Valid	Invalid	Valid
Normal transmission end	Not done	Not made	Valid	Invalid	Invalid
Transmission ended up with error	Not done	Made	Valid	Valid	Invalid
Transmission timed out	Not done	Made	Valid	Invalid	Invalid
Reception started	Not done	Not made	Valid	Invalid	Invalid
Normal reception ended	Done	Not made	Valid	Invalid	Valid
Reception ended up with error	Done	Made	Valid	Valid	Valid
Reception timed out	Not done	Made	Valid	Valid	Valid

- Condition check

  The OD.RING module performs condition check to determine whether to stop communication trace. When the condition is established, the module sets condition establishment in the trace factor and stops communication trace.

- Error stop

  When the execution/stop item is set to 2, the OD.RING module performs communication trace error stop processing.

- Trace factor

  The factor for creation of the trace data is set in the trace factor area.

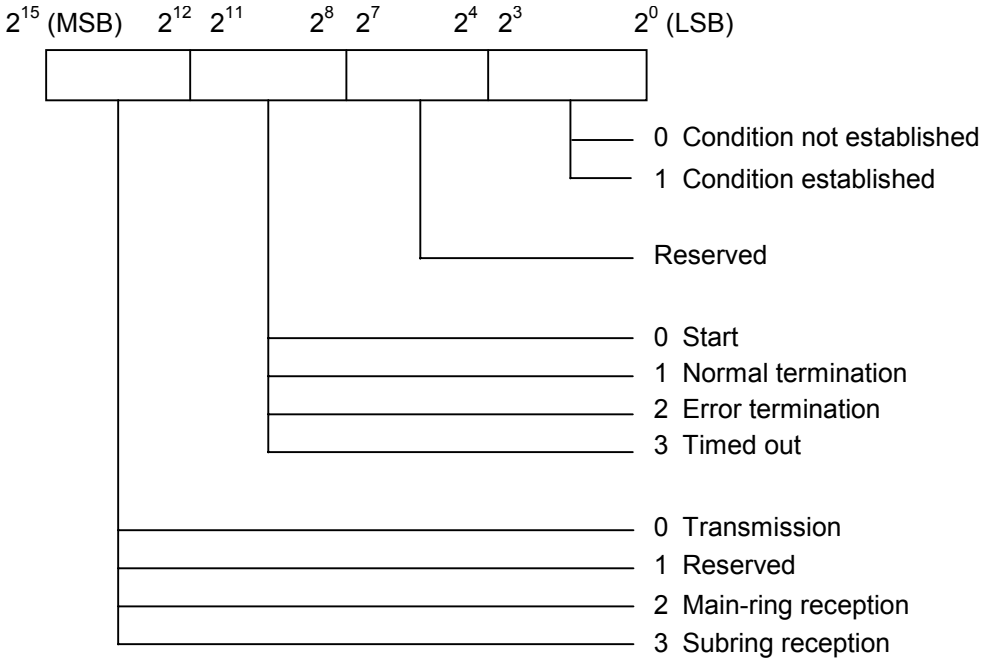


Figure 7-9 Trace Factor

- Error status

Error status on transmission

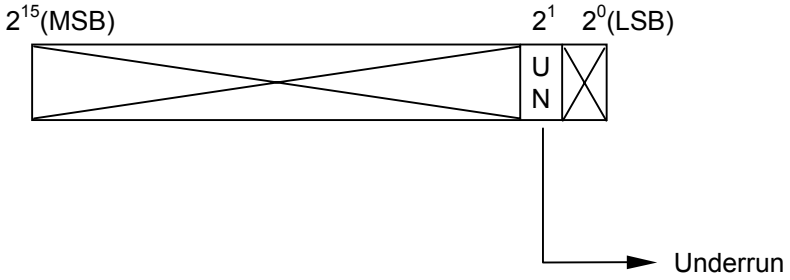


Figure 7-10 Error Status on Transmission

Error status on reception

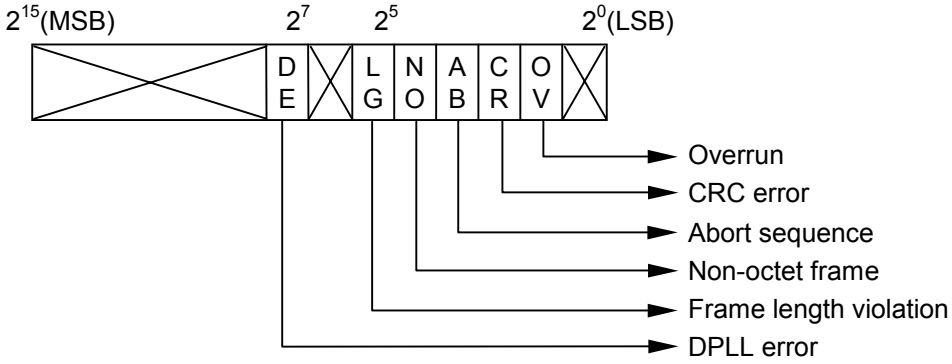


Figure 7-11 Error Status on Reception

CAUTION

If a time-out is generated during reception, the error status of FFFF will be returned.

Table 7-4 shows the error status in detail.

Table 7-4 Details of Error Status

Transmission/reception	Error name	Description
Transmission	Underrun	A transmitter underrun occurred when the HDLC controller was transmitting data in the corresponding data buffer.
Reception	DPLL error	The DE bit is set when transition omission occurred in the coding mode in which transition occurs per bit.
	Frame length violation	The frame length greater than the maximum value defined in this channel was recognized.
	Non-octet frame	A frame having a number of bits that cannot be accurately divided by 8 was received.
	Abort sequence	Not less than seven continuous 1s were received during frame reception.
	CRC error	A CRC error exists in the frame.
	Overrun	A receiver overrun occurred during frame reception.
	Time-out during reception	An attempt was made to send or receive more frames than permitted.

- Frame information

  Frame information is stored.

APPENDIX

A.1 Optical Fiber Cables

A.1.1 Types of optical fiber cables

It is technically difficult for users to separately purchase an optical fiber cable and optical connector for connector connections. For this reason, we recommend that the users purchase an optical fiber cable with a double-end connector or entrust the work to the expert worker. There are a variety of different optical fiber cables. Select a proper cable according to its use. Optical fiber cables are usually divided into four types: single core, flat, round, and spacer.

Table A-1 Types of Optical Fiber Cables (for the LQE010)

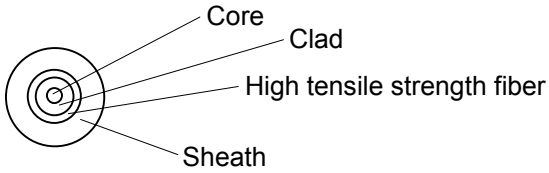
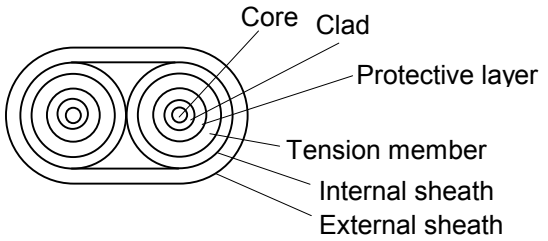
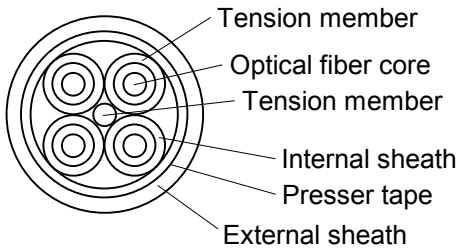
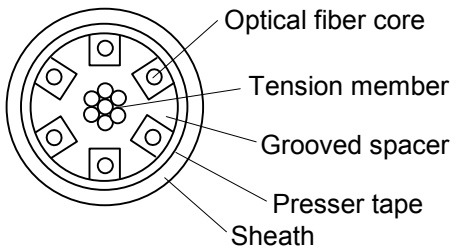
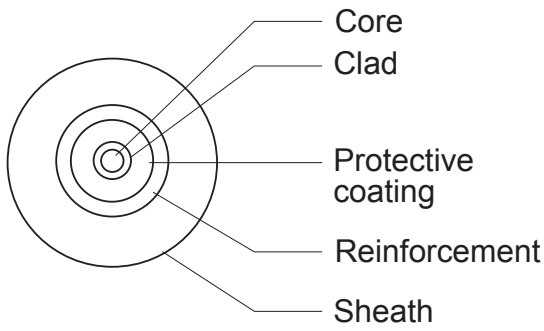
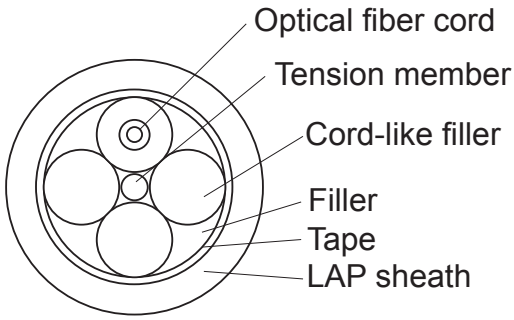
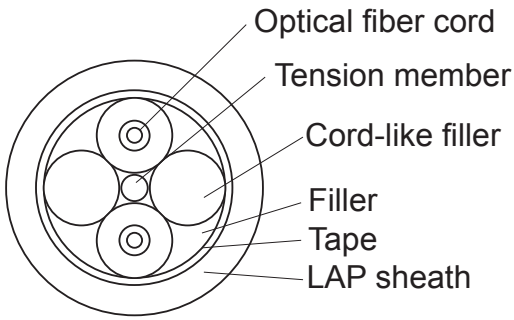
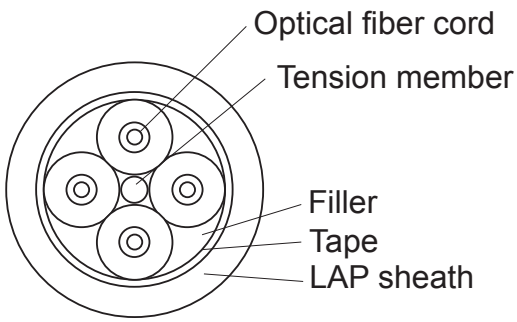
Type	Characteristics	Cross section
Single core	In indoor wiring, the single core cable is specially used for panel wiring.	
Flat	In indoor wiring, use the flat-type cable in the place where the laying distance is comparatively short and external force is rarely applied.	
Round	To improve mechanical characteristics, a tension member is inserted into the center of the cable. In indoor wiring, use the round cable where external force is comparatively small.	
Spacer	The structure of the spacer cable is more complicated than the structures of the flat and round cables. The spacer cable is superior in mechanical characteristics. For this reason, in indoor wiring, etc., the cable of this type is suited for the place where external force is large.	

Table A-2 Optical Fiber Cables (for the LQE015)

Type	Characteristics	Cross section
Single-core cord	Suitable for indoor wiring, particularly for wiring in the cubicle. Use this type of cable in a place to which little or no force is applied.	
Single-core cable (1C-LAP type)	The tension member at the center improves mechanical characteristics. The LAP sheath also improves resistance to water and heat. As a result, this type of cable is suitable for outdoor wiring.	
Two-core cable (2C-LAP type)		
Four-core cable (4C-LAP type)		

A.1.2 Optical fiber cable specifications

The types of optical fiber cables that can be used by the OD.RING module are limited. The user must purchase the optical fiber cables satisfying the specifications shown in Table A-3.

Table A-3 Optical Fiber Cable Specifications (for the LQE010)

Item	Specifications
Fiber core material	Quarts glass
Type of optical fiber	GI (grated index type)
Core diameter	50 μm
Clad diameter	125 μm
Transmission loss	3 dB/km maximum (λ=850 nm)
Optical connector	FC type (JIS C5970 F01 connector)

Table A-4 Optical Fiber Cable Specifications (for the LQE015)

Item		Specifications	
Optical fiber		Plastic-clad, multi-mode optical fiber	
Core	Material	Quartz glass	
	Outer diameter	200 ± 5 μm	
	Noncircularity	6% or less	
Clad	Material	Fluoroacrylate resin	
	Outer diameter	230 μm	
	Eccentricity	6 μm or less	
Numerical aperture (NA)		About 0.4	
Transmission loss		7 dB/km maximum (λ=850 nm)	
Protective coating		Outer diameter: 0.5 ± 0.1 mm	Material: Ethylene-tetrafluoroethylene
Reinforcement		Aromatic tensile strength fiber	
Sheath		Outer diameter: 2.2 ± 0.2 mm	Material: Heat-resistant PVC (black)
Optical connector		SMA single-core optical connector	

A.1.3 Recommended cables

Cables of Hitachi Cable, Ltd. are recommended as cables with FC connectors. When procuring a cable, specify the type of optical fiber, number of cores, type of cable, and cable length, etc., as described below. Use this as the reference when ordering a cable.

GI 50 3 - 2 R - C 7 - 500M
(1) (2) (3) (4) (5) (6) (7) (8)

(1) Type of optical fiber
GI: Grated index type
(2) Core diameter
50: 50 mm
(3) Transmission loss
3: 3 dB/km
(4) Number of cores
None: Valid for single core cable
2: Valid for flat 2-core cable
2, 3, 4, 6: Valid for round cable
1: Valid for spacer cable
(5) Type of cable
None: Single core
R: Round
F: Flat
S: Spacer
(6) Optical connector connection
B: Single end
C: Double end
(7) Type of optical connector
7: FC connector (JIS C5970 F01 connector)
(8) Cable length
Specify the cable length in meters.

The above type indicates cable having the following attributes: The type of the optical fiber is grated index, the core diameter is 50 um, transmission loss is 3 dB/km or lower, and the number of cores is 2. In addition, the type of cable is round, the optical connector connection is double end, the type of connector is FC, and the cable length is 500 m.

As a cable with SMA connectors, the cable manufactured by Sumitomo Electric Industries, Ltd. is recommended. To order the appropriate cable, specify the model name correctly that represents the optical fiber type, the number of cores, the cable type, the cable length, and other information, as shown below. The example below is to order LQE015 optical cables from Hakuto Co., Ltd.

- Single-core cord

$$\underset{(1)}{\text{HC}} \,/\, \underset{(2)}{\text{1C}} - \underset{(3)}{\text{CCV}} - \underset{(4)}{\text{SMA}} - \underset{(5)}{\text{L}}$$

(1) Optical fiber type
H-PCF optical fiber
(2) Number of cores
Number of optical fiber cores: 1
(3) Cord type
Fiber cord
(4) Optical connector type
SMA connectors at both ends of the cable
(5) Cable length
Total length of the cable

- Outdoor cable

$$\underset{(1)}{\text{HC}} \,/\, \underset{(2)}{\text{2C}} - \underset{(3)}{\text{LAP}} - \underset{(4)}{\text{SMP}} - \underset{(5)}{\text{0.2}} \,/\, \underset{(6)}{\text{L}}$$

(1) Optical fiber type
H-PCF optical fiber
(2) Number of cores
Number of optical fiber cores: 2
(3) Cable type
Outdoor LAP sheath cable
(4) Optical connector type
SMA connectors at both ends of the cable
(5) Length without sheath
0.2 m
(6) Cable length
Total length of the cable

A.2 Trouble Report

Fill out this form and submit it to local source.

Your company name			Person in charge	
Data and time of occurrence	(year / month / day / hour / minute)			
Where to make contact	Address			
	Telephone			
	FAX			
	E-mail			
Model of defective module			CPU model	
OS Ver. Rev.	Program name:		Ver.	Rev.
Support program	Program name:		Ver.	Rev.
Symptom of defect				
Connection load	Type			
	Model			
	Wiring state			
System configuration and switch setting				
Space for correspondence				