

**HITACHI**

**HARDWARE MANUAL**

***OPT.D-NET***

SME-1-120 (D)

**HARDWARE MANUAL**

***OPT.D-NET***

First Edition, April 2002, SME-1-120(A) (out of print)  
Second Edition, July 2004, SME-1-120(B) (out of print)  
Third Edition, December 2005, SME-1-120(C) (out of print)  
Fourth Edition, September 2008, SME-1-120(D)

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Printed in Japan.

BI-NR-HS<IC-IC> (FL-MW20, A18.0)

## 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.



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



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

Failure to observe any  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:



This product with its full name “Optical Adapter for DeviceNet (OPT.D-NET)” is hereinafter simply called the Optical Adapter.

Note: The name “DeviceNet” is a registered trademark of ODVA (Open DeviceNet Vendor Association, Inc.)



## **DANGER**

- Provide an emergency stop circuit, interlock circuit, and other similar circuits outside the optical adapter. Disregarding this rule may result in damage to the equipment or cause an accident if the optical adapter fails.
- Keep it in mind that this hardware unit is powered from a high-voltage power supply. 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 a specified amount of space between units of the optical adapter and between the optical adapter and other equipment.
- After installing this hardware unit, measure temperatures near the installed optical adapter and the mount base during its initial test run, and check whether the measurements are within the specified limits. If a specified amount of space cannot be provided or the measured temperature is too high, install 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, possibly resulting in an extremely high temperature. This may cause the hardware unit to fail or, if not so serious, 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:
  - Do not use any fixing screws other than specified.
  - Take sufficient care not to make wrong wiring at terminal blocks.
  - Where protection against lightning is necessary, install a surge absorber outside the optical adapter.
- The Optical Adapter supports both CAN standard frames (11-bit ID field) including remote frames and CAN extension frames (29-bit ID field). However, CAN standard frames and CAN extension frames cannot be used together. Module revision B or later supports remote frames and CAN extension frames. (Module revision A only supports CAN standard frames.)



## REQUIREMENT

An electric shock may lead to a death or burn. Noise may cause the system to malfunction. To avoid these, ground the optical adapter in the following way:

- If the optical adapter is not secured on to a flat sheet of iron or other similar metal, ground the unit by Class-D or higher grounding via the terminal block (FG).
- If the optical adapter is secured on to a flat sheet of iron or other similar metal, ground the unit by connecting the terminal block (FG) to the iron sheet, and ground the iron sheet by Class-D or higher grounding.



## REQUIREMENT

An excessive amount of heat accumulated in the enclosure for this product may cause the optical adapter to fail or, even worse, may lead to a fire. If the ambient temperature reaches 55°C, components in the optical adapter may fail. When installing the optical adapter, pay attention to the environment where it is to be installed, and install a cooling fan in the enclosure if necessary.



## PROHIBITION

If a part in a module is damaged, do not replace the part, but replace the faulty module in its entirety.

## 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>

OPT.D-NET (HPC-8500)

<Changes added to this manual>

Description of added changes	Page
Subsection 7.1.1, "Replacing or adding on the module" is newly added.	7-3

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





## **PREFACE**

Thank you for purchasing the Optical Adapter for DeviceNet (OPT.D-NET).

This manual describes how to handle the Optical Adapter. Read this manual thoroughly to properly use the product.

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# 1 BEFORE USE



# 1 BEFORE USE

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## ■ Installation

The Optical Adapter is not fireproof, dustproof, or dripproof. When you install the product, mount it in a dust- and dripproof iron cubicle as shown below.

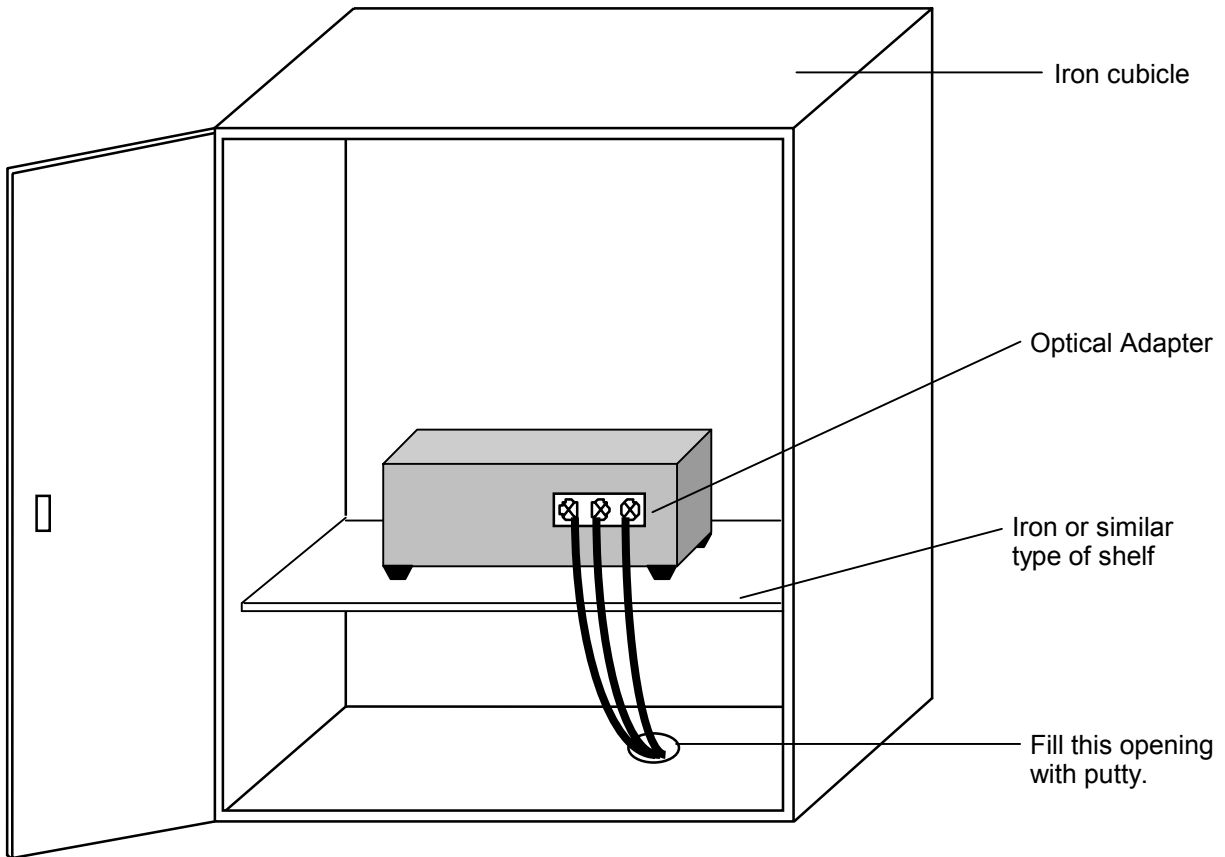


Figure 1-1 Installation Example (Installation on a Shelf)

## ■ Environment

The Optical Adapter, which the user is advised to replace after 10 years of use, must be used in an environment that satisfies the conditions listed in Table 1-1. To use the product stably and safely for a long period of time, it is recommended that the user run it at normal temperature and humidity (15 to 30°C and 45 to 85% RH). Any use at higher temperatures and humidities than normal or in an environment where the temperature fluctuates violently may shorten the service life of the product.

Table 1-1 Operating Environment

Supply voltage	100 to 120 VAC, single phase, 50/60 Hz $\pm$ 4%	100 to 110 VDC
Operating voltage range	85 to 132 VAC	85 to 132 VDC
Temperature	Operating: 0 to 55°C; Storage: -20 to 75°C	
Relative humidity	Operating: 30 to 90% RH; Storage: 10 to 90% RH	
Vibration resistance	5.8 m/s <sup>2</sup> (1000 rpm)	
Shock resistance	98 m/s <sup>2</sup>	
Ambient air	Dust: 1.1 mg/m <sup>3</sup> or less (given that there is no corrosive gas)	

## ■ Grounding point

Provide Class D\* or better independent grounding. Do not use any other existing ground as a substitute. It is particularly important that the grounding point for the Optical Adapter be at least 15 meters away from an AC panel grounding point. It is the best that the grounding wire be welded to the steel frame of a building. In case when the aforesaid is impossible, bury the grounding rod in earth.

\* 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 or less 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.

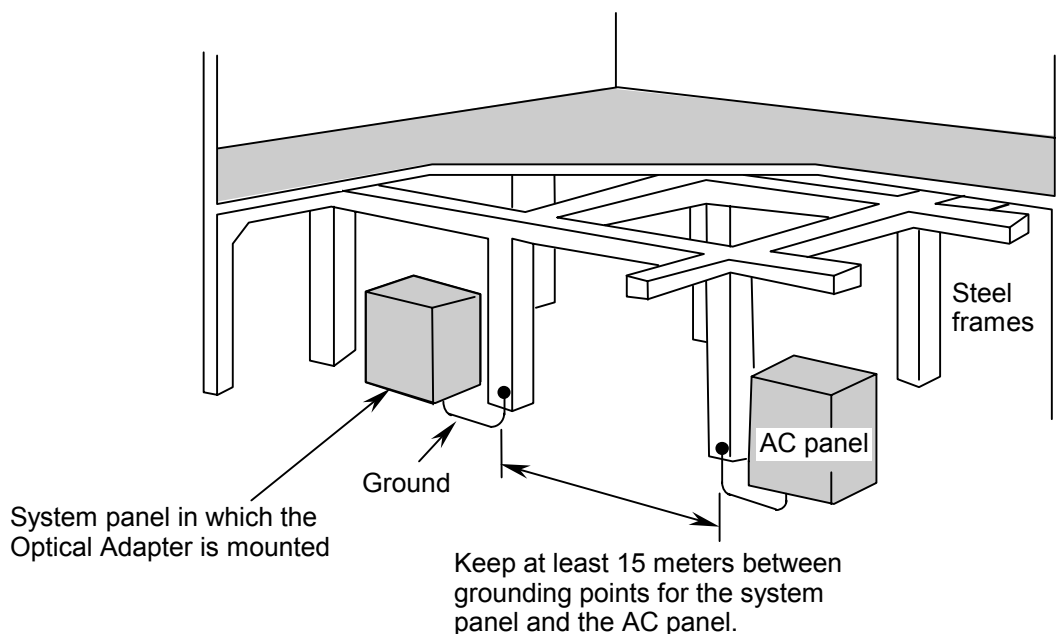


Figure 1-2 Grounding Specifications

## ■ Noise

Do not install the Optical Adapter inside or near a panel enclosure in which a high-voltage device such as an inverter is mounted. If the product needs to be so installed, provide a shielding plate to protect it and its cables from electromagnetic or electrostatic induction.

## ■ Internal parts replacement

Users must not replace internal parts of the Optical Adapter. If any of its parts fails, replace the whole Optical Adapter, not the damaged part only.

## ■ Equipment addition

If peripheral equipment is added or removed, conduct an inspection as directed in Section 7.1, “Preventive Maintenance,” to confirm whether the Optical Adapter is properly functioning. In particular, perform the following inspections for the power supply and grounding:

### ● Power supply

#### \* Inspection of the supply voltage and waveform

- Check for a voltage drop.
- Check for a significant increase in the amount of noise in the power supply line.
- Check for a change in the waveform (normally, a sine wave with root-mean-square value in the range of 85 V to 132 VAC).

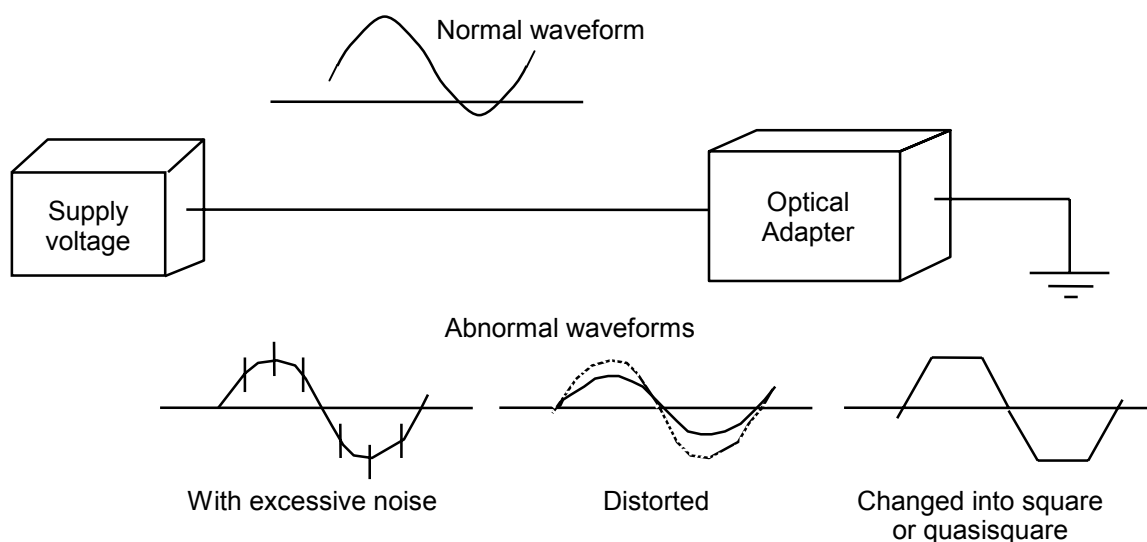


Figure 1-3 Power Supply Input Waveform

## 1 BEFORE USE

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- Grounding

- \* Inspection of the ground wiring

- Check if a ground wire is shared with another ground wire.
    - Check if the grounding point is at least 15 m away from the grounding point for the AC panel.

- \* Check if a power cable or a lead cable (e.g., a motor lead cable) is laid near signal cables, such as DeviceNet transmission lines.

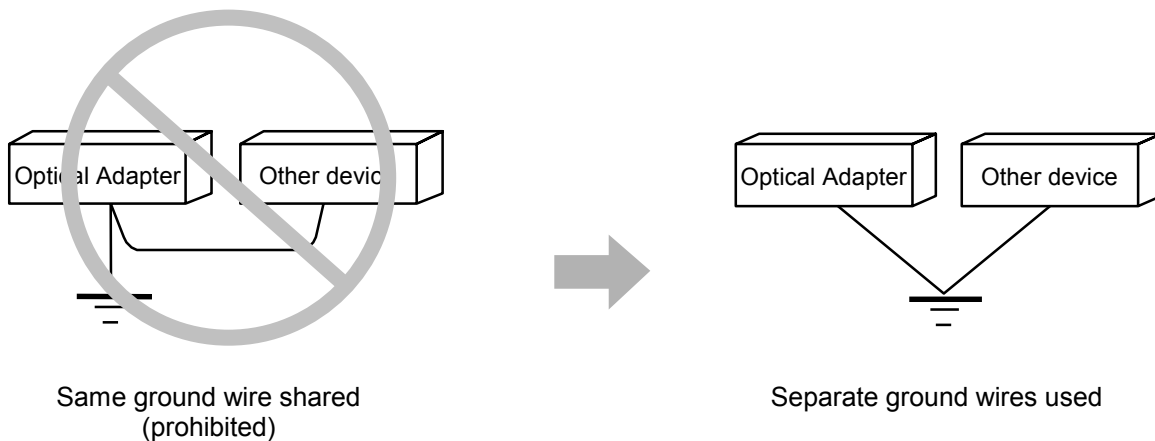


Figure 1-4 Grounding Examples

## **2 GENERAL INFORMATION**

2.1 System Overview

The following shows an example of the Optical Adapter system configuration. The Optical Adapter (model HPC-8500) is a device that enables connection of a DeviceNet network by using optical cable. This device is intended to make the DeviceNet network connectable by optical cable, but can also connect a CAN-only network by optical cable. Therefore, “DeviceNet” means “DeviceNet or CAN” in the following descriptions.

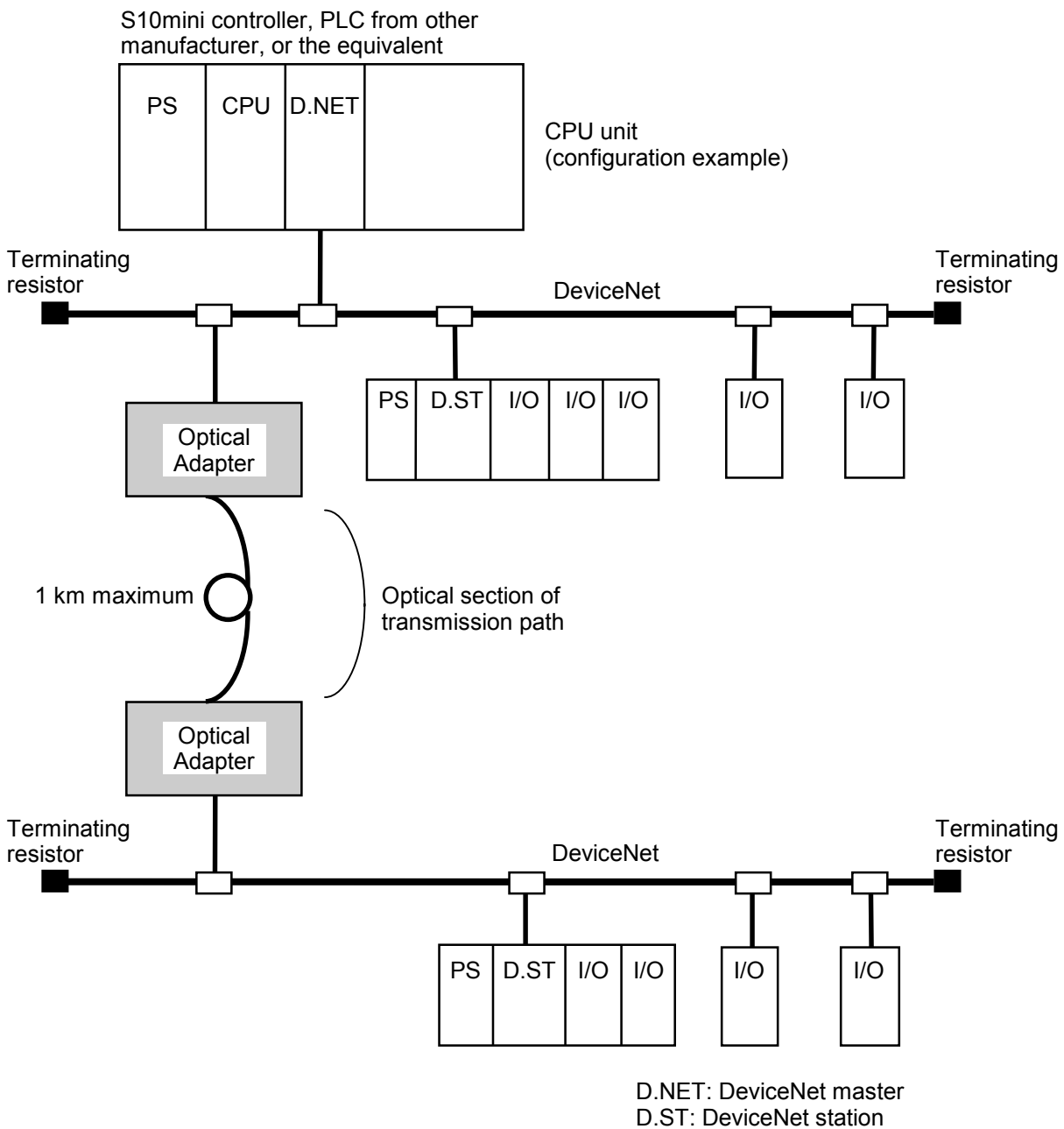


Figure 2-1 System Configuration Example

# 3 SPECIFICATIONS



### 3 SPECIFICATIONS

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#### 3.1 Specifications


##### 3.1.1 Optical Adapter specifications

Table 3-1 Optical Adapter Specifications

Item	Specifications
Model	HPC-8500
Dimensions	66 × 210 × 135 mm (60 × 205 × 115 mm: protruding parts excluded)
Current consumption	100 VAC: 100 mA or less; 100 VDC: 50 mA or less
Insulation resistance	500 VDC: 5 MΩ or more
Dielectric strength	1500 VAC applied for one minute
Noise tolerance	AC noise: 1500 V
Rush current	33 A or less
Permissible instantaneous power outage	10 ms or less for AC, 5 ms or less for DC
Weight	1 kg

## 3.1.2 Communication specifications

Table 3-2 Communication Specifications

Item		Specifications	
MAC layer	Transmission path access method	CSMA/NBA (Carrier Sense Multiple Access with Non-destructive Bitwise Arbitration)	
	Protocol	CAN (Control Area Network) protocol (including DeviceNet)	
Physical layer	Transmission rate	Variable (selected from among 125 kbps, 250 kbps, and 500 kbps)	
	Communication type	CAN standard frames (11-bit ID field) including remote frames and CAN extension frames (29-bit ID field) are supported. However, CAN standard frames and CAN extension frames cannot be used together. CAN standard frames include DeviceNet. Module revision B or later support remote frames and CAN extension frames.	
	Word counter	128 bytes maximum	
	Encoding system/Insulation	NRZ (Non Return to Zero) / Photocoupler, 500 volts	
	Optical sections of DeviceNet transmission path	20 maximum (regardless of the transmission rate used)	
	Power supply	100 VAC/DC power (self-feeding)	
	Transmission media	Connectors	Open-plug connector and shield connector used
		Taps	Open type and shielded type used
		DeviceNet cable	Trunk (or main) line Total line length  <span style="border: 1px solid black; padding: 2px;">Total drop-line length: 156 m for 125 kbps or shorter 78 m for 250 kbps or shorter 39 m for 500 kbps or shorter</span> (variable with the transmission rate) 5-conductor thick cable Drop line: 6 m maximum/line 5-conductor thin cable Power line: 3 m maximum
		Optical cable	Bidirectional cable with plastic-clad silica fibers (H-PCF) Core diameter, 200 μm; cladding diameter, 230 μm; model, DCV-HC-20/07; optical connector type, CF-2001-H; transmission loss, 7 dB/km
		Transmitter optical power	-18 dB or more (in optical signal output with a 100% duty cycle)
		Terminating resistance	Connector with built-in terminating resistor, or 121 Ω ±1% (1/4 W or more) metal film resistor as a terminator

### 3 SPECIFICATIONS

#### 3.1.3 Performance

Figure 3-1 shows how a delay occurs during transmission of a frame between a sending Optical Adapter and a receiving Optical Adapter in a network. The delay here means the time the network takes from when the sending Optical Adapter receives a transmitted frame until when the receiving Optical Adapter forwards the same frame received from the sending Optical Adapter. Table 3-3 shows the relationship between the transmission rate when using DeviceNet or CAN extension frames, and the maximum delay time with the Optical Adapter. Table 3-4 shows the relationship between the transmission rate when using CAN extension frames and the maximum delay time with the Optical Adapter. The maximum delay time here means the maximum delay time in communication made possible when the sending (B side) DeviceNet or CAN line is not occupied and no frame is being processed via the Optical Adapter.

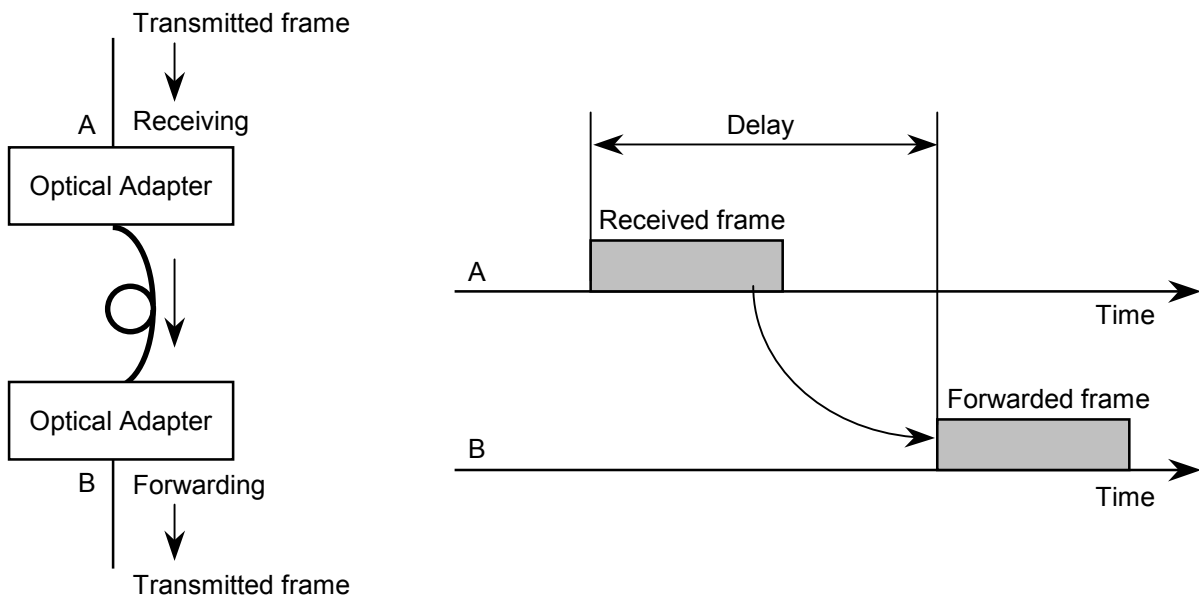


Figure 3-1 Delay during Frame Transmission

Table 3-3 Relationships between DeviceNet Transmission Rates and the Corresponding Maximum Delay Times (For using CAN Standard Frames)

Transmission rate	Bit time	Maximum delay time
125 kbps	0.008 ms	3 ms
250 kbps	0.004 ms	2 ms
500 kbps	0.002 ms	1.5 ms

Table 3-4 Relationships between DeviceNet Transmission Rates and the Corresponding Maximum Delay Times (For using CAN Extension Frames)

\* Supported by REV B or later.

Transmission rate	Bit time	Maximum delay time
125 kbps	0.008 ms	3.3 ms
250 kbps	0.004 ms	2.2 ms
500 kbps	0.002 ms	1.6 ms

#### ■ Internode transmission time

The transmission delay that occurs between DeviceNet or CAN devices (between nodes) is expressed by the following equation. In this equation, the frame transmission wait time means how long the Optical Adapter must wait until the frames flowing on the line are sent when the Optical Adapter starts sending a frame on DeviceNet or CAN line.

$$\text{Internode transmission time} = d \times n + w$$

Explanatory notes:

d: Optical adapter delay time

n: Number of optical sections of transmission path used

w: Frame transmission wait time

The frame transmission wait time above may be ignored if a combined total of the frame times of all frames underway at that time is less than the fixed value of transmission interval (i.e., the number of occurrences of transmission wait is negligibly small).

### 3 SPECIFICATIONS

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#### ■ Number of frames underway (for using DeviceNet or CAN standard frames)

Where a large number of frames flow in a network at regular intervals, the number of frames underway at a particular moment may be restricted depending on the capacity of the Optical Adapters involved. An attempt to transmit more frames than the Optical Adapters can handle may result in a delay in frame transmission or some frames left untransmitted. The following is an equation expressing the relationship between the communication interval and allowable number of communication frames for using DeviceNet or CAN standard frames. Figure 3-2 shows graphical representations of their relationships.

Equations to find the maximum permissible number of frames underway at transmission rates of 125 kbps, 250 kbps, and 500 kbps:

$$\text{At 125 kbps: } F = (T - 3 \times n) / 1.1704$$

$$\text{At 250 kbps: } F = (T - 2 \times n) / 0.5852$$

$$\text{At 500 kbps: } F = (T - 1.5 \times n) / 0.2926$$

Explanatory notes:

F: Maximum (worst) permissible number of frames underway

T: Transmission interval (ms)

n: Number of optical sections of transmission path used

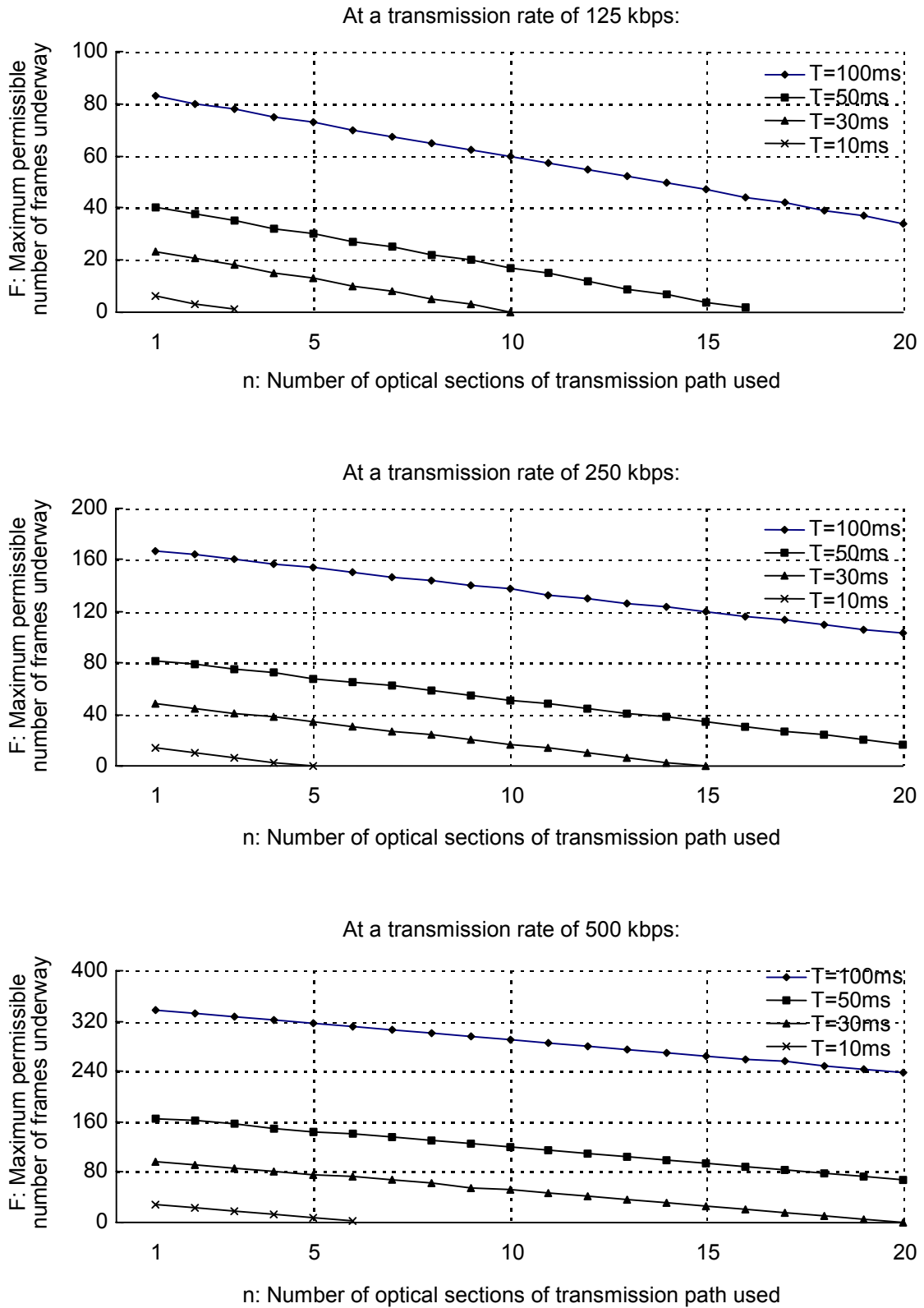


Figure 3-2 Relationship between Transmission Interval and Allowable Number of Transmission Frames (Worst Value) for Using CAN Standard Frames

### 3 SPECIFICATIONS

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#### ■ Number of frames underway (for using CAN extension frames)

\* Supported by REV B or later.

Where a large number of frames flow in a network at regular intervals, the number of frames underway at a particular moment may be restricted depending on the capacity of the Optical Adapters involved. An attempt to transmit more frames than the Optical Adapters can handle may result in a delay in frame transmission or some frames left untransmitted. The following is an equation expressing the relationship between the communication interval and allowable number of communication frames for using CAN extension frames. Figure 3-3 shows graphical representations of their relationships.

Equations to find the maximum permissible number of frames underway at transmission rates of 125 kbps, 250 kbps, and 500 kbps:

$$\text{At 125 kbps: } F = (T - 3 \times n) / 1.3781$$

$$\text{At 250 kbps: } F = (T - 2 \times n) / 0.6890$$

$$\text{At 500 kbps: } F = (T - 1.5 \times n) / 0.3445$$

Explanatory notes:

F: Maximum (worst) permissible number of frames underway

T: Transmission interval (ms)

n: Number of optical sections of transmission path used

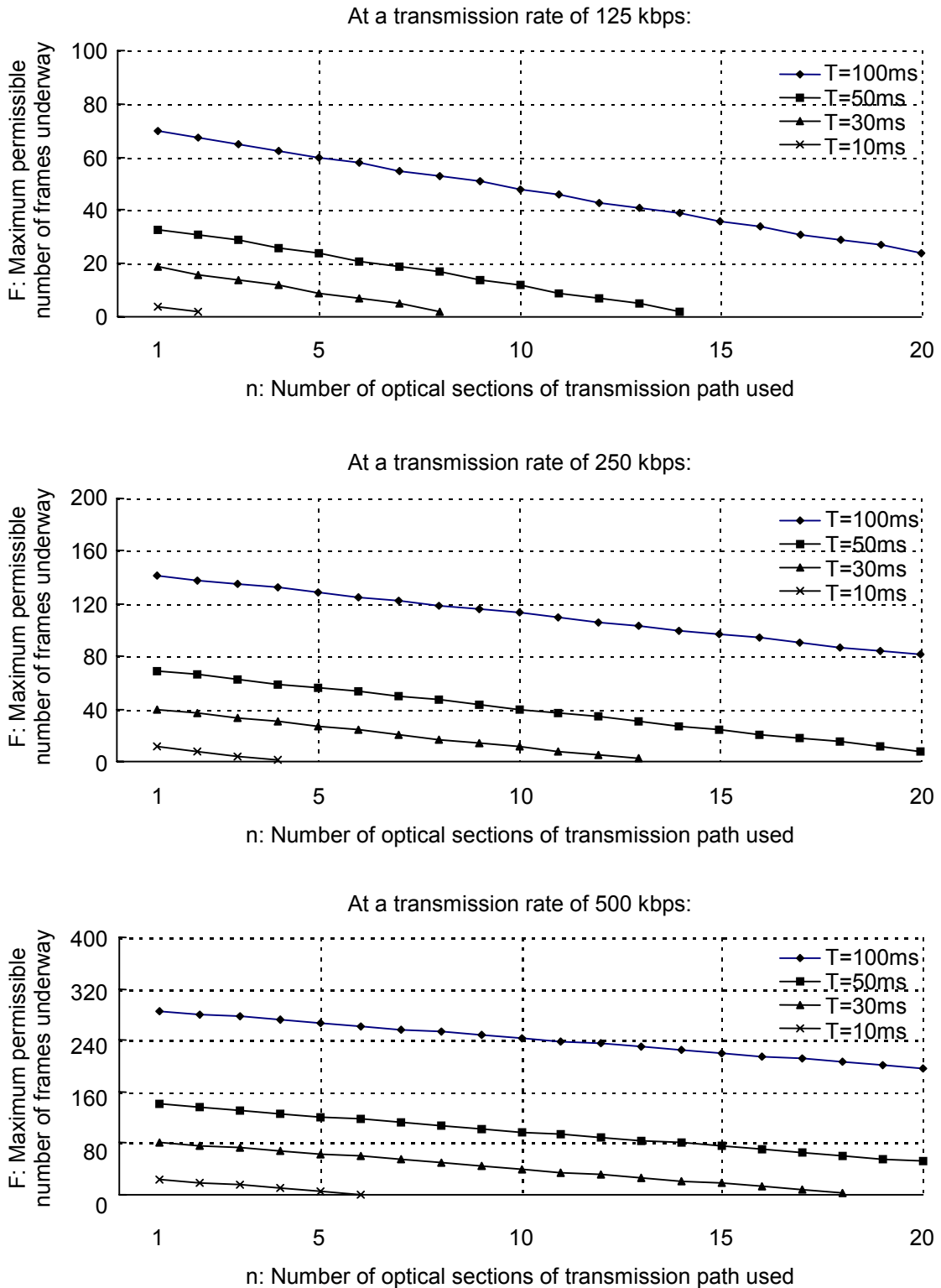


Figure 3-3 Relationship between Transmission Interval and Allowable Number of Communication Frames (Worst Value) for Using CAN Extension Frames



### 3 SPECIFICATIONS

#### 3.1.4 General system configuration including more than one optical section

As shown in Figure 3-4, Optical Adapters can be used to form up to 20 optical sections for any transmission path in a network.

The DeviceNet cable lengths in the figure below are limited independently of the number of optical sections of any transmission path (a detailed description will be given in Subsection 6.1.4, “Restrictions on cable lengths”). The limit of each optical cable length is 1 km, independent of the other optical cable lengths in the same network.

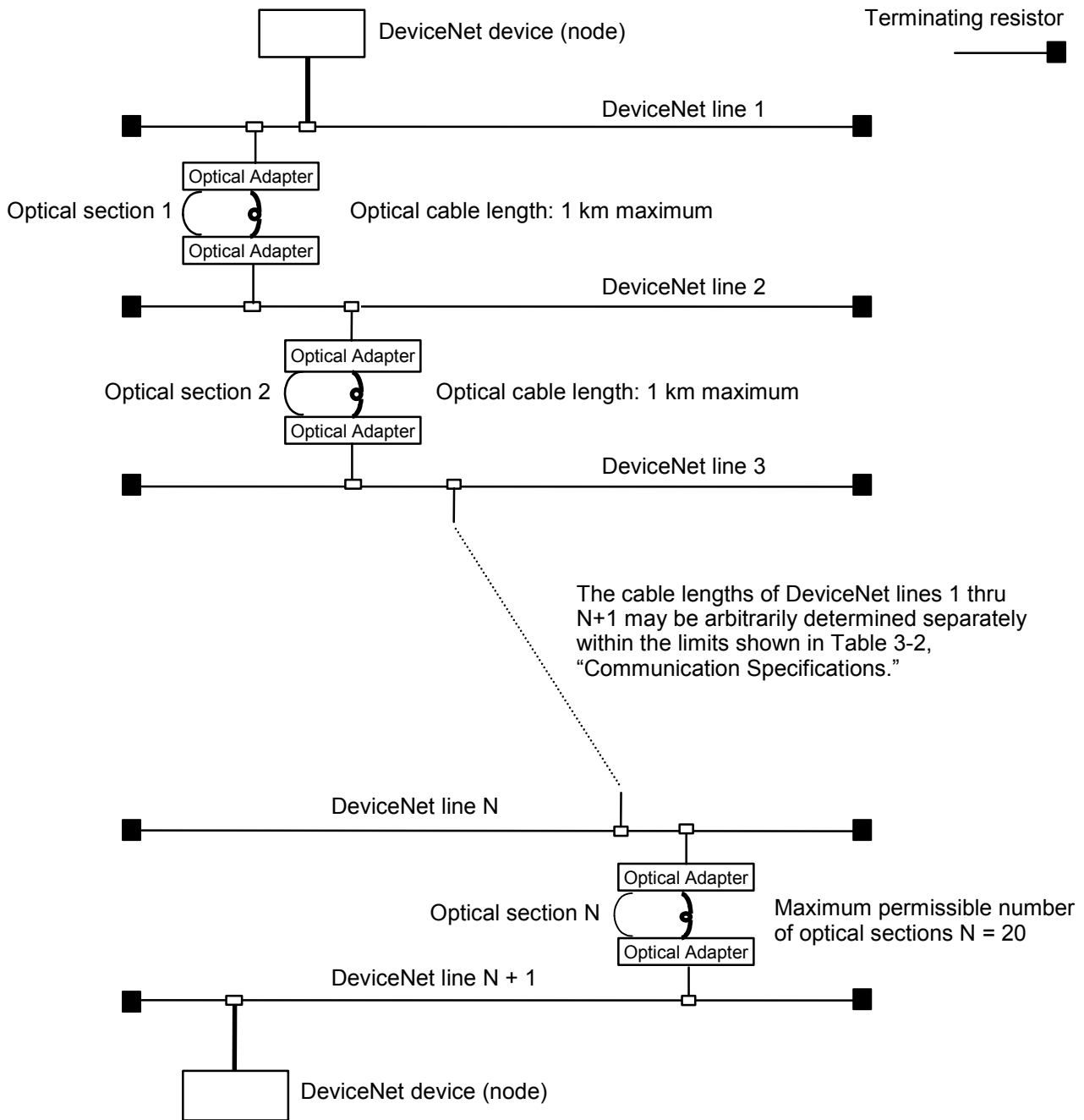


Figure 3-4 General System Configuration Including More Than One Optical Section

### 3.1.5 Optical Adapter usage precautions

#### (1) Duplicate MACID detection

In a system configuration where Optical Adapters are employed, a duplicate MACID may sometimes be undetectable by the DeviceNet device involved. In such a case, the Optical Adapter may detect a NETERR (bus-OFF) condition frequently.

#### (2) Optical cable length

As stated above, the optical cable length used in any optical section of transmission path is limited to 1 km (max.). Even with an optical cable length of less than 1 km, data transmission over the path may be disabled due to a severe light attenuation if the cable length is extended by some means such as interconnection devices. Thus, no optical cable length of about 1 km should include such extensions. If the optical cable length in an optical section is much less than 1 km and needs to be so extended, use interconnection devices with a loss margin (including a loss due to their connector) less than or equal to the value found by solving the following equation:

<Loss margin calculation equation>

- Loss margin = 7 dB - sum of all the transmission losses occurring in cables of optical section
- When an optical cable length is less than 100 m:

Transmission loss = 1.1 dB

- When an optical cable length (L) is in the range  $100 \text{ m} \leq L < 1 \text{ km}$ :

Transmission loss =  $(7 - 4 \times \log_{10}L) \times L$ , where L is in kilometers.

For example, if an optical cable length is 200 m, the transmission loss is:

$$(7 - 4 \times \log_{10}0.2) \times 0.2 \cong 1.96 \text{ dB}$$

Example: An optical section consisting of cables as shown in Figure 3-5:

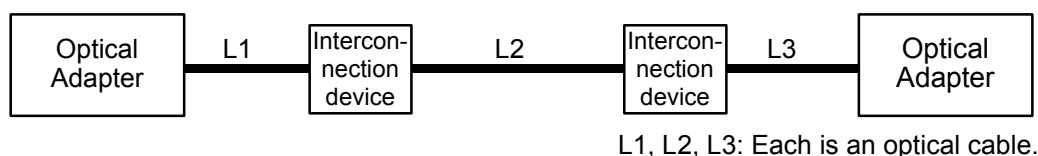


Figure 3-5 An Optical Section Consisting of Three Cables

### 3 SPECIFICATIONS

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In this figure, if L1, L2 and L3 are 100 m, 200 m, and 100 m respectively, then the sum of all the transmission losses occurring in the three optical cables is:

$$1.1 \text{ dB} + 1.96 \text{ dB} + 1.1 \text{ dB} = 4.16 \text{ dB}$$

and the loss margin is:

$$7 \text{ dB} - 4.16 \text{ dB} = 2.84 \text{ dB}.$$

Therefore, the interconnection devices used in this example must be such that the sum of their losses is 2.84 dB or less.

# 4 NAMES AND FUNCTIONS OF EACH PART

## 4 NAMES AND FUNCTIONS OF EACH PART

### 4.1 Names and Functions of Each Part

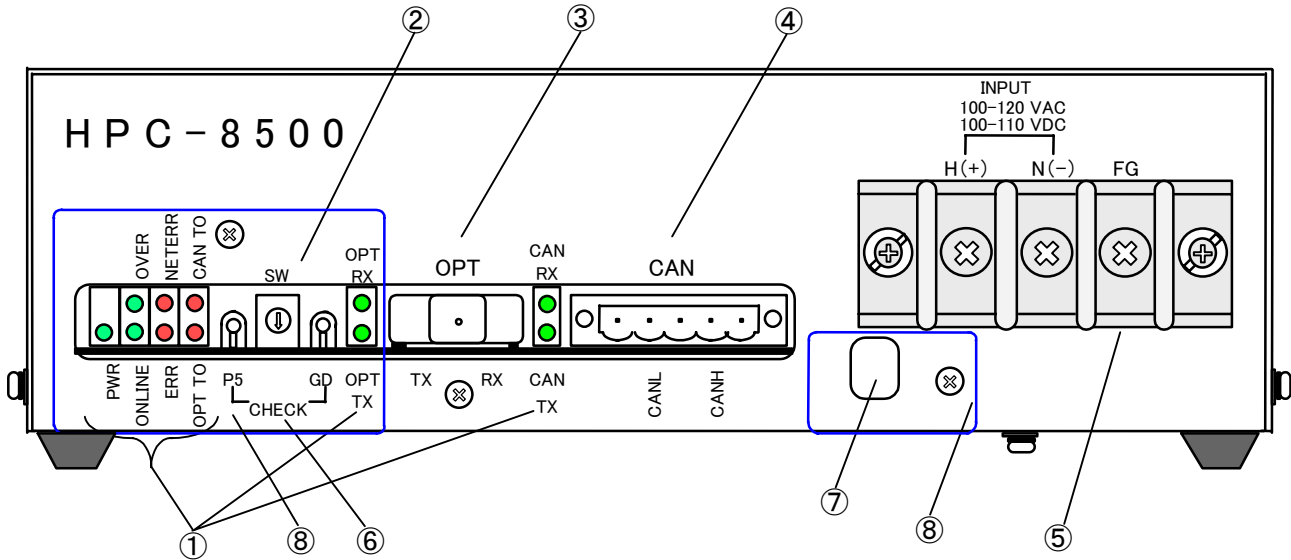


Figure 4-1 Front View of the Optical Adapter

Table 4-1 Functions of Each Part

No.	Name	Function
①	LED indicators (green or red)	Optical Adapter status indicators. (For indications on these LED indicators and their meanings, see item (1) below.)
②	Rotary switch	A rotary switch to select a DeviceNet transmission rate. (For settings of this rotary switch, see item (2) below.)
③	OPT	Optical connector
④	CAN	5-pin connector conforming to the DeviceNet standard. The power supply pins do not function, which are made unnecessary by the adoption of the self-feeding system.
⑤	Terminal block (TB)	An assembly of terminals for supplying electric power in 100-VAC/DC by the self-feeding system.
⑥	CHECK terminals	Internal voltage (5 V) check terminals. Used only by service persons; ordinary users are not allowed to use them.
⑦	Voltage adjustment hole.	A hole accessed when adjusting the internal voltage (5 V). Used only by service persons; ordinary users are not allowed to use them.
⑧	Front cover	A cover used to conceal the openings (e.g., around the LED indicators) in the front surface of the Optical Adapter housing. Secured to the housing with M3 × 8 sems screws (nickel plating). This cover is screwed or unscrewed when setting the rotary switch, for instance. Before screwing or unscrewing it, be sure to disconnect the optical cable and power cable.

## (1) Indications on the LED indicators and their meanings

Table 4-2 Indications on the LED Indicators and Their Meanings

Labeling	Name	Indication color	Description
PWR	Power-ON indicator	Green	Lit when the power supply is ON.
OVER	Receive-buffer overflow indicator	Green	Lit when the following event happens: The Optical Adapter internally has a buffer for holding 400 or less frames of data temporarily, in anticipation of the send-side DeviceNet line to be completely occupied by some other node. If such a completely occupied condition arises and lasts until more than 400 frames of data have been received, the buffer overflows, resulting in discarding of the rest of the received frames. The indicator stays lit until the above event stops.
ONLINE	Online condition indicator	Green	After a start-up diagnosis process has been completed, lit when the Optical Adapter begins to operate. This indicator continues blinking (ON for 0.5 seconds and OFF for 0.5 seconds) while the Test and Maintenance (T&M) program, which will be described later in Chapter 7, runs normally.
NETERR	Network status indicator	Red	Comes on when a bus-OFF condition is detected, and goes out when a data transmission is terminated normally. Stays lit until a detected bus-OFF condition is cleared. If a detected bus-OFF condition lasts only briefly, the ON-condition of this indicator may not be recognized.
ERR	Error indicator	Red	Begins to blink when an abnormality is detected during a start-up diagnosis process. This is followed by automatic stoppage of the Optical Adapter. The ON-condition and OFF-condition of the blinking last for the following time periods: <ul style="list-style-type: none"> <li>• On a ROMSUM error, ON for 0.25 seconds, OFF for 0.25 seconds.</li> <li>• On a RAM Write/Read error, ON for 0.5 seconds, OFF for 0.5 seconds.</li> <li>• On an HCAN Write/Read error, ON for 1.0 second, OFF for 1.0 second.</li> </ul> This indicator also comes on when an error, such as a compare error or receive timeout, is detected during a T&M operation.
CAN TO	CAN-side receive status indicator	Red	Stays lit for one second as no data is received from the CAN side for one second during a data transmission. This indicator may be lit only when a data transmission is in progress.
OPT TO	OPT-side receive status indicator	Red	Stays lit for one second as no data is received from the OPT side for one second during a data transmission. This indicator may be lit only when a data transmission is in progress.
OPT RX	OPT-side receive indicator	Green	Lit when an optical signal (pulse) is received.
OPT TX	OPT-side send indicator	Green	Lit when an optical signal (pulse) is sent out.
CAN RX	CAN-side receive indicator	Green	Lit when a DeviceNet signal is received.
CAN TX	CAN-side send indicator	Green	Lit when a DeviceNet signal is received.

## 4 NAMES AND FUNCTIONS OF EACH PART

(2) The following table shows the rotary switch settings:

Table 4-3 Rotary Switch Settings

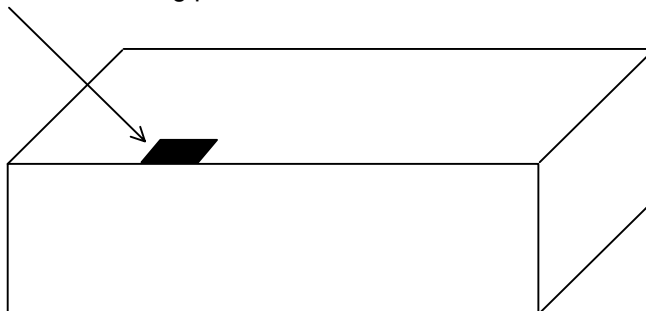
Set value	Settings		Set value	Settings
0	For using DeviceNet or CAN standard frames	Transmission speed: 125 kbps	8	Reserved
1		Transmission speed: 250 kbps	9	
2		Transmission speed: 500 kbps	A	
3	Reserved		B	
4	For using CAN extension frames * Supported by REV B or later.	Transmission speed: 125 kbps	C	
5		Transmission speed: 250 kbps	D	
6		Transmission speed: 500 kbps	E	
7	Reserved		F	T&M mode



### CAUTION

Before removing the front cover setscrews of the Optical Adaptor when changing the rotary switch setting, be sure to remove the optical cable.

\* REV label sticking position



# 5 INSTALLATION



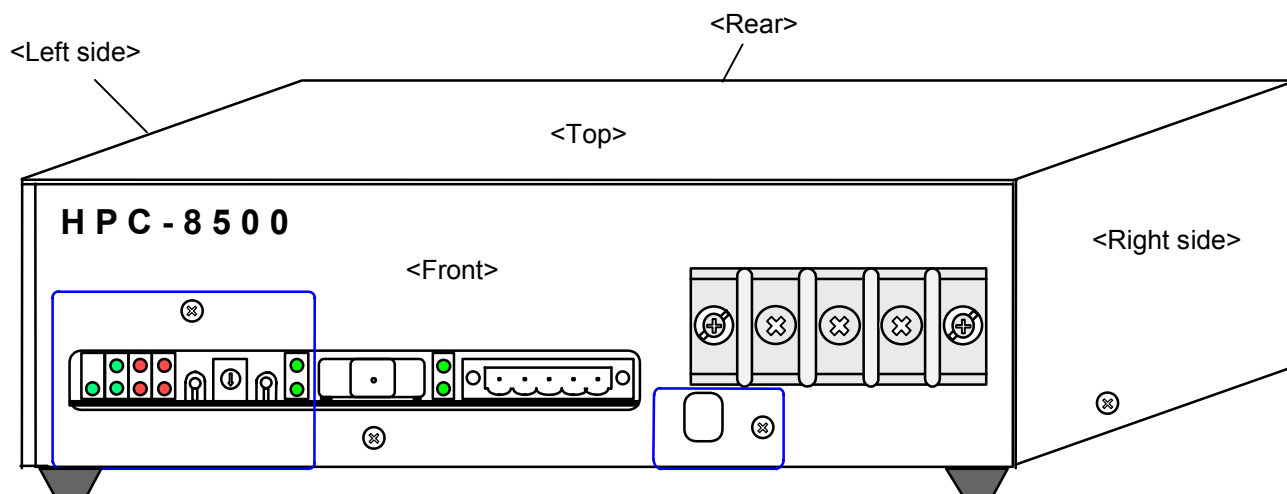


**CAUTION**

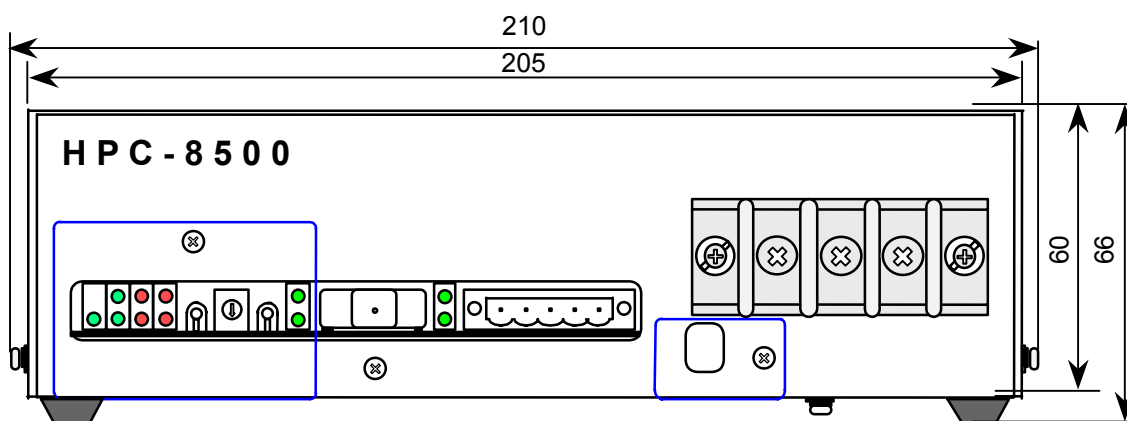
- This hardware unit may fail if the ambient temperature is too high. The hardware unit may also malfunction due to interference by electromagnetic waves from adjacent hardware. To dissipate heat and reduce electromagnetic interference, provide a specified amount of space between units of the optical adapter and between the optical adapter and other equipment.
- After installing this hardware unit, measure temperatures near the installed optical adapter and the mount base during its initial test run, and check whether the measurements are within the specified limits. If a specified amount of space cannot be provided or the measured temperature is too high, install 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, possibly resulting in an extremely high temperature. This may cause the hardware unit to fail or, if not so serious, its parts to deteriorate.

## 5 INSTALLATION

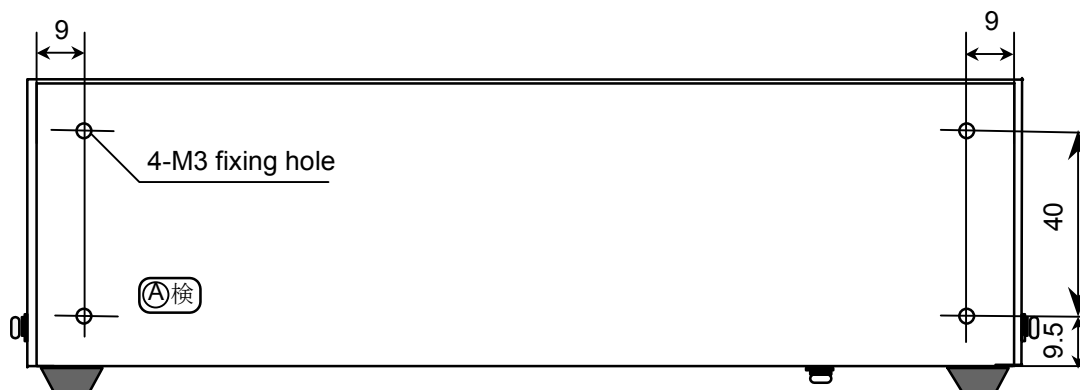
### 5.2 Outside Dimensions



<Front view>



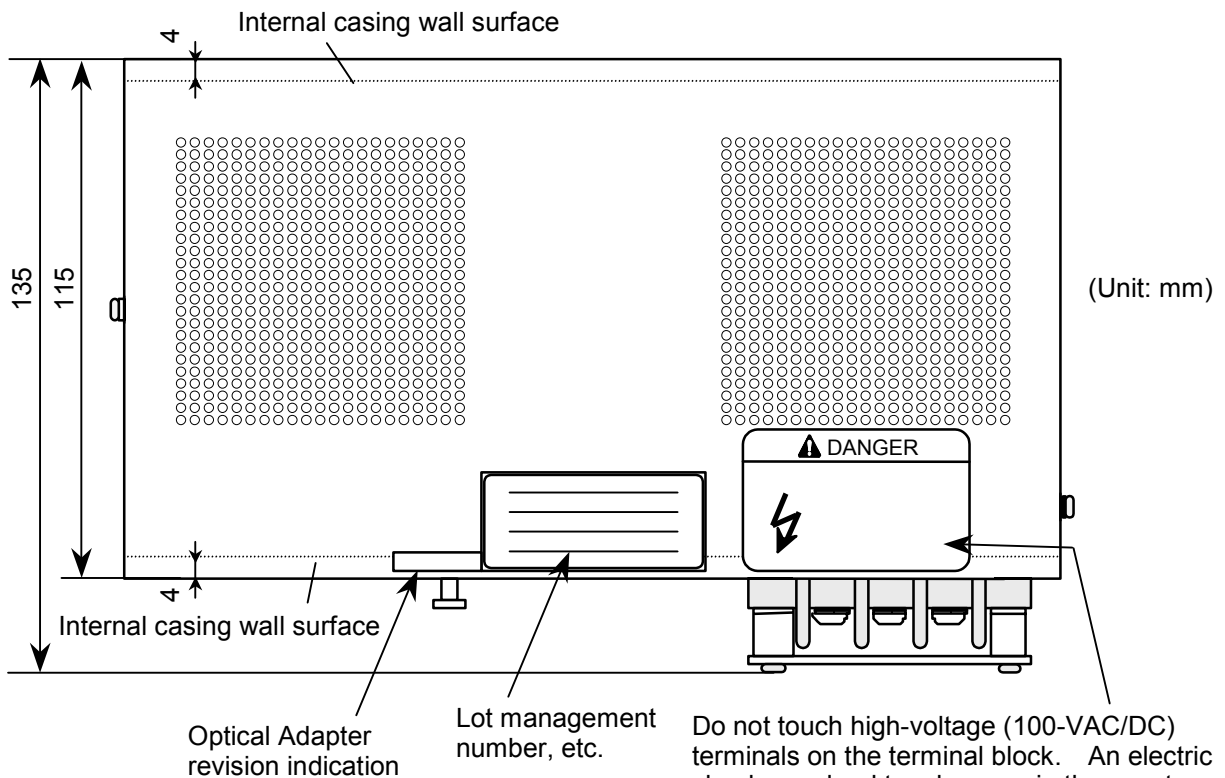
<Rear view>



(Unit: mm)

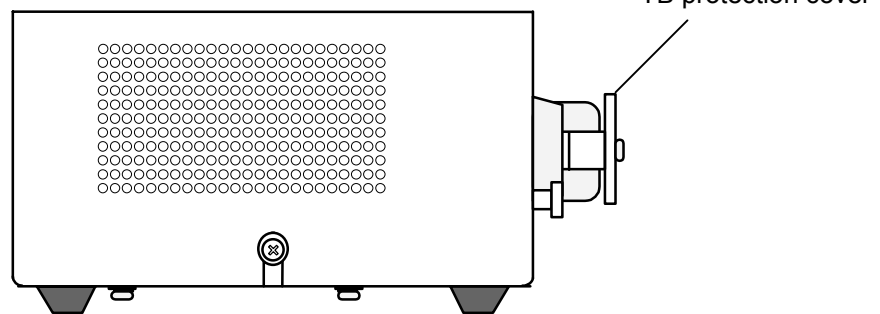
Figure 5-2 Outside Dimensions -- Width, Height, etc

<Top view>



Do not touch high-voltage (100-VAC/DC) terminals on the terminal block. An electric shock may lead to a burn or, in the worst case, a death. No one other than authorized service persons is allowed to remove this cover.

<Left-side view>



<Right-side view>

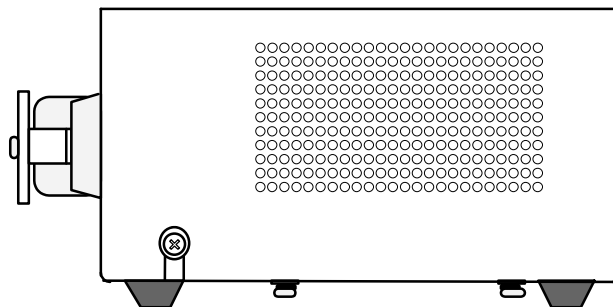
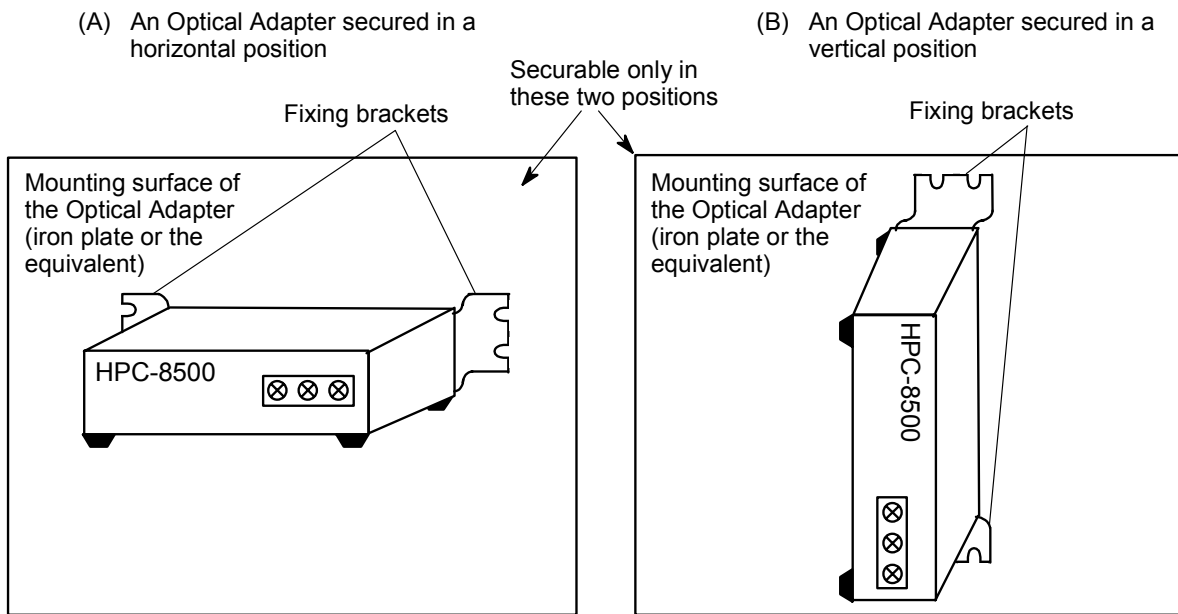


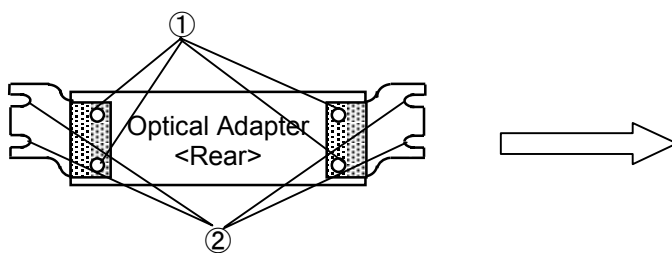
Figure 5-3 Outside Dimensions -- Depth, etc.

### 5.3 Securing the Optical Adapter

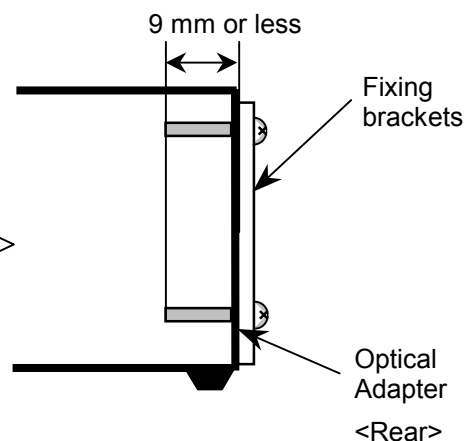
As explained before, the Optical Adapter may be either mounted on a shelf or secured to the Mounting surface of the Optical Adapter (iron plate or the equivalent) in the cubicle. When you secure the product to the plate, be sure to secure it either in a horizontal or a vertical position as shown below. Securing it in any other position is prohibited. Figure 5-5 shows the dimensions of the recommended fixing bracket.



- ① A usual procedure for securing with recommended fixing brackets:  
Fix brackets to the rear of the Optical Adapter by using M3 screws at four locations.



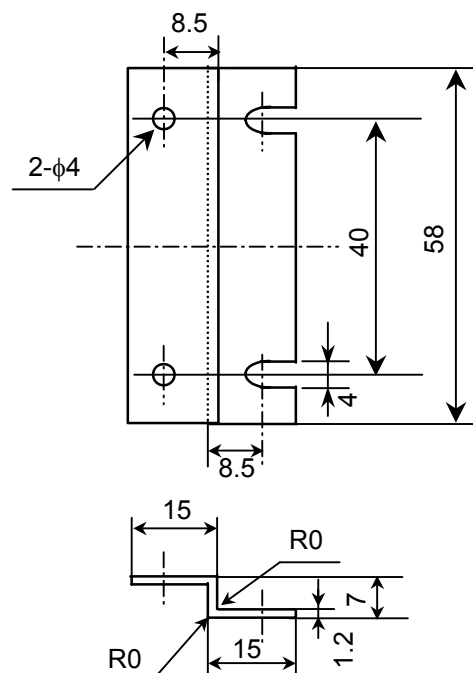
- ② Fix the Optical Adapter to the Mounting surface of the Optical Adapter (iron plate or the equivalent) by using screws at the four U-shaped indentations in the fixing brackets -- two in each bracket.



Note: The screws screwed into the rear panel of the Optical Adapter must be such that the portions of their threaded rods inside the rear are less than 9 mm long.

- ③ The recommended fixing brackets are procured by the user.

Figure 5-4 Securing the Optical Adapter



(Unit: mm)

Figure 5-5 Dimensions of the Recommended Fixing Bracket

**DANGER**

Be sure to switch off this hardware unit before connecting or disconnecting its cable. If the unit remains energized and a user touches a high-voltage terminal inadvertently during connection or disconnection of the cable, he or she may suffer from an electric shock. Also, this hardware unit may be damaged due to a short circuit or noise.

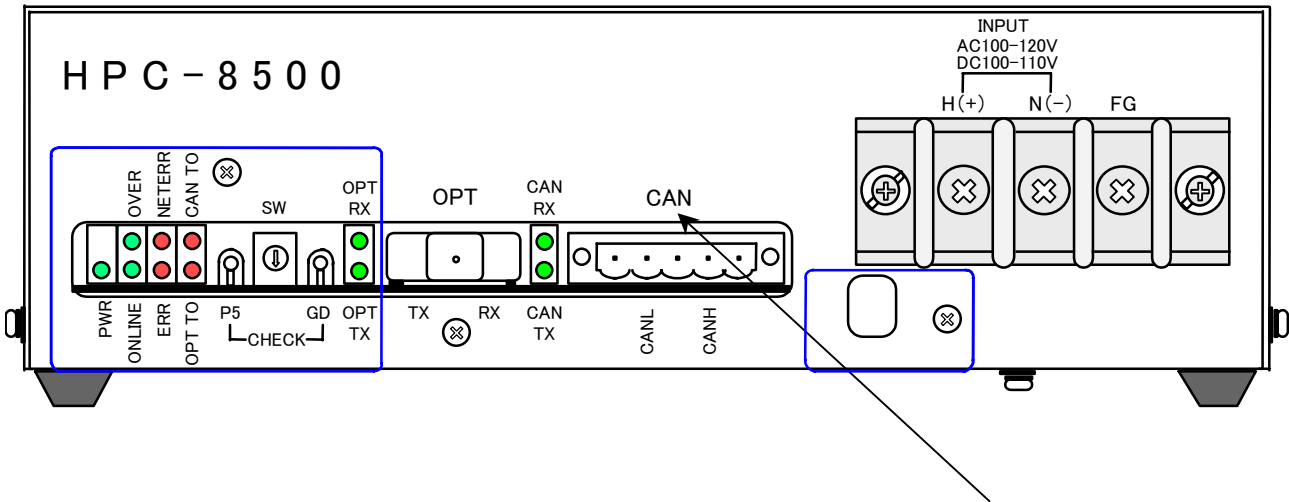
**CAUTION**

- 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:
  - Do not use any fixing screws other than specified.
  - Take sufficient care not to make wrong wiring at terminal blocks.
  - Where protection against lightning is necessary, install a surge absorber outside the optical adapter.

# 6 CABLING

6.1 DeviceNet Cabling

6.1.1 Interface signals and cabling



DeviceNet connector

Optical Adapter indication	Signal	
	Symbol	Name
(Unused)	V-	Power supply line (GND)
CANL	CAN-L	Signal line (L-side)
(Unused)	SHD	Shield (Drain wire)
CANH	CAN-H	Signal line (H-side)
(Unused)	V+	Signal line (+24 V)

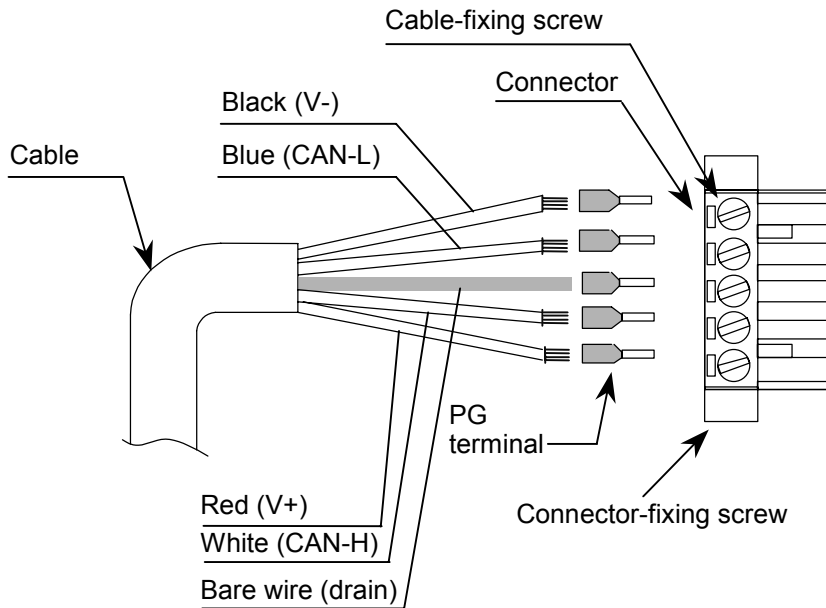


Figure 6-1 Optical Adapter Wiring



As shown in the diagram 6-1, insert the stripped end portions of the cable wires into the cylindrical portions of PG terminals and crimp the cylindrical portions for solderless connections. (For information on permissible cable lengths, see Subsection 6.1.4, “Restrictions on cable lengths.”) Then, insert the crimped PG terminals of the power supply lines, signal lines, and drain wire into the corresponding holes in the connector, and firmly tighten each terminal screw on the connector (with a tightening torque of about  $0.5\pm 0.1$  N·m). After you have connected the cable to the connector, properly insert the connector into the mating connector of the Optical Adapter, and then tighten the connector-fixing screws.

**CAUTION**

- Before inserting the cable connector to the mating connector, turn OFF the power to the Optical Adapter, and assure that all the connected DeviceNet devices and communication power supply are switched OFF.
- The Optical Adapter supplies its required communication power on an individual basis (self-feeding), so it requires no external communication power feeding. However, connection of the power lines as shown in Figure 6-1 causes no problem.
- Check the cable connector periodically (every 3 to 6 months) for any loosened connector-fixing screw, and tightly screw the connector, if necessary.

6.1.2 Hardware configuration

An example of a DeviceNet hardware configuration is shown below. In a DeviceNet network, a control device connected to the network is called a “node” and the Optical Adapter is one of such nodes. Nodes can be classified into two groups: slaves, which exchange information with outside entities, and masters which collectively control and manage slaves in the network.

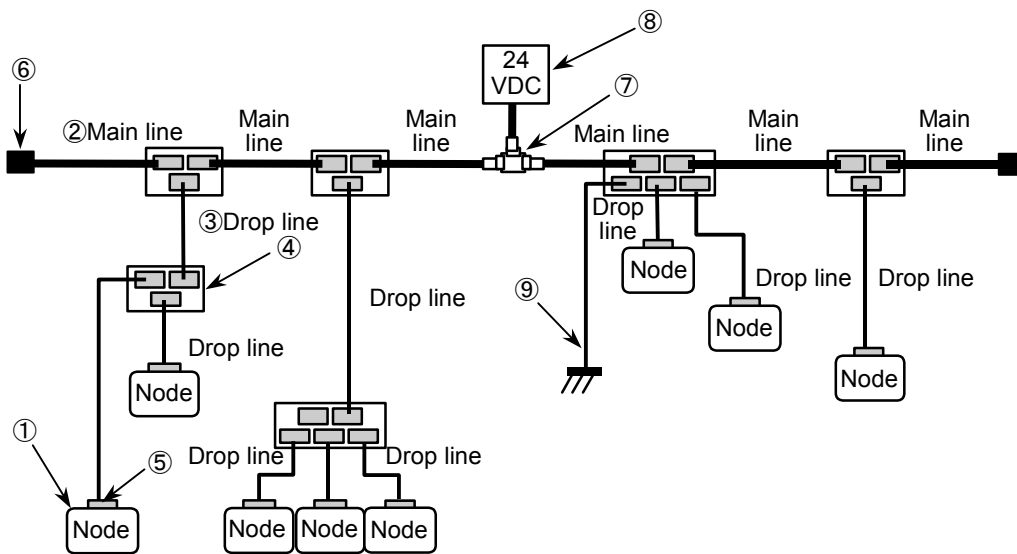


Figure 6-2 Network Hardware Configuration

Any DeviceNet network is constructed of such hardware as the following:

① Node

Nodes classified as slaves exchange information with outside entities, and those classified as masters collectively control and manage slaves in the network. These two types of nodes can be placed anywhere in the network, regardless of their roles.

②, ③ Main line and drop line

Communication cables connected to the network can be classified into two groups: main (or trunk) lines and drop lines. A main line is a series of cables connected together as a single communication line, terminating resistors being attached to its two ends. A cable branching out from a main line is called a drop line, and a cable branching out from a drop line is also called a drop line. A node is connected to a drop line. The communication cables used are all dedicated 5-wire cables, which are either thick cables or thin cables.

④ T-branch tap

In a DeviceNet network, main lines and drop lines are connected by T-branch taps. Use of T-branch taps also enables branching out from a drop line and connecting a node to the second drop line. In place of T-branch taps, a terminal block (TB) may also be used for the same purpose.

⑤ Connector

There are two types of connectors, open and enclosed, that connect communication cables to a node and to a T-branch tap. The open-type connector is preferably used to connect a communication cable to an Optical Adapter and to a T-branch tap.

⑥ Terminating resistor

In any DeviceNet network, terminating resistors ( $121 \Omega \pm 1\%$ ) must be attached to the two ends of the main line. Out of many available methods, the use of terminal blocks (TBs) and terminating resistors suitable for connection with a TB is recommended.

⑦, ⑧ Power tap and communication power supply

To communicate using a DeviceNet network, a communication power supply must be connected to the network by means of a power tap and then must supply power to each connected node in the network via a communication cable. In place of power taps, T-branch taps and TBs may also be used to connect a communication power supply to the network. The communication power supply voltage applied to DeviceNet networks is 24 VDC.

⑨ Network grounding

The shields of communication cables must be grounded only at one point around the center of the network so that no ground loops will be formed in the entire electrical system. There is more than one way of grounding -- for instance, by drawing a ground wire from a tap or from a TB. In the example configuration above, the ground wire is drawn from a T-branch tap.

Other recommended hardware items that can be used to construct a DeviceNet control mechanism are listed in Table 6-1. The Nos. in the table are keyed to the encircled numbers assigned to the components listed above. When a TB needs to be used, the TB itself, screws for the TB, and solderless terminals suitable for use with selected communication cables are also required in addition to the items listed below.

Table 6-1 Recommended Components

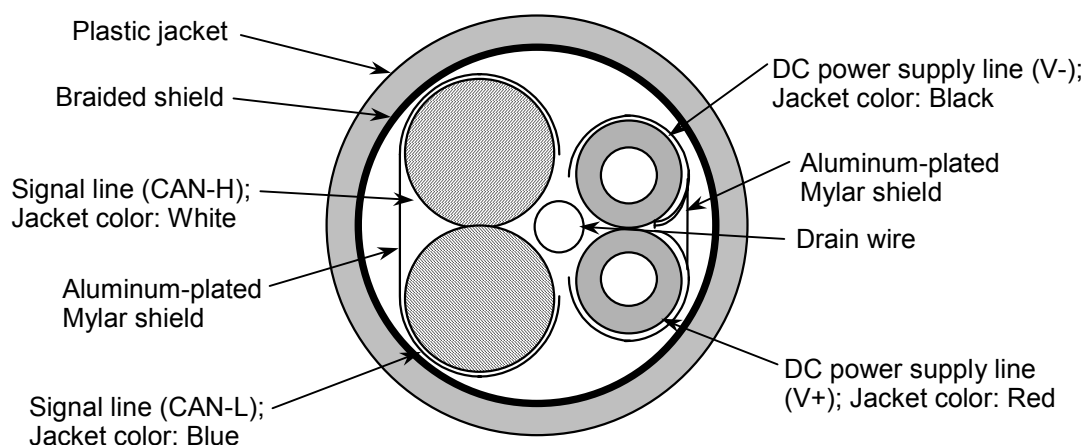
No.	Name	Specifications	Recommended product	
			Model	Manufacturer
②	Thick cable	5-wire communication cable	UL20276-PSX (*) 1P × 18AWG + 1P × 14AWG	Hitachi Cable, Ltd.
③	Thin cable	5-wire communication cable	UL20276-PSX (*) 1P × 24AWG + 1P × 22AWG	Hitachi Cable, Ltd.
④	T-branch tap	Open-type T-branch tap	DCN1-1C	OMRON Corp.
		Open-type 3-branch tap	DCN1-3C	
⑤	Connector	Open type	MSTBT2.5/5-STF-5.08-AU	Phoenix Contact GmbH & Co. KG
	PG terminal	For connecting a thick cable (signal) to a connector	A1-6	
	PG terminal	For connecting a thick cable (power) to a connector	A2.5-7	
	PG terminal	For connecting a thin cable to a connector	VPC-0.5-F8	JST Mfg. Co., Ltd.
⑥	Terminating resistor	Attached to a TB	MFB120ΩCT1	Tama Electric Co., Ltd.
⑦	Power tap	Equipped with a reverse-current stopper and a ground terminal	1485T-P2T5-T5	Rockwell Automation Japan Co., Ltd.
⑧	Communication power supply	24 VDC	S82J-5524	OMRON Corp.

(\*) The cable length is specified separately for this model.

### 6.1.3 Components

#### (1) Communication cable

Dedicated 5-wire communication cables conforming to the DeviceNet standard have the physical structure shown below. These communication cables can be classified into two groups: thick cables and thin cables. The physical structure of these two types of cable is identical.



Cable type	Outer diameter (mm)
Thick cable	11.2 to 12.1
Thin cable	6.9

Figure 6-3 Cross-section of the Communication Cable

Generally, thick cables are suitable for communications over a comparatively long distance as they are strong against bending forces and produce less signal attenuation. Thick cables are often used as main lines that are required to have a long length.

In contrast, thin cables are not suitable for long distance communications, because they are soft, easy to bend, and attenuate signals. Therefore, they are typically used as drop lines.

However, a thin line can also be used as a short-distance main line if the network to be constructed is of a small scale.

As shown below, an at least 5-cm end portion of the communication cable to be connected to an Optical Adapter must be set aside as a portion at which bending is prohibited, and the bending radius of the cable must be at least 25 cm for a thick cable or 15 cm for a thin cable.

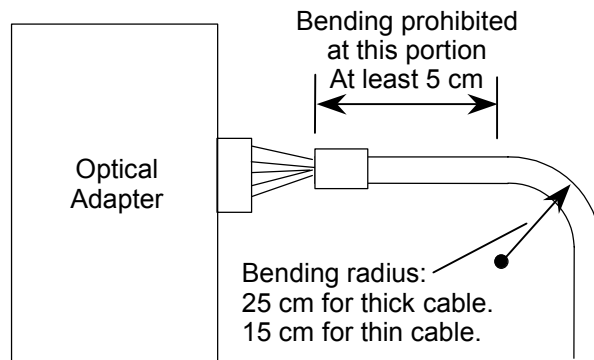


Figure 6-4 Bending Radius of the Cable



**CAUTION**

- Do not mix cables of one type (e.g., communication cables) with cables of another type (e.g., power cables or motor lead cables) during cabling work. Lead cables from inverters, motors, and power regulators, in particular, must be isolated at least 300 mm from any communication cable. Communication cables must be pulled in a dedicated pipe or conduit separately from those in which lead cables are pulled.
- Always use dedicated 5-wire communication cables conforming to the DeviceNet standard. Do not use any other cables.
- Use communication cables longer than their actually required lengths, in consideration of future troubleshooting, moving, and resulting recabling.
- When you bundle cables, do not fasten them tightly. If they are so fastened, you may not be able to move the cables easily. If tightly fastened cables are moved forcibly, excessive compression and tension forces may be exerted on them, resulting in cable breakage.
- Do not forcefully pull the communication cable. Exerting an excessive force on such a cable may cause disconnection or cable breakage.
- Do not place heavy objects on the communication cable. Disregarding this rule may result in disconnection or cable breakage.

## (2) Connector

Detachable connectors are used to connect communication cables to nodes and to branch taps. In DeviceNet networks, these connectors are classified either as enclosed-type or open-type. The connectors connecting to an Optical Adapter and a recommended T-branch tap are all open-type connectors, and plug-in screw connectors are recommended.

Where plug-in screw connectors are used to connect with communication cables, a connected node can be removed from the network without creating an open network circuit.

Figure 6-5 shows the external view, wiring (colors), and pinout of the plug-in screw connector.

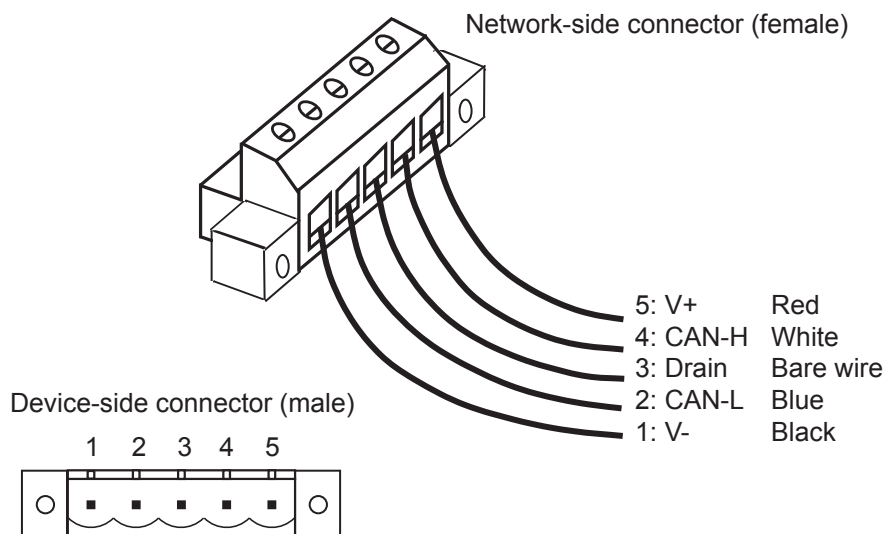


Figure 6-5 Connector Wiring

**CAUTION**

- Always use PG terminals to wire a communication cable to the plug-in screw connector. If PG terminals are not used, the cable may be broken or have its connection broken.
- Connect to an open-type connector a communication cable longer than its actually required length, in order to prevent a tensile force from being exerted on the cable. Disregarding this rule may result in the connector or cable having its connection broken.
- User-procured nodes except Optical Adapters may require connectors other than open-type ones. Connect such nodes to communication cables according to the instruction manuals that come with the nodes.
- Connect the signal wires, power wires, and the drain wire correctly to the connectors. Use proper PG terminals for the power wires of a thick cable; these power wires require different PG terminals from the other wires of that cable.

(3) T-branch tap

T-branch taps are used to branch the main line or a drop line. Two types of T-branch taps, open and enclosed, are available for DeviceNet networks, and the open-type tap is preferably used. These two types can further be classified into two groups: 1-branch taps and 3-branch taps. Their connection methods are identical. Shown below are the structures and connections of the 1-branch tap and 3-branch tap.

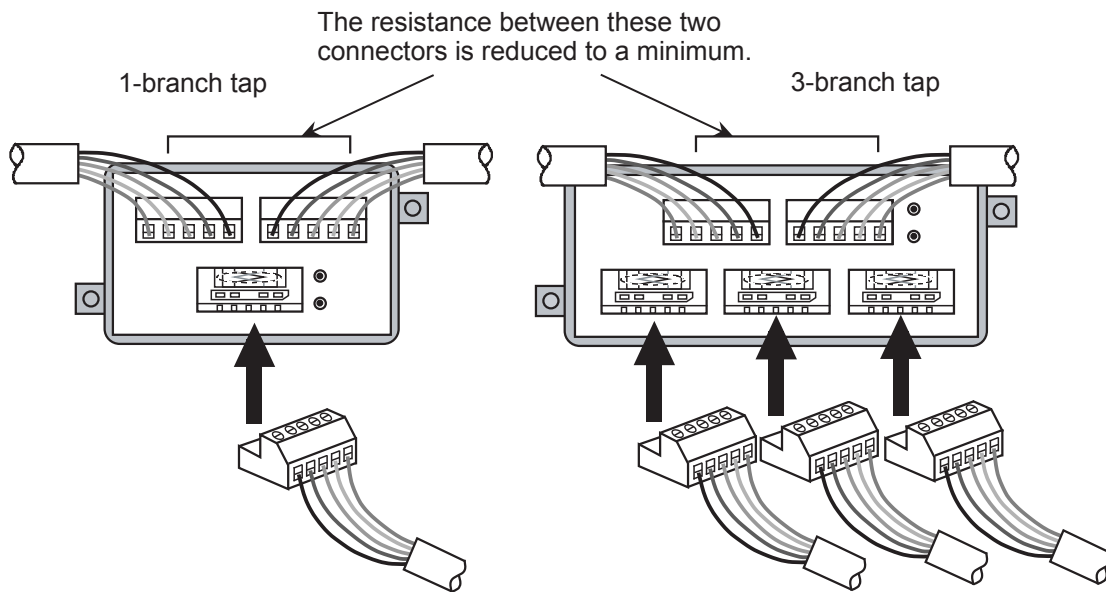


Figure 6-6 Branching with Branch Taps

There exists a resistance between the connectors of a T-branch tap. However, the resistance between the connectors of each T-branch tap shown above is reduced to a minimum. So, if a T-branch tap is used to branch a drop line, it is recommended that the user connect whichever new branch is longer between the two or longest among the four to the other connector.

**CAUTION**

Each T-branch tap has holes for fixing screws. After you have connected all the required communication cables to the tap, be sure to secure the tap firmly with the fixing screws.



The communication cables can also be branched by means of a terminal block (TB). Connect each cable wire to the TB by using appropriate solderless terminals. An example of a TB connected with communication cables is shown below.

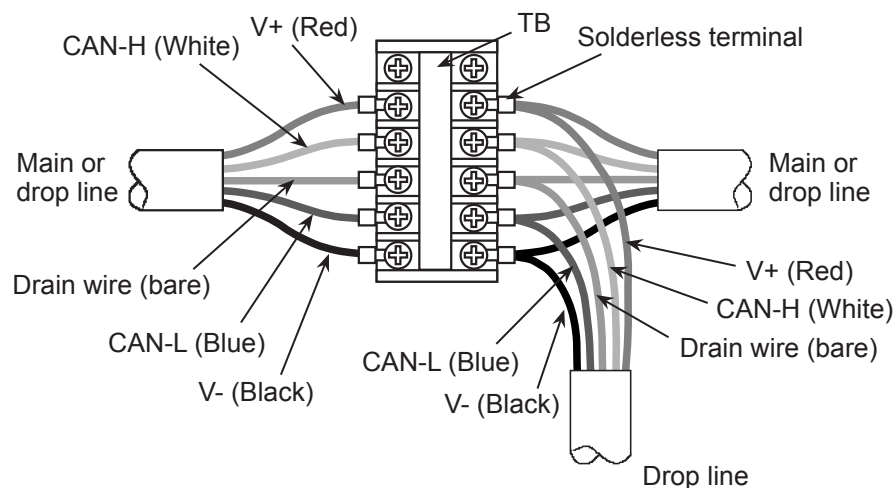


Figure 6-7 Branching with a TB



### CAUTION

If a TB is used for branching, two wires need to be connected to a single terminal on the TB. When so connecting two wires, place the two crimped solderless terminals back to back on the TB terminal and secure them. If they are placed front to front or front to back, there may arise a problem in communication, due to incomplete contact between the terminals.

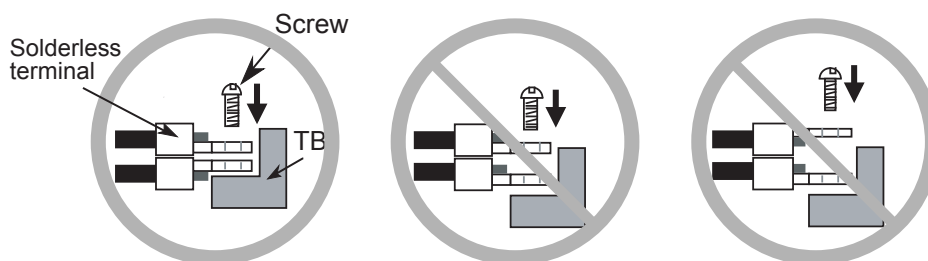


Figure 6-8 Recommended and Prohibited Examples of Solderless Terminals Secured to TBs

(4) Terminating resistor

Terminating resistors must always be connected to the two ends of a main line. The physical characteristics of the terminating resistor are as follows:

Physical characteristics:

Resistance: 121 Ω

Tolerance: ±1%

Permissible loss: 1/4 W

Type: Metal film

There are several ways to connect terminating resistors to a main line, but it is recommended to use a terminal block for the purpose. To connect terminating resistors to a main line, use the following 3-step procedure: (1) solder appropriate solderless terminals to each lead of the terminating resistors, as shown below, (2) cover each lead with Teflon tube, and (3) secure the terminating resistors to the TB. The terminating resistors may be attached to the TB in any orientation, but they must always be connected to the TB terminals for the signal lines (CAN-H and CAN-L). The following example shows how to connect a terminating resistor to a TB:

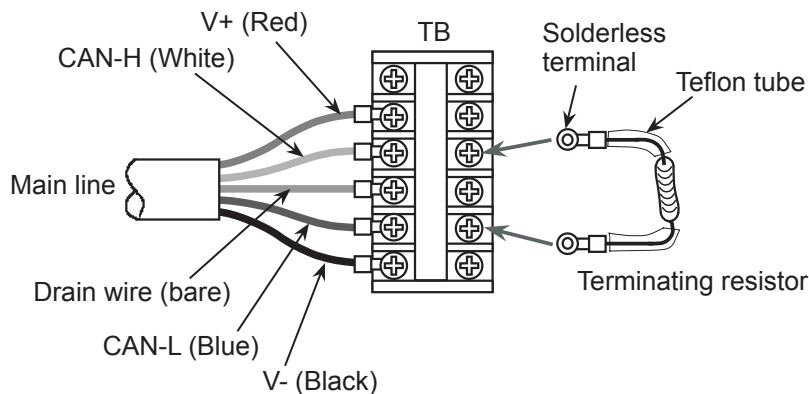


Figure 6-9 Connection of a Terminal Resistor to a TB



**CAUTION**

When connecting a terminating resistor to a TB, always connect it to the TB terminals of the signal lines (CAN-H and CAN-L). If it is connected to a different TB terminal(s), a problem will arise in data communication.

## (5) Power supply tap and communication power supply

DeviceNet does not require communication power supply for each node, because it feeds power directly via cables. Instead, a communication power supply rated at 24 V must be connected to the main line cable. The Optical Adapter, however, does not draw power from the network, because it contains its own communication power supply. An exception to this is when another node without power supply is connected to the product. In these cases, a communication power supply must be connected as described below.

There are two means available for connecting a communication power supply to the main line: a dedicated power tap and a TB. In addition to these means, a T-branch tap is also available if the current consumption is 3 A or less.

Basically, DeviceNet uses only one communication power supply per network. If two or more such power supplies are found necessary through preliminary consideration, which will be described later in Subsection 6.1.5, then they must be electrically separated in the installed power supply system. In practice, this can be achieved by isolating the V+ power lines of the power supplies from each other by the use of either a power tap or a TB. The following diagrams show how to use a power tap and a TB for connection and isolation of communication power supplies:

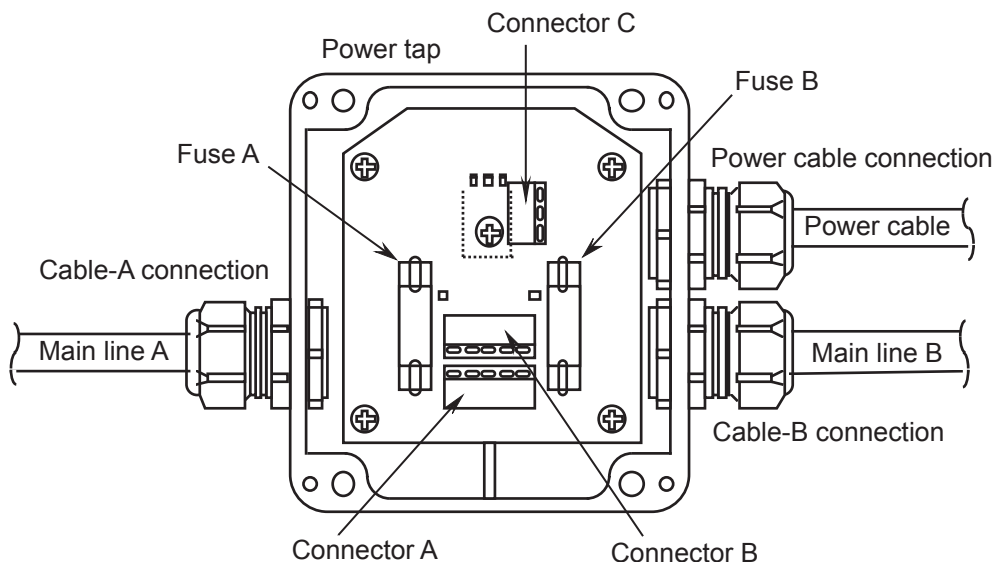


Figure 6-10 Power Supply Connection by a Power Tap

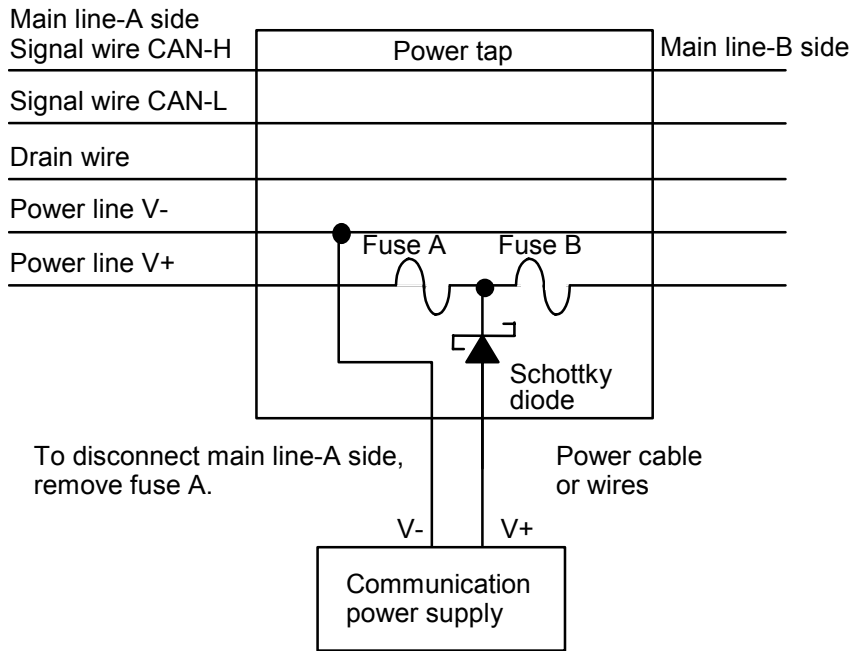


Figure 6-11 Power Supply Isolation by a Power Tap

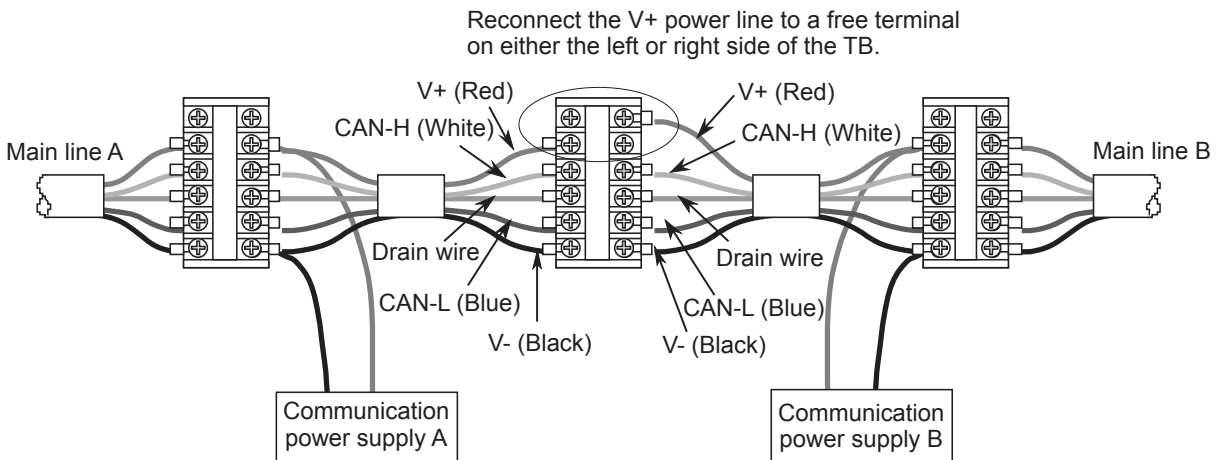


Figure 6-12 Power Supply Connection and Isolation by TBs

The table below lists the specifications of communication power supplies conforming to the DeviceNet standard.

Table 6-2 Communication Power Supply Specifications

Item	Specifications
Initial power supply setting	24 VDC $\pm$ 1% (23.76 to 24.24 V)
Maximum rating	Output current of 16 A or less
Voltage fluctuation	0.3% maximum
Load fluctuation	0.3% maximum
Influence by ambient temperature	0.03% maximum/ $^{\circ}$ C
Input voltage range	120 V $\pm$ 10% 230 V $\pm$ 10%, if necessary, or automatically selected in the range 95 to 250 V.
Input frequency range	48 to 62 Hz
Output ripple	250 m Vp-p
Electrostatic capacitance of load	7000 $\mu$ F maximum
Ambient temperature	Operating: 0 to 60 $^{\circ}$ C Non-operating: -40 to 85 $^{\circ}$ C
Restriction of rush current from power supply	Restricted to less than 65 A
Protection against overvoltage	Provided (no specified value)
Protection against overcurrent	Provided (maximum current: 125%)
Time required for power-ON	250 ms to reach 5% of the final output voltage
Overshoot at startup	0.2% maximum
Insulation	Between output and AC power supply and between output and enclosure ground
Conformance	Required: UL Recommended: FCC Class B, CSA, TUV, VDE
Ambient relative humidity	5 to 95% (non-condensing)
Surge current withstand	Reserved capacity: 10%



### CAUTION

Always use a communication power supply equipped with overvoltage and overcurrent protection.



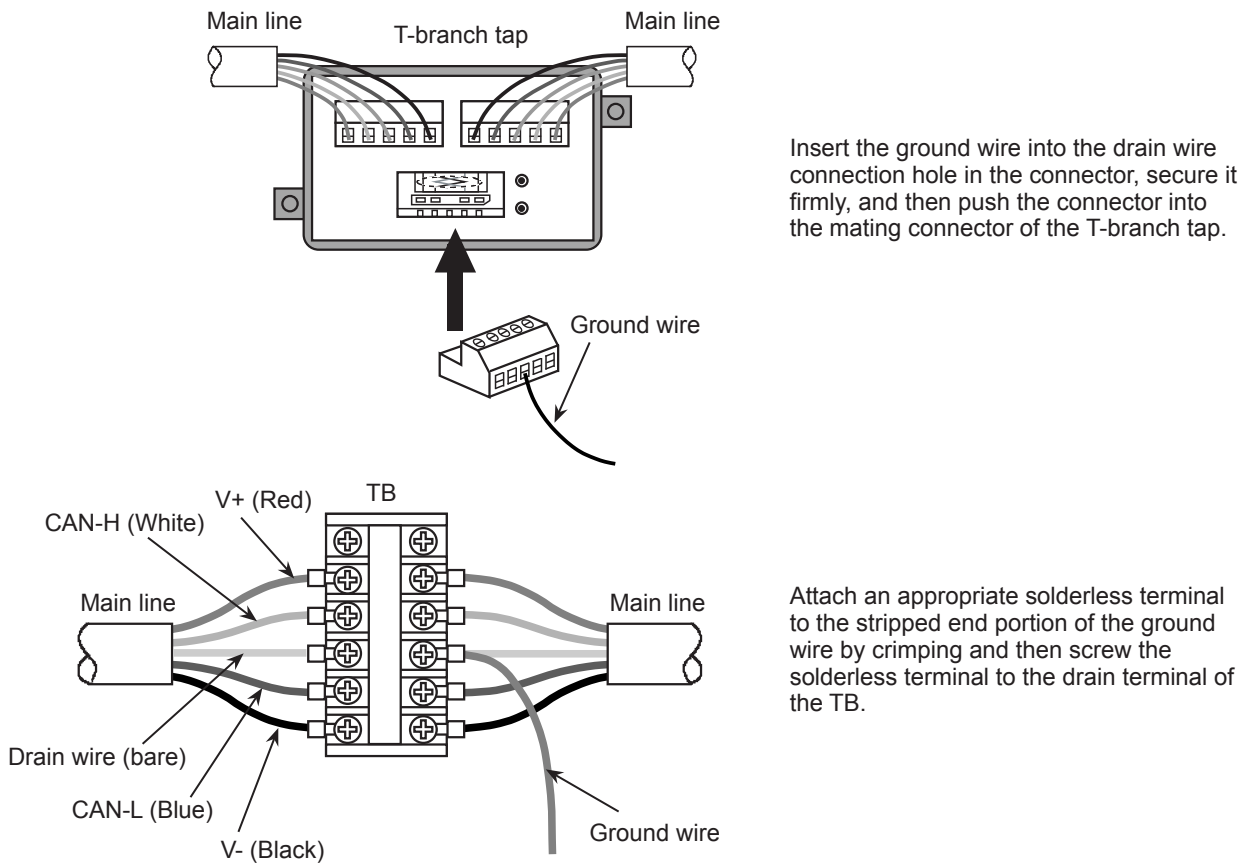
### REQUIREMENT

- Before turning ON the power supply, ensure that the cables are all connected correctly.
- Add a line filter to the primary side of the communication power supply.

(6) Network grounding

Any DeviceNet network not grounded may be affected by emission of static electricity and external power noise, resulting in malfunction or, in the worst case, equipment failure. To prevent this, DeviceNet requires grounding at a single point in the network. If the network is grounded at more than one point, a ground loop may occur. In addition, the network must be grounded as close to its center as possible by using Class D grounding.

The drain wires connected to the shields of main lines must be connected to the conforming ground electrode or the ground conductor in the building. This can be accomplished by connecting the drain wires to a T-branch tap or TB and then the corresponding leads -- such as solid wires, stranded conductors, or braided copper conductors -- from the tap or TB to the ground point. The following diagrams shows how to make leads from a T-branch tap and a TB:



Insert the ground wire into the drain wire connection hole in the connector, secure it firmly, and then push the connector into the mating connector of the T-branch tap.

Attach an appropriate solderless terminal to the stripped end portion of the ground wire by crimping and then screw the solderless terminal to the drain terminal of the TB.

Figure 6-13 Network Grounding

Another way of grounding is from a node or TB connected near the center of the network. Since the drain terminal of the communication cable connector to be connected to an Optical Adapter is not grounded, it must be grounded as follows: (1) make a lead from the braided shield of the communication cable and (2) attach an M3 solderless terminal to the end of the lead by crimping or soldering, and (3) connect the solderless terminal to Class D ground. When performing this procedure, be sure to separate the ground point of the network from that of the Optical Adapter.

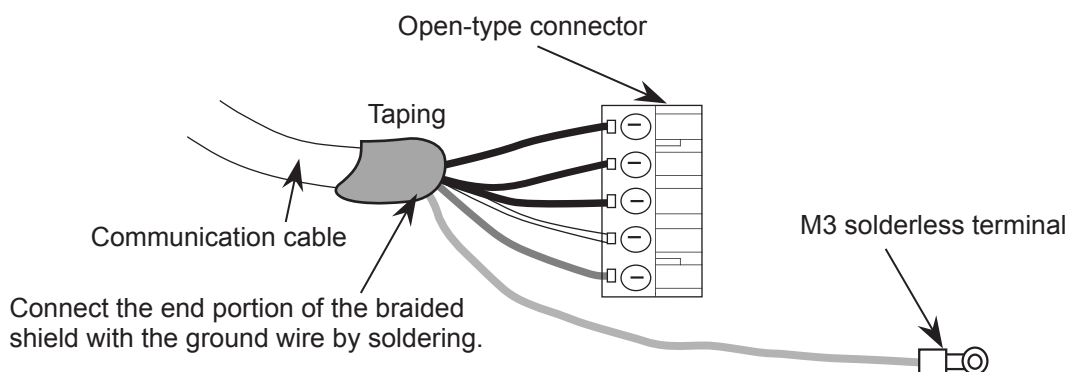

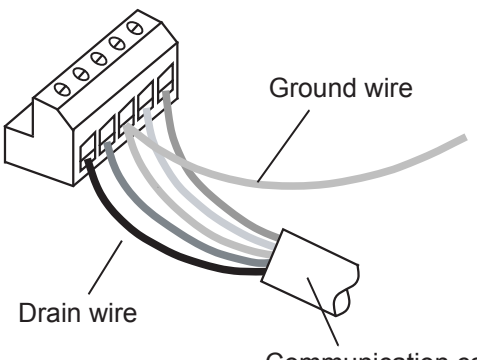


Figure 6-14 Making a Lead from the Braided Shield


**PROHIBITION**

- Do not connect the ground wire to the open-type connector's drain terminal which already has a drain wire connected:



Ground wire

Drain wire

Communication cable

Figure 6-15 A Prohibited Example of a Ground Lead from the Braided Shield

- Do not ground the communication cable and any lead cable of an electric machine together. Disregarding this rule may result in power noise induced into the communication cable through the ground wire.

6.1.4 Restrictions on cable lengths

Some restrictions are imposed on the lengths of DeviceNet cables. This section describes these restrictions. When constructing a DeviceNet network, be sure to satisfy the restrictions.

(1) Maximum permissible network length

The maximum permissible network length means the distance between the nodes or terminating resistors which may be located most distant from each other in the network. As shown below, this length is dependent on the type of the main line cable and the transfer rate of the network.

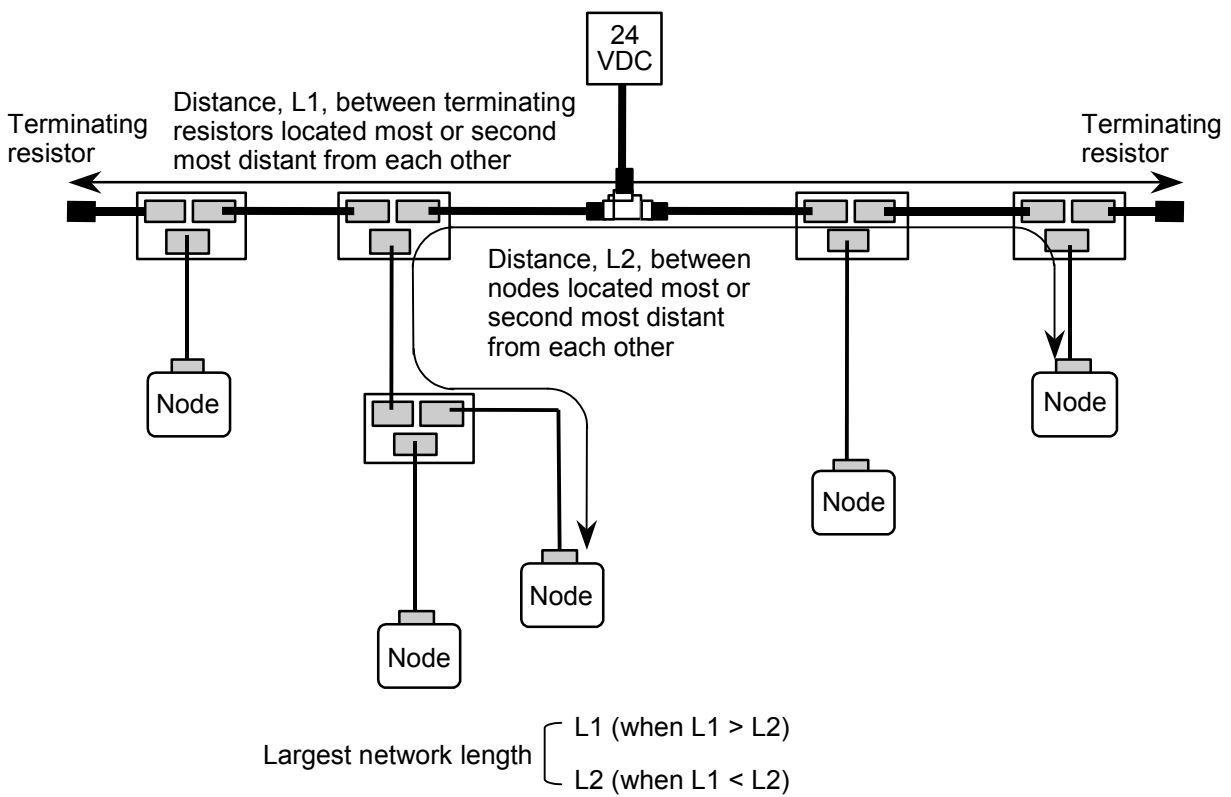


Figure 6-16 Largest Network Length

Table 6-3 Maximum Permissible Cable Lengths and Line Types

Transfer rate	Cable types used for the main line		
	Thick cable only	Thin cable only	Both thick cable and thin cable
500 kbps	100 m or shorter	100 m or shorter	$L_{THICK} + L_{THIN} \leq 100 \text{ m}$
250 kbps	250 m or shorter		$L_{THICK} + 2.5 \times L_{THIN} \leq 250 \text{ m}$
125 kbps	500 m or shorter		$L_{THICK} + 5 \times L_{THIN} \leq 500 \text{ m}$

“LTHICK” denotes the cumulative length of the thick cables; “LTHIN” is that of the thin cables.



## (2) Drop-line length

The drop-line length means the distance between the point at which a drop line branches out from the main line and the point at which the drop line ends at a node. The maximum permissible drop-line length is 6 meters, regardless of the transmission rate used, and the maximum permissible length of the power lines extending from the main line to the communication power supply is 3 meters.

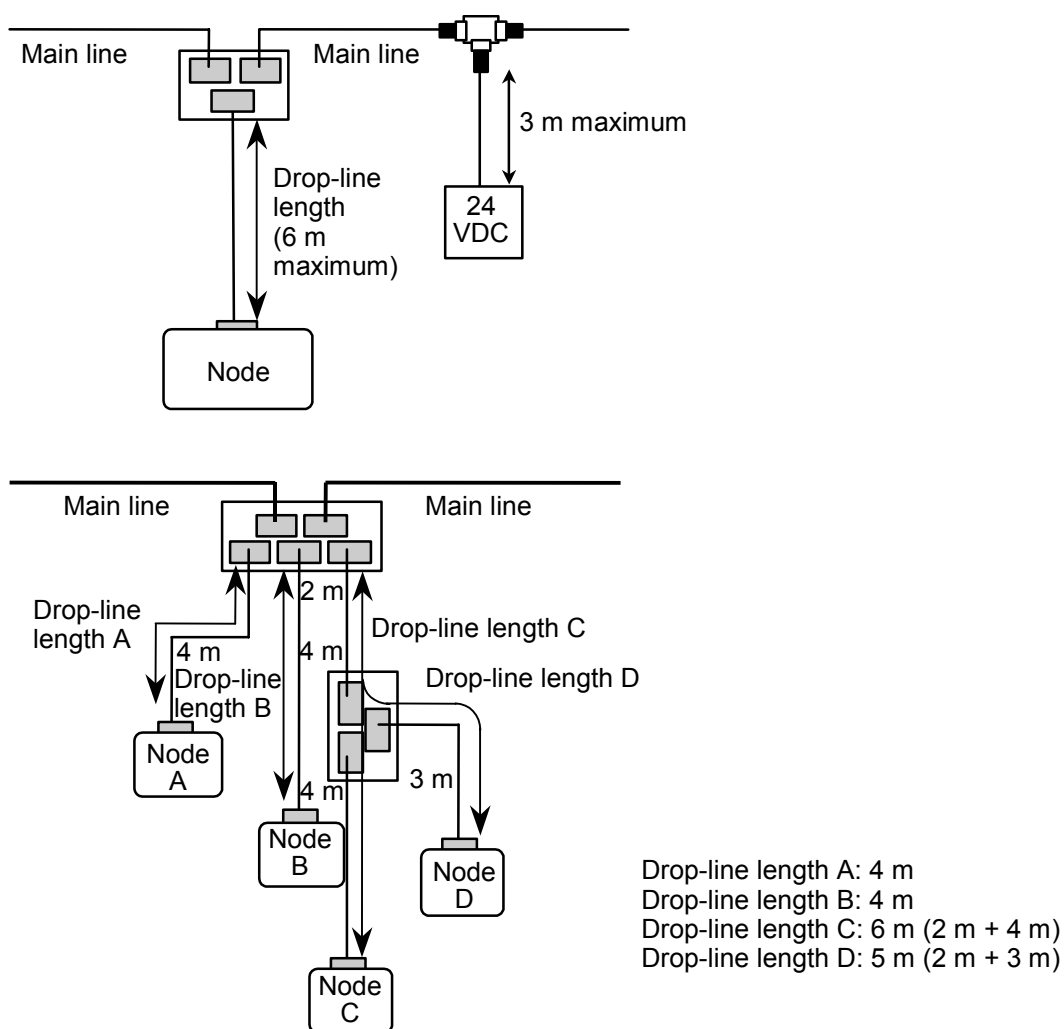


Figure 6-17 Examples of Drop-Line Lengths

(3) Total drop-line length

The total drop-line length is the sum of all drop cable lengths in the network; it is not the sum of all drop-line lengths (each from a branch tap on the main line to a node) in the network. Permissible total drop-line length differs depending on the transfer rate of the network. In the example network below, the total drop-line length is 40 meters, so the usable transfer rate is either 125 kbps or 250 kbps.

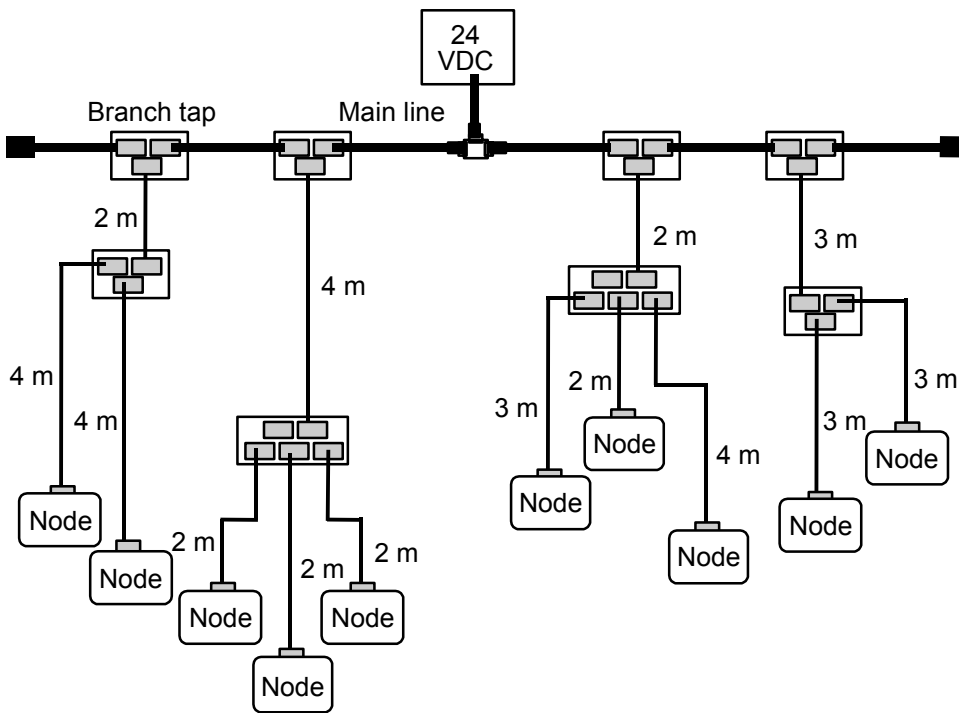


Figure 6-18 An Example of a Total Drop-Line Length

Transfer rate	Total drop-line length
500 kbps	39 m or shorter
250 kbps	78 m or shorter
125 kbps	156 m or shorter

Table 6-4 Communication Cable Specifications

Item		Main line cable (thick)	Drop line cable (thin)
Signal line	Cross-section of conductor	AWG18	AWG24
	Outer diameter of insulator	3.81 mm	1.96 mm
	Color	Blue and white	Blue and white
	Impedance	120 $\Omega \pm 10\%$	120 $\Omega \pm 10\%$
	Propagation delay	4.46 ns/m	4.46 ns/m
	Attenuation factor	500 kHz: 0.820 dB/100 m 125 kHz: 0.426 dB/100 m	500 kHz: 1.640 dB/100 m 125 kHz: 0.951 dB/100 m
	Conductor resistance	22.6 $\Omega$ /1000 m	91.9 $\Omega$ /1000 m
Power line	Cross-section of conductor	AWG15	AWG22
	Outer diameter of insulator	2.49 mm	1.40 mm
	Color	Red and black	Red and black
	Conductor resistance	8.9 $\Omega$ /1000 m	57.4 $\Omega$ /1000 m
	Maximum permissible current	8 A	3 A
Outer diameter of finished cable product		10.41 to 12.45 mm	6.10 to 7.11 mm

## &lt;Recommended cables&gt;

- Manufacturer: Hitachi Cable, Ltd.

Models		Length	Color
Main line cable (thick)	Drop line cable (thin)		
UL20276-PSX 1P $\times$ 18AWG + 1P $\times$ 14AWG	UL20276-PSX 1P $\times$ 24AWG + 1P $\times$ 22AWG	100 m	Gray
		300 m	
		500 m	

- Manufacturer: SHOWA ELECTRIC WIRE & CABLE CO., LTD.

Models		Length	Color
Main line cable (thick)	Drop line cable (thin)		
TDN18-100G	TDN24-100G	100 m	Light gray
TDN18-300G	TDN24-300G	300 m	
TDN18-500G	TDN24-500G	500 m	
TDN18-100B	TDN24-100B	100 m	Light blue
TDN18-300B	TDN24-300B	300 m	
TDN18-500B	TDN24-500B	500 m	

6.1.5 Locational consideration for the communication power supply

Generally, in DeviceNet networks, the power to each node is supplied via a 5-wire communication cable through a communication connector. Thus, when such a network is to be constructed of hardware items from Hitachi and other manufacturers, due consideration should be given to whether the power to each node can be supplied from a planned power supply location, independently of the cable length restrictions described in Subsection 6.1.4. This consideration requires prior calculation of the values listed below. However, Hitachi's S10mini products such as D.NETs (DeviceNet masters) and D.STATIONs (DeviceNet slaves) require no communication power supply to be connected to the network, provided that only D.NETs, D.STATIONs, and Optical Adapters are connected to the network. This is because they employ self-feeding.

- Current requirement (consumption) at each node
- Type (thick or thin) and length of each communication cable selected as explained in Subsection 6.1.4

First of all, confirm that the total amount of current required by all the nodes is within the capacity of the communication power supply. If it exceeds the capacity, either replace the power supply with one that has a larger current capacity, or split the power supply system into two or more subsystems, each covered by a single power supply, so that the power to the nodes will be supplied from the respective power supplies.

Secondly, check the current-carrying capacity or, simply, current capacity of cables. The current capacity of the main-line cable is 8 A (for a thick cable) or 3 A (for a thin cable). Thus, as shown below, a single communication power supply can feed a current of up to 16 A (for a thick cable) or 6 A (for a thin cable).

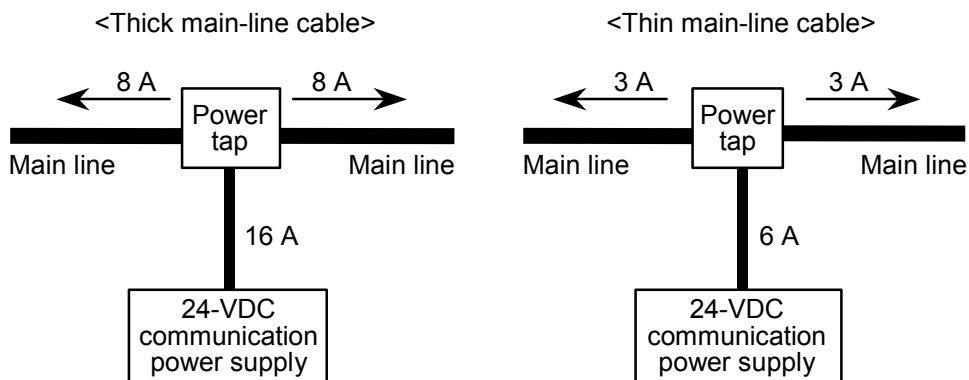


Figure 6-19 Current Capacity by Main-Line Cable Thickness

If the main line is to be constructed of thin cables only, and the total amount of current required by the nodes exceeds the current capacity of 6 A, then the requirements cannot be satisfied, no matter where the communication power supply is located. So, consider the use of thick cables instead of thin ones.

As regards a drop-line cable, its current capacity varies depending on its length and becomes smaller as the drop line becomes longer. This is true with both thick cables and thin cables. The current capacity,  $I$ , of a drip line (i.e., a total amount of current flowing in the drop line) can be calculated by solving the following equation:

$$I = 4.57/L$$

Explanatory notes:

$I$ : Current capacity (A) of the drop line

$L$ : Drop-line length (m)

( $I$  is less than 8 A for the thick cable and less than 3 A for the thin cable.)

If the current capacity of a drop line is less than the total amount of current required by the node(s) connected to the line, take the following measures:

- Reduce the drop-line length.
- If more than one node is connected to the drop line, install an addition drop line or lines to connect them.

When you have so far done your task successfully, ensure that the total amount of current required by the node(s) connected to the drop line is within the current capacity of the drop line, and determine the location of the communication power supply, or more specifically, where to connect the power supply on the main line, while taking all voltage drops in the main line into consideration. There are two ways to accomplish this:

- By using a graph.
- By calculating the voltage drops from the unit resistance of each communication cable and current requirement, according to a mathematical formula

If the result of location determination by the first method above satisfies the given conditions, the power supply can be placed at the planned location. Generally, the first method assumes a worst possible case in terms of power supply, so even if the result does not meet the given conditions, the second method above may obtain a result meeting the conditions. In such a case, the power supply can of course be placed at the planned location.

### (1) Location determination using a graph

This method enables quick and easy determination of an appropriate location for the power supply. However, care should be taken when referring to the graph. There are two different graphs provided for main-line cables, one for thick cables and the other for thin cables. Use the right graph for the main-line cable employed.

First of all, refer to the right one of the two graphs or tables on the next page, and find out the current capacity corresponding to the cable type and main-line length used. If the total amount of current required by all the nodes is within the current capacity found, then the power supply can be placed anywhere near the main line.

If the required total amount of current exceeds the current capacity found, then try the measures listed below. If none of the measures solves the problem, use the second method described in item (2) below, which takes the actual locations of the nodes into consideration and calculates the voltage drops for location determination.

- If thin cables are used in the main line, replace them with thick cables and find out the current capacity of the thick cables.
- Move the communication power supply towards the center of the main line so that the distribution of the nodes will be relatively even in respect to the power supply. Then, find out the current capacities of the left and right portions of the main line between which the connection to the power supply exists, and compare the obtained values with the total amounts of current required by the nodes at each side.
- If the distribution of the nodes is already relatively even, and the total amount of current required by the nodes at one side is greater than that at the other side, then move the power supply towards the former side along the main line and repeat the find-and-compare procedure described in the second measure above.



### **CAUTION**

Current requirement by the Optical Adapter is not included in the calculated value of the total amount of current required by the nodes, because the Optical Adapter supplies its required communication power on an individual basis (self-feeding). In addition, even if the network power lines are connected to the power terminals of the Optical Adapter, no problem will arise, because the power terminals are connected nowhere inside the product.

Table 6-5 Thick-Cable Main-Line Lengths and Current Capacities

Main-line length (m)	0	25	50	100	150	200	250	300	350	400	450	500
Current capacity (A)	8.00	8.00	5.42	2.93	2.01	1.53	1.23	1.03	0.89	0.78	0.69	0.63

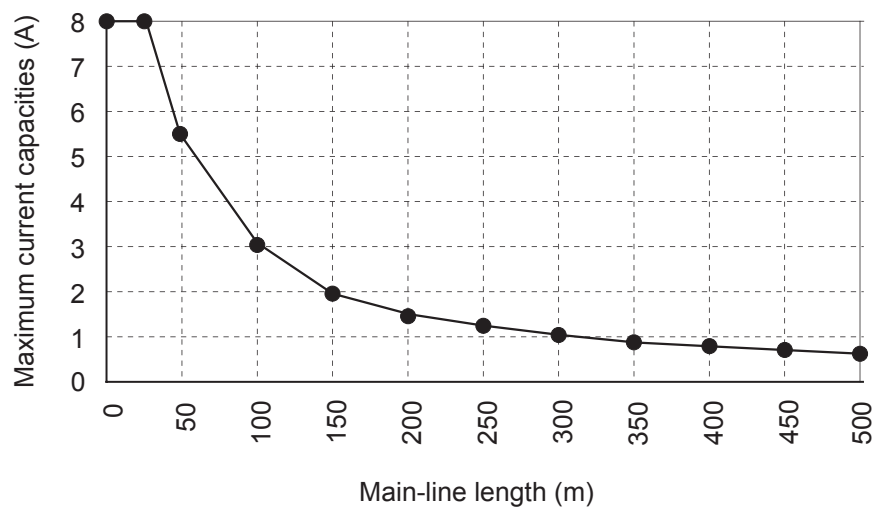
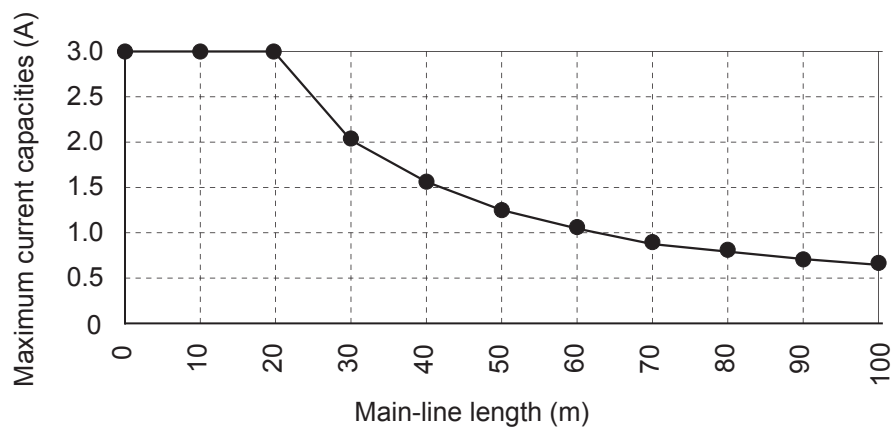


Table 6-6 Thin-Cable Main-Line Lengths and Current Capacities

Main-line length (m)	0	10	20	30	40	50	60	70	80	90	100
Current capacity (A)	3.00	3.00	3.00	2.06	1.57	1.26	1.06	0.91	0.80	0.71	0.64



<Example of location determination using a graph>

Assumes that a single power supply is connected to one end of a main line of 300 m long, and that the nodes in the network require the amounts of current shown below.

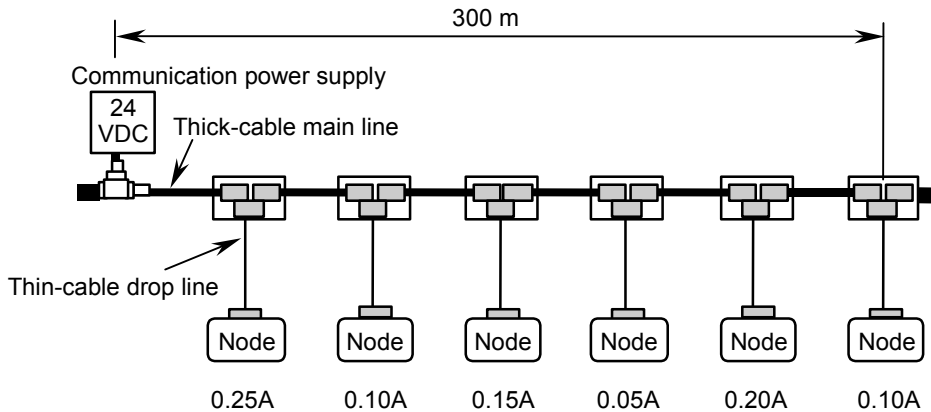


Figure 6-20 An Example of Current Requirement Calculation

Total amount of current required by the nodes:  $0.25 + 0.10 + 0.15 + 0.05 + 0.20 + 0.10 = 0.85 \text{ A}$

Total length of power line: 300 m

From Table 6-5, "Thick-Cable Main-Line Lengths and Current Capacities," the current capacity of the 300-m thick-cable line is 1.03 A. Comparing this value with the above-calculated total amount of current required, we find that the former is greater than the latter. Therefore, we can conclude that the power supply is capable of feeding power to all of the nodes.

(2) Location determination according to a mathematical formula

If the result of location determination by the first method above does not satisfy the given conditions, this second method is used, which employs a mathematical formula for calculating the voltage drops from both the unit resistance of each communication cable and current requirement -- in other words, the method calculates the voltage drops in respect to the actual locations of the nodes and power supply.

Calculation method:

In the DeviceNet standard, the maximum permissible voltage drop in each of the power lines V+ and V- of the power supply system is 5 V, as stated in the voltage specification (24 VDC) for the communication power supply and the input voltage specification (11 to 25 VDC) for the power supplies of each device used for communication purposes. For voltage drops, see the Figure 6-21.



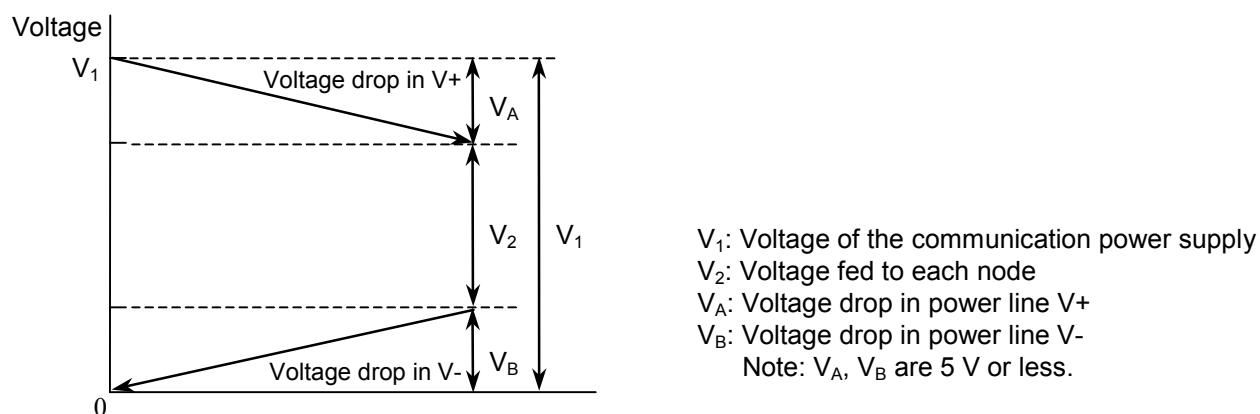


Figure 6-21 Voltage Drops

In the standard, it is also stated that the supply voltage (24 VDC) of the communication power supply be within a tolerance of 4.0%. Thus, we set  $V_1$  voltage equal to 23 V in consideration of a margin. Since the voltage drops in the power lines V+ and V- must be within 5 V, the voltage,  $V_2$ , fed to each node is therefore less than or equal to 13 V. This value has a margin, compared with the minimum permissible supply voltage of 11 V that can be fed to each node. Given the maximum permissible voltage drop of 5 V in each power line, we can calculate the maximum permissible voltage drops in the main line and a given drop line in the following way:

- Calculation of the maximum permissible voltage drop in the drop line

If the maximum permissible drop-line length of 6 m is used, the current,  $I$ , to flow into the drop line can be calculated by solving the equation to find the current capacity:

From the known maximum permissible unit resistance,  $0.069 \Omega/\text{m}$ , of the thin cable, the resistance,  $R$ , of the maximum permissible drop-line length can be calculated as follows:

$$I = 4.57 / 6 = 0.761 \text{ (A)}$$

Thus, the maximum permissible voltage drop,  $IR$ , in the drop line is as follows:

$$R = 0.069 \times 6 = 0.414 \text{ } (\Omega)$$

Taking a margin into consideration, we choose 0.33 V as the maximum permissible voltage drop in the drop line.

$$IR = 0.761 \times 0.414 = 0.315 \text{ (V)}$$

- Calculation of the maximum permissible voltage drop in the main line

Since it is stated in the standard that the maximum permissible voltage drop in each of the power lines (V+, V-) be 5 V, the maximum permissible voltage drop in the main line can be obtained in the following way:

The second method of location determination according a mathematical formula is based on the above-calculated maximum permissible voltage drop in the main line. This is shown below.

- Mathematical formula involving the maximum permissible voltage drop in the main line

$$\Sigma (L(n) R(c) + N(t) \times 0.005) \times I(n) \leq 4.67$$

Explanatory notes:

L(n): Distance between the communication power supply and each node. (Excluding the drop-line length.)

R(c): Maximum permissible unit resistance of the cable. (This resistance is 0.015  $\mu$ /m for the thick cable and 0.069  $\mu$ /m for the thin cable.)

N(t): Number of branch taps existing between the communication power supply and each node.

I(n): Amount of current required by the communication circuitry of each node.

0.005  $\Omega$ : Contact resistance value of a tap.

As far as the above condition is satisfied, the power supply at the planned location can feed power to every node, provided that the total amount of current required by the nodes does not exceed the current capacity of the main-line cable (8 A for the thick cable and 3 A for the thin cable). If the condition is not satisfied, take the following measures:

- If thin cables are used in the main line, replace them with thick cables and re-evaluate the formula by substituting new values.
- Move the communication power supply towards the center of the main line so that the distribution of the nodes will be relatively even in respect to the power supply. Then, re-evaluate the formula by substituting new values for the left and right portions of the main line between which the connection to the power supply exists.
- If the distribution of the nodes is already relatively even, and one of the two sides does not meet the condition, then move the power supply towards that side along the main line and re-evaluate the formula by substituting new values for both sides.
- Move close to the communication power supply those nodes that require a relatively large amount of current, and re-evaluate the formula by substituting new values.

If the condition is still not fulfilled after all the above measures have been taken, split the power supply system into two or more subsystems, each covered by a single power supply, so that the power to the nodes will be supplied from the respective power supplies.

<Example of location determination using a mathematical formula>

Suppose that a network has a single power supply connected to the center of a main line of 240 m long (120 m from each end to the center), and that its nodes have current requirements as shown below.

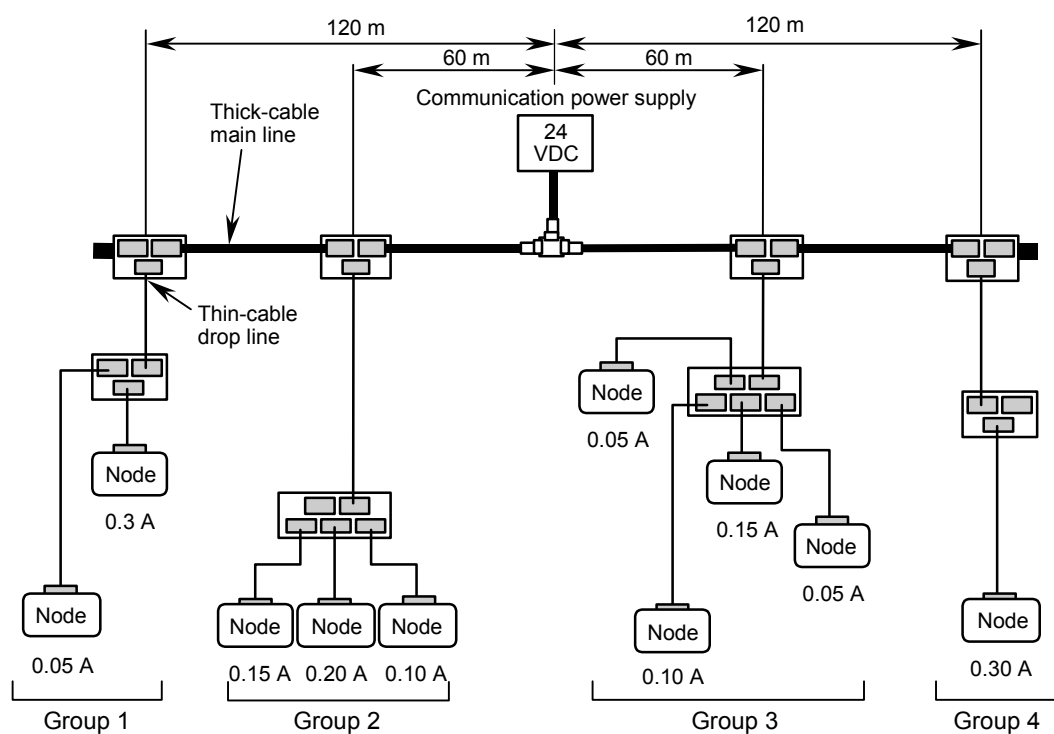


Figure 6-22 An Example of Voltage-Drop Calculation

Then, by substituting given values in the left side of the formula, we find voltage drops for each group:

For the left half of the main line:

$$\text{Group-1 voltage drop: } (120 \times 0.015 + 2 \times 0.005) \times 0.35 = 0.634 \text{ V}$$

$$\text{Group-2 voltage drop: } (60 \times 0.015 + 1 \times 0.005) \times 0.45 = 0.407 \text{ V}$$

$$\text{Sum of the voltage drops: } = 0.634 + 0.407 = 1.041 \text{ V}$$

For the right half of the main line:

$$\text{Group-3 voltage drop: } (60 \times 0.015 + 1 \times 0.005) \times 0.35 = 0.317 \text{ V}$$

$$\text{Group-4 voltage drop: } (120 \times 0.015 + 2 \times 0.005) \times 0.30 = 0.543 \text{ V}$$

$$\text{Sum of the voltage drops: } = 0.317 + 0.543 = 0.860 \text{ V}$$

From the obtained sums, we can conclude that, since the left and right halves of the main line satisfy the condition, the power supply is capable of feeding power to all of the nodes.



### CAUTION

When the power supply system is split into two or more subsystems so that the power to the nodes will be supplied from the respective power supplies, evaluate the formula for each subsystem and ensure that each subsystem can feed power to the corresponding group of nodes.

### 6.1.6 Grounding specification

The transmission paths in a network must be collectively grounded at a single point, and all the internal communication circuitries of the nodes connected to the paths must be isolated from their other internal circuitries so that the former circuitries will be collectively grounded only at that point. Where more than one power supply is used in a network (for instance, self-feed power supplies and power supply subsystems), one of the power supplies must be selected in order to ground all the transmission path drain wires and V- lines via that power supply. This is shown in the diagram below.

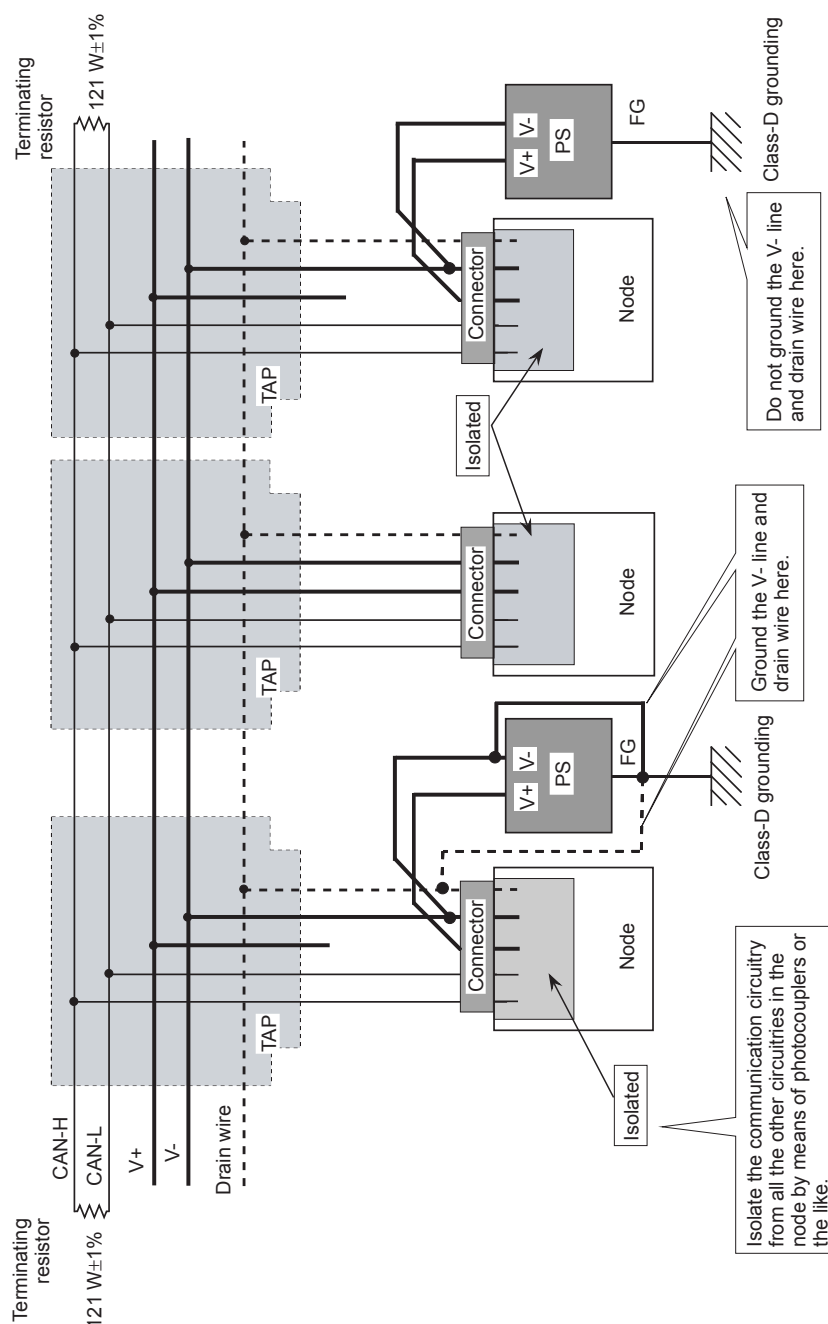


Figure 6-23 An Example of a Grounding Specification

## 6.2 Optical Cable Connection

### 6.2.1 Connection method

To connect the optical cable to the optical module (OPT) of an Optical Adapter, remove the cap from the OPT module at the front of the adapter, and then connect it, with the connector retainer facing up, as shown below. (The connector will not click into place in any other orientation.)

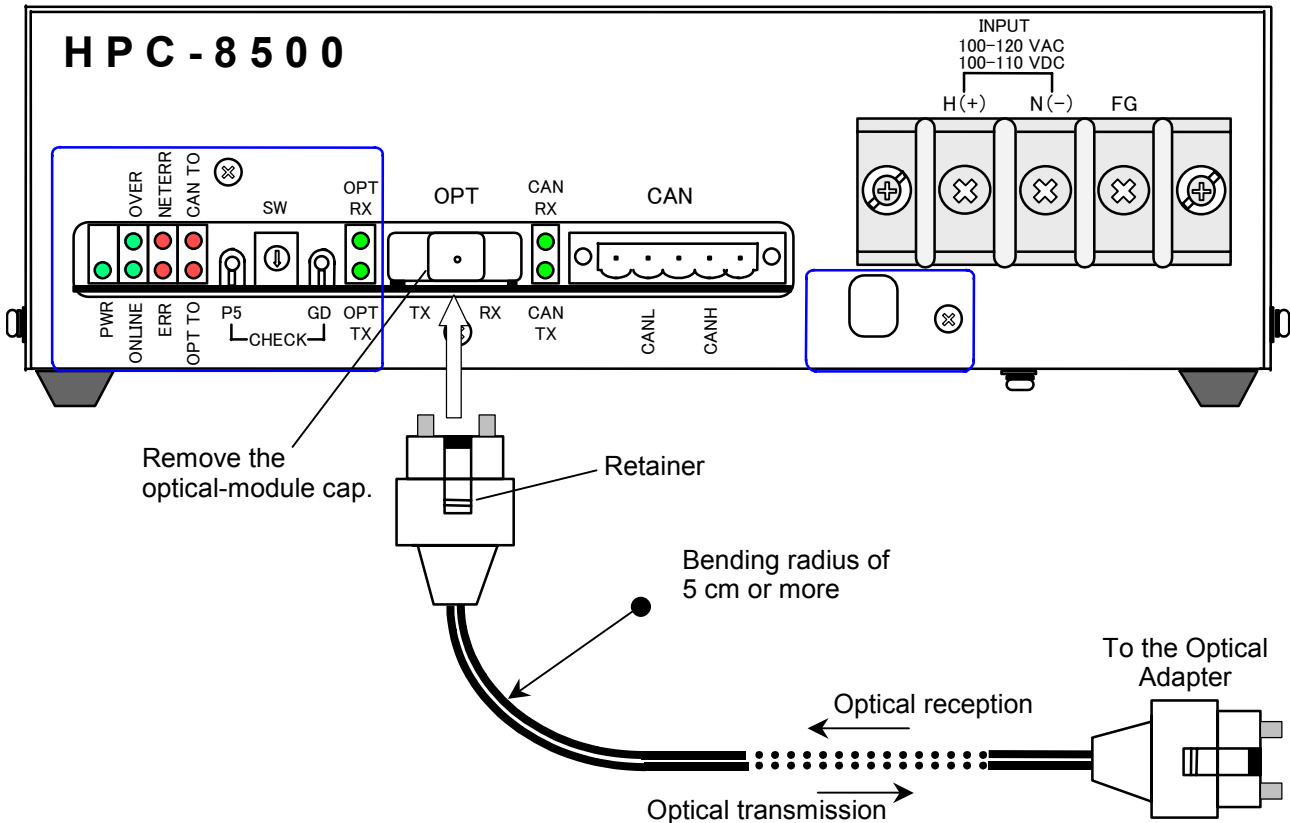


Figure 6-24 Optical Cable Connection

### CAUTION

- Before connecting and disconnecting the cable from the module, be sure to turn OFF the power to the Optical Adapter and all existing DeviceNet devices, as well as the communication power supplies.
- Check the connection of the optical connector periodically (every 3 to 6 months).
- When the optical module is not in use, cover its connector with the cap.
- Do not pull the optical cable with excessive force. Disregarding this rule may result in connector disconnection or cable breakage.
- Do not place a heavy object on the optical cable. Disregarding this rule may result in cable breakage.

## 6.2.2 Components

### (1) Optical module specifications

Table 6-7 Optical Module Specifications

Item	Specifications
Operating voltage	5 V $\pm$ 0.25 V
Operating temperature	-20 to +70°C
Storage temperature	-20 to +75°C
Flashing operation	ON when the input signal is high. OFF when the input signal is low.
Transmission rate	DC to 4 Mbps
Fiber-coupled optical power output	-15 to -18 dBm
Light reception level	-15 to -29 dBm
Peak light emission wavelength	880 nm average
Resistance to electromagnetic induction noise	8500 V/m minimum

### (2) Optical cable specifications

<Recommended cable>

Manufacturer: Sumitomo Electric Industries, Ltd.

Cable-ordering designation: 2001H-MM-L DCV-HC-20/07

(Note: L is a cable length in meters.)

Table 6-8 Optical Cable Specifications

Item	Specifications
Product name	2-fiber H-PCF cord
Type of optical fiber	Plastic-clad multimode fiber
Core	Quartz glass, 200 $\mu$ m $\pm$ 5 $\mu$ m, noncircularity of 6% or less.
Cladding	Fluorinated acrylate resin, 230 $\mu$ m, deviation from center, 6 $\mu$ m or less
Numerical aperture (NA)	Approx. 0.4
Inner jacket	Fluororesin, 0.5 mm $\pm$ 0.1 mm
Reinforcing material	High-tensile aromatic fiber
Outer jacket	Heat-resistant PVC (black), 2.2 mm $\pm$ 0.2 mm $\times$ 4.4 mm $\pm$ 0.4 mm
Approx. mass	8 kg/km
Cord identification	Marking on one of the two cords
Transmission loss (880 nm)	7 dB/km maximum

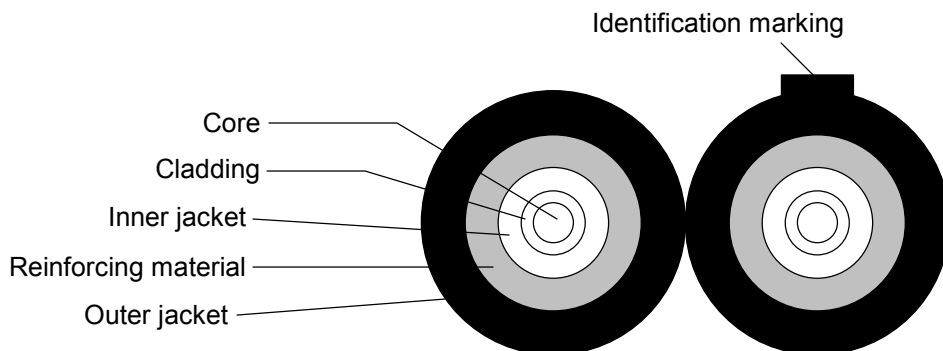


Figure 6-25 Cross-Section of the Optical Cable

(3) Optical cable connector

<Recommended connector>

Manufacturer: Sumitomo Electric Industries, Ltd.

Model: CF-2001H

Table 6-9 Optical Cable Connector Specifications

Item	Specifications
Product name (Symbol)	CF-2001H (2001H)
Cable splice loss (880 nm)	Standard: 1.0 dB (at one location) Maximum: 2.0 dB (at one location)



## 6.3 Power Supply Wiring

### 6.3.1 Wiring method

When wiring the power cable to this product, be sure to remove the protection cover from the terminal block (TB). After the cable has been wired to the TB, be sure to attach the cover to the TB.

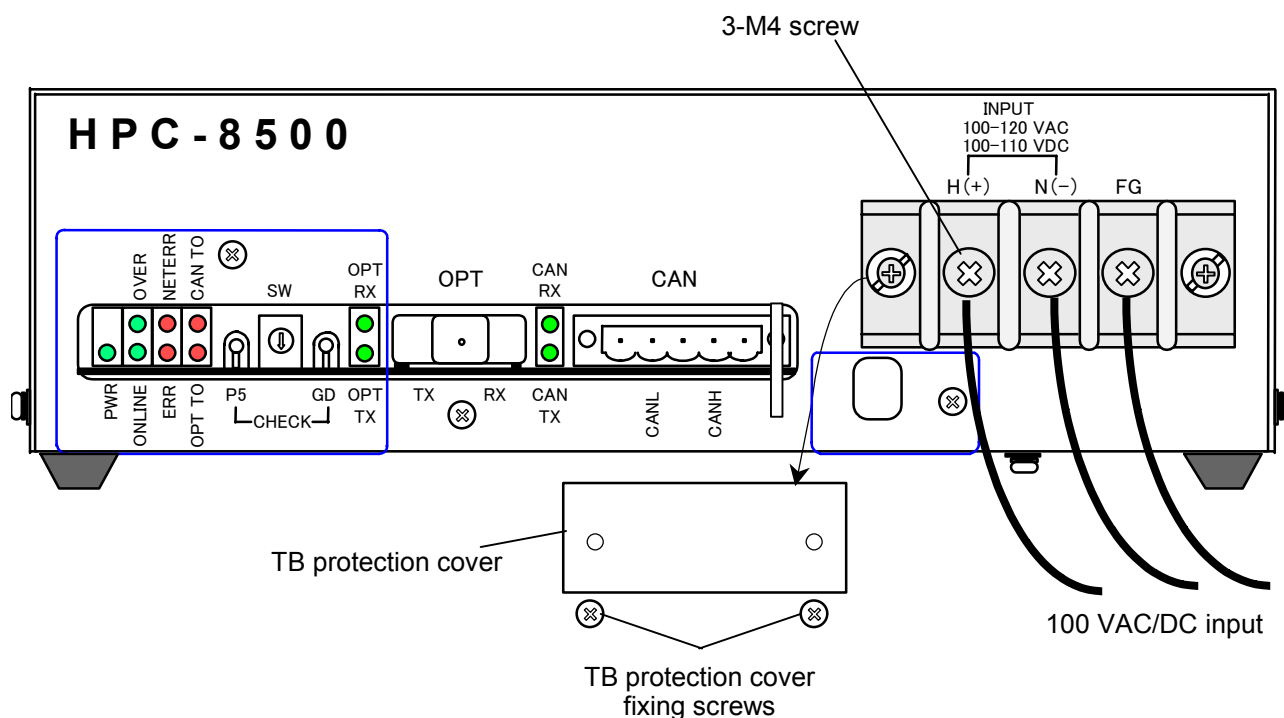


Figure 6-26 Power Supply Wiring

Table 6-10 Power Supply Terminals

Terminal name	When used in AC input	When used in DC input
H (+)	AC input	Positive electrode
N (-)	AC input	Negative electrode
FG	Equivalent to the ground point for external power supply. Used as the frame ground for the Optical Adapter.	(Unused)

6.3.2 Optical Adapter grounding specification

The Optical Adapter must be grounded in either of the following two ways:

(A) Grounding used when the Optical Adapter is not mounted in the system panel cubicle or the like

(B) Grounding used when the Optical Adapter is mounted in the system panel cubicle or the like

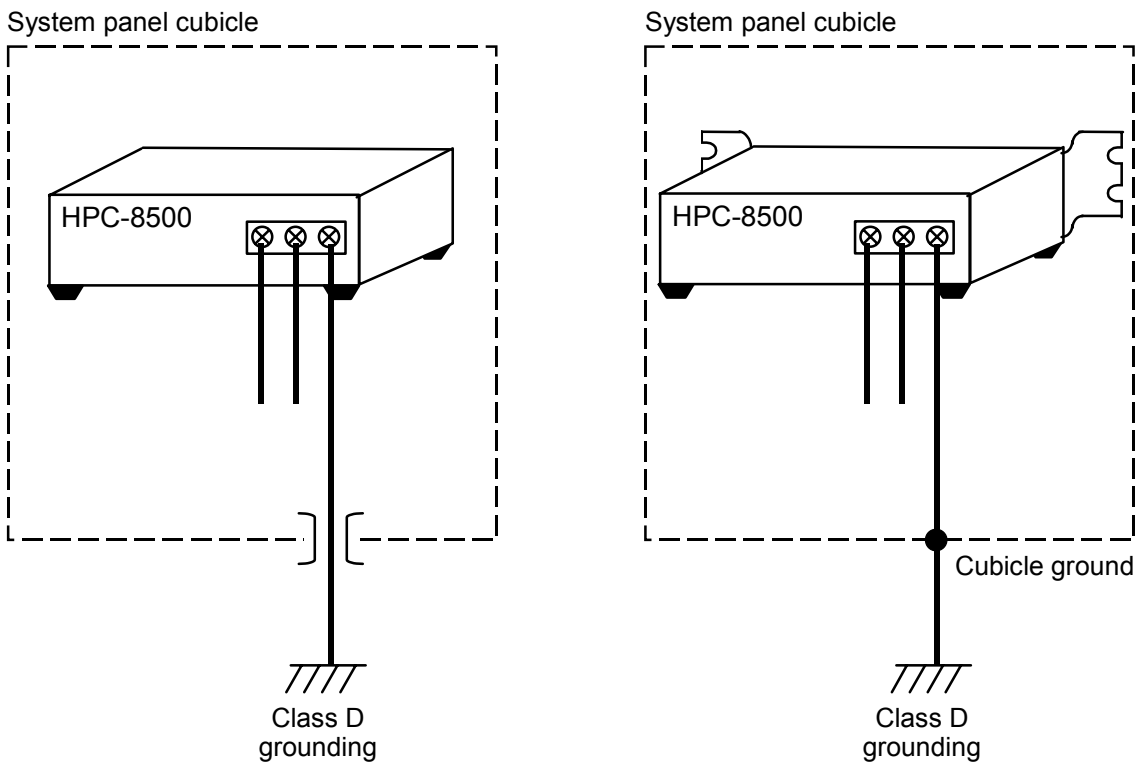


Figure 6-27 Optical Adapter Grounding

 **CAUTION**

- Keep it in mind that this product is powered from a high-voltage power supply. If the user touches a high-voltage terminal inadvertently during connection or disconnection of this product or its cable, he or she may suffer from an electric shock. Be sure to turn OFF the power to the product before connecting or disconnecting the cable.
- Correctly wire the cable to the Optical Adapter. Wiring it to wrong terminals on the TB may result in damage to the product.
- Ground the Optical Adapter by Class D grounding or better.

# 7 MAINTENANCE

### 7.1 Preventive Maintenance

For optimum use of the Optical Adapter, it is essential that you carry out the following maintenance daily or periodically (two or more times a year).

Maintenance item
Adapter appearance check
Fixing-screw, Adapter internal-screw, etc. check for looseness
Cable/wire jacket check
Dust accumulation check
Supply voltage check (100 V to 120 VAC, 100 V to 110 VDC)
Power supply voltage fluctuation ranges: 85 V to 132 VAC, 85 V to 132 VDC.
Indicator indication check
5-V supply voltage check

- Adapter appearance check  
Check to see if the Optical Adapter’s casing has a sign of rusting and corrosion. If the casing has such a problem, the internal circuit may have been damaged and, in such a case, may lead to system malfunction.
- LED indicator indication check  
Observe indications on the LED indicators and check the indicators for abnormality.
- Fixing-screw, TB-screw, connector-screw, etc. check for looseness  
Check if the Optical Adapter fixing screws, TB screws, connector screws, etc. are loose. Any loose screws must be tightened because this may cause the system to malfunction or some of the components to burn out due to generated heat.
- Adapter replacement  
Hot swapping of the Optical Adapter may result in damage to the hardware and software. Be sure to turn OFF the power to the product before replacement.
- Cable/wire jacket check  
Check if the cable and wire jackets are in good condition. Any peeled or damaged cable or wire jacket may result in system malfunction, electric shock, or shorting-caused component burnout.
- Dust accumulation check  
Check if dust or other foreign matter is accumulated on the Optical Adapter. If any dust or foreign matter buildup is found, remove it with a vacuum cleaner. Allowing dust or foreign matter buildup may lead to short in the internal circuitry or a component burnout.

- Supply voltage check

Check that the voltages of the external power supply for the Optical Adapter are within the specified ranges. Any supply voltage outside its specified range may result in system malfunction.

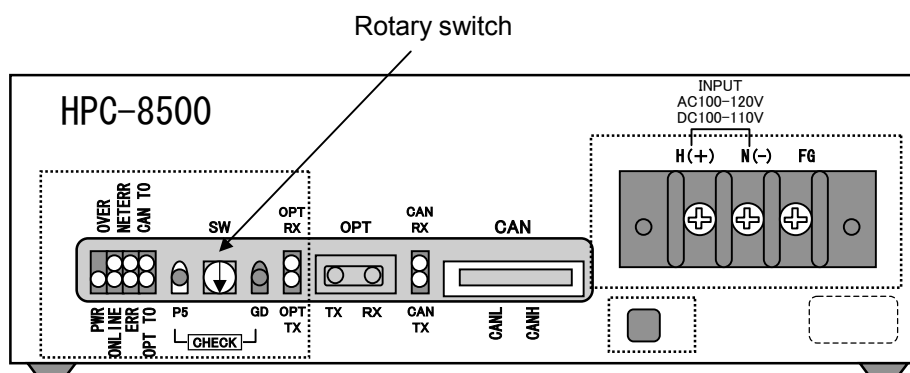
**CAUTION**

Static electricity accumulated on your body may damage the Optical Adapter. Before working on the product, be sure to discharge the static electricity.

### 7.1.1 Replacing or adding on the module

- What you should get in preparation

- ① New or add-on OPT.D-NET (model HPC-8500)



- Replacement procedure

- ① Write down, on a piece of paper, the current setting of the rotary switch (SW) that is installed at the front side of the HPC-8500 module to be replaced.
- ② Turn off the power to the module to be replaced.
- ③ Disconnect all of the power cable, OPT cable, and CAN cable from the module to be replaced.
- ④ Replace the module with the new one. Then, set the new module's rotary switch in the same position as the one you wrote down in Step ①.
- ⑤ Connect all of the power, OPT, and CAN cables that you disconnected in Step ③ to the new module.
- ⑥ Turn on the power to the new module, and check that it is running normally.

## 7 MAINTENANCE

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- Add-on procedure

- ① Ensure that your application system has been shut down, and mount the add-on HPC-8500 module in place according to the instructions given under “5.1 Mounting Clearances” and those under “5.3 Securing the Optical Adapter.”
- ② Set the add-on module’s rotary switch, installed at its front side, in the desired position.
- ③ Connect all of the power, OPT, and CAN cables to the add-on module.
- ④ Turn on the power to the add-on module and check that it is running normally.

## 7.2 Test & Maintenance (T&M) Program

The Test & Maintenance program (hereinafter simply called the T&M program) is a test tool for checking and maintaining the Optical Adapter. The program is pre-stored in the product, so you can execute the program by performing the simple steps: (1) select two Optical Adapters directly communicating with each other, (2) turn the rotary switches to proper positions, and (3) turn OFF the power to the products and then back ON again.

### NOTE

Before performing T&M, ensure that you are using an appropriate hardware arrangement for the purpose (see Figure 7-1).

### 7.2.1 T&M program for hardware diagnosis

The T&M program for hardware diagnosis is capable of checking the communication capabilities of the Optical Adapters.

#### (1) Details of hardware checking by the T&M program

The T&M program performs hardware checking in the following way: it transmits data from the OPT side of the Optical Adapter set in T&M mode, receives the data at the CAN side, and compares the received data with the original data. This transmit-receive-and-compare procedure is repeated at regular intervals of 0.5 seconds, and the online condition indicator (green) stays ON during each CAN-side transmission and stays OFF during each OPT-side transmission. If an error occurs in a CAN-side transmission, the error (ERR) LED indicator comes on in the next OPT-side transmission, thus enabling you to identify which side is abnormal from the indicator ON-OFF pattern. This will be detailed later in item (4).

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### (2) Hardware arrangement for T&M

As shown below, connect terminating resistors to each of the two TBs in order to terminate the DeviceNet cable. For information on the TBs and how to install terminating resistors, see Figures 6-8 and 6-9.

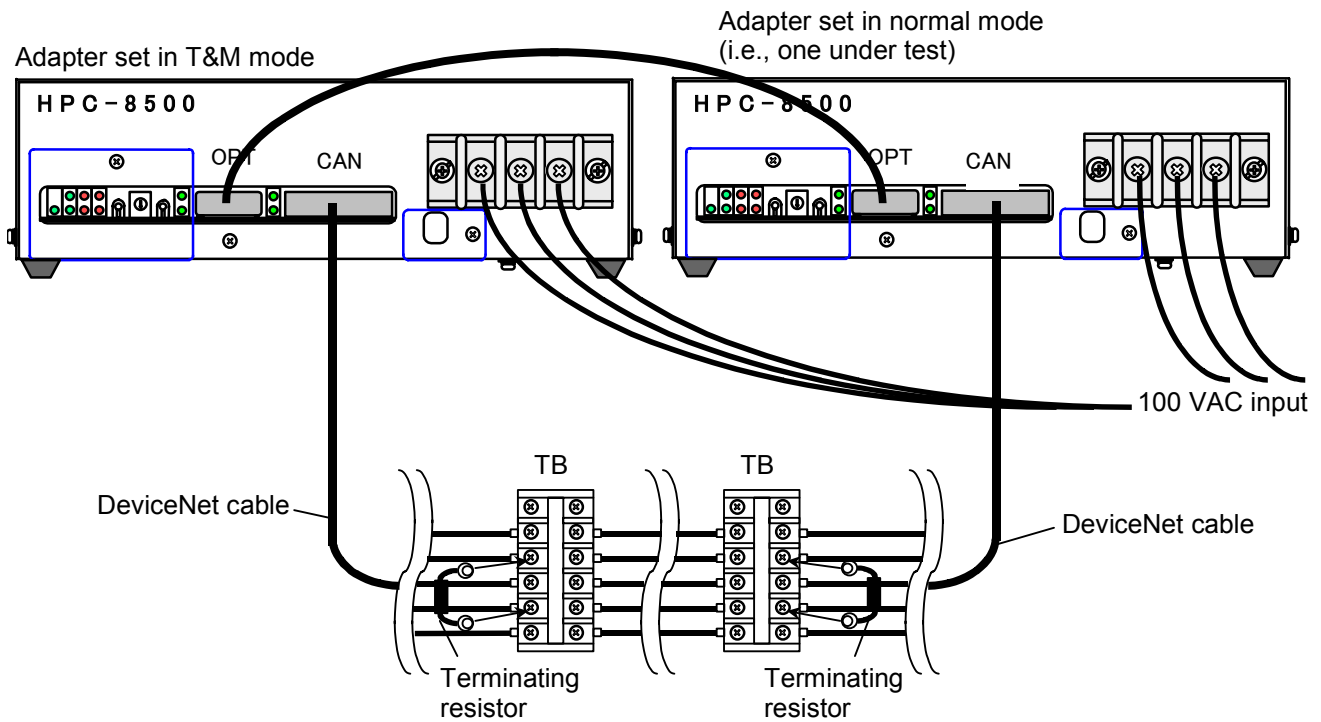


Figure 7-1 Hardware Arrangement for T&M

### (3) T&M program execution method

#### ● Cable and wire connection

Connect the cables and wires to the product, as shown in Figure 7-1, “Hardware Arrangement for T&M.”

#### ● Rotary-switch setting

To execute the T&M program, turn the rotary switches of the two Optical Adapters to the positions listed below. Before operating the rotary switches, be sure to turn OFF the power to the products.

- To set the adapter in T&M mode, turn the switch to F.
- To set the adapter in normal node, turn the switch to 2.

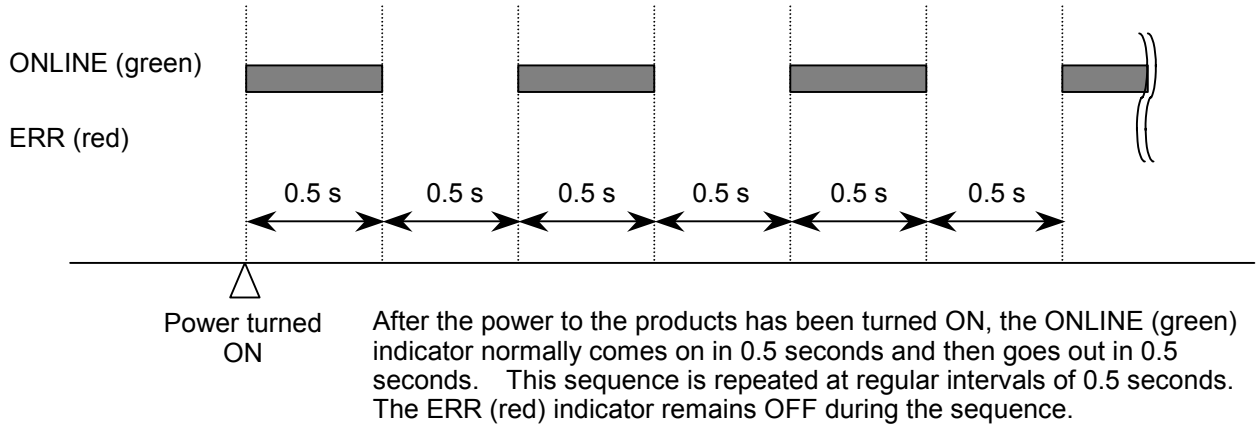
#### ● Program execution

To execute the T&M program, turn OFF the power to the products and then back ON again. Be sure to turn ON the Optical Adapter to be used in normal mode before that to be used in T&M mode.



(4) Operation of the T&M program

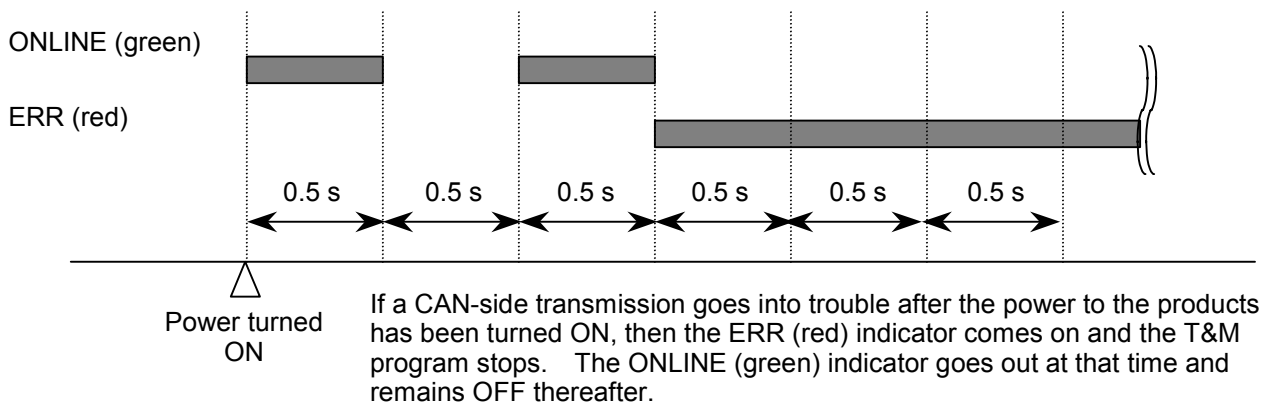
- Operation when the hardware is running normally



- Operation when a hardware abnormality occurs

If both Optical Adapters go into trouble, then the T&M program will terminate by following either of the two patterns shown below.

- CAN-side transmission in trouble



- OPT-side transmission in trouble

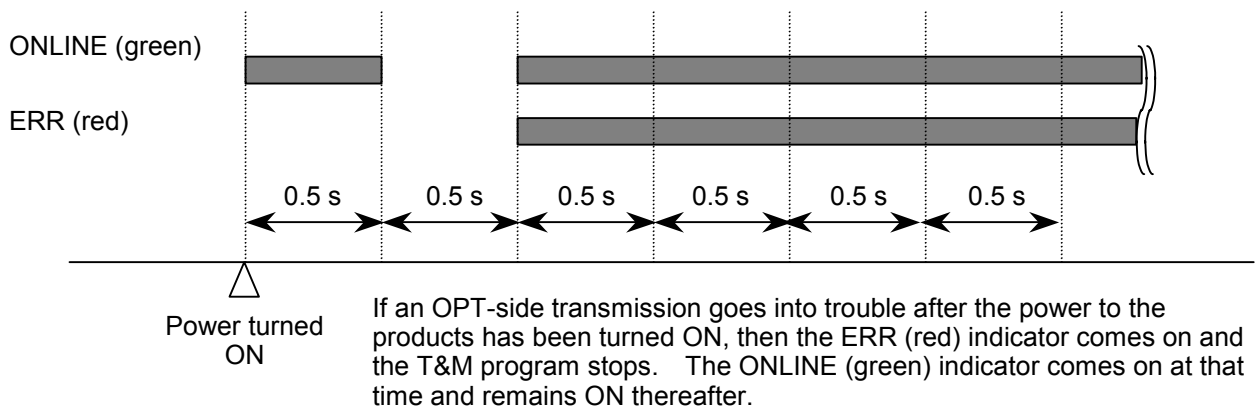
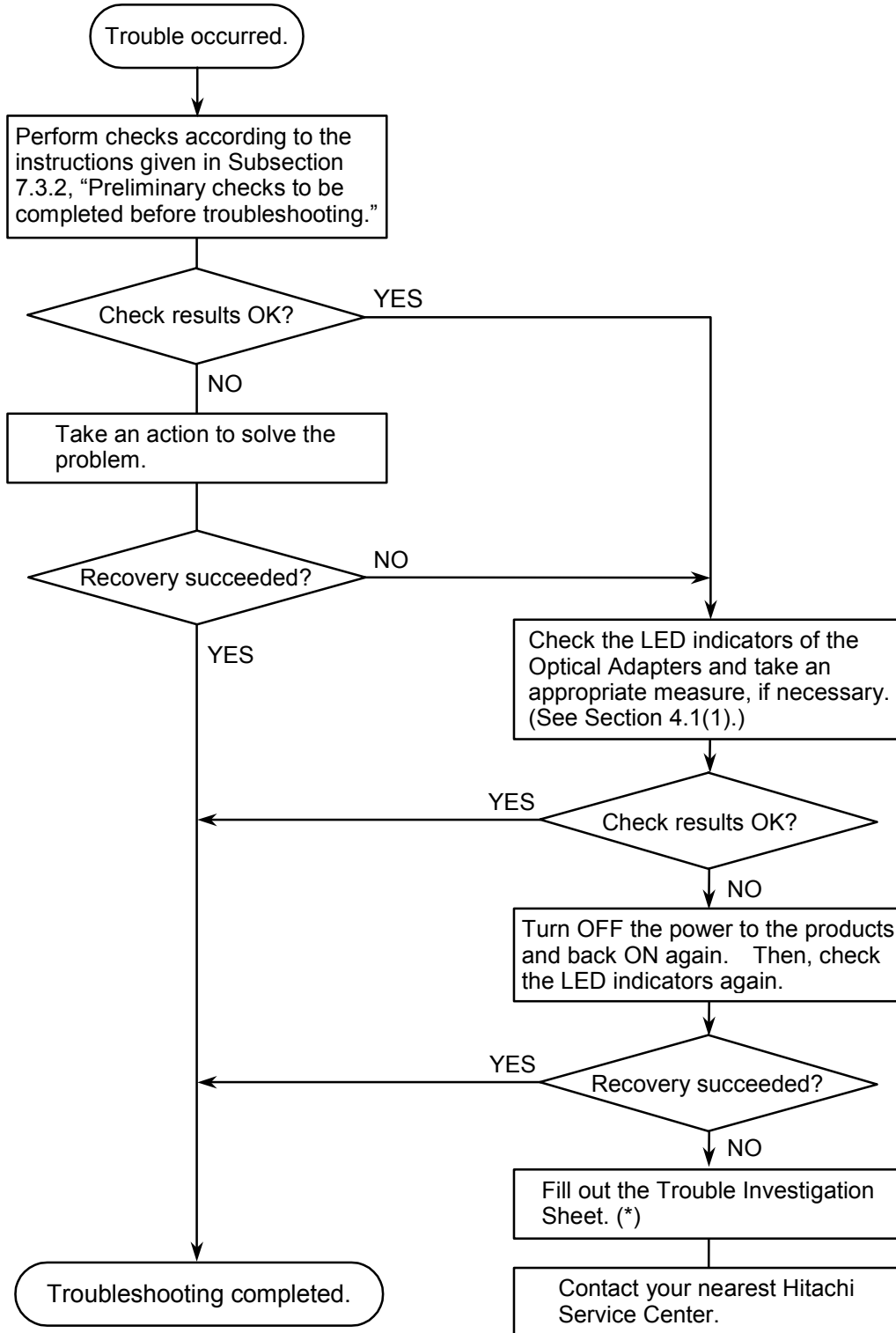


Figure 7-2 Indications on the LED Indicators during T&M Operations

7.3 Troubleshooting

7.3.1 Procedure



(\*) Use the Troubleshooting Investigation Sheet given in Section 8.2.

### 7.3.2 Preliminary checks to be completed before troubleshooting

(1) Possible causes of an Optical Adapter unable to transmit

The table below lists all conceivable possible causes of an Optical Adapter unable to transmit. If any one of the possible causes is true, take the corresponding remedial action described below.

Possible cause	Remedial action
The Optical Adapter does not agree with the master node in transmission rate.	Select the same transmission rate as for the master node.
The buffer has overflowed due to overload, resulting in some frames discarded.	Alter the system design according to the information provided in Subsection 3.1.3, "Performance," so that the maximum permissible number of frames underway at a particular moment will not be exceeded.
No communication power is being fed to the network. Although the Optical Adapters do not require such power, DeviceNet products from other manufacturers require it.	Connect the communication power supply to the network.
Although communication power is being fed to the nodes, the entire current requirement is beyond the capacity of the communication power supply.	See Subsection 6.1.5, "Locational consideration for the communication power supply," and solve the problem according to the instructions given therein.
The maximum permissible cable length has been exceeded.	<ul style="list-style-type: none"> <li>• See Subsection 6.1.4, "Restrictions on cable lengths," and reduce the cable length.</li> <li>• The maximum permissible optical cable length is 1 km.</li> </ul>
A terminating resistor is not connected to the main line.	See Subsection 6.1.3(4), "Terminating resistor," and connect a terminating resistor to it.
The connector connection to one of the Optical Adapters is loosened.	Ensure that the connectors are properly connected.
The CAN-H or CAN-L cable is loosely attached to a connector.	Ensure that the cable is properly attached to the connectors.
Input voltage is beyond its specified value.	Reduce the input voltage below the specified upper limit.

(2) Is the cabling normal?

Check if there is a disconnected cable or erroneously connected cable among the cabling.

(3) Is grounding made correctly?

- Ground any high-voltage electrical machines separately from the network.
- Ground the Optical Adapters by Class D grounding or better.

### 7.3.3 Optical power level measurement

Figure 7-3 shows the equipment arrangement required for optical power level measurement.

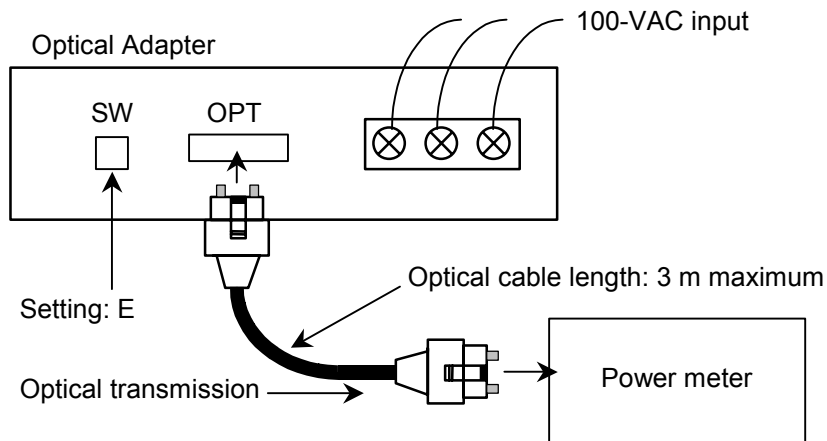


Figure 7-3 Equipment Arrangement for Optical Power Level Measurement

Perform the following procedure in order to measure the level of optical power:

- **Setting the rotary switch**  
Turn OFF the power to the Optical Adapter and turn the rotary switch to the following position:  
Rotary switch setting: E (optical signal output with a 100% duty cycle)
- **Connecting the optical cable**  
As shown above, connect one end of the optical cable (3 m long or shorter) to the Optical Adapter and the other end to the power meter.
- **Measuring the power level**  
Turn ON the power to the Optical Adapter and obtain a meter reading. Then, check if the measured value is within the following range:  
-15 dB to -18 dB

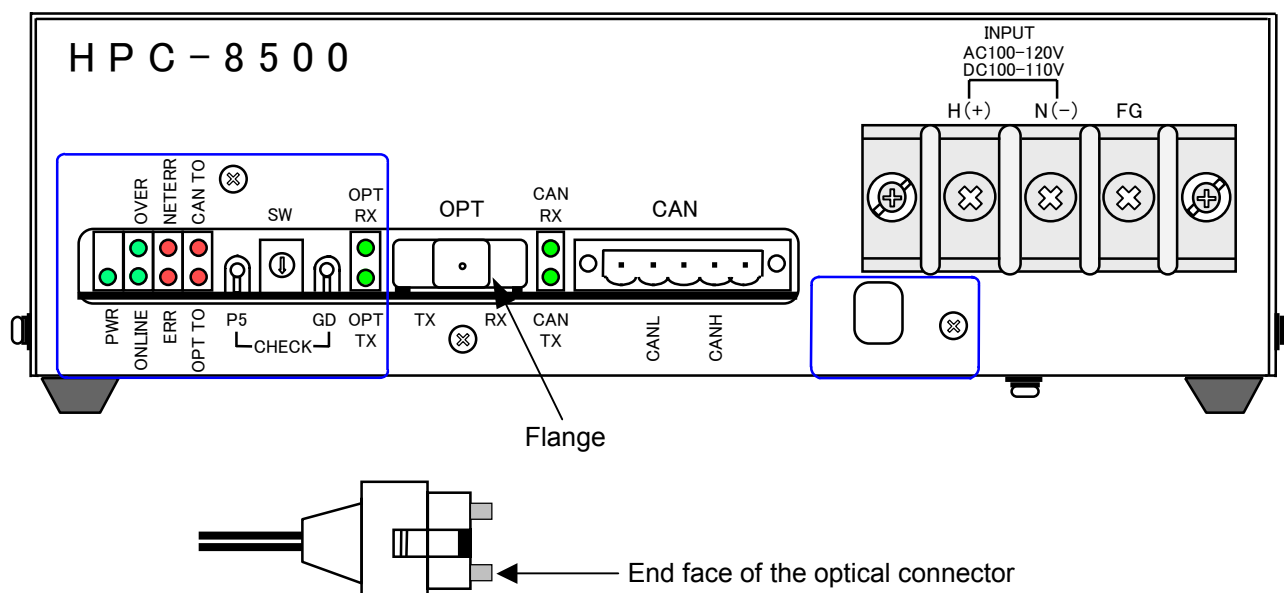
### 7.3.4 Cleaning the Optical Adapter/optical connector

Any dust adhering to the end faces of the Optical Adapter flange or optical connector when mounting or dismounting the optical connector will cause communication failure. Therefore, before mounting or dismounting the optical connector, be sure to perform the following:

Optical Adapter: Use a dust blower to blow off any dust on the flange.

Optical connector: Use an absorbent gauze dipped in alcohol or use to wipe clean the end face of the optical connector.

For how to use the dust blower, see (1) below.



#### CAUTION

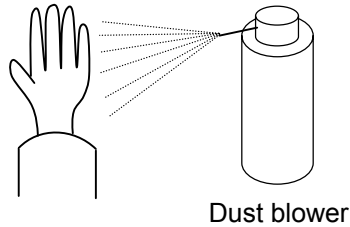
Network communication devices cannot be guaranteed when there is any dust adhering to the end faces of the Optical Adapter flange and optical connector. Therefore, before mounting or dismounting the optical connector, be sure to clean the end faces of the Optical Adapter flange and optical connector.

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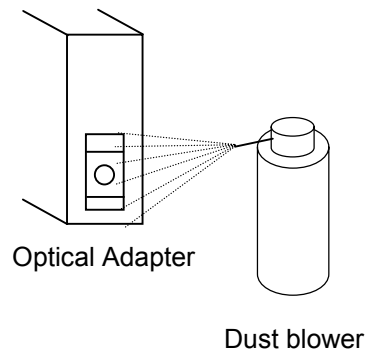
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### (1) How to use the dust blower

- ① Before using the dust blower on the Optical Adapter, blow air against the palm of your hand for 1 or 2 seconds to confirm that no water drips out from the nozzle.

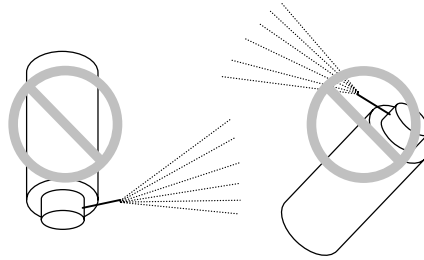


- ② While holding the dust blower can upright, blow air into of the Optical Adapter flange with the end of the nozzle 2 to 3 cm from the Optical Adapter. At this time, be careful not to bring the end of the nozzle too close to inside the Optical Adapter flange.



### **NOTE**

When the cap of the Optical Adapter is dusty or dirty, use the dust blower to clean it in the same way as described above.

**CAUTION**

Be sure to use the dust blower while keeping the can standing upright.  
Do not use it in upside-down or at an angle. (Otherwise, misty air will blow out.)  
Do not use the dust blower on a person's face.

# 8 APPENDIX



8.1 Installation Checklist

Table 8-1 Installation Checklist

Component	Item	Description	Result
Optical Adapters	Rotary switch	Check if every switch setting is in conformity with the system design.	
	Casing	Check if any fixing screw is loosened.	
DeviceNet cabling	Cable length	Check if the total network cable length and drop-line length are within the limits specified for the transmission rate. (See Section 6.1, "DeviceNet Cabling.")	
	Cabling environment	Check if all the network cabling is isolated from induction noise sources such as motor lead cables.	
	Current capacity	Check if the current flowing in each cable is within the permissible limits. (See Section 6.1, "DeviceNet Cabling.")	
	Cable specification	Check if the cables used are all specified ones. (See Section 6.1, "DeviceNet Cabling.")	
Optical cables	Cable specification	Check if the optical cables used are all conforming ones as specified in Subsection 6.2.2, "Components."	
	Cable specification	Check if every cable length is 1 km or shorter.	
	Cable connections	Check if every optical cable is connected properly.	
Input power supplies	Voltage value	Check if every input voltage value is within the specified limits.	
	Wiring	Check if all the power wires are connected properly to the TBs.	
	TB	Check if any screws on the TBs are loosened.	
Connectors	Voltage value	Check if all the cable wires (distinguishable by their colors) are connected to the right terminals. (See Section 6.1, "DeviceNet Cabling.")	
	Shielded-type connector	Check if every shielded-type connector is inserted completely in place and secured with non-slanted fixing screws.	
	Open-type connector	Check if, when attaching open-type connectors to every cable, solderless terminals are crimped on all the end portions of the cable wires. Check, also, if every terminal screw on the connectors is firmly tightened with a tightening torque of about $0.5 \pm 0.1 \text{ N}\cdot\text{m}$ .	
		Check that no two wires are connected to the same terminal of an open-type connector. Connecting of wires in this way is prohibited.	
Terminating resistors	Location	Check if terminating resistors are connected to the ends of the CAN-H and CAN-L lines of every main line. Do not connect them at any other point on the main line.	
	Resistance value tolerance	Check if the resistance values of all terminating resistors used are within the tolerance $121 \Omega \pm 1\%$ (1/4 W or more).	
Grounding	Ground points	Check if all the shields of the communication cables used are grounded at one point around the center of the network. Check, also, if all the V- lines in the network are grounded via a single power supply in the same network.	
	Grounding environment	Check if Class D grounding or better is used. Check, also, if that grounding is isolated from the grounding of electric machines.	

## 8.2 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			
Symptom of defect				
Connection load	Type			
	Model			
	Wiring state			
System configuration and switch setting				
Space for correspondence				