HIOKI

Instruction Manual

SM7860-01 to -07
SM7860-21 to -27

POWER SOURCE UNIT

600347521

Contents

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Contents

Introduction

Thank you for purchasing the HIOKI Model SM7860 series Power Source Unit. To obtain maximum performance from the device, please read this manual first, and keep it handy for future reference.

Confirming Package Contents

When you receive the device, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories, panel switches, and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your dealer or Hioki representative.

Confirm that these contents are provided.

☐ SM7860 series Power Source Unit (1)
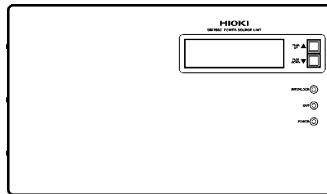
☐ Power Cord (1)   ☐ Voltage output connector
                                        SM7860-01, -02, -21, -22 2
                                        SM7860-03, -04, -05, -06, -07,
                                                -23, -24, -25, -26, -27 4
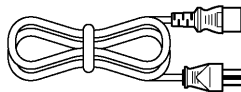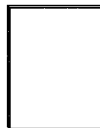
☐ Instruction Manual (1)
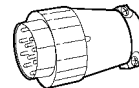
Options ☐ Model 9637 RS-232C Cable (9pin-9pin/Cross/1.8m)
         ☐ Model 9638 RS-232C Cable (9pin-25pin/Cross/1.8m)
         ☐ Model 9151-02 GP-IB Connector Cable (2 m)

Notes on Transportation

• To ensure safe handling, when transporting the device, please use the original box and packing materials, but do not use if the box is damaged or warped, or if the packing materials are in poor condition or incomplete.
• When packing the device, make sure to disconnect the power cords from the main device.
• When transporting, avoid dropping or other excessive impact.

Safety Information

⚠ DANGER **This device is designed to comply with IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, mishandling during use could result in injury or death, as well as damage to the device. Using the device in a way not described in this manual may negate the provided safety features.**
Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from device defects.

This manual contains information and warnings essential for safe operation of the device and for maintaining it in safe operating condition. Before using it, be sure to carefully read the following safety precautions.

Safety Symbols

⚠	In the manual, the ⚠ symbol indicates particularly important information that the user should read before using the device.
	The ⚠ symbol printed on the device indicates that the user should refer to a corresponding topic in the manual (marked with the ⚠ symbol) before using the relevant function.
⏚	Indicates a grounding terminal.
⎓	Indicates DC (Direct Current).
∼	Indicates AC (Alternating Current).
I	Indicates the ON side of the power switch.
○	Indicates the OFF side of the power switch.

The following symbols in this manual indicate the relative importance of cautions and warnings.

⚠ DANGER	Indicates that incorrect operation presents an extreme hazard that could result in serious injury or death to the user.
⚠ WARNING	Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user.
⚠ CAUTION	Indicates that incorrect operation presents a possibility of injury to the user or damage to the device.
NOTE	Indicates advisory items related to performance or correct operation of the device.

Other symbols

🚫	Indicates a prohibited action.
*	Indicates that descriptive information is provided below.
PAGE UP (Bold)	Bold characters within the text indicate operating key labels.
(p.)	Indicates the location of reference information.

Operating Precautions

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions.

Preliminary Checks

Before using the device for the first time, verify that it operates normally to ensure that no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.

Device Installation

Operating temperature and humidity
: 0 to 40°C at 80%RH or less (non-condensing)

Temperature and humidity range for guaranteed accuracy
: 23±5°C, 80%RH or less (non-condensing)

Avoid the following locations that could cause an accident or damage to the device.

Exposed to direct sunlight
Exposed to high temperature

In the presence of corrosive or explosive gases

Exposed to water, oil, other chemicals, or solvents
Exposed to high humidity or condensation

Exposed to strong electromagnetic fields
Near electromagnetic radiators

Near electromagnetic radiators (e.g., high-frequency induction heating systems and IH cooking utensils)

Exposed to high levels of particulate dust

Subject to vibration

⚠ **CAUTION**

- Do not slant the device or place it on top of an uneven surface. Dropping or knocking down the device can cause injury or damage to the device.
- Ventilation holes for heat radiation are provided on the side and rear panels of the device. Leave sufficient space around the ventilation holes and install the device with the holes unobstructed. Installation of the device with the ventilation holes obstructed may cause a malfunction or fire.

Installing   To prevent overheating, be sure to leave the specified clearances around the unit.

- Vents must not be obstructed.
- When rack-mounting the device, fans must be installed above or on top of the rack to ensure proper ventilation. Be sure that the rack is adequately ventilated so that the internal temperature remains at or below 40°C. Continued use of the device in a high-temperature environment will shorten its service life. Keep the temperature as low as possible.
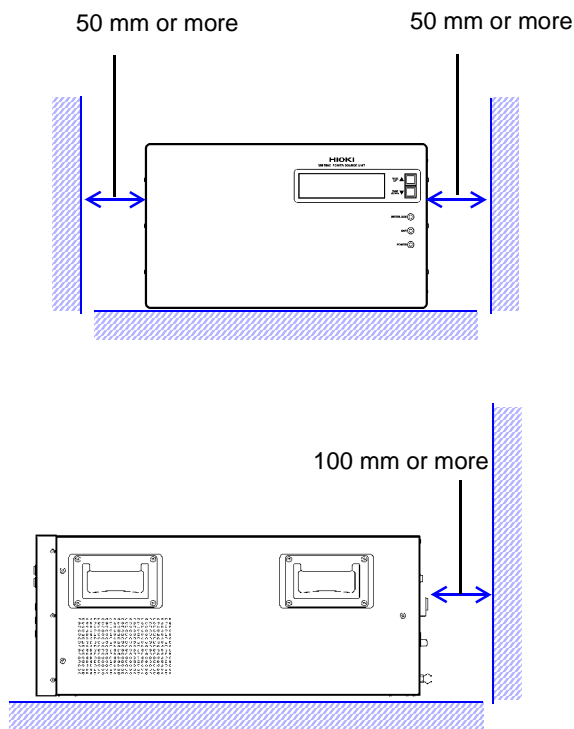
Handling the Device

⚠️**WARNING**
- **Do not allow the device to get wet, and do not take measurements with wet hands. This may cause an electric shock.**
- **Touching any of the high-voltage points inside the device is very dangerous. Do not attempt to modify, disassemble or repair the device; as fire, electric shock and injury could result.**

⚠️**CAUTION**
- To avoid damage to the device, protect it from physical shock when transporting and handling. Be especially careful to avoid physical shock from dropping.

Failure to observe the following precaution may result in bodily injury.
- The device weighs approximately 45 kg (SM7860-07, -27: approximately 32 kg). It should be moved by at least two people, who should grip it using the handles on the left and right sides.
- The device is heavy. When transporting it, follow your company's workplace safety standards to assure safety (for example, by wearing non-slip gloves and protective footwear).

Handling the Cords

⚠DANGER **Before using the device, make sure that the insulation on the Connection Cable is undamaged and that no bare conductors are improperly exposed. Using the device in such conditions could cause an electric shock, so contact your dealer or Hioki representative for replacements.**

⚠CAUTION
- Avoid stepping on or pinching cables, which could damage the cable insulation.
- To avoid breaking the cables, do not bend or pull them.
- To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the power outlet.
- Keep the cables well away from heat sources, as bare conductors could be exposed if the insulation melts.

NOTE Use only the specified connection cables. Using a non-specified cable may result in incorrect measurements due to poor connection or other reasons.

Before Connecting

⚠WARNING
- **Before turning the device on, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the device and present an electrical hazard.**
- **To avoid electrical accidents and to maintain the safety specifications of this device, connect the power cord only to a 3-contact (two-conductor + ground) outlet.**

To ensure measurements are accurate,
- Warm up the device an hour or more before use.
- The device should be calibrated once a year.

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Operating Precautions

Overview   Chapter 1

1.1   Product Overview and Features

The SM7860-01 to -07 and SM7860-21 to -27 are power supply units designed for use with the Model SM7810 or SM7810-20 Super MΩ HiTester. They support bipolar, multi-channel output and are compatible with multi-channel systems. Used in combination with the Model SM7810 or SM7810-20 Super MΩ HiTester, they are ideal for use in automated testing and measurement of capacitors.

◆ Bipolar, multi-channel output

The device delivers an 8-channel, positive/negative power supply, allowing an optimized testing line to be built using the smallest possible number of power supplies.

◆ Independent on/off output switching and current limitations for all channels

Since each channel has its own output on/off switch, it is possible to control voltage application without an external circuit (allowing charging and discharging). Use of semiconductor switches eliminates the need for maintenance. Additionally, the ability to limit current (to 50 mA) for individual channels means the measurement of other channels won't be affected when a target workpiece has a short.

◆ Output current capacity: 50 mA/channel

High-capacity capacitors can be charged rapidly, and the number of charges can be reduced.

◆ Output voltage: 1,000 V/channel

Devices are available with output voltages of up to ±1,000 V.

◆ Standard interfaces

Devices ship standard with external I/O, GP-IB, and RS-232C interfaces for sequencing. Interfaces are used to configure and power the devices.

◆ Inter-lock Function

1.2 Names and Functions of Parts

Front Panel

LCD screen
The screen uses a 2-page layout to display setting values and setting status information.
"1.3 Screen Layout" (p.10)

Scroll keys (PAGE UP▲/ PAGE DOWN▼)
Used to scroll through the display pages.
"1.3 Screen Layout" (p.10)
The scroll keys are also used to set the GP-IB address. (p.21)
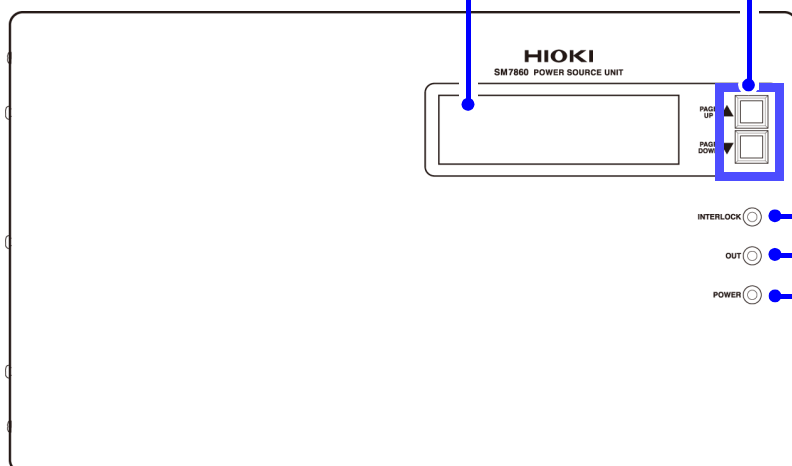
Inter-lock indicator
Lights up when the interlock is on.

Voltage output indicator
Lights up when a voltage is being output.

Power indicator
Lights up when the device is on.

Rear Panel

Voltage output terminal
Connect the included voltage output connector.
(p.13)

Vent
Keep clear of obstructions.

POWER switch
Turns the device on and off.
| : Power On
○ : Power Off
(p.15)
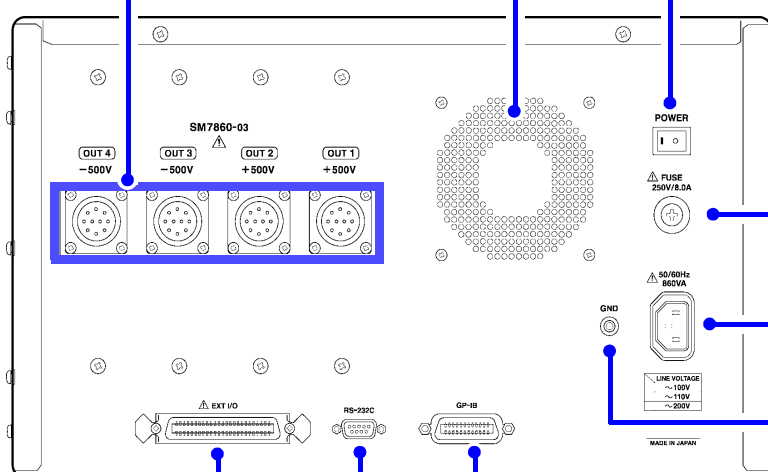
Fuse holder
Allows the fuse to be replaced.
(p.47)

Power inlet
Connect the supplied power cord here. (p.12)

GND terminal
Serves as the ground terminal. The GND terminal is connected to the device's enclosure.

EXT I/O connector
The external I/O connector can be used to control the device.
(p.33)

RS-232C connector
Connect to a computer when using the RS-232C interface.
(p.19)

GP-IB connector
Connect to a computer when using the GP-IB interface.
(p.19)

Side Panel

Handle
It should be moved by at least two people, who should grip it using the handles on the left and right sides.

Vent
Keep clear of obstructions.

1.3 Screen Layout

The LCD screen consists of two display pages. When the SM7860 is turned on, page 1 is shown.

The scroll keys on the front of the device (**PAGE UP▲**/ **PAGE DOWN▼**) are used to scroll among the display pages, which can also be selected directly by sending the "**PAG**" command from the GP-IB or RS-232C interface.

See: Message List "PAG" (p.30)

■ **Screen P1: Displays output voltage settings.**

Output voltage setting

VA: Displays the power supply A circuit voltage setting.
VB: Displays the power supply B circuit voltage setting.

Temperature error display

When a temperature error is detected, "TEMP" flashes in reverse video.

```
V A ( + ) I R : 1 0 0 0 . 0         TEMP
V B ( + ) I R :   2 5 0 . 0         TEMP
T E R M I N A L :
  O U T 1 : 1 1 1 0 0 0 0 0
  O U T 2 : 1 1 1 0 0 0 0 0
  O U T 3 : 1 1 1 0 0 0 0 0
  O U T 4 : 1 1 1 0 0 0 0 0    V M A : 1 0 0 0 . 0    O K
L                              V M B :   2 5 0 . 0    O K
```

PAGE UP ▲

PAGE DOWN ▼

Key lock display

When the keys are locked, **L** flashes in reverse video.

Monitor voltage value

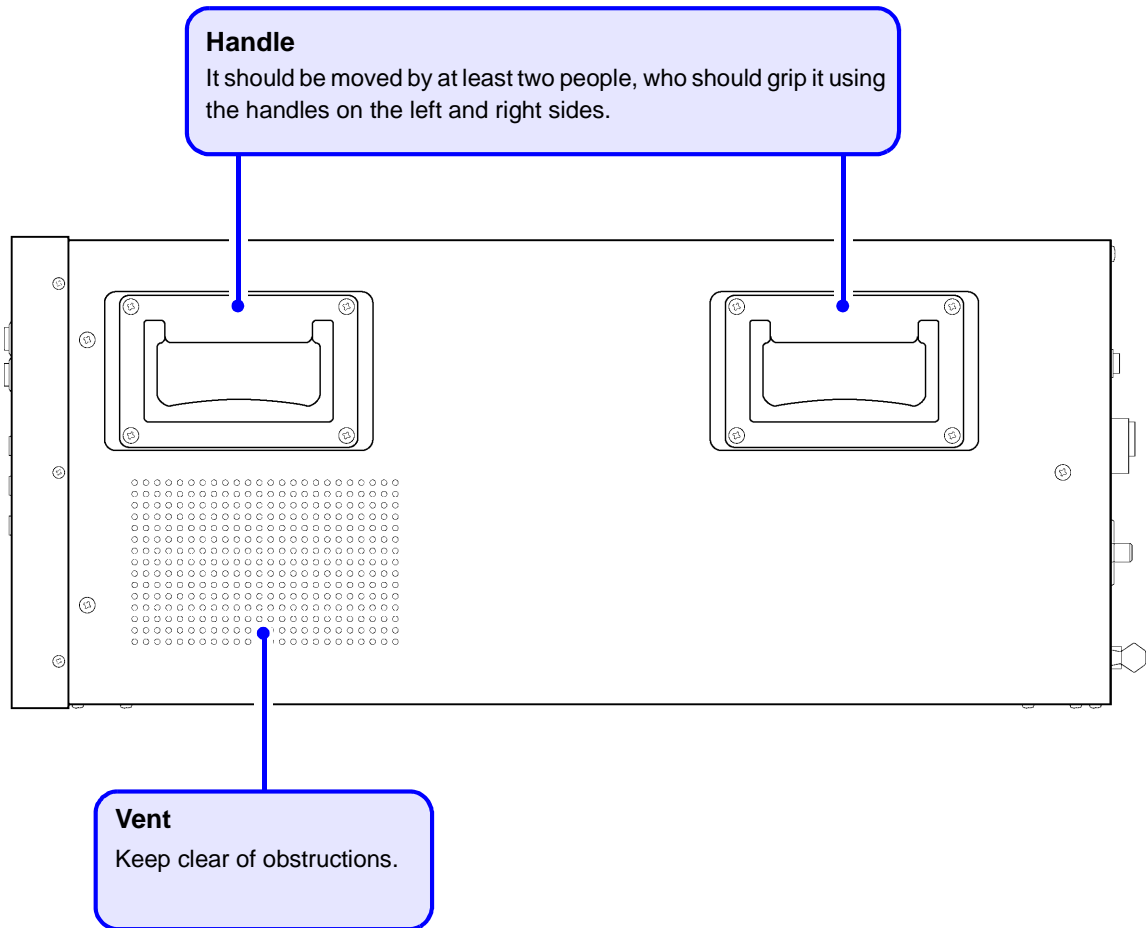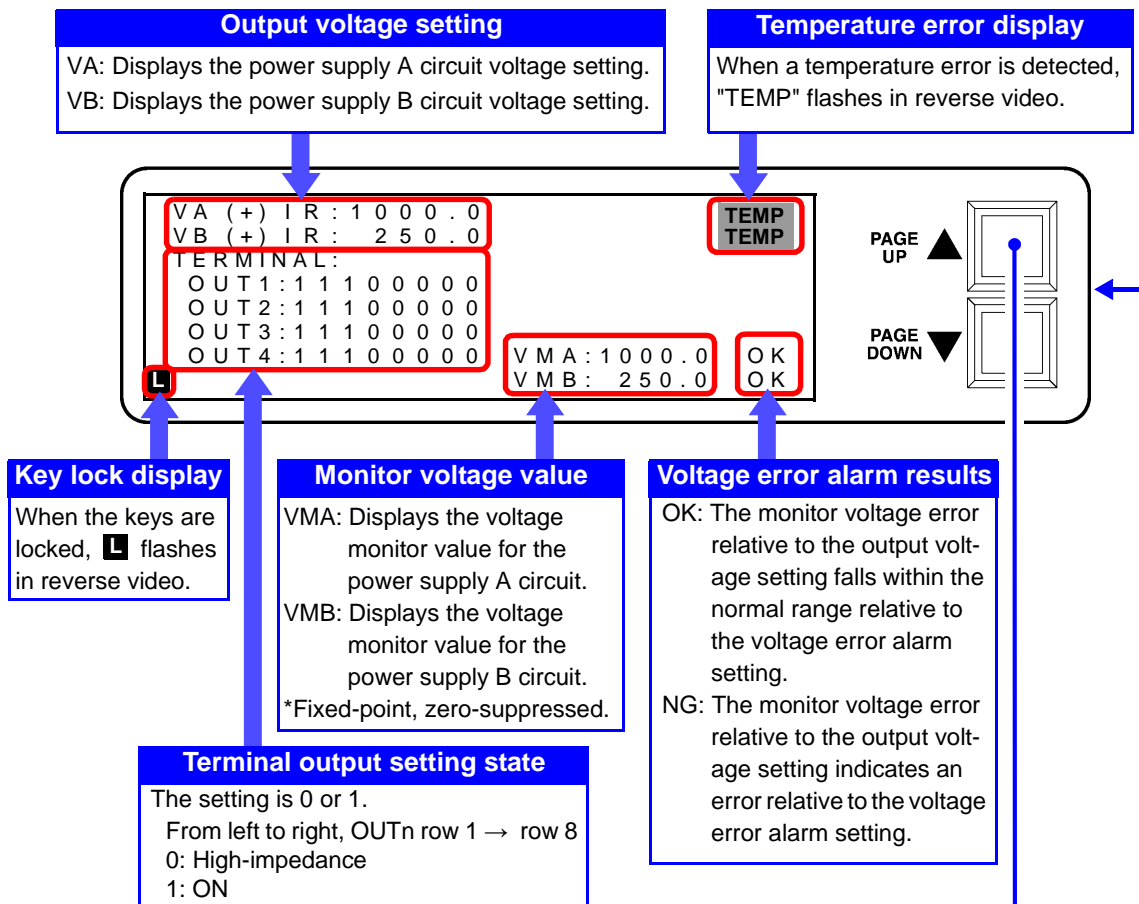VMA: Displays the voltage monitor value for the power supply A circuit.
VMB: Displays the voltage monitor value for the power supply B circuit.
*Fixed-point, zero-suppressed.

Voltage error alarm results

OK: The monitor voltage error relative to the output voltage setting falls within the normal range relative to the voltage error alarm setting.
NG: The monitor voltage error relative to the output voltage setting indicates an error relative to the voltage error alarm setting.

Terminal output setting state

The setting is 0 or 1.
From left to right, OUTn row 1 → row 8
0: High-impedance
1: ON

■ **Screen P2: Alarm/GP-IB address setting display**

Voltage error alarm setting

VA: Power supply A circuit voltage error alarm setting ±(%)
VB: Power supply B circuit voltage error alarm setting ±(%)

Temperature error display

When a temperature error is detected, "TEMP" flashes in reverse video.

```
V A   A L A R M : 1 9              TEMP
V B   A L A R M : 1 9              TEMP
G P I B   A D D R : 1


L
```

PAGE UP ▲

PAGE DOWN ▼

GP-IB address
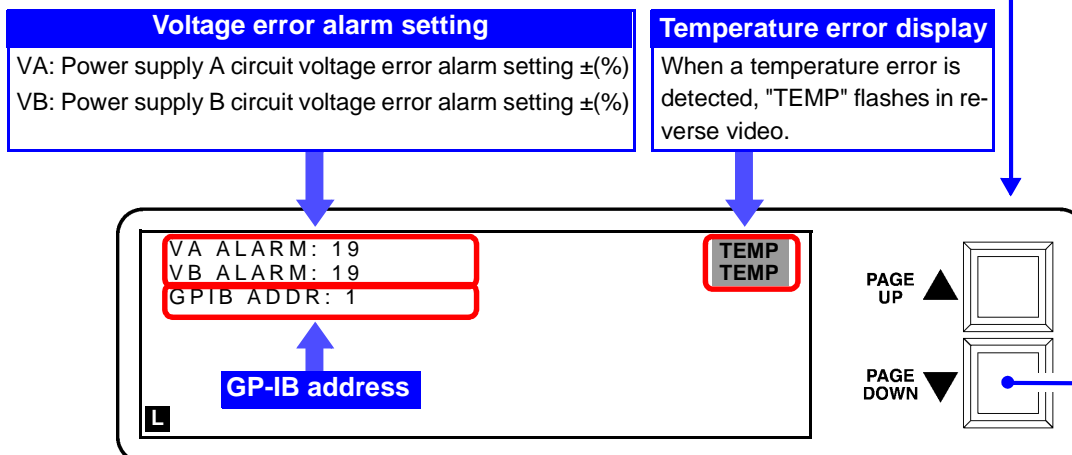
Preparing to Use the Device and Supplying Power

Chapter 2

2.1   Installation & Connection Procedures

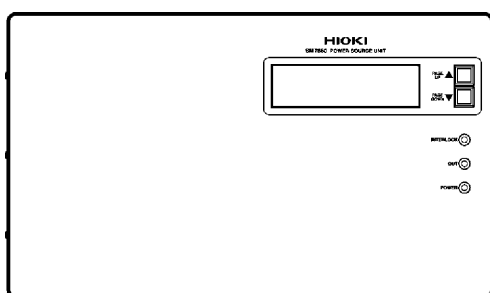**Be sure to read the "Operating Precautions" (p.3) before installing and connecting this device.**

Front Panel

Rear Panel

1 **Install this device (p.3)**

2 **Connect the power cord (p.12)**

3 **Connect the device to the measuring instrument. (p.13)**

4 **Connect the external interface**
- Using the GP-IB or RS-232C interface (p.17)
- Using the EXT I/O (p.33)

5 **Be sure to complete the pre-operation inspection (p.14) before using the device**

6 **Turn the power on (p.15)**

7 **Make device settings (p.16) (via the external interface)**

8 **Activate the power source**

2.2   Connecting the Power Cord ⚠

⚠**WARNING**	• **Before turning the device on, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the device and present an electrical hazard.** • **To avoid electrical accidents and to maintain the safety specifications of this device, connect the power cord only to a 3-contact (two-conductor + ground) outlet.** • **Before using the device, make sure that the insulation on the power cord is undamaged and that no bare conductors are improperly exposed. Using the device in such conditions could cause an electric shock, so contact your dealer or Hioki representative for replacements.**

⚠**CAUTION**	To avoid damaging the power cord, grasp the plug, not the cord, when unplugging it from the power outlet.

Turn off the power before disconnecting the power cord.

Connection Methods

Power inlet

1 **Confirm that the device is turned off.**

2 **Confirm that the mains supply voltage matches the device, and connect the power cord to the power inlet on the device.**

Rear Panel

3 **Plug the power cord into the mains outlet.**
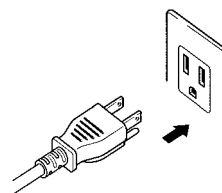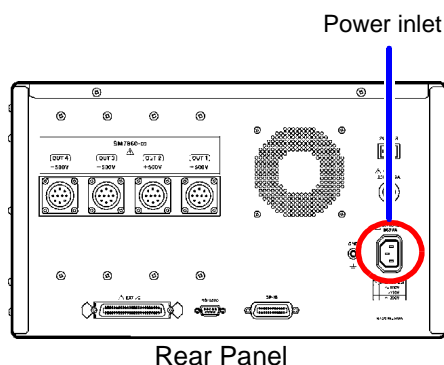
2.3 Connecting the Device to the Measuring Instrument ⚠

⚠ **WARNING**

To avoid electric shock or damage to the equipment, always observe the following precautions when connecting to voltage output terminal.
- **Always turn off the power to the device and to any devices to be connected before connecting the voltage output connectors.**

⚠ **CAUTION**

To avoid damaging the device, be sure to observe the following precautions:
- Do not connect the device to a load with a charge in excess of the output voltage range.
- Do not connect the device to a load with a charge that has the opposite polarity of the output voltage range.
- Do not connect the device to a load that has a charge when the device's power supply is turned off.

Connection Methods

1 Confirm that the device is turned off.

2 Connect the included voltage output connector to the voltage output terminal on the rear of the device.
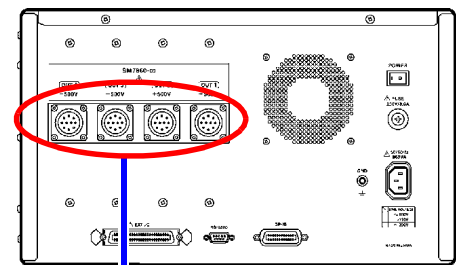
Voltage output terminal

Rear Panel

Specifications

Voltage output pin assignments
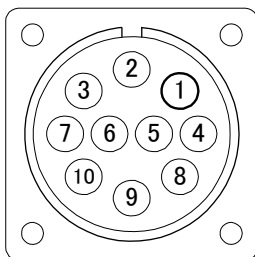
(View of terminal on device)

Pin No.	OUT1 Circuit A	OUT2[*1] Circuit A	OUT3 Circuit B	OUT4[*2] Circuit B
1	CH1	CH1	CH1	CH1
2	CH2	CH2	CH2	CH2
3	CH3	CH3	CH3	CH3
4	CH4	CH4	CH4	CH4
5	CH5	CH5	CH5	CH5
6	CH6	CH6	CH6	CH6
7	CH7	CH7	CH7	CH7
8	CH8	CH8	CH8	CH8
9	NC	NC	NC	NC
10	COM	COM	COM	COM

*1 On the SM7860-05, -06, -25, and -26, serves as the discharging terminal.
*2 On the SM7860-05, -06, -07, -25, -26 and -27, serves as the discharging terminal.

2.4   Pre-Operation Inspection

Before using the device the first time, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.

1 **Peripheral Device Inspection**

- **Is the power cord insulation torn, or is any metal exposed?**
- **Is the connection cord insulation torn, or is any metal exposed?**

Metal Exposed → **Do not use a damaged cord because doing so may result in electric shock. (Replace the cord with a new one.)**

↓ **No Metal Exposed**

2 **Device Inspection**

Is damage to the device evident?

Yes → **If damage is evident, request repairs.**

↓ **No**

Does the supply voltage of your power source match the supply voltage indicated above the power source inlet on the rear of the device?

No → **Use of a supply voltage outside the specified range may damage the device or cause electric shock.**

↓ **Yes**

Inspection complete

**Please read the "Operating Precautions" (p.3) before use.**

2.5 Turning the Power On and Off

⚠ **WARNING**
- **Before turning the device on, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the device and present an electrical hazard.**
- **When turning the device on and off, do not touch the voltage output terminals. Doing so may cause electric shock.**

⚠ **CAUTION**
When turning the device on and off, do not connect a load to the voltage output terminals. Turning the device on or off with a load connected may damage the load.
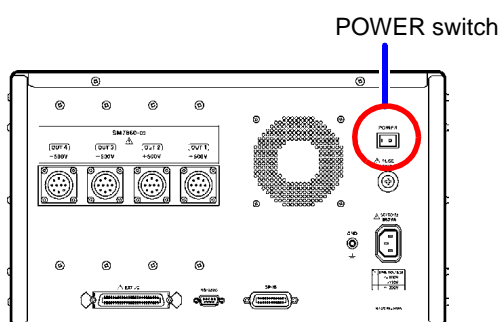
POWER switch

Rear Panel

Turning Power On

Turn the POWER switch on (|).

The power indicator and LCD screen on the front of the device will light up.

Before Starting Measurement
To obtain precise measurements, provide about an hour warm-up after turning power on.

Turning Power Off

Turn the POWER switch off (○).

2.6   Setting the Operating Conditions

This section describes how to set the operating conditions according to the manner in which the device is to be used.
Settings are configured via either of the device's external interfaces:
See: GP-IB/RS-232C Interface (p.17)

The device cannot be configured directly in a standalone manner.

Setting function	Description of operation and settings	See page
Output voltage	Sets the output voltage. Setup ranges: 1.0 to 1000.0 V (0.1 V resolution)	p.29
Voltage error alarm	Generates an alarm when the monitor voltage error relative to the output voltage setting falls outside the set value range. Setup ranges: ±2 to ±19% (1% resolution)	p.29
LCD display mode	Turns the LCD display on and off. [OFF/ ON]	p.30

Communication
(GP-IB/RS-232C Interface) Chapter 3

The symbol shown below indicates that the following instructions are specific to the RS-232C or the GP-IB interface. Instructions without these symbols are for both the RS-232C and the GP-IB interface.

GP-IB : GP-IB only

RS-232C : RS-232C only

Before Use
- Always make use of the connector screws to affix the GP-IB or RS-232C connectors.
- When issuing commands that contain data, make certain that the data is provided in the specified format.

Wiring Diagram (⇒ p.19)
Connect the device and Controller with a GP-IB or RS-232C Interface Cable

Communications Protocol Settings
GP-IB Enter a GP-IB address.
RS-232C Set the device to the same communications protocol as the controller
Set the transmission format.

3.1   Overview and Features

The device provides standard communication functionality in the form of GP-IB and RS-232C interfaces, both of which can be used to control the device remotely and to transfer data.

GP-IB
- This device is designed with reference to the following standard:
  Reference standard IEEE 488.1-1987

3.2   Specifications

NOTE

Precautions
RS-232C and GP-IB communications cannot be used simultaneously.

GP-IB Specifica-
tions

Electrical machinery specifications: IEEE std. 488.1-1987 compliant
Address setting   : Can be set to talker/listener addresses 1 to 30.

Interface Functions

GP-IB

SH1	All Source Handshake functions	●
AH1	All Acceptor Handshake functions	●
T6	Basic talker functions	●
	Serial poll function	●
	Talk-only mode	–
	The talker cancel function with MLA (My Listen Address)	●
L4	Basic listener functions	●
	Listen-only mode	–
	The listener cancel function with MTA (My Talk Address)	●
SR1	All Service Request functions	●
RL1	All Remote/Local functions	●
PP0	Parallel Poll function	–
DC1	All Device Clear functions	●
DT1	All Device Trigger functions	●
C0	Controller functions	–
E2	Tri-state output	

Operating Code: ASCII codes

RS-232C Specifica-
tions

RS-232C

Transfer method	Communications: Full duplex		
	Synchronization: Start-stop synchronization		
Baud rate	38400 bps		
Data length	8 bits		
Parity	none		
Stop bit	1 bit		
Flow control	none		
Electrical specification	Input voltage levels	5 to 15 V	: ON
		-15 to -5 V	: OFF
	Output voltage levels	+5 V or more	: ON
		-5 V or less	: OFF
Connector	RS-232C Interface Connector Pinout (Male 9-pin D-sub, with #4-40 attachment screws) The I/O connector is a DTE (Data Terminal Equipment) configuration Recommended cables: • Model 9637 RS-232C Cable • Model 9638 RS-232C Cable See: "3.3 Connect a cable to the GP-IB connector or RS-232C connector" (p.19)		

Operating Code: ASCII codes

3.3 Connect a cable to the GP-IB connector or RS-232C connector

⚠️**WARNING**
- Always turn both devices OFF when connecting and disconnecting an interface connector. Otherwise, an electric shock accident may occur.
- Failure to fasten the connectors properly may result is sub-specification performance or damage to the equipment.
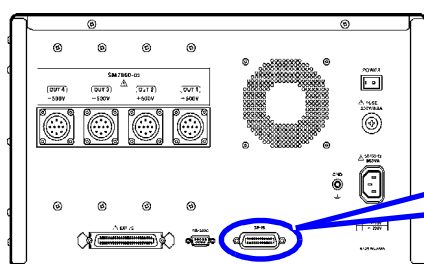
⚠️**CAUTION**
To avoid damage to the device, do not short-circuit the terminal and do not input voltage to the terminal.
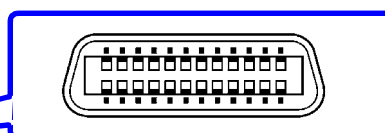
Using the GP-IB Interface   `GP-IB`

Connect the GP-IB cable to the GP-IB connector.

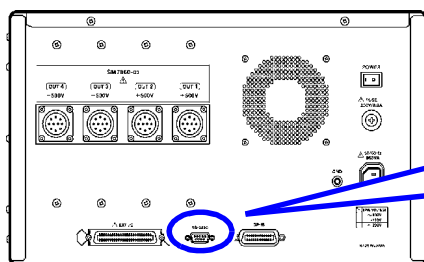Rear Panel

Recommended cable:

HIOKI Model 9151-02 GP-IB Connector Cable (2 m)

Using the RS-232C Interface   `RS-232C`

Connect the RS-232C cable to the RS-232C connector.

Rear Panel
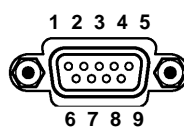
Male 9-pin D-sub
#4-40 attaching screws

Pin No.	Signal Name	Code Addr.		Mutual connection circuit name	Remarks
		EIA	JIS		
1	DCD	CF	CD	Carrier Detect	Not used
2	RXD	BB	RD	Receive Data	
3	TXD	BA	SD	Transmit Data	
4	DTR	CD	ER	Data Terminal Ready	Not used
5	GND	AB	SG	Signal Ground	
6	DSR	CC	DR	Data Set Ready	Not used
7	RTS	CA	RS	Request to Send	Not used
8	CTS	CB	CS	Clear to Send	Not used
9	RI	CE	CI	Ring Indicator	Not used

3.3 Connect a cable to the GP-IB connector or RS-232C connector

When connecting the device to a computer

Use a **crossover cable** with **female 9-pin D-sub** connectors.

Crossover Wiring

Female 9-pin
D-sub
Model SM7860
end

Female 9-pin
D-sub
PC/AT-end
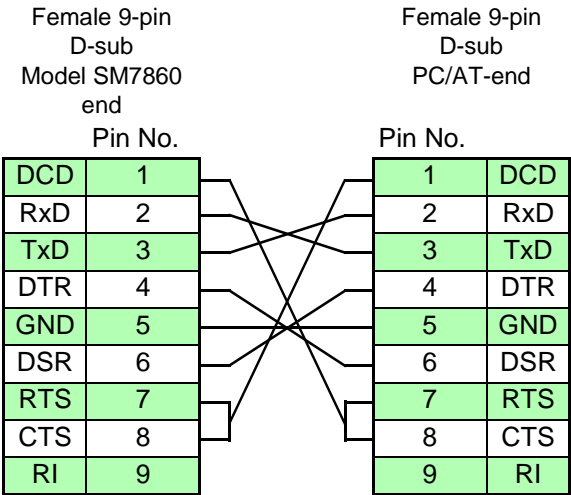
Recommended cable:

HIOKI
Model 9637 RS-232C
Cable (1.8 m)

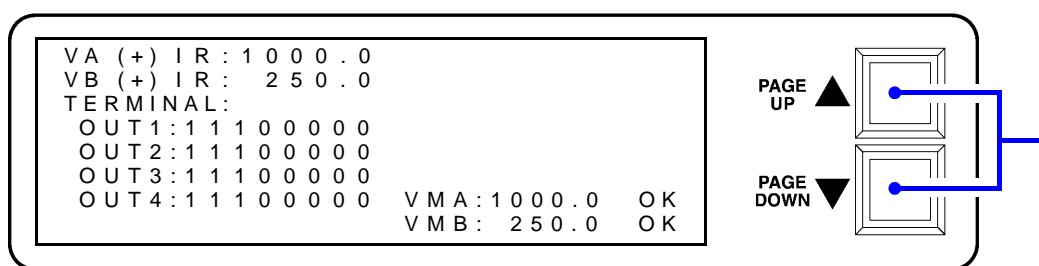|	Pin No.		Pin No.	
DCD	1		1	DCD
RxD	2		2	RxD
TxD	3		3	TxD
DTR	4		4	DTR
GND	5		5	GND
DSR	6		6	DSR
RTS	7		7	RTS
CTS	8		8	CTS
RI	9		9	RI

3.4 Configuring the Communications Protocol
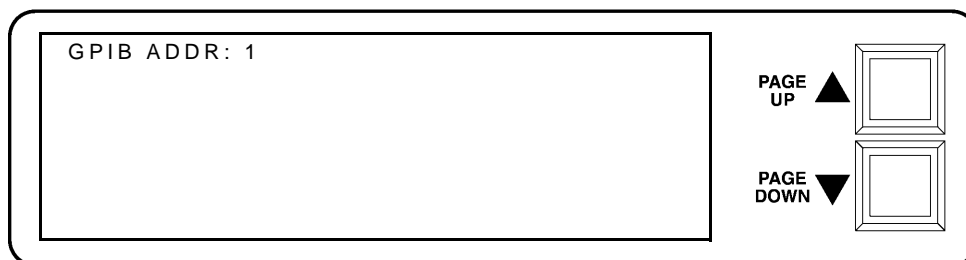
Configuring GP-IB Interface Communications

`GP-IB`

Setting the address

1 **Press and hold the scroll keys (PAGE UP▲/PAGE DOWN▼) on the front of the device for about 7 seconds. (The address can be set from the P1 or P2 screen.)**
■ **Screen P1: Status display**

```
VA (+) IR: 1000.0
VB (+) IR:  250.0
TERMINAL:
 OUT1:11100000
 OUT2:11100000
 OUT3:11100000
 OUT4:11100000   VMA:1000.0   OK
                 VMB: 250.0   OK
```

PAGE UP ▲
PAGE DOWN ▼

2 **Using the scroll keys (PAGE UP▲/PAGE DOWN▼), set the desired address. (Valid setting range: 1 to 30)**

```
GPIB ADDR: 1
```

PAGE UP ▲
PAGE DOWN ▼

3 **When finished making the setting, turn off the device.**

4 **Turn on the device.**

The device will revert to the initial screen, and the GP-IB address will be set to the selected address.

Configuring RS-232C Interface Communications

`RS-232C`

Communication conditions

Baud rate	38400 bps
Parity	none
Stop bit	1 bit
Data	8 bits
Flow control	none

Remote switching requests

Send the "**RMT**" command from the RS-232C interface.
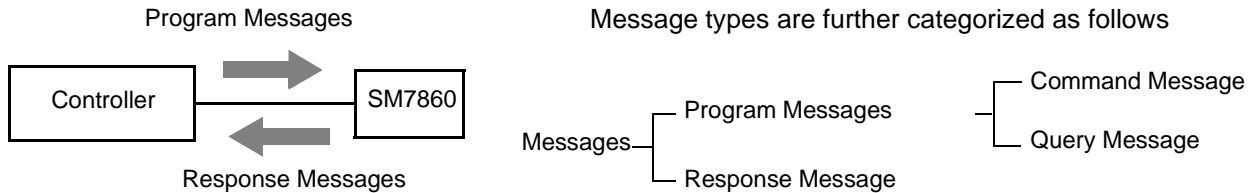
NOTE RS-232C interface communications will not be available until the "**RMT**" command is sent.

3.5 Communication Methods

Various messages are supported for controlling the device through the interfaces.

Messages can be either program messages, sent from the controller such as PC to the device, or response messages, sent from the device to the controller.

Program Messages

Controller → SM7860
Response Messages

Message types are further categorized as follows

Messages ┬ Program Messages ┬ Command Message
         └ Response Message └ Query Message

When issuing commands that contain data, make certain that the data is provided in the specified format.

Program Messages

1. Command Messages and Query Messages

(1) Command Messages

Commands that control the device, for example to configure settings or reset the device.

(2) Query Messages

Requests for responses relating to results of operation or measurement, or the state of device settings.
Query commands end with a question (**?**) mark.

2. Message delimiter (terminator)

This device recognizes the following input message delimiters:
CR+LR with EOI
LF with EOI
CR with EOI
EOI
CR+LF
LF

Response Messages

1. Response Messages

When a query message is received, its syntax is checked and a response message is generated.

2. Message delimiter (terminator)

The following three response message delimiters can be specified with the "**DLM**" command:
LF (initial setting)
CR+LF
EOI

Separators

1. Message Unit Separator

Multiple message can be written in one line by separating them with semicolons " **;** "

2. Header Separator

In a message consisting of both a header and data, the header is separated from the data by a space " " (ASCII code 20H).

3. Data Separator

In a message containing multiple data items, commas are required to separate the data items from one another.

Data Formats

Query messages use the formats outlined in Table 1. The format is selected according to the command.

Table 1: Response Messages and Parameter Data Types

| Data type	Description	Example	Notes
NR1	Integer	0, 1, 2, 3, etc.	Parameter settings, etc.
NR2	Fixed-point decimal number	+12.345, 400.0, etc.	Primarily settings
NR3	Floating-point decimal number	+1.234±50, etc.	Primarily settings and measured values
ASCII	ASCII string	XXXXXXXXXXXXXXX	Primarily hardware IDs

Status Byte Register

RS-232C RS-232C reads the status bytes to find out the status of the device.

GP-IB The device adopts the IEEE488.1-1987 defined status model for parts related to the serial polling performed by the service request function. A trigger for generating a service request is called an event.
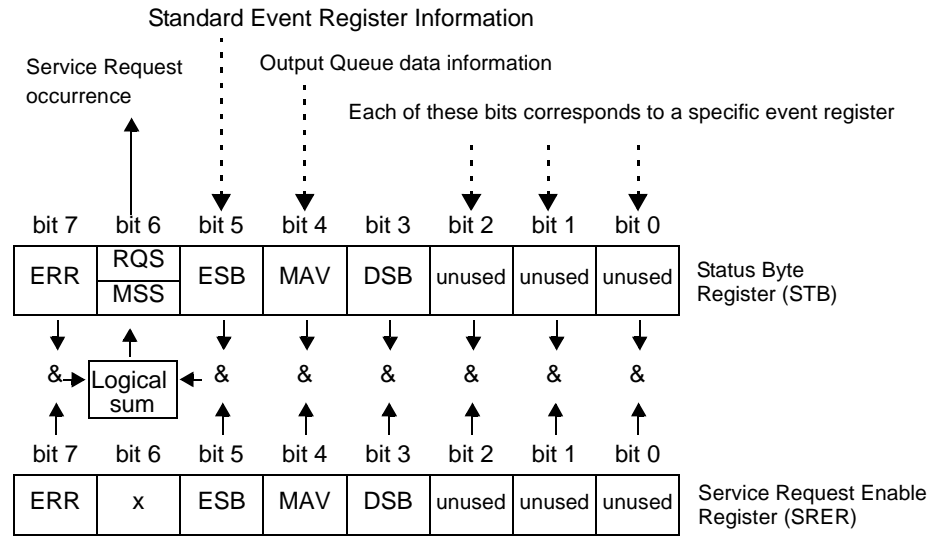
Overview of Service Request Occurrence

The Status Byte Register contains information about the event registers and the output queue. Required items are selected from this information by masking with the Service Request Enable Register. When any bit selected by the mask is set, bit 6 (MSS; the Master Summary Status) of the Status Byte Register is also set, which generates an SRQ (Service Request) message and dispatches a service request.

NOTE For RS-232C, bit 4 (MAV message available) of the status byte register is not set.

Status Byte Register (STB)_____

A status byte register is an 8-bit register output from the unit to the controller during serial polling. If even one of the status byte register bits enabled by the service request enable register changes from "0" to "1" the MSS bit becomes 1. At the same time, the RQS bit also becomes "1" and a service request is generated.

The RQS bit is always synchronized with the service request and only read and simultaneously cleared upon being serial polled. The MSS bit is only read by an "**∗STB?**" query and is not cleared until the event is cleared by a command such as a "**∗CLS**" command.

Bit 7	ERR	Unrecoverable error
Bit 6	RQS	Set to 1 when a service request is dispatched.
	MSS	This is the logical sum of the other bits of the Status Byte Register.
Bit 5	ESB	Standard Event Status (logical sum) bit This is logical sum of the Standard Event Status Register.
Bit 4	MAV	Message available Indicates that a message is present in the output queue.
Bit 3	DSB	Event Status (logical sum) bit This is the logical sum of Event Status Register.
Bit 2	–	unused
Bit 1	–	unused
Bit 0	–	unused

Service Request Enable Register (SRER)_____

This register masks the Status Byte Register. Setting a bit of this register to 1 enables the corresponding bit of the Status Byte Register to be used.

Event Registers

Standard Event Status Register (SESR)_____

A standard event status register is an 8-bit register.

If any bit in the Standard Event Status Register is set to 1 (after masking by the Standard Event Status Enable Register), bit 5 (ESB) of the Status Byte Register is set to 1.
See: "Standard Event Status Enable Register (SESER)" (p.27)

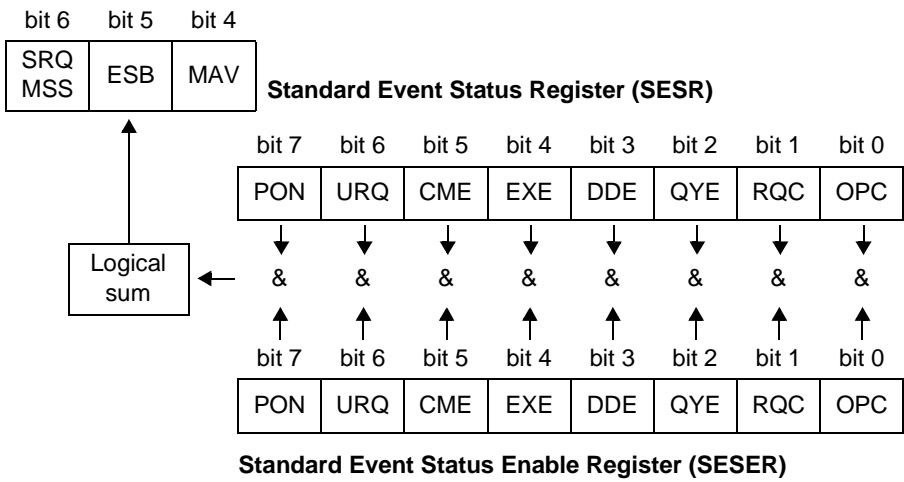The standard event status register is cleared at the following times:
- When a "***CLS**" command is executed
- When a "**ERR?**" command is executed
- When the device is powered on

Bit 7	PON	**Power-On Flag** Set to 1 when the power is turned on, or upon recovery from an outage.
Bit 6	URQ	**User Request** unused
Bit 5	CME	**Command error (The command to the message terminator is ignored.)** This bit is set to 1 when a received command contains a syntactic or semantic error: • Program header error • Incorrect number of data parameters • Invalid parameter format • Received a command not supported by the device
Bit 4	EXE	**Execution Error** This bit is set to 1 when a received command cannot be executed for some reason. • The specified data value is outside of the set range • The specified setting data cannot be set • Execution is prevented by some other operation being performed
Bit 3	DDE	**Device-Dependent Error** This bit is set to 1 when a command cannot be executed due to some reason other than a command error, a query error or an execution error. • When the command cannot be executed because there is an internal anomaly
Bit 2	QYE	**Query Error (the output queue is cleared)** This bit is set to 1 when a query error is detected by the controller of the output queue. • When an attempt has been made to read an empty output queue (GP-IB only) • When the data overflows the output queue • When data in the output queue has been lost
Bit 1	RQC	**Request Control** unused
Bit 0	OPC	**Operation Complete** This bit is set to 1 in response to an "***OPC**" command. • It indicates the completion of operations of all messages up to the "***OPC**" command

Standard Event Status Enable Register (SESER) _____

Setting any bit of the Standard Event Status Enable Register to 1 enables access to the corresponding bit of the Standard Event Status Register.
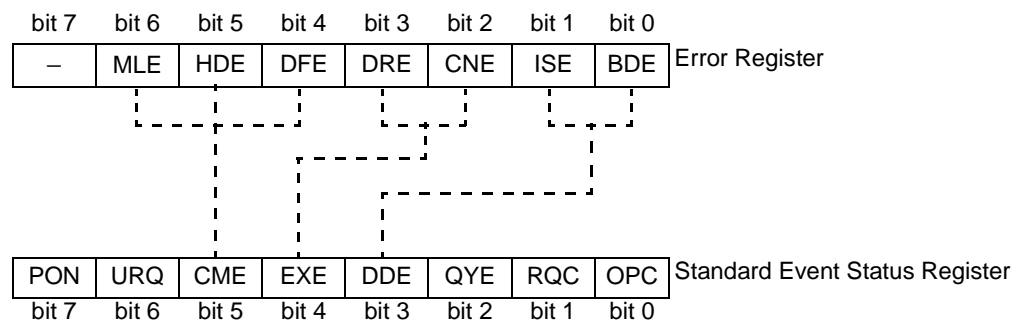
Standard Event Status Register (SESR) and Standard Event Status Enable Register (SESER)

bit 6	bit 5	bit 4
SRQ MSS	ESB	MAV

Standard Event Status Register (SESR)

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
PON	URQ	CME	EXE	DDE	QYE	RQC	OPC

Logical sum

&	&	&	&	&	&	&	&

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
PON	URQ	CME	EXE	DDE	QYE	RQC	OPC

Standard Event Status Enable Register (SESER)

Error Registers

The Error Register, which consists of 8 bits, manages error information. The contents of this register are aggregated in the CME, EXE, DDE, and QYE bits of the Standard Event Status Register (no mask processing is performed).
Error register-related message are listed below.

*CLS	Clears the following registers: • Status Byte Register • Standard Event Status Register • Error Register
ERR?	Queries and clears the Error Register.

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	
–	MLE	HDE	DFE	DRE	CNE	ISE	BDE	Error Register

PON	URQ	CME	EXE	DDE	QYE	RQC	OPC	Standard Event Status Register
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	

MLE: Message Length Error   HDE: Header Error
DFE: Data Format Error   DRE: Data Range Error
CNE: Can Not Execute   ISE: Internal communication Error
BDE: Environment Backup was Damaged (RAM)

Error Register structure

Bit No.	Name	Event/status indicated by set bit
Bit 7	–	Unused
Bit 6	MLE	Message Length Error Set when the message length exceeds the allowable range. The bit is reset after the register is read.
Bit 5	HDE	Message Header Error Set when an unrecognizable message header is received. The bit is reset after the register is read.
Bit 4	DFE	Data Format Error Set when the number of parameters exceeds the stipulated number or when there is an unrecognizable parameter. The bit is reset after the register is read.
Bit 3	DRE	Data Range Error Set when a parameter falls outside the stipulated range. The bit is reset after the register is read.
Bit 2	CNE	Unexecutable command Set when an unexecutable command is received. The bit is reset after the register is read.
Bit 1	ISE	Internal communication Error Set when an internal communication error occurs. The bit is reset after the register is read.
Bit 0	BDE	Environment Backup was Damaged Set when data stored in the instrument's backup RAM is corrupted. The bit is reset after the register is read.

3.6   Message List

RS-232C-only commands are indicated by **RS-232C** .

NOTE   When using the RS-232C interface to send commands, include a uniform wait time of 100 ms (excluding the following exceptions).

Command	Description	Formats
Communication conditions		
RMT	Remote switching request **RS-232C**	[Format] RMT
Delimiter		
DLM	Talker delimiter specification 　d1 (delimiter specification: 0 to 2) 　　0: LF<EOI>　Default 　　1: CRLF<EOI> 　　2: <EOI> 　Note: This setting reverts to its default value when the instrument 　　　　is powered on. A combination CR+LF is used as the RS- 　　　　232C delimiter for both data transmission and reception.	[Format]　　DLM d1 　　　　　　d1: NR1 format
DLM?	Delimiter query 　The contents of responses are the same as the settings.	[Format]　　DLM? [Response] d1
Output voltage setting		
VAI	Circuit A output voltage setting 　d1: 1.0 to 1000.0 V 　Note: Set as an absolute value. 　　　　The valid setting range varies with the model.	[Format]　　VAI d1 　　　　　　d1: NR2 format
VAI?	Circuit A output voltage setting query 　The contents of responses are the same as the settings.	[Format]　　VAI? [Response] d1
VBI	Circuit B output voltage setting 　d1: 1.0 to 1000.0 V 　Note: Set as an absolute value. 　　　　The valid setting range varies with the model.	[Format]　　VBI d1 　　　　　　d1: NR2 format
VBI?	Circuit B output voltage setting query 　The contents of responses are the same as the settings.	[Format]　　VBI? [Response] d1
	Output voltage setting range by model 	
Alarm setting		
ARM	Voltage error alarm setting 　d1: 2 to 19%, Circuit A voltage error alarm setting 　d2: 2 to 19%, Circuit B voltage error alarm setting 　Note: d1 or d2 can be omitted.	[Format]　　ARM d1,d2 　　　　　　ARM d1 　　　　　　ARM ,d2
ARM?	Voltage error alarm setting query 　The contents of responses are the same as the settings.	[Format]　　ARM? [Response] d1,d2

Output voltage setting range by model

Model	Lower limit (V)	Upper limit (V)
SM7860-01, -21	1.0	500.0
SM7860-02, -22	250.0	1000.0
SM7860-03, -23	1.0	500.0
SM7860-04, -24	250.0	1000.0
SM7860-05, -25	1.0	500.0
SM7860-06, -26	250.0	1000.0
SM7860-07, -27	1.0	10.0

30

Command	Description	Formats
Voltage monitor		
VMA?	Circuit A power supply voltage monitor value query	[Format] VMA? [Response] d1: NR2 format
VMB?	Circuit B power supply voltage monitor value query	[Format] VMB? [Response] d1: NR2 format
LCD display mode		

LCD	LCD display mode setting
	 d1 (Display mode: 0 to 1)
	  0: OFF (Display off)
	  1: ON (Display on)
		[Format] LCD d1
		 d1: NR1 format

LCD?	LCD display mode query The contents of responses are the same as the settings.	[Format] LCD? [Response] d1: NR1 format

PAG	LCD display page specification
	 d1 (Page number: 0 to 1)
	  0: Output voltage setting, monitor voltage value, channel-specific output setting state
	  1: Alarm setting, GP-IB address
		[Format] PAG d1
		 d1: NR1 format

Error information		
ERR?	Error information query d1 (Error information: 0 to 127) Note: Error information is cleared when the response is output.	[Format] ERR? [Response] d1: NR1 format
Others		
*RST	Device initialization Initializes all settings to their factory values. Device operation will be stopped.	[Format] *RST
*IDN?	Hardware ID query Returns the device's hardware ID as the response. d1 (HIOKI, SM7860-XX, 0, 01.00) Note: The SM7860-2X is shown as "SM7860-0X."	[Format] *IDN? [Response] d1: String
*SAV	Save environmental data (output voltage setting and alarm setting) d1 (Environmental data no.: 0 to 3)	[Format] *SAV d1 d1: NR1 format
*RCL	Recall environmental data (output voltage setting and alarm setting) d1 (Environmental data no.: 0 to 3)	[Format] *RCL d1 d1: NR1 format
*CLS	Clear status register	[Format] *CLS
*SRE	Sets the service request enable register. d1 (0 to 255)	[Format] *SRE d1 d1: NR1 format
*SRE?	Service request enable register query d1 (0 to 63, 128 to 191) Note: Bit 6 is not set by *SRE.	[Format] *SRE? [Response] d1: NR1 format
*STB?	Status byte register query d1 (0 to 255)	[Format] *STB? [Response] d1: NR1 format
*ESE	Sets the standard event status enable register. d1 (0 to 255)	[Format] *ESE d1 d1: NR1 format
*ESE?	Standard event status enable register query The contents of responses are the same as the settings.	[Format] *ESE? [Response] d1: NR1 format
*ESR?	Standard event status register query d1 (0 to 255)	[Format] *ESR? [Response] d1: NR1 format

Command	Description	Formats
∗OPC	Sets the standard event status register's OPC bit after all ongoing operations have completed. This command is used to detect the completion of commands that involve time-consuming processing.	[Format] ∗OPC
∗OPC?	Returns the value 1 when all ongoing operations have completed. 　d1: 1	[Format] ∗OPC? [Response] d1: NR1 format
CNF	Operating environment setting 　d1 (Interlock control enable/disable: 0 to 1) 　　0: CONNECT (Enables interlock.) 　　1: CUTOFF　 (Disables interlock.) Default	[Format] CNF d1 　　　d1: NR1 format
CNF?	Operating environment query 　The contents of responses are the same as the settings.	[Format] CNF? [Response] d1
KLC	Key lock setting 　d1 (0 to 1) 　　0: Key lock off 　　1: Key lock on	[Format] KLC d1 　　　d1: NR1 format
KLC?	Key lock query 　d1 (0 to 1) 　The contents of responses are the same as the settings.	[Format] KLC? [Response] d1: NR1 format

3.7　Listener Specification Precautions

Input buffer size

Multiple command messages can be transferred at once by joining them with message separators. Since the instrument provides an 128-byte input buffer, the instrument is unable to receive message strings in excess of 127 characters in length. In this case, the entire command will be ignored (discarded), and the Error Register's MLE (Message Length Error) bit will be set.

Reading from the output buffer

The output buffer uses a FIFO design, with older data being read first. Consequently, the read value may differ from the expected value under certain circumstances, for example if no response is acquired after issuing a query. Additionally, the output buffer is 511 bytes in size. If data in excess of 511 bytes is written to the buffer, it will be discarded, and the Error Register's QYE (Query Error) bit will be set.

External Control   Chapter 4

This chapter describes how to use the EXT I/O connector on the rear of the device to control the device.

Connect the device's EXT I/O connector to the signal output or input device.
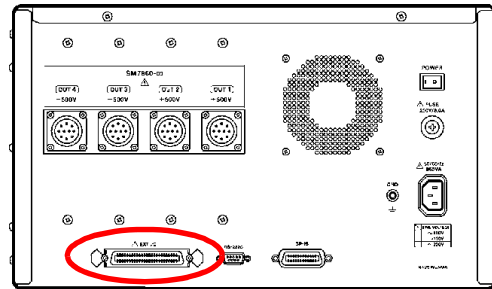
Rear Panel

4.1   External Input/Output Connector and Signals

⚠️ **WARNING**

To avoid electric shock or damage to the equipment, always observe the following precautions when connecting to the EXT I/O connector.

- **Always turn off the power to the device and to any devices to be connected before making connections.**

- **During operation, a wire becoming dislocated and contacting another conductive object can be serious hazard. Ensure that the cable is securely attached to the EXT I/O connector.**

- **Ensure that devices and systems to be connected to the EXT I/O connector are properly isolated.**
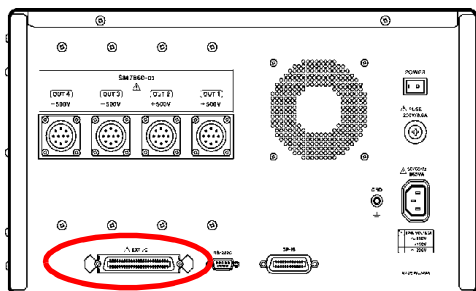
⚠️ **CAUTION**

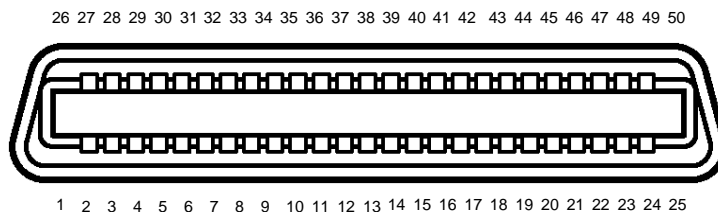To avoid damage to the device, observe the following cautions:

- Do not apply voltage or current to the EXT I/O connector that exceeds their ratings.

- When driving relays, be sure to install diodes to absorb counter-electromotive force.

See: "Connector Type and Signal Pinouts" (p.34)

Connector Type and Signal Pinouts

Rear Panel

EXT I/O connector

Connector

- 57RE-40500-730B (50-pin: DDK)

Pin	Signal name	I/O		Pin	Signal name	I/O
1	COM	-		26	COM	-
2	EXT_DCV2(+24V)	Input		27	EXT_DCV2(+24V)	Input
3	$\overline{\text{OUTPUT}}$	Input		28	$\overline{\text{INTERLOCK}}$	Input
4	$\overline{\text{OUT1(1)\_ON}}$	Input		29	$\overline{\text{OUT1(2)\_ON}}$	Input
5	$\overline{\text{OUT1(3)\_ON}}$	Input		30	$\overline{\text{OUT1(4)\_ON}}$	Input
6	$\overline{\text{OUT1(5)\_ON}}$	Input		31	$\overline{\text{OUT1(6)\_ON}}$	Input
7	$\overline{\text{OUT1(7)\_ON}}$	Input		32	$\overline{\text{OUT1(8)\_ON}}$	Input
8	$\overline{\text{OUT2(1)\_ON}}$	Input		33	$\overline{\text{OUT2(2)\_ON}}$	Input
9	$\overline{\text{OUT2(3)\_ON}}$	Input		34	$\overline{\text{OUT2(4)\_ON}}$	Input
10	$\overline{\text{OUT2(5)\_ON}}$	Input		35	$\overline{\text{OUT2(6)\_ON}}$	Input
11	$\overline{\text{OUT2(7)\_ON}}$	Input		36	$\overline{\text{OUT2(8)\_ON}}$	Input
12	$\overline{\text{OUT3(1)\_ON}}$	Input		37	$\overline{\text{OUT3(2)\_ON}}$	Input
13	$\overline{\text{OUT3(3)\_ON}}$	Input		38	$\overline{\text{OUT3(4)\_ON}}$	Input
14	$\overline{\text{OUT3(5)\_ON}}$	Input		39	$\overline{\text{OUT3(6)\_ON}}$	Input
15	$\overline{\text{OUT3(7)\_ON}}$	Input		40	$\overline{\text{OUT3(8)\_ON}}$	Input
16	$\overline{\text{OUT4(1)\_ON}}$	Input		41	$\overline{\text{OUT4(2)\_ON}}$	Input
17	$\overline{\text{OUT4(3)\_ON}}$	Input		42	$\overline{\text{OUT4(4)\_ON}}$	Input
18	$\overline{\text{OUT4(5)\_ON}}$	Input		43	$\overline{\text{OUT4(6)\_ON}}$	Input
19	$\overline{\text{OUT4(7)\_ON}}$	Input		44	$\overline{\text{OUT4(8)\_ON}}$	Input
20	(Reserved)			45	(Reserved)	
21	(Reserved)			46	(Reserved)	
22	(Reserved)			47	(Reserved)	
23	(Reserved)			48	(Reserved)	
24	$\overline{\text{ALARM}}$	Output		49	$\overline{\text{BUSY}}$	Output
25	$\overline{\text{TEMP}}$	Output		50	(Reserved)	

Do not connect to reserved pins.

Signal Descriptions

Input Signals

EXT_DCV2(+24V)	External power source input	
$\overline{\text{OUTPUT}}$	Output on/off setting	
$\overline{\text{OUT 1(1)\_ON}}$ to $\overline{\text{OUT 1(8)\_ON}}$	Channel-specific on/off setting	
$\overline{\text{OUT 2(1)\_ON}}$ to $\overline{\text{OUT 2(8)\_ON}}$	Channel-specific on/off setting	
$\overline{\text{OUT 3(1)\_ON}}$ to $\overline{\text{OUT 3(8)\_ON}}$	Channel-specific on/off setting	
$\overline{\text{OUT 4(1)\_ON}}$ to $\overline{\text{OUT 4(8)\_ON}}$	Channel-specific on/off setting	
$\overline{\text{INTERLOCK}}$	When on, no voltage can be generated.	

NOTE

- The $\overline{\text{INTERLOCK}}$ signal cannot be used unless it has been enabled with the operating environment setting (CNF=0). The device ships with this setting disabled (CNF=1).
  See: Message List "CNF" (p.31)

- The output voltage cannot be changed while the $\overline{\text{OUTPUT}}$ signal is enabled.

Output Signals

$\overline{\text{ALARM}}$	Generated voltage alarm	
$\overline{\text{BUSY}}$	Voltage being output	
$\overline{\text{TEMP}}$	Temperature alarm	

4.2 Timing Chart

Each signal level indicates a corresponding voltage level.

◆ **External output terminal**
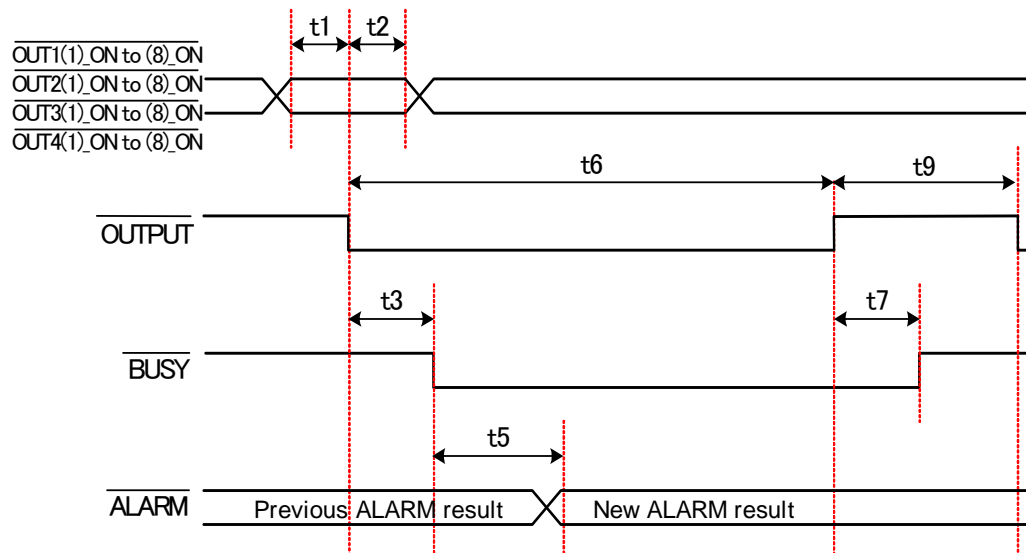
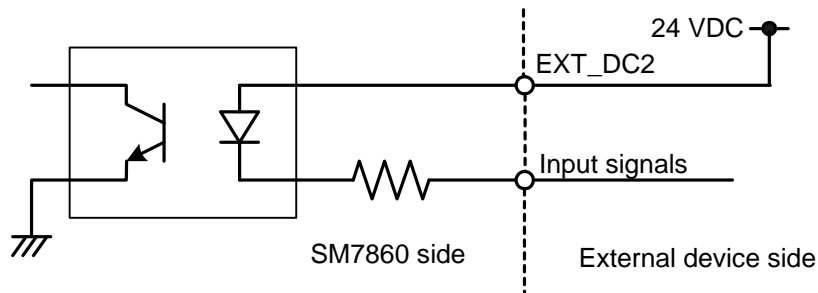◆ **Voltage output terminal**
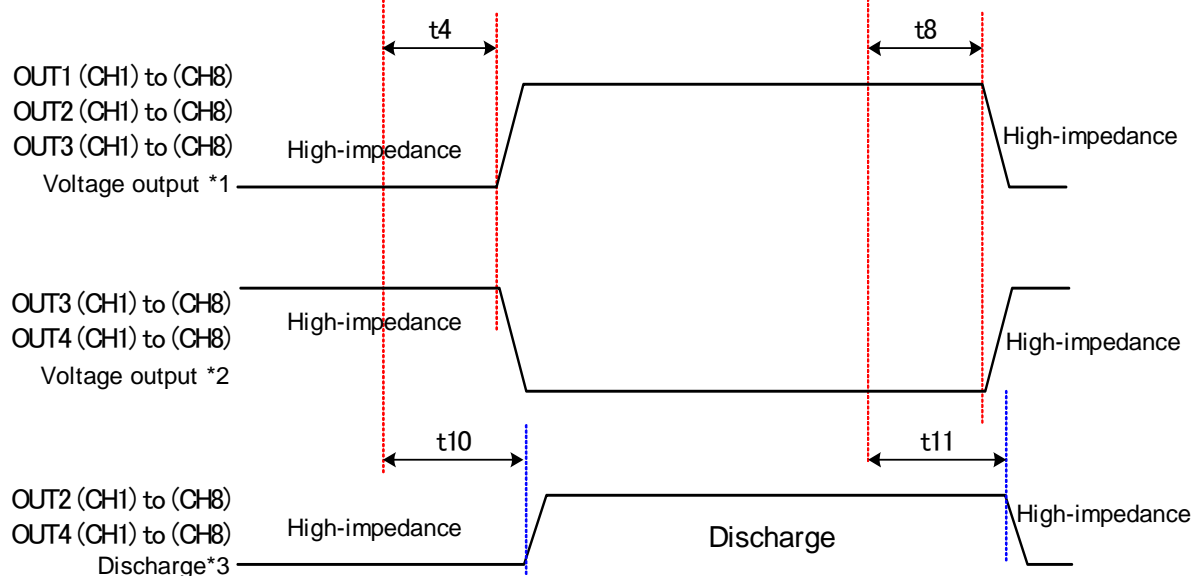
*1 to *3 vary with the model.

*1: SM7860-01, -02, -21, 22 : OUT1
    SM7860-03, 04, 05, 06, -23, 24, 25, 26 : OUT1 to OUT2
    SM7860-07, -27 : OUT1 to OUT3
*2: SM7860-01, 02, 05, 06, -21, 22, 25, 26 : OUT3
    SM7860-03, 04, -23, 24 : OUT3 to OUT4
*3: SM7860-05, 06, -25, 26 : OUT2, OUT4
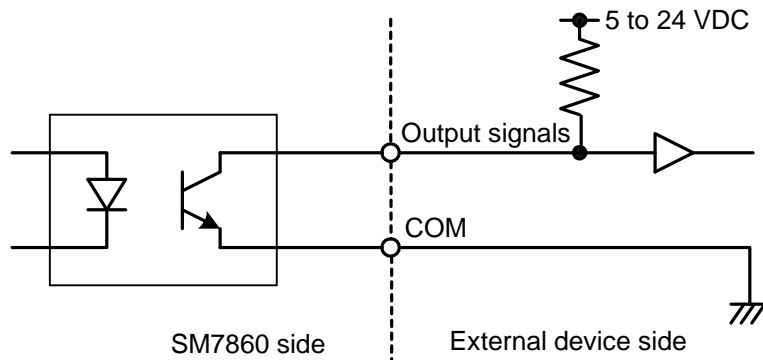   SM7860-07, -27 : OUT4

Timing Chart Interval Descriptions

Interval	Description	Duration
t1	Channel setup time	100 µs or more
t2	Channel hold time	200 µs or more
t3	OUTPUT ON → Busy delay time	200 µs or less
t4	OUTPUT ON → Voltage output delay time	600 µs or less
t5	Alarm delay time	3.5 ms or less
t6	Output pulse width	8 ms or more
t7	OUTPUT OFF → Busy delay time	800 µs or less
t8	OUTPUT OFF → Voltage output delay time	2.5 ms or less
t9	Output off time	4 ms or more
t10	OUTPUT ON → Discharging start delay time	1.2 ms or less
t11	OUTPUT OFF → Discharging complete delay time	1.1 ms or less

4.3   Internal Circuitry

Input Circuit

24 VDC

EXT_DC2

Input signals

SM7860 side   External device side

Output Circuit

5 to 24 VDC

Output signals

COM

SM7860 side   External device side

Input Signals	Input method	Photocoupler-isolated input
	Input voltage	LOW: 0 to 0.5 V, HIGH: 24 V±10%
Output Signals	Output method	Photocoupler-open collector output
	Output voltage/ current	LOW < 0.5 V, HIGH > 5 to 24 V (depends on external voltage)/ Max. 5 mA

Specifications   Chapter 5

5.1   General Specifications

Operating environment	Indoors, Pollution degree 2, up to 2,000 m (6562-ft.) ASL
Operating temperature and humidity	0 to 40°C (32 to 104°F), 80%RH or less (non-condensing)
Storage temperature and humidity	-10 to 55°C (14 to 131°F), 80%RH or less (non-condensing)
Dielectric strength	1.62 kV AC for 60 s, Cutoff current 10 mA, between all power terminals and protective ground, interfaces, and measurement terminals, between power supply line and power supply neutral
Applicable Standards Safety	EN61010
Power source	Rated supply voltage SM7860-01, 02, 03, 04, 05, 06, 07: 100 VAC, 110 VAC (Must specify when ordering) SM7860-21, 22, 23, 24, 25, 26, 27: 220 VAC (Voltage fluctuations of ±10% from the rated supply voltage are taken into account) Rated supply frequency : 50/60 Hz Anticipated transient overvoltage : 2,500 V
Maximum rated power	860 VA
Dimensions	Approx. 425W × 249H × 581D mm (16.73"W × 9.80"H × 22.87"D)
Mass	Approx. 45 kg (1587.3 oz.) (SM7860-01, 02, 03, 04, 05, 06, 21, 22, 23, 24, 25, 26) Approx. 32 kg (1128.7 oz.) (SM7860-07, 27)

Accessories	Power Cord..1
	Instruction manual 1
	Voltage output connector
	   SM7860-01, -02, -21, -22 2
	   SM7860-03, -04, -05, -06, -07, -23, -24, -25, -26, -27.........4

Options	Model 9637 RS-232C Cable (9pin-9pin/Cross/1.8m) Model 9638 RS-232C Cable (9pin-25pin/Cross/1.8m) Model 9151-02 GP-IB Connector Cable (2 m)
Replacement part	Fuse: MF60NRF-8A (250V M 8.0A φ6.4×30 mm)

5.2　Basic Specifications

Design

Model		Circuit A	Circuit B
SM7860-01 SM7860-21	Maximum output current	430 mA (200 VA)	430 mA (200 VA)
	Output voltage range	1.0 V to 500.0 V (0.1 V resolution)	-1.0 V to -500.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8): Voltage output OUT 2 (1) to (8): None	OUT 3 (1) to (8): Voltage output OUT 4 (1) to (8): None
	Current limit	±50 mA/CH	±50 mA/CH
SM7860-02 SM7860-22	Maximum output current	100 mA (100 VA)	100 mA (100 VA)
	Output voltage range	250.0 V to 1000.0 V (0.1 V resolution)	-250.0 V to -1000.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8): Voltage output OUT 2 (1) to (8): None	OUT 3 (1) to (8): Voltage output OUT 4 (1) to (8): None
	Current limit	±10 mA/CH	±10 mA/CH
SM7860-03 SM7860-23	Maximum output current	430 mA (200 VA)	430 mA (200 VA)
	Output voltage range	1.0 V to 500.0 V (0.1 V resolution)	-1.0 V to -500.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8): Voltage output OUT 2 (1) to (8): Voltage output	OUT 3 (1) to (8): Voltage output OUT 4 (1) to (8): Voltage output
	Current limit	±50 mA/CH	±50mA/CH
SM7860-04 SM7860-24	Maximum output current	100 mA (100 VA)	100 mA (100 VA)
	Output voltage range	250.0 V to 1000.0 V (0.1 V resolution)	-250.0 V to -1000.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8): Voltage output OUT 2 (1) to (8): Voltage output	OUT 3 (1) to (8): Voltage output OUT 4 (1) to (8): Voltage output
	Current limit	±10 mA/CH	±10 mA/CH
SM7860-05 SM7860-25	Maximum output current	430 mA (200 VA)	430 mA (200 VA)
	Output voltage range	1.0 V to 500.0 V (0.1 V resolution)	-1.0 V to -500.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8): Voltage output OUT 2 (1) to (8): Discharge	OUT 3 (1) to (8): Voltage output OUT 4 (1) to (8): Discharge
	Current limit	±50 mA/CH	±50 mA/CH
SM7860-06 SM7860-26	Maximum output current	100 mA (100 VA)	100 mA (100 VA)
	Output voltage range	250.0 V to 1000.0 V (0.1 V resolution)	-250.0 V to -1000.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8): Voltage output OUT 2 (1) to (8): Discharge	OUT 3 (1) to (8): Voltage output OUT 4 (1) to (8): Discharge
	Current limit	±10 mA/CH	±10 mA/CH
SM7860-07 SM7860-27	Maximum output current	430 mA (200 VA)	430 mA (200 VA)
	Output voltage range	1.0 V to 10.0 V (0.1 V resolution)	1.0 V to 10.0 V (0.1 V resolution)
	Channels	OUT 1 (1) to (8): Voltage output OUT 2 (1) to (8): Voltage output	OUT 3 (1) to (8): Voltage output OUT 4 (1) to (8): Discharge
	Current limit	±50 mA/CH	±50 mA/CH

Output terminals	Special round connector (support for 8 channels)
Setup method and operation	GP-IB Interface, RS-232C Interface, EXT I/O (No setup available on the SM7860 front panel except settings for GP-IB address)
LED indicator	POWER, Voltage output, Inter-lock
LCD screen	P1: Output voltage setting, monitor voltage value, channel-specific output setting state P2: Alarm setting, GP-IB address
Supported model	HIOKI Model SM7810, SM7810-20 Super MΩ HiTester

Functions

Voltage output function	
Operating method	Sink/source (support for charging and discharging)
Generation control	Output only when external I/O interface's $\overline{\text{OUTPUT}}$ signal is on.
Output on/off	Can be set independently for each channel.
Voltage error alarm	Operation : Alarm is generated when the monitor voltage falls outside the set range. Valid setting range : ±2 to ±19% (1% resolution)
Current limit function	
Limit method	Current can be limited independently for each channel.
Current limit direction	Current can be limited in both directions.
Backup Function	
Backup Items	Output voltage setting, alarm setting, GP-IB address
Voltage monitor function	
Voltage monitor	Measures and displays output voltage for each circuit.

Accuracy

Conditions of guaranteed accuracy	
Warm-up time	1 hour or more
Temperature and humidity range for guaranteed accuracy	23±5°C (73±9°F), 80%RH or less (non-condensing)
Temperature coefficient	From 0°C to 18°C and 28°C to 40°C, add 0.1 × accuracy specifications per °C.
Period of guaranteed accuracy	1 year
Generation accuracy	
Output voltage accuracy	±2% of setting ±0.5 V (no load)
Channel error	±0.01 V or less (no load, between outputs from same circuit)
Voltage monitor accuracy	±2% of output voltage ±0.5 V
Limit current accuracy	
SM7860-01, -03, -05, -07, -21, -23, -25, -27	50 mA ± 5 mA
SM7860-02, -04, -06, -22, -24, -26	10 mA ± 3 mA

5.2 Basic Specifications

Limitations

Voltage application target	Laminated ceramic capacitor
Number of charging channels	Up to 8 channels/circuit
Operating conditions	Charging interval must be greater than or equal to the time calculated from the graphs shown in Figure 1 and Figure 2 below. (Continuous charging is not supported.)

Figure 1: Charging Interval by Applied Voltage and Capacity
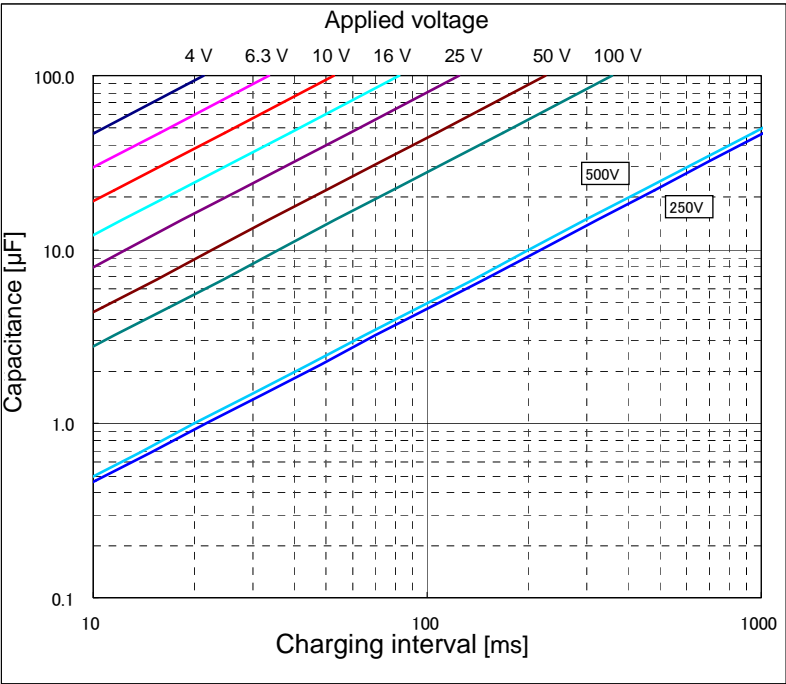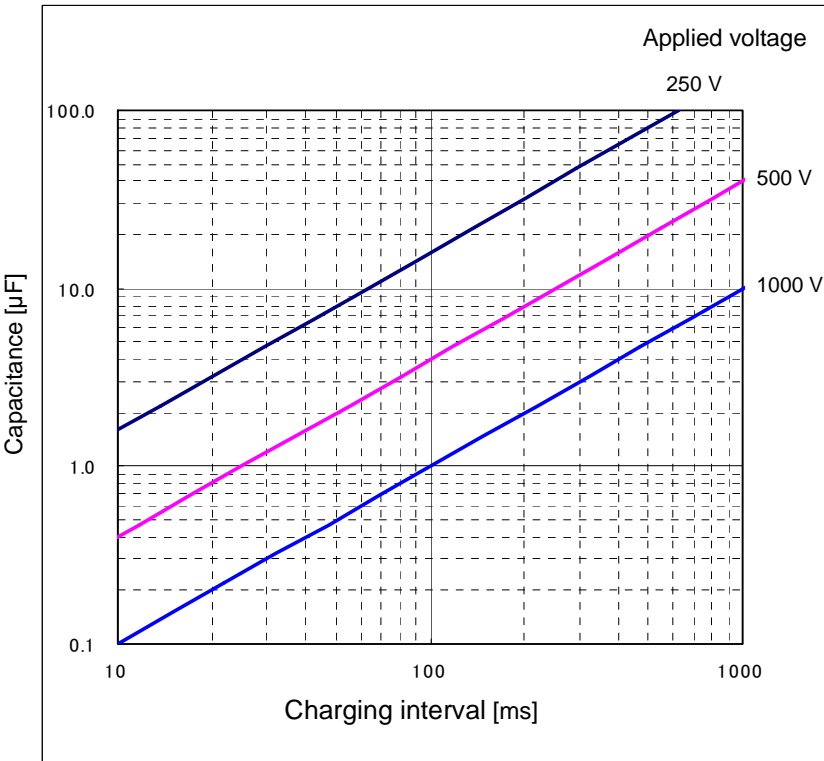(SM7860-01, 03, 05, 07, 21, 23, 25, 27)

Figure 2: Charging Interval by Applied Voltage and Capacity
(SM7860-02, 04, 06, 22, 24, 26)

Graph description and operating precautions

Because the SM7860 is designed to be embedded in an automated system in applications in which it charges capacitors, it cannot be used with a continuous load. Figures 1 and 2 define the minimum cycle times at which this automated system can operate based on the output voltage and capacitor capacitance.

For example, when charging a 25 V, 30 µF capacitor, a charge interval of approximately 37 ms can be read from the point at which a line extending from the 30 µF position on the vertical axis intersects the 25 V line. This figure (37 ms) defines the minimum cycle for the automated system.

The time (T) representing the interval during the 37 ms for which the SM7860 charges the capacitor at the full power of 50 mA or 10 mA can be calculated as follows:

$$T = C \times V / I$$

C : Capacitor capacitance
V : Voltage
I : Current (50 mA)

Using values of 25 V, 30 µF, and 50 mA yields:

T = 30 µF × 25 V / 50 mA
= 15 ms

The following diagram expresses this as a timing chart:
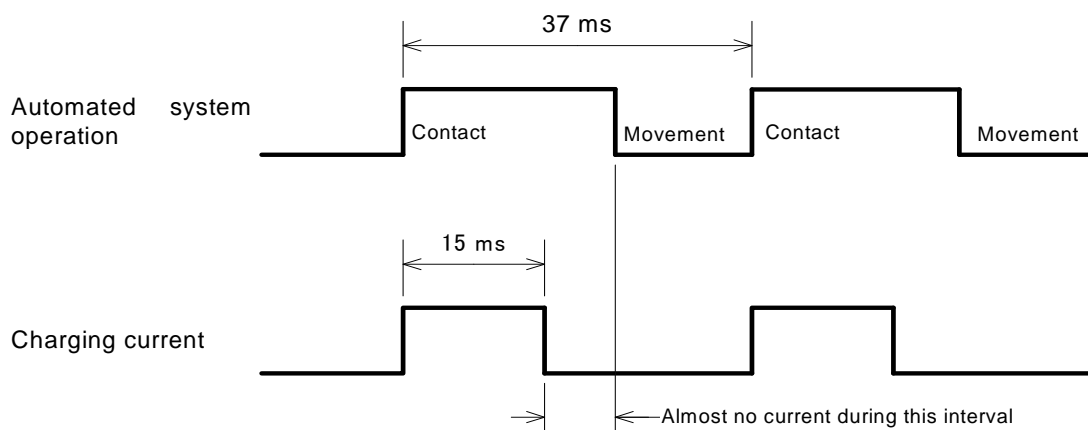
During the 37 ms interval, the charging current flows for 15 ms, and almost no current flows for the remaining 22 ms. If, for example, the automated system's cycle time were 100 ms instead of 37 ms, the charging current would flow for 15 ms, and almost no current would flow for the remaining 85 ms. This operation describes the normal manner in which the SM7860 is used.

Using the instrument when there are shorted components

If the capacitor being charged were shorted, for example due to defective insulation, the charging current would flow for the entire contact interval, rather than just 15 ms. If the test run is expected to include shorted components, check each component before initiating testing and avoid applying current if shorted.

(1) Design the system so that each of the external input (EXT I/O) signals, from $\overline{OUT1(1)\_ON}$ to $\overline{OUT4(8)\_ON}$, can be controlled (turned on and off) independently.
(2) When outputting voltage from the SM7860, check each capacitor for a short before initiating testing. (Have the automated system store the results of checks performed before testing, for example using capacitance measurement.)
(3) When a shorted component is encountered, turn the $\overline{OUT(X)\_ON}$ signal for the shorted component's channel off before turning the external input (EXT I/O) signal's $\overline{OUTPUT}$ signal on.

Using the instrument when capacitors are not mounted by the automated system

When capacitors are not properly mounted from the automated system's part feeder, the architecture of the system may cause the SM7860's output to enter the shorted state. This issue can be addressed in the same manner as described in "Using the instrument when there are shorted components" above.

5.3   Input / Output Functions

GP-IB Interface

Data reception	Output voltage setting, output on/off, voltage error alarm setting
Data transmission	Setting read access, error description

RS-232C Interface

Data reception	Output voltage setting, output on/off, voltage error alarm setting
Data transmission	Setting read access, error description

Communication conditions
    Baud rate
    Parity
    Stop bit
    Data
    Flow control
	
	38.4kbps
	none
	1 bit
	8 bit
	none

External I/O

Input/Output signals	
Input	$\overline{\text{OUTPUT}}$: Output on/off setting $\overline{\text{OUT 1(1)\_ON}}$ to $\overline{\text{OUT 1(8)\_ON}}$: Channel-specific on/off setting $\overline{\text{OUT 2(1)\_ON}}$ to $\overline{\text{OUT 2(8)\_ON}}$: Channel-specific on/off setting $\overline{\text{OUT 3(1)\_ON}}$ to $\overline{\text{OUT 3(8)\_ON}}$: Channel-specific on/off setting $\overline{\text{OUT 4(1)\_ON}}$ to $\overline{\text{OUT 4(8)\_ON}}$: Channel-specific on/off setting $\overline{\text{INTERLOCK}}$: When on, no voltage can be generated.
Output	$\overline{\text{BUSY}}$: Voltage being output $\overline{\text{ALARM}}$: Generated voltage alarm $\overline{\text{TEMP}}$: Temperature alarm
Electrical characteristics	
Input	Input method : Photocoupler-isolated input Input voltage : LOW; 0 to 0.5 V, HIGH; 24 V±10%
Output	Output method : Photocoupler-open collector output Output voltage/current : LOW <0.5 V, HIGH> 5 to 24 V (depends on external voltage) / Max. 5 mA
Connector	57RE-40500-730B (50-pin: DDK)

Maintenance and Service

Chapter 6

6.1 Troubleshooting

Inspection and Repair

⚠ **WARNING**

Touching any of the high-voltage points inside the device is very dangerous. Do not attempt to modify, disassemble or repair the device; as fire, electric shock and injury could result.

NOTE

If the device seems to be malfunctioning, confirm that "If the unit malfunctions/before you have it repaired" (p.46) before contacting your dealer or Hioki representative.

Transporting

Pack the device so that it will not sustain damage during shipping, and include a description of existing damage. We do not take any responsibility for damage incurred during shipping.

Replaceable Parts and Operating Lifetimes

Useful life depends on the operating environment and frequency of use. Operation cannot be guaranteed beyond the following periods.
For replacement parts, contact your dealer or Hioki representative.

Part	Life
Electrolytic Capacitors	Approx. 10 years
LCD backlight	Approx. 20,000 hours
Relay	Approx. 1 million operations

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If the unit malfunctions/before you have it repaired

| Symptom	Cause	Solution	See page
Neither the screen nor LEDs light up, even when the power switch is turned on.	Is the power cord properly connected?	Connect the power cord.	p.12
	Is the power supply fuse installed?	Install the power supply fuse.	p.47
	Has the power supply fuse been tripped?	Replace the power supply fuse.	p.47
The unit isn't accepting key input.	Is the unit in the key-lock state (indicated by the key-lock display on the screen)?	Cancel the key-lock state.	p.10 p.31
Settings cannot be configured from the GP-IB interface.	Do the GP-IB address settings on the unit and controller differ?	Set the correct GP-IB address.	p.10 p.21
	Did you use the RS-232C interface?	The GP-IB interface cannot be used after the RS-232C interface is used. Turn the unit off, wait a short amount of time, and then turn the unit back on.	p.18
Settings cannot be configured from the RS-232C interface.	Did you send the "**RMT**" command?	Send the "**RMT**" command. The RS-232C interface cannot be used to communicate unless the "**RMT**" command is sent first.	p.21
	Do the controller's RS-232C settings differ from the unit's communications conditions?	Change the controller's RS-232C communications settings.	p.21
	Did you use the GP-IB interface?	The RS-232C interface cannot be used after the GP-IB interface is used. Turn the unit off, wait a short amount of time, and then turn the unit back on.	p.18
	Are you using a straight cable?	Use a cross cable.	p.20
No voltage is being output from the voltage output terminal.	Is the interlock operating? Is the interlock indicator lit up?	The external I/O connector's interlock input signal is on. Check the reason that interlock has been activated and rectify it.	p.8 p.34
	Is the signal that turns the output channel on being input to the external I/O connector?	Set the channel being used to on with the input pins that turn each channel on and off.	p.34
	Is the signal that turns output on being input to the external I/O connector? Does the voltage output indicator light up when output is turned on?	Set the input pin that turns output on and off to on.	p.34
No voltage is being output from the voltage output terminal. The monitor voltage shown on the screen is 0.0 V, and the abnormal voltage alarm result is NG.	The unit's protective circuitry may have been triggered due to a failure.	Please contact your dealer or Hioki representative.	p.10
"TEMP" is flashing in reverse video on the screen, and a voltage is no longer being output from the voltage output terminal.	The overheat protection function has been activated. Are the limitations listed in the basic specifications being complied with?	Set the operating conditions so that the limitations in the basic specifications are complied with. While "TEMP" is displayed, all channels will be turned off, and the ability to control the unit from the interfaces and external I/O connector is disabled. Once the internal temperature decreases, the "TEMP" indicator on the screen will turn off, and you will once more be able to control the unit. All channels will be turned off when the unit resumes operation, so you will need to reconfigure the output channels for use.	p.10 p.42
"ERROR:011" is being shown in reverse video on the screen, and a voltage is no longer being output from the voltage output terminal.	The power supply A circuit's overcurrent protection function has been activated. Are the limitations listed in the basic specifications being complied with?	Set the operating conditions so that the limitations in the basic specifications are complied with. All channels will turn off, and the instrument will not accept control instructions from either interface or the external I/O connector. There is no way to recover from this state. Turn the unit off, wait a short amount of time, and then turn the unit back on.	p.10 p.42
"ERROR:012" is being shown in reverse video on the screen, and a voltage is no longer being output from the voltage output terminal.	The power supply B circuit's overcurrent protection function has been activated. Are the limitations listed in the basic specifications being complied with?		

6.2 Replacing the Power Fuse

⚠️ **WARNING**
- To avoid electric shock, turn off the power switch and disconnect the connection cables before replacing the fuse.
- Replace the fuse only with one of the specified characteristics and voltage and current ratings. Never use unspecified fuses and never use the device after the fuse holder has shorted. This will damage the device and cause injury.
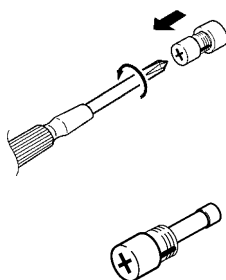 **Fuse type: MF60NRF-8A φ6.4 mm × 30 mm Normal-acting fuse**

Removing the Fuse Holder

Rear panel of the device
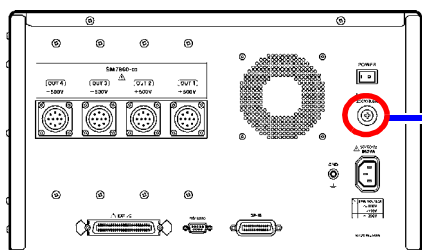
Fuse holder

Screwdriver

Replacing the Power Fuse

Fuse: φ6.4 mm × 30 mm

Tools to Prepare: Phillips head screwdriver

1 Turn off the power switch and disconnect the power cord.

2 Loosen the fuse holder screw with the Phillips head screwdriver and remove.
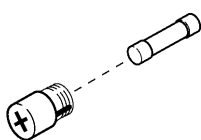
3 Replace the power fuse with a fuse of the designated rating.

4 Insert the fuse holder into its original location and tighten the screw.

6.3   Error Displays

Error Display	Description	Remedy
ERROR:001 Call Service Center	Backup data corrupt	Please contact your dealer or Hioki representative.
ERROR:002 Call Service Center	Backup data write failure	Please contact your dealer or Hioki representative.
ERROR:007 Call Service Center	Power source controller internal communication failure	Please contact your dealer or Hioki representative.
ERROR:011 Call Service Center	Power supply circuit A overcurrent	Check "If the unit malfunctions/before you have it repaired" (p.46).
ERROR:012 Call Service Center	Power supply circuit B overcurrent	Check "If the unit malfunctions/before you have it repaired" (p.46).

6.4   Cleaning

NOTE

- To clean the device, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.
- Wipe the LCD gently with a soft, dry cloth.