

# EC1000SA SPECIFICATIONS

1.1	Output	1-2
1.2	Current Limiter	1-6
1.3	Setting Range Limits	1-6
1.4	Signal Sources	1-7
1.5	Measurement Functions	1-8
1.6	Sequence Function	1-11
1.7	Arbitrary Waveform Memory	1-12
1.8	Setting Memory	1-12
1.9	Protection Functions	1-12
1.10	General	1-13
1.11	External Control I/O	1-14
1.12	External Interface	1-15
1.13	Power Input	1-15
1.14	Withstand Voltage and Insulation Resistance	1-16
1.15	Safety, EMC and RoHS	1-16
1.16	Ambient Temperature Range, Ambient Humidity Range, Etc.	1-17
1.17	External Dimensions and Weight	1-18

**A value with the accuracy is the guaranteed value of the specification. However, an accuracy noted as reference value shows the supplemental data for reference when the product is used, and is not under the guarantee. A value without the accuracy is the nominal value or representative value (shown as typ.).**

## 1.1 Output

Unless otherwise noted, the following conditions are adopted:

Load:	Resistance load of power factor 1
Output mode:	INT (internal signal source)
Output waveform:	Sine wave
Current Limiter:	Factory default setting
Output terminals:	Terminal block on rear panel

[set] indicates a setting value, and [rdg] indicates a reading value.

### 1.1 Output

<b>a) Output mode</b>	All eight modes (combination of operation mode + signal source mode)
AC-INT mode	(alternate current - internal signal source)
AC-EXT mode	(alternate current - external signal source)
AC-ADD mode	(alternate current - internal + external source)
AC-SYNC mode	(alternate current - external synchronization)
AC+DC-INT mode	(direct current - internal signal source)
AC+DC-EXT mode	(direct current - external signal source)
AC+DC-ADD mode	(direct current - internal + external source)
AC+DC-SYNC mode	(direct current - external synchronization)
<b>b) Output voltage ranges</b>	100 V range and 200 V range
<b>c) Maximum output power</b>	750 VA (AC) / 750 W (DC) Power supply input conditions: 100 V AC to 180 V AC input (hereinafter referred to as “AC 100 V input system”)  1000 VA (AC) / 1000 W (DC) Power supply input conditions: 180 V AC to 250 V AC input (hereinafter referred to as “AC 200 V input system”)
<b>d) Load power factor</b>	0 to 1 (phase lead or phase lag) <b>Note:</b> External power injection and regeneration are not available.

## 1.1 Output

### e) Output terminals

Terminal block with M4 screws (rear panel)

AC outlet (universal type, front panel)

**Note 1:** Use the AC outlet for AC (0 V AC to 250 V AC).

When DC is included, use screw terminal block on rear panel.

**Note 2:** Output is floating output. The Lo terminal can be grounded.

### f) Rated output voltage

100 V range: 100 Vrms (AC) / 100 V (DC)

200 V range: 200 Vrms (AC) / 200 V (DC)

### g) Output voltage settings (When signal source mode is INT, SYNC or ADD only)

**Note:** The AC settings (peak value) + DC setting that can be set are within the voltage setting limit range.

#### AC

100 V range: 0.0 Vrms to 155.0 Vrms (sine wave, square wave)

0.0 Vp-p to 440.0 Vp-p (arbitrary wave)

200 V range: 0.0 Vrms to 310.0 Vrms (sine wave, square wave)

0.0 Vp-p to 880.0 Vp-p (arbitrary wave)

Setting resolution: 0.1 Vrms (sine wave, square wave)

0.1 Vp-p (arbitrary wave)

Setting accuracy: 100 V range :  $\pm(0.5\% \text{ of set} + 0.6 \text{ Vrms})$

(23  $\pm$ 5°C, AC mode, 10 Vrms to 155 Vrms setting, 50 Hz or 60 Hz, sine wave, no load)

200 V range :  $\pm(0.5\% \text{ of set} + 1.2 \text{ Vrms})$

(23  $\pm$ 5°C, AC mode, 20 Vrms to 310 Vrms setting, 50 Hz or 60 Hz, sine wave, no load)

#### DC

100 V range: -220.0 V to +220.0 V

200 V range: -440.0 V to +440.0 V

Setting resolution: 0.1 V

Setting accuracy: 100 V range :  $\pm(0.5\% \text{ of set} + 0.6 \text{ V})$

(23  $\pm$ 5°C, AC+DC mode, output AC voltage setting = 0 V, -220 V to -10 V or +10 V to +220 V setting, no load)

200 V range :  $\pm(0.5\% \text{ of set} + 1.2 \text{ V})$

(23  $\pm$ 5°C, AC+DC mode, output AC voltage setting = 0 V, -440 V to -20 V or +20 V to +440 V setting, no load)

### h) Maximum output current

100 V range:	10 Arms (AC) / 10 A (DC)
200 V range:	5 Arms (AC) / 5 A (DC)

**Note 1:** For the AC 100 V input system, the limit on the maximum output power may cause a reduction in the maximum output current.

**Note 2:** If the output voltage is higher than the rated value, this is limited (lowered) to satisfy the power capacity.

**Note 3:** When output frequency is 40 Hz or lower, or it is 400 Hz or higher, the maximum output current may decrease.

**Note 4:** The RMS value for AC + DC is within the maximum output current.

### i) Maximum output peak current

100 V range:	40 Apk
200 V range:	20 Apk

**Note 1:** For the AC 100 V input system, the limit on the maximum output power may cause a reduction in the maximum output peak current.

**Note 2:** The above values are for the capacitor input type rectifier circuit whose crest factor is 4 or less.

**Note 3:** If the output voltage is higher than the rated value, the limit on the maximum output power may reduce the maximum output peak current.

**Note 4:** When output frequency is 45 Hz or lower, or it is 65 Hz or higher, the maximum output peak current may decrease.

### j) Frequency setting (When signal source mode is INT or ADD only)

Setting range:	1.0 Hz to 550.0 Hz
Setting resolution:	0.1 Hz
Setting accuracy:	$\pm 0.01\%$ (23 $\pm 5^\circ\text{C}$ )

### k) Output on phase (When signal source mode is INT, SYNC or ADD only)

Setting range:	0.0° to 359.9°
Setting resolution:	0.1°

### l) Output voltage waveform (When signal source mode is INT, SYNC or ADD only)

Sine wave, square wave, arbitrary waveform (16 types)

### m) Small amplitude frequency response

(When signal source mode is INT or SYNC only)

AC mode 40 Hz to 550 Hz:  $\pm 1\%$

AC+DC mode 40 Hz to 550 Hz:  $\pm 1\%$

(100 V range, output voltage is 20 Vrms, 50 Hz rating)

(When signal source mode is SYNC, the condition of the frequency is within the synchronization frequency range.)

### n) Output voltage distortion factor 0.5% or less

(50 Hz or 60 Hz, 50% or higher of the rated output voltage, the maximum output current or lower, THD+N)

### o) Output voltage stability

Fluctuation with output current: 45 Hz to 65 Hz Within  $\pm 0.15\%$

DC, 40 Hz to 550 Hz Within  $\pm 0.5\%$

(In the case that the output current is changed from 0% to 100% of the maximum output current, at the output terminal, the rated output voltage)

Fluctuation with input voltage: Within  $\pm 0.2\%$

(The power supply input voltage is 100 V, 120 V or 230 V, no load, the rated output voltage)

### p) Output DC offset

100 V range: Within  $\pm 50$  mV (typ., fine adjustment available)

200 V range: Within  $\pm 100$  mV (typ., fine adjustment available)

(AC - INT mode, output voltage setting = 0 V)

## 1.2 Current Limiter

- a) Output peak current limiter** When limiter is operating, output voltage is clipped.
- |                                 |  |
|---------------------------------|--|
| Positive current setting range: | 100 V range: +10.0 A to +42.0 A (Initial value: +42.0 A) |
|                                 | 200 V range: +5.0 A to +21.0 A (Initial value: +21.0 A)  |
| Negative current setting range: | 100 V range: -42.0 A to -10.0 A (Initial value: -42.0 A) |
|                                 | 200 V range: -21.0 A to -5.0 A (Initial value: -21.0 A)  |
| Setting resolution:             | 0.1 A  |
- b) Output RMS current limiter** When limiter is operating, suppresses output voltage.
- |                        |  |
|------------------------|--|
| Current setting range: | 100 V range: 1.0 A to 10.5 A (Initial value: 10.5 A) |
|                        | 200 V range: 1.0 A to 5.3 A (Initial value: 5.3 A)   |
| Setting resolution:    | 0.1 A  |

## 1.3 Setting Range Limits

- a) Voltage setting limit** (When signal source mode is INT, SYNC or ADD only)
- |                                 |   |
|---------------------------------|---|
| Positive voltage setting range: | 100 V range: +0.1 V to +220.0 V (Initial value: +220.0 V) |
|                                 | 200 V range: +0.1 V to +440.0 V (Initial value: +440.0 V) |
| Negative voltage setting range: | 100 V range: -220.0 V to -0.1 V (Initial value: -220.0 V) |
|                                 | 200 V range: -440.0 V to -0.1 V (Initial value: -440.0 V) |
| Setting resolution:             | 0.1 V   |
- b) Frequency setting limit**  
(Lower limit  $\leq$  upper limit) (When signal source mode is INT or ADD only)
- |                            |                    |                           |
|----------------------------|--------------------|---------------------------|
| Upper limit setting range: | 1.0 Hz to 550.0 Hz | (Initial value: 550.0 Hz) |
| Lower limit setting range: | 1.0 Hz to 550.0 Hz | (Initial value: 1.0 Hz)   |
| Setting resolution:        | 0.1 Hz             |                           |

## 1.4 Signal Sources

The signal sources that can be selected are internal (INT), external signal input (EXT), internal + external (ADD), and external synchronization (SYNC).

### a) Internal signal source (INT mode, ADD mode)

 See "9.1 Output".

### b) External signal input (EXT mode, ADD mode)

Gain setting range:	100 V range: 0.0 times to 220.0 times (initial value: 100.0) 200 V range: 0.0 times to 440.0 times (initial value: 200.0)
Gain setting resolution:	0.1 times
Gain accuracy:	±5% (DC, or 45 Hz to 65 Hz, gain is at initial value, with rated voltage output, no load)
Output phase to input:	In-phase
Input terminal:	BNC connector (rear panel) (also used as the external sync signal input terminal)
Input impedance:	10 kΩ
Input voltage range:	-2.2 V to +2.2 V
Nondestructive maximum input voltage:	±10 V
Frequency range:	DC to 550 Hz (sine wave) DC to 100 Hz (other than sine wave)

### c) External synchronization (SYNC mode)

Synchronization signal source:	External sync signal or line (select one)
Synchronization frequency range:	40 Hz to 500 Hz
Input terminal:	BNC connector (rear panel) (also used as the external signal input terminal)
	<b>Note:</b> External sync signal is not required when line synchronization is selected
Input impedance:	10 kΩ
Input voltage threshold value:	TTL
Minimum pulse width:	3 ms
Nondestructive maximum input voltage:	±10 V

## 1.5 Measurement Functions

### a) Output voltage measurement

RMS value:	RMS value of AC+DC
Full scale:	100 V range : 250.0 Vrms 200 V range : 500.0 Vrms
Display resolution:	0.1 Vrms
Measurement accuracy:	at 45 Hz to 65 Hz 100 V range : $\pm(0.5\% \text{ of rdg} + 0.3 \text{ Vrms})$ 200 V range : $\pm(0.5\% \text{ of rdg} + 0.6 \text{ Vrms})$ at DC, 40 Hz to 550 Hz 100 V range : $\pm(0.7\% \text{ of rdg} + 0.9 \text{ Vrms})$ 200 V range : $\pm(0.7\% \text{ of rdg} + 1.8 \text{ Vrms})$ (at $23 \pm 5^\circ\text{C}$ )
Average value:	Average value of AC+DC (measures DC component)
Full scale:	100 V range : $\pm 250.0 \text{ V}$ 200 V range : $\pm 500.0 \text{ V}$
Display resolution:	0.1 V
Measurement accuracy:	100 V range : $\pm( 0.5\% \text{ of rdg}  + 0.4 \text{ V})$ 200 V range : $\pm( 0.5\% \text{ of rdg}  + 0.8 \text{ V})$ (at $23 \pm 5^\circ\text{C}$ )
Peak value:	Maximum voltage and minimum voltage are displayed separately
Full scale:	100 V range : $\pm 250 \text{ Vpk}$ 200 V range : $\pm 500 \text{ Vpk}$
Display resolution:	1 Vpk
Measurement accuracy:	100 V range : $\pm( 1.5\% \text{ of rdg}  + 3 \text{ Vpk})$ 200 V range : $\pm( 1.5\% \text{ of rdg}  + 6 \text{ Vpk})$ (reference value, at $23 \pm 5^\circ\text{C}$ , sine wave of which frequency is 45 Hz to 65 Hz)

### b) Output current measurement

RMS value:	RMS value of AC+DC
Full scale:	15.00 Arms
Display resolution:	0.01 Arms
Measurement accuracy:	at 45 Hz to 65 Hz $\pm(0.5\% \text{ of rdg} + 0.04 \text{ Arms})$ at DC, 40 Hz to 550 Hz $\pm(0.7\% \text{ of rdg} + 0.08 \text{ Arms})$ (at $23 \pm 5^\circ\text{C}$ , output current is 5% to 100% of the maximum output current)

## 1.5 Measurement Functions

Average value:	Average value of AC+DC (measures DC component)
Full scale:	$\pm 15.00$ A
Display resolution:	0.01 A
Measurement accuracy:	$\pm(0.5\% \text{ of rdg} + 0.08 \text{ A})$ (at $23 \pm 5^\circ\text{C}$ , output current is 5% to 100% of the maximum output current)
Peak value:	Minimum current and maximum current are displayed separately
Full scale:	$\pm 45.0$ Apk
Display resolution:	0.1 Apk
Measurement accuracy:	$\pm(2\% \text{ of rdg} + 0.4 \text{ Apk})$ (reference value, at $23 \pm 5^\circ\text{C}$ , sine wave of which frequency is 45 Hz to 65 Hz)
Peak value hold:	Maximum value of   max current   and   min current
Full scale:	45.0 Apk
Display resolution:	0.1 Apk

### c) Output power measurement

#### Effective power

Full scale:	1200 W
Display resolution:	1 W
Measurement accuracy:	at 45 Hz to 65 Hz $\pm(2\% \text{ of rdg} + 1 \text{ W})$ at DC $\pm(3\% \text{ of rdg} + 12 \text{ W})$ (at $23 \pm 5^\circ\text{C}$ , load with the power factor 0.5 to lower than 1, 50 V or higher output voltage, output current is 10% to 100% of the maximum output current)

Apparent power: Calculated as output voltage RMS value  $\times$  output current RMS value

Full scale:	1400 VA
Display resolution:	1 VA
Measurement accuracy:	at 45 Hz to 65 Hz $\pm(2\% \text{ of rdg} + 1 \text{ VA})$ at DC $\pm(3\% \text{ of rdg} + 12 \text{ VA})$ (at $23 \pm 5^\circ\text{C}$ , 50 V or higher output voltage, output current is 10% to 100% of the maximum output current)

## 1.5 Measurement Functions

Reactive power:	Calculated as $\sqrt{(\text{apparent power})^2 - (\text{effective power})^2}$
Full scale:	1400 var
Display resolution:	1 var
Measurement accuracy:	$\pm(2\% \text{ of rdg} + 1 \text{ var})$ (at $23 \pm 5^\circ\text{C}$ , load with the power factor 0 to lower than 0.5, 45 Hz to 65 Hz, 50 V or higher output voltage, output current is 10% to 100% of the maximum output current)

**d) Load power factor measurement:** Calculated as effective power / apparent power

Measurement range:	0.00 to 1.00
Display resolution:	0.01

**e) Load crest factor measurement:** Calculated as (maximum value of | maximum current | and | minimum current |) / RMS current

Measurement range:	1.00 to 50.00
Display resolution:	0.01

**f) Output harmonic current measurement** (AC - INT mode only, fundamental wave is 50 Hz or 60 Hz only)

Measurement range:	To 40th harmonic of fundamental wave
Full scale:	15.00 Arms and 500.0%
Display resolution:	0.01 Arms and 0.1%
Measurement accuracy:	at RMS value current up to 10th $\pm(1\% \text{ of rdg} + 0.08 \text{ Arms})$ at RMS value current from 11th up to 20th $\pm(2\% \text{ of rdg} + 0.08 \text{ Arms})$ at RMS value current from 21st up to 40th $\pm(5\% \text{ of rdg} + 0.08 \text{ Arms})$

(All in the case of reference value, at  $23 \pm 5^\circ\text{C}$ )

**Note:** This measurement does not comply with the IEC or other standards.

**g) External synchronization frequency measurement** (SYNC mode only)

Measurement range:	38.0 Hz to 525.0 Hz
Display resolution:	0.1 Hz
Measurement accuracy:	$\pm 0.2 \text{ Hz}$ (at $23 \pm 5^\circ\text{C}$ )

### 1.6 Sequence Function

Output parameters can be changed abruptly or swept in sequence.

Signal source is INT only.

Sequence function settings are stored in memory with battery backup.

- a) Number of sequences**                      1 sequence per operation mode (AC or AC+DC mode) and output range (100 V or 200 V)
  
- b) Number of steps**                            1 to 255 (within 1 sequence)
  
- c) Step time**                                    0.1 ms to 999.9999 s (resolution 0.1 ms)
  
- d) Operations within step**                    Constant, keep, or linear sweep
  
- e) Parameters**                                 DC voltage, AC voltage, frequency, waveform, and synchronous step output (2 bits)
  
- f) Jump times**                                 1 to 999 or infinite
  
- g) Sequence control**
  - Start:    Starts a sequence.
  - Stop:     Stops a sequence.
  - Hold:     Maintains current step output. Restarted when a sequence is started.
  - Branch:    Branches to the specified step.

## 1.7 Arbitrary Waveform Memory

The contents of arbitrary waveform memory are retained by battery backup.

- a) **Number of waveform memories**      16
- b) **Waveform length**                      4096 words
- c) **Waveform data**                              15 bits

**Note:** Arbitrary waveform memory cannot be written to from the panel screen.

The USB interface is used for writing.

## 1.8 Setting Memory

Various settings are retained in memory with battery backup, and the settings when the power source was last turned off are restored at power-on. Among these various settings, the basic settings (output mode, output range, DC settings, AC settings, output current limiter, and setting range limits) can be stored in store/recall memory No. 1 to No. 30. These stored settings can be recalled.

The recall operation for store/recall memory can be executed only when the output is off.

## 1.9 Protection Functions

- a) **Abnormal output**                              When an output overvoltage or output overcurrent is detected, the output will be set to off and the error message is displayed.
- b) **Abnormal internal power source**              When an internal power source abnormality is detected, the output will be set to off and all operations will become disabled (system lock) except for the power-off operation. (In some cases, output will be set off but shutdown is not necessary.)
- c) **Abnormal internal control**                      When a control abnormality is detected, the output will be set to off and all operations will become disabled (system lock) except for the power shutdown operation. (In some cases, output will be set off but shutdown is not necessary.)
- d) **Abnormal internal temperature**              When an abnormality is detected, the output will be set to off.

## 1.10 General

### a) LCD settings

Contrast:	Adjustable
Display color:	White background or Blue background

### b) Beep sound

On or off  
When the setting is on and a key input error or other operation error occurs, a beep sound will be output. When a protection function-related error occurs, an alarm sound will be output regardless of the beep sound setting.

### c) Keylock

On or off  
When the setting is on, only the keylock off operation and the output off operation are enabled.

### d) Output setting at power-on

On or off  
When the setting is on, the output is automatically set to on at power-on.

### e) Reset function

This function resets all basic settings to their initial (factory) settings.

### f) Self test function

This function checks memory at power-on.

## 1.11 External Control I/O

**a) External control operation mode** Enabled or disabled (the state output is always on)

### b) Control input

Input level:	High level: +4.0 V or higher	
	Low level: +1.0 V or lower	
Nondestructive maximum input:	+10 V/-5 V	
Input impedance:	pull-up to +5 V at 47 kΩ	
Detection cycle:	2 ms	
Control items:	Output off	Output off at fall
	Output on	Output on at fall
	Sequence start	Start at fall
	Stop of sequence	Stop at fall
	Hold input	Hold at fall
	Branch inputs 0, 1	Start branch at fall

### c) State output

Output level:	0 V/+5 V (open)	
Output impedance:	100 Ω	
Switching cycle:	0.1 ms	
Status items:	Power source on/off status	L: off, H: on
	Output on/off status	L: off, H: on
	Limiter operation	L: Not operating, H: Operating
	Software busy	L: Normal, H: Busy
	Sequence operation step synchronized outputs L or H	

### d) Terminals

D-sub 25-pin multi-connector  
(rear panel, female, M2.6 screw)

## 1.12 External Interface

USB interface and RS232 interface are provided for external control from a personal computer.  
(The factory default is USB)

### a) USB interface

Interface standard: USB1.1, USBTMC  
ID: Already assigned to each device  
Terminator: "LF"

**Note:** The use of USB hub may cause a communication failure.  
It is recommended to use fully-shield, short cable.

### b) RS232 interface

Terminal: D-sub 9-pin (male, UNC #4 -40 screws)  
Baud rate: 9600 bps/ 19200 bps (Initial value: 9600 bps)  
Terminator: "CR""LF"/"CR""LF" (Initial value: "CR" "LF")  
Parity: None/Odd/Even (Initial value: None)  
Stop bit: 1 / 2 (Initial value: 1 bit)  
Data bit: 7 / 8 (Initial value: 8 bit)  
Flow control: None/Hardware/Software (Initial value: None)

**Note:** Binary transmission is not supported. So it is not possible to send or receive the arbitrary waveform data.

**Note:** Use a cross cable.

## 1.13 Power Input

**a) Input voltage range** 100 V AC to 230 V AC  $\pm 10\%$  (not exceeding 250 V)  
Overvoltage Category II

**b) Frequency range** 50 Hz  $\pm 2$  Hz or 60 Hz  $\pm 2$  Hz (single phase)

**c) Power consumption** 1.4 kVA or less

**d) Power factor (typ.)** 0.95 or higher (the power input voltage is 100 V, the rated output voltage, the resistance load at the maximum output current)  
0.90 or higher (the power input voltage is 200 V, the rated output voltage, the resistance load at the maximum output current)

### 1.14 Withstand Voltage and Insulation Resistance

Between input power line vs. output/chassis or input power line/ chassis vs. output

- a) **Withstand voltage** AC 1500 V, 1 minute
  
- b) **Insulation resistance** 30 MΩ or higher, 500 V DC

### 1.15 Safety, EMC and RoHS

Only Models with a CE Marking on the Rear Panel.

- a) **Safety** Compliant with the following standard requirement  
EN61010-1  
Pollution Degree 2
  
- b) **EMC** Compliant with the following standard requirement  
EN61326-1 (Group 1, Class A)  
EN61000-3-2  
EN61000-3-3  

Note: This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.
  
- c) **RoHS** Compliant with the following  
Directive 2011/65/EU

## 1.16 Ambient Temperature Range, Ambient Humidity Range, Etc.

- |                          |  |
|--------------------------|--|
| a) Operating environment | Indoor use   |
| b) Altitude              | 2000 m or lower  |
| c) Operation guarantee   | 0 °C to +40°C, 5 % to 85% RH<br>When absolute humidity is 1 g/m <sup>3</sup> to 25 g/m <sup>3</sup> , with no condensation   |
| d) Performance guarantee | +5 °C to +35°C, 5 % to 85% RH<br>When absolute humidity is 1 g/m <sup>3</sup> to 25 g/m <sup>3</sup> , with no condensation  |
| e) Storage condition     | -10 °C to +50°C, 5 % to 95% RH<br>When absolute humidity is 1 g/m <sup>3</sup> to 29 g/m <sup>3</sup> , with no condensation |

Figure 1-1 shows the ambient temperature and humidity ranges.

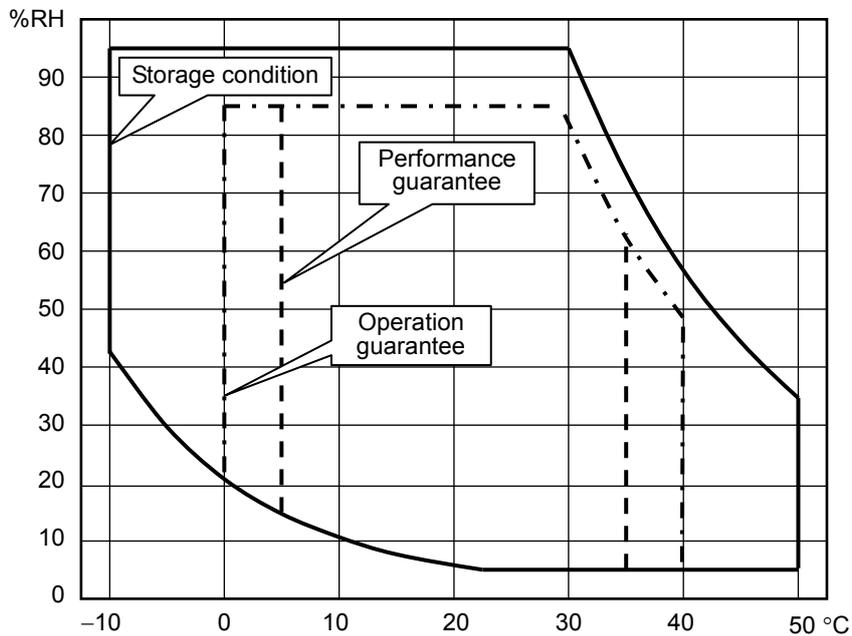


Figure 1-1. Temperature and Humidity Ranges

## 1.17 External Dimensions and Weight

### a) External dimensions

Width: 258 mm

Height: 176 mm

Depth: 440 mm

(Projections are not included.)

### b) Weight

Approximately 9.7 kg

**Figure 1-2** shows the external dimensions.

# 1.17 External Dimensions and Weight

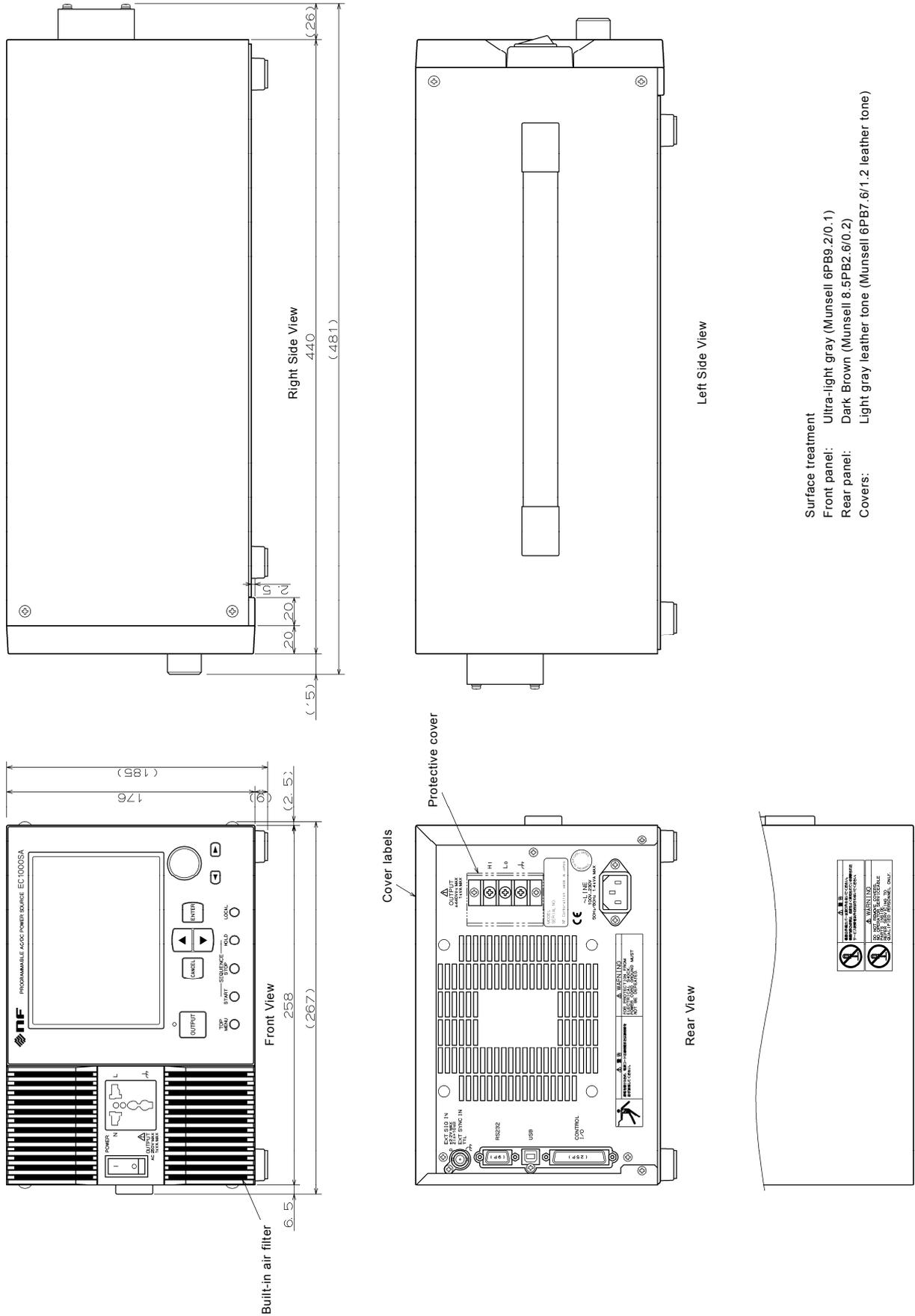


Figure 1-2. External Dimensions