

## WHEN THE INSTRUMENT HAS ARRIVED

The instrument is strictly factory inspected. After it has arrived, however, check the quantities of accessories, etc. and appearance and operation of the instrument to make sure nothing is wrong.

If some accessories are missing or the operation is poor, contact the nearest service agent given on the back cover of the manual.

### 1. ACCESSORIES

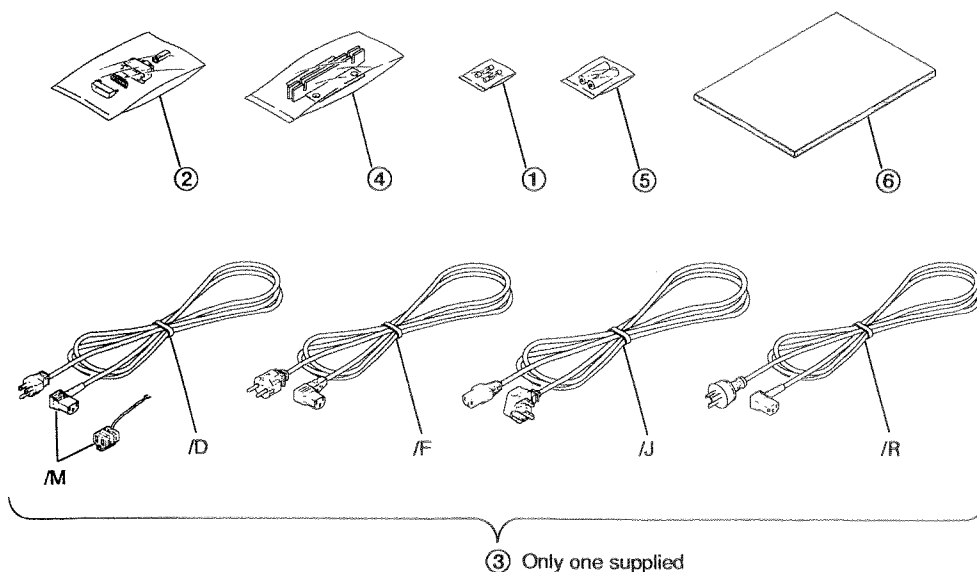
The instrument is furnished with accessories given in Figure 1 and Table 1. Check the quantities, etc. against them.

#### • Checking Model and Specifications of the 2533E

Model	Suffix Code	Specifications
2533E31	.....	Single-Phase, AC
2533E32	.....	Three-Phase 3-Wire, AC
2533E33	.....	Three-Phase 4-Wire, AC
2533E41	.....	Single-Phase, DC/AC
2533E42	.....	Three-Phase 3-Wire, DC/AC
2533E43	.....	Three-Phase 4-Wire, DC/AC
	-C1 .....	GP-IB interface
	-C2 .....	RS-232-C interface
	-1 .....	Rated supply voltage setting: 100 VAC (50/60 Hz)
	-3 .....	Rated supply voltage setting: 115 VAC (50/60 Hz)
	-5 .....	Rated supply voltage setting: 200 VAC (50/60 Hz)
	-7 .....	Rated supply voltage setting: 230 VAC (50/60 Hz)
	-M .....	UL/CSA standard power cord + 3-pin to 2-pin adapter (Part number: A1253JZ)
	-D .....	UL/CSA standard power cord (Rating: 125 VAC, 7 A) (Part Number: A1006WD)
	-F .....	VDE standard power cord (Rating: 125 VAC, 10 A) (Part Number: A1009WD)
	-R .....	VDE standard power cord (Rating: 240 VAC, 10 A) (Part Number: A1024WD)
	-J .....	BS standard power cord (Rating: 250 VAC, 5 A) (Part Number: A1023WD)
	/FREQ	
	/INTEG	

#### • Check Accessories

The following accessories are supplied with the 2533E.



## 1-4. Specifications

**Display:** LED (light-emitting diode)

**Display Mode (3 displays):**

Mode	Max. Display	Display Item
A	±99999	V, A, W (1, 2, 3, Σ for each)*
B	±99999	V, A, W (1, 2, 3, Σ for each)* integration lapse (option)
C	±99999 (±999999 Wh, Ah)	V, A, W, VA, var, PF, (Hz, Wh, Ah ... option, 1, 2, 3, Σ for each)*

\*: 1, 3, Σ for three-phase three-wire

**Unit:** m, k, M, V, A, W, VA, var, Hz h, ►


**Function Change:** display A, B, C can be changed independently (except VA, var, PF)

(mode is changed by GP-IB or RS-232-C interface)

**Sample Rate:** approx. 2.5 samples/s

**Range Change:** manual, auto and external control (GP-IB ... option) change all phase to the same ranges independently for V and A

**Auto Range Change:** by RMS or MEAN value in case of V, RMS value in case of A

**Demagnetizing:** Demagnetizes DC-CT core by pressing the  key in local mode, or receiving a DM command in remote or local mode. Demagnetizing time is approx. 5 seconds.

**Effective Input Range:** 10 to 110% of rated value (range)

**Response Time:** approx. 0.4 s (time required for analog value to reach specified accuracy at change of 30→100% or 100→30% when filter is OFF). Approx. 2 s when filter is ON.

**Data Output:** wave output;  $v_1$ ,  $v_2$ ,  $v_3$ ,  $i_1$ ,  $i_2$ ,  $i_3$  (for monitor)

Analog output:

$$V_1, V_2, V_3, \frac{V_1+V_3}{2} \text{ or } \frac{V_1+V_2+V_3}{3}$$

$$A_1, A_2, A_3, \frac{A_1+A_3}{2} \text{ or } \frac{V_1+V_2+V_3}{3}$$

$$W_1+W_2+W_3, W_1+W_3 \text{ or } W_1+W_2+W_3.$$

12 kinds output simultaneously at three-phase four-wire

9 kinds output simultaneously at three-phase three-wire

**D-A output:** one of VA, var, PF, Wh, Ah, Hz (data indicated on display C)

**GP-IB or RS-232-C interface:** display data and measurement data

**External Control:** measurement sample start, A-D BUSY (standard), integrator (option) start, stop and reset

Operating temperature and humidity ranges: 5 to 40°C (23 to 104°F), 20 to 80% R.H.

**Storage Temperature Range:** -10 to 50°C (14 to 122°F) (non-condensing)

**Warmup Time:** approx. 30 min (until all specifications are satisfied)

**Insulation Resistance:** Use a 500 V insulation resistance tester. At least 50 MΩ between: (input terminal and case, input and output terminals, voltage and current terminals, input terminal, output terminal, case and power supply terminal)

**Dielectric Strength:** 3,000 V AC, 50/60 Hz, 1 min (input terminal and case, input and output terminals, voltage and current terminals), 1,500 V AC, 50/60 Hz, 1 min. (input and output terminals, case and power supply terminals)

**Source:** 100 or 115 V ±10% AC, 48 to 63 Hz (200 V series to be specified)

**Power Consumption:** approx. 35 VA

**External Dimensions:** approx. 149×444×364 mm (5-7/8"×17-1/2"×14-5/16")

**Weight:** approx. 14 kg (31 lbs.) (for AC meter)  
approx. 16 kg (35 lbs.) (for DC/AC meter)

**Accessories:** power cord ... 1. Fuse ... 2 (1 A for 100 V series, 0.5 A for 200 V series). Connector ... 1. Mounting fixture ... 1 set. Dry cells (R6P) ... 2. Instruction manual ... 2 copies (separate manuals for options).

### Input section

Item	Input	Voltage	Current
Type of input	AC	Direct input (CT isolation after changing range)	CT isolation (secondary switching)
	DC/AC	Direct input (DC-CT isolated after changing range)	DC-CT isolated (secondary switching)
Rated value (range)	AC	30/60/150/300/600 V	0.5/1/2/5/10/20 A
	DC/AC		1/2/5/10/20 A
Frequency range	AC	10 Hz to 30 kHz	10 Hz to 30 kHz
	DC/AC	DC, 10 Hz to 30 kHz	DC, 10 Hz to 30 kHz
Max. allowable input for 1 s		Peak 3.5 times range or 1,400 V whichever smaller	Peak 10 times range or 70 A, whichever smaller
Max. continuous allowable input (at 50/60 Hz)		Peak 1,000 V or rms value 2 times range, whichever smaller	Peak 50 A or rms value 3 times range, whichever smaller
Instrument loss	AC	Input resistance approx. 1 MΩ (all ranges)	At 50 Hz, 2 mΩ in all ranges
	DC/AC		
Max. continuous common mode voltage, 50/60 Hz		1,000 Vrms	1,000 Vrms
Influence by common mode voltage at 50/60 Hz		Less than ±0.025% of range (input terminals shorted, 1,000 V applied to input-case)	Same as voltage (input terminal open)

\*DC/AC meters do not cover 0.5 A range.

## Measurement Functions

Measurement Functions		Voltage	Current	Power
Item				
Principle		Change of mean value rectification and true RMS by LOG-anti LOG	True RMS by LOG-anti LOG	PWM time division multiplication
Measured item	Three-phase three-wire	$V_1, V_3, \frac{V_1+V_3}{2} (\Sigma)$	$A_1, A_3, \frac{A_1+A_3}{2} (\Sigma)$	$W_1, W_3, W_1+W_3(\Sigma)$
	Three-phase four-wire	$V_1, V_2, V_3, \frac{V_1+V_2+V_3}{3} (\Sigma)$	$A_1, A_2, A_3, \frac{A_1+A_2+A_3}{3} (\Sigma)$	$W_1, W_2, W_3, W_1+W_2+W_3(\Sigma)$
Measurement frequency	AC	10 Hz to 30 kHz	10 Hz to 30 kHz	10 Hz to 30 kHz
	DC/AC	DC, 10 Hz to 30 kHz	DC, 10 Hz to 30 kHz	DC, 10 Hz to 30 kHz
Crest factor	AC	Max. 3	Max. 2	Same as these described in voltage and current column.
	DC/AC		Max. 3 or 50 A (peak)	
Accuracy	AC	10 to 20 Hz $\pm(0.3\% \text{ of rdg} + 0.3\% \text{ of range})$ 20 to 45 Hz $\pm(0.2\% \text{ of rdg} + 0.2\% \text{ of range})$ 45 to 66 Hz $\pm(0.1\% \text{ of rdg} + 0.1\% \text{ of range})$ 66 Hz to 2 kHz $\pm(0.2\% \text{ of rdg} + 0.2\% \text{ of range})$ 2 k to 10 kHz $\pm 1.0\% \text{ of range}$ 10 k to 20 kHz $\pm 1.5\% \text{ of range}$ 20 k to 30 kHz $\pm 2.0\% \text{ of range}$ (at input 10 to 110%)	10 to 20 Hz $\pm(0.3\% \text{ of rdg} + 0.3\% \text{ of range})$ 20 to 45 Hz $\pm(0.2\% \text{ of rdg} + 0.2\% \text{ of range})$ 45 Hz to 66 Hz $\pm(0.1\% \text{ of rdg} + 0.1\% \text{ of range})$ 66 Hz to 2 kHz $\pm(0.2\% \text{ of rdg} + 0.2\% \text{ of range})$ 2 k to 10 kHz $\pm 1.0\% \text{ of range}$ 10 k to 20 kHz $\pm 1.5\% \text{ of range}$ 20 k to 30 kHz $\pm 2.0\% \text{ of range}$ (at input 10 to 110%)	At $\cos \phi = 1$ 10 to 20 Hz $\pm(0.3\% \text{ of rdg} + 0.4\% \text{ of range})$ 20 to 45 Hz $\pm(0.2\% \text{ of rdg} + 0.2\% \text{ of range})$ 45 to 66 Hz 400 Hz $\pm(0.1\% \text{ of rdg} + 0.1\% \text{ of range})$ 66 Hz to 2 kHz $\pm(0.2\% \text{ of rdg} + 0.2\% \text{ of range})$ 2 k to 10 kHz $\pm 1.0\% \text{ of range}$ 10 k to 20 kHz $\pm 2.0\% \text{ of range}$ 20 k to 30 kHz $\pm 3.0\% \text{ of range}$
	DC/AC	DC: $\pm(0.1\% \text{ of rdg} + 0.2\% \text{ of range})$ 10 to 20 Hz $\pm(0.2\% \text{ of rdg} + 0.4\% \text{ of range})$ 20 to 45 Hz $\pm(0.2\% \text{ of rdg} + 0.4\% \text{ of range})$ 45 to 66 Hz $\pm(0.1\% \text{ of rdg} + 0.2\% \text{ of range})$ 66 Hz to 2 kHz $\pm(0.2\% \text{ of rdg} + 0.4\% \text{ of range})$ 2 k to 10 kHz $\pm 1.0\% \text{ of range}$ 10 k to 20 kHz $\pm 1.5\% \text{ of range}$ 20 k to 30 kHz $\pm 2.0\% \text{ of range}$ (at input 10 to 110%)	DC: $\pm(0.1\% \text{ of rdg} + 0.2\% \text{ of range} + 3 \text{ mA})$ 10 to 20 Hz $\pm(0.2\% \text{ of rdg} + 0.4\% \text{ of range})$ 20 to 45 Hz $\pm(0.2\% \text{ of rdg} + 0.4\% \text{ of range})$ 45 to 66 Hz $\pm(0.1\% \text{ of rdg} + 0.2\% \text{ of range})$ 66 Hz to 2 kHz $\pm(0.2\% \text{ of rdg} + 0.4\% \text{ of range})$ 2 k to 10 kHz $\pm 1.0\% \text{ of range}$ 10 k to 20 kHz $\pm 1.5\% \text{ of range}$ 20 k to 30 kHz $\pm 2.0\% \text{ of range}$ (at input 10 to 110%)	At $\cos \phi = 1$ DC: $\pm(0.1\% \text{ of rdg} + 0.3\% \text{ of range})$ 10 to 20 Hz $\pm(0.3\% \text{ of rdg} + 0.4\% \text{ of range})$ 20 to 45 Hz $\pm(0.2\% \text{ of rdg} + 0.4\% \text{ of range})$ 45 to 66 Hz 400 Hz $\pm(0.1\% \text{ of rdg} + 0.2\% \text{ of range})$ 66 Hz to 2 kHz $\pm(0.2\% \text{ of rdg} + 0.4\% \text{ of range})$ 2 k to 10 kHz $\pm 1.0\% \text{ of range}$ 10 k to 20 kHz $\pm 2.0\% \text{ of range}$ 20 k to 30 kHz $\pm 3.0\% \text{ of range}$
Influence by power factor		—	—	Within 50/60 Hz $\pm 0.5\%$ of rdg at $\cos \phi = 0.5$
Accuracy (analog output) at same conditions as for display		Add 0.05% of range to display accuracy shown above.		
Temperature coefficient 5 to 20°C (41 to 68°F), 26 to 40°C (79 to 104°F)		Less than $\pm 0.03\%$ of range/°C (Less than $\pm 0.02\%$ of range/°F)	Same as voltage	Same as voltage

\* Accuracy within one year after calibration: Compared with the 90 days accuracy, add (total error)  $\times 0.5$

**Computing Functions****Apparent Power, Reactive Power and Power Factor Computations**

Computing Function Item		Apparent Power (VA)	Reactive Power (var)	Power Factor (PF)
Arithmetic expression	1 to 3 (each part)	$V_i \times A_i$	$(V_i \times A_i)^2 - W_i^2$	$\frac{W_i}{V_i \times A_i}$
	$\Sigma$ (three-phase three-wire)	$\frac{V_1 + V_3}{2} \times \frac{A_1 + A_3}{2} \times \sqrt{3}$	$\sqrt{\left(\frac{V_1 + V_2}{2} \times \frac{A_1 + A_3}{2} \times \sqrt{3}\right)^2 - (W_1 + W_3)^2}$	$\frac{W_1 + W_3}{\frac{V_1 + V_3}{2} \times \frac{A_1 + A_3}{2} \times \sqrt{3}}$
	$\Sigma$ (three-phase four-wire)	$\frac{V_1 + V_2 + V_3}{3} \times \frac{A_1 + A_2 + A_3}{3} \times 3$	$\sqrt{\left(\frac{V_1 + V_2 + V_3}{3} \times \frac{A_1 + A_2 + A_3}{3} \times 3\right)^2 - (W_1 + W_2 + W_3)^2}$	$\frac{W_1 + W_2 + W_3}{\frac{V_1 + V_2 + V_3}{3} \times \frac{A_1 + A_2 + A_3}{3} \times 3}$
Computation range		Rated value depends on V, A ranges (F.S. resolution same as corresponding W range)	Same as apparent power	-1 to 0 to +1 (10 to 110% of rating for V and A)
Computation accuracy with respect to value calculated from measured value (V, A, W)		$\pm 0.05\%$ of rated value (VA)	$\pm 0.05\%$ of rated value (var)	$\pm 0.001$

\*Reactive power (var), apparent power (VA) and power factor (PF) of the instrument are obtained by digital computation from voltage, current, effective power, etc.

\*When distorted waveshapes are measured, differential in measured values using this instrument and other instrument with different principle of measurement may occur.

**Scaling Function**

Each measured value multiplied by PT ratio, CT ratio, SCALING FACTOR or others is displayed (unit is changed automatically)

**Effective Digit:** selected automatically according to effective digit of voltage and current ranges

**Setting Range:** 0.0001 to 10000

**Set Value:** DISPLAY A settable for PT ratio, DISPLAY B for CT ratio, DISPLAY C for scaling factor

**Averaging Function**

**Principle:** exponential averaging with attenuation factor  $K=8$

**■ GP-IB Interface**

**Electrical, Mechanical Specifications:** conform to IEEE Std 488-1978

**Functional Specifications:** SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0 (ADDRESSABLE/TALK ONLY)

**■ RS-232-C Interface**

**Data Transmission System:** Start-stop system

**Data Transmission Rate:** 75, 150, 300, 600, 1200, 2400, 4800, 9600 bps.

**Optional Specifications****■ Frequency Measurement (/FRQ)**

**Measurement Principle:** reciprocal

**Measurement Frequency Range:** 8 Hz to 200 kHz (filter OFF), 2 to 200 Hz (filter ON)

**Accuracy:**  $\pm(0.1\% + 1 \text{ digit})$

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**Min. Voltage and Current Input Sensitivity:**  $\pm 10\%$  of F.S.

**Display Range:** 2.000 Hz to 240.0 kHz (4 digits)

**Sampling Rate:** 400 ms (filter OFF), 1.6 s (filter ON)

**Measurement Input:** V1 or A1

**■ Integrator Function (/INTEG)**

**Max. Display:**  $\pm 999999$  (6 digits)

**Integration Time:** 999 h

**Display:** Ah or Wh by DISPLAY C

**Timer:** integration can automatically be stopped by timer setting. Set value ... 000 h:01 min to 999 h:00 min (timer OFF at 000 h:00 min).

**Lapse of Time:** lapse of time after integration start can be indicated as 0 to 999 h:00 min by display B

**Count Over:** if integrated value over ranges, lapse of time is held and control stops

**Accuracy:**  $\pm$  (mainframe accuracy  $+0.02\%$  of rdg  $+1$  digit)

**Temperature Characteristics:**  $\pm 0.025\%$  of range/ $^{\circ}\text{C}$  ( $\pm 0.045$  of range/ $^{\circ}\text{F}$ )

**Timer Accuracy:**  $\pm 0.02\%$

**Remote Control:** start, stop and reset control are made by external contact closure command

**■ D-A Converter Function**

**Principle:** 16 bit PWM system, D-A converter

**Output Range:**  $(-7.5 \text{ to } +7.5\text{V})$  rating: 5V/F.S.

**Accuracy:** mainframe accuracy  $+0.1\%$  of F.S.

**Temperature Characteristics:**  $\pm 0.02\%/^{\circ}\text{C}$  ( $\pm 0.036\%/^{\circ}\text{F}$ )

**Output Contents:** one of Wh, Ah, var, VA, PF and Hz (data specified at DISPLAY C)

**Sampling Rate:** 400 ms