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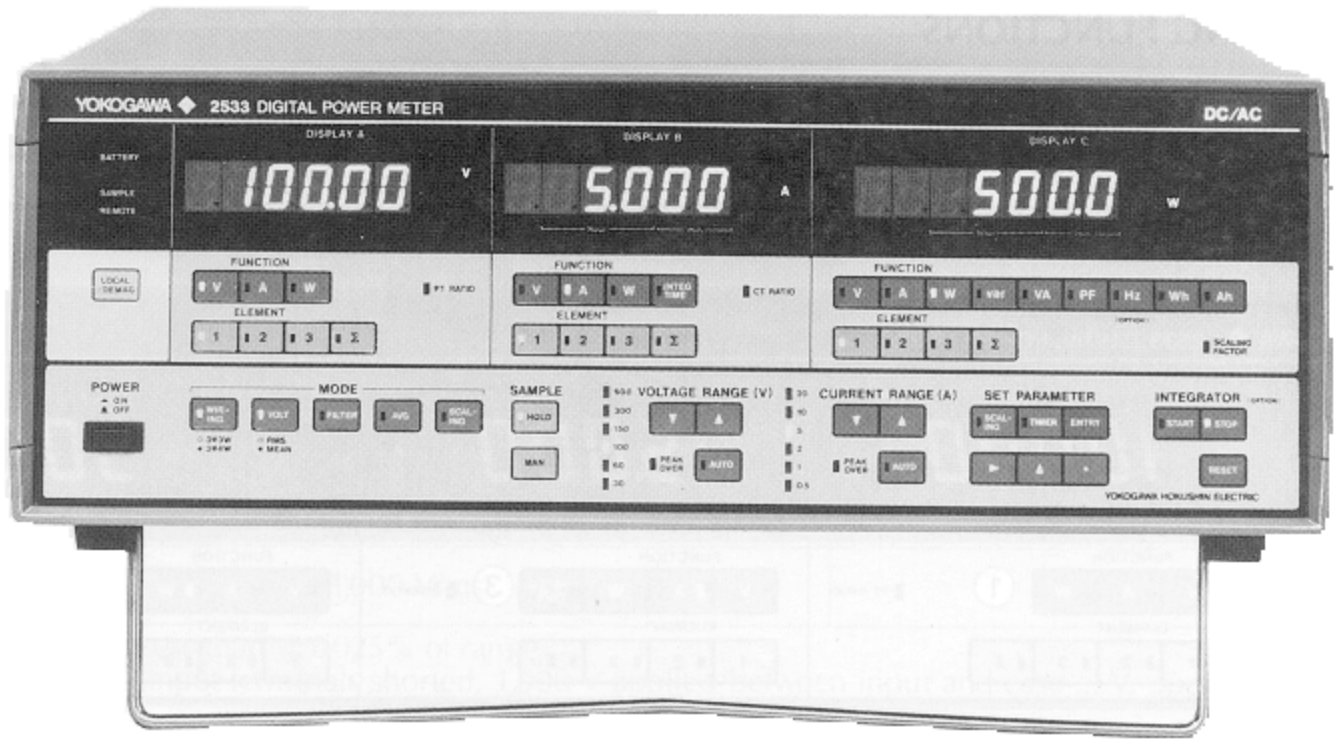
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2533
Digital Power Meter



RS-232-C
GPIB

2533
149 × 444 × 364 mm 16.0 kg
(5-7/8 × 17-1/2 × 14-3/8″ 35.3 lbs)

Distorted voltage and current waves are encountered when magnetic circuits, thyristor control circuits, or electric circuits containing fluorescent lamps, motors, transformers or the like are monitored or tested.

The 2533 Digital Power Meter is an outstanding solution to accurate effective power measurement of distorted waveforms. This power meter is ideal for use on production lines and in research and development.

A single digital power meter can measure effective values of AC voltage from 3 to 600 V (DC voltage can be superimposed), AC current from 100 mA to 30 A, and single-phase power from 300 mW to 18 kW (600 mW to 36 kW in three-phase, three-wire systems). Voltage, current, and power measurements can be conducted by simply making a key selection. This meter features faster response time and a greater number of features than conventional models. A built-in photo coupler provides complete isolation between the power meter input and output circuits. With its high dielectric strength and high resistance to external noise, this meter offers stable and reliable operation.

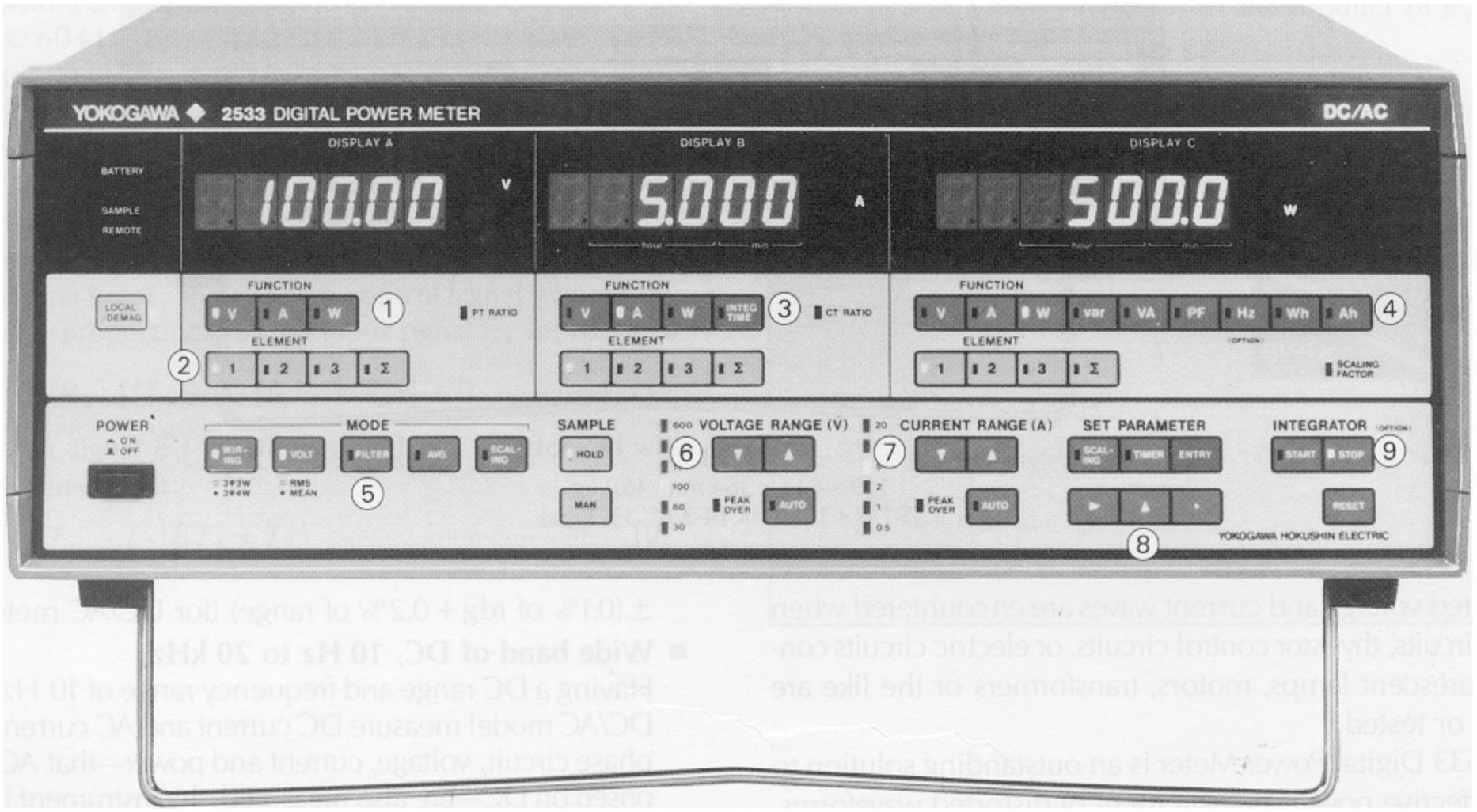
FEATURES

- **Simultaneous display of three measured values**
  Three values among measured or computed values are simultaneously displayed: voltage, current, power in each phase or total power, apparent power, reactive power, power factor, and more.
- **True rms measurement**
  The 2533 can measure triangular and square as well as distorted waveforms based on YOKOGAWA-original "log RMS-to-DC conversion system", and also measure DC voltage superimposed on AC voltage.
- **High precision**
  The voltage, current and power can be measured with high accuracy: ±(0.1% of rdg + 0.1% of range) (for AC meter 253311) ±(0.1% of rdg + 0.2% of range) (for DC/AC meter 253321).
- **Wide band of DC, 10 Hz to 20 kHz**
  Having a DC range and frequency range of 10 Hz to 20 kHz, DC/AC model measure DC current and AC current in a single-phase circuit, voltage, current and power—that AC is superimposed on DC—are also measured, the instrument is best suited for measuring power of distorted wave and inverters of every kind.
- **Versatile computing functions**
  Powerful computing functions include $\overline{V}$ (mean value of line or phase voltage), $\overline{A}$ (mean value of phase current), VA (apparent power), var (reactive power), and PF (power factor).
- **PT and CT scaling**
  Even when PT or CT is externally mounted, the voltage, current, power, etc. can directly be read through scaling function.
- **Analog output of up to 12 signals (standard)**
- **GPIB and RS-232-C interfaces (optional)**
  For data communications, the GPIB or RS-232-C interface is available. Full remote control is available for data output and range, function, etc. from external.
- **Integration and frequency measuring function (optional)**
  Current and power integrating function, and source frequency measuring function can be provided.
- **High noise immunity and excellent stability**
- **Dielectric strength**
  3,000 V AC for one minute between the input terminals and case, and between the input and output terminals.
  1,500 V AC for one minute between the case and power line, and between the output terminals and power line.
- **High input impedance**
  The input impedance is very high. So, the meter can accurately measure even very low power levels that conventional analog instruments have not been able to measure until now.
- **Simplified programming and operation via membrane-sealed keyboard**

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FUNCTIONS

■ DISPLAY & OPERATING FUNCTIONS



❶ FUNCTION keys
Selectable for V, A or W measurement.

❷ ELEMENT keys
Used to select each phase (or line) in 3-phase 3-wire or 4-wire circuit. Σ key provides mean value (V, A), or the sum of each power (W). (ELEMENT keys are not provided in the single-phase model)

❸ FUNCTION keys
In addition to V, A and W, integration time can also be displayed as an option.

❹ FUNCTION keys
In addition to V, A and W, var, VA, PF (Hz, Wh, Ah... optional) can also be selected.

❺ MODE keys
WIRING: For 3-phase 4-wire circuit. (WIRING key is not provided in the single-phase model)
VOLT: Selectable for RMS (true rms measurement & display), or MEAN (mean value rectification measurement & rms value display).
FILTER: Provides stable measurement even for signals containing low frequency ripple. (5/0.7 Hz low pass filter)
AVG: Provides exponential averaging of 8 measured data points.
SCALING: Scaling ON/OFF key.

❻ VOLTAGE RANGE keys
Manual selection of 6 ranges (30 to 600 V), plus autoranging. When the power is turned ON, previously entered voltage range is automatically selected.

❼ CURRENT RANGE keys
Manual selection of 6 ranges (0.5 to 20 A ... AC model), or 5 ranges (1 to 20 A ... DC/AC model), plus autoranging. When the power is turned ON, previously entered current range is automatically selected.

❽ SET PARAMETER keys
Used to program scaling (PT and CT ratios), and integration time:
▶ Digit designation.
▲ Data (0 to 9) designation.
● Decimal point designation.

❾ INTEGRATOR keys (optional)
Consist of integration START, STOP, RESET keys.

Applicable circuit

Connection	253311 253321	253312 253322	253313 253323
1 P 2 W	○	○	○
1 P 3 W	—	○*	○*
3 P 3 W (2 V, 2 A)	—	○	○*
3 P 3 W (3 V, 3 A)	—	—	○*
3 P 4 W	—	—	○

Selectable by an internal DIP selector.

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SPECIFICATIONS

■ INPUT

Input		Voltage	Current
	AC model	Direct (CT isolation after ranging)	CT isolation (secondary ranging)
		Direct (DC CT isolation after ranging)	DC CT isolation (secondary ranging)
		30, 60, 100, 150, 300, 600 V	0.5 A (AC model only), 1, 2, 5, 10, 20 A
		DC (DC/AC model only), 10 Hz to 20 kHz	
		3.5 × range (peak) or 1,400 Vpk (whichever is less)	10 × range (peak) or 70 Apk (whichever is less)
		2 × range (rms) or 1,000 V pk (whichever is less)	3 × range (rms) or 50 Apk (whichever is less)
		Approx. 1 MΩ on all ranges	Approx. 2 mΩ on all ranges (at 50 Hz)
		1,000 Vrms	1,000 Vrms
Effect of Common Mode Voltage (at 50 or 60 Hz)		Less than ±0.025% of range (input terminals shorted, 1,000 V applied between input and case ... V, open input terminals ... A)	

■ MEASUREMENTS

Function		Voltage	Current	Power
Operating Principle		True rms (log-antilog)/mean value rectification	True rms (log-antilog)	Feedback time division multiplier
Measure-ment	**Single-phase**	V_1	A_1	W_1
	3-phase 3-wire (balanced circuit)	V_1, V_3, $\frac{V_1+V_3}{2}$ (Σ)	A_1, A_3, $\frac{A_1+A_3}{2}$ (Σ)	W_1, W_3, W_1+W_3 (Σ)
	3-phase 4-wire (balanced circuit)	V_1, V_2, V_3, $\frac{V_1+V_2+V_3}{3}$ (Σ)	A_1, A_2, A_3, $\frac{A_1+A_2+A_3}{3}$ (Σ)	W_1, W_2, W_3, $W_1+W_2+W_3$ (Σ)
Frequency Range		DC (DC/AC model only), 10 Hz to 20 kHz		
Crest Factor		Up to 2	Up to 3 (or 50 Apk; DC/AC model)	Corresponds to V & A
Display Accuracy*		DC: ±(0.1% of rdg+0.2% of range) ... DC/AC model	DC: ±(0.1% of rdg+0.2% of range+3mA) ... DC/AC model	At cos φ=1, DC: ±(0.1% of rdg+0.3% of range) ... DC/AC model
		45 to 60 Hz: ±(0.1% of rdg+0.1% of range) ... AC model ±(0.1% of rdg+0.2% of range) ... DC/AC model 20 to 45 Hz, 66 Hz to 2 kHz: ±(0.2% of rdg+0.2% of range) ... AC model ±(0.2% of rdg+0.4% of range) ... DC/AC model 10 to 20 Hz, 2 to 10 kHz: ±1% of range 10 to 20 kHz: ±2% of range (at 10 to 110% input)		Corresponds to V & A
Power Factor Effect				Less than ±0.5% of rdg (at cos φ=0.5, 50 or 60 Hz)
Accuracy of Analog Output*		Display Accuracy + 0.05% of range		
Temperature Coefficient		Less than ±0.03% of range/°C (Less than ±0.02% of range/°F) (at 5 to 20°C, 26 to 40°C, or 41 to 68°F, 79 to 104°F)		

*Note: At 23±3°C (73±5°F), 45 to 75% relative humidity, 100 V±1% sine wave input, 3-month calibration cycle (common mode voltage 0 V, demagnetization ... DC/AC model).

■ 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 10,000
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

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■ COMPUTATION

Apparent Power, Reactive Power & Power Factor

Function		Apparent Power (VA)	Reactive Power (var)	Power Factor (PF)
Computing Formula	1 to 3 (each phase)	$Vi \times Ai$	$\sqrt{(Vi \times Ai)^2 - Wi^2}$	$\frac{Wi}{Vi \times Ai}$
	Σ (3-phase 3-wire)	$\frac{V_1+V_3}{2} \times \frac{A_1+A_3}{2} \times \sqrt{3}$	$\sqrt{\left(\frac{V_1+V_3}{2} \times \frac{A_1+A_3}{2} \times \sqrt{3}\right)^2 - (W_1+W_3)^2}$	$\frac{W_1+W_3}{\frac{V_1+V_3}{2} \cdot \frac{A_1+A_3}{2} \times \sqrt{3}}$
	Σ (3-phase 4-wire)	$\frac{V_1+V_2+V_3}{3} \times \frac{A_1+A_2+A_3}{3} \times 3$	$\sqrt{\left(\frac{V_1+V_2+V_3}{3} \times \frac{A_1+A_2+A_3}{3} \times 3\right)^2 - (W_1+W_2+W_3)^2}$	$\frac{}{\frac{V_1+V_2+V_3}{} \times \frac{A_1+A_2+A_3}{} \times 3}$
Computing Range		V & A range (rated value)	V & A range (rated value), var ≧1	−1 to 0 to +1 (10 to 110% of rated value for V & A)
Computing Accuracy*		±0.05% of rated value (VA or var)		±0.001

Notes: *1. For measured values of V, A, W.
2. Vi, Ai ... rms value, V_1 to V_3 .. rms or mean value, A_1 to A_3 rms value.

■ GENERAL SPECIFICATIONS

Display: LED display.
Display Combination:

Display Mode	Max. Reading	Display Configuration
A	±99999	V, A, W, (1, 2, 3, Σ)*
B	±99999	V, A, W, (1, 2, 3, Σ),* integration time ... optional
C	±99999 (±999999 ... Wh, Ah)	V, A, W, VA, var, PF (1, 2, 3, Σ),* (Hz, Wh, Ah ... optional)

*Notes: 1 only ... single phase model.
1, 3, Σ ... 3-phase 3-wire model.

Engineering Units: m, k, M, V, A, W, VA, var, Hz, h (hour).
Function Selection: Manual for Display A, B, C each by front-panel keys (or remote via optional GPIB or RS-232-C interface).
Sample Rate: Approx. 2.5 times/s.
Ranging: Automatic or manual (or remote via optional GPIB or RS-232-C interface).
Effective Measuring Range: 10 to 110% of rated value (range).
Response Time: Approx. 0.4 s. (at filter OFF, for analog output within ±0.2% accuracy against an input variation from 30 to 100% of range, or from 100 to 30% of range).
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, $\frac{V_1+V_3}{2}$ or $\frac{V_1+V_2+V_3}{3}$

A_1, A_2, A_3, $\frac{A_1+A_3}{2}$ or $\frac{A_1+A_2+A_3}{3}$

$W_1+W_2+W_3$, W_1+W_3 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)
GPIB or RS-232-C interface (option): display data and measurement data
Remote Controls: Remote control of sample START/STOP.
Operating Temperature Range: 5 to 40°C (41 to 104°F).
Humidity Range: 20 to 80% (relative humidity).
Storage Temperature Range: −10 to 50°C (14 to 122°F), non-condensing.
Warmup Time: Approx. 30 minutes (for reading within specified accuracy).
Dielectric Strength: 3,000 V AC (50, 60 Hz) for one minute between input terminals and case, between input and output terminals, and between V and A terminals, 1,500 V AC (50, 60 Hz) for one minute between input terminals, output terminals, case and power line.
Insulation Resistance: More than 50 MΩ at 500 V DC between input terminals and case, between input and output terminals, between V and A terminals, and between output terminals, case and power line.
Power Requirements: 100, 115, 200 or 230 V AC (must be specified), 48 to 63 Hz.
Power Consumption: Approx. 40 to 50 VA.
Dimensions: Approx. 149 × 444 × 364 mm (5-7/8 × 17-1/2 × 14-3/8″).
Weight: Approx. 12.0 kg (26.5 lbs) ... single phase AC model, 16.0 kg (35.3 lbs) ... 3-phase 4-wire DC/AC model.

■ OPTIONAL FEATURES

● GPIB INTERFACE (/GP-IB)

Functional, Electrical and Mechanical Specifications: Meets IEEE Standard 488-1978 "Digital Interface for Programmable Instrumentation."
Interface Function and Identification: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0 (Talker & Listener, Talk only).

● RS-232-C INTERFACE (/RS232C)

Functional Specifications: Hardware/software handshaking, synchronous (data transfer rates ... 75, 150, 300, 600, 1,200, 2,400, 4,800 and 9,600 bits/s).

● FREQUENCY MEASUREMENT (/FRQ)

Operating Principle: Reciprocal counting method.
Frequency Range: 10 Hz to 200 kHz (filter OFF), 2 to 500 Hz (filter ON).
Accuracy: ±(0.1% +1 digit).
Maximum Sensitivity: ±10% of full scale.
Display Range: 2.000 Hz to 240.0 kHz (4 digits).
Sample Time: 400ms.
Measuring Input: V1 or A1.

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- **INTEGRATOR (/INTEG)**

Maximum Reading: ±999999 (full 6 digits).
Integration Time: Up to 999 h
Integration Display: Ah or Wh (on Display C).
Timer: Automatically stops integration by presetting timer (setting range ... 000 h: 01 min to 999 h: 00 min, timer OFF at 000 h: 00 min), timer accuracy ... ±0.02%.
Elapsed Time Display: 00 h: 01 min to 999 h: 59 min after integration start (on Display B).
Accuracy: ±(2533 accuracy + 0.02% of rdg + 1 digit).
Temperature Coefficient: ±0.025% of range/°C (±0.014% of range/°F).
Remote Controls: Integrator START/STOP/RESET by external contact signal.
D-A Converter Function
Operating Principle: Pulse width modulation method (16 bits).
Output: Wh, Ah, var, VA, PF or Hz (display data).
Output Level: −7.5 to 7.5 V, 5 V/full scale, (accuracy ... 2533 accuracy + 0.1% of full scale).
Sample Time: 400 ms.
Temperature Coefficient: ±0.02%/°C (±0.01%/°F).

AVAILABLE MODELS

Model		Suffix Codes		Description
2533	.....	.....	.....	Digital power meter
	11	.....	.....	Single-phase (AC)
	12	.....	.....	3-phase 3-wire (AC)
	13	.....	.....	3-phase 4-wire (AC)
	21	.....	.....	Single phase (DC/AC)
	22	.....	.....	3-phase 3-wire (DC/AC)
	23	.....	.....	3-phase 4-wire (DC/AC)
Power Requirement		−1	.....	100 V AC (50 & 60 Hz)
		−3	.....	115 V AC (50 & 60 Hz)
		−5	.....	200 V AC (50 & 60 Hz)
		−7	.....	230 V AC (50 & 60 Hz)
Power Cord			/B	JIS standard
			/D	UL standard
			/F	VDE standard
			/G	SAA standard

STANDARD ACCESSORIES

No.	Name	Part No.	Q'ty	Description
①	Connector	A9026KC		analog output
②	Rack mount adapter	B9564EL	2	—
③	Fuse*	A9050KF	2	time lag type (100 V series)
		A9049KF	2	time lag type (200 V series)
		A9005ED	2	
		A9009WD	1	V series (JIS standard)
				V series (UL standard)
		A9011WD		V series (VDE standard)
		A9015WD	1	230 V series (SAA standard)
		—	1	—

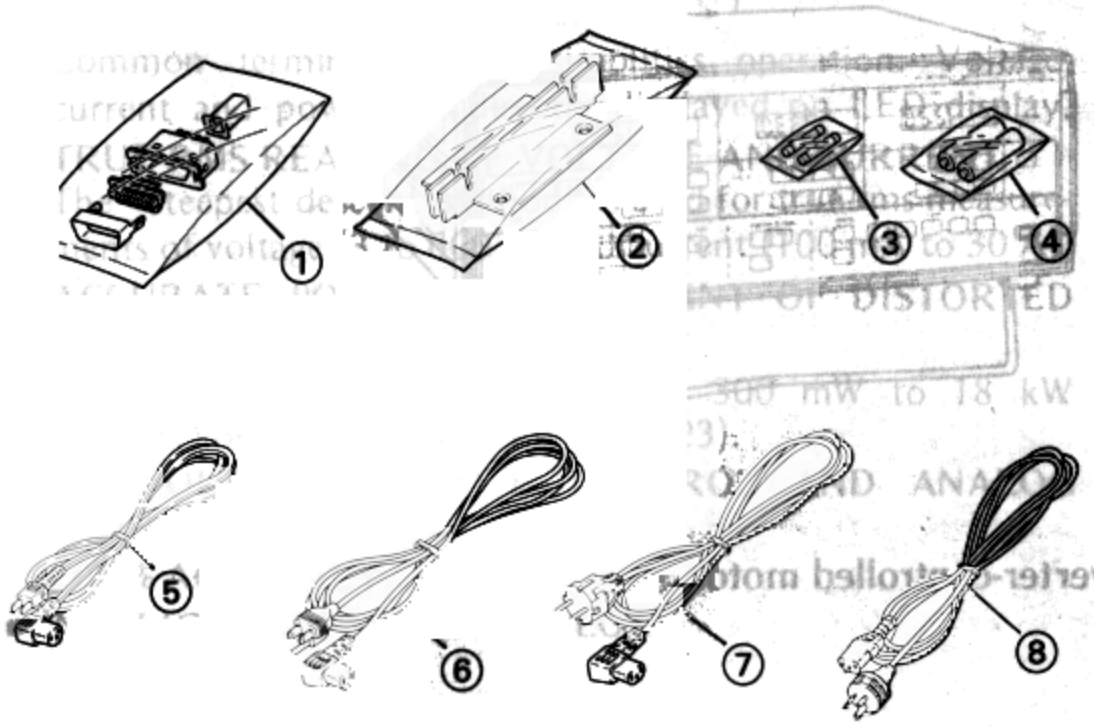
*Specified one.

OPTIONAL FEATURES

Option Code	Name
/GP-IB	GPIB interface
/RS232C	RS-232-C interface
/FRQ	Frequency measurement
/INTEG	Integrator

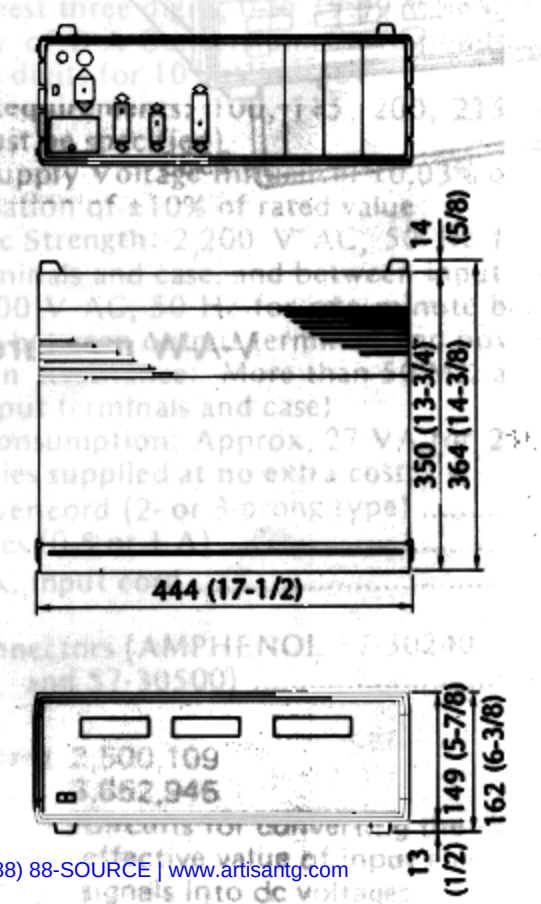
ORDERING INFORMATION

When ordering, specify:
Instrument name, model and suffix codes, and option code if required.



DIMENSIONS

Unit: mm (inch)





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