Instruction Manual

Type 2885

STANDARD WATT CONVERTER

YEW

YOKOGAWA HOKUSHIN ELECTRIC

Type 2885

STANDARD WATT CONVERTER

CERTIFICATION

YEW (Yokogawa Electric Works, Ltd.) certifies that this instrument underwent stringent inspections and performance tests before it was shipped from the factory, and was found to meet the specifications given in the specifications section of this document.

YEW also certifies that its calibration measurements are traceable to the Electrotechnical Laboratory of the Ministry of International Trade and Industry (which maintains Japan's primary electrical standards) to the extent allowed by the organization's calibration facilities. Calibration measurements not traceable to that organization are traceable to the calibration facilities of other members of the International Electrotechnical Commission, or to those of International Organization for Standardization (ISO) members.

WARRANTY

YEW warrants this product, for one year from the date of delivery, against defects in materials and workmanship. YEW will repair or replace a product which proves defective during the warranty period due to materials or workmanship defects, provided that the product is returned to YEW or a YEW representative authorized to perform in-warranty repair of the product. YEW reserves the right to determine whether product failures are due to defective materials or workmanship, or to other causes not covered by this warranty. No other warranty is expressed or implied. YEW is not liable for consequential damages.

Instruction Manual

Supplement

Type 2885

STANDARD WATT CONVERTER

Please, add the postscript as follow.

CAUTION

To avoid trouble, do not input signals having DC components greater than 5% of rated value.

YEW
YOKOGAWA HOKUSHIN ELECTRIC

June 1983

IM 2885-20EC

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IM 2885-20E

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1. GENERAL.

1-1. Description.

The YEW Type 2885 is a high accuracy standard watt converter that converts AC power frequencies up to 3 kHz to DC voltage.

When used with a DC voltage measuring instrument such as DVM (digital voltmeter), the combination becomes a high-accuracy digital AC wattmeter.

The converter employs YEW's unique time division multiplier. Two current transformer and low-drift input circuit are used for safety and accuracy.

1-2. Features.

(1) JEMIC Certificate (Type 2885-21).

The instrument is shipped with JEMIC (Japan Electric Meters Inspection Corporation) certificate, which qualifies the instrument as a standard wattmeter.

(2) High accuracy.

The instrument accuracy is within ±0.02% for frequencies from 47 to 63 Hz and within ±0.05% for frequencies from 63 to 400 Hz.

(3) Excellent frequency and power factor characteristics.

Accurate AC power measurements for distorted waveforms or for low power factors are now possible, and the instrument can be used from 30 Hz to 3 kHz.

(4) Wide measuring range.

The voltage input, current input and output terminals are isolated from each other. Voltage dividers and current transformers are installed, so that voltages from 75 to 300 V and currents from 0.5 A to 20 A may be directly applied to the input terminals.

(5) High reliability.

A feedback time division multiplier is used for power computation and no moving coils or thermocouples are used in the instrument. So the instrument is tolerant of overloads, may be used horizontally or vertically, and is not affected by vibration or external magnetic fields, etc.

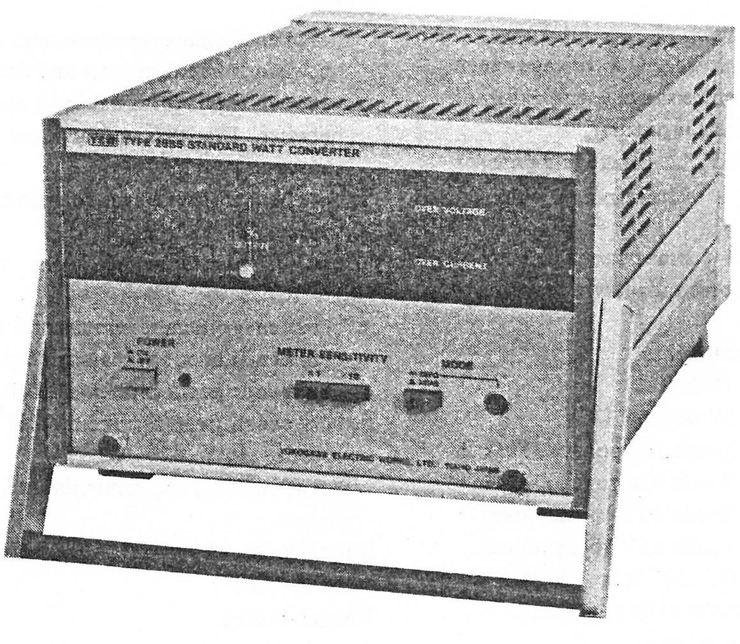

Figure 1-1. External View.

1-3. Specifications.

Measuring Ranges:

Voltage Ranges; 75/100/150/300 V AC
Current Ranges; 0.5/1/2/5/10/20 A AC
Output Voltages; 1 and 5V DC full scale, corresponding to (power range) = (voltage range) X (current range)
Frequency Range: 30Hz to 3kHz

Accuracy: on power range = (voltage range) X (5A current range) output voltage corresponding to power is accurate within ±0.02% of full scale from 47 to 63 Hz for cosϕ = 1 or 0.
On power range = (100V voltage range) X (5A current range) output voltage corresponding to power is accurate within ±0.05% of full scale from 47 to 400 Hz for cosϕ = 1

at ambient temperature	23 ±1°C
relative humidity	55 ±10%R.H.
power supply voltage	100V ±1%
input signal	Sine wave (distortion factor less than 0.3%)

Output Terminals:

(1) 5V terminals;
internal resistance .... 4Ω or less
maximum load current 5mA
maximum load capacitance 0.05µF
short circuit protection for 5 minutes

(2) 1V terminals;
internal resistance 800Ω

Maximum allowable input: voltage 2 X voltage range (peak value) current 5 X current range (peak value)

Maximum permissible continuous input:

voltage ..... rms voltage of 1.5 X voltage range or peak voltage of 2 X voltage range whichever is less.
current ..... rms current of 3 X current range or peak current of 5 X current range, whichever is less.

External input terminal of multiplier:

Rated input voltages	1V X 1V
Voltage outputs	5V and 1V DC
Input resistance	X-side Approx. 3.33kΩ Y-side Approx. 3.33kΩ
Allowable inputs	X-side ±2V (peak valve) Y-side ±5V (peak valve)
Operating frequency range ..	DC, 20 Hz to 10 kHz

Output monitor: ±5V(x1), ±0.5V(x10) selectable.
center-zero meter indication tolerance
±2% of full scale on 5V(x1) range
and ±1.5% of full scale on 5V(x10) range

Residual AC output voltage: for full scale input at 20 Hz 1mVrms at 5V output terminals

Temperature sensitivity of DC output: from 18 to 22°C or 24 to 27°C, for 100V, 5A input 60 Hz, cosϕ = 1
Zero point; ±0.01% of range/°C
Full scale; ±0.02% of range/°C

Response time: Approx. 2 seconds (time reach within ±0.01% of the steady state value).
However, allow approx. 20 second after an input overload or after power to momentarily cut off.

Input voltage terminal impedance:

75 V range	approx. 75 kΩ	less than 18 PF
100 V range	approx. 100 kΩ	less than 13 PF
150 V range	approx. 150 kΩ	less than 8 PF
300 V range	approx. 300 kΩ	less than 8 PF

Current input power loss:

0.5A	approx. 0.05VA
1A	approx. 0.06VA
2A	approx. 0.1VA
5A	approx. 0.2VA
10A	approx. 0.3VA
20A	approx. 0.5VA

Operating temperature range: 18 to 27°C (64 to 80°F)
Operating humidity range: 35 to 70% R.H.
Warmup time: 1 hour
Power consumption: approx. 20VA
Power supply voltage: 100, 120, 200, 220 or 240VAC ±10% 47 to 63 Hz (must be specified)
Dielectric strength: 2000VAC for one minute at 50 Hz
between Voltage terminals and current terminals
between Input terminals and output terminals
between Input terminals and case
between Input terminals and instrument power source
between Output terminals and instrument power source

Insulation resistance: More than 200 MΩ at 500 VDC
between Voltage terminals and current terminals
between Input terminals and output terminals
between Input terminals and case
between Input terminals and instrument power source
between Output terminals and instrument power source

Dimensions: Approx. 149 X 228 X 365mm (5-7/8 X 9 X 14-3/8")
Weight: 8.5 kg
Accessories: Fuse .... 2 pcs.
JEC certificate .... 1 copy (for Type 2885-21)
Instruction Manual .... 1 copy

2. NAMES AND FUNCTIONS OF COMPONENTS.

2-1. Front Panel.

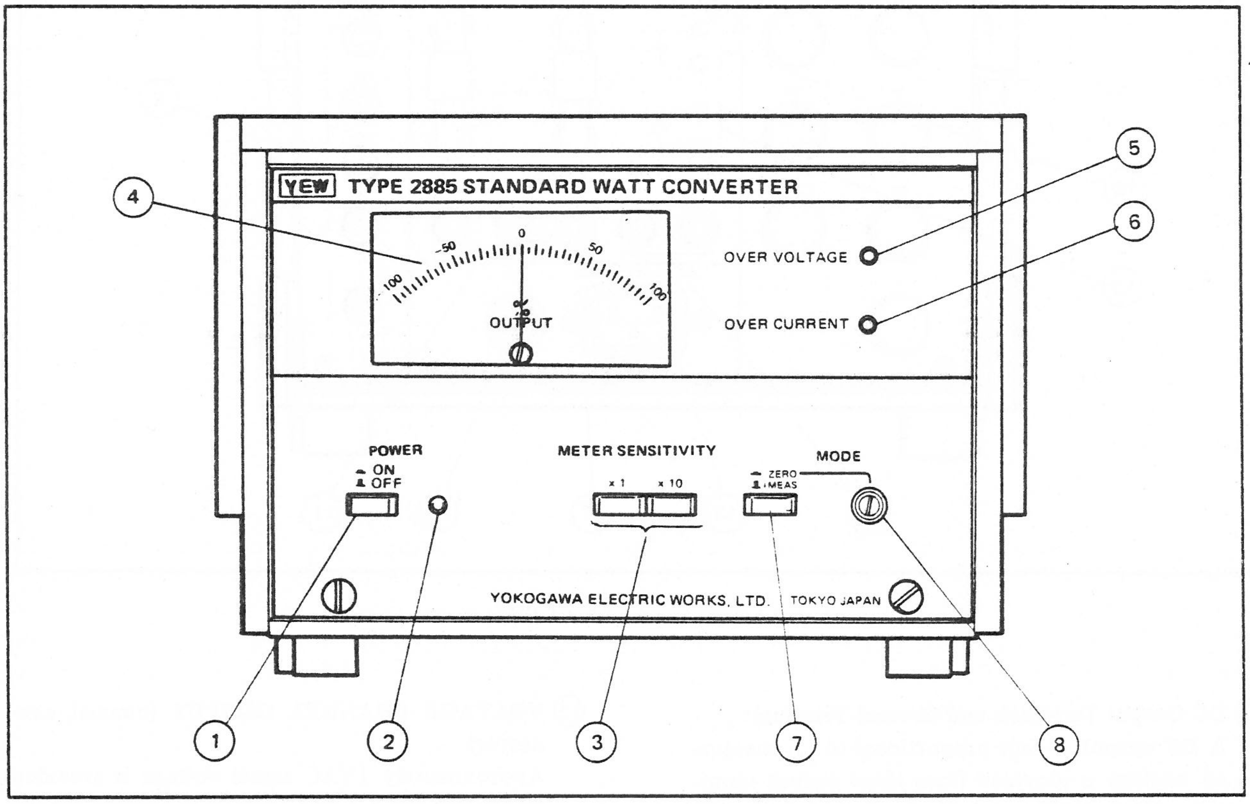

Figure 2-1. Front Panel.

① **POWER Switch:**
Press to Switch power ON, and press again to switch power OFF.

② **POWER Pilot Lamp:**
This lamp lights when power is on.

③ **METER SENSITIVITY Pushbuttons:**
These set the monitor meter sensitivity. When the x1 button is depressed, the meter indicates F.S. (100%) when output voltage equals range . When the x10 button is depressed the meter indicates F.S. (100%) at one tenth of rated output voltage.

④ **Output Monitor:**
Center-zero Scale meter to monitor the DC output voltage.

⑤ **OVERVOLTAGE Lamp:**
Lights when the input voltage exceeds the allowable operating range.

⑥ **OVERCURRENT lamp:**
Lights when the input current exceeds the allowable operating range.

⑦ **ZERO-MEAS Switch:**
A pushbutton to select ZERO or MEAS mode, press to adjust zero pount using ZERO adjustor ⑧.

⑧ **ZERO Adjustor:**
Depress the ZERO-MEAS switch ⑦, and adjust the zero point with a screwdriver.

2-2. Pear Panel.

⑨ **Voltage Terminals:**
Connect the voltage input leads between the voltage terminals corresponding to the desired range (75V, 100V, 150V and 300V) and the common terminal (±). Voltage terminals are isolated from all other terminals. If other leads are connected to these terminals, measurement errors may result.

⑩ **CURRENT terminals:**
Connect the current input leads between the current terminal corresponding to the desired range (0.5A, 1A, 2A, 5A, 10A or 20A) and the common terminal (±).
Current terminals are isolated from all other terminals. Do not connect other leads to these terminals.

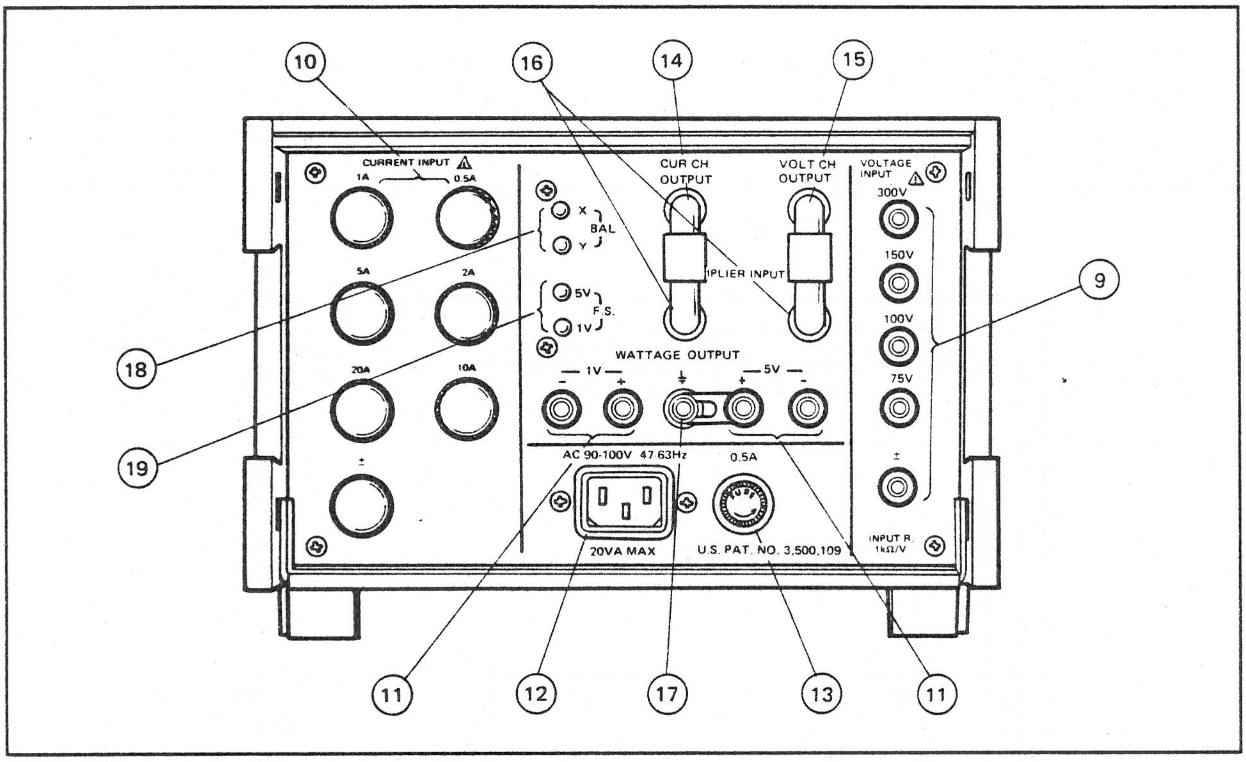

Figure 2-2. Rear Panel.

(11) **DC Output Terminals and Ground Terminal:**
A DC output voltage proportional to the measured wattage is provided from these output terminals. 5V and 1V terminals are provided; the 5V terminal output impedance is low, the maximum load current is 0.5 mA and the maximum load capacitance is 0.05μF, and the 1V terminal output impedance is approximately 800Ω.

(12) **POWER Supply Socket:**
This is used to connect the power cord supplied with the instrument. Central pin of this 3-pin socket is connected to the protective earth terminal (11).

(13) **Fuse:**
The fuse rating is 0.5 A for instruments on 100 or 120 V AC line power, or 0.2 A for 200, 220 or 240 V AC line power.
To replace the fuse, unplug the power cord and turn the fuse socket cap counterclockwise. Pull out cap, replace fuse, and reinstall.

(14) **CURRENT CHANNEL OUTPUT (coaxial connector):**
Approximately 1VAC signal voltage is provided when the rated input current is applied to the instrument. For normal measurements, this signal voltage is applied to the multiplier Y input, using the supplied connector.

(15) **VOLTAGE CHANNEL OUTPUT (coaxial connector)**
Approximately 1VAC signal voltage is provided when the rated input voltage is applied to the instrument. For normal measurements, this signal voltage is applied to the multiplier X inputs, using the supplied connector.

(16) **MULTIPLIER INPUT terminals (coaxial connector)**
The terminals to apply signal voltages directly to the multiplier for its calibration of adjustment.
The right terminal is for X(voltage side) and the left terminal is for Y (current side).

(17) **Protective Earth Terminal:**
This terminal should be connected to a protective earth, for safety. This terminal is connected to the earth terminal of the power supply socket (12).

(18) **BALANCE adjustors (BAL):**
Adjustors for multiplier balancing. These have been adjusted at the factory. Do not turn these adjustors unnecessarily, or measurement errors may result.

(19) **FULL SCALE adjustors (F.S.):**
Adjustors for multiplier full scale adjustment. These adjustors have been adjusted at the factory. Do not turn these adjustors unnecessarily, or measurement errors may result.

3. OPERATION.

3-1. Inclining Stand.

To use the instrument inclined on a table, tilt the handle downwards and lock. The handle serves as a stand. The handle can be locked at three positions as shown in Figure 3-1.

Note that unlocking methods differ for three locking positions.

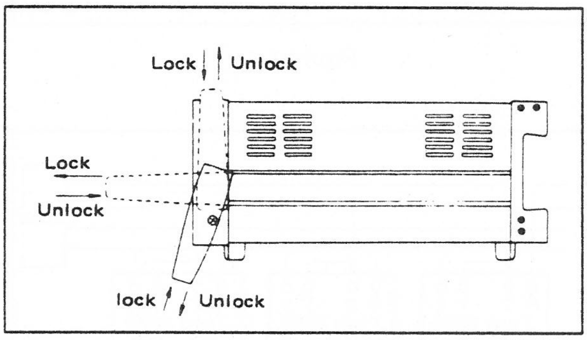

Figure 3-1.

CAUTION

- Do not place anything on top of the instrument as not to decrease the heat radiation from it.
- As the display window is made of thermoplastic resin, keep soldering irons away from it. Do not wipe the window with thinner, benzine, alcohol or the like.

3-2. Preparation.

Initially setup as follows,

POWER Switch: OFF

METER SENSITIVITY selector Switches: x1

Earth terminal: Connect to a protective earth ground.

Power cord: Plug the power cord into its socket on the rear panel of the instrument, then plug the other end of the power cord into an AC line outlet whose voltage corresponds to that written on the rear panel.

3-3. Wiring.

Connect loads to the instrument voltage and current terminals as shown in Figure 3-2. Connect a DC voltage measurement instrument (for example, DVM) to the instrument DC output terminals.

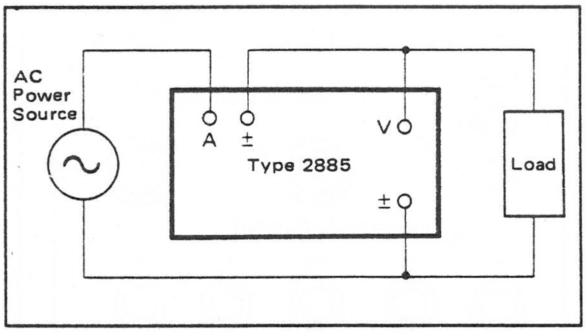

Figure 3-2.

WARNING

Voltage or current terminal wiring:

(1) Fasten leads tight. Loose leads are potentially dangerous.

(2) For accurate measurements of AC power at frequencies higher than 400 Hz or power of distorted waveforms, use stranded (twisted) leads for voltage and current connections. Keep the voltage and current leads well separated to minimize electromagnetic coupling between them.
Note that best high frequency characteristics are obtained when the "±" common voltage terminal at the same potential as the instrument case.

(3) Ensure that unused leads do not remain connected to the voltage or current terminals. This may be dangerous and cause measurement errors.

Connecting a DC voltmeter to the output terminals:

(1) The voltmeters accuracy and resolution should be adequate for the requirement.

(2) When the 1V output terminal is used, the lead of the DC voltmeter input resistance should be taken into consideration.

(3) When power of low phase-factor is to be measured, the DC voltmeter should be one that rejects the residual AC in the DC output voltage.

NOTE

The outer metal tube of the voltage, current channel connectors, multiplier input terminals and "+" side of the 1 and 5V output terminals are all connected together inside the instrument as shown in Figure 3-3.

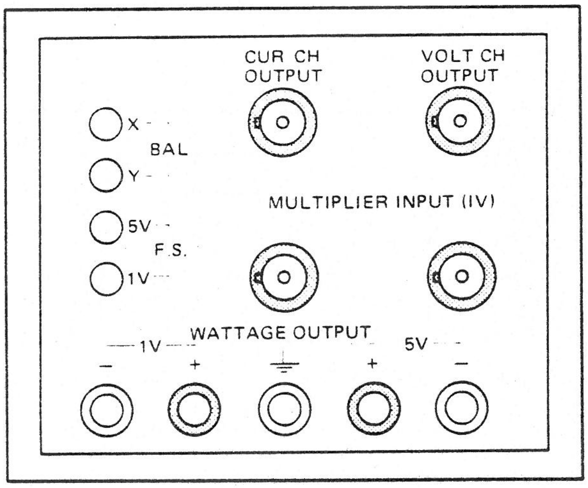

Figure 3-3.

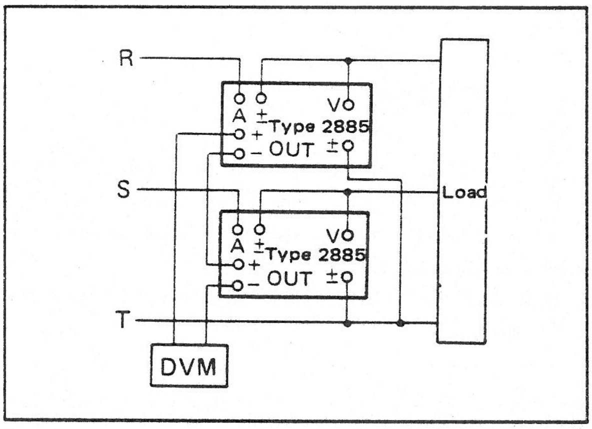

Figure 3-4.

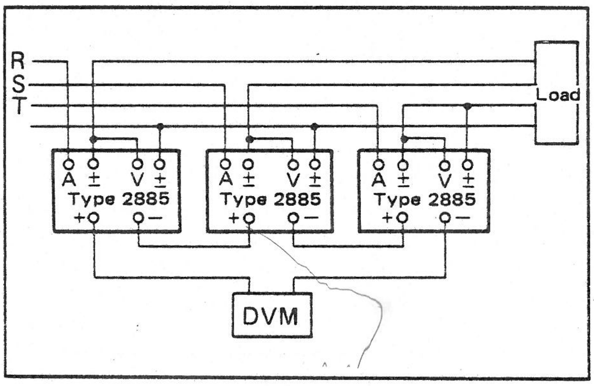

Figure 3-5.

3-4. Measuring Procedure.

(1) Connect the power cord. Turn the power switch on. Confirm that the power pilot lamp lights. Warm up the instrument for about one hour.

(2) With the input voltage and current zero, turn the zero adjustor using a screwdriver so that the output voltage is zero.

(3) Apply voltage and current to the respective input terminals and check if the overvoltage or overcurrent alarm lamps light. If so, the input voltage or current exceeds the range rating and an error in power measurement may result. Therefore, change to a higher voltage or current range.

(4) Measure the output voltage with a precision DC potentioneter or a digital voltmeter, etc. When a lead and power source are connected as shown in Figure 3-2, the DC output voltage polarity at the output terminals is as marked on the terminals. The relationship between output voltage and measured power is shown below.

Example: voltage range selected 150V
current range selected 5A

power range = voltage range x current range
= 150V x 5A
= 750W

Therefore 5V multiplier output at 5V output terminal corresponds to 750W input or 1V multiplier output at 1V output terminal corresponds to 750W input.

3-5. Measurement of Three-phase Power.

To measure power in three-phase three-wire circuits, two Type 2885 instruments are used, with their output terminals connected in series as shown in Figure 3-4.

To measure power in three-phase four-wire circuits, three Type 2885 instruments are connected with their output terminals in series as shown in Figure 3-5.

4. MAINTENANCE.

4-1. Storage.

When storing the instrument, avoid an area which is:

a. Very humid
b. Subjected to direct sunlight
c. Near high temperature heat sources
d. Subject to strong wibration
e. Very dusty
f. Exposed to saline or corrosive gases

NOTE

If you have any problems with the instrument, contact your nearest YEW service station or representative.

4-2. Calibration.

4-2-1. Calibration of Multiplier

(1) Equipment Needed

Instrument	Conditions	YEW unit
Digital voltmeter	Accuracy better than 50ppm	Type 2501
DC voltage and current standard	Accuracy better than 50ppm	Type 2552

(2) Turn the power switch on. Warm up the instrument for about one hour.

(3) Connect a digital voltmeter to the DC output 5V terminals, with the digital voltmeter H and L terminals connected to the DC 5V output plus and minus terminals, respectively.

(4) Confirm that the ZERO-MEAS switch on the front panel is set to MEAS.

(5) Plug the coaxial connectors into the multiplier input terminals on the rear panel. Short-circuit the X input terminals and apply +1VDC then, −1VDC to the Y input terminals using a DC voltage standard.

(6) Confirm that the difference between the above two DVM indications is 0.2 mV or less. If it is not, adjust X BALANCE adjustor.

(example) difference

Y = +1V output voltage = +0.4mV } 0.2mV
Y = −1V output voltage = +0.6mV } (Satisfactory)

Y = +1V output voltage = +0.4mV } 0.4mV
Y = −1V output voltage = 0.0mV } (should be readjusted)

(7) Next, short-circuit the multiplier Y input terminals, and apply +1VDC then −1VDC to the X input terminals using a DC voltage standard. Adjust Y BALANCE adjustor as above (6).

(8) Depress the ZERO-MEAS switch on the front panel. Turn the ZERO adjustor so that the pointer indicates zero.
Apply +1V to the multiplier X and Y terminals, and adjust the 5V full scale adjustor so that the DVM connected to the 5VDC output terminals indicates −5V ±0.001V.
Also adjust it to indicate −5V ±0.001V, when −1V is applied to X and Y terminals.

(9) After above adjustment (8) is completed, connect the DVM to the DC output 1V terminals, and adjust the 1V full scale adjustor so that the DVM indicates −1V ±0.0002V when ±1V is applied to the multiplier inputs as described in (8) above.

4-2-2. Calibration of the Type 2885 as a power-converter.

(1) Equipment needed
- A variable voltage, current, phase and frequencey, etc. wattmeter calibration set.
- Type 2885 Standard Watt converter (A standard that is calibrated periodically by JEMIC (Japan Electric Meters Inspection Corporation), etc.
- Null voltmeter (1mA full scale, for example, hp model 419A)
- DVM (accuracy more than 50ppm)

(2) Without applying input voltage to the type 2885 standard, confirm that the reading of the null voltmeter connected to the Type 2885 standard output 1V terminals is less than ±10μV. If it is not, adjust the zero adjustor on the front panel of the Type 2885 standard.

(3) Repeat the same procedure as described above (2), with the Type 2885 to be calibrated.

(4) Apply 300VAC voltage and 5A AC current (frequency 60 Hz, $\cos\varphi = 1$) to both of Type 2885 standard and watt converter to be calibrated using the wattmeter calibration set, as shown in Figure 4-1. (The voltage input terminals of the two Type 2885 instruments should be connected in parallel, and the current input terminals connected in series).

(5) Assume that the reading of the Null Voltmeter is [b].
Adjust the VOLTAGE DIVIDER (B9402NA) rheostat R10 (See Figure 4-2) so that − [b] = [a] where [a] : the error of the Type 2885 standard (μV). (The absolute full scale value is greater than 1V when the polarity is positive).
[b] : Null voltmeter indication

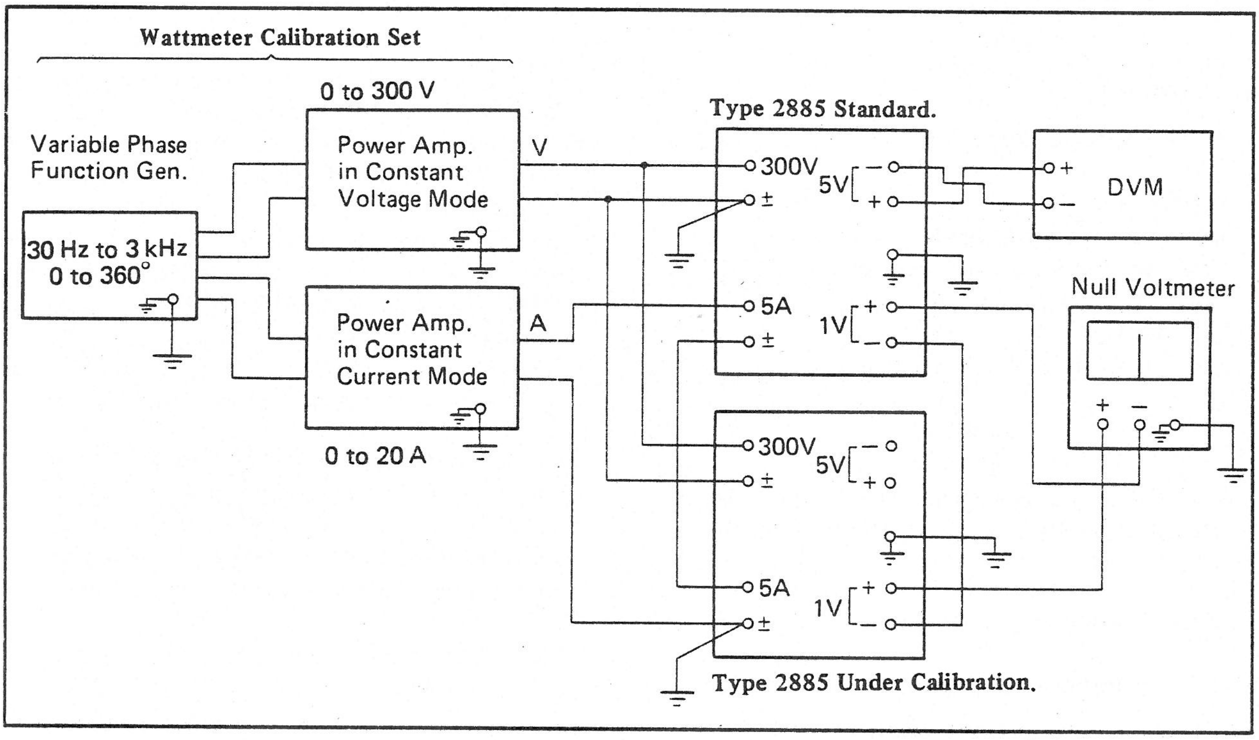

Figure 4-1.

(6) Set the voltage ranges of both the calibration set and the Type 2885 instruments to 150V. Apply 150VAC and 5A AC (frequency 60 Hz, $\cos\varphi=1$) to both Type 2885 instruments. Adjust the VOLTAGE DIVIDER (B9402NA) rheostat R11 as per the procedure in (5) above.

(7) Adjust 100 V and 75 V ranges in the same way. Adjust R12 for 100V, and R13 for 75V.

(8) Set voltage ranges of both the calibration set and the Type 2885 instruments to 300V. Apply 300-VAC and 5AAC (frequency 400 Hz) to the Type 2885 instruments and set the current phase to 90° while observing the DVM, then adjust C1 (see Figure 4-2) so that – [b] = [a.]

(9) Adjst the 150V, 100V and 75V ranges in the same way. Adjust C_2 for 150V, C_3 for 100V, and C_4 for 75V.

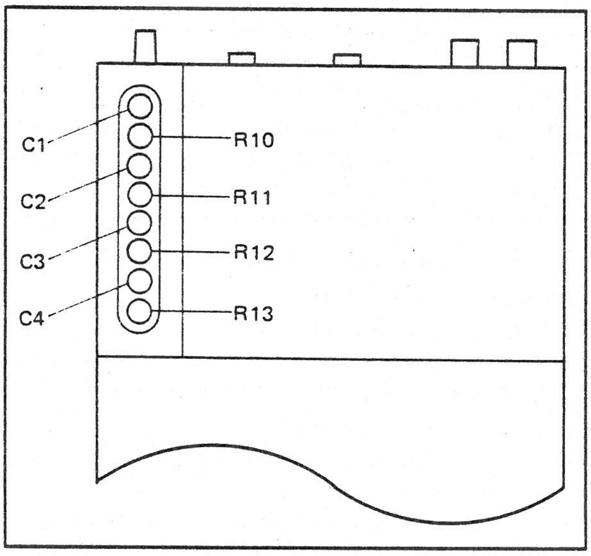

Figure 4-2

NOTE

For a frequency greater than 500 Hz, the AC potential between voltage circuit, current circuit, case, etc. and earth influences the accuracy of the instrument. Therefore, each circuit should be grounded at the designated point as shouwn in Figure 4-1. Twisted wires should be used for input connections, to minimize electromagnetic coupling between voltage and current inputs.

To prevent beating betweeen the calibration set frequency and the power line frequency, a 60 Hz power source is to be used for calibration at 50 Hz, and a 50 Hz power source for calibration at 60 Hz.

9

5. PRINCIPLES OF OPERATION

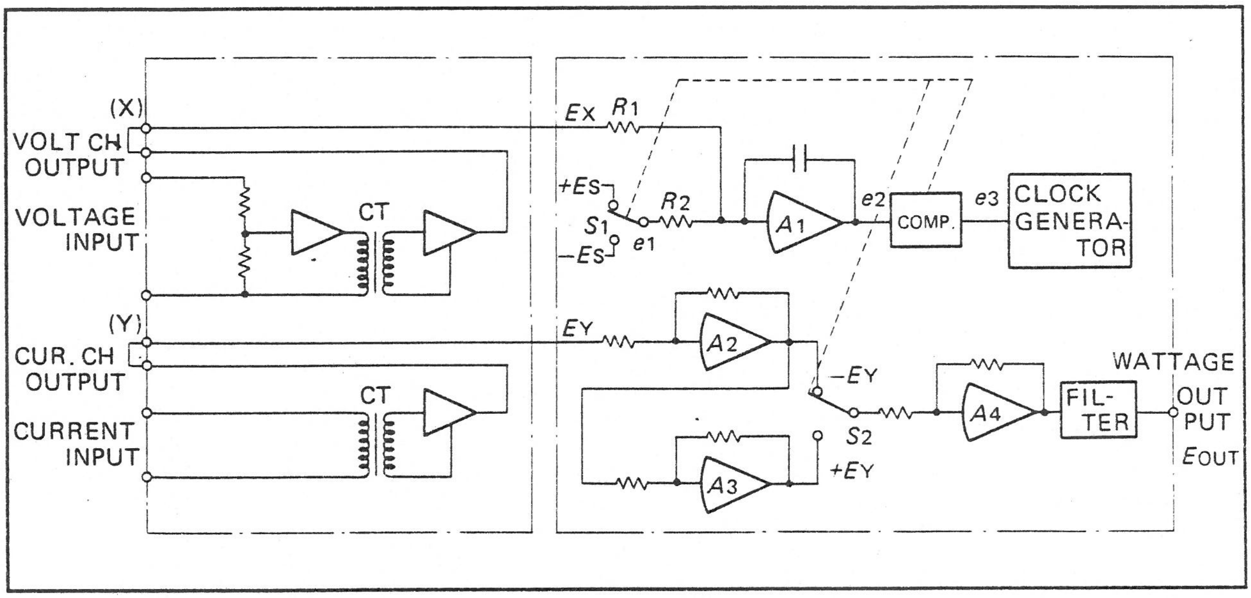

Figure 5-1.

A block diagram of the Type 2885 watt converter is shown in Figure 5-1. Input voltage and current are isolated from the output circuit through two current transformers (CT) and are converted into voltage input signals.

The time division multiplier circuit is used to multiply input voltage by input current.

The multiplier circuit makes use of the fact that the area of a train of electrical pulses is the cumulative product of pulse widths and pulse heights. The integrator output e_2 is the integrated sum of the input signal E_2 and the wave form e_1 (a square wave of amplitude $+ E_s$ generated by switch S_1). The level of e_2 is compared with the voltage e_3 of a triangular wave. When $e_2 > e_3$ the comparator sets switch S_1 to $+E_s$, and when $e_2 < e_3$, S_1 is set to $-E_s$. Thus switch S_1 is opened and closed in such a way that the sum of the mean values of e_1 and Ex is zero.

If T_1 is the time when S_1 is set to $-E_s$ and T_2 the time when S_1 is set to $+E_s$, then the following equation holds and the width of the switching signal thus obtained is accurately proportional to the input signal E_X.

$$\frac{E_X}{R_1} + \frac{E_s}{R_2} \cdot \frac{T_1 - T_2}{T_1 + T_2} = 0$$

The other input signal is chopped by switch S_2 (which is coupled with S_1) to produce an output

$$E_{out} = E_Y \cdot \frac{T_1 - T_2}{T_1 + T_2}$$

combining the two equations above and eliminating the factor $T_1 - T_2 / T_1 + T_2$,

we obtained: $$E_{out} = \frac{R_2}{R_1} \cdot \frac{E_X \cdot E_Y}{E_s}$$

If $R_2/R_1 \cdot E_s$ is constant, the output E_{out} is thus proportional to the product of E_X and E_Y.

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