Type
2041
(10)

INSTRUCTION MANUAL

PORTABLE SINGLE PHASE LOW POWER
FACTOR WATTMETER

YOKOGAWA

INSTRUCTIONS

INSTRUCTION MANUAL
PORTABLE
SINGLE PHASE LOW POWER FACTOR WATTMETER
TYPE 2041 (1ϕL)

1. General

TYPE 2041 Portable Single Phase Low Power Factor Wattmeter is a taut-band suspension, electro-dynamometer type wattmeter and is originally designed for measuring the Epstein iron loss, small power at low power factor.

2. Construction

The wattmeter is housed in a bakelite case, and the indicator is shielded with the double permalloy plates to avoid the influence of the external magnetic field. This low power factor wattmeter has the sensitivity to fullscale with the input of the (rated voltage) x (rated current) x (rated low power factor). One of the special features of this wattmeter is the superior characteristics of power factor. Accordingly this meter is used for the measurement of power at any power factor.

The external view and the internal connection of this meter are shown in Fig. 1 and Fig. 2 respectively.

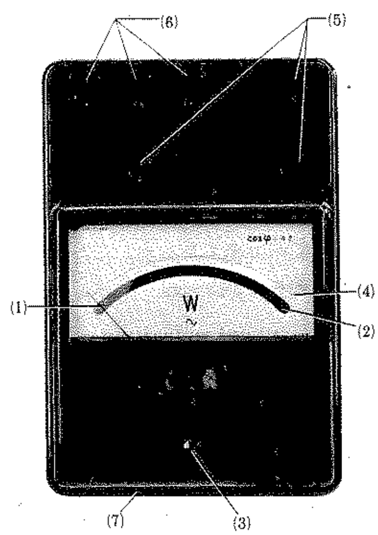

Fig. 1

(1) Knife-edge Pointer:

(2) Mirror: This is provided to eleminate parallax errors in reading the indication on the meter. Read the indication value at the position where you can observe the pointer just overlapped on its of the pointer in the mirror.

(3) Zero Adjusting Screw: This screw is used to adjust the zero position of the pointer in case that the pointer is out of the zero position. However, if the shift of the pointer is attributed to the bent pointer, the

screw must not be used to amend the deflection because it may cause reading errors.

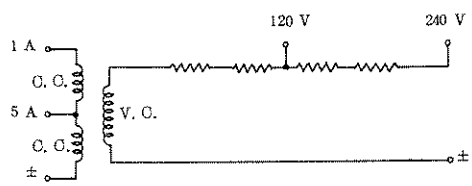

Fig. 2

(4) Scale: The scale is almost equally graduated into 120 divisions.

(5) Voltage Terminal: This is used for the voltage connection. The common terminal is marked with (±), and the others are marked with the respective rated voltage.

(6) Current Terminal: One of the terminals is marked with (±) to show the polarity relation to the voltage coil, and the others are marked with the respective rated current.

(7) Table of Multiplying Constant: The table is located on the side of the instrument case, and is used to obtain the actual power value by multiplying the constant listed in the table by the indication value on the scale. Refer to the operational procedure for more detailed informations.

3. Specifications

Thechnical specifications and characteristics of TYPE 2041 are as follows:

Type:	2041
Class:	Class 0.5, JIS C-1102
Over-all Dimensions:	Approx. 180 x 260 x 140mm
Weight:	Approx. 2.9kg
Scale Length:	Approx. 130mm
Scale Division:	120
Frequency:	50, 60Hz
Overload Capacity:	Voltage circuit 50%
	Current circuit 100%

Table 1 General Measurement: Rating, Internal Impedance, Rated Power Consumption VA

Range		Rating		Internal Impedance	Rated Power Consumption VA
Voltage / Current		120V		Approx 6,000 Ω	Approx 2.4 VA
			240 V	" 12,000 "	" 4.8 "
0.2/ 1A	0.2A	4.8W	9.6 W	" 31.3 "	" 1.25 "
	1A	24W	48 W	" 1.09 "	" 1.09 "
1 / 5A	1A	24W	48 W	" 1.70 "	" 1.70 "
	5A	120W	240 W	" 0.06 "	" 1.50 "
5 /25A	5A	120W	240 W	" 0.105 "	" 2.62 "
	25A	600W	1.2KW	" 0.004 "	" 2.50 "

Table 2 Epstein Iron Loss Test: Rating, Internal Impedance, and Rated Power Consumption VA

Range		Rating		Internal Impedance	Reated Power Consumption VA
Voltage / Current		30V		Approx 1,500 Ω	Approx 0.6 VA
			60V	" 3,000 "	" 1.2 "
0.2/1A	0.2A	1.2W	2.4W	" 31.3 "	" 1.25 "
	1A	6W	12W	" 1.09 "	" 1.09 "
1 /5A	1A	6W	12W	" 1.70 "	" 1.70 "
	5A	30W	60W	" 0.06 "	" 1.50 "

Characteristics

Self-heating Influence:	Approx. within 0.15%
External Temperature Influence:	Approx. within 0.25%/10deg.
External Magnetic Field Influence:	Approx. within 0.8%/400AT/m
Power Factor Influence:	Approx. within 0.2%, power factor from 1.0 to 0.0

4. Operating Procedure

In case that this wattmeter is used for measuring the Epstein iron loss, refer to the instruction manual of the Epstein loss tester.

4-1 Preparations

(1) Place the instrument on a fairly level surface.

(2) Check the instrument if the pointer rests on the zero (0) position in the scale. If not, turn the zero adjusting screw (Refer to Fig. 1) located on the front cover by using a proper screw-driver until the pointer stays at the zero position

(3) Make sure the power source if off before making any connection to the circuit to be measured.

4-2 Connections

(1) Measurement in Single Phase Circuit:

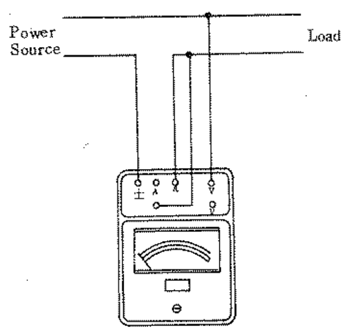

Fig. 3

(Note) * Remember that this meter is a low power factor wattmeter and has the sensitivity five times a normal wattmeter.

* As shown in Fig. 3, connect the voltage terminal (±) to the load side and complete the voltage connection through the current circuit.

* The meter will satisfactorily work with wiring connections described above. If the pointer deflects reversely, reverse the connection of the voltage terminals.

(2) Measurement in Three Phase Circuit:

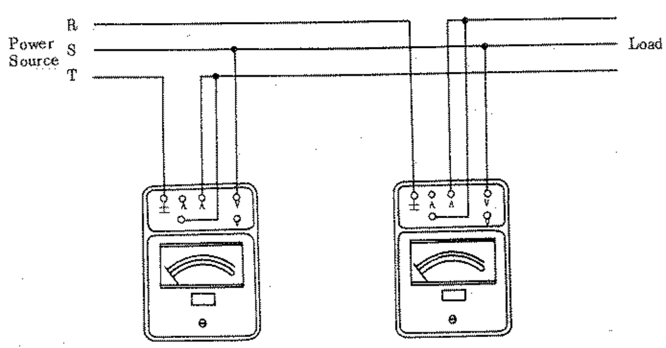

Fig. 4

(Note) * Three phase power measurement is made by connecting two sets of wattmeters as shown in Fig. 4. The power is indicated by the algebraical addition of the indications on the two wattmeters. When the power factor of the circuit to be measured is less than 50%, on one of the two wattmeters the pointer deflects off scale reversely. In this case, reverse the voltage connection of the whose meter pointer deflects reversely to the end, and the meter will indicate "positive" value on the scale. Substruct this value from the positive value on another meter.

* In measuring the low power factor electrical power, if the instrument transformers C. T. and P. T. are connected to the measuring circuit, the slight phase angle difference of them gives a considerably large influence to the indication of the wattmeter. Therefore the accurate wattage measurement cannot be expected with the instrument transformers C. T. and P. T. are connected to the measuring circuit, the slight phase angle difference of them gives a considerable large influence to the indication of the wattmeter. Therefore the accurate wattage measurement cannot be expected with the instrument transformers inserted in the circuit.

4-3 Range Selection

(1) In the measurement of the low power factor (within 0.2) wattage such as an Epstein iron loss test, select the voltage (or current) range which is possibly close to the voltage (or current) value of the circuit to be measured. If the load current is unknown, first select the largest current terminal for connection, and connect the power source. Both voltage and current ranges are changed by selecting terminals. The rated ratio of the voltage range is 2. The rated ratio of the current range is 5.

Be sure not to compose an open loop in the secondary circuit of the current transformer C. T. when changing the measuring range in the situation that the current circuit is connected to the secondary circuit of the current transformer. If the current transformer is provided with a secondary winding shorting key, close the winding with the key first, and then change the measuring range. If the key is not provided, the range changing is made after switching off the power source; or leaving the wiring connections on the current terminals as they are which should be removed when alternating the connections of the current terminals, connect one end of the wiring to the current terminal to be used, and then remove the wiring from the current terminal not to be used.

(2) In measuring the power of DC or the small power of commercial frequency around unity power factor, be careful when determining the current or voltage range. I
If the completely same range as the current or voltage value is selected for the measurement, the pointer of the wattmeter will scale out. Therefore, estimate the approximate value of the power to be measured, and select the rated power range which suitable (closed to and higher than) the estimated value.

4-4 How to use the table of multiplying constant.

Table 3 (Rated voltage 120/240V, Rated current 1/5A)
$\cos \phi = 0.2$

Voltage range	Multiplying Constant	
Current range	120V	240V
1 A	0.2	0.4
5 A	1	2

The table of multiplying constant, as shown in Table 3, in the instruction label located on the side of the wattmeter is used to convert the value read on the scale divisioned 120 into the power value. In other words, the power is obtained from the following

Load power = meter indication value x multiplying constant

The constant is obtained from the following, however the constant should be obtained from the table depending upon the range of the voltage or the current.

Multiplying constant = Rated current (A) x Rated voltage (V) x Rated power Facter (0.2) / All number of division (120)

4-5 Compensation of Self-consumption VA

The indication value on the wattmeter is the total sum of the load power and the consumption power of the coil (current or voltage coil) connected to the load side of the wattmeter. Therefore, in case of small rated power such as of this low power factor wattmeter, the power consumption of the meter itself must be reduced from the reading on the meter.

a) Compensation when the voltage coil is connected to the load side:
The connections are as shown in Fig. 5, and the loss of the voltage coil is almost the same as the indication value when the circuit is unloaded. (In case that the power source impedance is low, or load power is comparatively small), substruct this value mentioned above from the reading to obtain the true load power.

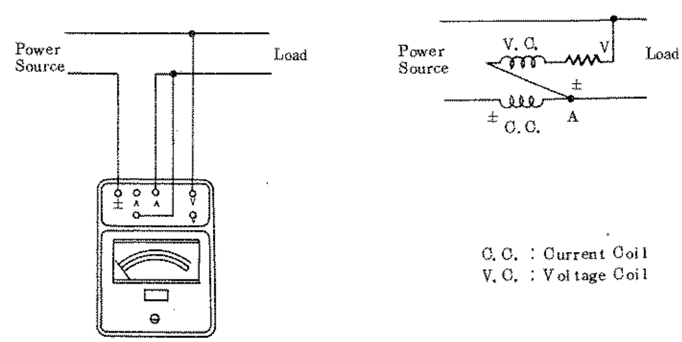

Fig. 5

b) Compensation when the current coil is connected to the load side:
In case that the current coil is connected to the load side through the voltage coil as shown in Fig. 6, if the point of the voltage connection is moved from P to Q, the wattmeter will indicate the loss of the current coil. Substruct this value from the reading on the scale to obtain the true load power.

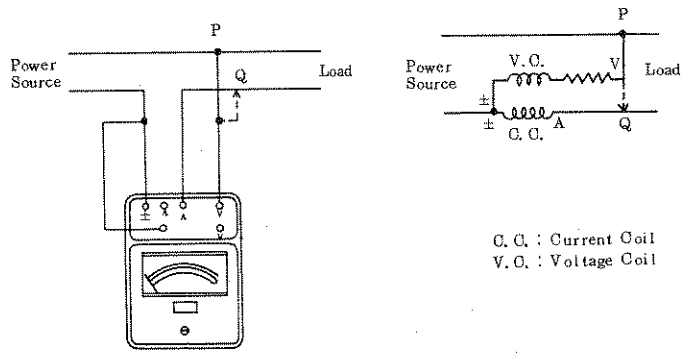
P
Power Source
Q
Load
P
Power Source
V.C.
V
Load
±
±
C.C.
A
Q
C.C. : Current Coil
V.C. : Voltage Coil

Fig. 6

YEW