WATT TRANSDUCER
P SERIES
OPERATION
& CALIBRATION
MANUAL

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WATT TRANSDUCER
P SERIES

1. OPERATING PRINCIPLES

The P Series Watt Transducers utilize a Hall Effect multiplier to provide an output which is proportional to the electric power consumed in a load.

Power is the instantaneous product of voltage time current. The Hall Effect multiplier performs this calculation.

Because it provides instantaneous power determination, the P Series Watt Transducer can be used on distorted waveforms, chopped waveforms or sinusoidal waveforms whenever high-accuracy, reliable measurements are desired.

Accurate operation is obtained from d.c. to 500 hertz so combinations of d.c. and A.C. waveforms can be measured.

2. TYPES

(A) SINGLE PHASE (ONE ELEMENT)
This type has one current sensor and one voltage circuit. It measures total power in a two wire circuit.

(B) POLYPHASE (TWO ELEMENT)
This type has two current sensors and two voltage circuits. It will measure total power in a 1 phase 3 wire or 3 phase 3 wire Delta Circuit without voltage or load restriction.

(C) POLYPHASE (THREE ELEMENT)
This type has 3 current sensors and three voltage circuits. It will measure total power in a 3 phase 4 wire WYE CIRCUIT without voltage or load restriction.

3. OUTPUT

A number of standard outputs to interface with monitoring or control equipment are available. The output is specified by the suffix, as follows:

B	0 to ± 1mAdc
D	0 to ± 10Vdc
E	4 to 20mA
EM	4-12-20mA
EA	0 to 20mA
X5	0 to ± 5Vdc

VOLTAGE INPUTS

P Series Watt Transducers are designed for nominal inputs of 120, 240 or 480 volts AC. The effective range at the specified accuracy is 0 to 150; 0 to 300 or 0-600VAC.

4. CURRENT TRANSDUCERS (SENSOR)

The Hall Effect sensor is built into the head of the current transducer. It has excellent current transient response necessary

where SCR control, chopped and distorted wave forms are present. Other features are low burden and no shock hazard when wires are disconnected.

The current transducers can be obtained as either a split or solid core unit in ranges up to 2000 amperes.

5. POWER FACTOR

All P Series units are designed to operate with power factor from zero lead to unity to zero lag in sinusoidal circuit operation. When waveforms are distorted, power factor is not defined; however the P units provide accurate power measurement.

6. FREQUENCY RANGE

The P Series Watt Transducer was designed to operate over a frequency range of 5 hertz to 500 hertz. For frequencies below 20 hertz additional output filtering is required to maintain an low ripple output.

7. AMPERE-TURNS

Additional turns can be applied through the current transducers window to increase sensitivity of the watt transducer.

If a current is much less than the full scale current rating of the transducer, additional turns can be used as long as NI does not exceed the rating. It should be apparent that the scale factor relating to output will be different.

8. CALIBRATION

All P Series Watt Transducers are factory calibrated and checked 100% for voltage, current linearity, power factor, frequency and initial set point. Temperature is checked on a random sample. All instrumentation used for calibration is checked against our standards which are traceable to NIST.

All P Series Watt Transducers are calibrated using a single-phase source, with current sensors connected in series and voltage inputs connected in parallel.

Ideally, the watt transducer should be connected to a precision calibrator, although adequate results can be obtained by using commercial power and a single phase .1% Watt meter Standard.

8.1 GENERAL

(A) The Wattmeter Standard must be capable of the desired range of input voltage and current required to calibrate the particular Watt Transducer under test.

Since all P Series Watt Transducers will be calibrated on a single phase source, the actual Wattmeter Standard reading will be 1/2 of the total specified watt reading. on 3Ø 3W and 1/3 of the total specified watt reading on 3Ø 4W.

For example a P-143B has a specified output of 1mA @ 40KW. Using the single phase calibration method, the Watt Standard would be set at 20KW and the P-143B would be adjusted to 1mA @ 20KW. In each case, each element is measuring the rated voltage and current.

(B) Use a standard voltmeter with an accuracy of 0.05%. For models that have a current output, a precision shunt resistor can be used. Recommended values are 1K Ohm for 1mA output and 500 ohms for the 4-20mA output.

(C) If full scale line current required is not available, amp-turns through the sensor's window can be used, although this might degrade the over-all calibration.

(D) Apply power to all inputs, including instrument power, 10 minutes before calibration.

(E) Full scale calibration of the watt transducer should be made at or near unity power factor.

(F) Calibration of all Standard Watt Transducer are scaled for power levels such as 10KW 20KW, 40KW, etc.

8.2 ADJUSTMENT

Overall calibration and zero adjustments are located through the lid underneath the plastic caps.

(A) ZERO OFFSET

Energize only the voltage inputs of Watt Transducer. Adjust the (Zero) 20 turn trimpot for a reading of zero.

8.3 FINAL CALIBRATION

(A) Before attempting the final calibration, read the section on calibration.

Figures 1, 2, 3 and 4 provide all the various standard test connections diagrams for the P Series Watt Transducer. As you can see, the voltage connections are in parallel and the current connections are in series.

All standard watt transducers are calibrated at even power levels such as 10KW, 20KW, 40KW, etc. Refer to "Watts At Rated Output" on the specification sheet for the full scale calibration point.

The best method of calibration is to use a Precision Wattmeter Calibrator; if this instrument is not available, the set up shown in figure 2 or 3 can be used.

In figure 2 the two variacs are used to give independent adjustment between the voltage and current circuits. The voltage input which is represented with the letter "E", requires a low current variac with a voltage range of either 0 to 150, 0 to 300 or 0 to 600VAC.

The variac for the current sensors must be capable of the required high current.

(B) The following is an example of calibration of a standard P Series Watt Transducer using the Calibration Test Set-up shown in figure 2.

Example

Model	P-143B
Voltage	240VAC
Current	100 AMPERES
Rated Output	1mA @ 40KW
Test Connections Drawing	Figure 1
Standard Wattmeter Set Up	20KW
Accuracy	±1%

Make the necessary connections between figure 2 and figure 1.

Please note: If the AC current source will not supply the required 100 amperes, amp-turns can be used. Consult Section 7.2.

Energize the 240VAC, apply the necessary current to obtain a reading of 20KW on the Standard Wattmeter.

Adjust the "Cal" trimpot for a 1 milliampere reading when the Standard Wattmeter reads 20KW. Decrease the current in 20% steps for linearity checks.

(C) It is necessary to have stable current and voltage sources when making these adjustments. A precision calibrator or constant dc voltage and current source may make calibration at higher currents easier.

9. INSTALLATION

The P Series Watt Transducer may be installed in any orientation and in an environment of not more than 40 Deg C or not less than 0 Deg C.

The current sensors should be mounted away from right angle busses, large magnetic fields, or return current busses. The current sensor should not be interchanged between phases and units. Each sensor is marked for proper phase and line L1 CT must go to

L1 line etc.

10. TROUBLE SHOOTING

The majority of the problems can usually be traced to improper connections.

Problems:	Solution
No output	1. Instrument power is not connected to terminals 15 & 16.
	2. One sensor turned backwards.
	3. Voltage phasing reversed.
	4. Monitor defective.
1/2 output	1. All 50 ampere units require two turns through sensor window for correct output.
Apparent Calibration Error	1. Calibration point is at the "Watts at Rated Output" not the full scale voltage.
	2. Customer relies on voltage and current measurement to compute power. This is only correct in a resistive load. The phase angle must be at a cosine of 1 (For 3 Ø only) P = EI cos Ø 3
	3. Miscounted the number of turns through sensors window. See sections 8.3
	4. Current sensors not installed to proper terminal connections.
Output is full scale	1. The constant current outputs require a load resistor before a voltmeter can measure the output signal.

TEST CONNECTIONS

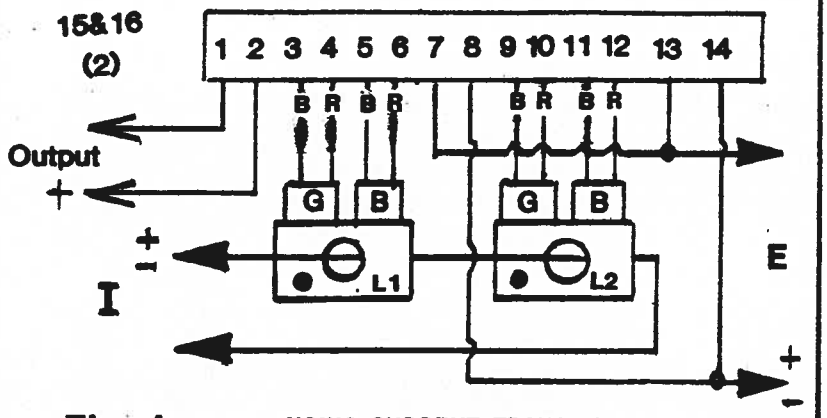

Fig. 1 USING CURRENT TRANSDUCERS (HIGH CURRENT)

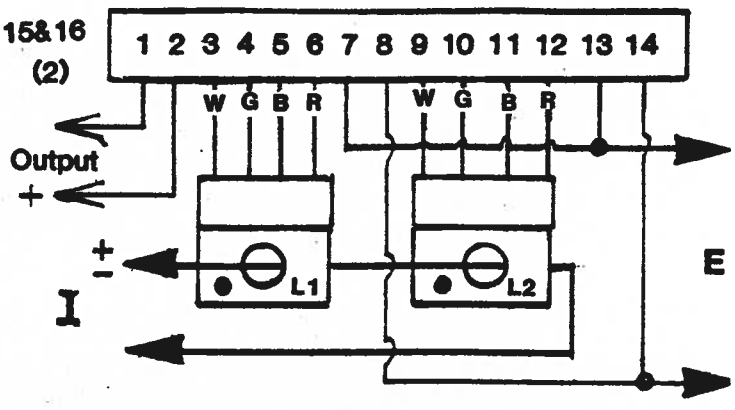

Fig.1a USING CURRENT TRANSDUCER (SPLIT CORE)

CALIBRATION TEST SET-UPS

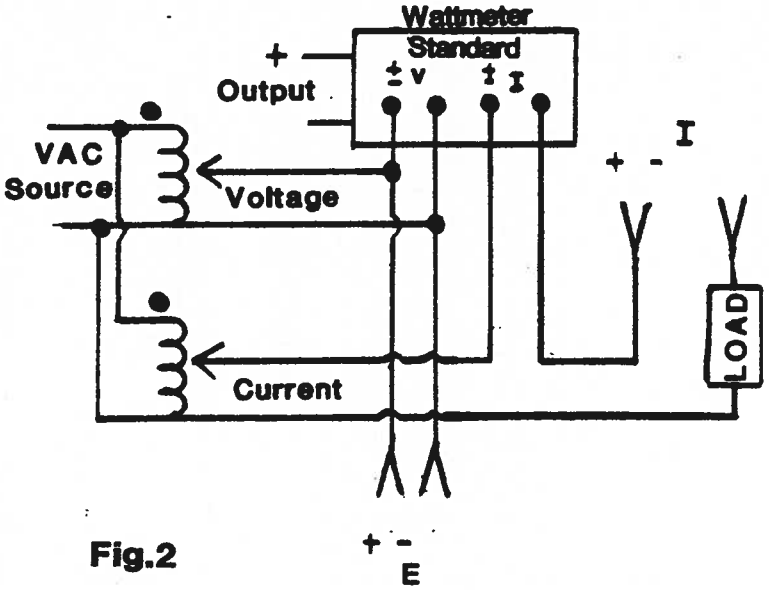

Fig.2

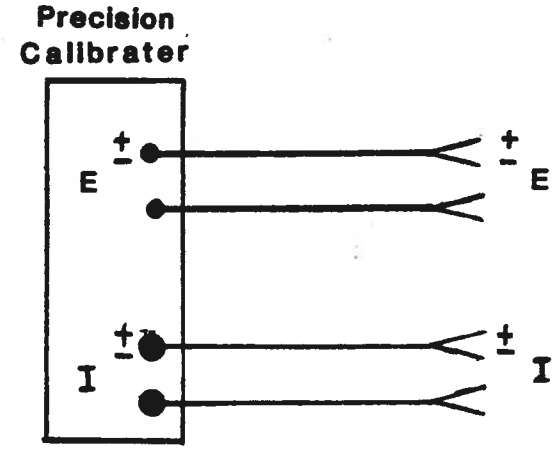

Fig.4

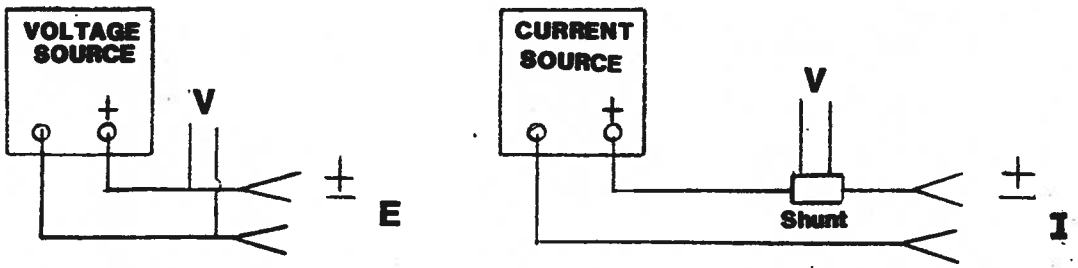

Fig.3

Note:

(1) 50 Ampere Models Require Two Turns Through Current Transducers Window

(2) Require 115Vac Inst. Pwr.

(3) Indicates Connection → Between P and Calibrater

INSTALLATION INSTRUCTIONS

MODEL P SERIES

General

The P series of watt transducers provide a dc output which is proportional to its average real power. They can be used to measure the instantaneous, variable frequency, dc and non-sinusoidal ac waves and provide continuous multiplication of the volts and amperes for an accurate measurement of real power delivered to the load.

Factory Calibration

Each P series watt transducer is calibrated at the factory as a set. Each model includes one main electronic enclosure and either one current sensor for single-phase, two current sensors for three-phase, three-wire, or three current sensors for three-phase four-wire.

Each current sensor is identified with the P series model number, serial number, and phase.

Polarity

Follow the connection diagram provided for that model.
Mount the current sensors with the RED DOT facing the AC incoming lines. Connect each current sensor to its own input terminals; for instance, L1 current goes to terminals 3, 4, 5 & 6 on three phase models.
Not matching current sensors to the proper connections will result in a miscalibrated output.

Mounting Precautions

Mount the current sensors away from right angle bends, return current cable "min. of three inches," power lines and VFD converter enclosures.
Mounting holes are located at the base of the electronic enclosure and pass through holes are provided on the current sensors. Metal nuts and bolts are OK for attaching the current sensors.
Keep the incoming voltage leads away from power lines which can pick up transients, and especially from VFD converter lines.

Instrument Power

Operating voltage 85 to 135Vac, 50 - 400 Hz, 15VA.
In some applications using VFD drives will require special attention: routing leads away from the VFD enclosure, adding RF line filter or isolated power source.

Shields

Cut the current sensor shields off if not done at the factory.
DO NOT tie any of the sensor shields to the case or ground, although grounding the case only is acceptable.
Output shielding is discussed in the attached Technical Bulletin No. 110. Do not attach signal shield at watt transducer.

WARNING SHOCK HAZARD

ALL CURRENT TRANSDUCER TERMINALS ARE AT LINE POTENTIAL.

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