MODEL PTB
AC MONITOR

INSTRUCTION AND
TROUBLE SHOOTING
MANUAL

OHIO SEMITRONICS, INC.

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A7004-25 Rev. A

AC POWER MONITOR

Model PTB

FEATURES

- Small Package
- Board Level
- High Accuracy
- Less Wiring
- Direct Inputs To 600Vac
- Low Cost

DESCRIPTION

The new, board level, power monitor is designed to measure and provide analog output signals for the parameters of voltage, current and total power. Optional output signals for power factor, apparent power (VA) and watthours are available through plug-in circuit cards. Output signal levels of 0 to 10 volts dc are standard. Optional 0 to 1mAdc or 4 to 20mAdc levels are available. The 10.75" x 8.9" x 2.5" circuit board is provided with mounting holes to fit a 10" x 12" NEMA case or the circuit board can be mounted in the user's cabiet with standoffs. Input and output terminals are located directly on the circuit board. The electronic circuitry consists of solid-state multipliers/dividers, TRMS converters and operational amplifiers. The unit requires 115Vac instrument power.

PHASE		VOLTS		AMPS		OUTPUTS		INST. PWR.		OPTION P	OPTION W	OPTION C
1	1 PH-2 W, 1 ELE	1	0 - 150 Vac	1	0 - 5 AMP AC	D	0 - 10Vdc	1	120Vac	Apparent Power & Power Factor	Watthours	Nema Case 10 x 12 x 4
2	3 PH-3 W, 2 ELE	2	0 - 300 Vac	2	0 - 100 AMP AC		Optional					
3	3 PH-4 W, 3 ELE	3	0 - 600 Vac	3	0 - 200 AMP AC	B	0 - 1mAdc	2	220Vac			
				4	0 - 400 AMP AC	E	4 - 20mAdc					

SPECIFICATIONS

INPUTS

Voltage
- Range (w/linearity)
- Overrange (w/o damage) 150V & 300V 600V
- Burden ≤

Current
- Range (w/linearity)
- Overrange (w/o damage)
- Burden ≤

Frequency Range
Power Factor
Configuration (1, 2, or 3 element)
Isolation (Input-to-Output)

OUTPUTS

Volt Amperes (optional) See Table
- Type (0 - 10V, 0 - 1mA) See Table
- Scaling 0 - 10V (or 0 - 1mA) = 0 - FS VA input (FS VA)=FS Voltage)x(FS Current)x(No. of elements)x(0.8)

Power Factor (optional) See Table
- Type (0 - 10V, 0 - 1mA) See Table
- Scaling 0 - 10V (or 0 - 1mA) = 0 - 1 Power Factor (no indication of lead or lag)

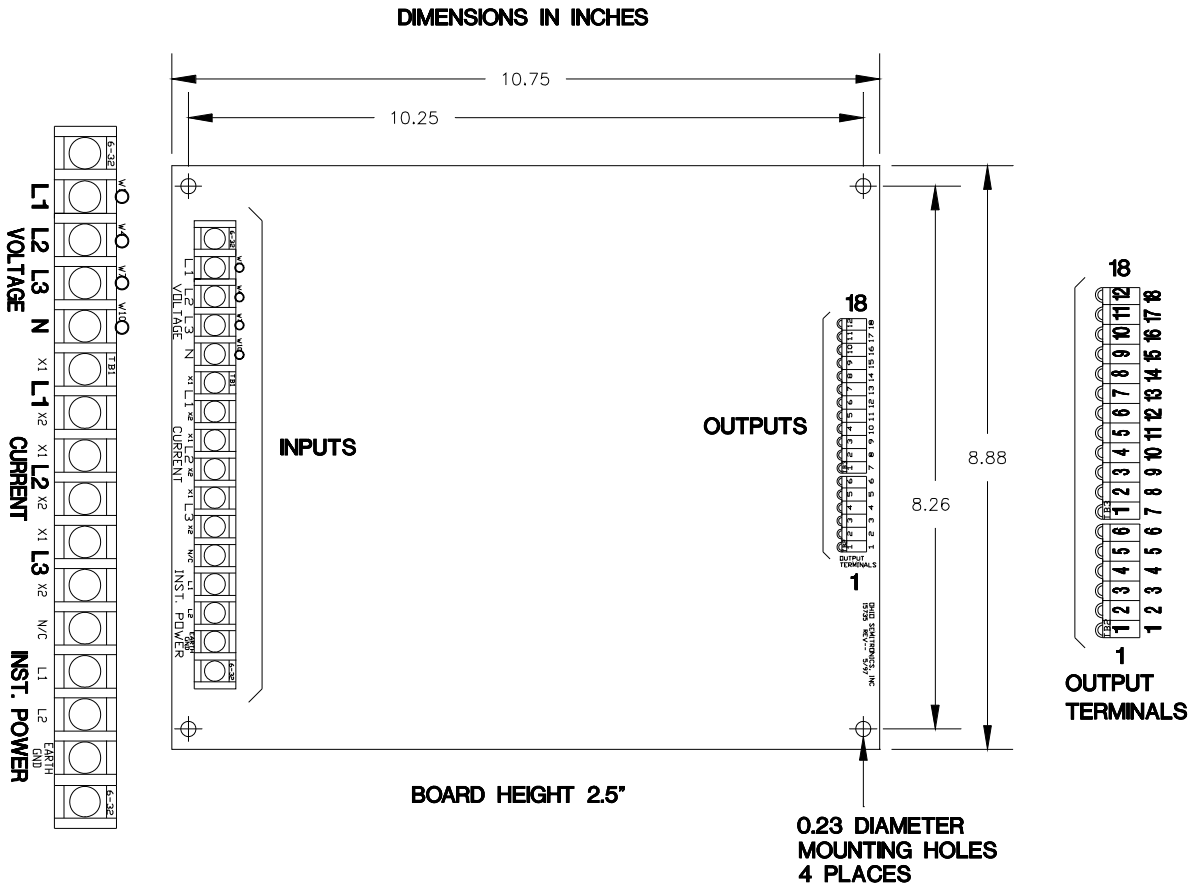
Loading
- 0 - 10V ≥ 2k
- 0 - 1mA ≤10k
- 4 - 20mA ≤500

Ripple ± 1% FS
Response (90%) 200mSec
Watthour (optional) See Table
- Type Form A, Relay
- Relay rating 120V, 0.5A
- Relay closure duration 200mSec
- Scaling
  - 5A Models 1 WH per closure
  - 100A Models 20 WH per closure
  - 200A Models 40 WH per closure
  - 400A Models 80 WH per closure

Accuracy (linearity, set point, repeatability)
- Voltage, Current, Watts, VA
  - 5A Models ± 0.3% FS
  - 100A - 400A Models ± 0.5% FS
- Power Factor (10% - 100% input) ± 0.01% PF
- Watthours ± 0.5% FS

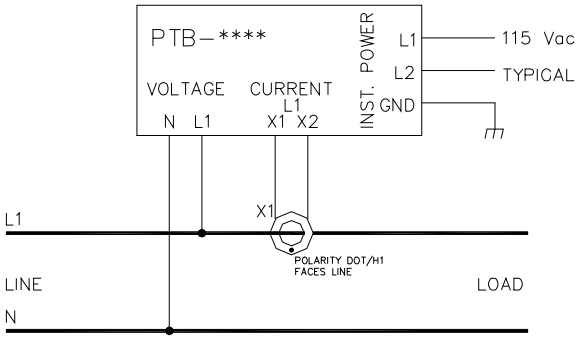
Temp. Effect (10° to 35°C) ± 0.5% FS

INSTRUMENT
- Power 115Vac, ± 10%, 50/60 Hz
- Dimensions
  - Board level 10.75" x 8.9" x 2.5"
  - Optional NEMA Case 12" x 10" x 4"

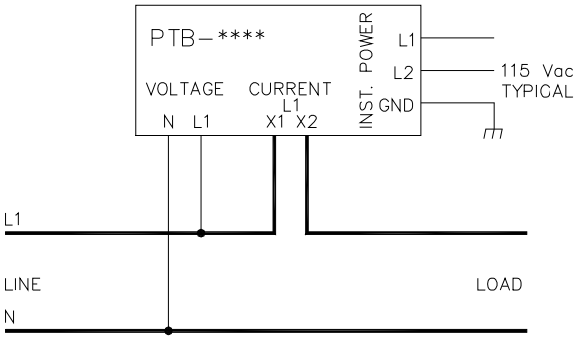


OUTPUTS							
1Ø-2W		3Ø-3W			3Ø-4W		
1	WATTHOUR RELAY	1	WATTHOUR RELAY		1	WATTHOUR RELAY	
2		2			2		
3	NA	3	NA		3	NA	
4	NA	4	NA		4	NA	
5	COMMON	5	COMMON		5	COMMON	
6	COMMON	6	COMMON		6	COMMON	
7	COMMON	7	COMMON		7	COMMON	
8	POWER FACTOR	8	POWER FACTOR		8	POWER FACTOR	
9	VOLT AMPERES	9	VOLT AMPERES		9	VOLT AMPERES	
10	WATTS	10	WATTS		10	WATTS	
11	COMMON	11	COMMON		11	COMMON	
12	NA	12	L3	CURRENT	12	L3	CURRENT
13	NA	13	L2		13	L2	
14	CURRENT	14	L1		14	L1	
15	COMMON	15	COMMON		15	COMMON	
16	NA	16	L1-L2	VOLTAGE	16	L1-N	VOLTAGE
17	NA	17	L2-L3		17	L2-N	
18	VOLTAGE	18	L3-L1		18	L3-N	

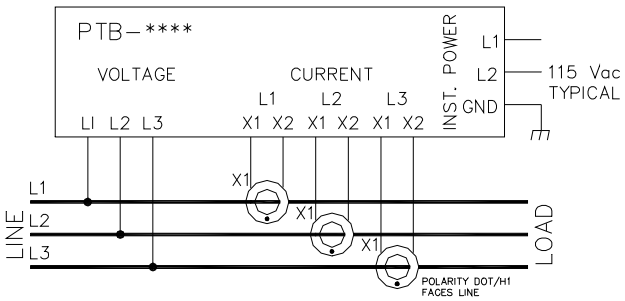
10–2W W/TRANSFORMER



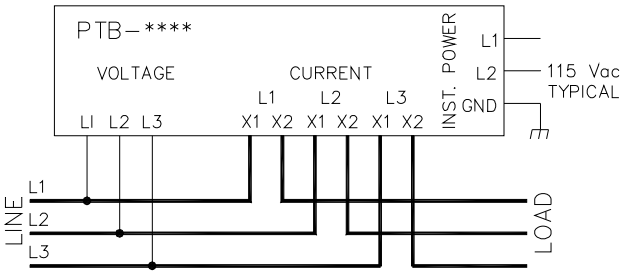
1Ø2W DIRECT CONNECTION



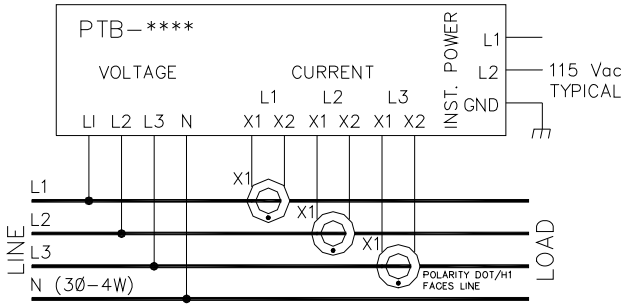
3Ø–3W W/TRANSFORMERS



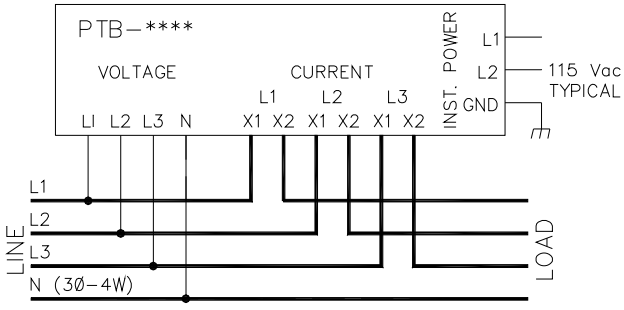
3Ø–3W DIRECT CONNECTIONS



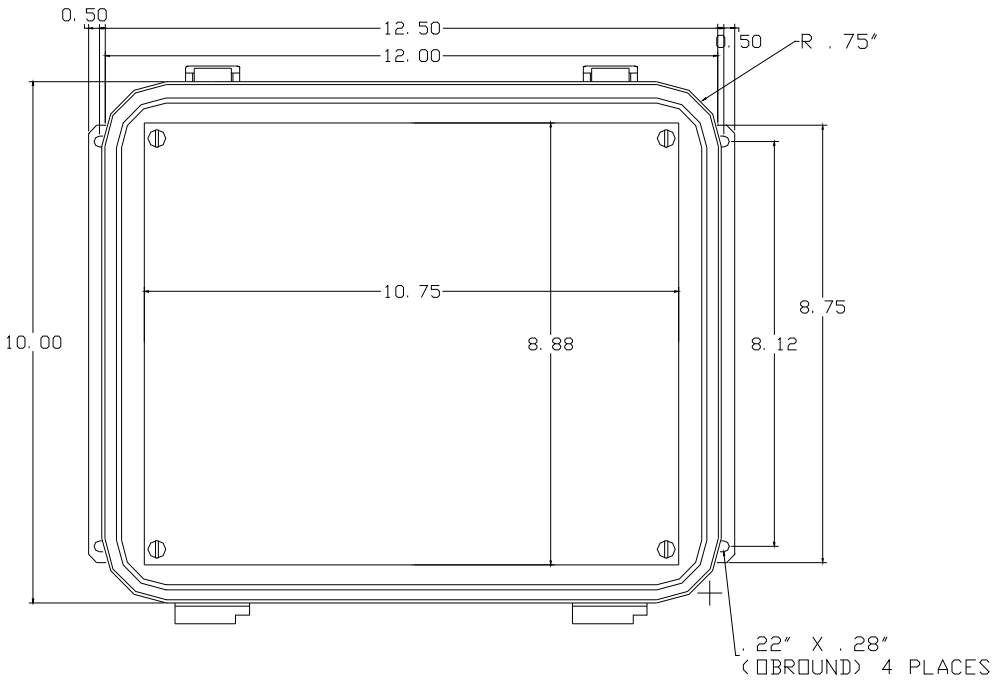
3Ø–4W W/TRANSFORMERS

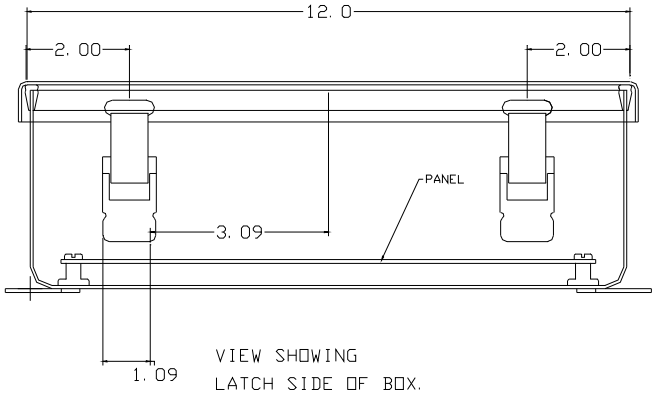


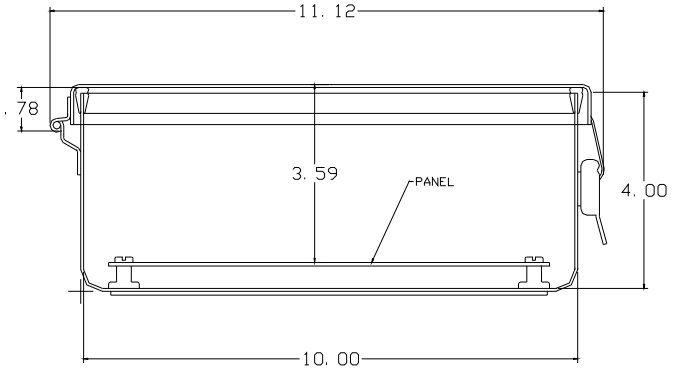
3Ø–4W DIRECT CONNECTIONS



NEMA 12 ENCLOSURE







NOTE:

1. PANELS ARE 14 GAUGE STEEL.
2. PANEL SCREWS ARE #10-32 PAN HEAD.

GENERAL

The PTB series of AC power monitors are fully self contained power test panels. The parameters supplied with each model are described in the specification sheet Model No. Table on page 1. Check the attached label on your PTB circuit board for the correct model number.

Less wiring is required since all interconnections are made on the circuit board. Terminals are provided on the circuit board for the input and output connections.

The base models provide up to 7 analog outputs for the RMS voltages, RMS currents, and total power.

Optional plug-in cards provide measurements for Volt-Amp, Power Factor and Watt-hours.

External current transformers are supplied with models with current ranges listed from 100 A to 400 A. One current transformer is supplied with single phase models and three current transformers are supplied with three phase models.

BOARD DESCRIPTION

The circuit board is laid out on a 10.75" x 8.9" x 3" mother board with optional plug-in cards for monitoring volt-amp, power factor and watthours. Other plug-in options are available for 1mAdc or 4-20mAdc outputs.

Input transformers provide the isolated low level AC signals which are coupled to the integrated circuits. The integrated circuits provide true RMS voltage and current measurements, instantaneous multiplication of each phase, which then is amplified and summed for total power measurement. Other integrated circuits use multipliers and dividers to calculate the volt-amps and power factor.

Standard outputs of 0 to 10 volts or optional plug-in cards for 0 - 1 mAdc or 4-20 mAdc are provided at the output terminals.

MEASURED PARAMETERS

Single Phase (1Ø2W)
- Power (P) = EICosΘ
- Apparent Power (VA) = EI
- Power Factor = P/VA

Three Phase (3Ø3W) Δ
- Power (P) = EI√3CosΘ
- Apparent Power (VA) = EI√3
- Power Factor = P/VA

Three Phase (3Ø4W) WYE
- Power (P) = 3EICosΘ
- Apparent Power (VA) = 3EI
- Power Factor = P/VA

- 1Ø2W Power = Van x Ia x CosΘ
- 3Ø3W Power = Vac x Ia x CosΘ
  + Vbc x Ib x CosΘ
- 3Ø4W Power = Van x Ia x CosΘ
  + Vbn x Ib x CosΘ
  + Vcn x Ic x CosΘ

E = Volts
I = Amperes
PF = Power Factor
VA = Volt-Amps
WH = Watthours

INSTALLATION

The PTB model is either supplied in a NEMA case or as a stand alone circuit board.

CIRCUIT BOARD : The circuit board is designed to be mounted in a cabinet on a vertical or horizontal flat surface. Refer to the layout drawing, page 7, for mounting dimensions.

Mounting holes are located in each of the four corners of the circuit board and are drilled for a #10 screw.

To maintain the 1500 Vac isolation, mount the circuit board a minimum of ½ inch above the surface. Use at least one metal standoff and a star lock washer for the corner hole next to the instrument power terminals. This connects the GND terminal to your ground.

NEMA CASE: If a case is provided, entrance and exit holes are not punched. Remove the circuit board before punching or drilling. To remove the board, unscrew the #10 screws located in each of the four corners and lift it out of the case.

Case mounting dimensions are 12.5" x 8.12"; hole size 0.22" x 0.28".

If a NEMA case is supplied by the user, a standard 10" x 12" x 4" case is recommended.

INPUT TERMINALS : The 14 terminal terminal strip is mounted directly on the circuit board and uses #6 screws with a 7/16" terminal spacing.

The terminal strips can accommodate 3/8" stripped solid wires or stranded wire with solderless ring or tongue terminals.

The terminals are identified by lettering on the circuit board.

Use wire rated at 600 Vac with wire sizes from 14 to 20 gauge for voltage lines and 12 to 14 gauge for current lines.

Instrument power inputs are L1, L2 and GND. The ground terminal is connected to the corner hole. Use a metal standoff and a star lockwasher to provide ground connections through the standoff to your ground.

OUTPUT TERMINALS : Eighteen output terminals are provided with signal commons at terminals 5, 6, 11 & 15. See page 7 for output connections.

The terminals are compression type screw terminals, 5 mm spacing; will handle wire sizes from 22 to 14 gauge and require a screwdriver with a 1/8 inch wide blade.

FUSING : Fusing is not provided on the circuit board. Check your electrical code to see if it is required. Recommended fuse sizes are from 1/4 to 1 A at a rating of 600 Vac.

Fuses and fuse holder can be ordered from OSI - Part No. FH-6-1/4-3.

CURRENT TRANSFORMERS (CTs): Current transformers which are supplied with the PTB are calibrated as part of the monitor's accuracy. Connections and dimensions are shown in the attached specifications, see pages 6 and 8.

Precautions should be taken when installing the CTs. See the following:

1. Keep the secondary leads as short as possible. Adding additional leads length can reduce the accuracy of the unit. See Table 1 for the maximum recommended lead lengths.

2. **NEVER** open the secondary leads of a current transformer under load. A severe shock may result, due to the high voltage pulse.

TABLE 1 MAXIMUM LEAD LENGTH IN FEET FOR VARIOUS GAUGES OF WIRE

CT RATING	10 GAUGE	12 GAUGE	14 GAUGE
100 A	20	15	10
200/400 A	40	30	20
600 A & up	80	60	40

3. **NEVER** leave the secondary leads open with current applied. Always short the leads together, unless the leads can be connected to the PTB board.

4. Current transformers rated below 100 Ampere are not recommended for power measurement. Use ampturns on the primary side of the current transformer for lower current loads.

5. AMPTURNS

When using 100 amp PTB models, it is possible to provide full scale outputs at lower current ranges of 10A, 25A or 50 Amps. This is done by adding turns to the primary side of the current transformer, as shown in the drawing below and Table 2. Count only the turns **inside** the window as an ampturn.

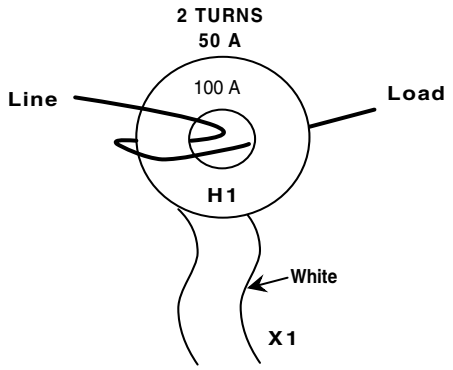


TABLE 2

INPUT AC CURRENT	NO. OF TURNS PRIMARY	* SCALE FACTORS FOR FS OUTPUT	
		CURRENT	WATTS & VA
50 A	2	50	÷ 2
25 A	4	25	÷ 4
10 A	10	10	÷ 10

* Full Scale Outputs are based on the PTB 100 A Models.

SCALING (Base Models)

Analog outputs are provided for each parameter specified. The full scale voltage equals the full scale output when specified at either 150 V, 300 V or 600 Vac. Full scale currents are listed at 5 amperes, 100 amperes, 200 amperes or 400 amperes.

Full scale watts and volt-amps are calculated by multiplying the number of elements times the full scale voltage times the full scale current times 0.8.

FS Watts or FS VA = FS Volts x FS Amps x No. of elements x 0.8

A single phase two wire (1Ø2W) is considered one element, three phase three wire (3Ø3W) two elements and three phase four wire (3Ø4W) three elements.

Watthours are based on current ranges: 5A = one watthour per relay closure (1WH/C), 100A = 20 WH/C, 200A = 40 WH/C and 400A = 80 WH/C.

SCALING 5A MODELS WITH CUSTOMER'S CURRENT TRANSFORMERS.

To calculate full scale outputs

1. Base unit times current transformer ratios. Base Unit = (No. of elements x FS Volts x 5 x 0.8)

For instance: PTB - 223D1
2 element, 300 Vac, 5 Amps
Use with 500:5 current transformers
Total Watts = 2 x 300 x 5 x 0.8 x 500/5
Total Watts = 240 KW = FS Output
Volt-Amps = Same as Total Watts or 240 KVA
Current = 500 Amps = FS Output
Optional Watthours are calculated by multiplying base unit of 1 WH/C times the ratio of the CT: New WH/C = 1 x Ratio of CT
or 100 WH/C

WIRING

Review the section on Installation, page 2, before wiring the AC power monitor.

It is important to wire the test panel as shown in the connection diagrams provided on page 6.

Phase rotation is not important, but phase relationships between L1 voltage and L1 current, L2 voltage and L2 current and L3 voltage and L2 current are very important.

If current transformers are used, the polarity is very important. In normal installation always place the current transformer with the polarity dot, or H1, toward the incoming power source. Mark each transformer to identify the line it is on. Run the current cable from the source through the line side "Dot or H1" of the window first before going to the load.

The secondary polarity of the CT is just as important. The input terminals are labeled L1, $X_1$and X_2, etc. The secondary leads or terminals will have a polarity dot or X_1. The white lead is considered X_1 for CTs supplied with the power monitor.

USER SUPPLIED CTS

The same precautions should be taken when using current transformers already installed or user provided, see page 3.

If the installed current transformers have the H1 side toward the load, reverse the secondary side, so thatX_2 goes to X_1 input terminals, etc.

OUTPUT SIGNALS

Always use twisted shielded cables when running cables to your data system. The output shields should only be terminated at your data system ground. Keep the cables away from sources of electrical interference.

TROUBLE SHOOTING

No outputs:
1. Check Instrument power.

Low output on watts:
1. Check your connections for both voltage and CTs phasing.
NOTE: One backwards CT will give you low output.
2. Check secondary wiring of CTs. Too long of a distance between the CT and the circuit board can cause low output.
(See Table 1, page 4)

Low output on Volt-Ampere:
1. Check current transformers
(See Table 1, page 4)

Negative output on watts or optional PF:
1. Check for correct voltage phasing
2. Current transformers backwards

Power Factor and Volt-Ampere output low:
1. Using a 3 phase 3 wire model on single phase. The $\sqrt{3}$ calculation is used on 3Ø3W Volt-Amps circuitry and not on single phase.
2. You don't have option for PF and Volt-amps.

Low current output:
1. Current transformers - see Table 1
2. The dc output is proportional to the RMS input value, not average.

LOW COST CURRENT TRANSFORMERS

FREQUENCY RANGE 50 TO 400 HERTZ

FEATURES

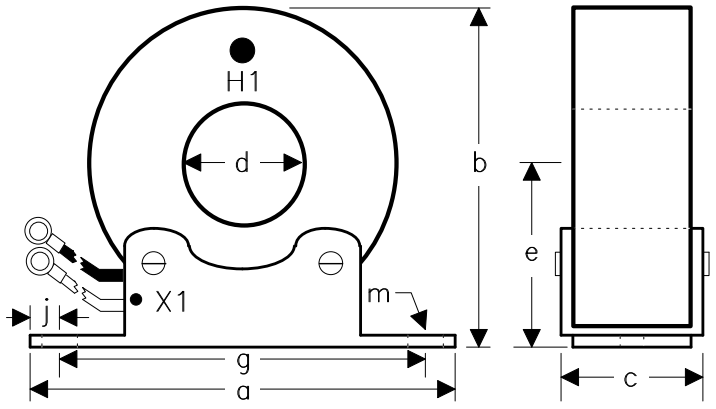
- Manufactured to meet requirements of UL1244 and revisions.
- Flexible leads are UL1015 105°C CSA approved.

APPLICATIONS

- For use with **OSI** PC series and model W Watt and Watt/Watt Hour transducers.
- Ideal for use with Ammeters, relays and Watt transducers.

50 TO 400 HERTZ CURRENT TRANSFORMER

CURRENT RATIO	ACCURACY AT 60HZ. (%)	BURDEN AT 60HZ. (VA)	PART NUMBER	WT. (LBS)	TRANSFORMER DIMENSIONS (INCHES)							
					a	b	c	d	e	g	j	m
50:5	3.0	2.5	10418	1.22	4.55	3.68	1.25	1.25	1.85	3.88	0.34	0.31 X 0.44
100:5	1.5	5.0	10424	1.28	4.55	3.68	1.25	1.25	1.85	3.88	0.34	0.31 X 0.44
150:5	1.0	7.5	10421	1.35	4.55	3.68	1.25	1.25	1.85	3.88	0.34	0.31 X 0.44
200:5	1.0	12.5	10425	1.37	4.55	3.68	1.25	1.25	1.85	3.88	0.34	0.31 X 0.44
250:5	1.0	20.0	12271	1.39	4.55	3.68	1.25	1.25	1.85	3.88	0.34	0.31 X 0.44
300:5	1.0	25.0	10417	1.41	4.55	3.68	1.25	1.25	1.85	3.88	0.34	0.31 X 0.44
400:5	1.0	15.0	10420	1.47	6.53	4.94	1.25	2.50	2.44	5.75	0.39	0.28
500:5	1.0	25.0	12279	1.53	6.53	4.94	1.25	2.50	2.44	5.75	0.39	0.28
600:5	1.0	30.0	10422	1.59	6.53	4.94	1.25	2.50	2.44	5.75	0.39	0.28
750:5	1.0	30.0	12476	1.60	6.53	4.94	1.25	2.50	2.44	5.75	0.39	0.28
800:5	1.0	35.0	12280	1.61	6.53	4.94	1.25	2.50	2.44	5.75	0.39	0.28
1000:5	1.0	20.0	10423	0.65	6.53	4.94	1.25	3.00	2.44	5.75	0.39	0.28
1200:5	1.0	25.0	11014	0.73	6.53	4.94	1.25	3.00	2.44	5.75	0.39	0.28
1500:5	1.0	30.0	10998	0.86	6.53	4.94	1.25	3.00	2.44	5.75	0.39	0.28
2000:5	1.0	40.0	12284	1.10	6.53	4.94	1.25	3.00	2.44	5.75	0.39	0.28



TRANSFORMER SPECIFICATIONS

FREQUENCY: 50 to 400 Hz.
INSULATION CLASS: 0.6KV BIL 10KV full wave
LEADS: UL1015 105°C CSA approved, #16 AWG, 24 In. length.
TERMINALS: No. 8 ring terminal.

REVISION			
REV.	**DESCRIPTION**	**DATE**	**APPROVAL**
A	Manual Number changed from A7004-42 to A7004-25.	11/13/01	JR

				OHIO SEMITRONICS, INC. **4242 REYNOLDS ROAD** **COLUMBUS, OH 43212**
		DWG.# A7004-25	**REV.** A	**SHEET** 1 **OF** 1