OPERATION & CALIBRATION MANUAL

GW5 & GV5 SERIES WATT & VAR TRANSDUCERS

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GW5&GV5 Manual
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WATT & VAR TRANSDUCER
GW5 & GV5 SERIES

1-1 DESCRIPTION

This series of transducers completely consists of solid state devices utilizing electronic circuitry for the instantaneous multiplication of the voltage and the current on a continuous basis. The Watt or VAR transducers provide the following measuring function:

P = E x I x Cos θ For 1 Phase 2 Wire
P = E x I x √3 x Cos θ For 3 Phase 3 Wire
P = E x I x 3 x Cos θ For 3 Phase 4 Wire
VAR = E x I x Sin θ For 1 Phase 2 Wire
VAR = E x I x √3 x Sin θ For 3 Phase 3 Wire
VAR = E x I x 3 x Sin θ For 3 Phase 4 Wire

P	Power
VAR	Reactive Power (**V**olts **A**mps **R**eactive)
E	Voltage
I	Current
θ	The angle by which the current lags or leads the voltage – the PF angle.
PF	Power Factor (Also Cosθ)
√3	The square root of 3 or approximately 1.732.
≈	Proportional to.

1-2 VOLTAGE INPUTS

The GW5 and GV5 Transducer are designed for a nominal input of 120V, 240/277 or 480VAC. The effective range at the specified accuracy is 0 to 150VAC, 0 to 300VAC,and 0 to 600VAC. In the event the transducer was specified with internal instrument power listed as option A, EG, CX5 or C, then the effective range would be limited to 85 to 135 volts, 200 to 280 volts, 380 to 550 volts respectively.

1-3 CURRENT INPUTS

Standard ranges are 5, 10 and 20 amperes AC. Accuracy is specified from 0 to 5, 0 to 10 and 0 to 20 amperes AC.

1-4 OUTPUTS

All GW5 and GV5 Transducers have a standard output of 1mA, 5V, 10V, 4-20mA, or 4 to 12 to 20mA. The option letter inserted in the model number indicates these. Check the specification sheet for your particular model's output.

2-1 GENERAL

The wattmeter Standard must be capable of the desired range of input voltage and current required to calibrated the particular transducer. Since all GW5 & GV5 Transducers will be calibrated on a single phase source, the actual Wattmeter Standard reading will be ½ of the total specified output on 2 elements, ¼ on 2½ element and 1/3 of the total specified output on 3 element transducers. For example, a GW-004B, 3 Phase 3 Wire has a specified output of 1mA≈1KW. Using the single phase calibration method, the Wattmeter Standard would be set at 500 rated watts and the GW5 would be calibrated for 1mA output at 500 W point on the Wattmeter Standard.

Second example, GW5-007B 3 phase 4 Wire has a specified output of 1mA≈1.5KW. Using the single-phase calibration method, the Wattmeter Standard would be set at 500W and the GW5-007B would be calibrated for 1mA output at the 500W point on the Wattmeter Standard. In each case, each element of GW5-007B is seeing the full-scale current and voltage.

2-2 RECALIBRATION

Instrumentation used for calibration is traceable to N.I.S.T. (National Institute of

Standards and Technology). All GW5 & GV5 Transducers are factory calibrated and checked 100% for voltage and current linearity, power factor, initial set point, and dielectric breakdown. Temperature is checked on random samples.

All GW5 & GV5 Transducers are calibrated on single phase with the current coils in series and voltage inputs in parallel. Polarities are chosen to produce a positive output on terminal 2 of the transducer. Ideally, the transducer is energized from a precision instrument calibrator (a regulated source of current and voltage in phase) but a single-phase 0.02% wattmeter Standard can be used. The wattmeter Standard current circuit is connected in series with the current coils of the watt transducer under test. The voltage potentials are connected in parallel.

Refer to FIGURE 6 on page 10.

1. Choose the method of calibration and make the necessary connections between the calibrator and transducer under test.

2. Check the specification sheet for the inputs voltage, current, "Watts at Rated Output" and number of elements pertaining to the transducer. All illustrations will be shown using option B — 1mA output.

3. Remove the transducer from its case, by removing four screws from the lid. Pull the lid away from the case by grasping the lid terminal strip and case.

4. Allow 30 minutes for the calibrator to stabilize and 5 minutes for the transducer.

5. All transducers will be calibrated on a single-phase source, so actual input wattage levels will be lower for all elements except single phase.
   (A) 2 Element input will be 1/2
   (B) 2½ Element input will be 1/4
   (C) 3 Element input will be 1/3

6. Overall calibration and zero adjustments are located through the lid underneath the plastic caps. Balance and power factor adjustments for 1, 2, 2 ½, and 3 elements are located inside the can. Refer to page 10 for location.

7. All illustrations will be shown using option B 1mA output.

8. Refer to page 8 Test Equipment

9. ***Power factor and balance adjustments are internal adjustments that normally do not require changing, unless the circuitry has been altered. These steps can be eliminated if so desired.***

3-1 1 PHASE 2 WIRE, 1 ELEMENT

The following information is for both the calibration of Watt or VAR Transducers. Use only the steps pertaining to the type of transducer under test, when indicated.

STEP 1
Connect the GW5 or GV5 to the calibrator as shown in Figure 1 on page 9.

STEP 2 - ZERO
Apply 115VAC-instrument power, allow 5 minutes to stabilize or have the unit on a 115VAC-power source. For internal power units apply rated voltage to terminals 3 & 4.

STEP 3
Adjust the "Zero" pot for a zero output, less than ± 0.1 millivolt, at terminals 1 & 2.

STEP 4
Set the calibrator for the "Rated Watts" see CHART 3, and adjust the "Cal" trimpot for 1 volt.

STEP 5 — POWER FACTOR (WATTS)
Set the calibrator potential input for the nominal voltage, either 120V, 240V, or 480VAC, adjust or set the calibrator to the "Rated Watts," see CHART 3. Now, set or shift the phase for a zero power factor (90.0°). Adjust the #1 PF trimpot. Figure 5 or 5A for an output less than ± 0.5 millivolts. Balance between lead and lag.

STEP 5A — POWER FACTOR (VARS)
Set the calibrator potential input for the nominal voltage, 120V, 240V or 480VAC, 60Hz ± 0.01Hz. Adjust or set the calibrator to the "Rated Watts," see CHART 3. Now, set or shift the phase for a power factor of 1 (0°). Adjust the #1 PF trimpot for an output less than ± 0.5 millivolts.

STEP 6 — CALIBRATION (WATTS)
Adjust zero offset if necessary. Set the calibration for the nominal voltage and the "Rated Watts" at unity power factor (0°). Adjust "Cal" trimpot for a 1.0000-volt output. Check linearity in 1/5 steps shown in CHART 4.

STEP 6A — FINAL CALIBRATION (VARS)
Adjust zero offset if necessary. Set the calibrator for the nominal 60.0Hz voltage and the "Rated Watts." Recheck the zero offset at a unity power factor (0°). Now, set or shift the phase for a zero power factor (90.0°). Adjust the "Cal" trimpot for a 1.0000-volt output. Check the linearity in steps shown in CHART 5.

STEP 7
Install unit in can with fiche paper on all 5 sides. Install and tighten the (4) 6-32 x 1/4 machine screws in the side of the lid. This completes calibration.

4-1 3 PHASE 3 WIRE, 2 ELEMENT

The following information is for watts and VARs calibration, use only the steps pertaining to the type of transducer under test, when indicated.

STEP 1
Connect the transducer to the calibrator as shown in Figure 2 on page 9. Switches are used for the ease of calibration. Direct connection can be made if desired.

STEP 2
Apply 115VAC-instrument power. Allow 5 minutes to stabilize. For internal power units apply rated voltage to -V+ input.

STEP 3
Adjust the "Zero" trimpot for a zero output, less than ± 0.01 millivolt, at terminals 1 & 2.

STEP 4 — POWER FACTOR (WATTS)
Switch SWT1 "FOR," SWT2 "ON" AND SWT3 "OFF." Set the calibrator voltage potential for nominal 120, 240, or 480V input. Set the watt input for the "Rated Watts." Consult CHART 3. Now, set or shift the phase for a zero power factor (90°) Adjust trimpot #1, Figure 5 or 5A for an output less than ± 0.5 millivolts. Balance between lead and lag. Repeat STEP 4 except change SWT2 "OFF" and SWT3 "ON." Adjust trimpot #2 see Figure 5 or 5A.

STEP 4A — POWER FACTOR (VARS)
Switch SWT1 "FOR," SWT2 "ON" AND SWT3 "OFF." Set the calibrator voltage potential for nominal 120V, 240V or 480V input. Set the watt input for the "Rated Watts," CHART 3. Now, set or shift the phase for unity power factor (0.00°). Adjust trimpot

#1, Figure 5, for an output less than ± 0.5 millivolts, balance between lead and lag. Repeat STEP 7 except change SWT2 "OFF" and SWT3 "ON." Adjust trimpot #2 see Figure 5 or 5A.

STEP 5 — BALANCE (WATTS)
Set the calibrator for the "Rated Watts," switch SWT1 "REV," SWT2 & SWT3 "ON." Adjust the internal B1 balance trimpot Figure 5 or 5A for a zero output ± 0.1 millivolts, with the rated watts applied.

STEP 5A — BALANCE (VARS)
Set the calibration for the "Rated Watts" Switch SWT1 "REV," SWT2 & SWT3 "ON." Now, set or shift the phase for zero power factor (90°). Adjust the internal B1 balance trimpot, Figure 5 or 5A for a zero output less than ± 0.1 millivolt.

STEP 6 — FINAL CALIBRATION (WATTS)
Place all switches in standard positions forward, on and on. Adjust zero offset if necessary. Set the calibration for the nominal voltage and "Rated Watts" at unity power factor (0°). Adjust "Cal" trimpot for a 1.0000V output. Check linearity as shown in CHART 4.

STEP 6A — FINAL CALIBRATION (VARS)
Place all switches in standard positions forward, on and on. Set the calibration for the nominal 60.0Hz voltage and the "Rated Watts." Now, set or shift the phase for a zero power factor (90.0°), adjust "Cal" trimpot for 1.0000 volt output. Check the linearity as shown in CHART 5.

STEP 7
Install unit in can with fiche paper on all 5 sides, install and tighten (4) 6-32 x 1/4 machine screws in the side of the lid. This completes calibration.

5-1 3 PHASE 4 WIRE, 3 ELEMENT

The following information is for both the calibration of Watt and VAR Transducers. Use only the steps pertaining to the type of transducer under test when indicated.

STEP 1
Connect the transducer to the calibrator as shown in Figure 3 on page 9.

STEP 2
Apply 115VAC-instrument power to terminals 6A & 12A. Allow 5 minutes to warm up or have the unit on a 115VAC-power source. For internal power units apply rated voltage to -V+ input.

STEP 3
Adjust the "Zero" trimpot for a zero output or less than ± 0.1 millivolt at terminals 1 & 2.

STEP 4
Set the calibrator for the "Rated Watts," consult CHART 3. With all switches in standard position, adjust "Cal" trimpot for 1V output.

STEP 5 — POWER FACTOR (WATTS)
Set the calibrator potential input for nominal voltage, either 120V, 240V or 480VAC. Adjust or set the calibrator to the "Rated Watts," see CHART 3. Now, set or shift the phase for a zero power factor (90°). The following chart (Chart 1 below) is set up for adjusting Power Factor.

STEP 5A — POWER FACTOR (VARS)
Set the calibrator potential input for nominal voltage, either 120V, 240V, or 480V, 60Hz ± 0.01Hz. Adjust or set the calibrator to the "Rated Watts," see CHART 3. Now, set or shift the phase for a unity power factor (90°). The following chart (Chart 2 below) is set up

for adjusting Power Factor.

To use the chart, with the "Rated Watts" set the power factor set to unit. Adjust the PF trimpot #1 for a zero output of less than ± 0.5 millivolts. Balance between lead or lag. Repeat the same steps for each phase. Refer to Figure 5 or 5A to trimpot location.

CHART 1 - Step 5

PHASE	SWT1	SWT2	SWT3	SWT4	ADJ PF TRIMPOTS
A	ON	FOR	OFF	OFF	#1
B	OFF	FOR	ON	OFF	#2
C	OFF	FOR	OFF	ON	#3

CHART 2 - Step 5A

PHASE	SWT1	SWT2	SWT3	SWT4	ADJ PF TRIMPOTS
A	ON	FOR	OFF	OFF	#1
B	OFF	FOR	OFF	ON	#2
C	OFF	FOR	ON	OFF	#3

STEP 6 — BALANCE (WATTS)

Switches SWT1 "ON," SWT2 "REV," SWT3 "ON," and SWT4 "OFF." Set the calibrator for the "Rated Watts" at unity power factor (0°), CHART 3. Adjust the B1 balance trimpot, Figure 5 or 5A, for a less than ± 0.1 millivolt output. Next, set switches SWT1 "ON," SWT2 "REV," SWT3 "OFF" and SWT4 "ON." Now adjust the B2 trimpot for a less than ± 1-millivolt output.

STEP 6A — BALANCE (VARS)

Switches SWT1 "ON," SWT2 "REV," SWT3 "ON" and SWT4 "OFF." Set the calibrator for the "Rated Watts" and the phase for a zero power factor (90.0°). Adjust the B1 balance trimpot, Figure 5 or 5A, for a less than ± 0.1 millivolt output. Next, set switches SWT1 "ON," SWT2 "REV," SWT3 "OFF" and SWT4 "ON." Now adjust B2 trimpot for a less than ± 0.1-millivolt output.

STEP 7 — FINAL CALIBRATION (WATTS)

Place all switches in standard positions forward, on and on. Adjust zero offset if necessary. Set the calibration for the nominal voltage and "Rated Watts" at unity power factor (0°). Adjust "Cal" trimpot for a 1.0000V output. Check linearity as shown in CHART 4.

STEP 7A — FINAL CALIBRATION (VARS)

Place all switches in standard positions forward, on and on. Set the calibration for the nominal 60.0Hz voltage and the "Rated Watts." Now, set or shift the phase for a zero power factor (90.0°), adjust "Cal" trimpot for 1.0000 volt output.

STEP 7A — FINAL CALIBRATION (VARS)
Check the linearity as shown in CHART 5.

STEP 8
Install unit in can with fiche paper on all 5 sides. Install and tighten (4) 6-32 x 1/4 machine screws in the side of the lid.
This completes calibration.

6-1 3 PHASE 4 WIRE, 2½ ELEMENT

The following information is for both the calibration of Watts and VARs Transducers. Use only the steps pertaining to the type of transducer under test when indicated.

STEP 1
Connect the transducer to the calibrator as shown in Figure 4 on page 9. Switches are used for the ease of calibration. Direct connections can be made if desired.

STEP 2
Apply 115VAC-instrument power. Allow 5 minutes to stabilize.

STEP 3
Adjust the "Zero" trimpot for a zero output, less than ± 0.1 millivolt, at terminals 1 & 2.

STEP 4 — POWER FACTOR (WATTS)
Switch SWT1 "FOR," SWT2 "ON," SWT3 "OFF" and SWT4 "ON." Set the calibrator potential input for a nominal voltage of watt input to the "Rated Watts." Consult CHART 3. Now, set or shift the phase for a zero power factor (90.0°). Adjust trimpot #1, Figure 5 or 5A, for an output less than ± 0.5 millivolts, balance between lead and lag. Repeat STEP 4 except change SWT2 "OFF," SWT4 "OFF" and adjust trimpot #2, in Figure 5, for less than ± 0.5 millivolts.

STEP 4A — POWER FACTOR (VARS)
Switch SWT1 "NOMINAL," SWT2 "ON," SWT3 "OFF" and SWT4 to "ON." Set the calibrator voltage for a nominal input of 120VAC 60.0Hz. Set the watt input to the "Rated Watts."

Consult CHART 3. Now, set or shift the phase for a unity power factor (90.0°). Adjust trimpot #1, Figure 5 or 5A, for an output less than ± 0.5 millivolts. Balance between lead and lag. Repeat STEP 4A except change SWT2 "OFF," SWT4 "OFF" and adjust trimpot #2, in Figure 5or 5 or less than ± 0.5 millivolts.

STEP 5 — BALANCE (WATTS)
Set the calibrator for the "Rated Watts" switches SWT1 "REV," SWT2 "ON," SWT3 "ON" and SWT4 "OFF." Now, set or shift the phase for unity power factor (0°). Adjust the internal B1 balance trimpot, Figure 5or 5A, for a zero output of less than ± 0.2 millivolts.

STEP 5A — BALANCE (VARS)
Switches SWT1 "REV," SWT2 "ON," SWT3 "ON" and SWT4 "OFF." Set the calibrator for "Rated Watts" and the phase for a zero power factor (90.0°). Adjust the B1 balance trimpot, Figure 5 or 5A, for a less than ± 0.1 millivolt output.

STEP 6 — FINAL CALIBRATION (WATTS)
Place all switches in standard position. Adjust zero if necessary. Set the calibrator for the nominal voltage of 120VAC and "Rated Watts" at unity power factor (0°). Adjust "Cal" trimpot for a 1.0000V output. Check linearity

as shown in CHART 4.

STEP 6A — FINAL CALIBRATION (VARS)
Place all switches in standard position as shown in Figure 4. Set the calibrator for the nominal voltage of 120VAC 60.0Hz and "Rated Watt" at zero power factor (90.0°). Adjust "Cal" trimpot for a 1.000V output. Check linearity as shown in CHART 5.

STEP 7
Install unit in can with fiche paper on all 5 sides. Install and tighten (4) 6-32 x 1/4 machine screws in the side of the lid. This completes calibration.

7-1

CHART 3

GW5/GV5	NOMINAL VOLTS	AMPS	RATED WATTS	ELEMENTS
001B	120	5	500	1
002B	240	5	1K	1
003B	480	5	2K	1
004B	120	5	500	2
005B	240	5	1K	2
006B	480	5	2K	2
007B	120	5	500	3
7.5B	120	5	375	2½
008B	277	5	1K	3
009B	480	5	2K	3
010B	120	10	1K	1
011B	240	10	2K	1
012B	480	10	4K	1
013B	120	10	1K	2
014B	240	10	2K	2
015B	480	10	4K	2
016B	120	10	1K	3
017B	277	10	2K	3
018B	480	10	4K	3
019B	120	20	2K	1
020B	240	20	4K	1
021B	480	20	8K	1
022B	120	20	2K	2
023B	240	20	4K	2
024B	480	20	8K	2
025B	120	20	2K	3
026B	277	20	4K	3
027B	480	20	8K	3

The above chart is for calibration purposes only. Actual ratings are listed on the specification sheet in this manual.

8-1 METHOD 1 – CALIBRATOR

(Refer To FIGURE 6)

1 Precision Watt Calibrator — Model 800 Rotek (Or Equivalent)

2 Precision Resistor — 1K Ω 0.02%

3 Digital Voltmeter — Model 179 Keithley (Or Equivalent)

8-2 METHOD 2 – CALIBRATOR

(Refer to FIGURE 7)

1 Sine Wave Source — Provides 60Hz nominal voltage and rated current for unit under test.

2 Precision 90° phase shifter — Model 402 Dynatronics (Or Equivalent) Watt Standard — Model 2885-20 Yokogawa (Or Equivalent).

3 Precision Resistor — 1K Ω 0.02%.

4 Voltmeter — 0.1%

9-1 WATTS

CHART 4

FULL SCALE "RO"	1.0000 ± .0024V
4/5	0.8000 ± .0020V
3/5	0.6000 ± .0016V
2/5	0.4000 ± .0012V
1/5	0.2000 ± .0008V
0	0.0000 ± .0004V
RO at 0.5 LEAD	0.5000 ± .0024V
RO at 0.5 LAG	0.5000 ± .0024V
RO at 0 LEAD and LAG	0.0000 ± .0024V

9-2 VARS

CHART 5

POWER FACTOR	PHASE ANGLE	RATED OUTPUT
ZERO PF	90°	1.000V ± 0.0024V
0.5 PF	60°	0.8667V ± 0.0022V
0.8 PF	36.869°	0.6000V ± 0.0016V
1 PF	0°	0.0000V ± 0.0004V

Accuracy of ± 0.2% reading ± 0.04 RO must be maintained over the effective range of volts, current and watts.

FIGURE 1

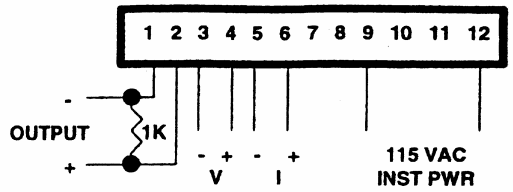

FIGURE 2

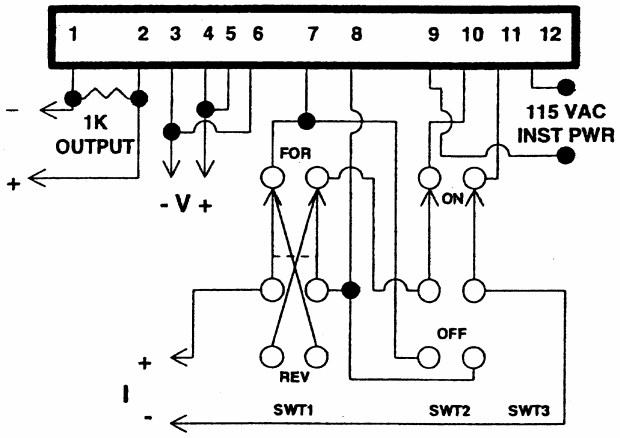

FIGURE 3

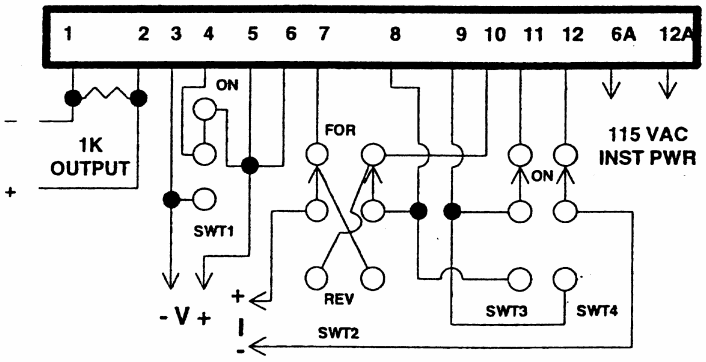

FIGURE 4

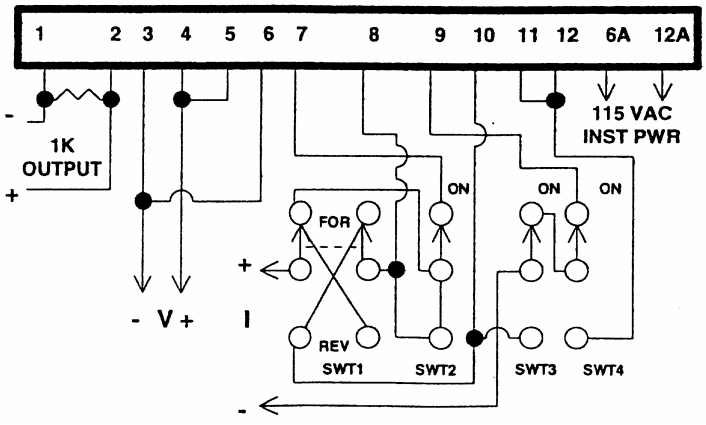

FIGURE 5
GW & GV ALL EXCEPT E OPTIONS

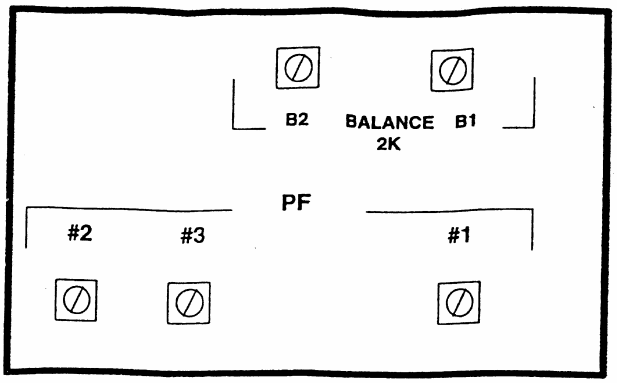

FIGURE 5A

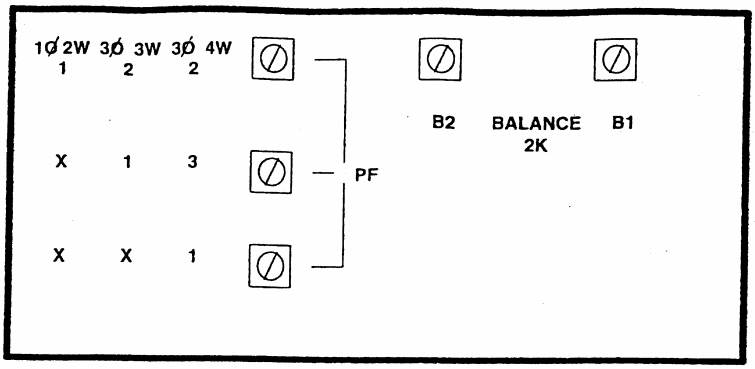

FIGURE 6
CALIBRATOR METHOD #1

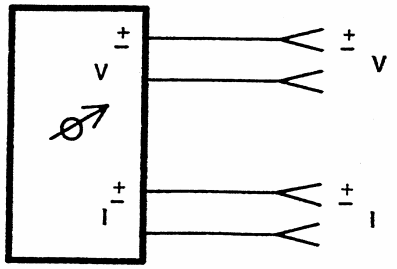

FIGURE 7
CALIBRATOR METHOD #2