INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

WATT TRANSDUCER TYPE VP4-846
VAR TRANSDUCER TYPE VV4-846 •

The type VP4-846 Watt Transducer and VV4-846 Var Transducer are solid state devices which produce a dc output directly proportional to the ac power (real or reactive) appearing at its input. This proportionality is maintained with reversal of power flow, since the dc output changes polarity accordingly. Styles are available with either ±10% or 0-110% adjustment of the nominal 0 to ±1mAdc output current which is independent of load from 0 to 10,000 ohms.

THEORY OF OPERATION

This new solid state watt transducer employs the time division multiplication principle. This method for measuring watts requires the generation of a train of pulses whose height is proportional to the amplitude of the current and whose length is proportional to the amplitude of the potential. If the number of pulses is large compared to the frequency of the measured waveform, the area of each pulse (i.e. the time integral of current flowing during the pulse) will be equal to the instantaneous power flowing in the measured circuit over the duration of the pulse. Integrating these pulses with a low pass filter removes the ac products of the multiplication leaving a dc signal which is proportional to the power being measured.

This relatively high level dc signal is applied to an operational amplifier, which provides the "constant−current" type of output. The high level input current eliminates the need for a zero adjustment of the operational amplifier, in contrast to Hall generator types which require zero adjustment as a result of their inherent low voltage output to a high gain operational amplifier. Critical electro-mechanical assemblies have also been eliminated as this is an all solid state design using the latest I.C. technology including complimentary MOS digital I.C.'s. •

Var (reactive power) transducers are similar to the watt transducer except the potential circuits are shifted 90° in phase by means of a R-C network, so that the multiplier responds to EI sin θ, compared to EI cos θ for real power.

3 Phase 3 Wire units employ two multipliers and perform with rated accuracy for any current or voltage unbalance. The 3 Phase 4 Wire units employ 2 multipliers also but use 3 current signals and 2 potential signals (known as 2½ element connection) to derive the 4 wire power. These units perform at rated accuracy for any current unbalance, but the system voltages should be balanced for best accuracy. Only two potential transformers need be provided on the system with this circuit.

CALIBRATION PROCEDURE (WHEN RE-CALIBRATION IS DESIRED)

These transducers may be calibrated on single phase by connecting the potential circuits in parallel and the current circuits in series as shown in Fig. 4 for 3 phase, 3 wire, and as shown in Fig.

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

Supersedes I.L. 43-846.1, dated June 1975
✪ Denotes change from superseded issue.
EFFECTIVE NOVEMBER 1976

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5 for 3 phase, 4 wire. (Note that the current circuit connected to terminals #13 and #14 of the 4 wire unit must be connected with reverse polarity in comparison to the other current circuits to achieve proper single phase operation. This is characteristic of the 2½ element principle. Failure to do this will result in zero output irrespective of input). The single phase test watts required for calibration are calculated as follows:

✪ 3 phase, 3 wire (2 El.)

$$1\emptyset \text{ test watts (or vars)} = \frac{\left(\begin{array}{l}\text{Desired self-contained*}\\ 3\emptyset \text{ input watts [or vars]}\\ \text{for rated output}\end{array}\right)}{2}$$

✪ 3 phase, 4 wire (2½ El.)

$$1\emptyset \text{ test watts (or vars)} = \frac{\left(\begin{array}{l}\text{Desired self-contained*}\\ 3\emptyset \text{ input watts [or vars]}\\ \text{for rated output}\end{array}\right)}{4}$$

NOTE: *For power systems which use current and/or potential transformers the desired self-contained *3∅ input watts* for the transducer are the system watts for rated output divided by the transformer ratios.

The power supply terminals #1 and 2 should be energized for at least 15 minutes before calibration to pre-condition the transducer.

The calibration adjustment for the *total output,* both watt and var transducers, is available through a hole in the top panel adjacent to terminal #5, and is labeled "CAL". This control allows the nominal 1 mA dc output for rated input to be scaled ±10% or 0 to 110% depending on the transducer style. All other adjustments are factory-set adjustments, and should not be disturbed unless a complete re-calibration can be performed.

The "CAL" adjustment does not change the voltage or current input ratings of the transducer, but only sets the output. The large over-range capability does allow wide latitude in the permissible input level, however. On the watt transducer individual element output adjustment is available by adjusting the trimmers through holes near terminals #6 and #10. These should not be adjusted unless a complete re-calibration procedure can be done, since the elements are balanced by these trimmers.

Var transducers can be calibrated in a similar single phase fashion except that a VAR standard must be used instead of a watt standard. A wattmeter standard provided with a 90° phase shifting network and having a 1:1 transfer ratio can be used. The calibration adjustment for the total output is the same as the watt transducer, but individual element balance adjustment for the VAR transducer is through holes in the base. In addition, each VAR element has an adjustment for phase shift through the base. The trimmers available through holes in the base should not be adjusted unless a complete recalibration procedure can be done.

ADJUSTMENT SCREW DRIVER SIZE

A small diameter instrument-type screw driver with a 0.1 in. wide X 0.02 in. thick bit is recommended.

ZERO ADJUSTMENT

There is no zero adjustment ever required on ±10% adjustment units because of the nature of their design. DC output current comes from a modulated current signal which has been obtained from an internal current transformer. No amplifiers have been employed in this circuit. This current signal is then run thru a "current pump" to permit supplying load resistances up to 10KΩ. (The current pump would not be required if the load resistance range had been limited to a few hundred ohms).

The "current pump" operates as a 1:1 current amplifier. The I.C. voltage offset and its temperature coefficient do not appear in the output with this circuit. Because the input is already 1mA, the bias current of the I.C. is insignificant, hence no zero adjustment is required.

The 0 to 110% adjustment units, however, do have an internal zero adjustment. Normally this is

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adjusted once at the factory and does not require any further attention. This is used because the large range of adjustment requires the use of another I.C. Repairs to the unit, particularly replacement of the type 747 integrated circuits, may require touching up this adjustment. It is also advisable when doing a complete recalibration to check and touch up the adjustment if required.

To reach the zero adjustment trimmer, remove the self threading binding head screws located on the ends of the case, and remove the case. The adjustment is a single turn pot located on the power supply printed circuit board approximately below terminal #11 on the top panel. Apply 120 volts ac to the power supply terminals #1 and 2 and both element potential circuits on terminals #3 and 4 and #7 and 8. Allow 15 minutes warm up. Then adjust the trimmer to get zero output (less than ±0.2 micro amps or ±2 millivolts across a 10K Ω load).

COMPLETE RECALIBRATION - WATTS

Connect the transducer as shown in Fig. 4 for a 3 phase, 3 wire unit and as shown in Fig. 5 for a 3 phase, 4 wire unit. Set the calibration adjustment adjacent to terminal #5 fully clockwise. Open the potential circuit to terminals #7 and 8 and apply rated single phase test watts to the transducer. Adjust the trimmer through the hole adjacent to terminal #6 to obtain 56% of rated output. Now apply reversed potential to terminals #7 and 8 and adjust the trimmer through the hole adjacent to terminal #12 to get zero output within ±0.125% of rated output. (This balances elements by opposing them and adjusting for zero output). Restore terminals #7 and 8 to the correct polarity as given by the appropriate test connection diagram. Apply precise single phase test watts to the transudcer and adjust the calibration trimmer through the hole adjacent to terminal #5 for the required output ±0.25%.

COMPLETE RECALIBRATION - VARS

Connect the transducer as shown in Fig. 4 for a 3 phase, 3 wire unit, and as shown in Fig. 5 for a 3 phase, 4 wire unit. Set the calibration adjustment adjacent to terminal #5 on the top panel fully clockwise. Open the potential circuit to terminals #7 and 8 and apply *unity power factor watts* from a non-inductive load bank to the transducer. Set the watts to be approximately equal to the rated single phase test vars of the transducer. Turn the trimmer through hole G1 (See Fig. 6), in the base of transducer fully clockwise. Adjust the pot through hole P1 in the base of the transducer to get zero output within ±0.125% of rated output. This sets the 90° phase shift network for element #1. Restore potential to terminals #7 and 8 and open the potential circuit to terminals #3 and 4. Turn the trimmer through hole G2 in the base of the transducer fully clockwise. Adjust the trimmer through hole P2 to get zero output within ±0.125% of rated ouput. This sets the 90° phase shift network for element #2.

Restore potential to terminals #3 and 4 and open the potential circuit to terminals #7 and 8. Apply rated single phase test VAR's to the transducer. Adjust the trimmer through hole G1 in the base of the transducer to get 56% of rated output. Apply reversed potential to terminals #7 and 8 and adjust the trimmer through hole G2 to get zero output within ±0.125% of rated output. (This balances elements, by opposing them and adjusting for zero output). Restore terminals #7 and 8 to the correct polarity as given by the appropriate test connection diagram. Apply precise single phase test VAR's to the transducer and adjust the calibration trimmer through the hole adjacent to terminal #5 on the top panel for the required output ±0.25%.

CAUTION: Attempts to get significantly more than the nominal ±1mA rated output by complete recalibration may result in the loss of voltage overrange capability or even voltage non-linearity if carried to the extreme.

CAUTION: These transducers are equipped with CMOS integrated circuits that are susceptible to damage by static electric charges applied to their leads when they are not in their sockets. Therefore, if repairs are ever required, the following precautions are recommended:

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1. Never install or remove any integrated circuit from a transducer which is energized.

2. The transducer and the technician making the repairs should be grounded.

3. Soldering irons used on the printed circuit boards should be grounded.

4. Loose CMOS integrated circuits should be stored only in conductive carriers, stuck into conductive foam or wrapped in aluminum foil.

CONSTRUCTION

All components are on two printed circuit boards mounted back to back perpendicular to the top panel. One board contains the switching function components the other board the power supply, triangle wave generator and output buffer amplifier. All integrated circuits are mounted in sockets to facilitate repairs. The complete assembly is mounted in a 3" wide rectangular case suitable for base mounting, with top connected terminals. The case may be removed be removing 2 screws from the ends of the case. All solid state devices have a storage temperature range of at least −40°C to +100°C. The external connections and output calibration control are available from the top panel, as are the element trimming adjustments of the watt transducers. The VAR transducers are similar except the element trimming and phase shift adjustments are located through holes in the base. The element trimming and phase shift adjustments are factory set and are not affected by the top panel calibration adjustment. The transducers are available with ±10% and 0-110% output calibration adjustment.

Transient protection, over current protection and protection against electromagnetic interference are built in. Low temperature coefficient resistors and zeners are used to obtain low temperature influence without resorting to resistor-thermistor temperature compensation schemes. Good temperature performance is designed in, not compensated in as with Hall generator transducers.

The external power connections for the transducer's power supply are brought out to a separate set of terminals which are connected at the factory by external jumpers to one of the watt potential circuits. If the potential circuits are to be operated at voltages below the minimum required power supply voltage of 85 volts, or if the transducer is to be used in a current totalizing scheme where the potential circuit is turned off when the other totalized transducers are still operating, then the jumpers should be removed and separate excitation at rated voltage should be supplied to terminals #1 and 2.

APPLICATION

The current-output transducer with capability of supplying load resistances up to 10,000 ohms without changing calibration is well suited for applications where the load resistance is a high resistance device, or where the load resistance varies and constant current is desired.

TOTALIZING

VOLTAGE SUMMING

Any number of transducers may be used, and the transducers themselves do not have to be calibrated to the required scale. Instead the voltage drop generated across a resistor can be adjusted by varying the resistance to give the correct scale from a transducer with standard calibration. All the individual dropping resistors are then connected together in series to provide a totalized voltage which must be measured by a high impedance device. To limit the error caused by the readout device loading the measured circuit, the measurement device should have an input impedance of at least 1000 times the sum of the resistances of the dropping resistors.

Simultaneous local indication is also possible as long as the maximum voltage output required of any transducer by the local indicator, the dropping resistor and the wiring does not exceed 11 volts.

Because of the ease of scaling the individual sources and the absence of an error in the output if one of the transducers is not energized, this is the preferred way to totalize these transducers.

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CURRENT SUMMING

Any number of transducers may be totalized by calibrating each unit as required for correct scaling and connecting all the outputs in parallel. One restriction is that all power supplies must be energized even if only one transducer is producing an output. This is necessary because the output impedance of a transducer is much smaller when the transducer is not energized and can load the external circuitry. Another restriction occurs because the maximum output voltage that the transducers can develop into an external load is limited. The totalized current of all units at maximum output cannot develop greater than 11 volts across the output of any transducer.

This connection can be useful in spite of its limitations if both local and remote indication on dc instruments are desired, or if the monitoring of all the individual outputs as well as the total is desired. Otherwise the voltage summing technique is best.

REPAIRS

Repair work is best done at the factory, or at any authorized instrument repair facility (see Service Directory 43-000). However, for those customers who wish to do their own repairs and are competent in working with small signal solid state devices Figures 8 to 16 includes schematic diagrams, board layouts, voltages and waveforms that should assist in trouble shooting and making repairs.

BASIC PRINCIPLES OF TROUBLESHOOTING

Connect in single phase test circuits as shown.

If at proper input the output is as follows:

Half Output – would indicate one element may be defective. Disconnecting one current circuit at a time will enable determining which element is operating and which is not. If one element is operaing then the power supply and triangle wave generator must be operating. Troubleshoot the switching circuit of the inoperative element.

NO OUTPUT

If the power supply, or the triangle wave generator, or the output stage is defective no output will be obtained. Troubleshoot these areas, checking for the voltages and wave forms at the various points as shown.

COMPONENT CHECKING

Components may be checked for opens or shorts, but it should be observed the nature of the circuit connected to these components will affect the reading of any ohmmeter used.

INTEGRATED CIRCUIT CHECKING:

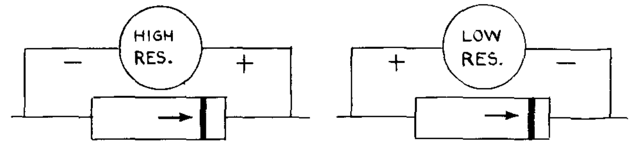
All integrated circuits are mounted in sockets for easy replacement. Unless an integrated circuit tester is available, the I.C. can only be checked by inserting in a working transducer, or by replacing with an I.C. known to be good. When inserting I.C. be sure alignment and orientation is correct. Observe the precautions about handling I.C.'s.

TRANSISTOR CHECKING

Transistors may be ckecked without power on by using an ohmmeter on the 100X range. A good transistor will give the following readings with the ohmmeter polarity as shown Fig. 8. (Check the ohmmeter polarity against a voltmeter, do not assume polarity from terminal color marking.)

Any circuit elements shunting the transistor terminals will change the actual readings, but usually resistor values are such that conducting versus non-conducting readings can be determined. The transistors are mounted approximately 3/16 inch off the board, so an in-circuit transistor tester can be used too.

Diodes can be checked with an ohmmeter also. An ohmmeter across the diode will indicate as shown in Fig. 7.



Zener diodes are more difficult to check because the non-conducting direction is voltage sensitive,

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but they can be checked for shorts or opens the same as regular diodes. For this check the diode zener voltage must be greater than the ohmmeter voltage. Zener diodes will appear to be non conducting in both directions if the voltage applied is below the zener voltage.

Transformers can be checked for continuity or for actual voltage output in the energized transducer.

SPECIFICATIONS

TYPE:	3Ø 3W	3Ø 4W
RATINGS:		
Input Watts/VARS	1000	1500
Input Current	5 amps	5 amps
Input Voltage	120 volts ac	120 volts ac
Input Frequency	60 Hz	60 Hz
Output into 0 to 10 kΩ	0±1mAdc	0±1mAdc

LINEARITY .... ≤±.1% of Rated Output

For the following reference conditions:

Current	0 to 6.5 amps
Temperature	23°C
P.F.	Unity
Potential	120 volts ac
Frequency	60 Hz
Load	5KΩ
Power Supply	120 volts ac

OPERATING ACCURACY	±10% Cal. Adjustment Type	≤±.5% of Rated Output
	0-110% Cal. Adjustment Type	≤±.6% of Rated Output

For the following conditions in any combination:

Current	0 to 6.5 amps
Potential	75 to 132 volts ac
Power Factor (Angle)	0±180°
Temperature	23±13°C
Frequency	Watt 60 ± 1 Hz VAR 60±.07Hz
Load	0 to 10 KΩ
Power Supply	85 to 135 volts ac
3rd Harmonic	0 to 3%

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EXTREME INFLUENCES

Current Linearity 0 to 10 amps	Load 0 to 4 KΩ	≤±.3% of Rated Output
Voltage Linearity 0 to 140 volts*		≤±.1% of Rated Output
Power Factor 0 to ± 180°	Watt	≤±.2% of Rated Output
	VAR	≤±.1% of Rated Output
Temperature −20 to +65°C	±10% Cal. Adjustment Type	±.25% typ.; ±.5% max.
	0 to 110% Cal. Adjustment Type	±.5% typ.; ±1% max.
Frequency	Watt 60±10Hz	±.1% of Rated Output
	VAR 60±0.1 Hz	±.15% of Rated Output
3rd Harmonic In Current 0 to 40%	Watt Only	≤±.25% of Rated Output
3rd Harmonic In Voltage 0 to 20%	Watt Only	≤±.25% of Rated Output

*With separate excitation of power supply.

OTHER OPERATING CHARACTERISTICS

Output Adjustment	±10% of Rated Output 0-110% of Rated Output
Ripple	≤1% peak to peak of Rated Output**
Response Time	400mSec to 99% of Rated Output
Burden:	
Current Circuit	≤.2 VA at 100% P.F.
Potential Circuit	≤.3 VA at 50% P.F.
Power Supply at 120 volts, 60 Hz	≤ 4 VA at 75% P.F.
Power Supply Voltage	85 to 135 volts, 50 to 400 Hz

WITHSTAND CAPABILITIES

Storage Temperature	−40 to +100°C
Current Overload	10 amps continuously 250 amps for 1 sec./hr.
Potential Overload	150 volts ac continuously
Dielectric Test***	1500 volts ac for 1 minute
Surge***	Meets test with applied test signal per IEEE Std. 472-1974
Output	120 vac across output terminals for 15 minutes

**If output circuit is connected to ground, the grounded terminal should be terminal 15 for minimum ripple.

***Test between all circuits and between all circuits tied together and the case.

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PARTS LIST ±10% AMP. & POWER SUPPLY BOARD 1426C48G01

RESISTORS

		(W) STYLE #
R1, R2, R9	1.5KΩ 1/2W 5% Carbon	184A763H31
R3, R5	10 KΩ 1/8W 1% Met Film	849A183H01
R4	825Ω 1/8W 1% Met Film	849A181H89
R6, R7	500Ω 5W ±5% Wire wound	762A679H04
R8	82Ω 1/2W 5% Carbon	184A763H01
R10	33Ω 1/2W 5% Carbon	187A290H13
R11, R12	27Ω 1/2W 5% Carbon	187A290H11
R13	36.5KΩ 1/8W 1% Met Film	849A183H55
R14	24.3KΩ 1/8W 1% Met Film	849A183H38
R15	18KΩ 1/2W 5% Carbon	184A763H57
R16	15KΩ 1/2W 5% Carbon	629A531H60

POT

R17	10K 1W ±10% wire wound 20 turn	880A707H01

CAPACITORS

C1, C2, C10, C14	.005mf 100v dc Ceramic	184A663H13
C3, C4	47uf 35V Tantalum	184A661H03
C5, C6, C7, C8, C9	.1uf 100V Ceramic	184A663H04
C11, C12, C13	300uf 3V electrolytic	876A280H04
C15	.0047uf 50V Mylar	763A487H13

DIODES - ZENERS - BRIDGE

Z1, Z2	1N966B .4W 5% 16V	862A288H05
Z3	1N825A 6.2V ±5% Temp. Comp	862A288H06
Z4, Z5	1N4747A 20V ±5% 1W	849A487H01
D1, 2, 3, 4, 5, 6, 7	1N645A	837A692H03
BR	100V 1 amp bridge rect.	3503A36H01

TRANSISTOR & IC's

Q1, Q4	2N1132	184A638H20
Q2, Q3	2N1711	762A585H08
IC1, IC2	747 (Mil temp range)	6277D60H13
IC3	709 Op Amp	201C826H02
IC4	4007 CMOS	3494A75H03

Transformer		1427C25H01

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PARTS LIST 0-110% AMP. & POWER SUPPLY BOARD 1531C02G01

RESISTORS		(W) STYLE #
R1, R2	1.5KΩ 1/2 W 5% Carb.	184A763H31
R3, R5	10KΩ 1/8W ±1% Met. Film 50 ppm/°C	849A183H01
R4	825Ω 1/8 W ± 1% Met. Film 50 ppm/°C	849A181H89
R6, R7	400Ω 5W ±5% Wire wound	763A129H16
R8	82Ω 1/2W ± 5% Carb.	184A763H01
R9	820Ω 1/2W ± 5% Carb.	184A763H25
R10	33Ω 1/2W ±5% Carb.	187A290H13
R11, R12	27Ω 1/2W ±5% Carb.	187A290H11
R13	40.2KΩ 1/8W ±1% Met Film	849A183H59
R14	24.3KΩ 1/8W ±1% Met. Film	849A183H38
R15	18KΩ 1/2W ±5% Carb.	184A763H57
R16	15KΩ 1/2W ±5% Carb.	629A531H60
R17	806Ω 1/8W ±1% Met. Film	849A181H88
R18	1KΩ 1/2W ±5% Carb.	184A763H27
R21	1KΩ 1/8W ±1% Met. Film	849A182H01

POTS		
R19	10KΩ .5W ±10% 1 turn cermet	3504A61H01
R20	k0KΩ .75W ±10% 15 turn cermet	3504A60H01

CAPACITORS		
C1, C2, C10, C14	.005 mf 100V dc ceramic	184A663H13
C3, C4	47 mf 35V tantalum	184A661H03
C5, C6, C7, C8, C9	0.1 mf ceramic	184A663H04
C11, C12, C13	300 mf 3V electrolytic	876A280H04
C15	.0047mf mylar	763A487H13

DIODES - ZENERS - BRIDGE		
D1, 2, 3, 4, 6, 7, 8, 9	1N645A	837A692H03
Z1, Z2	1N966B 16V .4W ±5%	862A288H05
Z3	1N825H 6.2V ±5 temp comp.	862A288H06
Z4, Z5	1N4747A 20V 1W	849A487H01
Z6, Z7	1N752A 5.6V .4W ±10%	186A797H12
BR	100V, 1 amp bridge rect.	3503A36H01

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TRANSISTOR & IC's

Q1, Q4	2N1132	184A638H20
Q2, Q3	2N1711	762A585H08
IC1, 2, 5	747 (Mil temp. range)	6277D60H13
IC3	709 Op Amp	201C826H02
IC4	4007 CMOS	3494A75H03
Transformer		1427C25H01

PARTS LIST WATT SWITCHING BOARD 1426C46G01 & 1426C46G02

RESISTORS		**(W) STYLE #**
R1, R2, R3, R4	4.02K 1/8W ±1% Met. Film	849A182H59
R5, R6, R7, F8	90.9K 1/8W ±1% Met. Film	849A183H93
R11, R13	130K 1/2W ±5% Carb.	836A909H15
R12, R14	91K 1/2W ±5% Carb.	836A909H11

POTS

R9, R10	2K .75W ±10% 20 turn wire wound	880A707H02

CAPACITORS

C1, C2	.018uf	3508A16H01

DIODES - ZENERS

Z1, 2, 3, 4, 5, 6	1N752A 5.6V .4W ±10%	186A797H12

TRANSFORMERS

†CT1, CT2	Current transformer - 3W	1427C25H03
†CT1, CT2	Current transformer - 4W	1427C25H04
PT1, PT2	Potential transformer	1427C25H02

IC's

IC1, IC3	4016 Quad Bilateral Switch	3494A75H07
IC2, IC4	4007 CMOS pairs + Inv.	3494A75H03

†Early production units come equipped with a different transformer. New transformers can be identified by the addition of a suffix "A" to the style number printed on the laminations. If an early production unit requires the replacement of a current transformer, both current transformers and resistor R13 on the amplifier-power supply board must be replaced.

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PARTS LIST VAR SWITCHING BOARD 1427C.*8G01 & 1427C48G02

RESISTORS		(W) STYLE #
R1, R2	7.13K 1/8W ±1% Met. Film	849A182H83
R3, R4	5.62K 1/8W ±1% Met. Film	849A182H73
R5, 6, 7, 8	1.0M 1/8W ±1% Met. Film	849A184H97
R13, R15	130K 1/2W ±5% Carb.	836A909H15
R14, R16	91K 1/2W ±5% Carb.	836A909H11
POTS		
R9, 10, 11, 12	2K W±10% wire wound 20 turn	880A707H02
CAPACITORS		
C1, C2, C3, C4	.33uf 50V ±5% Poly Carb.	863A166H16
DIODES - ZENERS		
Z1, 2, 3, 4, 5, 6	1N752A 5.6V 4W±10%	186A797H12
TRANSFORMERS		
*CT1, CT2	Current Transformer - 3W	1427C25H03
*CT1, CT2	Current Transformer - 4W	1427C25H04
PT1, PT2	Potential Transformer	1427C25H05
IC's		
IC1, IC2	4016 Quad Bilateral Switch CMOS	3494A75H07
IC3, IC4	4007 CMOS pair + Inv.	3494A75H03

*Early production units come equipped with a different transformer. New transformers can be identified by the addition of a suffix "A" to the style number printed on the laminations. If an early production unit requires the replacement of a current transformer, both current transformers and resistor R13 on the amplifier-power supply board must be replaced.

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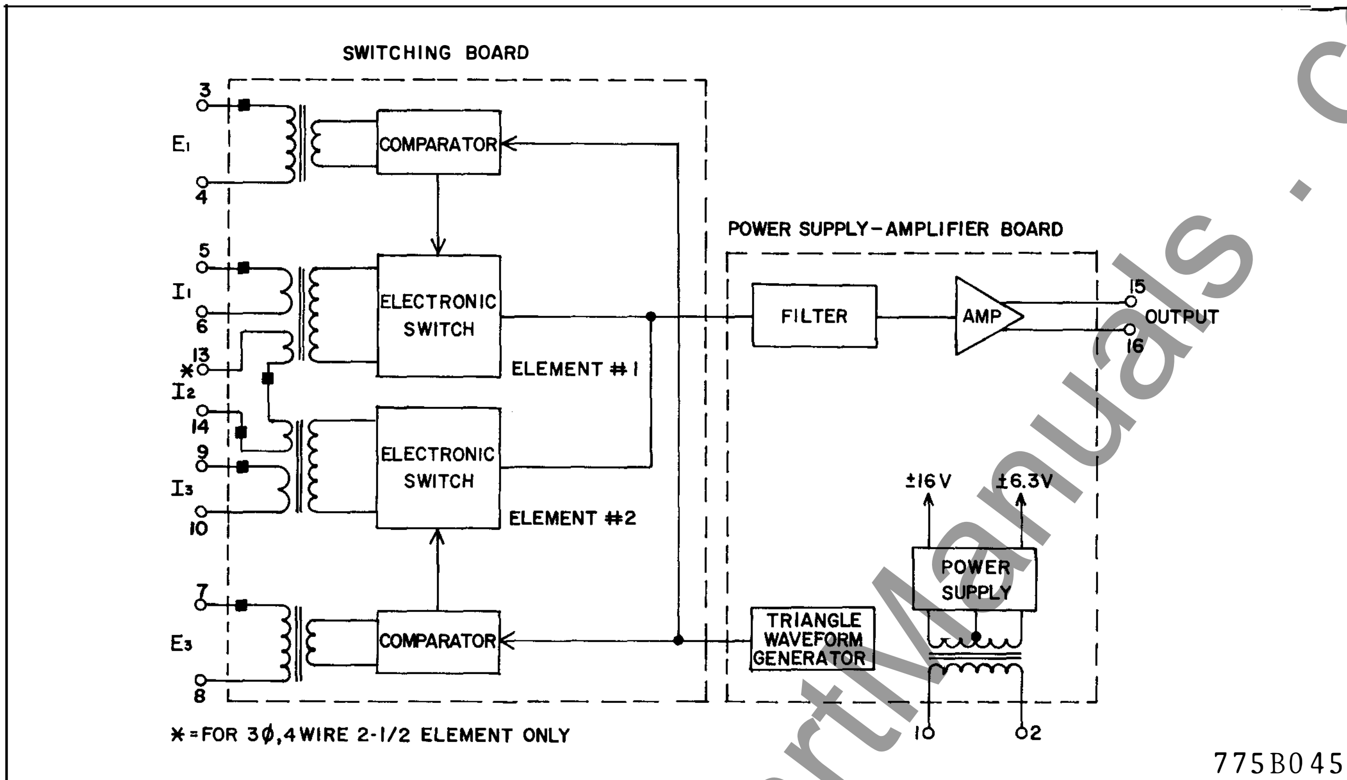

Fig. 1. Block Diagram of 2 Element Watt Transducer VP4-846.

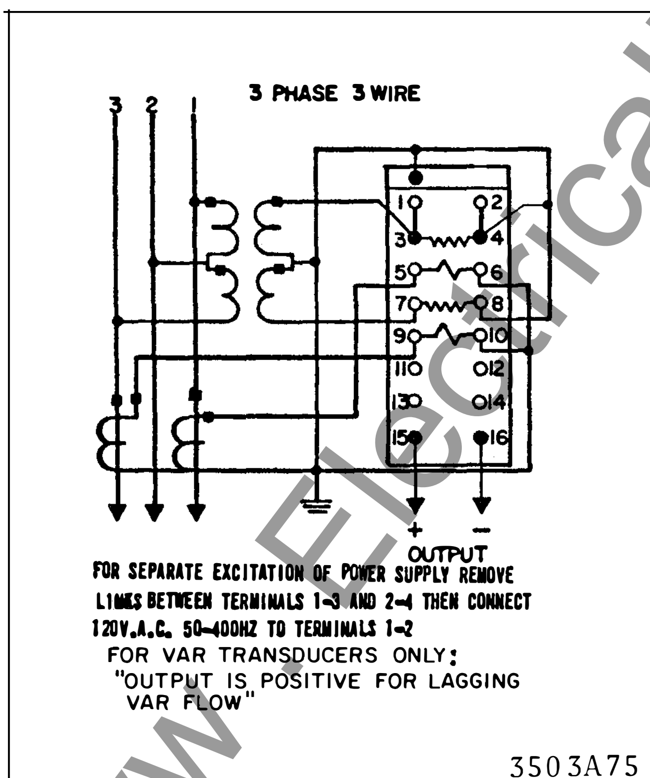

Fig. 2. Type VP4-846 Watt & VV4-846 Var Trans. 2-Current Coil 3 Phase 3 Wire 2 El. with C.T. and P.T. External Wiring.

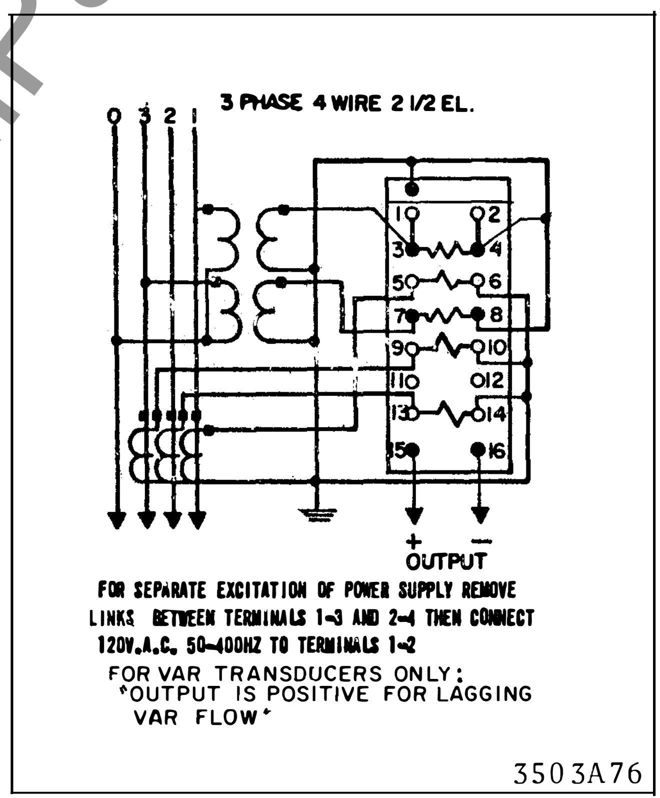

Fig. 3. Type VP4-846 Watt & VV4-846 Var Trans. 3-Current Coil 3 Phase 4 Wire 2½ El. with C.T. and P.T. External Wiring.

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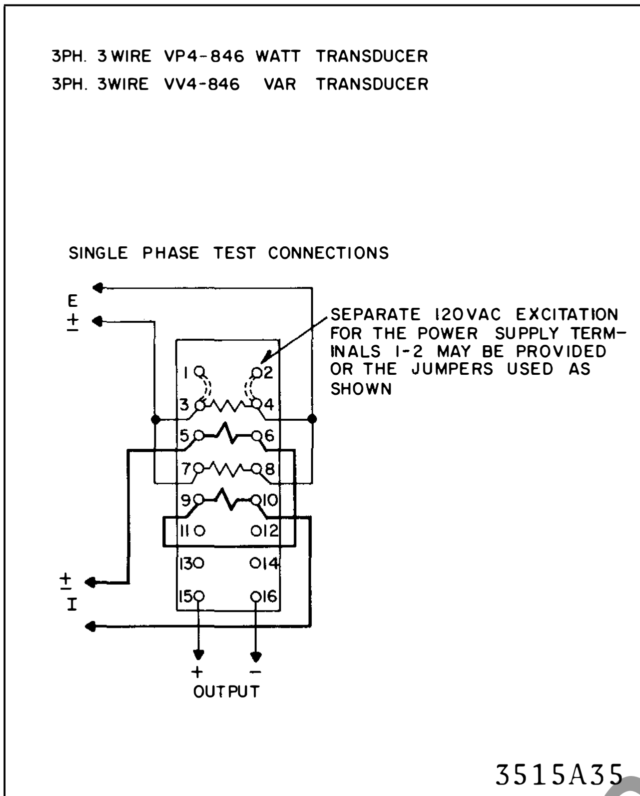

Fig. 4. Single Phase Test Conn., 3∅ 3W.

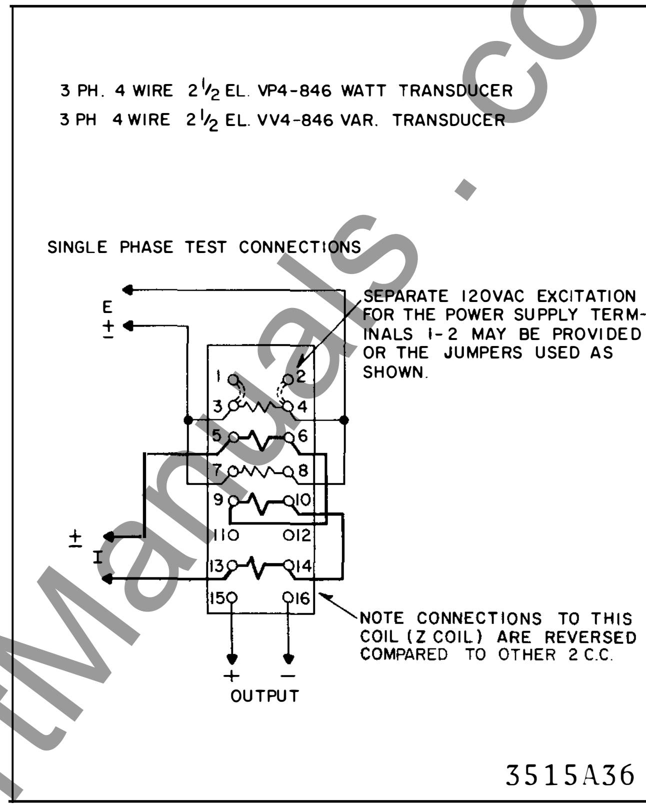

Fig. 5. Single Phase Test Conn., 3∅ 4W 2½ El.

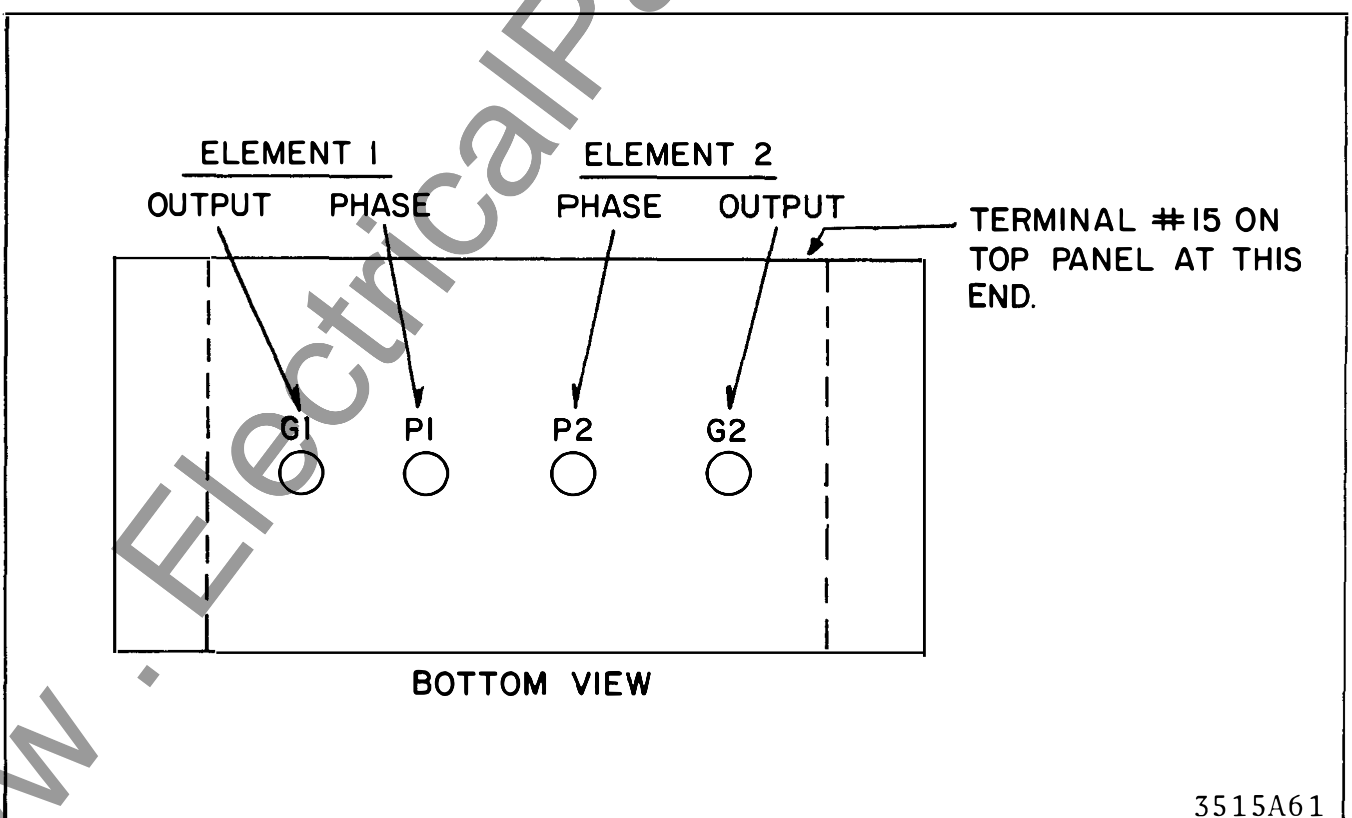

Fig. 6. Var Transducer Individual Element Adjustments.

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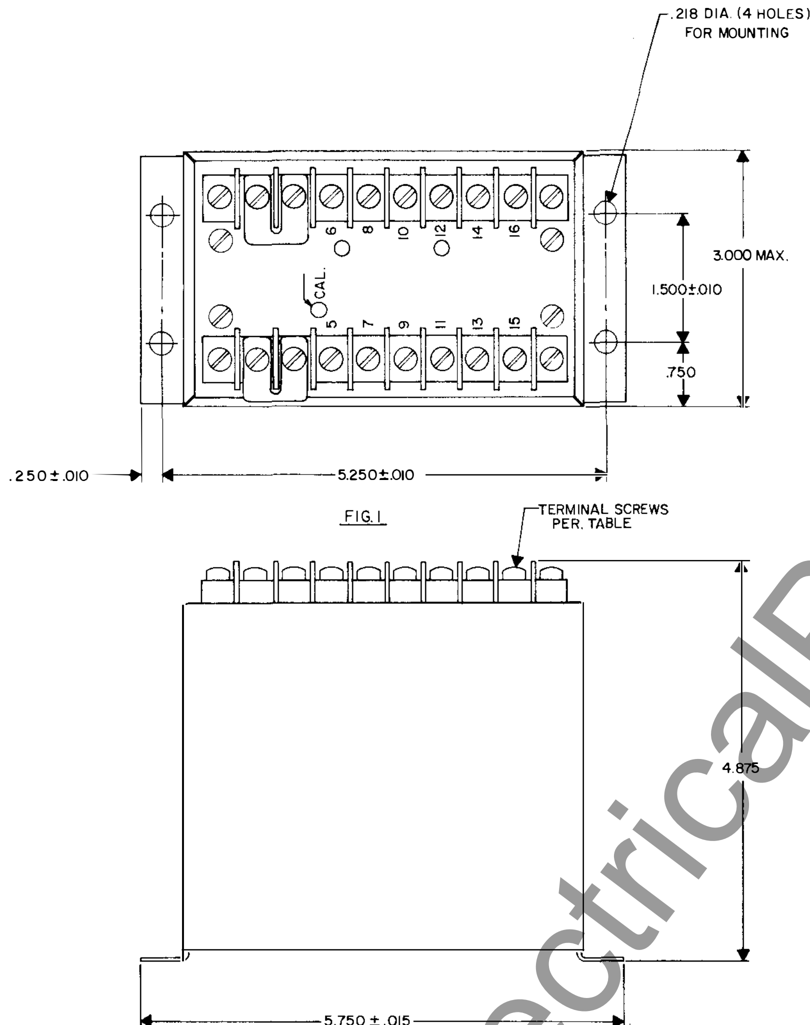

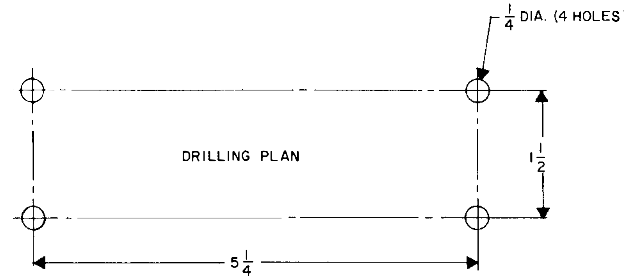

LINE NO.	TYPE	TRANSDUCER TYPE	TERMINAL IN POSITION NUMBER	TERM SCREWS
1	(LATER)			
2	VP4-846	3 WIRE 2 C.C. WATT	1-2-3-4-5-6-7-8-9-10-15-16	.164-32
3	VP4-846	4 WIRE 3 C.C. WATT	1-2-3-4-5-6-7-8-9-10-13-14-15-16	.164-32
4	VV4-846	3 WIRE 2 C.C. VAR.	1-2-3-4-5-6-7-8-9-10-15-16	.164-32
5	VV4-846	4 WIRE 3 C.C. VAR	1-2-3-4-5-6-7-8-9-10-13-14-15-16	.164-32

1428C23

Fig. 7. Outline and Dwg. VP4 & VV-846 Transducer in 3 inch case.

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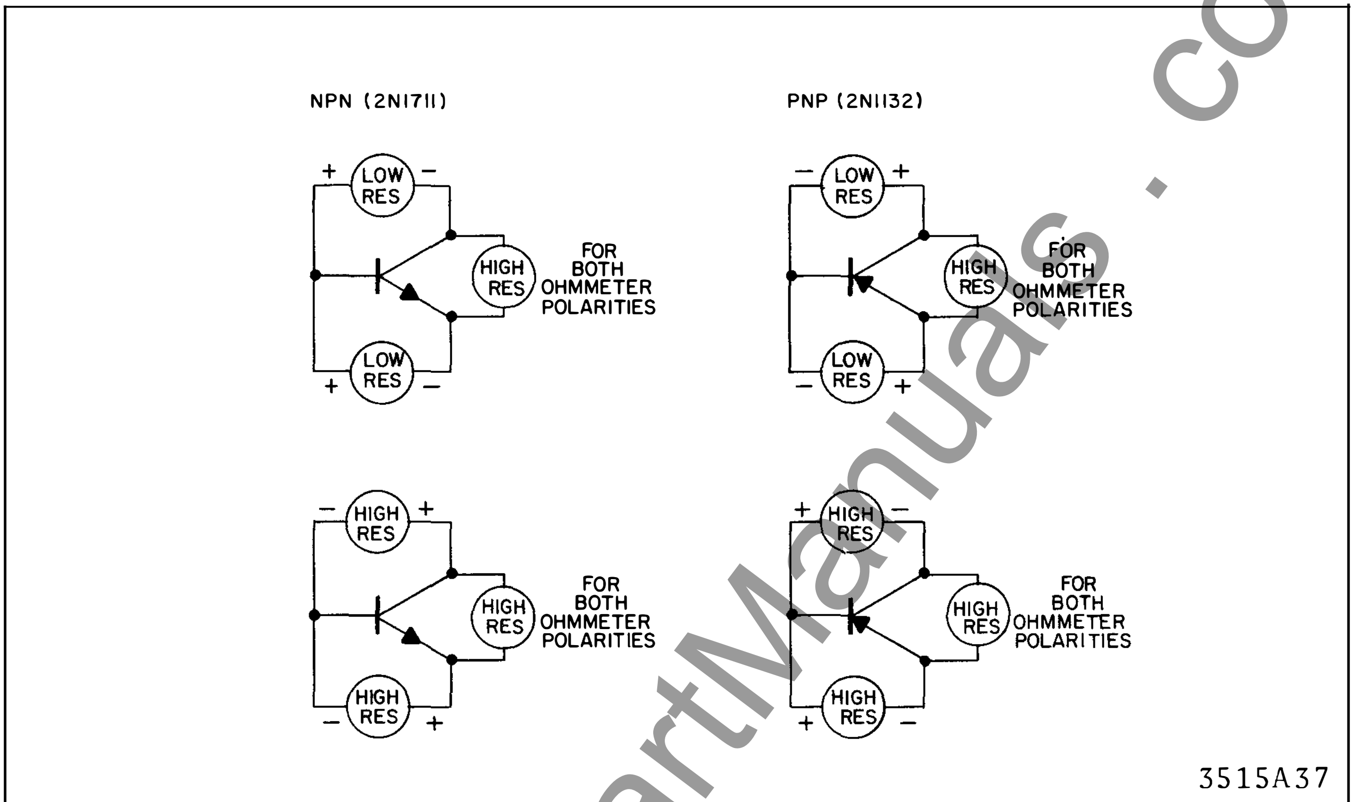

Fig. 8. Transistor Checking.

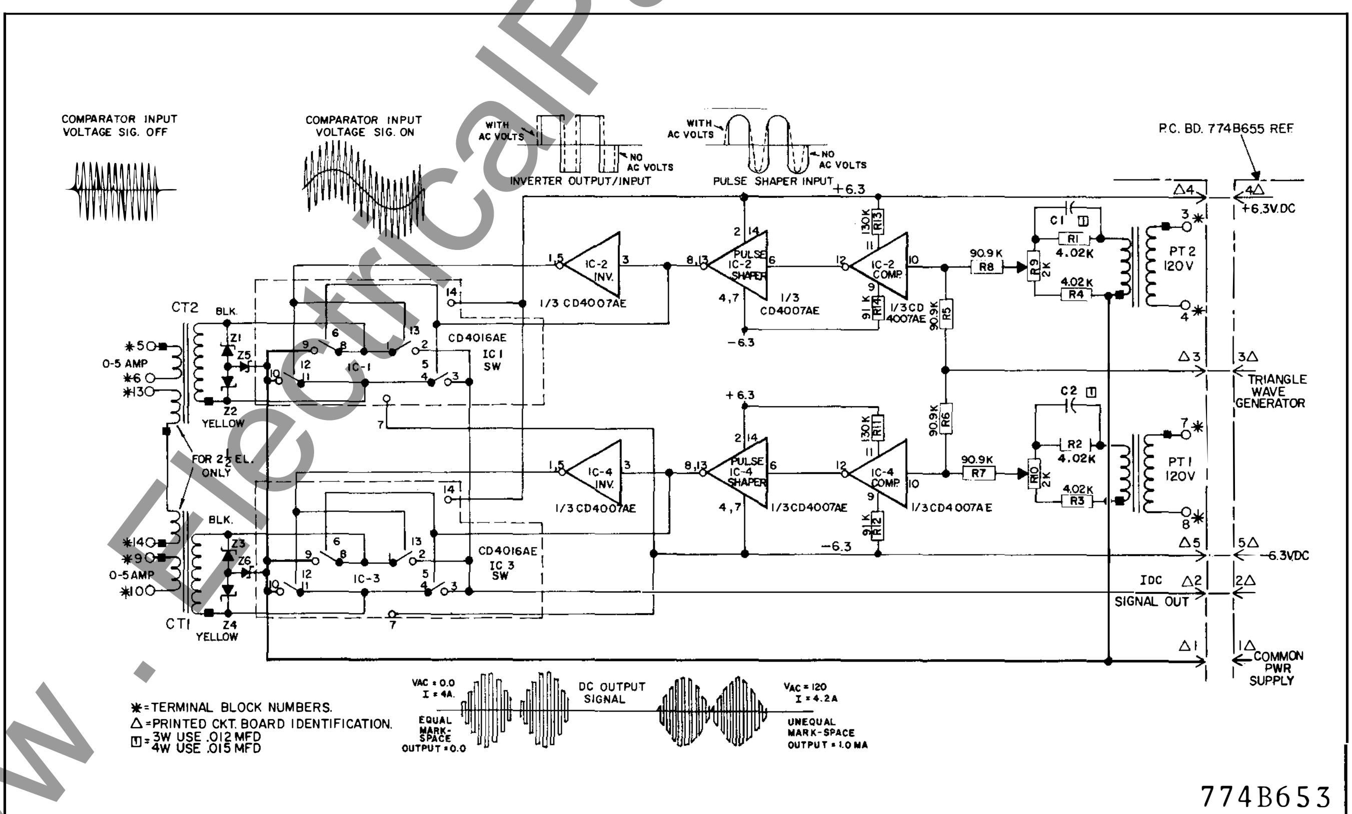

Fig. 9. Switching Bd., VP4-846 Watt Transducer (3∅, 3W, 2 El. & 3∅, 4W, 2½ El.).

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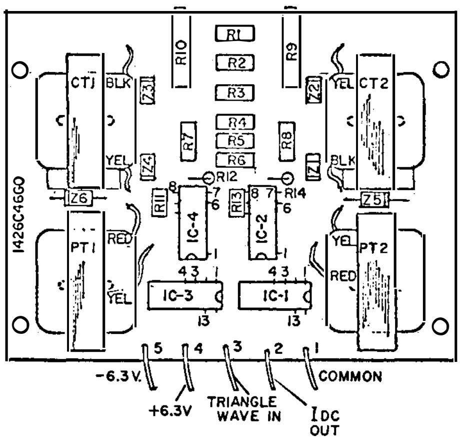
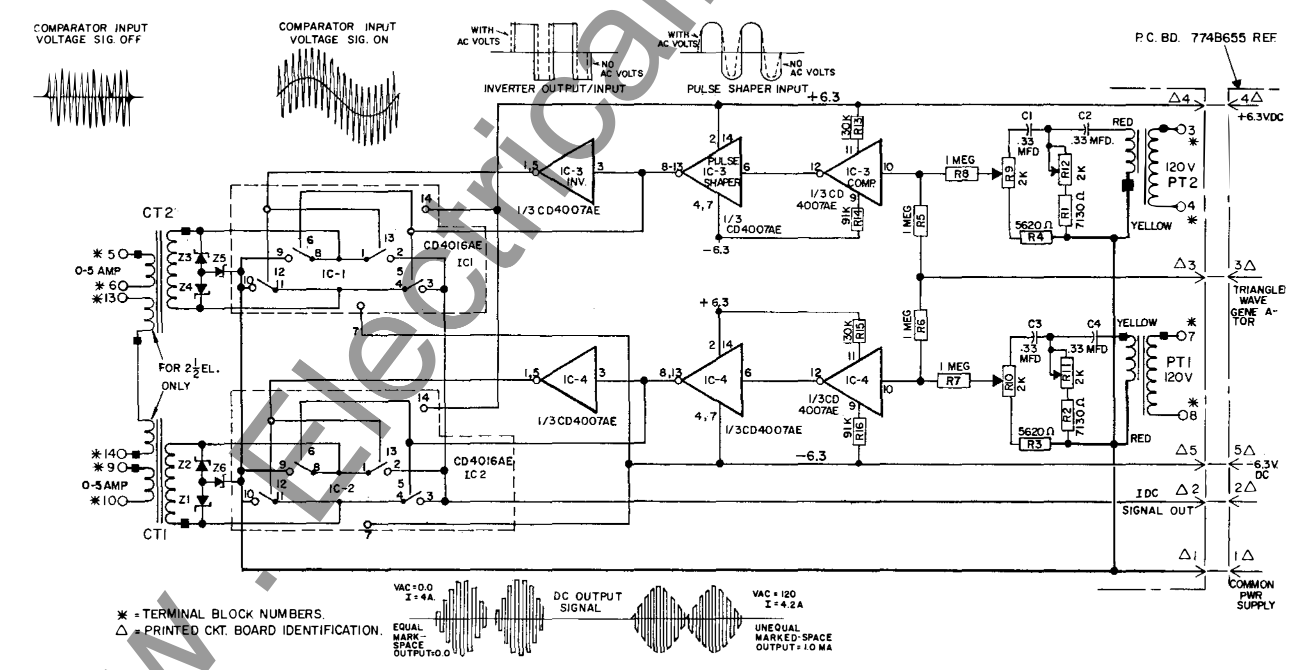


COMP.	DESCRIPTION
IC1,IC3	4016
IC2,IC4	4007

CIRCUIT	SCOPE APPLICATION POINTS *
COMPARATOR INPUT	IC2 & IC4 PIN 10 & COMMON
INVERTER INPUT INVERTER OUTPUT	IC2 & IC4 PIN 8 & COMMON IC2 & IC4 PIN 1 & COMMON
CURRENT TRANSFORMER SECONDARY	IC1 & IC3 PINS 1 & 4
PULSE SHAPER INPUT	IC2 & IC4 PIN6 & COMMON
DC OUTPUT OF SWITCH	IC1 & IC3 PIN 3 & COMMON
*= SEE SCHEMATIC FOR WAVE FORMS	

3514A50

Fig. 10. Component Location - Switching Bd. Watt Transducer.



774B654

Fig. 11. Switching Bd., VV4-846 Var Transducer (3∅, 2W, 2 El. & 3∅, 4∅, 2½ El.).

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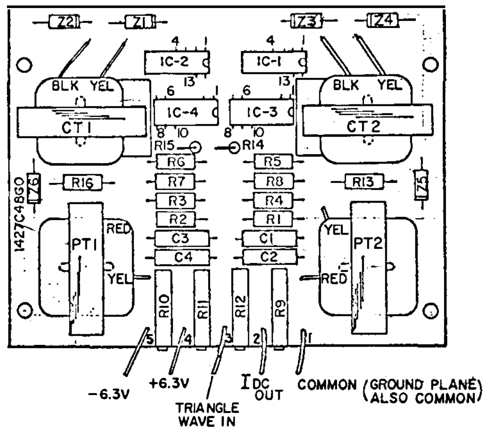


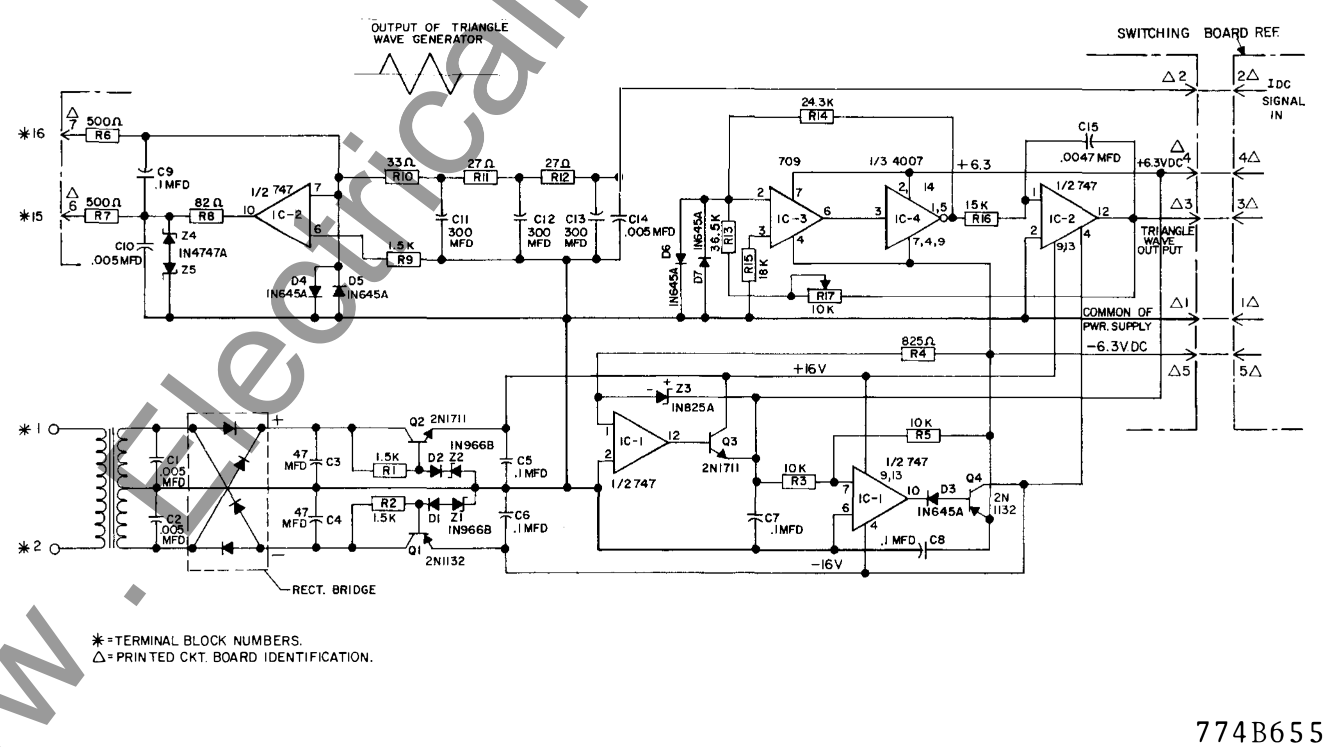
COMP.	DESCRIPTION
IC1, IC2	4016
IC3, IC4	4007

CIRCUIT	SCOPE APPLICATION POINTS *
COMPARATOR INPUT	IC3 & IC4 PIN 10 & COMMON
PULSE SHAPER INPUT	IC3 & IC4 PIN 6 & COMMON
INVERTER INPUT	IC3 & IC4 PIN 8 & COMMON
CURRENT TRANSFORMER SECONDARY	IC1 & IC2 PIN 1 & PIN 4
DC OUTPUT OF SWITCH	IC1 & IC2 PIN 3 & COMMON
INVERTER OUTPUT	IC3 & IC4 PIN 1 & COMMON
* = SEE SCHEMATIC FOR WAVE FORMS	

SCHEMATIC—774B654

3514A51

Fig. 12. Component Location - Switching Bd. Var Transducer.



* = TERMINAL BLOCK NUMBERS.
△ = PRINTED CKT. BOARD IDENTIFICATION.

774B655

Fig. 13. Power Supply Bd., VP4- and VV4-846 Watt & Var Transducer ±10% adj.

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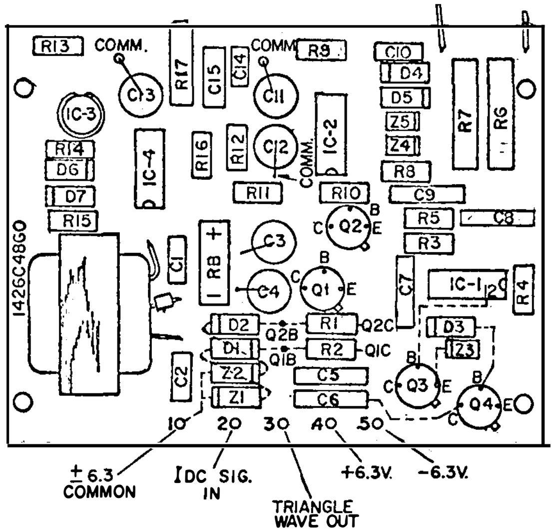


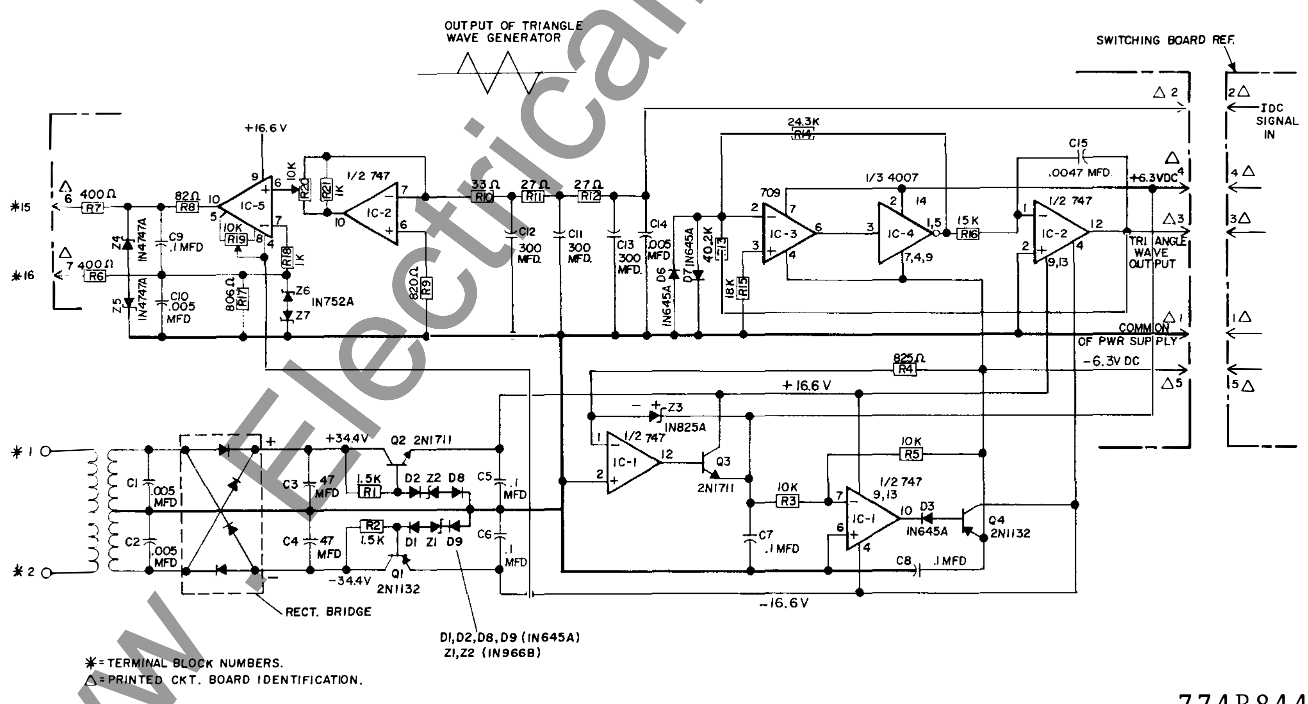
COMP.	DESCRIPTION
Q1,Q4	2N1132
Q2,Q3	2N1711
IC1,IC2	747
IC3	709
IC4	4007

NOTE:
COLLECTORS OF THE 2N1711 & 2N1132 ARE CONNECTED TO THE TRANSISTOR CASE.

CIRCUIT	SCOPE APPLICATION POINTS ✱
TRIANGLE WAVE OUTPUT	CABLE #3 BOARD EDGE TO COMMON, CABLE #1 BOARD EDGE.
✱ = SEE SCHEMATIC FOR WAVE FORMS.	

3514A52

Fig. 14. Component Location - Power Supply Bd. - ±10% adj.



774B844

Fig. 15. Power Supply Bd., VP4- and VV4-846 Watt & Var Transducer with 0-110% adj. amplifier.

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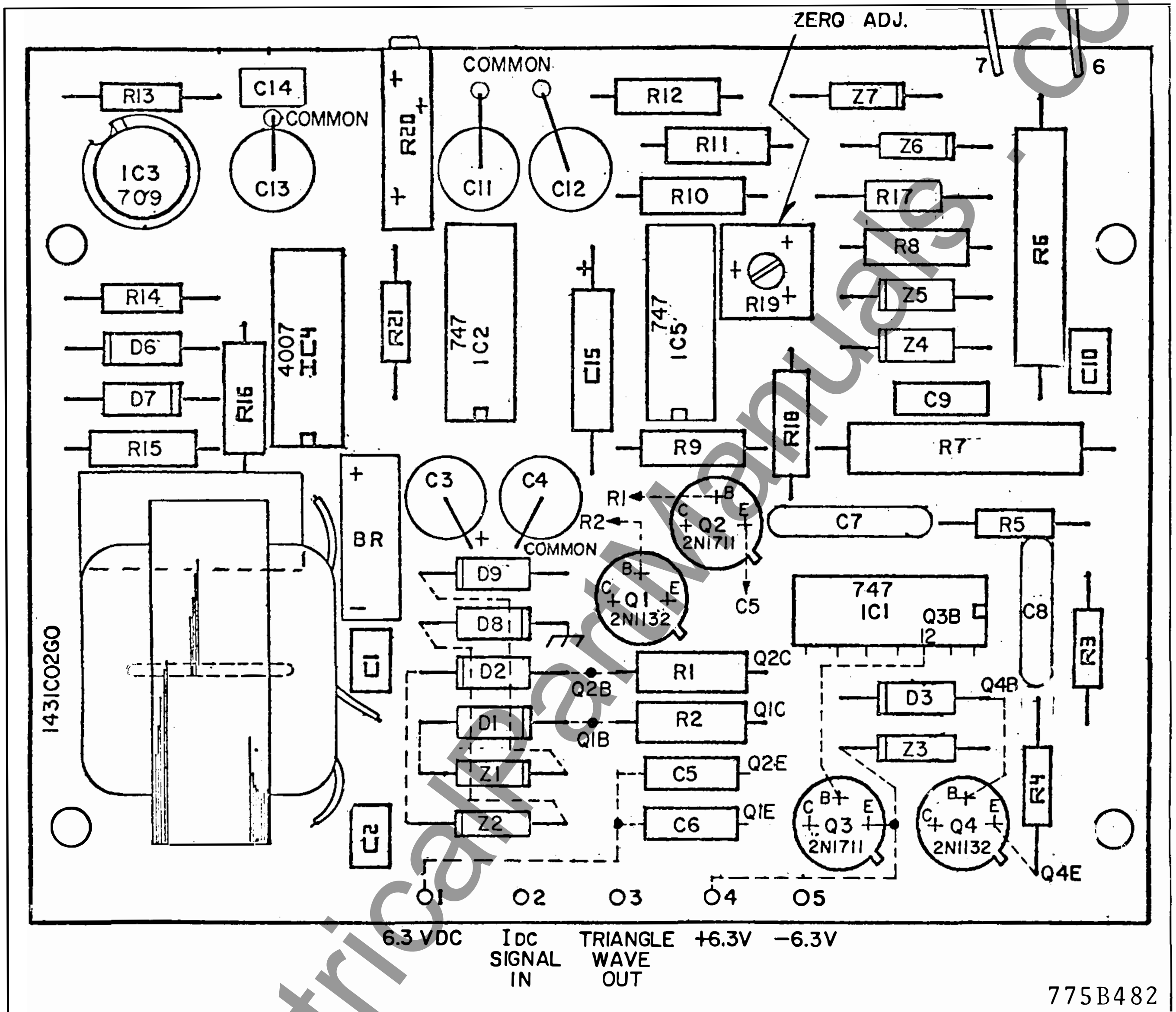

Fig. 16. Component Location Power Supply Bd. 0-110% adj.

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RELAY-INSTRUMENT DIVISION NEWARK, N. J.
Printed in U.S.A.