INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE TCT TEST METER UNIT

APPLICATION

The type TCT carrier test meter unit is an instrument for measuring current, voltage, and resistance values associated with power-line carrier or audio tone equipment.

CONSTRUCTION

MECHANICAL

The test set is built to plug into a mounting frame requiring three rack units (5-¼") space which mounts in a standard 19" rack. The test set is equipped with latch-type handles. It can be removed from the frame and used as a portable unit.

Three sets of different leads are supplied and the two batteries.

The panel contains selector switches to select the required function and range.

Molded binding posts which accept phone tips, spade lug, banana plug, alligator clip or wire leads are provided.

ELECTRICAL

The unit is self-contained; does not require any external power source. Two size "D" standard flashlight cells are used for resistance measurements. The indicating instruments are two taut-band panel instruments with 4" scales.

Radio frequency currents are measured by means of a thermocouple bulb and a taut-band indicating instrument. This instrument employs a specially shaped magnet to produce an almost linear deflection from the square law thermocouple output. Radio frequency shunts provide multi-range operation. The thermocouple bulb is used at only 2/3 of its full rating, thus providing an overload safety factor.

Dc and ac voltage, output level, dbm and resistance is measured by a second taut-band panel instrument. Ac voltage, output level, and dbm ranges utilize a full wave diode rectifier circuit.

SPECIFICATIONS

MECHANICAL:

	Frame Only
Height	5-1/4" 3 Rack Units
Width	19" Standard Rack Mounting
Depth	4-13/32"

	Test Set
Panel	5-1/8 x 17-1/8
Case	4-3/4 x 3 x 16-3/4

ELECTRICAL

Voltages Ranges:

Sensitivity dc at 20,000 ohms per volt
ac at 5,000 ohms per volt

0 – 2.5 – 10 – 50 – 250 – 500 volts full scale

Output Level Ranges:

−10 to +10, +2 to +22, +16 to +36, +30 to +50

+36 to +56 dbm

Zero level = 1 milliwatt in 600 ohms.

Resistance Ranges:

range, ohms: 0 - 1000 - 10,000 - 100,000 - 1 meg - 10 meg

ohms at mid scale: 5, 50, 500 5K, 50K

Dc Current Ranges: (at 200 MV burden)

0 - .25 - 2.5 - 25 - 250 ma

0 - 1 - 2.5 amps

R.F. Current Ranges: (at 200 MV burden)

0 - 100 - 250 - 500 - 1000 ma

These instructions neither cover all details or variations in equipment nor provide for all contingencies with regard to installation, ✪ operation or maintenance. On request, Westinghouse will be glad to supply further information as to particular problems or questions which are not covered sufficiently for the purchaser's needs.

SUPERSEDES I.L. 41-944.7C, dated March 1970

✪Denotes change from superseded issue.

EFFECTIVE MAY 1976

ACCURACY

d-c voltage & current ranges ± 3% of full scale

r.f. current ranges ± 3% of full scale

ohm ranges ± 1.5% of scale length, except for RX 10 range = ± 3%

scale length = 4 inches

ac volt ranges ± 5% of full scale

dbm range ± 5% of full scale

FREQUENCY RANGE

r-f current ranges – as stated above up to 300kHz.

ac volts and dbm ranges as stated above from 35 to 3000 Hz. Frequency error less than 0.5 db at 10 kHz.

OPERATION

The terminals for the R.F. milliammeter are separate from the others and located below the indicating R.F. instrument.

Connections for measuring current on the 2.5 amp dc range are made to the "COM" and "2.5 d-c amps" terminals.

Except for those two measurements, all other functions use the "COM" and "V-O-M" terminals in conjunction with proper switch settings.

Three switches provide for selection of the function required and the range desired.

D-C VOLTAGE MEASUREMENTS

1. Select "DCV" on switch marked "function."
2. Rotate "range" switch to desired range.

   If in doubt, start with highest range.
3. Plug red test lead into the red (+) terminal marked "V-O-M."

   Plug black test lead into the black (–) terminal marked "COM" and connect to circuit to be measured.
4. Read the dc volt scale corresponding to range switch setting. Reverse reading indicate reverse polarity.

A-C VOLTAGE MEASUREMENTS

1. Select "ACV" on switch marked "FUNCTION".
2. Rotate "RANGE" switch to desired range.

   If in doubt, start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.

   No polarity requirement is entailed.
4. Read the ac volt scale corresponding to range switch setting.

Note: Both sides of the ac circuit are ungrounded. For accurate measurements at high frequencies one side of the signal source should be grounded and connected to the black terminal marked "COM". The metal case of the TCT set should also be connected to this terminal.

RIPPLE VOLTAGE MEASUREMENT

1. Select "DB" on switch marked "FUNCTION."
2. Rotate "RANGE" switch to desired range.

   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.
4. Read the ac volt scale corresponding to range switch setting.

CAUTION:

The blocking capacitor used in the "DB" function is rated at 200 Vdc working voltage. To measure ripple in circuits with a dc voltage appreciably greater than this an external capacitor should be connected in series with one of the test leads.

DB LEVEL

1. Select "DB" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.

   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.

IMPORTANT:

For accurate measurements at high frequencies observe grounding practice per note under ac Voltage of these instructions.

4. Read all DB on the −10 to +10 DB scale. When the range switch is on the +0 DB position, this is the DB value. For all other positions of the range switch add the range switch setting to the scale indication algebrically.

CAUTION:

Observe blocking capacitor safe dc voltage limitation per note under "Ripple Voltage" of these instructions.

Note: Zero reference level is taken as one milliwatt in a 600 ohm line, which is equivalent to 0.775 volts.

RESISTANCE MEASUREMENT

1. Select "OHMS" on switch marked "FUNCTIONS".
2. Rotate "Range" switch to desired multiplier.
3. Plug test leads into the "COM" and "V-O-M" terminals.
4. Short test leads together and adjust the small knob marked "OHMS ADJ" to set ohmmeter on zero (right side full scale).

Note: Zero must be set for each range.

5. Connect test leads to unknown resistance.
6. Read indication on the OHMS scale.

When range switch is in the RX1 position, this is the resistance value. For all other positions of the range switch multiply scale indication by switch multiplier.

CAUTION:

When measuring resistance, a current is passed through the component under test. With the range switch set on RX1 this current can be as large as 0.3 amperes. When using this range setting, it is recommended readings, including zero setting, be made as quickly as possible to avoid excessive battery drain.

For general continuity testing, use RX10 or higher settings. When finished measuring ohms, it is recommended FUNCTION switch be turned to OFF.

Note: If ohmmeter does not indicate on any range, check the fuse or the batteries.

DC CURRENT – 1 AMP OR LESS

1. Select "DC MA" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.

If in doubt, start with highest range.

3. Plug red test lead into the red (+) terminal marked "VOM". Plug the black lead into the black terminal marked "COM".

Connect test leads in series with circuit to be measured.

4. Read the "DC and AC" volt scale corresponding to range switch setting. For the 2.5 VDC scale use the 0-250 scale figures and point off two decimal places to the left. For 0-500 Vdc use the 0-50 scale figures and multiply by 10.

DC CURRENTS ABOVE 1 AMPERE (2.5 AMP MAX)

1. Select "2.5 DC AMPS" on switch marked "FUNCTION".
2. The 2.5 ampere range is not selected by the "RANGE" switch but is obtained by plugging the red test lead into the red (+) terminal marked "2.5 DC AMPS" and the black test lead into the black terminal (−) marked "COM".
3. The "RANGE" switch is not connected when using these terminals and can be in any position.
4. Read indication on the 0-250 scale by pointing off two decimal places to the left.

RF CURRENT

Note: RF current measurment involve only the "RF MA" switch and "RF MA" terminals. The other RANGE and FUNCTION switches may be in any position.

1. Set RF MA switch to OFF position.
2. Plug test leads into terminals marked RF MA. Connect to circuit.
3. Turn range switch from OFF position to the highest range which will give a satisfactory indication. This switch is a shorting type switch and will not open the circuit when going from one range to another.
4. Read indication on scale corresponding to desired range.

Note: Set RF MA switch to OFF position when finished taking readings. This avoids energizing instrument with switch set on wrong range if step 1 is not observed next time instrument is used, and also eliminates losses which the thermocouple heater presents to the line.

MAINTENANCE

INSTRUMENTS

Both instruments are taut-band instruments, providing frictionless indication and freedom from damaging effects of vibration and shock.

A zero adjuster is provided on each instrument cover for setting pointer on zero if required.

BATTERIES

The batteries are used only in the ohmmeter circuit. They are satisfactory as long as zero can be set with the OHMS ADJ and are not corroded or leaking. The center post of the battery is inserted in the red cap of the battery holder when replacing.

FUSE

The ohmmeter circuit includes a fuse to protect the circuitry from an accidental internal short. If replaced, be sure fuse is inserted to seat properly in contoured clips.

THERMOCOUPLE

A burned out thermocouple bulb is best replaced by returning the complete test unit. If this is not practical, a new bulb and the four adjustable spools shown in series with the millivolt output of the bulb can be supplied. This unit will then require calibration by adjusting these spools. Calibration may be done on 60 hertz.

✪ REPAIRS AND RENEWAL PARTS

Repair work can be done most satisfactorily at the factory or at any Authorized Instrument Repair Facility (See Service Directory 43-000). However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

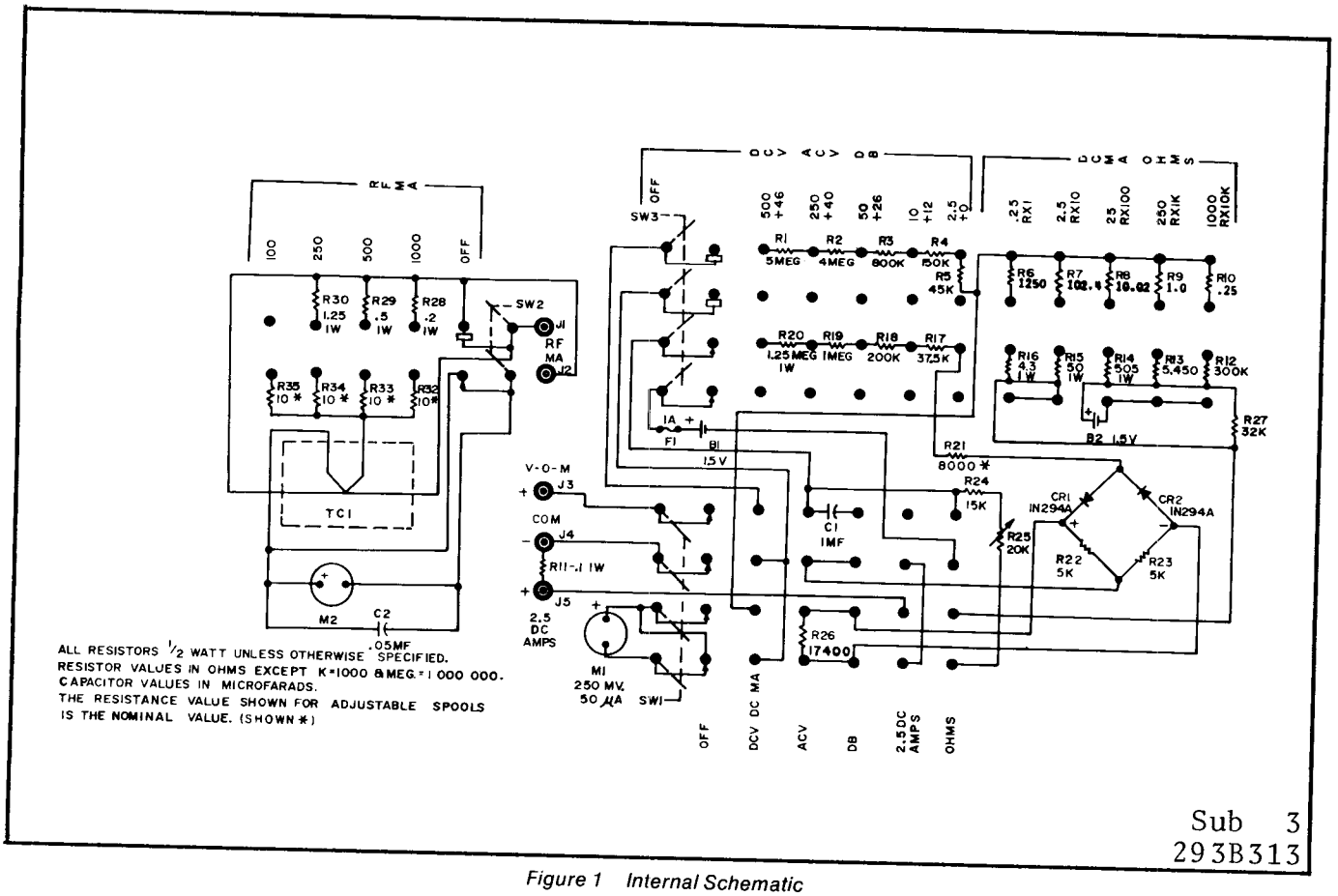


Figure 1 Internal Schematic

TYPE TCT TEST METER UNIT
TABLE I
List of Component Parts

DIAGRAM SYMBOL	FUNCTION	DESCRIPTION
B1 & B2	Battery	1.5V size D
C1	Blocking Capacitor	1.0 mfd., 200 WVDC
C2	By-pass Capacitor	.05 mfd., 50 WVDC
CR1 & CR2	Rectifier Diode	Type 1N294A
F1	Ohmmeter Fuse	3AG Littlefuse 1A-250V
M1	V-O-M Instrument	Westinghouse FX-372 50uA, 250MV
M2	R.F. MA Instrument	Westinghouse FX-373 667uA
J1 J2 J4	Terminal Post	Grayhill 29-1 Black
J3 J5	Terminal Post	Grayhill 29-1 Red
TC-1	Thermocouple Bulb	150MA 25MV O.C. 1.8 ohms Heater Res. Westinghouse 291B001H11
R1	Multiplier Resistance	5 meg., 500V, 1% ins. ½ W
R2	Multiplier Resistance	4 meg., 350V, 1% ins. ½ W
R3	Multiplier Resistance	800K ohm 350V, 1% T-1 Ins., ½ W
R4	Multiplier Resistance	150K ohm 350V, 1% T-1 Ins., ½ W
R5	Multiplier Resistance	45K ohm 350V, 1% T-1 Ins., ½ W
R6	Milliammeter Shunt Resistor	1250 ohm ½ W, 1% W.W.
R7	Milliammeter Shunt Resistor	102.4 ohm ½ W, 1% W.W.
R8	Milliammeter Shunt Resistor	10.02 ohm ½ W, 1% W.W.
R9	Milliammeter Shunt Resistor	1.0 ohm ½ W, 1% W.W.
R10	Milliammeter Shunt Resistor	.25 ohm ½ W, 1% W.W.
R11	Ammeter Shunt Resistor	0.10 ohm 1 W, ½% W.W.
R12	Ohmmeter Shunt Resistor	300K ohm ½ W, 1% T-1 Metal Film
R13	Ohmmeter Shunt Resistor	5450 ohms ½ W, ½% W.W.
R14	Ohmmeter Shunt Resistor	505 ohms ½ W, ½% W.W.
R15	Ohmmeter Shunt Resistor	50 ohm ½ W, ½% W.W.
R16	Ohmmeter Shunt Resistor	4.3 ohm ½ W, ½% W.W.
R17	Volt Multiplier Resistor	37.5K ohm ½ W, 1% T-1 Metal Film
R18	Volt Multiplier Resistor	200K ohm ½ W, 1% T-1 Metal Film
R19	Volt Multiplier Resistor	1 megohm ½ W, 1% T-1 Metal Film
R20	Volt Multiplier Resistor	1.25 megohm ½W, 1% T-1 Metal Film
R21	Volt Multiplier Resistor	10.1K ohm ½W, ½% W.W. Adjustable
R22-R23	Rect. Bridge Resistor	5K ohm ½W, 1% T-1 Metal Film
R24	Ohmmeter Series Resistor	15K ohm ½W, 1% T-1 Metal Film
R25	Ohmmeter Potentiometer	20K ohm Linear
R26	Voltmeter Shunt Resistor	20K ohm ½ W, ½% W.W. Adjustable
R27	Ohmmeter Series Resistor	32K ohm ½ W, 1% T-1 Metal Film
R28	R.F. Shunt	0.2 ohm 1W, ½% W.W., non-inductive
R29	R.F. Shunt	0.5 ohm 1W, ½% W.W.
R30	R.F. Shunt	1.25 ohm 1W, ½% W.W.
R32-R33-R34-R35	R.F. M.V. Swamp Resistor	12 ohm ½ W, W.W. Adjustable
SW-1	Function Switch	6 pos., 4 section Rotary Non-Shorting
SW-2	R.F. MA Switch	5 pos., 2 section Rotary (1 Shorting, 1 Non-Shorting)
SW-3	Range Switch	11 pos., 4 section Rotary (2 Shorting, 2 Non-Shorting)

TEST LEADS	WESTINGHOUSE STYLE
60" long, Insulated Test Prod and Plug	Red 293B287G01
60" long, Insulated Test Prod and Plug	Black 293B287G02
40" long, Insulated Double Banana Plug & Phone Jack	293B287G03
40" long, Insulated Double Banana Plug Both Ends	293B287G04

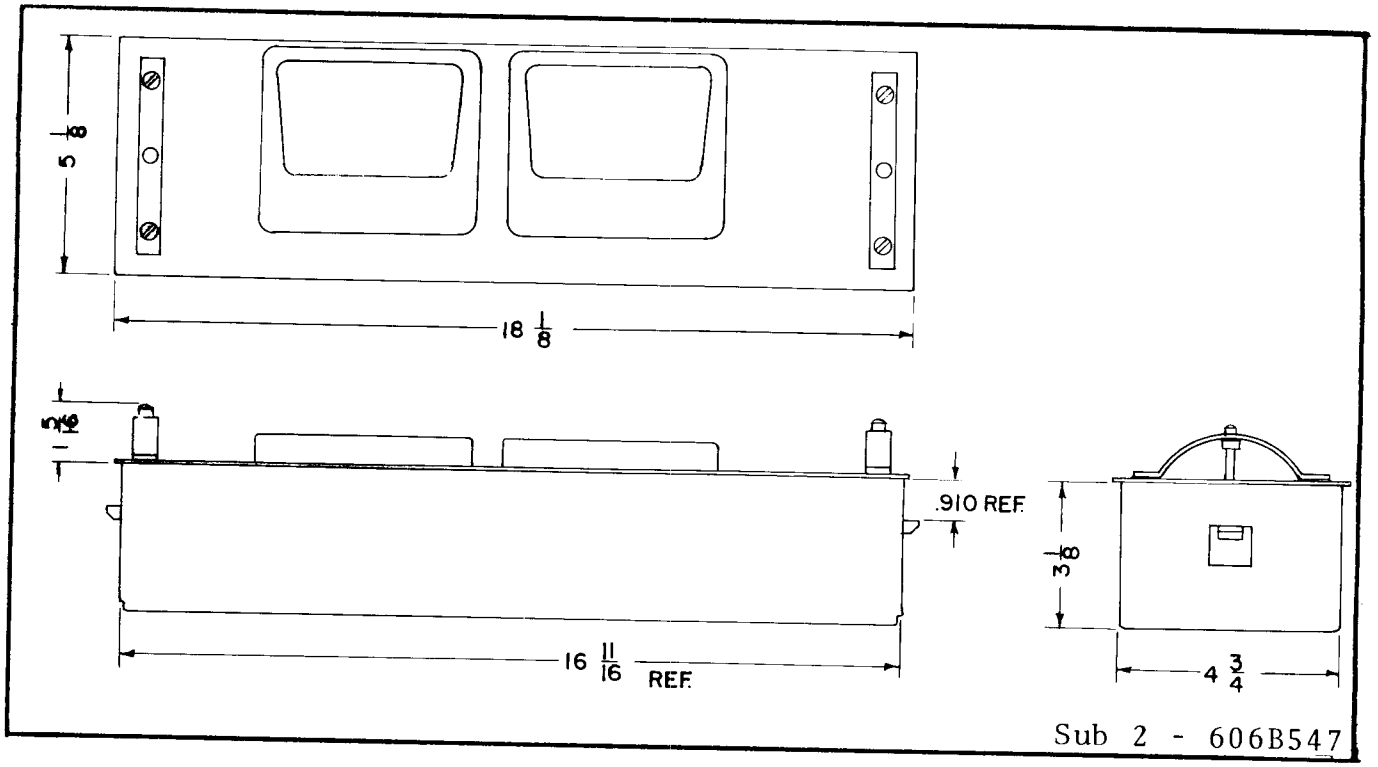


Figure 2 Outline of Test Unit Only.

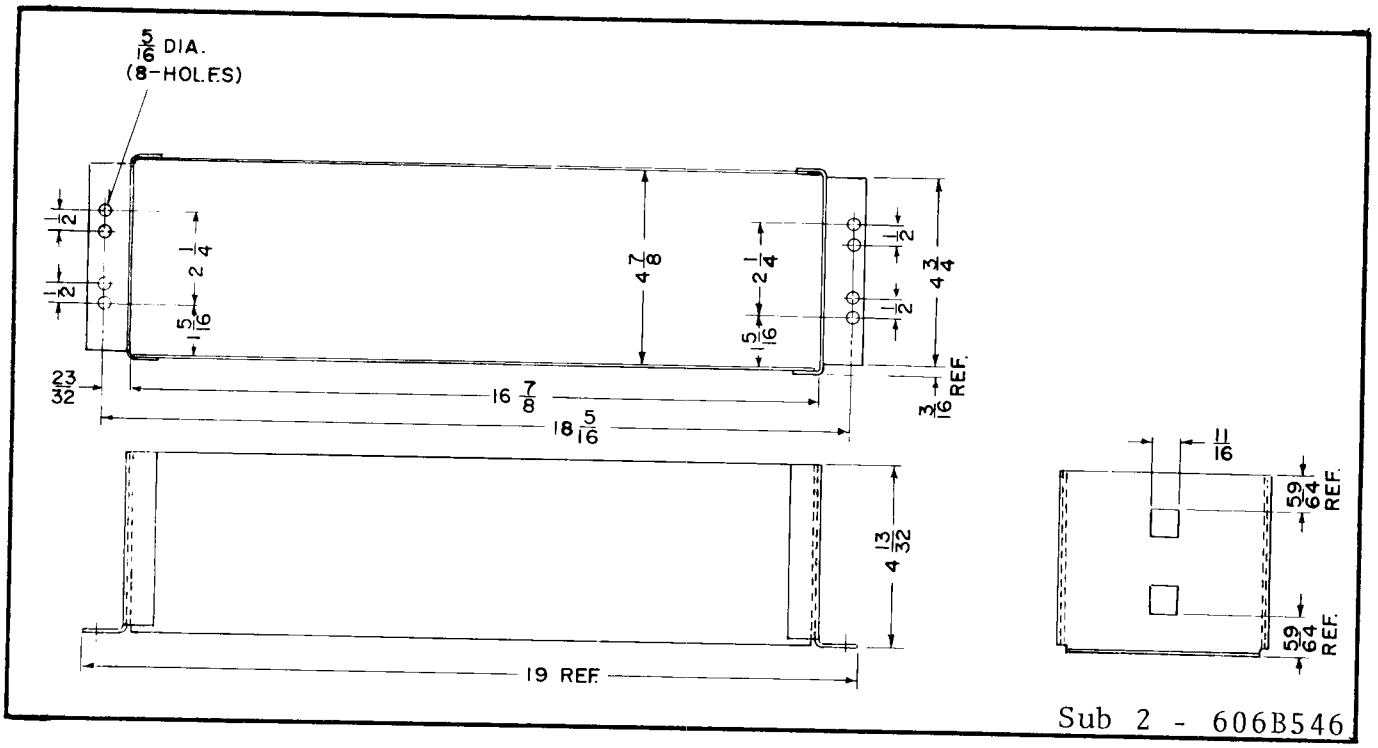
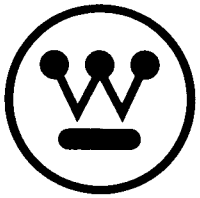


Figure 3 Outline of Mounting Frame Only.



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

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INSTRUCTIONS

TYPE TCT TEST METER UNIT

APPLICATION

The type TCT carrier test meter unit is an instrument for measuring current, voltage, and resistance values associated with power-line carrier or audio tone equipment.

CONSTRUCTION

Mechanical

The test set is built to plug into a mounting frame requiring three rack units (5-¼'') space which mounts in a standard 19'' rack. The test set is equipped with latch-type handles. It can be removed from the frame and used as a portable unit.

Three sets of different leads are supplied and the two batteries.

The panel contains selector switches to select the required function and range.

Molded binding posts which accept phone tips, spade lug, banana plug, alligator clip or wire leads are provided.

Electrical

The unit is self-contained; does not require any external power source. Two size ''D'' standard flashlight cells are used for resistance measurements. The indicating instruments are two taut-band panel instruments with 4'' scales.

Radio frequency currents are measured by means of a thermocouple bulb and a taut-band indicating instrument. This instrument employs a specially shaped magnet to produce an almost linear deflection from the square law thermocouple output. Radio frequency shunts provide multi-range operation. The thermocouple bulb is used at only 2/3 of its full rating, thus providing an overload safety factor.

D-C and A-C voltage, output level, dbm and resistance is measured by a second taut-band panel instrument. A-C voltage, output level, and dbm ranges utilize a full wave diode rectifier circuit.

SPECIFICATIONS

Mechanical:

	Frame Only
Height	5-1/4'' 3 Rack Units
Width	19'' Standard Rack Mounting
Depth	4-13/32''
	Test Set
Panel	5-1/8 x 17-1/8
Case	4-3/4 x 3 x 16-3/4

Electrical

Voltages Ranges:

Sensitivity D-C at 20,000 ohms per volt
A-C at 5000 ohms per volt

0 -- 2.5 — 10 — 50 — 250 — 500 volts full scale

Output Level Ranges:

—10 to +10, +2 to +22, +16 to +36, +30 to +50

* +36 to +56 dbm

Zero level = 1 milliwatt in 600 ohms.

Resistance Ranges:

range, ohms: 0-1000 - 10,000 - 100,000 - 1 meg - 10 meg

ohms at mid scale: 5, 50, 500 5K, 50K

D-C Current Ranges: (at 200 MV burden)

0 - .25 - 2.5 - 25 - 250 ma

0 - 1 - 2.5 amps

R.F. Current Ranges: (at 200 MV burden)

0 - 100 - 250 - 500 - 1000 ma

Accuracy

d-c voltage & current ranges ± 3% of full scale

SUPERSEDES I.L. 41-944.7B
*Denotes change from superseded issue.

EFFECTIVE MARCH 1970

r.f. current ranges ± 3% of full scale
ohm ranges ± 1.5% of scale length, except for RX10 range = ± 3%
scale length = 4 inches
a-c volt ranges ± 5% of full scale
dbm ranges ± 5% of full scale

Frequency Range

* r-f current ranges—as stated above up to 300kHz.
a-c volts and dbm ranges as stated above from 35 to 3000 Hz. Frequency error less than 0.5 db at 10 kHz.

OPERATION

The terminals for the R.F. milliammeter are separate from the others and located below the indicating R.F. instrument.

Connections for measuring current on the 2.5 amp d-c range are made to the "COM" and "2.5 d-c amps" terminals.
Except for those two measurements, all other functions use the "COM" and "V-O-M" terminals in conjunction with proper switch settings.

Three switches provide for selection of the function required and the range desired.

D-C VOLTAGE MEASUREMENTS

1. Select "DCV" on switch marked "function."
2. Rotate "range" switch to desired range.
   If in doubt, start with highest range.
3. Plug red test lead into the red (+) terminal marked "V-O-M."
   Plug black test lead into the black (—) terminal marked "COM" and connect to circuit to be measured.
4. Read the D-C volt scale corresponding to range switch setting. Reverse reading indicate reverse polarity.

A-C VOLTAGE MEASUREMENTS

1. Select "ACV" on switch marked "FUNCTION".
2. Rotate "RANGE" switch to desired range.
   If in doubt, start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.
   No polarity requirement is entailed.
4. Read the A-C volt scale corresponding to range switch setting.

Note: Both sides of the A-C circuit are ungrounded. For accurate measurements at high frequencies one side of the signal source should be grounded and connected to the black terminal marked "COM". The metal case of the TCT set should also be connected to this terminal.

RIPPLE VOLTAGE MEASUREMENT

1. Select "DB" on switch marked "FUNCTION."
2. Rotate "RANGE" switch to desired range.
   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.
4. Read the A-C volt scale corresponding to range switch setting.

CAUTION:

The blocking capacitor used in the "DB" function is rated at 200 VDC working voltage. To measure ripple in circuits with a D-C voltage appreciably greater than this an external capacitor should be connected in series with one of the test leads

DB LEVEL

1. Select "DB" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.
   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.

IMPORTANT:

For accurate measurements at high frequencies observe grounding practice per note under A-C Voltage of these instructions.

4. Read all DB on the −10 to +10 DB scale. When the range switch is on the +0 DB position, this is the DB value. For all other positions of the range switch add the range switch setting to the scale indication algebraically.

CAUTION:

Observe blocking capacitor safe D-C voltage

limitation per note under "Ripple Voltage" of these instructions.

Note: Zero reference level is taken as one milliwatt in a 600 ohm line, which is equivalent to 0.775 volts.

RESISTANCE MEASUREMENT

1. Select "OHMS" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired multiplier.
3. Plug test leads into the "COM" and "V-O-M" terminals.
4. Short test leads together and adjust the small knob marked "OHMS ADJ" to set ohmmeter on zero (right side full scale).

Note: Zero must be set for each range.

5. Connect test leads to unknown resistance.
6. Read indication on the OHMS scale.

When range switch is in the RX1 position, this is the resistance value. For all other positions of the range switch multiply scale indication by switch multiplier.

CAUTION:

* When measuring resistance, a current is passed through the component under test. With the range switch set on RX1 this current can be as large as 0.3 amperes. When using this range setting, it is recommended readings, including zero setting, be made as quickly as possible to avoid excessive battery drain.

* For general continuity testing, use RX10 or higher settings. When finished measuring ohms, it is recommended FUNCTION switch be turned to OFF.

Note: If ohmmeter does not indicate on any range, check the fuse or the batteries.

DC CURRENT – 1 AMP OR LESS

1. Select "DC MA" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.

If in doubt, start with highest range.

3. Plug red test lead into the red (+) terminal marked "VOM". Plug the black lead into the black terminal marked "COM".

Connect test leads in series with circuit to be measured.

4. Read the "DC and AC" volt scale corresponding to range switch setting. For the 2.5 VDC scale use the 0-250 scale figures and point off two decimal places to the left. For 0-500 VDC use the 0-50 scale figures and multiply by 10.

DC CURRENTS ABOVE 1 AMPERES (2.5 AMP MAX)

1. Select "2.5 DC AMPS" on switch marked "FUNCTION".
2. The 2.5 ampere range is not selected by the "RANGE" switch but is obtained by plugging the red test lead into the red (+) terminal marked "2.5 DC AMPS" and the black test lead into the black terminal (–) marked "COM".
3. The "RANGE" switch is not connected when using these terminals and can be in any position.
3. Read indication on the 0-250 scale by pointing off two decimal places to the left.

RF CURRENT

Note: RF current measurements involve only the "RF MA" switch and "RF MA" terminals. The other RANGE and FUNCTION switches may be in any position.

1. Set RF MA switch to OFF position.
2. Plug test leads into terminals marked RF MA. Connect to circuit.
3. Turn range switch from OFF position to the highest range which will give a satisfactory indication. This switch is a shorting type switch and will not open the circuit when going from one range to another.
4. Read indication on scale corresponding to desired range.

Note: Set RF MA switch to OFF position when finished taking readings. This avoids energizing instrument with switch set on wrong range if step 1 is not observed next time instrument is used, and also eliminates losses which the thermocouple heater presents to the line.

MAINTENANCE

Instruments

Both instruments are taut-band instruments, providing frictionless indication and freedom from damaging effects of vibration and shock.

A zero adjuster is provided on each instrument cover for setting pointer on zero if required.

Batteries

The batteries are used only in the ohmmeter circuit. They are satisfactory as long as zero can be set with the OHMS ADJ and are not corroded or leaking. The center post of the battery is inserted in the red cap of the battery holder when replacing.

Fuse

The ohmmeter circuit includes a fuse to protect the circuitry from an accidental internal short. If replaced, be sure fuse is inserted to seat properly in contoured clips.

Thermocouple

A burned out thermocouple bulb is best replaced by returning the complete test unit. If this is not practical, a new bulb and the four adjustable spools shown in series with the millivolt output of the bulb can be supplied. This unit will then require calibration by adjusting these spools. Calibration may be done on 60 cycles.

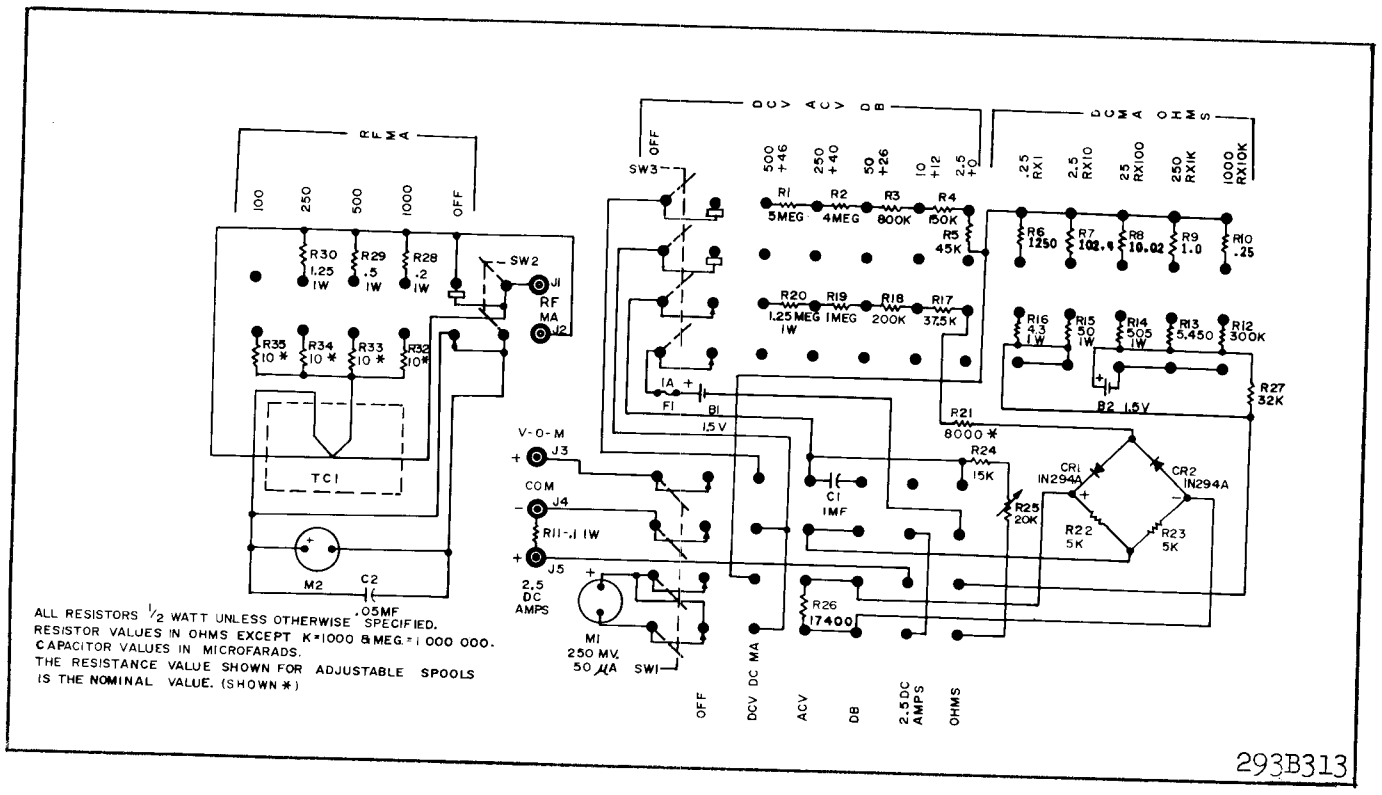

Figure 1 Internal Schematic

TYPE TCT TEST METER UNIT

TABLE I

List of Component Parts

DIAGRAM SYMBOL	FUNCTION	DESCRIPTION
B1 & B2	Battery	1.5V size D
C1	Blocking Capacitor	1.0 mfd., 200 WVDC
C2	By-pass Capacitor	.05 mfd., 50 WVDC
CR1 & CR2	Rectifier Diode	Type 1N294A
F1	Ohmmeter Fuse	3AG Littlefuse 1A-250V
M1	V-O-M Instrument	Westinghouse FX-372 50uA, 250MV
M2	R.F. MA Instrument	Westinghouse FX-373 667uA
J1 J2 J4	Terminal Post	Grayhill 29-1 Black
J3 J5	Terminal Post	Grayhill 29-1 Red
TC-1	Thermocouple Bulb	150MA 25MV O.C. 1.8 ohms Heater Res. Westinghouse 291B001H11
R1	Multiplier Resistance	5 meg., 500V, 1% ins. ½ W
R2	Multiplier Resistance	4 meg., 350V, 1% ins. ½ W
R3	Multiplier Resistance	800K ohm 350V, 1% T-1 Ins., ½ W
R4	Multiplier Resistance	150K ohm 350V, 1% T-1 Ins., ½ W
R5	Multiplier Resistance	45K ohm 350V, 1% T-1 Ins., ½ W
R6	Milliammeter Shunt Resistor	1250 ohm ½ W, 1% W.W.
R7	Milliammeter Shunt Resistor	102.4 ohm ½ W, 1% W.W.
R8	Milliammeter Shunt Resistor	10.02 ohm ½ W, 1% W.W.
R9	Milliammeter Shunt Resistor	1.0 ohm ½ W, 1% W.W.
R10	Milliammeter Shunt Resistor	.25 ohm ½ W, 1% W.W.
R11	Ammeter Shunt Resistor	0.10 ohm 1W ½% W.W.
R12	Ohmmeter Shunt Resistor	300K ohm ½W 1% T-1 Metal Film
R13	Ohmmeter Shunt Resistor	5450 ohms ½ W ½% W.W.
R14	Ohmmeter Shunt Resistor	505 ohms ½ W ½% W.W.
R15	Ohmmeter Shunt Resistor	50 ohm ½ W ½% W.W.
R16	Ohmmeter Shunt Resistor	4.3 ohm ½ W ½% W.W.
R17	Volt Multiplier Resistor	37.5K ohm ½ W 1% T-1 Metal Film
R18	Volt Multiplier Resistor	200K ohm ½W 1% T-1 Metal Film
R19	Volt Multiplier Resistor	1 megohm ½ W 1% T-1 Metal Film
R20	Volt Multiplier Resistor	1.25 megohm ½ W 1% T-1 Metal Film
R21	Volt Multiplier Resistor	10.1K ohm ½ W ½% W.W. Adjustable
R22-R23	Rect. Bridge Resistor	5K ohm ½ W 1% T-1 Metal Film
R24	Ohmmeter Series Resistor	15K ohm ½ W 1% T-1 Metal Film
R25	Ohmmeter Potentiometer	20K ohm Linear
R26	Voltmeter Shunt Resistor	20K ohm ½ W ½% W.W. Adjustable
R27	Ohmmeter Series Resistor	32K ohm ½ W 1% T-1 Metal Film
R28	R.F. Shunt	* 0.2 ohm 1W ½% W.W., non-inductive
R29	R.F. Shunt	0.5 ohm 1W ½% W.W.
R30	R.F. Shunt	1.25 ohm 1W ½% W.W.
R32-R33-R34-R35	R.F. M.V. Swamp Resistor	12 ohm ½ W.W.W. Adjustable
SW-1	Function Switch	6 pos., 4 section Rotary Non-Shorting
SW-2	R.F. MA Switch	5 pos., 2 section Rotary (1 Shorting, 1 Non-Shorting)
SW-3	Range Switch	11 pos., 4 section Rotary (2 Shorting, 2 Non-Shorting)

TEST LEADS	WESTINGHOUSE STYLE
60" long, Insulated Test Prod and Plug	Red 293B287G01
60" long, Insulated Test Prod and Plug	Black 293B287G02
40" long, Insulated Double Banana Plug & Phone Jack	293B287G03
40" long, Insulated Double Banana Plug Both Ends	293B287G04

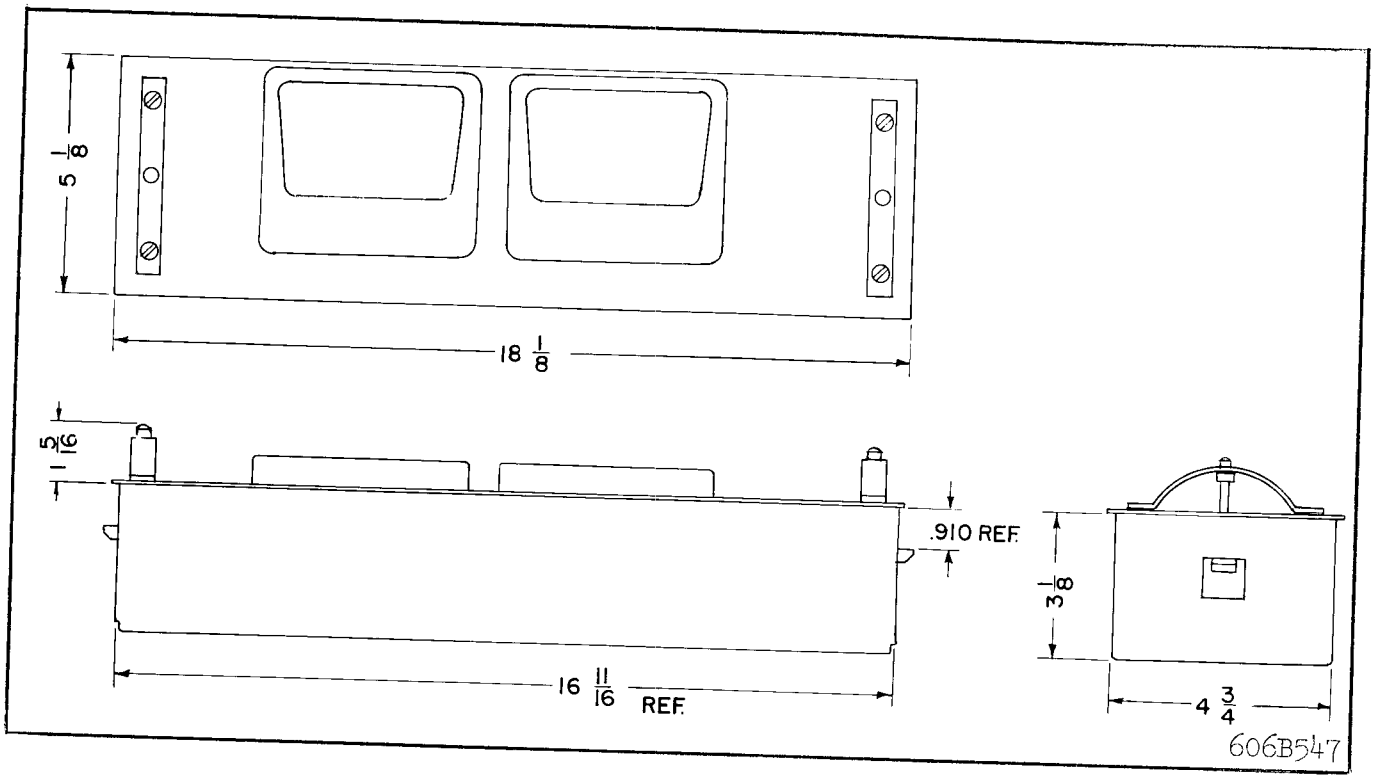

Figure 2 Outline of Test Unit Only.

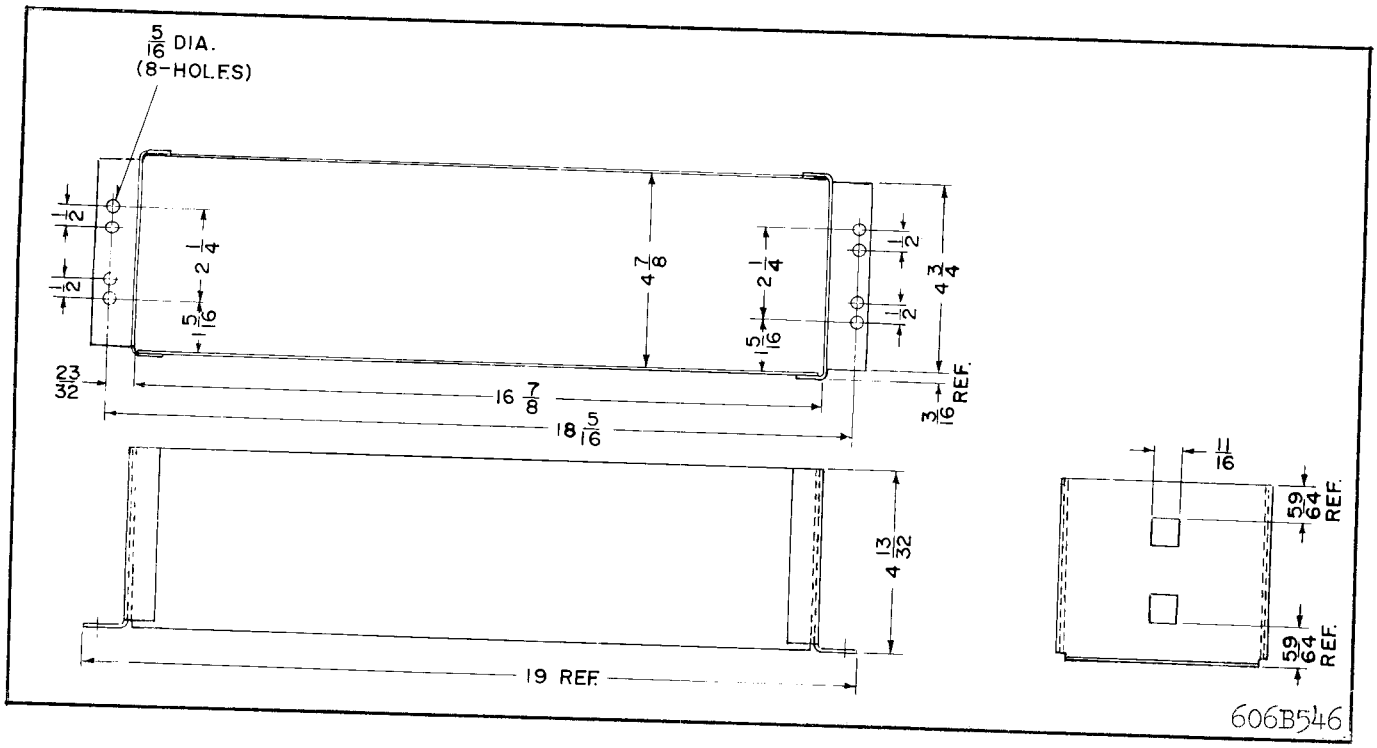

Figure 3 Outline of Mounting Frame Only.

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INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE TCT TEST METER UNIT

APPLICATION

The type TCT carrier test meter unit is an instrument for measuring current, voltage, and resistance values associated with power-line carrier or audio tone equipment.

CONSTRUCTION

Mechanical

The test set is built to plug into a mounting frame requiring three rack units (5-¼'') space which mounts in a standard 19'' rack. The test set is equipped with latch-type handles. It can be removed from the frame and used as a portable unit.

Three sets of different leads are supplied and the two batteries.

The panel contains selector switches to select the required function and range.

Molded binding posts which accept phone tips, spade lug, banana plug, alligator clip or wire leads are provided.

Electrical

The unit is self-contained; does not require any external power source. Two size ''D'' standard flashlight cells are used for resistance measurements. The indicating instruments are two taut-band panel instruments with 4'' scales.

Radio frequency currents are measured by means of a thermocouple bulb and a taut-band indicating instrument. This instrument employs a specially shaped magnet to produce an almost linear deflection from the square law thermocouple output. Radio frequency shunts provide multi-range operation. The thermocouple bulb is used at only 2/3 of its full rating, thus providing an overload safety factor.

D-C and A-C voltage, output level, dbm and resistance is measured by a second taut-band panel instrument. A-C voltage, output level, and dbm ranges utilize a full wave diode rectifier circuit.

SPECIFICATIONS

Mechanical:

	Frame Only
Height	5-1/4'' 3 Rack Units
Width	19'' Standard Rack Mounting
Depth	4-13/32''
	Test Set
Panel	5-1/8 x 17-1/8
Case	4-3/4 x 3 x 16-3/4

Electrical

Voltages Ranges:

Sensitivity D-C at 20,000 ohms per volt
A-C at 5000 ohms per volt

0 – 2.5 – 10 – 50 – 250 – 500 volts full scale

Output Level Ranges:

–10 to +10, +2 to +22, +16 to +36, +30 to +50

* +36 to +56 dbm

Zero level = 1 milliwatt in 600 ohms.

Resistance Ranges:

range, ohms: 0-1000-10,000-100,000-1 meg-10 meg

ohms at mid scale: 5, 50, 500 5K, 50K

D-C Current Ranges: (at 200 MV burden)

0-.25-2.5-25-250 ma

0-1-2.5 amps

R.F. Current Ranges: (at 200 MV burden)

0-100-250-500-1000 ma

Accuracy

d-c voltage & current ranges ± 3% of full scale

SUPERSEDES I.L. 41-944.7B
*Denotes change from superseded issue.

EFFECTIVE MARCH 1970

r.f. current ranges ± 3% of full scale
ohm ranges ± 1.5% of scale length, except for RX10 range = ± 3%
scale length = 4 inches
a-c volt ranges ± 5% of full scale
dbm ranges ± 5% of full scale

Frequency Range

* r-f current ranges — as stated above up to 300kHz.
a-c volts and dbm ranges as stated above from 35 to 3000 Hz. Frequency error less than 0.5 db at 10 kHz.

OPERATION

The terminals for the R.F. milliammeter are separate from the others and located below the indicating R.F. instrument.

Connections for measuring current on the 2.5 amp d-c range are made to the "COM" and "2.5 d-c amps" terminals.
Except for those two measurements, all other functions use the "COM" and "V-O-M" terminals in conjunction with proper switch settings.

Three switches provide for selection of the function required and the range desired.

D-C VOLTAGE MEASUREMENTS

1. Select "DCV" on switch marked "function."
2. Rotate "range" switch to desired range.
   If in doubt, start with highest range.
3. Plug red test lead into the red (+) terminal marked "V-O-M."
   Plug black test lead into the black (—) terminal marked "COM" and connect to circuit to be measured.
4. Read the D-C volt scale corresponding to range switch setting. Reverse reading indicate reverse polarity.

A-C VOLTAGE MEASUREMENTS

1. Select "ACV" on switch marked "FUNCTION".
2. Rotate "RANGE" switch to desired range.
   If in doubt, start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.
   No polarity requirement is entailed.
4. Read the A-C volt scale corresponding to range switch setting.

Note: Both sides of the A-C circuit are ungrounded. For accurate measurements at high frequencies one side of the signal source should be grounded and connected to the black terminal marked "COM". The metal case of the TCT set should also be connected to this terminal.

RIPPLE VOLTAGE MEASUREMENT

1. Select "DB" on switch marked "FUNCTION."
2. Rotate "RANGE" switch to desired range.
   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.
4. Read the A-C volt scale corresponding to range switch setting.

CAUTION:

The blocking capacitor used in the "DB" function is rated at 200 VDC working voltage. To measure ripple in circuits with a D-C voltage appreciably greater than this an external capacitor should be connected in series with one of the test leads

DB LEVEL

1. Select "DB" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.
   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.

IMPORTANT:

For accurate measurements at high frequencies observe grounding practice per note under A-C Voltage of these instructions.

4. Read all DB on the −10 to +10 DB scale. When the range switch is on the +0 DB position, this is the DB value. For all other positions of the range switch add the range switch setting to the scale indication algebraically.

CAUTION:

Observe blocking capacitor safe D-C voltage

limitation per note under "Ripple Voltage" of these instructions.

Note: Zero reference level is taken as one milliwatt in a 600 ohm line, which is equivalent to 0.775 volts.

RESISTANCE MEASUREMENT

1. Select "OHMS" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired multiplier.
3. Plug test leads into the "COM" and "V-O-M" terminals.
4. Short test leads together and adjust the small knob marked "OHMS ADJ" to set ohmmeter on zero (right side full scale).

Note: Zero must be set for each range.

5. Connect test leads to unknown resistance.
6. Read indication on the OHMS scale.

   When range switch is in the RX1 position, this is the resistance value. For all other positions of the range switch multiply scale indication by switch multiplier.

CAUTION:

* When measuring resistance, a current is passed through the component under test. With the range switch set on RX1 this current can be as large as 0.3 amperes. When using this range setting, it is recommended readings, including zero setting, be made as quickly as possible to avoid excessive battery drain.

* For general continuity testing, use RX10 or higher settings. When finished measuring ohms, it is recommended FUNCTION switch be turned to OFF.

Note: If ohmmeter does not indicate on any range, check the fuse or the batteries.

DC CURRENT – 1 AMP OR LESS

1. Select "DC MA" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.

   If in doubt, start with highest range.

3. Plug red test lead into the red (+) terminal marked "VOM". Plug the black lead into the black terminal marked "COM".

   Connect test leads in series with circuit to be measured.

4. Read the "DC and AC" volt scale corresponding to range switch setting. For the 2.5 VDC scale use the 0-250 scale figures and point off two decimal places to the left. For 0-500 VDC use the 0-50 scale figures and multiply by 10.

DC CURRENTS ABOVE 1 AMPERES (2.5 AMP MAX)

1. Select "2.5 DC AMPS" on switch marked "FUNCTION".
2. The 2.5 ampere range is not selected by the "RANGE" switch but is obtained by plugging the red test lead into the red (+) terminal marked "2.5 DC AMPS" and the black test lead into the black terminal (–) marked "COM".
3. The "RANGE" switch is not connected when using these terminals and can be in any position.
3. Read indication on the 0-250 scale by pointing off two decimal places to the left.

RF CURRENT

Note: RF current measurements involve only the "RF MA" switch and "RF MA" terminals. The other RANGE and FUNCTION switches may be in any position.

1. Set RF MA switch to OFF position.
2. Plug test leads into terminals marked RF MA. Connect to circuit.
3. Turn range switch from OFF position to the highest range which will give a satisfactory indication. This switch is a shorting type switch and will not open the circuit when going from one range to another.
4. Read indication on scale corresponding to desired range.

Note: Set RF MA switch to OFF position when finished taking readings. This avoids energizing instrument with switch set on wrong range if step 1 is not observed next time instrument is used, and also eliminates losses which the thermocouple heater presents to the line.

MAINTENANCE

Instruments

Both instruments are taut-band instruments, providing frictionless indication and freedom from damaging effects of vibration and shock.

A zero adjuster is provided on each instrument cover for setting pointer on zero if required.

Batteries

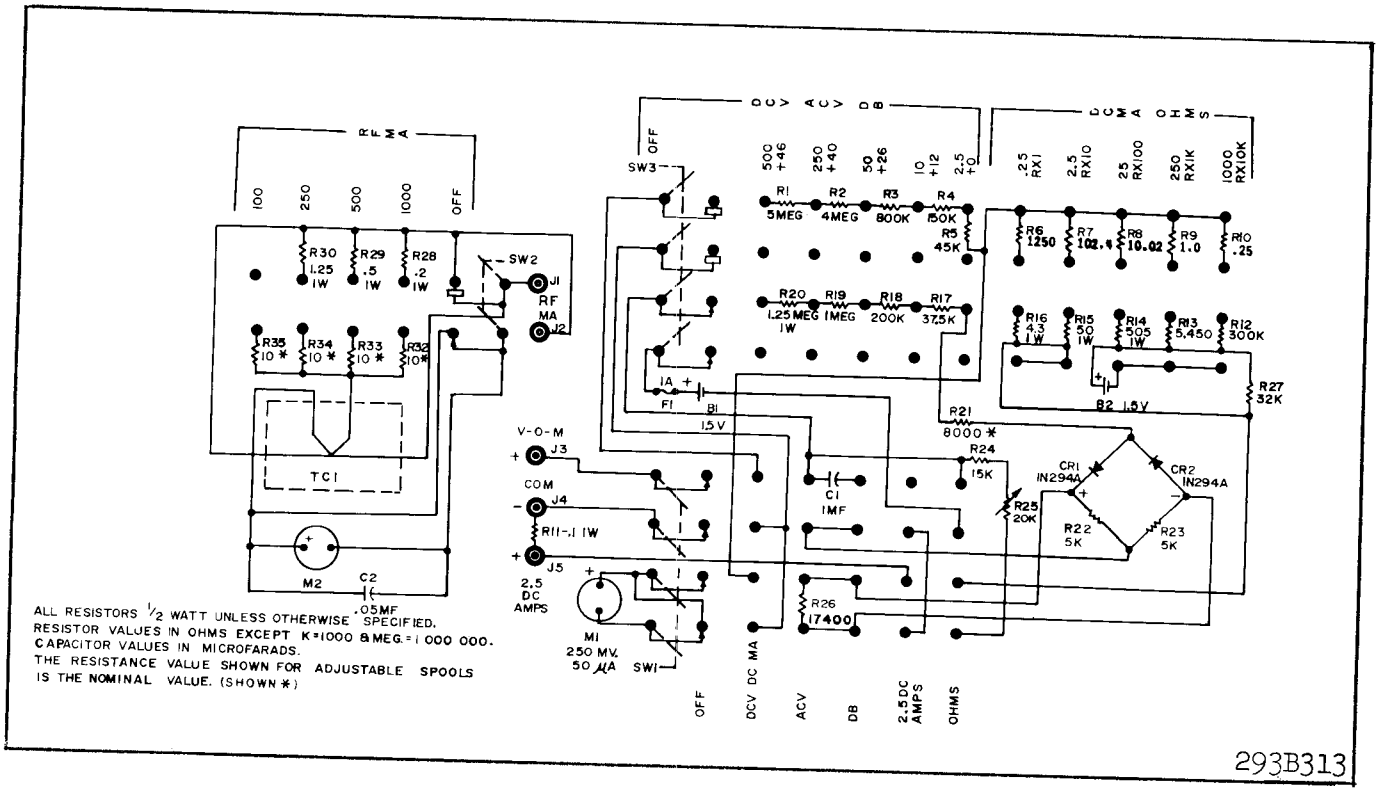
The batteries are used only in the ohmmeter circuit. They are satisfactory as long as zero can be set with the OHMS ADJ and are not corroded or leaking. The center post of the battery is inserted in the red cap of the battery holder when replacing.

Fuse

The ohmmeter circuit includes a fuse to protect the circuitry from an accidental internal short. If replaced, be sure fuse is inserted to seat properly in contoured clips.

Thermocouple

A burned out thermocouple bulb is best replaced by returning the complete test unit. If this is not practical, a new bulb and the four adjustable spools shown in series with the millivolt output of the bulb can be supplied. This unit will then require calibration by adjusting these spools. Calibration may be done on 60 cycles.



ALL RESISTORS 1/2 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN OHMS EXCEPT K=1000 & MEG.=1 000 000.
CAPACITOR VALUES IN MICROFARADS.
THE RESISTANCE VALUE SHOWN FOR ADJUSTABLE SPOOLS IS THE NOMINAL VALUE. (SHOWN *)

Figure 1 Internal Schematic

TYPE TCT TEST METER UNIT

TABLE I

List of Component Parts

DIAGRAM SYMBOL	FUNCTION	DESCRIPTION
B1 & B2	Battery	1.5V size D
C1	Blocking Capacitor	1.0 mfd., 200 WVDC
C2	By-pass Capacitor	.05 mfd., 50 WVDC
CR1 & CR2	Rectifier Diode	Type 1N294A
F1	Ohmmeter Fuse	3AG Littlefuse 1A-250V
M1	V-O-M Instrument	Westinghouse FX-372 50uA, 250MV
M2	R.F. MA Instrument	Westinghouse FX-373 667uA
J1 J2 J4	Terminal Post	Grayhill 29-1 Black
J3 J5	Terminal Post	Grayhill 29-1 Red
TC-1	Thermocouple Bulb	150MA 25MV O.C. 1.8 ohms Heater Res. Westinghouse 291B001H11
R1	Multiplier Resistance	5 meg., 500V, 1% ins. ½W
R2	Multiplier Resistance	4 meg., 350V, 1% ins. ½W
R3	Multiplier Resistance	800K ohm 350V, 1% T-1 Ins., ½W
R4	Multiplier Resistance	150K ohm 350V, 1% T-1 Ins., ½W
R5	Multiplier Resistance	45K ohm 350V, 1% T-1 Ins., ½W
R6	Milliammeter Shunt Resistor	1250 ohm ½ W, 1% W.W.
R7	Milliammeter Shunt Resistor	102.4 ohm ½ W, 1% W.W.
R8	Milliammeter Shunt Resistor	10.02 ohm ½ W, 1% W.W.
R9	Milliammeter Shunt Resistor	1.0 ohm ½ W, 1% W.W.
R10	Milliammeter Shunt Resistor	.25 ohm ½ W, 1% W.W.
R11	Ammeter Shunt Resistor	0.10 ohm 1W ½% W.W.
R12	Ohmmeter Shunt Resistor	300K ohm ½W 1% T-1 Metal Film
R13	Ohmmeter Shunt Resistor	5450 ohms ½W ½% W.W.
R14	Ohmmeter Shunt Resistor	505 ohms ½ W ½% W.W.
R15	Ohmmeter Shunt Resistor	50 ohm ½ W ½% W.W.
R16	Ohmmeter Shunt Resistor	4.3 ohm ½ W ½% W.W.
R17	Volt Multiplier Resistor	37.5K ohm ½ W 1% T-1 Metal Film
R18	Volt Multiplier Resistor	200K ohm ½W 1% T-1 Metal Film
R19	Volt Multiplier Resistor	1 megohm ½ W 1% T-1 Metal Film
R20	Volt Multiplier Resistor	1.25 megohm ½ W 1% T-1 Metal Film
R21	Volt Multiplier Resistor	10.1K ohm ½ W ½% W.W. Adjustable
R22-R23	Rect. Bridge Resistor	5K ohm ½ W 1% T-1 Metal Film
R24	Ohmmeter Series Resistor	15K ohm ½ W 1% T-1 Metal Film
R25	Ohmmeter Potentiometer	20K ohm Linear
R26	Voltmeter Shunt Resistor	20K ohm ½ W ½% W.W. Adjustable
R27	Ohmmeter Series Resistor	32K ohm ½ W 1% T-1 Metal Film
R28	R.F. Shunt	* 0.2 ohm 1W ½% W.W., non-inductive
R29	R.F. Shunt	0.5 ohm 1W ½% W.W.
R30	R.F. Shunt	1.25 ohm 1W ½% W.W.
R32-R33-R34-R35	R.F. M.V. Swamp Resistor	12 ohm ½ W.W.W. Adjustable
SW-1	Function Switch	6 pos., 4 section Rotary Non-Shorting
SW-2	R.F. MA Switch	5 pos., 2 section Rotary (1 Shorting, 1 Non-Shorting)
SW-3	Range Switch	11 pos., 4 section Rotary (2 Shorting, 2 Non-Shorting)

TEST LEADS	WESTINGHOUSE STYLE
60" long, Insulated Test Prod and Plug	Red 293B287G01
60" long, Insulated Test Prod and Plug	Black 293B287G02
40" long, Insulated Double Banana Plug & Phone Jack	293B287G03
40" long, Insulated Double Banana Plug Both Ends	293B287G04

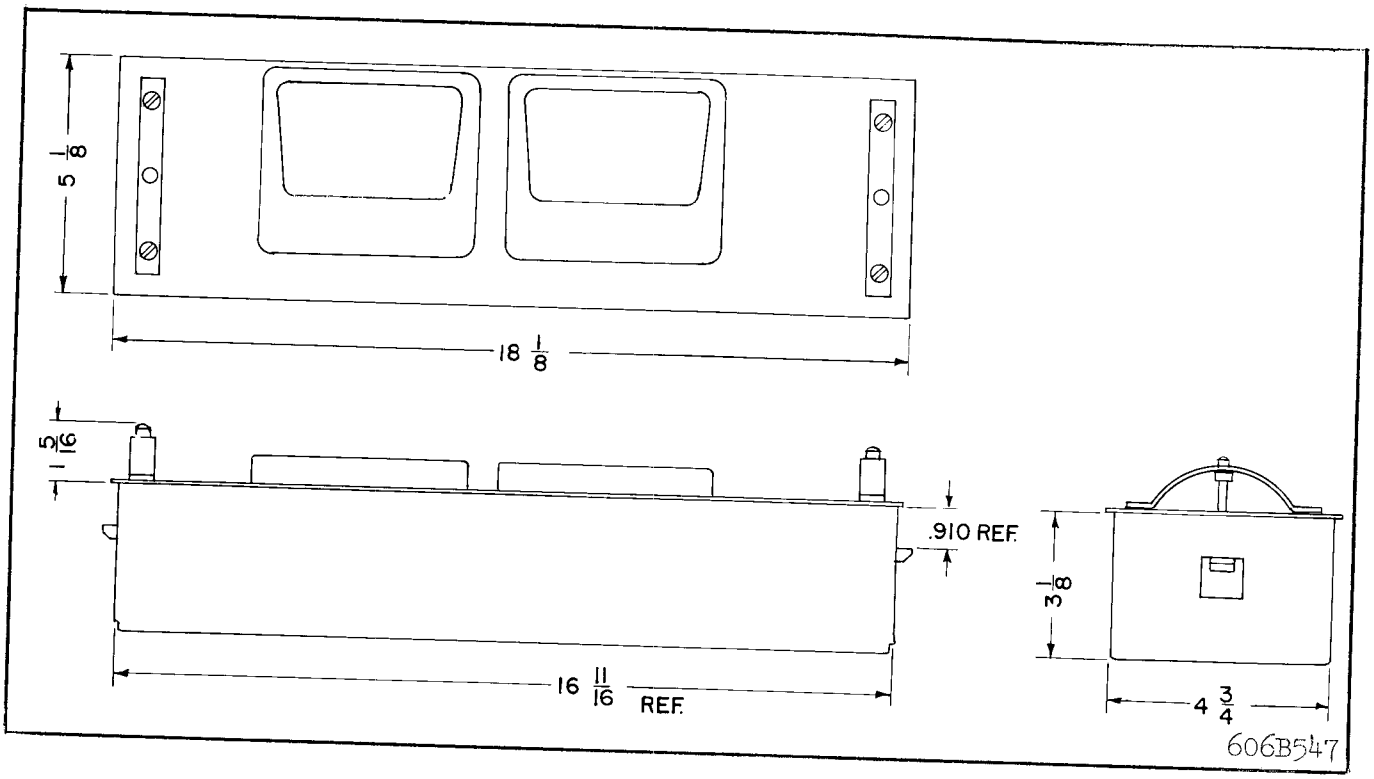


Figure 2 Outline of Test Unit Only.

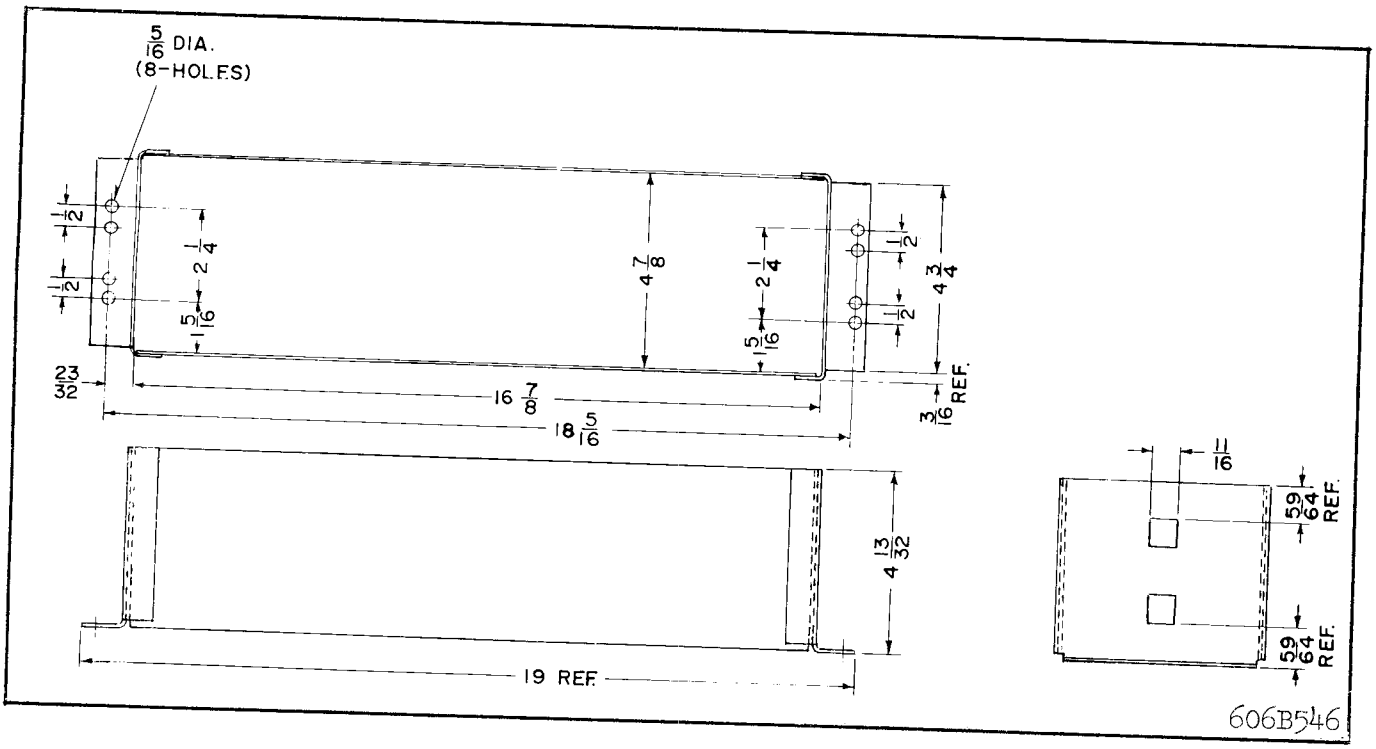


Figure 3 Outline of Mounting Frame Only.

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NEWARK, N. J.
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INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE TCT TEST METER UNIT

APPLICATION

The type TCT carrier test meter unit is an instrument for measuring current, voltage, and resistance values associated with power-line carrier or audio tone equipment.

CONSTRUCTION

Mechanical

The test set is built to plug into a mounting frame requiring three rack units (5-¼'') space which mounts in a standard 19'' rack. The test set is equipped with latch-type handles. It can be removed from the frame and used as a portable unit.

Three sets of different leads are supplied and the two batteries.

The panel contains selector switches to select the required function and range.

Molded binding posts which accept phone tips, spade lug, banana plug, alligator clip or wire leads are provided.

Electrical

The unit is self-contained; does not require any external power source. Two size ''D'' standard flashlight cells are used for resistance measurements. The indicating instruments are two taut-band panel instruments with 4'' scales.

Radio frequency currents are measured by means of a thermocouple bulb and a taut-band indicating instrument. This instrument employs a specially shaped magnet to produce an almost linear deflection from the square law thermocouple output. Radio frequency shunts provide multi-range operation. The thermocouple bulb is used at only 2/3 of its full rating, thus providing an overload safety factor.

D-C and A-C voltage, output level, dbm and resistance is measured by a second taut-band panel instrument. A-C voltage, output level, and dbm ranges utilize a full wave diode rectifier circuit.

SPECIFICATIONS

Mechanical:

	Frame Only
Height	5-1/4'' 3 Rack Units
* Width	19'' Standard Rack Mounting
Depth	4-13/32''
	Test Set
Panel	5-1/8 x 17-1/8
Case	4-3/4 x 3 x 16-3/4

Electrical

Voltages Ranges:

Sensitivity D-C at 20,000 ohms per volt
A-C at 5000 ohms per volt

0 – 2.5 – 10 – 50 – 250 – 500 volts full scale

Output Level Ranges:

–10 to +10, +2 to +22, +16 to +36, +30 to +50

+36 to +56 db

Zero level = 1 milliwatt in 600 ohms.

Resistance Ranges:

range, ohms: 0-1000 - 10,000 - 100,000 - 1 meg - 10 meg

ohms at mid scale: 5, 50, 500 5K, 50K

D-C Current Ranges: (at 200 MV burden)

0 - .25 - 2.5 - 25 - 250 ma

0 - 1 - 2.5 amps

R.F. Current Ranges: (at 200 MV burden)

0 - 100 - 250 - 500 - 1000 ma

Accuracy

d-c voltage & current ranges ± 3% of full scale

SUPERSEDES I.L. 41-944.7A
*Denotes change from superseded issue.

EFFECTIVE MAY 1967

r.f. current ranges ± 3% of full scale
ohm ranges ± 1.5% of scale length, except for
* RX10 range = ± 3%
scale length = 4 inches
a-c volt ranges ± 5% of full scale
dbm ranges ± 5% of full scale

Frequency Range

r-f current ranges — as stated above up to 250KC

a-c volts and dbm ranges as stated above from 35 to 3000 cps. Frequency error less than 0.5 db at 10 kc.

OPERATION

The terminals for the R.F. milliammeter are separate from the others and located below the indicating R.F. instrument.

Connections for measuring current on the 2.5 amp d-c range are made to the "COM" and "2.5 d-c amps" terminals.
Except for those two measurements, all other functions use the "COM" and "V-O-M" terminals in conjunction with proper switch settings.

Three switches provide for selection of the function required and the range desired.

D-C VOLTAGE MEASUREMENTS

1. Select "DCV" on switch marked "function."
2. Rotate "range" switch to desired range.

   If in doubt, start with highest range.
3. Plug red test lead into the red (+) terminal marked "V-O-M."

   Plug black test lead into the black (—) terminal marked "COM" and connect to circuit to be measured.
4. Read the D-C volt scale corresponding to range switch setting. Reverse reading indicate reverse polarity.

A-C VOLTAGE MEASUREMENTS

1. Select "ACV" on switch marked "FUNCTION".
2. Rotate "RANGE" switch to desired range.

   If in doubt, start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.

   No polarity requirement is entailed.
4. Read the A-C volt scale corresponding to range switch setting.

Note: Both sides of the A-C circuit are ungrounded. For accurate measurements at high frequencies one side of the signal source should be grounded and connected to the black terminal marked "COM". The metal case of the TCT set should also be connected to this terminal.

RIPPLE VOLTAGE MEASUREMENT

1. Select "DB" on switch marked "FUNCTION."
2. Rotate "RANGE" switch to desired range.

   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.
4. Read the A-C volt scale corresponding to range switch setting.

CAUTION:

The blocking capacitor used in the "DB" function is rated at 200 VDC working voltage. To measure ripple in circuits with a D-C voltage appreciably greater than this an external capacitor should be connected in series with one of the test leads

DB LEVEL

1. Select "DB" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.

   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.

IMPORTANT:

For accurate measurements at high frequencies observe grounding practice per note under A-C Voltage of these instructions.

4. Read all DB on the —10 to +10 DB scale. When the range switch is on the +0 DB position, this is the DB value. For all other positions of the range switch add the range switch setting to the scale indication algebraically.

CAUTION:

Observe blocking capacitor safe D-C voltage

limitation per note under "Ripple Voltage" of these instructions.

Note: Zero reference level is taken as one milliwatt in a 600 ohm line, which is equivalent to 0.775 volts.

RESISTANCE MEASUREMENT

1. Select "OHMS" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired multiplier.
3. Plug test leads into the "COM" and "V-O-M" terminals.
4. Short test leads together and adjust the small knob marked "OHMS ADJ" to set ohmmeter on zero (right side full scale).

Note: Zero must be set for each range.

5. Connect test leads to unknown resistance.
6. Read indication on the OHMS scale.

   When range switch is in the RX1 position, this is the resistance value. For all other positions of the range switch multiply scale indication by switch multiplier.

CAUTION:

When measuring resistance a current is passed through the component under test. With the range switch set on RX1 this current can be as large as 0.3 amperes. When using this range setting, it is recommended readings, including zero setting, be made as quickly as possible to avoid excessive battery drain.

For general continuity testing use RX10 or higher settings. When finished measuring ohms, it is recommended FUNCTION switch be turned to ⊙FF.

Note: If ohmmeter does not indicate on any range, check the fuse or the batteries.

DC CURRENT – 1 AMP OR LESS

1. Select "DC MA" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.

   If in doubt, start with highest range.

3. Plug red test lead into the red (+) terminal marked "VOM". Plug the black lead into the black terminal marked "COM".

   Connect test leads in series with circuit to be measured.

4. Read the "DC and AC" volt scale corresponding to range switch setting. For the 2.5 VDC scale use the 0-250 scale figures and point off two decimal places to the left. For 0-500 VDC use the 0-50 scale figures and multiply by 10.

DC CURRENTS – ABOVE 1 AMPERES (2.5 AMP MAX)

DC CURRENTS
ABOVE 1 AMPERES (2.5 AMP MAX)

1. Select "2.5 DC AMPS" on switch marked "FUNCTION".
2. The 2.5 ampere range is not selected by the "RANGE" switch but is obtained by plugging the red test lead into the red (+) terminal marked "2.5 DC AMPS" and the black test lead into the black terminal (–) marked "COM".
3. The "RANGE" switch is not connected when using these terminals and can be in any position.
3. Read indication on the 0-250 scale by pointing off two decimal places to the left.

RF CURRENT

Note: RF current measurements involve only the "RF MA" switch and "RF MA" terminals. The other RANGE and FUNCTION switches may be in any position.

1. Set RF MA switch to OFF position.
2. Plug test leads into terminals marked RF MA. Connect to circuit.
3. Turn range switch from OFF position to the highest range which will give a satisfactory indication. This switch is a shorting type switch and will not open the circuit when going from one range to another.
4. Read indication on scale corresponding to desired range.

Note: Set RF MA switch to OFF position when finished taking readings. This avoids energizing instrument with switch set on wrong range if step 1 is not observed next time instrument is used, and also eliminates losses which the thermocouple heater presents to the line.

MAINTENANCE

Instruments

Both instruments are taut-band instruments, providing frictionless indication and freedom from damaging effects of vibration and shock.

A zero adjuster is provided on each instrument cover for setting pointer on zero if required.

Batteries

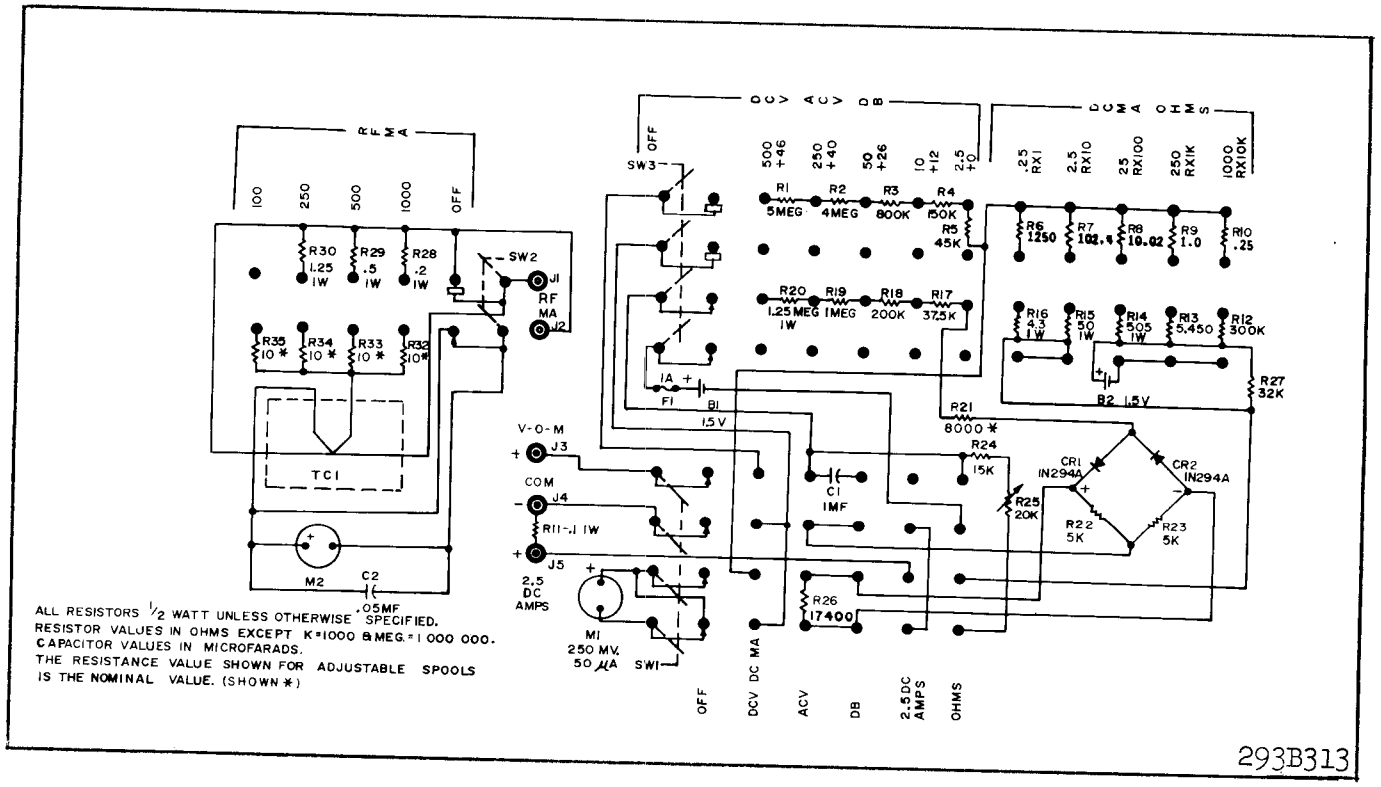
The batteries are used only in the ohmmeter circuit. They are satisfactory as long as zero can be set with the OHMS ADJ and are not corroded or leaking. The center post of the battery is inserted in the red cap of the battery holder when replacing.

Fuse

The ohmmeter circuit includes a fuse to protect the circuitry from an accidental internal short. If replaced, be sure fuse is inserted to seat properly in contoured clips.

Thermocouple

A burned out thermocouple bulb is best replaced by returning the complete test unit. If this is not practical, a new bulb and the four adjustable spools shown in series with the millivolt output of the bulb can be supplied. This unit will then require calibration by adjusting these spools. Calibration may be done on 60 cycles.



* *Figure 1 Internal Schematic*

TYPE TCT TEST METER UNIT

TABLE I

List of Component Parts

DIAGRAM SYMBOL	FUNCTION	DESCRIPTION
B1 & B2	Battery	1.5V size D
C1	Blocking Capacitor	1.0 mfd., 200 WVDC
C2	By-pass Capacitor	.05 mfd., 50 WVDC
CR1 & CR2	Rectifier Diode	Type 1N294A
F1	Ohmmeter Fuse	3AG Littlefuse 1A-250V
M1	V-O-M Instrument	Westinghouse FX-372 50uA, 250MV
M2	R.F. MA Instrument	Westinghouse FX-373 667uA
J1 J2 J4	Terminal Post	Grayhill 29-1 Black
J3 J5	Terminal Post	Grayhill 29-1 Red
TC-1	Thermocouple Bulb	150MA 25MV O.C. 1.8 ohms Heater Res. Westinghouse 291B001H11
R1	Multiplier Resistance	5 meg., 500V, 1% ins. ½W
R2	Multiplier Resistance	4 meg., 350V, 1% ins. ½W
R3	Multiplier Resistance	800K ohm 350V, 1% T-1 Ins., ½W
R4	Multiplier Resistance	150K ohm 350V, 1% T-1 Ins., ½W
R5	Multiplier Resistance	45K ohm 350V, 1% T-1 Ins., ½W
R6	Milliammeter Shunt Resistor	1250 ohm ½ W, 1% W.W.
R7	Milliammeter Shunt Resistor	102.4 ohm ½ W, 1% W.W.
R8	Milliammeter Shunt Resistor	10.02 ohm ½ W, 1% W.W.
R9	Milliammeter Shunt Resistor	1.0 ohm ½ W, 1% W.W.
R10	Milliammeter Shunt Resistor	.25 ohm ½ W, 1% W.W.
R11	Ammeter Shunt Resistor	0.10 ohm 1W ½% W.W.
R12	Ohmmeter Shunt Resistor	300K ohm ½W 1% T-1 Metal Film
R13	Ohmmeter Shunt Resistor	5450 ohms ½W ½% W.W.
R14	Ohmmeter Shunt Resistor	505 ohms ½ W ½% W.W.
R15	Ohmmeter Shunt Resistor	50 ohm ½ W ½% W.W.
R16	Ohmmeter Shunt Resistor	4.3 ohm ½ W ½% W.W.
R17	Volt Multiplier Resistor	37.5K ohm ½ W 1% T-1 Metal Film
R18	Volt Multiplier Resistor	200K ohm ½W 1% T-1 Metal Film
R19	Volt Multiplier Resistor	1 megohm ½ W 1% T-1 Metal Film
R20	Volt Multiplier Resistor	1.25 megohm ½ W 1% T-1 Metal Film
R21	Volt Multiplier Resistor	10.1K ohm ½ W ½% W.W. Adjustable
R22-R23	Rect. Bridge Resistor	5K ohm ½ W 1% T-1 Metal Film
R24	Ohmmeter Series Resistor	15K ohm ½ W 1% T-1 Metal Film
R25	Ohmmeter Potentiometer	20K ohm Linear
R26	Voltmeter Shunt Resistor	20K ohm ½ W ½% W.W. Adjustable
R27	Ohmmeter Series Resistor	32K ohm ½ W 1% T-1 Metal Film
R28	R.F. Shunt	0.2 ohm 1W ½% W.W.
R29	R.F. Shunt	0.5 ohm 1W ½% W.W.
R30	R.F. Shunt	1.25 ohm 1W ½% W.W.
R32-R33-R34-R35	R.F. M.V. Swamp Resistor	12 ohm ½ W.W.W. Adjustable
SW-1	Function Switch	6 pos., 4 section Rotary Non-Shorting
SW-2	R.F. MA Switch	5 pos., 2 section Rotary (1 Shorting, 1 Non-Shorting)
SW-3	Range Switch	* 11 pos., 4 section Rotary (2 Shorting, 2 Non-Shorting)

TEST LEADS	WESTINGHOUSE STYLE
60" long, Insulated Test Prod and Plug	Red 293B287G01
60" long, Insulated Test Prod and Plug	Black 293B287G02
40" long, Insulated Double Banana Plug & Phone Jack	293B287G03
40" long, Insulated Double Banana Plug Both Ends	293B287G04

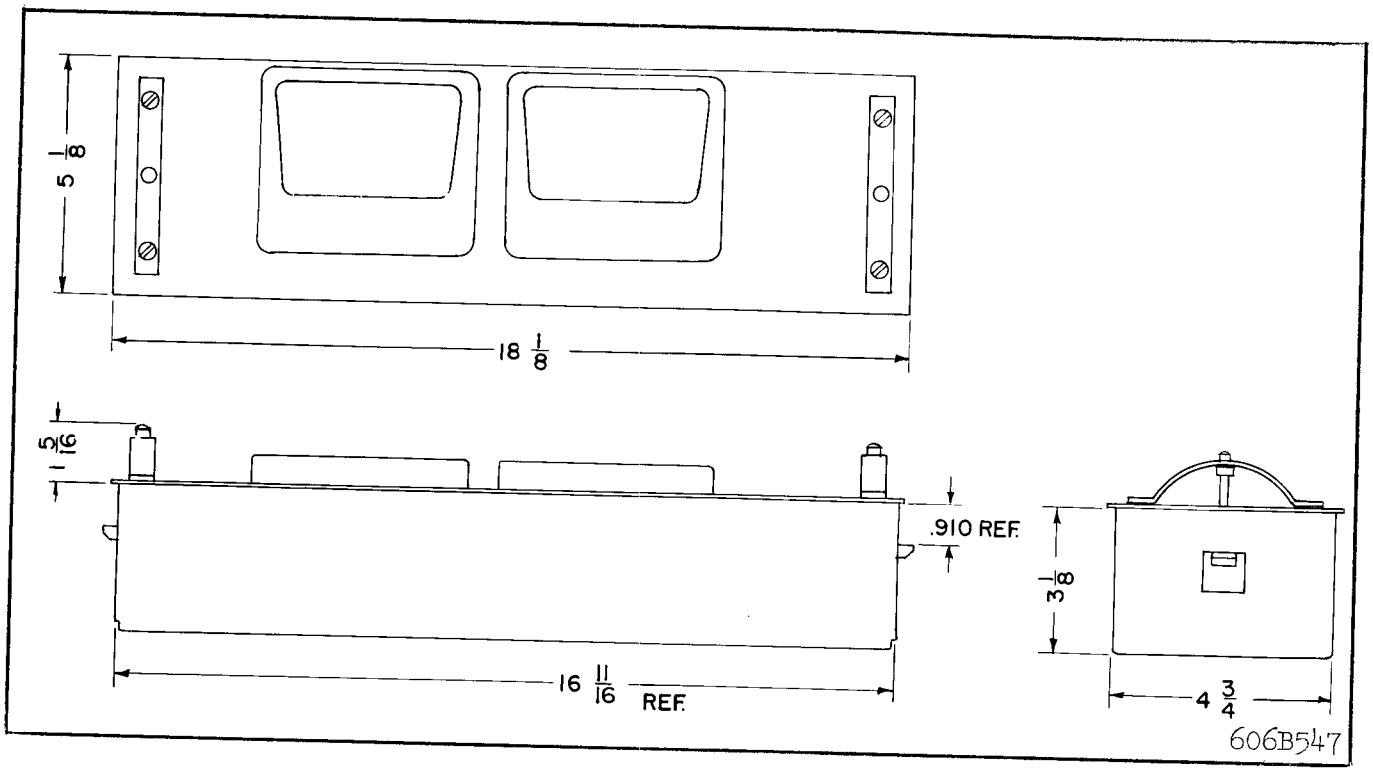


Figure 2 Outline of Test Unit Only.

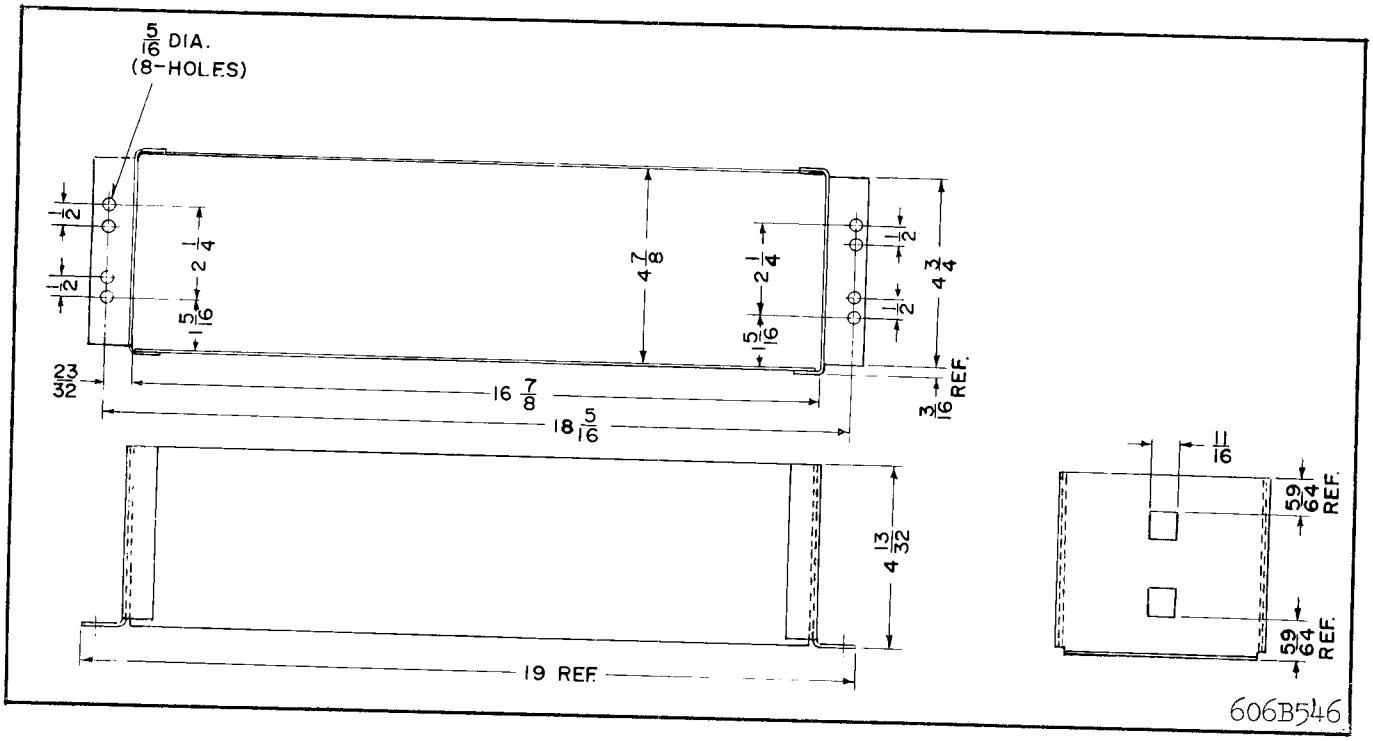
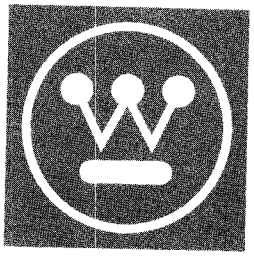


Figure 3 Outline of Mounting Frame Only.



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INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE TCT TEST METER UNIT

APPLICATION

The type TCT carrier test meter unit is an instrument for measuring current, voltage, and resistance values associated with power-line carrier or audio tone equipment.

CONSTRUCTION

Mechanical

The test set is built to plug into a mounting frame requiring three rack units (5-¼'') space which mounts in a standard 19'' rack. The test set is equipped with latch-type handles. It can be removed from the frame and used as a portable unit.

Three sets of different leads are supplied and the two batteries.

The panel contains selector switches to select the required function and range.

Molded binding posts which accept phone tips, spade lug, banana plug, alligator clip or wire leads are provided.

Electrical

The unit is self-contained; does not require any external power source. Two size ''D'' standard flashlight cells are used for resistance measurements. The indicating instruments are two taut-band panel instruments with 4'' scales.

Radio frequency currents are measured by means of a thermocouple bulb and a taut-band indicating instrument. This instrument employs a specially shaped magnet to produce an almost linear deflection from the square law thermocouple output. Radio frequency shunts provide multi-range operation. The thermocouple bulb is used at only 2/3 of its full rating, thus providing an overload safety factor.

D-C and A-C voltage, output level, dbm and resistance is measured by a second taut-band panel instrument. A-C voltage, output level, and dbm ranges utilize a full wave diode rectifier circuit.

SPECIFICATIONS

Mechanical:

	Frame Only
Height	5-1/4'' 3 Rack Units
Weight	19'' Standard Rack Mounting
Depth	4-13/32''
	Test Set
Panel	5-1/8 x 17-1/8
Case	4-3/4 x 3 x 16-3/4

Electrical

Voltages Ranges:

Sensitivity D-C at 20,000 ohms per volt
A-C at 5000 ohms per volt

0 – 2.5 – 10 – 50 – 250 – 500 volts full scale

Output Level Ranges:

–10 to +10, +2 to +22, +16 to +36, +30 to +50

+36 to +56 db

Zero level = 1 milliwatt in 600 ohms.

Resistance Ranges:

range, ohms: 0-1000 - 10,000 - 100,000 - 1 meg - 10 meg

ohms at mid scale: 5, 50, 500 5K, 50K

D-C Current Ranges: (at 200 MV burden)

0 - .25 - 2.5 - 25 - 250 ma

0 - 1 - 2.5 amps

R.F. Current Ranges: (at 200 MV burden)

0 - 100 - 250 - 500 - 1000 ma

Accuracy

d-c voltage & current ranges ± 3% of full scale

SUPERSEDES I.L. 41-944.7
* Denotes change from superseded issue

EFFECTIVE NOVEMBER 1965

* r.f. current ranges ± 3% of full scale
ohm ranges ± 1.5% of scale length, except for TX10 range = ± 3%
scale length = 4 inches
a-c volt ranges ± 5% of full scale
dbm ranges ± 5% of full scale

Frequency Range

r-f current ranges — as stated above up to 250KC
a-c volts and dbm ranges as stated above from 35 to 3000 cps. Frequency error less than 0.5 db at 10 kc.

OPERATION

The terminals for the R.F. milliammeter are separate from the others and located below the indicating R.F. instrument.

Connections for measuring current on the 2.5 amp d-c range are made to the "COM" and "2.5 d-c amps" terminals.
Except for those two measurements, all other functions use the "COM" and "V-O-M" terminals in conjunction with proper switch settings.

Three switches provide for selection of the function required and the range desired.

D-C VOLTAGE MEASUREMENTS

1. Select "DCV" on switch marked "function."
2. Rotate "range" switch to desired range.
   If in doubt, start with highest range.
3. Plug red test lead into the red (+) terminal marked "V-O-M."
   Plug black test lead into the black (—) terminal marked "COM" and connect to circuit to be measured.
4. Read the D-C volt scale corresponding to range switch setting. Reverse reading indicate reverse polarity.

A-C VOLTAGE MEASUREMENTS

1. Select "ACV" on switch marked "FUNCTION".
2. Rotate "RANGE" switch to desired range.
   If in doubt, start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.
   No polarity requirement is entailed.
4. Read the A-C volt scale corresponding to range switch setting.

Note: Both sides of the A-C circuit are ungrounded. For accurate measurements at high frequencies one side of the signal source should be grounded and connected to the black terminal marked "COM". The metal case of the TCT set should also be connected to this terminal.

RIPPLE VOLTAGE MEASUREMENT

1. Select "DB" on switch marked "FUNCTION."
2. Rotate "RANGE" switch to desired range.
   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.
4. Read the A-C volt scale corresponding to range switch setting.

CAUTION:

The blocking capacitor used in the "DB" function is rated at 200 VDC working voltage. To measure ripple in circuits with a D-C voltage appreciably greater than this an external capacitor should be connected in series with one of the test leads

DB LEVEL

1. Select "DB" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.
   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.

IMPORTANT:

For accurate measurements at high frequencies observe grounding practice per note under A-C Voltage of these instructions.

4. Read all DB on the —10 to +10 DB scale. When the range switch is on the +0 DB position, this is the DB value. For all other positions of the range switch add the range switch setting to the scale indication algebraically.

CAUTION:

Observe blocking capacitor safe D-C voltage

limitation per note under "Ripple Voltage" of these instructions.

Note: Zero reference level is taken as one milliwatt in a 600 ohm line, which is equivalent to 0.775 volts.

RESISTANCE MEASUREMENT

1. Select "OHMS" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired multiplier.
3. Plug test leads into the "COM" and "V-O-M" terminals.
4. Short test leads together and adjust the small knob marked "OHMS ADJ" to set ohmmeter on zero (right side full scale).

Note: Zero must be set for each range.

5. Connect test leads to unknown resistance.
6. Read indication on the OHMS scale.

When range switch is in the RX1 position, this is the resistance value. For all other positions of the range switch multiply scale indication by switch multiplier.

CAUTION:

When measuring resistance a current is passed through the component under test. With the range switch set on RX1 this current can be as large as 0.3 amperes. When using this range setting, it is recommended readings, including zero setting, be made as quickly as possible to avoid excessive battery drain.

For general continuity testing use RX10 or higher settings. When finished measuring ohms, it is recommended FUNCTION switch be turned to ⊙FF.

Note: If ohmmeter does not indicate on any range, check the fuse or the batteries.

DC CURRENT – 1 AMP OR LESS

1. Select "DC MA" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.

If in doubt, start with highest range.

3. Plug red test lead into the red (+) terminal marked "VOM". Plug the black lead into the black terminal marked "COM".

Connect test leads in series with circuit to be measured.

4. Read the "DC and AC" volt scale corresponding to range switch setting. For the 2.5 VDC scale use the 0-250 scale figures and point off two decimal places to the left. For 0-500 VDC use the 0-50 scale figures and multiply by 10.

DC CURRENTS – ABOVE 1 AMPERES (2.5 AMP MAX)

DC CURRENTS
ABOVE 1 AMPERES (2.5 AMP MAX)

1. Select "2.5 DC AMPS" on switch marked "FUNCTION".
2. The 2.5 ampere range is not selected by the "RANGE" switch but is obtained by plugging the red test lead into the red (+) terminal marked "2.5 DC AMPS" and the black test lead into the black terminal (–) marked "COM".
3. The "RANGE" switch is not connected when using these terminals and can be in any position.
3. Read indication on the 0-250 scale by pointing off two decimal places to the left.

RF CURRENT

Note: RF current measurements involve only the "RF MA" switch and "RF MA" terminals. The other RANGE and FUNCTION switches may be in any position.

1. Set RF MA switch to OFF position.
2. Plug test leads into terminals marked RF MA. Connect to circuit.
3. Turn range switch from OFF position to the highest range which will give a satisfactory indication. This switch is a shorting type switch and will not open the circuit when going from one range to another.
4. Read indication on scale corresponding to desired range.

Note: Set RF MA switch to OFF position when finished taking readings. This avoids energizing instrument with switch set on wrong range if step 1 is not observed next time instrument is used, and also eliminates losses which the thermocouple heater presents to the line.

MAINTENANCE

Instruments

Both instruments are taut-band instruments, providing frictionless indication and freedom from damaging effects of vibration and shock.

A zero adjuster is provided on each instrument cover for setting pointer on zero if required.

Batteries

The batteries are used only in the ohmmeter circuit. They are satisfactory as long as zero can be set with the OHMS ADJ and are not corroded or leaking. The center post of the battery is inserted in the red cap of the battery holder when replacing.

Fuse

The ohmmeter circuit includes a fuse to protect the circuitry from an accidental internal short. If replaced, be sure fuse is inserted to seat properly in contoured clips.

Thermocouple

A burned out thermocouple bulb is best replaced by returning the complete test unit. If this is not practical, a new bulb and the four adjustable spools shown in series with the millivolt output of the bulb can be supplied. This unit will then require calibration by adjusting these spools. Calibration may be done on 60 cycles.

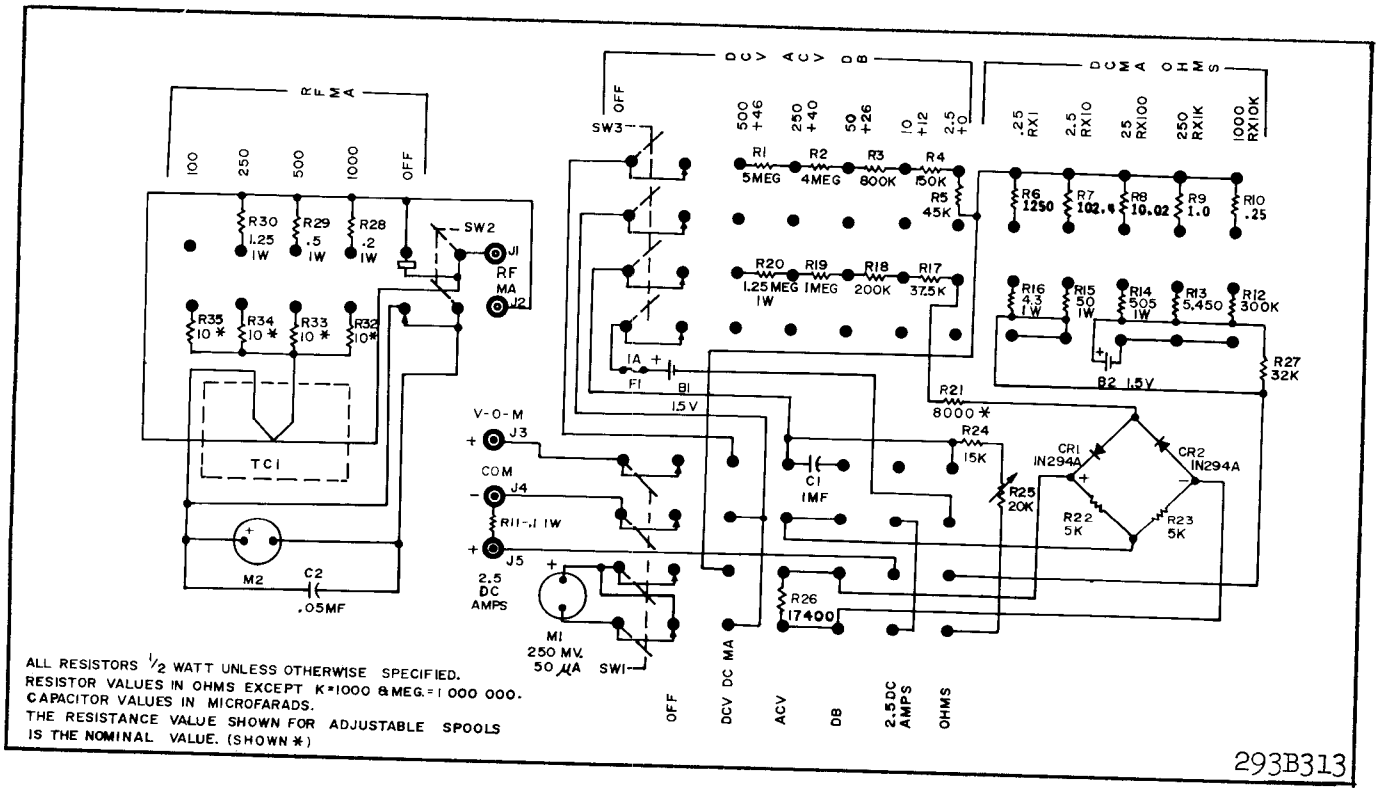


Figure 1 Internal Schematic

TYPE TCT TEST METER UNIT

TABLE I

List of Component Parts

DIAGRAM SYMBOL	FUNCTION	DESCRIPTION
B1 & B2	Battery	1.5V size D
C1	Blocking Capacitor	1.0 mfd., 200 WVDC
C2	By-pass Capacitor	.05 mfd., 50 WVDC
CR1 & CR2	Rectifier Diode	Type 1N294A
F1	Ohmmeter Fuse	3AG Littlefuse 1A-250V
M1	V-O-M Instrument	Westinghouse FX-372 50uA, 250MV
M2	R.F. MA Instrument	Westinghouse FX-373 667uA
J1 J2 J4	Terminal Post	Grayhill 29-1 Black
J3 J5	Terminal Post	Grayhill 29-1 Red
TC-1	Thermocouple Bulb	150MA 25MV O.C. 1.8 ohms Heater Res. Westinghouse 291B001H11
R1	Multiplier Resistance	5 meg., 500V, 1% ins. ½W
R2	Multiplier Resistance	4 meg., 350V, 1% ins. ½W
R3	Multiplier Resistance	800K ohm 350V, 1% T-1 Ins., ½W
R4	Multiplier Resistance	150K ohm 350V, 1% T-1 Ins., ½W
R5	Multiplier Resistance	45K ohm 350V, 1% T-1 Ins., ½W
R6	Milliammeter Shunt Resistor	1250 ohm ½ W, 1% W.W.
R7	Milliammeter Shunt Resistor	102.4 ohm ½ W, 1% W.W.
R8	Milliammeter Shunt Resistor	10.02 ohm ½ W, 1% W.W.
R9	Milliammeter Shunt Resistor	1.0 ohm ½ W, 1% W.W.
R10	Milliammeter Shunt Resistor	.25 ohm ½ W, 1% W.W.
R11	Ammeter Shunt Resistor	0.10 ohm 1W ½% W.W.
R12	Ohmmeter Shunt Resistor	300K ohm ½W 1% T-1 Metal Film
R13	Ohmmeter Shunt Resistor	5450 ohms ½W ½% W.W.
R14	Ohmmeter Shunt Resistor	505 ohms ½ W ½% W.W.
R15	Ohmmeter Shunt Resistor	50 ohm ½ W ½% W.W.
R16	Ohmmeter Shunt Resistor	4.3 ohm ½ W ½% W.W.
R17	Volt Multiplier Resistor	37.5K ohm ½ W 1% T-1 Metal Film
R18	Volt Multiplier Resistor	200K ohm ½W 1% T-1 Metal Film
R19	Volt Multiplier Resistor	1 megohm ½ W 1% T-1 Metal Film
R20	Volt Multiplier Resistor	1.25 megohm ½ W 1% T-1 Metal Film
R21	Volt Multiplier Resistor	10.1K ohm ½ W ½% W.W. Adjustable
R22-R23	Rect. Bridge Resistor	5K ohm ½ W 1% T-1 Metal Film
R24	Ohmmeter Series Resistor	15K ohm ½ W 1% T-1 Metal Film
R25	Ohmmeter Potentiometer	20K ohm Linear
R26	Voltmeter Shunt Resistor	20K ohm ½ W ½% W.W. Adjustable
R27	Ohmmeter Series Resistor	32K ohm ½ W 1% T-1 Metal Film
R28	R.F. Shunt	0.2 ohm 1W ½% W.W.
R29	R.F. Shunt	0.5 ohm 1W ½% W.W.
R30	R.F. Shunt	1.25 ohm 1W ½% W.W.
R32-R33-R34-R35	R.F. M.V. Swamp Resistor	12 ohm ½ W.W.W. Adjustable
SW-1	Function Switch	6 pos., 4 section Rotary Non-Shorting
SW-2	R.F. MA Switch	5 pos., 2 section Rotary (1 Shorting, 1 Non-Shorting)
SW-3	Range Switch	11 pos., 4 section Rotary Non-Shorting

TEST LEADS	WESTINGHOUSE STYLE
* 60" long, Insulated Test Prod and Plug	Red 293B287G01
60" long, Insulated Test Prod and Plug	Black 293B287G02
40" long, Insulated Double Banana Plug & Phone Jack	293B287G03
40" long, Insulated Double Banana Plug Both Ends	293B287G04

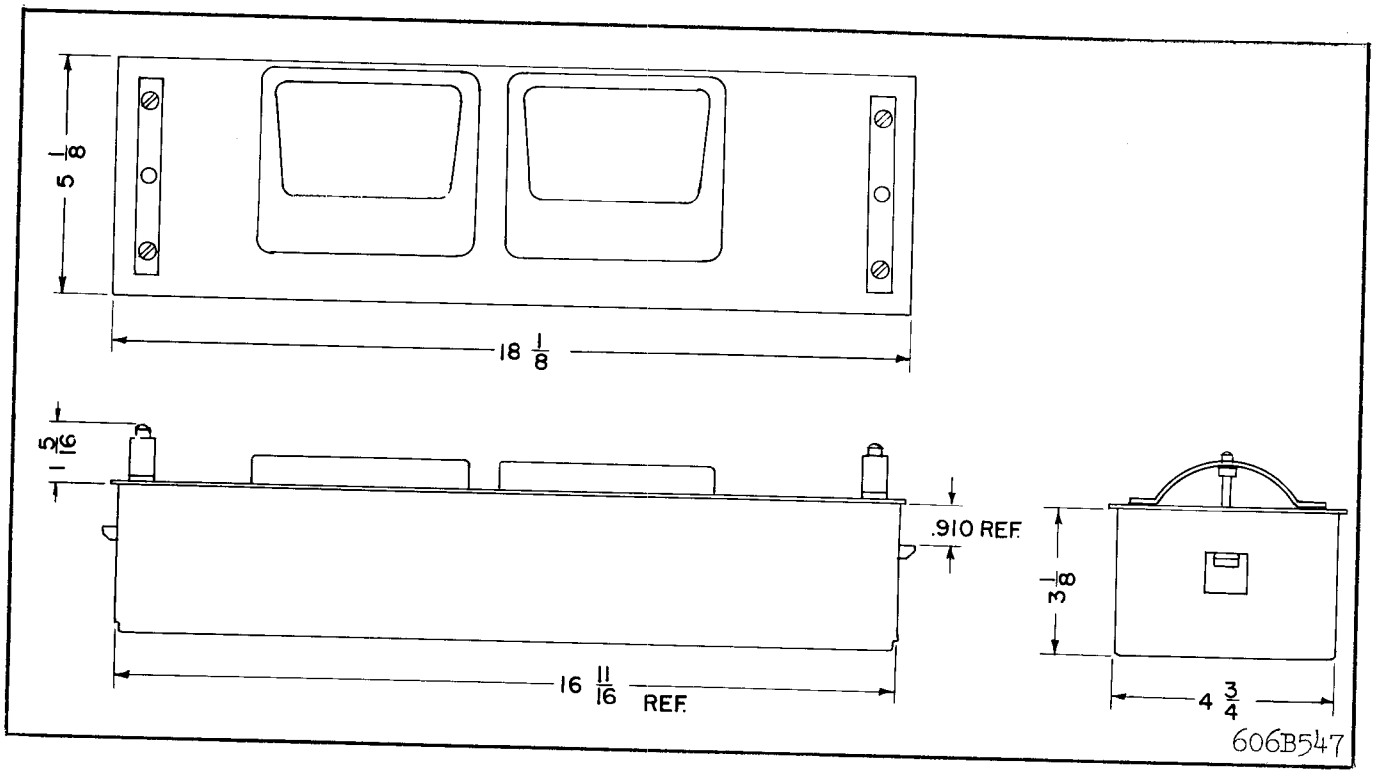


Figure 2 Outline of Test Unit Only.

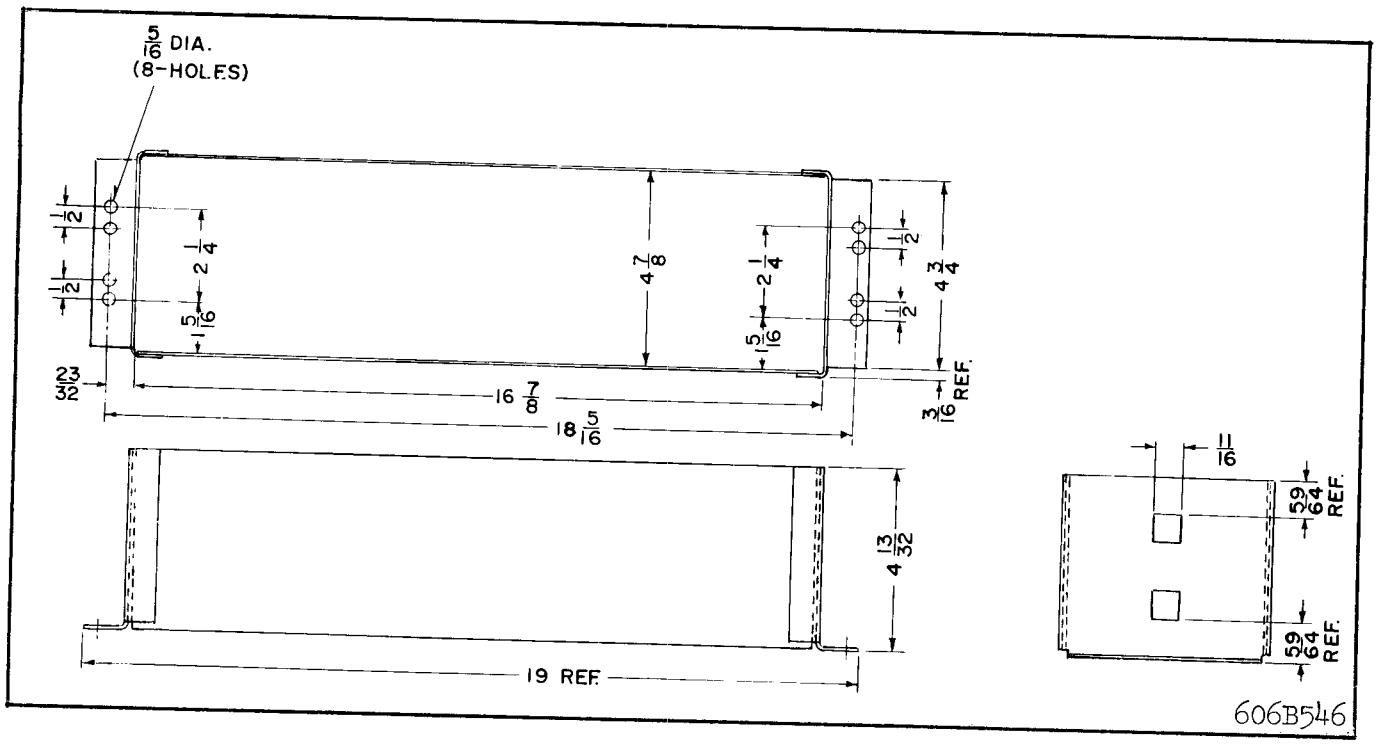
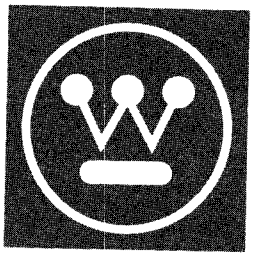


Figure 3 Outline of Mounting Frame Only.



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INSTRUCTIONS

TYPE TCT TEST METER UNIT

APPLICATION

The type TCT carrier test meter unit is an instrument for measuring current, voltage, and resistance values associated with power-line carrier or audio tone equipment.

CONSTRUCTION

Mechanical

The test set is built to plug into a mounting frame requiring three rack units (5-¼'') space which mounts in a standard 19'' rack. The test set is equipped with latch-type handles. It can be removed from the frame and used as a portable unit.

Three sets of different leads are supplied and the two batteries.

The panel contains selector switches to select the required function and range.

Molded binding posts which accept phone tips, spade lug, banana plug, alligator clip or wire leads are provided.

Electrical

The unit is self-contained; does not require any external power source. Two size ''D'' standard flashlight cells are used for resistance measurements. The indicating instruments are two taut-band panel instruments with 4'' scales.

Radio frequency currents are measured by means of a thermocouple bulb and a taut-band indicating instrument. This instrument employs a specially shaped magnet to produce an almost linear deflection from the square law thermocouple output. Radio frequency shunts provide multi-range operation. The thermocouple bulb is used at only 2/3 of its full rating, thus providing an overload safety factor.

D-C and A-C voltage, output level, dbm and resistance is measured by a second taut-band panel instrument. A-C voltage, output level, and dbm ranges utilize a full wave diode rectifier circuit.

SPECIFICATIONS

Mechanical:

	Frame Only
Height	5-1/4'' 3 Rack Units
Weight	19'' Standard Rack Mounting
Depth	4-13/32''
	Test Set
Panel	5-1/8 x 17-1/8
Case	4-3/4 x 3 x 16-3/4

Electrical

Voltages Ranges:

Sensitivity D-C at 20,000 ohms per volt
A-C at 5000 ohms per volt

0 – 2.5 – 10 – 50 – 250 – 500 volts full scale

Output Level Ranges:

–10 to +10, +2 to +22, +16 to +36, +30 to +50

+36 to +56 db

Zero level = 1 milliwatt in 600 ohms.

Resistance Ranges:

range, ohms: 0-1000 - 10,000 - 100,000 - 1 meg - 10 meg

ohms at mid scale: 5, 50, 500 5K, 50K

D-C Current Ranges: (at 200 MV burden)

0 - .25 - 2.5 - 25 - 250 ma

0 - 1 - 2.5 amps

R.F. Current Ranges: (at 200 MV burden)

0 - 100 - 250 - 500 - 1000 ma

Accuracy

d-c voltage & current ranges ± 3% of full scale

SUPERSEDES I.L. 41-944.7
* Denotes change from superseded issue

EFFECTIVE NOVEMBER 1965

* r.f. current ranges ± 3% of full scale
ohm ranges ± 1.5% of scale length, except for TX10 range = ± 3%
scale length = 4 inches
a-c volt ranges ± 5% of full scale
dbm ranges ± 5% of full scale

Frequency Range

r-f current ranges – as stated above up to 250KC
a-c volts and dbm ranges as stated above from 35 to 3000 cps. Frequency error less than 0.5 db at 10 kc.

OPERATION

The terminals for the R.F. milliammeter are separate from the others and located below the indicating R.F. instrument.

Connections for measuring current on the 2.5 amp d-c range are made to the "COM" and "2.5 d-c amps" terminals.
Except for those two measurements, all other functions use the "COM" and "V-O-M" terminals in conjunction with proper switch settings.

Three switches provide for selection of the function required and the range desired.

D-C VOLTAGE MEASUREMENTS

1. Select "DCV" on switch marked "function."
2. Rotate "range" switch to desired range.
   If in doubt, start with highest range.
3. Plug red test lead into the red (+) terminal marked "V-O-M."
   Plug black test lead into the black (–) terminal marked "COM" and connect to circuit to be measured.
4. Read the D-C volt scale corresponding to range switch setting. Reverse reading indicate reverse polarity.

A-C VOLTAGE MEASUREMENTS

1. Select "ACV" on switch marked "FUNCTION".
2. Rotate "RANGE" switch to desired range.
   If in doubt, start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.
   No polarity requirement is entailed.
4. Read the A-C volt scale corresponding to range switch setting.

Note: Both sides of the A-C circuit are ungrounded. For accurate measurements at high frequencies one side of the signal source should be grounded and connected to the black terminal marked "COM". The metal case of the TCT set should also be connected to this terminal.

RIPPLE VOLTAGE MEASUREMENT

1. Select "DB" on switch marked "FUNCTION."
2. Rotate "RANGE" switch to desired range.
   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.
4. Read the A-C volt scale corresponding to range switch setting.

CAUTION:

The blocking capacitor used in the "DB" function is rated at 200 VDC working voltage. To measure ripple in circuits with a D-C voltage appreciably greater than this an external capacitor should be connected in series with one of the test leads

DB LEVEL

1. Select "DB" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.
   If in doubt start with highest range.
3. Plug test leads into the "COM" and "V-O-M" terminals and connect to circuit to be measured.

IMPORTANT:

For accurate measurements at high frequencies observe grounding practice per note under A-C Voltage of these instructions.

4. Read all DB on the –10 to +10 DB scale. When the range switch is on the +0 DB position, this is the DB value. For all other positions of the range switch add the range switch setting to the scale indication algebraically.

CAUTION:

Observe blocking capacitor safe D-C voltage

limitation per note under "Ripple Voltage" of these instructions.

Note: Zero reference level is taken as one milliwatt in a 600 ohm line, which is equivalent to 0.775 volts.

RESISTANCE MEASUREMENT

1. Select "OHMS" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired multiplier.
3. Plug test leads into the "COM" and "V-O-M" terminals.
4. Short test leads together and adjust the small knob marked "OHMS ADJ" to set ohmmeter on zero (right side full scale).

Note: Zero must be set for each range.

5. Connect test leads to unknown resistance.
6. Read indication on the OHMS scale.

   When range switch is in the RX1 position, this is the resistance value. For all other positions of the range switch multiply scale indication by switch multiplier.

CAUTION:

When measuring resistance a current is passed through the component under test. With the range switch set on RX1 this current can be as large as 0.3 amperes. When using this range setting, it is recommended readings, including zero setting, be made as quickly as possible to avoid excessive battery drain.

For general continuity testing use RX10 or higher settings. When finished measuring ohms, it is recommended FUNCTION switch be turned to ⊙FF.

Note: If ohmmeter does not indicate on any range, check the fuse or the batteries.

DC CURRENT – 1 AMP OR LESS

1. Select "DC MA" on switch marked "FUNCTION".
2. Rotate "Range" switch to desired range.

   If in doubt, start with highest range.

3. Plug red test lead into the red (+) terminal marked "VOM". Plug the black lead into the black terminal marked "COM".

   Connect test leads in series with circuit to be measured.

4. Read the "DC and AC" volt scale corresponding to range switch setting. For the 2.5 VDC scale use the 0-250 scale figures and point off two decimal places to the left. For 0-500 VDC use the 0-50 scale figures and multiply by 10.

DC CURRENTS – ABOVE 1 AMPERES (2.5 AMP MAX)

DC CURRENTS
ABOVE 1 AMPERES (2.5 AMP MAX)

1. Select "2.5 DC AMPS" on switch marked "FUNCTION".
2. The 2.5 ampere range is not selected by the "RANGE" switch but is obtained by plugging the red test lead into the red (+) terminal marked "2.5 DC AMPS" and the black test lead into the black terminal (–) marked "COM".
3. The "RANGE" switch is not connected when using these terminals and can be in any position.
3. Read indication on the 0-250 scale by pointing off two decimal places to the left.

RF CURRENT

Note: RF current measurements involve only the "RF MA" switch and "RF MA" terminals. The other RANGE and FUNCTION switches may be in any position.

1. Set RF MA switch to OFF position.
2. Plug test leads into terminals marked RF MA. Connect to circuit.
3. Turn range switch from OFF position to the highest range which will give a satisfactory indication. This switch is a shorting type switch and will not open the circuit when going from one range to another.
4. Read indication on scale corresponding to desired range.

Note: Set RF MA switch to OFF position when finished taking readings. This avoids energizing instrument with switch set on wrong range if step 1 is not observed next time instrument is used, and also eliminates losses which the thermocouple heater presents to the line.

MAINTENANCE

Instruments

Both instruments are taut-band instruments, providing frictionless indication and freedom from damaging effects of vibration and shock.

A zero adjuster is provided on each instrument cover for setting pointer on zero if required.

Batteries

The batteries are used only in the ohmmeter circuit. They are satisfactory as long as zero can be set with the OHMS ADJ and are not corroded or leaking. The center post of the battery is inserted in the red cap of the battery holder when replacing.

Fuse

The ohmmeter circuit includes a fuse to protect the circuitry from an accidental internal short. If replaced, be sure fuse is inserted to seat properly in contoured clips.

Thermocouple

A burned out thermocouple bulb is best replaced by returning the complete test unit. If this is not practical, a new bulb and the four adjustable spools shown in series with the millivolt output of the bulb can be supplied. This unit will then require calibration by adjusting these spools. Calibration may be done on 60 cycles.

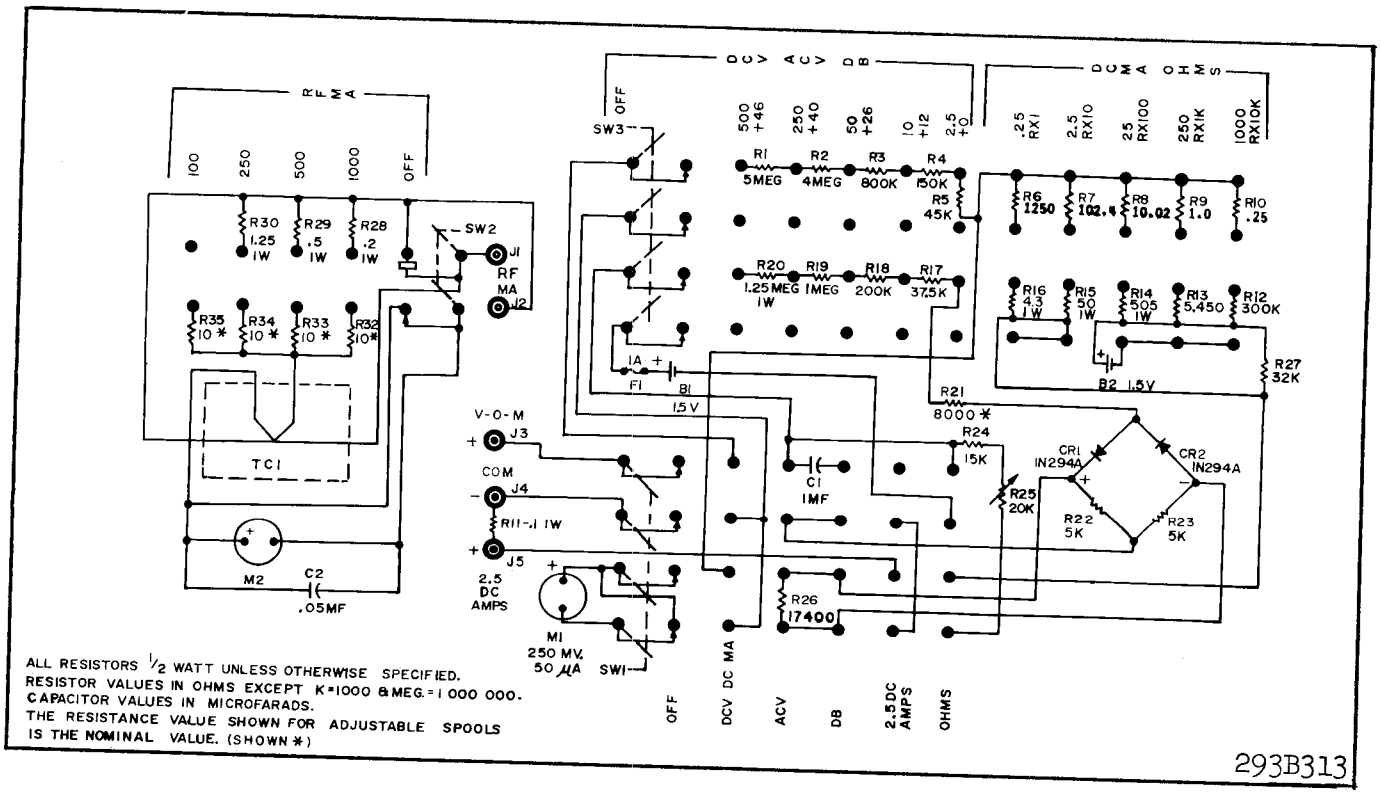


Figure 1 Internal Schematic

TYPE TCT TEST METER UNIT

TABLE I

List of Component Parts

DIAGRAM SYMBOL	FUNCTION	DESCRIPTION
B1 & B2	Battery	1.5V size D
C1	Blocking Capacitor	1.0 mfd., 200 WVDC
C2	By-pass Capacitor	.05 mfd., 50 WVDC
CR1 & CR2	Rectifier Diode	Type 1N294A
F1	Ohmmeter Fuse	3AG Littlefuse 1A-250V
M1	V-O-M Instrument	Westinghouse FX-372 50uA, 250MV
M2	R.F. MA Instrument	Westinghouse FX-373 667uA
J1 J2 J4	Terminal Post	Grayhill 29-1 Black
J3 J5	Terminal Post	Grayhill 29-1 Red
TC-1	Thermocouple Bulb	150MA 25MV O.C. 1.8 ohms Heater Res. Westinghouse 291B001H11
R1	Multiplier Resistance	5 meg., 500V, 1% ins. ½ W
R2	Multiplier Resistance	4 meg., 350V, 1% ins. ½ W
R3	Multiplier Resistance	800K ohm 350V, 1% T-1 Ins., ½ W
R4	Multiplier Resistance	150K ohm 350V, 1% T-1 Ins., ½ W
R5	Multiplier Resistance	45K ohm 350V, 1% T-1 Ins., ½ W
R6	Milliammeter Shunt Resistor	1250 ohm ½ W, 1% W.W.
R7	Milliammeter Shunt Resistor	102.4 ohm ½ W, 1% W.W.
R8	Milliammeter Shunt Resistor	10.02 ohm ½ W, 1% W.W.
R9	Milliammeter Shunt Resistor	1.0 ohm ½ W, 1% W.W.
R10	Milliammeter Shunt Resistor	.25 ohm ½ W, 1% W.W.
R11	Ammeter Shunt Resistor	0.10 ohm 1W ½% W.W.
R12	Ohmmeter Shunt Resistor	300K ohm ½W 1% T-1 Metal Film
R13	Ohmmeter Shunt Resistor	5450 ohms ½ W ½% W.W.
R14	Ohmmeter Shunt Resistor	505 ohms ½ W ½% W.W.
R15	Ohmmeter Shunt Resistor	50 ohm ½ W ½% W.W.
R16	Ohmmeter Shunt Resistor	4.3 ohm ½ W ½% W.W.
R17	Volt Multiplier Resistor	37.5K ohm ½ W 1% T-1 Metal Film
R18	Volt Multiplier Resistor	200K ohm ½W 1% T-1 Metal Film
R19	Volt Multiplier Resistor	1 megohm ½ W 1% T-1 Metal Film
R20	Volt Multiplier Resistor	1.25 megohm ½ W 1% T-1 Metal Film
R21	Volt Multiplier Resistor	10.1K ohm ½ W ½% W.W. Adjustable
R22-R23	Rect. Bridge Resistor	5K ohm ½ W 1% T-1 Metal Film
R24	Ohmmeter Series Resistor	15K ohm ½ W 1% T-1 Metal Film
R25	Ohmmeter Potentiometer	20K ohm Linear
R26	Voltmeter Shunt Resistor	20K ohm ½ W ½% W.W. Adjustable
R27	Ohmmeter Series Resistor	32K ohm ½ W 1% T-1 Metal Film
R28	R.F. Shunt	0.2 ohm 1W ½% W.W.
R29	R.F. Shunt	0.5 ohm 1W ½% W.W.
R30	R.F. Shunt	1.25 ohm 1W ½% W.W.
R32-R33-R34-R35	R.F. M.V. Swamp Resistor	12 ohm ½ W.W.W. Adjustable
SW-1	Function Switch	6 pos., 4 section Rotary Non-Shorting
SW-2	R.F. MA Switch	5 pos., 2 section Rotary (1 Shorting, 1 Non-Shorting)
SW-3	Range Switch	11 pos., 4 section Rotary Non-Shorting

TEST LEADS	WESTINGHOUSE STYLE
* 60" long, Insulated Test Prod and Plug	Red 293B287G01
60" long, Insulated Test Prod and Plug	Black 293B287G02
40" long, Insulated Double Banana Plug & Phone Jack	293B287G03
40" long, Insulated Double Banana Plug Both Ends	293B287G04

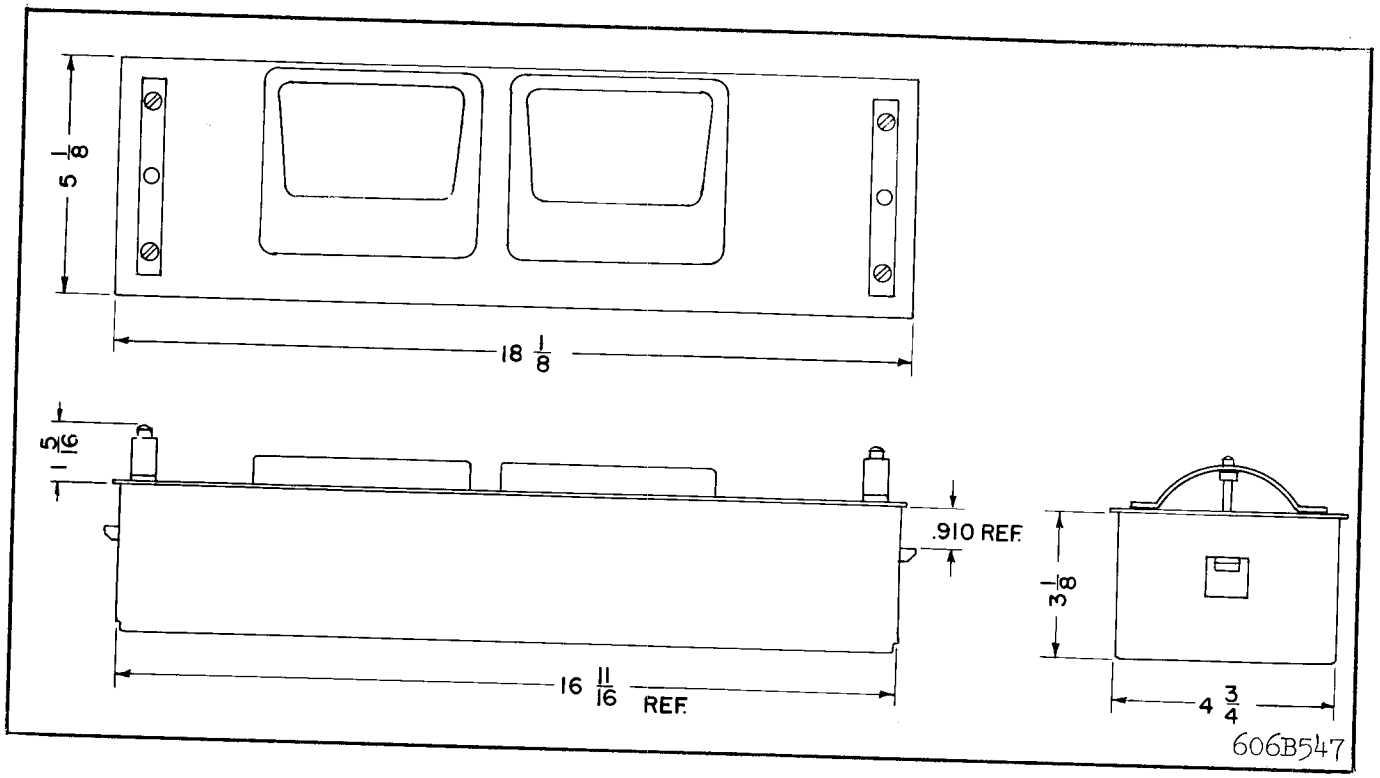


Figure 2 Outline of Test Unit Only.

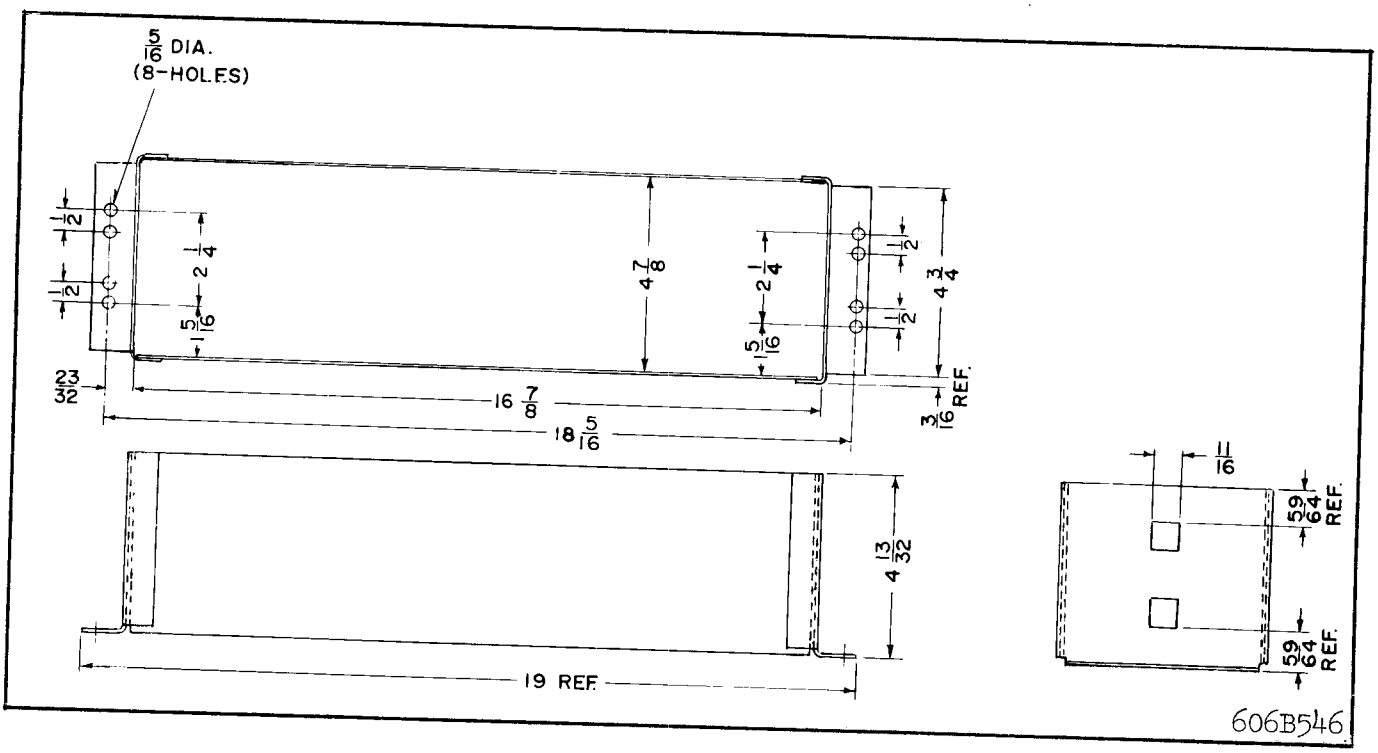
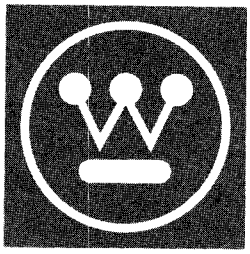


Figure 3 Outline of Mounting Frame Only.



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