

 **MOBILE RADIO**

ASSEMBLY, OPERATION & MAINTENANCE

GENERAL ELECTRIC TEST SET KIT MODEL 4EX8K12



SPECIFICATIONS *

Description

Portable meter for aligning and troubleshooting MASTR II radios which have centralized metering facilities. For servicing equipment without centralized metering, test set can be used as 20,000 ohm-per-volt voltmeter.

Meter used in test set

2-3/4" panel meter with jeweled pivot, off-center zero

Sensitivity

-10 and +50 microamperes full scale. External resistance added to make useable sensitivity -0.2 and +1.0 volt full scale (20,000 ohms per volt)

Internal resistance

1370 ohms $\pm 15\%$

Damping factor

32 nominal

Response time

1.4 seconds nominal

Accuracy

$\pm 3\%$ of full scale

Overload protection

Meter movement protected by diodes

Centralized metering functions

With test cable connected to
transmitter

With test cable connected to
receiver

Test selector

Selects 1 of 11 circuits to be metered

Range selector

Selects 1-volt or 3-volt meter range

Polarity switch

Reverses meter polarity

Reverses meter polarity

High Sensitivity switch

Provides a 100-millivolt full scale meter range and permits transmitter & supply voltage to be metered

XMTR TEST

Keys transmitter

MIKE jack

For keying or voice-modulating Xmtr with mike or handset and monitoring Rcvr with handset

For monitoring Rcvr with handset

DC voltmeter functions

Using test probes

Range selector

Selects 1 or 3-volt range (with Test Selector in "EXT" position)

Polarity switch

Reverses polarity of meter

Operating temp range

0°C to +50°C (+32°F to +122°F)

Size (H x W x D)

3-3/4" x 6-1/2" x 2-7/8"

Weight

1-1/2 pounds

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL  ELECTRIC

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WARNING

No one should be permitted to handle any portion of the equipment that is supplied with voltage or RF power; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

DESCRIPTION

Test Set Model 4EX8K12 is designed for servicing General Electric MASTR II mobile radios. The Test Set can also be used for servicing other two-way radios.

For MASTR II radios, Test Cable W2 includes a red plug (P1) for connecting the Test Set to the systems board, and a black plug (P2) for connecting the set to the transmitter or receiver. For radios that are not equipped for centralized metering, the Test Set can be used as a 20,000-ohm-per-Volt DC voltmeter with a 1- or 3-Volt scale.

The off-center zero on the meter scale permits both positive and negative discriminator voltages to be measured with changing polarity. At the same time it preserves maximum scale lengths, so that readings can be easily and accurately made.

OPERATION

All controls on the Test Set are conveniently located on the front panel. The microphone jack and the external test jacks are located on the right side of the set. The Test Set was designed to operate with the front panel facing up.

NOTE

To protect the meter movement when transporting the Test Set, damp the meter movement by placing a shorted dual-banana plug in the EXTERNAL jacks.

CENTRALIZED METERING

When servicing two-way radios with centralized metering jacks, connect the test cable from the Test Set to the metering jack on the transmitter or receiver. The Test Selector switch can then be used to select the circuit which is to be metered. A decal is normally provided near the centralized metering jacks to indicate which circuits are metered with the Test Selector switch in position "A" through "J", and "B+". Alignment instructions for transmitters and receivers with centralized metering also indicate the metering positions to be used. The transmitter alignment procedures also contain instructions for measuring the PA current and voltage.

NOTE

Since many transmitters designed for centralized metering are adjusted for a PA PLATE loading of 0.7 Volt (position "G"), a red mark has been provided on the meter scale at this reading.

Range-Selector Switch

This switch sets the meter range for either 1 Volt or 3 Volts full scale. For centralized metering, this switch should normally be in the "IV" position.

Polarity-Reversing Switch

If the needle on the meter should deflect to the left end of the scale, this switch can be used to reverse the polarity of the meter and bring the reading on-scale. It may be necessary to switch the polarity of the meter while checking battery voltage, depending upon whether the radio is installed in a vehicle with a positive-ground or negative-ground battery.

High Sensitivity Switch

The High Sensitivity switch is used for two different functions when servicing MASTR II transmitters.

With the range selector switch in the 1-Volt position and the test selector switch in position G, pressing the HIGH SENSITIVITY switch shunts R1 and R2 with potentiometer R6 and resistor R5. This lower resistance in the meter input provides a 100-millivolt full-scale reading. The voltage reading obtained may be converted to amperes according to the instructions on the applicable transmitter Alignment Procedure.

With the range selector switch in the 1-Volt position and the test selector switch in the B+ position, pressing the HIGH SENSITIVITY switch shunts the 20-megohm, 2-Watt resistor with 30k-ohm resistor R7. This lower resistance permits the transmitter PA supply voltage (Vcc) to be read on the 15-Volt scale, (approximately 12.5 Volts).

CAUTION

Do not press the HIGH SENSITIVITY switch when metering tubed transmitters. This may apply the high B+ directly across the meter, damaging the Test Set. Use the HIGH SENSITIVITY switch only where directed in the MASTR II Maintenance Manual.

XMTR Test Switch

While servicing transmitters, the transmitter can be easily keyed by pressing the XMTR Test Switch.

Microphone Jack

The microphone jack on the front of the Test Set provides a convenient place to connect a microphone or handset for keying or

voice-modulating a MASTR transmitter. The audio output of the receiver can also be monitored by a handset connected to this jack.

DC VOLTMETER MEASUREMENTS

To use the Test Set as a DC voltmeter, just place the Test Selector switch in the "EXT" (external) position. Use the Range Selector switch to select the desired voltage range (1 or 3 Volt scale). Connect a pair of test probes (not provided) to the red and black jacks on the front of the Test Set.

With the polarity-reversing switch in the "+" position, the red test probe jack will be positive and the black jack will be negative. To quickly change the polarity of the test probes, just flip the switch to the "-" position.

CIRCUIT ANALYSIS

The voltage range desired is selected by Range Selector switch S3, which connects meter M1 to Test Selector switch S1. S2 switches the positive sides of the meter to twelve floating pins in S2 which selects the circuit to be metered.

Diodes CR1 and CR2 limit the meter overload to approximately six times the rated current of the meter, with less than 1.5% full-scale compression. As a 1-Volt instrument, the meter is protected for a 1000 to 1 overload. However, under this condition, one or more of the metering resistors may be damaged.

CAUTION

Due to the lower resistance in the meter circuit, the meter is more susceptible to damage when using the high sensitivity (HS) switch. Always check the meter reading before pressing the high sensitivity switch.

ASSEMBLY & WIRING INSTRUCTIONS

The Assembly and Wiring Instructions in this manual are listed in the proper sequence for assembling the Test Set in a minimum amount of construction time. Following each step in the order listed will help eliminate wiring errors and incorrect assembly procedures.

The first step in the assembly is to collect all of the necessary equipment in a suitable work area. The following equipment is required:

- A 30 to 100-Watt soldering iron or gun.

- A roll of rosin core solder - Important: Do not use acid core solder for this assembly.
- A set of wire cutters (diagonal cutters preferred).
- A knife or other tool for stripping insulation from wires.
- A pair of pliers (long-nosed pliers will also be helpful in attaching wires and component leads to terminals).
- A 5/64-inch Allen wrench.
- A Phillips screwdriver.
- A set of nut drivers would be helpful in assembly of the front panel.
- A set of test probes would be helpful in performing the Calibration Procedure.

PARTS LIST

The second step is to carefully unpack the kit and check off each part in the space provided on the following Parts List.

✓	SYMBOL	GE PART NUMBER	QUANTITY	DESCRIPTION
	C1	5494481P12	1	Capacitor, ceramic disc; .001 μ f \pm 20%
	CR1, CR2	5494922P1	2	Diode, Silicon
	J2	19B209152P2	1	Red tip jack, EXTERNAL
	J3	19B209152P3	1	Black tip jack, EXTERNAL
	J4	19B219627G1	1	Mike jack: 6 contacts
	M1	5493947P3	1	Meter: DC, 20-0-100, .5-0-3, 2.5-0-15 scale.
	R1	5495948P321	1	Resistor, deposited carbon: 16,200 ohms \pm 1%, 1/2 Watt
	R2	5495948P238	1	Resistor, deposited carbon: 2,430 ohms \pm 1%, 1/2 Watt
	R3	5495948P359	1	Resistor, deposited carbon: 40,200 ohms \pm 1%, 1/2 Watt
	R4	5496955P576	1	Resistor, deposited carbon: 20 megohms \pm 2%, 2 Watts
	R5	3R77-P391J	1	Resistor, composition: 390 ohms \pm 5%, 1/2 Watt (orange-white-brown-gold bands)
	R6	19B209358P102	1	Resistor, variable (calibration potentiometer): 25 to 500 ohms \pm 20%, 0.2 Watt
	R7	5495948P447	1	Resistor, deposited carbon: 301,000 ohms \pm 1%, 1/2 Watt
	S1	19C307113P2	1	Test Selector Switch: Rotary, 2 pole, 12 position
	S2	7145098P1	1	Polarity switch: slide, DPDT
	S3	7145098P3	1	Range switch: slide, SPDT
	S4	19B209165P1	1	XMTR switch: momentary contact, SPST

	S5	4033364P1	1	High sensitivity (HIGH SENS) switch: momentary contact, SPDT
	TB1	7775500P11	1	Terminal board: phenolic, 5 terminals
	W2	19D416574P1	1	Metering Cable: 3 foot, includes 9 pin plugs P1 (Red) and P2 (Black)
		19B212634G1	1	Back cover
		NP276168	1	Front Panel Nameplate
		19B212633G3	1	Front Panel Back-up plate
		19A115431P1	1	Knob (for Test Selector Switch S1)
		7147223P1	1	Cable clamp (for W1)
		19B209260P12	2	Terminals (for M1)
		4036780P3	3 Ft.	Red hookup wire, 22 AWG
		19A115060P26	1 Ft.	Bare hookup wire, 22 AWG
		4038593P6	1 Ft.	Sleeving (for bare hookup wire)
		7162441P21	2 In.	Black Sleeving (for W1)
		N84P13005C13	1	Flat head screw, #6-32
		7141225P2	7	Nut, #4-40
		N404P11C13	10	Lockwasher, #4
		7165075P2	1	Hexnut, 3/8-32
		7115130P9	1	Lockwasher, 3/8
		5491541P212	1	Hex Spacer, 2-inch
		N80P15007C13	2	Phillips, pan head #8-32 x 7/16
		N403P16C13	2	Lockwasher, #8
		N210P15C13	2	Hexnut, #8-32
		N404P13C13	1	Lockwasher #6
		7115130P11	1	Lockwasher, 15/32"
CALIBRATION RESISTORS				
		5495948P17	1	Resistor, deposited carbon: 14.7 ohms $\pm 1\%$, 1/2 Watt
		5495948P113	1	Resistor, deposited carbon: 133 ohms $\pm 1\%$, 1/2 Watt
		3R77-P101K	1	Resistor, composition: 100 ohms $\pm 10\%$, 1/2 Watt (brown-black-brown-silver bands)

STEP-BY-STEP PROCEDURE

When performing the step-by-step assembly procedure, be sure to read each step all the way through before beginning the work. Where illustrations are indicated, study the figure carefully. After completing each step, check it off in the box provided.

The letter (S) used in the instructions indicates a solder connection. The letters (NS) indicate that the connection is not to be soldered at this time, as another wire or lead is to be added. Where two or more leads are connected to the same terminal, solder all of the leads when indicated by the letter (S).

Assembly of TB1 (see Figure 1)

☐ Connect 16.2 K resistor R1 from terminal 1 (NS) to terminal 4 (NS).

☐ Connect 2.43 K resistor R2 from terminal 4 (NS) to terminal 2 (NS).

☐ Connect diode CR1 from terminal 4 (NS) to terminal 5 (NS) with its color bands towards terminal 5.

☐ Connect diode CR2 from terminal 4 (S) to terminal 5 (NS) with its color bands towards terminal 4.

☐ Connect .001 μ f capacitor C1 from terminal 2 (NS) to terminal 5 (NS). Use sleeving on both leads.

Next, make the following connections to TB1 using the red hook-up wire. Strip off 1/4-inch of insulation from each end of the wire.

☐ Connect one end of a 2-inch piece of red hook-up wire to terminal 5 (NS) of TB1. Next, crimp on the spade lug to the other end of the wire.

☐ Connect one end of a 5-inch piece of red hook-up wire to terminal 5 (S) of TB1.

☐ Connect one end of a 3-inch piece of red hook-up wire to terminal 2 (S) of TB1. Next, crimp on the spade lug to the other end of the wire.

☐ Connect one end of a 2-1/2-inch piece of red hook-up wire to terminal 1 (NS) of TB1.

Test Selector Switch Wiring (see Figure 4)

- ☐ Peel the protective film off of the nameplate and align with the backup plate. Then install Selector Switch S1 with a 3/8-inch nut and lockwasher (see Figure 2).

Next, make the following connections to the Test Selector switch by stringing a single length of bare hook-up wire and sleeving as indicated (see Figure 4).

<input checked="" type="checkbox"/>	FROM TERMINAL ON S1	TO TERMINAL ON S1
<input type="checkbox"/>	Terminal 11 (S) on Section A	Terminal 1 (NS) on Section B (Sleeve)
<input type="checkbox"/>	Terminal 1 (S) on Section B	Terminal 2 (NS) on Section B
<input type="checkbox"/>	Terminal 2 (S) on Section B	Terminal 3 (NS) on Section B
<input type="checkbox"/>	Terminal 3 (NS) on Section B	Terminal 4 (S), Section B

- ☐ Connect a piece of bare hook-up wire from Terminal 9 on Section B (NS) to Terminal 10 on Section B (NS).

Make the following connections to the Test Selector switch using the red hook-up wire. Strip off 1/4-inch of insulation from each end of the wire.

- ☐ Connect a 2-1/2-inch piece of red hook-up wire to terminal 12 (S) on section A of switch S1.

- ☐ Connect a 3-1/2-inch piece of red wire to terminal 12 (S) on section B of switch S1.

- ☐ Connect a 4-3/4-inch piece of red wire to terminal 22L (S) on section A of S1.

- ☐ Connect a 4-inch piece of red hook-up wire to terminal 22L (S) on section B of switch S1.

After completing the Selector switch wiring, go back and check each step carefully to make sure no wiring error was made. A thorough check at this time may prevent trouble later.

Assembly of Metering Cable W1 (see Figure 3)

- ☐ Trim 4 inches of braid from cable W1, taking care not to cut any of the wires. Tape the cut edge of the braid to prevent raveling. Slip the 2-inch piece of black sleeving over the cable to hold the braid.
- ☐ Mount the cable clamp to the front panel with a #4-40 nut and two #4 lockwashers (one under the mounting foot and one under the nut).
- ☐ Run the cable through the hole until the sleeving is in the cable clamp. Let 1/2-inch of sleeving extend past the front of the panel. Then tighten the cable clamp with a pair of pliers.

Meter Cable Connections (see Figure 4)

- ☐ Connect the wires from metering cable W1 to the terminals on Test Selector switch S1 as shown in the following chart. Cut off leads to proper length, and strip off 1/4-inch of insulation from each lead.

✓	WIRE COLOR FROM METERING CABLE	CONNECT TO SECTION A OF S1
	White-orange	Terminal 1 (S)
	White-brown	Terminal 2 (S)
	White-green	Terminal 3 (S)
	White-blue	Terminal 4 (S)
	White-orange-brown	Terminal 6 (S)
	Blue	Terminal 7 (S)
	White-orange-green	Terminal 9 (S)
	White-orange-blue	Terminal 10 (S)
✓	WIRE COLOR FROM METERING CABLE	CONNECT TO SECTION B OF S1
	White-black	Terminal 3 (S)
	White-black-green	Terminal 6 (S)
	Red	Terminal 7 (NS)
	White-orange-black	Terminal 9 (S)

After completing the meter cable connections, go back and check each step carefully to make sure that no wiring error was made. A thorough check at this time may prevent trouble later.

Front Panel Assembly (see Figure 2)

- ☐ Install Polarity switch S2 (6 terminals) and Range Selector switch S3 (3 terminals) with #4-40 nuts and #4 lockwashers. Tighten adjacent nuts first.
- ☐ Install High Sensitivity switch S5 (4 terminals) and XMTR switch (2 terminals) with 15/32-inch nuts and lockwashers.
- ☐ Install the red and black EXTERNAL jacks with the #5/16 hex nut supplied on the jacks.
- ☐ Install Mike Jack J4 on the front of the panel with the #8-32 hex nuts, #8 lockwashers, and the two #8-32 x 7/16-inch Phillips-head screws supplied.
- ☐ Install meter M1 using three #4-40 nuts and four #4 lockwashers. Do not use the split lockwashers in the envelope containing the hardware. Note that TBI mounts on one of the meter screws. Use a lockwasher under the mounting foot of TBI and one under the nut.

Mike Jack Wiring

Connect the remaining wires from test cable W1 to Mike Jack J1 as shown in the following chart (see Figure 3).

<input checked="" type="checkbox"/>	WIRE COLOR	CONNECT TO J1
	Shield of Gray cable	Terminal 1 (S)
	Center conductor of Gray cable	Terminal 2 (S)
	White-brown-red	Terminal 3 (NS)
	White-black-blue	Terminal 4 (S)
	White-black-brown	Terminal 6 (S)

Final Connections (see Figure 3)

- ☐ Sleeve a 1-inch piece of bare hook-up wire and connect from terminal 1 (NS) to terminal 6 (S) on Polarity switch S2.
- ☐ Sleeve a 1-inch piece of bare hook-up wire and connect from terminal 3 (S) to terminal 4 (NS) of Polarity switch S2.
- ☐ Sleeve a 1-1/2-inch piece of bare hook-up wire and connect from terminal 4 (S) on Polarity switch S2 to terminal 3 (NS) on Range Selector switch S3.
- ☐ Connect a 1-3/4-inch piece of red hook-up wire from terminal 1 (S) on XMTR switch S4 to terminal 3 (S) on Mike Jack J1.
- ☐ Connect the 40.2 K resistor R3 from terminal 2 (NS) to terminal 3 (S) on Range Selector switch S3.
- ☐ Connect the red wire from terminal 22L on section A of Test Selector switch S1 to terminal 1 (S) of Polarity switch S2.
- ☐ Connect the red wire from terminal 12 on section A of Test Selector switch S1 to the red external jack J2 (S).
- ☐ Connect the red wire from terminal 12 on section B of Test Selector switch S1 to the black external jack J3 (S).
- ☐ Connect the red wire from terminal 22L on section B of Test Selector switch S1 to terminal 2 (S) of Range switch S3.
- ☐ Connect the red wire from terminal 5 of TBI to terminal 5 (S) of Polarity switch S2.
- ☐ Connect the wire from terminal 1 of TBI to terminal 2 (S) of Polarity switch S2.
- ☐ Connect a 2-inch piece of red wire from terminal 5 (S) of mike jack J4 to terminal 2 (NS) of XMTR switch S4.
- ☐ Connect a 3-inch piece of red wire from terminal 9 (S) of section B of the Selector switch to terminal 2 (S) of XMTR switch S4.
- ☐ Connect the wire with the spade lug from terminal 5 of TBI to the + pole of meter M1. Use one nut and one flat washer.
- ☐ Connect the other wire with the spade lug from terminal 2 of TBI to the remaining pole on meter M1. Use one nut and one flat washer.
- ☐ Sleeve both leads and connect the 20-Megohm resistor R4 from terminal 7 (NS) to terminal 11 (NS) on section B of switch S1 (see Figure 4).

- ☐ Screw the 2-inch hex spacer on the screw post, using a #6 lock-washer (see Figure 2). Bend TBl away from the spacer so that none of the components touch the spacer.
- ☐ Sleeve one lead of 390-ohm resistor R5 (orange-white-brown-gold bands). Connect unsleeved lead of R5 to terminal 1 (S) of calibration potentiometer R6 and connect the sleeved lead of R5 to the top terminal of section 1 (S) on High Sensitivity switch S5.
- ☐ Connect a 1-1/2-inch piece of bare hook-up wire (use sleeving) from terminal 2 (S) to terminal 3 (S) of potentiometer R6, and then the - meter post. Use flat washer and nut.
- ☐ Connect a 1-inch piece of bare hook-up wire from the bottom terminal of section 1 (S) on High Sensitivity switch S5 to terminal 1 (S) of TBl.
- ☐ Connect a 3-inch piece of insulated hook-up wire from the top terminal of section 2 (S) on High Sensitivity switch S5 to terminal 11 (S) on section B of Test Selector switch S1.
- ☐ Connect the 301K-ohm resistor R7 from the bottom terminal of section 2 (S) on High Sensitivity switch S5 to terminal 7 (S) on section B of Test Selector switch S1.
- ☐ Attach the Selector switch knob. Position the knob so that the set screw opposite the white pointer will screw into the flat side of the shaft. Tighten the two set screws with a 5/64-inch Allen wrench.
- ☐ Check the test set carefully and remove any loose bits of solder or wire clippings. Then check the assembled test set against Figures 1 through 5 for any mistakes.
- ☐ Before attaching the back cover, refer to the CALIBRATION PROCEDURE and adjust calibration potentiometer R6 as directed.

CALIBRATION PROCEDURES

1. Place the Test Selector switch (S1) in the EXT position, the Range Selector switch (S3) in the 1V position and the Polarity switch in the "+" position.
2. Connect the three calibration resistors and a fresh "D" cell flashlight battery as shown in Figure 6.
3. Apply the test probes as shown and note the exact meter reading (should read approx. 90 on the top meter scale).
4. Now move the test probe connected to the red EXT jack to point "A" (the junction of the 133 ohm and 14.7 ohm resistor). Then, hold down the HS (high sensitivity) switch and adjust calibration potentiometer R6 for the exact reading obtained in step 3.

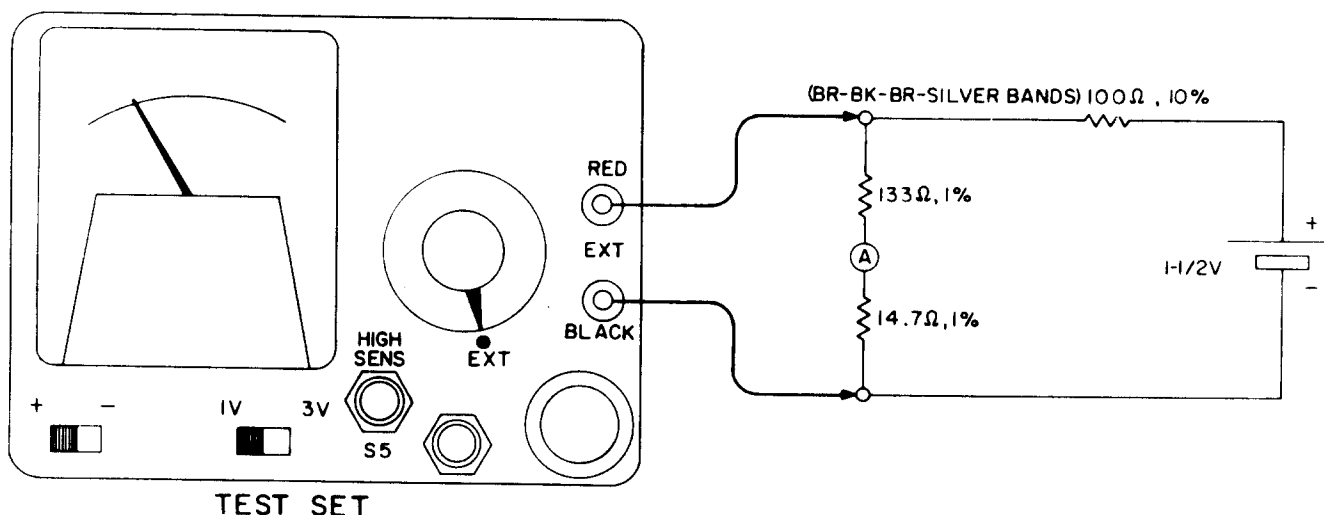


Figure 6 - Calibration Setup

5. Repeat steps 3 and 4 until the meter readings are the same.
6. Attach the back cover with the #6 flat-head screw.

TROUBLESHOOTING PROCEDURE

In the event that the test set does not operate properly, the following steps should prove helpful in troubleshooting the unit.

1. Make sure that the test set is not connected to a two-way radio.
2. Remove the back cover and re-check the chassis for any loose bits of solder or wire clippings.

WARNING

Do not remove the back cover of the test set with the unit connected to a mobile transmitter. High B+ is present on the meter leads with the Selector switch in the B+ position.

3. Check the meter and the resistors with an ohmeter.
4. Check all of the solder connections. Reheat all connections if necessary to assure a good solder connection.
5. Refer to the illustrations and check to see that each part is properly assembled and wired into the circuit.
6. Carefully recheck all wiring. Refer to the Wiring Diagram and mark off each wire as checked.

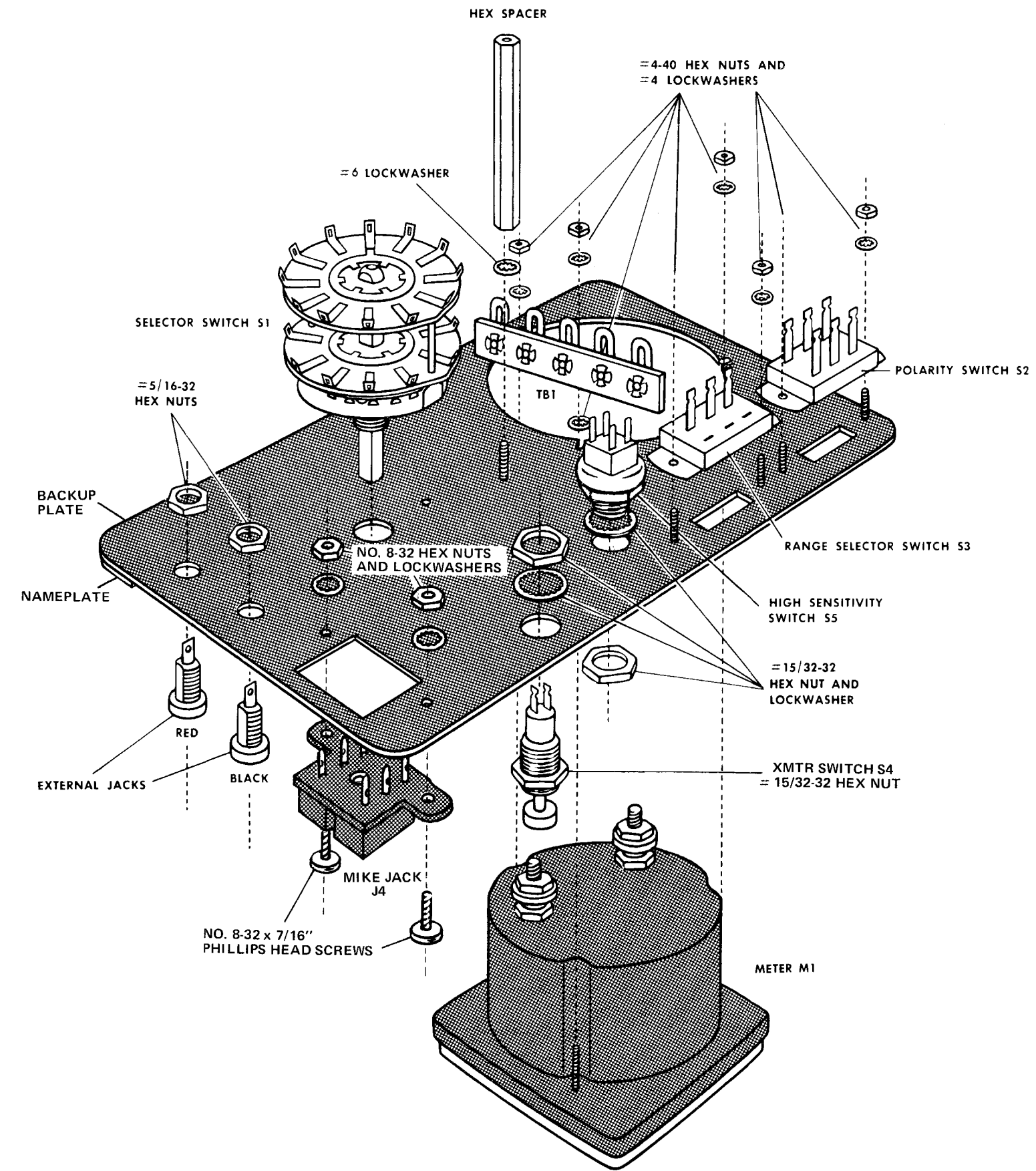


Figure 2 - Front Panel Assembly

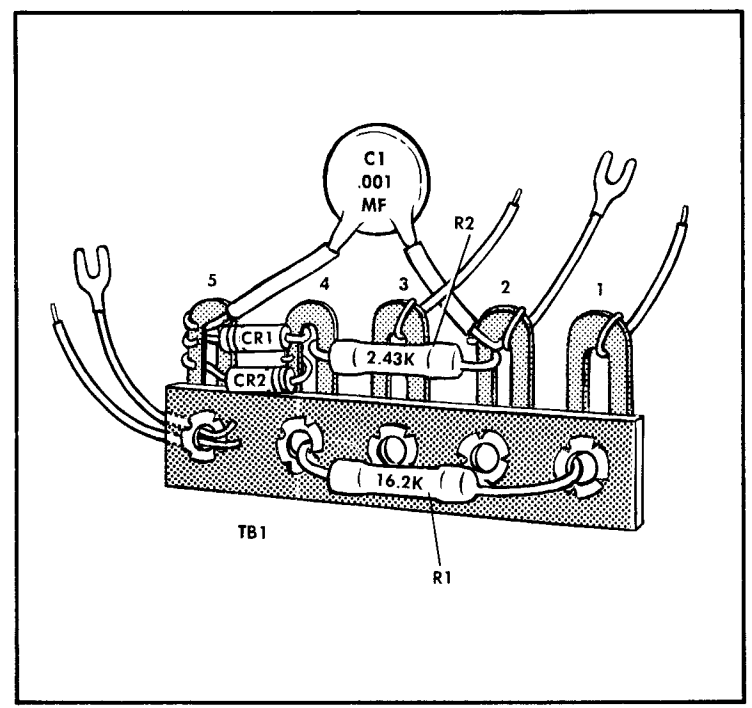


Figure 1 - Assembly of TB1

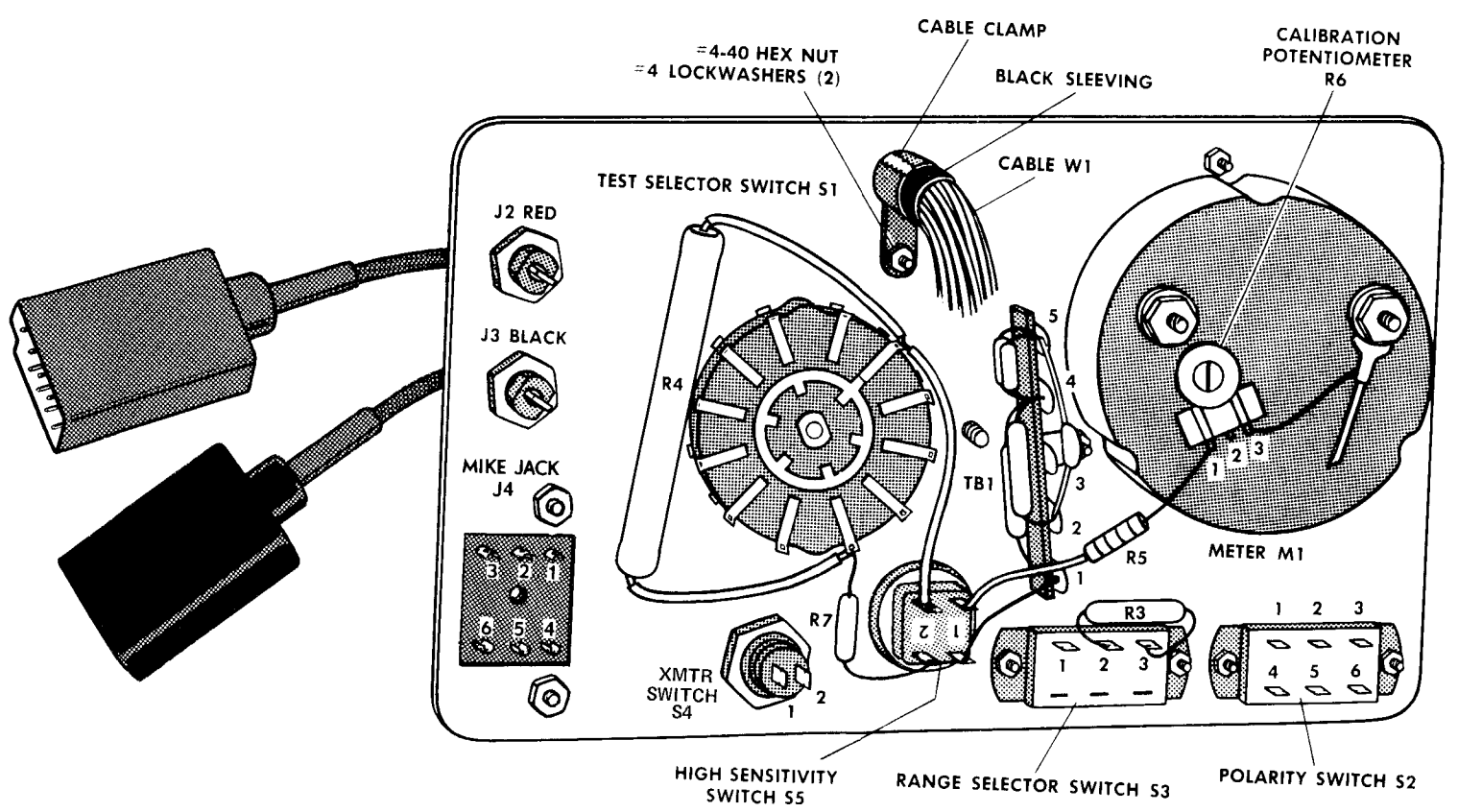


Figure 3 - Front Panel Wiring

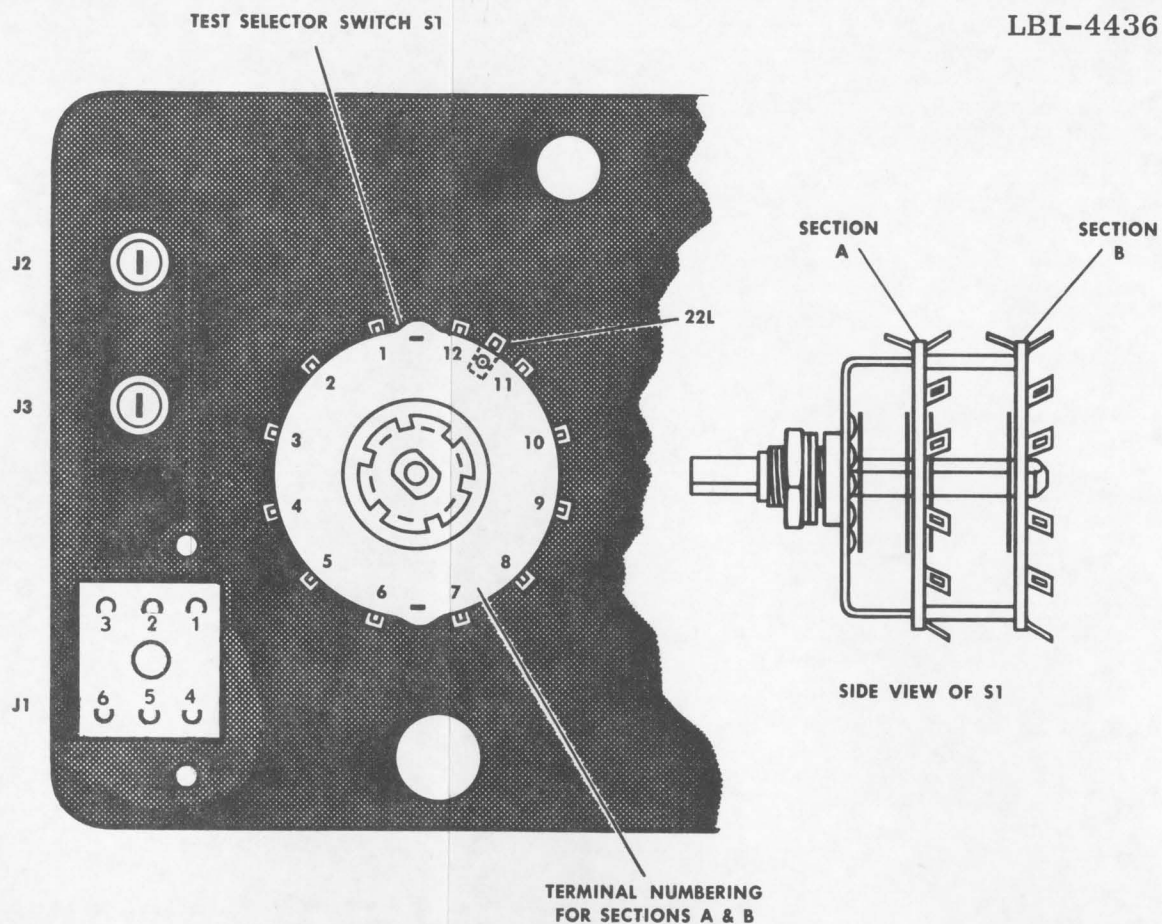
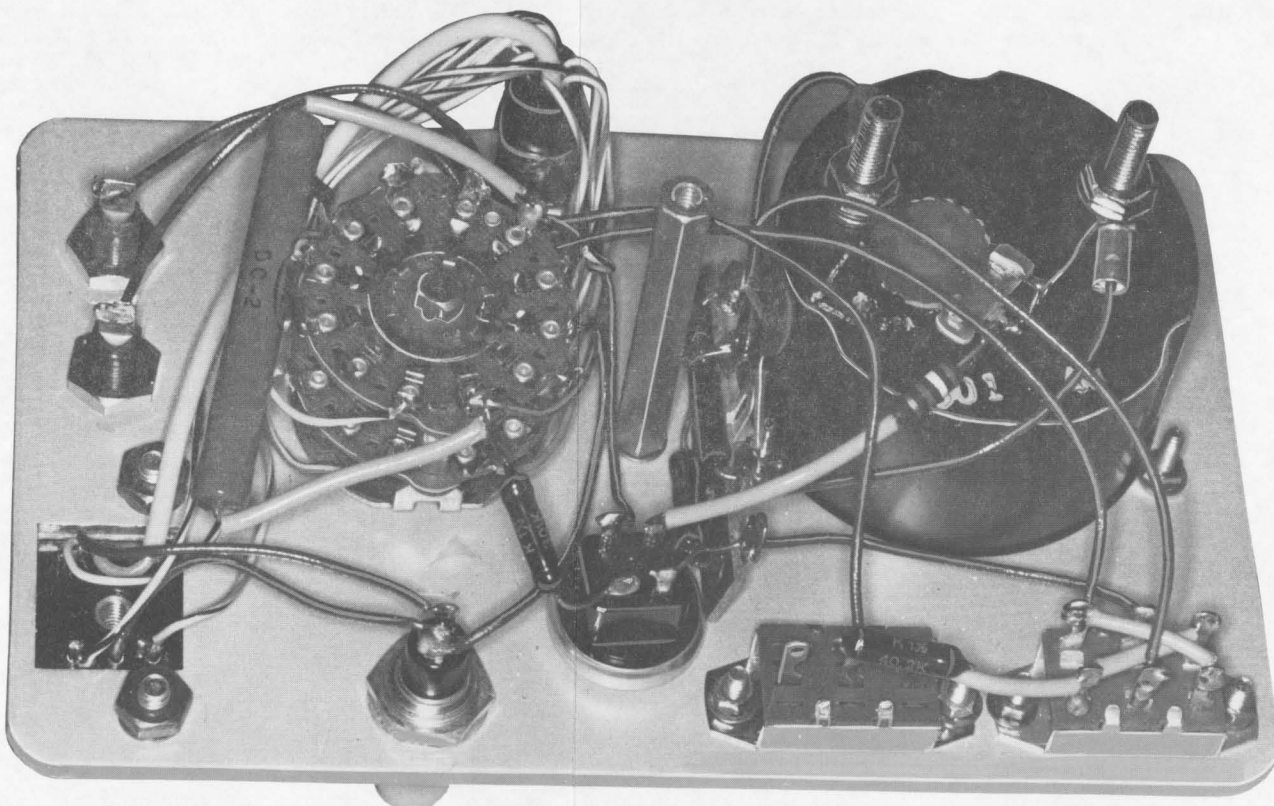
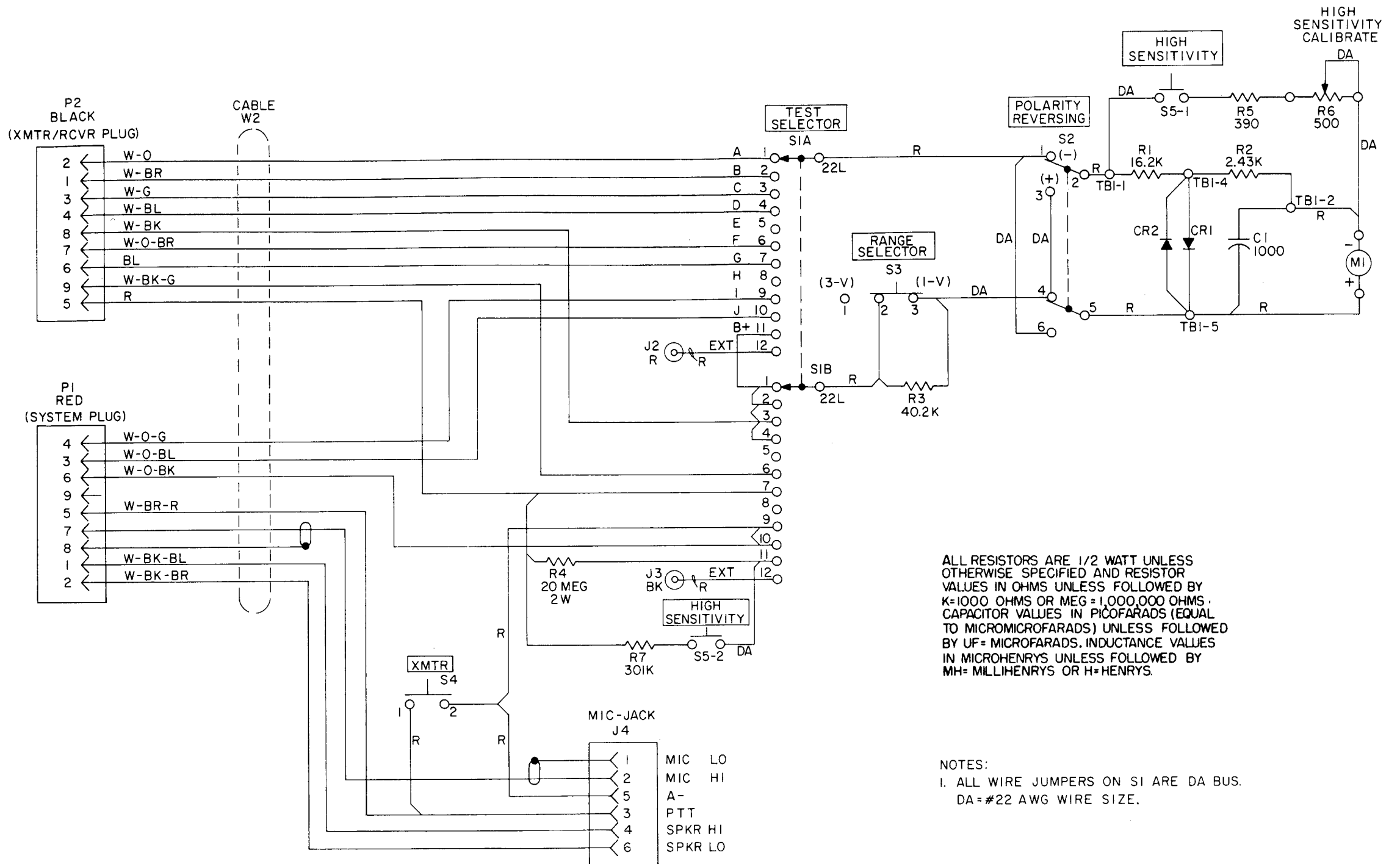


Figure 4 - Selector Switch Wiring



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Figure 5 - Typical Test Set Assembly



(19C320408, Rev. 2)

WIRING DIAGRAM **GENERAL ELECTRIC TEST SET** **MODEL 4EX8K12**