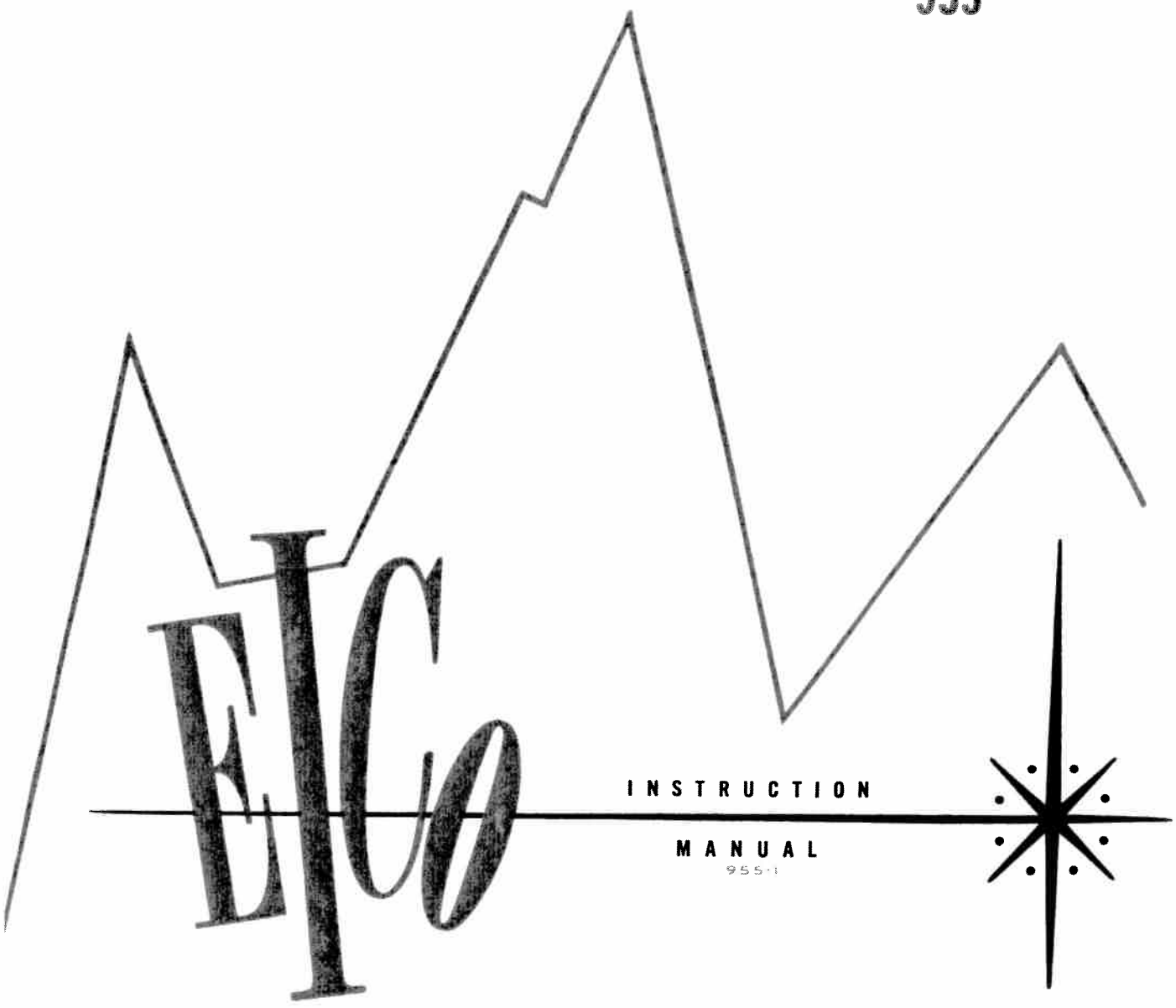
IN-CIRCUIT CAPACITOR TESTER

MODEL

955



INSTRUCTION

MANUAL

955-1

ELECTRONIC INSTRUMENT CO. INC.
3300 NORTHERN BLVD., L. I. CITY 1, N. Y.

IN-CIRCUIT CAPACITOR TESTER

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FIGURES

ELECTRONIC INSTRUMENT CO., INC.
33-00 NORTHERN BLVD., L.I.C. 1, N.Y.

SECTION I. GENERAL DESCRIPTION AND FACILITIES

1-1. GENERAL DESCRIPTION

The Model 955 is a truly advanced, highly dependable in-circuit and out-of-circuit capacitor tester. In addition to providing extraordinarily sensitive short and open tests, the Model 955 includes a Wien Bridge for capacity measurements, with a unique shunt resistance balancing provision* that permits in-circuit measurement even when the shunting resistance is comparatively low.

1-2. FACILITIES

Indicator: Electron-ray tube EM84/6FG6 Bright bar pattern gives sharp, unmistakable indications.

Test Selector: Three-position switch — SHORT, CAPACITY, OPEN

Test Leads: One coax-type for all tests; detachable, with input connector coupling to unit.

Short Test: Out-of-circuit or in-circuit short check with shunt resistance as low as 1 ohm. Reliable up to 2000mf. Closed bars indicate short. 60 cps test frequency. Max. test voltage 6.3VAC (open leads), decreasing with decreasing impedance.

Open Test: Out-of-circuit or in-circuit open test of capacitors as small as 15mmf with instrument adjusted normally. (With constant voltage supply, internal adjustment can be made for 5mmf sensitivity). For in-circuit testing, shunt resistance may be as low as 35 ohms for capacitors above 100mmf (3KΩ at 10mmf). Closed bars indicate open. Test frequency approximately 22Mc, very low voltage.

Capacity Measurement: From 0.1 to 50mf using Wien Bridge with unique shunt resistance balancing* permitting ±10% accuracy at any point on the capacity dial in either in-circuit or out-of-circuit measurement. The capacity scale is screened on a 4" diameter, heavy-gauge lucite disc. The reading point is just above the center of the indicator bar-pattern. Operating frequency of the bridge is 60 cps.

The RC BALANCE control is calibrated in RC product (equivalent shunt resistance in kilohms multiplied by the capacitance in microfarads) in two ranges, 0.6 to 10.5 and 7 to infinity, selected by the RC RANGE switch. The very wide RC product range provided, with excellent spread permitting easy setting to any value, is the key to the accurate capacity measurement provided either in or out of circuit. For out-of-circuit measurements, the RC product value can be translated into dissipation or power factor with the help of the graph on page 16.

*Patent applied for

Line Voltage: 105 to 130VAC, 60 cps; 8 watts drain. A LINE ADJ control on the panel permits adjustment to maximum sensitivity regardless of the voltage variation within this range.

Miscellaneous: Exceptionally attractive, professional laboratory styling. Transformer-operated and protected by fuse in extractor-post mount.

Tubes: 1-6C4, 1-EM84/6FG6.

Size (HWD): 8 1/2" x 5 3/4" x 6"

Weight: 4 lbs.

CAUTION

This instrument is provided with the highest sensitivity practical in its class, thus permitting the lowest practical test voltage. This low test voltage permits practically all capacitors commonly encountered to be tested. Even this low test voltage, however, would exceed the ratings of some capacitors, which should therefore not be tested with this instrument to avoid the possibility of damaging them. These capacitors may be encountered in special sub-miniature equipment, as well as in equipment working on very low voltages. As a rule, testing of capacitors with rated DC working voltage below 6 volts with this instrument should be avoided; for capacitors between 9 and 6 volts rated, the short-test should not be prolonged. Testing of all types of polarized tantalum capacitors, regardless of their working voltages, also should be avoided, as these capacitors can be tested only with a polarized a-c bridge (never applies reverse polarity voltage). Tantalum capacitors are easily recognizable by their very small dimensions for a given capacitance and working voltage.

SECTION II. OPERATING INSTRUCTIONS

2-1. CONTROLS AND TERMINALS

TEST switch

Provides selection of the desired test. Three positions for selection of the short test, capacity measurement, or open test.

.1-50MFD Capacity Dial

Provides balance for the capacitive component of the tested impedance. 4" in diameter transparent dial is read at hairline on panel, just above the indicator bar-pattern, after the bridge is balanced.

RC RANGE switch

Provides selection from two ranges of RC Balance, 0.6-10.5 and 7-INFinity.

RC BALANCE control & AC POWER switch

When the control is turned past maximum counter-clockwise rotation of the potentiometer to the OFF

Fig. 2-1. Front Panel Controls and Terminals

position, the instrument is disconnected from the AC power line. Clockwise rotation from OFF turns the instrument on, as indicated by the pilot lamp located just below this control. The RC BALANCE control provides balance for the resistive component of the tested impedance such as shunting resistance and/or equivalent parallel resistance or equivalent series resistance of the tested capacitor. The reading from the RC BALANCE dial (either range according to the setting of the RC RANGE switch) can be converted into equivalent shunting resistance, dissipation factor, or power factor, as desired and in keeping with the test situation. The setting of the RC BALANCE control is not significant when the instrument is set for the short test or open test except that it must be turned clockwise from the OFF position.

INPUT CONNECTOR

Input connector provides positive connection to the test cable furnished with a matching connector.

LINE ADJ control

Provides convenient compensation for line voltage variation from 105V to 130 VAC, assuring proper functioning of the instrument for all supply voltages within this range.

FUSE

An extractor post fuseholder on the rear apron contains a cartridge fuse in the primary circuit of the power transformer. This fuse is a standard type, rated 1/2 ampere.

2-2. OPERATION

NOTES

Adequate ventilation is necessary for proper operation of the instrument and to avoid the possibility of heat damage. The use of a perforated case permits convective movement of air through the instrument to remove the heat generated by tubes and other components. The air movement consists of cool air, drawn through the sides of the case, being heated and escaping through the top. Take sensible measures to avoid impeding the required air flow.

The test cable supplied is used for all functions. However, its exact length, cable type, and construction is determined by the open test circuit, which is designed to match this cable. No substitute for this cable that differs even slightly in length, type, or construction is acceptable in the OPEN test function and therefore, this exact cable must be considered an electrically inseparable part of the instrument circuit. It is made detachable in the interest of convenient portability of the instrument and to permit easy replacement. You are strongly advised, however, not to disconnect the cable from the instrument, unless you have to for such reasons as mentioned above. Otherwise the cable may be mislaid, or a similar looking cable connected to the instrument by mistake. If the test cable is replaced, internal re-adjustments are required (see Maintenance-Section 4).

CAUTION

The instrument should be connected to a 105 - 130 VAC 60 cps supply line only. It will not operate from, nor should it be connected to, any other kind of supply.

a. PRELIMINARY OPERATIONS

1. Rotate the RC BALANCE control clockwise from the OFF position to switch the instrument on. This is indicated by the glowing pilot light.

2. Allow a 5-minute warm-up period, during which the electron-ray indicator tube will attain its characteristic green glow and the instrument will reach conditions required for normal operation.

3. Set the TEST selector at SHORT, and short the test clips.

4. Set the LINE ADJ control so that the green bars of the indicator tube close together at the center without overlapping. This condition will be referred to as "closed bars".

5. Separate the test clips. The instrument is now ready for use.

NOTE: Steps 3, 4, and 5 should be repeated reasonably often to compensate for possible changes in the supply line voltage.

b. CIRCUIT PREPARATION

Whenever a capacitor is tested in a circuit, the circuit as a whole should be switched off and disconnected from its supply, and all capacitors should be discharged. When batteries are used in the circuit under test as an additional supply, or as the sole supply, the batteries should be removed and capacitors discharged. Failure to discharge any charged capacitors before testing may well result in damage to the instrument as well as erroneous test results. Whenever a capacitor is tested out of a circuit, make sure that it is discharged.

Discharge of the capacitor before testing is also a general personal safety precaution.

c. POLARITY

When connecting the test leads to the capacitor under test, it is advised to follow this simple rule:

1. The black test lead should be connected to the terminal of capacitor which under normal working conditions has a potential closer to that of the chassis.

2. The red test lead should be connected to the remaining terminal of the capacitor.

If the above rule is not followed, there will be no change in indication or accuracy in the short test and capacity test, but there may occur a slight drop in sensitivity on the open test. If the highest sensitivity is not important for the particular test, the rule can obviously be ignored.

d. SHORT TEST

1. Set the TEST selector to SHORT.

2. Connect the test clips to the capacitor under test. The use of additional test leads of reasonable length connected to extend the regular test leads is, in this test, permissible.

3. The indicator tube bars will remain open (at least a small gap) if the impedance across the test clips is more than 1 ohm (at 60 cps). Only closed bars indicate impedance less than 1 ohm. (Note that a 2000mfd capacitor has an impedance of 1.33 ohms at 60 cps). Partially open bars indicate an impedance between 1 ohm and 10 ohms. (Note that a 200mfd capacitor has an impedance of 13.3 ohms at 60 cps.) A short or very low resistance across a good capacitor will also cause a "short" indication. Check for this condition before discarding the capacitor as internally shorted.

The instrument may also be used as a continuity tester in the SHORT position of the TEST selector.

e. OPEN TEST

1. Set the TEST selector to OPEN.

2. Connect the test clips directly to the capacitor under test. (No additional test leads may be used.)

3. The indicator tube bars will remain open (at least a small gap) if the capacitance across the test clips is more than 15mmf. Only closed bars indicate an open capacitor or a capacitance of less than 15mmf. Partially open bars indicate capacitance below 25mmf but more than 15mmf. If the latter indication is obtained when testing a capacitor greater than 25mmf in-circuit, it may be due entirely to stray capacity and the tested capacitor may be open. On the other hand, a capacitor below 100mmf that is not open, may show open in-circuit if it is shunted by a resistance below a critical value. This is discussed in (8) below. Also, some types of tubular electrolytics may show open due to a peculiarity of their construction, even though they are almost always not open. This is discussed in (9) below. Circuit examination in the first case, and capacity measurement in the second case will always settle any doubts.

4. An in-circuit open test should not be given to capacitors shunted with a resistance of less than 35 ohms because a false indication will occur. The actual limit is somewhat lower and can be found for each particular instrument by a simple check with a resistor connected across the test leads. (With the critical value or less, the instrument will show "not open" with only a resistor but no capacitor across the test clips.)

5. A good capacitor connected in parallel with an open one may cause an indication "not open". Therefore, all indications should be interpreted on the basis of circuit examination. For example, in Figure 2-2, if R is less than 35 ohms and Ca is open, but Cb is large, the indication may be "not open" while checking Ca because small R does not isolate the capacitors sufficiently. In the same case, but with R larger than 35 ohms, the indication will be correct.

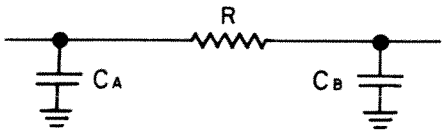


Fig. 2-2. Example

6. The open test may give false indication on capacitors in resonant circuits unless the resonant frequency of the circuit is much below the test frequency (approximately 22Mc.) False indication is very likely in open-testing capacitors in resonant circuits above 22Mc.

7. The sensitivity given in (3) above as 15mmf is the lowest sensitivity that will be obtained with the supply line voltage at 105 VAC. With the line voltage at 115 VAC, the sensitivity will rise to 10mmf, and with the line voltage about 130 VAC there will be a gap between the indicator tube bars with a capacitance as low as 5mmf between the test clips. The instrument can be adjusted for the highest sensitivity at any given line voltage within the range 105V - 130V (see 4-3.) This is advisable only if the highest sensitivity is really necessary, and when the instrument can be supplied with a stable supply line voltage (as e.g. through an a-c voltage stabilizer), because the highest sensitivity can be achieved for one particular supply line voltage only, and with higher line voltages there will be a gap between the indicator tube bars even with an open circuit between the test clips.

8. As stated in (3) above, a capacitor below 100mmf that is good may show open in-circuit if it is shunted by a resistance below a critical value. The critical resistance value varies in an inverse manner with the capacitance value as follows:

3KΩ for 10mmf
1.5KΩ for 15mmf
750Ω for 20mmf
500Ω for 25mmf
250Ω for 50 mmf
50Ω for 100mmf

When the shunt resistance is close to the critical limit for the particular capacitance value, the indicator tube bars may open only partially. Additional tests can be performed, and positive indication can be obtained, after disconnecting one end of the capacitor (or the shunt resistance, if this is easier) and checking again the same way.

9. As stated in (3) above, some types of tubular electrolytic capacitors (depending on their internal structure) will give an open indication in most in-circuit cases, and always show open out of the circuit. Some of them, for the same reason, may give only a partial opening of the indicator tube bars, which could be interpreted as stray capacity or capacitance of less than 25mmf. Whenever these indications are obtained with an electrolytic capacitor (they very seldom are really open) the instrument should be switched to the CAPACITY test and a capacity measurement should be performed to determine the capacitance.

f. CAPACITY MEASUREMENT

1. Set the TEST selector to CAPACITY.

2. If the values of the expected capacitance and parallel resistance are known, set the RC RANGE switch and the RC BALANCE control to indicate a value slightly higher than the product received by simple multiplication of the value of the expected capacitance in mfd by the value of the expected (or measured with an ohmmeter) resistance in kilohms. When the values are not known, set the RC RANGE switch to the 7-INF position and the RC BALANCE control to INF.

3. Connect the test clips to the capacitor under test. The use of additional test leads of reasonable length connected to extend the regular test leads is, in this test, permissible.

4. Rotate the capacity dial to find the position in which the indicator tube bars have the smallest gap. Then rotate the RC BALANCE control counterclockwise until the gap becomes a little smaller (do not try to close the gap by rotating the RC BALANCE control only). Correct the position of the capacity dial for the smallest gap and then again close the gap partially by rotating the RC BALANCE control. By repeating this procedure a few times, a point of balance will be achieved indicated by a complete closure of the gap between the indicator tube bars with the largest possible overlapping. (Overlapping appears as a bright line at the bar closure point, the brightness of the line increasing with the degree of overlapping.)

The point of balance should be approached always by rotating the RC BALANCE control counterclockwise and without going beyond the point of best balance. For instance, when balance can not be achieved at the 7-INF position of the RC RANGE switch, and it is necessary to go to lower values of RC — after the RC RANGE switch is set at the .6-10.5 position — the RC BALANCE control should be turned fully clockwise and then the point of balance should be approached again by rotating the RC BALANCE control counterclockwise toward balance, alternately with correcting the capacity dial setting, as described above. Disregard of this procedure may lower the accuracy of the measurement.

When measuring a capacitor in a circuit where the RC is high, or when the capacitor is out of the circuit, very often it is possible to achieve a complete closure of the gap between the indicator tube bars by rotating the capacity dial only. Nevertheless, in most cases it is possible to improve the balance with the use of the RC BALANCE control. In some cases when the capacitance is more than 15mf, it may happen that the balance position of the RC BALANCE control is not indicated sharply and the setting can be varied over a wide range without a significant change in indication. However, the balance indication achieved with rotating the capacity dial will still be sharp enough to give the value of the capacitance with the usual accuracy.

5. To assure maximum accuracy in capacity measurement, observe the following rule:

a. If the RC product is between 7 and 10 on in-circuit measurement, use the .6-10.5 position of the RC RANGE switch for balancing.

b. In the same circumstances on out-of-circuit measurement, use the 7-INF position.

6. After the bridge is properly balanced, the value of the capacitance can be read directly from the capacity dial. When used properly, and according to the procedures given, the instrument will indicate the values of capacitance with an error not exceeding 10% unless the power factor of the capacitor under test is more than 30%. With the value of the power factor exceeding 30%, the error becomes larger and can be roughly estimated as follows:

$\frac{(PF)^2}{100}$ % PF is the power factor in percent.

Practically speaking, the increase of the error can be neglected in many cases because the indicated capacitance is the equivalent parallel capacitance, which is what counts when the capacitor is used for filtering. A large decrease of the equivalent parallel capacitance caused by the loss of capacity itself, as well as by the increase of the power factor, should be considered a sufficient indication that the capacitor under test should be replaced.

7. At balance, the setting of the RC BALANCE control indicates the value of RC product, defined as the product of multiplying the value of measured capacitance in mfd and the value of the parallel resistance in kilohms. Therefore, the value of the parallel resistance can be determined by simply dividing the value indicated on the appropriate range of the RC BALANCE dial by the value of capacitance indicated on the capacity dial. It is necessary to remember that the parallel resistance determined in this manner will be in most cases lower than that measured with an ohmmeter, because the internal equivalent parallel resistance of the capacitor appears to be connected in parallel with the external parallel resistance and lowers the resultant value. With this explanation it becomes obvious that the difference will be larger with capacitors having a high power factor and smaller with capacitors having a low power factor, larger where capacitors are connected in parallel with high resistances and smaller where these resistances are low. When the capacitor under test is out of the circuit, the indication from the RC BALANCE dial can be converted into the dissipation factor or power factor with the help of the graph given on page 16.

8. A balance indication above the 50mf mark indicates a large capacitance beyond the range of the capacity dial, or a short. Which is the case, can be determined by applying the short test. A balance indication beyond the 0.1mf mark indicates a small capacity beyond the range of the capacity dial (with not less than 3K ohms in parallel), or an open circuit. Which is the case can be determined by applying the open test.

9. To avoid false and misleading indications, the rules given below should be followed closely:

a. Capacitors connected in parallel with a resistance of less than 35 ohms should not be measured because this may cause false indication. These capacitors should be measured after one end of the capacitor is disconnected, or after a part of the parallel circuit is disconnected, so as to bring the parallel resistance to some higher value, whichever is easier. To determine the value of the parallel resistance, a check with an ohmmeter is advised rather than relying on the schematic values.

b. Do not attempt to measure capacitors known to be out of the 0.1 to 50mfd capacity range or capacitor-resistance parallel combinations having an RC product less than 1.0. Either or both conditions exclude the possibility of in-circuit measurement. The best thing to do in these cases is to disconnect one end of the capacitor and measure it effectively out of circuit, provided of course, that it is greater than 0.1mfd. Stating the same thing from another point of view; should it be found that balance can not be obtained within the 0.1 to 50mfd capacity dial range and the 1 to INF RC BALANCE range, then either the capacity is outside the measuring range of the instrument, or the RC product is below 1 (the useful low limit of RC BALANCE provided) or both. Again the best thing to do is to disconnect one end of the capacitor and measure it effectively out-of-circuit. If balance can not be obtained between 0.1 and 50mfd in the out-of-circuit measurement, then the capacity value is out of the measuring range of the instrument, and the only tests that can be applied to the capacitor by this instrument are the short and open tests.

c. Whenever a capacitor under test is connected in parallel with another capacitor, the indication at the point of balance will give the resultant capacitance of this parallel combination. Measurement of these capacitors separately can be performed only after the lead that connects them in parallel is disconnected at one point.

d. When two or more capacitors are connected in an RC-type network (see figure 2-3), the capacitors next to the measured one should be shorted to eliminate possible errors. Of course the requirements of a. and b. above have to be met.

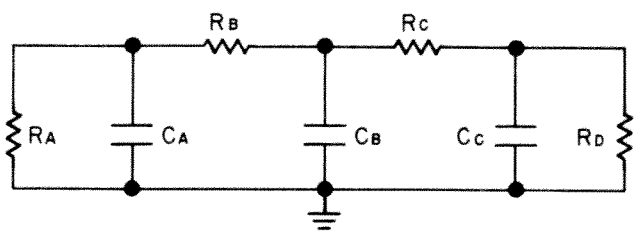


Fig. 2-3. Example

EXAMPLE:

1. To measure Ca, short Cb. It is required that

$$\frac{Ra \times Rb}{Ra + Rb} > 35 \text{ ohms}$$

and that $\frac{Ca \times Ra \times Rb}{1000\ (Ra + Rb)} > 1.0$. The resistance is in ohms and capacitance in mfd.

2. To measure Cb, short Ca and Cc. It is required that the values of

$$\frac{Rb \times Rc}{Rb + Rc} > 35 \text{ ohms}; \quad \frac{Cb \times Rb \times Rc}{1000\ (Rb + Rc)} > 1.0.$$

3. To measure Cc, short Cb. It is required that the values of

$$\frac{Rc \times Rd}{Rc + Rd} > 35 \text{ ohms}; \quad \frac{Cc \times Rc \times Rd}{1000\ (Rc + Rd)} > 1.0.$$

SECTION III. CIRCUIT DESCRIPTION

3-1. CIRCUIT DESCRIPTION

SHORT TEST

With the TEST selector at the SHORT position, the part of the circuit employed can be shown in a simplified schematic given in figure 3-1.

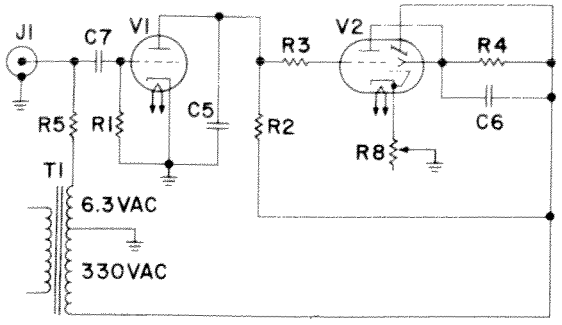


Fig. 3-1. Short Test Circuit

The a-c voltage (330 VAC) from transformer T1 is applied to the plate of V1 through the resistor R2. At the same time a small a-c voltage (6.3 VAC) of opposite phase is applied to the grid of V1 through R5 and C7, and the same voltage is applied to the capacitor under test. Whenever the impedance across the test leads is more than 10 ohms the voltage appearing on the grid of V1 is large enough to keep the plate current in V1 down to very low values (keep in mind the phase opposition of the grid and plate voltages). The voltage drop across R2 will then be very small and with a properly set LINE ADJ (R8) control, this will make the grid of the triode part of V2 very slightly negative with respect to the cathode. The plate current of V2 will therefore be comparatively high. This will cause a large voltage drop across R4. With a large difference of potential between the ray-control electrode and the target, the indicator tube bars will be wide open. When the test leads (or the capacitor across them) are shorted, the grid of V1 is at the same potential as the cathode. The plate current in V1 increases and the voltage drop across R2 increases. The grid of the triode section of V2 becomes much more negative with respect to the cathode, and the plate current in the triode section decreases. The voltage drop across R4 decreases accordingly, so that the potential difference between the ray-control electrode and the target decreases and the indicator tube closes. With the impedance across the test leads between 0 and 1 ohms the indicator tube bars are closed (occasionally a more sensitive set may have the limit even below 1 ohm); and with the impedance between 1 and 10 ohms, the indicator tube bars are partially open.

OPEN TEST

With the TEST selector at the OPEN position, the part of the circuit employed can be shown in a simplified schematic given in figure 3-2.

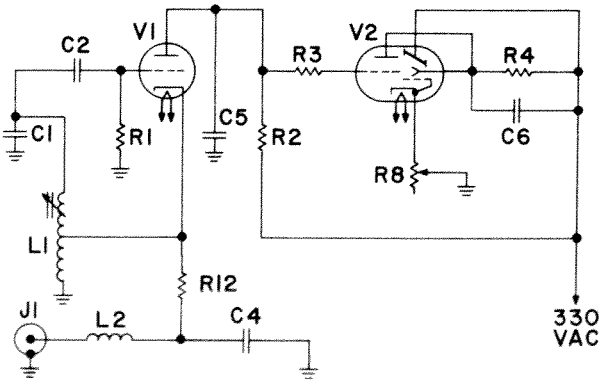


Fig. 3-2. Open Test Circuit

With the exception of R12, C4, and L2, the circuit connected to V1 represents a simple Hartley oscillator. Whenever there is oscillation in the circuit of C1 and L1, the grid of V1 is negative, and the plate current in V1 very small; consequently (see above) the indicator tube bars stay open. When there is no oscillation in the circuit of C1 and L1, the grid of V1 is at the same potential as the cathode, and the plate current is large; consequently, the indicator tube bars are closed. The presence of oscillation in the circuit depends on the impedance connected across the test leads. The test cable together with L2, R12 and C4 represents a quarter wave-length line for the frequency of oscillation (about 22Mc). This quarter wave-length line is connected to L1. Whenever this line is open at the end with test leads, it represents a short at the input, and this means that a part of coil L1 will appear shorted. This will obviously suppress the oscillation in the circuit of C1 and L1, and keep the indicator tube bars closed. With an impedance of sufficient value at the end of the test cable with the test leads, the line will represent at the input an impedance large enough to maintain the oscillations in circuit of L1 and C1, and keep the grid of V1 negative. This will cause the indicator tube bars to open.

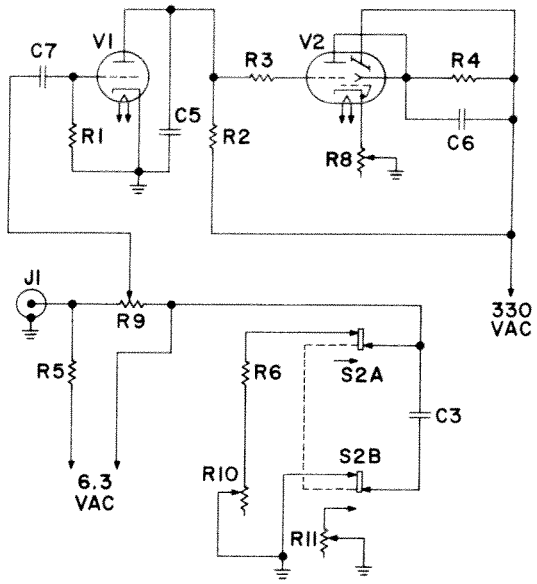


Fig. 3-3. Capacity Measurement Circuit

CAPACITY MEASUREMENT

With the TEST selector at the CAPACITY position, the part of the circuit employed can be shown in a simplified schematic given in figure 3-3. The circuit ahead of C7 represents a series and parallel capacitance comparison bridge, and the circuit after C7 represents an indicator. Whenever the bridge is balanced, the voltage coming from the bridge to the indicator is zero. The grid of V1 is then at the same potential as the cathode and the plate current in V1 is large. This keeps the indicator tube bars closed. With a non-zero voltage coming from the bridge (the bridge out of balance) the grid of V1 becomes negative, and the indicator tube bars are open — at least partially. The bridge circuit is somewhat different from the bridges in common use. The resistance balancing potentiometer is connected in series with the standard capacitor only for the high values of RC (or low values of dissipation factor or power factor). For low RC, the resistance balancing potentiometer is connected in parallel with the standard capacitor. This way it is possible to measure capacitors shunted with small resistances with a comparatively high accuracy of capacity measurement.

SECTION IV. MAINTENANCE

4-1. GENERAL

Your instrument will normally require little service outside of tube replacement. The performance of the instrument is not dependent on tube selection and both types employed are available nationally.

All of the required adjustment procedures are described in this section. Trouble-shooting information is provided also. Operating voltages and transformer winding resistances are shown on the schematic diagram. In reading the schematic diagram it may be found helpful to refer to the simplified schematics given in Section 3.

4-2. CASE REMOVAL

Loosen and remove the two sheet metal screws at the rear. Slide the case out of the panel frame and off the instrument.

4-3. OPEN TEST SENSITIVITY ADJUSTMENT

Remove case. Connect test lead to instrument. Perform PRELIMINARY OPERATIONS, Section 2-2a, allowing a half-hour warm-up before setting LINE ADJ control. For best results, the actual line voltage at the time of the following adjustments should be determined as accurately as possible. The tuning slug of coil L1 (located in Figure 4-1) should be adjusted with a tuning wand or an insulated screwdriver.

a. Set the TEST selector at OPEN.

b. Straighten out the test lead and separate the test clips.

c. Turn the slug in L1 to its maximum counter-clockwise position. Do not force it or the slug will break. At this point, there will be some gap between the bars in the indicator tube.

d. Turn the L1 slug slowly clockwise until the gap is just closed. Do not turn it beyond this point.

e. Now turn the L1 tuning slug further clockwise, to an extent depending on the measured line voltage at the time of test, as follows:

105 volts - 1 turn clockwise
111 volts - 3/4 turn clockwise
117 volts - 1/2 turn clockwise
123 volts - 1/4 turn clockwise
129 volts - do not turn at all

The purpose of the added turning of the L1 slug is to cover a 10% line voltage variation.

If the line voltage cannot be accurately measured and there is no reason to believe that it is abnormally high or low at the time, then assume it is 117V and add 1/2 turn clockwise, as indicated above.

If the instrument is supplied from a stabilized a-c voltage supply, no additional turning of the L1 slug is necessary after adjusting it for closure of the indicator tube bars as described.

f. Short the test clips. The indicator tube bars should open wide. This completes the adjustment; disconnect the instrument from the power line and replace the case.

g. With aging or part replacement, it will probably be necessary to perform the entire OPEN TEST SENSITIVITY ADJUSTMENT given above again. There are two possible indications that this is necessary:

1. After completing step b. above, there is a considerable gap between the indicator tube bars.

2. The sensitivity of the instrument on the open test drops considerably.

4-4. TROUBLE-SHOOTING CHART

The chart is given with the assumption that the wiring of the instrument was checked and found correct and in good order, the solder joints were checked, and the resistances measured and found within tolerances.

4-4. TROUBLE SHOOTING CHART.

SYMPTOM	POSSIBLE CAUSE & REPAIR PROCEDURE
Instrument inoperative, pilot light does not glow.	Blown fuse — check and replace if necessary. Defective line cord or defective on-off switch S3 — check for primary resistance of T1 through line cord plug with the RC BALANCE control turned clockwise from OFF.
Instrument inoperative, pilot lamp does glow but indicator tube does not glow.	Defective tube V2 — check and replace if necessary. No filament voltage — check between pins 4 and 5 of V2. No plate voltage — check at pin 6 of V2. Defective potentiometer R8 LINE ADJ — check resistance between pin 3 of V2 and chassis for zero resistance at the extreme counter-clockwise position and 50 kilohms at the extreme clockwise position.
Instrument inoperative, pilot lamp and indicator tube glow.	Defective tube V1 — check and replace if necessary. Defective test lead or bad contact on the input jack — check by shorting the inner and outer conductor terminals of the input jack with the TEST selector at SHORT. Defective switch S1 — check. Defective capacitor C7 — short pin 6 on V1 to chassis; if the instrument can be adjusted for closing of the indicator tube columns with the use of the LINE ADJ. control, then replace C7.
Instrument performs properly on the SHORT test but does not work properly on the CAPACITY test.	Make sure that this is the case by performing the CAPACITY test on a good capacitor alone and then with a parallel resistance (e.g. 2mf alone with the RC RANGE switch in the position "7-INF" and 2mf shunted by 500 ohms with the RC RANGE switch in the position "0.6 - 10.5" and the RC BALANCE control about 1.0). Defective switch S1 — check. Defective potentiometer R9, R10, or R11 — check. Defective switch S2 — check. Defective capacitor C3 — check.
Instrument performs properly on the SHORT test, but on the OPEN test it does not work properly or the indicator tube bars stay closed with shorted test clips.	Instrument requires readjustment — see Section 4-3. If the readjustment can not be done, it may be: Weak tube V1 — check and replace if necessary. Defective or wrong test lead — check for length and type of cable and its condition. Defective switch S1 — check. Defective part in circuit formed by C1, C2, R12, C4, C5, L1, and L2.
Instrument is entirely operative and performs properly, but pilot light does not glow.	Defective indicator light I1 — check and replace if necessary.
Instrument is operative but does not work properly on the CAPACITY measurement (check as above), and in the SHORT test the gap on the indicator tube with separated test leads is very wide (the bars disappear from view), or the edges are not sharply defined; line adjustment difficult.	Defective capacitor C6 — check and replace if necessary.

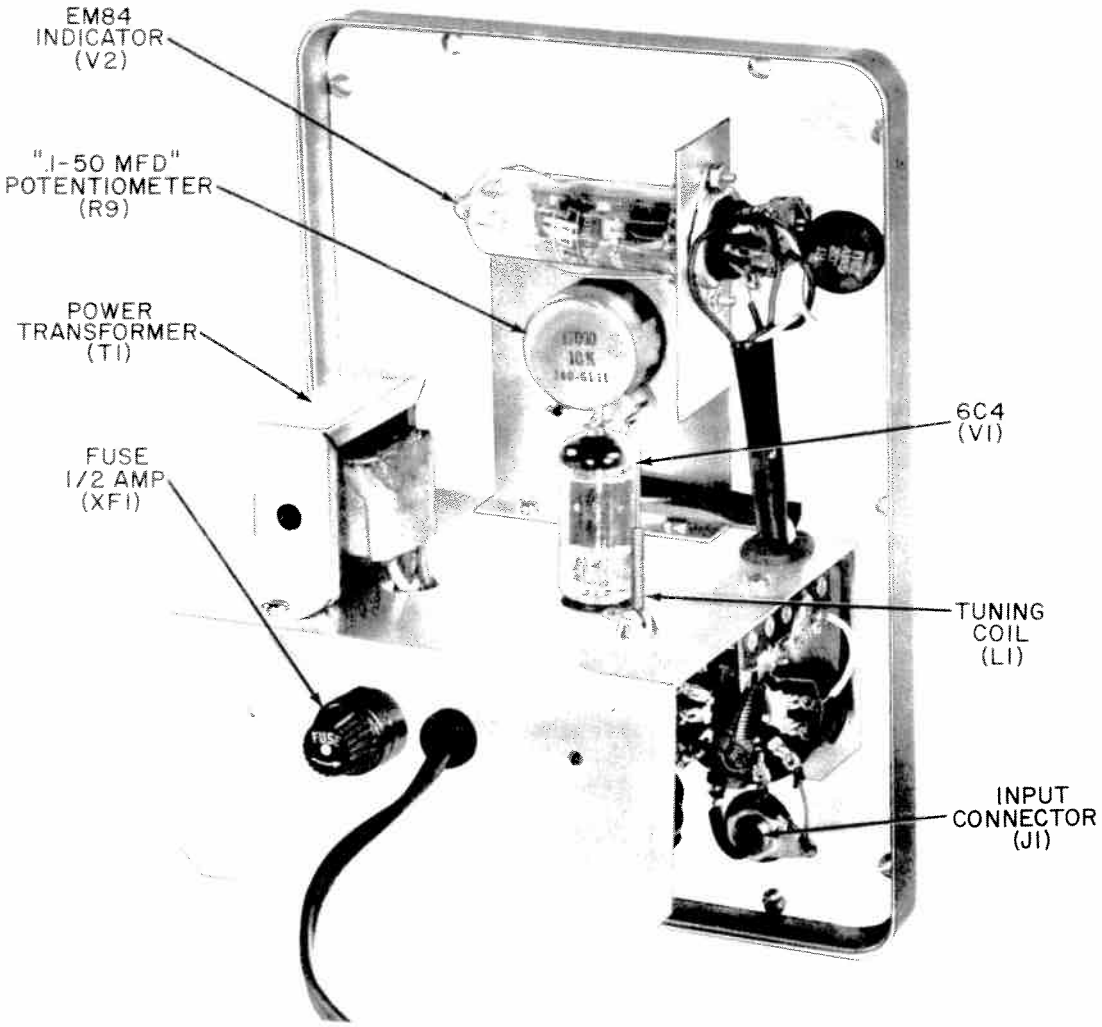


Fig. 4-1. Tube Layout and Tuning Adjustment

REPLACEMENT PARTS LIST

SYM.#	STOCK#	AM'T.	DESCRIPTION
C1	22533	1	capacitor, disc, 47mmf, 10%
C2	22534	1	capacitor, disc, 68mmf, 10%
C3	20501	1	capacitor, paper, 2mfd, 150V, 2%
C4	22536	1	capacitor, disc, 25mmf, 10%
C5	22500	1	capacitor, disc, .001mfd (1K or 1000mmf), GMV
C6	22510	1	capacitor, disc, .02mfd (20K or 20,000mmf), GMV
C7	20001	1	capacitor, paper, .05mfd, 400V, 20%
F1	91007	1	fuse, .5 Amp, 3AG
I1	97715	1	indicator, neon
J1	50002	1	connector, male
L1	36019	1	coil, variable oscillator
L2	35058	1	choke, 1uh
P1	51000	1	connector, female
R1	10407	1	resistor, 1M ohm, 1/2W, 10% (brown,black, green, silver)
R2	10435	1	resistor, 150K ohm, 1/2W, 10% (brown,green,yellow,silver)
R3	10455	1	resistor, 1.5M ohm, 1/2W, 10% (brown,green,green,silver)
R4	10408	1	resistor, 680K ohm, 1/2W, 10% (blue,gray,yellow,silver)
R5	10965	1	resistor, 33 ohms, 2W, 10% (orange,orange,black,silver)

REPLACEMENT PARTS LIST (Cont'd)

SYM.#	STOCK#	AM'T.	DESCRIPTION
R6	10446	1	resistor, 270 ohms, 1/2W, 10% (red,violet,brown,silver)
R7	10426	1	resistor, 33K ohm, 1/2W, 10% (orange,orange,orange,silver)
R8	18089	1	potentiometer, 50K ohm, (LINE ADJ.)
R9	17000	1	potentiometer, W.W., 10K ohm, 10%
R10-R11-S3	18086	1	potentiometer, dual, 5K ohm, 500 ohm. w SPST switch
R12	10448	1	resistor, 68 ohm, 1/2W, 10% (blue, grey, black, silver)
S1	60096	1	switch, rotary
S2	62016	1	switch, slide, DPDT
T1	30052	1	transformer, power
TB1	54013	1	terminal strip, 1 Post left with ground
TB2	54018	1	terminal strip, 4 Post with ground
TB3	54021	1	terminal strip, 2 Post upright left
V1	90002	1	tube, 6C4
V2	90058	1	tube, EM84/6FG6
XF1	97804	1	fuseholder, grey
XV1	97024	1	socket, tube, 7 pin miniature, bottom mount
XV2	97023	1	socket, tube, 9 pin miniature, bottom mount
	40000	12	nut, hex, No. 6-32
	40001	5	nut, hex, 3/8
	40007	11	nut, hex, No. 4-40
	40016	1	nut, hex, 1/2
	41086	8	screw, No. 6-32 x 5/16, binding head
	41047	2	screw, No. 8 self tapping
	41063	4	screw, No. 6-32 x 1/4, flat head
	41089	10	screw, No. 6-32 x 3/16, round head
	41090	8	screw, No. 4-40 x 5/16, binding head
	41091	3	screw, No. 4-40 x 1/4, flat head
	41113	3	screw, No. 4-40 x 1/4, flat head, Type F, self-tapping
	42000	5	washer, lock, 3/8
	42001	4	washer, flat, 3/8
	42002	12	washer, lock, No. 6
	42007	11	washer, lock, No. 4
	42005	4	washer, flat, No. 6
	42029	1	washer, rubber, 1/2"
	42511	1	retainer, spring indicator
	43001	2	lug, pot. solder, 3/8
	43006	2	lug, ground, No. 4
	46004	1	grommet, rubber, 5/8
	46013	4	foot, rubber
	51052	2	clip, crocodile
	53036	2	knob, 1-1/16" diameter
	53037	1	knob, 3/4" diameter
	53052	1	knob, 1-1/2" diameter
	56520	1	retainer, tube
	57004	1	line cord
	58400	length	cable, kinkless, black
	58404	length	cable, kinkless, red
	58405	length	cable, coaxial, 50 ohm, RG58A/U
	80103	1	panel
	81322	1	chassis
	81323	1	bracket, tube
	82104	1	strain relief
	86005	1	frame
	87006	1	handle with rings
	88081	1	cabinet
	89260	1	label
	89525	1	sleeve, insulated rubber, red
	89526	2	sleeve, insulated rubber, black
	89649	2	bracket, handle
	89678	1	dial, plastic
	66104	1	manual of instruction (wired)
	66357	1	manual of construction (kit)

Service Policy

SECTION IV. EICO SERVICE POLICY

SERVICE CONSULTATION

If you are experiencing trouble that you cannot diagnose yourself, you are invited to avail yourself of the EICO Service Consultation Department. The consultant handling your inquiry will make every effort to diagnose the cause of your particular difficulty based on the information that you provide. Please be as thorough as possible. Include the following information about your unit:

a) Have you made a thorough check of the wiring, checking also for cold solder joints, or accidental shorting between parts, or to chassis?

b) Have you checked that the proper tube or transistor is in each socket, and also making proper contact in the socket? Are all shields firmly in place?

c) Does the trouble occur at one time or one operating situation, but not at another time or operating situation? Be as specific as possible in this respect.

d) If the unit is of the type that involves alignment or calibration, be as specific as possible as to what you have done or not done with regard to these requirements. If the unit incorporates tuned circuits stated to be factory pre-aligned, did you change any settings? If so, what alignment procedure did you use?

e) Have you observed any pecularity about a part? If a part appears charred or otherwise damaged by excessive heat, please say so. If you think you have damaged a particular part in the assembly or wiring, please say so. In conjunction with the symptoms, the consultant may be able to determine whether such a part is likely to be defective.

f) Have you gone through any trouble-shooting procedure that may be provided? If your manual includes a table of contacts made at each switch position, have you checked out the switches accordingly (if the trouble is such that doing this would be appropriate)? Have you been able to make checks of the operating voltages and/or resistances, if this is appropriate, and your manual provides a table of voltages and resistances? What are the results of these checks? Also, have you taken any other trouble-shooting approaches? What have been the results?

In addition, list any code numbers in red under the words INSTRUCTION MANUAL on the cover of the book provided with your unit. If there are no red code numbers, state this specifically. If the unit bears a serial number, it is essential that you include this also.

PARTS REPLACEMENT

If it appears that a component is defective, and you desire a replacement from EICO, address your correspondence to our Customer Service Department.

If you are claiming the right to a no-charge replacement under the terms and conditions of the warranty, it is required that you shall have sent in the registration card within 10 days of the date of purchase, and that you send back the defective part transportation prepaid. EICO will make the necessary replacement at no charge for parts eligible under the terms and conditions of the warranty. In returning tubes, pack them very carefully to avoid breakage in shipment. Broken tubes will not be replaced. Please read the warranty on the subject of parts eligible for replacement.

Further information required on a part returned to the factory for a no-charge replacement under the terms and conditions of the warranty is as follows:

a) Model number and serial number, if any, of unit. Also any code numbers in red under the words INSTRUCTION MANUAL on the cover of the book supplied with the unit.

b) Stock number and description of part as given on the parts list.

c) Describe as completely as possible the nature of the defect, or your reason for requiring replacement.

FACTORY REPAIR SERVICE

EICO maintains a Factory Repair Service Department for in-warranty or out-of-warranty repair of EICO equipment. It is intended to serve those customers who are not adequately familiar with electronics to make use of the EICO Service Consultation facilities, or whose difficulties cannot be solved by correspondence.

For all out-of-warranty units, there is a minimum labor and handling fee. For the Model 955, this fee is $6.00 Charges for components replaced are additional to the minimum fee.

For in-warranty completed kit units, there is a minimum labor and handling fee. For the Model 955, this fee is $6.00 There is no charge for a replaced

defective part provided that the terms and conditions of the warranty for no charge replacement are not violated in the judgement of EICO.

For in-warranty factory-wired units, there is no labor and handling fee if the unit complies with the terms and conditions of the warranty in the judgement of EICO. However, if the terms and conditions of the warranty are violated, then there will be charged to customer a minimum labor and handling fee plus the cost of parts replaced.

In all cases, the unit must be sent to the factory transportation prepaid, and the unit will be returned to the customer transportation collect.

The services rendered for the minimum labor and handling fee are the correction of any minor wiring errors (not extensive corrections or re-wiring), the labor involved in replacing defective parts, and any adjustments, alignment, or calibration procedures that would normally be performed on a factory-wired unit. Units not wired according to instructions, or modified in any way, or showing evidence of the use of acid core solder, will not be serviced and will be returned to the customer forthwith.

Units requiring extensive corrections or re-wiring will incur an additional labor charge which will be set by EICO. The customer will be informed of this situation and written authorization from the customer will be required before the work is done.

Please note: minimum labor and handling fees are subject to revision at any time.

LOCAL REPAIR FACILITIES

Out-of-warranty repair work may also be performed by authorized service stations as well as the EICO factory. A list of authorized service stations is provided with this manual. The roster of stations may change from time to time, and if considerable time has elapsed since you purchased your unit, you are advised to contact the station you choose before sending the unit to them for repair. Use of a local service station will often result in faster service, and, usually, lower transportation costs.

It is necessary that you comply with the Shipping Instructions that follow when sending in a unit for service.

SHIPPING INSTRUCTIONS

You are strongly advised to retain the original shipping carton and inserts in the case that re-shipment is required for service or any other purpose. The carton may be collapsed, for storage in as small a space as possible. In very many cases, the same carton is used for kit and factory-wired units so that the kit carton will serve for re-shipment of the completed kit.

To submit a unit for service, either to the factory or an authorized service station,* fill out completely the Service Work Order form provided with the manual.

Pack the unit very carefully, preferably in the original shipping carton with the original inserts.

If this is not possible, use a strong oversize carton, preferably wood, allowing at least 3 inches of resilient packing material such as shredded paper or excelsior, to be inserted between all sides of the unit and the carton. Seal the carton with strong gummed paper tape or strong twine, or both. Include the Service Work Order in the carton and in addition, attach a tag to the instrument on which is printed your name and address and brief reference to the trouble experienced. Affix "FRAGILE" or "HANDLE WITH CARE" labels to at least four sides of the carton, or print these words large and clear with a bright color crayon. Ship by prepaid Railway Express or pacel post to:

EICO Electronic Instrument Co., Inc.
33-00 Northern Blvd.
Long Island City 1, New York
Attention: Service Department

Include your name and address on the outside of the carton. Return shipment will be made transportation charges collect. Note that a carrier cannot be held liable for damages in transit, if packing, IN HIS OPINION, is insufficient.

*Authorized service stations are for out-of-warranty units only, unless the station is specifically noted on the List of Authorized Service Stations to be authorized for other work.

THE EICO WARRANTY

The Electronic Instrument Company, Inc., hereafter referred to as EICO, warrants that, for a period of 90 days from the date of purchase, any EICO kit will be free of defects in parts, and that any EICO factory-wired unit will be free of defects in parts and workmanship. For an EICO kit, EICO's obligation is limited to those parts which are returned transportation prepaid to the factory without further damage, and in the judgement of EICO are either originally defective or have become defective in normal use. For an EICO factory-wired unit, EICO's obligation is limited to those parts, sections, or the entire unit which is returned transportation prepaid to the factory without further damage, and in the judgement of EICO are either originally defective or have become defective in normal use.

The warranty does not apply to any parts damaged in the course of handling, assembling, or wiring by the customer, or damaged due to abnormal usage or in violation of instructions or reasonable practice, or further damaged to a consequential degree in return shipment. Furthermore, the foregoing warranty is made only to the original customer, and is and shall be in lieu of all other warranties, whether expressed or implied, and of all other obligations or liabilities on the part of EICO, and in no event shall EICO be liable for any anticipated profits, consequential damages, loss of time, or other losses incurred by the customer in connection with the purchase or operation of EICO products or components thereof.

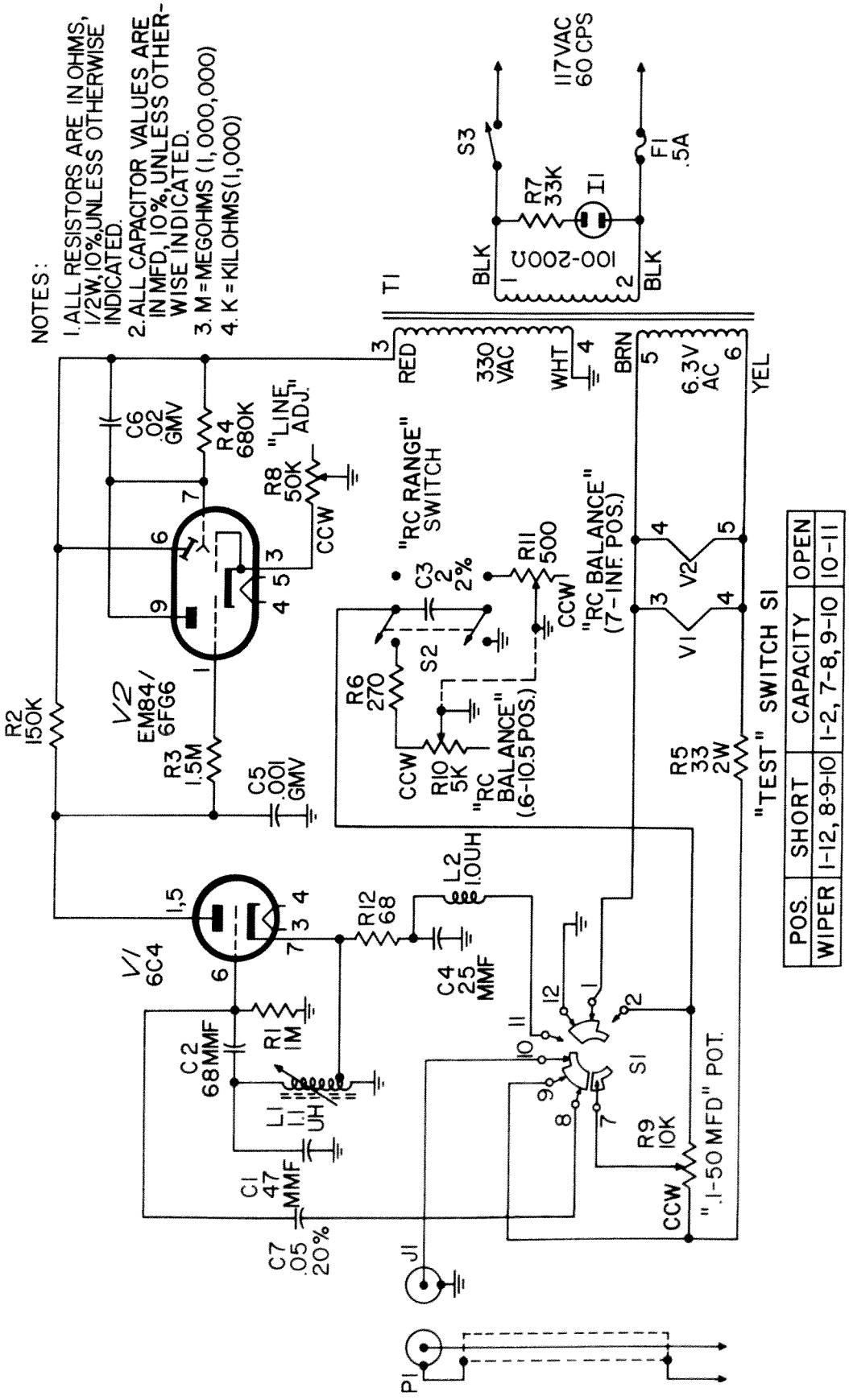
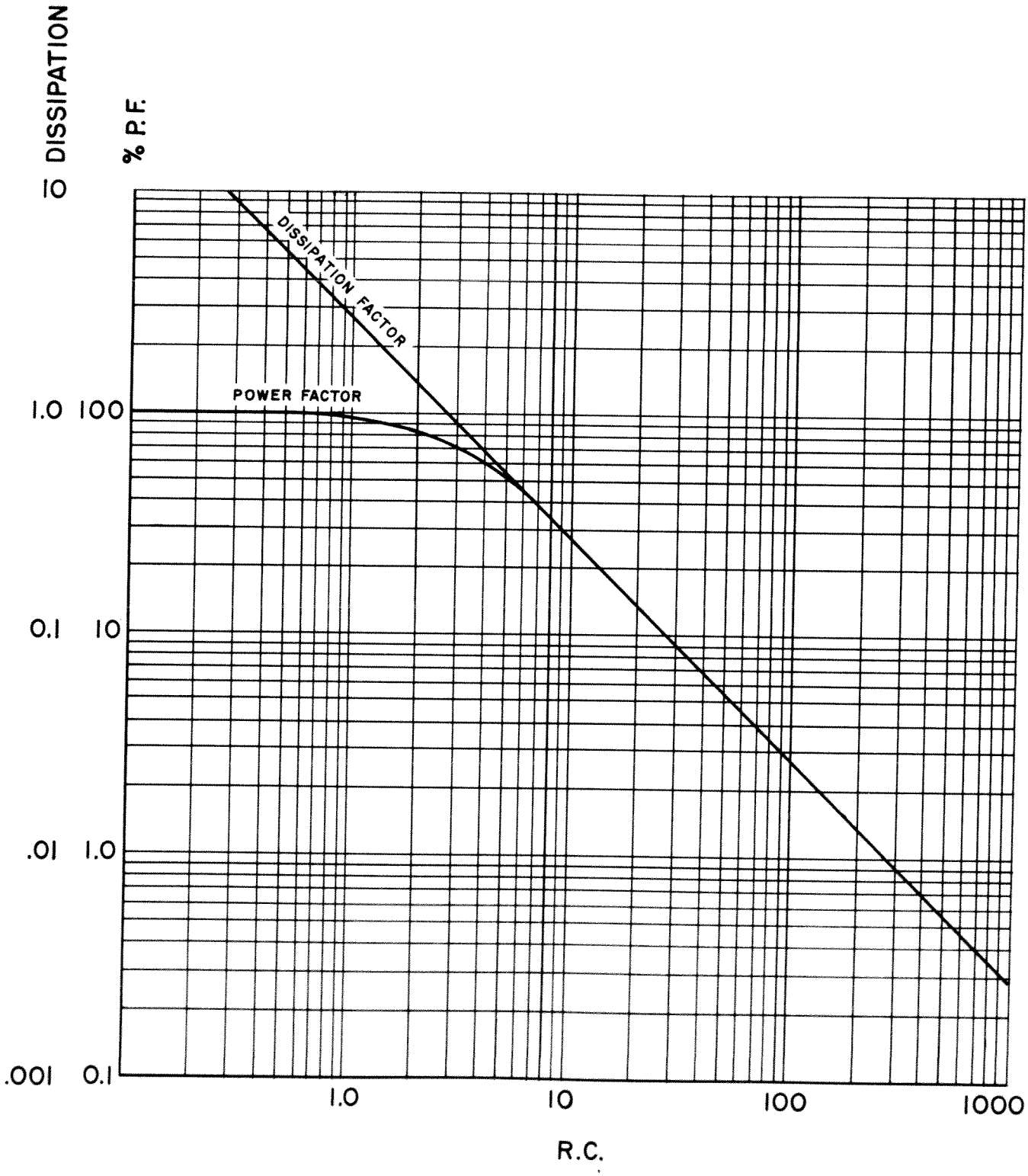
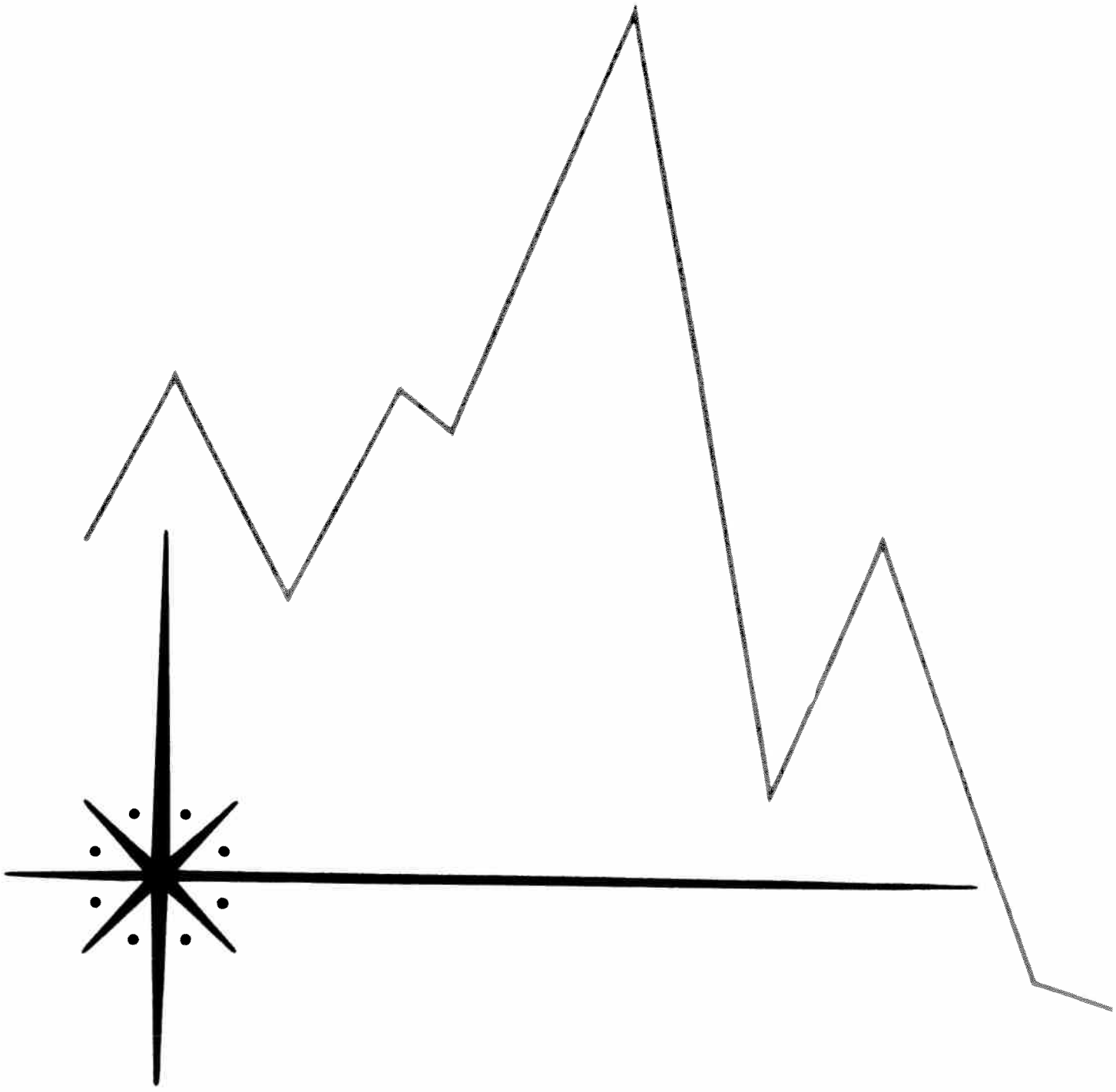


Fig. 4-2. Schematic Diagram w/Switching Table for 955



Graph: Dissipation and Power Factor vs. R.C.



EICO

ANOTHER PERFORMANCE PROVEN PRODUCT

CONSTRUCTION BOOK

955-1

IN-CIRCUIT CAPACITOR TESTER

GENERAL INTRODUCTION

The EICO kit you are about to assemble and wire has been designed to meet the highest standards of performance. It is a high quality Capacitor Tester to be constructed from the finest components available anywhere.

The following Construction Book has been written to carefully guide you through the construction of your kit. If you follow all the instructions implicitly and work carefully without haste, you will be rewarded with many years of fine performance from this instrument and a personal inner satisfaction from a job well done.

The Construction Section: Beginning with the number on this page, and throughout the rest of the construction book, the page numbers are followed by a "C" (1C, 2C, etc.). The Instruction Manual, detailing the installation, operation and maintenance of your instrument, are identified by numerals only, without any letters following these numerals.

After you are certain that you have successfully completed the wiring of your kit, you no longer need the Construction Book. Keep the Instruction Manual for information as to the installation and operation, as well as for any maintenance that may be necessary in the future, on your Capacitor Tester.

Choosing a Workbench and Tools: To avoid the accidental loss or misplacement of components, choose a convenient workbench before unpacking your new kit. You will find it most advantageous to choose a corner on a table that will not be used for any other purpose until you have completed the construction of your kit. Proper precautions should be observed to prevent damage to any table top from a soldering iron or heavy tools.

When you check the component parts against the Parts List later on, it will be convenient to separate the various pieces into types of components and hardware sizes. It will be helpful to keep these sorted pieces separated in the compartments of specially made trays. Small cartons, egg trays or a refrigerator ice tray with dividers serve equally well.

Several basic tools are required to construct this kit. They are:

1. Screwdriver - 3/16" to 1/4" blade
2. Screwdriver - 1/8" blade
3. Longnose pliers - 5" or 6"
4. Gas Pliers
5. Diagonal wire cutters
6. Small soldering iron or pencil iron (35 watts or less).
7. High quality 60-40 rosin core radio solder. DO NOT use Acid Core solder or paste fluxes under any circumstances.

The following tools are useful, but are not absolutely necessary to construct this kit.

1. Socket wrench set
2. Open end wrench set
3. Wire stripper

STK. NO. 66357

Unpacking the Kit: This procedure serves two purposes. First, it lets you get acquainted with the various types of components. Second, it enables you to ascertain if you have received all the parts required to build the kit. This is your opportunity to have any packing errors corrected.

When unpacking, handle all parts carefully so that you will not damage any fragile components. Do not throw any packing material away until you have completed the checking of all components. Check each part off against the "Parts List" which you will find in your Instruction Manual. Check the packing for any small parts.

From time to time, due to modernization or possible error, it may be necessary to correct your Parts List. If there are any changes to be made, they will be listed on the loose addenda sheets included with this book. Make the corrections, if any, before checking the components. If no corrections of your Parts List are noted on the addenda sheets, or if there are no addenda sheets, assume that your Parts List is correct and commence to check all components against this list.

To enable rapid identification of electronic parts, each part has been assigned one or two letters of the alphabet called a "reference designation". These "reference designations" are nothing more than an initial letter or two representing the name of the part. For example, a tube has been assigned the "reference designation" letter "V", and a transformer the letter T. Thus, if you have two vacuum tubes and one transformer in your kit, these parts would be identified by the designation V1, V2 and T1, respectively.

The reference designation assigned to capacitors is C.

All capacitors in this kit may be mounted in either direction. Some paper capacitors have a black line near one end. Although these can be mounted without any concern for direction, it is preferable that the capacitor be mounted with the direction for the black line shown on the drawing. If there is no black line shown on the drawing or on the capacitor, just mount the capacitor in either direction.

The peak or working voltages are important capacitor characteristics. A capacitor marked with a higher voltage may be substituted for a lower voltage unit. Thus, a 50 volt capacitor may be used in place of a 10 volt unit. The reverse is obviously not true. You cannot use a 10 volt unit as a substitute for a 50 volt capacitor. Where more than one capacitor of identical value but different breakdown voltages are used, the unit you are to use is indicated in the appropriate construction step.

Ceramic capacitor tolerance may be noted by a letter rather than a number. "K" is 10%. "M" is 20%. "P" or "GMV" means guaranteed minimum value.

Ceramic capacitors have specific temperature characteristics – percent and degree of variation of capacity with temperature. These variations are indicated by means of a code number stamped on most capacitors. Thus, a capacitor marked 68 Z5E indicates a 68mmf capacitor having a Z5E temperature characteristic. The actual meaning of Z5E, or any other characteristic, is important to the engineer. When building the kit, be sure to use the capacitor with the characteristic specified by the engineer, if it is indicated in the construction steps. If no value is indicated in the construction book, use any of the ceramic capacitors of proper value, tolerance and voltage characteristics, supplied with the kit.

Resistors are denoted by the symbol letter R.

Some resistors have their resistance value stamped on the surface of the resistor body. However, other fixed resistors are coded with color bands which indicate their value. The actual color code of these resistors is noted in the parts list. In some instances, even when the color code is noted in the book, the actual resistor value may be stamped on the body, rather than the color code.

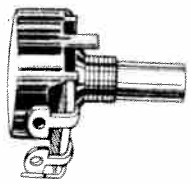
The tolerance of a resistor is the amount the resistance can vary around its marked value. Thus, if a 1K ohm (1000 ohms) resistor has a ±10% tolerance, its actual value can be between 900 ohms and 1100 ohms. If the same resistor has a ± 5% tolerance, its actual value can be between 950 ohms and 1050 ohms. In all cases, the tolerance is always stated or given as part of the color code when the resistor is listed. If the resistor is marked with a number rather than a color code, the tolerance is stamped on the body. In your kit, 5% resistors may be substituted for 10% components and 10% resistors substituted for the 20% ones. However, be certain that you do not use a 10% resistor when a 5% resistor is required or a 20% resistor when a 10% or 5% resistor is specified.

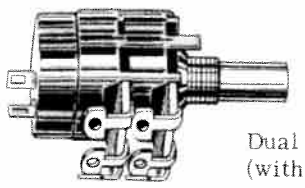
Resistors are capable of dissipating power. Large resistors handle more power while smaller ones handle less. A 1/4 watt resistor is usually smaller than a 1/2 watt unit, while a 1/2 watt resistor is usually smaller than a 1 watt unit. If like valued resistors are used in the kit, differing in power rating, the proper resistor to use is designated in the particular construction step.

Besides the fixed resistors discussed, there are also variable resistors known as potentiometers.

Resistor

Single Potentiometer

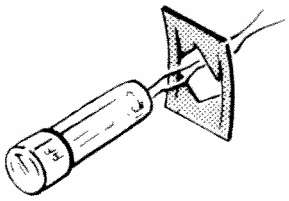




Dual Potentiometer
(with SPST switch)

Inductors or choke coils are designated by the letter L. An inductor is variable if it has a moveable slug, adjusted by a screw head protruding from the inductor's body.

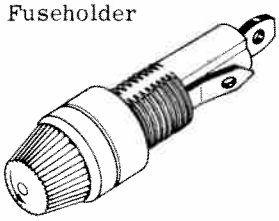
The reference designation given to the neon indicator is I. The spring retainer is used to hold the bulb in the panel.

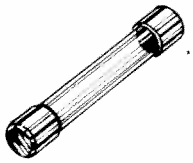


Neon Indicator with Retainer

The fuse has been assigned a reference designation, F, while the fuse holder is denoted by XF.

Fuseholder

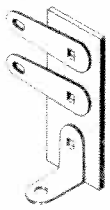




1/2 Amp Fuse

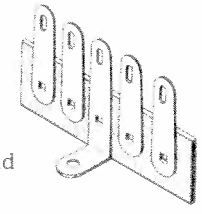
The various types of terminal strips are assigned the designation letters TB. The types used in this kit are illustrated.

TERMINAL STRIPS



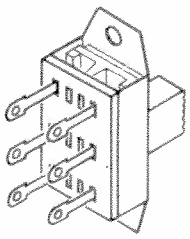
2 Post Left, Upright

1 Post Left with Ground



4 Post with Ground

Switches are designated by the letter S. S1 refers to the switch assigned number 1. S2 refers to the switch assigned number 2. Switches may take several forms. In the 955 the rotary switch has been assigned a number S1.



DPDT
Slide Switch

The power on-off switch S3 is mounted on the rear of the dual pot, R10, R11. The RC ranges are set by actuating a DPDT slide switch.

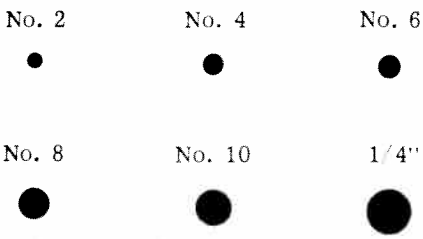
HARDWARE

Hardware is a general term for mechanical parts used in the assembly of EICO kits. Such items are usually screws, nuts and washers. Machine screws are sized in accordance with the diameters of the threaded portion (No. 4, No. 6, No. 8), with the smaller number denoting the smaller diameter. The second number indicates the number of threads to an inch. Thus, a No. 6-32 screw has a No. 6 diameter with 32 threads per inch. The final number indicates the length of the threaded portion. A No. 6-32 x 3/8 screw has a 3/8" long threaded portion. The diameters are shown in the figure.

EXAMPLE:

No. 6-32 x 3/16 Round Head
Length
Threads Per Inch
Diameter

ACTUAL SCREW DIAMETERS

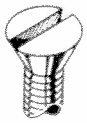


SCREW HEADS

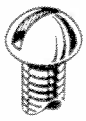
Binding Head

Set Screw (Headless)

Flat Head

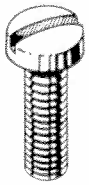


Round Head

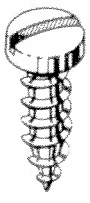


SCREW THREADS

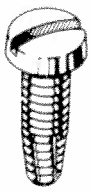
Machine



Self-Tapping



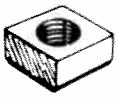
Self Threading



NUTS

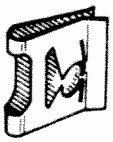
Hex

Square



Ring

Large Tinnerman

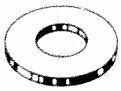


Small Tinnerman

WASHERS

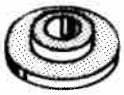
Lock

Flat



Fibre

Shoulder



Rubber

LUGS

Small Solder
(with lock)

Potentiometer
(Solder)

Brass

Small Solder
(without lock)

Spade

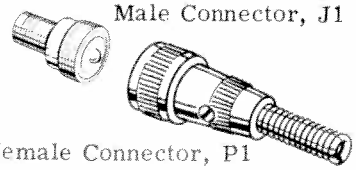
CLAMPS

Plastic

Steel

MISCELLANEOUS

Male Connector, J1



Female Connector, P1

5/8" Rubber
Grommet

The figure also shows the various head types in which these screws are supplied. Use the type specified in the particular step.

Washers and nuts are sized in accordance with the diameter of the screws they are used with.

Various types of washers are supplied. A lockwasher may have internal or external teeth. A flat washer is made out of flat metal. Fiber and bakelite washers are used for insulating devices. They generally separate two metallic pieces of hardware.

Self tapping screws are used where it is not desirable to hold the screw to the chassis by a nut. The screw actually taps the threads in the metal into which it is screwed. The sizes are designated by numbers similar to those used for machine screws, with the smaller number indicating a smaller diameter screw.

Most of the other component parts used with the kit are self evident and require little further explanation or description.

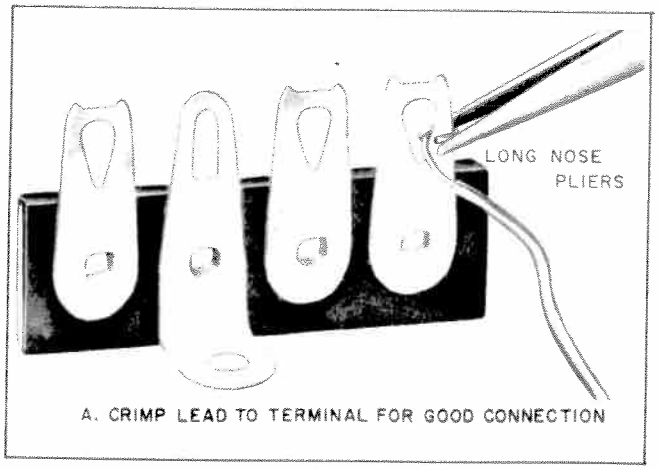
If after having checked all your components against the parts list, you find a shortage, please write us at:

Customer Service
EICO Electronic Instrument Co., Inc.
33-00 Northern Blvd.
Long Island City 1, N. Y.

Include the inspection slip, with your letter, describing the shortage. If there is a slight hardware shortage, you can expedite matters by purchasing these pieces at your local jobber or hardware store.

SOLDERING

Soldering Techniques: To get a good, clean connection, use the soldering techniques described below. USE THE BEST GRADE OF ROSIN CORE RADIO SOLDER ONLY. UNDER NO CIRCUMSTANCES SHOULD ACID CORE SOLDER OR ACID FLUX BE USED. The use of acid core solder or acid paste fluxes can cause serious corrosion and will void all the repair and service guarantees.

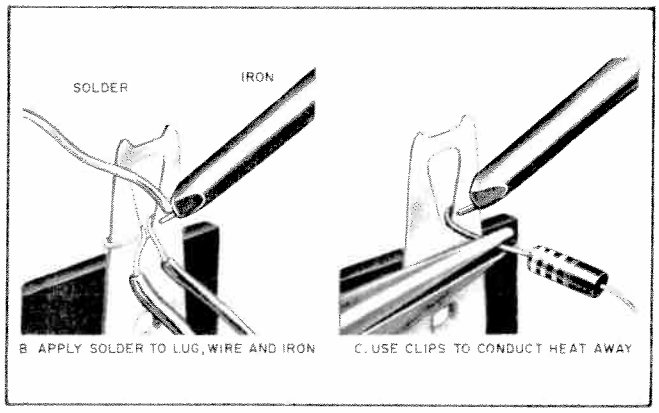


A. CRIMP LEAD TO TERMINAL FOR GOOD CONNECTION

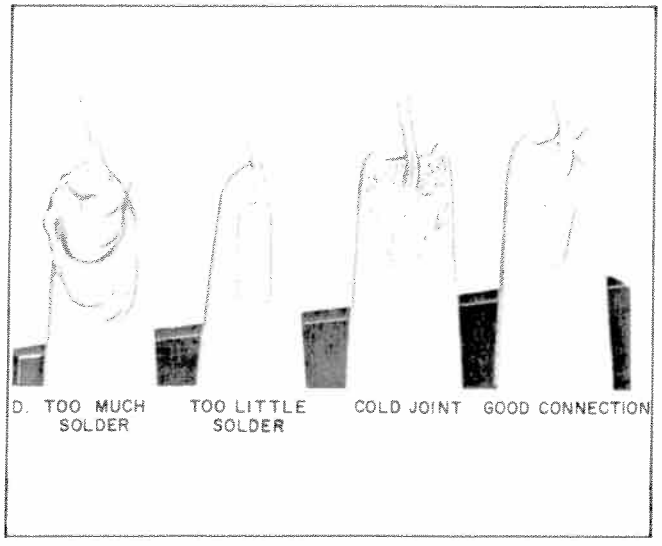
The soldering and wiring techniques described below should be practiced several times before attempting to wire or solder components in the actual kit.

Practice several connections with a spare piece of wire and a socket or terminal strip that can be purchased at your local jobber.

First make a good mechanical connection. Remove 1/4" of insulation from the end of the wire. Feed the wire through the solder lug opening so that the wire insulation just touches the lug. With the long-nose pliers, bend the wire lead around the lug and crimp the wire lead to the lug. To solder the connection, place the tip of the hot soldering iron on the lug or terminal at a point close to the wire being soldered. Apply the solder to the junction of the lug, wire and soldering iron. When the lug and wire have been heated to the correct temperature, the solder will flow into and over the joint. Remove the solder when it starts to flow and remove the iron immediately after. Use only enough solder to cover the wire at the connection point. To get good heat conduction from the iron to the joint, remove scales from the iron tip with steel wool and keep the iron freshly tinned.



A poor solder connection is obvious by its appearance. A grainy or pitted joint is a poor connection due to insufficient heat. Blobs on the wire or solder lug is also due to insufficient heat. Solder should flow as a result of the heated lug and wire. Do not solder by applying solder to the iron tip and then wiping the hot solder onto the joint. A well soldered joint is indicated by a smooth shiny finish on the soldered connection.



Construction Hints: The various lengths of wire to be used in the kit are specified in the construction steps. After cutting the wire to the length specified, strip the insulation off 1/4" from each end. The exposed wire will be used to make the actual connection to the solder lug.

Components such as resistors and neon indicator lamps, may have longer leads than specified. Cut the leads to the length indicated in the particular construction step. This length is to be measured from the body of the component. In the case of insulated leads, strip 1/4" of insulation off from the ends and twist the strands (if any) of the wire together.

As an example, one step may specify that each lead on a resistor be cut to 1/2". 1/4" of each lead is used to make a mechanical connection to the solder lug. The other 1/4" is between the terminal board and the component so that the component will not be overheated when soldering.

When a connection is indicated, a (C) or an (S) will appear next to the lug involved, when appropriate. The (C) indicates that the connection should be simply mechanical without soldering, since other leads are to be connected to this same lug. The (S) indicates that the connection should be made and soldered immediately. However, the (S) is always followed by a number, such as (S1), (S2), (S3), etc. This number indicates the number of connections made to the lug. It is a check on the accuracy of your work.

As an example, if it says (S3) you should count three leads going to the lug to be soldered. If there are less than three leads at this particular lug, you will know that you have forgotten one or more leads, or connected them to the wrong lugs. If there are more than three leads, you can be certain you have connected an extra wire to this lug, which should probably go elsewhere.

When you assemble the parts in your unit, mark the symbol of each component on the chassis near the part, with a crayon. This will facilitate your wiring operation.

When wiring, dress the leads and components as shown in the drawing. Be careful to avoid shorts at the lugs. The book is written so that the wiring closest to the chassis will usually be wired first. A second and third layer of wires will be connected in sequence and place above these.

Next to each step number you will find a parenthesis ( ). After you have completed each step, make a check mark in the parenthesis so that you will have a record of your work. Follow the steps in the sequence given in the book. Do not skip steps or pages.

If any addendas are included in your book to modernize your instrument or to make corrections or part substitutions, be sure to correct the Construction Book first before you start to assemble and wire your kit.

You are now ready to construct your fine instrument.

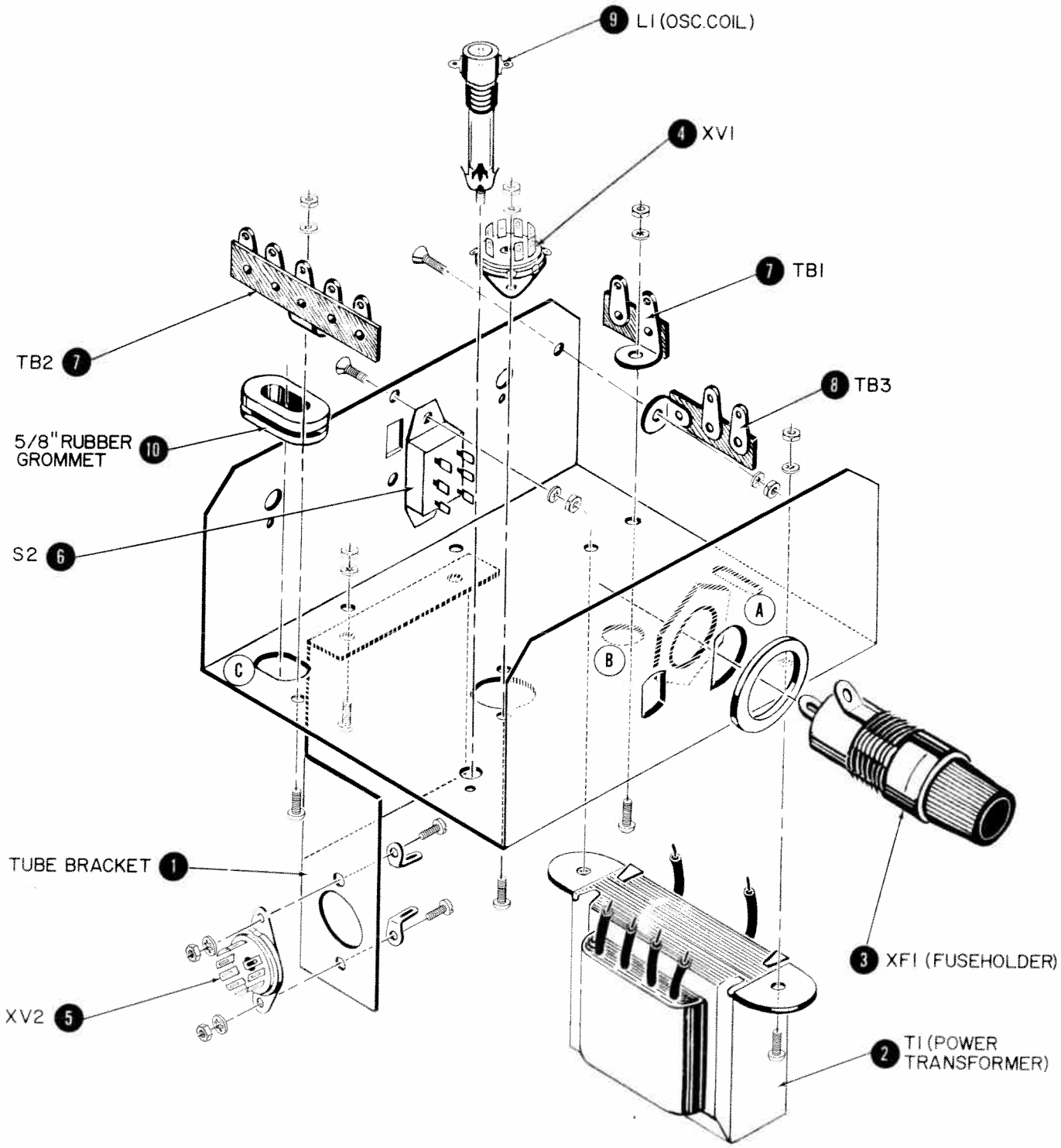


Figure 1. Chassis Mounting

The following steps refer to Figure 1.

( ) 1. Mount the tube bracket to the chassis as shown. Use two No. 6-32 x 5/16 binding head screws, two No. 6 lockwashers and two No. 6-32 hex nuts. Orient it as shown in Figure 6.

( ) 2. Mount the power transformer, T1, to the chassis as shown. Orient it so that the two black leads are closest to the edge of the chassis, near the slit "A". Pass the black leads through slit "A" and all other leads through round hole "B". Secure the transformer to the chassis using two No. 6-32 x 5/16 binding head screws, two No. 6 lockwashers and two No. 6-32 hex nuts.

( ) 3. Place a 1/2" rubber washer over the fuseholder, XF1. Insert the fuseholder into the rear apron as shown. Secure with a 1/2"-24 hex nut. Do not overtighten or the fuseholder may crack.

( ) 4. Mount the seven pin miniature socket, XV1, to the bottom surface of the chassis, as shown. Orient it so that the space between pins 1 and 7 are closest to the nearest edge of the chassis. Use two No. 4-40 x 5/16 binding head screws, two No. 4 lockwashers and two No. 4-40 hex nuts. Note the orientation in Figure 4.

( ) 5. Mount the nine pin miniature socket XV2, to the tube bracket, as shown. Orient it so that the space between pins 1 and 9 are facing the main chassis. Secure it to the bracket using two No. 4-40 x 5/16 binding head screws, two No. 4 lockwashers and two No. 4-40 hex nuts. Under each of the screw heads, place one No. 4 ground lug. Bend pin No. 8 flat against the socket. See Figure 6.

( ) 6. Mount the slide switch, S2, to the front apron of the chassis, as shown. Use two No. 4-40 x 1/4 flat head screws, two No. 4 lockwashers and two No. 4-40 hex nuts.

( ) 7. Mount the one post left with ground terminal strip, TB1, and the four post with ground terminal strip, TB2, to the chassis as shown. Use one No. 6-32 x 5/16 binding head screw, one No. 6 lockwasher and one No. 6-32 hex nut for each.

( ) 8. Mount the two post upright left terminal strip, TB3, to the front apron of the chassis. Use one No. 4-40 x 1/4 flat head screw, one No. 4 lockwasher and one No. 4-40 hex nut.

( ) 9. On the metal mounting clip of the variable (slug adjusted by screw) oscillator coil, L1, are two wings. There is a small pin or locating key on one of these wings. Next to the mounting hole in the chassis, you will find a tiny hole. When properly mounted and oriented, the locating key will fit into this hole.

Push the mounting clip portion of the coil through the mounting hole, orienting it so that the locating key fits through the appropriate hole. Push the coil form towards the chassis so that the sides of the metal mounting clip spread out to hold the coil firmly to the chassis.

( ) 10. Push the 5/8" rubber grommet into hole "C" in the chassis.

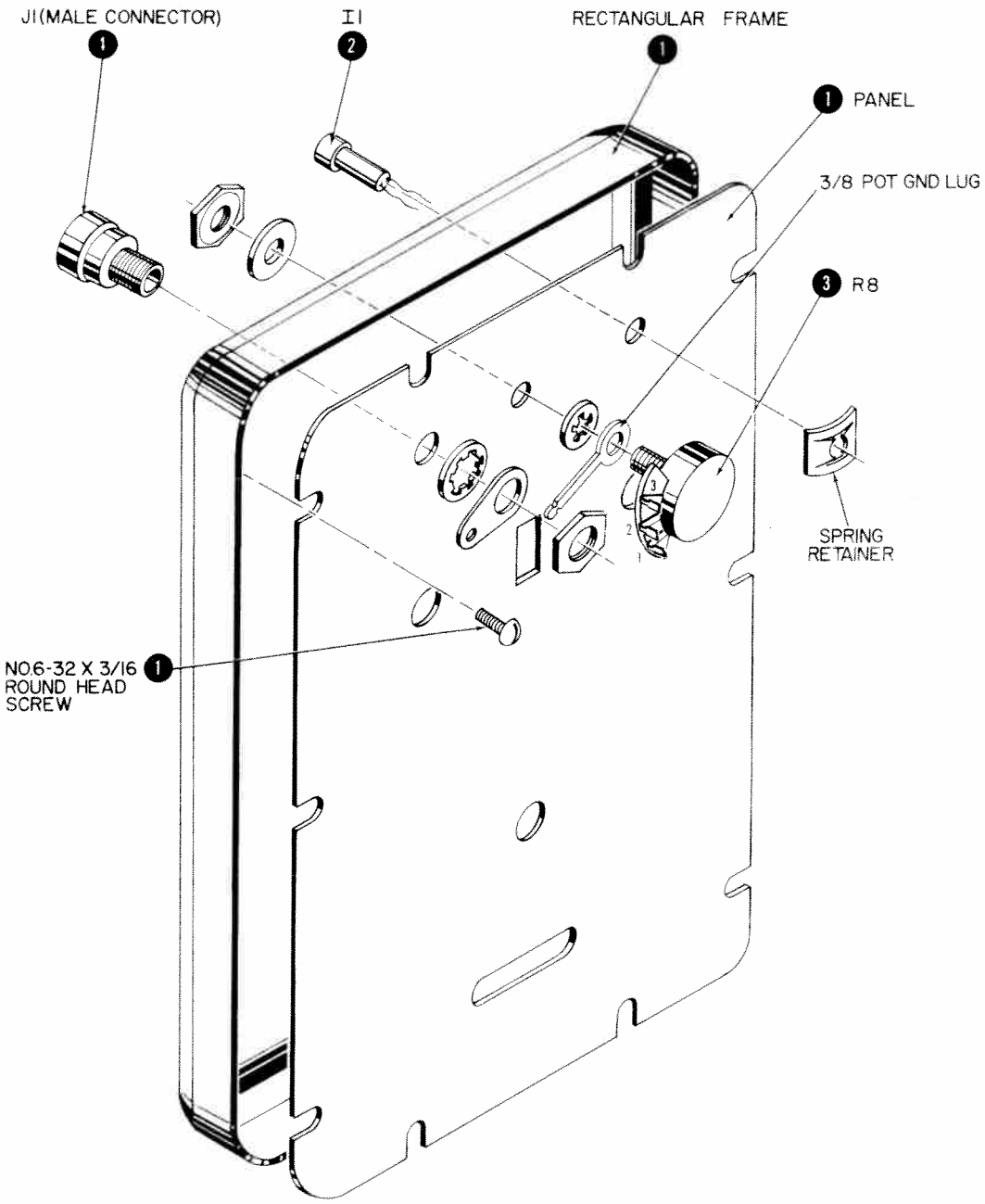


Figure 2. Panel Mounting

The following steps refer to Figure 2.

PANEL MOUNTING

( ) 1. Place the rectangular frame on the worktable with the tapped screw holes up toward you. Insert the panel face (printed side) down into the frame. Secure the panel to the frame with ten No. 6-32 x 3/16 round head screws.

( ) 2. Pass the neon indicator bulb, I1, through its hole from the front of the panel. Use the flat spring indicator retainer to secure the bulb to the panel. Press the retainer over the rear of the bulb while holding the bulb to the front panel with your hands or resting it against a small wooden block.

( ) 3. Mount the 50K potentiometer, R8, into the hole in the front panel marked LINE ADJ. Use a 3/8 lockwasher and the 3/8 pot. solder lug between the potentiometer and the panel. Use a 3/8 flatwasher and 3/8 hex nut to secure the potentiometer to the panel. Bend the 3/8 lug over R8-2 and solder it to this terminal on the potentiometer.

( ) 4. Mount the male connector J1, into the hole under the EICO 955, in the front panel. At the rear surface of the panel, place a lockwasher and the solder lug over the threaded portion of the connector. Secure the entire assembly with the hex nut. (Discard fibre washers).

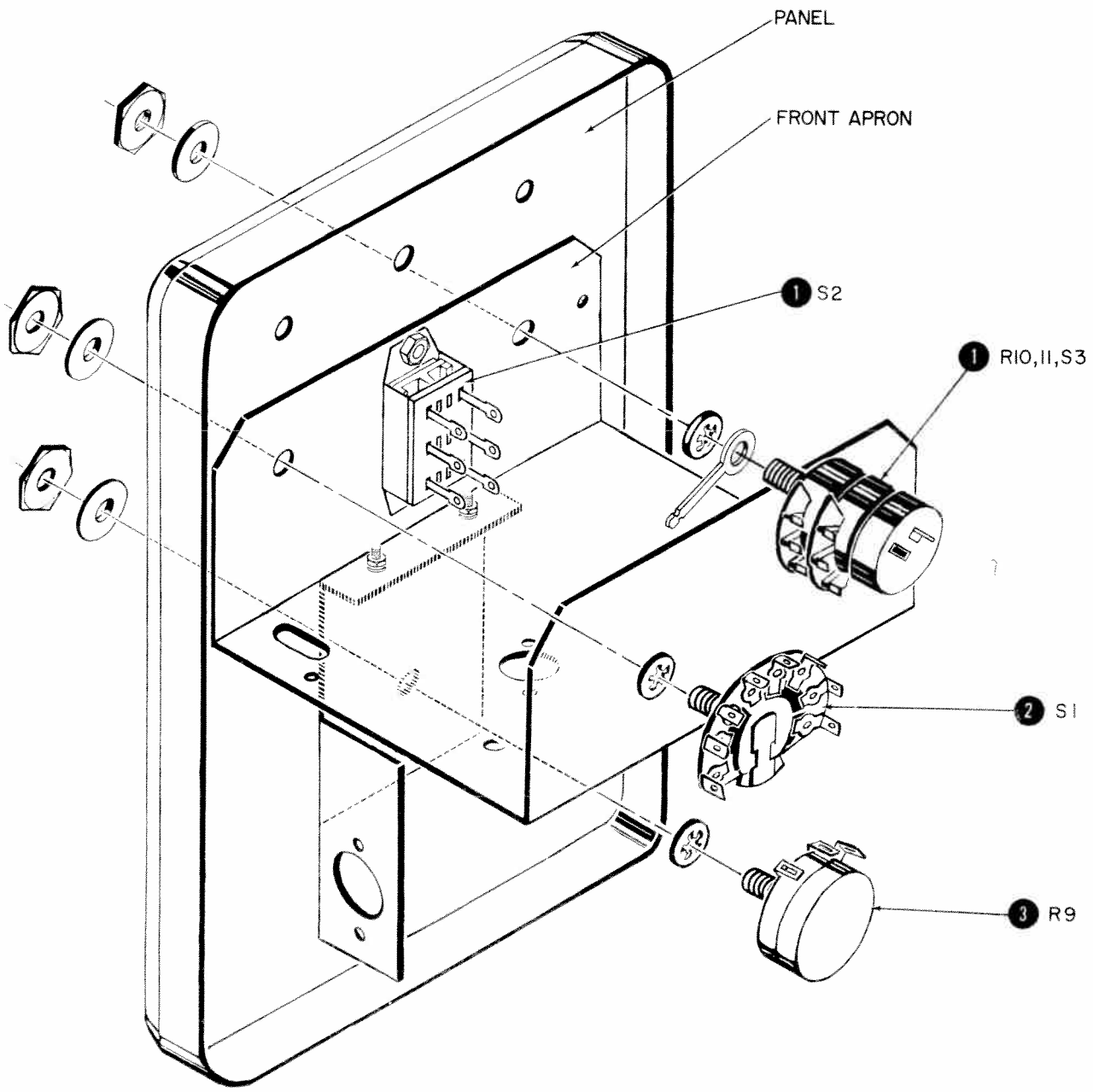


Figure 3. Mounting the Chassis to Front Panel

The following steps refer to Figure 3.

( ) 1. Place the front apron of the chassis against the rear surface of the panel. The slider on the slide switch must pass through the hole marked RC range. The remaining holes in the panel must line up with those on the front apron of the chassis. Mount the dual potentiometer with switch, R10, R11, S3, through the hole marked RC BALANCE. This potentiometer shaft-bushing is to pass through the hole in the chassis and the panel. Use a 3/8 lockwasher and a 3/8" pot. solder lug between the potentiometer and the chassis and a 3/8 flat washer and 3/8 hex nut to secure the potentiometer to the panel.

( ) 2. Mount the rotary switch, S1, through the hole marked TEST. The switch shaft and bushing is to pass through the hole in the chassis and the panel. Use a 3/8 lockwasher between the switch and the panel and a 3/8 flatwasher and 3/8 hex nut to secure the switch to the panel.

( ) 3. Mount the 10K wire wound potentiometer, R9, through the remaining hole in the panel. This potentiometer shaft and bushing is to pass through the hole in the tube bracket and panel. Use a 3/8 lockwasher between the potentiometer and the bracket and a 3/8 flatwasher and 3/8 hex nut to secure the potentiometer to the panel.

The following steps refer to Figure 4. Here, all parts have been mounted, but the panel is not shown to simplify the drawing.

( ) 1. From hole "B", connect the red lead to TB2-2 (C), the brown lead to XV1-3 (C), the yellow lead to XV1-4 (C) and the white lead to TB1-2 (S1).

( ) 2. Connect a 4" piece of brown wire from S2-5 (S1) to TB1-1 (C).

( ) 3. Cut both leads on the 33K (orange, orange, orange, silver) resistor, R7, to 5/8". Connect from TB3-2 (C) to R10, R11, S3-8 (C). Do not short the leads of the resistor to the body of the potentiometer.

( ) 4. Connect a 5/8" piece of bare wire from R10, R11, S3-1 (C) to R10, R11, S3-2 (C).

( ) 5. Connect a 7/8" piece of bare wire from R10, R11, S3-1 (S2) to S2-6 (S1).

( ) 6. Connect a 7/8" piece of bare wire from R10, R11, S3-3 (S1) to S2-4 (S1).

( ) 7. Connect a 7/8" piece of bare wire from R10, R11, S3-2 (S2) to R10, R11, S3-5 (C). Solder ground lug to S3-2.

( ) 8. Connect a 5/8" piece of bare wire from R10, R11, S3-5 (S2) to R10, R11, S3-6 (S1).

( ) 9. Cut both leads on a 270 ohm (red, violet, brown, silver) resistor, R6, to 5/8". Connect from S2-3 (S1) to R10, 11, S3-4 (S1).

( ) 10. Connect one end of an 8" piece of yellow wire to XV1-4 (C) and one end of an 8" piece of brown wire to XV1-3 (C). Twist the two leads together and run them along the chassis, as shown. Push the other end of the two leads through the grommet into hole "C" to the top of the chassis.

( ) 11. Connect one end of a 6" piece of brown wire to XV1-3 (S3). Run it along the chassis, as shown. Connect the other end of S1-1 (S1).

( ) 12. Connect one end of a 1-1/2" piece of black wire to lug "Z" (C) at XV1. The other end will be connected later.

( ) 13. Cut both leads on the .001mfd (1K or 1000mmf) disc capacitor, C5, to 5/8". Connect from XV1-5 (S1) to ground lug "Y" (S1) at XV1.

( ) 14. Cut both leads on the 1 Meg (brown, black, green, silver) resistor, R1, to 1/2". Connect from XV1-6 (C) to ground lug "Z" (S2) at XV1.

( ) 15. Connect a 1-1/2" piece of white wire from TB2-5 (C) to S1-2 (S1).

( ) 16. Connect one end of a 6" piece of blue wire to S1-7 (S1). Run it along the chassis as shown. Push the other end of the lead through the grommet into hole "C" to the top of the chassis.

( ) 17. Connect one end of a 7" piece of orange wire to S1-9 (C). Run it along the chassis as shown. Push the other end of the lead through the grommet in hole "C" to the top of the chassis.

( ) 18. Connect a 4" piece of white wire from S2-2 (S1) to TB2-5 (C).

( ) 19. Connect one end of a 5" piece of white wire to TB2-5 (C). Push the other end of the lead through the grommet into hole "C" to the top of the chassis.

( ) 20. Cut both leads on the 1.5M (brown, green, green, silver) resistor, R3, to 5/8". Connect from XV1-1 (C) to TB2-1 (C).

( ) 21. Cut both leads on the 150K (brown, green, yellow, silver) resistor, R2, to 5/8". Connect from TB2-2 (C) to XV1-1 (S2).

( ) 22. Cut both leads on the .05mfd, 400V, 20% paper capacitor, C7, to 1-1/4". Cover each lead with a 1" piece of spaghetti. Connect from XV1-6 (C) to S1-8 (S1).

( ) 23. Cut both leads on the 33 ohm (orange, orange, black, silver) 2 watt resistor, R5, to 1-1/4". Cover each lead with a 1" piece of spaghetti. Connect from XV1-4 (S3) to S1-9 (S2).

( ) 24. Cut both leads on the 25mmf disc capacitor, C4, to 1/2". Connect from TB2-3 (S1) to TB2-4 (C).

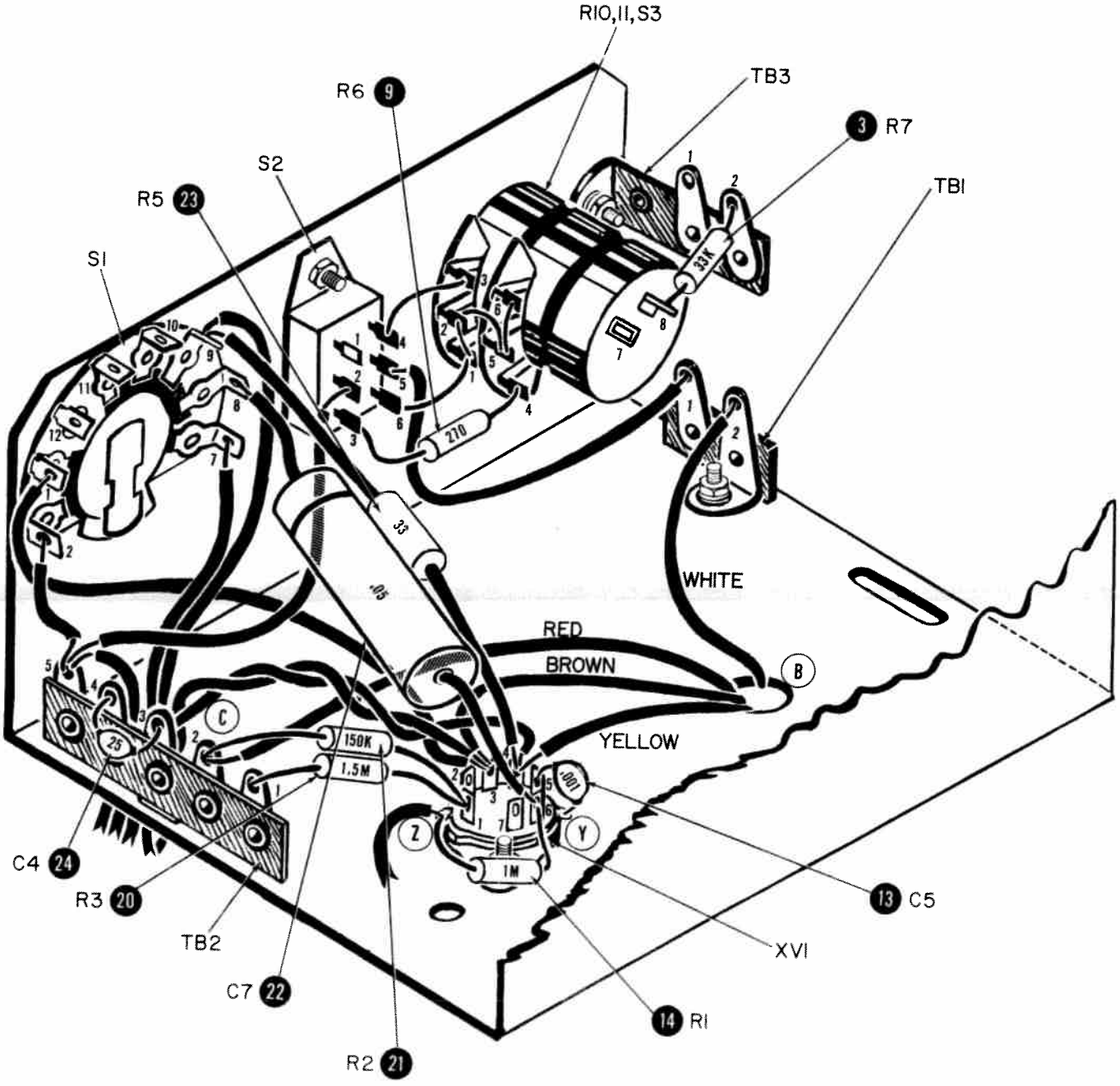


Figure 4. Bottom Chassis Wiring

The following steps refer to Figure 5.

( ) 1. Connect one end of a 9" piece of violet wire to R8-1 (S1). Run it along the chassis as shown under all previously mounted components and wires. Push it through the grommet in hole "C" to the top of the chassis.

( ) 2. Connect one end of a 5" piece of red wire to TB2-2 (S3). Run it along the chassis as shown. Push the other end through the grommet in hole "C" to the top of the chassis.

( ) 3. Connect one end of a 5" piece of green wire to TB2-1 (S2). Run it along the chassis as shown, under all components. Put it through the grommet in hole "C" to the top of the chassis.

( ) 4. From slot "A" in the chassis, connect one black lead to R10, R11, S3-8 (S2) and the second black lead to XF1-2 (C).

( ) 5. Cut both leads from neon indicator, I1, to 1-1/2". Cover each lead with a 1-1/4" piece of spaghetti. Connect one lead to TB3-1 (C) and the second lead to TB3-2 (S2).

( ) 6. Connect a 6-1/2" piece of black wire from TB3-1 (S2) to XF1-2 (S2). Run it along the chassis as shown.

( ) 7. Connect a 1-1/4" piece of bare wire from S1-12 (S1) to J1-1 (S1).

( ) 8. Twist all leads on one end of a 2" piece of red kinkless cable. Tin these leads with solder so that all strands will be soldered together. Push this end through the center of jack J1, so that the tinned leads will pass through the hole in the center of the jack. Solder this to the center of the jack. When completed, a small ball of solder should be formed at the center. Trim off any excess wire and solder. Do not let solder or rosin flow too freely or it will short the center to the threaded portion or ground. Be sure that the connection is soldered well and that you do not have a cold solder joint. Connect the other end of the lead to S1-10 (S1).

( ) 9. One end of a black lead was previously connected to ground lug "Z" at XV1. Connect the other end of this lead to L1-3 (C).

( ) 10. Cut both leads on the 47mmf disc capacitor, C1, to 5/8". Connect from L1-3 (S2) to L1-1 (C).

( ) 11. Cut both leads on the 68mmf disc capacitor, C2, to 3/4". Connect from XV1-6 (S3) to L1-1 (S2).

( ) 12. Connect a 1-1/4" piece of bare wire covered with a 7/8" piece of spaghetti from L1-2 (C) to XV1-7 (S1).

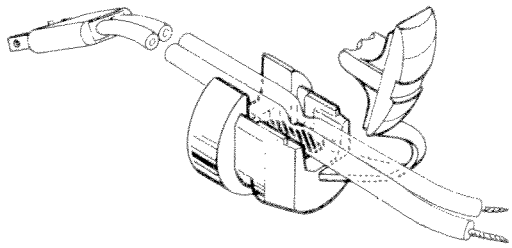
( ) 13. Cut both leads on the 2mfd, 150 volts paper capacitor, C3, to 1-1/4". Slide this capacitor under all components to the corner of the chassis. Connect from TB2-5 (S4) to TB1-1 (S2).

( ) 14. Cut one lead on the 1uh choke, L2, to 5/8" and the other lead to 1". Connect the shorter lead to TB2-4 (C) and the longer lead to S1-11 (S1).

( ) 15. Cut both leads on the 68 ohm (blue, gray, black, silver) resistor, R12, to 1". Cover each lead with a 3/4" piece of spaghetti. Connect from TB2-4 (S3) to L1-2 (S2).

NOTE: The line cord and strain relief will be mounted and connected after the wiring is completed in Figure 6.

( ) 16. Referring to figure 5 and the insert, place the line cord 4" from the tinned ends, onto the groove of the larger section and between the two sections of the two piece strain relief, with the tinned ends toward the smaller section. Bend the smaller section over the line cord and position the smaller section in the channel of the larger section. Compress the two sections together with a plier, grasping the larger diameter end of the strain relief. Pass the tinned ends of the line cord through the hole from the rear of the chassis and press it in until it snaps into position. Connect one tinned lead to R10, R11, S3-7 (S1) and the second tinned lead to XF1-1 (S1).



Detail of Strain Relief

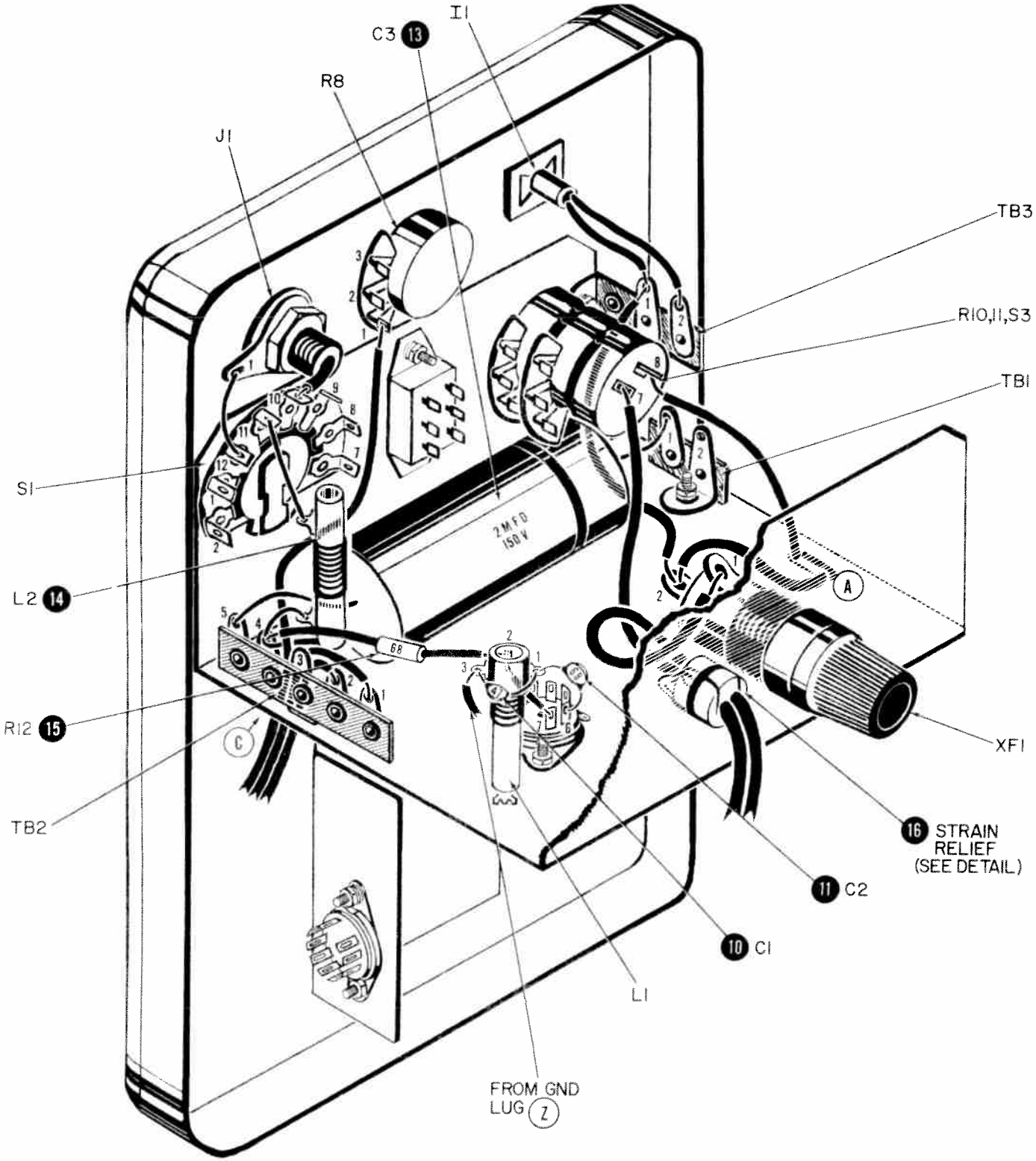


Figure 5. Bottom Chassis Wiring (Cont'd.)

The following steps refer to Figure 5.

( ) 1. Connect one end of a 9" piece of violet wire to R8-1 (S1). Run it along the chassis as shown under all previously mounted components and wires. Push it through the grommet in hole "C" to the top of the chassis.

( ) 2. Connect one end of a 5" piece of red wire to TB2-2 (S3). Run it along the chassis as shown. Push the other end through the grommet in hole "C" to the top of the chassis.

( ) 3. Connect one end of a 5" piece of green wire to TB2-1 (S2). Run it along the chassis as shown, under all components. Put it through the grommet in hole "C" to the top of the chassis.

( ) 4. From slot "A" in the chassis, connect one black lead to R10, R11, S3-8 (S2) and the second black lead to XF1-2 (C).

( ) 5. Cut both leads from neon indicator, I1, to 1-1/2". Cover each lead with a 1-1/4" piece of spaghetti. Connect one lead to TB3-1 (C) and the second lead to TB3-2 (S2).

( ) 6. Connect a 6-1/2" piece of black wire from TB3-1 (S2) to XF1-2 (S2). Run it along the chassis as shown.

( ) 7. Connect a 1-1/4" piece of bare wire from S1-12 (S1) to J1-1 (S1).

( ) 8. Twist all leads on one end of a 2" piece of red kinkless cable. Tin these leads with solder so that all strands will be soldered together. Push this end through the center of jack J1, so that the tinned leads will pass through the hole in the center of the jack. Solder this to the center of the jack. When completed, a small ball of solder should be formed at the center. Trim off any excess wire and solder. Do not let solder or rosin flow too freely or it will short the center to the threaded portion or ground. Be sure that the connection is soldered well and that you do not have a cold solder joint. Connect the other end of the lead to S1-10 (S1).

( ) 9. One end of a black lead was previously connected to ground lug "Z" at XV1. Connect the other end of this lead to L1-3 (C).

( ) 10. Cut both leads on the 47mmf disc capacitor, C1, to 5/8". Connect from L1-3 (S2) to L1-1 (C).

( ) 11. Cut both leads on the 68mmf disc capacitor, C2, to 3/4". Connect from XV1-6 (S3) to L1-1 (S2).

( ) 12. Connect a 1-1/4" piece of bare wire covered with a 7/8" piece of spaghetti from L1-2 (C) to XV1-7 (S1).

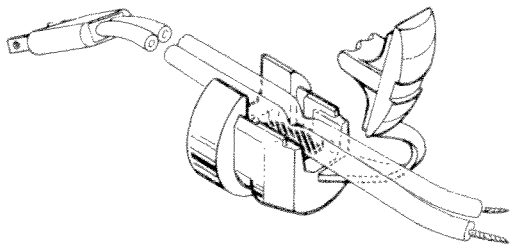
( ) 13. Cut both leads on the 2mfd, 150 volts paper capacitor, C3, to 1-1/4". Slide this capacitor under all components to the corner of the chassis. Connect from TB2-5 (S4) to TB1-1 (S2).

( ) 14. Cut one lead on the 1uh choke, L2, to 5/8" and the other lead to 1". Connect the shorter lead to TB2-4 (C) and the longer lead to S1-11 (S1).

( ) 15. Cut both leads on the 68 ohm (blue, gray, black, silver) resistor, R12, to 1". Cover each lead with a 3/4" piece of spaghetti. Connect from TB2-4 (S3) to L1-2 (S2).

NOTE: The line cord and strain relief will be mounted and connected after the wiring is completed in Figure 6.

( ) 16. Referring to figure 5 and the insert, place the line cord 4" from the tinned ends, onto the groove of the larger section and between the two sections of the two piece strain relief, with the tinned ends toward the smaller section. Bend the smaller section over the line cord and position the smaller section in the channel of the larger section. Compress the two sections together with a plier, grasping the larger diameter end of the strain relief. Pass the tinned ends of the line cord through the hole from the rear of the chassis and press it in until it snaps into position. Connect one tinned lead to R10, R11, S3-7 (S1) and the second tinned lead to XF1-1 (S1).



Detail of Strain Relief

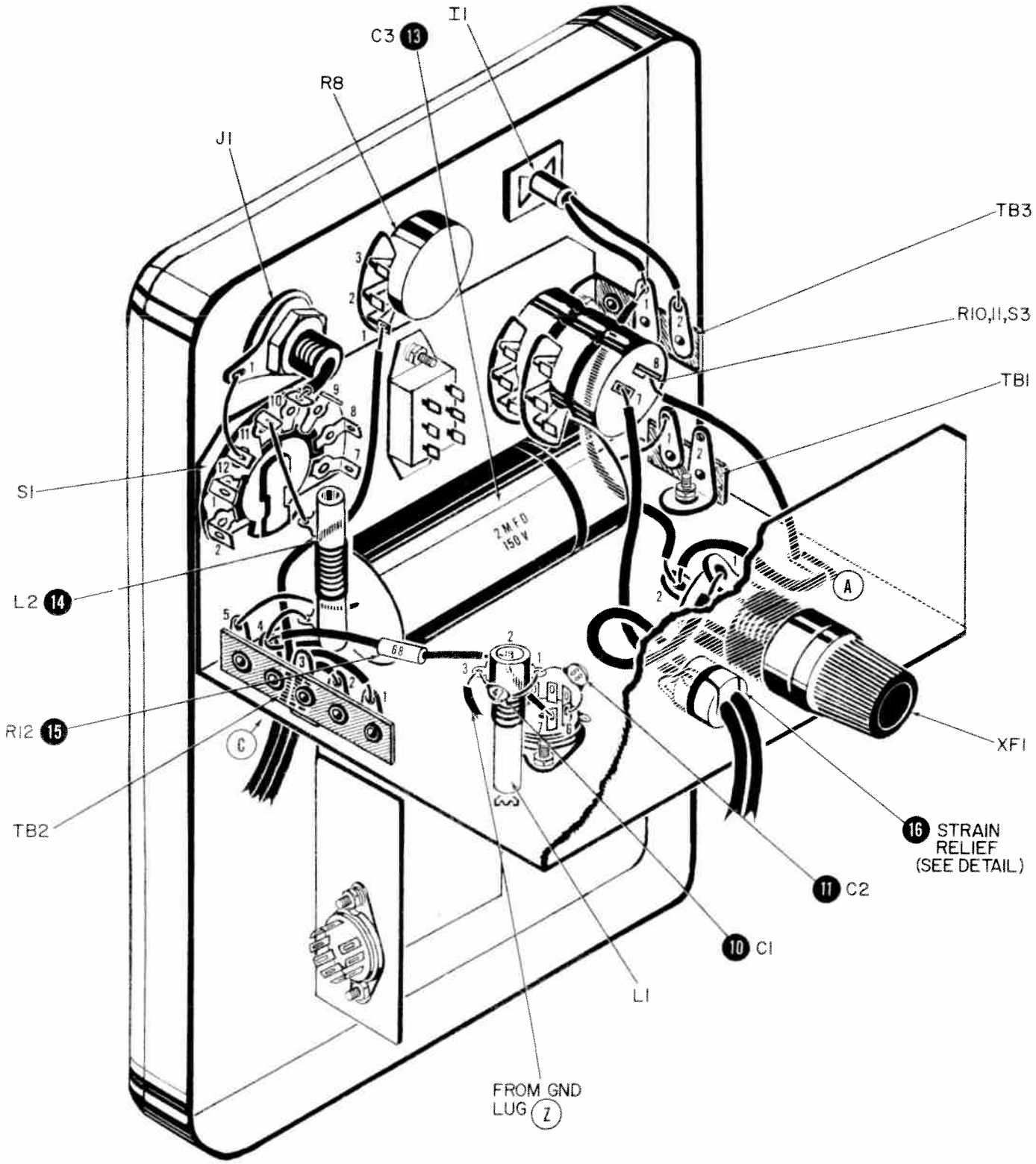
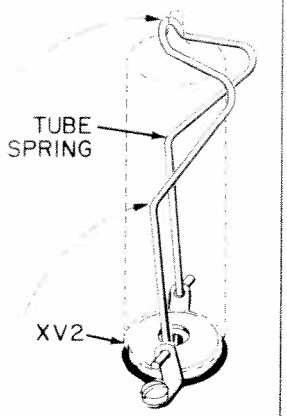


Figure 5. Bottom Chassis Wiring (Cont'd.)



Detail of Tube Spring

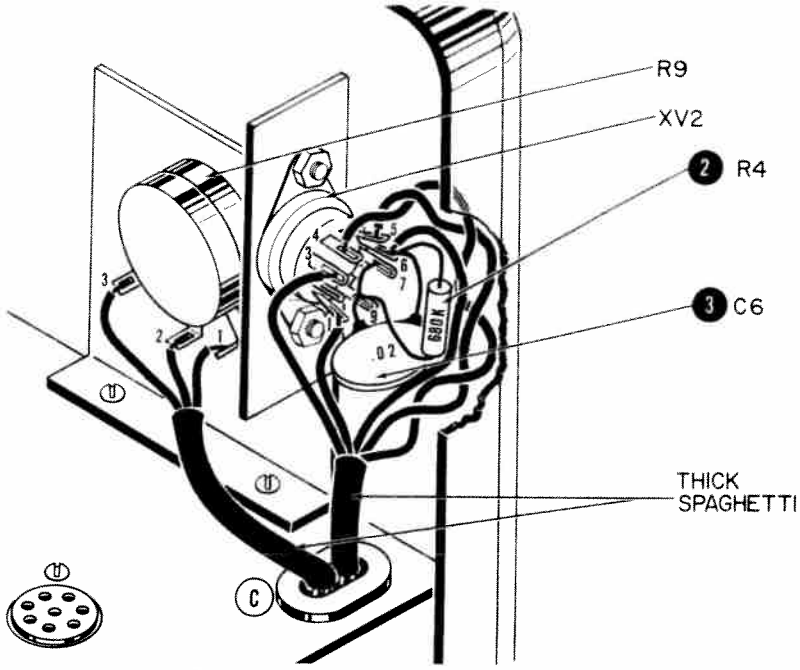


Figure 6. Top Chassis Wiring

The following steps refer to Figure 6.

( ) 1. Connect a 3/4" piece of bare wire from XV2-7 (S1) to XV2-9 (C).

( ) 2. Cut both leads on the 680K (blue, grey, yellow, silver) resistor, R4, to 1/2". Connect from XV2-6 (C) to XV2-9 (C).

( ) 3. Cut both leads on the .02 mfd (20K or 20,000mmf) disc capacitor, C6, to 1/2". Connect from XV2-6 (C) to XV2-9 (S3).

( ) 4. Slip a 2-1/4" length of thick spaghetti over the red, green, violet brown and yellow leads from hole "C". Run it along the front panel as shown. Connect the red lead to XV2-6 (S3), the yellow lead to XV2-5 (S1), the brown lead to XV2-4 (S1), the violet lead to XV2-3 (S1) and the green lead to XV2-1 (S1).

( ) 5. Slip a 2-1/4" piece of thick spaghetti over the orange, blue and white leads from hole "C". Run it along the front panel as shown. Connect the orange lead to R9-1 (S1), the blue lead to R9-2 (S1) and the white lead to R9-3 (S1).

( ) 6. Bend the two ground lugs at socket XV2 so that they are perpendicular to the bracket. Insert the tabs of the tube spring into both ground lugs. Orient the spring as shown in the detail drawing with the sharp bend towards the front panel. Insert the EM84 Indicator tube V2, into XV2 socket. Secure V2 in the socket by pushing the spring over the tube.

( ) 7. Insert the 6C4 tube, V1, into the 7 pin socket.

The following steps refer to Figure 7.

( ) 1. Cut the length of the coaxial cable to 42".

( ) 2. Slip one of the black insulated rubber sleeves over one end of the cable. It will be necessary to moisten the cable first, so that the sleeve will slide over it. Temporarily, position the sleeve at about the center of the cable.

( ) 3. Strip the end of the cable closest to the narrower portion of the sleeve as shown. To do this, strip back 3/4" of the outer insulation, 1/2" of the shield and 1/4" of the insulation from the inner conductor.

( ) 4. Loosen the screw in the side of the connector and pull the spring out. Push the stripped end of the cable through the larger diameter end of the spring until the shield braid just protrudes from the smaller diameter end. Solder the braid to the edge of the spring. Do not use excess solder. Replace the spring in the rest of the connector. While doing this, pass the inner conductor of the cable through the hole in the center of the bakelite section of the connector. Retighten the set screw at the side of the connector. Solder the center conductor to the center of the plug. When completed, a small ball of solder should be found at the center. Trim off any excess wire and solder from the center conductor. Do not let solder or rosin flow too freely or it will short the center to the threaded portion. Be sure that the connection is soldered well and that you do not have a cold solder joint.

( ) 5. On the other end of the same piece of coaxial cable, strip the outer insulation back 3/4". Separate all the wire strands in the metal braid and twist them together. Strip the insulation back 1/2" from the inner conductor.

( ) 6. Connect one end of a 5" piece of kinkless red

cable to one alligator clip and one end of a 5" piece of kinkless black cable to a second alligator clip. Slip a red insulated sleeve over the alligator clip on the red cable and a black insulated sleeve over the alligator clip on the black cable. You can do this by sliding the wider portion of the sleeve over the end of the cable without the clip and then forcing this portion over the clip.

( ) 7. Strip back 1/2" from the remaining ends of the black and red kinkless cables. Connect this end of the red wire to the center conductor of the shielded cable and this end of the black wire to the twisted shield strands on the shielded cable. Wind electrical tape over a 1" length of each of these leads so that they will not short to each other. With a piece of tape, tie the two leads together. Once again moisten the outer insulation of the shielded lead and force the black insulated rubber sleeve (now located at the center of the cable) into a position so that it will cover the taped portion of the leads.

FINAL STEPS

You have now completed the assembly and wiring of your In-Circuit Capacitor Tester. When you have completed the following steps your unit will be ready for use.

( ) 1. To catch any wiring errors, it is suggested that the entire wiring be checked point-by-point against the wiring instructions (and preferably also against the schematic wiring diagram) in order to become more familiar with the component layout and circuitry. While doing so, check for rosin joints, loose lumps of solder, poor lead dress, and accidental shorts or leakage paths arising from the flow of rosin between contacts. Remove any rosin with a stiff brush dipped in carbon tetrachloride.

( ) 2. Insert the 1/2 Amp fuse in the fuseholder.

( ) 3. Turn the "Test" switch and "Line Adjust" to the maximum counter-clockwise position. Turn the "RC BALANCE" control to the maximum counter-clockwise position without activating the switch.

a) Place the small knob over the shaft of the "Line Adjust" potentiometer. Tighten the setscrew.

b) Place one of the two medium size knobs over the shaft of the "RC Balance" potentiometer with the indicator pointing to the "7" position. Tighten setscrew.

c) Place the other medium size knob over the shaft of the "Test" switch with the indicator pointing to "Short". Tighten the setscrew.

d) Place the clear plastic dial over the large knob so that the three equidistant holes line

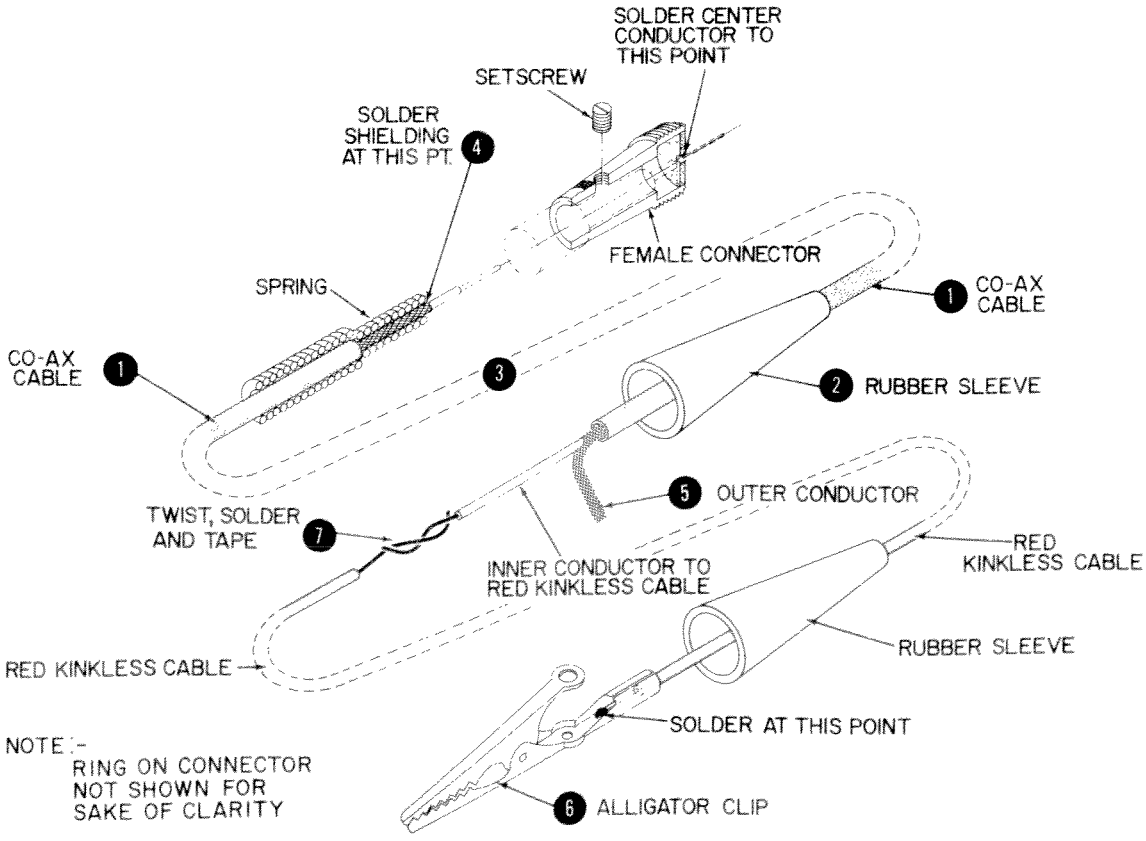


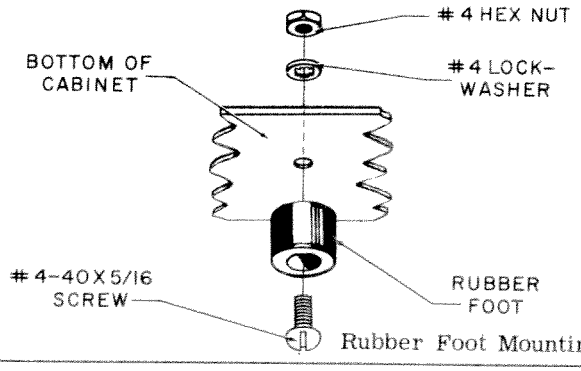
Figure 7. Construction and Wiring of Connector

up with the holes on the knob. Insert in each of the three holes, a No. 4-40 self-threading flat head screw. Do not over-tighten. Turn the ". 1-50MFD" potentiometer to the maximum clockwise position. Place the entire dial assembly over the shaft of the potentiometer. The calibration line over the arrow on the dial must coincide with the hairline on the panel. Tighten the setscrew.

( ) 4. Do not plug the unit into the AC line. Turn the unit on and check for a cold resistance of at least 80 ohms across the AC line cord. The resistance from TB2-2 to ground should be at least 600 ohms. If any resistance is smaller than amount specified, recheck the circuit.

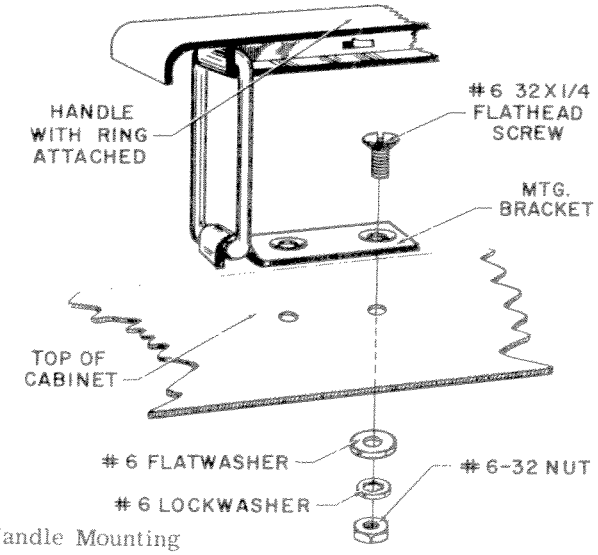
( ) 5. Proceed to Section IV (Maintenance) in the instruction section of the manual and carry out the adjustment procedures in Paragraph 4-3. After these adjustments are completed, return to this point and proceed with the remaining steps to complete the assembly of the instrument.

( ) 6. Pass a No. 4-40 x 5/16 screw through the large hole on a rubber foot. Position the screw in one of the four small holes in the bottom of the cabinet. On the inside of the cabinet secure the foot with a No. 4 lockwasher and a No. 4-40 hex nut. Mount the remaining three feet in a similar manner.



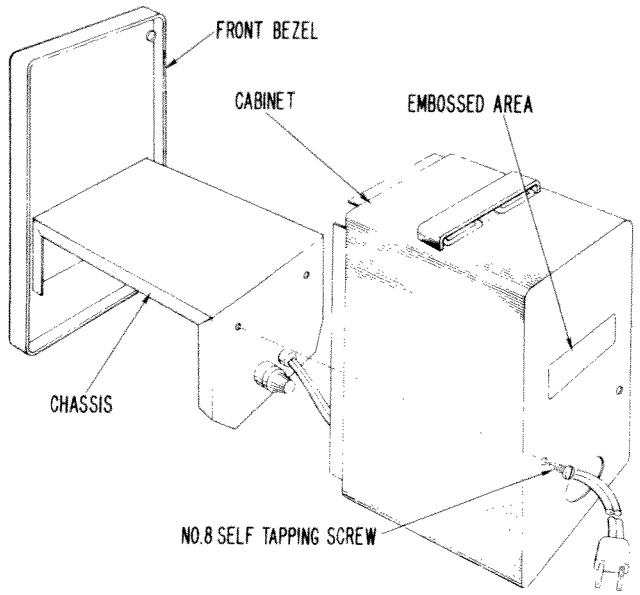
Rubber Foot Mounting

( ) 7. The handle as supplied comes with two rings attached. Place one of the handle mounting brackets over the exposed side of a ring and position on the top of the cabinet. Secure the bracket with two No. 6-32 x 1/4 flat head screws, two No. 6 flat metal washers, two No. 6 lockwashers and two No. 6-32 hex nuts. Secure the other ring and bracket in a similar manner.



Handle Mounting

( ) 8. Remove the backing from the nomenclature label and position in embossed area on rear of cabinet.



Cabinet Assembly

( ) 9. Pass the line cord through the large cut-out at the rear of the cabinet. Then slide the unit into the cabinet. When it is properly mounted, the front bezel will fit snugly against the lip around the cabinet. Secure the chassis with two No. 8 self tapping screws at the rear.

You have now completed building your fine instrument.

IN CASE OF DIFFICULTY

If the completed kit does not operate properly, refer to the MAINTENANCE section and read it thoroughly. The information provided may itself lead to a solution of the problem without outside assistance, and also includes the course of action you may take to obtain assistance from EICO. In any case, do not neglect the checking procedures which usually correct 90% of the difficulties that may be encountered. If you omitted to perform step 1 of the Final Steps "To catch any wiring errors.....", do it now, and do it thoroughly. Often, a person is unable to detect his own errors because he misunderstands an instruction. For this reason, have a friend go over the wiring with you, if possible. Also, do not neglect the obvious kind of mistake or trouble such as tubes or transistors placed incorrectly, shields not making proper contact, accidental shorting of leads or parts to the bottom plate, line cord plug making improper contact in outlet, blown fuse, etc.