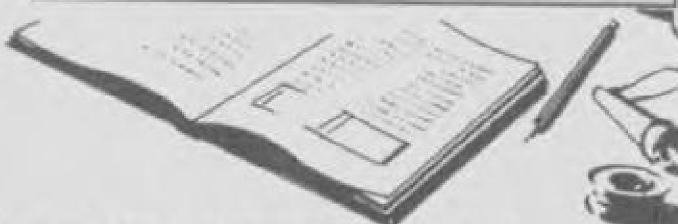
HEATHKIT® MANUAL

for the

SOLID-STATE DIP METER

Model HD-1250



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INTRODUCTION

Your Heathkit Solid-State Dip Meter can be used to determine the approximate resonant or operating frequency of either energized or de-energized circuits in the frequency range between 1.6 and 250 MHz. In the oscillation or injection mode, you may use the Dip Meter to determine the resonant frequency of tuned circuits or as a variable signal source to align receivers. In the absorption mode, it will locate sources and frequencies of RF energy. It is also valuable for locating sources of parasitic oscillations and harmonics.

You can select any of the seven frequency ranges by using the appropriate plug-in coil. Its size and battery-powered circuit make the Dip Meter completely portable. Two circuit boards are used to provide compactness and ease of assembly. Two transistors and two hot-carrier diodes are used in the all-solid-state circuit. To help in both transportation and storage, a molded carrying case is provided for your convenience.

Refer to the "Kit Builders Guide" for information on tools, wiring, soldering, resistors, and capacitors.

OPERATION

NOTE: Specific uses for your Solid-State Dip Meter are outlined in the "Applications" section of this Manual on Page 47. The fundamental procedure is presented in this "Operation" section.

IMPORTANT NOTE: You should always observe certain precautions when you use your Dip Meter. Some of these are:

1. Protect the Dip Meter from strong RF fields. These can damage electronic components in the Dip Meter, even when the unit is turned off.
2. To conserve batteries, keep the unit turned off when it is not in use.
3. Use only magnetic or dynamic headphones with your Dip Meter.
4. Do not force the main tuning dial beyond the tuning capacitor stop points; you will have to recalibrate the instrument.
5. Do not use any power source other than the battery type recommended. An electronic power supply can cause the Dip Meter to malfunction.

CAUTION: If the Dip Meter coil or case should come in contact with high voltages in units under test, a severe or fatal shock may result.

Each of the seven pickup coils supplied with your Solid-State Dip Meter is color coded to match a color band on the tuning dial of the instrument. When you know the approximate resonant frequency of the circuit to be tested, find that frequency on one of the dial scales. Note the color of the dial scale. Then, locate the coil whose color matches that dial color. Plug the coil into the coil socket on the rear of the Dip Meter.

Figure 2-1 is an illustration which shows the Dip Meter with a coil installed, prepared for a typical operation.

INJECTION MODE OF OPERATION

If the approximate resonant frequency of the circuit under test is known, select the proper coil and plug it into the coil socket. Then, adjust the Dip Meter in the following manner:

1. Depress the pushbutton switch to turn the Meter on.
2. Turn the OSC LEVEL control until you obtain a midscale reading. Rotate the tuning dial through its entire range and note that there is a noticeable tapering in the meter level at each end of the dial range. This is normal.

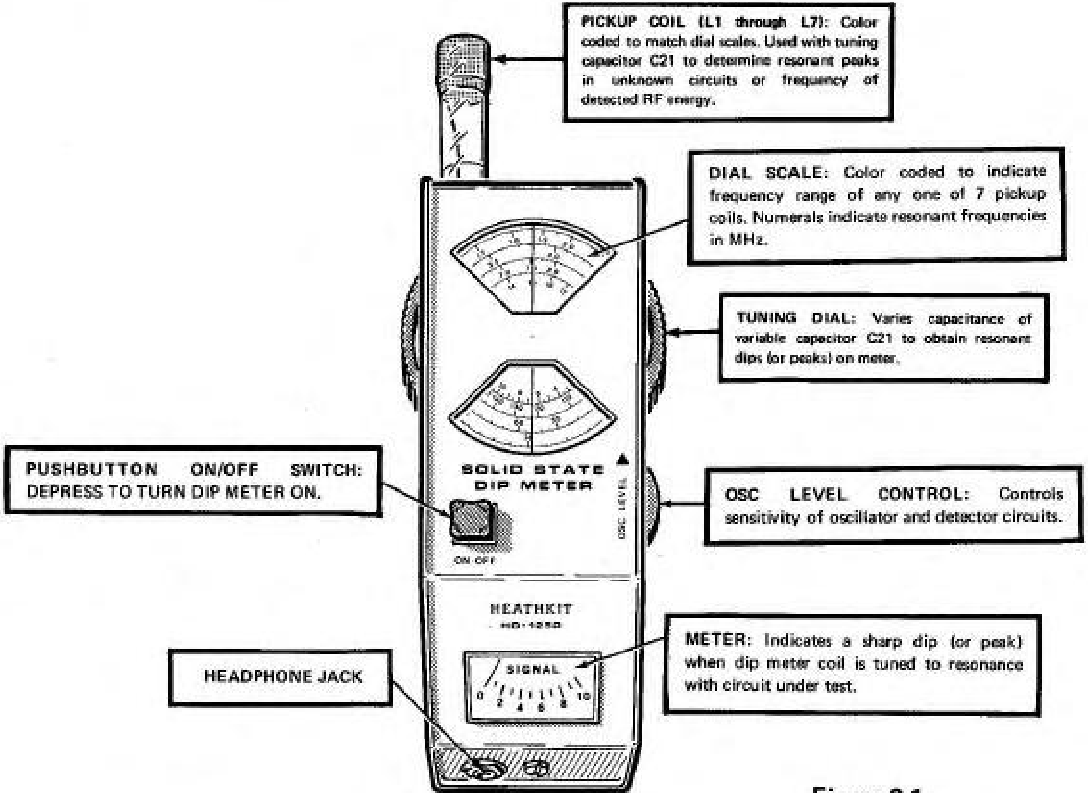

PICKUP COIL (L1 through L7): Color coded to match dial scales. Used with tuning capacitor C21 to determine resonant peaks in unknown circuits or frequency of detected RF energy.
DIAL SCALE: Color coded to indicate frequency range of any one of 7 pickup coils. Numerals indicate resonant frequencies in MHz.
TUNING DIAL: Varies capacitance of variable capacitor C21 to obtain resonant dips (or peaks) on meter.
PUSHBUTTON ON/OFF SWITCH: DEPRESS TO TURN DIP METER ON.
SOLID STATE DIP METER
OSC LEVEL
ON-OFF
OSC LEVEL CONTROL: Controls sensitivity of oscillator and detector circuits.
HEATHKIT
HEADPHONE JACK
SIGNAL
METER: Indicates a sharp dip (or peak) when dip meter coil is tuned to resonance with circuit under test.

Figure 2-1

3. Refer to Figure 2-2 and position the end of the meter coil close to, and directly in line with, the coil or inductance to be tested.

4. Slowly turn the tuning dial from one extreme toward the other. At the point of resonance, the meter indication should drop abruptly, and almost immediately rise again to the nonresonant meter level.

5. Carefully turn the tuning dial back and forth across the point of meter dip until you locate the lowest point of indication on the meter scale. Slowly move the dip meter coil from the coil under test to reduce the coupling, and re-dip the meter.

6. Read the tuning dial scale on the color that corresponds with the coil you have chosen, and note the frequency in megahertz.

Injection Mode Theory

Refer to Figure 2-3 as you read the following information.

*In the injection or oscillator mode of operation, the Dip Meter operates as an absorption trap.

As shown in Figure 2-3, test circuit $L_t - C_t$ is not energized and has a resonant frequency f_0. When you tune the Dip Meter to that frequency, mutual coupling between L_t and the pickup coil causes a high circulating current to develop in the test circuit. Simultaneously, a high impedance is reflected into the oscillator circuit and degenerates or "dips" the level of oscillation. This change in level is detected and then indicated on the instrument meter. The resonant frequency of the test circuit is then read directly from the calibrated dial.

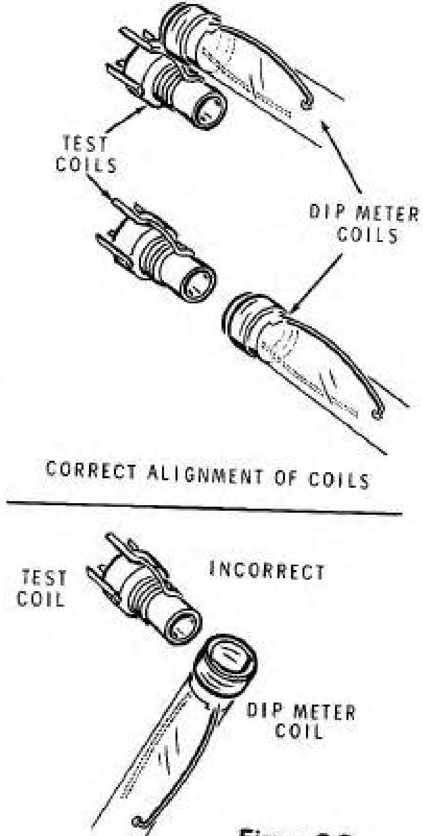


Figure 2-2

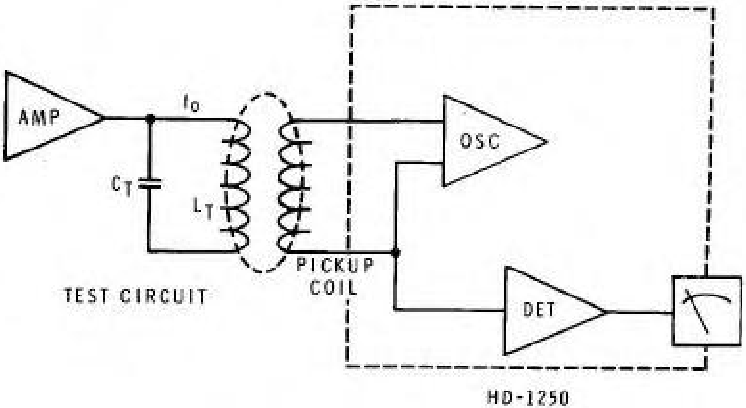


Figure 2-3

ABSORPTION WAVE METER MODE OF OPERATION

CAUTION: When you use the Dip Meter near energized RF circuits, start with the Dip Meter some reasonable distance away from the circuit to avoid overdriving the meter circuits.

Adjust the Dip Meter in the following manner:

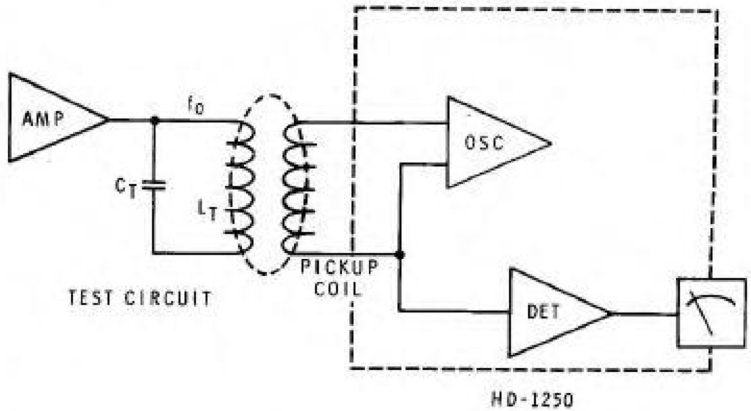
1. If possible, select a coil whose frequency range will cover that of the unknown circuit. For example, the IF frequency in FM circuits will be at or near 10.7 MHz. If the circuit under test were in a stereo IF circuit, logically the yellow coil would be used to make the test, since the range of the coil is 6.3 to 13 MHz. Plug the coil into the coil socket.

2. Press the pushbutton to turn the Dip Meter On.

3. Turn the OSC LEVEL control to obtain a midscale reading on the meter.

4. Turn the tuning dial from one extreme to the other and note the taper of the reading at both ends of the dial. Select the very highest reading possible; then leave the tuning dial set at that point.

5. Carefully turn the OSC LEVEL control to reduce the meter reading just to the zero point. Leave the OSC LEVEL control at this setting.



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5. Carefully turn the tuning dial back and forth across the point of meter dip until you locate the lowest point of indication on the meter scale. Slowly move the dip meter coil from the coil under test to reduce the coupling, and re-dip the meter.

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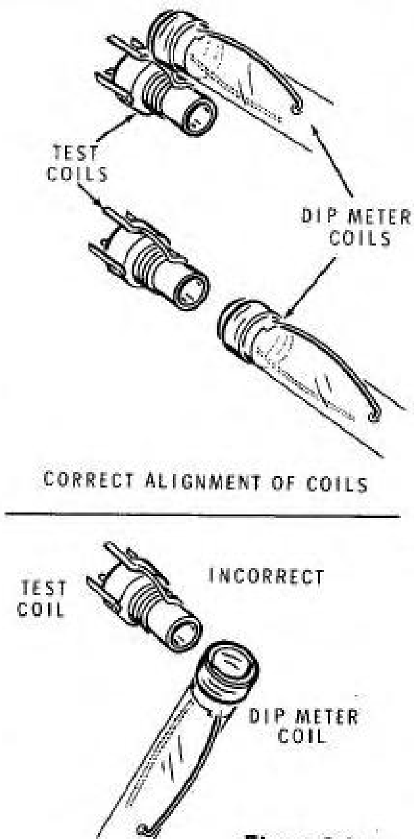


Figure 2-2

Figure 2-4

6. Closely couple the Dip Meter coil to the test circuit as shown in Figure 2-4.

7. Slowly turn the dial from one extreme toward the other. As the Dip Meter tunes to the electromagnetic field of the test coil, the meter will quickly rise to a peak indication.

8. Very carefully turn the tuning dial back and forth to obtain the highest meter reading while you slowly pull the Dip Meter away from the test coil.

9. Read the frequency, in MHz, of the test circuit directly from the scale whose color is the same as that of the chosen coil.

Absorption Mode Theory

In the absorption mode of operation, the Dip Meter detects the presence of external RF energy. Test circuit $L_t - C_t$ in Figure 2-5 is energized and inductively couples its energy to the Dip Meter pickup coil. As the Dip Meter is tuned to this frequency, a circulating current develops in the Dip Meter tank circuit. Regeneration within the oscillator circuit is insufficient for oscillation, but acts as a Q-multiplier and increases the selectivity of the RF detector. This external energy is then indicated on the meter as a peak at the resonant frequency.

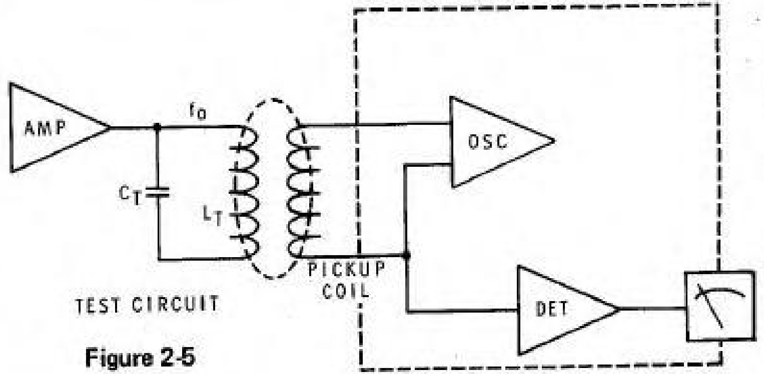


Figure 2-5

HEADPHONES

In dip meter applications, headphones are not frequently used. In some situations, however, they may be helpful. When the Dip Meter is used with the headphones, and the tuning dial is moved across a point of resonance, usually the indication will be a clicking sound in the phones. There is an exception. When an RF circuit is modulated with an audio signal, this audio will be reproduced in the headphones, providing it is of sufficient amplitude.

LOG SCALE

A log, or general reference, scale is included on the inner ring of your dip meter dial. If you wish to make additional plug-in coils, you may use this 0 to 17 uncolored scale to correlate frequency-to-dial readings.

APPLICATIONS

Although there are many applications for your Solid-State Dip Meter, only a few will be described in this section of the Manual.

NOTE: In all applications, coupling between the Dip Meter and the test circuit should be as loose as possible. That is, keep the dip meter coil as far away from the test circuit as possible and still be able to observe a useable meter reading.

RECEIVER ADJUSTMENT

1. Without power applied to the receiver, tune the receiver local oscillator stage to its approximate frequency, as you use the Dip Meter in its injection mode.
2. As you work toward the antenna, align any doubler stages to their approximate frequencies.
3. Align the RF front end to its center frequency.
4. If the receiver IF is within the coil-coverage of the Dip Meter, align the IF stages.
5. Turn the receiver on, and prepare the Dip Meter for use in the absorption mode.
6. Set the Meter to the frequency corresponding to the receiver oscillator-multiplier stages. Then adjust these stages for a maximum meter reading. Be sure to keep the coupling loose.
7. Set the Dip Meter frequency to the center frequency of the receiver bandspread.
8. Place the dip meter coil (wrapped with a short antenna) near the receiver antenna; this injects a signal. If the output of the Dip Meter is too strong, move it further from the antenna. NOTE: Keep the Dip Meter away from large surface areas of metal to avoid detuning its oscillator circuit.
9. Tune receiver stages for desired performance.
10. Lightly tap the dip meter case; this will generate microphonics you can hear at the receiver output.

TRANSMITTER ADJUSTMENT

1. Use the Dip Meter in the injection mode.
2. Turn the transmitter on, but do not apply plate voltage.
3. Pretune all resonant circuits to their respective frequencies.
4. Change the Dip Meter to the absorption mode.
5. Apply final voltage to the transmitter.
6. Start with a large coupling distance as you search for the transmitter frequency. Decrease coupling until the signal is detected on the meter or heard in the headphones.
7. Peak the individual circuits of the transmitter as you use the transmitter's meters or the Dip Meter (in the absorption mode).

SHUNT AND SERIES TRAP ADJUSTMENT

NOTE: Other passive filters may also be aligned if you use the method described in the following steps.

1. Use the Dip Meter in the injection mode.
2. For parallel traps, position the coil close to the test circuit. Tune the Dip Meter for a dip indication on the meter; read the resonant frequency from the tuning dial.
3. To determine the resonant frequency of series traps, the inductor and capacitor must first be connected in parallel. Then, find the resonant frequency as outlined in the previous step. Replace the components back into the circuit in their original series arrangement.

TO MEASURE THE Q OF A TUNED CIRCUIT

Refer to Figure 3-1 for the following steps.

1. Use the Dip Meter in the injection mode.
2. Connect a high impedance input voltmeter (through an RF probe) across the test circuit as shown in Figure 3-1. Use the lowest range of the voltmeter.
3. Loosely couple the Dip Meter to the tank circuit. Adjust the Dip Meter for a maximum reading on the voltmeter. IMPORTANT: Do not change the coupling during the rest of this operation.
4. Read the Dip Meter frequency from the scale whose color corresponds to the color of the coil used for this test. Record the frequency; this is F_0.
5. Carefully decrease the Dip Meter frequency to obtain a voltmeter reading equal to 70.7% of the F_0 reading. Record this frequency as F_1.
6. Carefully increase the Dip Meter frequency, past center frequency F_0, to obtain another voltmeter reading equal to 70.7% of the peak voltage at F_0. Record this frequency as F_2.

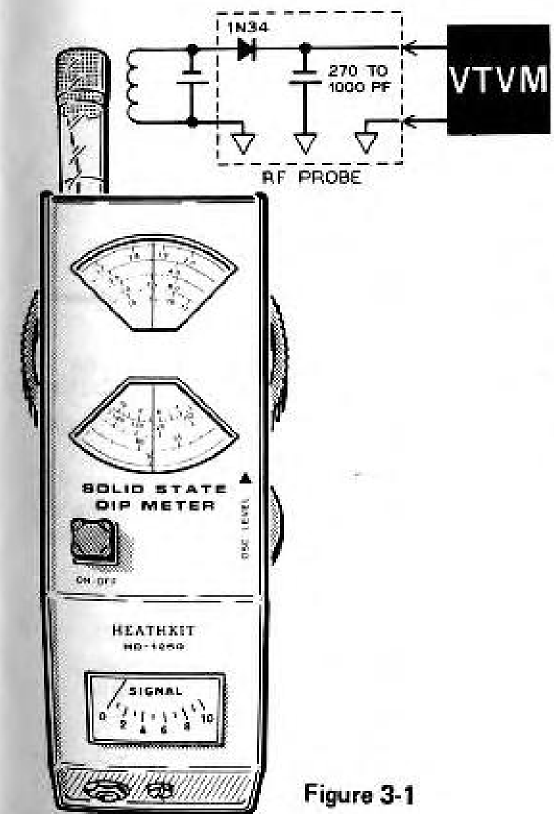


Figure 3-1

NOTE: The result of the readings can be plotted on a graph similar to that shown in Figure 3-2.

7. Calculate the Q of the circuit using the following formula:

$$Q = \frac{F_0}{F_2 - F_1}$$

Relative Q

The Relative Q of a circuit may be determined by observing the indication of the Meter when it is used in the injection mode.

As you observe the dip in the meter pointer, a sharp dip and rise at resonance indicates a circuit having a relatively high Q. A broad, shallow dip in the meter indication indicates a relatively low Q.

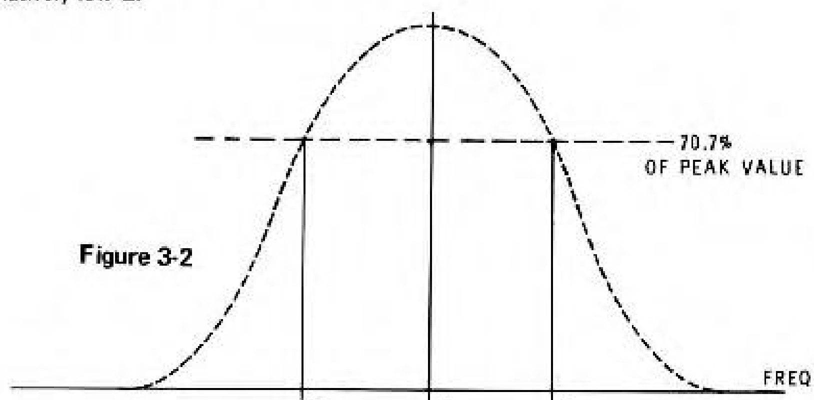


Figure 3-2

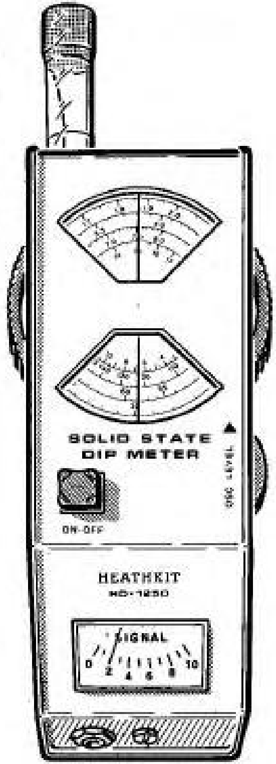
TO FIND AN UNKNOWN CAPACITOR VALUE

Refer to Figure 3-3 for the following steps.

1. Connect the unknown capacitance across a phono socket as shown.
2. Plug any of the pickup coils, except the brown coil, from the dip meter set into the phono socket.
3. Adjust the Dip Meter for use in the injection mode of operation. NOTE: By trial and error, you may need to plug any of the remaining coils into the coil socket on the Dip Meter to determine the resonant frequency of the "test circuit." Record the frequency (f), in MHz, from the dial.
4. Refer to Table A and find the color of the coil which you used in the phono socket. Record the value of the inductor (L) in henries.
5. Substitute the recorded quantities in the formula below to determine the value of the unknown capacitor in farads:

$$C = \frac{1}{4\pi^2 f^2 L} = \frac{1}{39.48 \times f^2 \times L}$$

Note: 1 MHz = 10^6 Hertz
1 μF = 10^{-6} farads
1 pF = 10^{-12} farads
f = dial reading (MHz)
L = Inductance (in Henries)



COIL	COLOR	INDUCTANCE
L1	Red	171 μH
L2	Orange	41.1 μH
L3	Yellow	10.2 μH
L4	Green	2.62 μH
L5	Blue	0.72 μH
L6	Violet	0.196 μH
L7	Brown	*

*Do not use to calculate formulas.

TABLE A

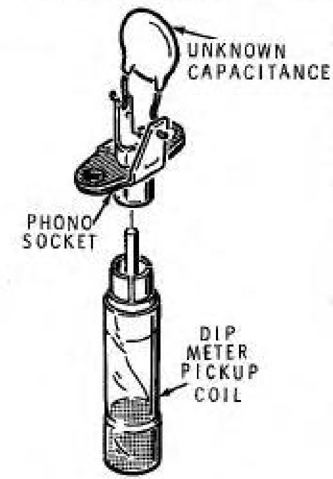


Figure 3-3

HEATHKIT

TO FIND THE INDUCTANCE OF RF COILS

1. Connect a low value capacitor across the unknown inductor; for example 100 pF.
2. Use the Dip Meter in the injection mode.
3. By trial and error, find a coil that will dip on the resonant frequency of the parallel circuit. Record the frequency.
4. Compute the inductance of the coil with the following formula:

$$L = \frac{1}{39.48 \times f^2 \times C}$$

$1\ \mu H = 10^{-6}$ henries
$1\ mH = 10^{-3}$ henries

TO FIND THE INDUCTANCE OF TOROID COILS

The previous steps cannot be applied to toroid coils because they have self-shielding properties. However, these coil values may be determined in the following manner:

1. Use the Dip Meter in the injection mode.
2. Connect the extension probe to several loops of wire wound around the core of the coil. A magnetic flux will be picked up in the special-wound link and coupled to the Dip Meter. See Figure 3-4.
3. Compute the unknown inductance as in the previous section.

TO CHECK FOR PARASITIC OSCILLATIONS

1. Apply power to the transmitter.
2. Use the Dip Meter in the absorption mode.
3. Carefully check transmitter stages for undesired frequencies.
4. Once a parasitic oscillation has been located, turn off transmitter power.
5. Use the Dip Meter in the injection mode. Check the areas of the transmitter near the point the first resonance was detected, at or near the original frequency. Check circuit wiring, RF chokes, circuit grounds, and other potential resonant circuits.

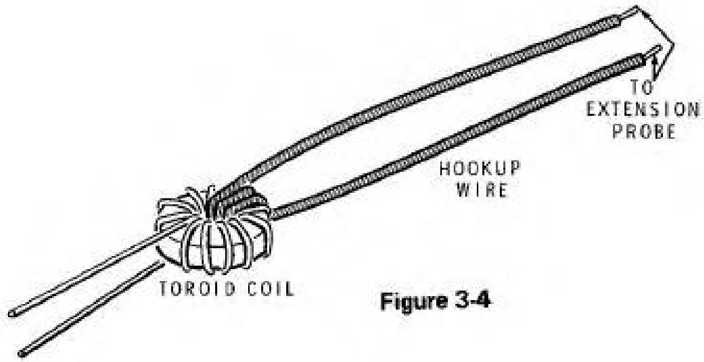


Figure 3-4

NEUTRALIZATION

1. Remove the final voltage from the transmitter.
2. Apply power to the driver stage.
3. Use the Dip Meter in the absorption mode.
4. Couple the dip meter coil to the output of the stage being neutralized.
5. Adjust the Dip Meter to the driver frequency to obtain a maximum meter deflection.
6. Adjust the neutralizing capacitor for a minimum meter reading.

USE AS A RELATIVE FIELD-STRENGTH METER

Refer to Figure 3-5 for the following steps.

1. Connect a short antenna around the dip meter pickup coil as shown.
2. Set the Dip Meter for use in the absorption mode.
3. Tune the Dip Meter to the resonant frequency of the transmitter output.
4. Position the pickup antenna at various points around the transmitting antenna to determine relative strength.

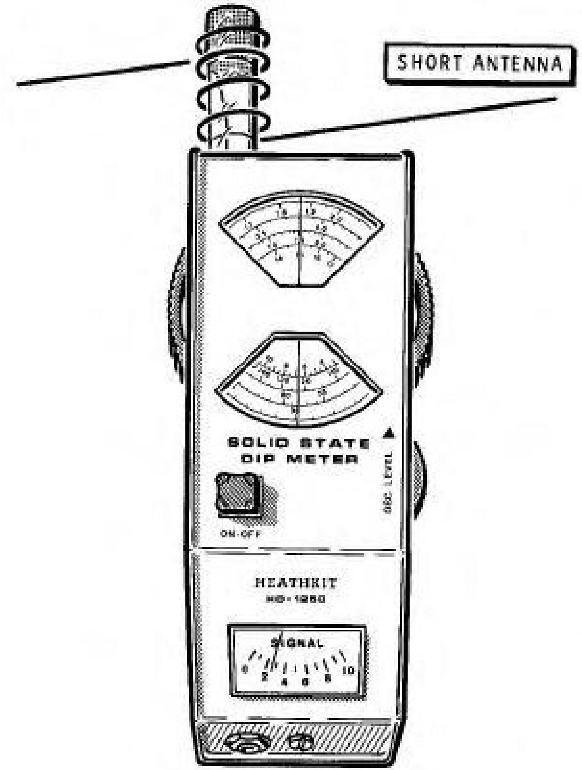


Figure 3-5

ANTENNAS

Use the Dip Meter in the injection mode. When you couple to an antenna, the meter should be coupled at the low impedance or high current point as shown in Figure 3-6. For a half-wave antenna, this point is at the center, and for longer wires, it is at points of odd quarter wavelengths. as measured from either end of the antenna. A full-wave antenna will not be a half wave at its half-resonant point. This is because end effects are only at the ends of the antenna, and will be absent at other points when the antenna is a full-wave length, or longer. The antenna should be positioned as near its operating location as possible under the conditions desired during operation.

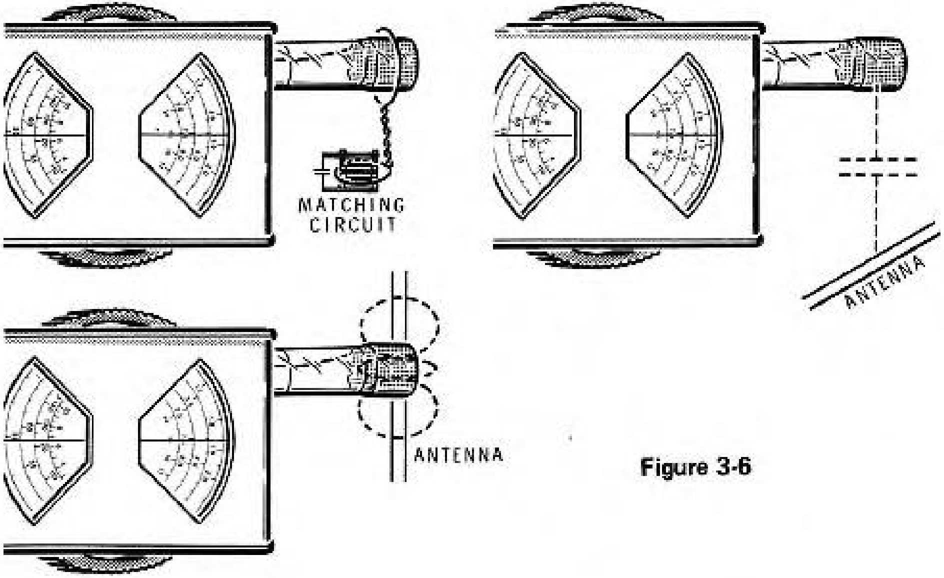


Figure 3-6

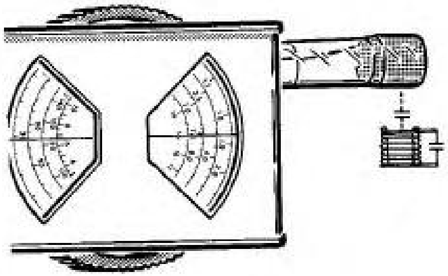


Figure 3-7

If you cannot reach a low impedance point, you may make a check at a high impedance or high voltage point. Use capacitive (right-angled) coupling as shown in Figure 3-7. Note that if the high impedance point is near either end of the antenna, the end-effect will be altered due to the presence of the Dip Meter, and the resonant frequency of the antenna will tend to increase slightly. You must take this into consideration when measuring antenna ends; the reading will be slightly lower than the true antenna resonant frequency. This difference will be from 1-1/2 to 3%.

In each case, remember the physical length as opposed to electrical length (half-wave, full-wave, etc.) as calculated by formula.

To make the measurements described, you must remove the feeder lines from the antenna. Such feeders would have to be perfectly balanced and matched or terminated. True antenna resonance cannot be indicated because unmatched feeders or incorrectly terminated feeders will provide positive or negative reactances which will alter the electrical length of the antenna.

In some cases, large antenna elements may present a difficult situation when you attempt to couple your Dip Meter to them. A small wire coupled across a foot or so of the antenna at the center may provide sufficient coupling to obtain a reading.

Should you wish to measure an antenna with an open center, close it temporarily with the shortest possible wire during the measurement. This must also be done with a folded-dipole antenna. Do not forget to remove this wire before you connect the feeder lines again.

Tuned (Resonant) Feeders

Adjust the Dip Meter for use in the injection mode. Check for the desired resonant point on the series or parallel tuned circuit at the transmitter end of the feeder. If you cannot obtain a resonance indication at the desired frequency, alterations may be made in the tuned circuit or in the feeder length according to the actual resonant frequency found. Do not be confused by other resonant indications. You must remember that a Zepp antenna, for instance, is a long-wire antenna partially folded back on itself and you may observe resonances at frequencies both above and below the desired frequency.

Untuned (Nonresonant) Feeders

After an antenna has been adjusted to its correct length, you may connect an untuned feeder line to it, provided some type of matching device is used. A correct match may be obtained if you make the necessary adjustments in conjection with an impedance bridge or a standing-wave ratio bridge. In this application, you will use the Dip Meter as an injection device.

If you use an impedance bridge or the SWR meter, it should have a meter whose full-scale sensitivity is 200 μA or less to obtain the most accurate readings. Couple the Dip Meter to the circuit as loosely as possible to obtain an accurate reading. If you employ tight coupling, frequency calibration may shift slightly.

Adjust the matching instrument for a reading as close to a unity standing-wave ratio as possible. If you cannot obtain a satisfactory ratio, you may have a fault in the matching system, or a shift in antenna resonance has occurred. You may check the latter circumstance by very slightly varying the Dip Meter tuning until a lower SWR is found or until a better null is seen on the meter of the bridge. This will be the resonant frequency of the antenna. You may then need to change the antenna length until a correct SWR is seen at the desired frequency. The matching system, then, may also require some adjustment.

Parasitic Beams

Use the Dip Meter as an injection device. Adjust the driven element of the beam for resonance. Disconnect the feeder lines; then adjust the parasitic elements to their calculated correct length. If the driven element is open at the center, use a short wire to close it temporarily. When this element has been properly adjusted, connect and match the feeder line as outlined in the previous paragraph. Be sure to open the center of the driven element if the matching system requires it. Adjust the parasitic elements as you use the Dip Meter as a signal generator coupled to the feeder line. Place a receiver some distance from the transmitter antenna and observe the readings of the receiver S-meter when the unit is connected to a short antenna. Observe the actual relative field-strength reading on the S meter after each adjustment is made. The Dip Meter should be coupled as loosely as possible. Check the actual frequency of the Dip Meter occasionally on the receiver as you make these adjustments.

After you have adjusted the parasitic elements, check the SWR again. The SWR will probably have changed as the adjustment of other elements will likely change the point of resonance in the antenna. You may wish to again refer to the previous section on "Untuned (Nonresonant) Feeders." Once you have completed these steps, they should be repeated to "peak up" the circuit.

If your beam is situated so surrounding objects may cause the system to detune as the beam is rotated, the steps outlined above may have to be performed in the direction your antenna will be pointed during its periods of most frequent use, or where the greatest degree of rotation has the least detuning effect.

If you wish, you may use the transmitter as a signal generator, and the Dip Meter is its absorption mode to perform these adjustments. However, this method is less desirable because unnecessary QRM (interference or noise) may be generated. Also, this method, when properly performed, will require more than one person.

Shorted Quarter-Wave Lines

Use the Dip Meter in the injection mode. Couple to open wire lines as shown in Figure 3-8, and to coaxial lines as shown in Figure 3-9. As you adjust the lines for correct length, temporarily install the connectors that will be fitted to the lines upon completion. Roughly calculate the frequency of the line. Resonant points can be found at three times the quarter-wave lengths, five times the quarter-wave length, and so on.

Open Quarter-Wave Lines

Connect a short at one end of the line, then measure as for the shorted line. Because of the length of the shorting line, a slight error will be introduced, depending on the line spacing. The closer the spacing, the less error will be encountered.

If the line is coaxial, the short at the open end should be as small as possible between the shield and the inner conductor. Include the fittings in your measurements. After you make the measurements, remove the short from the cable.

Shorted Half-Wave Lines

Use the Dip Meter in the injection mode. Couple at the center of the line as shown in Figure 3-10. For coaxial lines, measure as for a quarter-wave shorted line at half the calculated frequency. A resonant frequency determined in this manner must be multiplied by 2 for the half-wave shorted line.

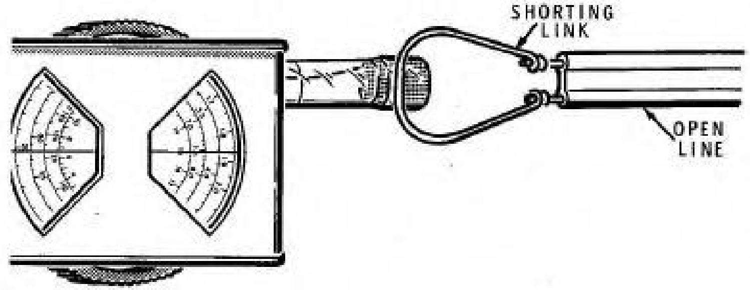


Figure 3-8

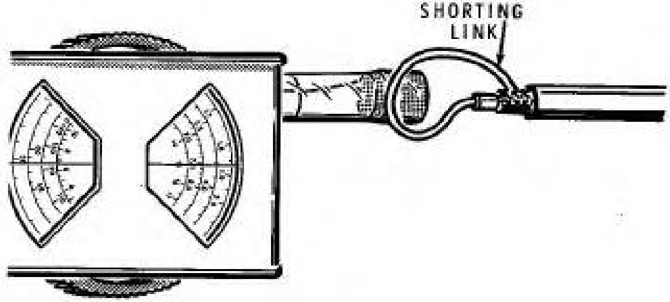


Figure 3-9

Open Half-Wave Lines

Couple at the center of the line as shown in Figure 3-10. When measuring coaxial lines, short the lines at one end and measure as for the quarter-wave shorted line at the calculated 1/2 frequency. Resonant frequency is then multiplied by 2 to determine the correct length of the line after you remove the shorting line.

Standing Waves

Maintain a uniform coupling as you move the Dip Meter along the feed-line by keeping the coil form against the line. This is possible as the coil windings are shielded from direct contact by the coil coating. A "flat" line is determined by the lack of meter fluctuation as you move the coil along the line. Do not overload the dip meter, it is highly sensitive to small changes due to its internal amplifier.

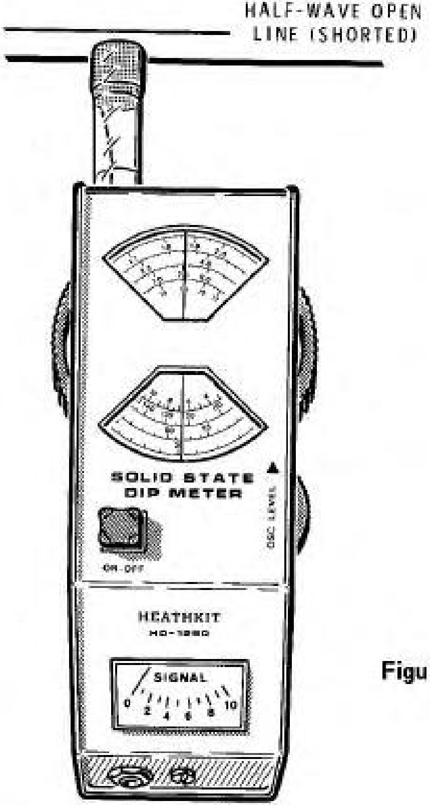


Figure 3-10

IN CASE OF DIFFICULTY

Begin your search for any trouble that occurs after assembly by carefully following the steps listed below in the "Visual Tests." After the "Visual Tests" are completed, refer to the "Troubleshooting Chart."

NOTE: Refer to the "Circuit Board X-Ray Views" on Page 64 for the physical location of parts on the circuit board.

VISUAL TESTS

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the kit builder.

2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the "Soldering" section of the "Kit Builders Guide." Be sure there are no solder bridges.

3. Check to be sure that the transistors and diodes are in their proper locations. Make sure each lead is connected to the proper point.

4. Check the values of the parts. Be sure in each step that the proper part has been wired into the circuit, as shown in the Pictorial Diagrams. It would be easy, for example, to install a 47 kΩ (yellow-violet-orange) resistor where a 4700 Ω (yellow-violet-red) resistor should have been installed.

5. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

6. Be sure all wires and leads connected to the circuit boards have been trimmed as close as possible to the circuit board foils.

7. A review of the "Circuit Description" may also help you determine where the trouble is.

If the trouble is still not located after the "Visual Tests" are completed, and a voltmeter is available, check voltage readings against those shown on the "Schematic Diagram" (fold-out from Page 67). Read the "Precautions for Troubleshooting" before you make any measurements. NOTE: All voltage readings were taken with a high impedance input voltmeter. Voltages may vary as much as ±20%.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover of the Manual.

PRECAUTIONS FOR TROUBLESHOOTING

Be cautious when you test diode and transistor circuits. Although they have almost unlimited life when used properly, they are much more sensitive to excessive voltage or current than tubes.

Silicon Bipolar Transistor Checking (Q11)

To check this transistor accurately, you should use a transistor checker. However, if one is not available, you can use an ohmmeter to determine the general condition of this transistor. The ohmmeter must have at least 1 volt DC at the probe tips to exceed the threshold of the diode junctions in the transistor being tested. Most vacuum tube and digital voltmeters meet this requirement.

To check a transistor with an ohmmeter, proceed as follows:

1. Remove the transistor from the circuit.

2. Set the ohmmeter on the X1000 range.

3. Connect one of the ohmmeter test leads to the base (B) of the transistor. Touch the other meter lead to the emitter (E) and then to the collector (C). Both readings should be the same, but may be either high or low. If one reading is high and the other low, the transistor should be replaced. (Identify the transistor leads on the "Identification Chart" on Page 66 of the Manual.)

4. Repeat step 3 with the test leads reversed.

NOTE: In the unusual case when the readings are all low, or all high, no matter which ohmmeter lead is connected to the base, the transistor should be replaced.

MOSFET Checking (Q21)

An insulated-gate type MOSFET is used at Q21 on the detector circuit board. Usually any defect in this device is found to be an internal short between the source (S) and one of the gates (G1) or (G2). They can be checked in the circuit with a high impedance input voltmeter (10 megohms or greater). An abnormally low source voltage may indicate an internal short circuit.

CAUTION: If you are going to remove the MOSFET from the circuit board, first wrap a small wire around all four leads to short them together. This is required because some soldering irons have an AC voltage at their tips of an amplitude high enough to short out the protective diodes in the MOSFET. Damage often occurs when an attempt is made to clean the leads of solder without the presence of the shorting wire. During normal installation of these devices, previously installed parts provide the necessary protection – a path to ground so the shorting wire is not necessary.

Troubleshooting Chart

The following chart lists the "Condition" and the "Possible Cause" of a number of malfunctions. If a particular part is mentioned (Q11, R13, C21, etc.) as a possible cause, check that part to see if it is incorrectly wired or installed improperly. Also check to see if an improper part was installed at that location. It is also possible, on rare occasions, for a part to be faulty.

To locate parts, refer to the "Circuit Board X-Ray Views" on Page 64, the "Voltage Charts" on Page 65, or the "Schematic Diagram" (fold-out from Page 67).

CONDITION	POSSIBLE CAUSE
1. No meter indication (red coil installed, oscillator level maximum).	1. Weak battery (less than 7 volts). 2. Coil not fully seated. 3. Open coil (substitute with orange coil). 4. Miswired or open headphone jack. 5. Level control wires reversed. 6. Shorting wire not remove from transistor Q21. 7. Transistors Q11, Q21. 8. Diodes D21, D22. 9. Meter shorting wire not removed. 10. Braid shorting to capacitor C21.

CONDITION	POSSIBLE CAUSE
2. Low or no meter indication (brown coil installed, oscillator level maximum). Unit operates properly with red coil (Step 1).	1. Weak battery. NOTE: Brown coil requires higher voltage than the other coils. 2. Defective coil. 3. Defective grounding. Resolder all three braids to circuit board foils. 4. Insufficient shielding. Be sure side panels are installed with all hardware secure. 5. Oscillator transistor Q11. 6. Resolder coil socket connections.
3. Low meter reading, oscillator level maximum.	1. Weak battery. 2. Diodes D21 or D22.
4. Intermittent meter fluctuations during tuning.	1. Capacitor C21 plates dirty or bent. 2. Washers missing between tuning capacitor and circuit board. See Pictorial 1-3 on Page 16.
5. Meter pointer does not move smoothly across scale as oscillator level control is adjusted.	1. Control R1. 2. Meter. Meter lugs bent.

SPECIFICATIONS

Frequency Range	1.6 to 250 MHz.
Controls	Tuning capacitor. Oscillator level control On/Off switch.
Meter Movement	150 microampere.
Solid-state Circuits	1 NPN transistor oscillator. 1 Dual-gate MOSFET amplifier. 2 Diffused silicon hot carrier diode detectors.
Power Source	9-volt NEDA Type 1604 battery.
Dimensions (less coils)	2" high x 2-5/16" wide x 5-7/8" long. (5.08 cm x 5.87 cm x 14.92 cm.)
Net Weight (Meter, case, and coils)	2 lbs. (.746 kg.)

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (fold-out from Page 67) while you read this "Circuit Description."

The Dip Meter is basically made up of an oscillator and a detector circuit. In the injection mode, the oscillator generates the signal which is injected into the circuit under test. Then the detector circuit detects changes in the impedance reflected back from the circuit under test and displays these changes on the meter. In the absorption mode, the oscillator in the Dip Meter is used as a Q-multiplier, but does not oscillate. The detector circuit detects the signal that is already in the circuit under test.

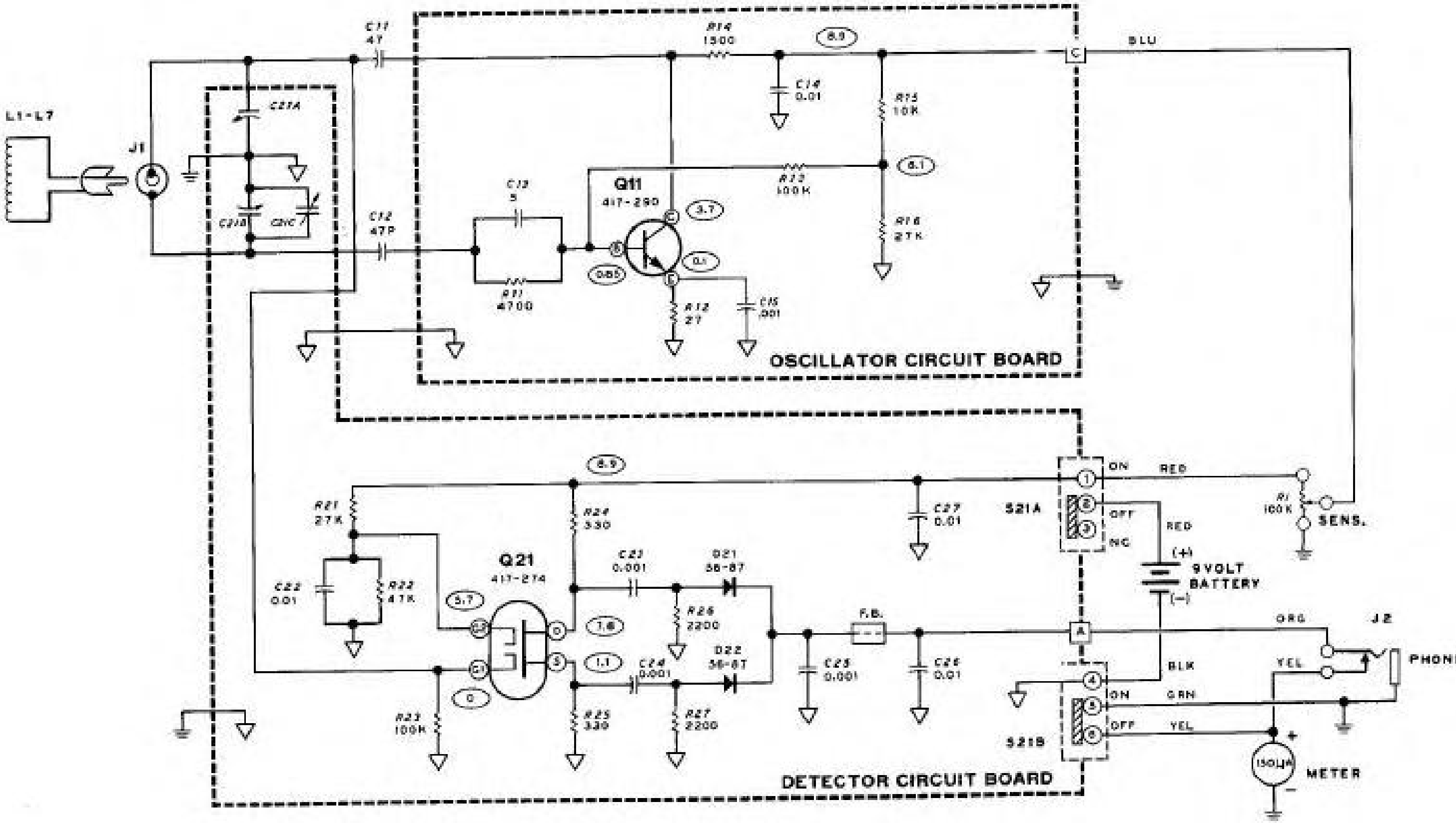
OSCILLATOR

The Solid-State Dip Meter uses a balanced Colpitts RF oscillator. Transistor Q11, a plug-in coil, and split-stator variable tuning capacitor C21 furnish the phase shift required for oscillation. Capacitors C11 and C12 are silver mica coupling capacitors chosen for their inherent stability. Resistor R11 determines the RF input current at low frequencies and is bypassed by capacitor C13 at high frequencies. Transistor Q11 is a uhf bipolar transistor, operating Class A.

Resistor R14 is a load resistor, while resistor R12 provides bias stability. Supply decoupling and a good RF ground is ensured by capacitor C14. Variable resistor R1 is a variable supply control for the oscillator and sets the level of regeneration.

DETECTOR

The voltage impressed across the oscillator tank (one of the coils L1 through L7, and C21) is amplified by a broad-band MOSFET amplifier. In a balanced phase-splitter configuration, transistor Q21 develops two output voltages across resistors R24 and R25. These out-of-phase signals are rectified by series hot-carrier diodes D21 and D22. The detected signals are combined and filtered by capacitors C25 and C26 to develop an average positive-peak DC voltage. This DC voltage is indicated by the Meter which provides mechanical filtering by its movement inertia.



SCHEMATIC OF THE HEATHKIT® SOLID–STATE DIP METER MODEL HD-1250

NOTES:

1. ALL RESISTORS ARE 1/4-WATT, 5% TOLERANCE UNLESS OTHERWISE NOTED. VALUES ARE IN OHMS (k=1000).
2. CAPACITORS LESS THAN 1 ARE IN µF; GREATER THAN 1 ARE IN pF.
3. ⏚ THIS SYMBOL INDICATES A CHASSIS GROUND.
4. ▽ THIS SYMBOL INDICATES A CIRCUIT BOARD GROUND.
5. □ THIS SYMBOL INDICATES AN EXTERNAL CONNECTION TO THE CIRCUIT BOARD.
6. ◯ THIS SYMBOL INDICATES A POSITIVE DC VOLTAGE, TAKEN WITH A HIGH INPUT IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO GROUND, WITH NO COIL IN THE OSCILLATOR CIRCUIT.

PARTS ARE GROUPED AS FOLLOWS

- 1-9 MOUNTED ON CHASSIS
- 11-19 MOUNTED ON OSCILLATOR CIRCUIT BOARD
- 21-29 MOUNTED ON DETECTOR CIRCUIT BOARD

	RANGE	PART NO.	COLOR
L1	1.6-3.4MHz	40-1689	RED
L2	3.2-6.6MHz	40-1690	ORANGE
L3	6.3-13MHz	40-1691	YELLOW
L4	12.5-26MHz	40-1692	GREEN
L5	25-51MHz	40-1693	BLUE
L6	48-100MHz	40-1694	VIOLET
L7	100-250MHz	40-1695	BROWN