OPERATING AND SERVICING MANUAL

MODEL 200CD/CDR

SERIALS PREFIXED: 229-

WIDE RANGE OSCILLATOR

P.O. Box 301, LOVELAND, COLORADO, U.S.A.

00084-4

Printed: SEP 1962

MANUAL CHANGES

MODEL 200CD

WIDE RANGE OSCILLATOR

Manual Serial Prefixed: 229
Manual Printed: 9/62

To adapt this manual to instruments with other serial prefixes check for errata below, and make changes shown in tables.

Instrument Serial Prefix	Make Manual Changes	Instrument Serial Prefix	Make Manual Changes
212-	1		
129-	1, 2		
103-	1, 2, 3		

CHANGE 1

Table of Replaceable Parts,
Delete the following:

Disc Ass'y Vernier Drive; hp Stock No. G-14J; Mfr. 28480; TQ, 1.
Bearing Capacitor Drive; hp Stock No. G-36J; Mfr. 28480, TQ, 1.
Spring Thrust; hp Stock No. G-91A; Mfr. 28480, TQ, 1.

Add the following:

Disc, vernier drive	G-14A
Disc, vernier drive	G-14B
Spring, compression	1460-0019

CHANGE 2

R23, R24: Change to resistor, fixed, composition, 820,000 ohms ±10%, 1/2W; Stock No. 0687-8241.

CHANGE 3

R50: Change to 250K ohms; hp Stock No. 2100-0175, connected between R23 and R24.

R30, 31: Change to resistors, matched pair, 2500 ohms each matched to within 1%; hp Stock No. 200J-26.

R35, 36: Delete.

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Instrument Serial Prefix	Make Manual Changes	Instrument Serial Prefix	Make Manual Changes
333-	1		
ALL	ERRATA		

CHANGE #1

Table of Replaceable Parts:

Add the following:

Gear, Assembly	5060-0020
Gear, Assembly	5060-0021

ERRATA

Change T1 and T2, Figure 4-10, as follows:

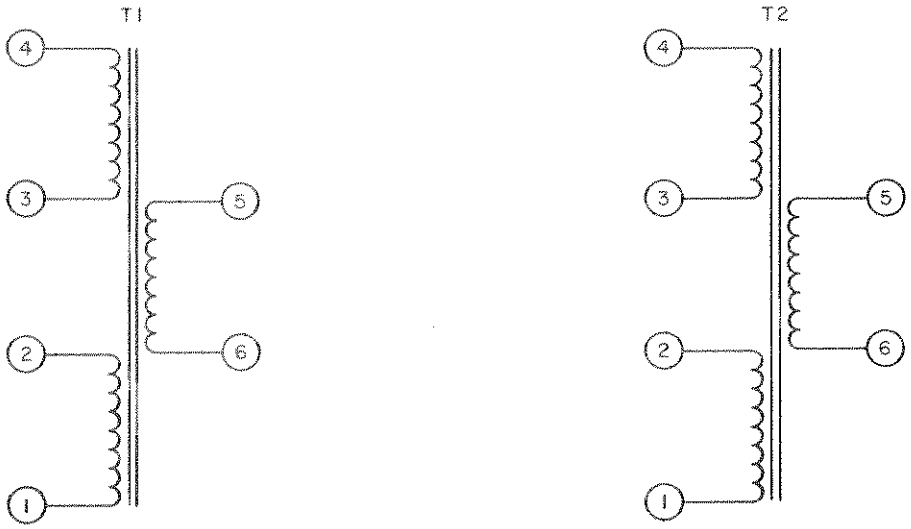

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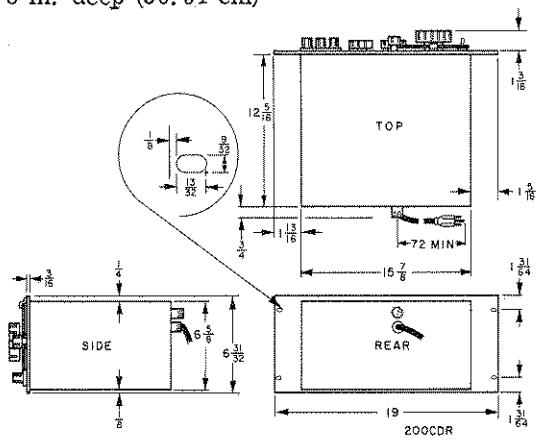
Table 1-1. Specifications

FREQUENCY RANGE:	5 cps to 600 kc covered in five ranges
RANGES:	X1 5 cps to 60 cps X10 50 cps to 600 cps X100 500 cps to 6 kc X1000 5 kc to 60 kc X10000 50 kc to 600 kc
ACCURACY:	±2% including calibration error, warmup, changes due to aging of components, tubes, etc
DIAL:	6-inch diameter calibrated over 300° of arc. 85 divisions. Total scale length, 78 inches
FREQUENCY RESPONSE:	±1 db entire frequency range (reference 1 kc)
OUTPUT:	160 milliwatts (10 volts) into 600-ohm rated load, 20 volts open circuit
OUTPUT BALANCE:	Better than 0.1% at lower frequencies and approximately 1% at higher frequencies
INTERNAL IMPEDANCE:	600 ohms. Output is balanced to ground for zero attenuation. (May be operated with one side grounded if desired.)
DISTORTION:	Less than 0.5% below 500 kc; less than 1% 500 kc and above. Independent of load impedance.
HUM VOLTAGE:	Less than 0.1% of rated output; decreases as output is attenuated
POWER:	115/230 volts ±10%, 50-1000 cps, 75 watts
ACCESSORIES AVAILABLE:	℗ AC-60A Line Matching Transformer (provides balanced output at any attenuator setting at 135 and 600 ohms) ℗ AC-16A Cable Assembly, 44 in. long, terminated each end with dual banana plugs ℗ AC-16B Cable Assembly, 45 in. long, with one dual banana plug and one BNC male connector
DIMENSIONS:	Cabinet Mount: 7-3/8 in. wide (18.73 cm), 11-1/2 in. high (29.21 cm) 14-3/8 in. deep (36.51 cm) Rack Mount: 
WEIGHT:	Cabinet Mount: Net 22 lbs (9.98 kg) Rack Mount: Net 27 lbs (12.26 kg)

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The Model 200CD Wide Range Oscillator generates frequencies of excellent waveform in the subsonic, audio, and ultrasonic ranges (5 cycles to 600 kc, in five overlapping decade bands). The Model 200CD includes new design features which result in still finer performance than previous Hewlett-Packard instruments. Special circuitry ensures an output voltage of low distortion and high stability with any output load impedance from zero ohms to open circuit. Usefulness of the oscillator has been extended by designing the 200CD output circuit so that the instrument may be operated balanced as well as unbalanced and by providing a 600-ohm impedance match.

1-3. The Model 200CD is easy to operate: frequency and amplitude of the output voltage are set merely by operating dials on the control panel. The easily-read, 6-inch diameter frequency dial is calibrated over 300° of arc, and has an effective scale length of approximately 80 inches.

1-4. The Model 200CD furnishes up to 10 volts into a 600-ohm load (20 volts open circuit) at any frequency from 5 cps to 600 kc. A bridged tee variable attenuator in the output circuit controls the output power.

1-5. The Model 200CD provides an ideal signal source for testing servo and vibrating systems, medical and geophysical equipment, audio amplifier circuits and transducers, sonar and supersonic apparatus, carrier telephone systems, video frequency circuits, and low radio-frequency equipment.

1-6. DIFFERENCES BETWEEN INSTRUMENTS.

1-7. Hewlett-Packard uses a two-section eight-digit serial number (000-00000). If the first three digits of the serial number on your instrument do not agree with those on the title page of this manual, change sheets supplied with the manual will define differences between your instrument and the Model 200CD described in this manual.

Figure 1-1. Model 200CD Wide Range Oscillator

SECTION II
PREPARATION FOR USE

2-1. INTRODUCTION.

2-2. This section contains information on unpacking, inspection, repacking, and installation of Model 200CD.

2-3. UNPACKING AND INSPECTION.

2-4. Unpack the instrument upon receipt and inspect it for signs of physical damage such as scratched panel surfaces, broken knobs, etc. If there is any apparent damage, file a claim with the carrier and refer to the warranty page in this manual.

2-5. An electrical inspection should be performed as soon as possible after receipt. To aid in electrical inspection a list of performance checks are given in section V, paragraph 5-39. These procedures make a good test as part of incoming quality-control inspection.

2-6. POWER REQUIREMENTS.

2-7. The Model 200CD requires a power source of 115/230 volts +10%, 50/1000 cps, 75 watts.

2-8. POWER CABLE.

2-9. This Hewlett-Packard instrument is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground pin.

2-10. To preserve the protection feature when operating instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the pigtail on the adapter to ground.

2-11. 230-VOLT OPERATION.

2-12. The Model 200CD is normally wired for operation from a nominal 115-volt supply. Operation from a 230-volt source is easily accomplished by reconnecting the dual 115-volt primary windings of the power transformer from a parallel configuration to a series configuration. (See figure 5-9). At the time of the change, replace the 1.25 amp, slow-blow line fuse with a 0.6 amp, slow-blow line fuse.

2-13. REPACKING FOR SHIPMENT.

2-14. The following list is a general guide for repackaging an instrument for shipment. If you have any questions, contact your authorized Hewlett-Packard sales representative.

a. If possible, use the original container designed for the instrument.

b. Wrap the instrument in heavy paper or plastic before placing it in the shipping container.

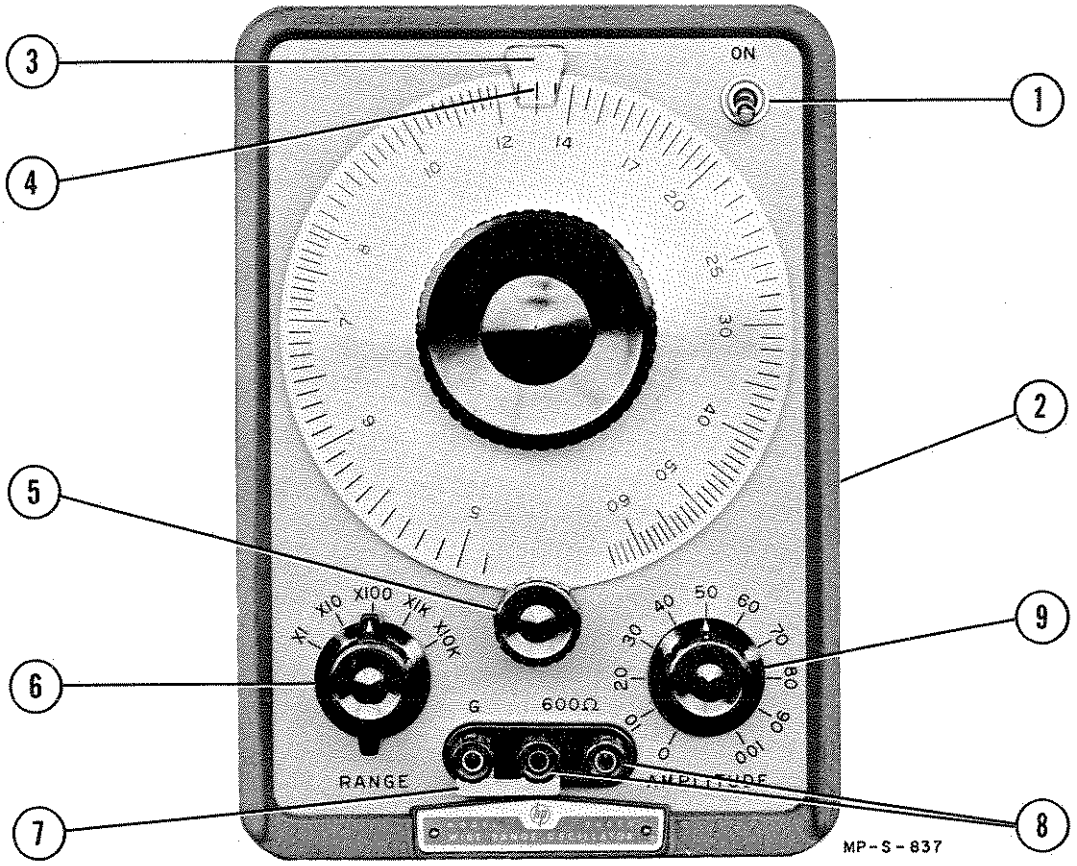
c. Use plenty of packing material around all sides of the instrument and protect the panel with cardboard strips.

d. Use heavy cardboard carton or wooden box to to house the instrument and use heavy tape or metal bands to seal the container.

e. Mark the packing box with "Fragile", "Delicate Instrument," etc.

Note

If the instrument is to be shipped to Hewlett-Packard Company for service or repair, attach to the instrument a tag identifying the owner and indicating the service or repair to be accomplished. In any correspondence be sure to identify the instrument by model number, serial prefix, and serial number.



1. Turn on power to instrument.
2. Fuse on rear of instrument.
3. Glows when instrument is energized.
4. Read frequency of operation multiplied by RANGE switch position.
5. Vernier, adjust frequency.
6. Select frequency range of operation.
7. Jumper for 600 ohm unbalanced output.
8. Balanced output terminals internal impedance equals 600 ohms.
9. Adjust output voltage level. Output balanced to ground only with amplitude control in full clockwise position.

Figure 3-1. Controls and Terminals

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. This section contains operating instructions for the Model 200CD Wide Range Oscillator. Figure 3-1 gives basic operating instructions. The remainder of this section supplements these instructions.

3-3. OPERATION.

3-4. ON. The oscillator is ready for use as received from the factory and will give specified performance after a short warmup period. Turn oscillator on and allow approximately five minutes to warm up. Where maximum accuracy is desired, this warm-up period should be extended to at least thirty minutes.

3-5. RANGE. The RANGE is selected with the five position RANGE switch. The position of this switch indicates the multiplying factor for the frequency dial calibration.

3-6. FREQUENCY dial. The frequency dial varies the frequency between the RANGE switch steps. The dial is calibrated from 5 to 60 and its indication multiplied by the factor indicated by the RANGE switch will give the actual output frequency of the oscillator. The small knob below the frequency dial is a vernier control for the dial.

3-7. OUTPUT CIRCUIT OPTIONS. The output circuit of the Model 200CD may be arranged for balanced or unbalanced operation. Typical connections for each are indicated in figure 3-2.

a. Unbalanced Operation. To operate with side grounded, a strap is placed between the G terminal, as indicated in figure 3-2A.

b. Balanced Operation. Connections for balanced operation are indicated in figure 3-2B. (The broken line from the ground terminal indicates the output circuit is balanced to ground, within the tolerances given below.)

3-8. The AMPLITUDE control in the output circuit is a bridged-T attenuator and at any setting except minimum attenuation unbalances the circuit. Therefore, for balanced operation the AMPLITUDE control must be set for maximum output (full clockwise). Output balance also is a function of frequency because of capacitive feed-through at higher frequencies. Up to 10 kc, however, unbalance is less than 0.1%, and at 600 kc is approximately 1%. If small outputs are desired, or if balance at higher frequencies is critical, turn the AMPLITUDE control maximum clockwise, and connect an external attenuator, designed for the frequencies involved, between the Model 200CD and the load.

3-9. A balanced output may also be obtained over the full range of the AMPLITUDE control by using an HP AC-60A/B Line Matching Transformer at the output terminals of the oscillator.

3-10. The following chart indicates the area where within 1% of balance may be obtained. This chart indicates balance obtainable at various settings of the AMPLITUDE control when operating into a 600-ohm load. Where other values of load are used, the chart does not apply directly but does apply for settings of the AMPLITUDE control that would produce the indicated voltage across at 600-ohm load.

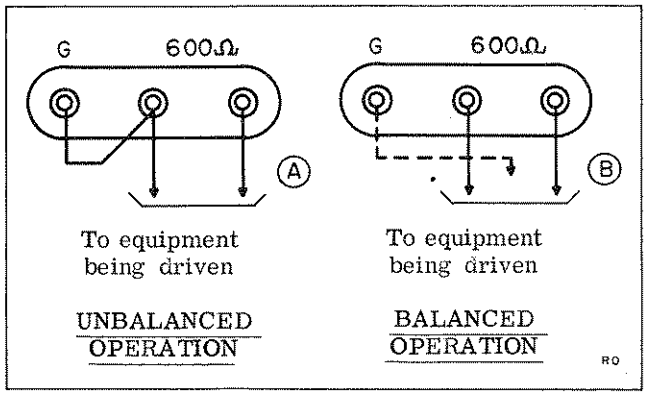


Figure 3-2. Typical Output Connections

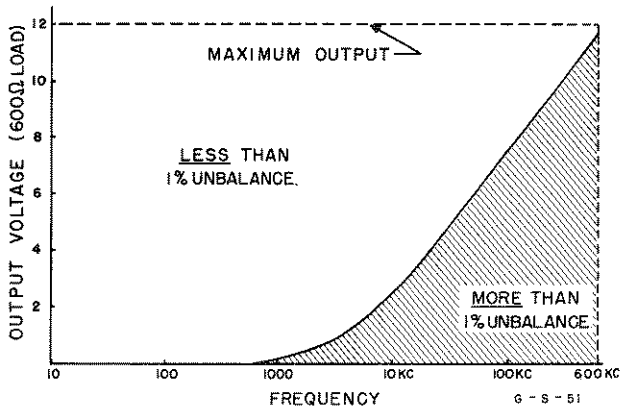


Figure 3-3. Balance Chart Operating into 600-ohm Load

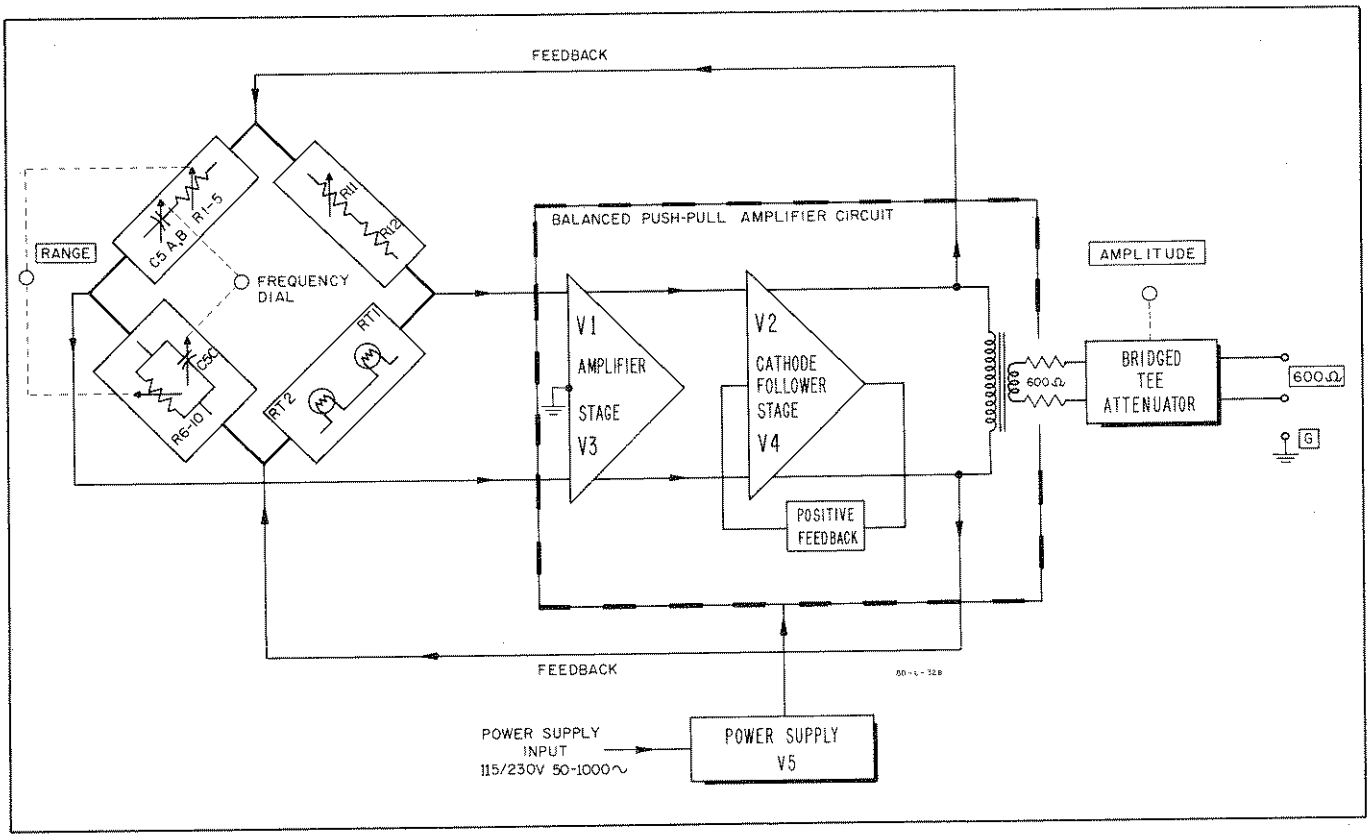


Figure 4-1. Model 200CD Block Diagram

SECTION IV
THEORY OF OPERATION

4-1. GENERAL.

4-2. The Model 200CD Wide Range Oscillator uses a balanced (push-pull) oscillator circuit from which the output is taken directly, avoiding the complication and possible distortion of an isolating amplifier. Reaction of the load on the oscillator is avoided by the use of a zero source impedance output stage. This arrangement results in a simple, trouble-free circuit having low distortion and high stability over the entire frequency range.

4-3. Functionally, the circuits of the Model 200CD include a frequency-controlling bridge and balanced push-pull amplifier which constitute the oscillator circuit, an output circuit which may be arranged either for balanced or unbalanced operation, and a power-supply circuit. These are shown in block diagram form in figure 4-1 and in detail in the schematic diagram.

4-4. FREQUENCY-CONTROLLING BRIDGE.

4-5. The frequency-controlling circuit is arranged as a floating bridge, symmetrical with respect to ground. With no connection to ground on any terminal of the bridge, stability of calibration is assured since any stray capacity or leakage to ground present at the bridge output terminals does not shunt either the frequency-controlling or amplitude-stabilizing arms of the bridge. The frequency-controlling components (RC networks which are varied by operation of the RANGE switch and frequency dial) comprise two arms of the bridge, while the amplitude-stabilizing components (a voltage divider which includes a thermally-sensitive resistance) comprise the other two arms. The amplitude is stabilized at such a level that the amplifier tubes are operated in the substantially linear portion of their characteristics, which, together with the large negative feedback at harmonic frequencies, results in a very pure sine wave oscillation.

4-6. The bridge is fed by the balanced voltage developed at the cathodes of V2 and V4 in the output of the balanced amplifier. The output of the frequency-controlling branch of the bridge is applied to the grid of V3 and the output of the amplitude-stabilizing branch is applied to the grid of V1. The manner in which the voltage-versus-frequency and phase-versus-frequency characteristics of an RC network can be utilized with an amplifier of proper design to achieve an oscillator which delivers a voltage of excellent stability and waveform is well covered in texts such as Terman & Pettit's Electronic Measurements.

4-7. Variable resistor R11 is provided for adjustment of the amplitude-stabilizing branch of the bridge should it be found after replacement of lamp RT1 or RT2 that less or more than rated voltage is being delivered to the output terminals.

4-8. Variable capacitors C3, C6, and C7 are adjusted at the factory for optimum calibration and amplitude constancy with frequency. They should not require adjustment unless the RANGE switch is replaced.

4-9. AMPLIFIER.

4-10. The oscillator amplifier is a balanced push-pull circuit including a voltage-amplifier stage (V1, V3) and a special cathode-follower stage (V2, V4). Criss-cross positive feedback is used in the cathode-follower stage to provide an essentially zero output impedance as seen by the cathode-to-cathode load. The feedback paths are from the plate of V2 to the control grid and screen of V4, and from the plate of V4 to the control grid and screen of V2. The degree of the positive feedback is a function of the load and increases as the load impedance decreases, thus tending to maintain the output constant regardless of load. Self-oscillation in the amplifier circuit is prevented by proper choice of resistance in the feedback circuits and by controlling plate and cathode impedances over the entire frequency range of the oscillator. The output stage is protected against a cathode-to-cathode short circuit by the resistors in series with the transformer secondaries. These resistors also make the oscillator present a 600-ohm impedance to the attenuator.

4-11. OUTPUT CIRCUIT.

4-12. Transformer coupling provides isolation between the oscillator circuit and the output circuit, and allows the output to be obtained either balanced or unbalanced. Since a single transformer will operate suitably over only a part of the frequency range covered 200CD, two transformers are provided. Connections between cathode-followers V2 and V4 and the proper transformer for the band in use are set up by the RANGE switch. The secondary windings of the coupling transformers supply a conventional bridged tee attenuator, the setting of which is adjusted by operation of the AMPLITUDE control on the front panel. As the control is turned counterclockwise, the loss inserted by the attenuator is increased. The source impedance at the output terminals is 600 ohms.

4-13. With attenuator set for minimum loss, the output circuit is arranged for balanced operation, and is so designed that for frequencies up to 10 kc, stray capacity and leakage resistance will cause less than 0.1% unbalance. Unbalance at 600 kc is approximately 1%.

4-14. When it is desired to operate unbalanced, ground should be connected to the center output terminal, the termination for the connection brought out from terminal 6 of output transformers T1 and T2. Proper operation cannot be obtained if the ground is connected to the side of the circuit which includes the attenuator.

Table 5-1. Test Instruments Required

Instrument Type	Minimum Required Specifications	Recommended ℌ Instruments
DC Electronic Voltmeter	Sensitivity: 1 volt full scale minimum Input resistance: 10 megohms or higher	Model 410B or 412A Vacuum Tube Voltmeter
AC Transistor Voltmeter	Input impedance: 2 megohms shunted by 40 pf (below the 0.3 volt range) Accuracy: ±3% from 5 cps to 500 kc	Model 403A Transistor Voltmeter
AC Electronic Voltmeter	Input impedance: 10 megohms shunted by 25 pf (below the 0.3 volt range) Accuracy: ±2% from 20 cps to 1 mc	Model 400D/H/L Vacuum Tube Voltmeter
Distortion Analyzer		Model 330B Distortion Analyzer
600-ohm Resistor	600 ohms ±1% to 100 kc	Model 470E Shunt Resistor
Electronic Counter —or—	Frequency and period readings available. Frequency measuring capabilities to at least 600 kc	Models 523C/CR, D/DR or 524C/D Electronic Counters
Frequency Standard —and—	Frequencies available: a) 10 cps b) 100 cps c) 1 kc d) 100 kc Output voltage: 5 volts rms minimum Frequency accuracy: ±0.05%	100ER Precisions Frequency Standard
(Optional - recommended) Oscilloscope	Frequency range: flat from 5 cps to at least 600 kc	Models 150A, 160B, 170A Oscilloscopes

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains test and maintenance information for Model 200CD Wide Range Oscillator. A performance check is included (paragraph 5-39) that may be used to verify operation within published specifications. This check should be made with the instrument in its cabinet. This section also includes recommended test equipment, troubleshooting, repair and adjustment procedures.

5-3. PERIODIC MAINTENANCE.

5-4. The Model 200CD should require a minimum of maintenance, since there are few moving parts. The following procedure performed once or twice a year should insure smooth operation.

a. Put one drop of oil in each of the three oil holes on the tuning drive mechanism.

b. Place a small amount of high quality contact cleaner on the RANGE switch contacts. Rotate the switch back and forth several times.

c. Using compressed air, gently blow any accumulated dust out of the tuning capacitor plates (C5). See figure 5-1.

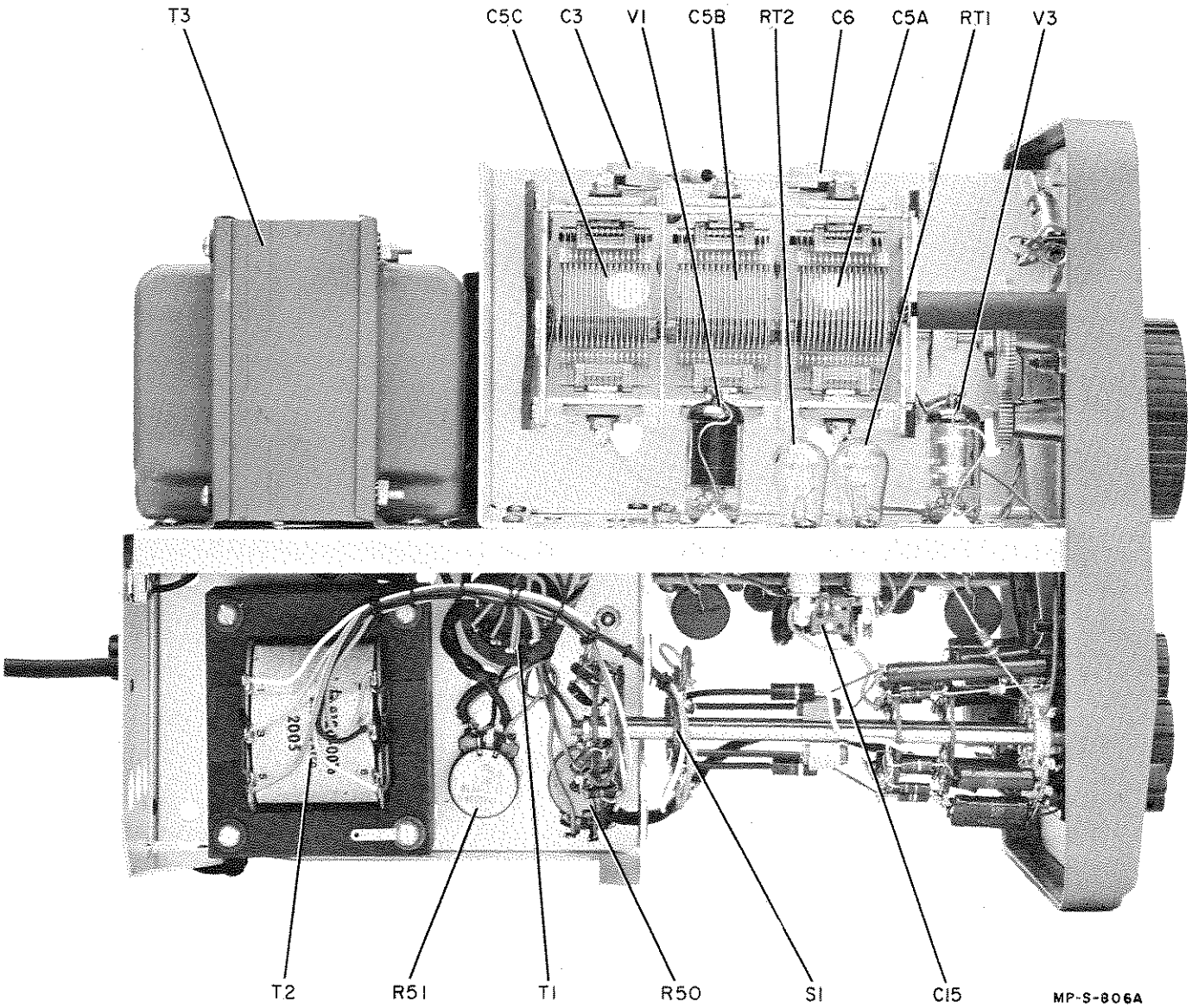


Figure 5-1. Left Side View Model 200CD

5-5. TEST EQUIPMENT.

5-6. Table 5-1 lists the test equipment required to accurately check the Model 200CD. Equipment having similar characteristics can be substituted for the equipment listed.

5-7. TROUBLESHOOTING.

5-8. The following section gives information to aid in the localizing of troubles in the Model 200CD. In many cases a visual inspection of the instrument will reveal the area of the faulty component if not the component itself. To further assist in troubleshooting, table 5-2 and a voltage-resistance diagram, figure 5-8, have been included in this section. The troubleshooting table (5-2) gives a list of symptoms and their possible causes.

5-9. AMPLIFIER POWER SUPPLY.

5-10. Amplifier and power supply operation is best checked by voltage-resistance readings and tube substitution. If tube substitution does not correct the difficulty, return the original tube to the instrument. Voltages and resistances are indicated in figure 5-8; these are typical readings and may vary somewhat from instrument to instrument.

5-11. REPAIR AND REPLACEMENT.

5-12. CABINET REMOVAL.

5-13. To remove the Model 200CD proceed as follows:

a. Disconnect the Model 200CD from the power source.

b. Remove the two screws at the rear of the cabinet. The Model 200CDR rack mount unit has two additional screws on the front panel which must be removed.

c. Carefully slide the instrument forward, out of the cabinet.

Table 5-2. Troubleshooting

Symptom	Probable Cause	Symptom	Probable Cause
Resistance to ground less than 100K ohms	C13A, B, C leaky C14 leaky C10, 11 shorted	200CD obviously microphonic	V1-V4 defective RT1, RT2 defective Tuning capacitor dirty or defective
Tubes not glowing, pilot light out	Blown fuse F1 S2 defective	Dial springs back when turned clockwise against the stop	Tuning capacitor closed too far when fully meshed
One or more tubes not glowing, pilot light on	One or more tubes burned out	Impossible to set low end on frequency Dial springs back when turned counterclockwise against the stop	Tuning capacitor open too far when fully meshed
Power supply voltage variation exceeds test limit	C13A, B, C or C14 breaking down under high voltage V5 defective V1-V4 shorted	Calibration bad on one range only	Dirty RANGE switch contacts C1, C2, C7, or C16 need adjusting One RANGE switch resistor has changed resistance
Impossible to set 200CD output to 20 volts (unloaded)	V1-V4 defective RT1, RT2 defective		
With RANGE set to X1-X100 ranges and output set to 20 volts rms, addition of 600-ohm termination does not lower output to 10 volts ±0.5 v	T2 defective	Excessive distortion on X1K-X10K ranges	R50 or R51 misadjusted T2 defective
		Excessive distortion on	R50 or R51 misadjusted T1 defective
Same as above with RANGE set at X1K or X10K	T1 defective		
		Excessive distortion on all ranges	V1-V4 defective RT1-RT2 defective Dust between tuning capacitor plates
Turning AMPLITUDE control causes jumpy output	R39 (AMPLITUDE control) defective		
		Impossible to set 11.5 v out with 200CD terminated with 600 ohms (adjustment procedure)	RT1, RT2 defective V1-V4 weak
Recovery time exceeds test limit	V1, V3 defective RT1, RT2 defective		

5-14. SERVICING ETCHED CIRCUIT BOARDS.

Note

Excessive heat or pressure can lift copper conductors from etched circuit boards.

5-15. To remove components from board, clip leads on component side of board. New components can then be soldered to the leads extending from the board or the leads can be removed. If leads are removed, clean holes with a toothpick or wooden splinter (metal awls or soldering aids may destroy the copper conductor) before inserting leads.

5-16. TUBE REPLACEMENT.

5-17. Tubes used in the Model 200CD are listed in Tube Replacement List (table 5-3). If V2 or V4 are changed, replace the special tube shields in their original positions, (shown in figure 5-2).

Table 5-3. Tube Replacement List

Tube	Type	Function	Required Checks or Adjustments
V1	6AU6	Voltage Amplifier	Recheck calibration and distortion.
V2	6CW5/ EL86		Reset output voltage. (paragraphs 5-24 through 5-38)
V3	6AU6	Cathode Followers	Recheck distortion, (paragraph 5-37)
V4	~~6AU6~~ 6CW5/ EL86		Reset output voltage, (paragraph 5-38)
V5	5AR4	Rectifier	Check power supply (paragraph 5-28)

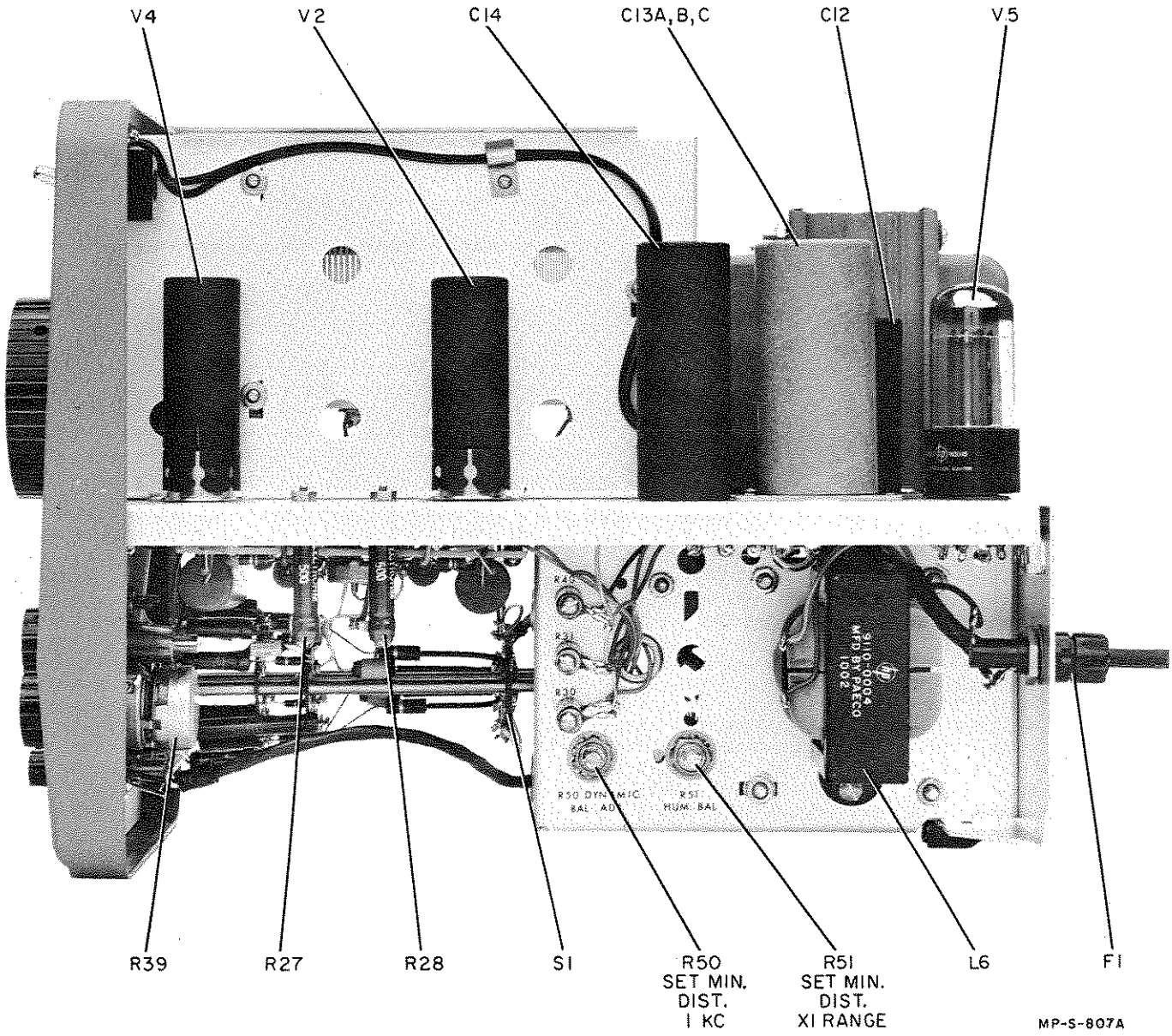


Figure 5-2. Left Side View Model 200CD

5-18. REPLACEMENT OF LAMPS, RT1 and RT2

5-19. The amplitude stablization lamps operate well below their rating and should have a long life, unless they are damaged by severe mechanical vibration. When RT1 or RT2 (see figure 5-1) are replaced, reset output voltage (paragraph 5-38).

5-20. TUNING CAPACITOR REPAIR.

5-21. The tuning capacitor, C5 A, B, C (shown in figure 5-1), should not be loosened unless absolutely necessary, since doing so may cause misalignment of the tuning capacitor shaft with the shaft extension to the gears. If C5 A, B, C has been removed or loosened for any reason, it should be readjusted mechanically before any electrical adjustment is attempted. In some cases, due to slippage, the tuning capacitor will not mesh far enough to allow perfect calibration at the extreme low end of the dial. When correctly set, the edge of the insulation protruding from the rotor plate spacer on C5 should line up with the topmost stator spacer when the dial is set fully clockwise.

5-22. RANGE SWITCH REPAIR.

5-23. Resistor values on S1 have been carefully bridged and adjusted at the factory to the exact value required for proper tracking on all ranges. If one range is found to be badly out of calibration and all other possibilities have been exhausted (especially dirty RANGE switch contacts) try adjusting the value of C1, C2, C7 or C16 (depending on the range affected) slightly. If any part of the RANGE switch is found to be defective, it is recommended that the switch be replaced as an assembly. Figure 5-3 shows all wiring detail for replacement.

5-24. ADJUSTMENTS.

5-25. The following section is a complete adjustment procedure and should be made only if it has been definitely determined that the Model 200CD is out of adjustment.

Note

In order to minimize the effects of hand capacity, a "tuning wand" or tuning screwdriver with a plastic shank should be used for all adjustments.

5-26. PRELIMINARY CHECKS.

5-27. The following basic tests are given to avoid possible unnecessary adjustment of the Model 200CD. If the instrument fails any of these tests, some component is probably at fault and should be replaced before attempting any adjustment. Proceed as follows:

5-28. POWER SUPPLY:

a. With the instrument turned off, check the resistance from C13 to ground and the resistance across C13. This resistance is typically many megohms. A very low reading (below 100K) indicates a shorted or leaky capacitor between the B+ line and ground.

b. Turn the instrument on, and allow it to warm up for at least 15 minutes.

c. Check to see that all tubes are glowing.

d. Using an dc electronic voltmeter, measure the positive and negative power supply voltages using ground as a reference. The positive voltage (approximately 225 volts) may be measured between the chassis and C14. The negative voltage (approximately 155 volts) is measured from the chassis to the junction of R30, R31 and R40 (figure 5-2). The difference between the negative and positive voltage should be 380 volts ±75 volts.

5-29. AMPLITUDE CONTROL OPERATION:

a. With a 600-ohm load connected to the OUTPUT terminals, and the Model 200CD output connected to the ac voltmeter, set the Model 200CD RANGE to X100.

b. Turn the Model 200CD AMPLITUDE fully clockwise. If necessary adjust R11 to obtain 12 vac.

c. Now, while observing the voltmeter indication and switching to lower voltmeter ranges as necessary, slowly turn the Model 200CD AMPLITUDE fully counter clockwise. Note the voltmeter reading again. The attenuation should be smooth and the final reading should be at least 46 db below the reference in step b.

5-30. RECOVERY TIME:

a. Switch RANGE to X10 and frequency to 50 kc.

b. Connect the output of the Model 200CD to an oscilloscope.

c. Switch from range to range, observing the oscilloscope pattern after range switching.

d. The oscilloscope presentation should become stable within 5 seconds after switching ranges.

5-31. CALIBRATION.

5-32. The calibration procedure for the Model 200CD is divided into two sections. The first section, paragraph 5-33, is intended to produce a flat frequency response for the Model 200CD, and is accomplished with the instrument set on the X10 range. The second section, paragraph 5-34, is intended to produce correct frequency dial tracking and is accomplished with the instrument set on the X100 range.

5-33. FREQUENCY RESPONSE ADJUSTMENTS:

a. Turn Model 200CD RANGE to X10, frequency dial to 5.

b. Connect the Model 200CD to an ac voltmeter and a frequency measuring device (counter or frequency standard) as shown in figure 5-4.

c. Using Model 200CD AMPLITUDE, set a reference of 9 volts as read on the ac voltmeter.

d. Turn the frequency dial to 60. The ac voltmeter should read within ±1/4 db of the reference in step c and the frequency should be correct within 2%.

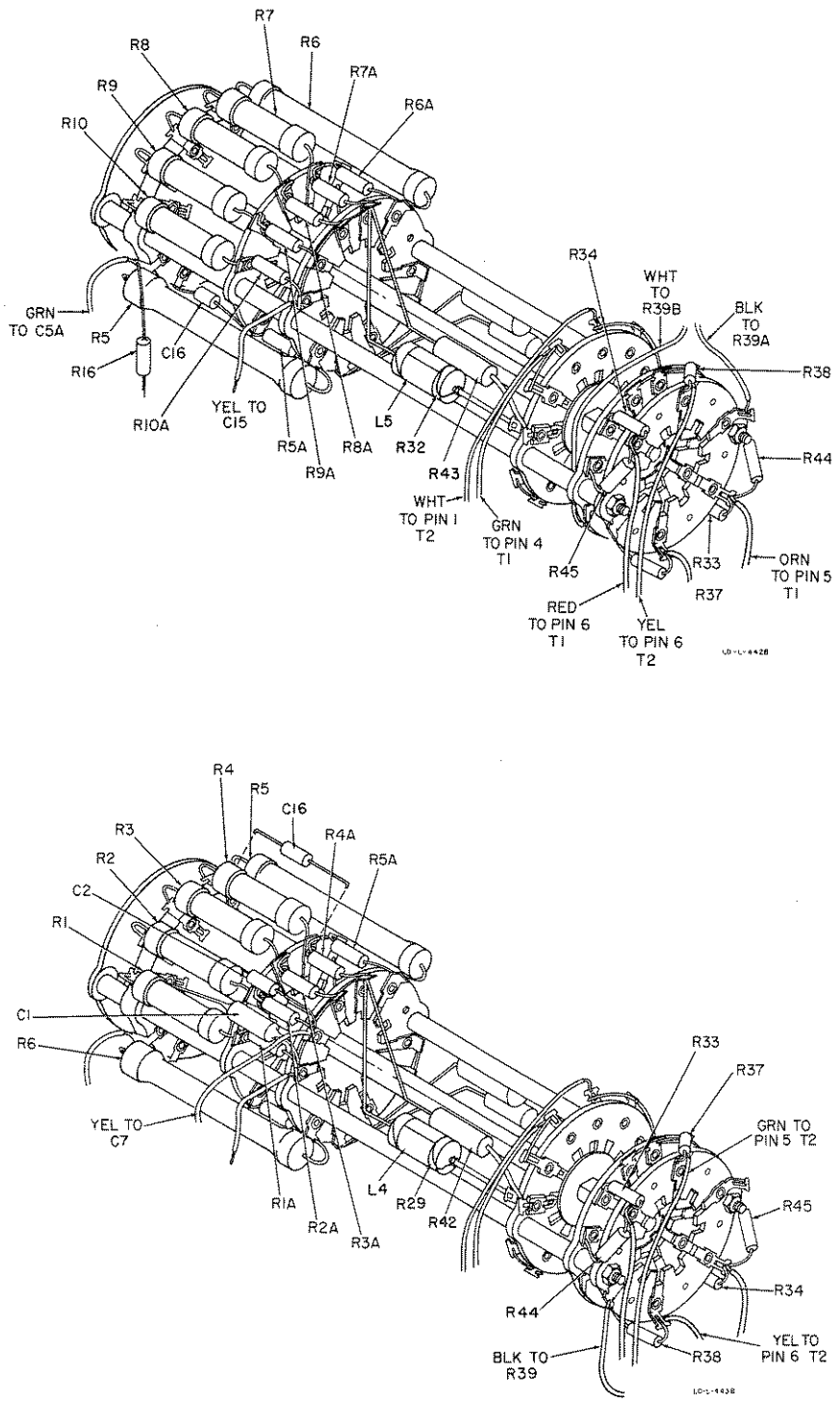


Figure 5-3. Range Switch Detail

e. If 600 cps is off more than 2%, set the frequency on with C6.

Note

Since replacing the cabinet raises the frequency slightly, it is advisable to set the frequency slightly low (e.g., 599 cps) when making this adjustment.

f. Observe the output voltage and determine how much it differs from the reference.

g. Adjust C3 to correct for half this difference. Then adjust C6 so that the output frequency is again 600 cps.

h. Observe the output voltage. If it is more than ±1/4 db from the reference in step c repeat steps c through h until a flat response is obtained with 600 cps set on frequency (see note above).

5-34. FREQUENCY DIAL TRACKING:

a. Switch Model 200CD RANGE to X100. Connect the equipment as shown in figures 5-4 and 5-5.

b. Check the frequency at 5. The frequency reading should be 500 cps ±2%. If the frequency is off more than ±2%, slip the dial to put it on frequency:

1) Remove center knob on frequency dial.

2) Loosen the four screws which secure the dial plate to the drive shaft.

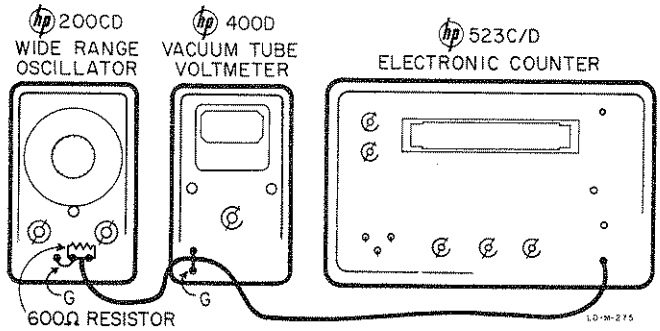


Figure 5-4. Calibration Test Setup

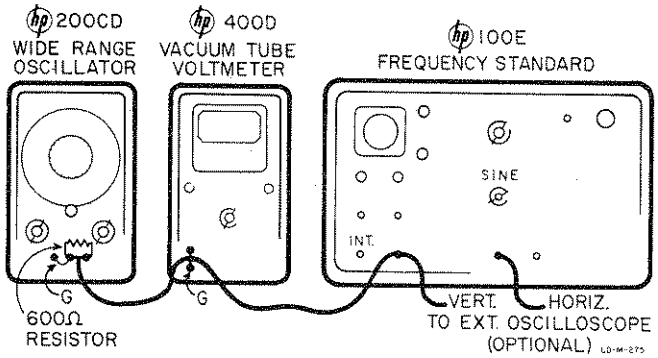


Figure 5-5. Alternate Calibration Setup

3) Reset dial to position indicated in the text.

4) Tighten the four securing screws. (Center knob may be replaced at the end of this procedure.)

c. If it was necessary to slip the dial, repeat steps a through h in paragraph 5-33.

d. If step c was necessary, repeat step b. It is possible that the entire dial will now track without further adjustment.

e. Check all numbered points on the dial, beginning at the high end. If some points exceed test limits (±2%) try to equalize the error by slipping the dial to get all points within these limits.

f. Switch RANGE to X10K, and set the Model 200CD frequency dial to 60.

g. Adjust C7 to put 600 kc on frequency.

h. Check calibration on the remaining ranges. Calibration should be correct to ±2%.

Note

It will be advantageous to set the counter FUNCTION SELECTOR to 10 PERIOD AVERAGE when measuring frequency on the X1 range (refer to table 5-4).

Table 5-4. Frequency/Period Conversion

Frequency (cps)	Frequency Limits	Period Limits
5	5.1 4.9	196.0 ms 204.0 ms
10	10.2 9.8	098.0 ms 102.0 ms
20	20.4 19.6	049.0 ms 051.0 ms
40	40.8 39.2	024.5 ms 025.5 ms
60	61.2 58.8	016.3 ms 017.0 ms

5-35. If the above procedures do not result in correct calibration, start over by adjusting C3 and/or C6 as in step a through h, paragraph 5-33. Then work toward the low end by setting the dial to the next numbered point and bending one of the outer rotor plates in each section of C5 at the point of mesh. Continue this procedure to the low end of the dial to obtain approximately correct frequencies. Repeat the bending procedure from the high end, this time making fine adjustments of frequency with the other outer rotor plates. In this way, bending of any one plate is minimized.

5-36. When bending rotor plates, observe the following precautions: 1) keep all bends as near the shaft as possible; 2) keep all segments in line. The rotor plates should taper gradually inward or outward, depending on whether you must compress or expand the

frequency range. This gradual taper is essential for linearity. 3) Bending of plates near the high frequency end should be unnecessary.

5-37. DISTORTION.

a. Connect the Model 200CD to the distortion analyzer as shown in figure 5-6.

b. Set the Model 200CD RANGE to X1 and the frequency dial to 20.

c. The distortion analyzer switches should be in the following positions:

AF-RF	AF
FREQUENCY	20
Selector switch	SET LEVEL
RMS VOLTS-DB switch	±20 db

d. Adjust distortion analyzer INPUT control for a zero db reference on the distortion analyzer meter.

e. Switch selector to DISTORTION.

f. Adjust BALANCE and FREQUENCY controls for a dip on the meter.

g. Turn RMS VOLTS-DB switch counterclockwise while continually adjusting distortion analyzer BALANCE and FREQUENCY until the lowest possible dip is obtained.

h. Adjust R50 (dynamic balance) for a dip (minimum distortion; see figure 5-2) on the distortion analyzer meter until the lowest possible dip is obtained.

Note

For optimum results use lowest frequency setting of the 200CD Wide Range Oscillator.

i. Repeat steps a through h, adjusting all distortion analyzer controls for 50 cps (60 cps if 50 cps line frequency is being used) instead of 1000 cps.

j. Adjust R51 (hum balance; see figure 5-2) instead of dynamic balance in step h.

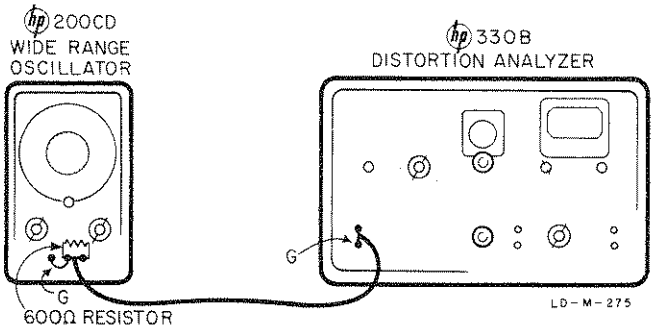


Figure 5-6. Distortion Test Setup

5-38. OUTPUT VOLTAGE

a. Connect the Model 200CD to an ac voltmeter.

b. Load the Model 200CD with a 600-ohm load resistor.

c. Turn Model 200CD AMPLITUDE fully clockwise, and adjust R11 for 11.5 volts on the ac voltmeter (see figure 5-7.

5-39. PERFORMANCE CHECK.

5-40. Proper operation of the Model 200CD is verified in the following procedure. A complete adjustment procedure is given in paragraph 5-24.

5-41. OUTPUT IMPEDANCE.

a. Set Model 200CD RANGE to X100, frequency dial to 10.

b. Connect Model 200CD output to an ac transistor voltmeter. Set the voltmeter RANGE to 30 volts.

c. Turn Model 200CD AMPLITUDE fully clockwise. The voltmeter should read at least 20 volts.

d. Set Model 200CD AMPLITUDE for exactly 20 volts as read on the voltmeter.

e. Connect a 600-ohm resistor such as the Model 470E Shunt Resistor across output of Model 200CD.

f. The voltage as read on the voltmeter should drop to 10 volts +0.5 volts.

5-42. FREQUENCY RESPONSE.

a. Connect the Model 200CD to an ac voltmeter and an electronic counter as shown in figure 5-4. Substitute an ac transistor voltmeter for the ac electronic voltmeter in figure 5-4.

b. Set Model 200CD RANGE to X100, frequency dial to 10. Terminate output with 600 ohms.

c. Adjust Model 200CD AMPLITUDE for a convenient reference around 0.9 on the voltmeter scale.

d. Starting with the X1 range, rotate the frequency dial across the band while observing the meter.

e. Repeat this process for each range. The voltmeter indication should not vary more than ±1 db throughout the ranges checked.

5-43. DIAL ACCURACY.

a. Set Model 200CD RANGE to X10K, frequency dial to 60. Observe the frequency reading on the electronic counter.

b. Check frequency at 40, 20, 10 and 5 on the dial.

c. Repeat this procedure for the remaining ranges. The frequency should be correct within ±2%.

Note

For the lower end of the X10 range and the entire X1 range, it will be advantageous to measure the frequency indirectly by switching the electronic counter FUNCTION SELECTOR to 10 PERIOD AVERAGE. Table 5-4 lists the specifications in terms of period readings for each point on the X1 range. To check X10 range, divide the period limit in table 5-4 by 10.

5-44. DISTORTION.

a. Connect the Model 200CD to a distortion analyzer as shown in figure 5-6.

b. Set Model 200CD RANGE switch and frequency dial to one of the frequencies indicated in table 5-5.

c. The distortion analyzer switches should be set to the following positions:
AF-RF . . . . . AF
FREQUENCY. .incoming frequency selected in step b
Selector switch . . . . . SET LEVEL
RMS VOLTS-DB switch . . . . . ±20 db

d. Adjust distortion analyzer INPUT control for a zero db reference on the distortion analyzer meter.

e. Switch selector to DISTORTION.

f. Adjust BALANCE and FREQUENCY controls for a dip on the meter.

g. Turn RMS VOLTS-DB switch counterclockwise while continually adjusting distortion analyzer BALANCE and FREQUENCY until the lowest possible dip is obtained. Specifications are listed in table 5-5.

Table 5-5. Distortion Test Frequencies

Range	Frequency	Specifications
X10	100 cps	46 db
X100	1000 cps	46 db
X100	6 kc	46 db
X1K	5 kc	46 db

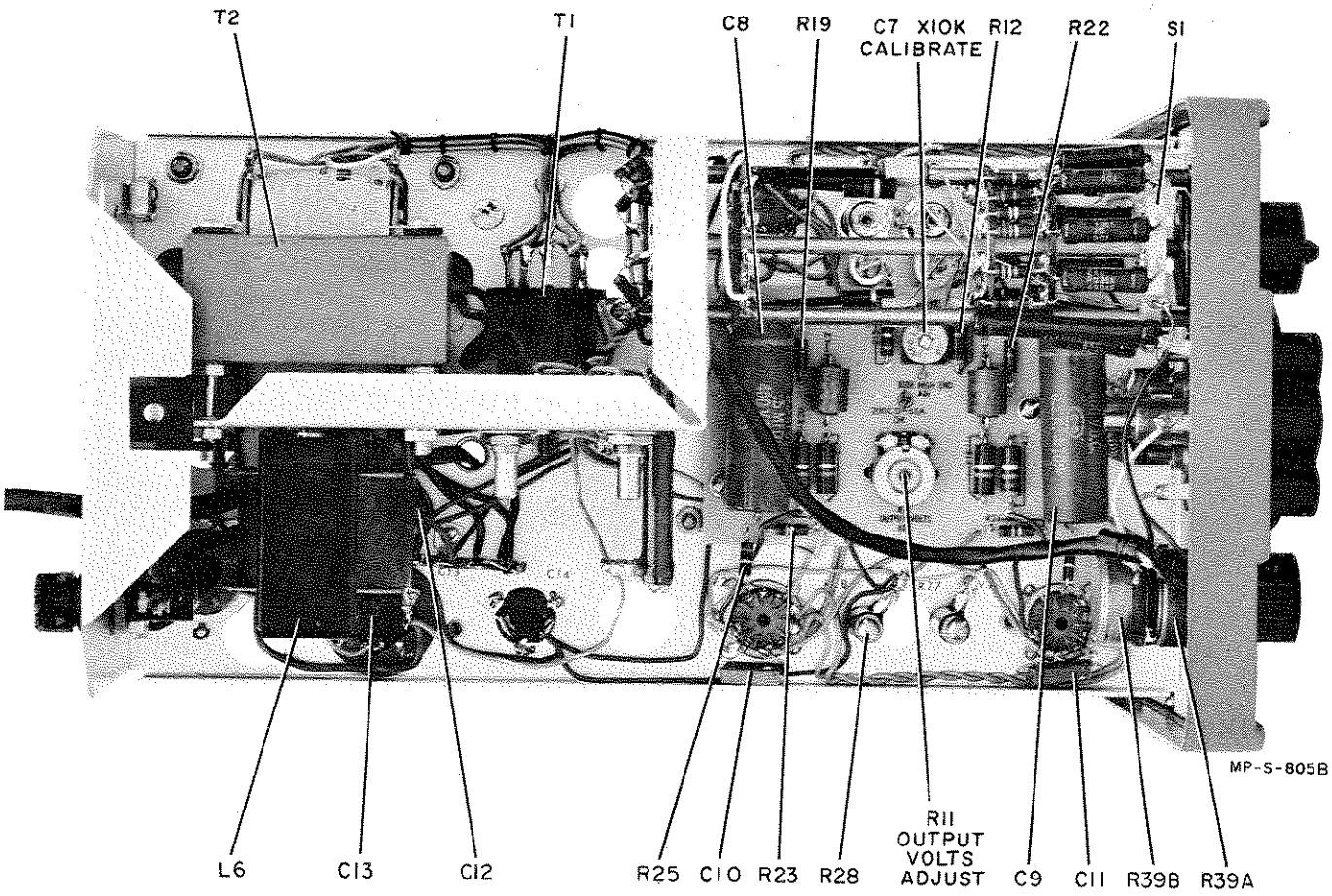


Figure 5-7. Bottom View Model 200CD

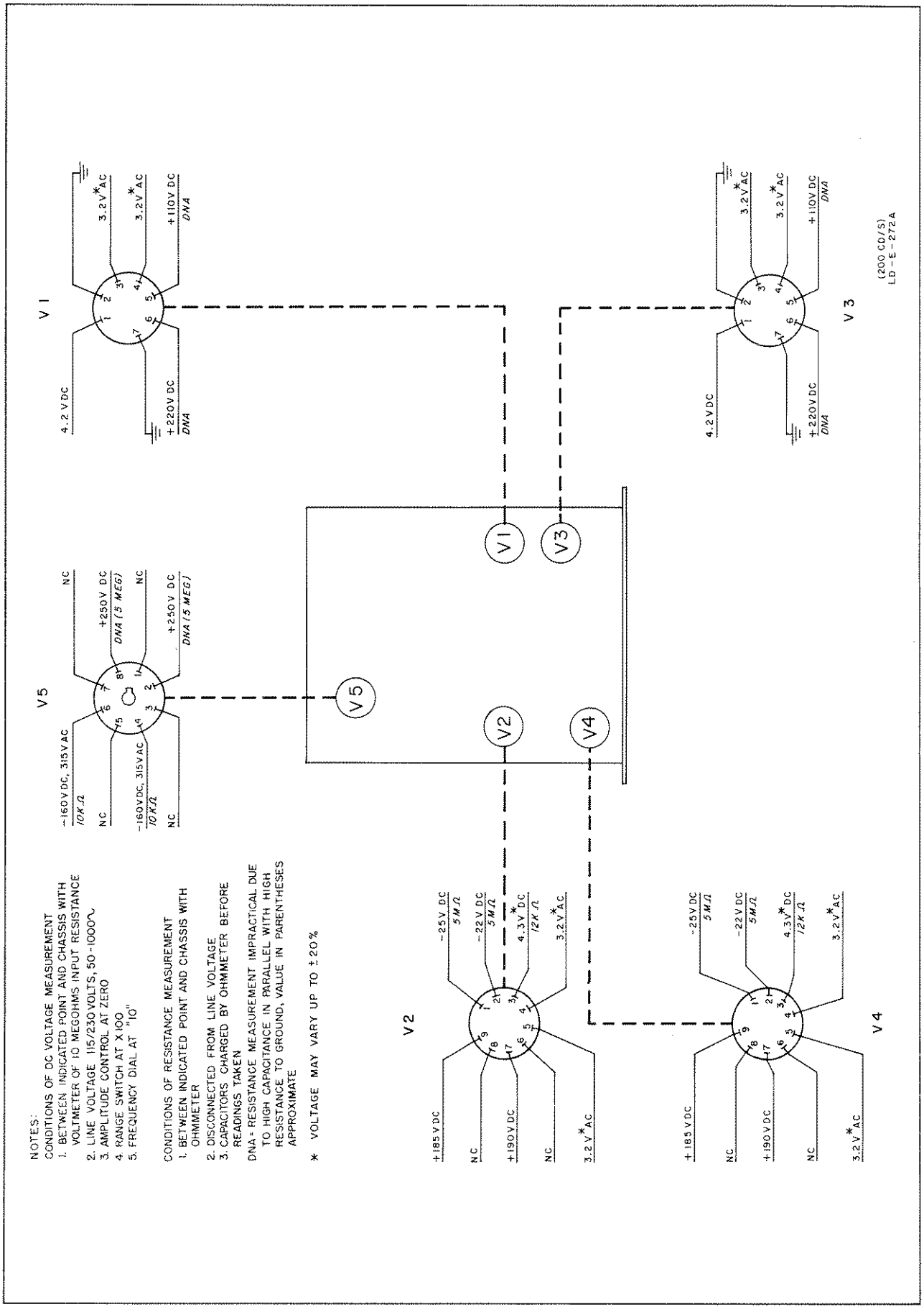


Figure 5-8. Model 200CD Voltage and Resistance Diagram

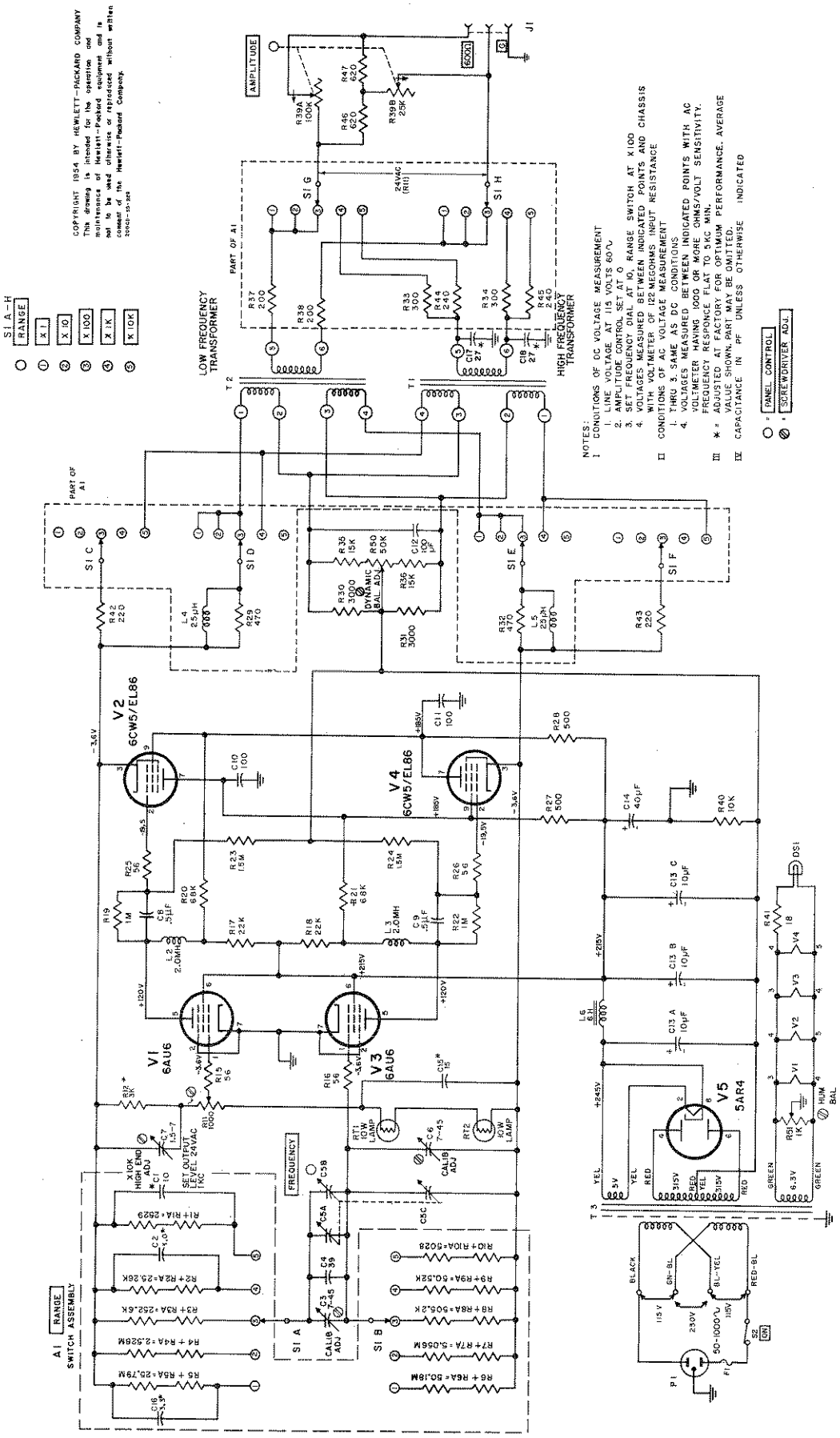


Figure 5-9. Model 200CD Schematic Diagram

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alpha-numerical order of their reference designators and indicates the description and hp stock number of each part, together with any applicable notes. Table 6-2 lists parts in alpha-numerical order of their hp stock numbers and provides the following information on each part:

a. Description of the part (see list of abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in appendix.

c. Manufacturer's stock number.

d. Total quantity used in the instrument (TQ col.).

e. Recommended spare part quantity for complete maintenance during one year of isolated service (RS column).

6-3. Miscellaneous parts not indexed in table 6-1 are listed at the end of table 6-2.

6-4. ORDERING INFORMATION.

6-5. To order a replacement part, address order or inquiry either to your authorized Hewlett-Packard sales representative or to

CUSTOMER SERVICE
Hewlett-Packard Company
Box 301
Loveland, Colorado

or, in Western Europe, to

Hewlett-Packard S.A.
54-54bis Route des Acacias
Geneva, Switzerland

6-6. Specify the following information for each part:

a. Model and complete serial number of instrument.

b. Hewlett-Packard stock number.

c. Circuit reference designator.

d. Description.

6-7. To order a part not listed in tables 6-1 and 6-2, give a complete description of the part and include its function and location.

REFERENCE DESIGNATORS

A	= assembly	F	= fuse	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
B	= motor	FL	= filter	Q	= transistor	W	= cable
C	= capacitor	J	= jack	R	= resistor	X	= socket
CR	= diode	K	= relay	RT	= thermistor	XF	= fuseholder
DL	= delay line	L	= inductor	S	= switch	XDS	= lampholder
DS	= device signaling (lamp)	M	= meter	T	= transformer	Z	= network
E	= misc electronic part	MP	= mechanical part				

ABBREVIATIONS

a	= amperes	elect	= electrolytic	mtg	= mounting
bp	= bandpass	encap	= encapsulated	my	= mylar
bwo	= backward wave oscillator	f	= farads	NC	= normally closed
c	= carbon	fxd	= fixed	Ne	= neon
cer	= ceramic	Ge	= germanium	NO	= normally open
cmo	= cabinet mount only	grd	= ground (ed)	NPO	= negative positive zero (zero temperature coefficient)
coef	= coefficient	h	= henries	nsr	= not separately replaceable
com	= common	Hg	= mercury	obd	= order by description
comp	= composition	impg	= impregnated	p	= peak
conn	= connection	incd	= incandescent	pc	= printed circuit board
crt	= cathode-ray tube	ins	= insulation (ed)	pf	= picofarads = 10^{-12} farads
dep	= deposited	K	= kilo = 1000	pp	= peak-to-peak
EIA	= Tubes or transistors meeting Electronic Industries' Association standards will normally result in instrument operating within specifications; tubes and transistors selected for best performance will be supplied if ordered by hp stock numbers.	lin	= linear taper	piv	= peak inverse voltage
		log	= logarithmic taper	pos	= position(s)
		m	= milli = 10^{-3}	poly	= polystyrene
		M	= megohms	pot	= potentiometer
		ma	= milliamperes	rect	= rectifier
		μ	= micro = 10^{-6}	rot	= rotary
		minat	= miniature	rms	= root-mean-square
		mfgl	= metal film on glass	rmo	= rack mount only
		mfr	= manufacturer	s-b	= slow-blow
				Se	= selenium
				sect	= section(s)
				Si	= silicon
				sil	= silver
				sl	= slide
				td	= time delay
				TiO_2	= titanium dioxide
				tog	= toggle
				tol	= tolerance
				trim	= trimmer
				twt	= traveling wave tube
				var	= variable
				w/	= with
				W	= watts
				ww	= wirewound
				w/o	= without
				*	= optimum value selected at factory, average value shown (part may be omitted)

01194-4

Table 6-1. Reference Designation Index

Circuit Reference	Stock No.	Description	Note
A1	200CD-19WB	Assy, range switch includes: C1, C2, C16, L4, L5, R1 thru R10, R33, R34, R37, R38, R42 thru R45, S1	
C1		Nsr; part of A1	
C2		Nsr; part of A1	
C3	0130-0001	C: var, cer, 7-45 pf, 500 vdcw	
C4	0140-0116	C: fxd, mica, 39 pf ±2%, 500 vdcw	
C5	0121-0018	C: var, 3 sect, 0-600 pf/sect	
C6	0130-0001	C: var, cer, 7-45 pf, 500 vdcw	
C7	0130-0011	C: var, cer, 1.5-7 pf, 500 vdcw	
C8, C9	0160-0024	C: fxd, my, 0.5 µf ±10%, 400 vdcw	
C10, C11	0140-0054	C: fxd, mica, 100 pf ±10%, 500 vdcw	
C12	0180-0013	C: fxd, elect, 100 µf, 100 vdcw	
C13A, B, C	0180-0017	C: fxd, elect, 3 sect, 10 µf/sect, 450 vdcw	
C14	0180-0024	C: fxd, aluminum elect, 40 µf, 450 vdcw	
C15	0140-0004	C: fxd, mica, 15* pf ±10%, 500 vdcw	
C16		Nsr; part of A1	
C17, C18	0140-0005	C: fxd, mica, 27* pf ±10%, 500 vdcw	
DS1	2140-0009	Lamp, incd: 0.15 amp, 6-8 V	
F1	2110-0021	Fuse, 1.25 amp, s-b (for 115 V operation)	
	2110-0016	Fuse, 0.6 amp, s-b (for 230 V operation)	
J1		Connector assy, consists of:	
	G-76J	Binding post w/ground link	
	AC-10D	Binding post: red	
	AC-54B	Binding post: bl, 3 hole (outside)	
	AC-54F	Binding post: black, 3 hole (inside)	
L1		Not assigned	
L2, L3	200CD-60C	Coil, R.F., 2 mh	
L4, L5		Nsr; part of A1	
L3	9110-0004	Rector, filter choke, 6 h	
P1	8120-0050	Assy, power cable: smooth, black, shiny, 7.5 ft, NEMA plug	
R1 thru R10		Nsr; part of A1	
R11	2100-0154	R: var, comp, lin, 1 K ohms ±30%, 3/10 W	
R12	0689-3025	R: fxd, comp, 3 K ohms ±5%, 1 W	
R13, R14		Not assigned	
R15, R16	0687-5601	R: fxd, comp, 56 ohms ±10%, 1/2 W	
R17, R18	0690-2231	R: fxd, comp, 22K ohms ±10%, 1 W	
R19	0686-1055	R: fxd, comp, 1 M ±5%, 1/2 W	
R20, R21	0690-6831	R: fxd, comp, 68 K ohms ±10%, 1 W	
R22	0686-1055	R: fxd, comp, 1 M ±5%, 1/2 W	
R23, R24	0687-1551	R: fxd, comp, 1.5 M ±10%, 1/2 W	
R25, R26	0687-5601	R: fxd, comp, 56 ohms ±10%, 1/2 W	
R27, R28	0816-0003	R: fxd, ww, 500 ohms ±10%, 10 W	
R29		R: 470 ohms, nsr; part of L4	
R30, R31	0816-0002	R: fxd, ww, 3 K ohms ±10%, 10 W	
R32		R: 470 ohms, nsr; part of L5	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	Stock No.	Description	Note
R33, R34		Nsr; part of A1	
R35, R36	0690-1531	R: fxd, comp, 15 K ohms ±10%, 1 W	
R37, R38		Nsr; part of A1	
R39A, B	2100-0113	R: var, comp, dual tandem, 100 K/sect, 25 K/sect, 2 W	
R40	0816-0008	R: fxd, ww, 10 K ohms ±10%, 10 W	
R41	0690-1801	R: fxd, comp, 18 ohms ±10%, 1 W	
R42 thru R45		Nsr; part of A1	
R46, R47	0686-6215	R: fxd, comp, 620 ohms ±5%, 1/2 W	
R48, R49		Not assigned	
R50	2100-0013	R: var, comp, lin, 50 K ohms ±20%, 1/2 W	
R51	2100-0036	R: var, comp, lin, 1 K ohms, 0.5 W	
RT1, RT2	2140-0007	Lamp, incd: 250 V, 10 W	
S1		Nsr; part of A1	
S2	3101-0001	Switch, tog: SPST, 3 amp	
T1	200CD-9	Transformer, output: high frequency	
T2	9120-0016	Transformer, output: low frequency	
T3	9100-0036	Transformer: power	
V1	1923-0021	Tube, elect: 6AU6, 7 pin minat	
V2	1923-0044	Tube, elect: EL 86, 9 pin minat	
V3	1923-0021	Tube, elect: 6AU6, 7 pin minat	
V4	1923-0044	Tube, elect: EL 86, 9 pin minat	
V5	1930-0003	Tube, elect: 5AR4, octal	
XF1	1400-0084	Fuseholder: extrator post type	
XV1	1200-0009	Socket, tube: 7 pin, minat	
XV2	1200-0072	Socket, tube: 9 pin	
XV3	1200-0009	Socket, tube: 7 pin, minat	
XV4	1200-0072	Socket, tube: 9 pin	
XV5	1200-0020	Socket, tube: octal	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Circuit Reference	℗ Stock No.	Description	Note
		MISCELLANEOUS	
	AC-32A	Coupler, flexible	
	G-14J	Assy, disc VERNIER DRIVE	
	G-36J	Bearing, capacitor drive	
	G-74F	Knob: frequency dial vernier	
	G-74K	Knob: AMPLITUDE	
	G-74N	Knob: RANGE	
	G-74Z	Knob: frequency dial, 2-1/4 "	
	G-91A	Spring, thrust	
	G-99K	Window, dial for curved frequency dial	
	200CD-40A	Dial, frequency calibrator	
	1220-0002	Shield, capacitor (for C14)	
	1220-0006	Shield, base: 9 pin	
	1220-0029	Shield, tube (for V1, V2)	
	1400-0005	Clamp, tube (for V1, V3)	
	1400-0034	Base, tube clamp	
	1450-0009	Lampholder	
	1450-0013	Lampholder, candelabra	

See introduction to this section

Table 6-2. Replaceable Parts

℗ Stock No.	Description	Mfr.	Mfr. Part No.	TQ	RS		
AC-10D	Insulator: binding post red	28480	AC-10D	2	1		
AC-32A	Coupler, flexible	28480	AC-32A	1	1		
AC-54B	Insulator: binding post, 3 hole	28480	AC-54B	1	1		
AC-54F	Insulator: binding post, black, 3 hole	28480	AC-54F	1	1		
G-14J	Assy, disc vernier drive	28480	G-14J	1	1		
G-36J	Bearing, capacitor drive	28480	G-36J	1	1		
G-74F	Knob: frequency dial vernier	28480	G-74F	1	1		
G-74K	Knob: AMPLITUDE	28480	G-74K	1	1		
G-74N	Knob: RANGE	28480	G-74N	1	1		
G-74Z	Knob: frequency dial	28480	G-74Z	1	1		
G-76J	Assy, binding post, ground w/link	28480	G-76J	1	1		
G-91A	Spring, thrust	28480	G-91A	1	1		
G-99K	Window, dial for curved frequency dial	28480	G-99K	1	1		
200CD-9	Transformer	28480	200CD-9	1	1		
200CD-19WB	Assy, range switches includes: C1, C2, C16 R33, R34, R37, R38 L4, L5 R42 thru R45 R1 thru R10 S1	28480	200CD-19WB	1	1		
200CD-40A	Dial, frequency calibrator	28480	200CD-40A	1	1		
200CD-60C	Coil, RF	28480	200CD-60C	2	1		
0121-0018	C: var, 3 sect, 0-600 pf/sect	76854	797-B-3-60	1	1		
0130-0001	C: var, cer, 7-45 pf, 500 vdcw	72982	503-000D2PO-33R	2	1		
0130-0011	C: var, cer, 1.5-7 pf, 500 vdcw	72982	557-023-COPO-10R	1	1		
0140-0004	C: fxd, mica, 15 pf ±10%, 500 vdcw	72136	CM15B150K	1	1		
0140-0005	C: fxd, mica, 27 pf ±10%, 500 vdcw	14655	CM15B270K	2	1		
0140-0054	C: fxd, mica, 100 pf ±10%, 500 vdcw	14655	CM20B101K	2	1		
0140-0116	C: fxd, mica, 39 pf ±2%, 500 vdcw	14655	CM15E390G	1	1		
0160-0024	C: fxd, my, 0.5 μf ±10%, 400 vdcw	14655	PKM4P5	2	1		
0180-0013	C: fxd, elect, 100μf, 100 vdcw	56289	D33067	1	1		
0180-0017	C: fxd, elect, 3 sect/10 μf, 450 vdcw	56289	D32631	1	1		
0180-0024	C: fxd, aluminum elect, 40 μf, 450 vdcw	56289	D32441	1	1		
0686-1055	R: fxd, comp, 1 M ±5%, 1/2 W	01121	EB 1055	2	1		
0687-1551	R: fxd, comp, 1.5 M ±10%, 1/2 W	01121	EB 1551	1	1		
0686-6215	R: fxd, comp, 620 ohms ±5%, 1/2 W	01121	EB 6215	2	1		
0687-5601	R: fxd, comp, 56 ohms ±10%, 1/2 W	01121	EB 5601	4	1		
0689-3025	R: fxd, comp, 3 K ohms ±5%, 1 W	01121	GB 3025	1	1		
0690-1531	R: fxd, comp, 15 K ohms ±10%, 1 W	01121	GB 1531	2	1		
0690-1801	R: fxd, comp, 18 ohms ±10%, 1 W	01121	GB 1801	1	1		
0690-2231	R: fxd, comp, 22 K ohms ±10%, 1 W	01121	GB 2231	2	1		
0690-6831	R: fxd, comp, 68 K ohms ±10%, 1 W	01121	CB 6831	4	1		
0816-0002	R: fxd, ww, 3 K ohms ±10%, 10 W	35434	Type GC10-3KA	2	1		
0816-0003	R: fxd, ww, 5000 ohms ±10%, 10 W	35434	G-10, obd#	2	1		
0816-0008	R: fxd, ww, 10 K ohms ±10%, 10 W	35434	Type C-10, obd#	1	1		
1200-0009	Socket, tube: 7 pin, minat	91662	316PH-3702	2	1		
1200-0020	Socket, tube: octal	71785	51A12272	1	1		

See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

ℎ Stock No.	Description	Mfr.	Mfr. Part No.	TQ	RS		
1200-0072	Socket, tube: 9 pin	91662	988PHTDX103	2	1		
1220-0002	Shield, capacitor (for C14)	37942	CE-6	1	1		
1220-0006	Shield, base: 9 pin	71785	441-43-11-215/202	2	1		
1220-0029	Shield, tube (for V1, V2)	98978	TRTg-6027B	2	0		
1400-0005	Clamp, tube (for V1, V3)	92196	obd#	2	1		
1400-0034	Base, tube clamp	92196	obd#	2	1		
1400-0084	Fuseholder: extrator post type	75915	342014	1	1		
1450-0009	Lampholder	72765	223G-CE	1	1		
1450-0013	Lampholder, candelabra	72765	169B	1	1		
1923-0021	Tube, elect: 6AU6, 7 pin minat	33173	6AU6	2	2		
1923-0044	Tube, elect: EL86, 9 pin minat	73445	EL 86/6CW5	2	2		
1930-0003	Tube, elect: 5AR4, octal	73445	GZ-34	1	1		
2100-0013	R: var, comp, lin, 50 K ohms ±20%, 1/2 W	71590	Model 2	1	1		
2100-0036	R: var, comp, lin, 1 K ohms, .5 W	01121	JA1L0405502UC	1	1		
2100-0113	R: var, comp, dual tandem, 2 W	02848	obd#	1	1		
2100-0154	R: var, comp, lin, 1 K ohms ±30%, 3/10 W	11237	UPE-70	1	1		
2110-0016	Fuse, 0.6 amp, s-b (for 230 V operation)	75915	313.600				
2110-0021	Fuse, 1.25 amp, s-b (for 115 V operation)	71400	MDL 1.25	1	10		
2140-0007	Lamp, incd: 250 V, 10 W	24455	8A/S6-12V	2	1		
2140-0009	Lamp, incd: 0.15 amp, 6-8 V	24455	47	1	1		
3101-0001	Switch, tog: SPST, 3 amp	04009	80994-11	1	1		
8120-0050	Assy, power cable: Smooth, black, shiny, 7.5 ft, NEMA plug	70903	KH-4096/PH-151/ 7.5 ft.	1	1		
9100-0036	Transformer, power	98734	4007	1	1		
9110-0004	Rector, filter choke	72964	8168-D	1	1		
9120-0016	Transformer, low freq. output	98734	2005	1	1		

See introduction to this section

APPENDIX
CODE LIST OF MANUFACTURERS (Sheet 1 of 2)

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 handbooks.

CODE NO.	MANUFACTURER	ADDRESS
00334	Humidial Co.	Colton, Calif.
00335	Westrex Corp.	New York, N.Y.
00373	Garlock Packing Co., Electronic Products Div.	Camden, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Company, Ordill Division (Capacitors)	Marion, Ill.
00866	Goe Engineering Co.	Los Angeles, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	Pacific Semiconductors, Inc.	Culver City, Calif.
01295	Texas Instruments, Inc. Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01561	Chassi-Trak Corp.	Indianapolis, Ind.
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02286	Cole Mfg. Co.	Palo Alto, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	El Monte, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co.	Morristown, N.J.
03954	Air Marine Motors, Inc.	Los Angeles, Calif.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04062	Elmenco Products Co.	New York, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04298	Elgin National Watch Co., Electronics Division	Burbank, Calif.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Prods., Inc. Electronic Tube Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Division	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire & Cable Company	Redwood City, Calif.
04870	P. M. Motor Co.	Chicago 44, Ill.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp., Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Illumitronic Engineering Co.	Sunnyvale, Calif.
05624	Barber Colman Co.	Rockford, Ill.
05729	Metropolitan Telecommunications Corp., Metro Cap. Div.	Brooklyn, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
06004	The Bassick Co.	Bridgeport, Conn.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
07115	Corning Glass Works Electronic Components Dept.	Bradford, Pa.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07261	Avnet Corp.	Los Angeles, Calif.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Rheem Semiconductor Corp.	Mountain View, Calif.
07966	Shockley Semi-Conductor Laboratories	Palo Alto, Calif.
07980	Boonton Radio Corp.	Boonton, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08717	Sloan Company	Burbank, Calif.
08718	Cannon Electric Co. Phoenix Div.	Phoenix, Ariz.
08792	CBS Electronics Semiconductor Operations, Div. of C.B.S. Inc.	Lowell, Mass.
08994	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays, Inc.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11312	Microwave Electronics Corp.	Palo Alto, Calif.
11534	Duncan Electronics, Inc.	Santa Ana, Calif.
11711	General Instrument Corporation Semiconductor Division	Newark, N.J.
11717	Imperial Electronics, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12697	Clarostat Mfg. Co.	Dover, N.H.
14655	Cornell Dubilier Elec. Corp.	So. Plainfield, N.J.
15909	The Daven Co.	Livingston, N.J.
16688	De Jur-Amsco Corporation	Long Island City 1, N.Y.
16758	Delco Radio Div. of G. M. Corp.	Kokomo, Ind.
18873	E. I. DuPont and Co., Inc.	Wilmington, Del.
19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19701	Electra Manufacturing Co.	Kansas City, Mo.
20183	Electronic Tube Corp.	Philadelphia, Pa.
21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.
21335	The Fafnir Bearing Co.	New Britain, Conn.
21964	Fed. Telephone and Radio Corp.	Clifton, N.J.
24446	General Electric Co.	Schenectady, N.Y.
24455	G.E., Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
37942	P. R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C. A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer and Inst. Co.	Philadelphia, Pa.
49956	Raytheon Company	Lexington, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Sorenson & Co., Inc.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex, Inc.	St. Paul, Minn.
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Swissvale, Pa.
62119	Universal Electric Co.	Owosso, Mich.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N.J.
66295	Wittek Manufacturing Co.	Chicago 23, Ill.
66346	Wollensak Optical Co.	Rochester, N.Y.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control Co., Inc.	New York, N.Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	New York, N.Y.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio Inc.	Cleveland, Ohio
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Allen D. Cardwell Electronic Prod. Corp.	Plainville, Conn.
71400	Bussmann Fuse Div. of McGraw-Edison Co.	St. Louis, Mo.
71450	CTS Corp.	Elkhart, Ind.
71468	Cannon Electric Co.	Los Angeles, Calif.
71471	Cinema Engineering Co.	Burbank, Calif.
71482	C. P. Clare & Co.	Chicago, Ill.
71528	Standard-Thomson Corp., Clifford Mfg. Co. Div.	Waltham, Mass.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71700	The Cornish Wire Co.	New York, N.Y.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71753	A. O. Smith Corp., Crowley Div.	West Orange, N.J.
71785	Cinch Mfg. Corp.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72354	John E. Fast & Co.	Chicago, Ill.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	General Ceramics Corp.	Keasbey, N.J.
72758	Girard-Hopkins	Oakland, Calif.
72765	Drake Mfg. Co.	Chicago, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Resistor Corp.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Electronic Co., Div. of North American Phillips Co., Inc.	Hicksville, N.Y.
73506	Bradley Semiconductor Corp.	Hamden, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Inc.	Philadelphia, Pa.

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APPENDIX
CODE LIST OF MANUFACTURERS (Sheet 2 of 2)

CODE NO.	MANUFACTURER	ADDRESS
73734	Federal Screw Products Co.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	The General Industries Co.	Elyria, Ohio
73905	Jennings Radio Mfg. Co.	San Jose, Calif.
74455	J. H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E. F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75173	Jones, Howard B., Division of Cinch Mfg. Corp.	Chicago, Ill.
75378	James Knights Co.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littelfuse Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C. W. Marwedel	San Francisco, Calif.
76433	Micamold Electronic Mfg. Corp.	Brooklyn, N.Y.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J. W. Miller Co.	Los Angeles, Calif.
76530	Monadnock Mills	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	Bendix Pacific Division of Bendix Corp.	No. Hollywood, Calif.
77221	Phaostron Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	Potter and Brumfield, Div. of American Machine and Foundry	Princeton, Ind.
77630	Radio Condenser Co.	Camden, N.J.
77638	Radio Receptor Co., Inc.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78283	Signal Indicator Corp.	New York, N.Y.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	Pasadena, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products	Elizabeth, N.J.
80130	Times Facsimile Corp.	New York, N.Y.
80131	Electronic Industries Association Any brand tube meeting EIA standards	Washington, D.C.
80207	Unimax Switch, Div. of W. L. Maxson Corp.	Wallingford, Conn.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Laboratories, Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Fulton Controls Co.	Columbus 16, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80583	Hammerlund Co., Inc.	New York, N.Y.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
81030	International Instruments, Inc.	New Haven, Conn.
81312	Winchester Electronics Co., Inc.	Norwalk, Conn.
81415	Wilkor Products, Inc.	Cleveland, Ohio
81453	Raytheon Mfg. Co., Industrial Components Div., Industr. Tube Operations	Newton, Mass.
81483	International Rectifier Corp.	El Segundo, Calif.
81860	Barry Controls, Inc.	Watertown, Mass.
82042	Carter Parts Co.	Skokie, Ill.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Allen B. DuMont Labs., Inc.	Clifton, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc., Electronic Tube Div.	Emporium, Pa.
82376	Astron Co.	East Newark, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals and Controls, Inc., Div. of Texas Instruments, Inc., Spencer Prods.	Attleboro, Mass.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfr. Co.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	Pyramid Electric Co.	Darlington, S.C.
83148	Electro Cords Co.	Los Angeles, Calif.
83186	Victory Engineering Corp.	Union, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
84171	Arco Electronics, Inc.	New York, N.Y.
84396	A. J. Glesener Co., Inc.	San Francisco, Calif.
84411	Good All Electric Mfg. Co.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A. B. Boyd Co.	San Francisco, Calif.
85474	R. M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	New Haven, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86197	Clifton Precision Products	Clifton Heights, Pa.
86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N.J.
87216	Philco Corp. (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
89473	General Electric Distributing Corp.	Schenectady, N.Y.
89636	Carter Parts Div. of Economy Baler Co.	Chicago, Ill.
89665	United Transformer Co.	Chicago, Ill.
90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Brothers, Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Philadelphia, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91921	Minneapolis-Honeywell Regulator Co., Micro-Switch Division	Freeport, Ill.
92196	Universal Metal Products, Inc.	Bassett Puente, Calif.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins and Myers, Inc.	New York, N.Y.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93983	Insuline-Van Norman Ind., Inc. Electronic Division	Manchester, N.H.
94144	Raytheon Mfg. Co., Industrial Components Div., Receiving Tube Operation	Quincy, Mass.
94145	Raytheon Mfg. Co., Semiconductor Div., California Street Plant	Newton, Mass.
94148	Scientific Radio Products, Inc.	Loveland, Colo.
94154	Tung-Sol Electric, Inc.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Paterson, N.J.
94310	Tru Ohm Prod. Div. of Model Engineering and Mfg. Co.	Chicago, Ill.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
95236	Allies Products Corp.	Miami, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	New York, N.Y.
95264	Lerco Electronics, Inc.	Burbank, Calif.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95354	Methode Mfg. Co.	Chicago, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Huggins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Division of Aerovox	Olean, N.Y.
96256	Thordarson-Meissner Div. of Maguire Industries, Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic and Precision Mfg. Co.	Yonkers, N.Y.
97966	CBS Electronics, Div. of C.B.S., Inc.	Danvers, Mass.
98141	Axel Brothers Inc.	Jamaica, N.Y.
98220	Francis L. Mosley	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98405	Carad Corp.	Redwood City, Calif.
98734	Palo Alto Engineering Co., Inc.	Palo Alto, Calif.
98821	North Hills Electric Co.	Mineola, N.Y.
98925	Clevite Transistor Prod. Div. of Clevite Corp.	Waltham, Mass.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99515	Marshall Industries, Electron Products Division	Pasadena, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Ill.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING H-P VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

0000F	Malco Tool and Die	Los Angeles, Calif.
0000I	Telefunken (c/o American Elite)	New York, N.Y.
0000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
0000N	Nahm-Bros. Spring Co.	San Leandro, Calif.
0000P	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
0000T	Texas Instruments, Inc. Metals and Controls Div.	Versailles, Ky.
0000U	Tower Mfg. Corp.	Providence, R.I.
0000W	Webster Electronics Co. Inc.	New York, N.Y.
0000X	Spruce Pine Mica Co.	Spruce Pine, N.C.
0000Y	Midland Mfg. Co. Inc.	Kansas City, Kans.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AA	British Radio Electronics Ltd.	Washington, D.C.
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CC	Computer Diode Corp.	Lodi, N.J.
000EE	A. Williams Manufacturing Co.	San Jose, Calif.
000FF	Carmichael Corrugated Specialties	Richmond, Calif.
000GG	Goshen Die Cutting Service	Goshen, Ind.
000HH	Rubbercraft Corp.	Torrance, Calif.
000II	Birtcher Corporation, Industrial Division	Monterey Park, Calif.
000KK	Amatom	New Rochelle, N.Y.
000LL	Avery Label	Monrovia, Calif.
000MM	Rubber Eng. & Development	Hayward, Calif.
000NNA	"N" D Manufacturing Co.	San Jose 27, Calif.
000PP	Atohm Electronics,	Sun Valley, Calif.
000QQ	Cooltron.	Oakland, Calif.
000RR	Radio Industries	Des Plaines, Ill.
000SS	Control of Elgin Watch Co.	Burbank, Calif.
000TT	Thomas & Betts Co., The	Elizabeth 1, N.J.

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