



OPERATING AND SERVICE MANUAL

-hp- Part No. 00350-90203

**ATTENUATOR SET
MODEL 350D**

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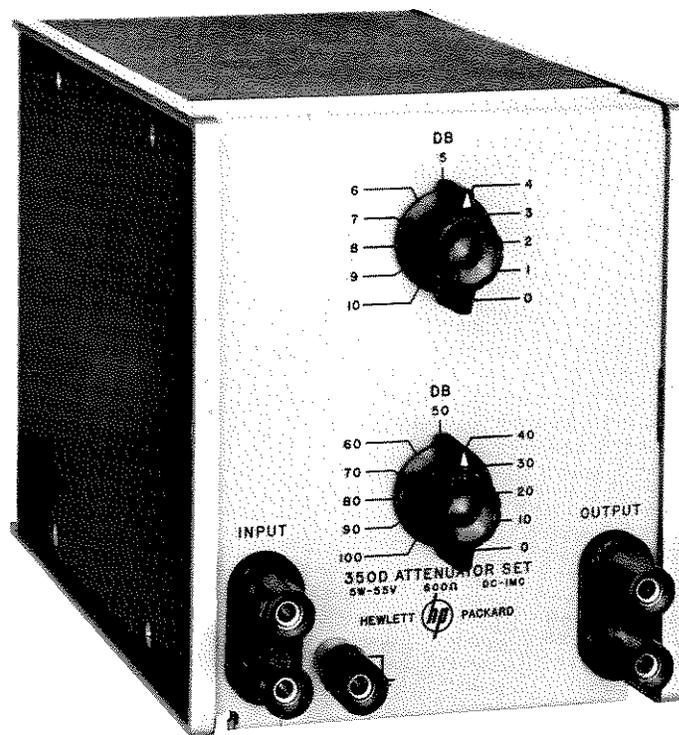


Figure 1-1. Model 350D Attenuator Set

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This section contains information relating to the description and uses of the Model 350D Attenuator Set. Instrument serial numbering and manual identification are also discussed.

1-3. DESCRIPTION.

1-4. The Model 350D is an accurate, wide frequency range attenuator which provides attenuation from 0 dB to a maximum of 110 dB. The Model 350D will dissipate a maximum of 5 watts in continuous use with good accuracy from dc to 1 MHz. The Model 350D consists of two sections: (1) 100 dB adjustable in 10 dB-steps, and (2) 10 dB, adjustable in 1-dB steps. The two sections are additive, allowing attenuation in 1-dB or 10-dB increments over the full 110-dB range. A floating input is included which isolates the attenuator circuit ground from cabinet ground, allowing an ac input to be at a dc level.

1-5. The -hp- modular enclosure design allows convenient conversion from a bench model to a model which mounts in a standard 19-inch rack. The modular design provides the mechanical stability necessary for stacking instruments on a flat surface.

1-6. USES.

1-7. Wide frequency range, high power dissipation capability, and accuracy make the Model 350D useful in such applications as attenuating an oscillator output, checking gain and frequency response of an amplifier, and determining transmission loss. Use of the Model 350D is possible with a mismatched load or source impedance. Information on impedance matching networks and the attenuation losses involved are given in section III.

1-8. INSTRUMENTS AND MANUAL IDENTIFICATION.

1-9. Hewlett-Packard uses a two-section serial number. The first section (prefix) identifies a series of instruments. The last section (suffix) identifies a particular instrument within the series. If a letter is included with the serial number, it identifies the country in which the instrument was manufactured. If the serial prefix of your instrument differs from the one on the title page of this manual, a change sheet will be supplied to make this manual compatible with newer instruments. All correspondence with Hewlett-Packard should include the complete serial number.

Table 1-1. Specifications

<p>ATTENUATION: 110 dB in 10 dB and 1 dB steps (additive)</p> <p>ACCURACY, 10-DB SECTION: From dc to 100 KHz, error is less than ± 0.125 dB at any step; from 100 KHz to 1 MHz, error is less than ± 0.25 dB at any step.</p> <p>ACCURACY, 100-DB SECTION: From dc to 100 KHz, error is less than ± 0.25 dB at any step up to 70 dB, less than ± 0.5 dB above 70 dB; from 100 KHz to 1 MHz, error is less than ± 0.5 dB at any step up to 70 dB; less than ± 0.75 dB above 70 dB.</p> <p>POWER CAPACITY: In 600 ohms: 5 watts (55 Vdc or rms) maximum continuous duty</p> <p>DIMENSIONS: Module 6-3/32 in. high, 5-1/8 in. wide, 8 in. deep</p>
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SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for the installation and shipping of the Model 350D Attenuator Set. Included are initial inspection procedures, installation information, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. The -hp- Model 350D Attenuator Set received a careful mechanical and electrical inspection before shipment. As soon as the Model 350D is received, verify that the contents are intact and as ordered. Although the instrument should be free of marks and scratches and in perfect electrical condition, it should be inspected for any physical damage which may have been incurred in transit. Also test the electrical performance of the instrument using the procedures given in Paragraphs 5-10 thru 5-15. If any physical damage or electrical deficiency is found, refer to the warranty on the inside front cover of this manual. Should shipping of the instrument become necessary, refer to Paragraph 2-11 for repackaging and shipping instructions.

2-5. INSTALLATION.

2-6. The Model 350D is a submodular unit suitable for bench top use. However, when used in combination with other submodular units it can be bench or rack mounted. The -hp- combining case and adapter frame are designed for this purpose.

2-7. COMBINING CASE.

2-8. The combining case is a full-module unit which accepts various combinations of submodular units. Being a full-module unit, it can be bench or rack mounted and is analogous to any full-module instrument.

2-9. ADAPTER FRAME.

2-10. The adapter frame is a rack frame that accepts any combination of submodular units. It can be rack mounted only. For additional information, address inquiries to your -hp- Sales and Service Office. (See Appendix B for office locations.)

2-11. REPACKAGING FOR SHIPMENT.

2-12. The following paragraphs contain a general guide for repackaging for shipment. Refer to Paragraph 2-13 if the original container is to be used; 2-14 if it is not. If you have any questions, contact your local -hp- Sales and Service office.

NOTE

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

2-13. If original container is to be used, proceed as follows:

- a. Place instrument in original container if available. If original container is not available, one can be purchased from your nearest -hp- Sales and Service Office.
- b. Ensure that the container is well sealed with strong tape or metal bands.

2-14. If original container is not to be used, proceed as follows:

- a. Wrap instrument in heavy paper or plastic before placing in an inner container.
- b. Use packing material around all sides of instrument and protect panel face with cardboard strips.
- c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.
- d. Mark shipping container with "DELICATE INSTRUMENT," "FRAGILE," etc.

Table 3-1. Attenuator Factors

dB	Attenuation Factor,	dB	Attenuation Factor,	dB	Attenuation Factor,
0	1.0000	37	.01413	74	.0001995
1	.8913	38	.012590	75	.0001778
2	.7943	39	.011220	76	.00015850
3	.7079	40	.010000	77	.00014130
4	.6310	41	.008913	78	.00012590
5	.5623	42	.007943	79	.00011220
6	.5012	43	.007079	80	.00010000
7	.4467	44	.006310	81	.00008913
8	.3981	45	.005623	82	.00007943
9	.3548	46	.005012	83	.00007079
10	.3162	47	.004467	84	.00006310
11	.2818	48	.003981	85	.00005623
12	.2512	49	.003548	86	.00005012
13	.2239	50	.003162	87	.00004467
14	.1995	51	.002818	88	.00003981
15	.1778	52	.002512	89	.00003548
16	.1585	53	.002239	90	.00003162
17	.1413	54	.001995	91	.00002818
18	.1259	55	.001778	92	.00002512
19	.1122	56	.001585	93	.00002239
20	.1000	57	.001413	94	.00001995
21	.08913	58	.001259	95	.00001778
22	.07943	59	.001122	96	.00001585
23	.07079	60	.001000	97	.00001413
24	.06310	61	.0008913	98	.00001259
25	.05623	62	.0007943	99	.00001122
26	.05012	63	.0007079	100	.000010000
27	.04467	64	.0006310	101	.000008913
28	.03981	65	.0005623	102	.000007943
29	.03548	66	.0005012	103	.000007079
30	.03162	67	.0004467	104	.000006310
31	.02818	68	.0003981	105	.000005623
32	.02512	69	.0003548	106	.000005012
33	.02239	70	.003162	107	.000004467
34	.01995	71	.0002818	108	.000003981
35	.01778	72	.0002512	109	.000003548
36	.01585	73	.0002239	110	.000003162

SECTION III

OPERATING INSTRUCTIONS

3-1. OPERATING CONSIDERATIONS.

3-2. IMPEDANCE.

3-3. For full accuracy and ease of application, the source and load impedances should match the impedance at the INPUT and OUTPUT terminals of the Model 350D. When source and load impedances are the same as the impedance of the Model 350D, the amount of attenuation in the circuit is the sum of the two attenuator-knob settings. If an impedance-matching network is used (see Paragraph 3-12), the amount of insertion loss must be added to the Model 350D setting to obtain the amount of attenuation between source and load.

3-4. LEADS AND CONNECTIONS.

3-5. When making connections to the Model 350D and the other instruments in the test of measurement setup, use shielded (coaxial) leads as short in length as possible. Failure to use shielded leads may result in attenuation of a different value from that set on the Model 350D controls, especially at high attenuator settings and at frequencies above 100 KHz. The shunting effect of stray capacitance (leads, terminals, etc) is a factor at high frequencies unless shielded connections and short lead lengths are used. Three connectors at the INPUT terminals allow an ac input to be floated at a dc potential. Connect all inputs to the top and lower left INPUT terminals. If both input leads are shielded, connect the shield to the lower right terminal (marked \perp) which is at cabinet ground potential. If an input is ac, but at some dc level, the load on the Model 350D must also be floating, i.e. not connected to cabinet ground potential (\perp).

3-6. INPUT POWER LIMITATIONS.

3-7. Do not apply more than 5 watts maximum to the Model 350D INPUT terminals. For the Model 350D (input impedance, 600 ohms), 5 watts corresponds to approximately 55 volts (dc or rms).



The Model 350D may be damaged by applying power to the OUTPUT terminals or by applying more than 5 watts to the INPUT terminals.

3-8. OPERATING PROCEDURES.

3-9. MATCHED IMPEDANCE.

3-10. When the Model 350D INPUT and OUTPUT termi-

nals are terminated properly, attenuation is the sum of the 10 DB and the 100 DB control settings. The voltage at the output of the Model 350D may be determined if input voltage (or input dB level) and the amount of attenuation inserted by the Model 350D are known. Table 3-1 shows the attenuation factor (A_f) over the attenuation range of the Model 350D. The method for finding the input level in dBm, is explained in Section IV. To find the voltage at the output terminals proceed as follows:

- a. Determine the input voltage to the Model 350D and the amount of attenuation set on the Model 350D.
- b. Locate the amount of attenuation in the dB column of Table 3-1 and read the corresponding attenuation factor.
- c. To calculate the output voltage, multiply the input voltage by the attenuation factor. See Paragraph 3-11 for an example.

3-11. In Figure 3-1 A and B the Model 350D is shown connected to a matching source and load. In both cases the Model 350D is set to attenuate the signal by 24 dB. The attenuation factor for 24 dB from Table 3-1 is 0.0631 and the output voltage, for the conditions shown in Figure 3-1A, is then:

$$V_{out} = (55v)(0.0631) = 3.47 \text{ volts}$$

For Figure 3-1B the attenuation factor is the same as for Figure 3-1A and the output voltage is:

$$V_{out} = (50v)(0.0631) = 3.155 \text{ volts}$$

3-12. USE OF IMPEDANCE-MATCHING NETWORK.

3-13. NEED FOR INPUT MATCH. An impedance-matching network is necessary between source and Model 350D attenuator under the following conditions:

- a. Source frequency is 100 KHz or above.
- b. Model 350D is set for less than 20-dB attenuation.
- c. Source output frequency response is affected by mismatched impedance.
- d. Source output is monitored by meter which is accurate only when source operates into matched load.

3-14. MATCHING AT THE INPUT.

- a. When the source is not affected by mismatch and source impedance is lower than that of Model

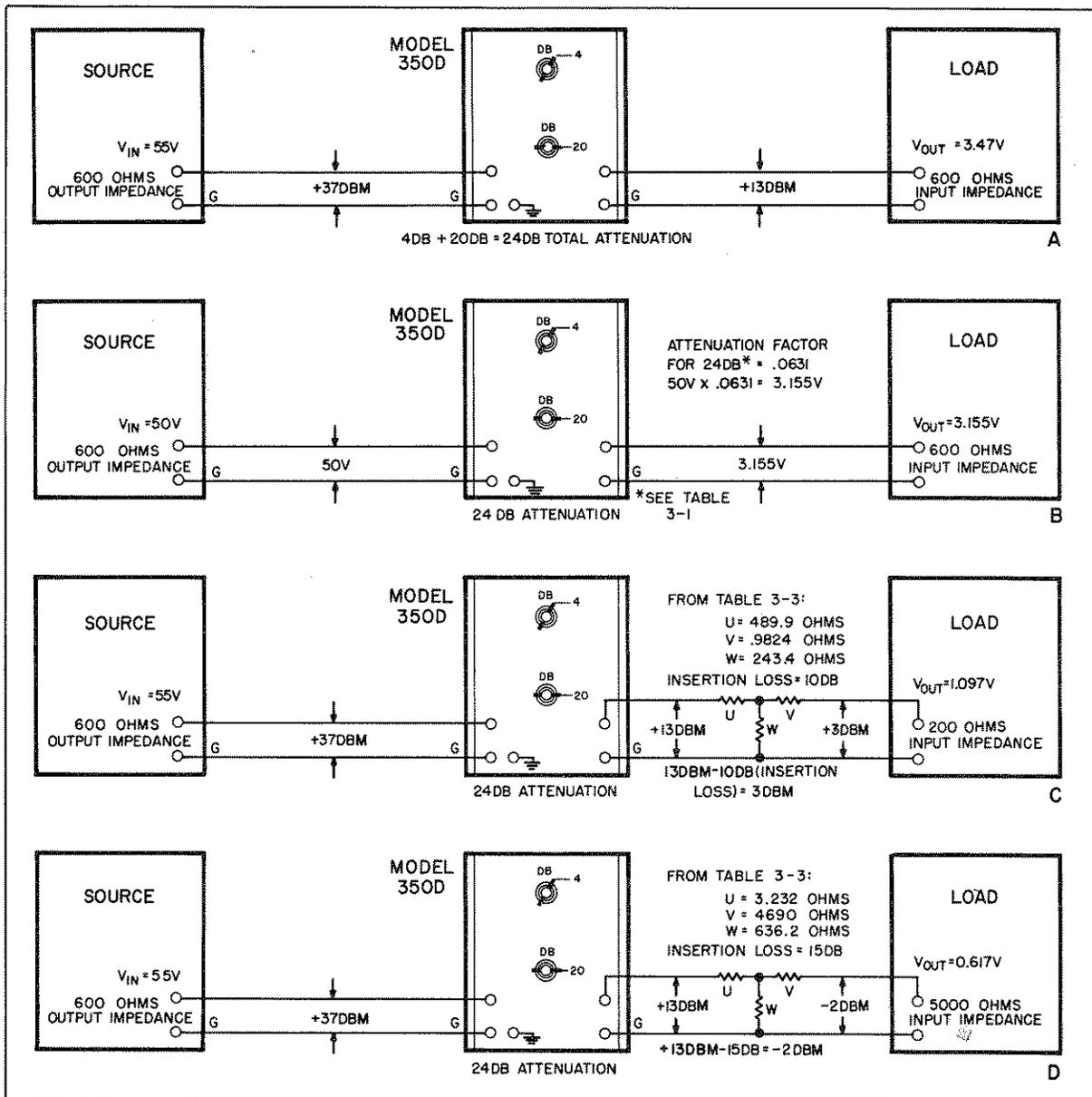


Figure 3-1. Model 350D Typical Applications

Table 3-2. Model 350D Matching Network Values

Z (ohms)	U (ohms)	V (ohms)	W (ohms)	Insertion Loss
50	574.5	2.111	49.92	17 dB
200	489.9	.9824	243.4	10 dB
500	245.2	13.22	1148.0	4 dB
2000	33.06	1674.0	670.8	11 dB
5000	3.232	4690.0	636.2	15 dB

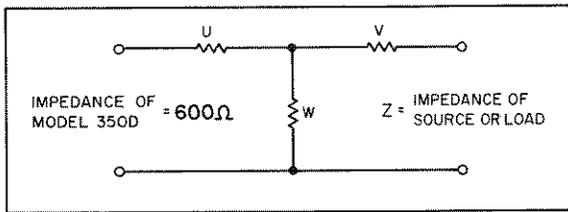


Figure 3-2. Model 350D Matching Network

350D, a series resistor may be used between source and attenuator. The resistor value should be the difference between Model 350D impedance and source impedance.

- b. Except for the condition stated in a., a resistive impedance-matching network should be used. Resistors should be deposited film or carbon type. Also, better accuracy is obtained if the network is enclosed in a shielded container and connecting leads are kept short. Data on impedance-matching networks for the Model 350D are given in Figure 3-2 and Table 3-2. The amount of insertion loss is included in Table 3-2.

3-15. NEED FOR OUTPUT MATCH. To maintain the rated attenuation accuracy of the Model 350D, the impedance of the load must match the output impedance of the Model 350D. When the load also must be terminated in its matching impedance, a resistive matching network must be used. When mismatch does not affect the load, under some

conditions the required impedance match for the Model 350D can be obtained by use of a single resistor. Conditions under which a resistor can be used, and use of matching networks, are discussed below.

3-16. MATCHING AT THE OUTPUT.

- a. When the impedance of the load is lower than that of the Model 350D and the load is not affected by a mismatch, impedance match for the Model 350D output can be obtained by inserting a resistor between 350D output and load. Resistor value should be the difference between the Model 350D output impedance and the load impedance.
- b. When the impedance of the load is much higher than that of the Model 350D, on the order of 50,000 ohms or more, impedance match for the Model 350D can be obtained by using a shunting resistor across the Model 350D output. For the Model 350D, the shunting resistor should be 600 ohms.
- c. Networks may be used which provide the Model 350D and its load with an impedance match. Network data and connections are given in Figure 3-2 and Table 3-2. Figure 3-1C shows a network for matching a 200-ohm load and the 600-ohm Model 350D Output; Figure 3-1D shows a network for matching a 5000-ohm load and the 600-ohm Model 350D Output.

SECTION IV THEORY OF OPERATION

4-1. GENERAL.

4-2. The Model 350D is shown in simplified schematic form in Figure 4-1. In the complete schematic (Figure 5-7) note that each attenuator section, 10 dB and 100 dB, is composed of four segments, each basically the same configuration as shown in Figure 4-1. The attenuator circuit ground is isolated from the cabinet by capacitor C1, to allow a floating input, i.e. an ac signal at a dc level.

4-3. ATTENUATION EXPRESSED IN DECIBELS.

4-4. POWER AND VOLTAGE RATIOS.

4-5. The basic equation for computing attenuation in decibels is based on a power ratio where P = power, V = voltage, and R = resistance:

$$\text{no. of decibels} = 10 \log_{10} \left(\frac{P_1}{P_2} \right) \quad (1)$$

Since power is expressed as: $P = \frac{V^2}{R}$ (2)

Equation (1) may be rewritten as:

$$\text{no. of dB} = 10 \log_{10} \left(\frac{\frac{V_1^2}{R_1}}{\frac{V_2^2}{R_2}} \right) \quad (3)$$

and if $R_1 = R_2$ then,

$$\text{no. of dB} = 10 \log_{10} \left(\frac{V_1}{V_2} \right)^2 \quad (4)$$

The basic rules for exponents of logarithms then allow equation (4) to be written as:

$$\text{no. of dB} = 20 \log_{10} \left(\frac{V_1}{V_2} \right) \quad (5)$$

4-6. The values of attenuation factor given in table 3-1 are based on a voltage ratio assuming the resistance at the input and output is the same. Values for A_f are computed using equation (5) where $V_1 = V_{in}$ and $V_2 = V_{out}$:

$$V_{out} = V_{in} A_f \text{ or } \frac{V_{in}}{V_{out}} = \frac{1}{A_f} \quad (6)$$

Then substituting equation (6) in equation (5) gives

$$\text{no. of dB} = 20 \text{ dB}_{10} \left(\frac{1}{A_f} \right) \quad (7)$$

Solving for A_f gives

$$A_f = \frac{1}{\text{antilog}_{10} \frac{\text{no. of dB}}{20}} \quad (8)$$

An example will check the value for A_f given in table 3-1 to 24 dB.

$$A_f = \frac{1}{\text{antilog}_{10} \left(\frac{24}{20} \right)} = \frac{1}{\text{antilog}_{10} (1.2)} \quad (9)$$

From a log table, the antilog_{10} of 1.2 is 15.85 and

$$A_f = \frac{1}{15.85} = 0.0631 \quad (10)$$

4-7. REFERENCE FOR DB.

4-8. The dB levels given in figure 3-1 are referenced to a milliwatt of power, hence the term dBm. This indicates that the logarithm is taken of a power ratio where 1 milliwatt is the reference. For the 37 dBm shown in figure 3-1D, equations (1) and (2) show that:

$$\text{dBm} = 10 \log_{10} \frac{\left(\frac{50^2}{600} \right)}{1 \text{ milliwatt}}$$

$$\text{dBm} \cong 10 \log_{10} (5000) = (3.7) = 37$$

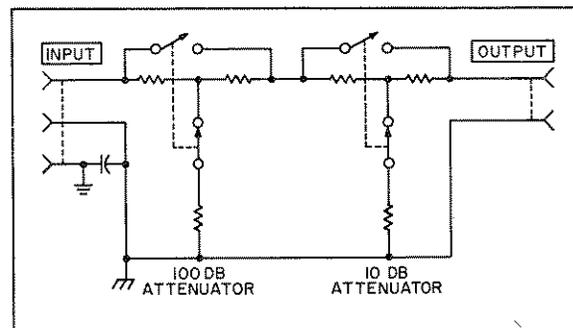


Figure 4-1. Model 350D Simplified Circuit

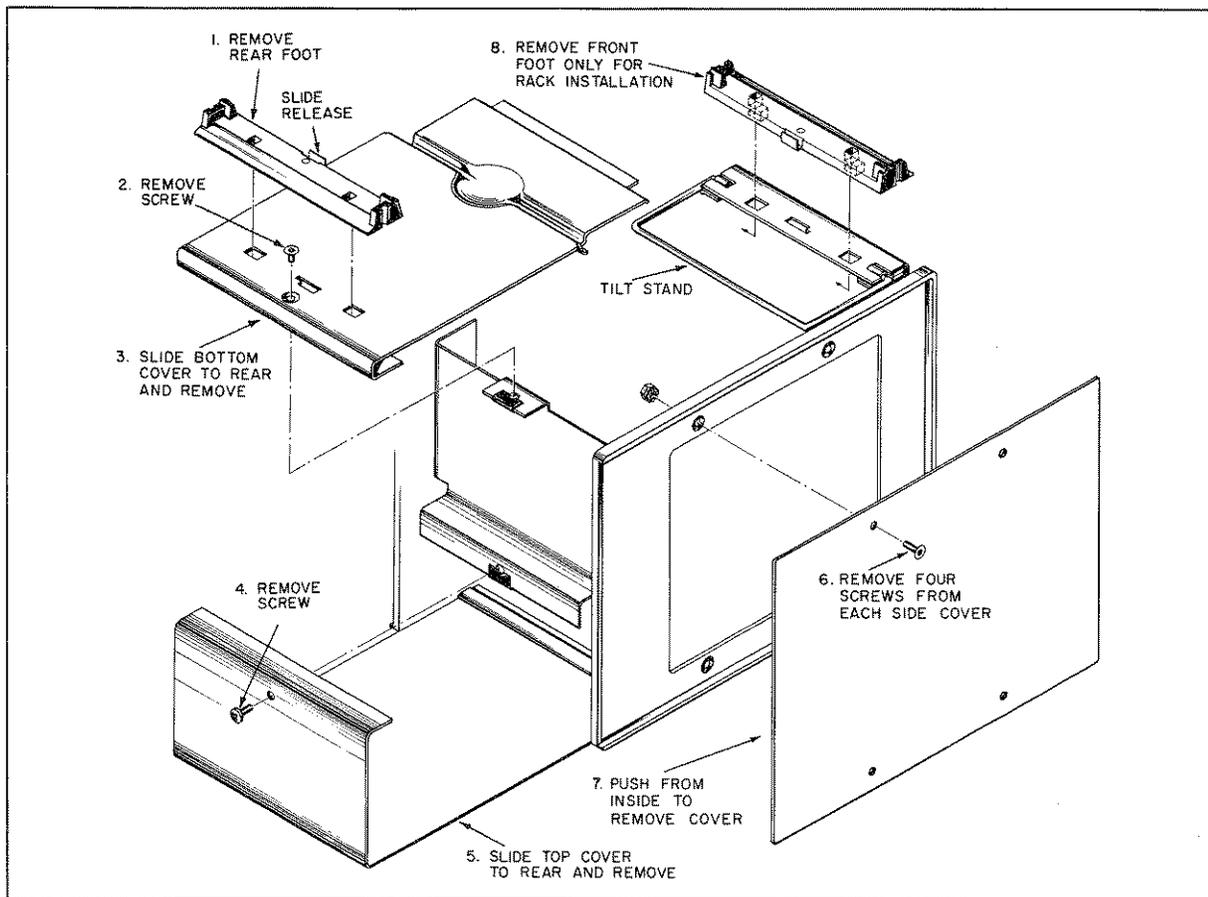


Figure 5-1. Cabinet Removal

5-1. Test Equipment Required

Instrument Type	Required Characteristics	Use	Recommended Model
Power Supply	Output Voltage: 0 to 50 V Load Regulation: Less than 5 MV change at output terminals for 0 to 2 amperes change	DC Performance Test	-hp- Model 6217A Power Supply
DC Voltmeter	Accuracy: $\pm 1\%$ full scale Ranges: 1 MV to 100 V, 11 ranges	DC Performance Test	-hp- Model 412A DC Voltmeter
Oscillator	Output Frequency: 100 KHz and 1 MHz Output Voltage: 6 volt rms	AC Performance Test	-hp- Model 651B Test Oscillator
Amplifier	Voltage Gain: 10 Frequency Range: 100 KHz to 1 Mhz	AC Performance Test	Krohn-Hite DCA-10 Wide Band Amplifier
AC Voltmeter	Accuracy: $\pm 2\%$ full scale (Para. 5-14) Ranges: -60 dB to +40 dB, 11 ranges Battery operated	AC Performance Test	-hp- Model 403B/Option 01 AC Voltmeter
Resistor	600 ohm, 10 W, LPI-10 $\pm 2\%$	AC/DC Performance Test	Corning Glass Works Co. resistor, as specified
Resistor	500 ohm, 10 W, LPI-10 $\pm 2\%$	AC Performance Test	Corning Glass Works Co. resistor, as specified

SECTION V MAINTENANCE

5-1. INTRODUCTION.

5-2. Maintenance of the Model 350D should be minimal unless an overload voltage or physical damage requires replacement of a part. To prevent possible leakage across terminals at high frequencies, keep the instrument free of dust. The attenuator shaft bushings under the front panel DB knobs should be lubricated annually with one drop of light machine oil. Figure 5-7 is a schematic diagram for the Model 350D.

5-3. INSTRUMENT COVER REMOVAL.

5-4. Figure 5-1 illustrates the removal of all instrument covers. This should be necessary only when replacing an attenuator section or a switch component (see Paragraphs 5-5 and 5-7).

5-5. COMPONENT REPLACEMENT.

5-6. REMOVAL OF ATTENUATORS.

5-7. Figure 5-2 illustrates the Model 350D with rear panel removed and identifies the components and assemblies. To remove the attenuator assemblies, proceed as follows:

- a. Remove all instrument covers (see figure 5-1).
- b. Loosen screws in both attenuator knobs and remove knobs.
- c. Disconnect coaxial cables from connectors J1 and J2 (see figure 5-2). Mark cables for proper reinstallation. Remove capacitor C1 lead from ground lug.
- d. Remove flathead screws which fasten attenuator chassis (see figure 5-2) to instrument side castings. Remove attenuator chassis from instrument frame.
- e. Remove switch shaft nuts holding assemblies to attenuator chassis.
- f. Remove the slotted metal sleeve which clamps each shield around the attenuator assembly. To completely remove shield, unsolder the coaxial lead between the two attenuators; use care to avoid damage to cable insulation. This frees each attenuator for individual repair or replacement.
- g. Reassembly is essentially the reverse of the above procedures.

5-8. REPLACEMENT OF RESISTORS.

5-9. Figure 5-3 identifies the resistors on the 100 dB attenuator, A1, and figure 5-4 on the 10 dB attenuator, A2. Replacement resistors may be ordered from the parts information in section VI. When a resistor is replaced, a padding resistor may be necessary to restore calibration accuracy.

5-10. DC PERFORMANCE TEST.

5-11. The dc performance test setup is illustrated in Figure 5-5. A DC Power Supply (-hp- Model 6217A) and a DC Voltmeter (-hp- Model 412A) are required for this test. In addition, a Corning Glass Works Co. 600 ohm, 10 watt, LPI-10 $\pm 2\%$ resistor is required. This resistor must be enclosed in a shield as shown in Figure 5-5.

5-12. To perform the dc performance test, proceed as follows:

- a. Make test setup illustrated in Figure 5-5.
- b. Make control settings indicated in Step 1 of Table 5-2.

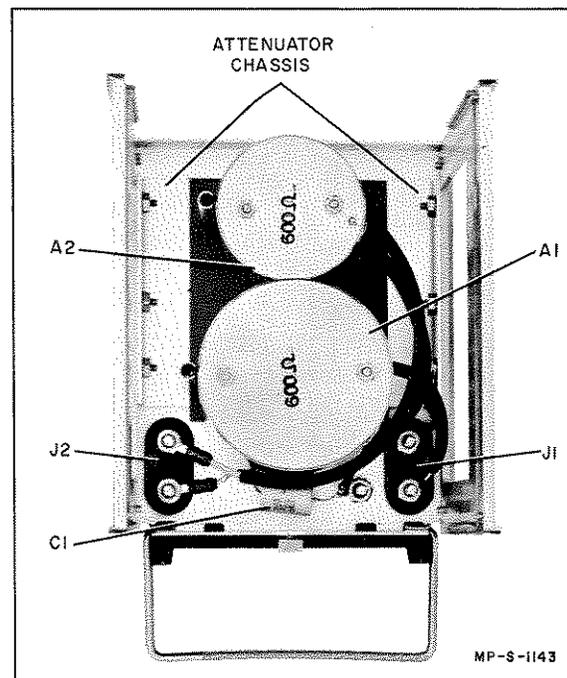


Figure 5-2. Model 350D Rear View (Rear Panel Removed)

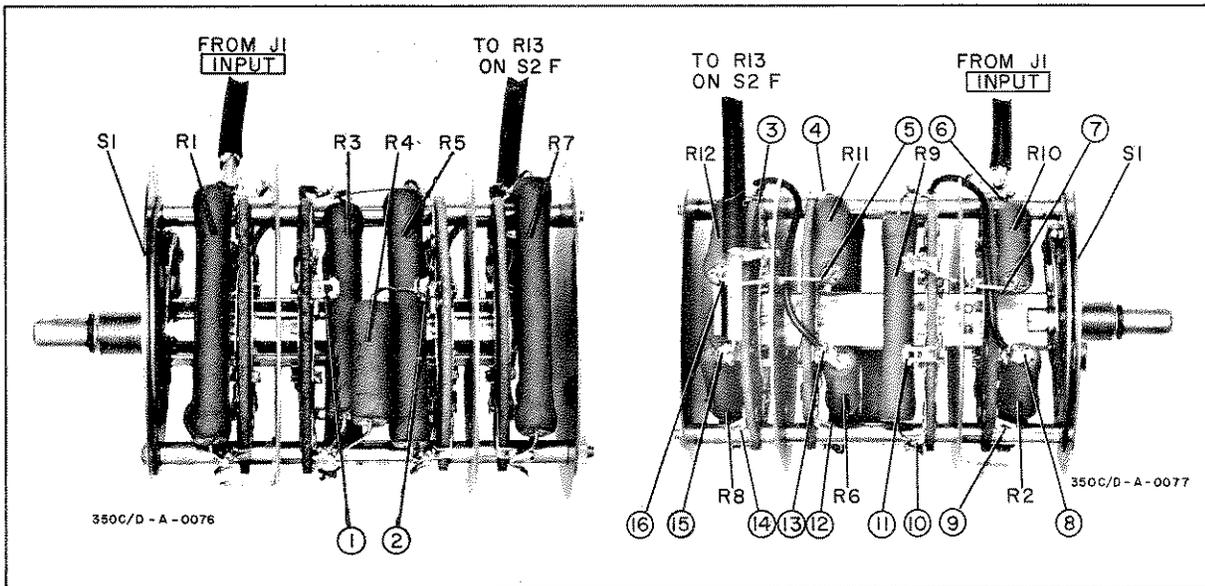


Figure 5-3. Assembly A1 Component Identification

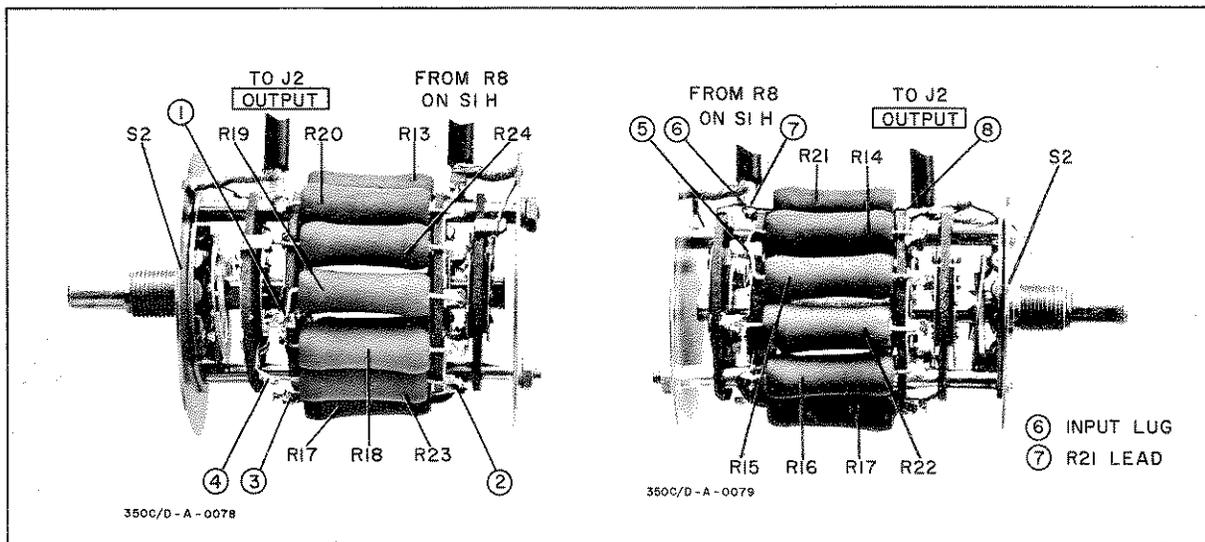


Figure 5-4. Assembly A2 Component Identification

- c. Adjust DC Power Supply for 50 volt indication on DC Voltmeter for 350D.
- d. Make control settings indicated in Step 2 of Table 5-2; if DC Voltmeter does not deflect to same position as in Step c \pm tolerance listed for Step 2, perform adjustment procedure contained in Paragraph 5-16.
- e. Repeat Step d for remaining steps of Table 5-2.

5-13. AC PERFORMANCE TEST.

5-14. The ac performance test setup is illustrated in Figure 5-6. An Oscillator (-hp- Model 651 B), an Amplifier (Krohn-Hite DCA-10), and a battery operated AC Voltmeter (-hp- Model 403B) are required for this test. In addition, (one 500 ohm and one 600 ohm, 10 watt, LPI-10 \pm 2% resistors for the 350D). These resistors must be enclosed in a shield as shown in Figure 5-6. The range-to-range accuracy of the AC Voltmeter from +40 dB to -60 dB must be known to within 0.1 dB at 100 KHz and 1 MHz. Any errors should be

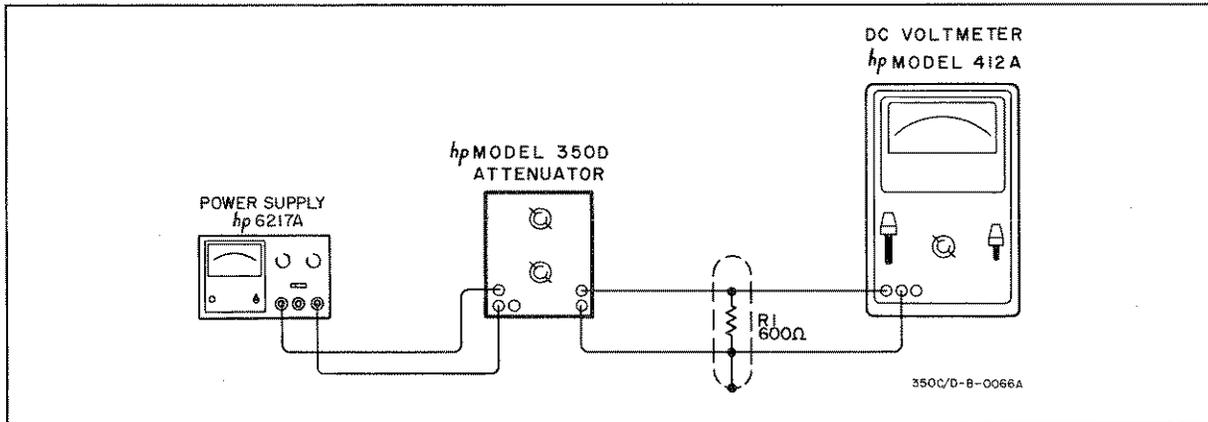


Figure 5-5. DC Performance Test Setup

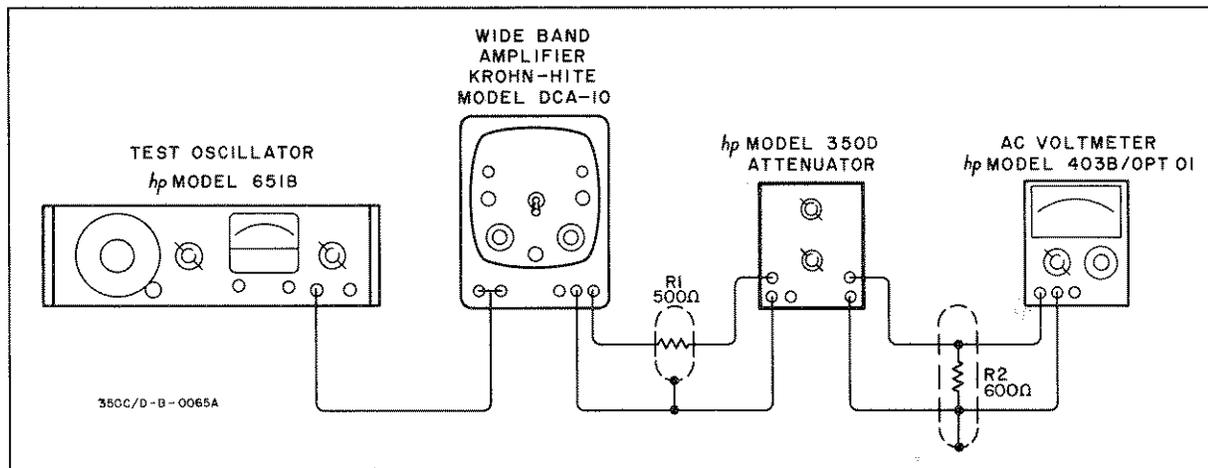


Figure 5-6. AC Performance Test Setup

algebraically subtracted from the error found during the performance test.

5-15. To perform the ac performance test, proceed as follows:

- a. Make test setup illustrated in Figure 5-6.
- b. Make control settings indicated in Step 1 of Table 5-3.
- c. Set Wide Band Amplifier for maximum gain.
- d. Adjust Oscillator AMPLITUDE control for convenient reference on AC Voltmeter.
- e. Make control settings indicated in Step 2 of Table 5-3; if AC Voltmeter does not indicate same as reference \pm tolerance listed in Table 5-3, perform adjustment procedure contained in Paragraph 5-16.

Table 5-2. DC Performance Test, Supplemental Data

Step	350D Attenuator Setting	DC Voltmeter Volts Range	Tolerance
1	0	100	
2	10	30	$\pm 46v$
3	20	10	$\pm 1.5v$
4	30	3	$\pm 46mv$
5	40	1	$\pm 15mv$
6	50	.3	$\pm 4.6mv$
7	60	.1	$\pm 1.5mv$
8	70	.03	$\pm 46mv$
9	80	.01	$\pm 30mv$
10	90	.003	$\pm 93\mu v$
11	100	.001	$\pm 30\mu v$

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- f. Repeat Step e for Steps 3 thru 11 of Table 5-3.
- g. Set 350D for 50 dB; AC Voltmeter for -20 dB. Adjust Oscillator AMPLITUDE control for +2 dB indication on AC Voltmeter.
- h. Change 350D Attenuation to 60 dB in 1 dB steps; if AC Voltmeter does not indicate 1 (± 0.125) dB change for each step, perform calibration procedure contained in Paragraph 5-16.
- i. Make control settings indicated in Step 12 of Table 5-3.
- j. Adjust Oscillator AMPLITUDE control for convenient reference as indicated on AC Voltmeter.
- k. Make control settings indicated in Step 13 of Table 5-3; if AC Voltmeter does not indicate same as reference \pm tolerance listed in Table 5-3, perform adjustment procedure contained in Paragraph 5-16.
- l. Repeat Step e for Steps 14 thru 22.
- m. Repeat Step g.

Table 5-3. AC Performance Test, Supplemental Data

Step	Oscillator Frequency	DB Setting	AC Voltmeter DB Range	Tolerance in DB
1	100 KHz	0	+40	
2	100 KHz	10	+30	± 0.25
3	100 KHz	20	+20	± 0.25
4	100 KHz	30	+10	± 0.25
5	100 KHz	40	0	± 0.25
6	100 KHz	50	-10	± 0.25
7	100 KHz	60	-20	± 0.25
8	100 KHz	70	-30	± 0.25
9	100 KHz	80	-40	± 0.5
10	100 KHz	90	-50	± 0.5
11	100 KHz	100	-60	± 0.5
12	1 MHz	0	+40	
13	1 MHz	10	+30	± 0.5
14	1 MHz	20	+20	± 0.5
15	1 MHz	30	+10	± 0.5
16	1 MHz	40	0	± 0.5
17	1 MHz	50	-10	± 0.5
18	1 MHz	60	-20	± 0.5
19	1 MHz	70	-30	± 0.5
20	1 MHz	80	-40	± 0.75
21	1 MHz	90	-50	± 0.75
22	1 MHz	100	-60	± 0.75

- n. Change 350D Attenuation to 60 dB in 1 dB steps; if AC Voltmeter does not indicate 1 (± 0.25) dB change for each step, perform adjustment procedure contained in Paragraph 5-16.

5-16. ADJUSTMENT PROCEDURE.

5-17. The adjustment procedure comprises the addition of padding resistors to the attenuator switches. This procedure should be performed only when one of the attenuators is found to be out of tolerance. Table 5-4 contains the information necessary to pad the 10 dB attenuator. Table 5-5 contains the information necessary to pad the 100 dB attenuator.

5-18. Attenuation values above 40 dB are obtained by using a combination of the 10, 20, 30, and 40 dB attenuator data. The error on any one of these steps might be within tolerance, with the combination of two or more being out of tolerance. Therefore, padding resistor values are given in Tables 5-4 and 5-5 for errors which are by themselves, not out of tolerance.

5-19. To perform the adjustment procedure, find the value of padding resistor which corresponds to the magnitude and direction of error. Add this resistor between the points indicated. Check the calibration by performing the appropriate performance test.

Table 5-4. 1 DB Step Attenuator Padding Data

1 DB Step Attenuation Position	Magnitude and Direction of Error			Padding Resistor		Ref Des	Position on S2 (See Figure 5-4)
	0-0.05	0.05-0.075	0.075-0.1	Value	-hp- Stock No.		
3	+			7.5 K	0758-0047	R37	7-8
3	-			10 K	0758-0006	R36	5-6
3		+		4.7 K	0758-0005	R37	7-8
3		-		6.8 K	0758-0009	R36	5-6
3			+	3.3 K	0758-0010	R37	7-8
3			-	5.1 K	0758-0037	R36	5-6
4	+			15 K	0758-0018	R41	2-4
4	-			18 K	0758-0019	R40	1-3
4		+		9.1 K	0758-0038	R41	2-4
4		-		12 K	0758-0012	R40	1-3
4			+	6.8 K	0758-0009	R41	2-4
4			-	9.1 K	0758-0038	R40	1-3

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Table 5-5. 10 DB Attenuator Padding Data

10 DB Step Attenuator Position	Magnitude and Direction of Error						Padding Resistor		Ref Des	Position on S1 (See Figure 5-3)
	0.1-0.15	0.15-0.2	0.2-0.25	0.25-0.3	0.3-0.35	0.35-0.4	Value	-hp- Stock No.		
10	+						6.8 K	0758-0009	R27	10-11
10	-						33 K	0758-0049	R26	1-2
10		+					4.7 K	0758-0005	R27	10-11
10		-					24 K	0758-0073	R26	1-2
10			+				3.9 K	0758-0045	R27	10-11
10			-				20 K	0758-0039	R26	1-2
20	+						4.7 K	0758-0005	R31	4-5
20	-						162 K	0757-0130	R28	12-13
20		+					3.6 K	0758-0036	R31	4-5
20		-					120 K	0758-0061	R28	12-13
20			+				2.7 K	0758-0004	R31	4-5
20			-				100 K	0758-0053	R28	12-13
20				+			2.4 K	0758-0034	R31	4-5
20				-			82 K	0758-0022	R28	12-13
20					+		2 K	0758-0033	R31	4-5
20					-		75K	0758-0075	R28	12-13
30	+						1.8 K	0758-0043	R30	6-7
30	-						511 K	0757-0135	R25	8-9
30		+					1.5 K	0758-0017	R30	6-7
30		-					383 K	0757-0133	R25	8-9
30			+				1.1 K	0758-0069	R30	6-7
30			-				332 K	0757-0132	R25	8-9
30				+			910	0758-0068	R30	6-7
30				-			274 K	0757-0131	R25	8-9
30					+		750	0758-0067	R30	6-7
30					-		215 K	0757-0127	R25	8-9
30						+	680	0758-0031	R30	6-7
30						-	200 K	0757-0128	R25	8-9
40	+						620	0758-0066	R32	3-16
40	-						1.62 M	0728-0001	R29	14-15
40		+					470	0758-0029	R32	3-16
40		-					1.33 M	0757-0140	R29	14-15
40			+				390	0758-0008	R32	3-16
40			-				1.1 M	0757-0139	R29	14-15
40				+			300	0758-0016	R32	3-16
40				-			909 K	0757-0138	R29	14-15
40					+		270	0758-0028	R32	3-16
40					-		750 K	0757-0137	R29	14-15
40						+	220	0758-0015	R32	3-16
40						-	619 K	0757-0136	R29	14-15

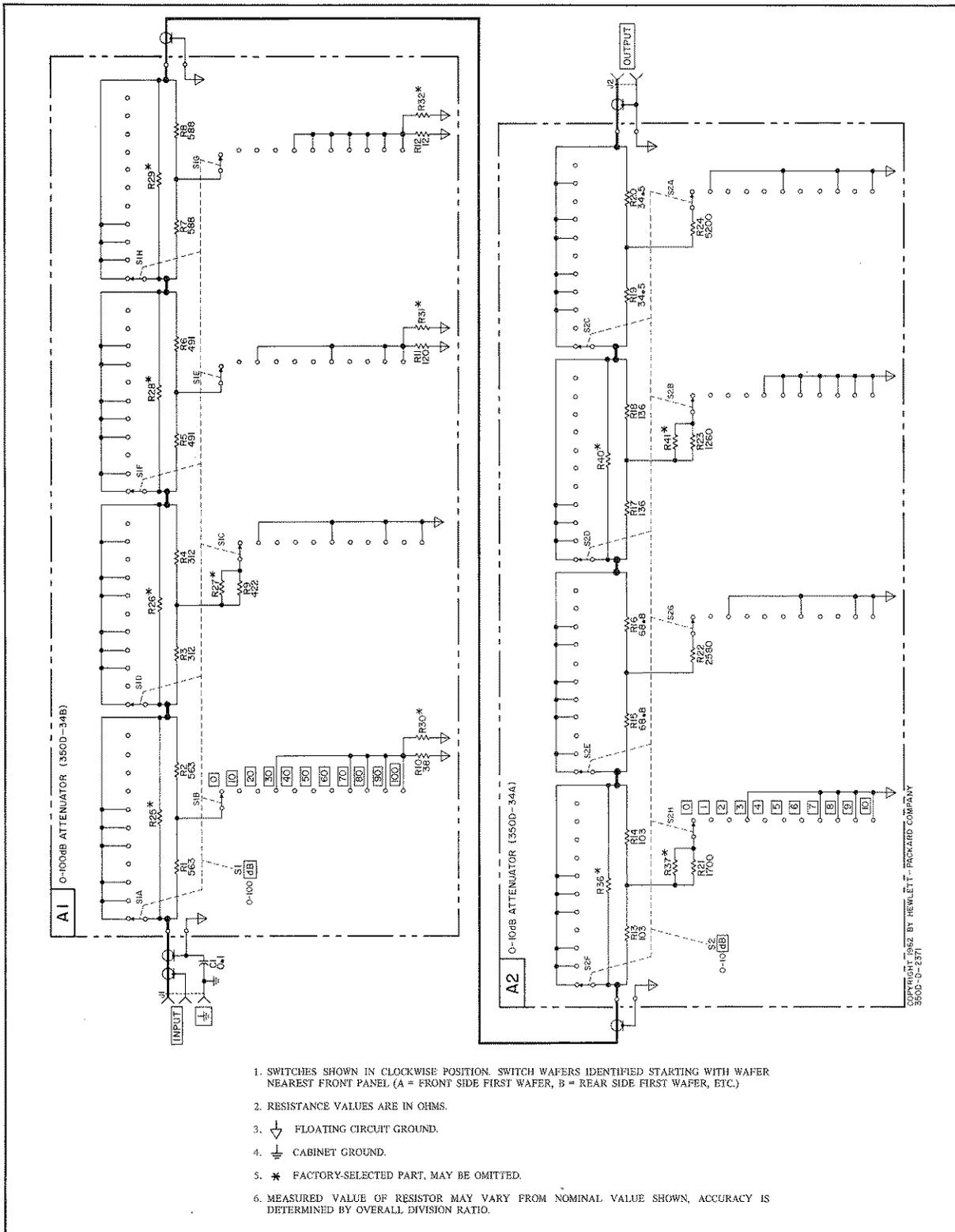


Figure 5-7. Model 350D Schematic Diagram

SECTION VI REPLACEABLE PARTS

6-1. INTRODUCTION.

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

- a. Total quantity used in the instrument (TQ column). The total quantity of a part is given the first time the part number appears.
- b. Description of the part. (See list of abbreviations below.)
- c. Typical manufacturer of the part in a five-digit code. (See Appendix A for list of manufacturers.)
- d. Manufacturer's part number.

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See Appendix B for list of office locations.) Identify parts by their Hewlett-Packard part numbers.

6-6. NON-LISTED PARTS.

6-7. To obtain a part that is not listed, include:

- a. Instrument model number.
- b. Instrument serial number.
- c. Description of the part.
- d. Function and location of the part.

ABBREVIATIONS			
Ag silver Al Aluminum A Amperes(s) Au gold C capacitor cer ceramic coef coefficient com common comp composition conn connection dep deposited DPDT double-pole double-throw DPST double-pole single-throw elect electrolytic encap encapsulated F farad(s) FET field effect transistor fld fixed GaAs gallium arsenide GHz gigahertz = 10 ⁹ hertz gd guard(ed) Ge germanium grd ground(ed) H henry(ies) Hz hertz (cycles per second)	ID inside diameter impg impregnated incd incandescent ins insulation(ed) kΩ kilohm(s) = 10 ³ ohms kHz kilohertz = 10 ³ hertz L inductor lin linear taper log logarithmic taper mA milliampere(s) = 10 ⁻³ amperes MHz megahertz = 10 ⁶ hertz MΩ megohm(s) = 10 ⁶ ohms met (fm) metal film mfr manufacturer ms millisecond mtg mounting mV millivolt(s) = 10 ⁻³ volts μF microfarad(s) μs microsecond(s) μV microvolt(s) = 10 ⁻⁶ volts my Mylar® nA nanoampere(s) = 10 ⁻⁹ amperes NC normally closed Ne neon NO normally open NPO negative positive zero (zero temperature coefficient)	ns nanosecond(s) = 10 ⁻⁹ seconds nsr not separately replaceable Ω ohm(s) oob order by description OD outside diameter p peak pA picoampere(s) pc printed circuit pF picofarad(s) = 10 ⁻¹² farads piv peak inverse voltage p/o part of pos position(s) poly polystyrene pot potentiometer p-p peak-to-peak ppm parts per million prec precision (temperature coefficient, long term stability, and/or tolerance) R resistor Rh rhodium rms root-mean-square rot rotary Se selenium sect section(s) Si silicon sl slide	SPDT single-pole double-throw SPST single-pole single-throw Ta tantalum TC temperature coefficient TiO ₂ titanium dioxide tog toggle tol tolerance trim trimmer TSTR transistor V volt(s) vacw alternating current working voltage var variable vdcw direct current working voltage W watt(s) w/ with wiv working inverse voltage w/o without ww wirewound * optimum value selected at factory, average value shown (part may be omitted) ** no standard type number assigned (selected or special type)

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DECIMAL MULTIPLIERS					
Prefix	Symbols	Multiplier	Prefix	Symbols	Multiplier
tera	T	10 ¹²	centi	c	10 ⁻²
giga	G	10 ⁹	milli	m	10 ⁻³
mega	M or Meg	10 ⁶	micro	μ	10 ⁻⁶
kilo	K or k	10 ³	nano	n	10 ⁻⁹
hecto	h	10 ²	pico	p	10 ⁻¹²
deca	da	10	femto	f	10 ⁻¹⁵
deci	d	10 ⁻¹	atto	a	10 ⁻¹⁸

DESIGNATORS			
A assembly B motor BT battery C capacitor CR diode DL delay line DS lamp E misc electronic part F fuse Rev J	FI filter HR heater J jack K relay L inductor M meter MP mechanical part P plug Q transistor	QCR transistor-diode R resistor RT thermostat S switch T transformer TB terminal board TC thermocouple TP test point TS terminal strip	U integrated circuit V vacuum tube, neon bulb, photocell, etc. W cable X socket XDS lampholder XF fuseholder Y crystal Z network

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Table 6-1. Replaceable Parts

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A1	350D-34B	1	Assy, attenuator, 0-100 dB, includes: R1 thru R12, R25 thru R32, S1	-hp-	
A2	350D-34A	1	Assy, attenuator, 0-10 dB, includes: R13 thru R24, R36 thru R43, S2	-hp-	
C1	0170-0022	2	C: fxd, my, 0.1 uF 20%, 600 vdcw	84411	HEW 7
J1	5060-0634 5060-0635 0340-0086 0340-0090	2 3 2 2	Connector: INPUT, includes: Assy, binding post: red Assy, binding post: black Insulator, binding post: 2 hole (outside) Insulator, binding post: 2 hole, keyed (inside)	-hp- -hp- -hp- -hp-	
J2	5060-0634 5060-0635 0340-0086 0340-0090		Connector: OUTPUT, includes: Assy, binding post: red Assy, binding post: black Insulator, binding post: 2 hole (outside) Insulator, binding post: 2 hole, keyed (inside)	-hp- -hp- -hp- -hp-	
R1	0775-0002	1	R: fxd, mfgl, 563 ohms 2%, 7 W	04674	LPI-7 obd
R2	0766-0013	1	R: fxd, mfgl, 563 ohms 2%, 3 W	04670	LPI-3 obd
R3	0772-0001	1	R: fxd, mfgl, 312 ohms 2%, 5 W	04670	LPI-5 obd
R4	0766-0009	1	R: fxd, mfgl, 312 ohms 2%, 3 W	04670	LPI-3 obd
R5	0775-0001	1	R: fxd, mfgl, 491 ohms 2%, 7 W	04670	LPI-7 obd
R6	0766-0011	1	R: fxd, mfgl, 491 ohms 2%, 3 W	04670	LPI-3 obd
R7	0775-0003	1	R: fxd, mfgl, 588 ohms 2%, 7 W	04670	LPI-7 obd
R8	0766-0015	1	R: fxd, mfgl, 588 ohms 2%, 3 W	04670	LPI-3 obd
R9	0772-0002	1	R: fxd, mfgl, 422 ohms 2%, 5 W	04670	LPI-5 obd
R10	0766-0012	1	R: fxd, mfgl, 38 ohms 2%, 3 W	04670	LPI-3 obd
R11	0766-0010	1	R: fxd, mfgl, 120 ohms 2%, 3 W	04670	LPI-3 obd
R12	0766-0014	1	R: fxd, mfgl, 12 ohms 2%, 3 W	04670	LPI-3 obd
R13, R14	0766-0005	2	R: fxd, mfgl, 103 ohms 2%, 3 W	04670	LPI-3 obd
R15, R16	0766-0003	2	R: fxd, mfgl, 68.8 ohms 2%, 3 W	04670	LPI-3 obd
R17, R18	0766-0007	2	R: fxd, mfgl, 136 ohms 2%, 3 W	04670	LPI-3 obd
R19, R20	0766-0001	2	R: fxd, mfgl, 34.5 ohms 2%, 3 W	04670	LPI-3 obd
R21	0766-0006	1	R: fxd, mfgl, 1700 ohms 2%, 3 W	04670	LPI-3 obd
R22	0766-0004	1	R: fxd, mfgl, 2580 ohms 2%, 3 W	04670	LPI-3 obd
R23	0766-0008	1	R: fxd, mfgl, 1260 ohms 2%, 3 W	04670	LPI-3 obd
R24	0766-0002	1	R: fxd, mfgl, 5200 ohms 2%, 3 W	04670	LPI-3 obd
R25* thru R32* R33 thru R35 R36*, R37* R38, R39 R40*, R41*			Factory selected part, may be omitted Not assigned Factory selected part, may be omitted Not assigned Factory selected part, may be omitted		
S1			Nsr; part of A1		
S2			Nsr; part of A2		
	5060-0705 5060-0727	1 1	Assy, cover: half recess (top) Assy, foot	-hp- -hp-	
	5000-0710 5000-0702	1 2	Cover (bottom) Cover, 6 x 8 (side)	-hp- -hp-	
	5060-0702	2	Frame, side 6 x 8	-hp-	
	0370-0112	2	Knobs: bar w/arrow, black	-hp-	
	00350-90203	1	Manual: instruction (350D)	-hp-	
	350D-2A 5000-7293	1 1	Panel: front (350D only) Panel: rear	-hp- -hp-	

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Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A2 (Cont'd)	2460-0008	1	Screw: phillips head for rear of top cover	-hp-		
	2370-0020†	8	Screw: phillips head for side panels	-hp-		
	1490-0031	1	Stand: tilt	-hp-		
	350C-55A	1	10 dB shield	-hp-		
	350C-12A	1	10 dB shield clamp	-hp-		
	350C-55B	1	100 dB shield	-hp-		
	350C-12B	1	100 dB shield clamp	-hp-		
	350D-95A	1	Attenuator Assy, 10 dB step; Includes the following parts: 350C-12A, 350C-55A and 350D-34A	-hp-		
	350D-95B	1	Attenuator Assy, 100 dB step; Includes the following parts: 350C-12B, 350C-55B and 350D-34B	-hp-		
			† If screw with nut is used, these are the stock numbers:			
		2420-0004	8	Nut: hex w/lock	-hp-	
	2370-0013	8	Screw: phillips head for side panel	-hp-		

CODE LIST OF MANUFACTURERS

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	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
00000	U. S. A Common	Any supplier of U.S.	05347	Ultronix, Inc.	San Mateo, Cal.	11236	CTS of Berne, Inc.	Berne, Ind.
00136	McCoy Electronics	Mount Holly Springs, Pa.	05397	Union Carbine Corp., Elect.		11237	Chicago Telephone of California, Inc.	So. Pasadena, Cal.
00213	Sage Electronics Corp.	Rochester, N. Y.		Div.	New York, N. Y.		Bay State Electronics Corp.	Waltham, Mass
00287	Cemco, Inc.	Danielson, Conn.	05574	Viking Ind. Inc.	Canoga Park, Cal.	11242	Teledyne Inc., Microwave Div.	Palo Alto, Cal.
00334	Humidial	Colton, Calif.	05593	Icore Electro-Plastics Inc.	Sunnyvale, Cal.	11312	National Seal	Downey, Cal.
00348	Mictron, Co., Inc.	Valley Stream, N. Y.	05616	Cosmo Plastic (e/o Electrical Spec. Co.)	Cleveland, Ohio	11314	Precision Connector Corp.	Jamaica, N. Y.
00373	Garlock Inc.	Cherry Hill, N. J.	05624	Barber Colman Co.	Rockford, Ill.	11453	Duncan Electronics Inc.	Costa Mesa, Cal.
00656	Aerovox Corp.	New Bedford, Mass.	05728	Hiffen Optical Co.		11711	General Instrument Corp., Semiconductor Division Products Group	Newark, N. J.
00779	Amp. Inc.	Harrisburg, Pa.	05729	Metro-Tel Corp.	Westbury, N. Y.	11717	Imperial Electronic, Inc.	Buena Park, Cal.
00781	Aircraft Radio Corp.	Booton, N. J.	05783	Stewart Engineering Co.	Santa Cruz, Cal.	11870	Melabs, Inc.	Palo Alto, Cal.
00809	Crown, Ltd.	Whitby, Ontario, Canada	05820	Wakefield Engineering Inc.	Wakefield, Mass.	12136	Philadelphian Handle Co.	Camden, N. J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.	06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.	12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S. C.	06175	Bausch and Lomb Optical Co.	Rochester, N. Y.	12574	Gulton Ind. Inc., Data System Div.	Albuquerque, N. M.
00866	Goe Engineering Co.	City of Industry, Cal.	06402	E. T. A. Products Co. of America	Chicago, Ill.	12597	Ciarostat Mfg. Co.	Dover, N. H.
00891	Carl E. Holmes Corp.	Los Angeles, Cal.	06540	Anatom Electronic Hardware Co., Inc.	New Rochelle, N. Y.	12728	Elmar Filter Corp.	W. Haven, Conn.
00929	Microlab Inc.	Livingston, N. J.	06555	Beede Electrical Instrument Co., Inc.	Penacook, N. H.	12859	Nippon Electric Co., Ltd.	Tokyo, Japan
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N. Y.	06666	General Devices Co., Inc.	Indianapolis, Ind.	12881	Metex Electronics Corp.	Clark, N. J.
01009	Alden Products Co.	Brockton, Mass.	06751	Components Inc., Ariz. Div.	Phoenix, Arizona	12930	Delta Semiconductor Inc.	Newport Beach, Cal.
01121	Allen Bradley Co.	Milwaukee, Wis.	06812	Torrington Mfg. Co., West Div.	Van Nuys, Cal.	12954	Dickson Electronics Corp.	Scottsdale, Arizona
01255	Litton Industries, Inc.	Beverly Hills, Cal.	06980	Varian Assoc. Etmac Div.	San Carlos, Cal.	13019	Aircro Supply Co., Inc.	Wichita, Kansas
01281	TRW Semiconductors, Inc.	Lawndale, Cal.	07088	Keivin Electric Co.	Van Nuys, Cal.	13061	Wilco Products	Detroit, Mich.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas	07126	Digitran Co.	Pasadena, Cal.	13103	Thermolloy	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio	07137	Transistor Electronics Corp.	Minneapolis, Minn.	13327	Solotron Devices Inc.	Tappan, N. Y.
01538	Small Parts Inc.	Los Angeles, Cal.	07138	Westinghouse Electric Corp., Electronic Tube Div.	Elmira, N. Y.	13396	Telefunken (GmbH)	Hanover, Germany
01589	Pacific Relays, Inc.	Van Nuys, Cal.	07149	Filmohm Corp.	New York, N. Y.	13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
01670	Gudebrod Bros. Silk Co.	New York, N. Y.	07233	Cinch-Graphix Co.	City of Industry, Cal.	14089	Sem-Tech	Newbury Park, Cal.
01930	Amerock Corp.	Rockford, Ill.	07256	Silicon Transistor Corp.	Carle Place, N. Y.	14193	Calif. Resistor Corp.	Santa Monica, Cal.
01980	Pulse Engineering Co.	Santa Clara, Cal.	07261	Avnet Corp.	Culver City, Cal.	14298	American Components, Inc.	Conshohocken, Pa.
02114	Ferroxcube Corp. of America	Saugerties, N. Y.	07263	Fairchild Camera & Inst. Corp., Semiconductor Div.	Mountain View, Cal.	14433	ITT Semiconductor, a Div. of Int. Telephone and Telegraph Corporation	West Palm Beach, Fla.
02116	Wheelock Signals, Inc.	Long Branch, N. J.	07322	Minnesota Rubber Co.	Minneapolis, Minn.	14493	Hewlett-Packard Company	Loveland, Colo.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Cal.	07387	Birtcher Corp., The	Monterey Park, Cal.	14655	Cornell Dublier Electric Corp.	Newark, N. J.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.	07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Cal.	14674	Corning Glass Works	Corning, N. Y.
02735	Radio Corp. of America, Semiconductor and Materials Division	Somerville, N. J.	07700	Technical Wire Products Inc.	Cranford, N. J.	14752	Electro Cube Inc.	San Gabriel, Cal.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.	07829	Bodine Elect. Co.	Chicago, Ill.	14966	Williams Mfg. Co.	San Jose, Cal.
02777	Hopkins Engineering Co.	San Fernando, Cal.	07910	Continental Device Corp.	Hawthorne, Cal.	15106	The Sphere Co., Inc.	Little Falls, N. J.
02875	Hudson Tool & Die	Newark, N. J.	07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Cal.	15287	Webster Electronics Co.	New York, N. Y.
03296	Nylon Molding Corp.	Springfield, N. J.	07980	Hewlett-Packard Co., New Jersey Division	Rockaway, N. J.	15558	Scionics Corp.	Northridge, Cal.
03508	G. E. Semiconductor Prod. Dept.	Syracuse, N. Y.	08145	U. S. Engineering Co.	Los Angeles, Cal.	15586	Adjustable Bushing Co.	N. Hollywood, Cal.
03705	Apex Machine & Tool Co.	Dayton, Ohio	08289	Blina, Delbert Co.	Pomona, Cal.	15681	Micron Electronics, Garden City, Long Island, N. Y.	Amprobe Inst. Corp., Lynbrook, N. Y.
03797	Elidma Corp.	Compton, Calif.	08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada	15683	Cabletronics	Costa Mesa, Cal.
03818	Parker Seal Co.	Los Angeles, Cal.	08524	Deutsch Fastener Corp.	Los Angeles, Cal.	15772	Trentieth Century Coil Spring Co.	Santa Clara, Cal.
03877	Transiron Electric Corp.	Wakefield, Mass.	08664	Bristol Co., The	Waterbury, Conn.	15801	Penwal Elect. Inc.	Frankingham, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N. J.	08717	Sloan Company	Sun Valley, Cal.	15818	Amelec Inc.	Mountain View, Cal.
03954	Singer Co., Diehl Div.	Palo Alto, Cal.	08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona	16037	Spruce Pine Mica Co.	Spruce Pine, N. C.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.	08727	National Radio Lab. Inc.	Paramus, N. J.	16179	Omni-Spectra Inc.	Detroit, Ill.
04013	Tarus Corp.	Lambertville, N. J.	08792	CBS Electronics Semiconductor Operations, Div. of CBS Inc.	Lowell, Mass.	16352	Computer Diode Corp.	Lodi, N. J.
04062	Arco Electronic Inc.	Great Neck, N. Y.	08806	General Electric Co., Miniature Lamp Dept.	Cleveland, Ohio	16554	Electroid Co.	Union, N. J.
04217	Essex Wire	Los Angeles, Cal.	08984	Mel-Rain	Indianapolis, Ind.	16585	Boots Aircraft Nut Corp.	Pasadena, Cal.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S. C.	09026	Babcock Relays Div.	Costa Mesa, Cal.	16688	Ideal Prec. Meter Co., Inc.	
04354	Precision Paper Tube Co.	Wheeling, Ill.	09097	Electronic Enclosures Inc.	Los Angeles, Calif.	16758	De Jur Meter Div.	Brooklyn, N. Y.
04404	Palo Alto Division of Hewlett-Packard Co.	Palo Alto, Cal.	09134	Texas Capacitor Co.	Houston, Texas	16759	Delco Radio Div. of G. M. Corp.	Kokomo, Ind.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Cal.	09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Cal.	17109	Thermonetics Inc.	Canoga Park, Cal.
04673	Dakota Engr. Inc.	Culver City, Cal.	09250	Electro Assemblies, Inc.	Chicago, Ill.	17474	Tranex Company	Mountain View, Cal.
04713	Motorola Inc. Semiconductor Prod. Div.	Phoenix, Arizona	09353	C & K Components Inc.	Newton, Mass.	17675	Hamlin Metal Products Corp.	Akron, Ohio
04732	Filttron Co., Inc. Western Div.	Culver City, Cal.	09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada	17745	Angstrom Prec. Inc.	No. Hollywood, Cal.
04773	Automatic Electric Co.	Northlake, Ill.	09795	Pennsylvania Florocarbon	Clifton Heights, Penn.	17856	Siliconix Inc.	Sunnyvale, Cal.
04796	Sequoia Wire Co.	Redwood City, Cal.	09922	Burndy Corp.	Norwalk, Conn.	17870	McGraw-Edison Co.	Manchester, N. H.
04811	Precision Coil Spring Co.	El Monte, Cal.	10214	General Transistor Western Corp.	Los Angeles, Cal.	18042	Power Design Pacific Inc.	Palo Alto, Cal.
04870	P. M. Motor Company	Westchester, Ill.	10411	Ti-Tal, Inc.	Berkeley, Cal.	18083	Clevite Corp. Semiconductor Div.	Palo Alto, Cal.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.	10646	Carborundum Co.	Niagara Falls, N. Y.	18324	Signetics Corp.	Sunnyvale, Cal.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Cal.				18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
05277	Westinghouse Electric Corp. Semiconductor Dept.	Youngwood, Pa.				18486	TRW Elect. Comp. Div.	Des Plaines, Ill.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
19644	LRC Electronics	Horseheads, N. Y.	71492	C. P. Clare & Co.	Chicago, Ill.	78452	Thompson-Bremer & Co.	Chicago, Ill.
19701	Electra Mfg. Co.	Independence, Kansas	71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.	78471	Tilley Mfg. Co.	San Francisco, Cal.
20183	General Atronics Corp.	Philadelphia, Pa.	71616	Commercial Plastics Co.	Chicago, Ill.	78488	Stackpole Carbon Co.	St. Marys, Pa.
21226	Executone, Inc.	Long Island City, N. Y.	71700	Cornish Wire Co., The	New York, N. Y.	78493	Standard Thomson Corp.	Waltham, Mass.
21355	Fafnir Bearing Co., The	New Britain, Conn.	71707	Coto Coil Co., Inc.	Providence, R.I.	78553	Tinnerman Products, Inc.	Cleveland, Ohio
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.	71744	Chicago Miniature Lamp Works	Chicago, Ill.	78790	Transformer Engineers	San Gabriel, Cal.
23020	General Reed Co.	Metuchen, N. J.	71785	Ching Mfg. Co.	Chicago, Ill.	78947	Uclinite Co.	Newtonville, Mass.
23042	Texscan Corp.	Indianapolis, Ind.	71984	Howard B. Jones Div.	Chicago, Ill.	79136	Waldes Kohinoor Inc.	Long Island City, N. Y.
23783	British Radio Electronics Ltd.	Washington, D.C.	72136	Dow Corning Corp.	Midland, Mich.	79142	Weeder Root, Inc.	Hartford, Conn.
24455	G. E. Lamp Division, Nela Park	Cleveland, Ohio	72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.	79251	Wenco Mfg. Co.	Chicago, Ill.
24655	General Radio Co.	West Concord, Mass.	72619	Dialight Corp.	Brooklyn, N. Y.	79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.	72656	Indiana General Corp.	Keasby, N. J.	79963	Zierick Mfg. Corp.	New Rochelle, N. Y.
26365	Gries Reproducer Corp.	New Rochelle, N. Y.	72699	General Instrument Corp., Cap Division	Newark, N. J.	80031	Mepeco Division of Sessions Clock Co.	Morristown, N. J.
26462	Grobert File Co. of America, Inc.	Carlstadt, N. J.	72765	Drake Mfg. Co.	Harwood Heights, Ill.	80033	Prestole Corp.	Toledo, Ohio
26851	Compac/Hollister Co.	Hollister, Cal.	72825	Hugh H. Eby Inc.	Philadelphia, Pa.	80120	Schnitzer Alloy Products Co.	Elizabeth, N. J.
26992	Hamilton Watch Co.	Lancaster, Pa.	72928	Gudemann Co.	Chicago, Ill.	80131	Electronic Industries Association, Standard tube or semi-conductor device, any manufacturer.	
28480	Hewlett-Packard Co.	Palo Alto, Cal.	72962	Elastic Stop Nut Corp.	Union, N. J.	80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
28520	Heyman Mfg. Co.	Kenilworth, N. J.	72964	Robert M. Hadley Co.	Los Angeles, Cal.	80223	United Transformer Corp.	New York, N. Y.
30817	Instrument Specialties Co., Inc.	Little Falls, N. J.	72982	Eric Technological Products, Inc.	Eric, Pa.	80248	Oxford Electric Corp.	Chicago, Ill.
33173	G. E. Receiving Tube Dept.	Owensboro, Ky.	73061	Hansen Mfg. Co., Inc.	Princeton, Ind.	80294	Bourns Inc.	Riverside, Cal.
35434	Lectrohm Inc.	Chicago, Ill.	73076	H. M. Harper Co.	Chicago, Ill.	80411	Arco Div. of Robertshaw Controls Co.	Columbus, Ohio
36196	Stanwyck Coil Products, Ltd.	Hawkesbury, Ontario, Canada	73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Cal.	80486	All Star Products Inc.	Defiance, Ohio
36287	Cunningham, W. H. & Hill, Ltd.	Toronto, Ontario, Canada	73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Cal.	80509	Avery Label Co.	Monrovia, Cal.
37942	P. R. Mallory & Co., Inc.	Indianapolis, Ind.	73445	Amperex Elect. Co.	Hicksville, L. I., N. Y.	80583	Hammamund Co., Inc.	Mars Hill, N. C.
39543	Mechanical Industries Prod. Co.	Akron, Ohio	73506	Bradley Semiconductor Corp.	New Haven, Conn.	80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
40920	Miniature Precision Bearings, Inc.	Keene, N. H.	73559	Carling Electric, Inc.	Hartford, Conn.	80813	Dimco Gray Co.	Dayton, Ohio
40931	Honeywell Inc.	Minneapolis, Minn.	73586	Circle F Mfg. Co.	Trenton, N. J.	81030	International Inst. Inc.	Orange, Conn.
42190	Muter Co.	Chicago, Ill.	73682	George K. Garrett Co., Div. MSL Industries, Inc.	Philadelphia, Pa.	81073	Grayhill Co.	LaGrange, Ill.
43990	C. A. Norgren Co.	Englewood, Colo.	73734	Federal Screw Products, Inc.	Chicago, Ill.	81095	Triad Transformer Corp.	Venice, Cal.
44655	Ohmite Mfg. Co.	Skokie, Ill.	73743	Fischer Special Mfg. Co.	Cincinnati, Ohio	81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
46394	Penn Eng. & Mfg. Corp.	Doylestown, Pa.	73793	General Industries Co., The	Elyria, Ohio	81349	Military Specification	
47904	Polaroid Corp.	Cambridge, Mass.	73846	Goshen Stamping & Tool Co.	Goshen, Ind.	81483	International Rectifier Corp.	El Segundo, Cal.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.	73899	JFD Electronics Corp.	Brooklyn, N. Y.	81541	Airpax Electronics, Inc.	Cambridge, Maryland
49956	Microwave & Power Tube Div.	Waltham, Mass.	73905	Jennings Radio Mfg. Corp.	San Jose, Cal.	81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
52090	Rowan Controller Co.	Westminster, Md.	73957	Groove-Pin Corp.	Ridgefield, N. J.	82042	Carter Precision Electric Co.	Skokie, Ill.
52983	HP Co., Med. Elec. Div.	Waltham, Mass.	74276	Signalite Inc.	Neptune, N. J.	82047	Sperli Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N. J.
54294	Shallcross Mfg. Co.	Selma, N. C.	74455	J. H. Winns and Sons	Winchester, Mass.	82116	Electric Regulator Corp.	Norwalk, Conn.
55026	Simpson Electric Co.	Chicago, Ill.	74861	Industrial Condenser Corp.	Chicago, Ill.	82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
55933	Sonotone Corp.	Elmsford, N. Y.	74868	R. F. Products Division of Amphenol-Borg Electronic Corp.	Danbury, Conn.	82170	Fairchild Camera & Inst. Corp., Space & Defense Systems Div.	Paramus, N. J.
55938	Raytheon Co. Commercial Apparatus & System Div.	So. Norwalk, Conn.	74970	E. F. Johnson Co.	Waseca, Minn.	82209	Magurie Industries, Inc.	Greenwich, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N. Y.	75042	International Resistance Co.	Philadelphia, Pa.	82219	Sylvania Electric Prod., Inc. Electronic Tube Division	Emporium, Pa.
56289	Sprague Electric Co.	North Adams, Mass.	75203	Keystone Carbon Co., Inc.	St. Marys, Pa.	82376	Astron Corp.	East Newark, Harrison, N. J.
58474	Superior Elec. Co.	Bristol, Conn.	75378	CTS Knights, Inc.	Sandwich, Ill.	82389	Switchcraft, Inc.	Chicago, Ill.
59446	Thelx Corp.	Tulsa, Okla.	75382	Kulka Electric Corp.	Mt. Vernon, N. Y.	82647	Metals & Controls Inc., Spencer Products	Attleboro, Mass.
59730	Thomas & Betts Co.	Elizabeth, N. J.	75818	Leuz Electric Mfg. Co.	Chicago, Ill.	82768	Phillips-Advance Control Co.	Joliet, Ill.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio	75915	Littlefuse, Inc.	Des Plaines, Ill.	82866	Research Products Corp.	Madison, Wis.
61775	Union Switch and Signal Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.	76005	Lord Mfg. Co.	Eric, Pa.	82877	Rolton Mfg. Co., Inc.	Woodstock, N. Y.
62119	Universal Electric Co.	Owosso, Mich.	76210	C. W. Marwedel	San Francisco, Cal.	82893	Vector Electronic Co.	Glendale, Cal.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N. Y.	76433	General Instrument Corp., Micamold Division	Newark, N. J.	83058	Carr Fastener Co.	Cambridge, Mass.
64959	Western Electric Co., Inc.	New York, N. Y.	76487	James Millen Mfg. Co., Inc.	Malden, Mass.	83086	New Hampshire Ball Bearing, Inc.	Peterborough, N. H.
65082	Weston Inst. Inc.	Weston-Newark, Newark, N. J.	76493	J. W. Miller Co.	Los Angeles, Cal.	83125	General Instrument Corp., Capacitor Div.	Darlington, S. C.
66395	Witek Mfg. Co.	Chicago, Ill.	76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Cal.	83148	ITT Wire and Cable Div.	Los Angeles, Cal.
66346	Minnesota Mining & Mfg. Co.	St. Paul, Minn.	76545	Mueller Electric Co.	Cleveland, Ohio	83186	Victory Eng. Corp.	Springfield, N. J.
70276	Revere Mincom Div.	Hartford, Conn.	76703	National Union	Newark, N. J.	83298	Bendix Corp., Red Bank Div.	Red Bank, N. J.
70309	Allied Control	New York, N. Y.	76854	Oak Manufacturing Co.	Crystal Lake, Ill.	83324	Rosan Inc.	Newport Beach, Cal.
70318	Allmetal Screw Product Co., Inc.	Garden City, N. Y.	77068	The Bendix Corp. Electrodynamics Div.	N. Hollywood, Cal.	83330	Smith, Herman H., Inc.	Brooklyn, N. Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.	77075	Pacific Metals Co.	San Francisco, Cal.	83332	Tech Labs	Palisades Park, N. J.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.	77221	Phaostroan Instrument and Electronic Co.	So. Pasadena, Cal.	83385	Central Screw Co.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N. J.	77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.	83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
70674	ADC Products Inc.	Minneapolis, Minn.	77342	American Machine & Foundry Co. Potter & Brunfield Div.	Princeton, Ind.	83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N. J.
70903	Belden Mfg. Co.	Chicago, Ill.	77630	TRW Electronic Components Div.	Camden, N. J.	83740	Union Carbide Corp., Consumer Prod. Div.	New York, N. Y.
70998	Bird Electric Corp.	Cleveland, Ohio	77638	General Instrument Corp., Rectifier Division	Brooklyn, N. Y.	83777	Model Eng. and Mig., Inc.	Huntington, Ind.
71002	Birnbach Radio Co.	New York, N. Y.	77764	Resistance Products Co.	Harrisburg, Pa.	83821	Lloyd Scruggs Co.	Festus, Mo.
71034	Bliley Electric Co., Inc.	Eric, Pa.	77969	Rubbercraft Corp. of Calif.	Torrance, Cal.	83942	Aeronautical Inst. & Radio Co.	Lodi, N. J.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincey, Mass.	78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.	84171	Arco Electronics Inc.	Great Neck, N. Y.
71218	Bud Radio, Inc.	Willoughby, Ohio	78277	Sigma	So. Braintree, Mass.	84396	A. J. Glesener Co., Inc.	San Francisco, Cal.
71279	Cambridge Thermionics Corp.	Cambridge, Mass.	78283	Signal Indicator Corp.	New York, N. Y.	84411	TRW Capacitor Div.	Ogallala, Neb.
71286	Camloc Fastener Corp.	Paramus, N. J.	78290	Kruthers-Dunn Inc.	Pitman, N. J.			
71313	Cardwell Condenser Corp.	Lindenhurst, L. I., N. Y.						
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.						
71436	Chicago Condenser Corp.	Chicago, Ill.						
71447	Calif. Spring Co., Inc.	Pico-Rivera, Cal.						
71450	CTS Corp.	Elkhart, Ind.						
71468	ITT Cannon Electric Inc.	Los Angeles, Cal.						
71471	Cinema, Div. Aerovox Corp.	Burbank, Cal.						

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
94870	Sarkes Tarzian, Inc.	Bloomington, Ind.	91929	Honeywell Inc., Micro Switch Division		96095	Hi-Q Div. of Aerovox Corp.	Olean, N. Y.
85454	Boonton Molding Company	Boonton, N. J.				96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
85471	A. B. Boyd Co.	San Francisco, Cal.	91961	Nahm-Bros. Spring Co.	Oakland, Cal.	96296	Solar Mfg. Co.	Los Angeles, Cal.
85474	R. M. Bracamonte & Co.	San Francisco, Cal.	92180	Tru-Connector Corp.	Peabody, Mass.	96396	Microswitch, Div. of	
85560	Kolled Kords, Inc.	Hamden, Conn.	92367	Elgeet Optical Co., Inc.	Rochester, N. Y.		Mimm-Honeywell	Freeport, Ill.
85911	Seamless Rubber Co.	Chicago, Ill.	92607	Tensolite Insulated Wire Co., Inc.		96330	Carlton Screw Co.	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.				96341	Microwave Associates, Inc.	Burlington, Mass.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.	92702	IMC Magnetics Corp.	Westbury, L. I., N. Y.	96501	Excel Transformer Co.	Oakland, Cal.
			92966	Hudson Lamp Co.	Kearney, N. J.	96508	Xcelite, Inc.	Orchard Park, N. Y.
86579	Precision Rubber Products Corp.	Dayton, Ohio	93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.	96733	San Fernando Elec. Mfg. Co.	San Fernando, Cal.
86684	& Devices Division	Harrison, N. J.	93369	Hobbs & Myers Inc.	Pallisades Park, N. J.	96881	Thomson Ind. Inc.	Long Island, N. Y.
86928	Seastron Mfg. Co.	Glendale, Cal.	93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio	97464	Industrial Retaining Ring Co.	Irvington, N. J.
87034	Marco Industries	Anaheim, Cal.	93632	Waters Mfg. Co.	Culver City, Cal.	97539	Automatic & Precision Mfg.	Englewood, N. J.
87216	Phileo Corporation (Lansdale Division)	Lansdale, Pa.	93929	G. V. Controls	Livingston, N. J.	97979	Reon Resistor Corp.	Yonkers, N. Y.
87473	Western Fibrous Glass Products Co.	San Francisco, Cal.	94137	General Cable Corp.	Bayonne, N. J.	97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N. Y.
87664	Van Waters & Rogers Inc.	San Francisco, Cal.	94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.	98141	R-Tronics, Inc.	Jamaica, N. Y.
87930	Tower Mfg. Corp.	Providence, R. I.	94148	Scientific Electronics Products, Inc.	Loveland, Colo.	98159	Rubber Teck, Inc.	Gardena, Cal.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.	94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N. J.	98220	Hewlett-Packard Co., Medical Elec. Div.	Pasadena, Cal.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.	94197	Curtiss-Wright Corp., Electronics Div.	East Patterson, N. J.	98278	Microdod, Inc.	So. Pasadena, Cal.
88698	General Mills, Inc.	Buffalo, N. Y.	94222	South Chester Corp.	Chester, Pa.	98291	Sealectro Corp.	Mamaroneck, N. Y.
89231	Graybar Electric Co.	Oakland, Cal.	94330	Wire Cloth Products, Inc.	Bellwood, Ill.	98376	Zero Mfg. Co.	Burbank, Cal.
89473	G. E. Distributing Corp.	Schenectady, N. Y.	94375	Automatic Metal Products Co.	Brooklyn, N. Y.	98410	Etc. Inc.	Cleveland, Ohio
89479	Security Co.	Detroit, Mich.	94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.	98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
89665	United Transformer Co.	Chicago, Ill.	94696	Magnecraft Electric Co.	Chicago, Ill.	98734	Pasco Division of Hewlett-Packard Co.	Palo Alto, Cal.
90030	United Shoe Machinery Corp.	Beverly, Mass.	95023	George A. Philbrick Researchers, Inc.	Boston, Mass.	98821	North Hills Electronics, Inc.	Glen Cove, N. Y.
90179	U. S. Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N. J.	95146	Alco Elect. Mfg. Co.	Lawrence, Mass.	98978	International Electronic Research Corp.	Burbank, Cal.
90365	Belleville Speciality Tool Mfg., Inc.	Belleville, Ill.	95236	Allies Products Corp.	Dania, Fla.	99109	Columbia Technical Corp.	New York, N. Y.
90763	United Carr Fastener Corp.	Chicago, Ill.	95238	Continental Connector Corp.	Woodside, N. Y.	99313	Varian Associates	Palo Alto, Cal.
90970	Bearing Engineering Co.	San Francisco, Cal.	95263	Leecraft Mfg. Co., Inc.	Long Island, N. Y.	99378	Atlee Corp.	Winchester, Mass.
91146	ITT Cannon Elect. Inc., Salem Div.	Salem, Mass.	95275	National Coil Co.	Sheridan, Wyo.	99515	Marshall Ind., Capacitor Div.	Monrovia, Cal.
91260	Connor Spring Mfg. Co.	San Francisco, Cal.	95348	Vitramon, Inc.	Bridgeport, Conn.	99707	Control Switch Division, Controls Co. of America	El Segundo, Cal.
91345	Miller Dial & Nameplate Co.	El Monte, Cal.	95354	Gordos Corp.	Bloomfield, N. J.	99800	Delevan Electronics Corp.	East Aurora, N. Y.
91418	Radio Materials Co.	Chicago, Ill.	95566	Methode Mfg. Co.	Rolling Meadows, Ill.	99848	Wilco Corporation	Indianapolis, Ind.
91506	Augat Inc.	Aittleboro, Mass.	95712	Arnold Engineering Co.	Marengo, Ill.	99928	Branson Corp.	Whippany, N. J.
91637	Dale Electronics, Inc.	Columbus, Nebr.	95712	Dage Electric Co., Inc.	Franklin, Ind.	99934	Rembrandt, Inc.	Boston, Mass.
91662	Eico Corp.	Willow Grove, Pa.	95887	Siemon Mfg. Co.	Wayne, Ill.	99942	Hoffman Electronics Corp., Semiconductor Division	El Monte, Cal.
91673	Epiphone Inc.	New York, N. Y.	96067	Microwave Assoc., West, Inc.	Sunnyvale, Cal.	99957	Technology-Instrument Corp. of California	Newbury Park, Cal.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.						
91827	K F Development Co.	Redwood City, Cal.						
91886	Malco Mfg., Inc.	Chicago, Ill.						

The following HP 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.	000CS	Hewlett-Packard Co., Colorado Springs Div.	Colorado Springs, Colorado	000QQ	Cooltron	Oakland, Cal.
0000Z	Willow Leather Products Corp.	Newark, N. J.	000MM	Rubber Eng. & Development	Hayward, Cal.	000WW	California Eastern Lab.	Burlington, Cal.
000AB	ETA	England	000NN	A "N" D Mfg. Co.	San Jose, Cal.	000YY	S. K. Smith Co.	Los Angeles, Cal.
000BB	Precision Instrument Comp. Co.	Van Nuys, Cal.						

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