Errata

Title & Document Type: **3555B Transmission and Noise Measuring Set Operating and Service Manual**

Manual Part Number: **03555-90008**

Revision Date: **June 1976**

About this Manual

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HP References in this Manual

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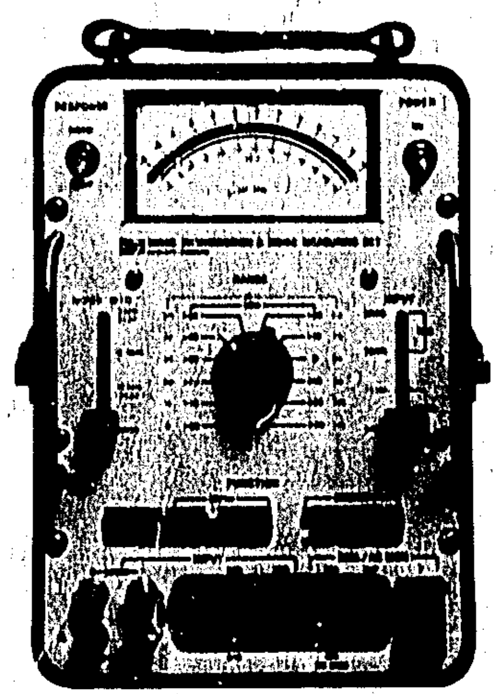
HP 3555B

OPERATING AND SERVICE MANUAL

TRANSMISSION AND NOISE MEASURING SET

MODEL 3555B



HEWLETT hp PACKARD

HP 3555B

OPERATING AND SERVICE MANUAL

TRANSMISSION AND NOISE MEASURING SET MODEL 3555B

Serial Number: 0992A-03537

Appendix C, Manual Backdating Changes, adapts this manual to instruments with lower serial numbers.

Manual Part No. 03555-90008
Microfiche Part No. 03555-90059

P.O. Box 301, Loveland, Colorado, 80537, U.S.A.

Printed: June 1976

HEWLETT PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment, except that in the case of certain components, if any, listed in Section I of this operating manual, the warranty shall be for the specified period. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the proper preventive maintenance procedures as listed in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

If this product is sold as part of a Hewlett-Packard integrated instrument system, the above warranty shall not be applicable, and this product shall be covered only by the system warranty.

Service contracts or customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

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SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The Hewlett-Packard Model 3555B Transmission and Noise Measuring Set is a versatile set designed for uses in testing telecommunications equipment. The extreme sensitivity of this set, linked with its wide and flat frequency response, make it suitable for noise and level measurements at voice, program and carrier frequencies. Levels from -80dBm to +31dBm (+10dBrn to +121dBrn) full-scale can be measured and displayed on a meter calibrated to indicate both in dBm for level measurements and in dBrn for noise measurements.

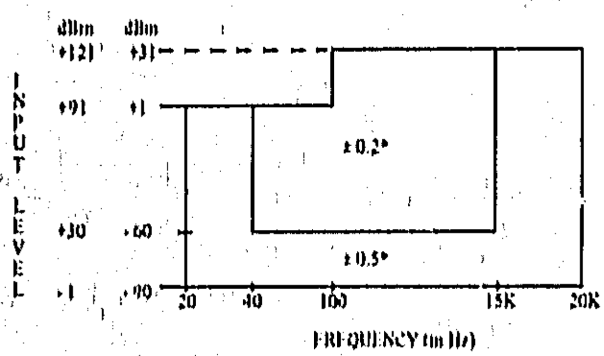
1-3. The set combines the features of a voice and noise frequency measuring set and the features of a carrier frequency measuring set. For voice and program frequencies impedances of 900 ohms and 600 ohms are provided, balanced or unbalanced, bridged or terminated. For noise measurements a noise-to-ground (Ng) function is provided which provides 40dB of attenuation for longitudinal noise. For carrier frequencies 600 ohm, 135 ohm and 75 ohm impedances are provided. The 600 and 135 function can be either balanced or unbalanced, bridged or terminated. The 75 function is unbalanced only. Bridging impedance is over 100 kilohms, allowing measurements with a bridging loss of less than 0.05dB. The meter indicates in dBm for any selected input impedance.

1-4. The 3555B includes a 3kHz flat, a C-Message, a Program and a 15kHz flat filter, each easily selectable by a front panel control. These filters conform to the standards set up by the Bell System and Edison Electric Institute. Other filters are available upon request.

Table 1-1. Specifications.

VOICE-FREQUENCY MEASUREMENTS (VF/Nm)

Amplitude Accuracy:



*With HOLD on, accuracy only specified from 100 Hz to 4 kHz.

Longitudinal Balance: > 80 dB at 60 Hz
> 70 dB from 20 Hz to 6 kHz
> 50 dB from 6 kHz to 20 kHz

Bridging Loss: < 0.3 dB at 1 kHz

Balanced Impedances:
600 ohm, Return loss > 30 dB (50 Hz to 20 kHz)
900 ohm, Return loss > 30 dB (50 Hz to 20 kHz)

Weighting Filter Frequency Response:

3 kHz FLAT

Frequency in Hz	dB ref to 1 kHz
60	0 ± 1.75
250	0 ± 1
1 K	0
2 K	-.5 ± 1.75
2.5 K	-1.5 ± 2
3 K	-3.0 ± 3
6 K	-14.5 ± 3

15 kHz FLAT

Frequency in Hz	dB ref to 1 kHz
60	0 ± 1.75
250	0 ± 1
1 K	0
5 K	0 ± 1
10 K	-.5 ± 1.75
12.5 K	-1.5 ± 2
15 K	-3.0 ± 3
20 K	-7.0 ± 3

C-MESSAGE

Frequency in Hz	dB ref to 1 kHz
60	-55.7 ± 2
200	-25.0 ± 2
500	-7.5 ± 1
600	-4.7 ± 1
1 K	0
2 K	-1.3 ± 1
2.5 K	-1.4 ± 2
3 K	-2.5 ± 2
3.3 K	-5.2 ± 2
4 K	-14.5 ± 3
5 K	-28.5 ± 3

PROGRAM

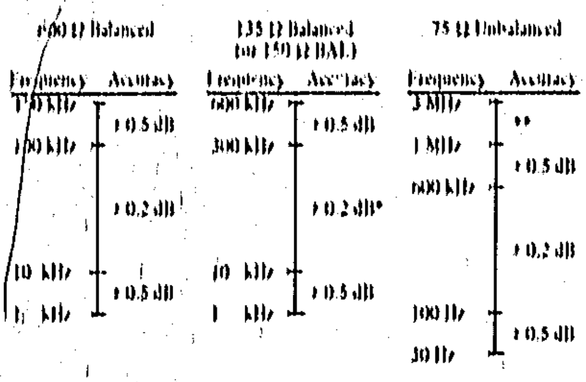
Frequency in Hz	dB ref to 1 kHz
200	-17.3 ± 2
500	-6.6 ± 1
1 K	0
2 K	+4.8 ± 2
4 K	+6.5 ± 2
5 K	+6.5 ± 2
6 K	+6.4 ± 3
8 K	+4.0 ± 3
10 K	-8.5 ± 4

Table 1-1. Specifications (Cont'd).

CARRIER-FREQUENCY MEASUREMENTS

Input Levels: -61 dBm to +11 dBm (-50 dBm to +10 dBm RANGE switch settings)

Amplitude Accuracy:



*Accuracy of 135 Ω (or 150 Ω) balanced is ± 0.5 dB when 3555B is powered from ac line.

**Accuracy of 75 Ω unbalanced from 1 MHz to 3 MHz is: ± 0.5 dB plus ± 10% of meter reading in dBm. Example:
RNG -50 dBm, meter 0 dBm, specification: -50 ± .5 dBm
RNG -50 dBm, meter -5 dBm, specification: -55 ± 1 dBm

Longitudinal Balance: > 70 dB from 1 kHz to 10 kHz
> 60 dB from 10 kHz to 100 kHz
> 40 dB from 100 kHz to 600 kHz

Bridging Loss: < 0.05 dB at 1 kHz

Unbalanced Impedance:
75 ohm, Return loss > 30 dB (30 Hz to 3 MHz)

Balanced Impedances:
135 ohm, Return loss > 26 dB (1 kHz to 600 kHz)
600 ohm, Return loss > 26 dB (1 kHz to 150 kHz)

Table 1-2. General Information.

Hold Circuit: Operable in Voice Frequency and Noise Measurement mode only (VF/Nm).
INPUT switch must be in TERM.
Applied loop currents of over 60 mA dc will degrade accuracy specifications.
Hold coil used; ≈ 10 henry, dc resistance 700 Ω ± 5%.

Weighting Filters: Meet joint requirements of Edison Electric Institute and Bell Telephone System.

Crest Factors: Crest factors up to 4:1 are acceptable (See Paragraph 3-24).

Noise to Ground Measurements (Ng):
Input Impedance
80 K ohms Tip to Ring
100 K ohms Tip or Ring to ground
Accuracy: ± .5 dB plus accuracy of NOISE WTG filter used. Readings are 40 dB low relative to 600 Ω metallic inputs, i.e. a reading of 40 dBrn on the 3555B indicates that the Noise to Ground ≈ 80 dBrn (See Paragraph 3-37).

Maximum Input Voltage:
Metallic (tip to ring): 150 V peak
Longitudinal (tip or ring to ground): ± 200 V dc plus 200 V rms.

Meter: Linear dB scale with 12 dB range. Indication proportional to rms.

Response:
Normal mode: within specs 200 ms after step input
Damp mode: within specs 500 ms after step input

AC Monitor: Nominal .275 V rms for 0 dBm indication on the meter with frequencies between 20 Hz and 1 kHz. Rout ≈ 8 kilohms. Available at DIAL/AC MON jacks. Sufficient to drive WE 1011B or type 52 headsets.

DC Monitor: Nominal 1 V for 0 dBm indication on the meter, Rout ≈ 2 kilohms. Available on 310 jack (tip negative).

Input Jacks: Will accept Western Electric (WE) 241, 309, 310 and 358 plugs. Binding posts accept banana plugs, spade lugs, phone tips, or bare wires.

Dial/AC Monitor Jacks: Will accept WE 289, 310 and 347 plugs. Accepts WE 1011B lineman's handset or type 52 headsets.

Temperature Range: Specifications apply from 0°F to 120°F between 0 and 95% relative humidity. Instrument will operate to -40°F.

Power Requirements:
Internal Battery: single NEDA 202 45 V "B" battery included. Expected battery life is 180 hours at 4 hours per day at 70°F.
External Battery: 24 V or 48 V office battery. Jack accepts 310 plug TIP NEGATIVE. Current drain less than 15 mA.
AC: 115 V or 230 V ± 10%, 48 - 440 Hz, 10 VA.

1-5. A noise-to-ground (Ng) function is included which permits the measurement of longitudinal noise. When making noise-to-ground measurements the impedance between INPUT terminals is about 80 kilohms and is about 100 kilohms between each terminal and ground. A HOLD function permits holding the line while noise measurements are being made. The input circuitry provides 40 dB of longitudinal noise attenuation when noise-to-ground measurements are being made.

1-6. A DIAL/BAT function permits connecting a lineman's handset to the line for the purpose of dialing and at the same time connects the front panel meter to the power supply so that the battery voltage or unregulated power supply voltage can be monitored.

1-7. Jacks accepting Western Electric type 241, 309, 310, 347, and 358 plugs are provided for INPUT connections to the 3555B. Dual binding posts accept banana plugs, wires, lugs or phone tips and a special connector permits the attachment of clip leads from a lineman's handset.

1-8. The Model 3555B can be operated from either the internal 45V dry cell battery or from the ac line, 115 or 230Vac, 48Hz to 440Hz. A special device is included in the cover to automatically turn the set off when the cover is replaced. The set can also be operated from the central office battery. A jack is provided on the side of the set for this purpose.

1-9. ACCESSORY EQUIPMENT SUPPLIED.

1-10. The accessory equipment supplied with the Model 3555B is listed in Table 1-3.

1-11. INSTRUMENT IDENTIFICATION.

1-12. Hewlett-Packard uses a two-section serial number. The first section (prefix) identifies a series of instruments.

Table 1-3. Accessory Equipment Supplied

-hp- Part No.	Description	Quantity
8120-1518	Power Cord	1
1420-0026	Battery, 45 Volt dry cell	1
03555-26510	Test Board (inside case)	1
5000-7135	Decal, 150 BAL	1

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 compatable with newer instruments or the backdating information in Appendix C will adapt this manual to earlier instruments. All correspondence with Hewlett-Packard should include the complete serial number.

1-13. 150 BAL MODIFICATION.

1-14. The Model 3555B is shipped from the factory with a 135 BAL function. If a 150 BAL function is desired instead of the 135 BAL function, the set can be converted by simply clipping a shorting wire within the set, applying a 150 BAL decal (supplied with the set) over the 135 BAL decal and making only one adjustment.

1-15. For detailed instructions on modification of the set refer to Paragraph 5-6. If your set is known to be within specification tolerances a simplified procedure can be used to modify the set and is described in Paragraph 3-69.

1-16. WARRANTY EXCEPTION.

1-17. The battery supplied with the 3555B is warranted for a period of 60 days, beginning at the time of receipt of the set. This warranty is based on an expected battery life of 180 hours at 4 hours per day to 70°F as specified in Table 1-2 in this Manual.

SECTION II
INSTALLATION

2-1. INSPECTION.

2-2. The set was carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect electrical condition on receipt. To confirm this, the set should be inspected for physical damage in transit, for supplied accessories and for electrical performance. Paragraph 5-7 outlines the electrical performance checks using test equipment listed in Table 5-1. If there is damage or a deficiency, see the warranty in the front of this manual.

2-3. WARRANTY EXCEPTION.

2-4. The battery supplied with the 3555B is warranted for a period of 60 days, beginning at the time of receipt of the set. This warranty is based on an expected battery life of 180 hours at 4 hours per day to 70° F as specified in Table 1-2 in this Manual.

2-5. POWER REQUIREMENTS.

2-6. This set is designed to operate from an internal 45 volt dry cell battery, an external 24 to 48 volt CO battery or from an ac power source (115/230V, 48 to 440Hz). The power source is selected by the AC/BAT switch on the side of the set. The line voltage is selected by the 115/230 volt slide switch on the rear of the set. The set is protected by a 0.15A slow-blow fuse.

2-7. THREE-CONDUCTOR POWER CABLE.

2-8. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the panel and cabinet be grounded. This set is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the set. The offset pin on the power cable three-prong connector is the ground wire. This power cable is detachable from the set and is stored inside the front cover.

2-9. Figure 2-1 illustrates the standard power plug configurations that are used throughout the United States and in other countries. The -hp- part number shown directly above each plug drawing is the part number for a 3555B power cord equipped with the proper plug. If the appropriate power cord is not included with the instrument, notify the nearest Hewlett-Packard office and a replacement cord will be provided.

Table 2-1. Suitable Batteries Meeting NEDA 202 Specifications

Manufacturer	Mfr. Part No.
Hewlett-Packard	1420-0026
Western Electric	KS-14370
Military	BA-59
Eveready	482
Burgess	M-30
RCA	VS013
Bright Star	3033-158, 30-33
Mallory	M-202
Ray-O-Vac	202, P7830
Sears	6461
Wards	42
Wizard	3B6241
Zenith	2783
General	W30B
Marathon	4202
National Carbon	482

2-10. BATTERY.

2-11. This set is operated from a single NEDA 202 45V dry cell internal battery or an external 48V CO battery when the power selection switch, on the side of the case, is in the DIAL/BAT position. Inserting a Western Electric plug into the battery jack disconnects the internal battery. (See Table 2-1 for batteries suitable for use in this instrument.

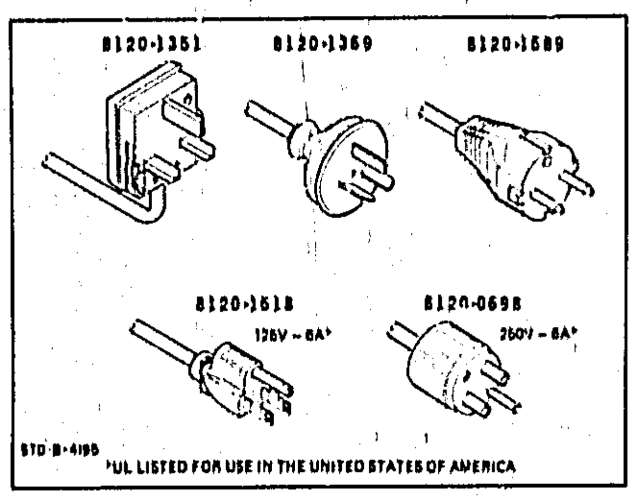


Figure 2-1. Power Plugs.

2-12. INSTALLATION AND REMOVAL OF BATTERY.

2-13. To install or replace a battery, turn the four 1/4 turn fasteners on the battery cover on the rear of the case counterclockwise to remove the cover. Lift off the cover, lift the battery out of its recess and unplug the three-prong connector.

2-14. Reverse the above procedure when installing a new battery.

2-15. COVER REMOVAL.

2-16. To remove the cover from the instrument, release the two spring latches on either side of the instrument, then lift cover. When replacing the cover, first check the latches for released position; then place cover in position for latching. The power cord is stored inside the cover by wrapping it around the retainer fastened inside the cover.

CAUTION

DO NOT FORCE COVER INTO PLACE. THERE IS A PROJECTION ON THE COVER WHICH TURNS THE POWER SWITCH TO THE OFF POSITION TO PRESERVE BATTERY LIFE. IF THIS IS NOT BINDING, THE COVER FITS EASILY INTO PLACE.

2-17. REPACKAGING FOR SHIPMENT.

2-18. The following is a general guide for repackaging an instrument for shipment. If you have any questions, contact your local Sales and Service Office. (See Appendix for locations.)

a. Place instrument in original container if available. If not available, one can be purchased from your nearest -hp- Sales and Service Office.

b. Wrap instrument in heavy paper or plastic before placing in inner container.

c. Use plenty of packing material around all sides of instrument.

d. Use a heavy carton or wooden box to house the instrument and inner container and use strong tape or metal bands to seal the shipping container.

e. Mark shipping container with "Delicate Instrument" or "Fragile".

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 3555B Transmission and Noise Measuring Set is an extremely versatile transmission and noise measuring set which satisfies many of the requirements in testing telecommunications equipment. The 3555B features a choice of 900 or 600 ohms bridging or terminated for voice frequencies and 600, 135 or 75 ohms bridging or terminated for carrier frequencies. Noise-to-ground and noise Metallic may be measured with 3 kHz Flat, C-Message, Program, or 15 kHz Flat weighting. A HOLD function permits seizing the line while measurements are being made at voice and program frequencies. The set is portable and operates from the internal battery, office battery or ac power source.

3-3. This section of the manual contains all the information necessary in the operation of the 3555B along with a description of all controls, connectors and indicators.

3-4. CONTROLS, CONNECTORS AND INDICATORS.

3-5. Figure 3-1, 3-2 and Table 3-1 illustrate and describe the function of all front and side panel controls, indicators and connectors.

3-6. OPERATION.

3-7. To operate the Model 3555B, refer to figure 3-1 and perform the following steps:

a. Before connecting the 3555B to an ac power source, insure that the 115/230 volt switch located on the rear panel is positioned to indicate the line voltage to be used. Some earlier instruments did not have the 115/230 volt selector switch. To change these instruments, jumper wires must be changed on the power transformer. Refer to Appendix C for a wiring diagram of the two configurations.

b. If the set is to be operated from the internal battery or from an external office battery, place the AC/BAT switch (located on the side of the set) to the BAT position using a small pointed object; if the set is to be operated from the ac line, place the AC/BAT switch to the AC position. For operation from a 24 or 48V office battery, connect a patch cord with a Western Electric 310 plug to the battery jack on the side of the case and then connect the cord to the office battery on the test board or bay. Inserting the plug disconnects the internal battery. The office battery is arranged for -48V or -24V ±2V with the negative terminal of the battery connected to the tip and the ground terminal connected to the sleeve. Current consumption by the 3555B is approximately 15mA.

WARNING

DURING BATTERY OPERATION, THE "G" BINDING POST MUST BE CONNECTED TO EARTH GROUND.

CAUTION

THE CORD MUST BE CONNECTED TO THE MEASURING SET BATTERY JACK FIRST AND THEN PLUGGED INTO THE BATTERY SUPPLY TO AVOID SHORTING THE OFFICE BATTERY TO GROUND.

c. Turn the POWER switch to ON and depress the DIAL/BAT pushbutton on the FUNCTION switch. The meter pointer should indicate in the BAT GOOD area indicating that the battery condition is good if the set is being operated from the internal battery. The meter will also monitor the ac supply voltage or the external office battery voltage, providing an indication of low voltage should it exist. The voltage should cause meter deflection above the lower end of the green BAT GOOD area for proper set operation.

3-8. BATTERY.

3-9. The internal dry cell battery has a voltage range between 45 volts when new to 24 volts at cut-off which is the end of useful life. The cut-off voltage corresponds to the left end of the green BAT GOOD area on the meter. The condition of the battery and the approximate time to cut-off can be estimated by observing the position of the meter pointer in the BAT GOOD area.

3-10. The internal battery is of the carbon-zinc type with its attendant limitations due to temperature. The service obtained from carbon-zinc batteries depends on factors such as current drain, discharge temperature, discharge time and storage prior to use. The battery supplied with the 3555B should provide in excess of 180 hours of operation based on a 4 hours/day duty cycle at 70° F (21° C). At other temperatures this time will change. At temperatures above 131° F (55° C) the batteries may fail suddenly while at temperatures below -40° F (-20° C), the service life will be short.

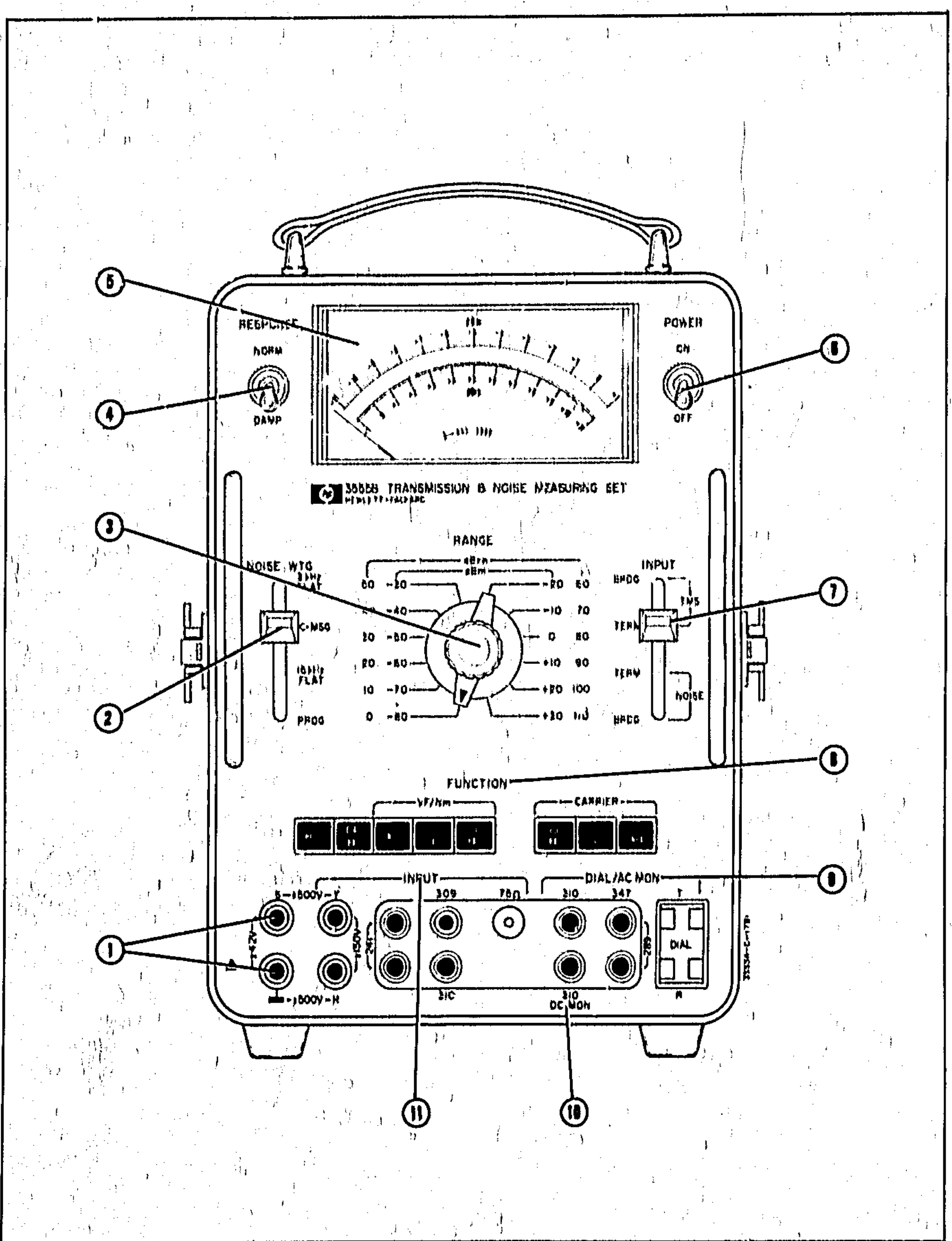


Figure 3-1. Front Panel Controls, Indicators, and Connectors

Table 3-1. Front, Side and Rear Panel Controls, Indicators and Connectors

(1) S and G Jacks: Binding posts accepting banana plugs, spade lugs, phone tips or bare wires for connection to the case ground (⊥) and sleeves (S) of all INPUT jacks (11) and DIAL/AC MON jacks (9) and (10). The black binding post (⊥) must be connected to earth ground during battery operation.

(2) WTG Switch: Selects weighting filters for noise measurements. These filters are selectable only when the INPUT switch is in one of the two NOISE positions. The 3kHz FLAT, C-MSG, 15kHz FLAT and PROG filters all conform to the standards set up by the Bell System and Edison Institute for measuring message circuit noise.

(3) RANGE SWITCH: Selects dBm or dBrn ranges of input sensitivity. The RANGE switch markings correspond to the 0 markings on the meter scale (5). The black markings are dBm for transmission measurements and the blue markings are dBrn for noise measurements. Note 0 dBm = 90 dBrn.

(4) RESPONSE Switch: Selects NORM meter response for transmission level measurements or DAMP for noise measurements where noise is impulsive in nature.

(5) Meter: A taut band individually calibrated meter with shaped pole pieces to provide a linear dBm indication with equal accuracy and resolution over the entire meter scale. The dBm scale is marked in black and has 0.1dB resolution for transmission measurements. The 0 marking at the right end of the scale corresponds to the black RANGE switch setting. The dBrn scale is marked in blue for noise measurements. The 0 marking at the left end of the scale corresponds to the blue RANGE switch setting. The green arc marked BAT GOOD corresponds to the green DIAL BAT pushbutton for checking the power source. The left edge of the arc corresponds to the battery cut-off voltage of 24 volts and the right edge (meter full-scale) represents 60 volts which is the maximum voltage that can be used to power the set without internal damage.

(6) POWER ON/OFF Switch: turns on all power to the set. The set operates from either 115 volts or 230 volts ac, the internal 45 volt dry cell battery or from an external office battery supply.

(7) INPUT Switch: Selects TMS, either BRDG or TERM for transmission measurements and NOISE, either BRDG or TERM for noise measurements. For noise measurements the switch must be in either the NOISE BRDG or the NOISE TERM before the NOISE WTG filters can be selected.

(8) FUNCTION Switch: A series of interlocking pushbutton switches (with the exception of the HOLD switch which is push push type) with the following functions:

a. VF/Nm

1. HOLD: Applies a dc holding bridge across the metallic line for the NG, 900 and 600 functions. The HOLD pushbutton is the push-push type, ie, push to make and push to break. The HOLD function cannot be accomplished when any one of the CARRIER pushbuttons is depressed.

2. DIAL/BAT: Connects the multiple INPUT jacks in parallel with the DIAL/AC MON jacks for the dial and talk operation. The circuit is arranged for loop dialing and the line under test must supply talk battery. Connects the meter circuit and a load to the internal power supply to check the condition of the battery, ac power or external office battery as indicated on the green meter scale. POWER (6) must be ON for this test.

3. Ng: Selects the noise-to-ground input circuits for measuring longitudinal noise. Attenuation of 40 dB is inserted by this circuit. Earth ground must be connected to the black binding post ⊥.

4. 900 BAL: Selects the input circuitry for balanced 900 ohm circuits. This function selects a low frequency transformer for voice frequencies. Response of this transformer is 20 Hz to 20 kHz.

5. 600 BAL: Selects the input circuitry for balanced 600 ohm circuits. A low frequency transformer is selected for this function.

b. CARRIER

1. 600 BAL: Selects the input circuitry for balanced 600 ohm circuits. A high frequency transformer is selected for this function. Response of this transformer is 1 kHz to 600 kHz. The HOLD function is not operative in any of the carrier functions.

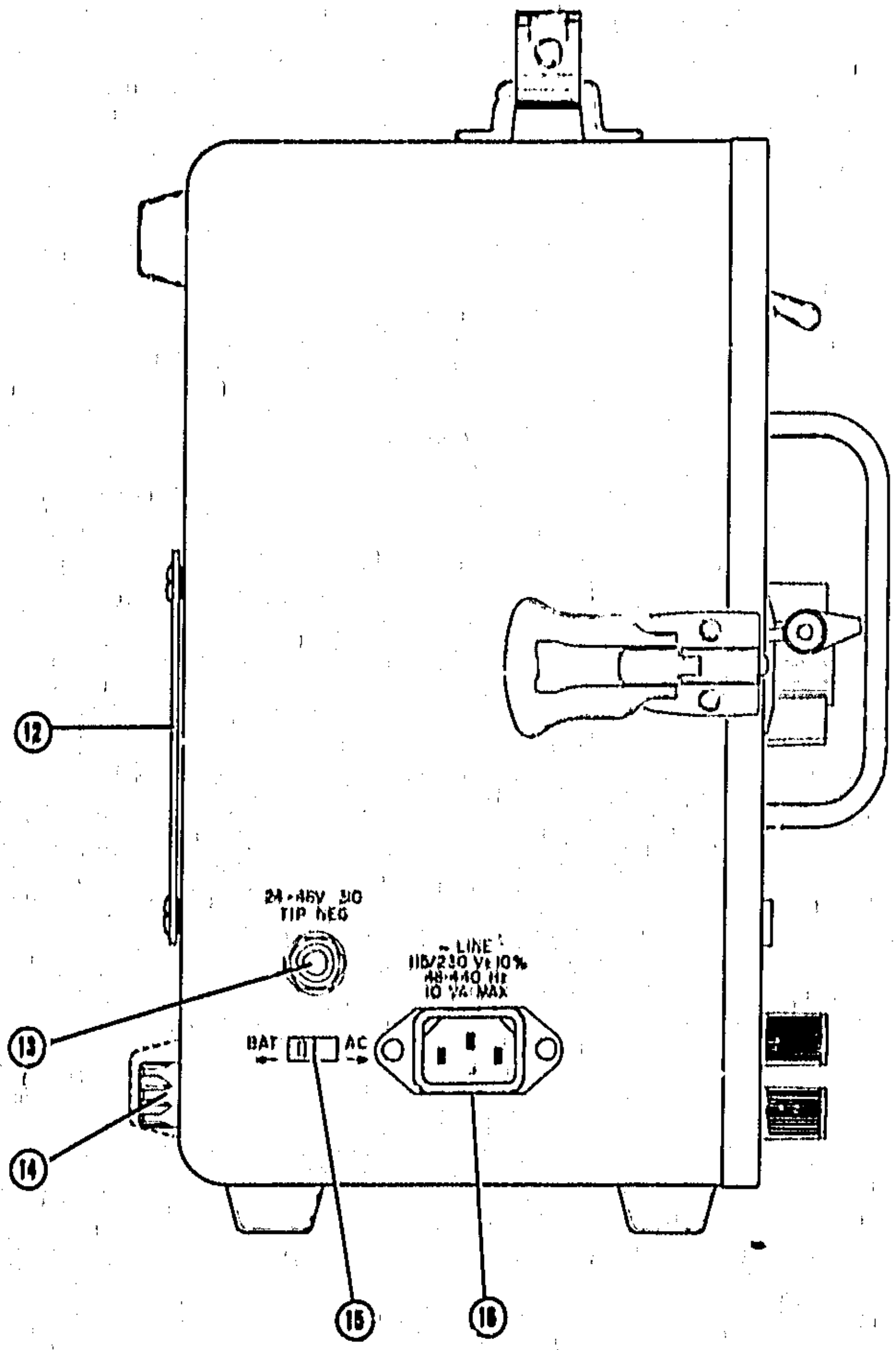


Figure 3-2. Side Panel Controls and Connectors

Table 3-1. Front, Side and Rear Panel Controls, Indicators and Connectors (Cont'd)

2. 135 BAL: Selects the input circuitry for 135 ohm balanced circuits. A high frequency transformer is selected for this function.

3. 75 UNBAL: Selects the input circuitry for 75 ohm unbalanced operation. Only the 75 ohm jack can be used for this function. This function does not utilize an input transformer, therefore the maximum bandwidth is available on this function. This jack accepts a 358 plug.

(9) DIAL/AC MON: A set of multiple jacks accepting Western Electric type 310 or 347 plugs, 289 dual plugs and a special dial connector marked T and R which accept a Western Electric 1011B lineman's handset for the dial and talk operation when the FUNCTION pushbutton marked DIAL/BAT is depressed. Loop dialing is used and the circuit must supply talk battery. When any other FUNCTION pushbutton is depressed, the tip and ring of these jacks are connected to the AC MON output of the internal amplifiers for monitoring purposes.

(10) DC MON: Accepts a Western Electric 310 or 347 plug for tip negative and sleeve connections to an external dc recorder. Output voltage is proportional to the input voltage on any one setting of the RANGE switch.

(11) INPUT: A set of multiple jacks accepting Western Electric 241 (or 289), 309, 310 and 358 plugs and a pair of binding posts marked T and R for banana plugs, spade lugs, phone tips or bare wires providing connection to the input circuitry of the measuring set. When the DIAL BAT pushbutton is depressed, the INPUT jacks are connected in parallel with the DIAL/AC MON jacks.

(12) Battery Cover: Removable by four 1/4 turn screw fasteners to expose the internal battery for replacement.

(13) 24 - 48 V 310: A jack accepting a Western Electric 310 plug with tip negative and sleeve ground to supply external office battery power to the set. Insertion of a 310 plug into this jack disconnects the internal battery. The BAT-AC switch (15) must be set to BAT for office battery operation.

CAUTION

WHEN OPERATING FROM AN EXTERNAL BATTERY, CORD SHOULD BE CONNECTED TO MEASURING SET FIRST, THEN PLUG INTO BATTERY SUPPLY TO AVOID SHORTING THE OFFICE BATTERY.

(14) 0.15A-SPARE Fuse: A 0.15A slo-blo fuse and a spare for measuring set protection when operating from AC power. Fuses are not used when the set is battery powered.

(15) BAT-AC Switch: A slide switch for selecting the ac power source or the internal battery and office battery jack, (13), power source. The switch may be operated by a small screwdriver or pointed tool inserted into the slot in the switch.

(16) AC Power Receptacle: A 3 prong power receptacle for the special power cord stored inside the front cover. The BAT-AC switch (15), must be positioned to AC for this power source.

3-11. High storage temperature is damaging to dry cells and tends to reduce shelf life. Low storage temperature is beneficial to battery life although the battery should be warmed to room temperature prior to use. Turning off the set when not in use and consideration of the above factors will maximize battery life. The instant turn-on characteristics of this set with no warm-up time required allows turning off between measurements.

NOTE

If the battery voltage indication drops below the left end of the arc on the meter face the set will not operate properly. This will be noted by a slow oscillation of the meter. If this symptom is encountered, depress the DIAL/BAT pushbutton and check the battery condition. If the indication is to the left of the arc on the meter face, replace the battery.

3-12. LEVEL AND NOISE MEASUREMENTS.

3-13. Since the 3555B is both a level measuring set and a noise measuring set, the procedure for making these measurements will be treated separately. Level measurements can be made at voice frequencies and carrier frequencies. Since the procedures for making voice and Carrier level measurements are identical except for the FUNCTION pushbutton utilized, only one procedure will be described in detail.

3-14. LEVEL MEASUREMENTS.

3-15. The 3555B can be used as a wide range and wide frequency Transmission Measuring Set (TMS) for voice, program and carrier multiplex measurements. The set will operate over a wide range ironmental conditions and maintain a high degree of

3-16. In general, transmission surements are made by connecting the circuit under test to the INPUT jacks with a suitable patch cord, selecting the proper bridging or terminate condition and impedance, and then operating the RANGE switch to provide an on-scale meter indication. Transmission level measurements are made with the INPUT switch in TMS position either bridging or terminated. In this position, the set has its maximum frequency range.

3-17. The multiple INPUT jacks and binding posts accept the Western Electric 309, 310 and 358 single plugs and the 241 or 289 twin plug. The two red binding posts marked T (tip) and R (ring) will accept banana plugs, spade lugs, phone tips or bare wires. These jacks and binding posts are all connected in parallel and only one should be used at a time. A patching cord such as the Western Electric 3P12H, consisting of a cord with a 310 plug on one end and a 309 plug on the other end, should be kept with the instrument as a universal patch cord. The 75 ohm jack accepts Western Electric type 358 plugs for 75 ohms unbalanced carrier measurements.

3-18. The sleeves of all the INPUT jacks are connected together and to the gray binding post marked S. Note that the 75 Ω INPUT jack does not have a "sleeve". The outer part of this jack connects to the black binding post . Type 347 plugs must not be used unless the gray binding post (s) is connected to the black binding post (⊥).

3-19. The Multiple jacks marked DIAL/AC MON are connected in parallel and accept a 310 or a 347 single plug or a 289 dual plug. A dial with the impulse springs connected to the tip and ring of a 310 or 347 plug may be used or a lineman's handset such as the Western Electric 1011B may be connected to the DIAL terminal for the dialing and talk operation. When the FUNCTION pushbutton marked DIAL/BAT is depressed, the DIAL jack is connected to the INPUT jacks and a number may be dialed on the line connected to the INPUT jacks. The circuit is arranged for loop dial operation and the circuit under test must supply talk battery.

3-20. Once the switching equipment has been seized by the dialing operation, the connection can be held by depressing the HOLD pushbutton. This places a dc bridge consisting of a high impedance retardation coil, across the INPUT terminals. This coil has negligible effect on measurements of voice frequencies. Once any other pushbutton is depressed, the AC output of the internal amplifier circuit is returned to the DIAL/AC MON jacks for an external head phone which can be used to monitor the noise or tones being measured. The lineman's hand set which was used for the dialing operation can be used for monitering by leaving it connected to the DIAL terminal. The jack marked 310 will accept a head phone or recorder connected to the tip and ring of a 310 plug or tip and sleeve of a 347 plug. The performance of the set is not affected by this output and any impedance head-phone may be used.

3-21. The DIAL/BAT function also checks the power source used. The green arc on the meter marked BAT GOOD corresponding to the green BAT marking on the pushbutton, indicates the range of voltages for proper operation. Full scale corresponds to 60 volts and the left end of the arc corresponds to the battery cut-off voltage of 24 volts. Thus the remaining battery life can be estimated by noting the position of the pointer in the green arc. Since the set POWER must be turned ON to perform this check, the battery is properly loaded to give a true indication of its condition. When operating from the external office battery or AC power, the meter monitors this voltage to indicate if it is the correct level to properly power the set. The POWER switch turns OFF and ON all power to the set.

3-22. The remaining FUNCTIONS are used to set up the input conditions. The Ng function will be discussed under the paragraph heading, "NOISE MEASUREMENTS". The impedance of the set is selected by the pushbuttons marked 900 and 600 for voice frequencies and 600, 135 and 75 for carrier frequencies. The 900 and 600 ohm impedances are normally used for loop plant testing while 600, 135 and 75 ohms are usually reserved for carrier system measurements. A bridged or terminated condition is determined by the position of the INPUT switch. Using this procedure, the meter will always indicate in dBm for the impedance selected, bridging or terminated. The terminations, when used, are provided with a dc blocking capacitor. Accidental application of carrier or telegraph battery, office battery or ringing voltage will not damage the set. The pushbutton marked HOLD bypasses the INPUT switch and terminates the circuit in addition to placing the holding bridge across the line that is connected to the INPUT. When the INPUT switch is in either of the NOISE positions, weighting filters can be selected by the NOISE WTG switch for noise measurements.

3-23. The RANGE switch selects the dBm range of the meter. To avoid overloading the set, turn the RANGE switch to +30dBm when connecting a circuit for testing. Once the circuit connection is established turn the RANGE switch counterclockwise until an on-scale indication is obtained. The black dBm marking on the RANGE switch identifies the input level required to deflect the meter to the 0 mark on the black scale. The meter uses shaped pole pieces to present linear dBm markings on the scale with marks at 0.1dBm increments. The accuracy and resolution of this type of meter is the same at any point on the scale and it is not necessary to keep the pointer in the upper portion of the scale for maximum accuracy. The accuracy of the set is not affected by the position of the set. This type of meter will have the pointer off-scale to the left when no input signal is present and a mechanical zero adjust is not required. The actual input level to the set is the algebraic sum of the black dBm meter scale and black RANGE setting. For example, RANGE is set to -40dBm and the meter indicates -6.3dBm. The input level is then (-40) + (-6.3) = -46.3dBm. If the RANGE switch is at +20dBm and the meter indication is -4.7dBm, the level is (+20) + (-4.7) = +15.3dBm.

3-24. All panel markings corresponding to the proper dBm markings on the RANGE switch and meter face are in black, as is the TMS position of the INPUT switch. The blue markings correspond to the settings for noise measurements as discussed in Paragraph 3-28. The response of the meter rectifier circuit is proportional to RMS which allows the set to measure the true power of any arbitrary input waveform provided the crest factor does not exceed 4:1. Crest factor is defined as the ratio of the peak value of the waveform to the RMS value of that waveform. In most telephonic measurements, consideration of this crest factor is not necessary.

3-25. The balanced input to the set is achieved through the use of two repeat coils, one for voice frequencies from 20 Hz to 20 kHz and the other for carrier frequencies from 1 kHz to 600 kHz. The maximum high frequency range is achieved through the use of the 75 ohm functions and the 75 ohm jack. This input bypasses both input repeat coils, thus allowing measurements from 30 Hz to 3 MHz. The maximum longitudinal input voltage is 150 volts peak between tip and ring and 200 volts rms plus ± 200 V dc between either tip or ring and ground.

3-26. The switch marked RESPONSE determines the speed of the meter response and is usually left in the NORM position for transmission measurements.

3-27. The jack marked DC MON accepts a Western Electric 310 or 347 plug with connections to the tip and sleeve. The dc voltage supplied by this jack can be used to operate a dc potentiometric recorder requiring 1V or a dc galvanometric recorder requiring 500uA. The dc output is proportional to input level on any one range and not meter deflection since the meter is logarithmically scaled. Knowing the current required to drive the recorder full scale and the input impedance of the recorder, enter these numbers into the recorder compatibility chart Figure 3-4 to determine if the recorder is suitable for use with this set. If these numbers do not fall within the compatibility area, refer to Paragraph 3-41. Connect an input voltage to the set and adjust the RANGE switch until a near full scale indication is observed on the meter. Connect the recorder plug with the tip negative to the DC MON jack and adjust the input level until the meter indicates 0dBm. Mark this point, which should be near full scale, on the recorder paper. Decrease the input level until the meter indicates -1dBm. Mark this point on the recorder paper. Continue until the recorder has been calibrated for each major dBm division on the meter. The actual input level to the set as indicated on the recorder will be the algebraic sum of the RANGE switch setting and the dB indication on the recorder.

3-28. NOISE MEASUREMENT.

3-29. One of the primary functions of this set is to measure message circuit noise, both metallic and noise-to-ground. The weighting filters built into this set are switch selected and their characteristics conform to the standards set up by the Bell System and Edison Electric Institute.

3-30. In general, noise-metallic measurements are made by connecting the circuit under test to the INPUT jacks with a suitable patch cord, selecting the proper bridging or terminate condition and impedance, selecting the proper weighting filter and operating the RANGE switch to provide an on-scale meter indication. Noise measurements involve many of the same operations as the level measurements discussed in Paragraph 3-14 and only the differences will be discussed.

3-31. Four filters are supplied for noise measurements; C-MESSAGE and 3kHz FLAT for message circuit noise measurement, a PROG and 15kHz FLAT for broadcast studio-transmitter links and telephone company program circuits. These filters are necessary to allow the measuring set to approximate the response of the human ear and give an indication representative of a person's subjectiveness to noise. The frequency response of these filters is shown in Figures 4-5 and 4-6.

3-32. Once a circuit has been connected, the RANGE switch is adjusted until the noise fluctuations appear on-scale on the meter with normal response, and a two-to-three minute observation of the pointer fluctuations is made to establish the point at which the pointer appears most of the time, disregarding the occasional high peaks. For rapidly fluctuating noise such as atmospheric static or switching noise, operate the RESPONSE switch to DAMP. In this position of the switch, the level of the most frequently occurring peaks should be read. Noise is specified in dBrn (decibels above reference noise) and the type of filter used is noted, for example, dBrnC meaning C-message weighting is used.

3-33. The noise-metallic level is the algebraic sum of the indication on the blue dBrn meter scale and the blue dBrn RANGE switch setting. For example, RANGE is set to 20dBrn and the meter indicates +7dBrn. The noise-metallic level is (20) + (+7) = +27dBrn. The RANGE switch marking indicates the level at the 0dBrn mark on the left end of the meter scale.

3-34. Occasionally other message circuit weightings such as the older Bell System F1A weighting or the International Telecommunication Union's CCITT or psophometric weighting may be required. To convert from C-message to F1A, subtract 6dBrn from the C-message indication. The units for F1A weighting are dBa, meaning decibels adjusted. To convert from C-message to CCITT or psophometric weighting, subtract 1dBm from the C-message level as read on the black dBm meter scale and RANGE switch setting. This will give the noise level in dBm which is acceptable for psophometric measurements.

3-35. As an aid in identifying the source of noise, the DIAL/AC MON jacks can be used with a monitoring receiver to listen to the noise which will have approximately the same quality as that heard by a subscriber. Particular types of noise like power line induction, switching noise, atmospheric static, crosstalk or random noise may be identified by this listening test. To aid in bringing up the level of the lower frequency power line noise, the 3kHz flat weighting is used. A substantial increase in meter indication with the 3kHz flat weighting indicates the presence of low frequency noise and it will also sound louder in the monitoring headphone.

3-36. In some cases recording of the noise during a busy period is necessary. The recorder connections and operation is discussed in Paragraph 3-27. The calibration should be done using the dBrn scale rather than the dBm scale and it should be noted that the RESPONSE switch also damps the recorder.

3-37. Noise-to-ground measurements are made by a special input circuit arrangement which is used when the N_g pushbutton is depressed. Dial and talk may be accomplished on the metallic circuit and the metallic connection held by using the HOLD pushbutton. It is necessary to establish a good earth or system ground and connect it to the black binding post marked ⊥. The noise-to-ground measurement is 40 dB less sensitive than the noise metallic measurement because of the voltage divider in the input circuit. This requires adding 40 dB to the meter indication to arrive at the correct noise-to-ground level. The level is the algebraic sum of the blue RANGE switch setting and the blue meter scale indication plus 40 dB. For example, RANGE is set to 20 dBrn and the meter indicates +3 dBrn. The noise-to-ground level is 20 + (+3) + 40 = 63 dBrn. Some telephone company operating procedures disregard the 40 dB correction factor in which case the noise-to-ground level would be 20 + 3 = 23 dBrn.

3-38. The Nm and Ng indications can be used to compute the balance of a facility since balance is defined as the degree of rejection of longitudinal signals. The degree of balance in dB where the major part of noise-metallic is due to noise-to-ground, is given by the equation, Balance in dB = Ng - Nm. For example, if the noise-metallic level of a circuit is +26 dBrn and the noise-to-ground of the same circuit is +90 dBrnC, the balance in dB is (+90) - (+26) = 64 dB. In the case mentioned above where the 30 dB correction factor is neglected, the balance in dB = (Ng + 40) - (Nm).

3-39. Other general purpose uses of the 3555B are volume and crosstalk measurements. The ballistic characteristics of the set make it approximately correct for VU measurements. The RANGE switch should be adjusted until the meter pointer fluctuations are on-scale and should be observed for the maximum of the frequently occurring peaks, disregarding the occasional high peaks. The meter indication in dBm is equal to VU (volume units.)

3-40. Crosstalk measurements involve low level measurements and part of the meter indication may be caused by noise in addition to crosstalk. The general technique is to measure with crosstalk and noise present and then measure noise alone. A correction factor must then be applied and can be found in Table 3-2.

3-41. RECORDER COMPATIBILITY.

3-42. If an external recorder is to be used to monitor the dc output of the 3555B, the Recorder Compatibility graph, Figure 3-4 should be consulted to determine if your particular recorder can be used. Recorders with input characteristics that fall below the compatibility area can be used provided a suitable resistor is used between the 3555B dc output and the recorder input.

3-43. To choose the value of this resistance, simply follow the line designating the full scale current of your recorder, horizontally until it intersects the top line in the Recorder Compatibility graph. From this intersection follow the vertical line to find the total impedance R_T required for full scale deflection (see Figure 3-3). The input impedance of the recorder should be subtracted from this value R_T to determine the value of R1. For example, assume that your particular recorder has an input impedance of 2000 ohms with a full scale sensitivity of 20uA. Follow the 20uA line to the right until it intersects the top line at 48 kilohms. The value of R1 will then be 48 kilohms -2 kilohms input impedance = 46 kilohms.

3-44. Recorders with input characteristics that fall above the compatibility area in Figure 3-4 cannot be used to monitor the 3555B dc output since full scale deflection of the recorder cannot be accomplished by the 3555B.

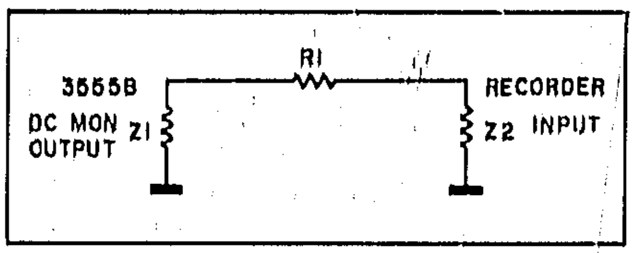


Figure 3-3. Impedance Matching 3555B to Recorder

3-45. APPLICATIONS.

3-46. Sometimes it is necessary to transmit or send a tone on a line and then measure the received signal coming back on the same line. Rather than change connections back and forth between the 3555B and 236A Oscillator when changing from SEND to RECEIVE and thus take a chance on dropping the line, it is much more convenient to make one set of connections and then select SEND or RECEIVE by means of a switch. Refer to Figure 3-5.

3-47. By utilizing the test set-up shown in Figure 3-5, send and receive can be accomplished with a minimum number of operations. To dial, set both function switches to DIAL and dial the desired line on the butt-in. To send, change the

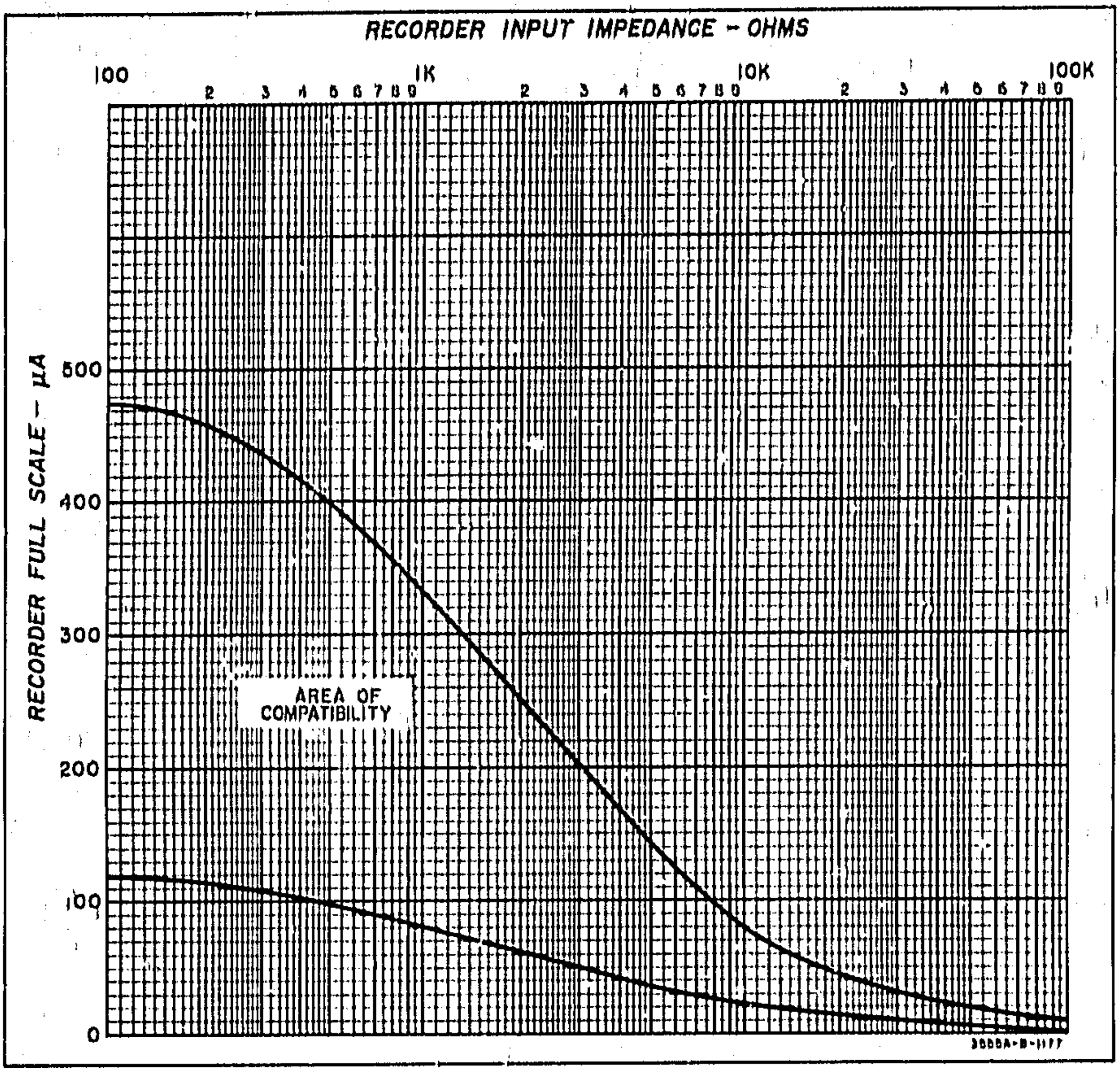


Figure 3-4. Recorder Compatibility Chart

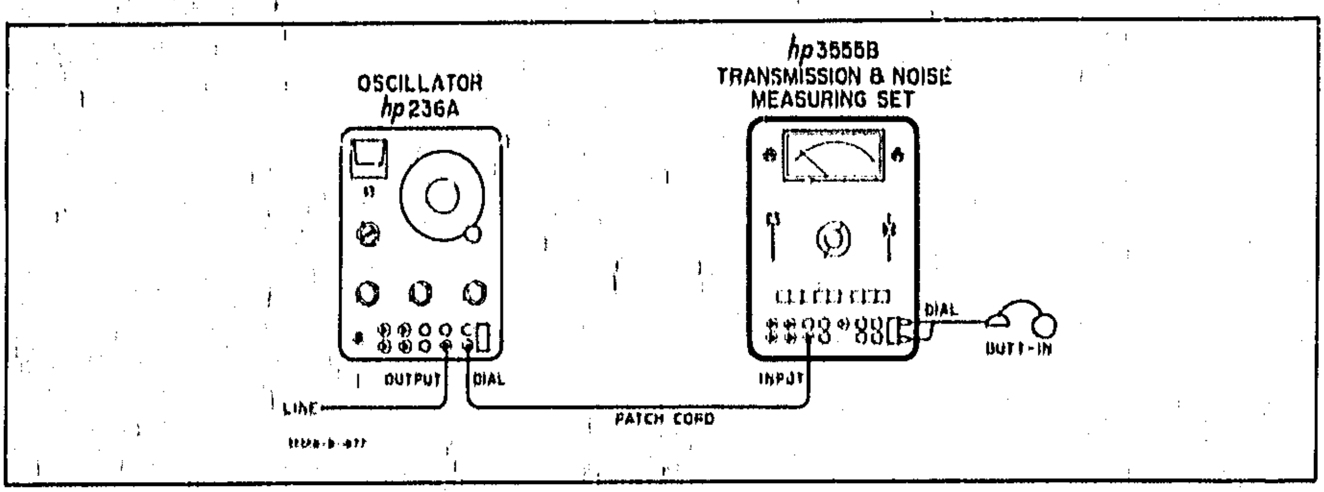


Figure 3-5. Simplified Send/Receive Test Set-up

236A FUNCTION switch to 600 HOLD or 900 HOLD, depending on the impedance required. To receive a tone, set 3555B FUNCTION switch to either 600 HOLD or 900 HOLD (whichever is appropriate) and change the 236A FUNCTION switch to DIAL. To send again, simply change the 236A to 600 HOLD or 900 HOLD. If holding is not required or dialing is not required, simply select the impedance and switch back and forth on the 236A FUNCTION switch.

3-48. TRANSMISSION LOSS MEASUREMENTS.

3-49. Transmission loss is defined as the ratio of power from a transmission line by a receiving terminal to the power available from the sending equipment and is dependent on three factors; power dissipated by the dc resistance of the line, power losses because of impedance mismatch, power transferred to other circuits by inductive or capacitive coupling. (See Figure 3-6).

3-50. These factors are difficult to measure separately. Their sum, however, is relatively easy to measure with the -hp- 236A/3555B combination.

3-51. Figure 3-6 shows a typical transmission loss measurement setup. The oscillator is adjusted for a reference level and the signal is measured at the other end of the line with a level meter. Loss measurements are usually made at various frequencies to determine the response of the line.

3-52. Ideally the man at each end of the line will have both an oscillator and a Transmission Measuring Set (TMS) so that the loss can be measured in both directions. If the line that is being tested passes through central office switching equipment, the oscillator or TMS at the remote end is placed in the DIAL mode and the lineman's handset connected to the DIAL terminal, permitting the repairman to bypass the instrument circuitry and dial his test board at the central office. Tests are then made in the 600 or 900 ohm HOLD positions, which provide a dc path to hold the switching relays.

3-53. CROSSTALK MEASUREMENTS.

3-54. Crosstalk is interference on a transmission line caused by inductive and capacitive coupling between pairs of transmission lines in close proximity. Crosstalk can be classified as near-end and far-end. Far-end crosstalk is interference at the end of the transmission line opposite the signal source while near-end crosstalk is interference detected at the same end of the line as the signal source.

Table 3-2. Crosstalk Correction Factor

(Crosstalk + Noise) in dB Minus Noise Alone in dB	dB Correction Factor Crosstalk in dB = (Crosstalk + Noise) Minus Correction Factor
1	7
2	4
3	3
4 to 5	2
6 to 8	1
9 and above	0

3-55. Since different frequency bands are used for each direction of transmission on two wire carrier systems, near-end crosstalk cannot be detected. The situation is quite different, however, for far-end crosstalk since it is in the same frequency band as the desired signal and can be detected.

3-56. Referring to Figure 3-7, one line is designated A-B and the other designated C-D, with A and C representing the near-end of one of the pairs, and B and D representing the far-end of the other pair. First measure the transmission loss between A and B. Then measure the transmission loss from A to D. The crosstalk coupling loss in dBx is the difference in the reading from A to B and the reading from A to D.

3-57. IDENTIFYING NOISE CHARACTERISTICS.

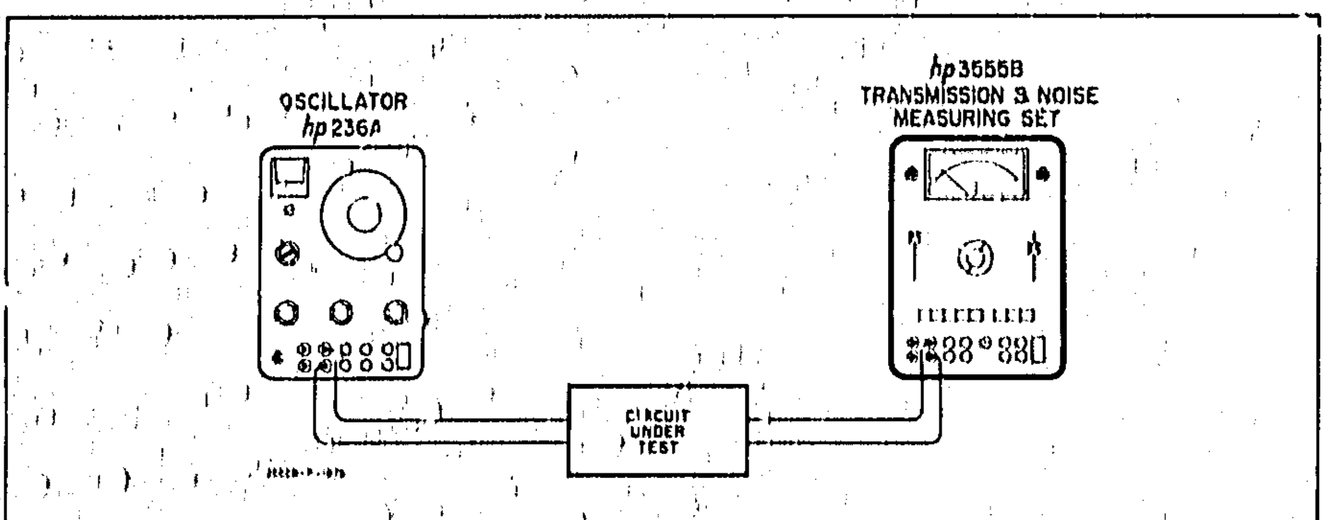


Figure 3-6. Typical Test Setup for Measuring Insertion Loss

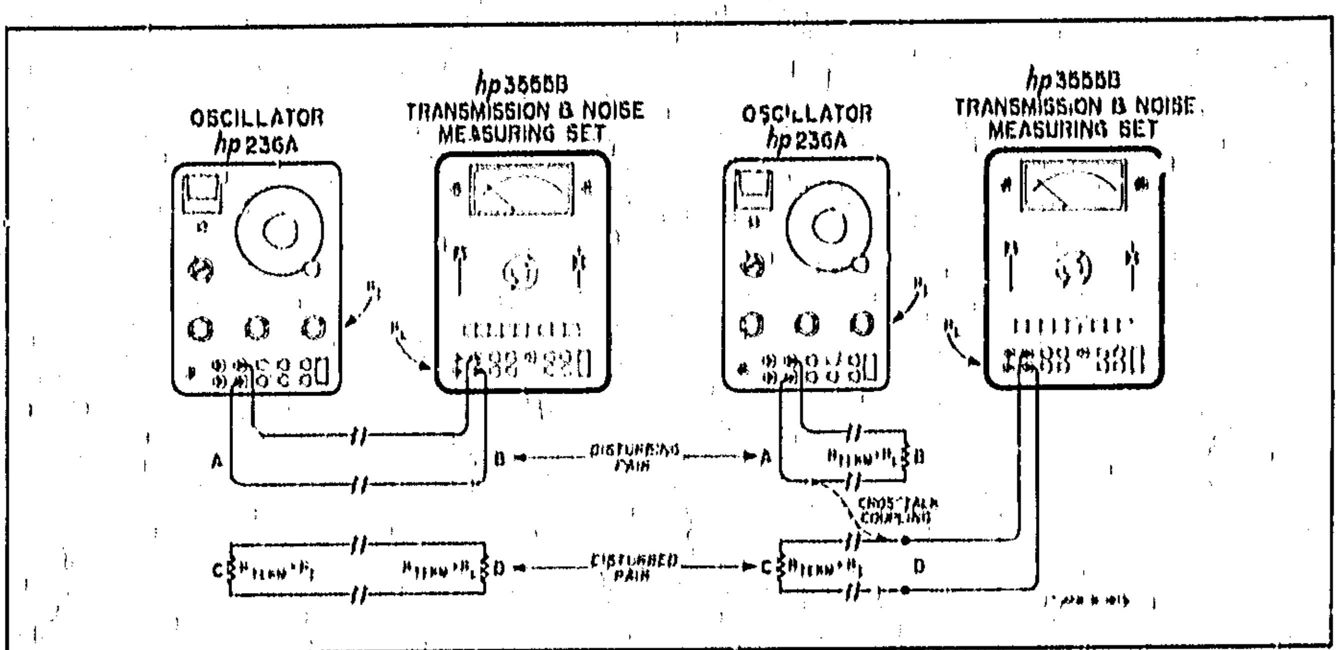


Figure 3-7 Test Setup for Measuring Crosstalk Coupling Loss

3-58. Normally, a frequency selective voltmeter is used to identify the characteristics of transmission line interference in order to trace it down to its origin and apply the appropriate corrective action. As an expedient for troubleshooting, there are several subjective measurements that the 236A/3555B can make to help identify the interference characteristics.

3-59. Since power line noise is the most common nuisance, a quick check with the 3555B should be made first. By noting the difference in noise readings between the 3kHz FLAT and C-message weighted modes, an indication of line frequency disturbance can be ascertained if the 3kHz flr mode shows a substantially higher reading.

3-60. As a further aid in identifying noise, the lineman's handset can be connected to the AC MONITOR terminals and an aural analysis made. Although the handset will not respond to 60Hz, line interference is usually very rich in odd harmonics and 180Hz can easily be identified. This test also helps to identify "babble" and other audio frequency interference.

3-61. Vagrant noise, such as atmospheric noise, can be analyzed by connecting a strip chart recorder to the DC MONITOR terminals. Long-term seasonal and temperature effects can also be measured very conveniently with a recorder.

3-62. Frequency of strong interfering periodic signals, such as radio transmitters, can be roughly determined with the 236A and 3555B. The 236A is connected to one end of the line and the 3555B to the remote end, as with transmission loss measurements. The oscillator output is increased until the test meter barely indicates a signal above the noise. The oscillator frequency is then changed very slowly while the repairman observes the 3555B for a beat. By tuning for a beat, the frequency of the interfering signal can be read directly off the oscillator frequency dial to an accuracy of approximately ± 3%. In practice, this measurement would probably be made using a "loop around" technique. The oscillator would be connected to a quiet line at the remote location and this line would be tied to the noisy line back at the central office. This permits one man to operate both the oscillator and the test meter.

3-63. When a current flows through a conductor, it sets up two distinct fields around the conductor -- the electrostatic (capacitive) field and the magnetic (inductive) field. Both are capable of inducing longitudinal voltages in adjacent conductors, and both increase in proportion to the power and frequency of the current from which they result. They differ greatly, however, in how they affect nearby circuits. The voltage resulting from magnetic induction varies inversely with the impedance of the line. That is, the higher the line impedance, the less voltage that can be induced by a magnetic field. Capacitively coupled voltage, on the other hand, increases in direct proportion to line impedance -- the higher the impedance, the greater the capacitive coupling. By means of a simple test, it is possible to identify the coupling between two lines, as shown in Figure 3-8. Since induced voltages are inversely proportional to line impedance the voltage coupled from pair A into pair B (Figure 3-8a) will increase as the impedance is lowered (i.e., shorted). Conversely, since capacitively coupled voltages are directly proportional to impedance, the coupled voltage in Figure 3-8b would increase as the impedance is increased (i.e., open circuited). Both tests in Figure 3-8 should be performed to correlate the result.

3-64. MEASUREMENTS IN DBC.

3-65. The term dBC means dB Collins and is defined as

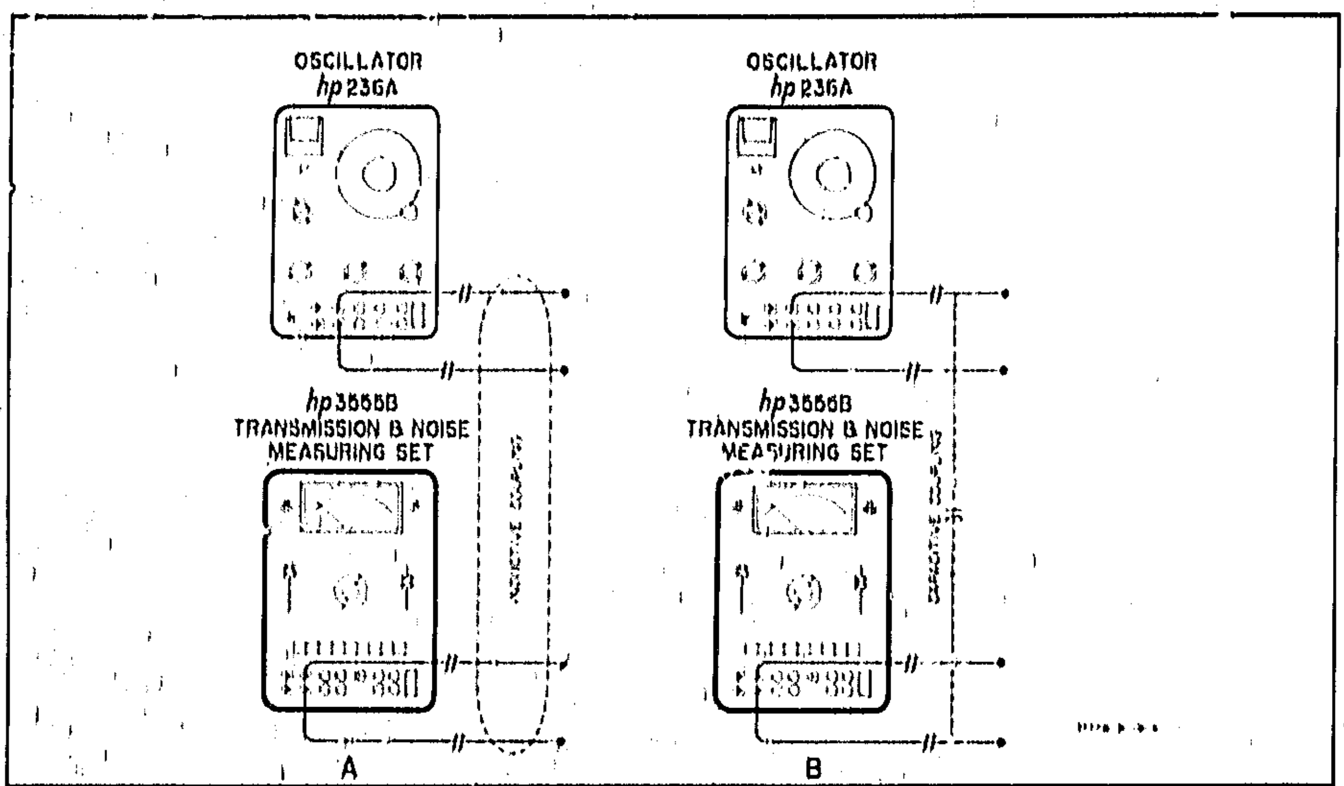


Figure 3-8. Simple Test for Inductive and Capacitive Coupling

0dBC = 0.775V across any impedance as read on an -hp- Model 400D AC Vacuum Tube Voltmeter. Thus, the dBC is strictly a relative term.

3-66. Measurements can easily be made in dBC by utilizing the Model 3555B Telephone Test Meter. To make these measurements, set FUNCTION to 600 and the INPUT switch to TMS BRDG. Any termination required other than 600 ohms must be provided externally and connected across the two binding posts T and R. Termination can also be made using a patch cord and any one of the other INPUT jacks since all INPUT jacks are connected in parallel. If a 600 ohm termination is to be used, the internal termination can be utilized by placing the INPUT switch to the TMS TERM position.

3-67. MEASUREMENT PROCEDURES.

3-68. Tables 3-3 through 3-8 list the step by step procedures for measuring levels and noise balance, recorder calibration and transmission loss using the 3555B. For a more detailed discussion on level and noise measurements refer to paragraphs 3-12 through 3-47.

3-69. 150 BAL CONVERSION.

3-70. The 3555B comes equipped with all the necessary parts for converting the 135 BAL function to a 150 BAL function. The following is a simplified procedure for making the modification.

a. Remove the set from the case and remove the FUNCTION board. Clip the shorting wire from across A1R17 (see Figure 7-2) and reinstall the FUNCTION board. Leave the set out of the case.

b. Set the 3555B controls as follows:

RANGE 0dBm
FUNCTION .... 135 BAL
INPUT .... TMS TERM

c. Remove the 150 BAL decal from the envelope supplied with the set. Remove the backing from the decal and place it over the 135 BAL function pushbutton.

d. Connect a 150 ohm balanced source to the input of the 3555B at a level of 0dBm (387mV rms) at a frequency of 1kHz. Turn the 3555B ON and adjust A3R24 (Figure 7-3) for 0dBm indication on the 3555B meter.

e. Reinstall the set in its case.

Table 3-3. Level Measurement

STEP	PROCEDURE
1.	Turn the 3555B/ON and depress the DIAL/BAT pushbutton. The meter should indicate in the green BAT GOOD area. If it does not, replace the battery or check the power source before attempting to make any measurements. The battery test operates for internal battery, office battery or ac power source.
2.	Select either TMS BRDG or TMS TERM, depending on the measurement being made. The weighting filters are not in the circuit at this time.
3.	Select the impedance (FUNCTION pushbutton) to match the circuit to be tested. Select either 900 BAL or 600 BAL (VF/Nm) for frequencies between 20Hz and 20kHz. Select 600 BAL or 135 BAL (CARRIER) for balanced measurements between 1kHz and 600kHz. Select 75 UNBAL for 75 ohm unbalanced measurements between 30Hz and 3MHz.
4.	Set the RANGE switch to +30dBm. Set the RESPONSE switch to DAMP.
5.	Connect the set to the line using a suitable patch cord. For balanced measurements use a cord having a 309 or 310 single plug, a 241 dual plug or banana plugs, bare wires or clip leads. For unbalanced carrier measurements (75 ohm only) use a cord having a 358 plug. NOTE Carrier measurements are limited to the -50 dBm RANGE thru the +10 dBm RANGE (-61 thru +11 dBm).
6.	Down range the RANGE switch for an on-scale indication. Level is equal to the algebraic sum of the black RANGE setting plus the black meter scale indication. EXAMPLES: RANGE = -50 dBm METER = + 1 dBm LEVEL = -49 dBm RANGE = +10 dBm METER = - 4 dBm LEVEL = + 6 dBm

Table 3-4. Noise Metallic Measurements

STEP	PROCEDURE
1.	Turn the POWER switch to ON and depress the DIAL/BAT pushbutton. The meter should indicate in the green BAT GOOD area. If it does not, replace the battery or check the power source. The battery test operates on internal battery, office battery or ac power source.
2.	Select either NOISE TERM or NOISE BRDG, depending on the measurement being made.
3.	Select the impedance to match the circuit to be tested using the FUNCTION pushbuttons. The 600 BAL VF/Nm and 900 BAL VF/Nm pushbuttons only should be used for noise metallic measurements in the frequency range of 20 Hz to 20 kHz. The HOLD function can be used in NOISE TERM if desired.
4.	Select the appropriate weighting filters using the NOISE WTG switch.
5.	Set the RANGE switch to 110dBrn.
6.	Connect the set to the circuit to be tested using a suitable patch cord and down range for an on-scale indication.
7.	Observe the meter fluctuations for two or three minutes and take a reading where the meter pointer appears to be most of the time, disregarding any occasional peaks. NOTE For rapidly fluctuating noises such as atmospheric noise or switching noise, operate the RESPONSE switch to DAMP and read the level of the most frequently occurring peaks.
8.	Noise level is equal to the sum of the blue RANGE switch setting in dBrn and the indication on the blue meter scale in dBrn. EXAMPLE: RANGE = 40dBrn METER = + 5dBrn NOISE LEVEL = +45dBrn

Table 3-5. Noise-to-Ground Measurements

STEP	PROCEDURE
1.	Turn the 3555B POWER switch to ON and depress the DIAL/BAT pushbutton. The meter should indicate in the green BAT GOOD area. If it does not replace the battery or check the power source. The battery test operates for internal battery, office battery or ac power source.
2.	Set the INPUT switch to NOISE BRDG.
3.	Select the appropriate weighting filter using the NOISE WTG switch.
4.	Set the RANGE switch to 110dBrn.
5.	Depress the Ng pushbutton and connect the set to the circuit to be tested. Remember that a good ground is necessary. Down range for an on-scale indication. **NOTE** Dial and talk may be accomplished on the metallic circuit and the connection held by depressing the HOLD pushbutton. Input switch must be in TERM for HOLD to operate.

Table 3-6. Balance Measurement

STEP	PROCEDURE
1.	Perform the Noise-to-ground measurement as described in Table 3-5.
2.	Perform the Noise Metallic measurements as described in Table 3-4.
3.	Compute the line balance in dB using the results of the above checks. Balance (dB) = Ng - Nm EXAMPLE: Noise Metallic = 90 dBrn Noise-to-ground = (-) +26 dBrn Balance in dB = 64 dBrn **NOTE** The noise-to-ground measurement above includes the 40dB correction factor.

Table 3-7. Recorder Calibration

STEP	PROCEDURE
1.	Determine the input impedance and full scale sensitivity of your recorder and refer to paragraph 3-41 and Figure 3-4 to determine if your recorder is suitable for use with this set. The dc voltage supplied by the DC MON 310 jack will drive a dc potentiometric recorder requiring 1V or a dc galvanometric recorder requiring 500uA.
2.	Connect an input voltage to the set and adjust the RANGE switch until a near full-scale indication is observed on the meter.
3.	Connect the recorder plug with the tip negative, to the DC MON jack and adjust the input level until the meter indicates 0dBm. Mark this point on the recorder paper which should be near full scale.
4.	Decrease the input level to the set until the meter indicates -1dBm. Mark this point on the recorder paper. Continue this procedure until every major dBm division on the meter has been calibrated on the recorder paper.
5.	The actual level to the set as indicated on the recorder is equal to the algebraic sum of the RANGE setting and recorder indication.

Table 3-8. Transmission Loss Measurement

STEP	PROCEDURE
1.	For a transmission loss measurement to be meaningful, it should first be determined if there are any extraneous signals present that will affect your measurement. To do this, connect the measuring set to the circuit and determine if interfering signals are present. Levels below -60 dBm can, in most cases, be ignored. A butt-in can be connected to the AC MON jacks to aid in determining the interfering source.
2.	Establish a connection like the ones shown in Figure 3-6.
3.	Adjust the oscillator output level for 0dBm. Measure the level at the receiving end and record this level.
4.	Insertion loss is equal to the difference between the sending level and the receiving level, ignoring any extraneous signals. EXAMPLE: Sending level = 0dBm Receiving level = (-) -20dBm Insertion loss = 20dB

SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. The Model 3555B Transmission and Noise Measuring Set is a special measuring set designed for uses in testing telecommunications equipment. Inputs between -80dBm and +30dBm full scale can be selected in twelve ranges for level measurements and correspond to the black markings on the meter scale and the RANGE switch. Noise measurements between 0dBrn and +120dBrn full scale can be made, selectable in twelve ranges and corresponds to the blue markings on the meter scale and RANGE switch. When measuring rapidly fluctuating noises, a damping circuit can be inserted by the RESPONSE switch.

4-3. Impedances of 75, 135 and 600 ohms, terminated or bridging can be selected for carrier level measurements. The 135 and 600 ohm functions can be either balanced or unbalanced while the 75 ohm function is unbalanced only. For voice frequencies, impedances of 600 and 900 ohms are provided. These impedances are selectable by the pushbutton FUNCTION switch and can be terminated or bridging, balanced or unbalanced.

4-4. A noise-to-ground (Ng) function is included to permit measurement of longitudinal noise. When the Ng pushbutton is depressed, a 40dB attenuator is placed across the INPUT terminals.

4-5. The HOLD function places a high inductance holding coil across the INPUT terminals to simulate an off-hook condition while measurements are being made. The HOLD function is not operative on any of the carrier functions or hi BRDG.

4-6. A variety of INPUT and DIAL jacks are provided which accept Western Electric type 241 and 289 dual plugs, 309, 310, 347, and 358 single plugs, dual banana plugs, clip leads and bare wires.

4-7. BLOCK DIAGRAM DESCRIPTION.

4-8. Figure 4-1 illustrates a simplified block diagram of the Model 3555B Transmission and Noise Measuring Set. Refer to this figure for the following block diagram description.

4-9. The input signal is first applied to the FUNCTION switch where the input circuitry is set up to accomodate the type of measurement being made. For voice frequencies, impedances of 900 ohms or 600 ohms can be selected, bridged or terminated. Voice frequencies are then applied to a transformer with a frequency range of 20Hz to 20kHz. The HOLD function places a high inductance bridge across the INPUT terminals to simulate an off-hook condition. For carrier frequencies impedances of 600 ohms, and 135 ohms can be selected, terminated or bridged, balanced or unbalanced. Carrier frequencies at these impedances are applied to a transformer having a frequency range from 1 kHz to 600 kHz. For 75 ohm carrier frequencies an unbalanced input is provided. This input can be either terminated or bridged. HOLD is not possible on any of the carrier functions.

4-10. For longitudinal measurements, an Ng function is provided which places a 40dB attenuator across the INPUT terminals. The HOLD function bridges the input with a holding coil while measurements are being made. The output of the 40dB attenuator is always applied to the voice frequency transformer.

4-11. The DIAL/BAT function serves two functions. First it connects the DIAL/AC MON jacks to the INPUT jacks so that a handset can be used for dialing. Secondly, the meter is connected to the unregulated power supply so that the battery condition can be monitored.

4-12. After the signal is conditioned by the input circuitry it is coupled to the RANGE attenuator where the signal level is adjusted to provide the proper input for the Input Amplifier. The RANGE attenuator provides from 0dB to 80dB of attenuation. It also provides gain switching for the Input Amplifier.

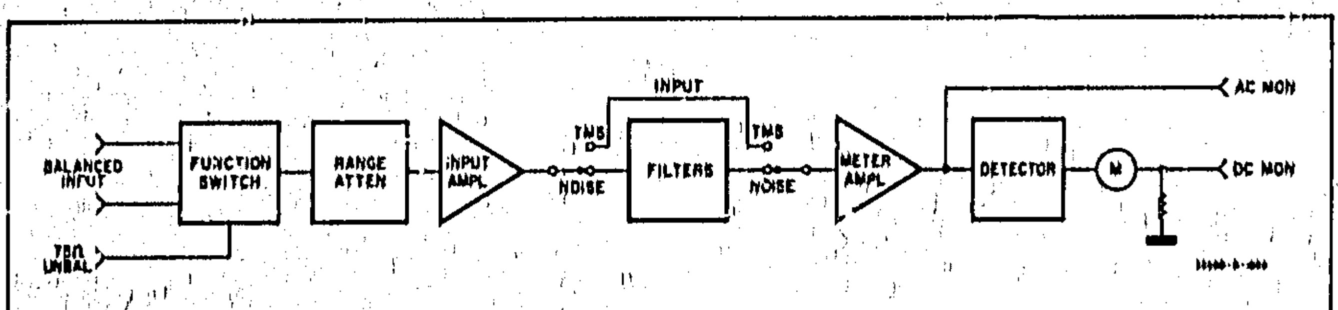


Figure 4-1. Simplified Block Diagram

4-13. The output of the Input Amplifier goes to the INPUT switch where noise filters are set up for selection by the NOISE WTG switch. In the NOISE position, either 3kHz FLAT weighting, C Message weighting, 15kHz FLAT weighting or PROGRAM weighting can be selected by the NOISE WTG switch. In the TMS position of the INPUT switch the filters are bypassed for transmission level measurements.

4-14. The output from the INPUT switch goes to the meter amplifier. This amplifier provides an ac signal to the DIAL/AC MON jacks so that a handset can be used to listen to the signal being measured. This is particularly useful in determining noise characteristics.

4-15. The detector circuit provides an equivalent rms detected voltage to drive the meter. The meter has shaped pole pieces to provide a linear meter scale both for dBm and dBrn.

4-16. DETAILED CIRCUIT DESCRIPTION.

4-17. The purpose of the function switch is to set up the input conditions to match the type of measurement being made. Impedances can be selected to match the lines to be tested and can be either bridged or terminated. Separate transformers are selected for voice frequency and carrier frequency measurements. A 40dB attenuator is bridged across the input terminals for longitudinal noise measurements when the Ng pushbutton is depressed. The HOLD function places a high inductance holding coil across the input terminals to simulate an off-hook condition. Each of these functions is described in detail in the following paragraphs.

a. HOLD: When the HOLD pushbutton is depressed a high inductance coil L1 is connected across the balanced INPUT terminals if the INPUT switch is in the TERM position. A bridging HOLD is not possible. The TERM switch connects the two windings of L1 in series.

b. DIAL BAT: (See Figure 4-2) The DIAL BAT pushbutton serves two purposes. First it disconnects the meter from the detector and connects it to the unregulated power supply so that the battery voltage can be monitored. Secondly, the DIAL/AC MON jacks are disconnected from the amplifier ac output and connected to the INPUT jacks. This permits connecting the lineman's handset to the balanced line for the purpose of dialing.

c. Ng: (See Figure 4-3) The Ng pushbutton connects a 40dB attenuator across the balanced input terminals for longitudinal measurements. This attenuator consists of A1R5 thru A1R8 and A1C1. The output is taken from the junction of A1C1 and A1R8. This output is referenced to ground and applied to the voice frequency transformer A1T2.

d. 900 (Vf/Nm): The 900 function switch S4 selects terminating resistors A1R1 and A1R9 for 900 ohm terminations. The INPUT switch must be in the TERM position to complete the circuit for this termination. The 900 function switch also places a ground on the 900 ohm relay A3K1 which provides gain switching in the Input Amplifier so that the meter will indicate in dBm. The 900 ohm signal is applied to the voice frequency transformer A1T2. HOLD can be accomplished on this function.

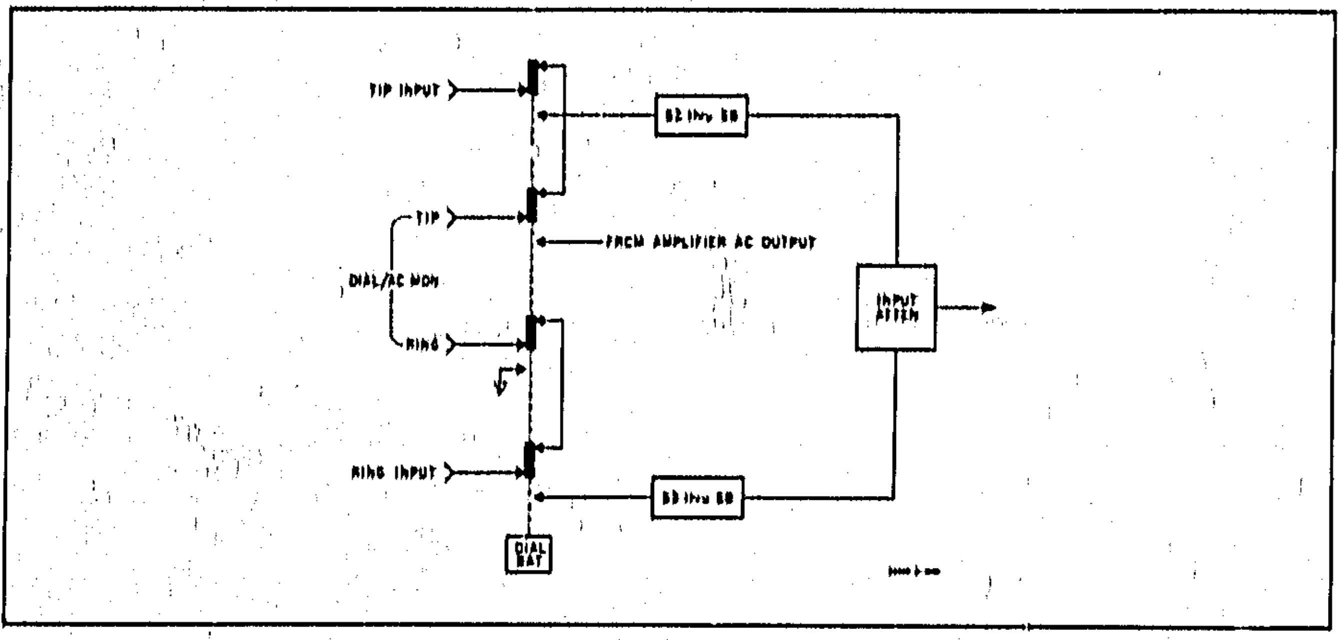


Figure 4-2. Simplified DIAL BAT Function

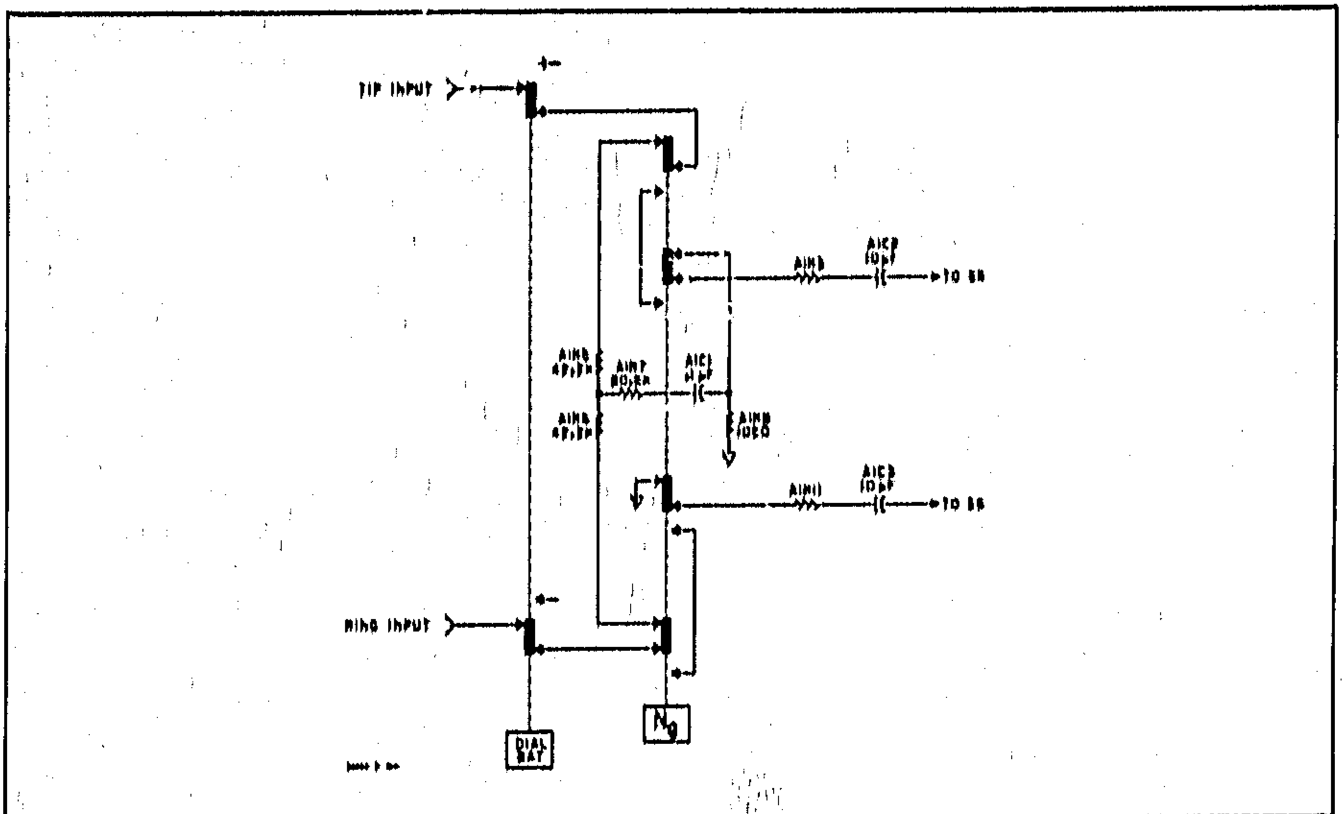


Figure 4-3. Simplified Ng Function

e. 600 (Vf/Nm): The 600 function switch S5 selects terminating resistors A1R2 and A1R10 for a 600 ohm termination. The INPUT switch completes the circuit for this termination. The 600 (Vf/Nm) signal is applied to T2. No gain switching is performed in this function since the set is normalized at 600 ohms. HOLD can be accomplished on this function.

f. 600 (Carrier): This function is identical to the 600 (Vf/Nm) function except that the signal is applied to A1T1 and HOLD cannot be accomplished on this function.

g. 135 (Carrier): The 135 function is identical to the 600 (carrier) function except that the gain switching in the Input Amplifier is accomplished by one section of the 135 function switch S7, and resistors A1R4, A1R16 and A1R17 provide termination.

h. 75 UNBAL: The 75 UNBAL function bypasses the balanced input circuitry and transformer A1T1 and A1T2. Gain switching is performed by one section of the function switch. When the 75 UNBAL function is selected the output of the balanced circuitry is disconnected. A 75 ohm termination is provided thru the INPUT switch.

4-18. RANGE ATTENUATOR A2. (Schematic No. 2)

4-19. The RANGE attenuator adjusts the input signal to a suitable level for the Input Amplifier. This attenuator is composed of four L pads, selectable in combinations to provide from 0dB to 80dB of attenuation. Two 30dB pads are selected by A2S1A and A2S1B, a 20dB pad is selected by A2S1C and a 10dB pad is selected by A2S1D. Another section of the RANGE attenuator switch provides gain switching for the Input Amplifier in the -80dBm, -70dBm and -60dBm positions. Refer to Table 4-1 for more detailed information on range attenuation and amplifier gain.

4-20. INPUT AMPLIFIER A3. (Schematic No. 2)

4-21. The purpose of the Input Amplifier is to provide the necessary gain at each setting of the RANGE switch and to provide the necessary gain at all impedances. This amplifier is normalized at 600 ohms and the following discussion is for the 600 ohm function.

4-22. Diodes A3CR1 thru A3CR4 serve as protection for the input amplifier. Signals greater than 7 volts peak-to-peak will be conducted to ground through these diodes. The gain of this amplifier is determined by the negative feedback from the emitter of A3Q5 to the base of A3Q2. This feedback is first determined by the ratio of A3R13 to the sum of A3R13, A3R14 and A3R15. In position 1 of the RANGE switch (-80 dBm) this feedback is further divided by the ratio of A3R11 to the sum of A3R11, A3R25 and A3R26. In position 2 (-70 dBm) of the RANGE switch the feedback is determined by the ratio of A3R11 to the sum of A2R13, A3R11, A3R25 and A3R26. In position 3 (-60 dBm) of the switch the feedback is determined by the ratio of A3R11 to the sum of A2R13, A2R14, A3R11, A3R25 and A3R26.

Table 4-1. Range Attenuation and Amplifier Gain

RANGE Setting	RANGE Attenuation	ATTENUATOR PADS USED	Input Amplifier Gain
+30dBm	80dB	A,B,C	3.6dB
+20dBm	70dB	A,B,D	3.6dB
+10dBm	60dB	A,B	3.6dB
0dBm	50dB	B,C	3.6dB
-10dBm	40dB	B,D	3.6dB
-20dBm	30dB	B	3.6dB
-30dBm	20dB	C	3.6dB
-40dBm	10dB	D	3.6dB
-50dBm	0dB	0	3.6dB
-60dBm	0dB	0	13.6dB
-70dBm	0dB	0	23.6dB
-80dBm	0dB	0	33.6dB

In positions 4 thru 12 (-50 dBm thru + 30 dBm), A3R11 is bypassed for maximum feedback. The gain of the amplifier in these nine positions is a constant 2.5 dB. Potentiometer A3R26 is for calibration of the -80 dBm range, 600 ohm function. Resistor A3R27 is used to maintain a charge on A3C15 to prevent transients when changing ranges.

4-23. In order that the meter always indicate in dBm regardless of the impedance selected, additional gain switching must be performed. When the 75 function is chosen, A3K2 energizes and places A3R16 in parallel with A3R14 and A3R15. This reduces the negative feedback (with respect to the 600 function) and increases the amplifier gain by 9 dB. When the 135 function is selected, the combination of A3R16/R21/R22/R23/R24 is connected in parallel with A3R14 and A3R15, reducing the feedback and increasing the amplifier gain by 6.4 dB with respect to the 600 function. When the 900 function is depressed, A3R17/R18/R19/R20/R21/R16 provide a second negative feedback path, increasing the negative feedback and reducing the amplifier gain by 1.7 dB. Relays A3K1 thru A3K3 are controlled by the FUNCTION switch when any of the impedance functions except 600 are selected.

4-24. Transistors A3Q1 and A3Q2 form a differential amplifier. The signal is taken from the collector of A3Q1, amplified by A3Q4 and A3Q5 with A3Q5 providing feedback to the base of A3Q2. Transistor A3Q3 provides isolation between A3Q2 and A3Q4 to prevent undesired feedback. This results in a greater bandwidth than could be achieved without its use. The output signal is coupled through A3R17 and A3C10 to the INPUT switch.

4-25. FILTERS. (Schematic No. 3)

4-26. The 3555B contains a 3kHz FLAT weighting filter, a C MSG weighting filter, a PROG weighting filter and a 15kHz FLAT weighting filter. These active filters consist of five amplifiers with controlled feedback for waveshaping. They are used in combinations to form each of the filters (refer to Figure 7-1). Since all of these amplifiers are

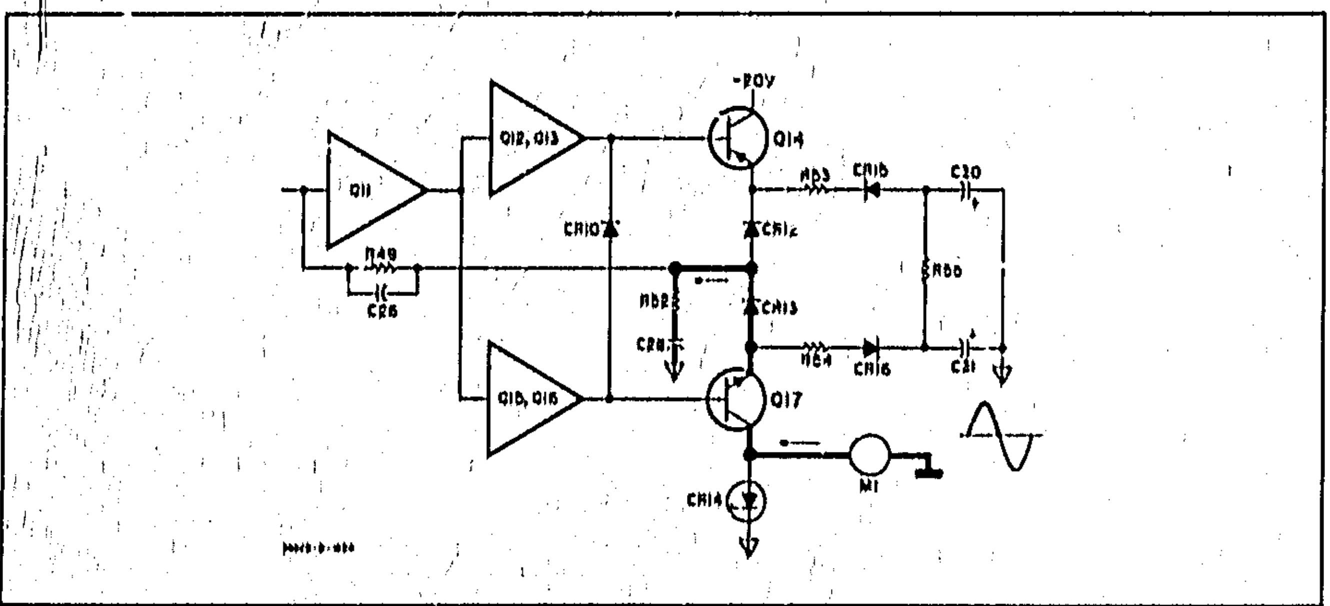


Figure 4-4. Simplified Average Detection

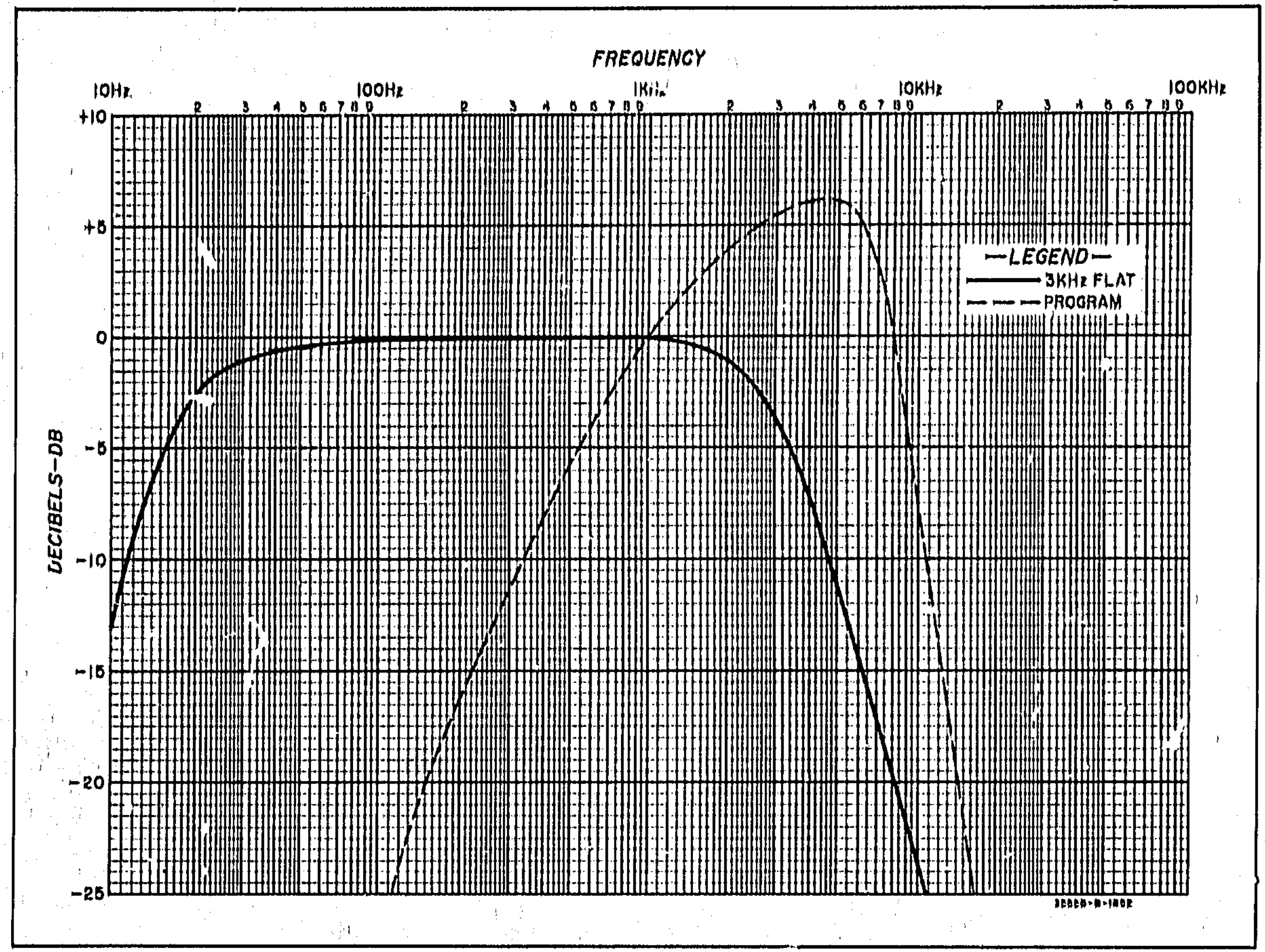


Figure 4-5. 3kHz FLAT and Program Weighting Curves

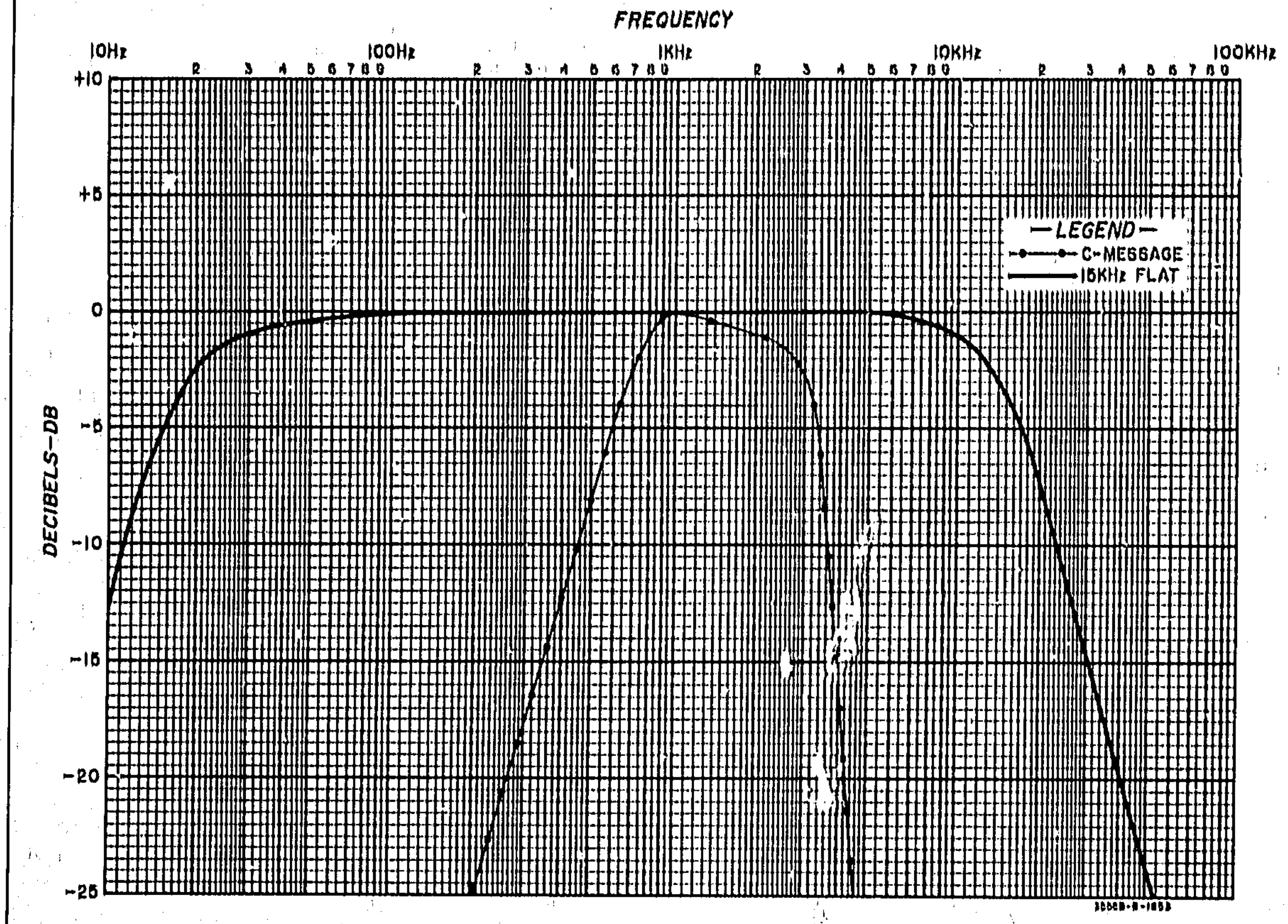


Figure 4-6. C-MSG and 15kHz FLAT Weighting Curves

identical in operation, only the first will be discussed in detail.

4-27. Referring to Figure 7-4, the signal is applied to the assembly through pin 22. If C MSG is selected the signal is first attenuated by A4R1, A4R2 and A4R3A. Potentiometer A4R3A is for C MSG level adjustment for 0dB at 1kHz. The signal is then applied to the first in a series of amplifiers. The first amplifier consists of A4Q1 through A4Q4. Differential amplifier A4Q1 and A4Q2 amplifies the signal and applies it to A4Q3 and A4Q4. The emitter circuit of A4Q4 provides two feedback signals, positive feedback through A4R8 and A4C4 to the base of A4Q1 and negative feedback to the base of A4Q2. The gain of this amplifier is controlled by the ratio of the value of A4R10 to the value of A4R9. For example, increasing the value of A4R9 would increase the negative feedback and reduce the amplifier gain. Gain can be calculated by the equation:

$$\text{Gain} = 1 + \frac{A4R10}{A4R9}$$

Positive feedback to the base of A4Q1 determines the frequency response of this amplifier and is controlled by the value of A4C4 and A4R8. All five of the amplifiers are used in C Message weighting.

4-28. The Program weighting filter utilizes only amplifiers A and B as shown in Figure 7-1. These amplifiers are identical to the one described in the preceeding paragraph except for the value of the positive feedback utilized for shaping and the negative feedback used for gain control. This negative feedback is modified by resistance in the feedback divider at the base of A4Q12. Transistors A4Q5 and A4Q6 provide additional gain required for Program weighting. Potentiometer A4R3P is used for PROG level adjustment at 1 kHz.

4-29. The 3 kHz FLAT and 15 kHz FLAT weighting filters utilize only amplifier C as indicated in Figure 7-1. The only difference between these two active filters is in the positive feedback used for shaping.

4-30. METER AMPLIFIER. (Schematic No. 4)

4-31. The meter amplifier consists of A3Q6 through A3Q10. The signal is first amplified by differential amplifier A3Q6 and A3Q7. The signal is taken from the collector of A3Q6 and then amplified by A3Q9 and A3Q10. Transistor A3Q8 provides isolation between A3Q7 and A3Q9 to prevent undesired feedback. Two signals are taken from A3Q10. The collector circuit supplies a signal to the DIAL/AC MON jacks for the purpose of listening to the measured signal. The emitter circuit of A2Q10 provides a drive signal for the detector circuit.

4-32. DETECTOR. (Schematic No. 4)

4-33. The detector is a class B equivalent rms detector which combines the features of an average detector and a peak detector. When the average detected signals and the peak detected signals are combined in the proper proportion an equivalent rms response is produced.

4-34. First consider the average detection in this circuit. (See Figure 7-5). Transistors A3Q12-A3Q13 and A3Q15-A3Q16 are functionally symmetrical. This means that A3Q14 and A3Q17 are driven by the same signal. When the signal at the base of A3Q17 and A3Q14 goes negative, A3Q14 turns on and A3Q17 turns off. No current will flow through the meter. On the positive half cycle A3Q14 turns off and A3Q17 turns on. The current paths for the average detector are shown in Figure 4-4.

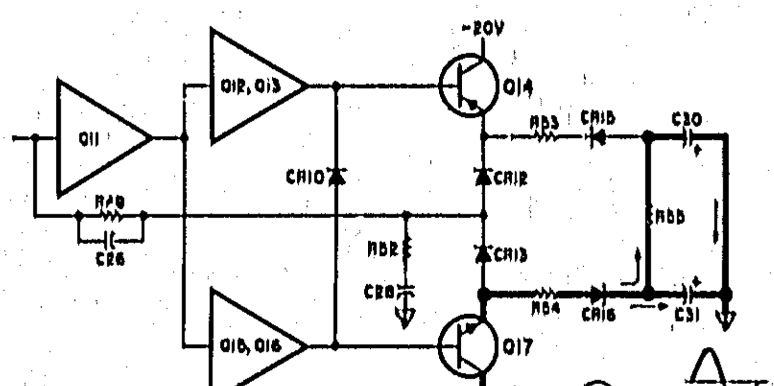


Figure 4-7. Simplified Peak Detection

4-35. Now consider the peak detection. (See Figure 7-5). When A3Q14 is turned on and A3Q17 is turned off, no current flows through the meter from the peak detector. When A3Q14 is turned off and A3Q17 is turned on, the current path is as shown by the heavy lines in Figure 4-7. Diodes A3CR12 and A3CR13 are included to offset the junction drop of A3CR15 and A3CR16 respectively.

4-36. When the average detection and the peak detection are combined in the proper proportion, an equivalent rms response is produced. The advantage of this type of rms detection is fast response.

4-37. POWER SUPPLY AND SERIES REGULATOR. (Schematic No. 4)

4-38. The 3555B can be operated from 115 V or 230 V ac, the internal 48 V dry cell battery or from a central office battery (tip negative). When operating from an ac source, power is applied through transformer T1 to rectifiers CR1 thru CR4. This rectified voltage is filtered by C2 before being applied to the series regulator through the AC/BAT switch (S3), J3, cable W7 and CR17.

4-39. The regulator is of the conventional series type with A3Q19 acting as the sensing element and A3CR20 as the reference. Changes in the output level are amplified by differential amplifier A3Q18 and A3Q19. The output of the differential amplifier is amplified by A3Q20 and applied to A3Q21 which controls the conduction of the series transistor A3Q22. The output of this series regulator is held at +20 volts ± 1 volt. The maximum ac ripple and noise on the output voltage is 5 mV rms.

4-40. It should be noted that when operating the set from either the battery or from an ac source, capacitor C2 will always be charged, whether the set is turned on or not, if the line power cord is connected to an ac source. Caution should be exercised when servicing the power supply.

WARNING

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section of the manual contains information necessary in the maintenance of the -hp- Model 3555B Transmission and Noise Measuring Set. Included are performance checks, adjustment and calibration procedures, and troubleshooting.

5-3. The test equipment needed to properly maintain and service the Model 3555B is listed in Table 5-1. Included in Table 5-1 is the equipment to be used, required specifications and recommended model. If the recommended model is not available other equipment can be substituted provided they meet the required specifications.

5-4. FACTORY SELECTED VALUES.

5-5. Factory selected values are denoted on the schematic diagrams by an asterisk. The nominal value is shown. The value in your instrument may be different or the part may be omitted.

5-6. 150 BAL CONVERSION.

a. To convert the 135 BAL function to a 150 BAL

Table 5-1. Required Test Equipment

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	RECOMMENDED MODEL
Oscillator	Frequency Range: 20 Hz to 3 MHz Levels: -80 dBm to +30 dBm Accuracy: ± 0.15 dB	-hp- 654A
Oscillator	Frequency Range: 100 Hz to 20 kHz Amplitude: 30 V	-hp- 201C
Voltmeter, digital	Function: AC and DC Accuracy: ± .1% Output: +/- 20 V peak at 0.5 A peak	-hp- 3465A
Voltmeter, AC	Frequency Range: 30 Hz - 3 MHz Accuracy: ± 2%	-hp- 3403C
Special Cables	Balanced BNC to 310 plug	See Figure 5-1
Special Adapter	BNC to 358 plug	Trompeter Electronics No. AD-1W
Resistors	25 ohms ± .1% 851 ohms ± .25% 300 ohms ± 0.1% (2) 600 ohms ± 0.1% 135 ohms ± 0.1% 75 ohms ± 0.1% 900 ohms ± 0.1% 550 ohms ± .25% 85 ohms ± 1%	-hp- Part No. 0698-8011 -hp- Part No. 0698-5430 -hp- Part No. 0698-6295 -hp- Part No. 0698-7408 -hp- Part No. 0698-7364 -hp- Part No. 0698-7363 -hp- Part No. 0698-5453 -hp- Part No. 0757-1016 -hp- Part No. 0757-1046
Counter	Frequency Range: 60 Hz to 20 kHz	-hp- 5300A/5302A

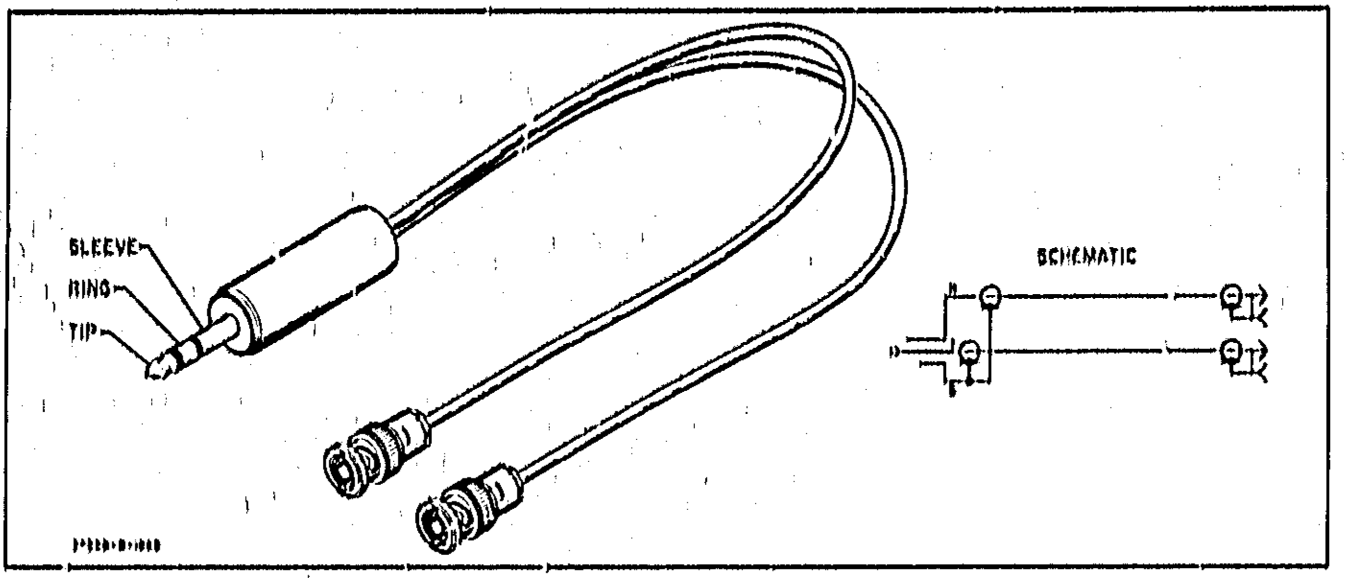


Figure 5-1. Balanced BNC to 310 Plug

function, remove or clip the shorting bar from across A1R17 (see Figure 7-2).

b. Remove the 150 BAL decal from the small envelope supplied with the set and stick it over the existing 135 BAL decal.

c. Adjust the 150 function as described in Paragraph 5-20 in this manual.

5-7. PERFORMANCE CHECKS.

5-8. The performance checks presented in this section are in-cabinet checks designed to compare the Model 3555B with its published specifications. These checks can be used for incoming inspection, periodic maintenance checks and to verify performance after adjustment or repair. A performance check test card appears at the end of this section which can be used to record the specification performance of your set.

5-9. LEVEL ACCURACY CHECKS.

a. Connect the 654A and 3465A to the 3555B as shown in Figure 5-2 and set the 3555B controls as follows:

FUNCTION . . . . CARRIER, 75 UNBAL
INPUT . . . . TMS, TERM
RANGE . . . . + 10 dBm

b. Set the 654A frequency to 20 kHz, IMPEDANCE to 75 UNBAL and adjust the output level for 866 mV ac (+10 dBm) indication on the 3465A.

c. Set the 654A meter for a reference indication and be sure to maintain this indication throughout the following procedures unless otherwise instructed.

d. Disconnect the 3465A and the cable. Connect the 654A output directly to the 3555B input. The 3555B meter should indicate 0 dBm ± 0.1 dBm.

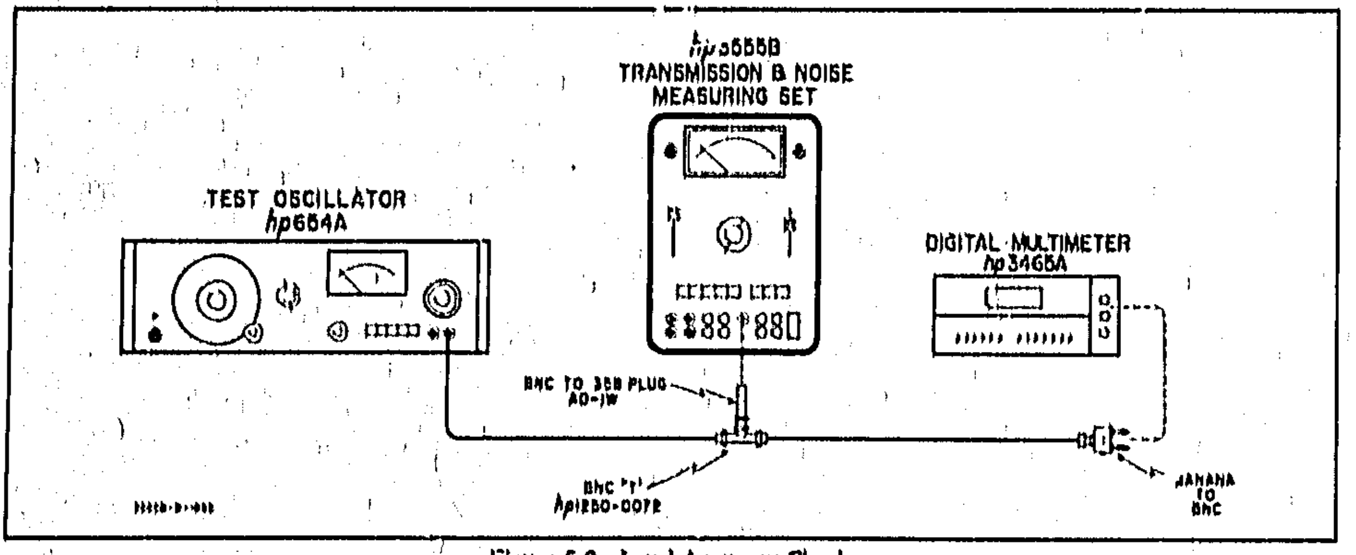


Figure 5-2. Level Accuracy Check

Table 5-2. 75 UNBAL Carrier Accuracy Check**

3555B INPUT	3555B INDICATION (dBm) FREQUENCY 30 Hz to 1 MHz	FREQUENCY 100 Hz to 600 kHz	1 MHz to 3 MHz
+ 10 dBm	+10 ±0.5	+10 ±0.2	+10 ±0.5 ±10% of meter indication in dBm
0 dBm	0 ±0.5	0 ±0.2	0 ±0.5 ±10% of meter indication in dBm
- 10 dBm	-10 ±0.5	-10 ±0.2	-10 ±0.5 ±10% of meter indication in dBm
- 20 dBm	-20 ±0.5	-20 ±0.5	-20 ±0.5 ±10% of meter indication in dBm
- 30 dBm	-30 ±0.5	-30 ±0.2	-30 ±0.5 ±10% of meter indication in dBm
- 40 dBm	-40 ±0.5	-40 ±0.2	-40 ±0.5 ±10% of meter indication in dBm
- 50 dBm	-50 ±0.5	-50 ±0.2	-50 ±0.5 ±10% of meter indication in dBm
- 60 dBm	-60 ±0.5	-60 ±0.2	-60 ±0.5 ±10% of meter indication in dBm

e. Check all the input levels and frequencies listed in Table 5-2 for the specified tolerances. Be sure to maintain the 654A reference established in Step e.

f. Change the 654A to 600 BAL and change the 3555B to CARRIER, 600 BAL. Connect the 654A 600 BAL output to the 3555B 310 jack input using a balanced cable (See Figure 5-1). Connect sleeve (s) to ground (⊥) on the 3555B front panel terminal posts.

g. Check the input levels and frequencies in Table 5-3, using the same procedure described for the 75 UNBAL function.

h. Change the 654A to 135 BAL and change the 3555B to 135 BAL. Repeat Step g for the RANGES and tolerances indicated.

i. Change the 3555B to VF/Nm, 600 BAL, HOLD off, and change the 654A to 600 BAL. Check the + 10 dBm thru - 80 dBm ranges in Table 5-4 for the tolerances indicated.

j. Change the 3555B to 900 BAL and set the RANGE to 0 dBm. Connect the 3465A to the 3555B red binding posts (T and R). Set the 654A AMPLITUDE and LEVEL controls for an output of .9487 volts (as indicated on the 3465A) at a frequency of 1 kHz. Note the 654A meter indication and use this as a reference. Disconnect the 3465A and check the + 10 dBm thru - 80 dBm ranges in Table 5-4 for the tolerances indicated.

k. To check the top two ranges, connect the equipment as shown in Figure 5-3 and set the 3555B controls as follows:

FUNCTION . . . . VF/Nm 600 BAL
INPUT . . . . TMS, TERM
RANGE. . . . . +20 dBm

l. Adjust the 201C for 7.75 V on the 3465A at 100 Hz.

m. Tune the 201C from 100 Hz to 20 kHz, maintaining 7.75 V on the DVM. Between 100 Hz and 15 kHz, the 3555B indication must be +20 ± 0.2 dBm. Between 15 kHz and 20 kHz, the indication must be + 20 ± 0.5 dBm.

n. Check the + 30 dBm range using the procedure described in Steps k through m except change the 3555B range to + 30 dBm and change the 201C output level for 24.49 V.

o. Change the 3555B to 900 BAL and change the range to + 20 dBm.

p. Adjust the 201C output for 9.49 V as indicated on the 3465A.

q. Check for the tolerances indicated in Table 5-4 for the + 20 dBm range.

r. Change the 3555B range switch to + 30 dBm and adjust the 201C for 30.0 V on the 3465A. Check for the tolerances indicated in Table 5-4 for the + 30 dBm range.

Table 5-3. Carrier Level Accuracy**

3555B INPUT		3555B Indication (dBm)	
	135 / 600	1 kHz -600 kHz / 1 kHz -150 kHz	10 kHz -300 kHz / 10 kHz -100 kHz
-60 thru +10 dBm		± 0.5	± 0.2*

*Increase specification by ± 0.3 dB on 135 ohms (or 150 ohms) when not battery powered.

**Specifications only apply to the + 10 dBm to - 50 dBm RANGE settings.

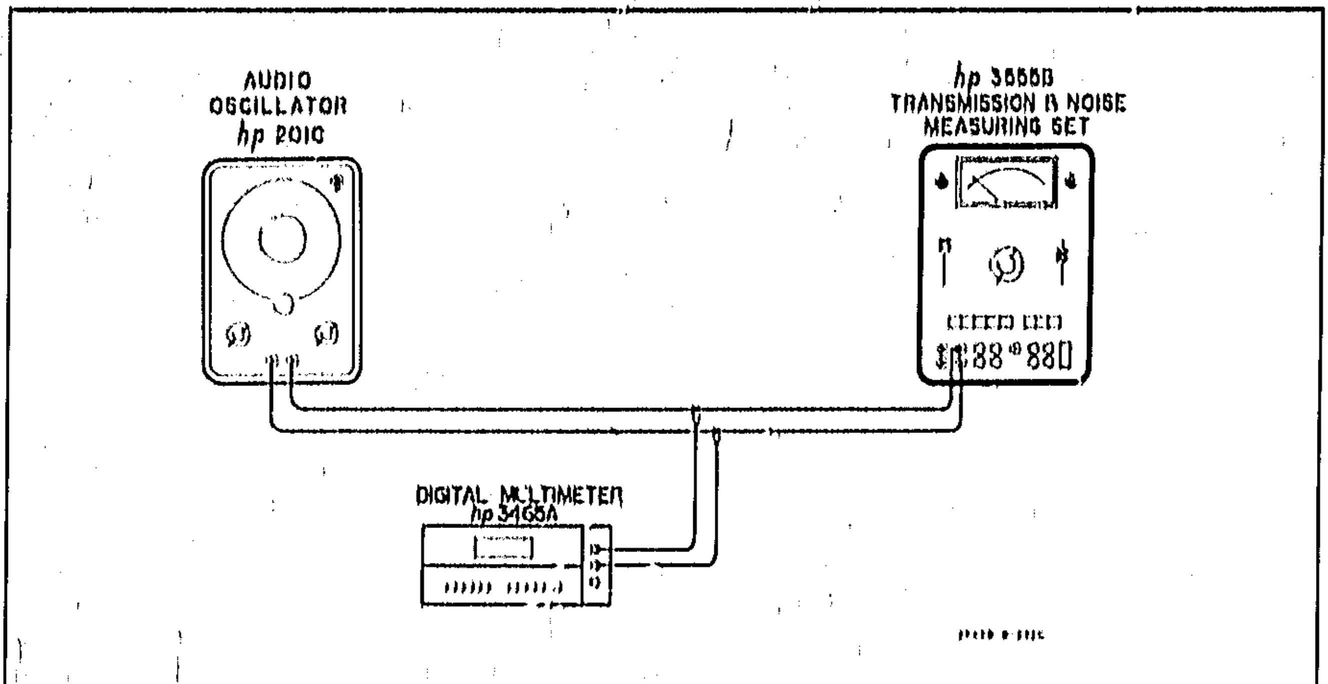


Figure 5-3. +20dBm and +30dBm Level Accuracy Check

5-10. RETURN LOSS CHECK.

a. Return loss in dB may be found using the following equation:

$$RL = -20 \log \left| \frac{R_2 - R_1}{R_2 + R_1} \right| = -20 \log \left| \frac{2V_2 - V_1}{V_1} \right|$$

when R_1 is the source resistance, V_1 is its open circuit voltage, R_2 is the load resistance, and V_2 is the voltage across the load.

b. Connect the equipment as shown in Figure 5-4. Make R_s = 850 Ω. Set the 3403C on the 1 V ac RANGE.

c. Set the 654A OUTPUT LEVEL to + 10 dBm, 50 ohm UNBAL, at 20 kHz. Record the reading on the 3403C (this is V_1).

d. Connect a 900 ohm .1% resistor (R_L) on the unconnected BNC Tee terminal. Record the reading on the 3403C (this is V_2).

e. Calculate the return loss (RL) of the test equipment. It must be greater than 40 dB in order to be accurate enough to test the 3555B. If it is not greater than 40 dB check R_s, the TEST OSCILLATOR, and the interconnecting wiring.

NOTE

If 2 V_2 = V_1 the return loss is "infinite". It is not actually infinite but is beyond the measuring capability of the test equipment.

Table 5-4. VF/Nm Level Accuracy Checks 600 BAL and 900 BAL
-80 dBm through +30 dBm

RANGE	20 Hz - 40 Hz	40 Hz - 100 Hz	100 Hz - 15 kHz	15 kHz - 20 kHz
+30 dBm			+30 ± 0,2	+30 ± 0,5
+20 dBm			+20 ± 0,2	+20 ± 0,5
+10 dBm			+10 ± 0,2	+10 ± 0,5
0 dBm	0 ± 0,5	0 ± 0,2	0 ± 0,2	0 ± 0,5
-10 dBm	-10 ± 0,5	-10 ± 0,2	-10 ± 0,2	-10 ± 0,5
-20 dBm	-20 ± 0,5	-20 ± 0,2	-20 ± 0,2	-20 ± 0,5
-30 dBm	-30 ± 0,5	-30 ± 0,2	-30 ± 0,2	-30 ± 0,5
-40 dBm	-40 ± 0,5	-40 ± 0,2	-40 ± 0,2	-40 ± 0,5
-50 dBm	-50 ± 0,5	-50 ± 0,2	-50 ± 0,2	-50 ± 0,5
-60 dBm	-60 ± 0,5	-60 ± 0,2	-60 ± 0,2	-60 ± 0,5
-70 dBm	-70 ± 0,5	-70 ± 0,5	-70 ± 0,5	-70 ± 0,5
-80 dBm	-80 ± 0,5	-80 ± 0,5	-80 ± 0,5	-80 ± 0,5

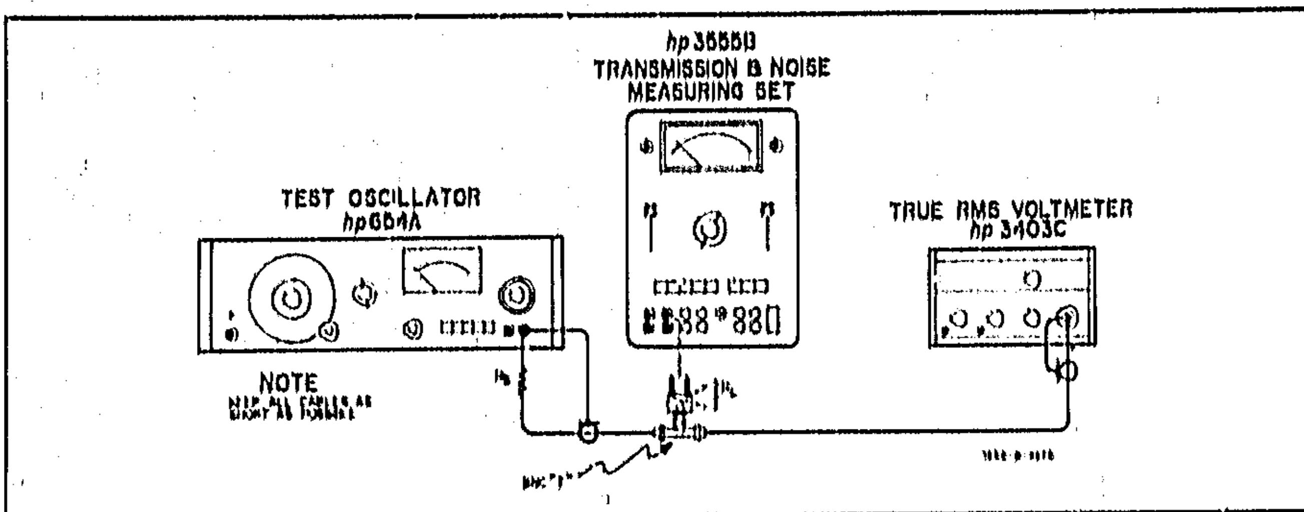


Figure 5-4. Return Loss Test Set-Up

f. Set the 3555B controls as follows:

FUNCTION . . . . VF/Nm, 900 BAL
INPUT . . . . TMS, TERM
RANGE. . . . . + 10 dBm
POWER. . . . . OFF

g. Remove R_L and connect the BNC Tee to the 3555B input. Sweep the frequency from 50 Hz to 20 kHz and record both the highest and lowest voltages measured by the 3403C along with their applicable frequencies.

h. Disconnect the 3555B and find the open circuit voltage at both frequencies found in Step g.

i. Calculate the return loss for both cases where V_1 is the voltage from Step h and V_2 is the voltage from Step g. The Return Loss must be greater than 30 dB.

j. Change R_s to 550 ohms and the 3555B Function to VF/Nm, 600 BAL. Redo Steps c through i. Use a 600 ohm .1% resistor for R_L. The Return Loss must be greater than 30 dB.

k. Change the 3555B FUNCTION to CARRIER, 600 BAL, and redo Steps c through i. Use R_s = 550 Ω and R_L = 600 Ω. The Return Loss must be greater than 26 dB between 1 kHz and 150 kHz.

l. Change the 3555B FUNCTION to CARRIER, 135 BAL. Redo Steps c through i using R_s = 85 Ω and R_L = 135 Ω ± .1%. The Return Loss must be greater than 26 dB between 1 kHz and 600 kHz.

m. Change the 3555B FUNCTION to CARRIER, 75 UNBAL. Redo Steps c through i using R_s = 25 Ω (or the 654A 75 UNBAL IMPEDANCE if so equipped) and R_L = 75 Ω ± .1%. Remember to use the 75 Ω INPUT jack and keep all cables SHORT. The Return Loss must be greater than 30 dB from 30 Hz to 3 MHz.

NOTE

If any of the Return Losses were out of specifications, recheck Step c at the questionable frequency and impedance before starting repairs.

5-11. FILTER RESPONSE CHECKS.

a. C MSG FILTER RESPONSE

1. Connect the equipment as shown in Figure 5-5 and set the 3555B controls as follows:

FUNCTION . . . . VF/Nm, 600 BAL
INPUT . . . . NOISE TERM
RANGE. . . . . 0 dBm
NOISE WTG. . . . . C-MSG

2. Connect a counter to the 654A COUNTER OUTPUT (rear panel). Whenever a frequency must be set in the filter checks use the counter reading.

3. Adjust the output of the 654A for 0 dBm at a frequency of 1 kHz. The 3555B should indicate 0 dBm ± 0.2. Adjust the 654A AMPLITUDE slightly so the 3555B indicates exactly 0 dBm.

4. Check the frequencies listed in Table 5-5 for the tolerances indicated.

b. 3 kHz FLAT FILTER RESPONSE

1. Set the 3555B NOISE WTG switch to 3 kHz FLAT.

2. Set the 654A frequency to 1 kHz and adjust the output level for 0 dBm on the 3555B.

3. Check the frequencies listed in Table 5-5 for the tolerances indicated.

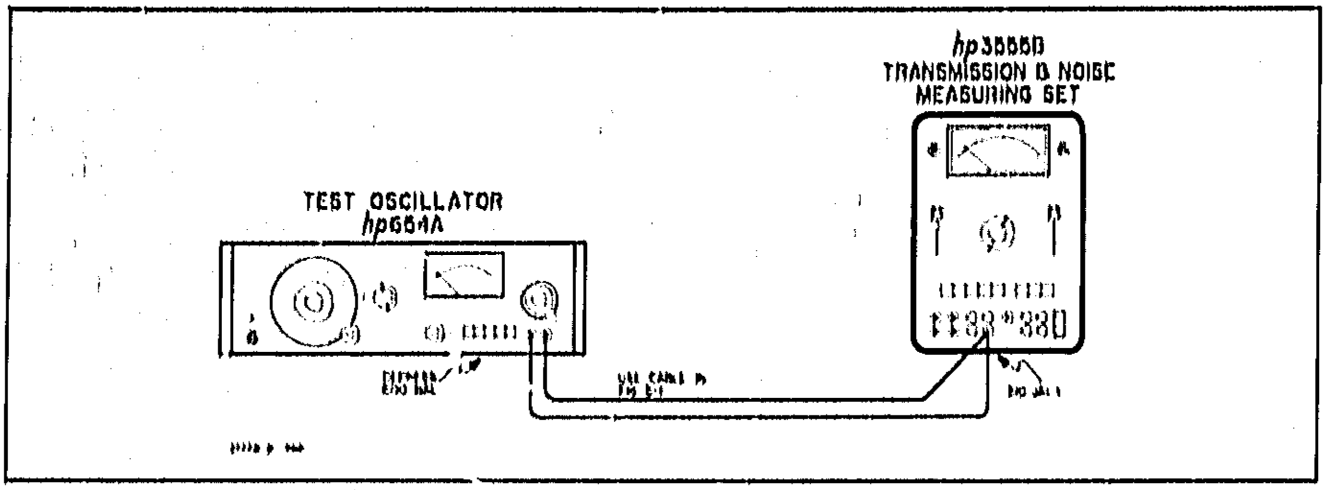


Figure 5-5. Filter Response Test Set-Up

c. 15 kHz FLAT FILTER RESPONSE

1. Set the 3555B NOISE WTG switch to 15 kHz FLAT.

2. Reset the 654A output level for 0 dBm indication on the 3555B meter at a frequency of 1 kHz.

3. Check the frequencies listed in Table 5-5 for the tolerances indicated.

d. PROG FILTER RESPONSE

1. Set the 3555B NOISE WTG switch to PROG.

2. Reset the 654A frequency to 1 kHz and adjust the output level for 0 dBm indication on the 3555B meter.

3. Check the frequencies listed in Table 5-5 for the tolerances indicated.

5-12. BRIDGING LOSS.

a. Connect the equipment as shown in Figure 5-6 and set the 3555B controls as follows:

FUNCTION . . . . DIAL
INPUT . . . . TMS BRDG
RANGE . . . . 0 dBm

b. Adjust the output of the 654A (600 BAL function) for a frequency of 1 kHz and an indication on the 3465A of .7746 V ac.

c. Depress the VF/Nm 600 BAL button on the 3555B. The reading on the 3465A should not drop by more than .0262 volts (.3 dB).

NOTE

$$\text{Bridging Loss} = 20 \log \frac{\text{reading}}{.7746}.$$

Table 5-5. Filter Response Checks

FREQUENCY	C MSG (dBm)	3 kHz FLAT (dBm)	15 kHz FLAT (dBm)	PROGRAM (dBm)
60Hz	-55.7 ± 2	0 ± 1.75	0 ± 1.75	
200Hz	-25 ± 2			-17.3 ± 2
250Hz		0 ± 1	0 ± 1	
500Hz	-7.5 ± 1			-6.6 ± 1
1kHz	0 (Ref)	0 (Ref)	0 (Ref)	0 (Ref)
2kHz	-1.3 ± 1	-0.5 ± 1.75		+4.8 ± 2
2.5kHz	-1.4 ± 1	-1.5 ± 2		
3kHz		-3 ± 3		+6.5 ± 2
4kHz	-14.5 ± 3			+6.5 ± 2
5kHz	-28.5 ± 3		0 ± 1	+6.5 ± 2
6kHz		-14.5 ± 3		+6.4 ± 3
8kHz				+4 ± 3
10kHz			-0.5 ± 1.75	-8.5 ± 4
12.5kHz			-1.5 ± 2	
15kHz			-3 ± 3	
20kHz			-7 ± 3	

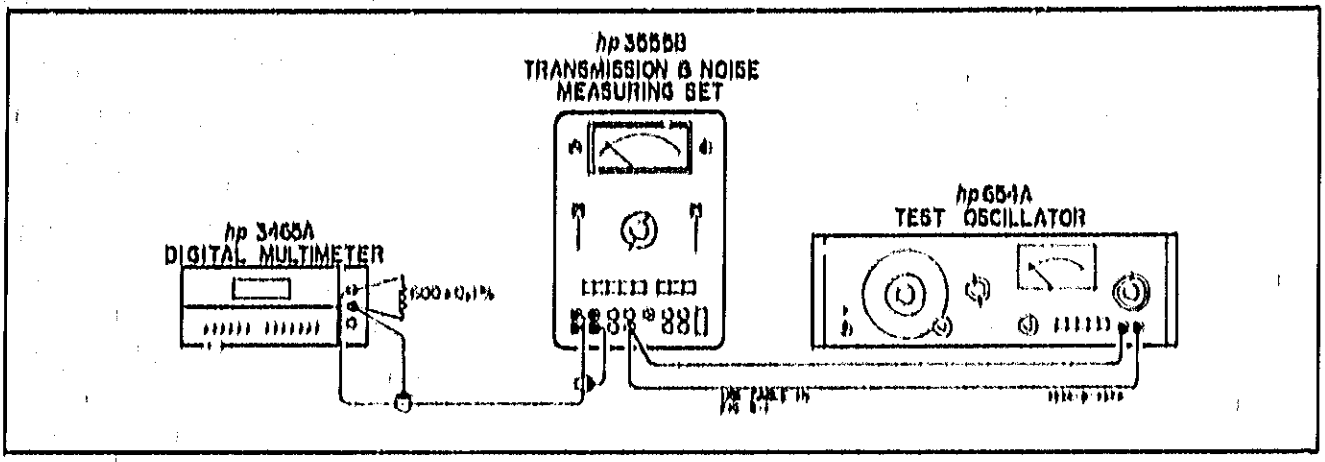


Figure 5-6. Bridging Loss Test Set-Up

d. Change the FUNCTION switch to CARRIER 600 BAL and repeat the above procedure at a frequency of 10 kHz. The 3465A indication should not drop by more than .0044 volts (.05 dB).

5-13. INPUT BALANCE.

a. Set the 3555B controls as follows:

FUNCTION . . . . VF/Nm, 600 BAL
INPUT . . . . TMS BRDG
RANGE . . . . 0 dBm

b. Connect the 654A 50 ohm UNBAL output to the tip and ring input (red binding posts) of the 3555B. Set the output frequency of the 654A to 60 Hz and adjust the amplitude control for 0 dBm indication on the 3555B meter.

c. Change the equipment setup to that shown in Figure 5-7.

d. Change the 3555B RANGE switch to -80 dBm. The 3555B indication (meter + RANGE setting) must be down over 80 dB.

e. Change the 3555B RANGE switch to -70 dBm and tune the 654A between 20 Hz and 6 kHz. The 3555B indication must be down over 70 dB.

f. Change 3555B RANGE switch to -50 dBm and tune the 654A between 6 kHz and 20 kHz. The 3555B indication must be down over 50 dB.

g. Change the 3555B FUNCTION switch to CARRIER 600 and repeat the above procedure. Between 1kHz and 10kHz, the balance must be greater than 70dB. Between 10kHz and 100kHz, the balance must be better than 60dB. Between 100kHz and 600kHz, balance must be better than 40dB.

5-14. ADJUSTMENT AND CALIBRATION PROCEDURE.

5-15. The following is a complete adjustment and calibration procedure for the Model 3555B. These adjustments should be performed only after it has been determined by the performance checks that the set is not operating within its published specifications.

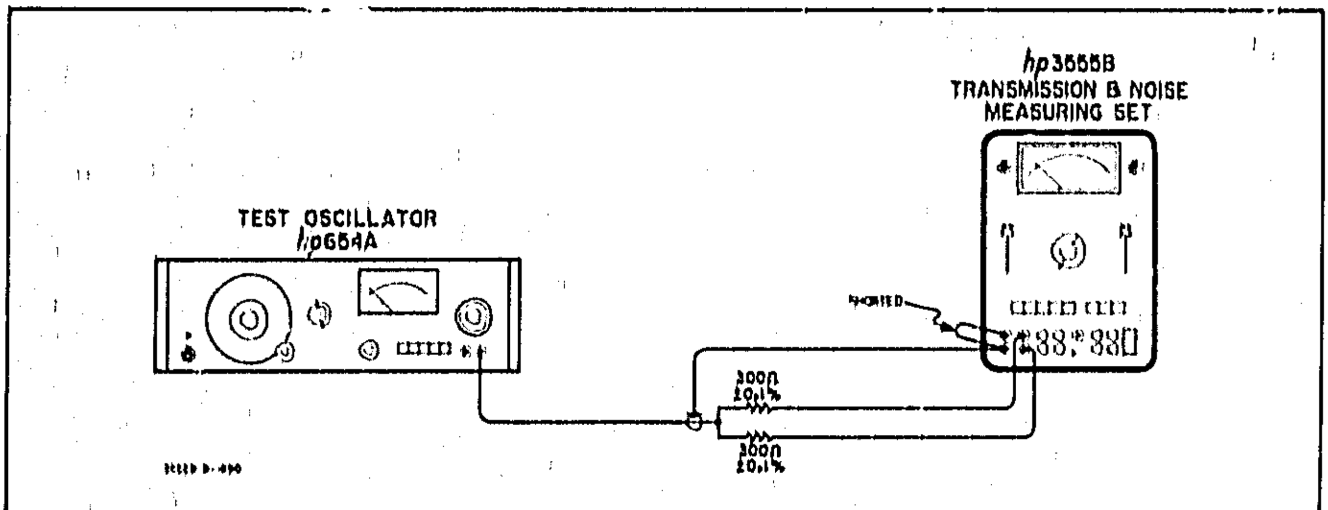


Figure 5-7. Input Balance Test Set-Up

NOTE

The inner shield covering the switches must be in place and fastened with at least one screw before calibration is attempted. Also the A3 board must have at least one screw holding it down at all times to provide a good ground return.

5-16. POWER SUPPLY CHECK.

5-17. Before attempting the following calibration procedures, first check the power supply voltage to be sure that it is correct and that the ripple voltage is not abnormal. To do this perform the following steps.

NOTE

Calibration of the 3555B should be performed with the set operating from the internal battery except for the power supply ripple check in the following steps. Operate the set from the ac power source long enough to make this check and then return the set to internal battery operation. This is accomplished by changing the position of the slide switch mounted on the side of the set. When operating from the battery, disconnect the ac power cord from the set.

CAUTION

Do not inadvertently change the line selector switch on the rear panel.

a. Remove the set from the case and connect the 3465A dc voltmeter between the -20 V supply and ground. The negative side of A3C34 is a convenient place.

b. Turn the set on. The 3465A should indicate -20 volts ± 1.0 V.

c. Set the 3465A to the 100 mV ac range and measure the ripple voltage. The maximum allowable ripple is 5 mV rms.

5-18. 75 UNBAL CALIBRATION.

a. Connect the 654A and 3465A to the 3555B as shown in Figure 5-2 and set the 3555B controls as follows:

FUNCTION . . . . 75 UNBAL
INPUT . . . . TMS, TERM
RANGE. . . . . +10 dBm

b. Set the 654A frequency to 10 kHz, 75 UNBAL, and adjust the output level for 866 mV ac (+10 dBm) indication on the 3465A.

c. Set the 654A meter for a reference indication and be sure to maintain this indication throughout the following procedures unless otherwise instructed.

d. Change the 654A to -50 dBm and change the 3555B RANGE switch to -50 dBm.

e. Disconnect the 3465A and the cable. Connect the 654A output directly to the 3555B input.

f. Adjust A3R43 for 0dBm indication on the 3555B meter.

g. Change 654A frequency to 3MHz maintaining the reference established on the 654A meter.

h. Adjust A3C8 for 0dBm indication on the 3555B meter.

5-19. ATTENUATOR CALIBRATION.

a. Remove the FUNCTION board (A1) and replace it with the test board supplied with the set. Reinstall the A3 board.

b. With the equipment and controls set as in the preceding check, change the 3555B RANGE to -40dBm and change the 654A attenuator to -40dBm. Change the 654A frequency to 100kHz.

c. Adjust A2C12 for 0dBm indication on the 3555B meter.

d. Change the 3555B RANGE switch to -30dBm and change the 654A attenuator to -30dBm. Adjust A2C7 for 0dBm indication on the 3555B meter.

e. Change the 3555B RANGE switch to -20dBm and change the 654A attenuator to -20dBm. Adjust A2C4 for 0dBm indication on the 3555B meter.

f. Change the 3555B RANGE switch to +10dBm and change the 654A attenuator to +10dBm. Adjust A2C1 for 0dBm indication on the 3555B meter.

g. Check the frequencies listed in Table 5-2 for the tolerance indicated. If any of the checks in Table 5-2 do not meet the indicated tolerances, repeat steps b through f.

5-20. FUNCTION CALIBRATION.

a. Remove the test board from the set and install the function board assembly A1. Reinstall the A3 board. Connect the 654A balanced output to the 3555B balanced input terminals. See Figure 5-5. Set the 3555B controls as follows:

FUNCTION . . . . CARRIER, 600 BAL
INPUT . . . . TMS, TERM
RANGE. . . . . -50 dBm

b. Set the 654A frequency to 10kHz and adjust the output attenuators for -50dBm output level, using the 600 BAL output function.

c. Adjust A3R15 for 0dBm indication on the 3555B meter.

d. Change the 654A frequency to 1 kHz. Change the 3555B FUNCTION switch to VF/Nm, 600 BAL. Compare the 3555B meter indication with the indication in Step c. If any difference exists, adjust A3R15 to split the difference between these two indications. Total difference should not exceed .1 dBm.

NOTE

If the set is being operated from the ac line ground currents may be encountered on the low ranges, particularly if other instruments are connected in any way to the 3555B. In order to eliminate this problem, operate the set from its own internal battery or use the C MSG filter. If the C MSG filter is used, perform the filter calibration described in Paragraph 5-24 and then perform the following step.

e. Change the 654A to -80dBm output level at 1.00kHz. Change the 3555B RANGE switch to -80dBm. Adjust A3R26 for 0dBm indication on the 3555B meter.

f. Change the 654A to 135 BAL (150 BAL) and change the 3555B FUNCTION to 135 BAL (150 BAL). Adjust A3R24 for 0dBm indication on the 3555B meter.

g. Change the 3555B RANGE switch to -50 dBm, and the FUNCTION switch to VF/Nm 600 BAL. Change the 654A output level to -50 dBm, 600 BAL. Adjust the AMPLITUDE control for exactly 0 dBm indication on the 3555B meter.

h. Change the 3555B FUNCTION switch to 900 BAL without changing anything else. Adjust A3R20 for -0.15 dBm indication on the 3555B meter.

5-21. FREQUENCY RESPONSE ADJUSTMENT.

a. The following adjustment consists of selecting fixed values for frequency compensation at 20 Hz, 600 BAL, -70 dBm; and 20 Hz, 900 BAL, 0 dBm.

b. Connect the 654A 600 BAL output to the 3555B input. Set the 3555B controls as follows:

FUNCTION	VF/Nm 900 BAL
INPUT	TMS, TERM
RANGE	0dBm
RESPONSE	DAMP

c. Set the 654A (600 BAL) output level to 0dBm at a frequency of 20Hz. The 3555B meter should indicate 0.15dBm ±0.3dBm. Note this indication.

d. Change the 654A output level to -70dBm at a frequency of 20Hz. Change the 3555B RANGE switch to -70dBm and change the FUNCTION to VF/Nm 600 BAL. The 3555B meter should indicate 0dBm ±0.3dBm. Note the exact indication.

e. Compensation should be made between the 900 BAL, 0 dBm check (Step c) and the 600 BAL, -70 dBm check (Step d). To raise the level, increase the value of A3R72 until the 900 BAL 0 dBm check indicates low by the same amount that the 600 BAL, -70 dBm check indicates high. The total difference should not exceed ± 0.4 dBm.

5-22. COMMON MODE ADJUSTMENT.

a. Connect the equipment as shown in Figure 5-5 and set the 3555B controls as follows:

FUNCTION	VF/Nm, 600 BAL
INPUT	TMS, TERM
RANGE	0dBm

b. Set the 654A frequency to 20kHz and adjust the output level of the 654A for 0dBm indication on the 3555B meter.

c. Disconnect the left output terminal on the 654A and short the tip and ring together (the red banana jacks) on the 3555B front panel. Down range the 3555B RANGE switch for an on-scale indication.

d. Adjust A1C7 for minimum indication on the 3555B meter. This indication must be down at least 50 dB.

e. Change the 3555B FUNCTION switch to CARRIER, 600 BAL and change the 654A frequency to 100kHz.

f. Adjust A1C4 for minimum indication on the 3555B meter. This indication must be down at least 60 dB.

5-23. BALANCE CHECK.

a. First check the balance as described in paragraph 5-13 to be sure that the balance does not meet specifications. If it does, disregard this step. If it does not perform the following procedure.

b. Since there are no adjustments for balance it will be necessary to change the value of a fixed factory selected capacitor. To adjust the balance on the

CARRIER function, change A1C5. To change the balance on VF/Nm, change the value of A1C8, (C4 and A1C9 may be changed as a last resort. See Table 5-11).

e. To determine whether the value of these capacitors should be increased or decreased, lightly touch the tip and ring banana jack insulators and watch the direction in which the meter indication goes. The side (tip or ring) that causes the meter indication to decrease needs added capacitance. The capacitance should be changed in very small steps and checked again.

5-24. FILTER CALIBRATION.

a. Connect the equipment as shown in Figure 5-5 and set the 3555B controls as follows:

FUNCTION . . . . VF/Nm, 600 BAL
RANGE . . . . 0 dBm
INPUT . . . . NOISE, TERM
NOISE WTG . . . . 3 kHz FLAT

b. Connect a frequency counter to the 654A COUNTER OUTPUT and adjust the 654A frequency to exactly 1.00 kHz as indicated on the frequency counter. Adjust the 654A output level for exactly 0 dBm.

c. Adjust A4R3C for 0dBm indication on the 3555B meter.

d. Change the NOISE WTG switch to 15kHz FLAT and note the meter indication. If it differs from the indication set up in step c, adjust A4R3C to split the difference between these two indications.

e. Change the 3555B NOISE WTG switch to C MSG and adjust A4R3A for 0 dBm indication on the 3555B meter (654A frequency of 1.00 kHz).

f. Change the 654A frequency to 3.00 kHz as indicated on the counter and adjust A4R3D for an indication of -2.15 dBm on the 3555B meter.

g. Repeat steps e and f until both points are within specifications.

h. Change the 3555B NOISE WTG switch to PROG and change the 654A frequency back to 1.00kHz with the output level still set to 0dBm. Adjust A4R3B for 0dBm indication on the 3555B meter.

5-25. ASSEMBLY REMOVAL.

5-26. To gain access to the various assemblies in the 3555B use the following procedure.

a. Turn the set off and remove it from the case by removing four front panel screws.

b. Unplug the small cable on the A3 assembly.

c. Remove the two screws that secure the A3 board.

d. Gently lift up the bottom of the A3 board to unplug it from the A1 FUNCTION assembly.

e. Hold the bottom of the A3 board high enough to clear the FUNCTION board and pull the A3 assembly out. This is easily accomplished by gently rocking the board back and forth while pulling it down (toward the FUNCTION board).

f. Once the A3 assembly has been removed, the A1 FUNCTION board can be removed by pulling it out.

g. To gain access to the RANGE attenuator (A2), input switch and the NOISE WTG switch, the shield must be removed. To do this, remove the two screws on each side of the set and lift out the shield.

h. To reassemble the set, use the reverse of the procedure described above.

5-27. TROUBLESHOOTING PROCEDURES.

5-28. The following information is supplied to assist in locating a malfunction in the set in a minimum of time. It should first be determined that a malfunction does indeed exist and that the trouble is not external to the set.

5-29. Before starting to troubleshoot the set, use the front panel controls to determine exactly which function, if any, is operating properly. Table 5-6 can aid you in this analysis. In many cases a good front panel analysis of the symptoms can lead you directly to the trouble.

5-30. To simplify troubleshooting the following information is supplied:

a. Troubleshooting Tree -- The troubleshooting tree (Figure 5-8) is based on the half-split method of troubleshooting a set. The trouble can be isolated to a general area or block using this tree. Once the trouble has been isolated to an area, a reference is given to a paragraph where more specific information can be found.

b. Functional Block Diagram -- The functional block diagram can also be used to isolate the trouble to block. The diagram contains all of the essential blocks that make up the set and includes voltage levels, test points and adjustments. The troubleshooting tree and functional block diagram are keyed together by the numbers with a circle around them. If the levels or indications in your set do not agree with those on the functional block diagram or troubleshooting tree, refer to the paragraph indicated for more detailed information.

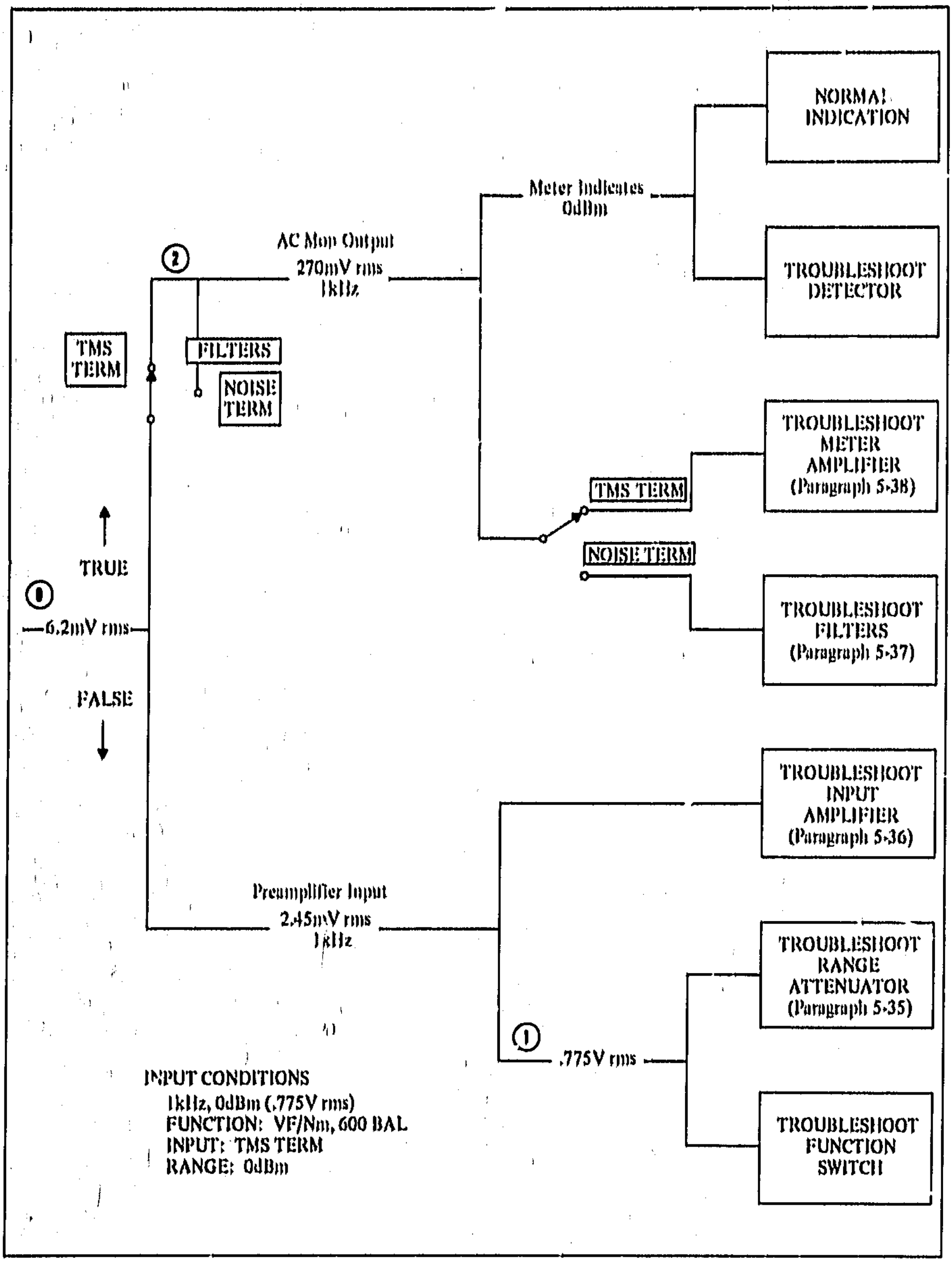


Figure 5-8. Troubleshooting Tree

Table 5-6. Front Panel Trouble Analysis

INPUT CONDITIONS	FUNCTION	3555B SHOULD INDICATE (RANGE + METER)*	SET ACTUALLY INDICATES	CORRECTIVE ACTION
FUNCTION: VF/Nm 1kHz, 0dBm, 600 BAL	DIAL BAT	In green area, BAT GOOD		Replace battery
	Input: TMS, TERM VF/Nm: 600 BAL	0dBm ±0.2dBm		Refer to Paragraph 5-34
	Change INPUT to BRDG RANGE to +10dBm	+6dBm ±0.2dBm		Refer to Paragraph 5-34
	Depress 900 BAL	+1.2dBm ±0.2dBm		Refer to Paragraph 5-34
	INPUT to TERM RANGE to 0dBm	-0.15dBm ±0.2dBm		Refer to Paragraph 5-34
FILTERS	INPUT: NOISE TERM	0dBm		Refer to Paragraph 5-37
	NOISE WTG: 3kHz FLAT VF/Nm, 600 BAL	0dBm ±0.2dBm		Refer to Paragraph 5-37
	Change to C MSG	0dBm ±0.2dBm		Refer to Paragraph 5-37
	Change to 15kHz FLAT	0dBm ±0.2dBm		Refer to Paragraph 5-37
	Change to PROG	0dBm ± 0.2dBm		Refer to Paragraph 5-37
FUNCTION: CARRIER 20kHz, 0dBm 600 BAL	INPUT: TMS, TERM FUNCTION: CARRIER 600 BAL	0dBm		Refer to Paragraph 5-34
	Change INPUT to BRDG RANGE to +10dBm	+6dBm ±0.5dBm		Refer to Paragraph 5-34
	Depress 135 BAL RANGE to +20dBm	+12.6dBm ±0.5dBm		Refer to Paragraph 5-34
	Change INPUT to TERM RANGE to 0dBm	-2.2dBm ±0.5dBm		Refer to Paragraph 5-34
Change to 75 UNBAL	INPUT: TMS, TERM FUNCTION: 75 UNBAL RANGE: 0dBm	0dBm ±0.2dBm		Refer to Paragraph 5-34
	Change INPUT to BRDG RANGE to 10dBm	+6dBm ±0.2dBm		Refer to Table 5-8
	Change INPUT back to TERM RANGE to 0dBm	0dBm ±0.2dBm		Refer to Table 5-8
RANGE 1kHz, 600 BAL, LEVEL +10dBm	Change RANGE to +10dBm FUNCTION: VF/Nm 600 BAL	+10dBm ±0.2dBm		See Paragraph 5-35
LEVEL -10dBm	Change RANGE to -10dBm	-10dBm ±0.2dBm		See Paragraph 5-35
LEVEL -20dBm	Change RANGE to -20dBm	-20dBm ±0.2dBm		See Paragraph 5-35

Table 5-6. Front Panel Trouble Analysis (Cont'd)

INPUT CONDITIONS	FUNCTION	3555B SHOULD INDICATE (RANGE + METER)*	SET ACTUALLY INDICATES	CORRECTIVE ACTION
LEVEL -30dBm	Change RANGE to -30dBm	-30dBm ±0.2dBm		See Paragraph 5-35
LEVEL -40dBm	Change RANGE to -40dBm	-40dBm ±0.2dBm		See Paragraph 5-35, Table 5-9
LEVEL -50dBm	Change RANGE to -50dBm	-50dBm ±0.2dBm		See Paragraph 5-35, Table 5-9
LEVEL -60dBm	Change RANGE to -60dBm	-60dBm ±0.2dBm		See Paragraph 5-35, Table 5-9
LEVEL -70dBm	Change RANGE to -70dBm	-70dBm ±0.2dBm		See Paragraph 5-35, Table 5-9
LEVEL -80dBm	Change RANGE to -80dBm	-80dBm ±0.2dBm		See Paragraph 5-35, Table 5-9
LEVEL 0dBm	RANGE to 0dBm INPUT: TMS, TERM	0dBm Measure 275 mV ac ± 30 mV at AC MON jacks		See Paragraph 5-38
Ng CHECK 75 UNBAL, Connect UNBAL signal at 1 kHz between tip and ring	RANGE: 0dBm FUNCTION: VF/Nm 600 BAL	Adjust oscillator level for 0dBm on 3555B meter		
Change input connection. Connect signal between ring and sleeve (tip and ring shorted together), ground lead to sleeve	Depress Ng button Change RANGE to -40 dBm	-40dBm ± .5 *Some meter jitter may be experienced, but the reading should be within the tolerance indicated.		Refer to Table 5-8

c. Schematics -- The schematic diagrams contain dc voltage levels and signal levels for a specified input condition. This will assist in troubleshooting individual circuits.

5-31. FRONT PANEL TROUBLESHOOTING.

5-32. Before attempting to troubleshoot the set, first determine from the front panel controls exactly which functions are performing properly and which ones are not. In this way, many troubles can be isolated to a specific area and sometimes to a component.

5-33. Table 5-6 is a step by step procedure for checking out the front panel controls. This table indicates what the results should be for each check along with the specified tolerance. A space is provided to enter your results. If these spaces are completed for each check, they will be of great assistance in making further troubleshooting checks. Whenever a discrepancy exists between your results and those indicated in column 3, refer to the "corrective action" column.

NOTE

This table is designed to help locate catastrophic failures. If your set is only out of the specified tolerances, a complete adjustment and calibration procedure should be performed as described in Paragraph 5-14.

5-34. FUNCTION TROUBLESHOOTING.

a. First determine from the Front Panel Analysis chart (Table 5-6) exactly which function is defective. Refer to Table 5-7 for the probable cause of the malfunction in the FUNCTION switch assembly.

Table 5-7. Function Troubleshooting

DEFECTIVE FUNCTION	VF/Nm	CARRIER
75 UNBAL		A3K2, A1S8
135 BAL		A1T1, A3K3, A3R22,A3R23, A3L1, A3R24
600 BAL		A1T1, A1S6
600 BAL	A1T2	
900 BAL	A1T2, A3K1, A3R19, A3R20 A1S4	
Ng	A1R5 thru A1R8, A1C1, A1S3	
HOLD	L1A/B, A1S1, S1	
DIAL BAT	A1S2, A3R59	

5-35. RANGE TROUBLESHOOTING.

a. First determine from the Front Panel Trouble Analysis chart (Table 5-6) exactly which range or ranges are defective.

b. Refer to Table 5-9 to determine the changes that take place when switching ranges. Select the attenuator pads and/or gain switching resistors that match your symptom and check them.

5-36. TROUBLESHOOTING THE INPUT AMPLIFIER.

a. Check the dc voltages as indicated in Figure 7-3 to determine if a catastrophic failure does exist. If the dc voltages are abnormal (greater than ±10% of the indicated level), check for open or shorted components in the area of the abnormal indication.

b. Check to see that A3K1, A3K2 and A3K3 are operating properly. All relays are de-energized when either of the 600 BAL FUNCTION pushbuttons is depressed. Depress each of the other impedance functions (900 BAL, 135 BAL and 75 UNBAL) to see that A3K1, A3K3 and A3K2 respectively, energize and de-energize properly. If any relay fails to operate properly, check the relay and the energizing ground supplied through either pins 1, 2 or 3 on XA1.

5-37. FILTER TROUBLESHOOTING.

a. First determine that the set is operating in the TMS input mode. This bypasses the filters. If the set functions properly in the TMS mode, check each of the filters by applying a 1kHz signal at a 0dBm level to the set. All filters are calibrated for 0dBm indication on the 3555B meter at a frequency of 1kHz.

b. Since all the amplifiers in Figure 7-1 are used in C MSG, the loss of any one will obviously cause the loss of the C MSG weighting. However, the bad amplifier can be isolated by checking the other filters. Use the following guide to isolate the trouble to a particular amplifier.

1. First be sure that the filters have the correct operating potential applied. Check the voltage at the junction of A4R49 and A4C33 to be sure that there -20 volts ± 1 volt.

2. If none of the filters work, check Amplifier 3 in Figure 7-1 (A4Q11 through A4Q14).

3. If the PROG filter does not work but the others do, check Amplifier 6 (A4Q5 and A4Q6).

4. If C MSG does not work but the others do, check Amplifiers 1, 4, and 5.

c. After the trouble has been isolated to an amplifier, check the dc potentials indicated on the schematic diagram. This will normally isolate the trouble to a component. If the dc levels are correct but the filter response is out of tolerance, no attempt should be made to change the filter characteristics. Return the filter to your nearest -hp- Sales and Service office listed in the back of this manual.

5-38. TROUBLESHOOTING THE METER AMPLIFIER AND DETECTOR.

a. Inject a 1kHz, 0dBm signal (.775V rms) into the 3555B and set the INPUT switch to TMS TERM, RANGE to 0dBm and the FUNCTION to VF/Nm, 600 BAL. Measure the signal at the input of the meter amplifier (XA3 pin 9). The signal level should be 6.2mV rms. If not the malfunction is ahead of the meter amplifier (refer to troubleshooting tree, Figure 5-8).

Table 5-8. FUNCTION Switch Resistance Values

NOTE

The following resistance measurements were made with C1 shorted. Be sure to remove the short after completion of your measurements.

FUNCTION	INPUT JACKS				DIAL/AC MON JACKS	
	Tip to Ring		Tip to Ground		Ring to Ground	
	BRDG	TERM	BRDG	TERM	BRDG	TERM
DIAL BAT						
Ng	80.4 kilohms	80.4 kilohms				
VF/dBm						
900 BAL		900 ohms			DIAL JACKS, resistance is infinite Tip to Ring, Tip to Ground and Ring to Ground on all functions.	
900 BAL HOLD		400 ohms				
600 BAL		600 ohms				
600 BAL HOLD		350 ohms				
CARRIER						
600 BAL		600 ohms				
600 BAL HOLD		600 ohms				
135 BAL		135 ohms				
135 BAL HOLD		135 ohms				
75 UNBAL, to Ground		BRDG:	100 kilohms,		-30dBm thru +30dBm ranges	
			120 Kilohms,		-40dBm Range	
			400 kilohms,		-50dBm thru -80dBm ranges	
		TERM:	75 ohms			

b. With a 6.2 mV rms signal at XA3 pin 9, measure the signal at XA1, pin 6 or at the AC MON jacks. This signal should be 275 ± 30 mV. If not, check A3Q6 through A3Q10 and associated components, using the dc levels indicated in Figure 5-5.

c. If a 275 mV rms signal appears at the AC MON jacks, check the detector circuit (A3Q11 through A3Q17).

5-39. FACTORY SELECTED VALUES.

5-40. Table 5-11 lists all the factory selected components in the Model 3555B, along with the purpose of each. Nominal values are shown on the schematic diagrams in Section VII and in the parts list, Table 6-1.

Table 5-9. Range Attenuation and Amplifier Gain

RANGES	Attenuator Pads Used (See Figure 7-3) A	B	C	D	Amplifier Gain Switching
+30	X	X	X		
+20	X	X		X	
+10	X	X			
0		X	X		
-10		X		X	
-20		X			
-30			X		
-40				X	
-50					
-60					A2R13, A2R14
-70					A2R13
-80					
Ranges Affected if Defective	+30 +20 +10	-20 thru +30	+30 0 -30	+20 -10 -40	-60 and -70

Table 5-11. Factory Selected Values

Designator	Purpose
C4	Adjust balance at 600 kHz, 135 BAL.
A1C5	Padding capacitor for A1C4
A1C9	Adjust balance 20 kHz, 600 BAL (VF/Nm)
A1C8	Padding capacitor for A1C7
A1C10 and A1R12	Frequency response correction for A1T1
A1R14	600 BAL, VF/Nm calibration
A3C1	Padding capacitor for A2C12
A3C15	Frequency response, 20 Hz, -80 dBm, 600 BAL (VF/Nm)
A3R44	Use 1180 Ω with meters having .5 mA movements, and 1240 Ω for meters having .488 mA movements
A3R46	Adjust the bias level for A3Q10 (-10 V at + side of A3C24)
A3R72	Response, 20 Hz, 600 BAL (VF/Nm) -70 dBm and 20 Hz, 900 BAL, 0 dBm. Compromise between these two settings.
A3R74 and A3R75	Meter tracking at 1/10 full scale.

Table 5-10. Resistance Checks on Connector XA3

RANGE (dBm)	Pin 1 to 3	Pin 2 to 3	Pin 1 to 2
-50 thru +30	154 kilohms	< 1 ohm	> 150 kilohms
-60	13 kilohms	28.64 kilohms	41.6 kilohms
-70	2.33 kilohms	28.64 kilohms	31 kilohms
-80	< 1 ohm	28.64 kilohms	28.64 kilohms

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 3555B
Transmission and Noise Measuring Set
Serial No. ______________________

Tests Performed By ______________________

Date ______________________

DESCRIPTION	CHECK
CARRIER 75 UNBAL	
LEVEL ACCURACY CHECK	
30 Hz to 1 MHz	
+10 dBm Input	______ +10 dBm ± 0.5 dBm
0 dBm Input	______ 0 dBm ± 0.5 dBm
-10 dBm Input	______ -10 dBm ± 0.5 dBm
-20 dBm Input	______ -20 dBm ± 0.5 dBm
-30 dBm Input	______ -30 dBm ± 0.5 dBm
-40 dBm Input	______ -40 dBm ± 0.5 dBm
-50 dBm Input	______ -50 dBm ± 0.5 dBm
-60 dBm Input	______ -60 dBm ± 0.5 dBm
100 Hz to 600 Hz	
+10 dBm Input	______ +10 dBm ± 0.2 dBm
0 dBm Input	______ 0 dBm ± 0.2 dBm
-10 dBm Input	______ -10 dBm ± 0.2 dBm
-20 dBm Input	______ -20 dBm ± 0.2 dBm
-30 dBm Input	______ -30 dBm ± 0.2 dBm
-40 dBm Input	______ -40 dBm ± 0.2 dBm
-50 dBm Input	______ -50 dBm ± 0.2 dBm
-60 dBm Input	______ -60 dBm ± 0.2 dBm
1 MHz to 3 MHz	
+10 dBm Input	______ +10 dBm ± 0.5 dBm ± 10% of meter indication
0 dBm Input	______ 0 dBm ± 0.5 dBm ± 10% of meter indication
-10 dBm Input	______ -10 dBm ± 0.5 dBm ± 10% of meter indication
-20 dBm Input	______ -20 dBm ± 0.5 dBm ± 10% of meter indication
-30 dBm Input	______ -30 dBm ± 0.5 dBm ± 10% of meter indication
-40 dBm Input	______ -40 dBm ± 0.5 dBm ± 10% of meter indication
-50 dBm Input	______ -50 dBm ± 0.5 dBm ± 10% of meter indication
-60 dBm Input	______ -60 dBm ± 0.5 dBm ± 10% of meter indication
CARRIER 135 BAL	
LEVEL ACCURACY CHECK	
1 kHz to 600 kHz	
+10 dBm Input	______ +10 dBm ± 0.5 dBm
0 dBm Input	______ 0 dBm ± 0.5 dBm
-10 dBm Input	______ -10 dBm ± 0.5 dBm
-20 dBm Input	______ -20 dBm ± 0.5 dBm
-30 dBm Input	______ -30 dBm ± 0.5 dBm
-40 dBm Input	______ -40 dBm ± 0.5 dBm
-50 dBm Input	______ -50 dBm ± 0.5 dBm
-60 dBm Input	______ -60 dBm ± 0.5 dBm
10 kHz to 300 kHz	
+10 dBm Input	______ +10 dBm ± 0.2 dBm*
0 dBm Input	______ 0 dBm ± 0.2 dBm*
-10 dBm Input	______ -10 dBm ± 0.2 dBm*
-20 dBm Input	______ -20 dBm ± 0.2 dBm*
-30 dBm Input	______ -30 dBm ± 0.2 dBm*
-40 dBm Input	______ -40 dBm ± 0.2 dBm*
-50 dBm Input	______ -50 dBm ± 0.2 dBm*
-60 dBm Input	______ -60 dBm ± 0.2 dBm*

*Spec is ± 0.5 dBm if operating on ac line power.

CARRIER 600 BAL LEVEL ACCURACY CHECK		
1 kHz to 150 kHz		
+10 dBm Input		+10 dBm ± 0.5 dBm
0 dBm Input		0 dBm ± 0.[illegible] dBm
-10 dBm Input		-10 dBm ± 0.5 dBm
-20 dBm Input		-20 dBm ± 0.5 dBm
-30 dBm Input		-30 dBm ± 0.5 dBm
-40 dBm Input		-40 dBm ± 0.5 dBm
-50 dBm Input		-50 dBm ± 0.5 dBm
-60 dBm Input		-60 dBm ± 0.5 dBm
10 kHz to 100 kHz		
+10 dBm Input		+10 dBm ± 0.2 dBm
0 dBm Input		0 dBm ± 0.2 dBm
-10 dBm Input		-10 dBm ± 0.2 dBm
-20 dBm Input		-20 dBm ± 0.2 dBm
-30 dBm Input		-30 dBm ± 0.2 dBm
-40 dBm Input		-40 dBm ± 0.2 dBm
-50 dBm Input		-50 dBm ± 0.2 dBm
-60 dBm Input		-60 dBm ± 0.2 dBm

VF/Nm 600 BAL and 900 BAL LEVEL ACCURACY CHECK	600 ohms	900 ohms	
20 Hz to 40 Hz			
0 dBm Range			0 dBm ± 0.5 dBm
-10 dBm Range			-10 dBm ± 0.5 dBm
-20 dBm Range			-20 dBm ± 0.5 dBm
-30 dBm Range			-30 dBm ± 0.5 dBm
-40 dBm Range			-40 dBm ± 0.5 dBm
-50 dBm Range			-50 dBm ± 0.5 dBm
-60 dBm Range			-60 dBm ± 0.5 dBm
-70 dBm Range			-70 dBm ± 0.5 dBm
-80 dBm Range			-80 dBm ± 0.5 dBm
40 Hz to 100 Hz			
0 dBm Range			0 dBm ± 0.2 dBm
-10 dBm Range			-10 dBm ± 0.2 dBm
-20 dBm Range			-20 dBm ± 0.2 dBm
-30 dBm Range			-30 dBm ± 0.2 dBm
-40 dBm Range			-40 dBm ± 0.2 dBm
-50 dBm Range			-50 dBm ± 0.2 dBm
-60 dBm Range			-60 dBm ± 0.2 dBm
-70 dBm Range			-70 dBm ± 0.5 dBm
-80 dBm Range			-80 dBm ± 0.5 dBm
100 Hz to 15 kHz			
+30 dBm Range			+30 dBm ± 0.2 dBm
+20 dBm Range			+20 dBm ± 0.2 dBm
+10 dBm Range			+10 dBm ± 0.2 dBm
0 dBm Range			0 dBm ± 0.2 dBm
-10 dBm Range			-10 dBm ± 0.2 dBm
-20 dBm Range			-20 dBm ± 0.2 dBm
-30 dBm Range			-30 dBm ± 0.2 dBm
-40 dBm Range			-40 dBm ± 0.2 dBm
-50 dBm Range			-50 dBm ± 0.2 dBm
-60 dBm Range			-60 dBm ± 0.2 dBm
-70 dBm Range			-70 dBm ± 0.5 dBm
-80 dBm Range			-80 dBm ± 0.5 dBm

PERFORMANCE CHECK TEST CARD (Cont'd)

	600 ohms	900 ohms	
15 kHz to 20 kHz			
+30 dBm Range	______	______	+30 dBm ± 0.5 dBm
+20 dBm Range	______	______	+20 dBm ± 0.5 dBm
+10 dBm Range	______	______	+10 dBm ± 0.5 dBm
0 dBm Range	______	______	0 dBm ± 0.5 dBm
-10 dBm Range	______	______	-10 dBm ± 0.5 dBm
-20 dBm Range	______	______	-20 dBm ± 0.5 dBm
-30 dBm Range	______	______	-30 dBm ± 0.5 dBm
-40 dBm Range	______	______	-40 dBm ± 0.5 dBm
-50 dBm Range	______	______	-50 dBm ± 0.5 dBm
-60 dBm Range	______	______	-60 dBm ± 0.5 dBm
-70 dBm Range	______	______	-70 dBm ± 0.5 dBm
-80 dBm Range	______	______	-80 dBm ± 0.5 dBm
RETURN LOSS CHECK	600 ohms	900 ohms	
VF/Nm			
600 ohms, 50 Hz to 20 kHz	______	______	>30 dB
900 ohms, 50 Hz to 20 kHz	______	______	>30 dB
CARRIER			
600 ohms, 1 kHz to 150 kHz	______	______	>26 dB
135 ohms, 1 kHz to 600 kHz	______	______	>26 dB
75 ohms, 30 Hz to 3 MHz	______	______	>30 dB
FILTER RESPONSE CHECKS			
C-MSG			
60 Hz		______	-55.7 dBm ± 2 dBm
200 Hz		______	-25 dBm ± 2 dBm
500 Hz		______	-7.5 dBm ± 1 dBm
1 kHz		______	0 dBm (Ref)
2 kHz		______	-1.3 dBm ± 1 dBm
2.5 kHz		______	-1.4 dBm ± 1 dBm
4 kHz		______	-14.5 dBm ± 3 dBm
5 kHz		______	-28.5 dBm ± 3 dBm
3 kHz FLAT			
60 Hz		______	0 dBm ± 1.75 dBm
250 Hz		______	0 dBm ± 1 dBm
1 kHz		______	0 dBm (Ref)
2 kHz		______	-0.5 dBm ± 1.75 dBm
2.5 kHz		______	-1.5 dBm ± 2 dBm
3 kHz		______	-3 dBm ± 3 dBm
6 kHz		______	-14.5 dBm ± 3 dBm
15 kHz FLAT			
60 Hz		______	0 dBm ± 1.75 dBm
250 Hz		______	0 dBm ± 1 dBm
1 kHz		______	0 dBm (Ref)
5 kHz		______	0 dBm ± 1 dBm
10 kHz		______	-0.5 dBm ± 1.75 dBm
12.5 kHz		______	-1.5 dBm ± 2 dBm
15 kHz		______	-3 dBm ± 3 dBm
20 kHz		______	-7 dBm ± 3 dBm
PROGRAM			
200 Hz		______	-17.3 dBm ± 2 dBm
500 Hz		______	-6.6 dBm ± 1 dBm
1 kHz		______	0 dBm (Ref)
2 kHz		______	+4.8 dBm ± 2 dBm
3 kHz		______	+6.5 dBm ± 2 dBm
4 kHz		______	+6.5 dBm ± 2 dBm
5 kHz		______	+6.5 dBm ± 2 dBm
6 kHz		______	+6.4 dBm ± 3 dBm
8 kHz		______	+4 dBm ± 3 dBm
10 kHz		______	-8.5 dBm ± 4 dBm

PERFORMANCE CHECK TEST CARD (Cont'd)

BRIDGING LOSS CHECK		
VF/Nm 600 BAL, 1 kHz	________	< 0.3 dBm
CARRIER 600 BAL, 10 kHz	________	< .05 dBm
INPUT BALANCE CHECK		
VF/Nm 600 BAL		
60 Hz	________	> 80 dB
20 Hz to 6 kHz	________	> 70 dB
6 kHz to 20 kHz	________	> 50 dB
CARRIER 600 BAL		
1 kHz to 10 kHz	________	> 70 dB
10 kHz to 100 kHz	________	> 60 dB
100 kHz to 600 kHz	________	> 40 dB

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 ... ampere(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
fxd ... fixed

GaAs ... gallium arsenide
GHz ... gigahertz = 10^{9} hertz
gl ... glass
Ge ... germanium
grd ... ground(ed)

H ... henry(ies)
Hg ... mercury

Hz ... hertz (cycle(s) 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 flm ... metal film
mfr ... manufacturer
ms ... millisecond
mtg ... mounting
mV ... millivolt(s) = 10^{-3} volts
μF ... microfarad(s)
μA ... microampere(s)
μV ... microvolt(s) = 10^{-6} volts
my ... Mylar(R)

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)
obd ... 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)

(R) Dupont de Nemours

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}
deka	da	10	femto	f	10^{-15}
deci	d	10^{-1}	atto	a	10^{-18}

STD-B-7734

DESIGNATORS

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

Table 6-1. Replaceable Parts

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A1	**03555-66507**	**1**	**PC Board Ass'y: function**	**-hp-**	
C1	0170-0055	1	C: fxd mylar 0.1uF +/-20% 200 vdcw	56289	192P10402-PTS
C2,C3	0180-0089	2	C: fxd Al elect 10uF +50% -10% 150 vdcw	56289	30D106F150DD2-DSM
C4	0121-0105	3	C: var 9-35pF	72982	538-00604D
C5*	0160-0205	2	C: fxd mica 10pF +/-5%	72136	RDM15C100J5S
C6	0160-2200	1	C: fxd mica 150pF +/-5%	72136	RDM15F151J3C
C7					
C8*					
C9*	0140-0176	1	C: fxd 100pF +/-2% 300 vdcw Mica	72136	DM15F101G0300WV1CR
C10*			Normally not loaded		
R1	0698-0000	2	R: fxd met flm 464 ohms +/-1% 1/2W	91637	MFF-1/2-T-1 obd
R2	0811-2846	2	R: fxd ww 300 ohms +/-1% 1/2W	-hp-	
R3	0684-2211	3	R: fxd comp 220 ohms +/-10% 1/4W	01121	CB2211
R4	0811-2847	2	R: fxd ww 67.5 ohms +/-1% 1/2W	-hp-	
R5,R6	0698-3499	2	R: fxd met flm 40.2 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R7	0698-4503	1	R: fxd met flm 78.7 kilohms +/-1% 1/8W	14674	C4 obd
R8	0698-4467	1	R: fxd met flm 1.05 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R9	0698-0000		R: fxd met flm 464 ohms +/-1% 1/2W	91637	MFF-1/2-T-1 obd
R10	0811-2846		R: fxd ww 300 ohms +/-1% 1/2W	-hp-	
R11	0684-2211		R: fxd comp 220 ohms +/-10% 1/4W	01121	CB2211
R12*	0684-8211		R: 820 10% .25W	01121	CB8211
R13	0811-2704		R: fxd prec ww 25 kilohms 5%	-hp-	
R14*	0684-3311		R: 330 10% .25W	01121	CB3311
R15	0757-0472	3	R: fxd met flm 200 kilohms +/-1% 1/8W	75042	CEA obd
R16	0811-2847		R: fxd ww 67.5 ohms +/-1% 1/2W	-hp-	
R17	0683-1505	1	R: fxd 15 ohms +/-5% 1/4W	01121	CB1505
S1	3100-1703	1	Switch Ass'y: pushbutton	71590	1332 obd
T1	9100-1458	1	Transformer: carrier frequency	-hp-	
T2	9100-1460	1	Transformer: audio	-hp-	
W1	03555-61616	1	Cable Ass'y: function	-hp-	
A2	**03555-66509**	**1**	**PC Board Ass'y: range switch**	**-hp-**	
C1	0121-0128	4	C: var 1.4-9.2pF air trim	74970	189-503-5
C2	0160-0196	2	C: fxd mica 24pF +/-5%	72136	RDM15C240J3S
C3	0160-2130	4	C: fxd mica 865pF +/-1% 100 vdcw	72136	RDM15F(865)F1C
C4	0121-0128		C: var 1.4-9.2pF air trim	74970	189-503-5
C5	0160-0196		C: fxd mica 24pF +/-5%	72136	RDM15C240J3S
C6	0160-2130		C: fxd mica 865pF +/-1% 100 vdcw	72136	RDM15F(865)F1C
C7	0121-0128		C: var 1.4-9.2pF air trim	74970	189-503-5
†C8	0160-2307	1	C: fxd mica 47pF 5%	00853	RDM15E470J3C
†C9	0160-3482	1	C: fxd mica 430pF 1% 300 vdcw	14655	RDM15F431F3C
†C10	0160-3686	1	C: fxd mica 43pF 300 vdcw	72136	RDM15E430D3C
†C11	0160-3083	1	C: fxd mica 62pF 1% 500 V	72136	RDM15D620F5C
C12	0121-0128		C: var 1.4-9.2pF air trim	74970	189-503-5
R1	0698-7330	2	R: fxd flm 96.84 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R2	0698-7329	2	R: fxd met flm 3.266 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R3	0684-2701	2	R: fxd comp 27 ohms +/-10% 1/4W	01121	CB2701
R4	0698-7330		R: fxd flm 96.84 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R5	0698-7329		R: fxd met flm 3.266 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd

† See backdating in Appendix C.

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

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A2 (Cont'd)					
R6	0683-1805	1	R: fxd comp 18 ohms +/-5% 1/4W	01121	CB1805
R7	0698-4342	1	R: fxd met flm 90 kilohms +/-0.1% 1/8W	01637	MF-1/10-32 obd
R8	0698-4330	1	R: fxd met flm 11.11 kilohms +/-0.1% 1/8W	01637	MF-1/10-32 obd
R9	0698-5005	1	R: fxd carbon comp 12 ohms +/-10% 1/2W	01121	CB1201
R10	0698-7328	1	R: fxd met flm 68.38 kilohms +/-0.1% 1/8W	01637	MF-1/10-32 obd
R11	0698-7331	1	R: met flm 46.28 kilohms +/-0.1% 1/8W	01637	MF-1/10-32 obd
R12			Not assigned		
R13	0698-3150	1	R: fxd met flm 2.37 kilohms +/-1% 1/8W	01637	MF-1/10-32 obd
R14	0698-3264	1	R: fxd met flm 11.8 kilohms +/-1% 1/8W	14674	C4 obd
S1	3100-2709	1	Switch: rotary range	-hp-	
A3	**03555-66508**	**1**	**Board Ass'y: amplifier**	**-hp-**	
C1*		2	Normally not loaded		
C2	0180-0197	5	C: fxd Ta 2.2uF +/- 10% 20 vdcw		
C3	0180-1746	4	C: fxd Ta elect 15uF +/- 10% 20 vdcw		
C4	0160-2064	6	C: fxd cer 0.01 uF +80% -20% 25 vdcw	72982	5835-000-Y5U0-1032
C5	0140-0201		C: fxd 12pF +/- 5% 500 vdcw Mica	72136	DM15C120J0500WV1CR
C6,C7	0160-0378	2	C: fxd mica 27pF +/-5%	72136	RDM15E270J5S
C8	0121-0105		C: var 9-35pF	72982	538-00694D
C9	0140-0196	1	C: fxd mica 150pF +/-5%	72136	RDM15F151J3C
C10	0180-0228	10	C: fxd Ta elect 22uF +/-10% 15 vdcw	37942	TA5226K015P1C
C11	0180-0106	1	C: fxd Ta 60uF +/-20% 6 vdcw	56289	90803
C12 thru C14	0160-2064		C: fxd cer 0.01uF +80% -20% 25 vdcw	72982	5835-000-Y5U0-1032
C15*	0180-0228		C: fxd Ta elect 22uF +/-10% 15 vdcw	37942	TA5226K015P1C
C16	0180-0393	3	C: fxd Ta elect 39uF +/-10% -10 vdcw	37942	TAS396K010P1C
C17	0160-2064		C: fxd cer 0.01uF +80% -20% 25 vdcw	72982	5835-000-Y5U0-1032
C18			Not assigned		
C19	0180-0197		C: fxd Ta 2.2uF +/-10% 20 vdcw	56289	150D225X0020A2-DYS
C20	0160-0763		C: fxd mica 5pF +/-10%	72136	RDM15C050K5S
C21	0180-1702	1	C: fxd Ta elect 180uF +/-20% 6 vdcw	37942	obd
C22	0160-2064		C: fxd cer 0.01uF +80% -20% 25 vdcw	72982	5835-000-Y5U0-1032
C23	0180-0197		C: fxd Ta 2.2uF +/-10% 20 vdcw	56289	150D225X0020A2-DYS
C24	0180-0137	1	C: fxd Ta 100uF +/-20% 10 vdcw	56289	150D107X0010R2-DYS
C25	0180-0197		C: fxd Ta 2.2uF +/-10% 20 vdcw	56289	150D225X0020A2-DYS
C26	0150-0011	1	C: fxd TiO_2 1.5pF +/-20% 500 vdcw	78488	Type GA obd
C27	0180-0393		C: fxd Ta elect 39uF +/-10% -10 vdcw	37942	TAS396K010P1C
C28	0180-0106	1	C: fxd Ta 56uF +/-10% 15 vdcw	37942	TA5566K015P1F
C29	0180-0374	1	C: fxd Ta elect 10uF +/-10% 20 vdcw	37942	TA5106K020P1C
C30 thru C32	0180-0228		C: fxd Ta elect 22uF +/-10% 15 vdcw	37942	TA5226K015P1C
C33	0180-0197		C: fxd Ta 2.2uF +/-10% 20 vdcw	56289	150D225X0020A2-DYS
C34	0180-1794	1	C: fxd Ta elect 22uF +/-10% 35 vdcw	56289	150D226X0035R2-DYS
C35 thru C37	0180-1746		C: fxd Ta elect 15uF +/-10% 20 vdcw	56289	150D156X0020B2-DY[illegible]
CR1,CR2	1901-0376	2	Diode: Si 35 wiv 2pF	07933	RD5288
CR3,CR4	1902-3030	4	Diode: zener 3.01V +/- 5% 400mW 20mA	04713	SZ10939-32
CR5 thru CR7	1901-0040	11	Diode: Si 30 wiv 2pF .05A 2ns	07263	FDG1088
CR8	1902-1275	3	Diode: zener 6.2V +/-5% 400mW 7.5mA	04713	Type 1N821
CR9	1902-3030		Diode: zener 3.01V +/-5% 400mW 20mA	04713	SZ10939-32
CR10	1901-0040		Diode: Si 30 wiv 2pF .05A 2ns	07263	FDG1088
CR11	1902-3030		Diode: zener 3.01V +/-5% 400mW 20mA	04713	SZ10939-32
CR12,CR13	1901-0040		Diode: Si 30 wiv 2pF .05A 2ns	07263	FDG1088
CR14	1902-1275		Diode: zener 6.2V +/-5% 400mW 7.5mA	04713	Type 1N821
CR15,CR16	1901-0040		Diode: Si 30 wiv 2pF .05A 2ns	07263	FDG1088
CR17	1901-0025	7	Diode: Si 100 wiv 12pF 100mA	24446	SS410
CR18,CR19	1901-0040		Diode: Si 30 wiv 2pF .05A 2ns	07263	FDG1088

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

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A3 (Cont'd)					
CR20	1902-1276		Diode: zener 6.2V +/-5% 400mW 7.5mA	04713	Type 1N821
CR21	1901-0040		Diode: Si 30 wiv 2pF ,05A 2ns	07263	FDG1088
K1 thru K3	0490-0780	3	Relay Ass'y: reed and coil	-hp-	
	0490-0778	3	Reeds	95348	MR5830
L1	9100-1637	1	Inductor: fxd 120uH +/-5%	82142	15-1315-14J
Q1	1853-0086	7	TSTR: Si PNP 2N5087	04713	SPS-3322
Q2, Q3	1853-0036	9	TSTR: Si PNP 2N3906	04713	SPS-3612
Q4	1854-0215	3	TSTR: Si NPN 2N3904	04713	SPS-3611
Q5 thru Q8	1853-0036		TSTR: Si PNP 2N3906	04713	SPS-3612
Q9	1854-0215		TSTR: Si NPN 2N3904	04713	SPS-3611
Q10	1853-0036		TSTR: Si PNP 2N3906	04713	SPS-3612
Q11	1855-0057	1	TSTR: Si FET N channel Type A	04713	SS-3651
Q12	1853-0036		TSTR: Si PNP 2N3906	04713	SPS-3612
Q13	1854-0092	2	TSTR: NPN 2N3563	04713	MPS-3563
Q14	1853-0049	2	TSTR: Si PNP	04713	-hp-
Q15	1854-0215		TSTR: Si NPN 2N3904	04713	SPS-3611
Q16	1853-0049		TSTR: Si PNP	04713	-hp-
Q17	1854-0401	1	TSTR: NPN	04713	-hp-
Q18,Q19	1853-0236	3	TSTR: Si PNP 2N3547	12040	NS62048
Q20	1854-0022	1	TSTR: NPN	01295	SG1294
Q21	1853-0236		TSTR: Si PNP 2N3547	12040	NS62048
Q22	1853-0051	1	TSTR: Si PNP 2N4037	02735	2N4037
R1	0757-0334	1	R: fxd met flm 301 ohms +/-1% 1/4W	91637	MF-1/8-44 obd
R2	0698-4521	2	R: fxd met flm 154 kilohms +/-1% 1/8W	14674	C4 obd
R3	0698-4533	1	R: fxd met flm 294 kilohms +/-1% 1/8W	14674	C4 obd
R4	0684-4731	2	R: fxd comp 47 kilohms +/-10% 1/4W	01121	CB4731
R5	0684-1221	2	R: fxd comp 1.2 kilohms +/-10% 1/4W	01121	CB1221
R6	0684-1011	5	R: fxd comp 100 ohms +/-10% 1/4W	01121	CB1011
R7,R8	0684-2241	2	R: fxd comp 220 kilohms +/-10% 1/4W	01121	CB2241
R9	0684-4721	3	R: fxd comp 4700 ohms +/-10% 1/4W	01121	CB4721
R10	0684-1011		R: fxd comp 100 ohms +/-10% 1/4W	01121	CB1011
R11	0698-7376	3	R: fxd met flm 28.64 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R12	0684-1011		R: fxd comp 100 ohms +/-10% 1/4W	01121	CB1011
R13,R14	0757-0273	2	R: fxd met flm 3.01 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R15	2100-2820	1	R: var carbon comp 500 ohms +/-30% 1/4W 4 sec type V	71590	Type EB-83716
R16	0698-4468	1	R: fxd met flm 590 ohms +/-1% 1/8W	14674	C4 obd
R17	0684-1011		R: fxd comp 100 ohms +/-10% 1/4W	01121	CB1011
R18	0684-1041	1	R: fxd comp 100 kilohms +/-10% 1/4W	01121	CB1041
R19	0698-3154	1	R: fxd met flm 4.22 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R20	2100-2829		R: var carbon comp 5 kilohms +/-30%	71590	Type EB-83716
R21	0698-3155	1	R: fxd met flm 4.64 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R22	0698-4405	1	R: fxd met flm 107 ohms +/-1% 1/8W	14674	C4 obd
R23	0684-2221	1	R: fxd comp 2200 ohms +/-10% 1/4W	01121	CB2221
R24	2100-2820		R: var carbon comp 500 ohms +/-30%	71590	Type EB-83716
R25	0696-4014	1	R: fxd met flm 787 ohms +/-1% 1/8W	14674	C4 obd
R26	2100-2820		R: var carbon comp 500 ohms +/-30%	71590	Type EB-83716
R27	0698-4521		R: fxd met flm 154 kilohms +/-1% 1/8W	14674	C4 obd
R28,R29			Not assigned		
R30	0684-3341	1	R: fxd comp 330 kilohms +/-10% 1/4W	01121	CB3341
R31	0684-1541	3	R: fxd comp 150 kilohms +/-10% 1/4W	01121	CB1541
R32	0684-1011		R: fxd comp 100 ohms +/-10% 1/4W	01121	CB1011
R33	0684-1221		R: fxd comp 1.2 kilohms +/-10% 1/4W	01121	CB1221
R34	0684-1021	6	R: fxd comp 1000 ohms +/-10% 1/4W	01121	CB1021
R35,R36	0684-1541		R: fxd comp 150 kilohms +/-10% 1/4W	01121	CB1541
R37	0684-4721		R: fxd comp 4700 ohms +/-10% 1/4W	01121	CB4721
R38	0698-4464	1	R: fxd met flm 523 ohms +/-1% 1/8W	91637	MF-1/10-32 obd
R39	0684-3921	3	R: fxd comp 3900 ohms +/-10% 1/4W	01121	CB3921

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

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A3 (Cont'd)					
R40	0684-4721		R: fxd comp 4700 ohms +/-10% 1/4W	01121	CB4721
R41,R42	0698-3382	2	R: fxd met flm 5.49 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R43	2100-1770	1	R: var ww 100 ohms +/-10% 1/2W trimmer	80294	3-366P-E88-101
R44	0698-3612	1	R: fxd met flm 1.18 kilohms +/-1% 1/8W	16299	C4-1/8-To-1181-F obd
R45	0684-2231	3	R: fxd comp 22 kilohms +/-10% 1/4W	01121	CB2231
R46*	0684-3921		R: fxd comp 3900 ohms +/-10% 1/4W	01121	CB3921
R47	0684-8211	2	R: fxd comp 820 ohms +/-10% 1/4W	01121	CB8211
R48	0684-2231		R: fxd comp 22 kilohms +/-10% 1/4W	01121	CB2231
R49	0757-0442	3	R: fxd met flm 10 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R50	0684-1031	2	R: fxd comp 10 kilohms +/-10% 1/4W	01121	CB1031
R51	0684-8211		R: fxd comp 820 ohms +/-10% 1/4W	01121	CB8211
R52	0757-0280		R: fxd met flm 1 kilohm +/-1% 1/8W	91637	CMF-1/10-32 obd
R53,R54	0684-1211	2	R: fxd comp 120 ohms +/-10% 1/4W	01121	CB1211
R55	0757-0442		R: fxd met flm 10 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R56 thru R58			Not assigned		
R59	0757-0468	1	R: fxd met flm 130 kilohms +/-1% 1/8W	14674	C4 obd
R60	0684-1031	2	R: fxd comp 10 kilohms +/- 10% 1/4W	01121	CB1031
R61	0684-1001	3	R: fxd comp 10 ohms +/-10% 1/4W	01121	CB1001
R62	0684-3921		R: fxd comp 3900 ohms +/-10% 1/4W	01121	CB3921
R63	0684-1031		R: fxd comp 10 kilohms +/-10% 1/4W	01121	CB1031
R64	0684-2231		R: fxd comp 22 kilohms +/-10% 1/4W	01121	CB2231
R65 thru R67	0684-1021		R: fxd comp 1000 ohms +/-10% 1/4W	01121	CB1021
R68	0698-4503	1	R: fxd met flm 66.5 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R69	0698-4491	1	R: fxd met flm 30.9 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R70,R71	0684-1001		R: fxd comp 10 ohms +/-10% 1/4W	01121	CB1001
R72*	0684-2701		R: fxd comp 27 ohms +/-10% 1/4W	01121	CB2701
R73	0684-1021		R: fxd comp 1000 ohms +/-10% 1/4W	01121	CB1021
R74*			Normally not loaded		
R75*	0684-8221		R: fxd 8.2K 10% .25W	01121	CB8221
XA1	1251-1941	1	Connector: PC 6 pin	71785	252-06-30-310
W1	03555-61616	1	Cable	-hp-	
A4	**03555-66506**	**1**	**PC Board Ass'y: filter**	**-hp-**	
C1	0140-0177	1	C: fxd mica 400pF +/-1%	72136	RDM15F3C
C2	0180-0291	4	C: fxd Ta elect 1uF +/-10% 35 vdcw	56289	150D105X9035A2-DYS
C3,C4	0160-2130		C: fxd mica 865pF +/-1% 100 vdcw	72136	RDM15F(865)F1C
C5	0140-0203	5	C: fxd mica 30pF +/-5%	72136	RDM15F421F3C
C6	0180-0228		C: fxd elect 22uF +/-10% 15 vdcw	37942	TAS226K015P1C
C7	0140-0163	6	C: fxd mica 4751pF +/-1% 300 vdcw	72136	RDM20F(4751)F3S
C8	0160-3024	4	C: fxd mica 1700pF +/-1% 100 vdcw	72136	RDM19F172F1S
C9	0140-0203		C: fxd mica 30pF +/-5%	72136	RDM15F421F3C
C10	0160-3024		C: fxd mica 1700pF +/-1% 100 vdcw	72136	RDM19F172F1S
C11	0180-0228		C: fxd Ta elect 22uF +/-10% 15 vdcw	37942	TAS226K01P1C
C12	0140-0163		C: fxd mica 4751pF +/-1% 300 vdcw	72136	RDM20F(4751)F3S
C13 thru C15			Not assigned		
C16	0160-3024		C: fxd mica 1700pF +/-1% 100 vdcw	72136	RDM19F172F1S
C17	0140-0203		C: fxd mica 30pF +/-5%	72136	RDM15F421F3C
C18	0160-3024		C: fxd mica 1700pF +/-1% 100 vdcw	72136	RDM19F172F1S
C19	0180-0228		C: fxd Ta elect 22uF +/-10% 15 vdcw	37942	TAS226K015P1C
C20,C21	0180-0291		C: fxd Ta elect 1uF +/-10% 35 vdcw	56289	150D105X9035A2-DYS
C22			Not assigned		
C23	0180-0197		C: fxd Ta 2.2uF +/-10% 20 vdcw	56289	150D225X9020A2-DYS
C24	0140-0163		C: fxd mica 4751pF +/-1% 300 vdcw	72136	RDM20F(4751)F3S
C25	0140-0203		C: fxd mica 30pF +/-5%	72136	RDM15F421F3C
C26	0140-0163		C: fxd mica 4751pF +/-1% 300 vdcw	72136	RDM20F(4751)F3S
C27	0180-0228		C: fxd Ta elect 22uF +/-10% 15 vdcw	37942	TAS226K015P1C
C28,C29	0140-0163		C: fxd mica 4751pF +/-1% 300 vdcw	72136	RDM20F(4751)F3S
C30	0140-0203		C: fxd mica 30pF +/-5%	72136	RDM15F421F3C

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

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A4 (Cont'd)					
C31	0180-0228		C: fxd Ta elect 22uF +/-10% 15 vdcw	37942	TAS226K015P1C
C32	0180-0291		C: fxd Ta elect 1uF +/-10% 35 vdcw	56289	150D105X9035A2-DYS
C33	0180-0387	1	C: fxd Ta elect 47uF +/-5% 20 vdcw	37942	TAS476J020P1F
CR1 thru CR6	1901-0025		Diode: Si 100 wiv 12pF 100mA	24446	55410
Q1,Q2	1854-0071	16	TSTR: Si NPN 2N3391	01295	SKA1124
Q3	1853-0086	6	TSTR: Si PNP 2N5087	04713	SPS-3322
Q4,Q5	1854-0071		TSTR: Si NPN 2N3391	01295	SKA1124
Q6	1853-0086		TSTR: Si PNP 2N5087	04713	SPS-3322
Q7,Q8	1854-0071		TSTR: Si NPN 2N3391	01295	SKA1124
Q9	1853-0086		TSTR: Si PNP 2N5087	04713	SPS-3322
Q10 thru Q12	1854-0071		TSTR: Si NPN 2N3391	01295	SKA1124
Q13	1853-0086		TSTR: Si PNP 2N5087	04713	SPS-3322
Q14 thru Q16	1854-0071		TSTR: Si NPN 2N3391	01295	SKA1124
Q17	1853-0086		TSTR: Si PNP 2N5087	04713	SPS-3322
Q18 thru Q20	1854-0071		TSTR: Si NPN 2N3391	01295	SKA1124
Q21	1853-0086		TSTR: Si PNP 2N5087	04713	SPS-3322
Q22	1854-0071		TSTR: Si NPN 2N3391	01295	SKA1124
R1	0757-0450	2	R: fxd met flm 22.1 kilohms +/-1% 1/8W	75042	CEA obd
R2	0698-4482	1	R: fxd met flm 17.4 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R3 (A,B,C,D)	2100-0406	1	R: var carbon comp 5 kilohms +/-30% 4 sec	71590	Series 5 Type 70-4
R4	0698-7373	1	R: fxd met flm 98.941 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R5,R6	0698-7374	2	R: fxd met flm 217.88 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R7(A/B/C)	1810-0027	5	R: carbon flm network 2X100K 10 kilohms +/-10%	56289	178C5
R8	0698-7372	1	R: fxd met flm 108.94 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R9	0698-7376	1	R: fxd met flm 11.397 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R10	0698-6943	5	R: fxd met flm 20 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R11	0698-7375		R: fxd met flm 28.640 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R12,R13	0757-0476	2	R: fxd met flm 301 kilohms +/-1% 1/8W	14674	C4 obd
R14	0684-6821	1	R: fxd comp 6800 ohms +/-10% 1/4W	01121	CB6821
R15	0684-4731		R: fxd comp 47 kilohms +/-10% 1/4W	01121	CB4731
R16*	0698-3557	1	R: fxd met flm 806 ohms +/-1% 1/8W	14674	C4 obd
R17	0698-3510	1	R: fxd met flm 12.4 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R18*	0757-0443	1	R: fxd met flm 11 kilohms +/-1% 1/8W	14674	C4 obd
R19			Not assigned		
R20	0698-7375		R: fxd met flm 28.640 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R21(A/B/C)	1810-0027		R: carbon flm network 2X100K 10 kilohms +/-10%	56289	178C5
R22	0757-0451	1	R: fxd met flm 24.3 kilohms +/-1% 1/8W	14674	C4 obd
R23	0757-0450		R: fxd met flm 22.1 kilohms +/-1% 1/8W	75042	CEA obd
R24	0698-6943		R: fxd met flm 20 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R25	0698-4207	1	R: fxd met flm 44.2 kilohms +/-1% 1/8W	14674	C4 obd
R26(A/B/C)	1810-0027		R: carbon flm network 2X100K 10 kilohms +/-10%	56289	178C5
R27	0698-7365	1	R: fxd met flm 13.394 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R28	0698-6943		R: fxd met flm 20 kilohms +/-0.1%	91637	CMF-1/10-32 obd
R29	0757-0465	1	R: fxd met flm 100 kilohms +/-1% 1/8W	14674	C4 obd
R30,R31	0684-1051	3	R: fxd comp 1 megohm +/-10% 1/4W	01121	CB1051
R32	0757-0280	2	R: fxd met flm 1 kilohm +/-1% 1/8W	91637	CMF-1/10-32 obd
R33	0757-0442		R: fxd met flm 10 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R34	0757-0448	1	R: fxd met flm 18.2 kilohms +/-1% 1/8W	91637	MF-1/10-32 obd
R35,R36	0757-0472		R: fxd met flm 200 kilohms +/-1% 1/8W	75042	CEA obd
R37,R38	0698-7366	2	R: fxd met flm 109.64 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R39(A/B/C)	1810-0027		R: carbon flm network 2X100K 10 kilohms +/-10%	56289	178C5
R40	0698-6943		R: fxd met flm 20 kilohms +/-0.1%	91637	CMF-1/10-32 obd
R41	0698-7367	1	R: fxd met flm 78.028 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R42,R43	0698-7369	2	R: fxd met flm 73.803 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R44(A/B/C)	1810-0027		R: carbon flm network 2X100K 10 kilohms +/-10%	56289	178C5
R45	0698-7368	1	R: fxd met flm 36.301 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R46	0698-6943		R: fxd met flm 20 kilohms +/-0.1%	91637	CMF-1/10-32 obd

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

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A4 (Cont'd)					
R47	0698-7370	1	R: fxd met flm 17,670 kilohms +/-0.1% 1/8W	91637	CMF-1/10-32 obd
R48	0684-1051		R: fxd comp 1 megohm +/-10% 1/4W	01121	CB1051
R49	0684-1021		R: fxd comp 1000 ohms +/-10% 1/4W	01121	CB1021
	03555-60104	1	Chassis Ass'y: power supply	-hp-	
			CHASSIS MOUNTED COMPONENTS		
BT1	1420-0026	1	Battery: 45V	83740	No. 482
C1	0180-2230	1	C: fxd Al elect 150uF -10% + 100% 200 vdcw	56289	62D10046-DFP
C2	0180-0149	1	C: fxd Al elect 65uF 60 vdcw	-hp-	
C3	0180-0393		C: fxd Ta elect 39uF +/-10% -10 vdcw	37942	TAS396K010P1C
C4*	0160-0087	1	C: fxd mica 12pF +/-5%	72136	RDM15C120J5S
C5	0150-0023	1	C: fxd cer 2000pF +/-20% 1000 vdcw	56289	20C205A2-CDH
C6	0150-0195	1	C: fxd cer 1000 pF 20% 250 vac	56289	18C251A1-CDH
CR1 – 4	1901-0025	4	Diode: Si 100 wiv 12pF 100mA	24446	SS410
CR6	1901-0040	?	Diode: Si 30 V 50 mA	-hp-	
DS1,DS2	2140-0298	2	Neon lamp	74276	A230
F1	2110-0320	2	Fuse: 0.15A 125V Slo-Blo	71400	MDL 15/100
	1400-0085	?	Holder: fuse	75915	342004
J1	1251-2357	1	Connector: AC pow r cord receptacle	82389	EAC-301
J2	1251-1800	4	Jack: telephone	82389	22A obd
J3	1200-0163	1	Receptacle: 5 pin	74868	78PCG5
J4	1251-1144	1	Jack: telephone	82389	MT-342B
J5	1251-1143		Jack: telephone	82389	MT-332B
J6,J7	1251-0065	4	Jack: telephone	82389	MT-331
J8,J9	1510-0084	2	Binding post: red	-hp-	
J10	1510-0087	1	Binding post Ass'y	-hp-	
J11	1510-0531	1	Binding post Ass'y	-hp-	
J12,J13	1251-0065		Jack: telephone	82389	MT-331
J14	1251-1143		Jack: telephone	82389	MT-332B
J17	1250-1053	1	Jack: coaxial	70674	CJ-1010
J18	1251-1143		Jack: telephone	82389	MT-332B
L1	9100-1390	1	Inductor: audio (≈ 10 H)	-hp-	
L2	9140-0028	1	Inductor: [illegible] .33uH +% -5% 200mA	95262	NB 0.37 PS
M1	1120-0809	1	Meter: log calibrated	-hp-	

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

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
			CHASSIS MOUNTED COMPONENTS (Cont'd)		
	03555-67905	1	Power Supply Ass'y	-hp-	
R1	0757-0795	1	R: fxd met flm 75 ohms +/-1% 1/2W	01637	MFF-1/2-T-1 obd
R2	0698-4205	1	R: fxd met flm 21 kilohms +/-1% 1/8W	01637	MF-1/10-32 obd
R3	0698-7371	2	R: fxd met flm 20.605 kilohms +/-0.1% 1/8W	01637	CMF-1/10-32 obd
R4	0698-3158	2	R: fxd met flm 23.7 kilohms +/-1% 1/8W	01637	MF-1/10-32 obd
R5	0698-4488	1	R: fxd met flm 26.7 kilohms +/-1% 1/8W	01637	MF-1/10-32 obd
R6	0698-7371		R: fxd met flm 20.605 kilohms +/-0.1%	01637	CMF-1/10-32 obd
R7	0757-0290	1	R: fxd met flm 6.19 kilohms +/-1% 1/8W	14674	C4 obd
R8	0698-3158		R: fxd met flm 23.7 kilohms +/-1% 1/8W	01637	MF-1/10-32 obd
R9	0698-3246	1	R: fxd flm 20.5 kilohms +/-1% 1/8W	14674	C4 obd
R10	0757-0455	1	R: fxd met flm 36.5 kilohms +/-1% 1/8W	14674	C4 obd
R11	0698-4434	1	R: fxd met flm 2.32 kilohms +/-1% 1/8W	01637	CMF-1/10-32 obd
S1	3100-1794	1	Switch: lever, input	76854	1332 obd
S2	03555-61904	1	Switch Ass'y: weighting	-hp-	
S3	3101-0045	1	Switch: slide	82389	11A-1014A
S4,S5	3101-0001	2	Switch: toggle SPST	04009	80994-HB
S6	3101-1234	1	Switch: slide DPDT	82389	11A-1242A
†T1	9100-3448	1		-hp-	
W1	8120-1518		Power Cord	-hp-	
W2	03555-69504	1	Cable Ass'y	-hp-	
W3	03555-69502	1	Cable Ass'y	-hp-	
W4	03555-69505	1	Cable Ass'y	-hp-	
W5	5060-5993	1	Cable Ass'y: Range cable	-hp-	
W6	5060-5994	1	Cable Ass'y	-hp-	
W7	03555-61611	1	Cable Ass'y: Power cable, PS to instrument	-hp-	
XA1	1251-2056	2	Conn: 22 pin	00799	582388-5
XA3	1251-2066	1	Conn: 12 pin	00799	582388-5
XA4	1251-2055		Conn: 22 pin	00799	582388-5
	1251-2075		Conn: Clips, small, for above connectors	00779	86140-3
			MISCELLANEOUS		
	0340-0718	4	Insulator: binding post	-hp-	
	0340-0719	2	Insulator: binding post single	-hp-	
	0370-0035	1	Knob: bar w/arrow black	-hp-	
	0370-0046	2	Knob: lever switch, black	-hp-	
	0370-1802	8	Knob: pushbuttons, black	-hp-	
	1390-0137	4	Washer: retaining 1/4 turn fastener	71286	2600-1W
	1390-0186	4	Stud: 1/4 turn fastener	71286	26542-4
	1400-0062	1	Clip: cable	78553	C21891-017-24
	1400-0076	2	Clip: fuse	75915	101002
	1520-0001	1	Wafer: cap plate mtg 4 lug	56137	Grade X-831
	4040-0476	1	Insulator: jack	-hp-	
	5000-7128	1	Decal: pushbutton "75 UNBAL"	-hp-	
	5000-7134	1	Decal: pushbutton "135 BAL"	-hp-	
	5000-7135	1	Decal: pushbutton "150 BAL"	-hp-	
	5000-7136	2	Decal: pushbutton "600 BAL"	-hp-	
	5000-7138	1	Decal: pushbutton "HOLD"	-hp-	
	5000-7139	1	Decal: pushbutton "DIAL-BAT"	-hp-	
	5000-7140	1	Decal: pushbutton "NG"	-hp-	
	5000-7141	1	Decal: pushbutton "900 BAL"	-hp-	
	8120-1518	1	Cord Set: power	70903	obd

†See Appendix C

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

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
			MISCELLANEOUS (Cont'd)		
	1251-1145	1	Plug: battery	72825	7364
	5260-40A	2	Handle: panel	-hp-	
	00236-04105	1	Cover: battery	-hp-	
	1390-0156		Stud: fastener cadmium plated steel	71286	26542-4
	00741-01212	2	Bracket: meter	-hp-	
	03555-00206	1	Panel: front	-hp-	
	03555-00204	1	Panel: sub	-hp-	
	0340-0732	1	Insul: Bdg Post	-hp-	
	03555-26510	1	Test board: blank	-hp-	
	03555-00604	1	Shield Ass'y: amplifier	-hp-	
	03555-01204	1	Retainer Ass'y: cord/headphone	-hp-	
	03555-01203	1	Retainer: headphone	-hp-	
	03555-64507	1	Cover: assembly	-hp-	
	03555-64508	1	Case Assembly	-hp-	
	03555-90007	1	Manual: operating and service	-hp-	
	0500-0126	4	Nuts: Instrument to case		
	0510-0707	2	Cover latch		

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
00000	U.S.A Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Cemco, Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Mictron, Co., Inc.	Valley Stream, N.Y.
00373	Garlock Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00800	Croven, Ltd.	Whitby, Ontario, Canada
00816	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Cal.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01009	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Cal.
01281	TRW Semiconductors, Inc.	Lawndale, Cal.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co	Alliance, Ohio
01538	Small Parts Inc.	Los Angeles, Cal.
01589	Pacific Relays, Inc.	Van Nuys, Cal.
01670	Gudebrod Bros. Silk Co.	New York, N.Y.
01930	Amerock Corp.	Rockford, Ill.
01960	Pulse Engineering Co	Santa Clara, Cal.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Cal.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Division	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Cal.
02876	Hudson Tool & Die	Newark, N.J.
03296	Nylon Molding Corp.	Springfield, N.J.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Cal.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div., Finderne Plant	Somerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04217	Essex Wire	Los Angeles, Cal.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Palo Alto Division of Hewlett-Packard Co.	Palo Alto, Cal.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Cal.
04673	Dakota Engr. Inc.	Culver City, Cal.
04713	Motorola Inc. Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Cal.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Cal.
04811	Precision Coil Spring Co.	El Monte, Cal.
04877	P.M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Cal.
05277	Westinghouse Electric Corp. Semiconductor Dept.	Youngwood, Pa.
	Ultronix, Inc.	San Mateo, Cal.
	Union Carbide Corp., Elect. Div.	New York, N.Y.
05574	Viking Ind. Inc.	Canoga Park, Cal.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Cal.
05616	Cosmo Plastic (c/o Electrical Spec Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Cal.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Cal.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Components Inc., Ariz. Div.	Phoenix, Arizona
06812	Torrington Mfg. Co., West Div.	Van Nuys, Cal.
06980	Varian Assoc. Eimac Div.	San Carlos, Cal.
07088	Kelvin Electric Co.	Van Nuys, Cal.
07126	Digitran Co.	Pasadena, Cal.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp., Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Cal.
07256	Silicon Transistor Corp.	Carle Place, N.Y.
07261	Avnet Corp.	Culver City, Cal.
07263	Fairchild Camera & Inst. Corp., Semiconductor Div.	Mountain View, Cal.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Birtcher Corp., The	Monterey Park, Cal.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Cal.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp.	Hawthorne, Cal.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Cal.
07980	Hewlett-Packard Co., New Jersey Division	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Cal.
08289	Blinn, Delbert Co.	Pomona, Cal.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Cal.
08664	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Cal.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div. of CBS Inc.	Lowell, Mass.
08806	General Electric Co., Miniature Lamp Dept.	Cleveland, Ohio
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Inc.	Costa Mesa, Cal.
09097	Electronic Enclosures Inc.	Los Angeles, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Cal.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09795	Pennsylvania Fluorocarbon	Clifton Heights, Penn.
09922	Burndy Corp.	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Cal.
10411	Ti-Tal, Inc.	Berkeley, Cal.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Cal.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Cal.
11324	National Seal	Downey, Cal.
11463	Precision Connector Corp.	Jamaica, N.Y.
11534	Duncan Electronics Inc.	Costa Mesa, Cal.
11711	General Instrument Corp., Semiconductor Division Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Cal.
11870	Melabs, Inc.	Palo Alto, Cal.
12136	Philadelphia Handle Co.	Camden, N.J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc., Data System Div.	Albuquerque, N.M.
12697	Clarostat Mfg. Co.	Dover, N.H.
12728	Elmar Filter Corp.	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Cal.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13019	Airco Supply Co., Inc.	Witchita, Kansas
13061	Wilco Products	Detroit, Mich.
13103	Thermolloy	Dallas, Texas
13327	Solitron Devices Inc.	Tappan, N.Y.
13366	Telefunken (GmbH)	Hannover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Cal.
14193	Calif. Resistor Corp.	Santa Monica, Cal.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, a Div. of Int. Telephone and Telegraph Corporation	West Palm Beach, Fla.
14493	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell Dubilier Electric Corp.	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Cal.
14960	Williams Mfg. Co.	San Jose, Cal.
15106	The Sphere Co., Inc.	Little Falls, N.J.
15203	Webster Electronics Co.	New York, N.Y.
15287	Scionics Corp.	Northridge, Cal.
15291	Adjustable Bushing Co.	N. Hollywood, Cal.
15558	Micron Electronics	Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.	Lynbrook, N.Y.
15631	Cabletronics	Costa Mesa, Cal.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Cal.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Amelco Inc.	Mountain View, Cal.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Detroit, Mich.
16352	Computer Diode Corp.	Lodi, N.J.
16554	Electroid Co.	Union, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Cal.
16688	Ideal Prec. Meter Co., Inc., De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Cal.
17474	Tranex Company	Mountain View, Cal.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Cal.
17856	Siliconix Inc.	Sunnyvale, Cal.
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Cal.
18083	Clevite Corp. Semiconductor Div.	Palo Alto, Cal.
18324	Signetics Corp.	Sunnyvale, Cal.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18565	Chomerics	Plainville, Mass.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison	West Orange, N.J.
19589	Concoa	Baldwin Park, Cal.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
18841	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21335	Fafnir Bearing Co., The	New Britain, Conn
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
22070	General Devd Co.	Metuchen, N.J.
23042	Texscan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division, Nela Park	Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
26806	Memcor Inc., Comp. Div.	Huntington, Ind.
26315	Gries Reproducer Corp.	New Rochelle, N.Y.
26412	Grobert File Co. of America, Inc.	Carlstadt, N.J.
27651	Compar Hollister Co.	Hollister, Cal
27992	Hamilton Watch Co.	Lancaster, Pa
28480	Hewlett-Packard Co.	Palo Alto, Cal
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products, Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W.H. & Hill Ltd.	Toronto, Ontario, Canada
37942	P.R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
40931	Honeywell Inc.	Minneapolis, Minn.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo
44655	Ohmite Mfg. Co.	Skokie, Ill
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa
47904	Polaroid Corp.	Cambridge, Mass
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md
52983	RP Co., Med. Elec. Div.	Waltham, Mass
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & System Div.	So. Norwalk, Conn
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
58474	Superior Elect. Co.	Bristol, Conn
59446	Telex Corp.	Tulsa, Okla
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa
62119	Universal Electric Co.	Owosso, Mich
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill
66346	Minnesota Mining & Mfg. Co. Revere-Mincom Div.	St. Paul, Minn
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn
70903	Belden Mfg. Co.	Chicago, Ill
70998	Bird Electric Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Bliley Electric Co., Inc.	Erie, Pa
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionic Corp.	Cambridge, Mass
71286	Camloc Fastener Corp.	Paramus, 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
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis
71616	Commercial Plastics Co.	Chicago, Ill
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill
71984	Dow Corning Corp.	Midland, Mich
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap Division	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill
72825	Hugh H. Eby Inc.	Philadelphia, Pa
72928	Gudeman Co.	Chicago, Ill
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Cal
72982	Erie Technological Products, Inc.	Erie, Pa
73061	Hansen Mfg. Co., Inc.	Princeton, Ind
73076	H.M. Harper Co.	Chicago, Ill
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Cal
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Cal
73445	Amperex Elect. Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn
73559	Carling Electric, Inc.	Hartford, Conn
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries, Inc.	Philadelphia, Pa.
73734	Federal Screw Products, Inc.	Chicago, Ill
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Cal
73957	Groov-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
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.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa
75378	CTS Knights, Inc.	Sandwich, Ill.
75382	Kulka Electric Corp.	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, Cal
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass
76493	J.W. Miller Co.	Los Angeles, Cal
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Cal
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Cal.
77075	Pacific Metals Co.	San Francisco, Cal.
77221	Phaostron Instrument and Electronic Co.	So. Pasadena, Cal
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Division	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Cal.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill
78471	Tilley Mfg. Co.	San Francisco, Cal
78488	Stackpole Carbon Co.	St. Marys, Pa
78493	Standard Thomson Corp.	Waltham, Mass
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Cal
78947	Ucinite Co.	Newtonville, Mass
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
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.
80033	Prestole Corp.	Toledo, Ohio
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association Standard tube or semiconductor device, any manufacturer	
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill
80294	Bourns Inc.	Riverside, Cal
80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Cal
80583	Hammarlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass
81015	Dimco-Gray Co.	Dayton, Ohio
81030	International Inst. Inc.	Orange, Conn
81073	Grayhill Co.	LaGrange, Ill
81095	Triad Transformer Corp.	Venice, Cal
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn
81349	Military Specification	
81483	International Rectifier Corp.	El Segundo, Cal
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass
82042	Carter Precision Electric Co.	Skokie, Ill
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82116	Electric Regulator Corp.	Norwalk, Conn
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp., Space & Defense Systems Div.	Paramus, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn
82219	Sylvania Electric Prod., Inc. Electronic Tube Division	Emporium, Pa
82227	Airtron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc., Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Cal
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Cal.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Cal.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisades Park, N.J.
83385	Central Screw Co.	Chicago, Ill
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp., Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind
83821	Loyd Scruggs Co.	Festus, Mo
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Cal
84411	TRW Capacitor Div.	Ogallala, Neb.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Cal.
85474	R.M. Bracamonte & Co.	San Francisco, Cal.
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Division	Harrison, N.J.
86928	Seastrom Mfg. Co.	Glendale, Cal.
87034	Marco Industries	Anaheim, Cal.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Cal.
87664	Van Waters & Rogers Inc.	San Francisco, Cal.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Cal.
89473	G.E. Distributing Corp.	Schenectady, N.Y.
89479	Security Co.	Detroit, Mich.
89665	United Transformer Co.	Chicago, Ill.
90030	United Shoe Machinery Corp.	Beverly, Mass.
90179	U.S. Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90365	Belleville Specialty Tool Mfg., Inc.	Belleville, Ill.
90763	United Carr Fastener Corp.	Chicago, Ill.
90970	Bearing Engineering Co.	San Francisco, Cal.
91146	ITT Cannon Elect. Inc., Salem Div.	Salem, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Cal.
91345	Miller Dial & Nameplate Co.	El Monte, Cal.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91673	Epiphone Inc.	New York, N.Y.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Cal.
91886	Malco Mfg., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Division	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Cal.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co., Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Westbury, L.I., N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Palisades Park, N.J.
93410	Stemco Controls Div. of Essex Wire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Cal.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Paterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researches, Inc.	Boston, Mass.
95146	Alco Elect. Mfg. Co.	Lawrence, Mass.
95236	Allies Products Corp.	Miami, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Microwave Assoc., West, Inc.	Sunnyvale, Cal.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Mfg. Co.	Los Angeles, Cal.
96306	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Cal.
96508	Xcelite, Inc.	Orchard Park, N.Y.
96733	San Fernando Elec. Mfg. Co.	San Fernando, Cal.
96881	Thomson Ind., Inc.	Long Island, N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Tronics, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Cal.
98220	Hewlett-Packard Co., Medical Elec. Div.	Pasadena, Cal.
98278	Microdot, Inc.	So. Pasadena, Cal.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co.	Burbank, Cal.
98410	Etc. Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Division of Hewlett-Packard Co.	Palo Alto, Cal.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98925	International Electronic Research Corp.	Burbank, Cal.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Cal.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, Cal.
99707	Control Switch Division, Controls Co. of America	El Segundo, Cal.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99928	Branson Corp.	Whippany, N.J.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp., Semiconductor Division	El Monte, Cal.
99957	Technology Instrument Corp. of California	Newbury Park, Cal.

The following HP Vendors have no number assigned in the latest supplement to the Federal Supply Code for Manufacturers Handbook.

Code No.	Manufacturer	Address
0000F	Malco Tool and Die	Los Angeles, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AD	ETA	England
000BD	Precision Instrument Comp. Co.	Van Nuys, Cal.
000CS	Hewlett-Packard Co., Colorado Springs Div.	Colorado Springs, Colorado
000MM	Rubber Eng. & Development	Hayward, Cal.
000NN	A "N" D Mfg. Co.	San Jose, Cal.
000QQ	Cooltron	Oakland, Cal.
000WW	California Eastern Lab.	Burlingame, Cal.
000YY	S.K. Smith Co.	Los Angeles, Cal.

SUPPLEMENTAL CODE LIST OF MANUFACTURERS

Code No.	Manufacturer	Address
12040	National Semiconductor Corp.	Danbury, Conn.

SECTION VII
CIRCUIT DIAGRAMS

7-1. INTRODUCTION.

7-2. This section of the Manual contains circuit diagrams for the Model 3555B Transmission and Noise Measuring Set. The functional block diagram (Figure 7-1) contains signal levels to assist in troubleshooting. The schematic diagrams (Figures 7-2 through 7-5) show dc voltage levels which should also aid in locating faulty components.

7-3. FUNCTIONAL BLOCK DIAGRAM.

7-4. The functional block diagram (Figure 7-1) of the 3555B serves the dual purpose of showing how various circuits are arranged to form the set and at the same time gives voltages and adjustments for use in troubleshooting the set. This functional block diagram should be used in conjunction with the troubleshooting procedure described in Section V.

7-5. SCHEMATIC DIAGRAMS.

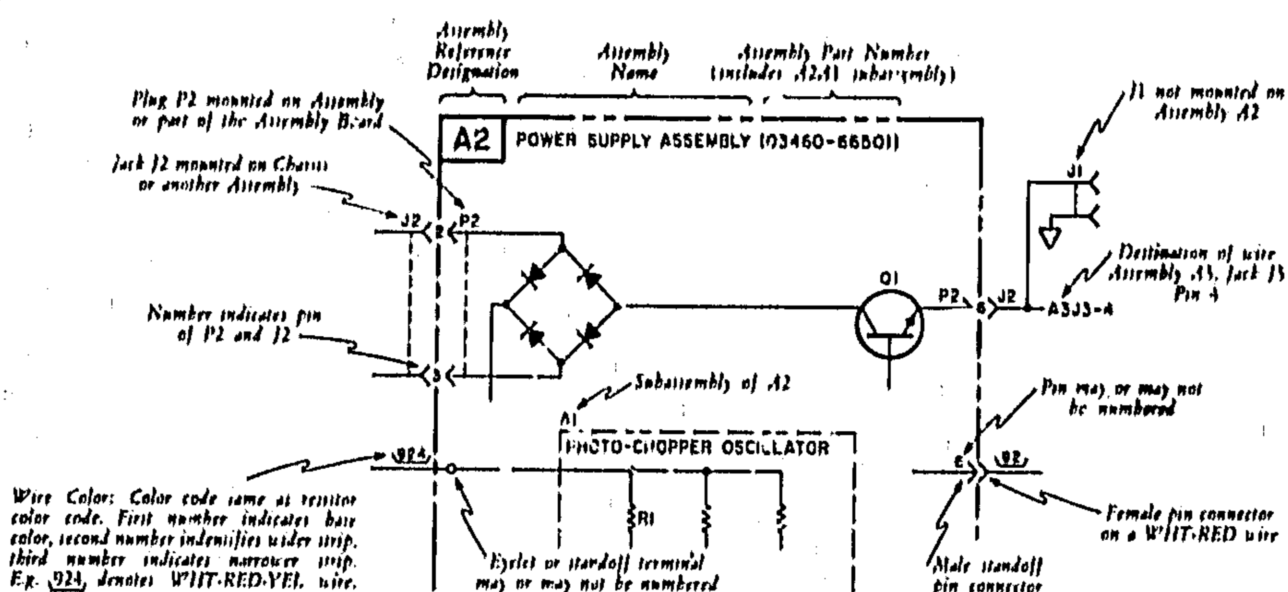
7-6. The schematic diagrams (Figures 7-2 through 7-5) contained in this section show the detailed circuits in the Model 3555B. Components marked with an asterisk are those that are critical in value. The value of these components may vary slightly from one set to another due to variations in transistor Beta etc, and the values shown on the schematic are average.

7-7. Voltage levels have been included on the schematics which should greatly assist in troubleshooting the set. When measuring these voltages a high input impedance voltmeter (1 megohm or greater) should be used to prevent circuit loading.

REFERENCE DESIGNATIONS

PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.

ASSEMBLY	SUBASSEMBLY	COMPONENT	COMPLETE DESIGNATION
A2	NONE	Q1	A2Q1
A2	A1	R1	A2A1R1
NONE	NONE	J1	J1



SCHEMATIC NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.

2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.

   RESISTANCE IN OHMS

   CAPACITANCE IN MICROFARADS

3. DENOTES ASSEMBLY CIRCUIT GROUND.

4. DENOTES CHASSIS CIRCUIT GROUND.

5. DENOTES POWER LINE GROUND.

6. DENOTES ASSEMBLY.

7. DENOTES MAIN SIGNAL PATH.

8. DENOTES FEEDBACK PATH.

9. DENOTES FRONT PANEL MARKING.

10. DENOTES SIDE AND REAR PANEL MARKING.

11. DENOTES SCREWDRIVER ADJUST.

12. 024 DENOTES WIRE COLOR: COLOR CODE SAME AS RESISTOR COLOR CODE. FIRST NUMBER IDENTIFIES BASE COLOR, SECOND NUMBER IDENTIFIES WIDER STRIP, THIRD NUMBER IDENTIFIES NARROWER STRIP.
   (e. g. 924 = WHITE, RED, YELLOW.)

13. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY.

14. TRANSISTORS ARE ALL CONNECTED TO CIRCUIT BOARD IN TO-5 CONFIGURATION, ie, C B E AS VIEWED FROM THE COMPONENT SIDE OF BOARD.

15. WAVEFORM AND VOLTAGE MEASUREMENTS WERE MADE WITH RESPECT TO CHASSIS GROUND USING A HIGH INPUT IMPEDANCE (GREATER THAN 1 MEGOHM) OSCILLOSCOPE AND TRANSISTOR VOLTMETER. VOLTAGE LEVELS SHOWN ARE NOMINAL AND MAY VARY SOMEWHAT FROM ONE INSTRUMENT TO ANOTHER. A VARIATION OF +/-10% IN MEASUREMENTS SHOULD BE ALLOWED.

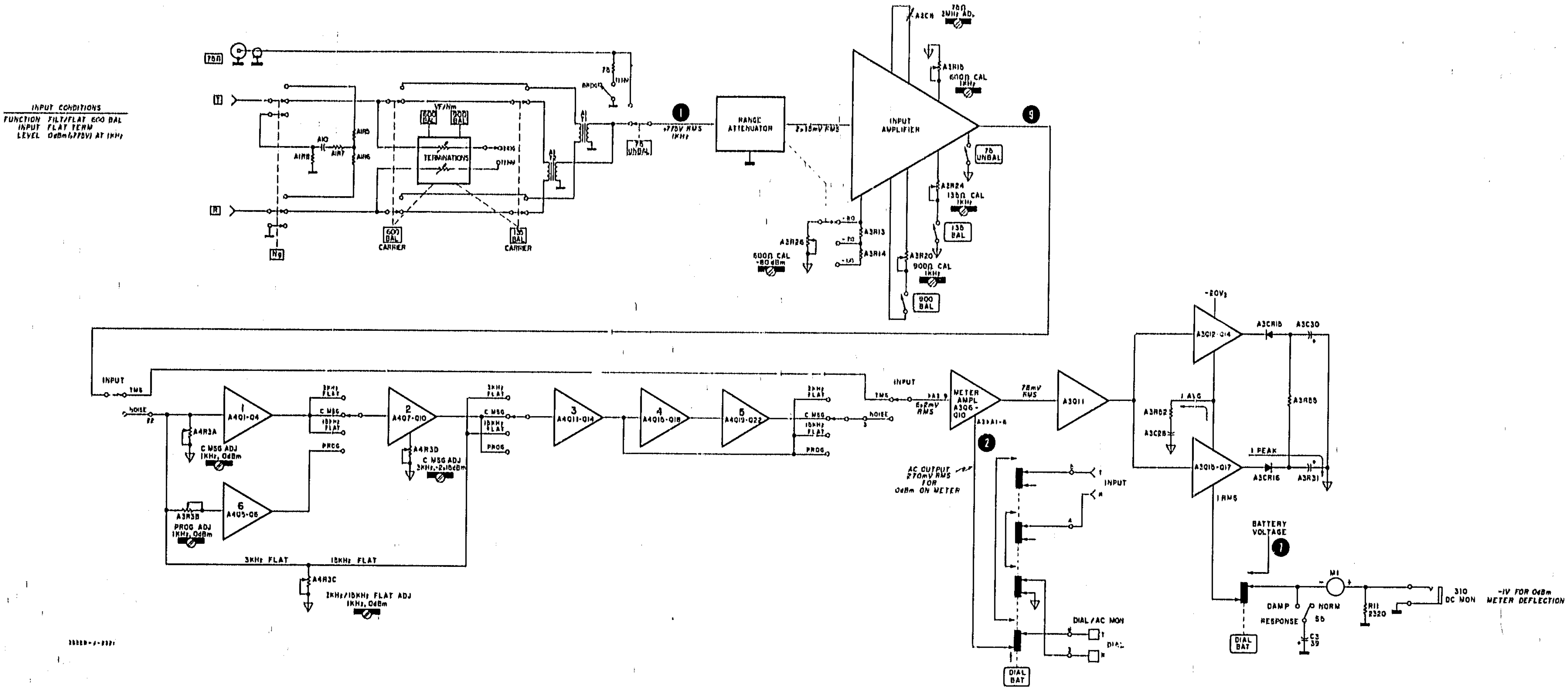
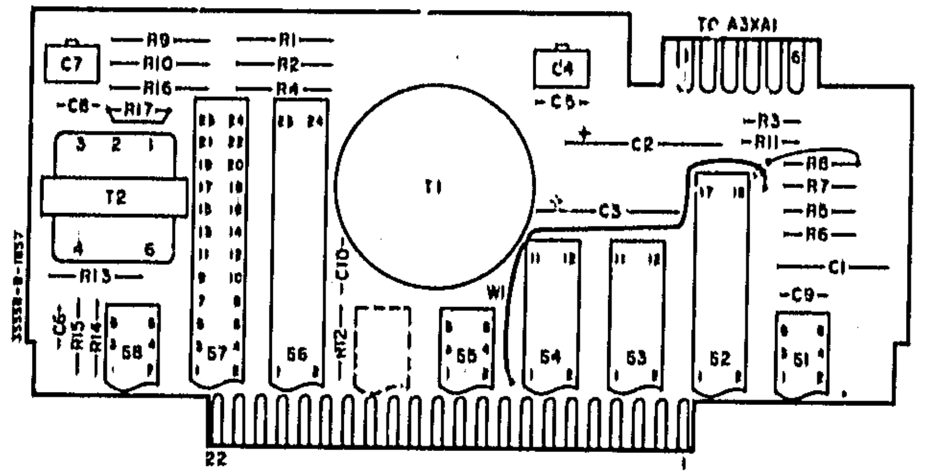
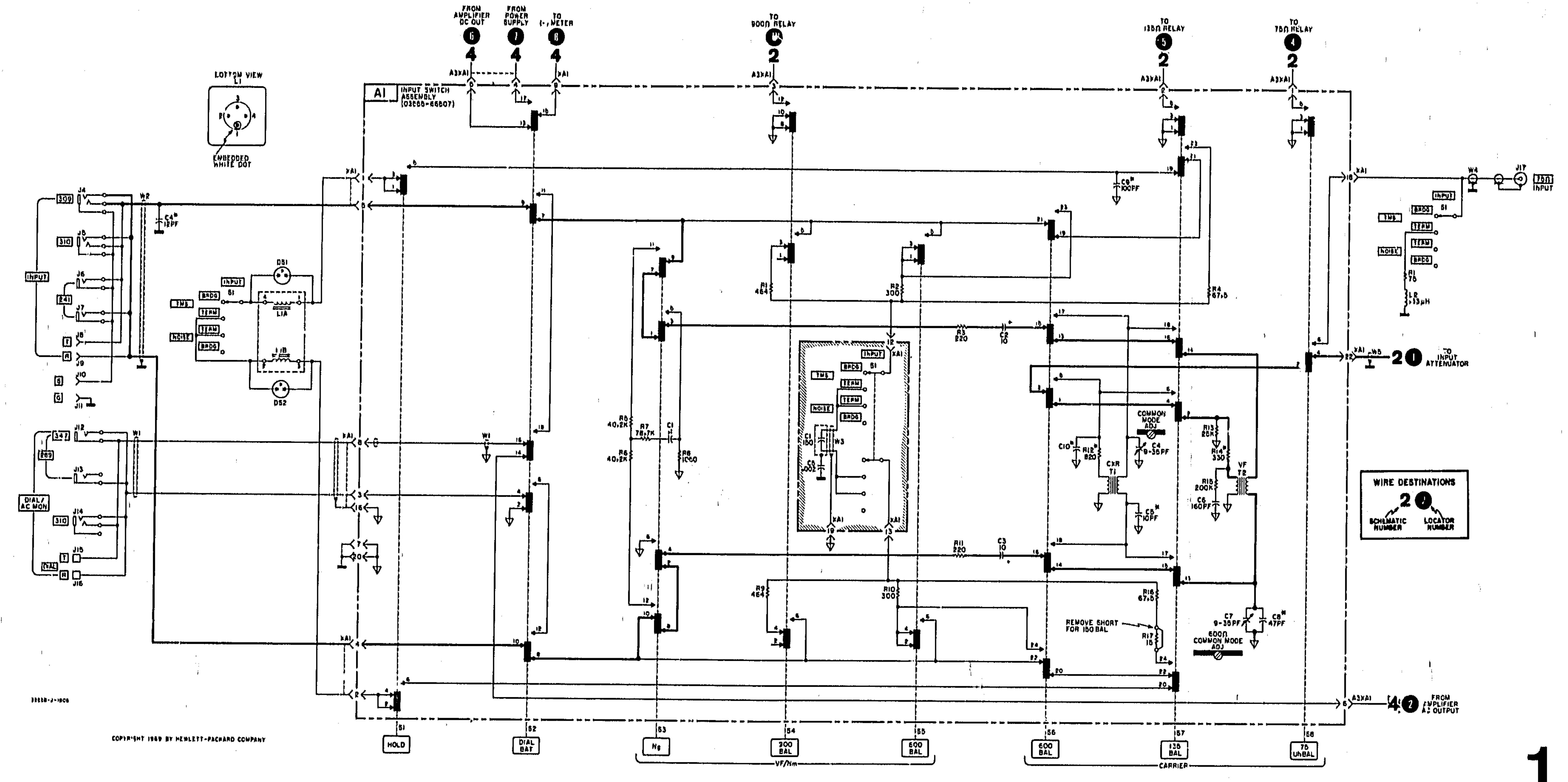


Figure 7-1. Functional Block Diagram



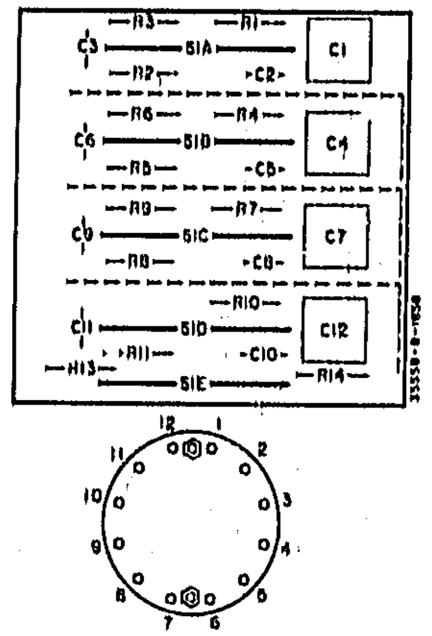
A1
hp Part No. 03555-66507

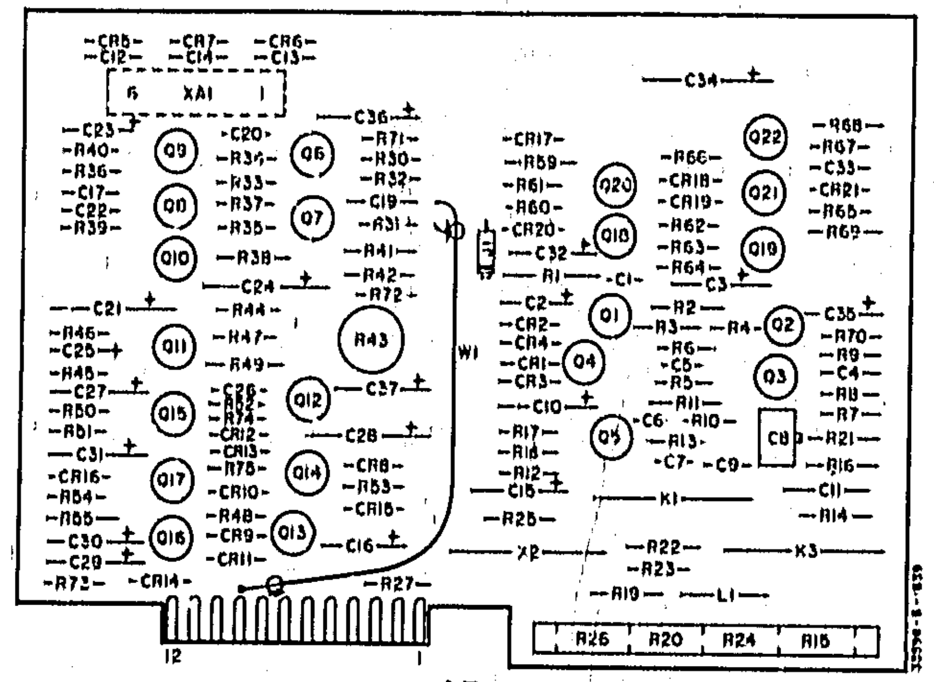


1

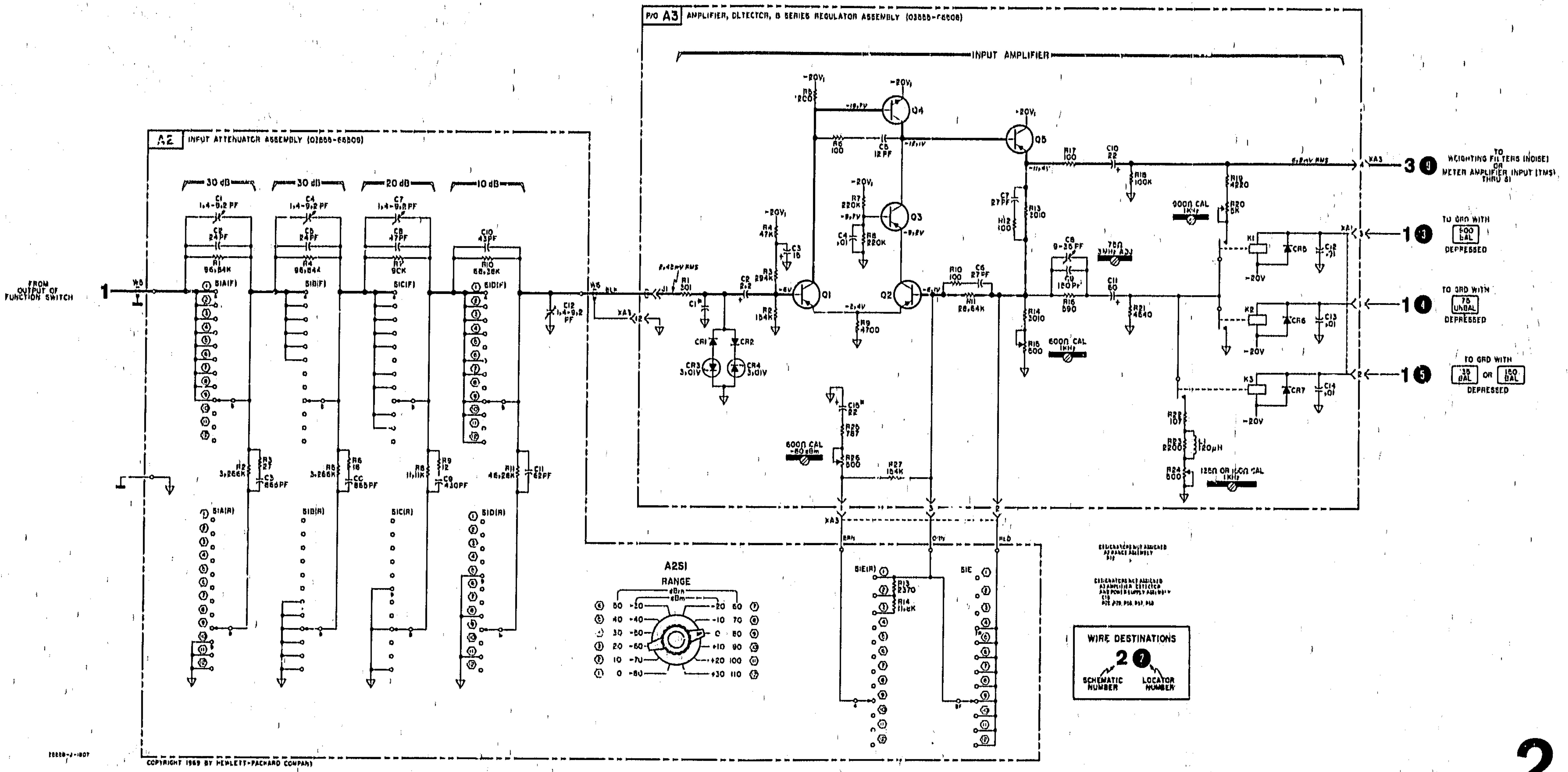
Figure 7-2. A1 Function Assembly Schematic and Component Location

A2
hp Part No. 03555-66509



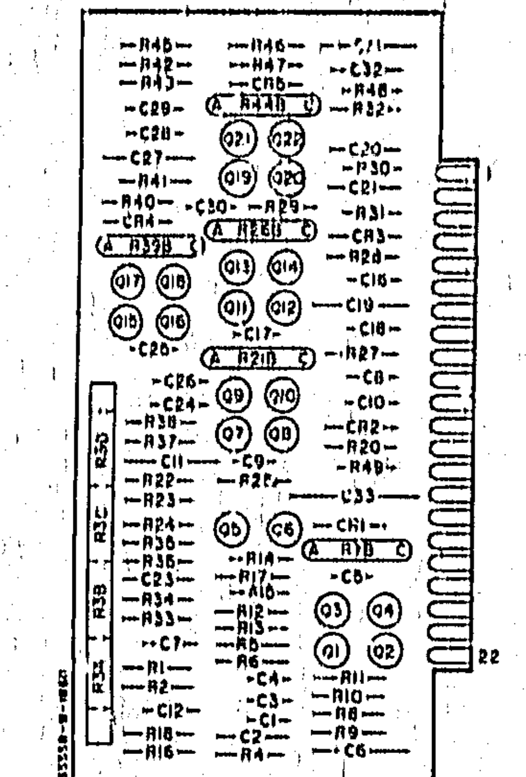


A3
hp Part No. 03555-66508



2

Figure 7-3. A2 Range Attenuator and A3 Input Amplifier Schematic and Component Location

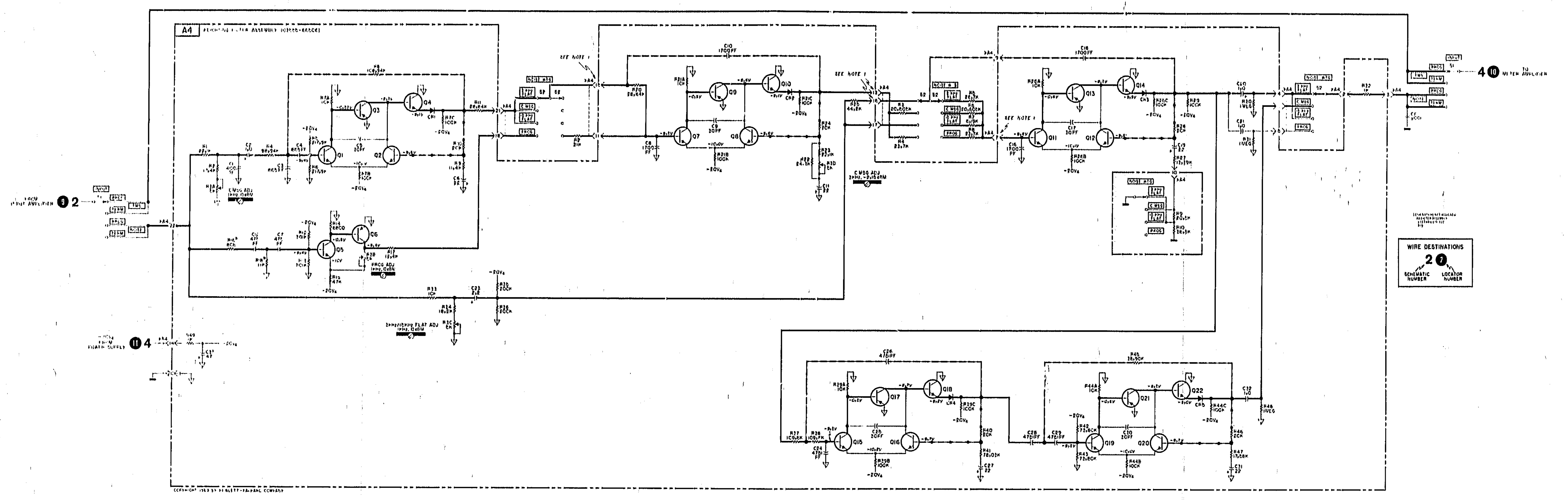


A4

hp Part No. 03555-66506

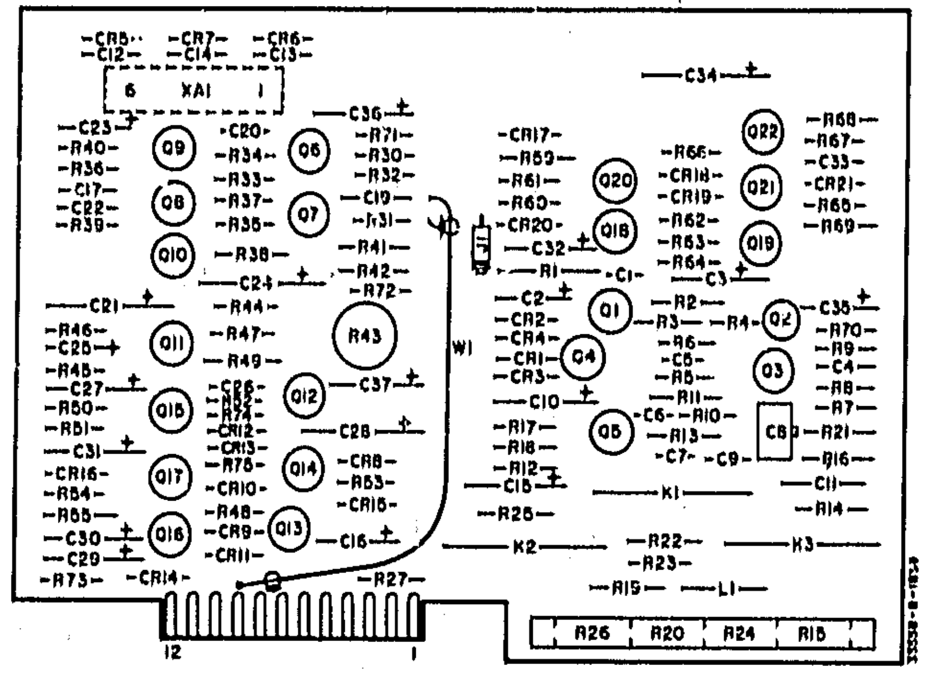
NOTE

1. Refer to Appendix C, change no. 3 for backdating.

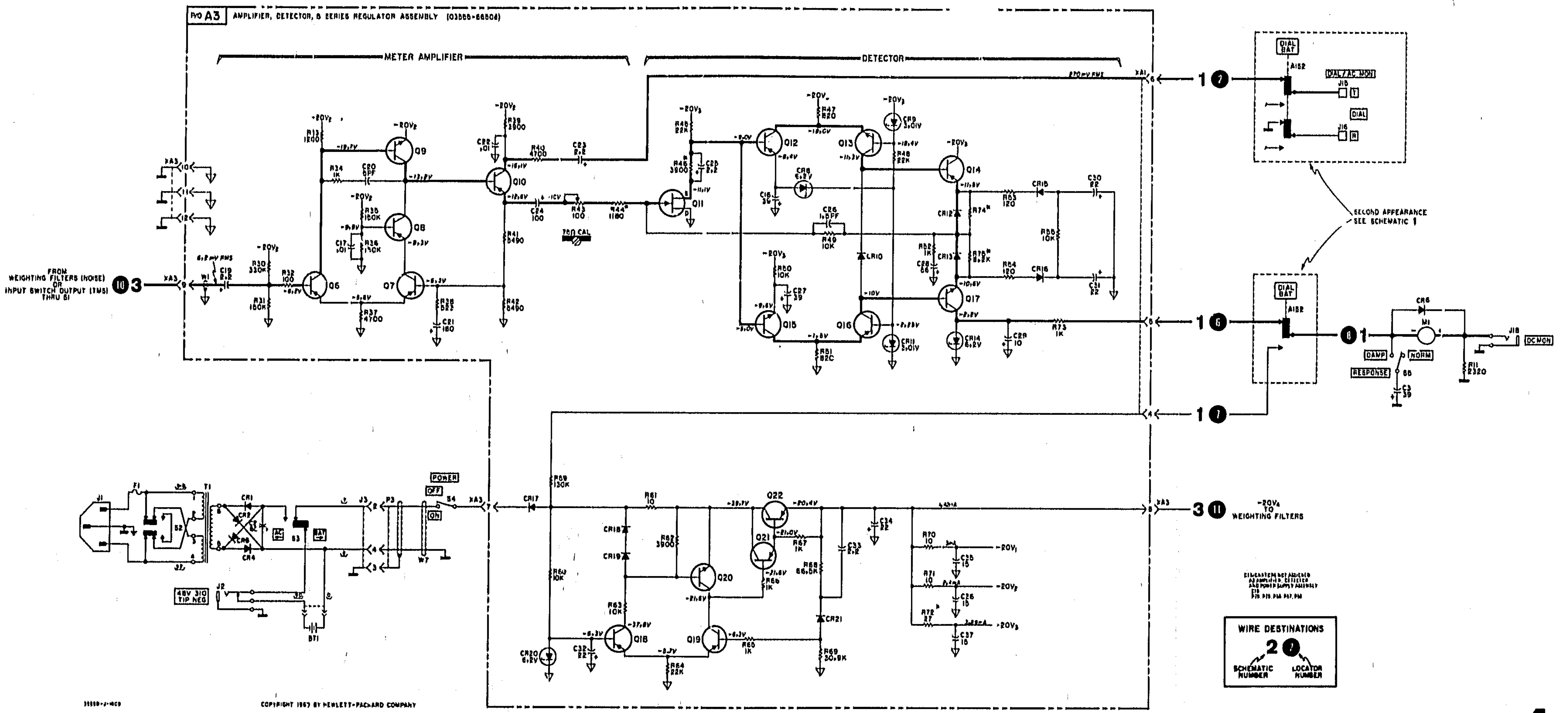


3

Figure 7-4. A4 Filter Schematic and Component Location



A3
hp Part No. 03555-66508



NOTE

1. Some earlier instruments did not have S6. Refer to Appendix C, change no. 4 for backdating.

2. CR1 and C2 were located at a different place in some earlier instruments. Refer to Appendix C, change no. 1 for backdating.

4

Figure 7-5. A3 Meter Amplifier, Detector and Series Regulator Schematic and Component Locations

MANUAL BACKDATING CHANGES

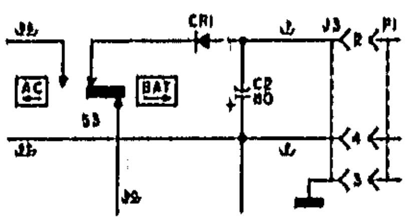
Model 3555B

TRANSMISSION AND NOISE MEASURING SET

This manual backdating sheet makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

Instrument Serial Prefix	Make Manual Changes	Instrument Serial Prefix	Make Manual Changes
916-00500 and below	1 thru 7	0992A03537 and below	7
916-00509 and below	2 thru 7		
953-00544 and below	3 thru 7		
953-00825 and below	4 thru 7		
0992A01395 and below	5 thru 7		
0992A03536 and below	6, 7		

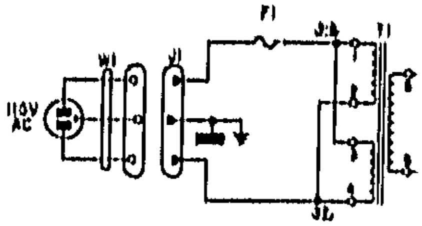
Change No. 1
In instruments with S/N 916-00500 and below CR1 and C2 in the power supply were located as shown in the following figure:

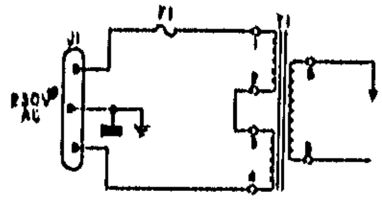


Change No. 2
Table 6-1 and figure 7-3, change:
A2C8 to 33pF, part no. 0160-2150
A2C9 to 320pF, part no. 0140-0226
A2C10 to 39pF, part no. 0140-0175
A2C11 to 51pF, part no. 0160-2201

Change No. 3
Figure 7-4, change the pin connections as follows: 7 to 6, 13 to 12, 16 to 15, 15 to 13. Instruments with serial numbers 953-00544 and below had a 03555-66506 Revision A board in them. This board is not interchangeable with the Revision B board. The above pin connections are for the Revision A board.

Change No. 4
Delete S6 in figure 7-5 and in Table 6-1. Earlier instruments did not have this switch. See the following figure for earlier instruments.





Change part no. of the case assembly to 03555-04505.
Change cover part no. to 03555-04504.
Table 6-1.
Change the part no. of the power cord to 8120-0249.
Change the part no. of the power connector J1 to 1251-0148.

Change No. 5
Table 6-1. Change to the following gray parts:

Cover, battery	00236-04104
Bracket, meter	00741-01209
Panel, front	03555-00203
Assy, cover	03555-64504
Assy, case	03555-64506
Knob, pushbutton	0370-0440

Change No. 6
Page 6-7. Change C2 to 0180-0110, 80 uF
Delete CR2 - 4 1901-0025.
Page 6-8. Change T1 part no. to 9100-1457.
Figure 7-5. Delete CR2 - 4 from the Power Supply Rectifier.
Change C2 to 80 uF.

Change No. 7
Page 6-7. Delete CR6, 1901-0040.
Figure 7-5. Delete CR6 across M1.