METALLIC FACILITY TERMINAL
4-4 REPEATERS (J99343SA, SB)
2-4 TERMINAL REPEATERS (J99343RA, RF)
SD-1C359-01
INSTALLATION AND TESTING

CONTENTS PAGE

1. GENERAL

1.01 This section describes the installation and test procedures for four Metallic Facility Terminal (MFT) transmission units designed for use on 4-wire circuits without 2-wire extensions. These units are the 2-4 Terminal Repeater (J99343RA), the 2-4 Terminal Repeater (Pre-Equalization) (J99343RF), the 4-4 Terminal Repeater (J99343SA), and the 4-4 Intermediate Repeater (J99343SB).

1.02 This section is reissued to include the J99343RF 2-4 wire terminal (pre-equalization) repeater and to reference low-capacitance metropolitan area trunk (MAT) cable. Arrows normally used to indicate changes are not used due to the extensive revision.

1.03 The MFT repeaters covered in this section can operate with 19-, 22-, 24-, or 26-gauge high-capacitance (.083 μF per mile) H88 loaded or nonloaded cable. They are also compatible with 25-gauge low-capacitance (.064 μF per mile) H88 loaded or nonloaded MAT cable.

1.04 Detailed descriptions of the units in this section may be found in Section 332-912-131.

OPTIONS

A. 2-4 Terminal Repeaters (J99343RA, RF)

1.05 The J99343RA, RF 2-4 terminal repeater installations are included in this section with the 4-4 repeaters because of the similarity of operation and adjustment. The 2-4 terminal repeaters are designed to terminate loaded or nonloaded 4-wire facilities in either 600 or 900 ohm 2-wire equipment. Two slide switches, labeled HYB1 600/900 and HYB2 600/900 allow selection of the 2-wire impedance. Both switches must be operated as a single switch when selecting the appropriate impedance. A slide switch labeled OUT 600/1200 is used to select the 4-wire impedance. The 600 position is used for nonloaded cable and the 1200 position is used for loaded cable. Four slide switches are used to select the signaling options:

- SX SH—Shorts the SX inductors in the A and B leads when operated
- SX RV—Reverses the 4-wire SX and SX1 lead connections when operated
- RV and RV/T—Control the routing of the A and B and SX and SX1 leads to the companion signaling unit, when a signaling unit is required.

The RV and RV/T switches, when in the NOR (normal) position, connect the A and B leads to the switch-side of the signaling unit and the SX and SX1 leads to the station-side of the signaling unit. With both switches operated in the opposite position, away from NOR, the leads to the signaling unit are reversed. When through signaling is desired, the RV switch should be in the NOR position and the RV/T switch in the opposite position. This will connect the A and B leads directly to the SX and SX1 leads.

1.06 Screw switches allow midpoint capacitance to be selected for both the 2-wire line and network side of the internal hybrid. Three values (1.06, 3.24, and 4.3 μF) are available by turning the screws down. For most applications, 1.06 μF is chosen as the midpoint capacitance on both the line and network sides. In some applications, the trunk or signaling circuit connecting to the 2-4 repeater may have capacitance across its A and B leads. In this event, the mid-point capacitance for the 2-wire line side of the repeater may not be needed. The SX inductors must be shorted and the value of capacitance selected on the network side must match the total capacitance on the line side of the hybrid. Screw switches also allow selection of network building-out capacitance (NBOC) for balancing the capacitance of office cabling on the 2-wire side. The NBOC is adjustable in .002 μF steps from 0 to .126 μF.

B. 4-4 Terminal Repeater (J99343SA)

1.07 The J99343SA 4-4 terminal repeater is designed to terminate loaded or nonloaded 4-wire cable facilities in 600 ohm 4-wire equipment. The A side of the repeater has a fixed 600-ohm impedance while the B side impedance of either 600 or 1200 ohms to match the cable facility is selected by a slide switch labeled OUTPUT. Nonloaded cable requires 600 ohms while loaded cable requires 1200 ohms.

1.08 Switches labeled RV and RV/T allow selection of the routing of the SX/SX1 leads through the 4-4 repeater from the A side to the B side. Routing for normal, reverse, and through-signaling connections are as described for the 2-4 terminal repeater.

C. 4-4 Intermediate Repeater (J99343SB)

1.09 The J99343SB 4-4 intermediate repeater is designed for use at intermediate points on 4-wire circuits. It is basically the same as the 4-4

terminal repeater with two additions. A switch labeled INPUT 600/1200 allows selection of either 600- or 1200-ohm impedances on the A side of the repeater to match nonloaded or loaded cable. Also, the 4-4 intermediate repeater has active equalizers in both transmission paths as discussed in 1.12.

GAIN ADJUSTMENTS

1.10 All the units in this section use 309-type repeater units for adjustable gain or loss from -20 dB to +24 dB.

A. 309A Repeater Unit

1.11 The 309A repeater unit is a flat gain device and is used as the transmit amplifier in the J99343RA, SA terminal repeaters.

1.12 Gain adjustment is controlled by three rocker switches and a potentiometer mounted on top of the module (Fig. 1). The switches labeled -2, -1, and +1 are operated when pressed toward the number. The numbers represent 20 dB loss, 10 dB loss and 10 dB of gain, respectively. Only one switch should be operated at a time. When all switches are off, the gain of the 309A repeater unit is 0 dB. The potentiometer is used for fine adjustment and its value (0 to 14 dB) is added to the switch setting for total flat gain of the unit.

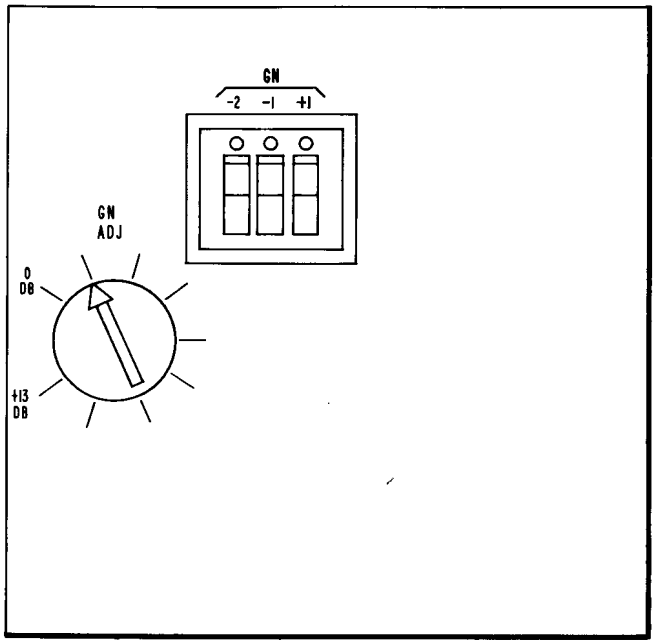

Fig. 1—309A Repeater Unit

B. 309B Repeater Unit

1.13 The 309B repeater unit (Fig. 2) is the 309A with an active equalizer included. The gain switches are identical to the 309A. Active equalization over the voice frequency range is available by selection of combinations of switches labeled SLOPE, HT, and BW. Adjustment of the flat gain is identical to the 309A as described in 1.11.

1.14 Since the 309B also includes an active equalizer section, the total 1 kHz gain of the module equals the sum of the flat gain and the effective 1 kHz gain of the equalizer section. It is important to note that equalizer settings must be known before flat gain at 1 kHz may be calculated.

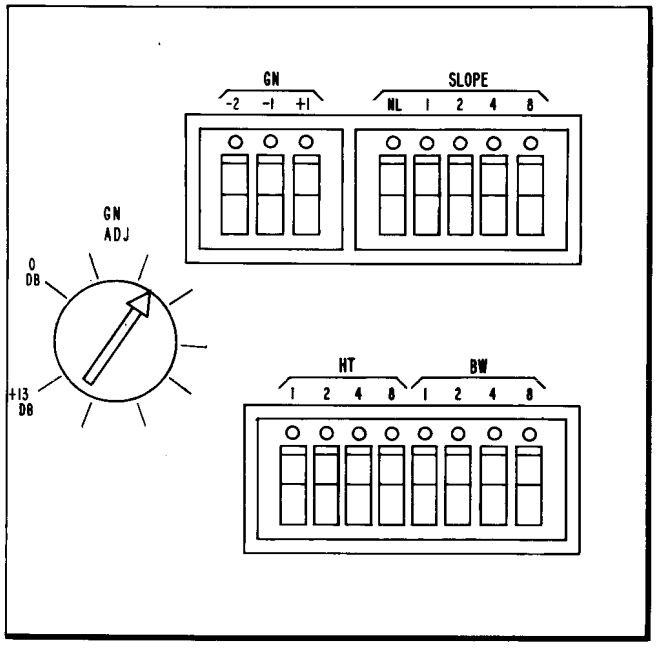

Fig. 2—309B Repeater Unit

Table A lists the additional 1 kHz gain of the SLOPE section of the equalizer and Table B gives the 1 kHz gain of the BUMP section. (See 1.18 for explanation of the equalizer section gain calculations.)

EQUALIZER ADJUSTMENTS

1.15 The equalizer section of the 309B repeater unit has three groupings of adjustments. The NL switch (hereafter referred to as the NL/L switch) programs the equalizer for loaded or nonloaded cable. The SLOPE section equalizes the low frequencies (below 1 kHz) while high-frequency (above 1 kHz) equalization is accomplished by a "bump shape" section.

A. NL/L Switch

1.16 The NL/L switch is used to program the equalizer for the type of cable being used. The operated position (pressed toward the designation NL) is for nonloaded cable. The nonoperated position (no designation) is used for loaded cable. When complicated mixtures of cable are used the NL/L switch setting may be determined as explained in Part 4 of this section.

B. SLOPE Unit

1.17 A switch group labeled SLOPE controls the low-frequency equalization. Four switches labeled 1, 2, 4, and 8 allow 16 combinations of adjustments. The switch settings will be given as the sum of the switches operated (pressed toward the number). All switches off (designated SL = 0) disable the slope section, ie, no low-frequency equalization is used, and all switches operated (SL = 15) give maximum low-frequency equalization.

C. Bump Shape

1.18 The bump shape is additional gain introduced into the circuit centered at 3250 Hz. The amount of gain added is controlled by two switch groups (height [HT] and bandwidth [BW]). Each group is designated like the SLOPE switches and the degree of equalization is written as the sum of the switches operated. The bump shape section may be disabled by setting the HT switches to zero (all switches nonoperated). With the HT switches set to zero, the setting of any of the BW switches is immaterial.

TABLE A

1 KHZ GAIN IN DB FOR SLOPE SETTINGS

SLOPE SETTING	NL/L SWITCH NL	L
0*	0	0
1	0.4	1.4
2	0.9	2.6
3	1.4	3.7
4	1.8	4.7
5	2.3	5.5
6	2.8	6.3
7	3.4	7.2
8	3.7	7.8
9	4.2	8.4
10	4.6	9.0
11	5.0	9.5
12	5.4	10.0
13	5.8	10.5
14	6.2	11.0
15	6.6	11.4

* SLOPE setting 0 disables the slope unit.

D. Equivalent 1 KHz Gain

1.19 Since the 309B repeater unit includes an active equalizer the total gain of the unit must include the 1 kHz gain of the equalizer section. A maximum of 15.3 dB of gain may be added to the 1 kHz level by the equalizer section.

1.20 Total 1 kHz gain of the repeater unit equals the gain of the slope section, the gain of the bump shape section, plus the flat gain of the amplifier. Table A lists the gain of the slope unit for each setting and Table B gives the additional 1 kHz gain for the combinations of HT and BW settings.

TABLE B

1 KHz GAIN IN dB FOR HT AND BW SETTINGS

BW SETTING	HT SETTING 0*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1
5	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1
6	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.2
7	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3
8	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4
9	0	0	0	0	0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5
10	0	0	0	0	0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.7
11	0	0	0	0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.6	0.7	0.9
12	0	0	0	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.8	0.9	1.2
13	0	0	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1.1	1.3	1.7
14	0	0	0.1	0.1	0.2	0.3	0.4	0.5	0.7	0.8	1.0	1.2	1.4	1.7	2.0	2.5
15	0	0.1	0.2	0.3	0.4	0.5	0.7	0.9	1.2	1.5	1.7	2.0	2.4	2.8	3.3	3.9

* HT setting 0 disables the bump unit for all BW settings.

2. APPLICATIONS

2.01 The application guidelines which are given in the following paragraphs for the 4-4 and 2-4 terminal MFT repeaters apply to single-repeater sections as shown in Fig. 3. The gain and equalization values are determined on a repeater section as shown.

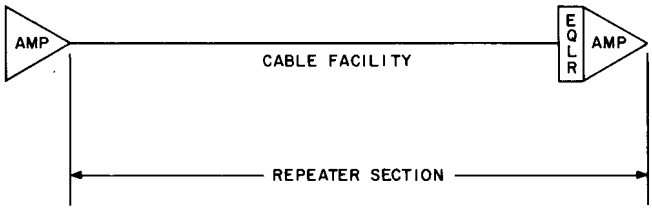

Fig. 3—Repeater Section

2.02 To avoid interference with other circuits, transmission levels at repeater inputs and outputs are restricted to minimum and maximum 1 kHz levels with respect to the transmission level point (TLP) as shown in Table C. When the repeater section adjacent to a PBX or other customer location consists of both loaded and nonloaded cable, levels for nonloaded cable may be used only if there is a minimum of 9 kft of cable between the repeater and the first load coil.

2.03 The maximum lengths of cable allowed for a repeater section in terms of 1 kHz loss are shown in Table D.

2.04 Since selection of either 600- or 1200-ohm impedance is available to match the cable impedance, the following rules should be used to determine the impedance of the 4-wire units:

- Nonloaded cable—600 ohms on both ends
- H88 loaded cable—1200 ohms on both ends
- Mixed loaded and nonloaded—600 ohms on nonloaded end and 1200 ohms on loaded end*

* The selection rule for mixed facilities assumes at least 9 kft of cable between the repeater and the first load coil. If less than 9 kft of nonloaded cable is present, the cable section should be treated as loaded and 1200 ohms impedance used.

2.05 For circuit design, the cable makeup must be known and equalizer settings determined before the flat gain of the amplifiers can be computed. Equalizer settings for various gauges and lengths of cable may be found in Section 332-912-232.

2.06 When cable makeup is not known or consists of cable for which loss data cannot readily be calculated, or the prescription settings given on the circuit layout record (CLR) do not provide the frequency response required for the circuit, equalizer settings may be determined by using the actual cable loss data as described in Part 4 of this section.

2.07 Since V4 repeater equipment may be used to terminate one end of a circuit and a MFT unit the other end, the following compatibility information may be helpful.

2.08 MFT units and V4 equipment are directly compatible on H88 loaded facilities. The 359-type equalizers used with the V4 equipment should be prescription set as described in Section 332-116-201 and MFT unit equalizers should be prescription set as described in Section 332-912-232.

2.09 On nonloaded facilities, V4 equipment uses nonadjustable impedance mismatching for equalization. Some circuit designs which have V4 equipment at one end of long nonloaded cable and MFT equipment at the other end may encounter difficulty in equalization since the V4 equipment is not adjustable. For long lengths of cable, equalization is available only from the mismatch of the 150 ohms of the V4 359B equalizer and the 600 ohms of the MFT repeater. The roll-off at 3 kHz relative to 1 kHz for varying gauges and lengths of nonloaded cable is given in Table E.

2.10 Post-equalization offers advantages in crosstalk and other circuit parameters and is the generally preferred method for equalization of all 4-wire facilities. When possible, MFT equipment should be used to terminate both ends of a facility and post-equalization employed for both directions of transmission.

2.11 When a nonloaded circuit must be terminated in a combination of MFT and V4 equipment, the J99343RF (pre-equalization) repeater may be used to supply adjustable equalization for both directions of transmission. The equalizer in the receive leg of the J99343RF is prescription set to

TABLE C

PERMISSIBLE TRANSMITTING AND RECEIVING LEVELS AT 1 KHZ
WITH RESPECT TO TRANSMISSION LEVEL POINT (TLP)

REPEATER LOCATION	CABLE TYPE	MINIMUM INPUT LEVEL (dB)	MAXIMUM OUTPUT LEVEL (dB)
Central Office	Nonloaded	−9	+6
	H88 loaded	−9	+6
PBX or other customer location	Nonloaded	−9	+6
	H88 loaded	−6	+3

TABLE D

MAXIMUM LENGTH OF CABLE WITHIN A REPEATER SECTION

REPEATER SECTION	MAXIMUM LENGTH	
	NONLOADED	H88 LOADED
PBX or cust to PBX or cust	15 dB	9 dB
PBX or cust to CO	15 dB	12 dB
CO to CO	15 dB	15 dB

TABLE E

3 KHZ ROLL-OFF CAUSED BY IMPEDANCE MISMATCH
EQUALIZATION USING V4 AND MFT (150Ω V4 END, 600Ω MFT END)

GAUGE	3 KHz ROLL-OFF		
	2.0 dB	3.0 dB	4.0 dB
19	20.5 kft	25.3 kft	29.3 kft
22	17.0 kft	20.0 kft	23.3 kft
24	14.5 kft	17.3 kft	20.0 kft
26	12.5 kft	15.0 kft	17.3 kft

post-equalize using the tables in Section 332-912-232. The other equalizer is set identically to pre-equalize in the transmit direction. The V4 equipment at the opposite end of the circuit is set to the standard impedance for the cable facility (600 ohms for nonloaded or 1200 ohms to the loaded end of a mixed cable section) and does not appreciably affect the overall circuit equalization.

3. INSTALLATIONS AND TESTS

GENERAL

3.01 Installation and testing procedures outlined in this section require the use of the MFT Test Extender, J99343TB. The test extender is described in Section 332-910-102.

3.02 The following test equipment will be required in addition to the test extender:

- Oscillator with adjustable output level (preferably with optional 600- and 900-ohm output impedance)
- Transmission Measuring Set (TMS) (preferably with optional 600- and 900-ohm input impedance)

Note: The oscillator and TMS may be a combination unit similar to the Hewlett-Packard 3550B or the Northeast Electronics TTS-15B.

- Test cords with appropriate plugs and connections.

A CLR will also be required.

3.03 The CLRs may indicate the gain or loss requirements of a repeater unit in one of two ways. One method is by use of expected measured gain (EMG). The EMG is the 309-type repeater unit gain at 1000 Hz measured with the equalizer switches set as specified on the CLR. The EMG is always calculated assuming the use of 600 ohm test equipment applied at the repeater or amplifier input and output. If EMG is specified on the CLR, the procedures in Chart 2, Repeater Unit Gain Adjustment, should be used. A second method of indicating gain or loss requirements is by the use of design gains or levels, eg, transmission level points (TLPs). This method also assumes equalizer switches are set according to the CLR and all measurements are made with test equipment whose impedance matches the circuit impedance at the point of measurement. When the preferred test equipment impedance is used the gains or losses may be measured directly or if the preferred test equipment is not available, correction factors (Table F) must be used. When design gains are specified the procedures in Chart 2, 2-4 Repeater Gain Adjustment should be used. For design level adjustments the procedures in Chart 3, 2-4 Repeater Unit Level Adjustment should be followed.

3.04 In some instances, the facility makeup may not be known by the circuit designer, or the facility may be different from that assigned. When this happens, prescription settings may not be given, or those given may be incorrect. In this event, frequency response measurements must be made and the procedures given in Chart 6, Frequency Response Measurements, and in Part 4 of this section must be followed.

TABLE F

TEST EQUIPMENT IMPEDANCE CORRECTION FACTORS

REPEATER IMPEDANCE		PREFERRED TEST EQPT IMPEDANCE	ALTERNATE TEST EQPT IMPEDANCE	CORRECTION dB
A SIDE	B SIDE			
600	600	600	900	.4
600	1200	900	600	.5
900	600	600 or 900	—	—
900	1200	900	600	.7
1200	600	900	600	.5
1200	1200	900	600	1.0

2-4 TERMINAL REPEATERS (J99343RA, RF)

A. General Installation Procedures

3.05 The 2-4 terminal repeater test arrangement is shown in Fig. 4. In applications requiring through or terminal balance the NBOC must be set according to the office records or determined by measurement. When adjustment of the NBOC by measurement is required the procedures in Chart 1, Adjustment of 2-4 Repeater NBOC, should be performed prior to adjusting the gain or level of the repeater. If use of the NBOC is not required, the NBOC screws (A-F) should be turned out and the procedures in Chart 2 or 3 used.

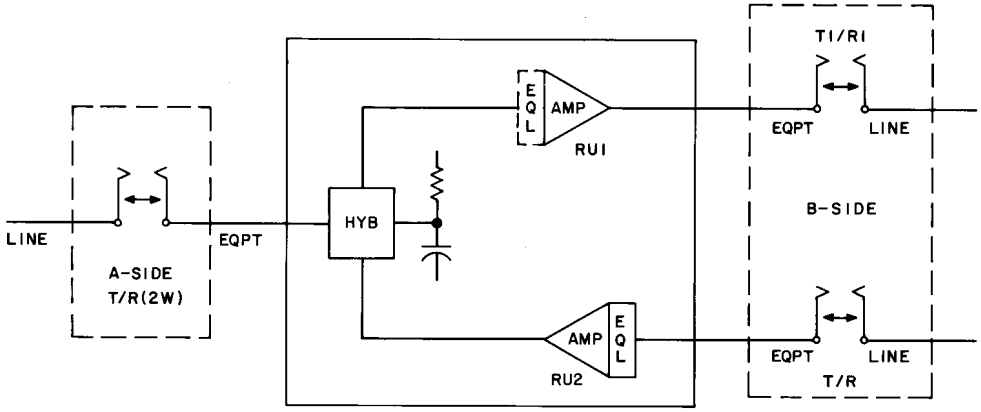

Fig. 4—Test Arrangement for 2-4 Terminal Repeater

CHART 1

ADJUSTMENT OF 2-4 REPEATER NBOC

STEP	PROCEDURE
1	Set the following options as specified on CLR: • 4-wire impedance (OUT) • 2-wire impedance (HYB1 and HYB2) • Midpoint capacitance (MPC) • Signaling options (SXSH, SXREV, RV and RV/T).
2	Set equalizer and gain switches to off (SL = 0, HT = 0) and gain potentiometer to zero.

CHART 1 (Cont)

STEP	PROCEDURE
3	Set key switches on test extender as follows: A SIDE: 2W/4W to 2W; 600/900 to impedance of unit; COMP NET to OUT B SIDE: 2W/4W to 4W; 600/900 to 600
4	Insert test extender card into proper transmission unit slot of MFT shelf.
5	Insert 2-4 repeater into mounting on side of test extender.
6	Set oscillator output to 600 ohms and 0 dBm at 1 kHz.
7	Terminate the 2-wire side of the circuit (at switch or trunk equipment).
8	Connect detector to T1/R1 EQUIP jack on B-side of test extender.
9	Connect oscillator to T/R EQUIP jack on B-side of test extender.
10	Adjust NBOC for maximum loss indication on detector (This will balance the network for the capacitance of the office cabling.)
11	Remove tone and detector from test extender.
12	Go to Chart 2 or Chart 3 as required by the information given on the CLR.

B. Setting Specified Gain

3.06 The procedures in Chart 2 for adjusting the repeater to a specific gain assumes the procedures in Chart 1 have been completed if adjustment of the NBOC is required.

CHART 2

2-4 REPEATER UNIT GAIN ADJUSTMENT

STEP	PROCEDURE
1	Set equalizer switches as specified on CLR. (If equalizer settings are unknown, they may be determined by the procedures in Part 4 of this section.)

CHART 2 (Cont)

STEP	PROCEDURE
	Note: Amplifiers with equalizer sections must have equalizer switches set as specified on the CLR before gain adjustments are made. Changes in equalizer settings will affect the repeater gain.
2	Set gain switches OFF and potentiometer to zero.
3	Determine gain of transmit amp from CLR. Call it G.
4	If gain is an EMG the measuring equipment impedance must be 600 ohms. Go to Step 6a.
5	If gain is design gain and the impedance of test equipment is not the preferred impedance (see Table F), subtract correction factor from G. Call the result M. Go to Step 6b.
6a	Adjust output of oscillator to indicate a level of -G on the detector.
6b	Adjust output of oscillator to indicate a level of -M on the detector.
7	Connect oscillator output to T/R EQUIP jack on A Side of test extender.
8	Connect detector to T1/R1 EQUIP jack on B Side of test extender.
9	Adjust gain switches and potentiometer on transmit amp to obtain 0 dBm reading on the detector.
10	Remove oscillator and detector cords from test extender.
11	Determine receive amp gain from CLR (G).
12	If necessary, apply correction factor as in Step 5.
13	Adjust oscillator output for -G or -M reading on the detector.
14	Connect the detector to the T/R EQUIP jack on the A side of the test extender.
15	Connect the oscillator to the T/R EQUIP jack on the B side of the test extender.
16	Adjust the receive amp gain switches and potentiometer for a 0 dBm reading on the detector.
17	Remove oscillator and detector cords from the test extender.
18	Remove the 2-4 repeater from the test extender.
19	Remove test extender card from MFT shelf.
20	Insert repeater into mounting shelf.
21	This concludes the gain adjustment procedure for the 2-4 terminal repeater.

C. Setting Specified Output Level

3.07 The procedures in Chart 3 for adjusting the repeater for a specific level at the output of the repeater assumes the procedures in Chart 1 have been completed if adjustment of the NBOC is required.

CHART 3

2-4 REPEATER UNIT LEVEL ADJUSTMENT

STEP	PROCEDURE
1	Set equalizer switches as specified on CLR. (If equalizer settings are unknown, they may be determined by the procedures in Part 4 of this section.) ***Note:*** Equalizer switches must be set as specified on the CLR before level adjustments are made. Changes in equalizer settings will affect the repeater output level.
2	Set gain switches OFF and potentiometer to zero.
3	Set key switches on the test extender as follows: **A SIDE**: 2W/4W to 2W; 600/900 to impedance of unit; COMP NET to OUT **B SIDE**: 2W/4W to 4W; 600/900 to 600
4	Insert the test extender card into the proper slot in the MFT mounting shelf.
5	Insert the repeater into the mounting on the side of the test extender.
6	Have 1 kHz tone at 0 dBm put on the circuit at the 0 TLP on the A side of the circuit (switch or trunk equipment).
7	Connect detector input to T1/R1 EQUIP jack on B side of test extender. If test equipment impedance at the test point is not the preferred test equipment impedance, the correction factor in Table G must be substracted from the specified level for proper readings.

TABLE G

TEST EQUIPMENT IMPEDANCE CORRECTION FACTORS FOR LEVEL MEASUREMENTS

REPEATER IMPEDANCE AT MEASURING POINT	PREFERRED TEST EQPT IMPEDANCE	ALTERNATE TEST EQPT IMPEDANCE	CORRECTION (DB)
600	600	900	+.2
900	900	600	+.2
1200	900	600	+.5

CHART 3 (Cont)

STEP	PROCEDURE
8	Determine output level of repeater from CLR. (Subtract correction if necessary.)
9	Adjust transmit amp gain switches and potentiometer for level specified in Step 8 on detector.
10	Remove detector cord from test extender.
11	Request distant end to measure and adjust output of receive amp at distant end to specified level.
12	Remove tone from circuit.
13	Have distant end put on 0 dBm 1 kHz tone at 0 TLP.
14	Have distant end adjust transmit amp to proper output level.
15	Determine level at the input to the receive amp from the CLR. Apply correction factor from Table G if required.
16	Connect detector to T/R LINE jack on B side of test extender and verify that received level is approximately that specified by the CLR. ***Note:*** If received level is not the approximate level specified on the CLR, the cable pairs should be tested for trouble.
17	Remove the detector from the B side of the test extender and connect it to the T/R EQUIP jack on the A side of the test extender.
18	Determine the output level of the receive amp from the CLR. Apply the correction factor from Table G if necessary.
19	Adjust the receive amp gain switches and potentiometer for the level in Step 18.
20	Remove tone from the circuit.
21	Remove detector cord from the test extender.
22	Remove the unit from the test extender.
23	Remove the test extender card from the MFT mounting shelf.
24	Insert the repeater into the proper MFT mounting slot.
25	This completes the level adjustment procedure for the 2-4 Terminal Repeater.

4-4 TERMINAL OR INTERMEDIATE REPEATERS (J99343SA, SB)

3.08 The 4-4 Terminal and Intermediate Repeaters are combined in the procedures that follow since the only difference is an additional impedance switch and equalizing amplifier.

A. Setting Specified Gain

3.09 The procedures for adjustment of either 4-4 repeater are identical and Fig. 5 illustrates the test configuration for gain or level adjustment. Chart 4 describes the procedures for 4-4 repeater unit gain adjustment.

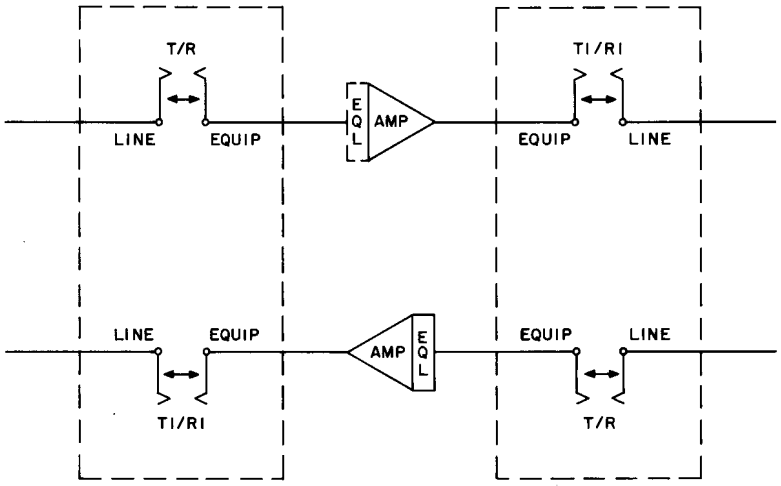

Fig. 5—Test Configuration for 4-4 Terminal or Intermediate Repeaters

CHART 4

4-4 REPEATER UNIT GAIN ADJUSTMENT

STEP	PROCEDURE
1	Set the following options as specified on the CLR: Impedance Input (4-4 intermediate only) and Output (600/1200) Equalizer Settings (Receive amp only in terminal repeater; both amps in intermediate) Signaling (RV and RV/T) ***Note:*** Equalizers must be set before gain adjustments are made. If equalizer settings are unknown, they may be determined by the procedures in Part 4 of this section.
2	Set gain switches OFF and potentiometer to zero.

CHART 4 (Cont)

STEP	PROCEDURE
3	Set key switches on test extenders as follows: A SIDE: 2W/4W to 4W; 600/900 to 600 B SIDE: 2W/4W to 4W; 600/900 to 600
4	Insert test extender card into MFT mounting slot.
5	Insert repeater unit into slot on side of test extender.
6	Determine gain of transmit amp from CLR. Call it G.
7	If specified gain is an EMG, the measuring equipment impedance must be 600 ohms. Go to Step 9a.
8	If specified gain is not an EMG and preferred test equipment is not used, correction factors (see Table F) must be subtracted from gain specified on CLR. Call the result M. Go to Step 9b.
9a	Adjust output of oscillator for -G indication on the detector.
9b	Adjust output of oscillator for -M indication on the detector.
10	Connect the detector to the T1/R1 EQUIP jack on the B side of the test extender.
11	Connect the oscillator to the T/R EQUIP jack on the A side of the test extender.
12	Adjust the transmit amp gain switches and potentiometer for a 0 dBm indication on the detector.
13	Remove oscillator and detector cords from the test extender.
14	Determine receive amp gain from CLR.
15	If specified gain is not an EMG, corrections as in Step 8 must be made.
16	Adjust output of oscillator for a -G or -M indication on the detector.
17	Connect the detector to the T1/R1 EQUIP jack on the A side of the test extender.
18	Connect the oscillator output to the T/R EQUIP jack on the B side of the test extender.
19	Adjust the receive amp gain switches and potentiometer for a 0 dBm indication on the detector.

CHART 4 (Cont)

STEP	PROCEDURE
20	Remove the unit from the test extender.
21	Remove the test extender card from the MFT mounting shelf.
22	Insert repeater into mounting shelf.
23	This completes the gain adjustment of the 4-4 repeaters.

B. Setting Specified Output Level

3.10 The procedure for setting a specified level on the 4-4 terminal or intermediate repeater is very similar to that for the 2-4 terminal repeater.

3.11 It is important to note that the impedance of the repeater must be set to match the facility, and equalizer settings must be installed prior to setting the levels.

CHART 5

4-4 REPEATER UNIT LEVEL ADJUSTMENT

STEP	PROCEDURE
1	Install or verify transmission and signaling options as specified on CLR. Impedance Input (4-4 intermediate only) and Output (600/1200) Equalizer Settings (Receive amp only in terminal repeater; both amps in intermediate). ***Note:*** Equalizers must be set before gain adjustments are made. If equalizer settings are unknown, they may be determined by the procedures in Part 4 of this section.
2	Set gain switches OFF and potentiometer to zero.
3	Set key switches on test extender as follows: **A SIDE**: 2W/4W to 4W; 600/900 to 600 **B SIDE**: 2W/4W to 4W; 600/900 to 600

CHART 5 (Cont)

STEP	PROCEDURE
4	Insert test extender card into proper MFT mounting slot.
5	Insert repeater unit into slot on side of test extender.
6	Have 0 dBm 1 kHz test tone put on circuit at 0 TLP (for A side of circuit).
7	Connect detector to T1/R1 EQUIP jack on B side of test extender.
8	Determine proper level at output of transmit amp from CLR.
9	If test equipment impedance is other than the preferred impedance at the measuring point, subtract correction factor from Table G from the specified level for the proper reading.
10	Adjust transmit amp gain switches and potentiometer for level determined in Step 9 on the detector.
11	Remove detector cord from test extender and have distant end adjust the receive amp for proper output level.
12	Request distant end to put on 0 dBm 1 kHz tone at 0 TLP, and adjust distant end transmit amp for proper output level.
13	Connect detector to T/R line jack on B side of test extender, and verify level on cable pair with input level specified on CLR.
14	If level in Step 13 is not approximate level specified on CLR, test cable pairs for trouble.
15	Remove detector from B side of test extender and connect it to the T1/R1 EQUIP jack on the A side of the test extender.
16	Determine level at output of the receive amp from the CLR, and apply correction factor from Table G if necessary.
17	Adjust receive amp gain switches and potentiometer for proper level indication on the detector.
18	Remove the detector cord from the test extender.
19	Remove the repeater from the test extender.
20	Remove the test extender card from the MFT mounting shelf.
21	Insert the repeater into the MFT mounting shelf.
22	This completes the level adjustment procedure.

FREQUENCY RESPONSE MEASUREMENTS

3.12 Frequency response measurements are used to determine the equalizer settings from actual cable loss measurements. The readings obtained in the following procedures are then used in the procedure in Part 4 of this section to determine the equalizer settings.

3.13 When MFT units are used on both ends of the cable section, the test arrangement in Fig. 6 is used. The jacks in Fig. 6 are provided by the test extenders.

3.14 It is very important to have the proper terminating impedance of the repeater selected as loss-frequency measurements are heavily influenced by the terminating impedance. The following procedure is for either the 2-4 terminal or the 4-4 type repeaters and it is assumed the measurements are being made to determine the equalizer settings. The same test arrangement may be used with equalizer settings installed for gain-frequency response tests.

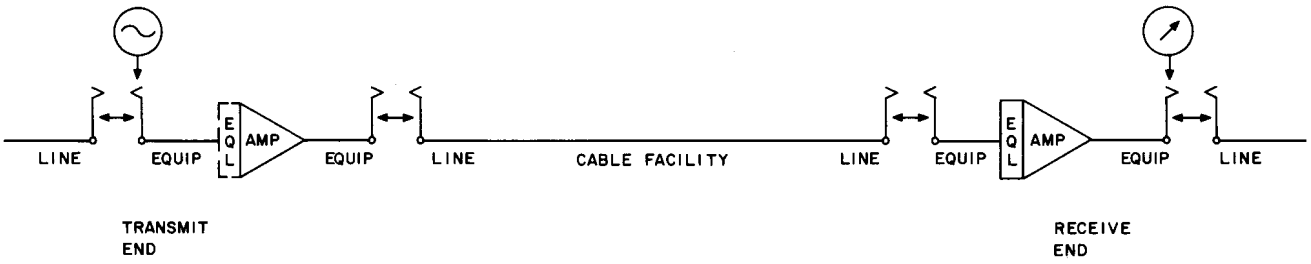

Fig. 6—Test Configuration for Loss Frequency Measurements

CHART 6

FREQUENCY RESPONSE MEASUREMENTS

STEP	PROCEDURE
1	Verify or install the proper transmission and signaling options in the repeater. **4-4 TYPE** Impedance (Input, Output) Signaling (RV, RV/T) **2-4 TYPE** Impedance (HYB, OUT) Midpoint Capacitor NBOC Signaling (SXSH, SXREV, RV RV/T)
2	If equalizer settings have been installed, note the settings and then disable the equalizer by setting SL = 0 and HT = 0. ***Note:*** Equalizer settings must be removed from both transmit (4-4 intermediate only) and receive repeaters for equalizer setting calculation. For frequency response measurements, equalizers must be removed from the transmit (4-4 intermediate) end and installed in the receive repeater.

CHART 6 (Cont)

STEP	PROCEDURE
3	Designate one end of the circuit as TRANSMIT and the other end as RECEIVE.
4	Set the gain of all repeater units to zero.
5	Set key switches on test extender as follows:

A SIDE	B SIDE
2W/4W to 2W for 2-4; 4W for 4-4	2W/4W to 4W
600/900 to 600	600/900 to 600
COMP NET to OUT	

6	Insert test extender card into proper slot of MFT mounting shelf.
7	Insert repeater into slot on side of test extender.
8	TRANSMIT END

Calibrate oscillator for 0 dBm output at 1 kHz. Connect oscillator output to T/R EQUIP jack on A side of test extender.

Note: Connection of test equipment to 4-4 intermediate repeaters must be determined by circuit connections.

RECEIVE END

Connect detector to T/R EQUIP jack if 2-4 repeater or T1/R1 EQUIP jack if 4-4 terminal repeater on A side of test extender. Observe and record 1 kHz level.

Note: Connection of test equipment to 4-4 intermediate repeaters must be determined by circuit connections.

9	Have transmit end send 500 Hz at 0 dBm and record level received.
10	Have transmit end send 2400 Hz at 0 dBm and record level received.
11	Have transmit end send 3200 Hz at 0 dBm and record level received.
12	Use levels to compute equalizer settings as described in Part 4 of this section.
13	Make loss measurements in the opposite direction using the same procedures.
14	Compute equalizer settings as in Step 12, if required.
15	Install equalizer settings determined in Step 12 and/or Step 14.

CHART 6 (Cont)

STEP	PROCEDURE
16	Make loss measurements again to see if circuit is equalized. If not in limits, touch-up procedures are found in Part 5 of this section.
17	Set gain or level of amplifiers as described in previous procedures.
18	Remove test cords from test extender.
19	Remove unit from test extender.
20	Remove test extender card from MFT mounting shelf.
21	Insert repeater into the proper MFT mounting slot.
22	This completes the frequency response measurement procedures.

4. EQUALIZER SETTINGS FROM CABLE LOSS DATA

4.01 The equalizer settings of the 309B equalizing amplifiers used in the MFT transmission units may be determined from cable section loss data as described in the following procedure.

4.02 Cable loss is measured at four frequencies: 500 Hz, 1000 Hz, 2400 Hz, and 3200 Hz (following the procedures given in Chart 6) to determine the

- Nonloaded/loaded switch setting
- Slope unit setting
- Height and Bandwidth settings of the bump shape.

4.03 Equalizer adjustments are determined by the difference in the 1 KHz loss and the loss at the other three frequencies. This difference is located on the bottom scale of the appropriate range chart and the setting is found on the top scale. If the difference is exactly equal to the number on the range scale the setting to the right of the number should be used. If the difference is smaller than the lowest range value, the smallest setting on the chart should be used. If the difference is greater than the largest range value, the highest setting on the chart should be used.

4.04 The NL/L switch setting is determined in Step 3 of the procedure. The values 1.4 and 0.3 are computed values of relative loss at 2400 Hz for mixtures of loaded and nonloaded cable. If either test is met, the switch should be placed in the L or off position.

4.05 The procedure is outlined by the form in Fig. 7. This form may be reproduced as necessary to aid in the computations. Two examples, one for nonloaded and one for loaded cable are given in the following procedures and knowledge of cable makeup is not required.

STEP

1. Determine Cable Loss
   500 Hz _____
   1000 Hz _____
   2400 Hz _____
   3200 Hz _____

2. 1000 Hz Loss _____
   500 Hz Loss _____

   DIFFERENCE _____

   From Table H [SL =]

   From Table I find 2400 Hz adjustment corresponding to SLOPE setting and enter in STEP 3. @

3. 2400 Hz Loss _____
   1000 Hz Loss _____

   DIFFERENCE _____ If less than 1.4, proceed to STEP 7.
   2400 Hz Adj. _____ @

   DIFFERENCE _____ If less than 0.3, proceed to STEP 7.

   Record the final difference in STEP 6.

4. Set [NL/L = NL]

5. 3200 Hz Loss _____
   2400 Hz Loss _____

   DIFFERENCE _____

   From Table J [BW =]

6. Difference
   From STEP 3 _____

   Using BW determined in STEP 5

   From Table K [HT =]

END OF SETTING CALCULATION

TO USE RANGE CHARTS: Determine the range on the lower scale which includes the computed difference. Read the setting from the top scale directly above range selected. If the difference is exactly equal to one of the numbers on the range scale, use the setting for the range to the right of the number.

TABLE H

INITIAL SLOPE SETTING

SLOPE SETTINGS															
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	.3	.6	.9	1.2	1.5	1.7	2.0	2.2	2.4	2.6	2.8	3.0	3.1	3.3	

500 HZ RANGE

TABLE I

DETERMINING 2400 HZ ADJUSTMENT

SLOPE SETTING	2400 HZ ADJUSTMENT
0	0.0
1	0.6
2	1.2
3	1.6
4	2.0
5	2.3
6	2.6
7	2.8
8	3.0
9	3.1
10	3.3
11	3.4
12	3.5
13	3.6
14	3.6
15	3.7

TABLE J

BANDWIDTH SETTINGS FOR NONLOADED CABLE

BANDWIDTH SETTINGS				
14	13	12	11	10
4.5	5.4	6.3	7.1	

RANGE OF ROLL OFF BETWEEN 2400 HZ AND 3200 HZ

TABLE K

HEIGHT SETTINGS FOR NONLOADED CABLE

	HEIGHT SETTINGS															
BW = 1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	.1	.3	.5	.7	.9	1.2	1.6	2.0	2.3	2.7	3.1	3.5	4.0	4.6	5.3	
	2400 HZ RANGE															
	HEIGHT SETTINGS															
BW = 11	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	.2	.3	.6	.8	1.1	1.4	1.9	2.4	2.7	3.1	3.5	4.0	4.5	5.1	5.8	
	2400 HZ RANGE															
	HEIGHT SETTINGS															
BW = 12	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	.2	.4	.7	1.0	1.3	1.7	2.2	2.8	3.1	3.5	4.0	4.5	5.0	5.6	6.3	
	2400 HZ RANGE															
	HEIGHT SETTINGS															
BW = 13	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	.2	.5	.8	1.2	1.6	2.0	2.6	3.2	3.6	4.0	4.4	4.9	5.5	6.0	6.6	
	2400 HZ RANGE															
	HEIGHT SETTINGS															
BW = 14	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	.3	.6	1.0	1.4	1.8	2.3	2.9	3.5	3.9	4.3	4.8	5.2	5.7	6.2	6.7	
	2400 HZ RANGE															

Fig. 7—Computation of Equalizer Settings From Cable Loss Data

STEP

7. Set NL/L = L

8. Compute new Slope setting

   1000 Hz Loss _____
   500 Hz Loss _____

   DIFFERENCE _____

   From Table L SL =

   From Table M, find 2400 Hz Adj. -Enter in STEP 10*
   find 3200 Hz Adj. -Enter in STEP 9#

9. 3200 Hz Loss _____
   3200 Hz Adj. _____ #

   DIFFERENCE _____
   1000 Hz Loss _____

   DIFFERENCE _____

   From Table N HT =

10. 2400 Hz Loss _____
    2400 Hz Adj. _____ *

    DIFFERENCE _____
    1000 Hz Loss _____

    DIFFERENCE _____

    From Table O BW =

TABLE L

SLOPE SETTINGS FOR LOADED CABLE

SLOPE SETTINGS										
0	1	2	3	4	5	6	8	12		15
0	.4	.6	.8	.9	1.0	1.1	1.2	1.3		
500 HZ RANGE										

TABLE M

2400 HZ AND 3200 HZ ADJUSTMENTS FOR LOADED CABLE FROM SLOPE SETTING (TABLE L)

SLOPE SETTING	2400 HZ ADJUSTMENT	3200 HZ ADJUSTMENT
0	0	0
1	.2	.2
2	.2	.3
3	.3	.3
4	.4	.4
5	.4	.4
6	.4	.5
8	.4	.5
12	.5	.5
15	.5	.5

TABLE N

HEIGHT SETTINGS FOR LOADED CABLE

HEIGHT SETTINGS															
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
.9	1.4	2.0	2.6	3.3	4.1	5.0	5.6	6.2	6.8	7.6	8.4	9.2	10.2	11.3	
3200 HZ RANGE															

TABLE O

BANDWIDTH SETTINGS FOR LOADED CABLE

HT = 0
HT = 1
HT = 2
BW = 7

HT = 3
BW SETTINGS: 3 6 7 8 9 10 11 12 13 14 15
2400 HZ RANGE: .1 .2 .3 .4 .5 .6 .7 .8 1.0 1.1

HT = 4
BW SETTINGS: 2 5 6 7 8 9 10 11 12 13 14
2400 HZ RANGE: .1 .2 .3 .5 .6 .7 .8 1.0 1.2 1.4

HT = 5
BW SETTINGS: 1 4 5 6 7 8 9 10 11 12 13 14
2400 HZ RANGE: .1 .2 .3 .4 .6 .8 .9 1.1 1.3 1.6 1.8

HT = 6
BW SETTINGS: 0 3 5 6 7 8 9 10 11 12 13 14
2400 HZ RANGE: .1 .2 .4 .6 .9 1.0 1.2 1.4 1.7 2.0 2.3

HT = 7
BW SETTINGS: 0 2 4 5 6 7 8 9 10 11 12 13
2400 HZ RANGE: .1 .2 .3 .5 .8 1.1 1.3 1.6 1.9 2.2 2.6

HT = 8
BW SETTINGS: 0 1 3 4 5 6 7 8 9 10 11 12
2400 HZ RANGE: .1 .2 .3 .4 .6 1.1 1.5 1.8 2.0 2.4 2.8

HT = 9
BW SETTINGS: 0 2 3 4 5 6 7 8 9 10 11
2400 HZ RANGE: .2 .3 .4 .5 .8 1.3 1.8 2.0 2.3 2.7

HT = 10
BW SETTINGS: 0 2 3 4 5 6 7 8 9 10
2400 HZ RANGE: .2 .3 .4 .6 .9 1.5 2.0 2.3 2.7

HT = 11
BW SETTINGS: 0 1 2 3 4 5 6 7 8 9
2400 HZ RANGE: .2 .3 .4 .5 .7 1.1 1.7 2.4 2.7

HT = 12
BW SETTINGS: 0 1 2 3 4 5 6 7 8
2400 HZ RANGE: .3 .4 .5 .6 .9 1.1 2.0 2.7

HT = 13
BW SETTINGS: 0 2 3 4 5 6 7
2400 HZ RANGE: .4 .6 .8 1.1 1.6 2.4

HT = 14
BW SETTINGS: 0 1 2 3 4 5 6
2400 HZ RANGE: .4 .6 .7 .9 1.3 1.9

HT = 15
BW SETTINGS: 0 1 2 3 4 5
2400 HZ RANGE: .6 .7 .9 1.2 1.6

Fig. 7—Computation of Equalizer Settings From Cable Loss Data (Cont)

Example 1: Nonloaded Cable

1 Loss of the Repeater Section

500 Hz ***11.4 dB***

1000 Hz ***12.0 dB***

2400 Hz ***15.7 dB***

3200 Hz ***21.9 dB***

2 Difference between 500 Hz and 1000 Hz

1000 Hz loss	12.0
500 Hz loss	11.4
Difference	.6

From Table H, locate .6 on bottom scale. Since .6 is the dividing point the slope value to the right is used.

Slope = 3.

From Table I, the 2400 Hz adjustment for SL = 3 is 1.6.

3 Difference between 2400 Hz and 1000 Hz loss.

2400 Hz loss	15.7
1000 Hz loss	12.0
Difference	3.7

The 2400-Hz difference is tested against the first parameter to determine the NL/L switch setting. 3.7 is not less than 1.4.

The 2400-Hz adjustment is subtracted from the difference and tested against the second parameter.

Difference	3.7	(From Step 3)
Adjustment	1.6	(From Step 2)
New Difference	2.1	

2.1 is not less than .3.

4 Since neither test against the parameters was positive, the NL/L switch is set to the NL position.

Since the switch is in the NL position, all other computations will use Tables J and K.

5 Compute the bandwidth (BW) setting by finding the difference between the 3200-Hz loss and the 2400 Hz loss.

3200 Hz loss	21.9
2400 Hz loss	15.7
Difference	6.2

From Table J, the difference 6.2 on the lower scale is between 5.4 and 6.3. The top scale indicates a BW setting of 12.

BW = 12

6 To determine the height (HT) setting, the 2400-Hz difference minus the 2400-Hz adjustment is located in Table K for BW = 12. From Step 3, the 2400-Hz difference (3.7) minus the 2400-Hz adjustment (1.6) is 2.1.

From the table HT = 6.

All settings are now known

NL/L = NL

Slope = 3

BW = 12

HT = 6

Example 2: Loaded Cable

1 Measure cable section loss.

500 Hz = 6.2 dB

1000 Hz = 6.5 dB

2400 Hz = 6.7 dB

3200 Hz = 9.0 dB

2 Compute the difference between 500 Hz and 1000 Hz loss.

1000 Hz loss	6.5
500 Hz loss	6.2
Difference	.3

From Table H the slope setting is 2. SLOPE = 2.

From Table I the 2400-Hz adjustment for SL = 2 is 1.2.

3 Compute the difference between 2400-Hz loss and 1000-Hz loss.

2400 Hz loss	6.7
1000 Hz loss	6.5
Difference	.2

Testing against the parameter of 1.4, .2 is less than 1.4. Proceed to Step 7.

7 Set NL/L to L position.

8 Compute new slope setting from Table L.

1000 Hz loss	6.5
500 Hz loss	6.2
Difference	.3

New Slope = 1.

From Table M the 2400-Hz adjustment is .2 and the 3200-Hz adjustment is .2.

9 Compute the height (HT) by the following formula:

3200 Hz loss	9.0
minus 3200 Hz adjustment	.2
Difference	8.8
minus 1000 Hz loss	6.5
Difference	2.3

From Table N the range 2.3 on the bottom scale corresponds to a HT setting of 3.

10 Compute the bandwidth setting from Table O using the formula:

2400 Hz loss	6.7
minus 2400 Hz adjustment	.2
Difference	6.5
minus 1000 Hz loss	6.5
Difference	0

From Table O (the chart with HT = 3) the difference 0 is less than the smallest range value; therefore, the BW is the lowest setting on the chart or 3.

All equalizer settings have now been determined.

NL/L Switch = L

SL = 1

BW = 3

HT = 3

5. GUIDELINES FOR EQUALIZER TOUCHUP

5.01 The following guidelines are intended for use in final adjustment of equalizers and not as an initial procedure.

5.02 Low-frequency equalization is controlled by the NL/L switch and the slope setting. With the NL/L switch in the L position, increasing the slope setting increases the low-frequency loss with respect to the 1 kHz loss. Whereas decreasing slope adds more gain at the low frequencies, there is almost no effect on the frequencies above 1 kHz.

5.03 When the NL/L switch is in the NL position, increasing the slope setting increases the loss of the low frequencies while more gain is added to the mid-band frequencies. When the slope setting is decreased, gain is added to the low frequencies and loss is added to the mid band frequencies relative to the 1 kHz gain. Changes to the slope setting always affect the 1 kHz gain of the repeater.

5.04 High-frequency (above 1 KHz) equalization is accomplished by a bump shape with two controls, bandwidth (BW) and height (HT). For large values of BW, increasing the HT setting adds more gain at the high frequencies and almost as much gain at the mid-band frequencies. When small values of BW are used, increasing the HT setting adds more gain at 3 KHz with almost no change in mid-band level.

5.05 When touch up of the equalizers is required, the low frequency roll-off should be adjusted first since the slope setting can have a major effect on the high frequency response.

Compare the 500-Hz loss with the 1 KHz loss and if

500-Hz loss is greater—decrease SL

500-Hz loss is less—increase SL.

5.06 The adjustment of the HT and BW settings depends on the initial value of BW and the position of the NL/L switch. For BW greater than 9 and NL/L in the NL position

- Check 3 kHz roll-off against 1 kHz level

  too much loss—increase HT
  too much gain—decrease HT

- Check 2.4 kHz roll-off against 1 kHz level

  too much loss—increase BW
  too much gain—decrease BW

5.07 When the BW setting is less than 10, two comparisons must be made; the roll-off in the range of 2.4 kHz to 3.0 kHz versus the 1 kHz loss, and the 3.0 kHz to 3.2 kHz roll-off versus the 1 kHz loss. Table P gives the general direction of adjustment for the BW and HT settings for the various roll-off comparisons.

5.08 If satisfactory results cannot be obtained in two or three adjustments, the original equalizer settings were not close to the required settings. It is suggested that the settings be determined as outlined in Part 4 of this section.

6. REFERENCES

6.01 The following additional references may provide additional information.

REFERENCE	TITLE
332-910-100	General Description of MFT
332-910-180	General Application Information for MFT
332-910-102	MFT Test Extender
332-912-131	MFT 4-4 Wire and 2-4 Wire Terminal Repeaters—Description
332-912-232	MFT Prescription Equalizer Settings for 4-4 Wire and 2-4 Wire Terminal Repeaters
SD-1C359-01	Metallic Facility Terminal Circuit
CD-1C359-01	Common Systems—Metallic Facility Terminal Circuit

TABLE P

DIRECTION OF BW AND HT ADJUSTMENT FOR TOUCHUP

ROLL-OFF RANGE		ADJUSTMENT
2.4 – 3.0 kHz	3.0 – 3.2 kHz	
Too much loss	OK	Increase BW; increase HT if necessary
Too much loss	Too much loss	Increase BW; adjust HT if necessary
Too much loss	Too much gain	Increase BW; decrease HT
OK	Too much loss	Increase HT; adjust BW
OK	Too much gain	Decrease HT; adjust BW
Too much gain	OK	Decrease BW; adjust HT
Too much gain	Too much loss	Decrease HW; increase HT if necessary
Too much gain	Too much gain	Decrease BW; decrease HT