SIGNALING CONVERTER UNITS

DESCRIPTION

TYPE F SIGNALING SYSTEM

CONTENTS PAGE

1. GENERAL

1.01 This section describes the FUA and FUD single-frequency (SF) signaling converter circuits, SD-1C226-01 and SD-1C226-02 (Fig. 1), which are a component part of the Type F Signaling System.

1.02 This section is reissued for the following reasons:

(a) To add statement to paragraph 2.08 pertaining to the setting of the slope control

(b) To change the statement in the comment column for switch function S of Table C

(c) To add the word NONLOADED to the cable length in Fig. 10, 11, and 12.

Arrows will be used to indicate the change in paragraph 2.08.

A. System and Unit Description

1.03 The FUA and FUD (Fig. 1) are plug-in devices which are used, in conjuncton with an auxiliary, to convert DC signals to AC tone signals and vice versa. Six FUAs or FUDs plus six auxiliaries can be plugged into a 23-inch die cast shelf. A maximum of 12 shelves can be mounted on an 11-foot 6-inch bay, 10 shelves on a 10-foot 6-inch bay, 8 shelves on a 9-foot bay, and 6 shelves on a 7-foot bay. Space is also provided in each of these bays for two 2600-Hz tone supplies and their associated transfer circuit, a fuse and alarm circuit, and a plug-in carrier group alarm control circuit. In the 11-foot 6-inch bay and the 10-foot 6-inch bay, space is provided for three DC-to-DC power converters while in the 9-foot and 7-foot bays, space is provided for only two DC-to-DC power converters.

1.04 The FUA or FUD is placed in service by inserting it into the guides on the shelf and sliding it toward the rear of the bay. A locking device on the face of the unit locks the module in place when sufficient contact with the bay mounting is made. The FUA or FUD is removed by releasing the locking device and withdrawing the unit.

1.05 Components of the FUA and FUD are mounted on a printed wiring board. The board is held in a die cast aluminum frame approximately 10-1/2 inches by 7 inches by 1-1/2

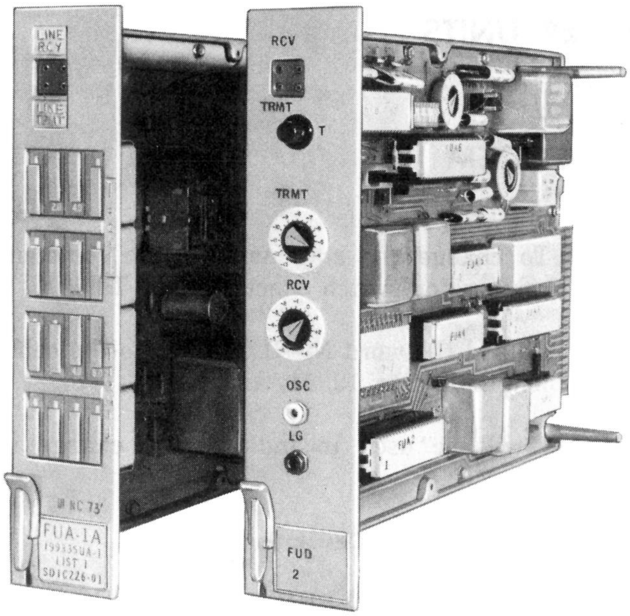


Fig. 1—FUA and FUD Units

inches. All interconnections between the bay and the SF module are via a 40-pin connector which is part of the printed wiring board.

1.06 The FUA provides a zero loss 4-wire transmission path to the auxiliaries and includes pads which allow adjustment for the transmission level. These pads are adjusted with 16 slide switches on the front of the unit. (See Fig. 1). These pads permit the introduction of attenuation in the transmit or receive path over a range of 0 to 16.5 dB in 0.1-dB steps. An external echo suppressor, equalizer, or other voice equipment can be inserted between the signaling circuit and the pad when proper cabling arrangements are made in the bay.

1.07 The FUD unit has variable gain circuits as part of the transmit and receive paths rather than external attenuators like the FUA unit. The variable gain circuits are controlled by potentiometers which are located on the front panel. These potentiometers are calibrated in linear dB to represent the actual gain or loss of the unit. The FUD unit does not allow the use of external echo suppressors and does not require external repeaters. The FUD unit has build-in balance networks and line build-out capacitors to compensate for external cables from auxiliary units. A comparision of circuits employing the FUD and auxiliary without external equipment versus circuits employing the FUA and auxiliary with external equipment can be seen in Fig. 2.

B. Application and Compatibility

1.08 ***FUA Signaling Converter Unit***—The FUA signaling converter provides the interface between the 4-wire transmission facility and the auxiliary signaling unit (Fig. 3). One FUA and an auxiliary unit are required at one end of a carrier to operate with a compatible E or F signaling unit at the other end. The FUA is designed to be applied to 4-wire carrier facilities with -16 dBm and +7 dBm voice transmission level points (TLP). The carrier must be within 5 dB of these nominal TLPs as measured at 2600 Hz. Auxiliary units provide signaling for 2-wire and 4-wire E & M lead signaling, loop reverse-battery signaling, and special access type signaling. Table A lists the auxiliaries and each unit function, application, and comparable type E unit.

1.09 ***FUD Signaling Converter Unit***—The FUD signaling converter provides all the FUA unit functions plus additional functions between the 4-wire transmission facilities and the auxiliary signaling unit (Fig. 4). One FUD and an auxiliary unit are required at one end of a signaling link to operate with a compatible E or F signaling unit at the other end. The FUD like the FUA was designed to be applied to a 4-wire facility at the -16 dBm and +7 dBm transmission level points. The transmission of the FUD is different from the FUA due to the additional built-in gain in the FUD. The gain of the FUD receive circuit is -6 dB to +4 dB. With a +7 dBm input at the line receive port, the output at the equipment receive port can be adjusted for a level of +1 dBm to +11 dBm. The gain of the FUD transmit circuit is -13 dB to -3 dB. With an input level to the equipment transmit port of -13 dBm to -3 dBm, the gain of the transmit circuit can be adjusted for a -16 dBm level at the line transmit port. These input, output, and gain levels are illustrated in Fig. 5. The FUD unit has a line balancing network and a line build-out capacitor circuit. The balancing network is designed to meet both loaded and nonloaded cable impedance matching requirements.

The line build-out capacitor circuit is incorporated in the FUD to build out the near end section of the cable to 6000 feet. Table A lists the auxiliary units that are compatible with the FUD unit.

1.10 ***Gain Transfer of FUD***—The FUD was designed to provide gain transfer. Gain transfer can be defined as the amount of gain that the 2-wire port of a hybrid at the far end of a loop exceeds the gain of the 2-wire port of a hybrid at the near end of a loop as measured in dB. Normally it has been necessary to keep gain transfer to a value less positive than -3 dB to avoid ***singing*** problems. However, in order to eliminate external repeaters, the -3 dB gain transfer has to be increased to +6 dB, resulting in a gain increase of 9 dB. This gain of 9 dB is accomplished on loaded and nonloaded cable by adding precision balance networks, line build-out capacitors, and frequency slope controls in the FUD unit. In order for gain transfer to be practical, three requirements must be satisfied. First, there must be enough gain to provide the required levels at the load at 1000 Hz. Second, the gain must be controlled relative to frequency to give the required signal levels at the load over the frequency band of interest. Third, the hybrid must give a transhybrid loss (THL) that is sufficient to keep the 4-wire loop stable during the signaling and talking conditions. The minimum THL that must be achieved at the hybrid for each equalizer setting and the RCV and TRMT dial settings for cable inputs of -3 to +6 dBm at 1000 Hz is shown in Table B. If the THL shown in Table B is achieved, the loss is at least -22 dB between the +7 and -16 TLP interfaces. This minimum value is required for gain transfer. To determine if gain transfer has been achieved on a particular circuit, perform Test A per Section 179-363-301.

1.11 These type F units are compatible with all present type E equipment except E1E and E1F revertive pulsing signaling units. There is no provision for revertive pulsing within the type F system. For compatibility with switching circuits see Section 179-100-308 or with other signaling units see SD-1C240-02 or descriptive BSPs on the auxiliaries.

2. OPERATIONAL PRINCIPLES

A. Transmitter

FUA Unit

2.01 The transmitter portion of the FUA (Fig. 6) provides both signaling and speech transmission functions. This circuit can be divided into three main parts: (1) tone level timing circuit, (2) CT relay control circuit, and (3) transmission path.

2.02 The 2600-Hz signal tone coming from the common oscillator is controlled by the auxiliary and sent into the FUA through the TN and TG leads at a -10 dBm level. It then passes through the tone level gate and timing circuit and is applied to the line transmit path through T5, a high impedance transformer. The tone level timing circuit, controlled by the auxiliary on the HL lead, allows for two output levels 12 dB apart. If tone is applied to TN and TG, high level tone (-24 dBm) is present at the -16 TLP. If HL is grounded when tone is applied, high level tone (-24 dBm) is transmitted for a period of 400 milliseconds after which time it goes to low level (-36 dBm at the -16 TLP). During pulsing operations, switching of the HL lead holds the tone at a high level.

2.03 The CT relay control circuit provides a balanced cut and termination of the transmission path during idle circuit conditions, during change of states (on-hook to off-hook and vice versa), and during pulsing to prevent transients from switching equipment from interfering with the 2600-Hz tone. When the CT lead is grounded, the CT relay releases and provides a through path for transmission. The CT relay is operated when a negative voltage from the auxiliary is applied to the CT lead. If this negative voltage on the CT lead is removed when the HL ground is removed the relay release is delayed (125 ms) by the holdover cut timer. When the relay releases, it provides a through path for transmission. A precut condition is achieved by delaying the 2600-Hz tone until after the CT relay is operated. The transmission path is not cut instantaneously because of the delay (approximately 10 ms) in the operation of the CT relay.

FUD Unit

2.04 The transmitter portion of the FUD unit (Fig. 7) provides both signaling and speech transmission functions and also provides gain to compensate for cable loss. The transmitter circuit in the FUD can be divided into three main parts: (1) tone level timing circuit, (2) CT control circuit, and (3) transmission path. The transmitter section of the FUD is primarily composed of integrated circuits, called TEDs (transmission equipment devices) while the FUA is composed of discrete components.

2.05 The 2600-Hz tone is supplied by a common oscillator and is controlled by the auxiliary unit. The tone is injected into the FUD on the TN and TG leads at a -10 dBm level. The tone gain control circuit varies the tone level from -36 dBm low level (LL) to -24 dBm high level (HL) at the line TRMT port (-16 TLP). When the HL input is grounded, the 400-ms timer is started and the tone gain control circuit output level is -24 dBm. After 400 ms delay the HG output is grounded and the tone control circuit returns to its low level state. When the ground is removed from the HL input and HG output, the 125-ms timer is operated and cuts the voice path an additional 125 ms. This voice path cut occurs during the switching interval of the auxiliary unit.

2.06 In the FUD unit, the transmission path cut is accomplished with an operational amplifier circuit, whereas in the FUA unit, the cut is accomplished with the CT relay. When a negative voltage is applied to the CT lead, the operational amplifier is biased to the cut-off state, opening the transmission path. When the negative voltage is removed, the cut circuit allows normal transmission through the operational amplifier. When the negative voltage is applied to the CT lead, the transmission path is cut with no delay involved.

2.07 The voice transmission path consists of a slope control, a variable gain amplifier, and push-pull output amplifiers. The variable gain amplifier has a TRMT control located on the front panel (Fig. 1) that is calibrated from -13 to -3 dB. With a -13 to -3 dBm signal at the EQPT TRMT port, the TRMT control can be adjusted to maintain -16 dBm at the LINE TRMT carrier port. The TRMT control setting is calculated by adding the cable loss to the hybrid loss and then subtracting this value from -16 TLP. When single gauge cable is being used, the TRMT and slope controls are set per prescription tables. If more than one gauge of cable is used, manually adjust the balance network per Section 179-363-301. After manual adjustments are completed set the TRMT control as previously indicated.

2.08 The slope control is used to compensate for the frequency response of the cable which decreases as frequency increases. Slope compensation is accomplished by a phase lead network controlled by a 4-position switch mounted on the printed wiring board (Fig. 8). Operation of the switch to either positions 1, 2.5, 4, or 5 dB (only the end positions of the switch are labeled) sets the slope functions in both the transmit and receive circuits to provide gain increases with frequency of the values specified by the switch settings between 1000 and 3000 Hz. These slopes have been properly chosen to compensate for cable rolloff. The resulting frequency response of the unit is shown by the curves in Fig. 9. The 1000-Hz gain is not affected by the slope control for 1-, 2.5-, and 4-dB curves, but is reduced 1 dB for the 5-dB curve. When the slope of the cable is known, it is best to set the slope control for the lowest value of slope required. If the slope of the cable is not known, use the graphs in Fig. 10 through 12 to determine the slope control settings ▶for nonloaded cable. For loaded cable, slope 1 is normally used.◀ The slope settings are completely independent of the gain settings.

B. Receiver

FUA Unit

2.09 The receive portion of the circuit (Fig. 6) provides both signaling and speech transmission functions. This circuit can be divided into three main parts: (1) voice transmission circuit, (2) signal and guard detector circuits, and (3) timing circuit.

2.10 The voice transmission path consists of an input buffer amplifier, an output amplifier for obtaining essentially zero gain and a band elimination filter which is inserted when the F relay is activated. When an input is received by this unit, it passes through the buffer amplifier stage and is inserted into the signal and guard detector circuits. The band elimination filter may or may not be inserted, depending upon the frequency of the input. If it is other than pure 2600 Hz it will pass through the output amplifier with little loss or distortion.

2.11 The signal and guard detector circuit consists of signal and guard amplifiers, detectors, and a dc comparator. When a signal is present at the output of the buffer amplifier, a portion of it is fed into the signal and guard amplifiers. The output of each amplifier is fed into its respective rectifiers and the output of the rectifiers are fed into the dc comparator. When a 2600-Hz signal is received, the output of the signal rectifier is positive and greater than the negative output of the guard rectifier. These outputs (the guard being connected through a make contact of the G relay which is operated when 2600-Hz tone is absent and for a period after tone is applied) are fed into a dc comparator where they are recognized as a turn-on signal. This results in the operation of the F relay. Two conditions, broadband or narrowband, may exist as a result of the absence or presence of a 2600-Hz signal. When a 2600-Hz signal is on the line and the G relay is released, the broadband condition exists. This means that the F relay will be held operated even if the frequency is changed by as much as ±500 Hz. When the G relay operates, the narrowband condition exists and the bandwidth reduces to 75 Hz.

2.12 The dc comparator is preset to operate when the ratio of the signal to guard power is at least 10 dBm. A positive output causes the comparator to operate the F relay. A command sent on the E1 lead tells the auxiliary to apply ground to the GD lead causing the normally operative G relay to release. The release of the G relay removes the guard amplifier from the circuit and thus the broadband condition exists. The narrowband condition exists when the G relay is operated and the guard amplifier is in the circuit. This condition exists when tone is not being received and also during pulsing since the G relay timing circuit, controlled by the auxiliary, delays its release. This narrowbanding reduces false operation by speech simulated signals when in the talking mode. The broadband condition is invoked for long duration signals such as start dial or free call conditions, to eliminate the possibility of false release of the receiver by noise or speech interference. In the absence of guard energy a nominal level of -13 ±6 dBm 2600-Hz tone will operate the unit.

2.13 The purpose of the timing circuit is to keep the F relay operated when the 2600-Hz signal is removed for short periods of time, such as when dialing. When no signal tone is applied, the F relay is released and the voice transmission path is connected through the buffer amplifiers and matching pad. When 2600-Hz tone is applied, the F relay operates and the voice transmission path is through the amplifiers and the band elimination filter which attenuates a band of frequencies near 2600 Hz. The nominal band width of the 2600-Hz filter is 75 Hz. A 300 ms release timing circuit is placed into the circuit when 2600-Hz tone is applied. The timing circuit keeps the F relay operated during pulse trains to minimize the noise generated in the voice path by short filter insertions.

FUD Unit

2.14 The receive portion of the FUD unit (Fig. 7), like the FUA unit, provides both signaling and speech transmission functions. The circuit is divided into three main parts: (1) voice transmission circuit, (2) signal and guard detector circuit, and (3) timing circuit.

2.15 The voice transmission path consists of input and output amplifiers, a band elimination filter, a slope control, a variable gain amplifier, and a test-operate circuit. The band elimination filter is inserted or removed from the transmission path with a bypass circuit. When 2600-Hz tone is applied, the bypass circuit is biased to a cutoff condition inserting the band elimination filter. When tone is removed, the bypass circuit removes the band elimination filter.

2.16 The slope function is achieved in both the transmit and receive circuits, simultaneously, with one switch. The explanation of the slope control is the same as that in 2.08.

2.17 The variable gain amplifier has a 10-dB gain. This gain is controlled by the RCV control located on the front panel (Fig. 1) of the FUD. This control is calibrated from -6 to +4 dB. With a carrier input of +7 dBm at the LINE RCV port a signal level of +1 to +11 dBm at the EQPT RCV port can be acheived by adjusting the RCV control. The RCV control setting is calculated by taking the difference between the level required at the load and the cable loss and adding this value to the hybrid loss. This value is the FUD output. The RCV control setting is the difference between the FUD output value and the +7 TLP. When single gauge cable is used, the RCV and slope controls are set per prescription tables. If more than one gauge of cable is used, manually adjust the balance network per Section 179-363-301. After manual adjustments are completed, set the RCV control as previously indicated.

2.18 The test-operate circuit is used to make loop gain measurements. The test-operate circuit is cut in and out of the voice transmission path with the T-0 switch (Fig. 8) which is mounted on the printed wiring board. When the switch is in the T position (up) the LED on the front panel lights. Also when the switch is operated to the T position, the LG and OSC jacks, which are located on the front panel, are connected to the voice transmission path. Due to the 20 dB pads in the test circuit, when the OSC input is set at +10 dBm, the signal actually applied to the loop is -10 dBm, so a meter reading of -10 dBm at the LG jack represents a zero loss loop. All other loop measurements must consider this correction factor.

2.19 The signal and guard detector circuit and dc comparator circuit for the FUD unit operate essentially like the FUA unit described in 2.11 and 2.12. The main difference is that the FUD unit does not use the F relay to cut the band elimination filter in and out of the circuit. In the FUD unit a bypass circuit cuts the filter in and out of the transmission path. When a 2600-Hz tone greater than -27 dBm is applied to the signal detector circuit, the output level of the dc comparator will be positive biasing the bypass circuit so as to insert the band elimination filter in the transmission path. Another difference in the FUD signal and guard detector circuit is that the G relay contact is not used to cut the guard circuit path as is done in the FUA unit. The guard circuit path is opened by a cut circuit and operational amplifier when the GD input is grounded. The 180-ms timer output operates the G relay. Grounding of the GD input activates the 180-ms timer which delays the cut of the guard circuit by 180 ms. Operation of the G relay closes the GA/GC and GB outputs.

2.20 The 12.5/300-ms timer controls the insertion and removal of the band elimination filter in the transmission path. When 2600-Hz tone is applied, the timer is activated and delays the insertion of the band elimination filter by 12.5 ms. This delay keeps any 2600-Hz tone with a duration of less than 12.5 ms from inserting the band elimination filter in the transmission path. When tone is removed, the timer delays the removal of the filter for 300 ms.

3. PULSING CHARACTERISTICS

3.01 This circuit, in conjunction with an appropriate auxiliary, is capable of transmitting and receiving dial pulses and supervisory signals. MF pulses will be passed through either the transmit or receive transmission paths without distortion.

3.02 The FUA and FUD convert the 2600-Hz tone to dc, but pulse correction, if any, is provided by the auxiliary. Graphs and tables concerning the pulsing characteristics for the auxiliary plus the FUA and FUD are given in the descriptive section of each particular auxiliary.

4. TRANSMISSION CHARACTERISTICS

4.01 Transmission characteristics can be found in individual auxiliary BSP sections.

A. Transmitting

FUA Unit

4.02 Since the transmit path has a balanced cut, no transformers are required between the carrier and SF unit to eliminate longitudinal noise.

4.03 The transmit circuit consists of a straight through connection with transformer T5 bridged across it. Contacts of the CT relay are also in the path and control the closure of the T and R leads in the talking conditions. When the circuit is idle, and also during dialing, the CT relay cuts the transmission path and applies a 600-ohm termination on each side of the cut. There is no loss in the transmit path (excluding the P-pads) of the FUA. The P-pads give up to 16.5 dB loss.

FUD Unit

4.04 The transmit path of the transmitter circuit consists of a pad, input transformer, slope control, variable gain amplifier, output amplifier, and an output transformer. The 2600-Hz tone is applied to the output transformer through an operational amplifier. The operational amplifier controls the level of the tone output. When 2600-Hz tone is being transmitted, the transmission path preceding the output transformer is cut. This transmission path cut is achieved by a cut circuit consisting of an operational amplifier. The operational amplifier is reduced in gain to cut the transmission path when required. With the operational amplifier cut circuit, there is no delay in the cut of the transmission path when cut is required as it was with the relay-type cut circuit. The overall gain of the transmit circuit will vary from -13 to -3 dB by adjusting the TRMT control. With these levels in the transmitter circuit, external repeaters are not required when cables are added to the auxiliary units. Setting of the TRMT control is calculated as indicated in 2.07.

B. Receiving

FUA Unit

4.05 The transmission path through the receive circuit is via input pad, input transformer T1, an input buffer amplifier, an attenuation circuit, an output amplifier, and output transformer T2. A band-elimination filter is also bridged across the receiving circuits transmission path. The output level of the receiving circuits transmission path is within 0.4 dB of the input signal level between 300 and 3000 Hz. A sharp drop-off between 2200 and 2800 Hz is provided by the band-elimination filter. Insertion of the filter prevents 2600 Hz from being passed through the transmission path to another link.

4.06 Voice frequencies entering the receive circuit pass through the input buffer amplifier, the band elimination filter, and the output amplifier. This circuit provides zero dB loss at 1000 Hz.

4.07 The harmonic distortion performance of the voice path is shown in Fig. 13. Most of the distortion is caused by the second harmonic. It can be concluded that, for signals entering the receive circuit below +5 dBm, the total harmonic distortion will be at least 55 dB below the input signal level. Internal noise of the receive circuit which includes battery noise is below 20 dBrnc0.

4.08 The FUA provides high return loss and longitudinal balance characteristics. For an input between 250 and 4000 Hz, return loss measurements against 600 ohms exceed 30 dB with a minimum longitudinal balance of 65 dB. A minimum of 60 dB of longitudinal balance exists at the output for frequencies between 200 and 3000 Hz.

4.09 The band-elimination filter is switched in the receive circuit under control of the F relay. With F relay operated, the band-elimination filter is connected to the output amplifier stage. When the F relay is released, a resistive termination is provided in place of the filter in the voice transmission path.

FUD Unit

4.10 The transmission path of the receiver circuit consists of an input pad, input transformer, band elimination filter, slope control, variable gain amplifier test-operate circuit, output amplifier, and output transformer. The gain of the transmission path can be varied from -6 to +4 dB by adjusting the RCV control. The RCV control setting is calculated as indicated in 2.17. When 2600-Hz is detected by the signal and guard circuit, the band elimination filter is inserted in the transmission path. Insertion of the band elimination filter prevents 2600-Hz from being transmitted to another link.

4.11 The band elimination filter is switched in the transmission path under control of the bypass circuit. When 2600 Hz is detected, the bypass circuit inserts the filter in the transmission path.

4.12 During normal operation the T-0 switch must be in the O position. The T position puts a 20 dB pad in the loop for test purposes and the T lamp on the front panel indicates this condition.

5. BALANCE NETWORK AND LBOC OPERATION

5.01 The FUD is more versatile than the FUA in that it contains a balance network and adjustable LBOC. The balance network for the FUD unit is a combination of two metallic facility terminal networks. One of the networks is for loaded cable and one is for nonloaded cable. The networks are selected by operating L-N switch S5 (Fig. 8) to L for loaded cable and N for nonloaded cable. Figures 14 and 15 are simplified schematics and graphs which show the effects of the M, R1, R, X, and Z controls on the impedance of loaded and nonloaded cables.

5.02 The output of the balance network is controlled by R and Z potentiometers and 9 element switch S6 (Fig. 8). Switch S6 is divided into four sections, M, R1, X, and Z. When the FUD is connected to a loaded cable, the M, X, and Z switches plus the Z potentiometer control the impedance. As can be seen in Fig. 14, the Z controls increase and decrease the magnitude of the cable impedance equally over the frequency band, while the X control increases and decreases the impedance over the low frequency band. When 25-gauge MAT cable is used, the M control increases the high end roll-off to about 3.6 kHz. The R1 and Z switches plus the R and Z potentiometer control the impedance of nonloaded cable. As can be seen in Fig. 15, the Z control increases and decreases the cable impedance while the R control changes the slope of the cable impedance at the higher frequencies. The R1 control increases and decreases the impedance at the low frequencies. The NW switch (S3) cuts the balance network in and out of the circuit. When the FUD unit is being operated with a 4-wire auxiliary unit, the balance network must be removed from the circuit by opening the NW switch.

5.03 When the type, gauge, and length of cable in the loop is determined from records and the cable is single gauge, switch S6 and potentiometers R and Z must be set as prescribed in the prescription tables. For prescription designs, the switch and potentiometer settings should be made before the FUD is plugged into the bay. If, during the installation test, the FUD does not meet the requirements of the transmission facility, the FUD must be plugged into the test extender (SD-1C241-02) and adjustments made as specified in Section 179-363-301.

5.04 The line build-out capacitors are used in conjunction with the balance network for loaded cable. The line build-out capacitors are cut in and out of the circuit by operating LBOC switch elements of S4 (Fig. 8). The value of the line build-out capacitor is calculated by using the formula $C = (6\text{-}N)\ (0.016\mu f)$, where N equals the near end section of cable in thousands of feet (Fig. 16). When the capacitance value needed to buildout the near end section to 6000 feet is determined by use of the formula, operation of switch S4 will connect the capacitance across the cable input. By operating different sections of switch S4, the capacitance can be varied from 0.002 μf to 0.126 μf in 0.002-μf steps. When the FUD is connected to a nonloaded cable, the line build-out capacitors are not required. To remove the line build-out capacitors, operate all sections of switch S4 to the open position.

6. ADJUSTMENTS AND MAINTENANCE

6.01 There are no field adjustments provided on the FUA (excluding the P-pads). The P-pads must be adjusted for the proper transmission levels. FUA units not meeting circuit requirements should be sent to Western Electric Co. for repair. Defective units should be replaced with spare units.

6.02 The FUD unit requires network and LBOC settings per Tables C and D through H for loaded cables and Tables C and I through M for nonloaded cables prior to installation in F-signaling bay. If more than one gauge cable is used in the transmission link, field adjustments are required to obtain the proper settings. For this case the balance network and LBOC must be manually adjusted per Section 179-363-301. The TRMT, RCV, LBOC, and slope controls must also be set prior to installation in F-signaling bays. Figures 17 through 19 give the cable losses for nonloaded cables as functions of cable resistance and length. Figures 10 through 12 give recommended slope settings for nonloaded cables as functions of cable resistance and length. For these values cable gauge need not be known.

6.03 The type F test extender (SD-1C241-02) is provided to gain access to the transmission and signaling ports. Use of the test extender will necessitate the removal of the SF units from the bay. The test extender provides jack access to all transmission and signaling ports of the SF units.

6.04 Descriptive or test practices on other related components within the type F signaling system can be found under individual component headings in the BSP index 179-000-000.

TABLE A

TYPE F AUXILIARY AND MISCELLANEOUS SIGNALING UNITS GENERAL INFORMATION AND APPLICATION

CODE	COMPATIBLE WITH FUD	SECTION	FUNCTIONAL DESCRIPTION	GENERAL APPLICATION	SPECIFIC USE	E TYPE SF UNITS REPLACED
FA( )	No	179-364-101	600- or 900-Ohm 2W E&M Lead	2-Way Trunks	2-Wire Switching	E1A or E-B + Term. Set
FB( )	No	179-364-101	4-W E&M Lead	2-Way Trunks	4-Wire Switching DP or MF	E-B + "P" Pads
FC( )	Yes	179-364-101	Loop Reverse Battery Originating	1-Way Trunks	DP or MF 2W-900 Ohm	E3C, E4C, E5C
FD( )	Yes	179-364-101	Loop Reverse Battery, Terminating	1-Way Trunks	DP or MF 2W-900 Ohm	E3D, E4D, E5D
FGM FGN	Yes	179-368-101	20 Hz Ringdown Unit	2-Way Trunks	2W-900 Ohm	—
FHM FHN	No	179-368-101	20 Hz Ringdown Unit	2-Way Trunks	4W-900 Ohm	—
FL( )	Yes	179-365-101	Special Access CO End	Special Access Loop-Start or Ground-Start	2W-600 or 900 Ohm	E2L — E2LA E1P + Term. Set
FP( )	No	179-365-101	Special Access CO End	Special Access Loop-Start or Ground-Start	4-Wire Extension	E1P + 4182 Type Network
FR( )	No	179-365-101	Special Access Station End	Special Access Loop-Start or Ground-Start	4-Wire Extension	E1R + 4182 Type Network
FS( )	Yes	179-365-101	Special Access Station End	Special Access Loop-Start or Ground-Start	2W-600 or 900 Ohm	E2S — E2SA E1R Term. Set

TABLE A (Contd)

TYPE F AUXILIARY AND MISCELLANEOUS SIGNALING UNITS
GENERAL INFORMATION AND APPLICATION

CODE	COMPATIBLE WITH FUD	SECTION	FUNCTIONAL DESCRIPTION	GENERAL APPLICATION	SPECIFIC USE	E TYPE SF UNITS REPLACED
FM( )	Yes	179-366-101	Nonsignaling By-Pass	Nonsignaling By-Pass	Nonsignaling By-Pass	—
FGA	Yes	179-367-101	DX Signaling	2-Way Trunks	W2-900 Ohms	—
FHA	No	179-367-101	DX Signaling	2-Way Trunks	4W-Extension	—

TABLE B

TRANSHYBRID LOSS VALUES

1 KHz CABLE INPUT IN dBm	RCV DIAL	TRMT DIAL	RCV PLUS TRMT LOSS IN dB	MINIMUM THL IN dB			
				EQ 1	EQ 2.5	EQ 4	EQ 5
−3	−6	−12	18	6	9	12	12
−2	−5	−11	16	8	11	14	14
−1	−4	−10	14	10	13	16	16
0	−3	−9	12	12	15	18	18
+1	−2	−8	10	14	17	20	20
+2	−1	−7	8	16	19	22	22
+3	0	−6	6	18	21	24	24
+4	+1	−5	4	20	23	26	26
+5	+2	−4	2	22	25	28	28
+6	+3	−3	0	24	27	30	30

TABLE C

SWITCH SETTINGS FOR PRESCRIPTION TABLES

SWITCH FUNCTION	SWITCH SETTING	COMMENTS
LOADED CABLE (Single Gauge)		
L-N	L	—
LBOC	—	Set by formula: C=(6-N) (0.016 Mfd), where N = near end section in Kft.
S6	Tables D-H	Set S6-1 ON for MAT (25 Gauge) Cable. S6-789 adjust low frequency response of the balance network
Z	Tables D-H	—
NW	ON	—
S	—	Set for equalization required. (Set to 1 unless slope is known.)
NONLOADED CABLE (Single Gauge)		
L-N	N	—
LBOC	OFF	—
S6	Tables I-M	S6-23 Control the Z Function S6-456 Control the R1 Function
R	Tables I-M	—
Z	Tables I-M	—
NW	ON	—
S	—	Select value from Fig. 10 through 12

TABLE D

PRESCRIPTION SETTINGS FOR 19-GAUGE LOADED CABLE

	900C		600C		TEL	
Kft	S6	Z	S6	Z	S6	Z
6		10.0		10.0		10.0
12		9.4		10.0		10.0
18		9.0		9.9	8	10.8
24		8.9		9.5	9	9.6
30		8.8		9.2		9.3
36		8.8		9.0		8.8
42		8.8		9.0		8.7
48		8.8		8.8		8.6
54		8.8		8.8		8.5
60		8.8		8.7		8.5

TABLE E

PRESCRIPTION SETTINGS FOR 22-GAUGE LOADED CABLE

	900C		600C		TEL	
Kft	S6	Z	S6	Z	S6	Z
6		10.0		10.0		10.0
12		9.4		10.0	89	10.0
18		8.8		9.4	7	8.8
24		8.6	9	8.6	89	8.2
30		8.5	9	8.4	8	8.0
36		8.5		8.6	9	8.1
42		8.5		8.5		8.3
48		8.4		8.4		8.3

Note: Loads in Tables D through M are 900 ohms plus 2.15 Mfd (900/C), 600 ohms plus 2.15 Mfd (600/C), or a telephone (Tel)

TABLE F

PRESCRIPTION SETTINGS FOR 24-GAUGE LOADED CABLE

Kft	900C		600C		TEL	
	S6	Z	S6	Z	S6	Z
6		10.0		10.0		10.0
12	8	8.4	9	9.6	78	9.0
18	89	7.5	89	7.9	79	7.7
24	8	7.6	89	7.5	7	7.3
30	8	7.5	8	7.6	89	7.3

TABLE G

PRESCRIPTION SETTINGS FOR 25-GAUGE LOADED CABLE

Kft	900C		600C		TEL	
	S6	Z	S6	Z	S6	Z
6	19	10.0	1	10.0	1	10.0
12	179	10.0	179	10.0	1789	10.0
18	178	10.0	178	10.0	1789	10.0
24	179	10.0	178	10.0	1789	10.0
30	179	9.9	179	10.0	178	9.7
36	17	10.0	179	9.9	179	9.9

TABLE H

PRESCRIPTION SETTINGS FOR 26-GAUGE LOADED CABLE

Kft	900C		600C		TEL	
	S6	Z	S6	Z	S6	Z
6	7	9.3	•	10.0	79	10.0
12	78	7.1	78	7.5	789	8.1
18	78	6.5	789	6.3	789	6.7

TABLE I

PRESCRIPTION SETTINGS FOR 19-GAUGE NONLOADED CABLE

Kft	900C			600C			TEL		
	S6	R	Z	S6	R	Z	S6	R	Z
1.0	456	0	10.0	3456	0	7.4	456	0	10.0
1.5	456	1.5	10.0	3456	0	7.3	456	0	10.0
2.0	456	2.3	10.0	3456	0	7.2	456	0	10.0
2.5	456	2.6	10.0	3456	0	7.0	456	0	10.0
3.0	456	7.9	5.7	3456	0	6.8	456	0	10.0
3.5	3456	11.4	6.3	3456	0	6.5	456	0	10.0
4.0	2456	13.9	7.2	3456	3.8	4.9	456	0	10.0
4.5	2456	15.0	5.0	2456	7.5	7.7	456	.5	10.0
5.0	2456	15.0	4.5	2456	9.9	6.0	456	1.0	10.0
5.5	2456	15.0	4.0	2456	11.9	4.3	456	7.0	5.7
6.0	2456	15.0	3.6	23456	13.3	7.7	3456	10.8	6.5
6.5	2456	15.0	3.1	23456	14.3	6.5	3456	13.0	3.4
7.0	245	12.9	3.1	23456	15.0	5.6	2456	14.5	5.6
7.5	2345	13.5	7.0	23456	15.0	5.4	2456	15.0	4.4
8.0	2345	13.9	6.2	23456	15.0	5.2	2456	15.0	4.1
8.5	2345	14.5	5.3	23456	15.0	5.1	2456	15.0	3.7
9.0	2345	15.0	4.5	23456	15.0	4.9	2456	15.0	3.3
9.5	2345	15.0	4.3	23456	15.0	4.7	23456	15.0	7.8
10.0	2345	15.0	4.0	23456	15.0	4.5	23456	15.0	7.4
10.5	2345	15.0	3.8	23456	15.0	4.3	23456	15.0	7.1
11.0	2345	15.0	3.6	23456	15.0	4.2	2345	13.6	6.4
11.5	2345	15.0	3.4	2345	13.1	4.2	2345	14.4	5.4
12.0	2345	15.0	3.2	2345	13.0	4.1	2345	14.5	5.0
12.5	2345	15.0	3.1	2345	13.4	3.7	2345	14.8	4.5
13.0	2345	15.0	2.9	2345	13.5	3.5	2345	15.0	4.1
13.5	2345	15.0	2.8	2345	13.8	3.2	2345	15.0	3.9
14.0	2345	15.0	2.6	2345	13.8	3.1	2345	15.0	3.7
14.5	2345	15.0	2.5	2345	14.1	2.8	2345	15.0	3.6
15.0	2345	15.0	2.3	2345	14.1	2.7	2345	15.0	3.4
15.5	2345	15.0	2.2	2345	14.2	2.5	2345	15.0	3.3
16.0	2345	10.0	2.1	2345	14.3	2.4	2345	15.0	3.1
16.5	2345	15.0	2.0	2345	14.3	2.3	2345	15.0	3.0
17.0	2345	15.0	1.9	2345	14.5	2.1	2345	15.0	2.8
17.5	2345	15.0	1.8	2345	14.2	2.2	2345	15.0	2.7
18.0	2345	15.0	1.7	2345	14.4	2.0	2345	15.0	2.6
18.5	2345	15.0	1.6	2345	14.1	2.1	2345	15.0	2.5
19.0	2345	15.0	1.5	2345	14.3	1.9	2345	15.0	2.4
19.5	2345	15.0	1.4	2345	14.5	1.7	2345	15.0	2.3
20.0	2345	15.0	1.4	2345	14.5	1.7	2345	15.0	2.2
20.5	2345	15.0	1.3	2345	14.3	1.7	2345	15.0	2.1
21.0	2345	15.0	1.2	2345	14.4	1.6	2345	15.0	2.0
21.5	2345	15.0	1.2	2345	14.3	1.6	2345	15.0	1.9
22.0	2345	15.0	1.1	2345	14.2	1.6	2345	15.0	1.8
22.5	2345	15.0	1.1	2345	14.1	1.6	2345	15.0	1.8
23.0	2345	15.0	1.0	2345	14.0	1.6	2345	15.0	1.7
23.5	2345	15.0	1.0	2345	13.7	1.7	2345	15.0	1.6

TABLE I (Contd)

PRESCRIPTION SETTINGS FOR 19-GAUGE NONLOADED CABLE

Kft	900C			600C			TEL		
	S6	R	Z	S6	R	Z	S6	R	Z
24.0	2345	14.9	1.0	2345	13.7	1.7	2345	15.0	1.5
24.5	2345	14.6	1.1	2345	13.5	1.7	2345	15.0	1.5
25.0	2345	14.3	1.2	2345	13.5	1.7	2345	15.0	1.4
25.5	2345	14.2	1.2	2345	13.3	1.7	2345	15.0	1.4

TABLE J

PRESCRIPTION SETTINGS FOR 22-GAUGE NONLOADED CABLE

Kft	900C			600C			TEL		
	S6	R	Z	S6	R	Z	S6	R	Z
1.0	456	1.0	10.0	456	0	3.2	456	0	10.0
1.5	456	2.8	10.0	456	0	3.5	456	0	10.0
2.0	456	3.9	10.0	456	0	3.6	456	0	10.0
2.5	456	4.4	10.0	456	0	3.7	456	0	10.0
3.0	456	6.9	8.0	456	0	3.7	456	0	10.0
3.5	456	11.1	3.2	456	0	3.7	456	1.8	10.0
4.0	3456	13.3	4.6	3456	2.8	7.3	456	3.1	10.0
4.5	2456	14.9	6.3	3456	6.6	5.4	456	3.9	10.0
5.0	2456	15.0	5.7	3456	9.4	3.5	456	4.4	10.0
5.5	2456	15.0	5.3	2456	11.5	6.5	456	7.9	7.0
6.0	2456	15.0	4.8	2456	12.7	5.2	3456	11.4	7.5
6.5	2456	15.0	4.4	2456	13.6	4.1	3456	13.4	4.4
7.0	2456	15.0	4.0	23456	14.6	7.6	2456	14.7	6.7
7.5	245	12.9	4.1	23456	14.9	7.1	2456	15.0	5.8
8.0	245	13.1	3.6	23456	15.0	6.8	2456	15.0	5.4
8.5	2345	13.4	7.7	23456	15.0	6.7	2456	15.0	5.0
9.0	2345	13.7	7.1	23456	15.0	6.5	2456	15.0	4.7
9.5	2345	14.0	6.5	23456	15.0	6.4	2456	15.0	4.4
10.0	2345	14.3	6.0	23456	15.0	6.2	2456	15.0	4.0
10.5	2345	14.6	5.5	23456	15.0	6.1	245	12.9	4.1
11.0	2345	14.5	5.4	23456	15.0	6.0	245	13.0	3.7
11.5	2345	14.6	5.1	23456	15.0	5.8	245	13.3	3.1
12.0	2345	14.4	5.1	2345	11.8	6.9	2345	13.5	7.4
12.5	2345	14.4	4.9	2345	11.5	7.0	2345	14.0	6.6

TABLE J (Contd)

PRESCRIPTION SETTINGS FOR 22-GAUGE NONLOADED CABLE

Kft	900C			600C			TEL		
	S6	R	Z	S6	R	Z	S6	R	Z
13.0	2345	14.6	4.6	2345	11.7	6.7	2345	14.1	6.3
13.5	2345	14.6	4.4	2345	11.9	6.4	2345	14.1	6.1
14.0	2345	14.5	4.4	2345	12.0	6.3	2345	14.1	5.6
14.5	2345	14.1	4.6	2345	12.0	6.2	2345	14.3	5.6
15.0	2345	14.1	4.5	2345	12.1	6.0	2345	14.1	5.6
15.5	2345	14.2	4.3	2345	12.1	5.9	2345	14.3	5.3
16.0	2345	14.2	4.2	2345	12.1	5.8	2345	14.1	5.3
16.5	2345	14.1	4.2	2345	12.0	5.8	2345	14.2	5.1
17.0	2345	13.7	4.4	2345	12.0	5.7	2345	14.3	4.9
17.5	2345	13.6	4.4	2345	11.9	5.7	2345	14.2	4.8
18.0	2345	13.5	4.4	2345	11.9	5.6	2345	13.9	5.0
18.5	2345	13.3	4.5	2345	12.0	5.5	2345	13.9	4.9
19.0	2345	13.1	4.5	2345	11.7	5.6	2345	13.8	4.9
19.5	2345	12.9	4.6	2345	11.8	5.5	2345	13.8	4.8
20.0	2345	12.8	4.6	2345	11.7	5.5	2345	13.7	4.8
20.5	2345	12.6	4.7	2345	11.6	5.5	2345	13.3	5.0
21.0	2346	9.5	6.1	2345	11.5	5.5	2345	13.3	4.9
21.5	2346	8.7	6.4	2345	11.5	5.5	2346	10.6	6.3
22.0	2346	8.6	6.4	2345	11.3	5.6	2346	9.9	6.6
22.5	2346	8.3	6.5	2345	11.1	5.6	2346	9.8	6.6
23.0	2346	8.1	6.5	2345	11.1	5.6	2346	9.7	6.6
23.5	2346	7.9	6.6	2345	10.9	5.7	2346	9.4	6.7
24.0	2346	7.6	6.7	2345	10.8	5.7	2346	9.2	6.7

TABLE K

PRESCRIPTION SETTINGS FOR 24-GAUGE NONLOADED CABLE

Kft	900C			600C			TEL		
	S6	R	Z	S6	R	Z	S6	R	Z
1.0	456	2.2	10.0	456	0	3.9	456	0	10.0
1.5	456	4.2	10.0	456	0	4.5	456	0	10.0
2.0	456	5.4	10.0	456	0	4.9	456	0	10.0
2.5	456	6.1	10.0	456	0	5.3	456	.4	10.0
3.0	456	7.7	8.7	456	0	5.6	456	3.2	10.0
3.5	456	11.4	4.1	456	0	5.7	456	4.9	10.0
4.0	3456	13.5	5.4	456	4.2	4.0	456	6.0	10.0
4.5	2456	14.9	7.3	3456	7.3	7.0	456	6.6	10.0
5.0	2456	15.0	6.7	3456	10.1	4.9	456	7.0	10.0
5.5	2456	15.0	6.3	3456	11.7	3.3	456	10.4	6.0
6.0	2456	15.0	5.9	2456	13.1	6.5	3456	13.0	6.8
6.5	2456	15.0	5.5	2456	13.9	5.4	3456	14.5	3.8
7.0	245	11.8	6.9	2456	14.7	4.2	2456	15.0	7.3
7.5	245	11.9	6.5	2456	15.0	3.7	2456	15.0	6.9
8.0	245	12.5	5.4	2456	15.0	3.6	2456	15.0	6.5
8.5	245	12.7	4.9	2456	15.0	3.4	2456	15.0	6.2
9.0	245	12.9	4.4	2456	15.0	3.3	2456	15.0	5.8
9.5	245	13.1	3.9	2456	15.0	3.2	2456	15.0	5.5
10.0	245	13.3	3.5	2456	15.0	3.0	245	12.8	5.7
10.5	245	13.4	3.1	23456	15.0	7.7	245	12.6	5.7
11.0	2345	13.4	7.7	245	10.9	5.0	245	12.8	5.1
11.5	2345	13.4	7.5	245	10.5	5.2	245	13.1	4.5
12.0	2345	13.3	7.5	245	10.8	4.8	245	13.0	4.4
12.5	2345	13.3	7.3	245	11.1	4.5	245	13.4	3.7
13.0	2345	13.3	7.2	245	11.2	4.3	245	13.4	3.5
13.5	2345	13.2	7.1	245	11.3	4.1	245	13.4	3.3
14.0	2345	12.8	7.4	245	11.3	4.0	245	13.3	3.3
14.5	2345	12.9	7.2	245	11.3	3.9	245	13.3	3.1
15.0	2345	12.7	7.3	245	11.3	3.8	2345	13.4	7.7
15.5	2345	12.6	7.3	245	11.3	3.7	2345	13.2	7.7
16.0	2345	12.4	7.3	245	11.2	3.7	2345	13.1	7.7
16.5	246	9.2	4.4	245	11.3	3.6	2345	13.1	7.6
17.0	246	8.6	4.7	245	11.2	3.6	2345	13.0	7.6
17.5	246	8.5	4.7	245	11.1	3.6	2345	12.8	7.6
18.0	246	8.2	4.8	245	11.0	3.6	246	9.7	4.8
18.5	246	8.0	4.9	245	11.0	3.6	246	9.3	5.0
19.0	246	7.7	5.0	245	11.0	3.5	246	9.2	5.0
19.5	246	7.6	5.0	245	10.8	3.6	246	8.9	5.1
20.0	246	7.3	5.1	245	10.8	3.6	246	8.8	5.1
20.5	246	7.1	5.2	245	10.7	3.6	246	8.6	5.1
21.0	246	6.9	5.3	245	10.7	3.6	246	8.4	5.2
21.5	246	6.8	5.3	245	10.5	3.7	246	8.2	5.2
22.0	246	6.6	5.4	245	10.5	3.7	246	8.0	5.3

TABLE L

PRESCRIPTION SETTINGS FOR 25-GAUGE NONLOADED CABLE

Kft	900C			600C			TEL		
	S6	R	Z	S6	R	Z	S6	R	Z
1.0	456	2.4	10.0	456	0	4.5	456	0	10.0
1.5	456	4.7	10.0	456	0	5.5	456	0	10.0
2.0	456	6.3	10.0	456	0	6.4	456	0	10.0
2.5	456	7.3	10.0	456	0	7.2	456	.1	10.0
3.0	456	8.0	10.0	456	0	7.9	456	3.6	10.0
3.5	456	8.6	10.0	456	0	8.5	456	5.9	10.0
4.0	456	8.9	10.0	456	0	9.1	456	7.4	10.0
4.5	456	11.0	7.2	456	0	9.5	456	8.4	10.0
5.0	456	12.8	4.1	456	3.2	8.3	456	9.1	10.0
5.5	3456	14.1	6.3	456	6.2	6.7	456	9.5	10.0
6.0	3456	15.0	4.2	456	8.5	5.0	456	9.9	10.0
6.5	3456	15.0	4.0	456	10.4	3.3	456	10.1	10.0
7.0	3456	15.0	3.7	3456	11.9	6.4	456	11.7	7.5
7.5	3456	15.0	3.5	3456	13.0	4.9	456	13.4	4.1
8.0	3456	15.0	3.2	3456	13.6	4.1	3456	14.4	6.6
8.5	345	10.5	6.7	3456	14.2	3.1	3456	15.0	5.1
9.0	345	10.5	6.4	2456	15.0	6.5	3456	15.0	4.8
9.5	345	11.0	5.5	2456	15.0	6.4	3456	15.0	4.5
10.0	345	11.4	4.8	2456	15.0	6.3	3456	15.0	4.3
10.5	345	11.6	4.3	2456	15.0	6.3	3456	15.0	4.0
11.0	345	11.8	3.8	2456	15.0	6.2	3456	15.0	3.7
11.5	345	12.0	3.3	2456	15.0	6.1	345	11.5	6.0
12.0	245	12.2	7.7	2456	15.0	6.0	345	11.5	5.7
12.5	245	12.2	7.5	345	9.9	5.1	345	11.6	5.3
13.0	245	12.3	7.2	345	9.6	5.3	345	12.0	4.5
13.5	245	12.2	7.2	345	9.9	4.9	345	12.2	4.0
14.0	245	12.3	6.9	345	10.2	4.5	345	12.4	3.5
14.5	245	12.2	6.9	345	10.4	4.2	345	12.4	3.3
15.0	245	12.3	6.7	345	10.5	4.0	245	12.6	7.7
15.5	245	12.2	6.6	345	10.6	3.8	245	12.5	7.6
16.0	245	12.1	6.6	345	10.7	3.6	245	12.4	7.6
16.5	245	12.1	6.6	345	10.7	3.5	245	12.5	7.3
17.0	346	8.5	4.6	345	10.8	3.3	245	12.3	7.4
17.5	346	8.2	4.8	345	10.9	3.2	245	12.5	7.0
18.0	346	8.1	4.8	345	10.9	3.1	245	12.5	6.9
18.5	346	7.9	4.8	345	10.8	3.1	245	12.4	6.9
19.0	346	7.8	4.8	245	10.9	7.7	346	9.2	4.8
19.5	346	7.7	4.9	245	10.9	7.7	346	8.8	5.0
20.0	346	7.6	4.9	245	10.9	7.6	346	8.6	5.1
20.5	346	7.4	5.0	245	10.8	7.7	346	8.5	5.1
21.0	346	7.3	5.0	245	10.8	7.6	346	8.4	5.1
21.5	346	7.1	5.1	346	7.0	5.5	346	8.3	5.1
22.0	346	7.0	5.1	346	6.7	5.7	346	8.2	5.1

TABLE M

PRESCRIPTION SETTINGS FOR 26-GAUGE NONLOADED CABLE

Kft	900C			600C			TEL		
	S6	R	Z	S6	R	Z	S6	R	Z
1.0	456	3.8	10.0	456	0	5.1	456	0	10.0
1.5	456	6.0	10.0	456	0	6.2	456	0	10.0
2.0	456	7.4	10.0	456	0	7.2	456	.6	10.0
2.5	456	8.2	10.0	456	0	8.1	456	4.6	10.0
3.0	456	8.7	10.0	456	0	8.8	456	6.9	10.0
3.5	456	11.1	6.9	456	0	9.3	456	8.3	10.0
4.0	456	13.3	3.1	456	4.3	7.6	456	9.1	10.0
4.5	3456	14.8	4.7	456	7.8	5.4	456	9.6	10.0
5.0	3456	15.0	3.9	456	10.5	3.0	456	10.0	10.0
5.5	3456	15.0	3.6	3456	12.2	5.9	456	12.0	6.8
6.0	3456	15.0	3.3	3456	13.5	4.1	3456	14.0	7.5
6.5	2456	15.0	7.7	2456	14.4	7.5	3456	15.0	5.0
7.0	345	11.1	5.6	2456	14.9	6.5	3456	15.0	4.7
7.5	345	11.2	5.1	2456	15.0	6.3	3456	15.0	4.3
8.0	345	11.5	4.4	2456	15.0	6.2	3456	15.0	4.0
8.5	345	11.9	3.6	2456	15.0	6.1	3456	15.0	3.7
9.0	345	12.0	3.2	2456	15.0	6.0	345	11.6	5.7
9.5	245	12.3	7.4	345	9.7	5.2	345	11.6	5.3
10.0	245	12.3	7.2	345	9.7	5.1	345	12.0	4.5
10.5	245	12.4	6.8	345	10.0	4.6	345	12.2	3.9
11.0	245	12.2	6.9	345	10.2	4.3	345	12.4	3.3
11.5	245	12.2	6.7	345	10.5	3.9	345	12.4	3.1
12.0	245	12.1	6.7	345	10.7	3.6	245	12.6	7.4
12.5	245	12.1	6.5	345	10.9	3.3	245	12.6	7.2
13.0	245	12.1	6.4	345	10.9	3.1	245	12.5	7.1
13.5	346	8.6	4.4	245	11.0	7.7	245	12.6	6.8
14.0	346	8.2	4.6	245	11.0	7.7	245	12.4	6.9
14.5	346	8.0	4.6	245	11.0	7.6	245	12.3	6.9
15.0	346	7.8	4.7	245	10.9	7.6	346	9.2	4.6
15.5	346	7.7	4.7	245	11.0	7.4	346	8.7	4.9
16.0	346	7.6	4.7	245	11.0	7.4	346	8.6	4.9
16.5	346	7.4	4.8	245	10.7	7.6	346	8.6	4.8
17.0	346	7.2	4.9	346	7.0	5.3	346	8.3	4.9
17.5	346	7.1	4.9	346	6.7	5.5	346	8.2	4.9
18.0	346	6.9	5.0	346	6.7	5.4	346	8.1	4.9

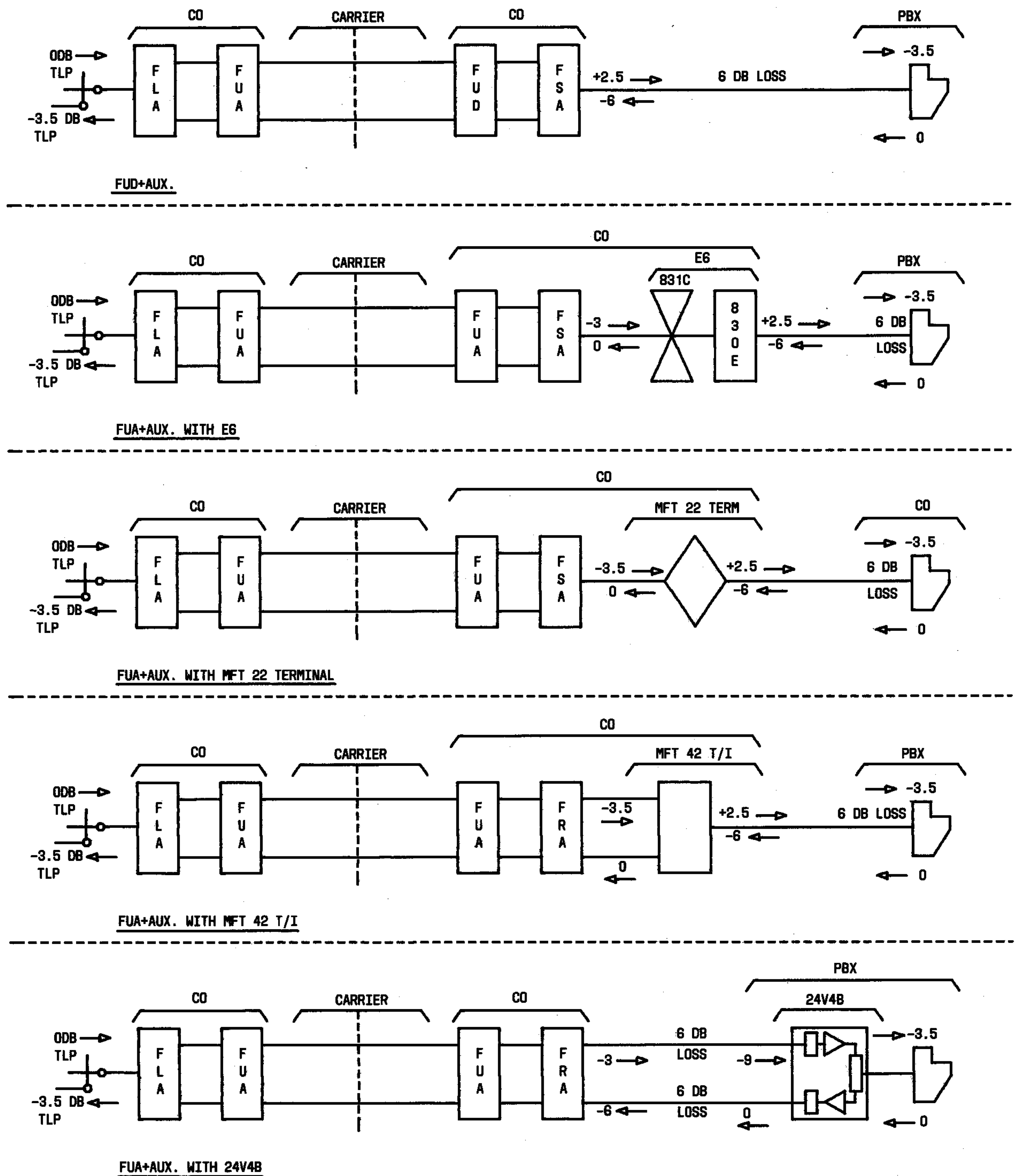


Fig. 2—Typical Circuits Illustrating FUD Plus Auxiliary Versus FUA Plus Auxiliary with External Equipment

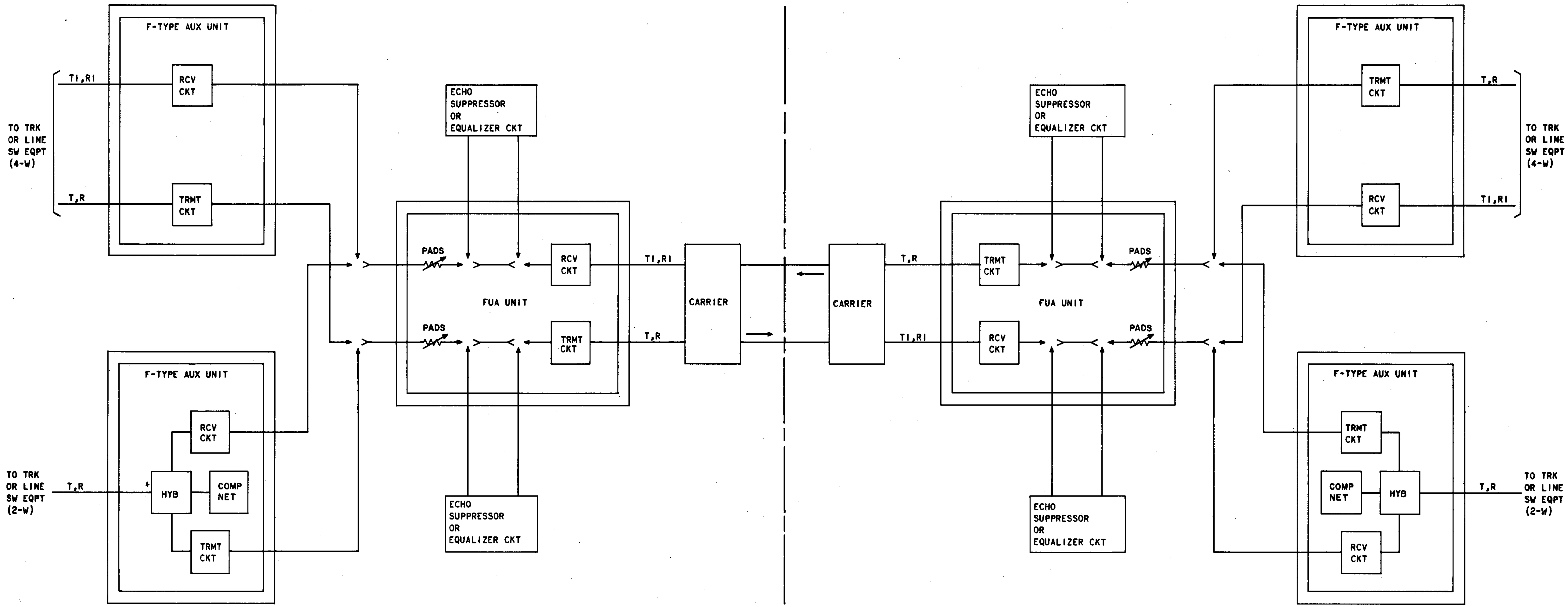


Fig. 3—Simplified Application Schematic of the FUA Unit Plus the Auxiliary Unit

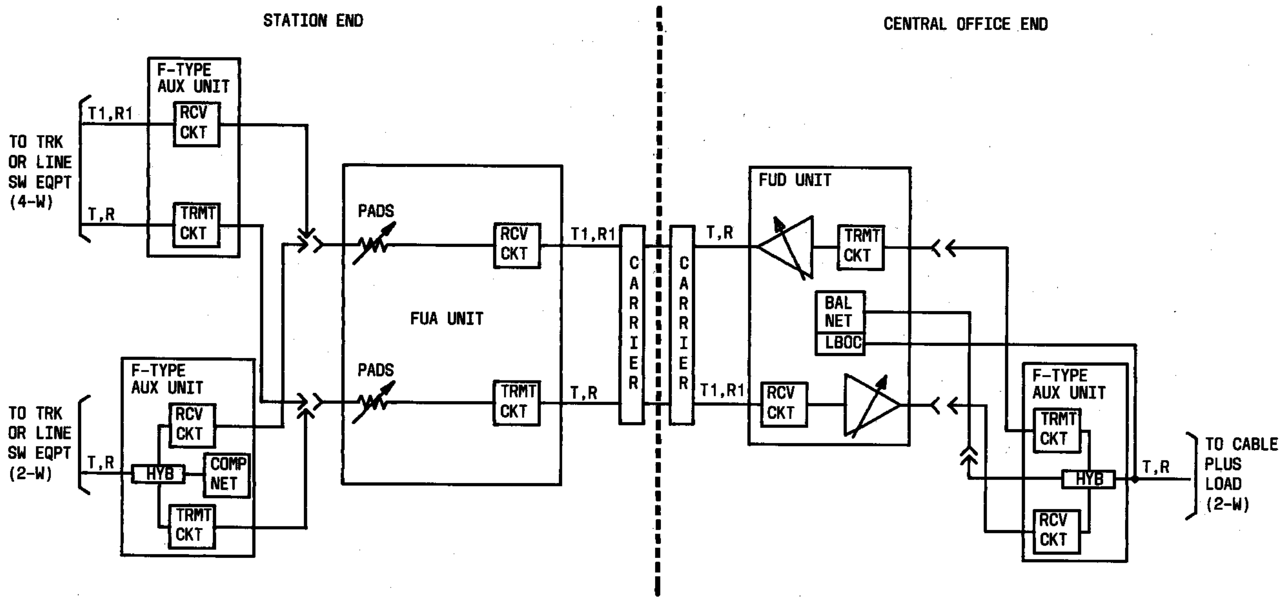


Fig. 4—Simplified Application Schematic of the FUD Unit Plus the Auxiliary Unit

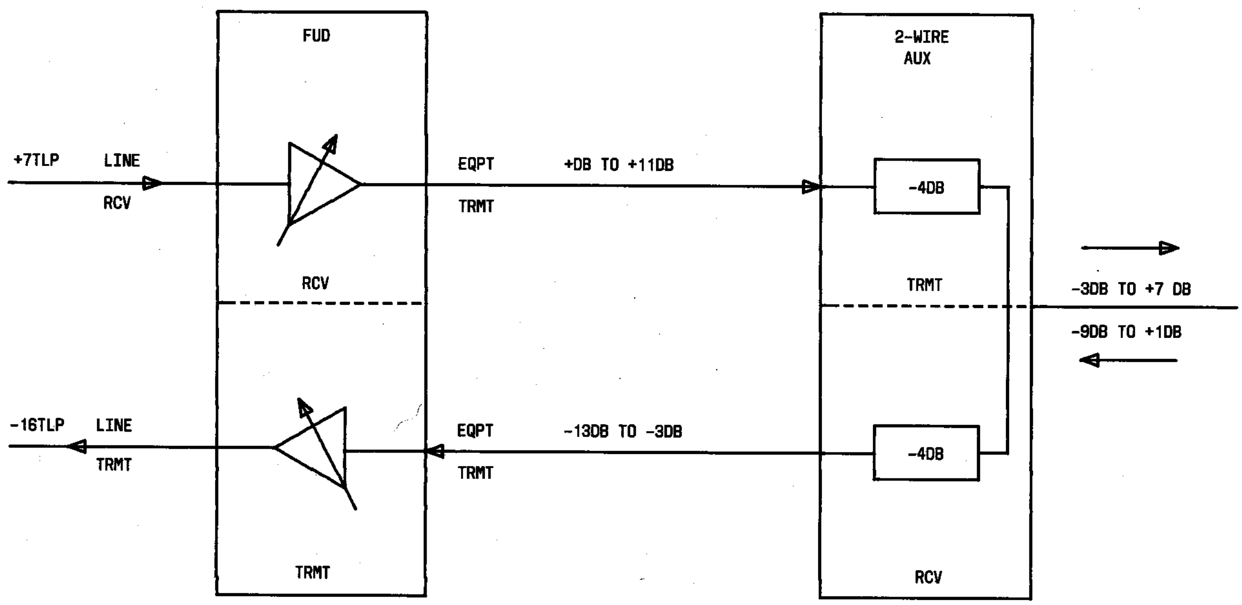


Fig. 5—Illustration of Gain of FUD and 2-Wire Auxiliary Unit

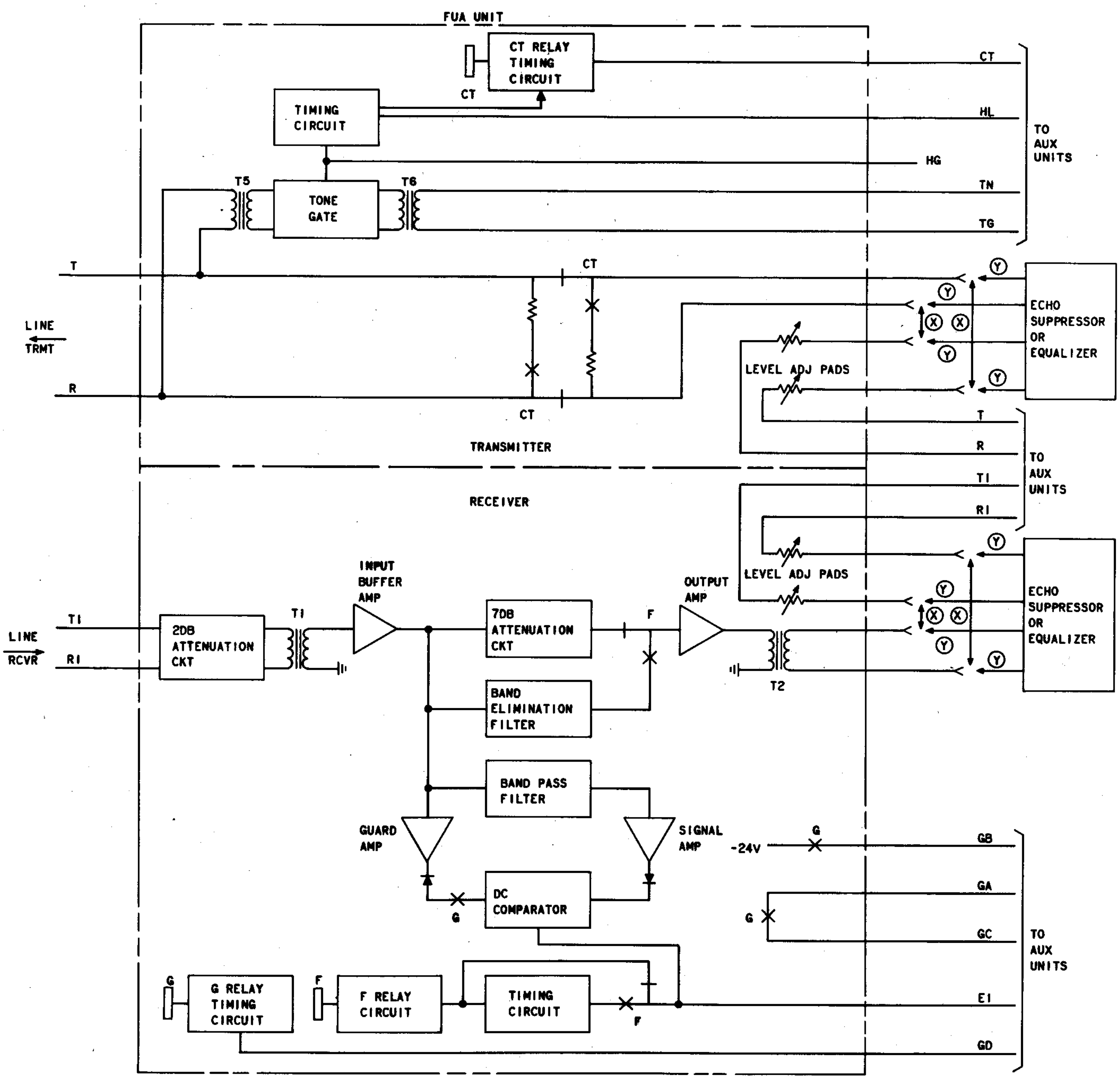


Fig. 6—Block Diagram of FUA Unit

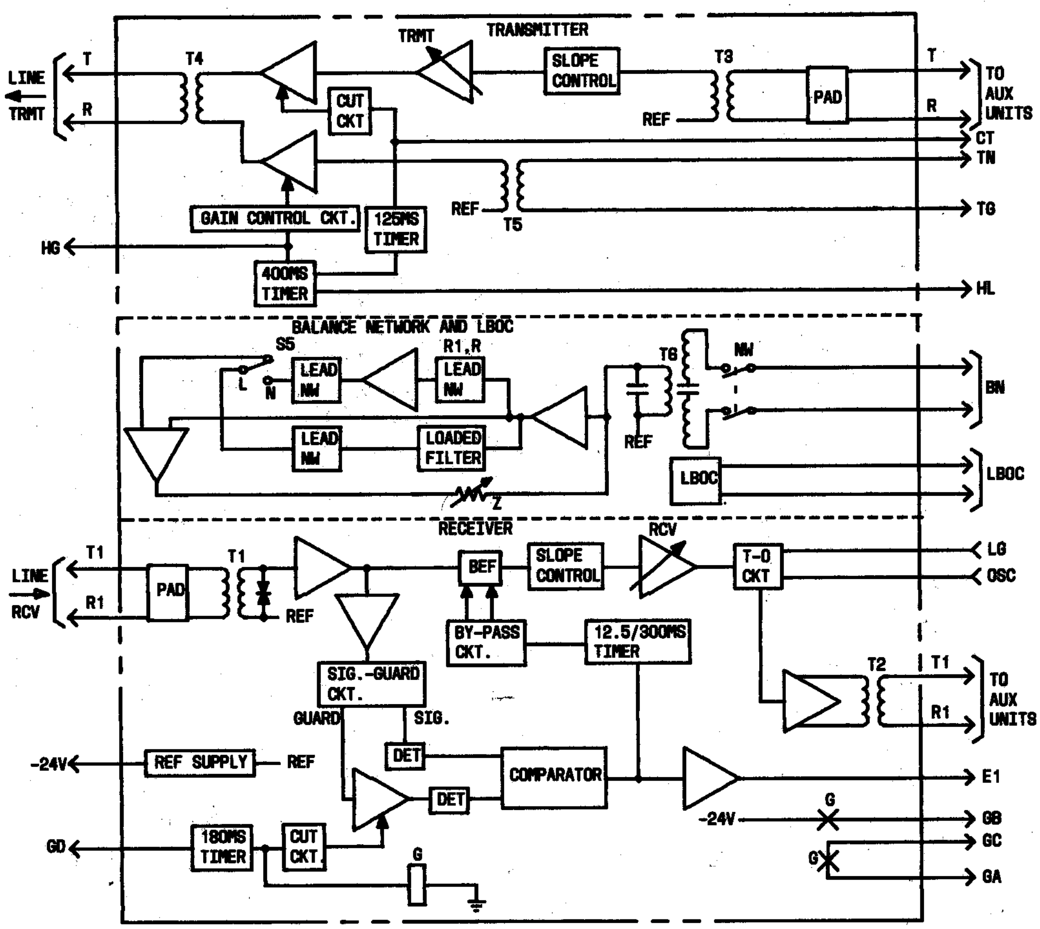


Fig. 7—Block Diagram of FUD Unit

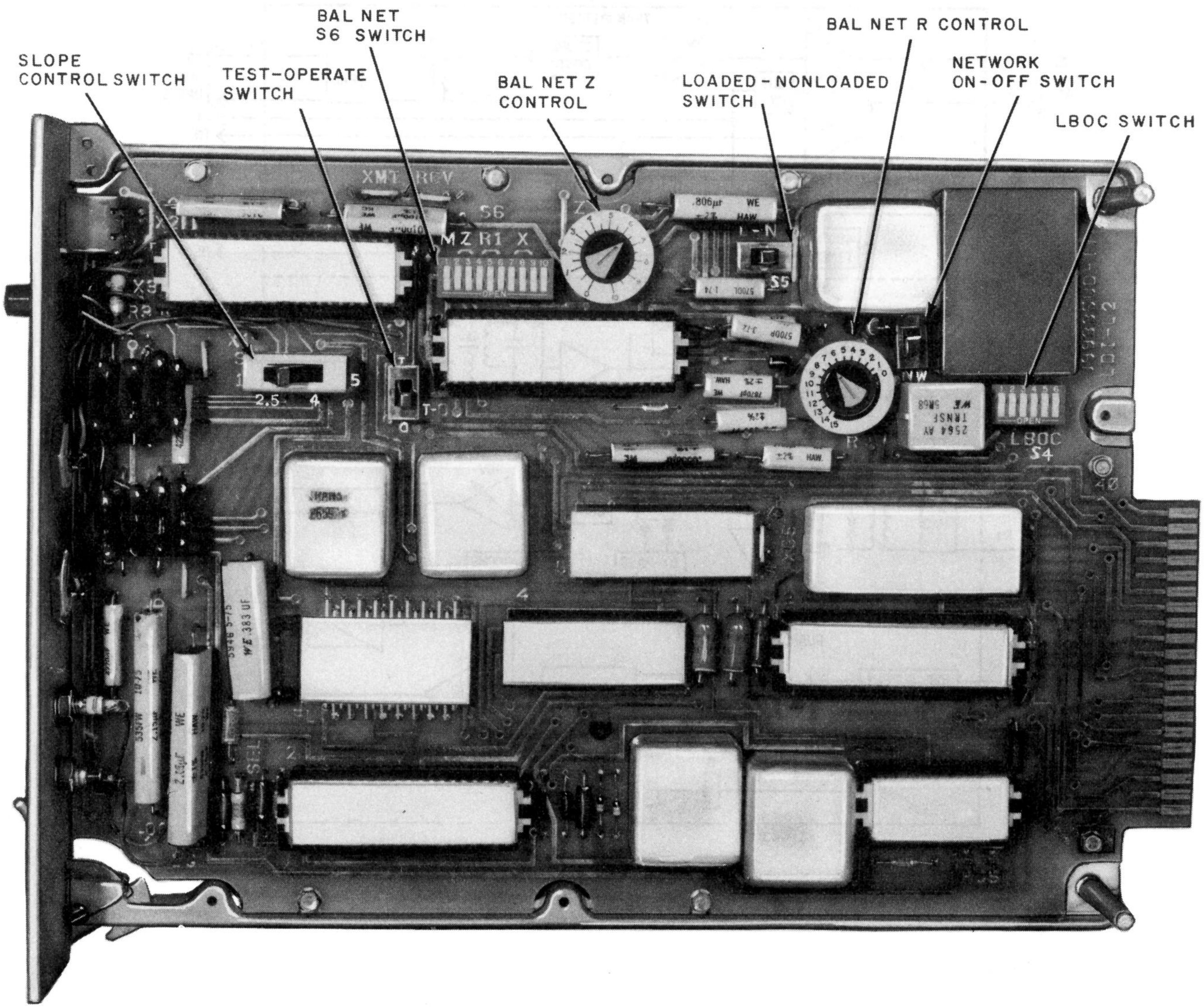


Fig. 8—FUD PC Assembly Showing Balance Network and LBOC Controls

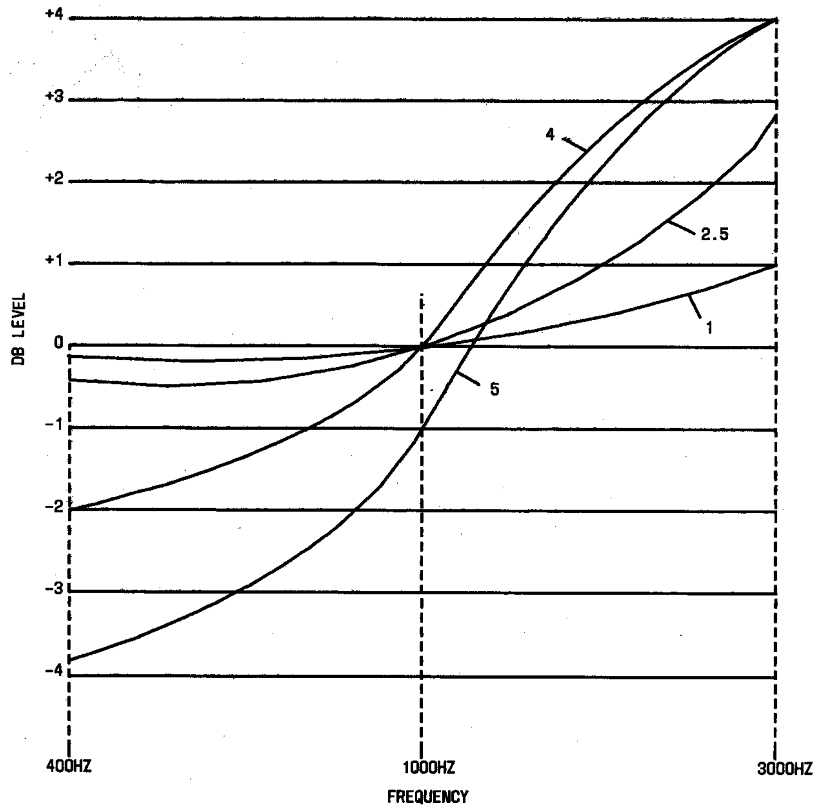


Fig. 9—Frequency Response for Slope Control Switch Settings

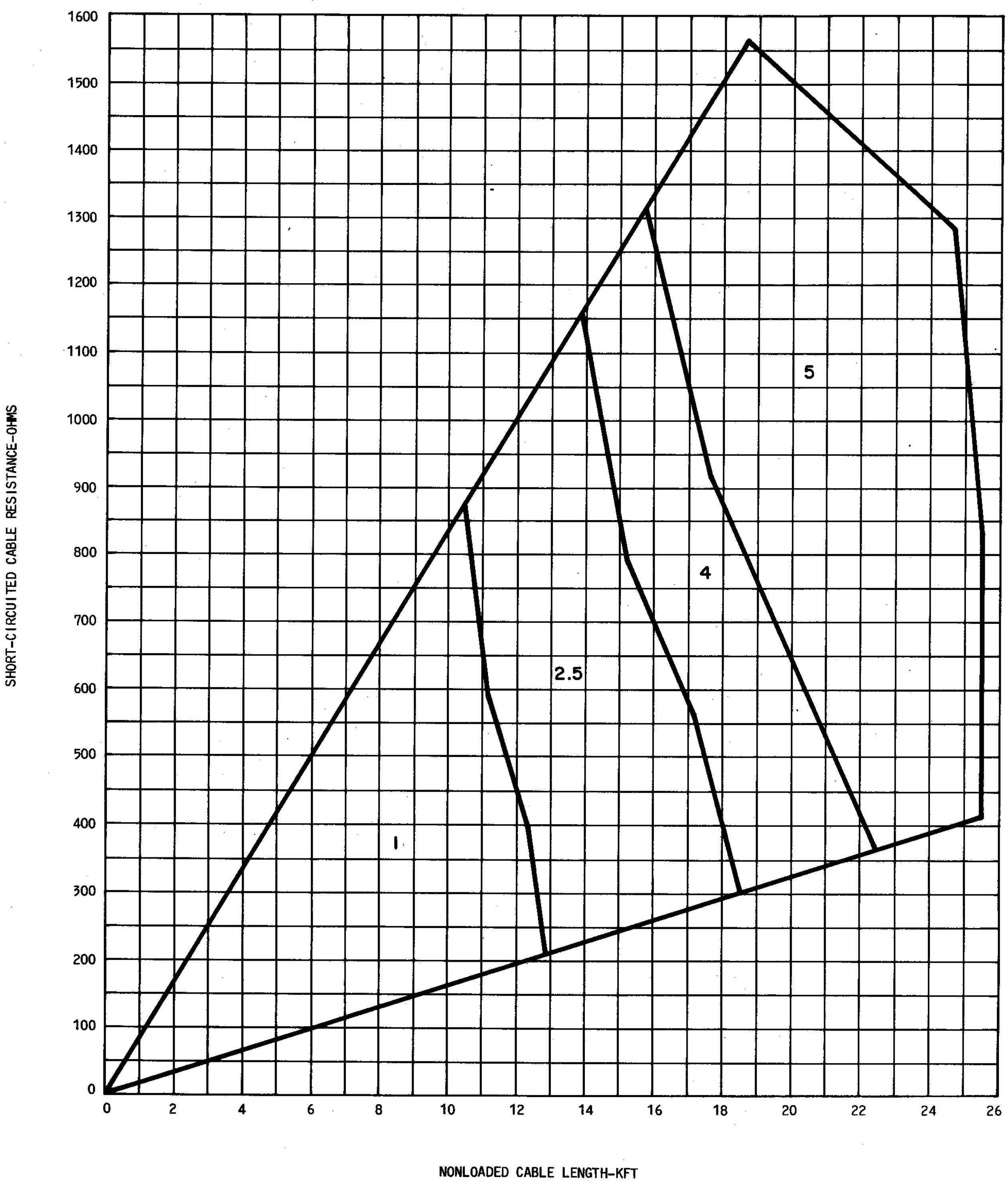


Fig. 10—FUD Slope Control Settings for 600-Ohm Load and 600-Ohm Source

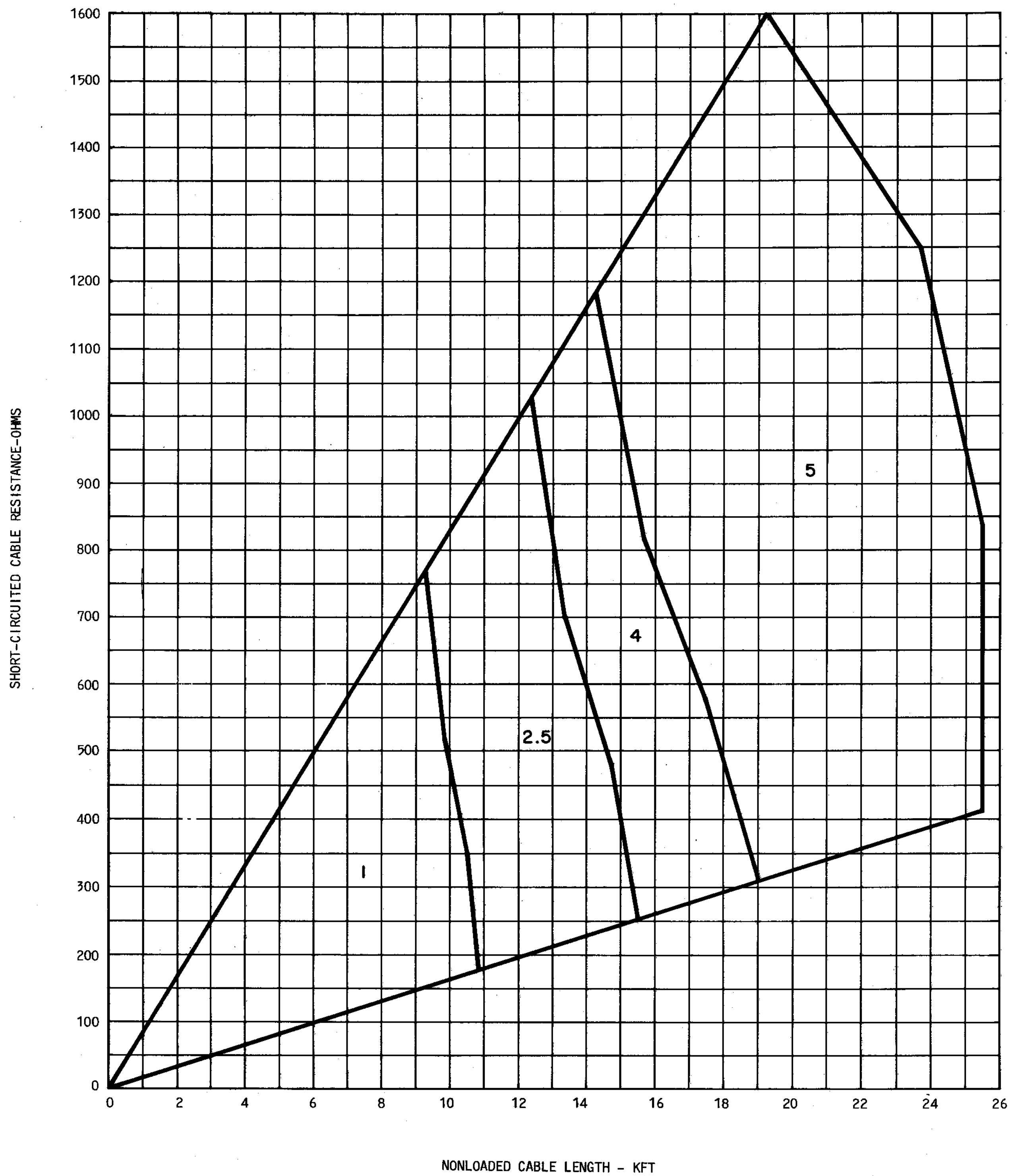


Fig. 11—FUD Slope Control Settings for 600-Ohm Load and 900-Ohm Source

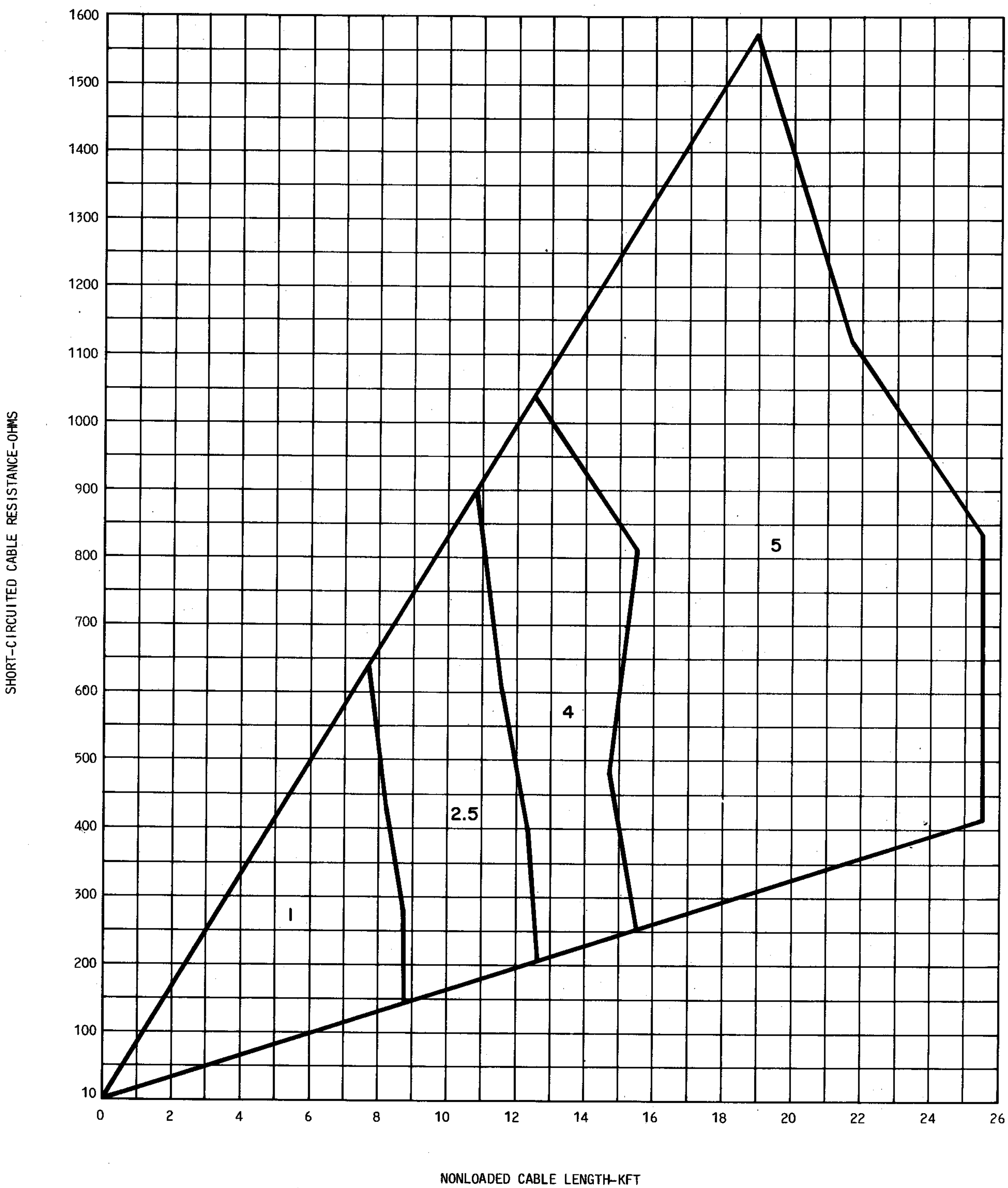


Fig. 12—FUD Slope Control Settings for 900-Ohm Load and 900-Ohm Source

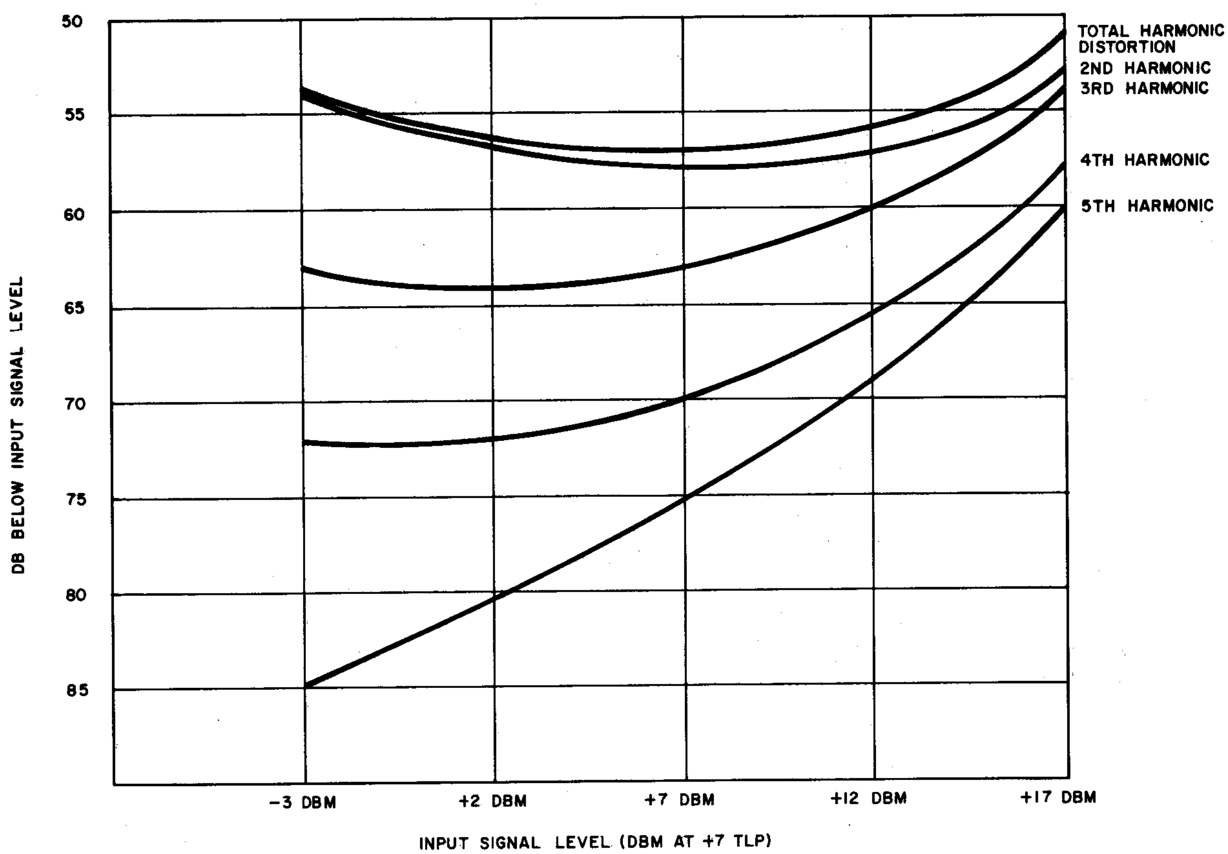
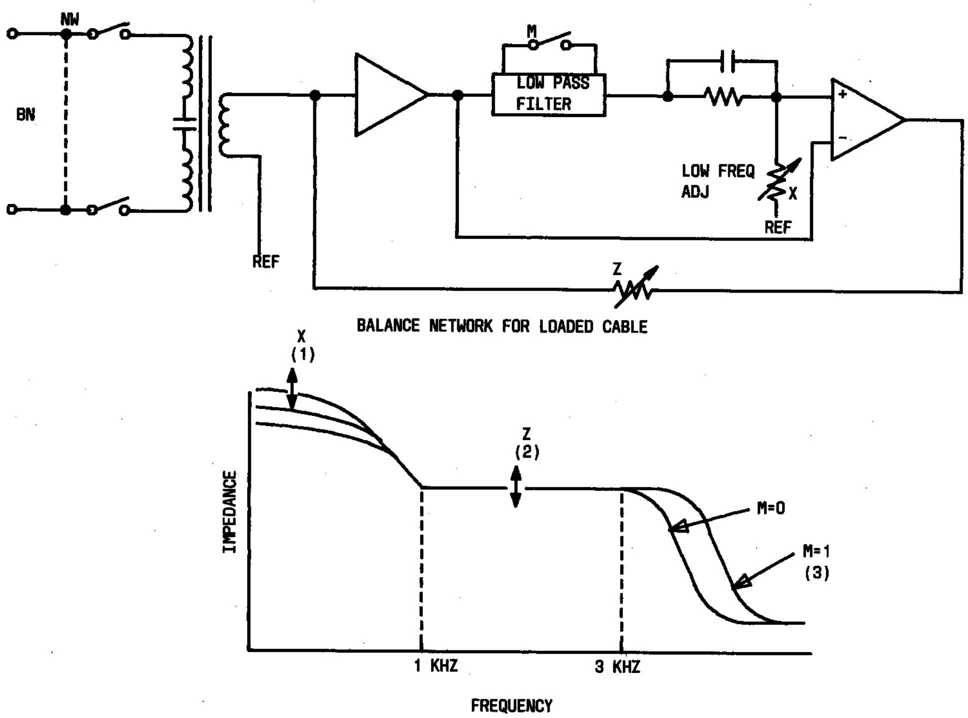
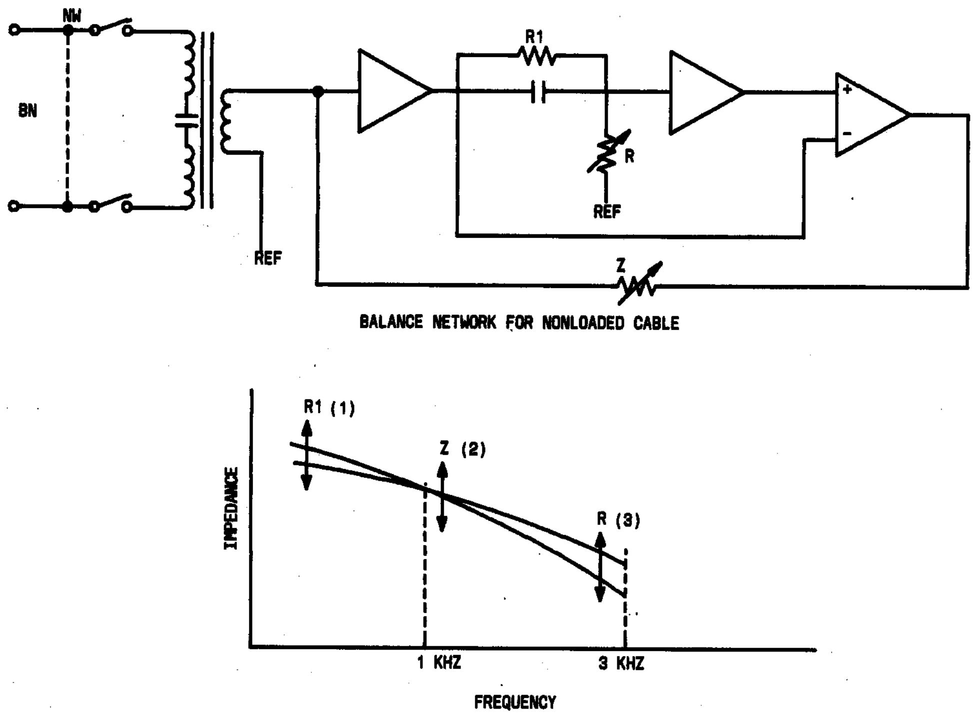


Fig. 13—Receive Harmonic Distortion Effect



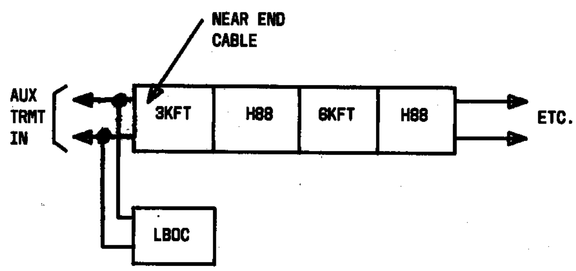
1. X CONTROL (S6-789) ADJUST THE CABLE IMPEDANCE AT LOW FREQUENCIES
2. Z CONTROL ADJUST THE CABLE IMPEDANCE AT ALL FREQUENCIES
3. M CONTROL (S6-1) ADJUSTS THE HIGH END ROLLOFF TO 3.6 KHZ

Fig. 14—Simplified Schematic of Balance Network for Loaded Cable and Graph Showing the Effects the Controls have on the Cable Impedance



1. R1 CONTROL (SS-456) ADJUST THE CABLE IMPEDANCE AT LOW FREQUENCIES
2. Z CONTROL ADJUST THE CABLE IMPEDANCE AT ALL FREQUENCIES
3. R CONTROL ADJUST THE CABLE IMPEDANCE AT HIGH FREQUENCIES

Fig. 15—Simplified Schematic of Balance Network for Nonloaded Cable and Graph Showing the Effects the Controls Have on the Cable Impedance



NOTE:
TO BUILD OUT NEAR END SECTION OF CABLE TO 6KFT, CALCULATE VALUE OF LBOC USING FORMULA C=(6-NX.016µF) WHERE N EQUAL NEAR END SECTIONN IN KFT.

EXAMPLE: C=(6-3X.016UF)
C=(3X.016µF)
C=.048µF

Fig. 16—Typical Loaded Cable Plus LBOC

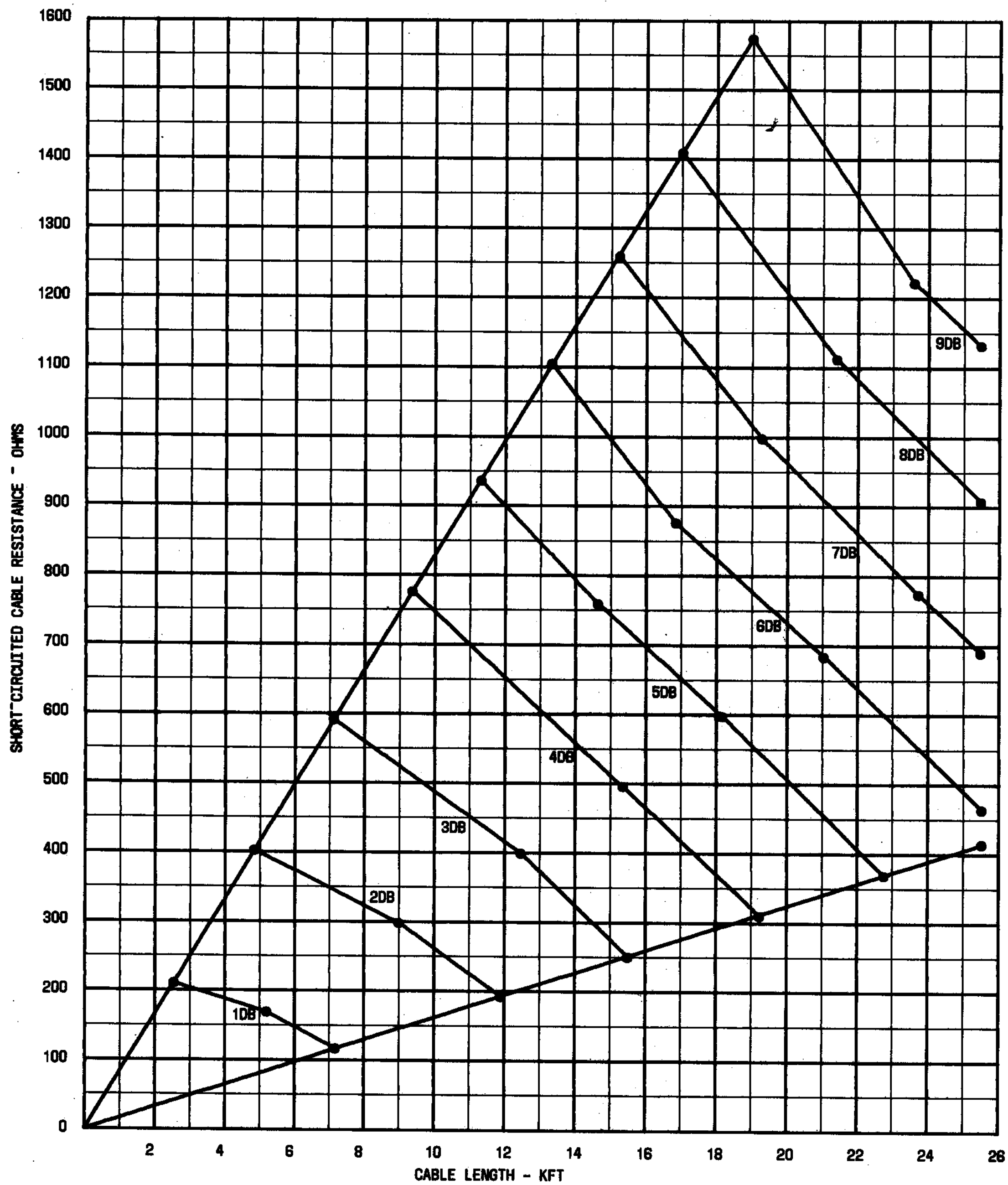


Fig. 17—Nonloaded Cable Loss At 1 kHz for 900-Ohm Load and 900-Ohm Source

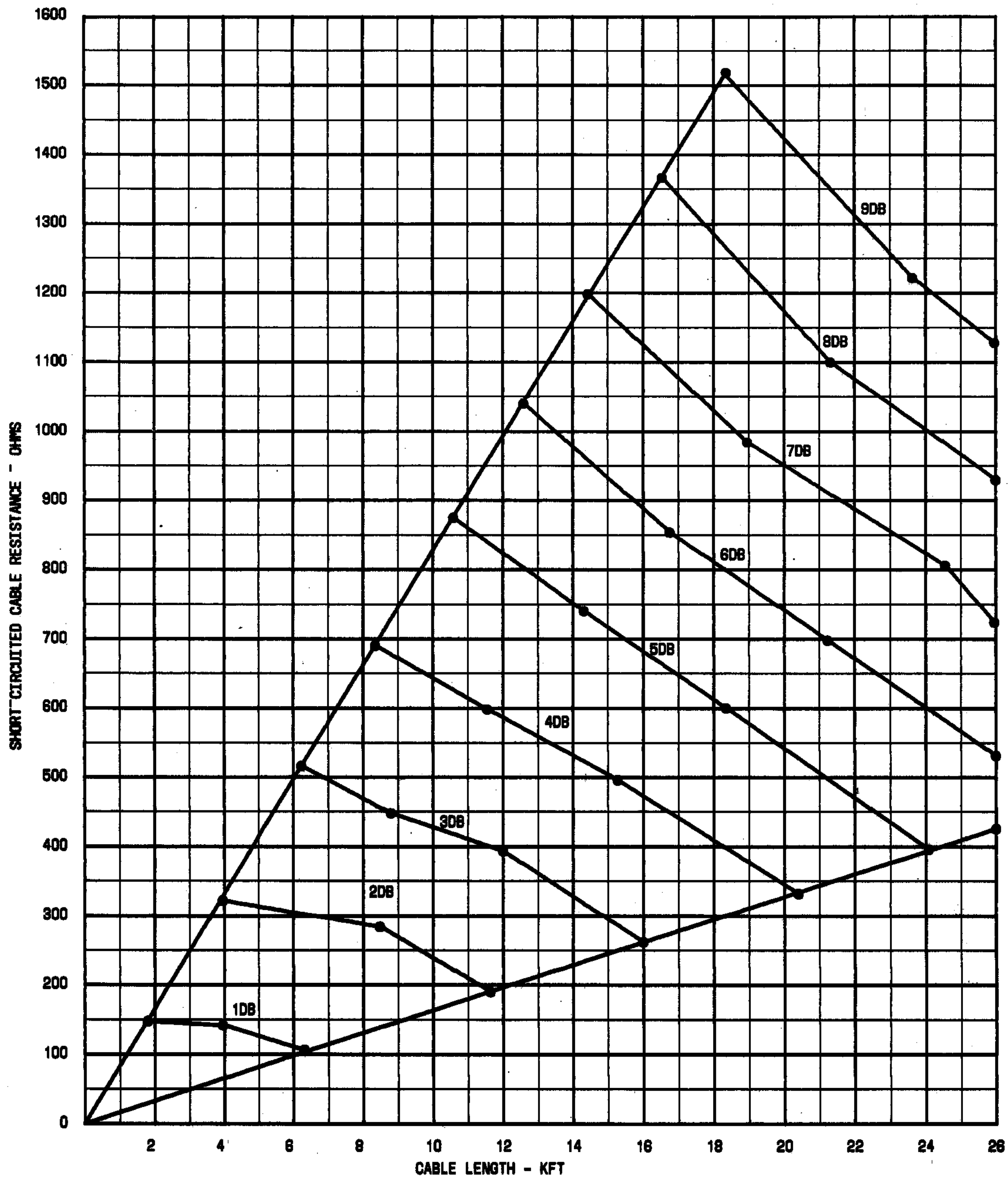


Fig. 18—Nonloaded Cable Loss At 1 kHz for 600-Ohm Load and 900-Ohm Source

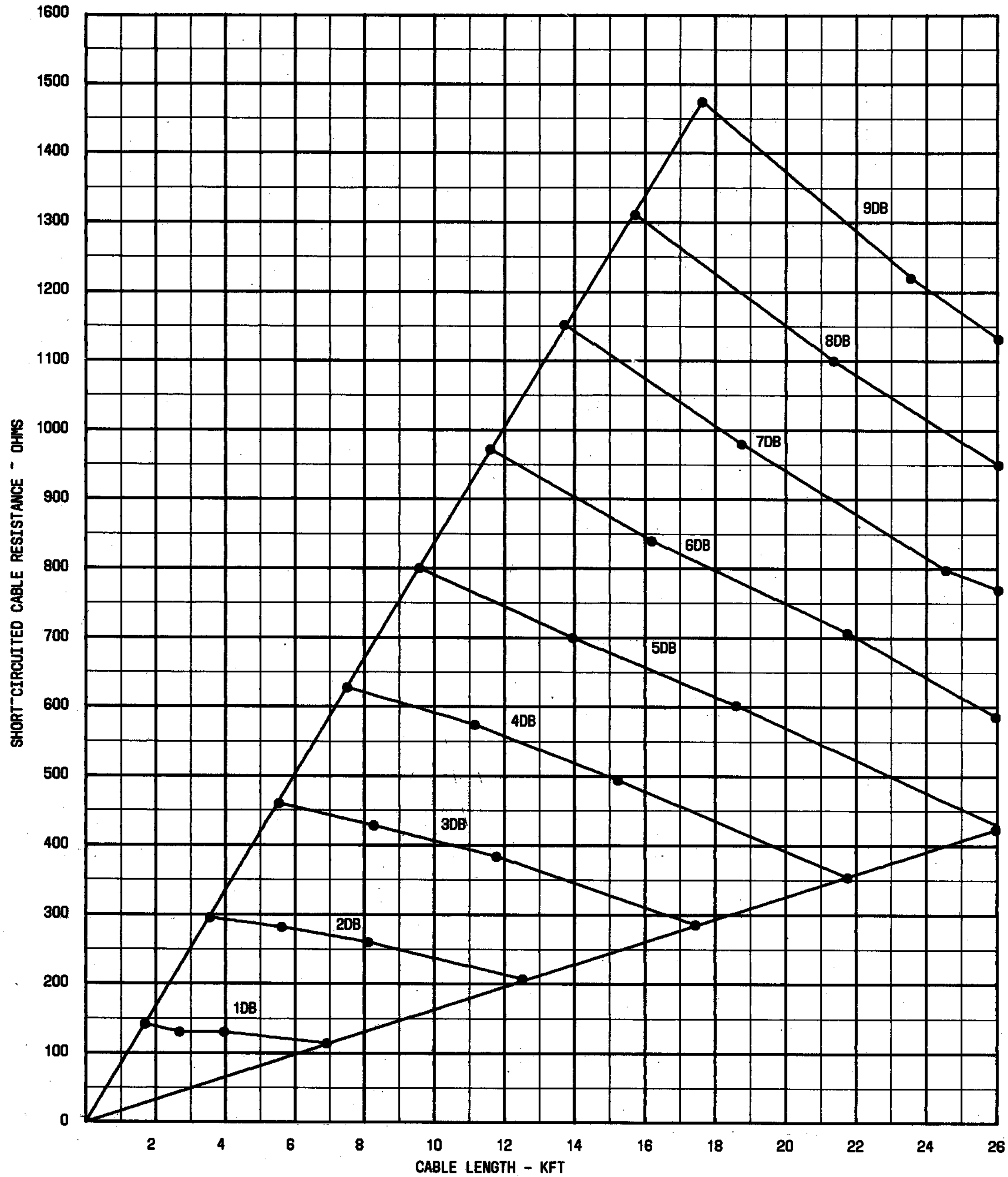


Fig. 19—Nonloaded Cable Loss At 1 kHz for 600-Ohm Load and 600-Ohm Source