

**J99343HA DX1-DX2/4-4 WIRE TERMINAL REPEATER AND  
J99343HB DX1/4-4 WIRE TERMINAL REPEATER**

**DESCRIPTION**

**METALLIC FACILITY TERMINAL**

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1. GENERAL . . . . .	1	<b>1.01</b> This section provides a physical description and discusses the basic functions of the DX1-DX2/4-4 wire terminal repeater and the DX1/4-4 wire terminal repeater combined function unit (CFU). The CFUs are described in detail, and transmission and/or signaling performance, typical applications, and maintenance philosophy are also discussed.
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3. FUNCTIONAL DESCRIPTION - J99343HB . . . . .	6	<b>1.02</b> This section is reissued to include the DX1/4-4 wire terminal repeater CFU, J99343HB. Since this is an extensive revision, change arrows have been omitted.
A. Operation . . . . .	6	
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4. PERFORMANCE CHARACTERISTICS . . . . .	9	<b>1.03</b> The Metallic Facility Terminal (MFT) is a standard equipment arrangement for providing various transmission and signaling functions that may be required by metallic facilities. The DX1-DX2/and the DX1/4-4 wire terminal repeater CFUs are MFT plug-ins that consist of a component board held by a molded polycarbonate frame. The MFT unit measures 1-11/16 inches wide, 7-7/8 inches high, and 9 inches deep.
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D. Output Power Capability . . . . .	12	<b>1.04</b> These units are CFUs that combine the functions of a transmission unit and a signaling unit on a single plug-in. A CFU can be used in either a single- or double-module mounting arrangement. It can be mounted in any slot of a single-module shelf. When the CFU is used in the double-module arrangement, it is mounted in the transmission slot. The companion signaling unit slot must be vacant. Section 332-910-101 contains additional information on MFT mounting arrangements.
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provides the functions of the DX1-DX2 signaling unit J99343DB and the 4-4 wire terminal/intermediate repeater J99343SB except that the A-side impedance is fixed at 600 ohms. The J99343HB provides the functions of the DX1 signaling unit J99343DA and the 4-4 wire terminal repeater J99343SA. In addition, the J99343HB provides Type II E&M signaling capability. These CFUs provide conversion between E&M and DX signaling on metallic facilities, and they provide gain and equalization between 4-wire 600-ohm equipment (A-side) and loaded or nonloaded facilities (B-

side). Section 332-912-261 provides installation and testing and touch-up procedures for these units.

2. FUNCTIONAL DESCRIPTION—J99343HA

2.01 The J99343HA is shown in Fig. 1. It provides gain, equalization, and E&M to DX signaling conversion on 4-wire circuits. Figure 2 shows a block diagram of the unit.

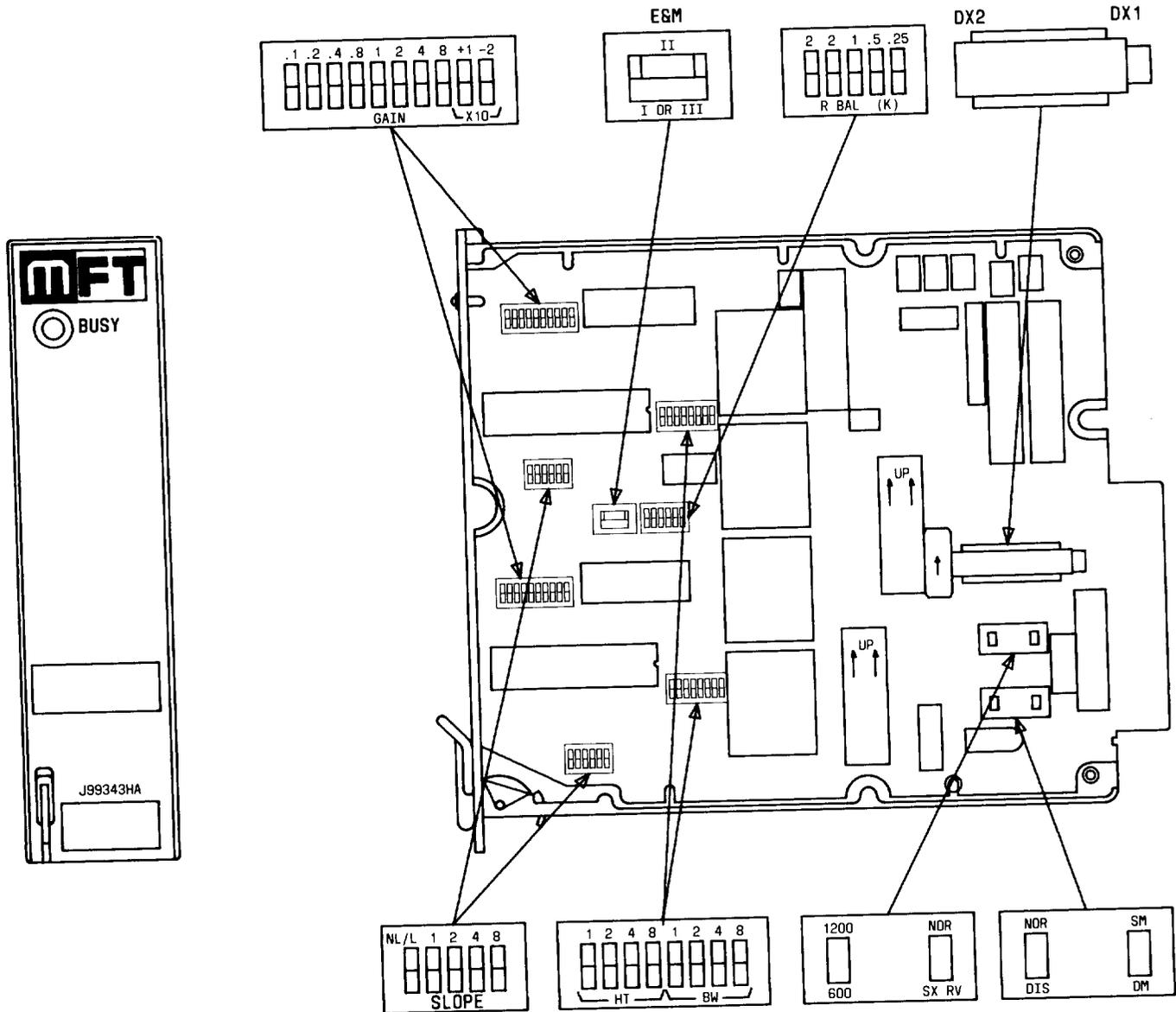
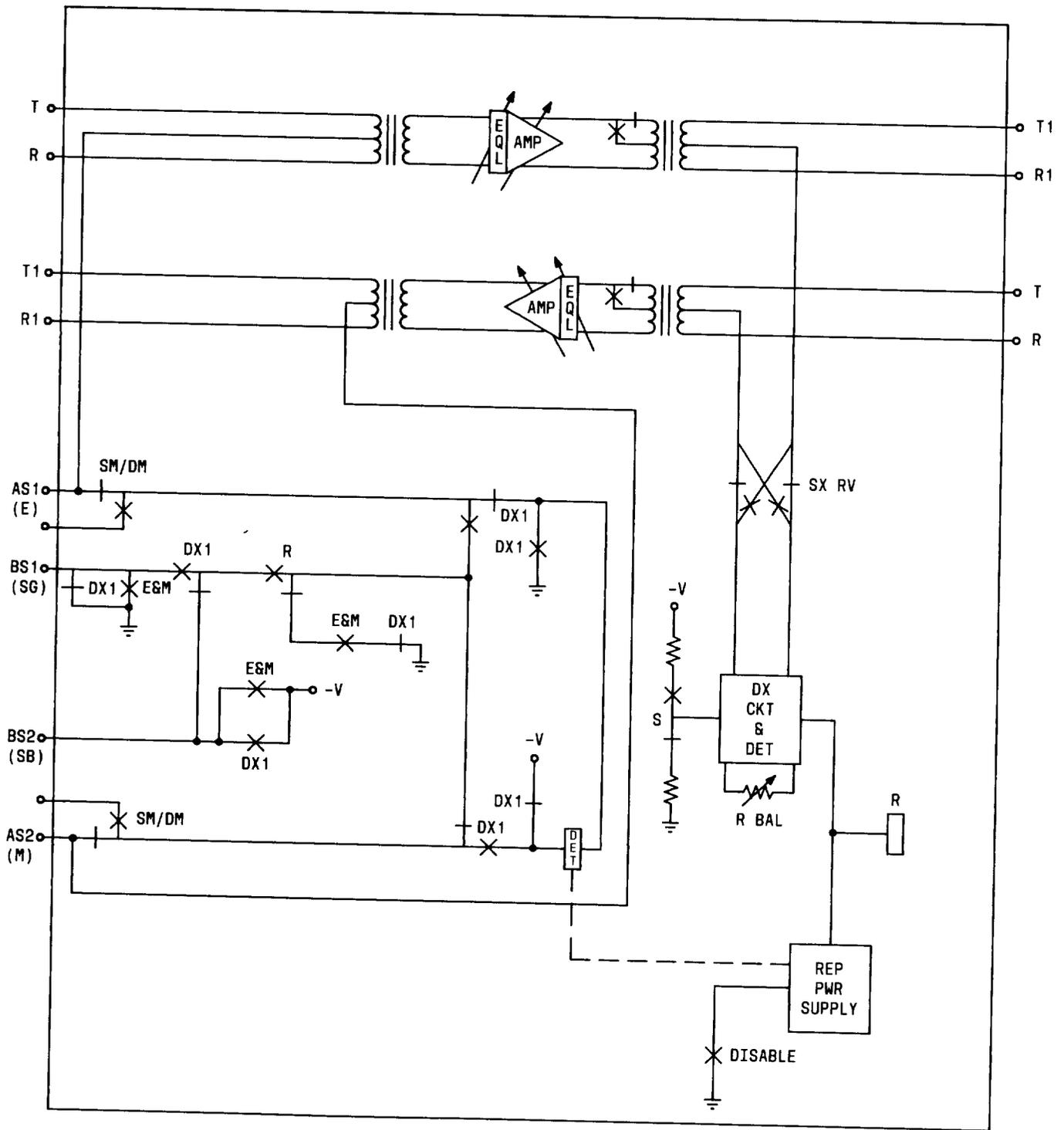


Fig. 1—Component Layout—J99343HA



NOTE: FOR TYPE II ESM SIGNALING BS1 (SG) AND BS2 (SB) LEADS MUST BE CONNECTED TO THE DISTRIBUTING FRAME.

Fig. 2—Block Diagram—J99434HA

## A. Operation

## Transmission

**2.02 Amplifier Units:** An individual amplifier provides adjustable gain for each direction of transmission. The control for the amplifier is designated GAIN. The range of the amplifier is  $-20$  dB to  $+23.5$  dB.

**Caution:** For crosstalk considerations, the maximum gain on 4-wire repeaters typically is limited to 15 dB.

**2.03 Equalizer:** Adjustable equalization is provided in both directions of transmission. The controls for each equalizer are designated HT, BW, and SLOPE.

**2.04 Transformers:** Each of the four repeater interfaces has an associated coupling transformer. The A-side transformer matches 4-wire 600-ohm equipment. The B-side transformer provides simplex lead access for the DX bridge. Facility impedance matching is provided by the 1200/600 switch.

## Signaling

**2.05 DX Circuit and Detector:** The HA satisfies the signaling requirements of the three types of E&M interfaces. The three types of E&M interfaces are shown in Fig. 3, 4, and 5. The HA employs a resistor duplex bridge with a voltage comparator to detect incoming pulses. It is capable of interfacing

with E&M trunk circuits (DX1 function), utilizing interface type I, II, or III. It also interfaces with E&M signaling circuits (DX2 function), utilizing interface type I or II. The E&M interface circuitry is designated such that the operation of the DX1/DX2 switch and the E&M type switch configures the E&M interface circuitry of this CFU to match the desired circuit shown in Fig. 3, 4, or 5.

**2.06 R-Balance:** The R-balance function provides static balance that balances the resistance of the DX circuit with the impedance of the line.

## B. Unit Controls

**2.07** The rocker-type switches for a particular function, which are described in the following paragraphs, are operated when depressed toward the respective designation. The sum of the values of the switches operated is the setting for that function. The unit controls are illustrated in Fig. 1.

## Transmission

**2.08 GAIN:** Ten miniature switches (designated GAIN) control the gain of the repeater. These switches are labeled .1, .2, .4, .8, 1, 2, 4, 8 +10, and  $-20$ . The gain is adjustable from  $-20$  to  $+23.5$  dB in 0.1 dB increments. See **Caution** in paragraph 2.02.

**Note:** The sum of the coarse adjust gain switches (1, 2, 4, and 8) should not exceed a total of 12 dB.

**2.09 HT, BW, and SLOPE:** Thirteen rocker switches (designated HT [1, 2, 4, 8], BW [1, 2,

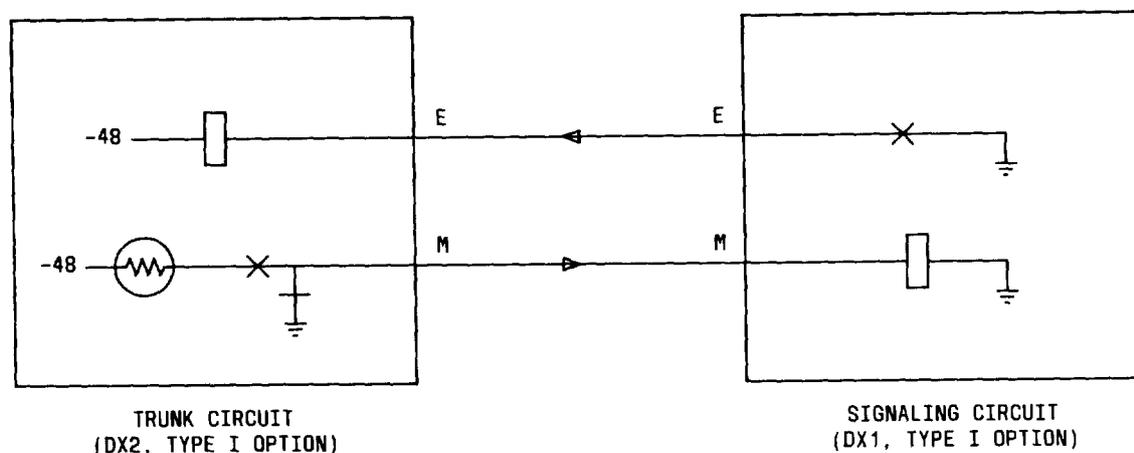


Fig. 3—Type I E&M Interface

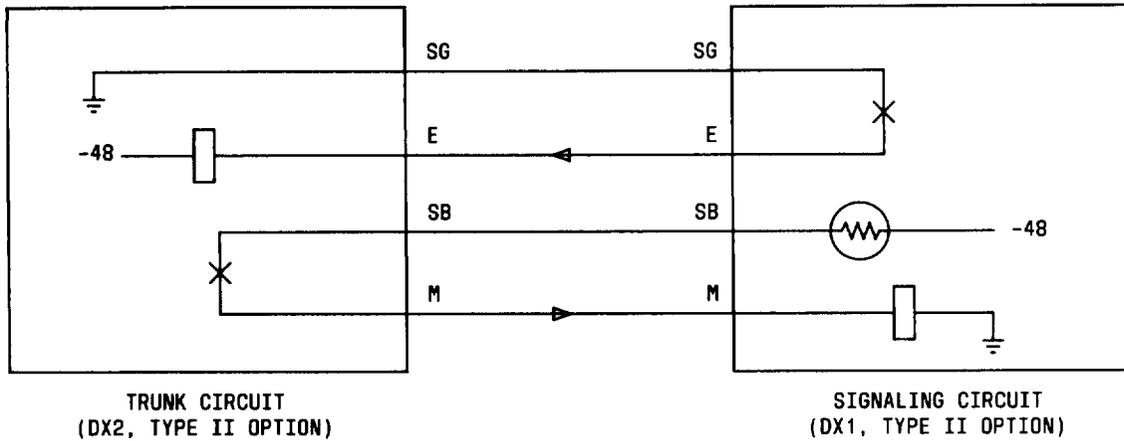


Fig. 4—Type II E&M Interface

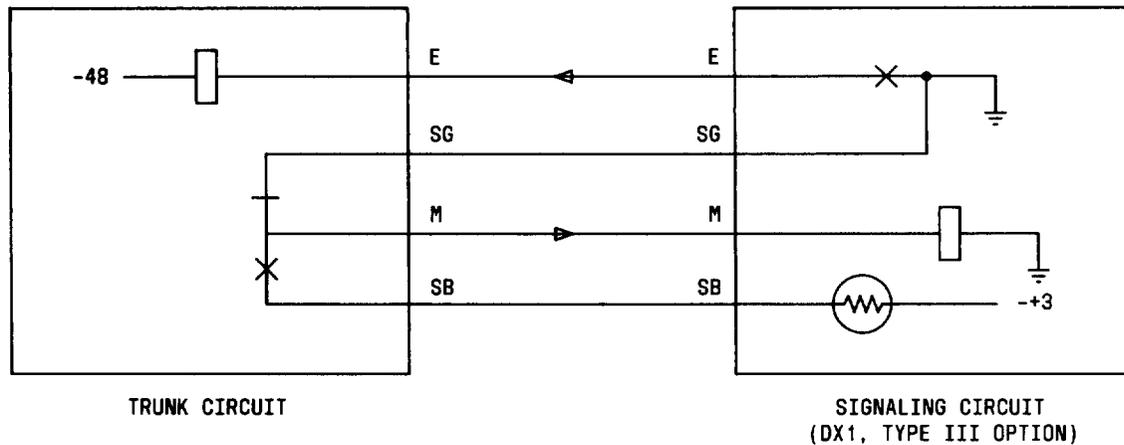


Fig. 5—Type III E&M Interface

4, 8], and SLOPE [NL, 1, 2, 4, 8]) adjust the equalization. A separate equalizer is provided for each direction of transmission. The sum of these switches determines the equalization. The NL switch acts as a range selector and, when operated, provides a steeper degree of equalization. See Section 332-912-232 for prescription settings of the HT, BW, and SLOPE switches. See **Caution** in paragraph 2.02.

**2.10 1200·600:** The transformers that interface a cable facility are provided with a 600/1200-ohm impedance selection switch. The 1200 ohms is used for loaded cable and 600 ohms for nonloaded cable. The impedance option switch is provided only

on the B-side. The A-side is a fixed 600 ohms and interfaces terminal equipment.

**2.11 NOR·SX RV:** The NOR·SX RV switch provides a means for reversing the simplex leads at one end in order to keep SX and SX1 leads consistent at both ends.

**Signaling**

**2.12 E&M:** The E&M selection switch is a slide switch which slides vertically to select either type II E&M signaling in the up position or type I or III E&M signaling in the down position.

**2.13 DX1/DX2:** The DX1/DX2 switch is a slide switch which slides horizontally to select either the DX1 or DX2 signaling mode. This switch is used in conjunction with the E&M switch to configure the signaling circuits shown in Fig. 3, 4, and 5.

**2.14 R-BAL:** The R-BAL switch contains five selectable rockers which are labeled 2, 2, 1, .5, and .25 in k ohms. The resistance values of the rockers are additive, but the maximum R balance should not exceed 5 k ohms.

**2.15 NOR-DIS:** This switch provides a special test arrangement for the CFU. With the switch in the NOR position, the repeater section can be tested independently of the signaling section. In this arrangement the repeater is continuously activated. In the DISABLE position, the CFU operates in the normal manner.

**2.16 SM-DM:** The single module/double module switch is a slide switch labeled SM/DM. In the SM position the unit is configured for single module shelf arrangements. In the DM position the unit is configured for double module shelf arrangements.

### 3. FUNCTIONAL DESCRIPTION - J99343HB

**3.01** The J99343HB is shown in Fig. 6. It provides gain, equalization, and E&M to DX1 signaling on 4-wire circuits. Figure 7 shows a block diagram of the unit.

#### A. Operation

##### Transmission

**3.02 Amplifier Units:** An individual amplifier provides adjustable gain for each direction of transmission. The control for the amplifier is designated GAIN. The range of the amplifier is -20 dB to +23.5 dB.

**Caution:** For crosstalk considerations, the maximum gain on 4-wire repeaters typically is limited to 15 dB.

**3.03 Equalizer:** An adjustable equalizer is provided only in the B-to-A direction of transmission. The controls for the equalizer are designated HT, BW, and SLOPE.

**3.04 Transformers:** Each of the four repeater interfaces has an associated coupling trans-

former. The A-side transformer matches 4-wire 600-ohm equipment. The B-side transformer provides simplex lead access for the DX bridge.

#### Signaling

**3.05 DX Circuit and Detector:** The J99343HB satisfies the signal requirements for E&M to DX1 signal conversions. It employs a resistor duplex bridge with a comparator to detect incoming pulses. It is capable of interfacing with E&M trunk circuits (DX1 function) utilizing interface type I, II, or III.

**3.06 R-Balance:** The R-balance function provides static balance that balances the resistance of the DX circuit with the impedance of the line.

#### B. Unit Controls

**3.07** The rocker-type switches for a particular function, which are described in the following paragraphs, are operated when depressed toward the respective designation. The sum of the values of the switches operated is the setting for that function. The unit controls are illustrated in Fig. 6.

##### Transmission

**3.08 GAIN:** Ten miniature switches (designated GAIN) control the gain of the repeater. These switches are labeled .1, .2, .4, .8, 1, 2, 4, 8, +10, and -20. The gain is adjustable from -20 dB to +23.5 dB in 0.1 dB increments. See **Caution** in paragraph 3.02.

**Note:** The sum of the coarse adjust gain switches (1, 2, 4, and 8) should not exceed a total of 12 dB.

**3.09 HT, BW, and SLOPE:** Thirteen rocker switches (designated HT [1, 2, 4, 8], BW [1, 2, 4, 8], and SLOPE [NL, 1, 2, 4, 8]) adjust the equalization. The sum of these switches determines the equalization. The NL switch acts as a range selector and, when operated, provides a steeper degree of equalization. See Section 332-912-232 for prescription settings of the HT, BW, and SLOPE switches. See **Caution** in paragraph 3.02.

**3.10 OUTPUT:** The transformer that interfaces the cable facility on the B-side provides selectable impedance matching of either 1200 or 600 ohms.

**3.11 NOR-SX RV:** The NOR-SX RV switch provides a means for reversing the simplex leads

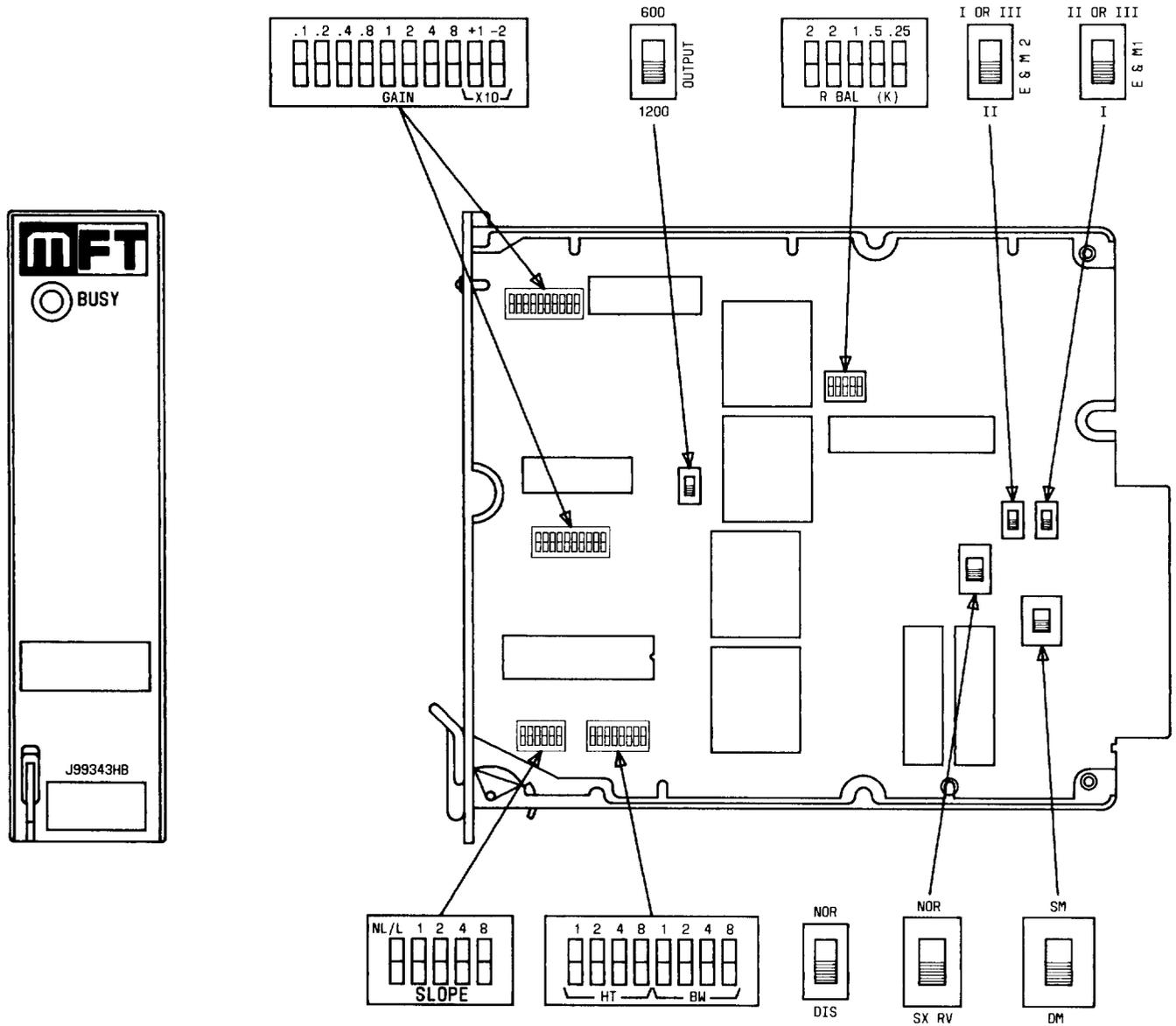


Fig. 6—Component Layout—J99343HB

at one end in order to keep SX and SX1 leads consistent at both ends.

**Signaling**

**3.12 E&M1 and E&M2:** These switches are used in conjunction with each other to select either type I, II, or III E&M signaling.

**3.13 R-BAL:** The R-BAL switch contains five selectable rockers which are labeled 2, 2, 1, .5,

and .25 in k ohms. The resistance values of these rockers are additive, but the maximum R balance should not exceed 5 k ohms.

**3.14 NOR-DIS:** This switch provides a special test arrangement for the CFU. With the switch in the NOR position, the repeater section can be tested independently of the signaling section. In this arrangement the repeater is continuously activated. In the DISABLE position, the CFU operates in the normal manner.

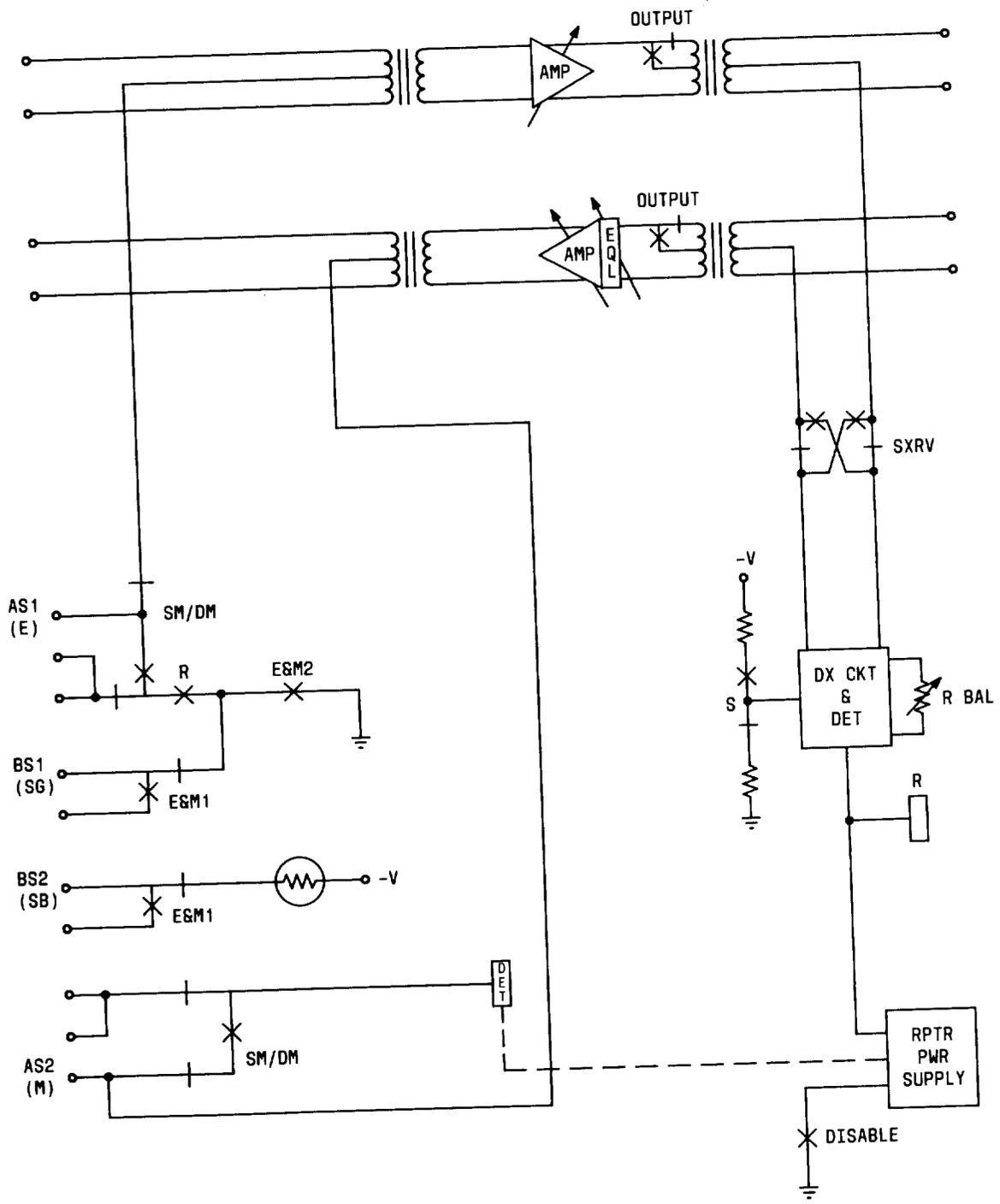


Fig. 7 — Block Diagram — J99343HB

**3.15 SM-DM:** The single module/double module switch is a slide switch labeled SM:DM. In the SM position the unit is configured for single module shelf arrangements. In the DM position the unit is configured for double module shelf arrangements.

#### 4. PERFORMANCE CHARACTERISTICS

**4.01** The performance of the J99343HA and HB CFUs is discussed in the following paragraphs. Table A gives a summary of characteristics for both units.

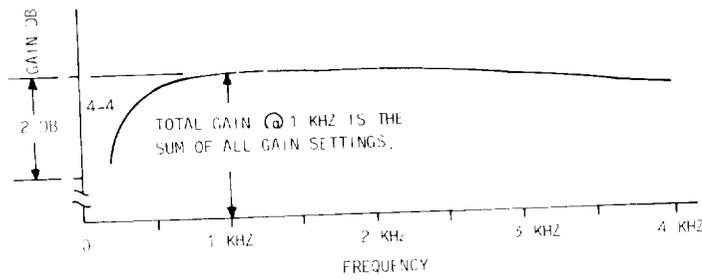
#### A. Amplifier/Equalizer Frequency Response

**4.02** Figures 8 through 12 give the frequency response of the gain and equalizer units. Figure 8 gives the response curves with no equalization. Figure 9 gives the response curves for various SLOPE settings with the NL switch set to interface nonloaded cable (switch toward NL). Figure 10 provides response curves for the same SLOPE settings with the NL switch set to interface loaded cable (switch away from NL). Figure 11 gives the response curves for various HT settings with the BW switch at a small setting. Figure 12 gives the response curves for the same HT settings with the BW switch at a large setting.

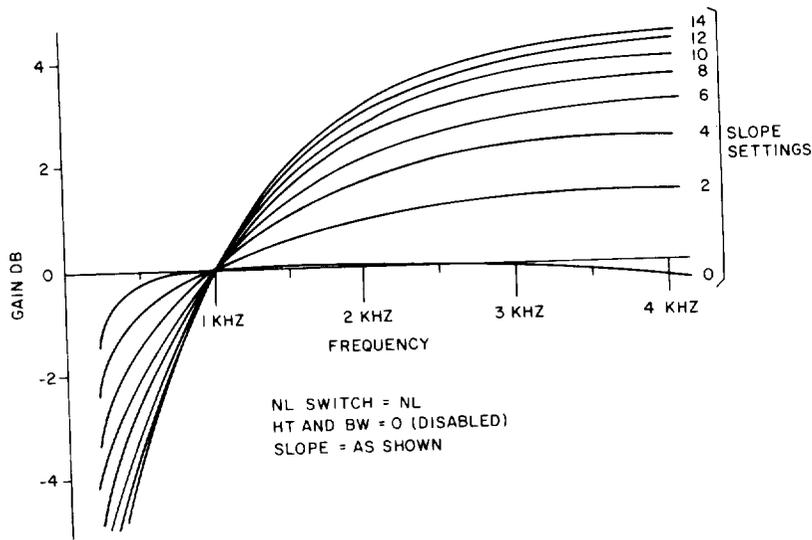
**TABLE A**

**UNIT CHARACTERISTICS**

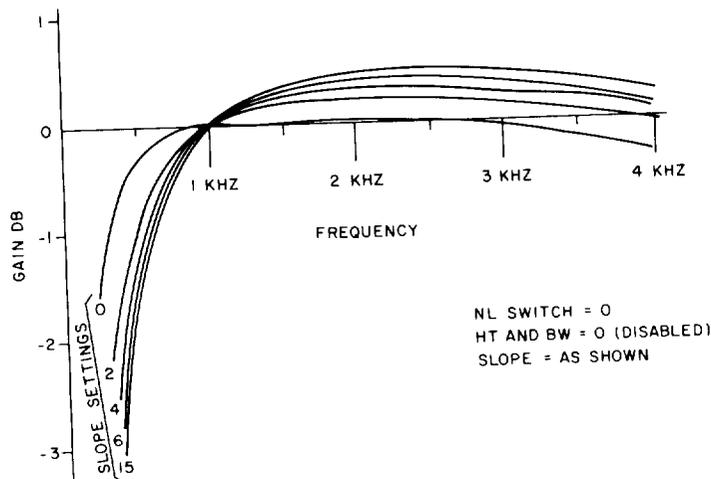
FUNCTION	J99343HA	J99343HB
<b>TRANSMISSION</b>		
Gain	-20 to +23.5 dB	-20 to +23.5 dB
Equalization		
A to B	adjustable	none
B to A	adjustable	adjustable
Impedance		
A-side	600 $\Omega$	600 $\Omega$
B-side	1200 or 600 $\Omega$	1200 or 600 $\Omega$
<b>CURRENT DRAIN ( -48V Battery)</b>		
Idle	79 mA	30 mA
Typical	131 mA	65 mA
Maximum	147 mA	80 mA
<b>INTERNAL DC RESISTANCE</b>		
	<b>T1/R1</b> <b>T/R</b>	<b>T1/R1</b> <b>T/R</b>
A-side	34 $\Omega$ 34 $\Omega$	34 $\Omega$ 34 $\Omega$
B-side	DX Bridge	DX Bridge
<b>SIGNALING</b>		
DX1	E&M Types I, II, III	E&M Types I, II, III
DX2	E&M Types I, II	None



**Fig. 8—Amplifier/Equalizer Frequency Response (No Equalization)**



**Fig. 9—Amplifier/Equalizer Frequency Response (NL/L = Loaded SLOPE = Variable)**



**Fig. 10—Amplifier/Equalizer Frequency Response (NL/L = Loaded, SLOPE = Variable)**

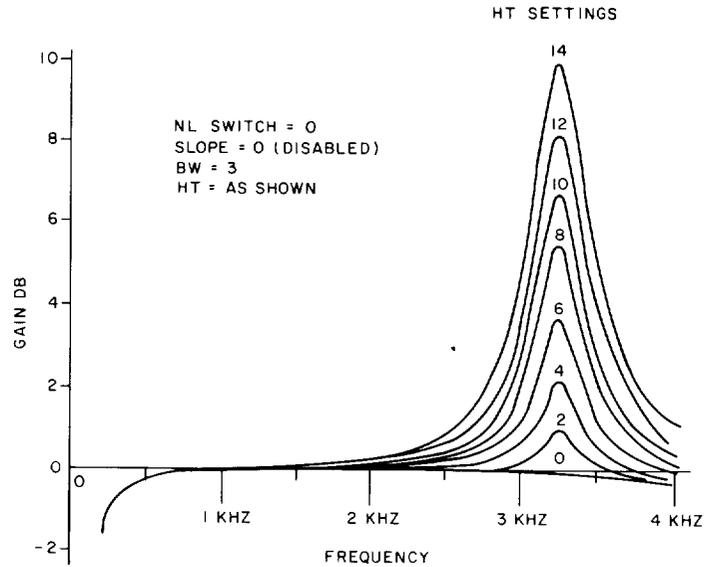


Fig. 11—Amplifier/Equalizer Frequency Response (BW = Small Settings, HT = Variable)

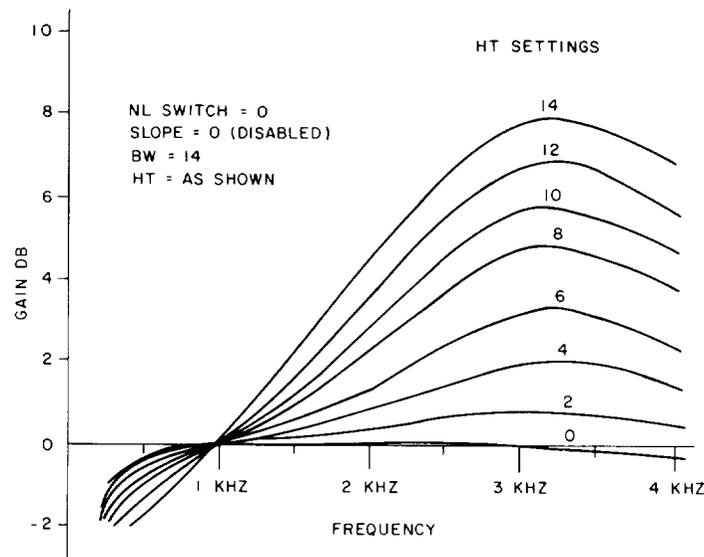


Fig. 12—Amplifier/Equalizer Frequency Response (BW = Large Settings, HT = Variable)

**B. Envelope Delay Distortion**

4.03 Figures 13 through 17 give the envelope delay distortion (EDD). Figure 13 shows the EDD for the repeaters with the equalizer disabled. Figure 14 shows the EDD for various SLOPE settings with the NL switch set to interface nonloaded cable (switch toward NL). Figure 15 shows the EDD for the same SLOPE settings with the NL switch set to interface loaded cable (switch away from NL). Figure 16

shows the EDD for various HT settings with the BW switch at a small setting. Figure 17 provides the EDD for the same HT settings with the BW switch at a large setting.

**C. Longitudinal Balance**

4.04 The longitudinal balance for these repeaters is at least 60 dB from 60 Hz to 4000 Hz.

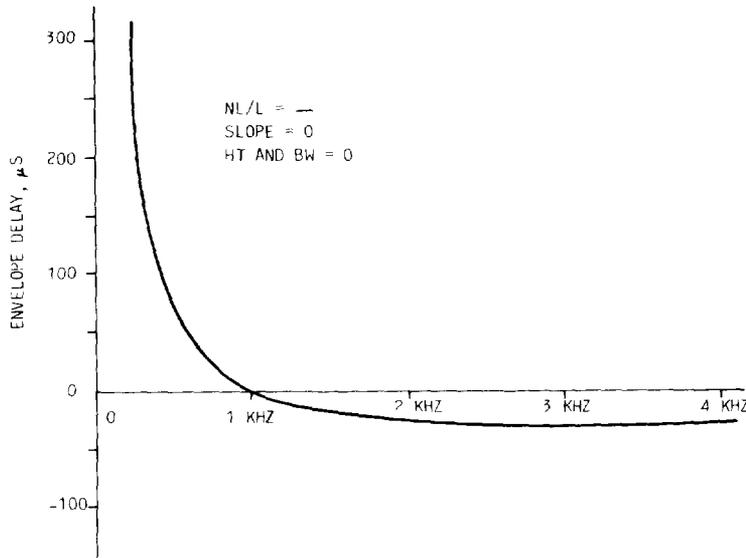


Fig. 13—Relative Envelope Delay Distortion (Equalizer Disabled)

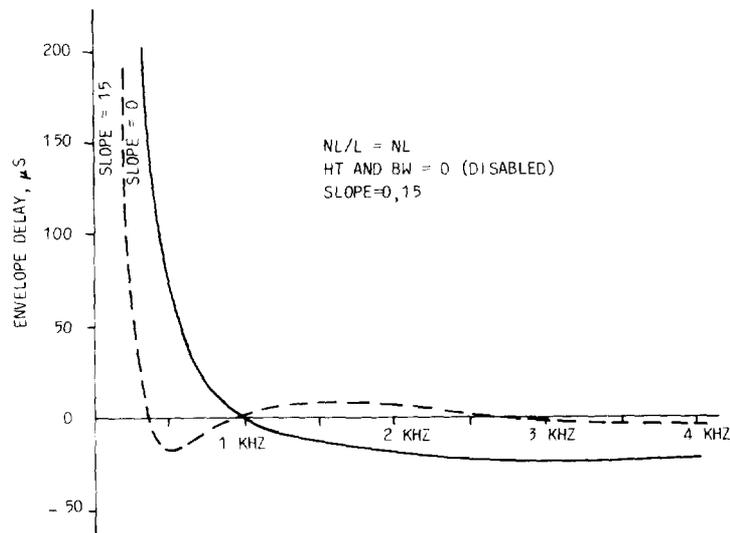


Fig. 14—Relative Envelope Delay Distortion (Nonloaded, SLOPE = Variable)

D. Output Power Capability

4.05 Figure 18 shows the output power capability of the J99343HA and HB CFUs. The output power is determined by the input power and repeater gain as shown by the +6 dB gain line in the figure. Power limiting occurs in this unit at about +18 dBm.

5. APPLICATIONS

A. Typical Applications

5.01 The J99343HA may be used for most types of 4-wire DX circuits by selecting the proper DX1 or DX2 setting on the DX function switch. The J99343HB may be used for most types of 4-wire DX1

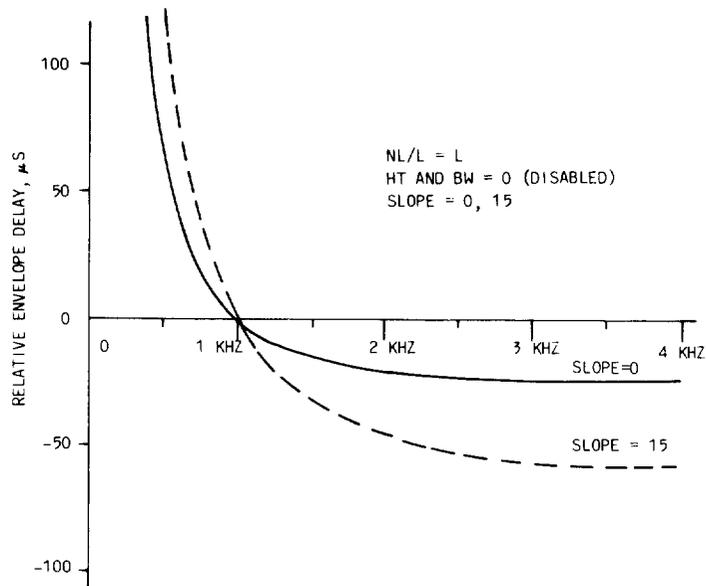


Fig. 15—Relative Envelope Delay Distortion (Loaded, SLOPE = Variable)

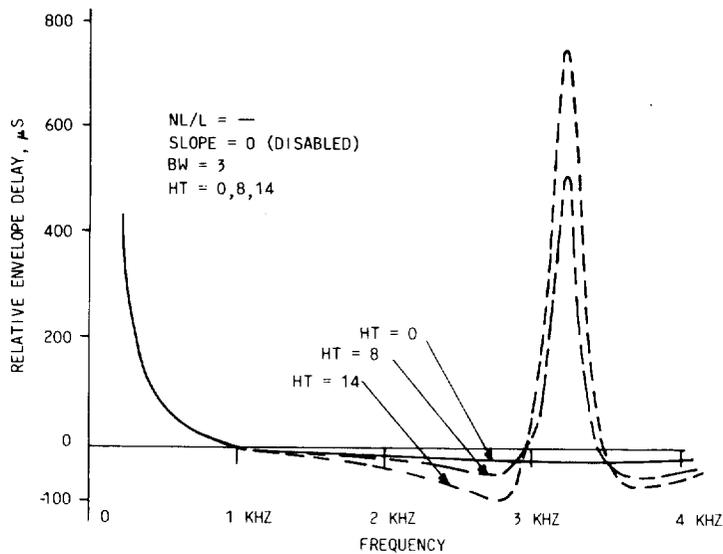


Fig. 16—Relative Envelope Delay Distortion (BW = Small Setting, HT = Variable)

circuits where pre-equalization is not required. Some typical applications for both units are shown in Fig. 19.

**Incompatibility**

**5.02** The only incompatibility that exists for the J99343HA unit is the E-type, SF signaling units which employ E&M leads. The J99343HA is not

capable of meeting the E&M interface requirements. In this application, the J99343HA is in the DX2 mode with type I E&M signaling.

**B. Split-Frame Applications**

**5.03** The J99343HA and HB requires that the E&M and SB and SG leads be on the same frame for looped E&M applications. The J99343HA and HB are not compatible with split frame offices using looped E&M signaling.

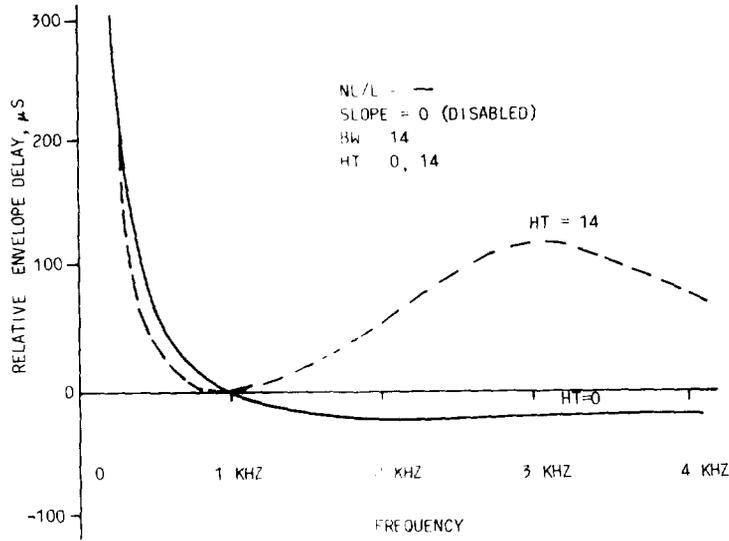


Fig. 17—Relative Envelope Delay Distortion (BW = Large Setting, HT = Variable)

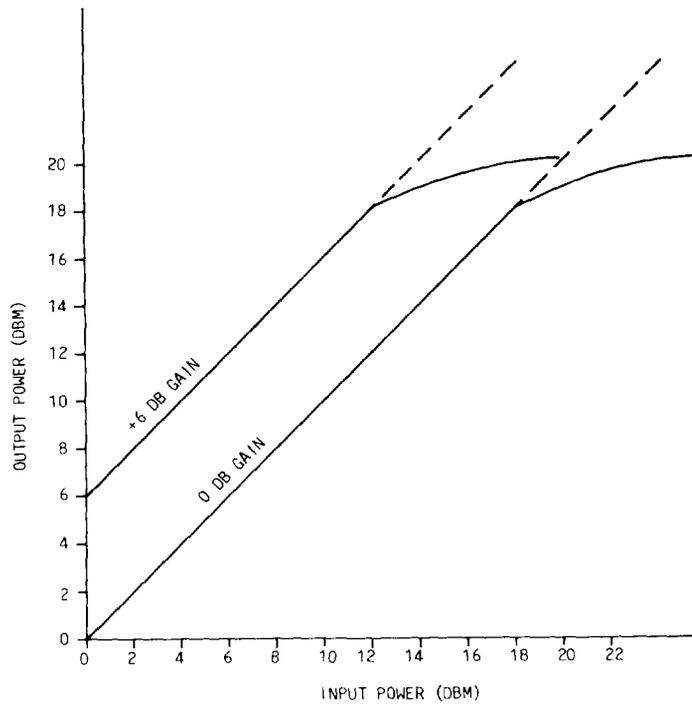
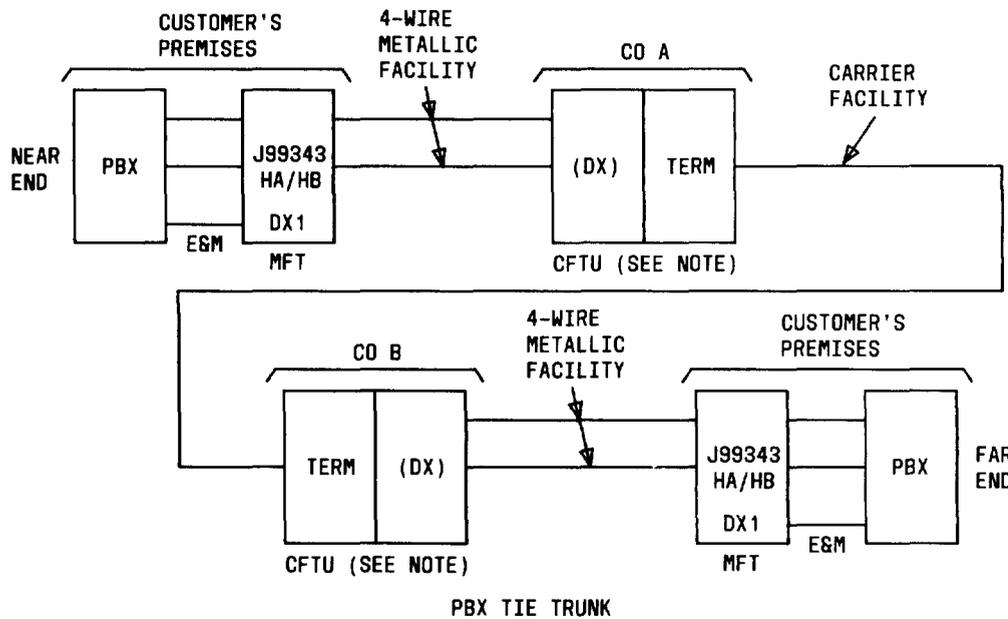


Fig. 18—Output Power Capacity

6. MAINTENANCE

6.01 There is no routine maintenance required for MFT units. If trouble occurs on a circuit, the

problem should first be localized. If an MFT unit is determined to be faulty, it should be removed from service and replaced with spare. The defective unit should be sent to the nearest Western Electric Service Center for repair.



NOTE:  
 THE CARRIER FACILITY TERMINAL UNITS (CFTU) CONVERT THE METALLIC INTERFACE TO CARRIER FACILITY AND CONSISTS OF TWO TYPES: THE ANALOG CARRIER FACILITY TERMINAL (ie F-TYPE AND G-TYPE SIGNALING) AND DIGITAL CARRIER FACILITY TERMINAL (ie D1, D3, D4 UNITS).

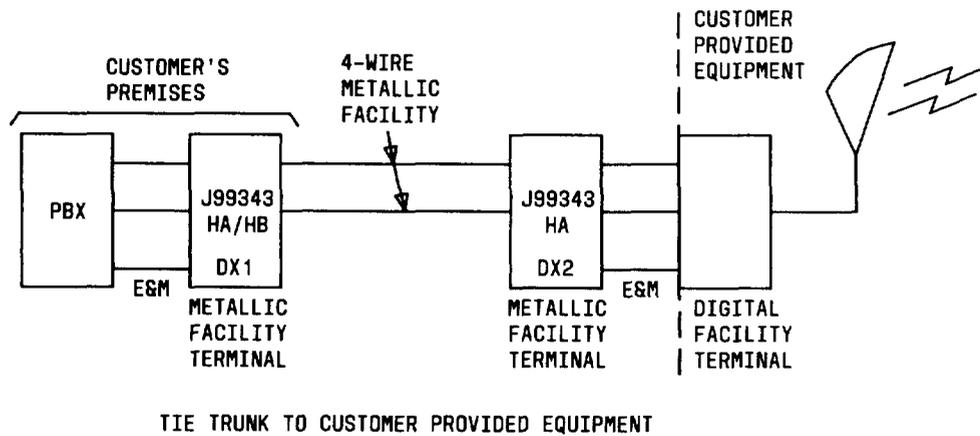
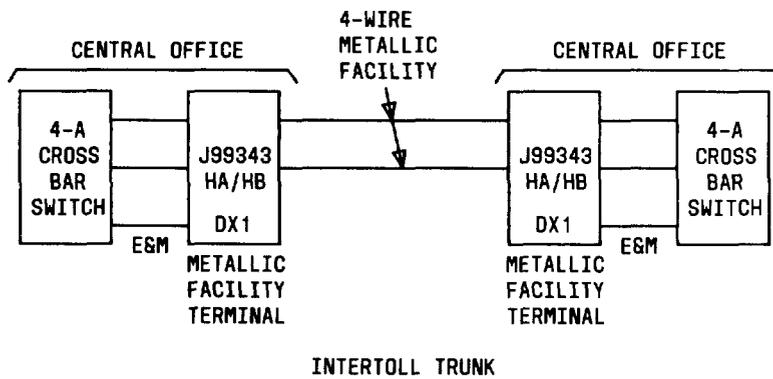


Fig. 19—Typical Application

**SECTION 332-912-161**

**7. REFERENCES**

**7.01** The documents listed below contain additional information on the J99343HA and HB MFT units:

<b>SECTION</b>	<b>TITLE</b>
332-610-100	General Description—CPFT for MFT Equipment
332-610-200	Installation—CPFT for MFT Equipment
332-610-500	Maintenance and Testing Information—CPFT for MFT Equipment
332-910-100	MFT—General Description
332-910-180	MFT—General Application Information
332-911-103	DX1 And DX1/DX2 Signaling Units (J99343DA, DB), Description

<b>SECTION</b>	<b>TITLE</b>
332-912-134	4-4 Wire Repeaters (J99343SA, SB), Description
332-912-232	MFT 4-Wire Repeaters—Prescription Settings
332-912-261	DX1-DX2/4-4 Wire Terminal Repeater (J99343HA) Installation and Test
975-230-100	DX Signaling System

<b>REFERENCE</b>	<b>TITLE</b>
CD-7C050-01	Circuit Packs, MFT—Circuit Description
SD-7C050-01	Circuit Packs, MFT—Schematic Drawing.

The appropriate numerical index section should be consulted to find the current issue of the sections listed and any addendum that may have been issued. The pertinent numerical index for the sections listed here is Section 332-000-000.