J99343SA AND SB
4-4 WIRE TERMINAL/INTERMEDIATE REPEATERS
DESCRIPTION
METALLIC FACILITY TERMINAL

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

1.01 This section provides a physical description and discusses the basic functions of the 4-4 repeaters, J99343SA and SB. The individual units are described in detail; and transmission performance, typical applications, and maintenance philosophy are also discussed.

1.02 This section is reissued to provide a general update of information. Since this is an extensive revision, change arrows have been omitted.

Physical Description

1.03 The Metallic Facility Terminal (MFT) is a standard equipment arrangement for providing various transmission and/or signaling functions that may be required by metallic facilities. The 4-4 wire intermediate/terminal units are MFT plug-ins that consist of a component board held by either a die-cast aluminum or molded polycarbonate frame. The MFT unit measures 1-11/16 inches wide, 7-7/8 inches high, and 9 inches deep.

1.04 These units can be used in either a single- or double-module mounting arrangement. They can be mounted in any slot of a single-module shelf or in the transmission slot of a double-module shelf.

In double-module applications, the repeaters may be used with or without a companion signaling unit. Section 332-910-101 contains additional information on MFT mounting arrangements.

1.05 The 4-4 terminal repeaters are J99343SA, Lists 1, 2, and 3. They provide gain and equalization between loaded or nonloaded 4-wire facilities and 600-ohm terminal equipment. The 4-4 intermediate repeaters are J99343SB, Lists 1, 2, and 3. They provide gain and equalization between loaded or nonloaded 4-wire facilities.

1.06 The J99343SA, Lists 1, 2, and 3 are functionally similar. However, the switch format and the physical layout of the J99343SA, Lists 1 and 2 differ from the List 3; therefore, these units are described separately. The J99343SB, Lists 1, 2, and 3 are also functionally similar. However, the J99343SB, Lists 1 and 2 differ from the List 3 and are therefore described separately. Section 332-912-234 provides installation and testing and touch-up procedures for these units.

2. FUNCTIONAL DESCRIPTION—J99343SA, LISTS 1 AND 2

A. Operation

2.01 The J99343SA, Lists 1 and 2 are shown in Fig. 1. They provide gain between loaded or nonloaded 4-wire facilities and 600-ohm terminal equipment. Equalization is provided in the B-to-A direction of transmission. Figure 2 is a block diagram of these units.

Amplifier Units

2.02 The RU1 amplifier unit provides adjustable gain for the A-to-B direction of transmission. The controls for the amplifier units are designated GAIN ADJ and GN. The range of the amplifier unit gain is approximately −20 dB to +24 dB.

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

Equalizer/Amplifier Units

2.03 The RU2 equalizer/amplifier unit provides adjustable gain and equalization for the B-to-A direction of transmission. The controls for gain and equalization are designated GAIN ADJ, GN, SLOPE, HT, and BW. The range of the amplifier unit gain is approximately −20 dB to +24 dB. Additional gain is provided by the adjustable equalizer. See Caution in paragraph 2.02.

Input and Output Transformers

2.04 Each of the four repeater interfaces has an associated coupling transformer. These transformers provide simplex leads (SX and SX1) for signaling unit access. Facility impedance matching is provided by the OUTPUT switch.

Signaling

2.05 The signaling leads (SX and SX1) are derived through the transformer windings on each side of the repeater. The three basic signaling modes (normal, reverse, and through) are controlled by the NOR RV and NOR RV/T switches.

B. Unit Controls

2.06 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.

GAIN ADJ and GN

2.07 The RU1 and RU2 amplifiers are controlled by a dial-type potentiometer designated GAIN ADJ and three rocker switches designated GN. The GAIN ADJ is calibrated in a range from 0 to 14 dB. Gain is increased by rotating the dial clockwise. The GN switches are labeled −2, −1, and +1. When operated, the −2 switch provides 20 dB of loss, the −1 switch provides 10 dB of loss, and the +1 switch provides 10 dB of gain. The gain setting is the sum of the GAIN ADJ and GN controls. See ***Caution*** in paragraph 2.02.

SLOPE, HT, and BW

2.08 Thirteen rocker switches (designated SLOPE [NL, 1, 2, 4, 8], HT [1, 2, 4, 8], and BW [1, 2, 4, 8)] adjust the equalization in the B-to-A direction of transmission. These switches are located on the RU2 amplifier unit. The sum of the values of the switches operated and the setting of the NL switch determines

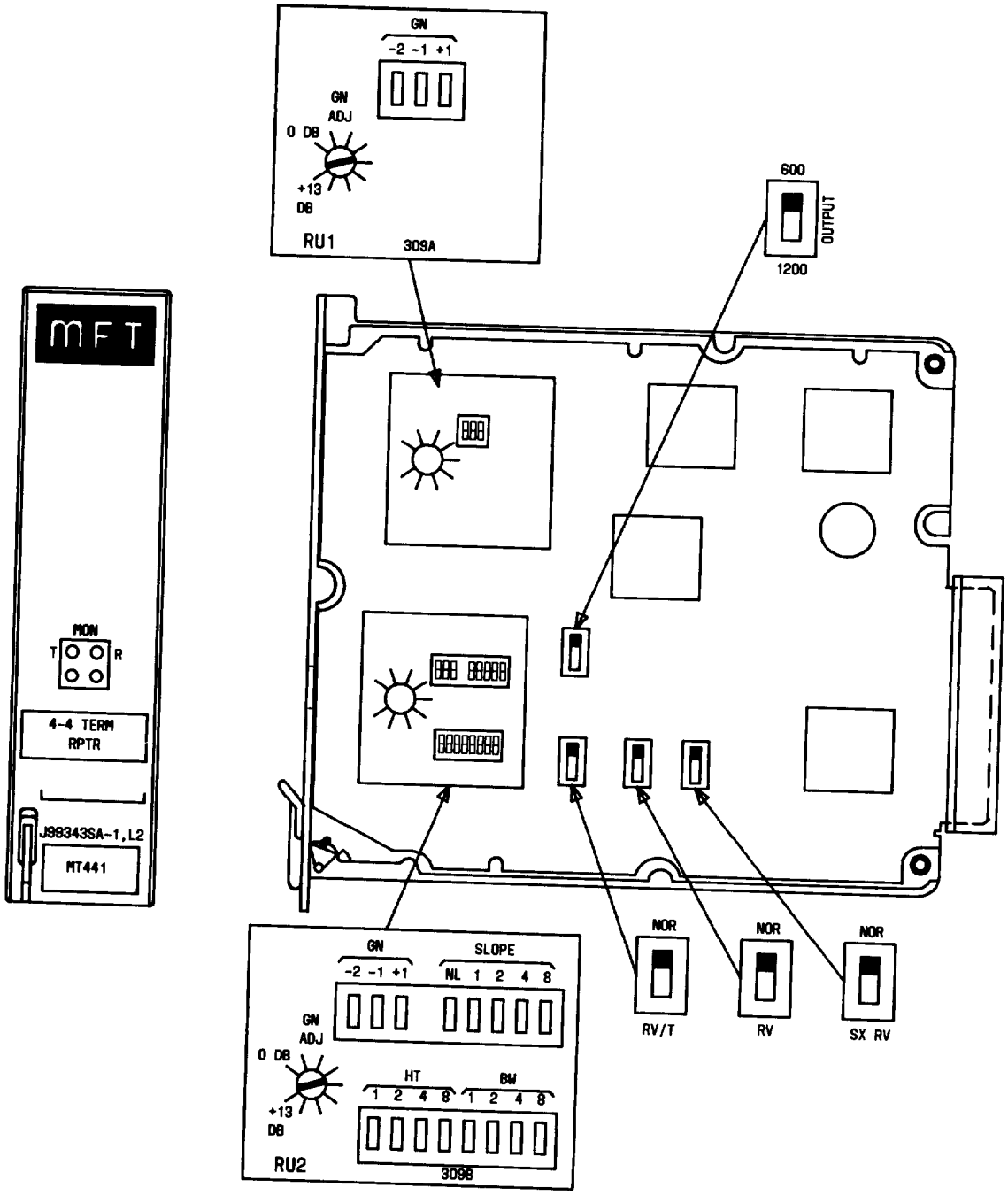
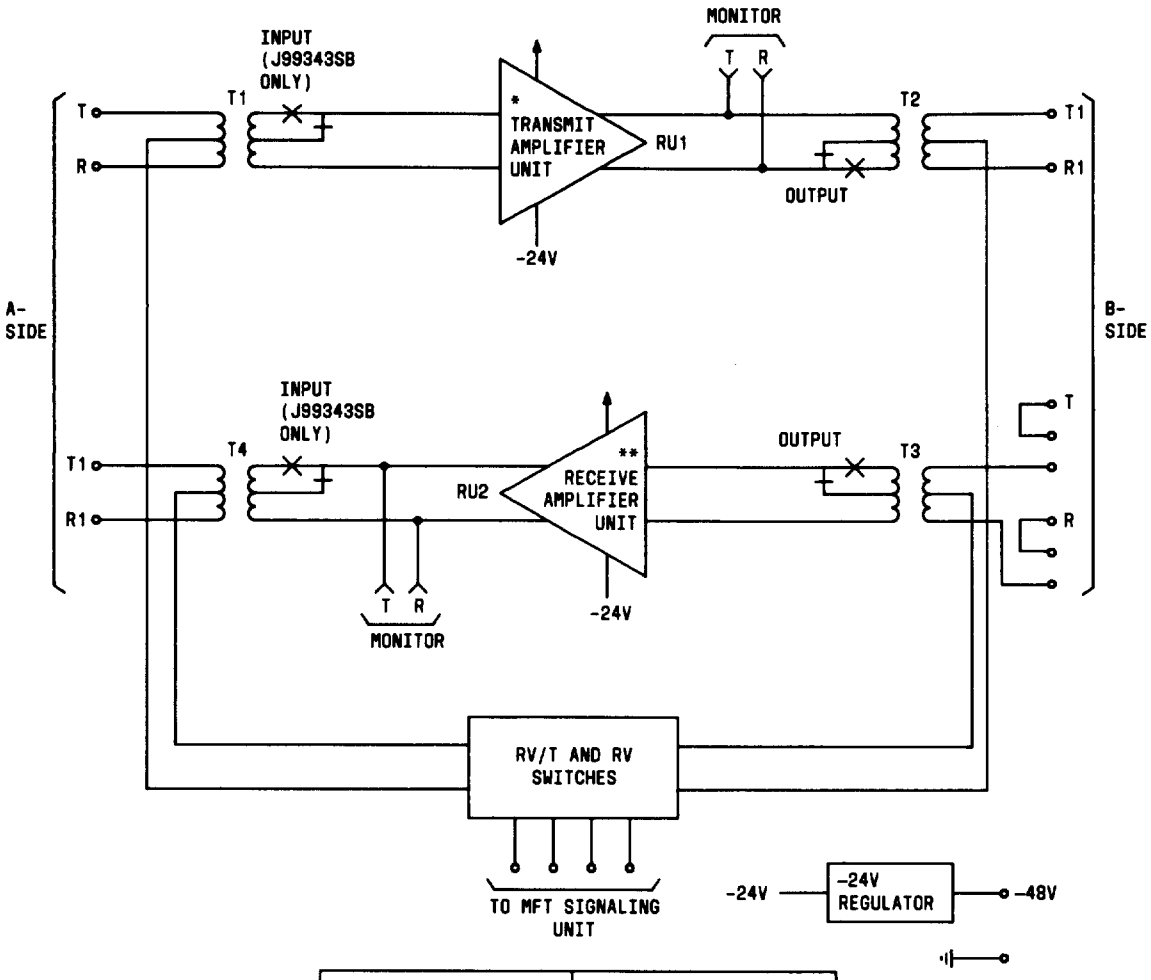


Fig. 1—J99343SA, Lists 1 and 2 (MD) Repeaters Component Layout



	*TRANSMIT AMPLIFIER	**RECEIVE AMPLIFIER
J99343SA	FLAT GAIN ONLY	GAIN AND EQUALIZATION
J99343SB	GAIN AND EQUALIZATION	GAIN AND EQUALIZATION

Fig. 2—Block Diagram of the J99343SA and SB, Lists 1 and 2 Repeaters

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 SLOPE, HT, and BW switches. See ***Caution*** in paragraph 2.02.

NOR·RV and NOR·RV/T

2.09 These switches are used to establish a signaling mode of either normal, reverse, or through. Figure 3 gives the required switch positions to achieve a prescribed mode. These switches only affect the dc signaling path to the signaling unit.

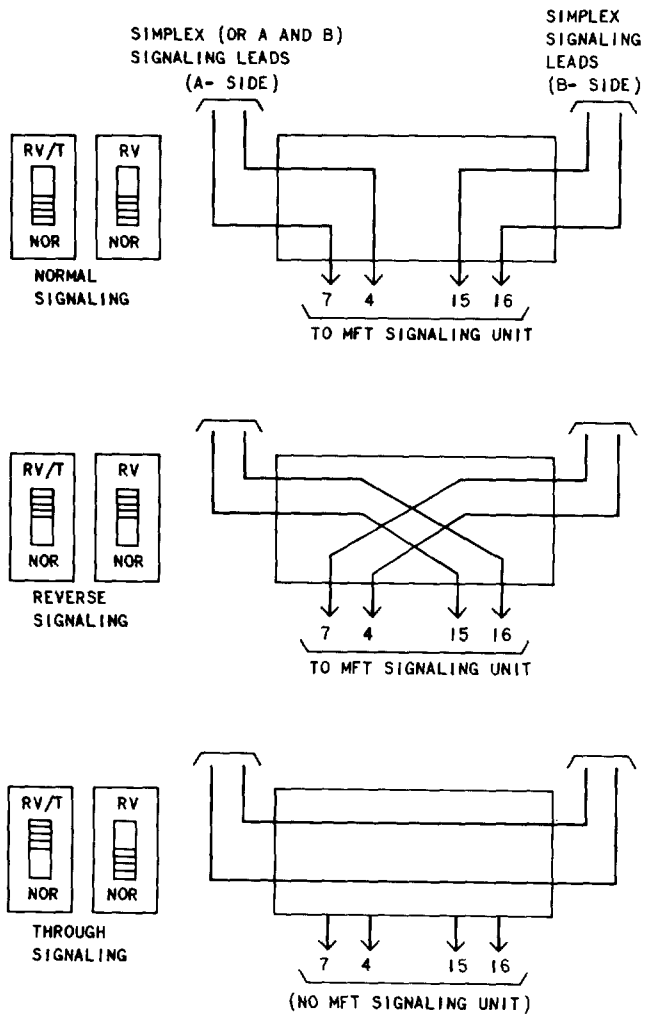
Note: If no companion signaling unit is used, these switches should be set for the through mode.

NOR·SX RV

2.10 This switch is used to reverse the simplex signaling leads (SX and SX1) on the B-side of the repeater.

Output

2.11 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



NOTE:
THESE DIAGRAMS SHOW FUNCTIONALLY THE THREE SIGNALING CONNECTIONS. THE EXACT WIRING CONNECTIONS HAVE BEEN OMITTED FOR CLARITY.

Fig. 3—Signaling Options for the J99343SA and SB Repeaters

impedance option switch is provided only on the B side. The A side is a fixed 600 ohms and interfaces terminal equipment.

3. FUNCTIONAL DESCRIPTION—J99343SA, LIST 3

A. Operation

3.01 The J99343SA, List 3 is shown in Fig. 4. It provides gain between loaded or nonloaded 4-wire facilities and 600-ohm terminal equipment. Equalization is provided in the B-to-A direction of transmission. Figure 5 is a block diagram of this unit.

Amplifier Units

3.02 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.***

Equalizer

3.03 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.

Input and Output Transformers

3.04 Each of the four repeater interfaces has an associated coupling transformer. These transformers provide simplex leads (SX and SX1) for the signaling unit access. Facility impedance matching is provided by the OUTPUT switch.

Signaling

3.05 The signaling leads (SX and SX1) are derived through the transformer windings on each side of the repeater. The three basic signaling modes (normal, reverse, and through) are controlled by the NOR RV and NOR RV/T switches.

B. Unit Controls

3.06 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. 4.

GAIN SW

3.07 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 rocker switches 1, 2, 4, and 8 should not exceed 12.

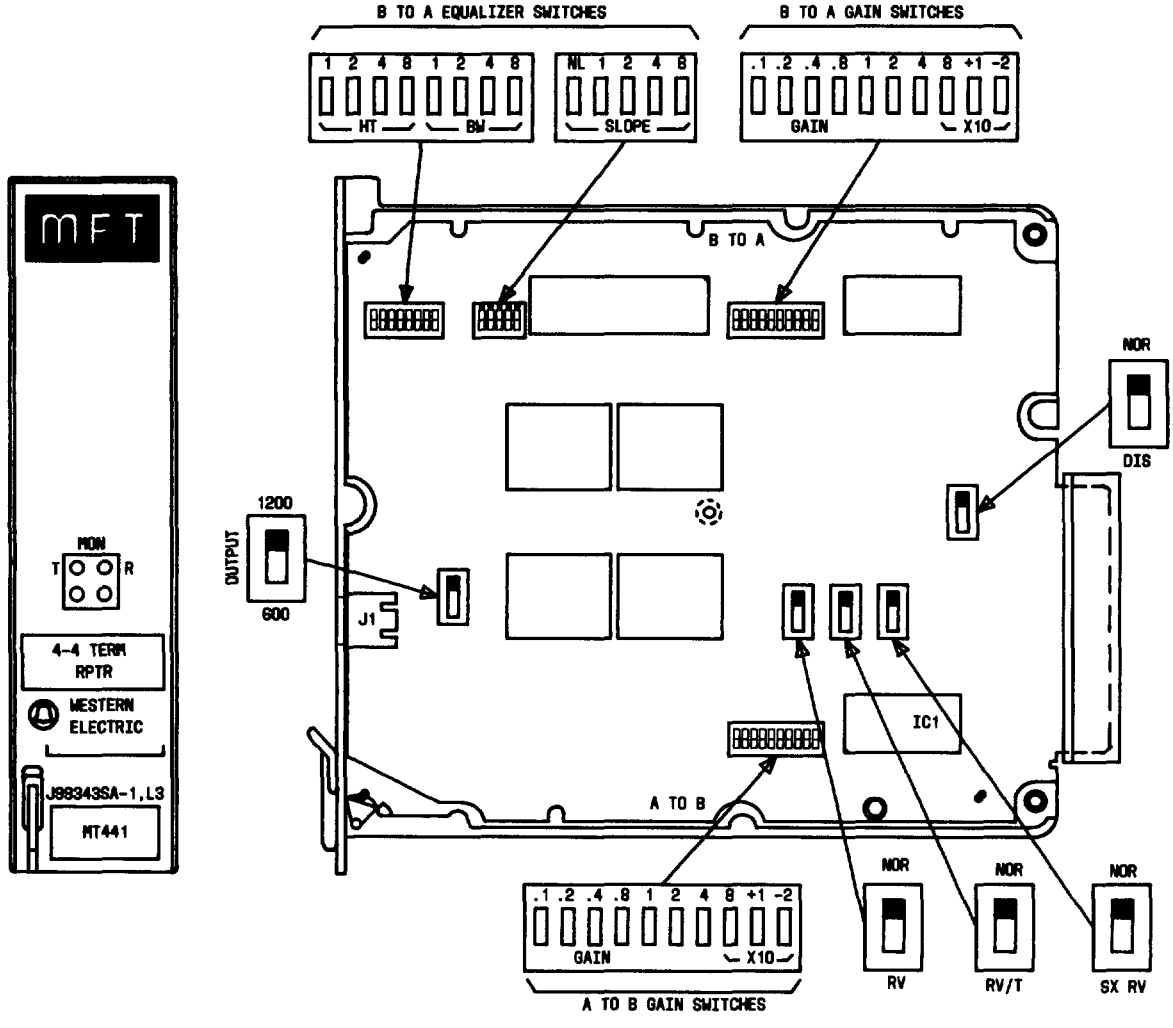


Fig. 4—J99343SA, List 3 Repeater Component Layout

HT, BW, and SLOPE

3.08 Thirteen rocker switches (designated HT [1, 2, 4, 8], BW [1, 2, 4, 8], and SLOPE [NL, 1, 2, 4, 8]) adjust the equalization in the B-to-A direction of transmission. The sum of the values of these switches determines 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.

NOR·RV and NOR·RV/T

3.09 These switches are used to establish a signaling mode of either normal, reverse, or through. Figure 3 gives the required switch positions to achieve a prescribed mode. These switches only affect the dc signaling path to the signaling unit.

> ***Note:*** If no companion signaling unit is used, these switches should be set for the through mode.

NOR·SX RV

3.10 This switch is used to reverse the simplex signaling leads (SX and SX1) on the B-side of the repeater.

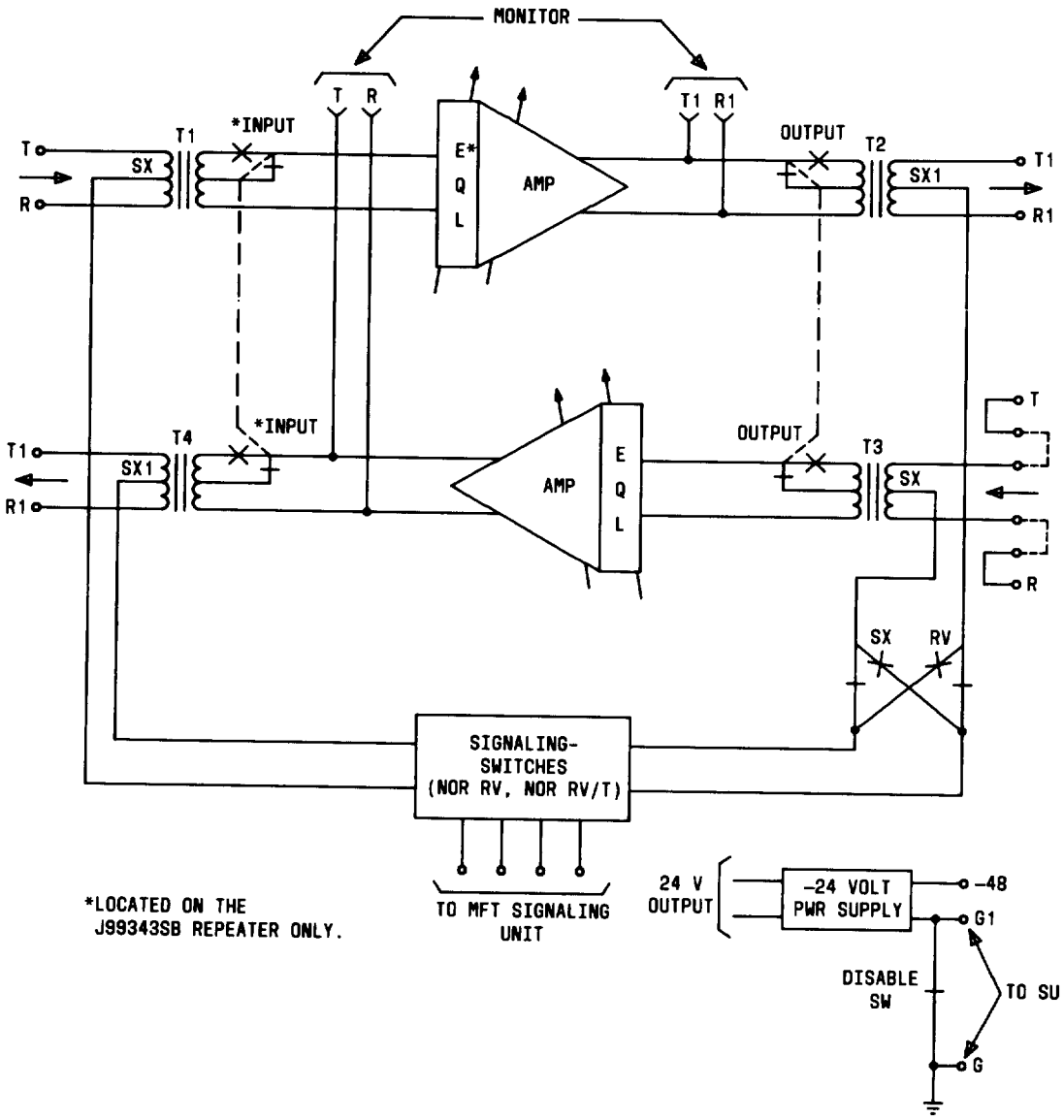


Fig. 5—Block Diagram of the J99343SA and SB, List 3 Repeaters

NOR-DIS

3.11 This switch permits any companion signaling unit having the disable function to control the power to the repeater. In the DIS position, the power input to the repeater is removed during the idle circuit condition. In the NOR position, the power is continuous.

Note: If no companion signaling unit is used or if the signaling unit does not have the disabling function, the switch must be in the NOR position.

OUTPUT

3.12 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.

4. FUNCTIONAL DESCRIPTION—J99343SB, LISTS 1 AND 2

A. Operation

4.01 The J99343SB, Lists 1 and 6. They provide intermediate gain and equalization between loaded or nonloaded 4-wire facilities. Figure 2 is a block diagram of these units.

Equalizer/Amplifier Units

4.02 The RU1 and RU2 equalizer/amplifier units provide adjustable gain and equalization in these repeaters. RU1 provides gain and equalization in the A-to-B direction of transmission, and RU2 provides gain and equalization in the B-to-A direction. The controls for gain and equalization are designated

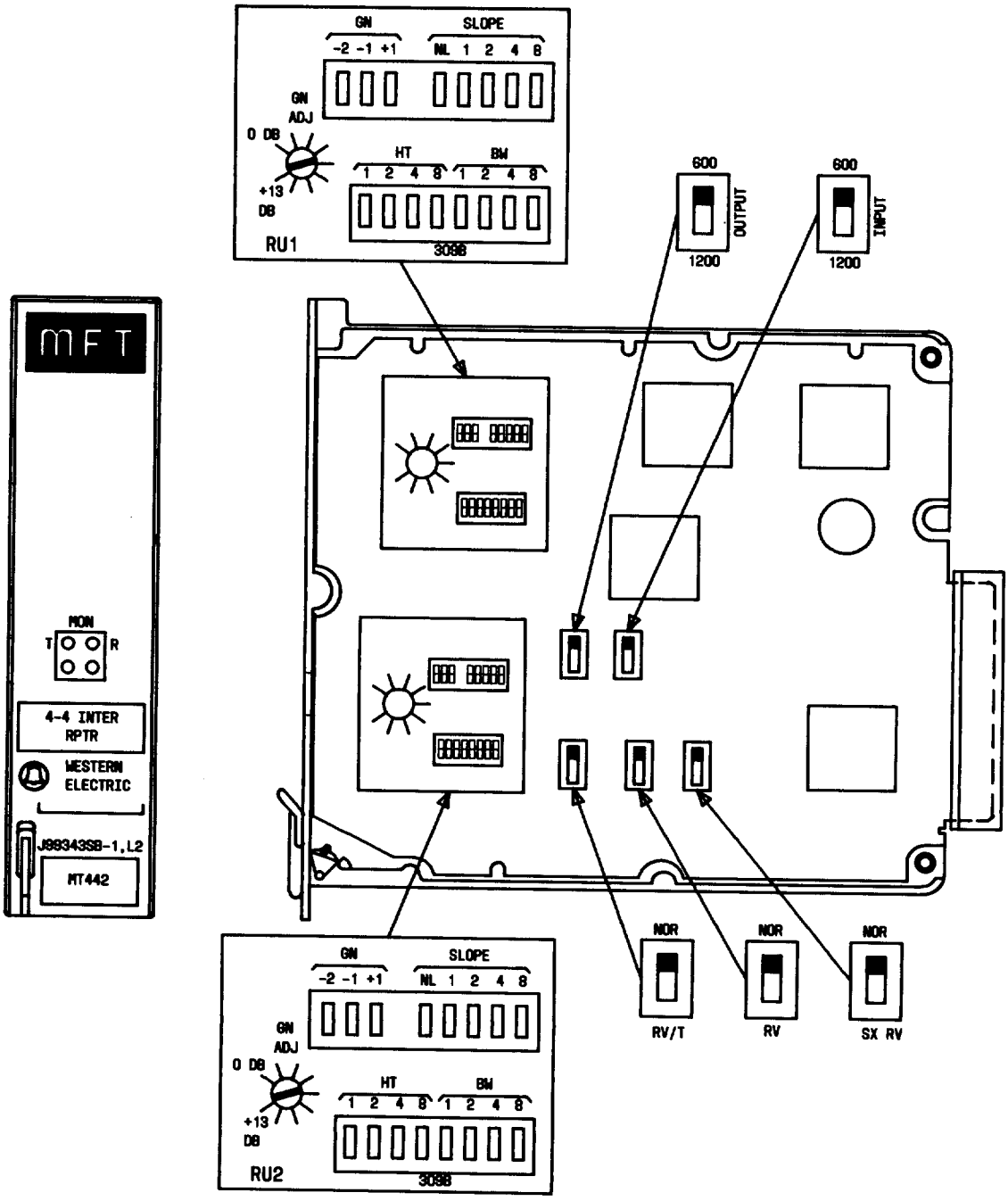


Fig. 6—J99343SB, Lists 1 and 2 Repeaters (MD) Component Layout

GAIN ADJ, GN, SLOPE, HT, and BW. The range of the amplifier unit gain is approximately −20 dB to +24 dB. Additional gain is provided by the adjustable equalizer.

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

Input and Output Transformers

4.03 Each of the four repeater interfaces has an associated coupling transformer. These transformers provide simplex leads (SX and SX1) for the signaling unit access. Facility impedance matching is provided by the INPUT and OUTPUT switches.

Signaling

4.04 The signaling leads (SX and SX1) are derived through the transformer windings on each side of the repeater. The three basic signaling modes (normal, reverse, and through) are controlled by the NOR RV and NOR RV/T switches.

B. Unit Controls

4.05 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.

GAIN ADJ and GN

4.06 The RU1 and RU2 amplifiers are controlled by a dial-type potentiometer designated GAIN ADJ and three rocker switches designated GN. The GAIN ADJ is calibrated in a range from 0 to 14 dB. Gain is increased by rotating the dial clockwise. The GN switches are labeled −2, −1, and +1. When operated, the −2 switch provides 20 dB of loss, the −1 switch provides 10 dB of loss, and the +1 switch provides 10 dB of gain. The gain setting is the sum of the GAIN ADJ and GN controls. See ***Caution*** in paragraph 4.02.

SLOPE, HT, and BW

4.07 Thirteen rocker switches (designated SLOPE [NL, 1, 2, 4, 8], HT [1, 2, 4, 8], and BW [1, 2, 4, 8]) adjust the equalization. The group of switches on the RU1 amplifier adjusts the equalization in the A-to-B direction of transmission, and the group of switches on the RU2 amplifier adjusts the equalization in the B-to-A direction of transmission. The sum of the values 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 SLOPE, HT, and BW switches. See ***Caution*** in paragraph 4.02.

NOR·RV and NOR·RV/T

4.08 These switches are used to establish a signaling mode of either normal, reverse, or through. Figure 3 gives the required switch positions to achieve a prescribed mode. These switches only affect the dc signaling path to the signaling unit.

Note: If no companion signaling unit is used, these switches should be set for the through mode.

NOR·SX RV

4.09 This switch is used to reverse the simplex signaling leads (SX and SX1) on the B-side of the repeater.

INPUT/OUTPUT

4.10 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 the 600 ohms for nonloaded cable. The impedance option switches are provided on the A-side (INPUT) and the B-side (OUTPUT).

5. FUNCTIONAL DESCRIPTION—J99343SB, List 3

A. Operation

5.01 The J99343SB, List 3 is shown in Fig. 7. It provides intermediate gain and equalization between loaded or nonloaded 4-wire facilities. Figure 5 is a block diagram of the unit.

Amplifier Units

5.02 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.

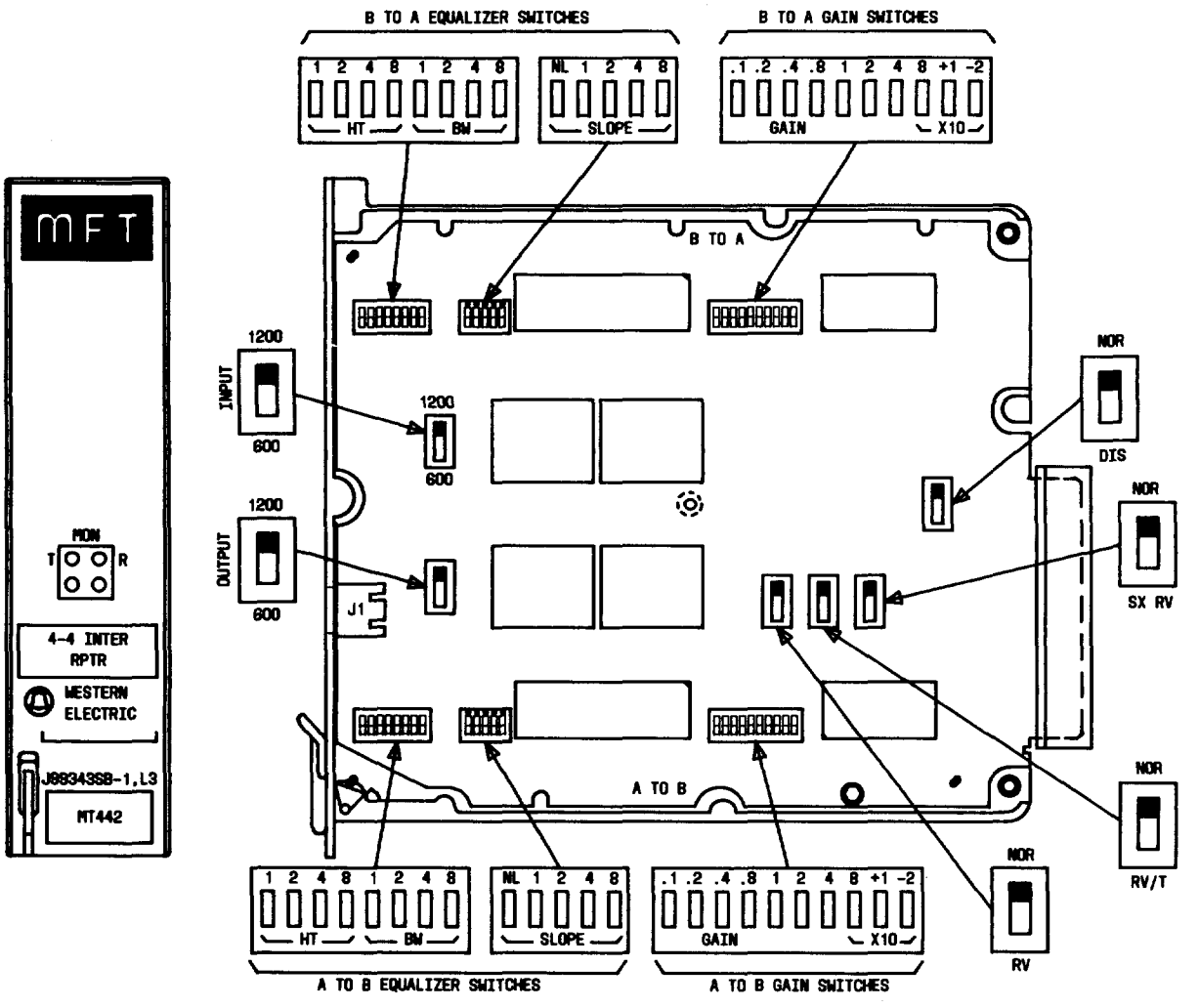


Fig. 7—J99343SB, List 3 Repeater Component Layout

Equalizer

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

Input and Output Transformers

5.04 Each of the four repeater interfaces has an associated coupling transformer. These transformers provide simplex leads (SX and SX1) for the signaling unit access. Facility impedance matching is provided by the INPUT and OUTPUT switches.

Signaling

5.05 The signaling leads (SX and SX1) are derived through the transformer windings on each side of the repeater. The three basic signaling modes (normal, reverse, and through) are controlled by the NOR RV and NOR RV/T switches.

B. Unit Controls

5.06 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. 7.

GAIN SW

5.07 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 5.02.

> ***Note:*** The sum of rocker switches 1, 2, 4, and 8 should not exceed 12.

HT, BW, and SLOPE

5.08 Thirteen rocker switches (designated HT [1, 2, 4, 8], BW [1, 2, 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 5.02.

NOR·RV and NOR·RV/T

5.09 These switches are used to establish a signaling mode of either normal, reverse, or through. Figure 3 gives the required switch positions to achieve a prescribed mode. These switches only affect the dc signaling path to the signaling unit.

> ***Note:*** If no companion signaling unit is used, these switches should be set for the through mode.

NOR·SX RV

5.10 This switch is used to reverse the simplex signaling leads (SX and SX1) on the B-side of the repeater.

NOR·DIS

5.11 This switch permits any companion signaling unit having the disable function to control the power to the repeater. In the DIS position, the power input to the repeater is removed during the idle circuit condition. In the NOR position, the power is continuous.

> ***Note:*** If no companion signaling unit is used or if the signaling unit does not have the disabling function, the switch must be in the NOR position.

INPUT/OUTPUT

5.12 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 the 600 ohms for nonloaded cable. The impedance option switches are provided on the A-side (INPUT) and the B-side (OUTPUT).

6. PERFORMANCE CHARACTERISTICS

6.01 The performance of the J99343SA and SB repeaters is discussed in the following paragraphs. Table A gives a comparison of characteristics for all versions of the J99343SA and SB repeaters.

A. Amplifier/Equalizer Frequency Response

6.02 Figures 8 through 11 give the frequency response of the gain and equalizer units. Figure 8 gives the response curves for various SLOPE settings with the NL switch set to interface nonloaded cable (switch toward NL). Figure 9 provides response curves for the same SLOPE settings with the NL switch set to interface loaded cable (switch away from NL). Figure 10 gives the response curves for various HT settings with the BW switch at a small setting. Figure 11 gives the response curves for the same HT settings with the BW switch at a large setting.

B. Envelope Delay Distortion

6.03 Figures 12 through 16 give the envelope delay distortion (EDD). Figure 12 shows the EDD for the repeaters with the equalizer disabled. Figure 13 shows the EDD for various SLOPE settings with the NL switch set to interface nonloaded cable (switch toward NL). Figure 14 shows the EDD for the same SLOPE settings with the NL switch set to interface loaded cable (switch away from NL). Figure 15 shows the EDD for various HT settings with the BW switch at a small setting. Figure 16 provides the EDD for the same HT settings with the BW switch at a large setting.

C. Longitudinal Balance

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

TABLE A

UNIT CHARACTERISTICS

FUNCTION	J99343SA		J99343SB	
Gain	—20 dB to +23.5 dB		—20 dB to +23.5 dB	
Equalizer Gain*	0 dB to +15.3 dB		0 dB to +15.3 dB	
A-Side Impedance B-Side Impedance	600 Ohms 600/1200 Ohms		600/1200 Ohms 600/1200 Ohms	
DC Resistance (Ohms) Normal/Reverse Mode Through Mode	17 34		17 34	
Current Drain (MA) Disabled	Lists 1 and 2	List 3	Lists 1 and 2	List 3
No Signal	25	29	25	34
Typical	30 to 35	30 to 35	30 to 35	35 to 40
Maximum	50	60	50	65

*Equalizer gain measured at 1-kHz gain will vary with equalizer setting.

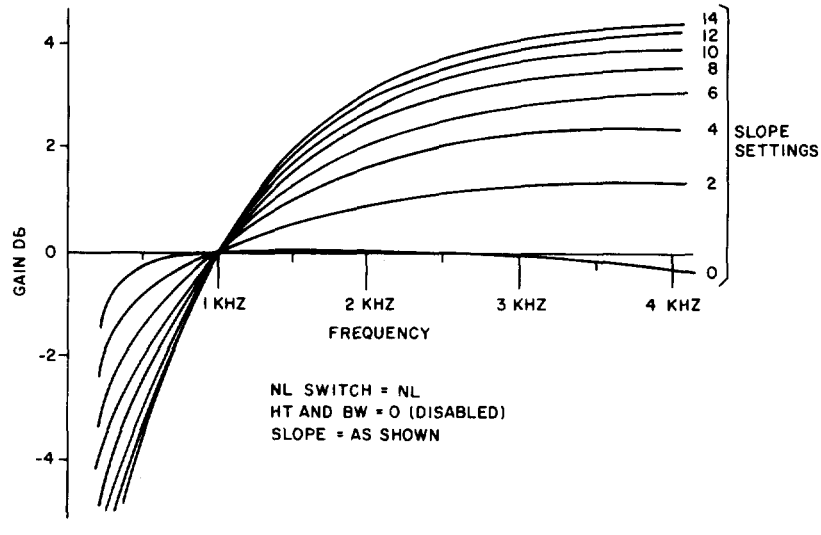


Fig. 8—Amplifier/Equalizer Frequency Response, NL Switch = NL, Slope = Variable

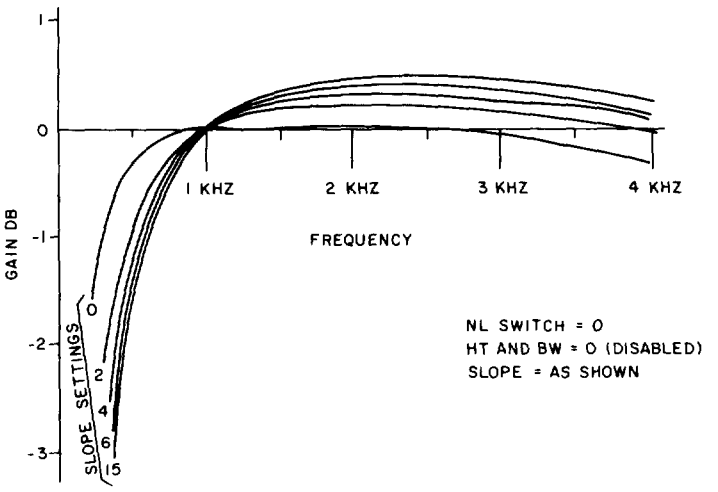


Fig. 9—Amplifier/Equalizer Frequency Response, NL Switch = O, Slope = Variable

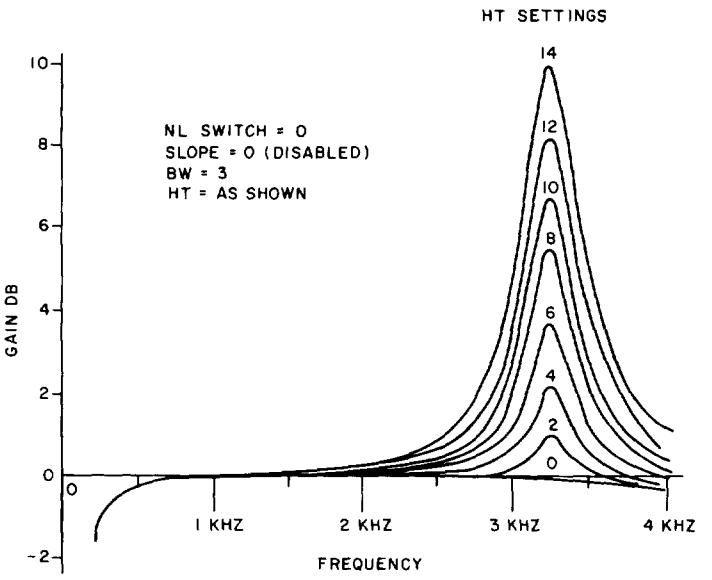


Fig. 10—Amplifier/Equalizer Frequency Response, BW = Small Setting, HT = Variable

D. Output Power Capability

6.05 Figure 17 shows the output power capability of the J99343SA, SB repeaters. 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.

7. APPLICATIONS

7.01 The J99343SA unit may be used to provide gain on any 4-wire metallic circuit as a terminal repeater. The J99343SB unit may be used to provide gain on any 4-wire metallic circuit as an intermediate repeater. Figure 18 shows typical applications using the units in a foreign exchange (FX)

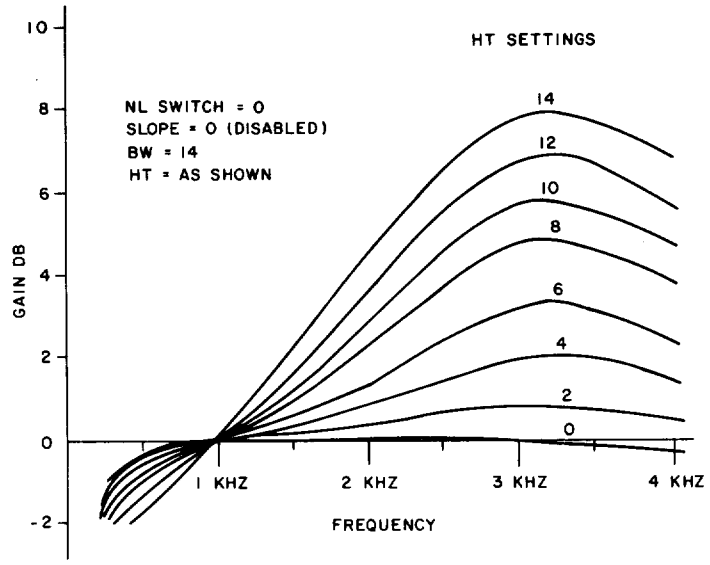


Fig. 11—Amplifier/Equalizer Frequency Response, BW = Large Setting, HT = Variable

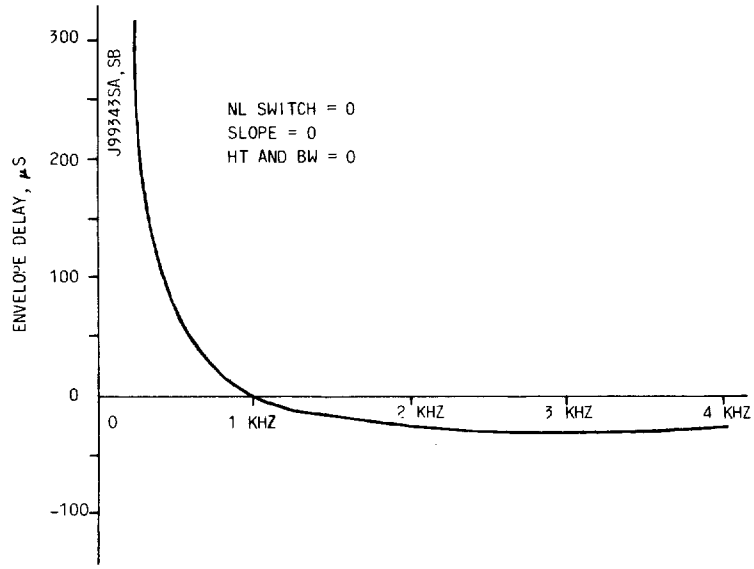


Fig. 12— Envelope Delay Distortion of J99343SA and SB Repeaters, Equalizer Disabled

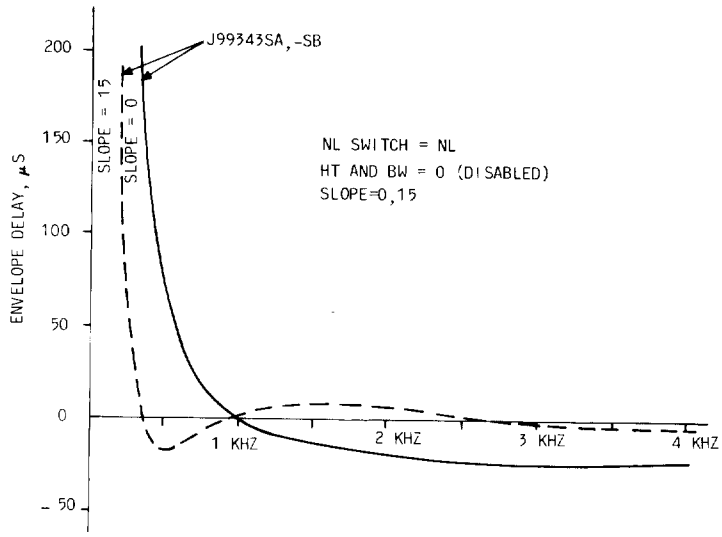


Fig. 13—Envelope Delay Distortion of J99343SA and SB Repeaters, NL Switch = NL, Slope = Variable

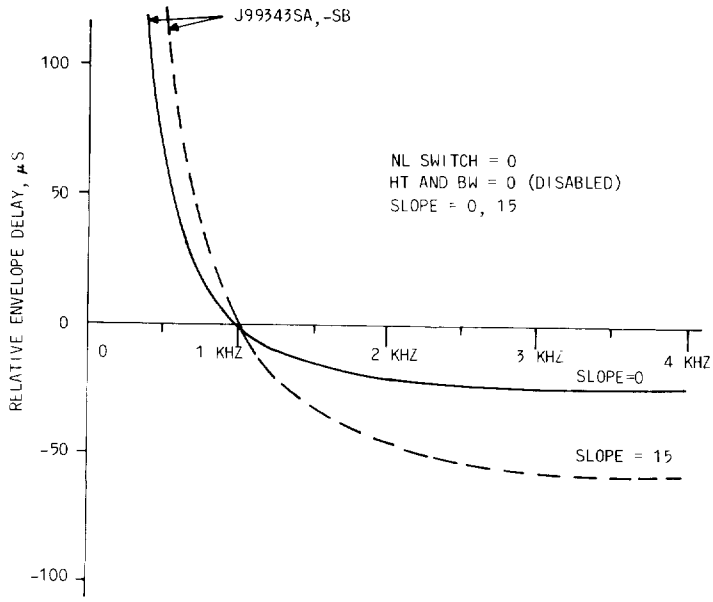


Fig. 14—Envelope Delay Distortion of J99343SA and SB Repeaters, NL Switch = 0, Slope = Variable

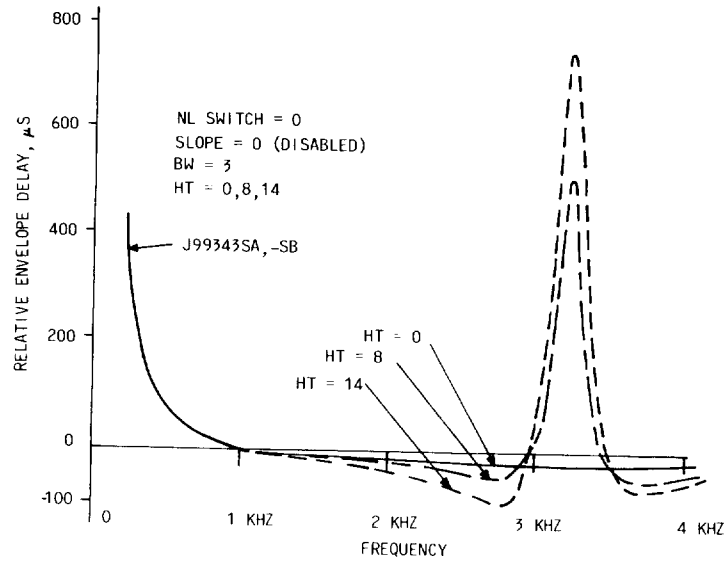


Fig. 15—Envelope Delay Distortion of J99343SA and SB Repeaters, BW = Small Setting, HT = Variable

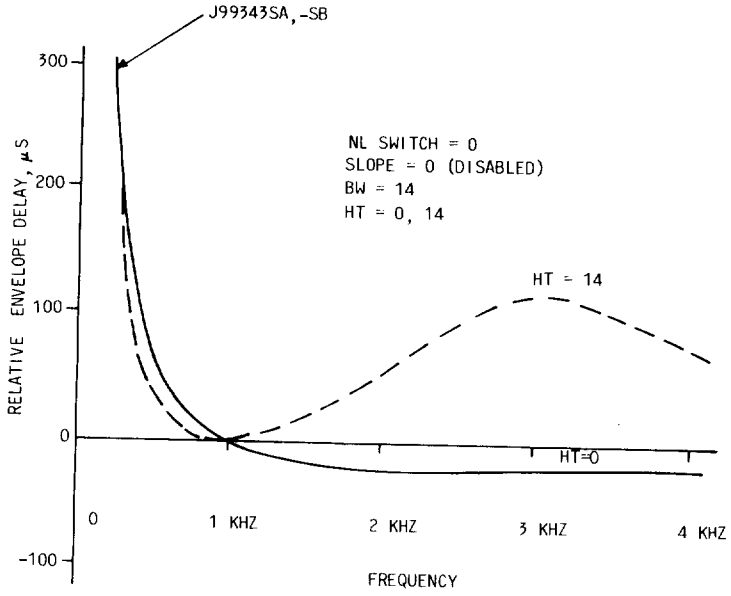


Fig. 16—Envelope Delay Distortion of J99343SA and SB Repeaters, BW =Large Setting, HT = Variable

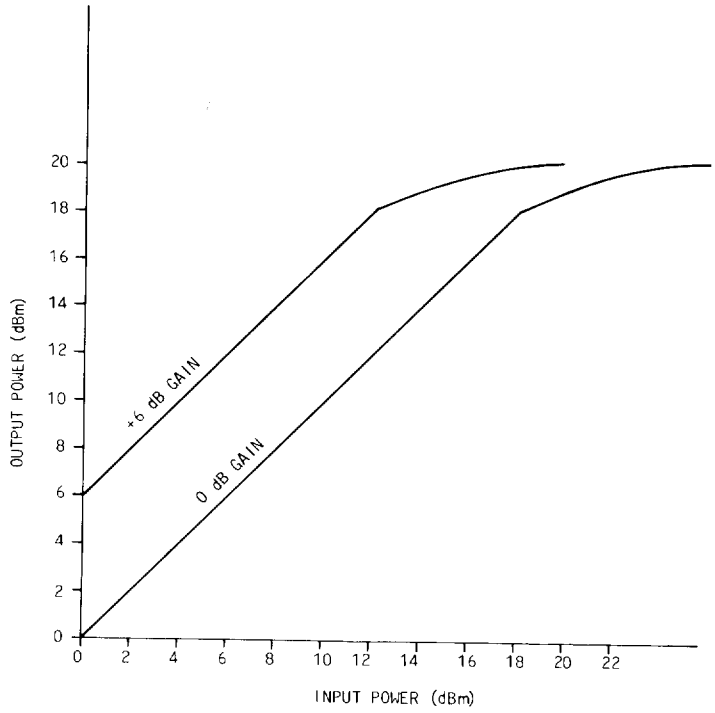


Fig. 17—Output Power Capability of J99343SA and SB Repeaters

trunk. These units also can be used on off-premises station (OPS) lines, wide area telephone service (WATS) trunks and lines, and other metallic facility special service applications. Section 332-910-180 provides additional information.

8. MAINTENANCE

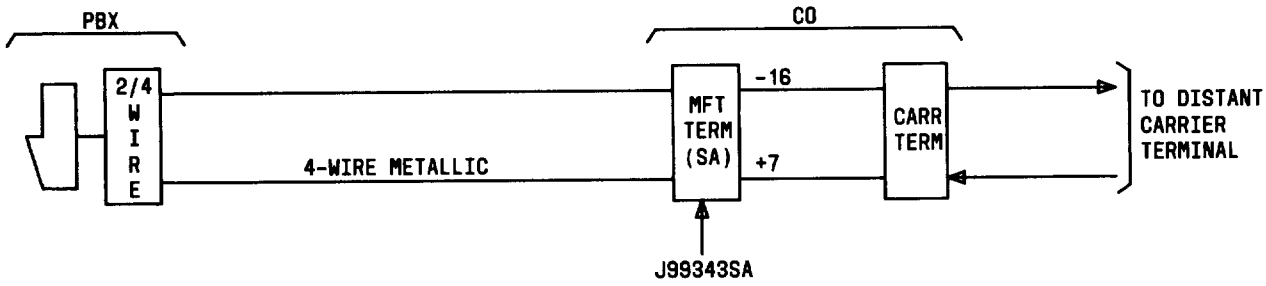
8.01 The MFT repeaters require no routine maintenance. If the repeater is determined to be faulty, it should be removed from service and replaced with a spare. The defective unit should be sent to the nearest Western Electric Service Center for repair.

9. REFERENCES

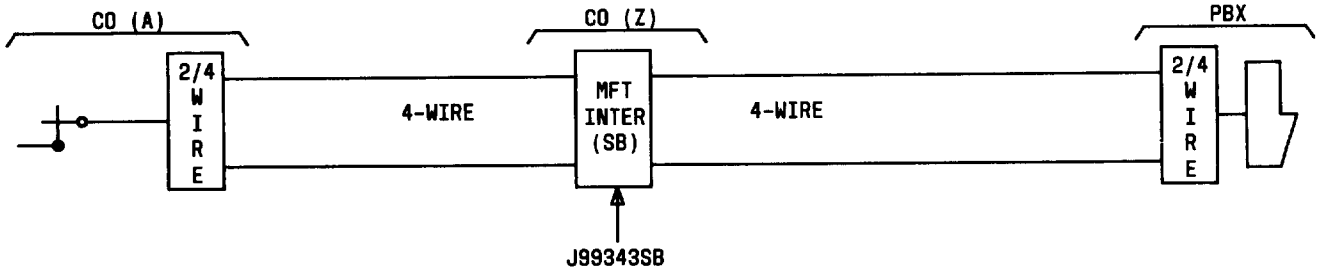
9.01 The following references provide additional information concerning 4-4 wire repeaters.

REFERENCE	TITLE
332-910-100	MFT—General Description
332-910-101	MFT—Shelf, Frame, Power Panel, and Distributing Frame Arrangements, Description
332-910-180	MFT—General Applications Information
332-912-232	J99343SA, SB—Prescription Settings
332-912-234	J99343SA, SB—Installation and Testing
CD-1C359-01	Common Systems, MFT—Circuit Description
SD-1C359-01	Common Systems, 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.



J99343SA TERMINAL REPEATER



J99343SB INTERMEDIATE REPEATER

Fig. 18—Typical Applications of J99343SA and SB Repeaters