359B EQUALIZER

DESCRIPTION

1. GENERAL

1.01 This section describes the 359B equalizer, which is a plug-in apparatus unit designed for use in V4 telephone repeater applications. The 359B equalizer supplies amplitude equalization required to correct for the frequency-attenuation characteristic of long lengths of nonloaded cable.

1.02 This section is reissued to add Part 4, Application, which includes metropolitan area trunk (MAT) cable. Arrows normally used to indicate changes have been omitted.

1.03 Voiceband data systems have more stringent equalization requirements than voiceband message systems and should use the 359M equalizer instead of the 359B equalizer. See Section 332-116-112 for a description of the 359M equalizer.

1.04 The 359B equalizer consists of two 600:150-ohm transformers, one for each transmitting and receiving side, with the low-impedance side facing the cable. Equalization results from the variations (with frequency) of the impedance mismatch between the equalizer and the cable in the transmitted frequency range. The 1000-Hz power loss of each transformer is 0.5 dB.

2. EQUIPMENT DESCRIPTION

2.01 The 359B equalizer (Fig. 1) is a plug-in unit equipped with a 20-pin connector plug and is designed to be plugged directly into the equalizer connector socket of the repeater mounting shelf.
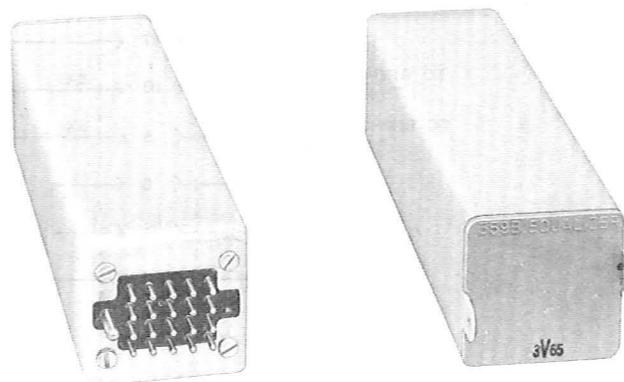
Fig. 1—359B Equalizer

2.02 The 359B equalizer consists of two transformers mounted on a printed wiring board and housed in a metal can approximately 1-3/4 inches wide by 1-3/4 inches high by 7 inches long. Tabs on the front of the can permit removal of the equalizer from the repeater mounting shelf by the use of a 602C or a 602D extraction tool.

3. CIRCUIT DESCRIPTION

3.01 Figure 2 is a schematic showing typical circuit connections when the 359B equalizer is plugged into the equalizer socket of a 24V4 or 44V4 repeater. The transmitting side of the 359B equalizer is connected to the AMPL OUT and MON jacks. A 2543K 600:150-ohm transformer T1 connects the 600-ohm transmitting amplifier circuit output to the nonloaded 4-wire line. The centertap of transformer T1 on the 150-ohm side is brought out to terminal 10 to derive a simplex leg of the transmitting cable pair.
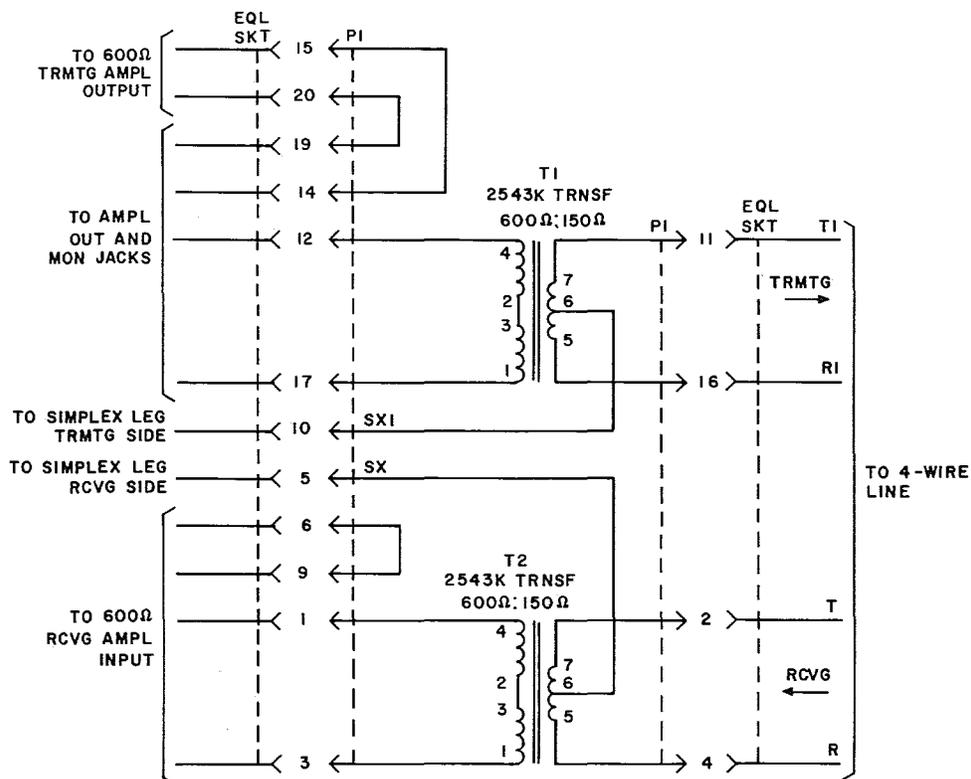
Fig. 2—359B Equalizer—Schematic and Typical Circuit Connections

3.02 The receiving side also contains a 2543K 600:150-ohm transformer T2 which connects the nonloaded cable to the 600-ohm amplifier input circuit. The centertap of transformer T2 on the 150-ohm side is brought out to terminal 5 to derive a simplex leg of the receiving cable pair. The strap between terminals 6 and 9 in the equalizer provides the required circuit continuity in the associated receiving amplifier to give an amplifier input impedance of 600 ohms.

3.03 Equalization of long lengths of nonloaded cable is accomplished by working the cable between the 150-ohm windings of the equalizer transformers. The best impedance matches between cable and repeater circuits occur at high frequencies where the cable attenuation is greatest. As frequency is reduced with consequent decrease in attenuation, the cable impedance increases and produces increasing mismatches of impedances. These mismatches produce losses which tend to offset the reduced cable attenuation and thus cause a more nearly uniform overall loss throughout the transmitted band.

3.04 Cable transducer losses for the various gauges of nonloaded cable terminated in the standard impedances are given in Section 304-305-100, Charts 1 through 5.

3.05 Typical loss-frequency and delay-frequency characteristics of each transformer in the 359B equalizer as measured between nominal impedances of 150 and 600 ohms are given in Table A.

4. APPLICATION

4.01 The 359B equalizer is used to equalize long lengths of nonloaded 19, 22, 24, 25 MAT, and 26 gauge cable. The equalizer may be used:

(a) At one end of a facility only

(b) At both ends of a facility

(c) At one end of a facility with a 359F equalizer at the other end.

TABLE A

LOSS-FREQUENCY AND DELAY-FREQUENCY
CHARACTERISTICS OF 359B EQUALIZER

FREQ, Hz	LOSS, DB RELATIVE TO 1000 Hz	DELAY, MICROSECONDS
100	1.2	538
200	0.6	250
300	0.4	100
400	0.3	55
500	0.2	36
700	0.1	19
1000	0	11
2000	0	4
3000	0	3

4.02 The recommended applications for the 359B equalizer are given in Table B. The equalizer selection is based on cable gauge, length, and desired equalization. The cable lengths specified in Table B are expressed in kilofeet (kft), miles (MI), and approximate attenuation (dB).

4.03 The cable lengths given in Table B may be equalized with only one 359B, assuming the other end is terminated in 600- or 150-ohm equipment as shown at the top of columns 2, 3, and 4. Slightly better equalization will be accomplished with equalizers on both ends of the cable.

TABLE B

359B EQUALIZER APPLICATION CHART

NONLOADED CABLE TYPE	COLUMN 1 (NOTE 2) EQUALIZER LOSS (dB) REFLECTION LOSS (dB)		COLUMN 2 (NOTES 1, 4) 359B EQUALIZER ONE END WITH 359F EQUALIZER OR 600-OHM EQUIPMENT AT OTHER END		COLUMN 3 (NOTES 1, 4) 359B EQUALIZER EACH END OR 359B AT ONE END AND 150-OHM EQUIPMENT AT OTHER END		COLUMN 4 (NOTES 1, 4) 359B EQUALIZER EACH END OR 359B AT ONE END AND 150-OHM EQUIPMENT AT OTHER END	
	359B	359F	FROM	TO	FROM	TO	FROM	TO
All 19 gauge low capacitance	EQL 0.5 REFL 1.8	EQL 0.5 REFL 0.0	10.1 kft 1.9 MI 2.1 dB	20.0 kft 3.8 MI 4.3 dB	20.1 kft 3.8 MI 4.3 dB	31.0 kft 5.9 MI 6.6 dB	31.1 kft 5.9 MI 6.6 dB	45.0 kft 8.5 MI 9.0 dB
All 19 gauge high capacitance	EQL 0.5 REFL 1.8	EQL 0.5 REFL 0.1	8.1 kft 1.5 MI 1.9 dB	16.0 kft 3.0 MI 3.8 dB	16.1 kft 3.0 MI 3.8 dB	25.0 kft 4.7 MI 6.0 dB	25.1 kft 4.7 MI 6.0 dB	36.0 kft 6.8 MI 8.6 dB
All 22 gauge	EQL 0.5 REFL 1.8	EQL 0.5 REFL 0.0	8.1 kft 1.5 MI 2.7 dB	14.0 kft 2.7 MI 4.8 dB	14.1 kft 2.7 MI 4.8 dB	20.0 kft 3.8 MI 6.9 dB	20.1 kft 3.8 MI 6.9 dB	28.0 kft 5.3 MI 9.6 dB
All 24 gauge	EQL 0.5 REFL 2.5	EQL 0.5 REFL 0.0	7.6 kft 1.4 MI 3.2 dB	12.0 kft 2.3 MI 5.3 dB	12.1 kft 2.3 MI 5.3 dB	17.0 kft 3.2 MI 7.4 dB	17.1 kft 3.2 MI 7.4 dB	22.0 kft 4.2 MI 9.7 dB
All 25 gauge (MAT)	EQL 0.5 REFL 3.2	EQL 0.5 REFL 0.0	8.1 kft 1.5 MI 3.5 dB	12.5 kft 2.4 MI 4.4 dB	12.6 kft 2.4 MI 5.4 dB	17.0 kft 3.2 MI 7.3 dB	17.1 kft 3.2 MI 7.3 dB	24.0 kft 4.5 MI 10.3 dB
All 26 gauge	EQL 0.5 REFL 3.4	EQL 0.5 REFL 0.0	7.1 kft 1.3 MI 3.7 dB	10.0 kft 1.9 MI 5.4 dB	10.1 kft 1.9 MI 5.4 dB	14.0 kft 2.7 MI 7.7 dB	14.1 kft 2.7 MI 7.7 dB	19.0 kft 3.6 MI 10.2 dB
Mixed gauge nonloaded (Note 3)	EQL 0.5 REFL 2.7	EQL 0.5 REFL 0.0	3.4 dB	5.3 dB	5.4 dB	8.0 dB	8.1 dB	10.5 dB
Equalized deviation			0.5 dB short to 1.0 dB long — 1 kHz to 3 kHz		1.0 dB long at 3 kHz		1.0 to 3.0 dB long at 3 kHz	

Note 1: In computing the length of the facility, include the length of all bridged taps. The gauge of the taps is immaterial.

Note 2: When 359B or 359F equalizers are used at both ends of a facility, coil and reflection loss should be considered for each end (column 1).

Note 3: To find the loss for mixed gauge cable, add the 1000-Hz attenuation of all facilities present, making no adjustment for reflection loss but including the attenuation of bridged taps as if they were in tandem with the other facilities.

Note 4: The use of an equalizer at one end only assumes an approximate impedance match at the other end. Slightly better equalization is accomplished by using equalizers at both ends of the facility.