

359M EQUALIZER DESCRIPTION

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1. GENERAL

1.01 This section describes the 359M equalizer, which is a plug-in unit designed for use in V4 telephone repeater applications.

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 The 359M equalizer is intended primarily for use in voiceband data transmission systems. It is similar to the 359B equalizer but is equipped with transformers which have less envelope delay distortion, flatter low-frequency response, improved longitudinal balance, and an electrostatic shield between the windings. The 359M equalizer supplies attenuation equalization required to correct for the frequency-attenuation characteristic of long lengths of nonloaded cable over the frequency range of 200 to 3000 Hz.

1.04 The 359M equalizer consists of two 600:150-ohm transformers, one for the transmitting and one for the receiving side of the 4-wire circuit, with the 150-ohm windings facing the cable. Equalization results from variation (with frequency) of the impedance mismatch between the equalizer and the cable in the transmitted frequency range. The transformers are centertapped on the 150-ohm cable side to derive SX and SX1 leads. Centertaps

are also available on the 600-ohm side, on an optional basis, under control of screw-type switches on the faceplate. This arrangement allows use of the equalizer transformers as repeating coils in other than V4 repeater applications. The 1000-Hz power loss of each transformer is 0.3 dB.

2. EQUIPMENT DESCRIPTION

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

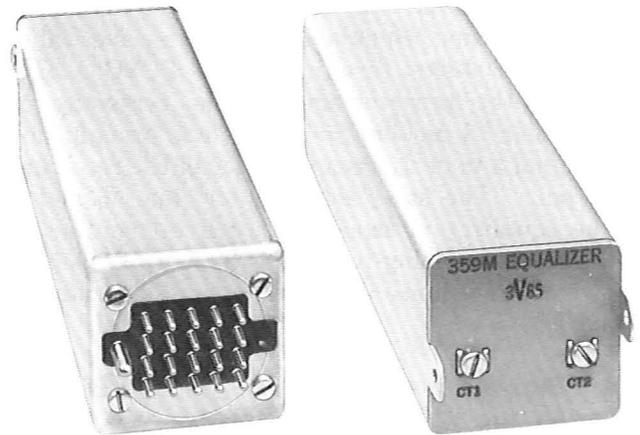


Fig. 1—359M Equalizer

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

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2.03 Two screw-type switches, CT1 and CT2, are mounted on the equalizer faceplate. These switches, when turned down, extend the centertaps of the 600-ohm windings of T1 and T2 to pins 18 and 7 on the connector plug.

3. CIRCUIT DESCRIPTION

3.01 Figure 2 is a schematic illustrating typical circuit connections when the 359M equalizer is plugged into the equalizer socket of a 24V4 or 44V4 repeater. The transmitting side of the 359M equalizer is wired to provide connections to the AMPL OUT and MON jacks. The 2578M 600:150-ohm transformer T2 couples the 600-ohm terminals of the TRMTG AMPL socket of the repeater shelf to the transmit cable pair. The centertap of transformer T2 on the 150-ohm side is brought out to terminal 10 to derive a simplex leg of the transmitting cable pair.

3.02 The receiving side also contains a 2578M 600:150-ohm transformer T1 which couples the transmission signals from the receive cable pair to the 600-ohm terminals of the RCVG AMPL socket of the repeater shelf. The centertap of transformer T1 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 is required for circuit continuity in the associated plug-in unit in the R AMPL socket to give an impedance of 600 ohms across terminals 1 and 3.

3.03 Transformers T1 and T2 are centertapped on the 600-ohm side to allow use of the transformers as repeating coils. Faceplate screw-type switches CT1 and CT2 make these taps available on an optional basis. When the equalizer is used in normal V4 repeater applications, screw-type switches CT1 and CT2 must be opened (turned out). When the 359M equalizer transformers are used as repeating coils in other than V4 repeater applications, screw-type switches CT1 and CT2 are closed (turned in) to gain access to the transformer centertaps through terminals 7 and 18, respectively.

3.04 The 2578M transformer has a flatter low-frequency response and less delay distortion than that used in the 359B equalizer. In addition, it is equipped with an electrostatic shield which helps to reduce the noise due to longitudinal currents. In the 359M equalizer, the electrostatic shields from both transformers are connected

together and brought out to terminal 8 for connection to ground through the repeater circuit.

3.05 Equalization of the nonloaded cable is accomplished by working the cable between 150-ohm impedances. Thus, the best impedance match between cable and repeater occurs at high frequencies where the cable attenuation is greatest. As frequency is reduced with consequent decrease in cable attenuation, the cable impedance increases and produces an increasing mismatch of impedance, thus increasing the reflection losses. These reflection losses tend to offset the reduced cable attenuation, resulting in more nearly uniform overall transmission through the cable and repeater throughout the voiceband.

3.06 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.

3.07 The electrostatic shield and balanced construction of the new 2578M transformer combine to reduce longitudinal unbalance currents by 75 dB minimum over the voiceband. The loss-frequency distortion over the voiceband (300 to 3200 Hz) is ± 0.1 dB relative to 1000 Hz. The envelope delay distortion over the data transmission band (500 to 3200 Hz) is less than 3 microseconds; from 1 to 5 kHz, the delay distortion is negligible. The delay at 300 Hz relative to 1000 Hz is 7 microseconds.

3.08 It should be noted that the performance data given above is for 0 dc current through the transformer winding. With 2 mA dc, the 600-ohm winding inductance is reduced from 3.3 H minimum (0 mA dc) to about 1.6 H. This increases the 200-Hz loss about 0.1 dB. For this reason, it is recommended that dc currents be applied on a simplex basis only and that any loop current due to unbalances be limited to 1 mA maximum. The simplex current itself may be as high as 250 mA without damage to the transformer winding.

4. APPLICATION

4.01 The 359M equalizer is used to equalize long lengths of nonloaded 19, 22, 24, 25 (MAT), and 26 gauge cable. Although designed for data services, the 359M equalizer may be used in place of the less expensive 359B equalizer which is recommended for message circuit applications.

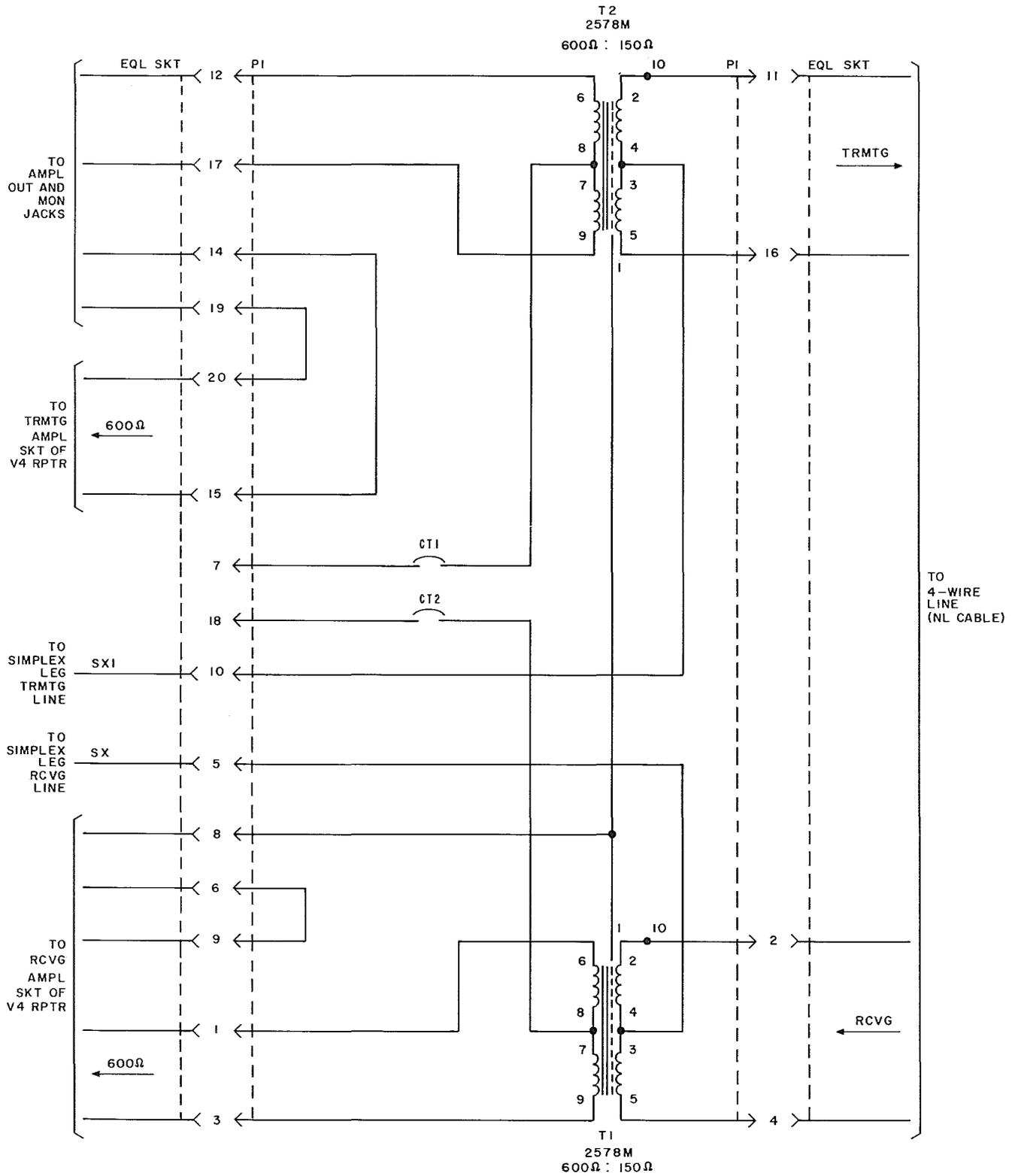


Fig. 2—359M Equalizer—Schematic and Typical Circuit Connections

SECTION 332-116-112

4.02 The 359M 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 359N equalizer at the other end.

4.03 The recommended applications for the 359M equalizer are given in Table A. The equalizer selection is based on cable gauge, length, and

desired equalization. The cable lengths are expressed in kilofeet (kft), miles (MI), and approximate attenuation (dB).

4.04 The cable lengths given in Table A may be equalized with only one 359M equalizer, 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 A
359M EQUALIZER APPLICATION CHART

NONLOADED CABLE TYPE	COLUMN 1 (NOTE 2) EQUALIZER LOSS (dB) REFLECTION LOSS (dB)		COLUMN 2 (NOTES 1, 4) 359M AT ONE END WITH 359N OR 600-OHM EQUIPMENT AT THE OTHER END		COLUMN 3 (NOTES 1, 4) 359M AT EACH END OR 359M AT ONE END WITH 150-OHM EQUIPMENT AT THE OTHER END		COLUMN 4 (NOTES 1, 4)	
	359M	359N	FROM	TO	FROM	TO	FROM	TO
	All 19 gauge capacitance	EQL 0.3 REFL 1.8	EQL 0.3 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
All 19 gauge capacitance	EQL 0.3 REFL 1.8	EQL 0.3 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 4.8 MI 6.0 dB	36.0 kft 6.8 MI 8.6 dB
All 22 gauge	EQL 0.3 REFL 1.8	EQL 0.3 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 0.3 REFL 2.5	EQL 0.3 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 0.3 REFL 3.2	EQL 0.3 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 0.3 REFL 3.4	EQL 0.3 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 0.3 REFL 2.7	EQL 0.3 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 between 1 kHz and 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 359M and 359N equalizers are used at both ends of a facility, coil and reflection loss should be considered for both ends (column 1).

Note 3: To find the loss for mixed gauge cable, add the 1000-Hz attenuation of all facilities present, making no adjustments 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 with equalizers at both ends.