359D EQUALIZER

DESCRIPTION

1. GENERAL

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

1.02 This section is reissued to include information on 25-gauge metropolitan area trunk (MAT) cable, to correct Fig. 5, and to include information previously covered in an addendum. Arrows normally used to indicate changes are not used due to the extensive revision.

1.03 The 359D equalizer is typically used in conjunction with an 849B network to provide loss equalization of H88-loaded cable facilities when gain is not required. Independently adjustable low- and high-frequency equalization sections provide the necessary equalization to obtain a substantially flat frequency response over the range of 250 to 3000 Hz. The high-frequency section is designed specifically for equalization of H88-loaded, high-capacitance cable. The low-frequency section is not limited to equalization of H88-loaded, high-capacitance cable but may be used to provide low-frequency equalization in other loading systems, such as 25-gauge MAT cable. The 1000-Hz insertion loss varies between 0 and 3 dB as equalization is adjusted.

1.04 Strapping charts for the 359D equalizer used with an 849B network may be found in Section 332-116-201.

2. EQUIPMENT DESCRIPTION

2.01 The 359D 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.

2.02 The 359D equalizer consists of ten resistors, five capacitors, and one inductor mounted on a printed wiring board and housed in a metal can approximately 1-3/4 inches high by 1-3/4 inches wide by 7 inches long. Tabs are provided on the front of the can to facilitate removal of the equalizer from the repeater mounting shelf with the use of a 602D tool.

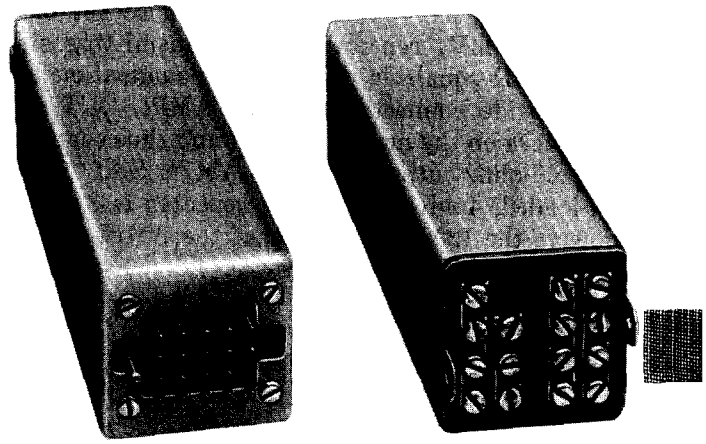

Fig. 1—359D Equalizer

2.03 The equalizer faceplate mounts 15 screw-type switches. These switches permit the indicated component values to be added to or removed from the circuit, as required, when adjusting equalization.

3. CIRCUIT DESCRIPTION

A. General

3.01 The general circuit configuration of the 359D equalizer is illustrated in Fig. 2. This figure illustrates how the equalizer is used with the associated 849B network. Resistor R_{LF} and capacitor C_{LF} make up the series arm, low-frequency equalizing section; inductor L1, capacitor C1, and resistor R_{HF} make up the shunt arm, high-frequency section. The pad-socket and associated 89-type resistor in the 849B network make up a 600-ohm pad which reduces interaction between the high- and low-frequency

sections. The transformer in the 849B network changes the 600-ohm network impedance to 1200 ohms facing the cable facilities.

3.02 Figure 3 is a schematic of the 359D equalizer illustrating typical circuit connections when plugged into the equalizer connector socket of a 24V4 or a 44V4 repeater. The transmitting side of the 359D equalizer provides no equalization but does provide connections to the AMPL OUT and MON jacks on the mounting shelf and thus connects the 1200-ohm output at the T AMPL SKT to the H88-loaded, 4-wire line if the repeater is 24V4 or connects the 1200-ohm output at the AMPL 1 SKT to the line if the repeater is 44V4.

3.03 The receiving side of the equalizer contains the actual equalizing elements. Received transmission signals from the 4-wire line enter the equalizer at terminals 2 and 4 and are connected through to terminals 1 and 3. Shelf wiring connects from terminals 1 and 3 on the equalizer socket to the R AMPL SKT, which is normally equipped with an 849B network. Terminals 6, 7, 8, and 9 connect the high- and low-frequency equalizing sections to the associated 849B network. Interaction between the high- and low-frequency equalizing sections is reduced by any pad used in the associated 849B network. The shelf and equalizer wiring places the pad electrically between the high- and low-frequency sections of the equalizer.

3.04 The high- and low-frequency sections are adjusted by means of the faceplate screw-type switches. In the low-frequency section, the capacitors are added to the circuit when the associated screw-type switches are closed (turned in) and are removed when the switches are opened (turned out). The resistors in both the high- and low-frequency sections are bypassed when the associated screw-type switches are closed (turned in) and are placed in the circuit when the screw-type switches are opened (turned out). The screw-type switch designated IN puts the high-frequency section in the circuit when closed (turned in) and removes the high-frequency section when opened (turned out).

B. High Capacitance (.083 μF per mile) H88 Loaded Cable

3.05 The series arm, low-frequency components R_{LF} and C_{LF} provide compensation for amplitude distortion in the 4-wire line facilities at frequencies up to approximately 1000 Hz. Figures 4 and 5 illustrate typical equalization losses which may be obtained by various combinations of C_{LF} and R_{LF} when inserted between 600-ohm terminations. These results are approximately correct for the actual repeater environment. Figure 4 shows the

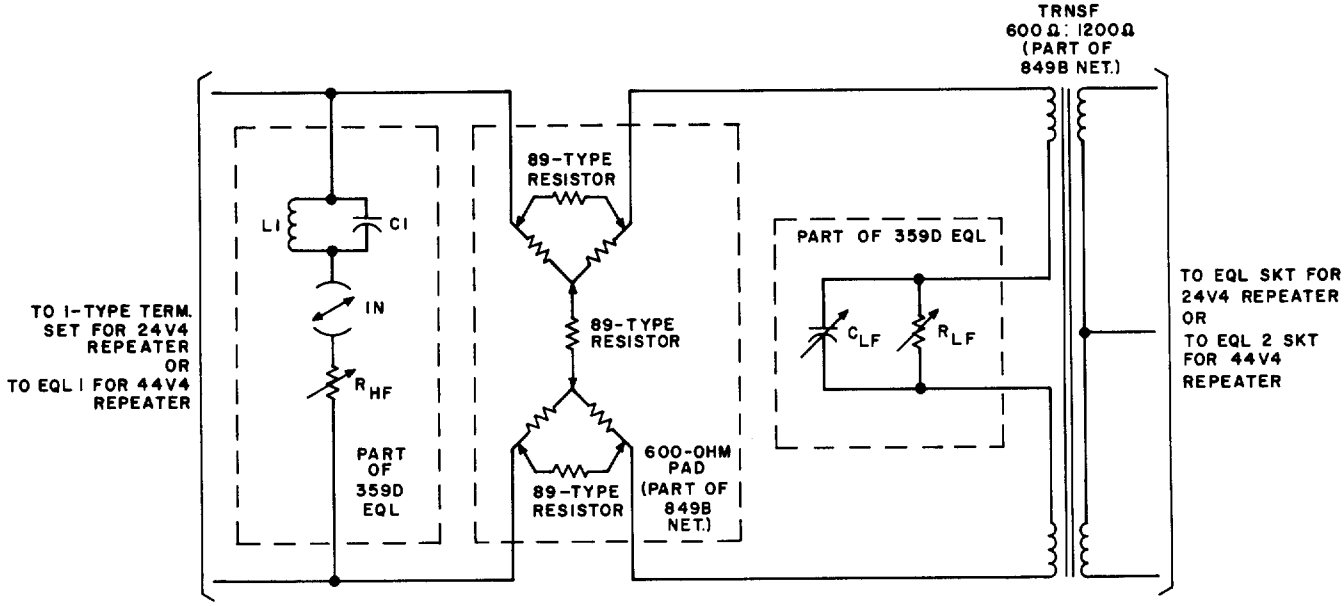

Fig. 2—359D Equalizer—General Circuit Configuration and Location in 849B Network

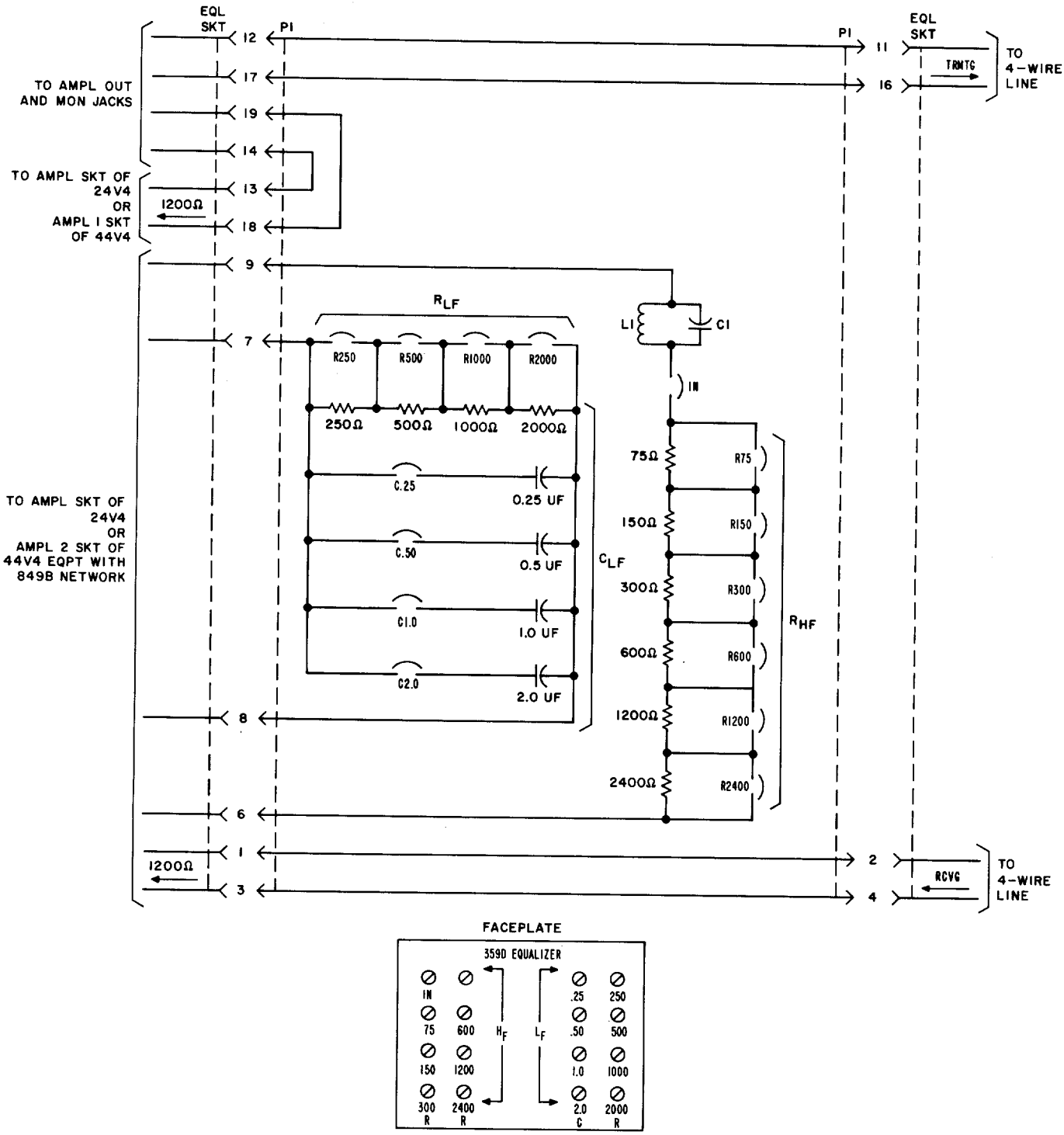

Fig. 3—359D Equalizer—Schematic and Typical Circuit Connections

results of keeping C_{LF} constant at 0.25 μF and varying R_{LF} with the HF section out of the circuit; Fig. 5 shows the results of keeping R_{LF} constant at 1500 ohms and varying C_{LF} with the HF section out of the circuit.

3.06 The shunt arm, high-frequency components provide amplitude equalization for H88-loaded, high-capacitance cable where the nominal cutoff is 3500 Hz. Capacitor C1 and inductor L1 form a parallel resonant circuit tuned to 3000 Hz which is in series with the adjustable resistor R_{HF} . Varying resistor R_{HF} adjusts the amount of high-frequency equalization for various lengths and gauges of facilities. Figure 6 illustrates the typical corrective losses which may be obtained by various settings

of R_{HF} . Although the characteristics are given for the equalizer between 600-ohm impedances, they are also approximately correct for the equalizer when used in its repeater environment with loaded cable facilities.

3.07 While the series arm, low-frequency components R_{LF} and C_{LF} provide compensation for amplitude distortion, they introduce delay distoration at the same time. Figures 7 and 8 illustrate typical delay-frequency characteristics obtained by various combinations of C_{LF} and R_{LF}. Figure 7 illustrates results of keeping C_{LF} constant at 0.25 μF and varying R_{LF} with the HF section out of the circuit; Fig. 8 shows the results of keeping R_{LF} constant at 1500 ohms and varying C_{LF} with the HF section out of the circuit.

3.08 While the shunt arm, high-frequency components provide compensation for amplitude distortion, they introduce delay distortion at the same time. Figure 9 illustrates typical delay-frequency characteristics obtained by varying R_{HF}.

C. Low Capacitance (.064 μF per mile) H88 Loaded Cable

3.09 The 359D equalizer in combination with an 849B network may be used to effectively equalize the low-capacitance MAT cable. Since the new MAT cable has a relatively flat frequency response between 1 and 3 kHz, only the low frequency section of the equalizer is required (the HF section of the equalizer must be removed from the circuit by opening the IN screw).

3.10 The insertion loss of the network, not including the 89-type resistor in the 849B network, varies between 0.4 and 0.8 dB depending on the amount of equalization required.

3.11 The loss-frequency and delay characteristics are identical to those shown for high-capacitance cable.

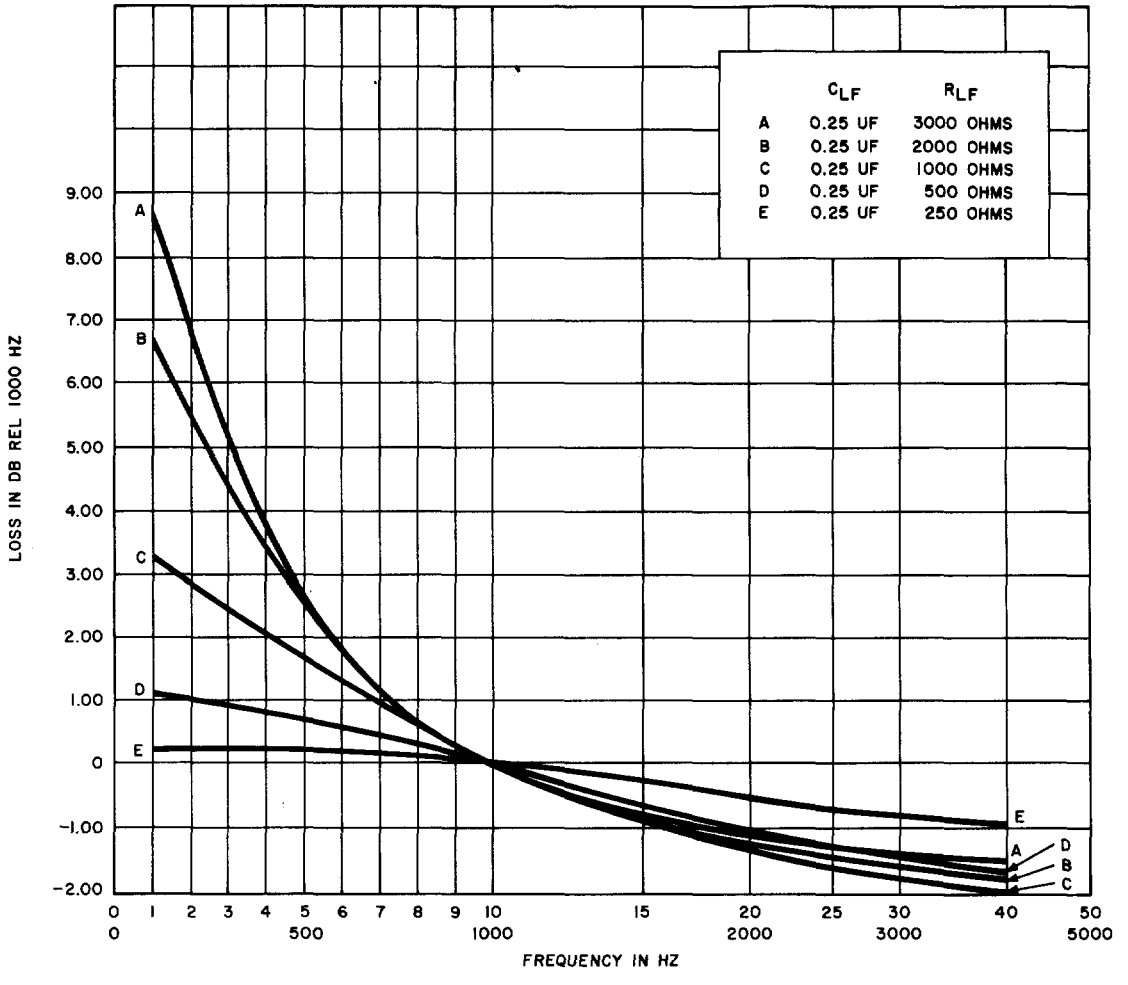

Fig. 4—359D Equalizer, Low-Frequency Section—Loss-Frequency Characteristics—Between 600-Ohm Impedances—Varying R_{LF} for C_{LF} Constant at 0.25 μF

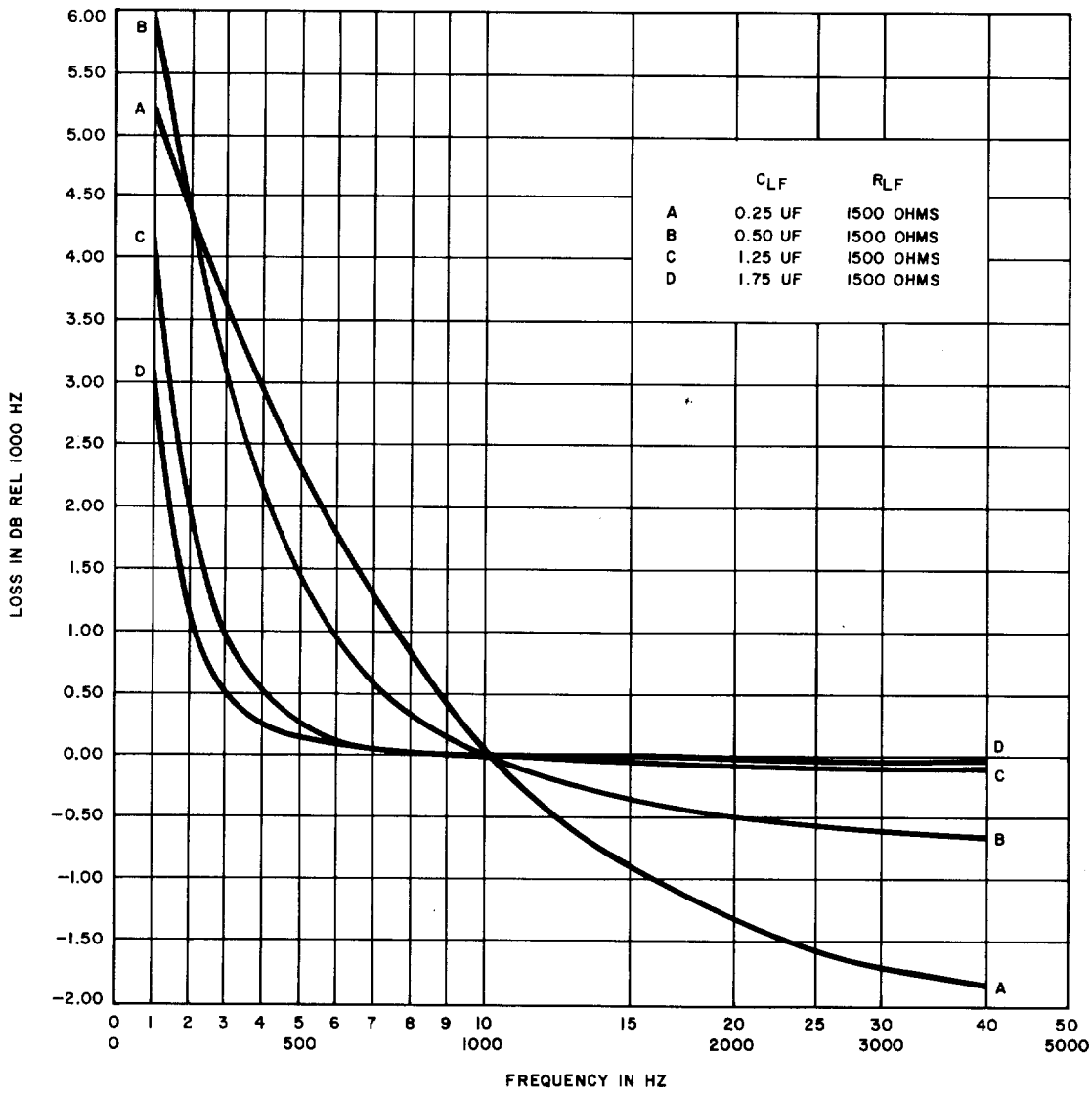

Fig. 5—359D Equalizer, Low-Frequency Section—Loss-Frequency Characteristics—Between 600-Ohm Impedances—Varying C_{LF} for R_{LF} Constant at 1500 Ohms

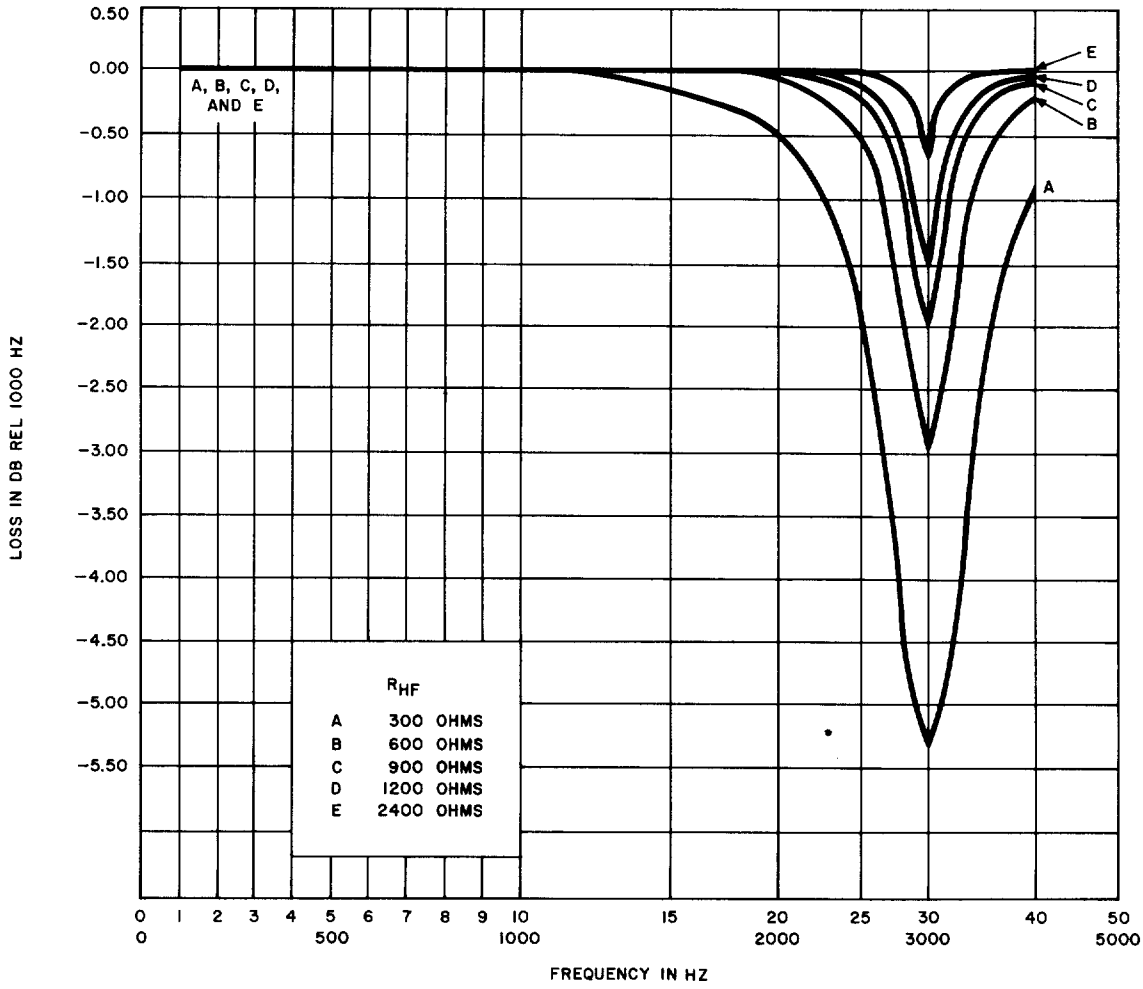

Fig. 6—359D Equalizer, High-Frequency Section—Loss-Frequency Characteristics—Between 600-Ohm Impedances—At Various Settings of R_{HF}

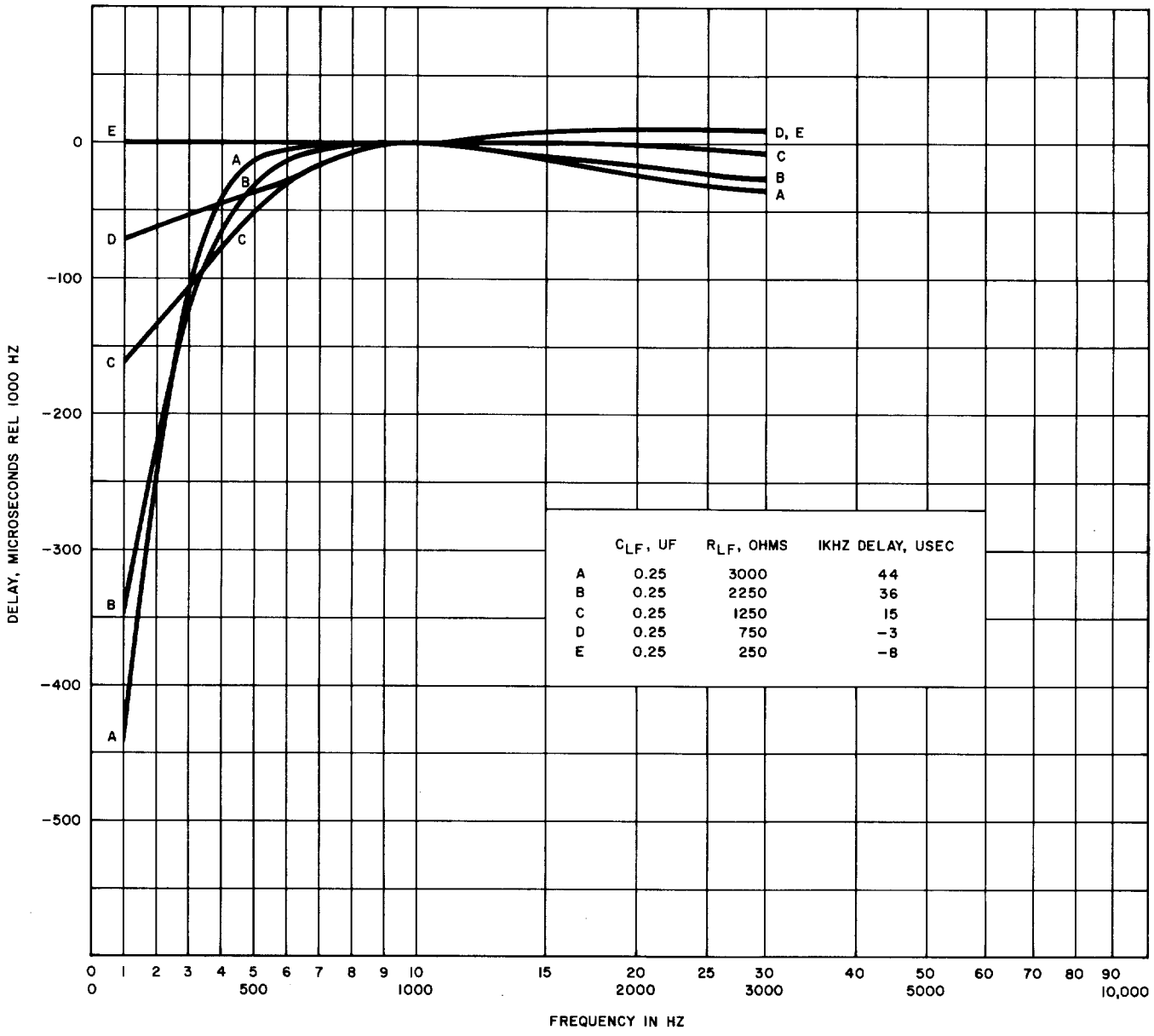

Fig. 7—359D Equalizer, Low-Frequency Section—Delay-Frequency Characteristics—Between 600-Ohm Impedances—Varying R_{LF} for C_{LF} = 0.25 μF

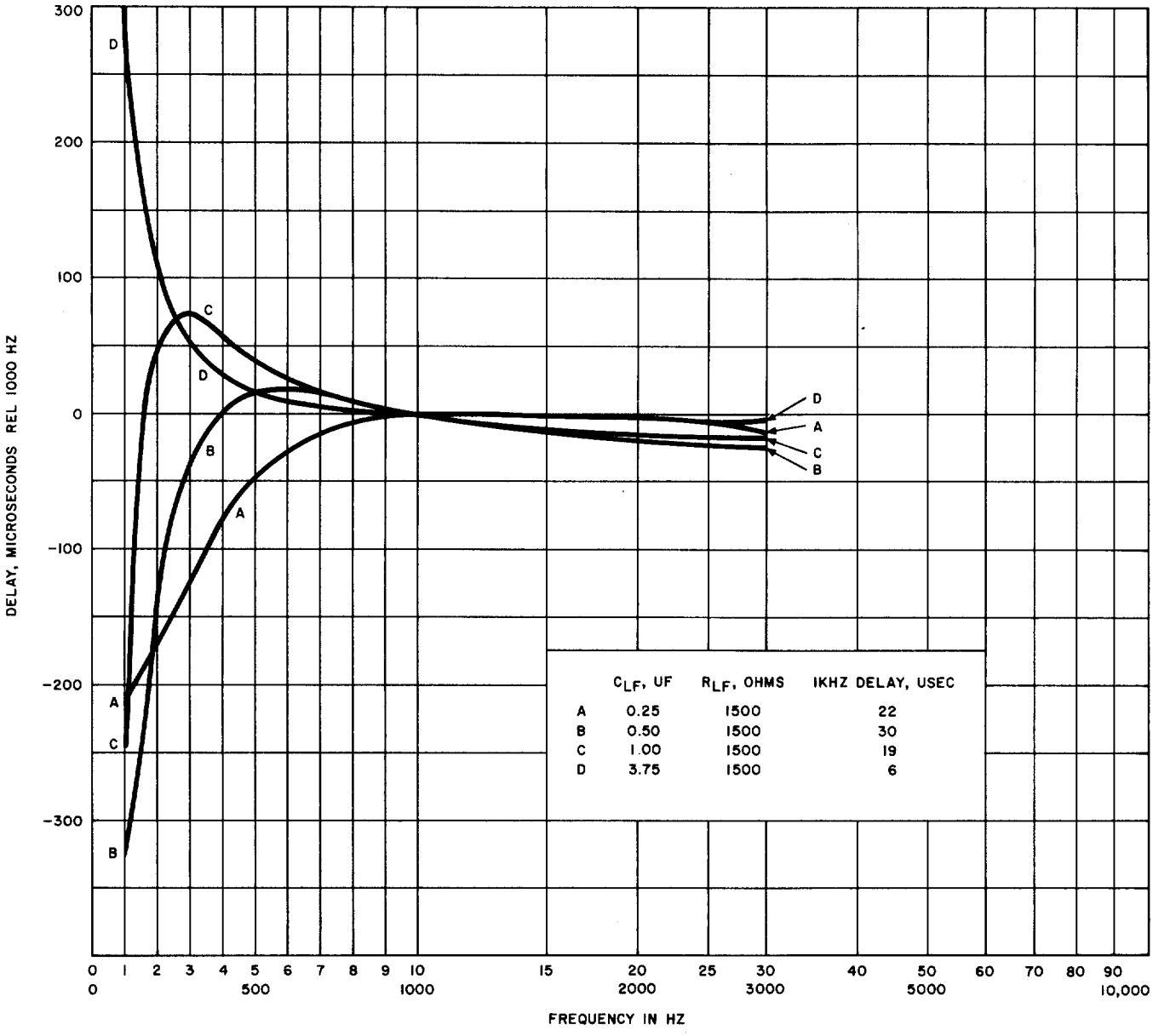

Fig. 8—359D Equalizer, Low-Frequency Section—Delay-Frequency Characteristics—Between 600-Ohm Impedances—Varying C_{LF} for R_{LF} = 1500 Ohms

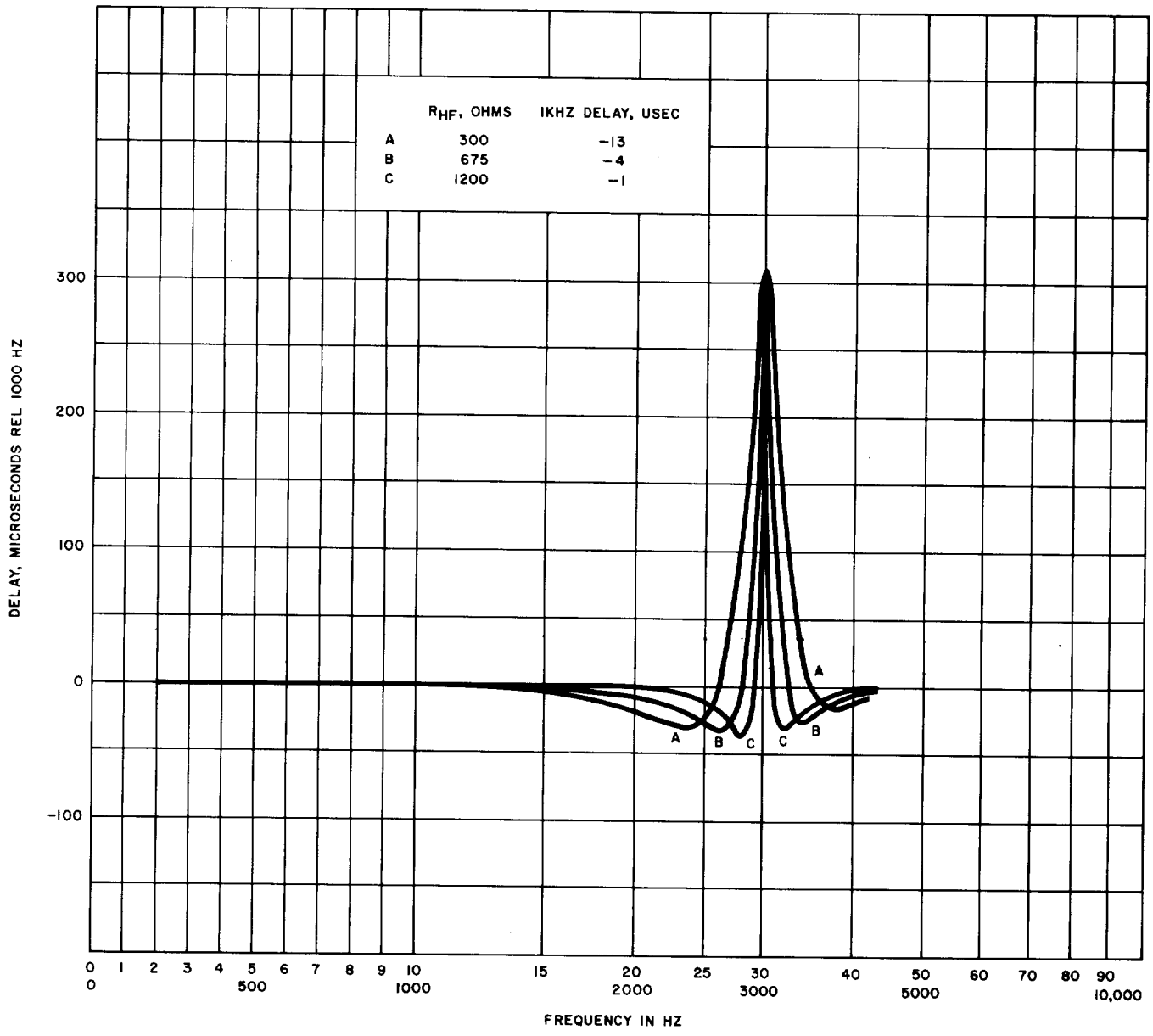

Fig. 9—359D Equalizer, High-Frequency Section—Delay-Frequency Characteristics—Between 600-Ohm Impedances—At Various Settings of R_{HF}