

SIGNALING BY-PASS AUXILIARY UNITS

DESCRIPTION

TYPE F SIGNALING SYSTEM

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Buildout Capacitance (NBOC) in the FMD and FME units. The color coded label on the face of the FM_ units is gold lettering on a red background.

1.05 The FMA, FMB, and FMC units may be used in either the FUA-type installation or the FWA- and FWB-type installation. When used in the FUA-type installation, the FMA or FMB unit may be substituted for the FUA unit with a FMB, FMC, or FME used in the auxiliary positions.

1.06 Fig. 1 is a photograph of an FMC unit which shows some of the components which are used in unit construction. Fig. 2 shows the details of the various FM_ faceplates.

1. GENERAL

1.01 This section describes the FMA, FMB, FMC, FMD, and FME units to be used with the type F signaling system. These units provide no signaling function. They are intended primarily for use in Special Service applications and through circuit applications where the signaling function is not required or provided elsewhere. Each circuit function is listed in Table A.

1.02 Components in these units are mounted on a printed wiring board. The board is mounted on a die cast aluminum frame approximately 10-1/2 inches by 1-1/2 inches. All interconnections between the bay and the unit are via a 40-pin connector which is part of the printed wiring board.

1.03 These units are placed into service by inserting them into the guides of the shelf and sliding them toward the rear of the bay. A locking device on the face of the unit locks the unit in place when sufficient contact with the bay mounting is made. To remove the unit, release the locking device and withdraw the unit.

1.04 Slide switches, on the face of the FMA unit, adjust the attenuators for the desired attenuation. Screw switches adjust the impedance and equalization in the FMC unit and Network

2. EQUIPMENT DESCRIPTION

2.01 The FMA unit (Fig. 3) provides a 4-wire transmission path through the bay. Built-in 34-type attenuators enable transmission level adjustments from 0 to 16.5 dB loss in 0.1 dB increments. If the bay is equipped with connections to external echo suppressors or equalizers, they may be included in the circuit.

2.02 The FMB unit (Fig. 3) provides only a zero loss 4-wire transmission path. It contains no attenuators and bypasses the echo suppressor access terminal.

2.03 The FMC unit (Fig. 4) provides 4-wire line matching and loss-frequency equalization on the transmit side. Additional resistance and capacitance can be inserted by screw switches for impedance matching. The taps on the equipment side of transformers T101 and T202 can be varied by screw switches to allow matching at this point.

2.04 The FMD and FME units (Fig. 5) have 4-wire terminating sets. The only difference between the FMD unit and the FME unit is the value of resistor R201. A 600-ohm resistor is used in a FME unit for 600-ohm office impedance matching whereas a 898-ohm resistor is used in a

FMD unit for 900-ohm office impedance matching. Access is provided for an external precision network if required. Provision is made for NBOC adjustments from 0.0 to 0.127 μf in .002 μf steps. In circuits where an external capacitor is provided across the A & B leads, a screw switch on the FMD and FME unit allows the internal capacitor in the term set to be removed. For the FMD unit only, additional capacitance on the equipment side of the term set may be provided by the NB4 screw switch. The additional capacitance (3 μf) is required to balance the term set due to additional capacitance present on the A and B leads.

3. TRANSMISSION CHARACTERISTICS

A. 2-Wire Operation

3.01 The envelope delay distortion present in the transmit and receive circuits can be seen in Fig. 6. In the FMD and FME units the delay distortion is about 15 microseconds for frequencies of 3000 Hz and above for either the transmit or receive portions. The rise in distortion is quite rapid below 2000 Hz. The delay increases from 18 μS delay at 2000 Hz to 160 μS delay at 500 Hz as shown as shown in Fig. 6.

3.02 The transmit and receive path of the FMA or FMB units (excluding the P-pads) insert virtually no loss. Therefore, when one of these units is used in the place of the FUA unit, the loss in the transmission path is due to the FMD or FME unit. The 2- to 4-wire and the 4- to 2-wire transmission loss for the FMD and FME units are shown in Fig. 7 and 8.

3.03 The 2-wire return loss and the transhybrid loss curves for the FMD and FME units are shown in Fig. 9 through 12.

B. 4-Wire Operation

3.04 Impedance ratios suitable for the connecting line facilities are selected by means of the screw-type switches located on the face of the FMC units. Equalization for long lengths of nonloaded cable is obtained by using the 150-ohm taps on the transformer in the transmit and receive paths. The 150-ohm impedance faces the cable. The resulting deliberate impedance mismatch between the network and cable is larger at low frequencies and thus produces reflection loss that tends to complement cable loss and flattens the

overall loss-frequency response. Some equalization for short lengths of nonloaded cable is obtained by using the 600:600-ohm taps on the network. The small amount of equalization required is provided by the low-frequency loss in the transformers. The 1200-ohm taps on the transformers are used to match the cable impedance when loaded H88 cable is used. Table B shows the loss-frequency and delay-frequency characteristics of a typical FMC unit as measured between nominal impedances.

3.05 For loaded H88 cable, 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 1000-Hz insertion loss varies between 0 and 3 dB as equalization is adjusted.

3.06 Fig. 13 through 18 are curves that illustrate the effect of varying the values of the components of the equalizer sections of the network.

3.07 The series arm low-frequency components (R_{LF} and C_{LF}) provide compensation for the 4-wire line facilities at frequencies up to approximately 1000 Hz. Fig. 13 and 14 illustrate typical equalization losses which can be obtained by various combinations of C_{LF} and R_{LF} . Fig. 13 shows the results of keeping C_{LF} constant at 0.25 μF and varying R_{LF} with the HF section out of the circuit. Fig. 14 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 The shunt arm high-frequency components provide equalization H88 loaded, high-capacitance cable where the nominal cutoff is 3500 Hz. Capacitor C_{HF} and inductor L_{HF} 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. Fig. 15 illustrates the typical corrective losses which may be obtained by various settings of R_{HF} .

3.09 While the series arm low-frequency components (R_{LF} and C_{LF}) provide compensation, they introduce delay distortion at the same time. Fig. 16 and 17 illustrate typical delay-frequency characteristics obtained by various combinations of C_{LF} and R_{LF} . Fig. 16 illustrates results of keeping C_{LF} constant at 0.25 μF and varying R_{LF} with the HF section out of the circuit. Fig. 17 shows the results of

keeping R_{LF} constant at 1500 ohms varying C_{LF} with the HF section out of the circuit.

3.10 While the shunt arm high-frequency components provide compensation for amplitude distortion, they also introduce delay distortion. Fig. 18 illustrates typical delay-frequency characteristics obtained by varying R_{HF} .

4. MAINTENANCE

4.01 There are no field adjustments provided on the FMA, FMB, FMC, FMD, and FME units. SF units not meeting circuit requirements should

be sent to Western Electric Company for repair. Defective units should be replaced with spare units.

4.02 The Type F Test Extender SD-1C241-02 may be used to provide jack access to the transmission and signaling ports. Use of the test extender will necessitate the removal of the SF units from the bay. The test extender provides jack access to all transmission and signaling ports of the SF units.

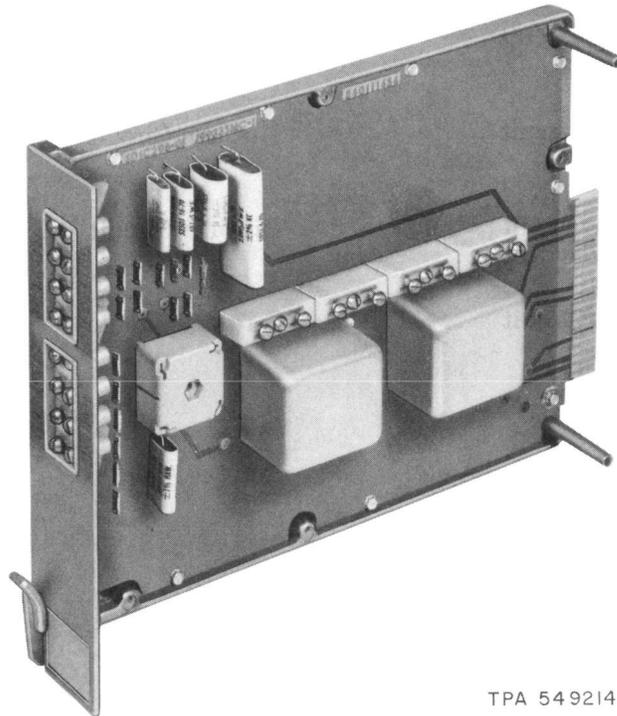
4.03 BSP sections covering related equipment components within the Type-F signaling system can be found in Section 179-000-000.

TABLE A

CODE	FUNCTIONAL DESCRIPTION	GENERAL APPLICATION	SPECIFIC USE
FMA	Through Circuit	Through Circuit	4-wire with level adjusting
FMB	Through Circuit	Through Circuit	4-wire path only
FMC	Through Circuit	Through Circuit	4-wire line matching and equalization
FMD	Through Circuit	Through Circuit	2-wire 900 ohms
FME	Through Circuit	Through Circuit	2-wire 600 ohms

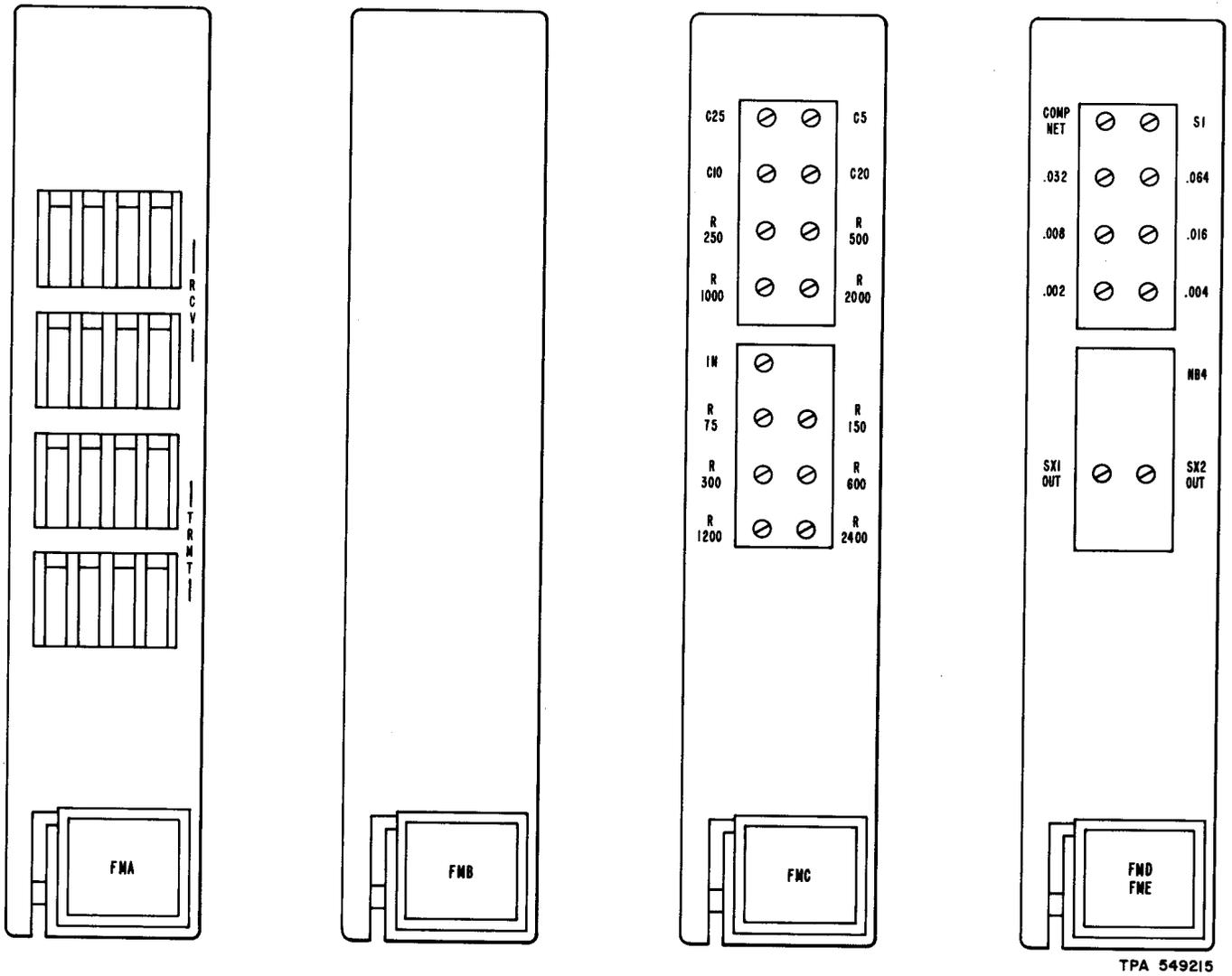
TABLE B
 FMC UNIT – TYPICAL LOSS-
 FREQUENCY AND DELAY-
 FREQUENCY CHARACTERISTICS

FREQUENCY HZ	LOSS (DB) RELATIVE TO 1000 HZ	DELAY (MICROSECONDS)
100	0.15	65.0
200	0.10	30.0
300	0.08	12.0
400	0.06	7.0
500	0.04	4.5
700	0.02	2.5
1000	0	2.0
2000	-0.04	1.5
8000	-0.07	1.2



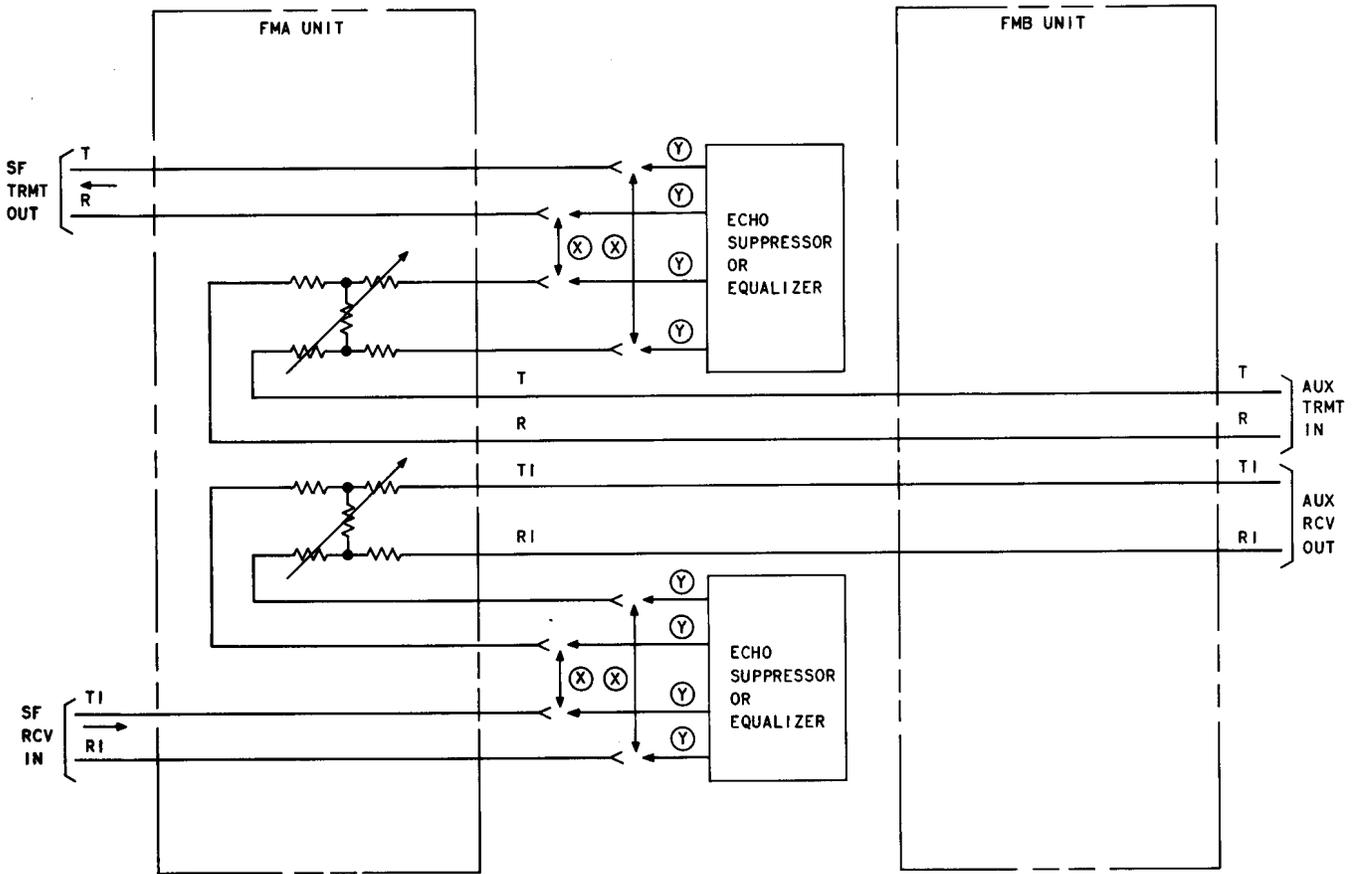
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Fig. 1—FMC Unit



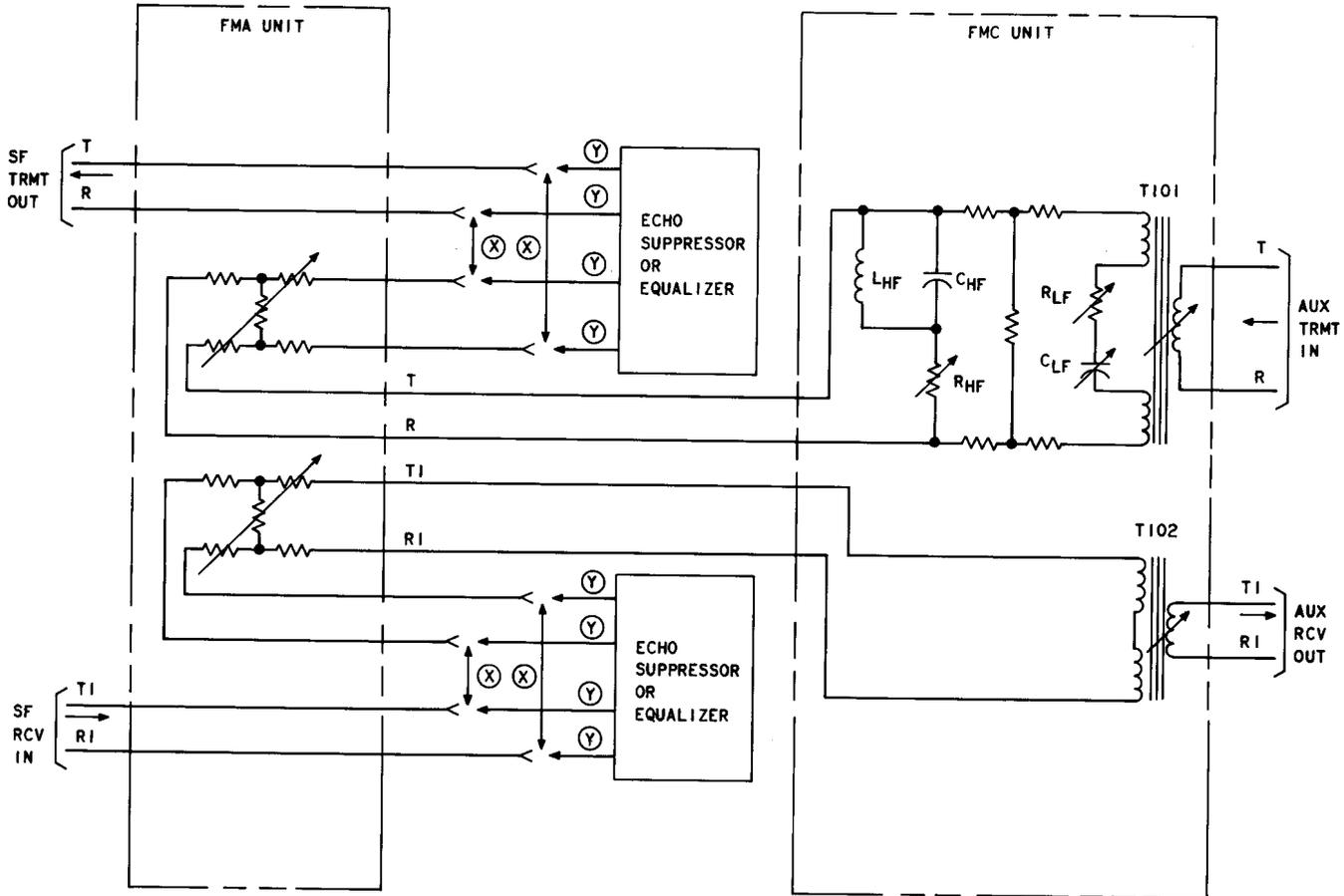
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Fig. 2—FMA, FMB, FMC, FMD, and FME Unit Faceplates



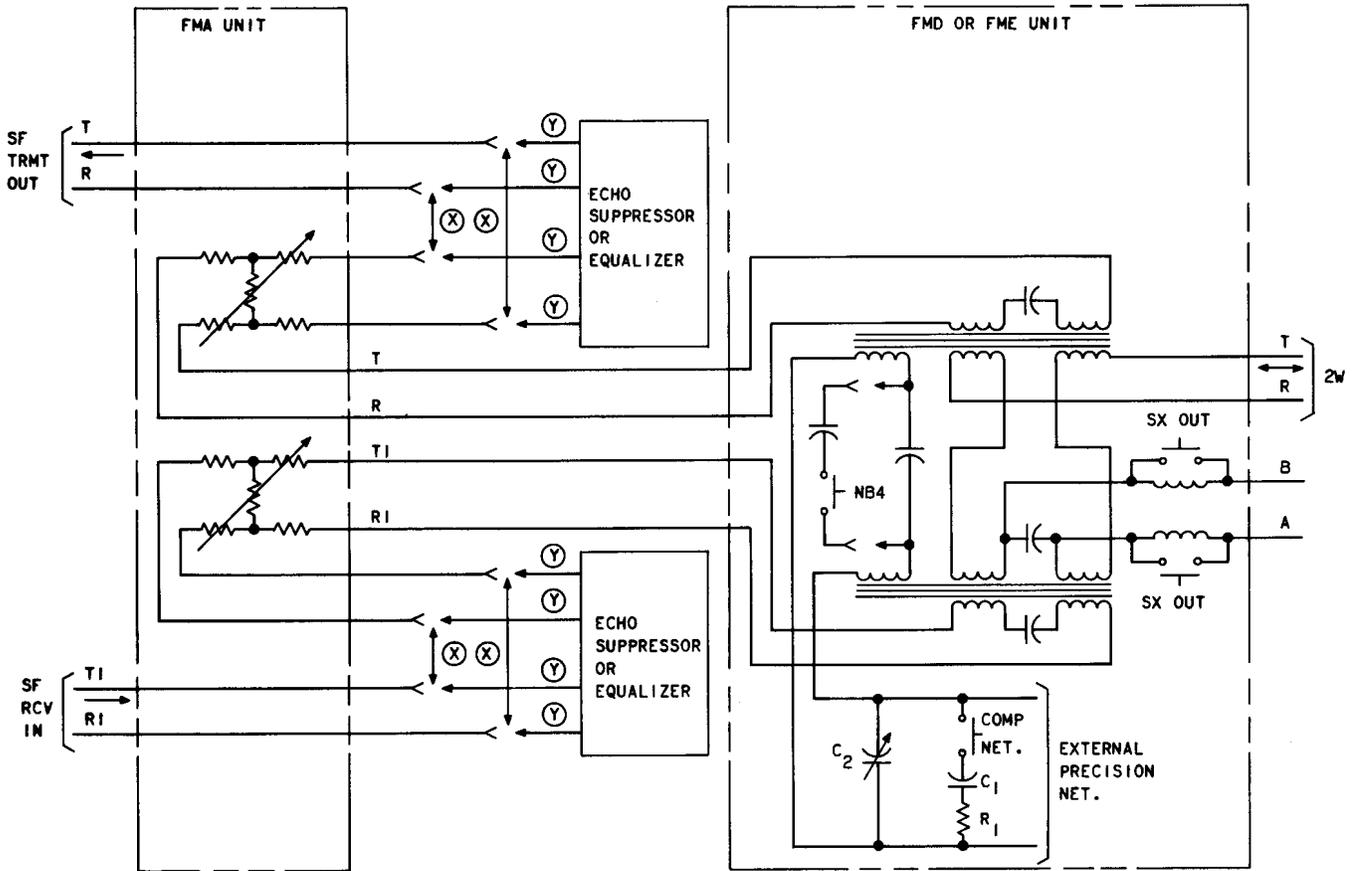
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Fig. 3—FMA Plus FMB



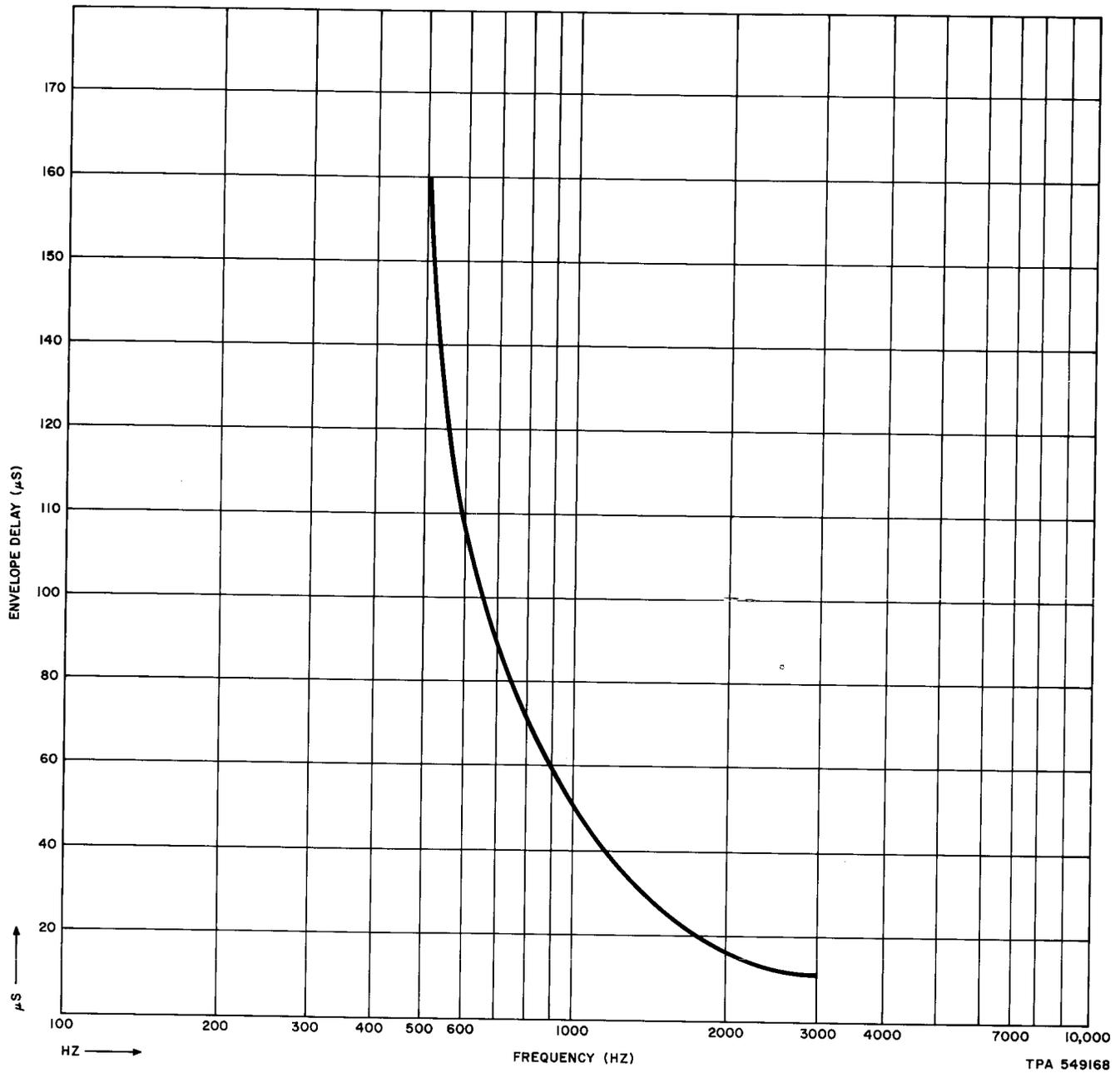
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Fig. 4—FMA Plus FMC



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Fig. 5—FMA Plus FMD or FME Units



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Fig. 6—Nominal Envelope Delay Distortion for the FMD and FME Units

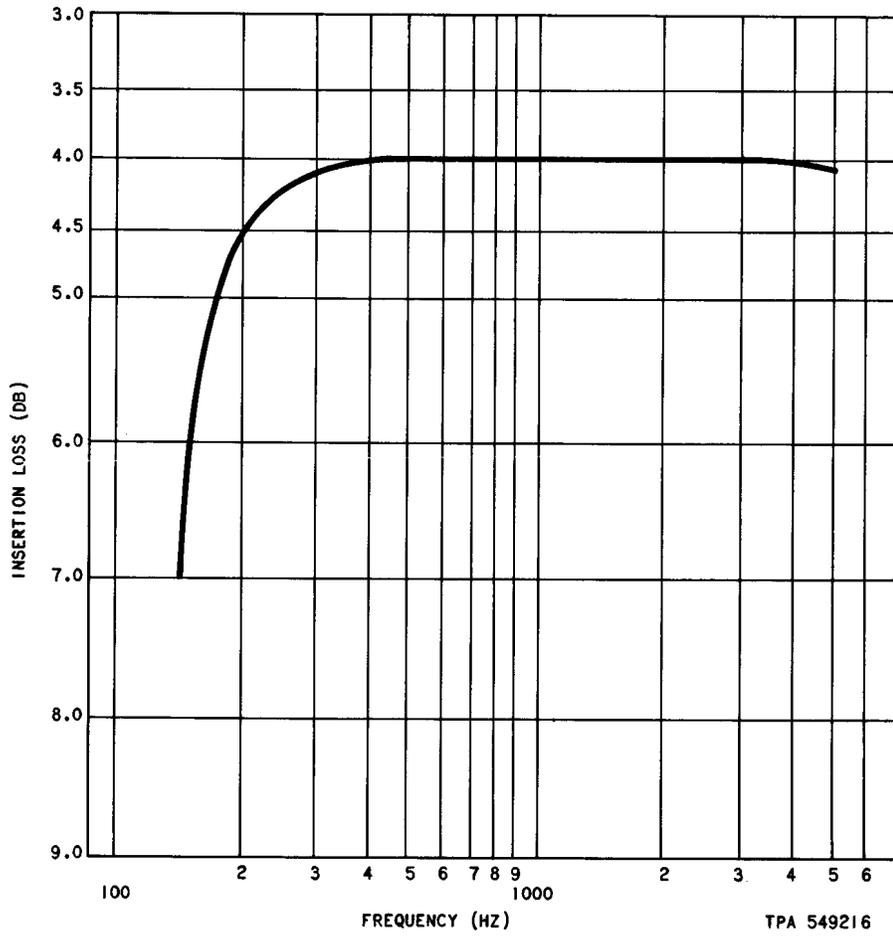


Fig. 7—Nominal 2-Wire to 4-Wire Loss Frequency Characteristics for the FMD Unit

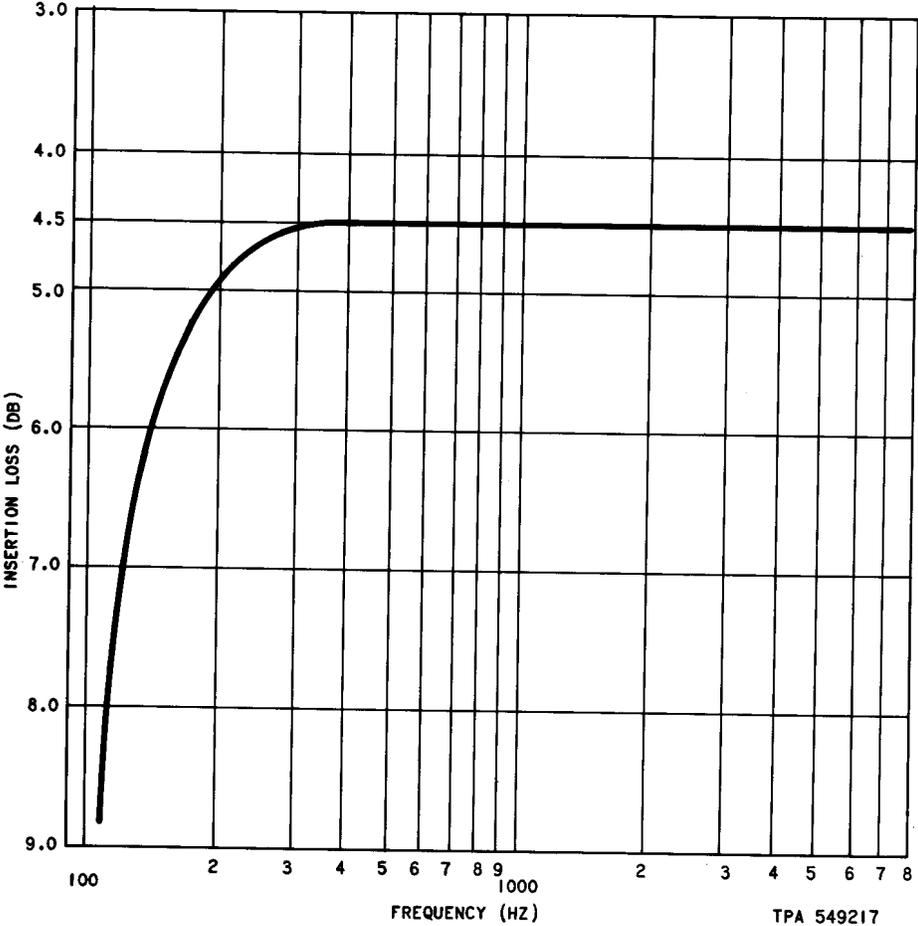
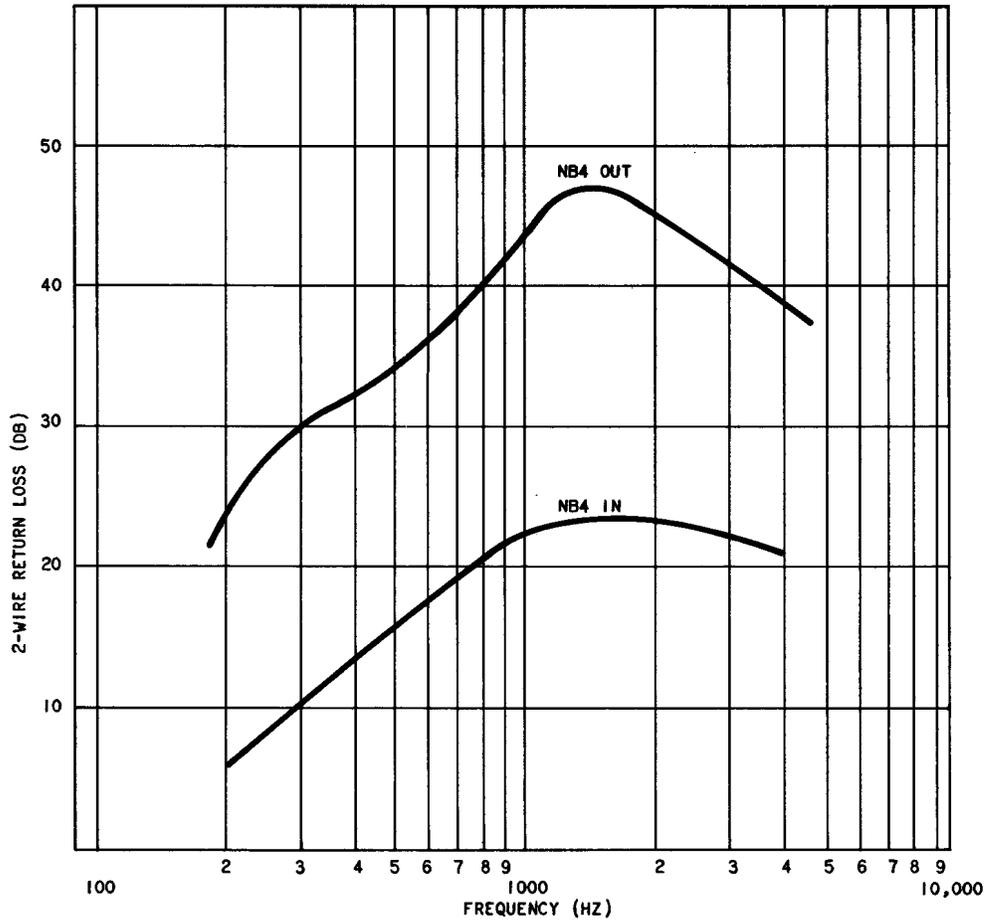


Fig. 8—Nominal 2-Wire to 4-Wire Loss Frequency Characteristics for the FME Unit



NOTE:
WITH NB4 IN THERE IS 4 μ F ON NETWORK SIDE
AND WITH NB4 OUT THERE IS 1 μ F ON NETWORK SIDE.

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Fig. 9—FMD Unit Nominal Return Loss Frequency Characteristics—2-Wire Line Against 900-Ohms Plus 2.15 μ f

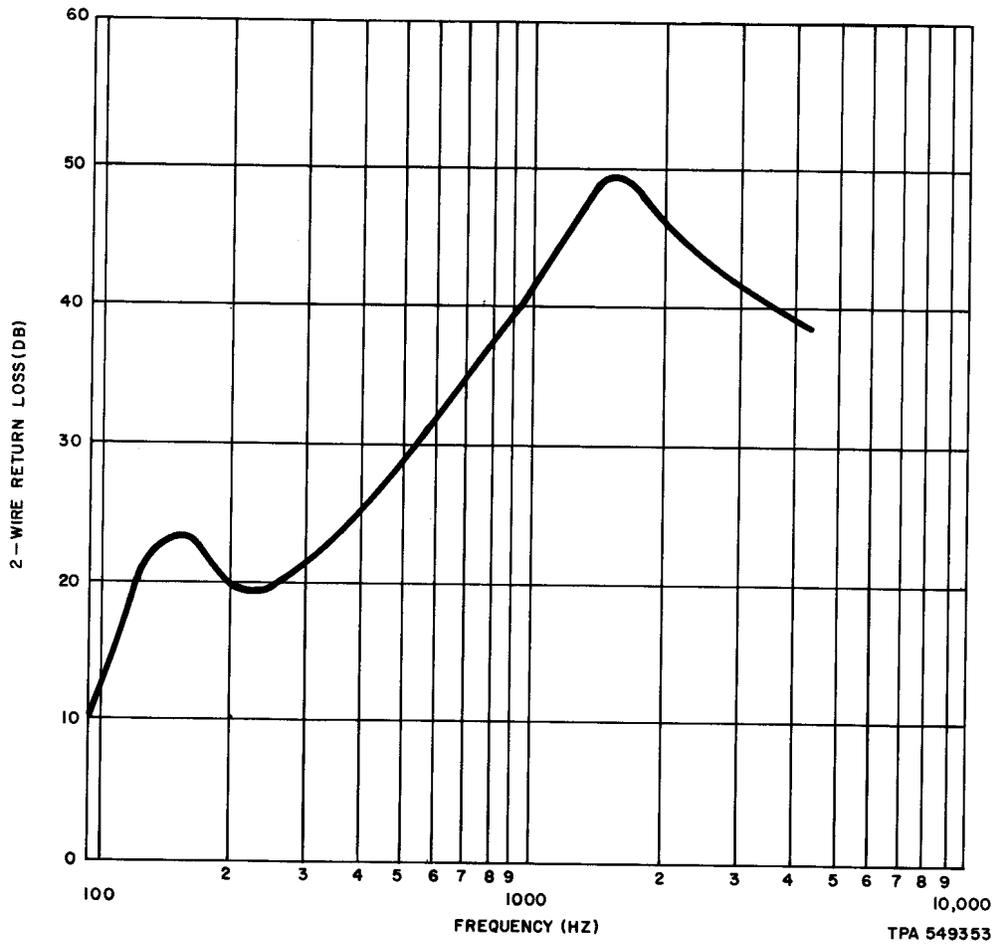


Fig. 10—FME Unit—Nominal Return Loss-Frequency Characteristic—2-Wire Side Against 600 Ohms Plus 2.15 μ f

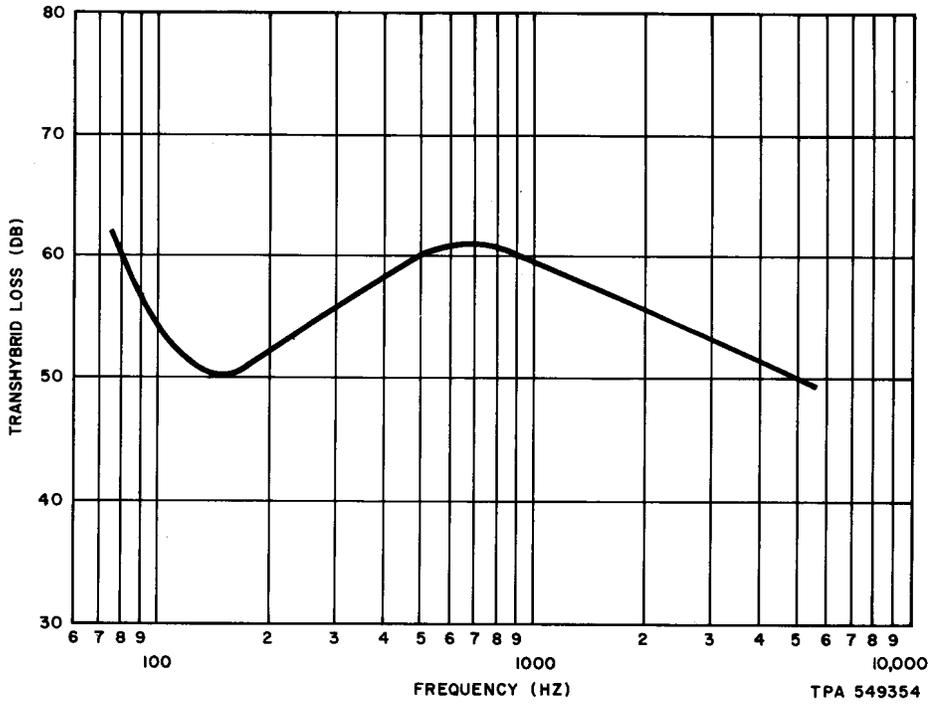


Fig. 11—FMD Unit—Nominal Transhybrid Loss

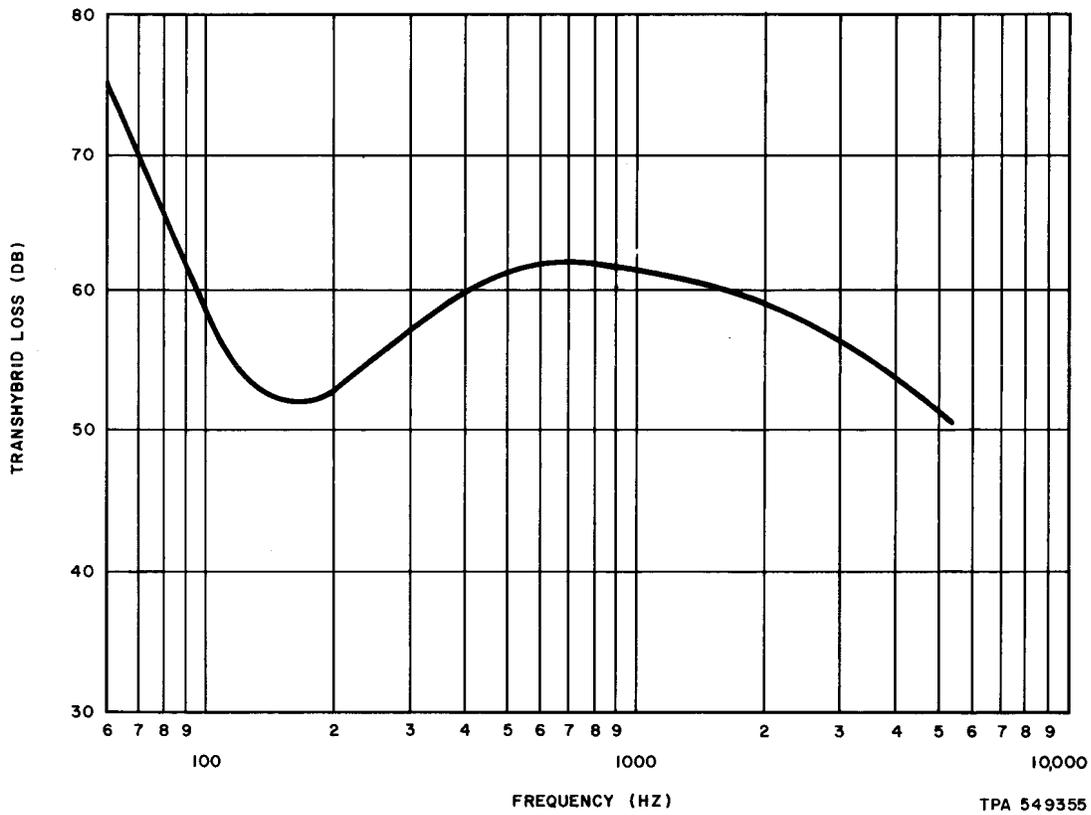


Fig. 12—FME Unit—Nominal Transhybrid Loss

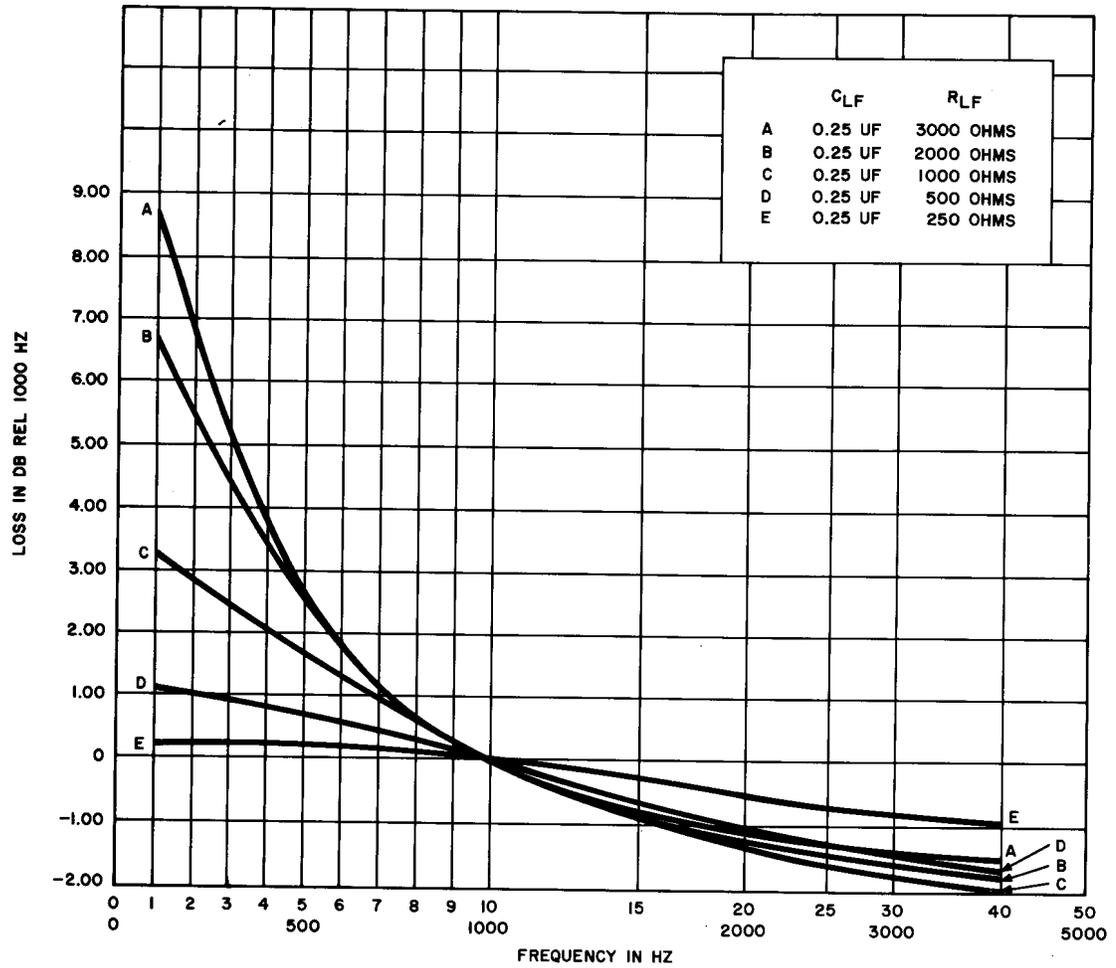


Fig. 13—FMC Unit Nominal Low-Frequency Section, Loss-Frequency Characteristics for the 1200-Ohm Taps on Transformer (T1) and 1200-Ohm Input and 600-Ohm Output Impedance—Varying R_{LF} for C_{LF} Constant at 0.25 μf

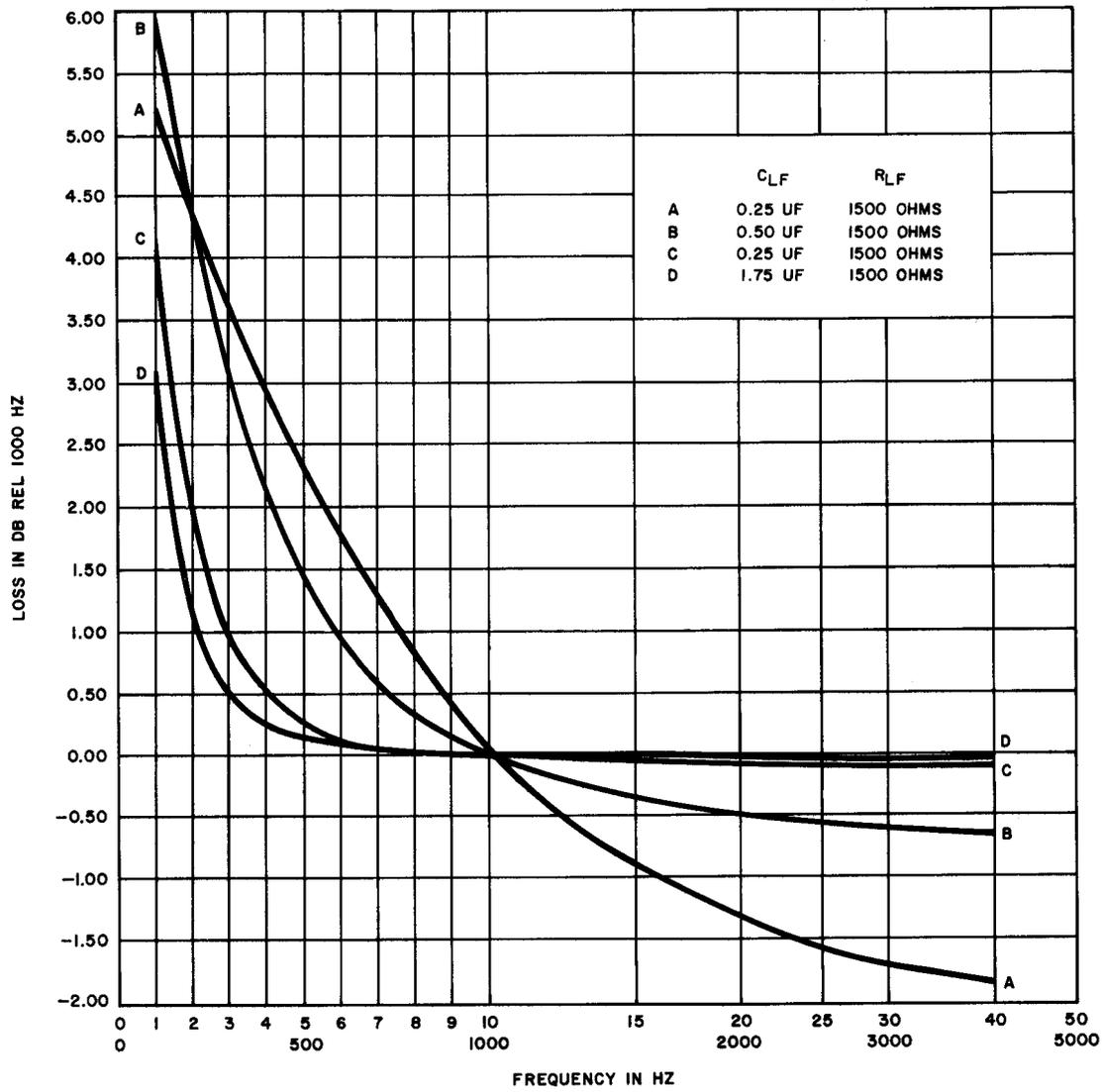


Fig. 14—FMC Unit—Nominal Low-Frequency Section, Loss-Frequency Characteristics for the 1200-Ohm Taps on Transformer (T1) and 1200-Ohm Input and Output Impedances—Varying C_{LF} for R_{LF} Constant at 1500 Ohms

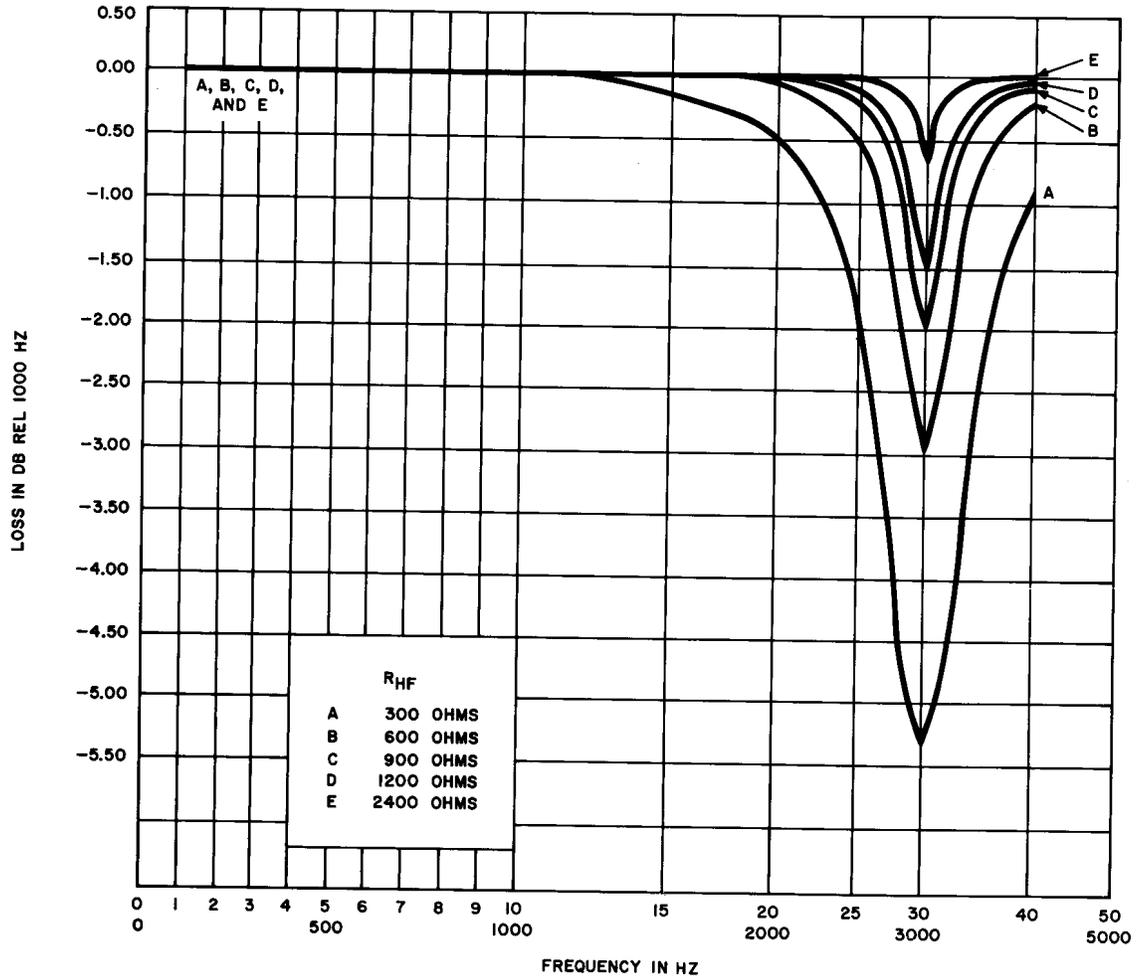


Fig. 15—FMC Unit Nominal High-Frequency, Loss-Frequency Characteristics for the 1200-Ohm Taps on Transformer (T1) and 1200-Ohm Input and 600-Ohm Output Impedances—At Various Settings of RHF

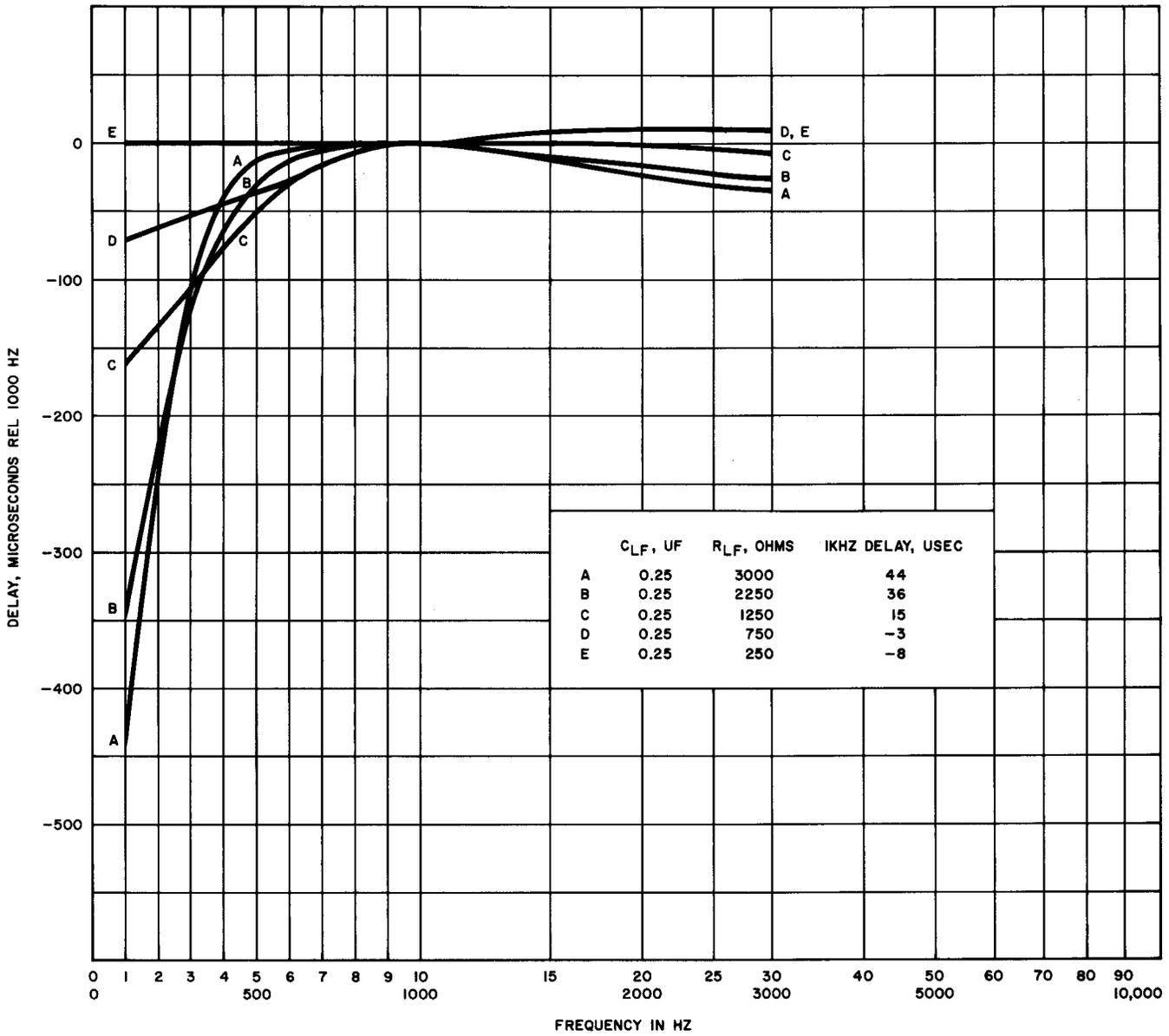


Fig. 16—FMC Unit—Nominal Low-Frequency Section, Delay-Frequency Characteristics for the 1200-Ohm Taps on Transformer (T1) and 1200-Ohm Input and 600-Ohm Output Impedances—Varying RLF for $C_{LF} = 0.25 \mu f$

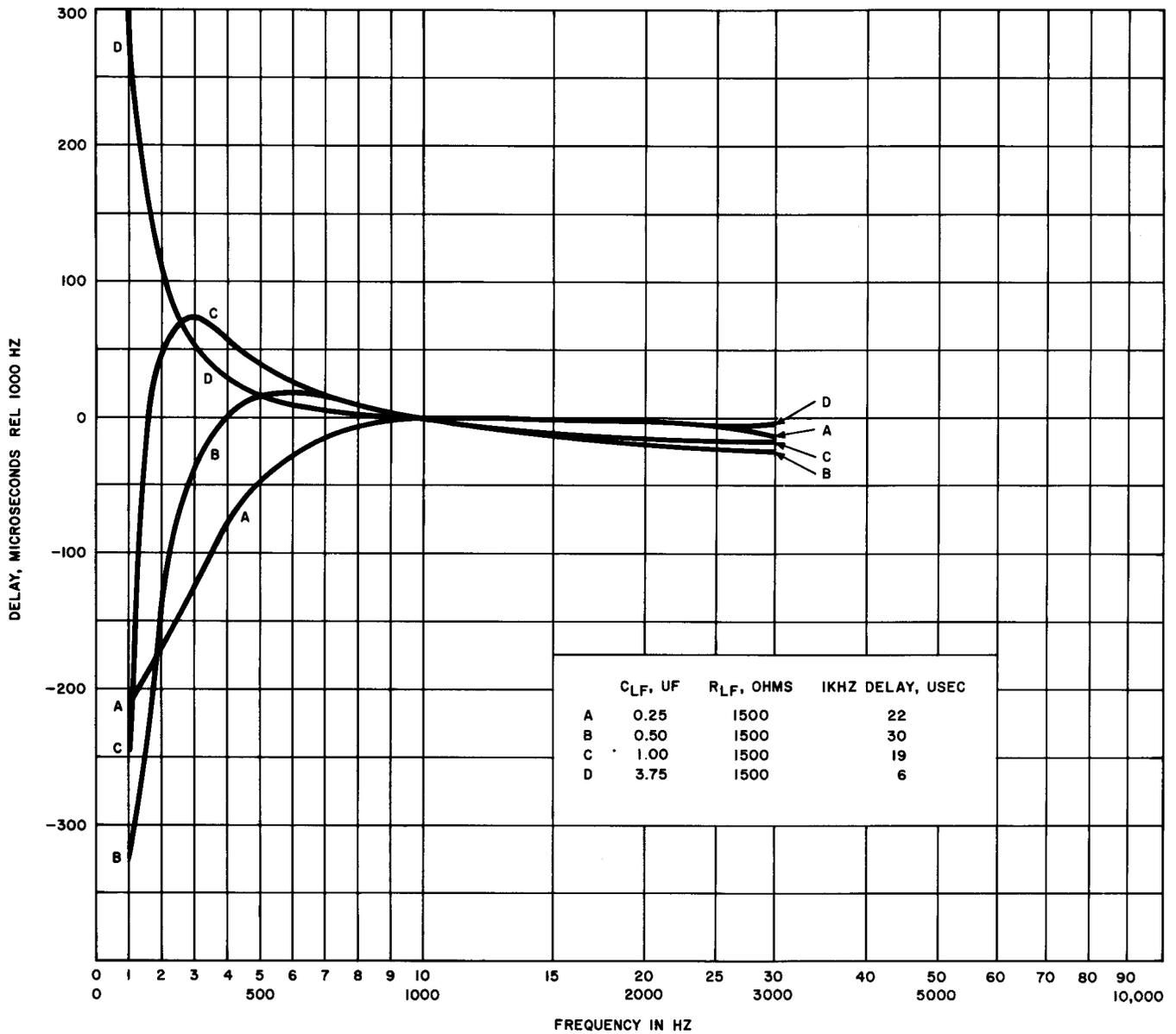


Fig. 17—FMC Unit Nominal Low-Frequency Section, Delay-Frequency Characteristics for the 1200-Ohm Taps on Transformer (T1) and 1200-Ohm Input and 600-Ohm Output Impedances—Varying CLF for RLF = 1500-Ohms

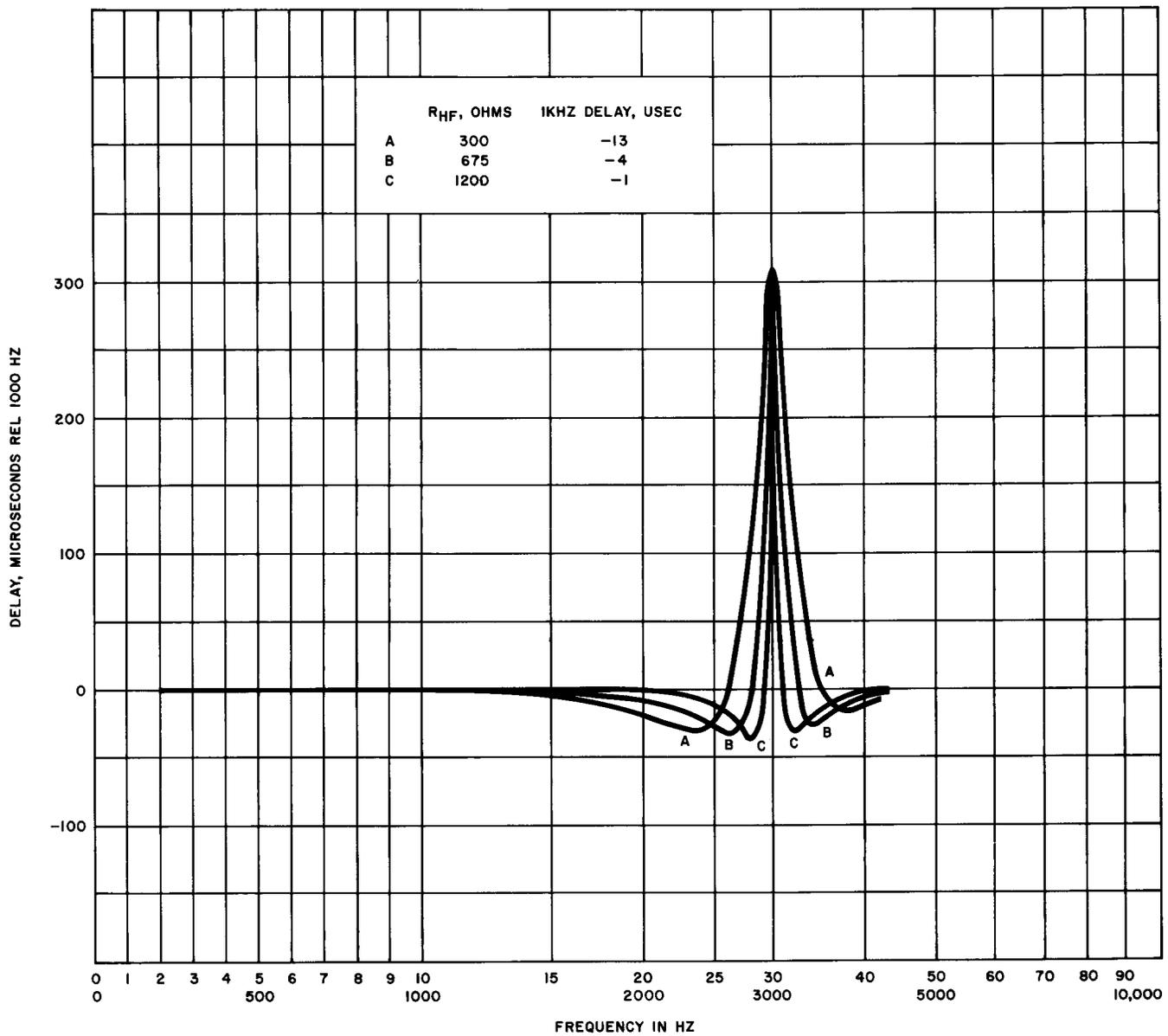


Fig. 18—FMC Unit Nominal High-Frequency Section, Delay-Frequency Characteristics for the 1200-Ohm Taps on Transformer (T1) and 1200-Ohm Taps on Transformer (T1) and 1200-Ohm Input and 600-Ohm Output Impedances—At Various Settings of RHF