RADIO ENGINEERING
MICROWAVE RADIO
4A FM TERMINALS (J68418)

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1. GENERAL

1.01 The 4A FM terminals (J68418) are smaller and less expensive solid-state units than the 3A FM terminals which they replace. The IF is 70 MHz, thus 4A terminals can be used with TD-2, TD-3, and TH-3 microwave radio systems. This section will cover only the 4A receiver (Fig. 1) until the 4A transmitter becomes available. Where terminal pair characteristics are given, data was obtained by operating a 3A transmitter back-to-back with a 4A receiver.

1.02 No internal alarm features are provided since 4A terminals normally function with 200A protection switching systems which perform alarm and automatic protection switching functions.

1.03 Access to the input and output of the receiver for testing or rearrangement is through a patching jack field which is part of the standard bay arrangement for use with 4A receivers.

1.04 Until the 4A transmitter is available, 3A transmitters will be used with 4A receivers to provide modulation on long-haul radio systems. Terminal pair characteristics of a 3A transmitter and a 4A receiver are given in Table A, along with pertinent characteristics of the 4A receiver alone. Worst channel noise contributions of a terminal pair may be used for calculation of noise in radio systems of random lengths and containing varying numbers of FM terminals pairs. FM terminal noise is expected to add on a power (random) basis rather than on a voltage basis.

2. DESCRIPTION

2.01 The 4A FM terminal receiver, Fig. 2, accepts a 70-MHz, −7 dBm unbalanced IF carrier input from a microwave radio receiver and delivers a +4 dBm baseband signal for 4 MHz peak sine wave deviation to a multiplex, video, or other broadband circuit. Section 420-215-100 provides further description of the 4A FM receiver.

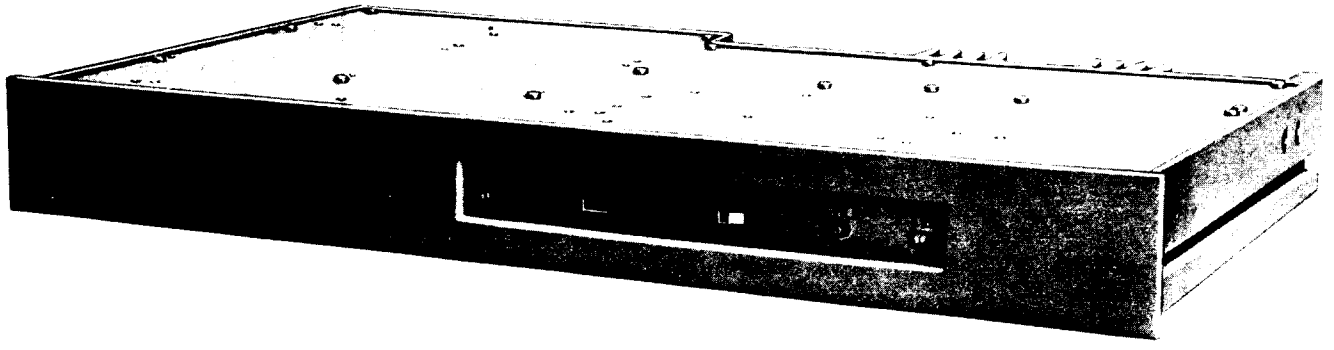

Fig. 1—4A FM Terminal Receiver

2.02 An input amplifier-limiter suppresses amplitude modulation (AM) by more than 30 dB and also provides 5 dB gain. The following 4167A network suppresses harmonics generated by the limiting action and provides envelope delay equalization for the receiver. Characteristics of the 4167A network are shown in Fig. 3. The signal then passes to the output amplifier-limiter which provides additional AM suppression and extends the dynamic range of the receiver so that a 10 dB reduction in the IF input signal level results in less than a 0.25 dB reduction in the baseband output signal.

2.03 The second amplifier-limiter feeds a combined double-balanced discriminator and baseband amplifier. Baseband output is +4 dBm into a 124-ohm balanced line when deviation at the transmitter is ±4 MHz.

2.04 Regulated dc voltage is provided to active circuits of the receiver from a built-in −20 volt regulator. Primary input power for the regulator is supplied from office signal battery or from an auxiliary power source.

TABLE A

4A FM TERMINAL TRANSMISSION CHARACTERISTICS

TERMINAL PAIR*	
Baseband response (6 Hz to 10 MHz)	±0.1 dB
Channel net gain	16 dB
Worst channel noise	
600 channel (457A pre-emphasis network)	15.5 dBrnc0
900 channel (457D pre-emphasis network)	16.0 dBrnc0
1200 channel (457D pre-emphasis network)	17.0 dBrnc0
1800 channel (457D pre-emphasis network)	22.0 dBrnc0
Differential gain (±4 MHz deviation)	<0.05 dB
Differential phase (±4 MHz deviation)	<0.1°
Operating temperature range	0 to 50° C
Warmup time (F_t within 100 kHz of nominal)	≈1 hour
RECEIVER	
IF input impedance	75Ω unbalanced
IF input return loss (60 to 80 MHz)	>30 dB
Nominal IF input power	−7 dBm
IF input reduction to vary baseband output by 0.25 dB	>10 dB
Baseband output impedance	124Ω balanced
Baseband output power (±4 MHz deviation)	+4 dBm
Baseband output adjustment range	±3 dB

*4A FM receiver operating with 3A FM transmitter.

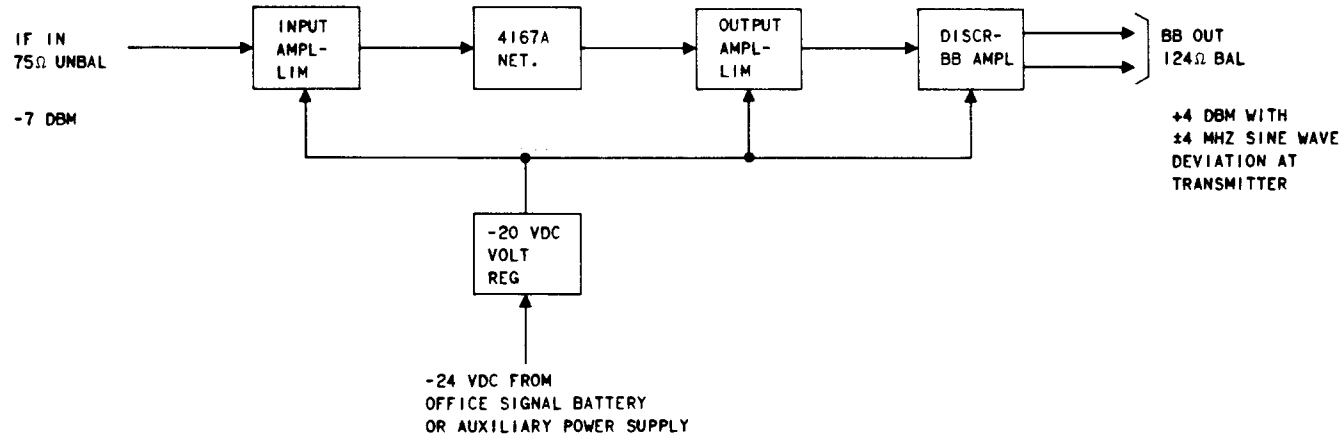

Fig. 2—4A FM Terminal Receiver Block Diagram

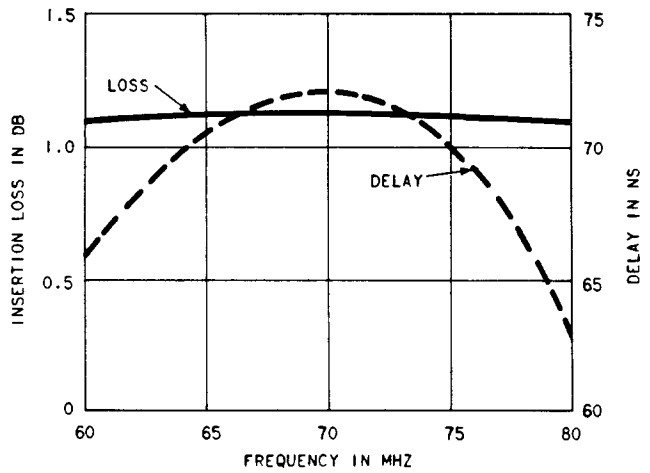

Fig. 3—4167A Network Delay and Insertion Loss

3. PERFORMANCE CHARACTERISTICS

3.01 Typcial performance characteristics of 4A FM receivers operating back-to-back with 3A FM transmitters as terminal pairs are shown in this part. Noise load curves for 1200 and 1800 circuit loading, baseband response, fluctuation noise, and linearity and delay are given.

A. Noise Loading

3.02 Noise load curves obtained with a typical 3A/4A FM terminal pair are given in Fig. 4 and 5 for 1200 and 1800 circuits, respectively. The upper and lower curves in each figure are for frequencies near the extreme ends of the message baseband under measurement.

3.03 Noise load performance is strongly influenced by the shapes of pre-emphasis and de-emphasis networks employed in the system. Message pre-emphasis, as well as video pre-emphasis, is shown in Fig. 6. De-emphasis networks are inverse forms of the pre-emphasis networks.

B. Baseband Response

3.04 Overall baseband response of a 3A/4A terminal pair is shown in Fig. 7. The response is flat within 0.1 dB from 4 Hz to beyond 10 MHz. Flat response down to 60 Hz with roll-off occurring well below this point is essential for low distortion transmission of television baseband signals.

C. Fluctuation Noise

3.05 Fluctuation noise of a typical terminal pair is shown in Fig. 8. A 3A transmitter supplied IF drive for the 4A receiver. The receiver was adjusted to provide a +4 dBm output with an IF input signal deviation of ± 4 MHz.

D. Linearity and Delay

3.06 Figure 9 is a display of both linearity and envelope delay distortion of a 3A/4A FM terminal pair. Transmitter deviation was adjusted to ± 5 MHz for this test.

4. SPACE REQUIREMENTS

4.01 A 4A FM receiver is 19 inches wide, 9-1/2 inches deep, and 2 inches high. The unit may be mounted in a series of ED-50999-50 shelf assemblies which attach to 19-inch, duct-type FM terminal bays.

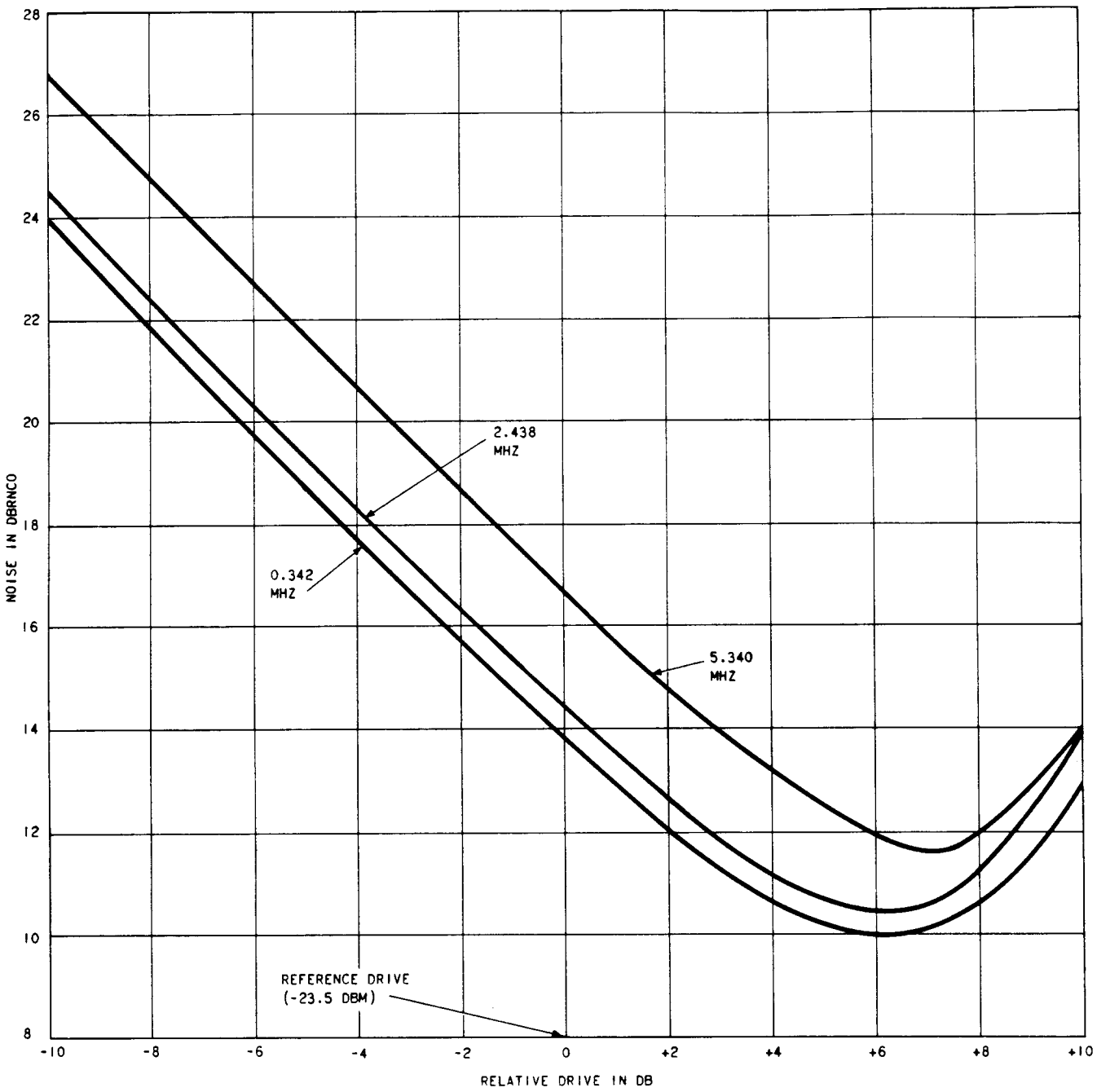

Fig. 4—Typical 3A/4A FM Terminal Pair 1200-Circuit Noise Load Curves (With 457D and 457E Networks)

4.02 A standard arrangement for mounting five 3A FM transmitters, five 4A FM receivers, a patching jack field, and a panel of pre-emphasis and de-emphasis networks plus balanced-to-unbalanced repeating coils as required is shown on ED-50842-31.

4.03 An alternate arrangement which intermixes 3A FM transmitters and both 3A and 4A FM receivers is shown on ED-50842-30. This arrangement may be used when an FM terminal bay is partially equipped with 3A FM terminals,

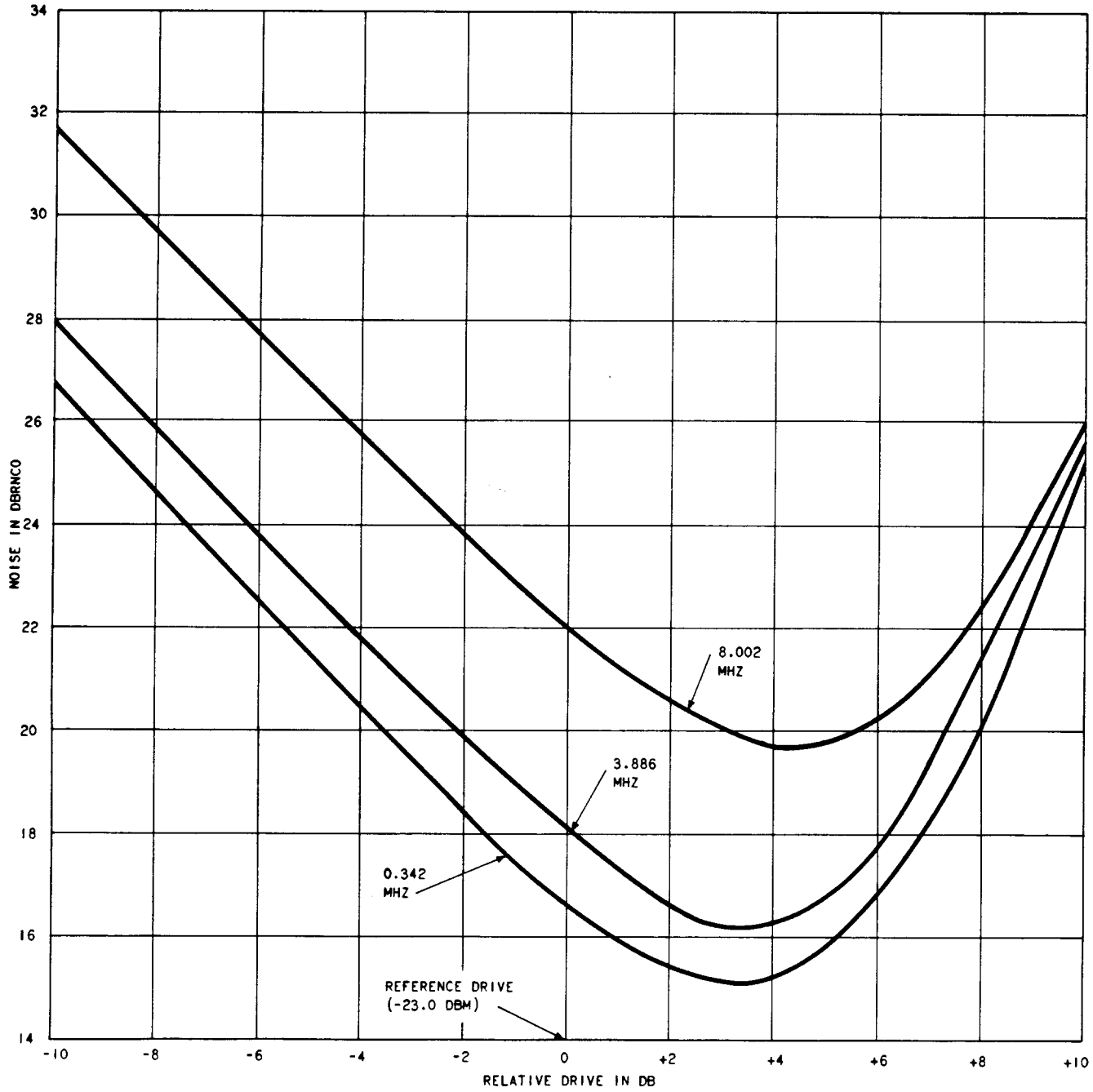

Fig. 5—Typical 3A/4A FM Terminal Pair 1800-Circuit Noise Load Curves (With 457D and 457E Networks)

then 4A receivers are used with additional 3A transmitters to expand the FM terminal facilities.

4.04 4A receiver input and output cables must always be wired to a jack field on the FM terminal bay to provide test access as well as service flexibility. In the standard bay arrangement (ED-50842-31), all 3A transmitters and 4A receivers are cabled to the jack field. In ED-50842-30 arrangements, the original 3A terminal pairs may already be equipped with individual access jacks on each separate unit. In this case, only the additional 3A transmitters and the 4A receivers will be cabled to the jack field.

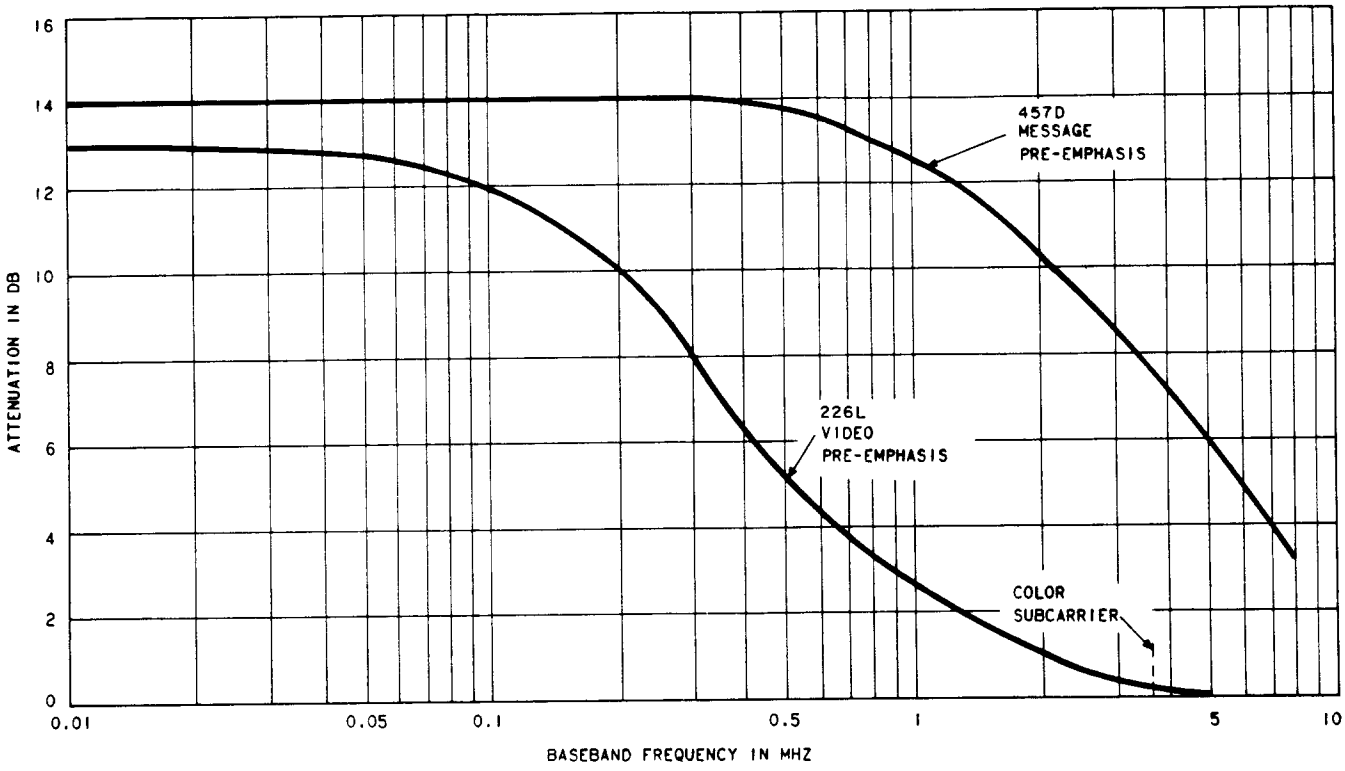

Fig. 6—Pre-Emphasis Characteristics

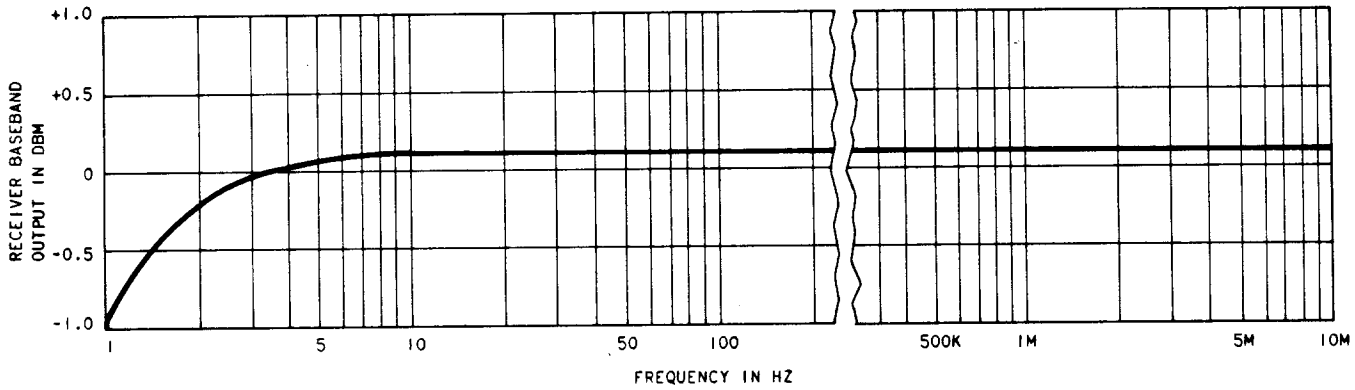

Fig. 7—3A/4A FM Terminal Pair Baseband Response

5. POWER REQUIREMENTS

5.01 Primary −24 (−21 to −26) volt signal battery at 0.4 ampere is required for each 4A receiver. This power is provided from a battery distribution circuit breaker bay (BDCBB) over separate leads to each receiver. One-ampere circuit breakers are used in the BDCBB to provide battery protection and battery alarm features for each power lead. The −24 volt power may be supplied from auxiliary power sources if required.

6. TEST EQUIPMENT

6.01 Maintenance of 4A FM receivers is accomplished with the same test equipment employed for 3A receiver testing. As described in Sections 940-340-103 and 104-303-100, the J68337H FM Terminal Test Set used for TD-2 FM terminal testing must be modified by addition of a J68337J 3A FM Terminal Test Panel before tests on the newer 3A and 4A FM terminals can be accomplished.

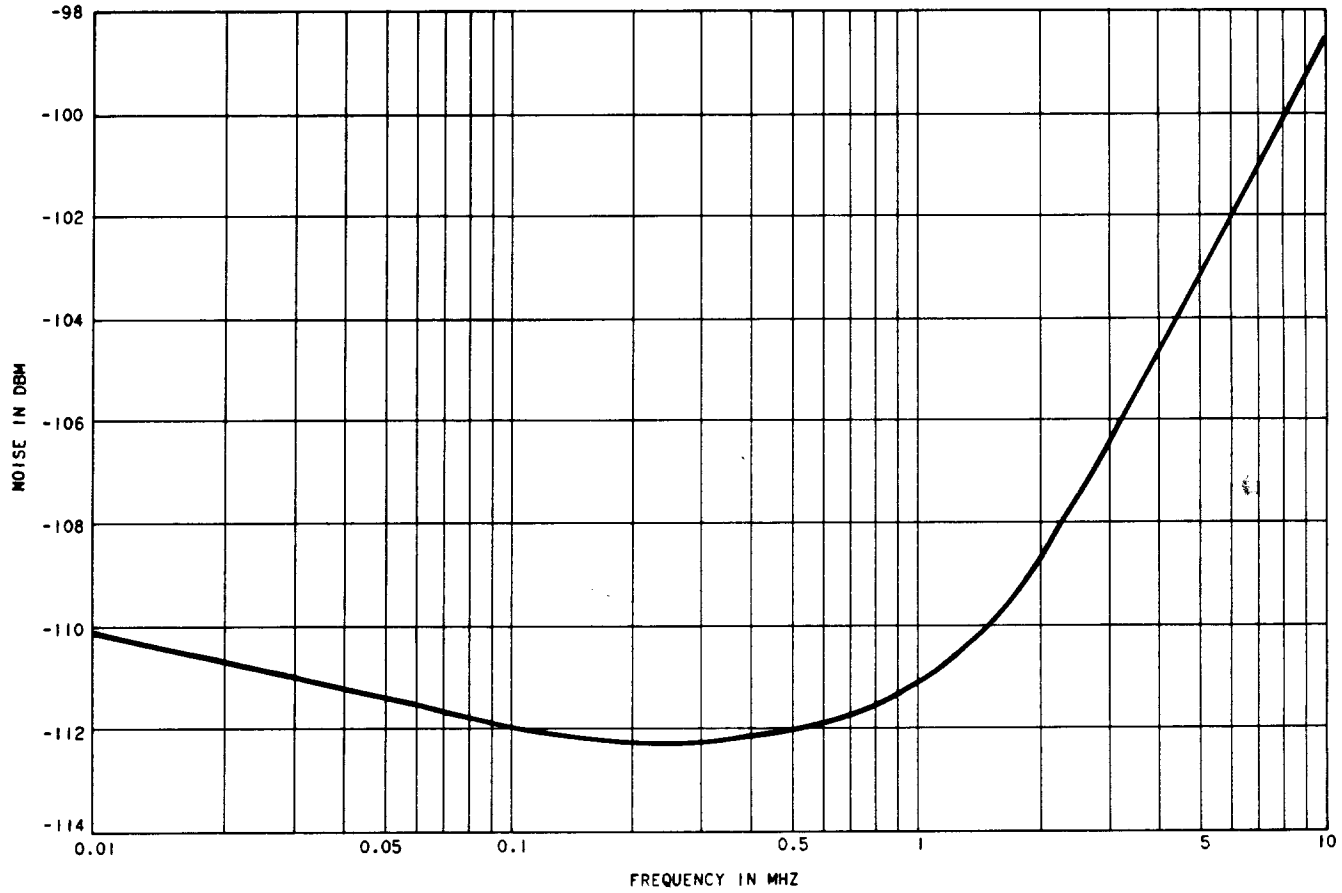

Fig. 8—3A/4A FM Terminal Pair Fluctuation Noise (Without Pre-Emphasis)

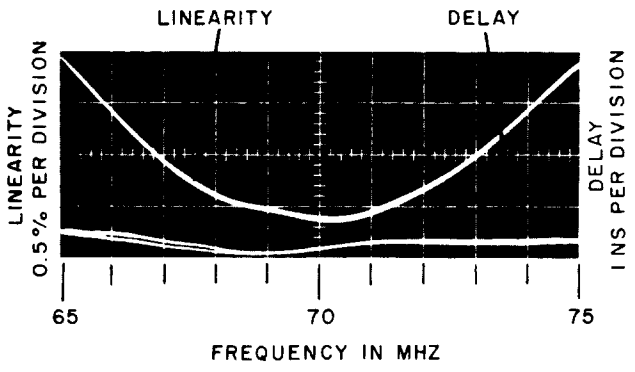

Fig. 9—3A/4A FM Terminal Pair Linearity and Delay

7. REFERENCES

7.01 The following provide detailed information on the 4A FM terminal receiver and associated equipment.

SECTION	TITLE
AA266.107	Microwave Radio, IF Patch and Access, FM Terminals, FM Terminal Patching, and Associated Miscellaneous Equipment (J68417)
AA266.108	TD and TH Radio, 4-Type FM Terminal Equipment (J68418)
420-215-100	Microwave Radio, FM Terminal, 4A FM Receiver, Description
940-390-100	Radio Engineering, Microwave Radio, FM Terminals, General
940-390-103	Radio Engineering, Microwave Radio, 3-Type FM Terminals (J68383)

DRAWING	TITLE
SD-50562-01	Microwave Radio, FM Terminal Bay, Application Schematic
SD-50577-01	Microwave Radio, 4A FM Terminal Receiver