RADIO ENGINEERING
MICROWAVE RADIO
TH-1 FM TERMINALS (J68406)

CONTENTS PAGE

1. GENERAL 1
2. FUNCTIONAL DESCRIPTION 1
3. TERMINAL PAIR PERFORMANCE . . . 4
4. SPACE REQUIREMENTS 4
5. POWER REQUIREMENTS 4
6. TEST EQUIPMENT 6
7. REFERENCES 7

1. GENERAL

1.01 The TH-1 FM transmitting terminal (J68406A) accepts a baseband signal of approximately 0.3 to 8 MHz and produces a 74.13-MHz frequency-modulated IF signal for application to a TH-1 radio transmitter. A TH-1 FM receiving terminal (J68406K) demodulates the radio receiver IF output to baseband at the receiving end of the MUR. Eighteen hundred and sixty message circuits are normally carried on a TH-1 radio channel. TH-1 radio systems are primarily used in long haul applications and approximately 16 pairs of TH-1 FM terminals, shown in Fig. 1, may operate in tandem on a maximum length circuit.

1.02 TH-1 FM terminals are described in Section 412-200-100. Transmission characteristics of the terminals are summarized in Table A for quick reference. TH-1 FM terminals (election tube type) are now rated "Manufacture Discontinued" and are superseded by solid-state 3B (J68383) FM terminals.

2. FUNCTIONAL DESCRIPTION

2.01 A block diagram of the TH-1 FM terminal transmitter is shown in Fig. 2. Baseband signals are applied through a video amplifier to a

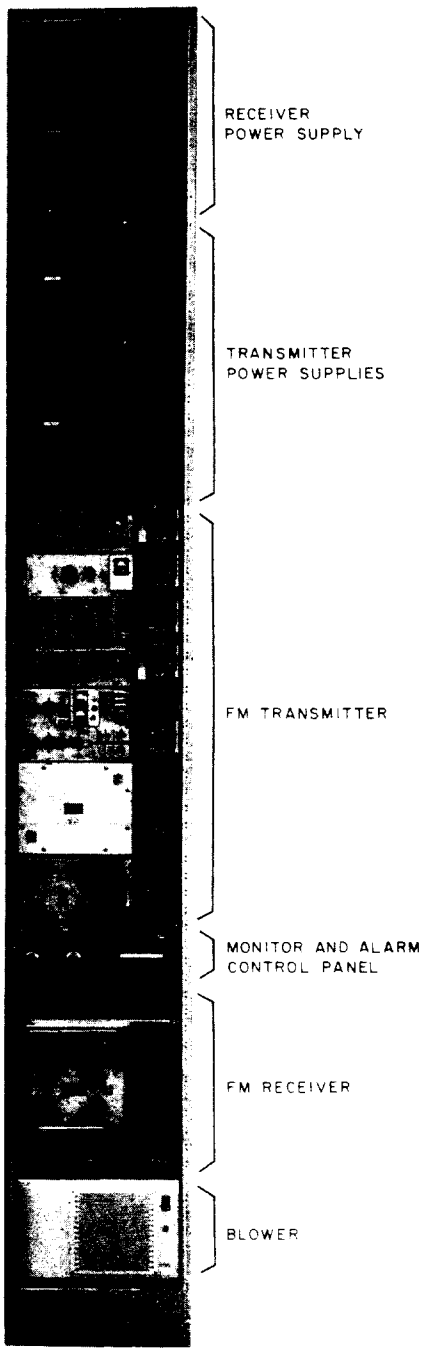

Fig. 1—TH-1 FM Terminal Bay

TABLE A

TH-1 FM TERMINAL TRANSMISSION CHARACTERISTICS

TERMINAL PAIR	
Baseband response (60 Hz to 10 MHz)	±0.1 dB
Channel net gain	8 dB
Number of message circuits	1860
Number of NTSC television signals	1
Worst channel noise (normal drive)	27 dBrnc0
Differential gain (±4 MHz deviation)	1.25 dB max
Differential phase (±4 MHz deviation)	0.3 degree max
Operating temperature range	0 to 50°C
Warmup time	60 minutes
TRANSMITTER	
Baseband input impedance	124Ω balanced
Baseband input power for ±4 MHz deviation	0 dBm sine wave
Baseband input power of 1860 message circuits	−12 dBm
Deviation oscillator frequency	6174.13 MHz
Beat oscillator frequency	6100.00 MHz
Carrier frequency	74.13 MHz
Carrier frequency stability	±0.1 MHz
IF output impedance	75Ω unbalanced
Nominal IF output power	+11 dBm
Flatness of IF output (64 to 84 MHz)	±0.1 dB
RECEIVER	
IF input impedance	75Ω unbalanced
IF input return loss (64 to 84 MHz)	> 25 dB
Nominal IF input power	+1 dBm
Baseband output impedance	124Ω balanced
Baseband output power (±4 MHz deviation)	+8 dBm

reflex klystron deviation oscillator. The baseband signal varies the repeller voltage of the klystron to form a frequency modulated signal with a midfrequency of 6174.13 MHz. This signal is heterodyned in a crystal mixer circuit with a 6100-MHz signal from a klystron-type beat oscillator to produce a 74.13-MHz IF signal. The IF signal is amplified by the transmitter amplifier, then fed through a splitting pad to the IF input of the radio transmitter, usually via an IF patch bay or protection switching equipment. The deviation sense is negative; i.e., a negative going input voltage on the tip side of the input circuit results in an increase of the IF.

2.02 A low-level signal (−17 dBm) is fed from the splitting pad in the main transmission path to AFC circuits. These circuits generate a bias voltage for application to the beat oscillator to maintain the IF frequency at 74.13 ±0.1 MHz. The AFC circuits consist of an amplifier, reference oscillator, limiter-discriminator, and frequency comparator. These circuits also provide an alarm if the IF frequency drifts as much as 1 MHz from 74.13 MHz.

2.03 An optional IF level detector provides an alarm output if the IF output power deviates as much as 2 dB from the nominal output of +11

dBm. The output of the baseband video amplifier is also monitored and an alarm is generated if this signal changes level by as much as 3 dB. These two alarm inputs, plus AFC alarms (of which frequency drift is most significant) are fed through the monitor and alarm control panel to external alarm and protection switching circuits.

2.04 Two power supplies provide heater and plate power for the transmitter. The power supplies are fed from a firm 230-volt, ac source.

2.05 The FM terminal receiver (Fig. 3) is fed a 74.13-MHz IF signal from the TH-1 radio receiver. An input signal of at least 1 dBm is required by the receiver; therefore, an IF amplifier having 22 dB maximum gain may be optionally installed to boost a low-level IF signal. An amplifier-limiter circuit, preceded by a 343C equalizer, limits the signal to suppress amplitude modulation components. It also amplifies the signal before application through a variable attenuator to the discriminator-video amplifier. Balanced tuned circuits in the discriminator, offset in opposite directions by about 20 MHz from the 74.13-MHz carrier, convert the FM signal back to baseband. The output into a 124-ohm balanced line is +8 dBm.

2.06 A video amplifier monitor and an optional IF level detector furnish alarm and switching instructions in the event of equipment failure. Heater and plate potentials for the receiver are provided by a single power supply.

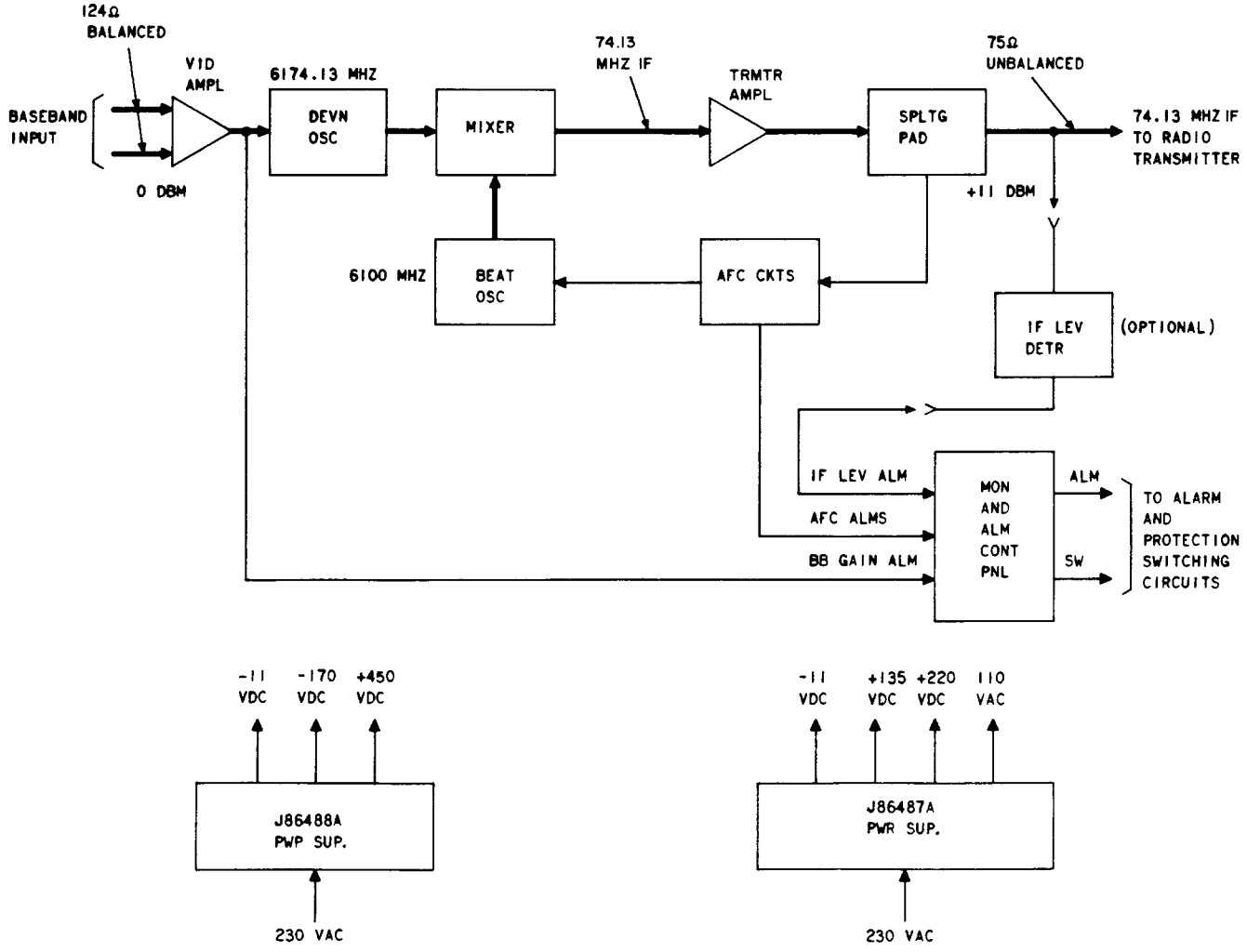

Fig. 2—TH-1 FM Terminal Transmitter

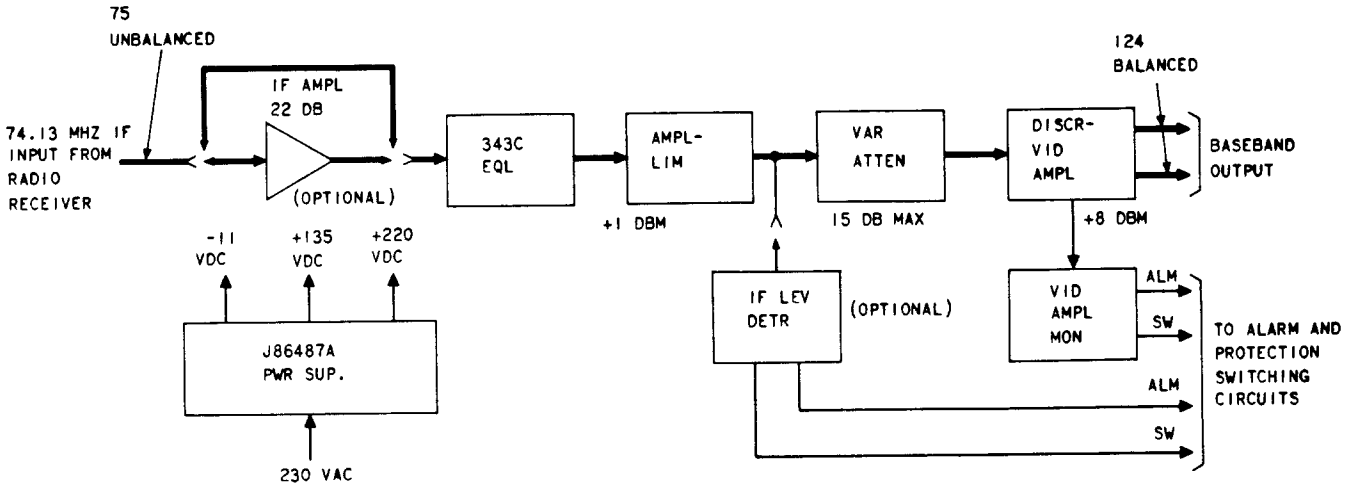

Fig. 3—TH-1 FM Terminal Receiver

3. TERMINAL PAIR PERFORMANCE

3.01 Typical performance characteristics of TH-1 terminal pairs connected back-to-back are shown in this part by graph and oscilloscope presentations. Noise load curves, baseband response, and envelope delay distortion are shown.

Noise Loading

3.02 Noise load curves obtained with a typical TH-1 terminal pair loaded with the equivalent of 1860 message circuits are shown in Fig. 4. Curves at 360 kHz and 8.0 MHz represent noise generated by a terminal pair near the lowest and highest frequencies of the message load baseband.

3.03 The noise load applied for test purposes is shown in Fig. 5. Its bandwidth corresponds to that of 1860 message circuits and its amplitude versus frequency characteristic approximates the stepped pre-emphasis normally used with TH-1 radio systems. For comparison purposes, stepped pre-emphasis levels are also shown in Fig. 5.

Baseband Response

3.04 Overall baseband response of a typical TH-1 FM terminal pair is shown in Fig. 6. Maintenance limits for a terminal pair are flat response ± 0.05 dB from 0.3 to 10 MHz.

Envelope Delay Distortion

3.05 Envelope delay distortion of a TH-1 FM terminal pair is shown in Fig. 7. Transmitter drive was adjusted to produce ± 4 MHz deviation for this test.

4. SPACE REQUIREMENTS

4.01 A standard bay of TH-1 FM terminal equipment (coded J68406R) contains a J68406A transmitter, J68406K receiver, J68406B monitor and alarm control unit, three power supplies, and a blower. The units mount in a 19-inch duct-type bay that is 11-feet, 6-inches high. A complete J68406R FM terminal bay constitutes an FM terminal pair.

5. POWER REQUIREMENTS

5.01 Power for the terminal components of the FM terminal bay is derived from a firm 230-volt ac source by three power supplies mounted at the top of the bay. One J86487A and one J86488A are required by the transmitter. A single J86487A is required to power the receiver. The capacity of the power supplies is given in Table B.

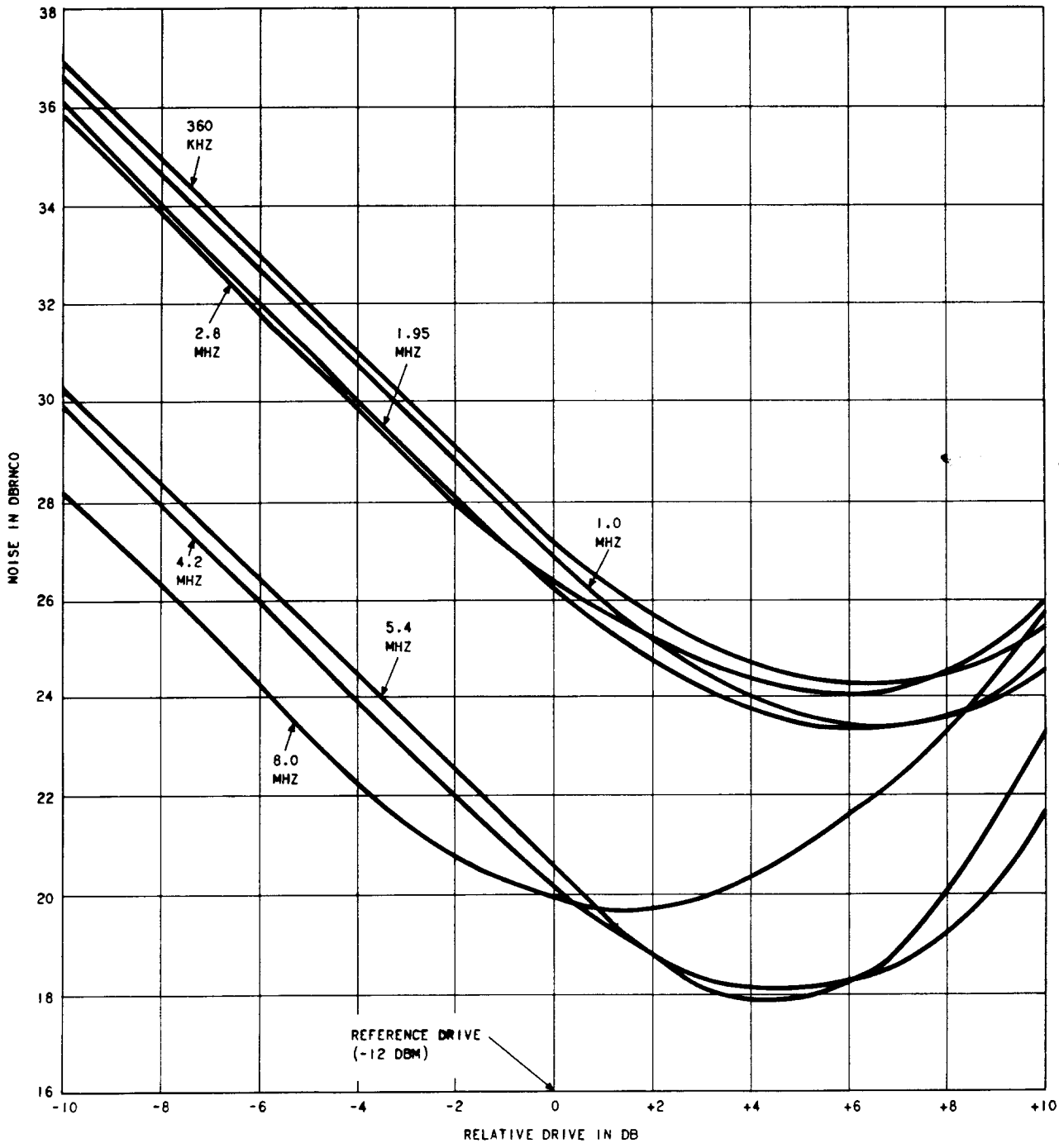

Fig. 4—TH-1 FM Terminal Pair 1860-Circuit Noise Load Curves (Pre-Emphasized)

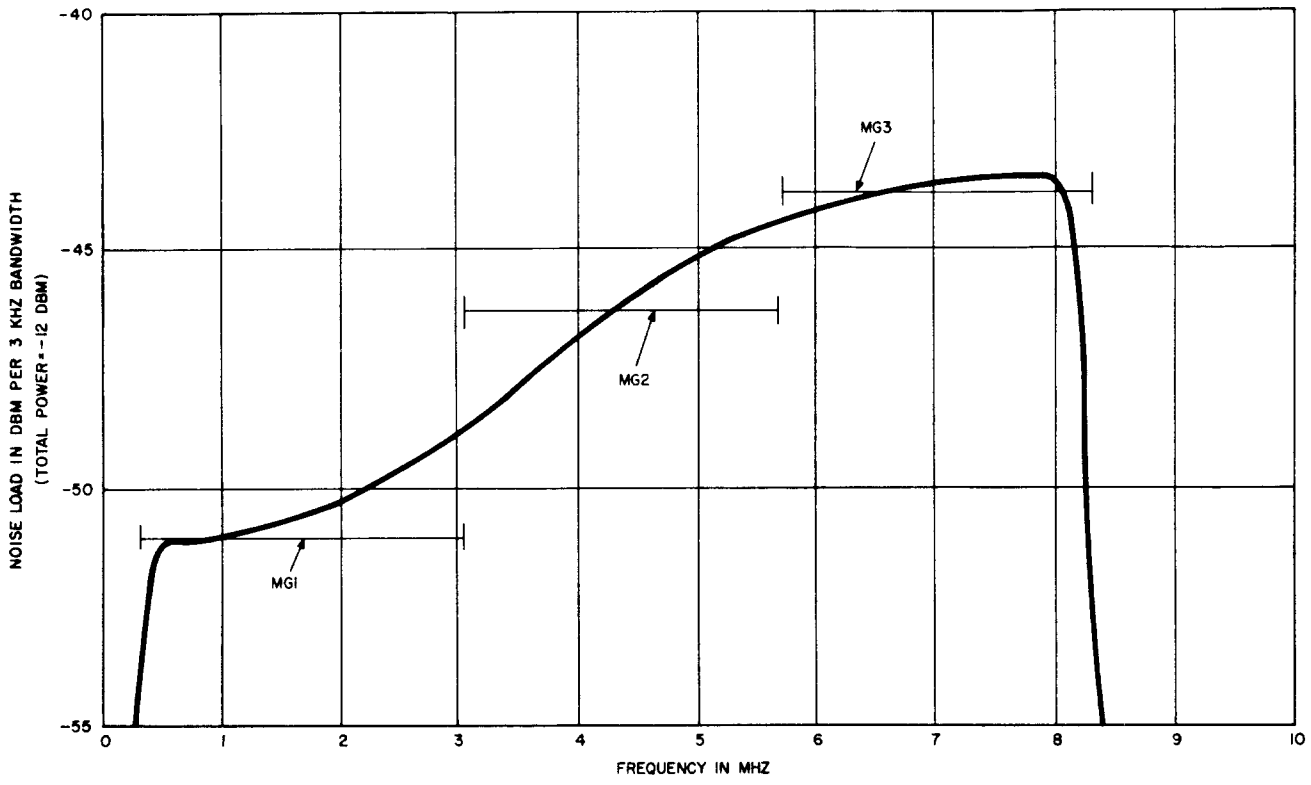

Fig. 5—Noise Load

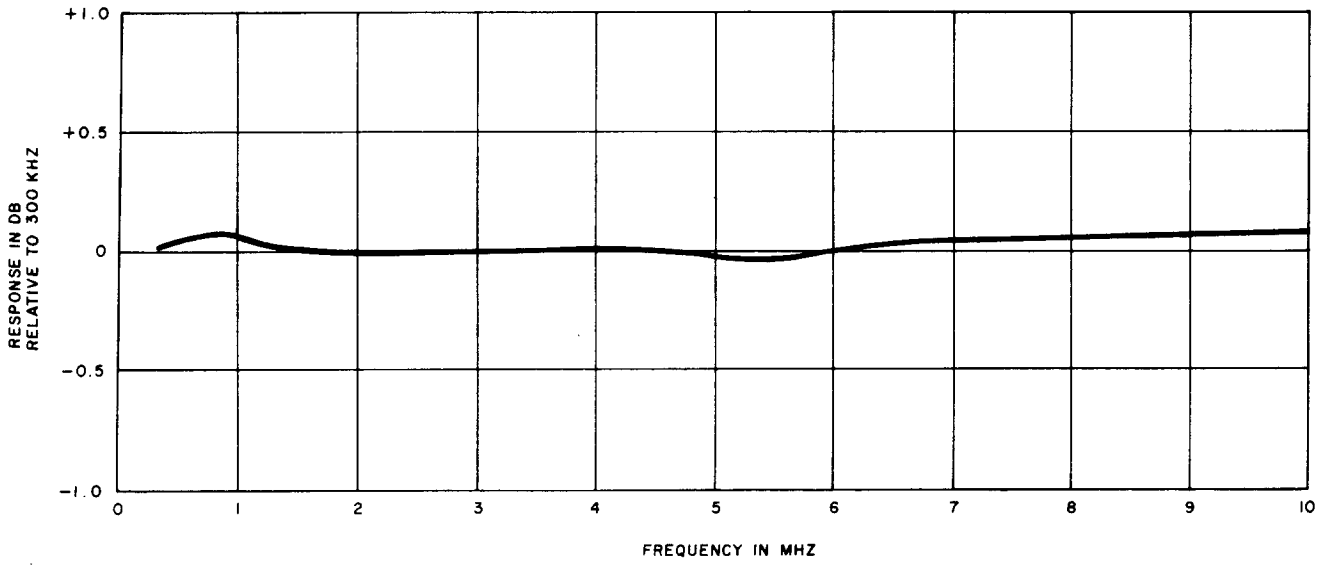

Fig. 6—TH-1 FM Terminal Pair Baseband Response

6. TEST EQUIPMENT

6.01 The J68408A FM Terminal Test Set is required to test and align TH-1 FM terminals. The test set is a mobile console-type cabinet on which are mounted individual test units. Tests and adjustments fall into broad categories of (1) IF transmission, (2) IF power, (3) IF return loss, (4) video transmission, (5) transmitter and receiver deviation sensitivity, and (6) transmitter and receiver linearity. A complete description of the test set is given in Section 104-306-100.

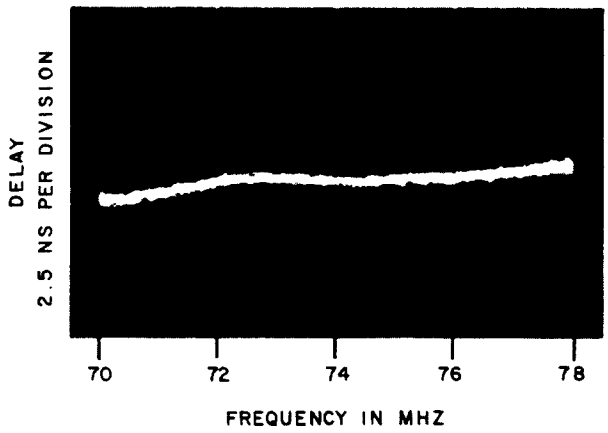

Fig. 7—TH-1 FM Terminal Pair Envelope Delay Distortion

7. REFERENCES

7.01 The following provide detailed information on TH-1 FM terminals and associated equipment.

SECTION	TITLE
AA266.067	TH Radio System, General Requirements (J68401)
AA266.073	TH Radio, FM Terminal Equipment (J68406)
AA266.078	TH Microwave Radio, FM Terminal Test Set (J68408)
104-306-100	Radio Test Equipment, FM Terminal Test Sets, J68408A FM Terminal Test Set, Description
167-770-306	J86487A Power Supply, +220V, +135V, −11V DC, and 110V AC, TH Radio, Operating Methods 167-770-311 J86488A Power Supply, +450V, −170V, and −11V Regulated DC, TH Radio, Operating Methods
412-100-100	TH Microwave Radio, Overall System, Descripton
412-200-100	TH Microwave Radio, FM Terminal Transmitter and Receiver, Description
940-390-100	Radio Engineering, Microwave Radio, FM Terminals , General

DRAWING	TITLE
SD-53080-01	TH Radio, FM Terminal Test Set Circuit
SD-59823-01	TH Radio, Application Schematic, FM Terminal Transmitter
SD-59830-01	TH Radio, Application Schematic, FM Terminal Receiver
SD-81442-01	Power Systems, Power Supply Circuit, TH Radio (J86487A)
SD-81443-01	Power Systems, Power Supply Circuit, TH Radio (J86488A)

TABLE B

CAPACITY OF POWER SUPPLIES

POWER SUPPLY	LOADED 230 VAC DRAIN (WATTS)	AMPERES DELIVERED AT					
		−11 VDC	+135 VDC	−170 VDC	+220 VDC	+450 VDC	115 VAC
J86487A, L1	368	10	0.375	—	0.500	—	0.001
J86488A, L1	138	2	—	0.004	—	0.120	—