TECHNICAL MANUAL

OPERATOR'S ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL FOR

TELEPHONE LINE EQUALIZER CN-1468/FTC (NSN 5805-01-012-5966)

HEADQUARTERS, DEPARTMENT OF THE ARMY
SEPTEMBER 1976

WARNING

HIGH VOLTAGE

is used in the operation of this equipment.

DEATH ON CONTACT

may result if operating personnel fail to observe safety precautions.

DON'T TAKE CHANCES!

Be careful when working on the 115/230-volt ac line connections. Turn off the power and disconnect the line cord plug from the ac source before making any teat connections or before working inside the chassis. Before connecting the CN-1468/FTC to a 115/230-volt ac source, be sure that the chassis is grounded properly.

WARNING

DANGEROUS CHEMICALS

are used to clean this equipment.

or severe burns may result if personnel fail to observe safety precautions.

TECHNICAL MANUAL
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HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *1 September 1976*

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REPORTING OF ERRORS

You can improve this manual by recommending improvements using DA Form 2028-2 (Test) located in the back of the manual. Simply tear out the self-addressed form, fill it out as shown on the sample, fold it where shown, and drop it in the mail.

If there are no blank DA Forms 2028-2 (Test) in the back of your manual, use the standard DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward to the Commander, US Army Electronics Command, ATTN: DRSEL-MA-Q, Fort Monmouth, New Jersey 07703.

In either case a reply will be furnished direct to you.

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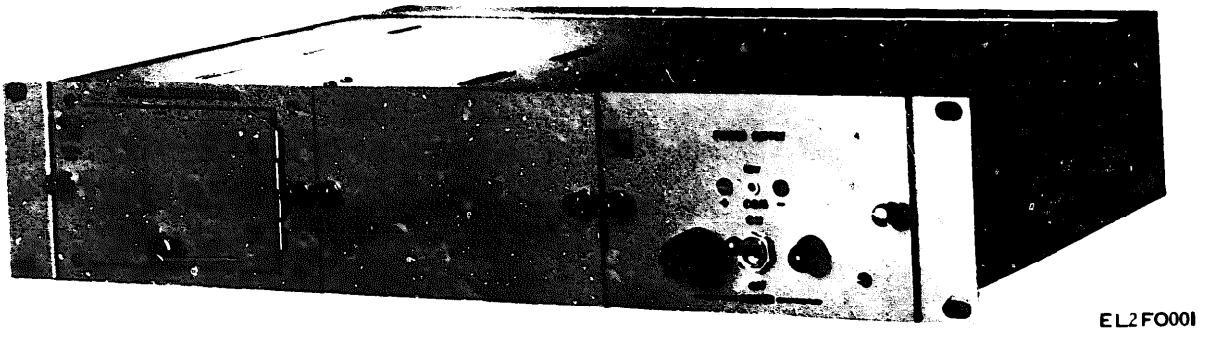


Figure 1-1. Equalizer, Telephone Line CN-1468/FTC.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual describes Equalizer, Telephone Line CN-1468/FTC. It contains instructions for operation, and for maintenance of the equipment. Appendix A contains a list of current references, forms, and other publications applicable to the Equalizer. Maintenance responsibilities are allocated to the operator, organizational, and general support in the maintenance allocation chart (app C). No direct support is authorized.

1-2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-3. Forms and Records

a. Reports of Maintenance and Unsatisfactory [redacted]

ports which are to be wed by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A, and DSAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33A/AFR 76-18/MCO P4610.19B and DSAR 4500.15.

1-4. Administrative Storage

Administrative storage of equipment issued to and used by Army activities shall be in accordance with TM 74040-l.

1-5. Destruction of Army Electronics Material

Destruction of Army electronic8 materiel to prevent enemy use shall be in accordance with TM 750-244-2.

Section II. DESCRIPTION AND DATA

1-6. Purpose and Use

Equalizer, Telephone Line CN-1468/FTC is a rack-mounted unit for use on standard transmission [redacted] am&k&ion and slope equaliza- 50 kilobit baseband and diphase data over the frequency range of 10 Hz to 70 kHz. The unit provides slope equalization on 19 AWG, 22 AWG, 24 AWG, and 26 AWG nonload, toll-quality cable pairs.

1-7. Description (fig. 1-1)

a. Equalizer, Telephone Li[redacted]e CN-1468/FTC is a self-contained, solid state, [redacted] rack-mounting unit. It comp[redacted] and high frequency rolloff of [redacted]

b. The unit (consists of a shelf assembly, a plug-in equalizer module, and a plug-in power supply module. Additional space is provided in the shelf assembly for another equalizer module. The power supply module provides sufficient power for one or two plug-in equalizer modules.

1-8. Tabulated Data

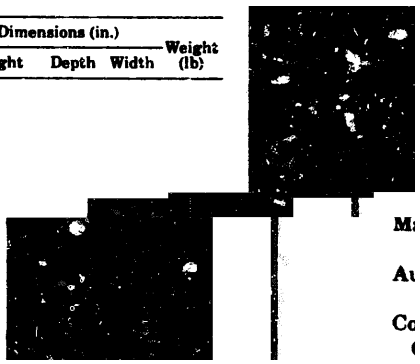
Frequency Response	Flat, 10 Hz to 70 kHz +/- 3db high frequency boost 25 db

	at 70 kHz high frequency rolloff, over 12 db per octave above 70 kHz.
Input/Output Impedance	135 ohms ± 10%, balanced.
Data Level--Input	0 dbm (1.1V peak-to-peak) max. - 23.5 dbm min, flat.
output	0 dbm, regulated, adjustable.
Automatic Path Control	
Path 1	Passes signals, input to output, from 10 Hz to 70 kHz with adjustable gain, 0 to 23 db, in path.
Path 2	Passes signals, input to output, from 10 Hz to 70 kHz with automatic gain control 0 to 23 db, in path.
Path-Switching Control.	Frequency spectrum of signal. Path 2 secured with data frequency spectrum signal at input. Idle state and input frequencies below 3 kHz result in path 1 selection.
Path-Switching Time	From path 1 to path 2 after application of data signal, less than 2 seconds.
Frequency Response Correction	
Main Control	Provides up to 25 db boost at 70 kHz.
Auxiliary Control	Provides up to 5 db boost at 5 kHz.
Correction Response Curve.	Smooth curve as dictated by a single pole, rc filter.
Automatic Cain Control	Provide8 less than +l db output variation for any +/-7.5 db input variation in the range of -23.5 dbm to 0 dbm. AGC IN-OUT switch provides disabling of AGC.

Impulse Noise	Not over 20 hits in 10 minute period with threshold of 54 dBRN. 20 Hz to 50 kHz bandwidth.
Power Requirements	115/230VAC ±10%, 47 to 63
isions	3 15/22" H x 19" W x 20" D. Shelf accommodates two plug-in equalizer units (one supplied) and one plug-in power supply.
lizer	Panel 3 15/22" H x 5 9/16" W.
r Supply	Panel 3 15/22" H x 5 9/16" D.

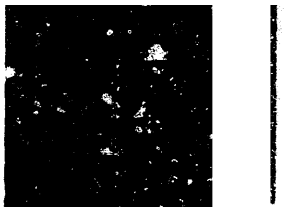
1-9. Items Comprising an Operable Equipment

m	Qty	Dimensions (in.) Height	Depth	Width	Weight (lb)
lizer, Tele-ne Line CN-8/FTC Con-ing of:					
	20	5 9/16	1 5/8		
	20	5 9/16	1 1/4		
	20	19	3 1/2		



1-10. Running Spares

	Qty
	5
	1



CHAPTER 2

SERVICE UPON RECEIPT AND INSTALLATION

Section I. SYSTEMS PLANNING

2-1. Equalizer Configurations

a. The equalizer, which is supplied in two configurations (one or two equalizer modules), is installed in a telephone central office environment. The unit is used, in a system application, with the following items:

(1) FTC-31 switches.

(2) KY-3 equipments.

b. System planning should take into account the associated equipment listed in a above, the installation and suitability of racks, patch panels to be used as distribution points, and interconnecting' cabling and/or wiring Bower requirements for the equalizer are given in paragraph 1-9.

2-2. Site and Shelter Requirements

The equalizer is housed normally in a permanent **shelter during use; i.e., a central telephone office.** Nineteen inch relay racks are used for installation.

Section II. SERVICE UPON RECEIPT OF MATERIEL

2-3. Unpacking

a. Packaging Data. When packed for shipment, the entire unit is packed in one carton. A typical shipping carton and its contents are shown in figure 2-l.

b. Removing Contents.

(1) Cut the tape on top of the carton and fold back the flaps.

(2) Cut the steel strapping and the tape on top of the inner carton and fold back the flaps.

(3) Open the barrier bag.

(4) Cut the tape on top of the carton and fold back the flaps.

(6) Remove the desiccant and the corrugated pad.

(6) Remove the envelope that contains the manual.

(7) Remove the unit from the carton.

2-4. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If equipment has been damaged, report the damage on DD Form 6 (para 1-3).

b. See that the equipment is complete as listed on the packing slip Report all discrepancies in accordance with TM 38-750. Shortage of minor assembly or part that does not affect proper functioning of the equipment should not prevent use of the equipment.

c. If the equipment has been used or reconditioned, see whether it has been changed by a modification work order (MWO). If the equipment has been modified, the MWO number will appear on the front panel near the nomenclature plate. If modified, see that any operational instruction changes resulting from the modification have been entered in the equipment manual.

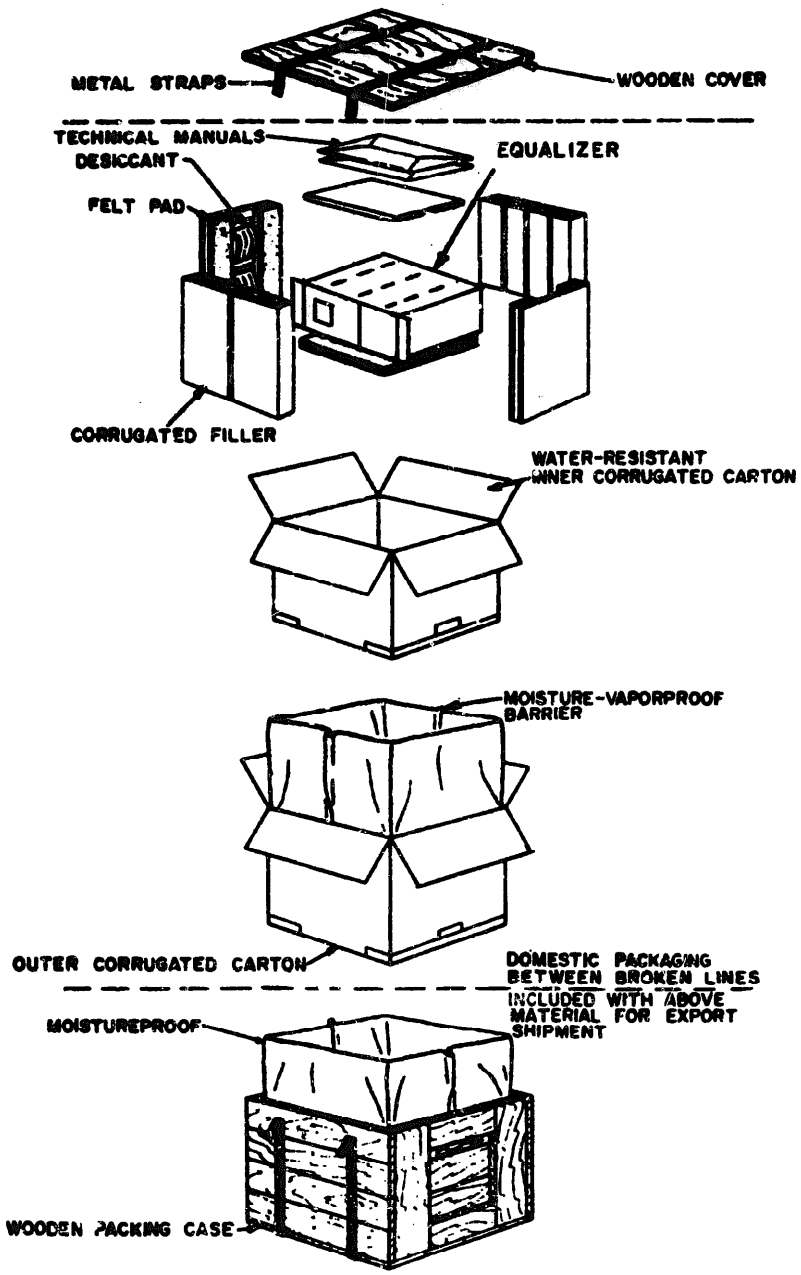


Figure 2-1. Equalizer, Telephone Line CN-1468/FTC, packaging diagram.

Section III. INSTALLATION INSTRUCTIONS

2-5. Test equipment Required for Installation

Standard tools and hardware are all that are required for installation of the equalizer.

2-6. Installation

Equalizer, Telephone Line CN-1468/FTC is shipped with one equalizer module and t supply module assembled in its shelf.

2-7. Interconnections and Cabling

NOTE

Unless otherwise indicated, refer t ure 2-2 when performing *a* throu below.

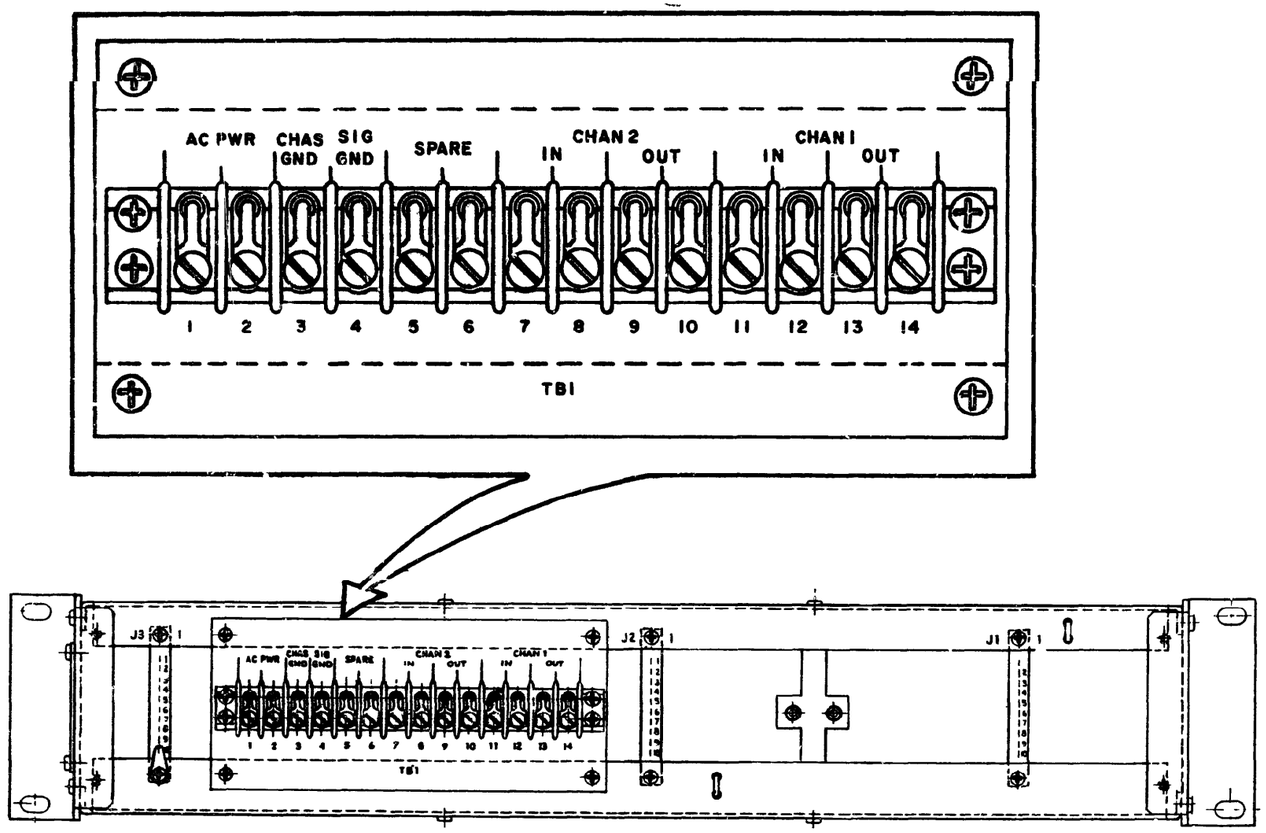
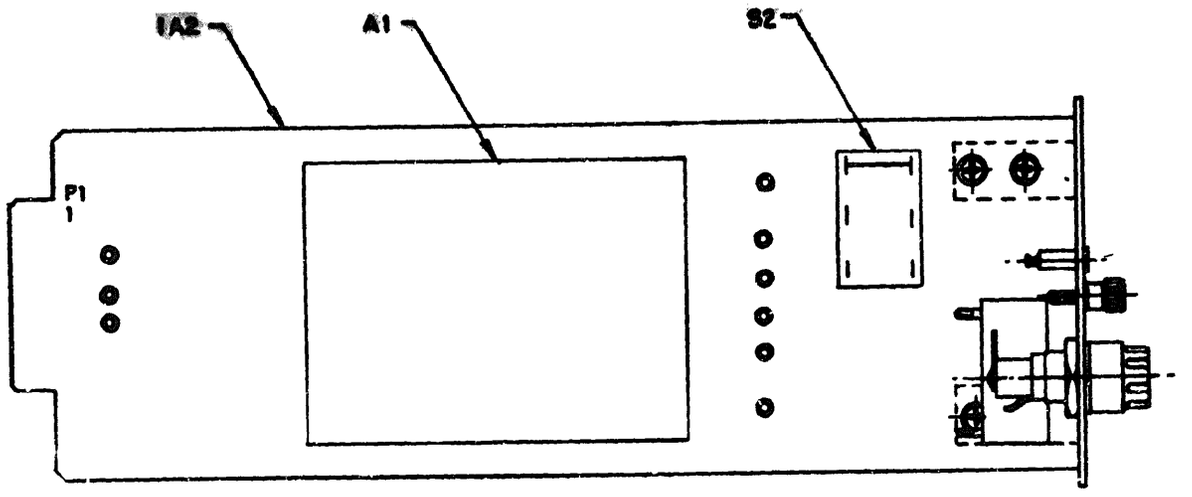


Figure 2-2. Shelf assembly-rear view, cover removed



EL2F0004

Figure 2-3. Power supply assembly, side view

a. Remove rear cover plate.

b. Connect 115/230 volts ac to terminals marked AC **PWR.**

c. Set switch S2 (located on power supply assembly) to 115VAC for 115-volt ac operation; or 230VAC for 230-volt ac operation (fig. 2-3).

d. Connect the ground wire to the terminal marked CHAS GND.

e. Connect the transmission line pair from the source of data signals to the two IN line terminals (of channel 1) on the equalizer terminal board.

f. Connect the transmission line pair that goes to the receiving data equipment to the two OUT line terminals of channel 1 on the equalizer terminal board.

NOTE

Channel 1 is the equalizer at the front left of the shelf assembly (normally supplied with the equipment).

g. Connect a lead from the SIG GND terminal to station signal ground.

h. Connect a lead from the CHAS GND terminal to the station drain ground.

NOTE

In some installations the two ground leads may be connected together.

a. Replace the rear cover plate allowing the wiring to come through the hole in the cover plate.

CHAPTER 3

OPERATING INSTRUCTIONS

3-1. Controls and Indicators

The **controls** and indicators to operate the equalizer are shown in figures 3-1,3-2, and 3-3. Refer to table 3-1 for function, operation, and pertinent data

3-2. Types **of Operation**

a. Equalizer, Telephone Line CN-1468/FTC operates to compensate for flat loss and high frequency rolloff of telephone-type cable transmisdon systems over the frequency bandpass of 10 Hz to 70 kHz, as specified below.

(1) Flat gain -23 db.

(2) High frequency boost-up to 25 db at 70 kHz with correction a smooth curve as dictated by a single pole **rc** filter.

b. The equalizer will operate with diphase or baseband data signals.

c. The equalizer will operate with line supervisory signals of 2600 Hz or less in frequency.

d. The equalizer should be placed to operate where line loss before the equalizer does not exceed the gain figures stipulated in a above.

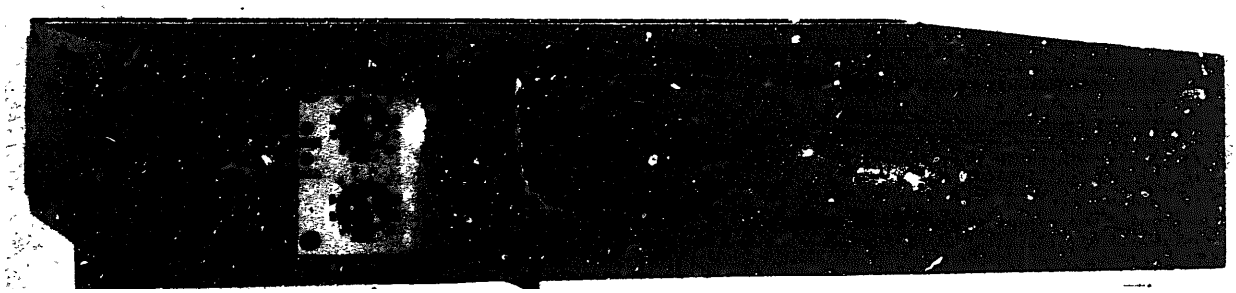
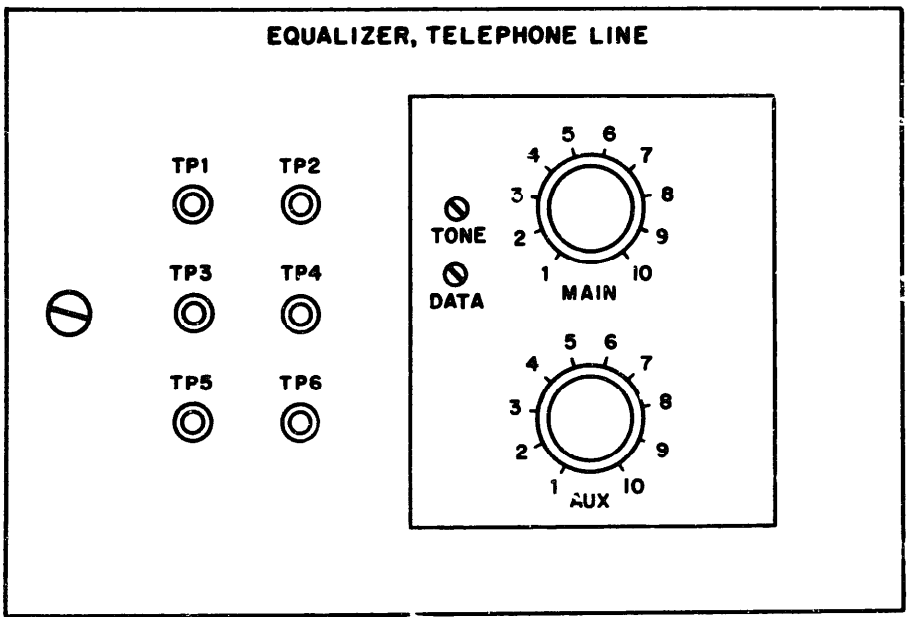
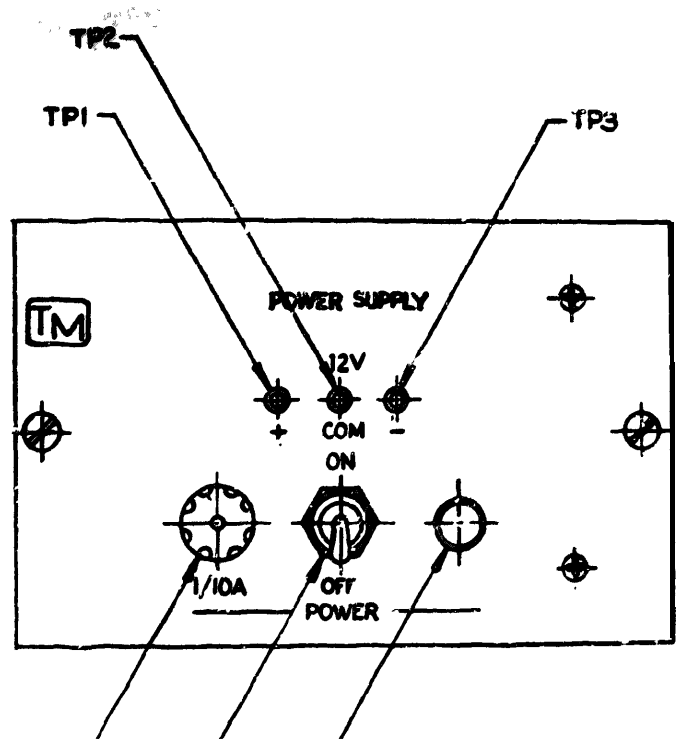


Figure 3-1. Equalizer, Telephone Line CN-1468/FTC, front panel view. EL2F0005



EL2F0006

Figure 3-2. Equalizer assembly, front panel controls.



EL2F0007

Figure 3-3. Power supply assembly, front panel controls.

Table 3-1. Controls and Indicators

Control, indicator, or connector	Function
MAIN control (knob control with 1 to 10 panel calibration).	Provides the main amount of equalization boost, up to 25 db, at the high frequency (70 kHz) end of the spectrum.
AUX control (knob control with 1 to 10 panel calibrations).	Provides auxiliary equalization boost at the center (5 kHz) of the spectrum.
TONE control (screwdriver control).	Provides a means of setting the gain and output level of the supervisory tone path through the equalizer.
DATA control (screwdriver control).	Provides a means of setting the gain and output level of the data path through the equalizer.
ut	Provides measurement of input signal level to the equalizer.
al	Provides measurement of signal after equalization in the equalizer.
r-	Provides measurement of signal after regulating amplifier and low pass (70 kHz) filter in the equalizer.

Table 3-1. Controls and Indicators - Continued

Control, indicator, or connector	
TP4	Provides signal ground connection or test equipment.
TP5	Provides connection to one leg of balanced output line of equalizer.
TP6	Provides connection to other leg of balanced output line of equalizer.
POWER switch	Controls application of power to equipment.
1/10A fuse	Contains 1/10 ampere fuse used as protective device in ac line.
POWER indicator	Indicates power is on when lamp is lighted.
+ (red) test point	Provides measurement for +12 volts dc when power supply is in operation.
COM (white) test point	Provides common signal ground point for measurement of +/-12 volts.
.- (violet) test point	Provides measurement for -12 volts dc when power supply is in operation.

3-3. Preliminary Starting Procedure

a. **Adjust** equalizer controls as follows:

(1) MAIN control counter&&wise to 1.

(2) AUX control counterclockwise to 1.

b. Set POWER switch to ON.

c. Check to see that the POWER indicator lamp **lights.**

3-4. Operation on Supervisory Signals

a. General. Where the telephone line carries SF supervisory signals, such as 2,600 Hz idle state tone or l,000 Hz ring signaling, adjust the TONE control. Signaling tones of 2,600 Hz are used on trunk circuits for conveying supervisory and dial information. Ring signaling usually is conveyed **with** a 1,000-Hz signal having a low frequency modulation superimposed.

b.Operation.

(1) Where the equalizer is in a trunkline with SF units at both ends, instruct the end operators to go on-hook, thus putting the 2,600 Hz signal on the line.

(2) Connect Test Set, Telephone AN/USM-181B (ac voltmeter) to TP5 and TP6. Set the voltmeter to operate from -10 to -20 dbm.

(3) Adjust the TONE control for an output level of -18 dbm. If adjustment cannot be made, check for 2,600 Hz input signal at TP2 and TP4 using Oscilloscope AN/USM-281C.

(4) Where 1,000 Hz ring signal is used on the line rather than 2,600 Hz supervisory tone, have the remote operator apply the ring signal to the line continuously and proceed as in (2) and (3) above. In (2) and (3) above, set the voltmeter to measure a level of 0 dbm to -10 dbm and adjust the TONE control for an output level of -6 dbm at TP5 and TP6.

3-5. Operation on baseband Signals

a. General. Baseband 50 kilobit signals provide a 25-kHz reversal or square wave signal where in-bit durations are varied for informational purposes. An oscilloscope usually is employed to ob serve these signals using an eye pattern for adjustment purposes. When the eye pattern has a flat top with zero bit crossings that fall on each other, an optimum adjustment of the equalizer has been made (fig. 3-4). The overshoot at the front edge of the bit is caused by the low pass filter used in the equalizer.

b. Operation.

(1) Operate the equalizer as specified in paragraph 3-3.

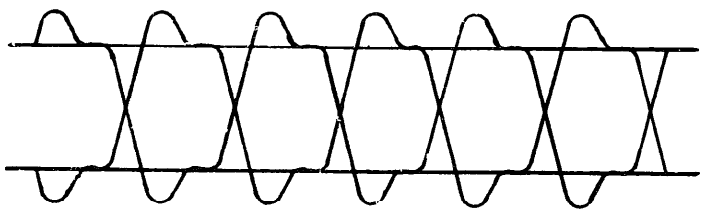
(2) Connect an oscilloscope to TP5 and TP6.

(3) Instruct the remote end operator to apply a baseband idle pattern data signal to the equalizer.

(4) Allow a few seconds for stabilization and adjust the oscilloscope sweep and amplitude control to secure a pattern similar to that shown in figure 3-4.

(5) Adjust the MAIN and AUX controls of the equalizer clockwise until the flat top section of the pattern is as flat as possible while the zero axis crossovers overlap. Use as little sync on the oscilloscope as possible since the sync may be inclined to distort the crossover (overlapping) pattern seen on the oscilloscope.

(6) Adjust the DATA level control on the equalizer until the data signal has a 1 volt peak-to-peak value as seen on the oscilloscope (fig. 3-4).



EL2F0008

Figure 3-4. Baseband eye pattern.

3-6. Operation on Diphase Signals

a. General. The diphase data signal uses a one-cycle signal for each bit during a steady-state condition. A change in state of the input signal results in one-half cycle per bit. Basic frequencies present on the line are therefore 50 kHz and 25 kHz. Amplitude equalization of the line between 25 kHz and 50 kHz is thus of prime importance. To accomplish this the oscilloscope is adjusted to secure a waveform as shown in figure 3-5. This portrays an active signal on the line supplying both 25 kHz and 50 kHz signals with changing bits.

b. Operation.

(1) Perform the operations of paragraph 3-5b, but supply an actively keyed diphase signal when performing paragraph 3-5b(3).

(2) Adjust the oscilloscope to secure a pattern as shown in figure 3-3. This displays an overlap ping 50 kHz and 25 Hz pattern where the trace portion labeled flat top is a result of the 25 kHz signal.

(3) Adjust the MAIN equalizer control so that the flat top section is parallel to the base-line while the zero axis crossovers overlap.

(4) Adjust the DATA level control on the equalizer until the data signal has a one volt peak-to-peak value as seen on the oscilloscope (fig. 3-5).

3-7. Line Equalization Without Data Signal

a. General. A telephone line may be equalized, within the capabilities of the equalizer, by transmitting discrete tone signals at the far end terminal and adjusting the equalizer MAIN and AUX control for optimum correction.

b. Operation.

(1) Connect an audio oscillator (part of AN/USM-181B) having a frequency range of 10 Hz to 100 kHz and an output impedance of 135 ohms to the sending end of a telephone line over which data is to be sent. For best results, the equalizer should be installed at a b-mile interval in the line or at such point where the 70 kHz attenuation relative to the attenuation does not exceed 25 db.

(2) Adjust the oscillator for 100 Hz and a level of 0 dbm (approximately a peak-to-peak level of 1.1 volts as viewed on an oscilloscope).

(3) Remove the equalizer PC card from the shelf and set the AGC slide switch S1 to the OUT position. Replace the equalizer PC card in the shelf. Set the MAIN and AUX equalizer controls fully counterclockwise.

(4) Connect an oscilloscope to TP5 and TP6 of the equalizer to view the signal.

(5) Adjust the equalizer DATA control to secure a 1.1 volt signal as seen on the oscilloscope.

(6) Apply a 70 kHz signal at a 1.1 volt peak-to-peak level to the line.

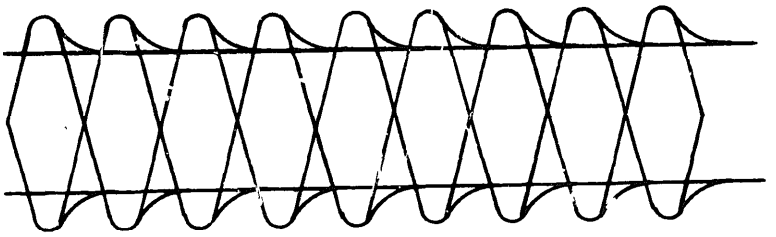


Figure 3-5. Diphase signal. EL2F0009

(7) Operate the MAIN control clockwise until the oscilloscope shows a 1.1 volt reading. If this amplitude cannot be reached, leave the control set at a maximum cloc+wise position.

(8) Adjust the oscillator for 5 kHz at an amplitude of 1.1 volts peak-to-peak at the sending end.

(9) Adjust the AUX control to secure a 1.1 volt peak-to-peak signal at the oscilloscope.

(10) Adjust the oscillator for 25 kHz at an amplitude of 1.1 volts peak-to-peak.

(11) Check the oscilloscope to see the amplitude of the signal at the equalizer output. This should be in the order of 1.1 volts peak-to-peak. If it is not, proceed as follows:

(a) For diphase signals, adjust the AUX control at 25 kHz and the MAIN control at 50 kHz to secure as close as possible equal level signals at the equalizer output.

(b) For baseband signals, adjust the AUX control at 5 kHz and the MAIN control at 25 kHz to secure the same output level at each frequency. Leave the controls set for maximum equalization (uniformity of output signal) at these frequencies.

(c) For baseband signals, check the output level from the equalizer at 100 Hz, 1000 Hz, 5 kHz, 10 kHz, 25 kHz and 50 kHz.

3-8. Normal Automatic Operation

a. General.

(1) Once the equalizer is installed in the telephone transmission line, and equalization adjustments have been made, operation is automatic for supervisory and data signals that are on the line from time to time.

(2) With equalizers installed in both paths of the four-wire full-duplex telephone line, and adjusted for signal level and equalization, make an operational test between the two end terminals (b below).

b. Operation.

(1) Place a call from one operator to the second operator by dial or line signaling means.

(4 Operate the data equipment to place an idle-state data signal on the line in both directions.

(3) Operate the equipment to apply data to the line in each direction and observe that recognizable intelligence is secured in each of the two directions.

3-9. Supervisory Signaling Strapping Option

a. The supervisory signaling path may be selected to include equalization or to exclude any equalization. As the equalizer is shipped, strap ping is such that the supervisory signaling path comes from the output of equalization amplifier via strapping terminal E2 to terminal E3.

b. If no equalization is desired in the supervisory signal path, remove the strap from terminal E2 to E3. Reconnect the strap from terminal E3 to terminal E4.

3-10. Stopping Procedure

To stop operation of the equalizer, turn the POWER switch to OFF. The POWER indicator lamp should extinguish, indicating removal of p o w e r .

3-11. Operation Under Unusual Conditions

Although the CN-1468/FTC has been designed to operate over a wide range of temperature and humidity, operation may be difficult in extreme cold, heat, humidity, moisture, and similar conditions. Observe the following procedures when operating under adverse conditions.

a. Cold Climates. Keep the equipment as warm and dry as possible. If the equipment has been exposed to the cold and then brought into a warm room, moisture will gather on the equipment. When the equipment reaches room temperature, dry it thoroughly.

b. Hot Chutes. Provide adequate ventilation. When the surrounding temperature drops, moisture will form on the equipment. Always dry the equipment thoroughly before operating it.

c. Dry Chutes. Keep the equipment as free from dust as possible.

CHAPTER 4

OPERATOR/CREW AND ORGANIZATIONAL MAINTENANCE

4-1. Duties of Operator

There is no risk of damage to the equipment from incorrect control settings. Operator duties include:

a. Visually inspecting the equipment and reporting abnormalities such as burned-out lamp, blown fuse, loose parts, etc.

b. Cleaning equipment by wiping it with a lint free cloth.

c. Evaluating information received from other operators in the overall communications system, that could indicate the equalizer is malfunctioning. In case the proper functioning of the equalizer is questioned, the operator requests general support maintenance to check the unit.

4-2. Scope of Organizational Maintenance

Organizational maintenance duties are given in the maintenance allocation chart (app C). These duties include:

a. Checking for tightness or firm seating of:
(1) Rack-mounting screws.
(2) Front panel captive screws.
(3) Back panel captive screws.
(4) Wiring to rear terminal strip.
(5) Front panel controls.

b. Visually inspecting rear cabling for fraying, chafing or other conditions that could develop into sources of trouble.

c. Replacing burned-out lamp and blown fuse.

4-3. Tools and Equipment

No special tools or equipment are required for operator and organizational maintenance. Tool Kit, Electronic Equipment TK-105/G (NSN 5180-00-610-8177) is authorized for maintenance (app C).

4-4. Repainting and Refinishing Instructions

Remove rust and corrosion from metal surfaces by lightly sanding with a fine grade sandpaper. Paint bare metal surfaces according to TB 43-0118. Use color number 26307, per FED-STD-595. Do not paint nonmetallic surfaces.

4-5. Preventive Maintenance Checks and Services

To insure that the CN-1468/FTC is always ready for operation, it should be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services to be performed are listed and described in table 4-l. The item numbers indicate the sequence of and minimum inspection required. Defects discovered during operation of the unit will be noted for future correction to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment. Record all deficiencies together with the corrective action taken on DD Form 6. Instructions for performing the required checks are listed in the reference columns of the table.

a. Operator Preventive Maintenance. Operator preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce down time, and to maintain the equipment in serviceable condition. Operator preventive maintenance is performed daily and weekly; specific procedures are listed in table 4-l.

b. Organizational Preventive Maintenance. Organizational preventive maintenance is performed monthly and quarterly; specific procedures are listed in table 4-1. Troubleshooting procedures are provided in paragraph 4-7.

c. Preventive Maintenance Checks and Services. The preventive maintenance checks and services described in table 4-l outline inspections to be made at specific intervals and are designed to help maintain equipment in serviceable condition. They indicate what items should be checked and how. Also included are procedures for authorized repairs and references to test, illustrations, and

other manuals that contain supplementary information.

d. Defective Items. Defective items that cannot be corrected must be reported to higher category maintenance personnel. Records and reports of repairs and preventive maintenance must be made in accordance with the procedures given in TM 38-750.

e. Cleaning.

WARNING

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT USE NEAR AN OPEN FLAME. Trichloroethane is not flammable, but exposure of the fumes to an open flame or a hot metal surface forms highly toxic phosgene gas.

(1) Use a dry, clean, lint-free cloth or brush to remove dust or dirt. If necessary, moisten the cloth or brush with trichloroethane (National stock number 6810-292-9625 for 1-quart can). After cleaning, wipe dry with a clean cloth.

WARNING

Compressed air is dangerous and can cause serious bodily harm. It can also cause mechanical damage to the equipment. Do not use compressed air to dry parts where trichloroethane has been used.

(2) Dry compressed air not to exceed 60 psi may be used to remove dirt and dust from inaccessible places.

4-6. Preventive Maintenance Check and Services Periods

Preventive maintenance checks and services for an operating CN1468/FTC are required daily as specified in table 4-1. These checks must be performed during the specified intervals. In addition, the daily checks and services must be performed under the following special conditions:

a. When the equipment is installed initially.

b. At least once *a* week if the equipment is maintained in a standby condition.

4-7. Troubleshooting

Troubleshooting is based on symptoms that may be discovered during normal operating procedures, or incorrect indications in preventive maintenance checks and services (table 4-1). when a trouble symptom occurs, refer to the appropriate system in the troubleshooting chart (table 4-2) to

Table 4-1. Preventive Maintenance Checks and Services

Interval: Operator (Daily B D A)	Interval: Org. (W M Q)	Item Number	Item to be Inspected	Procedure	Reference
			B—Before Operation D—During Operation	A—After Operation W—Weekly	M—Monthly Q—Quarterly
X		1	Completeness	See that the equipment is complete.	Para 1-9.
X		2	Cleaning	Clean dirt and moisture from exposed surfaces of case, cover, panel and meter.	Para 4-5e.
X		3	Controls and indicators	Observe that the mechanical action of each knob, control, and switch is smooth and free of external or internal binding and no excessive looseness is apparent.	
	X	4	Cabling	Inspect for breaks, cuts, kinks. strains, or frayed insulation. Repair or replace as required.	
	X	5	Hardware	Inspect handle and latches for looseness. Replace as necessary.	
	X	6	Metal surface8	Inspect exposed metal surfaces for rust and corrosion. Touch up with paint.	Para 4-4.
	X	7	Publications	See that all publications are complete, serviceable, and current.	DA Pam 310-4.
	X	8		Determine if now applicable MWO'S must be applied. All NORMAL MWO'S must be scheduled.	TM 38-750 and DA Pam 310-4.
	X	9		Check all spare parts (operator and organizational) for general condition and method of storage. No overstock should be evident and all shortages must be on valid requisitions.	

find the possible trouble and corrective measure. Perform the corrective measure as authorized in the maintenance allocation chart (app C). If the corrective measure does not correct the trouble, report trouble to higher category maintenance personnel.

Table 4-2. Troubleshooting Chart

Symptom	*Possible Trouble*	*Corrective Measure*
Unit does not operate.	Blown fuse.	Replace fuse.

C H A P T E R 5

FUNCTIONING OF EQUIPMENT

5-1. Functional Description

a. Telephone Line Equalizer CN-l468/FTC is a self-maintained, solid-state unit. It utilizes a regulating amplifier circuit to compensate for flat line loss and an adjustable RC equalizer to compensate for high frequency rolloff of cable transmission systems over the frequency range of 10 Hz to 70 kHz. It generally provides slope equalization on 19 AWG, 22 AWG, 24 AWG, and 26 AWG nonloaded, toolquality cable pairs over the same range of frequencies.

b. Supervisory tone signals do not pass through the regulating amplifier section of the equalizer. They are maintained at the output at the correct transmission lines to allow passage of 50-kilobit data over the frequency range of 10 Hz to 70 kHz.

c. The equalizer consists of a plug-in equalizer assembly and a plug-in power supply assembly. Provision is made to accommodate a second equalizer assembly. All assemblies are housed in a standard 19-inch rack-mountable shelf.

5-2. Block Diagram Analysis (fig. 5-1)

a. Figure 5-1 represents the block diagram of the equalizer. The balanced input is applied to transformer T1, which reflects a 135-ohm impedance to the input line. The broadband (10 Hz to 70 kHz) frequency path is coupled from transformer T1 to amplifier IC1. The signal level at the input of amplifier IC1 is about 35 db below the level of the signal at the output of transformer T1.

b. When MAIN control R4 is set clockwise, a high frequency boost (at 70 kHz) of 25 db is obtained. When MAIN control R4 is set counterclockwise, a flat response from 10 Hz to 70 kHz is obtained. Various settings of this control provide boosts at 70 kHz from over 25 db to 0 db.

c. To provide boost at the center of the frequency band, AUX control R3 is provided. Rotation of this control (clockwise) increases the boost at the center frequencies with little effect on the 70-kHz signal amplitude.

d. The amplified output from integrated circuit IC1 can be applied to each of two paths. Path 1 has an unequalized amplitude/frequency response from 10 Hz to 70 kHz within 3 db. With equalization, this path has additional gain as the frequency increases to as much as 25 db at 70 kHz relative to the low frequency end. Path 2 provides a flat frequency response from 10 Hz to 70 kHz within 2 db and with equalization. If no equalization is desired in path 2, a jumper-strap option is provided to bypass signals from the regulating amplifier circuit.

e. Initial application of a data signal to the equalizer causes several functions to occur. The regulating amplifier has a long time constant in the control circuit to operate at 10 Hz. Some time is required for the regulating amplifier to stabilize during which time its output is in a transient mode. The data signal utilizes path 2 until the path 1 signal is stabilized.

f. Path 2 gain is normally set via TONE control R35 for correct output signal level according to the supervisory signal input level. Supervisory signal levels are relative in amplitude to the wideband data levels so that the initial output data signal through path 2 is approximately correct in level.

g. In 2 seconds or less after initial application of data signals, relay K1 is operated to the path 1 signal which now appears at the equalizer output regulated to approximately 0 dbm. The phase of the signal is the same through path 1 or path 2. In this fashion, the switching provides elimination of unwanted initial transients through the regulating amplifier. The switching also provides a nonregulated path for supervisory signals where it is desired to maintain discrete levels.

h. In path 1, the output from regulating amplifier IC2 is coupled through an active low-pass filter utilizing integrated circuit IC3. The filter provides a 12 db per octave rolloff of signals above 70 kHz to reduce noise through the path. The output from integrated circuit IC3 is applied to DATA control R36 and then to contact 4 of relay K1. This contact is normally- open with no signal

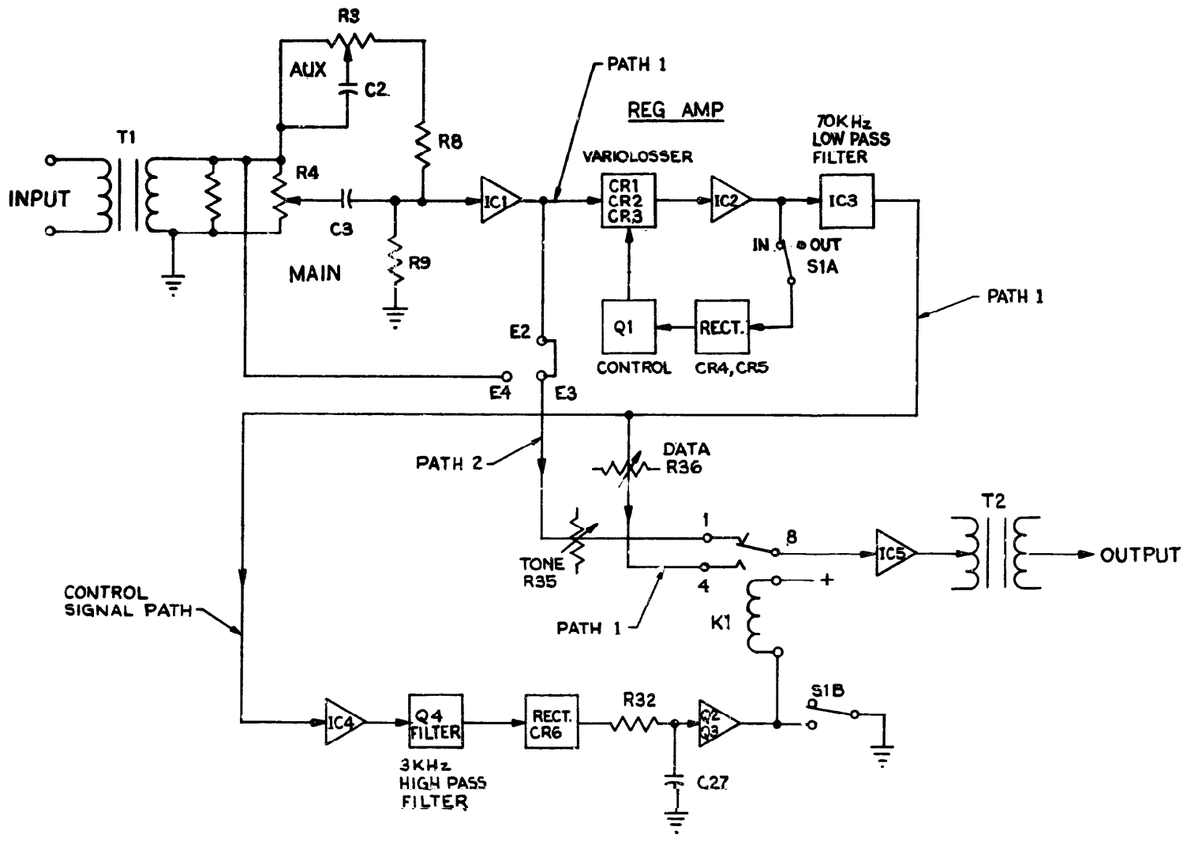


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Figure 5-1. Equalizer assembly, block diagram.

or supervisory signal input. DATA control R36 establishes the level of the regulated signals to the output line.

i. The output from integrated circuit IC3 is also coupled via a control signal path to amplifier IC4. The control signal path provides operation of relay K1 when the input signal has frequency components above 3 kHz. Tine output from amplifier IC4 is applied to an active high-pass filter utilizing transistor Q4 to pass signals above 3 kHz and to attenuate signals below 3 kHz. It is then applied via transistors Q2 and Q3 to operate relay K1. Switch S1 is utilized to disable the agc action of the regulating amplifier when a static test of the equalizer is desired. This switch also activates relay K1 so that low frequencies as well as high frequencies will proceed through path 1 when the agc is disabled.

5-3. Detailed Circuit Analysis (fig. FO-1, FO-3, and 5-2)

a. Input Circuit. The input to the equalizer is applied through pins 1 and 2 of connector P1 and is coupled to transformer T1. The resistive loading on the secondary of transformer T1 reflects a 135-ohm impedance to the primary. MAIN control R4 provides adjustment of the signal level applied from transformer T1 through capacitor C3 to the input of amplifier IC1. Resistor R5 is employed to compensate for the bypassing effect of capacitor C3 when the MAIN control is set for no equalization (fully counterclockwise). AUX control R3 operates to apply signals via capacitor C2 to resistor R8 and then to the input of amplifier IC1. The MAIN control provides high frequency signal boost, and the AUK control provides center frequency signal boost. Resistors R1 and R2 load the secondary of transformer T1 and provide a signal voltage measurement from test point TP1 to test point TP4 (ground). This measurement is of approximately the same level as the input signal applied to the primary of transformer T1.

b. Amplifier IC1. Amplifier IC1 provides about 40 db of gain as established by resistors R6 and R7. Capacitors C4, C5, and C8 provide the flat frequency response from 10 Hz to 70 kHz. Capacitor C4 provides some high frequency rolloff for noise suppression. The output from pin 6 of amplifier IC1 is applied through coupling capacitors C9 and Cl0 and resistor R11 to the regulating amplifier circuit. Test point TP2 provides a measurement of the amplified input signal.

c. Regulating Amplifier Circuit (Agc).

(1) The output of amplifier IC1 is coupled though capacitors C14 and C16 to amplifier IC2 in the agc circuit. Amplifier IC2 provides a flat response from 10 Hz to 70 kHz. The output of amplifier IC2 is rectified by diodes CR4 and CR5, and is filtered by resistor R20 and capacitors Cl6 and C17. This dc signal is then applied to emitter follower Q1.

(2) Transistor Q1 operates the agc variolosser circuit consisting of diodes CR1, CR2, and CR3. With a small signal input, the output from amplifier IC2 is insufficient to produce an output from rectifier diodes CR4 and CR5. No current flows in transistor Q1, and variolosser diodes CR1, CR2, and CR3 do not conduct. The signal level at the input, pin 3 of amplifier IC2, is now determined by the values of resistors R11 and R17 and is at a maximum. With a high signal level from amplifier IC1, the rectified output of diodes CR4 and CR5 causes appreciable current to flow in transistor Q1, and the input signal applied to amplifier IC2 is considerably reduced. The current flowing in variolosser diodes CR1, CR2, and CR3 is a function of the signal level so that the output signal from amplifier IC2 stays relatively constant when the input signal levels from amplifier IC1 vary in amplitude.

(3) When the agc switch S1A is set to OUT, the path to rectifiers CR4 and CR5 is opened to disable the agc. The gain in amplifier IC2 is reduced to a nominal amount. Resistor R13 is applied in the feedback path of amplifier IC2 when the agc switch is set to OUT.

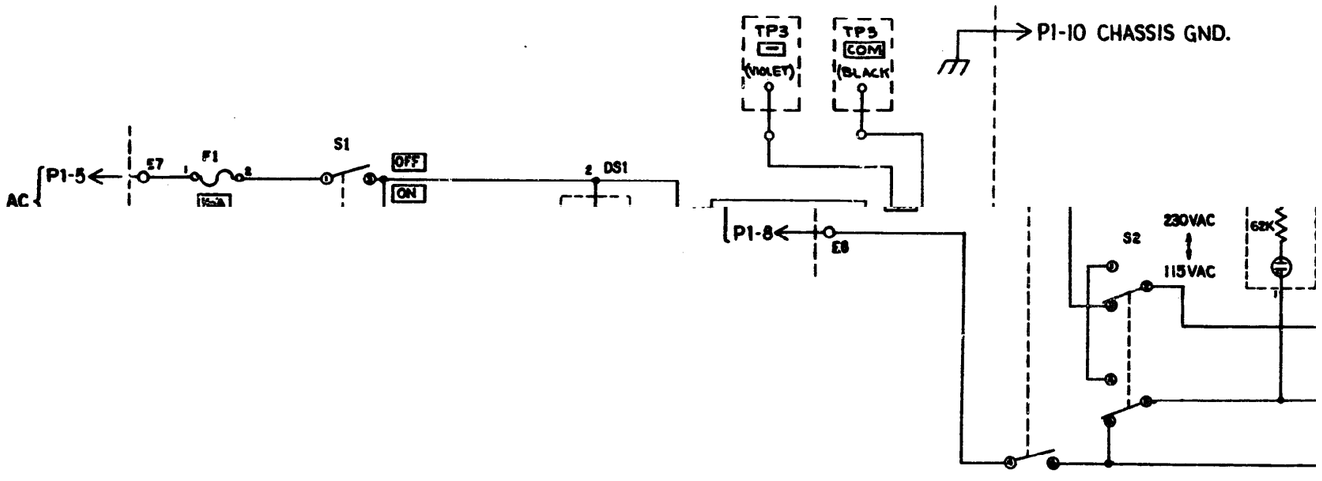
(4) The output from amplifier IC2 is applied via resistor R22 to the active filter using integrated circuit IC3, resistors R23 and R24, and capacitors C33 and C20. This low-pass filter provides a rolloff attenuation above 70 kHz for noise reduction while providing a relatively flat response on the low frequency side.

(5) The output of amplifier IC3 is coupled to DATA control R36 and to the input of amplifier IC4 via capacitor C21 and resistor R28.

d. Path-Switching Circuit.

(1) Amplifier IC4 produces the high level signal necessary eventually to operate path-switching relay K1. While amplifier IC4 provides uniform response in the frequency range of 3 kHz to 70 kHz, response below 3 kHz falls off through the circuit because of the value of capacitor C21.

(2) The output from amplifier IC4 is fed to a high-pass filter circuit consisting of capacitors C24 and C25, resistors R29 and R30, and transistor Q4. This filter attenuates signals below 3 kHz so that data signals, not supervisory tone signals, operate relay K1. The output from emitter follower Q4 is



NOTES:

1. ▭ INDICATES FRONT PANEL MARKING.
2. ┌ ─ ┐ INDICATES PANEL MOUNTED.

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Figure 5-2. Power supply assembly, schematic diagram.

rectified by diode CR6 and is applied to transistor Q2 via a low-pass filter consisting of resistor R32 and capacitor C27. The time constant of this filter is such that relay K1 will not operate until the signal path through the regulating amplifier has stabilized after initial application of signal.

(3) Transistor Q2 provides the high impedance to the low-pass filter and drives dc amplifier Q3, the action of which operates path-switching relay K1.

(4) The low frequency signal path through the equalizer is from the output of amplifier IC1 via strapping option (terminals E2 and E3), supervisory TONE control R35, and contacts 1 and 8 of relay K1 to output amplifier IC5 and output transformer T2. This path allows supervisory signals (below 3 kHz) to be present at the output of the equalizer since relay K1 is not operated.

(5) Wideband data signals having frequency components basically above 3 kHz cause relay K1 to operate, thereby disabling the low frequency signal path. In this mode, the regulated data signals are applied from the output of amplifier IC3 (via the DATA control R36) through contacts 4 and 8 of relay K1 to the output amplifier IC5. The gain in amplifier IC5 is established by feedback resistors R39 and R40 at about 20 db while the frequency response is flat from 10 Hz to 70 kHz. The output of amplifier IC5 is applied through impedance-matching resistor R42 and capacitor C30 to output transformer T2 to drive a 135-ohm balanced line.

e. Power Supply. The power supply employs a sealed module mounted on a plug-in assembly. A 115/230 volt switch, S2, is also located on this assembly. Switch S2 is factory-set for 115-volt operation. The power supply provides a dc output of +/- 12 volts at 100 milliamperes. Each plug-in equalizer assembly requires a maximum current of 30 milliamperes. Front panel test points are provided to monitor the +/-12 vdc. Front panel POWER switch S1 turns the equipment ON or OFF. A 1/10 ampere fuse and pilot lamp are also located on the front panel of the power supply assembly.

CHAPTER 6

GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. GENERAL

6-1. Maintenance Procedures

a. Fault Localization and Isolation. First, localize the fault by tracing it to a defective function or circuit responsible for the abnormal condition. Then, isolate the fault by locating the defective part or parts. Isolation may be accomplished by visual inspection (burned-out resistors) and/or voltage and resistance measurements. The troubleshooting chart in table 6-2 should be used as an aid in fault localization and isolation.

b. Operational Tests. The general location and nature of a fault can frequently be determined by operational testing. The daily preventive maintenance checks and services listed in table 4-1 are a good guide for operational testing.

c. Voltage and Resistance Measurements. This equipment contains integrated circuits and semiconductors. Observe all precautions given to prevent part damage. Make voltage and resistance measurements on this equipment only as specified. When measuring voltages use tape or sleeving to insulate the entire test prod except for the extreme tip. A momentary short can destroy a part.

6-2. Tools and Equipment

Table 6-1 lists the test equipment required for troubleshooting Telephone Line Equalizer CN-1468/FTC.

Table 6-1. Tools and equipment

Item	Nomenclature
Test Set, Telephone	AN/USM-181B
Multimeter	AN/USM-223
Oscilloscope	AN/USM-281C
Tool Kit, Electronic Equipment	TK-105/G
Resistor	130 ohms, 1/2 watt, 5

6-3. Troubleshooting

Troubleshooting at general support includes the procedures outlined for operator and o[illegible] organizational maintenance and those specific

6-2. The procedures in table 6-2 are not necessarily all-inclusive, but they do indicate the probable location of a fault. Use the lists and procedures as a guide in analyzing symptoms that may not be listed.

Table 6-2. General Support Troubleshooting Procedures

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
1. The CN-1468/FTC does not operate when connected to a serviceable power supply and when the POWER switch is operated to the ON position. NOTES 1. Refer to figure 3-3 when performing steps 1 through 6 below unless otherwise indicated. 2. Refer to paragraph 6-11 for general repair procedures as required for steps 1 through 6 below. Step 1. Check to see that DS1 illuminates and that 12 vdc is present on both the negative (-) and the positive (+) test points (TP's). If DS1 does not illuminate or if either voltage is not present, perform the procedures in steps 2 through 6 below and take corrective action as indicated. Step 2. Remove fuse F1 by pushing fuseholder XF1 in while turning it clockwise. Check for fuse opening. Replace fuse F1 if defective. WARNING Insure that power is disconnected from the equalizer before performing steps 3, 4, and 5 below. Step 3. Check continuity of power cable between AC PWR terminals 1 and 2 of the shelf assembly (fig. 2-2) and the terminating plug. a. Repair or replace power cable as required. b. Repair or replace AC PWR terminals 1 and 2 as required. Step 4. Loosen two captive screws securing power supply assembly to shelf assembly. Pull power supply assembly forward, discon-

Table 6-2. General Support Troubleshooting Procedures-continued

NCTION ST OR INSPECTION CORRECTIVE ACTION
necting plug P1 (fig. 2-3) from jack J1 of shelf assembly (fig. 2-2), far enough to expose switch S2 (fig. 2-3). Check to see that S2 is in the proper position (115 or 230 vac) depending on voltage available at power source. Set S2 to proper position as required. Check continuity of DS1, S1, S2, and XF1 (fig. 5-2). Repair or replace these components as required (fig. 2-3 and fig 3-3).
Step 5. Check continuity between jack J1 and jack J3 and/or jack J2 of the shelf assembly (fig. 2-2). Repair or replace J1, J2, and/or J3 and interconnecting wiring as required.
Step 6. Re-install equalizer and power supply assemblies in shelf assembly, reconnect power cable, and reapply power. Check for presence of signal at TP1 and TP4, TP2 and TP4, TP3 and TP4, and at TP5 and TP6. Insure that power is disconnected from the equalizer before performing a and b below. a. If signal is not present at TP1 and TP4: (1) Loosen two captive screws securing equalizer assembly to shelf assembly. (2) Pull equalizer assembly forward until transformer T1 and resistor R2 are exposed (fig. FO-2). (3) Check T1 and R2 for continuity (fig. FO-1). Repair or replace T1 and/or R2 if defective. 1. If signal is not present at TP2 and TP4, TP3 and TP4, or at TP5 and TP6, perform following tests and corrective actions in the order given and as required. NOTE Refer to figures FO-1 and FO-2 in performing (1), (2), and (3) below. (1) Check IC1 and associated circuitry for continuity. Repair or replace IC1 and/or associated circuitry as required. (2) Check IC2 and IC3 and their associated circuitry for continuity. Repair or replace as required. (3) Check amplifier IC5 and relay X1 and their associated circuitry for continuity. Repair or replace as required. 2. The CN-1468/FTC still does not operate after performing steps 1 through 6 above. Test or inspection are not applicable. a. Replace either or both the equalizer assembly and the power supply assembly as required. b. Replace the shelf assembly. e. Replace the entire end item as a unit.

Table 6-2. General Support Troubleshooting Procedures-Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Section II. GENERAL SUPPORT TESTING PROCEDURES

6-4. General

a. Testing procedures are prepared for use by Electronics Field Maintenance Shops and Electronics Service Organizations responsible for general support maintenance of equipment. These procedures set forth specific requirements that repaired equipment must meet before it is returned to the using organization.

b. A chart is provided for each function the equipment can perform plus a chart for physical tests and inspection, Comply with the instructions preceding each chart before proceeding to the chart. Perform each step in sequence. For each step, perform all actions required in the Control settings column; then perform each specific test procedure and verify it against its performance standard.

6-5. Physical Tests and Inspection

a. Test Equipmemt and Materials. None.

b. Test Connections and Conditions. None.

c. Procedure.

ualizer control settings	Test procedure	Performance standards
N/A	*a.* Inspect all connectors for looseness or damage.	*a.* No looseness or damage shall be evident.
	b. Inspect the shelf and front panel for damage or missing parts and inspect condition of the finish.	*b.* No damage or missing parts shall be evident. No surface intended to be painted shall show bare metal. All lettering shall be legible.
Operate front panel controls from complete cw to complete ccw. Operate POWER switch.	*a.* Control rotates freely without binding. Knob tight on shaft. *b.* Switch action positive—no looseness or binding.	

2

6-6. Power Supply Functional Test

a. Test Equipment and Materials. Multimeter **AN/USM-223.**

b. Test Connections and Conditions. Make no connections until instructed to do so in procedure.

c. Procedure.

Step No.	Equalizer control settings	Test procedure	Performance standards
1	**N/A**	***a.* POWER switch: ON.**	***a.* White panel indicator lamp is illuminated.**
		***b.* Connect multimeter to test points com (black) and to + (red).**	***b.* Multimeter shall read between +11 and +13 VDC.**
		***c.* Connect multimeter to test points COM (black) and to − (violet).**	***c.* Multimeter shall read between −11 and −13 VDC.**

6-7. Frequency Response Functional Test

a. Test Equipment and Materials. See figure 6-1.

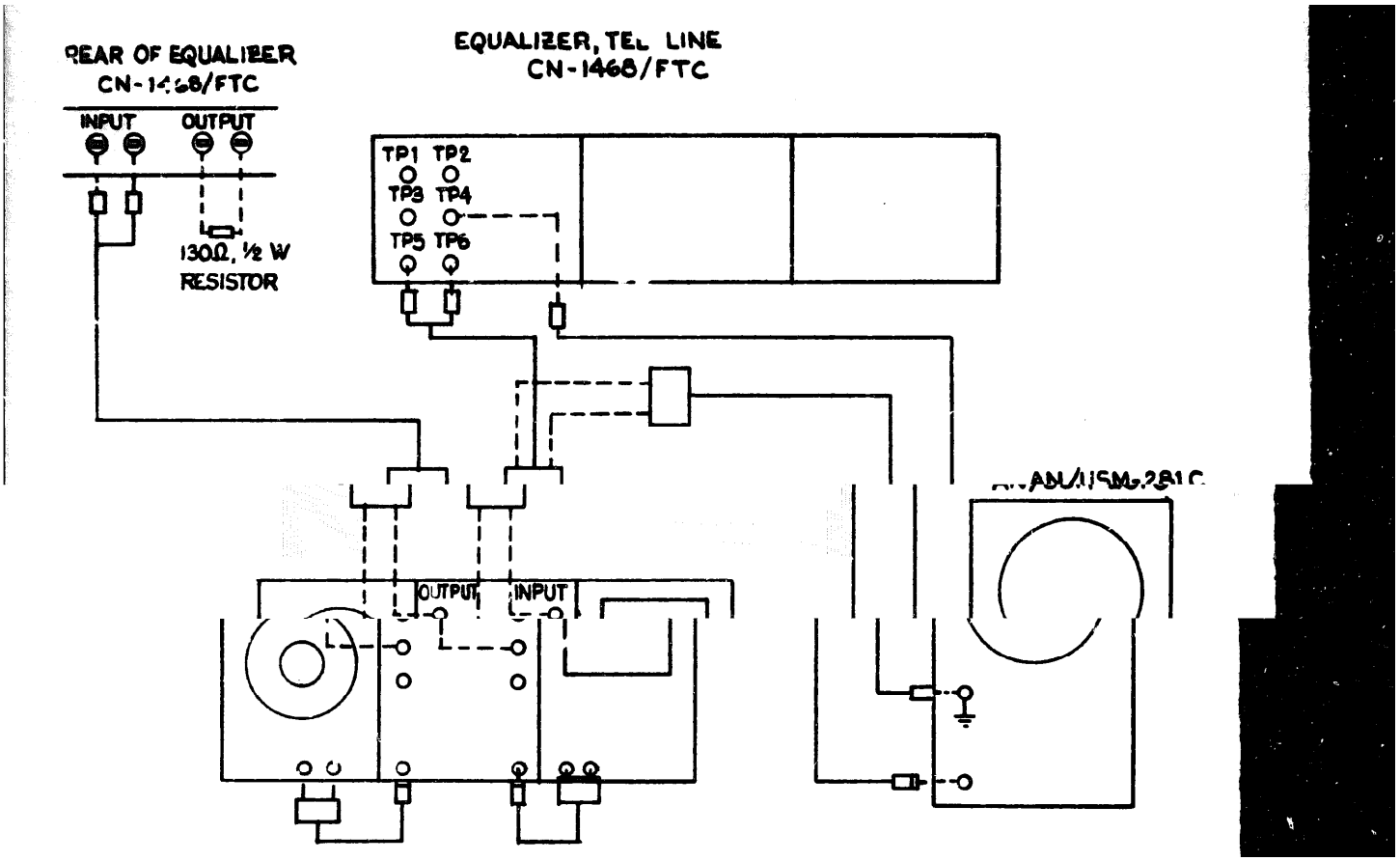
b. Test Connections and Conditions. Make no connections until instructed to do so in procedure.

c. Procedure.

Step No.	Equalizer control settings	Test procedure	Performance standards
1	MAIN and AUX controls fully counterclockwise (CCW).	a. Connect the test equipment as shown in figure 6-1.	a. N/A.
		b. AGC switch (located on equalizer PC board): IN.	b. N/A.
		c. POWER switch: ON.	c. N/A.
		d. Apply a 1 kHz signal at -26 dbm from the AN/USM-181B (at 135-ohm impedance setting of AN/USM-181B).	d. N/A.
		e. Adjust TONE control for -6 dbm output as indicated on AN/USM181B.	e. AN/USM-181B shall read between -5.9 and -6.1 dbm.
		f. Apply a 10 Hz signal at -26 dbm from the AN/USM-181B.	f. AN/USM-181B shall read between -3 and -9 dbm.
		g. Apply a 2.5 kHz signal at -26 dbm from the AN/USM-181B.	g. AN/USM-181B shall read between -3 and -9 dbm.
2	Same as step 1.	a. Same as step 1.	a. N/A.
		b. Apply a 25 kHz signal at -26 dbm from the AN/USM-181B.	b. N/A.
		c. Adjust DATA control for -6 dbm output as indicated on AN/USM-181B.	c. AN/USM-181B shall read between -6.9 and -6.1 dbm.
		d. Apply a 5 kHz signal at -26 dbm from the AN/USM-181B.	d. AN/USM-181B shall read between -3 and -9 dbm.
		e. Apply a 70 kHz signal at -26 dbm from the AN/USM-181B.	e. AN/USM-181B shall read between -3 and -9 dbm.
3	Same as step 1.	a. Same as step 1.	a. N/A.
		b. AGC switch (located on equalizer PC board): OUT.	b. N/A.
		c. Apply a 1 kHz signal at -26 dbm from the AN/USM-181B.	c. N/A.
		d. Adjust DATA control for -6.	d. AN/USM-181B shall read between -5.9 and -6.1 dbm.
		e. Apply the following signals from the AN/USM-181B at -26 dbm. (1) 10 Hz. (2) 10 kHz. (3) 25 kHz (4) 70 kHz	e. AN/USM-181B shall read between -6.9 and -6.1 dbm at each frequency setting.

Figure FO-1. Equalizer assembly, schematic diagram.

(Located in back of manual.)



AN/USM-181B

Figure 6-1. Test equipment setup and materials.

6-8. Equalization Functional Test

[redacted] connections utilizing

a. Test Equipment and Materials. See figure 6-1.

b. Test Connections and Conditions. Make no

c. Procedure.

Step No.	Equalizer control settings	Test procedure
1	MAIN control: CW AUX control: CCW AGC switch: OUT	a. Connect the test equipment as shown in figure 6-l. b. Apply a 500 Hz signal at -35 dbm from the AN/USM-181B. c. Adjust DATA control for -35 dbm out put as indicated on AN/USM-181B. d. Apply the following signals from the AN/USM-181B at -35 dbm. (1) 100 Hz. (2) 1 kHz. (3) 10 kHz. (4) 25 kHz. (5) 70 kHz.	a. N/A. b. N/A. c. AN/USM-181B shall read between -34.8 and -35.2 dbm. d. AN/USM-181B shall read as noted below: (1) -34 to -36 dbm. (2) -33.5 to -34.5 dbm. (3) -22.5 to -26.5 dbm. (4) -14.5 to -18.5 dbm. (5) -6 to -10 dbm.
2	MAIN control: CCW AUX control: CW AGC switch: OUT	a. Same as step 1. b. Apply a 100 Hz signal at -35 dbm from the AN/USM-181B. c. Adjust DATA control for -35 dbm output as indicated on AN/USM-181B. d. Apply the following signals from the AN/USM-181B at -35 dbm. (1) 1 kHz. (2) 10 kHz. (3) 25 kHz.	a. N/A. b. N/A. c. AN/USM-181B shall read between -34.8 and -35.2 dbm. d. AN/USM-181B shall read as noted below: (1) -33 to -35 dbm. (2) -27 to -30 dbm. (3) -26.5 to -29.5 dbm.

6-9. Agc Functional Test

a. Test Equipment and Materials. See figure 6-1.

b. Test Connections and Conditions. Make no connections until instructed to do so in procedure.

c. Procedure.

Step No.	Equalizer control settings	Test procedure	Performance standards
1	**MAIN control: CCW AUX control: CCW AGC switch: IN**	***a.* Connect the test equipment as shown in figure 6-1.**	***a.* N/A.**
		b. Apply a 10 kHz signal at -6 dbm from AN/USM-181B.	b. N/A.
		c. Adjust the DATA control for -6 dbm output as indicated on the AN/USM-181B.	c. AN/USM-181B shall read between -5.9 and -6.1 dbm. A sine wave with neglible clipping is seen on the AN/USM-281C.
		d. Adjust the level of the 10 kHz signal from the AN/USM-181B to -26 dbm.	d. AN/USM-181B shall read between -5.9 and -6.2 dbm. A sine wave with no clipping is seen on the AN/USM-281C.

6-10. Path-Switching Functional Test

a. Test Equipment and Materials. See figure 6-1.

b. Test Connections and Conditions. Make no connections until instructed to do so in procedure.

c. Procedure.

Step No.	Equalizer control settings	Test procedure	Performance standards
1	**MAIN control: CCW A... ntrol: CCW AGC switch: IN**	***a.* Connect the test equipment as shown in figure 6-1.**	***a.* N/A.**
		b. Apply a 1 kHz signal at -10 dbm from the AN/USM-181B.	b. N/A.
		c. Adjust the TONE control for -10 dbm as indicated on the AN/USM-181B.	c. AN/USM-181B shall read between -9.8 and -10.2 dbm.
		d. Change frequency from 1 kHz to 10 kHz using RANGE switch on the AN/USM-181B.	d. N/A.
		e. Adjust the DATA control for -6 dbm as indicated on the AN/USM-181B.	e. AN/USM-181B shall read between -5.8 and -6.2 dbm.
		f. Change frequency from 10 kHz to 1 kHz using RANGE switch on the AN/USM-181B.	f. Note that the amplitude of the signal observed on the AN/USM-281C increases after a short delay.
		g. Change frequency from 1 kHz to 10 kHz using RANGE switch on the AN/USM-181B.	g. Note that the amplitude of the signal observed on the AN/USM-281C returns to a lesser amount after a longer delay.

6-11. General Parts Replacement Techniques (fig. 2-3, 3-3, and FO-2)

Most of the parts of the equipment can be reached and replaced easily without special procedures. The following precautions apply to this equip ment.

a. When removing a component from the circuit boards, apply heat to the component lead on the conductor side of the board. Remove the component with a straight upward pull. Use a toothpick or wooden splinter to clean the hole. Solder the replacement component from the conductor side of the board.

b. Use a pencil-type soldering iron with a 25-watt maximum capacity. If the iron must be used with ac, use an isolating transformer between the iron and the line. DO NOT use a soldering gun; damaging voltages can be induced into the components.

c. When soldering integrated circuit or transistor leads, solder quickly; whenever wiring permits, use a heat sink (such as long-nosed pliers) between the solder joint and the part. Use approximately the same length and dress of part leads as used originally.

APPENDIX A
REFERENCES

Following is a list of applicable publications available to the operator, organizational, and general support maintenance repairmen of Telephone Line Equalizer CN-l468/FTC.

DA Form 2028	Recommended Changes to Publications and Blank Forma
DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	US Army Equipment Index of Modification Work Orders.
DD Form 6	Report of Packaging and Handling Deficiencies.
FED-STD-595	**Colors.**
SB 708-42	Federal Supply Code for Manufacturers (Cataloging Handbook H4-2).
SC-5180-91-CL-R07	Tool Kit, Electronic Equipment TK-105--.
TM 11-6625-602-12-1	Operator's and Organizational Maintenance Manual: Teat Set, Telephone AN/USM-181B.
11-6625-654-14	0perator's, Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools Lists (including Depot Maintenance Repair Parts and Special Tools Lists) for Multimeter AN/USM-223.
TM 11-6625-2658-l4	Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Oscilloscope AN/USM-281C.
TM 38-	The Army Maintenance Management System (TAMMS).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronic Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations for CN-1468/FTC. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed stand-

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean, preserve, drain, paint, or to replenish fuel/lubricants/hydraulic fluids or compressed air supplies.

d. Adjust. Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

h. Replace. The act of substituting a serviceable like-type part, subassembly, model (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/assembly, end item or system. This function does not include the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

j. Overhaul. That periodic maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in
with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc) considered in classifying Army equipment/components.

C-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

b, Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, *Maintenance* Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number of complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C-Operator/Crew
O-Organizational
F-Direct Support
H-General Support
D-Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and sup port equipment required to perform the designated function.

C-4. Tool and Test Equipment Requirements (Table 1)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

SECTION II MAINTENANCE ALLOCATION CHART
FOR
TELEPHONE LINE EQUALIZER CN-1468/FTC

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIPMENT
			C	O	F	H	D	
01	TELEPHONE LINE EQUALIZER, CN-1468/FTC	Inspect			0.3			4
		Test[1]				0.5		1 thru 4
		Repair[2]				0.5		1 thru 4
0101	EQUALIZER ASSEMBLY, P/N 31336203	Inspect			0.2			4
		Test[1]				0.5		1 thru 4
		Repair[2]				0.5		1 thru 4
0102	POWER SUPPLY ASSEMBLY, P/N 41336204	Inspect			0.1			4
		Test[1]				0.3		1 thru 4
		Repair[2]				0.2		1 thru 4
0103	SHELF ASSEMBLY, P/N 41336202	Inspect			0.1			4
		Test[3]				0.2		2
		Repair[2]				0.2		2,4

(1) erformance test.
(2) Repair by replacement of components.
(3) Continuity test.

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
TELEPHONE LINE EQUALIZER CN-1468/FTC

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H	TEST SET, TELEPHONE AN/USM-181B	6625-00-740-0344	
2	H	MULTIMETER AN/USM-223	6625-00-999-7465	
3	H	OSCILLOSCOPE AN/USM-281C	5625-00-106-9622	
4	F,H	TOOL KIT, ELECTRONIC EQUIPMENT TK-105/G	5180-00-610-8177	

By Order of the Secretary of the Army:

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USACC (5)
USACC-CONUS (10)
USACC-EUR (10)
USACC-A (5)
USACC-SO (5)
USACC-PAC (2)
OS Maj Comd (3)
Armies (2)
Corps (2)
USACC-SIG-GP-Korea (3)
USACC-SIG-GP-Japan (3)
USACC-SIG-GP-Okinawa (3)
USACC-SIG-GP-Taiwan (3)
USREDCOM (2)
TRADOC (ATOPS-C-E) (2)
USACSA (6)
USASG (Aus) (1)
USASG (CA) (1)
USASG (UK) (1)
Instl (2) except
Ft Gillem (5)
Ft Gordon (5)
Ft Huachuca (5)
Ft Carson (3)
SAAD (30)
TOAD (15)
LBAD (5)
HISA (Ft Monmouth) (33)
Pirmasens Dep (10)
Sig FLDMS (1)
Units org under fol TOE: 1 ea.
11-302
11-347
11-357
29-119
29-134
29-136

ARNG & USAR: None.

For explanation of abbreviations used, see AR 310-50.

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RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN. . .JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)
Commander
Stateside Army Depot
ATTN: AMSTA-US
Stateside, N.J. 07703

DATE 10 July 1975

PUBLICATION NUMBER	DATE	TITLE
TM 11-5840-340-12	23 Jan 74	Radar Set AN/[illegible]-76

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.	IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
2-25	2-28			Recommend that the installation antenna alignment procedure be changed throughout to specify a 2° IFF antenna lag rather than 1°. REASON: Experience has shown that with only a 1° lag, the antenna servo system is too sensitive to wind gusting in excess of [illegible] knots, and has a tendency to rapidly accelerate and decelerate as it hunts, causing strain to the drive train. Hunting is minimized by adjusting the lag to 2° without degradation of operation
3-10	3-3		3-1	Item 5, Function column. Change "2 db" to "3db." REASON: The adjustment procedure for the TRANS POWER FAULT indicator calls for a 3 db (500 watts) adjustment to light the TRANS POWER FAULT indicator.
5-6	5-8			Add new step f.1 to read, "Replace cover plate removed in step e.1, above." REASON: To replace the cover plate.
		F03		Zone C 3. On J1-2, change "+24 VDC to "+5 VDC." REASON: This is the output line of the 5 VDC power supply. + 24 VDC is the input voltage.

TEAR ALONG DOTTED LINE

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER
SSG I. M. DeSpiritof 999-1776

SIGN HERE: SSG I. M. DeSpiritof

DA FORM 1 AUG 74 2028-2 (TEST)

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HE

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DATE

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ULD BE DONE ABOUT IT:

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S

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FORM, T
IT AND D
MAIL!

PUBLICATION NUMBER

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.

TYPED NAME, GRADE OR TITLE, AND TEL

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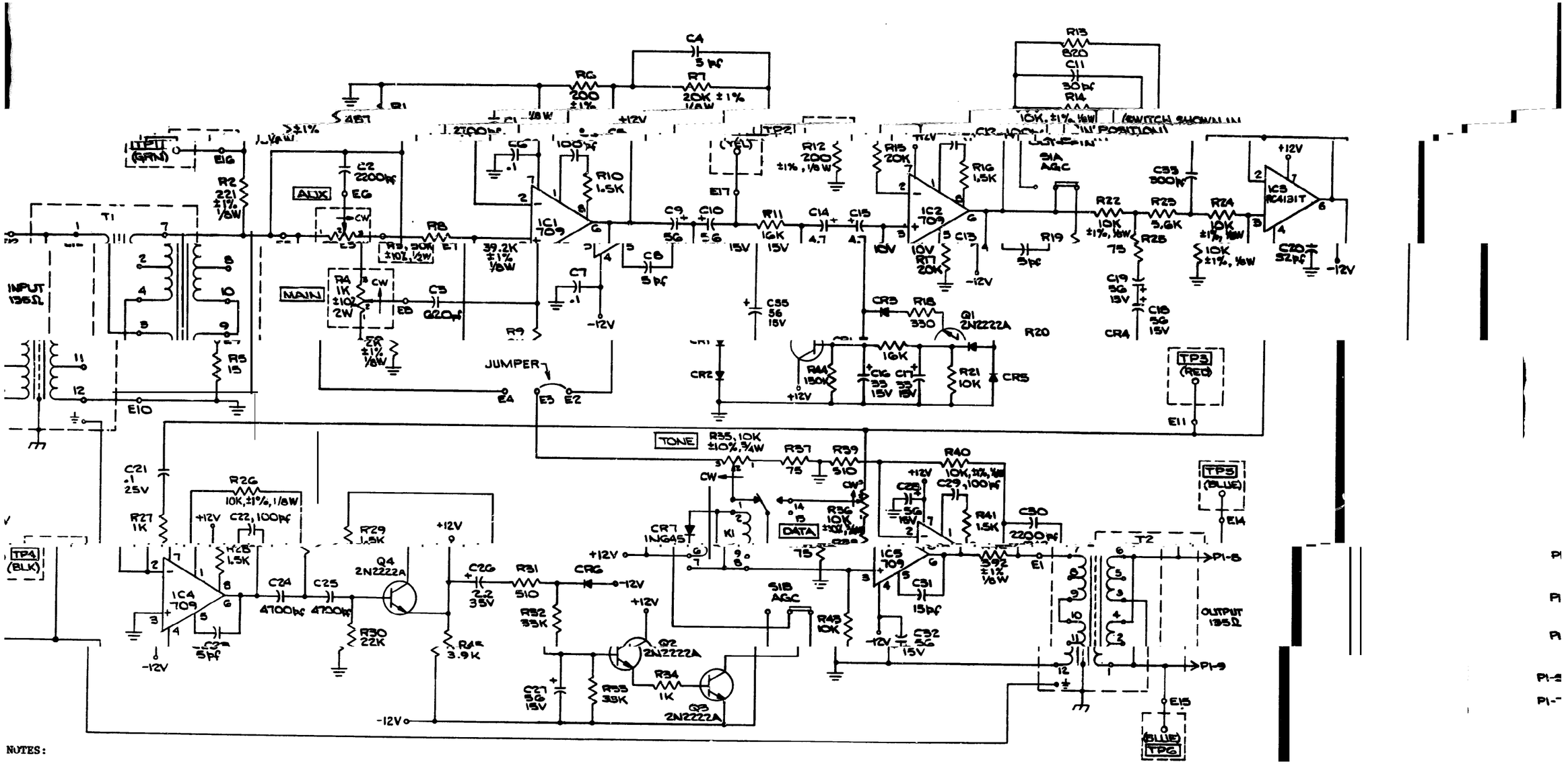


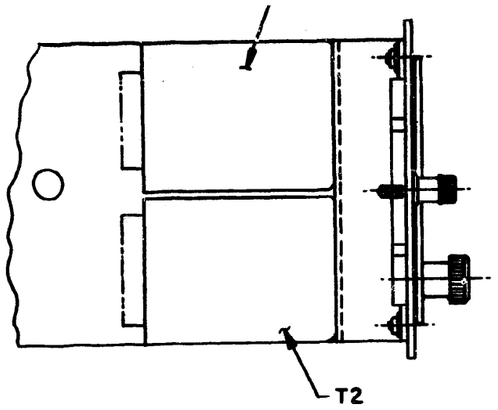
NOTES:

OHMS.
N MICROFARADS.

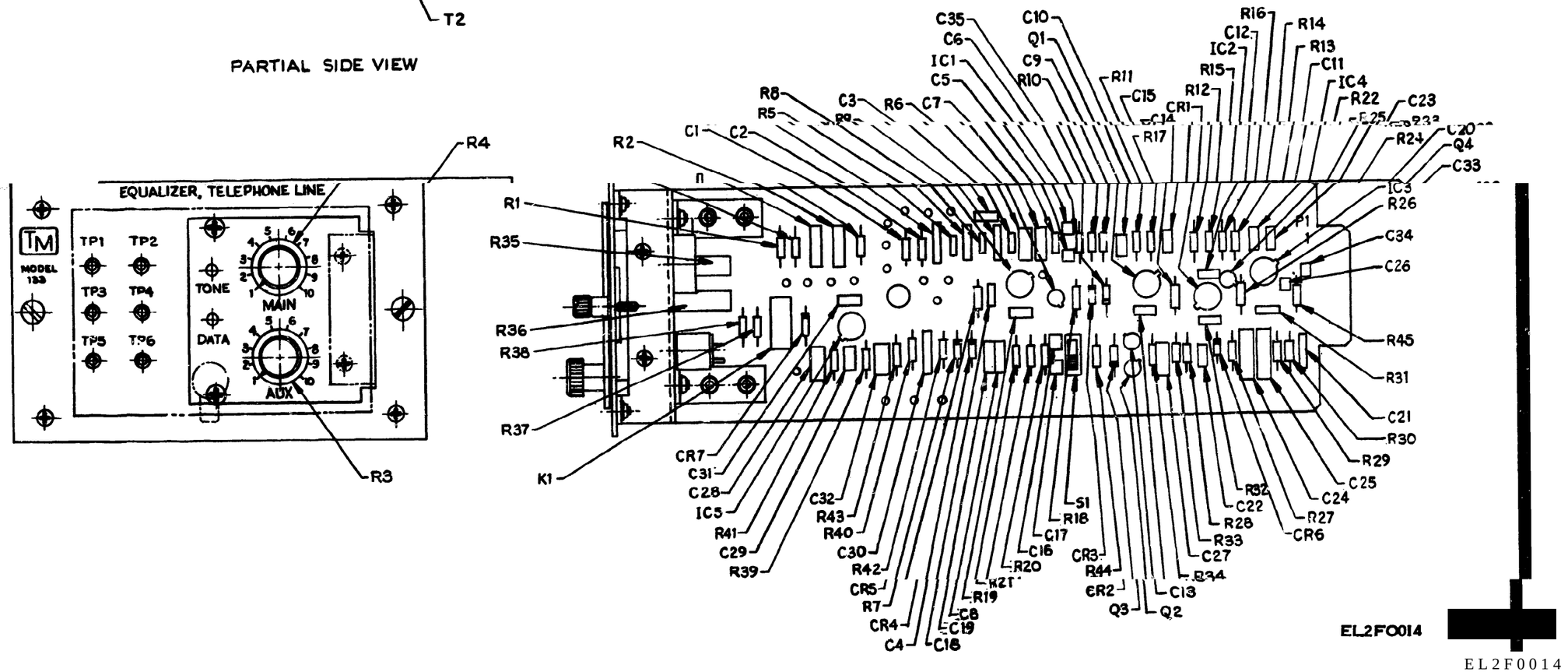
KING.

Figure FO-1. Equalizer assembly, schematic diagram.

EL2F0013

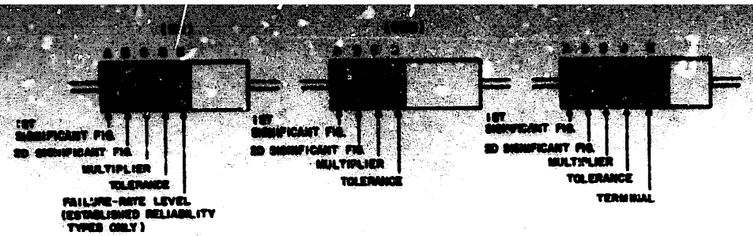


PARTIAL SIDE VIEW



EL2F0014

Figure FO-2. Equalizer assembly, components location.



COLOR CODE MARKING FOR COMPOSITION TYPE RESISTORS.

COLOR-CODE MARKING FOR FILM-TYPE RESISTORS.

TABLE I
COLOR CODE FOR COMPOSITION TYPE AND FILM TYPE RESISTORS.

BAND A		BAND B		BAND C		BAND D		BAND E		
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)	COLOR	FAILURE RATE LEVEL	TERM.
BLACK.....	0	BLACK.....	0	BLACK.....	1			BROWN...	M=1.0	
BROWN.....	1	BROWN.....	1	BROWN.....	10			RED.....	P=0.1	
RED.....	2	RED.....	2	RED.....	100			ORANGE..	R=0.01	
ORANGE....	3	ORANGE....	3	ORANGE...	1,000			YELLOW..	S=0.001	
YELLOW....	4	YELLOW...	4	YELLOW...	10,000	SILVER.	±10 (COMP. TYPE ONLY)	WHITE...	.....	SOLDERABLE
GREEN.....	5	GREEN.....	5	GREEN....	100,000	GOLD...	±5			
BLUE.....	6	BLUE.....	6	BLUE.....	1,000,000	RED....	±2 (NOT APPLICABLE TO ESTABLISHED RELIABILITY).			
PURPLE.... (VIOLET)	7	PURPLE.... (VIOLET)	7							
GRAY.....	8	GRAY.....	8	SILVER...	0.01					
WHITE....	9	WHITE.....	9	GOLD	0.1					

BAND A — THE FIRST SIGNIFICANT FIGURE OF THE RESISTANCE VALUE (BANDS A THRU D SHALL BE OF EQUAL WIDTH.)

BAND B — THE SECOND SIGNIFICANT FIGURE OF THE RESISTANCE VALUE.

BAND C — THE MULTIPLIER (THE MULTIPLIER IS THE FACTOR BY WHICH THE TWO SIGNIFICANT FIGURES ARE MULTIPLIED TO YIELD THE NOMINAL RESISTANCE VALUE.)

BAND D — THE RESISTANCE TOLERANCE.

BAND E — WHEN USED ON COMPOSITION RESISTORS, BAND E INDICATES ESTABLISHED RELIABILITY FAILURE-RATE LEVEL (PERCENT FAILURE PER 1,000 HOURS); ON FILM RESISTORS, THIS BAND SHALL BE APPROXIMATELY 1-1/2 TIMES THE WIDTH OF OTHER BANDS, AND INDICATES TYPE OF TERMINAL.

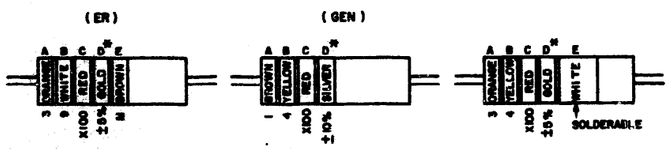
RESISTANCES IDENTIFIED BY NUMBERS AND LETTERS
(THESE ARE NOT COLOR CODED)

SOME RESISTORS ARE IDENTIFIED BY THREE OR FOUR DIGIT ALPHA NUMERIC DESIGNATORS. THE LETTER R IS USED IN PLACE OF A DECIMAL POINT WHEN FRACTIONAL VALUES OF AN OHM ARE EXPRESSED. FOR EXAMPLE:

2R7 = 2.7 OHMS 10R0 = 10.0 OHMS

FOR WIRE-WOUND-TYPE RESISTORS COLOR CODING IS NOT USED, IDENTIFICATION MARKING IS SPECIFIED IN EACH OF THE APPLICABLE SPECIFICATIONS.

EXAMPLES OF COLOR CODING



NOMINAL RESISTANCE 3,900 OHMS
RESISTANCE TOLERANCE ±5%
FAILURE RATE LEVEL M

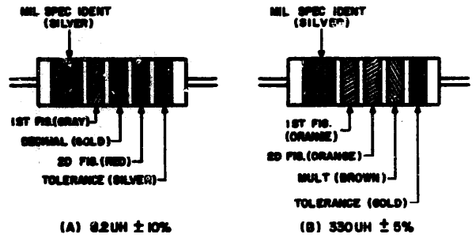
NOMINAL RESISTANCE 1,400 OHMS
RESISTANCE TOLERANCE ±10%

NOMINAL RESISTANCE 3,400 OHMS
RESISTANCE TOLERANCE ±5%
TERMINAL SOLDERABLE

COMPOSITION-TYPE RESISTORS FILM-TYPE RESISTORS

* IF BAND D IS OMITTED, THE RESISTOR TOLERANCE IS ±20% AND THE RESISTOR IS NOT MIL-STD.

A. COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS.



(A) 0.2UH ± 10% (B) 330UH ± 5%

COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES. AT A, AN EXAMPLE OF OF THE CODING FOR AN 0.2UH CHOKE IS GIVEN. AT B, THE COLOR BANDS FOR A 330UH INDUCTOR ARE ILLUSTRATED.

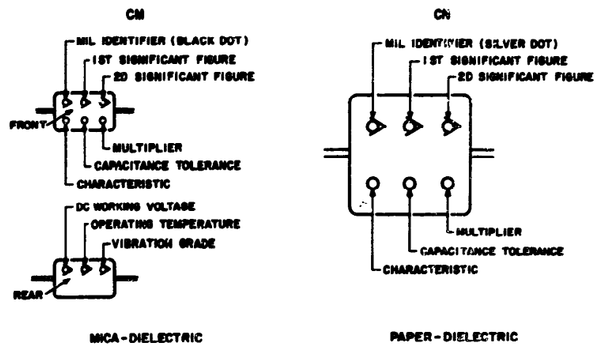
TABLE 2
COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES.

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	INDUCTANCE TOLERANCE (PERCENT)
BLACK	0	1	
BROWN	1	10	1
RED	2	100	2
ORANGE	3	1,000	3
YELLOW	4		
GREEN	5		
BLUE	6		
VIOLET	7		
GRAY	8		
WHITE	9		
NONE			20
SILVER			10
GOLD	DECIMAL POINT		5

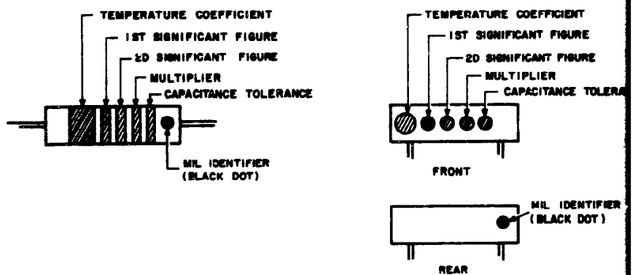
MULTIPLIER IS THE FACTOR BY WHICH THE TWO COLOR FIGURES ARE MULTIPLIED TO OBTAIN THE INDUCTANCE VALUE OF THE CHOKE COIL.

B. COLOR CODE MARKING FOR MILITARY STANDARD INDUCTORS.

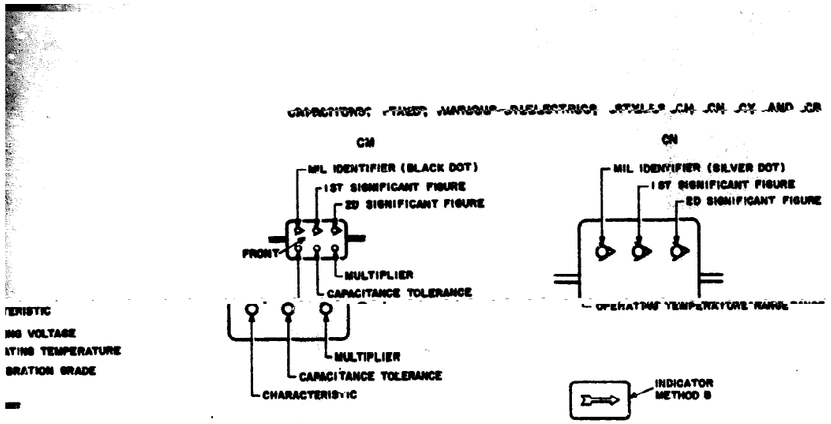
CAPACITORS, FIXED, VARIOUS-DIELECTRICS, STYLES CM, CN, CY, AND CB.



MICA-DIELECTRIC PAPER-DIELECTRIC GLASS-DIE



AXIAL LEAD RADIAL LEAD



-DIELECTRIC

PAPER-DIELECTRIC

GLASS-DIELECTRIC, GLASS CASE

MICA, BUTTON TYPE

TABLE 3 — FOR USE WITH STYLES CM, CN, CY AND CB.

COLOR	MIL ID	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER[1]	CAPACITANCE TOLERANCE CM	CN	CY	CB	CHARACTERISTIC[2] CM	CN	CB	DC WORKING VOLTAGE CM	OPERATING TEMP. RANGE CY, CM	VIBRATION GRADE CM
BLACK	CM, CY, CB	0	0	1			±20%	±20%		A			-55°TO+70°C	10-55 HZ
BROWN		1	1	10					B	E	B			
RED		2	2	100	±2%		±2%	±2%	C				-55°TO+85°C	
ORANGE		3	3	1,000		±30%			D		D	300		
YELLOW		4	4	10,000					E				-55°TO+125°C	10-2,000HZ
GREEN		5	5		+5%				F			500		
BLUE		6	6										-55°TO+150°C	
PURPLE (VIOLET)		7	7											
GRAY		8	8											
WHITE		9	9											
GOLD				0.1			±5%	±5%						
SILVER	CN			0.01	±10%	±10%	±10%	±10%						

AXIAL LEAD

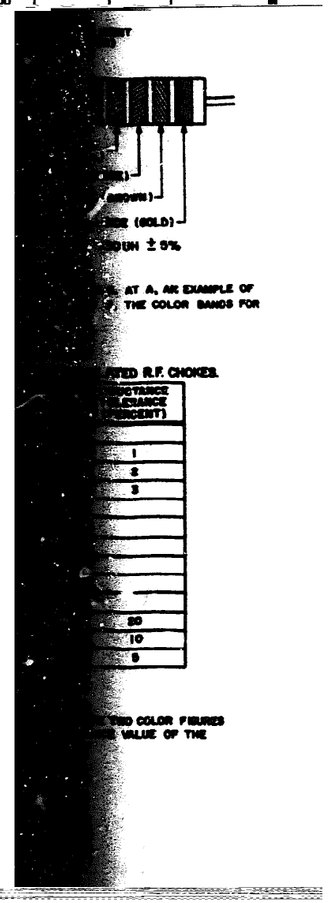
RADIAL LEAD

DISK-TYPE

TABLE 4 — TEMPERATURE COMPENSATING, STYLE CC.

COLOR	TEMPERATURE COEFFICIENT[4]	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER[1]	CAPACITANCE TOLERANCE: CAPACITANCES OVER 10 UUF	CAPACITANCES 10 UUF OR LESS	MIL ID
BLACK	0	0	0	1		±2.0 UUF	CC
BROWN	-30	1	1	10	±1%		
RED	-80	2	2	100	±2%	±0.25 UUF	
ORANGE	-150	3	3	1,000			
YELLOW	-220	4	4				
GREEN	-33.	5	5		±5%	±0.5 UUF	
BLUE	-470	6	6				
PURPLE (VIOLET)	-750	7	7				
GRAY		8	8	0.01*			
WHITE		9	9	0.1*	±10%		
GOLD	+100			0.1		±1.0 UUF	
SILVER				0.01			

1. THE MULTIPLIER IS THE NUMBER BY WHICH THE TWO SIGNIFICANT (SIG) FIGURES ARE MULTIPLIED TO OBTAIN THE CAPACITANCE IN UUF.
2. LETTERS INDICATE THE CHARACTERISTICS DESIGNATED IN APPLICABLE SPECIFICATIONS: MIL-C-5, MIL-C-250, MIL-C-11272B, AND MIL-C-10950C RESPECTIVELY.
3. LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-11015D.



* OPTIONAL CODING WHERE METALLIC PIGMENTS ARE UNDESIRABLE.

M 913-73

[redacted] INDUCTORS.

[redacted] FOR MILITARY STANDARD CAPACITORS.

[redacted]

ESC-FM 913-73

C. COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS.

Figure FO-3. Color code markings for MIL STD resistors, inductors, and capacitors.

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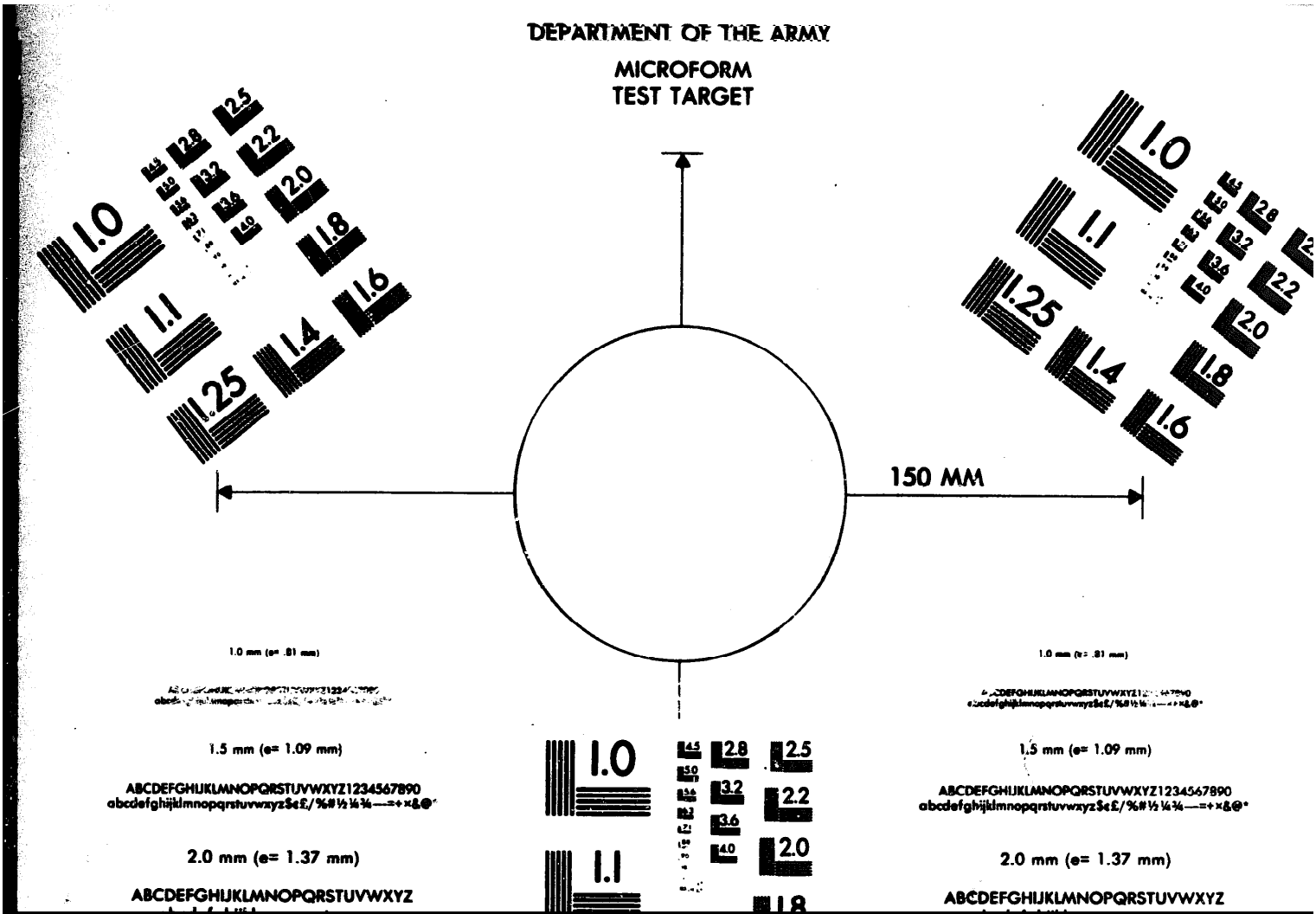
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MICROFORM
TEST TARGET
150 MM
1.5 mm (e= 1.09 mm)
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*
2.0 mm (e= 1.37 mm)
ABCDEFGHIJKLMNOPQRSTUVWXYZ