DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

EQUALIZER,GROUP DELAY
CN-1425/'MSC-46(V)
(NSN 5820-00-155-8572)'

DEPARTMENTS OF THE ARMY, THE NAVY, AND THE AIR FORCE

JUNE 1977

The following are general safety precautions that are not related to any specific procedures and, therefore, do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

WARNING

Operator and maintenance personnel should be familiar with the safety precautions before attempting installation or operation of the equipment covered in this manual. Failure to follow requirements and observe the safety precautions could result in injury or damage to the equipment.

WARNING

Do not operate the equipment without a suitable ground connection. Electrical defects in- the- unit, load-lines, or load equipment can cause DEATH by electrocution when contact is made with an ungrounded system.

WARNING

For the successful execution of methods of equipment destruction involving the use of demolition materials, all personnel should become familiar with the provisions of FM 5-25.

WARNING

HIGH VOLTAGE is used in this equipment. DEATH ON CONTACT may result if safety precautions are not observed.

WARNING

Performance of a field expedient repair may create a situation dangerous to equipment and personnel. The equipment so repaired should be taken out of service as soon as possible for replacement of the defective part.

WARNING

Under no circumstances should any personnel reach within an equipment inclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

WARNING

The cesium beam frequency standard C-field should not be adjusted, the phase lock opened, or time from the clock bechanged without a directive from the U.S. Naval Observatory (NAVOBSY).

TECHNICAL MANUAL
No. 11-5895-833-34-6
NAVELEX 0967-LP-550-1130
TECHNICAL ORDER 0967-LP-550-1130
TECHNICAL ORDER
No. 31R5-2MSC46-32

HEADQUARTERS
DEPARTMENTS OF THE ARMY,
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DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL EQUALIZER, GROUP DELAY CN-1 425/MSC-46(V) (NSN 5820-0-155-8572)

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.

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For Navy, mail comments direct to: Commander, Naval Electronics Systems Command, Code 4903, Washington, DC 20360.

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

LIST OF ILLUSTRATIONS

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual contains instructions for direct and general support maintenance of the Equalizer, Group Delay CN-1425/MSC-46(V). The coverage includes functioning of equipment, troubleshooting data, removal and replacement procedures, repairs, alignment, and materials required for maintenance.

b. The following technical manuals, in addition to this manual, provide complete coverage of the Frequency Conversion Subsystem for the AN/TSC-54 Satellite Communications Terminal

TM 11-5895-833-12	Operator's and organizational Maintenance Manual - Frequency Conversion Subsystem for satellite Communications Terminal AN\TSC-54
TM11-5895-833-20P	Organizational Maintenance Repair Parts and Special Tools List Frequency Conversion Subsystem for Satellite Communications Terminal AN\TSC-54
TM11-5895-833-34-1	Direct Support and General Support Maintenance Manual - Frequency Conversion Subsystem for Satellite Communications Terminal AN\TSC-54
TM11-5895-833-34-2	Direct Support and General Support Maintenance Manual Converter, Frequency, Electronic CV-3084/MSC-46(v), CV-308A/MSC-46(v)
TM11-5895-833-34-3	Direct Support and General Support Maintenance Manual Synthesizer, Electrical Frequency 0-1658/MSC-46(V)
TM 11-5895-833-34-4	Direct Support and General Support Maintenance Manual Amplifier, Radio Frequency AM-6631/MSC-46(v)
TM 11-5895-833-34-5	Direct Support and General Support Maintenance Manual Test Translator SM-F753378
TM115895-833-34-7	Direct Support, and General Support Maintenance Manual Converter, Frequency, Electronic CV-3085/MSC-46(V), CV-3085A/MSC-46(V)
TM11-5895-833-34P-1	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Frequency Conversion Subsystem for Satellite Communications Terminal AN/TSC-54
TM11-5895-833-34P-2	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Converter, Frequency, Electronic CV-3084/MSC-46(V)
TM11-5895-833-34P-3	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and

	Special Tools) for Synthesizer , Electrical Frequency O-1658/MSC-46(V)
TM 11-5895--833-34P-4	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools)for Amplifier, Radio Frequency-y AM4631/MSC-46(V)
TM 11-5895-83334P-5	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance-Repair Parts and Special Tools) for TestTranslatorSM-F-753378
TM 11-589583334P6	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance-repair Parts and Special Tools)for Equalizer, Group DelayCN-1425/MSC-46(V)
TM 11-5895-83334P-7	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maitenace Repair Parts and Special Tools) for Converter, Frequency Electronic CV-3085/MSC-46(V);CV-3085A/ MSC-46(V)

1-2. Maintenance Forms and Records

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750.

1-3. **Equipment Analysis**

a. Delay distortion is a condition created within a communications system by circuit components possessing nonlinear phase characteristics such as filters and tuned circuits. These components introduce delay distortion by delaying the various signals passing through the system by different amounts of time. Invoice communications this presents no problem as the human ear is relatively insensitive to phase variations. In data, multiplexed multi-channel telegraph, facimile, time division multiplex and other pulsed techniques, transmitted data can be destroyed. In digital data transmission, time delay or complete time inversion of pulses can result in incorrect data being received. In other forms of pulse transmission severe distortion of pulses can occur and the coherency of the information degraded or destroyed. To negate the effect of delay distortion, a delay equalizer is employed. Its purpose is to correct those areas within the communications channel that are affected by delay. This is achieved by introducing roducing a controlled amount of delay to those areas within the band pass as necessary, and thereby
minimize delay distortion across the entire pass band.

b. The group delay equalizer consists of 16 phase compensating filters which may be inserted in series with the 70-MHz if. signal. These filters introduce a selected value of positive or negative linear slope, in combination with parabolic phase delay, to counteract the group delay present in the if. signal. Attenuator networks isolate linear and parabolic filter sections from each other and from external components. A low-noise amplifier adds 11 to 14 dB gain to compensate for signal losses created by the filters and attenuator networks. The overall net gain of the group delay equalizer is thereby maintained at a nominal value of 0 dB.

Section II. DESCRIPTION AND DATA

1-4. Description

(See figure 1-1.)

a. the group delay equalizer is a completely solid-state device, utilizing modular construction to reduce size and maximize performance and reliability. The modules and assemblies to be replaced at direct and general support are easily removable for maintenance purposes. Replaced modules require no adjustement

b Modules comprising a group delay equalizer are as follows:

1) AlFL1 is a front panel plug in type module which provides -2 nS linear equalization.

(2) A1FL2 is a front panel plug in type module which provides 1 nS parabolic equalization.

(3) A1FL3 is a front panel plug in type module which provides +2 nS linear equalization.

(4) A1FL4 is a front panel plug in type module which provides +1 nS linear equalization.

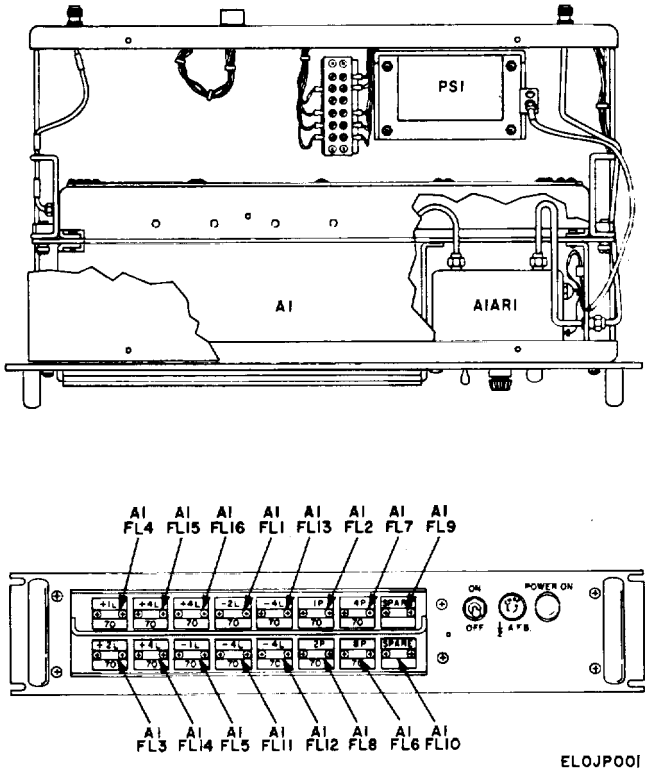
(5) A1FL5 is a front panel plug in type module which provides -1 nS linear equalization.

(6) A1FL6 is a front panel plug in type module which provides 8 nS parabolic equalization.

(7) A1FL7 is a front panel plug in type module which provides 4 nS parabolic equalization.

(8) A1FL8 is a front panel plug in type module which provides 2 nS parabolic equalization.

Figure 1-1. Group delay equalizer.



(9) AlFL9 and AlFL10 are shorting plugs inserted into spare module sockets. The shorting plugs provide no equalization but complete a series circuit. Should additional equalization be required, one or both of the shorting plugs can be replaced by active + linear or parabolic filter modules.

(10) AIFL11, AlFL12, and AlFL13 are front panel plug in type modules which provides -4 nS linear equalization.

(11) AlFL14, AIFL15, and AlFL16 are front panel plug in type modules which provides +4 nS linear equalization.

(12) The 70-MHz low-noise amplifier (AlARl) is mounted within the equalizer assembly of the group delay equalizer. It provides 11 to 14 dB of gain. The +24 Vdc power supply PS1 is mounted at the rear of the group delay equalizer chassis. It pro-vides the B + voltage for the amplifier

1-5. Technical Characteristics

Electrical:

Power requirement	115 Vac + 10% 47-420 Hz
Frequency range	50 to 90 MHz
Amplitude response	0.5 dB overall (at any group
Group delay response	near and 15 nS parabolic eq
Gain	0 dB (nominal)Signal
input\output	0 dBm (maximum)
	50 ohms inpedence

Physical:

Overall dimensions	19 in. wide3.5 in. high13 Weight 15 pounds
Mountain	Standard 19 in. Rack mtg

CHAPTER 2
FUNCTIONING OF EQUIPMENT

2-1. Introduction

(See figure 2-1.)

a. This chapter contains an analysis of Group Delay Equalizer CN-1425/MSC-46(V).

b. Circuit components (piece parts) are not shown on the diagrams except where they are necessary to clarify the action of a circuit upon a particular signal. The individual circuit paths are traced through units, modular assemblies, subassemblies, and circuit stages of their physical location. Each function and operational characteristic of the individual components of the group delay equalizer is described in detail to provide a complete understanding of the operation of the equipment.

c. Operation of the group delay equalizer is established in conjunction with the group delay measurement procedure set forth in paragraph 4-3.

2-2. Functional Analysis

a. The group delay equalizer consists of 14 passive equalizer networks (phase compensating filter modules) arranged in groups with attenuators between the various groups. Following the filters is a 20 dB, 70 MHz+20 MHz amplifier to compensate for the various attenuation introduced throughout the group delay equalizer, and thereby establish an overall group delay equalizer insertion loss of 0 dB +1 dB. The filter sconsist of a number of bridged-T networks, each with
an individual delay characteristic that can be cascaded in series to provide the overall required group delay equalization in the system in which the group delay equalizer is installed. Linear equalization at 70 MHz is provided in individual positive and negative slope 1, 2and 4 nS phase compensating filters which can be cas-caded to provide from 0 to 15 nS delay equalization in 1nS steps. Parabolic equalization is accomplished in the same manner by 1, 2, 4, and 8 nS filters providing from 0 to 15 nS equalization also in 1 nS steps

b. The mechanical configuration of the individual phase compensating filters is such that when the net-work is physically inserted into the group delay equalizer in a specific position, the filter is connected into the overall series circuit and is said to be active. However, if the filter is unplugged from the group delay equalizer, and physically rotated 180° and then plugged in again, the network is bypassed. That is, the bypass position, a short circuit is inserted in the overall series circuit and no equalization is obtained. Spare modules A1FL9 and A1FL10 are shorting plugs. When inserted in either position they will provide a short circuit, without equalization, in the overall series circuit.

c The 70-MHz amplifier is self-contained and provides 11 to 14 dB of gain to compensate for the various losses introduced within the group delay equalizer.

d. The power supply is a series-regulated, short circuit proof power supply operating from the primary power of 115 Vac. The output voltage of the power supply is a regulated +24 Vdc used to provide the operating voltage required by the 70-MHz low-noise amplifier.

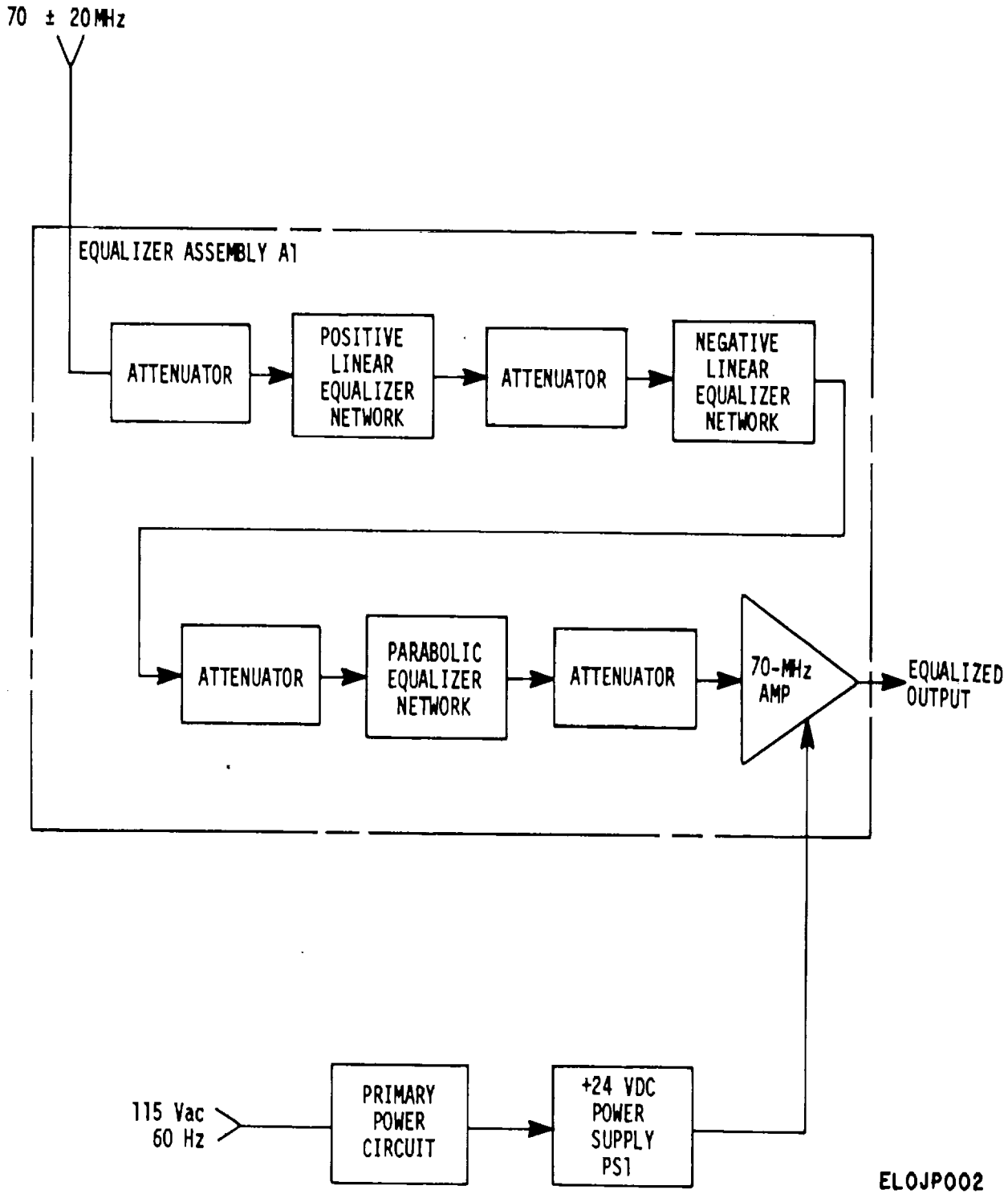


Figure 2-1. Group delay equalizer, functional block diagram.

CHAPTER 3
DIRECT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. GENERAL

3-1. Introduction

This chapter contains direct and general support maintenance procedures for the Equalizer, Group Delay CN-1425/MSC46(V). Maintenance of the group delay equalizer consists of troubleshooting, removal and replacement of defective components and testing.

a. Troubleshooting procedures are provided in Section III. These procedures are used to isolate troubles to a defective subassembly within a malfunctioning group delay equalizer. A troubleshooting chart is utilized to isolate the defective subassembly

b. The group delay equalizer maintenance procedures are provided in Section IV. These procedures include instructions for removal and replacement of defective subassemblies.

c. The group delay equalizer testing procedure is provided in chapter 4. This procedure may be used to check operation following repairs, replacement of defective subassemblies, or whenever improper operation is suspected. The test procedure may also be used to check the operation of a replacement assembly after installation.

NOTE

Careless replacement of parts often creates new troubles. Whenever a part has been replaced, make all necessary adjustments, and check the performance of the equipment to be sure that the original malfunction has been remedied and that no new trouble has de-veloped in the equipment as a result of the repair.

3-2. Voltage and Resistance Measurement

Voltage resistance measurements are an aid in determining circuit conditions and in evaluating clues in the course of troubleshooting.

a. Take voltage readings with the equipment operating and unless otherwise specified measure all voltages with respect to ground. This equipment is transistorized; when measuring voltages, use tape or sleeving (spaghetti) to insulate the entire test prod, except for the extreme tip. A momentary short can destroy a transistor.

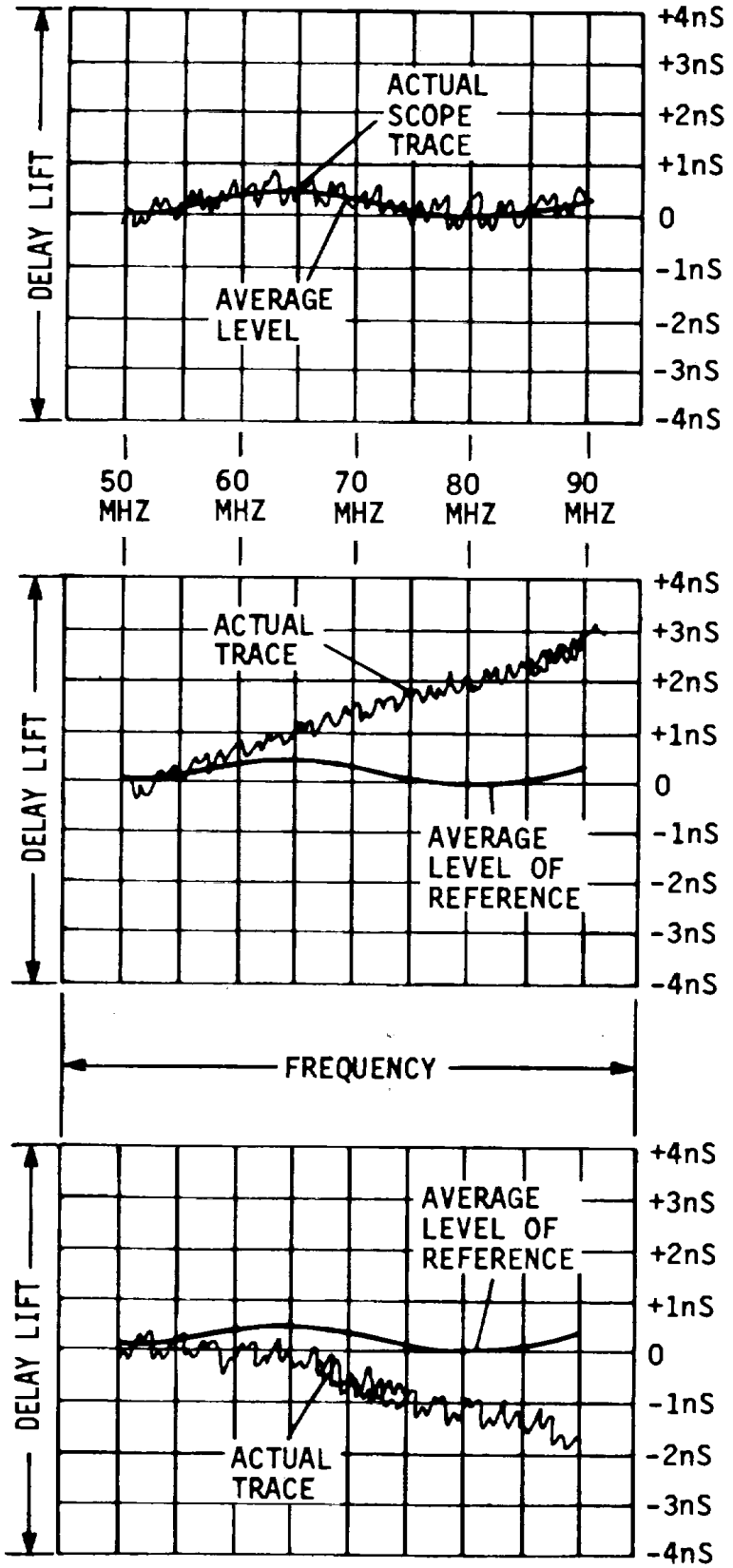
CAUTION

Before using any ohmmeter to test transistors or transistorized circuits, check the open circuit voltage across the ohmmeter test leads *Do not* use the ohmmeter if the open circuit voltage exceeds 1.5 volts. *Do not* use the R x 1 range of any ohmmeter when testing low power transistors. The R X 1 range normally connects ohmmeter internal battery directly across the test leads; the comparatively high current may damage the transistor under test.

b Make all resistance measurements with the cables disconnected. *Do not* make resistance measurements on the printed circuit boards which contain transistors.

3-3. Waveforrms

Typical delay lift waveforms to be obtained during performance of the group delay test contained in chapter 4 are as presented in figure 3-1 (1).)



TYPICAL REFERENCE TRACE

VERTICAL SCOPE CALIBRATION:
1 DIVISION = 1nS

TRACE OF +2L PHASE COMPENSATING FILTER

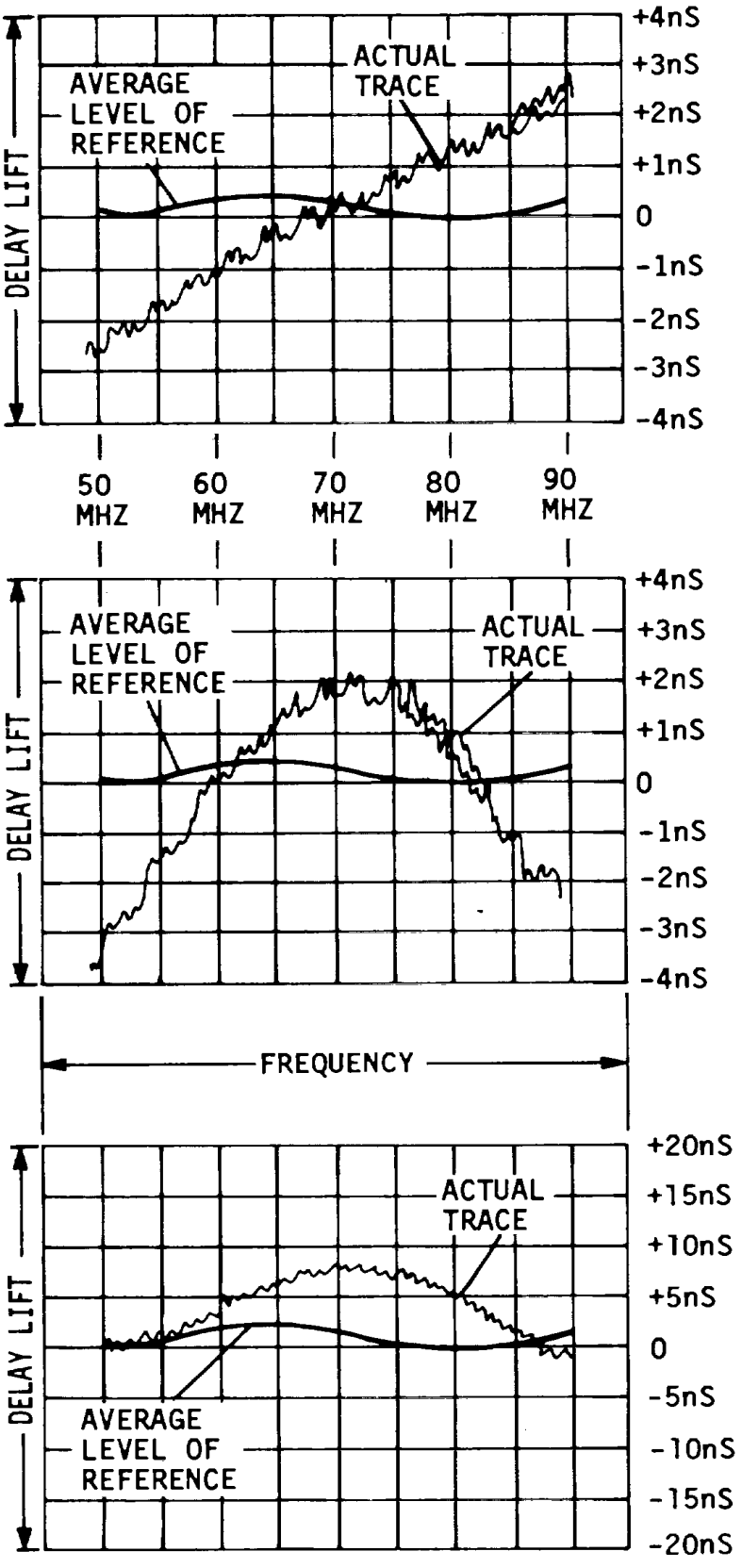
VERTICAL CALIBRATION:
1 DIVISION = 1nS

TRACE OF -2L PHASE COMPENSATING FILTER

VERTICAL CALIBRATION:
1 DIVISION = 1nS

ELOJPOO3

Figure 3-1 (1). Typical delay lift waveforms (sheet 1 of 2).



TRACE OF +4L PHASE COMPENSATING FILTER
VERTICAL CALIBRATION:
1 DIVISION = 1nS

TRACE OF 4P PHASE COMPENSATING FILTER
VERTICAL CALIBRATION:
1 DIVISION = 1nS

TRACE OF 8P PHASE COMPENSATING FILTER
VERTICAL CALIBRATION:
1 DIVISION = 5nS

ELOJP004

Figure 3-1 (2). Typical delay lift waveforms (sheet 2 of 2).

Section II. TOOLS AND EQUIPMENT

3-4. Tools

No special tools are required to perform maintenance on the group delay equalizer. For standard shop tools required, refer to the Maintenance Allocation Chart contained in TM 11-5895-83-12 (Operator's and Organizational Maintenance Manual, Frequency Conversion Subsystem for Satellite Communications Terminal AN/TSC54).

3-5. Test Equipment and Materials

a. The test equipment required for maintenance of the group delay equalizer is listed in the appropriate paragraphs in which the test procedure is given. Test equipment that meets the specification presented in the procedure should be used to comply with the requirements of this chapter.

NOTE

Before using the test equipment, carefully read the operating instructions. For maximum accuracy in all measurements, use the range that will produce a meter reading as close to midscale (full scale for power meters) as possible.

b. When using test equipment, place it on a firm support and position the test equipment so that its controls are within easy reach.

WARNING

Do not allow any test leads to drape across high-voltage circuits. Severe burns or electrical shock to the user and damage to the equipment under test may result.

Section III. TROUBLESHOOTING

3-6. Equalizer, Group Delay CN-1425/MSC-46(V) Troubleshooting

a. Problems in the group delay equalizer will generally consist of a complete loss of signal through the overall group delay equalizer. The troubleshooting chart, covers the symptom, probable trouble and corrective action. Since the various components are sealed, troubleshooting is confined to testing, substitution, removal and replacement. A list of repair parts authorized to be kept on hand by activities performing maintenance on the group delay equalizer is contained in TM 11-5895-833-34P-6 (Direct and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools).

b. Before any subassembly is replaced, make certain that a loose cable connector is not the cause of the trouble. If normal operation is not restored by replacement of a subassembly indicated as defective in the troubleshooting chart, check interfacing coaxial cable assemblies by substituting a spare cable.

c. See figure FO-1 for a combined schematic and RF interconnecting diagram of the group delay equalizer. Point-to-point wiring data for the primary power and dc distribution circuits is given in the wire run list (paragraph 3-7).

Troubleshooting Chart

Item No.	Symptom	Probable Trouble	Corrective Action
1	No 70-MHz (+20 MHz nominal) signal at the output of the delay equalizer.	a. No input signal from equipment(down converter) or from user (up converter).	a. Use a spectrum analyzer frequency and amplitude of input signal.
		b. Defective phase compensating filter.	b. Using a spectrum analyzer at the output, remove phase compensating filter one at a time, and place in the bypass position (markings on the filter module inverted). Observe if the signal is present at the output. If signal is not present at the output, restore to original position and repeat for all modules until faulty module is located.
		c. + 24 VDC power supply failure.	c. Connect a multimeter across the (+) and (-) terminals of the power supply. The indication should be +24 VDC. If no output terminals of the power supply. If the fuse is good, check for 115 Vac input into the power supply. If it is available, replace the power supply

Item No.	Symptom	Probable Trouble	Correction Action
		d. 70-MHZ amplifier failure.	d. Connect a 70-MHz CW signal generator to the input of the amplifier, set the signal generator to -MHz at an output level equal to the group delay equalizer Set a power meter to indicate 20 dB over the amplifier input level. Note the amplifier gain, it should be from 13.0 to 13.5 dB. If the gain is low , or zero , replace the amplifier.
2	User complaint regarding reception of digital communications.	a. Improper delay equalization.	*a.* Perform test as presented in chapter4.

3-7.Wire Run List

Wire no.	*From*	*To*	*Size (AWG)*	*Color*	*Remarks*
1	J3-A	XF1-2	18	BLK	P/O W3 harness
2	J3-B	S1-4	18	WHT	P/O W3 harness
3	J3-C	TB1-5	18	GRN	P/O W3 harness
4	XDS1-1	TB1-5	22	GRN	P/O W3 harness
5	KDS1-2	TB1-1	22	WHT	P/O W3 harness
6	S1-1	TB1-1	22	BLK	P/O W3 harness
7	S1-2	TB1-2	22	WHT	P/O W3 harness
9	J4	TB1-3	22	WHT	P/O W3 harness
10	PS1-AC	TB1-1	22	BLK	P/O W3 harness
11	PS1-AC	TB1-2	22	WHT	P/O W3 harness
12	PS1(+)	TB1-3	22	WHT	P/O W3 harness
13	PS1(-)	TB1-6	22	GRN	P/O W3 harness
-	XF1-1	S1-3	18	BLK	Wire jumper
	TB1-5	TB1-6	-----	-----	TB barrier jumper
	TB1-6	Chassis	-----	-----	TB barrier jumper

Section IV. MAINTENANCE OF EQUALIZER, GROUP DELAY CN-1 425/MSC-46(V)

3-8. Removal of Group Delay Equalizer Parts and Subassemblies

(See figure 3-2.)

Access to internal parts of the group delay equalizer is gained by removal of the top cover (16). The cover is secured to the chassis (3) by ten screws, with lock and flat washers. To replace the phase compensating filter modules (19 through 34) remove the filter retainer (15).The retainer is secured to the front panel by twos crews, with lock and flat washers. A filter module may then be removed by pulling straight out by its handle Access to the rear of front panel mounted components is gained by removal of the six screws, lock washers, and flat washers which secure the front panel (18) to the chassis. Care should be exercised in removal of the front panel since the panel mounted components are still connected to the terminal board (41) by the wiring harness. Sufficient slack exists in the harness, however, to permit adequate separation of the front panel and chassis. It is not necessary to remove the filter retainer in order to remove the front panel. Specific instructions for removal of the 24-volt power supply (PS1), the equalizer assembly (Al), and the 70-MHz low-noise amplifier are given in the following para-graphs.

3-9. Removal of Power Supply PS1

a. Remove ten screws, lock washers, and flat washers securing the top cover (16, figure 3-2) to the chassis (3).

b. Disconnect cable assembly W3 connector P1 (8) from feed-through connector J4 on the power supply support (6).

c. Remove four screws, nuts, lock washers, and flat washers which secure the power supply support (6) to
the chassis.

d. Unsolder wiring from the power supply (7) as follows: Wires 10 and 11 from Ac terminals
Wire 12 from (+) terminal
Wire 13 from (-) terminal

e. Remove three screws, lock washers, and flat washers which secure the power supply to the support.

3-10. Removal of Equalizer Assembly Al

a. Remove ten screws, lock washers, and flat washers that secure top cover (16, figure 3-2) to chassis (3). Remove cover.

b. Disconnect cable assembly W3 connector P1 (8) from feed-through connector J4.

c. Disconnect RF cable assembly W2 connector P2 (12) from bulkhead connector A1J2 on the equalizer assembly chassis.

d. Disconnect RF cable assembly WI connector P2(1) from bulkhead connector AlJ1 on the equalizer assembly chassis.

e. Remove six screws, lock washers, and flat washers which secure the front panel assembly (18) to the chassis. (Do not remove the screws which secure the filter retainer (15) to the front panel.)

CAUTION

The front panel assembly is still connected to the group delay equalizer by the wiring harness.

f. Carefully remove the front panel from the chassis, and place the panel along side the group delay equalizer.

g. From the underside of the chassis (3) remove four screws, lock washers, and flat washers which secure the equalizer supports (10 and 17) to the chassis.

h. Remove four flat head screws that secure the equalizer assembly (14) to the front surface of the chassis. Remove the equalizer assembly from the chassis.

i. Loosen two captive screws which secure each of the equalizer supports (10 and 17) to the equalizer assembly. Remove the supports.

3-11.Removal of 70-MHzLow-Noise Amplifier A1AR1

a. Remove equalizer assembly Al (14, figure 3-2) from the group delay equalizer chassis (paragraph 3-9.)

NOTE

It is not necessary to remove the supports (10 and 17) from the equalizer assembly chassis (i, paragraph 3-9).

b. Remove 14 screws, lock washers, and flat washers which secure the rear access panel (5, figure 3-2) *of the assembly.

C .Disconnect cable assembly AlW2 connector P1 from the J1 IN connector on the rear of amplifier A1AR1 (13).

d. Disconnect cable assembly A l W l connector P2 from the J2 OUT connector on the rear of amplifier AlAR1.

e. Loosen, but do not remove, the screw securing the loop clamp (11) to the equalizer assembly chassis.

f. Remove four flat head screws that secure the 70-MHz amplifier to the bottom of the equalizer assembly chassis.

g. Carefully withdraw the amplifier from the equalizer assembly.

NOTE

Input power cable A1W3 may be pushed through the grommet and cable clamp to pro- vide slack required for step g.

h. Unsolder wiring as follows:

(1) Center conductor of A1W3 from C14 + 24 VDC terminal of amplifier A1AR1.

(2) Shield (pigtail) of A1W3 from E 1 GND terminal of amplifier AlAR1.

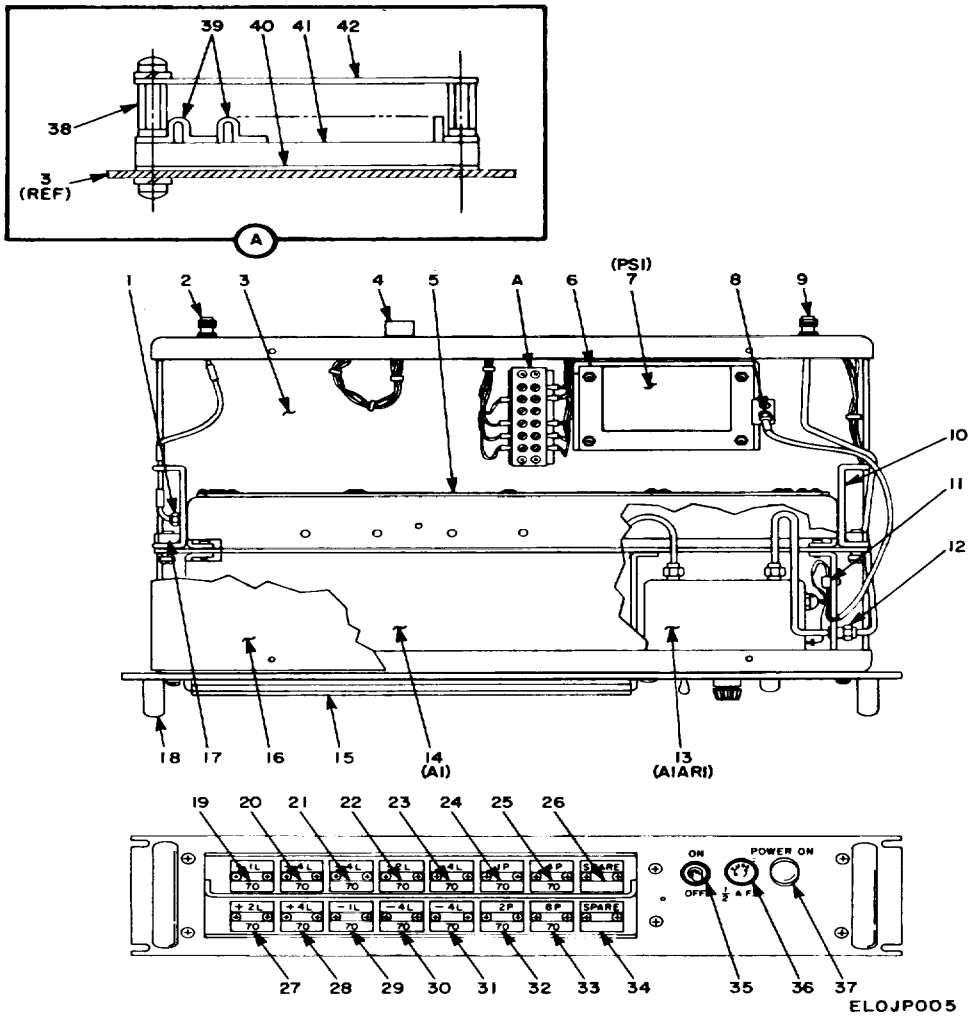
3-12. Removal of Terminal Board TB1

a. Remove four screws, lock washers, and flat washers, which secure the terminal board shield (42, figure 3-2). Remove the shield.

b. Unscrew four hexagonal standoffs (38) from ter-minal board (41). Remove four lock washers and flat washers.

c. Disconnect ring terminals and barrier jumpers. Refer to wire run list, paragraph 3-7, for replacement.

d. From underside of chassis (3) remove four screws, lock washers, and flat washers that secure terminal board TB1 (41) and marker strip (40).



1 Cable assembly W1 connector P2
2 ConnectorJl (If. INPUT) (+1L)
4 Connector J3 (POWER INPUT)
5 Equalizer assembly Al rear access cover
6 Power supply support
7 +24 Vdc power supply PS1
8 Cable assembly W3 connector P1
9 Connector J2 (If. OUTPUT)
10 Equalizer support, right hand
11 Loop clamp
12 Cable assembly W2 connector P2
13 Amplifier AlARI
14 Equalizer assembly Al
15 Filter retainer
16 Top cover
17 Equalizer support ,left hand
18 Front panel assembly
19 1 nS positive linear filter module A1FL4
30 4 nb negative linear filter module
20 4 nS positive linear filter module AFL15 (+4L) 21 4 nS positive linear filter module AlFL16 (+4L)
22 2 nS positive linear filter module AIFLI (-2L)
23 4 nS negative linear filter module A1FL13 (-4L) 24 1 nS parabolic filter module A1FL2 (1P) 25 4 nS parabolic filter module A1FL7 (4P)
26 Spare filter module AlFL9 (SPARE)
27 2 nS positive linear filter module A1FL3 (+2L) 28 4nSpositivelinearfltermoduleAlFL14 (+4L)
29 1 nS negative linear filter module A1FL5 (-1L)3 Chassis AFL11 (-4L)
31 4 nS negative linear filter module A1FL12 (-4L)
32 2 nS parabolic filter module A1FL8 (2P)
33 8 nS parabolic filter module A1FL6 (8P)
34 Spare filter module AlFL10 (SPARE)
35 ON-OFF switch SI
36 Fuse F1; fuse holder XF1
37 Lamp PS1; lamp holder XDS1
38 Standoff
39 Jumper
40 Marker strip
41 Terminal board TBI
42 Shield

Figure 3-2. Group delay equalizer, parts location diagram.

CHAPTER 4

DIRECT AND GENERAL SUPPORT TESTING PROCEDURES

4-1. Introduction

a. The detailed testing procedures contained in this chapter present a comprehensive program to measure and determine the significant operating parameters of the group delay equalizer. In addition to utilization as an adjunct to troubleshooting and maintenance, these tests may be used as a checkout procedure, or a guide to rehabilitation of the group delay equalizer.

b. All test procedures are performed with the group delay equalizer under test removed from the frequency conversion subsystem. Before taking any component off line to perform a test, record orientation of phase compensating filters to facilitate restoration of normal operating conditions after the test.

4-2. Test Equipment and Materials

a. Specifications for test equipment required for testing the group delay equalizer are given in paragraph 4-3, *b.* Any test equipment which meets these minimum specifications may be used for the test. The following special tools and test equipments are required for performance of this test:

(1) Group Delay Test Set, Comtech Model No. STS-701

(2) Fabricated power cable, per Figure 4-1.

b. Coaxial cable for general interconnection of test equipment is designated on test setup diagrams. Between series connector adapters are normally not specified 3ince their selection will vary depending on the particular test equipment used. To prevent introducing excessive dB losses, use the shortest available coaxial cable that will satisfy necessary test setup connections. In addition to special test cables specified for individual procedures, the following test cables are recommended for general inter connection.

Cable	*Connectors*	*Length*	*Quantity*
RG 223( )/U	N male--BNC male	6 Ft	2
RG-223( )/U	N male--BNC male	3 Ft	1
RG-223( )/U	BNC male--BNC male	6 Ft	6
RG-223( )/U	BNC male--BNC male	4 Ft	7
RG-223( )/U	BNC male--BNC male	1 Ft	2

4-3. Group Delay Equalizer Test Procedure

a. Performance Standards.

Input return loss (VSWR): 21 dB minimum (1.2:1)
Output return loss (VSWR): 21 dB minimum (1.2:1)
Gain: O dB - 1 dB
Group delay:

Module Designation	*Delay Lift and Limits*
+1L	+1nS±0.25 (linear)
+2L	+2nS±0.5 (linear)
+4L (each of 3)	+4nS±1.0 (linear)
-1L	-1nS ± 0.25 (linear)
-2L	-2nS ± 0.5 (linear)
-4L (each of 3)	-4nS±1.0 (linear)
1P	1nS±0.25 (parabolic)
2P	2nS±0.5 (parabolic)
4P	4nS±1.0 (parabolic)
8P	8nS±1.0 (parabolic)
SPARE (each of 2)	0±0.5 nS

b. Test Equipment and Materials.

(1) Group delay test set, Comtech model no. STS- 01.
(2) Oscilloscope.
(3) 1-dB increment variable step attenuator (50 to 90 MHz
(4) Frequency counter (-13 dBm sensitivity).
(5) Sweep generator (50 to 90 MHz at +13 dBm, (20mW) 50 ohms) with automatic internal and external leveling, and directional detector for external leveling.
(6) Two 10-dB directional couplers (50 to 90 MHz, 40-dB directivity).
(7) Rf power meter (-30 to 0 dBm) with 50-ohm, 50-90 MHz power detector.
(8) One 6-dB and two 3-dB fixed coaxial attenuators.
(9) 50-ohm coaxial, termination (TNC-male).
(10) Test cables and adapters:
*(*a) Two RG-223/U cables (2 ft) with N-male/ NC-male connectors.
*(*b) Two BNC-female/TNC-male adapters.
*(*c) Type TNC-female/female bullet adapter.
*(*d) Two RG-223/U cables (1 ft) with BNC-male connectors both ends.
(e) Special fabricated power cable (See paragraph 4-2, *a.)*
(f) RG-223/U cables and adapters compatible with selected test equipment.

c. Test Connections and Conditions.

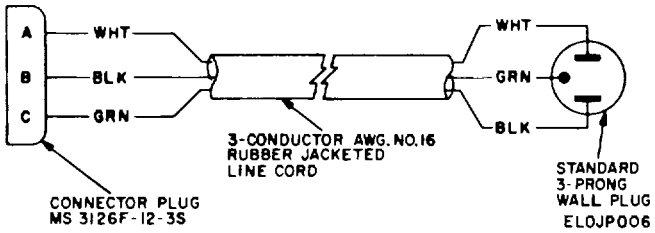


Figure 4-1. Power cable fabrication diagram.

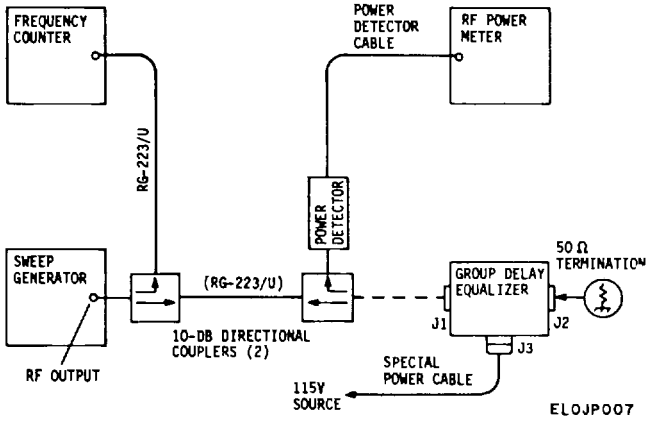


Figure 4-2. Group Delay equalizer, return loss test setup diagram.

NOTE

The phase compensating filters on the goup delay equalizer are *active* (connected to provide designate delays when the markings are right reading and are *bypassed* when the markings are inverted.

(1) Set all phase compensating filters on the group delay equalizer to the *bypassed* orientation.

(2) Connect 50-ohm termination to group delay equalizer as shown in figure 4-2.

(3) Connect the sweep generator, directional couplers, frequency counter, and power meter as shown in figure 4-2. (Do not connect the second directional coupler to J1 of the group delay equalizer.)

(4) Energize test equipment. Allow 15 minutes for warm up and stabilization.

d. Return Loss Test.

(1) Set the sweep generator for a 50-MHz CW output.

(2) Adjust the output level of the sweeper for a -10 dBm indication on the power meter.

(3) Connect the open port of the directional coupler directly to J1 of the group delay equalizer. Power meter indication should not be greater than -31 dBm.

CAUTION

When a filter module is removed from the group delay equalizer, the power meter indication may jump to a level as high as -10 dBm. Be certain to set the power meter to a suffiently high range before removing a filter module.

(4) Rotate all of the positive linear phase compensating filters to the *a*ctive position. Power meter reading should not be greater than -31 dBm.

(5) Disconnect the directional coupler from J1 of the group delay equalizer, and replace with the 50 ohm termination.

(6) Connect the open port of the directional coupler directly to J2 of the group delay equalizer. Power meter indication should not be greater than -31 dBm.

(7) Disconnect the directional coupler from J2 of the group delay equalizer.

(8) Return all phase-compensating filters to the *bypassed* position.

(9) Connect the 50 ohm termination to J2 of the group delay equalizer.

(10) Set the sweep generator for a 70-MHz CW output, and repeat steps (2) through (8).

(11) Set the sweep generator for a 90-MHz CW output, and repeat steps (2) through (8).

e. Gain and Ripple Test.

(1) Connect test equipment as shown in figure 4-3, using the bullet adapter in place of the group delay equalizer.

(2) Check that the sweep generator is set for a 90-MHz CW output.

3) Ensure that all phase-compensating filters are in the *bypassed* position.

(4) Adjust the output level of the sweep generator for a -1 dBm indication on the power meter, with leveling on.

(5) Replace the barrel adapter with the group delay equalizer as shown in figure 4-3. Power meter indication should be between -2 and 0 dBm.

(6) Rotate all parabolic (P) phase-compensating filters to the *active* position.

(7) Rotate all positive linear phase-compensating filters to the *active* position.

(8) Observe the power meter. It should indicate from -2 to O dBm.

(9) Rotate all positive linear phase-compensating filters to the *bypassed* position.

(10) Rotate all negative linear phase-compensating filters to the *active* position.

(11) Observe the power meter. Power measurement should be from -2 to 0 dBm.

(12) Return all phase-compensating filters to the *bypassed* position.

(13) Replace the group delay equalizer with the bullet adapter as shown in figure 4-3.

(14) Set the sweep generator to 70-MHz CW.

(15) Repeat steps (4) through (13).

(16) Set the sweep generator to 50MHz CW.

17) Repeat steps (4) through (12).

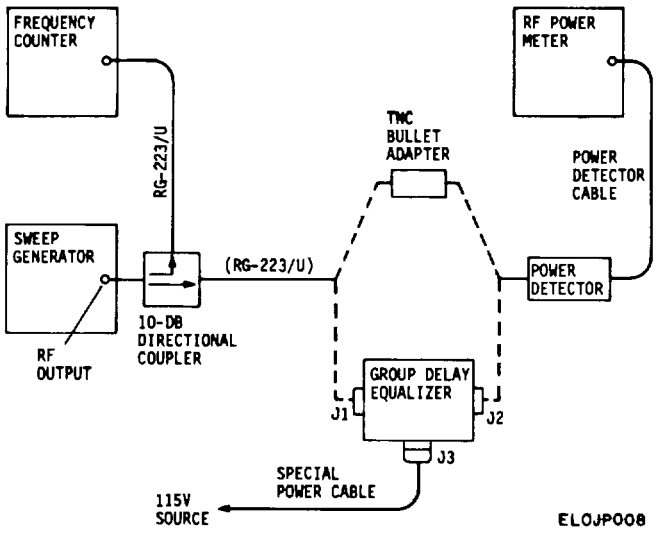


Figure 4-3. Group delay equalizer, gain and ripple test setup diagram

(18) Set the sweep generator for a manually swept test signal from 50 t0 90-MHz

(19) While observing the power meter, manually weep the generator from 50 to 90-MHz. Measure the mplitude difference (ripple) between consecutive peaks and valleys. Overall consecutive peak-to-valley excursions should not exceed 0.5 dB overall (+ 0.25 dB).

(20) Repeat steps (6) and (19).

(21 Repeat steps (7) and (19).

(22) Repeat steps (9), (10), and (19).

(23) Return all phase-compensating filters to the *bypassed* position.

f. Group Delay Test.

(1) Ensure that all phase-compensating filters are inthe *bypassed* position.

(2) Connect test equipment as shown in figure

(3) Check that the sweep generator is adjusted to sweep frequencies from 50 to 90-MHz. Manually sweep the generator to 70-MHz.

(4) Set the output level of the sweep generator to+13 dBm (20 mW) with leveling on.

(5) Set the selector switch on the group delay test set to the REF AMP position and note the meter reading. Reset the switch to the DATA AMP position and adjust the demodulator LEVEL ADV control for the same meter reading.

(6) Set the vertical gain of the scope to 2 volts/cm.

(7) Calibrate the group delay test set:

*(*a) Set the selector switch to ±+500 nS DELAY.

*(*b) Center the meter using the DELAY ZERO knob.

(c) Set the selector switch to +50 nS DELAY.

*(*d) Center the meter using the DELAY ZERO knob.

*(*e) Set scope for a dc presentation; adjust vertical balance to bring dot on CRT midway vertical.

f) Tune the DELAY ZERO knob for a -30 nS reading on the meter.(@) Adjust the vertical gain of the scope for a 3 cm deflection below the level established in step (e).

*(*h) Center the meter using the DELAY ZERO knob. Dot on CRT should return to center (midway-vertical).

NOTE

If dot is centered, scope is calibrated. If not, repeat steps (e) through *(h)* until calibration conditions are satisfied.

*(*i) Set selector switch for -5 nS delay, and adjust DELAY ZERO control to center the meter.

NOTE

A deflection of 1 cm on the scope now represents 1 nS delay lift.

(8) Set the sweep generator for a fast sweep of frequencies from 50 to 90-MHz.

(9) Adjust the width of the scope trace to fill 80% of the graticule width. Trace the CRT display on the scope face using a marking pencil. This is the reference.(Trace only the average level of the peak-to-peak display.)

(10) Rotate the +1L phase compensating filter to t*he active* position.

(11) Adjust the vertical position control on the scope to align the average level of the scope trace with the reference at a convenient point for comparison.

(12) Determine the average level of the filter trace, and compare with the reference. The filter trace (delay lift) from start to stop should increase in amplitude by 1+ 0.25cm (1 + 0.25 nS) with respect to the reference.(See figure 3-1 (1) for typical examples of reference and delay lift waveforms.

(13) Return the +1L filter to *bypassed.*

(14) Repeat steps (10) through (13) for each of the following phase compensating filters:

Marking	*Delay lift and tolerance*s
+1L	lnS- 0.25 (inear)
+2L	+2NS + 0.5 (linear)
+4L	+4nS + 1.0 (linear)
-1L	-lnS +0.25 (linear)
-2L	-2nS + 0.5 (linear)
-4L	-4nS + 1.0 (linear)
1P	InS + 0.25 (parabolic)
2P	2nS ± 0.5 (parabolic)
4P	4nS + 1.0 (parabolic)

NOTE

Negative linear filter traces should drop the specified amplitude with respect to the reference. Parabolic filter traces should rise in the center only with respect to the reference.

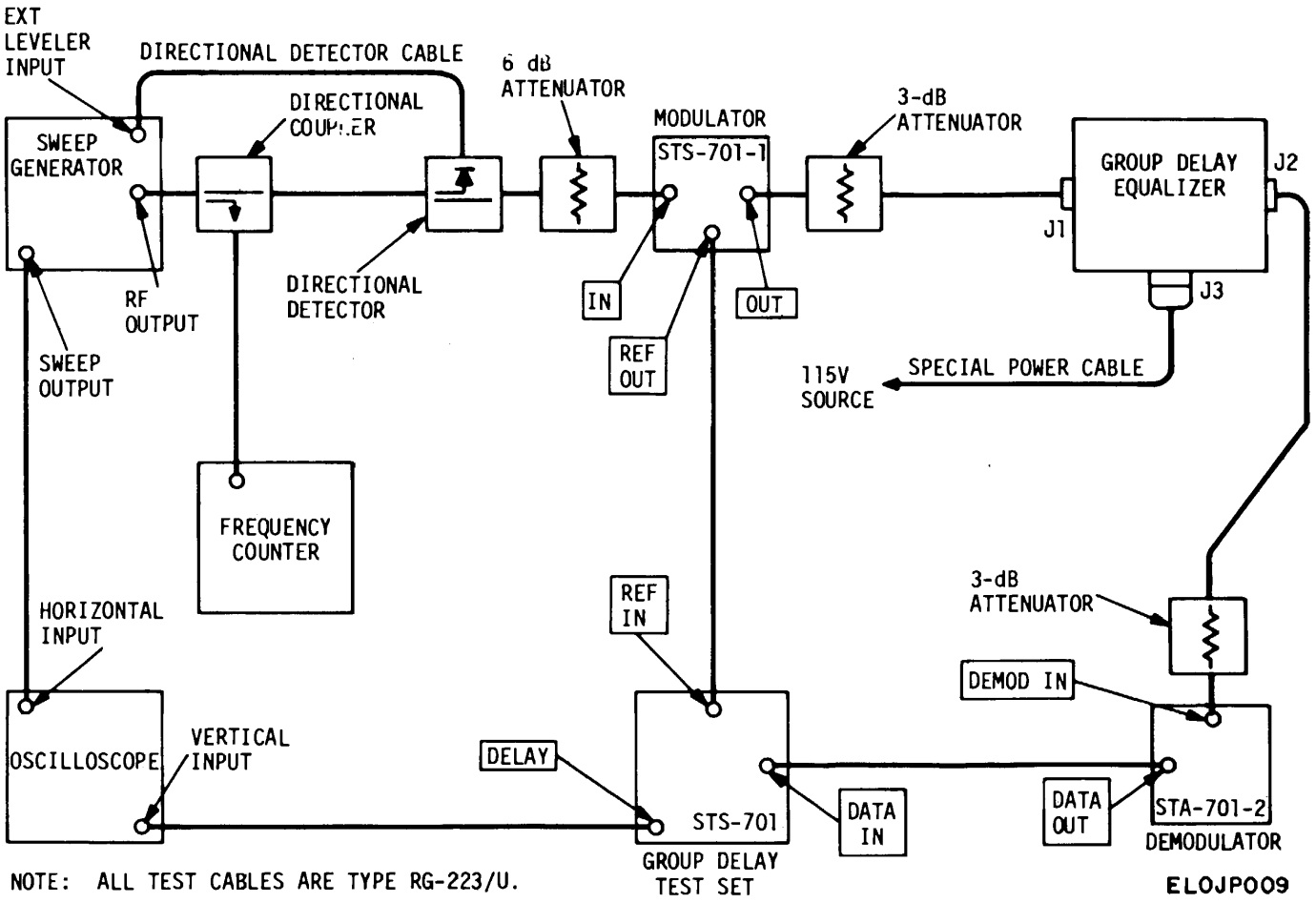


Figure 4-4. Group delay equalizer, group delay test setup diagram

(15) On the group delay test set, change the selector switch setting to ± 50 nS. On the scope, change the vertical gain to 1 volt per cm. (The scope is now calib-rated at 1 cm = 5 nS.)

(16) Repeat steps (10) through (13) for the 8P filter. Delay lift at the center of the trace (70-MHz) should be 1.6 cm±0.2cm

APPENDIX A
REFERENCES

The following is a list of publications applicable to direct and general support maintenance personnel.

AR 3805	Department of the Army Supplement to DOD 5200.1-R (DODISPR)
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	Military Publications: US Army Equipment Index of Modification Work Orders
TM 11-5895-833-12	Operator's and Organizational Maintenance Manual - Frequency Conversion Subsystem for Satellite Communications Terminal *AN/TSC-54* (NAVELEX 0967-LP-550-1010/TO 31R5-2TSC54-91)
TM 11-5895-833-20P	Organizational Maintenance Repair Parts and Special Tools List Frequency Conversion Subsystem for Satellite Communications Terminal AN/TSC-54 (NAVE LEX 0967-LP-550-1020/TO 31R5-2TSC54-94)
TM 11-5895-833-34-1	Direct Support and General Support Maintenance Manual - Frequency Conversion Subsystem for Satellite Communication Terminal AN/TSC-54(NAVELEX 0967-LP-550-1030 TO 31R5-2TSC54-102)
TM 11-5895-83334-2	Direct Support and General Support Maintenance Manual Frequency Conversion Subsystem for Converter, Frequency, Electronic CV-3084/MSC-46(V), CV-3084A/MSC-46(V) (NAVELEX 0967-LP-550-1050/TO31R5-2MSC46-2)
TM 11-5895-833-34-3	Direct Support and General Support Maintenance Manual Synthesizer, Electrical Frequency 0-1658/MSC-46(V) (NAVELEX 0967-LP-550-1070/TO31R5-2MSC46-12)
TM 11-5895833-344	Direct Support and General Support Maintenance Manual Amplifier, Radio Frequency AM-6631/MSC-46(V) (NAVELEX 0967-LP-550-1090/TO31R5-2MSC46-22)
TM 11-5895-833-345	Direct Support and General Support Maintenance Manual Test Translator SM-F-753378 (NAVELEX 0967-LP-550-1110/TO 31R5-2TSC54-112)
TM 11-5895-833-34-7	Direct Support and General Support Maintenance Manual-Converter, Frequency, Electronic CV-3085/MSC-46(V), CV-3085A/MSC-46(V)(NAVELEX 0967-LP-550-1150/TO 31R5-2MSC46-42)
TM 11-5895-833-4P-1	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools)for Frequency Conversion Subsystem for Satellite Communication Terminal AN/TSC-54 (NAVELEX 0967-LP-550-1040/TO 31R5-2TSC54-104)
TM 11-5895-83334P-2	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Converter, Frequency, Electronic CV-3084/MSC-46(V); CV3084A/ MSC-46(V) (NAVELEX 0967-LP-550-1060/TO 31R5-2MSC46-4)
TM 11-5895-83334P-3	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Synthesizer, Electrical Frequency 0-1658/MSC-46(V) (NAVELEX 0967-LP-550-1080/TO 31R5-2MSC46-14)
TM 11-5895-8334P-4	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Amplifier, Radio Frequency AM-6631/MSC-46(V) (NAVELEX 0967-LP-550-1100/TO 31R5-2MSC46-24)
TM 11-5895-833-34P-5	Direct Support, and General Support Maintenance Repair Parts and Special

	Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Test Translator SM-F-753378
TM 11-5895-83-34P-6	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Equalizer, Group Delay CN-1425/MSC-46(V) (NAVELEX 0967-LP-550-1140/TO 31R5-2MSC46-34)
TM 11-589583334P-7	Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Converter, Frequency, Electronic CV-3085/MSC-46(V); CV-3085A/ MSC46(V) (NAVELEX 0967-LP-550-1160/TO 31R5-2MSC46-44)
TM 38-750	The Army Maintenance Management System (TAMMS)

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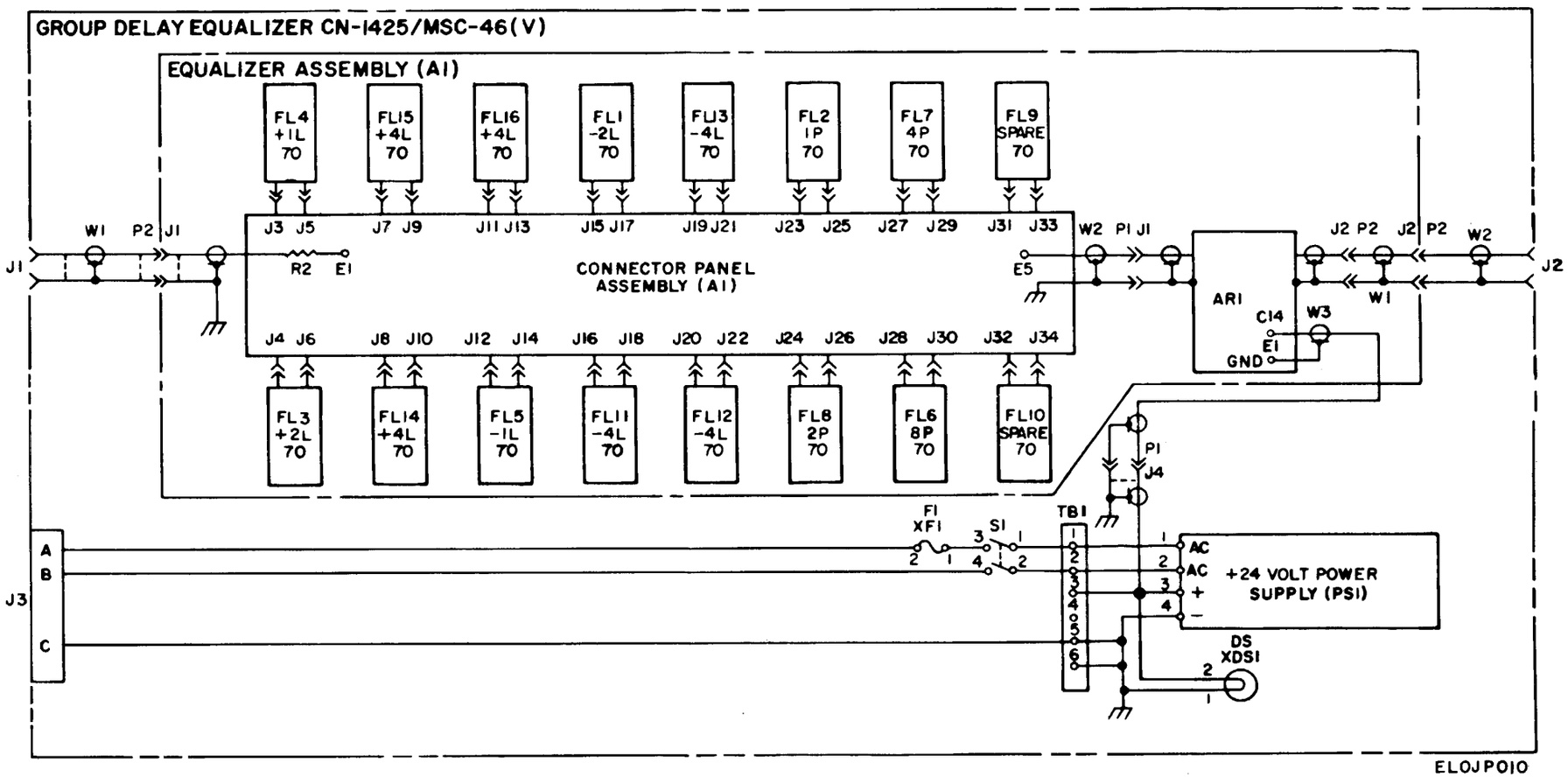

Figure FO-1. Group delay equalizer, schematic and rf interconnection diagram

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