

NAVSHIPS 94028.61

(Non-Registered)

OVERHAUL AND REPAIR INSTRUCTION
TECHNICAL MANUAL

for

COMPARATOR-
CONVERTER GROUP
AN/URA-17

HOFFMAN ELECTRONICS CORPORATION
MILITARY PRODUCTS DIVISION
LOS ANGELES 7, CALIFORNIA

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1-0 to 1-7	Original	7-1	Original
2-1 to 2-7	Original	8-1 to 8-2	Original
3-1	Original	9-1	Original
4-1	Original	i-0 to i-1	Original

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From Chief, Bureau of Ships
To: All Activities concerned with the Installation, Operation,
and Maintenance of the Subject Equipment

Subj: Overhaul and Repair Manual for Comparator-Converter Group
AN/URA-17, NAVSHIPS 94028.61

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2. When superseded by a later edition, this publication shall be destroyed.
3. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.
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Chief of Bureau

TABLE OF CONTENTS

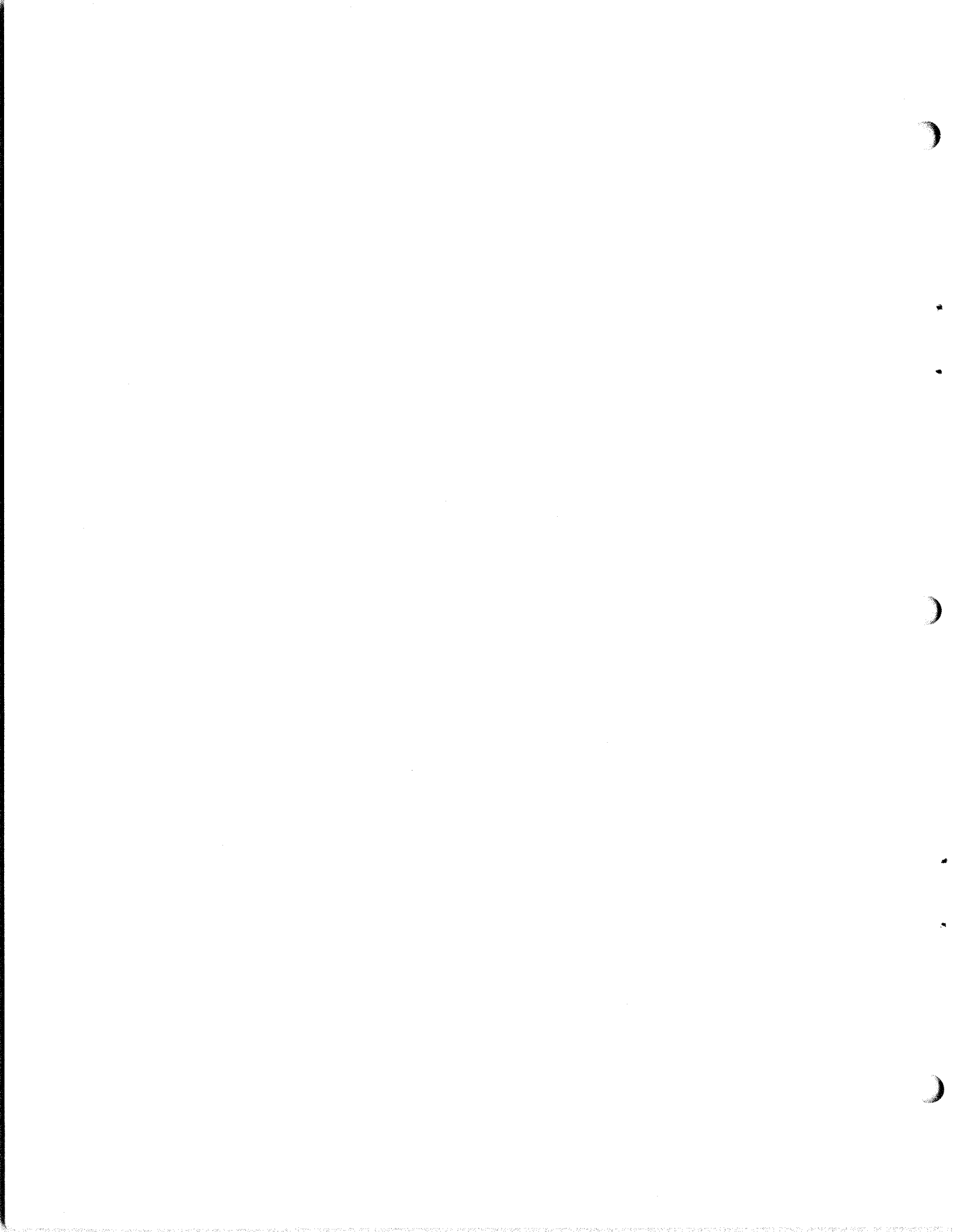
SECTION I—GENERAL INFORMATION		SECTION VI—REPAIR AND REPLACEMENT	
Paragraph	Page	Paragraph	Page
1-1. Equipment Illustration	1-1	6-1. General	6-1
1-2. Functional Description	1-1	6-2. Repair	6-1
1-3. Description of the Major Unit	1-1	6-3. Replacement	6-1
1-4. Factory or Field Changes	1-3	a. General	6-1
1-5. Quick Reference Data	1-3	b. Transformer and Filter Replacement	6-1
a. Af Input Signal	1-3	c. Printed Circuit Board Replacement	6-1
b. Operating Frequencies	1-3	d. Receptacle Panel Removal	6-1
c. Maximum Keying Speeds	1-3	e. Transistor Replacement	6-1
d. Output	1-3	f. Tuning Indicator Cathode Ray Tube Replacement	6-2
e. Power Source Requirements	1-3	g. Transistor Socket Replacement	6-2
1-6. Equipment Lists	1-3	h. Replacing Defective Switch Wafer	6-2
a. Equipment Supplied	1-3	i. Replacing Defective Switch	6-2
b. Equipment and Publications Required but not Supplied	1-3	j. Bandpass Filter Tests	6-2
c. Shipping Data	1-3	k. Interconnecting Cable Replacement	6-4
d. Equipment Similarities	1-3	l. Replacement of the Cable Retractor	6-4
e. Transistor and Diode Complement	1-3	m. Replacement and Adjustment of Drawer Slides	6-4
SECTION II—TEST EQUIPMENT AND SPECIAL TOOLS		SECTION VII—FINAL ASSEMBLY	
2-1. Test Equipment	2-1	7-1. General	7-1
2-2. Test Cables	2-1	7-2. Final Assembly	7-1
a. Audio Input Lines	2-1	SECTION VIII—EXAMINATION, TESTING, AND PACKAGING	
b. Power Transformer Connections	2-3	8-1. Examination and Testing	8-1
c. Cable Assembly	2-3	8-2. Packaging	8-1
SECTION III—DISMANTLING AND DISASSEMBLY		SECTION IX—DIFFERENCE DATA SHEETS	
3-1. Dismantling and Disassembly	3-1	9-1. General	9-1
a. Removal and Disassembly	3-1	9-2. Changes made at Serial A11 and Subsequent	9-1
SECTION IV—CLEANING		9-3. Changes made at Serial A156 and Subsequent	9-1
4-1. Cleaning	4-1	9-4. Changes made at Serial A246 and Subsequent	9-1
4-2. Cleaning Solutions	4-1	9-5. Field Changes	9-1
SECTION V—INSPECTION			
5-1. General	5-1		
5-2. Preliminary Check	5-1		
5-3. Electrical Inspection	5-1		

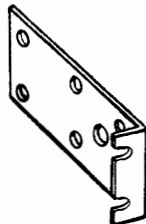
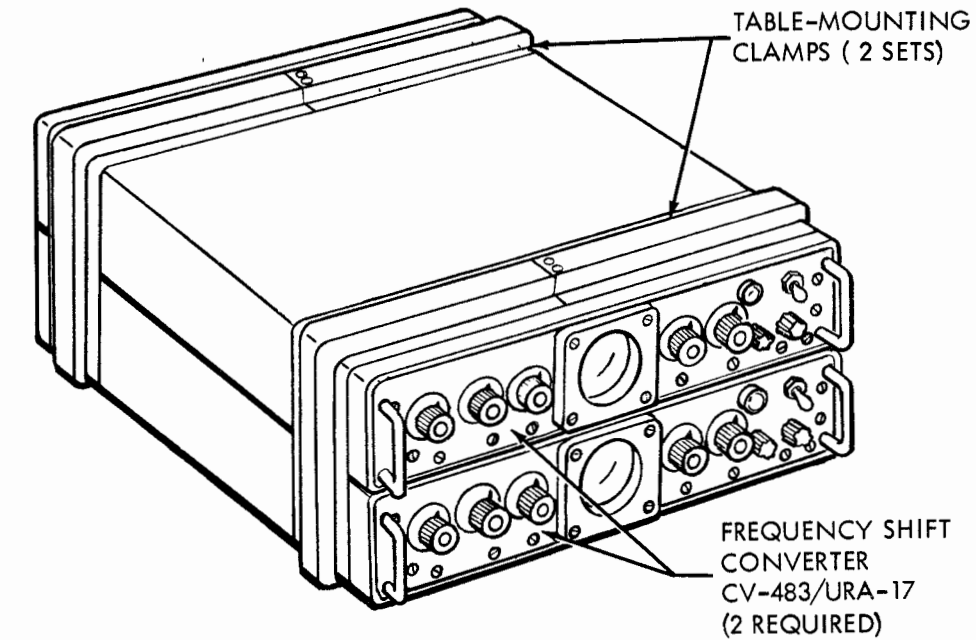
LIST OF ILLUSTRATIONS

SECTION I—GENERAL INFORMATION		SECTION II—TEST EQUIPMENT AND SPECIAL TOOLS—(Continued)	
Figure	Page	Figure	Page
1-1. Comparator-Converter Group AN/URA-17, Equipment Supplied	1-0	2-3. Frequency Shift Converter CV-483/URA-17, Cable Receptacle Panel, Interior View	2-4
1-2. Frequency Shift Converter CV-483/URA-17, Top View, Chassis Fully Withdrawn	1-2	2-4. Attaching UG-88D/U Plug to RG-58A/U Coaxial Cable	2-5
SECTION II—TEST EQUIPMENT AND SPECIAL TOOLS		2-5. Attaching MS Plug to MCOS-2 Cable	2-7
2-1. Frequency Shift Converter CV-483/URA-17, Interconnecting Data for Single-Receiver Operation	2-2	2-6. Attaching MS Plug to TTHFWA-1-1/2 Cable	2-7
2-2. Comparator-Converter Group AN/URA-17, Interconnecting Data for Diversity Operation	2-3	SECTION III—DISMANTLING AND DISASSEMBLY	
		3-1. Frequency Shift Converter CV-483/URA-17, Parts Location	3-1
		SECTION VI—REPAIR AND REPLACEMENT	
		6-1. Interconnecting Cable and Retractor	6-5

LIST OF TABLES

SECTION I—GENERAL INFORMATION		SECTION II—TEST EQUIPMENT AND SPECIAL TOOLS	
Table	Page	Table	Page
1-1. Comparator-Converter Group AN/URA-17, Equipment Supplied	1-4	2-1. Comparator-Converter Group AN/URA-17, Test Equipment Required for Overhaul	2-1
1-2. Comparator-Converter Group AN/URA-17, Equipment and Publications Required but not Supplied	1-5	2-2. Cabling Required for Single-Receiver Operation	2-2
1-3. Comparator-Converter Group AN/URA-17, Shipping Data	1-5	2-3. Cabling of each Converter for Diversity Operation	2-4
1-4. Frequency Shift Converter CV-483/URA-17, Transistor Complement	1-6	SECTION VI—REPAIR AND REPLACEMENT	
1-5. Frequency Shift Converter CV-483/URA-17, Diode Complement	1-7	6-1. Filter Characteristics	6-6





RACK-MOUNTING
BRACKETS (4)



UG-88D/U
CONNECTORS (6)

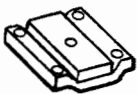
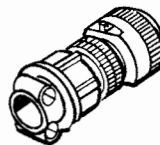


TABLE MOUNTING
FEET (4)



MS3106A 145-7P,
CONNECTORS (2)
MS3106A 145-7S
CONNECTORS (2)
MS3106A 145-9S
CONNECTORS (2)

497-1

Figure 1-1. Comparator-Converter Group AN/URA-17,
Equipment Supplied

SECTION I
GENERAL INFORMATION

1-1. EQUIPMENT ILLUSTRATION.

Figure 1-1 illustrates Comparator-Converter Group AN/URA-17, Federal Stock No. F5820-474-3975, the equipment supplied under Contract NObsr 81579. This equipment is manufactured by the Military Products Division, Hoffman Electronics Corp., Los Angeles 7, Calif.

1-2. FUNCTIONAL DESCRIPTION.

Comparator-Converter Group AN/URA-17, hereinafter referred to as the AN/URA-17, provides a link in the receiving end of a frequency-shift communication system. In this system, teletype mark-space characters are transmitted as rapid shifts above and below the center frequency of an rf carrier. These frequency-shift-keyed (fsk) signals are translated by a standard communications receiver into frequency variations about a center frequency of 1000 or 2550 cycles per second (cps). The AN/URA-17 changes these frequency-shifted audio signals into dc mark-space pulses for operation of a loop keying circuit of an automatic recording device. This method of communication provides the noise reduction advantages of frequency modulation for coded teletype messages at speeds to 400 words per minute.

The AN/URA-17 consists of two Frequency Shift Converters CV-483/URA-17, hereinafter referred to as converters. Either converter may be operated in a single-receiver fsk receiving system, or used together in combination with two receivers and a single teletype printer to provide a "diversity" receiving system. The diversity system makes use of the principles of space-diversity or frequency-diversity reception to eliminate severe signal fading over long transmission distances.

In space-diversity operation, two receivers are tuned to the same rf carrier frequency but their receiving antennas are spaced several wavelengths apart. The advantage of this method of reception is that maximum fading of a given carrier frequency usually does not coincide in time at points so separated. The audio output of each receiver is applied to a separate converter.

In frequency-diversity operation, two receivers are tuned to different rf carrier frequencies, both containing the same mark-space modulation. The audio output of each receiver is applied to a separate converter. The advantage of this method of reception is that maximum fading of two different carrier frequencies seldom occurs at the same time in a given location. Two transmitting stations as well as two frequency channels are required. This method may be used when space limitations at the receiving site do not allow sufficient antenna separation for effective space-diversity operation.

During diversity operation, a comparator circuit in each converter continuously compares the two received signals, selecting the stronger signal for operation of the teletype printer. The teletype printer may be connected to either of the converters. When operating in a single-receiver system, the comparator circuits are inoperative.

1-3. DESCRIPTION OF THE MAJOR UNIT.

Each converter is installed in a navy gray aluminum cabinet. A handle is provided on each side of the front panel and at each end of the back panel. The cabinet is equipped with ball-bearing drawer slides which lock in the fully withdrawn position (figure 1-2). When fully withdrawn, all chassis terminals and connections are visible and easily accessible.

All external cables are attached to the converter by means of connectors which match receptacles on a removable panel at the rear of the cabinet. This panel is sloped 30 degrees to allow easy access to the cable receptacles. The cable receptacles at the rear of the cabinet are connected to the chassis by a single cable and connector. This cable is equipped with a retractor which keeps the cable in place.

A tuning indicator (two-inch cathode-ray tube) is located in the center of the front panel of each converter to allow a quick visual check of receiver tuning. The tuning indicator uses a 60 cps sweep voltage. An external indicator may be connected to a receptacle on the rear panel, for use when the operator cannot see the converter tuning indicator while tuning the receiver.

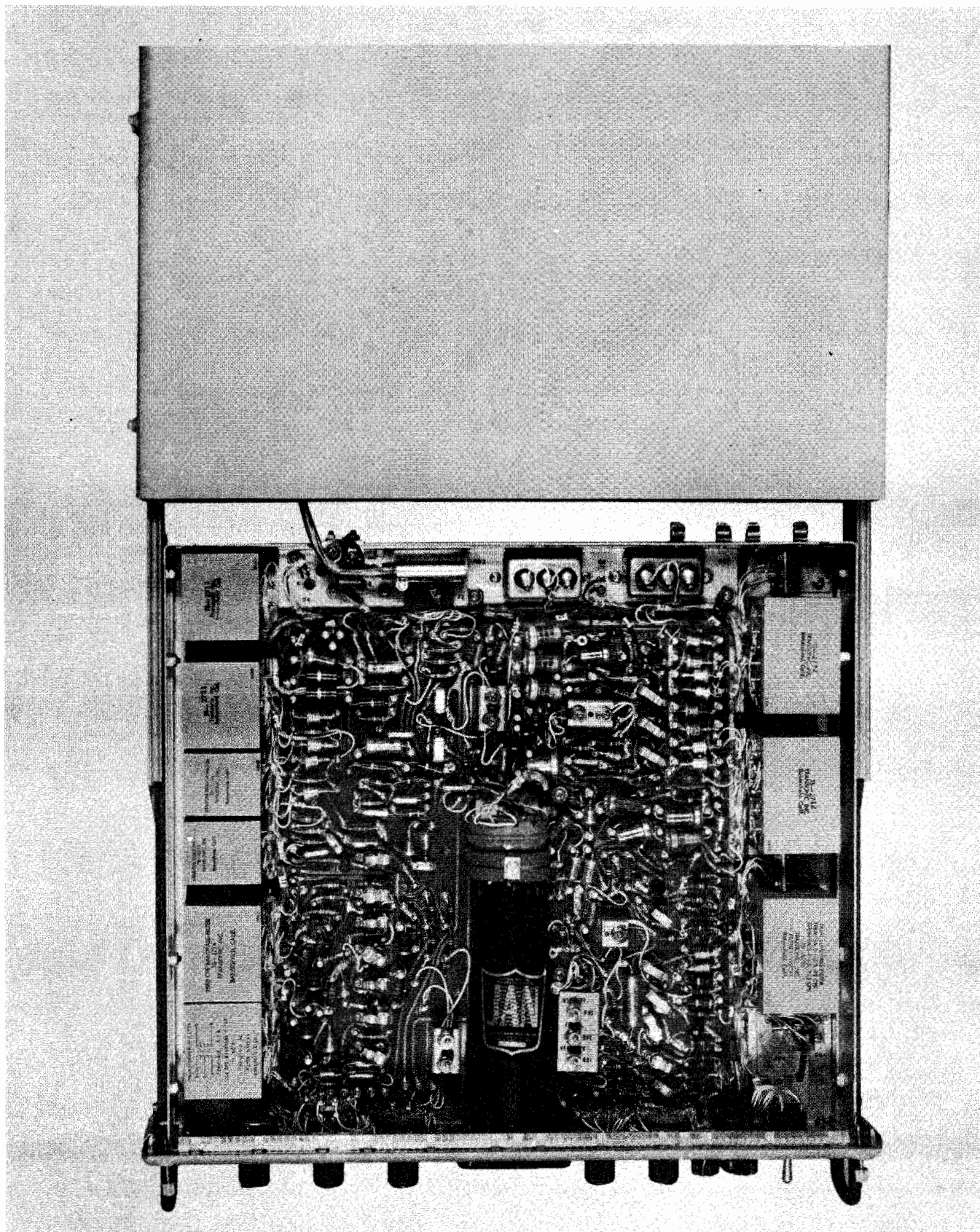


Figure 1-2. Frequency Shift Converter CV-483/URA-17,
Top View, Chassis Fully Withdrawn

The converters each operate from a power source of 105, 115, or 125 volts, 50 to 400 cps, single phase ac. Except for the tuning indicator cathode-ray tube, only semiconductors are used.

Brackets and mounting bolts are supplied (figure 1-1) for installation of the converters in standard 19-inch racks. Feet for table-mounting a single converter and clamps for table-mounting two converters (one above the other) are also included.

1-4. FACTORY OR FIELD CHANGES.

Factory changes have been made. At Serial A11 an improved tube shield (with padding which has less tendency to harden) was incorporated. At Serial A156 resistor R71 was changed. At Serial A246 resistors R20 and R22 were changed. As a result of field changes now in process the new tube shield will be installed in Serials A1 through A10, R71 will be changed in Serials A1 through A155, and resistors R20 and R22 will be changed in Serials A1 through A245. When the field changes are distributed and these changes have been made, all units will be alike.

1-5. QUICK REFERENCE DATA.

- a. AF INPUT SIGNAL. - Operates from 600 ohm line, with input signals of 60 microwatts to 60 milliwatts power.
- b. OPERATING FREQUENCIES. - Narrow shift, 1000 cps mean frequency; width of shift, 10 to 200 cps. Wide shift, 2550 cps mean frequency; width of shift, 200 to 1000 cps.
- c. MAXIMUM KEYING SPEEDS. - 100 words per minute, single channel; 400 words per minute, when used in four-channel, time-division multiplex with each channel operating at 100 words per minute.
- d. OUTPUT. - Keys 60 ma current in teletype printer dc loop circuit.
- e. POWER SOURCE REQUIREMENTS. - Frequency Shift Converter CV-483/URA-17, 35 watts each, with source of 105 to 125 volts, 50 to 400 cps, single phase ac.

1-6. EQUIPMENT LISTS.

- a. EQUIPMENT SUPPLIED. - Table 1-1 lists equipment supplied.
- b. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED. - Table 1-2 lists equipment and publications required but not supplied.
- c. SHIPPING DATA. - Table 1-3 provides information covering the complete equipment as packed for shipment.
- d. EQUIPMENT SIMILARITIES. - Comparator-Converter Group AN/URA-17 performs functions similar to those of Comparator-Converter Group AN/URA-8. The AN/URA-17 uses semiconductors rather than vacuum tubes. The AN/URA-17 is not electrically or mechanically interchangeable with the AN/URA-8.
- e. TRANSISTOR AND DIODE COMPLEMENT. - Tables 1-4 and 1-5 list the transistor and diode complement, respectively.

TABLE 1-1. COMPARATOR-CONVERTER GROUP AN/URA-17,
EQUIPMENT SUPPLIED

QUANT. PER EQUIP.	NOMENCLATURE		*OVERALL DIMENSIONS			*VOLUME	*WEIGHT
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
2	Frequency Shift Converter	CV-483/URA-17	3-15/32	16-11/16	18-7/8	0.63	26
2	Clamps for table-mounting AN/URA-17		8	17-11/16	3-3/4	0.08	1.5
8	Feet for table-mounting Frequency Shift Converter CV-483/URA-17		1/4	2-3/8	2-3/8	0.005	0.12
4	Bracket for rack-mounting Frequency Shift Converter CV-483/URA-17		3-15/32	1-5/32	8	0.007	0.75
6	Cable connector	UG-88D/Ū					
2	Cable connector	MS3106A14S-7S					
2	Cable connector	MS3106A14S-7P					
2	Cable connector	MS3106A14S-9S					
2	Technical manual	NAVSHIPS 94028					

*Unless otherwise stated, dimensions are in inches, volume in cubic feet, weight in pounds.

TABLE 1-2. COMPARATOR-CONVERTER GROUP AN/URA-17, EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QUANT. PER EQUIP.	NOMENCLATURE		REQUIRED USE	REQUIRED CHARACTERISTICS
	NAME	DESIGNATION		
2	Standard navy radio receiver	RBA, RBB, RBC, SRR-11, SRR-12, SRR-13, or equivalent	To receive frequency-shifted rf signals and deliver frequency-shifted af signals to input of Comparator-Converter Group AN/URA-17.	Frequency-shifted af output of 600 ohms impedance, and up to 60 milliwatts power.
-	Technical manual	--	For operating instructions.	---
4	Mounting bolts	--	For table-mounting the AN/URA-17.	1/4-28 thread x mounting surface thickness + 3/8 inch long.
-	Interconnecting cables	MCOS-2 TTHFWA-1-1/2 TTHFWA-1-1/2 RG-58A/U RG-58A/U	Connect source power to POWER connector (J3). Connect teletype printer to TTY OUTPUT connector (J6). Connect audio input to AUDIO INPUT connector (J2). Connect remote indicator (if used) to REMOTE TUNING IND connector (J7). Connect DIV. A connector (J4) of each converter to the DIV. B connector (J5) of the other converter.	---
1	Teletype printer, or other automatic recorder	--	To record messages represented by the keyed output of the AN/URA-17.	Keying loop current of 60 ma, dc.

TABLE 1-3. COMPARATOR-CONVERTER GROUP AN/URA-17, SHIPPING DATA

BOX NO.	NOMENCLATURE		*OVERALL DIMENSIONS			*VOLUME	*WEIGHT
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	Comparator-Converter	AN/URA-17	16-3/4	26-3/4	24-3/4	6.42	125

*Unless otherwise stated, dimensions are in inches, volume in cubic feet, and weight in pounds; equipment crated and ready for shipment.

TABLE 1-4. FREQUENCY SHIFT CONVERTER CV-483/URA-17, *
TRANSISTOR COMPLEMENT

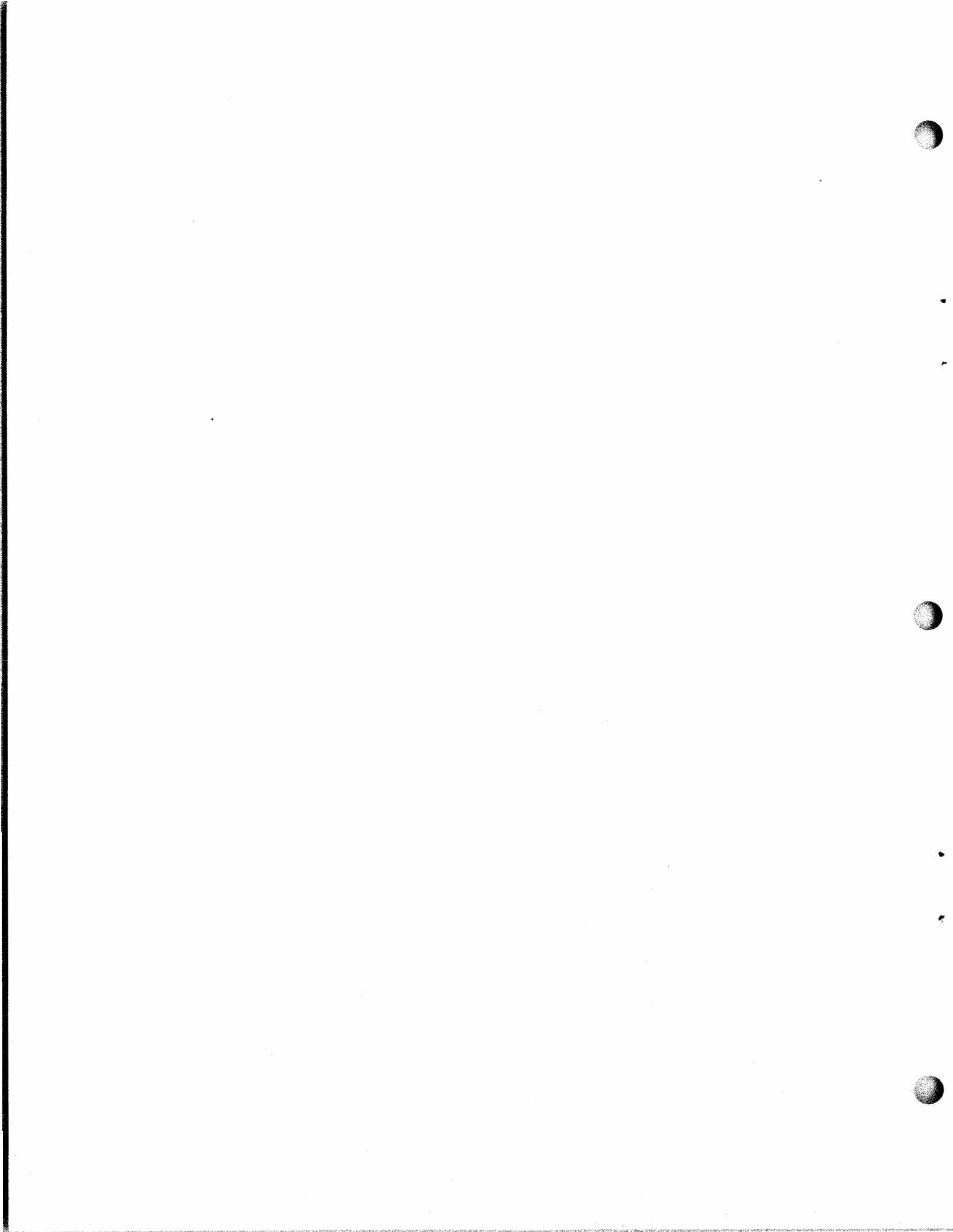
REF DESIG	NUMBER OF TRANSISTORS OF TYPES INDICATED								
	2N328A	2N333	2N336	2N497	2N424	2N526	2N657	2N1412	TOTAL
Q1						1			1
Q2						1			1
Q3						1			1
Q4								1	1
Q5								1	1
Q6		1							1
Q7		1							1
Q8		1							1
Q9		1							1
Q10							1		1
Q11			1						1
Q12				1					1
Q13		1							1
Q14	1								1
Q15	1								1
Q16		1							1
Q17							1		1
Q18							1		1
Q19		1							1
Q20					1				1
Q21		1							1
Q22		1							1
Q23					1				1
Q24				1					1
Total Number of Each Type	2	9	1	2	2	3	3	2	24

*The AN/URA-17 complement is twice the above.

TABLE 1-5. FREQUENCY SHIFT CONVERTER CV-483/URA-17, *
DIODE COMPLEMENT

NUMBER OF DIODES OF TYPES INDICATED							
REF DESIG	1N457	1N538	1N1731	1N3025B	1N3029B	1N3042B	TOTAL
CR1		1					1
CR2		1					1
CR3		1					1
CR4		1					1
CR5		1					1
CR6		1					1
CR7				1			1
CR8				1			1
CR9		1					1
CR10		1					1
CR11	1						1
CR12	1						1
CR13	1						1
CR14	1						1
CR15	1						1
CR16	1						1
CR17	1						1
CR18		1					1
CR19	1						1
CR20		1					1
CR21						1	1
CR22						1	1
CR23		1					1
CR24		1					1
CR25		1					1
CR26		1					1
CR27					1		1
CR28		1					1
CR29		1					1
CR30		1					1
CR31		1					1
CR32			1				1
CR33			1				1
CR34					1		1
Total Number of Each Type	8	18	2	2	2	2	34

*The AN/URA-17 complement is twice the above.



SECTION II
TEST EQUIPMENT AND SPECIAL TOOLS

2-1. TEST EQUIPMENT.

Table 2-1 provides a list of test equipment required to overhaul Comparator-Converter Group AN/URA-17. Special tools are not required.

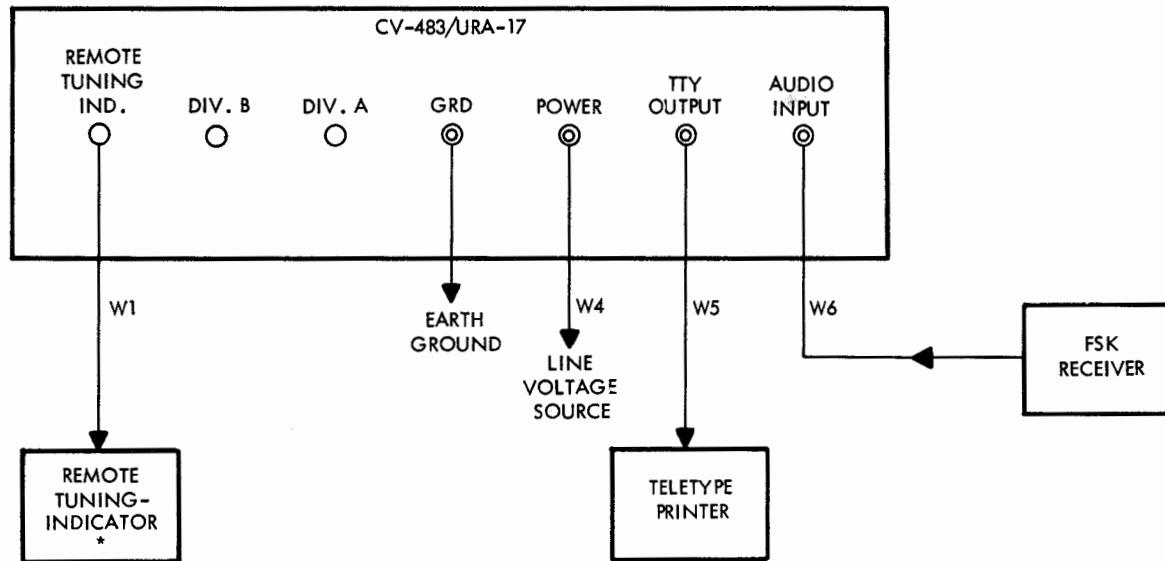
2-2. TEST CABLES.

It is necessary to fabricate a set of test cables to check the AN/URA-17 in the single-receiver mode of operation and in the diversity-operation mode. Figure 2-1 shows the cables required for single-receiver operation. Table 2-2 provides bulk cable information and connection data. Figure 2-2 and table 2-3 provide the same information for the diversity operation mode. Make these cables long enough to suit the work-bench layout. A minimum length of eight feet is suggested for those cables which connect outside the equipment, ac power for example.

a. AUDIO INPUT LINES. - The AN/URA-17 requires 600 ohm, 60 milliwatt outputs from the associated receivers. If the receiver outputs are balanced, STANDOFF E1 in each converter may be grounded. This circuit is normally left floating. STANDOFF E1 should be grounded only if it becomes necessary to reduce interference pickup on the external audio line. To accomplish this, loosen the four captive screws at corners of receptacle panel, remove panel from the rear of each converter cabinet (figure 2-3), and solder a lead from STANDOFF E1 to a nearby ground terminal. If the receiver outputs are unbalanced (one side grounded) leave STANDOFF E1 ungrounded.

TABLE 2-1. COMPARATOR-CONVERTER GROUP AN/URA-17, TEST EQUIPMENT
REQUIRED FOR OVERHAUL

NOMENCLATURE		REQUIRED USE	REQUIRED CHARACTERISTICS
NAME	DESIGNATION		
Oscilloscope	DuMont 304-A	Troubleshooting the AN/URA-17.	Display 800 to 3600 cps audio frequency signals at amplitude of 0.1 to 50.0 volts.
Vtvm, ac	ME-30/U	Troubleshooting and alignment of converters; checking filters and discriminators.	Measure audio frequency voltages, 0.1 to 20 volts at 800 to 3600 cps, $\pm 5\%$.
Audio oscillator	TS-382A/U	Alignment of converters; checking filters and discriminators.	Audio frequency output: 800 to 3600 cps at amplitudes 0 to 10 volts.
Frequency meter	AN/TSM-9	Checking filters and discriminators.	Measurement of audio frequencies, $\pm 1\%$.
Multimeter	AN/PSM-4	Troubleshooting, measurement of power supply outputs, alignment, checking filters and discriminators.	DC voltages 0 to 560 volts $\pm 3\%$, ac voltages 0 to 125 volts $\pm 5\%$, at 50 to 400 cps.
Test set,	TS-1100/U	Test transistors and diodes.	Test semiconductors (in circuit or out).



* OPTIONAL

Figure 2-1. Frequency Shift Converter CV-483/URA-17, Interconnecting Data for Single-Receiver Operation

TABLE 2-2. CABLING REQUIRED FOR SINGLE-RECEIVER OPERATION*

CABLE TYPE	PLUG		CONNECTIONS		TERMINATIONS	
	REF DESIG	TYPE	LEAD COLOR	PIN NO.	FROM	TO
TTHFWA-1-1/2 (W6)	P202	MS3106A14S-7P	BLACK WHITE RED	A B SPARE	AUDIO INPUT connector J2	FSK receiver
MCOS-2 (W4)	P203	MS3106A14S-7S	BLACK WHITE	A C (B is grd)	POWER INPUT connector J3	Line voltage source
TTHFWA-1-1/2 (W5)	P206	MS3106A14S-9S	BLACK WHITE RED	B (GRD) A (HOT +) SPARE	TTY OUTPUT connector J6	Teletype printer keying loop
RG-58A/U (W1)**	P207	UG-88D/U	---	---	REMOTE TUNING IND. connector J7	Remote tuning indicator
Copper braid	---	---	---	---	GRD terminal	Good earth ground

*Use in conjunction with figure 2-1.

**Required only when remote tuning indicator is used.

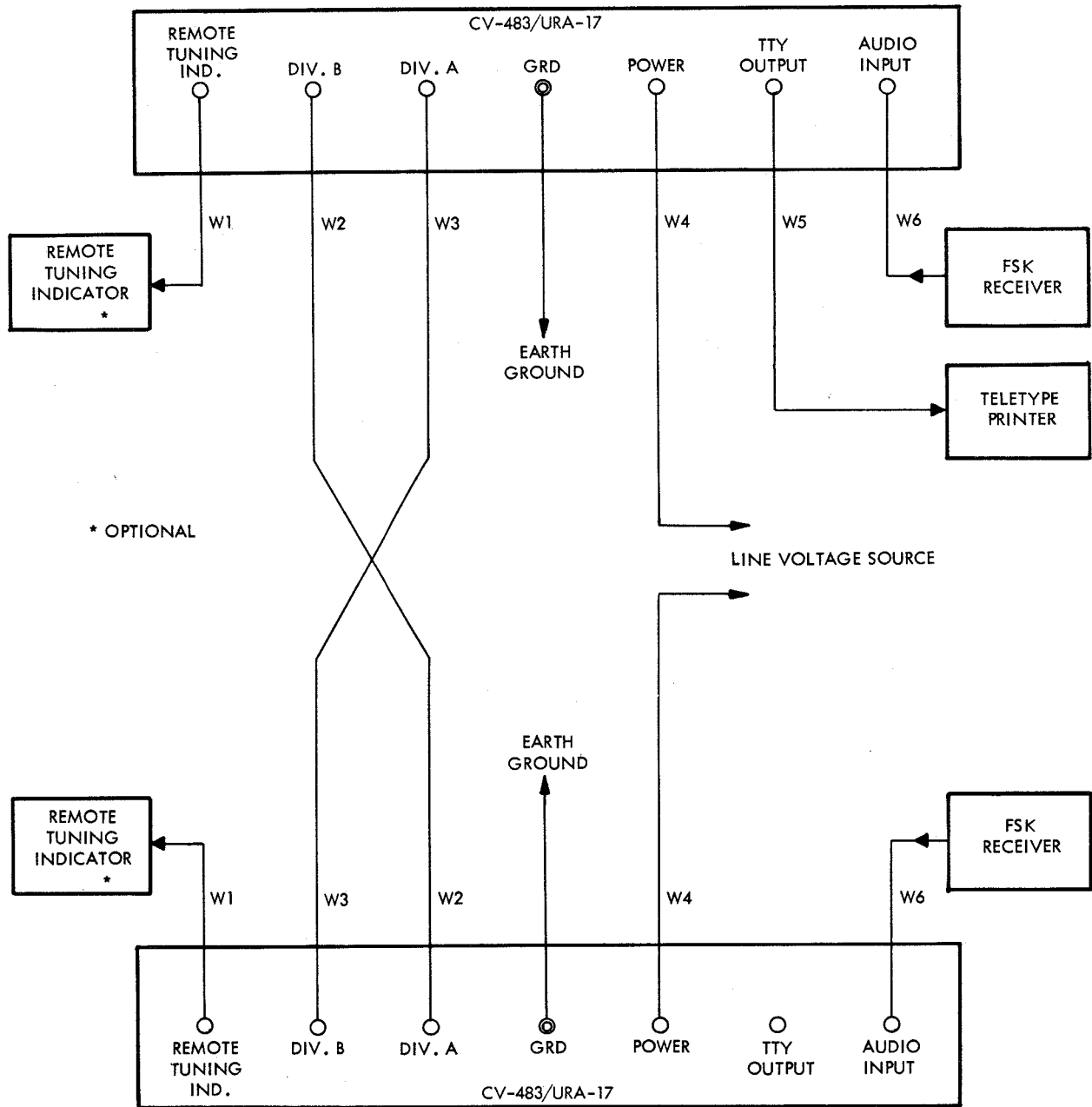


Figure 2-2. Comparator-Converter Group AN/URA-17, Interconnecting Data for Diversity Operation

b. POWER TRANSFORMER CONNECTIONS. - The AN/URA-17 is shipped from the factory with power transformers T3 and T4 in each converter connected for a nominal line voltage of 115 volts. If nominal line voltage is 105 volts, the leads connected to terminal 3 of T3 and T4 must be moved to terminal 2 of the respective transformer. If nominal line voltage is 125 volts, the leads connected to terminal 3 of T3 and T4 must be moved to terminal 4 of the respective transformer.

c. CABLE ASSEMBLY. - Attach the connectors to interconnecting cables as follows:

(1) **ATTACHING UG-88D/U CONNECTORS TO RG-58A/U COAXIAL CABLE.** - Attach the UG-88D/U connectors (supplied) to RG-58A/U coaxial cable as described in figure 2-4.

(2) **ATTACHING MS CONNECTOR TO MCOS-2 CABLE.** - Attach each MS connector (supplied) to MCOS-2 cable as described below (see figure 2-5).

TABLE 2-3. CABLING OF EACH CONVERTER FOR DIVERSITY OPERATION*

CABLE TYPE	PLUG		CONNECTIONS		TERMINATIONS	
	REF DESIG	TYPE	LEAD COLOR	PIN NO.	FROM	TO
TTHFWA-1-1/2 (W6)	P202	MS3106A14S-7P	BLACK WHITE RED	A B SPARE	AUDIO INPUT connector J2	FSK receiver
MCOS-2 (W4)	P203	MS3106A14S-7S	BLACK WHITE	A C (B is grd)	POWER input connector J3	Line voltage source
TTHFWA-1-1/2 (W5)**	P206	MS3106A14S-9S	BLACK WHITE RED	B (GRD) A (HOT +) SPARE	TTY OUTPUT connector J6	Teletype printer keying loop
RG-58A/U (W3)**	P204	UG-88D/U	---	---	DIV. A connector J4	DIV. B. on other converter
RG-58A/U (W2)**	P205	UG-88D/U	---	---	DIV. B connector J5	DIV. A. on other converter
RG-58A/U (W1)***	P207	UG-88D/U	---	---	REMOTE TUNING IND. J7	Remote tuning indicator
Copper braid	---	---	---	---	GRD terminal	Good earth ground

*Use in conjunction with figure 2-2.

**These cables required only for one converter.

***Required only when remote tuning indicator is used.

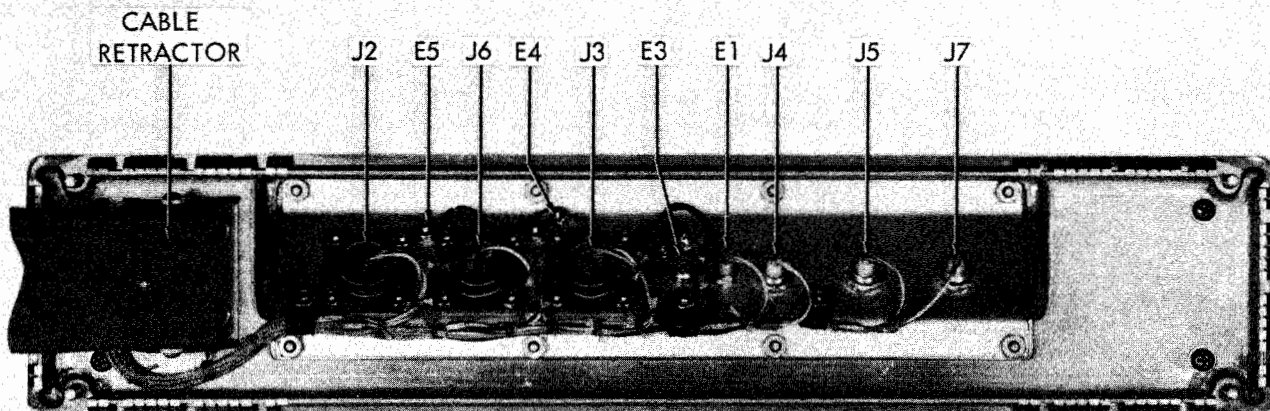
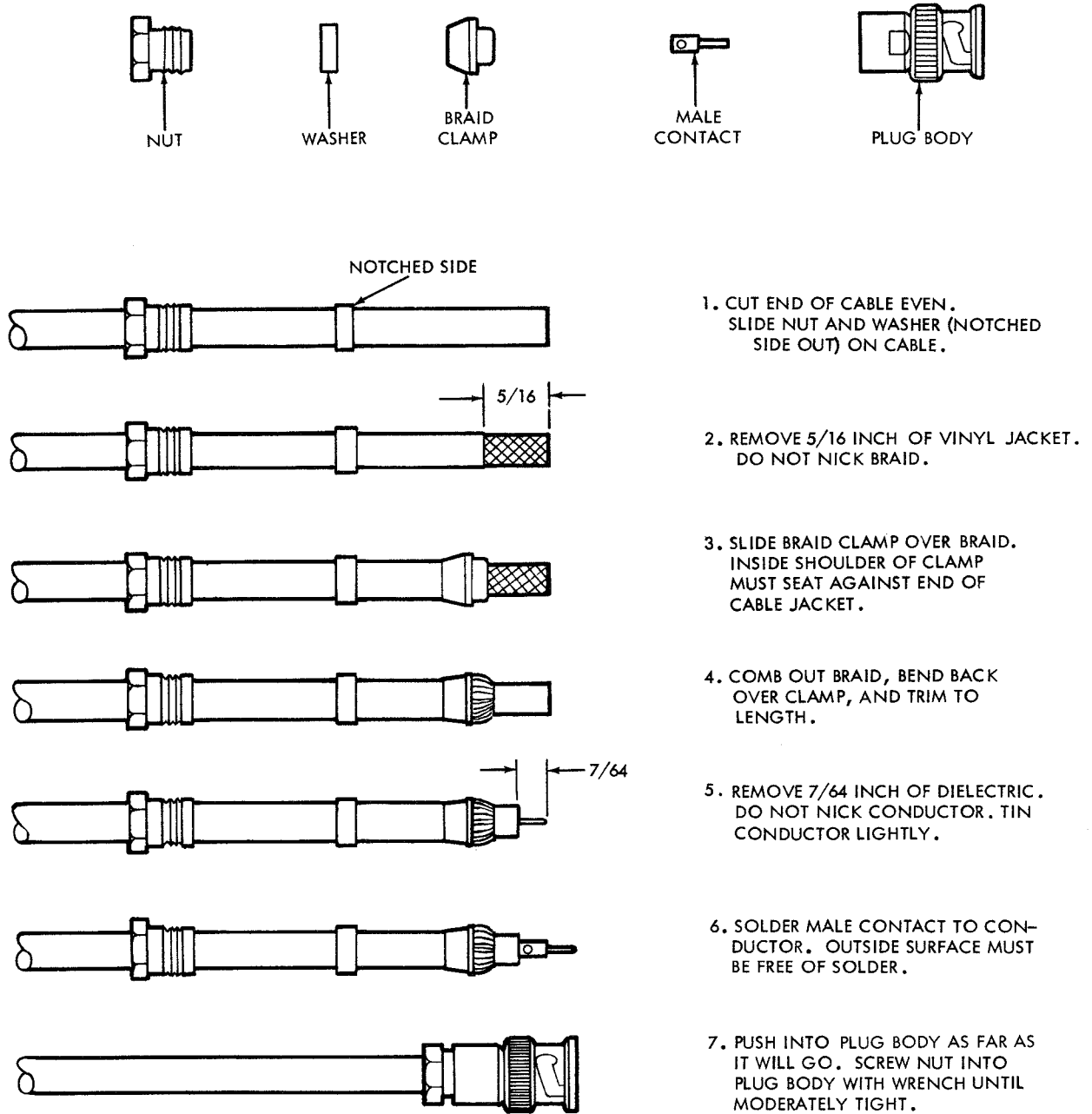


Figure 2-3. Frequency Shift Converter CV-483/URA-17, Cable Receptacle Panel, Interior View



NOTE: ALL DIMENSIONS ARE IN INCHES

Figure 2-4. Attaching UG-88D/U Plug to RG-58A/U Coaxial Cable

- Step 1. Cut cable end even.
- Step 2. Slide cable clamp (1), rubber washer (2), soldering ring (3), and extension (4) over end of cable, in order given.
- Step 3. Remove vinyl jacket from 11/16 inch of cable.
- Step 4. Unbraid and pigtail braid.
- Step 5. Remove insulation from 3/16 inch of leads.

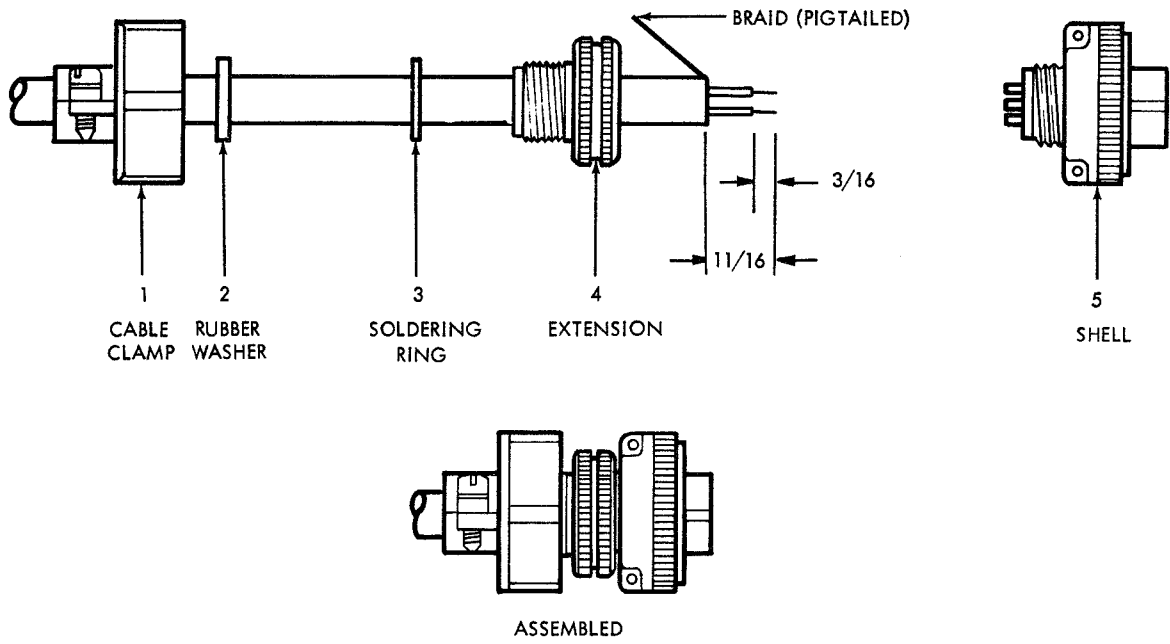
ORIGINAL

- Step 6. Tin bare lead ends.
- Step 7. Slide a 1/2 inch length of vinyl tubing over end of each lead.
- Step 8. Solder each lead to plug pin, according to table 2-2 or 2-3, as applicable.
- Step 9. Slide vinyl tubing on each lead so it covers soldered connection. Wrap a layer of adhesive plastic tape around leads.
- Step 10. Slide extension (4) over pigtail and screw extension on shell (5).
- Step 11. Solder pigtail to soldering ring (3).
- Step 12. Screw cable clamp (1) on extension and tighten cable clamp screws.

(3) ATTACHING MS CONNECTORS TO TTHFWA-1-1/2 CABLE. - Attach each MS connector (supplied) to TTHFWA-1-1/2 cable as described below (see figure 2-6).

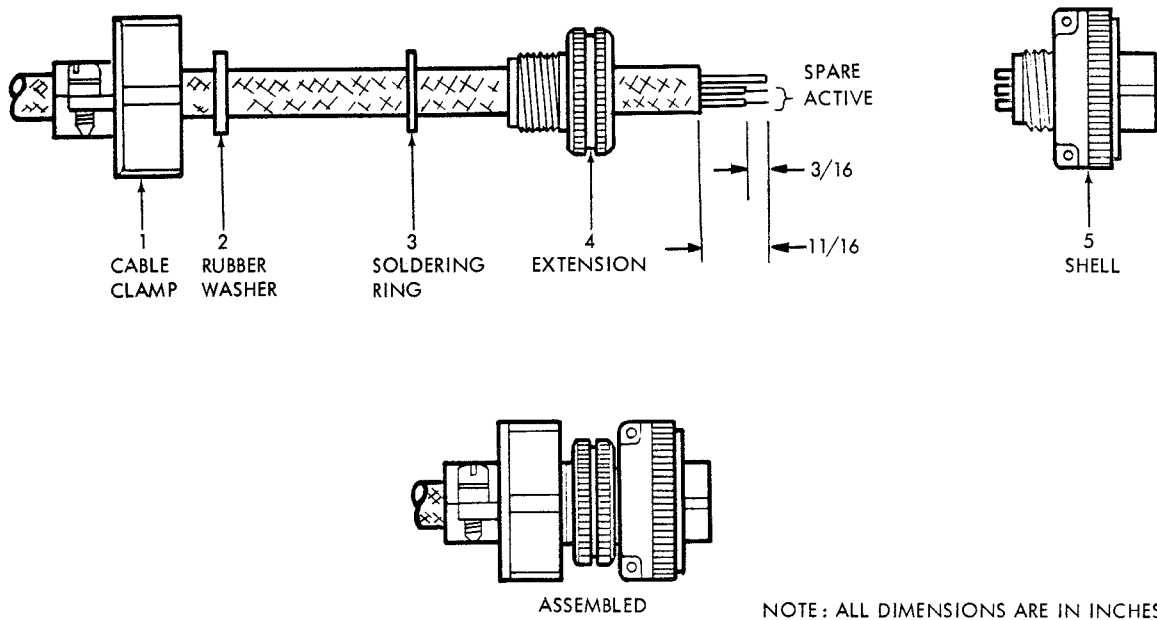
- Step 1. Cut cable end even.
- Step 2. Wrap layer of adhesive plastic tape around armor (exposing 11/16 inch end of cable).
- Step 3. Slide cable clamp (1), rubber washer (2), soldering ring (3), and extension (4) over end of cable in order given.
- Step 4. Remove armor, vinyl jacket, and wrappings from 11/16 inch of cable.
- Step 5. Remove insulation from 3/16 inch of leads to be used. Do not remove insulation from "spare" lead.
- Step 6. Tin bare lead ends.
- Step 7. Slide a 1/2 inch length of vinyl tubing over end of each lead to be used. Slide a 11/16 inch length of vinyl tubing over end of spare lead.
- Step 8. Solder each lead to plug pin, according to table 2-2 or 2-3, as applicable.
- Step 9. Slide vinyl tubing on each lead so it covers soldered connection. Wrap a layer of adhesive plastic tape around leads.
- Step 10. Slide extension (4) over pigtail and screw it on shell (5).
- Step 11. Screw cable clamp (1) on extension and tighten cable clamp screws.

22



NOTE: ALL DIMENSIONS ARE IN INCHES

Figure 2-5. Attaching MS Plug to MCOS-2 Cable



NOTE: ALL DIMENSIONS ARE IN INCHES

Figure 2-6. Attaching MS Plug to TTHFWA-1-1/2 Cable

SECTION III
DISMANTLING AND DISASSEMBLY

3-1. DISMANTLING AND DISASSEMBLY.

The AN/URA-17 is a relatively simple equipment, and the dismantling and disassembly is equally simple and straightforward. Use the following procedure.

a. REMOVAL AND DISASSEMBLY. - Removal and disassembly instructions are given in the following paragraphs. To remove converter chassis from cabinet, proceed as follows:

- Step 1. Loosen four captive screws on front panel, one at each corner.
- Step 2. Pull converter chassis forward until drawer slides lock.
- Step 3. Remove main cable plug, P1, from J1 at rear of chassis (figure 3-1), and remove cable from clamp near J1.
- Step 4. Lift latch on bottom near front of each drawer slide, grasp both sides of converter chassis, and pull forward until chassis is free of cabinet drawer slides. To replace chassis, reverse this procedure.

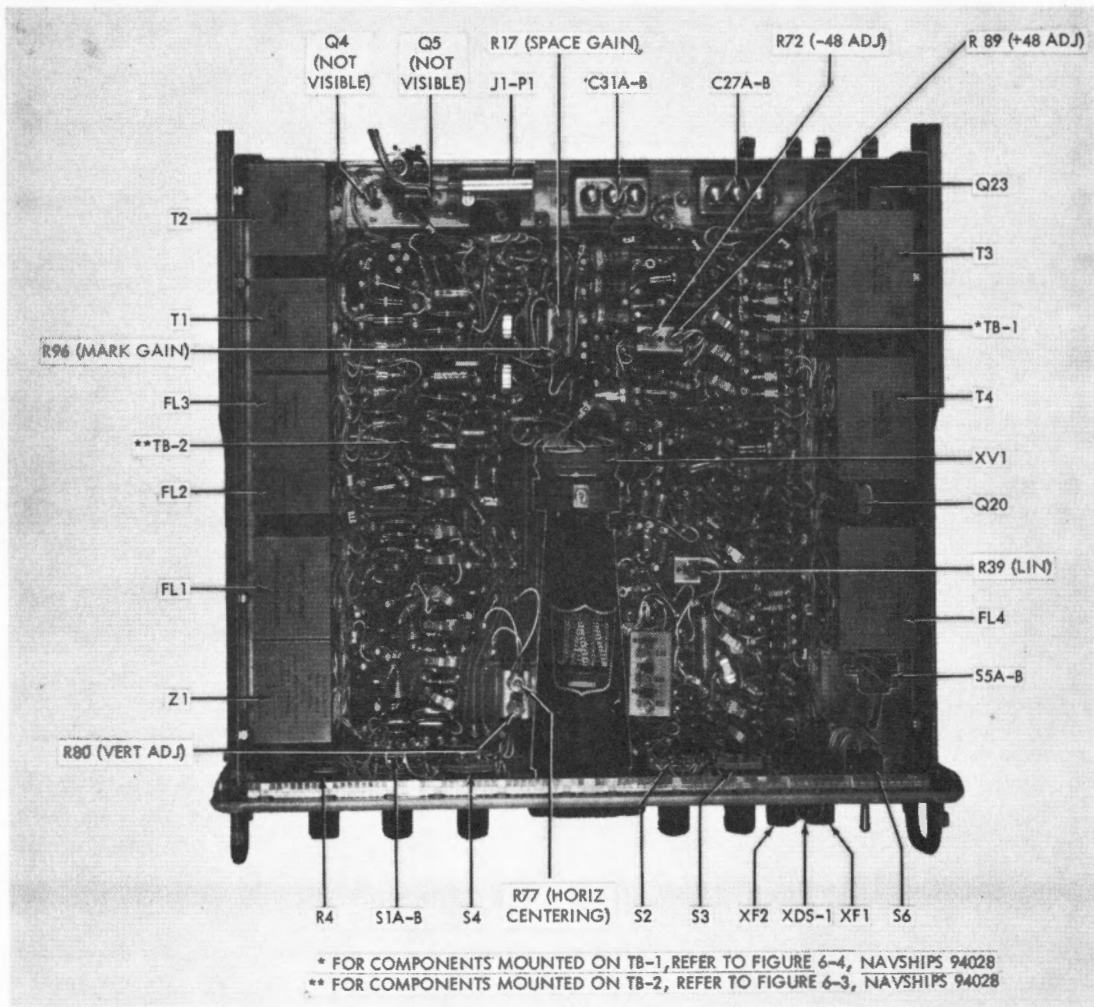


Figure 3-1. Frequency Shift Converter CV-483/URA-17, Parts Location

SECTION IV

CLEANING

4-1. CLEANING.

Clean the AN/URA-17 by blowing away dust with dry, compressed air.

NOTE

When using compressed air to clean dust from electrical and electronic equipment, always check to assure that the air supply system is regulated to provide a maximum pressure of 25 lbs. per square inch. Higher pressures can drive dust into assemblies, resulting in more damage than the dust which would more practically have been left on the equipment. Always be sure that the water trap on the airline is operating, and that moist air will not be blown into equipment.

4-2. CLEANING SOLUTIONS.

Areas which cannot be satisfactorily cleaned with compressed air may be cleaned with an approved, nontoxic, nonflammable cleaning solution, such as Dry Cleaning Solvent, specification P-S-661B. Use a small brush and minimum solvent.

CAUTION

DO NOT USE CARBON TETRACHLORIDE FOR CLEANING.
EXPOSURE TO THE FUMES OF THIS SOLVENT ARE
HAZARDOUS TO PERSONNEL. DO NOT USE GASOLINE
OR ANY FLAMMABLE LIQUID.

Most cleaning solutions leave, upon evaporation, a nonconducting film. To improve electrical performance, clean the contact surface of switches, the contact surfaces of tube sockets and electrical connectors, and any other contact surface where a wiping action is required, with commercial isopropyl alcohol (or "isophyl"), available from medical supply. When isopropyl alcohol evaporates, it does not leave a nonconducting film, and improved performance of the electrical equipment is achieved.



SECTION V
INSPECTION

5-1. GENERAL.

Comparator-Converter Group AN/URA-17, hereinafter referred to as the AN/URA-17, is part of a system for the reception and recording of transmitted teletype messages.

The AN/URA-17 consists of two Frequency Shift Converters CV-483/URA-17, hereinafter referred to as the converters.

Maintenance personnel should be thoroughly familiar with the operation of the overall frequency-shift receiving system, and the function of each equipment used.

Prior to inspecting the AN/URA-17, the technician should become familiar with the equipment operation during normal conditions. It is mandatory that overhaul personnel read Sections 1, 3, and 4 of technical manual NAVSHIPS 94028 before performing any inspection procedures.

It is assumed that overhaul personnel are experienced in standard methods of testing and repairing naval electronic equipment; therefore, detailed descriptions of common tests are not given.

5-2. PRELIMINARY CHECK.

The first and most natural step in inspection is to analyze the symptoms of the equipment. Often the conclusions reached will aid the technician in selecting the test(s) that will most quickly locate the cause of trouble. Normally, the malfunction can be traced to the receiver, the teletype printer, or one of the converters.

When possible, use sensory tests, such as visually checking parts (fuses, resistors, capacitors, etc.), and smelling or feeling for signs of overheating. Simple tests often will reveal the difficulty.

NOTE

If, during the preliminary check, a part is found that is responsible for the malfunction, determine what caused its failure before replacing it.

Malfunctions other than the result of faulty transmission, bad receiving conditions, or improper operating methods must first be localized to one of the system components. If the evidence is not definite, a simple expedient is to substitute equipment known to be in proper operating condition for the suspected equipment.

The receiver may be tested independently by monitoring the audio output with a headset or loudspeaker and tuning in various signals.

The teletype printer may be checked with signals from another source of known accuracy, such as another teletype circuit.

5-3. ELECTRICAL INSPECTION.

When a unit is returned for overhaul, it is important that its condition be determined before additional work is attempted. Not all equipment which is returned for overhaul maintenance needs to be overhauled. Contributing factors, such as handling damage, operating personnel who have not become familiar with the equipment, or lack of maintenance personnel or replacement spare parts might result in equipment evacuated to overhaul shops which require only routine maintenance.

To assure that the equipment requires complete disassembly, testing of all parts, and complete reassembly, determine the condition of all equipment received. The tests necessary to provide this evaluation are in the basic technical manual, NAVSHIPS 94028, and they will not be repeated here. With reference to the basic technical manual, perform the following steps:

Step 1. Obtain a set of test cables. Refer to paragraph 2-2 of this technical manual.

Step 2. Obtain the required test equipment. Refer to table 2-1 of this technical manual.

- Step 3. Set the converter controls as follows:
- (1) LEVEL control to 0.
 - (2) SHIFT switch to NARROW.
 - (3) FUNCTION switch to TUNE.
 - (4) POLARITY switch to NORMAL.
 - (5) SPEED switch to slow.
 - (6) POWER switch off (down).
- Step 4. Perform the system troubleshooting procedure of NAVSHIPS 94028, paragraph 5-3d. Isolate trouble to a malfunction during single-receiver, or diversity mode.
- Step 5. If the result of Step 4, above, indicates that the converter may be returned to service with simple repair(s), further isolate the trouble to its functional sections, steps 6 to 8 below.
- Step 6. Perform the signal processing circuits troubleshooting procedure of NAVSHIPS 94028, paragraph 5-4b.
- Step 7. Perform the keyer circuits troubleshooting procedure of NAVSHIPS 94028, paragraph 5-4c.
- Step 8. Perform the power supply circuits troubleshooting procedure of NAVSHIPS 94028, paragraph 5-4d.
- Step 9. Isolate all trouble(s), and use the procedures in Section 6 to repair the AN/URA-17.

30

SECTION VI
REPAIR AND REPLACEMENT

6-1. GENERAL.

As a result of the inspection tests performed in Section 5 of this technical manual, overhaul personnel are in a position to determine the extent of repairs required.

The repairs and parts replacement procedures performed by overhaul personnel are simple and straightforward. The AN/URA-17 contains no moving parts of any kind--no blowers, motors, relays, or mechanical indicators. There are no air filters which require cleaning.

Repairs are made by referring to the parts location figures (5-1, 6-3, and 6-4), voltage and resistance charts (figures 5-3, 5-5, and 5-7), the schematic diagram (figure 6-5), and the parts list (Section 7) of NAVSHIPS 94028.

6-2. REPAIR.

Repairs are effected when the malfunctioning part is localized and replaced with the correct replacement part from the parts list in Section 7 of NAVSHIPS 94028. There are no parts which require step-by-step repair procedures.

6-3. REPLACEMENT.

Use the following general instructions for replacing parts in the AN/URA-17.

a. GENERAL. - All electrical components of the converter are installed on two printed circuit boards or the surrounding metal frame.

CAUTION

Most of these components are small and a heat sink must be used when soldering or unsoldering them. Be sure all loose solder and bits of wire are removed before power is applied.

b. TRANSFORMER AND FILTER REPLACEMENT. - The transformers and filters are bolted to the metal frame around the printed circuit boards (figure 5-1, NAVSHIPS 94028). Remove the securing nuts and washers beneath the frame, tag and unsolder connecting wires, and lift transformer or filter straight upward. Replace by reversing the procedure.

c. PRINTED CIRCUIT BOARD REPLACEMENT. - There are two printed circuit boards (figure 5-1, NAVSHIPS 94028) used in the converter. Remove either of them as follows:

Step 1. Tag for identification and unsolder leads to terminals on printed circuit board.

Step 2. Remove securing screws holding printed circuit board to metal frame and remove board. To replace printed circuit board, reverse this procedure.

d. RECEPTACLE PANEL REMOVAL. - To remove receptacle panel at rear of converter (figure 2-6, NAVSHIPS 94028), loosen the captive screw at each corner of receptacle panel and pull panel from cabinet.

e. TRANSISTOR REPLACEMENT. - All transistors except power transistors Q4, Q5, Q20, and Q23 (figure 5-1) are mounted in sockets, with clamps holding them in place. The transistors are easily removed by pulling clamps away from the transistors.

The four power transistors are bolted to metal plates which serve as heat sinks. These metal plates are fastened to the chassis. Collector terminals of power transistors are common to their metal shells and must be insulated from the metal plates. Special anodized aluminum washers are provided for this purpose. When Q4, Q5, Q20, or Q23 is replaced, be sure the proper washer is installed and that mounting bolts are tightened. This is necessary to assure good heat conduction.

f. TUNING INDICATOR CATHODE-RAY TUBE REPLACEMENT. - Replace the tuning indicator crt as follows:

- Step 1. Pull chassis forward on drawer slides.
- Step 2. Remove socket from tube base.
- Step 3. Loosen screws that hold hood and window assembly in front of tube face and remove the assembly.
- Step 4. Loosen screw in clamp at tube base.
- Step 5. Remove tube and shield. Install new tube in shield (tube socket key way up). Install tube and shield behind chassis opening. Replace tube socket, front hood, and window assembly. Push tube forward against hood assembly and tighten clamp.

g. TRANSISTOR SOCKET REPLACEMENT. - Transistor sockets are attached to the printed circuit boards by screws. Remove the 3/32 inch lock nuts from below socket, unsolder socket terminals from printed circuit board, and lift off socket. To reinstall, position socket and check that socket terminals line up properly with printed circuit leads. Then replace the screws and lock nuts and solder socket terminals to printed circuit leads.

h. REPLACING DEFECTIVE SWITCH WAFER. - Replace defective switch wafer as follows:

- Step 1. Remove nuts and washers from rear (chassis side) of switch.
- Step 2. Slip defective wafer from switch shaft.

NOTE

SHIFT switch (S1A-B) has two switch wafers. If front wafer is defective, remove rear wafer, spacers between wafers, and the defective wafer. Pay close attention to position of wafers on switch shaft.

- Step 3. Place new wafer on switch shaft. Be sure wafer is correctly positioned.
- Step 4. Replace removed hardware (nuts, lock washers, and spacers) if applicable.
- Step 5. Unsolder wires (one at a time) from defective wafer and solder to replacement wafer. Be very careful that wires are correctly placed and mechanically secure before soldering.

i. REPLACING DEFECTIVE SWITCH. If defect is other than switch wafer, replace entire switch as follows:

- Step 1. Loosen set-screw in front panel knob and remove knob.
- Step 2. Remove securing nut and lock washer from switch shaft.
- Step 3. Tag and identify wires on switch terminals.
- Step 4. Unsolder wires from defective switch.
- Step 5. Push switch back, through front panel hole.
- Step 6. Solder wires to new switch, being sure wires are correctly placed and mechanically secure before soldering to new switch terminals.
- Step 7. Place switch in position, add securing nut, lock washer, and knob.

j. BANDPASS FILTER TESTS. Perform the following procedures to check characteristics of bandpass filters. Replace any filter not passing applicable tests.

(a) WIDE-SHIFT FILTER FL1 (Table 6-1)

- Step 1. Withdraw chassis to stops on drawer slides, and operate interlock switches (figure 2-10, NAVSHIPS 94028) by pressing in on button at left side of switch block.

- Step 2. Connect vtvm's audio oscillator, and frequency meter to power source and turn power switches on. Allow at least 15 minutes warm-up for frequency meter.
- Step 3. Set converter SHIFT switch to WIDE, and turn POWER switch to On position. Allow five minute warm-up period.
- Step 4. Disconnect cable from AUDIO INPUT connector, J2, at rear of converter cabinet.
- Step 5. Connect audio oscillator output terminals to AUDIO INPUT connector, J2, or to terminals 1 and 3 of Z1 (figure 5-1, NAVSHIPS 94028).
- Step 6. Set audio oscillator to 2550 cps, measured with frequency meter.
- Step 7. Set vtvm range switch to 10 volts and connect between gray test point (figure 5-2, NAVSHIPS 94028) and converter chassis.
- Step 8. Adjust audio oscillator output to obtain vtvm indication of 5.0 volts.
- Step 9. Set range switch of second vtvm to 10 volts and connect to audio oscillator output terminals.
- Step 10. Decrease audio oscillator frequency until vtvm connected to the gray test point indicates 2.5 volts, keeping audio oscillator output voltage constant. Record audio oscillator frequency. Increase frequency until vtvm connected to the gray test point indicates 2.5 volts, keeping audio oscillator output voltage constant. Subtract lower frequency from higher frequency. Result must be 2100 cps \pm 150 cps.
- Step 11. Increase audio oscillator frequency until vtvm connected to the gray test point indicates 0.05 volts, keeping audio oscillator output voltage constant. Record audio oscillator frequency. Decrease frequency until vtvm connected to the gray test point indicates 0.05 volt, keeping audio oscillator output voltage constant. Subtract lower frequency from higher frequency. Result must be 3100 cps \pm 200 cps.
- Step 12. Turn POWER switch to Off and disconnect vtvm and audio oscillator from converter. Reconnect cable to AUDIO INPUT connector, J2, on rear of converter cabinet.

(b) NARROW-SHIFT FILTER (PART OF Z1).

- Step 1. Withdraw chassis to stops on drawer slides, and operate interlock switches by pressing in on button at left side of switch block.
- Step 2. Connect vtvm's, audio oscillator, and frequency meter to power source and turn power switches on. Allow at least 15 minutes warm-up for frequency meter.
- Step 3. Set converter SHIFT switch to NARROW, and turn POWER switch to On position. Allow five minute warm-up period.
- Step 4. Remove cable attached to AUDIO INPUT connector, J2, at rear of converter cabinet.
- Step 5. Connect audio oscillator output terminals to AUDIO INPUT connector, J2, or to terminals 1 and 3 of Z1.
- Step 6. Set audio oscillator to 1000 cps, using frequency meter.
- Step 7. Set vtvm range switch to 10 volts and connect between gray test point and converter chassis.
- Step 8. Adjust audio oscillator output to obtain vtvm indication of 5.0 volts.
- Step 9. Set range switch of second vtvm to 10 volts and connect to audio oscillator output terminals. Record vtvm indication.
- Step 10. Decrease audio oscillator frequency until vtvm connected to the gray test point indicates 2.5 volts, keeping audio oscillator output voltage constant. Record audio oscillator frequency. Increase audio oscillator frequency until vtvm connected to the gray test point indicates 2.5 volts, keeping audio oscillator output voltage constant. Subtract lower frequency from higher frequency. Result must be 500 cps \pm 50 cps.

Step 11. Increase audio oscillator frequency until vtvm connected to the gray test point indicates 0.05 volt, keeping audio oscillator output voltage constant. Record audio oscillator frequency. Decrease audio oscillator frequency until vtvm connected to the gray test point indicates 0.05 volt, keeping audio oscillator output voltage constant. Subtract lower frequency from higher frequency. Result must be 1400 cps \pm 100 cps.

Step 12. Turn POWER switch to Off and disconnect vtvm and audio oscillator from converter. Reconnect cable to AUDIO INPUT connector, J2, at rear of converter.

k. INTERCONNECTING CABLE REPLACEMENT. - These instructions provide information for the replacement of the entire cable, interconnecting the receptacle panel and connector J1 of the converter. If the cable is slightly damaged, follow these instructions only so far as is necessary to effect the repair. Retain all reusable electromechanical parts for replacement.

Step 1. Remove the receptacle panel as described in paragraph 6-3d.

Step 2. Remove the clamps securing the cable to the receptacle panel and the cable retractor. See figure 6-1.

Step 3. Unsolder the wires of the defective cable.

Step 4. Prepare a replacement cable, referring to the wire chart in figure 6-1. Replace the cable insulation and lacing.

Step 5. Solder the wires to the respective connections, referring to the wiring diagram of figure 6-1.

Step 6. Secure the cable to the receptacle panel and the cable retractor using the clamps removed during step 2. Insure that the cable does not bind or chafe through the action of the retractor.

l. REPLACEMENT OF THE CABLE RETRACTOR. - These instructions provide information for the replacement of the cable retractor as a complete assembly. Minor repairs to the retractor, such as replacement of rivets, spacers, and grommets, may also be made. To replace the cable retractor, proceed as follows.

Step 1. Remove the clamps securing the interconnecting cable to the retractor.

Step 2. Remove the screws, nuts, and lockwashers securing the cable retractor to the receptacle panel.

Step 3. Install the replacement cable retractor by following the procedures of steps 1 and 2 in reverse.

m. REPLACEMENT AND ADJUSTMENT OF DRAWER SLIDES. - The drawer slides are replaced as complete assemblies. Notice that the assemblies are right- and left-hand, and are not interchangeable. The drawer slides are replaced and/or adjusted as follows:

Step 1. Remove the screws and nuts securing the drawer slides to the cabinet, or converter, as applicable.

Step 2. Remove the defective drawer slide and position the replacement drawer slide in its place.

Step 3. Replace the screws and nuts removed in step 1.

Step 4. Install the converter in the drawer slides and check for binding in all positions. If binding occurs, adjust the relative positioning of the drawer slides, within the tolerance allowed by the mounting screw holes.

34

WIRE NO. (24 AGW PER MIL-W-16878)	LENGTH	COLOR	FROM	TO
153	30 3/4	WHT-ORN-RED (SHIELDED)	P1-1	J2-A
154	31	WHT-BRN-RED (SHIELDED)	P1-2	J2-B
155	35 1/2	WHT-BRN-GRN (SHIELDED)	P1-3	E1
156	37 3/8	WHT-BLK-BRN (SHIELDED)	P1-5	J5
157	36	WHT-ORN-GRN (SHIELDED)	P1-6	J4
158	33 1/2	WHT-BLU-YEL (SHIELDED)	P1-8	J6-A
159	34 1/4	GY	P1-9	J3-A
160	34	WHT-GY	P1-10	J3-C
161	38 1/4	WHT-ORN-YE	P1-12	J7
162	35 5/8	BLK	P1-14	E3
163	5 1/4	BLK	J3-B	E3
164	6 3/4	BLK	J6-B	E3
165	2 1/2	BLK	E3	E4
166	2	BLK	E4	E5
167	3 1/2	BLK	Shield of 153	E5
168	3 1/4	BLK	Shield of 154	E5
169	3 1/4	BLK	Shield of 155	E3
170	5	BLK	Shield of 156	E3
171	3 3/4	BLK	Shield of 157	E3
172	3	BLK	Shield of 158	E4

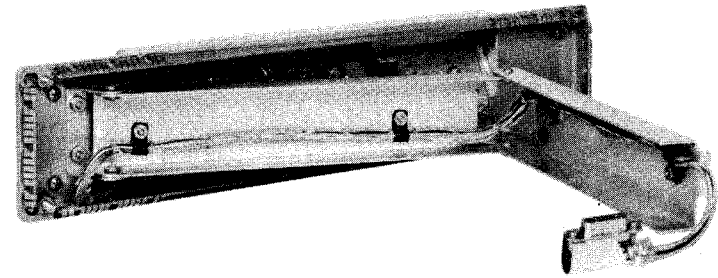
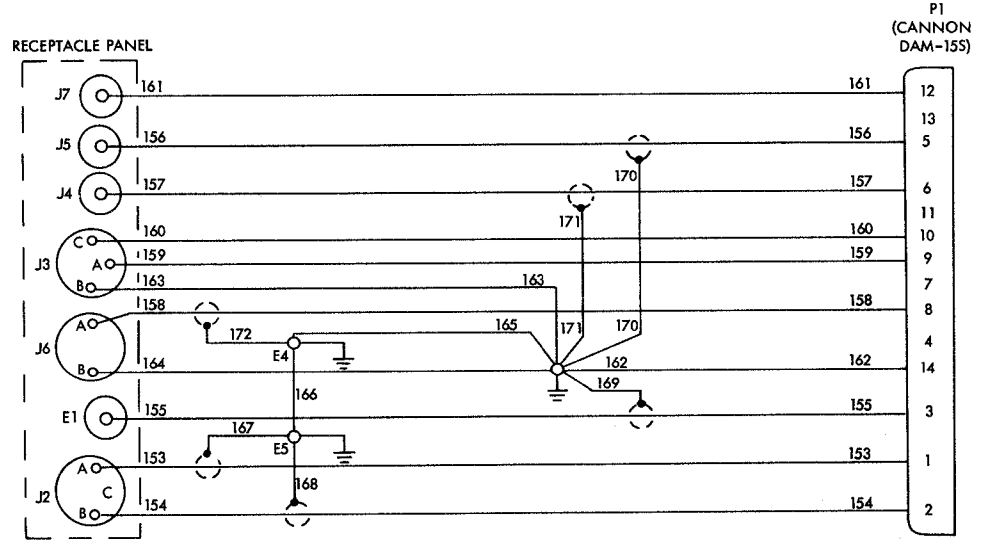


Figure 6-1. Interconnecting Cable and Retractor

TABLE 6-1. FILTER CHARACTERISTICS

REF DESIG	NAME	INPUT TERMINATION (OHMS)	OUTPUT TERMINATION (OHMS)	REQUIRED FREQUENCY RESPONSE	ATTENUATION	INSERTION LOSS	TEST LEVEL
Z1	Narrow-shift bandpass filter.	8000 ±5% at 1000 cps.	8000 ±5% at 1000 cps.	900 to 1100 cps.	6 db bandwidth: 500 ±50 cps. 40 db bandwidth: 1400 ±100 cps.	3 db max. at 1000 cps.	10v rms, (no dc)
FL1	Wide-shift bandpass filter.	8000 ±5% at 2550 cps.	8000 ±5% at 2550 cps.	2050 to 3050 cps.	6 db bandwidth: 2100 ±150 cps. 40 db bandwidth: 3100 ±200 cps.	3 db max. at 2550 cps.	10v rms, (no dc)
FL4	Lowpass keying filter.						
	Section A: (terminals 1, 2, 3.)	20K ±20% at 5 cps.	20K ±20% at 5 cps.	0 to 45 cps.	2 db at 15 cps. 3.5 db at 45 cps. 18 db (min) at 140 cps. 50 db (min) at 560 cps. 65 db (min) from 1500 cps to 8000 cps.	--	10v rms, (no dc)
	Section B: (terminals 4, 5, 6.)	20K ±20% at 5 cps.	20K ±20% at 5 cps.	0 to 175 cps.	2 db at 15 cps. 3.5 db at 175 cps. 18 db (min) at 560 cps. 50 db (min) at 2240 cps. 65 db (min) from 4000 cps to 8000 cps.	--	10v rms,

36

SECTION VII
FINAL ASSEMBLY

7-1. GENERAL.

Final assembly is the reverse of the disassembly procedures (paragraph 3-1).

7-2. FINAL ASSEMBLY.

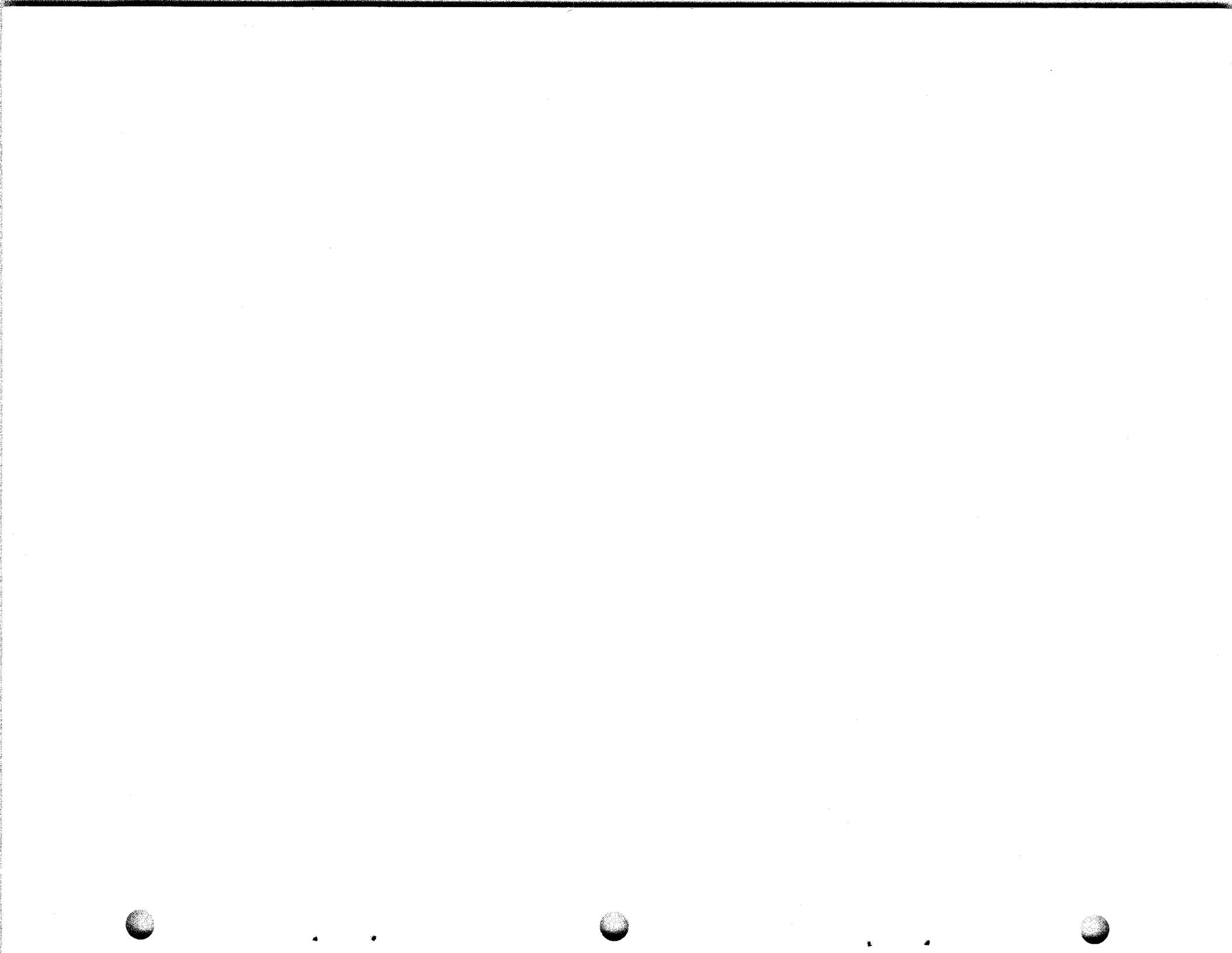
Use the following procedure for final assembly.

Step 1. Remove all external test cables.

Step 2. Insert the chassis into the cabinet, lift catch on bottom near front of each drawer slide, and slide chassis fully into cabinet.

Step 3. Tighten four captive screws on front panel, one at each corner.

153



SECTION VIII
EXAMINATION, TESTING, AND PACKAGING

8-1. EXAMINATION AND TESTING.

Final examination and testing is performed after all troubles have been located, and all parts have been changed. Alignment is also performed at this time. Use the following procedure.

- Step 1. Open chassis far enough to reach all adjustments. Refer to paragraph 3-1a, Steps 1 and 2.
- Step 2. Connect external test leads. Refer to paragraph 2-2.
- Step 3. Set the controls as shown in paragraph 5-3, Step 3.
- Step 4. Align the power supply circuits. Refer to paragraph 6-2f, NAVSHIPS 94028.
- Step 5. Make the cathode ray tube adjustments. Refer to paragraph 6-2g, NAVSHIPS 94028.
- Step 6. Make the mark and space gain control adjustments. Refer to paragraph 6-2h, NAVSHIPS 94028.
- Step 7. Adjust the differential amplifier circuits. Refer to paragraph 6-2i, NAVSHIPS 94028.

8-2. PACKAGING.

Before packing for shipment, check all items against table 1-1. Instruct the packing facility if the equipment is to be packed for domestic shipment-immediate use, domestic pack for storage, or for overseas shipment.

If the equipment is to be packed for domestic shipment for immediate use, and the original shipping containers have been destroyed, pack the equipment against handling damage. Use the following procedure.

- Step 1. Wrap the equipment in oil and greaseproof paper.
- Step 2. Fold and tape corrugated paper pads for each side of the equipment.
- Step 3. Place the equipment and pads in a corrugated cardboard carton.
- Step 4. Seal the carton with gummed paper tape.

If the equipment is to be packed for domestic shipment and storage, use the following procedure.

- Step 1. Pack the equipment with at least three pounds of dessicant. Use one-quarter and one-half pound bags as required. The bags may be placed in the packing pads.
- Step 2. Fold and tape the shipping pads for each side of the equipment.
- Step 3. Wrap the equipment with oil and greaseproof paper.
- Step 4. Place the wrapped equipment and pads in the inner shipping carton. Use gummed paper tape and seal the carton.
- Step 5. Attach a humidity indicator to the carton.

- Step 6. Insert the carton in a vaporproof bag. Seal the vaporproof bag.
- Step 7. Insert the vaporproof bag into the outer shipping carton. Use waterproof cloth tape and seal the outer carton.

If the equipment is to be packed for overseas shipment, use the above procedure, Steps 1 through 6, and pack for domestic shipment and storage. Place the outer shipping carton in a wooden shipping crate. Nail the crate securely, and strap with steel bands.

Regardless of the packing method used, mark the outside of the container TECHNICAL MANUALS INSIDE.

40

SECTION IX
DIFFERENCE DATA SHEETS

9-1. GENERAL.

The following information is supplied to provide information on differences in models of Comparator-Converter Group AN/URA-17, contract NObsr 81579, Manufactured by the Military Products Division, Hoffman Electronics Corporation, Los Angeles, California.

9-2. CHANGES MADE AT SERIAL A11 AND SUBSEQUENT.

At serial A11, improved padding was used around the cathode ray tube shield. This padding has less tendency to harden with age.

9-3. CHANGES MADE AT SERIAL A156 AND SUBSEQUENT.

At serial A156, resistor R71 was changed to provide better centering of the -48 vdc adjustment.

9-4. CHANGES MADE AT SERIAL A246 AND SUBSEQUENT.

At serial A246, resistors R20 and R22 were changed to improve the reliability of capacitors C12 and C13.

9-5. FIELD CHANGES.

Field change bulletins are in preparation, but not printed and distributed, at the time this overhaul technical manual is shipped. When these field changes are distributed, and the required work is completed, the equipment will have the following characteristics:

- a. The improved tube shield will be installed in Serials A1 through A10.
- b. Resistor R71 will be changed in Serials A1 through A155.
- c. Resistors R20 and R22 will be changed in Serials A1 through A245.
- d. All equipment will therefore be alike.

I N D E X

SUBJECT	PARAGRAPH (Figure) *Table
A	
Af Input Signal.....	1-5 <u>a</u>
B	
Bandpass Filter Tests.....	6-3 <u>j</u>
C	
Cable Retractor Replacement	6-3 <u>l</u> , (2-3)
Cleaning	4-1
Cleaning Solutions	4-1
D	
Description of Unit.....	1-3
Difference Data Sheets	9-1
Diode Complement	1-6 <u>e</u> , *1-5
Dismantling and Disassembly	3-1
Drawer Slide Replacement	6-3 <u>m</u>
E	
Electrical Inspection.....	5-3
Equipment Required, not Supplied	1-6 <u>b</u> , *1-2
Equipment Similarities.....	1-6 <u>d</u>
Equipment Supplied	1-6 <u>a</u> , (1-1), *1-1
Examination and Testing.....	8-1
F	
Factory or Field Changes	1-4
Field Changes.....	9-5
Filter Characteristics	*6-1
Filter Replacement	6-3 <u>b</u>
Final Assembly	7-1
Frequency Shift Converter	(1-2)
Functional Description	1-2
I	
Interconnecting Cable Replacement	6-3 <u>k</u>
Interconnecting Data for Diversity Operation	(2-2)
Interconnecting Data for Single-Receiver Operation	(2-1)
Inspection	5-1
M	
Maximum Keying Speeds	1-5 <u>c</u>

42

SUBJECT	PARAGRAPH (Figure) *Table
O	
Operating Frequencies	1-5 <u>b</u>
Output of Unit	1-5 <u>d</u>
P	
Packaging	8-2
Parts Location	(3-1)
Power Requirements	1-5 <u>e</u>
Printed Circuit Board Replacement	6-3 <u>c</u>
R	
Receptacle Panel Removal	6-3 <u>d</u>
Removal and Disassembly	3-1
Repair and Replacement	6-1
S	
Shipping Data	1-6 <u>c</u> , *1-3
Special Tools	2-1
Switch Replacement	6-3 <u>h</u>
T	
Test Cables	2-2, *2-2, *2-3
Test Equipment	2-1, *2-1
Testing	8-1
Transformer Replacement	6-3 <u>b</u>
Transistor Complement	1-6 <u>e</u> , *1-4
Transistor Replacement	6-3 <u>e</u>
Tuning Indicator Replacement	6-3 <u>f</u>

431-44

