NAVSHIPS 91278

[redacted]

INSTRUCTION BOOK
for

FREQUENCY SHIFT CONVERTER-COMPARATOR GROUP AN/URA-8A

HOFFMAN RADIO CORPORATION
Los Angeles 7, California

BUREAU OF SHIPS NAVY DEPARTMENT

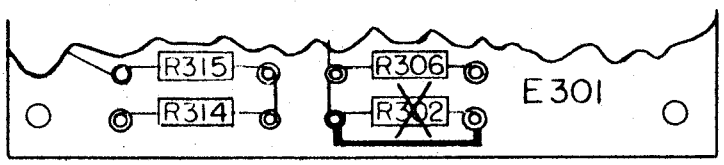
Contract: NObsr-42027 *Approved by BuShips: 5 Dec. 1949*

Temporary Correction T-1 to Instruction Book for Frequency Shift Converter-Comparator Group AN/URA-8A NAVSHIPS 91278

MAKE THE FOLLOWING CORRECTIONS:

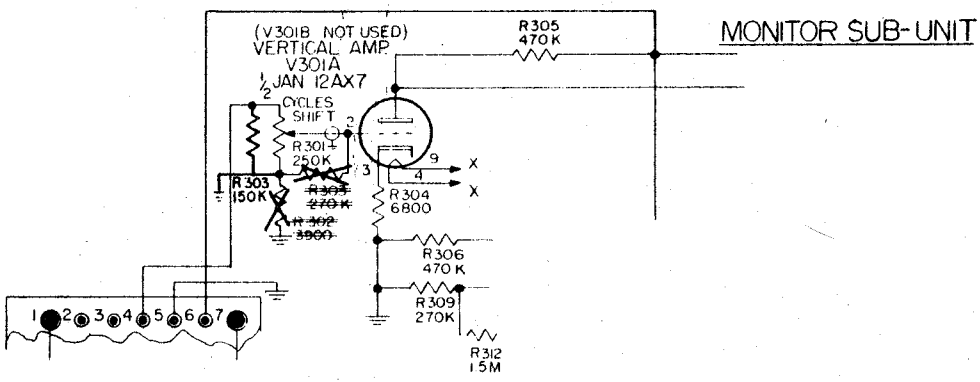
Page 5-20; Figure 5-9

On terminal board E301, cross out R302 and show a jumper between its terminals:



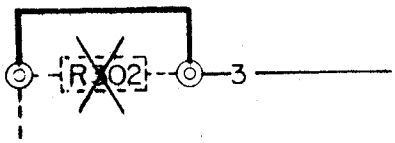
Page 5-29, 5-30; Figure 5-17

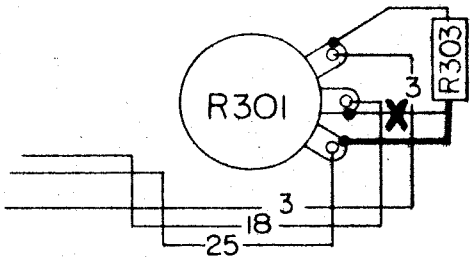
On the schematic diagram, delete R302 and the original R303, and add a new R303 as shown below:



Page 5-37, 5-38; Figure 5-21

On the wiring diagram, cross out R302 and draw in a jumper between its terminals; show R303 shunted across the outer terminals of R301:





Pages 6-20 and 6-21; Table 6-4

Correct the parts table as shown on the next page.

Note: Wet the gummed edge and insert this sheet under the front cover of NAVSHIPS 91278. Make the indicated corrections in the book.

Corrections for

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST

Only the items to be corrected are listed.

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIG-NATION	CON-TRACTOR DRAW-ING & PART NO.	ALL SYMBOL DESIG. IN-VOLVED	Total per Equip.
R302	Deleted ~~RESISTOR, fixed: composition; 3900 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11~~	~~Limits Minimum Setting of R301~~	~~RC20BF392J~~	~~N16-R-50092-431~~	~~CBZ RC20BF 392J~~	~~RC-279~~	R302	~~2~~
R303	RESISTOR, fixed: composition ~~270,000 ohms ±5%~~; ½ w; characteristic letter F; spec JAN-R-11	Shunts R301 ~~Corrects Taper of R301~~	~~RC20BF274J~~ RC20BF154M	~~N16-R-50740-431~~ N16-R-50680-291	CBZ RC20BF ~~274J~~ 154M	~~RC-228~~ RC-340	R303 ~~R309~~	~~4~~ 2
R309	RESISTOR, fixed: composition; 270,000 ±5%; ½ w; ~~Same as R303~~ characteristic letter F; spec JAN-R-11	Horizontal Positioning Voltage Divider	RC20BF274J	N16-R-50740-431	CBZ RC20BF 274J	RC-228	R309	2

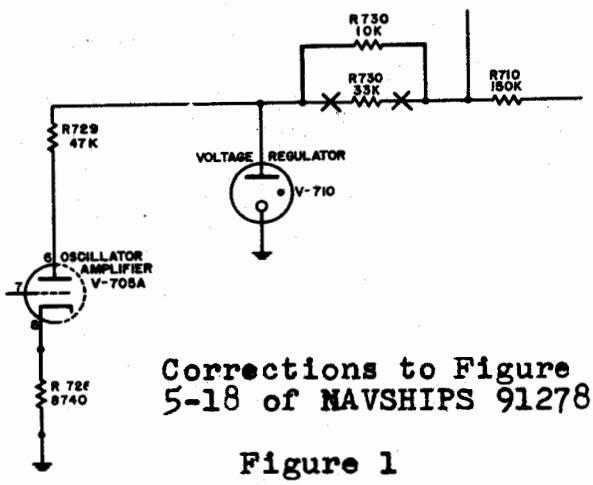
TEMPORARY CORRECTION T-2 TO TECHNICAL MANUAL FOR FREQUENCY SHIFT CONVERTER AN/URA-8A NAVSHIPS 91278

This temporary correction is in effect after Field Change 1-AN/URA-8A has been made. Therefore, do not correct the manual until the field change has been made.

This temporary correction changes the manual to reflect the equipment changes made by Field Change 1-AN/URA-8A. The field change applies to all sets and its purpose is to improve the voltage regulation on tubes V-201A and V-705B.

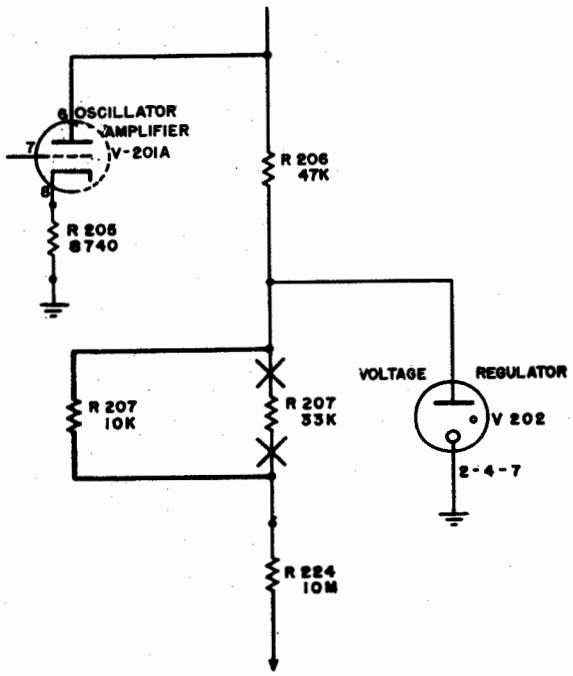
Make the following pen and ink corrections. Insert this temporary correction in the technical manual immediately after the front cover and preceding T-1.

FIGURE	PAGE	ACTION
5-17 and 5-18		Correct figures in accordance with figures 1 and 2.
	6-19	Opposite R-207 delete the following: a. 33,000 ± 10 percent. b. RC 40 BF 33K. c. N16-R-50418-551. d. CBZ, RC40BF, 333K. e. RC-264. Opposite R-207, add the following: a. 10,000 + 10 percent. b. RC 42 BF, 103K. c. N16-R-50283-529.



Corrections to Figure 5-18 of NAVSHIPS 91278

Figure 1



Corrections to Figure 5-17 of NAVSHIPS 91278

Figure 2

TEMPORARY CORRECTION T-3 TO THE TECHNICAL MANUAL FOR
FREQUENCY SHIFT CONVERTER-COMPARATOR GROUP AN/URA-8A
NAVSHIPS 91278

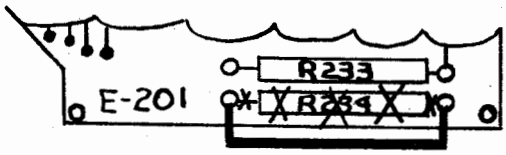
This temporary correction is in effect after Field Change No. 2-AN/URA-8A, AN/URA-8B has been made. Therefore do not correct the manual until the field change has been made.

This temporary correction changes the manual to reflect the equipment changes made by Field Change 2-AN/URA-8A, AN/URA-8B. The field change applies to all sets and its purpose is to increase teletype loop current to the required minimum of 60 ma for proper operation of teletype equipment. It also cancels Field Change #1 to the AN/URA-8A, 8B equipments which is no longer considered desirable.

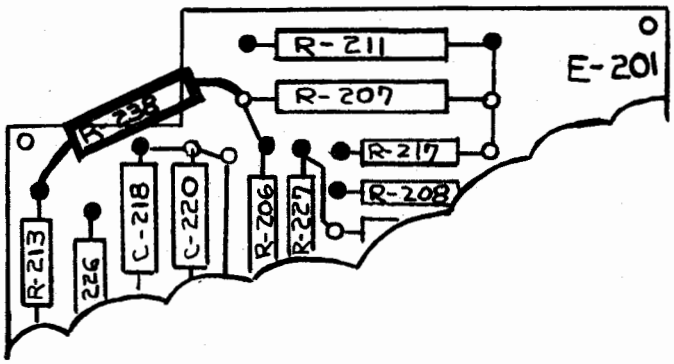
Make the following pen and ink corrections. The correction sheet should then be inserted in the book directly following the front cover as a permanent record.

PAGE NO	CHANGE IN EFFECT	PARA & LINE OR FIG OR LOCATION		ACTION
2-5	Orig.	2b(1)	38 thru 41	Delete these lines which state "V202 is an OA2 regulator tube which regulates the voltage applied to the plate of the first oscillator tube V201A. This OA2 holds the voltage to within two volts of its working voltage (approximately 150 volts)."
2-6	Orig.	2b(5)	end	Add a new paragraph directly following the last line of Electronic Relay Theory which states, "V202 is an OA2 regulator tube which regulates the voltage of the screen grids of V207 and V208 and keeps it from exceeding 150 volts during the spacing condition of teletype keying and protects the screen grids from overheating when plate voltage is removed (when patch cords are removed from teletype patchpanel). Limiting the screen grid voltage to 150 volts also has the effect of reducing the spacing current in the teletype loop circuit to less than one milliampere."

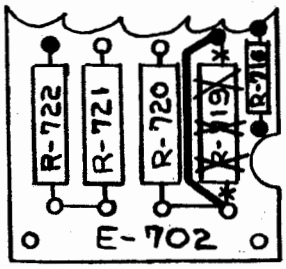
PAGE NO	CHANGE IN EFFECT	PARA & LINE OR FIG & LOCATION		ACTION
5-20	Orig.	5-9	E-201	On terminal board E-201 cross out R-234 and draw a jumper across its terminals.



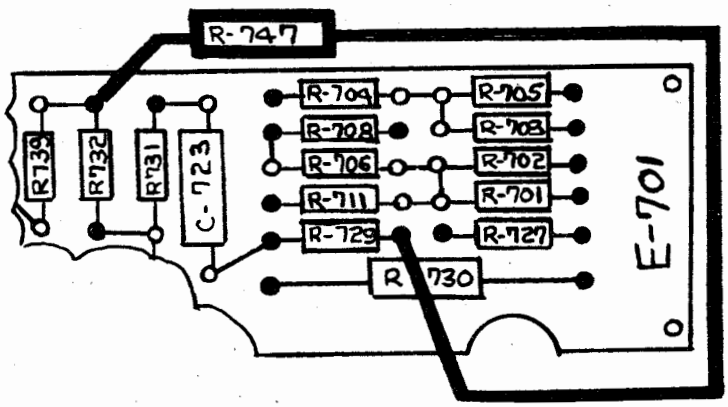
		5-9	E-201	On terminal board E-201 draw a resistor, R-238, connected between junction of R-206 and R-207 to R-213 (blank end).



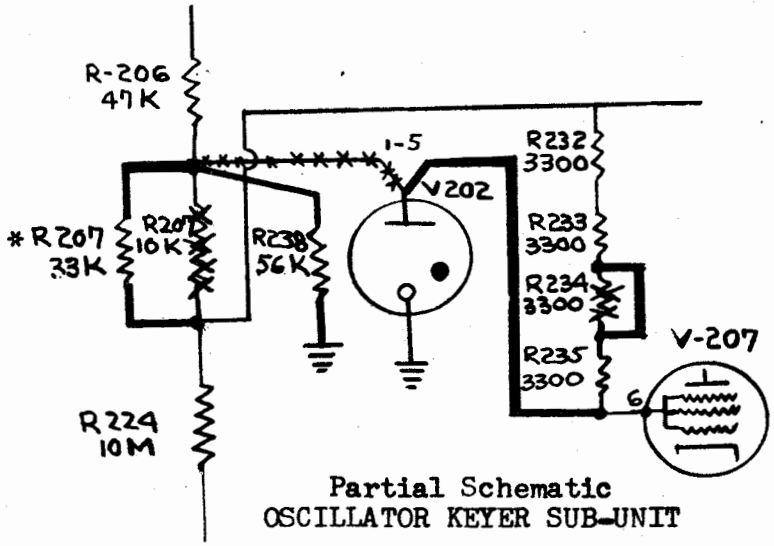
5-25	Orig.	5-14	E-702	On terminal board E-702 cross out R-719 and draw a jumper across its terminals.



PAGE NO	CHANGE IN EFFECT	PARA & LINE OR FIG & LOCATION		ACTION
5-25	Orig.	5-14	E-701	On terminal board E-701 draw a resistor, R-747, connected between junction of R-732 and R-739 to R-729 (end nearest R-727).



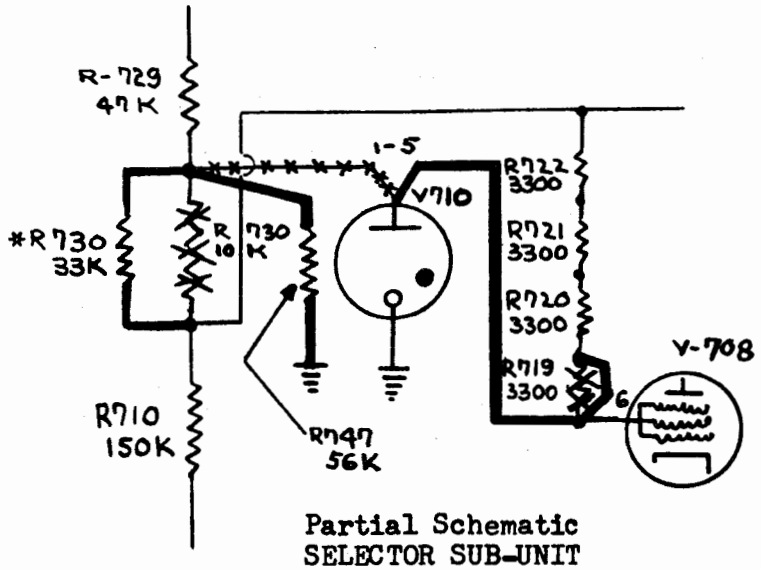
5-29, 5-30	Orig.	5-17	Osc.Keyer Sub-Unit	Correct the Frequency Shift Converter CV-89/URA-8A Schematic Diagram as shown in partial schematic below:



Partial Schematic
OSCILLATOR KEYER SUB-UNIT

*NOTE: If Field Change #1 which converts R-207 from 33K ohms to 10K ohms has not been accomplished the revision of this resistor to 33K ohms is not applicable.

PAGE NO	CHANGE IN EFFECT	PARA & LINE OR FIG & LOCATION	ACTION
5-31, 5-32	Orig.	5-18 Selector Sub-Unit	Correct the Comparator CM-22/ URA-8A Schematic Diagram as Shown in partial schematic below:



Partial Schematic
SELECTOR SUB-UNIT

*NOTE: If Field Change #1 which converts R-730 from 33K ohms to 10K ohms has not been accomplished the revision of this resistor to 33K ohms is not applicable.

5-35, 5-36	Orig.	5-20	- - -	Correct Oscillator Keyer Sub-Unit Wiring Diagram as follows: (a) Redraw wire 26 showing it going from "V-202 terminal 1 to V-207 terminal 6" instead of from "V-202 terminal 1 to R-206". (b) Add a resistor, R-238, on terminal board E-201 and show it connected from R-213 (end on which wires 3 and 4 are now connected) and junction of R-206 and R-207. (c) On Terminal Board E-201 add a jumper wire across R-234 and cross R-234 out. (d) On wire table change "Point to Point" information concerning wire 26 to read "V202 (1) TO V207 (6)" instead of "V202 (1) TO R206".

PAGE NO	CHANGE IN EFFECT	PARA & LINE OR FIG & LOCATION	ACTION
5-45, 5-46	Orig.	5-25 - - -	Correct Selector Sub-Unit Wiring Diagram as follows: (a) On terminal board E-702 add a jumper across R-719 and cross R-719 out. (b) Redraw wire 40 showing it going from "V-710 terminal 5 to V-708 terminal 6" instead of from "V-710 terminal 5 to R-729". (c) Add a resistor, R-747, on terminal board E-701 and show it connected from junction of R-729 and R-730 to junction of R-732 and R-739. (d) On wire table change "Point to Point" information concerning wire 40 to read "V-708-6 TO V-710-5" instead of "R729 TO V710-5".
6-19	Orig.	- - - - - -	Change data under Locating Function for R207 to read "V201A Series Dropping" instead of "V202 Series Dropping".

NOTE: If Field Change #1 which converts R207 from 33K ohms to 10K ohms has not been accomplished delete the following step as it will be inapplicable and proceed to the next step.

			Change data for R-207 in the columns concerned: Column (2) Change "10,000" to "33,000", Column (4) Change "RC42BF103K" to "RC40BF333K", Column (5) Change "N16-R-50283-529" to "N16-R-50418-551", and Column (7) add RC-264.
6-20	Orig.	- - - - - -	Add the following information directly following R-237 in the 9 columns concerned: (1) R-238 (2) RESISTOR, fixed: composition; 56000 ohms, ± 10%, 1 watt, (3) V201A Plate Bleeder, (4) N5905-299-2011, (5) --, (6) --, (7) --, (8) R238, R747, (9) 3.

PAGE NO	CHANGE IN EFFECT	PARA & LINE OR FIG & LOCATION	ACTION
6-23	Orig.	- - - - - -	(a) Change data under Locating Function for R730 to read "V705A Series Dropping" instead of "V710 Series Dropping". (b) Add the following information directly following R746 in the first 3 columns concerned: (1) R747, (2) Same as R238, (3) V705A Plate Bleeder.
6-27	Orig.	- - - - - -	(a) Change data under Locating Function for V202 to read "Voltage Regulator for V207 and V208 Screen Voltage" instead of "Voltage Regulator for V201A Plate Supply". (b) Change data under Locating Function for V710 to read "Voltage Regulator for V708 and V709 Screen Voltage" instead of "Voltage Regulator for Plate of V705A".

LIST OF EFFECTIVE PAGES

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
Title Page	Original	3-0 to 3-14	Original
A to C	Original	4-1 to 4-5	Original
i to vii	Original	5-0 to 5-54	Original
1-0 to 1-9	Original	6-1 to 6-35	Original
2-0 to 2-7	Original	i-0 to i-4	Original

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION 1—GENERAL DESCRIPTION

SECTION 2—THEORY OF OPERATION

SECTION 3—INSTALLATION

SECTION 4—OPERATION

SECTION 5—MAINTENANCE

LIST OF ILLUSTRATIONS (Cont.)

LIST OF TABLES

ADDRESS NAVY DEPARTMENT
BUREAU OF SHIPS

Code 993-100
REFER TO FILE NO. AND DATE

NAVY DEPARTMENT
BUREAU OF SHIPS
WASHINGTON 25, D. C.

RESTRICTED

5 December 1949

To: All Activities Concerned with the Installation, Operation and Maintenance of the Subject Equipment.

Subj: Instruction Book for Frequency Shift Converter-Comparator Group AN/URA-8A (NAVSHIPS 91278).

1. NAVSHIPS 91278 is the instruction book for the subject equipment and is in effect upon receipt.

2. NAVSHIPS 91278 is a [redacted] non-registered publication and shall be handled, transported, and safeguarded in accordance with U. S. Navy Regulations. When superseded by a later edition, this publication shall be destroyed.

3. Any person known to be in the service of the United States and persons of undoubted loyalty and discretion who are cooperating in government work may have access to this publication. However, information contained herein shall not be communicated to the public or to the press.

4. This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, 50 U. S. C., 31 and 32, as amended. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law. (ART. 76 U. S. N. REGS-1920).

5. Extracts from this publication may be made to facilitate the preparation of other Navy instruction books and handbooks.

6. All requests for NAVSHIPS Electronic Publications should be directed to the nearest District Publications and Printing Office. When changes or revised books are distributed, notice will be included in the applicable maintenance bulletin and the BuShips Electron.

D. H. CLARK
Chief of Bureau

FROM BUREAU OF SHIPS

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

GUARANTEE

The Contractor guarantees that at the time of delivery thereof the articles provided for under this contract will be free from any defects in material or workmanship and will conform to the requirements of this contract. Notice of any such defect or non-conformance shall be given by the Government to the Contractor within one year of the delivery of the defective or nonconforming article, unless a different period of Guaranty is specified in the schedule. If required by the Government within a reasonable time after such notice, the Contractor shall with all possible speed correct or replace the defective or nonconforming article or part thereof. When such correction or replacement requires transportation of the article or part thereof, shipping costs, not exceeding usual charges, from the delivery point to the Contractor's plant and return, shall be borne by the Contractor; the Government shall bear all other shipping costs. This Guaranty shall then continue as to corrected or replacing articles or, if only parts of such articles are corrected or replaced, to such corrected or replacing parts, until one year after the date of redelivery, unless a different period of Guaranty is specified in the schedule. If the Government does not require correction or replacement of a defective or non-conforming article, the Contractor, if required by the contracting officer within a reasonable time after the notice of defect or non-conformance, shall repay such portion of the contract price of the article as is equitable in the circumstances.

INSTALLATION RECORD

Contract NObsr-42027 Date of Contract 8 Oct. 1947

Serial Number of equipment.....

Date of acceptance by the Navy.....

Date of delivery to contract destination.....

Date of completion of installation.....

Date placed in service.....

Blank spaces on this page shall be filled in at time of installation.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its entire service life, shall be made at the Bureau of Ships in accordance with current regulations using form NAVSHIPS NBS 383 (revised) except for Marine Corps equipment, in which case the "Signal Equipment Failure Report" form shall be used and distributed in accordance with instructions pertaining thereto. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the *Bureau of Ships Manual* or superseding instructions.

ORDERING PARTS

All requests or requisitions for replacement material should include the following data:

1. Federal stock number or, when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of part.

If the appropriate stock number is not available the following shall be specified:

1. Equipment model or type designation, circuit symbol, and item number.
2. Name of part and complete description.
3. Manufacture's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

DESTRUCTION OF ABANDONED MATERIAL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment, and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED, OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper or wood.
4. Grenades and shots from available firearms.
5. Burying all debris, where possible and when time permits.
6. Throwing overboard or disposing of in streams or other bodies of water.

Procedure:

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch and instrument boards.
3. Destroy all controls, switches, relays, connections and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil, and water cooling systems in gas engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the of *Bureau of Ships Manual* or superseding instructions on the subject of radio-safety precautions to be observed.

This equipment employs voltage which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS:

Operating personnel must at all time observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties always remove power and discharge and ground circuits prior to touching them.

DON'T SERVICE OR ADJUST ALONE:

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

NEVER MEASURE POTENTIALS IN EXCESS OF 1000 VOLTS BY MEANS OF FLEXIBLE TEST LEADS OR PROBES.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR, OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

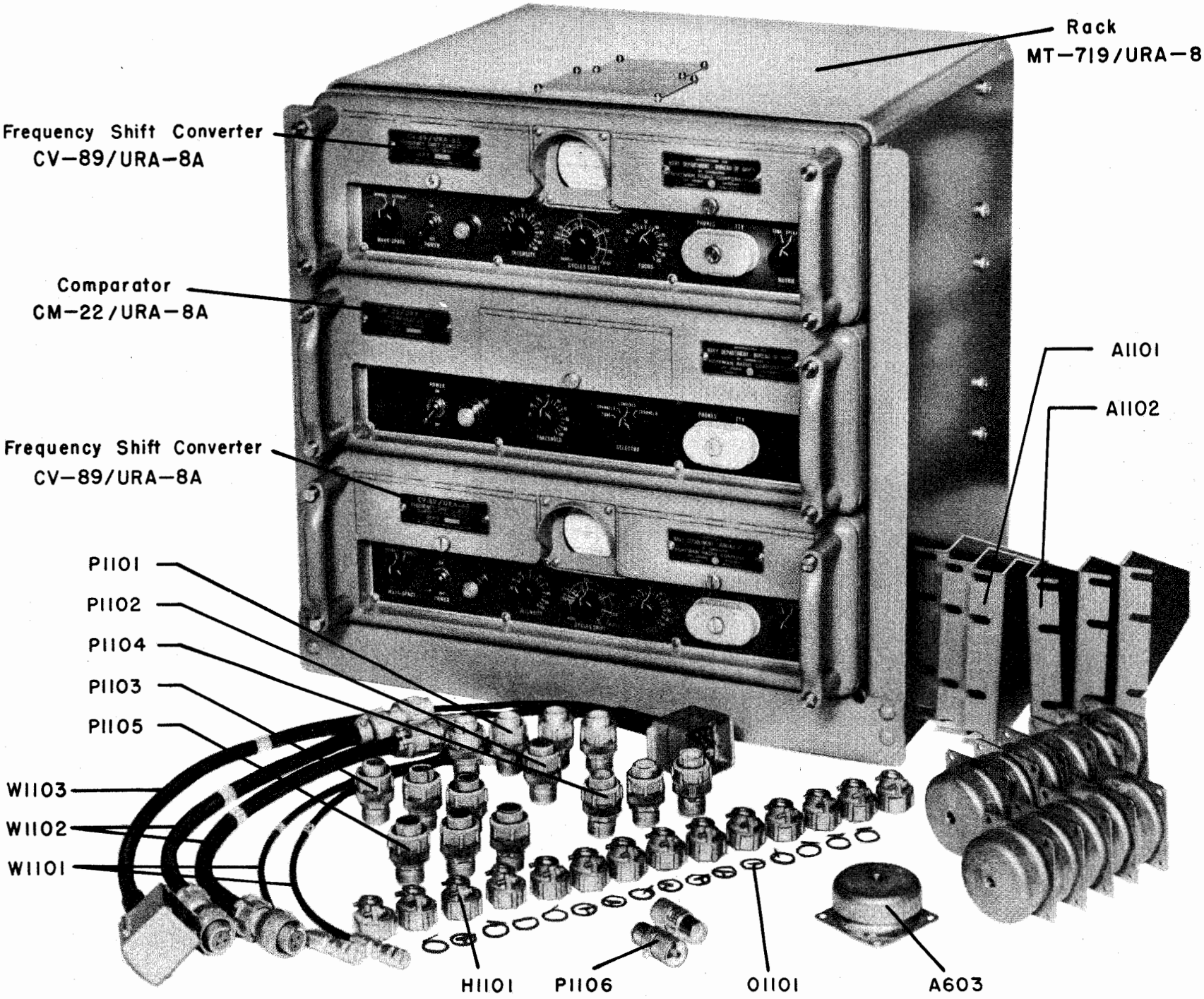


Figure 1-1. Frequency Shift Converter-Comparator Group AN/URA-8A

John J. Wilson
3119 S.E. Boise Street
Portland, Oregon 97206

SECTION I
GENERAL DESCRIPTION

1. PURPOSE AND FUNCTION OF EQUIPMENT.

The Frequency Shift Converter-Comparator Group AN/URA-8A (figure 1-1) is designed primarily to operate from the audio output of two Navy type RBA, type RBB, type RBC or similar standard Navy radio receivers in dual diversity reception of frequency-shift transmissions, converting the audio frequency shifts into pulses which are used to key the dc loop circuit energizing automatic teletype printers. A keyed tone output signal is also produced for feeding the intelligence to remotely located telegraph or teletype terminal equipment over wire lines or radio links.

The equipment will operate with the radio receivers in either space-diversity or frequency-diversity on carriers within the frequency range(s) of the receivers employed.

The Frequency Shift Converter-Comparator Group comprises two Frequency Shift Converters CV-89/URA-8A and one Comparator CM-22/URA-8A mounted in the special table-type Rack MT-719/URA-8A, and includes interconnecting cables, plugs and accessories. In diversity reception the output of each receiver is connected to one of the two Converter units and the dc signals from the discriminator circuits of the two Converters are fed to the Comparator. In the Comparator the two signals are compared in a circuit which automatically selects the better mark and the better space pulse for each character. In this manner optimum characters are obtained from diversity reception.

The Frequency Shift Converters may be used separately for single receiver reception of the frequency-shift signals. Each Converter has its own output circuits for keying the teletype dc loop and providing a keyed audio tone. When the Converters are on single receiver operation the Comparator may be associated with one of them to provide an additional set of output circuits, if desired.

The AN/URA-8A equipment is originally supplied mounted in the table type Rack, however, the units may be mounted separately on individual sets of shock-mounts or each unit may be adapted to mount in a standard 19 inch relay rack. The individual shock-mounts and adapter brackets are supplied as accessories.

2. DESCRIPTION OF MAJOR UNITS.

The Converter and Comparator units are alike in size and general shape and are similar in appearance and construction. Each unit is housed in its own Navy gray aluminum-alloy case and each case is fitted with "file-drawer" type double-extension drawer slides which support the chassis-panel assembly of the unit when it is completely withdrawn from the case. When the chassis assembly is withdrawn it may be tilted by swinging the panel up or down and be locked in any one of five positions (see figures 1-2 and 5-2). This is to facilitate inspection, adjustment and maintenance. The positions include horizontal, vertical with the panel end up, vertical with the panel end down, and two 45 degree positions between the others. The slides have latches which lock the unit in the case and secure it at the fully withdrawn position. The cases have no openings for ventilation and are sealed with gaskets so as to be drip proof when closed. Two handles extend forward from the sides of the front panel for use in withdrawing and tilting the chassis assembly. Push-buttons in the top of each handle release the slide latches, when depressed, and pushbuttons in the bottom of the handles release the tilt locks. At a position of 22½ degrees from the horizontal, panel lowered, the chassis assembly may be removed by simply lifting it out of the drawer slide supports. This position is indicated by a slight detent in the tilt lock disks which can be felt as the chassis-panel assembly is tilted. (See figures 1-2 and 5-2.)

A cable filter is mounted inside the rear of each case. These are similar physically for the Converter and Comparator but differ electrically. Connections between the cable filter and its corresponding chassis-panel assembly are made through a pair of mating multiple-contact connectors. These connectors are separated when the chassis assembly is pulled out.

A jumper cable is provided to complete the circuits to a withdrawn unit, the connectors being the same on both units. The jumper cable is stored inside a compartment in the Comparator.

Input and output connections to the units are made by means of a row of connectors at the back, which are

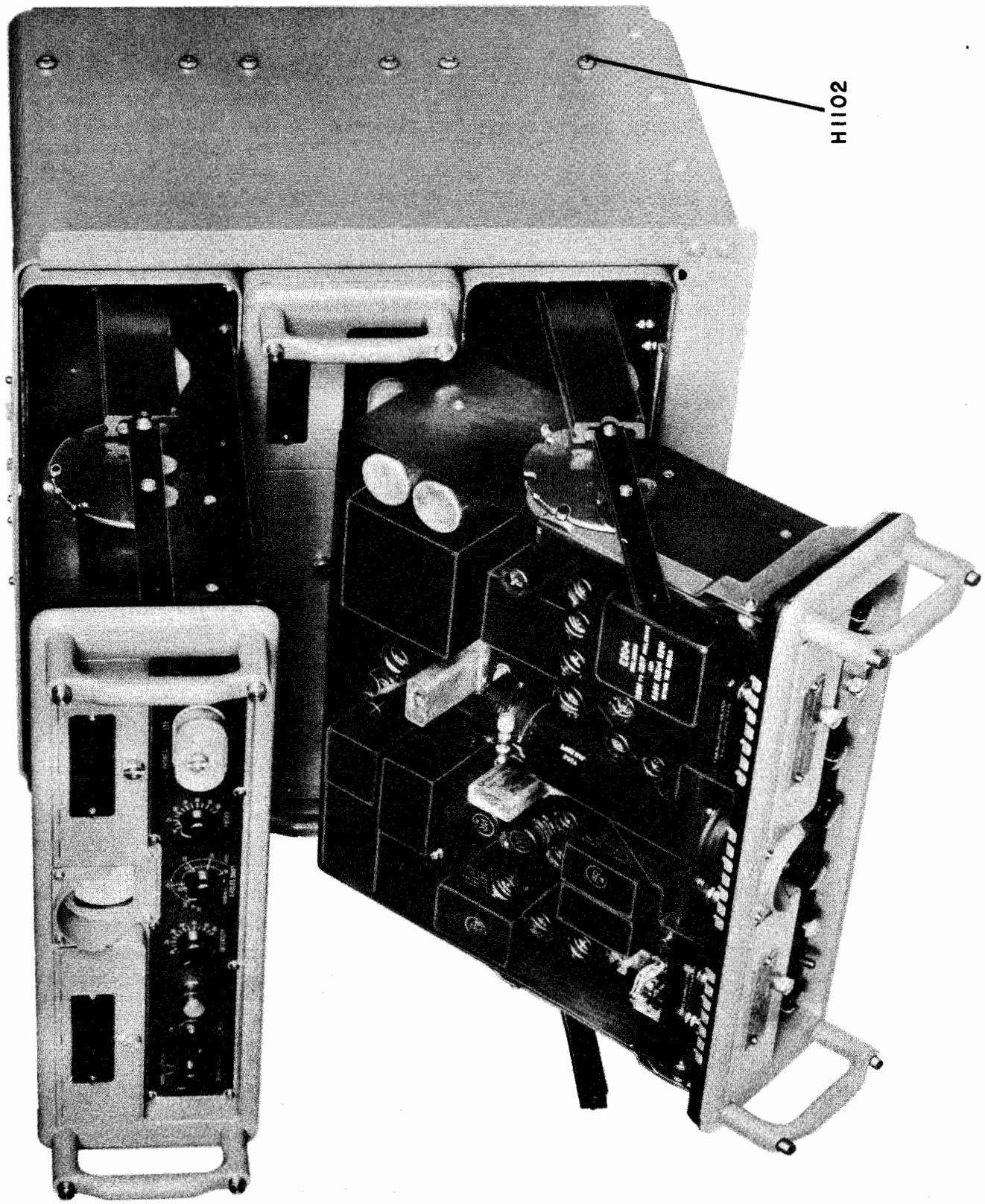


Figure 1-2. View of Drawer Slides and Tilt Action in Units of AN/URA-8A Equipment

part of the cable filter in each unit and extend through an opening at the back of the case.

The operating controls for each unit are in a recessed area in the lower half of the front panel. Semipermanent controls and adjustments on the front panels are covered by small hinged access doors. Two jacks are provided on the control panel of each unit for monitoring the teletype dc loop circuit and the tone output circuit. These are also covered by a small hinged door.

The chassis of the Converter and of the Comparator is divided up into separate sub-units which plug into the main shell of the chassis. The chassis-panel assembly with its sub-units is called the chassis assembly or drawer assembly.

Provision is made for removing the sub-units which contain operating controls by having the control knobs mounted on separate shafts which may be pulled forward to disengage from the shafts of the controls in the sub-units. Each sub-unit is secured in place by three to five captive screws, and all its connections to the wiring of the chassis-panel assembly are made through a mating pair of multiple contact connectors. This construction makes possible the rapid replacement of any defective section of the equipment to insure the most continuous operation.

The interior of the cases and the metal surfaces of the chassis are finished with anodize and black alumilite to give the best transfer of heat through the unit to the case for dissipation by the case.

a. FREQUENCY SHIFT CONVERTER CV-89/URA-8A.

The Frequency Shift Converter CV-89/URA-8A is divided into the following plug-in sub-units and major assemblies, which are shown in figure 1-3:

1. Discriminator Sub-unit (SU101)
2. Oscillator-Keyer Sub-unit (SU201)
3. Monitor Sub-unit (SU301)
4. Power Supply Sub-unit (SU401)
5. Cable Filter Assembly (Z505)
6. Chassis-Panel Assembly
7. Case

The Discriminator Sub-unit is located directly behind the Converter control panel at the left side. It contains wide-shift and narrow-shift filters, a discriminator circuit for narrow or wide shift signals, slow-speed and fast-speed filters, and an axis restorer circuit. These circuits are described in Theory of Operation, Section 2.

The Oscillator-Keyer Sub-unit contains the circuits for keying the teletype dc loop and operating the teletype recorders. It also provides the keyed-tone output by keying a self-generated tone which may be selected to any one of eight audio frequencies. Provision is made for the use of an external tone, if desired. This sub-unit is located at the right, behind the front panel. The output circuits of this sub-unit are used in single receiver operation; but in diversity reception, the signal from the Converter is taken directly from the low-pass filter after the discriminator and fed to the Comparator, without using the tone and output circuits of the Oscillator-Keyer Sub-unit. These are available, however, if it is desired to use the signal from one channel of the system while operating in diversity combination.

The Monitor Sub-unit is a 2-inch oscilloscope used as a monitor for indicating proper tuning of the receiver, for checking the approximate width of the frequency shift of the signal, and for observing the polarity of the mark-space characters and other details of the signal. It has a 60 cycle sinusoidal sweep. The vertical amplifier gain control is calibrated in cycles of shift, represented by a full pattern between horizontal lines marked on the screen window. The customary simple oscilloscope controls are provided. An external connection from this circuit is provided for the use of a remote monitor or test oscilloscope. This sub-unit is in the center of the chassis-panel assembly with the tube showing through the hooded window at the center of the front panel.

The Power Supply Sub-unit is located in the right rear corner of the chassis-panel assembly. It furnishes all the power required by the other sub-units of the Frequency Shift Converter and is designed to operate from a power source of 105/115/125 volts, 50 to 60 cycles, single phase ac. A link connector is provided for selecting the correct transformer tap for the voltage being used.

The Cable Filter Assembly is mounted in the rear of the case. On its front side is a receptacle which carries all the connections to the circuits of the chassis-panel assembly and its sub-units. On the rear of the Cable Filter Assembly and extending out through the rear of the case is a row of ten connectors for accommodating all the input and output connections to the Frequency Shift Converter unit. The purpose of the cable filter assembly is to remove extraneous noise and signals which might cause errors in keying. It comprises radio frequency filters for the ac input, the teletype output, the tone output, and for the external tone input circuit. This assembly is removable, being held in the case by four captive screws accessible through the front of the case.

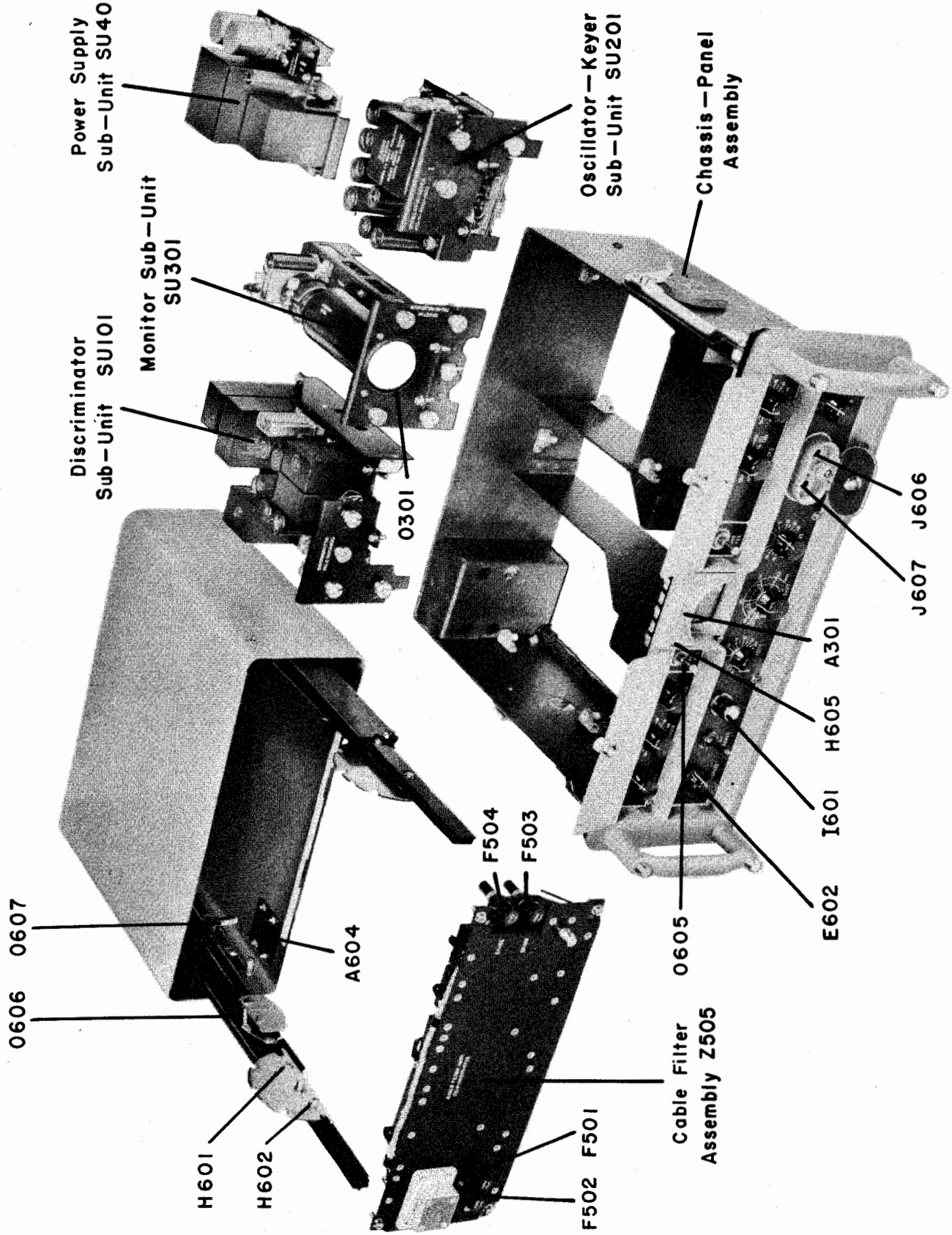


Figure 1-3. Frequency Shift Converter CV-89/URA-8A, Sub-Units and Major Assemblies

The Chassis-Panel Assembly consists principally of the front panel and a skeleton chassis into which the four sub-units are plugged and mounted. It has cabled wiring carrying the circuits between the receptacles for the sub-units and cable filter assembly and to the electrical components on the front panel, which are: the ac power switch, the pilot light and the two monitor jacks. The control knobs are mounted on short shafts, each having a crank pin at the rear end which engages a slotted bushing on the corresponding control shaft to couple the shafts together. The knob shafts are designed to pull forward and disengage from the controls of the sub-unit when the sub-unit is to be removed or inserted. The shafts have spring locking in both "release" and "engage" positions. The Chassis-Panel Assembly mounts on the drawer slides and carries parts of the locking and latching mechanism, including the release buttons in the handles on the front panel.

The Case provides a mounting for the cable filter assembly inside the rear and carries the drawer slides which mount the chassis-panel assembly. It becomes a completely closed drip-proof housing for the whole unit when the chassis-panel assembly is inside and latched in place. Threaded inserts in the sides of the case provide for mounting the case in the Rack MT-719/URA-8A, or for attaching the accessory brackets for 19" relay rack mounting.

b. COMPARATOR CM-22/URA-8A.

The Comparator CM-22/URA-8A is divided into the following plug-in sub-units and major assemblies, which are shown in figure 1-4:

1. Selector Sub-unit (SU701)
2. Power Supply Sub-unit (SU801)
3. Cable Filter Assembly (Z905)
4. Chassis-Panel Assembly
5. Case

The Selector Sub-unit contains the circuit which compares the simultaneous signals from the two Converter units and selects the best mark pulse and best space pulse for each character in the signals. Following this is an axis restorer similar to that in the Converter, after which the circuits are identical in circuitry and function to the corresponding ones in the Converter, namely: keying, tone and output circuits. The selected mark-space pulses are used by these circuits to key the teletype dc loop and produce the keyed-tone output. The Selector Sub-unit plugs in at the right side of the Comparator chassis-panel assembly just behind the front panel.

The Power Supply Sub-unit is located behind the front panel on the left side. It supplies the power required to operate the Selector Sub-unit and, like the supply in the Converter, is designed with a link selector for adjusting the transformer to operate from 105/115/125 volts, 50 to 60 cycles, single phase ac.

The Cable Filter Assembly of the Comparator is nearly identical to the corresponding assembly of the Converter. It mounts by four captive screws inside the rear of the case. On the front side is a receptacle which carries all the connections to the circuits of the Comparator chassis-panel assembly and its sub-units, and on the rear is a row of eight receptacles for accommodating all the input and output connections to the Comparator unit. The receptacles on this assembly are different in number and arrangement from those on the Converter filter assembly, making the two cable filter assemblies easily distinguishable. Two extra parallel ac power connectors are included to provide for interconnecting ac power to the two other units. The individual filters in the Comparator cable filter assembly are duplicates of those in the Converter, filtering the ac input, the teletype and tone outputs and the external tone input circuits.

The Chassis-Panel Assembly of the Comparator consists principally of the front panel and a skeleton chassis into which the two sub-units are plugged and mounted. Its general construction is very similar to that of the Converter chassis-panel assembly. Cabled wires carry the Comparator circuits in the chassis-panel assembly between the sub-unit and cable-filter receptacles and to the electrical components on the front panel, which are: the ac power switch, pilot light and the two monitor jacks. The control knobs are on short disengageable shafts like those in the Converter unit. The mechanical mounting to the drawer slides is identical in both the Comparator and Converter.

The Case of the Comparator is identical to the Case of the Converter; except for the stencilling on the back of the case which designates the names of the connectors that extend out the rear.

c. RACK MT-719/URA-8A.

The Rack MT-719/URA-8A is made especially for mounting the three units of the Frequency Shift Converter-Comparator Group AN/URA-8A. It is a table-type rack with an open front and open back, which mounts the units one above the other in a close-fitting, compact arrangement. The top, side panels, and bottom-rest channels of the rack are all formed from one piece of metal, and the bottom plate and lower-front strip are riveted to it. Anchor nuts are provided in the bottom channels for bolting the rack solidly to the mount-

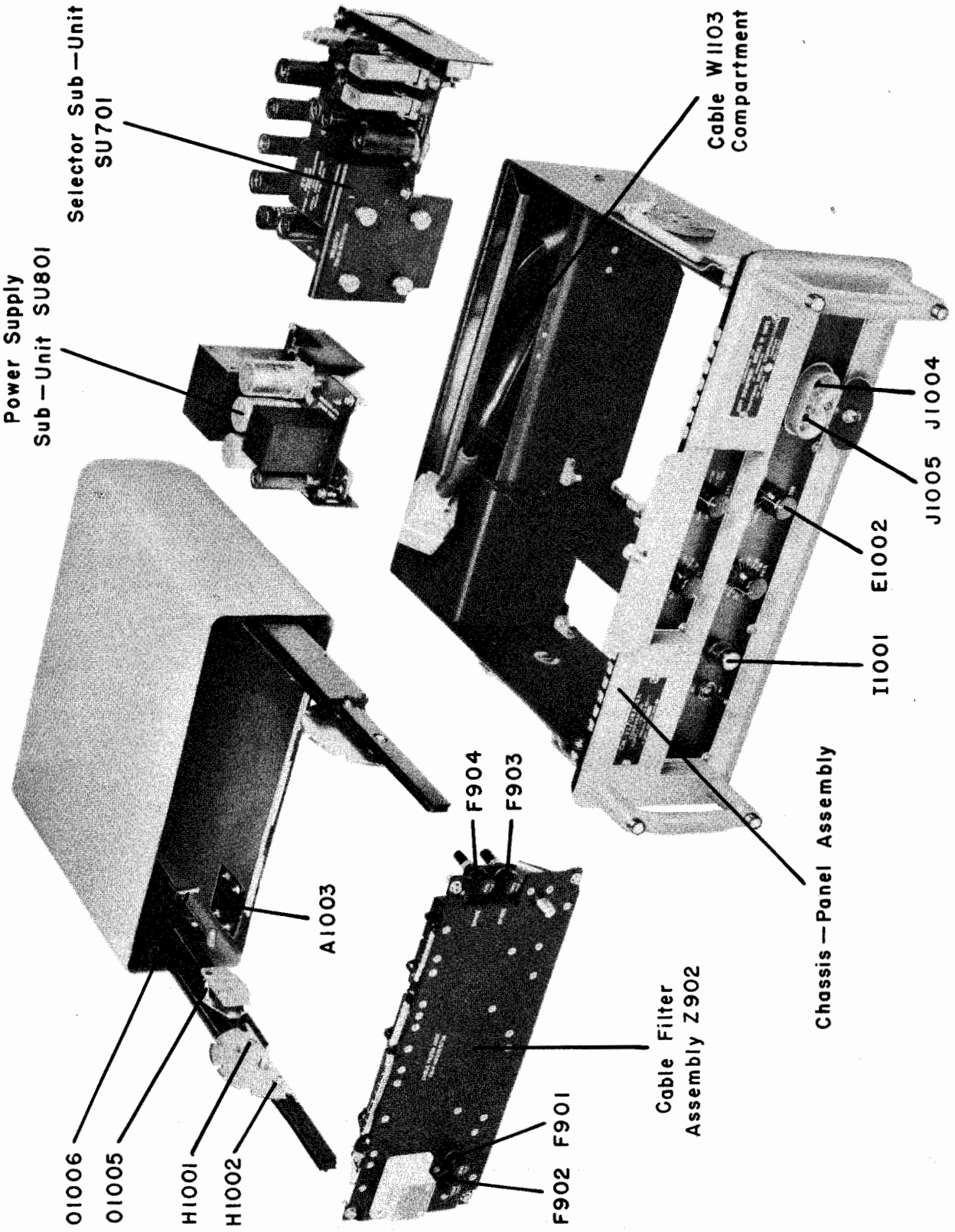


Figure 1-4. Comparator CM-22/URA-8A, Sub-Units and Major Assemblies

ing surface. The units are secured in place by means of screws through holes in the rack side panels into threaded inserts in the sides of the cases. The panels of the rack are reinforced by flanges on most of the edges, the side panels having flanges which flare outward at the front edge. The finish is a Navy gray enamel which matches the cases of the units.

3. REFERENCE DATA.

a. NOMENCLATURE.—Frequency Shift Converter-Comparator Group AN/URA-8A.

b. CONTRACT NUMBER AND DATE.—NObsr-42027, 8 October 1947.

c. CONTRACTOR.—Hoffman Radio Corp., 3761 South Hill Street, Los Angeles 7, California.

d. COGNIZANT NAVAL INSPECTOR.—Inspector of Naval Material, Los Angeles District, 1206 Santee, Los Angeles 15, California.

e. NUMBER OF PACKAGES PER COMPLETE SHIPMENT OF EQUIPMENT.—Two. One package of Equipment, one package containing Maintenance Parts Kit.

f. TOTAL CUBICAL CONTENTS. — Equipment and Maintenance Parts Kit: crated 13.2 cubic feet, uncrated 6.55 cubic feet. (See tables 1-1 and 1-3 for separate volume listings.)

g. TOTAL WEIGHT.—Equipment and Maintenance Parts Kit: crated 389 pounds, uncrated 239.5 pounds. (See tables 1-1 and 1-3 for separate weight listings.)

h. OPERATING FREQUENCIES.—Narrow shift: mean (or center) frequency 1000 cps ± 1%, width of shift 10 to 200 cps. Wide shift: mean frequency 2550 cps ± 1%, width of shift 200 to 1000 cps.

i. MAXIMUM KEYING SPEED.—Sixty words per minute, equivalent to 23 dot cycles per second (fundamental frequency) for a single telegraph channel, or, 100 words per minute, equivalent to 100 dot cycles per second (fundamental frequency) when employed with external apparatus for the reception of four channel multiplex telegraph signals, diversity or single unit operation.

j. TELETYPE OUTPUT.—Keys current in teletype dc loop, 60 ma at 70 volts dc. (Same for Frequency Shift Converter and Comparator.)

k. KEYED TONE OUTPUT.—Any one of eight audio frequencies, 1.5 to 12 milliwatts of power, 600 ohms impedance, balanced winding with center tap available. (Same for Frequency Shift Converter and Comparator.)

TABLE 1-1. EQUIPMENT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NAVY TYPE DESIGNATION	OVER-ALL DIMENSIONS			VOLUME	WEIGHT
			HEIGHT	WIDTH	DEPTH		
1	FREQUENCY SHIFT CONVERTER-COMPARATOR GROUP	AN/URA-8A	18	19 9/16	17 5/32	3.5	144 1/2
	Consisting of the following units:						
2	Frequency Shift Converter	CV-89/URA-8A	5 1/4	17	17	0.88	47
1	Comparator	CM-22/URA-8A	5 1/4	17	17	0.88	36
1	Rack	MT-719/URA-8A	18	19 9/16	14 3/4	3.0	15 1/4
1 Set	ACCESSORIES, CABLES AND PLUGS:		.....	.....	.....	.....	9
	12 Mount, vibration (A603) For table mounting of units individually.						
	3 Bracket, RH (A1102)						
	3 Bracket, LH (A1101)						
	For mounting units in standard 19" relay rack.						
	4 Connector, plug (P1101)	AN3106-14S-7P					
	1 Connector, plug (P1102)	AN3106-14S-7S					
	3 Connector, plug (P1103)	AN3106-14S-9S					
	3 Connector, plug (P1104)	AN3106-14S-12P					
	3 Connector, plug (P1105)	AN3106-14S-12S					
	14 Clamp, cable (H1101)	AN3057-6					
	14 Ring, bonding (O1101)						
	2 Connector, plug (P1106)	49195					
	2 Cable Assembly, RF (W1101)						
	2 Cable Assembly, power (W1102)						
	1 Cable Assembly, special purpose (jumper) (W1103)						
2	INSTRUCTION BOOK	NAVSHIPS 91278					
1 Set	MAINTENANCE PARTS KIT		12 3/4	25	16 1/2	3.05	95

Dimensions are inches, volume cubic feet, weight pounds.

TABLE 1-2. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NAVY TYPE DESIGNATION	REQUIRED USE	REQUIRED CHARACTERISTICS
2	Standard Navy Radio Receivers	Model RBA Series Model RBB series or Model RBC series	To receive frequency shift rf signals and deliver frequency shift af signals to the input of two Frequency Shift Converters CV-89/URA-8A in diversity reception. May be used separately in single receiver reception.	AF frequency shift output suitable for input to Frequency Shift Converter CV-89/URA-8A.
4	Mounting bolts 3/8"	——	For mounting Rack MT-719/URA-8A.	3/8"-24 thread, length as required.
——	Receiver Instruction Books	——	For receiver operating instructions, etc.	——
As required	Lengths of twin conductor and coaxial cable for connecting inputs and output to equipment.	MCOS-2 RG-11/U TTHFWA-1 or any similar suitable cables	——	See Installation.
1 or more	Teletype or telegraph automatic printer and/or terminal equipment.	——	To record messages from keyed output (s) from AN/URA-8A equipment.	Printer having a loop circuit with 60 ma at 70 volts dc energizing power. Terminal equipment capable of operating from a keyed audio tone.
1 or more	Teletype battery or other source of loop current.	——	Power source for teletype loop current.	See Teletype.

l. AF INPUTS.—Two inputs, one for narrow shift and one for wide shift; each 600 ohms impedance; 60 microwatts to 60 milliwatts input power. (Frequency Shift Converter, only.)

m. POWER SOURCE REQUIREMENTS. — Complete Equipment: 105/115/125 volts ac, 50 to 60 cps, single phase, 1.383 amperes (115v), 154.9 watts, 97.4% power factor. Frequency Shift Converter unit: .520 amperes (115v), 58 watts, 97% power factor. Comparator unit: .343 amperes (115v), 38.9 watts, 98.6% power factor.

n. EQUIPMENT LISTS.—Tables 1-1 and 1-2 list the equipment supplied and the equipment and publications required but not supplied.

o. SHIPPING DATA.—Table 1-3 gives information on the equipment and Maintenance Parts Kit as packed for shipment.

p. EQUIPMENT SIMILARITIES.—The AN/URA-8A equipment and the AN/URA-8 equipment are electrically and mechanically interchangeable; however, this instruction book cannot be used with AN/URA-8 equipment.

q. ELECTRON TUBE COMPLEMENT.—The complement of electron tubes for the units and complete equipment is listed in table 1-4.

TABLE 1-3. SHIPPING DATA

SHIPPING BOX NO.	CONTENTS		OVER-ALL DIMENSIONS			VOLUME	WEIGHT
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	Frequency Shift Converter Comparator Group	AN/URA-8A	23 3/8	27	24	8.75	253
2	Maintenance Parts Kit		14 7/8	28 5/8	18 3/8	4.45	136

Dimensions are inches, volume cubic feet, weight pounds.

TABLE 1-4. ELECTRON TUBE COMPLEMENT

UNIT	NUMBER OF TUBES OF TYPE INDICATED									
	JAN 0A2	JAN 1Z2	JAN 2BP1	JAN 6AL5W	JAN 6AQ5	JAN6X4	JAN 12AX7	JAN 12AU7	JAN 991	Total No. of Tubes
Two Frequency Shift Converters CV-89/URA-8A	2	2	2	4	4	2	8	8	2	34
One Comparator CM-22/URA-8A	1			4	2	1	2	3	1	14
Total number of each type	3	2	2	8	6	3	10	11	3	48

SECTION 2
THEORY OF OPERATION

1. GENERAL.

a. FREQUENCY SHIFT METHOD OF COMMUNICATION.

The frequency-shift method of communication is a system of automatic code transmission and reception that shifts the carrier frequency back and forth between two distinct frequencies to designate, respectively, the mark and space portions of the code characters. It provides noise reduction and other advantages of frequency modulation for telegraph, teletype, and similar signals.

The system of reception to be considered here involves the use of a radio receiver for changing the rf carrier into an audio tone by means of the beat-frequency oscillator. The carrier-shift then becomes an audio frequency-shift of the same number of cycles per second.

The frequency-shift employed may be as little as 10 cycles per second and as much as 1000 cycles per second, frequency separation between mark and space signals. This scope of frequency-shifts is divided into two ranges called "narrow shift" and "wide shift." Narrow shift covers the range of 10 to 200 cycles per second, and wide shift covers the range of 200 to 1000 cycles per second.

b. DIVERSITY RECEPTION.

The Frequency Shift Converter-Comparator Group AN/URA-8A is designed for use with two standard Navy radio receivers operating in a diversity system. In space diversity reception the two receivers are tuned to the same frequency but the receiving antennas are spaced more than one wavelength apart. In frequency diversity reception the two receivers are tuned to separate frequency-shift carriers (of different frequencies) which are simultaneously carrying the same mark-space characters. The advantages of diversity operation for reception of distant signals result from the fact that a single rf carrier does not generally fade simultaneously at spots that are more than one wavelength apart, or to the fact that fading of carriers of different frequencies does not generally occur at the same time.

The output of each of the receivers is connected to one Frequency Shift Converter CV-89/URA-8A which converts the frequency-shift characters into dc pulses. These mark-space pulses are fed to the Comparator CM-22/URA-8A where an automatic circuit selects and uses the better signal to ultimately control an automatic teletype printer and/or to produce a keyed output tone.

c. SINGLE RECEIVER RECEPTION.

Where conditions do not require diversity operation, each Frequency Shift Converter may be used separately with a single receiver for reception of frequency-shift signals. In single-receiver reception, using one Frequency Shift Converter, the dc pulses derived from the frequency-shift characters are used by the Converter's own output circuits to key the teletype dc loop and produce a keyed tone output. In this use, the two Frequency Shift Converters may be operated simultaneously in two independent communication circuits. The Converter output circuits provided for this purpose are the same as the corresponding circuits of the Comparator.

d. SIMPLIFIED BLOCK DIAGRAM.

The top row of blocks in figure 2-1 indicate the basic functions of converting an rf frequency-shift signal into a signal for controlling the dc loop of a teletype printer. The frequency shifts of the audio-frequency output of the radio receivers are converted into dc pulses by the action of an audio-frequency discriminator. The dc pulses are fed into a keyer and electronic-relay circuit which opens and closes the dc loop circuit of the associated teletype printer, causing the mark-space characters to operate the teletype.

The lower blocks in figure 2-1 represent the circuits for the keyed tone output. A tone, generated by the audio oscillator, is fed to the tone modulator. The tone modulator stage is prevented from passing signal by the high bias from the keyer representing a space pulse, and is biased as a normal push-pull output stage during the mark-signal pulse from the keyer.

The frequency vs mark-space relationships shown in figure 2-1 are the most typical case, but a reversing switch (not shown) following the discriminator provides for the other cases where the frequency-mark-space relationship is opposite. In the most common frequency-shift modulation the higher radio frequency represents mark and the lower represents space. However,

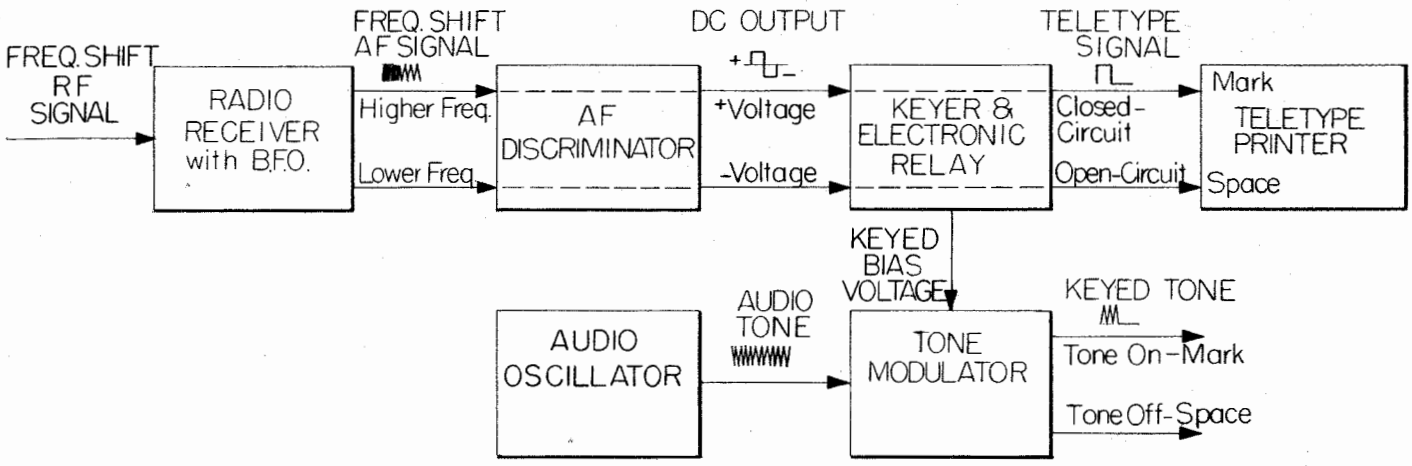


Figure 2-1. Simplified Block Diagram

the opposite is sometimes used, and also, in the receiver the tuning and heterodyning of the signal may reverse the relationship.

Except for the comparing and selecting of signals in diversity operation, the basic functions of the complete equipment are the same as for a single Converter unit.

e. FUNCTIONAL BLOCK DIAGRAM.

Figure 2-2 is a block diagram representing the principal functions of the circuits of the complete equipment and including two receivers and a teletype printer, all shown in diversity connection. The second Frequency Shift Converter is identical to the first and is represented by a single block for simplicity. The receivers may be in space diversity or frequency diversity on any rf frequency(s) within their ranges.

The circuits represented by the blocks are discussed separately in the following paragraphs. Reference should also be made to the two schematics of the units, figures 5-17 and 5-18. For the function of the individual component parts see the function column of the parts list, Section 6.

2. FREQUENCY SHIFT CONVERTER CV-89/URA-8A. figure 5-17.

a. DISCRIMINATOR SUB-UNIT. (SU101)

(1) INPUT FILTER.—The input filter of Converter CV-89/URA-8A is composed of two separate filters, a high pass filter, Z101, and a band-pass filter, Z102. Each filter is connected to a separate AF input through three sections of the NARROW-WIDE shift switch, S101. The purpose of these filters is to eliminate the possibility of false keying in the Converter by extraneous signals at frequencies outside the frequency-shift range being used.

The high pass filter, Z101, is used for the reception of narrow frequency-shift signals and has an input impedance of 600 ohms. This filter is flat (±1 db) from 775 to 1400 cps, and down not less than 40 db at 425 cps and below. The audio amplifier circuits of standard Navy receivers (such as Model RBA) and the other circuits of the Converter attenuate frequencies above 1400 cps, giving a band-pass effect.

The band-pass filter, Z102, is used for the reception of wide frequency-shift signals and also has an input impedance of 600 ohms. The pass band of this filter is within 6 db from 1450 to 3650 cps, and the attenuation is 40 db or better at frequencies of 1000 cps and below and 4100 cps and above.

The output of the input filter is coupled to the limiter amplifier by the matching transformer, T101, through one section of the NARROW-WIDE SHIFT switch, S101A.

The frequency response characteristics for these two filters, Z101 and Z102, are given in tables 5-4.

(2) LIMITER AMPLIFIER.—The limiter amplifier consists of two resistance coupled stages, each stage employing one half of a 12AX7 high mu twin triode, V101. This limiter is designed to apply a constant voltage to the input circuit of the discriminator with variations of input to the limiter amplifier from 60 microwatts to 60 milliwatts.

In the first stage of the limiter amplifier the bias voltage that is obtained from the voltage divider, R104 and R105, is midpoint between the zero grid voltage point and the grid bias cutoff point. The signal limiting on the positive peaks is obtained by rectified grid current through the series grid resistor, R103, and on the negative peaks by cutoff bias.

The second stage of the limiter amplifier functions

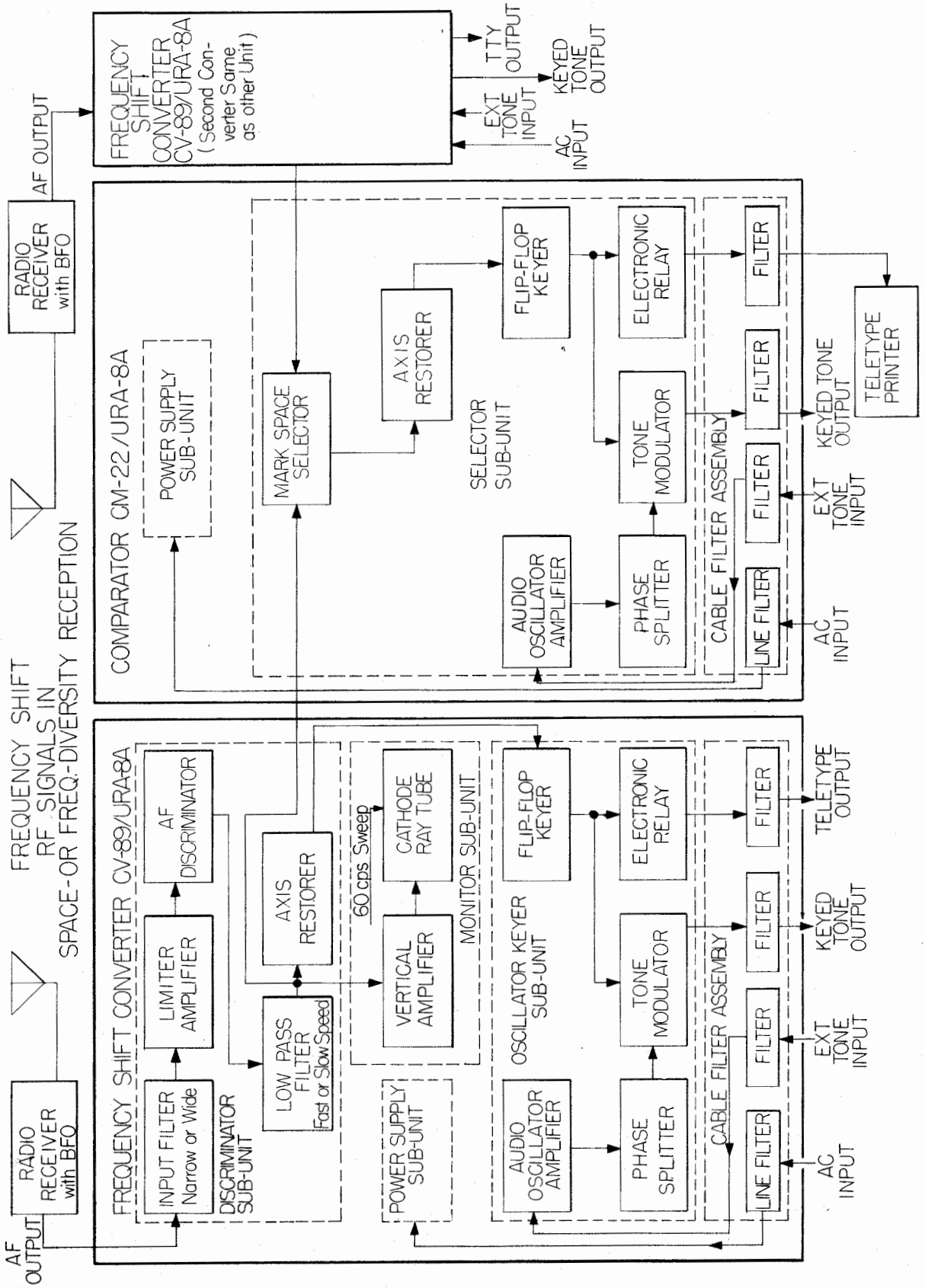


Figure 2-2. Functional Block Diagram, Frequency Shift Converter-Comparator Group AN/URA-8A

in the same manner as the first limiter stage except that it is operating at a higher level.

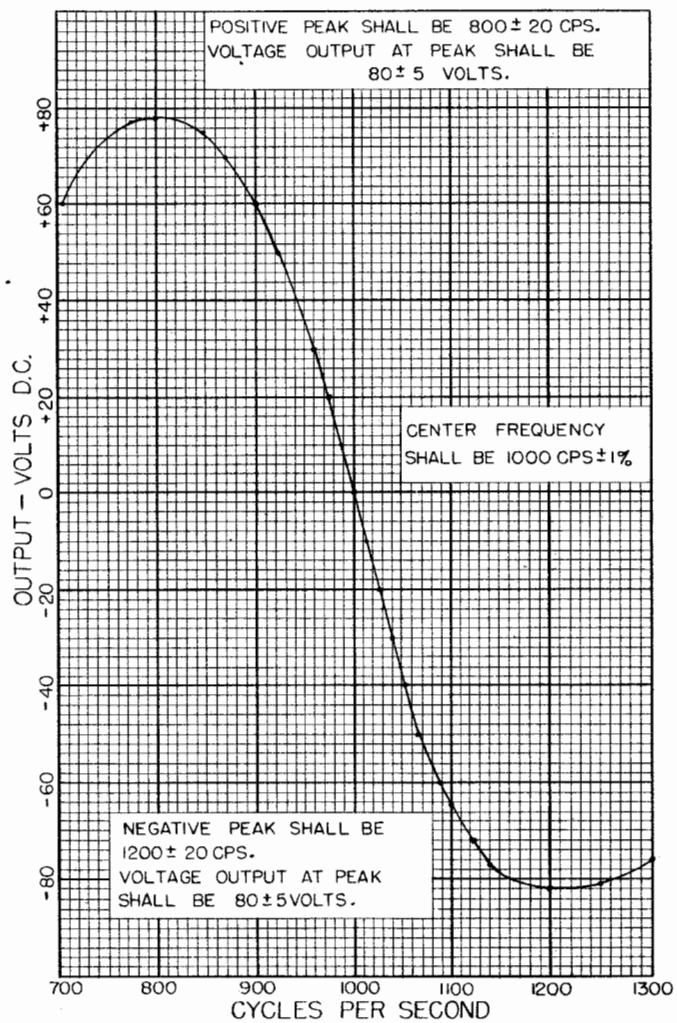
The output of the limiter amplifier is coupled to the input of the discriminator circuit by the coupling condenser, C102, through one section of the NARROW-WIDE SHIFT switch, S101B.

(3) DISCRIMINATOR. — The discriminator circuit is essentially a two-slope back-to-back detector consisting of three sections: the discriminator input network, the discriminator buffer amplifier, and the discriminator rectifier. The purpose of the discriminator circuit is to convert frequency-shift changes into corresponding dc voltages.

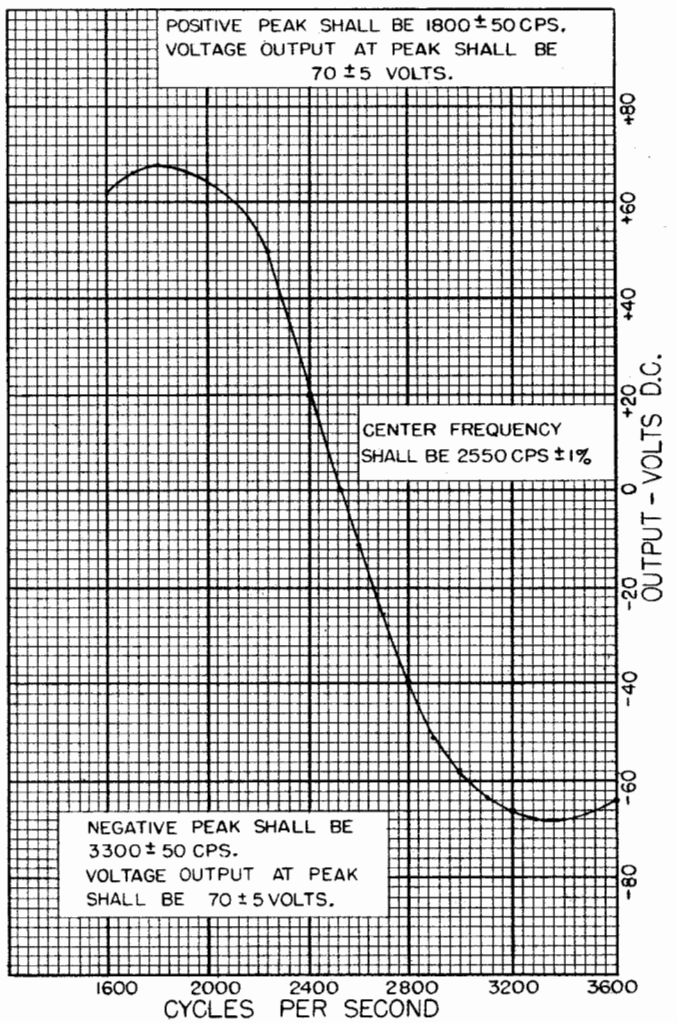
(*a*) DISCRIMINATOR INPUT NETWORK.— Two separate discriminator input networks are employed, Z103 and Z104, one for narrow frequency-shift operation and the other for wide frequency-shift operation.

The narrow frequency-shift network, Z103, is composed of two separate filters having a cross-over or center frequency of 1000 cps, plus or minus 1%, and are designed to cover the 10 to 200 cps frequency-shift range. One filter is tuned to 200 cps higher than the center frequency and the other is tuned to 200 cps lower than the center frequency. The response curves of these two filters overlap in such a way that when used in the complete discriminator circuit, the resulting dc output versus frequency input of the discriminator is as shown in the curve A of figure 2-3.

The frequency-shift network, Z104, is also composed of two filters and has a cross-over or center frequency of 2550 cps, plus or minus 1%. It is designed to cover



CURVE A, NARROW SHIFT



CURVE B, WIDE SHIFT

Figure 2-3. Discriminator Frequency Response Curves

the 200 to 1000 cps frequency-shift range. One of these filters is tuned to 750 cps higher than the center frequency and the other is tuned to 750 cps lower than the center frequency. The curves of these two filters also overlap and produce the frequency response curve for the complete discriminator shown in B of figure 2-3.

The output of the two discriminator network filters is connected to the grids of the two triodes of the discriminator buffer amplifier through two sections of the NARROW-WIDE SHIFT switch S101B.

(*b*) DISCRIMINATOR BUFFER AMPLIFIER.—The discriminator buffer amplifier consists of two separate low gain amplifiers, one for each side of the circuit, each employing one half of a 12AU7 tube, V102A & B. The grid of V102B is driven by the output from the lower frequency output terminal of the discriminator input network (pin 1 of Z103 or Z104) and the grid of V102A is driven by the higher frequency from the other output terminal (pin 4). Thus, one stage is amplifying the high frequency output of the discriminator input network and the other stage is amplifying the low frequency output. The output of these buffer amplifiers is transformer coupled to the discriminator rectifiers by two transformers, T102 and T103. T102 and T103 are conventional audio transformers, which pass all the frequencies involved in the discriminator operation. R110, R111 and R112 furnish the proper bias for both halves of the buffer amplifier.

(*c*) DISCRIMINATOR RECTIFIER.—The discriminator rectifier consists of two rectifiers, each employing one half of a 6AL5W duodiode. One diode, V103B, functions to rectify the low frequency output of the buffer amplifier and the other diode, V103A, functions to rectify the high frequency output. The dc voltage at the output terminals of the rectifier will vary in polarity and magnitude corresponding to the differences in the audio input to the rectifier. The dc output of the rectifier is delivered to the fast and slow speed low pass filters through the reversing switch S102 and FAST-SLOW filter selecting switch S103.

(4) FAST-SLOW SPEED FILTER.—The fast-slow filter consists of two separate low pass filters, a slow speed filter, Z105A, and a high speed filter, Z105B. These attenuate spurious signals above the frequency of the pulse-rate of the circuit, to prevent faulty keying action due to noise, harmonics, etc.

The high speed filter, Z105B, is employed for keying speeds of 60 words per minute or more and is flat (within 6 db) from 80 to 300 cps. The attenuation of this filter is 40 db or more at 500 cps and above.

The slow speed filter, Z105A, is employed for keying speeds of 60 words per minute or less and is flat (within 6 db) from 80 to 140 cps. This filter is down 40 db or more at frequencies of 240 cps and above.

The output of the high and low speed filter is delivered to the axis restorer and lock-up circuit through one section of the FAST-SLOW switch, S103.

(5) AXIS RESTORER AND LOCK-UP CIRCUIT.—The axis restorer circuit is included to produce the optimum signal output when the received signal is weighted heavily on one side or the other, either mark or space, and to maintain the optimum axis, or bias, for keying the weakest portion of a fading signal. The weighting of the signal may be due to the relative mark and space in each character, to selective fading conditions, or to mis-tuning of the receiver. The axis restorer also contains a system which "locks-up" the teletype circuit (closing the loop circuit) whenever there is a prolonged mark, space, or no-signal condition. V104A and B and V105A and B are the tubes in this circuit.

When no signal is received by the converter, either mark or space, the circuits of V104A and B and V105A and B come to rest with a small positive voltage at the output of the circuit, the outer end of R120, which is applied through the inter-sub-unit wiring and S202 to the grid of V201B. This positive voltage produces a mark-signal output from the keyer and output circuits. The level of this voltage is adjusted by the THRESHOLD control R122 by adjusting the plate supply voltage to the axis-restorer's dc amplifier, V105A and B. The two triodes of V105 are in parallel, acting as one triode. There is also positive voltage at one plate and one cathode, pins 1 and 2, of V104A and B, which, due to the conductivity of the V104B diode in this direction, charges C106A to this voltage. Later, through R116 and R118, C106B is also charged to the same level. This positive voltage is applied to the grids of V105A and B, and, with the cathode bias developed by R123, forms its at-rest bias. The bias, in turn, determines the positive voltage in the circuits just discussed by controlling the plate current of V105A and B and establishing the drop in its plate resistor R121.

When a symmetrical, evenly-weighted signal comes through C105 from the discriminator filter circuit, the diode of V104B rectifies the positive pulses, and V104A rectifies negative. The charges on C106A and C106B are thus equally displaced in opposite directions. Due to the difference or unbalance between R116 and R118 there is a small shift to more-positive on V105A and B grids, which in return reduces the positive lock-up voltage delivered to the keyer.

The proper setting of R122, THRESHOLD, for a

low level symmetrical signal will produce a bias, or operating axis, at V201B grid which gives the optimum keying. It is the purpose of the axis restorer to maintain this optimum axis for non-symmetrical signals.

At the grid of V201B a positive voltage of approximately one volt or more is required to swing the flip-flop keyer to key a mark signal. It will remain on mark until a negative voltage of approximately one volt or greater is applied whereupon it flips over to key a space signal. It will, in turn, remain on space until flopped back to mark by a positive voltage. The optimum keying axis will depend upon signal strength, noise conditions, etc. On strong, noise-free signals the axis setting is not critical, but on weak signals or on the weak portion of fading signals a careful setting is important. Under noisy conditions the axis must be set enough positive that negative peaks of noise signal will not key.

The signal pulses from the discriminator pass through R115 and R120 to reach V201B. The grid of V201B is prevented from being driven excessively positive by the drop in R120 when the grid circuit conducts.

When a non-symmetrical signal, which has more and/or higher positive pulses (mark) than negative, passes through the system, the tendency would be for the bias axis to average in a positive direction away from the optimum value if it were not for the action of the axis restorer. The excess positive is rectified by V104B, charging C106A relatively more positive. This change is reflected through the resistor network to V105A and B which counteracts the change in the axis and, due to the amplification of the tube, essentially restores the bias to that occuring with a symmetrical signal.

A signal that is largely space characters would tend to move the axis negative but the axis restorer holds the axis practically at the symmetrical signal condition.

Since only the ac component of the signal reaches the axis restorer circuit from the discriminator, a prolonged mark signal, a prolonged space signal, and a no-signal condition appear the same to the axis restorer, except for the abrupt change at the beginning of the mark or space signal. A mark signal keys a mark output, and so a prolonged mark signal will leave the circuit in the mark or no-signal "lock-up" condition. A space signal keys a space output, and so a prolonged space signal will start as a space output and then shift over momentarily to the normal no-signal "lock-up" condition.

The time of the "lock-up" action varies with the setting of the THRESHOLD control, R122, and with the operating conditions. It will range from instantaneous "lock-up" to a possible condition where two or three seconds are required to "lock-up" from a strong continuous space signal. The time constant for any one condition is determined by all the components in the axis restorer circuits.

b. OSCILLATOR-KEYER SUB-UNIT. (SU201)

(1) AUDIO OSCILLATOR-AMPLIFIER.—In this circuit V201A and V203A are used in a resistance-coupled audio amplifier which is made to oscillate by the use of positive feedback in the network between the output of V203A and the input of V201A. The positive and negative feedback network is designed in the form of a Wien bridge and is a frequency-selective resistance-capacity combination which allows one frequency to be applied to the grid of V201A in the proper phase and amplitude for oscillation. This frequency of oscillation is determined by the values of the components in the Wien bridge network. The parallel combination of R204 and the condensers switched by S201B form a parallel leg of the bridge network while R201 in series with the condensers switched by S201A forms the series leg of the network.

In order to provide for good wave form the net amplification of the two oscillator tubes is kept low by introducing a fairly large degree of negative feedback together with the positive feedback used to provide oscillation. The negative feedback loop consists of R202 and the cathode resistor of V201A, R205.

V203B is connected as a diode which rectifies signals greater than the level established by the bias on the cathode of V203B, and applies this rectified voltage to the grid of V203A as bias. This stabilizes the output level of the oscillator.

This oscillator-amplifier is tuneable to the following frequencies: 595 cps, 765 cps, 935 cps, 1105 cps, 1275 cps, 1445 cps, 1615 cps and 1785 cps, by switching the condensers in the two legs of the Wien bridge network. This is accomplished by switching the FREQ-CPS switch, S201, to positions one through eight respectively. When in position nine, the FREQ-CPS switch allows an external tone to drive the grid of V201A and the oscillator-amplifier functions as a two stage resistance-coupled amplifier.

V202 is an OA2 regulator tube which regulates the voltage applied to the plate of the first oscillator tube V201A. This OA2 holds the voltage to within two volts of its working voltage (approx. 150 volts). The output of the audio oscillator-amplifier is capacitively coupled by C221, to the grid of the phase splitter stage.

(2) PHASE SPLITTER.—V204A is connected in a

conventional phase splitter circuit to supply push-pull input to the grids of the tone modulator. The output from the cathode of V204A is capacitively coupled by C223 to the grid of V206B and the output from the plate of V204A is coupled to the grid of V206A by the capacitor C222.

(3) TONE MODULATOR.—The tone modulator, V206, is a conventional push-pull audio output amplifier employing a 12AU7 twin triode. The output of the tone modulator is keyed from "tone on" to "tone off" by a high negative bias applied to the grids of the tone modulator V206A and B, from the keyer circuit. This negative keying voltage drives the grids of the modulator tube to approximately two times cut-off, which results in no tone output. The output of the tone modulator is transformer coupled by T201 through the filter Z502 to the tone output receptacle, J506.

(4) KEYER.—The keyer is a flip-flop circuit employing two triodes and a small neon tube. They are: V201B, one half of a 12AX7 twin triode; V204B, one half of a 12AU7 twin triode; and V205, a 991 voltage regulator. V205, is used in the keyer circuit for triggering the flip-flop action. The action of this circuit under the "mark" condition is as follows: A normal mark signal is a positive voltage of about one volt, or higher, from the discriminator or from the axis restorer "lock-up" circuit. When this is applied to the grid of V201B, it causes the triode to conduct heavily. This causes a large voltage drop across R226 and across R230. The triode of V204B is then biased beyond cutoff because of the negative voltage reaching the grid through R229, and the positive on the cathode from the drop across R230. V204B will not conduct and thus allows full B+ to reach V205 through R228. This ionizes the neon gas, and V205 suddenly conducts current through R228 and R231. This causes a voltage drop across R231 of approximately 37 volts which is of opposite polarity to that of the negative 38 volts applied to R231 and results in a total of approximately one volt negative at the output of the keyer circuit. Under this condition the Tone Modulator is biased as an amplifier and the Electronic Relay is conductive. This results in "tone on" or tone output from the Tone Modulator, and allows the Electronic Relay to conduct the dc loop current that energizes the teletype printer.

The action of the keyer circuit under the "space" condition is as follows: a normal space signal (about one volt or more negative) applied to the grid of V201B from the discriminator will cause V201B to draw less current. As V201B draws less current the voltage drop across R226 becomes smaller and allows the grid of V204B to become less negative. V204B now starts to conduct and due to the common cathode coupling between V201B and V204B the cathode of V201B becomes more positive which causes V201B to stop conducting. When V204B starts to conduct a greater voltage drop is developed across R228 which reduces the voltage at the trigger tube. This causes the ionization of the trigger tube V205 to be suddenly quenched and it stops conducting, which means there will be no drop across R231 to cancel out the negative bias. Thus the negative 38 volts is applied to the grids of the Tone Modulator and the Electronic Relay biasing them beyond cutoff. Under this condition both the Tone Modulator and the Electronic Relay block the passage of plate current or signal, resulting in "tone off" or no tone output from the Tone Modulator and causing the Electronic Relay to open the dc loop circuit that energizes the teletype printer.

When the input to V201B is swung from approximately one volt positive to one volt negative, or wider, the keyer produces sharply squared-off output pulses producing sharply defined characters at the output of the unit.

(5) ELECTRONIC RELAY.—The Electronic Relay, consisting of two 6AQ5 pentodes, V207 and V208, is employed for opening and closing the dc loop of the teletype printer. V207 and V208 are connected in parallel and obtain their plate supply from the dc teletype printer loop. In this circuit it is necessary to operate the cathodes of V207 and V208 at ground potential because the negative side of the dc loop is at ground potential. R236 and R237 are suppressors to prevent parasitic oscillation of the paralleled tubes. The Electronic Relay is keyed, opened or closed, by the keying voltage from the flip-flop keyer that is applied to the grids of V207 and V208. Under the "mark" condition, the keying voltage is approximately one volt negative which allows the Electronic Relay tubes to conduct, closing the dc loop of the teletype printer. Under the "space" condition, the keying voltage is approximately 38 volts negative. This completely blocks V207 and V208 producing an open circuit of the teletype dc loop.

c. MONITOR SUB-UNIT. (SU301)

The Monitor is a conventional oscilloscope circuit using one triode of a 12AX7, V301, as the vertical amplifier and employing a 60 cps sinudoidal horizontal-sweep voltage obtained from the high voltage secondary of the power transformer. This circuit includes the usual oscilloscope controls, VERTICAL POSITIONING, HORIZONTAL POSITIONING, FOCUS and INTENSITY. The primary purpose of the Monitor is for observing the tuning of the audio input to the discriminator and for determining the cycles shift that is

being received. It displays the discriminator dc output. The audio input to the discriminator from the receiver is properly set by tuning the receiver until the pattern on the screen of the cathode ray tube, V302, is centered, indicating the frequency shift is symmetrical above and below the mean frequency. (See figure 4-3.) The cycles shift is determined by adjusting the vertical amplifier gain control, CYCLES SHIFT, R301, until the pattern on V302 fills the space between the top and bottom parallel lines marked on the window in front of the tube. The CYCLES SHIFT is then read directly from the calibrated markings on the control panel.

d. POWER SUPPLY SUB-UNIT. (SU401)

The Power Supply Sub-Unit furnishes all power required to operate the three Sub-units contained in the Frequency Shift Converter CV-89/URA-8A, including filament, plate and bias voltages. (See the Power Supply description in the Parts List for voltage and current ratings.) A tapped primary is used on the power transformer for the selection of three line voltages, 105 volts, 115 volts and 125 volts.

e. CABLE FILTER ASSEMBLY. (Z505)

The Cable Filter Assembly consists of four low pass RF filters: tone input filter Z501, tone output filter Z502, teletype output filter Z503, and the ac input filter Z504. The purpose of this filter assembly is to filter out extraneous noise, or signals, that might cause the equipment to function improperly. Each filter is a low-pass type with cutoff frequency set for the frequencies in the particular circuit. The data for these is given in the parts list descriptions and in table 5-4.

3. COMPARATOR CM-22/URA-8A.—fig. 5-17.

a. SELECTOR SUB-UNIT. (SU701)

(1) MARK-SPACE SELECTOR CIRCUIT.—Two double diodes are connected together in a special circuit for automatically comparing the two diversity signals and selecting the better mark pulse and the better space pulse for each character of the code message. The filtered output of the discriminator from each Frequency Shift Converter CV-89/URA-8A is fed to the circuit for this purpose.

When the SELECTOR switch, S701, is in the DIVERSITY position the signal from one Converter is fed to the plate of V701B and the cathode of V701A. The V701B diode is connected to pass positive pulses to one diode load (R701) and the V701A diode is arranged to pass negative to the other diode load (R702). The signal from the second Converter is similarly connected to V702B and V702A to pass positive to R701 and negative to R702. To illustrate the comparing and selecting action of this circuit consider that the first Converter was delivering a three volt positive pulse at the instant the second Converter was delivering a two volt like pulse. The three volt pulse at V701B plate would pass through the diode with negligible drop and produce a three volt drop across R701 (for the moment considering R701 to be returning to ground potential). This will result in a plus three volts on the cathode of V702B while there is only a plus two volts on its plate. Thus only the diode with the higher potential in the conducting direction will pass signal. This same selection occurs for the negative pulses at V701A and V702A, having R702 as their common load. When the two signals have pulses of equal voltage there is some combining due to phase differences, but otherwise the circuits pass only the stronger positive, or mark, pulse and the stronger negative, or space, pulse. The selection is instantaneous, even to selecting parts of poorly shaped pulses.

The output of the mark-space selector circuit is from the junction of R701 and R702. The dc potential at this point is determined by the axis restorer and threshold setting, which will be considered in the following paragraphs. The mark pulses pass through R701 into the circuits that follow and the space pulses pass through R702. These do not tend to cancel at the junction of R701 and R702 because they do not occur at the same time.

Thus it can be seen that one of the principal functions of the Comparator unit is performed by the comparing and selecting action of these diode circuits.

(2) AXIS RESTORER.—The axis restorer in the Comparator is identical in circuitry and function to the axis restorer in the Converter unit (par. 2.a(5) of this section), except for the circuit into the axis restorer diode, V703A and B. V703B is connected to pass positive signals into the axis restorer circuit from the positive side of the mark-space selector circuit, and V703A works from the negative side of the selector circuit. The resulting action in biasing the axis restorer circuit from signal pulses is, however, the same as that in the Converter axis restorer circuit.

The dc components in the output of the mark-space selector circuit are not isolated from the following signal circuits by a capacitor, as is done from the discriminator in the Converter, but the axis restorer is definite enough in its control not to be appreciably affected by this voltage; but rather, it establishes the bias at the junction of R701 and R702 into which the mark-space selector diodes operate.

(3) IDENTICAL CIRCUITS.—The following circuits of the Comparator are identical in circuitry and

component parts to the corresponding circuits in the Frequency Shift Converter: 1) flip-flop keyer circuit, V705B, V706A and V707; 2) electronic relay or teletype output, V708 and V709; 3) audio oscillator and amplifier, 705A, 711B and V706B; 4) voltage regulator V710; 5) phase splitter, V711A; 6) tone modulator, V712A and B.

b. POWER SUPPLY SUB-UNIT. (SU801)

The Comparator power supply is a conventional full-wave type supply which furnishes the power required by the various Comparator circuits. It supplies B power of 35 milliamperes at 250 volts dc and has a separate negative circuit which supplies the required 32 volts of negative bias. A separate bias supply and two separate B+ outputs are used to obtain voltage stability equivalent to that in the Converter power supply because this supply has much less steady current drain. The other ratings for this sub-unit are on the schematic diagram and in the Comparator Power Supply Sub-unit description in the parts list.

c. CABLE FILTER ASSEMBLY. (Z905)

The cable filter assembly in the comparator has individual filters that are identical to those in the Frequency Shift Converter and serve the same purpose. The wiring detail is slightly different between the two assemblies because of having some different input and output circuits.

SECTION 3
INSTALLATION

1. UNPACKING.

The Frequency Shift Converter-Comparator Group AN/URA-8A and its Maintenance Parts Kit are overseas packed in two wooden shipping boxes. Each shipping box has a water-proof liner. The equipment is packaged with a moisture-vaporproof barrier and a desiccant and should not be unpacked until ready for use. The items of the Maintenance Parts Kit are each packaged with a moisture-vaporproof barrier and a desiccant and the individual packages should not be opened until ready for use.

Box number one contains the equipment, the accessories, two instruction books and a packing list. Open it by breaking the steel straps and removing the top cover. Tear open the box liner, remove the upper and side packing materials, and lift out the contents. Open the equipment and accessory packages by tearing open the top flaps of the corrugated cartons. Do not cut open the cartons unless the cutting blade has a guard which will prevent cutting deeper than the thickness of the fiberboard. The equipment package is a double carton with a vapor-proof bag between the outer and inner sections. After opening the outer carton tear open the bag, open the inner carton, and remove the upper and side packing material from around the equipment. Lay the carton over on its side so the equipment rests on its back, and carefully slide out the whole assembly by pulling on the handles.

CAUTION

Do not lift the whole equipment by the handles of the units. Excess strain may damage the drawer-latch mechanism.

Tip the equipment upright and remove any remaining packing materials from it. The Frequency Shift Converter-Comparator Group AN/URA-8A is shipped ready for use and no preinstallation servicing is required. However, the complete equipment should be carefully inspected for any damage that may have occurred during shipment. Press the upper pushbutton in the handles and pull out each drawer assembly, in turn, for this inspection. Press down on each tube to make certain it is well seated in its socket.

Box number two contains the Maintenance Parts Kit and a packing list. Open it in the same manner as box one and remove the metal spare parts box. This may be opened for removal of the individual packages, as required.

2. GENERAL.

Determine what receivers are to be used with the AN/URA-8A and locate the equipment so that the tuning monitor can be conveniently observed while tuning each receiver.

Two receivers are required for diversity reception, each one selected to receive the desired radio frequency

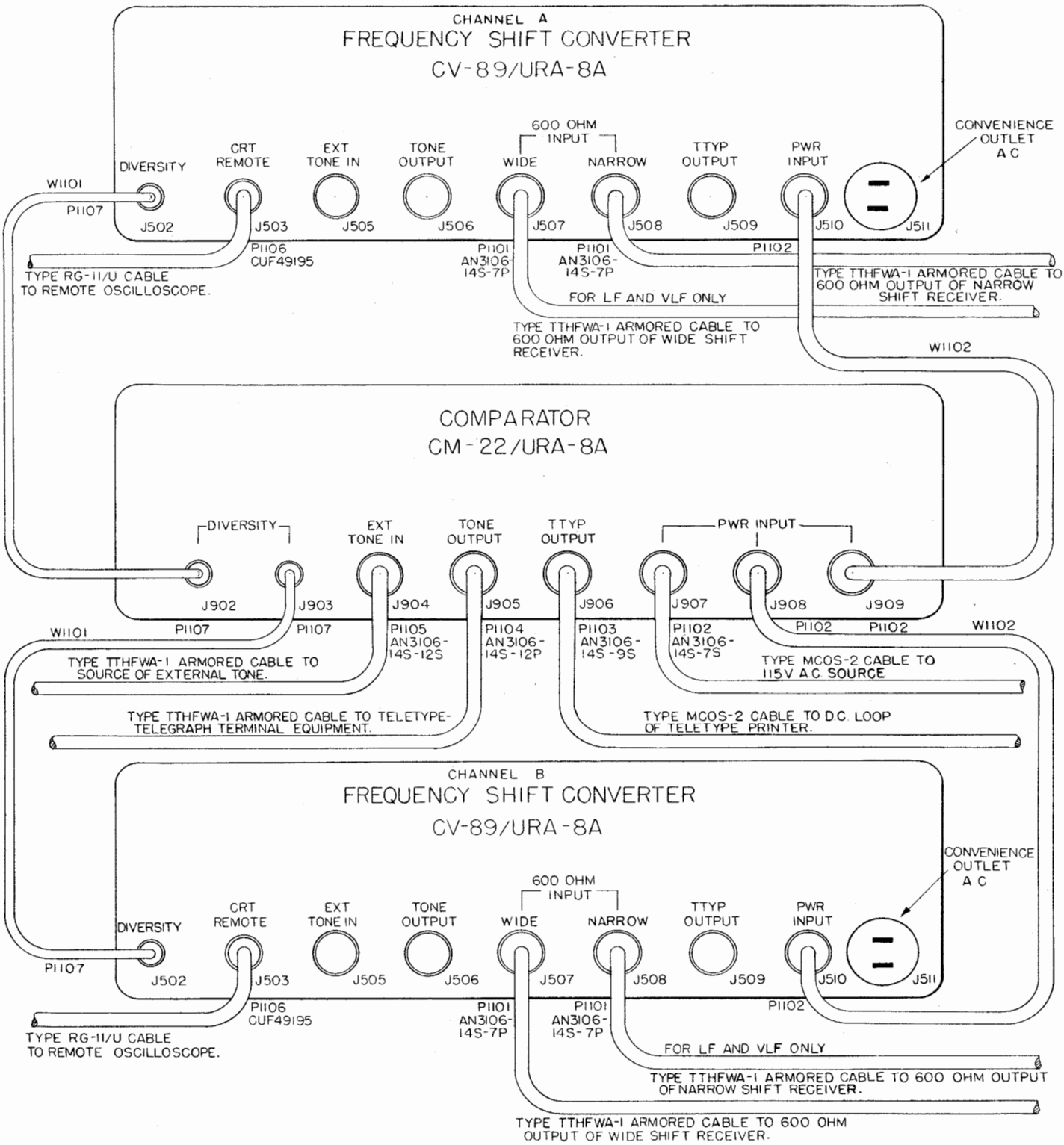


Figure 3-1. Interconnecting Cable Diagram, Diversity

or frequencies. Provision is also made for the connection of four receivers to the equipment, two to each Converter. When the link connections on terminal board E102 are set at OPEN (see figure 5-6), the WIDE 600 ohm INPUT (J507) and NARROW 600 ohm INPUT (J508) are separated, being selected by the NARROW-WIDE SHIFT switch (S101). In this way a narrow-shift receiver and a wide-shift receiver may be connected to each Converter, to be selected as desired. It is common practice to use narrow frequency shift on carriers below 500 kc and wide-shift on carriers above 500 kc.

When one receiver is used with each Converter the links on E102 are to be set at PARALLEL; this puts both inputs in parallel and the NARROW-WIDE SHIFT switch conditions the input circuit and other circuits for the shift to be used.

Where reception conditions permit, single receiver reception may be used, with one Frequency Shift Converter unit alone. The teletype and/or keyed-tone outputs of the Converter itself are then connected. One receiver or a narrow-shift and a wide-shift receiver may be connected to the input circuits, as desired.

When single receiver reception is used, a second set of output circuits is available from the Comparator CM-22/URA-8A by making the regular DIVERSITY connection between the Converter and Comparator.

Provision is made for the TONE OUTPUT to feed a balanced line, when desired, by grounding terminal 4 of the tone-output filter, Z902 or Z502. This is the center-tap of the secondary of the output transformer in the tone-output filter of each unit. See figures 5-11, 5-15 and 5-16 for the location of the filters and of terminal 4.

After it has been determined what equipments are to be associated with the AN/URA-8A equipment, or its units, proceed with the installation as instructed in the applicable paragraphs that follow.

3. INSTALLATION.

a. MOUNTING THE COMPLETE EQUIPMENT. The equipment required for the installation of Frequency Shift Converter-Comparator Group AN/URA-8A is given in tables 1-1 and 1-2.

In mounting the table type Rack MT-719/URA-8A containing complete equipment, select a location that will allow space at the rear for attaching the cables and clearance at the front for withdrawing and tilting each of the drawer assemblies, as illustrated in the installation drawing figure 3-6.

The following is a step-by-step installation procedure:

(1) Drill four one-half inch mounting holes in the mounting surface according to the dimensions given in figure 3-6.

(2) Place the Rack directly over the four mounting holes.

(3) Obtain four $\frac{3}{8}$"-24 mounting bolts which are long enough to expose three-fourths inch to one and one-half inches of thread above the mounting surface when pushed up through the drilled holes. Place a lock washer on each bolt. See figure 3-6 for the bolt clearance dimensions.

(4) Align the Rack mounting holes with the holes in the mounting surface and screw the four mounting bolts into the anchor nuts. Make certain each bolt is tightened securely.

b. INTERCONNECTIONS FOR DIVERSITY OPERATION.

Interconnect the units of Frequency Shift Converter-Comparator Group AN/URA-8A according to the Interconnecting Cable Diagram, figure 3-1, using the cables and plugs listed in tables 1-1 and 1-2.

Attach the plugs to the cables for the external circuits according to the instructions of paragraphs 3.c., 3.d. and 3.e. as illustrated in figures 3-2, 3-3 and 3-4.

Adjust the power supply of each unit for the voltage of the power line to be used and set the links on terminal board E102 in each converter as follows:

(1) ADJUSTMENT FOR LINE VOLTAGE.—Before power is applied to the equipment, the line-voltage link adjustment on terminal board E401 in the Converters and E801 in the Comparator must be properly set. See figures 5-7, 5-9, 5-13 and 5-14. Measure the ac power line voltage with an ac voltmeter. Press the pushbuttons in the tops of the handles on one unit and withdraw the drawer assembly its full travel out of the case. Press the lower pushbuttons in the handles and tilt the assembly up to 90° where the bottom is accessible (position A of figure 5-2). Adjust the link to the voltage setting most nearly corresponding to the line voltage. Tighten the link screws firmly. Tilt the drawer to horizontal, slide it back in the case and push in tight to latch it in position. Repeat the adjustment on the other two units.

(2) ADJUSTMENT OF CONVERTER INPUT FOR ONE OR TWO RECEIVERS.—When only one receiver is to be connected to the input of a Converter, connect it to either the WIDE or NARROW 600 OHM INPUT and set the PARALLEL-OPEN links on termi-

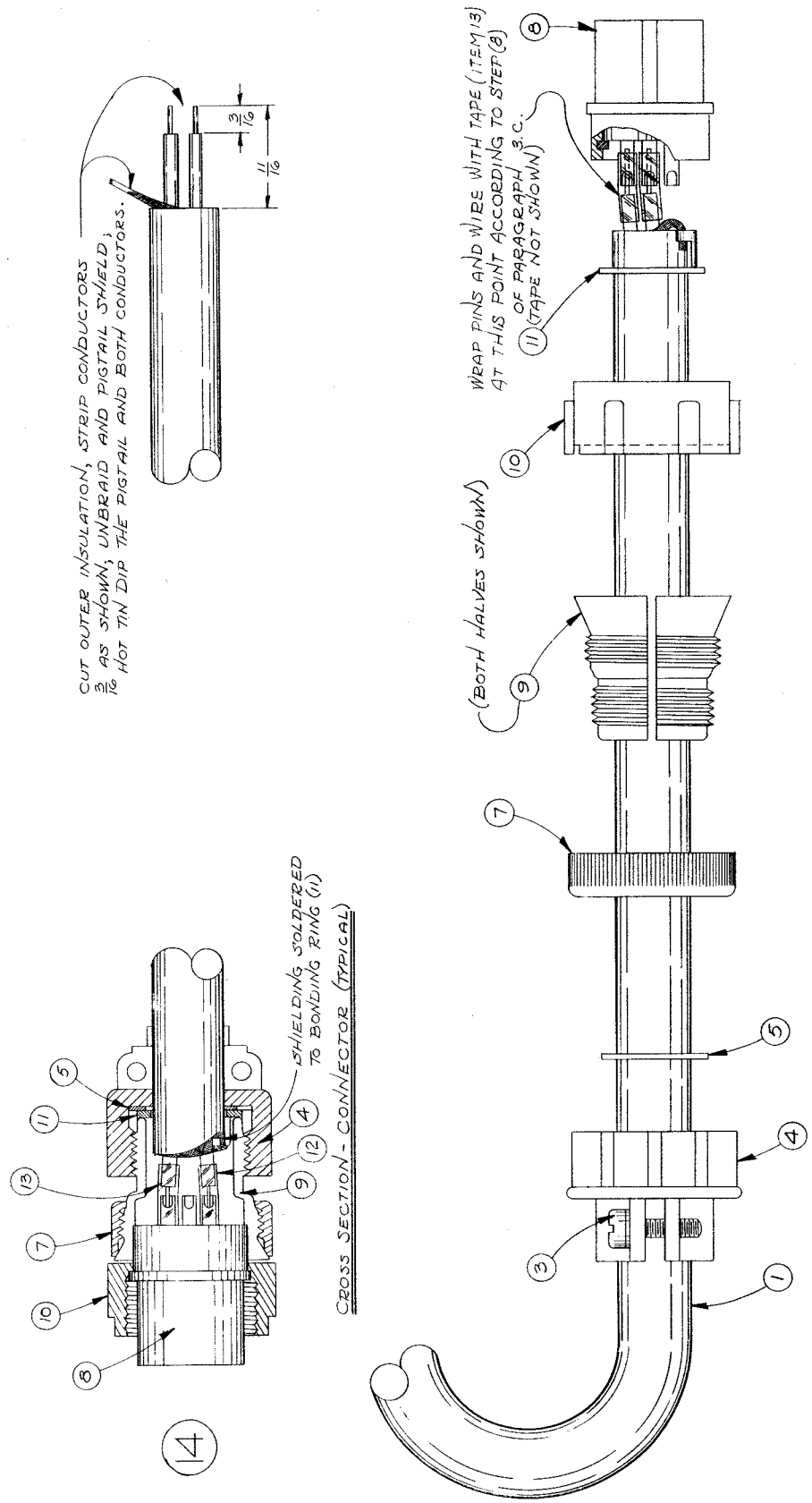


Figure 3-2. Installation of Connectors on MCOS-2 Cable

TABLE 3-1. TERMINATIONS FOR MCOS-2 CABLE USED FOR EXTERNAL CONNECTIONS

PLUG		CONNECTIONS		EXT. CIRCUIT
Symbol	Designation	Lead Color	Pin Number	
P1102	AN3106-14S-7S	White No Connection Black	A B C	PWR INPUT
P1103	AN3106-14S-9S	White Black	A B	TTYP OUTPUT

nal board E102 to PARALLEL. To set the links, loosen the screws, move the link to the desired position and retighten the screws securely. E102 is illustrated in figures 5-6 and 5-9. When two receivers are to be connected to the Converter, connect the wide-shift receiver to 600 OHM INPUT—WIDE, connect the narrow-shift receiver to 600 OHM INPUT—NARROW and set the links on E102 to OPEN.

c. ATTACHING PLUGS TO TYPE MCOS-2 CABLES.

The external MCOS-2 cables are to be prepared and terminated with their plugs as follows and as illustrated in figure 3-2:

(1) Square off the end of the MCOS-2 cable.

(2) Cut off the outer jacket of the cable for one inch from the end. Be careful not to nick the braid underneath.

(3) Fan out the exposed braid, form it into a pigtail and tin the pigtail. Remove the cloth filler from around the two insulated conductors.

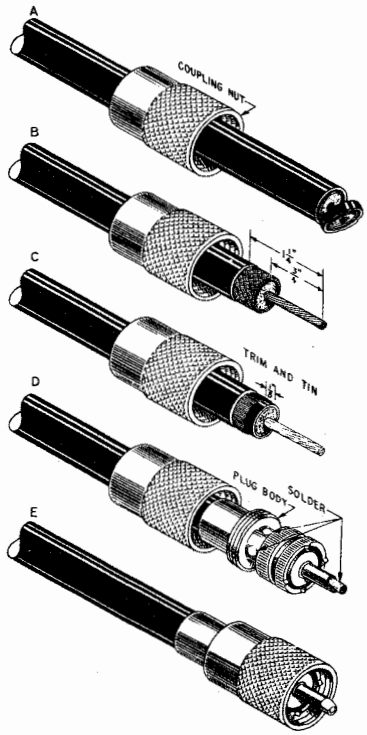
(4) Remove the insulation from the two conductors one-quarter of an inch from the end and tin. Place a five-eighths inch piece of #10 clear vinylite tubing (item 12) over each conductor.

(5) See table 3-1 and select the correct plug for the circuit to be connected, and select an AN3057-6 cable clamp (H1101).

(6) Disassemble the plug, pull the washer out of the cable clamp, and loosen the cable clamp screws. Slip the following items over the cable in the order shown in figure 3-2: item 4—cable clamp, 5—fiber washer, 7—shell assembly nut, 10—coupling nut, and 11—soldering ring.

(7) Solder the cable leads (black and white) to the corresponding pin numbers as given in table 3-1, and solder the pigtailed braid to the lug on the soldering ring, item 11 (O1101).

(8) Slip the vinylite tubing over the soldered connections and wrap the connections with adhesive plastic



(A) Square off the end of the RG-11/U cable. Slide the coupling nut over the cable.

(B) Cut the outer jacket of the cable 1¼" from the end. Be careful not to nick the copper braid underneath. Cut the copper braid and inner insulation ¾" from the end.

(C) Fan out, trim, and tin the copper braid.

(D) Screw the plug body over the outer jacket until 1/16" of the inner conductor is exposed. Be careful not to push back the copper braid. Solder the plug body to the copper braid through the 4 holes provided. Solder the inner conductor to the contact sleeve. Remove any excess solder and cut off the inner conductor where it projects past the contact sleeve.

(E) Slide the coupling nut forward until it is free from the internal thread.

Figure 3-3. Installation of Connectors on RG-11/U Cable

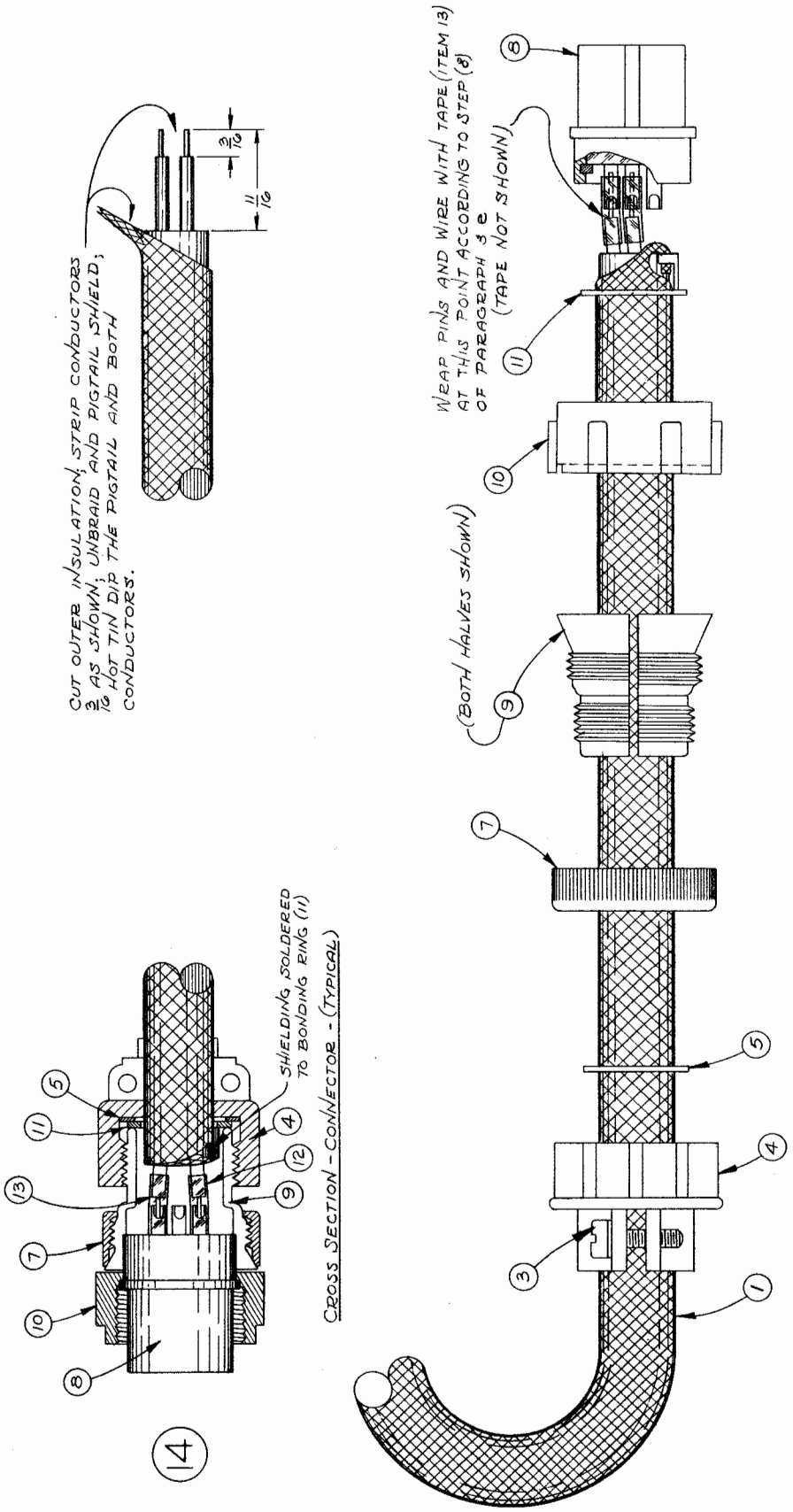


Figure 3-4. Installation of Connectors on TTHFWA-1 Cable

TABLE 3-2. TERMINATIONS FOR TTHFWA-1 ARMORED CABLE USED FOR EXTERNAL CONNECTIONS

PLUG		CONNECTIONS		EXT. CIRCUIT
Symbol	Designation	Lead Color	Pin Number	
P1101	AN3106-14S-7P	White Black No Connection	A B C	NARROW INPUT
P1101	AN3106-14S-7P	White Black No Connection	A B C	WIDE INPUT
P1104	AN3106-14S-12P	White No Connection Black	A B C	TONE OUTPUT
P1105	AN3106-14S-12S	White Black No Connection	A B C	EX TONE IN

tape, indicated as item 13, but not shown, in figure 3-2.

(9) Assemble the plug as shown in figure 3-2, item 14.

(10) Tighten the shell assembly nut securely and screw the cable clamp tightly onto the shell.

(11) Tighten the clamping screws, item 3, so that the cable clamp has a firm grip on the cable.

d. ATTACHING PLUGS TO TYPE RG-11/U CABLES.

The external RG-11/U cables are prepared and terminated with their plugs in accordance with the detailed procedure outlined in figure 3-3.

e. ATTACHING PLUGS TO TYPE TTHFWA-1 CABLES.

The external TTHFWA-1 cables are to be prepared and terminated with their plugs as follows and as illustrated in figure 3-4:

(1) Square off the end of the TTHFWA-1 armored cable.

(2) Fan out one and one-eighth inches of the armor braid and form it into a pigtail; tin the pigtail.

(3) Cut away the outer jacket, inner jacket and transparent wrapping from around the two insulated wires for one inch from the end. Be very careful not to nick the insulation on the two conductors.

(4) Remove the insulation from the two conductors one-quarter of an inch from the end and tin. Place a five-eighths inch piece of #10 clear vinylite tubing (item 12) over each conductor.

(5) See table 3-2 and select the correct plug for the circuit to be connected, and select an AN3057-6 cable clamp, (H1101).

(6) Disassemble the plug, pull the washer out of the cable clamp, and loosen the clamping screws. Slip the following items over the cable in the order shown in figure 3-4: item 4—cable clamp, 5—fiber washer, 7—shell assembly nut, 10—coupling nut, and 11—soldering ring.

(7) Solder the cable leads (black and white) to the corresponding pin numbers as given in table 3-2, and solder the pigtailed braid to the lug on the soldering ring, item 11 (O1101).

(8) Slip the vinylite tubing over the soldered connections and wrap the connections with adhesive plastic tape, indicated as item 13, but not shown, in figure 3-4.

(9) Assemble the plug as shown in figure 3-4, item 14.

(10) Tighten the shell assembly nut securely and screw the cable clamp tightly onto the shell.

(11) Tighten the clamping screws, item 3, so that the clamp has a firm grip on the cable.

f. TABLE MOUNTING SINGLE UNIT.

Provision is made for table mounting the individual units of Frequency Shift Converter-Comparator Group AN/URA-8A on shockmounts. Twelve shockmounts are supplied as accessory parts for this purpose. Details for shockmounting the individual units are shown in figure 3-7, Shockmounted Single Unit, Installation Drawing.

Remove the unit that is to be shockmounted from the Rack MT-719/URA-8A (see steps 1 and 2 of par. 3.h. of this Section). Then take the drawer assembly out of its case. This is done by depressing the two pushbuttons at the top of the handles and pulling the drawer assembly its full travel out of the case. With the drawer assembly withdrawn, depress the two pushbuttons at the bottom of the handles and tilt down 22.5

degrees. See D of figure 5-2. In this position the complete drawer assembly can be lifted out. Remove the four cover plates located inside of the case on the bottom by taking out the four screws that hold each of them in place. With the same screws, lockwashers and nuts, secure the shockmounts to the unit according to figure 3-7. Then select a location that will allow space at the rear for attaching the cables and clearance at the front for withdrawing and tilting the drawer assembly, as illustrated in the installation drawing figure 3-7.

The following is a step-by-step installation procedure:

(1) Drill four one-half inch mounting holes in the mounting surface according to the dimensions given in figure 3-7.

(2) Place the case of the unit on the mounting surface and properly align all the mounting holes.

(3) Guide four 3/8" diameter mounting bolts (not supplied) through the access holes down through the shockmounts and through the drilled mounting holes.

(4) Place a lockwasher and nut on each bolt and tighten securely, holding the head of the bolt with a socket wrench.

(5) Replace the drawer assembly in its case by reversing the procedure for removing it, as given above.

CAUTION

When replacing the drawer asesmbly in the drawer-slide support, be very careful not to damage component parts by striking or resting them on the drawer slide mechanism.

g. INTERCONNECTIONS FOR SINGLE RECEIVER OPERATION.

For single receiver operation, interconnect the Frequency Shift Converter CV-89/URA-8A according to figure 3-5. To complete the connections it is necessary to attach plugs to the external cables. The procedures for attaching these plugs are given in paragraphs 3.c., 3.d. and 3.e. and are illustrated in figures 3-2, 3-3 and 3-4. See paragraph 3.b.(1) of this section for the line voltage setting to be made in the Converter unit, and set the PARALLEL-OPEN links on terminal board E102 according to the instructions in paragraph 3.b.(2).

h. STANDARD RELAY RACK MOUNTING.

Provision is also made for mounting the units of Frequency Shift Converter-Comparator Group AN/URA-8A in a standard 19 inch relay rack. This is accomplished by attaching a pair of mounting brackets to each unit. The brackets are supplied as accessory parts and listed in table 1-1. The detailed procedure is as follows:

(1) Remove the twelve screws at each side of Rack MT-719/URA-8A that secure the three units of Frequency Shift Converter-Comparator Group in the Rack.

(2) Remove each unit from the Rack by pulling it straight out, the top Frequency Shift Converter CV-89/URA-8A first, the Comparator CM-22/URA-8A second, and the bottom Frequency Shift Converter last. After the units have been removed, stow Rack MT-719/URA-8A for possible use at a later time; it is not used when the units are mounted in a standard 19 inch relay rack (or when individually mounted).

(3) Attach the brackets, A1101 and A1102, to each unit according to figure 3-8, Rackmounted Unit, Installation Drawing. When attached, the brackets and unit simulate a standard 19 inch relay panel $5\frac{7}{32}$ inches high (equivalent to panel C of BuShips drawing RE 23F 225D).

(4) Mount the units in the standard 19 inch rack in the conventional manner.

4. PRELIMINARY CHECK

After the complete equipment has been installed, there are no preliminary adjustments other than the steps of regular operation of the equipment.

Before turning the equipment over to operation personnel for regular operation, a preliminary check of the correctness of the installation and condition of the equipment should be made by operating it for a short period of time according to the steps of subsection 3 of Section 4, Operation. Also, consult the paragraphs of subsection 1 of Section 4. The operating results should be carefully observed. Try each operating control to see that it works normally. Check the tone output at each frequency by plugging a set of headphones into the PHONES jack and listening to the tone output. Plug in a 100 milliampere meter at the TTY jack and note whether the teletype dc loop current is normal for the teletype equipment used. Connect the meter positive to the plug sleeve and the negative to the plug tip.

CAUTION

Both sides of the TTY jack are 70 volts above ground when a teletype loop is connected and energized. Do not contact these circuits.

If the installation is for single receiver operation, check the operation according to subsection 5 of Section 4, Operation. Also consult the paragraphs of subsection 1 of Section 4.

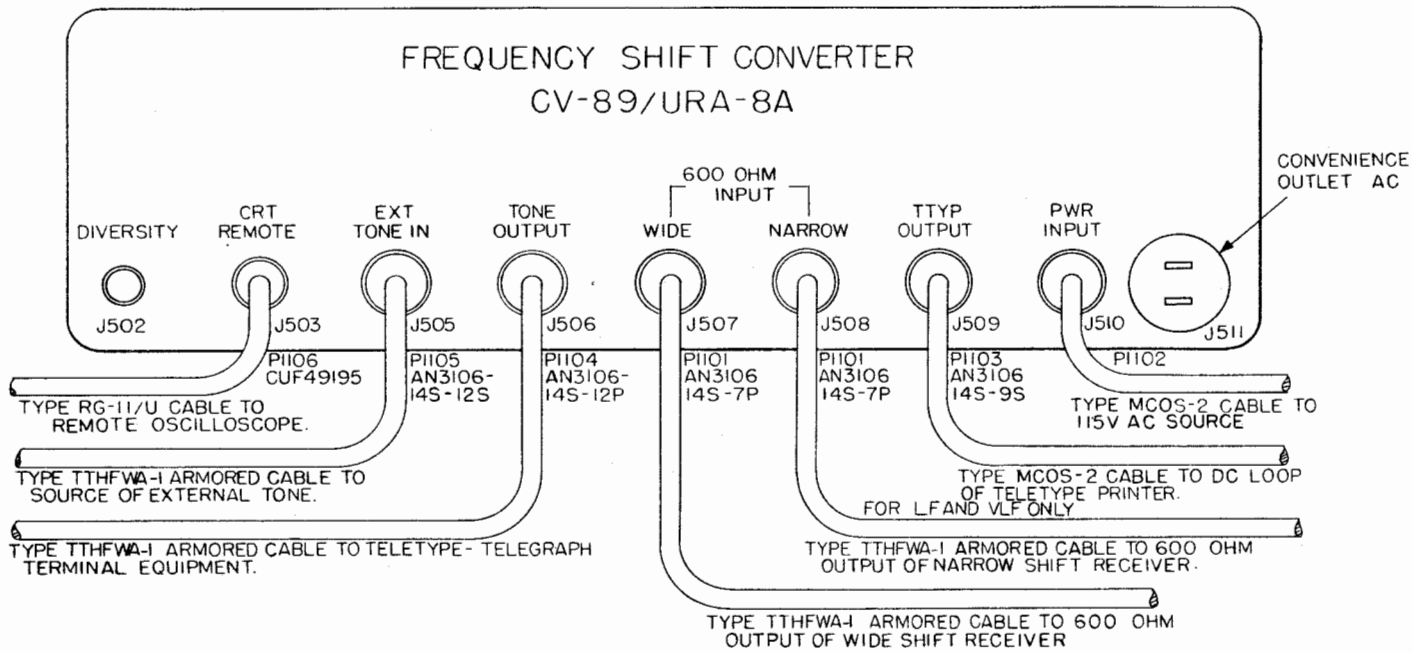
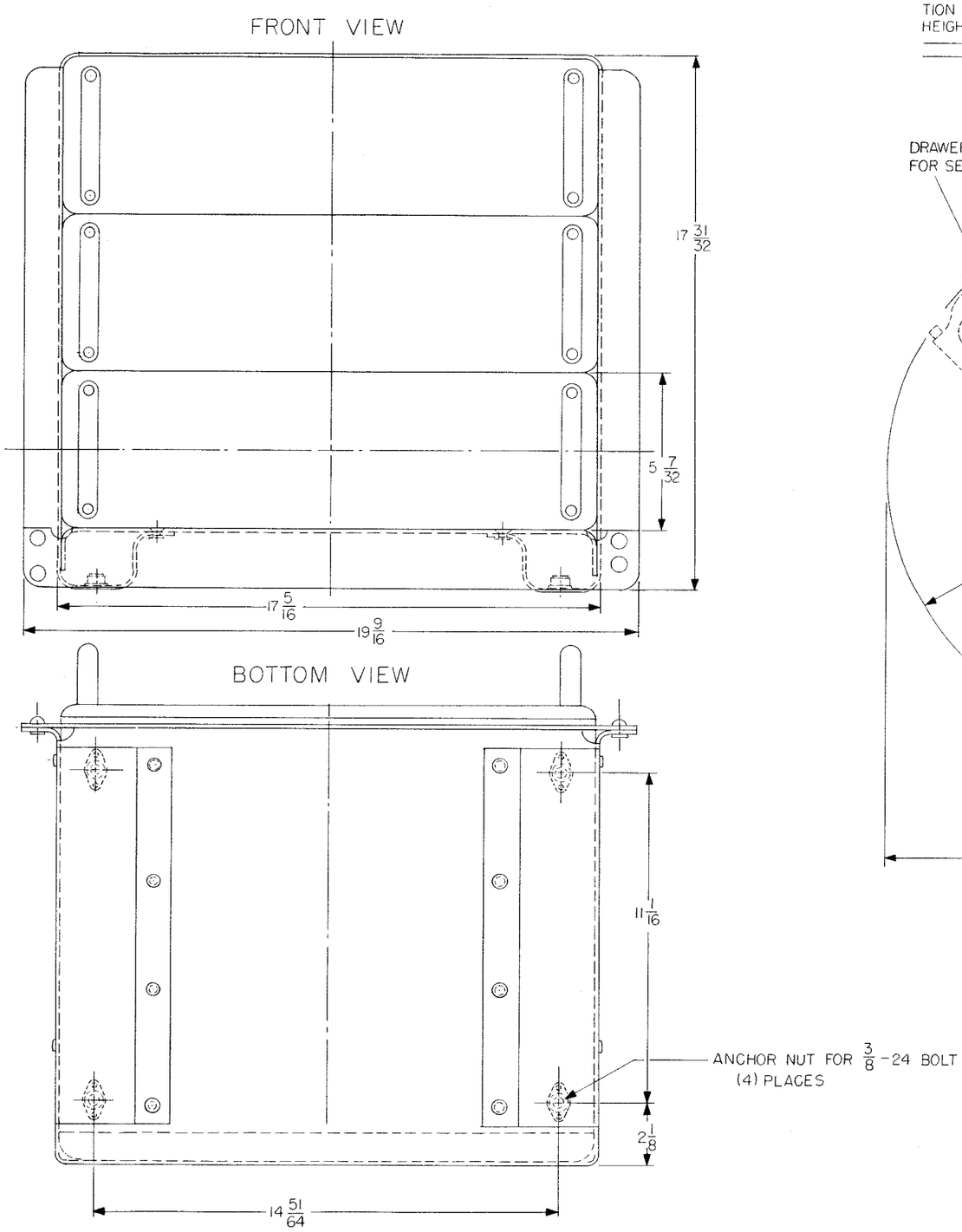


Figure 3-5. Interconnecting Cable Diagram, Single Receiver Operation



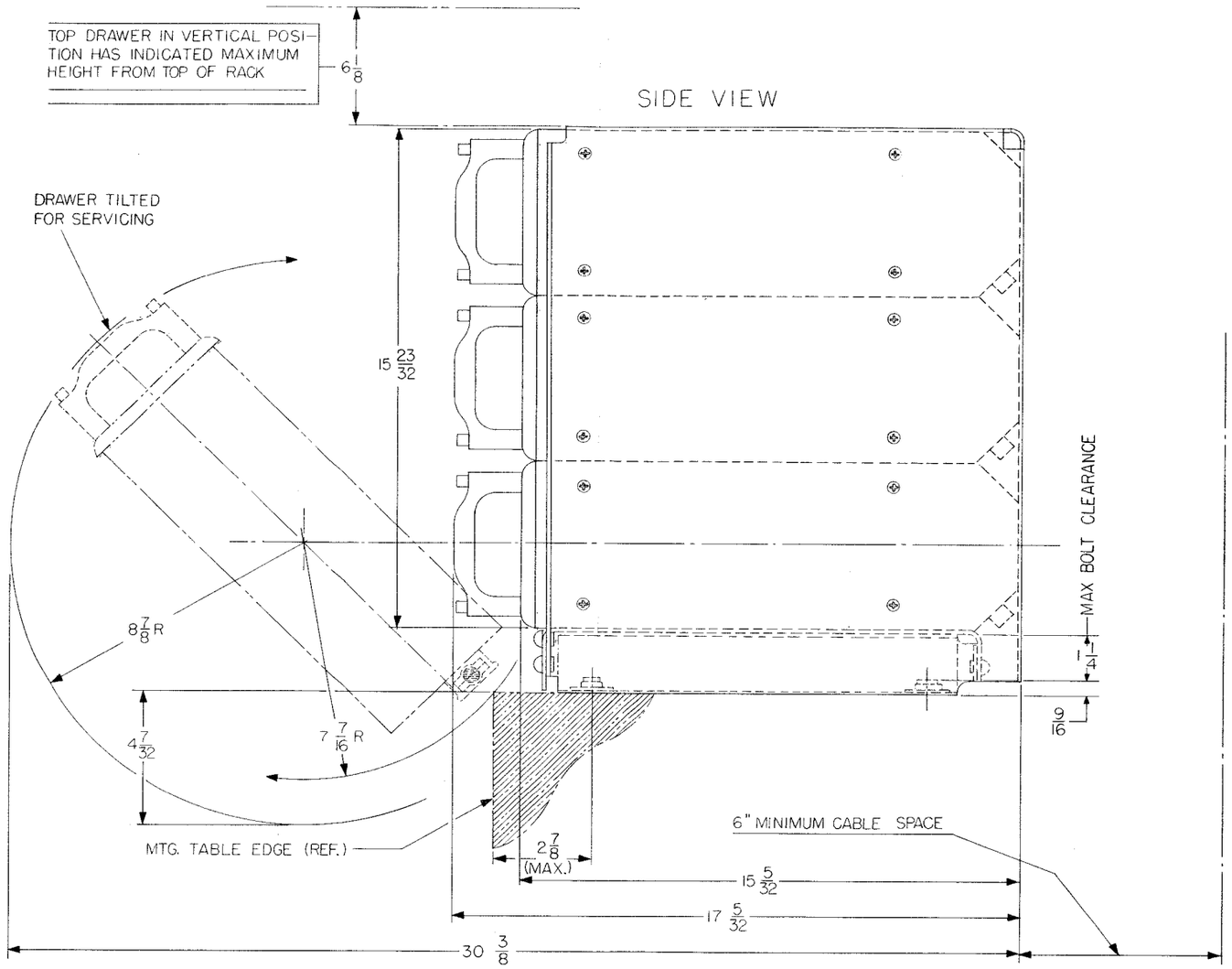
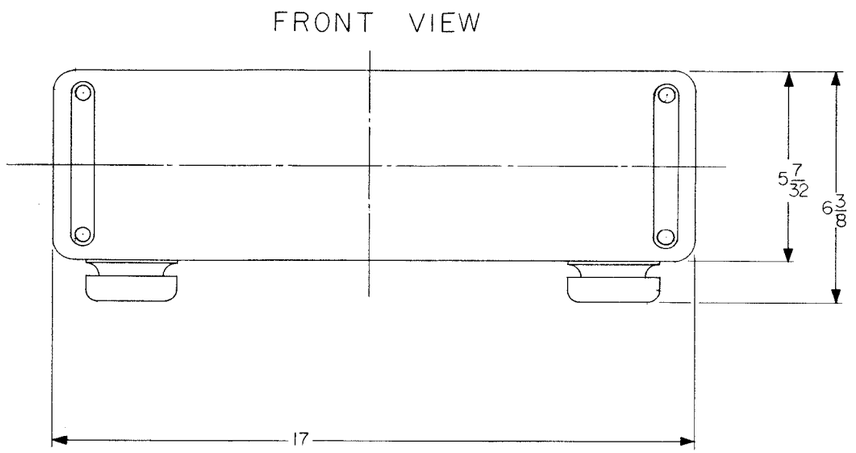
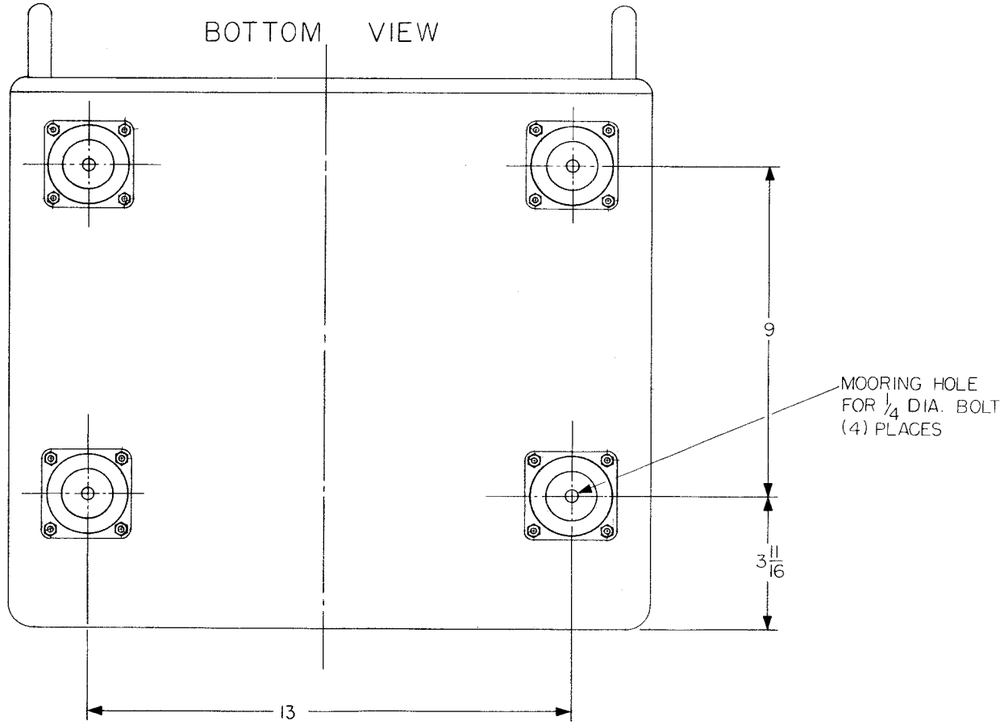
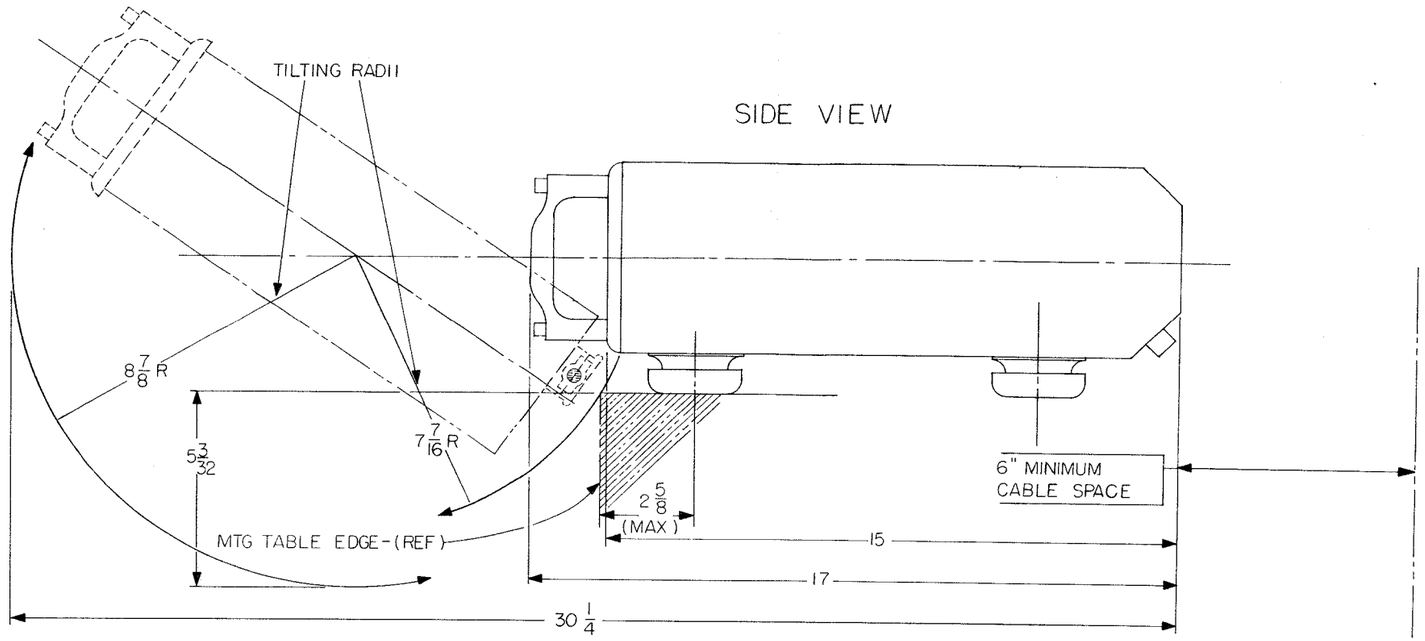
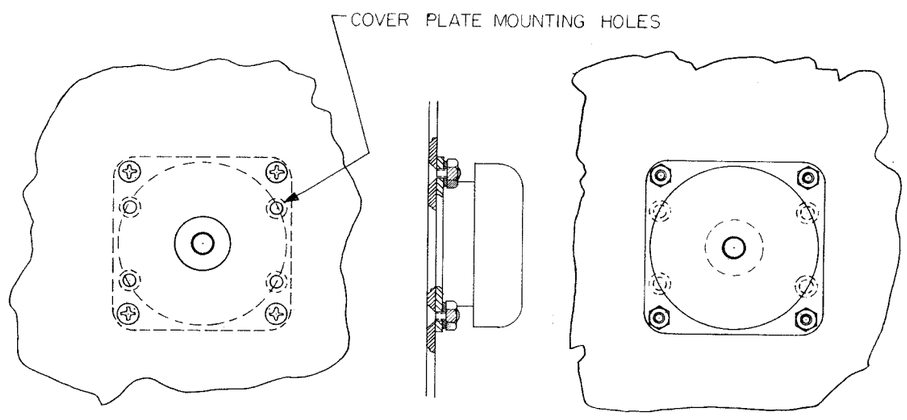


Figure 3-6. Frequency Shift Converter-Comparator Group AN/URA-8A, Installation Drawing









DETAIL OF SHOCKMOUNTS HG-20 (SYMBOL A603) FASTENING

USE SCREWS, WASHERS & NUTS THAT HOLD HOLE COVER PLATE (AS-443 IN POSITION.

Figure 3-7. Shockmounted Single Unit, Installation Drawing

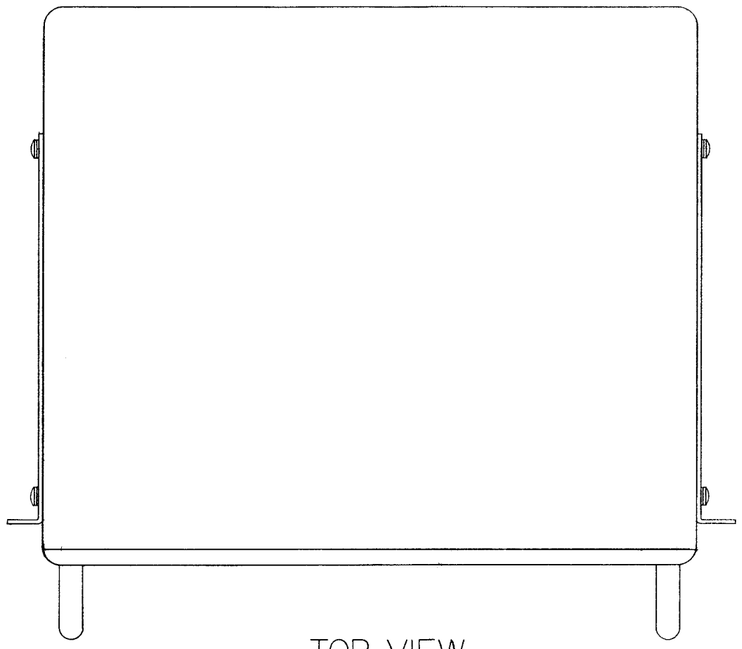


Figure 3-8. Rackmounted Unit, Installation Drawing

SECTION 4
OPERATION

1. GENERAL.

The Frequency Shift Converter-Comparator Group AN/URA-8A is intended for use with Standard Navy radio receivers, such as the Model RBA/RBB/RBC Series, to form a communication link for receiving frequency-shift keyed telegraph signals, and to provide the necessary keying facilities for the operation of automatic recording devices (teletype printers).

In order to obtain the optimum in operation of the Frequency Shift Converter-Comparator Group AN/URA-8A, it is necessary for the operator to have a basic understanding of the receivers that will be used in conjunction with this equipment. For this purpose, the operator's handbook for each receiver used with this equipment must be available to the operator.

When frequency-shift keyed signals using narrow-shift (10 to 200 cps) are to be received, the receiver beat frequency oscillator should be adjusted to produce a beat note having a mean frequency of 1000 cps. When signals using wide-shift (200 to 1000 cps) are to be received, the receiver beat frequency oscillator should be adjusted to produce a beat note having a mean frequency of 2550 cps. Where the BFO is not set to produce this frequency, it can usually be obtained by slight detuning, provided the selectivity is not too sharp.

When employing the higher frequency receivers (RBB or RBC) on wide-shift signals, optimum operation is usually obtained with medium selectivity. However, under adverse noise and very weak signal conditions, improved operation can be obtained by using sharp selectivity, provided that the beat frequency oscillator in the receiver can be adjusted to be approximately 2550 cps either higher or lower than the IF frequency of the receiver, so as to produce a 2550 cps beat note when the receiver is tuned exactly on the frequency-shift carriers. (The Navy model RBA series receivers have the beat frequency oscillator tracked to produce a 1000 cycles per second beat so no beat frequency oscillator adjustment is required for narrow-shift reception. On the Navy model RBB and RBC series receivers, 1000 cycles per second beat notes for narrow-shift reception should be obtained by adjusting the "FREQUENCY VERNIER" to zero, and 2550 cycles per second beat notes for wide-shift reception should be obtained by adjusting the "FREQUENCY VERNIER" to its extreme clockwise position and slightly detuning the receiver.)

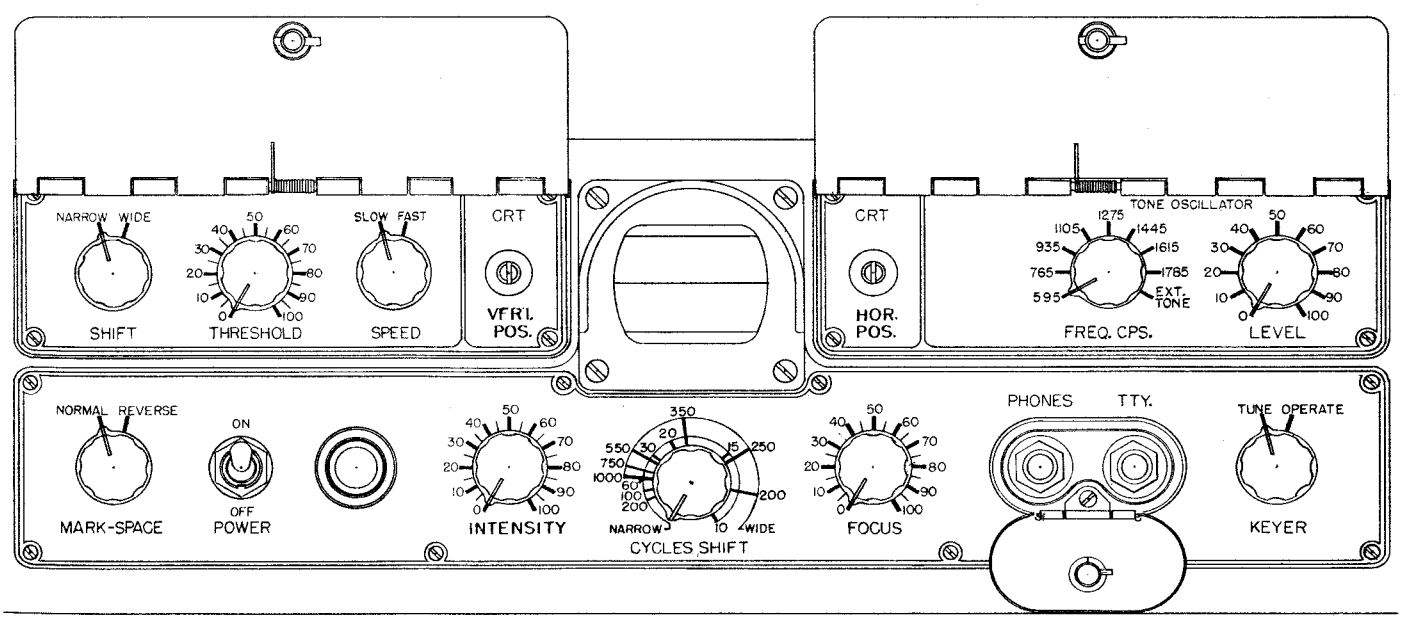


Figure 4-1. Frequency Shift Converter CV-89/URA-8A, Operating Controls

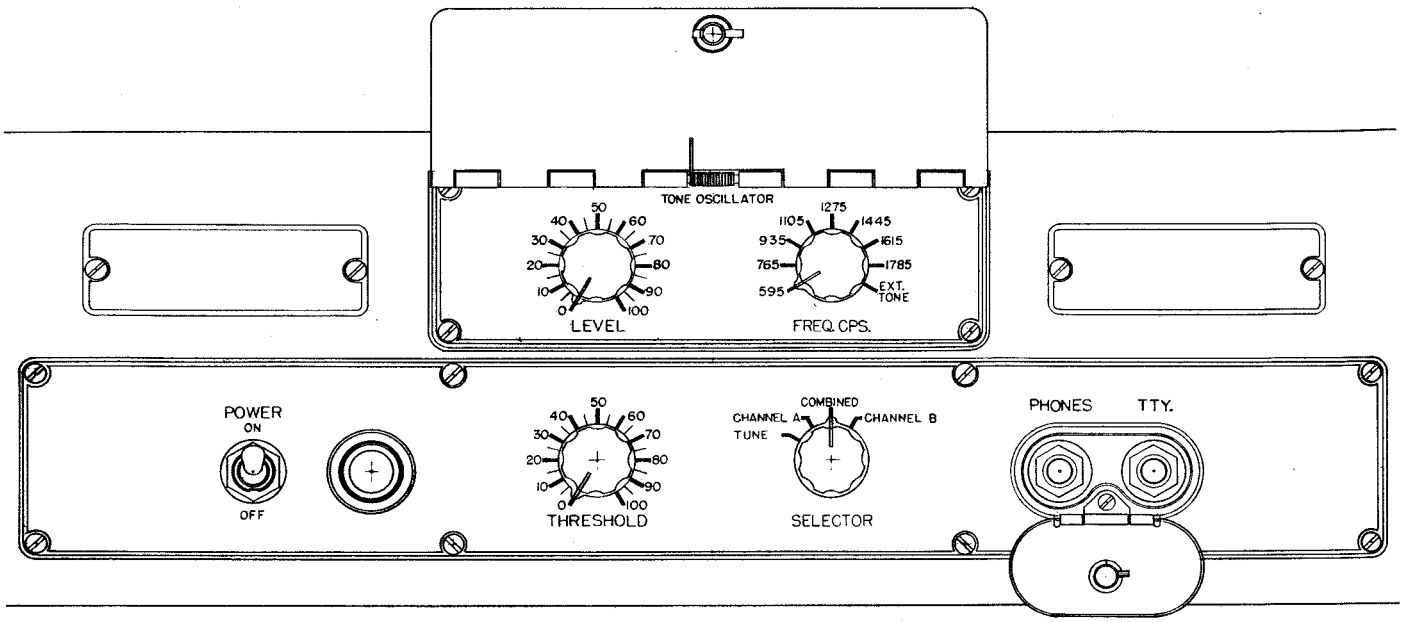


Figure 4-2. Comparator CM-22/URA-8A, Operating Controls

TABLE 4-1. OPERATING CONTROLS

Frequency Shift Converter CV-89/URA-8A

SYMBOL	CONTROL	FUNCTION
R122	THRESHOLD	Adjusts Bias (Axis) to Keyer Grid (V201B)
R220	LEVEL	Adjusts LEVEL of Tone Output
R301	CYCLES SHIFT	Adjusts Height of Oscilloscope Pattern and Indicates Cycles Shift
R307	VERT. POS.	Adjusts Vertical Position of Oscilloscope Pattern
R310	HOR. POS.	Adjusts Horizontal Position of Oscilloscope Pattern.
R319	INTENSITY	Adjusts Brightness of Oscilloscope Pattern
R320	FOCUS	Adjusts Sharpness of Oscilloscope Trace-lines
S101	SHIFT	Conditions Discriminator Circuits for NARROW or WIDE Shift Input
S102	MARK-SPACE	Reverses Polarity of Discriminator Output
S103	SPEED	Selects FAST or SLOW Keying Speed Filters
S201	FREQ. CPS.	Selects Frequency Determining Elements for Tone Oscillator
S202	KEYER	For Locking-up Teletype During Tuning of the Receiver
S601	POWER	Switches AC Power Input ON and OFF

Comparator CM-22/URA-8A

SYMBOL	CONTROL	FUNCTION
R709	THRESHOLD	Adjusts Bias (Axis) to Keyer Grid (V705B)
R743	LEVEL	Adjusts Level of Tone Output
S701	SELECTOR	Selects Input to Comparator
S702	FREQ. CPS.	Selects Frequency Determining Elements for Tone Oscillator
S1001	POWER	Switches AC Power Input ON and OFF

2. OPERATING CONTROLS.

Table 4-1 is a list of the operating controls for the units of the equipment. These are shown in figures 4-1 and 4-2.

3. DIVERSITY OPERATION.

With the Frequency Shift Converters CV-89/URA-8A and the Comparator CM-22/URA-8A of the Frequency Shift Converter-Comparator Group AN/URA-8A installed and connected for diversity operation as shown in figure 3-1, proceed with the operation of the equipment following the detailed procedure outlined below.

a. Set the Comparator SELECTOR to TUNE.

b. Turn the Comparator THRESHOLD to zero.

c. Throw all POWER switches to the ON position and allow sufficient time for the receivers to stabilize.

d. Set the SHIFT on each Converter to the WIDE position; or, if the shift width of the signal to be received is known, set the SHIFT to the corresponding position.

e. Turn the CYCLES SHIFT on each Converter to approximately 800 on the WIDE range. If the cycles shift of the signal to be received is known, set the CYCLES SHIFT to the corresponding position on the NARROW or WIDE range.

f. Adjust the other oscilloscope controls on each Converter, as required, according to paragraph 4 of this section.

g. Set the SPEED on each Converter to the SLOW position. The SLOW position is used for any keying speed of less than 60 words-per-minute and the FAST position is used for keying speeds in excess of 60 words-per-minute. However, under unusual conditions, operation is sometimes improved by switching to the FAST position when receiving less than 60 words-per-minute.

h. Set the Comparator FREQ. CPS to the desired tone output frequency and turn the LEVEL to the required output level, when tone output is used.

i. Tune the receivers to the desired RF carrier, and adjust the tuning to center the signal pattern on the oscilloscope, as shown at A of figure 4-3. (The tuning of the receiver affects the vertical position of the pattern and the CYCLES SHIFT adjusts the vertical size of the pattern.) Aural reproduction of the audio output of the receiver is recommended to aid the operator in identifying signals. The output of the receiver should be set for 30 db (60mW).

The oscilloscope on each converter functions as a monitor for tuning the receiver. When the receiver is tuned correctly and the CYCLES SHIFT is properly adjusted, the pattern on the oscilloscope of each Converter should coincide with the upper horizontal line for a "mark" pulse and the lower horizontal line for a "space" pulse. If the receiver is not correctly tuned, the patterns appearing on the oscilloscope will resemble patterns B and C of figure 4-3. Under bad noise conditions the pattern on the oscilloscope will resemble patterns D, G and H of figure 4-3. A correctly tuned steady "space" or "mark" signal is shown by E and F respectively in figure 4-3.

j. The width of shift being received is indicated on the CYCLES SHIFT WIDE or NARROW scale when the oscilloscope mark-space pattern is adjusted between the upper and lower calibrating lines, as shown in A of figure 4-3. Read the scale corresponding to the setting of the SHIFT control.

k. Set the Comparator SELECTOR to CHANNEL A (upper Converter unit).

l. Turn the Comparator THRESHOLD clockwise until the teletype printer starts to print.

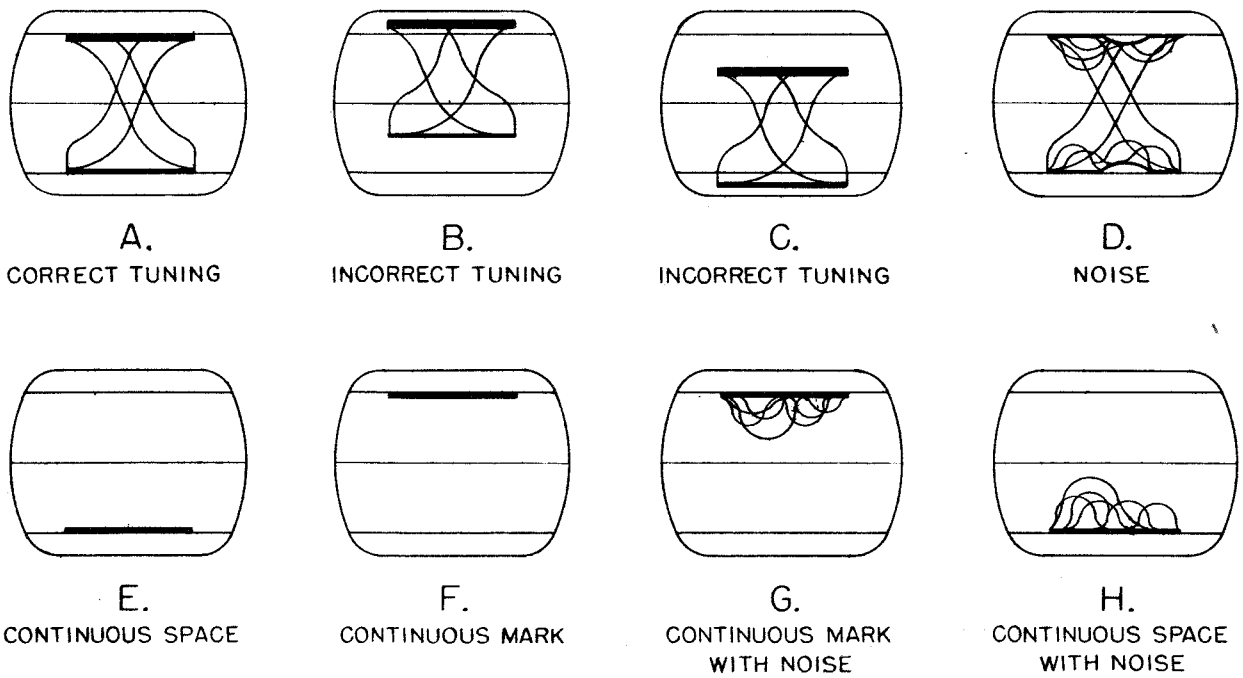


Figure 4-3. Monitor Oscilloscope Patterns

m. Try the channel A Converter MARK-SPACE in both the NORMAL and REVERSE position, and leave it in the position that gives correct copy on the teletype printer. In the correct position the characters are of the right polarity to control the teletype printer but in the other position the characters are reversed and will not synchronize the control mechanism of the teletype, resulting in no intelligence in the printed copy.

n. The teletype should now print correct copy (except in the low parts of a fading signal) indicating channel A is ready for diversity operation.

o. Set the Comparator SELECTOR to CHANNEL B (lower Converter).

p. Turn the Comparator THRESHOLD clockwise until the teletype printer starts to print.

q. Set the channel B MARK-SPACE according to step *m*.

r. The teletype should now print correct copy (except in the low parts of a fading signal) indicating channel B is ready for diversity operation.

s. Set the Comparator SELECTOR to COMBINED.

t. Adjust the Comparator THRESHOLD to the highest scale reading which does not allow noise pulses to cause errors in the copy. A practical way to find this setting is to detune both receivers slightly off their respective signals to where noise alone is received. Turn the THRESHOLD clockwise to allow the noise to key the teletype, and then turn counterclockwise to where the threshold bias just prevents the noise from keying.

u. Retune each receiver correctly on its station, as it was before detuning.

The Frequency Shift Converter-Comparator Group AN/URA-8A is now adjusted for diversity operation, either continuous or intermittent. Except for occasional retuning of the receivers and readjusting for changing conditions, the equipment requires little operator attention.

With experience in the use of this equipment, the art of tuning and adjusting can be developed to where the proper settings can be readily recognized from the teletype printer copy and the monitor oscilloscope pattern. Under bad noise conditions it is frequently possible to obtain satisfactory teletype copy in diversity operation from signals which audibly are hardly distinguishable from the noise.

4. OSCILLOSCOPE ADJUSTMENTS.

When putting the Frequency Shift Converter-Comparator Group AN/URA-8A into operation for the first time it is necessary to make the initial adjustments on the oscilloscope of each Frequency Shift Converter CV-89/URA-8A. Two of these adjustments are semi-permanent and need only be checked periodically after they are once set. The other two are panel controls that may have to be readjusted according to light conditions in the room where the equipment is mounted. To make the above adjustments, follow the procedure outlined below.

a. Turn the receiver off and adjust the INTENSITY and the FOCUS on the Converter to give a clear, fine trace on the oscilloscope, with the desired brightness.

b. Adjust the Converter screwdriver adjustment marked VERT. POS. to make the trace coincide with the center line on the face of the oscilloscope.

c. Adjust the Converter screwdriver adjustment marked HOR. POS. to center the trace on the face of the oscilloscope.

After making the above adjustments, turn the receiver ON and proceed with the operation of the equipment. During operation the INTENSITY and FOCUS should be readjusted whenever necessary, to give the clearest presentation.

5. SINGLE RECEIVER OPERATION.

With the Frequency Shift Converter CV-89/URA-8A of the Frequency Shift Converter-Comparator Group AN/URA-8A installed and connected for single receiver operation, as shown in figure 3-5, proceed with the operation as given below.

a. Set the Converter KEYER switch to TUNE.

b. Turn THRESHOLD to 0.

c. Throw all POWER switches to the ON position and allow sufficient time for the receiver to stabilize.

d. Set the SHIFT to the WIDE position, or if the shift-width of the signal to be received is known, set the SHIFT to the corresponding position.

e. Turn CYCLES SHIFT to approximately 800 on

the WIDE range. If the cycles shift of the signal to be received is known, set the CYCLES SHIFT to the corresponding position on the WIDE or NARROW range.

f. Adjust the other oscilloscope controls, as required, according to paragraph 4 of this section.

g. Set SPEED to the SLOW position. The SLOW position is used for any keying speed of less than 60 words-per-minute and the FAST position is used for keying speeds in excess of 60 words-per-minute. However, under unusual conditions, operation is sometimes improved by switching to the FAST position when receiving less than 60 words-per-minute.

h. Set FREQ. CPS to the desired tone output frequency and turn LEVEL to the required output level, when tone output is used.

i. Tune the receiver to the desired RF carrier, and adjust the tuning to center the signal pattern on the oscilloscope, as shown at A of figure 4-3. (The tuning of the receiver affects the vertical position of the pattern and the CYCLES SHIFT adjusts the vertical size of the pattern.) Aural reproduction of the audio output of the receiver is recommended to aid the operator in identifying signals. The output of the receiver should be set for 60 milliwatts.

j. The width of shift being received is indicated on the CYCLES SHIFT WIDE or NARROW scale when the oscilloscope mark-space pattern is adjusted between the upper and lower calibrating lines, as shown in A of figure 4-3. Read the scale corresponding to the setting of the SHIFT control.

k. Set KEYER to OPERATE.

l. Turn THRESHOLD clockwise until the teletype printer starts to print.

m. Try the MARK-SPACE in both NORMAL and REVERSE position, and leave it in the position that gives correct copy on the teletype printer. In the correct position the characters are of the right polarity to control the teletype printer but in the other position the characters are reversed and will not synchronize the control mechanism of the teletype, resulting in no intelligence in the printed copy.

n. Adjust the THRESHOLD to the highest scale reading which does not allow noise pulses to cause errors in the copy. A practical way to find this setting is to detune the receiver slightly off the signal to where noise alone is received. Turn the THRESHOLD clockwise to allow the noise to key the teletype, and then turn counterclockwise to where the threshold bias just prevents the noise from keying. Retune the receiver correctly on the station.

The Frequency Shift Converter CV-89/URA-8A is now ready for continuous or intermittent single receiver operation. Except for occasional retuning of the receiver and readjustment for changing conditions, the equipment requires little operator attention.

FAILURE REPORTS

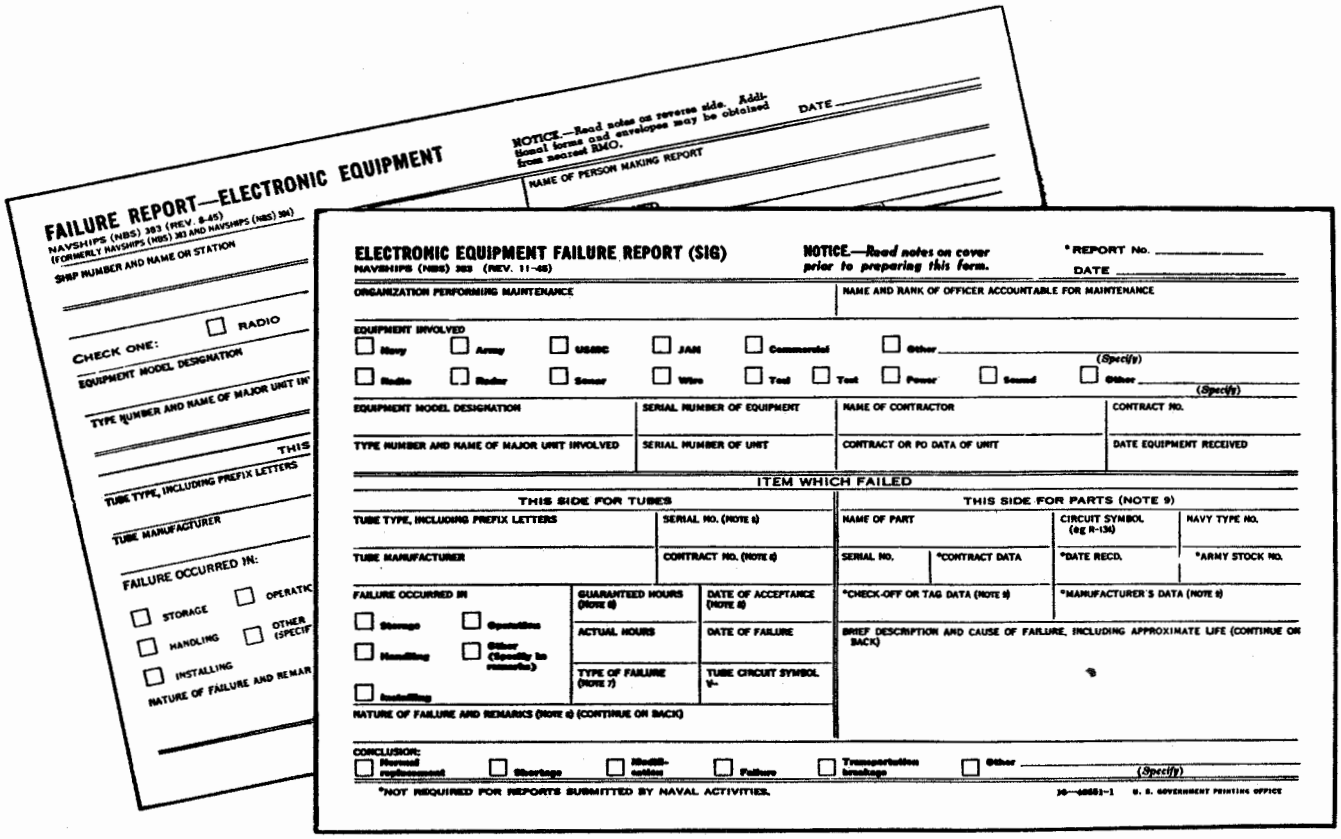
A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form NBS-383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards, and envelopes on board. They may be obtained from any Electronics Officer.



FAILURE REPORT—ELECTRONIC EQUIPMENT
NAVSHIPS (NBS) 383 (REV. 8-45)
(FORMERLY NAVSHIPS (NBS) 383 AND NAVSHIPS (NBS) 384)
SHIP NUMBER AND NAME OR STATION
CHECK ONE: RADIO
EQUIPMENT MODEL DESIGNATION
TYPE NUMBER AND NAME OF MAJOR UNIT IN
TUBE TYPE, INCLUDING PREFIX LETTERS
TUBE MANUFACTURER
FAILURE OCCURRED IN:
STORAGE
HANDLING
INSTALLING
NATURE OF FAILURE AND REMAR
NOTICE.—Read notes on reverse side. Addl. forms and envelopes may be obtained from nearest BMO.
DATE
NAME OF PERSON MAKING REPORT

ELECTRONIC EQUIPMENT FAILURE REPORT (SIG)
NAVSHIPS (NBS) 383 (REV. 11-45)
NOTICE.—Read notes on cover prior to preparing this form.
*REPORT No.
DATE
ORGANIZATION PERFORMING MAINTENANCE
NAME AND RANK OF OFFICER ACCOUNTABLE FOR MAINTENANCE
EQUIPMENT INVOLVED
Navy Army USMC JAN Commercial Other
Radio Radar Sonar Wire Test Test Power Sound Other
(Specify)
EQUIPMENT MODEL DESIGNATION
SERIAL NUMBER OF EQUIPMENT
NAME OF CONTRACTOR
CONTRACT NO.
TYPE NUMBER AND NAME OF MAJOR UNIT INVOLVED
SERIAL NUMBER OF UNIT
CONTRACT OR PO DATA OF UNIT
DATE EQUIPMENT RECEIVED
ITEM WHICH FAILED
THIS SIDE FOR TUBES
TUBE TYPE, INCLUDING PREFIX LETTERS
SERIAL NO. (NOTE 6)
TUBE MANUFACTURER
CONTRACT NO. (NOTE 6)
FAILURE OCCURRED IN
Storage Operation
Handling Other (Specify in remarks)
Installing
GUARANTEED HOURS (NOTE 6)
DATE OF ACCEPTANCE (NOTE 6)
ACTUAL HOURS
DATE OF FAILURE
TYPE OF FAILURE (NOTE 7)
TUBE CIRCUIT SYMBOL V-
NATURE OF FAILURE AND REMARKS (NOTE 6) (CONTINUE ON BACK)
THIS SIDE FOR PARTS (NOTE 9)
NAME OF PART
CIRCUIT SYMBOL (eg R-134)
NAVY TYPE NO.
SERIAL NO.
*CONTRACT DATA
*DATE RECD.
*ARMY STOCK NO.
*CHECK-OFF OR TAG DATA (NOTE 8)
*MANUFACTURER'S DATA (NOTE 8)
BRIEF DESCRIPTION AND CAUSE OF FAILURE, INCLUDING APPROXIMATE LIFE (CONTINUE ON BACK)
CONCLUSION:
Normal replacement Shortage Misdirection Failure Transportation breakage Other
(Specify)
*NOT REQUIRED FOR REPORTS SUBMITTED BY NAVAL ACTIVITIES.
16—46851-1 U. S. GOVERNMENT PRINTING OFFICE

Figure 5-1. Failure Report, Sample Form

SECTION 5
MAINTENANCE

1. OPERATOR'S MAINTENANCE

The Frequency Shift Converter-Comparator Group AN/URA-8A is designed to facilitate emergency maintenance, and all maintenance operations. The drawer-slide and tilt mechanism make the tubes, subchassis, and major assemblies readily accessible for rapid replacement, to assure the minimum interruption of the reception of coded intelligence.

If the equipment does not function properly, when properly operated on the correct type of signal(s), it should be turned over to maintenance personnel for correction of the troubles. However, for emergencies, the operator should consult table 5-1 and the related paragraphs.

This table is based on the assumption that the receiver(s) and the teletype recorder are in proper operating condition. These associated equipments should be checked according to their own maintenance instructions.

The Frequency Shift Converter CV-89/URA-8A and the Comparator CM-22/URA-8A are alike in many of their circuits and are both included in table 5-1. The location of components noted by symbol number can be determined from the grouping of the symbol numbers. Symbols in the series 101 to 699 are components of the Converter, and 701 to 1099 are components of the Comparator. See table 6-3. The sub-units and assemblies can be identified in figures 1-3 and 1-4. The troubles listed are progressive and should be considered in the order given, and each probable cause should be considered and checked in the order given. Only the tubes, sub-units or assemblies in the particular installation being used need be checked.

Notice to Operators

Operators shall not perform any of the following emergency maintenance procedures without proper authorization.

a. PILOT LAMP REPLACEMENT.—To replace the pilot lamp of any unit, unscrew the lens assembly, counterclockwise, from the front of the control panel. Release the lamp by pressing it in and turning counterclockwise. Insert the new lamp (neon glow lamp I601 or I1001) and lock it in place by pressing in and turning clockwise. Screw the lens assembly back in place.

b. FUSE REPLACEMENT.

WARNING

Never replace a fuse with one of higher rating unless continued operation of the equipment is more important than probable damage. If a fuse burns out immediately after replacement, do not replace it a second time until the cause has been corrected.

The fuses in each unit are located in the cable filter assembly inside the rear of the case. To replace fuses, first remove the drawer assembly from the case.

(1) REMOVAL OF DRAWER ASSEMBLY FROM CASE.—To remove the drawer assembly from its case proceed as follows:

(*a*) Depress the upper pushbuttons in the unit handles and withdraw the drawer assembly its full travel from the case.

(*b*) Depress the lower pushbuttons in the unit handles and tilt the assembly by lowering the panel, to about 22½ degrees down, where a slight detent in the latching plate gives a partial locking effect which can be felt. See position "D" of figure 5-2 (also see figure 1-2).

(*c*) Holding the unit at this angle, lift it straight up, out of the drawer-slide support.

(*d*) When replacing the unit, reverse the steps used in removing it.

CAUTION

When replacing the drawer assembly in the drawer-slide support, be very careful not to damage component parts by striking or resting them on the drawer-slide mechanism.

After removal of the unit from the case, the fuses are accessible through the open front of the case. They are in retractible fuse holders mounted in the plate that supports the cable filter assembly in the rear of the case. (See figures 1-3 and 1-4.) The holders are marked "fuse" on the cap and the value is stencilled beside the holder; the spare fuses are labeled "spare." Remove the fuse by pressing on the cap, turning counterclockwise to release, and pulling out the cap containing the fuse. Place a new fuse in the cap, reinsert in holder and lock in place by turning clockwise. Fuses F501 and

TABLE 5-1. OPERATOR'S EMERGENCY MAINTENANCE

For CV-89/URA-8A and/or CM-22/URA-8A

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTION
Pilot light off, with power switch on.	Pilot lamp defective; I601 or I1001.	Replace pilot lamp. See Pilot Lamp Replacement paragraph.
	Fuse of corresponding unit blown; F501, F502, F901 or F902.	Replace with spare fuses in unit or from general stock. See Warning, and Fuse Replacement paragraph.
	AC power source not on. Or power input cable or connections defective.	Turn on power source; report power failure. Check power input cable and connection.
	Rectifier tube burned out, V401 or V801.	Replace tube. See Tube Replacement paragraph.
	Power Supply Sub-unit defective in corresponding unit.	*Replace Power Supply Sub-unit. See Sub-unit Replacement paragraph.
	Defective power input filter.	Replace corresponding cable filter assembly. See Cable Filter Assembly Replacement paragraph.
No light on face of oscilloscope tube.	Tube burned out, V302.	Call technician.
	V302 socket loose or off tube.	Press socket firmly on tube.
	High voltage rectifier burned out, V303, or plate cap off tube.	Replace tube or put tube cap back on. See Tube Replacement paragraph. Warning: High Voltage! Power must be turned off.
No sweep on oscilloscope monitor.	Defective Monitor Sub-unit.	Replace Monitor Sub-unit. See Sub-unit Replacement paragraph.
No signal indicated on oscilloscope monitor.	Burned out tube in Monitor or Discriminator Sub-unit. V301A or V101 to V105.	See Tube Replacement paragraph. Replace defective tube or replace all tubes one by one.
	Defective Monitor Sub-unit or Discriminator Sub-unit.	If Converter output signals are normal, replace Monitor Sub-unit. If there are no output signals, replace Discriminator Sub-unit. See Sub-unit Replacement paragraph.
Low or no "mark" current in teletype dc loop, checked at TTY monitor jack.	Burned out or defective tube in keyer circuit or electronic relay; V705 through V709 or V201, V204, V205, V207, V208.	Replace tubes one by one. See Tube Replacement paragraph.
	Defective Selector Sub-unit or Oscillator-Keyer Sub-unit.	Replace Sub-unit. See Sub-unit Replacement paragraph.
	Defective output connections or defective Cable Filter Assembly.	Check output connectors and connections. Replace Cable Filter Assembly. See Cable Filter Assembly Replacement paragraph.
Normal "mark" current but no keying in ttyp dc loop, checked at TTY jack.	Defective tubes in Discriminator Sub-unit V101 through V105, or Selector Sub-unit V701 through V704.	Replace defective tubes, or all tubes one by one. See Tube Replacement paragraph. (Note. —keying is indicated by light in V205 or V707 for each "mark" signal.
	Defective Discriminator Sub-unit, Selector Sub-unit or Oscillator-Keyer Sub-unit.	Replace Sub-unit. See Sub-unit Replacement paragraph.
No tone output, or tone not keyed, checked at PHONES jack.	Defective tubes in Selector Sub-unit, V705, V706, V710, V711, V712; or in Oscillator-Keyer Sub-unit, V201, V202, V203, V204, V206.	Replace defective tube, or all tubes one by one. See Tube Replacement paragraph.
	Defective Selector Sub-unit or Oscillator-Keyer Sub-unit.	Replace Sub-unit. See Sub-unit Replacement paragraph.

*** CAUTION**

After replacing a Power Supply Sub-unit, do not leave the power turned on longer than 45 seconds if operation is not restored. Overloading due to defects in other sub-units or other circuits may damage the replacement Power Supply, if left on. In general, replace all other suspected sub-units before replacing the Power Supply Sub-unit.

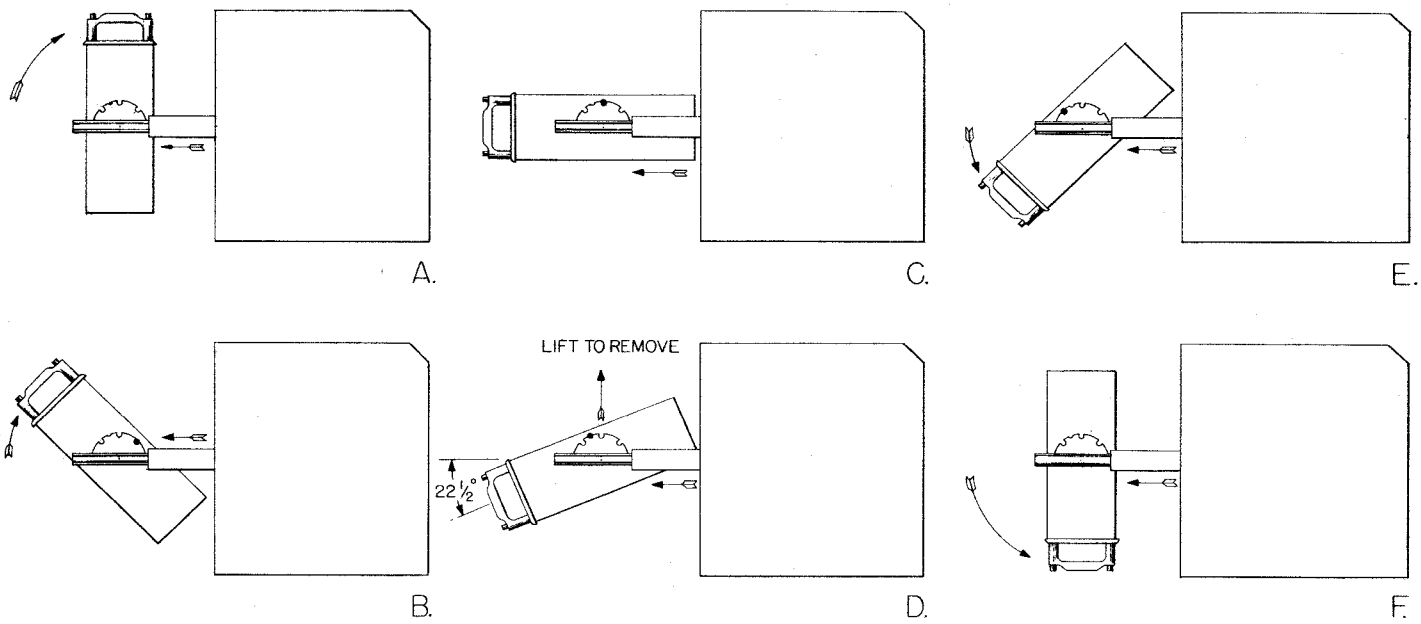


Figure 5-2. Tilt Positions of Drawer Assembly

F502 in the Converter are ¾ ampere and F901 and F902 in the Comparator are ½ ampere. Use the spare fuses for replacement and replenish spares from general stores.

c. TUBE REPLACEMENT.—To replace tubes, depress the buttons at the top of the unit handles and withdraw the drawer assembly to its full travel from the case. Depress the lower buttons in the handles and tilt the assembly to the most convenient angle. See figures 5-2 and 1-2.

To replace a tube, first remove the shield by pressing down and turning counterclockwise and then pulling straight up. Grasp the tube and pull straight up from the socket with a slight rocking motion. Use only a slight rocking motion, if any; excessive rocking will break off tube pins or damage the socket. Protect the fingers with gloves or a cloth to prevent burns from hot tubes. V205 and V707 are exceptions to this method of removal, being not shielded and having a bayonet base which is released by pressing slightly on the tube and turning counterclockwise; the tube then lifts straight out.

When putting a tube back into the socket, align the pins to correspond with the socket holes and press them straight into the socket to where the tube is fully seated. Put the shield over the tube and lock it in place. Insert V205 or V707 straight into the socket and, after engaging the side pins in the slots, press down and turn clockwise to lock. Be sure to place the cap connector back on V303 when it is replaced.

WARNING

There is high voltage at the cap of V303. Do not contact it while power is on.

(1) USE OF JUMPER CABLE.—To operate a unit while the drawer assembly is withdrawn, complete the connections between the drawer assembly and the cable filter assembly by using the jumper cable (W1103), which is stored in the compartment at the rear of the Comparator chassis-panel assembly (see figure 1-4).

(*a*) Remove the drawer assembly from the drawer slide support as instructed in paragraph b.(1) above.

(*b*) Plug the male end of the cable into the receptacle on the front of the Cable Filter Assembly in the rear of the case.

(*c*) Replace the drawer assembly in the drawer slide support and plug the other end of the jumper cable into the receptacle of the drawer assembly.

d. CATHODE RAY TUBE REPLACEMENT.—The cathode ray oscilloscope tube V302 in the Monitor is replaceable through the control panel of the Converter unit.

(1) Loosen the four captive screws that hold the hood and window assembly in front of the end of the tube (these screws, H605, are visible in figure 1-3) and remove the assembly.

(2) Depress the pushbuttons at the top of the unit handles and pull out the drawer assembly.

(3) Pull off the socket, XV302, from the base of the tube.

(4) Loosen the screw in the clamp around the tube base (H301 in figure 5-6) and then push the tube forward, out through the front panel.

(5) To reinsert the tube reverse the process, but do not tighten the screw (H301) in the clamp around the tube base until the hood assembly has been reinstalled. Then slide the tube forward against the hood assembly and tighten the clamp.

If the Monitor Sub-unit is to be removed the cathode-ray tube may be removed while the Sub-unit is out.

e. SUB-UNIT REPLACEMENT.—To remove a sub-unit from the chassis-panel assembly (see Caution under table 5-1):

(1) Disengage the controls (if any) of the sub-unit from the control shafts in the front panel by pulling the panel control shafts forward. These shafts spring-lock in the forward or back position. All have knobs except the two oscilloscope position controls. The Power Supply Sub-units do not have front panel controls.

(2) Loosen the three to five captive screws (H101 or H701) which hold the sub-unit in place. See figures 5-6 and 5-12. When properly loosened these screws will be free of the threads in the chassis-panel assembly but still captive in the sub-unit chassis.

(3) If the Monitor Sub-unit is to be removed, loosen the two tube-bracket screws marked "A" in figure 5-6 and move the cathode-ray tube back a fraction of an inch to clear the panel when the sub-unit is removed.

(4) Pull the sub-unit upward, separating the two receptacles that connect the sub-unit to the chassis-panel assembly. Keep the sub-unit straight so as not to put undue strain on the receptacles. When free, lift the sub-unit out.

To reinstall a sub-unit, plug it carefully into position; tighten the captive screws in place, and engage the panel control shafts (if any) by pressing in and turning until the drive pin engages the control-bushing slot, and then pushing in to where the shaft spring-locks in the engaged position. On the Monitor Sub-unit, slide the cathode-ray tube forward against the front panel rubber cushion and tighten the tube-bracket screws.

f. CABLE FILTER ASSEMBLY REPLACEMENT.—To replace a cable filter assembly:

(1) Disconnect all cables from the receptacles at the rear of the unit.

(2) Remove the drawer assembly as instructed in paragraph 1.b.(1) above.

(3) Loosen the four captive screws (H101 or H701) that secure the corners of the cable filter assembly in the rear of the case and lift the cable filter assembly forward, out of the case.

To reinstall the cable filter assembly reverse the above steps.

Note

THE ATTENTION OF MAINTENANCE PERSONNEL IS CALLED TO THE REQUIREMENTS OF CHAPTER 67 OF THE BUREAU OF SHIPS MANUAL, OF THE LATEST ISSUE.

2. PREVENTIVE MAINTENANCE.

a. After each 500 hours of operation, all tubes, except the cathode-ray tube (V302), should be removed from the equipment and tested. See paragraph 1.c. above. Replace all defective tubes. When the tubes listed in table 5-2 are replaced the corresponding adjustments should be rechecked and reset according to the referenced paragraph of this Section.

TABLE 5-2. READJUSTMENTS AFTER TUBE REPLACEMENTS

TUBE REPLACED	ADJUSTMENT TO BE RESET		ADJUSTMENT INSTRUCTION PARAGRAPH
	Symbol	Function	
V101	R102	Converter input level	3.j.(1)
V102	R111	Discriminator balance	3.j.(2)
V206	R223	Tone modulator balance	3.j.(3)
V712	R746	Tone modulator balance	3.j.(4)
V802	R803	Comparator bias control	3.j.(5)

The cathode-ray tube in the Monitor Sub-unit should be replaced whenever it cannot be adjusted to normal intensity or when it fails in any way. See paragraph 1.d. above.

b. When the tubes are tested, the equipment should be given a thorough visual inspection for loose, broken or corroded connections and for damaged components.

c. Make certain that each power supply is correctly adjusted for the line voltage (Sec. 3, par. 3.b.(1)). Excessive voltage will shorten tube life.

d. The drawer slides will not require lubricating

during the life of the equipment. Every six months, a very sparing amount of light machine oil (such as Typewriter Oil per Federal spec. VV-0-836) should be applied to the bearing surfaces in the latch and tilt mechanism.

3. CORRECTIVE MAINTENANCE.

a. FAILURE REPORTS.—Make failure reports as instructed in figure 5-1 on page 5-0.

b. GENERAL.

The Frequency Shift Converter-Comparator Group AN/URA-8A is intermediate equipment used between standard Navy radio receivers and automatic teletype recorders and/or line terminating equipment for the reception and recording of frequency-shift teletype or telegraph signals. The associated equipments should be tested, adjusted and maintained according to their individual maintenance instructions.

It is important that maintenance personnel be thoroughly acquainted with the operation of the overall frequency-shift receiving system and the function of each equipment involved. The other sections of this instruction book should be consulted and studied for information regarding the AN/URA-8A equipment. It is assumed that maintenance personnel are experienced in the standard methods of testing and repairing Naval electronic equipment, and therefore detailed descriptions of simple common tests are not given here.

When there is malfunctioning in the frequency-shift receiving system which is not due to improper operation, to faulty transmissions, or to bad receiving conditions, the trouble must first be localized to one equipment. Indicators such as: pilots, meters, oscilloscope monitor, aural reproduction, etc., should be checked on all equipments, as available, to see if they show which equipment is the cause of the trouble. If these evidences are not definite, a simple expedient is to substitute equipment known to be in proper operating condition in place of the equipment that is suspected. This, however, is frequently impractical and other means must be employed for localizing the trouble.

The receiver may be tested independently by monitoring the audio output with a headset or loudspeaker and tuning in various signals to check its general performance. Other tests may be made according to the receiver maintenance instructions, as required.

The teletype, or other recorder, may be checked with signals from another source which are of known accuracy, such as: another teletype circuit, a teletype transmitter-distributor, or the like. If required, tests should be made on the automatic recording equipment according to the applicable maintenance instructions.

The best means of testing the output of the Converter or Comparator is by recording with the teletype printer or other automatic printer. Because of this, the tests of the AN/URA-8A equipment in the following paragraphs involving the receivers and recorders are predicated upon use with equipments which are known to be operating normally, and on reception of signals known to be reliable.

c. SIMPLE TESTS.

When the cause of a trouble is not obvious, start first with simple tests and then proceed with the purpose of localizing the trouble to one unit, to one subunit or assembly, and to one circuit, where more detailed testing can locate the exact component at fault. Analyze symptoms and try to select tests that will most quickly localize and reveal the cause of the trouble. Simple tests involve all of Operator's Maintenance, including table 5-1. Visual inspection of components and careful check of input and output connections will often reveal imperfections and causes of malfunctioning.

d. TROUBLE SHOOTING CHART.

Table 5-3 is a chart of possible symptoms of trouble and probable causes to be used as guide in trouble shooting.

e. VOLTAGE TESTS.

Observe the SAFETY NOTICE on page vii. Typical voltages are shown in the charts of figures 5-3 and 5-4 and on the schematic diagrams, figures 5-17 and 5-18. In some cases it will be necessary to remove the screws and raise the terminal boards to reach the sockets below them, see figure 5-8. Refer to the schematic diagrams to interpret the cause of incorrect voltage readings.

f. RESISTANCE TESTS.

CAUTION

Do not make resistance measurements with power on.

Resistance values from each tube pin to ground are given in the charts of figures 5-3 and 5-4. Other resistance values may be found on the schematics, in the Winding Data Table, 5-8 and in the Parts List. The continuity of the circuits in the chassis-panel assembly and the cable filter assembly of each unit may be checked by refering to the schematic diagrams and the wiring diagrams: The interconnections between the subunits may also be checked in the same way. Continuity tests are also valuable in testing the interconnecting cables and their connections.

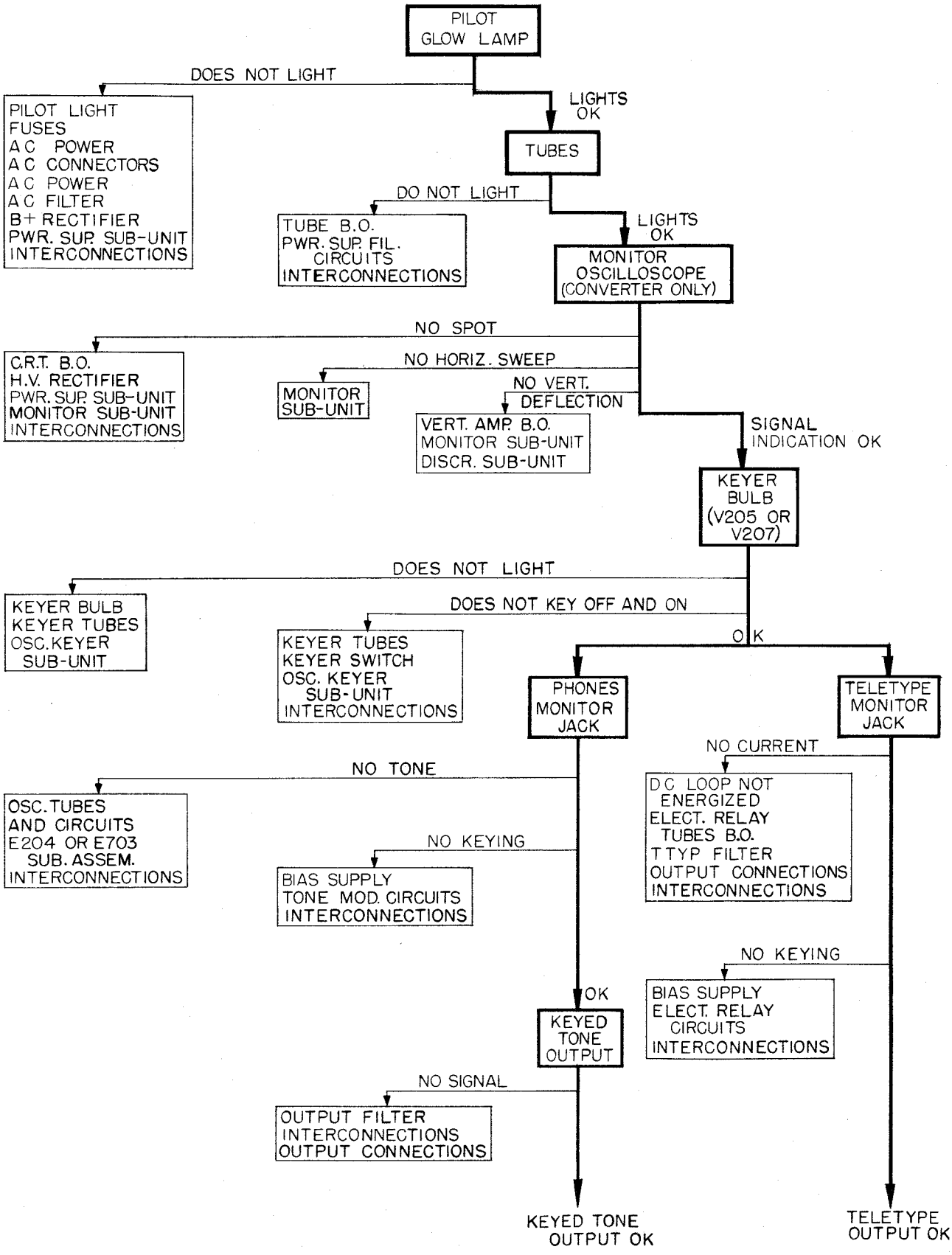


Table 5-3. Trouble Shooting Chart

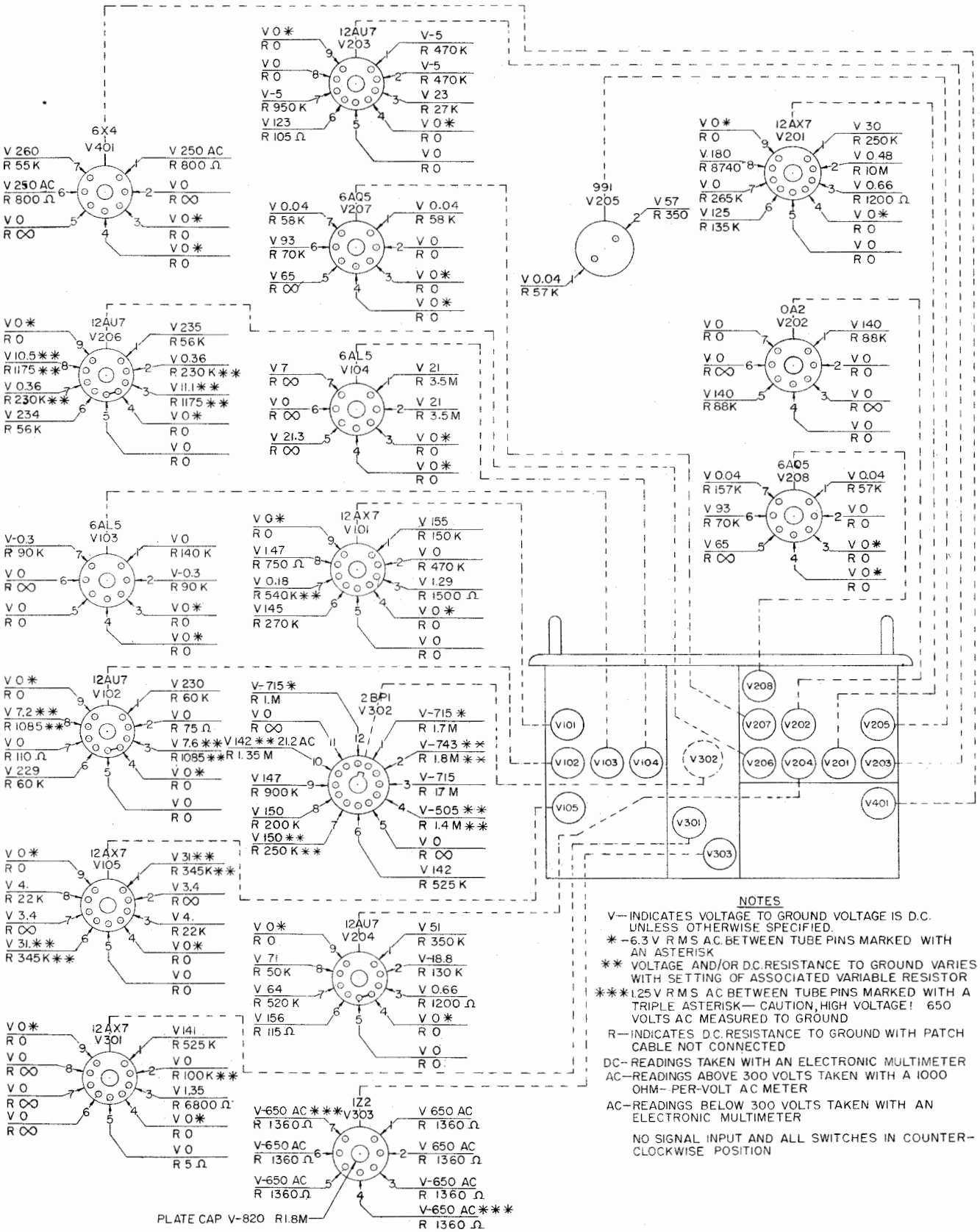


Figure 5-3. Frequency Shift Converter Voltage and Resistance Chart

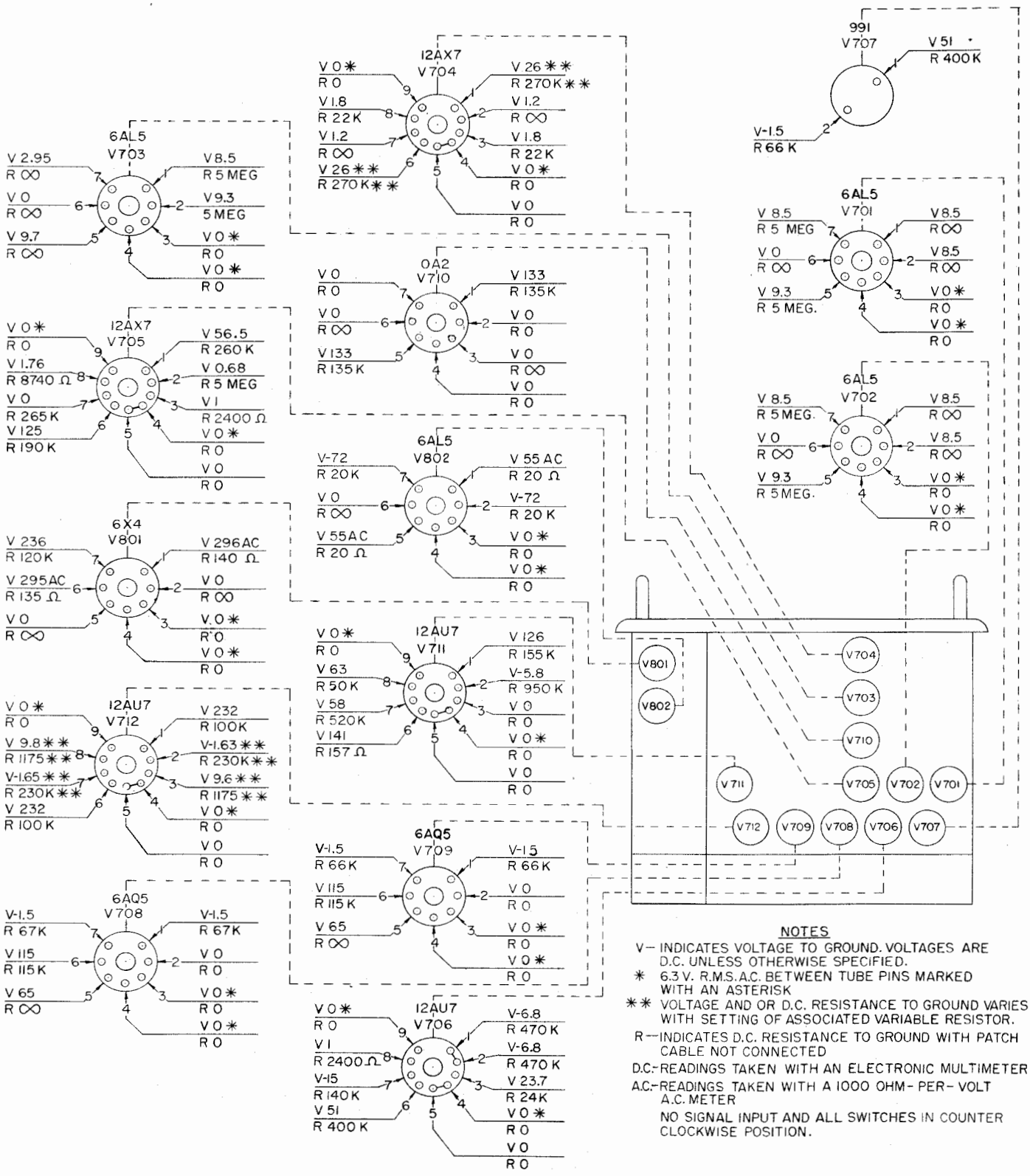


Figure 5-4. Comparator Voltage and Resistance Chart

g. CAPACITOR TESTS.

The values of capacitors are shown on the schematics and their other ratings are given in the Parts List. These may be checked on a capacitor tester; or they may be checked by substitution of a correct new capacitor for each one that is suspected of being faulty.

b. FILTER TESTS.

Table 5-4 lists the characteristics of each filter in the equipment (except the discriminator filters which are covered in sub-section *i*, below). The pass frequencies of these filters and the attenuation at audio frequencies can be measured with an audio frequency generator and an audio frequency electronic voltmeter, in which case the filter input and output must be terminated with the correct resistive load. The accuracy of the results will depend upon the accuracy of the test equipment. A rough check will be sufficient to locate a filter that has failed completely.

The resistance information on the aprons of figures 5-17 and 5-18 will be useful in ohmmeter tests.

(1) CHECK OF AF CHARACTERISTICS.

The following is a step-by-step procedure for checking the AF characteristics of the filters listed in table 5-4.

EQUIPMENT REQUIRED:

AF Signal Generator—(800 to 3500 cps $\pm 1\%$), such as Navy model LAJ series.

Two Electronic Multimeters, such as Navy Multimeter ME-25/U series.

(*a*) Disconnect the filter from its associated circuit.

(*b*) Connect an Audio Signal Generator, such as Navy model LAJ series, to the input terminals of the filter.

(*c*) Add resistance in series or parallel with the Generator output to give the proper termination at the filter input, taking into consideration the output impedance of the Audio Signal Generator. See table 5-4 for the correct input terminations.

(*d*) Terminate the filter output with the correct resistive load, according to table 5-4.

(*e*) Connect one Electronic Multimeter across the output terminals of the Signal Generator and one across the output terminals of the filter.

(*f*) Adjust the output frequency of the Signal Generator to the mid-frequency of the pass band, as given for each filter in table 5-4 under "Required Frequency Response."

(*g*) Adjust the output level of the Signal Generator to correspond with the test level, as given in table 5-4 for each filter. If the Generator does not put out high enough signal voltage, use a high-grade audio transformer to step up the voltage. Connect the transformer between the generator output and filter input, adding resistance in series or in parallel with the transformer secondary to properly terminate the filter. (The impedance of the transformer secondary will be the Generator output impedance multiplied by the transformer impedance ratio.) Measure the test level voltage at the transformer secondary, instead of at the Generator output.

(*h*) Record the voltage measured at the filter output terminals; this will be the reference voltage.

(*i*) To check the audio pass band: keep the Generator output constant at the test level; adjust the frequency of the Signal Generator to at least five or six different frequencies (including the high and low frequencies) within the pass band of the filter under test; and record the voltage measured at the filter output terminals for each frequency.

Z503 and Z903 should be checked at the lowest possible output frequency of the Signal Generator and then checked with an ohmmeter. If the dc resistance and the measureable part of the af response are normal, the response between zero frequency and the lowest generator frequency should be considered normal.

(*j*) To check the audio attentuation: keep the Generator output constant at the test level; adjust the frequency of the Generator to several frequencies in the attentuation range of the filter under test; and record the voltage measured at the output terminals for each frequency.

With the above information the attenuation and band pass characteristics (in db) can be determined for each filter by using the following formula:

$$db = 20 \log \frac{E_{ref}}{E_{out}}$$

where: db = decibels of gain or loss

E_{ref} = reference output voltage, for the mid-frequency, as measured in step (h)

E_{out} = output voltage for test frequency, as measured in step (i) or (j).

The audio attenuation and band-pass characteristics of the filters should fall within the tolerance given for each filter in table 5-4 under "Required Frequency Response" and "Attenuation." If any filter does not meet the specified audio requirements, it should be replaced.

The audio characteristics of Z504 and Z904 are not

TABLE 5-4. FILTER CHARACTERISTICS

SYMBOL	NAME	INPUT TERMINATION (OHMS)	OUTPUT TERMINATION (OHMS)	REQUIRED FREQUENCY RESPONSE	ATTENUATION	TEST LEVEL	INSERTION LOSS	NOTES
Z101	Narrow-shift input filter	600 ±10%	600 ±10%	775-1400 cps ±1 db	425 cps and below, 40 db or more	6 volts	Less than 8 db	High-pass filter.
Z102	Wide-shift input filter	600 ±10%	600 ±10%	Pass band 2200 cps at 6 db down. Mean freq. 2550 ±50 cps	Band width at 40 db down, not more than 3100 cps	6 volts	Less than 8 db	Band-pass filter. Case includes T101.
Z105A	Slow-speed keying filter	100,000	100,000	80-140 cps ±3 db	240 cps and above, 40 db or or more	60 volts RMS	Less than 8 db	Low-pass filter. Applied voltage 60 v RMS. Cased with Z105B.
Z105B	Fast-speed keying filter	100,000	100,000	80-300 cps ±3 db	500 cps and above, 40 db or more	60 volts RMS	Less than 8 db	Low-pass filter. Applied voltage 60 v RMS. Cased with Z105A.
Z501 and Z901	External tone input filter	600 ±10%	(Self-terminated)	500-1850 cps ±2 db	14 kc to 10 mc 65 db min. 10 mc to 30 mc 50 db min.	2.45 volts	.....	Low-pass and RF filter. Contains 1500 ohm terminating resistor. Filter between terms. 2 and 4. Terms. 1 and 3 common. Max. level 10 mw.
Z502 and Z902	Keyed tone output filter	600 ±10%	600 ±10%	500-1850 cps ±2 db	14 kc to 10 mc 65 db min. 10 mc to 30 mc 50 db min.	3 volts	Not more than 2 db	Low-pass and RF filter. Includes af trans. with CT output. Max. level 15 mw.
Z503 and Z903	Teletype output filter	1200	1200	Within 5 db from 0 to 600 cps. Passes DC current, 178 ohms ±10% DC resistance	15 kc to 10 mc 65 db min. 10 mc to 30 mc 50 db min.	20 volts RMS	.....	Low-pass and RF filter. Passes 60 ma at 70 v dc. Filter between terms. 2 and 4. Terms. 1 and 3 common.
Z504 and Z904	Power input line filter	.....	.....	50-60 cps single phase (power source)	14 kc to 10 mc 65 db min. 10 mc to 30 mc 50 db min.	.....	2 volts max. at 60 cps.	RF filter. 0.565 amps max. 105-125 volts.

Schematics and resistance data for these filters are printed on the apron next to figures 5-17 and 5-18.

important as they are ac line filters and only have to pass the power frequency (50 or 60 cps). However, these filters should be checked in their respective circuits to see that the voltage drop across them does not exceed the tolerance given in table 5-4 under "Insertion Loss."

If measuring equipment is not available for the above tests, substitution of an individual filter from Stock Spare Parts is a practical way to check a suspected unit.

(2) CHECK BY SUBSTITUTION.

RF attenuation characteristics are not practical to measure with normal maintenance test equipment. If it is suspected that an RF filter is defective, it should be checked by substitution.

A cable filter assembly for the Converter and one for the Comparator are supplied in the Maintenance Parts Kit, and they are also supplied as Stock Spare Parts. When it is suspected that any filter in either assembly is defective, replace the complete cable filter assembly. See paragraph 1.f. of this section for the procedure. Individual filters of all types are also supplied in Stock Spare Parts, for replacing defective filters and for substitution in place of those believed to be defective.

i. DISCRIMINATOR TESTS.

The discriminator frequency response characteristics are given in the curves of figure 2-3. These are in terms of frequency versus discriminator dc output volts, and are based on measurement of the whole discriminator circuit. The method of checking the discriminator response is as follows:

EQUIPMENT REQUIRED:

AF Signal Generator—(800 to 3500 cps ±1%) such as Navy model LAJ series.

Electronic Multimeter, such as Navy Multimeter ME-25/U series.

DC Voltmeter—20,000 ohms/volt, such as Navy model OE series.

(1) Withdraw the Converter drawer assembly and connect the jumper cable; see paragraph 3.c.(1) of this Section. Disconnect the NARROW and WIDE INPUT cables.

(2) Connect terminals 1 and 4 of Z103 or Z104 together and apply signal between this point and ground: 3 volts rms at 2550 cps ±1% for Z104, or 1000 cps ±1% for Z103, as set by the SHIFT NARROW-WIDE switch.

(3) Connect the dc voltmeter from ground to the terminal of R114 (See E101 figure 5-9) nearest rear of chassis (discriminator output), and turn the MARK-SPACE switch to NORMAL.

(4) Adjust R111 for zero discriminator output, as indicated on the dc voltmeter.

(5) Remove the short circuit from Z103 and Z104.

(6) Apply 3 volts rms across R107 (see E101 figure 5-9).

(7) Hold the voltage constant across R107 and vary the frequency, noting the discriminator output voltage on the dc voltmeter.

(8) The discriminator response should be the same as the corresponding curve of figure 2-3 within the tolerances given. The accuracy of the plots will depend upon the accuracy of the equipment used. The condition of the tubes and other parts of the discriminator circuit must also be taken into consideration and be corrected whenever faulty.

(9) Disconnect test equipment and restore the unit to normal conditions.

If it is not possible to make an accurate test of the discriminator, a frequency response test with less accurate equipment will still have value in detecting many of the possible defects in the circuit.

j. INTERNAL ADJUSTMENTS.

The internal adjustments in the Converter and Comparator units should be reset whenever tubes or other components are replaced in the related circuits. See table 5-2. For each of the following adjustments, first withdraw the Converter drawer assembly and connect the jumper cable; see paragraph 1.c.(1) of this Section.

(1) ADJUSTMENT OF R102 — CONVERTER INPUT LEVEL CONTROL.

(*a*) Apply 6 volts of audio frequency to the NARROW INPUT of the Converter at approximately 1000 cps, with the SHIFT switch at NARROW.

(*b*) Measure the af voltage from the junction of R109 and C102 to ground (see E101 figure 5-9), isolating the meter from the dc plate voltage with an .01 mfd capacitor. This should be approximately 50 volts rms.

(*c*) Drop the input to 0.19 volts.

(*d*) Adjust R102 to the point which will hold the voltage at the junction of R109 and C102 most constant while the input power is changed back and forth from 0.19 volts to 6 volts.

(*e*) Disconnect the test equipment and restore the Converter to normal conditions.

(2) ADJUSTMENT OF R111 — DISCRIMINATOR BALANCE CONTROL.

When R111 is to be adjusted to balance the discriminator circuits for operation of the Converter, the following method should be used. This is different from the setting of R111 as used in testing the discriminator circuits, (paragraph 3.i. of this section) in that the input amplifier-limiter stage is included when the adjustment is made.

(a) Connect terminals 1 and 4 of Z103 together.

(*b*) Connect an electronic multimeter across terminals 4 and 5 of Z105B.

(*c*) Set the SHIFT switch to NARROW and the SPEED switch to FAST.

(*d*) Apply 6 volts rms at 1000 cps to the NARROW INPUT connector, J508, terminals A and B. Terminal B is the low side of the balanced input and may be grounded if necessary.

(*e*) Adjust R111 for zero discriminator output, as indicated on the dc scale of the electronic multimeter.

(*f*) Disconnect the test equipment and restore the Converter to normal conditions.

(3) ADJUSTMENT OF R223—TONE MODULATOR BALANCE CONTROL.

With the Converter operating on a frequency-shift test signal:

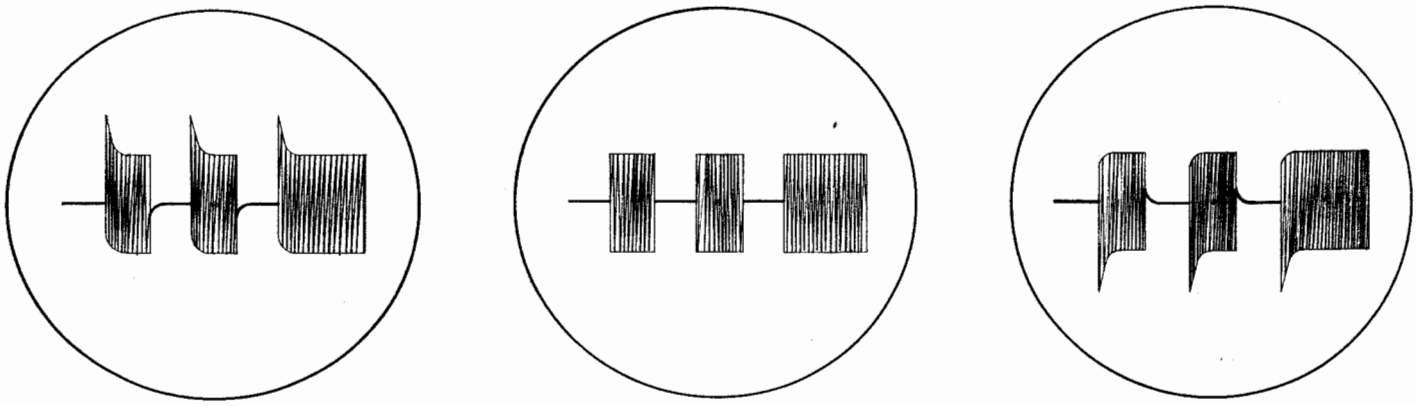


Figure 5-5. Tone Output Pulse Shapes

(*a*) Disconnect the TONE OUTPUT cable (if used) and connect a 600 ohm resistor from pins A to C of J506, TONE OUTPUT. Connect a test oscilloscope from pin A to ground. Ground pin C; or, if terminal 4 of Z502 is grounded for balanced output, do not ground pin C. Grounding terminal 4 is discussed in sub-section 2 of section 3, Installation, and the terminal is shown in figures 5-11 and 5-16.

(*b*) Adjust the sweep to about four or five cycles per second, so that the shape of the keyed-tone pulses can be observed.

(*c*) Adjust R223 back and forth and set it at the point which gives the most cleanly squared-off pulses, as illustrated in figure 5-5. If a correct balance cannot be reached, try another 12AU7 tube for V206, until a proper pattern is obtained.

(4) ADJUSTMENT OF R746—TONE MODULATOR BALANCE CONTROL.

With the Comparator operating on a frequency-shift test signal:

(a) Disconnect the TONE OUTPUT cable (if used) and connect a 600 ohm resistor from pins A to C of J905, TONE OUTPUT. Connect an oscilloscope from pin A to ground. Ground pin C; or, if terminal 4 of Z902 is grounded for balanced output, do not ground pin C. Grounding terminal 4 is discussed in subsection 2 of section 3, Installation, and the terminal is shown in figures 5-15 and 5-16.

(*b*) Adjust the sweep to about four or five cycles per second, so that the shape of the keyed-tone pulses can be observed.

(*c*) Adjust R746 back and forth and set it at the point which gives the most cleanly squared off pulses, as illustrated in figure 5-5. If a correct balance cannot be reached, try another 12AU7 tube for V712, until a proper pattern is obtained.

(5) ADJUSTMENT OF R803—COMPARATOR BIAS CONTROL.

Adjust R803 to give 32 volts from center contact to ground, with the Comparator in normal operating condition and the SELECTOR switch (S701) at TUNE. See figures 5-12 and 5-13 for the location of R803.

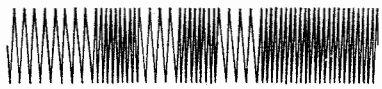
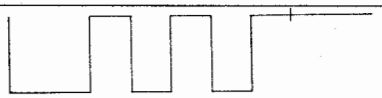
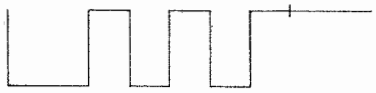
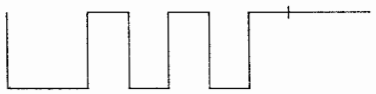
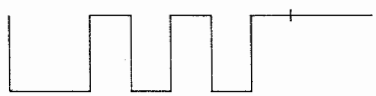
k. OSCILLOSCOPE TESTS.

(1) CRT REMOTE.—The dc output of the discriminator is available at the CRT REMOTE receptacle at the back of the Frequency Shift Converter. This is provided for connecting another oscilloscope, to monitor the tuning of a receiver which is remote from the equipment. The connection to this remote scope must be made to the dc input and the scope must be calibrated to agree with the presentation on Converter monitor.

If a linear sweep is used on a test oscilloscope which is dc connected to the CRT REMOTE output, and the sweep is adjusted to a low frequency of about four sweeps per second, the wave shape of the dc pulses can be observed. Study of these pulses will reveal much about the overall and detailed operation of the frequency-shift system, such as: the correctness of the pulse shapes and spacing, the effects of various noises and other interference, the effects of fading and of selective fading, the effects of receiver selectivity and alignment, etc.

(2) AXIS RESTORER TESTS.—The action of the axis restorer can be displayed on a dc oscilloscope by connecting directly to the axis restorer circuit. In the Converter the connection should be made to the junction of R115 and R119 on E101 (See figures 5-7 and 5-9), and to ground. In the Comparator the connection should be made to the common point between R701, R702, R706 and R711 on E701 (See figures 5-13 and 5-14). The position of the (straight line) trace on the scope with no signal will indicate the bias or axis in the circuit; this should move up and down with the setting of the THRESHOLD control, from −1.8 to approximately 47 volts. When signal pulses reach the

TABLE 5-5. SIGNAL TRACING KEY TEST POINTS

SIGNAL	POINT OF TEST	NORMAL WAVEFORM *	NOTES
Frequency Shift Input from Receiver	Converter: Across Terminals 1 and 2 of T101		Input .19 volts to 6 volts. SHIFT switch at WIDE or NARROW depending upon the incoming signal from the receiver that is receiving the steady R character.
Discriminator Output	Converter: Junction of R124 and R125 to Ground		MARK-SPACE switch at NORMAL or REVERSE, as required.
Keyer Input	Converter: Pin #2 of J604 to Ground Comparator: Pin #2 of XV705 to Ground		KEYER switch at OPERATE. SELECTOR switch at COMBINED.
Keyer Output	Converter: Junction of R218 and R219 to Ground Comparator: Junction of R741 and R742 to Ground		KEYER switch at OPERATE. SELECTOR switch at COMBINED.
Teletype Output	Converter: Sleeve of J607 to Ground (jack closed) Comparator: Sleeve of J1005 to Ground (jack closed)		KEYER switch at OPERATE. SELECTOR switch at COMBINED.
Tone Output	Converter: Across J606, terminated with 600 ohms Comparator: Across J1004, terminated with 600 ohms		KEYER switch at OPERATE. LEVEL control set at maximum (full clockwise). Tone Oscillator FREQ. CPS switch set for desired tone output frequency. SELECTOR switch at COMBINED.

* Waveforms shown represent an R character repeated continuously as received from a tape-fed transmitter and displayed on an oscilloscope whose sweep is operating at the character repetition rate. When the sweep is not in sync with the character repetition rate, or when mixed characters are received, a distinct waveform will not be shown but various intermixed combinations of moving characters will normally be displayed.

circuit, the oscilloscope trace will jump up and down with the positive and negative voltage. When the input to the Converter is a continuous mark or space signal the axis should rest at exactly the same level as with no input, for all settings of the THRESHOLD control. When a continuous mark is shifted suddenly to a continuous space the trace will jump in the negative direction but should return instantly to the axis position. When the shift is from continuous space to continuous mark, the trace will jump in the positive direction but should instantly return to the axis position. On regular reception of mark and space characters the axis should average very near the no-signal setting regardless of the weighting of the signal.

When the axis-restorer circuit is defective or suspected of malfunctioning, tests of tubes, resistors, capacitors and connections in the circuit should readily detect the trouble. The insulation resistance of the capacitors, C106A & B and C703A & B, should not fall below 50 megohms at the highest operating temperature and should normally be 100 megohms or higher.

(3) SIGNAL TRACING.—Signal tracing with a standard oscilloscope is a good method of detecting and localizing troubles in this equipment. Starting with the input, the signal can be observed in the various stages as it progresses through the equipment. Reference should be made to the two block diagrams, figures 2-1 and 2-2, and to the schematics, figures 5-17 and 5-18. The typical waveforms encountered in the various sections of the circuits are illustrated in figure 2-1. These are: audio signals of two distinct frequencies, dc pulses of square or rectangular shape, and audio unkeyed and keyed of various frequencies. The dc pulses should be well squared off and free of pips or extraneous signals, except those between the output of the low-

TABLE 5-6. TUBE OPERATING VOLTAGES AND CURRENTS

TUBE TYPE AND SYMBOL NUMBER		FUNCTION	PLATE (E)	PLATE (MA)	SCREEN (E)	SCREEN (MA)	SUPP. (E)	* CATH. (E)	GRID (E)	HEATER (E) A-C
12AX7	V101A	Limiter Amplifier	143	.45	—	—	—	1.47	−1.29	6.3
	V101B	Limiter Amplifier	153	.87				1.29	−1.29	
12AU7	V102A	Discriminator Amplifier	[1]222	[1]6.47	—	—	—	[1]7.2	[1]−7.2	6.3
	V102B	Discriminator Amplifier	[1]223	[1]6.85				[1]7.6	[1]−7.6	
6AL5	V103A	Discriminator Rectifier	−.3	.001	—	—	—	0	—	6.3
	V103B	Discriminator Rectifier	−.3	.001				0		
6AL5	V104A	Axis Restorer Rectifier	[1]−14	[1].002	—	—	—	[1]21	—	6.3
	V104B	Axis Restorer Rectifier	[1]−.3	0				[1]21.3		
12AX7	V105A	Axis Restorer DC Amplifier	[1]27	[1].095	—	—	—	[1]4	[1]−.6	6.3
	V105B	Axis Restorer DC Amplifier	[1]27	[1].095				[1]4	[1]−.6	
12AX7	V201A	Audio Oscillator-Amplifier	123	.21	—	—	—	1.8	−1.8	6.3
	V201B	Keyer Amplifier	29	.67				.66	−.18	
OA2	V202	Voltage Regulator	140	3	—	—	—	0	—	—
12AU7	V203A	Audio Oscillator-Amplifier	123	2.27	—	—	—	0	−5	6.3
	V203B	Oscillator Rectifier-Regulator	[2]−28	[2].0055				23	[2]−28	
12AU7	V204A	Phase Splitter	75	1.43	—	—	—	71	−7	6.3
	V204B	Keyer	50	0				.66	−18.9	
991	V205	Trigger Tube	57	.6	—	—	—	.04	—	—
12AU7	V206A	Tone Modulator	[1]224	[1]4.9	—	—	—	[1]10.5	[1]−10	6.3
	V206B	Tone Modulator	[1]224	[1]4.8				[1]11.1	[1]−10.5	
6AQ5	V207	Electronic Relay	65	30	93	5.3	0	0	.04	6.3
6AQ5	V208	Electronic Relay	65	30	93	5.3	0	0	.04	6.3
12AX7 V301B not used	V301A	Oscilloscope Vertical Amplifier	140	.2	—	—	—	1.35	−1.35	6.3
2BP1	V302	Monitor Tuning Indicator	Grid No. 2, 150 Volts; Anode No. 1, −505 Volts; Plate No. 1, 142 Volts; Plate No. 2, 147 Volts; Plate No. 3, 142 Volts; Plate No. 4, 150 Volts.					−715	−28 (Grid No. 1)	6.3
1Z2	V303	High Voltage Rectifier	−820	3.2	—	—	—	—	—	1.25
6X4	V401	High Voltage Rectifier	250 AC	51	—	—	—	260	—	6.3
6AL5	V701A	Channel A Mark-Space Selector	[1]0	0	—	—	—	[1]8.5	—	6.3
	V701B	Channel A Mark-Space Selector	[1]−.8	0				[1]9.3		
6AL5	V702A	Channel B Mark-Space Selector	[1]0	0	—	—	—	[1]8.5	—	6.3
	V702B	Channel B Mark-Space Selector	[1]−.8	0				[1]9.3		
6AL5	V703A	Axis Restorer Rectifier	[1]−5.5	0	—	—	—	[1]8.5	—	6.3
	V703B	Axis Restorer Rectifier	[1]−.4	[1].001				[1]9.7		
12AX7	V704A	Axis Restorer DC Amplifier	[1]24	[1].04	—	—	—	[1]1.8	[1]−.6	6.3
	V704B	Axis Restorer DC Amplifier	[1]24	[1].038				[1]1.8	[1]−.6	
12AX7	V705A	Audio Oscillator-Amplifier	123	.2	—	—	—	1.76	−1.76	6.3
	V705B	Keyer Amplifier	55.5	.4				1	−.32	
12AU7	V706A	Keyer	50	0	—	—	—	1	−16	6.3
	V706B	Oscillator Rectifier-Regulator	[2]−30.5	[2].012				23.7	[2]−30.5	
991	V707	Trigger Tube	52.5	.6	—	—	—	−1.5	—	—
6AQ5	V708	Electronic Relay	66.5	30	116.5	4.7	0	0	−1.5	6.3
6AQ5	V709	Electronic Relay	66.5	30	116.5	4.7	0	0	−1.5	6.3
OA2	V710	Voltage Regulator	133	2.5	—	—	—	0	—	—
12AU7	V711A	Phase Splitter	78	1.3	—	—	—	63	−5	6.3
	V711B	Audio Oscillator-Amplifier	126	2.1				0	−5.8	
12AU7	V712A	Tone Modulator	[1]222	[1]4.1	—	—	—	[1]9.8	[1]−11.4	6.3
	V712B	Tone Modulator	[1]222	[1]4.1				[1]9.6	−11.2	
6X4	V801	High Voltage Rectifier	296 AC	29.8	—	—	—	236	—	6.3
6AL5	V802	Bias Voltage Rectifier	−72	3.9	—	—	—	55 AC	—	6.3

* Voltage measured to ground.
Notes: [1]Voltage and Currents vary with setting of associated variable resistor.
[2]Grid and plate connected to form diode, plate current given is total diode current.

TABLE 5-7. RATED TUBE CHARACTERISTICS

TUBE TYPE	FILAMENT VOLTAGE (V)	FILAMENT CURRENT (A)	PLATE VOLTAGE (V)	GRID BIAS (V)	SCREEN VOLTAGE (V)	PLATE CURRENT (MA)	SCREEN CURRENT (MA)	A-C PLATE RESISTANCE (OHMS)	VOLTAGE AMPLIFICATION (MU)	TRANSCONDUCTANCE (MICROHMS)		EMISSION	
										Normal	Minimum	IS (MA)	TEST VOLT
OA2	Operating Voltage 150 Volts; Starting Voltage 185 Volts; Regulation 6 Volts												
1Z2	1.25	.265	7,500			1.5						9.5	7,500
2BP1	6.3	.600	Anode No. 2 and Grid No. 2 Voltage, 1000 Volts; Anode No. 1 Voltage for focus, 150 to 280 Volts; Grid No. 1 voltage for visual cutoff, −67.5 Volts. Deflection Sensitivity: Plates 1 and 2 = 135 vdc/in., Plates 3 and 4 = 87 vdc,in.										
6AL5W	6.3	.300	[1]165			[1]10						[1]40	[1]10
6AQ5	6.3	.440	250	−12.5	250	45	3.25	52,000	213	4,100	3,000	100	30
6X4	6.3	.600	[1]400			[1]70						[1]140	[1]50
12AU7	6.3 12.6	.300 .150	[1]250	[1]−8.5		[1]10.5		[1]7,700	[1]17	[1]2,200	[1]1,750	[1]70	[1]30
12AX7	6.3 12.6	.300 .150	[1]250	[1]−2		[1]1.2		[1]62,500	[1]100	[1]1,650	[1]1,250	[1]55	[1]30
991	Operating Voltage 59 Volts; Starting Voltage 67 to 87 Volts; Regulation 8 Volts												

[1] Values are for each unit.

pass filter (Z105A & B) and the input to the keyer (V201B) in the Converter. Here, there is a slight ripple in the horizontal part of the pulse due to the normal effect of the filter.

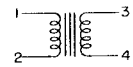
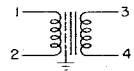
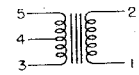
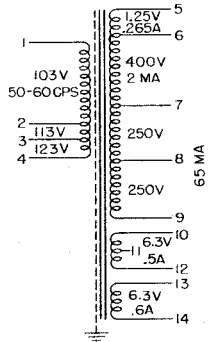
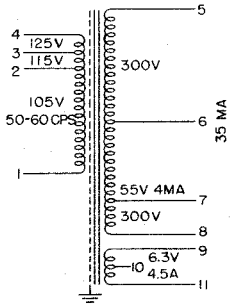
The presence or absence of signal at successive stages immediately localizes a failure to one stage. Generally, intermittant and unusual troubles can be readily tracked down by careful signal tracing with an oscilloscope. Other conventional tests should be used in conjunction with the signal tracing, as required.

Table 5-5 shows normal waveforms obtained under set conditions (continuous R character as received from a tape fed transmitter) for the purpose of signal tracing. This table gives the key test points at which these waveforms are obtained and should be very helpful in systematically tracing through signals. Waveforms are also shown on the schematic diagrams, figures 5-17 and 5-18.

TABLE 5-8. WINDING DATA

DESIGNATION SYMBOL	MFR. & MFR'S DESIG. *	DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RESISTANCE IN OHMS	IMPEDANCE RATIO	HIPOT AC VOLTS	REMARKS
L401	CTR 14989		#34 and #33 wire connected in series internally to give single 3254 turn winding	#34 P.E. and #33 P.E.	2221 1033	337	—	1750	Hermetically sealed case; 16 henries. #34 wire wound next to core, start term #1, finish term #2. Vacuum impregnated in Synthite Varnish #PG-1 under 2" of vacuum. Bake for 7.5 hours at 104° to 116°C. (220° to 240°F.)
L801	CTR 14990		Single	#35 P.E.	3366	328	—	1750	Hermetically sealed case; 15 henries. Start term #1, finish term #2. Vacuum impregnated in Synthite Varnish #PG-1 under 2" of vacuum. Bake for 7.5 hrs at 104° to 116°C. (220° to 240°F.)

TABLE 5-8. WINDING DATA (Continued)

DESIGNATION SYMBOL	MFR. & MFR'S DESIG. *	DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RESISTANCE IN OHMS	IMPEDANCE RATIO	HIPOT AC VOLTS	REMARKS
T101	CTR 14981		Pri. Term. 1-2 Sec. Term. 3-4	#41 P.E. #41 P.E.	1620 4135	366 1990	1 to 6.25	500 500	Hermetically sealed case; start terms 1 and 3, finish terms 2 and 4. Pre-heat for 1½ hrs at 116°C (240°F), then impregnate in Irvington No. 100 Clear Baking Varnish under 1" of vacuum, followed by 25 pounds per square inch for minimum of 15 minutes. Bake for 10 hrs at 143°C (289°F). Part of Z102.
T102	CTR 14976		Pri. Term. 1-2 Sec. Term. 3-4	#43 H.F. #43 H.F.	3327 5550	864 1990	1 to 2.4	750 750	Hermetically sealed case; start terms 1 and 3, finish terms 2 and 4. Pre-heat for 1½ hrs at 116°C (240°F), then impregnate in Irvington No. 100 Clear Baking Varnish under 1" of vacuum, followed by 25 pounds per square inch for minimum of 15 minutes. Bake for 10 hrs at 143°C (289°F).
T201	CTR 14977		Pri. Term. 3-5 CT Term. 4 Sec. Term. 1-2	#42 P.E. #36 P.E.	2740 CT at 1370 582	600 41	23.3 to 1	750 750	Hermetically sealed case; start terms 1 and 3, finish terms 2 and 5. Pre-heat for 1½ hrs at 116°C (240°F), then impregnate in Irvington No. 100 Clear Baking Varnish under 1" of vacuum, followed by 25 pounds per square inch for minimum of 15 minutes. Baked for 10 hrs at 143°C (289°F).
T401	CTR 14979		Pri. Term. 1-4 Tap Term. 2 Tap Term. 3 Sec. #1 Term. 5-9 incl Term. 5-6 Term. 6-7 Term. 7-9 CT Term. 8 Sec. #2 Term. 10-12 CT Term. 11 Sec. #3 Term. 13-14	#22 P.E. #23 P.E. #38 P.E. #33 P.E. #13 P.E. #23 P.E.	378 Tap at 315 Tap at 347 4 1263 1570 CT at 785 20 CT at 10 20	3.25 .083 564 206 .03 .305	— — — — — —	2500 2500 2500 2500 2500 2500	Hermetically sealed case; start terms 1, 5, 6, 7, 10, and 13, finish terms 4, 6, 7, 9, 12, and 14. Pre-heat for 1½ hrs at 116°C (240°F), then impregnate in Irvington No. 100 Clear Baking Varnish under 1" of vacuum, followed by 25 pounds per square inch for minimum of 15 minutes. Bake for 10 hrs at 143°C (289°F).
T801	CTR 14978		Pri. Term. 1-4 Tap Term. 2 Tap Term. 3 Sec. #1 Term. 5-8 CT Term. 6 Tap Term. 7 Sec. #2 Term. 9-11 CT Term. 10	#23 P.E. #35 P.E. #16 P.E.	478 Tap at 400 Tap at 439 2418 CT at 1209.5 Tap at 1429 26 CT at 13	4.5 514 .08	— — —	1750 1750 1750	Hermetically sealed case; start terms 1,5, and 9, finish terms 4, 8, and 11. Pre-heat for 1½ hrs at 116°C (240°F), then impregnate in Irvington No. 100 Clear Baking Varnish under 1" of vacuum, followed by 25 pounds per square inch for minimum of 15 minutes. Bake for 10 hrs at 143°C (289°F).

* See Table 6-8. List of Manufacturers

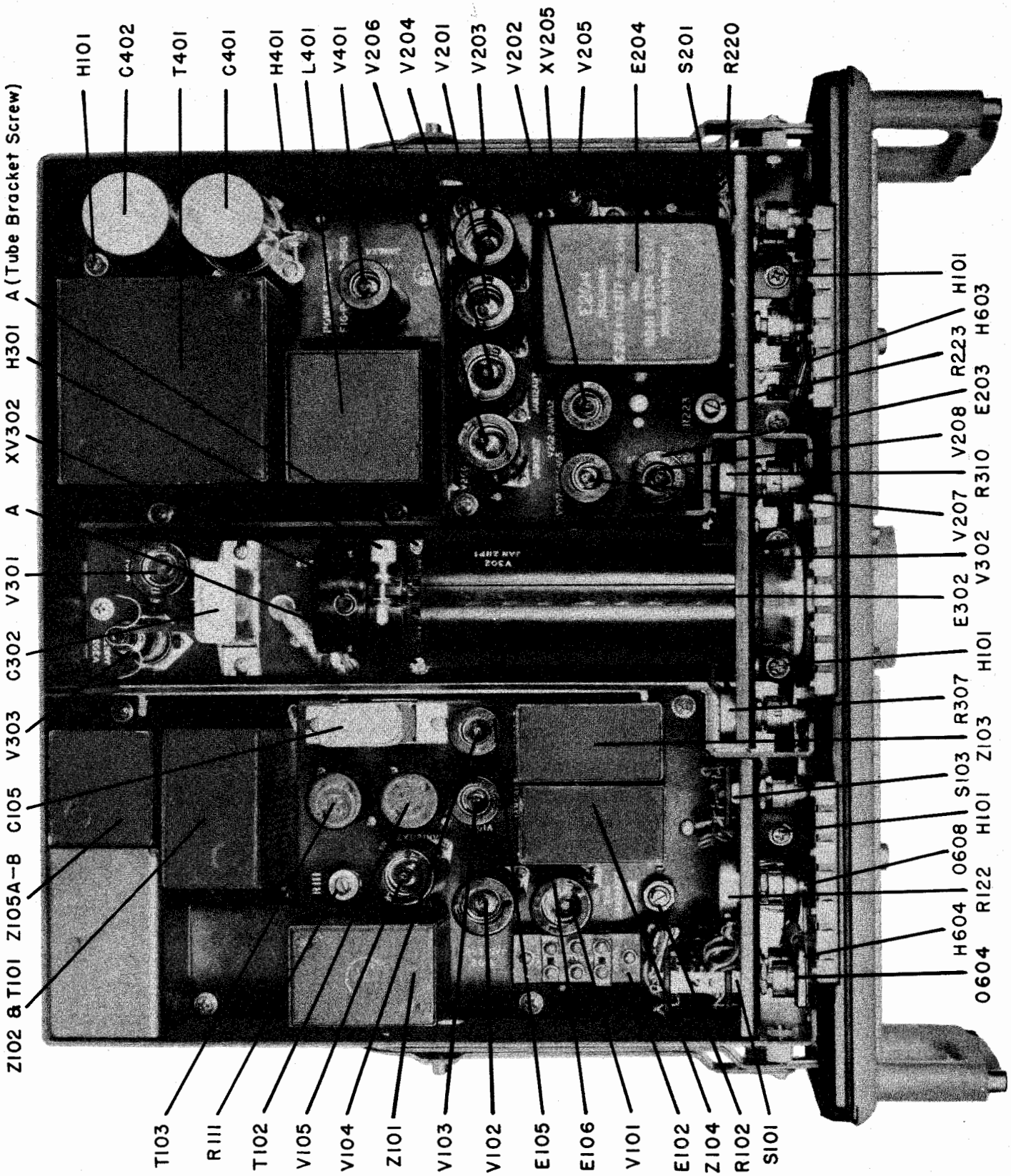


Figure 5-6. Frequency Shift Converter CV-89/URA-8A, Top of Drawer Assembly Chassis

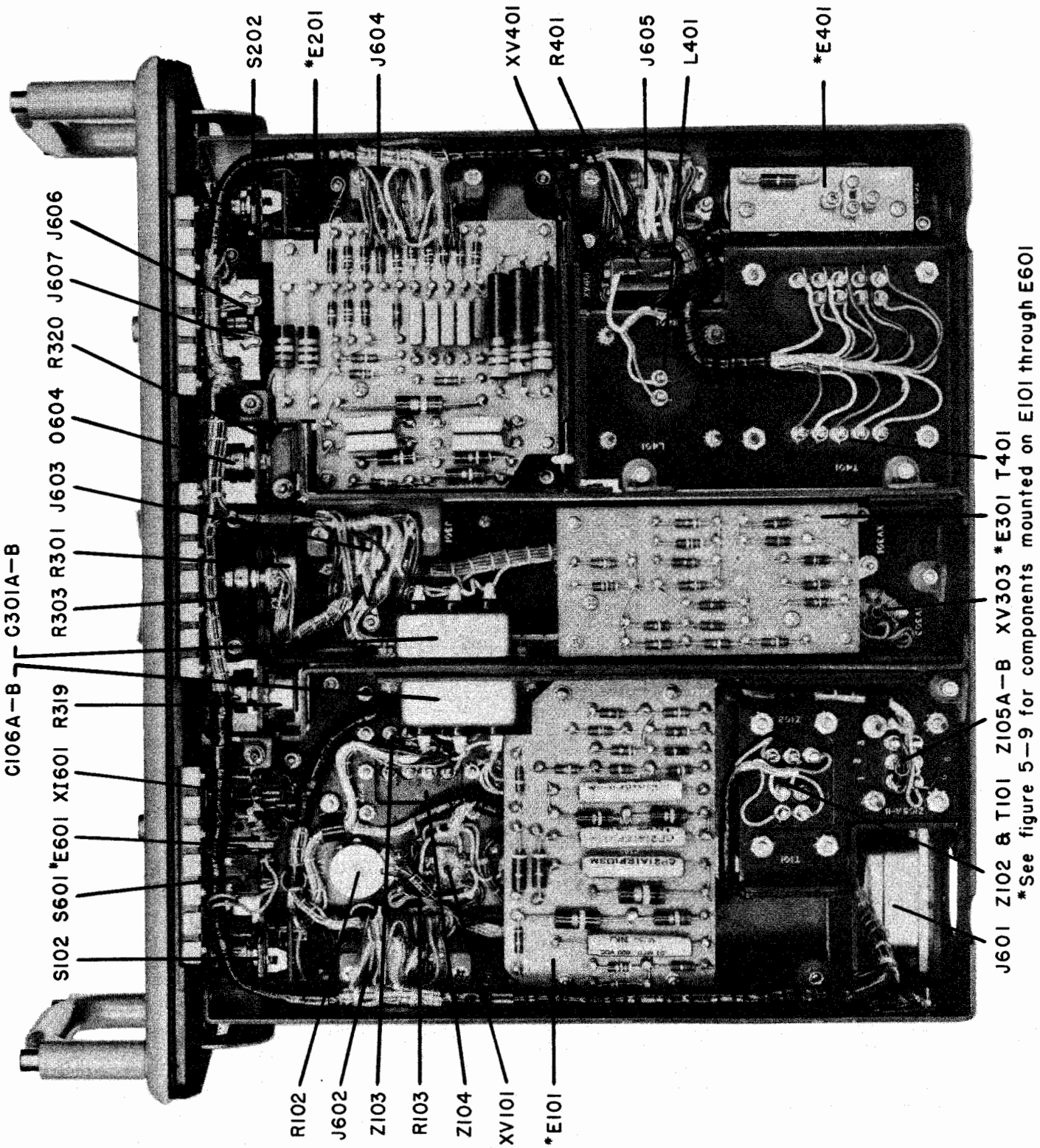


Figure 5-7. Frequency Shift Converter CV-89/URA-8A, Bottom of Drawer Assembly Chassis

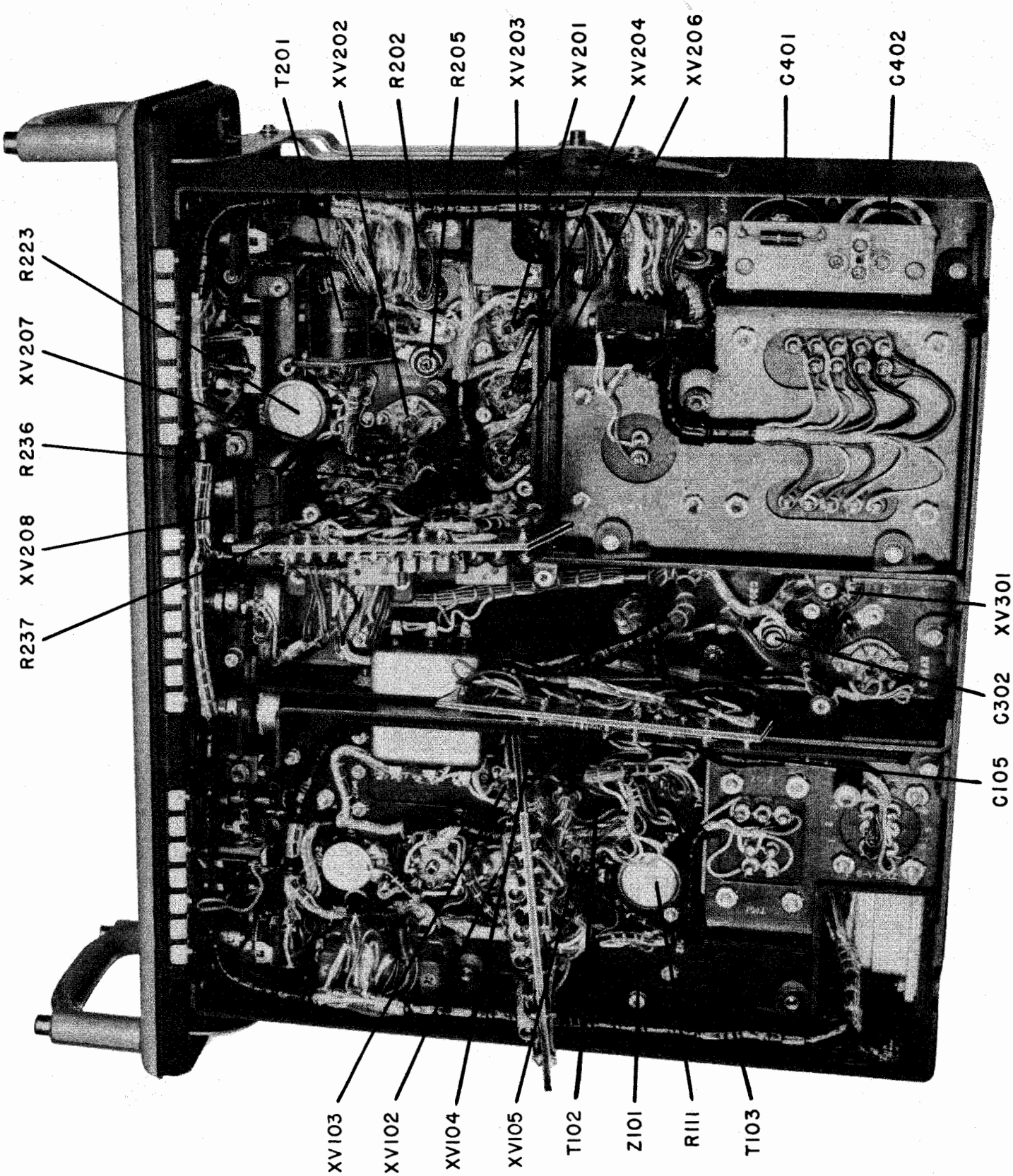
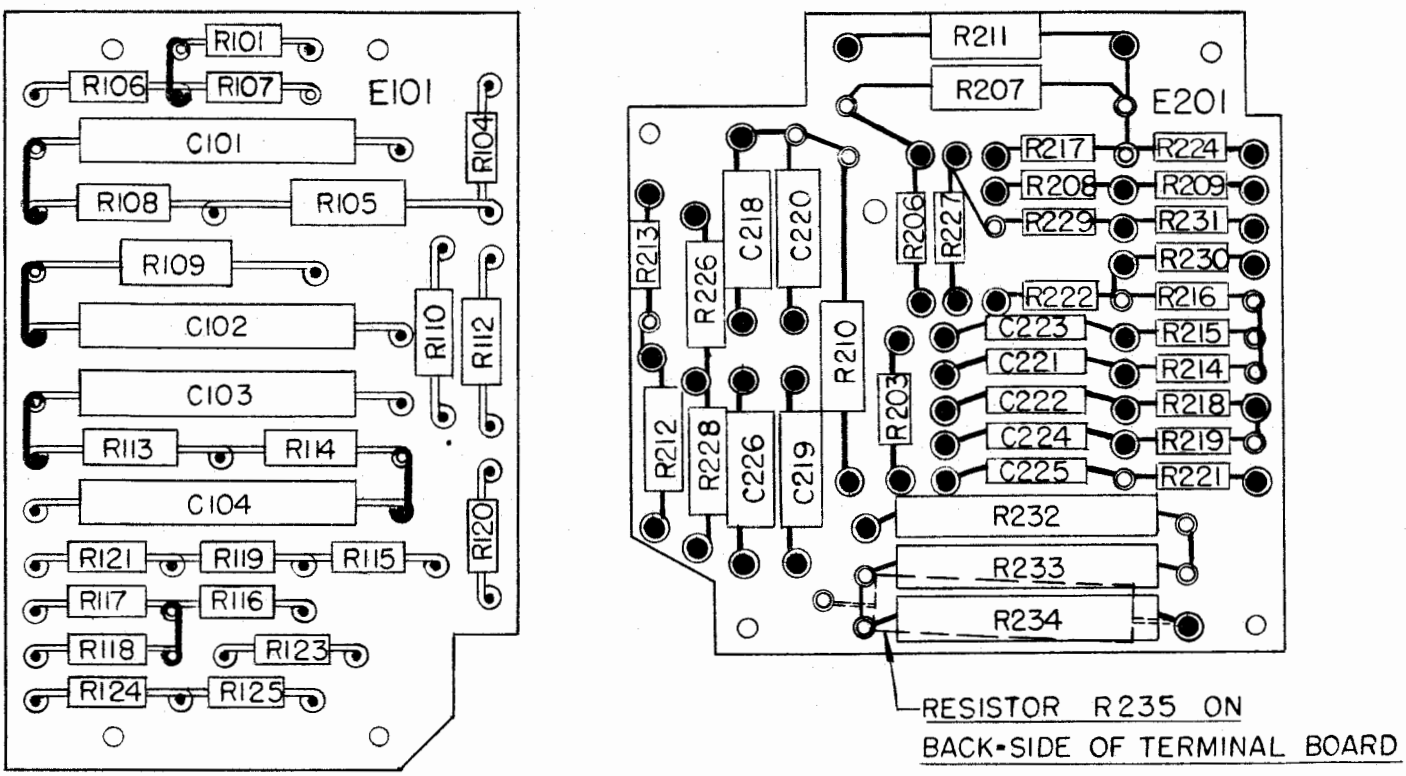
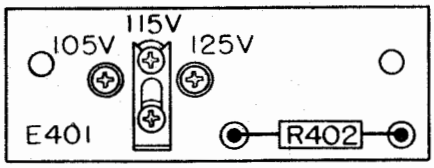
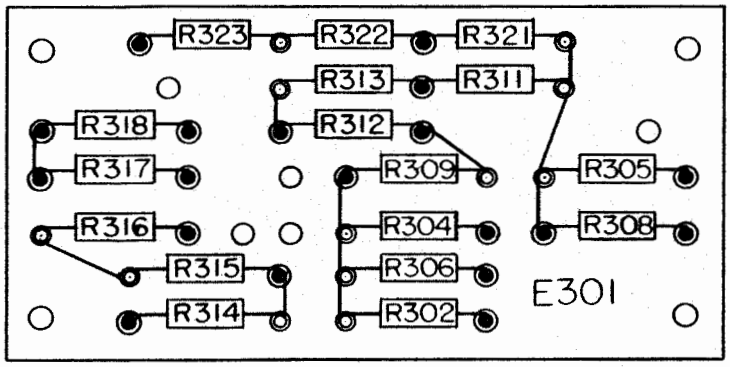


Figure 5-8. Frequency Shift Converter CV-89/URA-8A, Bottom of Drawer Assembly with Terminal Boards Raised







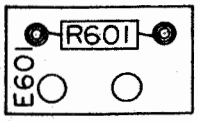


Figure 5-9. Frequency Shift Converter CV-89/URA-8A, Components Mounted on Terminal Boards

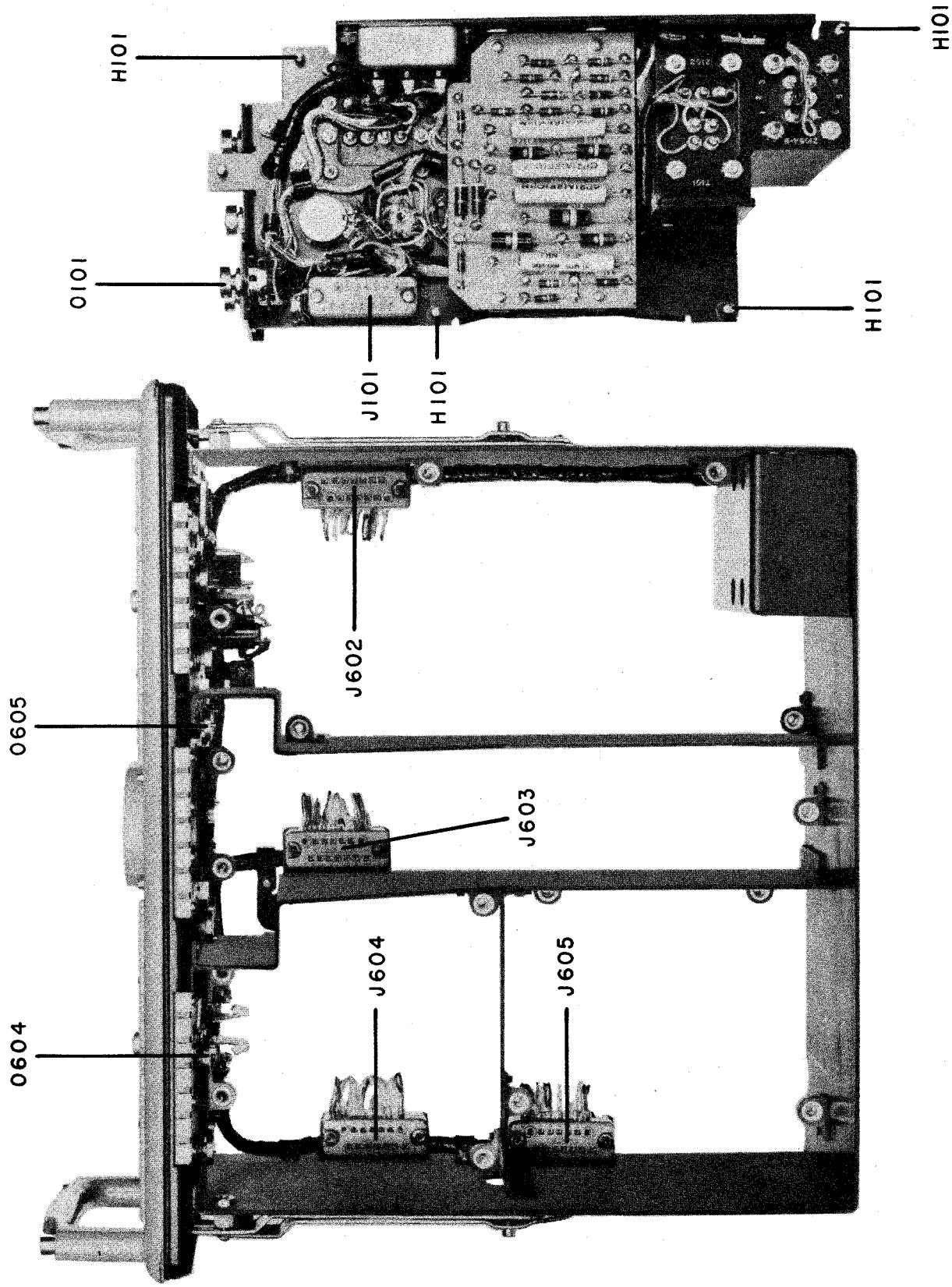


Figure 5-10. View of Receptacles in Chassis-Panel Assembly (Typical)

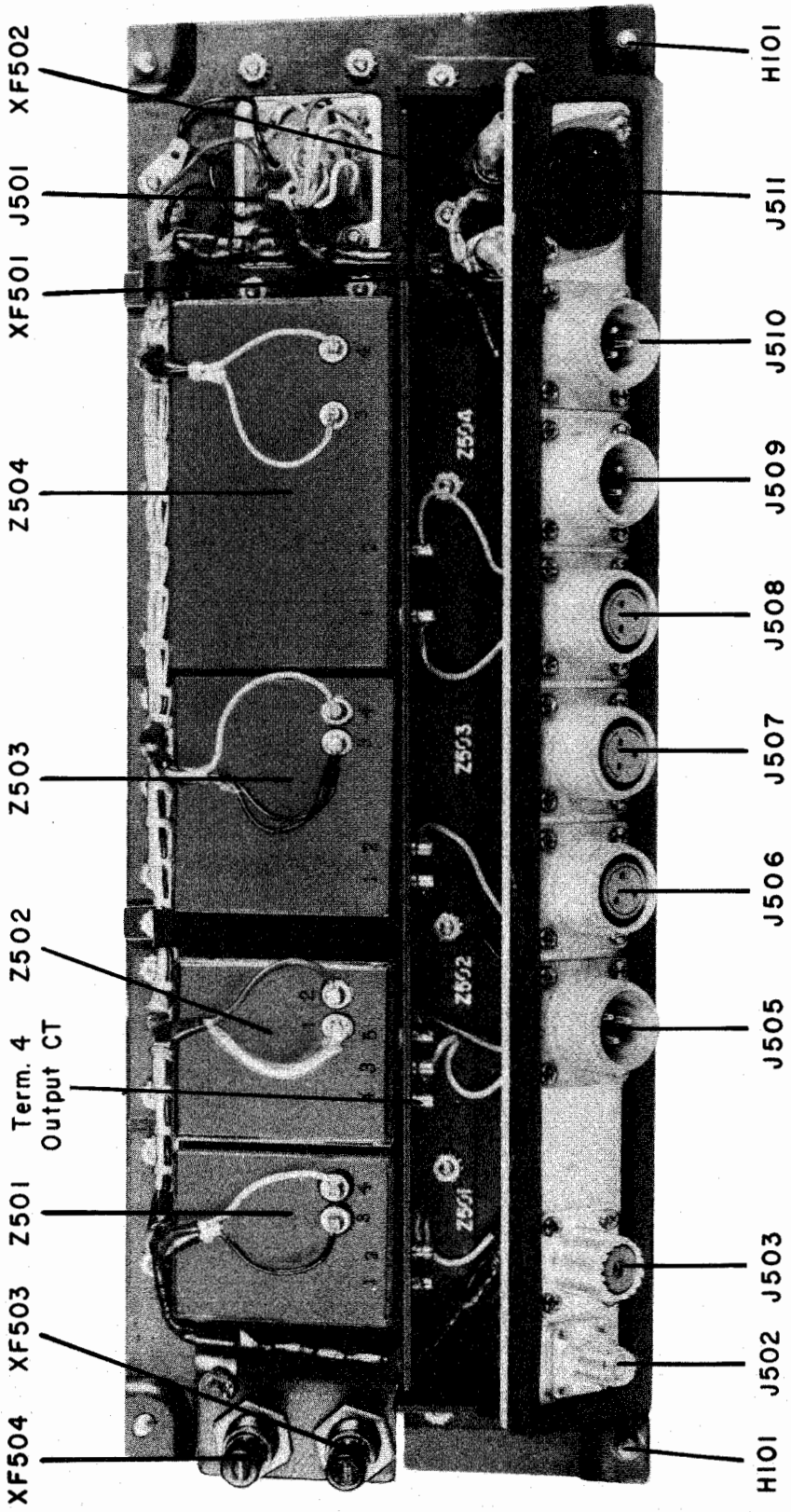


Figure 5-11. Converter Cable Filter Assembly

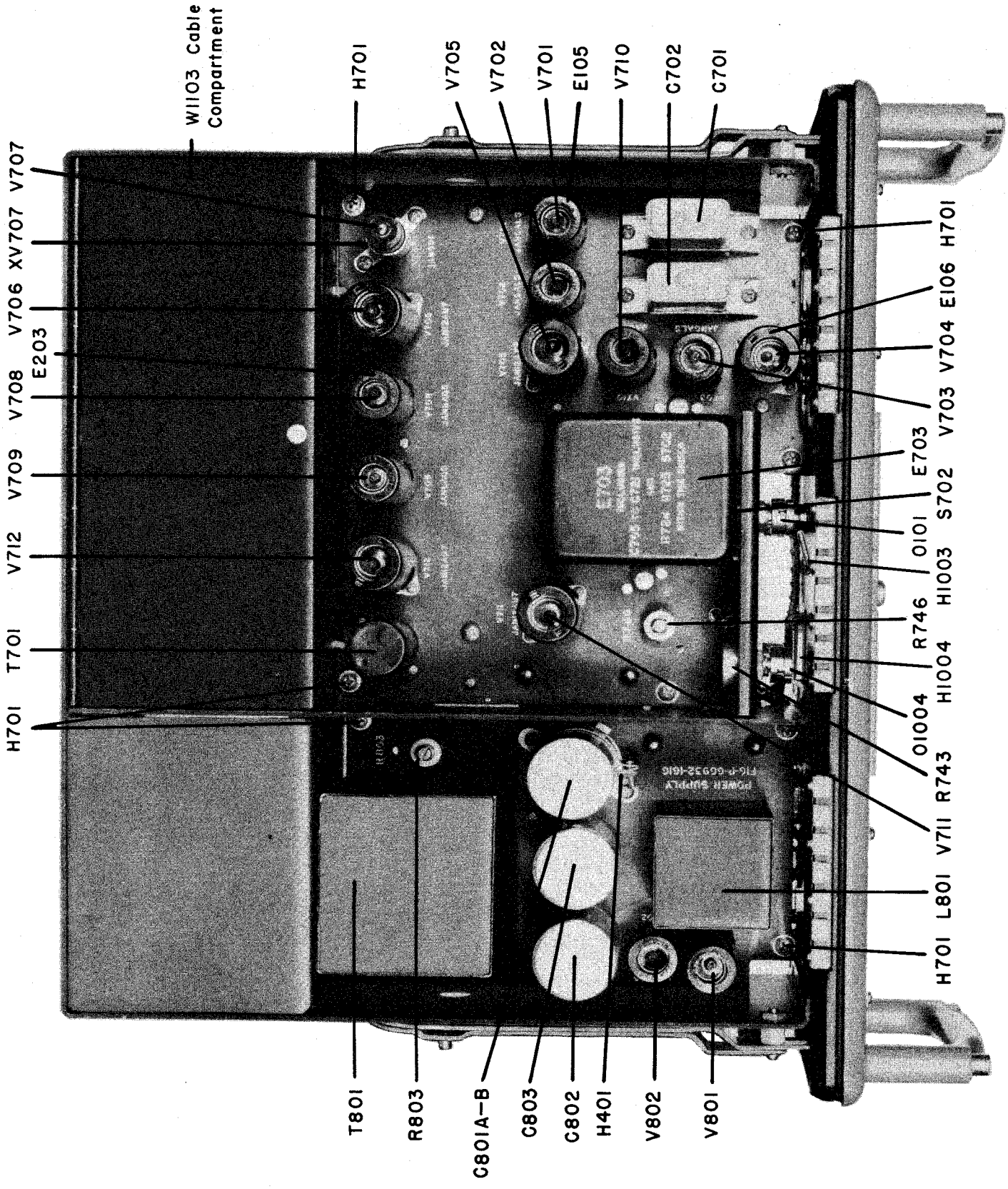


Figure 5-12. Comparator CM-22/URA-8A, Top of Drawer Assembly Chassis

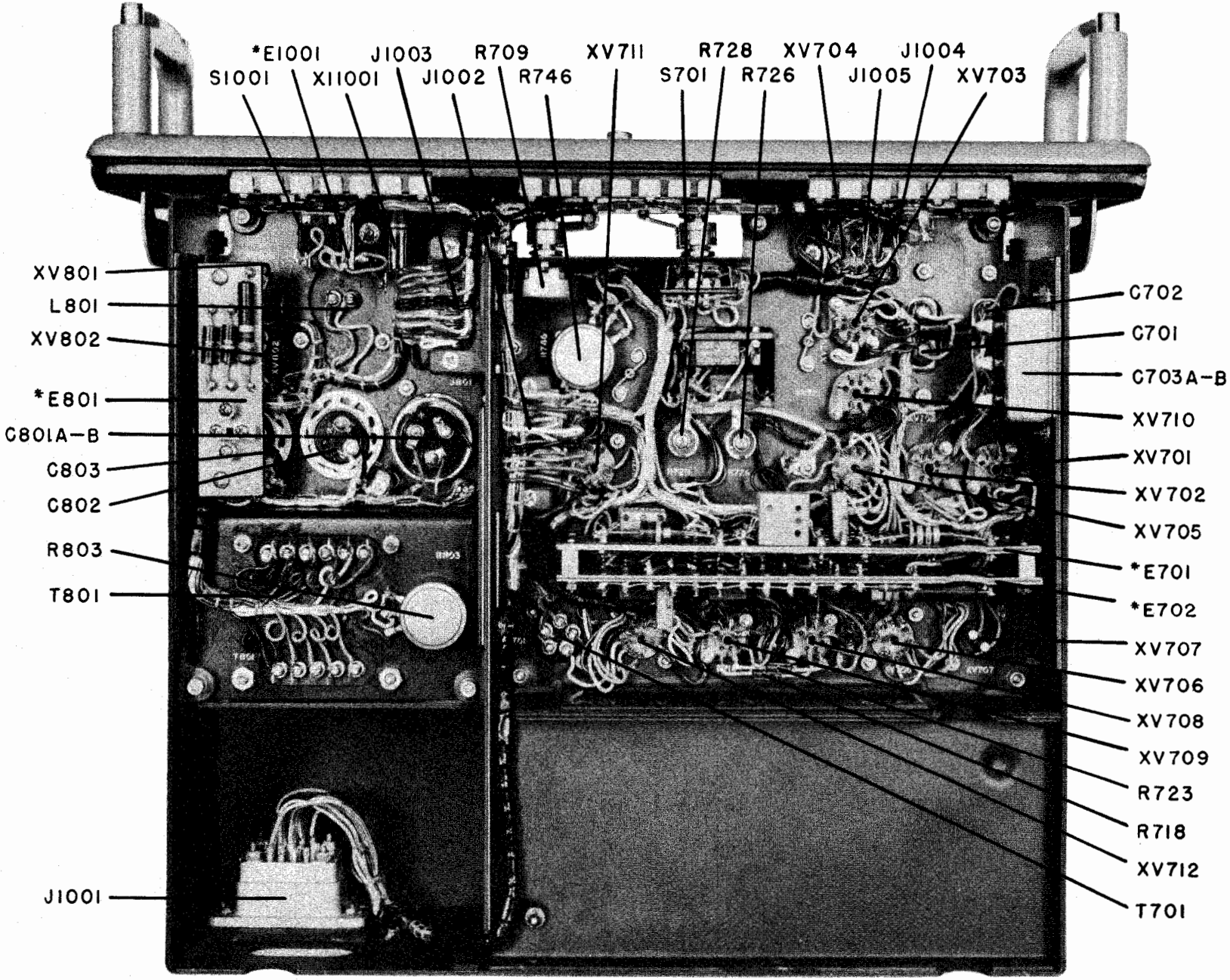
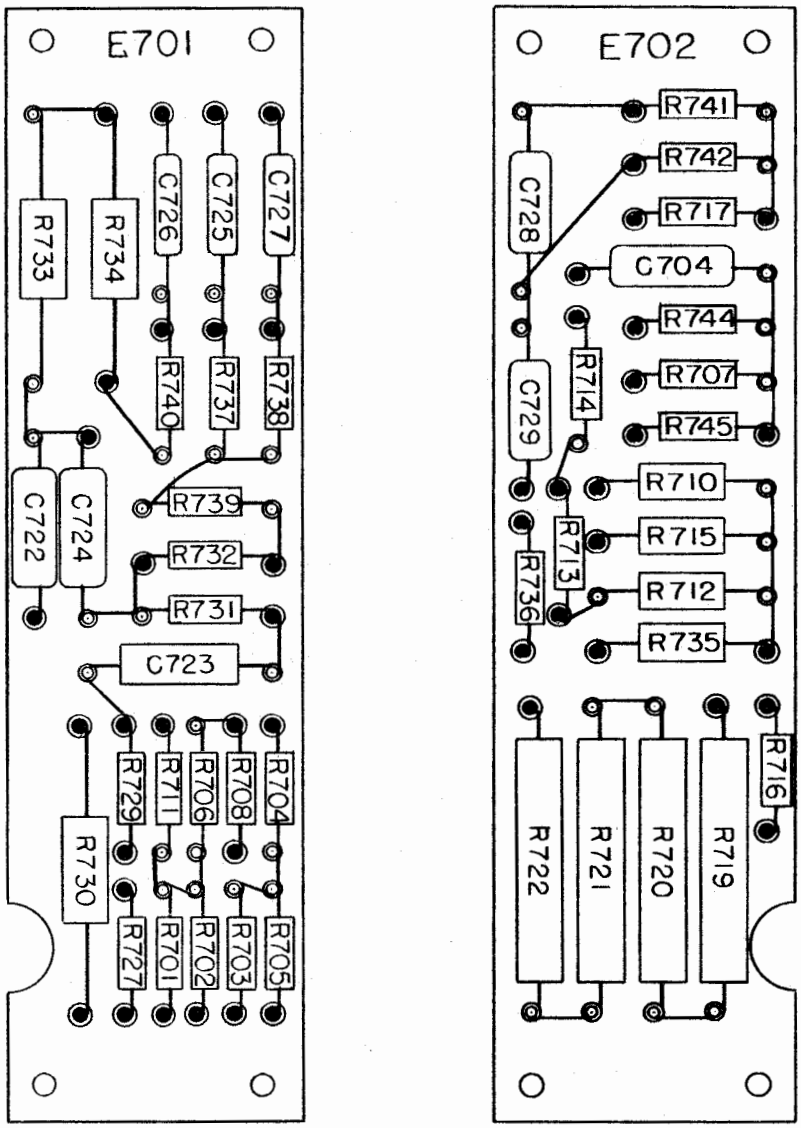


Figure 5-13. Comparator CM-22/URA-8A, Bottom of Drawer Assembly Chassis

*See figure 5-14 for components mounted on E701 through E1001



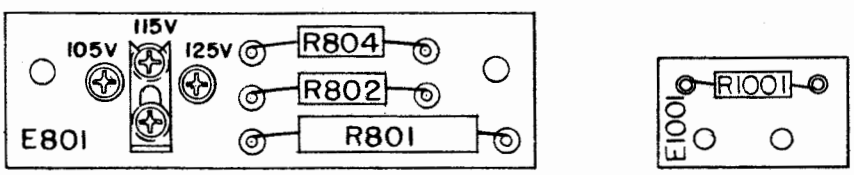


Figure 5-14. Comparator CM-22/URA-8A, Components Mounted on Terminal Boards

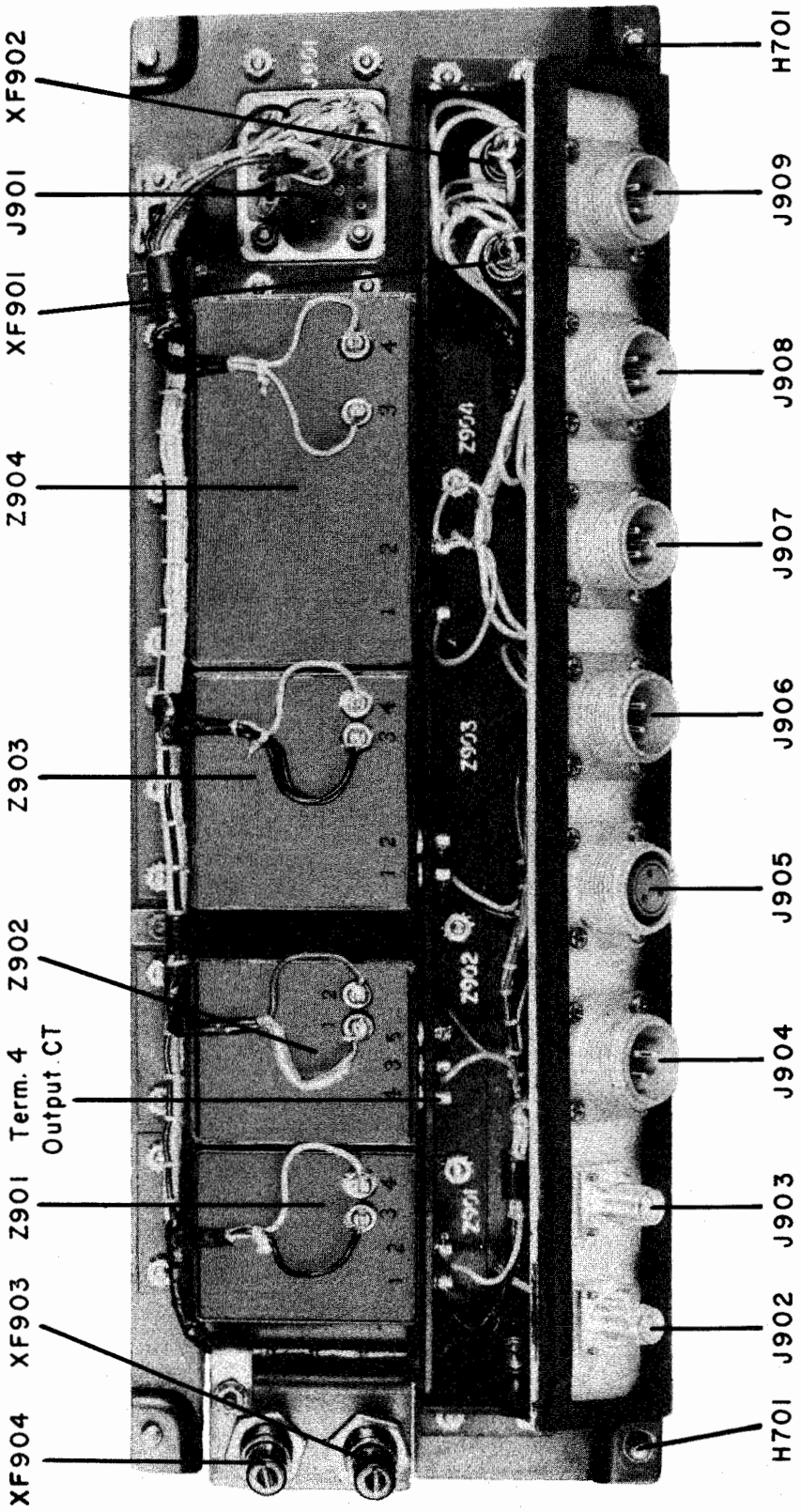


Figure 5-15. Comparator Cable Filter Assembly

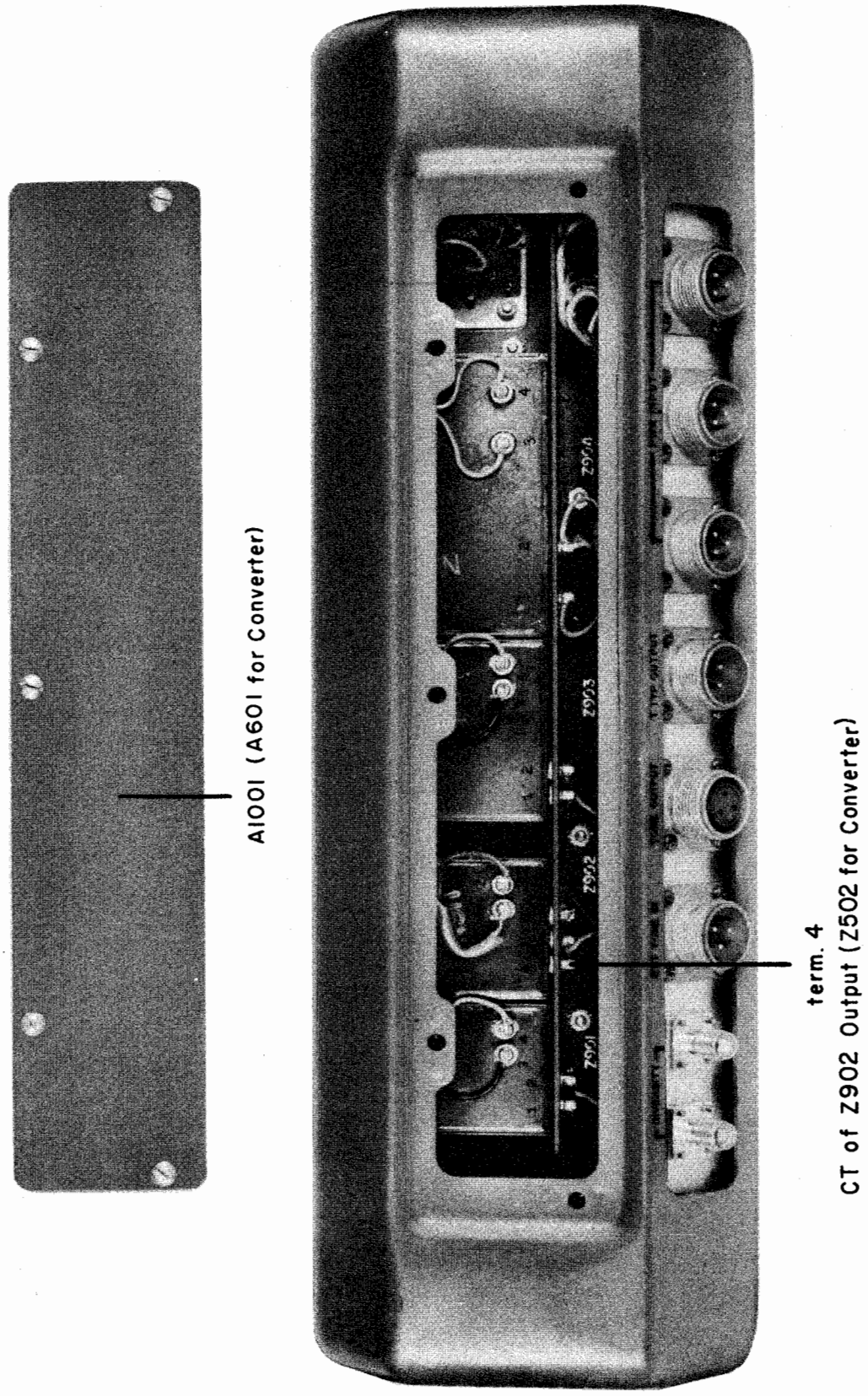
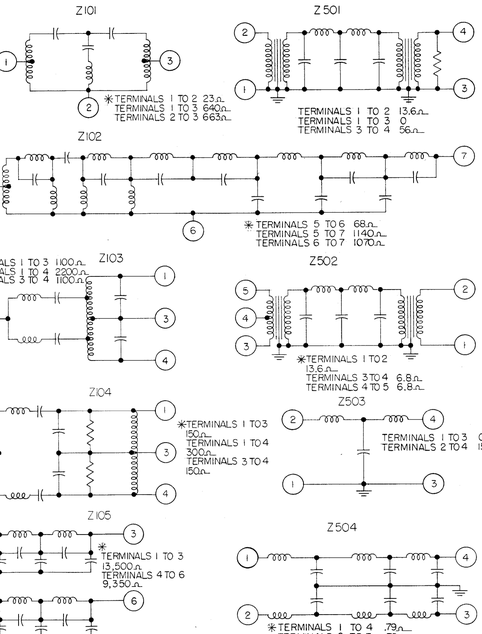
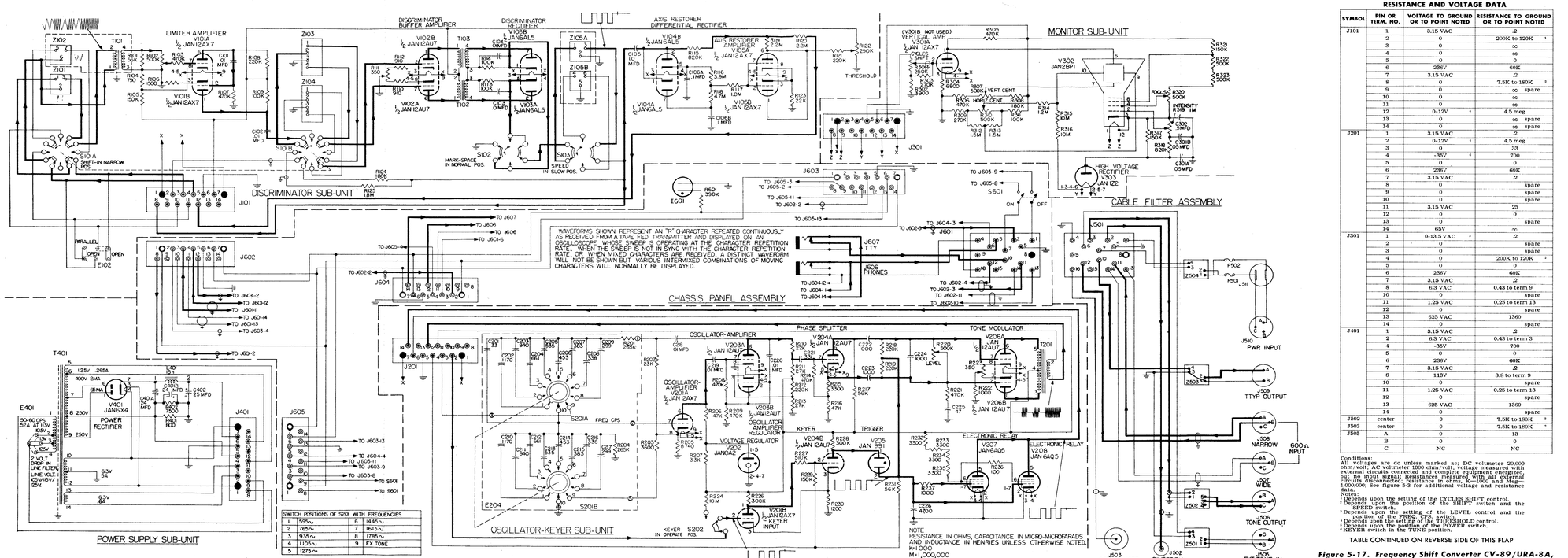


Figure 5-16. View of Access Opening to Cable Filter (Typical)



* FOR FILTERS MARKED WITH AN ASTERK, THE INSULATION RESISTANCE BETWEEN ANY TERMINAL AND CASE WILL NORMALLY BE 50 MEGOHMS OR HIGHER WHEN MEASURED WITH A POTENTIAL OF 500 VOLTS.



SWITCH POSITIONS OF S201 WITH FREQUENCIES			
1	595~	6	1445~
2	765~	7	1615~
3	935~	8	1785~
4	1105~	9	EX TONE
5	1275~		

RESISTANCE AND VOLTAGE DATA

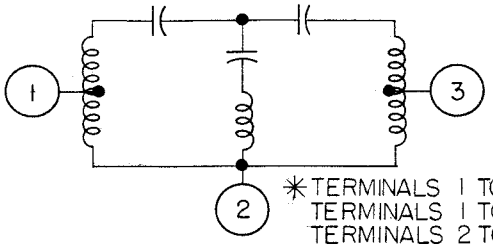
SYMBOL	PIN OR TERM. NO.	VOLTAGE TO GROUND OR TO POINT NOTED	RESISTANCE TO GROUND OR TO POINT NOTED
J101	1	3.15 VAC	2
	2	0	200K to 320K [1]
	3	0	∞
	4	0	∞
	5	0	∞
	6	236V	60K
	7	3.15 VAC	.2
	8	0	7.5K to 180K [2]
	9	0	∞ spare
	10	0	∞
	11	0	∞
	12	0-12V [4]	4.5 meg
	13	0	∞ spare
	14	0	∞ spare
J201	1	3.15 VAC	.2
	2	0-12V [4]	4.5 meg
	3	0	33
	4	-35V [4]	700
	5	0	0
	6	236V	60K
	7	3.15 VAC	.2
	8	0	spare
	9	0	spare
	10	0	spare
	11	3.15 VAC	25
	12	0	∞
	13	0	spare
	14	65V	∞
J301	1	0-13.5 VAC [3]	.2
	2	0	spare
	3	0	spare
	4	0	200K to 320K [1]
	5	0	0
	6	236V	60K
	7	3.15 VAC	.2
	8	6.3 VAC	0.43 to term 9
	10	0	spare
	11	1.25 VAC	0.25 to term 13
	12	0	spare
	13	625 VAC	1360
	14	0	spare
J401	1	3.15 VAC	.2
	2	6.3 VAC	0.43 to term 3
	4	-35V [4]	700
	5	0	0
	6	236V	60K
	7	3.15 VAC	.2
	8	113V	3.8 to term 9
	10	0	spare
	11	1.25 VAC	0.25 to term 13
	12	0	spare
	13	625 VAC	1360
	14	0	spare
J502	center	0	7.5K to 180K [2]
J503	center	0	7.5K to 180K [2]
J505	A	0	13
	B	0	0
	C	NC	NC

Conditions:
All voltages are dc unless marked ac; DC voltmeter 20,000 ohm/volt; AC voltmeter 1000 ohm/volt; voltage measured with external circuits connected and complete equipment energized, SHIFT switch in 850 position; resistance measured with all external circuits disconnected. Resistance in megohms when followed by 1,000,000; See figure 5-3 for additional voltage and resistance data.
Notes:
[1] Depends upon the setting of the CYCLES SHIFT control, the position of the SHIFT switch and the SPEED switch.
[2] Depends upon the setting of the LEVEL control and the position of the FREQ. CPS. switch.
[3] Depends upon the setting of the THRESHOLD control.
[4] Depends upon the position of the POWER switch.
[5] KEYER switch in the TUNE position.

TABLE CONTINUED ON REVERSE SIDE OF THIS FLAP

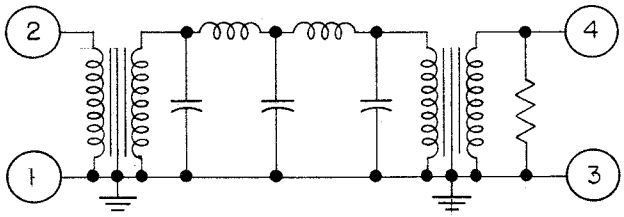
Figure 5-17. Frequency Shift Converter CV-89/URA-8A, Schematic Diagram

Z101



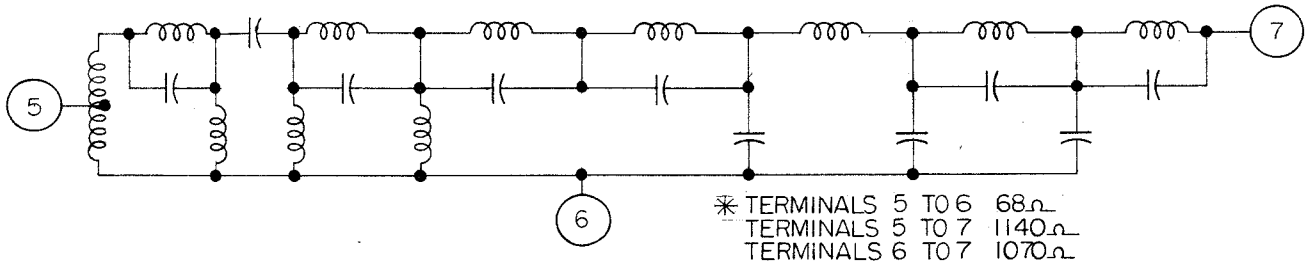
✳TERMINALS 1 TO 2 23Ω
TERMINALS 1 TO 3 640Ω
TERMINALS 2 TO 3 663Ω

Z 501



TERMINALS 1 TO 2 13.6Ω
TERMINALS 1 TO 3 0
TERMINALS 3 TO 4 56Ω

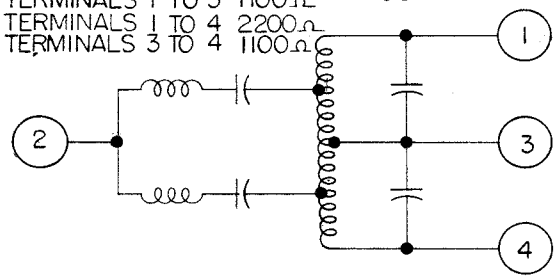
Z102



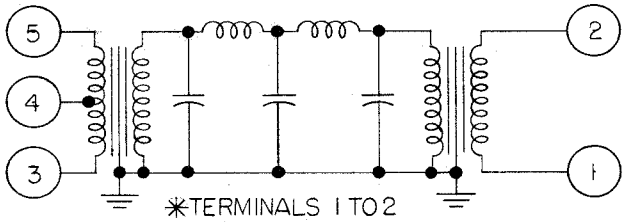
✳TERMINALS 5 TO 6 68Ω
TERMINALS 5 TO 7 1140Ω
TERMINALS 6 TO 7 1070Ω

✳TERMINALS 1 TO 3 1100Ω
TERMINALS 1 TO 4 2200Ω
TERMINALS 3 TO 4 1100Ω

Z103

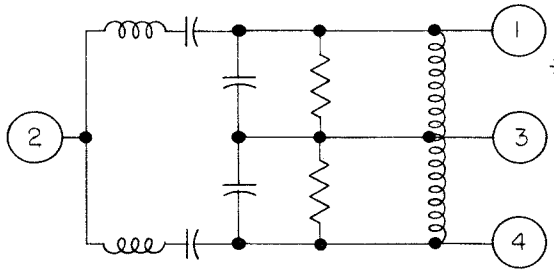


Z502



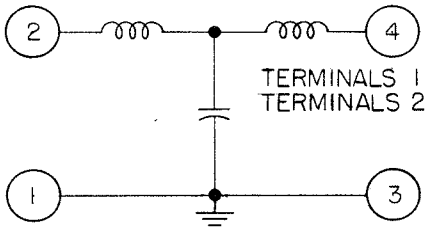
✳TERMINALS 1 TO 2 13.6Ω
TERMINALS 3 TO 4 6.8Ω
TERMINALS 4 TO 5 6.8Ω

Z104



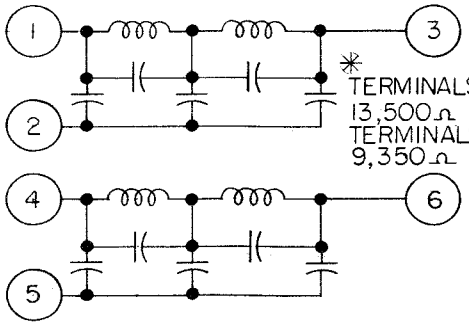
✳TERMINALS 1 TO 3 150Ω
TERMINALS 1 TO 4 300Ω
TERMINALS 3 TO 4 150Ω

Z503



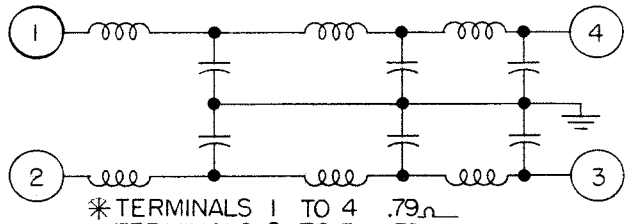
TERMINALS 1 TO 3 0
TERMINALS 2 TO 4 158Ω

Z105



✳TERMINALS 1 TO 3 13,500Ω
TERMINALS 4 TO 6 9,350Ω

Z504

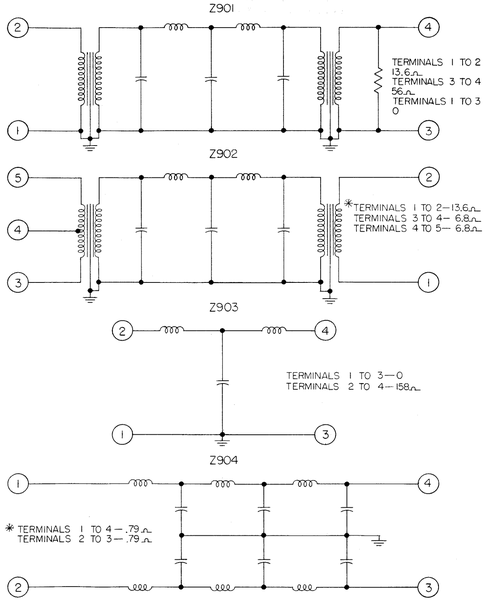


✳TERMINALS 1 TO 4 .79Ω
TERMINALS 2 TO 3 .79Ω

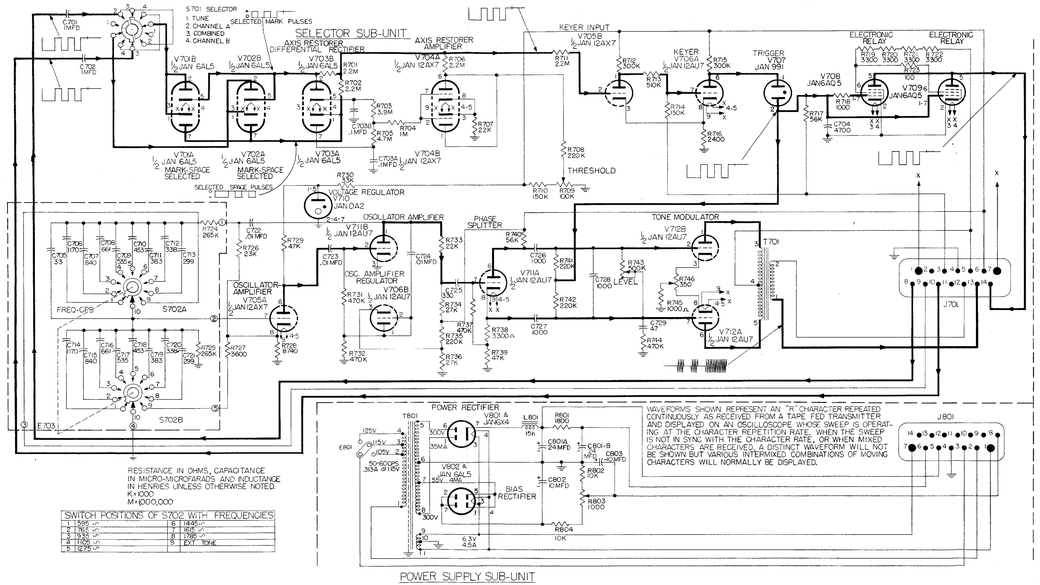
✳ FOR FILTERS MARKED WITH AN ASTERK, THE INSULATION RESISTANCE BETWEEN ANY TERMINAL AND CASE WILL NORMALLY BE 50 MEGOHMS OR HIGHER WHEN MEASURED WITH A POTENTIAL OF 500 VOLTS.

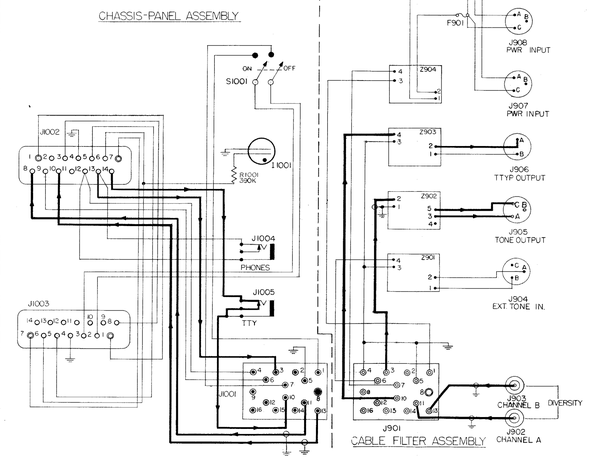
RESISTANCE AND VOLTAGE DATA (Continued)

SYMBOL	PIN OR TERM. NO.	VOLTAGE TO GROUND OR TO POINT NOTED	RESISTANCE TO GROUND OR TO POINT NOTED
J509	A	65V	∞
	B	0	0
	C	NC	NC
J510	A	115V	∞ to 8 to term C [5]
	B	NC	NC
J601	1	113V	∞ -4 to term 7 [5]
	2	0	7.5K to 180K [2]
	3	0-13.5 VAC [3]	25
	4	0	0
	5	0	0
	6	0	33
	8	0	spare
	9	0	spare
	10	65V	∞
	11	0	∞
	12	0	∞
	13	0	∞
	14	0	∞
	15	0	spare
	16	0	7.5K to 180K [2]
T101	1	0	18 to term 2
	3	0	1000 to term 4
T102	1	9.5V	1250 to term 2
	3	-0.3V	5.2K to term 4
T103	1	8.5V	1250 to term 2
	3	-0.3V	5.2K to term 4
T201	1	0-13.5 VAC	25 to term 2
	3	2.4V	600 to term 4
	5	2.4V	600 to term 4
T401	1	103 VAC	3.5 to term 2
	1	113 VAC	3.8 to term 3
	1	123 VAC	4.1 to term 4
	5	1.25 VAC	0.25 to term 6
	6	410 VAC	560 to term 7
	7	255 VAC	86 to term 8
	8	255 VAC	84 to term 9
	9	510 VAC	170 to term 7
	10	3.15 VAC	0.2 to term 11
	12	3.15 VAC	0.2 to term 11
	13	6.3 VAC	0.43 to term 14
L401	1	33V	325 to term 2
C401A	+ term	255V	60K
	— term	-35V	700
C401B	+ term	0	0
C402	+ term	236V	60K
	— term	0	0



* FOR FILTERS MARKED WITH AN ASTERISK, THE INSULATION RESISTANCE BETWEEN ANY TERMINAL AND CASE WILL NORMALLY BE 50 MEGOHMS OR HIGHER WHEN MEASURED WITH A POTENTIAL OF 500 VOLTS.



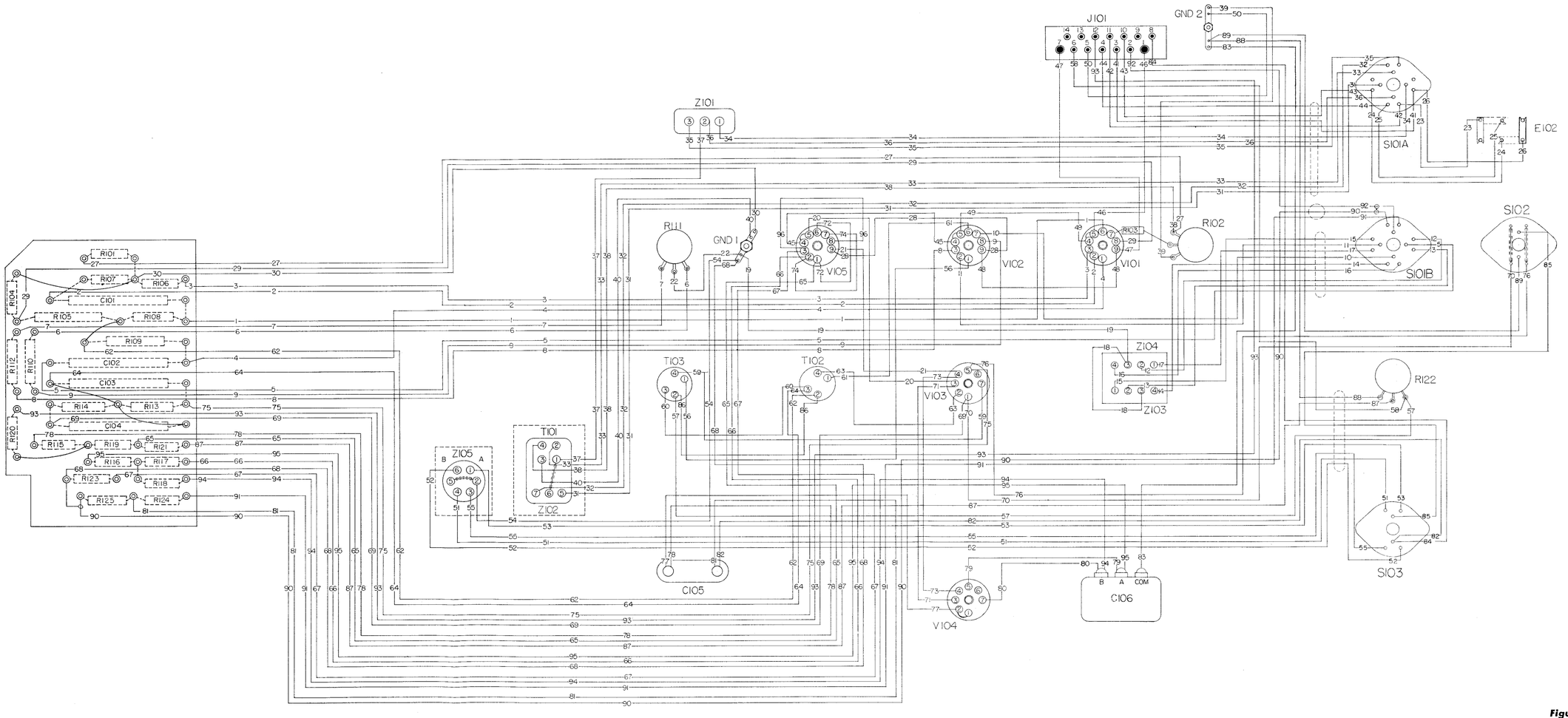


RESISTANCE AND VOLTAGE DATA

SYMBOL	PIN OR TERM. NO.	VOLTAGE TO GROUND OR TO POINT NOTED	RESISTANCE TO GROUND OR TO POINT NOTED
J701	1	3.15 VAC	.1
	2	0	spare
	3	32-35V [3]	10K to 11K [3]
	4	0	0
	5	240V	100K
	6	220V	100K
	7	3.15 VAC	.1
	8	0	∞
	9	0	33
	10	0	∞
	11	0	spare
	12	0	0
	13	0-13.5 VAC [1]	25
	14	65V	∞
J801	1	3.15 VAC	.1
	2	114 VAC	4.2 to term 3
	3	0	0
	4	0	0
	5	240V	100K
	6	220V	100K
	7	3.15 VAC	.1
	8	32-35V [3]	10K to 11K [3]
	9	0	spare
	10	0	spare
	11	0	spare
	12	0	spare
	13	0	spare
	14	0	spare
J904	A	0	13
	B	0	0
	C	NC	NC
J906	A	65V	∞
	B	0	0
	C	NC	NC
J907	A	115V	∞ —10 to term C [3]
	B	NC	NC
J908	A	115V	∞ —10 to term C [3]
	B	NC	NC
J909	A	115V	∞ —10 to term C [3]
	B	NC	NC
J1001	1	114 VAC	∞ —5 to term 7 [3]
	2	0	spare
	3	0-13.5 VAC [1]	25
	4	0	0
	5	0	0
	6	0	33
	8	0	spare
	9	0	spare
	10	65V	∞
	11	0	∞
	12	0	spare
	13	0	∞
	14	0	spare
	15	0	spare
	16	0	spare
T701	1	0-13.5 VAC [1]	25 to term 2
	3	2V	600 to term 4
	5	2V	600 to term 4
T801	1	104 VAC	3.8 to term 2
	1	114 VAC	4.2 to term 3
	1	124 VAC	4.6 to term 4
	5	295 VAC	230 to term 6
	6	55 VAC	45 to term 7
	7	241 VAC	220 to term 8
	8	650 VAC	495 to term 5
	9	3.15 VAC	.09 to term 10
	11	3.15 VAC	.09 to term 10
L801	1	9.2V	320 to term 2
C801A	+ term	240V	100K
	- term	0	0
C801B	+ term	220V	100K
C802	- term	72V	21K
	+ term	0	0
C803	+ term	32-35V [3]	10K to 11K [3]
	- term	0	0

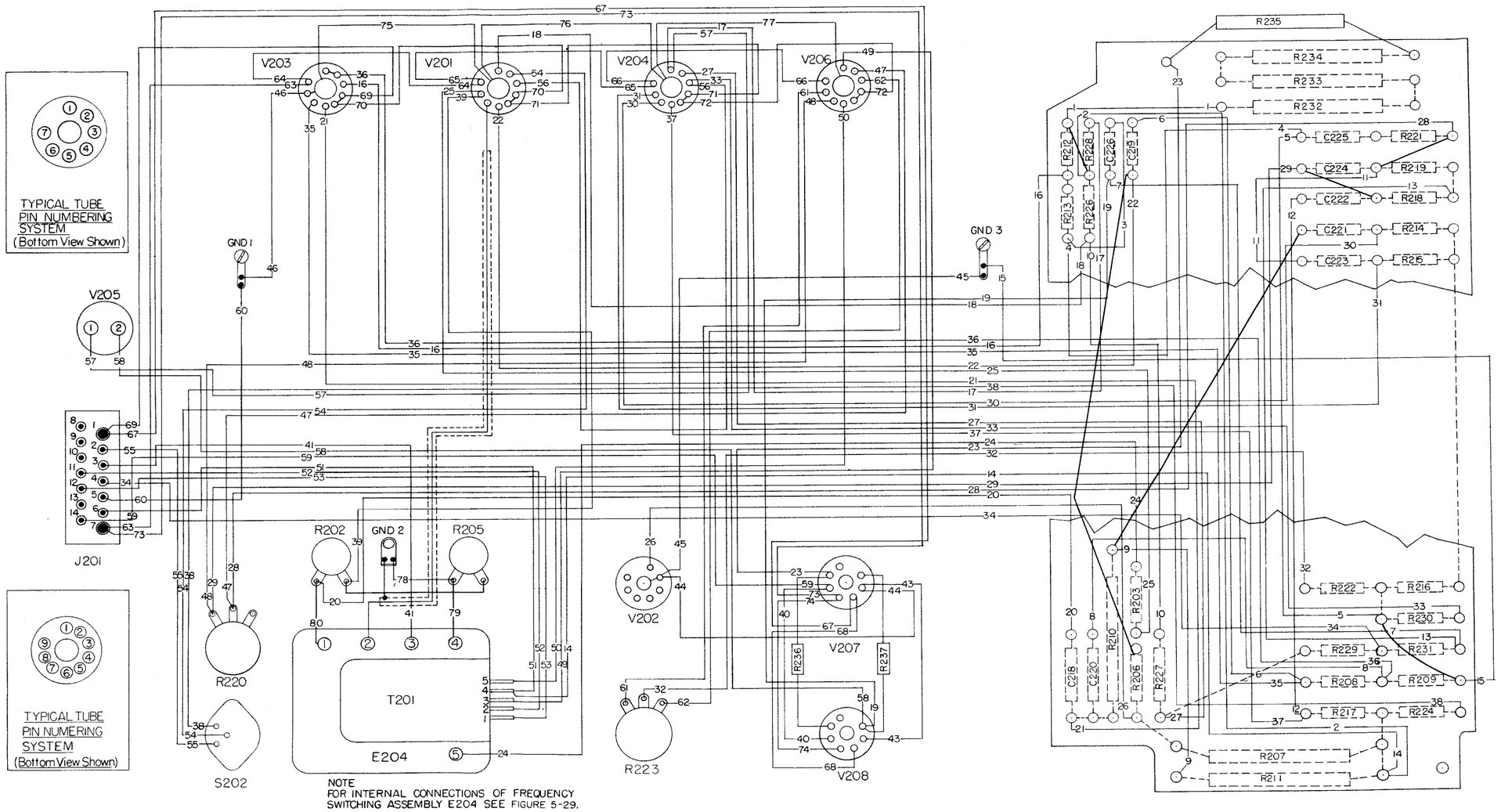
Conditions:
All voltages are dc unless marked ac; DC voltmeter 20,000 ohm/volt, AC voltmeter 1000 ohm/volt. Voltages measured with the CM-22/URA-8A connected to a control unit energized, but no input signal. Resistances measured with all external circuits disconnected. Resistance in ohms, K=1000 and Meg=1,000,000. See figure 5-4 for additional voltage and resistance data.
Notes:
[1] Depends upon the setting of the LEVEL control and the position of the FREQ. CPS. switch.
[2] Depends upon the position of the POWER switch.
[3] Depends upon the setting of R803.

Figure 5-18. Comparator CM-22/URA-8A, Schematic Diagram



WIRE NO	POINT	TO	POINT	COLOR	GAGE
1	V101-6	TO	C101,R106	BLUE	24
2	V101-2	TO	R107,C101	GREEN	24
3	V101-3	TO	R106	YELLOW	24
4	V101-1	TO	R109, C102	BLUE	24
5	S102	TO	S101B	BLUE WHITE	24
6	R110	TO	R111	WHITE	24
7	R112	TO	R111	WHITE BLACK	24
8	V102-3	TO	R112	YELLOW WHITE	24
9	V102-8	TO	R110	YELLOW	24
10	V102-7	TO	S101B	GREEN	24
11	V102-2	TO	S101B	GREEN WHITE	24
12	Z104-5	TO	S101B	BLUE	24
13	Z103-5	TO	S101B	WHITE	24
14	Z103-4	TO	S101B	BROWN	24
15	Z103-1	TO	S101B	GRAY	24
16	Z104-4	TO	S101B	YELLOW	24
17	Z104-1	TO	S101B	RED	24
18	Z103-3	TO	Z104-5	BLACK	24
19	Z104-3	TO	GROUND 1	BLACK	24
20	V103-3	TO	V105-5	BROWN	20
21	V103-4	TO	V105-3	BROWN	20
22	R111	TO	GROUND 1	BLACK	24
23	E102	TO	S101A	BROWN	24
24	E102	TO	S101A	ORANGE	24
25	E102	TO	S101A	YELLOW	24
26	E102	TO	S101A	VIOLET	24
27	R101	TO	R101	GREEN	24
28	V102-9	TO	V105-9	BROWN	20
29	R104, R105	TO	V101-8	YELLOW	24
30	R107, R106	TO	GROUND 1	BLACK	24
31	Z102-5	TO	S101A	GRAY	24
32	Z102-2	TO	S101A	BLUE	24
33	T101-2	TO	S101A	GREEN WHITE	24
34	Z101-1	TO	S101A	RED	24
35	Z103-2	TO	S101A	RED WHITE	24
36	Z101-2	TO	S101A	WHITE	24
37	Z101-3	TO	T101-1	WHITE	24
38	R104	TO	R102	GREEN	24
39	R102	TO	GROUND 2	BLACK	24
40	T101-3	TO	GROUND 1	BLACK	24
41	J101-5	TO	S101A	VIOLET	24
42	J101-11	TO	S101A	BROWN	24
43	J101-10	TO	S101A	ORANGE	24
44	J101-4	TO	S101A	YELLOW	24
45	V102-4	TO	V105-4	BROWN	20
46	J101-1	TO	V101-5	BROWN	20
47	J101-7	TO	V101-9	BROWN	20
48	V101-9	TO	V102-9	BROWN	20
49	V101-4	TO	V102-5	BROWN	20
50	J101-1	TO	GROUND	BLACK	24
51	Z105-4	TO	S103	ORANGE	24
52	Z105-6	TO	S103	GRAY	24
53	Z105-1	TO	S103	VIOLET	24
54	Z105-2	TO	GROUND 1	BLACK	24
55	Z105-5	TO	S103	BROWN	24
56	T103-1	TO	V102-1	BLUE WHITE	24
57	T103-2	TO	R122	RED	24
58	J101-6	TO	R122	RED	24
59	T103-6	TO	V103-7	GREEN	24
60	T103-5	TO	T102-3	WHITE	24
61	T102-1	TO	V103-6	BLUE	24
62	T102-2	TO	R109	RED	24
63	T102-4	TO	V103-2	GREEN	24
64	T102-3	TO	C104	WHITE	24
65	V105-1	TO	R115, R121	BLUE	24
66	V105-2	TO	R117	GREEN	24
67	V105-3	TO	R123	YELLOW	24
68	R123	TO	GROUND 1	BLACK	24
69	V103-1	TO	C104	YELLOW	24
70	V103-8	TO	S102	YELLOW	24
71	V103-3	TO	V104-3	BROWN	24
72	V105-1	TO	V105-6	BLUE	24
73	V104-4	TO	V104-8	BROWN	24
74	V105-2	TO	V104-7	GREEN	24
75	V103-5	TO	R113	YELLOW WHITE	24
76	V103-5	TO	S102	YELLOW WHITE	24
77	V104-2	TO	C105	GREEN WHITE	24
78	C105	TO	R125	GREEN WHITE	24
79	V104-5	TO	C106A	YELLOW	24
80	V104-7	TO	C106B	ORANGE	24
81	C105	TO	R124, R125	GREEN	24
82	C105	TO	S103	GREEN	24
83	C105 COM	TO	GROUND 2	BLACK	24
84	J101-8	TO	S103	GREEN	24
85	S103	TO	S102	GREEN	24
86	T103-2	TO	T102-2	RED	24
87	R101	TO	R107	ORANGE	24
88	R122	TO	GROUND 2	BLACK	24
89	S102	TO	GROUND 2	BLACK	24
90	R125	TO	S101B	GREEN SHIELDED	24
91	R124	TO	S101B	VIOLET	24
92	S101B	TO	J101C	GREEN WHITE SHI	24
93	J101-12	TO	R120	GREEN	24
94	R118	TO	C106B	ORANGE	24
95	R116	TO	C106A	YELLOW	24
96	V105-3	TO	V105-8	YELLOW	24

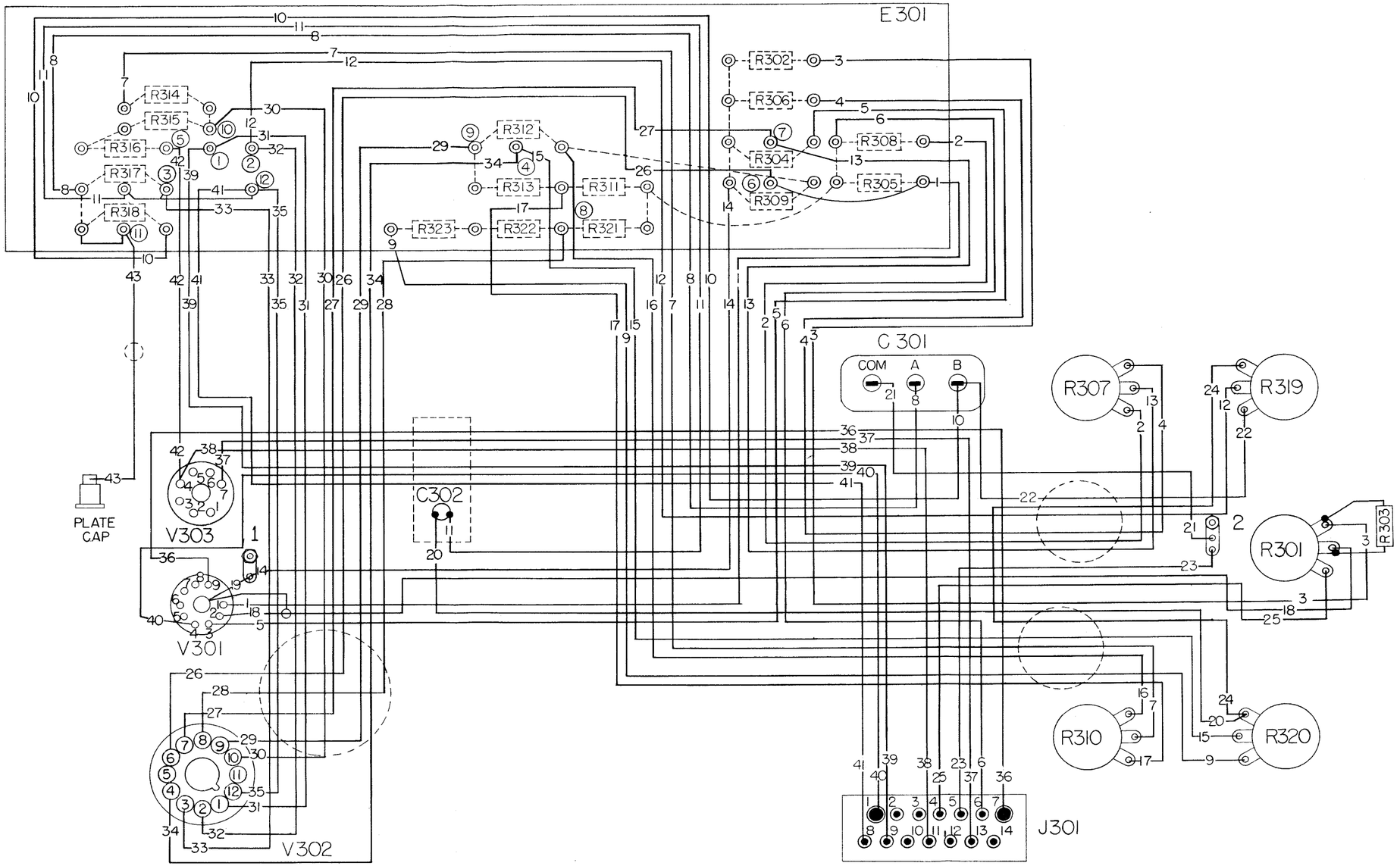
Figure 5-19. Discriminator Sub-Unit, Wiring Diagram



✳ ALL WIRES 24 GA UNLESS OTHERWISE SPECIFIED

WIRE NO.	POINT TO POINT	COLOR & GA.✳
1	R212 TO R232	RED
2	R226,R228 TO R211	RED
3	R213 TO C226	BLACK
4	R213 TO C225	BLACK
5	R230 TO C225	BLACK
6	C219 TO R208	GREEN
7	C226 TO R231	GREEN
8	C220 TO R208,R209	BLUE-WHITE TRACER
9	R210 TO R211	GREEN
10	R227 TO R226	BLUE
11	C224,R219 TO C223	GREEN
12	C222 TO R217	BLUE
13	R218 TO R231	GREEN
14	T201(4) TO R211	RED
15	R209 TO GROUND LUG	BLACK
16	V203(3) TO R212	YELLOW
17	V204(1) TO R228	BLUE
18	V201(1) TO R226	BLUE
19	V208(1) TO C226	GREEN
20	R202 TO C218	BLUE
21	V203(6) TO C218	BLUE
22	V201(6) TO C219	BLUE
23	V207(6) TO R235	ORANGE
24	E204(5) TO R203	YELLOW
25	V201(8) TO R203	YELLOW
26	V202(1) TO R206	BLUE
27	V204(2) TO R227	GREEN
28	R220 TO R221	GREEN-WHITE TRACER
29	R220 TO C224	GREEN
30	V204(7) TO C221,R214	GREEN WHITE TRACER
31	V204(8) TO C223,R215	YELLOW
32	R223 TO R222	ORANGE
33	V204(3) TO R230	YELLOW
34	J201(4) TO R229,R231	WHITE
35	V203(7) TO R208	GREEN
36	V203(2) TO R208,R209	BLUE WHITE TRACER
37	V204(6) TO R217	BLUE
38	S202 TO R224	VIOLET
39	V201(8) TO R202	YELLOW
40	V207(5) TO V208(5)	BLUE
41	J201(3) TO E204(3)	GREEN WHITE TRACER
42		
43	V207-2 TO V208(2)	BLACK
44	V207(2) TO V202(2)	BLACK
45	V202(2) TO GROUND 3	BLACK
46	V203(8) TO GROUND 1	BLACK
47	V206(2) TO R220	GREEN WHITE TRACER
48	V206(7) TO R220	GREEN
49	V206(1) TO T201(3)	BLUE WHITE TRACER
50	V206(6) TO T201(5)	BLUE
51	T201(4) TO J201(6)	RED
52	T201(2) TO J201(11)	VIOLET
53	T201(1) TO J201(12)	VIOLET WHITE TRACER
54	V201(2) TO S202	GREEN WHITE TRACER
55	S202 TO J201(2)	GREEN
56	V201(3) TO V204(3)	YELLOW
57	V204(1) TO V205(1)	BLUE
58	V205(2) TO V208(1)	GREEN
59	V207(5) TO J201(14)	BLUE
60	J201(5) TO GOUND (1)	BLACK
61	R223 TO V206(8)	YELLOW
62	R223 TO V206(3)	YELLOW WHITE TRACER
63	J201(7) TO V203(9)	20 BROWN
64	V203(9) TO V201(9)	24 BROWN
65	V201(9) TO V204(9)	24 BROWN
66	V204(9) TO V206(9)	24 BROWN
67	J201(1) TO V207(3)	20 BROWN
68	V207(3) TO V208(3)	24 BROWN
69	J201(1) TO V203(4)	20 BROWN
70	V203(5) TO V204(4)	24 BROWN
71	V201-(5) TO V204(4)	24 BROWN
72	V204(5) TO V206(4)	24 BROWN
73	J201(7) TO V207(4)	20 BROWN
74	V207(4) TO V208(4)	24 BROWN
75	V203 CENTER TO V201 CENTER	BLACK
76	V201 CENTER TO V204 CENTER	BLACK
77	V204 CENTER TO V206 CENTER	BLACK
78	GROUND 2 TO R205	BLACK
79	R205 TO E204(4)	BLACK
80	R202 TO E204(1)	BLUE

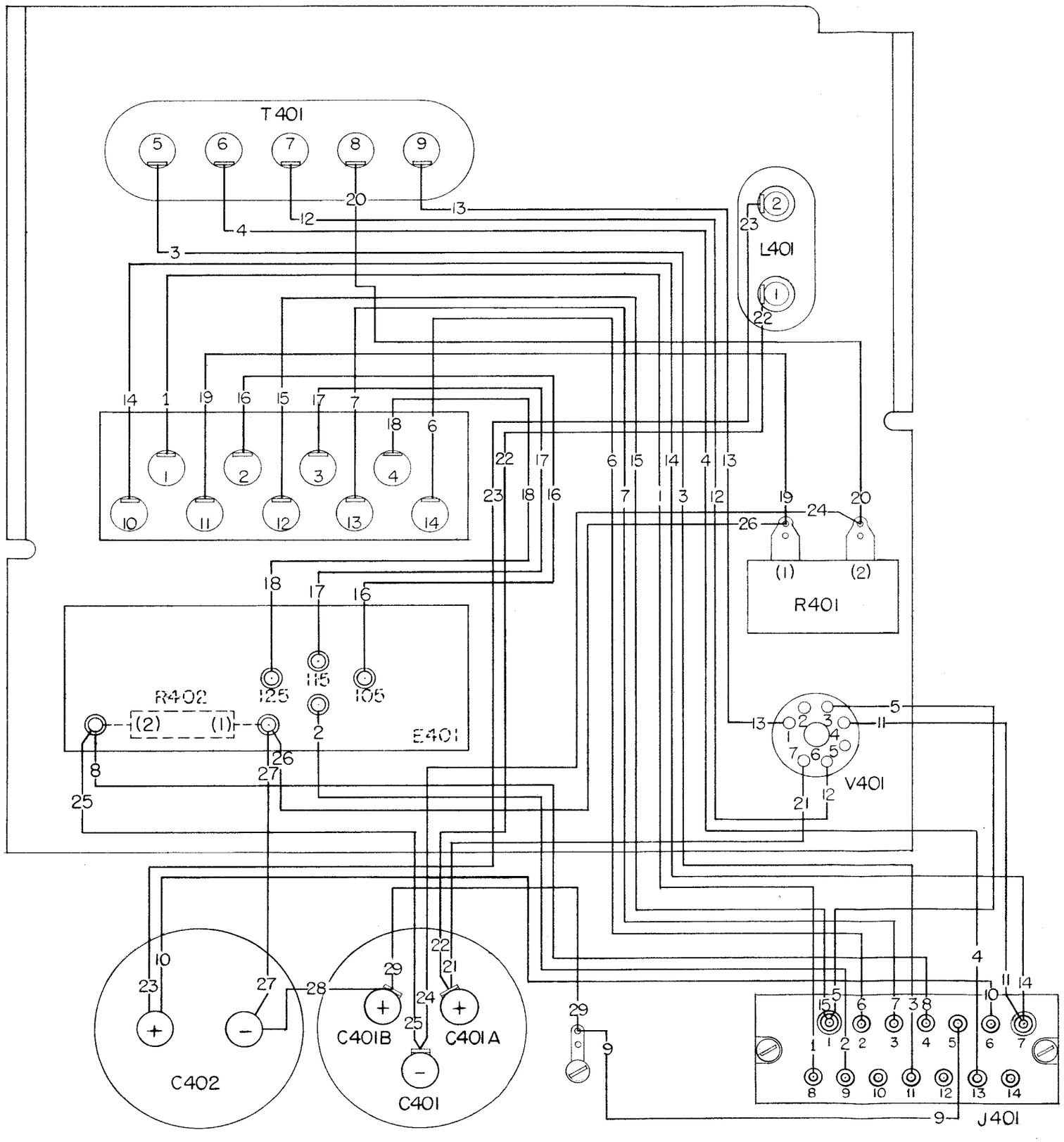
Figure 5-20. Oscillator-Keyer Sub-Unit, Wiring Diagram



WIRE NO.	STATION	TO	STATION	COLOR AND GAGE
1	R305	TO	V301-1	BLUE 24
2	R308	TO	R307	VIOLET 24
3	R302	TO	R301	" "
4	R306	TO	R307	RED-WHITE TR 24
5	R304	TO	V301-3	YELLOW 24
6	R308	TO	J 301-6	RED 24
7	R314	TO	R310	VIOLET 24
8	R317	TO	C301A	WHITE 24
9	R323	TO	R320	WHITE-BLACK 24
10	R318	TO	C301B	ORANGE 24
11	R317	TO	C302	YELLOW 24
12	E301-(2)	TO	R319	GREEN 24
13	E301-(7)	TO	R307	RED 24
14	R309	TO	GND 1	BLACK 24
15	E301-(4)	TO	R320	WHITE 24
16	R312	TO	R310	RED-WHITE 24
17	R311, 313	TO	R310	VIOLET 24
18	R301	TO	V301-2	GREEN SHIELDED 24
19	V301 CENTER	TO	GND 1	BLACK 24
20	C302	TO	R320	YELLOW 24
21	C301 COM	TO	GND 2	BLACK 24
22	C301 B	TO	R319	ORANGE 24
23	J301-5	TO	GND 2	BLACK 24
24	R320	TO	R319	YELLOW 24
25	R301	TO	J301-4	GREEN-WHITE 24
26	E301-(6)	TO	V302-6	BLUE 24
27	E301-(7)	TO	V302-7	RED 24
28	E301-(8)	TO	V302-8	ORANGE 24
29	E301-(9)	TO	V302-9	VIOLET 24
30	E301-(10)	TO	V302-10	GRAY 24
31	E301-(1)	TO	V302-1	YELLOW WHITE 20
32	E301-(2)	TO	V302-2	GREEN 24
33	E301-(3)	TO	V302-3	YELLOW 24
34	E301-(4)	TO	V302-4	WHITE 24
35	E301-(12)	TO	V302-12	ORANGE WHITE 20
36	J301-7	TO	V301-9	BROWN 24
37	J301-13	TO	V303-7	ORANGE WHITE 24
38	J301-11	TO	V303-4	ORANGE 24
39	J301-9	TO	E301-(1)	YELLOW WHITE 20
40	J301-1	TO	V301-4	BROWN 24
41	J301-8	TO	E301-(12)	ORANGE WHITE 20
42	V303-4	TO	E301-(5)	ORANGE 24
43	V303 CAP	TO	E301-(11)	NOT IN CABLE

Figure 5-21. Monitor Sub-Unit, Wiring Diagram

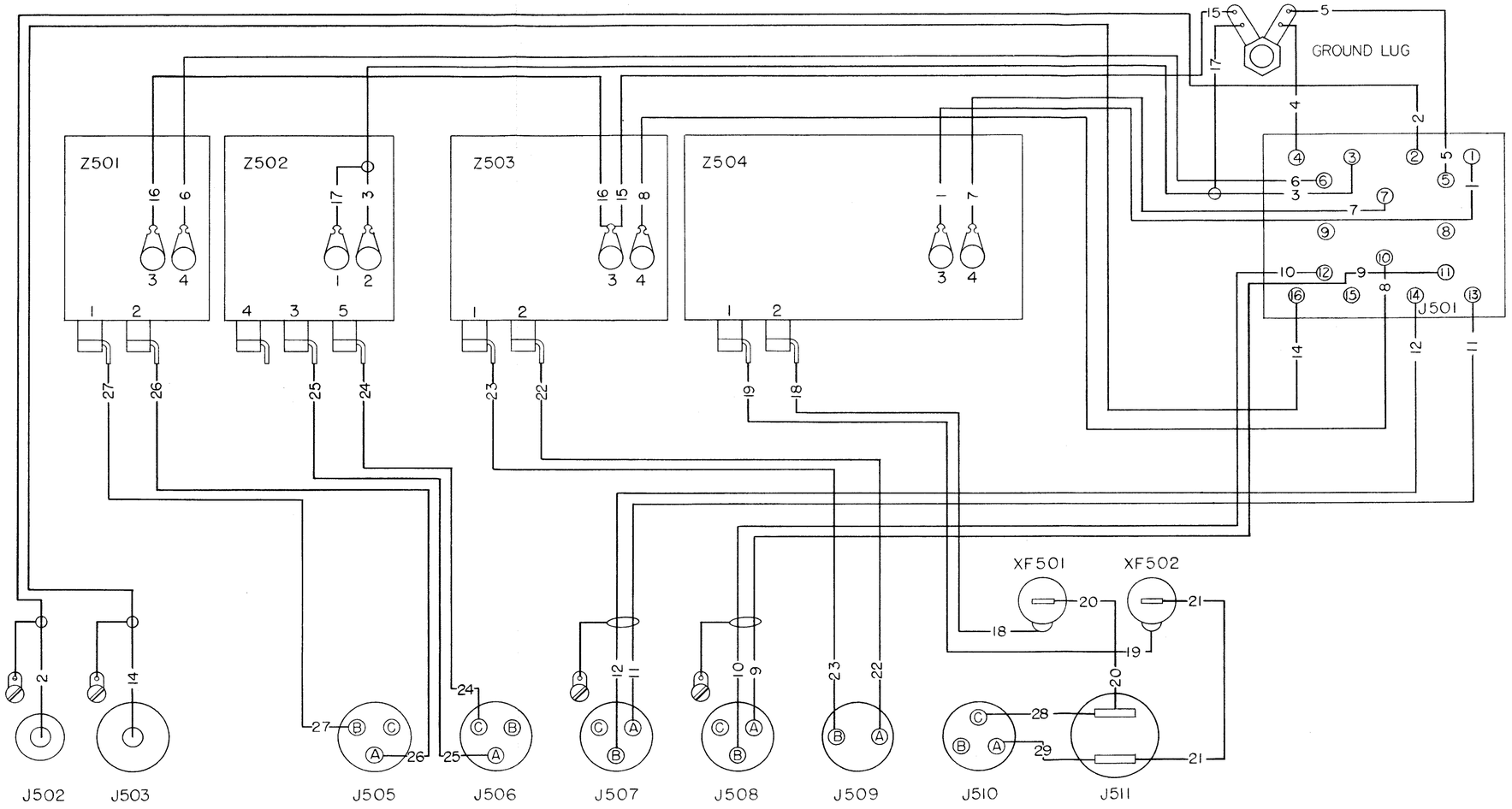
RESTRICTED
NAVSHIPS 91278



WIRE NO	POINT TO POINT	WIRE COLOR & GA.*
1	T401(1) TO J401(8)	GRAY-WHITE-TRACER
2	J401(9) TO COMMON VOLT. LINK	GRAY
3	J401(11) TO T401(5)	ORANGE
4	J401(13) TO T401(6)	ORANGE-WHITE-TRACER
5	J401(1) TO V401(3)	BROWN
6	J401(2) TO T401(14)	ORANGE-WHITE-TRACER 20
7	J401(3) TO T401(13)	YELLOW-WHITE-TRACER 20
8	J401(4) TO R402	WHITE
9	J401(5) TO GND LUG	BLACK
10	J401(6) TO C402(+)	RED
11	J401(7) TO V401(4)	BROWN
12	T401(7) TO V401(6)	VIOLET
13	T401(9) TO V401(1)	VIOLET
14	J401(7) TO T401(10)	BROWN 18
15	J401(1) TO T401(12)	BROWN 18
16	T401(2) TO 105 VOLT. LINK	GRAY
17	T401(3) TO 115 VOLT. LINK	GRAY-WHITE TRACER
18	T401(4) TO 125 VOLT. LINK	GRAY
19	T401(11) TO R401	BLACK
20	T401(8) TO R401	WHITE
21	V401(7) TO C401 A	YELLOW
22	L401 TO C401 A	YELLOW
23	L401 TO C402(+)	RED
24	R401 TO C401(–)	WHITE
25	C401(–) TO R402	WHITE
26	R401 TO R402	BLACK
27	R402 TO C402(–)	BLACK
28	C402(–) TO C401 B	BLACK
29	C401 B TO GND LUG	BLACK

* ALL WIRE 24 GA. UNLESS OTHERWISE INDICATED.

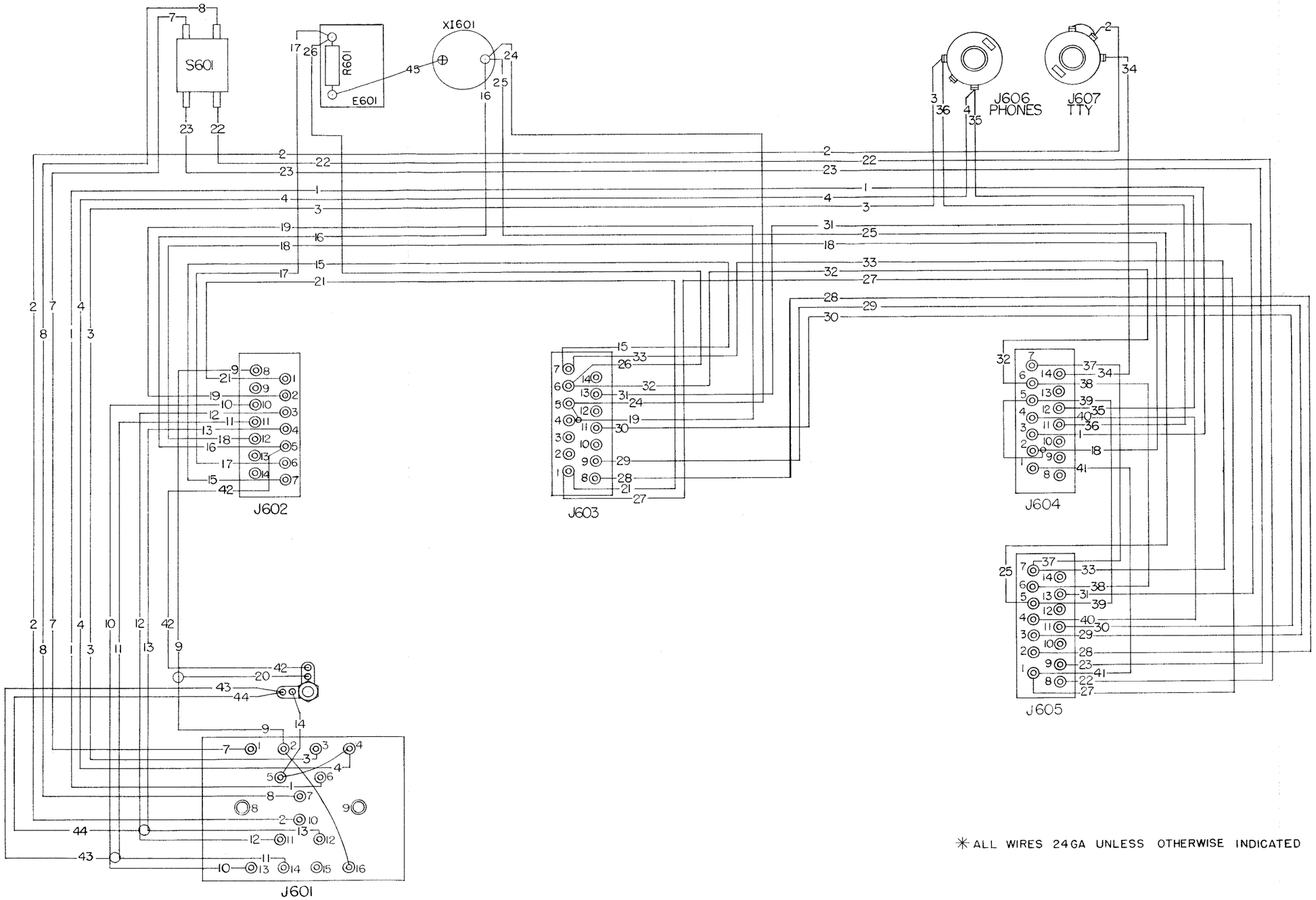
Figure 5-22. Converter Power Supply Sub-Unit, Wiring Diagram



NUMBER	POINT TO POINT		COLOR & GA.*
1	J501-1	– Z504-3	GRAY-WHITE TRACER
2	J501-2	– J502	GREEN SHIELDED
3	J501-3	– Z502-2	VIOLET SHIELDED
4	J501-4	– GND LUG	BLACK
5	J501-5	– GND LUG	BLACK
6	J501-6	– Z501-4	GREEN-WHITE TRACER
7	J501-7	– Z504-4	GRAY
8	J501-10	– Z503-4	BLUE
9	J501-11	– J508-A	VIOLET } SH
10	J501-12	– J508-B	VIOLET WHITE }
11	J501-13	– J507-A	ORANGE } SH
12	J501-14	– J507-B	ORANGE WHITE }
13			
14	J501-16	– J503	YELLOW-WHITE SHIELDED
15	Z503-3	– GND LUG	BLACK
16	Z503-4	– Z501-3	BLACK
17	Z502-1	– GND LUG	SHIELD FOR NO 3
18	Z504-2	– XF501	GRAY
19	Z504	– XF502	GRAY-WHITE TRACER
20	XF501	– AC OUT	GRAY 18
21	XF502	– AC OUT	GRAY-WHITE TRACER 18
22	Z503-2	– J509-A	BLUE
23	Z503-1	– J509-B	BLACK
24	Z502-5	– J506-C	VIOLET
25	Z502-3	– J506-A	ORANGE
26	Z501-2	– J505-A	GREEN-WHITE TRACER
27	Z501-1	– J505-B	BLACK
28	J511	– J510-C	GRAY 18
29	J511	– J510-A	GRAY-WHITE TRACER 18

*ALL WIRES 24 GA. UNLESS OTHERWISE SPECIFIED

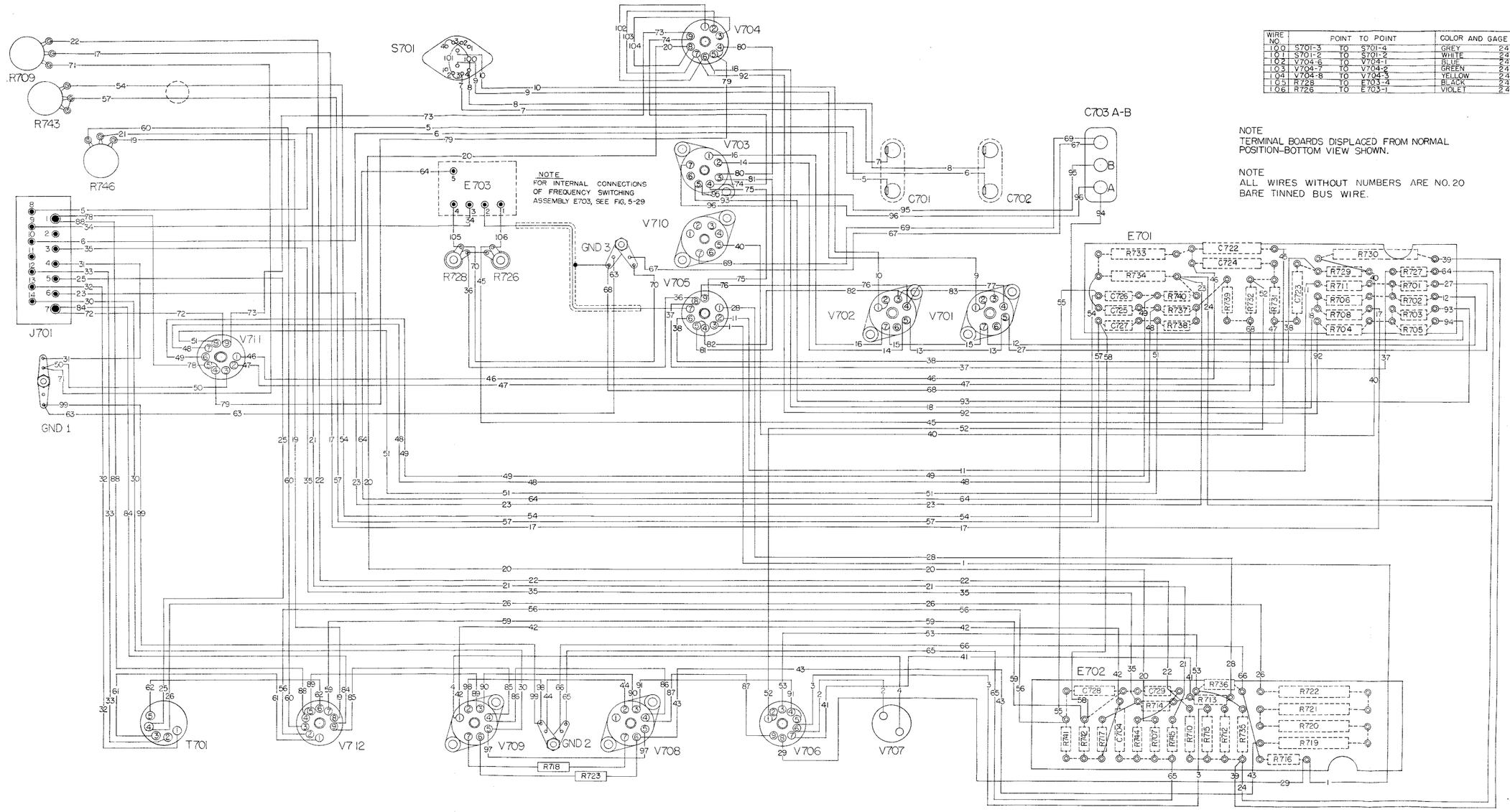
Figure 5-23. Converter Cable Filter Assembly, Wiring Diagram



WIRE NO	POINT TO POINT	COLOR & GA.*
1	J601-6 TO J604-3	GREEN WHITE TRACER
2	J601-10 TO J607	BLUE
3	J601-3 TO J606	VIOLET SHIELDED
4	J601-4 TO J606	SHIELD OF WIRE NO 3
7	J601-1 TO S601	GRAY WHITE TRACER
8	J601-7 TO S601	GRAY
9	J601-2 TO J602-8	GREEN SHIELDED
10	J601-13 TO J602-10	ORANGE TWISTED PAIR SHIELDED
11	J601-14 TO J602-11	ORANGE WHITE TRACER
12	J601-11 TO J602-3	VIOLET TWISTED PAIR SHIELDED
13	J601-12 TO J602-4	VIOLET WHITE TRACER
14	J601-5 TO GND	BLACK
15	J602-7 TO J603-7	BROWN 20
16	J602-5 TO I601	BLACK
17	J602-6 TO R601	RED
18	J602-12 TO J604-2	GREEN SHIELDED
19	J602-2 TO J603-4	GREEN WHITE SHIELDED
20	GROUND TO SHIELD 9	BLACK
21	J602-1 TO J603-1	BROWN 20
22	S601 TO J605-8	GRAY
23	S601 TO J605-9	GRAY WHITE TRACER
24	I601 TO J603-5	BLACK
25	I601 TO J605-5	BLACK
26	R601 TO J603-6	RED
27	J603-1 TO J605-1	BROWN 18
28	J603-8 TO J605-2	ORANGE WHITE TRACER 20
29	J603-9 TO J605-3	YELLOW WHITE TRACER 20
30	J603-11 TO J605-11	ORANGE
31	J603-13 TO J605-13	ORANGE WHITE TRACER
32	J603-6 TO J604-6	RED
33	J603-7 TO J605-7	BROWN 18
34	J607 TO J604-14	BLUE
35	J606 TO J604-12	SHIELD OF WIRE 36
36	J606 TO J604-11	VIOLET SHIELDED
37	J604-7 TO J605-7	BROWN 20
38	J604-6 TO J605-6	RED
39	J604-5 TO J605-5	BLACK
40	J604-4 TO J605-4	WHITE
41	J604-1 TO J605-1	BROWN 20
42	GND TO J602-5	BLACK
43	GND TO SHIELD 10-11	BLACK
44	GND TO SHIELD 12-13	BLACK
45	R601 TO XI601 +	RED

* ALL WIRES 24GA UNLESS OTHERWISE INDICATED

Figure 5-24. Converter Chassis-Panel Assembly, Wiring Diagram



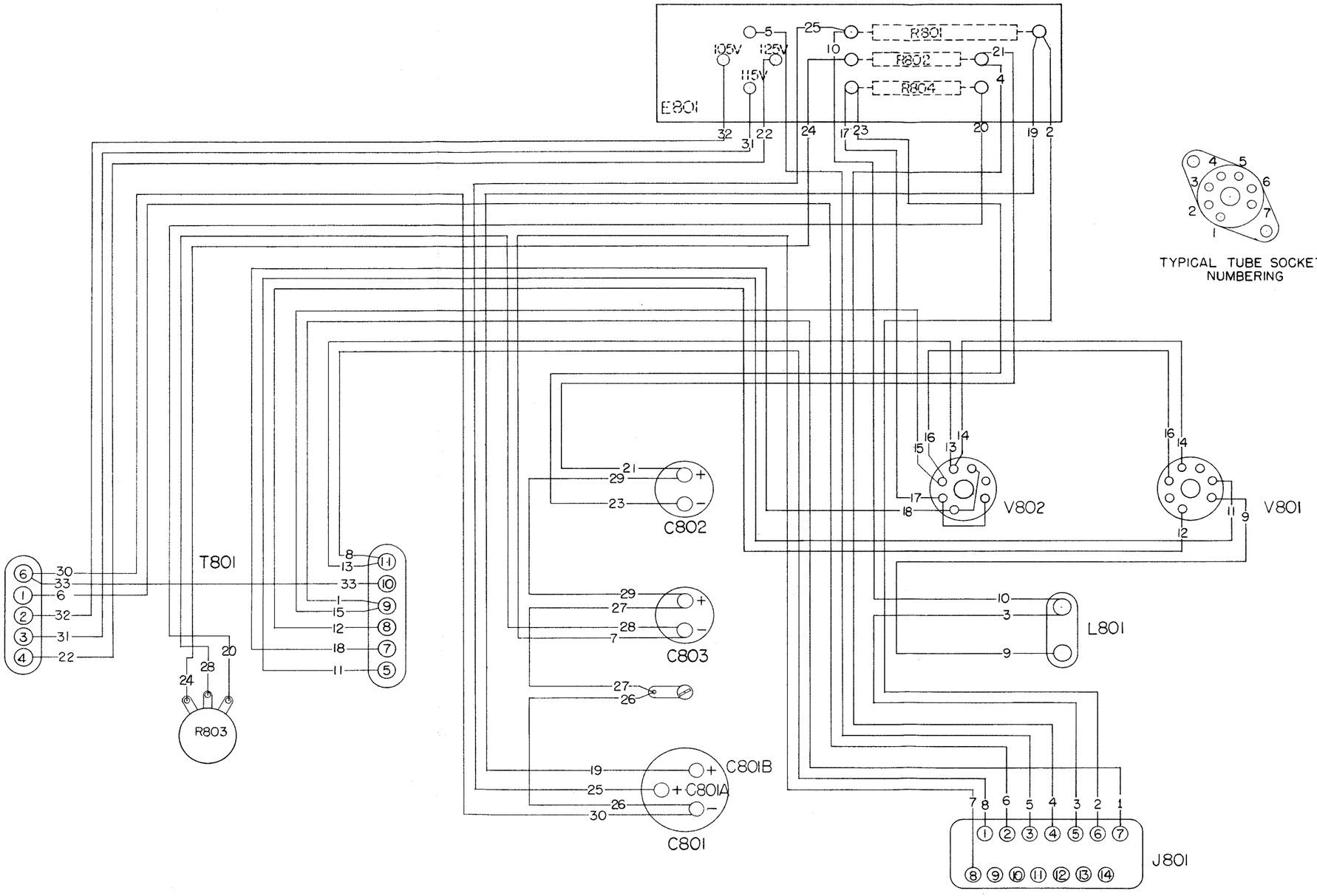
WIRE NO.	POINT	TO	POINT	COLOR AND GAGE
100	S701-3	TO	S701-4	GREY 24
101	S701-2	TO	S701-2	WHITE 24
102	V704-6	TO	V704-1	BLUE 24
103	V704-7	TO	V704-2	GREEN 24
104	V704-8	TO	V704-3	YELLOW 24
105	R728	TO	E703-4	BLACK 24
106	R726	TO	E703-1	VIOLET 24

NOTE
TERMINAL BOARDS DISPLACED FROM NORMAL POSITION-BOTTOM VIEW SHOWN.

NOTE
ALL WIRES WITHOUT NUMBERS ARE NO. 20 BARE TINNED BUS WIRE.

WIRE NO.	POINT	TO	POINT	COLOR AND GAGE
1	V705B-3	TO	R716	YELLOW 24
2	V706A-6	TO	V707	BLUE 24
3	V706A-6	TO	R715	BLUE 24
4	V709-1	TO	V707	GREEN 24
5	C701	TO	J701-8	GREEN-WHITE 24
6	C702	TO	J701-10	GREEN 24
7	C701	TO	S701	WHITE 24
8	C702	TO	S701	GRAY 24
9	S701	TO	V701-1	GREEN 24
10	V702-1	TO	S701	ORANGE 24
11	V705-2	TO	R711	GREEN 24
12	V707-7	TO	V702	BLUE 24
13	V701-5	TO	V702-5	YELLOW 24
14	V702-5	TO	V703-2	YELLOW 24
15	V701-7	TO	V702-7	BLUE 24
16	V702-7	TO	V703-1	BLUE 24
17	R708	TO	R709	ORANGE-WHITE 24
18	R708	TO	V704-6	BLUE 24
19	R746	TO	V712-5	YELLOW-WHITE 24
20	R707	TO	V704-8	YELLOW 24
21	R746	TO	R745	ORANGE 24
22	R710	TO	R709	RED-WHITE TR 24
23	R734	TO	J701-6	RED 24
24	R734	TO	R735	RED 24
25	T701-4	TO	J701-5	RED-WHITE TR 24
26	T701-4	TO	R722	RED-WHITE TR 24
27	R701	TO	V701-5	YELLOW 24
28	R713	TO	V705B-1	BLUE 24
29	R716	TO	V706A-8	YELLOW 24
30	V709-5	TO	J701-14	BLUE 24
31	GROUND 1	TO	J701-4	BLACK 24
32	T701-1	TO	J701-13	VIOLET 24
33	T701-2	TO	J701-12	YELLOW 24
34	E703-3	TO	J701-9	ORANGE 24
35	R714	TO	J701-3	WHITE 24
36	V705-8	TO	R726	YELLOW 24
37	R727	TO	V705-8	YELLOW 24
38	R729	TO	V705A-6	BLUE 24
39	R735	TO	R730	RED 24
40	R729	TO	V710-5	BLUE 24
41	V706A-7	TO	R713	GREEN 24
42	V709-1	TO	V704	GREEN 24
43	R719	TO	V708-6	ORANGE 24
44	V708-2	TO	GROUND 2	BLACK 24
45	C722	TO	R736	VIOLET 24
46	V711-1	TO	C724	BLUE 24
47	V711-2	TO	R731	GREEN 24
48	V711-7	TO	R737	GREEN 24
49	V711-6	TO	R740	BLUE 24
50	GROUND 1	TO	V711-3	BLACK 24
51	V711-8	TO	R738	YELLOW 24
52	V706B-1	TO	R732	BLUE 24
53	V706B-3	TO	R736	YELLOW 24
54	C726	TO	R743	GREEN 24
55	R741	TO	C726	GREEN 24
56	V712-2	TO	R741	GREEN 24
57	C727	TO	R743	GREEN-WHITE TR 24
58	R742	TO	C727	GREEN 24
59	V712-7	TO	R742	GREEN 24
60	R746	TO	V712-3	YELLOW 24
61	V712-1	TO	T701-3	BLUE 24
62	V712-6	TO	T701-5	BLUE 24
63	GROUND 1	TO	GND 3	BLACK 24
64	R727	TO	E703-5	GREEN 24
65	GROUND 2	TO	R745	BLACK 24
66	GROUND 2	TO	R736	BLACK 24
67	C703	TO	GROUND 3	BLACK 24
68	R732	TO	GROUND 3	BLACK 24
69	V710-7	TO	C703	BLACK 24
70	R728	TO	GROUND 3	BLACK 24
71	GROUND 1	TO	R709	BLACK 24
72	V711-9	TO	J701-7	BROWN 20
73	V711-9	TO	V704-9	BROWN 20
74	V704-9	TO	V703-4	BROWN 20
75	V703-4	TO	V705-9	BROWN 24
76	V705-9	TO	V702-4	BROWN 24
77	V702-4	TO	V701-6	BROWN 24
78	J701-1	TO	V711-5	BROWN 20
79	V711-4	TO	V704-5	BROWN 20
80	V704-4	TO	V703-3	BROWN 20
81	V703-3	TO	V705-6	BROWN 24
82	V705-4	TO	V702-3	BROWN 24
83	V702-3	TO	V701-5	BROWN 24
84	J701-7	TO	V712-9	BROWN 20
85	V712-9	TO	V709-4	BROWN 20
86	V709-4	TO	V708-4	BROWN 20
87	V708-4	TO	V709-9	BROWN 20
88	J701-1	TO	V712-4	BROWN 20
89	V712-5	TO	V709-3	BROWN 20
90	V709-3	TO	V708-5	BROWN 20
91	V708-3	TO	V706-4	BROWN 24
92	V704-7	TO	R704	GREEN 24
93	R703	TO	V703-6	YELLOW 24
94	R705	TO	C703A	BLUE 24
95	C703B	TO	V703-5	YELLOW 24
96	C703A	TO	V703-7	BLUE 24
97	V708-5	TO	V709-5	BLUE 24
98	V709-2	TO	GROUND 2	BLACK 24
99	GROUND 1	TO	GROUND 2	BLACK 24

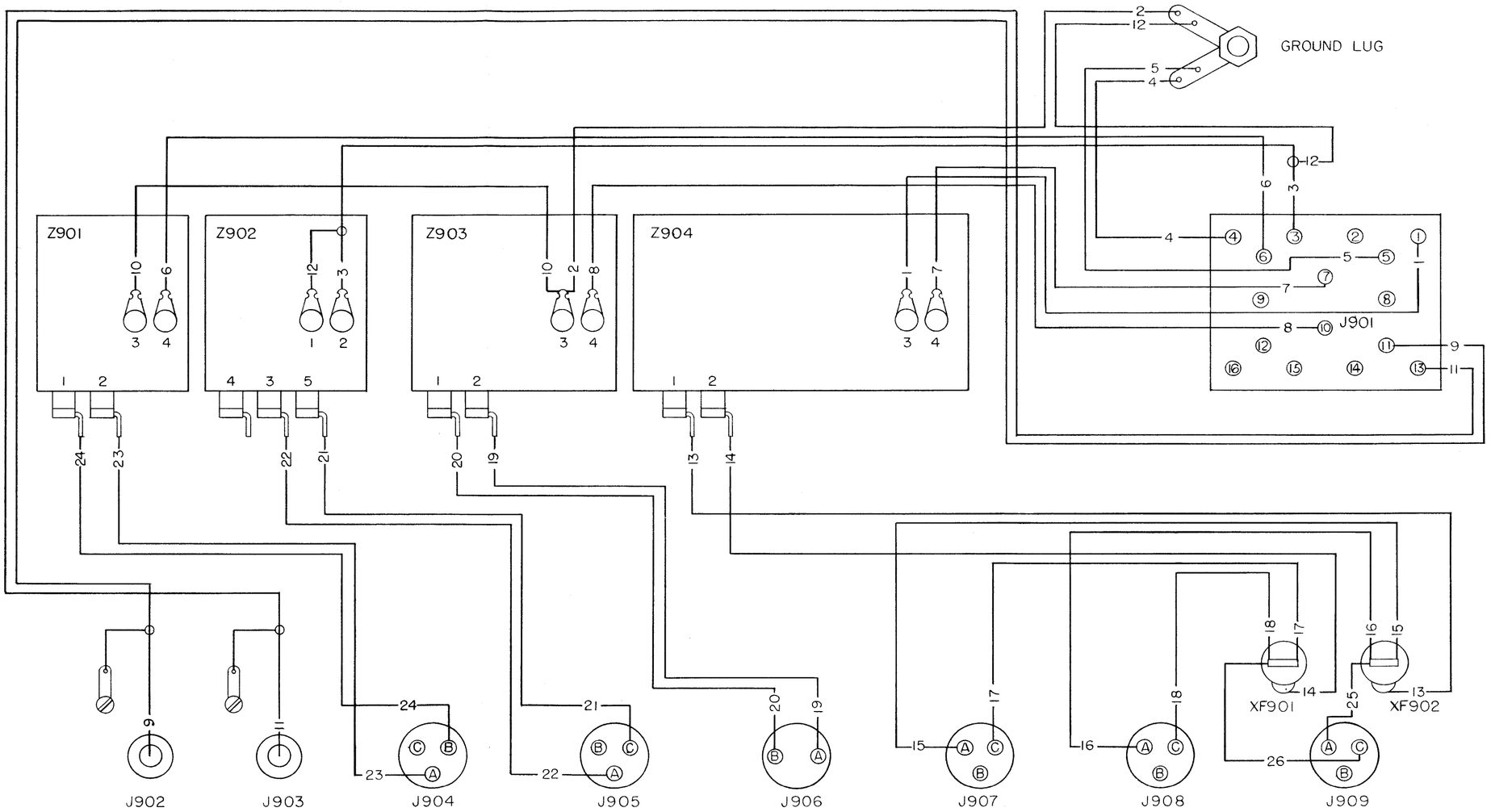
Figure 5-25. Selector Sub-Unit, Wiring Diagram



TYPICAL TUBE SOCKET NUMBERING

WIRE NO	POINT TO POINT	GAGE & COLOR
1	J801(7) TO T801(9)	18 BROWN
2	J801(6) TO R801	24 RED
3	J801(5) TO L801	24 RED-WHITE TRACER
4	J801(4) TO R802	24 BLACK
5	J801(3) TO COM. VOLT. LINK	24 GRAY-WHITE TRACER
6	J801(2) TO T801(11)	24 GRAY
7	J801(8) TO C803(-)	24 WHITE
8	J801(1) TO T801(11)	18 BROWN
9	L801 TO V801(7)	24 YELLOW
10	L801 TO R801	24 RED WHITE TRACER
11	V801(6) TO T801(5)	24 VIOLET
12	V801(1) TO T801(8)	24 VIOLET
13	V802(4) TO T801(11)	24 BROWN
14	V802(4) TO V801(4)	24 BROWN
15	V802(3) TO T801(9)	24 BROWN
16	V802(3) TO V801(3)	24 BROWN
17	V802(2) TO R804	24 BLUE
18	V802(1) TO T801(7)	24 YELLOW
19	C801B TO R801	24 RED
20	R803 TO R804	24 WHITE BLACK TRACER
21	R802 TO C802(+)	24 BLACK
22	T801(4) 125 VOLT LINK	24 GRAY
23	R804 TO C802(-)	24 BLUE
24	R803 TO R802	24 VIOLET
25	C801A TO R801	24 RED WHITE TRACER
26	C801(-) TO GROUND LUG	24 BLACK
27	C803(+) TO GROUND LUG	24 BLACK
28	R803 TO C803(-)	24 WHITE
29	C803(+) TO C802(+)	24 BLACK
30	T801-6 TO C801(-)	24 BLACK
31	T801-3 TO 115 VOLT LINK	24 GRAY
32	T801-(2) TO 105 VOLT LINK	24 GRAY
33	T801(6) TO T801(10)	24 BLACK

Figure 5-26. Comparator Power Supply, Wiring Diagram

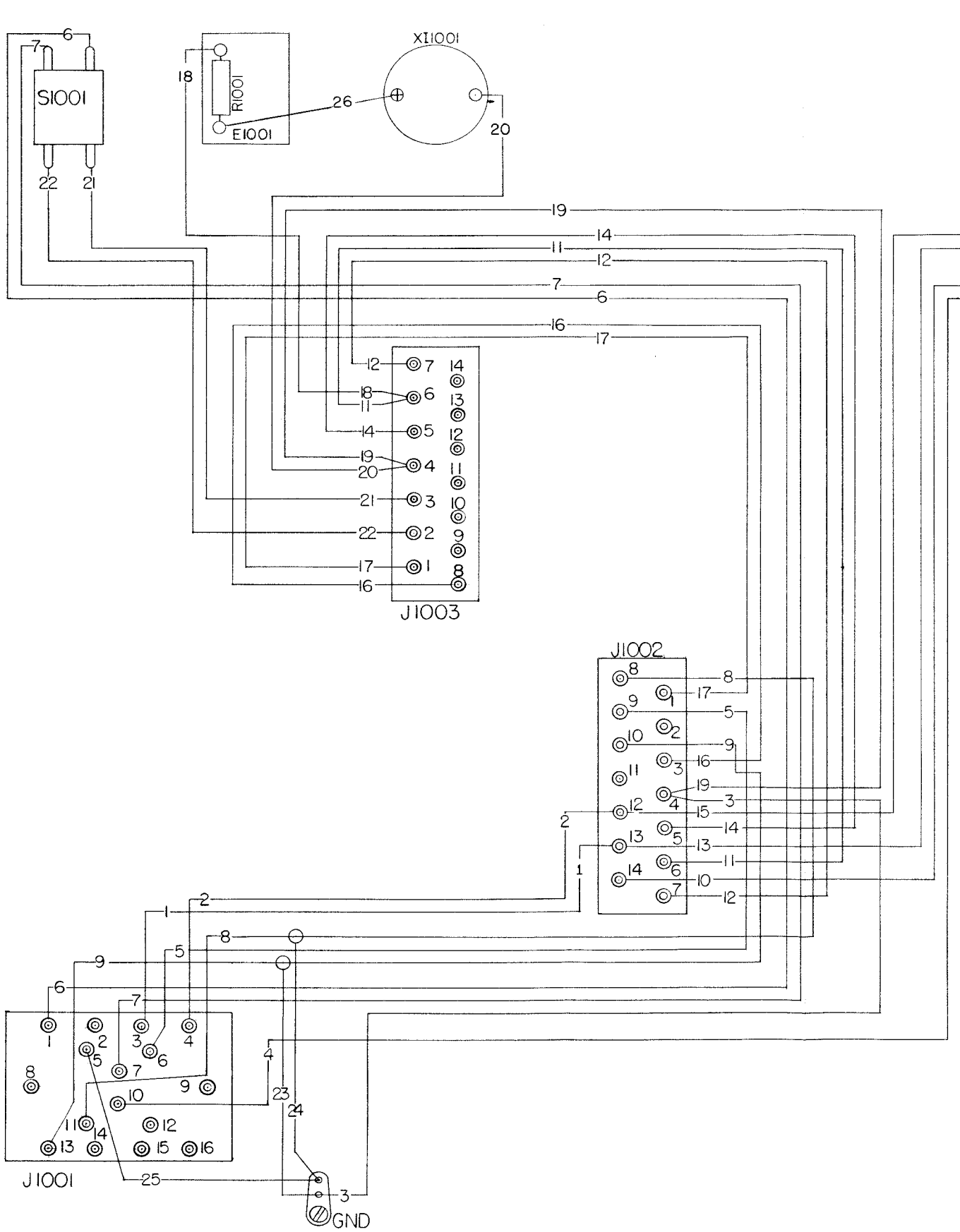


NUMBER	POINT TO POINT	COLOR & GA.*
1	J901-1 – Z904(3)	GRAY
2	Z903 (3) – GND LUG	BLACK
3	J901-3 – Z902(2)	VIOLET-SHIELDED
4	J901-4 – GND LUG	BLACK JUMPER
5	J901-5 – GND LUG	BLACK JUMPER
6	J901-6 – Z901(4)	ORANGE
7	J901-7 – Z904(4)	GRAY-WHITE TRACER
8	J901-10 – Z903(4)	BLUE-WHITE TRACER
9	J901-11 – J902	GREEN-WHITE SHIELDED
10	Z901(3) – Z903(3)	BLACK
11	J901-13 – J903	GREEN SHIELDED
12	Z902 (1) – GND LUG	SHIELD OF NO 3
13	Z904 (1) – XF902	GRAY
14	Z904 (2) – XF901	GRAY-WHITE TRACER
15	XF902 – J907-A	GRAY 18
16	XF902 – J908-A	GRAY JUMPER 18
17	XF901 – J907-C	GRAY-WHITE TRACER 18
18	XF901 – J908-C	GRAY-WHITE JUMPER 18
19	Z903 (2) – J906-A	BLUE-WHITE TRACER
20	Z903 (1) – J906-B	BLACK
21	Z902 (5) – J905-C	VIOLET
22	Z902 (3) – J905-A	BLUE
23	Z901(2) – J904-A	ORANGE
24	Z901 – J904-B	BLACK
25	J909-A – XF902	GRAY JUMPER 18
26	J909-C – XF901	GRAY-WHITE JUMPER 18

*ALL WIRE 24 GA. UNLESS OTHERWISE SPECIFIED.

Figure 5-27. Comparator Cable Filter Assembly, Wiring Diagram

RESTRICTED
NAVSHIPS 91278

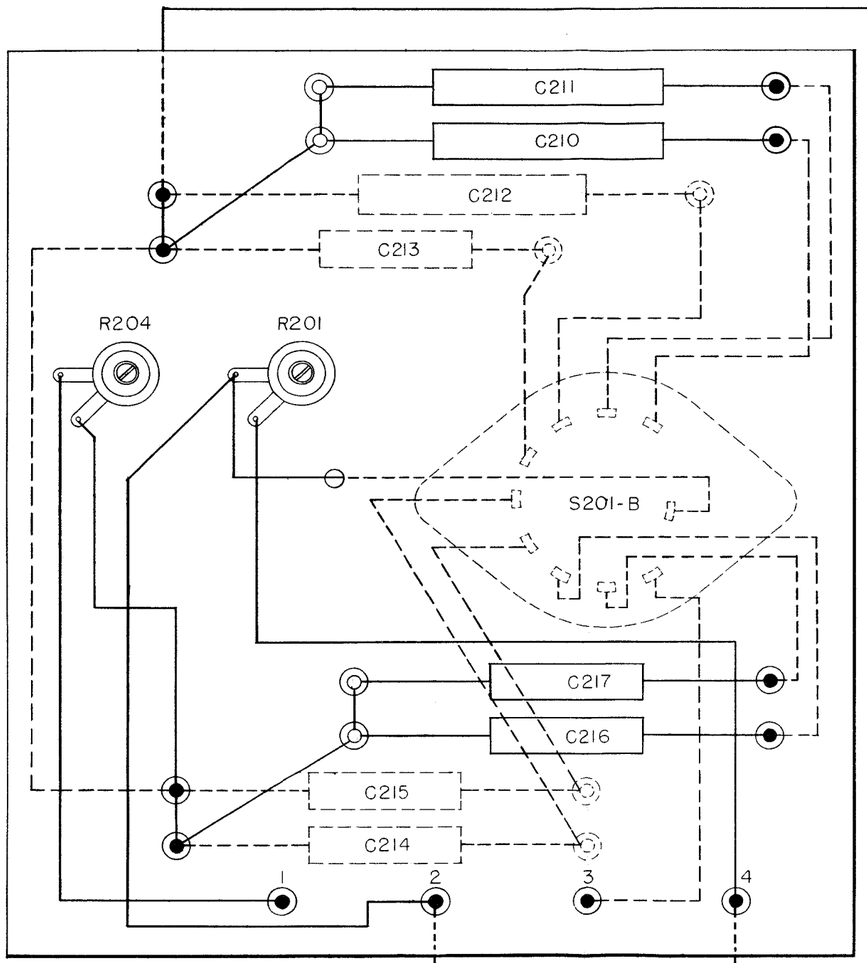


WIRE NO	POINT TO POINT	COLOR & GA.*
1	J1001-3 TO J1002-13	VIOLET
2	J1001-4 TO J1002-12	YELLOW
3	GND TO J1002-4	BLACK
4	J1001-10 TO J1005 TTY	BLUE-WHITE TRACER
5	J1001-6 TO J1002-9	ORANGE
6	J1001-1 TO S1001	GRAY
7	J1001-7 TO S1001	GRAY WHITE TRACER
8	J1001-11 TO J1002-8	GREEN WHITE SHIELDED
9	J1001-13 TO J1002-10	GREEN SHIELDED
10	J1002-14 TO J1005-TTY	BLUE
11	J1002-6 TO J1003-6	RED
12	J1002-7 TO J1003-7	BROWN 18
13	J1002-13 TO J1004	VIOLET
14	J1002-5 TO J1003-5	RED WHITE TRACER
15	J1002-12 TO J1004	YELLOW
16	J1002-3 TO J1003-8	WHITE
17	J1002-1 TO J1003-1	BROWN 18
18	J1003-6 TO R1001	RED
19	J1002-4 TO J1003-4	BLACK
20	J1003-4 TO I1001	BLACK
21	J1003-3 TO S1001	GRAY
22	J1003-2 TO S1001	GRAY-WHITE TRACER
23	GND TO SHIELD 9	BLACK
24	GND TO SHIELD 8	BLACK
25	J1001-5 TO GND	BLACK
26	R1001 TO XI1001+	RED

* ALL WIRES 24 GA. UNLESS OTHERWISE SPECIFIED

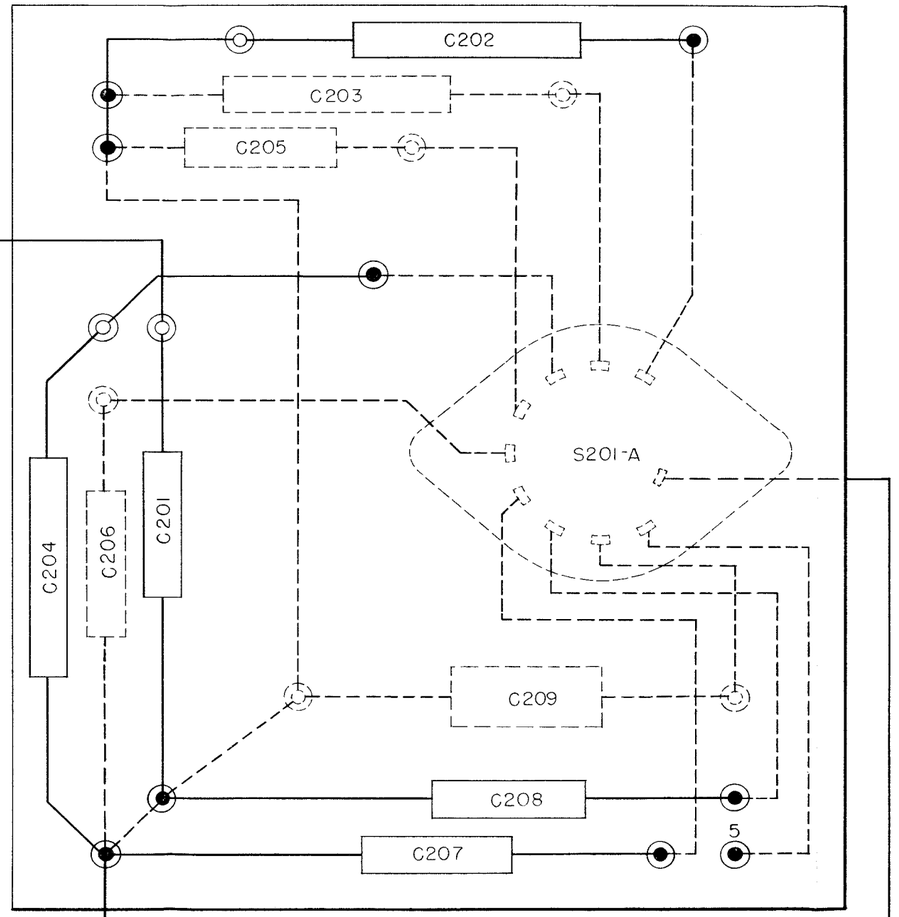
Figure 5-28. Comparator Chassis-Panel Assembly, Wiring Diagram

REAR SECTION



NOTE: TERMINAL NUMBERS (1 TO 5) ARE FOR REFERENCE ONLY AND DO NOT APPEAR ON THE ASSEMBLY.

FRONT SECTION



NOTE
SYMBOL NUMBERS ARE ON SHIELD COVERS ONLY

E703 IS IDENTICAL TO E204

CORRESPONDING SYMBOLS

FREQENCY SHIFT CONVERTER CV-89/URA-8A E204	COMPARATOR CM-22/URA-8A E703
C201	C705
C202	C706
C203	C707
C204	C708
C205	C709
C206	C710
C207	C711
C208	C712
C209	C713
C210	C714
C211	C715
C212	C716
C213	C717
C214	C718
C215	C719
C216	C720
C217	C721
R201	R724
R204	R725
S201	S702

Figure 5-29. Frequency Selector Sub-Assembly, E204 and E703, Wiring Diagram

SECTION 6
PARTS LISTS

TABLE 6-1. WEIGHT AND DIMENSIONS OF SPARE PARTS BOX

MAINTENANCE PARTS KIT					
SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT
	HEIGHT	WIDTH	DEPTH		
1	12¾	25	16½	3.05	95

Dimensions are inches, volume cubic feet, weight pounds.

Stock spare parts shipped in bulk.

TABLE 6-2. SHIPPING WEIGHT AND DIMENSIONS OF SPARE PARTS BOX

MAINTENANCE PARTS KIT						
SHIPPING BOX NUMBER	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT
		HEIGHT	WIDTH	DEPTH		
2	1 only	14⅞	28⅝	18⅜	4.45	136

Dimensions are inches, volume cubic feet, weight pounds.

Stock spare parts shipped in bulk.

TABLE 6-3. LIST OF MAJOR UNITS

SYMBOL GROUP	QUANTITY	NAME OF MAJOR UNIT	ARMY-NAVY DESIGNATION
101- 699	2	FREQUENCY SHIFT CONVERTER Each consisting of the following:	CV-89/URA-8A
101- 199	(1)	[1]Converter Sub-assembly	— —
201- 299	(1)	[2]Keyer-Oscillator	— —
301- 399	(1)	[3]Monitor: RF	— —
401- 499	(1)	[4]Power Supply	— —
501- 599	(1)	Cable Filter Assembly	— —
601- 699	(1)	Chassis-Panel Assembly and Case	— —
701-1099	1	COMPARATOR Consisting of the following:	CM-22/URA-8A
701- 799	(1)	[5]Keyer-Oscillator	— —
801- 899	(1)	[6]Power Supply	— —
901- 999	(1)	Cable Filter Assembly	— —
1001-1099	(1)	Chassis-Panel Assembly and Case	— —
1101-1199	—	ACCESSORIES, CABLES, AND PLUGS	— —
	1	RACK (Std. Navy Stock No. N16-R-400168-951)	MT-719/URA-8A

[1]Referred to as Discriminator Sub-unit throughout the rest of the book (Symbol SU101).
[2]Referred to as Oscillator-Keyer Sub-unit throughout the rest of the book (Symbol SU201).
[3]Referred to as Monitor Sub-unit throughout the rest of the book (Symbol SU301).
[4]Referred to as Power Supply Sub-unit throughout the rest of the book (Symbol SU401).
[5]Referred to as Selector Sub-unit throughout the rest of the book (Symbol SU701).
[6]Referred to as Power Supply Sub-unit throughout the rest of the book (Symbol SU801).

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIG-NATION	CON-TRACTOR DRAW-ING & PART NO.	ALL SYMBOL DESIG. IN-VOLVED	Total Per Equip.
A201*	COVER: dust protection for rotary switch; p/o CV-89/URA-8A Frequency Shift Converter; aluminum, black alumilite finish; rectangular shape; approx 3″ lg x 2 15/32″ wd x 2¼″ h o/a excl mtg ears; 2 dzus mtg fasteners in mtg ears on 3″ mtg/c; marked with symbol number of assem and symbol numbers of component parts; 2.388″ wd x 1 13/16″ h, opening one side with a 1.656″ lg x 3/16″ wd notch	Cover for E204 Frequency Selector		N17-C-945001-770	CKB AA-193	AA-193	A201	2
A301*	VISOR: used to shade face of cathode-ray tube; p/o CV-89/URA-8A Frequency Shift Converter; consists of Hoffman Radio Corp part #AC-33 hood, #PK-91 cushion, #MM-39 disk, 4 #HM-155 captive screws, #PK-131 seal and 4 #HWP-22 washers; approx 1 7/16″ lg x 2.394″ wd x 2.334″ d o/a; half circle beak of hood with 1.197″ rad x 1 5/32″ lg extending forward to shade face of cathode-ray tube	Shades Face of Cathode-Ray Tube. Called Hood in Text of Book		N16-V-300086-938	CKB AA-194	AA-194	A301	2
A601*	COVER: filter inspection; p/o CV-89/URA-8A Frequency Shift Converter and CM-22/URA-8A Comparator; consists of a rectangular shaped plate with 5 dzus fasteners with a rubber gasket cemented to bottom; aluminum, gray enamel; 12¾″ lg x 2⅜″ wide x .091″ thk o/a, excl dzus fasteners	Covers Opening to Filter		N16-C-650001-256	CKB AA-185	AA-185	A601 A1001	3
A602*	VISOR: p/o CV-89/URA-8A Frequency Shift Converter; aluminum alloy, dark gray enamel; approx 1.375″ lg x 2.394″ wd x 2.334″ d o/a; four .089″ diam mtg holes on 2″ x 1.971″ mtg/c; half circle beak of hood with 1.197″ rad x 1 5/32″ lg extending forward to shade face of cathode-ray tube; rectangular shaped cut out in front for window 1.625″ lg x 1.312″ d	Shades Face of Cathode-Ray Tube, Part of A301		N16-V-300081-876	CKB AC-33	AC-33	A602	2
A603	MOUNT, vibration: sq mtg; 43-100 lbs load rating; 2⅜″ lg x 2⅜″ wd x 1⅛″ h o/a; rubber cushion, 2 3/16″ diam x 9/16″ thk, plate mtd; ss center sleeve w/¼″ bolt hole; 4 mtg holes .196″ diam on 1 15/16″ x 1 15/16″ mtg/c; ss cup over rubber cushion	Mts. Unit, Absorbs Vibration and Shock		N17-M-75322-4551	CAYU C-1050-4 Stainless Steel	HG-20	A603 A1002	12
A604*	PLATE, cover: shockmount hole cover; p/o CV-89/URA-8A Frequency Shift Converter and CM-22/URA-8A Comparator; aluminum, black aluminite; square shape; 2 13/32″ lg x 2 13/32″ wd x .032″ thk o/a; four .199 diam mtg holes on 1.937″ x 1″ mtg/c	Covers Hole when Vibration Mount A603 is not used		N16-P-401881-125	CKB AS-443	AS-443	A604 A1003	12
A701*	COVER: dust protection for rotary switch; p/o CM-22/URA-8A Comparator; aluminum, black aluminite finish; rectangular shape; approx 2 15/16″ lg x 2 15/32″ wd x 2¼″ h o/a excl mtg ears; 2 dzus mtg fasteners in mtg ears on 3″ mtg/c; marked with symbol number of assem and symbol numbers of component parts; 2.388″ wd x 1 13/16″ h opening one side	Cover for E703 Frequency Selector		N17-C-945001-769	CKB AA-192	AA-192	A701	1
A1001	Same as A601	Covers Opening to Filter						
A1002	Same as A 603	Mts Unit, Absorbs Vibration and Shock						
A1003	Same as A604	Covers Hole when Vibration Mount A1002 is not used						
A1101	BRACKET, LH: mts CV-89/URA-8A Frequency Shift Converter or CM-22/URA-8A Comparator in a standard 19″ relay rack; essentially triangular shape with	Mts CV-89/URA-8A and CM-22/URA-8A in Rack		N16-B-750001-294	CKB AS-503	AS-503	A1101	3

	flange in front; aluminum, gray enamel; 10.466″ lg x 997″ wd x 5 7/32″ h o/a; holds unit by three .272″ diam holes spaced 9.375″ and 3.687″ c to c on side, flange in front 5 7/32″ h x 29/32″ wd with 4 slotted mtg holes ⅝″ d x ¼″ wd spaced in a straight line 1¼″ x 2¼″ x 1¼″ c to c for mtg in relay rack							
A1102	BRACKET, RH: mts CV-89/URA-8A Frequency Shift Converter or CM-22/URA-8A Comparator in a standard 19″ relay rack; essentially triangular shape with flange in front; aluminum, gray enamel; 10.466″ lg x .997″ wd x 5 7/32″ h o/a; holds unit by three .272″ diam holes spaced 9.375″ and 3.687″ c to c on side, flange in front 5 7/32″ h x 29/32″ wd with 4 slotted mtg holes ⅝″ d x ¼″ wd spaced in a straight line 1¼″ x 2¼″ x 1¼″ c to c for mtg in relay rack	Mts CV-89/URA-8A and CM-22/URA-8A in Rack		N16-B-750001-293	CKB AS-504	AS-504	A1102	3
C101	CAPACITOR, fixed: paper dielectric; 10,000 mmf ±20%; 600 vdcw; spec JAN-C-25	Coupling V101B Grid to Plate of V101A	CP21A1EF103M	N16-C-42767-7776	CD CP21A1 EF103M	CP-73	C101 C102 C103 C104	8
C102	Same as C101	Coupling Discriminator Filter to Plate of V101B						
C103	Same as C101	Discriminator Diode Load By-pass						
C104	Same as C101	Discriminator Diode Load By-pass						
C105	CAPACITOR, fixed: paper dielectric; 1mf ±10%; 400 vdcw; spec JAN-C-25	Coupling V104B Plate and V104A Cathode to Output of Discriminator	CP65B1FE105K	N16-C-48813-7458	CD CP65B1 FE105K	CP-77	C105 C701 C702	4
C106	CAPACITOR, fixed: paper dielectric; 2-sect; 100,000 mmf ±15% per sect; 600 vdcw; HS metal can; 2 mtg fl w/3/16″ holes 2⅛″ c to c; spec JAN-C-25	Section A: V104B Cathode By-pass Section B: V104A Plate By-pass	CP54B4FF104L	N16-C-53192-8240	CD CP54B5 FF104L	CP-61	C106 C703	3
C201	CAPACITOR, fixed: mica; 33 mmf ±1%; 500 vdcw; temp coef letter D; spec JAN-C-5 with spcl tol	Frequency Determining Element for V201A-V203A Tone Oscillator	CM20D330 (selected to ±1%)	N16-C-27175-5077	CMF 603M Silver CM20D 330F	CM-107	C201 C705	3
C202	CAPACITOR, fixed: mica; 1170 mmf ±2%; 300 vdcw; temp coef letter D; 1 1/16″ lg x 15″32″ wd x 7/32″ thk molded low loss phenolic; 2 axial wire leads	Frequency Determining Element for V201A-V203A Tone Oscillator		N16-C-31235-1721	CMF 601M Silver VSCM 25D 1171G	CM-115	C202 C210 C706 C714	6
C203	CAPACITOR, fixed: mica; 840 mmf ±2%; 500 vdcw; temp coeff letter D; 1 1/16″ lg x 15.32″ wd x 7/32″ thk; molded low loss phenolic; 2 axial wire leads	Frequency Determining Element for V201A-V203A Tone Oscillator		N16-C-30812-8261	CMF 601M Silver CM25D 841G	CM-114	C203 C211 C707 C715	6
C204	CAPACITOR, fixed: mica; 661 mmf ±2%; 500 vdcw; temp coef letter D; 1 1/16″ lg x 15/32″ wd x 7/32″ thk; molded low loss phenolic; 2 axial wire leads	Frequency Determining Element for V201A-V203A Tone Oscillator		N16-C-30496-5835	CMF 601M Silver SCM 25D 6610G	CM-113	C204 C212 C708 C716	6
C205	CAPACITOR, fixed: mica; 535 mmf ±1%; 300 vdcw; temp coef letter D; 51/64″ lg x 15/32″ wd x 7/32″ thk; molded low loss phenolic; 2 axial wire leads	Frequency Determining Element for V201A-V203A Tone Oscillator		N16-C-30233-4286	CMF 603M Silver SCM 20D 5350F	CM-112	C205 C213 C709 C717	6

* This item cannot be requisitioned from supply. In the event of failure it should be repaired or a new item fabricated.

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIG-NATION	CON-TRACTOR DRAW-ING & PART NO.	ALL SYMBOL DESIG. IN-VOLVED	Total Per Equip.
C206	CAPACITOR, fixed: mica; 453 mmf ±1%; 500 vdcw; temp coef letter D; 51/64" lg x 15/32" wd x 7/32" thk; molded low loss phenolic; 2 axial wire leads	Frequency Determining Element for V201A-V203A Tone Oscillator		N16-C-30098-7580	CMF 603M SCM 20D 4530F	CM-111	C206 C214 C710 C718	6
C207	CAPACITOR, fixed: mica; 383 mmf ±1%; 500 vdcw; temp coef letter D; 51/64" lg x 15/32" wd x 7/32" thk; molded low loss phenolic; 2 axial wire leads	Frequency Determining Element for V201A-C203A Tone Oscillator		N16-C-29888-6029	CMF 603M Silver SCM 20D 3830F	CM-110	C207 C215 C711 C719	6
C208	CAPACITOR, fixed: mica; 338 mmf ±1%; 500 vdcw; temp coef letter D; 51/64" lg x 15/32" wd x 7/32" thk; molded low loss phenolic; 2 axial wire leads	Frequency Determining Element for V201A-V203A Tone Oscillator		N16-C-29732-9369	CMF 603M Silver SCM 20D 3380F	CM-109	C208 C216 C712 C720	6
C209	CAPACITOR, fixed: mica; 299 mmf ±1%; 500 vdcw; temp coef letter D; 51/64" lg x 15/32" wd x 7/32" thk; molded low loss phenolic; 2 axial wire leads	Frequency Determining Element for V201A-V203A Tone Oscillator		N16-C-29654-5764	CMF 603M Silver SCM 20D 2990F	CM-108	C209 C217 C713 C721	6
C210	Same as C202	Frequency Determining Element for V201A-V203A Tone Oscillator						
C211	Same as C203	Frequency Determining Element for V201A-V203A Tone Oscillator						
C212	Same as C204	Frequency Determining Element for V201A-V203A Tone Oscillator						
C213	Same as C205	Frequency Determining Element for V201A-V203A Tone Oscillator						
C214	Same as C206	Frequency Determining Element for V201A-V203A Tone Oscillator						
C215	Same as C207	Frequency Determining Element for V201A-V203A Tone Oscillator						
C216	Same as C208	Frequency Determining Element for V201A-V203A Tone Oscillator						

C217	Same as C209	Frequency Determining Element for V201A-V203A Tone Oscillator						
C218	CAPACITOR, fixed: mica; 10,000 mmf ±10%; 300 vdcw; temp coef letter B; spec JAN-C-5	Feedback from V203A Plate to V201A Grid Network	CM35B103K	N16-C-33622-5222	CMF CM35B 103K	CM-7	C218 C219 C220 C722 C723 C724	9
C219	Same as C218	Coupling V203A Grid to Plate of V201A						
C220	Same as C218	Coupling V203B Grid to Plate of V203A						
C221	CAPACITOR, fixed: mica; 330 mmf ±10%; 500 vdcw; temp coef letter B; spec JAN-C-5	Coupling V204A Grid to Output of V203A	CM20B331K	N16-C-29718-7276	CMF CM20B 331K	CM-105	C221 C725	3
C222	CAPACITOR, fixed: mica; 1000 mmf ±5%; 300 vdcw; temp coef letter B; 51/64" lg x 15/32" wd x 7/32" thk; molded low loss phenolic; 2 axial wire leads	Coupling V206A Grid to Plate of V204A		N16-C-31085-2037	CMF 503M "B" CM20B 102J	CM-106	C222 C223 C224 C726 C727 C728	9
C223	Same as C222	Coupling V206B Grid to Cathode of V204A						
C224	Same as C222	Reduces High Frequency Signals at Grids of Tone Modulator, V206A and V206B						
C225	CAPACITOR, fixed; mica; 47 mmf ±10%; 500 vdcw; temp coef letter B; spec JAN-C-5	Keying Transient Suppressor	CM20B470K	N16-C-27582-1876	CMF CM20B 470K	CM-28	C225 C729	3
C226	CAPACITOR, fixed: mica; 4700 mmf ±20%; 500 vdcw; temp coef letter B; spec JAN-C-5	Keying Transient Suppressor	CM35B472M	N16-C-32651-9288	CMF CM35B 472M	CM-32	C226 C704	3
C301	CAPACITOR, fixed: paper dielectric; 2-sect; 50,000 mmf ±15% per sect; 1000 vdcw; spec JAN-C-25	Section A: High Voltage 60 cps Filter Section B: High Voltage 60 cps Filter	CP54B4FG503L	N16-C-53002-4350	CD CP54B4 FG503L	CP-75	C301	2
C302	CAPACITOR, fixed: paper dielectric; 500,000 mmf ±10%; 1000 vdcw; internally grounded; spec JAN-C-25	High Voltage 60 cps Filter	CP65B2FG504K	N16-C-47300-5928	CD CP65B2 FG504K	CP-76	C302	2
C401	CAPACITOR, fixed: electrolytic; 2-sect; 24 mf per sect; 400 vdcw; neg term grounded internally; spec JAN-C-62	Section A: Rectifier Filter Section B: Bias Supply By-pass from Power Supply Negative to Ground	CE32B240Q	N16-C-21868-1633	CD CE32B 240Q	CE-5	C401 C801	3
C402	CAPACITOR, fixed: electrolytic; 25 mf; 400 vdcw; neg term grounded internally; spec JAN-C-62	Rectifier Filter	CE41B250Q	N16-C-19792-7785	CD CE41B 250Q	CE-4	C402	2
C701	Same as C105	Channel A Input Coupling						
C702	Same as C105	Channel B Input Coupling						

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIGNATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	Total Per Equip.
C703	Same as C106	Sect. A: V703B Cathode By-pass Sect. B: V703A Plate By-pass						
C704	Same as C226	Keying Transient Suppressor						
C705	Same as C201	Frequency Determining Element for V705A-V711B Tone Oscillator						
C706	Same as C202	Frequency Determining Element for V705A-V711B Tone Oscillator						
C707	Same as C203	Frequency Determining Element for V705A-V711B Tone Oscillator						
C708	Same as C204	Frequency Determining Element for V705A-V711B Tone Oscillator						
C709	Same as C205	Frequency Determining Element for V705A-V711B Tone Oscillator						
C710	Same as C206	Frequency Determining Element for V705A-V711B Tone Oscillator						
C711	Same as C207	Frequency Determining Element for V705A-V711B Tone Oscillator						
C712	Same as C208	Frequency Determining Element for V705A-V711B Tone Oscillator						
C713	Same as C209	Frequency Determining Element for V705A-V711B Tone Oscillator						
C714	Same as C202	Frequency Determining Element for V705A-V711B Tone Oscillator						

C715	Same as C203	Frequency Determining Element for V705A-V711B Tone Oscillator						
C716	Same as C204	Frequency Determining Element for V705A-V711B Tone Oscillator						
C717	Same as C205	Frequency Determining Element for V705A-V711B Tone Oscillator						
C718	Same as C206	Frequency Determining Element for V705A-V711B Tone Oscillator						
C719	Same as C207	Frequency Determining Element for V705A-V711B Tone Oscillator						
C720	Same as C208	Frequency Determining Element for V705A-V711B Tone Oscillator						
C721	Same as C209	Frequency Determining Element for V705A-V711B Tone Oscillator						
C722	Same as C218	Frequency Determining Element for V705A-V711B Tone Oscillator						
C723	Same as C218	Coupling V711B Grid to Plate of V705A						
C724	Same as C218	Coupling V706B Grid to Plate of V711B						
C725	Same as C221	Coupling Output of V711B to Grid of V711A						
C726	Same as C222	Coupling V712B Grid to Plate of V711A						
C727	Same as C222	Coupling V712A Grid to Cathode of V711A						
C728	Same as C222	Reduces High Frequency Signals at Grids of Tone Modulator, V712A and V712B						
C729	Same as C225	Keying Transient Suppressor						
C801	Same as C401	Sections A & B Rectifier Filters						

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIGNATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	Total Per Equip.
C802	CAPACITOR, fixed: electrolytic; single sect; 10 mf; 150 vdcw; neg term grounded internally; spec JAN-C-62	Bias Rectifier Filter	CE41B100J	N16-C-19563-9901	CD CE41B 100J	CE-6	C802 C803	2
C803	Same as C802	Bias Rectifier Filter						
E101*	BOARD, terminal: mtg term strip for 4 capacitors and 21 resistors; 8 brass silver pl solder lug single end term and 34 brass silver pl solder lug double end term; term spaced irregularly to accommodate component parts; glass melamine; 5¼" lg x 3⅜ wd x ⅛" thk; four .147" diam mtg holes on 4¾" x 1¾" mtg/c; marked with symbol numbers of component parts and symbol number of term board; p/o CV-89/URA-8A Frequency Shift Converter	Mtg for C101, C102, C103, C104, R101, R104, R105, R106, R107, R108, R109, R110, R112, R113, R114, R115, R116, R117, R118, R119, R120, R121, R123, R124 and R125		N17-B-78282-3837	CKB EA-157	EA-157	E101	2
E102	BOARD, terminal: mtg term strip for circuit connection by 2 links; 6 brass silver pl solder lug term; term .406" c to c; glass melamine; 2" lg x 13/16" wd x 3/32" thk, less term; two .147" diam mtg holes on 1⅝" mtg/c; marked with symbol number of term board, and OPEN PARALLEL OPEN; p/o CV-89/URA-8A Frequency Shift Converter	Mtg for 2 E105 Links		N17-B-77736-1081	CKB EA-138	EA-138	E102	2
E103*	INSULATOR, plate: rectangular shape; natural phenolic, LTS-E-3 or LTS-E-4 per JAN-P-13; 2" lg o/a; ¾" wd x .015" thk; two .154" diam mtg holes on 1.687" mtg/c, symmetrical; corners rounded ⅛" rad	Insulator under J101, J201, J301, J401, J701 and J801		N17-I-64073-3039	CKB EL-132	EL-132	E103	8
E104*	LINK, connecting: u/w Hoffman Radio Corp part #EA-136, EA-137, and EA-138 term board assem; brass, dull silver pl, to withstand 200 hr, 20% salt spray test; 0.75" lg x 0.25" wd x 3/32" h	Selector Links on E102, E401 and E801		N16-L-498001-119	CKB AS-442	AS-442	E104	7
E105	SHIELD, electron tube: shield, spring and retainer; 2⅛" h x 1" diam o/a; 1 9/32" IL, .810" ID; two #4-40 x 15/16" lg spade bolts on ⅞" mtg/c riveted to retainer bottom, with top sides dimpled for mtg bayonet type shield; spiral spring .825" diam x ⅝" d o/a in top of shield; upper shield only black oxidized, whole assem nickel pl steel; (BuShips dwg #RE49F475A except for finish)	Shields and Holds V103, V104, V701, V702, V703 and V802		N16-S-34595-2100	CKB XA-9	XA-9	E105	8
E106	SHIELD, electron tube: brass, cad pl and moly black; cylindrical with partially closed top; bayonet mtg on shield base of socket; .950" ID x 1 15/16" lg; 19/32" diam vent hole at top; with coiled tube-retaining spring; same as JAN type TSF0T105 except finish, (spec JAN-S-28A)	Shields and Holds V101, V103, V105, V201, V203, V204, V206, V301, V704, V705, V706, V711 and V712		N16-S-34576-6508	CKB XA-12	XA-12	E106	21
E201*	BOARD, terminal: mtg term strip for 9 capacitors and 28 resistors; 18 brass silver pl solder lug single end term and 45 brass silver pl solder lug double end term; term spaced irregularly to accommodate component parts; glass melamine; 4 13/32" lg x 4 13/32" wd x 3/32" thk o/a excl term; four .120" diam mtg holes on 3.469" 3.944" x 3.771" x 3.417" mtg/c; marked with symbol numbers of component parts and symbol number of term board, 3 corners cut away, both upper ends and left lower end	Mtg for C218, C219, C220, C221, C222, C223, C224, C225, C226, R203, R206, R207, R208, R209, R210, R211, R212, R213, R214, R215, R216, R217, R218, R219, R221, R222, R224, R226, R227, R228, R229, R230, R231, R232, R233, R234 and R235		N17-B-78330-8995	CKB EA-159	EA-159	E201	2

E202*	INSULATOR, plate: rectangular shape; natural phenolic, LTS-E-3 or LTS-E-4 per JAN-P-13; 2″ lg o/a; ¾″ wd x 1/32″ thk; 21/64″ d x .316″ wd cutout ea end for mtg	Insulates Back Term on J201		N17-I-64094-6039	CKB EL-133	EL-133	E202	2
E203	SHIELD, electron tube: shield, spring and retainer; 3″ h x 1″ diam o/a; 2 5/32″ IL, .810″ ID; two #4-40 x 15/16″ lg spade bolts on ⅞″ mtg/c riveted to retainer bottom, with top sides dimpled for mtg bayonet type shield; spiral spring .825″ diam x ⅝″ d o/a in top of shield; upper shield only black oxidized, whole assembly nickel pl steel; (BuShips dwg #RE49F475A except for finish)	Tube Shield for V202, V207, V208, V401, V708, V709, V710 and V801		N16-S-34682-9100	CKB XA-11	XA-11	E203	12
E204*	CONVERTER SUB-ASSEMBLY: frequency selector; p/o CV-89/URA-8A Frequency Shift Converter and CM-22/URA-8A Comparator; consists of 1 rotary switch Hoffman Radio Corp part/dwg #SW-26, 17 fixed mica capacitors and 2 fixed resistors mtd on term boards; approx 3½″ lg x 2¼″ wd x 2⅛″ d o/a	Selects Capacitor to Determine Output Frequency of AF Oscillator V201A and V203A		N16-C-91201-1008	CKB EA-134	EA-134	E204 E703	3
E301*	BOARD, terminal: mtg term strip for 17 resistors; 20 brass nickel pl solder lug single end term and 19 brass nickel pl solder lug double end term; two .157″ diam holes for cable clamps; term spaced irregularly to accommodate component parts; glass melamine; 4¾″ lg x 2 7/16″ wd x 3/32″ thk, less term; four .147″ diam mtg holes on 4.250″ x 1⅞″ mtg/c; marked with symbol numbers of component parts and symbol number of term board; p/o CV-89/URA-8A Frequency Shift Converter	Mtg for R302, R304, R305, R306, R308, R309, R311, R312, R313, R314, R315, R316, R317, R318, R321, R322 and R323		N17-B-78267-2707	CKB EA-158	EA-158	E301	2
E302*	SHIELD, electron tube: mumetal, black enamel, dull; round, open top and bottom; brkt mtd; 2.187″ ID x 5″ lg inside; 5″ lg OL; .020″ wall thickness; 2 "L" shaped mtg brkts spotwelded to bottom with .154″ diam mtg holes spaced 110° apart, 1 brkt spotwelded on side 3½″ from bottom with two .154″ diam mtg holes on 1.844″ mtg/c; p/o CV-89/URA-8A Frequency Shift Converter; for CR tube	Tube Shield for V302		N16-S-34881-9713	CKB XA-13	XA-13	E302	2
E401*	BOARD, terminal: mtg term strip for 1 resistor and provides for link selection of 3 line voltages; 2 brass silver pl feed-through term and 4 brass silver pl term which provides for link selection; term spaced irregularly to accommodate component parts; glass melamine; 2⅞″ lg x 1 1/16″ wd x ⅛″ thk; two .154″ diam mtg holes on 2⅝″ mtg/c; marked with symbol number of component part, line voltages and symbol number of term board; p/o CV-89/URA-8A Frequency Shift Converter	Mtg for R402 and E105 Link		N17-B-77738-2807	CKB EA-137	EA-137	E401	2
E601*	BOARD, terminal: mtg term strip for 1 resistor; 2 brass silver pl solder lug term; term ⅞″ c to c; glass melamine; 1¼″ lg x ¾″ wd x 3/32″ thk, less term; two .147″ diam mtg holes on ½″ mtg/c; marked with symbol number of component part and symbol number of term board; p/o CV-89/URA-8A Frequency Shift Converter	Mtg for R601		N17-B-77534-2387	CKB EA-153	EA-153	E601	2
E602	KNOB: round; black phenolic; for ¼″ diam shaft; double #6-32 set screw; pointer, groove filled with white lacquer; 13/16″ diam x 9/16″ h o/a; brass insert; shaft hole 7/16″ d; 8 indents equally spaced; item 1 of BuShips dwg #RE10F479D	Control Knobs for R122, R220, R301, R319, R320, S101, S102, S103, S201 and S202		N16-K-700284-190	CKB EK-18	EK-18	E602 E1002	24
E603	INSULATOR, bushing: shoulder, phenolic molded plastic, MTS-E-1 per JAN-P-14; .102″ thk, .380″ ID, .843″ OD; cap back has .110″ diam x .062″ d hole 0.1405″ from edge, on 0.281″ radius, 0.04″ lg shank on 0.495″ diam projection on undersurface of cap beneath 0.110″ diam hole is 0.029″ thk, has 0.094″ radius based on hole center, with straight sides running to shank	Insulates Jack from Chassis		N17-I-49527-7100	CKB EM-111	EM-111	E603	6
E604	INSULATOR, spacer: covers and insulates bottom and walls of jack compartment; 1/32″ uniform thk, molded fiberglass with polyester resin; flat bottom with two holes, sides vertical to bottom and curved in shape resembling a "B"; 1.88″ lg x .88″ wd x .5″ h o/a; two .406″ diam mtg holes on 1″ mtg″c; u/w Frequency Converter CV-89/URA-8A and Comparator CM-22/URA-8A	Insulates J606 and J607 from Jack Compartment		N17-I-67035-9526	CKB EM-133	EM-133	E604 E1003	

* This item cannot be requisitioned from supply. In the event of failure it should be repaired or a new item fabricated.

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIG-NATION	CON-TRACTOR DRAW-ING & PART NO.	ALL SYMBOL DESIG. IN-VOLVED	Total Per Equip.
E701*	BOARD, terminal: mtg term strip for 6 capacitors and 19 resistors; 23 brass silver pl solder lug single end term and 27 brass silver pl solder lug double end term; term spaced irregularly to accommodate component parts; glass melamine; 7¾″ lg x 2″ wd x 3/32″ thk o/a excl term; four .147″ diam mtg holes on 7¼″ x 1½″ mtg/c; marked with symbol numbers of component parts and symbol number of term board; semi-circular cutout radius 5/16″; 6 17/32″ from left side	Mtg for C722, C723, C724, C725, C726, C727, R701, R702, R703, R704, R705, R706, R708, R711, R727, R729, R730, R731, R732, R733, R734, R737, R738, R739 and R740		N17-B-78322-9448	CKB EA-135	EA-135	E701	1
E702*	BOARD, terminal: mtg term strip for 3 capacitors and 18 resistors; 19 brass silver pl solder lug single end term and 23 brass silver pl solder lug double end term; term spaced irregularly to accommodate component parts; glass melamine; 7¾″ lg x 2″ wd x 3/32″ thk o/a excl term; four .147″ diam mtg holes on 7¼″ x 1½″ mtg/c; marked with symbol numbers of component parts and symbol number of term board; semi-circular cutout upper right side of board	Mtg for C704, C728, C729, R707, R710, R712, R713, R714, R715, R716, R717, R719, R720, R721, R722, R735, R736, R741, R742, R744 and R745		N17-B-78282-9448	CKB EA-154	EA-154	E702	1
E703	Same as E204	Selects Osc. Freq. for V705						
E801*	BOARD, terminal: mtg term strip for 3 resistors and provides for link selection of three line voltages; 6 brass silver feed-through term for mtg component parts and 4 brass silver pl term which provide for link selection; term spaced irregularly to accommodate component parts; glass melamine; 3 9/16″ lg x 1 1/16″ wd x 3/32″ thk, less term; two .154″ diam mtg holes on 3 1/16″ mtg/c; marked with symbol numbers of component parts, line voltages and symbol number of term board; p/o CM-22/URA-8A Comparator	Mtg for R801, R802, R804 and E105 Link		N17-B-77935-5131	CKB EA-136	EA-136	E801	1
E1001*	BOARD, terminal: mtg term strip for 1 resistor; 2 brass silver pl solder lug term; term ⅞″ c to c; glass melamine; 1¼″ lg x ¾″ wd x 3/32″ thk. less term; two .147″ diam mtg holes on ½″ mtg/c; marked with symbol number of component part and symbol number of term board; p/o CM-22/URA-8A Comparator	Mtg for R1001		N17-B-77534-2382	CKB EA-152	EA-152	E1001	1
E1002	Same as E602	Control Knobs for R707, R743, S701 and S702						
E1003	Same as E604	Insulates J1004 and J1005 from Jack Compartment						
F501	FUSE, cartridge: .75 amp, continuous 110% rating, blowing time 60 minutes for 135% load; rated 250 v; non-renewable; glass body; ferrule term; 1¼″ lg, 9/32″ diam of ferrule	Fuses Z504		N17-F-14309-325	CFA GTA ¾	FU-17	F501 F502 F503 F504	8
F502	Same as F501	Fuses Z504						
F503	Same as F501	For Replacement of F501 and F502						
F504	Same as F501	For Replacement of F501 and F502						
F901	FUSE, cartridge: .5 amp, continuous 110% rating, blowing time 60 minutes for 135% load; rated 250 v; non-renewable; glass body; ferrule term; 1¼″ lg, 9/32″ diam of ferrule	Fuses Z904		N17-F-14309-320	CFA GTA ½	FU-18	F901 F902 F903 F904	4

F902	Same as F901	Fuses Z904						
F903	Same as F901	For Replacement of F901 and F902						
F904	Same as F901	For Replacement of F901 and F902						
H101	SCREW, captive: slot drive; flat Fil H; SS; #10-24 NC-2; .600″ lg; threaded portion .220″ lg; 9/64″ thk head, .313″ diam hd; .190″ diam x .040″ thk shoulder; p/o CV-89/URA-8A Frequency Shift Converter	Mts Sub-Units and Cable Filter Assembly		N43-S-4799-8750	CKB HM-137	HM-137	H101 H701	53
H102	SCREW, set: Allen drive (socket head); headless; CHS, cad pl; #6-32 NC-2; 3/16″ lg; cup point; Navy spec 42S5e type G	Secures Various Components		N43-S-17365-215	QSSP	HS-1001	H102	5[illegible]
H103	SCREW, set: Allen drive (socket head); headless; CHS, cad pl; #6-32 NC-2; ⅛″ lg; cup point; Navy spec 42S5e type G	Secures Various Components		N43-S-17365-210	QSSP	HS-1002	H103	48
H301*	SCREW, thumb: knurled thumb head; brass nickel pl; #6-32 NC-2; ¾″ lg; threaded portion ¾″ lg; flat end; head ⅜″ diam x ⅝″ lg o/a, knurled ⅝″ lg; shoulder ¼″ lg x 5/16″ diam o/a, grooved to a 3/32″ rad x 3/16″ lg; p/o CV-89/URA-8A Frequency Shift Converter	Closes Cathode-Ray Tube Clamp		N43-S-19133-1272	CKB HM-147	HM-147	H301	2
H401	CLAMP: capacitor mtg; CRS .035″ thk; cadmium pl; 1 clamping bolt employed; 2 ¼″ lg x 1⅞″ wd x ¾″ h o/a, 1⅜″ ID; 2 mtg feet ea/with 7/32″ lg x 5/32″ wd mtg hole on 1 11/16″ or 1⅞″ mtg/c; accommodates 1⅜″ diam	Mts C401 and C801		N16-C-303202-388	CD 17843 with extra heavy cad pl	HM-152	H401	3
H601*	SCREW, socket head: Allen drive; flat Fil H; SS; #10-24 NC-2; .594″ lg; p/o CV-89/URA-8A Frequency Shift Converter and CM-22/URA-8A Comparator	Secures Index Plate on Drawer Slide		N43-S-4379-737	CKB HM-149	HM-149	H601 H1001	6
H602*	SCREW, socket-headcap: Allen drive; flat Fil H; SS, per Navy spec 46S18 class 7; #10-24 NC-2; .734″ lg; p/o CV-89/URA-8A Frequency Shift Converter and CM-22/URA-8A Comparator	Secures Eccentric Adjustment of Index Plate on Drawer Slide		N43-S-51871-9058	CKB HM-150	HM-150	H602 H1002	6
H603	WRENCH: angle, hex, for #6 Allen head set screw; 1/16″ across flats; 1¾″ lg x ⅝″ wd o/a; steel cad pl	Wrench for #6 Allen Head Set Screw		41-W-2445	QSSP	VW-4	H603 H1003	3
H604	WRENCH: angle hex, for 5/32″ socket; 5/32″ across flats; 2½″ lg x ⅞″ wd o/a; steel cad pl	Wrench for 5/32″ Socket		41-W-2451	QSSP	VW-5	H604 H1004	5
H605	SCREW, captive: Phillips drive; Bind H; SS; #4-40; .437″ lg; threaded portion .156″ lg; .183″ diam x .107″ thk head; .112″ diam x .040″ thk shoulder; p/o Hoffman Radio Corp part #AA-194 hood assembly	Mts Cathode-Ray Hood Assembly A301		N43-S-4799-8040	CKB HM-155	HM-155	H605	4
H606	NUT, hex: SS, unfinished bearing surface; #8-32 NC-2; ⅛″ thk; 11/32″ across flats; p/o Frequency Shift Converter-Comparator Group AN/URA-8A	Fastens A604 Plate or A603 Vibration Mount to Case		N43-N-5808-7520	CKB HNS-13	HNS-13	H606 H1005	48
H607	SCREW, machine: Phillips drive; FH unfinished; SS; #8-32 NC-2; ⅝″ lg; threaded full length; head .308″/.332″ diam x .084″/.100″ h; p/o Frequency Shift Converter-Comparator Group AN/URA-8A	Fastens A604 Plate or 603 Vibration Mount to Case		N43-S-71685-115	CKB HSS-628P	HSS-628P	H607 H1006	48
H608	WASHER, flat: SS; flat .203″ ID, 7/16″ OD, .036″ thk; p/o Frequency Shift Converter-Comparator Group AN/URA-8A	Fastens A604 Plate or A603 Vibration Mount to Case		N43-W-7599-7590	CKB HWS-129	HWS-129	H608 H1007	48
H701	Same as H101	Mts Sub-Units and Cable Filter Assembly						
H1001	Same as H601	Secures Index Plate on Drawer Slide						
H1002	Same as H602	Secures Eccentric Adjustment of Index Plate on Drawer Slide						

* This item cannot be requisitioned from supply. In the event of failure it should be repaired or a new item fabricated.

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIGNATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	Total Per Equip.
H1003	Same as H603	Wrench for #6 Allen Head Set Screw						
H1004	Same as H604	Wrench for 5/32" Socket						
H1005	Same as H606	Fastens A1003 Plate or A1002 Vibration Mount to Case						
H1006	Same as H607	Fastens A1003 Plate or A1002 Vibration Mount to Case						
H1007	Same as H608	Fastens A1003 Plate or A1002 Vibration Mount to Case						
H1101	CLAMP: cable; diecast aluminum alloy; sandblast and clear lacquer finish or tin plate and clear lacquer finish; 2 mach screws and lockwashers employed; 1 1/16" max diam x 1 5/64" lg max o/a; accommodates 7/16" cable, 5/32" clamp take-up; ¾"-20 female thread mates AN shell size 14 and 14S	Secures Cable to Plug P1101, P1102, P1103, P1104 and P1105	AN3057-6	N17-C-781366-251	CED AN-3057-6	WK-14	H1101	18
H1102	SCREW, machine: Phillips drive; straight-side binding head unfinished; SS; ¼"-20 NC-2; ⅝" lg; threaded full length; p/o Frequency Shift Converter-Comparator Group AN/URA-8A	Holds Units in Rack		N43-S-71368-1050	CKB HSS-989P	HSS-989P	H1102	24
I601	LAMP, glow: 105-125 v 1/25 w; striking v 65 v AC, 90 v DC; bulb T-3 ¼ clear; 1 3/16" lg o/a; miniature bayonet base; burn any position; BuShips dwg # RE38F149D	Indicates Power On		17-L-6806-130	CG NE-51	IL-8	I601 I1001	3
I1001	Same as I601	Indicates Power On						
J101	CONNECTOR, receptacle: 14 round male cont; straight; polarized; 2" lg x ¾" wd x 11/16" d excl term; rectangular, melamine; two 5/32" diam mtg holes on 1 11/16" mtg/c	Carries All Connections from Discriminator Sub-Unit to Chassis-Panel Assem		N17-C-73588-4094	CED DPM 14-34P	JR-50	J101 J201 J301 J401 J701 J801	10
J201	Same as J101	Carries all Connections from Oscillator-Keyer Sub-Unit to Chassis-Panel Assem						
J301	Same as J101	Carries all Connections from Monitor Sub-Unit to Chassis-Panel Assem						
J401	Same as J101	Carries all Connections from Power Supply Sub-Unit to Chassis-Panel Assem						

J501	CONNECTOR, receptacle: 16 round female cont; straight; polarized; 2 11/16″ lg x 1 11/16″ wd x 63/64″ h excl term; #14 wire 15 amp cont, #16 wire 10 amp cont; rectangular shape aluminum body with mtg flange, sand blast and clear lacquer finish; phenolic insert; four .144 csk mtg holes on 2.188″ x 1″ mtg/c	Mates all Connections from Cable Filter Assembly to Chassis-Panel Assembly		N17-C-73313-5487	CED DPB-F16-33S Type G	JR-49	J501 J901	3
J502	CONNECTOR, receptacle: 1 round female cont; non-polarized; straight; BuShips dwg #RE49F244D	Diversity Input	UG-87/U	N17-C-73108-1252	CPH UG-87/U	JR-46	J502 J902 J903	4
J503	CONNECTOR, receptacle: 1 round female cont; straight; BuShips dwg #RE49F167E	Converter Remote CRT	(49194)	N17-C-73108-5890	CPH 49194	JR-45	J503	2
J504	(not used)							
J505	CONNECTOR, receptacle: 3 round male cont, polarized; #16 AWG; straight; Service A; spec AN-C-591	External Tone Input	AN3102-14S-12P	N17-C-72604-1705	CED AN3102-14S-12P	JR-43	J505 J904	3
J506	CONNECTOR, receptacle: 3 round female cont, polarized; #16 AWG; straight; Service A; spec AN-C-591	Tone Output	AN3102-14S-12S	N17-C-72240-1705	CED AN3102-14S-12S	JR-42	J506 J905	3
J507	CONNECTOR, receptacle: 3 round female cont, polarized; #16 AWG; straight; Service A; spec AN-C-591	600 Ohm Input —Wide	AN3102-14S-7S	N17-C-72240-1522	CED AN3102-14S-7S	JR-52	J507 J508	4
J508	Same as J507	600 Ohm Input —Narrow						
J509	CONNECTOR, receptacle: 2 round male cont, polarized; #16 AWG; straight; Service A; spec AN-C-591	Teletype Output	AN3102-14S-9P	N17-C-72596-2880	CED AN3102-14S-9P	JR-41	J509 J906	3
J510	CONNECTOR, receptacle: 3 round male cont, #16 AWG; polarized; straight; spec AN-C-591	Power Input	AN3102-14S-7P	N17-C-72604-1522	CED AN3102-14S-7P	JR-40	J510 J907 J908 J909	5
J511	CONNECTOR, receptacle: 2 rectangular female cont, polarized; straight; 1⅞″ lg x 1 9/32″ wd x 9/16″ h; 10 amp 250 v, 15 amp 125 v; molded black bakelite insert; SS mtg plate molded into bakelite with two 5/32″ diam mtg holes on 1½″ mtg/c	AC Convenience Outlet		N17-C-73144-4810	CPH 61-MIP-61 FM	JR-47	J511	2
J601	CONNECTOR, receptacle: 16 round male cont; straight, polarized; 2 11/16″ lg x 1 11/16″ wd x 1 7/64″ d o/a; #14 wire 15 amp cont, #16 wire 10 amp cont; rectangular shaped aluminum body with mtg flange, sand blast and clear lacquer finish; phenolic insert; four .144″ diam mtg holes on 2.188″ x 1″ mtg/c	Carries all Connections from Chassis-Panel Assem to Cable Filter Assem		N17-C-73601-8385	CED DPB-F16-34P	JR-48	J601 J1001	3
J602	CONNECTOR, receptacle: 14 round female cont; straight; polarized; 2″ lg x ¾″ wd x 21/32″ d o/a; rectangular, melamine; two 5/32″ diam mtg holes on 1 11/16″ mtg/c	Mates all Connections from Chassis-Panel Assem to Discriminator Sub-Unit		N17-C-73301-6068	CED DPM-14-33	JR-51	J602 J603 J604 J605 J1002 J1003	10
J603	Same as J602	Mates all Connections from Chassis-Panel Assem to Monitor Sub-Unit						
J604	Same as J602	Mates all Connections from Chassis-Panel Assem to Oscillator-Keyer Sub-Unit						
J605	Same as J602	Mates all Connections from Chassis-Panel Assem to Power Supply Sub-Unit						

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIG-NATION	CON-TRACTOR DRAW-ING & PART NO.	ALL SYMBOL DESIG. IN-VOLVED	Total Per Equip.
J606	JACK, telephone: for 2 cond 0.25" diam plug; 1 7/32" lg x 1" wd x 7/8" h o/a; J4 cont arrangement; incl 3/8"-32 thd bushing, hex nut and plain washer; 3/8" diam mtg hole; has 0.092" diam locating pin	For Monitoring Teletype DC Loop Output	(49008)	N17-J-39254-1289	CBIM 2J-1074	JK-5	J606 J607 J1004 J1005	6
J607	Same as J606	For Monitoring Keyed Tone Output						
J701	Same as J101	Carries all Connections from Selector Sub-Unit to Chassis-Panel Assem						
J801	Same as J101	Carries all Connections from Power Supply Sub-Unit to Chassis-Panel Assem						
J901	Same as J501	Mates all Connections from Cable Filter Assem to Chassis-Panel Assem						
J902	Same as J502	Diversity Channel A						
J903	Same as J502	Diversity Channel B						
J904	Same as J505	External Tone Input						
J905	Same as J506	Tone Output						
J906	Same as J509	Teletype Output						
J907	Same as J510	Power Input						
J908	Same as J510	Power Input						
J909	Same as J510	Power Input						
J1001	Same as J601	Carries all Connections from Chassis-Panel Assem to Cable Filter Assem						
J1002	Same as J602	Mates all Connections from Chassis-Panel Assem to Selector Sub-Unit						
J1003	Same as J602	Mates all Connections from Chassis-Panel Assem to Pwr Supply Sub-Unit						
J1004	Same as J606	Monitor Jack for Teletype Output						
J1005	Same as J606	Monitor Phones for Keyed Tone Output						

L401	REACTOR: filter choke; 15 hy, 65 ma; 350 ohms max DC resistance at 25° C; 1750 v RMS test; HS metal case; 2 3/16″ lg x 2 3/16″ wd x 2⅞″ h excl term and mtg studs; four #6-32 x ⅝″ lg mtg studs on 1.688″ x 1.688″ mtg/c; 2 slotted turret term on bottom; p/o CV-89/URA-8A Frequency Shift Converter; spec JAN-T-27	Rectifier Filter Choke		N16-R-29317-6239	CTR 14989	LF-13	L401	2
L801	REACTOR: filter choke; 15 henries, 35 ma; 350 ohms max DC resistance at 25° C; 1750 v RMS test; HS metal case; 1⅞″ lg x 1⅞″ wd x 2½″ h excl term and mtg studs; four #6-32 x ⅜″ lg mtg studs on 1.344″ x 1.344″ mtg/c; 2 slotted turret term on bottom; p/o CM-22/URA-8A Comparator; spec JAN-T-27	Rectifier Filter Choke		N16-R-29316-1853	CTR 14990	LF-14	L801	1
O101	COLLAR, shaft: control coupling; p/o CV-89/URA-8A Frequency Shift Converter and CM-22/URA-8A Comparator; SS; OD ⅝″, ID .252″, .218″ lg	Couples and Decouples Panel Controls		N16-C-599931-109	CKB OM-383	OM-383	O101	30
O301*	CUSHION, cathode-ray tube: neoprene; round with flange, cutout in center 1.687″ lg x 1.375″ wd; 2.140″ diam x .234″ thk o/a; mts into 2.046″ diam hole	Cushions Front of V301		N17-C-965001-198	CKB PK-91	PK-91	O301	2
O302*	CUSHION, cathode-ray tube: neoprene; round with flange, 2.062″ diam cutout in center; 2 5/16″ diam x ⅝″ thk o/a; mts into 2 3/16″ diam hole	Cushions Front of E302 Cathode-Ray Tube Shield		N17-C-965001-199	CKB PK-92	PK-92	O302	2
O303*	GASKET: cathode-ray tube hood seal; neoprene, 25 to 30 shore durometer; single hole 2⅛″ diam; round, 2¼″ diam x 1/16″ thk o/a; p/o Hoffman Radio Corp part #AA-194 hood assembly	Seals Visor A301 Watertight Against Front Panel of Converter		N17-G-161780-392	CKB PK-131	PK-131	O303	2
O304*	CUSHION: liner for CRT clamp; u/w Frequency Shift Converter CV-89/URA-8A; corprene; rectangular; 6⅝″ lg x ½″ wd x .047″ h	Secures Tube in Clamp		N17-C-965001-189	CKB PK-97	PK-97	O304	2
O305*	SCALE: to protect face of cathode-ray tube; p/o CV-89/URA-8A Frequency Shift Converter; cellulose, acetate, transparent; 2.031″ diam x .032″ thk o/a; cemented in cathode-ray tube hood; 3 parallel lines cut .005″ d x .010″ wd filled with black paint spaced ½″ apart across face	Protects Face of Cathode-Ray Tube		N16-S-117101-271	CKB MM-39	MM-39	O305	2
O601*	GASKET: jack recess cover; neoprene; single hole, 0.437″ diam; flat strip with parallel sides and rounded ends, 2″ lg x 1″ wd x .020″ thk o/a; p/o CV-89/URA-8A Frequency Shift Converter	Seals Cover over Monitor Jacks		N17-G-152389-682	CKB PK-93	PK-93	O601 O1001	3
O602*	GASKET: cover; neoprene; 5 holes, ⅛″ diam; rectangular, 12¾″ lg x 2⅝″ wd x 1/16″ thk o/a; p/o CV-89/URA-8A Frequency Shift Converter	Seals Filter Inspection Cover to Case		N17-G-158183-882	CKB PK-95	PK-95	O602 O1002	3
O603*	GASKET: filter assem; neoprene; single hole; rectangular, 12⅛″ lg x 1 3/16″ wd x 5/32″ thk; p/o CV-89/URA-8A Frequency Shift Converter	Seals Cable Filter Receptacle Panel to Case		N17-G-158146-972	CKB PK-96	PK-96	O603 O1003	3
O604	SHAFT ASSEMBLY: control shaft coupling assembly; p/o CV-89/URA-8A Frequency Shift Converter and CM-22/URA-8A Comparator; SS; shape like shaft with flange; 1.1086″ lg x ⅝″ diam o/a; panel hole mtd; shaft length 57/64″ lg x ¼″ diam with two 3/32″ grooves, flange ⅝″ diam x ⅛″ thk with .092″ diam x .093″ lg pin	Provides for Uncoupling Control Knobs from Controls to Permit Removal of Sub-Unit		N16-S-21126-1045	CKB AA-178	AA-178	O604 O1004	24
O605	SHAFT ASSEMBLY: control shaft coupling assembly; p/o CV-89/URA-8A Frequency Shift Converter and CM-22/URA-8A Comparator; SS; shape like shaft with flange; 1.296″ lg x ⅝″ diam o/a; panel hole mtd; shaft length 1 5/64″ lg x ¼″ diam slotted for screwdriver adjustment with two 3/32″ grooves and turned down one place to .187″ diam, flange ⅝″ diam x ⅛″ thk with .092″ diam x .093″ lg pin	Provides for Uncoupling scdr Control from Controls to Permit Removal of Sub-Unit		N16-S-21126-1046	CKB AA-179	AA-179	O605	4
O606*	SPRING: helical extension type; slide; 0.024″ diam music wire cad pl; 1.048″ lg x .298″ wd o/a; coil 3/16″ OD; approx 24 turns; parallel hook term, one 3/16″ OD, one ¼″ ID, indexed 180°; p/o AN/URA-8A	On Drawer Slide		N17-S-46739-2026	CKB OM-365	OM-365	O606 O1005	6
O607*	SPRING: helical compression type; latch; .031″ diam music wire cad pl; 2″ lg x 23/64″ diam o/a; approx 17 turns; squared ends; p/o AN/URA-8A	On Drawer Slide Latch		N17-S-46681-2351	CKB OM-384	OM-384	O607 O1006	18

* This item cannot be requisitioned from supply. In the event of failure it should be repaired or a new item fabricated.

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIG-NATION	CON-TRACTOR DRAW-ING & PART NO.	ALL SYMBOL DESIG. IN-VOLVED	Total Per Equip.
O608	CLIP: hairpin; locks shaft; 18-8 SS wire; 9/16" lg x .280" wd x .031" thk o/a; 0.218" diam max open-ing; p/o CV-89/URA-8A Frequency Shift Converter	Spring Locks Shaft in Forward or Backward Position		N17-C-805220-905	CKB OM-402	OM-402	O608 O1007	28
O1001	Same as O601	Seals Cover over Monitor Jack						
O1002	Same as O602	Seals Filter Inspection Cover to Case						
O1003	Same as O603	Seals Cable Filter Receptacle						
O1004	Same as O604	Provides for Uncoupling Control Knobs from Controls to Permit Removal of Sub-Units						
O1005	Same as O606	On Drawer Slide						
O1006	Same as O607	On Drawer Slide Latch						
O1007	Same as O608	Secures Shaft in Panel						
O1101	RING, bonding grounds cable shielding to connector; u/w Cannon Electric connectors; soft copper; circu-lar with T-tongue in center; .682" OD x .557" ID x .020" thk o/a; mts between cable clamp and connector	Grounds Cable Shield Braid to Plug		N17-R-650211-112	CED 2250-3	HM-90	O1101	4
P1101	CONNECTOR, plug: 3 round male cont, polarized; straight; spec AN-C-591	Mates J507	AN3106-14S-7P	N17-C-70588-1523	CED AN3106-14S-7P	PL-67	P1101	4
P1102	CONNECTOR, plug: 3 round female cont, polarized; straight; spec AN-C-591	On W1102	AN3106-14S-7S	N17-C-70328-1523	CED AN3106-14S-7S	PL-58	P1102	5
P1103	CONNECTOR, plug: 2 round female cont, polarized; straight; spec AN-C-591	Mates J509	AN3106-14S-9S	N17-C-70320-2881	CED AN3106-14S-9S	PL-59	P1103	3
P1104	CONNECTOR, plug: 3 round male cont, polarized; straight; spec AN-C-591	Mates J506	AN3106-14S-12P	N17-C-70588-1706	CED AN3106-14S-12P	PL-60	P1104	3
P1105	CONNECTOR, plug: 3 round female cont, polarized; straight; spec AN-C-591	Mates J505	AN3106-14S-12S	N17-C-70328-1706	CED AN3106-14S-12S	PL-61	P1105	3
P1106	CONNECTOR, plug: 1 round male cont; straight; BuShips dwg #RE49F167E	Mates J503	(49195)	N17-C-71413-4752	CPH 49195	PL-63	P1106	2
P1107	CONNECTOR, plug: 1 round male contact; straight; BuShips dwg #RE49F243D	On W1101	UG-85/U	N17-C-71414-2794	CPH UG-85/U	PL-64	P1107	4
P1108*	CONNECTOR, plug: 16 round female cont; angle type, 90°; polarized; 2 3/64" lg x 1 1/16" wd x 1⅝" d o/a; #14 wire 15 amp cont, #16 wire 10 amp cont; rectangular shape aluminum body, sand blast and clear lacquer finish; phenolic insert; cable open-ing ⅝" diam; cable clamp is part of plug	On W1103		N17-C-70886-5200	CED DPB-F16-23C-5/8	PL-66	P1108	1

P1109*	CONNECTOR, plug: 16 round male cont; straight; polarized; 2″ lg x 1½″ wd x 2″ d o/a; #14 wire 15 amp cont, #16 wire 10 amp cont; rectangular shape aluminum body, sand blast and clear lacquer finish; phenolic insert; cable opening ⅝″ diam; cable clamp is part of plug	On W1103		N17-C-71600-5182	CED DPB-F16-22C-5/8	PL-65	P1109	1
R101	RESISTOR, fixed: composition; 56,000 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	In Parallel with R102 to form 50,000 ohm Load forT101 Secondary	RC20BF563J	N16-R-50515-431	CBZ RC20BF 563J	RC-261	R101 R217 R231 R717 R740	8
R102	RESISTOR, variable: composition; 500,000 ohms ±10%; ¼ w, 85°C max continuous oper; 3 solder lug term; enclosed metal case 15/16″ diam x .451″ d excl term; round metal shaft ¼″ diam x ⅝″ lg from mtg surface, slotted for screwdriver adj, friction lock; standard "D" taper; ins cont arm; normal torque; ⅜″-32 x ⅜″ lg bushing, split for use of shaft locking nut, non-turn device located on 7/16″ radius at 9 o'clock.	In Parallel with R101, Adjusts Signal Level to V101A Limiter Amplifier		N16-R-88177-8500	CTC #45 Type G8994	RV-58	R102	2
R103	RESISTOR, fixed: composition; 470,000 ohms ±10%; ½ w; characteristic letter F; spec JAN-R-11	V101A Grid Bias	RC20BF474K	N16-R-50822-811	CBZ RC20BF 474K	RC-68	R103 R107 R208 R209 R214 R221 R305 R306 R731 R732 R737 R744	20
R104	RESISTOR, fixed: composition; 750 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V101A Cathode Bias	RC20BF751J	N16-R-49858-431	CBZ RC20BF 751J	RC-267	R104	2
R105	RESISTOR, fixed: composition; 150,000 ohms ±5%; 2 w; characteristic letter F; spec JAN-R-11	V101A Cathode Bias Stabilizing	RC40BF154J	N16-R-50678-171	CBZ RC40BF 154J	RC-268	R105	2
R106	RESISTOR, fixed: composition; 1500 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V101B Cathode Bias	RC20BF152J	N16-R-49966-431	CBZ RC20BF 152J	RC-200	R106	2
R107	Same as R103	V101B Grid Return						
R108	RESISTOR, fixed: composition; 220,000 ohms ±5%; 1 w; characteristic letter F; spec JAN-R-11	V101A Plate Load	RC30BF224J	N16-R-50713-751	CBZ RC30BF 224J	RC-23	R108 R212 R735	5
R109	RESISTOR, fixed: composition; 100,000 ohms ±5%; 2 w; characteristic letter F; spec JAN-R-11	V101B Plate Load	RC40BF104J	N16-R-50633-171	CBZ RC40BF 104J	RC-269	R109	2
R110	RESISTOR, fixed: composition; 910 ohms ±%5; 1 w; characteristic letter F; spec JAN-R-11	V102A Cathode Bias	RC30BF911J	N16-R-49903-751	CBZ RC30BF 911J	RC-270	R110 R112	4
R111	RESISTOR, variable: composition; 350 ohms ±10%; 2 w, 70°C max continuous oper; 3 solder lug term; enclosed metal case 1 1/16″ diam x 9/16″ d excl term; round metal shaft ¼″ diam x ¾″ lg from mtg surface, slotted for screwdriver adj, friction lock; taper "U"; ins cont arm; normal torque; ⅜″-32 x ½″ lg bushing, split for use of shaft locking nut, non-turn device located on 17/32″ radius at 9 o'clock	V102A-V102B Output Balancing		N16-R-87129-4385	CBZ JLU-5 3511 SD-4048	RV-50	R111 R223 R746	5
R112	Same as R110	V102B Cathode Bias						
R113	RESISTOR, fixed: composition; 100,000 ohms ±5%; 1 w; characteristic letter F; spec JAN-R-11	V103B Diode Load	RC30BF104J	N16-R-50632-751	CBZ RC30BF 104J	RC-15	R113 R114	4
R114	Same as R113	V103A Diode Load						

* This item cannot be requisitioned from supply. In the event of failure it should be repaired or a new item fabricated.

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIGNATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	Total Per Equip.
R115	RESISTOR, fixed: composition; 820,000 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	Axis Restorer Voltage Divider	RC20BF824J	N16-R-50929-431	CBZ RC20BF 824J	RC-223	R115 R318	4
R116	RESISTOR, fixed: composition; 3.9 megohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	Divider for Voltage Rectified by V104A-V104B	RC20BF395J	N16-R-51136-431	CBZ RC20BF 395J	RC-277	R116 R703	3
R117	RESISTOR, fixed: composition; 1 megohm ±10%; ½ w; characteristic letter F; spec JAN-R-11	V105A-V105B Series Grid	RC20BF105K	N16-R-50975-811	CBZ RC20BF 105K	RC-65	R117 R704	3
R118	RESISTOR, fixed: composition; 4.7 megohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	Divider for Voltage Rectified by V104A-V104B	RC20BF475J	N16-R-51172-431	CBZ RC20BF 475J	RC-278	R118 R705	3
R119	RESISTOR, fixed: composition; 2.2 megohms ±10%; ½ w; characteristic letter F; spec JAN-R-11	Axis Restorer Voltage Divider	RC20BF225K	N16-R-51065-811	CBZ RC20BF 225K	RC-45	R119 R120 R701 R702 R706 R711	8
R120	Same as R119	V201B Series Grid Resistor, S202 at Operate						
R121	RESISTOR, fixed: composition; 220,000 ohms ±10%; ½ w; characteristic letter F; spec JAN-R-11	V105A-V105B Plate Load	RC20BF224K	N16-R-50714-811	CBZ RC20BF 224K	RC-47	R121 R708	3
R122	RESISTOR, variable: composition; 250,000 ohms ±10%; 2 w, 70°C max continuous oper; 3 solder lug term; enclosed metal case 1 1/16″ diam x 9/16″ d excl term; round metal shaft ¼″ diam x ½″ lg from mtg surface; linear "U" taper; ins cont arm; no off position; normal torque; ⅜″-32 x ¼″ lg bushing, non-turn device located on 17/32″ radius at 9 o'clock and 3 o'clock	THRESHOLD		N16-R-88079-4120	CBZ Type JU-2541 P-2032	RV-61	R122 R301	4
R123	RESISTOR, fixed: composition; 22,000 ohms ±10%; ½ w; characteristic letter F; spec JAN-R-11	V105A-V105B Cathode Bias	RC20BF223K	N16-R-50372-811	CBZ RC20BF 223K	RC-73	R123 R707	3
R124	RESISTOR, fixed: composition; 180,000 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	Limits Maximum Setting of R301, S101 in Narrow Position	RC20BF184J	N16-R-50695-431	CBZ RC20BF 184J	RC280	R124 R308	4
R125	RESISTOR, fixed: composition; 1.8 megohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	Limits Maximum Setting of R301, S101 in Wide Position	RC20BF185J	N16-R-51037-431	CBZ RC20BF 185J	RC281	R125	2
R201	RESISTOR, fixed: WW; 265,000 ohms ±1%; 1/3 w at 105°C max cont oper temp; spec JAN-R-93	Frequency Determining Element for V201A-V203A Tone Oscillator	RB11B26502F	N16-R-79450-9099	CSM RB11B 26502F	RP-27	R201 R204 R724 R725	6
R202	RESISTOR, fixed: WW; 23,000 ohms ±1%; 1/3 w at 105°C max cont oper temp; spec JAN-R-93	Negative Feedback from V203A Plate to V201A Cathode	RB11B23001F	N16-R-78175-7467	CSM RB11B 23001F	RP-26	R202 R726	3
R203	RESISTOR, fixed: composition; 3600 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V201A Cathode Bias with S201 in Ext. Tone Position	RC20BF362J	N16-R-50083-431	CBZ RC20BF 362J	RC-260	R203 R727	3

R204	Same as R201	Frequency Determining Element for V201A-V203A Tone Oscillator						
R205	RESISTOR, fixed: WW; 8740 ohms ±1%; 1/3 w at 105°C max cont oper temp; spec JAN-R-93	V201A Cathode Bias	RB11B87400F	N16-R-79243-1719	CSM RB11B 87400F	RP-25	R205 R728	3
R206	RESISTOR, fixed: composition; 47,000 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V201A Plate Load	RC20BF473J	N16-R-50479-431	CBZ RC20BF 473J	RC-74	R206 R216 R729 R739	6
R207	RESISTOR, fixed: composition; 33,000 ohms ±10%; 2 w; characteristic letter F; spec JAN-R-11	V202 Series Dropping	RC40BF333K	N16-R-50418-551	CBZ RC40BF 333K	RC-264	R207 R730	3
R208	Same as R103	V203A Grid Return						
R209	Same as R103	V203B Diode Load						
R210	RESISTOR, fixed: composition; 22,000 ohms ±5%; 2 w; characteristic letter F; spec JAN-R-11	V203A Plate Load	RC40BF223J	N16-R-50372-171	CBZ RC40BF 223J	RC-238	R210 R733	3
R211	RESISTOR, fixed: composition; 27,000 ohms ±5%; 2 w; characteristic letter F; spec JAN-R-11	V203A Plate Load	RC40BF273J	N16-R-50399-171	CBZ RC40BF 273J	RC-263	R211 R734	3
R212	Same as R108	V203B Cathode Bias Stabilizing						
R213	RESISTOR, fixed: composition; 27,000 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V203B Cathode Bias	RC20BF273J	N16-R-50398-431	CBZ RC20BF 273J	RC-96	R213 R736	3
R214	Same as R103	V204A Grid Return						
R215	RESISTOR, fixed: composition; 3300 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V204A Cathode Bias	RC20BF332J	N16-R-50065-431	CBZ RC20BF 332J	RC-124	R215 R738	3
R216	Same as R206	V204A Cathode Load						
R217	Same as R101	V204A Plate Load						
R218	RESISTOR, fixed: composition; 220,000 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V206A Grid Return	RC20BF224J	N16-R-50713-431	CBZ RC20BF 224J	RC-101	R218 R219 R741 R742	6
R219	Same as R218	V206B Grid Return						
R220	RESISTOR, variable: composition; 500,000 ohms ±10%; ¼ w, 85°C max continuous oper; 3 solder lug term; enclosed metal case 15/16″ diam, .451″ d excl term; round metal shaft ¼″ diam x ½″ lg from mtg surface; taper "A"; ins cont arm; high torque; ⅜″-32 x ¼″ lg bushing, non-turn device located on 7/16″ radius at 9 o'clock	Controls LEVEL of Tone Modulator V206A and V206B		N16-R-88177-8445	CTC Type #HT-45 G8990	RV-54	R220 R743	3
R221	Same as R103	Keying Transient Filter						
R222	RESISTOR, fixed: composition; 1000 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V206A-V206B Cathode Bias	RC20BF102J	N16-R-49921-431	CBZ RC20BF 102J	RC-256	R222 R745	3
R223	Same as R111	V206A-V206B Output Balancing						
R224	RESISTOR, fixed: composition; 10 megohms ±10%; ½ w; characteristic letter F; spec JAN-R-11	V201B Grid Return with S202 in Tune Position	RC20BF106K	N16-R-51326-811	CBZ RC20BF 106K	RC-181	R224 R315 R316	6
R225	(not used)							

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIG-NATION	CON-TRACTOR DRAW-ING & PART NO.	ALL SYMBOL DESIG. IN-VOLVED	Total Per Equip.
R226	RESISTOR, fixed: composition; 300,000 ohms ±5%; 1 w; characteristic letter F; spec JAN-R-11	V201B Plate Load	RC30BF304J	N16-R-50749-751	CBZ RC30BF 304J	RC-33	R226 R228 R712 R715	6
R227	RESISTOR, fixed: composition; 510,000 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	Coupling V204B Grid to V201B Plate	RC20BF514J	N16-R-50839-431	CBZ RC20BF 514J	RC-88	R227 R322 R323 R713	7
R228	Same as R226	V204B Plate Load						
R229	RESISTOR, fixed: composition; 150,000 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V204B Grid Return	RC20BF154J	N16-R-50677-431	CBZ RC20BF 154J	RC-126	R229 R317 R321 R714	7
R230	RESISTOR, fixed: composition; 1200 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V201B-V204B Common Cathode Coupling	RC20BF122J	N16-R-49939-431	CBZ RC20BF 122J	RC-266	R230	2
R231	Same as R101	Bias for V206A, V206B, V207 and V208 from c— to Grid Keying Point						
R232	RESISTOR, fixed: WW; 3300 ohms ±5%; 2 w at 110°C max cont oper temp; spec JAN-R-184	V207-V208 Screen Dropping	RU6C332J	N16-R-68415-3206	CIR Type BW-2	RW-45	R232 R233 R234 R235 R719 R720 R721 R722	12
R233	Same as R232	V207-V208 Screen Dropping						
R234	Same as R232	V207-V208 Screen Dropping						
R235	Same as R232	V207-V208 Screen Dropping						
R236	RESISTOR, fixed: composition; 100 ohms ±10%; ½ w; characteristic letter F; spec JAN-R-11	V208 Screen Isolating	RC20BF101K	N16-R-49580-811	CBZ RC20BF 101K	RC-57	R236 R723	3
R237	RESISTOR, fixed: composition; 1000 ohms ±10%; ½ w; characteristic letter F; spec JAN-R-11	V207 Grid Isolating	RC20BF102K	N16-R-49922-811	CBZ RC20BF 102K	RC-114	R237 R718	3
R301	Same as R122	CYCLES SHIFT Vertical Amplitude Control at Grid of V301A						
R302	RESISTOR, fixed: composition; 3900 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	Limits Minimum Setting of R301	RC20BF392J	N16-R-50092-431	CBZ RC20BF 392J	RC-279	R302	2
R303	RESISTOR, fixed: composition; 270,000 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	Corrects Taper of R301	RC20BF274J	N16-R-50740-431	CBZ RC20BF 274J	RC-228	R303 R309	4
R304	RESISTOR, fixed: composition; 6800 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V301A Cathode Bias	RC20BF682J	N16-R-50200-431	CBZ RC20BF 682J	RC-275	R304	2
R305	Same as R103	V301A Plate Load						

R306	Same as R103	Vertical Positioning Voltage Divider						
R307	RESISTOR, variable: composition; 500,000 ohms ±10%; ¼ w, 85°C max continuous oper; 3 solder lug term; enclosed metal case 15/16″ diam x .451″ d excl term; round metal shaft ¼″ diam x ½″ lg from mtg surface; standard "D" taper; ins cont arm; w/o off position; high torque; ⅜″-32 x ¼″ lg bushing, non-turn device located on 7/16″ radius at 9 o'clock	VERTICAL POSITIONING		N16-R-88177-8447	CTC Type #HT-45 FG8992	RV-60	R307 R310	4
R308	Same as R124	Vertical Positioning Voltage Divider						
R309	Same as R303	Horizontal Positioning Voltage Divider						
R310	Same as R307	HORIZONTAL POSITIONING						
R311	RESISTOR, fixed: composition; 100,000 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	Horizontal Positioning Voltage Divider	RC20BF104J	N16-R-50632-431	CBZ RC20 BF10 4J	RC-97	R311	2
R312	RESISTOR, fixed: composition; 15 megohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	Horizontal Positioning Voltage Divider	RC20BF155J	N16-R-51019-431	CBZ RC20BF 155J	RC-262	R312 R313	4
R313	Same as R312	Horizontal Positioning Voltage Divider						
R314	RESISTOR, fixed: composition; 1.2 megohms ±10%; ½ w; characteristic letter F; spec JAN-R-11	Horizontal Positioning Voltage Divider	RC20BF125K	N16-R-50993-811	CBZ RC20BF 125K	RC-127	R314	2
R315	Same as R224	Horizontal AC Coupling						
R316	Same as R224	Horizontal AC Coupling						
R317	Same as R229	60 cps Filter						
R318	Same as R115	60 cps Filter						
R319	RESISTOR, variable: composition; 1,000,000 ohms ±10%; ¼″ w 85″C max continuous oper; 3 solder lug term; enclosed metal case 15/16″ x .451″ d excl term; round metal shaft ¼″ diam x ½″ lg from mtg surface; standard "D" taper; ins cont arm; w/o off position; normal torque; ⅜″-32 x ¼″ lg bushing, non-turn device located on 7/16″ radius at 9 o'clock	INTENSITY Control		N16-R-88337-8435	CTC Type #45 G-8991	RV-55	R319	2
R320	RESISTOR, variable: composition 500,000 ohms ±10%; ¼ w, 85°C max continuous oper; 3 solder lug term; enclosed metal case 15/16″ diam x .451″ d excl term; round metal shaft ¼″ diam x ½″ lg from mtg surface; standard "D" taper; ins cont arm; normal torque; ⅜″-32 x ¼″ lg bushing, non-turn device located on 7/16″ radius at 9 o'clock	FOCUS Control		N16-R-88177-8480	CTC Type #45 G-8993	RV-62	R320	2
R321	Same as R229	CRT B+ Voltage Divider						
R322	Same as R227	CRT B+ Voltage Divider						
R323	Same as R227	CRT B+ Voltage Divider						
R401	RESISTOR, fixed: WW; 800 ohms ±5%; 8 w at 275°C max cont oper temp; spec JAN-R-26A	Power Supply Negative Return Bias	RW30G801	N16-R-65974-5966	CIR RW30G 801	RW-44	R401	2
R402	RESISTOR, fixed: composition; 7500 ohms ±5%; 1 w; characteristic letter F; spec JAN-R-11	Power Supply Negative Return Bias	RC30BF752J	N16-R-50218-751	CBZ RC30BF 752J	RC-32	R402	2

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIG-NATION	CON-TRACTOR DRAW-ING & PART NO.	ALL SYMBOL DESIG. IN-VOLVED	Total Per Equip.
R601	RESISTOR, fixed: composition; 390,000 ohms ±10%; ½ w; characteristic letter F; spec JAN-R-11	Series Voltage Dropping for I601	RC20BF394K	N16-R-50786-811	CBZ RC20BF 394K	RC-113	R601 R1001	3
R701	Same as R119	Axis Restorer Voltage Divider						
R702	Same as R119	Axis Restorer Voltage Divider						
R703	Same as R116	Divider for Voltage Rectified by V703A-V703B						
R704	Same as R117	V704A-V704B Series Grid						
R705	Same as R118	Divider for Voltage Rectified by V703A-V703B						
R706	Same as R119	Axis Restorer Voltage Divider						
R707	Same as R123	V704A-V704B Cathode Bias						
R708	Same as R121	V704A-V704B Plate Load						
R709	RESISTOR, variable: composition; 100,000 ohms ±10%; 2 w, 70°C max continuous oper; 3 solder lug term; enclosed metal case 1 1/16" diam x 9/16" d excl term; round metal shaft ¼" diam x ½" lg from mtg surface; taper "U"; ins cont arm; w/o off position; normal torque; ⅜"-32 x ¼" lg bushing, non-turn device, located on 17/32" radius at 9 o'clock and at 3 o'clock	THRESHOLD		N16-R-88009-4180	CBZ Type JU-1041-P2032	RV-63	R709	1
R710	RESISTOR, fixed: composition; 150,000 ohms ±5%; 1 w; characteristic letter F; spec JAN-R-11	Threshold Voltage Divider	RC30BF154J	N16-R-50677-751	CBZ RC30BF 154J	RC-83	R710	1
R711	Same as R119	V205B Series Grid						
R712	Same as R226	V705B Plate Load						
R713	Same as R227	Coupling V706A Grid to V705B Plate						
R714	Same as R229	V706A Grid Return						
R715	Same as R226	V706A Plate Load						
R716	RESISTOR, fixed: composition; 2400 ohms ±5%; ½ w; characteristic letter F; spec JAN-R-11	V705B-V706A Common Cathode Coupling	RC20BF242J	N16-R-50020-431	CBZ RC20BF 242J	RC-258	R716	1
R717	Same as R101	Bias for V708, V709, V712A and V712B from C— to Grid Keying Point						
R718	Same as R237	V708 Grid Isolating						
R719	Same as R232	V708-V709 Screen Dropping						

R720	Same as R232	V708-V709 Screen Dropping						
R721	Same as R232	V708-V709 Screen Dropping						
R722	Same as R232	V709-V709 Screen Dropping						
R723	Same as R236	V709 Screen Isolating						
R724	Same as R201	Frequency Determining Element for V705A-V711B Tone Oscillator						
R725	Same as R201	Frequency Determining Element for V705A-V711B Tone Oscillator						
R726	Same as R202	Negative Feedback from V711B Plate to V705A Cathode						
R727	Same as R203	V705A Cathode Bias with S201 in Ext Tone Position						
R728	Same as R205	V705A Cathode Bias						
R729	Same as R206	V705A Plate Load						
R730	Same as R207	V710 Series Dropping						
R731	Same as R103	V711B Grid Return						
R732	Same as R103	V706B Diode Load						
R733	Same as R210	V711B Plate Load						
R734	Same as R211	V711B Plate Load						
R735	Same as R108	V706B Cathode Bias Stabilizing						
R736	Same as R213	V706B Cathode Bias						
R737	Same as R103	V711A Grid Return						
R738	Same as R215	V711A Cathode Bias						
R739	Same as R206	V711A Cathode Load						
R740	Same as R101	V711A Plate Load						
R741	Same as R218	V712B Grid Return						
R742	Same as R218	V712A Grid Return						
R743	Same as R220	Controls LEVEL of Tone Modulator V712A and V712B						
R744	Same as R103	Keying Transient Filter						
R745	Same as R222	V712A-V712B Cathode Bias						
R746	Same as R111	V712A-V712B Output Balancing						
R801	RESISTOR, fixed: WW; 1800 ohms ±10%; 1 w at 110°C max continuous oper temp; spec JAN-R-184	Rectifier Filter	RU4C182K	N16-R-68407-6726	CIR Type BW-1	RW-43	R801	1

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIG-NATION	CON-TRACTOR DRAW-ING & PART NO.	ALL SYMBOL DESIG. IN-VOLVED	Total Per Equip.
R802	RESISTOR, fixed: composition; 10,000 ohms ±5%; 1 w; characteristic letter F; spec JAN-R-11	Bias Voltage Divider	RC30BF103J	N16-R-50281-751	CBZ RC30BF 103J	RC-109	R802 R804	2
R803	RESISTOR, variable: composition; 1000 ohms ±10%; 2 w, 70°C max continuous oper; 3 solder lug term; enclosed metal case 1 1/16″ diam x 9/16″ excl term; round metal shaft ¼″ diam x ¾″ lg from mtg surface, slotted for screwdriver adj, friction lock; taper "U"; ins cont arm; no off position; normal torque, with shaft locking device; ⅜″-32 x ½″ lg bushing, split for use of shaft locking nut, non-turn device located on 17/32″ radius at 9 o'clock and 3 o'clock	Bias Voltage Control		N16-R-87349-4580	CBZ JLU-1021 SD4048	RV-51	R803	1
R804	Same as R802	Bias Voltage Divider						
R1001	Same as R601	Series Voltage Dropping for I1001						
S101	SWITCH, rotary: 4 pole, 2 position; silver pl brass cont; phenolic body, wax impregnated; approx 1 17/32″ lg x 2 3/32″ wd x 1 5/16″ h; solder lug term; single hole mtg, ⅜″-32 x ¼″ lg bushing; shaft ¼″ diam x ½″ lg	SHIFT Narrow-Wide		N17-S-65278-8151	GA C-2295-2M-2	SW-27	S101	2
S102	SWITCH, rotary: 2 pole, 2 position; 1 section; silver pl brass cont; phenolic body wax impregnated; approx 19/32″ lg x 1 3/32″ wd x 1 5/16″ h; solder lug term; single hole mtg, ⅜″-32 x ¼″ lg bushing; shaft ¼″ diam x ½″ lg	MARK-SPACE Normal-Reverse		N17-S-60906-7860	GA C-2293-2M	SW-25	S102 S103	4
S103	Same as S102	SPEED Slow-Fast						
S201	SWITCH, rotary: 2 pole, 9 position; 18 contacts; silver pl brass cont; phenolic body, wax impregnated; approx 1 17/32″ lg x 1 3/32″ wd x 1 5/16″ h; solder lug term; single hole mtg, bushing ⅜″-32 x ⅜″ lg; shaft ¼″ diam x ⅝″ lg	FREQ-CPS Selector		N17-S-63693-9979	GA B-2294-2M-2	SW-26	S201 S702	3
S202	SWITCH, rotary: 1 pole, 2 position; silver pl brass cont; phenolic body, wax impregnated; approx 19/32″ lg x 1 3/32″ wd x 1 5/16″ h; solder lug term; single hole mtg, bushing ⅜″-32 x ¼″ lg; shaft ¼″ diam x ½″ lg	KEYER Tune-Operate		N17-S-59673-1701 For Replacement use N17-S-60906-7860, see S102	GA C-2292-2M	SW-24	S202	2
S601	SWITCH, toggle: 2 pole, 2 position; 5 amp at 125 v, 2 amp at 250 v; spec JAN-S-23	POWER On-Off	ST22K	N17-S-73082-9028	CHH ST22K	SW-10	S601 S1001	3
S701	SWITCH, rotary: 2 pole, 4 position; 1 section; silver pl brass cont; phenolic body, wax impregnated; approx 19/32″ lg x 1 3/32″ wd x 1 5/16″ h; solder lug term; single hole mtg; bushing ⅜″-32 x ¼″ lg; shaft ¼″ diam x ½″ lg	SELECTOR Tune-Channel A Diversity-Channel B		N17-S-61361-1501	GA Type A2866-2M	SW-38	S701	1
S702	Same as S201	FREQ-CPS Selector						
S1001	Same as S601	POWER On-Off						
SU101	DISCRIMINATOR SUB-UNIT: wide or narrow frequency-shift AF tones; for changing frequency-shift signals into pulsed DC; narrow shift; 1000 cps mean freq and 10 to 200 cps shift width, wide shift: 2550 cps mean freq and 200 to 1000 cps shift width; input 6.3 v AC @ 1.5A and 250 v DC @18.5 ma ; plugs into and becomes integral part of Frequency Shift Converter CV-89/URA-8A, secured by four captive	See Description		F16-C-91201-1010	CKB AA-212	AA-212	SU101	2

	screws; 9.838″ lg x 5.49″ wd x 4½″ h o/a; includes five tubes: 2—12AX7, 1—12AU7, 2—6AL5 in double tuned type special discriminator circuit; stenciled with tube numbers and component symbols, four controls mounted on vertical panel at front, includes input and output signal filters							
SU201	OSCILLATOR-KEYER SUB-UNIT: generates AF tone from 595 cps to 1785 cps in eight steps, uses impulses from Frequency Shift Converter Sub-unit to key generator tone and to key DC current in teletype control loop; p/o Frequency Shift Converter, CV-89/URA-8A; consists of eight tubes: 3—12AU7, 1—12AX7, 2—6AQ5, 1—OA2, and 1—991, with their associated oscillator and keying circuits all mounted on sub chassis; keys teletype circuit 70 v @ 60 ma DC max; sub-chassis approx square with all tubes mounted above and most of components mounted below, three controls on vertical panel at front; 5.646″ lg x 5.476″ wd x 4 19/32″ h o/a; mounts by plugging into CV-89/URA-8A chassis-panel assembly, secured by four captive screws; stencilled with tube numbers and component symbols; all connections to CV-89/URA-8A unit made by 14 pin connector when sub-unit is plugged-in.	See Description		F16-K-49161-1002	CKB AA-211	AA-211	SU201	2
SU301	MONITOR SUB-UNIT: discriminator output monitor, tuning indicator; 2″ screen; 11.597″ lg x 2.625″ wd x 4.594″ h o/a; 60 cps sinusoidal sweep circuit included; vertical deflection sensitivity 0.7 RMS v per inch vertical; oper freq range 0 to 200 cps; vertical input impedance .25 meg; 6.3 v @ .15 amp, 6.3 v @ .6 amp, 1.25 v @ .265 amp, 650 v RMS @ 2 ma, all AC 50-60 cps, 250 v DC @ 1.8 ma; mounts by plugging into Frequency Shift Converter CV-89/URA-8A, secured by four captive screws; all input and output connections through 14 contact receptacle	See Description		F16-M-46251-1019	CKB AA-210	AA-210	SU301	2
SU401	POWER SUPPLY, SUB-UNIT: electronic type; 250 v DC, 65 ma; input voltage 105/115/125, 50-60 cyc, single phase, .520 amp, 58.0 w rating, pf = 0.97; 5 31/32″ lg x 5 41/64″ wd x 4½″ h; JAN 6X4 rectifier tube; full wave; filter included; mts by 4 captive screws on 4.094″ x 3.922″ x 5.468″ x 4.156″ mtg/c; p/o CV-89/URA-8A Frequency Shift Converter and plugs into Chassis-Panel Assembly	Supplies all Filament, B+ and Bias Voltage to Converter Unit		F16-P-66932-1566	CKB AA-213	AA-213	SU401	2
SU701	SELECTOR SUB-UNIT: generates AF tone from 595 cps to 1785 cps in eight steps, uses impulses from one or two Frequency Shift Converters either singly or in diversity to key generator tone and to key DC current in teletype control loop; p/o Comparator CM-22/URA-8A; consists of twelve tubes: 3—6AL5, 3—12AU7, 2—12AX7, 2—6AQ5, 1—OA2,and 1—991, with their associated selector, oscillator and keying circuits all mounted on sub-chassis; keys teletype circuit 70 v @ 60 ma DC max; sub-chassis is rectangular with all tubes mounted above and most components mounted below, two controls on vertical panel at front; 9.04″ lg x 7.75″ wd x 4.594″ h o/a; mounts by plugging into CM-22/URA-8A chassis-panel assembly, secured by five captive screws on 5.25″ x 8.284″ x 7.25″ x 3.909″ x 4.068″ mtg/c; stencilled with tube numbers and component symbols; all connections to CM-22/URA-8A unit made by 14 pin connector when sub-unit is plugged in	See Description		F16-K-49161-1001	CKB AA-209	AA-209	SU701	1
SU801	POWER SUPPLY SUB-UNIT: electronic type; 250 v DC, 35 ma and 32 v DC, 2 ma; input voltage 105/115/125, 50-60 cyc, single phase, .343 amp, 38.9 w rating, pf=0.986; 7¾″ lg x 4⅞″ wd x 4½″ h o/a; JAN 6X4 and JAN 6AL5 rectifier tubes; full wave; filter included; mts by 4 captive screws on 3 13/16″ x 7¼″ x 4⅝″ mtg/c; p/o CM-22/URA-8A Comparator and plugs into Chassis-Panel Assembly	Supplies all Filament, B+ and Bias Voltage to Comparator Unit		F16-P-66932-1616	CKB AA-208	AA-208	SU801	1
T101*	TRANSFORMER, AF: line type; pri 600 ohms ±10% impedance; secd 50,000 ohms ±10% impedance; max oper level 60 mw with no DC current in HS case with Z102; See Z102	Matching between Input Filter and Discriminator				Part of ZM-3	T101	

* This item cannot be requisitioned from supply. In the event of failure it should be repaired or a new item fabricated.

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIGNATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	Total Per Equip.
T102	TRANSFORMER, AF: plate coupling type; pri 12,500 ohms impedance, secd 30,000 ohms impedance, pri 10 ma max; HS metal case; 1½" lg x 63/64" diam excl term and mtg flange; .8 w operating level; turns ratio of pri to secd 1:166; freq response ± 1 db from 800 to 3600 cps; 4 slotted turret term on bottom; flange mtd, two .120" diam mtg holes on 1.187" mtg/c; spec JAN-T-27	Coupling between V102A and V103B		N17-T-65626-4001	CTR 14976	TA-21	T102 T103	4
T103	Same as T102	Coupling between V102B and V103A						
T201	TRANSFORMER, AF: plate coupling type; pri 14,000 ohms impedance, secd 600 ohms impedance, pri current 10 ma ea side; HS metal case; 1½" lg x 63/64" diam excl term and mtg flange; 20 mw oper level; turns ratio ½ pri to secd 2.35:1; freq response ± 1 db 500 to 2000 cps; 5 slotted turret term on bottom; flange mtd, two .120" diam mtg holes on 1.187" mtg/c; spec JAN-T-27	Audio Tone Output		N17-T-65696-7191	CTR 14977	TA-22	T201 T701	3
T401	TRANSFORMER, power: plate and filament type; input 103/113/123 v, 50-60 cps, single ph; 3 output windings; secd #1—terminals 5 through 9 inclusive one continuous winding, term 5 and 6—1.25 v at .265 amp, term 6 and 7—400 v at 2 ma, term 7 and 9—500 v at 65 ma, CT at term 8; secd #2—6.3 v at 5 amp CT; secd #3—6.3 v at 600 ma; electrostatic shield between pri and secd; spec JAN-T-27	Filament and Plate Transformer for Converter Power Supply		N17-T-73580-6501	CTR 14979	TP-19	T401	2
T701	Same as T201	Audio Tone Output						
T801	TRANSFORMER, power: plate and filament type; input 105/115/125 v, 50-60 cps, single ph; 2 output windings; secd #1—terminals 5 through 8 inclusive, one continuous winding, term 5 and 8—600 v at 35 ma, CT at term 6, term 6 and 7—55 v at 4 ma; secd #2—6.3 v at 4.5 amp CT; electrostatic shielding between pri and secd; spec JAN-T-27	Filament and Plate Transformer for Comparator Power Supply		N17-T-73624-1801	CTR 14978	TP-18	T801	1
V101	TUBE, electron: double triode; spec JAN-1A	Converter Input Two-Stage Amplifier-limiter	12AX7	N16-T-58241-60	JAN-()-12AX7		V101 V105 V201 V301 V704 V705	10
V102	TUBE, electron: double triode; spec JAN-1A	Discriminator Amplifier	12AU7	N16-T-58241	JAN-()-12AU7		V102 V203 V204 V206 V706 V711 V712	11
V103	TUBE, electron: double diode; spec JAN-1A	Discriminator Rectifier	6AL5W	N16-T-56195-50	JAN-()-6AL5W		V103 V104 V701 V702 V703 V802	8
V104	Same as V103	Axis Restorer Rectifier						
V105	Same as V101	Axis Restorer DC Amplifier						
V201	Same as V101	V201A Audio Amplifier and						

		First Stage of Audio Oscillator V201B Input Stage to Keyer Circuits						
V202	TUBE, electron: voltage regulator; spec JAN-1A	Voltage Regulator for V201A Plate Supply	OA2	N16-T-52001	JAN-()-OA2		V202 V710	3
V203	Same as V102	V203A Audio Amplifier and Oscillator V203B Oscillator Rectifier-Regulator						
V204	Same as V102	V204A Phase Splitter V204B Keyer Second Stage						
V205	TUBE, electron: used as trigger element in keyer circuit; spec JAN-1A	Triggers Keyer Output	991	N16-T-69910	JAN-()-991		V205 V707	3
V206	Same as V102	Tone Modulator, Push-Pull Output Stage						
V207	TUBE, electron: beam pentode; spec JAN-1A	Electronic Relay	6AQ5	N16-T-56198	JAN-()-6AQ5		V207 V208 V708 V709	6
V208	Same as V207	Electronic Relay						
V301	Same as V101	V301A Oscilloscope Vertical Amplifier V301B Not Used						
V302	TUBE, electron: cathode-ray; spec JAN-1A	Monitor Tuning Indicator	2BP1	N16-T-52230	JAN-()-2BP1		V302	2
V303	TUBE, electron: half wave rectifier; spec JAN-1A	Oscilloscope High Voltage Rectifier	1Z2	N16-T-51990	JAN-()-1Z2		V303	2
V401	TUBE, electron: full wave rectifier; spec JAN-IA	Power Supply Rectifier	6X4	N16-T-56840	JAN-()-6X4		V401 V801	3
V701	Same as V103	Channel A Mark-Space Selector						
V702	Same as V103	Channel B Mark-Space Selector						
V703	Same as V103	Axis Restorer Rectifier						
V704	Same as V101	Axis Restorer DC Amplifier						
V705	Same as V101	V705A Audio Amplifier and First Stage of Audio Oscillator V705B Input Stage to Keyer						
V706	Same as V102	V706A Keyer Second Stage V706B Oscillator Rectifier-Regulator						
V707	Same as V205	Trigger Keyer Output						
V708	Same as V207	Electronic Relay						
V709	Same as V207	Electronic Relay						
V710	Same as V202	Voltage Regulator for Plate of V705A						

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIGNATION	CONTRACTOR DRAWING & PART NO.	ALL SYMBOL DESIG. INVOLVED	Total Per Equip.
V711	Same as V102	V711A Phase Splitter V711B Audio Amplifier and Oscillator						
V712	Same as V102	Tone Modulator Push-Pull Output Stage						
V801	Same as V401	B Power Rectifier						
V802	Same as V103	Bias Supply Rectifier						
W1101*	CABLE ASSEMBLY, RF: AN type #RG-58/U cable; 12 11/16″ lg excl terminations; 17″ lg o/a; 1 NT UG-85/U connector ea end	Diversity Connection Converter to Comparator		N16-C-11943-4431	CKB WA-32	WA-32	W1101	2
W1102*	CABLE ASSEMBLY, power: uses NT cable MC0S-2, 2 cond, #18 AWG stranded, 16/.010″ wire, round .460″ OD, 600 v max, color-coded, syn-rubber or resin ins, cov w/ a braided shield, separator and an impervious sheath, oil resistant; 14″ lg excl terminations, 17″ lg o/a; plug AN3106-14S-7S and cable clamp AN3057-6 both ends	AC Power Connection Comparator to Converter		N17-C-48194-4010	CKB WA-33	WA-33	W1102	2
W1103	CABLE ASSEMBLY, special purpose: total 14 cond; 7 SRIR-2/5(7)-24 color-coded cond, 3 shielded SRIR-2/5(7)-24 color-coded cond, 2 shielded pairs SRIR-2/5(7)-24 color-coded cond; outer covering ½″ ID vinylite tubing; 28″ lg excl terminations, 30½″ lg o/a; Cannon Electric Co type #DPB-F16-23C-⅝ connector one end, DPB-F16-23C-⅝ other end	Jumper Cable to Complete Connections to Withdrawn Unit		N17-C-48886-9863	CKB WA-34	WA-34	W1103	1
XF501	FUSEHOLDER: extractor post type; for one 3AG cartridge fuse; 1¼″ lg x ¼″ diam; molded phenolic; 15 amps at 250 v 2¼″ lg x 11/16″ diam o/a; mts in single "D" shaped hole ½″ diam with ¼″ flat on side; 2 solder lug term	Holds F501		N17-F-74267-5075	CFA #HKP	FH-4	XF501 XF502 XF901 XF902	6
XF502	Same as XF501	Holds F502						
XF503*	FUSEHOLDER: extractor post type; for one 3AG cartridge fuse; 1¼″ lg x ¼″ diam; molded phenolic; 1 15/16″ lg x 11/16″ diam o/a; ½″ diam threaded body for panel hole mtg; no term; used for spare fuse, adapted to standard fuse holder except for rear term; p/o CV-89/URA-8A Frequency Shift Converter	Holds Spare Fuse F503		N17-F-74266-9392	CFA HKP-M	FH-11	XF503 XF504 XF903 XF904	6
XF504	Same as XF503	Holds Spare Fuse F504						
XF901	Same as XF501	Holds F901						
XF902	Same as XF501	Holds F902						
XF903	Same as XF503	Holds Spare Fuse F903						
XF904	Same as XF503	Holds Spare Fuse F904						
XI601	LIGHT, indicator: with lens; ½″ diam clear frosted lens; for a single cont miniature bayonet base, T-3¼ bulb; 105-125 v 1/25 w; enclosed shell; black bakelite housing; 2 9/32″ lg x 1″ diam o/a; 11/16″ diam mtg hole required, 5/16″ max panel thk; replaceable from front of panel; horiz mtg; threaded jewel; 2 solder lug term located on opposite sides of base of housing	Holds I601		N17-L-76737-2764	CAYZ 88410-135 Clear	IM-14	XI601 XI1001	3

XI1001	Same as XI601	Holds I1001						
XV101	SOCKET, electron tube; noval (9 pin miniature); one piece saddle mtg, above chassis; two .125″ diam mtg holes on 1.125″ mtg/c, for ¾″ diam chassis cutout; mica-filled bakelite body approx 13/16″ diam x 11/32″ thk excl term; copper base nonmagnetic alloy contacts, silver plated; marked with pin nos and JAN no; saddle includes base for mtg shock shield, center shield .180″ max OD (ID not specified); spec JAN-S-28A	Socket for V101	TSE9T101	N16-S-64063-6718	CMG TSE9T 101	XT-28	XV101 XV102 XV105 XV201 XV203 XV204 XV206 XV301 XV704 XV705 XV706 XV711 XV712	21
XV102	Same as XV101	Socket for V102						
XV103	SOCKET, tube: seven axial type cont minature; below chassis wafer mtg; two ⅛″ diam mtg holes ⅞″ c to c; oval mineral filled plastic body type MTS-E-4, 1⅛″ lg x ¾″ wd x 21/32″ h o/a excluding term; beryllium copper silver pl cont; no metal shock shield has a 3/32″ ID ctr shield; BuShips dwg #RE49AA455C	Socket for V103	(491675)	N16-S-62603-6446	CNA XOA	XT-6	XV103 XV104 XV202 XV207 XV208 XV303 XV401 XV701 XV702 XV703 XV708 XV709 XV710 XV801 XV802	22
XV104	Same as XV103	Socket for V104						
XV105	Same as XV101	Socket for V105						
XV201	Same as XV101	Socket for V201						
XV202	Same as XV103	Socket for V202						
XV203	Same as XV101	Socket for V203						
XV204	Same as XV101	Socket for V204						
XV205	LAMPHOLDER, cand bayonet double cont: two pin type cont with spring action telescoping into solder term; brass shell, nickel pl; two ears for mtg; two 5/32″ diam mtg holes on 1 7/32″ mtg/c; round black bakelite insert, 1 3/16″ lg x 1⅛″ wd x ⅝″ h; brass silver pl cont; used for mtg bayonet type tube; u/w AN/URA-8A	Socket for V205		N17-L-51708-2648	FWM 242	XT-22	XV205 XV707	3
XV206	Same as XV101	Socket for V206						
XV207	Same as XV103	Socket for V207						
XV208	Same as XV103	Socket for V208						
XV301	Same as XV101	Socket for V301						
XV302	SOCKET, tube: 12 cont duo-decal; cont #5 and #11 are missing; unmounted; round bakelite body 1⅞″ diam x 15/16″ d excl term; phosphor bronze-silver pl cont; removable socket cap	Socket for V302		N16-S-64286-3953	CPH 59-402	XT-29	XV302	2
XV303	Same as XV103	Socket for V303						
XV401	Same as XV103	Socket for V401						
XV701	Same as XV103	Socket for V701						
XV702	Same as XV103	Socket for V702						
XV703	Same as XV103	Socket for V703						
XV704	Same as XV101	Socket for V704						
XV705	Same as XV101	Socket for V705						
XV706	Same as XV101	Socket for V706						
XV707	Same as XV205	Socket for V707						
XV708	Same as XV103	Socket for V708						
XV709	Same as XV103	Socket for V709						

* This item cannot be requisitioned from supply. In the event of failure it should be repaired or a new item fabricated.

TABLE 6-4. COMBINED PARTS AND REPAIR PARTS LIST (Continued)

SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	LOCATING FUNCTION	JAN AND (NAVY TYPE) NO.	STANDARD NAVY & (SIGNAL CORPS) STOCK NO.	MFGR. AND MFGR'S DESIG-NATION	CON-TRACTOR DRAW-ING & PART NO.	ALL SYMBOL DESIG. IN-VOLVED	Total Per Equip.
XV710	Same as XV103	Socket for V710						
XV711	Same as XV101	Socket for V711						
XV712	Same as XV101	Socket for V712						
XV801	Same as XV103	Socket for V801						
XV802	Same as XV103	Socket for V802						
Z101	FILTER, high-pass: cut off freq 775 cps; 2 5/16″ lg x 1⅝″ wd x 2¼″ h excl term and mtg studs; filter input and output impedance 600 ohms; HS rectangular metal case; four #6-32 x ⅜″ lg mtg studs on 1.75″ x 1.125″ mtg/c; 3 solder lug term on bottom; attenuation at 425 cps and below 40 db or more, freq response ±1 db 775 to 1400 cps; p/o Frequency Shift Converter CV-89/URA-8A; spec JAN-T-27	Passes Narrow Shift Signals		N16-F-40023-4261	CTR 14980	ZM-2	Z101	2
Z102	FILTER, band pass: peak freq 2550 ±50 cps, pass-band 2200 cps wide with peak freq at center, nominal range 1450 to 3650 cps; 2 9/16″ lg x 1 9/16″ wd x 4″ h excl term and mtg studs; filter input and output impedance 600 ohms; HS rectangular metal case; four #8-32 x ⅝″ lg mtg studs on 1″ x 2″ mtg/c; 7 solder lug term on bottom; case includes AF transformer; line type; pri impedance 8000 ohms ±10%, secd impedance 50,000 ohms ±10%; max oper level 60 mw with no DC current; turns ratio pri to secd 1:6.25, freq response ±1 db 800 to 3000 cps; electrostatic shield between pri and secd; p/o Frequency Shift Converter CV-89/URA-8A; spec JAN-T-27	Passes Wide Shift Signals		N16-F-32226-8525	CTR 14981	ZM-3	Z102	2
Z103	FILTER, AF discriminator: double peaked at 800 ±20 cps and 1200 ±20 cps with cross-over freq of 1000 cps ±1%; 2 7/32″ lg x 1¼″ wd x 2¼″ h excl term and mtg studs; input from high mu triode plate, zero dc current, term 2 and 3; two outputs to tube grids, term 1 and 3 and 4 and 3; HS rectangular metal case; four #6-32 x ⅜″ lg mtg studs on 1 11/16″ x 11/16″ mtg/c; 4 solder lug term on bottom; for use in special discriminator circuit; p/o Frequency Shift Converter CV-89/URA-8A; spec JAN-T-27	AF Tuning for Narrow-Shift Discriminator		N16-F-32000-1501	CTR 14984	ZM-9	Z103	2
Z104	FILTER, AF discriminator: double peaked at 1800 ±50 cps and 3300 ±50 cps with cross-over freq of 2550 cps ±1%; 2 7/32″ lg x 1½″ wd x 2½″ h excl term and mtg studs; input from high mu triode plate, zero DC current, term 2 and 3; two outputs to tube grids, term 1 and 3 and term 3 and 4; HS rectangular metal case; four #6-32 x ⅜″ lg mtg studs on 1 11/16″ x 11/16″ mtg/c; 4 solder lug term on bottom; for use in special discriminator circuit; p/o Frequency Shift Converter CV-89/URA-8A; spec JAN-T-27	AF Tuning for Wide-Shift Discriminator		N16-F-32000-1751	CTR 14983	ZM-8	Z104	2
Z105	FILTER, low-pass: cut-off freq section "A" 140 cps, section "B" 300 cps; 1 27/32″ lg x 1⅝″ wd x 4″ h excl term and mtg studs; ea sect 100,000 ohm input impedance and 100,000 ohm output impedance; HS rectangular metal case; four #8-32 x ⅝″ lg mtg studs on 1″ x 1.250″ mtg/c; 6 slotted turret term ¼″ diam x ⅜″ lg on bottom; section "A" attenuation 240 cps and above at least 40 db, section "B" attenuation 500 cps and above at least db, ea section insertion loss less than 8 db, impedance in and out 100,000 ohms, applied voltage 60v RMS; p/o Frequency Shift Converter CV-89/URA-8A; spec JAN-T-27	Filters Output of Discriminator for Slow or Fast Keying		N16-F-44009-3511	CTR 14982	ZM-4	Z105	2
Z501	FILTER, low-pass: cut off freq 1850 cps; 3⅛″ lg x 1⅝″ wd x 1 13/16″ h o/a; input impedance 600 ohms ±10%, output impedance 1500 ohms; HS rectangular	Filters External Tone Input		N16-F-44037-8262	CTR 14986	ZM-11	Z501 Z901	3

	metal case; flange mtd, two .173″ diam mtg holes on 1⅛″ mtg/c one side, other side has a "U" shaped cutout 3/16″ wd x 11/32″ d; 4 slotted turret term ¼″ diam x ⅜″ lg; freq response ±2 db 500 to 1850 cps, attenuation 65 db min from 14 kc to 10 mc and 50 db min from 10 mc to 30 mc; p/o Frequency Shift Converter-Comparator Group AN/URA-8A; spec JAN-T-27							
Z502	FILTER, low-pass: cut-off freq 1850 cps; 2″ lg x 1¾″ wd x 1⅜″ h less term and mtg flange; 600 ohm input impedance, 600 ohm output impedance CT; HS rectangular metal case; flange mtd, two .173″ diam mtg holes on 1¼″ mtg/c one side; 5 slotted turret term ¼″ diam x ⅜″ lg; insertion loss 500 to 1850 cps not more than 2 db, attenuation 14 kc to 10 mc 65 db min, 10 mc to 30 mc 50 db min; p/o Frequency Shift Converter-Comparator Group AN/URA-8A; spec JAN-T-27	Filters Keyed Tone Output		N16-F-44037-8256	CTR 14985	ZM-10	Z502 Z902	3
Z503	FILTER, low-pass: cut-off freq 600 cps; 3⅛″ lg x 2¼″ wd x 1 13/16″ h o/a; input impedance 1200 ohms, output impedance 1200 ohms; HS rectangular metal case; flange mtd, three .173″ diam mtg holes on one side spaced ⅞″ c to c in straight line; 4 slotted turret term ¼″ diam x ⅜″ lg; series insertion resistance 700 ohms max, attenuation 15 kc to 10 mc 65 db min, 10 mc to 30 mc 50 db min; p/o Frequency Shift Converter-Comparator Group AN/URA-8A; spec JAN-T-27	Filters Teletype Output		N16-F-44019-5390	CTR 14987	ZM-12	Z503 Z903	3
Z504	SUPPRESSOR, electrical noise: network of capacitors and coils; 3½″ lg x 3⅛″ wd x 1 13/16″ h o/a; 105-125 v 50-60 cps, 0.565 amp max; HS rectangular metal case; flange mtd, three 0.173″ diam mtg holes spaced 1½″ c to c in straight line on one side; other side has "U" shaped cutout 3/16″ wd x 11/32″ lg; 4 slotted turret term ¼″ x ⅜″ lg; cut-off freq 725 cps; attenuation 14 kc to 10 mc 65 db, 10 mc to 30 mc 50 db min, 60 cps voltage drop = 2.0 max; p/o Frequency Shift Converter-Comparator Group AN/URA-8A; spec JAN-T-27	Filters AC Power Input		N17-S-50986-8410	CTR 14988	ZM-13	Z504 Z904	3
Z505	CABLE FILTER ASSEMBLY: RF filters for AC line, teletype output, AF tone input and AF tone output; p/o Frequency Shift Converter CV-89/URA-8A; consists of: four filters—Hoffman part/dwg #ZM-10, #ZM-11, #ZM-12 and #ZM-13, eleven receptacles for input and output connections to CV-89/URA-8A, two active and two spare fuses; passes all currents and signals used by CV-89/URA-8A; assembly is essentially rectangular; 14.312″ lg x 4.944″ wd x 2.875″ d o/a; mounts inside rear of CV-89/URA-8A case by four captive screws on 13.5″ x 4.475″ mtg/c; stencilled with component symbols; all connections from filters to other circuits of CV-89/URA-8A unit made by one 16 pin receptacle	See Description		F16-F-48295-9733	CKB AA-203	AA-203	Z505	2
Z901	Same as Z501	Filters External Tone Input						
Z902	Same as Z502	Filters Keyed-Tone Output						
Z903	Same as Z503	Filters Teletype Output						
Z904	Same as Z504	Filters AC Power Input						
Z905	CABLE FILTER ASSEMBLY: RF filter for AC line, teletype output, AF tone input and AF tone output; p/o Comparator CM-22/URA-8A; consists of four filters—Hoffman part/dwg #ZM-10, #ZM-11, #ZM-12 and #ZM-13, nine receptacles for input and output connections to CM-22/URA-8A, two active and two spare fuses; passes all currents and signals used by CM-22/URA-8A; assembly is essentially rectangular; 14.312″ lg x 4.944″ wd x 2.875″ d o/a; mounts inside rear of CM-22/URA-8A case by four captive screws on 13.5″ x 4.475″ mtg/c; stencilled with component symbols; all connections from filters to other circuits of CM-22/URA-8A unit made by one 16 pin receptacle	See Description		F16-F-48295-9738	CKB AA-205	AA-205	Z905	1

TABLE 6-5. MAINTENANCE PARTS KIT

KEY SYMBOLS	QUANTITY	KEY SYMBOLS	QUANTITY
SU101	1	SU701	1
SU201	1	SU801	1
SU301	1	Z505	1
SU401	1	Z905	1

TABLE 6-6. CROSS REFERENCE PARTS LIST

JAN (OR AWS) DESIGNATION	KEY SYMBOL
CE32B240Q	C401
CE41B100J	C802
CE41B250Q	C402
CM20B331K	C221
CM20B470K	C225
CM20D330	C201
CM35B103K	C218
CM35B472M	C226
CP21A1EF103M	C101
CP54B4FF104L	C106
CP54B4FG503L	C301
CP65B1FE105K	C105
CP65B2FG504K	C302
RB11B23001F	R202
RB11B26502F	R201
RB11B87400F	R205
RC20BF101K	R236
RC20BF102J	R222
RC20BF102K	R237
RC20BF104J	R311
RC20BF105K	R117
RC20BF106K	R224
RC20BF122J	R230
RC20BF125K	R314
RC20BF152J	R106
RC20BF154J	R229
RC20BF155J	R312
RC20BF184J	R124
RC20BF185J	R125
RC20BF223K	R123
RC20BF224J	R218
RC20BF224K	R121
RC20BF225K	R119
RC20BF242J	R716
RC20BF273J	R213
RC20BF274J	R303
RC20BF332J	R215
RC20BF362J	R203
RC20BF392J	R302
RC20BF394K	R601
RC20BF395J	R116
RC20BF473J	R206
RC20BF474K	R103
RC20BF475J	R118
RC20BF514J	R227
RC20BF563J	R101
RC20BF682J	R304
RC20BF751J	R104
RC20BF824J	R115
RC30BF103J	R802
RC30BF104J	R113
RC30BF154J	R710
RC30BF224J	R108
RC30BF304J	R226
RC30BF752J	R402
RC30BF911J	R110
RC40BF104J	R109
RC40BF154J	R105
RC40BF223J	R210
RC40BF273J	R211
RC40BF333K	R207
RU4C182K	R801
RU6C332J	R232
RW30G801	R401
ST22K	S601
TSE9T101	XV101
UG-85/U	P1107
UG-87/U	J502
991	V205
OA2	V202
1Z2	V303
2BP1	V302
6AL5W	V103
6AQ5	V207
6X4	V401
12AU7	V102
12AX7	V101

NAVY TYPE	KEY SYMBOL
49008	J606
49194	J503
49195	P1106
491675	XV103

ARMY-NAVY TYPE	KEY SYMBOL
AN3102-14S-7S	J507
AN3102-14S-7P	J510
AN3102-14S-9P	J509
AN3102-14S-12P	J505
AN3102-14S-12S	J506
AN3106-14S-7P	P1101
AN3106-14S-7S	P1102
AN3106-14S-9S	P1103
AN3106-14S-12P	P1104
AN3106-14S-12S	P1105

STANDARD NAVY AND (SIGNAL CORPS) STOCK No.	KEY SYMBOL
F16-C-91201-1010	SU101
F16-F-48295-9733	Z505
F16-F-48295-9738	Z905
F16-K-49161-1001	SU701
F16-K-49161-1002	SU201
F16-M-46251-1019	SU301
F16-P-66932-1566	SU401
F16-P-66932-1616	SU801
N16-B-750001-293	A1102
N16-B-750001-294	A1101
N16-C-11943-4431	W1101
N16-C-19563-9901	C802
N16-C-19792-7785	C402
N16-C-21868-1633	C401
N16-C-27175-5077	C201
N16-C-27582-1876	C225
N16-C-29654-5764	C209
N16-C-29718-7276	C221
N16-C-29732-9369	C208
N16-C-29888-6029	C207
N16-C-30098-7580	C206
N16-C-30233-4286	C205
N16-C-303202-388	H401

STANDARD NAVY AND (SIGNAL CORPS) STOCK No.	KEY SYMBOL
N16-C-30496-5835	C204
N16-C-30812-8261	C203
N16-C-31085-2037	C222
N16-C-31235-1721	C202
N16-C-32651-9288	C226
N16-C-33622-5222	C218
N16-C-42767-7776	C101
N16-C-47300-5928	C302
N16-C-48813-7458	C105
N16-C-53002-4350	C301
N16-C-53192-8240	C106
N16-C-599931-109	O101
N16-C-650001-256	A601
N16-C-91201-1008	E204
N16-F-32000-1501	Z103
N16-F-32000-1751	Z104
N16-F-32226-8525	Z102
N16-F-40023-4261	Z101
N16-F-44009-3511	Z105
N16-F-44019-5390	Z503
N16-F-44037-8256	Z502
N16-F-44037-8262	Z501
N16-K-700284-190	E602
N16-L-498001-119	E104
N16-P-401881-125	A604
N16-R-29316-1853	L801
N16-R-29317-6239	L401
N16-R-49580-811	R236
N16-R-49858-431	R104
N16-R-49903-751	R110
N16-R-49921-431	R222
N16-R-49922-811	R237
N16-R-49939-431	R230
N16-R-49966-431	R106
N16-R-50020-431	R716
N16-R-50065-431	R215
N16-R-50083-431	R203
N16-R-50092-431	R302
N16-R-50200-431	R304
N16-R-50218-751	R402
N16-R-50281-751	R802
N16-R-50372-171	R210
N16-R-50372-811	R123
N16-R-50398-431	R213
N16-R-50399-171	R211
N16-R-50418-551	R207
N16-R-50479-431	R206
N16-R-50515-431	R101
N16-R-50632-431	R311
N16-A-50632-751	R113
N16-R-50633-171	R109
N16-R-50634-231	R113
N16-R-50677-431	R229
N16-R-50677-751	R710
N16-R-50678-171	R105
N16-R-50695-431	R124
N16-R-50713-431	R218
N16-R-50713-751	R108
N16-R-50714-811	R121
N16-R-50740-431	R303
N16-R-50749-751	R226
N16-R-50786-811	R601
N16-R-50822-811	R103
N16-R-50839-431	R227
N16-R-50929-431	R115
N16-R-50975-811	R117
N16-R-50993-811	R314
N16-R-51019-431	R312
N16-R-51037-431	R125
N16-R-51065-811	R119
N16-R-51136-431	R116

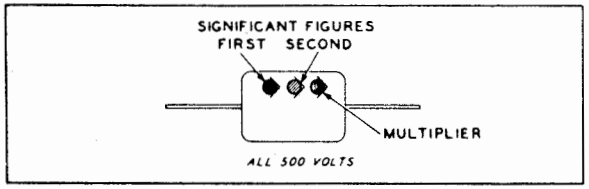
TABLE 6-6. CROSS REFERENCE PARTS LIST (Continued)

STANDARD NAVY AND (SIGNAL CORPS) STOCK No.	KEY SYMBOL	STANDARD NAVY AND (SIGNAL CORPS) STOCK No.	KEY SYMBOL	STANDARD NAVY AND (SIGNAL CORPS) STOCK No.	KEY SYMBOL	STANDARD NAVY AND (SIGNAL CORPS) STOCK No.	KEY SYMBOL	STANDARD NAVY AND (SIGNAL CORPS) STOCK No.	KEY SYMBOL
N16-R-51172-431	R118	N16-S-64063-6718	XV101	N17-C-70320-2881	P1103	N17-C-965001-189	O304	N17-S-61361-1501	S701
N16-R-51326-811	R224	N16-S-117101-271	O305	N17-C-70328-1523	P1102	N17-C-965001-198	O301	N17-S-63693-9979	S201
N16-R-65974-5966	R401	N16-T-51990	V303	N17-C-70328-1706	P1105	N17-C-965001-199	O302	N17-S-65278-8151	S101
N16-R-68407-6726	R801	N16-T-52001	V202	N17-C-70588-1523	P1101	N17-F-14309-320	F901	N17-S-73082-9028	S601
N16-R-68415-3206	R232	N16-T-52230	V302	N17-C-70588-1706	P1104	N17-F-14309-325	F501	N17-T-65626-4001	T102
N16-R-78175-7467	R202	N16-T-56195-50	V103	N17-C-70886-5200	P1108	N17-F-74266-9392	XF503	N17-T-65696-7191	T201
N16-R-79243-1719	R205	N16-T-56198	V207	N17-C-71413-4752	P1106	N17-F-74267-5075	XF501	N17-T-73580-6501	T401
N16-R-79450-9099	R201	N16-T-56840	V401	N17-C-71414-2794	P1107	N17-G-152389-682	O601	N17-T-73624-1801	T801
N16-R-87129-4385	R111	N16-T-58241	V102	N17-C-71600-5182	P1109	N17-G-158146-972	O603	N43-N-5808-7520	H606
N16-R-87349-4580	R803	N16-T-58241-60	V101	N17-C-72240-1522	J507	N17-G-158183-882	O602	N43-S-4379-737	H601
N16-R-88009-4180	R709	N16-T-69910	V205	N17-C-72240-1705	J506	N17-G-161780-392	O303	N43-S-4799-8040	H605
N16-R-88079-4120	R122	N16-V-300081-876	A602	N17-C-72596-2880	J509	N17-I-49527-7100	E603	N43-S-4799-8750	H101
N16-R-88177-8445	R220	N16-V-300086-938	A301	N17-C-72604-1522	J510	N17-I-64073-3039	E103	N43-S-17365-210	H103
N16-R-88177-8447	R307	N17-B-77534-2382	E1001	N17-C-72604-1705	J505	N17-I-64094-6039	E202	N43-S-17365-215	H102
N16-R-88177-8480	R320	N17-B-77534-2387	E601	N17-C-73108-1252	J502	N17-I-67035-9526	E604	N43-S-19133-1272	H301
N16-R-88177-8500	R102	N17-B-77736-1081	E102	N17-C-73108-5890	J503	N17-J-39254-1289	J606	N43-S-51871-9058	H602
N16-R-88337-8435	R319	N17-B-77738-2807	E401	N17-C-73144-4810	J511	N17-L-51708-2648	XV205	N43-S-71368-1050	H1102
N16-S-21126-1045	O604	N17-B-77935-5131	E801	N17-C-73301-6068	J602	N17-L-76737-2764	XI601	N43-S-71685-115	H607
N16-S-21126-1046	O605	N17-B-78267-2707	E301	N17-C-73313-5487	J501	N17-M-75322-4551	A603	N43-W-7599-7590	H608
N16-S-34576-6508	E106	N17-B-78282-3837	E101	N17-C-73588-4094	J101	N17-R-650211-112	O1101	17-L-6806-130	I601
N16-S-34595-2100	E105	N17-B-78282-9448	E702	N17-C-73601-8385	J601	N17-S-46681-2351	O607	41-W-2445	H603
N16-S-34682-9100	E203	N17-B-78322-9448	E701	N17-C-781366-251	H1101	N17-S-46739-2026	O606	41-W-2451	H604
N16-S-34881-9713	E302	N17-B-78330-8995	E201	N17-C-805220-905	O608	N17-S-50986-8410	Z504		
N16-S-62603-6446	XV103	N17-C-48194-4010	W1102	N17-C-945001-769	A701	N17-S-59673-1701	S202		
N16-S-64286-3953	XV302	N17-C-48886-9863	W1103	N17-C-945001-770	A201	N17-S-60906-7860	S102		

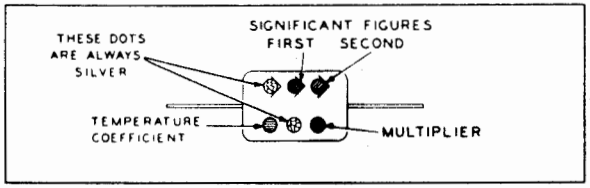
TABLE 6-7. APPLICABLE COLOR CODES AND MISCELLANEOUS DATA

CAPACITOR COLOR CODES

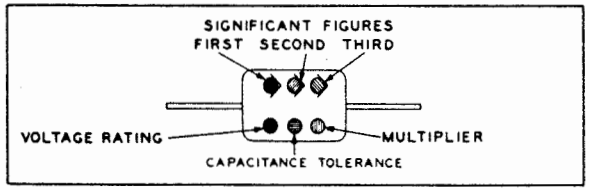
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



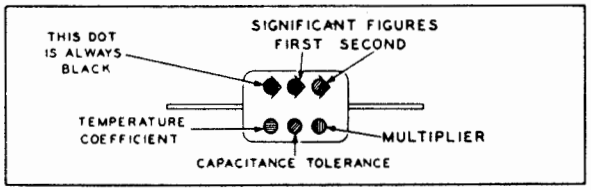
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



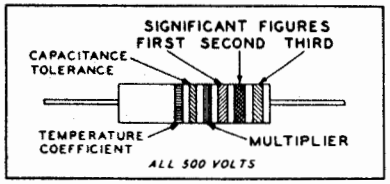
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

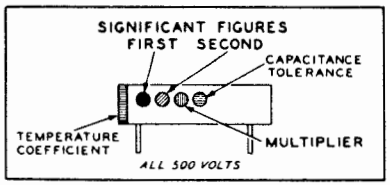


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

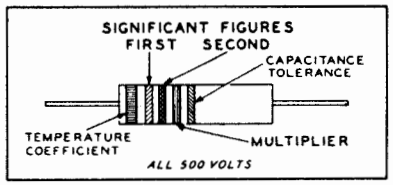


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



AXIAL TYPE INSULATED



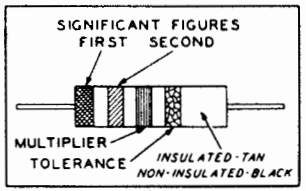
RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

RESISTORS		CAPACITORS						
				MULTIPLIER				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	RMA MICA AND CERAMIC-DIELECTRIC	JAN MICA AND PAPER-DIELECTRIC	JAN CERAMIC DIELECTRIC	VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	1	1	1		A
	10	1	BROWN	10	10	10	100	B
	100	2	RED	100	100	100	200	C
	1,000	3	ORANGE	1,000	1000	1000	300	D
	10,000	4	YELLOW	10,000			400	E
	100,000	5	GREEN	100,000			500	F
	1,000,000	6	BLUE	1,000,000			600	G
	10,000,000	7	VIOLET	10,000,000			700	
	100,000,000	8	GRAY	100,000,000		0.01	800	
	1,000,000,000	9	WHITE	1,000,000,000		0.1	900	
5	0.1		GOLD	0.1	0.1		1000	
10	0.01		SILVER	0.01	0.01		2000	
20			NO COLOR				500	

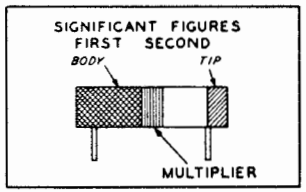
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

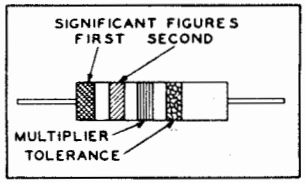


RADIAL TYPE



JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED

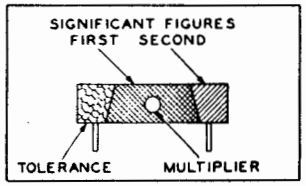


TABLE 6-8. LIST OF MANUFACTURERS

ABBREVIATIONS	PREFIX	NAME	ADDRESS
CAYU	CAYU	L. N. Barry	489 Main St. Cambridge, Mass.
CAYZ	CAYZ	Dial Light Corp.	900 Broadway New York, N.Y.
CBIM	CBIM	Switchcraft Co.	1328-30 N. Halsted St. Chicago, Ill.
CBZ	CBZ	Allen-Bradley Co.	118 W. Greenfield Ave. Milwaukee, Wis.
CD	CD	Cornell-Dubilier Corp.	1000 Hamilton Blvd. South Plainfield, N.J.
CED	CED	Cannon Electric Development Co.	3291 Humboldt St. Los Angeles 31, Calif.
CFA	CFA	Bussman Mfg. Co.	2538 W. University St. St. Louis, Mo.
CG	CG	General Electric Co.	1 River Rd. Schenectady, N.Y.
CHH	CHH	Arrow-Hart & Hegemen Elect. Co.	102 Hawthorne St. Hartford, Conn.
CIR	CIR	International Resistance Corp.	401 N. Broad St. Philadelphia, Pa.
CKB	CKB	Hoffman Radio Corp.	3761 S. Hill St. Los Angeles 7, Calif.
CMF	CMF	Electro-Motive Mfg. Co.	Willimantic, Conn.
CMG	CMG	Cinch Mfg. Co.	2339 W. Van Buren St. Chicago, Ill.
CNA	CNA	National Company, Inc.	61 Sherman Ave. Malden, Mass.
CPH	CPH	American Phenolic Corp.	1830 S. Fifty-fourth Ave. Chicago, Ill.
CSM	CSM	Shallcross Mfg. Co.	Pusey and Jackson Aves. Collingdale, Mass.
CTC	CTC	Chicago Telephone Supply Co.	Elkhart, Ind.
CTR	CTR	Chicago Transformer Corp.	3501 Addison St. Chicago, Ill. Div. of Essex Wire Corp.
FWM		Frank W. Morse Co.	1300 Soldiers Field Rd. Boston 35, Mass.
GA		Grigsby-Allison Co., Inc.	407 N. Salem Ave. Arlington Heights, Ill.
QSSP		Quality Socket Screw Products	110 S. 6th St. Montebello, Calif.