CG-273-11

INSTRUCTION BOOK

for

RADIO TRANSMITTER
TYPE T-325B/FPN

FEDERAL TELEPHONE AND RADIO CORPORATION
CLIFTON, NEW JERSEY

U. S. COAST GUARD TREASURY DEPARTMENT

UNITED STATES COAST GUARD

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EEE-2
17 January 1962

ELECTRONICS FIELD CHANGE BULLETIN

TYPE 1 F.C. NO 5 to T-325B/FPN T.M. CG-273-11

PURPOSE:

The purpose of this Field Change is to accomplish the following:

a. Eliminate arcing of inductors L-117A and L-117B by replacing present inductor shafts and replacement of the brass rotor shaft bushings with insulated bushings supplied in the field change kit.

DESCRIPTION:

a. The field change kit for Loran Transmitters T-325B/FPN Field Change #5 contains the instructions and parts required for the modification of one T-325B/FPN.

b. Approximately 2 man-hours are required to accomplish this field change.

EQUIPMENT AFFECTED:

a. All T-325B/FPN Loran Transmitters are affected by this field change.

IDENTIFICATION OF ACCOMPLISHMENT:

The appearance of insulated bushings on the rotor shafts of L-117A and L-117B will indicate the accomplishment of this field change.

MATERIALS REQUIRED BY INSTALLING ACTIVITY:

All material required for this field change will be issued in the kit for Field Change #5 to Model T-325B/FPN Loran Transmitter.

ROUTINE INSTRUCTIONS:

1. The Technical Manual CG-273-11 shall be corrected as follows:

(a) Insert and log this field change in the front of the Technical Manual CG-273-11, upon completion.

2. RECORD OF ACCOMPLISHMENTS:

Personnel making this field change shall record the completion data of the change on the Electronics Equipment History Card NAVSHIPS-536, and on the Record of Field Changes Card NAVSHIPS-537.

3. DISPOSITION OF REPLACED MATERIAL:

After completing this field change destroy all removed material.

4. DISPOSITION OF FIELD CHANGE BULLETIN:

Maintenance support facilities shall maintain a library copy of this Field Change Bulletin. Holders of equipment shall not destroy this Field Change Bulletin until the Field Change has been accomplished, the equipment tested, and the applicable manuals, drawing, charts, and identification plates have been corrected or replaced.

5. ACTION REQUIREMENTS:

All Units having installed Loran Transmitters, Models T-325B/FPN shall comply with Routine Instructions Paragraphs Nos. 1, 2 and 3. A field change kit will be provided for each unmodified equipment by Commandant (EEE) without further Unit or District action.

J. A. ALGER, JR.
Chief, Office of Engineering

DIST (SDL NO 73)

A: NONE
B: b,c,d,g,l,(4) p(2) i(200)
C: l(4)
D: a,e(4)

SPECIAL DISTRIBUTION LIST NO 193

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C: c1(10)
D: d1(14)
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EEE-2
2 March 1961

LORAN TRANSMITTERS
T-325-B/FPN AND T-325-C/FPN

Field Change #4 to T-325-B/FPN
Field Change #2 to T-325-C/FPN
Amendment #4 to Technical Manual, CG-273-11, for T-325-B/FPN
Amendment #2 to Technical Manual, CG-273-36, for T-325-C/FPN

1. Purpose. The purpose of these field changes and technical manual amendments is to remove the crystal detector circuit used to display the detected RF output pulse on the 256-D Scope with the Monitored Circuit Switch S-116 in the Antenna (Detected) position.

2. Publications Amended. Technical Manuals for Loran Transmitters T-325-B/FPN and T-325-C/FPN are hereby amended.

3. Introduction. This circuit was originally designed to aid technical personnel in obtaining pulse shape information by increasing trace intensity. A recent modification to the Dumont 256-D Oscillograph provides grid illumination and thereby makes the increased trace intensity unnecessary. Since this circuit also caused some pulse distortion it is being removed.

4. Materials Required. All materials required will be provided in a field change kit. This kit will be supplied by the Commandant (EEE) without action by Loran Stations.

5. Modification Procedure.

a. Secure all power to the transmitter.

b. Remove the test oscilloscope from the transmitter.

c. Locate the terminal board mounted above to the right and behind the normal position of the test oscilloscope. This board contains all of the components of the pulse rectifier circuit.

d. Sever the two RG-58/U cable leads at the points of connection to the terminal board.

e. Remove the terminal board by removing the four corner screws. This may be more easily accomplished from the rear of the transmitter.

f. On terminal 14 of S-116-A locate and remove the end of the RG-58/U cable referred to in step (d). Insure that other circuits are not interfered with.

g. Tape all of the loose ends of the RG-58/U Cable and tag them "Terminated by Field Change #___." These leads should then be laced tightly along the cable run.

h. Mount the phenolic plate provided in the field change kit in accordance with the instructions therein.

6. Technical Manual Amendment. Amend the Technical Manuals, CG-273-11, for the T-325-B/FPN and CG-273-36, for the T-325-C/FPN, as follows:

a. Page 1-11, Table 1-3: Under "Radio Transmitter Type T-325-B/FPN - Remarks,"

(1) delete: (d) Contains crystal detector circuit to display detected output of antenna coupling units as selected by MON CIRCUIT switch.

(2) Correct lettering of paragraphs to show proper alphabetical sequence.

b. Page 2-14; Figure 2-11:

(1) delete: R-263.

(2) delete: Antenna (detected).

c. Page 2-15; Table 2-1: Under "Switch Pos. 15 - Waveform Monitored":

(1) delete: Detected output of antenna coupling unit.

d. Pages 7-47, 7-48; Figure 7-38:

(1) Correct to reflect changes made.

7. Applicability of Field Changes. These field changes are applicable to all T-325-B/FPN and T-325-C/FPN Loran Transmitters.

8. Change in Nomenclature. There will be no change in nomenclature as a result of these field changes.

LORAN TRANSMITTERS, T-325-B/FPN AND T-325-C/FPN.
Field Change #4 to T-325-B/FPN.
Field Change #2 to T-325-C/FPN.
Amendment #4 to Technical Manual, CG-273-11, for T-325-B/FPN.
Amendment #2 to Technical Manual, CG-273-36, for T-325-C/FPN.

9. Action Requirements. These field changes shall be performed at stations having any of the above listed equipments installed.

E. H. Thiele
E. H. THIELE
By direction

DIST (SDL NO. 72)

A: None
B: bd (4); cg (4); i (200); lp (2)
C: l (4)
D: a (2); e (8)
E: l (4)
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LORAN TRANSMITTERS
MODELS T-137, T-137-A, T-325/FPN
T-325-A/FPN, T-325-B/FPN, T-325-C/FPN

Coast Guard Technical Manual:

Amendment #20 to Model T-137
Amendment #19 to Model T-137-A
Amendment #16 to Model T-325/FPN
Amendment #11 to Model T-325-A/FPN (CG-273-5)
Amendment #3 to Model T-325-B/FPN (CG-273-11)
Amendment #1 to Model T-325-C/FPN (CG-273-36)

Field Change #17 to Model T-137
Field Change #16 to Model T-137-A
Field Change #14 to Model T-325/FPN
Field Change #11 to Model T-325-A/FPN
Field Change #3 to Model T-325-B/FPN
Field Change #1 to Model T-325-C/FPN

1. Purpose. The purpose of these amendments and field changes is to:

a. Authorize and direct a change to the technical manuals for Loran transmitters.

b. Modify the monitor oscilloscopes, Type 256-D, to improve control of illumination.

2. Publications Amended. The technical manuals for the above named Loran transmitters are hereby amended.

3. Materials Required. One 5.6 ohm, 2 watt resistor is needed to modify each oscilloscope. A field change kit will be provided by the Commandant (EEE) without further Unit or District action. Each kit will consist of 4 such resistors, to be used for modification of two oscilloscopes and to provide maintenance parts.

4. Modification Procedure.

a. Remove the bezel scale assembly and rotate the green color filter plate 45 degrees so that the C and D (large) holes are now used for mounting.

b. Mount the 5.6 ohm resistor in series with the dimmer control potentiometer, insuring that the leads are insulated against contact with the oscilloscope panels.

5. Technical Manual Amendment.

a. Technical Manuals for T-325-B and T-325-C designate the dimmer control potentiometer as R-304. This designation should be made in all other manuals.

b. The new resistor is to be designated R-305 and these resistors will be entered in the parts list, Section 8, of the technical manual.

c. Show the addition of R-305 to the illuminated scale schematic provided in the addendum sheets.

6. Action Requirements. All technical manuals for the above named transmitters will be amended. All Units having the above listed equipments installed will perform this field change.

E. H. Thiele
E. H. THIELE
Engineer-in-Chief

DIST (SDL No. 72)

A: None
B: b(4); c(4); d(4); g(4); i(200); l(4); p(2).
C: l(4)
D: a(4); e(4)
E: l(2)

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LORAN TRANSMITTER
MODEL T-325-B/FPN

Coast Guard Instruction Book Amendment #1

Field Change #1

1. Purpose. The purpose of this amendment and field change is to:

a. Authorize and direct a change in the Instruction Book for Loran Transmitter Model T-325-B/FPN.

b. Replace the presently installed disposable fibre glass air filters with permanent type metallic mesh air filters. This filter replacement is made to provide better air filtration and to decrease maintenance costs.

2. Publications Amended, Canceled, or Modified. The Instruction Book for Loran Transmitter Model T-325-B/FPN is amended hereby.

3. Field Change. When the supply of fibre glass air filters for Loran Transmitter Model T-325-B/FPN is exhausted, replacement with permanent type metallic mesh air filters is to be accomplished. The new allowance is four installed and one spare per equipment. The permanent filter physically is a direct replacement for the presently installed disposable type. The stock description is CLEANER ELEMENT, air; aluminum mesh, permanent type; 10" x 10" x 1", (SNSN) 17-C-794001-237.

The new air filter is permanent in nature. It is constructed with a welded aluminum frame and cloth covered aluminum wire mesh media; the entire assembly is anodized. The cloth flocking is permanent, and increases the filtering ability tremendously as it retains the oil longer than bare wire. A filter of this type of construction increases the percentage of filtration afforded by nearly 100% with only a minute increase in static drop of air flow.

4. Instruction Book Amendment. Amend the Instruction Book for Loran Transmitter Model T-325-B/FPN as follows:

a. Insert this amendment in the Instruction Book.

b. Section 6, para 4i: Delete the last sentence and insert the following: "Clean the filters by brushing or blowing off all loose accumulated dust and dirt. The filters should be washed in hot water containing soap detergent. When dried, immerse each filter in engine lubricating oil (SAE 20 to 50) and drain by laying along the shortest dimension for run-off. DO NOT USE GASOLINE OR OTHER SUCH SOLVENTS."

c. Section 8: Change the description of symbol designations O111-1 to O111-4 to read: "CLEANER ELEMENT, air; aluminum mesh, permanent type; 10" x 10" x 1", Standard Navy Stock No. 17-C-794001-237, Manufacturer Type P1A."

5. Applicability of Field Change. The above described field change is applicable to all units having installed Loran Transmitter Model T-325-B/FPN.

6. Changes in Nomenclature. There will be no change in nomenclature caused by this field change.

7. Action Requirements. All units having installed Loran Transmitter Model T-325-B/FPN shall comply with paragraphs 3, 4, and 5. An allowance of new filters will be provided by the Commandant (EEE) without further Unit or District action. The amendment to the Instruction Book for Loran Transmitter Model T-325-B/FPN shall be recorded on the sheet provided.

K K Cowart
K. K. COWART
By direction

Dist. (SDL NO. 59)

A: NONE
B: i (250); g (25); c (11)
f (9); m (6); d l (2)
C: l v (4)
D: e (6); a (1)
E: g s v (4)

7361 TREASURY, USCGHQ, WASH., D.C.

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EEE-2
19 January 1962

ELECTRONIC FIELD CHANGE BULLETIN

Type 2 FC #18 to T-137 TM
FC #17 to T-137-A TM

FC #15 to T-325/FPN TM

FC #12 to T-325-A/FPN TM CG-273-5

~~FC #6 to T-325-B/FPN TM CG-273-11~~

FC #4 to T-325-C/FPN TM CG-273-36

PURPOSE:

The purpose of this field change is to modify the monthly preventive maintenance schedule to include testing the accuracy of voltmeters M-102, M-103 and M-104 multiplier resistors in the above equipment. Experience has shown that considerable damage can result to final amplifier and pulse forming tubes when improper plate and bias voltages are applied. These improper voltages can be applied even though all associated meters read the correct values and result from a change in value of the meter multiplier resistors. These changes can seldom be detected with the equipment normally available.

DESCRIPTION:

This test is accomplished by substituting a set of multiplier resistors, taken from equipment spares known to be of the proper value, in the equipment. The voltage measured with the test set of resistors is compared with the previous reading for the same dial settings. Any variation in the two readings indicate defective multipliers.

EQUIPMENT AFFECTED:

All Loran Transmitters, Model T-137, T-137-A, T-325/FPN, T-325-A/FPN, T-325-B/FPN and T-325-C/FPN, installed and operating.

IDENTIFICATION OF ACCOMPLISHMENT:

The test should be performed during the monthly preventive maintenance schedule and included in the weekly and monthly check list shown in Figure 2-32 Page 61 of CG-155.

MATERIALS REQUIRED BY INSTALLATION ACTIVITY:

None.

PROCEDURE:

None.

ROUTINE INSTRUCTIONS:

1. The applicable equipment technical manuals and operating instructions shall be corrected in accordance with the following instructions:

a. Section 6, Para. 4; insert the following:

"K. Check the accuracy of the P.A. Plate Voltage Meter (M-102), the Medium Voltage meter (M-103) and the High Bias Supply Meter (M-104). This is accomplished by the following procedure:

1. Remove from spares the appropriate multiplier resistors; R-101 through R-104 for meter M-102; R-105, R-181 and R-182 for meter M-103; and R-107 for Meter M-104. These will be used as a substitute test set.

2. Energize the equipment under test and advance the High Voltage Control (T-101) until the meter, M-102, indicates the proper operating potential.

3. Carefully note the position of the high voltage control dial.

4. Remove all power. Short all elements to ground with the capacitor-discharge rod provided.

5. Substitute a set of multiplier resistors, R-101 through R-104, of known resistance in the circuit of M-102.

6. Energize the equipment and adjust the high voltage control until the proper operating potentials are obtained. Compare the high voltage dial position with the one previously obtained.

7. If the high voltage control position is different from the position in Step 2 above, one or more of the multiplier resistors are defective. The defective resistor may be located by substituting the test resistors one at a time until a change in the dial position is noted. Before substituting any resistors, be sure that the equipment is de-energized.

8. Once the high voltage meter M-102 is correct, repeat the procedure outlined in steps 1 through 6 for M-103 and M-104 using appropriate test multipliers from spares."

2. RECORD OF ACCOMPLISHMENT: Personnel making this Field Change shall record the completion data of the change on the Electronic History Card - NAVSHIPS 536 and Record of Field Change Card - NAVSHIPS 537.

3. DISPOSITION OF FIELD CHANGE BULLETIN: Maintenance support facilities shall maintain a library copy of this Field Change Bulletin. Holders of equipment shall insure that this Field Change has been accomplished and the applicable manuals, drawings and charts have been corrected. A copy of this Field Change Bulletin shall be placed in the manual.

J. A. ALGER, JR.
Chief, Office of Engineering

DIST (SDL NO. 74)

A: None
B: b(4); c(4); d(4); i(200); l(4); P(2)
C: l(4)
D: a(4); e(4)

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E: e1(18)

24730 TREAS. CGHQ. WASH., D.C.

CG-273-11

INSTRUCTION BOOK

for

RADIO TRANSMITTER
TYPE T-325B/FPN

FEDERAL TELEPHONE AND RADIO CORPORATION

CLIFTON, NEW JERSEY

U. S. COAST GUARD TREASURY DEPARTMENT

Contract: Tcg-39108 (CG-24,984-A) *Approved by C. G. Headquarters*

9 *November* 1953

LIST OF EFFECTIVE PAGES

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
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A to C	Original	5-1 to 5-9	Original
i to xi	Original	6-0 to 6-13	Original
1-0 to 1-16	Original	7-0 to 7-78	Original
2-1 to 2-28	Original	8-1 to 8-172	Original
3-1 to 3-48	Original	i-1 to i-10	Original

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U. S. COAST GUARD
HEADQUARTERS
WASHINGTON 25, D. C.

EEE

LETTER OF PROMULGATION

1. CG-273-11 is the Instruction Book for Radio Transmitter, Type T-325B/FPN, and is in effect upon receipt. The two copies furnished with the equipment are parts thereof and shall always accompany the basic equipment.

2. When superseded by a later edition, this publication shall be destroyed.

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

4. Copies of this publication may be obtained by requisition to the Commanding Officer, Coast Guard Supply Center, Jersey City, N. J., via Commandant (EEE).

5. Corrections to this publication will be made by serially numbered amendments. They shall be entered promptly by the responsible personnel.

K K Cowart

K. K. COWART
Rear Admiral, U. S. Coast Guard
Engineer-in-Chief
By direction of the Commandant

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION
1		Baltes ETZ
3		Baltes ETZ
4		Baltes ETZ
5		Baltes ETZ
6		Baltes ETZ

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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 such defect or noncomformance shall be given by the Government to the Contractor within two years of the delivery of the defective or nonconforming article, or within one year of the date it is placed in service, whichever expires first. To the extent the equipment, including all parts and spare parts, as defined above, is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing conditions, against defects in design with the understanding that if ten percent (10%) or more of any such said item, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred percent (100%) correction or replacement by a suitably redesigned item. If required by the Government 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 redelivery. If the Government does not require correction or replacement of a defective or nonconforming article, the Contractor, if required by the Contracting Officer within a reasonable time after the notice of defect or nonconformance, shall repay such portion of the contract price of the article as is equitable in the circumstances.

INSTALLATION RECORD

Contract Number Tcg–39108 (CG-24,984-A) Date of Contract, 30 September 1952

Serial Number of equipment ....

Date of acceptance by the Coast Guard..

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 the time of installation. Operating personnel shall also mark the "Date Placed in Service" on the date of acceptance plate located below the model nameplate on the equipment, using suitable methods and care to avoid damaging the equipment.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its entire service life, shall be made to the Commandant via channels in accordance with current instructions using form CG-2643 (revised). The report shall cover all details of the failure and give date of installation of the equipment.

ORDERING PARTS

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

1. Standard Navy 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. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

SAFETY NOTICE

THIS EQUIPMENT EMPLOYS VOLTAGES WHICH ARE DANGEROUS, AND WHICH 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 times 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 equipment for the purpose of servicing or adjusting it without the immediate presence or assistance of another person capable of rendering aid.

DON'T TAMPER WITH INTERLOCKS:

Do not depend upon door switches or interlocks for protection but always remove power from the equipment. Under no circumstances should any access gate, door, or safety interlock switch be removed, short-circuited, or tampered with in any way, by other than authorized maintenance personnel, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

WHERE 1,000 VOLTS OR MORE, TAKE NOTE:

NEVER MEASURE POTENTIALS IN EXCESS OF 1,000 VOLTS BY MEANS OF FLEXIBLE TEST LEADS OR PROBES.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR, OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE COAST GUARD SUPPLY CENTER, JERSEY CITY, NEW JERSEY.

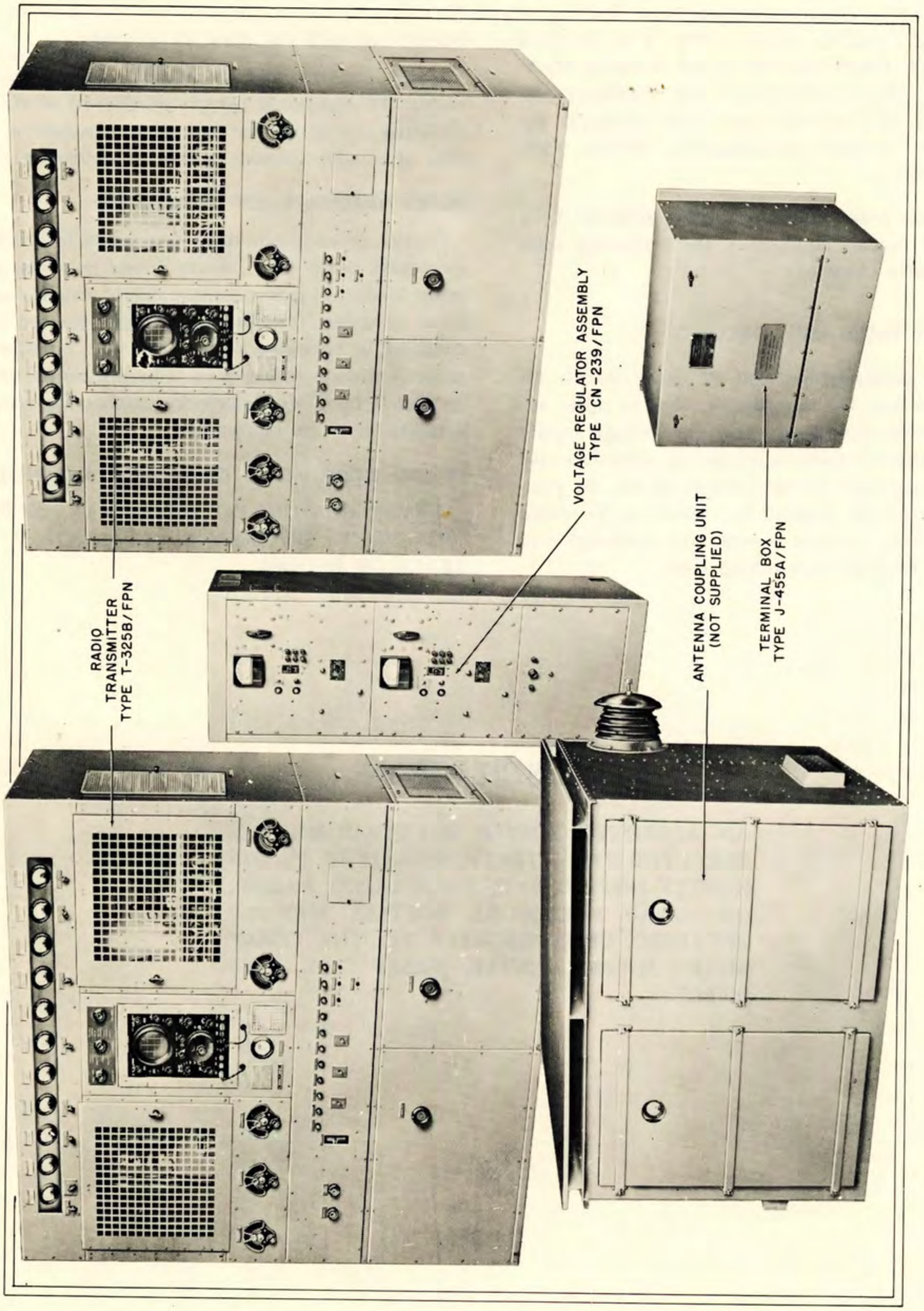


Figure 1–1. Radio Transmitter Type T–325B/FPN and Associated Units

SECTION 1
GENERAL DESCRIPTION

1. INTRODUCTION.

Radio Transmitter Type T–325 B/FPN is one of the basic units of a loran transmitting station. Supplied along with the transmitter are a Voltage Regulator Assembly Type CN–239/FPN, a Terminal Box Type J–455A/FPN, and a complete set of crystals to permit crystal-controlled operation on all transmitting frequencies. It is the function of this book to supply all the information necessary for the installation, operation, and maintenance of the transmitter, the terminal box, and the voltage regulator unit. In addition, information is supplied for connection to typical timer and switchgear equipment which is required to complete the station complement. The switchgear is the Navy Model UM Switching Equipment as modified under a previous contract specifically for use with transmitters of the T–325B/FPN type. Details of this modification are described. The timer equipment discussed in this book is the Navy Model UE–1 Timer. A modification kit was supplied for this timer, under previous contracts, to make the timer suitable for use with transmitters of the T–325B/FPN type. Refer to the instruction book for the timer and switchgear equipments to be used at the particular installation for detailed information on these equipments.

An antenna coupling unit, which is not furnished on Contract TCG–39108, is also needed to complete a loran transmitting system. The Federal Telephone and Radio Corporation furnished such antenna coupling units to the Coast Guard on an earlier contract for the Model T–137 Loran Transmitter. This manual includes instructions pertinent to that particular coupling unit even though it is not furnished with the T–325B/FPN transmitter. For information on coupling units of other manufacture that may be supplied for use with a T–325B/FPN transmitter, refer to the instruction books provided with those units.

Where higher output power (than can be obtained from a T–325B/FPN transmitter) is required, the T–325B/FPN unit may be used as a driver for a Coast Guard Model T–138 or T–138A high-power r-f amplifier. With this arrangement a peak power output of 1,000 kilowatts may be generated for loran applications.

Note

It should be recognized that the term "exciter" as generally used throughout this manual refers to the designation of functional sections of a T–325B/FPN transmitter and *not* to a T–325B/FPN transmitter used as a driver for an external amplifier. (Each T–325B/FPN transmitter includes two "exciter" sections within its frame.)

2. EQUIPMENT CONSTITUTING A LORAN STATION.

The two basic units of a loran transmitting station are the radio transmitter and the timer. In addition, suitable power equipment, radiating equipment, switching equipment, test equipment, etc., must be provided. A system which utilizes Radio Transmitter Type T–325B/FPN will normally include the equipment listed. However, a station may consist of only the operating units (the quantity to depend on whether single- or double-pulsed operation is used), without having the spare units. A system diagram utilizing typical transmitting equipment specified is shown in figure 1–12.

a. 2 Radio Transmitters Type T–325B/FPN (1 operating, 1 spare).

b. (1) Double-pulsed operation: 4 loran timers* (2 operating, 2 spares).

(2) Single-pulsed operation: 2 loran timers* (1 operating, 1 spare).

c. 1 switching equipment*.

d. 1 Voltage Regulator Assembly, Type CN–239/FPN.

e. 1 Terminal Box Type J–455A/FPN.

f. 1 Antenna Coupling Unit (for transmitter)*.

g. 1 transmitting antenna*.

h. 1 receiving antenna*.

i. 1 Antenna Coupling Unit (for receiver)*.

j. Suitable power equipment*.

k. Suitable test equipment*.

l. Miscellaneous materials (cables, ground wire, spares, etc)*.

3. RADIO TRANSMITTER TYPE T–325B/FPN.

a. FUNCTIONS OF TRANSMITTER AND ITS SUBSECTIONS. — The transmitter produces high-powered r-f pulses which, when radiated, may be

*Not supplied under this contract.

utilized by aircraft and shipboard receiver-indicators to determine a line of position. Functionally, a transmitter consists of two "exciters," two IPA stages, and a PA stage, plus required accessory items such as power supplies, a monitoring oscilloscope, operating controls, and indicating devices.

The term "exciter" is a nominal one and is applied to a transmitter functional circuit group which is not an integral mechanical assembly. This group includes the frequency-generating subassembly which (from an external 100-kc timer input or a contained crystal) develops radio frequency, and a pulse-forming section which (from external timer impulse excitation) develops shaped pulses used in modulating the transmitter. Note figure 2–2, Section 2.

Each transmitter contains two "exciter" groups in order to permit double pulsing (described in Section 2, paragraph 9).

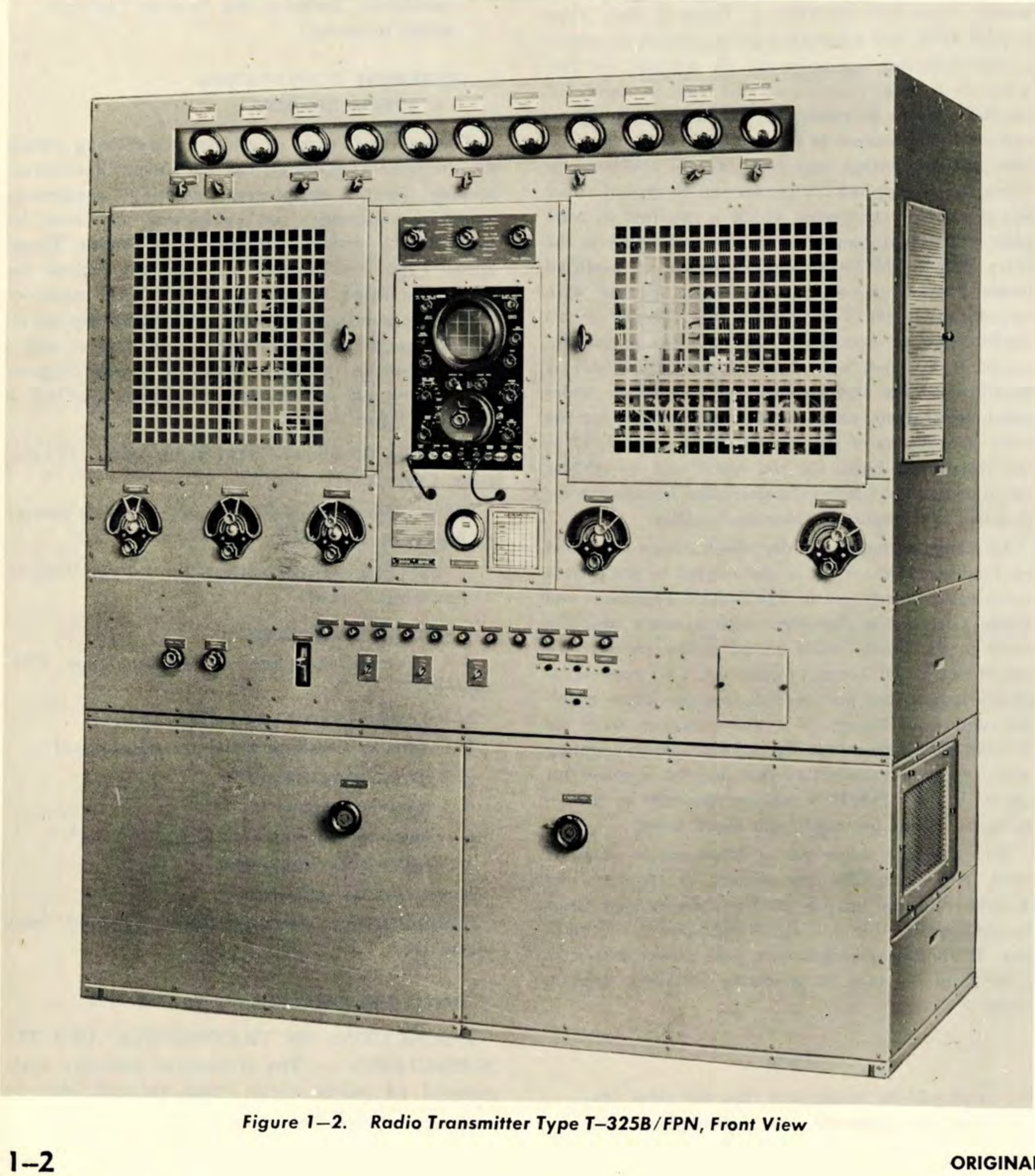


Figure 1—2. Radio Transmitter Type T–325B/FPN, Front View

b. DESCRIPTION. — The components of Radio Transmitter Type T–325B/FPN are contained in an aluminum cabinet 72¼ inches wide by 36-5/16 inches deep by 80⅛ inches high (figure 1–2). All panels are permanently secured to the frame with screws, and hinged access doors are provided in front and rear to permit inspection, adjustment, or replacement of those components which require periodic attention. As far as practicable, components are grouped functionally, within the cabinet and on the front panel, to correspond roughly to the electrical subdivisions (exciter, IPA, etc.) mentioned in paragraph 3*a* above.

A meter panel extending across the uppermost portion of the transmitter (front) contains all the principal meters used for ordinary monitoring purposes (figure 1–2). Above each meter are two plates; one contains the meter designation, and the other, a plasticized matte plate, contains the normal meter reading

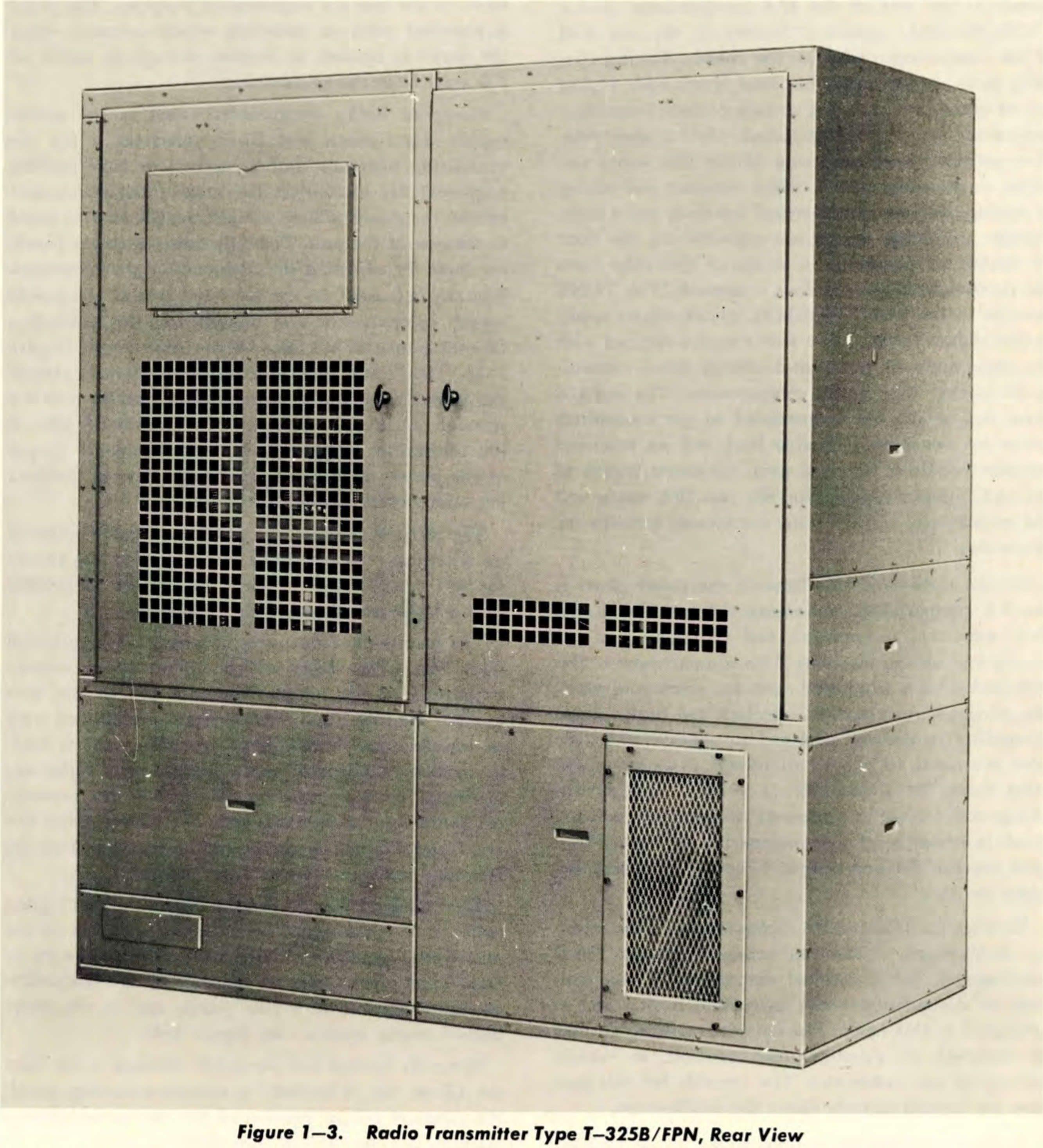


Figure 1—3. Radio Transmitter Type T–325B/FPN, Rear View

or, in cases where the readings may change, write-in space to log the readings for monitoring purposes. Appropriately designated selector switches are located beneath these meters which may be connected into more than one circuit of the transmitter.

Beneath the meter panel on the left is the IPA compartment containing two IPA stages suitably shielded from each other. The two frequency-generator sections of the two exciters are contained on vertically mounted chassis at the rear of the IPA compartment, and a TUNE-NORMAL switch is located on the rear wall of the compartment beneath the chassis. Tuning controls, jacks, and a coiled test lead fitted with a plug are mounted on the facing surface of each frequency-generator chassis. A hinged door with a glass window permits visual inspection of the IPA tubes and access to the compartment when necessary for tuning or testing purposes. An electrical interlock and a high-voltage grounding switch are provided on the door to remove all potentials in excess of 230 volts from the transmitter when the door is opened. [The TUNE position of the TUNE-NORMAL switch allows application of low voltage (300 volts) to the exciters with the doors open.] A capacitor-discharge rod is conveniently located within the compartment. The hooked brass end of the rod is grounded to the transmitter frame by means of a flexible lead, and an insulated bakelite handle is provided over the major length of the rod. Tuning controls for the two IPA stages and the output stage of the exciter are located beneath the access door.

On the right-hand side beneath the meter panel is the PA compartment containing the four PA tubes, their associated components, and a dummy load for tuning and testing purposes. This compartment is also provided with a windowed door for access and viewing purposes. An electrical interlock and high-voltage grounding switch are arranged to operate when the door is opened, to remove all voltage in excess of 230 volts from the transmitter; a second capacitor-discharge rod, for use by personnel entering the compartment, is located within the compartment. Tuning controls for the PA and output circuits are located beneath the door.

Between the IPA and PA compartments is the monitor oscilloscope, a DuMont commercial type 256-D oscillograph. For a detailed description of this unit refer to the manufacturer's instruction book which is appended to this book. The monitor oscilloscope may be switched, by panel-mounted controls, to various circuits of the transmitter. The controls for this purpose are located directly above the oscilloscope.

Beneath the monitor oscilloscope is a TUBE HOURS meter which registers the length of time that the tube filaments are energized.

Start-stop controls, overload controls, and supervisory indicating lamps are mounted on a panel across the front of the transmitter beneath the IPA compartment, the scope, and the PA compartment. This panel is hinged across the bottom edge and is secured in its normal upright position by screws. Removing the screws permits the panel to swing forward, providing access to the rear for maintenance purposes. The panel is provided with an interlock which operates, when the panel is opened, to remove voltage in excess of 230 volts from the transmitter.

Heavy or bulky components (such as the power supply transformers and filter capacitors, a fan for ventilating purposes, and a blower for tube cooling purposes) are located on the base of the transmitter behind the panels which extend from the control panel to the base of the unit. The only controls on the panels are those for adjusting the filament and plate voltages. The fan is located on the left-hand side of the power supply compartment and obtains cool air through a filtered intake at the rear of the transmitter (figure 1–3). The blower is located on the right-hand side of the power supply compartment and obtains cool air through a filtered intake on the right-hand side of the transmitter (figure 1–2). The forced-air output of the blower is directed against the base of the four PA tube sockets through a metal duct.

The rectifier tubes of the power supply are mounted on a centrally located shelf at the rear of the power supply compartment. These tubes are accessible through the rear doors of the transmitter.

The rear of the transmitter (figure 1–3) is provided with two access doors which extend approximately two-thirds of the length from the top of the unit towards the base. Each of these doors is equipped with an interlock and high-voltage grounding switch similar to those on the front access doors; a third capacitor-discharge rod is mounted on the frame of the transmitter behind the right-hand door (as viewed from the rear) and a fourth discharge rod is located behind the left-hand door (as viewed from the rear).

The left-hand door (as viewed from the rear) gives access to a relay shelf, a relay panel, and one of the pulse-forming sections of the two exciters. The right-hand door gives access to the rear of the frequency-generator chassis, to a fuse panel, and to the other pulse-forming section (see figure 1–4).

Centrally located and accessible through either door are (from top to bottom) a resistor-mounting panel, the common output portion of the two pulse-forming sections, and the rectifier tube shelf.

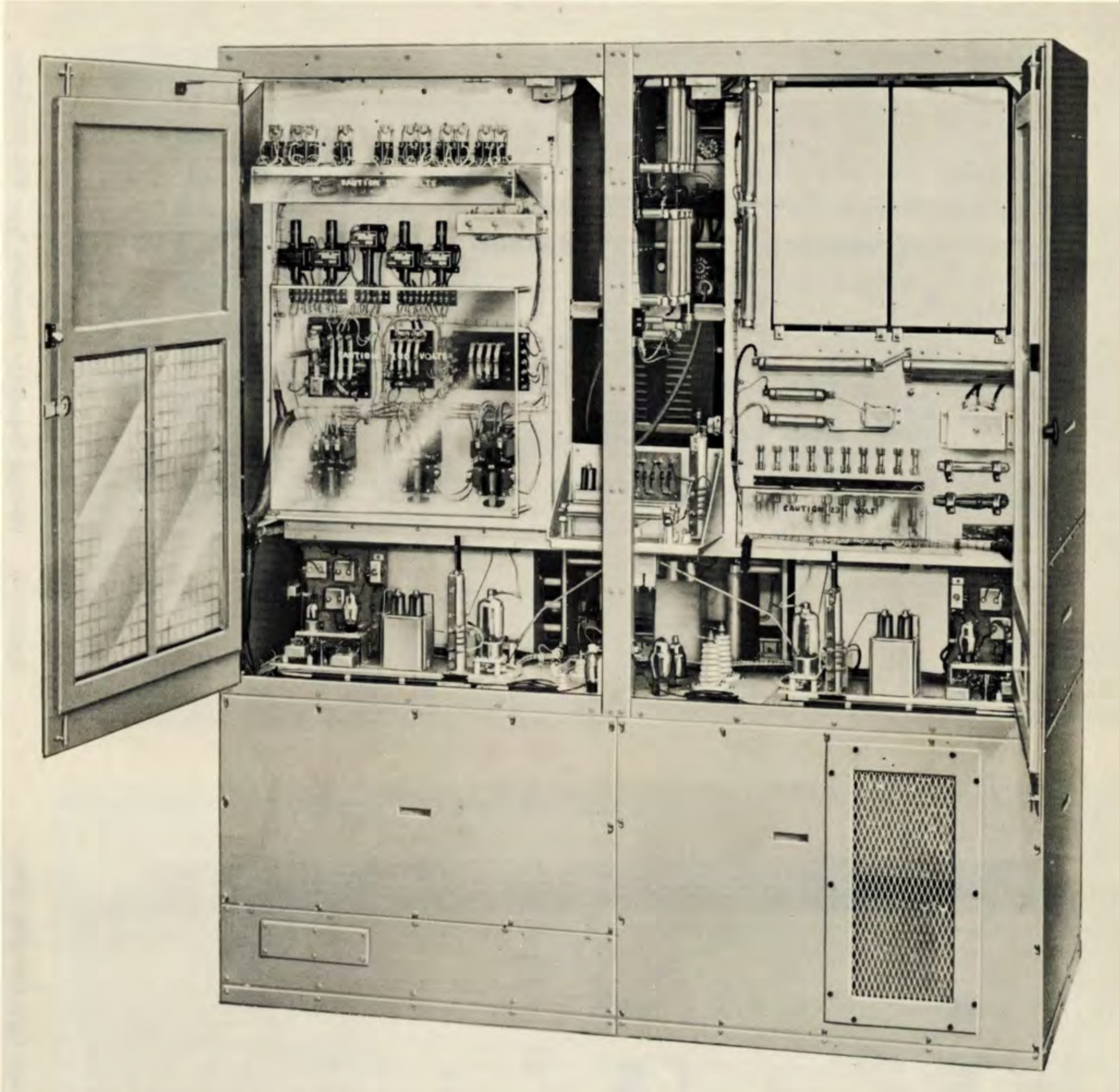


Figure 1—4. Radio Transmitter Type T-325B/FPN, Rear View with Access Doors Open

A terminal board for external connections is provided in the rear left-hand corner (as viewed from the rear) of the power supply compartment. An opening in the base of the cabinet allows for cable entry from a trenchwork. A metal plate covers three holes which have been cut in the rear of the cabinet as an alternate means of cable entry.

4. VOLTAGE REGULATOR ASSEMBLY TYPE CN-239/FPN.

a. FUNCTION. — The Voltage Regulator Assembly supplies the transmitters of a loran transmitting station with regulated a-c line voltage. The assembly consists of two identical automatic voltage regulators and a blower. The voltage regulators operate independently of one another. Each is able to supply the power requirements of any one of the T-325B/FPN transmitters.

b. DESCRIPTION.

(1) CABINET ASSEMBLY. — As shown in figure 1-5, the two voltage regulators are mounted, one above the other, in an all-steel cabinet, 21⅝ inches wide, 57-25/32 inches high, and 19-13/16 inches deep. The regulators are fastened to the cabinet by means of 12 screws located along the sides of the front panels of

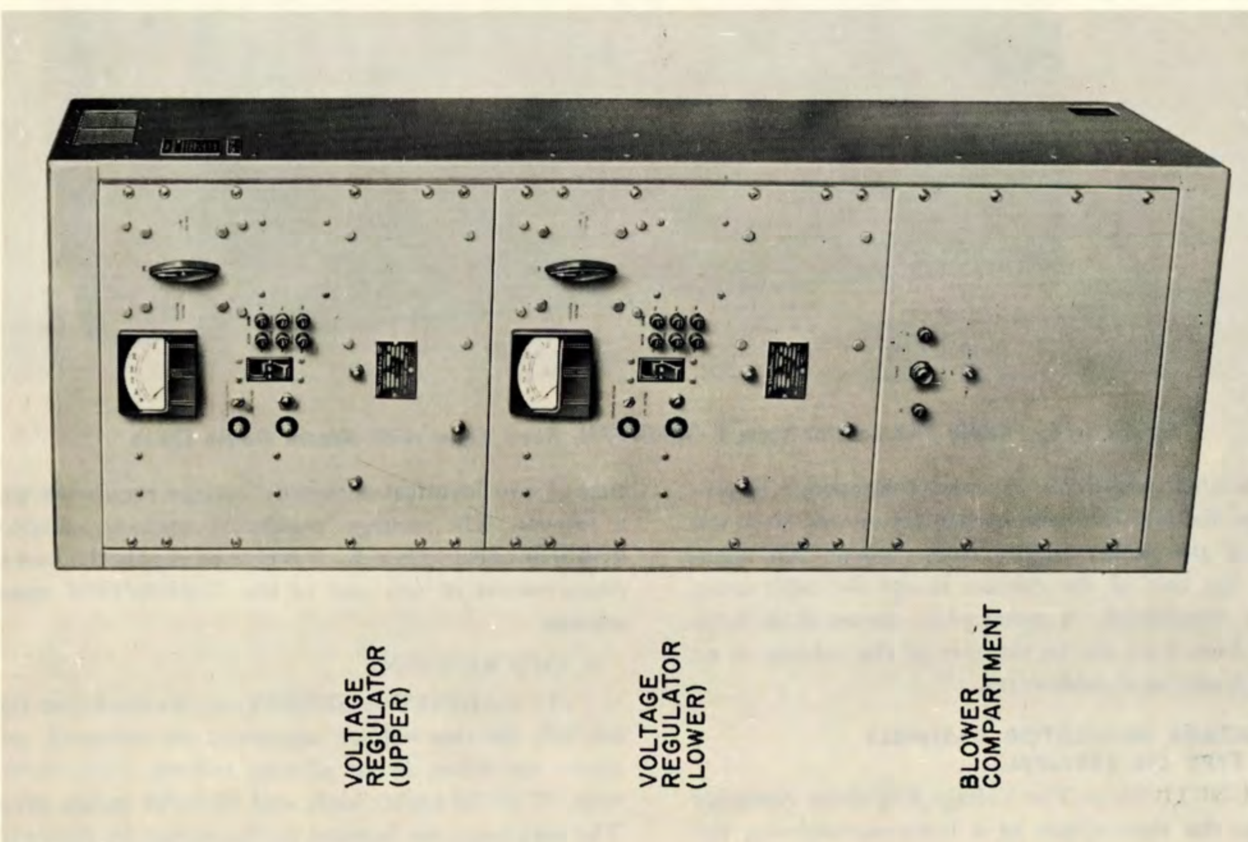


Figure 1–5. Voltage Regulator Assembly Type CN–239/FPN, Front View

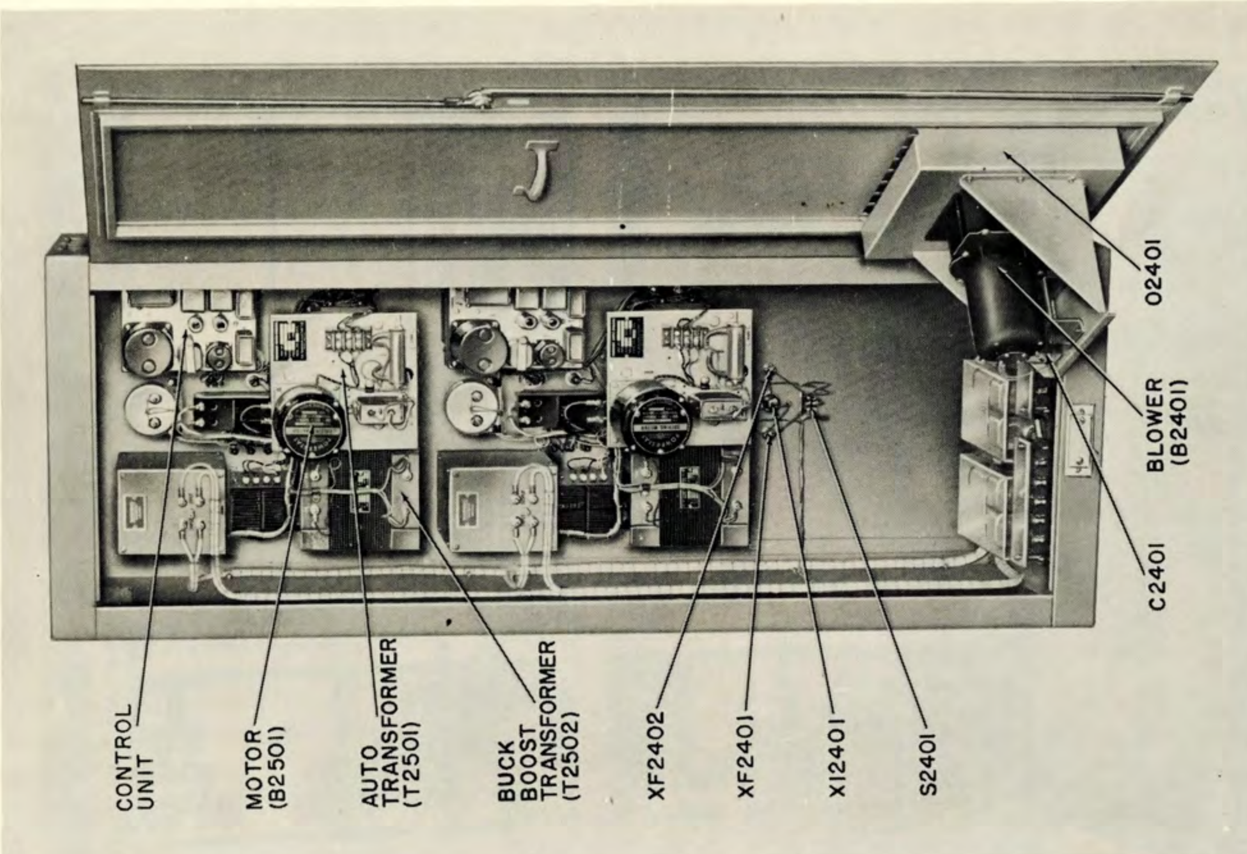


Figure 1–6. Voltage Regulator Assembly Type CN–239/FPN, Rear View with Access Door Open

the regulators. The blower compartment is located at the bottom of the cabinet below the two regulators. Access to the interior of the cabinet can be had by means of a hinged door located in the rear of the cabinet. See figure 1–6. The blower itself is mounted along the bottom of the interior side of the door. Square openings on the door in front of the blower and protected screen openings along the top of both sides of the cabinet provide for ventilation.

Cover plates with conduit knockouts for entry of connecting power cables are provided for at the bottom rear of both sides of the cabinet. In addition an opening in the cabinet floor plate provides an entrance for cables from the floor duct.

(2) VOLTAGE REGULATOR. — The voltage regulator consists principally of two units, the power unit and the control unit. The power unit occupies the greater portion of the regulator and includes a motor-driven variable autotransformer, a two-phase motor, and a buck-boost transformer.

The control unit is mounted on a separate small inclosed aluminum chassis approximately 6¼ inches long, 4¾ inches wide, and 6 inches high. Two screws, one on either side of the chassis, secure the control unit to the voltage regulator. An eight-contact male connector is mounted on the bottom cover of the chassis to provide electrical connection to the rest of the regulator.

5. TERMINAL BOX TYPE J–455A/FPN.*

a. FUNCTION. — The Terminal Box Type J-455A/FPN provides for connecting the output line of either of two transmitters (one operating, one spare) to either of two transmission lines (one operating, one spare) leading to the Antenna Coupling Unit; the unit also provides for connecting a monitor line between the Antenna Coupling Unit and either transmitter.

b. DESCRIPTION. — The terminal box (figure 1–7) is an all-aluminum housing, 20 inches wide, 16 inches high, and 11 inches deep. The side panels of the housing extend slightly beyond the rear of the housing and are bent at right angles to form a one-inch mounting surface. Access to the interior of the unit may be had by rotating the two latches at the top of the front panel and opening the hinged door. Opening the door causes operation of two electrical interlocks, each one of which is wired into the control circuits of a separate transmitter. The front panel may be completely removed by unfastening the four binding head screws at the bottom and lower sides of the panel and unlatching the top fasteners. The entire bottom plate of the unit is also removable.

*A similar unit, furnished on previous contracts, was designated Transmission Line Junction Unit.

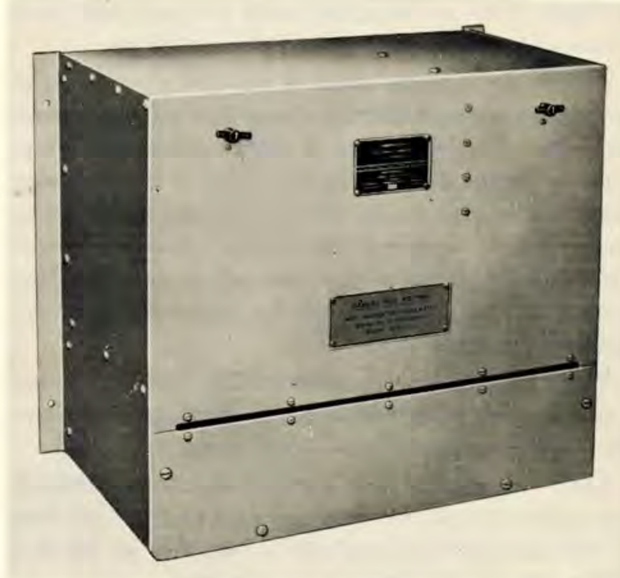


Figure 1–7. Terminal Box Type J–455A/FPN

Knockouts in the bottom of the housing allow entry of the cables from the transmitters and the Antenna Coupling Unit. The insulated terminal bushings to which the cables connect within the housing are provided with fuse clip type ferrules and removable links to facilitate changing of connections. Two sets of bushings are provided to accommodate either RG-147/U* or RG-148/U** type transmission lines.

6. ANTENNA COUPLING UNIT.†

a. FUNCTION. — The Antenna Coupling Unit matches the system antenna to the transmission line which comes from the transmitter via the terminal box. In addition to the components necessary for this purpose, the coupling unit contains a 50-ohm resistive dummy load for tuning and testing purposes, and a capacitive pick-up for a monitor line returning to the transmitter.

b. DESCRIPTION. -- As shown in figure 1–8, the Antenna Coupling Unit is housed in a weatherproofed aluminum inclosure 57 inches high by 74⅜ inches wide by 69¾ inches deep, exclusive of projecting insulator, conduit boxes, and ventilating hoods. The roof is slanted to shed water, and a removable sun shield is attached for tropical use. An aluminum mounting base and four supporting legs (not shown

*Previously designated RG–19/U with special Coast Guard armor.

**Previously designated RG–8/U with special Coast Guard armor.

†Not supplied with this equipment. The description given here covers one type of coupling unit used. Other types are used which vary somewhat from this description. See this Section, paragraph 1.

in figure 1–8) are supplied with the unit and must be assembled to it at the time of installation.

Hinged doors at the front of the unit give access to the tuning controls, tuning chart, line current meter, and antenna current meter. A rubber gasket and wing-nuts are provided on the doors to insure weatherproof closure. Windows in the doors allow the meters to be read without opening the doors. Similar hinged weatherproof doors at the rear allow access to the interior of the coupling unit for maintenance or adjustment purposes.

Ventilation, to reduce condensation within the unit, is provided by protected screened openings in the two side panels and in the rear panel above the doors.

Cable entries for the transmission lines, monitor line, and 115-volt a-c line are provided in the base of the unit. A bowl insulator is installed on the side of the unit for the antenna connection.

A 115-volt convenience outlet is mounted in a weatherproof conduit box on the left side of the unit to the rear. Control of the 115-volt line to this outlet and to illuminating lamps within the inclosure is provided by a switch mounted in a similar conduit box on the left side at the front.

7. MODIFICATION OF LORAN SWITCHING EQUIPMENT NAVY MODEL UM.*

a. PURPOSE. — Loran Switching Equipment Navy Model UM provides among other things for switching the pulse outputs of any one of four timers to any one of four exciter units (two per transmitter). The switching equipments to be used with Radio Transmitter Type T–325B/FPN have been modified to provide this same switching function for the 100-kc output of the timers.

Only modification details are discussed in this instruction book; for complete details on the switching equipment, refer to the instruction book supplied with that equipment.

b. MODIFICATION DETAILS. — All modifications to the switching equipment are associated with the Excitation Switching Unit of that equipment. Figures 1–9 to 1–11 show the extent of these modifications.

An additional mounting plate for four coaxial jacks has been bolted to a mounting bracket which already exists in the top rear portion of the cabinet. (See figure 1–9.) The four jacks (J3722 to J3725 inclusive) accept incoming 100-kc signals from four timer units.

In the entrance box at the side of the switching equipment, two existing spare jacks (J3608 and J3611) have been utilized and two jacks (J3621 and J3622) have been added, for outgoing 100-kc signals to the exciter units of two transmitters. (Refer to figure 1–9.)

Modifications to the Excitation Switching Unit (figures 1–10 and 1–11) include the addition of eight coaxial jacks and four rotary switches (S3001B, S3002B, S3003B, and S3004B); the removal of the shafts and detents on four existing switches (S3001, S3002, S3003, and S3004); and the ganging of the new switches with

*Not supplied under this contract.

Figure 1–8. Antenna Coupling Unit (Not Supplied)

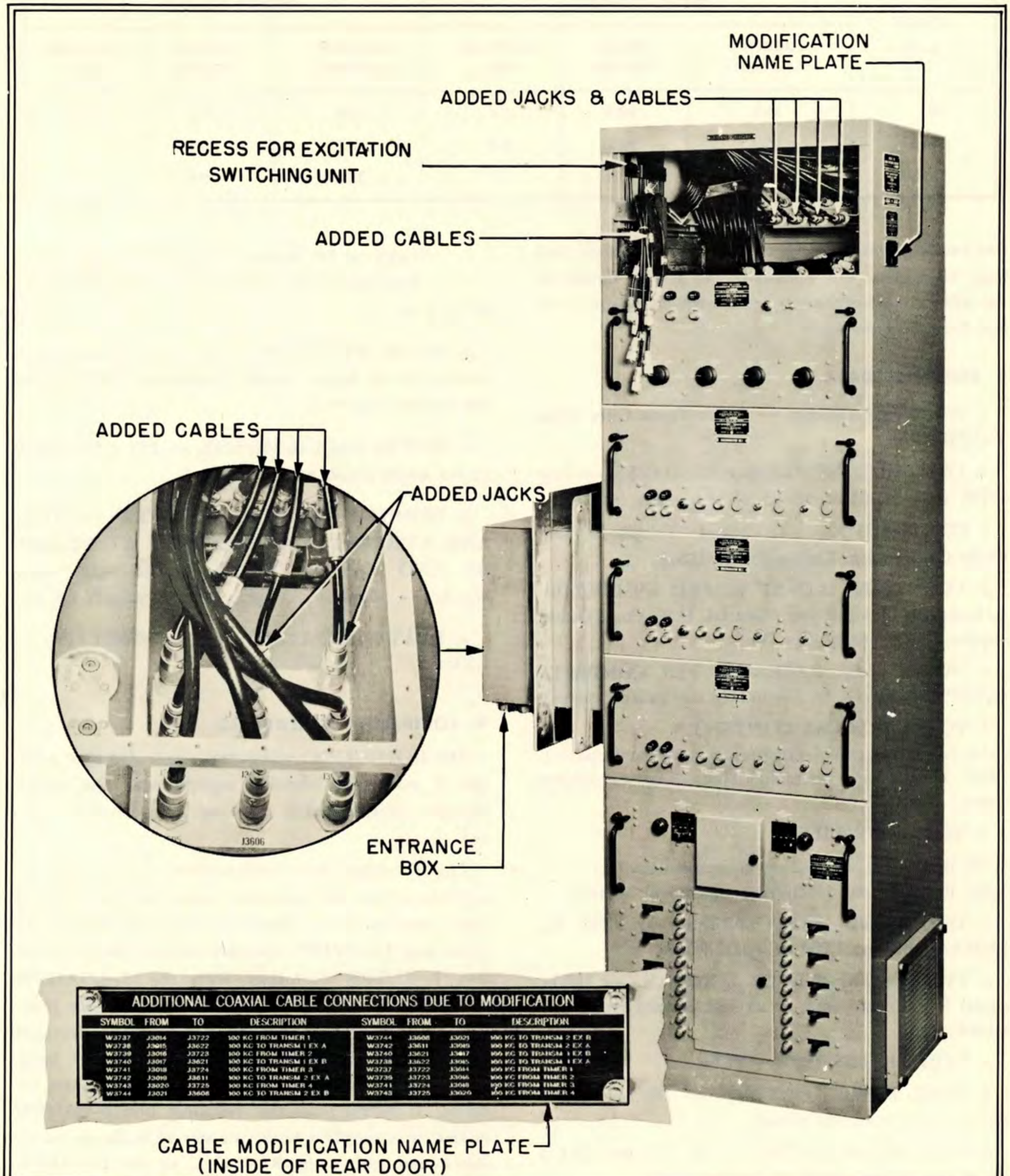


Figure 1—9. Modifications to Cabinet and Entrance Box of Loran Switching Equipment, Navy Model UM

PULSE RATE	SINGLE-PULSED			DOUBLE-PULSED		
	CURRENT (AMPERES)	POWER FACTOR	WATTAGE (KW)	CURRENT (AMPERES)	POWER FACTOR	WATTAGE (KW)
20	15.0	90%	3.2	18.5	90%	3.9
25	16.0	90%	3.4	20.0	90%	4.2
33-1/3	17.5	90%	3.7	23.0	90%	4.8

the existing switches by means of new detent and shaft assemblies. The schematic and wiring details of the additional components are shown on figures 7–42 and 7–52, respectively.

8. REFERENCE DATA.

a. NOMENCLATURE. — Radio Transmitter Type T–325B/FPN.

b. CONTRACT NUMBERS AND DATES. — Tcg-39108 (CG–24,984-A) dated 30 September 1952.

c. CONTRACTOR. — Federal Telephone and Radio Corporation, Clifton, N. J., U.S.A.

d. COGNIZANT COAST GUARD INSPECTOR. — Inspector of Electronic Material, U. S. Coast Guard Supply Center, Jersey City, N. J.

e. NUMBER OF PACKAGES PER COMPLETE EQUIPMENT.* — 18 (including equipment spares).

f. TOTAL CUBICAL CONTENT.*
407.8 cubic feet crated (including equipment spares).
203.6 cubic feet uncrated (including equipment spares).

g. TOTAL WEIGHT.*

7,100 lbs. crated (including equipment spares).
4,307 lbs. uncrated (including equipment spares).

h. OPERATING FREQUENCIES. — 1,750 kc, 1,800 kc, 1,850 kc, 1,900 kc, and 1,950 kc.

i. TYPE OF FREQUENCY CONTROL. — 100-kc signal from loran timer or crystal control from contained circuit.

j. TYPE OF EMISSION. — Pulse.

k. PEAK POWER OUTPUT. — 160 kw single pulsed, 128 kw double pulsed.

l. BASIC PULSE RATES. — 20, 25, and 33-1/3 pulses per second, single or double pulsed.

m. PULSE SHAPE.

Width at 10 percent amplitude: Approximately 65 μs.

Width at 50 percent amplitude: 40μs ± 1 μs.

Rise time from 10 to 90 percent amplitude: 21 μs $\pm$ 1 μs.

n. PULSE SPECTRUM. — Side bands are approximately 60 db below carrier amplitude, 100 kc from the carrier frequency.

o. POWER REQUIREMENTS. — 230 v AC, 50/60 cycles, single phase, 5.5 kva max.

p. NOMINAL WATTAGE, POWER FACTOR, AND CURRENT REQUIREMENTS AT STAND-BY AND VARIOUS PULSE RATES. (*See table above.*) — Stand-by: 12 amp., 90 percent p.f., 2.6 kw.

q. HEAT DISSIPATION OF TRANSMITTER. — 4.5 kw.

9. EQUIPMENT SIMILARITIES.

The T–325B/FPN transmitter is preceded by a number of essentially identical equipments. The design changes incorporated in these units are listed in table 1–3.

The Terminal Box J–455A/FPN is a design improvement over the preceding units, the Transmission Line Junction Unit furnished with the T–137, T–137A, and T–325/FPN transmitters, and the Terminal Box J–455/FPN furnished with the T–325A/FPN transmitter. It differs from the Transmission Line Junction Unit in that it employs clip-mounted electrical connectors which may be easily rearranged and a hinged cover which gives ready access to the cabinet interior. It differs from the Terminal Box J–455/FPN in that it is supplied with two sets of bushings to accommodate either the RG–147/U or the RG–148/U type transmission cables.

This instruction book may be used with any of the transmitters in this series, provided, of course, that the equipment similarities and differences are kept in mind.

*Includes one transmitter per equipment.

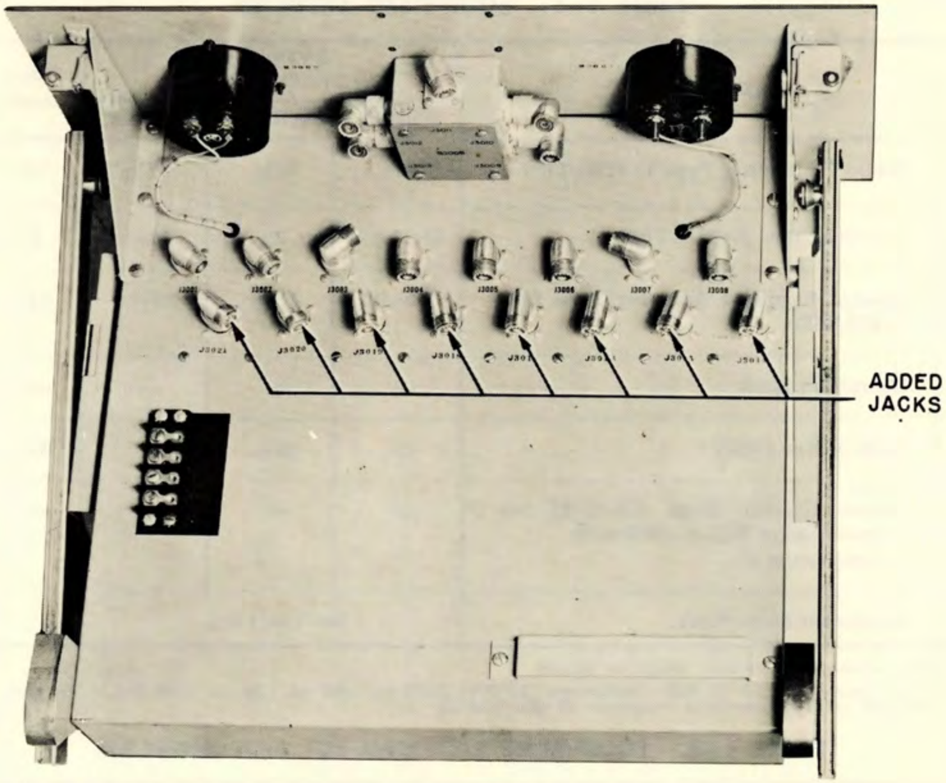


Figure 1—10. Modifications to Excitation Switching Unit, Loran Switching Equipment, Navy Model UM, Top View

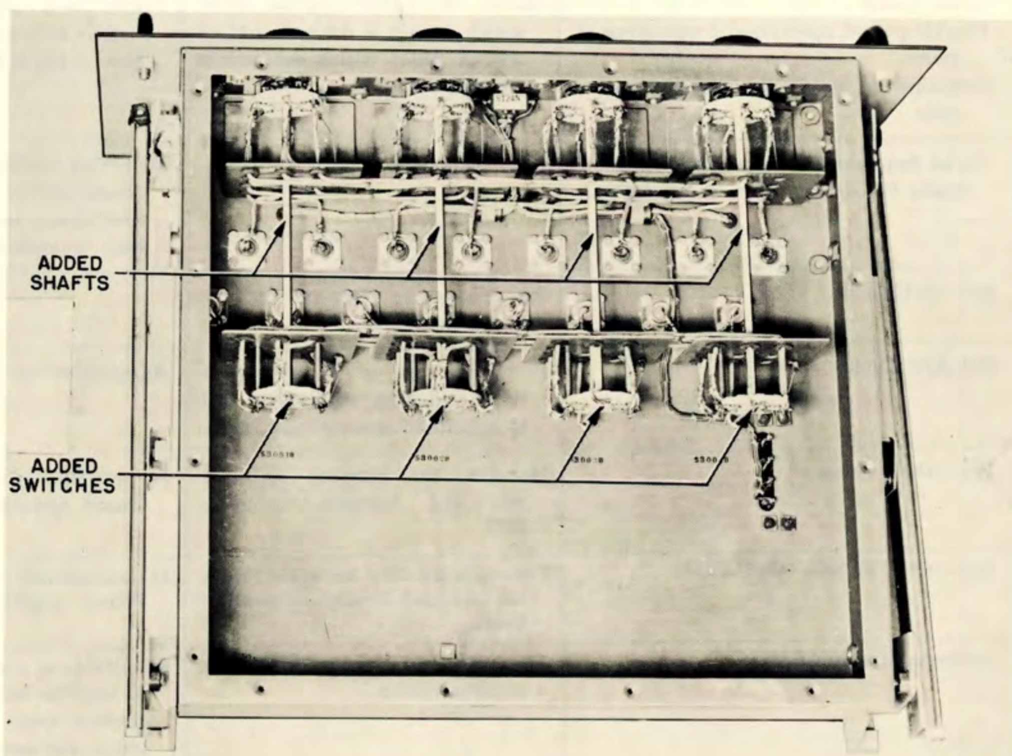


Figure 1—11. Modifications to Excitation Switching Unit, Loran Switching Equipment, Navy Model UM, Bottom View

TABLE 1–1. EQUIPMENT SUPPLIED

QUAN. PER NORMAL STATION	NAME OF UNIT	OVER-ALL DIMENSIONS*			VOL-UME	WEIGHT
		HEIGHT	WIDTH	DEPTH		
2	Radio Transmitter Type T–325B/FPN	80⅛	72¼	37⅞	130	2,950
1	Terminal Box J–455A/FPN	16-11/16	20	11½	2	27
1	Voltage Regulator Assembly Type CN–239/FPN	57-25/32	21⅝	19 13/16	14	350
4	Instruction Book	—	—	—	—	—
2 sets	Tube Spares (300%)	40	38½	23½	24	175
4**	Quartz Crystals Type CR–18/U per Specification MIL–C–3098 with Amendment #1.	—	—	—	—	—
2 sets	Equipment Spare Parts	See Table 8–1				

*Dimensions are in inches, volume in cubic feet, weight in pounds.

**Crystals are furnished on contract for all (5) loran frequencies (1,750 kc, 1,800 kc, 1,850 kc, 1,900 kc, 1,950 kc). A particular station will normally be provided with crystals for only the operating frequency of that station.

TABLE 1–2. EQUIPMENT REQUIRED BUT NOT SUPPLIED

QUAN. PER NORMAL STATION	NAME OF UNIT	REQUIRED USE	REQUIRED CHARACTERISTICS
4 2	Loran Timer Double-pulsed operation: 2 operating, 2 spares. Single-pulsed operation: 1 operating, 1 spare.	Source of 100-kc signal from which carrier is derived, and of trigger pulse which determines repetition rate.	100-kc and pulse output signals as specified in Section 2, paragraph 2.
1	Loran Switching Equipment for use with Radio Transmitter Type T–325B/FPN.	Input switching.	Switching facilities to allow connection of any one of four timers to any one of four transmitter exciters.
	RG–19/U Cable.	For connecting terminal box to transmitter.	
	RG–8/U Cable.	Interconnection of transmitter with switching equipment and switching equipment with timer.	As specified in JAN-C-17A.
	RG–148/U Cable.	Monitor line between terminal box and Antenna Coupling Unit.	In accordance with Coast Guard specifications.
	RG–147/U or RG–148/U Cable.	Transmission line between terminal box and Antenna Coupling Unit.	In accordance with Coast Guard specifications.
1	Antenna Coupling Unit	To match transmitter output to antenna system.	Adjustable to provide match to antenna having any resistance from 25 to 150 ohms, any reactance from −300 to +150 ohms, at any frequency from 1,700 to 2,000 kc (inclusive in all cases).

TABLE 1–3. COMPARISON OF LORAN TRANSMITTERS

MODEL	COMPENSATION FOR AMPLITUDE VARIATION WITH DOUBLE PULSE CROSS-OVER	TYPE OF PULSE FORMING CAPACITORS	CARRIER FREQ. SOURCE	REMARKS
Loran Transmitter Model T–137	Not part of original circuit. Modification kit to change modulation pulse generator cathode circuit to provide compensation supplied under contract TCG-38411 (CG-18,669-C).	Series-parallel mica stacks. Modification kit to convert to single paper capacitors supplied under contract TCG-39130 (CG-25,176-A).	Timer 100 kc. Modification kit to permit use of installed crystal supplied under contract TCG-38323 (CG-18,359-C).	R246 and R247 = 4,700 ohms
Loran Transmitter Model T–137A	Compensation incorporated in 2nd I.P.A. screen circuit.	Series-parallel mica stacks. Modification kit to convert to single paper capacitors supplied under contract TCG-39130 (CG-25,176-A).	Timer 100 kc. Modification kit to permit use of installed crystal supplied under contract TCG-38323 (CG-18,359-C).	R246 and R247 = 4,700 ohms for serial nos. 1 to 34 incl; = 2,200 ohms for serial nos. 35 to 54 incl. TY115 added in serial nos. 35 to 54 incl.
Radio Transmitter Type T–325/FPN	Compensation incorporated in 2nd I.P.A. screen circuit.	Series-parallel mica stacks. Modification kit to convert to single paper capacitors supplied under contract TCG-39130 (CG-25,176-A).	Timer 100 kc. Modification kit to permit use of installed crystal supplied under contract TCG-38323 (CG-18,359-C).	Jack J311 added for frequency monitoring. Two hooks added for holding plasticized drawings.
Radio Transmitter Type T-325A/FPN	Compensation incorporated in 2nd I.P.A. screen circuit.	Single paper units replace mica stacks used in previous models.	Either timer 100 kc or contained crystal.	Same features as T–325/FPN plus improved control relays and minor cabinet changes.
Radio Transmitter Type T–325B/FPN	Same features as T–325A/FPN plus the following: (a) Supplied with two sets of terminal bushings to accommodate either RG–8/U, RG–19/U, RG–147/U, or RG–148/U type transmission lines. (b) Supplied with plasticized matte write-in plates above top panel meters. (c) Supplied with feeler gauges for adjusting ball gaps. (d) ~~Contains crystal detector circuit to display detected output of antenna coupling unit as selected by MON CIRCUIT switch~~. AMENDMENT #4 (e) Over-all transmitter height reduced by 4 inches. (f) 715–C type tubes replaced by 4PR60A type tubes.			

TABLE 1–4. SHIPPING DATA

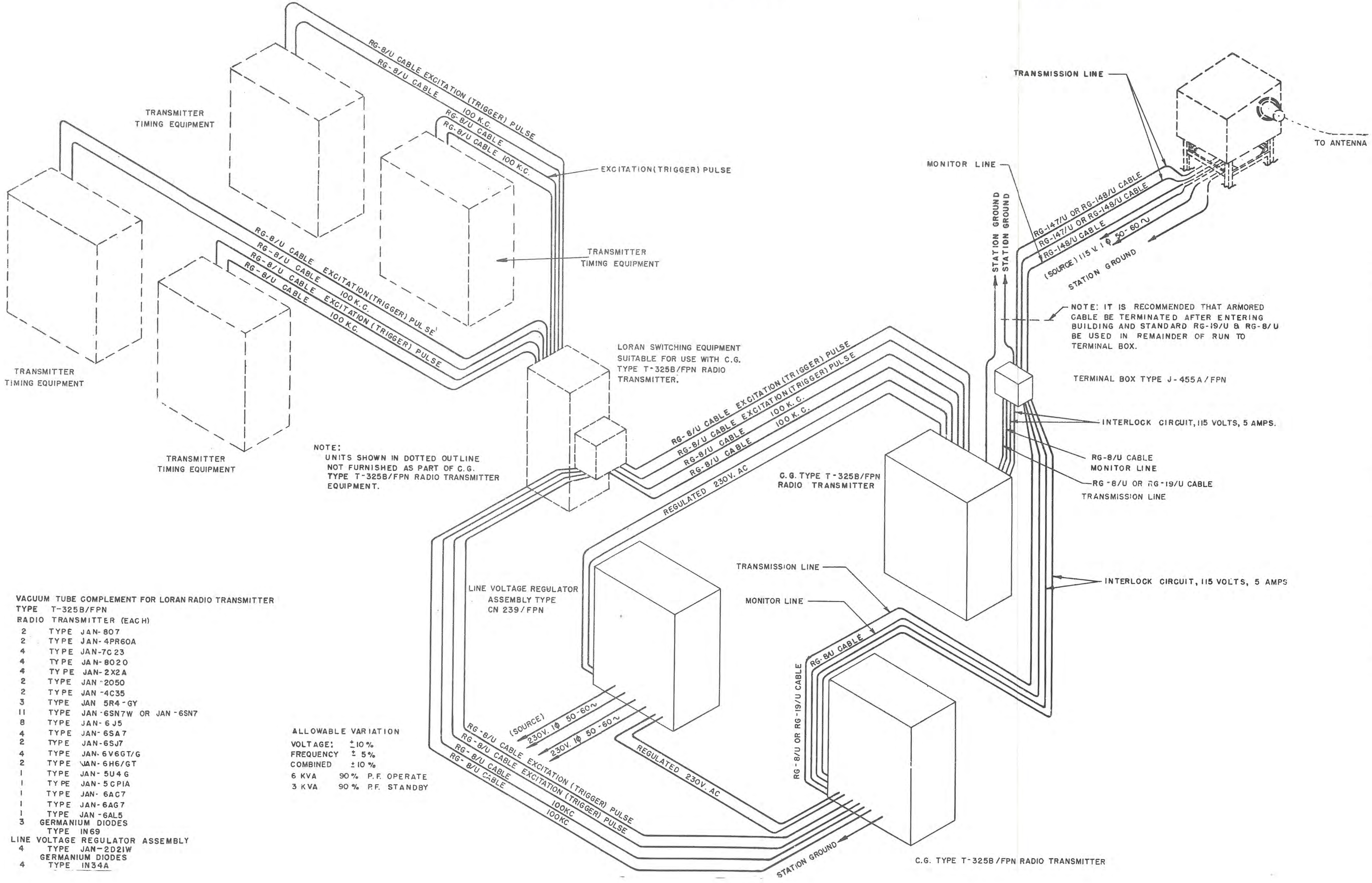
SHIP-PING BOX NO.	CONTENTS	OVER-ALL DIMENSIONS*			VOL-UME	WEIGHT
		HEIGHT	WIDTH	DEPTH		
	1 Radio Transmitter Type T–325B/FPN	99½	92	53½	284	4,100
	1 Set of tubes for Radio Transmitter Type T–325B/FPN (less tubes for Monitor Oscilloscope OS101)	26	37	30	17	161
	1 Radio Transmitter Type T–325B/FPN	99½	92	53½	284	4,100
	1 Set of tubes for Radio Transmitter Type T–325B/FPN (less tubes for Monitor Oscilloscope OS101)	26	37	30	17	161
	1 Voltage Regulator Assembly Type CN–239/FPN	28	67½	30	32	665
	1 Terminal Box Type J–455A/FPN	29⅛	26½	17⅝	7.8	70
	2 Tube Spare Sets (300%)	43	41	26	27	260
	2 Equipment Spare Parts		See table 8–1.			

*Dimensions are in inches, volume in cubic feet, and weight in pounds.

TABLE 1–5. VACUUM TUBE COMPLEMENT*

UNIT	2D21W	2X2A	4C35	4PR60A	5CP1A	5R4GY	5U4G	6AC7	6AG7	6AL5	6H6 (GT)	6J5	6SA7	6SJ7	6SN7GT	6SN7W	6V6GT/G	7C23	807	2050	8020	Total No. Of Tubes
Radio Transmitter Type T–325B/FPN:																						
Pulse Formers			2													2				2		6
Frequency Generators												8	4	2			4					18
1st IPA																			1			1
2nd IPA				2																		2
PA																		4				4
LV-Bias Rect.						1																1
High Bias Rect.		2																				2
High Volt Rect.																					4	4
Oscilloscope		2			1		1	1	1	1	2				9				1			19
Compensator						2																2
Voltage Regulator Assembly CN–239/FPN:																						
Upper Voltage Regulator	2																					2
Lower Voltage Regulator	2																					2
Total Number of Each Type	4	4	2	2	1	3	1	1	1	1	2	8	4	2	9	2	4	4	2	2	4	63

*Tube complement listed is for one transmitter.



VACUUM TUBE COMPLEMENT FOR LORAN RADIO TRANSMITTER
TYPE T-325B/FPN
RADIO TRANSMITTER (EACH)

2	TYPE JAN-807
2	TYPE JAN-4PR60A
4	TYPE JAN-7C23
4	TYPE JAN-8020
4	TYPE JAN-2X2A
2	TYPE JAN-2050
2	TYPE JAN-4C35
3	TYPE JAN 5R4-GY
11	TYPE JAN-6SN7W OR JAN-6SN7
8	TYPE JAN-6J5
4	TYPE JAN-6SA7
2	TYPE JAN-6SJ7
4	TYPE JAN-6V6GT/G
2	TYPE JAN-6H6/GT
1	TYPE JAN-5U4G
1	TYPE JAN-5CPIA
1	TYPE JAN-6AC7
1	TYPE JAN-6AG7
1	TYPE JAN-6AL5
3	GERMANIUM DIODES TYPE IN69

LINE VOLTAGE REGULATOR ASSEMBLY

4	TYPE JAN-2D21W
4	GERMANIUM DIODES TYPE IN34A

ALLOWABLE VARIATION

VOLTAGE:	±10 %	
FREQUENCY	± 5%	
COMBINED	±10 %	
6 KVA	90 %	P.F. OPERATE
3 KVA	90 %	P.F. STANDBY

Figure 1–12. System Diagram, Radio Transmitter Type T–325B/FPN

SECTION 2
THEORY OF OPERATION

1. SYSTEM COMPONENTS.

Figure 2–1 shows the functional relationship of the major components which are necessary to a loran transmitting station utilizing Radio Transmitter Type T–325B/FPN. In a double-pulsed station these components include four timers, one switching equipment, two transmitters, one voltage regulator assembly, one terminal box, and an antenna coupling unit. Two of the timers and one of the transmitters are spare units. In a single-pulsed station the complement includes only two timers (one operating, one spare) in addition to the equipment enumerated above. Each operating timer supplies r-f and pulse excitation for one of the dual exciters of a transmitter.

The transmitter develops a high-power radio-frequency pulse.

The voltage regulator supplies the transmitters with regulated a-c line voltage.

The terminal box connects the operating transmitter to either of two transmission lines which lead to the antenna coupling unit.*

The antenna coupling unit matches the antenna to the transmission line.

2. TIMER OUTPUTS.

Each timer supplies a 100-kc signal for use when the transmitter operates from an external frequency source,** and periodic triggering pulses at any one of the specific pulse rates associated with the basic repetition rates of 20, 25, or 33-1/3 pulses per second. For specific pulse rates, refer to the instruction book for the timing equipment.

The 100-kc signal is used by the frequency generating section of the transmitter exciter to develop a stable carrier at any 50-kc interval between 1,750 and 1,950 kc, inclusive. Radio-frequency stability of the 100-kc signal is better than 3.33 parts in one billion over a 10-minute period of normal timer operation.

The pulse excitation is used as a triggering voltage by the pulse-forming section of the transmitter exciter and as a triggering voltage for the sweep of the monitor oscilloscope. Pulse characteristics are as follows:

1. Polarity — positive.
2. Base width — 7 to 8 microseconds.
3. Rise time — 2 to 3 microseconds.
4. Width at 90 percent amplitude — 1.5 to 4 microseconds.
5. Output levels — 15 to 25 volts and 3 to 5 volts.
6. Output impedance — 50 ohms.
7. Basic rates — 20, 25, 33-1/3 pulses per second.

*Not supplied. See Section 1, paragraph 1.

**The transmitter may operate independently of this 100-kc source through use of a contained crystal.

3. TIMER MODIFIED CONNECTIONS (NAVY MODEL UE-1 TIMER).

After modification of the timer connections with the kit supplied,* the r-f output is fed from the plate of V1504 in the synchronization control unit via the newly installed series capacitor C2106 and resistor R2112 to the output connectors J2104/P2104. From this point it is fed via cable W2103 to the newly designated output connector J2600, which is used to connect into the switching equipment. Capacitor C2106, resistor R2112, cable W2103, and the connectors P2104/J2104 are all part of the modification kit supplied. Connector J2600 was formerly a spare.

4. FUNCTION OF MODIFIED SWITCHING EQUIPMENT (LORAN SWITCHING EQUIPMENT NAVY MODEL UM).

a. GENERAL. — Loran Switching Equipment Navy Model UM** is modified for use with Radio Transmitter Type T–325B/FPN to provide switching facilities for the 100-kc outputs of four loran timers. The additional switching facilities are mechanically ganged to the pulse-switching facilities which already exist in the standard equipment. The modified switching equipment provides for feeding both the pulse and the 100-kc signals from one or two of four timers to one of two transmitters. In making use of the standard instruction book for the switching equipment, it should be noted that the equipment over-all schematic diagram and the schematic diagram for the Excitation Switching Unit (figures 5–57 and 5–62 in that book) do not contain the modification information. Refer to figures 7–42 and 7–52 of this instruction book for the modification information.

b. SWITCHING CIRCUIT DETAILS. — As shown in figure 7–42, the 100-kc outputs of four timers are wired to contacts on each of the added switches (S3001B, S3002B, S3003B, and S3004B) in the Loran Switching Equipment. Switch S3001B may select the

*Supplied under previous contracts.

**Modified under previous contracts.

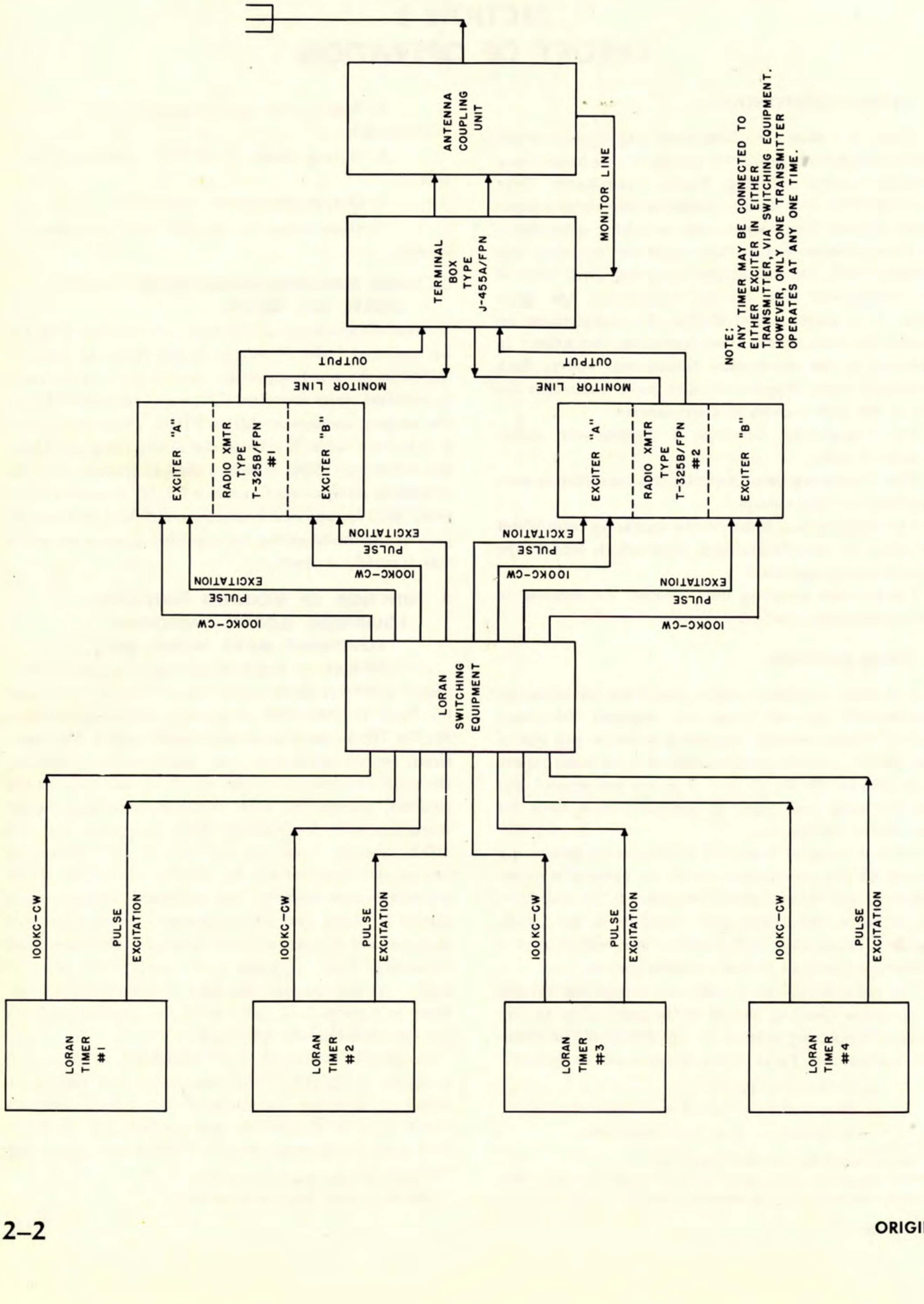


Figure 2–1. Block Diagram of Loran Transmitting System

output of any timer and feed it to Exciter A of transmitter #1. (Designations of timers and transmitters are arbitrary.) Since S3001B has been ganged with S3001 which switches the pulse excitation output of the timers (refer to the instruction book for Loran Switching Equipment Navy Model UM) the 100-kc and pulse outputs of a timer are simultaneously connected to Exciter A of transmitter #1. Similarly, switches S3002B, S3003B, and S3004B, respectively, may connect the outputs of any timer to Exciter B of transmitter #1, Exciter A of transmitter #2, and Exciter B of transmitter #2.

5. BLOCK DIAGRAM OF RADIO TRANSMITTER TYPE T–325B/FPN.

As shown in the block diagram (figure 2–2), Radio Transmitter Type T–325B/FPN consists of a dual exciter, two IPA stages, one PA stage, a monitor oscilloscope, and three power supplies. Since the two exciters are identical, only one will be discussed in succeeding paragraphs. It is sufficient to realize that one exciter will be employed for single-pulsed operation of the transmitter and both exciters will be used for double-pulsed operation. (Refer to paragraph 9*b* for the timing considerations important to double-pulsed operation.)

Two inputs are supplied from a loran timer to an exciter section via the switching equipment; a triggering pulse is supplied to the pulse former at one of the specific pulse rates of the timing equipment, and a continuous-wave 100-kc signal is supplied to the frequency generator. The pulse former develops a rectangular pulse used to key the output stage of the frequency generator, and a specially shaped pulse used to modulate the PA stage of the transmitter. The frequency generator multiplies the 100-kc signal and, when keyed by the rectangular pulse output of the pulse former, supplies excitation to the 1st IPA stage at one of the five operating frequencies of the transmitter: 1,750 kc, 1,800 kc, 1,850 kc, 1,900 kc or 1,950 kc.

The two IPA stages amplify the output of the frequency generator and supply excitation to the PA stage. The specially shaped modulating pulse from the pulse former and r-f excitation from the 2nd IPA are supplied simultaneously to the input of the PA, resulting in a high-powered r-f pulse in the output circuit. The envelope of the output pulse has essentially the same shape as the modulating pulse. This shape is used because it results in a practical minimum for the width of spectrum occupied by a transmitted r-f pulse having a rise time on the order of 21 microseconds. The output is fed via coaxial cable to the terminal box.

The monitor oscilloscope indicated in figure 2–2 provides a means of monitoring the pulse shape at significant points in the transmitter. Paragraph 10 discusses the switching facilities provided for the monitor oscilloscope.

The three power supplies (figure 2–2) supply all the operating voltages necessary for the transmitter. These supplies are discussed in paragraph 11.

6. PULSE FORMER.

a. FUNCTION. — As indicated in paragraph 5, the function of the pulse-forming section of the exciter is to develop a rectangular pulse for keying the output stage of the frequency generator, and a specially shaped pulse for modulating the PA stage of the transmitter.

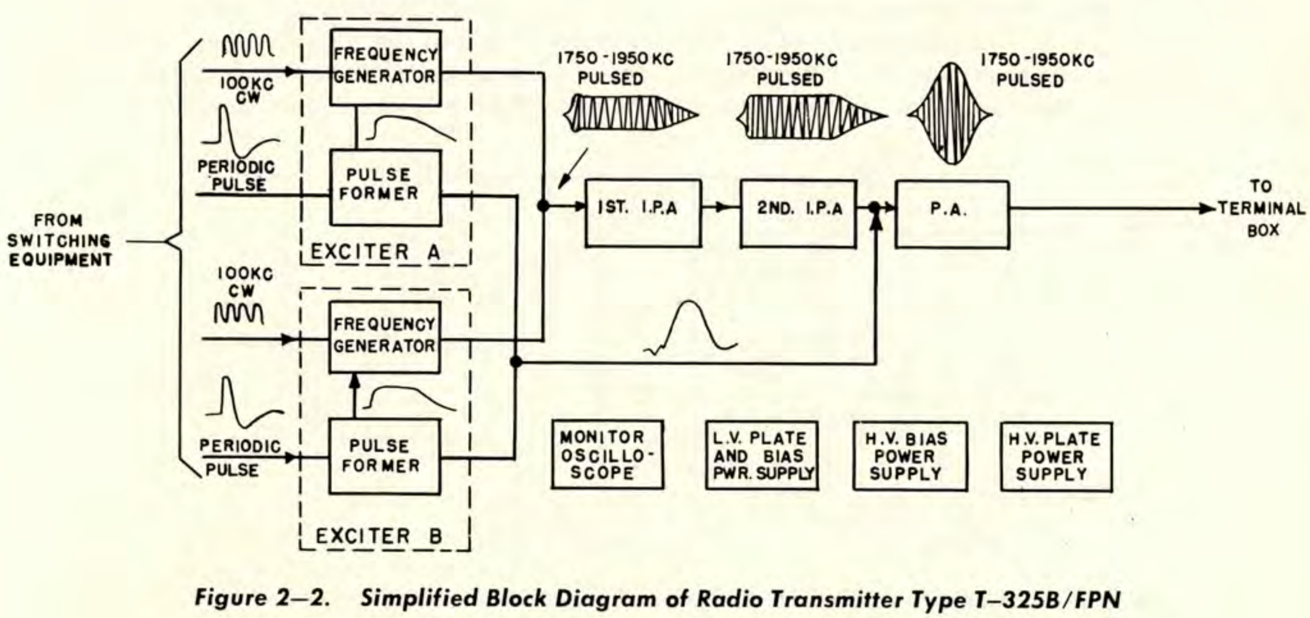


Figure 2–2. Simplified Block Diagram of Radio Transmitter Type T–325B/FPN

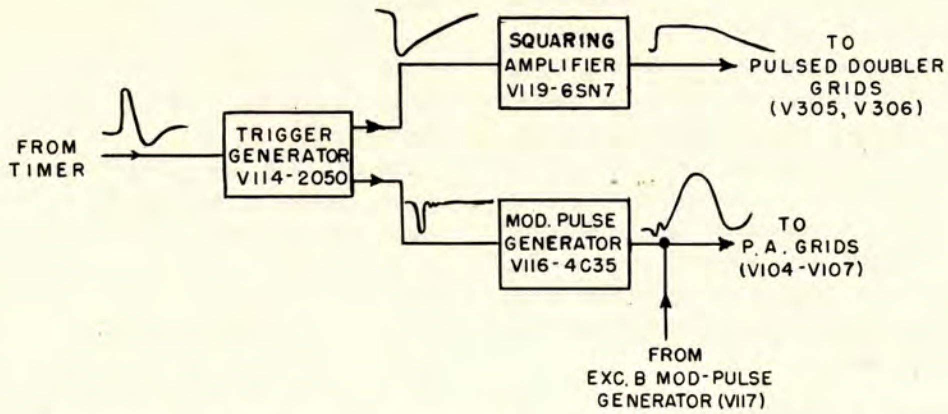


Figure 2–3. Block Diagram of Pulse-Forming Circuits (Part of Exciter A)

b. TRIGGER PULSE. — An oscillogram of the triggering pulse supplied to the pulse former from the external timing equipment is shown in figure 7–1; a facsimile of this waveform is shown on the block diagram of figure 2–3. The characteristics of this pulse as controlled by the timing equipment are tabulated in paragraph 2 of this section and, in greater detail, in the timer instruction book.

c. BLOCK DIAGRAM. — Figure 2–3 shows the three stages of the pulse-forming section. The symbol designations used pertain to Exciter A. For the equivalent designations in Exciter B, refer to the transmitter schematic, figure 7–38.

The trigger generator develops two separate pulse outputs when triggered by the pulse from the timer. One of these outputs is applied to the squaring amplifier which develops a rectangular-shaped keying pulse for the doubler output stage of the frequency generator. (See paragraph 7*g*.) The other output is used to trigger the modulator which develops the specially shaped modulating pulse. The modulating pulse is applied to the grids of the power amplifier tubes. (See paragraph 8*d*.) Note that the output circuit of the modulation pulse generator is common to both exciters.

d. TRIGGER GENERATOR STAGE. — The trigger generator stage (figure 2–4) utilizes a type 2050 thyratron tube, V114. Plate voltage (300 volts) is supplied by the low voltage and bias rectifier, V118. (See paragraph 11*a* and figure 7–38.) When a trigger pulse is not present on the grid of this stage, the thyratron is maintained in a nonconducting state by approximately five volts of fixed bias. This bias is developed across resistor R205 in a voltage divider circuit between ground and the 300-volt plate potential. During the time the tube is not conducting, capacitors C180 and C182 charge to the plate voltage of the tube, approximately 300 volts.

Input pulses to the trigger generator are supplied periodically by the positive pulse output of a loran timer. This trigger pulse may be viewed on the transmitter monitor oscilloscope as explained in paragraph 10. The amplitude of the trigger pulse is sufficient to overcome the bias on the thyratron, causing it to conduct. Capacitors C180 and C182 discharge rapidly through their respective circuits until the current

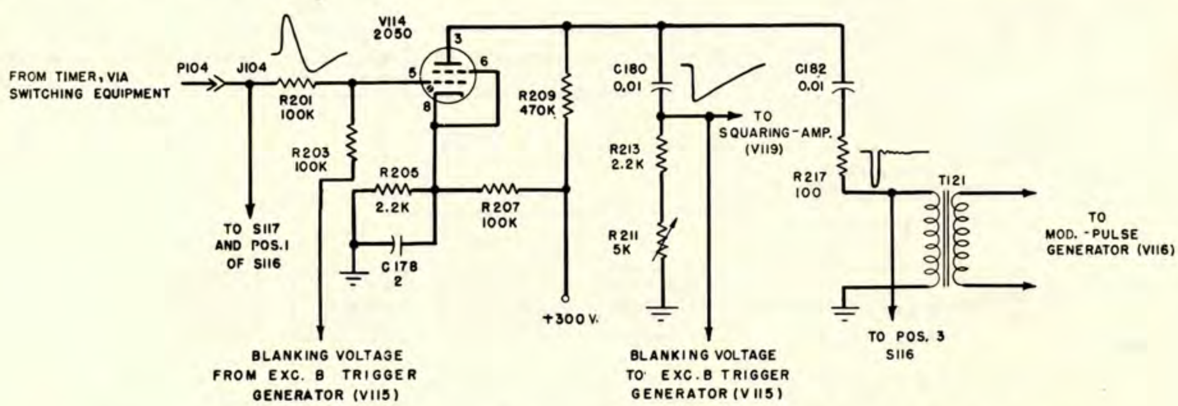


Figure 2–4. Simplified Schematic Diagram of Trigger Generator (Part of Exciter A)

through the tube becomes so low that the tube deionizes and ceases to conduct. The tube remains extinguished until the next input pulse starts the discharge cycle over again. Between pulses from the timer, the capacitors charge once again to the plate voltage of V114.

Capacitor C180 discharges through resistor R213, potentiometer R211, resistor R205, and the tube V114, and the resulting steep rise-exponential decay pulse developed across R213 and R211 is applied to the squaring amplifier stage. The duration of the pulse developed across R213 and R211, and hence the length of the pulse out of the squaring amplifier, is determined by the time constant of this R-C circuit. Potentiometer R211 adjusts the time constant and the width of the pulse from the squaring amplifier. An oscillogram of the waveform present at the junction of C180 and R213 is shown in figure 7–13; the facsimile shown on figure 2–4 reveals the sharp leading edge and long exponential decay of the pulse. Peak amplitude of the pulse is approximately 300 volts.

Capacitor C182 discharges through resistor R217, the primary of transformer T121, resistor R205, and tube V114. The resulting steep rise-exponential decay pulse developed across the primary of T121 is coupled to the grid of the modulator. A shorter time constant (C182 and R217) is used in this circuit, since the modulator requires a short-duration trigger. An oscillogram of the voltage present across the primary of T121 is shown in figure 7–2; this waveform may be viewed on the monitor oscilloscope as explained in paragraph 10. The schematic diagram (figure 2–4) shows a facsimile of this waveform.

In double-pulsed operation, both exciters function and each supplies drive to the r-f amplifiers at its individual repetition rate. In normal operation, the rates of the two exciters are different, hence "cross-over" of the two rates, or overlap between pulses of the two rates, will exist at regular time intervals (see the loran timer instruction book). These intervals are determined by the basic and specific pulse repetition rates. In order to prevent high-amplitude transients from occurring in the transmitter at the time of the cross-over, a blanking arrangement has been incorporated between the two trigger generators. This circuit eliminates the transient by preventing one of the exciters from generating a pulse at any time wherein the two trigger pulses occur within a 25-microsecond interval.

As shown in figure 2–4, the negative pulse output of V114 is applied to the grid of V115; likewise, the negative pulse output of V115 is applied to V114. If it is assumed that V114 has been triggered by its associated timer, a negative pulse will be transmitted to the grid of V115. This pulse is of sufficient magnitude, for approximately 25 microseconds, to prevent any trigger pulse from affecting the thyratron. Similarly, if V115 were fired first by its timer, V114 could not respond to an incoming trigger for 25 microseconds.

e. SQUARING AMPLIFIER. — The squaring amplifier (or limiter-amplifier) section of the pulse former (figure 2–5) utilizes a 6SN7W twin triode (V119) in a two-stage pulse-shaping circuit. Plate voltage for the tube (+300 volts) is supplied by the low voltage and bias rectifier, V118 (refer to figure 7–38 and paragraph 11*a*). Signal input is supplied by the wider of the two pulse outputs from the trigger generator (paragraph 6*d*).

The first section (V119A) of the twin triode functions as a grid limiter to square off the pulse from the trigger generator. During static conditions (no signal input) tube conduction is limited to a very low value by the large biasing resistor (R183) used

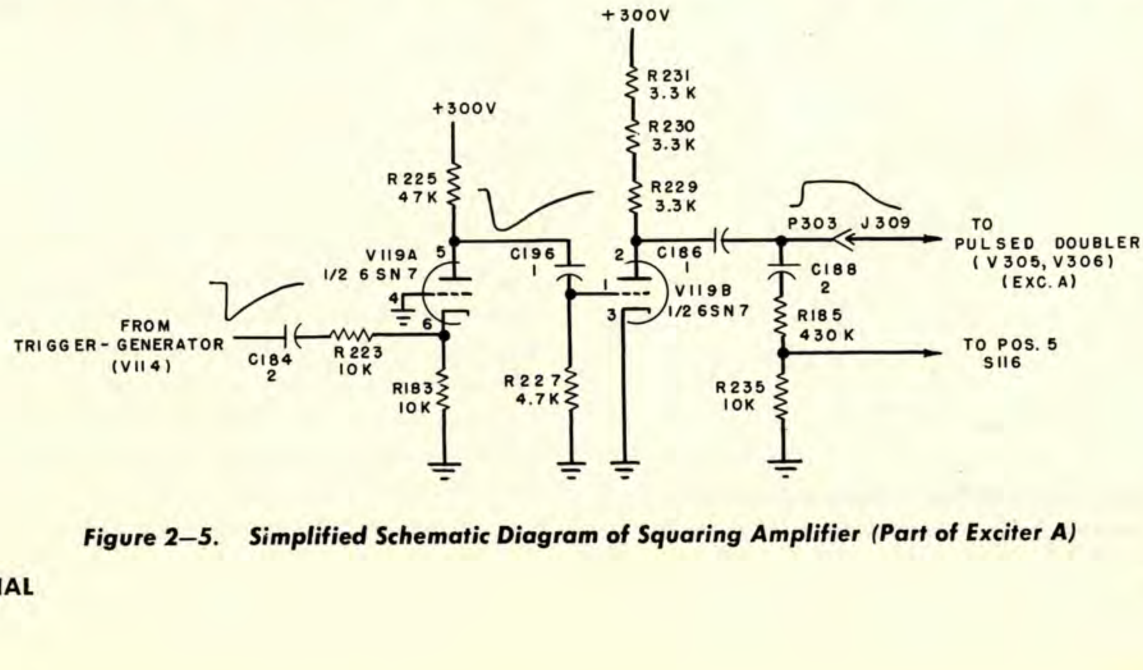


Figure 2–5. Simplified Schematic Diagram of Squaring Amplifier (Part of Exciter A)

in the cathode circuit. To avoid polarity inversion through the tube, the negative pulse input from the trigger generator is applied to the cathode instead of the grid. Resistor R223 is included in the input circuit to reduce the amplitude of the input signal. This signal overcomes the bias and, having the same effect as a highly positive signal on the grid, causes the grid to draw current. The grid current causes limiting and flattens off the bottom of the waveform appearing at the plate as illustrated in the facsimile on figure 2–5. Capacitor C196 couples this signal to the grid of V119B.

The second section (V119B) of the twin triode operates with zero bias and, during the static condition, conducts heavily. The negative pulse from V119A drives the tube sharply to cutoff, causing the plate voltage to rise rapidly to its full value of 300 volts. The tube then limits, flattening off the waveform for a still larger portion of the total pulse. An oscillogram of the waveform appearing at the plate of V119B as viewed on the monitor oscilloscope (paragraph 10) is shown in figure 7–3 and a facsimile is shown on the schematic diagram, figure 2–5. The full output voltage is applied through capacitor C186, coaxial cable, and jack J309 to the grids of the pulsed doubler in the frequency generator section of Exciter A. (A similar rectangular wave may be developed in the pulse former of Exciter B to key the pulsed-doubler of Exciter B. See figure 7–38.) A portion of the rectangular output is tapped off a voltage divider (C188, R185, and R235) for monitoring purposes. Refer to paragraph 10 for monitoring details.

f. MODULATION-PULSE GENERATOR.

(1) FUNCTION. — One of the requirements of the pulsed r-f output from the transmitter is that side-band energy be kept to a minimum, consistent with the desired pulse-rise time of 21 ±1 microseconds. (Refer to the "pulse spectrum" characteristic in Section 1, paragraph 8.) It is the function of the modulation-pulse generator to generate a wave which, when used to modulate the transmitted pulse, will produce an output with these required side-band characteristics. Typical side-band distribution is shown in figure 2–7. The pulse produced by the modulation-pulse generator in accordance with these spectrum requirements approximates the shape of one cycle of a mathematical cosine-square function.

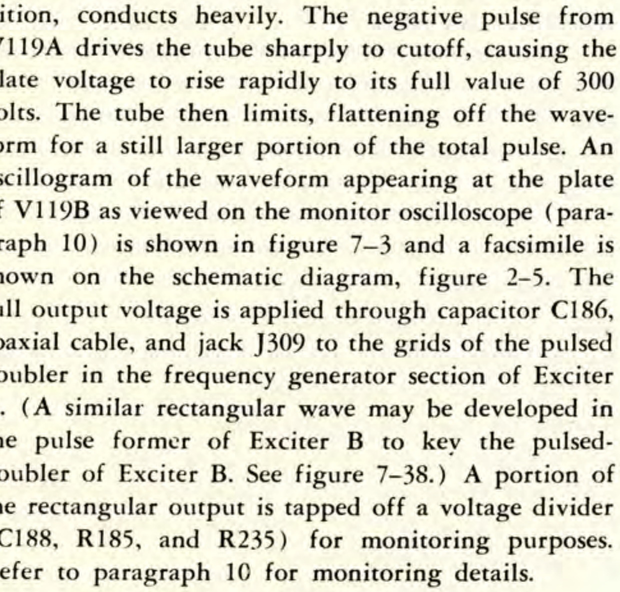


Figure 2–6. Simplified Schematic Diagram of Modulation-Pulse Generator (Part of Exciter A)

(2) CIRCUIT ANALYSIS. — Figure 2–6 is a simplified schematic which shows the essential elements of the modulation pulse generator in Exciter A. For complete circuit details of both Exciter A and Exciter B pulse formers, refer to figure 7–38.

As shown in figure 2–6, the pulse generator utilizes a type 4C35 thyratron (V116) which, with zero bias, 6,000 volts on its plate, and no signal input, is normally extinguished. During the nonconducting period, capacitor C190 charges through current-limiting resistors R219 and R220 to the 6,000-volt plate potential supplied by the high-voltage rectifier (paragraph 11*c*). The combination of capacitor C190 and inductance L120 forms an oscillatory circuit.

Input voltage to the pulse generator, in the primary of transformer T121, is a negative trigger pulse. The transformer is connected to provide polarity inversion of the pulse since a positive trigger is needed at the grid of V116. The amplitude of the triggering pulse at the grid is approximately 100 volts, transformer T121 stepping up (as well as inverting) the narrow pulse output of trigger generator V114. The leading edge of the 100-volt pulse fires the thyratron and thereby controls the starting point of the modulating pulse developed in the thyratron cathode circuit. Since grid voltage has no control over a thyratron, once the tube has fired, the trigger pulse has no further effect on the development of the modulating pulse.

As soon as the thyratron conducts, capacitor C190 begins to discharge through inductance L120, thyratron V116, the parallel combination of L102 and C201, resistors R238 and R239, and capacitor C120 which parallels the other elements in the cathode circuit. The inductance and capacity in the plate circuit cause the discharge current to be oscillatory and essentially sinusoidal. However, the tube ceases to conduct as the current tries to reverse direction after the first half-cycle, thus permitting only one half-cycle to be developed in

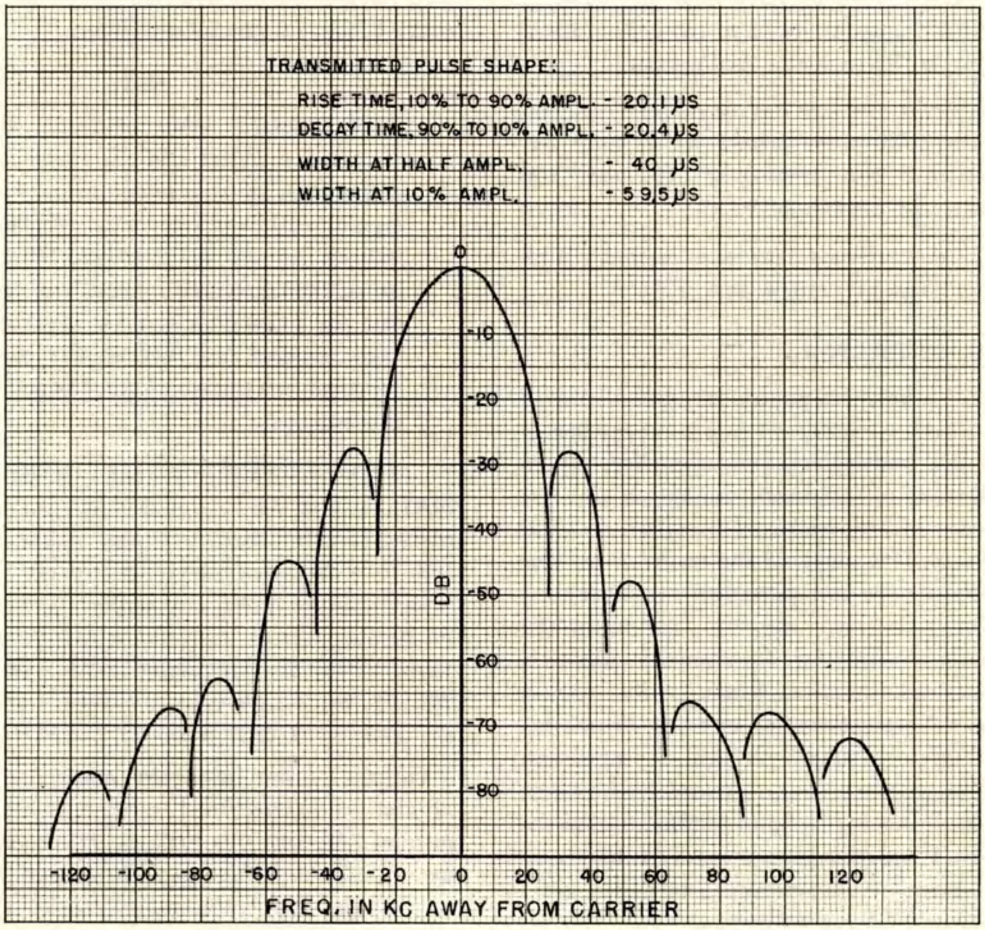


Figure 2–7. Typical Side-Band Distribution, R-f Output, Radio Transmitter Type T–325B/FPN

the cathode circuit. If the cathode circuit were purely resistive, the voltage from cathode to ground would be a single pulse resembling one half-cycle of a sine wave, and the width of the pulse would be determined by the resonant frequency of the L-C combination in the plate circuit. But, because of the capacitive and inductive elements in the cathode circuit, the pulse has a slower rate of rise and decay at the beginning and end than would a half sine-wave, and the pulse more nearly resembles the mathematical "cosine-squared" shape.

An oscillogram of the output waveform is shown in figure 7–7. Adjustments of L120 and L102 to obtain the correct waveform are outlined in Section 3, paragraph 9. Inductance L120 is used to adjust the width of the pulse and inductance L102 is used to adjust the rise time.

Once V116 becomes nonconductive it remains so until another triggering pulse is applied to its grid. The pulse interval is a function of the loran timer and is sufficiently long at any of the standard recurrence rates to allow complete recharging of capacitor C190.

The peak amplitude of the output pulse developed across resistors R238 and R239 is approximately 2,250 volts. This pulse is supplied to the grids of the PA tubes (V104 to V107 inclusive) at the recurrence rate of the loran timing equipment. The low (100-ohm) impedance of R238 and R239 minimizes the loading effect which the PA grid has on the modulation-pulse generator.

The following information, not readily apparent in the simplified schematic, may be discerned by reference to figure 7–38.

(*a*) Resistors R219 and R220 in the plate circuit of V116 are two 25,000-ohm resistors in series.

(*b*) Resistors R238 and R239 in the cathode circuit of V116 are two 200-ohm resistors in parallel. Two resistors are used in this instance and under (*a*) above to provide adequate power dissipation.

(*c*) A voltage divider (R240 through R244) is connected across the output circuit to provide a monitoring indication to the monitor oscilloscope.

(*d*) The entire cathode circuit of V116 is common to the modulation-pulse generators of both Exciter A and Exciter B, the junction of L102 and C120 being connected to the cathode of V117.

(*e*) T121 is protected against excessively high transients by the three-ball spark gap, TY112.

7. FREQUENCY GENERATOR.

a. GENERAL. — Each frequency generator (one in Exciter A, the other in Exciter B) is a combination of frequency dividers, multipliers, and amplifiers which is capable of developing sufficient voltage at any one of five frequencies (1,750, 1,800, 1,850, 1,900, or 1,950 kc) to drive the 1st IPA stage of the transmitter. The frequency generators are self-contained on individual chassis, are similar in every respect (including the symbol designations used for functionally identical components), and are interchangeable. In this respect they are unlike the pulse-forming sections which, because of their "mirror image" physical arrangement, use different designations for functionally identical components. The following subparagraphs discuss the r-f circuits of the frequency generators. For details on the power requirements and metering facilities, refer to paragraphs 11 and 12, respectively.

b. BLOCK DIAGRAM. — The frequency generator, figure 2–8, develops the output signal by one of two methods. The first method is to use the 100-kc signal from a loran timer to develop a signal at one of the five transmitter operating frequencies. The second method uses limiter-amplifier or crystal-oscillator stage V304 as a crystal oscillator.

Note

With external 100-kc operation the phase of the carrier signal and the pulse envelope are controlled by the same source and the two signals will bear a constant relationship when viewed on an oscilloscope. With operation using the contained crystal, the carrier signal and the pulse envelope are controlled by separate sources and may appear to move (one with respect to the other) when viewed on an oscilloscope.

(1) OPERATION WITH 100-KC TIMER SIGNAL. — The 100-kc signal is fed to a frequency-multiplying circuit utilizing tripler stages V301 and V302, and to a frequency-dividing circuit utilizing divider V307, doubler V308, and tripler V309. The frequency-multiplier section supplies a 900-kc signal to mixer stage V303; the frequency-divider section supplies a 25-, 50-, or 75-kc signal to mixer V303, depending on the position of FREQUENCY SELECTOR switch S301.

Output of the frequency multiplier and frequency divider are heterodyned in mixer V303 to produce outputs of 875, 900, 925, 950, or 975 kc as determined by the position of S301. Amplification of the mixer output is provided by V304 which feeds a pulsed-doubler stage, V305 and V306. The latter stage is normally cut off and conducts periodically when keyed by the rectangular pulse output of the pulse former. Output from the pulsed doubler, at one of the five operating frequencies of the transmitter, is supplied to the grid of the 1st IPA stage, V101.

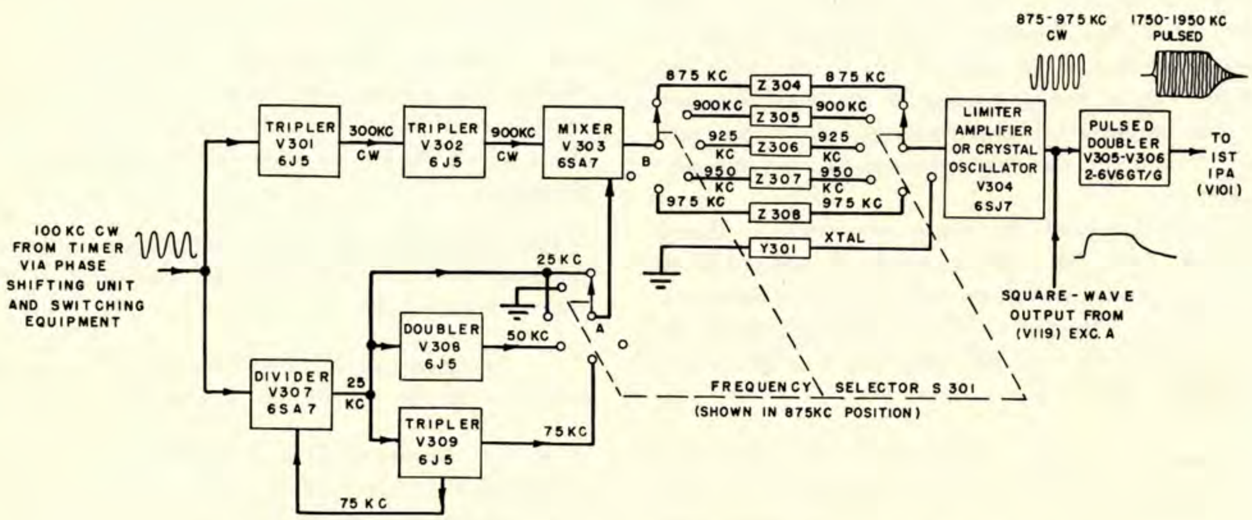


Figure 2–8. Block Diagram of Frequency Generator (Part of Exciter A)

(2) OPERATION WITH CONTAINED CRYSTAL. — When operating with the contained crystal the stages preceding V304 are disabled by removal of plate voltage. The current drawn by these stages is applied to a bleeder resistor, when crystal operation is used, and voltage distribution to the other stages thus does not change. Limiter-amplifier stage V304 is connected as a crystal oscillator and becomes the source of carrier frequency. Because V304 precedes the pulsed doubler the operating frequency of the crystal stage is one half the transmitter output frequency.

c. INPUT CIRCUIT. — The circuit detail of the frequency generator is shown on figure 7–39. For details on the input connections to J308, refer to the transmitter schematic, figure 7–38.

The 100-kc signal supplied to J308 is coupled through transformer assembly Z301 to the tripler stage (V301) of the frequency-multiplying section, and to the mixer stage (V303) of the frequency-dividing section. Z301 is slug-tuned to 100 kc.

Note

Complete tuning adjustments for Z301 and the other adjustable components of the frequency generator are outlined in Section 7, paragraph 8.

d. TRIPLER STAGES V301 AND V302. — Two type 6J5 tubes (V301 and V302) are used in conventional tripler circuits to convert the 100-kc input signal to a 900-kc signal. Heavy cathode bias is supplemented by grid-leak bias to cause a distorted plate current containing the desired (third) harmonic. Slug-tuned interstage transformers are tuned to the desired harmonic and couple it to the following stage. The 900-kc output of the second tripler is fed to the control grid of mixer V303.

A lead is brought out from a meter shunt in the cathode circuit of each stage to the terminal board at the top of the chassis. From the terminal board these leads connect to meter M112 in the transmitter proper to provide an indication of the cathode current of each tube. The second tripler is also provided with a metering jack (J301) in the grid circuit to allow monitoring of grid current.

Note

The cathode circuits of all stages in the frequency generator are tapped for metering purposes, and the grid circuits of all stages save the first tripler (V301) and the pulsed doubler (V305-V306) are equipped with metering jacks. The use of these metering facilities is described in detail in paragraph 12 of this section. Typical meter indications are listed in table 5–1.

e. FREQUENCY DIVIDER. — The frequency-divider section utilizes three stages to develop 25-, 50-, and 75-kc signals to heterodyne with the 900-kc signal in mixer stage V303. The 100-kc signal from the loran timer is applied to the injector grid of the 6SA7 divider stage, V307. Assuming a 75-kc signal on the control grid, the two signals will be heterodyned and a 25-kc signal will be developed in the tuned output circuit (Z310 and C335). The 25-kc signal is coupled to positions 1 and 3 of frequency selector switch S301, to the grid of doubler stage V308 and to the grid of tripler stage V309. The tuned output circuit (Z311 and C342) of the doubler develops a 50-kc signal which is coupled to position 4 of S301; the tuned output circuit (Z312 and C346) of the tripler develops a 75-kc signal which is coupled to position 5 of S301 and to the control grid of the divider stage, V307.

Note that there must be a 75-kc output from V309 to initiate the frequency division. When the equipment is first turned on, the 75-kc signal may be assumed to originate as a component of any random noise voltage present in the grid circuit of V309. Since the plate circuit of V309 is tuned to 75 kc, the 75-kc component is amplified and may be fed back to the control grid of the divider, V307. Once a 25-kc output is obtained from the divider, a 75-kc voltage is obtained by tripling in V309, as described in the preceding paragraph.

f. MIXER V303 AND LIMITER - AMPLIFIER OR CRYSTAL OSCILLATOR V304.—The control grid input to mixer V303 is the 900-kc output of tripler stage V302 (for 100-kc operation). The injector grid is either grounded (in which case the tube merely functions as an amplifier) or it is connected to one of the three outputs (25, 50, or 75 kc) of the frequency divider. For XTAL operation the control grid is connected to a crystal tank circuit. Input switching is accomplished by one section of the three-gang FREQUENCY SELECTOR, S301. Two other sections of S301 connect appropriate interstage transformers into the plate and grid circuits respectively of V303 and V304. The input signals supplied to the injector grid and the output signals developed in the plate circuit of V303 for each position of S301 are tabulated below. Note that the switch positions are designated to correspond to the operating frequencies of the transmitter, not to the output frequencies of the mixer.

SWITCH POSITION	SWITCH DESIGNATION	INJECTED SIGNAL	V303 PLATE IMPEDANCE	V303 OUTPUT FREQUENCY
1	1,750 KC	25 KC	Z304	875 KC
2	1,800 KC	0	Z305	900 KC
3	1,850 KC	25 KC	Z306	925 KC
4	1,900 KC	50 KC	Z307	950 KC
5	1,950 KC	75 KC	Z308	975 KC
6	XTAL	——	——	——

A type 6SJ7 pentode (V304) is used as an amplifier following the mixer, to raise the level of the signal fed to the pulsed doubler stage. The c-w output of V304 is brought out to jack J311 through coupling capacitor C352 to permit frequency checking of the unpulsed r-f driving voltage ahead of the pulsed doubler. V304 also acts as a limiter to provide fairly constant output over a wide range of input voltages to the unit. The primary winding of transformer Z309, fixed tuning capacitor C320, variable tuning capacitor C322, and trimmer capacitor C326A are used to tune the plate circuit of V304 over the range of 875 to 975 kc. The door of the IPA compartment provides access to the main tuning control (C322) and the screw-driver adjustable trimmer (C326A). The main tuning control is calibrated in terms of the transmitter output frequencies (1,750 to 1,950 kc) although the actual tuning range is at half the output frequency. Tuning procedure is outlined in Section 3, paragraph 8.

V304 is operated as a crystal oscillator when FREQUENCY SELECTOR switch S301 is in the XTAL position. For this operation the output tank circuit of V303 is disconnected from the grid of V304 and the V304 grid is connected to the crystal and to a plate-grid feedback capacitor (C353). The frequency multiplier and divider stages (V301, V302, V303, V307, V308, and V309) are disabled by interruption of plate voltage through contacts of FREQUENCY SELECTOR switch S301 when S301 is in the XTAL position. Resistor R348 is substituted for the plate loads of the disconnected tubes so that voltage balance throughout the other frequency generating unit circuits is not disturbed.

g. PULSED DOUBLER. — The pulsed doubler, utilizing two 6V6GT G tubes in a push-push doubler circuit, is normally held beyond cutoff by approximately 200 volts of fixed bias. The bias is developed in the low-voltage power supply section (refer to paragraph 11*a*) and is supplied to the grids of the 6V6GT G's via terminal 14 on the chassis terminal board. The bias is sufficient to hold the tubes cutoff, despite the presence of the r-f driving voltage supplied by V304. Capacitor C326B is used in conjunction with the secondary of Z309 to tune the grid circuit to half the transmitting frequency. The split-stator arrangement of the main tuning capacitor (C323) insures a more balanced drive to the grids. Access to C323 and the screw-driver adjustable trimmer (C326B) is possible through the IPA compartment.

The rectangular pulse output of the pulse former (paragraph 6*e*) is periodically supplied from jack J309 to the grids of the pulsed doubler in series with the bias voltage. The rectangular pulse acts as a keying pulse to reduce the bias on the 6V6GT G's and permits them to conduct. During the keying or pulsing period, the r-f signal from V304 (875 to 975 kc) is amplified and doubled. Doubling is achieved by feeding the grids in push-pull and connecting the plates in parallel to a tank circuit which is tuned to twice the input signal. The tuned plate circuit (L114 and C176), located in the IPA compartment, is common to both frequency generators (see figures 7–38 and 7–39.) The tuning is adjustable by means of a panel-mounted control designated PULSED DOUBLER PLATE TUNING. Connection from the frequency generator chassis to the plate tank is made via jack J310 and coaxial cable. Tuning adjustments for the plate circuit are outlined in Section 3, paragraph 9.

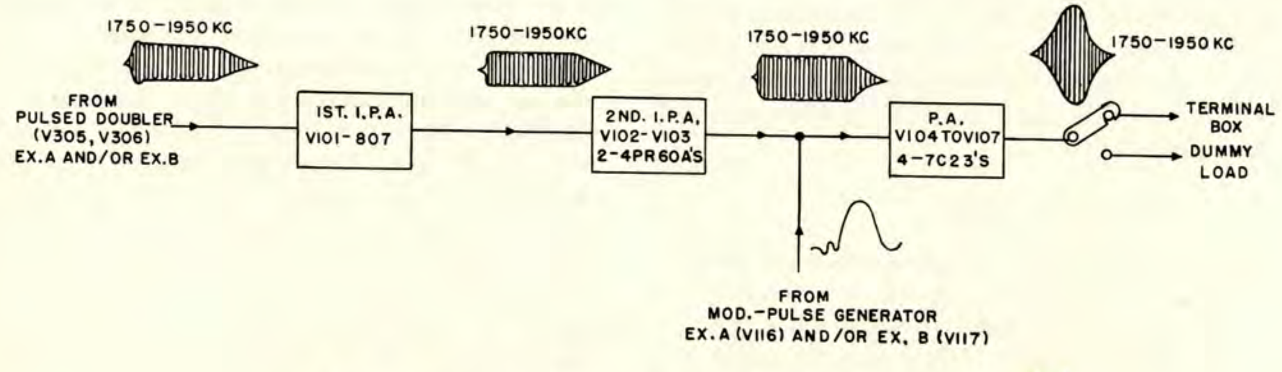


Figure 2–9. Block Diagram of IPA and PA Stages

Figure 7–4 is an oscillogram of the frequency generator output. This waveform is periodically supplied to the first IPA stage (V101) at the recurrence rate of the loran timer. A capacitive pick-up (a piece of copper tubing which extends into L114) couples a portion of the doubler output to the monitor oscilloscope via coaxial cable and position 7 of S116.

8. IPA AND PA STAGES.

a. BLOCK DIAGRAM. — As shown in the block diagram (figure 2–9), three stages of power amplification are used to develop a peak power output of 160 kilowatts at any one of five frequencies (1,750, 1,800, 1,850, 1,900, or 1,950 kc). Input is supplied periodically to the first IPA at one of these frequencies for durations of approximately 100 microseconds, the period being determined by the loran timing equipment and the duration being determined by the rectangular-pulse output of the pulse former. The two IPA stages in cascade amplify the pulses of r-f input and supply excitation to the PA. With no other input to the PA, the r-f excitation produces no output in the PA plate circuit because of the high cutoff bias. However, when the output of the modulation-pulse generator is supplied to the PA coincidently with the r-f drive, the PA develops r-f output for the duration of the modulating pulse, and the envelope of the r-f output is very similar to the specially shaped pulse supplied by the modulation-pulse generator. During normal operation, the modulated r-f output pulses are fed to the terminal box, whence they are directed to the Antenna Coupling Unit. For tuning or testing purposes on a stand-by transmitter, however, the PA output may be fed to a dummy load provided within the transmitter.

b. 1ST IPA STAGE. — The first IPA stage is a conventional circuit utilizing an 807 beam-power tube (V101) to amplify the output of the pulsed doubler. Circuit detail is shown on figure 7–38. Approximately 50 volts of fixed bias, supplied to the tube by the low-voltage rectifier (V118) in the power supply section, holds the tube cutoff when there is no r-f drive. Plate and screen voltages, approximately 750 volts and 300 volts respectively, are supplied by the high-voltage rectifier (V108 to V111 inclusive); filament voltage, 6.3 volts at 0.9 ampere ac, is furnished by transformer T117. Power supply adjustments to obtain correct operating voltages are outlined in Section 3, paragraph 9.

In the plate circuit, capacitor C107 is used to tune inductor L115 from 1,750 to 1,950 kc. Tuning procedure for capacitor C107, which has a panel-mounted control designated 1ST IPA PLATE, is outlined in Section 3, paragraph 9. The tank circuit is paralleled by damping resistor R110 to minimize any distortion of the pulse envelope by the tank circuit.

Capacitor C107 is a split-stator type with the rotor at r-f ground potential to develop a balanced drive for the push-pull 2nd IPA stage. B+ for the plate is applied to the center-tap of the tank coil through the parallel combination of inductance L103 and resistor R254.

The r-f output of the tank is coupled to the grids of the 2nd IPA stage through capacitors C108 and C109. A capacitive pick-up (a piece of copper tubing which extends into L115) couples a small portion of the r-f output to the monitor oscilloscope via coaxial cable and position 8 of switch S116. An oscillogram of the output signal is shown in figure 7–5. Meter M110 provides a means of monitoring the cathode current of the stage; M110 is located on the meter panel of the transmitter and is designated 1ST IPA PLATE.

c. 2ND IPA STAGE. — The 2nd IPA stage employs two type 4PR60A tetrodes (V102 and V103) in a push-pull circuit. Circuit detail is shown in figure 7–38. Plate and screen voltages, approximately 6,900 and 1,000 volts respectively, are furnished by the high-voltage rectifier (V108 to V111 inclusive) in the power supply section. Grid bias of −360 volts is furnished by the high-bias rectifier (V112 and V113), and is sufficient to hold the tubes cutoff when there is no r-f drive present. Filament voltage, 26 (±10 per cent) volts at 2.1 amperes for each tube, is supplied by two windings on transformer T104. (Refer to paragraph 11 for power supply details.)

The grids of V102 and V103 are fed out of phase, in a conventional push-pull arrangement, by the r-f output from the 1st IPA (V101). Each grid circuit includes a parasitic suppressor to prevent spurious high-frequency oscillations. These suppressors, designated E105 and E106, for V102 and V103 respectively, are small unit assemblies (see figure 7-31) made up of a resistor and an inductance connected in parallel. Protection against excessively high voltage, such as might be present because of internal tube flashovers, is afforded by the two-ball gaps, TY108 and TY109.

The cathodes of V102 and V103 are returned to ground through a metering circuit and overload-protection circuit. The metering circuit utilizes meter M109, shunt resistors R129, R130, and R131, and meter switch S114. Positions 1 and 2 of S114 connect M109 to read the cathode current of V102 and V103 respectively; position 3 connects the meter to read the total cathode current of the stage. The overload-protection circuit includes relay K112 paralleled by potentiometer R153. An excess of cathode current energizes K112, and its contacts operate to open the high-voltage control circuits. (Refer to paragraph 14 for a detailed discussion of overload circuits.) Potentiometer R153 may be adjusted, as described in Section 7, paragraph 10, to set the tripping point of relay K112. The cathode circuits are further protected against excessive voltages by gas-filled discharge tubes (TY101 and TY102) which will short the cathode to ground when voltage in excess of approximately 400 volts is present.

The plate tank circuit consists of variometer L116 paralleled by tuning capacitors C160, C161, C198, and C199. Tuning of the variometer to cover the frequency range of 1,750 to 1,950 kc is outlined in Section 3, paragraph 9. Capacitors C198 and C199, which constitute a small portion of the tank circuit capacity, are vacuum capacitors whose main function is to by-pass high-frequency parasitics. The tank circuit is paralleled by damping resistor R137 to minimize distortion of the pulse envelope of the tank circuit. Capacitors C158 and C159 are connected in a conventional cross-neutralizing arrangement.

R-f output pulses are periodically developed across the tank circuit (in accordance with the timing cycle of the loran timer) and are coupled to the grids of the final amplifier. A capacitive pick-up couples a small portion of the r-f output to the monitor oscilloscope via coaxial cable and position 9 of S116. An oscillogram of the 2nd IPA output is shown in figure 7–6.

It will be noted that a resistor, capacitor, and diode (V121, V122) network is attached to the screen circuit of the 2nd IPA tubes. The function of this network is explained in paragraph 9*c*, following, under the heading "Compensator Circuit."

d. POWER AMPLIFIER. — The power amplifier uses four type 7C23 air-cooled triodes (V104 to V107 inclusive) in a push-pull parallel circuit. The circuit arrangement (figure 7–38) is generally conventional and very similar to the 2nd IPA stage. Cross-neutralization is employed, individual parasitic suppressors are used in each grid circuit, grid and cathode circuits are protected against high transients by air gaps and discharge tubes respectively, and the cathode circuits are returned to ground through metering and overload circuits. Meter M106 may be connected by S113 to read the individual plate current of any tube or the total current of the four tubes. Excessive plate current energizes relay K113 in the cathode circuit, and the relay contacts open the high-voltage control circuits. Potentiometer R157 may be used (as described in Section 7, paragraph 9) to regulate the tripping point of K113.

Plate voltage for the PA, approximately 15,500 volts, is supplied by the high-voltage rectifiers (V108 to V111 inclusive); filament voltage, 11 volts at 29 amperes for each tube, is supplied by transformers T105 and T106; and approximately 3,000 volts of bias is supplied by the high-bias rectifier (V112-V113). The bias must be carefully adjusted to hold the PA tubes just beyond cutoff in the presence of the r-f drive from the 2nd IPA. (Refer to Section 3, paragraph 9, for the correct adjustment procedure.)

The output of the modulation-pulse generator is periodically supplied to the grids of the PA in series with the bias voltage and simultaneously with the r-f drive from the 2nd IPA. The modulating pulse has the effect of shifting the bias, and allows the tubes to conduct for the duration of the pulse. The modulation envelope of the output signal developed in the PA plate tank follows the shape of the modulating pulse.

The plate tank uses fixed capacitors (C162, C163, C164, and C165) and a variometer (L117) to tune the PA to the five discrete frequencies within the range of 1,750 to 1,950 kc. Capacitors C162 and C163 are essentially by-pass capacitors for high-frequency parasitic oscillations. Inductor L118 and capacitor C200 are used to couple the tank output to the output tuning section composed of variometer L119, capacitor C166, and capacitor C167. The plate tuning and output tuning controls are mounted on the front panel beneath the PA compartment access door; their use in the tuning procedure is outlined in Section 3, paragraph 9. The output coupling (position of L118 with respect to L117) is adjusted at the factory so that the two coils are concentric; this setting is the one normally used.

An r-f ammeter (M111), complete with thermocouple, may be switched into the output circuit (UNSHORT position of S115) to meter the transmission-line current. In the SHORT position, S115 by-passes the meter and connects the output tuning network directly to ground.

The high side of the output tuning network is normally connected via a link and coaxial cable to connector J109. From J109, connection is made to the terminal box. Link "A" is provided to allow substitution of a 50-ohm dummy load (R122 to R126 inclusive) for tuning or testing the transmitter when in stand-by. An adjustable capacitive pick-up is used to couple a portion of the r-f output to the monitor oscilloscope via coaxial cable and position 11 of S116. The pick-up consists of a disc-shaped plate whose position relative to capacitor C167 may be varied by means of a screw adjustment. An oscillogram of the PA output pulse is shown in figure 7–8.

9. DOUBLE-PULSING.

a. THEORY. — Double-pulsing is a system evolved to allow the simultaneous transmission of two different specific pulse repetition rates by a single transmitter, and consists of simultaneously pulsing the transmitter at the two specific rates.

b. CIRCUIT REQUIREMENTS. — In operating a single transmitter at two specific pulse rates simultaneously, the amplifier stages are common for both pulse rates. This is possible because the pulses of the individual rates occupy such a small fraction of the total pulse periods (approximately 80 microseconds out of 20,000 microseconds or more). Analysis of the shortest pulse recurrence period (refer to the timer instruction book) will show that cross-over between the rates occurs every nine seconds and thus only one out of every 300 pulses will be coincident. For slower pulse rates, coincidence occurs proportionately less frequently.

Dual exciters, however, are necessary since almost the entire pulse period is needed to restore the pulse-forming circuits to a static-charged condition (paragraph 6*f*) and because the carrier signal of each pulse rate must be generated from the 100-kc output of the appropriate timer.

c. COMPENSATOR CIRCUIT. — During double-pulsing operation, despite the fact that pulse coincidence occurs at relatively long intervals, there is a tendency for the PA pulse output amplitude to vary as the cross-over point is approached, passed, and departed from. This is caused by the heavy loading of the power supply at the time of any pulse and the power supply's inability to completely recover in the interval between two closely spaced pulses as contrasted to the interval between two pulses spaced nearly a full repetition period apart. To effectively minimize such undesired amplitude variation a compensating circuit is used. (Refer to the simplified schematic diagram, figure 2–10.) This network is seen to consist of resistors R258, R259, R215, R216, capacitors C141, C203, and the diode rectifiers V121 and V122. By means of the compensating network, a pulse of additional screen voltage is applied to the second IPA tubes, V102 and V103, at the times when the PA output pulse tends to drop in amplitude. This increases the drive to the PA at these times and offsets the undesired condition. The use of the resistor, capacitor, and diode arrangement permits the shaping of the compensating pulse so that it almost exactly compensates for the recovery characteristic of the power supply.

It will be noted that the modulation pulse coming from the cathode circuit of the modulation pulse generator stage is used for two applications. First, it is fed through capacitor C146 for normal modulation of the PA stage. Second, it is fed through resistors R259 and R258 to the diodes (V121, V122) and then via capacitor C141 to the screen circuit of the IPA tubes, V102 and V103. Resistors R259 and R258 are low in value and are used to set and adjust the amplitude of the compensating pulse. The conduction of the diodes provides a relatively fast rise to the wave front of the compensating pulse to offset the sudden load on the power supply that occurs with pulse transmission. During diode conduction capacitors C141 and C203 are

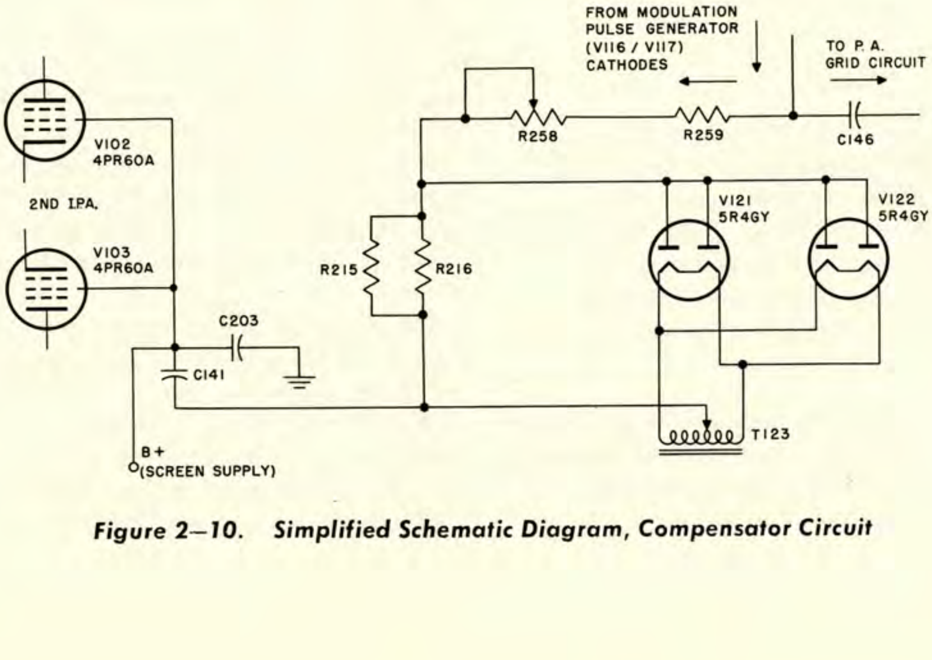


Figure 2—10. Simplified Schematic Diagram, Compensator Circuit

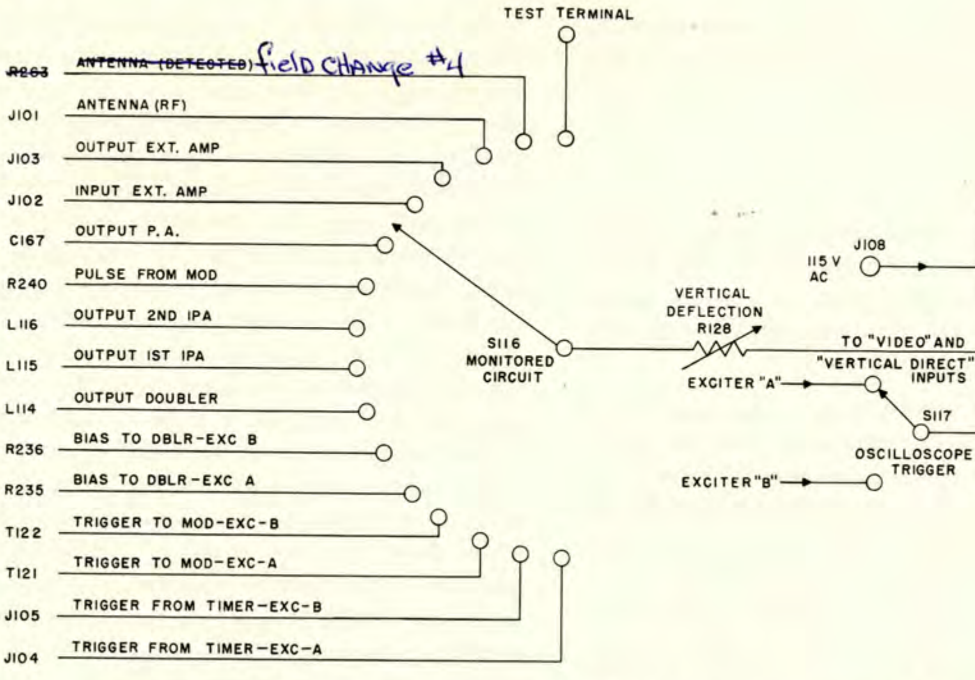


Figure 2–11. Functional Diagram of Monitor Oscilloscope Input Switching

charged to a higher level. When conduction ceases (as the modulating pulse terminates), this charge leaks off slowly through the resistors R215 and R216. This provides a trailing edge to the compensating pulse which is similar to the recovery characteristic of the power supply output voltage but of an opposite effect. The potentiometer R258 is factory-adjusted to bring the PA output pulse amplitudes to a uniform level.

10. MONITOR OSCILLOSCOPE INPUT SWITCHING.

a. GENERAL. — A functional diagram of the switching circuits associated with the monitor oscilloscope is shown in figure 2–11. (Complete circuit details are included on figure 7–38.)

Note

> Since the oscilloscope is a self-contained unit independent of the transmitter, it is discussed in a separate booklet (Operating and Maintenance Manual — Du Mont Type 256-D Cathode-Ray Oscillograph) appended to this instruction book. For circuit theory of the oscilloscope refer to Section IV of the appended booklet.

As indicated in figure 2–11, sample voltages from any one of 15 circuits in the transmitter, the antenna coupling unit, and an external 1,000-kw amplifier (if such is used) may be connected to the vertical input of the monitor oscilloscope by means of the MONITORED CIRCUIT rotary selector switch, S116. The sixteenth position of S116 is connected to a test terminal in the transmitter, making it possible to monitor additional points in the transmitter. Oscillograms of the normal waveforms which are monitored at various positions of S116 are included in Section 7, and are referenced in table 2–1.

It will also be noted in figure 2–11 that there are two switch positions which are labelled individually INPUT EXT. AMP. and OUTPUT EXT. AMP. and are shown as connected to J102 and J103, respectively. These are provided for use in higher power installations which include an external r-f power amplifier such as the Coast Guard Model T–138 or T–138A. In such installations, connectors J102 and J103 are connected to the external amplifier so that its input and output pulses may be checked on the T–325B/FPN transmitter oscilloscope by using the appropriate switch positions. Pulse monitoring for the complete system is thereby accomplished in the one oscilloscope unit. Further details on external amplifier pulse monitoring are included in the manual for the T–138 amplifier.

The sweep generator of the monitor oscilloscope must be synchronized with and triggered by the trigger pulse from the timers. The OSCILLOSCOPE TRIGGER switch (S117) serves to select the proper sync pulse to the scope for the exciter in use (see figure 7–38). The input trigger pulse is fed into jack J104 to Exciter A and into jack J105 to Exciter B. The

TABLE 2–1. MONITORED CIRCUIT SWITCH POSITIONS

SWITCH POS.	WAVEFORM MONITORED	OSCILLOGRAM FIG. NO.
1	Trigger pulse from timer to trigger generator (V114) in Exc. A.	7–1
2	Trigger pulse from timer to trigger generator (V115) in Exc. B.	7–1
3	Trigger pulse to mod.-pulse generator (V116) in Exc. A.	7–2
4	Trigger pulse to mod.-pulse generator (V117) in Exc. B.	7–2
5	Rectangular keying pulse to pulsed doubler (V305-V306) in Exc. A.	7–3
6	Rectangular keying pulse to pulsed doubler (V305-V306) in Exc. B.	7–3
7	Output of pulsed-doubler (V305-V306) in Exc. A. or Exc. B.	7–4
8	Output of first I.P.A. (V101).	7–5
9	Output of second I.P.A. (V102-V103).	7–6
10	Output of mod.-pulse generator (V116 or V117).	7–7
11	Output of P.A. (V104 to V107 inclusive).	7–8
12*	Input to external amplifier.	
13*	Output of external amplifier.	
14	R-f Output of Antenna Coupling Unit.	7–9
15	~~Detected Output of Antenna Coupling Unit.~~ field change #4	
16	Test terminal.	

*These positions are utilized only when an external amplifier is used with the transmitter.

desired pulse is then directed to the TRIGGER INPUT jack on the oscilloscope via switch S117 and plug P110. When switch S117 is in the EXC A position, the trigger input pulse to Exciter A also triggers the scope sweep; in the EXC B position of switch S117, the scope is triggered by the Exciter B input pulse.

b. CIRCUIT DETAIL. — Switch S116 and potentiometer R128, shown in simplified version on figure 2–11, are shown in detail on figure 7–38 as a five-gang rotary switch and dual potentiometer, respectively. Separate sections of S116 are utilized for switching r-f, video, and ground connections, and separate sections of R128 are used for controlling the amplitude of the r-f and video monitor signals.

Section 1 of S116 utilizes shorting contacts to ground all the r-f monitor lines except the one selected by the position of the switch. The high side of the selected line is connected to the oscilloscope via section 2 of S116, R128A, section 5 of S116, and plugs P108 and P109. The low side of the selected line is grounded near the pick-up point and is connected to the oscilloscope through section 3 of S116 and plugs P108 and P109. Single-point grounds are used to minimize stray pick-up. Plugs P108 and P109 connect respectively to the VIDEO INPUT and VERTICAL DIRECT input connectors of the oscilloscope. The VIDEO ATTENUATOR control on the scope selects the input from either P108 or P109. When the VIDEO ATTENUATOR is set to OFF, the input from P109 is fed directly to the deflection plates of the cathode-ray tube. Setting the VIDEO ATTENUATOR to any other position feeds the input from P108 through an attenuator and a video amplifier in the oscilloscope to the cathode-ray tube deflection plates. See Section IV, paragraph 21, of the appended oscilloscope instruction book for further details of the scope input circuit.

11. D-C POWER SUPPLIES.

Three rectifiers supply all the d-c operating voltages used in Radio Transmitter Type T–325B/FPN. A low-voltage rectifier supplies bias voltages for the 1st IPA stage, and plate, screen, and bias voltages for all stages of the exciters except the modulation-pulse generators; a high-bias rectifier supplies bias for the 2nd IPA and PA stages; and a high-voltage rectifier supplies plate and screen voltages for the modulation-pulse generators, the IPA stages, and the PA stage. Circuit details of all power supply circuits are shown on figure 7–38.

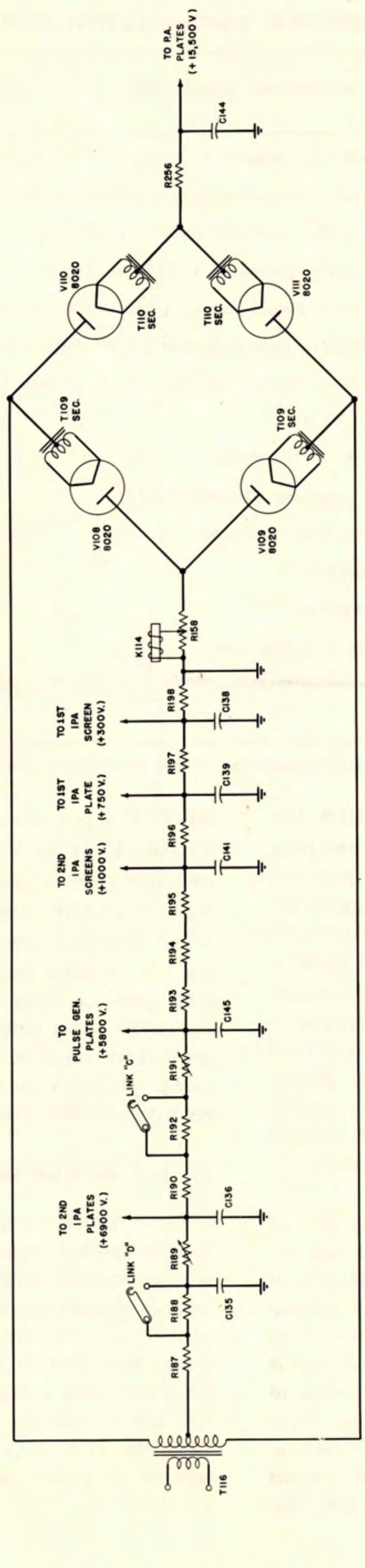


Figure 2–12. Simplified Schematic Diagram of High-Voltage Rectifier

a. LOW-VOLTAGE RECTIFIER. — The low-voltage rectifier employs a type 5R4GY (V118) in a full-wave circuit. Primary voltage is supplied to the filament and plate transformers, T119 and T113 respectively, via variable transformer T102, transformer T103, and appropriate control circuits. (Refer to paragraph 13 and figure 7–43 for details of the transmitter control circuits.) Variable transformer T102 is used to regulate the primary voltage. The filtered output of the rectifier is developed across a voltage divider consisting of resistors R159 to R164, inclusive. Variable resistor R163 regulates the current through the divider and is adjusted at the factory to obtain a reading of 300 volts on LOW VOLTAGE meter M105, with both exciters operating and S111 in the EXCITER PLATE position. Potentiometers R159 and R161 regulate the bias on the pulsed doublers and 1st IPA stage respectively.

Switches S118 and S119, designated EXCITER A and EXCITER B on the transmitter control panel, control application of the B+ output of the rectifier to the exciters. They also control application of filament voltages to all stages of the exciters except the modulation-pulse generators. When either switch is in the OFF position, variable resistor R237 is shunted across resistors R163 and R164 in the B+ voltage divider; when both exciters are used, this parallel bleeder circuit is opened. R237 is adjusted at the factory to provide the proper load on the rectifier when only one exciter is used.

b. HIGH-BIAS RECTIFIER. — Two type 2X2A diodes in parallel (V112 and V113) are connected in a half-wave rectifier circuit to provide bias for the 2nd IPA and PA stages. Primary voltage is supplied to filament transformer T111 and plate transformer T120 via variable transformer T102 and appropriate control circuits. (Refer to paragraph 13 and figure 7–43 for details of the transmitter control circuits.) Variable transformer T102 is used to regulate the filament primary voltage and the primary voltage of plate transformers T113 and T120. A separate adjustment for the high-bias supply is provided by variable resistor R165 in series with the primary winding of T120. Adjustment procedure is outlined in Section 3, paragraph 9.

Grid bias for the 2nd IPA stage is taken from potentiometer R171 in a bleeder and voltage-dividing network across the supply. This bias may be metered by LOW VOLTAGE meter M105 when S111 is in the 2nd IPA BIAS position. Approximately 3,000 volts of bias, metered by PA BIAS voltmeter M104, is tapped off the junction of resistors R168 and R176 and supplied to the PA grids. For protection of personnel working on the equipment, the 3,000-volt lead is connected through resistor R154 to grounding switches S126 to S129 inclusive. These switches are located on the front and rear access doors and operate automatically, whenever a door is opened, to ground the high-voltage lead and discharge the filter capacitors.

c. HIGH-VOLTAGE RECTIFIER. — The high-voltage rectifier is supplied by filament transformers T109 and T110 and plate transformer T116. Filament voltage may be regulated by means of variable transformer T102; plate voltage may be regulated by means of variable transformer T101. The control circuits which must be operated before the high-voltage rectifier can be energized are discussed in paragraph 13 of this section.

A simplified schematic diagram of the high-voltage rectifier, indicating only essential circuit components, is shown in figure 2–12. Four type 8020 high-vacuum rectifiers (V108 to V111 inclusive) are used to develop plate and screen voltages for the modulation-pulse generators, the IPA stages, and the PA stage. The four tubes are connected in a bridge circuit to develop 15,500 volts for the plates of the PA tubes. A half-voltage tap from the bridge circuit and a voltage divider develop 300 and 750 volts for the screen and plate respectively of the 1st IPA stage, 1,000 and approximately 6,900 volts for the screens and plates respectively of the 2nd IPA stage, and 5,800 volts for the plates of the modulation-pulse generators.

The 15,500-volt potential is taken from the junction of surge protection resistor R256 and filter capacitor C144 in the filament return of V110 and V111; PA PLATE voltmeter M102 meters the 15,500-volt potential. Operating voltages for the modulation-pulse generators and the IPA stage are developed across the voltage divider consisting of resistors R187 to R198 inclusive, between ground and the center-tap of plate transformer T116. Potentiometer R189 is provided for regulating the 2nd IPA plate voltage (Section 3, paragraph 9) to about 6,900 volts as read on the MEDIUM VOLTAGE meter, M103, when S112 is in the 2ND IPA PLATE position. Potentiometer R191 controls the modulator plate voltage, and should be adjusted for a reading of 5,800 volts on M103 when S112 is in the MOD PLATE position.

The low side of the circuit is returned to ground through the coil of overload relay K114. Potentiometer R158, in parallel with the coil, may be adjusted to regulate the tripping point of K114 (Section 7, paragraph 10). The gas-filled discharge tube, TY107, provides protection against excessive voltage surges across K114 during an overload. For protection of personnel working on the equipment, the PA and IPA plate leads are connected to grounding switches S126 and S129 inclusive. These switches are located on the front and rear access doors to ground the high-voltage leads and discharge the filter capacitors whenever a door is opened. Whenever the high-voltage control circuit is open, an additional discharge path is supplied for the filter capacitors by resistor R152 and the contact of relay K123 (refer to paragraph 13).

Links C and D, across resistors R192 and R188 respectively, serve to extend the ranges of the voltage-control potentiometers in the high-voltage divider network. Thus, when Link C is shorted across R192, the voltage range of R191 is increased; likewise, when R188 is shorted by Link D, R189 can effect a greater voltage variation. See Section 3, paragraph 9, for information as to the correct link positions.

12. METERING CIRCUITS.

Eleven panel-mounted meters are provided to monitor the operation of Radio Transmitter Type T–325B/-FPN. With the exception of the TUBE HOURS meter, which is centrally located below the monitor oscilloscope on the front panel, the meters are discussed in the sequence in which they are located, from left to right, across the top front panel of the transmitters. Meter switches referred to in the discussions are located on the front panel beneath the meters. (See figure 4–2.)

a. "TUBE HOURS" METER M107. — Meter M107 is connected across the filament primary bus to indicate the total length of time during which high-power filaments are energized. (See figure 7–43.) If the equipment is operated from a 50-cycle power source instead of a 60-cycle source, the meter reading must be multiplied by 6/5 to obtain the actual hours of operation.

b. "EXCITER CURRENT" METER M112. — Meter M112 is used in conjunction with switches S120 and S121 (see figures 7–38 and 7–39) to obtain arbitrary indications of cathode and grid current in the various stages of the frequency generators. Switch S121 connects the meter to the frequency generator of either Exciter A or Exciter B; switch S120 may connect the meter to the cathode of each stage in the frequency generator (first eight positions of the switch) or to a cord and plug (P301) mounted in each frequency generator (GRID CURRENT position of the switch). Plug P301 may be inserted into the various jacks (J301 to J307) on the chassis of the frequency generator to obtain an indication of the grid current drawn by the various stages. All stages except the first tripler (V301) and the pulsed-doubler (V305-V306) are provided with metering jacks; mixer stage V303 is provided with a metering jack in both control-grid and injector-grid circuits.

Note

The scale of meter M112 is arbitrarily calibrated from 0 to 100. The normal indications which should be obtained for each position of S120 are tabulated in table 5–1 of Section 5.

c. "1ST IPA PLATE" METER M110. — The plate current of the 1st IPA stage is metered by M110, a 0- to 5-milliampere meter, permanently connected in the cathode return of V101. (See figure 7–38.)

d. "2ND IPA PLATE" METER M109. — Meter M109 may be connected by switch S114 to read the cathode current of either tube (V102 or V103) of the 2nd IPA stage, or to read the combined current of both tubes. (See figure 7–38.) The shunts associated with M109 calibrate the meter so that the full-scale reading corresponds to a current of 50 milliamperes.

e. "LINE" METER M101. — LINE voltmeter M101 (0 to 300 volts ac) may be connected across the 230-volt line or the filament-primary bus by means of switch S110. (See figure 7–43.)

f. "PA BIAS" METER M104. — Meter M104 is permanently connected across the high-bias voltage divider (R169 to R176 inclusive) to read the bias on the PA stage. (See figure 7–38.) The meter scale is calibrated in kilovolts; full-scale reading is 5 kv.

g. "LOW VOLTAGE" METER M105. — Meter M105 may be connected by switch S111 to monitor the outputs (exciter plate voltage, doubler and 1st IPA bias) of the low-voltage rectifier, and the lower output (2nd IPA bias) of the high-bias rectifier. (See figure 7–38.) M105 is a 0- to 1-kilovoltmeter, with a scale calibrated in tenths of a kilovolt.

h. "PA PLATE" METER M102. — PA plate voltage is monitored by M102, a 0- to 20-kilovoltmeter which is permanently connected in the high-voltage rectifier circuit. (See figure 7–38.)

i. "MEDIUM VOLTAGE" METER M103. — Meter M103 may be connected by switch S112 to read the plate voltage of the modulation-pulse generators or the 2nd IPA stage. (See figure 7–38.) M103 is a kilovoltmeter, with a full-scale reading of 8 kv.

j. "PA GRID" METER M108. — The total grid current drawn by PA tubes V104 to V107 inclusive may be read on M108 which is a 0- to 10-milliampere meter, permanently connected in the low side of the high-bias rectifier. (See figure 7–38.)

k. "PA PLATE" METER M106. — Plate current of the individual PA tubes (V104 to V107 inclusive) or the combined current of the four tubes may be monitored on M106. (See figure 7–38.) Switch S113 is provided to connect the meter into the separate circuits. The shunts associated with M106 calibrate the meter so that a full-scale reading corresponds to 100 milliamperes of current.

l. "TRANSMISSION LINE" METER M111. — The UNSHORT position of switch S115 connects M111 into the output circuit of the transmitter to monitor the r-f output of the PA. (See figure 7–38.) The SHORT position of S115 short-circuits the thermocouple, effectively removing it from the circuit. M111 is a thermocouple-type r-f ammeter, calibrated in r-f amperes from 0 to 5.

Note

Meters which are described as reading plate current are actually connected in the cathode circuits of their particular stage (see figure 7–38) for reasons of safety. The actual current reading is more correctly "cathode current", which is the total plate, grid and screen (if a screen-grid is present) current of the tube. Since the values of grid and screen currents are small compared to the plate current for a given tube, they may be disregarded and the meter readings considered as plate current values.

13. POWER DISTRIBUTION AND CONTROL CIRCUITS.

For proper operation of the transmitter, operating voltages should be applied in a definite sequence. During routine operation, when starting and stopping procedures are controlled by the MAIN circuit-breaker (S101), the sequence is automatically provided by the interlocks and time-delays inherent in the control circuits. When initially energizing the transmitter, or at any other time it is found desirable, a step-by-step operation of the various control switches is employed. Both the manual step-by-step operation and the automatic sequencing are discussed in the following subparagraphs. Refer to figure 7–43 throughout the discussion on the control circuits.

a. PRIMARY POWER CIRCUITS. — Assuming that the FILAMENTS switch (S103), the LOW VOLTAGE-BIAS switch (S104), and the HIGH VOLT switch (S105) are in the OFF positions, and that the TUNE-NORMAL switch (S102) is in the NORMAL position, closure of the MAIN circuit-breaker (S101) connects the incoming 230-volt line to the following:

(1) Autotransformer T118, which supplies 115 volts ac to receptacle J108 for operation of the monitor oscilloscope.

(2) Transformer T107, which supplies 16.5 volts ac for operation of the indicator lamps. I101, the amber-colored MAIN indicator lamp, lights immediately to denote the closure of the 230-volt primary circuit. If all doors are closed, the amber-colored DOOR INTERLOCK indicator (I111) also lights.

(3) Blower BL101, which provides forced-air cooling of the power-amplifier tubes. The air pressure developed by BL101 operates a normally-open switch, S130, which is in series with FILAMENTS switch S103.

(4) Fan BL102, which provides ventilation within the cabinet.

(5) LINE voltmeter M101 (assuming S110 is in the LINE position).

(6) Low- and high-voltage variable transformers, T102 and T101 respectively, through dropping resistors R146 to R149 inclusive. T102 regulates the primary voltage of the filament transformers and the low-voltage-rectifier plate transformer; T101 regulates the primary voltage of the plate transformers for the high-bias and high-voltage rectifiers.

(7) Transformer T108, which supplies 115 volts ac for operation of various control relays. If all doors are closed and the TUNE-NORMAL switch (S102) is in the NORMAL position, relay K120 is energized by the 115-volt output of T108 as soon as MAIN switch S101 is closed. Four sets of normally-open contacts on K120 close, but the only immediate effect is the completion of the circuit for I111, the amber DOOR INTERLOCK indicator lamp. (The other contacts of K120 are in circuits held open by LOW VOLT-BIAS switch S104.)

b. FILAMENT CIRCUITS. — Assuming that the air pressure developed by blower BL101 has closed S130, closing FILAMENTS switch S103 completes a 115-volt circuit for the coils of relays K121, K115, and K119. K121 is energized immediately, K115 operates after 15 seconds, K119 operates after three minutes.

Contacts of K121 close to apply reduced voltage to the filament-primary bus. (This voltage is metered by M101 when S110 is in the FIL PRI position.) All filament transformers, TUBE HOURS meter M107, and relays K104 and K111 are connected across the filament-primary bus. The voltage applied to relays K104 and K111 is dropped to 110 volts by resistors R138 and R145. Transformers T112 and T115, which supply filament voltage for Exciters A and B respectively, have individual switches (S118 and S119) in series with them to allow use of either or both exciters.

When K104 is energized, two sets of normally-open contacts close. One set completes a circuit to I102, the clear LOW PWR FIL indicator; the other contacts, in series with relays K105 and K106 and the open LOW VOLT-BIAS switch (S104), have no immediate effect.

When K111 is energized, two sets of contacts close. One set completes a circuit to I103, the clear HIGH PWR FIL indicator; the second set, in the circuit of the high-voltage control relays (K103, K118, and K123), has no immediate effect.

Fifteen seconds after S103 is closed, K115 operates to complete a circuit to relay K101. The contacts of K101 close to short-circuit dropping resistors R146 to R149 and so allow normal operating voltage (230 volts) to be applied to the filament-primary bus.

Three minutes after S103 is closed, relay K119 operates to complete a circuit for K110. One contact of K110 completes a circuit to I104, the blue HIGH VOLT TD indicator lamp, and a second contact closes in the high-voltage control circuits of relays K103, K118, and K123. The lighting of I104 indicates that the high-power filaments have been heated sufficiently to allow application of plate voltage to the tubes.

c. BIAS AND LOW-VOLTAGE CIRCUITS. — LOW VOLT-BIAS switch S104 controls the application of bias and low plate voltage to the transmitter. (In the step-by-step starting procedure, S104 is generally closed after normal filament voltage has been applied and during the three-minute period in which K119 is cycling.) Closing S104 completes a 230-volt circuit to plate transformers T113 and T120, relay K105, and relay K106. T113 supplies plate voltage for the low-voltage rectifier; T120 supplies plate voltage for the high-bias rectifier. One set of contacts on K106 completes a circuit to I110, the red LOW VOLTAGE indicator lamp; one set of contacts on K105 completes a circuit to I105, the green BIAS indicator lamp. Both K106 and K105 close contacts in the high-voltage control circuits of relays K103, K118, and K123.

d. HIGH-VOLTAGE CIRCUITS. — Assuming operation of the control circuits discussed in the previous paragraphs, closure of HIGH VOLT switch S105 completes a 115-volt circuit to relays K103, K118, and K123. K103 and K123 operate immediately; K118 operates after a one-second delay.

Normally-closed contacts of K123 open to remove filter-discharge resistor R152 from the high-voltage rectifier circuit. (See figure 7–38.) Contacts of K103 operate to apply reduced voltage to high-voltage plate transformer T116, and to energize I106, the red HIGH VOLTAGE indicator.

One second after S105 is closed, K118 operates to complete a circuit to relay K102. The contacts of K102 short-circuit resistors R150 and R151 to apply normal operating voltage to transformer T116.

e. "TUNE-NORMAL" SWITCH S102. — TUNE-NORMAL switch S102 is provided to allow adjustment of the exciters within the cabinet with all voltages in excess of 300 volts removed from the equipment. One contact of S102 is in series with relay K120, and operation of S102 to the TUNE position keeps the relay de-energized. The circuits to the high-bias plate transformer (T120) and relay K105 are then opened, but additional contacts on S102 maintain the circuit to the low-voltage plate transformer (T113) and relay K106. De-energizing K105 causes relays K103, K118, and K123 to be de-energized, thereby removing voltage from the high-voltage plate transformer (T116) and discharging the high-voltage filter capacitors through resistor R152. Door interlocks S122 to S125 on the transmitter, S501 on the terminal box, and an interlock on an external amplifier (if one is used) are also wired in series with relay K120 so that it is impossible to apply voltage in excess of 300 volts if any door is open.

f. AUTOMATIC SEQUENCING. — During routine operation of Radio Transmitter Type T–325B/FPN, S102 is left in the NORMAL position and switches S103, S104, and S105 are left in the ON positions. Starting and stopping may be done entirely by operation of the MAIN switch (S101). The sequence is the same as described under paragraphs *a* to *d* above, except at the moment S101 is first closed.

Since switches S102, S103, and S104 are already closed, closing S101 immediately supplies reduced voltage to the filament transformers and to the low-voltage and high-bias plate transformers. All indicator lamps, except the overload and high-voltage indicators, light almost simultaneously. Fifteen seconds later, normal operating voltage is applied simultaneously to filament and plate transformers (except T116). After three minutes the HIGH VOLT TD lamp (I104) lights, followed immediately by the HIGH VOLTAGE lamp (I106). One second later, relays K118 and K102 operate, and the equipment is in full operating condition.

14. D-C OVERLOAD CIRCUITS.

a. FUNCTION. — The d-c overload circuits cause temporary removal and automatic restoration of high plate and screen voltages in the event of an overload. If the overload persists after two automatic reclosures within 15 seconds, the high voltage is removed until the overload circuit is manually reset. Excessive current in the 2nd IPA, PA, or high-voltage rectifier circuits causes operation of the overload circuits as described in the following subparagraphs. Refer to figure 7–43 for circuit details.

b. MOMENTARY OVERLOAD. — During normal operation, the circuit to the high-voltage control relays (K103, K123, and K118) is completed through normally-closed contacts on overload relays K112 K113, and K114, located in the 2nd IPA, PA, and high-voltage rectifier circuits respectively. Assuming that K112 is energized by a momentary overload, a double-throw contact operates to break the coil circuit of the high-voltage control relays and complete a circuit to relay K117 and the operate coil of relay K122; another contact of K112 closes to complete a circuit to lamp-control relay K107.

De-energizing the high-voltage control relays causes removal of high plate and screen voltages from the transmitter and causes the red HIGH VOLTAGE indicator lamp (I106) to go out.

When K107 is energized, one contact opens the circuit to I107, the 2ND IPA O.L. indicator lamp, and a second contact completes a hold-over circuit through INDICATOR LIGHT RESET switch S106.

When K117 is energized it operates a normally-closed contact in the coil circuit of the high-voltage control relays, the circuit already broken by a contact of K112. This second break in the high-voltage control circuit is necessary because K112 is de-energized, releasing its contacts, as soon as the high voltage is removed. Although K117 is also de-energized, its contacts do not release for two seconds, thus holding the high-voltage circuit open long enough for any fault of a temporary nature to clear. When the contacts of K117 release after two seconds, the high-voltage control relays are again energized, the red HIGH VOLTAGE indicator lights, and the transmitter is restored to normal operation.

The operate coil of relay K122 (which is energized simultaneously with relay K117) closes a normally-open contact in the circuit of time-delay relay K116. K122 is a three-step ratchet-type relay which advances one step each time its operate coil receives a pulse of current; the contacts closed at the time of the first pulse remain closed until the reset coil has been energized.

Fifteen seconds after the operate coil of K122 is energized, K116 operates to complete a circuit to the reset coil of K122. The reset coil causes the contacts of K122 to release, thus breaking the circuit to K116 and restoring the overload circuit to its original condition.

The indicator lamp (I107) remains out, however, unless INDICATOR LIGHT RESET switch S106 is pressed. The purpose of this is to inform the operator in which stage an overload has occurred, even though the fault may have been cleared.

A momentary overload in the power-amplifier circuit or high-voltage rectifier circuit will cause operation of K113 or K114 respectively, with the same results as outlined for an overload in the 2nd IPA circuit; that is, removal of high plate and screen voltage from the transmitter for approximately two seconds. Relays K122, K117, and K116 are common components of the overload circuits; separate overload relays, lamp-control relays, lamps, and reset switches are employed (figure 7–43) in the 2nd IPA, PA, and high-voltage rectifier circuits.

c. PERSISTENT OR RECURRENT OVERLOADS. — If an overload recurs as soon as high voltage is restored (after two seconds), the same sequence is repeated to break the high-voltage circuit again, and the second pulse of current to K122 causes the ratchet-operated contacts to move another step. If the overload is removed by the time plate voltage is again restored (after another two seconds), operation will again be normal and K116 will operate to reset the overload circuits after fifteen seconds.

If, however, the overload still persists, a third pulse of current to K122 will cause that relay to open a normally-closed set of contacts in the circuit of the high-voltage control relays, and a normally-closed set of contacts in the circuit of time-delay relay K116. The high-voltage control circuit and the reset circuit of K122 will then remain open until the O.L. LOCK-OUT switch S109 is pressed.

15. A-C OVERLOAD PROTECTION.

Protection against a-c overloads is provided by the main circuit breaker, S101. This is a two-pole single-throw breaker designed to carry 25 amperes at 600 volts continuously. It has an adjustable magnetic trip which may be set to operate at any current between 30 and 80 amperes, and which is preset at the factory to trip at approximately 50 amperes. Thus, in case of an a-c overload in excess of 50 amperes, the breaker will remove the main line voltage to shut down the transmitter completely. All indicator lamps will go out in this event and the breaker must be reset manually to restore power.

16. VOLTAGE REGULATOR ASSEMBLY TYPE CN–239/FPN.

The Voltage Regulator Assembly consists of two identical bridge-controlled, electro-mechanical type voltage regulators mounted in a cabinet. Each voltage

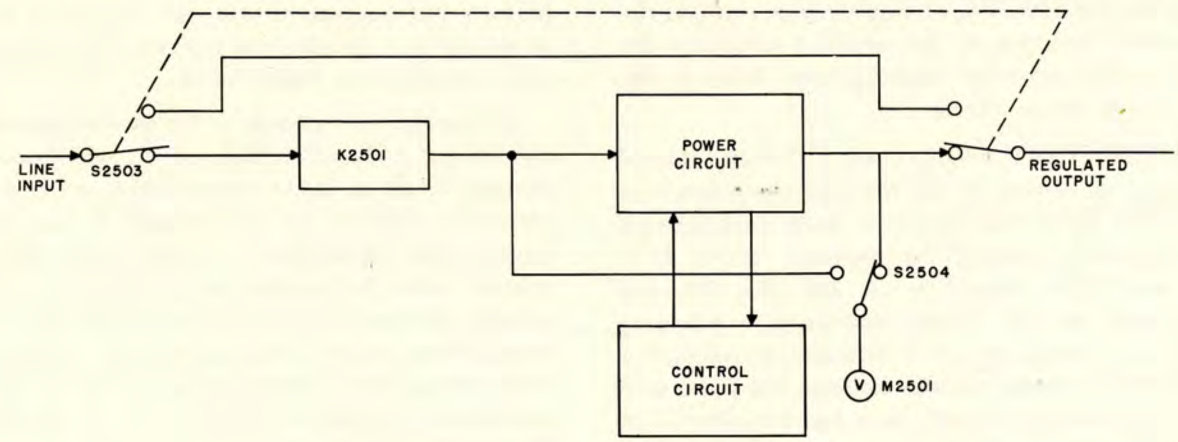


Figure 2–13. Voltage Regulator, Block Diagram

regulator supplies one loran transmitter with regulated a-c line voltage. The voltage regulator operates with an input voltage which can vary between 195 and 255 volts ac, single phase, 50 to 65 cycles per second. The output voltage is adjustable to any value over the range of 220 and 240 volts ac. It is regulated to within ±1.0 percent of the value to which it is adjusted for any combination of input voltage and frequency.

a. BLOCK DIAGRAM OF VOLTAGE REGULATOR. — As shown in figure 2–13 the voltage regulator consists principally of two circuits, the power circuit and the control circuit. The power circuit is primarily a motor-driven variable autotransformer which provides for an increase or decrease from the value of the input voltage as required. The control circuit continuously tests the output voltage and, when any change from the preset value of output voltage occurs, energizes the motor in the power circuit in the direction required to return the output voltage to the preset value.

In addition the unit is provided with a manually operated air circuit breaker (switch K2501) to protect the regulator from damage due to overload, and a voltmeter for reading either the REGULATED VOLTAGE or input LINE VOLTAGE as selected by switch S2504. A rotary disconnect switch, S2503, provides an OFF

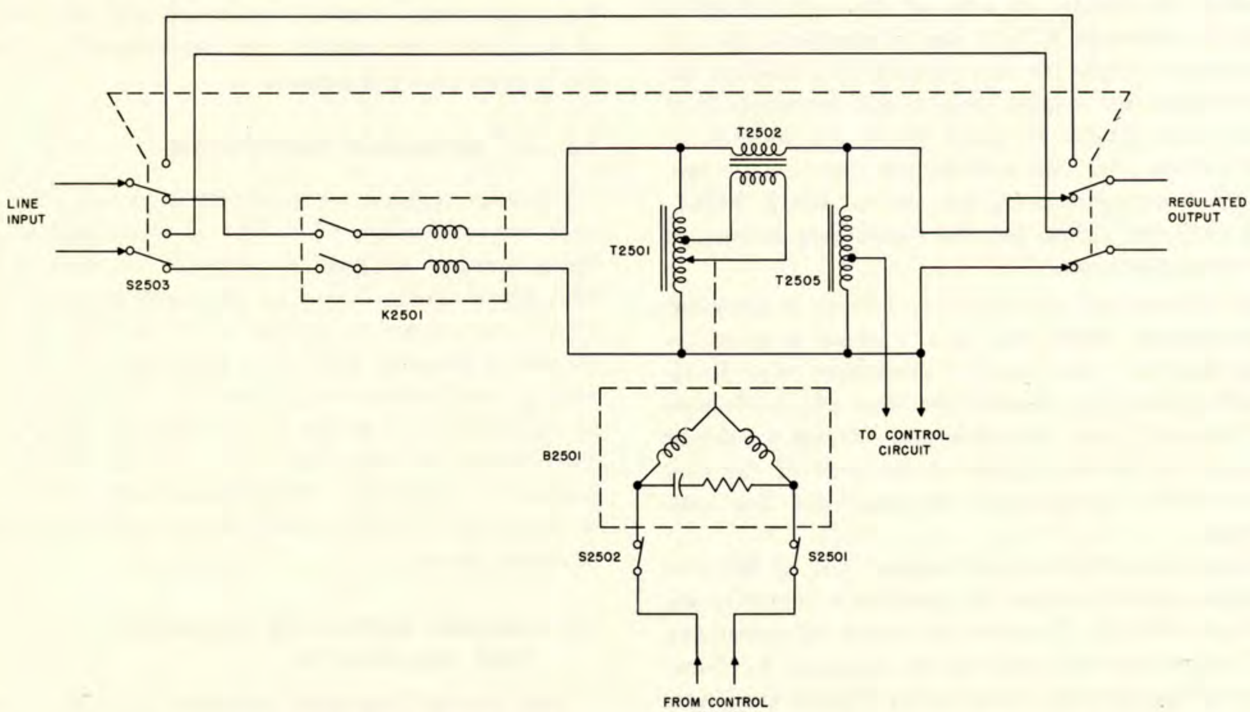


Figure 2–14. Voltage Regulator Power Circuit, Simplified Schematic Diagram

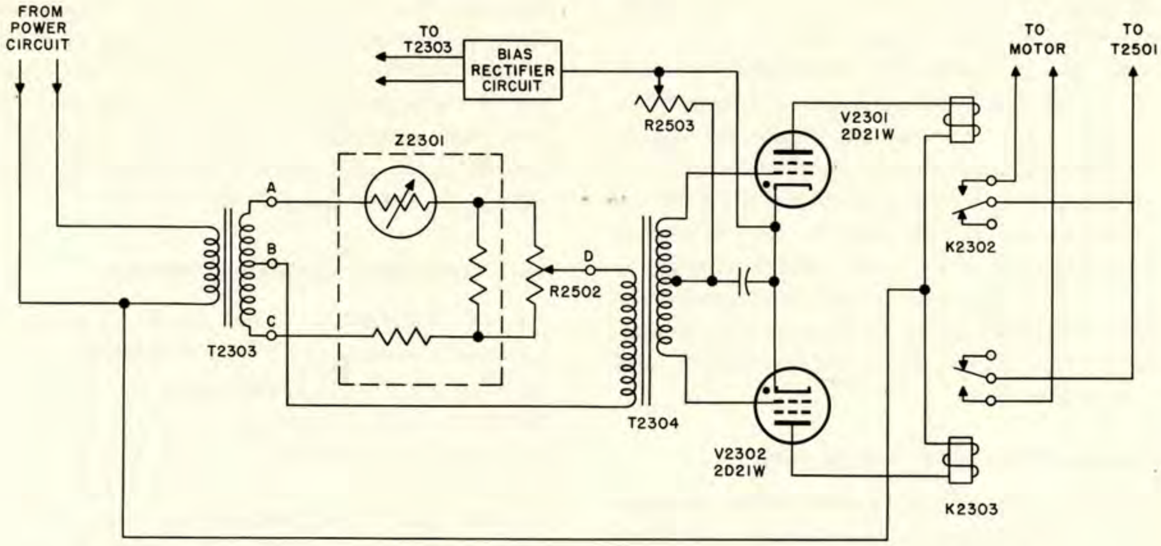


Figure 2–15. Voltage Regulator Control Circuit, Simplified Schematic Diagram

position, a REGULATED VOLTAGE position for normal operation, and a LINE VOLTAGE position. In the latter position the load is switched from the regulated output line to the unregulated input line and at the same time power is cut off from the regulator.

b. POWER CIRCUIT. — As shown in figure 2–14 the power circuit consists of a motor-driven variable autotransformer, T2501; a buck-boost transformer, T2502; a two-phase motor, B2501; and a step-down transformer, T2505. With the main disconnect switch, S2503, placed in the REGULATED VOLTAGE position, the input line voltage is fed through the circuit breaker onto the autotransformer, T2501. By means of one fixed and one variable tap on T2501 a certain portion of the input voltage is tapped from T2501 and developed across the secondary of the buck-boost transformer T2502. Depending upon the position of the variable tap relative to the fixed tap, the voltage induced in the secondary of T2502 is either in phase or 180° out of phase with the input voltage and hence is added or subtracted from the input voltage to form the regulated output voltage.

The two-phase driving motor B2501 is geared to the rotor on T2501. Limit switches S2501 and S2502 are provided to stop rotation of the variable autotransformer rotor at either limit of travel.

c. CONTROL CIRCUIT. — The control circuit continuously samples the regulated output voltage, and if the voltage departs from the preset value it energizes the motor in the power circuit in such a manner as to restore the output voltage to the desired value. The control consists mainly of an error sensing bridge circuit and a thyratron switching circuit. (See figure 2–15.)

The bridge circuit is designed to deliver an a-c error voltage of a certain polarity if the regulated output voltage differs from the desired voltage. The bridge itself consists of the secondary of T2303, Z2301 and R2502. Z2301 consists of two linear and one nonlinear resistors mounted together in a plug-in type aluminum can.

A part of the regulated output voltage is tapped from the step-down transformer T2505 in the power circuit and is applied to the primary of T2303. This will develop a-c voltage across points AC of the bridge. If the bridge is balanced, no voltage will appear across points BD of the bridge—i.e., no error voltage will be induced in the secondary of T2304. Now suppose the regulator output voltage changes. Since one arm of the bridge contains a nonlinear resistor—i.e., an element whose resistance is not constant with applied voltage—the bridge will become unbalanced and an a-c error voltage will be developed across T2304. The polarity of this error voltage with respect to the regulator output voltage will depend upon whether the regulator output voltage increased or decreased from its initial value.

The switching circuit consists of the two thyratrons, V2301 and V2302, in whose plate circuits are the energizing coils of the two relays, K2302 and K2303. The relays energize the two-phase motor in the power circuit.

The error voltage developed by the bridge circuit is applied to the grids of the thyratrons. When the error voltage becomes sufficiently large one of the tubes will fire. Exactly which tube fires depends upon the polarity of the error voltage with respect to the regulator output voltage and hence upon the direction of error. When the thyratron fires, the relay in its plate circuit is energized, causing the motor to rotate the variable contact on T2501 in the direction required to bring the regulator output voltage back to the value at which the bridge initially balanced.

By means of the OUTPUT VOLTAGE control, R2502, the bridge can be initially adjusted to balance at any desired output voltage and hence provides a means of presetting the regulated output voltage.

The potentiometer R2503 is a SENSITIVITY adjustment control. It controls bias on the thyratrons and hence the amount of a-c error voltage required to initiate a correction. The bias voltage is obtained from the secondary of T2303, using a full-wave rectifier consisting of two type IN34A crystal diodes, CR2301 and CR2302. See figure 7–40.

17. TERMINAL BOX TYPE J–455A/FPN.

The Terminal Box Type J–455A/FPN connects either of two transmitters to the Antenna Coupling Unit. The r-f output of each transmitter is fed to the terminal box via type RG–19/U or RG–8/U coaxial cable, and two transmission lines (type RG–147/U or RG–148/U cable) connect the terminal box to the Antenna Coupling Unit. Links are provided in the terminal box to connect the output of either transmitter to either transmission line.

A monitor line (coaxial cable type RG–148/U) is also routed from the Antenna Coupling Unit to the transmitter via the Terminal Box Type J–455A/FPN. A link is provided to connect the cable from the coupling unit to monitor cables from either transmitter. Figure 2–16 shows the arrangement of the links.

Two interlocks (S501 and S502) are provided in the terminal box for protection of personnel working on the equipment. One interlock is connected in series with the door interlocks of the operating transmitter, the other is connected in series with the door interlocks of the stand-by transmitter. Construction and mounting of the interlocks are such that opening the front door will cause the switch to open the interlocked control circuit and make it impossible to apply high voltage to either transmitter.

18. ANTENNA COUPLING UNIT.*

a. FUNCTION. — The primary function of the Antenna Coupling Unit is to match the system antenna to the 52-ohm transmission line from the transmitter. Secondly, it provides metering and monitoring facilities and a dummy load for tuning and testing purposes. The characteristics of the coupling network are such that it can match an antenna which has any resistance between 25** and 150 ohms and any reactance between —300 and +150 ohms at any frequency between 1,700 and 2,000 kc. The unit is rated to handle 1,000 kilowatts, peak pulse power.

b. LIGHTING AND SERVICE CIRCUIT. — Provisions are made to bring a 115-volt line into switch S403 through the base of the coupling unit. The switch controls power to a convenience outlet (J404) on the rear left-hand side of the unit, to illuminating lamps

*The Antenna Coupling Unit discussed in this paragraph is not supplied with the transmitter but may be considered as a typical example of such a unit. See Section 1, paragraph 1.

*Though not originally designed for such, the Antenna Coupling Unit can be adjusted to operate with antennas having resistances lower than 25 ohms with existing components. The method of setting up for this operation is covered in Section 3, paragraph 9*k*.

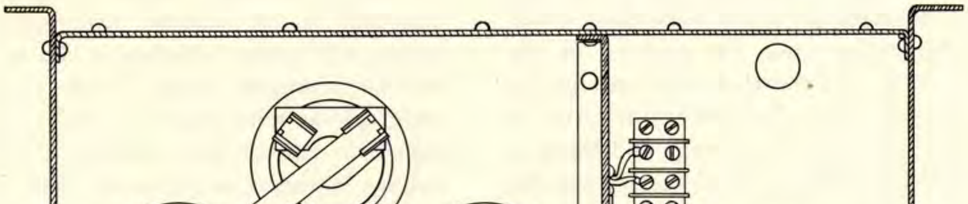


Figure 2—16. Plan View of Terminal Box Type J–455A/FPN

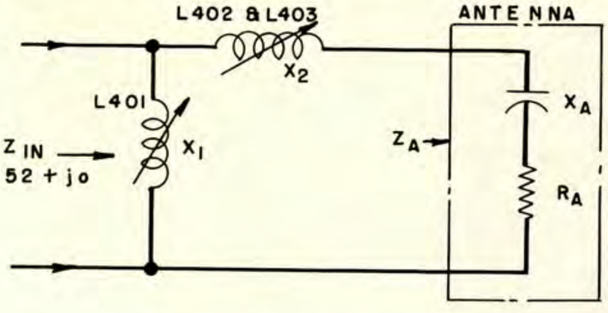


Figure 2–17. Simplified Schematic Diagram of Antenna Coupling Unit, "L"-Connected

(I401 and I402) within the unit, and to panel-illuminating lamps (I403 and I404) at the front of the unit. The 115-volt circuits are protected by two 15-ampere fuses (F401 and F402). Refer to figure 7–41 for schematic details.

c. INPUT CIRCUIT. — Two coaxial transmission lines from the terminal box connect to jacks J401 and J402 at the base of the coupling unit. A removable link (LINK 1) is used to connect the coupling network to the high side of line 1 (position A) or line 2 (position B). The outer conductors of both cables are connected directly to ground.

Connection is made to the coupling network proper or to a resistive dummy load through the primary or to a resistive dummy load through the primary (L405) of a meter transformer and another removable link (LINK 2). The meter transformer (L405-L406) consists of two hair-pin loops for which the coupling has been adjusted at the factory to provide a step-down ratio of 10. A 0- to 1-ampere r-f meter, LINE meter M401, is connected across the secondary of the transformer to provide an indication of the current in the transmission line. As indicated on the nameplate for the meter, the meter reading must be multiplied by 10 to obtain the actual line current. Normally, the meter is short-circuited by switch S401; when tuning or testing, the switch may be operated to remove the short.

An alternate adjustment of the hair-pin loop transformer spacing may be made to provide a step-down ratio of 5, for higher meter sensitivity. Reversing the meter designation plate will indicate a change in multiplier if the spacing is changed. The two positions of the transformer secondary for multiplying factors of 5 and 10 are marked on the secondary locking bar.

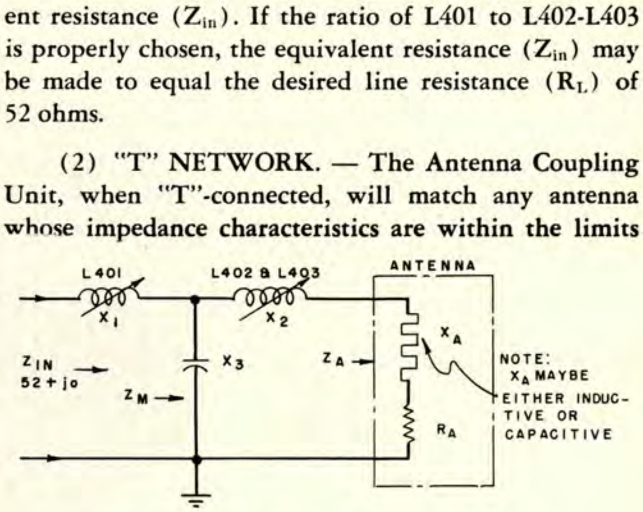
d. DUMMY LOAD. — The dummy load is made up of 24 resistors which are connected in parallel and may be put across the input line by means of LINK 2 (position B). Each resistor is 1,200 ohms and the total parallel resistance is 50 ohms. Capacitor C406, in series with the dummy load, tunes out the small inductance inherent in the load resistors.

e. COUPLING NETWORK. — To match different types of antennas to the transmission line, provisions are made to connect the coupling unit in an "L" network described in subparagraph (1) or in a "T" network described in subparagraph (2). Instructions for making the "T" and "L" connections are given in Section 3, paragraph 10*d*. In the description of the "L" and "T" networks following, only the essential elements of the matching networks are discussed, and reference is made to the simplified schematics of figures 2–17 and 2–18. Complete circuit details are shown in figure 7–41. Choke L404 (shown only on the complete schematic) is connected across the shunt capacitors in the "T" network to drain off any static charge which may be picked up from the atmosphere by the antenna.

(1) "L" NETWORK. — The Antenna Coupling Unit, when "L"-connected as shown in figure 2–17, is used with antennas whose resistive component is between 25 and 45 ohms, and whose reactive component is capacitive (negative) and between 100 and 300 ohms.

As indicated in figure 2–17, the "L" network consists of two inductances, one (L402 and L403, or L402 alone) in series with the antenna to ground, and the other (L401) paralleling this series combination. By adjusting the inductances, the entire circuit may be tuned to parallel resonance, thereby transforming the low resistance (R_A) of the antenna to a higher equivalent resistance (Z_{in}). If the ratio of L401 to L402-L403 is properly chosen, the equivalent resistance (Z_{in}) may be made to equal the desired line resistance (R_L) of 52 ohms.

(2) "T" NETWORK. — The Antenna Coupling Unit, when "T"-connected, will match any antenna whose impedance characteristics are within the limits



NOTE:
X3 WILL BE ONE OF THE FOLLOWING —
(1) C401 & C402 IN SERIES.
(2) C403 & C404 IN SERIES.
(3) C401, C402, & C403 IN SERIES.

Figure 2–18. Simplified Schematic Diagram of Antenna Coupling Unit, "T"-Connected

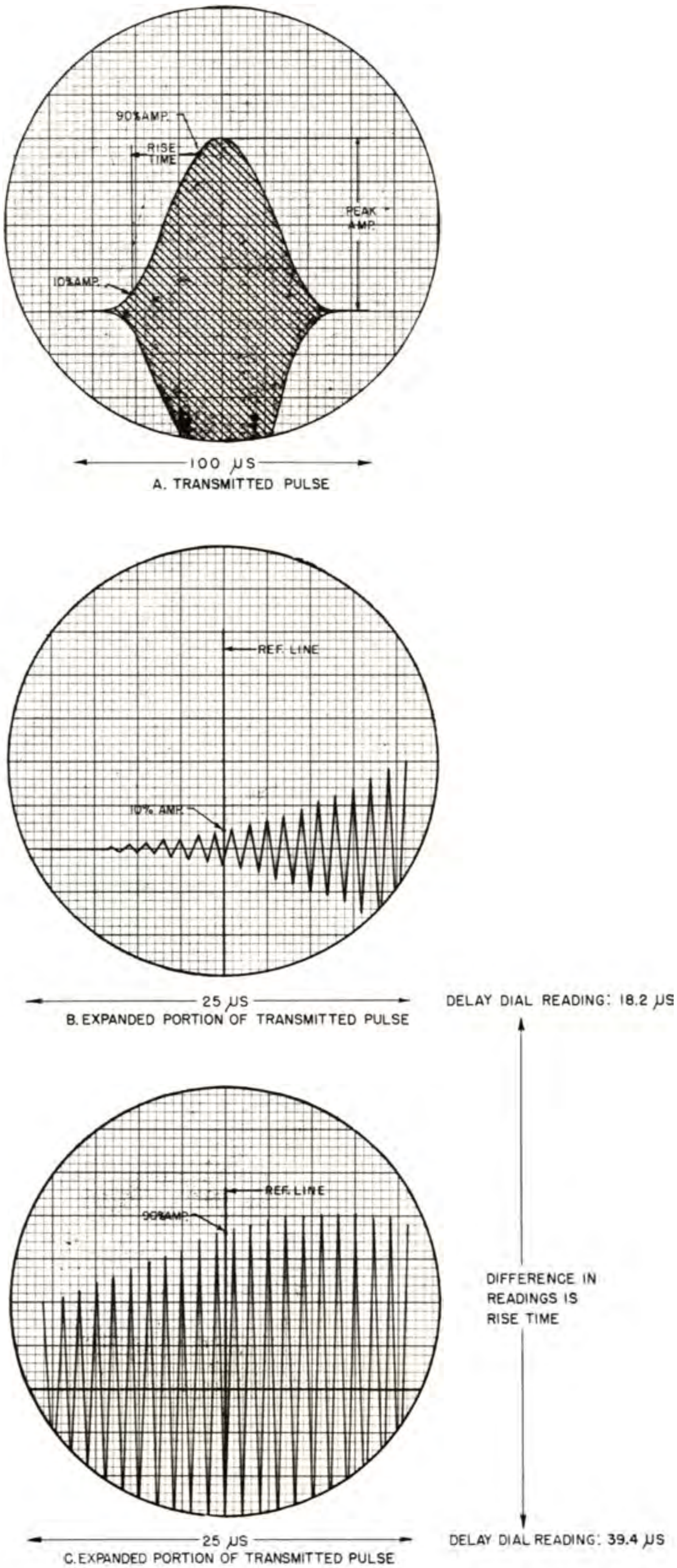


Figure 2–19. Measurement of Pulse-Rise Time

stated in paragraph 18*a*, except for those impedances matched by the "L" network, described above in subparagraph (1).

As shown in figure 2–18, the "T" network consists of an inductive arm (L402 and L403, or L402 alone) in series with the antenna, an inductive arm (L401) in series with the transmission line, and a shunt capacity (C401-C402, C403-C404, or C401-C402-C403) between ground and the junction of the series inductors. It is the function of the network components to provide a resistive input impedance, Z_{in}, which matches the line impedance, R_L (52 ohms, resistive).

The midpoint impedance of the network (looking toward the antenna) is represented on figure 2–18 as Z_M. For any antenna with the characteristics specified in this subparagraph (18*e* (2)), the shunt capacity may be selected and the series inductance (L402 and L403) may be adjusted so that the impedance Z_M will be equal to a resistive value of 52 ohms (R_M) plus a capacitive reactance component (X_M). When this condition is obtained, the inductance L401 may be adjusted so that its reactance (X_L) cancels the capacitive reactance (X_M) with the result that the desired input impedance of 52 ohms resistive is presented to the line from the transmitter. The shunt capacity is made up of various combinations of two or three capacitors selected from the group of four available, C401, C402, C403, and C404.

f. OUTPUT CIRCUIT. — The output of the coupling network connects to the antenna through the primary (L407) of a meter transformer and the antenna-entrance insulator at the side of the unit. The meter transformer (L407-L408) consists of two hairpin loops for which the coupling has been adjusted at the factory to provide a step-down ratio of 20. A 0- to 500-milliampere r-f meter, ANTENNA meter M402, is connected across the secondary of the transformer to provide an indication of the antenna current. As indicated on the meter nameplate, the meter reading must be multiplied by 20 to obtain the actual antenna current. Normally, the meter is short-circuited by switch S402; when tuning or testing, the switch may be operated to remove the short.

An alternate adjustment of the hair-pin loop transformer spacing may be used to provide a step-down ratio of 10. In this event, reversing the meter designation plate will indicate that the meter multiplier is 10. The two positions of transformer secondary for the multiplying factors of 10 and 20 are marked on the secondary locking bar.

g. MONITOR PROVISIONS. — The primary (L407) of the output-meter transformer is coupled through capacitor C405 to jack J403; J403 connects to the monitor oscilloscope in the transmitter via the terminal box. The plate spacing of capacitor C405 is adjustable to allow control of the amplitude of the monitor signal.

19. PULSE MEASUREMENTS.

For maximum accuracy of the loran system, it is required that the pulses emitted by all transmitters in the chain be similar in shape within very narrow limits. For this reason, operating personnel are required to make periodic checks of the pulse shape by means of the transmitter monitor oscilloscope. A brief discussion of pulse measurements is included here; a step-by-step procedure for taking the required measurements is included under initial adjustments in Section 3, paragraph 9.

In using the monitor oscilloscope to determine pulse characteristics, the SWEEP DELAY dial of the scope, in conjunction with the SWEEP LENGTH control, makes it possible to view any selected portion of a pulse. The SWEEP DELAY dial delays the start of the scope sweep any desired number of microseconds; and the delay is calibrated to one-tenth of a microsecond. Assuming, for example, that a 100-microsecond pulse is fed to the scope and that the SWEEP LENGTH control is set for a 100-microsecond sweep in the 25R position, any 25-microsecond portion of the pulse can then be viewed on the scope by rotating the SWEEP DELAY dial. When the SWEEP DELAY dial reads zero, the first 25 microseconds of the pulse are visible; when the dial reads "5", the portion of the pulse from 5 to 30 microseconds is visible, etc., a different 25-microsecond portion being visible for each setting of the dial.

The calibrated-delay facilities of the oscilloscope make possible very accurate measurement of the time interval from one point on the pulse envelope to another. The two characteristics of the pulse shape which are defined and used as a common reference for all Type T–325B/FPN Transmitters are the pulse width at 50 percent amplitude and the pulse-rise time from 10 percent to 90 percent amplitude. The width shall be 40 microseconds and the rise time 21 microseconds with a possible tolerance on either of ± 1 microsecond. The procedure for measuring rise time and width are developed in full detail in Sections 3, 5, and 7. Steps 1 to 3 inclusive, below, and figure 2–16 utilize the rise-time measurement as an illustration to demonstrate the general technique.

Note

Pulse shape measurement should always be made of the r-f output of the Antenna Coupling Unit, position 14 of the MONITOR CIRCUIT switch.

STEP 1. The complete transmitted pulse is first viewed on the scope (figure 2–19A) with a full 100-microsecond sweep. Oscilloscope controls are adjusted to obtain a peak deflection of exactly 20 divisions (for the upper half of the wave form), which corresponds to 100 percent amplitude.

STEP 2. The scope controls are then adjusted to view 25 microseconds of the pulse, and a convenient vertical calibration line is selected as a reference line for taking measurements. Next, the SWEEP DELAY dial is rotated until the leading edge of the pulse crosses the reference line at the 10-percent level (two divisions on the calibrated screen as shown in figure 2–19B). The reading of the delay dial is recorded, in this case 18.2 microseconds.

STEP 3. The SWEEP DELAY dial is then rotated until the leading edge of the pulse crosses the reference line at the 90-percent level (18 divisions on the calibrated screen as shown in figure 2–19C), and the new reading of the delay dial (here, 39.4 microseconds) is recorded. The difference between the 10-percent and 90-percent readings is a measurement of pulse-rise time. Thus, 39.4 microseconds minus 18.2 microseconds gives a pulse-rise time of 21.2 microseconds.

20. PULSE APPEARANCE ON FAST OSCILLOSCOPE, LORAN TIMER.

The output pulse shape of Radio Transmitter Type T–325B/FPN, as viewed on the "Fast Scope" of the Synchronization Indicator of a Loran Timer Navy Model UE-1, is shown in figure 2–20.

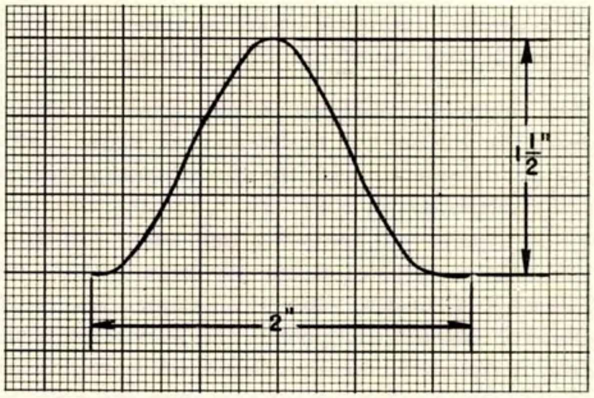


Figure 2–20. Pulse from Radio Transmitter Type T–325B/FPN, Viewed on Loran Timer Navy Model UE-1

SECTION 3
INSTALLATION

1. SCOPE OF INSTRUCTIONS.

As indicated in the system isometric drawing (figure 1-12), Radio Transmitter Type T-325B/FPN is to be used in conjunction with timing and switching equipment and, possibly, a high-powered amplifier. It is not within the scope of these instructions to describe the installation of units which are not supplied with the transmitter, nor to discuss a specific station layout. For details on the installation of the timing equipment, switching equipment, and higher-powered amplifier, refer to the instruction books supplied with those equipments. All details necessary for installing the transmitter, Voltage Regulator Assembly, terminal box, and coupling unit, and for interconnecting them with each other and with accessory equipment, are included in this manual.

2. UNPACKING INFORMATION.

The major units of Radio Transmitter Type T-325B-/FPN are packed in separate boxes, as listed in table 1-4. All equipment necessary for installation is supplied in these boxes, with the exception of material listed in table 1-2. Be certain that all boxes are kept upright, as indicated by notation on the outside. Observe the weights on each box, and make sure that appropriate lifting and transporting gear is used in handling the equipment, without subjecting it to shock or damage.

CAUTION

A nail puller should be used to remove nails. Do not use a pinch bar or claw hammer unless instructions specifically state that such tools may be used.

3. INSTALLATION OF TRANSMITTER.

a. UNPACKING. — Both transmitters, in their boxes, should be brought as close to their final locations as is practical before they are uncrated. Each transmitter is shipped intact, except tubes. The tubes have *not* been removed from the monitor oscilloscope. To uncrate each unit, the following procedure should be adhered to closely (see figure 3-1 for detail of box):

(1) Remove all nails on the perimeter of the case, which secure the top shroud of type E3 waterproof paper. A claw hammer may be used for this operation.

(2) Remove shroud.

(3) Remove all corner strapping.

(4) Remove nails securing top to ends and sides.

(5) Remove nails which secure the joist strap-hangers through the sides of the crate.

(6) Remove roof (as one assembly).

(7) Remove nails securing ends to sides.

(8) Remove nails securing ends to header assembly.

(9) Remove ends.

(10) Remove nails securing sides to skids.

(11) Remove sides.

(12) Remove nuts and washers from bolts which secure the header assembly to the skid.

(13) Remove the header assembly.

(14) Remove the single-faced corrugated paper barrier which surrounds the moisture- and vapor-proof barrier protecting the transmitter.

(15) Remove moisture- and vapor-proof barrier.

(16) Remove all bags of desiccant from the guy wires.

(17) Remove the bag of hardware attached to one of the guy wires. Place this bag aside for use later in mounting the transmitter.

(18) Remove the turnbuckles which secure the top harness assembly to the bottom angle assembly.

(19) Remove the top harness assembly and associated filler strips.

(20) Remove all nuts and washers which secure the bottom angle assembly to the pallet and skid assembly.

(21) Remove all filler strips protecting the transmitter and remove angles. The long angles are to be bolted to the bottom of the transmitter (as described in the following steps) to be used as runners for moving the transmitter to its final location.

(22) Remove the narrow bottom skirt panels from the front, rear, and both sides of the transmitter.

(23) Position four jacks along the base of the transmitter, two in front and two in the rear. Each jack should be placed between the spacers, approximately half-way between the center and corner feet of the unit.

(24) Obtain four lengths of 2 x 3 lumber, approximately 20 inches long. Place each piece on the inside of the angles along the front and rear of the transmitter, forming the base of the frame, so that each acts as a filler strip against which the tongue of the jack may exert its lifting force. Raise each jack until the filler strip is held in place.

(25) Raise all jacks equally until the transmitter is high enough to permit fitting the long angles, removed in step (21), to its base. Remove the spacers. Secure the angles to the hole in the bottom of each base foot, using the nuts, bolts, and washers supplied in the bag of hardware removed in step (17). Details of the angle assembly and bolt locations are shown in figure 3–2.

(26) Raise all jacks again until rollers can be placed under the transmitter, extending from front to rear and supported by the edges of the skid. Lower the transmitter until the angles rest on the rollers, remove the jacks, and move the unit until it is nearly balanced at one side of the skid.

(27) Lower the transmitter carefully to rollers placed on the floor, and roll it off of the skid until only one side rests on the skid.

(28) Place jacks at the front and rear of the transmitter, close to the skid. Using filler strips, as before, raise the transmitter until the skid can be pulled out from under the unit.

(29) Lower the transmitter on the rollers, remove the jacks, and move the unit to its final location, using the angles as runners for the rollers.

(30) Remove the angles and rollers by using the jacks in the same manner as in step (24); lower the transmitter into position and replace all skirt panels.

b. POSITIONING. — The specific location of the transmitter depends on the plans for a particular station. General factors to be considered, however, are accessibility of the unit for maintenance and service, and convenience of the unit to interconnecting ducts or trenchworks. The outline drawing of the transmitter (figure 3–3) shows all dimensions pertinent to positioning the unit relative to walls, ducts, or trenchworks, and spots the location of mounting holes which may be used to secure the unit in place.

In locating the transmitter relative to walls, attention should be paid to the clearance dimensions for access doors. In locating the unit relative to interconnecting media, attention should be paid to the location of the cable entry in the base of the unit (if trenchwork is used) or to the location of the cable entries in the rear of the transmitter (if connections are to be made to a duct above floor level). In anticipation of the use of trenchworks, the entries at the rear of the transmitter have been covered with a metal plate. To make use of the rear entries, remove the cover plate by loosening the screws which fasten it in place.

c. FINAL UNPACKING AND INSPECTION. — After each transmitter is positioned,

(1) Open all access doors.

(2) Remove all front and rear panels.

(3) Remove shoring, blocking, and bracing, using a saw where applicable. Special care must be taken to prevent damage to the transmitter.

(4) Remove any cord, tape, wire, etc., used to protect the equipment from damage during shipment.

(5) Make a careful and detailed inspection of all mechanical and electrical connections for any damage possibly incurred during shipment.

Note

Check the clamped connections to variometers L116, L117A, L117B, and L119, to see that they have not been disturbed. The position of these taps on the coils is *determined at the factory and should not be changed at any time.* If, through damage or error, the clamps have been loosened or changed, they should be restored in accordance with information shown in the wiring diagram, figure 7–47. There is some possibility that the output coupling coil, L118, may have become loose during shipment. The correct position for this coil is for maximum coupling; that is, its turns should be concentric with the turns of the L117 stator coil to which it is coupled. If there is occasion to restore this coil to its correct position, be sure to tighten the locknut when the adjustment is completed.

(6) Store the plasticized drawings, packed with the transmitter, in the pocket provided on the outside of the left rear door.

(7) Replace front and rear panels.

(8) Lamp banks should be placed in the base of the transmitter on both sides for drying purposes. They should be capable of dissipating at least 200 watts, and should be left on continuously until power is applied to the unit.

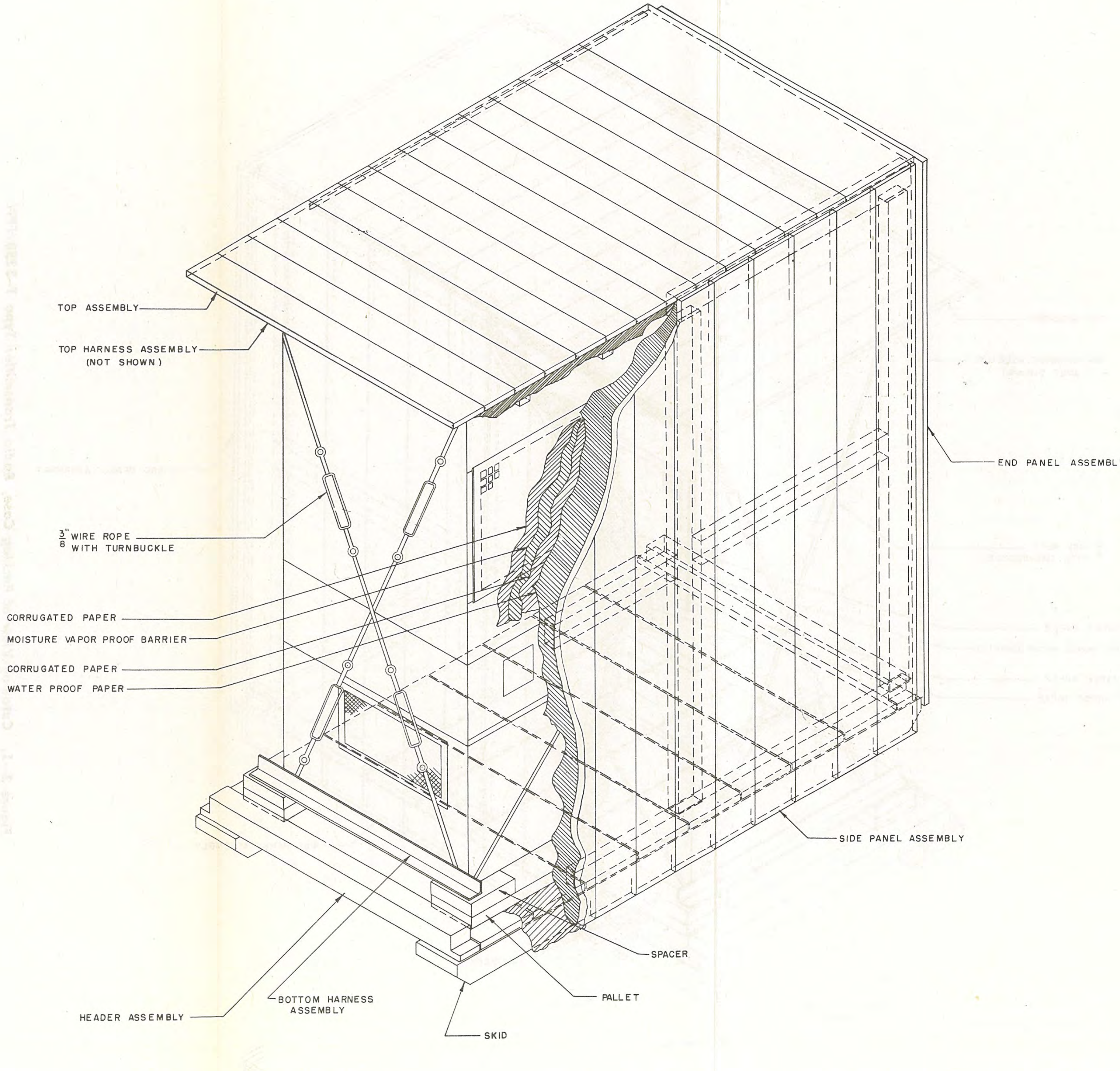


Figure 3–1. Cutaway View of Packing Case, Radio Transmitter Type T–325B/FPN

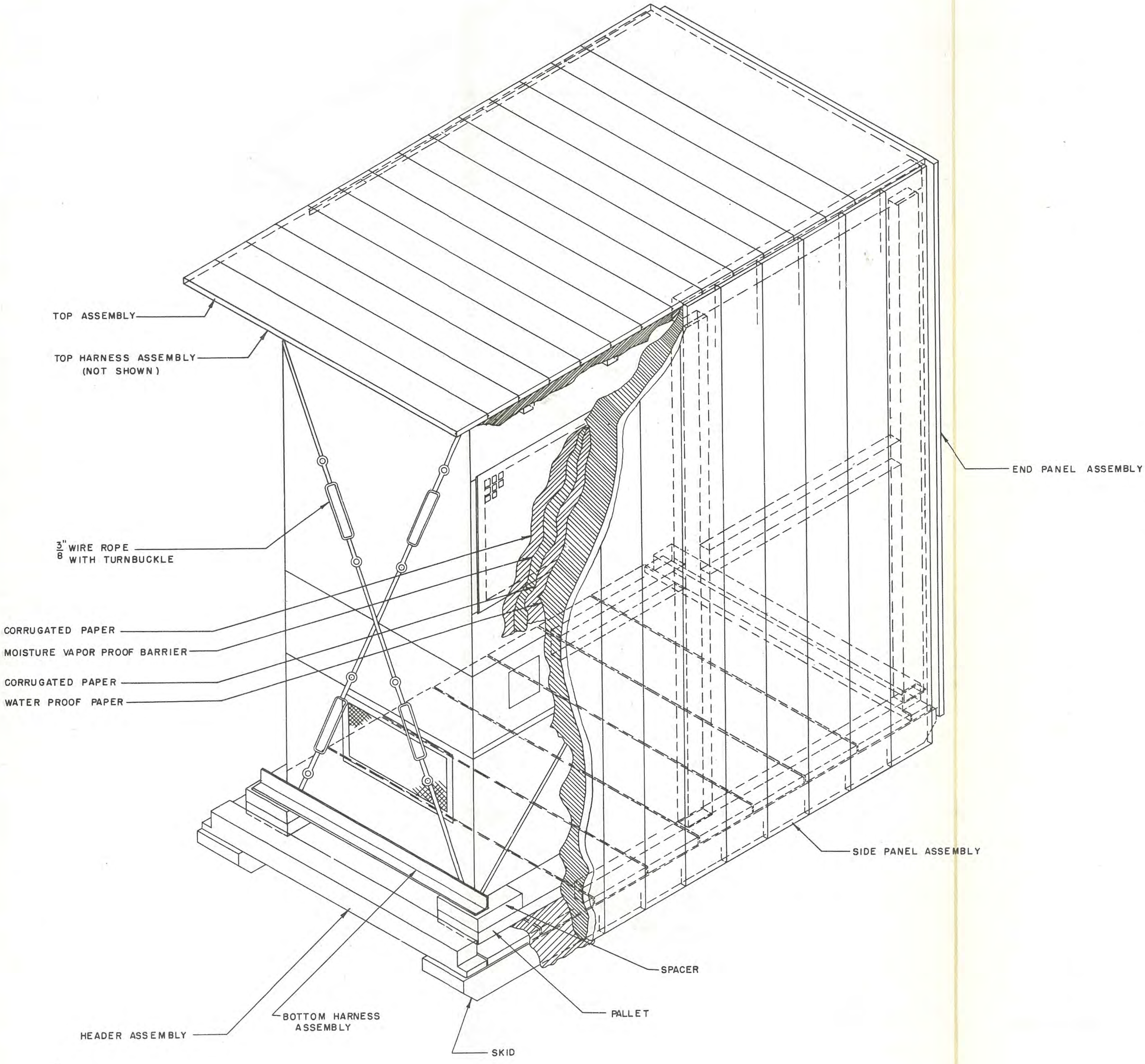
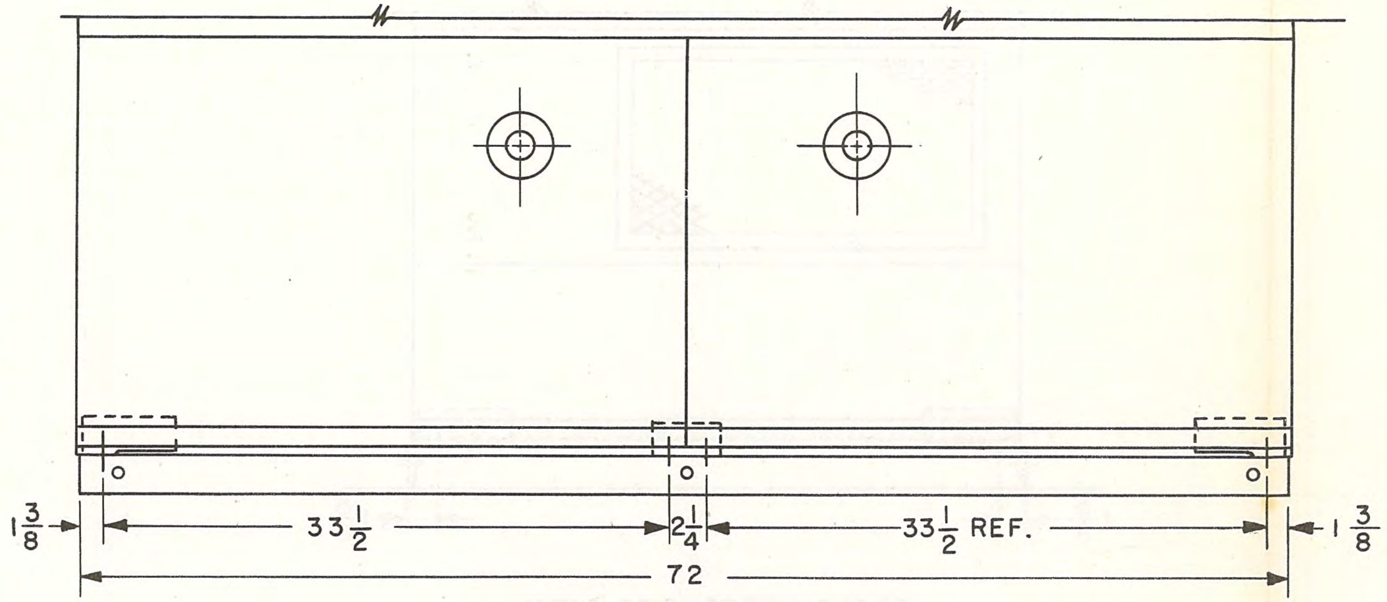
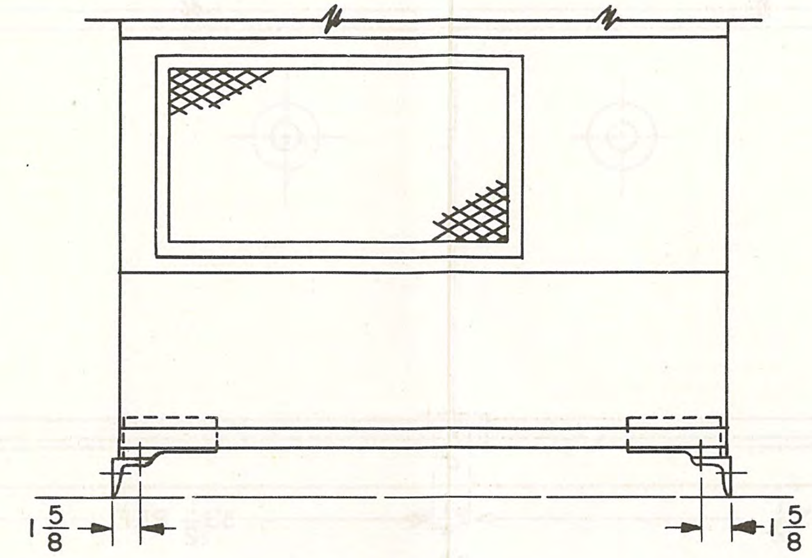


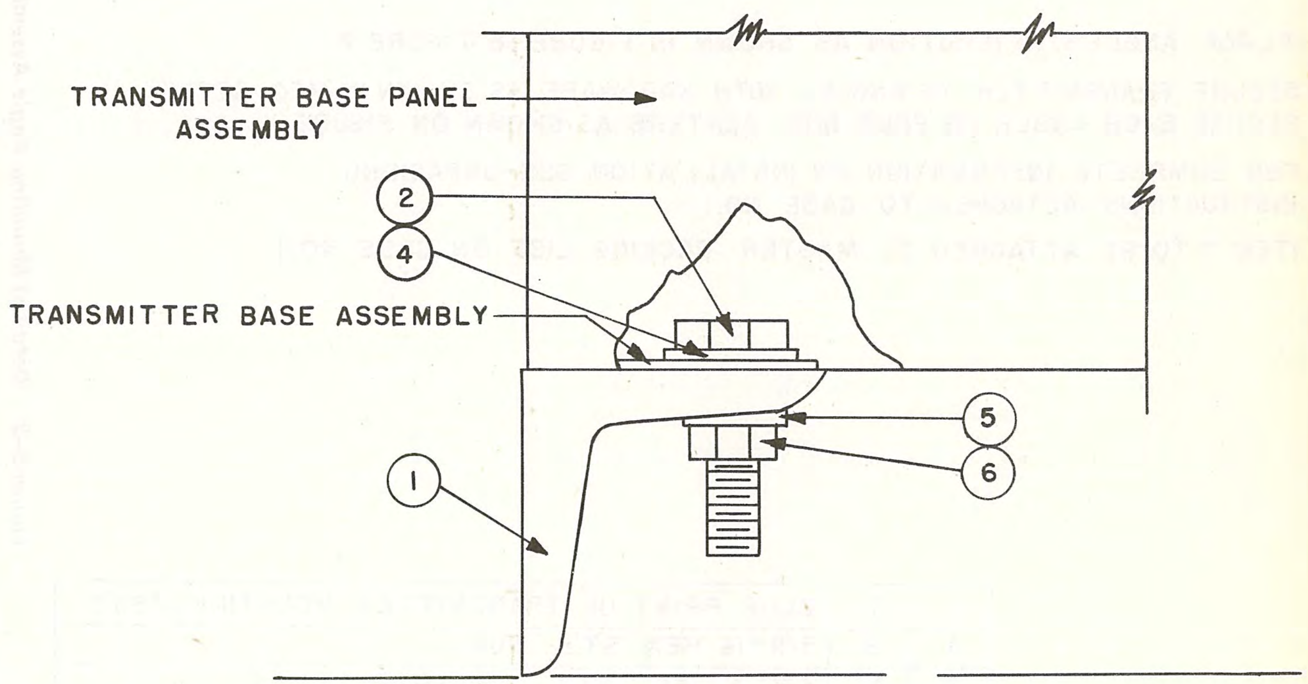
Figure 3–1. Cutaway View of Packing Case, Radio Transmitter Type T–325B/FPN



TRANSMITTER FRONT VIEW
SEE NOTE 1 & 2
FIGURE 1



TRANSMITTER SIDE VIEW
SEE NOTE 1 & 2
FIGURE 2



MOUNTING DETAIL
FULL SIZE

NOTE 1 PLACE ANGLES IN POSITION AS SHOWN IN FIGURE 1 & FIGURE 2

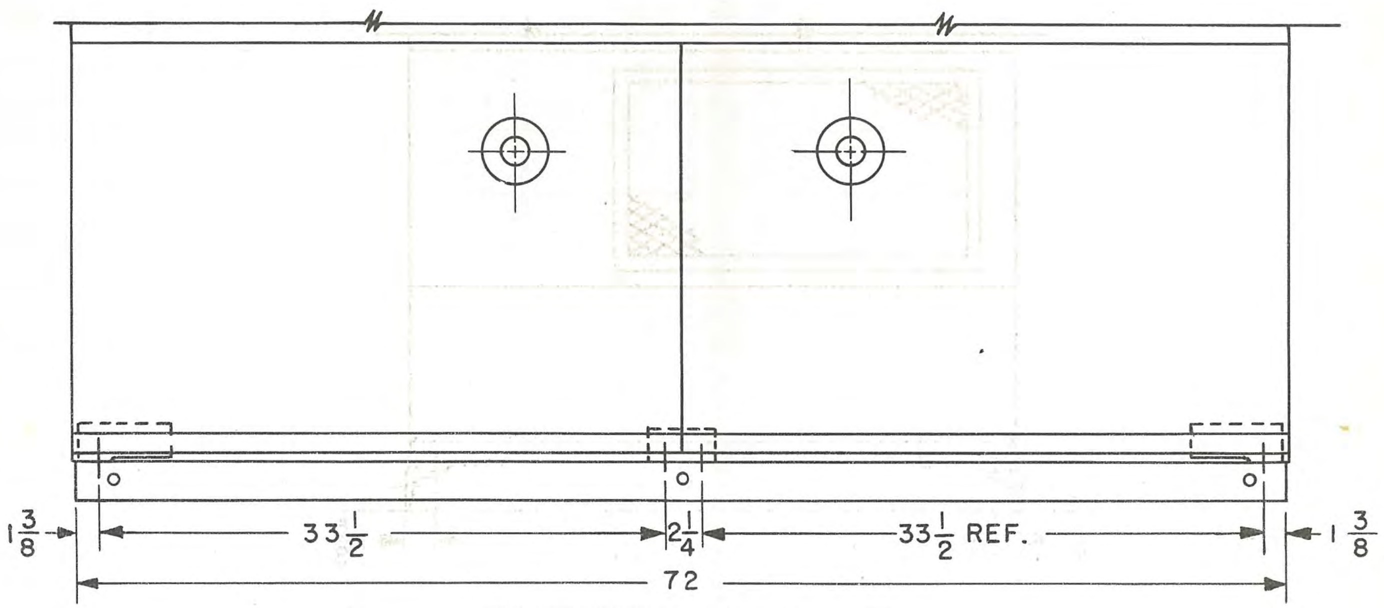
NOTE 2 SECURE TRANSMITTER TO ANGLES WITH HARDWARE AS SHOWN IN MTG. DETAIL SECURE EACH ANGLE ON FOUR MTG. CENTERS AS SHOWN ON FIGURE 1

NOTE 3 FOR COMPLETE INFORMATION ON INSTALLATION, SEE UNPACKING INSTRUCTIONS ATTACHED TO CASE NO.1

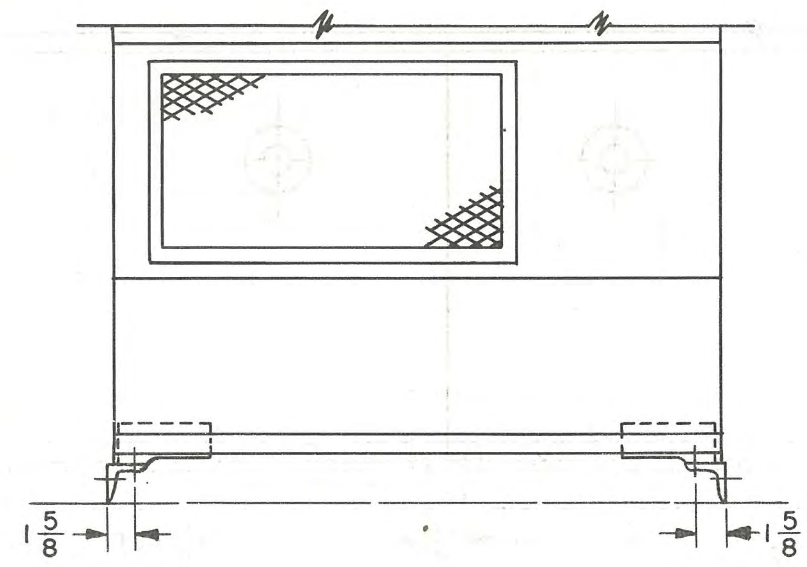
NOTE 4 ITEM 7 TO BE ATTACHED TO MASTER PACKING LIST ON CASE NO.1

	QUAN.	ITEM	DESCRIPTION
	1	7	BLUE PRINT OF TRANSMITTER MOUNTING ASS'Y
	8	6	3/8-16 HEX ST'L NUT
	8	5	3/8" N'LINK ST'L L'WASHER
	8	4	3/8 FLAT STEEL WASHER
	1	3	CLOTH BAG 4"X5"
	8	2	3/8-16X1" HEX HD STEEL CAP SCREW
*	2	1	FRS-20495-14 BOTTOM ANGLE ASS'Y DETAIL 2

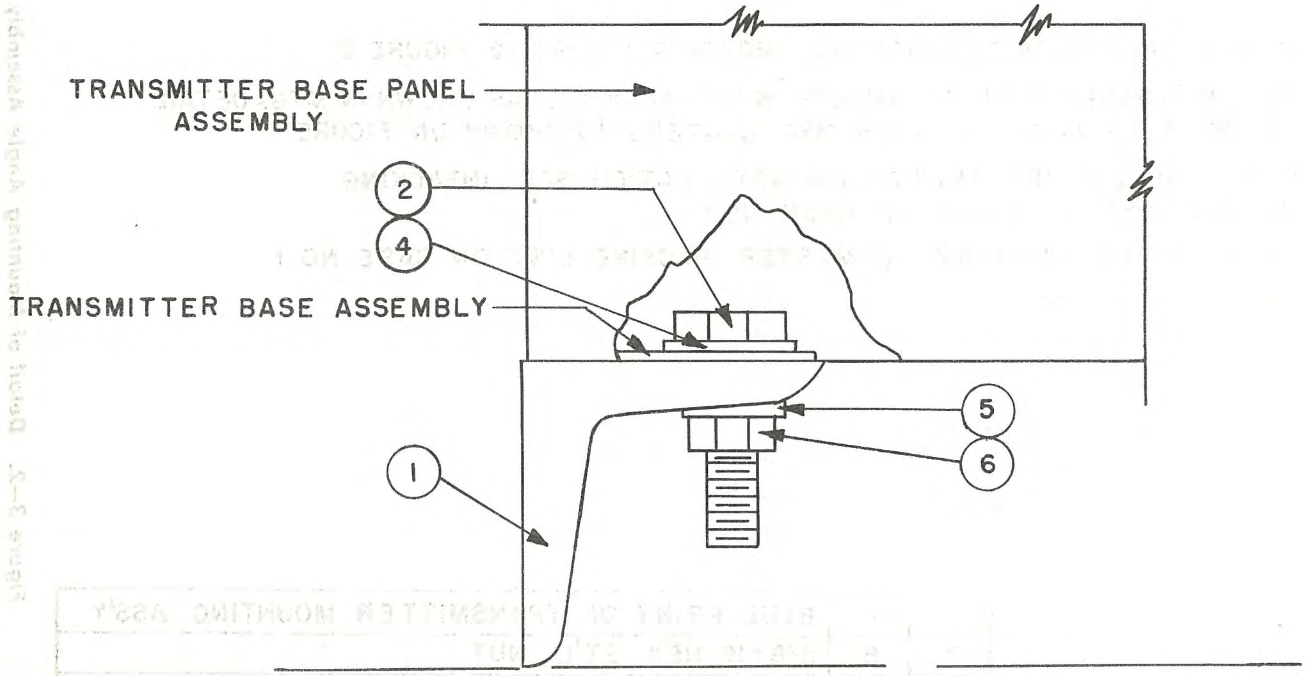
Figure 3-2. Detail of Mounting Angle Assembly for Radio Transmitter Type T-325B/FPN



TRANSMITTER FRONT VIEW
SEE NOTE 1& 2
FIGURE 1



TRANSMITTER SIDE VIEW
SEE NOTE 1&2
FIGURE 2



MOUNTING DETAIL
FULL SIZE

NOTE 1 PLACE ANGLES IN POSITION AS SHOWN IN FIGURE 1& FIGURE 2

NOTE 2 SECURE TRANSMITTER TO ANGLES WITH HARDWARE AS SHOWN IN MTG. DETAIL SECURE EACH ANGLE ON FOUR MTG. CENTERS AS SHOWN ON FIGURE 1

NOTE 3 FOR COMPLETE INFORMATION ON INSTALLATION, SEE UNPACKING INSTRUCTIONS ATTACHED TO CASE NO.1

NOTE 4 ITEM 7 TO BE ATTACHED TO MASTER PACKING LIST ON CASE NO.1

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8	5	3/8" N'LINK ST'L L'WASHER
8	4	3/8 FLAT STEEL WASHER
1	3	CLOTH BAG 4"X5"
8	2	3/8-16X1" HEX HD STEEL CAP SCREW
* 2	1	FRS-20495-14 BOTTOM ANGLE ASS'Y DETAIL 2
QUAN.	ITEM	DESCRIPTION

Figure 3-2. Detail of Mounting Angle Assembly for Transmitter Type T-325B/FPN

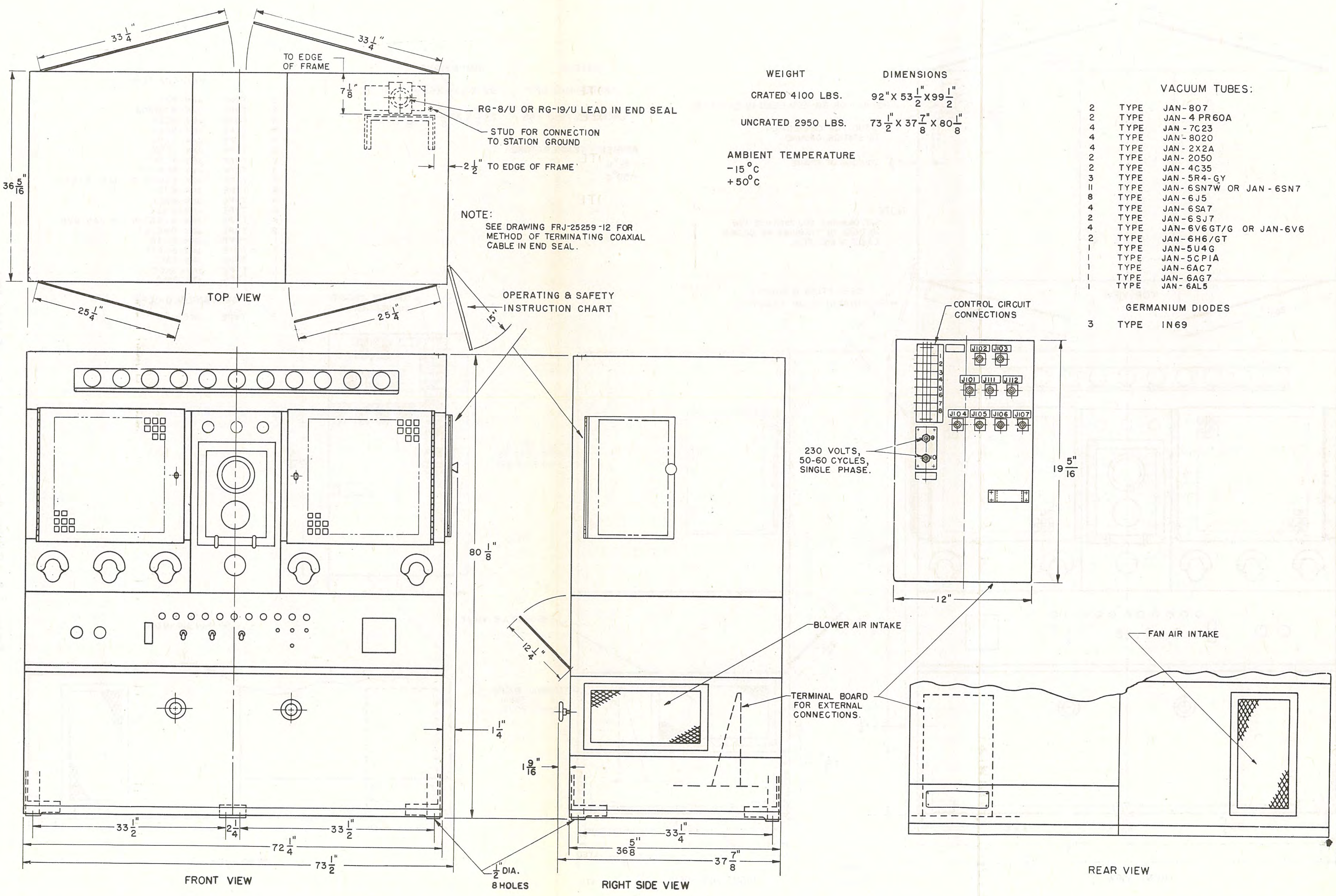


Figure 3–3. Outline, Radio Transmitter Type T–325B/FPN

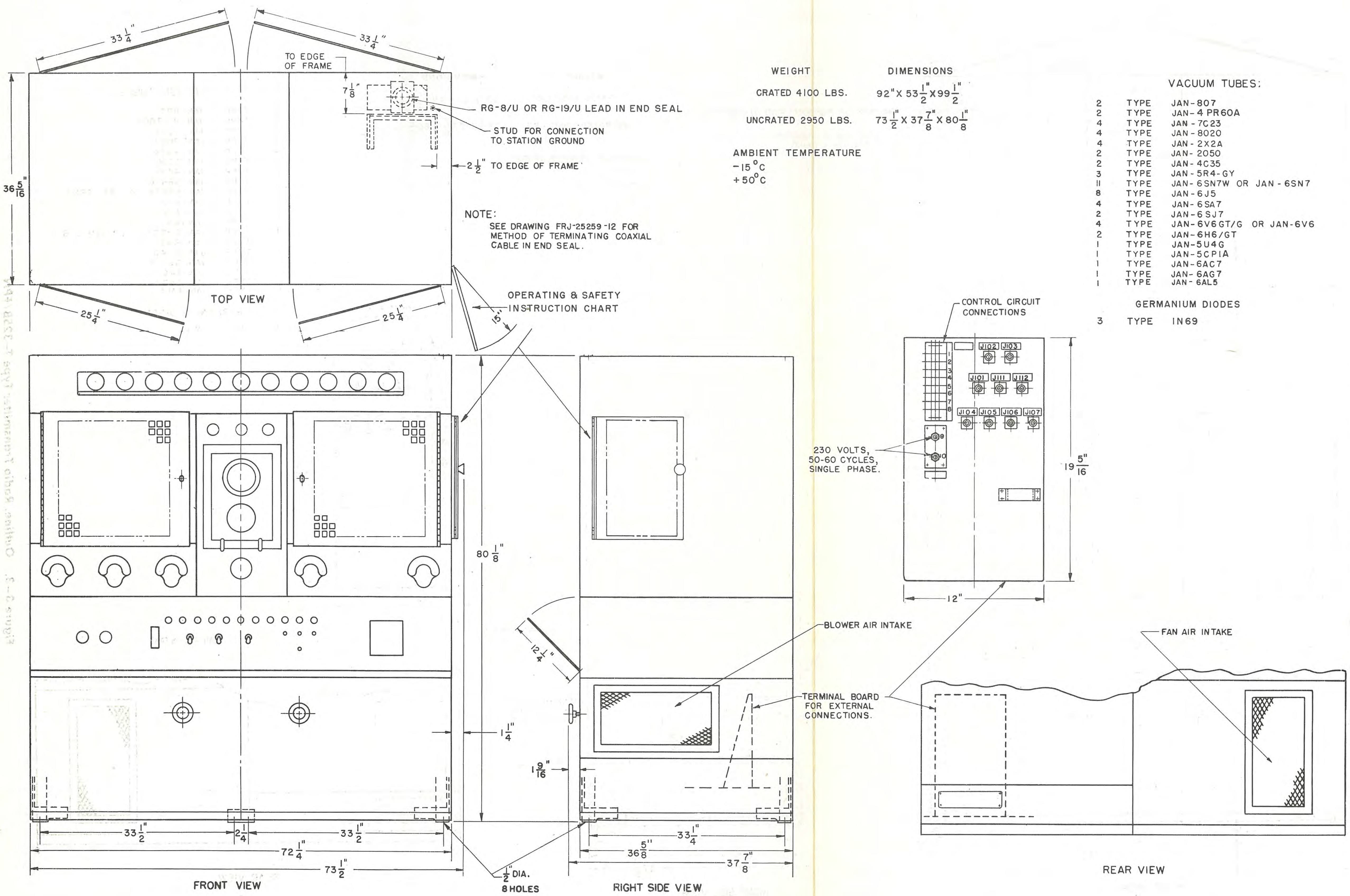


Figure 3-3. Outline Radio Transmitter Type T-325B/FPN

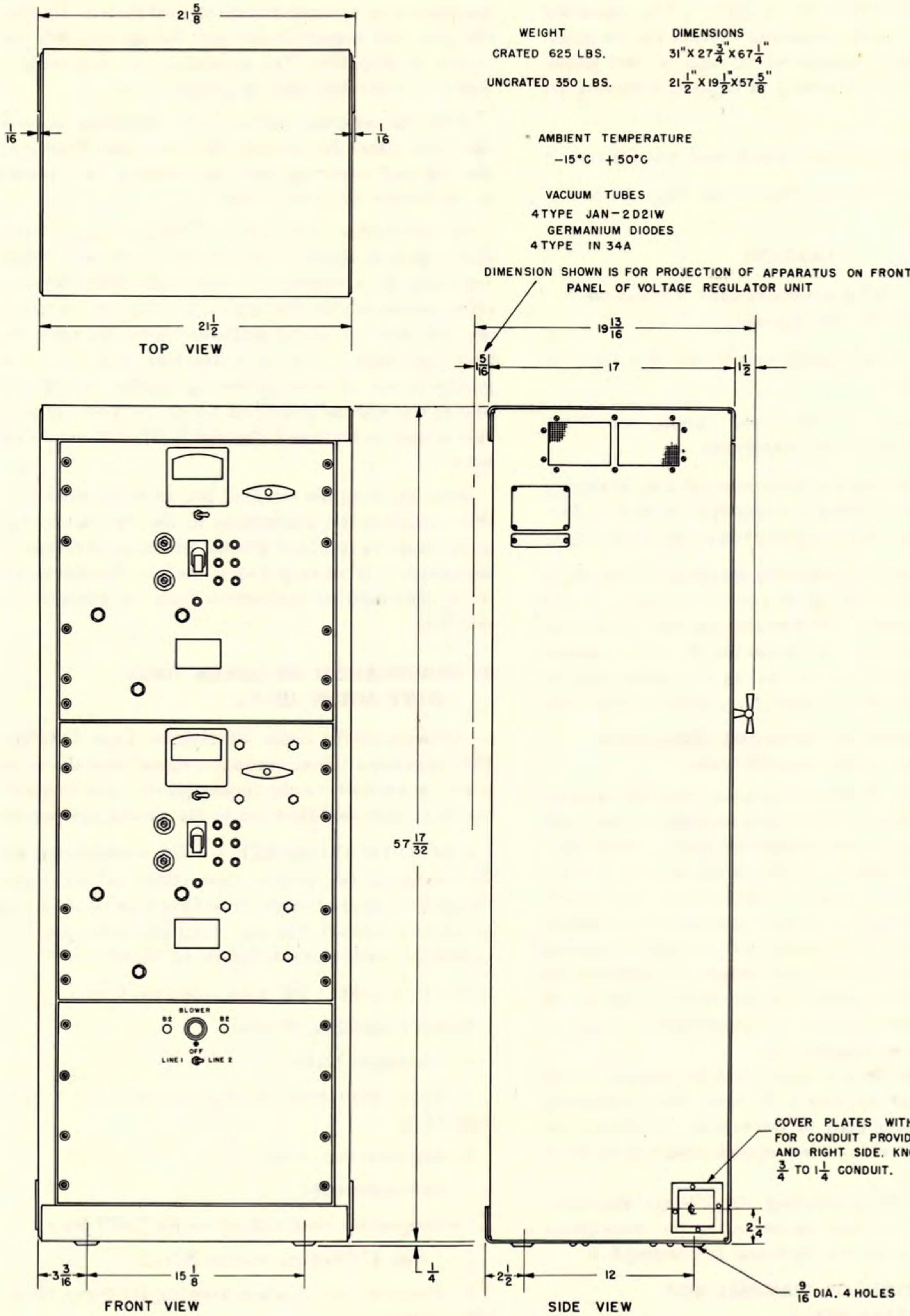


Figure 3–4. Outline, Voltage Regulator Assembly Type CN–239/FPN

d. INSTALLATION OF TUBES. — One complete set of tubes for each transmitter (except for the monitor oscilloscope) is supplied in each of two boxes. Each box is to be unpacked as follows, observing all precautions:

(1) Clip metal bands which bind wooden case.

(2) Remove at least three sides from the box.

CAUTION

Use a nail puller to remove nails. Do not use a pinch bar or claw hammer.

(3) Tear open sealed water-proof box liner of type L2 material.

(4) Remove the fiberboard carton, containing one set of tubes for one transmitter.

(5) Install tubes in both transmitters, following the procedure of Section 5, paragraphs *4a* and *4b*. Disregard that material which describes removal of tubes.

When the unit is completely assembled it should be connected to the Voltage Regulator Assembly, to the switching equipment, the terminal box, and the ground system as explained in paragraph 8. If a higher-powered amplifier is to be used in the system, refer to the amplifier instruction book for interconnection data.

4. INSTALLATION OF VOLTAGE REGULATOR ASSEMBLY TYPE CN-239/FPN.

The complete Voltage Regulator Assembly is shipped intact in its box and is to be installed at some convenient location in the transmitter room. General factors to be considered in positioning the unit are the accessibility of the unit for maintenance and service and the convenience to interconnecting ducts or trench works. After the box is placed near the desired location carefully uncrate the unit and inspect the cabinet, the blower, and the regulators for possible damage due to shipping. The procedure for uncrating is similar to that described in paragraph 3*a*.

After the unit is uncrated it can be secured at the desired location by means of floor bolts extending through the floor plate of the cabinet. Provisions are available for attaching a bolt at each corner of the floor plate.

Instructions for connecting the Voltage Regulator Assembly to a primary source and to the transmitters of the loran station are explained in paragraph 8.

5. INSTALLATION OF TERMINAL BOX TYPE J-455A/FPN.

Terminal Box Type J-455A/FPN, shipped intact in its box, is to be installed in the vicinity of the transmitter on any convenient vertical surface. Uncrate the unit and inspect it for any damage possibly incurred in shipment. The procedure for uncrating is similar to that described in paragraph 3*a*.

After the terminal box has been unpacked, remove the front panel by rotating the two panel latches at the top and removing the four binding head screws at the bottom and lower sides.

As indicated on the outline drawing (figure 3-5), dimensions of the terminal box are such as to allow mounting on a standard 19-inch rack. However, any other convenient vertical surface is adequate. In selecting the location, allow sufficient room between the floor and base of the unit (at least one foot) for manipulation of interconnecting cables. Secure the unit to the selected mounting surface by means of suitable screws or bolts and the four 0.281-inch mounting holes.

After securing the terminal box in the desired location, complete the connections to the transmitter, antenna coupling unit, and ground system as described in paragraph 7. If an amplifier is used in the system, refer to the amplifier instruction book for interconnection data.

6. MODIFICATION OF LORAN TIMER NAVY MODEL UE-1.

Operation of the Radio Transmitter Type T-325B/-FPN requires a 100-kc excitation signal from the loran timer, in addition to the timing pulse. This, in itself, entails certain modifications to the timing equipment.

a. MODIFICATION KIT. — The modification kit for changing the output connections of the timer should be unpacked carefully so that none of the items are lost or mislaid. The kit (supplied under previous contracts) consists of the following items:

1—0.01 mf, 300 v DC mica capacitor, C2106.

1—cable assembly, W2103.

1—receptacle, J2104.

4—round head brass machine screws, 4-40 x 7/16 inches long.

4—hex brass nuts, 4-40.

4—lockwashers, #4.

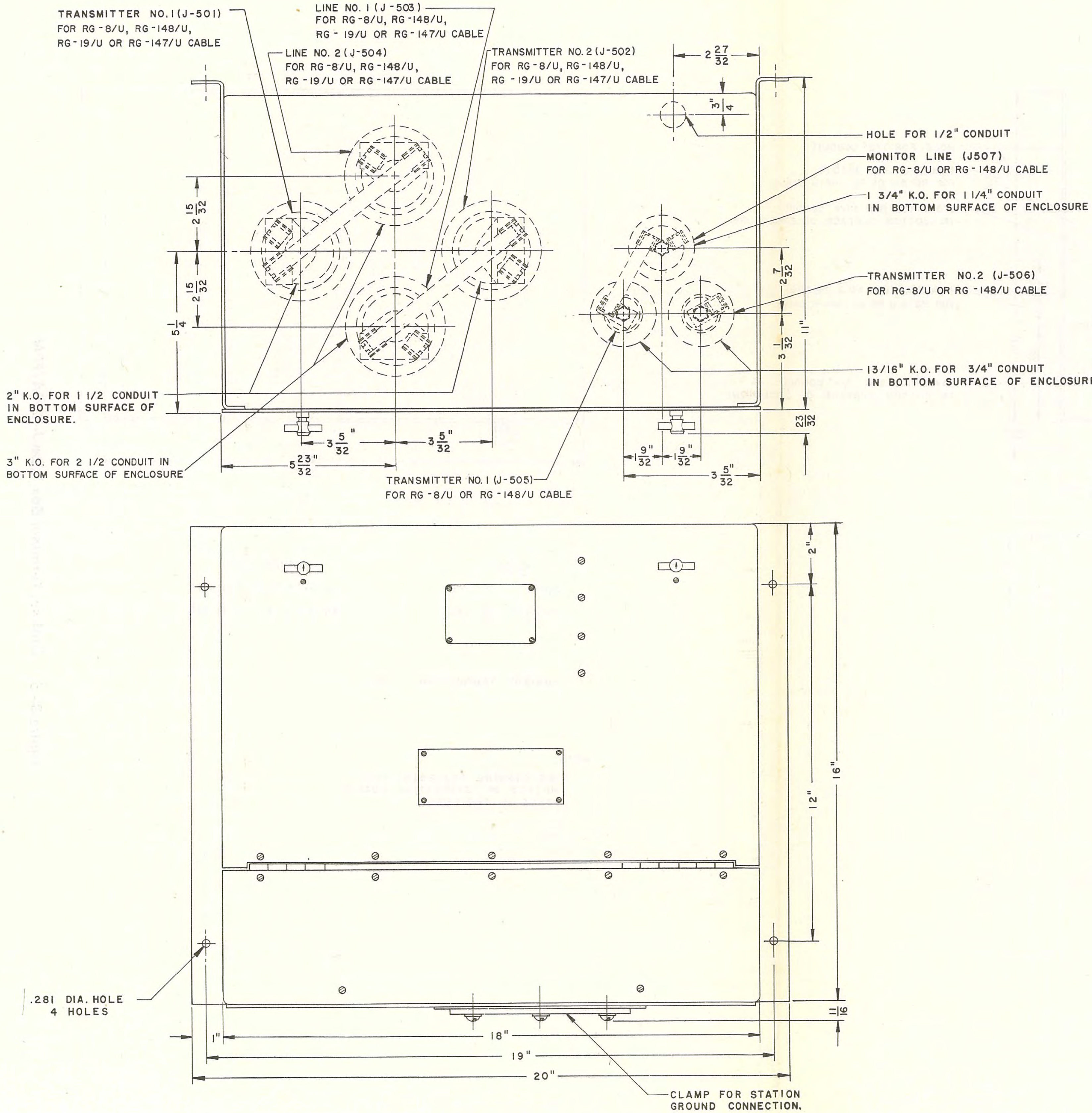
1—designation plate (substitute for J2600 plate).

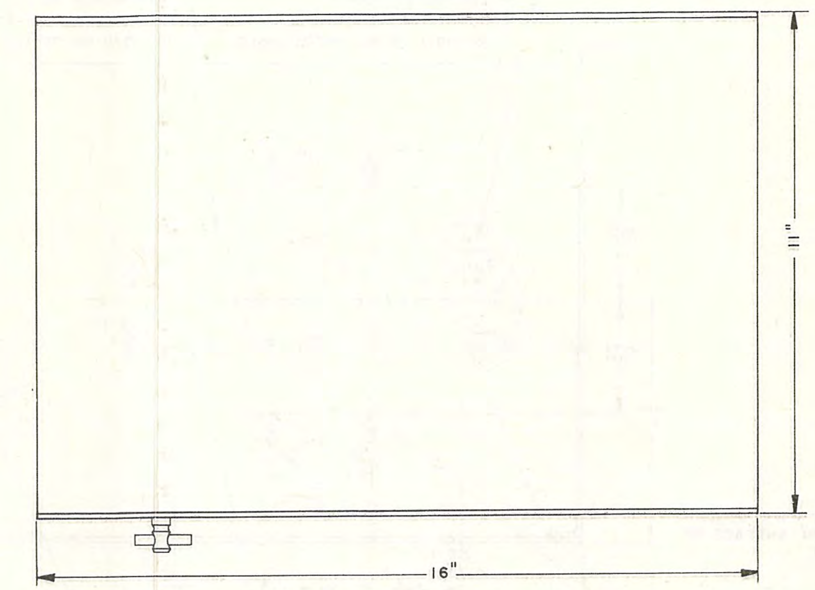
1—1 watt 47,000-ohm resistor, R2112.

1—blueprint modification drawing for Navy Model UE-1 Timer.

1—high-speed steel drill, #30 (0.128 inch).

1—high-speed steel drill, 11/16 inch.





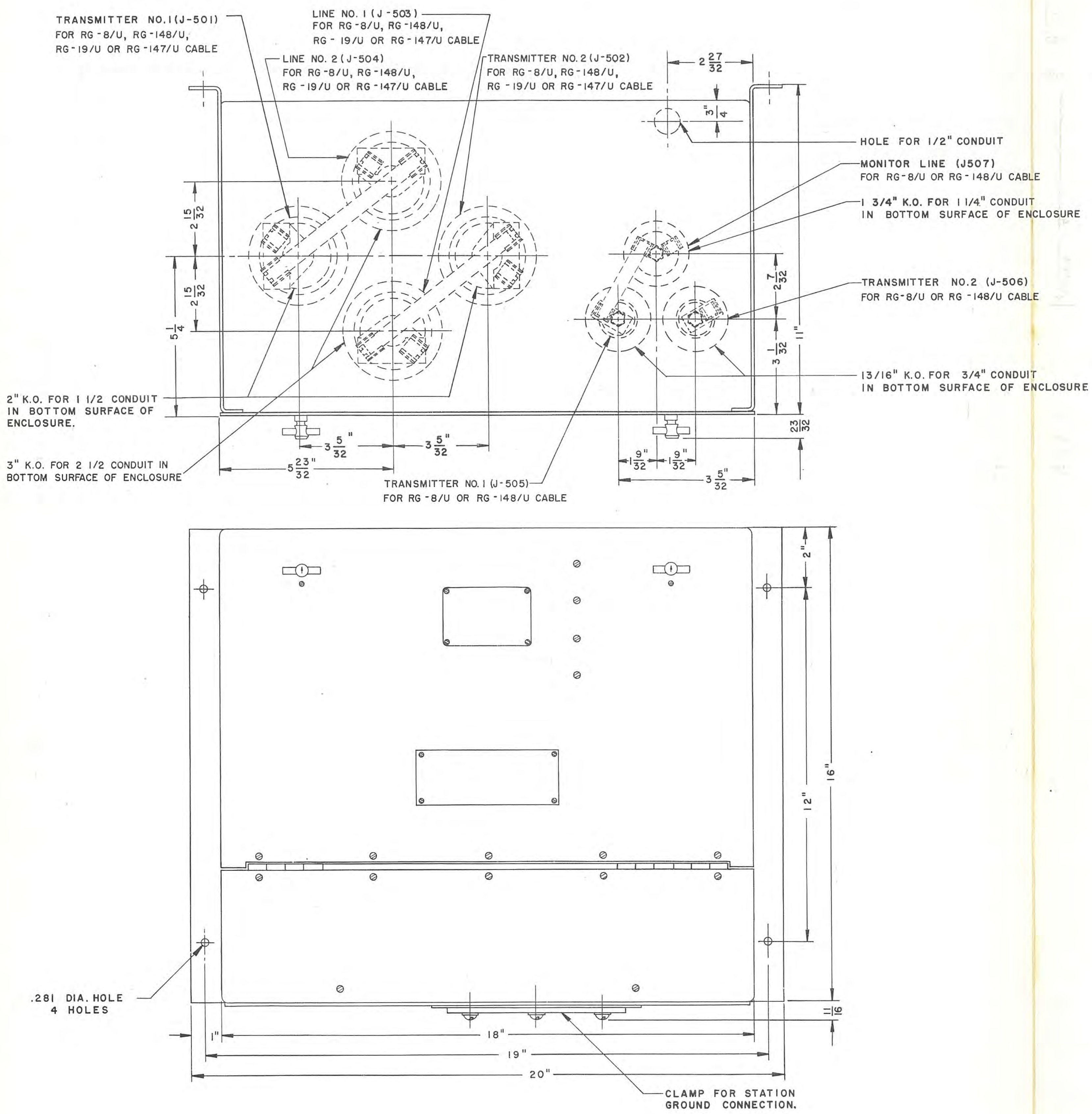
WEIGHT:
CRATED 70 LBS.
UNCRATED 29 LBS.

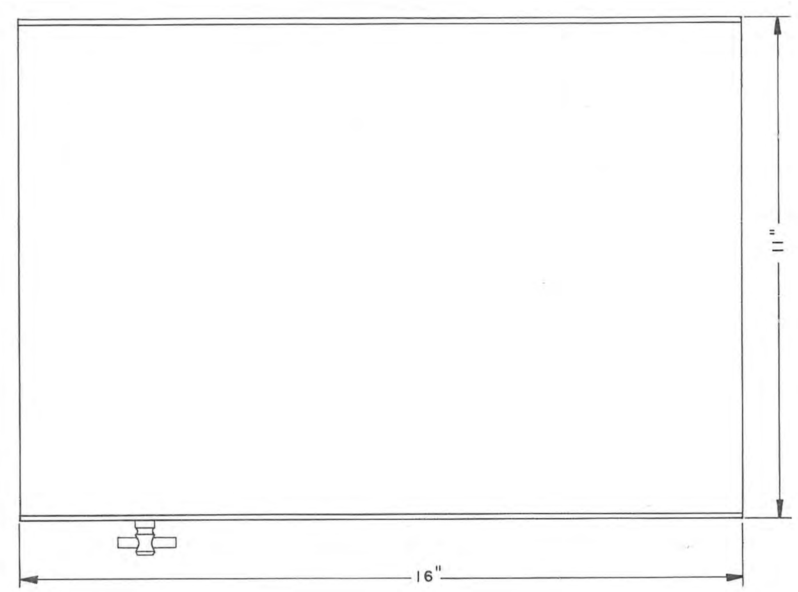
DIMENSIONS:
29 1/8" X 26 1/2" X 17 5/8"
20" X 16 11/16" X 11 23/32"

AMBIENT TEMPERATURE -15°C. +50°C.

NOTE:
SEE DRAWING FRJ-25259 FOR METHOD OF TERMINATING COAXIAL CABLE IN END SEALS.

Figure 3-5. Outline, Terminal Box Type J-455A/FPN





WEIGHT:	DIMENSIONS:
CRATED 70 LBS.	29 1/8" X 26 1/2" X 17 5/8"
UNCRATED 29 LBS.	20" X 16 11/16" X 11 23/32"

AMBIENT TEMPERATURE −15°C. +50°C.

NOTE:

SEE DRAWING FRJ-25259 FOR METHOD OF TERMINATING COAXIAL CABLE IN END SEALS.

Figure 3–5. Outline, Terminal Box Type J–455A/FPN

NOTES:

1- REMOVE THE SYNCHRONIZATION CONTROL UNIT FROM THE TIMER CABINET. DRILL 5 HOLES, USING ITEMS 11 AND 12 ON REAR OF CHASSIS FOR MOUNTING RECEPTACLE, J2104, ITEM 3, AS SHOWN ON REAR VIEW. MOUNT J-2104 USING HARDWARE, ITEMS 4, 5 AND 6.

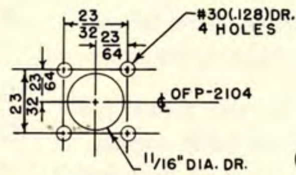
2- MOUNT RESISTOR R-2112, ITEM 9 AND CAPACITOR C-2106 ITEM 1, ON THE EXISTING TERMINAL BOARD TB 1505 IN SYNCHRONIZATION CONTROL UNIT TO UNUSED TERMINALS BETWEEN EXISTING RESISTORS R1524 AND R1525. THIS IS SHOWN ON WIRING DIAGRAM IN UPPER RIGHT HAND CORNER OF THIS DRAWING. WIRE C2106 AND R2112 TO V1504 AND J2104 AS ALSO SHOWN, USING ITEM 8.

3- USING RUBBER STAMP AND PRINTERS INK, OR OTHER SUITABLE METHOD, STAMP CIRCUIT SYMBOLS R2112, C2106 AND J2104 NEAR THE APPROPRIATE ADDED PARTS FOR REFERENCE WHEN SERVICING.

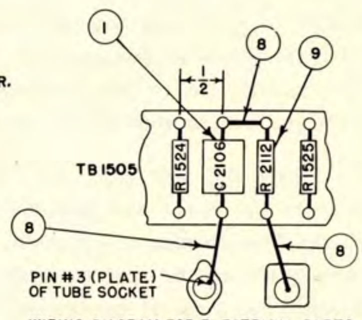
4- RESTORE THE SYNCHRONIZATION CONTROL UNIT TO POSITION IN THE TIMER CABINET.

5- CONNECT IN CABLE W2103 ITEM 2 AS SHOWN.

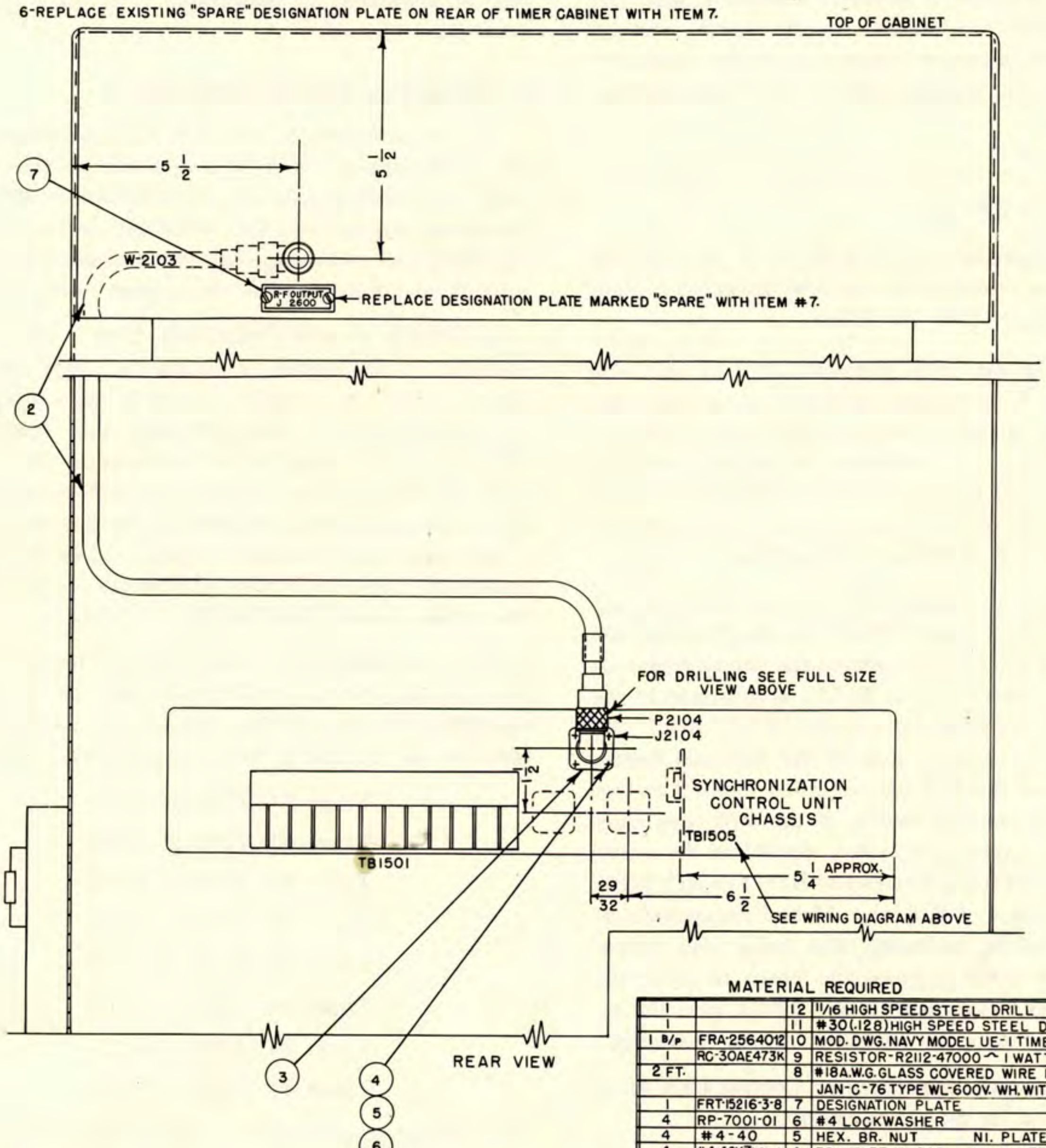
6- REPLACE EXISTING "SPARE" DESIGNATION PLATE ON REAR OF TIMER CABINET WITH ITEM 7.



MTG. HOLES FOR J-2104 (ITEM #3) FULL SIZE



WIRING DIAGRAM FOR ELECTRICAL PARTS ADDED IN SYNCHRONIZATION CONTROL UNIT



MATERIAL REQUIRED

PART 1	DWG. OR CAT. NO	ITEM NO.	DESCRIPTION
1		12	11/16 HIGH SPEED STEEL DRILL
1		11	#30(.128) HIGH SPEED STEEL DRILL
1 B/P	FRA-2564012	10	MOD. DWG. NAVY MODEL UE-1 TIMER
1	RC-30AE473K	9	RESISTOR-R2112-47000 Ω 1 WATT
2 FT.		8	#18 A.W.G. GLASS COVERED WIRE PER
			JAN-C-76 TYPE WL-600V. WH. WITH GN. TR.
1	FRT-15216-3-8	7	DESIGNATION PLATE
4	RP-7001-01	6	#4 LOCKWASHER
4	#4-40	5	HEX. BR. NUT NI. PLATE
4	#4-40X7/16LG	4	RD. HD. BR. M. SCR. NI. PLATE
1	TYPE 49194	3	RECEPTACLE NAVY J2104
1	FRA-15204-23	2	CABLE ASSEMBLY
1	CM35B103K	1	CAPACITOR-C-2106-.01MFD. 300V. D-C

Figure 3–6. Modification Information, Navy Model UE-1 Timer

b. MODIFICATION OF TIMER. — Facilities must be installed in the timer for bringing out the 100-kc signal which connects through the Navy Model UM switching equipment to the transmitter. The following procedure is recommended for modifying the timer.

(1) Open the left rear door of the timer (as viewed from the rear) and remove all cable connections to the Synchronization Control Unit. It will not be necessary to tag the disconnected leads, since each coaxial cable has a metal marker on which is stamped a "P" number which corresponds to the "J" number of the jack to which it normally connects. Also, the textolite spreader on the laced cable which connects to TB1501 makes proper connections readily apparent. (Refer to Section 3, paragraph 6, of the timer instruction book.)

(2) Remove the Synchronization Control Unit from the timer cabinet.

(3) Replace the SPARE designation plate on the top rear of the cabinet with the new designation plate (item 7 on figure 3–6) for J2600.

(4) Using the drills supplied, drill an entrance hole 11/16 inch in diameter and four mounting holes 0.128 inch in diameter for mounting the connector J2104. Locate the holes as shown on the rear view and the detail view of figure 3–6. Mount the jack (item 3 on figure 3–6) on the chassis, using the hardware (items 4, 5, and 6 of figure 3–6) supplied.

(5) Mount the resistor R2112 and the capacitor C2106 on terminal board TB1505 in the Synchronization Control Unit. Mount them on the empty terminals between resistors R1524 and R1525, as indicated in the wiring detail of figure 3–6. Connect R2112 and C2106 together on the bottom side of the terminal board, using a piece of the #18 wire supplied (item 8 on figure 3–6). Run another section of the #18 wire from the free end of capacitor C2106 to pin #3 on the socket for V1504. Connect the free end of R2112 to jack J2104 with another piece of #18 wire. Make firm mechanical connections before soldering. Use india ink, rubber stamp, or any other appropriate means to print the circuit symbols C2106, R2112, and J2104, near the respective components, for reference during servicing.

(6) Restore the Synchronizer Control Unit to its normal position in the timer cabinet.

(7) Connect cable W2103 (item 2 in figure 3-6) between J2104 and the newly designated J2600, as shown in figure 3–6.

(8) Restore other cable connections previously removed, and close the left rear door of the timer.

The timer is now ready for use as covered by this instruction book.

7. INSTALLATION OF ANTENNA COUPLING UNIT.

The antenna coupling unit is not supplied with this equipment. For unpacking and installation instructions refer to the instruction book supplied with the antenna coupling unit that is provided for the particular Coast Guard installation involved.

The antenna coupling unit should be connected to the antenna, the ground system, and the terminal box as explained in paragraph 7 of the applicable instruction manual.

8. INTERCONNECTION OF UNITS.

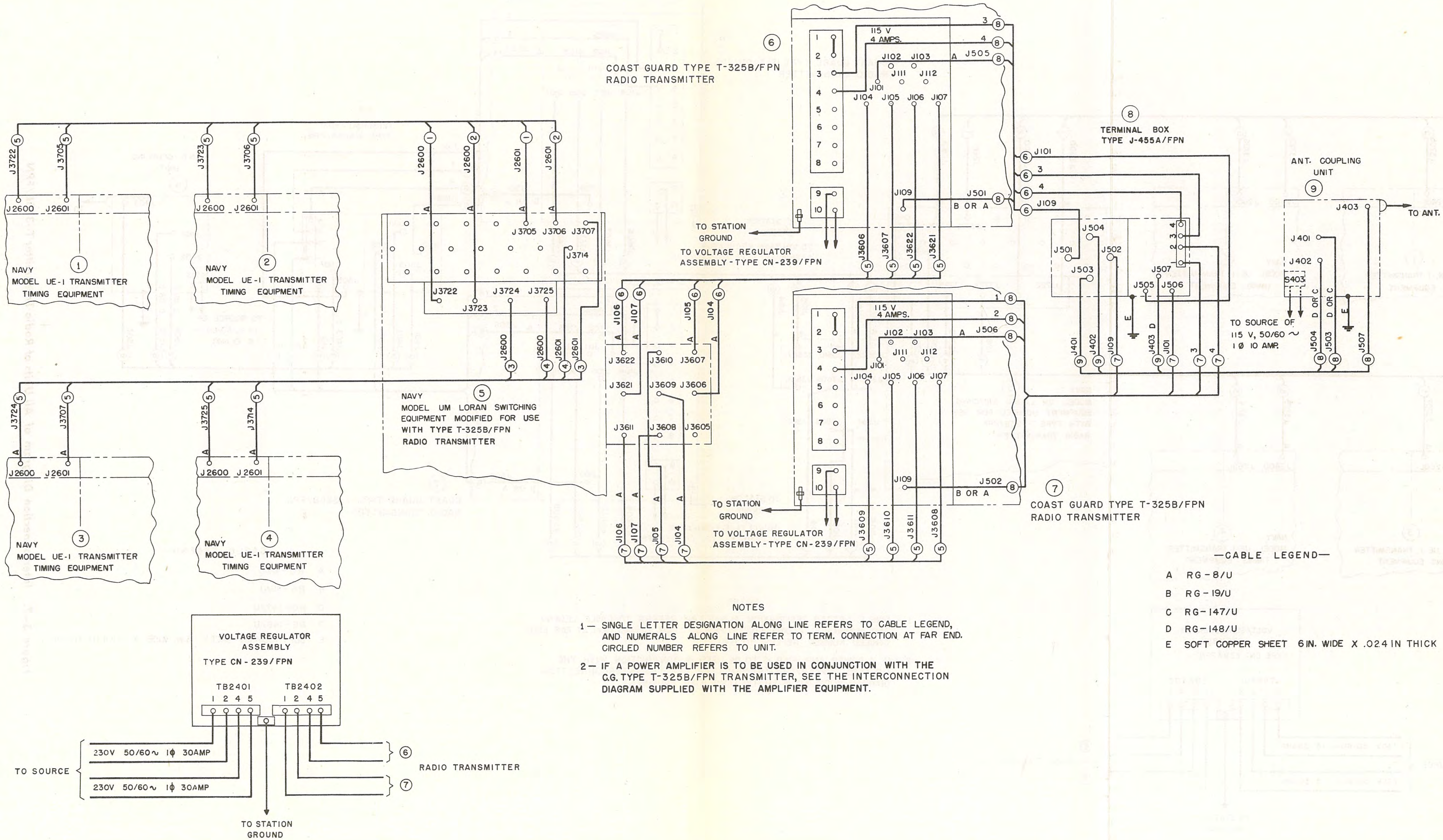
All interconnection data for the transmitter and the units supplied with it are shown in figure 3–7. Only those connections are included which affect the transmitter equipment. For additional information on the timer and switching unit connections, refer to the instruction books supplied with those units.

a. TIMER — SWITCHING UNIT CONNECTIONS. — As shown in figure 3–7, type RG–8/U coaxial cable (not supplied) is to be used to connect the timing units to the switching unit. Navy type #49195 plugs are supplied to terminate the cables. The plugs are supplied on the jack terminals to which the cables are to connect. Instructions for connecting the plugs to the coaxial cable will be found in Section 10, paragraph 3, of the Model UM Switching Equipment Instruction Book (NAVSHIPS 900,745).

Refer to figure 3–11, which shows the additional jacks added during modification of the switching equipment, to help in locating the terminating locations for the following connecting cables:

Timer #1: J2600 to J3722
Timer #1: J2601 to J3705
Timer #2: J2600 to J3723
Timer #2: J2601 to J3706
Timer #3: J2600 to J3724
Timer #3: J2601 to J3707
Timer #4: J2600 to J3725
Timer #4: J2601 to J3714

b. SWITCHING UNIT — TRANSMITTER CONNECTIONS. — Type RG–8/U coaxial cable, terminated with Navy #49195 plugs, is also used for all connections between the switching unit and each transmitter. The following connecting cables are required (see figures 1–9 and 3–12):



NOTES

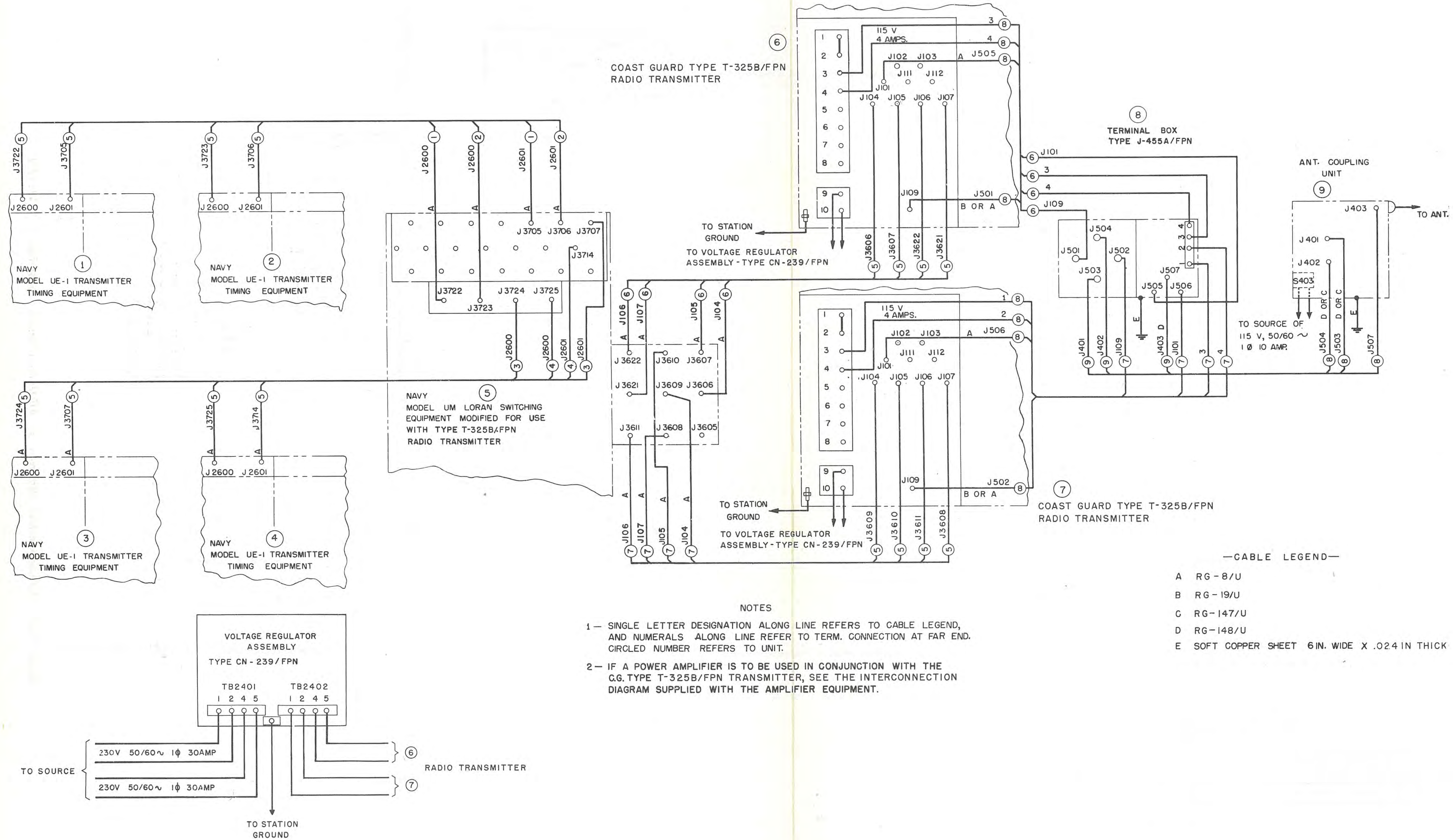
1 — SINGLE LETTER DESIGNATION ALONG LINE REFERS TO CABLE LEGEND, AND NUMERALS ALONG LINE REFER TO TERM. CONNECTION AT FAR END. CIRCLED NUMBER REFERS TO UNIT.

2 — IF A POWER AMPLIFIER IS TO BE USED IN CONJUNCTION WITH THE C.G. TYPE T-325B/FPN TRANSMITTER, SEE THE INTERCONNECTION DIAGRAM SUPPLIED WITH THE AMPLIFIER EQUIPMENT.

—CABLE LEGEND—

A RG-8/U
B RG-19/U
C RG-147/U
D RG-148/U
E SOFT COPPER SHEET 6 IN. WIDE X .024 IN THICK

Figure 3–7. Interconnection Diagram of All Units of Radio Transmitter T–325B/FPN



NOTES

1— SINGLE LETTER DESIGNATION ALONG LINE REFERS TO CABLE LEGEND, AND NUMERALS ALONG LINE REFER TO TERM. CONNECTION AT FAR END. CIRCLED NUMBER REFERS TO UNIT.

2— IF A POWER AMPLIFIER IS TO BE USED IN CONJUNCTION WITH THE C.G. TYPE T-325B/FPN TRANSMITTER, SEE THE INTERCONNECTION DIAGRAM SUPPLIED WITH THE AMPLIFIER EQUIPMENT.

—CABLE LEGEND—

- A RG-8/U
- B RG-19/U
- C RG-147/U
- D RG-148/U
- E SOFT COPPER SHEET 6 IN. WIDE X .024 IN THICK

Figure 3–7. Interconnection Diagram of All Units of Radio Transmitter T–325B/FPN

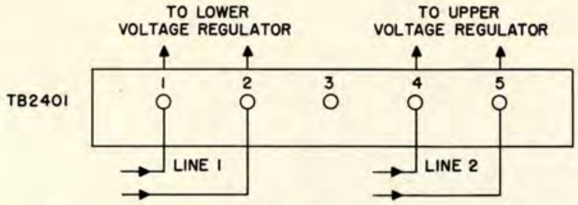


Figure 3–8. Voltage Regulator Assembly, Input Terminal Board Connections for Two Power Sources

J3606 to J104, Transmitter #1

J3607 to J105, Transmitter #1

J3622 to J106, Transmitter #1

J3621 to J107, Transmitter #1

J3609 to J104, Transmitter #2

J3610 to J105, Transmitter #2

J3611 to J106, Transmitter #2

J3608 to J107, Transmitter #2

The length of the cables between the switching unit and the transmitter should not exceed 100 feet for proper operation of the equipment.

c. VOLTAGE REGULATOR ASSEMBLY POWER AND GROUND CONNECTIONS. — The Voltage Regulator Assembly should be supplied with an input line voltage of 195 to 255 volts ac, single phase, 50 to 65 cycles per second. Either two separate power sources can be used, in which case each power source supplies one voltage regulator, or a single power source can be used to supply both voltage regulators. Where two power sources are used each must be capable of supplying a load of 30 amperes and are connected to the input terminal board TB2401 of the Voltage Regulator Assembly as shown in figure 3–8. Where one power source is used it must be capable of supplying a load of 60 amperes and can be wired to the input terminal board as shown in figure 3–9. As indicated in figures 3–8 and 3–9, the lower voltage regulator power input is obtained from terminals 1 and 2 of TB2401 and the upper voltage regulator power input from terminals 4 and 5 of TB2401.

Direct connection to the station ground system is to be made by copper strap or braid. A clamping plate for the ground connection is located at the bottom rear of the cabinet. See figure 3–10.

d. VOLTAGE REGULATOR ASSEMBLY—TRANSMITTER CONNECTIONS. — The Voltage Regulator Assembly supplies regulated 230 volts to both loran transmitters, each voltage regulator supplying one transmitter. As shown in figure 3–7 the regulated output voltage of the lower voltage regulator is obtained at terminals 1 and 2 of output terminal board TB2402 and the regulated output voltage of the upper regulator at terminals 4 and 5. As indicated on figure 3–7 the 230-volt leads from these terminals to the power input terminals 9 and 10 on the transmitter (see figure 3–12) must each be capable of carrying 30 amperes.

e. TRANSMITTER GROUND, INTERNAL, AND MONITOR CONNECTIONS. — Direct connection to the station ground system is to be made by copper strap or braid. A terminal for the ground connection is located in the lower rear left-hand corner of the transmitter.

Interlock terminals 1 and 2, on the control circuit terminal board, are to be jumpered with #18 wire, or larger. (If an external high-powered amplifier is to be used with the transmitter, the instruction book for the amplifier will provide alternate data for these terminals.)

Jacks J111 and J112 (figure 3–12) are to be used to supply synchronizing signals to an external monitor, via type RG–8/U cable. The Navy #49195 plugs for the cables are supplied on the jacks.

f. TRANSMITTER — TERMINAL BOX CONNECTIONS. — The r-f output connection from each transmitter to the terminal box is to be made with type RG–19/U or RG–8/U coaxial cable.* The cable is terminated in end-seal connections, and runs from J109 in each transmitter (figure 3–12) to J501 and J502 in the terminal box (figure 3–13). Instructions for making the end-seal connections are given on figures 3–14 and 3–15.

The monitor connections from terminal box to the transmitters are to be made with type RG–8/U cable from J505 and J506 in the terminal box to J101 in each transmitter. Each cable is terminated at the transmitter with a Navy plug and at the terminal box in an end-seal connection. Instructions for making the end-seal connection are given on figures 3–14 and 3–15.

The 115-volt interlock wiring, from terminals 1 and 2 in the terminal box to terminals 3 and 4 in trans-

*Not supplied with this equipment.

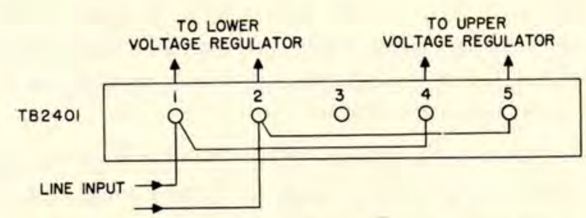


Figure 3–9.—Voltage Regulator Assembly, Input Terminal Board Connections for Single Power Source

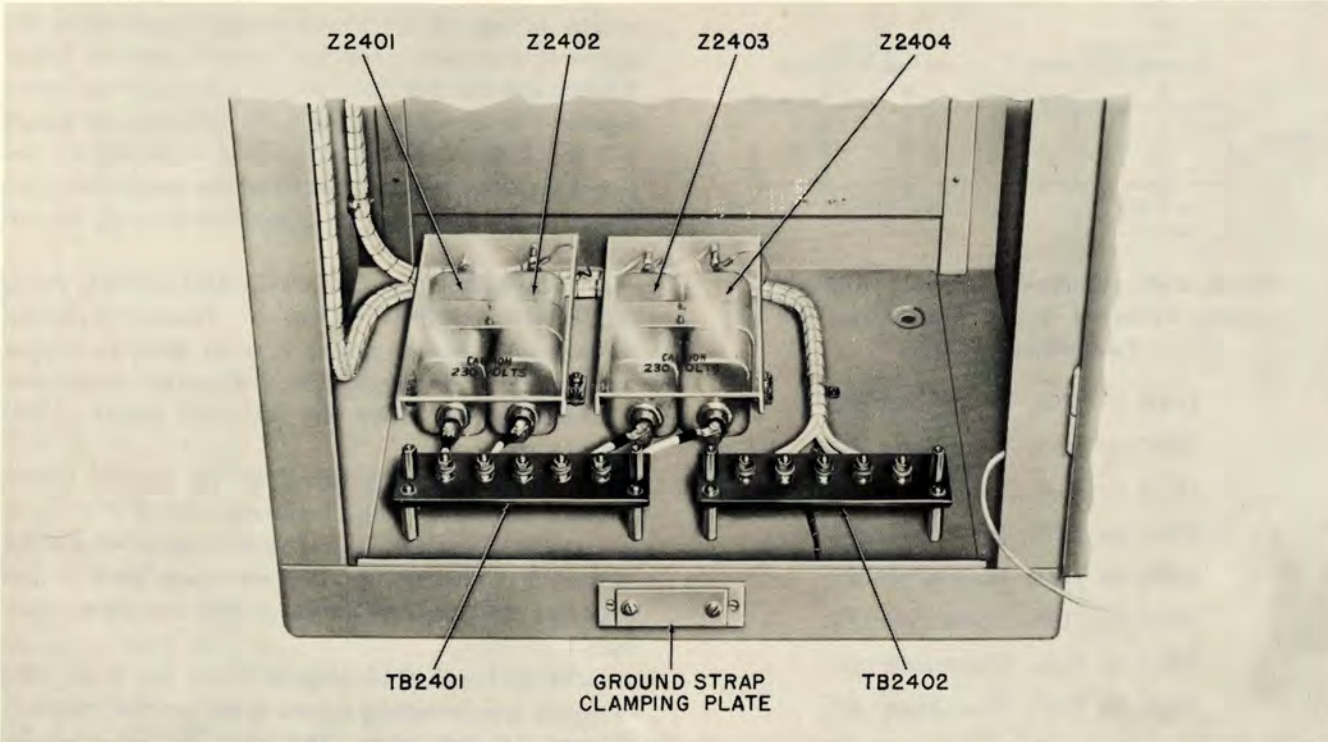


Figure 3–10. Voltage Regulator Assembly, Terminal Boards and Ground Terminal

mitter #1 and from terminals 3 and 4 in the terminal box to terminals 3 and 4 in transmitter #2, must be capable of carrying 4 amperes. Wire for this purpose is not supplied.

g. TERMINAL BOX — ANTENNA COUPLING UNIT* CONNECTIONS.—Two 500-foot reels of type RG–147/U coaxial cable are supplied** for the output transmission lines between terminating connectors J503 and J504 in the terminal box and J401 in the Antenna Coupling Unit. The reels are unpacked by removing the metal bands and all nails from the lagging, and then removing the waterproof barrier.

A monitor line of type RG–148/U cable (not supplied) is connected from J507 in the terminal box to J403 in the coupling unit. Both ends of these three cables are terminated in end-seal connections. Instructions for making the end-seal connections are given on figures 3–14 and 3–15.

h. TERMINAL BOX GROUND CONNECTION. — A bonding clamp is supplied on the bottom of the terminal box for connection of a ground strap to the equipment ground system.

i. COUPLING UNIT POWER CONNECTIONS. — The wire for the 115-volt a-c power connection to J404 in the Antenna Coupling Unit must be capable of carrying 10 amperes. This wire is not supplied.

j. ANTENNA AND GROUND CONNECTIONS. — The antenna lead-in cable is to be connected to the bowl-type antenna insulator located on the right-hand side of the coupling unit. Detailed information as to the dress of the lead-in, etc., will be found in the instructions for the particular type of antenna to be used.

The ground connection is to be made directly to the station ground system (preferably as close to the center as possible) by means of the six-inch wide copper strap supplied on the bottom of the housing.

9. INITIAL OPERATION OF THE TRANSMITTER.

a. GENERAL. — When the transmitter has been installed and interconnected as outlined in the previous paragraphs of this section, it is ready for initial operation. It is assumed at this point that all units have been completely checked for any mechanical or electrical defect, that units which are used with the transmitter (although not supplied with it) have also been carefully checked and adjusted. The factory-set adjustments of all ball-gap spacings and of the 2nd IPA neutralizing capacitors should also be checked; refer to Section 7, paragraphs 9 and 12. The initial operating procedure is described for one transmitter, but applies equally to both transmitters of a station. Both single- and double-pulsed operations are considered.

*Antenna Coupling Unit not supplied with this equipment. See Section 1, paragraph 1.

**This cable is not supplied under this contract but was supplied on previous contracts.

b. INPUT TO THE TRANSMITTER FROM TIMERS. — It is also assumed that the timer equipment and the switching equipment have been adjusted so that the excitation (trigger) pulses and 100-kc output of two timers are being fed to EXCITER A and EXCITER B in the transmitter through the interconnections previously described. If the transmitter is to be operated simultaneously at two different specific pulse rates, that is, double-pulsed, each timer will have been adjusted for the correct specific rate. If the transmitter is to be operated at only a single pulse rate, both timers will have been adjusted for this rate and will be operating, but only one exciter in the transmitter will be used at a given time.

c. PRELIMINARY SETTING OF CONTROLS. — When the transmitter is being operated for the first time, or after it has been shut down for an extended period of time, a step-by-step procedure should be employed to apply power and to bring the equipment up to its fully operating condition. Initially, all controls should be set as outlined below. Refer to figure 4–1 for location of controls. Unless otherwise indicated, the controls are located on the front panel of the transmitter.

(1) Place the MAIN switch (S101) in the OFF position.

(2) Place the FILAMENTS switch (S103) in the OFF position.

(3) Place the LOW VOLT-BIAS switch (S104) in the OFF position.

(4) Place the HIGH VOLT switch (S105) in the OFF position.

(5) Place the EXCITER A switch (S118) in the ON position.

(6) Place the EXCITER B switch (S119) in the ON position.

(7) Adjust the DBLR BIAS control (R159) for maximum bias (maximum clockwise position of the control). Access to this and the other bias controls may be had by removing the cover-plate at the right-hand side of the control panel.

(8) Adjust the 1st IPA BIAS control (R161) for maximum bias (maximum clockwise position of the control).

(9) Adjust the 2nd IPA BIAS control (R171) for maximum bias (maximum clockwise position of the control).

(10) Adjust the PA BIAS control (R165) for maximum bias (maximum clockwise position of the control).

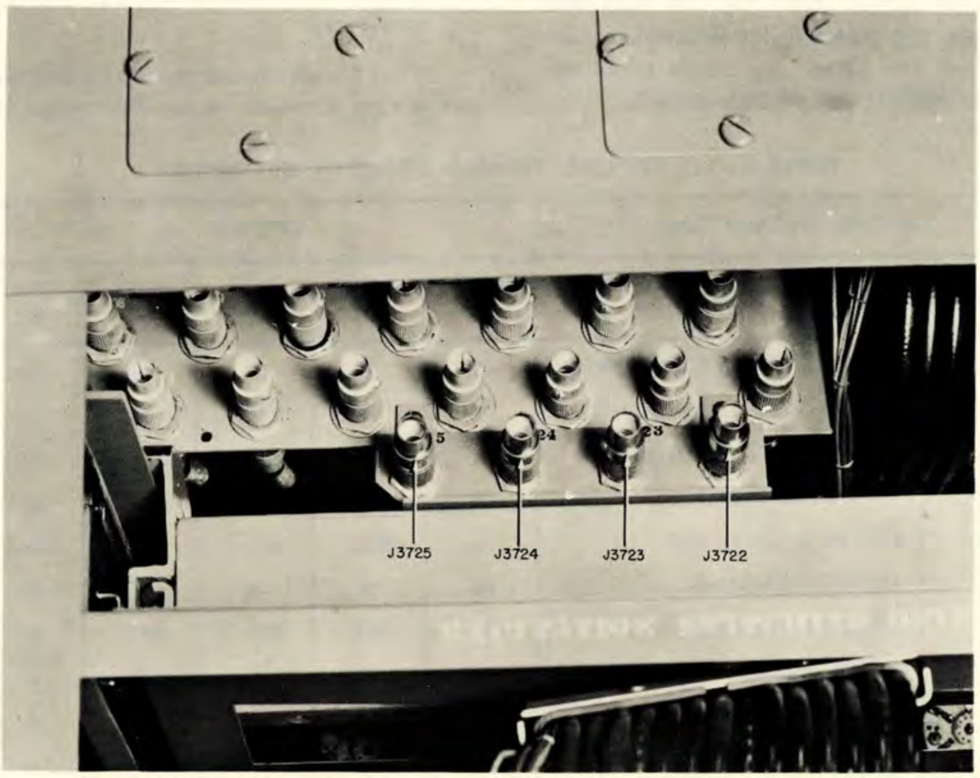


Figure 3–11. Modification of Loran Switching Equipment Navy Model UM– Rear View, Showing Additional Coaxial Connectors

(11) Turn the FILAMENT VOLTAGE control (T102) to the extreme counterclockwise position.

(12) Turn the PLATE VOLTAGE control (T101) to the extreme counterclockwise position.

(13) Place the POWER switch of the monitor oscilloscope in the OFF position.

(14) Refer to the calibration chart on the front of the transmitter or to table 3–1 for the settings of the DOUBLER PLATE TUNING control (A), the 1st IPA TUNING control (B), the 2nd IPA TUNING control (C), the PA TUNING control (D), the OUTPUT COUPLING control (E), the OUTPUT TUNING control (F), the PA NEUTRALIZATION control (G), the EXC A PULSE WIDTH control (H), the EXC B PULSE WIDTH control (I), and the PULSE SHAPE ADJ control (J). The settings given in table 3–1 are typical, and may vary slightly for different units. The calibration card supplied with each individual transmitter lists the settings determined for that particular unit.

Controls A, B, C, D, and F are located on the front panel. Controls E and G are located within the PA compartment (figure 5–4), and are adjusted at the factory; ordinarily, it should not be necessary to change those settings. However, an inspection should be made of the OUTPUT COUPLING coil (E) to be certain that it is concentric with the PA tank coil (L117), this being the position for maximum coupling. Also, tighten the gland nut which locks the coil in position, to prevent any possible slipping.

The PULSE WIDTH controls (H and I), which are located at the rear of the transmitter in the pulse-forming sections of Exciter A and Exciter B (figures 7–15 and 7–16), vary the setting of the tuning slugs in inductors L120 and L121 respectively. The slugs are fixed in position by locknuts at the top of each inductor, and a long adjusting screw on each slug parallels a calibrated scale. The setting of the slug is arbitrarily indicated by the alignment of a fixed nut, at the top of the adjusting screw, with a calibration mark on the scale. To change the adjustment, loosen the locknut at the top of the inductor and turn the screw until the black center-line of the fixed nut lines up with the desired calibration mark. Lock each control at the desired setting.

The PULSE SHAPE ADJ control (J) is located at the rear of the transmitter in the pulse-forming section common to both exciters (see figure 5–1), and affects the setting of the tuning slug in inductor L102. The adjustment procedure is the same as described above for the PULSE WIDTH controls.

Note

Inductors L120, L121, and L102 are each provided with two taps. Tap #1 is suitable for all conditions of operation contemplated by this instruction book. Tap #2 is provided in anticipation of extended applications of the transmitter.

(15) Check the connection of LINK A on the output tuning network in the PA compartment (figure

TABLE 3–1. TYPICAL TUNING CONTROL SETTINGS

CONTROL DESIGNATION		SETTING				
LETTER	NAME	1750 KC	1800 KC	1850 KC	1900 KC	1950 KC
A	DOUBLER PLATE TUNING	27	39	52	63	69
B	1st IPA PLATE TUNING	40	46	52	55	62
C	2nd IPA PLATE TUNING	33	45	55	66	78
D	PA PLATE TUNING	48	57	68	72	81
E	OUTPUT COUPLING	Max.	Max.	Max.	Max.	Max.
F	OUTPUT TUNING	26	39	48	54	59
*G	NEUTRALIZATION	057	057	057	057	057
H	PULSE WIDTH ADJ — EXC A	.95	.7	.7	.85	.6
I	PULSE WIDTH ADJ — EXC B	.95	.7	.7	.85	.6
J	PULSE SHAPE ADJ	1.4	1.4	1.4	1.4	1.4

*This control is adjusted at the factory. Readjustment is not required unless neutralizing capacitors are replaced.

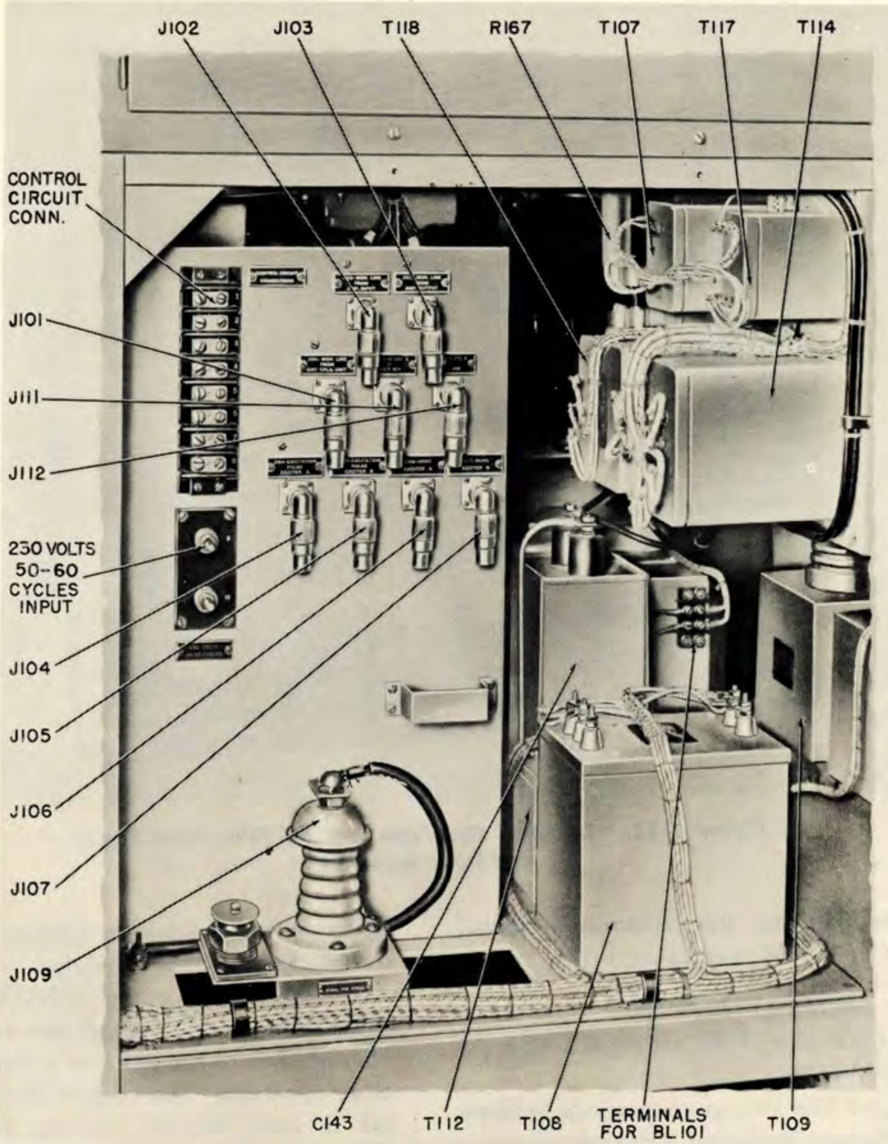


Figure 3—12. Transmitter Terminal Board

5–4). For initial operation, the link should be connected to the dummy load in the transmitter (DUMMY position).

(16) Place the TUNE-NORMAL switch (S102) in the TUNE position. S102 is located within the IPA compartment (figure 3–16) below the frequency-generator chassis.

(17) Set the FREQUENCY SELECTOR switch (S301), the PULSED DOUBLER GRID TUNING control (C323), and the LIMITER AMP. PL TUNING control (C322) of each frequency generator to the calibration for the desired transmitting frequency. These controls are located on the front of the frequency generator chassis (figure 3–16), which are on the rear wall of the IPA compartment.

(18) If the power-line frequency is 50 cycles, change the primary connection of the control-voltage transformer (T108) from the 230-volt tap to the 253-volt tap. The transformer is located (see figure 3–12) in the rear left-hand corner of the transmitter on the floor. When operating from 50 cycles, the designation plate for the TUBE HOURS meter should be reversed so as to read "TIME=READING x 6/5".

(19) Depending on which basic pulse repetition rate is to be used, LINK C across resistor R192 and LINK D across resistor R188, both in the high-voltage bleeder network, will be either open or shorted across their respective resistors. The link positions are tabulated in table 3–2. LINK C is located on the rear wall of the transmitter, on the fuse panel (see figure 5–1);

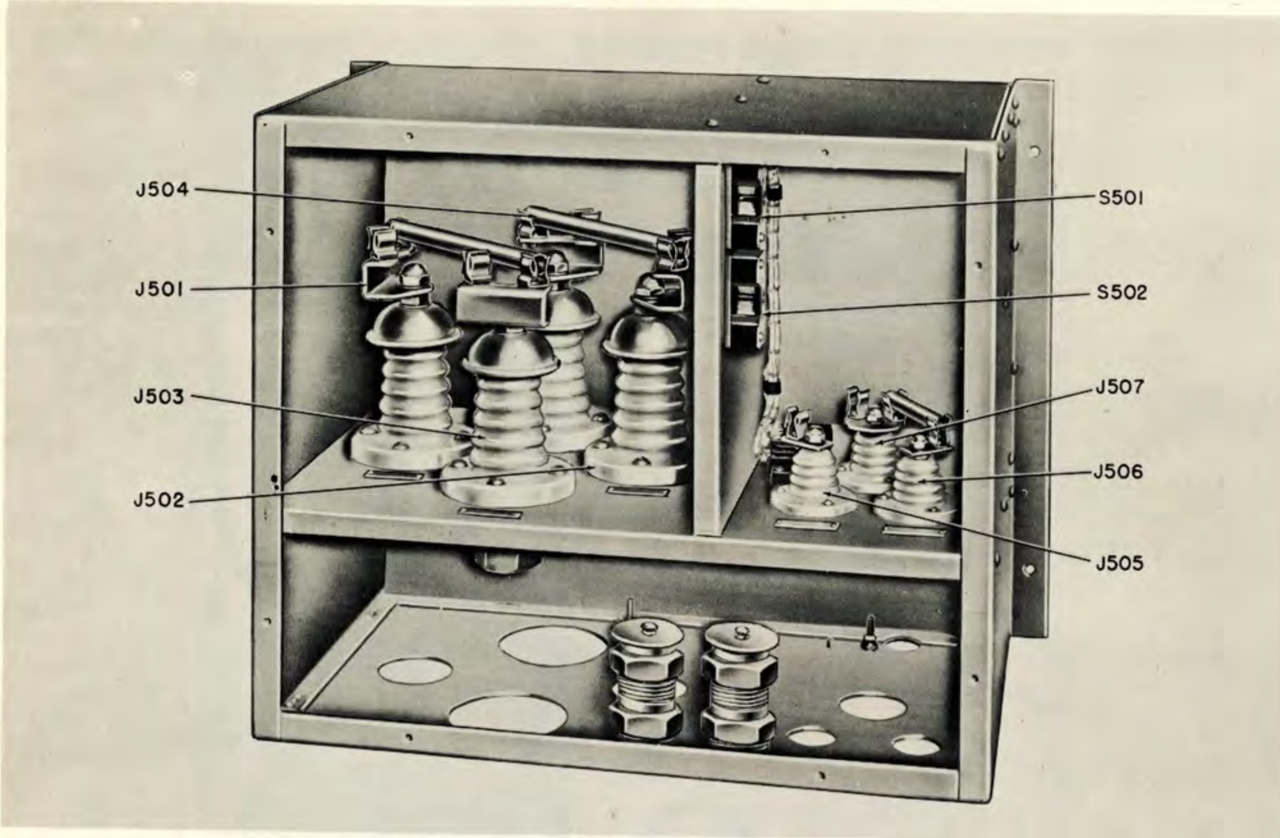


Figure 3–13. Terminal Box Type J–455A/FPN, Front Panel and Door Removed

LINK D is located behind the transmitter control panel, on the left-hand side (see figure 3–17).

d. APPLYING PRIMARY POWER.

(1) INITIAL OPERATION OF VOLTAGE REGULATOR.

(*a*) Check a-c line voltage connections between transmitter and Voltage Regulator Assembly to determine which regulator supplies the transmitter. See figure 3–6.

(*b*) Place the BLOWER switch (S2401) to LINE 1 or LINE 2 position. This should operate the blower and the BLOWER indicator lamp (I12401) should light.

(*c*) Check the voltage regulator main circuit breaker switch. It should be in the ON position. See figure 4–2.

(*d*) Place the main rotary disconnect switch S2503 to the REGULATED VOLTAGE position. This applies primary power to the voltage regulator. The indicator lamp I2501 should light.

(*e*) Check the input line voltage on the voltmeter M2501 by placing the meter switch S2504 to the LINE VOLTAGE position. For proper operation the input line voltage should be from 195 to 255 volts ac.

(*f*) Adjust the OUTPUT VOLTAGE control (R2502) for a regulated output voltage of 230 volts ac. In setting the output voltage reference is made to the voltmeter on the regulator.

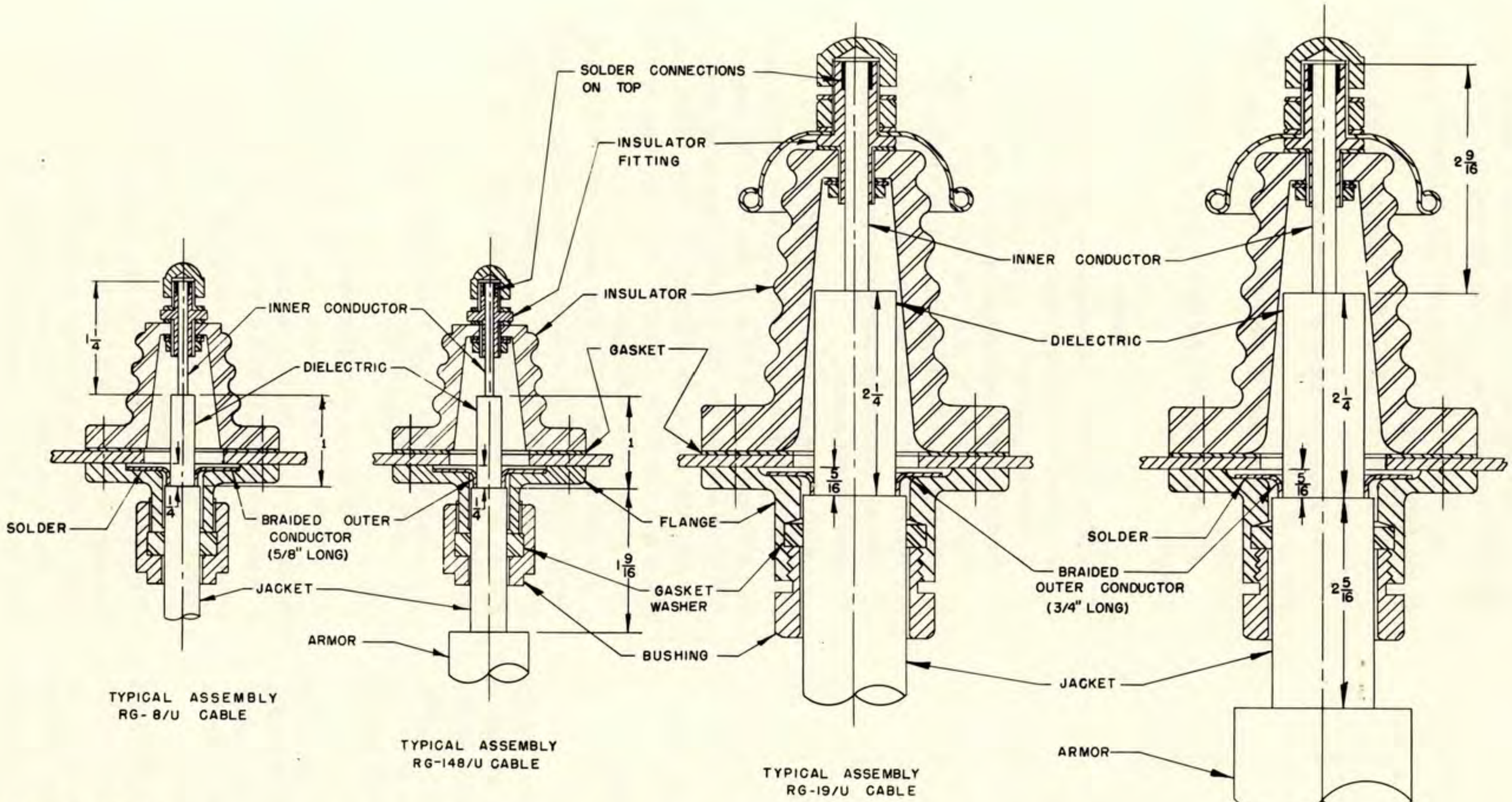
(*g*) Advance the SENSITIVITY control (R-2503) to a point at which the regulator continuously "hunts", i.e., to the point at which the motor does not cease operating. The control should then be "backed-off" a small amount, causing the regulator to stop hunting.

TABLE 3–2. LINK POSITIONS, SINGLE-PULSED OPERATION

BASIC PULSE REPETITION RATE	LINK C**	LINK D*
20 pps	Open	Open
25 pps	Closed	Closed
33-1/3 pps	Closed	Closed

*Because of component tolerances, it may be found that in some equipments the IPA plate voltage cannot be set to the value given in table 3–3 during 20 pps operation. In this case link D should be *closed* rather than open.

**Because of component tolerances, it may be found that in some equipments the modulator plate voltage cannot be set to 5,800 volts during 20 pps operation. If the reading of the MEDIUM VOLTAGE meter indicates less than 5,800 volts with meter switch S112 in the MOD PLATE position, LINK C should be *closed* rather than open.



ASSEMBLY PROCEDURE:

1. SKIN CABLE ENDS TO DIMENSIONS SHOWN.
2. REMOVE THE END SEAL FROM THE SURFACE ON WHICH IT IS MOUNTED BY REMOVING THE FOUR SECURING BOLTS.
3. UNSCREW THE BUSHING FROM THE FLANGE, REMOVING WITH IT THE GASKET-WASHER.
4. TIN THE INSET SURFACE OF THE FLANGE TO WHICH THE BRAIDED OUTER CONDUCTOR OF THE CABLE WILL BE SOLDERED.
5. SLIP THE BUSHING, THE GASKET-WASHER AND THEN THE FLANGE INTO PLACE ON THE SKINNED END OF THE CABLE AS SHOWN. SCREW THE BUSHING INTO PLACE.
6. FORM THE BRAIDED OUTER CONDUCTOR TO LAY OVER ON THE TINNED INSET SURFACE OF THE FLANGE. PUNCH SEVERAL SOLDER-FLOW HOLES THROUGH THE LAYED-OVER PORTION OF THE BRAIDED OUTER CONDUCTOR USING AN AWL OR OTHER SHARP INSTRUMENT.
7. SOLDER THE BRAIDED OUTER CONDUCTOR TO THE FLANGE ALLOWING THE SOLDER TO FLOW IN WELL. CAUTION! KEEP THE HEAT AWAY FROM THE DIELECTRIC PORTION OF THE CABLE AS MUCH AS POSSIBLE AS THIS MATERIAL HAS A LOW MELTING POINT.
8. FEED THE CABLE END THROUGH THE HOLE IN THE MOUNTING SURFACE. PLACE THE GASKET AND THEN THE INSULATOR OVER THE CABLE END, THREADING THE INNER CONDUCTOR THROUGH THE HOLE IN THE INSULATOR FITTING.
9. BOLT THE WHOLE END SEAL ASSEMBLY BACK TOGETHER AGAIN ON THE MOUNTING SURFACE.
10. SOLDER THE TOP OF THE INNER CONDUCTOR TO THE INSULATOR FITTING. CAUTION! KEEP THE SOLDER FROM FLOWING OVER ON TO THE OUTSIDE THREADED PORTION OF THE INSULATOR FITTING. APPLY HEAT ONLY FOR AS LONG AS ABSOLUTELY NECESSARY TO AVOID MELTING THE DIELECTRIC MATERIAL OF THE CABLE.

Figure 3—14. End-Seal Termination of Coaxial Cable

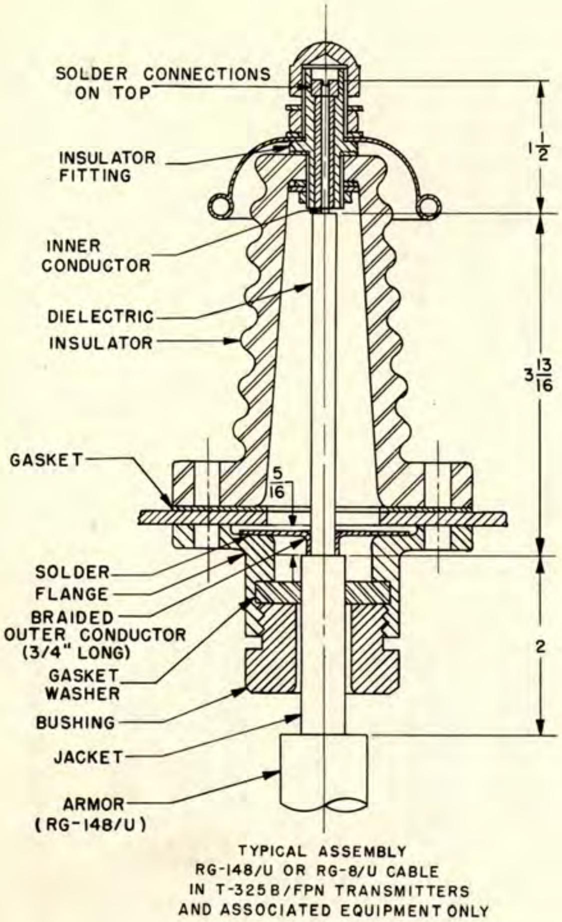


Figure 3–15. End-Seal Termination of Coaxial Cable (Cont'd.)

(2) APPLYING PRIMARY POWER TO TRANSMITTER. — Apply primary power to the transmitter by closing the MAIN switch (S101). Measure the primary voltage on the LINE voltmeter (M101) by placing meter switch S110 (located below the meter) in the LINE position. The line voltage should be 230 volts.

As soon as the MAIN switch is closed, the amber MAIN, 2nd IPA OVERLOAD, PA OVERLOAD, HV OVERLOAD, and DOOR INTERLOCK indicator lamps (I101, I107, I108, I109, and I111) should light, and the blower and fan should operate.

e. INITIAL OPERATION OF THE MONITOR OSCILLOSCOPE. — Place the POWER switch (S105) of the monitor oscilloscope in the ON position. Illumination of the dial lamp behind the SWEEP DELAY dial indicates that power has been supplied to the scope. Perform the tests and adjustments described for the oscilloscope in Section II, paragraph 2, of the appended oscilloscope instruction manual. If operation is satisfactory, restore any cables removed for the tests, and set the scope controls as follows (see figure 3–4 of attached oscilloscope manual):

(1) Place the VIDEO ATTENUATION control in the OFF position.

(2) Place the TRIGGER SOURCE switch in the EXT+ position.

(3) Place the SWEEP LENGTH control in the 100 μs A position.

(4) Place the R SWEEP switch in the DEL position.

(5) Place the MARKERS control in the Z IN position.

Note

Unless specific instructions to the contrary are given in following sections of this "Initial Transmitter Operation" description, the oscilloscope control settings given above should be maintained. As is true for any oscilloscope, the FOCUS, CENTERING, and INTENSITY controls are to be adjusted at will for the clearest pattern of reasonable intensity, centered on the screen.

f. ADJUSTMENT OF FILAMENT VOLTAGE. — Place the FILAMENTS switch (S103) in the ON position and meter switch S110 in the FIL PRI position. Allow 15 seconds for the filament-time-delay relay to operate, and adjust the FILAMENT VOLTAGE control (in a clockwise direction) for a reading of 230 volts on the LINE voltmeter.

The clear LOW PWR FIL and HIGH PWR FIL indicator lamps (I102 and I103) should light as soon as the FILAMENTS switch is closed; the blue HIGH VOLT T.D. lamp (I104) should light after three minutes.

g. ADJUSTMENT OF LOW BIAS AND PLATE VOLTAGE.

(1) With the TUNE-NORMAL switch (S102) in the TUNE position, place the LOW VOLT-BIAS switch (S104) in the ON position. (It is not necessary to wait for the HIGH VOLT T.D. lamp to light before performing this step.) The red LOW VOLTAGE indicator lamp (I110) should light immediately.

(2) Turn meter switch S111 (below LOW VOLTAGE meter M105) to the EXCITER PLATE position. The LOW VOLTAGE meter should read 300 volts. (If M105 does not read 300 volts and particularly if it reads any lower than 300 volts, refer to the adjustment procedure for potentiometer R163 in Section 7, paragraph 8*b*.)

(3) Turn OFF either the EXCITER A or EXCITER B switch and again check for a reading of 300

volts on the LOW VOLTAGE meter. (If a reading of 300 volts is not obtained and particularly if the reading is lower, refer to the adjustment procedure for potentiometer R237 in Section 7, paragraph 8*b*.) When satisfactory indications are obtained, return the exciter switch to the ON position.

(4) Place meter switch S111 in the DBLR BIAS position and adjust the DBLR BIAS control (R159) for a reading of approximately 190 volts on the LOW VOLTAGE meter. (Turn R159 counterclockwise to decrease the bias.) A final adjustment of the bias must be made after the exciters are tuned.

(5) Place meter switch S111 in the 1st IPA BIAS position and adjust the 1st IPA BIAS control (R161) for a reading of 50 volts on the LOW VOLTAGE meter. (Turn R161 counterclockwise to decrease the bias.) Lock the control at this setting.

h. TRIGGER MONITORING. — Check the trigger pulses coming to the transmitter as outlined in the following steps:

(1) Place the MONITORED CIRCUIT switch (S116) to the TRIGGER FROM TIMER-EXC A position (see figure 4–3).

(2) Place the OSCILLOSCOPE TRIGGER switch (S117) in the EXC A position.

(3) Place the VIDEO ATTENUATION control of the scope for an attenuation of 10.

(4) Set the VERTICAL DEFLECTION control (R128) about half-way open. The waveform should resemble the oscillogram shown in figure 7–1.

(5) Place the MONITORED CIRCUIT switch in the TRIGGER FROM TIMER-EXC B position and the OSCILLOSCOPE TRIGGER switch in the EXC B position. Essentially the same waveform should be observed as for (4) above.

i. FREQUENCY GENERATOR TUNING. — Tuning adjustments for the frequency generator units are located on each unit. Access to these adjustments may be had by opening the left front door of the transmitter and reaching into the compartment. The two different adjustment procedures, for operation with a

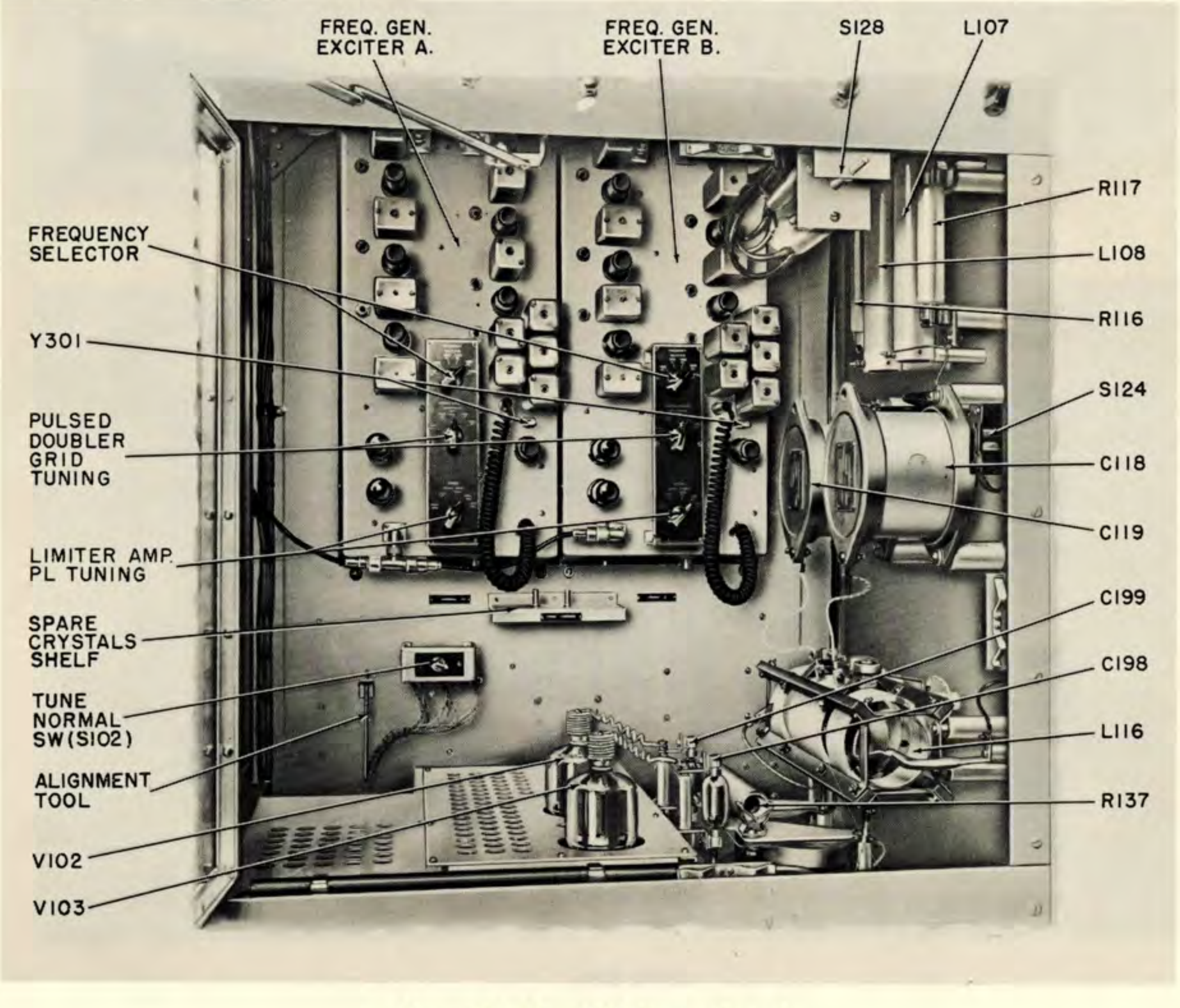
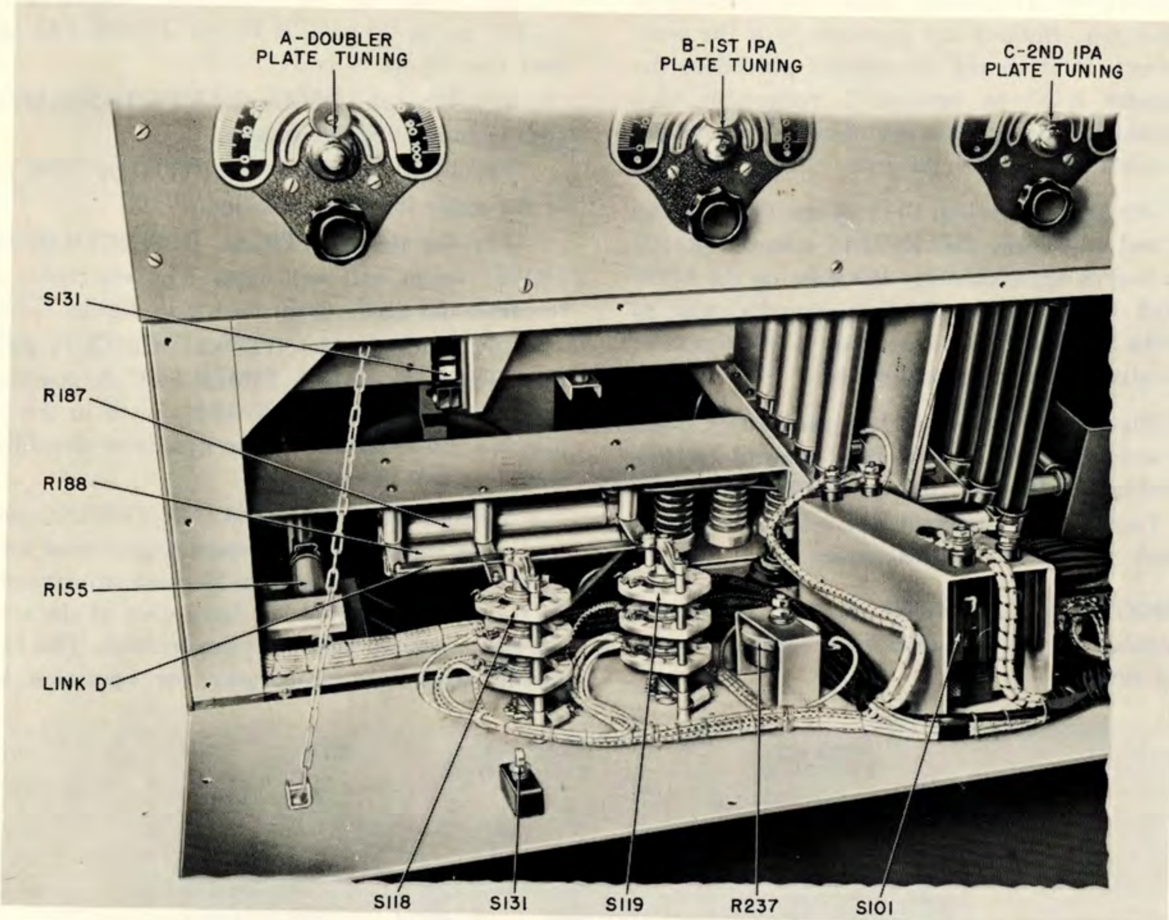
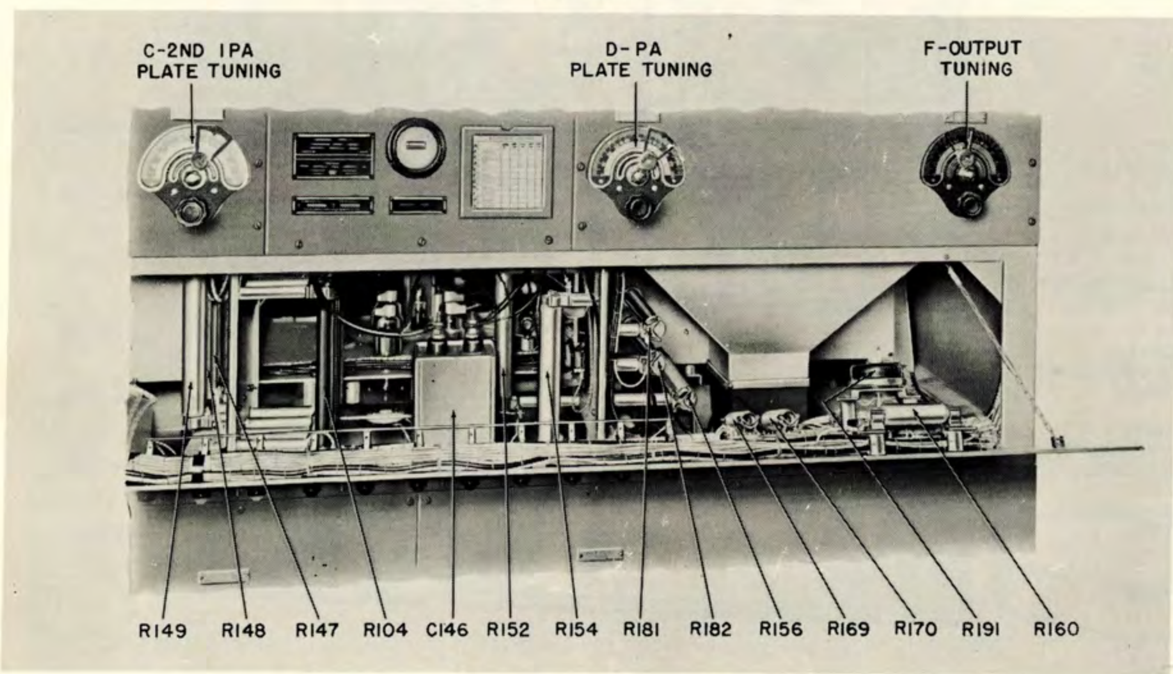


Figure 3–16. IPA Compartment



Left Side



Right Side

Figure 3–17. Transmitter Control Panel in Lowered Position

100-kc timer signal, and for operation with the contained crystal, are discussed below.

Note

When switching from one mode of operation to the other (100-kc timer signal or crystal) it is necessary to carry out the complete adjustment procedure for the mode to be used.

(1) OPERATION WITH 100-KC TIMER SIGNAL. — Before the following adjustments can be made the controls must be set to the preliminary positions of paragraphs 9*c* (16) and 9*c* (17) preceding. Proceed as follows:

(*a*) Place meter switch S121 (below EXCITER CURRENT meter M112) in the EXCITER A position.

(*b*) Place meter switch S120 (to the right of S121) in the V301 CATH. position, and adjust the inner (primary) tuning slug of input transformer Z301 in EXCITER A (figure 7–29) for a maximum indication on the EXCITER CURRENT meter. Use the tuning tool mounted under the frequency generator units for this adjustment and for all other adjustments on the units.

Note

The input transformer, the limiter-amplifier plate circuit, and doubler-grid circuit are the only portions of the exciter which are not pretuned at the factory. DO NOT DISTURB THE TUNING OF THE OTHER VARIABLE COMPONENTS.

(*c*) Place meter switch S120 in the V305 V306 CATH. position, and adjust the PULSED DOUBLER GRID TUNING control (C323) of EXCITER A for a resonance maximum on the EXCITER CURRENT meter. If no indication can be obtained on the meter, reduce the setting of the DBLR BIAS control (R159) until some deflection is obtained. If the reading is off-scale, increase the setting of this control for some convenient deflection.

(*d*) Adjust the LIMITER AMP. PL TUNING control (C322) of EXCITER A for a resonance maximum on the EXCITER CURRENT meter. Again, if this maximum reading is off scale, increase the setting of the DBLR BIAS control (R159) to keep the reading at some convenient value.

(*e*) Repeat the tuning adjustments of steps (*c*) and (*d*), and then note the reading on the EXCITER CURRENT meter. Adjust the DBLR BIAS control, if necessary, for a reading between 60 and 80. After making this final adjustment, the doubler bias, as read on the LOW VOLTAGE meter with meter switch S111 in the DBLR BIAS position, should be greater than 160 volts.

(*f*) Check the cathode current of each stage in the frequency generator by turning meter switch S120, in turn, to each of the eight CATH. positions of the switch. The readings on the EXCITER CURRENT meter should be close to the values indicated in table 5–1.

(*g*) Place meter switch S120 in the GRID CURRENT position and place plug P301 (see figure 7–29) successively in each of jacks J301 to J307. Readings should be approximately the same as those in table 5–1.

Note

If the readings obtained in steps (*f*) and (*g*) do not conform to the typical values listed in table 5–1, a complete realignment of the frequency generator *may* be necessary. Check all tubes and perform all other possible maintenance checks before attempting realignment. Refer to Section 7, paragraph 8, for the realignment procedure.

(*h*) Place meter switch S121 in the EXCITER B position and repeat the tuning adjustments of steps (*b*) to (*g*) for the frequency generator of Exciter B.

(*i*) After the frequency generator of Exciter B is tuned, place meter switch S120 in the V305 V306 CATH. position, and compare EXCITER CURRENT readings for both EXCITER A and EXCITER B positions of meter switch S121.

(*j*) Because of slight discrepancies between exciters, these readings will, in all probability, not be identical. To make them identical, note which exciter has the higher current and detune the PULSED DOUBLER GRID TUNING control of that exciter slightly until the current is reduced to equal the reading of the other exciter. At this point, the V305 V306 CATH. currents for both exciters should be of equal value (between 60 and 80), and the DBLR BIAS should be greater than 160 volts.

(2) CRYSTAL OPERATION. — For crystal operation make sure that a crystal for the desired frequency (one-half the transmitter output frequency) has been plugged into XY301 on each frequency generator unit chassis and that the controls are in the

preliminary settings previously described in paragraphs 9*c* (16) and 9*c* (17). FREQUENCY SELECTOR switch S301 should be set to XTAL. Proceed as follows:

(*a*) Place meter switch S121 (below and to the left of EXCITER CURRENT meter M112) in the EXCITER A position. Set the adjacent switch (S120) to the V304 CATH. position.

(*b*) Tune the LIMITER AMP. PL TUNING control (C322) on the frequency generating unit, as follows: Starting at the high frequency end of the scale, tune *slowly* towards the low end while observing the EXCITER CURRENT meter. As the crystal comes into oscillation the meter reading will slowly decrease, reach a minimum, and then suddenly increase. The sudden increase will be an indication that oscillation has stopped. Except when the crystal is oscillating strongly the meter reading will be near full scale or even off scale by a small amount. Tune for strong oscillation by adjusting for approximately the current minimum.

Note

If crystal operation, as evidenced by a decrease of meter reading, is not obtained it is probable that the plate tank circuit of limiter amplifier or crystal oscillator tube V304 is not tuning high enough in frequency. This condition would be most likely for crystals of 975 kc or 950 kc (loran frequencies of 1,950 kc or 1,900 kc). To raise the tuning range reduce the amount of capacity of trimmer capacitor C326A. The plates of this capacitor may be observed most easily by removing the rear cover plate of the frequency generating unit.

(*c*) Set meter switch S120 to the V305 V306 CATH. position and tune the PULSED DOUBLER GRID TUNING control (C323) for a peak reading on the EXCITER CURRENT meter. To give a sensitive indication of resonance the meter reading should be in the vicinity of 70 at the tuning peak. Control the meter sensitivity, as needed during the tuning process, with the DBLR BIAS control (R159). Increasing the bias (clockwise rotation) will lower the meter sensitivity; decreasing the bias will do the opposite.

Note

The tuning procedure up to this point has been carried out with the crystal oscillator stage (V304) tuned for minimum cathode current and the pulsed-doubler bias has been set to give a pulsed-doubler (V305-V306) cathode current in the vicinity of 70 for this condition of crystal tuning. These are preliminary adjustments for both the crystal stage tuning and the pulsed-doubler bias. These adjustments are used as a convenience in arriving at the proper and final setting of the PULSED DOUBLER GRID TUNING control.

In the several steps to follow the crystal stage tuning control (LIMITER AMP. PL TUNING) will be backed off towards the high-frequency side of resonance in order that the crystal have sufficient activity to start positively when plate voltage is turned off and on. Detuning the crystal reduces the drive to the pulsed doublers and hence reduces the pulsed doubler cathode current. This cathode current will be maintained at approximately 70 by reducing the pulsed-doubler bias. Continue as follows:

(*d*) With the exciter current meter switch still set to V305 V306 CATH., decrease the DBLR BIAS control setting (counterclockwise rotation) until the EXCITER CURRENT meter reading increases to 100. Then slowly detune the LIMITER AMP. PL TUNING control, *higher* in frequency, until the reading reduces to 70. Continue repeating this process of reducing the bias and detuning for a reading of 70 until, at the final adjustment, the bias control reaches minimum. Check that, at this setting, the doubler bias voltage is correct by noting that the LOW VOLTAGE meter reads approximately 160 volts with meter switch S111 in the DBLR BIAS position.

(*e*) Test that the above adjustments are satisfactory by turning the exciter on and off, using EXCITER A OFF-ON switch S118 (EXCITER B OFF-ON switch S119 when repeating the procedure for Exciter B), and noting that oscillation starts immediately after the unit is turned on. Oscillation will be indicated by normal reading of the EXCITER CURRENT meter.

(*f*) Place meter switch S121 in the EXCITER B position and place meter switch S120 in the V304 CATH. position. Repeat steps (*b*) through (*e*) above for Exciter B.

j. APPLYING HIGH-BIAS VOLTAGE. — When the frequency generators are tuned, place the LOW VOLT-BIAS switch in the OFF position, place the TUNE-NORMAL switch in the NORMAL position, close all access doors, and return the LOW VOLT-BIAS switch to the ON position. The amber DOOR INTERLOCK indicator lamp (I111) and the green BIAS indicator lamp (I105) should light. Perform the following preliminary bias adjustments:

(1) Adjust the PA BIAS control (R165) for a preliminary reading of 3,000 volts on the PA BIAS meter.

(2) Adjust the 2nd IPA BIAS control (R171) for a reading of 360* volts on the LOW VOLTAGE meter (M105) with meter switch S111 in the 2nd IPA BIAS position.

WARNING

AT THIS POINT IN THE ADJUSTMENT PROCEDURE HIGH VOLTAGES ARE PRESENT IN THE TRANSMITTER. ALL SAFETY PRECAUTIONS SHOULD BE OBSERVED WHILE WORKING ON THE EQUIPMENT.

(3) Check the operation of all interlocks by opening each door in turn and observing the PA BIAS meter. The meter reading should drop to zero, and the DOOR INTERLOCK and BIAS lamps should go out, whenever an access door is opened.

k. PRELIMINARY TUNING ADJUSTMENTS. — Before proceeding with the steps to follow, place the EXCITER B switch (S119) in its OFF position so that the transmitter will be pulsed at but a single rate while the initial tuning procedure is being carried out. This is to be done, even though the final signal is to be double-pulsed. Continue as follows:

(1) After making certain that the PLATE VOLTAGE control (T101) is in the extreme counterclockwise position, place HIGH VOLT switch S105 in the ON position. The red HIGH VOLTAGE indicator should light. Place PA PLATE current meter switch (S113), located below the PA PLATE milliammeter, in the TOTAL position.

(2) Allow one second for the high-voltage step-start circuit to operate, and advance the PLATE VOLTAGE control until the PA PLATE current meter (M106) just starts to indicate. This should occur when the PA PLATE voltmeter (M102) reads approximately 10 kv.

(3) Place the OSCILLOSCOPE TRIGGER switch in the EXC A position.

*Under some operating conditions it may not be possible to adjust this voltage as low as 360 volts. Higher voltages *not exceeding 400 volts* will be satisfactory.

(4) Place the MONITORED CIRCUIT switch in the OUTPUT 2nd IPA position.

(5) Adjust the VERTICAL DEFLECTION control to its maximum clockwise position. The resultant waveform should be similar to that of figure 7–6.

(6) Adjust the DOUBLER PLATE TUNING control (A) and the 1st IPA PLATE TUNING control (B), in that order, for maximum *length* of the flat top portion of the oscillogram. Most variation in the length will occur at the right-hand end of the pattern.

(7) Place the MONITORED CIRCUIT switch in the OUTPUT PA position and keep the VERTICAL DEFLECTION control set at maximum.

(8) Adjust the 2nd IPA PLATE TUNING control (C) and the PA PLATE TUNING control (D) for maximum *amplitude* of the oscilloscope pattern.

(9) Adjust the OUTPUT TUNING control (F) for maximum reading on the TRANSMISSION LINE r-f ammeter (M111). Meter switch S115, below M111, must be in the UNSHORT position.

l. VOLTAGE ADJUSTMENTS. — In the next step, the PA plate voltage will be advanced to the normal operating value of 15.5 kv. If the PA tubes (V104 to V107 inclusive) are new or have not been in service for some time, the voltage will have to be advanced in several steps to "season" the tubes; that is, condition them so that they can withstand the full plate voltage without internal arcing. It is a normal characteristic of tubes, such as the type 7C23, that operate at relatively high plate voltages, to arc internally when new or unused for an extended period of time. After each successive arc, the tube will withstand more voltage. The arc current is sufficiently limited by the circuit in the transmitter to prevent damage to the tube or transmitter. When the tube arcs internally, it is usually from plate to grid and, in turn, the external protective gaps TY110 or TY111, connected from grid to ground, will break down and either the PA OVERLOAD relay or the HV OVERLOAD relay will trip. With the above characteristic of the PA tubes in mind, the voltage adjustments are to be made as follows:

(1) Advance the PLATE VOLTAGE control in approximately 1-kv steps, as read on the PA PLATE voltmeter, until the final operating value of 15.5 kv is reached. Operate the transmitter at each voltage step for approximately 15 minutes before proceeding to the next. If, in going from one step to the next, a tube arc occurs, lower the voltage slightly and operate for 15 minutes at the slightly reduced voltage before proceed-

ing again to a higher voltage. If the PA tubes have recently been in service, the above procedure will not be necessary and the plate voltage can be advanced immediately to 15.5 kv.

(2) Place meter switch S112 in the 2nd IPA PLATE position and adjust potentiometer R189, located on the rear wall fuse panel (see figure 5–1), for a reading on the MEDIUM VOLTAGE meter (M103), as specified in table 3–3. Before making the adjustment, turn OFF the LOW VOLT-BIAS and HIGH VOLT switches and observe all safety precautions.

WARNING

GROUND THE CONTROL WITH THE CAPACITOR-DISCHARGE ROD INSIDE THE REAR OF THE TRANSMITTER BEFORE MAKING ANY ADJUSTMENT.

Turn the control slightly more than one-half revolution from the full counterclockwise position, close the access doors, and .return the LOW VOLT-BIAS and HIGH VOLT switches to their ON positions. Repeat this step, if necessary, to obtain the reading required in table 3–3.

TABLE 3–3. 2ND IPA PLATE VOLTAGE, SINGLE-PULSED OPERATION

BASIC PULSE REPETITION RATE	2ND IPA PLATE VOLTAGE
20 pps	6.7 kv*
25 pps	6.8 kv
33-1/3 pps	6.9 kv

*If this voltage cannot be obtained, see the footnote with reference to 20 pps operation and link D in connection with table 3–2 of this section.

Note

The voltage values in table 3–3, and also the 5,800-volt potential noted in the following paragraph (3), are nominal. Adjust as close to them as possible. The readings obtained should be within plus or minus two percent of the values given. However, once a voltage is initially logged, the logged value should be maintained in subsequent readings.

(3) Adjust the MOD PLATE voltage control (R191), located behind the cover plate on the right-hand side of the control panel, to obtain a reading of 5,800* volts on the MEDIUM VOLTAGE meter, with meter switch S112 in the MOD PLATE position. (See note immediately preceding.)

(4) Make slight readjustments in the settings of the PLATE VOLTAGE control (T101), the 2nd IPA PLATE voltage control (R189), and the MOD PLATE voltage control (R191), if necessary, until exact readings are obtained simultaneously. Lock the controls at their final settings.

m. FINAL TUNING ADJUSTMENTS.

(1) The oscilloscope MONITORED CIRCUIT switch should remain in the OUTPUT PA position. Adjust the VERTICAL CENTERING control on the scope and-the VERTICAL DEFLECTION control until the upper half of the pattern occupies about the middle 20 divisions on the screen, as in figure 2–19A.

(2) Retune the 2nd IPA PLATE TUNING control (C) slowly, noting that the width of the pulse varies at the base, that is, the hypothetical line dividing the symmetrical upper and lower halves of the oscillogram. Find the setting giving the *maximum* width at the base and lock the control.

(3) Retune the PA PLATE TUNING control (D) slowly for *maximum amplitude* of the pulse at the peak and then lock the control.

(4) Retune the OUTPUT TUNING control (F) for a *maximum reading* on the TRANSMISSION LINE current meter (M111) and then lock the control. Note that this tuning must be done slowly, as the meter movement is highly damped.

(5) Steps (2), (3), and (4) above complete the tuning procedure. In general, these controls should not be touched from this point on. If for any reason it is later deemed necessary to check their settings, carefully repeat the tuning procedures as indicated. Variance from these instructions may lead to difficulty in maintaining the transmitted pulse shape constant within close limits.

n. FINAL PA BIAS ADJUSTMENT. — Check the waveform observed on the scope for the OUTPUT PA position of the MONITORING CIRCUIT switch against the oscillogram shown in figure 3–18. Note in figure 3–19 how excessive bias narrows the output pulse, and in figure 3–20 how insufficient bias distorts the beginning of the pulse by letting it start abruptly. Vary the PA BIAS control (R165) and compare the resultant waveforms with the oscillograms. Finally, starting from the point of maximum bias, turn

*If this voltage cannot be obtained, see the footnote with reference to 20 pps operation and link C in connection with table 3–2 of this section.

the PA BIAS control* in a counterclockwise direction until the leading edge of the pulse still starts very gradually, but where any further reduction in bias voltage results in an abrupt start. When this setting is found, lock the control. Normally, the bias, as read on the PA BIAS meter (M104), will be in the vicinity of 3,000 volts after this adjustment. Log the actual voltage so that this value may be maintained during operation, and for reference in double-pulsed operation procedure.

o. ADJUSTMENT OF 2nd IPA OUTPUT PULSE, EXCITER A. — The length of the 2nd IPA output pulse has been adjusted correctly at the factory, but should be checked at this point as follows:

(1) Place the MONITORED CIRCUIT switch in the OUTPUT 2nd IPA position, and the OSCILLOSCOPE TRIGGER switch in the EXC A position. Exciter A is still ON from above, Exciter B is OFF.

(2) Leaving the other scope controls set as previously instructed, adjust the VERTICAL DEFLECTION and the VERTICAL CENTERING controls so that the upper half of the 2nd IPA waveform occupies some exact number of vertical divisions on the calibrated screen of the cathode-ray tube. Adjust the HORIZONTAL CENTERING control so that any vertical line adopted as a reference intersects the leading edge at about 50 percent amplitude.

(3) Turn the SWEEP LENGTH control to the 100 μs, 25R position and rotate the SWEEP DELAY dial until it reads 90 (microseconds).

(4) If the width of the rectangular pulse is correct, the amplitude of the trailing edge will be about 50 percent of the maximum amplitude, at the same vertical reference line.

(5) If the 50-percent level does not fall on the reference line, place the HIGH VOLT and LOW VOLT-BIAS switches in their OFF positions. Observing all safety precautions, open the rear doors and make a slight change in the setting of R211 behind the rear right door (see figure 7–15). A clockwise adjustment will increase the pulse width; turning the control counterclockwise will decrease the pulse width.

(6) Restore operating voltages to the transmitter and again check the pulse width, steps (3) and (4). Repeat step (5) until the pulse width is correct.

p. PA OUTPUT PULSE SHAPE ADJUSTMENT, EXCITER A. — Because transmitter operation using Exciter A was arbitrarily chosen during the adjusting procedures above, the PA output shape checked first will be that which is generated when Exciter A is oper-

*If necessary, the adjustment range can be extended by use of the additional primary taps on transformer T120.

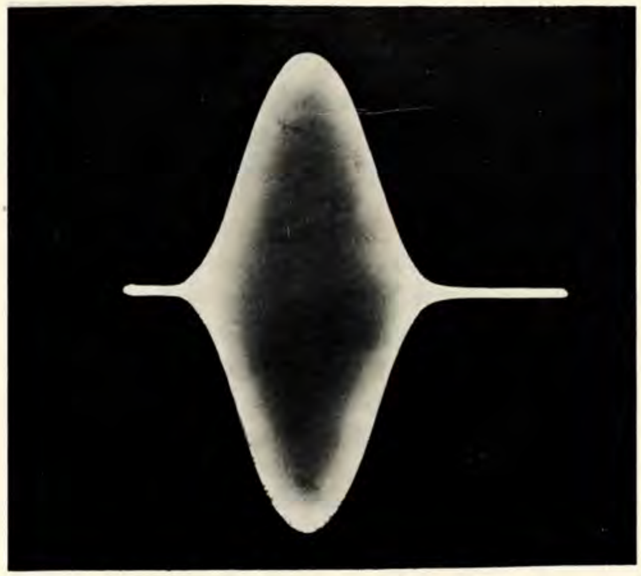


Figure 3—18. PA Output Pulse, Correct Bias

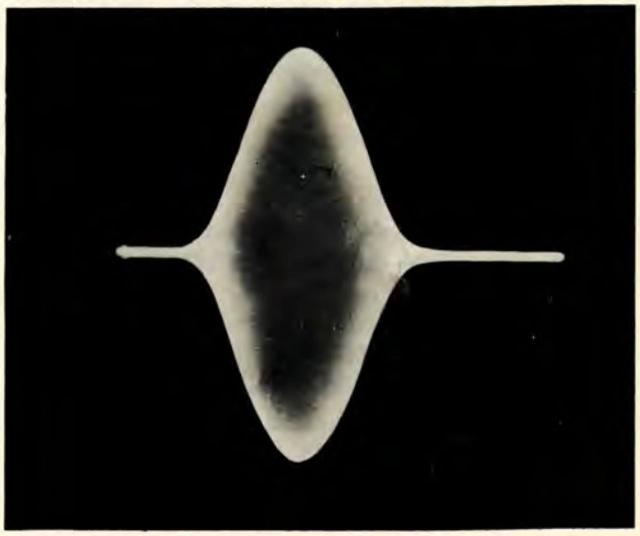


Figure 3—19. PA Output Pulse, Excessive Bias

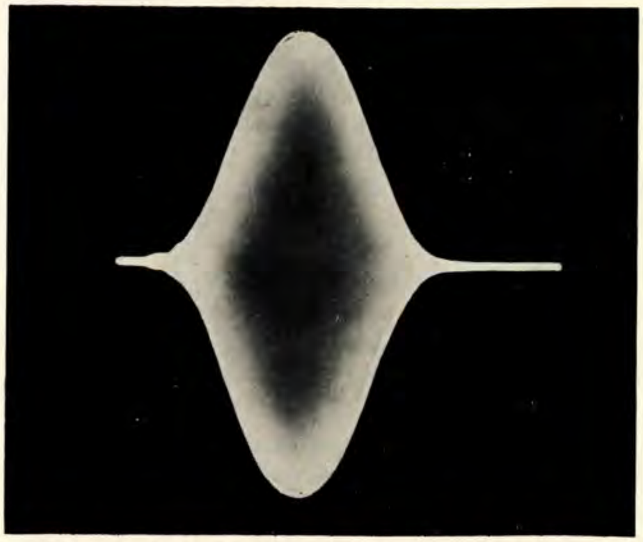


Figure 3—20. PA Output Pulse, Insufficient Bias

ating. The standard output pulse shape for this transmitter has a rise time from 10 percent to 90 percent amplitude of 21 microseconds and a width at 50 percent amplitude of 40 microseconds. The maximum tolerance for both time measurements is ± 1 microsecond.

It is to be emphasized that in the following oscilloscope measurements, reasonable care must be exercised in observing the scope pattern and in reading the SWEEP DELAY dial, if accurate and repeatable results are to be obtained. When making any observation on the scope pattern, avoid parallax by having the eye directly in line with the point being observed. This is easily checked by noting that the reflection of the eye on the screen is directly on the point at which the pattern is being observed. Keep the FIL PRI voltage and the PA PLATE voltage exactly at 230 volts and 15.5 kv, respectively, by means of the FILAMENT VOLTAGE and PLATE VOLTAGE controls during all output pulse shape measurements. This will eliminate the small secondary effects which changes in these voltages have on the pulse shape.

(1) Place the MONITORED CIRCUIT switch in the OUTPUT PA position, and keep the OSCILLOSCOPE TRIGGER switch in the EXC A position.

(2) Leaving other scope controls set as previously instructed, adjust the VERTICAL DEFLECTION, and the VERTICAL and HORIZONTAL CENTERING controls so that the upper half of the output waveform exactly occupies the center 20 horizontal divisions on the calibrated screen of the cathode-ray tube. See figure 2–19A.

(3) Turn the SWEEP LENGTH control to the 100 μs, 25R position, select a convenient vertical line near the center of the scope face as a reference (see Section 2, paragraph 18 and figure 2–19A), and rotate the SWEEP DELAY dial until the leading edge of the pulse crosses the reference line at exactly the 50-percent level (ten divisions above the baseline). Record the reading of the SWEEP DELAY dial.

(4) Rotate the SWEEP DELAY dial until the trailing edge of the pulse crosses the reference line at exactly the 50-percent level and again note the reading on the SWEEP DELAY dial. The difference between this and the reading from (3) above is a measurement of pulse width and should be 40 ± 1 microseconds. Because the pulse-shape controls have previously been adjusted to calibrated settings, the width will, in all probability, be close to or within these limits.

(5) If the pulse width is not within the required limits, place the HIGH VOLT and LOW VOLT-BIAS switches in the OFF positions, observe all safety precautions, and make a slight change in the setting of the EXC A-PULSE WIDTH ADJ control (H) in the rear of the transmitter (see figure 7–15). Moving the slug out of the coil narrows the pulse, while moving the slug in widens it. As a rough approximation, moving the slug an amount equal to one small division (three turns) on the coil scale results in a one-microsecond change in the pulse width.

(6) Restore operating voltages to the transmitter and again measure the pulse width, steps (3) and (4). Repeat step (5) until the pulse width is within the required limits.

(7) With the pulse width correctly adjusted, rotate the SWEEP DELAY dial until the leading edge of the pulse crosses the reference line at the 10-percent level (two divisions above the baseline). Note the reading on the SWEEP DELAY dial. See figure 2–19B.

(8) Rotate the SWEEP DELAY dial until the leading edge of the pulse crosses the reference line at the 90-percent level (18 divisions above the baseline). See figure 2–19C. The difference between the new and the preceding reading on the SWEEP DELAY dial is a measurement of pulse rise-time and should be 21 ± 1 microseconds.

(9) If the rise time is not within the required limits, turn OFF the HIGH VOLT and LOW VOLT-BIAS switches, observe all safety precautions and make a slight change in the setting of the PULSE SHAPE ADJ control (J) behind the rear doors (figure 5–1). Moving the slug into the coil increases the rise time, while moving it out decreases the rise time.

(10) Restore operating voltages to the transmitter and again measure the rise time, steps (7) and (8). Repeat step (9) until the rise time is within the specified limits.

(11) Recheck the pulse-width measurements after the rise time is correctly adjusted, since there is a small amount of interaction between the width and shape controls. Slight readjustments of the pulse width and rise time may again be necessary to obtain the required pulse characteristics. The transmitter is now completely adjusted for operation with Exciter A.

q. ADJUSTMENT OF 2ND IPA OUTPUT PULSE, EXCITER B.

(1) After placing the LOW VOLT-BIAS and HIGH VOLT switches in their OFF positions, turn the EXCITER A switch to its OFF position and the EXCITER B switch to its ON position. Allow about a

minute for the tubes in EXCITER B to warm up. Restore the LOW VOLT-BIAS and HIGH VOLT switches to the ON position.

(2) Place the MONITORED CIRCUIT switch in the OUTPUT 2ND IPA position and the OSCILLOSCOPE TRIGGER switch in the EXCITER B position.

(3) Repeat steps (2) to (6) inclusive of paragraph *o* above, except that the pulse width for EXCITER B is controlled by potentiometer R212 behind the left rear door (see figure 7–16). In this case *counter*clockwise rotation increases pulse width.

r. PA OUTPUT PULSE SHAPE ADJUSTMENT, EXCITER B.

(1) Place the MONITORED CIRCUIT switch in the OUTPUT PA position, leaving the OSCILLOSCOPE TRIGGER switch set for EXCITER B.

(2) Measure the width of the output pulse and adjust it, if necessary, in the same manner as was described for Exciter A in steps (2) to (6) under paragraph *p*, except that EXC B-PULSE WIDTH ADJ control (I) is used (see figure 7–16).

(3) PULSE SHAPE ADJ control (J) should not be touched as it is common to both Exciter A and Exciter B and was previously adjusted in conjunction with the pulse adjustments for Exciter A. At this point all meter readings should check with the typical values listed in table 5–1 for single pulsing at the basic rate being used.

s. OPERATION INTO THE TRANSMISSION LINE. — It is assumed that the antenna has been matched to the 52-ohm transmission line by correct adjustment of the Antenna Coupling Unit as described in paragraph 10 of this section. If this has not been done, refer to the instructions in paragraph 10 before proceeding.

(1) With the LOW VOLT-BIAS and HIGH VOLT switches in their OFF positions, disconnect the transmitter output from the dummy load and connect it to the transmission line by changing the position of the LINK A in the PA section (see figure 5–4). *Observe all safety precautions.*

(2) Return the LOW VOLT-BIAS and HIGH VOLT switches to ON. Retune the OUTPUT TUNING control (F) for a *maximum reading* on the TRANSMISSION LINE current meter (M111) and then lock the control. Note that this tuning must be done slowly as the meter movement is highly damped. All meter readings should again be checked with the typical values listed in table 5–1 for single pulsing at the basic rate being used.

(3) Place the oscilloscope MONITORED CIRCUIT switch in the ANT (RF) position and repeat the pulse-width and rise-time measurements described in paragraphs *p*(2), *p*(3), *p*(4), *p*(7), and *p*(8). Laboratory experience with simulated antennas working in conjunction with the Antenna Coupling Unit indicates that if the coupling unit has been correctly adjusted, the pulse shape measured will be the same as previously obtained when operating with the transmitter dummy load. See figure 7–9.

Note

The transmitter is now adjusted for single-pulsed operation, using either Exciter A or Exciter B. If single-pulsed operation of the transmitter is to be used, disregard paragraph *t*, and continue with paragraph *u*.

t. ADJUSTMENT FOR DOUBLE-PULSED OPERATION. — In the preceding portions of paragraph 9, the output pulse shape was adjusted with Exciter A and Exciter B operating separately. This procedure is to be followed, even though double-pulsed operation is to be the final mode of transmission. When the transmitter is double-pulsed, the pulse amplitudes vary a small amount between adjacent cross-over points of the two pulse repetition rates. Consequently, pulse measurements are more difficult to perform, unless these preliminary single-pulsed readings are made. To change over to double-pulsed operation, proceed as follows:

(1) Place the LOW VOLT-BIAS and HIGH VOLT switches in their OFF positions, and turn both the EXCITER A and the EXCITER B switches to ON.

(2) Set LINK C across resistor R192, located on the rear fuse panel (see figure 5–1), and LINK D across resistor R188, located behind the control panel section (see figure 3–17), so that both links short out their respective resistors.

Note

Unless LINK C and LINK D have previously been set for a basic pulse repetition rate of 20 pps in single-pulsed operation (table 3–2), no change should be required.

(3) Restore the operating voltages, and advance the PLATE VOLTAGE control slightly to maintain a reading of 15.5 kv on the PA PLATE voltmeter.

(4) Place the MEDIUM VOLTAGE meter switch (S112) in the 2nd IPA PLATE position and adjust potentiometer R189, located on the rear fuse panel (see figure 5–1), for a reading as required in table 3–4. Before making any adjustment, be certain to

place the LOW VOLT-BIAS and HIGH VOLT switches in their OFF positions and to ground all exposed components with the capacitor-discharge rod provided.

(5) Increase the MOD PLATE voltage control setting (behind the control panel cover plate) until a reading of 5,800 volts is obtained on the MEDIUM VOLTAGE meter, with meter switch S112 set to the MOD PLATE position. (See Note immediately following table 3–4.)

TABLE 3–4. 2ND IPA PLATE VOLTAGE, DOUBLE-PULSED OPERATION

BASIC PULSE REPETITION RATE	2ND IPA PLATE VOLTAGE
20 pps	6.9 kv
25 pps	7.0 kv
33-1/3 pps	7.1 kv

Note

The voltage values in table 3–4, and the 5,800-volt potential noted in paragraph (5) above, are nominal. Adjust as close to them as possible. The readings obtained should be within plus or minus two percent of the values given. However, once a voltage is initially logged, the logged value should be maintained in subsequent readings.

(6) Decrease the PA BIAS control setting (behind the control panel cover plate) to the same value recorded during the initial adjustments at a single pulse rate, described in paragraph *n*.

(7) Make any slight readjustments necessary in the settings of the PLATE VOLTAGE control, the 2nd IPA plate voltage control (R189), and the MOD PLATE voltage control, steps (3), (4), and (5), so that the exact required voltages exist simultaneously. The transmitter is now completely adjusted for double-pulsed operation into the dummy load.

(8) For operation into the transmission line, follow the procedure of paragraph *s*, above.

u. NORMAL METER AND OSCILLOSCOPE INDICATIONS. — With the transmitter completely tuned and operating normally into the antenna, check all meter readings against the typical values listed in table 5–1. Log the actual meter readings and use them as a basis for future comparison. When all meter readings have been logged, switch the EXCITER CURRENT meter to GRID CURRENT, and plug its cord into the jack (J305) provided for reading the grid current of the 25-kc tube (V307). Leave it this way during all routine operation, so that this grid current may be checked readily at any time. Oscilloscope patterns for all positions of the MONITORED CIRCUIT switch should appear as shown in figures 7–1 to 7–10, inclusive. At this point it is desirable to check the output frequency of each of the frequency generating units. To do this use a Navy LM Frequency Meter or equivalent. Couple the frequency meter to one frequency generating unit at a time by coupling the meter through jack J311.

Set the TUNE-OPERATE switch to TUNE and HIGH VOLT switch to OFF. This will prevent application of unnecessary high voltages in other portions of the transmitter during the frequency check. Turn on *only one exciter at a time,* and check the output frequency as closely as possible. If the frequencies are indicated to be correct in this manner, make a further check to assure proper "lock-in" with the 100-kc source. To do this observe the output pulse on the monitoring oscilloscope with the sweep set at 4R, with S116 in the OUTPUT PA position, and with HIGH VOLT switch ON. The individual r-f cycles thus made visible should not move horizontally. If horizontal movement is present, the frequency is not properly locked in and improper operation of the frequency generator's divider circuit is indicated. Refer to Section 7, paragraph 4, for further information on this condition.

v. COMPENSATOR CIRCUIT. — The compensator circuit adjustment R258, located in the IPA cabinet, is *factory-adjusted and should not require resetting* at this point. This circuit is inserted to offset heavy loading effects on the power supply during double pulsing, as described in Section 2, paragraph 9*c*. If, for any reason, readjustment of this circuit is found to be absolutely required, refer to Section 7, paragraph 15.

w. VOLTAGE ADJUSTMENTS.

(1) VOLTAGE REGULATOR. — In general, if the voltage regulator output voltage is correct initially, it will remain so. However, should any adjustment of the output voltage be required, it is done with the OUTPUT VOLTAGE control and must always be followed by a readjustment of the SENSITIVITY control as described in Section 3, paragraph 9*d* (1) (*g*).

(2) TRANSMITTER. — Under normal conditions, the line voltage regulator will automatically

Figure 3–21. Antenna Coupling Unit (Not Supplied), Front Access Doors Open

maintain correct input voltage for the transmitter. However, if at any time it should be necessary to operate the transmitter with the voltage regulator disconnected, routine voltage adjustments on the transmitter will be required to compensate for line-voltage changes. These adjustments are made with only the PLATE VOLTAGE and FILAMENT VOLTAGE controls. Keep the PLATE VOLTAGE control set to maintain a reading of 15.5 kv on the PA PLATE voltmeter. Set the FILAMENT VOLTAGE control to maintain a reading of 230 volts on the LINE meter (with meter switch set to FIL PRI). The proper setting of these controls generally assures correct voltages in all individual circuits in the transmitter. Avoid disturbing internal transmitter controls.

10. TUNING AND INITIAL OPERATION OF ANTENNA COUPLING UNIT.*

a. GENERAL. — Before power is applied to the antenna for the first time, the antenna coupling network must be adjusted to provide a proper match between the transmission line and antenna at the operating frequency. (At this point it is recommended that Section 2, paragraph 18, be reviewed.) The general steps of the adjustment procedure (described in more detail in paragraphs *b* to *h* below) are:

(1) Determination of antenna resistance and reactance at the operating frequency.

(2) Selection of correct antenna coupling unit network.

(3) Arrangement of antenna coupling unit as the proper network.

(4) Preliminary setting of tuning controls.

(5) Accurate adjustment of tuning controls.

(6) Operational checks.

For convenience in explanation it may be considered that there are two basic procedures for carrying out steps (1) through (5). In one case, radio-frequency

*This discussion applies specifically to only one manufacturer's type of antenna coupling unit and may be considered a typical case. See Section 1, paragraph 1.

bridge measurements and calculations are used to determine network arrangements and both the preliminary and accurate dial settings required. In the other procedure, network arrangements and preliminary dial settings are read directly from a table (table 3–5) and final accurate settings are accomplished by observing transmitter meter readings. The second procedure is possible only if the antenna involved is one of the three types whose characteristics are covered in table 3–5. The first procedure, involving bridge measurements, etc., is covered in paragraphs *b* through *g*, following. The second procedure, which uses table values, meter readings, etc., is covered in paragraph *h*.

It should be noted that these procedures are not restrictive, in that portions of the one can be interchanged with portions of the other at the convenience of the user (assuming required instruments are available). For example, if the antenna to be used is one of the three types covered by table 3–5, then the table can be used for network information and preliminary dial settings, but accurate settings may be made by using r-f bridge measurements and calculations, rather than by use of transmitter meter readings.

WARNING

DE-ENERGIZE THE TRANSMITTER AND GROUND ALL R-F CIRCUITS BEFORE TOUCHING ANYTHING IN THE ANTENNA COUPLING UNIT. "TAG" THE MAIN SWITCH ON THE TRANSMITTER SO THAT NO ONE WILL ENERGIZE THE EQUIPMENT WHILE PERSONNEL ARE WORKING ON THE COUPLING UNIT.

Before proceeding with the adjustment of the coupling network, check the 115-volt lighting circuit and the convenience outlet. Switch S403, which controls power to the lights and convenience outlet, is located

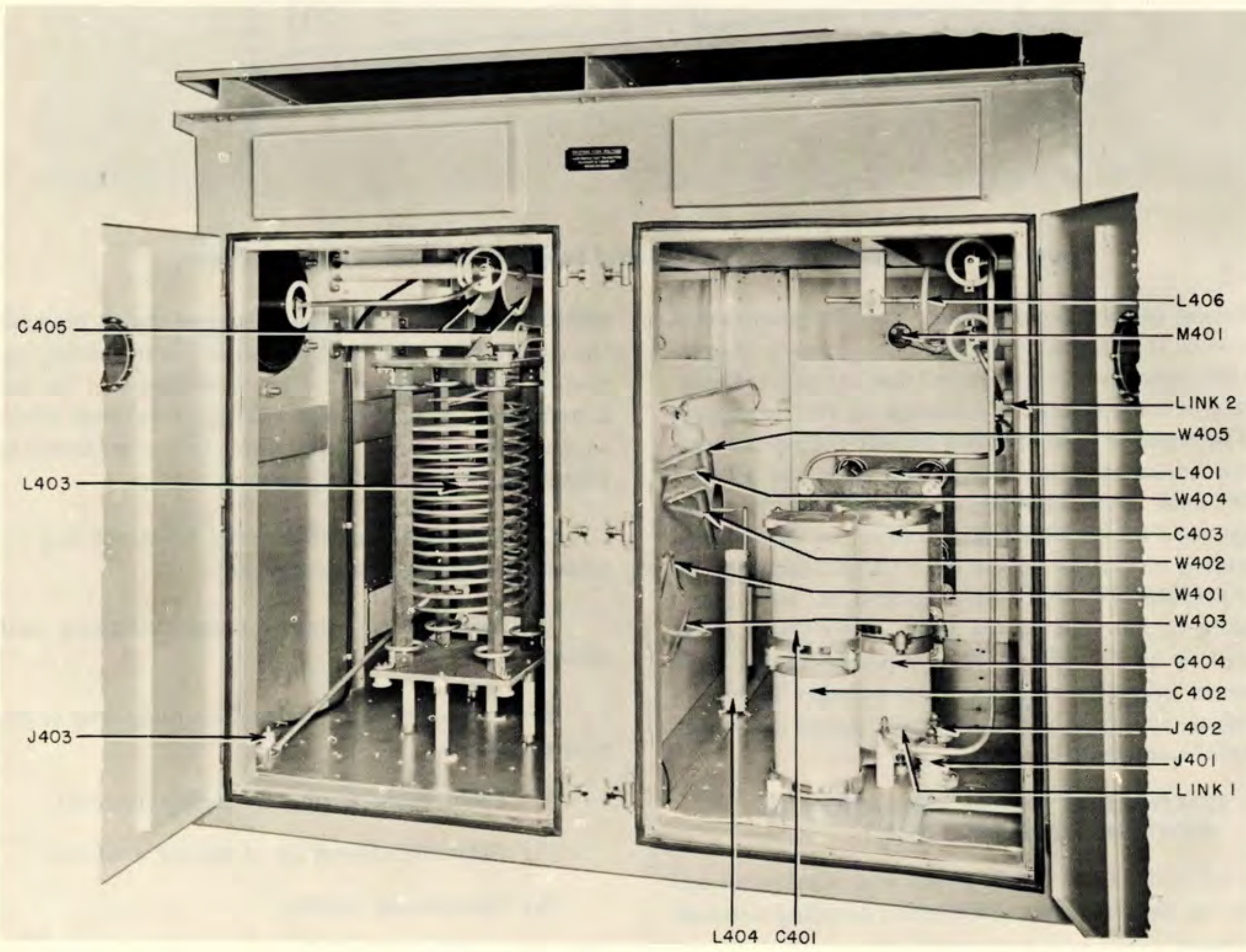


Figure 3—22. Antenna Coupling Unit (Not Supplied), Rear Access Doors Open

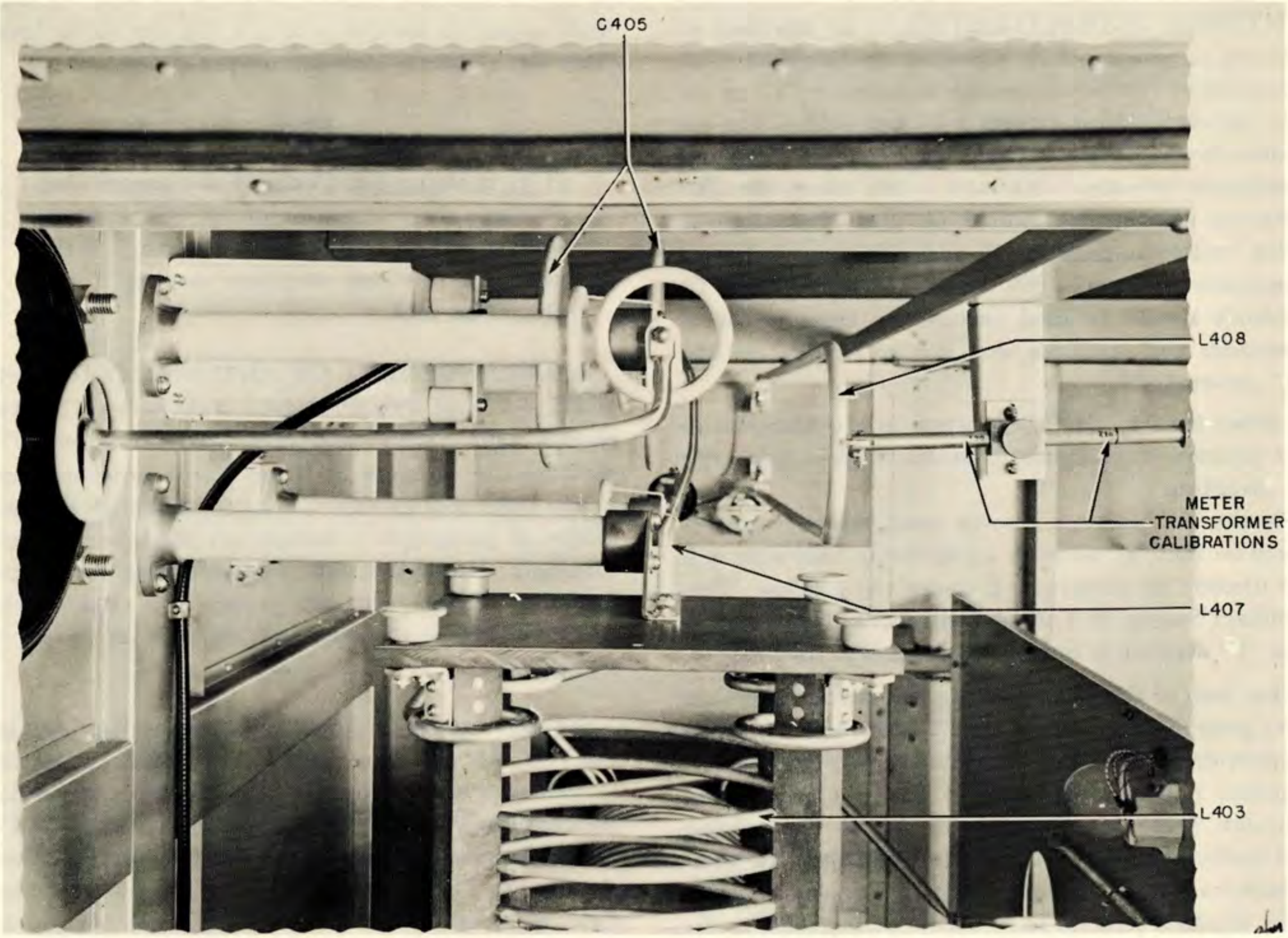


Figure 3—23. Details of Meter Transformer and Monitoring Pick-Up, Antenna Coupling Unit

in a conduit box on the left side of the unit toward the front; the convenience outlet is located in the conduit box on the left side of the unit toward the rear.

b. DETERMINATION OF ANTENNA RESISTANCE AND REACTANCE AT OPERATING FREQUENCY. — To be able to select the correct circuit in the Antenna Coupling Unit, it is essential that the antenna resistance and reactance at the operating frequency be known at least approximately.

The recommended procedure is to measure these characteristics as accurately as possible with a suitable radio-frequency bridge.

Note

If a radio-frequency bridge and accessories are not available for measurement of antenna characteristics, refer directly to paragraph 10*b* and table 3–5 for a possible alternate method.

A typical measuring set-up would consist of a General Radio Type 916A R-F Bridge, a General Radio Type 605B Signal Generator, and a good communications receiver covering the frequency range of 1,750 kc to 1,950 kc for use as a bridge detector. Connect these equipments as indicated in their appropriate instruction manuals.

To determine the antenna characteristics perform the following steps with the r-f bridge equipment:

(1) Disconnect the antenna lead from the Antenna Coupling Unit and connect it to the ungrounded "UNKNOWN" terminal of the bridge.

(2) Connect the grounded "UNKNOWN" terminal of the bridge to the ground strap of the coupling unit by means of a short lead.

(3) Adjust the signal generator output supplied to the bridge to the operating frequency.

(4) Determine the resistive and reactive components of the antenna impedance by means of the bridge, and identify the reactive component as inductive or capacitive.

c. SELECTION OF TYPE NETWORK TO MATCH ANTENNA CHARACTERISTICS. — As described in Section 2, paragraph 18, the Antenna Coupling Unit components can be connected as either a "T" or an "L" network. (Note figures 2–17 and 2–18.) For antennas having resistances between 25 and 45 ohms and reactances between —300 and —100 ohms, the "L" network arrangement should be used. For antennas with resistances between 25 and 150 ohms and with reactances between —300 and +150 ohms, the "T" network should be used (except for those values of resistance and reactance that can be handled by the "L" network).*

Select the "T" or "L" network in accordance with the antenna values measured as described in paragraph *b,* preceding.

If the "L" network is to be used, skip the instructions on the "T" network immediately following and go directly to paragraph *f,* under the heading "Preliminary Setting of Tuning Controls, 'L' Network." If the "T" network is to be used, proceed as follows:

For each of the five operating frequencies, there are four possible variations of the "T" network. These are to provide for efficient operation over a wide range of antenna impedances. A set of curves (figures 3–25 through 3–29) are provided for use in determining the correct "T" network variation, and network characteristics for the various operating frequencies available. Symbols referred to in the following, such as X_2, X_A, etc., are identical in meaning with those given in the explanatory diagrams, figures 2–17 and 2–18. The criterion for selecting the proper "T" network variation is that (X_2+X_A) shall be as low as possible for the particular antenna resistance. The antenna resistance R_A and antenna reactance X_A are known. The value of X_2 is governed by the setting of the B-ANTENNA tuning control. When this control is set at zero, the value of X_2 is approximately +60 ohms. With this in mind proceed in the following steps:

(1) Add +60 ohms to X_A. [The sign for X_A (plus for inductive, minus for capacitive reactance) must be taken into account.] This will give the minimum value for (X_2+X_A).

(2) Locate the point on the chart *for the correct operating frequency* (figures 3–25 through 3–29) where a line drawn vertically from the value of R_A intersects a line drawn horizontally from the minimum value derived for (X_2+X_A).

(3) Choose the curve of (X_2+X_A) which is nearest this point, but which lies above it. The "T"-network variation for this curve is the one to be used. Note the diagrams included on the chart.

Note

If X_A is negative and numerically greater than 60 ohms, the intersection of (X_2+X_A) (minimum) and R_A will be below the range of the chart. In this case variation number 1 will always be used.

d. ARRANGEMENT OF ANTENNA COUPLING UNIT AS THE PROPER NETWORK. — The Antenna Coupling Unit* is shipped from the factory "T"-connected in variation 2. If the unit is to be arranged in any other configuration, in accordance with the procedure of paragraph *c,* connections must be made accordingly within the unit. Copper-tubing connectors for other arrangements are provided in clips on the vertical shield at the center of the unit, as shown in figure 3–22.

See the Antenna Coupling Unit wiring diagram, figure 7–51, for full information as to which connectors to use and where to connect them. Each connector has an identifying symbol stamped on it, such as "W401". Fasten the required connectors securely in place. Note that for the "T" network, variations 3 and 4, capacitor C403 must be unbolted from its position on top of C404 and mounted with the same hardware on top of C402. Again, make certain that the connections are tight.

Adjust the output-monitoring-pickup capacitor (C405) so that the plate spacing is approximately two inches. See figure 3–23.

e. PRELIMINARY SETTING OF TUNING CONTROLS, "T" NETWORK. — Refer to the appropriate set of curves, figures 3–25 to 3–29, inclusive, for the particular operating frequency to be used. For the known value of antenna resistance R_A determined in accordance with paragraph *b,* and on the curve corresponding to the variation of the "T" network for which the Antenna Coupling Unit was connected, find the reactance for (X_2+X_A) and for X_1.** Determine the necessary value of X_2 by subtracting from (X_2+X_A) the known value of antenna reactance (X_A). Remember to take into account the sign associated with X_A.

As an example, assume (X_2+X_A) was found to be 90 ohms from the curve and that the known antenna reactance (X_A) was —20 ohms. Then

*Although not originally designed to be used with antennas having resistances lower than 25 ohms, the equipment actually can be arranged to accommodate lower values of antenna resistance. See paragraph *k* at the end of this section.

*Antenna Coupling Unit not supplied with this equipment. See Section 1, paragraph 1.

**Reactance of L401 (figure 2–18).

$$X_2=(X_2+X_A)-X_A$$
$$X_2=90-(-20)$$
$$X_2=110 \text{ ohms}$$

Refer to figure 3–29 and determine what dial settings for the A-ANTENNA TUNING AND B-ANTENNA TUNING controls correspond to the necessary values of X_1 and X_2 respectively. Adjust the A-ANTENNA TUNING control and the B-ANTENNA TUNING control accordingly.

f. PRELIMINARY SETTING OF TUNING CONTROLS, "L" NETWORK. — Refer to figure 3–24. For the known value of antenna resistance R_A determined in accordance with paragraph *b*, find the reactance for (X_2+X_A) and for X_1. Determine the necessary value of X_2 by subtracting from (X_2+X_A) the known value of antenna reactance X_A. Although X_A is always negative (capacitive) where the "L" network is used, the minus sign must not be disregarded when subtracting X_A from (X_2+X_A).

Refer to figure 3–29 and determine the dial settings for the A-ANTENNA TUNING and B-ANTENNA TUNING controls which correspond to the required values of X_1 and X_2, respectively. Adjust the A-ANTENNA TUNING control and the B-ANTENNA TUNING control accordingly.

g. ACCURATE ADJUSTMENT OF TUNING CONTROLS, USING AN R-F BRIDGE. — Having placed the tuning controls in their preliminary settings in accordance with either paragraph *e* or paragraph *f* above, it is now necessary that these settings be accurately adjusted so that an impedance of exactly 52 ohms resistive is presented to the transmission line which runs to the transmitter. Here, as in the case of determining the antenna impedance, the recommended procedure requires the use of an r-f bridge. The r-f bridge equipment would be the same as outlined in paragraph *b*.

To determine the precise settings for the two antenna coupling controls, perform the following steps, using the r-f bridge equipment.

WARNING

BE CERTAIN THAT THE TRANSMITTERS ARE INOPERATIVE BEFORE OPENING THE COUPLING UNIT ACCESS DOORS. GROUND ALL COMPONENTS WITH THE CAPACITOR-DISCHARGE ROD PROVIDED. OBSERVE ALL SAFETY PRECAUTIONS, INCLUDING TAGGING THE TRANSMITTERS.

(1) Make certain that the antenna lead is securely connected to the bowl insulator on the right-hand side of the Antenna Coupling Unit, and that the coupling unit ground strap is connected to the antenna ground or counterpoise system.

(2) Open the right rear door (as viewed from rear) and place the bridge equipment near the opening. Make certain that LINK 2 (see figure 3–22) is in the position which connects the antenna network (and not the dummy load) to the input line. Loosen LINK 1 (see figure 3–22) and tighten it in a neutral position so that neither of the two input lines is connected. In some convenient manner, make it possible for the operator to wear the bridge detector (receiver) earphones when in a position to adjust the tuning controls on the front of the coupling unit.

(3) Connect the grounded "UNKNOWN" terminal of the bridge to the ground strap of the coupling unit by means of a short lead. Connect the ungrounded "UNKNOWN" terminal of the bridge to the neutrally positioned LINK 1.

(4) Set the r-f bridge so that if the unknown impedance were 52 ohms resistance and zero ohms reactance $(52+j0)$, a balance would be obtained. Tune the signal generator output to the desired operating frequency.

(5) While listening to the bridge detector output, adjust the A-ANTENNA TUNING control and the B-ANTENNA TUNING control individually for the best signal null. This, in all probability, will not result in a perfect null as the controls are interdependent. However, it will provide a good starting point from which to proceed. For each of several small increments (about 20 divisions) of dial setting, in both directions, of control B, tune control A for the best null. Keep in mind the depth of the null at each of the increments. Proceed with the increments of A and retuning of B in the *direction of increasing null* until the bridge signal is at an irreducible minimum. The antenna coupling circuit input is then correct. Lock controls A and B.

(6) Remove the bridge connections and restore LINK 1 to either of the two input lines.

h. SET-UP AND ADJUSTMENT OF ANTENNA COUPLING UNIT WITHOUT USE OF R-F BRIDGE. — It is to be stressed that the best method of adjusting the Antenna Coupling Unit is with an r-f bridge as described in paragraph *g*. However, if an r-f bridge is not available for antenna and network measurements, the approximate characteristics for three types of antennas, and associated coupling unit settings, etc., are given in table 3–5. The values provided are

TABLE 3–5. APPROXIMATE ANTENNA COUPLING UNIT DIAL SETTINGS FOR VARIOUS ANTENNAS AND OPERATING FREQUENCIES

(Network variation number 1 used in all cases.)

FREQ. (KC)	1750	1800	1850	1900	1950
300-FOOT VERTICAL					
	R_A 98 X_A −210	R_A 80 X_A −180	R_A 70 X_A −150	R_A 61 X_A −125	R_A 55 X_A −100
A-Antenna Tuning	135	175	160	160	160
B-Antenna Tuning	545	490	430	410	365
120-FOOT VERTICAL					
	R_A 31 X_A −2	R_A 34 X_A +10.5	R_A 37.5 X_A +23	R_A 41.5 X_A +35.5	R_A 46 X_A +48
A-Antenna Tuning	275	260	240	210	180
B-Antenna Tuning	230	185	150	105	55
T-TYPE 74-FOOT FLAT TOP 64-FOOT LEAD-IN					
	R_A 23.2 X_A −67.5	R_A 25.3 X_A −47	R_A 26.7 X_A −27	R_A 28.1 X_A −7	R_A 30 X_A +13
A-Antenna Tuning	300	290	268	250	225
B-Antenna Tuning	345	295	250	200	145

for a 300-foot guyed vertical radiator, a 120-foot guyed vertical radiator, and a wire "T" antenna having a 74-foot flat top portion and a 60-foot down lead. At the time of manufacture it was anticipated that one of these three types would be used with Radio Transmitter T–325B/FPN. It will be noted that only the "T"-network is used and that variation number 1 is used in all cases.

Set up the Antenna Coupling Unit to the correct "T"-network variation for the type antenna and operating frequency to be used. Note the dial settings for the particular case and set the coupling unit A-ANTENNA and B-ANTENNA dials accordingly. When this is accomplished, proceed to refine the coupling unit dial settings through the use of meter readings, as follows (the transmitter *must* be in normal operating condition for this method of tuning):

(1) With the transmitter inoperative, open the right rear door (looking from rear) of the coupling unit and adjust LINK 2 (see figure 3–22) to connect the dummy load. Reclose the door.

(2) Turn the transmitter on, and record the readings on the TRANSMISSION LINE meter (M111) in the transmitter, and the LINE meter (M401) in the coupling unit. The readings observed on the meters will be used as a reference to judge the correct adjustment of the coupling network.

(3) Turn the transmitter off. Open the rear right door of the coupling unit and adjust LINK 2 to connect the antenna network. Reclose the door.

(4) Turn the transmitter on. If the coupling network is too far out of adjustment, arcing may occur in the output circuit of the transmitter because of the improper load. Under these circumstances, reduce the setting of the HIGH VOLTAGE control (T101) on the transmitter until the transmitter will operate without arcing.

(5) Note the reading on the coupling unit ANTENNA meter (M402). Change the B-ANTENNA TUNING control in a series of 20-division increments in both directions, and at each incremental setting of B, tune the A-ANTENNA TUNING control for maximum ANTENNA current. Find the combination which gives maximum ANTENNA current.

(6) If the transmitter HIGH VOLTAGE has been reduced, restore it to normal.

(7) Adjust the settings of A and B, as necessary, to make the LINE currents at the transmitter and at the coupling unit essentially the same as they were in step (2).

i. MONITOR OSCILLOSCOPE PICK-UP ADJUSTMENT. — The amplitude of the pulse on the transmitter monitoring oscilloscope with the MONITORED CIRCUIT switch in the ANT (RF) position is adjustable by means of capacitor C405 (figure 3–23) in the Antenna Coupling Unit. A pulse amplitude of about 25 divisions on the oscilloscope face for the upper half of the oscillogram should be obtained when the VERTICAL DEFLECTION control is set for maximum. Adjust capacitor C405, if necessary, to obtain this condition. Increasing the plate spacing of C405 will decrease the oscilloscope signal and vice versa. Make certain the transmitter is off when going into the coupling unit to make an adjustment. Ground LINK 1 with the capacitor-discharge rod as an added safety precaution.

j. METER TRANSFORMER ADJUSTMENTS. — As described in Section 2, paragraph 17, the hair-pin loop transformers for the LINE (M401) and ANTENNA (M402) meters have been set at the factory for step-down ratios of 10 and 20, respectively. It is possible, however, to reduce the step-down ratio by half, which will double the meter sensitivity. Thus, if the meter readings obtained under normal operating conditions are at the low end of the scale, where it is difficult to make accurate readings, it is possible to double the actual reading by halving the meter multiplying factor.

Two marks have been placed on the slider arm, attached to each hair-pin secondary, which adjusts the transformer spacing. In the case of the ANTENNA meter, the mark which corresponds to the greater spacing effects a step-down ratio of 20; this is set at the factory. If it is necessary to reduce the ratio to 10, the holding screw should be loosened and the slider arm moved so that the mark corresponding to a smaller spacing lines up with the side of the holding block that is nearer the hair-pin loop. Figure 3–23 shows the details of this assembly.

For the LINE meter, the procedure is the same, except that the factory-set ratio is 10, which may be reduced to 5 by increasing the transformer coupling (decreasing the spacing).

Whenever these changes are made, the meter designation plates should be reversed to indicate the correct multiplying factor.

k. SET-UP FOR OPERATION WITH ANTENNA RESISTANCES OF LESS THAN 25 OHMS. — If required, the Antenna Coupling Unit can be set up to work with antenna resistances of less than 25 ohms. There are two possible approaches toward accomplishing this end. (In either case, the "T" network is used.) The first method is to extend the curves of figures 3–25 through 3–29 (by approximation) to cover lower antenna resistance values, and to utilize them as far as possible. In this attempt, use the curves in the same manner as described for the higher antenna resistances in paragraphs *c* through *e*, preceding. Antenna reactance will in all probability be a negative value between zero and 100 ohms and variation 1 of the "T" network will be the one to try. Generally, the capability of any of the four "T"-network variations to match a low resistance antenna will be limited by the tuning range of the series inductance L401 (A-ANTENNA TUNING) whose reactance is designated X_1. It will be noted that the broken-line X_1 curves tend to rise sharply toward the lower antenna resistance region of the charts. If it is found that the desired setting is impossible, turn to the second method, which follows. [Also, if the desired setting is attained, but is found to necessitate an adjustment of A-ANTENNA TUNING (L401) near maximum, better efficiency will probably be obtained if the second method is used.]

WARNING

IN THE FOLLOWING ADJUSTMENTS OBSERVE ALL SAFETY PRECAUTIONS.

For the second method, connect for variation 1 of the "T" network and then add a connector between C403 and C402. This will put the two series capacitor combinations C401-C402 and C403-C404 in parallel. Then, if an r-f bridge and accessories are available, set them up as described in paragraph *g*, preceding, and search for a null by making individual rough checks on the A-ANTENNA TUNING and the B-ANTENNA TUNING controls and then refining them. Try a series of increments on the B-ANTENNA TUNING control in one direction. For each B increment readjust the A dial for best approach toward a null. In this manner the correct direction of adjustment for B-ANTENNA TUNING can be established. When this has been done, continue the increments of B-ANTENNA tuning with corresponding readjustment of A-ANTENNA TUNING until the best possible null is obtained.

If an r-f bridge is not available, use the meter-reading procedure as described in paragraph *b* (2) through (7).

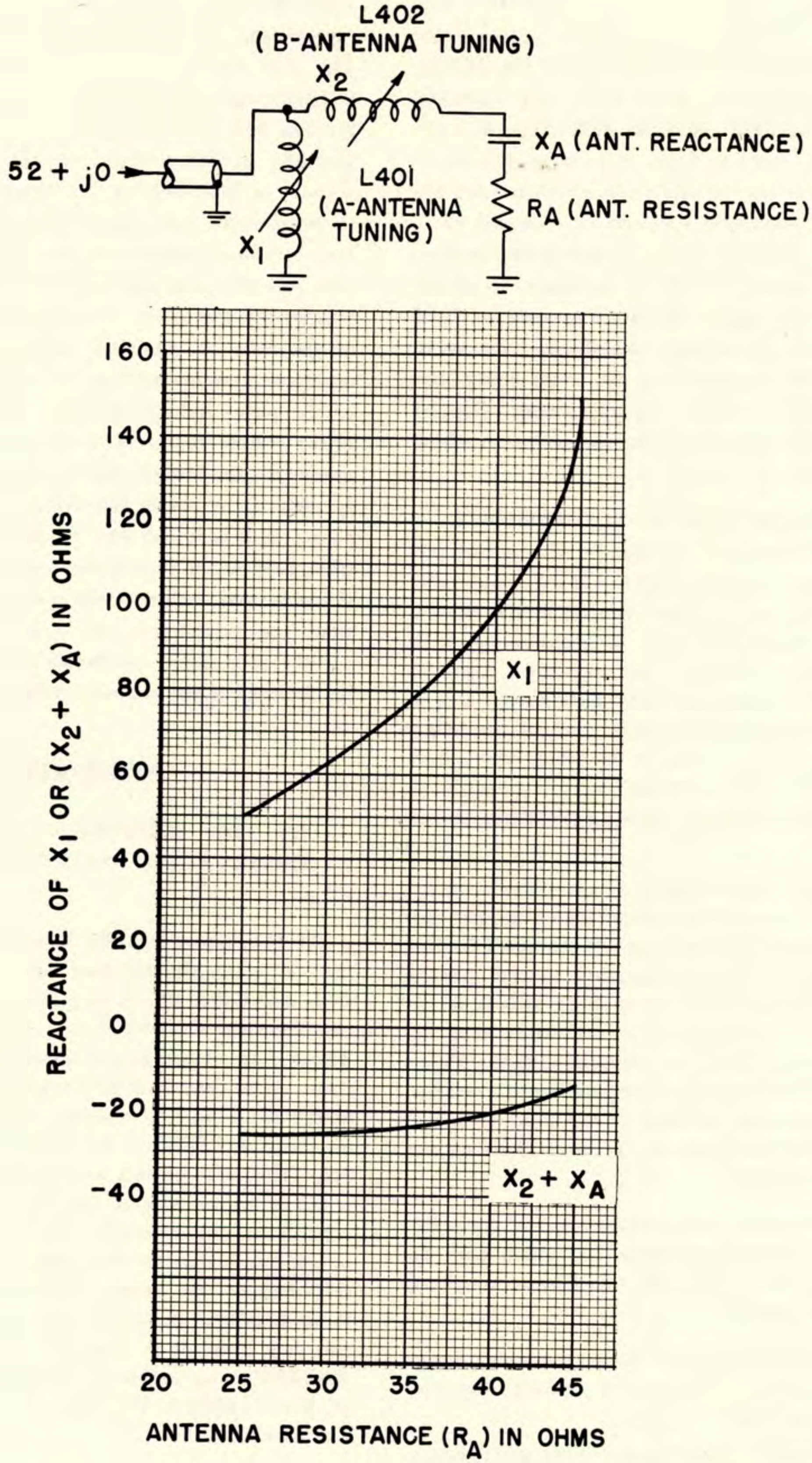


Figure 3–24. Antenna Tuning Curves, "L" Network

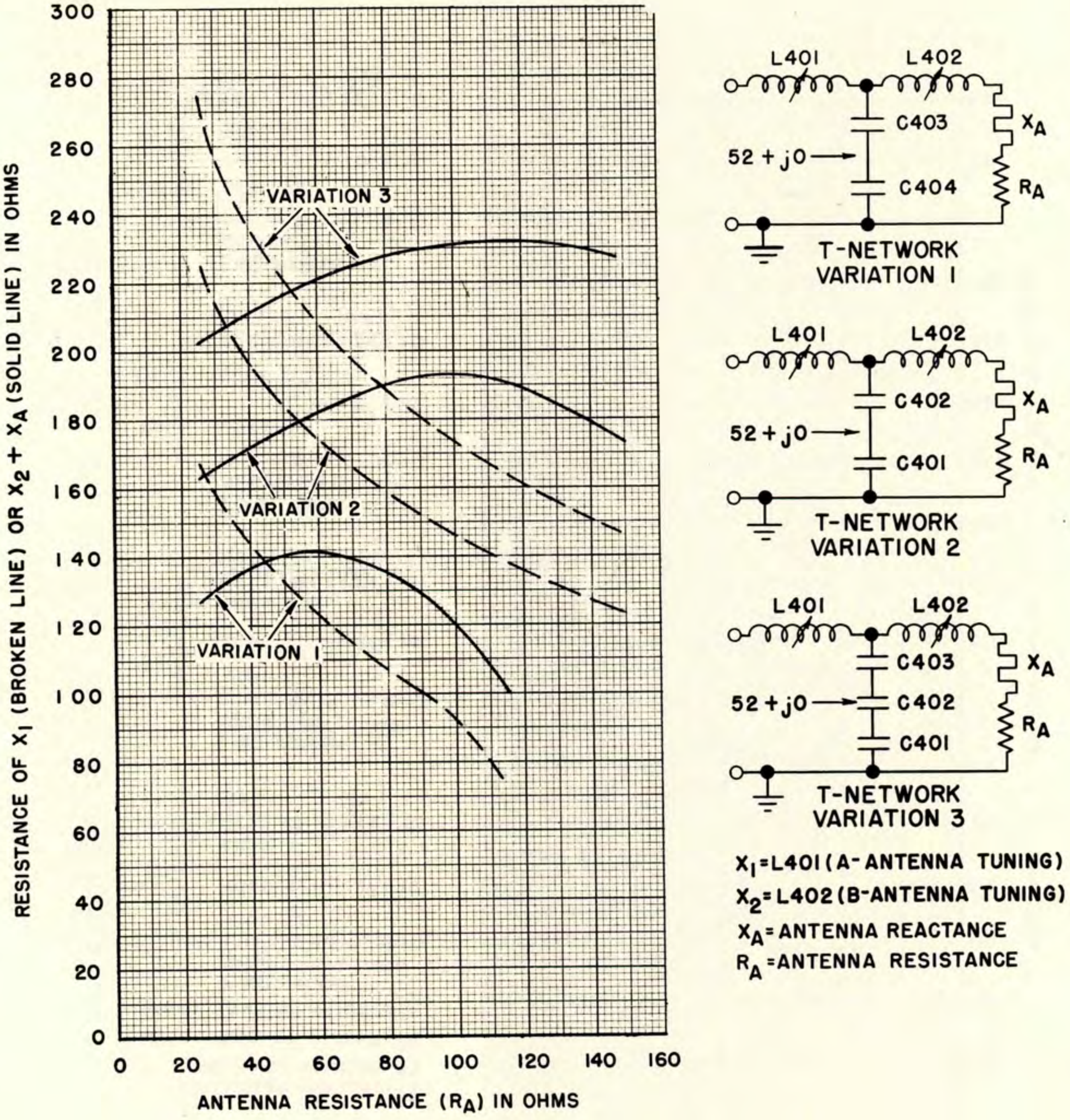


Figure 3—25. Antenna Tuning Curves, "T" Network, 1,750 KC

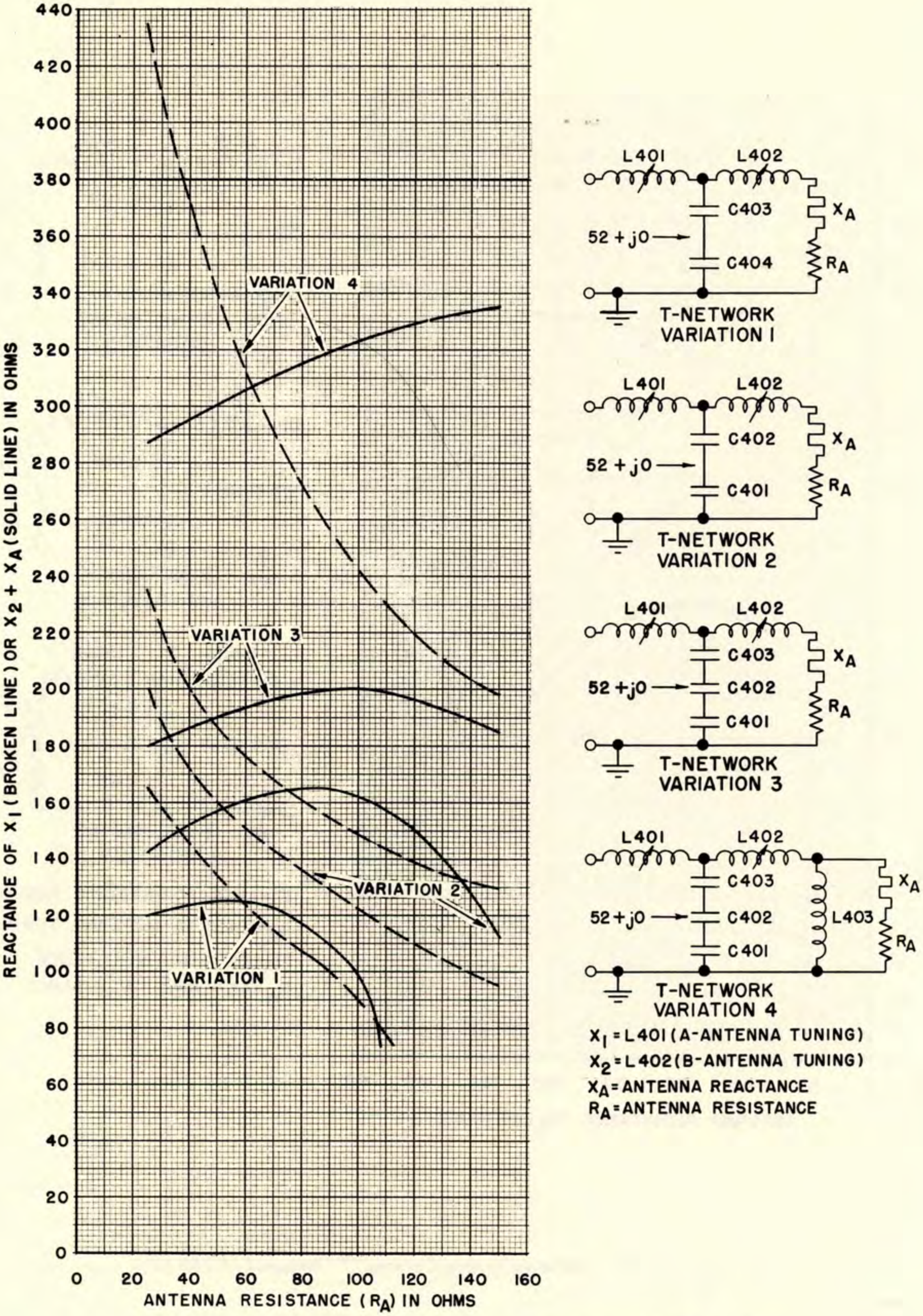


Figure 3–26. Antenna Tuning Curves, "T" Network, 1,800 KC

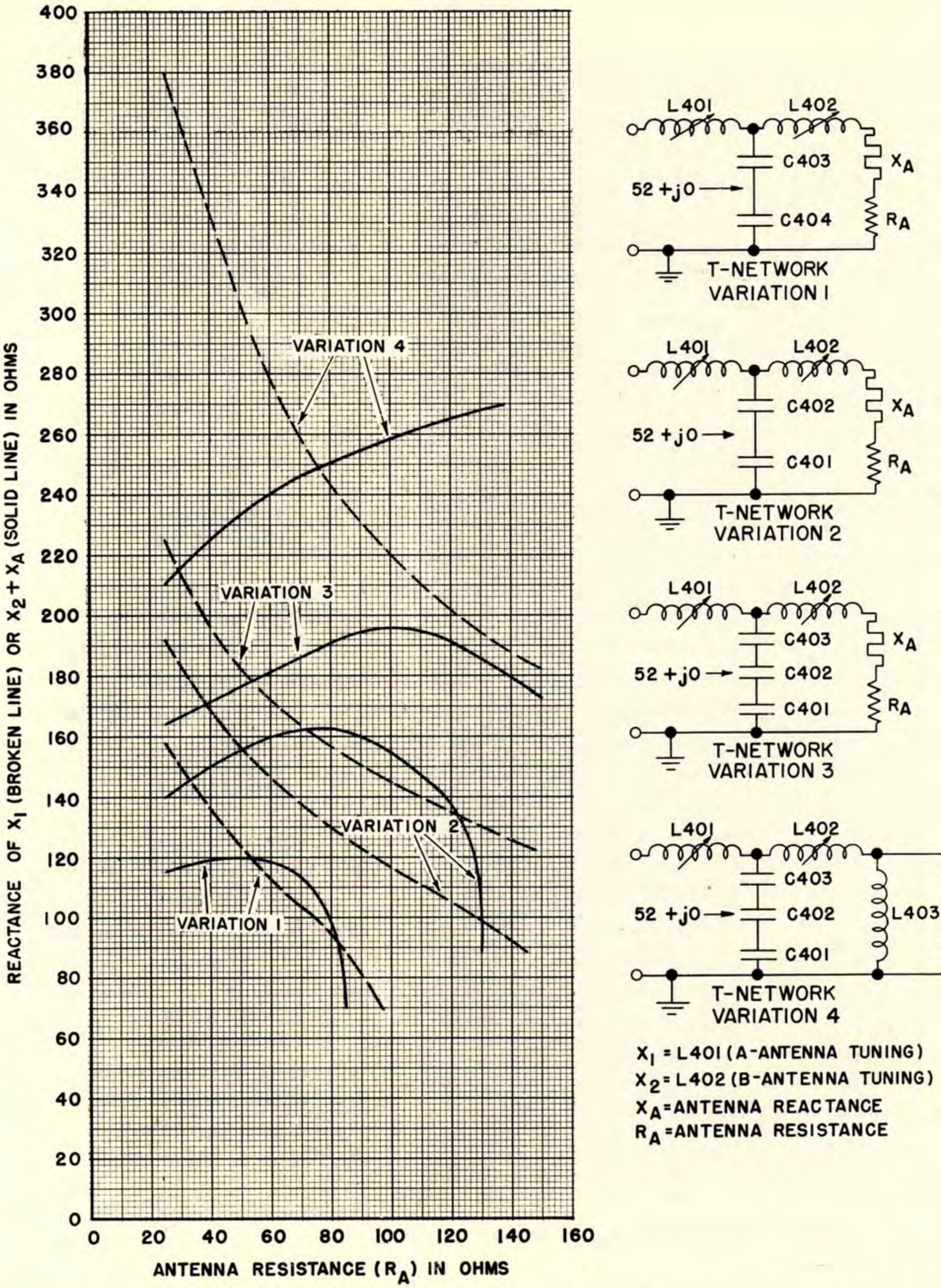


Figure 3–27. Antenna Tuning Curves, "T" Network, 1,850 KC

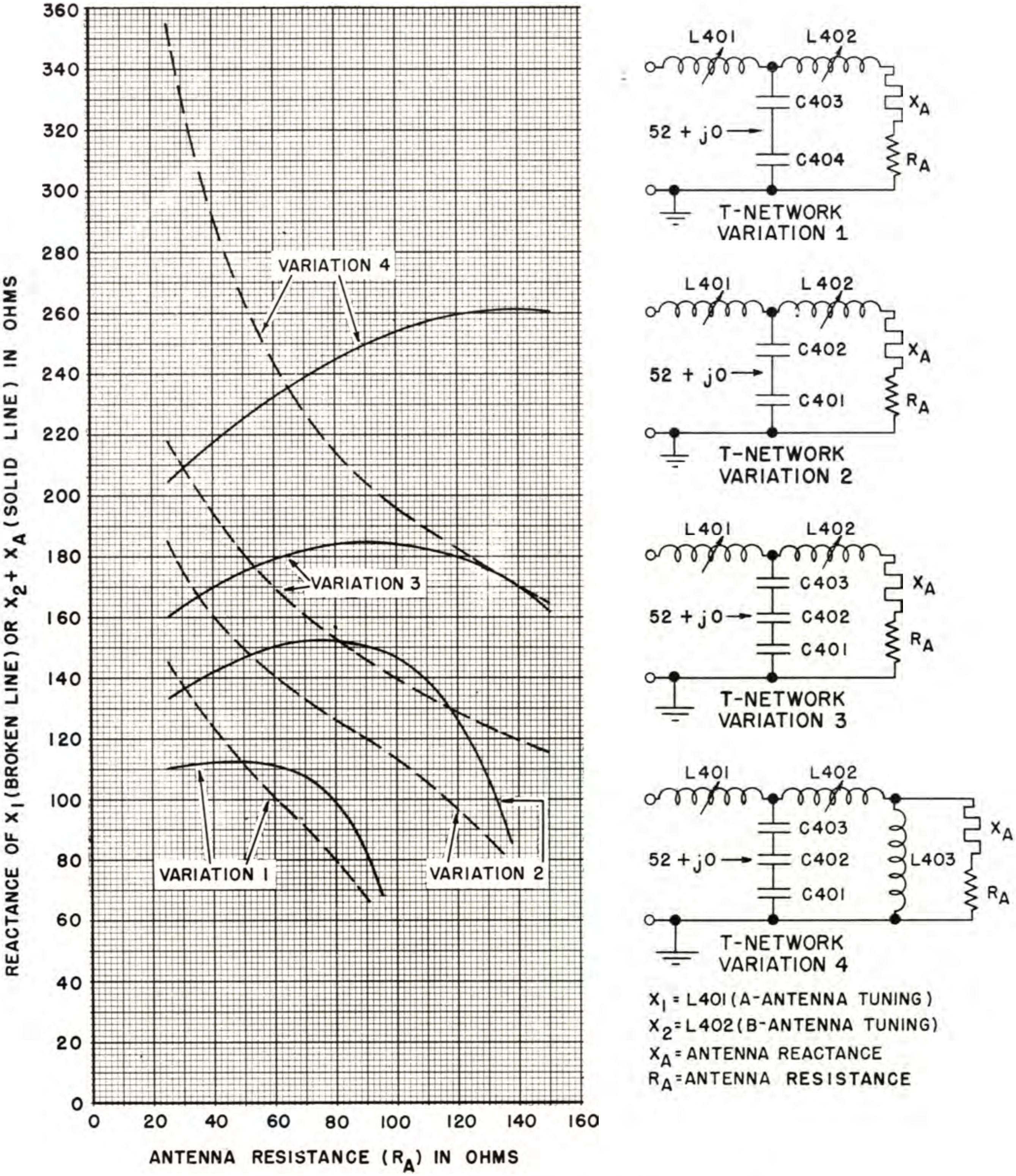


Figure 3–28. Antenna Tuning Curves, "T" Network, 1,900 KC

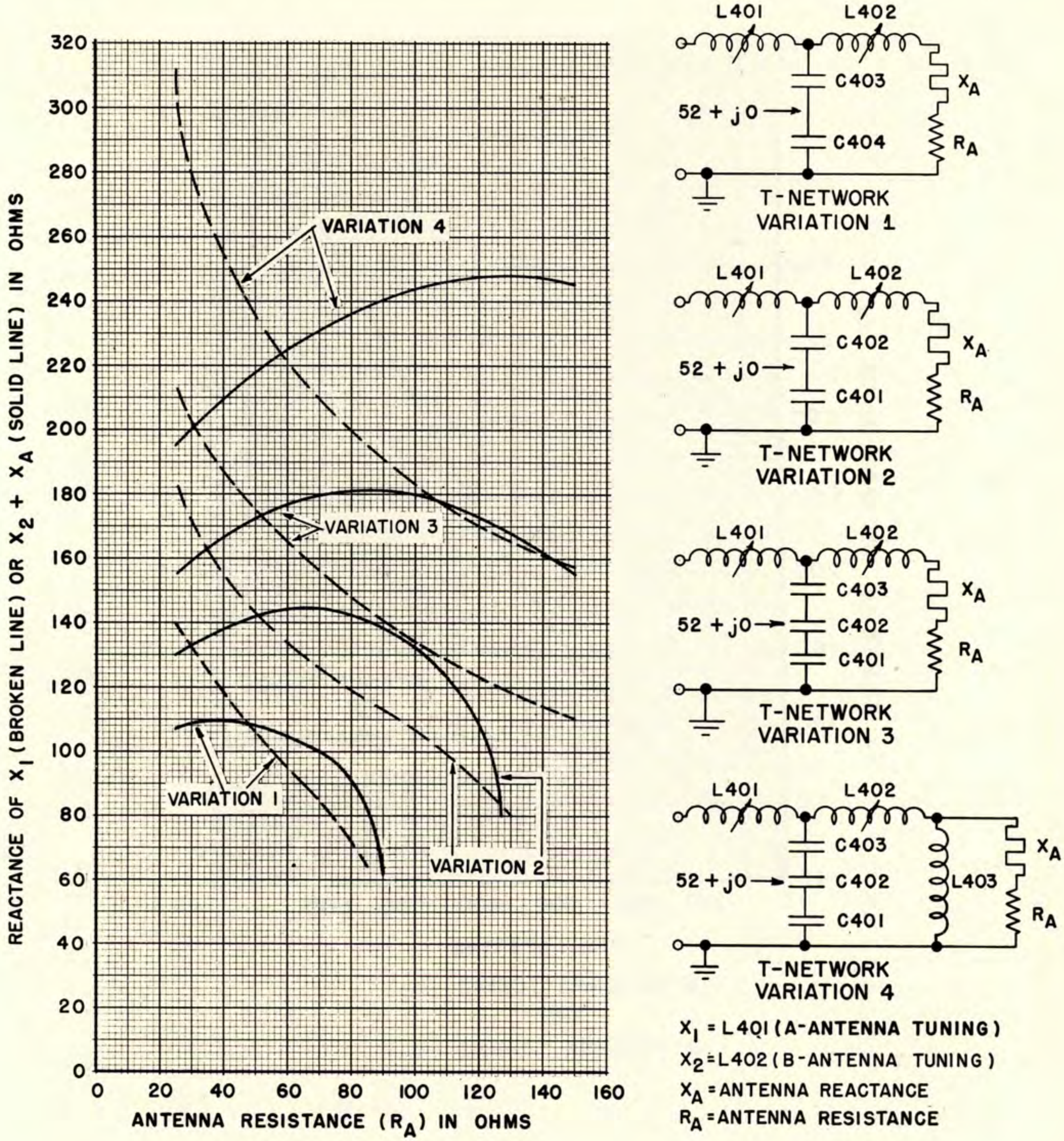


Figure 3—29. Antenna Tuning Curves, "T" Network, 1,950 KC

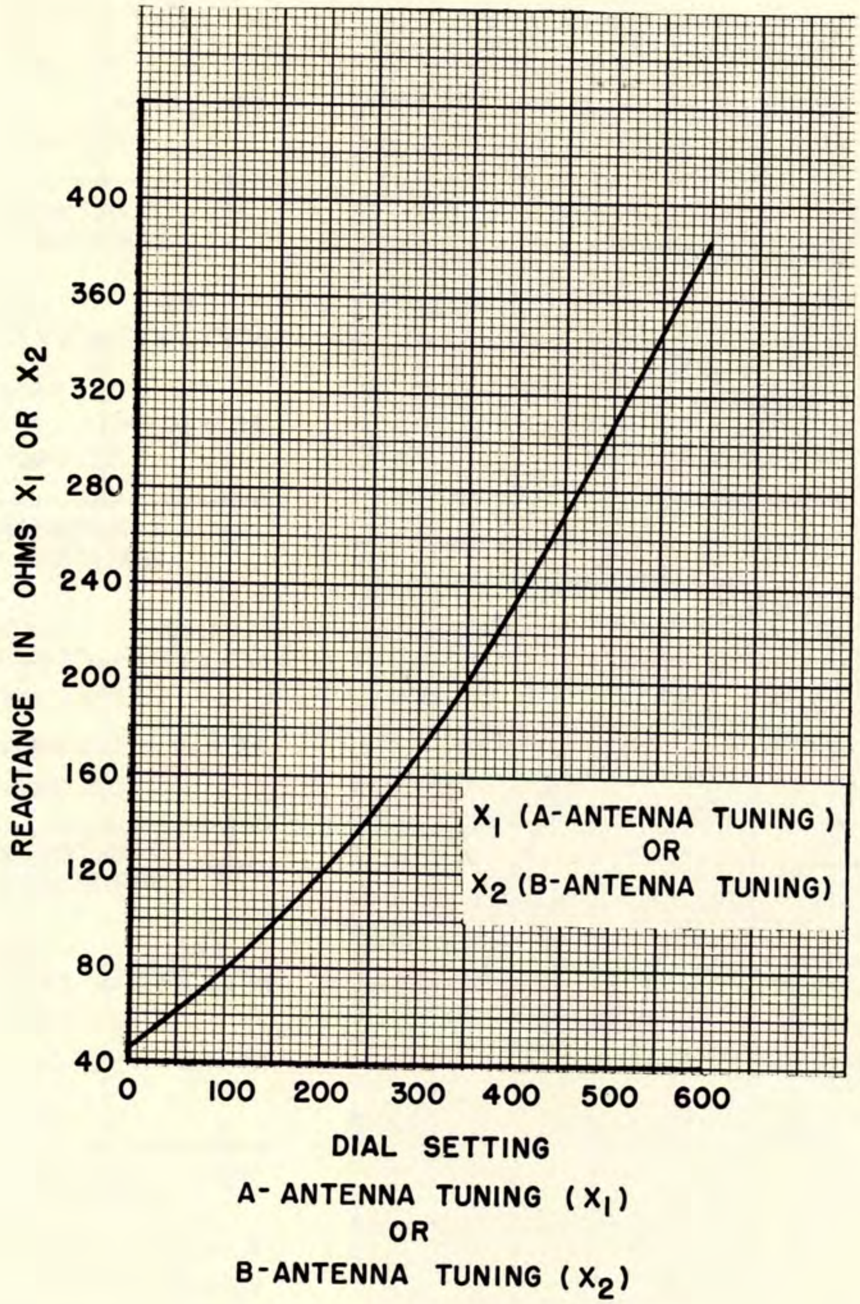


Figure 3—30. Tuning Control Calibration, Antenna Coupling Unit

SECTION 4
OPERATION

1. INTRODUCTION.

A loran station must consistently transmit uniform and accurately timed pulses, and the transmitter is only one of several units essential to the transmissions. (Refer to Section 1, paragraph 2, and Section 2, paragraph 1.) For this reason, operation of the transmitter cannot be considered a separate procedure but must be incorporated as part of the operating routine for a complete station. The operation of the timing, switching, and auxiliary equipment is covered in the respective instruction manuals. Normal operation of the transmitter includes a start-stop procedure, operational adjustments, and monitoring.

Normally, a transmitter is operated for an extended period of time, the period being determined by an adopted time-sharing schedule for the two transmitters of a station. Starting and stopping procedures, then, represent a relatively small portion of the operating routine. If the voltage regulator is operating properly and the input line-voltage changes are within the operating range of the regulator, all voltages, if initially correct, will remain so. However, should it be neces-

TABLE 4—1

OPERATIONAL CONTROLS

NAME	SYMBOL	FUNCTION
TRANSMITTER		
MAIN	S101	Start-stop control
FILAMENTS	S103	Start-stop control
LOW VOLT-BIAS	S104	Start-stop control
HIGH VOLT	S105	Start-stop control
FILAMENT VOLTAGE	T102	Voltage control
PLATE VOLTAGE	T101	Voltage control
INDICATOR LIGHT RESET	S106	Overload control
INDICATOR LIGHT RESET	S107	Overload control
INDICATOR LIGHT RESET	S108	Overload control
OVERLOAD LOCKOUT RESET	S109	Overload control
OSCILLOSCOPE TRIGGER	S117	Monitor control
MONITORED CIRCUIT	S116	Monitor control
VERTICAL DEFLECTION	R128	Monitor control
	S121	Meter switch
	S120	Meter switch
	S114	Meter switch
	S110	Meter switch
	S112	Meter switch
	S111	Meter switch
	S113	Meter switch
	S115	Meter switch
VOLTAGE REGULATOR		
	K2501	Circuit breaker switch
	S2503	Disconnect switch
	S2504	Meter switch
OUTPUT VOLTAGE	R2502	Voltage adjuster
SENSITIVITY	R2503	Sensitivity control

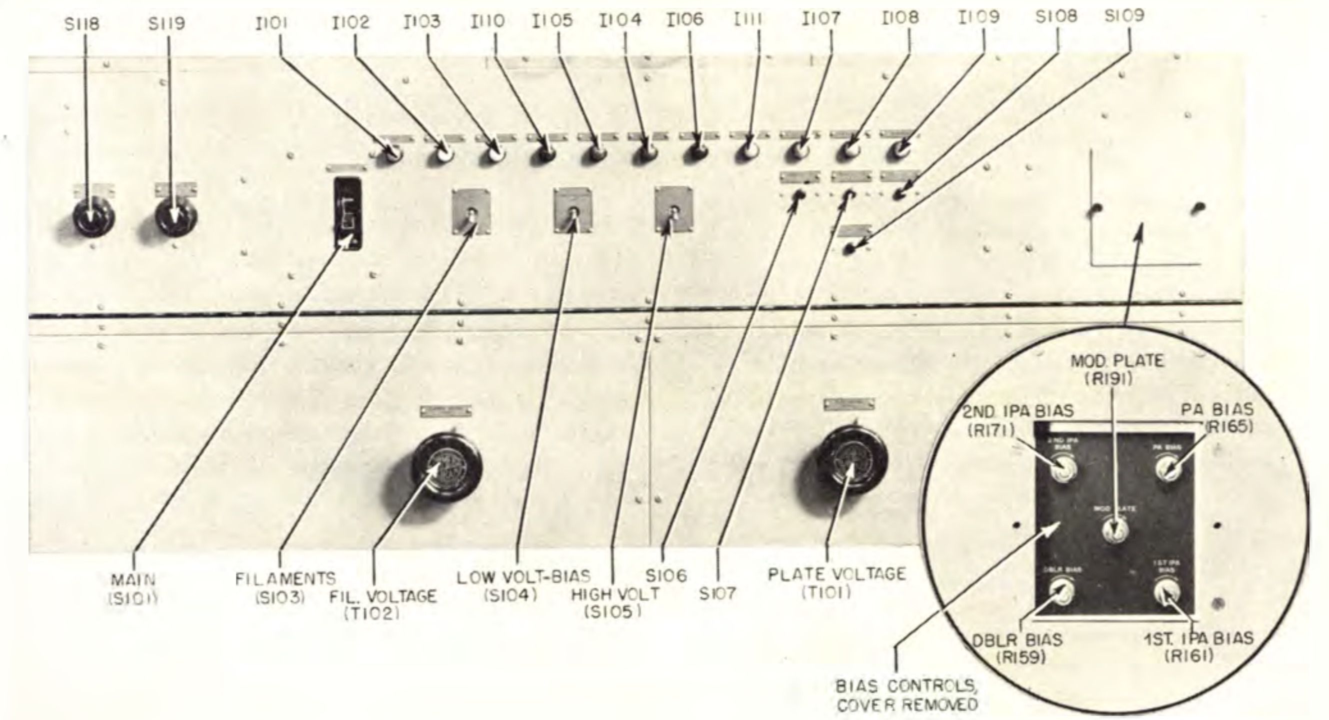


Figure 4—1. Transmitter Control Panel

TABLE 4—2
PANEL-MOUNTED NON-OPERATIONAL CONTROLS

NAME	SYMBOL	FUNCTION
EXCITER A	S118	Power switch
EXCITER B	S119	Power switch
DBLR PLATE TUNING	A	Tuning control
1st IPA PLATE TUNING	B	Tuning control
2nd IPA PLATE TUNING	C	Tuning control
PA PLATE TUNING	D	Tuning control
OUTPUT TUNING	F	Tuning control

sary to operate the transmitter with the regulator disconnected, operational adjustments will consist of readjusting the FILAMENT VOLTAGE and PLATE VOLTAGE controls to compensate for line-voltage changes. The intervals at which this must be done depend on the stability of the primary power source.

Monitoring consists of observation of the transmitted pulse on the transmitter oscilloscope and observation of the transmitter meter readings to establish that operation is normal. Since the uniformity of the pulse transmission is an important requirement of the loran system, the necessity of adequate monitoring cannot be overemphasized.

As a periodic and systematic routine, monitoring procedures are discussed in detail under "Operator's Maintenance" in Section 5. In this section, however, special stress is placed on those indications which give immediate information as to normal or abnormal operation, and upon those indications for which the operator can make any necessary corrective adjustments.

2. PRE-OPERATIONAL REQUIREMENTS.

When the equipment is ready to be placed in normal operation, it is assumed that both transmitters have been completely tuned and adjusted for single- or

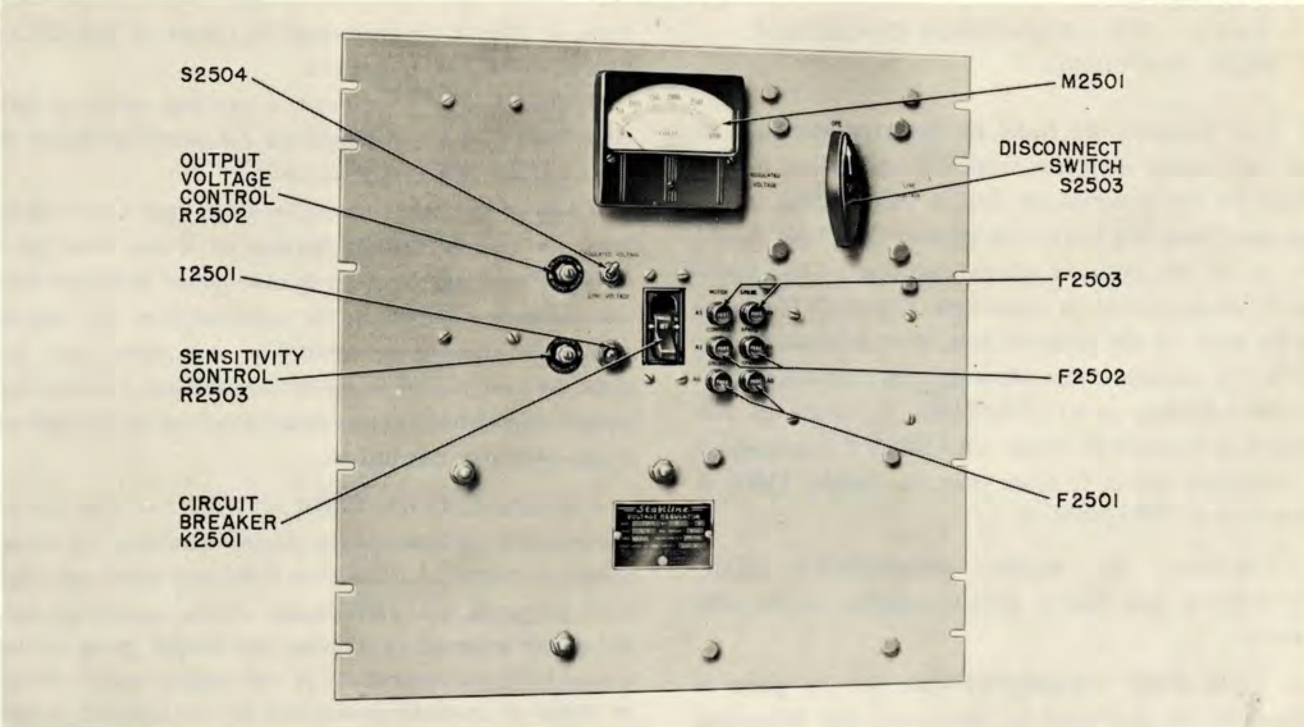


Figure 4–2. Voltage Regulator, Front Panel

double-pulsed operation as described in Section 3, paragraphs 9 and 10. Only those controls listed in table 4–1 should then be used by operating personnel, and those panel controls listed in table 4–2 (in addition to all controls mounted within the transmitter) should be left as set during installation and the initial operating procedure.

3. TRANSMITTER CONDITIONS.

Under normal station operating procedure, a loran transmitter may be kept in either a stand-by or operating state. As indicated in paragraph 1, the two transmitters of a station will generally be operated on a time-sharing basis; it is extremely important that change-over procedure from the stand-by to the operating condition be accomplished in a minimum of time.

a. STAND-BY CONDITION. — When a transmitter is in the stand-by condition, the various controls, etc., must be in the positions described below.

(1) The transmitter and voltage regulator should be completely tuned and adjusted in accordance with the instructions of Section 3, paragraph 9.

(2) All switches should be in the ON position, with the exception of the MAIN switch on the transmitter.

(3) LINK A should be in the LINE position, so that the transmission line is connected to the transmitter.

(4) If the stand-by transmitter is to be placed in operation within a short time, an alternative arrangement would be to place the LOW VOLT-BIAS and HIGH VOLT switches in the OFF position, and the MAIN and FILAMENTS switches in the ON position.

b. OPERATING CONDITION. — When a transmitter is in the operating condition, the following must be in effect:

(1) The transmitter and voltage regulator should be completely tuned and adjusted in accordance with the instructions of Section 3, paragraph 9.

(2) LINK A should be in the LINE position, and the links in the terminal box should be in such position that (a) the transmission line from the transmitter is connected to the transmission line in use and (b) the monitor line to the transmitter is connected to the monitor line from the coupling unit.

(3) All switches should be in the ON position.

4. OPERATING, STAND-BY, AND CHANGE-OVER PROCEDURES.

a. OPERATING TRANSMITTER. — To place a transmitter in operation, perform the following steps:

(1) Connect LINK A in the transmitter PA compartment (figure 5–4) in the LINE position.

WARNING

OBSERVE ALL SAFETY PRECAUTIONS AND GROUND ALL EXPOSED CIRCUITS

WITH THE CAPACITOR-DISCHARGE RODS PROVIDED.

(2) Connect the links in the terminal box so that the transmission line from the transmitter is connected to the transmission line in use, leading to the Antenna Coupling Unit. The monitor line link should also be in the position which connects to the transmitter being placed in operation. Figure 2–16 shows a plan view of the terminal box. If it is assumed that LINE 2 is the one in use (through the link connection in the coupling unit), TRANSM. 1 would be the operating transmitter, while TRANSM. 2 is connected to the spare LINE 1. Note that the MON. LINE is connected to TRANSM. 1.

(3) Place the MAIN, FILAMENTS, LOW VOLT-BIAS, and HIGH VOLT switches in the ON position.

b. STAND-BY TRANSMITTER. — To place a transmitter in the stand-by condition, the following procedure is recommended:

(1) Connect LINK A in the PA compartment in the LINE position (see figure 5–4).

(2) Place the MAIN switch in the OFF position; place the FILAMENTS, LOW VOLT-BIAS, and HIGH VOLT switches in the ON position.

(3) Routine operational checks on the stand-by unit are described in Section 5, paragraph 2.

c. CHANGE-OVER OPERATIONS. — To change-over operation of the transmitters and place the stand-by unit into operating condition, perform the following steps:

(1) De-energize the operating transmitter by placing the MAIN switch in the OFF position.

(2) Observing all safety precautions, change the links in the terminal box so that the transmission line in use and the monitor line are both connected to the transmitter to be placed in operation.

(3) Put the stand-by transmitter in operation by placing the MAIN switch in the ON position.

5. MONITORING PROCEDURES.

a. METER READINGS AND VOLTAGE ADJUSTMENTS. — At intervals prescribed by the adopted operating procedure, all meter readings should be logged and checked against the readings logged during the initial operations described in Section 3, paragraph 9.

If the LINE meter reading, with meter switch S110 in the FIL PRI position, varies from 230 volts at any time, it should be corrected by means of the FILAMENT VOLTAGE control.

If the PA PLATE voltmeter reading varies at any time from 15.5 kv, it should be corrected by means of the PLATE VOLTAGE control.

If any of the other meter readings vary appreciably from the values initially logged, or if the trend of a series of readings on a particular meter indicates that the readings will become far removed from the logged value, the transmitter should be shut down and the stand-by unit placed in operation. Section 7 covers the proper corrective maintenance procedure to be applied to the defective transmitter.

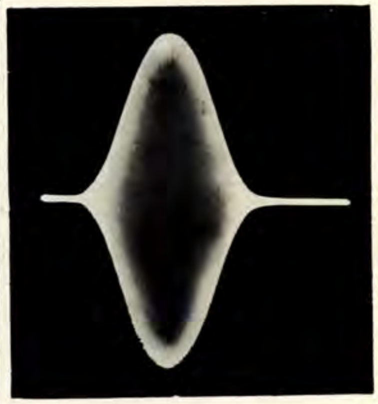
b. OSCILLOSCOPE INDICATIONS. — The use of the monitor oscilloscope for trouble-shooting the transmitter is described in Section 7. Except when used for such purposes, the oscilloscope of the operating unit should be adjusted to monitor the output pulse of the transmitter; measurements of the output pulse should be made at intervals prescribed by the adopted monitoring schedule. The settings of the oscilloscope controls for this purpose and an oscillogram of the waveform which should be obtained on the scope are shown in table 4–3. If the measured pulse does not agree with the oscillogram shown, the transmitter should be de-energized, the stand-by unit placed in operation, and corrective measures taken.

Note

If the PA OUTPUT pulse is absent or is unstable, the frequency generating unit divider circuit may be defective. If the pulse is unstable, switch the monitoring oscilloscope to its 4R sweep, and, with the sweep delay dial set to about 30 microseconds, observe the individual r-f cycles. They should be stationary. If they move horizontally in any manner, the divider operation is defective. Refer to Section 7, paragraph 4.

It is to be emphasized that in this oscilloscope measurement, reasonable care must be exercised in observing the scope pattern and reading the SWEEP DELAY dial, if accurate and repeatable results are to be obtained. When making any observation on the scope pattern, avoid parallax by having the eye directly in line with the point being observed. This is easily checked by noting that the reflection of the eye on the screen is directly on the point at which the pattern is being observed. Keep the FIL PRI voltage and the PA PLATE voltage exactly at 230 volts and 15.5 kv, respectively, by means of the FILAMENT VOLTAGE and PLATE VOLTAGE controls during all output

TABLE 4–3
MONITOR OSCILLOSCOPE OPERATION

CONTROL NAME	SYMBOL	POSITION	OSCILLOGRAM
MONITORED CIRCUIT	S116	ANT (RF)	
OSCILLOSCOPE	S117	EXC A or EXC B*	
VERTICAL DEFLECTION	R128	As required	
SWEEP LENGTH		100 μs A	
R SWEEP		DEL	
TRIGGER SOURCE		EXT	
MARKERS		Z IN	
VIDEO ATTENUATION		OFF	
HORIZONTAL CENTERING		As required	
VERTICAL CENTERING		As required	
INTENSITY		As required	Pulse Width: 40 μs ±1 μs
FOCUS		As required	Rise Time: 21 μs ±1 μs

*Depends on exciter in use; for monitoring double-pulsed operation, alternate triggers should be used as first one output, and then the other, is monitored.

pulse-shape measurements. This will eliminate the small secondary effects which changes in these voltages have on the pulse shape.

To measure the rise time and width of the output pulse, perform the following steps:

(1) Adjust the VERTICAL DEFLECTION control until the upper half of the waveform occupies *exactly* 20 divisions on the calibrated screen of the scope.

(2) Turn the SWEEP LENGTH control to the 100 μs 25 R position, select a convenient vertical calibration line on the scope face as a reference, and rotate the SWEEP DELAY dial until the leading edge of the pulse crosses the reference line at the 10-percent level (two divisions above the baseline). Record the reading of the SWEEP DELAY dial.

Note

If the 100-kc timer signal is used as the frequency control source, the r-f cycles observed should be stationary. If they move horizontally, off-frequency output and defective divider operation are indicated. See Section 7, paragraph 4.

(3) Rotate the SWEEP DELAY dial until the leading edge of the pulse crosses the reference line at the 90-percent level (18 divisions above the base line) and note the new reading on the SWEEP DELAY dial. The difference between the new and the preceding reading is a measurement of pulse rise-time. See figure 2–19 for an illustration of the pulse rise-time measurement.

(4) Measure the difference in readings obtained on the SWEEP DELAY dial with the dial set so that first the leading edge and then the lagging edge of the pulse crosses the reference line at the 50-percent level (10 divisions above the base line). The difference in readings is a measurement of pulse width.

When taking the above pulse-shape measurements on a transmitter which is being double-pulsed, additional precaution must be observed in making the various amplitude observations. This is necessary because the pulse amplitudes vary a small amount between points of cross-over of the two pulse rates. To minimize the effect on the results, all readings should be taken at as near the same instant of the cross-over interval as possible. Because the pulse amplitude changes least rapidly about half-way between cross-overs, it is recommended that this point be adopted as the one at which to take readings.

c. OVERLOAD INDICATIONS.

(1) TRANSMITTER. — In the event of momentary overloads in the transmitter which do not recur, the overload circuits in the transmitter operate and reset themselves automatically. The only operational procedure necessary is the resetting of the indicating circuit as explained in subparagraph (*a*) below. Three

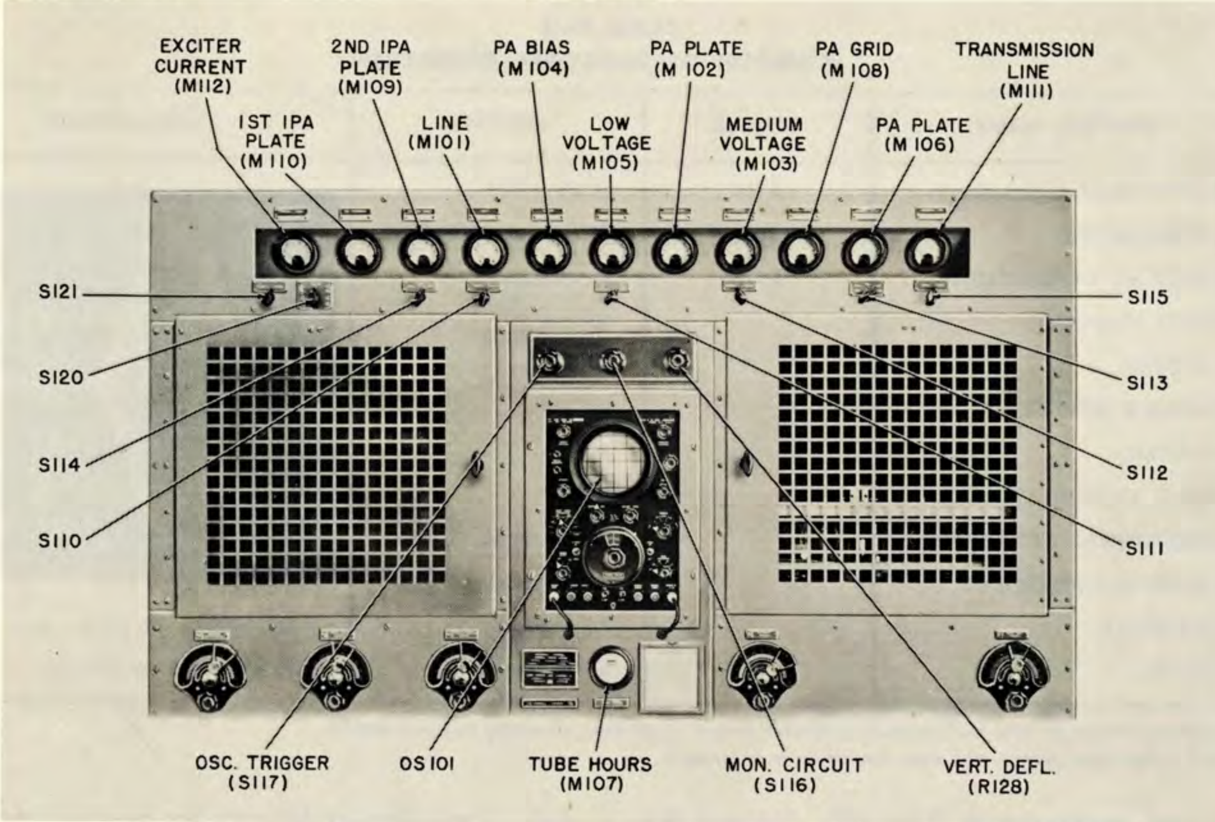


Figure 4—3. Transmitter Meter Panel and Monitoring Circuit Controls

repeated overloads within 15 seconds cause a lockout of the automatic reset circuit and remove high voltage from the transmitter until the circuit is manually reset, as described in subparagraph (*b*) below.

(*a*) MOMENTARY OVERLOADS. — If a momentary overload occurs in the transmitter, high voltage is removed from the transmitter and the red HIGH VOLTAGE indicator lamp goes out. At the same time, one or more of the overload indicator lamps extinguish to inform the operator in which circuit the overload has occurred. The overload circuit is reset automatically after two seconds, and high voltage is restored to the transmitter. The red HIGH VOLTAGE indicator lamp relights. The overload indicator lamps remain out, however, until their associated INDICATOR LIGHT RESET buttons are pressed. Repeated overloads in the same stage may be indicative of an aging tube. All overloads should be logged.

(*b*) RECURRENT OVERLOADS. — If an overload recurs three times within 15 seconds, the automatic reset circuit will be locked out, and it will be necessary to press the OVERLOAD LOCKOUT RESET button to restore high voltage to the transmitter. When repeated overloads occur, the transmitter should be deenergized, the stand-by unit placed in operation and the source of trouble investigated, as described in Section 7.

(2) VOLTAGE REGULATOR. — The voltage regulator is provided with a manually operated air circuit breaker, K2501. In the event of an overload the circuit breaker trips to the OFF position and the indicator lamp I2501 goes out. The circuit breaker is reset by switching it to the ON position. When repeated overloads occur, the stand-by transmitter should be placed in operation and the source of the trouble investigated, as described in Section 7.

SECTION 5
OPERATOR'S MAINTENANCE

1. GENERAL.

Periodic maintenance and checks of the stand-by transmitter are necessary in order that the unit be ready for operation at the scheduled change-over time, or in case of failure or breakdown of the operating transmitter. Under normal operating conditions, comparatively little trouble may be expected from this equipment. However, since the loran system requires that there be a minimum of time when no signal is transmitted, and that the signal transmitted be consistent, special care must be taken by operating personnel to insure continuous operation of the system.

2. MAINTENANCE OF STAND-BY TRANSMITTER.

The stand-by transmitter should be placed in operation at least once during each stand-by period of the adopted time-sharing schedule set up for the two transmitters in a station.

a. OPERATIONAL PROCEDURE. — In order to place the stand-by unit into operation for the scheduled maintenance check, use the following procedure:

(1) Place LINK A, located in the PA compartment (see figure 5–4), in the DUMMY position.

(2) Place the transmitter in operation, as described in Section 4, paragraph 4.

b. MONITORING CHECK. — To determine whether or not the stand-by transmitter is functioning properly, the following checks should be made:

(1) Check the voltages listed at the beginning of table 5–1 for the correct values, as indicated. In general, if all voltages were correct initially, they will remain so, provided the line voltage regulator is operating properly and the input line voltage variations are within the ±10 percent range which can be handled by the regulator. If a particular voltage has changed, readjust it with the appropriate panel or internal control as described in Section 3, paragraph 9.

(2) Check the values of currents listed in the second part of table 5–1 against the indicated typical values or, more preferably, against values logged for the particular transmitter during initial operation. A current reading which is radically different from typical or shows a progressive change from one stand-by check to another probably indicates an impending failure and should be investigated. Replace any tube which gives an indication of going bad. The method for replacing the various tubes is discussed in paragraph 4.

(3) Place the oscilloscope MONITORED CIRCUIT switch in the OUTPUT PA position. Monitor the pulse shape as described in Section 4, paragraph 5. If the pulse shape deviates from the given limits, remeasure carefully to eliminate the possibility of personal error. If the pulse is still not within the established limits, recheck all voltages. Human error in measurements or incorrect voltages are the most common cause of improper pulse shape indications.

3. REPLACEMENT OF FUSES.

Table 5–2 describes the functions of the various fuses and lists some of the symptoms which are indicative of fuse failure. When checking abnormal operation, refer to table 5–2 to eliminate or isolate the fuses as a source of trouble.

Two sets of fuses (one operating, one spare) are mounted on a panel towards the rear of the transmitter behind the rear right-hand access door, and on the front panel of the voltage regulator. (See figures 4–2 and 5–1.) The operating fuses in the transmitter are covered by a plexiglass shield which is secured with wing nuts; the spare fuses are mounted directly above the operating fuses.

Before replacing a fuse in the transmitter, place the MAIN switch in the OFF position and use a capacitor-discharge rod to ground the fuse terminals and any adjacent exposed circuits. Remove the plexiglass shield and remove the fuse with the fuse-pullers provided in clamps to the right of the fuse banks.

When a spare fuse is used, it should be replaced by one having a similar rating from the equipment spare parts. Replacement fuses should be checked for continuity with an ohmmeter, and their ratings compared with the prescribed values as indicated in the parts list.

4. TUBE REPLACEMENT.

Except for the type 4PR60A 2nd IPA tubes (V102 and V103) and the type 7C23 PA tubes (V104 to V107) in the transmitter, no special instructions are required. To replace tubes in the monitor oscilloscope, the oscilloscope must be removed from the transmitter, and the oscilloscope chassis must be removed from its cabinet as outlined in subparagraph *d* below. Various tube locations are shown in figures 5–2, 5–3, 5–4, 7–15, 7–16, 7–29, 7–31, and 7–33, of this book, and in figures 6–6 and 6–12 of the oscilloscope instruction booklet appended to this manual.

WARNING

BEFORE REPLACING ANY TUBE IN THE TRANSMITTER OR OSCILLOSCOPE, PLACE THE MAIN SWITCH IN THE OFF POSITION AND USE A CAPACITOR-DISCHARGE ROD TO GROUND EXPOSED CIRCUITS.

Ordinary precautions should be exercised in the handling of all tubes, in the removal and replacement of caps, and in the orientation of tubes in their sockets.

a. 2nd IPA TUBES. — In replacing the type 4PR-60A 2nd IPA tubes, special attention must be paid to the locking device on the tube socket. See figure 7–31. Before removing a tube, loosen the setscrew in the cap and remove the cap. Then turn the locking screw at the rear of the tube socket (as viewed from the front access door) in a counterclockwise direction until the clamping finger swings away from the tube. After replacing the tube. turn the locking screw on the socket in a clockwise direction until the clamping finger holds the tube in place Then replace the cap.

b. PA TUBE REPLACEMENT. — The PA tubes are external-anode, air-cooled, type 7C23 tubes with filament, grid, and cathode pins at the top. As shown in figure 5–3, the tops of the tubes project upward

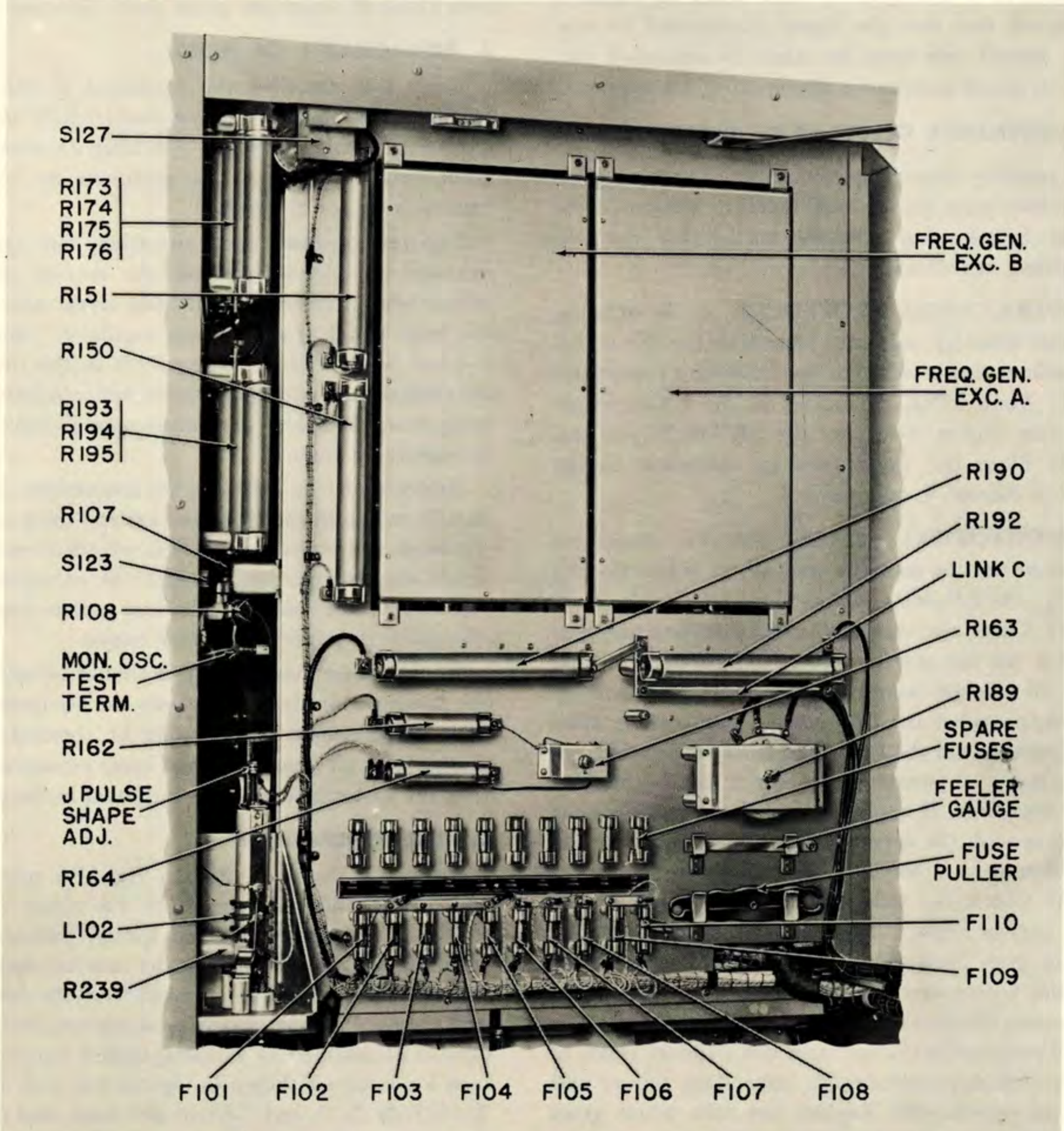


Figure 5–1. Transmitter Fuse Panel, Right Rear Access Door Open

through holes in a component-mounting shelf in the PA compartment. To replace a tube, perform the following steps:

(1) Loosen the thumbscrews on the filament, cathode, and grid connectors, pry off each connector individually, and lift the connector assembly away from the tube.

(2) Raise the tube directly upwards until the bottom of the tube clears the top of the mount. Tilt the tube slightly and lower it diagonally until the top

TABLE 5—1. TYPICAL METER READINGS

a. TRANSMITTER.

METER DESIGNATION	METER SWITCH		20 PPS		25 PPS		33-1/3 PPS	
	SYMBOL	POSITION	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE
LOW VOLTAGE	S112	DBLR BIAS[1]	200	200	200	200	200	200
		1st IPA BIAS	50	50	50	50	50	50
		2nd IPA BIAS[6]	360	360	360	360	360	360
		EXCITER PLATE	300	300	300	300	300	300
MEDIUM VOLTAGE	S111	MOD PLATE[7]	5.8	5.8	5.8	5.8	5.8	5.8
		2nd IPA PLATE[7]	6.7	6.9	6.8	7.0	6.9	7.1
PA BIAS[1]	——	——	3.0	3.0	3.0	3.0	3.0	3.0
PA PLATE (Voltmeter)	——	——	15.5	15.5	15.1	15.5	15.5	15.5
LINE	S110	LINE	214-244	214-244	214-244	214-244	214-244	214-244
		FIL PRI	230	230	230	230	230	230
1st IPA PLATE	——	——	0.73	1.46	.9	1.8	1.2	2.4
2nd IPA PLATE	S114	V103	33	66	37	74	50	100
		V104	33	66	37	74	50	100
		TOTAL	66	132	74	148	100	200
PA GRID[5]	——	——	0.9	1.8	1.0	2.0	1.5	3.0
PA PLATE (Milliammeter)	S113	V104	4.2	8.5	5.5	10.8	7.2	14.5
		V105	4.2	8.5	5.5	10.8	7.2	14.5
		V106	4.2	8.5	5.5	10.8	7.2	14.5
		V107	4.2	8.5	5.5	10.8	7.2	14.5
		TOTAL	16.8	34	22	43.2	28.8	58
TRANSMISSION LINE	S115	UNSHORT	1.3	2.0	1.6	2.2	1.8	2.3

METER DESIGNATION	SYMBOL	POSITION	100-KC OPERATION	CRYSTAL OPERATION
EXCITER CURRENT[2]	S120	V301 CATH	41	0
		V302 CATH	57	0
		V303 CATH	48	0
		V304 CATH	48	71
		V305-V306 CATH	71	69
		V307 CATH	65	0
		V308 CATH	61	0
		V309 CATH	52	0
		GRID CUR-J301	30	0
		GRID CUR-J302	25	0
		GRID CUR-J303[3]	35	0
		GRID CUR-J304[4]	25	67
		GRID CUR-J305	54	0
		GRID CUR-J306	7	0
		GRID CUR-J307	10	0

For all footnotes, see page 5—4.

TABLE 5–1. TYPICAL METER READINGS (Cont'd)

b. VOLTAGE REGULATOR.

METER SYMBOL	METER SWITCH SYMBOL	METER SWITCH POSITION	NORMAL READING
M2501	S2504	REGULATED VOLTAGE	230
		LINE VOLTAGE	195-255

[1]Approximate reading. Exact value to be the same as logged during initial operation procedure See Section 3, paragraph 8.

[2]These readings will vary considerably, depending on the 100-kc voltage level from the timer.

[3]This reading will be zero when output frequency is 1,800 kc.

[4]This reading will be 6 when output frequency is 1,800 kc.

[5]These readings are typical for tubes in operation for approximately 100 hours or more. For tubes having less service, the values may be lower, ranging down to zero or slightly negative.

[6]Under some operating conditions it may not be possible to adjust this voltage as low as 360 volts. Higher voltages *not exceeding* 400 *volts* will be satisfactory.

[7]The value indicated is nominal. Adjust as close to it a s possible, which should be within two percent. However, the initially logged reading should be maintained.

of the tube clears the hole in the component-mounting shelf; finally, tip the tube horizontally and remove it through the opening between the shelf and the bottom of the door frame. The right-hand tubes are taken out to the right of the tube mounts and the left-hand tubes to the left. Note that any of the four tubes can be removed with the remaining three in place.

(3) Move the replacement tube in horizontally through the opening between the door frame and the shelf to a position over the mount, moving it in from the extreme side of the compartment (right-hand side of the compartment for right-hand tubes, left-hand side of the compartment for left-hand tubes). Tilt it toward the vertical, and move it diagonally upwards until the top of the tube projects through the hole in the shelf and the tube can be held upright above the mount. Lower the tube into the mount.

(4) Turn the tube in the socket until the color-coded pins line up with similarly colored connectors. A diagram of the color-coded connections is etched on a caution plate on the shelf above the tubes.

(5) Press each connector firmly onto its respective pin and tighten the screw on each connector.

Note

Failure to tighten the thumbscrews securely, particularly those on the filament connectors, will result in burning and pitting of the tube pins and, after a short time, the destruction of the tube.

c. OPERATION USING NEW PA TUBES. — When new type 7C23 tube or tubes are installed, put them in service with the procedure indicated below. This procedure is necessary to "season" the tubes, that is, condition them so that they can withstand the full plate voltage without internal arcing. It is a normal characteristic of tubes, such as the type 7C23, that operate at relatively high plate voltages, to arc internally, when new or unused for an extended period of time, because of small loose particles lodging on the elements. As the tube arcs, the particles burn away and in general, after each successive arc, the tube will withstand more voltage. The arc current is sufficiently limited by the circuit in the transmitter to prevent damage to the tube or transmitter. When the tube arcs internally, it is usually from plate to grid and, in turn, the external protective gaps TY110 or TY111, connected from grid to ground, will break down and either the PA OVERLOAD relay or the HV OVERLOAD relay will trip. With the above characteristics of the PA tubes in mind, continue as follows:

(1) Place the oscilloscope MONITORED CIRCUIT switch in the OUTPUT PA position and turn the VERTICAL DEFLECTION control to the extreme clockwise position.

(2) Place the PLATE VOLTAGE control in the extreme counterclockwise (minimum voltage) position.

(3) Put the transmitter into operation, using the dummy load.

(4) While observing on the oscilloscope, advance the PLATE VOLTAGE control until a pulse just begins to appear. This should occur with a reading of approximately 10 kv on the PA PLATE voltmeter.

(5) Advance the PLATE VOLTAGE control in approximately 1-kv steps, as read on the PA PLATE voltmeter, until the final operating value of 15.5 kv is reached. Operate the transmitter at each voltage step for approximately 15 minutes before proceeding to the

next. If, in going from one step to the next, a tube arc occurs, lower the voltage slightly and operate for 15 minutes at the slightly reduced voltage before proceeding again to a higher voltage. When a reading of 15.5 kv is reached, operate at this full-power level for at least 15 minutes. The transmitter is then ready for service.

Note

As indicated in table 5-1, the grid current for a new tube is less than the current after a few hundred hours of operation. This is due to larger amounts of secondary grid-emission (opposite in polarity to the normal current drawn by the grid) being present when the tube is new and in a normal condition.

TABLE 5-2. FUSE FUNCTIONS AND SYMPTOMS OF FAILURE

a. TRANSMITTER.

SYMBOL	RATING	FUNCTION	SYMPTOMS OF FAILURE
F101	2.5 a, 250 v	Protects the primary of the oscilloscope 230/115-volt autotransformer, T118.	No light or trace on oscilloscope; all other operations normal.
F102	3.2 a, 250 v	Protects the primary of the control-voltage transformer, T108.	Blower, fan, and oscilloscope operate normally, LINE voltage is normal, FIL PRI voltage is low, all other meters read zero, only MAIN ind. lamps light.
F103	0.3 a, 250 v	Protects the primary of the indicator-lamp transformer, T107.	None of the indicator lamps light; all other indications normal.
F104	2.0 a, 250 v	Protects blower BL101.	Blower cannot be heard; only MAIN and O.L. ind. lamps light; all voltmeters show reduced readings.
F105	0.6 a, 250 v	Protects fan BL102.	Fan inoperative.
F106	1.25 a, 250 v	Protects the primary of the low voltage-bias rectifier plate transformer, T113.	LOW VOLTAGE meter M105 reads zero in the DBLR BIAS, 1st IPA BIAS, and EXCITER PLATE positions of S111; LOW VOLT ind. lamp goes out.
F107	1.0 a, 250 v	Protects the primary of the high-bias plate transformer, T120.	PA BIAS meter reads zero; LOW VOLTAGE meter reads zero in 2nd IPA BIAS position of S111; BIAS ind. lamp goes out.
F108	12.0 a, 250 v	Protects the primary of the high-voltage rectifier plate transformer, T116.	PA PLATE voltmeter reads zero; MEDIUM VOLTAGE voltmeter reads zero.
F109	0.8 a, 250 v	Protects the primaries of the low-power filament transformers, T111, T112, T115, T117, and T119.	LOW PWR FIL ind. lamp goes out; HIGH PWR FIL ind. lamp stays on.
F110	10.0 a, 250 v	Protects the primaries of the high-power filament transformers, T104, T105, T106, T109, T110, and T114.	HIGH PWR FIL ind. lamp goes out; LOW PWR FIL ind. lamp stays on.

TABLE 5-2. FUSE FUNCTIONS AND SYMPTOMS OF FAILURE (Cont'd)

b. VOLTAGE REGULATOR.

SYMBOL	TYPE	RATING	FUNCTION	SYMPTOMS OF FAILURE
F2501	A8	8 amp.	Protects brush of T2501.	Loss of voltage regulation.
F2502	A3	3 amp.	Protects primary of voltage control transformer T2303.	Loss of voltage regulation. Control indicator lamp I2501 out.
F2503	A3	3 amp.	Protects motor B2501.	Motor not operating. Loss of voltage regulation.
F2401	B2	2 amp.	Protects blower B2401.	Blower not operating. Blower indicator lamp out.
F2402	B2	2 amp.	Protects blower B2401.	Blower not operating. Blower indicator lamp out.

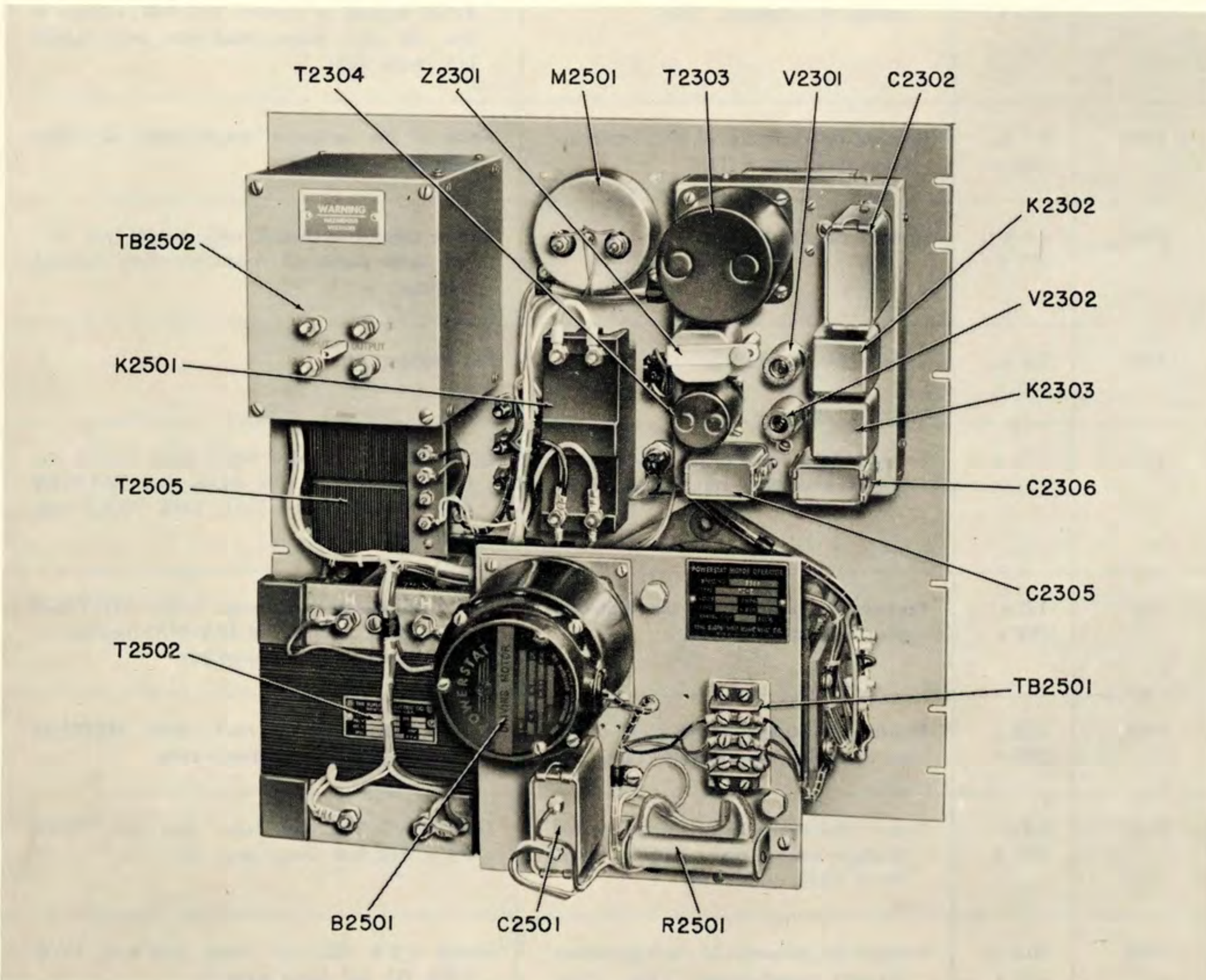


Figure 5–2. Voltage Regulator, Rear View

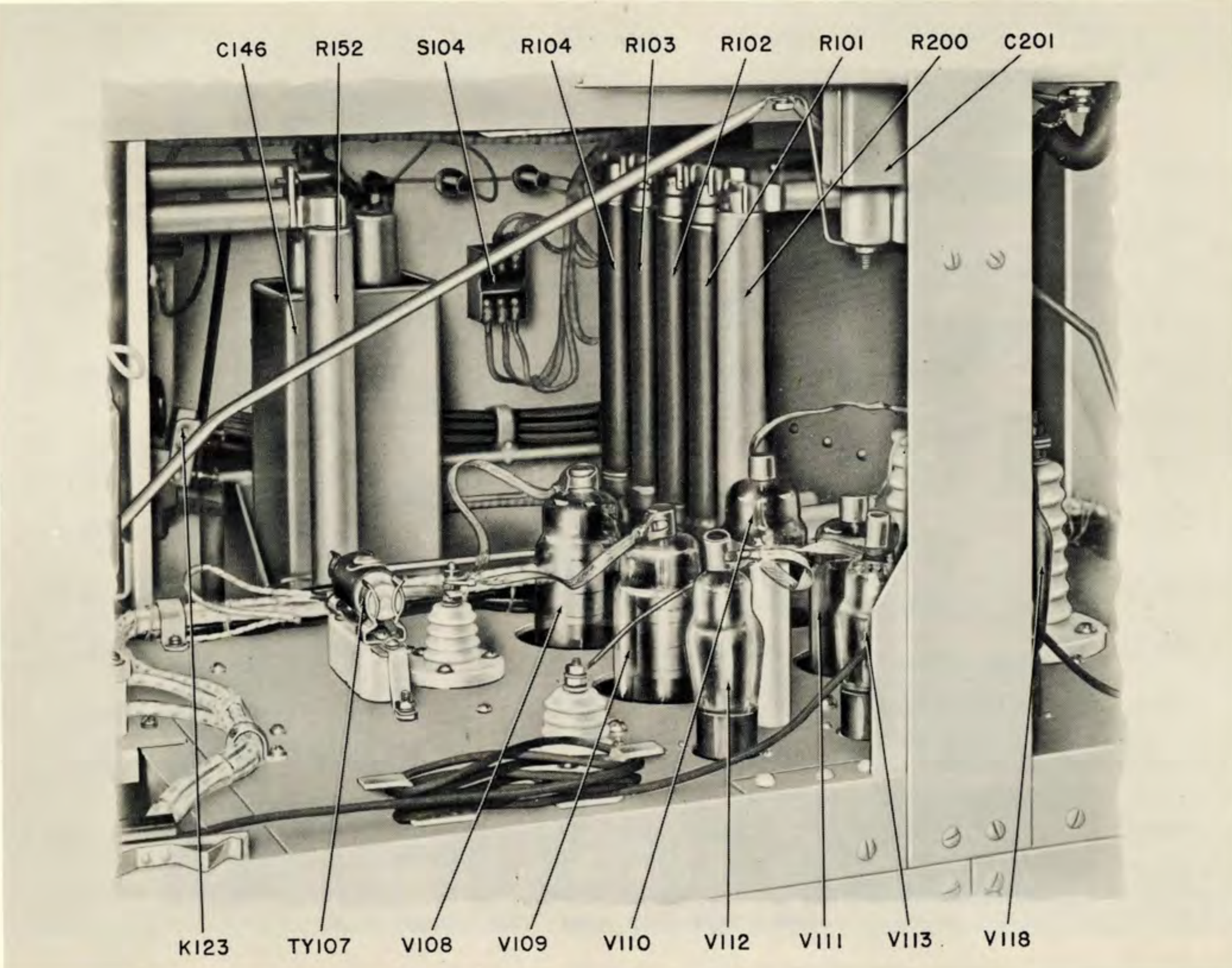


Figure 5–3. Rear Shelf, Showing Rectifier Tube Locations

d. REMOVING THE MONITOR OSCILLOSCOPE. — To replace any tube in the monitor oscilloscope, the oscilloscope must be removed from the transmitter, and the chassis removed from the cabinet of the oscilloscope as outlined in the following steps:

(1) Turn the MAIN switch OFF and remove the four external connections to the oscilloscope (the AC INPUT and VIDEO at the rear of the scope, and the EXTERNAL TRIGGER and VERTICAL DIRECT inputs at the front of the scope).

(2) Turn the four fasteners which hold the rectangular frame around the scope on the front of the transmitter. Remove the frame.

(3) Slide the oscilloscope forward and remove it to a test bench.

(4) Remove chassis retaining screws at the rear, on the back and bottom, of the oscilloscope. (See figure 6–1 of the appended oscilloscope instruction book.)

(5) Slide the cabinet off the oscilloscope chassis, being careful not to touch any uninsulated portions of the scope.

WARNING

BEFORE TOUCHING ANYTHING WITHIN THE OSCILLOSCOPE, USE A CAPACITOR-DISCHARGE ROD TO GROUND ALL EXPOSED CIRCUITS, PARTICULARLY THE INTENSIFIER-RING CONNECTION ON THE CATHODE-RAY TUBE. (SEE FIGURE 6–6 OF THE OSCILLOSCOPE INSTRUCTION BOOK.)

e. REPLACEMENT OF TUBES IN THE MONITOR OSCILLOSCOPE. — No special instructions are needed for any of the scope tubes except the cathode-ray tube. Tube locations are shown in figures 6–6 and

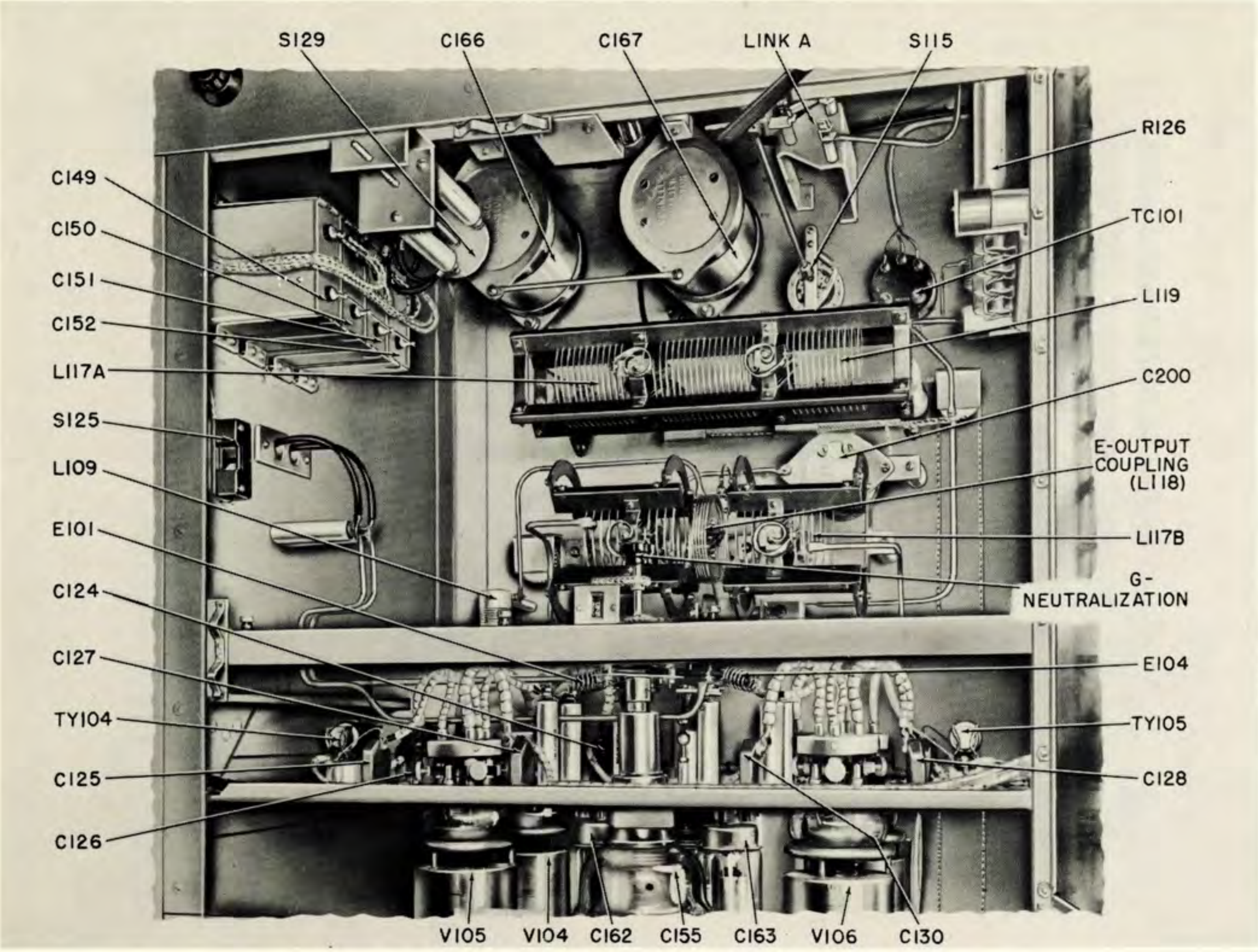


Figure 5–4. PA Compartment

6–12 of the appended instruction book. After the cabinet is removed from the oscilloscope, the cathode-ray tube may be replaced by performing the following steps:

(1) Remove the intensifier-ring connection on the side of the tube, observing all safety precautions.

(2) Remove the four screws which hold the front ring, the calibrated screen, and the green light-filter about the face of the cathode-ray tube.

(3) Remove the four screws which hold the inner ring about the face of the cathode-ray tube.

(4) Supporting the tube from the front and the side (near the intensifier connection), remove the tube through the front of the oscilloscope.

WARNING

GLOVES AND GOGGLES SHOULD BE WORN WHEN HANDLING THE CATHODE-RAY TUBE.

(5) Note the position of the keyway in the cathode-ray tube socket, and insert a new type 5CP1A tube into the socket. Replace the intensifier connection.

(6) Slide the chassis into the cabinet, connect the AC INPUT plug to a 115-volt source and turn on the POWER switch of the scope. Tighten the chassis-retaining screws, if necessary, until a trace on the scope or a light on the SWEEP DELAY dial indicates that power has been supplied to the oscilloscope. (The safety switch may not operate unless the retaining screws are securely tightened.)

(7) Place the TRIGGER SOURCE control on INT, and adjust the scope controls to obtain a trace on the cathode-ray tube. If the trace is horizontal, disregard steps (9) and (10) and replace the scope in the transmitter as outlined in steps (10), (11), and (12).

(8) If the trace on the scope is not horizontal, place a piece of friction, adhesive, or "Scotch" tape on

the face of the cathode-ray tube so that the tape is parallel to the trace. Then remove the a-c input connection from the oscilloscope and, observing all safety precautions, remove the chassis from the cabinet.

(9) Loosen the adjustment screws on the cathode-ray tube socket (figure 6–12 of the scope instruction book), and turn the socket so as to correct any deviation of the tape from the horizontal plane. Tighten the adjustment screws, replace the cabinet and again check for a horizontal trace on the cathode-ray tube. Remove the tape and carefully clean the face of the cathode-ray tube.

(10) When a horizontal trace is obtained, tighten the chassis retaining screws securely; replace the inner and outer rings, the calibrated scale, and green light-filter on the front of the oscilloscope, and restore the scope to its position in the transmitter.

(11) Reconnect the AC INPUT, the VIDEO INPUT, the EXTERNAL TRIGGER, and VERTICAL DIRECT inputs at the rear and front of the oscilloscope. Replace the rectangular frame about the front of the oscilloscope.

(12) Repeat the initial adjustment and test procedures outlined in Section II, paragraph 2, in the oscilloscope instruction book, and, when satisfactory performance is ascertained, restore the scope controls to their normal operating positions. (See table 4–4 of Section 4.)

SECTION 6
PREVENTIVE MAINTENANCE

1. GENERAL.

While it is anticipated that the Type T–325B/FPN Radio Transmitter and its associated equipment will give long and trouble-free service, systematic preventive maintenance will prevent or postpone some component failures, and will enable station personnel to anticipate other troubles. The techniques involved include periodic cleaning, inspection, adjustment, and lubrication; the keeping of records or logs of such operations is an equally important aid.

The following paragraphs outline a minimum preventive maintenance schedule for the loran equipment. This is not to be construed, however, as an unalterable procedure. The exact maintenance schedule and time interval between performances will normally depend on the station operating times and schedule and on the adopted time-sharing schedule of the two transmitters. Some items require more frequent attention than others; this will depend on local weather conditions and the station housing, among other things.

One of the most important factors in a successful maintenance program is an accurate and complete record of each maintenance operation. In this way, a systematic procedure will result and the same routine will be followed each time.

CAUTION

During routine maintenance checks, every cleaning procedure should be followed by an inspection, since the very act of cleaning may itself inadvertently cause a broken or loose connection.

2. DAILY MAINTENANCE SCHEDULE.

a. OPERATIONAL CHECK OF STAND-BY TRANSMITTER. — The stand-by transmitter should be placed in operation, feeding the dummy load, at least once during each stand-by period of the time-sharing schedule of the station. Since this is usually based on a 24-hour schedule, it is included as part of the daily maintenance. For the change-over procedure, see Section 5, paragraph 2.

b. METERS. — All meter pointers should return to zero with the power turned off, except, of course, the TUBE HOURS meter. If a meter does not return to zero, tap the case lightly. If it still does not return to zero, rotate the zero-adjust screw until the pointer is correctly set.

3. WEEKLY MAINTENANCE SCHEDULE.

a. TUBES AND SOCKETS. — Tubes operated at high voltages and with exposed plate and grid connections must be kept free of dirt and dust because of possible leakage between plate and grid terminals. Tubes operated at low voltages do not require as frequent cleaning. Dirt should not be permitted to accumulate on low-voltage tubes, but the presence of dirt on them is far less harmful than it is on high-voltage tubes.

WARNING

AVOID TOUCHING THE TUBES IMMEDIATELY AFTER SHUT-DOWN — THEY ARE HOT. SEVERE BURNS MAY RESULT FROM CONTACT WITH THE TUBE ENVELOPE.

(1) Inspect tube envelopes for accumulation of dirt and for possible break-away from the base. Examine the tube caps for dirt, corrosion, and possible break-away from the cement which attaches the tube caps to the envelopes. Replace tubes which have loose plate or grid caps or loose envelopes.

(2) Examine the spring clips, which make contact with the grid and plate caps, for corrosion and loss of tension. Remove the clips from the caps with great care. Be particularly careful when signs of corrosion exist; the clip may adhere to the cap. Check to see that the lead wires to these caps are free from exposed or broken strands.

(3) Test the firmness of tubes in their sockets by pressing the tubes down in their sockets, and not by partly withdrawing the tubes and jiggling them from side to side. Movement of a tube tends to spread the contacts in the socket, and will develop trouble where it did not exist before.

(4) Do not remove tubes from their sockets if only the tube envelope is to be cleaned. Use a clean, dry, lint-free cloth to remove dust and dirt from the tube envelopes. If the dirt is difficult to remove, use a clean, lint-free cloth moistened with an approved solv-

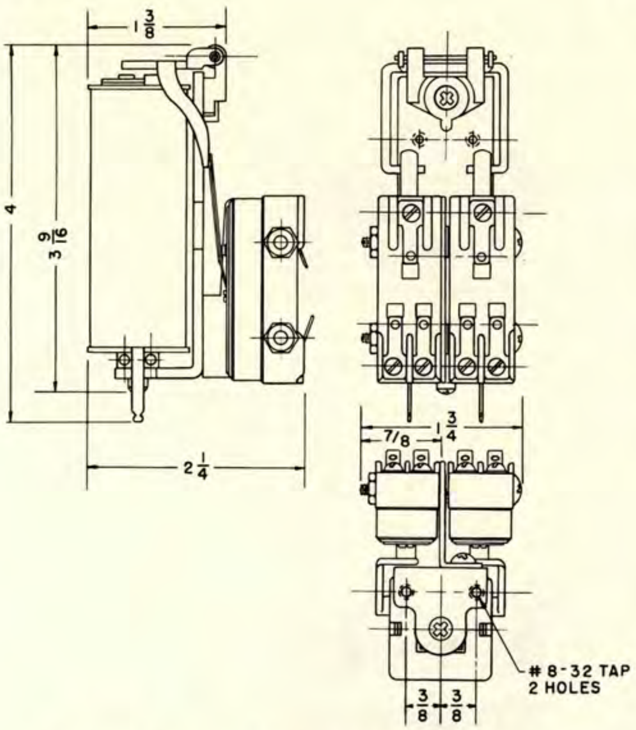


Figure 6–1. A-C Control Relay (K104 to K111)

ent. When the envelope has dried completely, polish the surface with a clean, dry cloth. When necessary, clean the grid and plate caps with crocus cloth or #0000 sandpaper, but be careful not to apply excessive pressure. Use crocus cloth to clean tube pins and sockets.

b. CAPACITORS. — Before maintenance work is begun, it is absolutely necessary for the safety of personnel to SHORT-CIRCUIT ALL HIGH-VOLTAGE CAPACITORS with one of the capacitor-discharge rods provided.

(1) Inspect the terminals of the capacitors for corrosion and loose connections. Wherever high-voltage bushings serve as terminal supports, inspect the gaskets to see whether they leak oil. Inspect the mountings for loose mounting screws, studs, or brackets. Examine the leads for poor insulation and excessive oil, for cracks, and for evidence of dry rot. Cut away frayed strands on insulation. If the wire is exposed, wrap it with a good grade of insulating tape. Inspect the case of each capacitor for leaks, bulges, and discoloration.

(2) When necessary, clean the case of the capacitor, the insulating bushings, and any connections that are dirty or corroded. Use a dry cloth, but if the deposit of dirt is hard to remove, moisten the cloth in dry-cleaning solvent. Clean corroded connections with fine sandpaper. Dry and polish all bushings with a clean cloth. The glass surface of all vacuum capacitors in the PA compartment should be cleaned as prescribed for the PA tubes.

(3) Tighten all loose terminals, mountings, and connections on the capacitors. Carefully tighten the retaining nuts on the insulation bushings if leakage occurs around the gaskets of the large oil-filled capacitors. When tightening a nut, be careful not to break the bushing or damage the gasket. Remove and replace oil-filled capacitors that have defective seams. If a replacement is not available, locate the leak and resolder.

(4) See subparagraph *e* below for high-voltage bushings.

c. RESISTORS. — Several types of resistors are used in Radio Transmitter Type T–325B/FPN and Voltage Regulator Assembly Type CN–239/FPN. One common type is the wire-wound resistor with shell of ceramic or other insulating material which has been baked around the resistance element. Another type is the carbon-body resistor with an insulating shell. The connections to all resistors are of either ferrule or pigtail type. The ferrule type of connection consists of metal clips into which the ends of the resistor are inserted. The pigtail type has leads that are easily soldered to make connections.

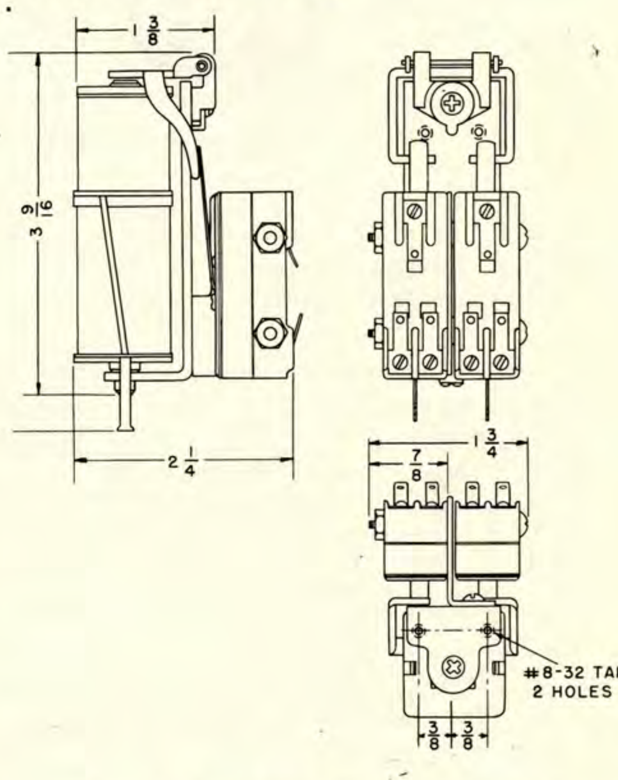
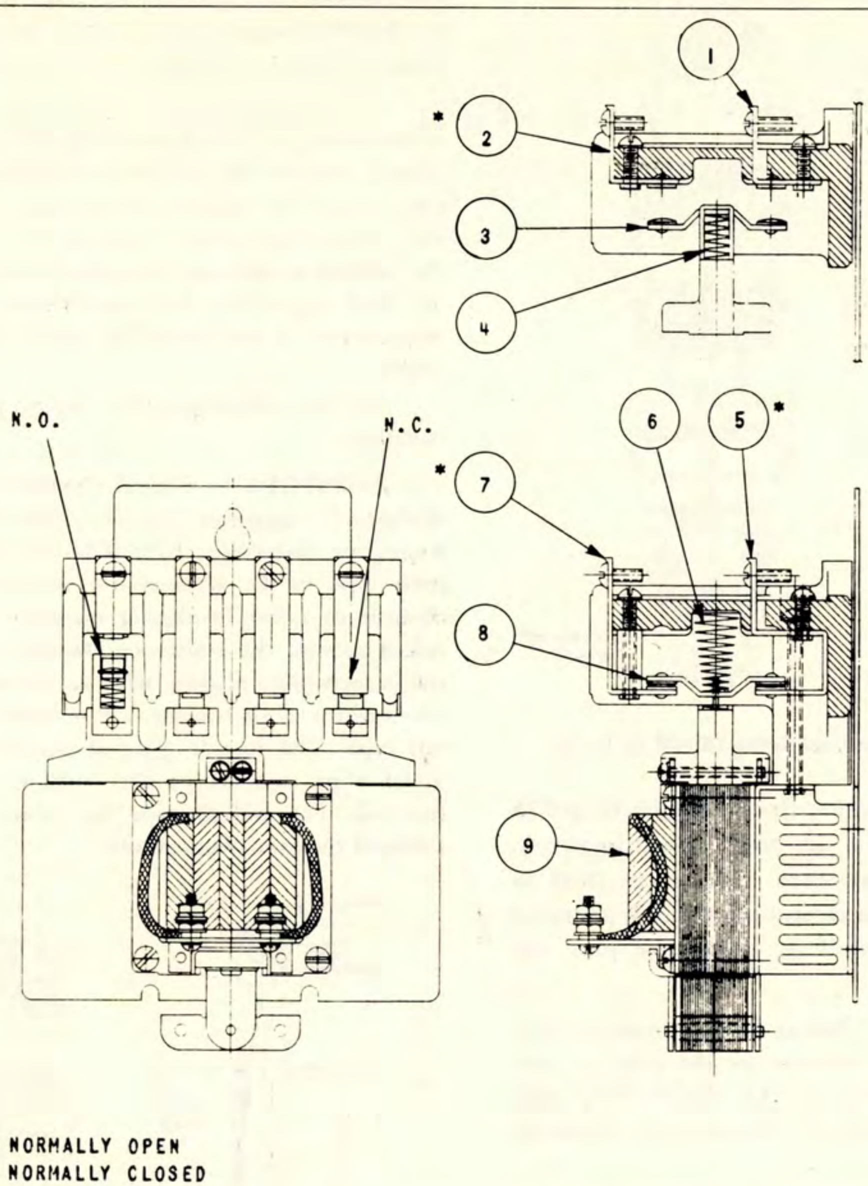


Figure 6–2. D-C Overload Control Relay (K112, K113, K114)



ITEM	PART NUMBER	NAME	LIST PRICE	ITEM	PART NUMBER	NAME	LIST PRICE
•1	7-49-1	REAR CONTACT - N.O.		•7	7-53-1	FRONT CONTACT - N.C.	
•2	7-48-1	FRONT CONTACT - N.O.		8	7-50-2	MOVABLE CONTACT - N.C.	
3	7-50-1	MOVABLE CONTACT - N.O.					
4	930-10-1	SPRING FOR N.O.					
		CONTACT					
•5	7-54-1	REAR CONTACT - N.C.					
6	930-2-31	SPRING FOR N.C. CONT.					

Figure 6–3. A-C Contactor (K101, K102, K103)

WARNING

DO NOT TOUCH POWER RESISTORS IMMEDIATELY AFTER THE POWER HAS BEEN SHUT OFF. THEY ARE USUALLY HOT, AND SEVERE BURNS MAY RESULT.

(1) Inspect the coating of ceramic resistors for signs of cracks and chipping, especially at the ends. Examine the bodies of resistors for blistering, discoloration, and other indications of overheating. Discoloration is indicative of overloading and may be caused by circuit trouble. Also look for arc pits or craters. Inspect leads, clips, metallic ends of ferrule-type resistors, and all other connections for corrosion, dirt, dust, looseness and broken strands in the connecting wires. Check all resistor mountings for looseness. Do not attempt to move resistors which have pigtail connections.

(2) Clean the metallic ends of ferrule-type resistors with a brush or cloth dipped in dry-cleaning solvent. If necessary, use crocus cloth or #0000 sandpaper. Wipe the ends with a dry cloth before remounting the resistor. Tighten all resistor connections and mountings whenever they are loose. When necessary, increase the tension of clips by pressing them together with the fingers or a pair of pliers. Care should be exercised in the removal of these resistors from their clips. Because they are constructed of porcelain, they may crack if pulled on or subjected to excessive strain. To remove them, use a screw driver or apply pressure with the thumb to one metal end until it is released from its clip. The resistor can then easily be withdrawn from the other clip.

d. FUSES. — Inspect fuse caps for evidence of overheating and corrosion. Check the fuse clips for proper tension, arc pits or craters, and loose connections. When necessary, clean all fuse caps and fuse clips with fine sandpaper; wipe with a clean cloth. Remove deep pits in the clips or fuse caps with a file and finish with fine sandpaper in order to leave a smooth contact surface. Wipe the surface with a clean cloth before remounting the fuse.

e. HIGH-VOLTAGE BUSHINGS AND INSULATORS. — Insulator bushings are used in the high-voltage leads, and as stand-offs for high-voltage terminals of transformers and capacitors. Insulator bushings are constructed of ceramic material with highly glazed surfaces. Highly glazed insulators may develop fine hairline surface cracks where dust and moisture will accumulate and eventually form a leakage path for a high-voltage flash-over.

Inspect insulator bushings for dust, dirt, cracks, chips, and loose mounting or connections. Replace defective units. If a bushing is a mounting for an oil-filled unit, install new gaskets when replacement is made. Use a clean, dry cloth to clean insulator bushings. If the dirt is hard to remove, use a clean cloth slightly dampened with dry-cleaning solvent. After the surface has been cleaned, carefully polish with a dry cloth. Do not use abrasive materials for cleaning because the glazed finish will be destroyed. Tighten all loose bushings and insulators. The procedure for tightening is self-evident. However, do not force the nuts or screws down too tight. Excessive pressure will damage the unit.

f. RHEOSTATS AND POTENTIOMETERS. — Inspect the mechanical condition of each rheostat and potentiometer. Also, inspect the assembly and mounting screws, setscrews, and nuts. Examine the insulating body of the rheostats for dust, dirt, cracks, or chipped places. Inspect all metallic parts for dust, dirt, and corrosion. Tighten all loose assembly or mounting screws. If binding is noted, apply a drop of light machine oil to the bearing surfaces with a toothpick. Do not let oil run into the windings. Wipe off any excess oil.

g. VARIABLE INDUCTORS. — The variometer-type inductors used in the transmitter should be inspected for dust, corrosion, and freedom of movement. If necessary, clean the coils with a soft cloth moistened with an approved solvent. The rotating member should move easily and smoothly, without binding. If binding is noted, the bearings supporting the rotor coil should be lubricated with a drop of light machine oil applied with the end of a toothpick or match-stick.

h. OVER-ALL CLEANING. — Use a compressed air stream to blow out accumulated dust from all units of the loran equipment. If an air hose is not available, use a dry, lintless cloth to wipe off the equipment. Care must be taken not to disturb the position of leads and wires, and an inspection must be made at the completion of the cleaning.

4. MONTHLY MAINTENANCE SCHEDULE.

a. RELAYS. — There are two general classifications of relays in the T–325B/FPN equipment. These are power-type relays and control relays. The control relays are smaller and equipped with sensitive switch contact assemblies. The power-type relays are generally large and open in construction.

(1) CONTROL RELAYS (K104 to K114). — The control relays are equipped with sensitive switch contact assemblies. These assemblies require no maintenance attention.

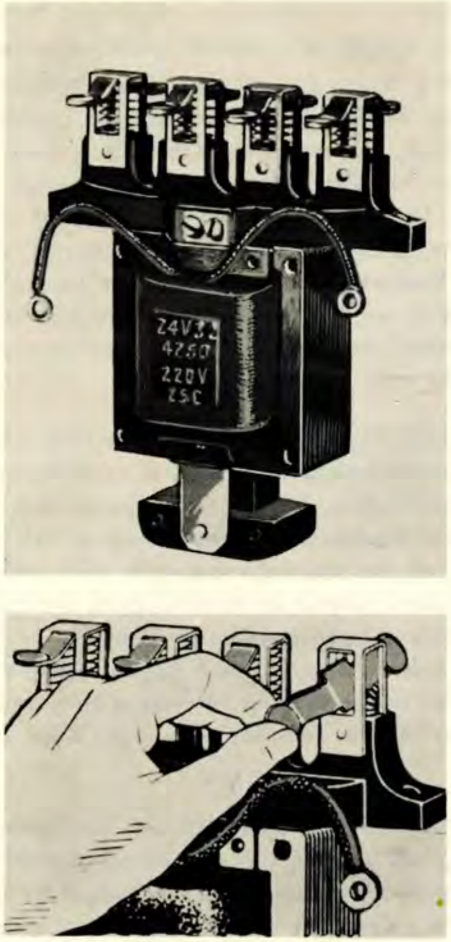


Figure 6—4. Replacement of Contacts in Relays K101, K102, and K103

(2) POWER-TYPE RELAYS (K101 to K103, K115 to K123). — Some of the power-type relays must be partially disassembled to allow inspection of contacts and must be completely disassembled for cleaning of contacts. Others can be inspected and contacts cleaned without being removed from their mountings or disassembled. Before removing a power-type relay, take these steps:

Step 1. Examine the base of the relay to determine the location of the mounting screws. If possible, examine the other side of the panel and determine how the screws are fastened in place. In some cases panels or other parts must be removed prior to the removal of the relay. Do not start the removal of the relay until sure that it is necessary and the proper procedure has been determined. This will save time and prevent damage to the equipment.

Step 2. Attach a tag to each relay terminal with a number or letter on it; attach a tag to the associated connecting lead with the same number on it.

Step 3. Remove each lead from its terminal and bend it carefully out of the way. When the leads are reconnected, match terminals and leads that have corresponding numbers.

(*a*) CONTACTS. — The contacts of the power-type relays in the set are the soft-surface type. In general they are silver alloy. Knowledge of the kind of material used in the contacts is important. Improper or careless cleaning of the contact surfaces will cause excessive wear.

Power relay contacts are of varied shapes, depending upon their size and application. In some instances both contacts are flat; in others, one is convex while its mate is flat. The original shape of a contact must be retained during cleaning. If burning or pitting has distorted the contact, the original shape must be restored. It is essential that maintenance personnel familiarize themselves with the details of the relays, by examining them while they are in good condition, in order to recognize abnormalities when such occur.

(*b*) POWER RELAY CHECK LIST. — Inspect the relay to detect abnormalities, using the following check list. Check to see that:

The assembly is free from dirt, dust, and other foreign matter.

The contacts are not burned, pitted, or corroded.

The contacts are lined up, correctly spaced, and make positive contact.

The contact springs are in good condition.

The moving parts travel freely and function in a satisfactory manner.

The connections to the relay are tight.

The wire insulation is not frayed or worn.

The relay assembly is securely mounted.

The field coil shows no signs of overheating.

(*c*) CLEANING POWER-TYPE RELAYS. — Wipe the exterior of the relay with a dry cloth or brush. If it is very dirty, clean it with a cloth or a brush dipped in dry-cleaning solvent, and wipe the surface with a dry cloth to remove the film left by the solvent when it dries. Be careful not to change the settings of adjustable relays.

(*d*) CONTACT CLEANING. — Clean dirty contacts by drawing a strip of thin, clean cloth or paper between them while holding them together. If necessary, moisten the cloth with dry-cleaning solvent.

Note

The brown discoloration that is found on silver and silverplated contacts is silver oxide and is a good conductor. It is not necessary to

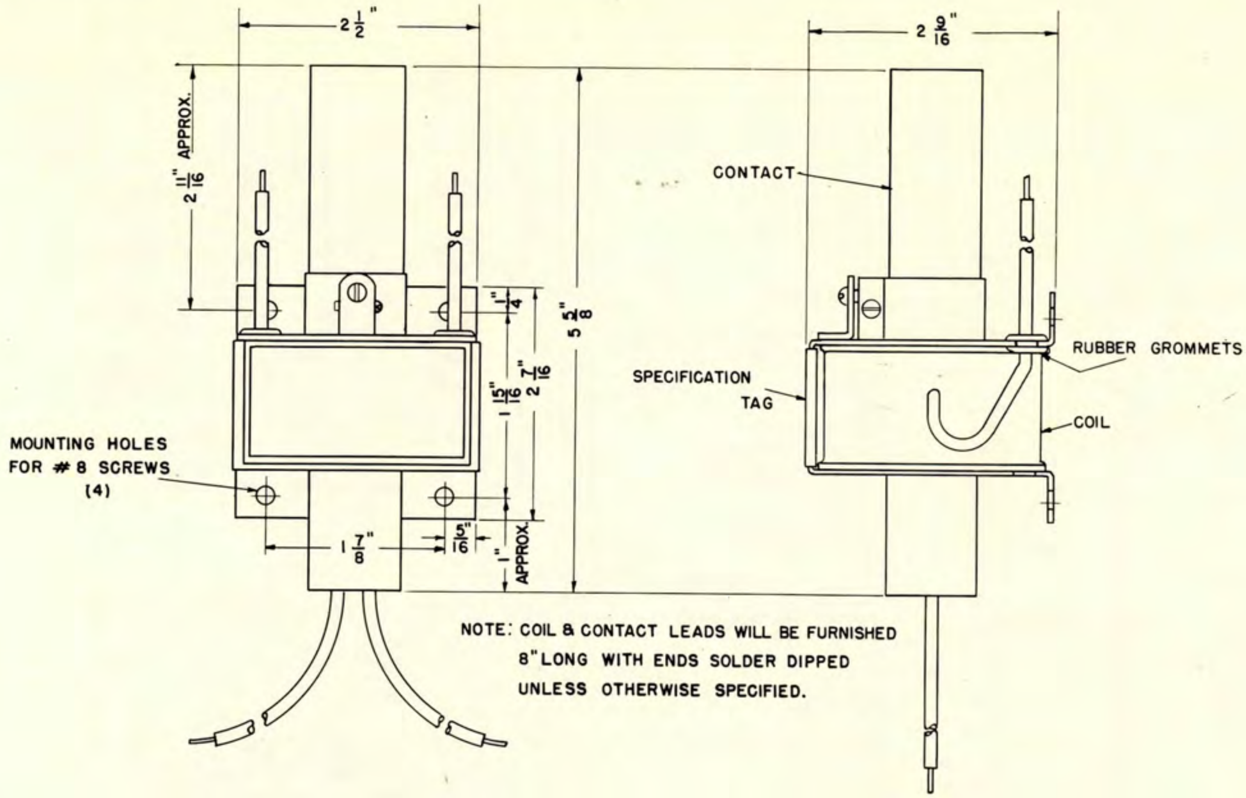


Figure 6–5. Normally Open Time Delay Relay, Mercury Column Type (K115, K116, K118, K119)

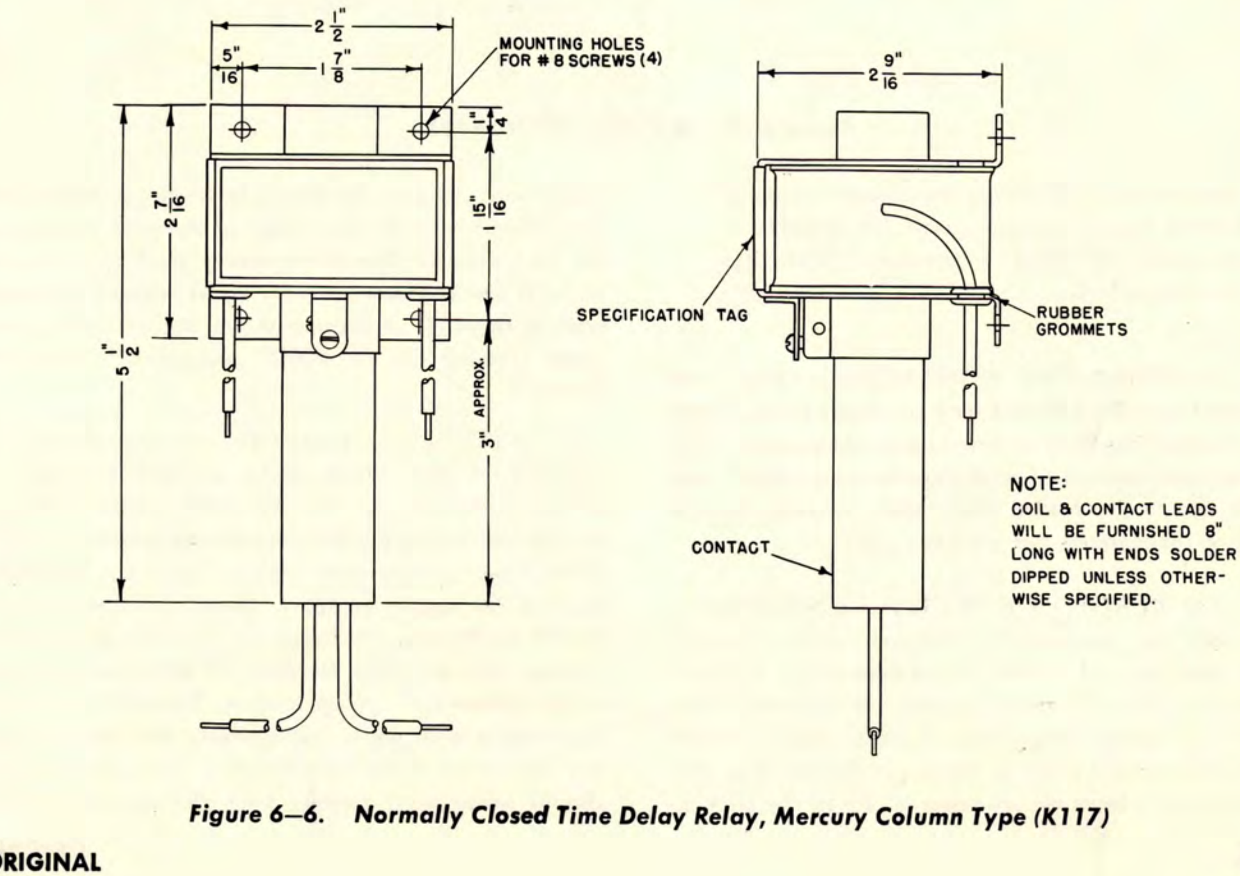
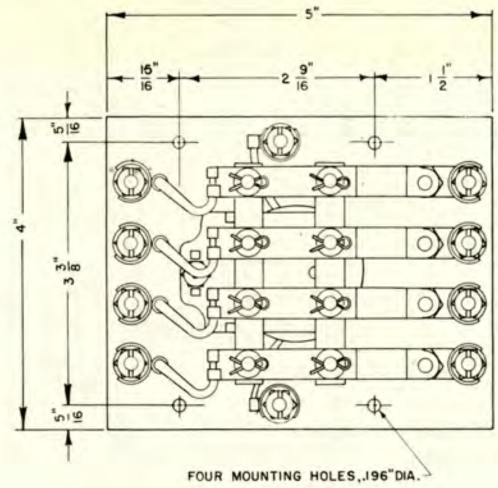


Figure 6–6. Normally Closed Time Delay Relay, Mercury Column Type (K117)

QTY.	ITEM NO.	MFR'S STOCK NO.	DESCRIPTION
1	1	7044	Armature stop
1	2	825	Tension spring
1	3	144-1/4	Screw
1	4	21	Tension stud
1	5	245	Nut
1	6	6054	Coil frame
8	7	2526	Compression spring
8	8	6164	Cotter pin
4	9	11899	Yoke assembly
8	10	7077	Washer
1	11	12148	Armature assembly
1	12	4265	Core assembly
1	13	5345	Coil
1	14		Band, blk, scotch tape
1	15	4891	Name plate
4	16	600	Contact body assembly
18	17	3145	Lock washer
18	18	11	Nut
4	19	31-1-3/8"	Screw
10	20	35	Nut
10	21	14	Cup washer
4	22	808-9/16"	Link
1	23		Base XXX blk. b'lite
10	24	624-7/8"	Screw
3	25	5868-3/8"	Screw



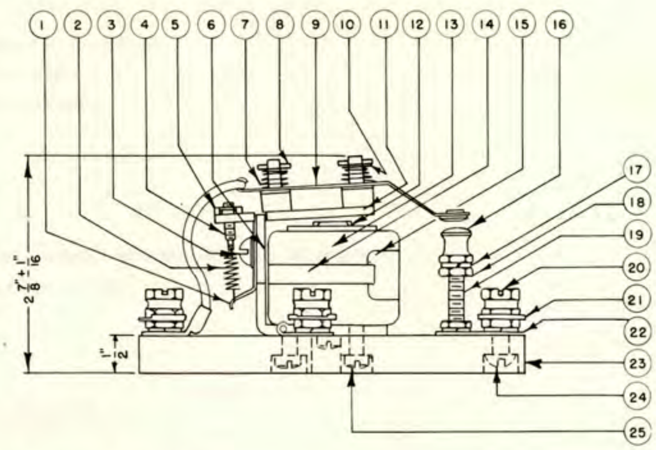


Figure 6–7. A-C Relay (K120, K121)

remove the oxide unless the contacts must be cleaned for some reason. It may be removed at any time with a cloth moistened with dry-cleaning solvent.

(*e*) CORRODED CONTACTS. — Dress the contacts first with a folded strip of crocus cloth. When the corrosion has been removed, wipe the contacts with a clean cloth moistened with dry-cleaning solvent, and polish with a dry folded cloth. Make certain that the shape of the contacts has not been altered.

(*f*) BURNED OR PITTED CONTACTS. — Resurface the contacts, if necessary, with a special relay-cleaning tool which is constructed as follows: Make up a piece of wood (or suitable equivalent material) 2½ inches long, ⅜ inch wide and 1/16 inch thick. Glue crocus cloth to the stick, making sure that both sides of the stick are covered. Place the stick in a vise until the glue hardens. The pieces of crocus cloth that extend over the back edge of the stick may be cut off with a knife. Never use emery cloth to clean contacts. If the contacts are very badly burned or pitted, replace them. If replacements are not available, use a small fine-cut file or #0000 sandpaper to dress the contacts.

b. SWITCHES. — Inspect the mechanical action of each switch and, while doing so, look for signs of dirt and corrosion on all exposed elements. Check to see that all mounting and connecting screws are tight. Where the contacts are inclosed and not accessible, such as on toggle switches, check the action of the switch by flipping the toggle or by pressing the switch button, and note the freedom of movement, as well as the amount of spring tension. Examine the wafer-type switches to see if the contacts are clean. Do not pry the leaves of the switch apart. The movable blade should make good contact with the stationary member, and as the former slides into the latter, a spreading of the stationary contact leaves should be seen.

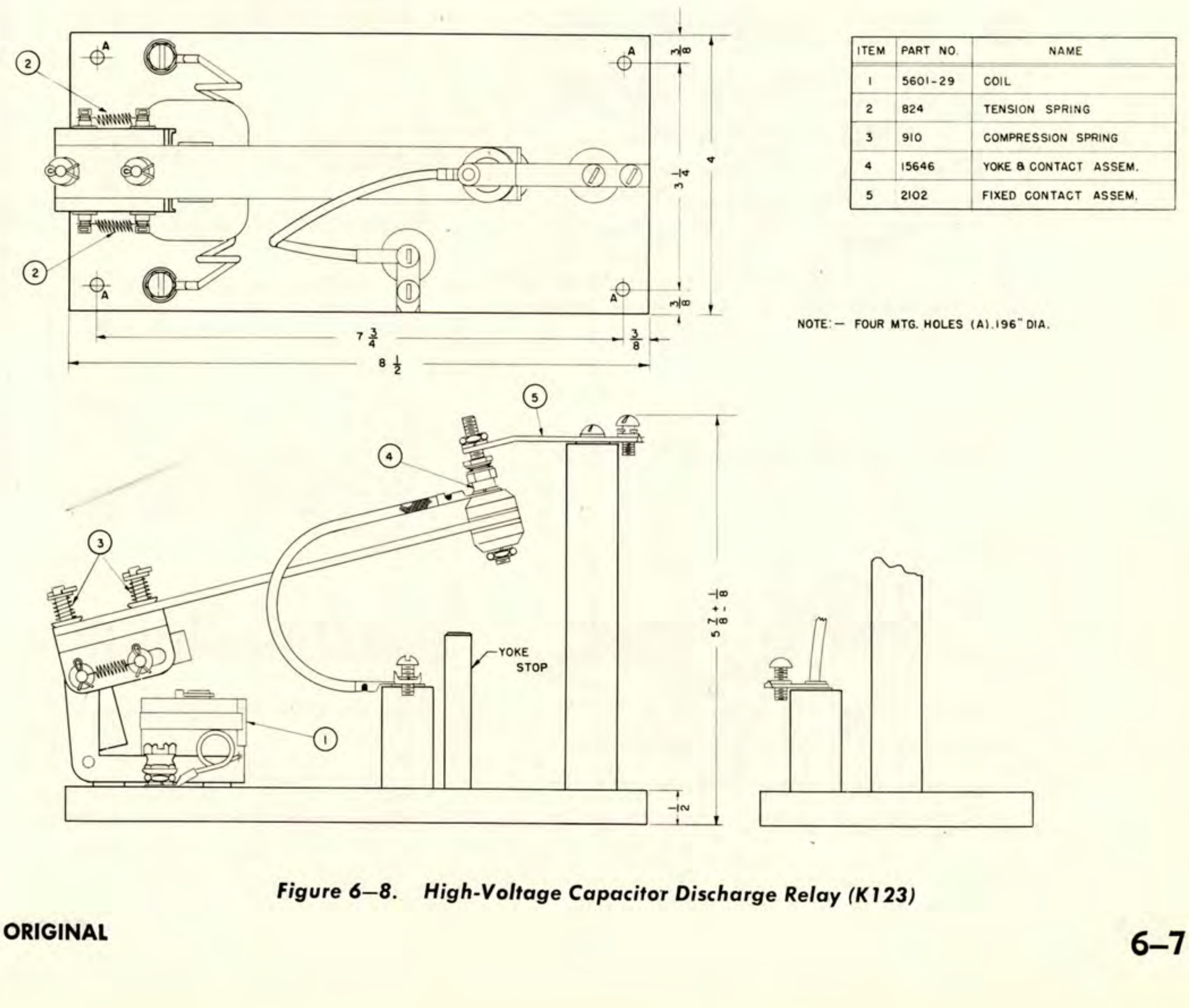
When necessary, clean the exterior surface of switches with a stiff brush moistened with dry-cleaning solvent. Clean corroded connections with #0000 sandpaper. If serious binding is noted, apply a drop of light machine oil to the bearing surfaces with a toothpick. Do not let oil run into the electrical contacts.

c. TRANSFORMERS AND FILTER CHOKES. — The transformers and chokes are of standard construction. Some are inclosed in a metal housing and all are impregnated with an insulating compound. Almost without exception, defective transformers and chokes must be replaced, but preventive maintenance techniques give some amount of protection against failure.

(1) Inspect the terminals of transformers and chokes for dirt, dust, moisture, and loose connections. Dust, dirt, or moisture between the terminals of high-voltage transformers, or chokes located at high-potential points in the circuit, may cause flash-over. Inspect transformers and chokes for loose mounting brackets and loose rivets. Inspect impregnated transformers for signs of overheating. The surest indication of overheating is the presence of insulating compound on the outside of the seams of the case. Overheating is an indication of circuit trouble and requires a systematic analysis.

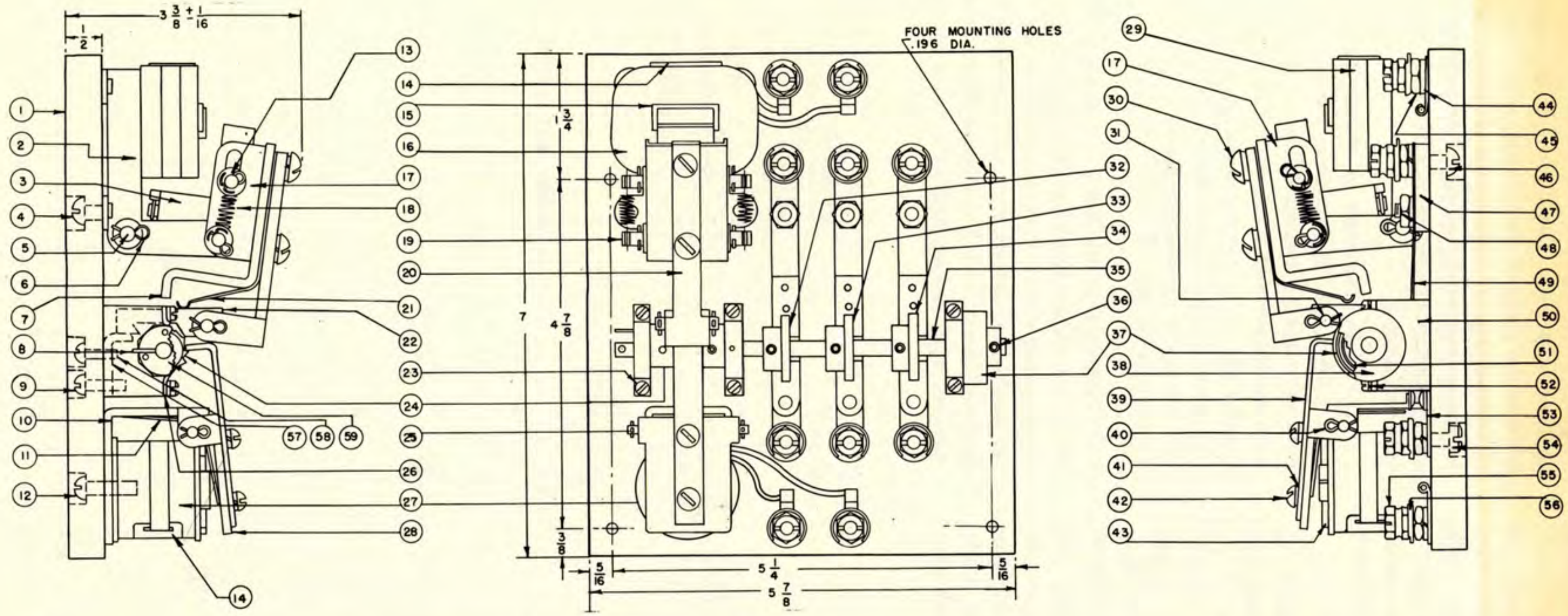
(2) Clean the cases of transformers and chokes with a dry cloth. If necessary, use a cloth moistened with dry-cleaning solvent. Clean corroded connections with sandpaper and wipe with a dry cloth before reconnecting. If it is necessary to remove wires to tighten loose parts, note the position of the wires before they are unsoldered. Restore all wires to their original positions.

d. TERMINAL BLOCKS. — Inspect the terminal blocks for cracks, breakage, dirt, and loose connections or mounting screws. Carefully examine the connections for mechanical defects, dirt, and corrosion. Clean dirty terminal blocks with a dry brush. Clean corroded connections with crocus cloth or a cloth moistened with



ITEM	PART NO.	NAME
1	5601-29	COIL
2	824	TENSION SPRING
3	910	COMPRESSION SPRING
4	15646	YOKE & CONTACT ASSEM.
5	2102	FIXED CONTACT ASSEM.

Figure 6–8. High-Voltage Capacitor Discharge Relay (K123)



QTY.	ITEM NO.	MFR'S STOCK NO.	DESCRIPTION
1	1	12377	Base, XXX blk b'lite
1	2	6162	Frame assem
1	3	6163	Armature assem
4	4	31-5/16"	Screw
1	5	10404	Hinge pin
8	6	6164	Cotter pin
1	7	6173	Live pawl stop
4	8	6097-1/2"	Groove pin
6	9	841-1/2"	Screw
1	10	6170	Coil frame
1	11	929	Torsion spring
1	12	147-3/4"	Screw
4	13	10295	Washer
2	14	4891	Name plate
1	15	3404	Shading coil
1	16	3612	Coil
1	17	12413	Yoke block plate
2	18	824	Tension spring
1	19	10403	Hinge pin
1	20	6165	Ratchet arm brk't
1	21	12386	Live pawl spring
1	22	6166	Live pawl
6	23	1978-3/8"	Screw
1	24	6168	Ratchet
1	25	12400	Hingepin
3	26	2777	Bearing clamp
1	27	8	Coil
1	28	6174	Reset armature
2	29		Band, blk, scotch tape, 1/4" wide
2	30	31-7/16"	Screw
1	31	9516	Pawl shaft
1	32	12406	Cam and hub assem.
1	33	12406	Cam and hub assem.
1	34	12406	Cam and hub assem.
1	35	12662-5-7/16"	Cam shaft
4	36	12379-1/8	Set screw
1	37	5280	Reset spring cover
1	38	12376	Spring hub
1	39	6171	Locking pawl
2	40	4656	Cotter pin
2	41	126	Lock washer
2	42	144-1/4"	Screw
1	43	4265	Core assem.
15	44	3145	Lock washer
13	45	11	Nut
3	46	31-1"	Screw
3	47	9428	Yoke support
3	48	31-5/8"	Screw
3	49	12922	Yoke assem.
3	50	2942	Bearing support
1	51	12644	Reset spring
6	52	6062	Lock washer
3	53	9431	Fixed contact
7	54	624-7/8"	Screw
10	55	35	Slotted nut
10	56	14	Cup washer
1	57	6172	Live pawl guide
2	58	841-3/8"	Screw

Figure 6–9. "Three-Strike" Ratchet-Type Overload Circuit Relay (K122)

Clean the filters by brushing or blowing off all loose accumulated dust and dirt. The filters should be washed in hot water containing soap detergent. When dried, immerse each filter in engine lubricating oil (SAE 20 to 50) and drain by laying along the shortest dimension for run-off.
DO NOT USE GASOLINE OR OTHER SUCH SOLVENTS.

the pilot-light jewels, the base assembly, and the glass envelope of the bulb with a dry cloth. Remove grime and corrosion from the connections or socket contacts with a cloth or a small brush moistened with cleaning fluid; polish the surfaces with a dry cloth. If the bulb is difficult to remove or replace, use the lamp extractor supplied with the equipment.

f. VARIABLE TRANSFORMERS. — Inspect the exterior of variable transformers for dirt or corrosion. Check to see that the mountings are firm and that there are no loose assemblies or terminal screws. Test the brush movement for easy sliding over wires. Make sure there are no wires sticking up which might catch the brush. Examine for corroded contact surfaces or a worn brush. Keep variable transformers clean by rubbing with a dry, clean cloth. If the contact surfaces show signs of corrosion, clean them with crocus cloth moistened in cleaning fluid, and polish with a dry, clean cloth. Replace the brush when it wears down to about 1/8 inch. Round the edges of the new brush slightly so that it will not dig into the wires.

Note

Examine the variable transformer brushes to be sure that their contact surfaces are the correct width. This width should be such that only two commutator turns are bridged. If the width is any greater than this, reduce it with a fine file or with abrasive paper or cloth. Two types of brushes are in use, one with tapered sides and the other with straight sides. Either is satisfactory as long as the brush contact surface width is correct. The correct width for bridging two commutator turns is approximately 1/16 inch.

Examine the insulating strips between the variable transformer wires and the mounting bracket. If the strips are damaged or charred, they should be replaced. If the defective strips are permitted to go unheeded, they may crack off and allow the variable transformer to be shorted to the mounting bracket. If the shaft shows signs of binding, or if it squeaks, apply a few drops of light machine oil to the front and rear bearings while rotating the shaft back and forth.

not attempt to remove individual prongs from cable plugs or receptacles. Clean corroded connectors with crocus cloth or, if necessary, use #0000 sandpaper.

The exposed portions of the spare transmission line between the Type J–455A/FPN Terminal Box and the Antenna Coupling Unit should be examined for breaks, abrasions, or any other physical damage. Its operation should be checked by the method described in Section 7, paragraph 13.

Should a cable need replacing, examine the old cable to determine the assembly procedure and the dimensions used in the cable-end preparation, in order to similarly attach a connector to the new cable.

h. METERS. — Inspect the leads and connections to the meters. Look for loose, dirty, and corroded connections. Also look for cracked or broken cases or cover-glass, and loose mounting screws. Clean dirty meter cases with a dry cloth. Use dry-cleaning solvent if necessary. Clean dirty connections with a small, stiff brush or a cloth moistened with dry-cleaning solvent. Use #0000 sandpaper to clean corroded connections; wipe with a clean cloth.

Tighten all loose connections. Be careful not to crack the meter case when tightening connections. To prevent breakage, hold the retaining nut which makes contact with the meter case and do not allow it to turn while the outside nut is tightened. This permits tightening the connection without increasing the pressure of the head of the stud against the inside of the meter case.

When power is turned off, all meters should return to zero. If they do not, tap the meter case lightly with the finger. If the pointer still does not come to rest at zero, rotate the zero-adjusting screw until the pointer is at zero.

i. AIR FILTERS. — To remove the air filters, located at the rear and right-hand side of the transmitter, remove the thumbscrews holding the frame and grill and lift out the filters. To remove the air filter in the voltage regulator assembly, lift the filter out from in front of the blower. Brush the air filters off at a place where the dust will not blow back into the transmitter. ~~If the filters are badly clogged or gummy, replace them with new units, inserting according to arrows indicating direction of air flow.~~

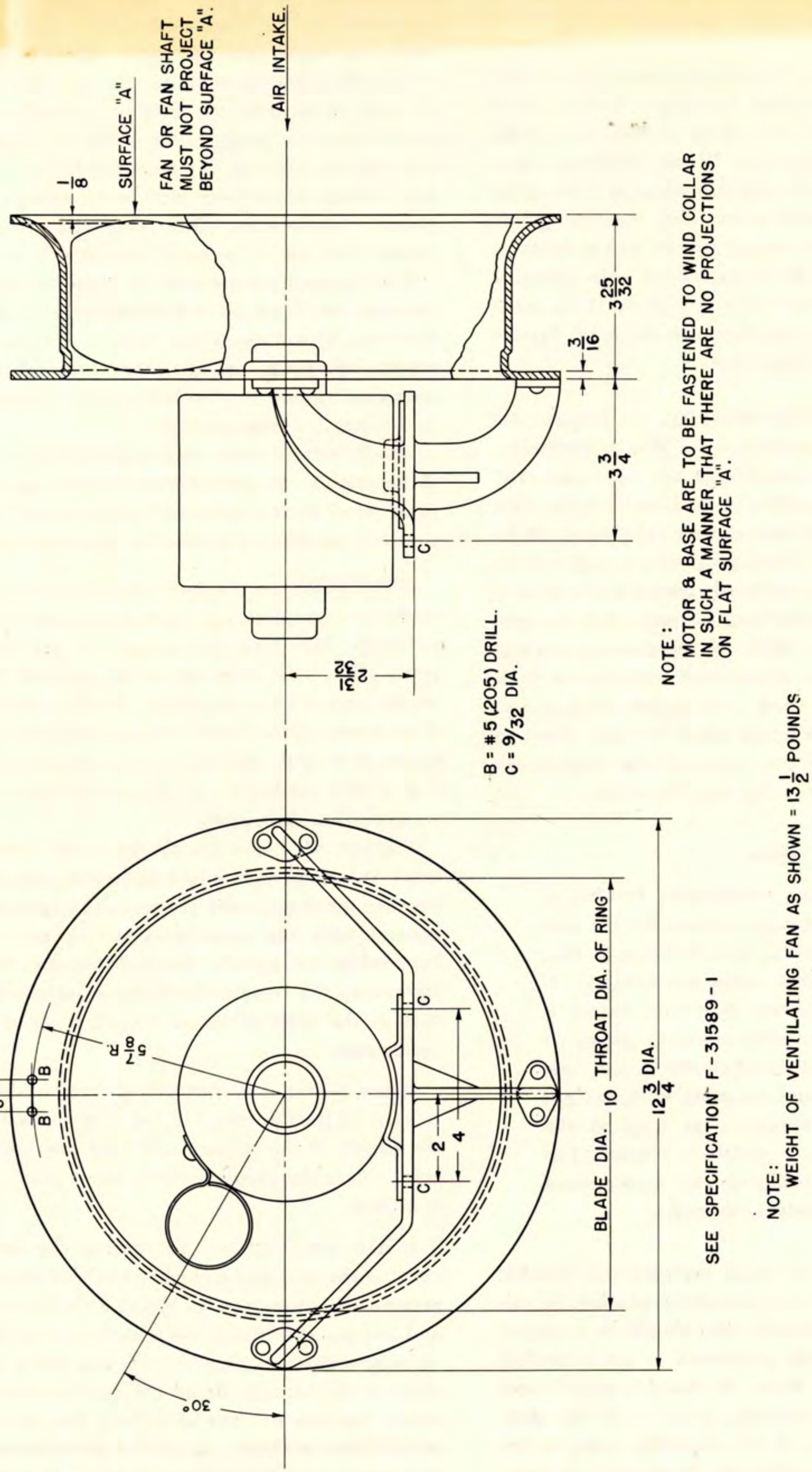


Figure 6–10. Outline, Fan BL102

FC#6

K. Check the accuracy of the P.A. Plate Voltage Meter (M102), the Medium Voltage meter(M103), and the High Bias Supply Meter(M104). Use The Following Procedure.

1. Remove from Spares the appropriate multiplier resistors,R101-104 for M102; R105-R181-182 for M103; R107 for M104. These will be used as a substitue test set.

2. Energize the equipment under test and advance the High voltage control(T101) until M 102 Indicates the proper operating potential.

3. Carefully note the position of the high voltage control dial.

4. Remove all power. Short all elements to ground with the capacitor discharge rod porvided.

5. Substitute a set of multiplier resis tors, r101-4 of known resistance in the circuit of M 102.

6. Energize the equipment and adjust the high voltage control until the proper ope ating potentioals are obtained Com pare the dial postion with the one previously obtained.

7. If.the high voltage control position is different from the position in step 2 above, one or more of the multiplier resistors are defective. the defective resistor may be located by substituting the test resistors one at a time until a change in the dial position is noted. Before substituting any resistors, be sure that the equipment is de-energized.

8. Once the high voltage meter M 102 is correct, repeat the procedure outlined in steps 1 through 6 for m 103 and M 104 using appropriate test multipliers from spares.

1 2 3 9

Model	H. P	...ture Assy	Arm. Shaft
		2	13
KP105AVW	1/20	4-9	20596-3

j. MECHAN... mechanical inspection should be made of all units of the equipment. All bolts, nuts, and screws should be checked and tightened. Connections to all components should be examined where other than a simple soldered joint is used. Particular attention should be paid to the link connectors in the transmitter, terminal box, and antenna coupling unit. Examine the links for evidence of arcing, and either sand or file them down, if such evidence is noted. Tighten all connections to all terminal boards, and inspect all ground leads and clamps.

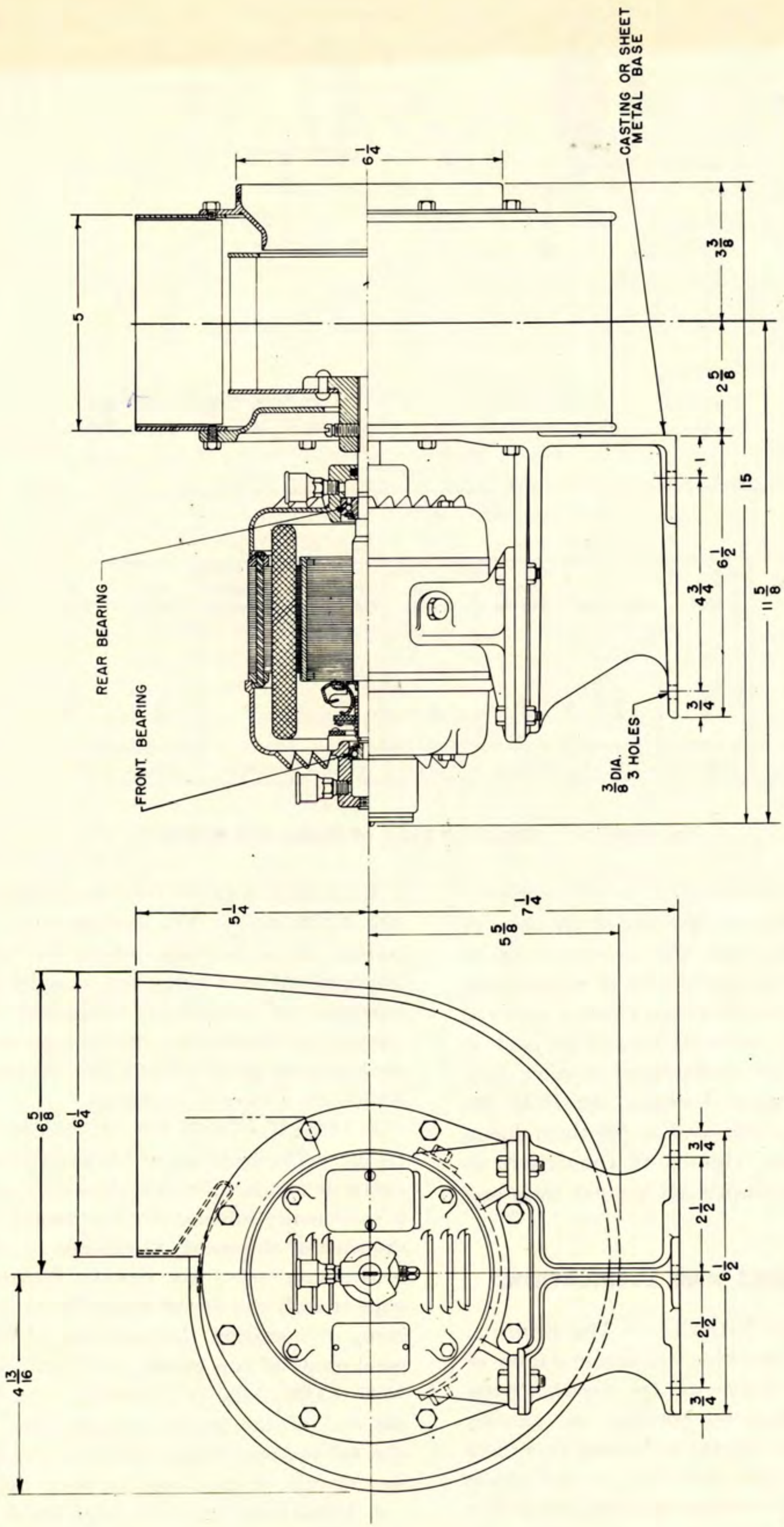
5. MOTOR MAINTENANCE AND LUBRICATION.

a. GENERAL MAINTENANCE. — The principal causes of faulty motor operation are accumulation of dirt and other foreign matter on the movable parts and insufficient lubrication on bearings and moving parts. Inspect the fan and blower to be sure that these items are in good condition; clean off dirt and grease to prevent unbalancing the motor load. Be certain that all bolts are tight, and that the shock mounts are flexible and absorbing the motor vibration.

...ER FAN BL-102 MOTOR. — The driving motor of fan BL102 utilizes sleeve bearings which are lubricated by oil-impregnated wool waste and yarn. When shipped, the bearings are sufficiently lubricated for six months' operation. Thereafter, the oil cups should be refilled with a good grade of SAE No. 20 oil, and refilled at six-month intervals, or oftener.

c. LUBRICATION OF TRANSMITTER BLOWER BL101.—The bearings of blower BL101 require lubrication at regular intervals. As with fan BL102, the unit is sufficiently lubricated for a period of six months at the time of shipment. At the end of this time and approximately every six months thereafter, the grease cups at each end of the motor should be given a slight turn. If necessary, the cups should be refilled with a good grade of cup grease. THIS CUP GREASE MUST NOT CONTAIN GRAPHITE. The ball bearings at the end of the blower should also be similarly inspected and maintained. However, to do so, it is necessary to remove the hood inclosing the fan.

d. LUBRICATION OF VOLTAGE REGULATOR ASSEMBLY BLOWER AND MOTOR B2501. — These units are completely sealed and lubricated at the factory



FAN IS SHOWN FOR COUNTERCLOCKWISE ROTATION. MOTOR IS ON OPPOSITE SIDE FOR CLOCKWISE ROTATION.

Figure 6–12. Assembly, Blower BL101

for lifetime operation. No further lubrication is required.

6. REPLACEMENT OF MOTOR BEARINGS.

a. FAN BL102. — The motor of fan BL102 utilizes sleeve-type bearings which require considerable skill and machine tools for proper replacement. Unskilled personnel should not attempt this operation unless an emergency warrants it. The following procedure is recommended (see figures 6–10 and 6–11):

(1) Remove the motor from its mount and remove the fan by loosening the shaft setscrew.

(2) Remove the four through-bolts, and disassemble the motor. Be careful not to damage the armature or windings.

(3) Remove the oil-well cover.

(4) Remove the wool waste and wool yarn through the oil-well cover hole.

(5) Press out bearing with a ½-inch shouldered plug.

(6) Reinsert a new bearing, using a ½-inch shouldered guide plug; press into housing so that oil slot is at the top of the bearing and the inner edge of bearing is flush with the housing.

(7) Place both heads on the motor shell in the correct position, tighten through-bolts, and line ream the bearings to 0.500 ± 0.0002 inch.

(8) Remove heads and reassemble motor. Clean all parts before reassembly.

(9) Place wool yarn in the oil well over the shaft and tamp to the bottom of the oil well. Make sure that the yarn touches the shaft. Fill the remainder of the oil well with the wool waste. Saturate the wool yarn and waste with a good grade of SAE No. 20 oil.

(10) Replace the oil caps, if necessary using new caps.

(11) Replace motor and fan on fan frame.

b. BLOWER BL101. — If ball bearings used in the motor of blower BL101 (figure 6–12) require replacement, the following procedure is recommended:

(1) Loosen the setscrew holding the blower to the motor shaft, and remove the motor from the blower frame.

(2) Remove the front and rear heads by removing the bolts holding the heads to the frame.

(3) Disassemble the motor, being careful not to damage the armature or windings.

(4) Remove the bearing from the armature shaft, using a puller, if necessary.

(5) Heat the replacement bearing in oil, not exceeding 100 degrees C (212 degrees F), to expand the bearing. This will permit fitting the bearing on the shaft with only slight pressure.

(6) Pack the bearing with a good grade of cup grease, and reassemble the motor. The cup grease must *not* contain graphite. After reassembly, also fill the grease cups with grease.

(7) Replace the motor on the blower assembly frame.

7. DRYING OUT EQUIPMENT.

Under operating conditions, the heat normally developed within the transmitter and the Antenna Coupling Unit is sufficient to prevent condensation. When initially starting the equipment, however, or starting it after a prolonged shut-down period, there is a possibility of condensation. Because of the high voltages which are present in the equipment, such condensation presents a possibility for arcing and short circuits.

To prevent arcs due to condensation, the transmitter and Antenna Coupling Unit should be dried out thoroughly by the use of lamp banks before the equipment is operated. The lamp banks should be capable of dissipating at least 200 watts, and a bank should be placed on either side in the bottom of the transmitter and the Antenna Coupling Unit. No power should be applied to the equipment during the drying-out period. Filament power should be applied as soon as the lamp banks are removed.

In an emergency, the precautionary drying-out period may have to be curtailed in order to render immediate service, but experience has shown that it should never be entirely eliminated. Subsequent failures may keep the equipment out of operation longer than the time required to eliminate dampness.

8. MAINTENANCE RECORDS.

Knowledge of small circuit changes, the times at which tubes are changed, or any change in operating conditions should not be confined to the memory of any particular individual. This important information should be recorded in such a manner as to be comprehensible to anyone at any future date. When the equipment is initially placed in operation, all meter readings should be logged and used as a basis for comparison with future readings. Similarly, the results of the routine checks outlined in this section should be logged and used for comparison purposes. An accurate log will provide indications of gradual as well as abrupt changes in operation, and allow the operator to anticipate and forestall failures.

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 CG-2643, which has been designed to simplify this requirement (see figure 7-0). The form must be filled out and forwarded in accordance with existing instructions.

Use great care in filling out the form to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T803, in the case of a transformer, or R207, for a resistor. Do not substitute brevity for clarity. Use the back of the form to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform the Commandant of the cause and rate of failures. The information is used by the Commandant in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The forms you send in, together with those from other units, furnish a store of information permitting the Commandant to keep in touch with the performance of the equipment of your unit and all other units of the Coast Guard.

This report is not a requisition. You must request the replacement of parts in accordance with current instructions.

Make certain you have a supply of Failure Report Forms on board.

TREASURY DEPARTMENT
U. S. COAST GUARD
CG-2643 (Rev. 8-51)

NOTICE: 1. Read instructions on reverse side
2. Report all failures (electronic, electrical, and mechanical)
3. Use separate sheet to report each part failure

ELECTRONIC FAILURE REPORT

DATE OF FAILURE ____

UNIT AT WHICH EQUIPMENT IS INSTALLED		NAME OF UNIT MAKING REPAIRS	REPAIRED BY (NAME AND RATE)
PRIMARY	SUBSIDIARY		
NAME	TYPE	EQUIPMENT CATEGORY: 1 ☐ RADIO 2 ☐ RADAR 3 ☐ SONAR 4 ☐ TEST 5 ☐ LORAN 6 ☐ D F 7 ☐ POWER 8 ____ OTHER (SPECIFY)	
NUMBER	NUMBER		

NAME PLATE DATA — EQUIPMENT			MAJOR UNIT INVOLVED
MODEL DESIGNATION	SERIAL NO.	NAME OF CONTRACTOR	TYPE NUMBER AND NAME
LEAVE BLANK	CONTRACT NO.	DATE INSTALLED	SERIAL NO.

PART FAILURE DATA (CHECK ONE)				
☐ TUBE	COMPLETE TUBE TYPE OR NAME OF PART	STANDARD NAVY STOCK NO. (SEE NOTE 7)	SYMBOL DESIGNATION (V-101, R-201, ETC.)	FAILED IN (CHECK ONE) 1 ☐ OPERATION 2 ☐ HANDLING 3 ☐ FAULTY PACKAGING 4 ☐ PREVENTIVE MAINTENANCE
☐ OTHER	APPROXIMATE LIFE (HRS.)	MANUFACTURER'S NAME	SERIAL NO. OF TUBE OR PART	MANUFACTURERS' DATA (SEE NOTE 10) — 5 ____ OTHER (SPECIFY)

CHECK TYPE OF FAILURE:

002 ☐ AIRLEAK	130 ☐ CHANGE OF VALUE	300 ☐ GROUNDED	360 ☐ INTERMITTENT OPERATION	225 ☐ MFR'S DEFECT	003 ☐ OPEN FILAMENT	540 ☐ PUNCTURED	620 ☐ SHORTED TO PRIMARY
007 ☐ ARCING	170 ☐ CORRODED	310 ☐ HANDLING IMPROPER	380 ☐ LEAKAGE	009 ☐ MICROPHONIC	460 ☐ OPEN PRIMARY	011 ☐ SCREEN DEFECTS	630 ☐ SHORTED TO SECONDARY
070 ☐ BROKEN	190 ☐ CRACKED	320 ☐ HIGH VOLTAGE BREAK-DOWN	013 ☐ LOOSE BASE	008 ☐ NOISY	470 ☐ OPEN SECONDARY	005 ☐ SHORTED INTERMITTENT	020 ☐ UNSTABLE OPERATION
014 ☐ BROKEN BASE	330 ☐ EXCESSIVE HUM	340 ☐ INSTALLED IMPROPERLY	012 ☐ LOOSE ELEMENTS	022 ☐ NO OSCILLATION	480 ☐ OVERHEATED	006 ☐ SHORTED PERMANENT	☐ OTHER (*Specify in remarks*)
015 ☐ BROKEN GLASS	001 ☐ GASSY	350 ☐ INSULATION BREAK-DOWN	004 ☐ LOW EMISSION	440 ☐ OLD AGE (*Specify in remarks*)	021 ☐ OVERLOADED	600 ☐ SHORTED TO CASE	
080 ☐ BURNED OUT	016 ☐ GLASS STRAIN		040 ☐ MECHANICAL BINDING	450 ☐ OPEN	010 ☐ POOR FOCUS	610 ☐ SHORTED TO FRAME	

REMARKS (MAKE ON REVERSE SIDE)

☐ APPROVED
☐ DISAPPROVED ____

16—65145-1 ____ (TECHNICIAN'S SIGNATURE) ____ COMMANDING OFFICER.

Figure 7-0. Failure Report, Sample Form

SECTION 7
CORRECTIVE MAINTENANCE

1. THEORY OF TROUBLE LOCALIZATION.

The greater part of corrective maintenance consists in the localization of trouble. Except for rare instances, replacement and repair techniques are relatively simple and constitute the lesser, though equally important, part of the maintenance.

Localization of trouble consists in the isolation of the cause of trouble to a particular component part. A logical succession of observations and then a logical process of reasoning are the most effective means of isolating trouble sources. It is true that some troubles will be simple in nature and their causes indicated by a single well-defined symptom. More often, the troubles will have various interacting and complex effects so that the symptoms will not be indicative as to the immediate cause of trouble. In such cases, a series of logical steps may be necessary to eliminate various units as a source of trouble, to isolate the trouble to a particular section or stage within a particular unit, and finally to determine the particular component part which is causing the trouble. In tracing the trouble, the technician should make use of the operating data which has been accumulated in the course of operating the equipment, and of the various aids which are incorporated in this instruction book. Among the more important aids included in this manual are:

a. The typical meter reading listed in table 5–1.

b. The test oscillograms, figures 7–1 to 7–14 of this section.

c. The voltage and resistance measurements listed in table 7–2.

d. The system diagram, figure 1–12, and block diagrams, figures 2–1 and 2–13.

e. The block diagrams of the transmitting circuits (figures 2–2, 2–3, 2–8, 2–9).

f. Wiring and schematic diagrams, figures 7–38 to 7–52, inclusive.

g. The simplified schematics in Section 2.

h. The alignment data of paragraph 8 of this section.

i. The tuning chart supplied with the equipment.

j. The photographic illustrations showing the location of components.

k. The sequential trouble-shooting chart, table 7–1.

2. USE OF THE MONITOR OSCILLOSCOPE.

The monitor oscilloscope is provided not only as a means of monitoring a normally operating transmitter, but also as an aid in trouble-shooting the equipment. The oscillograms which follow are representative of the waveforms which should be obtained on the oscilloscope for the various positions of the MONITORED CIRCUIT selector switch. Unless otherwise noted for a particular oscillogram, all controls involved are set as follows:

a. The OSCILLOSCOPE TRIGGER switch (above the scope) must be in either the EXC A or EXC B position, depending on which exciter is being used. If double-pulsed operation is used, observations must be made in both positions.

b. The MONITORED CIRCUIT switch (above the scope) must be set for the desired test point.

c. The TRIGGER SOURCE switch should be in the EXT + position.

d. The SWEEP LENGTH control should be in the 100 μs A position.

e. The R SWEEP switch should be in the delay (DEL) position.

f. The MARKERS switch should be in the Z IN position.

g. The HORIZONTAL and VERTICAL CENTERING controls should be adjusted to center the pattern on the scope.

h. The INTENSITY and FOCUS controls should be adjusted to obtain a well-defined pattern on the scope.

i. The settings of the VERTICAL DEFLECTION control and the VIDEO ATTENUATION control are listed for each oscillogram.

j. The transmitter HIGH VOLT switch must be in the OFF position when so specified on the oscillograms (figures 7–1 to 7–4, 7–13 and 7–14) to prevent r-f pick-up from appearing on the pattern.

Note

When the VIDEO ATTENUATION control is in anything but the OFF position, the scope

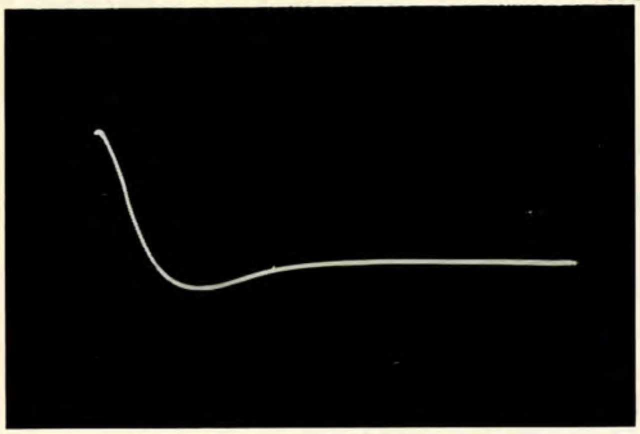


Figure 7—1. Input Trigger Pulse

MONITORED CIRCUIT: TRIGGER FROM TIMER
VIDEO ATTENUATION: 10
VERTICAL DEFLECTION: ½
HIGH VOLTAGE: OFF

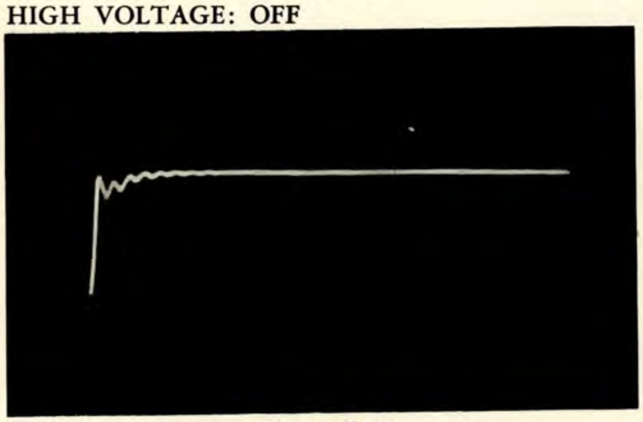


Figure 7—2.
Trigger Input to Modulation-Pulse Generator

MONITORED CIRCUIT: TRIGGER TO MOD.
VIDEO ATTENUATION: 10
VERTICAL DEFLECTION: ¾
HIGH VOLTAGE: OFF

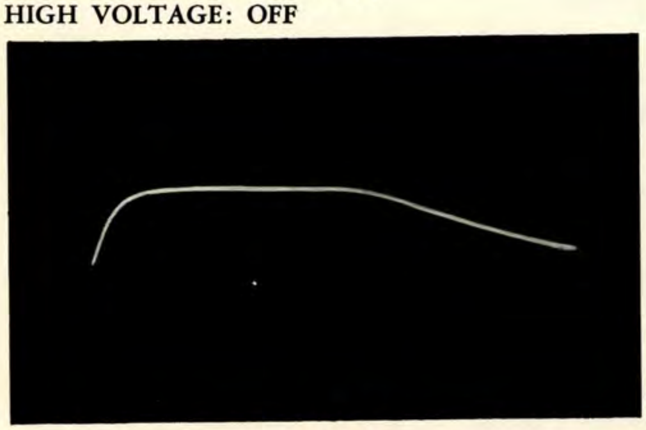


Figure 7—3.
Rectangular Keying Pulse to Pulsed Doubler

MONITORED CIRCUIT: BIAS TO DBLR.
VIDEO ATTENUATION: 3
VERTICAL DEFLECTION: Max.
HIGH VOLTAGE: OFF

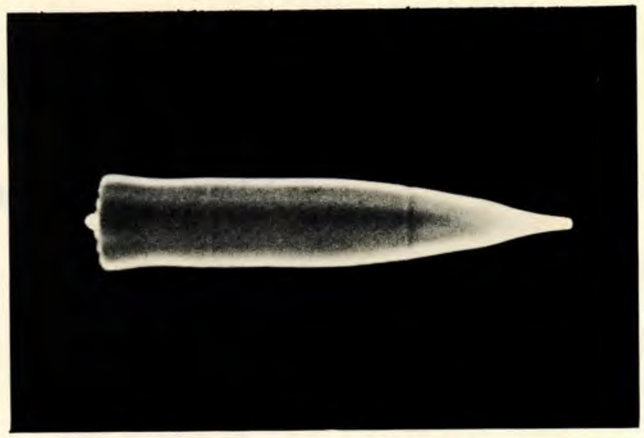


Figure 7—4. Pulsed Doubler Output

MONITORED CIRCUIT: OUTPUT DOUBLER
VIDEO ATTENUATION: 1
VERTICAL DEFLECTION: Max.
HIGH VOLTAGE: OFF

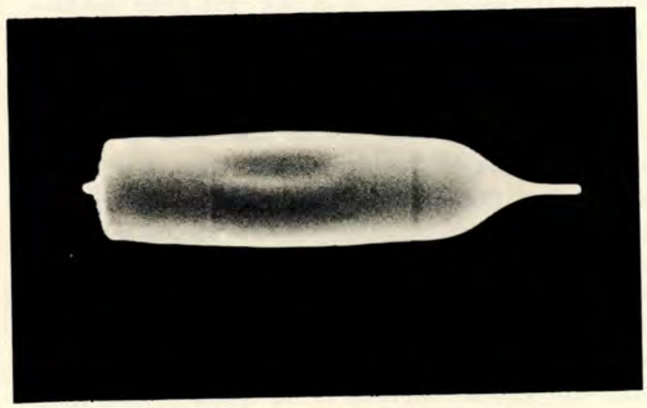


Figure 7—5. 1st IPA Output Pulse

MONITORED CIRCUIT: OUTPUT 1ST IPA
VIDEO ATTENUATION: 10
VERTICAL DEFLECTION: Max.
HIGH VOLTAGE: ON

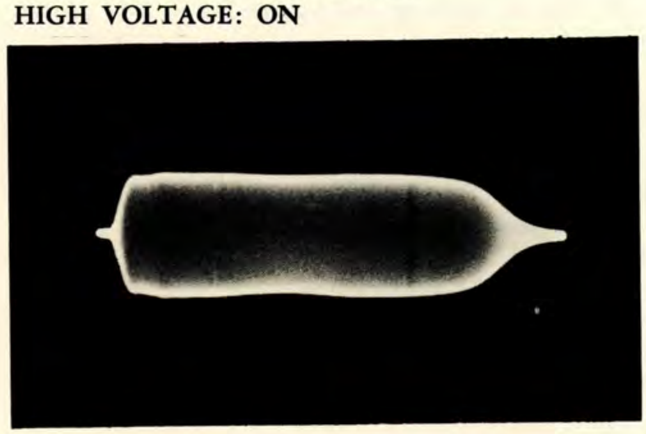


Figure 7—6. 2nd IPA Output Pulse

MONITORED CIRCUIT: OUTPUT 2ND IPA
VIDEO ATTENUATION: OFF
VERTICAL DEFLECTION: ¾
HIGH VOLTAGE: ON

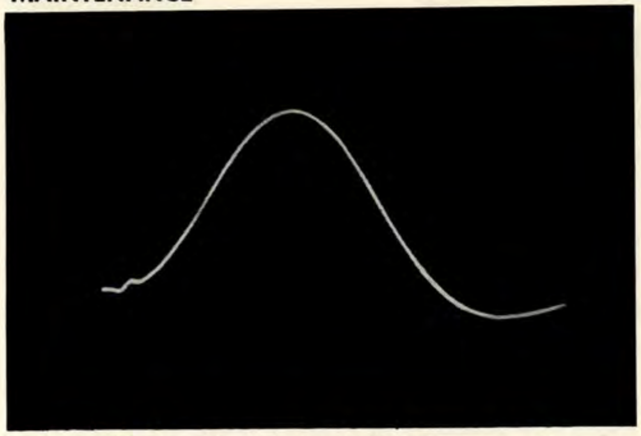


Figure 7–7. Modulation-Pulse Generator Output

MONITORED CIRCUIT: PULSE FROM MOD.
VIDEO ATTENUATION: OFF
VERTICAL DEFLECTION: ½
HIGH VOLTAGE: ON

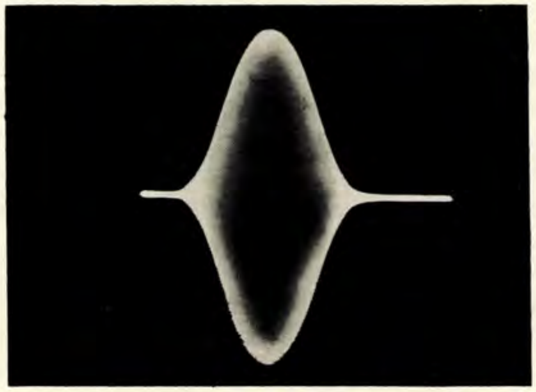


Figure 7–8. PA Output Pulse

MONITORED CIRCUIT: OUTPUT PA
VIDEO ATTENUATION: OFF
VERTICAL DEFLECTION: 1/3
HIGH VOLTAGE: ON

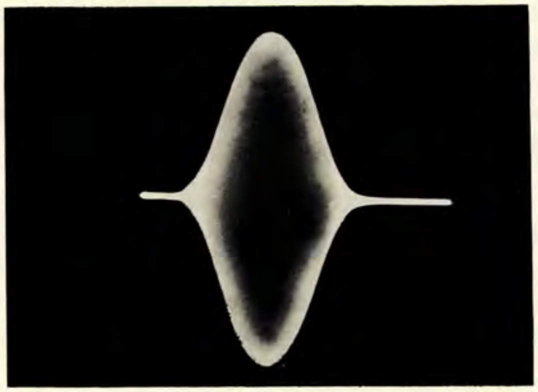


Figure 7–9. Antenna Output Pulse (RF)

MONITORED CIRCUIT: ANT (RF)
VIDEO ATTENUATION: OFF
VERTICAL DEFLECTION: 1/3
HIGH VOLTAGE: ON

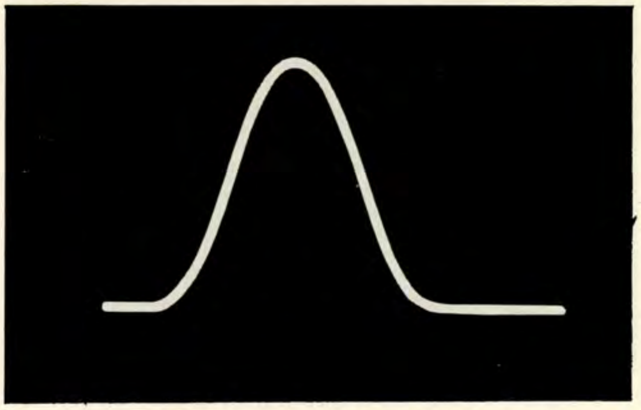


Figure 7–10. Antenna Output Pulse (Detected)

MONITORED CIRCUIT: ANT (Detected)
VIDEO ATTENUATION: OFF
VERTICAL DEFLECTION: 1/3
HIGH VOLTAGE: ON

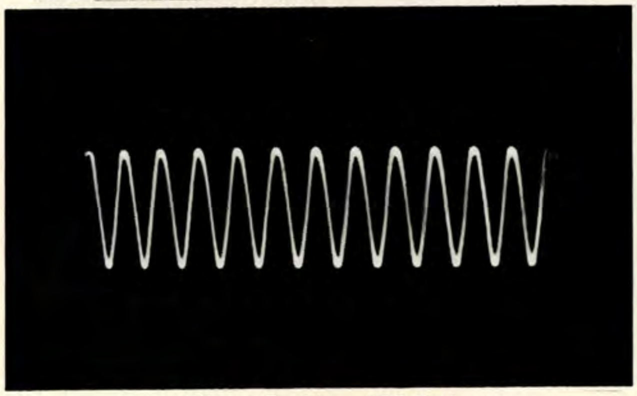


Figure 7–11. 100-Kc Input

MONITORED CIRCUIT: TEST; taken at P106 or P107.
VIDEO ATTENUATION: 10
VERTICAL DEFLECTION: Max.
HIGH VOLTAGE: OFF

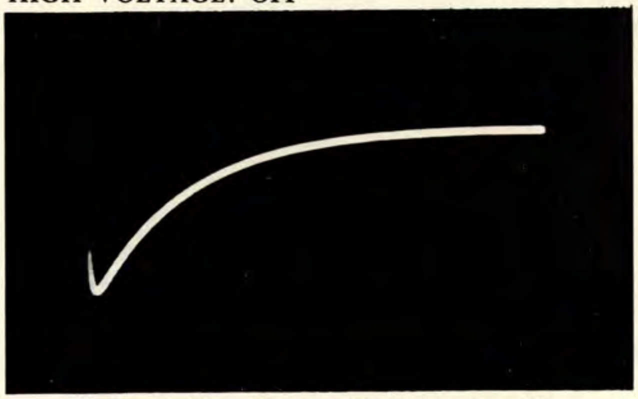


Figure 7–12. Input to Squaring Amplifier

MONITORED CIRCUIT: TEST; taken at junction of C180 and R213, or C181 and R214.
VIDEO ATTENUATION: OFF
VERTICAL DEFLECTION: ½
HIGH VOLTAGE: OFF

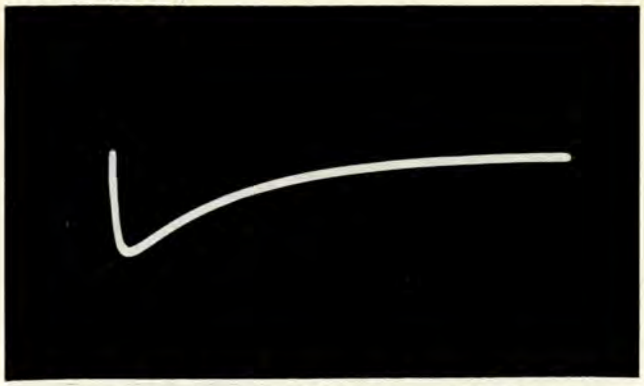


Figure 7—13. 1st Squaring Amplifier Output

MONITORED CIRCUIT: TEST; taken at junction of C196 and R227, or C197 and R228.
VIDEO ATTENUATION: OFF
VERTICAL DEFLECTION: Max.
HIGH VOLTAGE: OFF

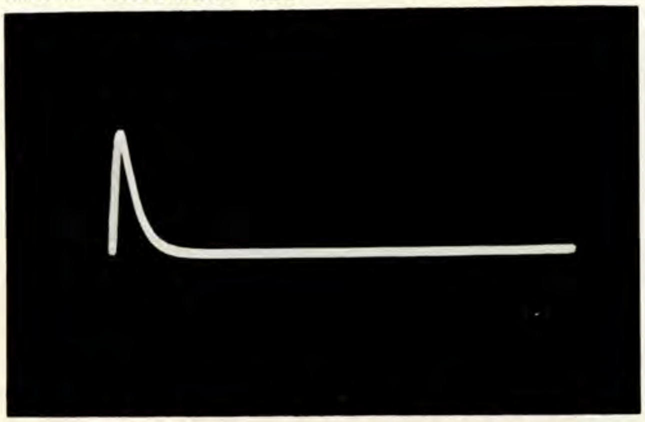


Figure 7—14. Trigger Input to Modulation-Pulse Generator Grid

MONITORED CIRCUIT: TEST; taken at terminal 4 of transformer T121 or T122.
VIDEO ATTENUATION: OFF
VERTICAL DEFLECTION: Max.
HIGH VOLTAGE: OFF

pattern should not be allowed to exceed one inch in amplitude. Otherwise limiting may occur in the video (vertical) amplifiers. Generally the controls should be set as outlined above and as noted for each oscillogram. The relative amplitude of the patterns should then closely approximate those of oscillograms.

3. TROUBLE SHOOTING, GENERAL.

When trouble occurs in an operating transmitter, all abnormal indications should be logged immediately, and the operator should change over to the stand-by unit (see Section 4, paragraph 4). This same general procedure will hold for most of the units in the loran transmitting system, so that prolonged off-the-air periods will not be a problem. In the rare instances when trouble develops in a unit which is not supplied in duplicate, complete shut-down will be necessary until the trouble has been repaired.

Any trouble which appears in the transmitter proper can be classified generally as being in either the r-f and pulse circuits, or in the power and control circuits. Once this is determined the defective circuit may be traced more easily.

A trouble which is present in the r-f or pulse stages may generally be isolated to one particular stage by the observation of waveforms which appear on the monitor oscilloscope (or by noting their non-appearance). For example, assume that, with all voltages apparently normal, there is no output from the PA stage. Use of the MONITORED CIRCUIT switch (S116) permits monitoring the output of each stage, including all stages from the PA back to the pulsed doubler, as well as the keying pulse to the doubler and the modulation-pulse generator output. The stage which produces no output, with normal excitation present from the preceding stage, is the portion of the transmitter most likely to be at fault. Should the defective circuit be in the pulse-forming stages, it may be necessary to check waveforms by means of the test terminal connected to the TEST position of the MONITORED CIRCUIT switch (S116). The monitoring points that will be found most useful are referenced in figures 7–11 to 7–14.

For troubles which occur in the voltage regulator and transmitter power and control circuits, table 7–1 has been prepared as an aid to the rapid localization of the defective component. This chart may be used in either of two ways, as follows:

a. Using the abnormal indications listed by the operator as a starting point, refer to the "Abnormal Indications" column of table 7–1. Proceed directly to the probable causes and corrective measures listed opposite the abnormal indications.

b. If the indications are complex and interacting so that it is difficult to identify them as a single item in the table, refer to the "Operating Step" column of the table. Proceed in sequence from the beginning of the chart, checking for normal indications at each step. The chart is arranged in the same sequence as the starting procedure so that the satisfactory completion of each step eliminates all preceding steps (and the circuits involved in those steps) as a possible source of trouble. Following this procedure will expedite the localization of troubles and decrease the tendency for haphazard checking.

TABLE 7–1. SEQUENTIAL TROUBLE-SHOOTING CHART

a. VOLTAGE REGULATOR.

OPERATING STEP	NORMAL INDICATIONS	ABNORMAL INDICATIONS	PROBABLE CAUSES	CORRECTIVE MEASURE
Place BLOWER switch S2401 in LINE 1 or LINE 2 position.	*a.* BLOWER indicator lamp I2401 lights.	1. BLOWER indicator lamp does not light. Other indications normal.	1. Lamp defective.	1. Replace lamp.
	b. Blower operates.	2. BLOWER indicator lamp does not light. Blower does not operate.	2. Blown fuse.	2. Replace fuse F2401.
Place circuit breaker switch in the ON position.	*c.* Circuit breaker stays on.	3. Circuit breaker will not stay on.	3. Shorted circuit at regulator output terminals.	3. Check for short.
	d. Control indicator lamp I2501 lights.	4. Control indicator lamp does not light.	4. *a.* Lamp defective.	4. *a.* Replace lamp.
			b. CONTROL fuse F2502 blown.	*b.* Check for shorted primary winding on transformer T2302. Replace fuse.
Place meter switch in the LINE VOLTAGE position.	*e.* Meter reading of 195-255 volts.	5. Meter reads zero voltage.	5. Faulty meter.	5. *a.* Replace meter.
			a. Faulty meter switch S2504.	*b.* Replace switch.
Adjust OUTPUT VOLTAGE control for a reading of 230 volts REGULATED OUTPUT on voltmeter.	*f.* Regulated voltage can be adjusted to 230 volts ac.	6. Output voltage cannot be adjusted to 230 volts ac.	6. See 7.	
	g. Output voltage is regulating.	7. Output voltage not regulating.	7. *a.* MOTOR fuse blown.	7. *a.* Check motor and gear train. Replace fuse F2503.
			b. BRUSH fuse blown.	*b.* Replace fuse F2501.
			c. Control element Z2301 faulty.	*c.* Replace control element Z2301.
			d. Thyratron tubes T2301 and/or T2302 faulty.	*d.* Replace tubes as needed.
			e. Control transformer T-2303 faulty.	*e.* Check for open or shorted primary or secondary windings. Replace if found faulty.
			f. Crystal diodes CR2301 and/or CR2302 faulty.	*f.* Replace as needed.

b. TRANSMITTER.

TABLE 7–1. SEQUENTIAL TROUBLE-SHOOTING CHART (Cont'd)

OPERATING STEP	NORMAL INDICATIONS	ABNORMAL INDICATIONS	PROBABLE CAUSES	CORRECTIVE MEASURES
Place MAIN switch (S101) in ON position. (Switch S102 should be in NORMAL position.)	*a.* MAIN indicator lamp (I101) lights.	1. MAIN indicator lamp (I101) does not light; all other indications normal.	1. Lamp burned out.	1. Replace lamp I101.
	b. DOOR INTERLOCK indicator lamp (I111) lights. *c.* 2ND IPA O.L. indicator lamp (I107) lights. *d.* PA O.L. indicator lamp (I108) lights. *e.* HV O.L. indicator lamp (I109) lights. *f.* Blower BL101 starts. *g.* Fan BL102 starts. *h.* LINE meter (M101) indicates a-c line voltage, with switch S110 in LINE position.	2. DOOR INTERLOCK indicator lamp (I111) does not light; all other indications normal.	2. *a.* Door open on transmitter, terminal box, or 1,000-kw amplifier (if used). *b.* Lamp burned out. *c.* Blown fuse. *d.* Coil of relay K120 open. *e.* Contacts of K120 in series with I111 do not close.	2. *a.* Check all doors for proper operation of interlock switches. If amplifier is not used, check jumper between terminals 1 and 2 of transmitter terminal board. *b.* Replace lamp I111. *c.* Replace fuse F102. *d.* Replace relay. *e.* (1) Repair or replace contacts. (2) Replace relay.
	i. Monitor oscilloscope pilot lamp (behind SWEEP DELAY dial) lights, if scope POWER switch is in ON position.	3. 2ND IPA O.L. indicator lamp (I107) does not light; all other indications normal.	3. *a.* Lamp burned out. *b.* Normally-closed contacts of relay K107 open.	3. *a.* Replace lamp I107. *b.* Replace relay.
		4. PA O.L. indicator lamp (I108) does not light; all other indications normal.	4. *a.* Lamp burned out. *b.* Normally-closed contacts of relay K108 open.	4. *a.* Replace lamp I108. *b.* Replace relay.
		5. HV O.L. indicator lamp (I109) does not light; all other indications normal.	5. *a.* Lamp burned out. *b.* Normally-closed contacts of relay K109 open.	5. *a.* Replace lamp I109. *b.* Replace relay.
		6. None of indicator lamps listed light.	6. Blown fuse.	6. Replace fuse F103.

b. TRANSMITTER.

TABLE 7–1. SEQUENTIAL TROUBLE-SHOOTING CHART (Cont'd)

OPERATING STEP	NORMAL INDICATIONS	ABNORMAL INDICATIONS	PROBABLE CAUSES	CORRECTIVE MEASURES
		7. Blower BL101 does not start.	7. Blown fuse.	7. Replace fuse F104.
		8. Fan BL102 does not start.	8. Blown fuse.	8. Replace fuse F105.
		9. LINE meter (M101) reads zero voltage.	9. See 14 *b*.	
		10. Oscilloscope pilot lamp does not light.	10. *a.* Blown fuse. *b.* Anything other than blown fuse.	10. *a.* Replace fuse F101. *b.* See appended instruction book for oscilloscope.
Place FILAMENTS switch (S103) in ON position. FILAMENT VOLTAGE control (T102) should be at normal setting.	*j.* LOW POWER FIL indicator lamp (I102) lights. *k.* HIGH POWER FIL indicator lamp (I103) lights.	11. FILAMENTS switch (S103) has no effect on transmitter.	11. Air-flow interlock switch (S130) inoperative.	11. *a.* See 7. *b.* Replace switch S130.
		12. LOW POWER FIL. indicator lamp (I102) does not light; all other indications normal.	12. *a.* Lamp burned out. *b.* Blown fuse. *c.* Coil of relay K104 open. *d.* Resistor R138 open. *e.* Contacts of relay K104 in series with lamp I102 do not close.	12. *a.* Replace lamp I102. *b.* Replace fuse F109. *c.* Replace relay. *d.* Replace resistor. *e.* Replace relay.
	l. LINE meter (M101) indicates approximately half filament bus voltage for 15 seconds, then normal voltage (230 v); switch S110 must be in FIL PRI position. *m.* After 3 minutes, HIGH VOLT T.D. indicator lamp (I104) lights.	13. HIGH POWER FIL indicator lamp (I103) does not light; all other indications normal.	13. *a.* Lamp burned out. *b.* Blown fuse. *c.* Coil of relay K111 open. *d.* Resistor R145 open. *e.* Contacts of relay K111 in series with lamp I103 do not close.	13. *a.* Replace lamp I103. *b.* Replace fuse F110. *c.* Replace relay. *d.* Replace resistor. *e.* Replace relay.

b. TRANSMITTER.

TABLE 7–1. SEQUENTIAL TROUBLE-SHOOTING CHART (Cont'd)

OPERATING STEP	NORMAL INDICATIONS	ABNORMAL INDICATIONS	PROBABLE CAUSES	CORRECTIVE MEASURES
		14. LINE meter (M101) reads zero voltage (switch S110 in FIL PRI position); all other indications normal.	14. *a.* If meter M101 shows reading with switch S110 in LINE position, switch S110 is faulty.	14. *a.* Replace switch.
			b. If meter M101 does not indicate in either position of S110, meter is faulty.	*b.* Replace meter.
		15. HIGH and LOW POWER FILAMENT indicator lamps (I102) and I103) do not light; LINE meter, (M101) reads zero voltage.	15. *a.* Blown fuses.	15. *a.* Replace fuses F109 and F110.
			b. Coil of relay K121 open.	*b.* Replace relay.
			c. Contacts of relay K121 do not close.	*c.* (1) Repair or replace contacts. (2) Replace relay.
		16. LINE meter (M101) does not indicate 230 v, regardless of setting of FILAMENT VOLTAGE control (T102).	16. *a.* Coil of relay K101 open.	16. *a.* Replace relay.
			b. Contacts of relay K101 do not close.	*b.* (1) Repair or replace contacts. (2) Replace relay.
			c. Coil of relay K115 open.	*c.* Replace relay.
			d. Contacts of relay K115 do not close.	*d.* (1) Check by measuring a-c voltage between terminals 14 and 15, on block below relay. (2) If 115 volts ac is present, and relay K101 and the coil of relay K115 check good, replace column in relay K115.

b. TRANSMITTER.

TABLE 7–1. SEQUENTIAL TROUBLE-SHOOTING CHART (Cont'd)

OPERATING STEP	NORMAL INDICATIONS	ABNORMAL INDICATIONS	PROBABLE CAUSES	CORRECTIVE MEASURES
		17. HIGH VOLT T.D. indicator lamp (I104) does not light after 3 min.	17. *a.* Lamp burned out. *b.* Coil of relay K110 open. *c.* Contacts of relay K110 in series with lamp I104 do not close. *d.* Coil of relay K119 open. *e.* Contacts of relay K119 do not close.	17. *a.* Replace lamp I104. *b.* Replace relay. *c.* Replace relay. *d.* Replace relay. *e.* (1) Check by measuring a-c voltage between terminals 6 and 7, on block below relay. (2) If 115 volts ac is present, and relay K110 and the coil of relay K119 check good, replace column in relay K119.
Place LOW VOLT-BIAS switch (S104) in ON position.	*n.* LOW VOLTAGE indicator lamp (I110) lights. *o.* BIAS indicator lamp (I105) lights. *p.* LOW VOLTAGE meter (M105) shows voltage reading.	18. LOW VOLTAGE indicator lamp (I110) does not light; all other indications normal.	18. *a.* Lamp burned out. *b.* Coil of relay K106 open. *c.* Resistor R140 defective. *d.* Contacts of relay K106 in series with lamp I110 do not close.	18. *a.* Replace lamp I110. *b.* Replace relay. *c.* Replace resistor. *d.* Replace relay.
	q. PA BIAS meter (M104) indicates PA grid bias. *r.* EXCITER CURRENT meter (M112) shows reading. (Switch S121 must be in proper position for the exciter in use.)	19. BIAS indicator lamp (I105) does not light; all other indications normal.	19. *a.* Lamp burned out. *b.* Coil of relay K105 open. *c.* Resistor R139 open. *d.* Contacts of relay K105 in series with lamp I105 do not close.	19. *a.* Replace lamp I105. *b.* Replace relay. *c.* Replace resistor. *d.* Replace relay.

b. TRANSMITTER.

TABLE 7–1. SEQUENTIAL TROUBLE-SHOOTING CHART (Cont'd)

OPERATING STEP	NORMAL INDICATIONS	ABNORMAL INDICATIONS	PROBABLE CAUSES	CORRECTIVE MEASURES
		20. LOW VOLTAGE and BIAS indicator lamps (I110 and I105) do not light; meter readings normal.	20. Contacts of relay K104 in series with relays K105 and K106 do not close.	20. Replace relay.
		21. LOW VOLTAGE meter (M105) does read in EXCITER PLATE, DBLR BIAS or 1st IPA BIAS positions of switch S112; all indicator lamps on.	21. *a.* Defective component in low voltage power supply.	21. *a.* (1) Check rectifier V118 and replace if bad. (2) Trouble-shoot low voltage supply and replace defective component.
			b. Short circuit in B+ line in frequency generator.	*b.* Trouble-shoot frequency generator units and repair faulty circuit.
		22. LOW VOLTAGE and BIAS indicator lamps (I110 and I105) do not light; no readings on LOW VOLTAGE and PA BIAS meters (M105 and M104).	22. Contacts of relay K120 do not close.	22. *a.* Repair or replace contacts. *b.* Replace relay.
		23. LOW VOLTAGE indicator lamp (I110) does not light; no reading on LOW VOLTAGE meter (M105) except in 2ND IPA BIAS position of switch S111; PA BIAS meter (M104) indicates voltage.	23. *a.* Blown fuse. *b.* Contacts of relay K120 do not close.	23. *a.* Replace fuse F106. *b.* (1) Repair or replace contacts. (2) Replace relay.
		24. BIAS indicator lamp (I105) does not light; no reading on PA BIAS meter (M104); LOW	24. *a.* Blown fuse. *b.* Potentiometer R165 open. *c.* Contacts of relay K120 do not close.	24. *a.* Replace fuse F107. *b.* Replace potentiometer. *c.* (1) Repair or replace contacts. (2) Replace relay.

b. TRANSMITTER.

TABLE 7–1. SEQUENTIAL TROUBLE-SHOOTING CHART (Cont'd)

OPERATING STEP	NORMAL INDICATIONS	ABNORMAL INDICATIONS	PROBABLE CAUSES	CORRECTIVE MEASURES
		24. (Con'td) VOLTAGE meter (M105) indicates in all positions of switch S111 except 2ND IPA BIAS.		
		25. No readings on LOW VOLTAGE meter (M105) in any position of switch S111; all other indications normal.	25. *a.* Resistor R108 open. *b.* Meter M105 defective. *c.* Contacts on switch S111 faulty.	25. *a.* Replace resistor. *b.* Replace meter. c. Repair or replace switch.
		26. No reading on PA BIAS meter (M104); all indicator lamps on.	26. *a.* Defective component in high bias power supply. *b* Resistor R107 open. *c.* Resistor R177 open. *d.* Meter M104 open.	26. *a.* (1) Check rectifiers V112 and V113 and replace if bad. (2) Trouble - shoot high bias power supply and replace defective component. *b.* Replace resistor. *c.* Replace resistor. *d.* Replace meter.
		27. Incorrect or no readings on EXCITER CURRENT meter (M112) in various positions of switch S120.	27. *a.* Defective component in frequency generating unit. *b.* Frequency generator not properly aligned. *c.* Meter M112 open.	27 *a.* Trouble-shoot frequency generator and replace defective component. *b.* Re-align frequency generator. *c.* Replace meter.
		28. Low or no reading on meter M112 in V305 V306 CATH. position of switch S120.	28. *a.* Exciter bias improperly adjusted. *b.* No rectangular keying pulse from pulse circuits.	28. *a.* Adjust setting of DBLR BIAS control (R159). *b.* Trouble-shoot pulse-forming circuits and replace defective component.

b. TRANSMITTER.

TABLE 7–1. SEQUENTIAL TROUBLE-SHOOTING CHART (Cont'd)

OPERATING STEP	NORMAL INDICATIONS	ABNORMAL INDICATIONS	PROBABLE CAUSES	CORRECTIVE MEASURES
Turn PLATE VOLTAGE control (T101) to minimum and place HIGH VOLT switch (S105) in ON pos.	*s.* HIGH VOLTAGE indicator lamp (I106) lights.	29. HIGH VOLTAGE indicator lamp (I106) does not light.	29. *a.* Lamp burned out.	29. *a.* Replace lamp I106.
			b. Coil of relay K103 open.	*b.* Replace relay.
			c. Contacts of relay K103 in series with lamp I106 do not close.	*c.* (1) Repair or replace contacts. (2) Replace relay.
			d. Contacts of relay K110 do not close.	*d.* Replace relay.
			e. Contacts of relay K111 do not close.	*e.* Same as *d.*
			f. Contacts of relay K106 do not close.	*f.* Same as *d.*
			g. Contacts of relay K105 do not close.	*g.* Same as *d.*
			h. Normally-closed contacts of relay K122 open.	*h.* (1) Press O.L. LOCK-OUT RESET switch (S109). (2) Same as *c.*
			i. Normally-closed contacts of relay K117 open.	*i.* Same as *c.*
			j. Normally-closed contacts of relay K112 open.	*j.* Same as *c.*
			k. Normally-closed contacts of relay K113 open.	*k.* Same as *c.*
			l. Normally-closed contacts of relay K114 open.	*l.* Same as *c.*
Turn PLATE VOLTAGE control (T101) to its approximate normal setting.	*t.* PA PLATE meter (M102) indicates PA plate voltage. *u.* MEDIUM VOLTAGE meter (M103) shows reading. *v.* 1ST IPA PLATE meter (M110) indicates 1st IPA plate current.	30. No readings on any of meters listed; HIGH VOLTAGE indicator lamp (I106) lights.	30. *a.* Blown fuse. *b.* Contacts of relay K103 do not close.	30. *a.* Replace fuse F108. *b.* (1) Repair or replace contacts. (2) Replace relay.

b. TRANSMITTER.

TABLE 7–1. SEQUENTIAL TROUBLE-SHOOTING CHART (Cont'd)

OPERATING STEP	NORMAL INDICATIONS	ABNORMAL INDICATIONS	PROBABLE CAUSES	CORRECTIVE MEASURES
	w. 2ND IPA PLATE meter (M109) shows current reading. *x.* PA GRID meter (M108) indicates PA grid current. *y.* PA PLATE meter (M106) shows current reading. *z.* TRANSMISSION LINE meter (M111) shows reading with switch S115 in UNSHORT position.	31. All readings on meters M102 and M103 below normal, regardless of setting of HIGH VOLTAGE control (T101).	31. *a.* Coil of relay K102 open. *b.* Contacts of relay K102 do not close. *c.* Coil of relay K118 open. *d.* Contacts of relay K118 do not close.	31. *a.* Replace relay. *b.* (1) Repair or replace contacts. (2) Replace relay. *c.* Replace relay. *d.* (1) Check by measuring a-c voltage between terminals 17 and 19 on block below relay. (2) If 115 volts ac is present, and relay K102 and the coil of relay K118 check good, replace column in relay K118.
		32. High voltage overload relay (K114) trips; HV OVERLOAD lamp (I109) goes out.	32. *a.* Current surge. *b.* Contacts of relay K123 do not open. *c.* Coil of relay K123 open. *d.* Faulty component in high voltage power supply. *e.* Short circuit in PA, IPA, or pulse generator stages.	32. *a.* Press O.L. LOCKOUT RESET switch (S109). *b.* (1) Repair or replace contacts. (2) Replace relay. *c.* Replace relay. *d.* (1) Check rectifiers V108 to V111 and replace if bad. (2) Trouble-shoot high voltage power supply and replace defective component. *e.* Trouble-shoot each stage and repair faulty circuit.

b. TRANSMITTER.

TABLE 7–1. SEQUENTIAL TROUBLE-SHOOTING CHART (Cont'd)

OPERATING STEP	NORMAL INDICATIONS	ABNORMAL INDICATIONS	PROBABLE CAUSES	CORRECTIVE MEASURES
		33. PA overload relay (K113) trips; PA OVERLOAD lamp (I108) goes out.	33. *a.* Flash arc in PA stage. *b.* Short circuit in PA stage. *c.* No grid bias.	33. *a.* Press INDICATOR LIGHT RESET switch S107. *b.* Trouble-shoot and repair PA circuit. *c.* See 26 *a.*
		34. 2ND IPA overload relay (K112) trips; 2ND IPA OVERLOAD lamp (I107) goes out.	34. *a.* V102 or V103 defective (persistent arcing). *b.* Short circuit in 2nd IPA stage. *c.* No grid bias.	34. *a.* Replace tube. *b.* Trouble-shoot and repair 2nd IPA circuit. *c.* See 21 *a.*
		35. 3-strike overload relay (K122) opens on first or second overload; HIGH VOLTAGE indicator lamp (I106) goes out.	35. *a.* Relay contact points out of adjustment. *b.* Relay cams not operating properly.	35. *a.* Repair or replace contacts. *b.* (1) Repair cams. (2) Replace relay.
		36. Overload circuits do not cut off high voltage momentarily on first overload.	36. *a.* Contacts of relay K117 do not open. *b.* Coil of relay K117 open.	36. *a.* Replace contacts. *b.* Replace relay.
		37. Overload circuits do not cut off high voltage permanently at third overload.	37. *a.* Normally-closed contacts of relay K122 do not open. *b.* Operate coil of relay K122 open.	37. *a.* (1) Repair or replace contacts. (2) Replace relay. *b.* Replace relay.

4. OFF-FREQUENCY OPERATION (100-KC TIMER SIGNAL).

A condition of off-frequency operation in the transmitter can occur under certain circumstances. If the frequency-generating unit divider (V307) circuit is inoperative, transmitter output will cease; but if the divider is defective, it may operate out of "lock" with the 100-kc output from the timer and cause off-frequency transmitter operation. This cannot occur at 1,800 kc, since the divider circuit is not used on this channel, but can occur at any of the other four frequencies. Off-frequency operation of this type cannot occur during crystal operation.

Indications of off-frequency operation caused by a nonsynchronous divider will probably be observed first on the monitoring oscilloscope. In some cases the output pulse will be erratic or unstable, but it is possible that the pulse may remain comparatively stable, in which event the off-frequency operation will be indicated only by movement of the individual r-f cycles when the pulse is viewed with an expanded sweep. For such a check turn the monitoring oscilloscope sweep to 4R.

The cw output of V304 is brought out through J311 so that a frequency meter, such as the type LM, may be used to determine the frequency of the unpulsed signal ahead of the pulsed doubler. Note that the pulsed doubler is driven at one half the output frequency of the transmitter. The tests described in this or in the preceding paragraph will both reveal off-frequency operation.

If such a condition is encountered, check the grid current of the 25-kc divider tube (V307) by switching the EXCITER CURRENT meter to GRID CURRENT and plugging its cord into the V307 grid-current jack, J305. Absence of grid current is a conclusive indication of an inoperative or defective divider circuit. Check the tubes involved and follow the instructions given in paragraph 8, this section, covering Alignment of the Frequency Generator.

5. INCORRECT TRANSMITTED PULSE SHAPES: THEIR CAUSE AND REMEDY.

Six possible trouble conditions which may cause defective pulse transmission are discussed in following paragraphs. These conditions may be detected and treated by using monitoring oscilloscope observations along with appropriate adjustments or repairs. Note paragraph 2 of this section regarding use of the monitoring oscilloscope. In connection with this it is important to note that observation of incorrect pulse shapes could occur with the transmitter actually operating normally, if the oscilloscope happened to be defective. If such apparent defective pulses are noted and the transmitter (with respect to meter readings, etc.) seems to be normal, check the oscilloscope. This may be done most easily by substituting a spare oscilloscope. If trouble is localized in the oscilloscope, refer to the instruction book for the Du Mont Type 256-D Oscillograph, which is included as a part of this manual.

a. FAILURE OF MODULATOR PLATE CIRCUIT PULSE-FORMING CAPACITOR. — If either modulator plate circuit pulse-forming capacitor (C190 or C191) should fail, pulse generation in the associated exciter unit would stop or become intermittent. In the event of intermittent or no pulse output, therefore, look for an open or shorted pulse-forming capacitor in the malfunctioning exciter unit. The locations of these capacitors may be seen in figures 7–15 and 7–16.

Note that in some instances of intermittent failure, an ohmmeter measurement will not show up a faulty capacitor and it will be necessary to use a "high-pot" (high-voltage) test in order to test a suspected capacitor. For this purpose a high-voltage test at approximately 2,500 volts direct current is required.

WARNING

USE EXTREME CAUTION IN HANDLING THIS HIGH VOLTAGE. IT CAN READILY HAVE FATAL RESULTS IF CONTACTED. SEE THE SAFETY NOTICE ON PAGE xi OF THIS MANUAL.

CAUTION

Be sure to disconnect the capacitor from the transmitter for a "high-pot" test. *Do not under any circumstances make such a test with the capacitor installed.*

The direct-current high-voltage supply used for this test should have no more than about five percent ripple. If no other source is available for test, the voltage from the 2,200-volt test jack in the high-voltage power supply of the Model UE-1 Timer may be used.

CAUTION

If this 2,200-volt supply is used, a series current-limiting resistor, on the order of one megohm, should be used in series with the voltage and the capacitor under test.

To make the high-pot test, apply the voltage to the capacitor (using the series resistor, as instructed).

Then remove the voltage. Using a screw driver, or similar tool, with a *well-insulated handle,* short the capacitor terminals. If the capacitor is good, a snapping discharge will occur. If the capacitor is defective, the charge will have leaked off and no discharge will be seen, or a much weaker one will occur. *Be sure that all capacitors which have had voltage applied are definitely discharged before they are handled in any manner. Otherwise severe shock may result.*

b. FAILURE OF THE PULSE-FORMING CAPACITOR IN THE MODULATOR CATHODE CIRCUIT (C120). — As in the case of the modulator plate circuit pulse-forming capacitors, failure of the modulator cathode network series capacitor (C120) will stop generation of the output pulse. As this capacitor is common to both exciters, its failure will stop pulse generation from both units.

C120 is located on a shelf immediately adjacent to the transmitter relay panel and is accessible for check and replacement when the left rear access door is opened. (See figure 7–32.)

c. BREAKDOWN OF CAPACITOR C201 IN MODULATOR CATHODE CIRCUIT. — If C201 (the capacitor in parallel with inductance L102 in the modulator cathode circuit) becomes shorted, the transmitted pulse will be distorted. The result of this defect is illustrated in figures 7–17 and 7–18. It may be continuous or intermittent.

C201 is mounted on the bottom surface of the center shelf which supports the components of the modulator cathode circuit. Its associated inductance (L102) is mounted on the top surface of this shelf. C201 is accessible when the left rear access door is opened.

(1) MONITORING OSCILLOSCOPE INDICATIONS. — The monitoring oscilloscope indications for the PULSE FROM MOD. and OUTPUT PA positions of the MONITORED CIRCUIT switch (S116) are illustrated in figures 7–17 and 7–18, respectively. In this case it will be noted that the modulator pulse tends to start more abruptly than the normal pulse illustrated in figure 7–7, this section. In addition, the same lengthening of the trailing edge with a lack of negative component occurs, similar to that described in

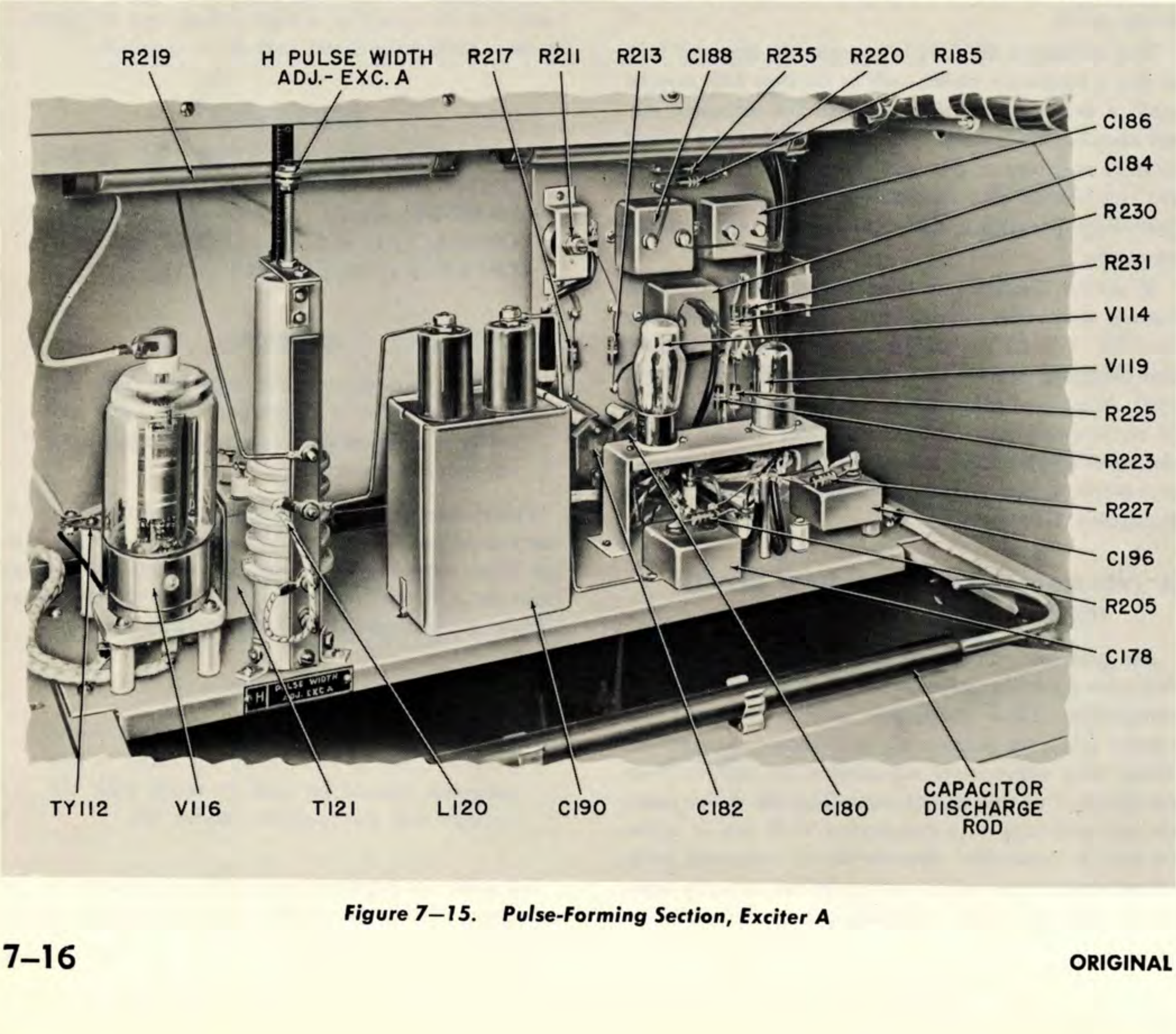


Figure 7—15. Pulse-Forming Section, Exciter A

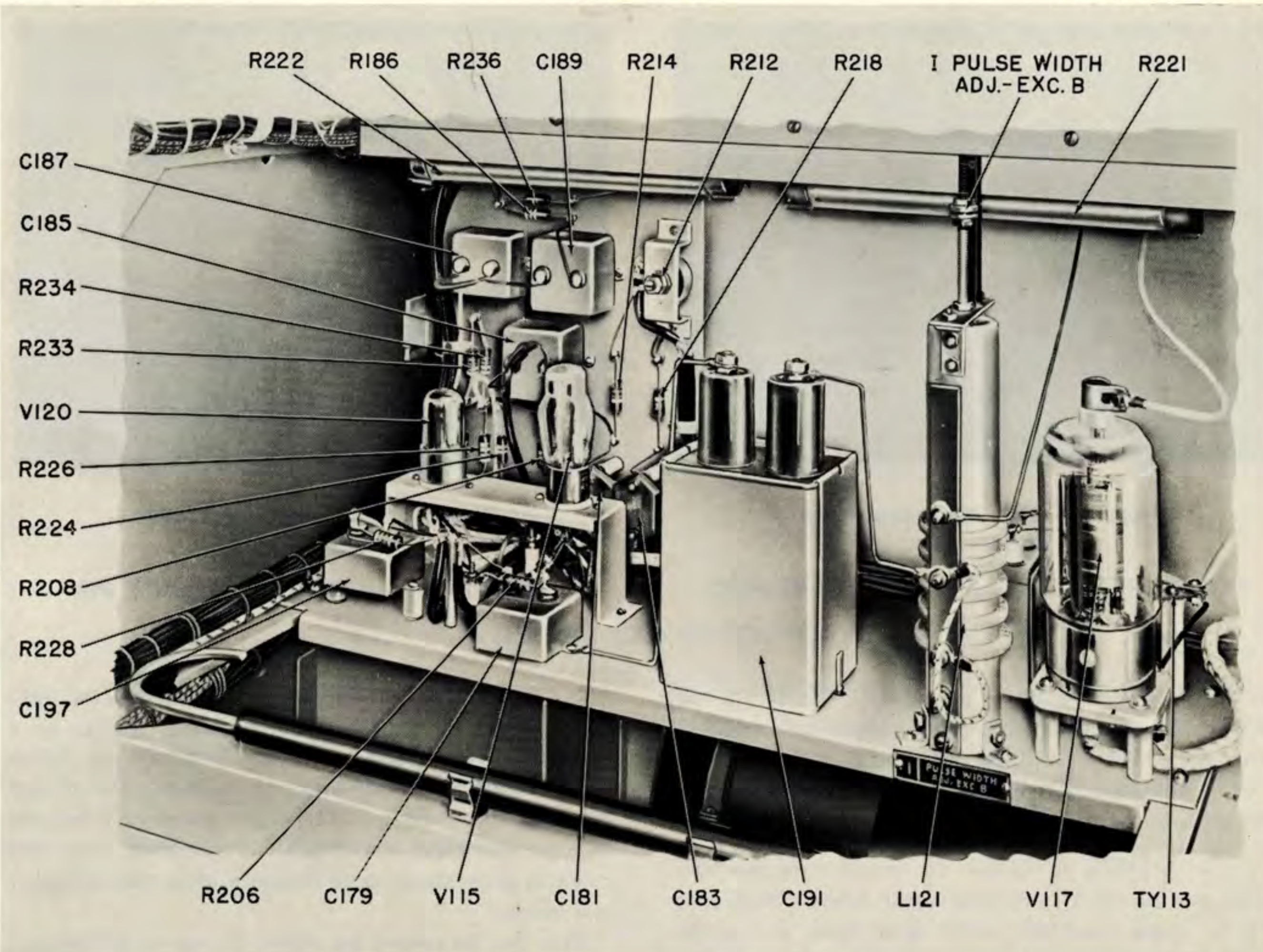


Figure 7—16. Pulse-Forming Section, Exciter B

connection with the plate and cathode pulse-forming networks in preceding paragraphs. These conditions are likewise passed on to the PA output pulse in a corresponding manner. On all other positions of the MONITORED CIRCUIT switch (S116) normal indications will be obtained.

(2) OTHER CHECKS. — This condition will be noticeable on pulses derived from both exciters, since the cathode circuit is common to both modulator tubes.

(3) CAPACITOR TEST. — Capacitor C201 may be checked and tested in the same manner as for the plate and cathode capacitors described in paragraphs 5*a* and 5*c*, preceding. *Note WARNING and CAUTION notations in paragraph* 5*a*.

d. CROSS-FIRING OF MODULATORS WHEN DOUBLE-PULSING. — A condition may be encountered where, during double-pulsing, one of the modulation pulse-generator tubes (V116 or V117) will respond not only to its own normal trigger pulses, but also to the pulsing of the alternate tube. For instance, V116 might be operating normally, delivering pulses in synchronism with the pulses it receives from its associated trigger generator, V114. However, V117 might, under certain abnormal conditions, follow not only the trigger pulse received from its own trigger generator, V114, but also a pulse derived spuriously through its common cathode connection with V116. The result of this defect is illustrated in figures 7–19 and 7–20.

(1) MONITORING OSCILLOSCOPE INDICATIONS. — The monitoring oscilloscope indications for the PULSE FROM MOD. and OUTPUT PA. positions of the MONITORED CIRCUIT switch (S116) are illustrated in figures 7–19 and 7–20, respectively. These may occur continuously or intermittently. Note that the defective modulator pulse has two peaks or humps. If this observation is made with the OSCILLOSCOPE TRIGGER switch set to the EXC A position, then the first peak will correspond to the normal firing of V116 in response to its trigger pulse from trigger generator V114. The second peak will result from the spurious firing of the other modulation pulse tube, V117. This defective waveform is readily identifiable and is carried over into the PA

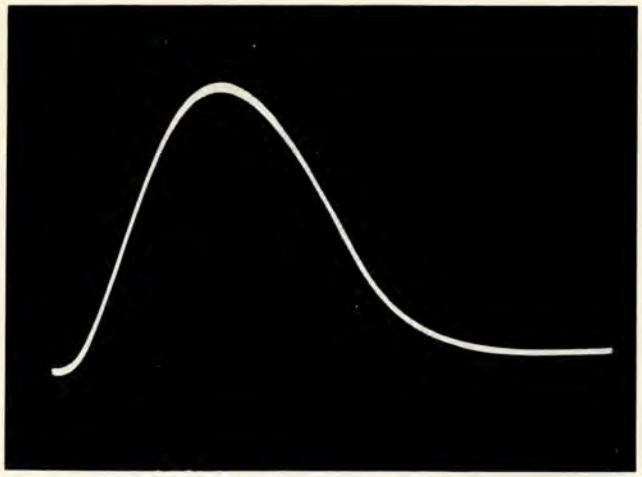


Figure 7—17. ***Modulator Pulse (abnormal)***

MONITORED CIRCUIT: PULSE FROM MOD.

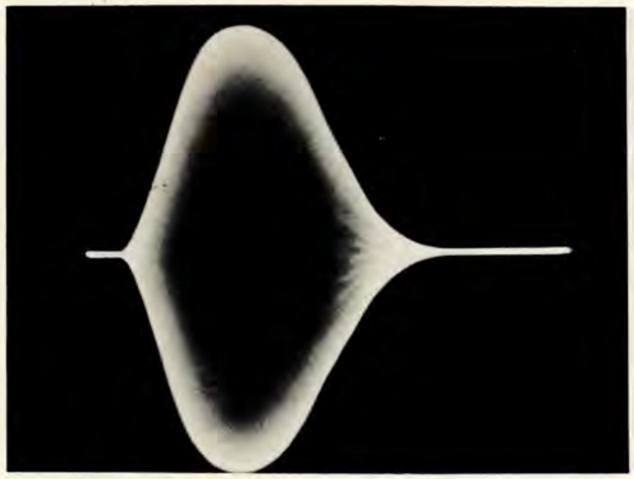


Figure 7—18. ***PA Output Pulse (abnormal)***

MONITORED CIRCUIT: OUTPUT PA

CAPACITOR C201 DEFECTIVE

output pulse as illustrated in figure 7–20. If, on the other hand, the abnormal pulse shapes are observed with the OSCILLOSCOPE TRIGGER switch in the EXC B position, the same phenomena are taking place but with the action of V116 and V117 interchanged.

(2) OTHER CHECKS. — While it is theoretically possible that both modulator tubes (V116 and V117) could cross-fire at the same time, it is quite unlikely that this will occur. Therefore this trouble will usually be observed on the pulses of only one of the two repetition rates. The pulses of the other rate will appear essentially normal except that their amplitude will change intermittently if the trouble is occurring intermittently.

(3) REMEDIES FOR CONDITION. — First try changing the modulator tube corresponding to the repetition rate A or B observed to be *normal.* Change V116 if rate A is normal, or V117 if rate B is normal. If this does not eliminate the trouble try changing the other modulator pulse tube.

If the condition still persists, check resistors R246 and R247 for normal value and continuity. These are mounted along with transformers T121 and T122 adjacent to the associated modulation pulse tubes V116 and V117, respectively. If the resistors are found to be normal, try replacing the transformers (T121 and T122), starting with the one that corresponds to the repetition rate of the pulses observed to be normal.

Another condition that may cause a tendency toward cross-firing is the use of excessively high inductance setting on the modulator cathode coil (L102). Check this setting and correct, if necessary.

e. TOO SHORT A SQUARE WAVE FROM SECOND IPA. — This particular defect results in a shortened PA output pulse as illustrated in figure 7-21. When compared with the normal pulse of figure 7–8, the abnormal PA output pulse will be seen to have shortened considerably. Its trailing edge also tends to drop much more abruptly than with the normal pulse.

This can be caused by either of two basic defects: (1) a too-short bias pulse to the pulsed-doubler stage of the Frequency Generating Unit, or (2) insufficient r-f drive somewhere in the r-f stage line-up. In the first case the shortened bias pulse applied to the pulsed doubler stage (V305, V306) causes the r-f pulse output of that stage to be too short and the effect is carried through the IPA stages to the final PA stage. With reference to the second case it should be noted that proper shaping of the second IPA output r-f pulse depends to some extent upon limiting occurring in this stage and in the first IPA. Insufficient drive at any point, from the second IPA back into the frequency generator, can reduce this limiting effect and thereby cause the rectangular r-f pulse at the 2nd IPA output to be too short.

(1) MONITORING OSCILLOSCOPE INDICATIONS. — The monitoring oscilloscope indications will vary depending upon the exact source of the trouble. In checking through the various MONITORED CIRCUIT switch (S116) positions, the first position that could give an improper indication is the BIAS TO DBLR position. If the trouble is caused by too short a bias pulse to the pulsed doubler in the Frequency Generating Unit, this switch position

will produce a defective pulse image as indicated in figure 7–23. Refer back to the normal BIAS TO DBLR pulse as illustrated in figure 7–3. Note the percentage of the 100-microsecond sweep length occupied by the normal pulse as contrasted to the faulty pulse of figure 7–23. The defect will continue to show up as the switch is turned to OUTPUT DOUBLER (figure 7–24), OUTPUT 1ST IPA (figure 7-25), OUTPUT 2ND IPA (figure 7–22), etc.

If the trouble is caused by insufficient r-f drive, the patterns seen in the various switch positions of MONITORED CIRCUIT switch (S116) will depend upon the particular location of the r-f trouble. For example, if the 1st IPA stage is the defective point, an improper pulse will be indicated in the OUTPUT 1ST IPA switch position (figure 7–25), the OUTPUT 2ND IPA position (figure 7–22), the OUTPUT PA position, etc. Indications for the PULSE FROM MOD. position and all switch positions before the OUTPUT 1ST IPA will be normal. If the trouble were only in the second IPA stage, the indication in the OUTPUT 1ST IPA switch position would be normal in addition to those previously mentioned. Since, as previously mentioned, variation of the exact location of the defective drive source will cause a varying degree of pulse defect, the images obtained may not be exactly the same as those referenced in the preceding. However, the general effect will be the shortening of the r-f pulses involved. The method of accurately checking the length of the 2ND IPA output pulse is fully described in Section 3, paragraph 9, "Adjustment of 2nd IPA Output Pulse".

(2) OTHER CHECKS. — If the trouble can be isolated as occurring in connection with only one of the two exciter circuits, this will obviously indicate that no trouble is occurring in the IPA or PA stages. In this case all effort can be concentrated on the particular exciter involved and no time need be wasted monitoring IPA or PA output pulses until a correct output has been obtained from the exciter involved.

(3) REMEDIAL MEASURES. — If the bias pulse from the squaring amplifier V119 or V120 is found to be defective, check the setting of the potentiometer R211 or R212, respectively. R211 is a screw-driver adjustment located near the large group of plate pulse-forming capacitors which are accessible when the right rear access door is open. R212 is located similarly except that it is accessible when the left rear access door is open. Note figures 7–15 and 7–16, respectively. If the pulse cannot be corrected with this adjustment, check further in the squaring amplifier circuit. Check the tube(s), circuit voltages and resistances involved, as required.

If the trouble is indicated to be due to insufficient r-f drive, isolate the stage where the low drive apparently first occurs and then check the tuning of that and previous stages. If this does not correct the trouble, check the tube and make further tests, as needed, using voltage and resistance measurements.

f. LOW OUTPUT, SECOND IPA. — A condition may be encountered where the output from the second IPA, and hence the drive to the PA, is below normal. This will be evidenced by the PA output pulse becom-

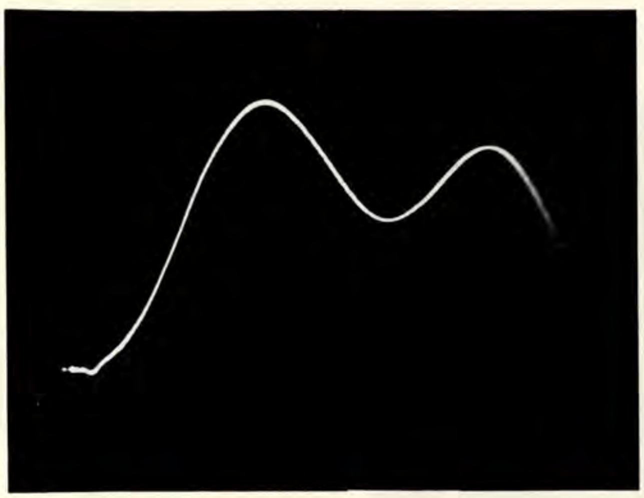


Figure 7—19. Modulator Pulse (abnormal)

MONITORED CIRCUIT: PULSE FROM MOD.

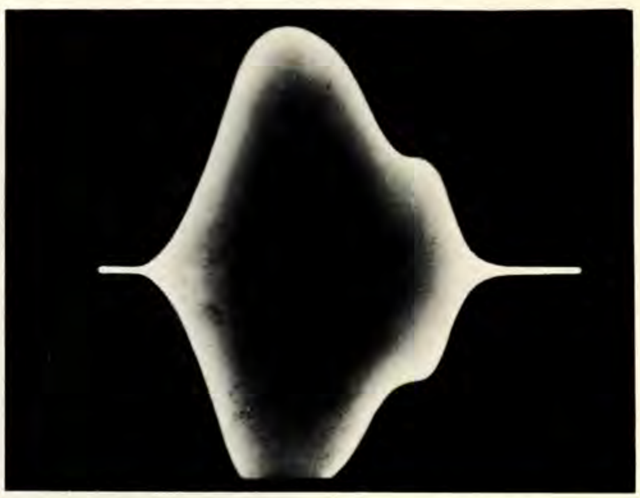


Figure 7—20. PA Output Pulse (abnormal)

MONITORED CIRCUIT: OUTPUT PA

MODULATOR CROSS-FIRING INDICATION

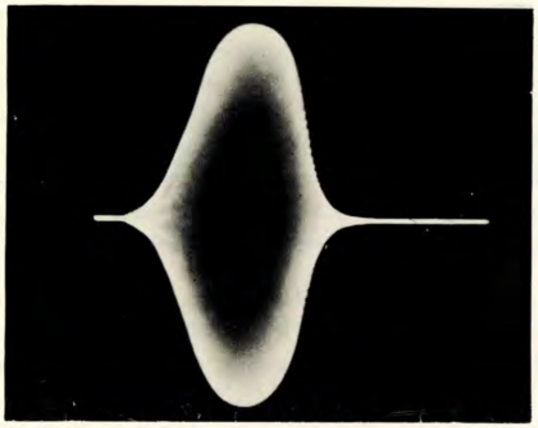


Figure 7—21. PA Output Pulse (abnormal)

MONITORED CIRCUIT: OUTPUT PA

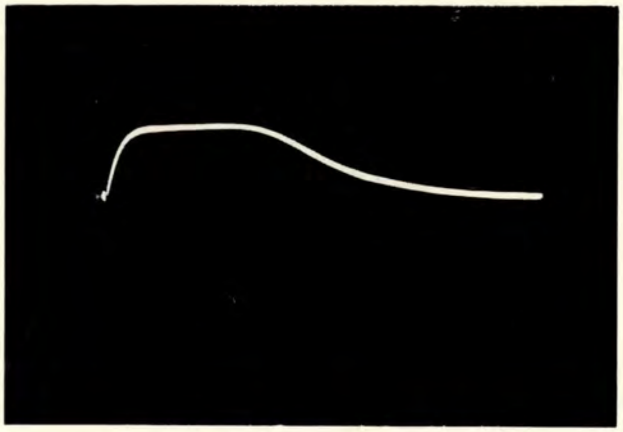


Figure 7—23. Bias Pulse to Doubler (abnormal)

MONITORED CIRCUIT: BIAS TO DOUBLER

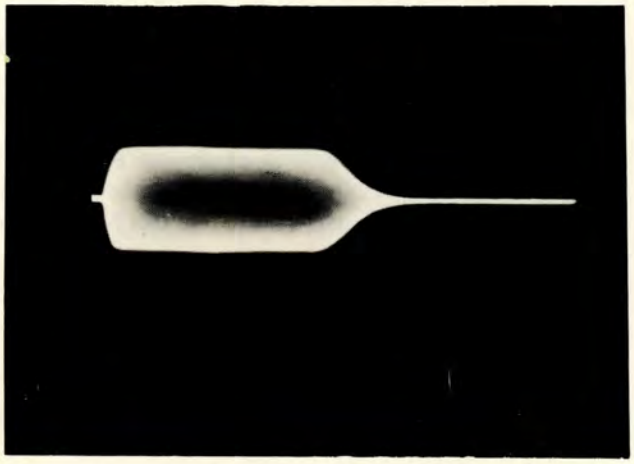


Figure 7—22. 2nd IPA Output Pulse (abnormal)

MONITORED CIRCUIT: OUTPUT 2ND IPA

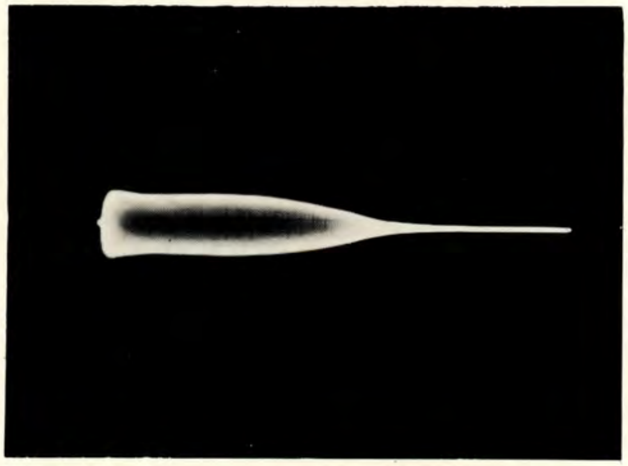


Figure 7—24. Pulsed Doubler Output (abnormal)

MONITORED CIRCUIT: OUTPUT DOUBLER

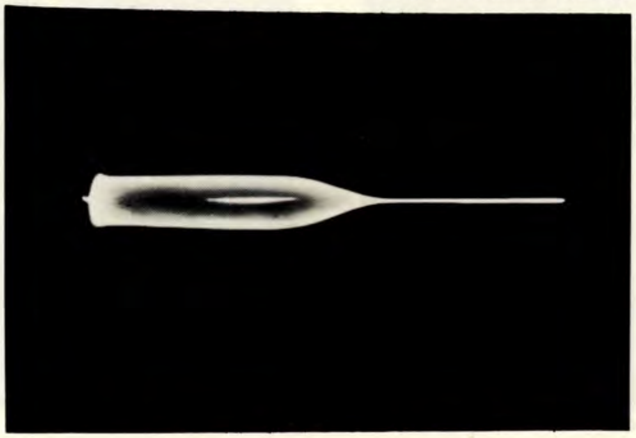


Figure 7—25. 1st IPA Output (abnormal)

MONITORED CIRCUIT: OUTPUT 1ST IPA

TOO SHORT A SQUARE WAVE FROM IPA

ing too narrow, and having too short a rise time, as compared to the normal pulse illustrated in figure 7–8. This will be noted during the monitoring check described in Section 4, paragraph 5*b*, "Oscilloscope Indications." Also check the radio-frequency line currents while operating the transmitter into the dummy antenna load. If a combination narrow PA output pulse is obtained with below-normal line currents the trouble is quite likely to be low 2nd IPA output. To remedy, check the tuning, tubes, operating voltages, etc., of the 2nd IPA stage and, if the need is indicated, of preceding r-f stages.

6. VOLTAGE AND RESISTANCE MEASUREMENTS.

After the trouble has been localized to a particular section or stage of the transmitter or associated units, further checks must be made to determine the exact component or components which have failed. All tubes which function in that portion of the circuit should be tested and replaced if necessary, to preclude possibility of tube failure being the cause. After a thorough physical inspection has been made for broken leads, etc., resistance and or voltage measurements should be made and compared to the typical readings listed in table 7–2.

a. TUBE PIN CONNECTIONS. — All tubes used in the transmitter have conventional RMA bases and pin connections, with the exception of the 2nd IPA, PA, and modulation-pulse generator tubes. Outline and basing diagrams have been included in this instruction book for these three types, which are the 4PR60A, the 7C23, and the 4C35, respectively. See figures 7–26, 7–27, and 7–28.

b. TEST EQUIPMENT REQUIRED. — All d-c voltages should be measured with a 20,000-ohms-per-volt meter, in order to obtain readings which may be compared to those listed. A 1,000-ohms-per-volt meter will suffice for a-c measurements. The Simpson Model #260 Volt-ohm-milliammeter, which is supplied with the loran timers, is suitable for all measurements. However, any multimeter having similar characteristics may be used. All readings should be taken with the test meter on the highest voltage range which will provide a readable indication.

WARNING

VOLTAGES ARE PRESENT IN THIS EQUIPMENT, WHENEVER THE *MAIN* SWITCH IS IN THE *ON* POSITION, WHICH ARE DANGEROUS AND MAY BE FATAL IF CONTACTED. WHERE VOLTAGE MEASUREMENTS ARE NOT LISTED IN TABLE 7–2, PERSONNEL SHOULD TAKE ONLY RESISTANCE READINGS. VOLTAGE READINGS INDICATED WITH A SYMBOL AND REFERENCED IN THE REMARKS COLUMN SHOULD BE READ FROM THE TRANSMITTER PANEL METERS ONLY.

c. MISCELLANEOUS MEASUREMENTS. — Although the voltage and resistance values listed in table 7–2 are complete for all tubes, there may arise, under certain conditions, necessity for making measurements at other points in the circuit. Usually, a careful study of the circuits involved will indicate whether the correct reading has been obtained at that particular point. Continuity measurements, for switches, relays, etc., are also worthy of mention, since these electromechanical components are responsible for equipment failures as well as the functional circuit components.

7. TUBE CHARACTERISTICS AND INDICATIONS OF FAILURE.

a. The characteristics for all tube types used in the Radio Transmitter Type T–325B/FPN, and the Voltage Regulator Assembly CN–239/FPN, including those in the monitor oscilloscope, have been incorporated into table 7–3. While the scope of this instruction book limits the amount of tube data that can be included, more detailed information may be obtained from available manuals, handbooks, and catalogs. Basing and outline diagrams have been included, however, for the type 4PR60A, type 4C35, and type 7C23 tubes.

b. The most common indication of tube failure or weakening is the gradual decrease in tube plate current. This condition will be evident from the logged values of current for each tube. A further indication of weak tubes is a reduction in drive to the PA stage, resulting in a change in the output pulse shape. This change will also be gradual in most cases and may be recognized by small changes in successive pulse-time measurements. Care must be taken to insure that all voltages in the transmitter are of the correct value, since the voltages themselves serve to establish the pulse shape.

c. Another indication of tube failure in the 2nd IPA stage is intermittent arcing in the type 4PR60A tubes. This condition will generally cause the 2nd IPA overload relay to trip; if the arcing persists, the overload will keep tripping, and the tubes must be replaced.

d. Procedure and instructions for the installation and replacement of tubes in the transmitter may be found in Section 5, paragraph 4.

a. TRANSMITTER.

TABLE 7–2. VOLTAGE* AND RESISTANCE MEASUREMENTS

TUBE	ELEMENT	RESISTANCE MEASUREMENT POINTS		RES. (OHMS)	VOLTAGE TO GROUND		REMARKS
					100-kc Oper.	Crystal Oper.	
V101 (807) 1st IPA	Plate	Cap	Gnd	20,000	720	720	Grid res. determined by setting of 1st IPA BIAS control (R161). †Grid bias read on LOW VOLTAGE meter.
	Screen	Pin 2	Gnd	10,000	280	280	
	Grid	Pin 3	Gnd	250-500	—50†	-50†	
	Cathode	Pin 4	Gnd	5	Low	Low	
	Heater	Pin 5	Gnd	Low	3.15 ac	3.15 ac	
	Heater	Pin 1	Gnd	Low	3.15 ac	3.15 ac	
V102 V103 4PR60A 2nd IPA	Plate	Cap	Gnd	100	6700-7100†	6700-7100†	Grid res. determined by setting of 2nd IPA BIAS control (R171). †Plate voltage, read on MEDIUM VOLTAGE meter, depends on pulse rate. **Grid bias read on LOW VOLTAGE meter.
	Screen	Pin 2	Gnd	90,000	980	980	
	Grid	Pin 3	Gnd	26,000-32,000	—360**	-360**	
	Heater	Pin 4	Gnd	2,400	13.0 ac	13.0 ac	
	Heater	Pin 1	Gnd	2,400	13.0 ac	13.0 ac	
V104 V105 V106 V107 (7C23) PA	Plate	Shell	Gnd	120	15,500†	15,500†	†Plate voltage read on PLATE meter. **Grid bias read on PA BIAS meter.
	Grid	Black	Gnd	10,000	—3000**	—3000**	
	Filament	Yellow	Gnd	240	5.5 ac	5.5 ac	
	Filament	Yellow	Gnd	240	5.5 ac	5.5 ac	
	Fil. CT	Red	Gnd	240	0	0	
V108 V109 (8020) HV Rect.	Plate	Cap	Gnd	100	———	———	LINKS "C" and "D" open. 5.0 v ac between pins 1 and 4.
	Filament	Pin 1	Gnd	6,000	1.0 ac	1.0 ac	
	Filament	Pin 4	Gnd	6,000	1.0 ac	1.0 ac	
V110 V111 (8020) HV Rect.	Plate	Cap	Gnd	6,000	———	———	LINKS "C" and "D" open. 5.0 v ac between pins 1 and 4.
	Filament	Pin 1	Gnd	2,600	1.45 ac	1.45 ac	
	Filament	Pin 4	Gnd	2,600	1.45 ac	1.45 ac	
V112 V113 2X2A Bias Rect.	Plate	Cap	Gnd	45,000	———	———	
	Heater	Pin 1	Gnd	2.4	0	0	
	Heater	Pin 4	Gnd	2.4	2.5 ac	2.5 ac	
V114 V115 (2050) Trigger Gen.	Plate	Pin 3	Gnd	45,000	210	210	
	Screen	Pin 6	Gnd	1,600	6	6	
	Grid	Pin 5	Gnd	38,000	1.25	1.25	
	Cathode	Pin 8	Gnd	1,600	6	6	
	Heater	Pin 2	Gnd	Low	3.15 ac	3.15 ac	
	Heater	Pin 7	Gnd	Low	3.15 ac	3.15 ac	
V116 V117 (4C35) Mod-Pulse Gen.	Plate	Cap	Gnd	70,000	6,000†	6,000†	†Plate voltage read on MEDIUM VOLTAGE meter.
	Grid	Pin 1	Gnd	340	——	——	
	Heater	Pin 2	Gnd	100	0	0	
	Heater	Pin 3	Gnd	100	6.3 ac	6.3 ac	

*D-c voltages measured with 20,000-ohms-per-volt meter;
A-c voltages measured with 1,000-ohms-per-volt meter.

TABLE 7–2. VOLTAGE* AND RESISTANCE MEASUREMENTS (Cont'd)

a. TRANSMITTER.

TUBE	ELEMENT	RESISTANCE MEASUREMENT POINTS		RES. (OHMS)	VOLTAGE TO GROUND		REMARKS
					100-kc Oper.	Crystal Oper.	
V118	Plate	Pin 4	Gnd	1,200	680 ac	680 ac	
(5R4GY)	Plate	Pin 6	Gnd	1,200	680 ac	680 ac	
LV Rect.	Heater	Pin 2	Gnd	3,200	1.75 ac**	1.75 ac**	**5.0 v ac between pins 2 and 8.
	Heater	Pin 8	Gnd	3,200	1.75 ac**	1.75 ac**	
V119	Plate #1	Pin 5	Gnd	50,000	250	250	
V120	Grid #1	Pin 4	Gnd	0	0	0	
(6SN7W)	Cathode #1	Pin 6	Gnd	9,200	12	12	
Squar.	Plate #2	Pin 2	Gnd	12,000	145	145	
Amp.	Grid #2	Pin 1	Gnd	4,500	–0.2	–0.2	
	Cathode #2	Pin 3	Gnd	0	0	0	
	Heater	Pin 7	Gnd	Low	3.15 ac	3.15 ac	
	Heater	Pin 8	Gnd	Low	3.15 ac	3.15 ac	
V121	Plate 1	Pin 6	Gnd	30,000	——	——	It is not practicable nor useful to measure voltages on V121 and V122.
V122	Plate 2	Pin 4	Gnd	30,000	——	——	
(5R4GY)	Filament	Pin 2	Gnd	820**	——	——	
Compensator Diodes	Filament	Pin 8	Gnd	820**	——	——	**Depending on setting of R258.
V301	Plate	Pin 3	B+	3,600	260	0	Resistance measurements to B+ for all tubes in the Frequency Generators should be made to terminal 13 of terminal block.
(6J5)	Grid	Pin 5	Gnd	95,000	–0.6	0	
1st	Cathode	Pin 8	Gnd	5,000	22.5	0	
Tripler	Heater	Pin 2	Gnd	Low	3.15 ac	3.15 ac	
	Heater	Pin 7	Gnd	Low	3.15 ac	3.15 ac	
	Shell	Pin 1	Gnd	0	0	0	
V302	Plate	Pin 3	B+	4,700	255	0	
(6J5)	Grid	Pin 5	Gnd	95,000	–0.4	0	
2nd	Cathode	Pin 8	Gnd	5,000	30	0	
Tripler	Heater	Pin 2	Gnd	Low	3.15 ac	3.15 ac	
	Heater	Pin 7	Gnd	Low	3.15 ac	3.15 ac	
	Shell	Pin 1	Gnd	0	0	0	
V303	Plate	Pin 3	B+	7,000	260	0	
(6SA7)	Grid #1	Pin 5	Gnd	20,000	–0.75	0	
Mixer	Grid #2, 4	Pin 4	B+	59,000	40	0	
	Grid #3	Pin 8	Gnd	470**	0	0	**Switch S301 in 1,800 KC position.
				100,000†	–6.25	0	†Switch S301 in any position other than 1,800 KC or XTAL.
	Grid #5	Pin 1	Gnd	0	0	0	
	Cathode	Pin 6	Gnd	600	+6	0	
	Heater	Pin 2	Gnd	Low	3.15 ac	3.15 ac	
	Heater	Pin 7	Gnd	Low	3.15 ac	3.15 ac	
V304	Plate	Pin 8	B+	25,000	170	170	
(6SJ7)	Suppressor	Pin 3	Gnd	0	0	0	
Lim-Amp.	Screen	Pin 6	B+	100,000	110	110	
	Grid	Pin 4	Gnd	220,000	–1.5	0	
	Cathode	Pin 5	Gnd	30	0.25	0.5	
	Heater	Pin 2	Gnd	Low	3.15 ac	3.15 ac	
	Heater	Pin 7	Gnd	Low	3.15 ac	3.15 ac	
	Shell	Pin 1	Gnd	0	0		

*D-c voltages measured with 20,000-ohms-per-volt meter;
A-c voltages measured with 1,000-ohms-per-volt meter.

TABLE 7–2. VOLTAGE* AND RESISTANCE MEASUREMENTS (Cont'd)

a. TRANSMITTER.

TUBE	ELEMENT	RESISTANCE MEASUREMENT POINTS		RES. (OHMS)	VOLTAGE TO GROUND		REMARKS
					100-kc Oper.	Crystal Oper.	
V305	Plate	Pin 3	B+	40	310	310	Grid res. determined by setting of DBLR BIAS control (R159).
V306	Screen	Pin 4	B+	26,000			
			Gnd	24,000	210	210	
(6V6GT/ G)	Grid	Pin 5	Gnd	65,000-80,000	-200**	-200**	**Grid bias read on LOW VOLTAGE meter.
Pulsed	Cathode	Pin 8	Gnd	2,700	0.3	0.3	
Dblr.	Heater	Pin 2	Gnd	Low	3.15 ac	3.15 ac	
	Heater	Pin 7	Gnd	Low	3.15 ac	3.15 ac	
V307	Plate	Pin 3	B+	7,000	260	0	
(6SA7)	Grid #1	Pin 5	Gnd	69,000	–1.2	0	
Divider	Grid #2, 4	Pin 4	B+	15,000	80	0	
			Gnd	16,000	0	0	
	Grid #3	Pin 8	Gnd	100,000	–0.02	0	
	Grid #5	Pin 1	Gnd	0	0	0	
	Cathode	Pin 6	Gnd	1,100	38	0	
	Heater	Pin 2	Gnd	Low	3.15 ac	3.15 ac	
	Heater	Pin 7	Gnd	Low	3.15 ac	3.15 ac	
V308	Plate	Pin 3	B+	29,000	140	0	
(6J5)	Grid	Pin 5	Gnd	100,000	0	0	
Doubler	Cathode	Pin 8	Gnd	2,800	13.5	0	
	Heater	Pin 2	Gnd	Low	3.15 ac	3.15 ac	
	Heater	Pin 7	Gnd	Low	3.15 ac	3.15 ac	
	Shell	Pin 1	Gnd	0	0	0	
V309	Plate	Pin 3	B+	2,000	260	0	
(6J5)	Grid	Pin 5	Gnd	100,000	0	0	
Tripler	Cathode	Pin 8	Gnd	4,700	32	0	
	Heater	Pin 2	Gnd	Low	3.15 ac	3.15 ac	
	Heater	Pin 7	Gnd	Low	3.15 ac	3.15 ac	
	Shell	Pin 1	Gnd	0	0	0	

b. VOLTAGE REGULATOR.

TUBE	ELEMENT	RESISTANCE MEASUREMENT POINTS		RES. (OHMS)	VOLTAGE TO GROUND	REMARKS
V2301	Grid #1	Pin 1	All mea-	110K	—.35†	†Measured to terminal #5 on P2301
V2302	Cathode	Pin 2	surements	0	0†	
(2D21W)	Heater	Pin 3	taken to	1570	5.7 ac	
Thyra-	Heater	Pin 4	terminal	1570	5.7 ac	
tron	Grid #2	Pin 5	#5 on	1570	0†	
Switch	Plate	Pin 6	P2301	0	107 ac†	
				4000		

*D-c voltages measured with 20,000-ohms-per-volt meter;
A-c voltages measured with 1000-ohms-per-volt meter.

Note

All tubes of a given type supplied with the equipment shall be consumed prior to employment of tubes from general stock.

8. ALIGNMENT OF FREQUENCY GENERATORS (100-KC TIMER SIGNAL OPERATION).

a. ALIGNMENT PROCEDURE. — The frequency generators in the exciters are aligned at the factory prior to shipment of the transmitters. Normally, the factory adjustments should not be disturbed. In the event of trouble which is localized to a frequency generator, tubes and other components should first be eliminated as possible causes of the trouble before realignment is attempted. Alignment will not be required if crystal operation is used exclusively. Alignment of stages used for crystal operation is described in Section 3, paragraph 9*i* (2). If it is an absolute certainty that realignment is necessary, follow the procedure outlined below. Refer to figures 7–29 and 7–30 for location of components.

REF	DIM IN INCHES
A	$5\frac{7}{8} \pm \frac{1}{8}$
B	$3\frac{1}{16}$ MAX DIA
C	$5\frac{15}{32} \pm \frac{1}{8}$
D	$1\frac{1}{8}$ MIN
E	2.950 $\pm$.050 DIA
F	.3355$\pm$.0075
G	$\frac{1}{2}$ MAX
H	.016 MIN
J	.566 $\pm$.007 DIA
K	$\frac{7}{16}$ MIN STRAIGHT SIDE
L	.187$\pm$.016
M	.187 $\pm$.016
P	687 NOM
Q	1.8005$\pm$.0125
R	.687 NOM
S	$\frac{1}{16}$ NOM
T	.187$\pm$.004 DIA 5PINS
V	$1\frac{1}{8}$ DIA NOM
W	$\frac{1}{4}$ NOM
X	$\frac{3}{16}$ NOM
Y	$\frac{1}{16}$ NOM

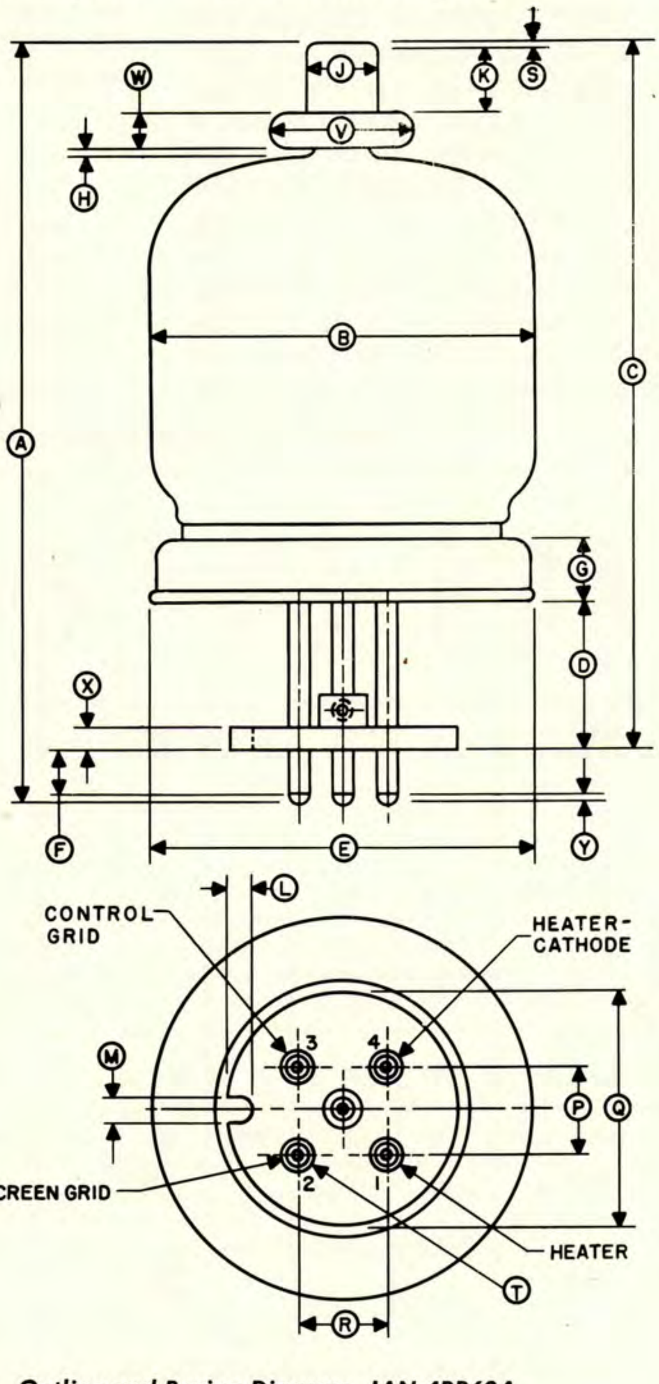


Figure 7—26. Outline and Basing Diagram, JAN-4PR60A

WARNING

BEFORE ENTERING THE IPA COMPARTMENT; USE THE CAPACITOR-DISCHARGE ROD TO GROUND ALL EXPOSED CIRCUITS.

(1) With the transmitter de-energized, place the TUNE-NORMAL switch (S102) in the TUNE position. It will then be possible to turn on the LOW VOLTAGE and all tuning adjustments may be made from the front of the transmitter through the open access door on the IPA compartment. See figure 3–16.

(2) Place the MAIN, FILAMENTS, and LOW VOLT-BIAS switches (S101, S103, and S104) in their ON positions. Check for a LINE voltmeter reading of 230 volts with the meter switch (S110) in the FIL PRI position. Adjust the FILAMENT VOLTAGE control (T102), if necessary, to obtain this reading.

(3) Apply filament and plate voltage to the frequency generator of Exciter A or Exciter B (whichever is being tuned) by placing either the EXCITER A or EXCITER B switch (S118 or S119) in the ON position. Check for a reading of 300 volts on the LOW VOLTAGE meter with switch S111 (beneath the meter) in the EXCITER PLATE position. Refer to paragraph 8*b* of this section for any correctional adjustment needed to obtain the 300-volt reading.

(4) Turn the DBLR BIAS control (R159) to its maximum clockwise position.

(5) Have the external timing and switching equipments adjusted to feed trigger pulses and a 100-kc signal to the frequency generator which is being aligned.

(6) Place the left-hand meter switch associated with the EXCITER CURRENT meter (S121) in the EXCITER A or EXCITER B position, depending upon which exciter is being aligned.

Note

The tuning slugs for the input transformer and the interstage transformers are coaxial and both are adjustable from the front. A special alignment tool with a narrow non-metallic blade for adjusting the inner (primary) slug and a stiff wire insert for adjusting the outer (secondary) slug are pro-

a. TRANSMITTER.

TABLE 7—3. 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)	Amplification Factor (mu)	Trans-conductance (Micro-mhos)		Emission	
										Normal	Minimum	Is (mA)	Test Volt
5CP1A	6.3	0.6		—60[1]	See Footnote[2]								
6AC7	6.3	0.45	300	—2	150	10	2.5	1 Meg.		9000	7000	40	10
6AG7	6.3	0.65	300	—3	125	28	7.0	130,000		11000	9200	180	20
6J5	6.3	0.3	250	—8		10		7700	20	2600	2400	40	30
6SA7	6.3	0.3	250	—2	100	3.5	8.5	1 Meg.		450[3]	300[3]	70	30
6SJ7	6.3	0.3	250	—3	100	3	0.8	1 Meg.		1650	1325	60	30
6SN7GT 6SN7W	6.3	0.6	250[4]	—8[4]		10[4]		7700[4]	20[4]	2600[4]	2400[4]	40[4]	30[4]
6V6GT/G	6.3	0.45	315	—13	225	34	2.2	77000		3750	3000	100	30
7C23	11.0	29	15000	—3500		1.25[7]			23			25[7]	4000
4PR60A	26.0	2.2	20000	—1000	1500	See Footnote[5]	8.0						
807	6.3	0.9	750	—50	250	100	9.0					300	50

For all footnotes, see page 7—27.

TABLE 7–3. TUBE CHARACTERISTICS (Cont'd)

Tube Type	Filament Voltage (V)	Filament Current (A)	Max. Inverse Peak Voltage (V)	Max. A-C Volts per Plate (RMS)	Peak Anode Voltage (V)	Max. D-C Output Current (mA)	Peak Anode Current (mA)	Grid #1 Voltage (V)	Grid #2 Voltage (V)		Emission	
											Is (mA)	Test Volt
2X2A	2.5	1.75	12500			7.5	45					
4C35	6.3	6.1	6000		8000	100	90[7]	0				
5R4GY	5.0	2.0	2800			175	700				225[4]	75[4]
5U4G	5.0	3.0	1700	550		250	750				225[4]	75[4]
6H6(GT)	6.3	0.3	465	150		8.8	50				15[4]	20[4]
2050	6.3	0.6	1300		650	100	500	—250	—100			
8020	5.0	6.0	40000			100	750				30	500[6]

b. VOLTAGE REGULATOR.

Tube Type	Filament Voltage (V)	Filament Current (A)	Max. Inverse Peak Voltage (V)	Anode Volts (V)	Peak Forward Anode Volts (V)	Average Cathode Amperes (A)	Surge Amperes (A)	
2D21W	6.3	0.6	1,300	400	650	0.1	10.0	

[1]Grid voltage for cutoff.
[2]Anode voltages: A_1 575 v, A_2 2000 v, A_3 4000 v.
[3]Conversion transconductance.
[4]Values are for each section.
[5]Peak anode current, 15 amp.
[6]Filament voltage 3.0 v for this test.
[7]Amperes.

vided in a holder in the IPA compartment beneath the frequency-generator chassis.

(7) Place the right-hand meter switch associated with the EXCITER CURRENT meter (S120) in the V301 CATH. position. Adjust the inner tuning slug and then the outer slug on the input transformer (Z301) for a maximum indication on the EXCITER CURRENT meter. Repeat the adjustments.

(8) Place meter switch S120 in the GRID CUR position and insert the meter plug (P301) into jack J301 in the grid circuit of the second tripler, V302. If there is any indication of grid current on the EXCITER CURRENT meter, adjust the primary and secondary tuning slugs on the tripler interstage transformer (Z302) for maximum deflection. If there is no indication of grid current, place meter switch S120 in the V302 CATH. position and make the tuning adjustments for maximum cathode current. Refine the adjustments by tuning for maximum grid current with meter switch S120 in the GRID CUR position.

(9) Transfer the meter plug to jack J302 in the grid circuit of the converter, V303. Adjust the primary and secondary tuning slugs in the interstage coupling transformer Z303 for maximum meter indication. Refine the adjustments.

(10) Insert the meter plug into jack J305, the grid circuit of the divider, V307. Adjust the slugs of Z312 and Z310 separately for a maximum meter reading. If no grid current is observed to start with, the regenerative divider is not regenerating. Under this condition, start with the tuning slugs of Z312 and Z310 in their maximum counterclockwise position and adjust each ten full turns in a clockwise direction. If there is still no grid current, change the settings from these positions, by cut and try, until grid current is obtained. Once regeneration has started, as evidenced

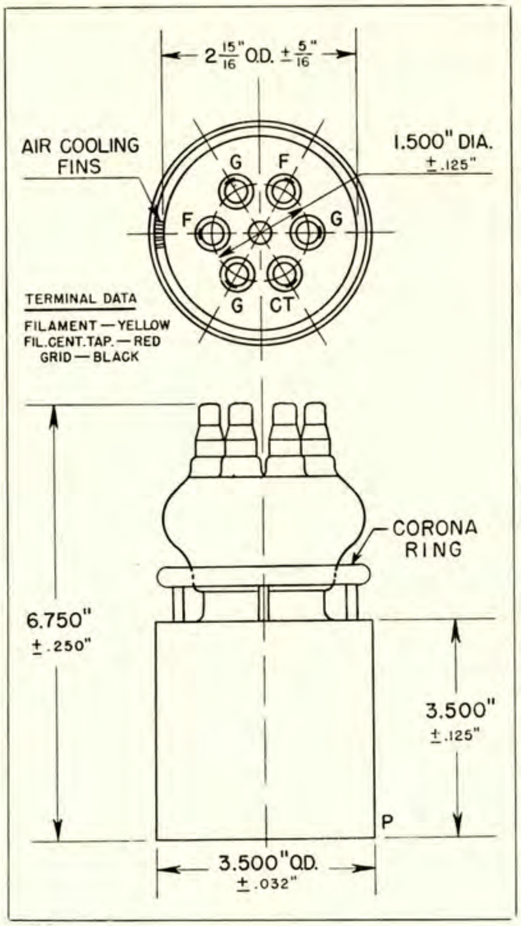


Figure 7—27.
Outline and Basing Diagram, JAN-7C23

by grid current, peak Z310 and Z312 for maximum grid current. At this point turn the Z312 tuning slug in a COUNTERCLOCKWISE direction until the meter reading drops to about three lines on the meter below the maximum value read.

Check the activity of the regenerative divider by placing the LOW VOLT-BIAS switch OFF, waiting a few seconds, and placing it ON again. If grid current does not reappear, it is because the divider did not go back into regeneration. Readjust the settings on Z310 slightly until the divider operates normally when the voltage is turned ON and OFF (S118 for Exciter A, S119 for Exciter B).

(11) Place the FREQUENCY SELECTOR switch (S301) in the 1,900-kc position and insert the meter plug into jack J303 in the injector-grid circuit of the mixer, V303. Adjust the tuning slug of the doubler plate-tuning coil (Z311) for a maximum indication on the EXCITER CURRENT meter.

(12) Place the FREQUENCY SELECTOR switch, the LIMITER AMP. PL TUNING control, and the PULSED DOUBLER GRID TUNING control to point at their 1,800-kc calibrations.

(13) Insert the meter plug into jack J304 in the grid circuit of the limiter-amplifier, V304. Starting from the maximum clockwise position of the adjusting screw, turn the inner slug of the mixer-amplifier interstage transformer (Z305) approximately ten turns in a counterclockwise direction. Adjust the outer slug for a maximum deflection on the EXCITER CURRENT meter. Refine the adjustments of both inner and outer slugs.

(14) Place meter switch S120 in the V305 V306 CATH. position and set the DOUBLER PLATE TUNING control (A) for 1,800 kc according to the tuning chart supplied with the transmitter or according to the list of typical settings shown in table 3–1 of Section 3. If there is no indication on the EXCITER CURRENT meter, turn the DBLR BIAS control in a counterclockwise direction until some reading is obtained. If it is still impossible to obtain a reading, observe the following note and make an initial adjustment on trimmer capacitor C326B in the pulsed-doubler grid circuit (step 16) until some indication is obtained on the meter. As soon as a reading is obtained, revert to step (15) and proceed in sequence.

Note

The EXCITER CURRENT meter is an extremely sensitive indicator, and care must be taken to prevent off-scale deflections. Make all tuning adjustments slowly and watch the meter carefully. As soon as the deflection tends towards full scale, turn the DBLR BIAS control in a clockwise direction to reduce the deflection.

(15) Adjust trimmer capacitor C326A in the limiter-amplifier plate circuit to obtain a maximum

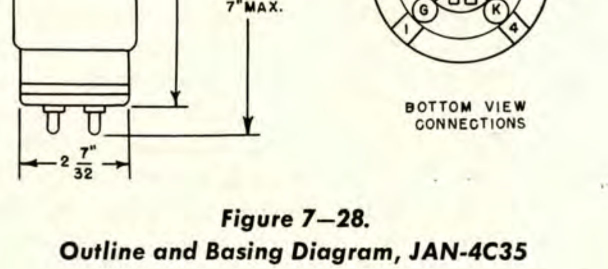


Figure 7—28.
Outline and Basing Diagram, JAN-4C35

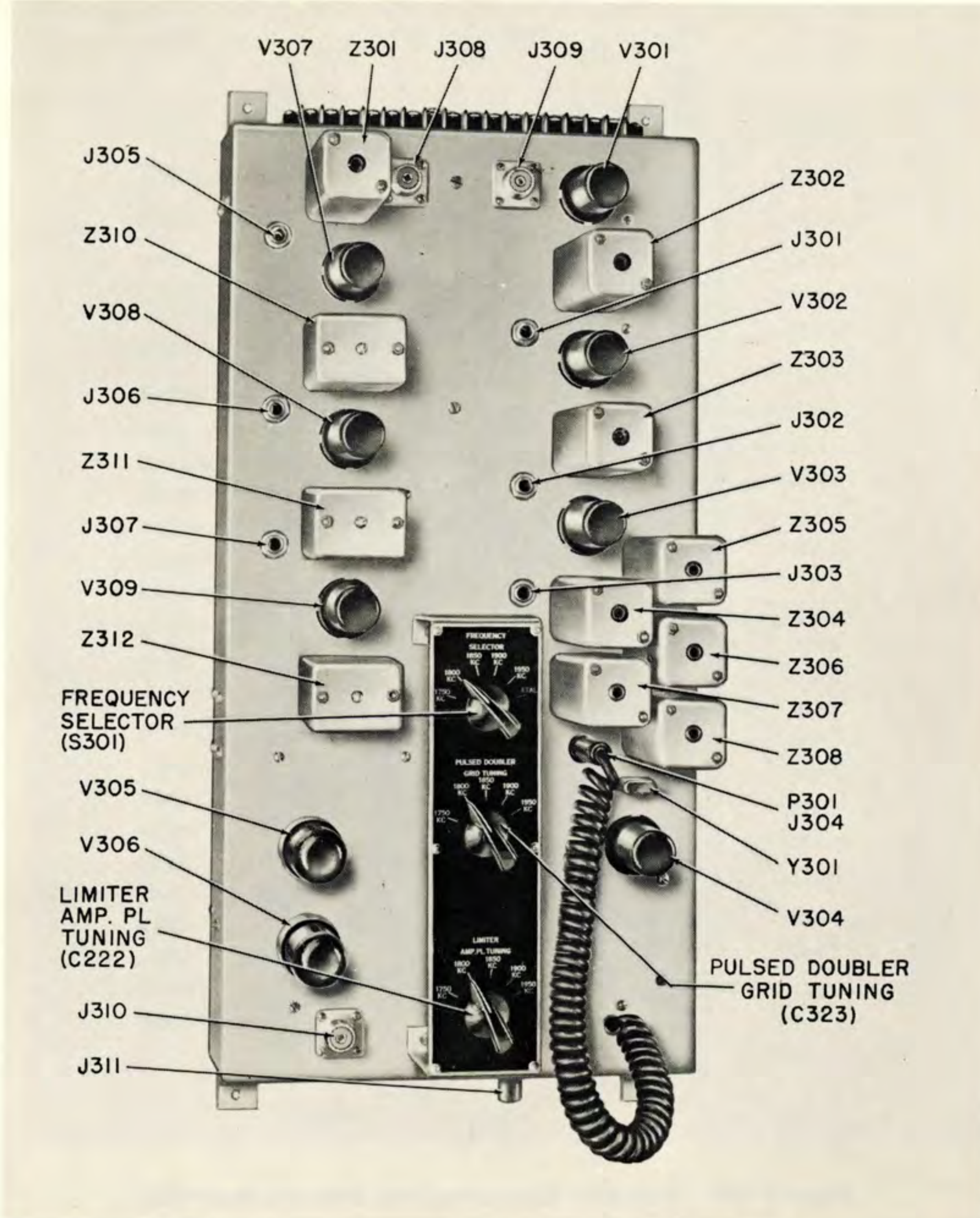


Figure 7–29. Frequency Generating Unit, Top or Front View

indication on the EXCITER CURRENT meter. The trimmer is accessible through a hole in the bottom of the chassis in the IPA compartment; the trimmer on the right is C326A. As the meter reading increases, take the precautions noted above against off-scale meter deflections.

(16) Adjust trimmer capacitor C326B in the pulsed-doubler grid circuit for a maximum reading on the EXCITER CURRENT meter. Again take precautions against off-scale deflections. The trimmer is accessible through a hole in the bottom of the chassis in the IPA compartment; C326B is the left-hand trimmer. When the trimmer is set properly, variation of the PULSED DOUBLER GRID TUNING control in either direction from the 1,800-kc calibration should result in a decrease in the EXCITER CURRENT reading.

(17) Adjust the DOUBLER PLATE TUNING control for a minimum indication on the EXCITER CURRENT meter.

(18) Make a final adjustment of the DBLR BIAS control to obtain a reading between 60 and 80 on the EXCITER CURRENT meter. Lock the control at this setting.

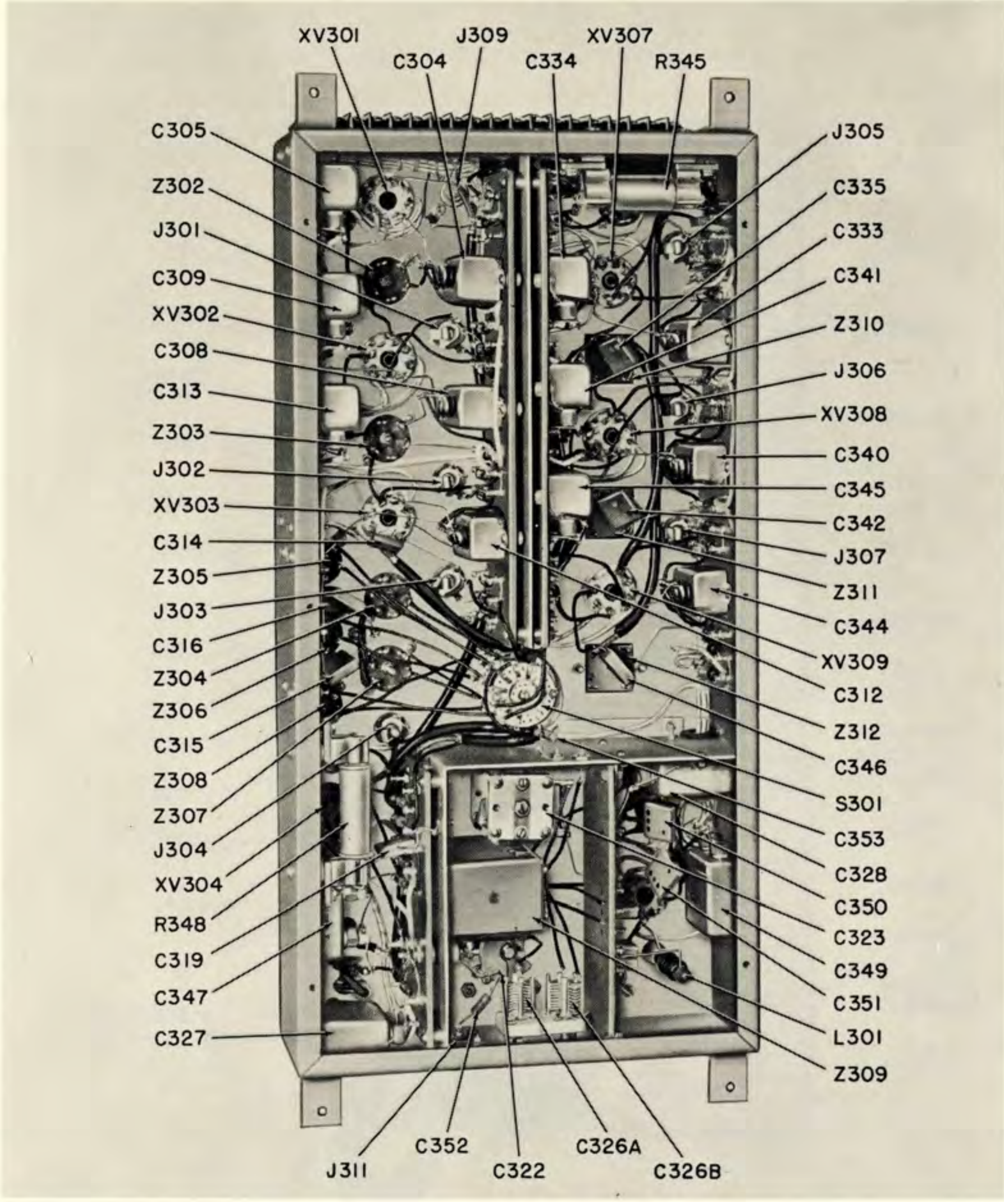


Figure 7—30. Frequency Generating Unit, Bottom or Rear View

Note

If the transmitter is to be operated at 1,800 kc, no further alignment is necessary. For operation at 1,750 kc, perform steps (19) to (22) inclusive; for operation at 1,850 kc, perform steps (23) to (26) inclusive; for operation at 1,900 kc, perform steps (27) to (30) inclusive; and for operation at 1,950 kc, perform steps (31) to (34) inclusive. If desired, the complete alignment may be made for all frequencies.

(19) Place the FREQUENCY SELECTOR switch, the LIMITER AMP. PL TUNING control, and the PULSED DOUBLER GRID TUNING control in the 1,750-kc positions. Place meter switch S120 in the V305 V306 CATH. position. Set the DOUBLER PLATE TUNING control for 1,750 kc according to the tuning chart.

(20) Adjust the inner and outer slugs of the mixer-amplifier 1,750-kc interstage transformer (Z304) for a maximum indication on the EXCITER CURRENT meter.

(21) Refine the PULSED DOUBLER GRID TUNING and LIMITER AMP. PL TUNING control settings for a maximum indication on the EXCITER CURRENT meter. The maximum indications should occur with the controls very close to (though not

necessarily exactly on) the 1,750-kc calibrations. If such is not the case, it is an indication that the interstage transformer is tuned to the wrong frequency; reset the PULSED DOUBLER GRID TUNING and LIMITER AMP. PL TUNING controls to 1,750 kc and repeat step (20) to find the correct maximum.

(22) Note the reading on the EXCITER CURRENT meter. If it is not between 60 and 80, adjust the DBLR BIAS control until the reading is within the required limits.

(23) Place the FREQUENCY SELECTOR switch, the LIMITER AMP. PL TUNING control, and the PULSED DOUBLER GRID TUNING control in the 1,850-kc positions. Place meter switch S120 in the V305 V306 CATH. position. Set the PULSED DOUBLER PLATE TUNING control for 1,850 kc according to the tuning chart.

(24) Adjust the inner and outer slugs of the mixer-amplifier 1,850-kc interstage transformer (Z306) for a maximum indication on the EXCITER CURRENT meter.

(25) Refine the PULSED DOUBLER GRID TUNING and LIMITER AMP. PL TUNING controls for a maximum indication on the EXCITER CURRENT meter. The maximum indications should occur with the controls very close to (though not necessarily exactly on) the 1,850-kc calibrations. If such is not the case, it is an indication that the interstage transformer is tuned to the wrong frequency; reset the PULSED DOUBLER GRID TUNING and the LIMITER AMP. PL TUNING to 1,850 kc and repeat step (24) to find the correct maximum.

(26) Note the reading on the EXCITER CURRENT meter. If it is not between 60 and 80, adjust the DBLR BIAS control until the reading is within the required limits.

(27) Place the FREQUENCY SELECTOR switch, the LIMITER AMP. PL TUNING control, and the PULSED DOUBLER GRID TUNING control in the 1,900-kc positions. Place meter switch S120 in the V305 V306 CATH. position. Set the DOUBLER PLATE TUNING control for 1,900 kc according to the tuning chart.

(28) Adjust the inner and outer slugs of the mixer-amplifier 1,900-kc interstage transformer (Z307) for a maximum indication on the EXCITER CURRENT meter.

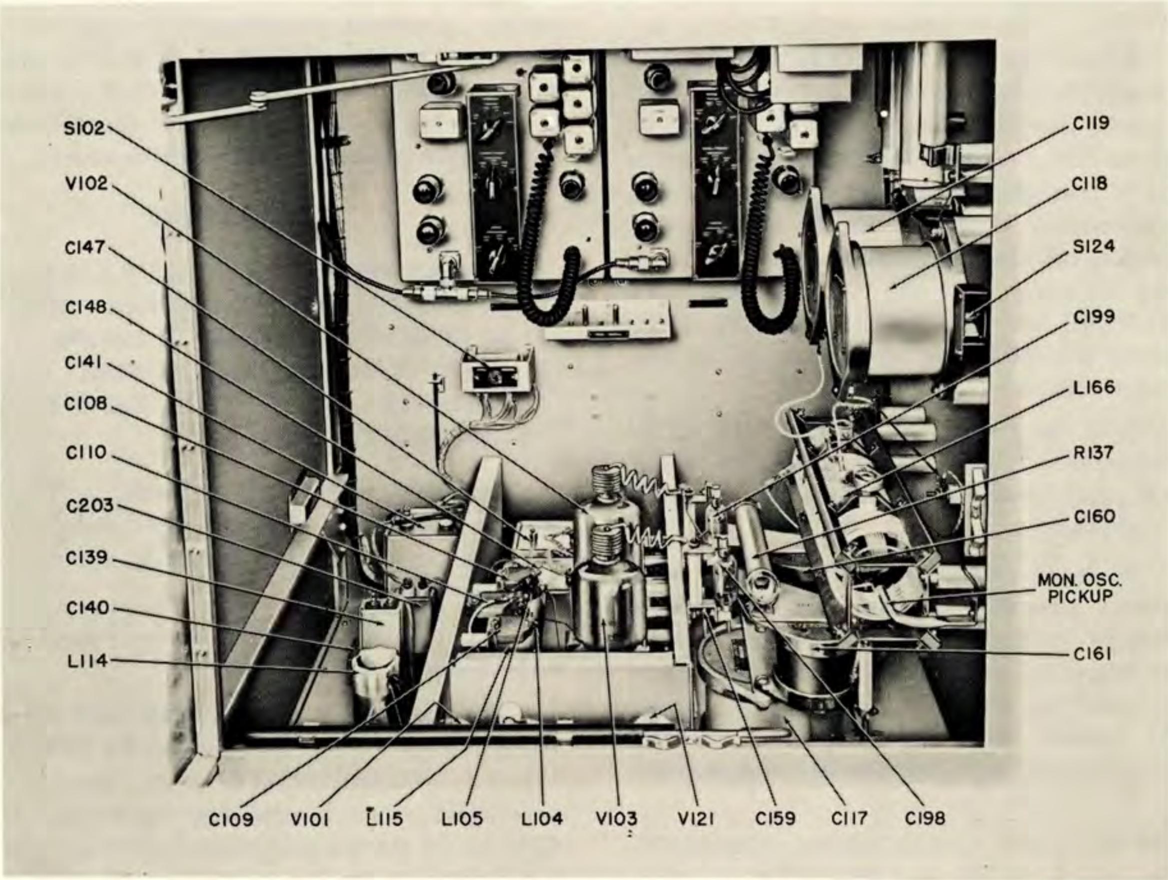


Figure 7—31. IPA Stages, Cover Plates Removed

(29) Refine the PULSED DOUBLER GRID TUNING and the LIMITER AMP. PL TUNING controls for a maximum indication on the EXCITER CURRENT meter. The maximum indications should occur very close to (though not necessarily exactly on) the 1,900-kc calibrations. If such is not the case, it is an indication that the interstage transformer is tuned to the wrong frequency; reset the PULSED DOUBLER GRID TUNING and LIMITER AMP. PL TUNING controls to 1,900 kc and repeat step (28) to find the correct maximum.

(30) Note the reading on the EXCITER CURRENT meter. If it is not between 60 and 80, adjust the DBLR BIAS control until the reading is within the required limits.

(31) Place the FREQUENCY SELECTOR switch, the LIMITER AMP. PL TUNING control, and the PULSED DOUBLER GRID TUNING control in the 1,950-kc positions. Place meter switch S120 in the V305 V306 CATH. position and insert the meter plug into jack J304. Set the DOUBLER PLATE TUNING control for 1,950 kc according to the tuning chart.

(32) Adjust the inner and outer slug of the mixer-amplifier 1,950-kc interstage transformer (Z308) for a maximum indication on the EXCITER CURRENT meter.

(33) Refine the PULSED DOUBLER GRID TUNING and the LIMITER AMP. PL TUNING controls for a maximum indication on the EXCITER CURRENT meter. The maximum indications should occur very close to (though not necessarily exactly on) the 1,950-kc calibration. If such is not the case, it is an indication that the interstage transformer is tuned to the wrong frequency; reset the PULSED DOUBLER GRID TUNING and the LIMITER AMP. PL TUNING controls to 1,950 kc and repeat step (32) to find the correct maximum.

(34) Note the reading on the EXCITER CURRENT meter. If it is not between 60 and 80, adjust the DBLR BIAS control until the reading is within the required limits.

(35) With the completion of the previous steps, the frequency generator is completely tuned. As a final check, all the cathode and grid current readings should be monitored and checked against the typical readings listed in table 5–1. Restore the TUNE NORMAL switch under the frequency generator chassis to NORMAL and close the IPA compartment door.

b. LOW-VOLTAGE ADJUSTMENT. — With EXCITER A switch (S118) and EXCITER B switch (S119) both in the ON position, and meter switch S111 (beneath the LOW VOLTAGE meter) in the EXCITER PLATE position, the LOW VOLTAGE meter (M105) should read 300 volts. If it does not, open the right rear door and adjust potentiometer R163 (see figure 5–1) until a reading of 300 volts is obtained.

WARNING

OBSERVE ALL SAFETY PRECAUTIONS. GROUND ALL EXPOSED COMPONENTS WITH THE CAPACITOR - DISCHARGE ROD PROVIDED.

Turn either the EXCITER A or the EXCITER B switch to the OFF position. The meter reading should remain 300 volts. If it does not, remove the retaining screws and allow the hinged front control panel to drop. Adjust potentiometer R237 until the meter reads 300 volts; see figure 3–17. Raise the control panel and tighten the retaining screws.

9. NEUTRALIZATION PROCEDURE.

Neutralization of the 2nd IPA and PA stages has been adjusted at the factory and should not be tampered with unless all trouble-shooting and maintenance procedure has eliminated any other possible cause of trouble. In general, the setting of the neutralizing capacitors is noncritical, and it is unlikely that they will be a source of trouble. However, if it is necessary to replace any of the capacitors, the stage in which the replacement is made should be reneutralized.

WARNING

BEFORE MAKING ANY ADJUSTMENTS IN THE PA AND IPA COMPARTMENTS, BE CERTAIN THAT THE *MAIN* SWITCH IS *OFF*. GROUND ALL EXPOSED COMPONENTS WITH THE CAPACITOR-DISCHARGE ROD.

a. 2ND IPA NEUTRALIZATION. — The adjustment of neutralizing capacitors C158 and C159 in the IPA compartment (C159 shown in figure 7–31) is made as follows:

(1) Loosen the locknut on the threaded shaft of each capacitor.

(2) Adjust the variable plate until the spacing between plates is 7/8 inch. Tighten the locknuts.

b. PA NEUTRALIZATION. — The PA stage is neutralized when neutralizing capacitors C154 and C155 in the PA compartment (C155 shown in figure 5–4) are each set for a capacity of approximately 32 $\mu\mu$f. This capacity is obtained to a sufficient degree

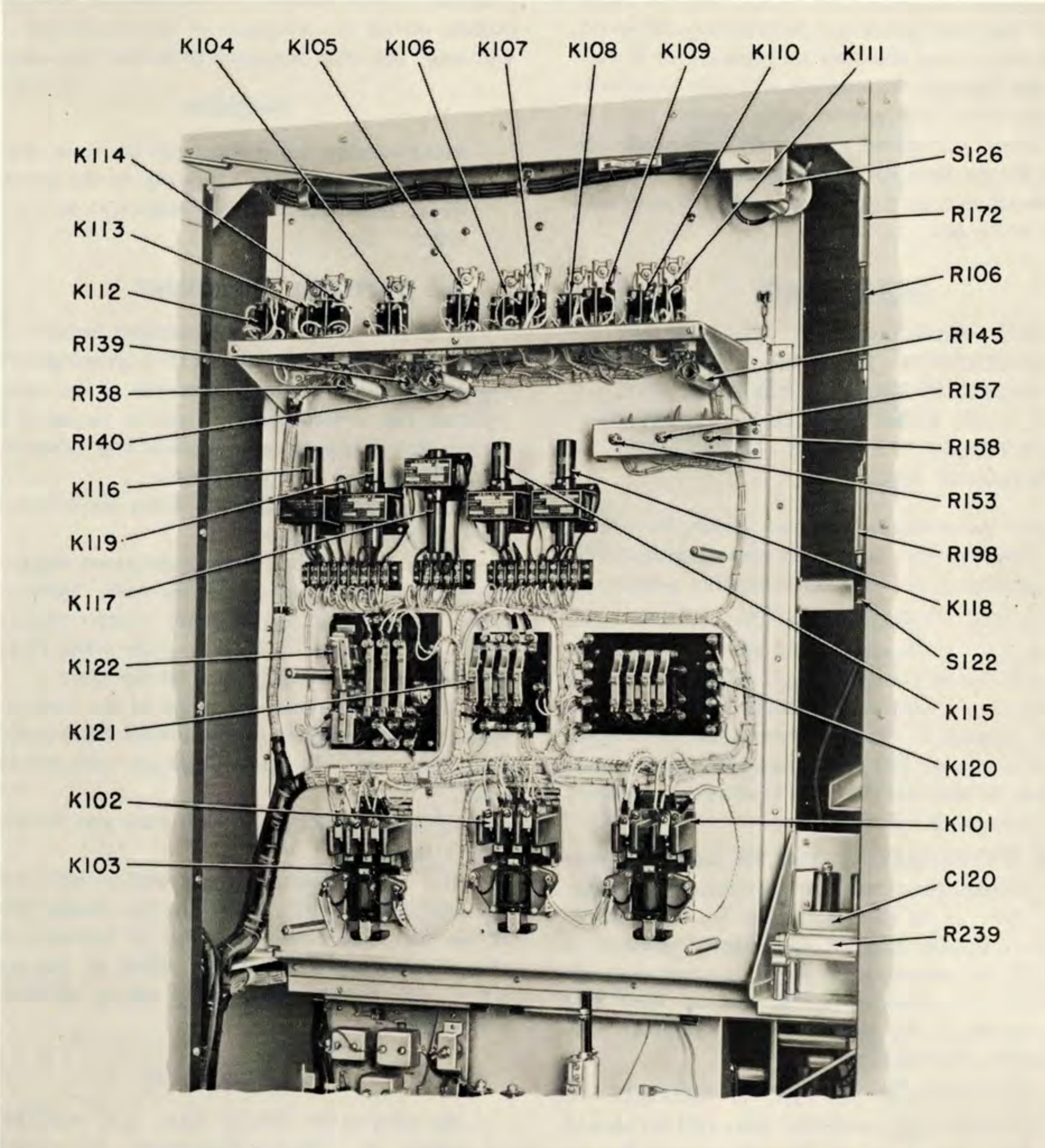


Figure 7—32. Transmitter Relay Panel, Left Rear Access Door Open

of approximation when the NEUTRALIZATION control (G) is set at 057, provided the capacitors are coupled to the ganged control in the correct manner.

If there is reason to believe that the couplings which connect the two capacitors to the control have slipped, or if a new capacitor is installed, use the following procedure (refer to figure 5–4):

(1) Loosen the couplings to both neutralizing capacitors.

(2) Adjust each capacitor to maximum capacity (fully meshed).

(3) Set the NEUTRALIZATION control to a setting of 857.

(4) Tighten both capacitor couplings securely, and set the NEUTRALIZATION control to 057, as described above.

10. D-C OVERLOAD RELAY ADJUSTMENT.

The d-c overload relays, protecting the 2nd IPA, the PA, and the high-voltage rectifier stages, have been adjusted at the factory so that the relays "kick out" at certain predetermined values of current. Under normal conditions, no adjustment of the controls which vary the "kick out" point will be necessary. However, if any of the control rheostats are replaced, or if their settings are changed, the controls will have to be reset so that the relays will operate at the correct value of current. These settings are not unduly critical and can be made on the basis of resistance checks of the control rheostats after disconnecting one end of each such rheostat to be set.

WARNING

WHEN MAKING THE FOLLOWING ADJUSTMENTS, BE SURE THE *MAIN* SWITCH IS IN THE *OFF* POSITION AND THAT ALL COMPONENTS HAVE BEEN GROUNDED WITH A CAPACITOR-DISCHARGE ROD.

To make the necessary resistance checks be sure to use an ohmmeter that is in good operating condition so that readings taken will be reasonably accurate.

a. 2ND IPA OVERLOAD. — The 2nd IPA overload relay (K112) should operate when approximately 50 milliamperes flow in its coil. To adjust for this setting check the resistance of R153 from center terminal to ground. If the resistance measured is other than approximately 450 ohms, turn the rheostat until that value is obtained. For the remaining procedure refer to paragraph 10*d*, following.

b. PA OVERLOAD. — The PA overload relay (K113) should operate when approximately 100 milliamperes flow in its coil. To adjust for this setting, check the resistance of R157 from center terminal to ground. If the resistance measured is other than approximately 155 ohms, turn the rheostat until that value is obtained. For the remaining procedure refer to paragraph 10*d*, following.

c. HIGH-VOLTAGE SUPPLY OVERLOAD. — The high-voltage supply overload relay (K114) should operate when approximately 325 milliamperes flow in its coil. To adjust for this setting check the resistance of R158 from center terminal to ground. If the resistance measured is other than approximately 58 ohms, turn the rheostat until that value is obtained. For the remaining procedure refer to paragraph 10*d*, following.

d. FINAL CHECK OF SETTING. — After adjusting any of the relays as described in paragraphs 10*a*, *b*, or *c*, preceding, try turning the plate power on and off a few times (with the transmitter in normal operating condition). It may be found that there is a tendency for one or more relays to "kick out" with the surge produced in this manner. If this condition occurs, turn the control rheostat of the relay(s) involved to slightly reduce the resistance of the rheostat(s). This will make the relay operation somewhat less sensitive.

CAUTION

Avoid turning the rheostat too far, since this may desensitize relay operation to the point where insufficient circuit protection is provided.

11. A-C OVERLOAD ADJUSTMENT.

The MAIN switch and a-c overload breaker, S101, has been adjusted at the factory for a tripping point of approximately 50 amperes. However, if the switch is replaced, the new component must be inspected to be certain that it is set to trip at about this value of current. This may be done as follows:

a. Remove the two screws holding the switch faceplate to the switch housing.

b. Note the two small rectangular plates inside, each having an arrow at one end, at the cutout corner. This arrow should point to the center calibration line between the "HI" and "LO" ends of the scale. The scale is visible in the cutout portion of the plate.

c. If the arrow does not point to the correct line, loosen the two screws in the slotted holes and slide each plate until the arrow lines up with the center mark.

d. Tighten the screws in each plate and replace the switch faceplate.

e. If, for any reason, it is necessary to inspect or adjust the MAIN switch (S101) in the transmitter (see figure 3–17), the same procedure is followed, except that the bracket holding the switch to the control panel must first be removed by taking off the four panel screws.

WARNING

BE CERTAIN THAT THE A-C POWER LINE IS DISCONNECTED AT THE TRANSMITTER TERMINAL BOARD BEFORE ATTEMPTING TO DISMANTLE THE *MAIN* SWITCH IN THE TRANSMITTER.

12. SPARK-GAP ADJUSTMENT.

Two types of spark-gap protectors are used as protective devices in the transmitter to guard against damage caused by high-voltage transients. They are generally placed in the grid and cathode circuits of the high-power r-f amplifiers, or in any other portions of the equipment where such transients are likely to occur.

One type of protector is a neon-filled, cartridge-type "lightning arrestor", which is nonadjustable and is designed to conduct when voltages of between 200 and 400 volts exist across it. These protectors are used to prevent damage to the coils of overload relays K112, K113, and K114.

"Ball-gap" protectors, which are adjustable, have been set at the factory for the correct spacing. If the spacing is changed, or a replacement is necessary, the gap between the conducting balls must be reset. The correct spacings for each protector of this type are indicated in table 7–4, and on identification plates located adjacent to the protector. These dimensions are critical and should be measured with feeler gages located on the fuse panel.

13. TRANSMISSION LINE CHECK.

After all tuning procedure for the Antenna Coupling Unit has been performed and checked, or at any other time during operation, suspicion that there is a faulty transmission line between the Type J–455A/FPN Terminal Box and the coupling unit may be verified as follows:

a. With the HIGH VOLT and LOW VOLT-BIAS switches in the OFF position, place LINK A in the transmitter in the dummy load position.

b. Check the connection in the terminal box to be certain that the transmitter being used will feed the transmission line under test.

c. Connect LINK 1 in the coupling unit to the transmission line under test, and move LINK 2 so that it goes to the dummy load.

d. Place the transmitter in normal operation and note the reading on the TRANSMISSION LINE meter (M111).

e. Place the HIGH VOLT and LOW VOLT-BIAS switches in the OFF position. Move LINK A to the transmission line position.

f. Place the transmitter back in operation and compare the reading now obtained on the TRANSMISSION LINE meter with that noted in step *d.* If the two readings are substantially the same, the line is all right. If the readings differ appreciably, the spare transmission line should be put into use and the faulty line replaced.

WARNING

BE SURE TO GROUND ALL COMPONENTS WITH A CAPACITOR-DISCHARGE ROD IN THE PA COMPARTMENT, TERMINAL BOX AND COUPLING UNIT.

14. MONITORING PICK-UP, PA STAGE.

The monitoring circuit pick-up capacitor, C202, has been adjusted at the factory for correct spacing, and should not be changed. However, if capacitor C167 is replaced, the spacing of C202 must be readjusted, since one end of C167 serves as one plate of the pick-up capacitor (see figure 7–33). The criteria of correct spacing is that a deflection of slightly more than 20 divisions is obtained on the monitor oscilloscope when observing the OUTPUT PA pulse with the VERTICAL DEFLECTION control in the extreme clockwise position. The transmitter should be operating at nor-

TABLE 7–4. SPACING OF BALL-GAP PROTECTORS

CIRCUIT	SYMBOL	SPACING
Pa Grid (V104, V105 and V106, V107)	TY110, TY111	0.063 +0.003 −0.002 inch
2nd IPA Grid (V102 and V103)	TY108, TY109	0.010 +0.001 −0.002 inch
Monitor scope pick-up; PA output	TY114	0.008 +0.001 −0.002 inch
Modulator Grid (V116 and V117)	TY112, TY113	0.010 ±0.002 inch, across transformer 0.030 +0.002 −0.000 inch, each side to ground
Modulator Pulse-Generator Output to PA grids	TY115	0.015 +0.002 −0.000 inch

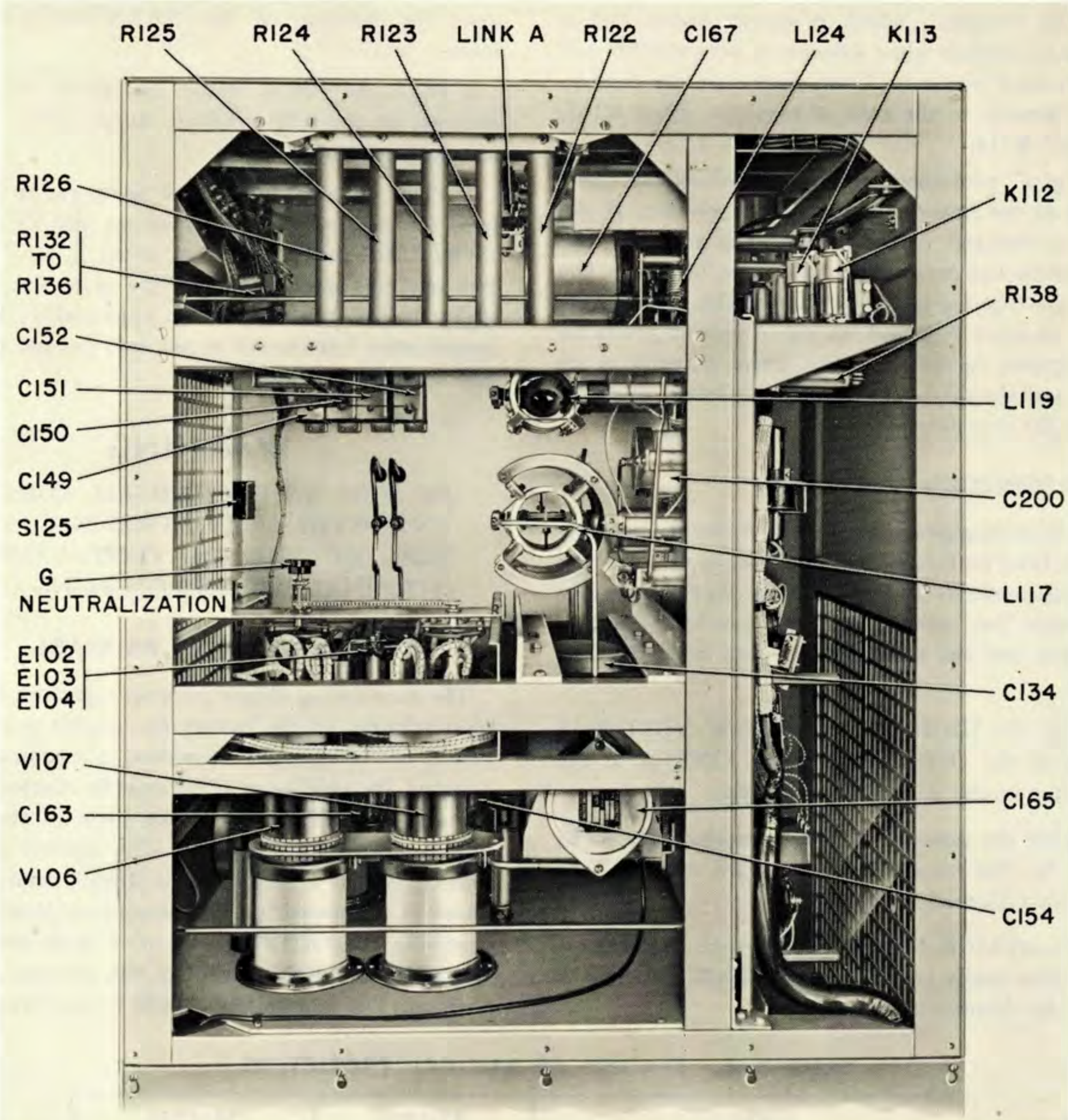


Figure 7—33. PA Compartment, Side Panel Removed

mal power output. A spacing of approximately 0.07 inch is normally required.

15. COMPENSATOR CIRCUIT ADJUSTMENT.

Note

The compensator circuit is factory-adjusted for correct pulse-amplitude stabilization during double pulsing and should not be disturbed unless it is definitely ascertained that adjustment is necessary.

The compensator circuit adjustment is made with the screw-driver potentiometer R258 located inside the right-hand portion of the IPA section. To adjust, proceed as follows: On the monitor oscilloscope set the SWEEP LENGTH switch to 4500A. On the front panel of the transmitter turn the MONITORED CIRCUIT switch to OUTPUT PA, and set the TRIGGER SELECTOR switch to either A or B, whichever setting is required to make the unsynchronized pulse move from the right to the left on the scope screen (while the synchronized pulse remains stationary). If the circuit is undercompensated, the fixed pulse will tend to rise in amplitude as it is approached by the moving pulse. Overcompensation will be indicated by the reverse effect, that is, the approach of the moving pulse will cause a decrease in the amplitude of the fixed pulse.

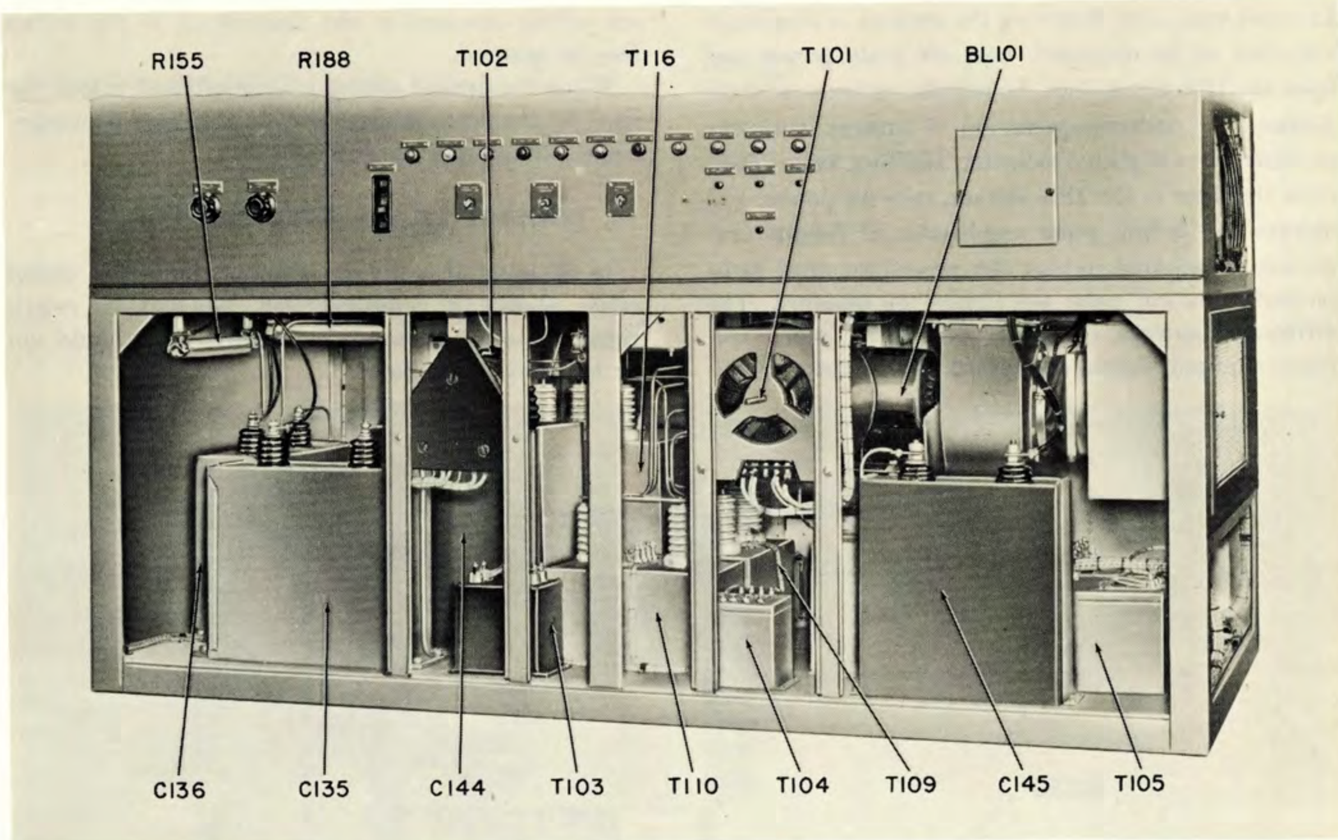


Figure 7—34. Power Supply Section, Front Panels Removed

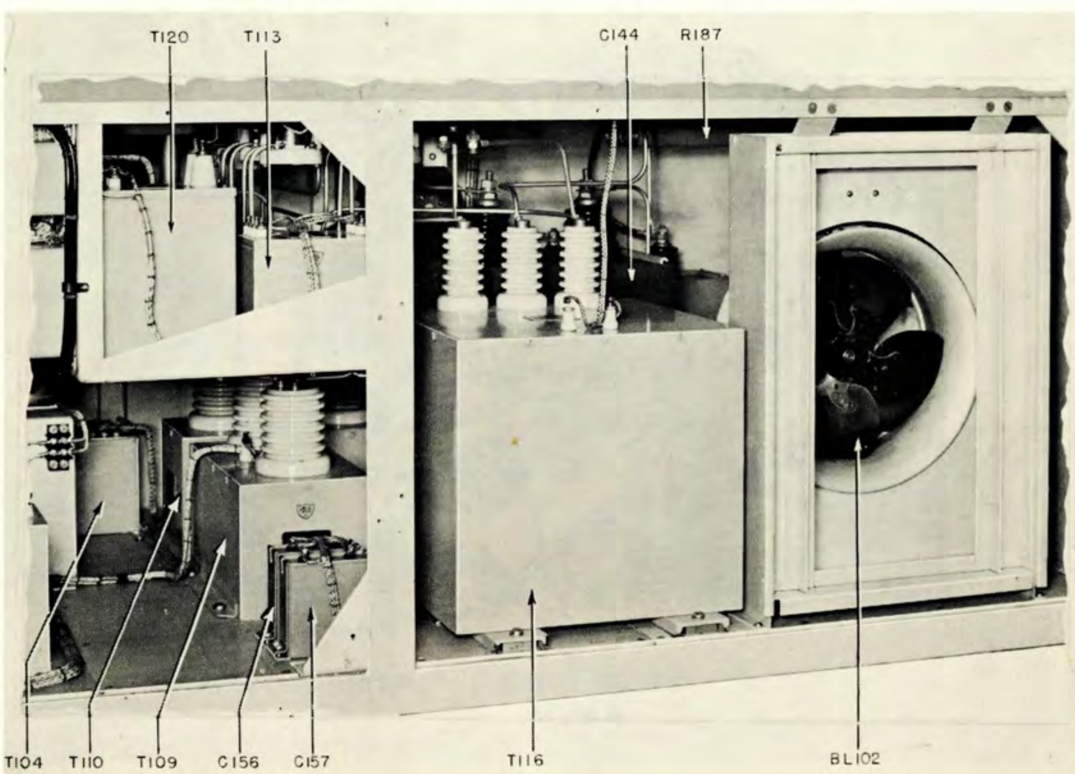


Figure 7—35. Power Supply Section, Rear Panels Removed

In either case, after observing the amount of amplitude variation to be corrected, turn off plate power and open the IPA access door. Loosen the adjustment shaft locknut. If undercompensation is present, turn the potentiometer slightly clockwise, and vice versa. Then close the door to the IPA section, turn on power, and observe the output pulse amplitudes. If further correction is required, repeat the procedure until satisfactorily uniform pulse amplitudes are obtained. The difference between the pulse amplitudes, when correctly adjusted, should not exceed two percent. Transient effects observed at the coincidence of the pulses may be ignored.

When the desired setting is accomplished, relock the shaft on the potentiometer R258 and restore the equipment to operation as required.

16. CONTROL RELAYS (K104 TO K114).

In the event of faulty operation of any of the control relays, replace the complete relay. The sensitive switch contact assemblies cannot be repaired and should not be replaced in the field.

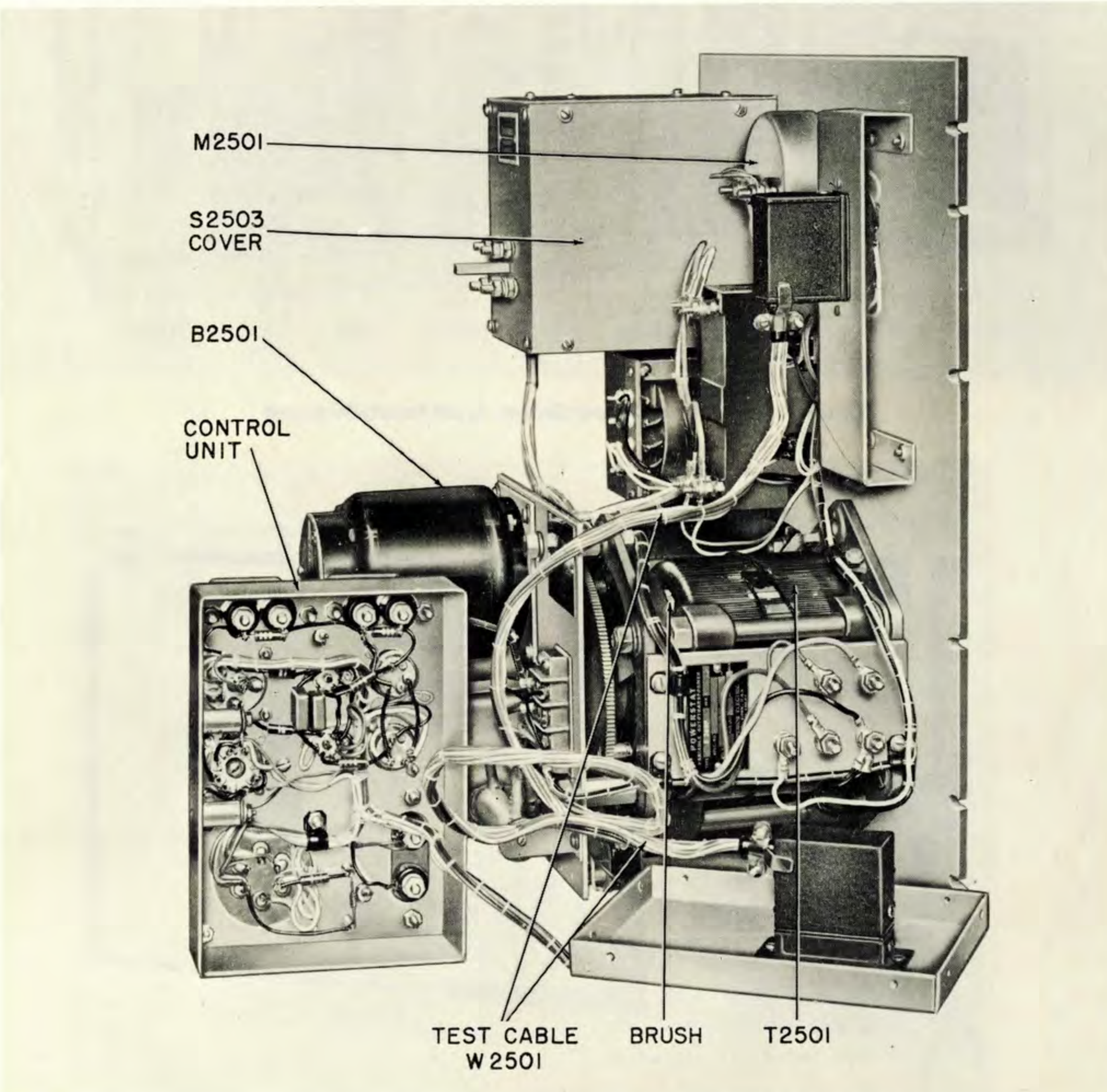


Figure 7—36. Voltage Regulator Control Unit Prepared for Maintenance

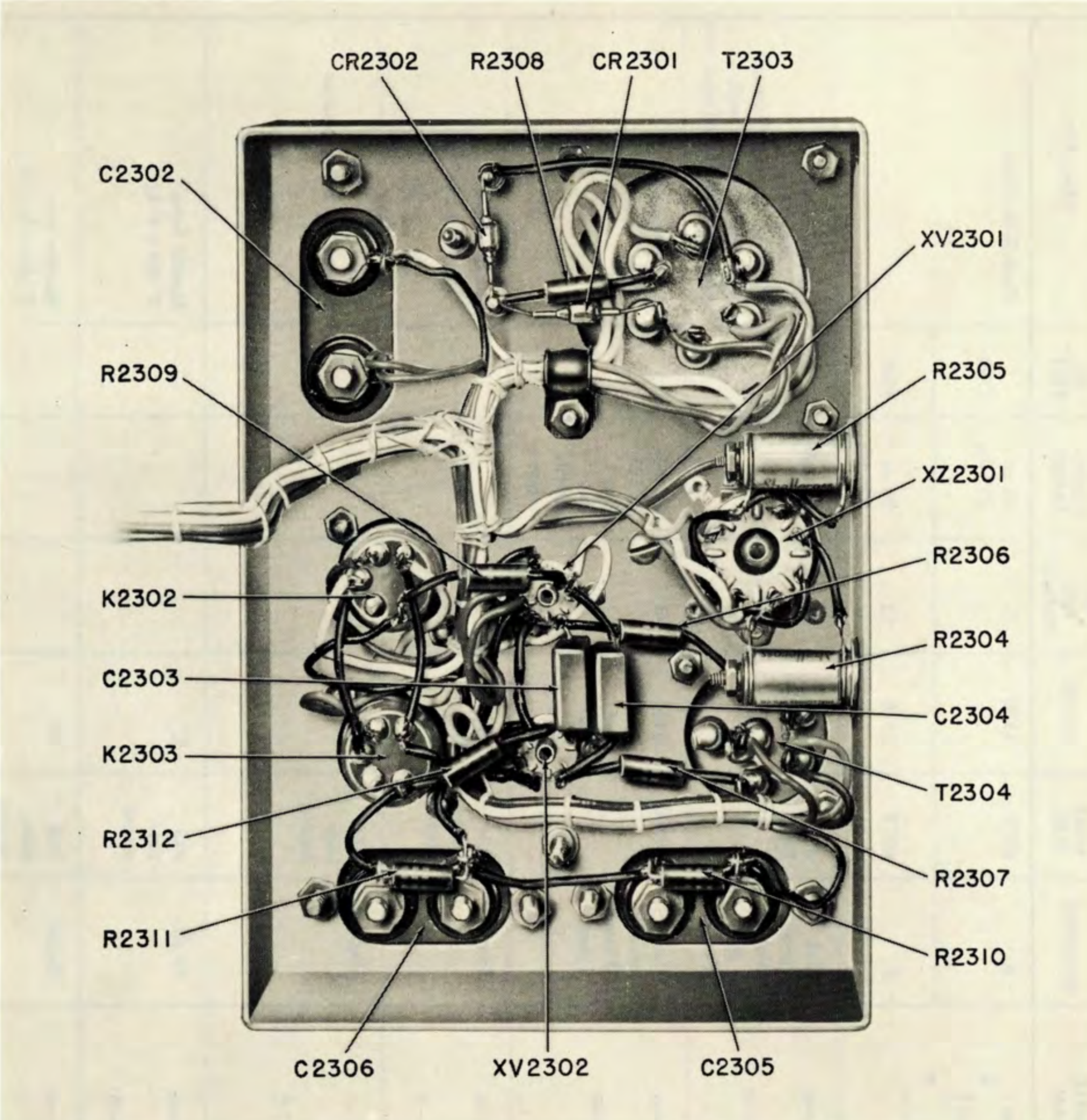


Figure 7—37. Voltage Regulator Control Unit, Under Chassis View

TABLE 7–5. WINDING DATA

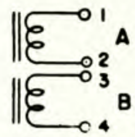
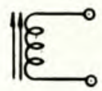
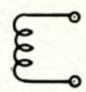
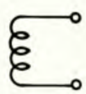
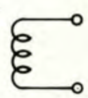
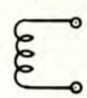
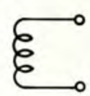
CIR. SYM.	FED TELE & RAD DWG AND (MFR'S TYPE) NUMBER	SCHEMATIC DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RES. (OHMS)	INDUC-TANCE	AC TEST	REMARKS
L101	FRE-16059-2		A	#27E	1570	72	5h at 250 ma	3500	Dual filter choke
			B	#27E	1570	72	5h at 250 ma	3500	
L102	FRA-19218-3-3		Uni-versal Wound, 5 pies	#28 DCC	251 (total)	7.5 tap at 5.2	2.7 mh		Ceramic form: 1½" dia. x 8½" lg Winding: 1st pie, 75 turns; other pies, 44 turns each. Adjustable powdered iron core
L103 L104 L105	(Natl Co) (R-100)		Uni-versal Wound, 4 pies	#35ES	888 (222 per pie)	50	2.5 mh at 125 ma; 1 $\mu\mu$f distrib. capacity		Isolantite core
L107 L108 L109	FRA-17956-2		Single	#24 bare tinned	90				Steatite form: 1½" dia x 7½" lg
L110 L111 L112 L113 L122 L123	FRA-18394-1		Single	#14 bare tinned	6				Dia: ½" Spaced ⅛" between turns
L114	FRA-17951-2		Single	#18 bare tinned	27				Steatite form: 2" dia x 4" lg
L115	FRA-17954-2		Single	#18 bare tinned	82				Steatite form: 2" dia x 8¼" lg,

TABLE 7-5. WINDING DATA (Cont'd)

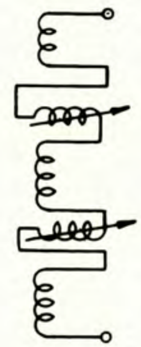
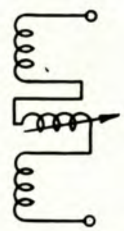
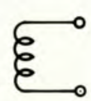
CIR. SYM.	FED TELE & RAD DWG AND (MFR'S TYPE) NUMBER	SCHEMATIC DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RES. (OHMS)	INDUC-TANCE	AC TEST	REMARKS
L116	FRA-19542-14		3-Section Stator	Cadmium plated copper: ¼" wd x 0.054" thk.	30 (total)				Coil edgewound on form
			2 Rotors	Cadmium plated copper: ¼" wd x 0.054" thk.	6½ (each)				Coil edgewound on form
L117A L117B	FRA-17646-14-1 FRA-17646-14-2		2 Section Stator	Cad-mium-plated copper: ¼" wd x 0.054" thk.	8½ (total)				Coil edgewound on form
			Rotor	Cad-mium-plated copper: ¼" wd x 0.054" thk.	4½				Coil edgewound on form
L118	FRA-19333-2		Single	Cad-mium-plated copper: ¼" wd x 0.054" thk.	5				Coil edgewound, closely wound; 3" ID

TABLE 7–5. WINDING DATA (Cont'd)

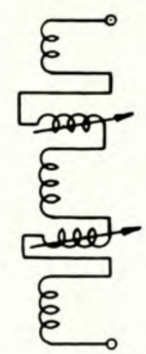
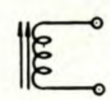
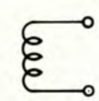
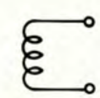
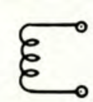
CIR. SYM.	FED TELE & RAD DWG AND (MFR'S TYPE) NUMBER	SCHEMATIC DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RES. (OHMS)	INDUC-TANCE	AC TEST	REMARKS
L119	FRA-19577-14		3 Section Stator	Cad-mium-plated copper: ¼" wd x 0.054" thk.	40 (total)				Coil edgewound on form
			2 Rotors	Cad-mium-plated copper: ¼" wd x 0.054" thk.	6½ (each)				Coil edgewound on form
L120 L121	FRA-19218-3-1		Uni-versal Wound; 5 pies	#28 DCC	420 (total)	11.6 tap at 8.3			Ceramic form: 1½" dia x 8⅜" lg Winding: 1st pie, 100 turns; other pies, 80 turns each. Adjustable powdered iron core.
L122 L123	See L110								
L124	FRA-19411-1		Single	#10 bare, cad-mium-plated	8				Dia: 1¼" Length: 1$\frac{15}{16}$"
L301	(Natl Co) (R-100 U)		Uni-versal Wound, 4 pies			50	2.5 mh at 125 ma; 1 $\mu\mu f$ distrib. capacity		Isolantite core; stand-off mounting

TABLE 7–5. WINDING DATA (Cont'd)

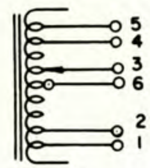
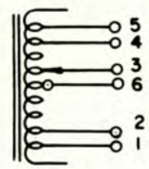
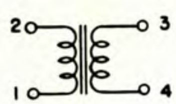
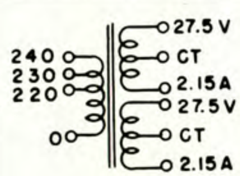
CIR. SYM.	FED TELE & RAD DWG AND (MFR'S TYPE) NUMBER	SCHEMATIC DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RES. (OHMS)	INDUC-TANCE	AC TEST	REMARKS
T101	FRE-31964-2		Single	#16 DGC	364 Taps: 361 309 182 55 3	1.14		2500	Res. measured between terminals 1 and 5. Variable autotransformer, 2.86 kva.
T102	FRE-13859-1		Single	#22 ESGC	460 Taps: 456 388 230 72 4	9.5		2500	Res. measured between terminals 1 and 5. Variable autotransformer, 650 va.
T103	FRE-13861-1		Pri.	#15E	116	.39		2500	106 volts
			Sec.	#11 Sq	26	0.307		2500	23 volts, 290 va.
T104	FRE-13831-2		Pri.	#21E	397 381 364	4.08 3.88 3.55		2500	240-volt tap 230-volt tap 220-volt tap
			Sec. 1	#16E	47	Low		2500	Each secondary: 27.5 volts at 2.15 amp; center-tapped at 23½ turns
			Sec. 2	#16E	47	Low		2500	

TABLE 7–5. WINDING DATA (Cont'd)

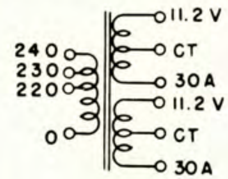
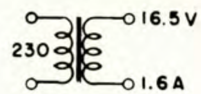
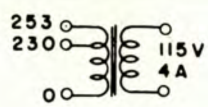
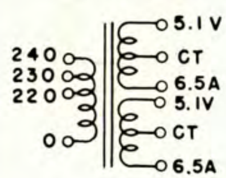
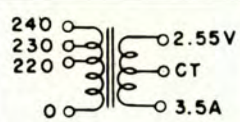
CIR. SYM.	FED TELE & RAD DWG AND (MFR'S TYPE) NUMBER	SCHEMATIC DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RES. (OHMS)	INDUC-TANCE	AC TEST	REMARKS
T105 T106	FRE-13827-12		Pri.	#13E	230 220 210	.514 .492 .460		2500	240-volt tap 230-volt tap 220-volt tap
			Sec. 1	2 x #7 Sq. DCC	11	Low		2500	Each secondary: 11.2 volts at 30 amp; center-tapped at 5½ turns
			Sec. 2	2 x #7 Sq. DCC	11	Low		2500	
T107	FRE-13821-2		Pri.	#29E	1078	43		1500	
			Sec.	#18E	82	.34		1500	16.5 volts at 1.6 amp
T108	FRE-13847-2		Pri.	#16E	304 276	1.23 1.12		1200	253-volt tap 230-volt tap
			Sec.	#13E	142	.37		1200	115 volts at 4 amp
T109 T110	FRE-13833-12		Pri.	#26E	533 512 489	14.1 13.5 12.9		2500	240-volt tap 230-volt tap 220-volt tap
			Sec. 1	#13 Sq. DCC	12	Low		37,000	Each secondary: 5.1 volts at 6.5 amp; center-tapped at 6 turns
			Sec. 2	#13 Sq. DCC	12	Low		37,000	
T111	FRE-13851-2		Pri.	#34E	1290 1235 1180	145 137 131		1500	240-volt tap 230-volt tap 220-volt tap
			Sec.	#16E	15	Low		6500	2.55 volts at 3.5 amp; center-tapped at 7½ turns

TABLE 7–5. WINDING DATA (Cont'd)

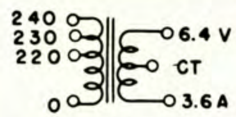
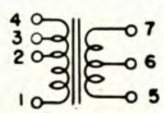
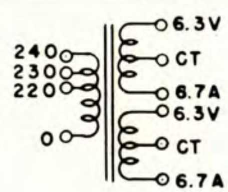
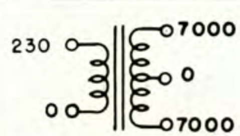
CIR. SYM.	FED TELE & RAD DWG AND (MFR'S TYPE) NUMBER	SCHEMATIC DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RES. (OHMS)	INDUC-TANCE	AC TEST	REMARKS
T112 T115	FRE-13823-2		Pri.	#30E	1190 1140 1091	57.3 54.5 52.0		1500	240-volt tap 230-volt tap 220-volt tap
			Sec.	#15E	34	Low		1500	6.4 volts at 3.6 amp; center-tapped at 17 turns
T113	FRE-16049-2		Pri.	#22E	423 385 350	5.84 5.30 4.83		2500	Output to 5-6-7 is 750-0-750 volts with 230 volts applied to 1-3; 825-0-825 volts with 230 volts applied to 1-2; 675-0-675 volts with 230 volts applied to 1-4.
			Sec.	#29E	2640 1320	220 110		2500	
T114	FRE-13849-2		Pri.	#24E	476½ 456½ 436	8.7 8.25 7.78		2500	240 - volt tap 230 - volt tap 220 - volt tap
			Sec. 1	#12 Sq DCC	13	Low		6000	Each secondary: 6.3 volts at 6.7 amp; center-tapped at 6½ turns
			Sec. 2	#12 Sq DCC	13	Low		6000	
T116	FRE-13829-12		Pri.	#9 Sq DCC	118	.15		2500	Secondary consists of eight coils of 920 turns each; connected in series. Data given for total secondary.
			Sec. (See Remarks)	#26 Heavy Formex	7360	578		37,000	

TABLE 7–5. WINDING DATA (Cont'd)

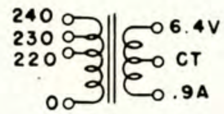
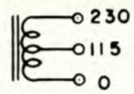
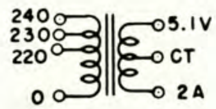
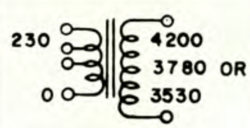
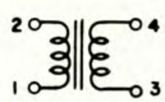
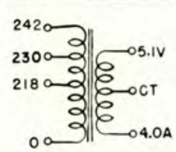
CIR. SYM.	FED TELE & RAD DWG AND (MFR'S TYPE) NUMBER	SCHEMATIC DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RES. (OHMS)	INDUC-TANCE	AC TEST	REMARKS
T117	FRE-14519-2		Pri.	#36E	2015 1930 1845	303 290 276		1500	240-volt tap 230-volt tap 220-volt tap
			Sec.	#22E	60	.435		2500	6.4 volts at 0.9 amp; center-tapped at 30 turns
T118	FRE-14517-2		Single	#17E	350 175	1.625 .81		2500	Autotransformer: Input: 230 v Output: 115 v, 3 amp
T119	FRE-16051-2		Pri.	#34E	1840 1760 1690	185 177 170		2500	240-volt tap 230-volt tap 220-volt-tap
			Sec.	#19E	45	Low		2500	5.1 volts at 2 amp; center-tapped at 22½ turns
T120	FRE-16047-2		Pri.	#21E	656 612 552	4.9		2500	–10% and –16% sec.; volt determined by pri. taps
			Sec.	#34E	10,600	2640		11,000	4200 volts at 0.0375 amp
T121 T122	FRE-17329-1		Pri.	#29E	100	1.0		2500	Primary wound in 2 coils, connected in series. Data given for total primary, terminals 1-2
			Sec.	#41E	1500	253		4500	Terminals 3-4
T123	FRE-25431-1		Pri.	#31E	1320 1255 1195	75		2500 4500	242-volt tap 230-volt tap 218-volt tap
			Sec.	#14E	30	.041			center-tapped at 15 turns

TABLE 7–5. WINDING DATA (Cont'd)

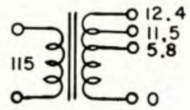
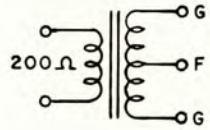
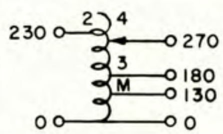
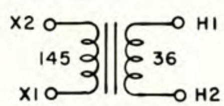
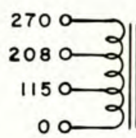
CIR. SYM.	FED TELE & RAD DWG AND (MFR'S TYPE) NUMBER	SCHEMATIC DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RES. (OHMS)	INDUC-TANCE	AC TEST	REMARKS
T2303	UNT M1566		Pri.	#25	589	8.8		1500	Bridge input transformer
			Sec.	#17	65	0.22		1500	
T2304	UNT M1565		Pri.	#35	225	7.1		1500	V2301 and V2302 grid input transformer. Center tapped secondary.
			Sec.	#44	15,750	11,250		1500	
T2501	SUPE S–369P		Single	#18 Form-ex	255 213 163 109	1.59 1.323 1.054 0.708		1800	Autotransformer Air colled Open frame Output, 1.8 kva
T2502	SUPE T5256		Pri.	#12 Form-Heavy ex	130	0.3		1500	Buck-boost transformer, Output, 26a Secondary winding is 0.010" x 2.75" strapping
			Sec.		33	.012		1500	
T2505	SUPE T5258		Single	#20 Form-ex	410 369 205	3.5		1500	Control unit stepdown transformer.

Figure 7—38. Schematic Diagram, Radio Transmitter Type T-325B/FPN

NOTE:
FOR EXTERNAL CONNECTIONS SEE TRANSMITTER SCHEMATIC DIAGRAM
VALUES SHOWN FOR RESISTANCE IN OHMS, INDUCTANCE IN MICRO-HENRYS, CAPACITANCE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
ALL WAVESHAPES SINUSOIDAL EXCEPT AS OTHERWISE SHOWN.

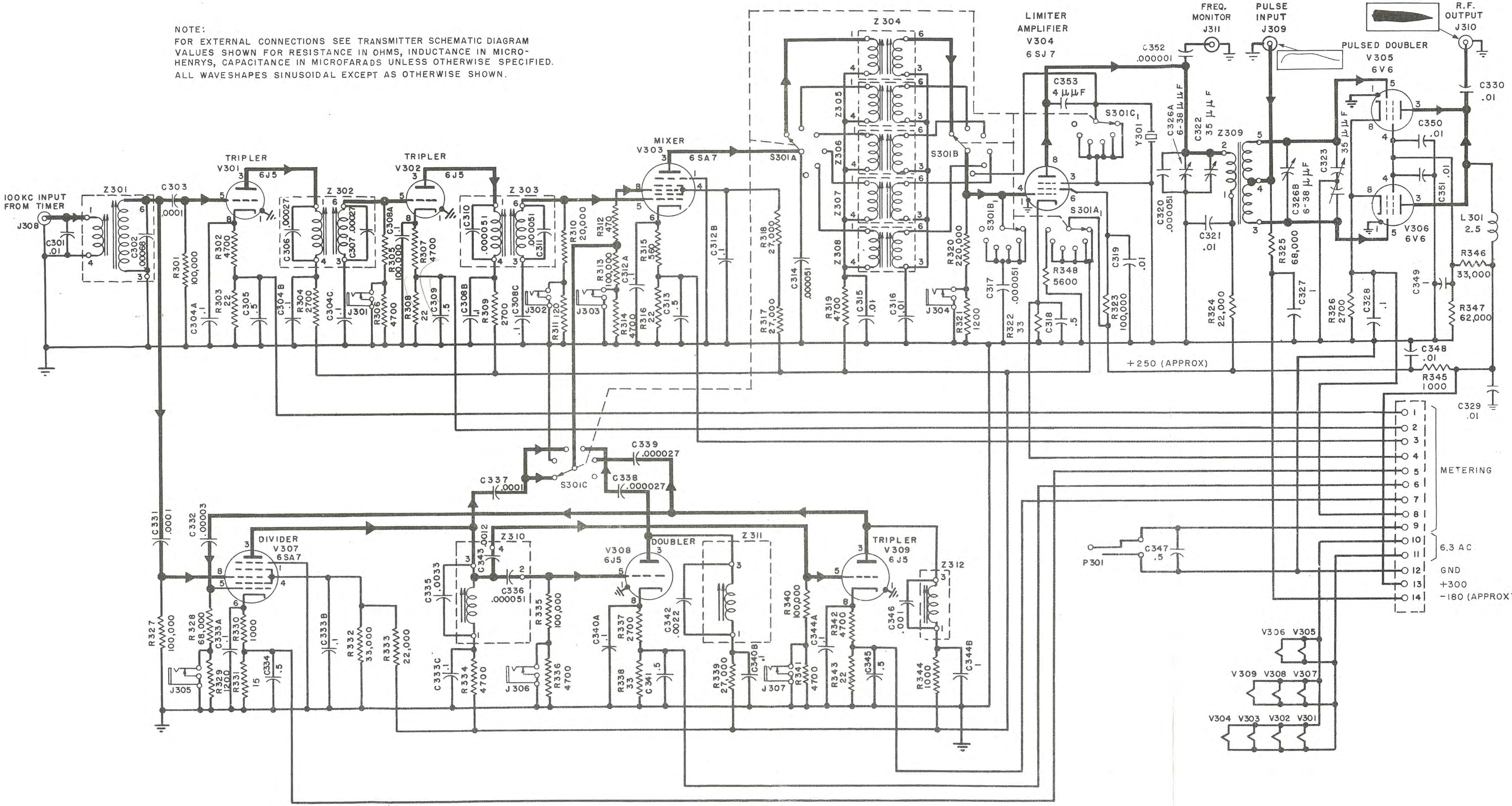
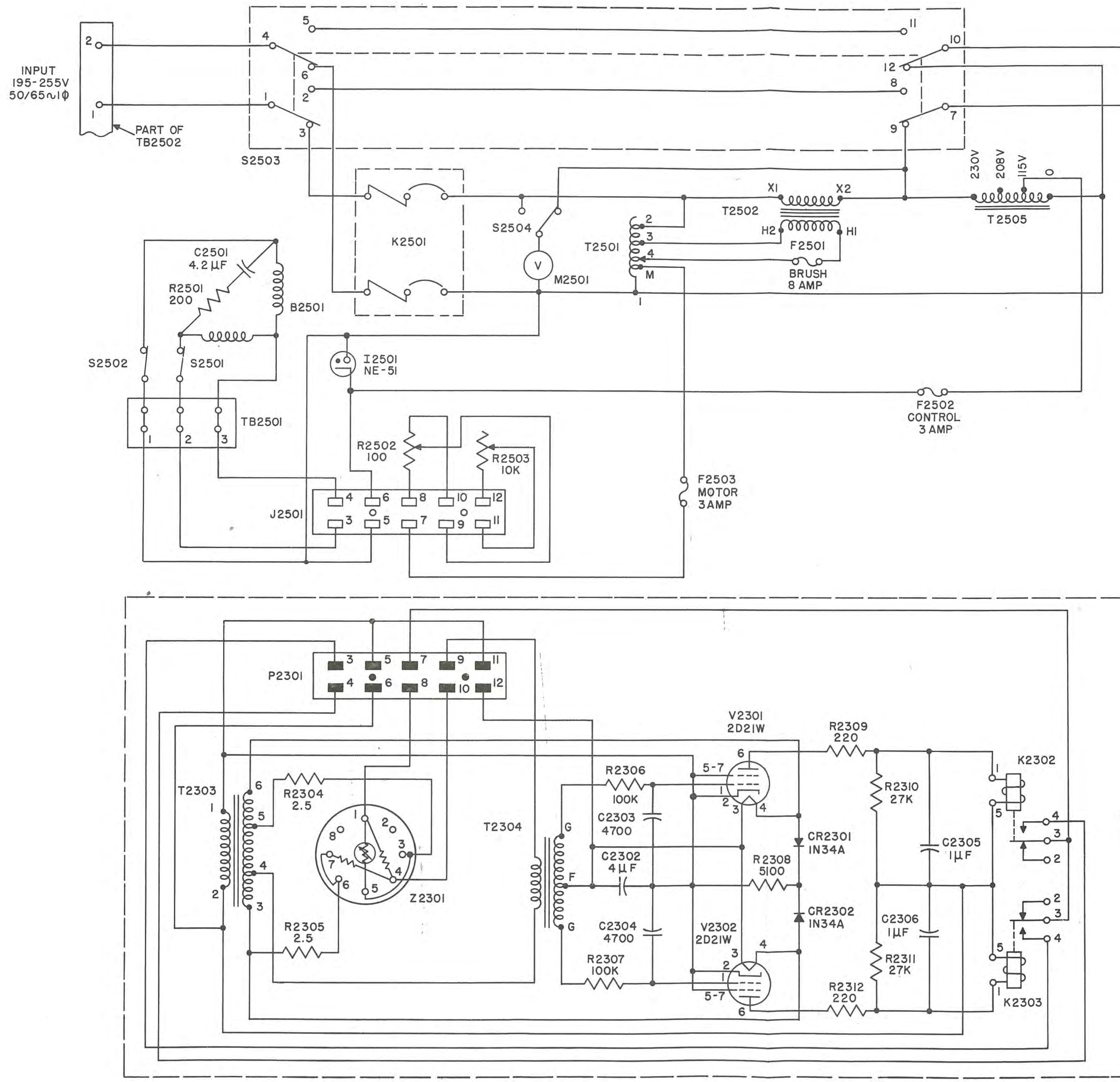


Figure 7–39. Schematic, Frequency Generating Unit



NOTES:

1 - RESISTOR VALUES ARE IN OHMS AND CAPACITOR VALUES ARE IN UUF UNLESS OTHERWISE NOTED.

2 - K = 1000 OHMS

Figure 7—40. Schematic Diagram, Voltage Regulator

ORIGINAL

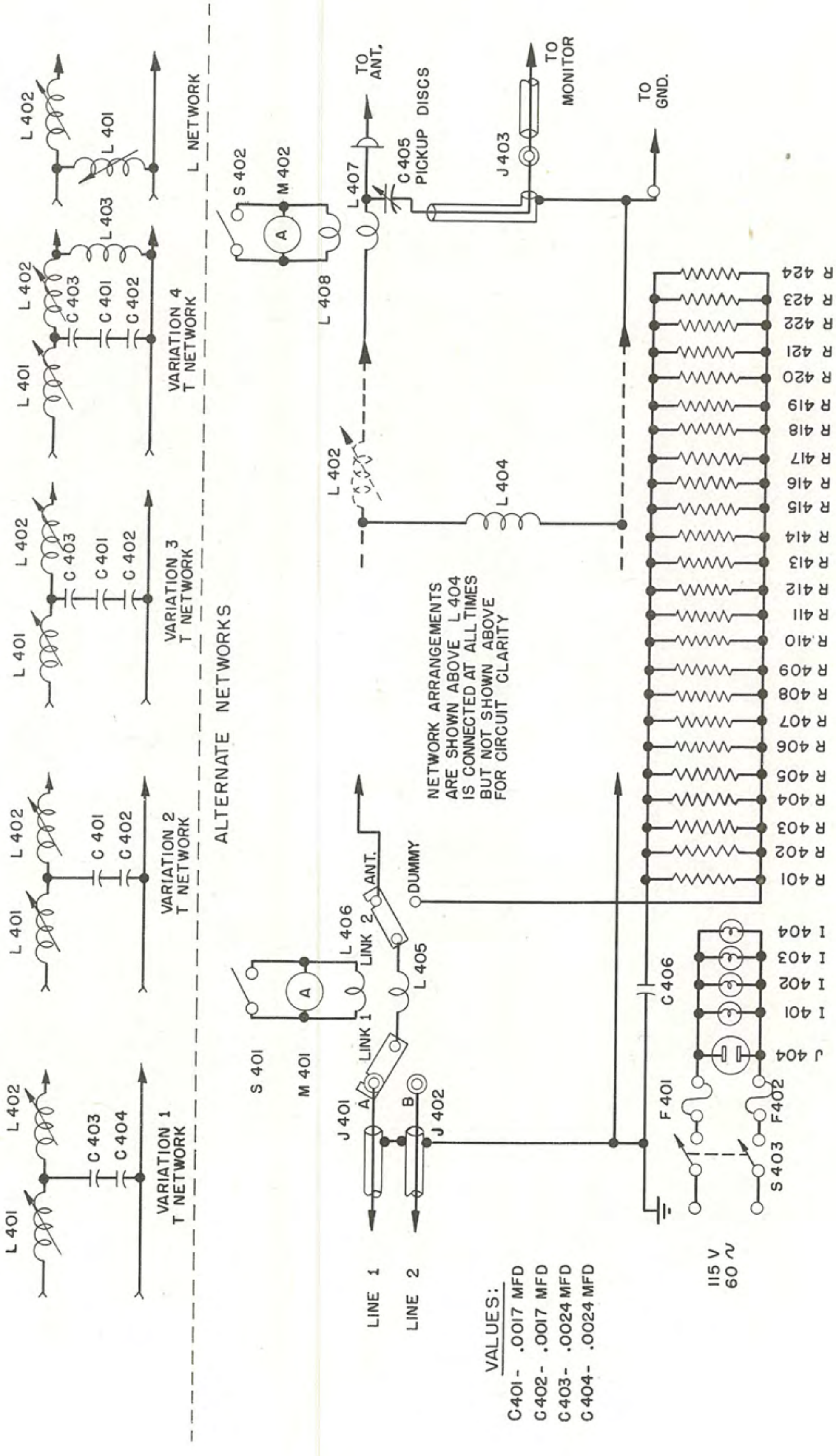


Figure 7–41. Schematic, Antenna Coupling Unit

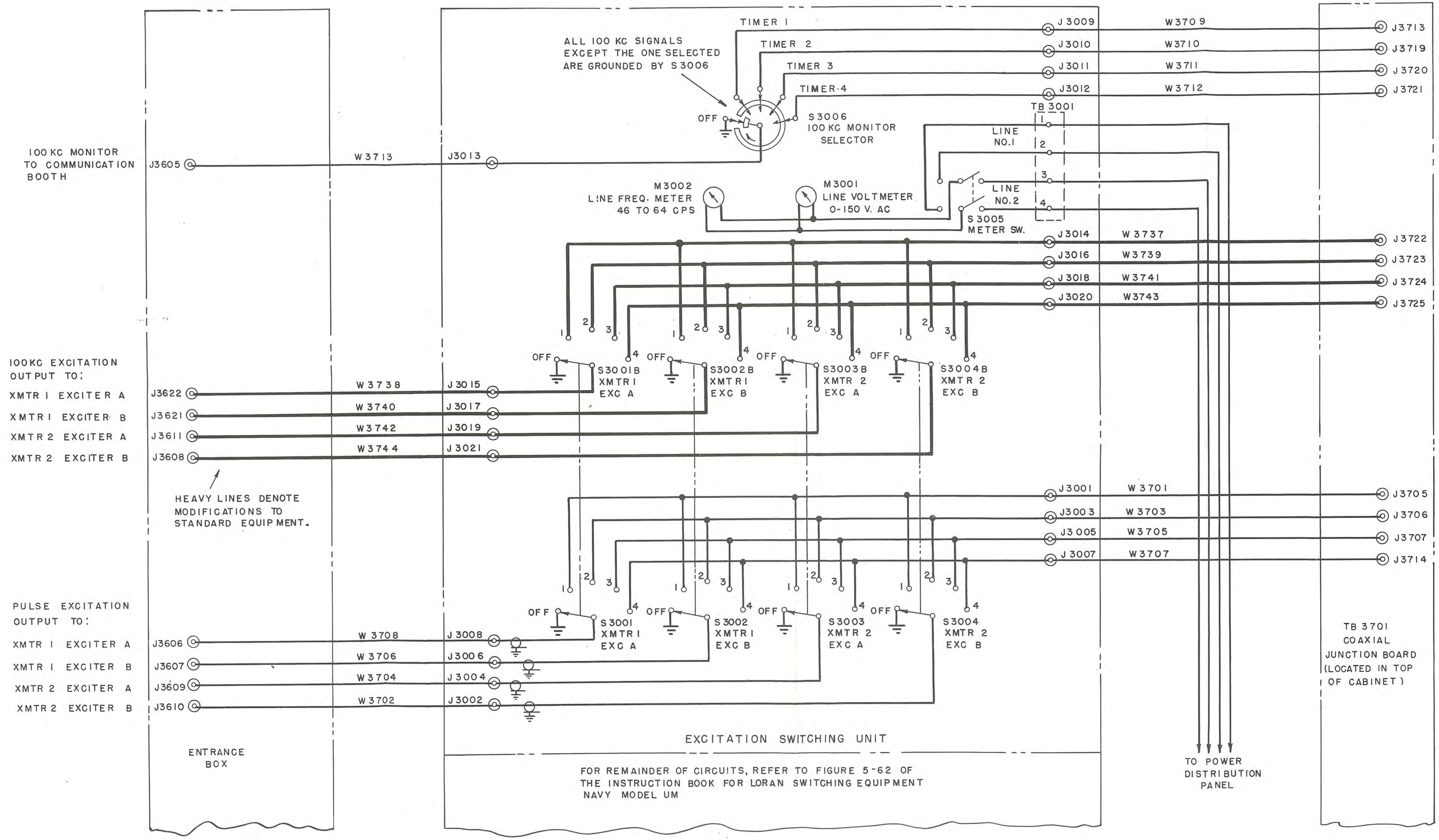


Figure 7—42. Schematic, Modifications to Loran Switching Equipment Navy Model UM

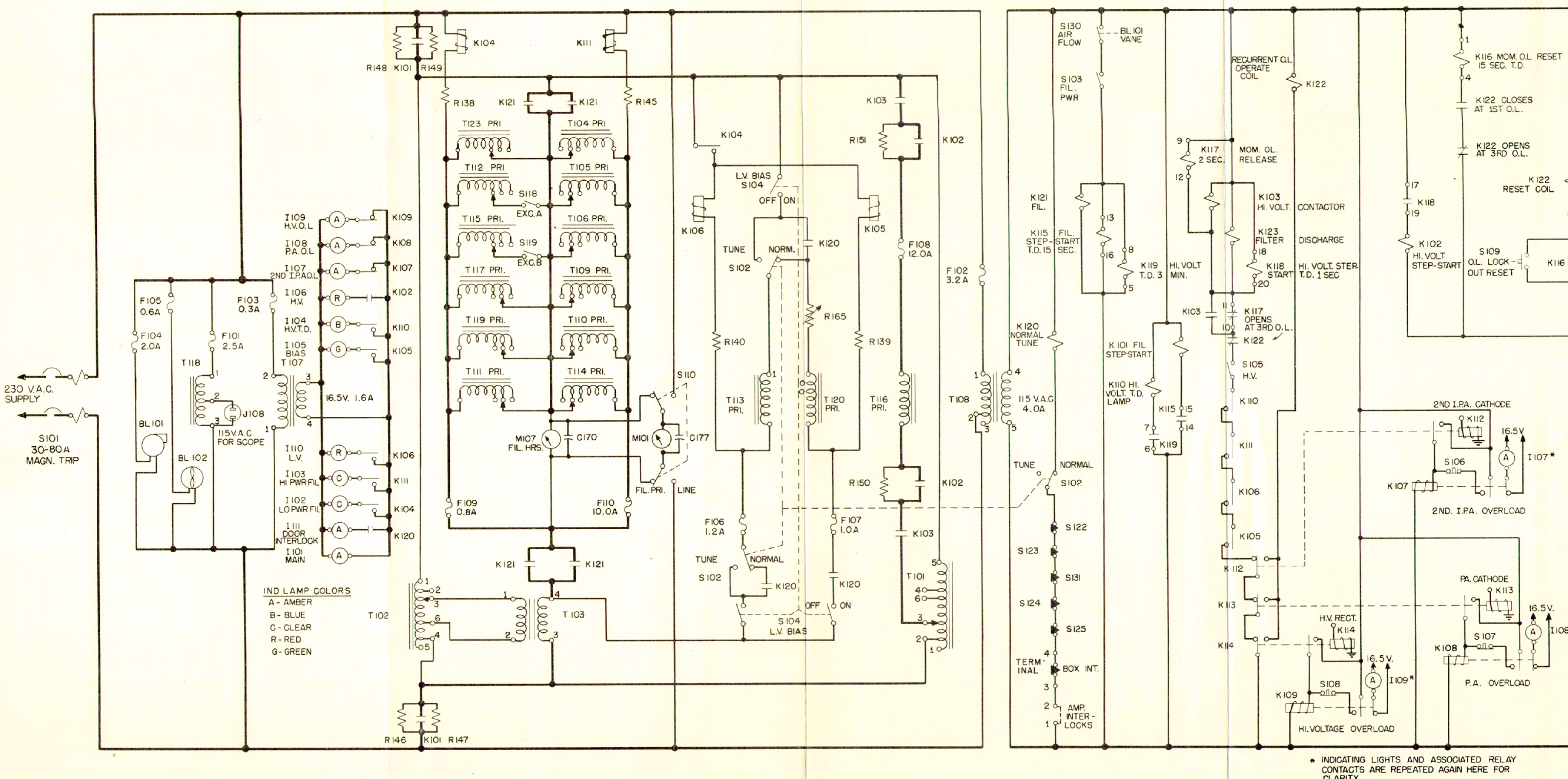


Figure 7—43. Transmitter Control and Relay Circuits

LEAD No.	FROM	TO	AWG	VOLT	COLOR OR TYPE	
101	TY107	R158	14	600	WH-BLK	
102	T114	V117	14	7500	WH-RD	ANSONIA
103	T114	V117	14	7500	WH-RD	CE421-3
104	T117	K121	14	600	WH-BR	
105	T107	K102	18	600	WH-BLK	
106	TB 5	K102	14	600	WH-OR	
107	R168	R176			EX 496	
108	R147	K101	8	600	WH-RD	
109	T108	K103	14	600	WH-GN	
110	T115	V120	14	600	WH-BL	
111	T115	V120	14	600	WH-YEL	
112	C145	R222			EX 496	
113	T103	K121	8	600	WH-BLK	
114	T101	K101	8	600	WH-BLK	
115	T101	K103	14	600	WH-BLK-YEL	
116	T101	K121	8	600	WH-YEL	
117	K123	K103	14	600	WH-BLK-RD	
118	S119	R226	14	600	WH-RD	
119	S103	K121	14	600	WH-BL	
120	S104	K120	14	600	WH-BL	
121	S104	K120	14	600	WH-BLK-OR	
122	S105	K110	14	600	WH-YEL	
123	S105	K122	14	600	WH-BLK-YEL	
124	S106	K107	14	600	WH-OR	
125	S106	K107	14	600	WH-BL	
126	S107	K108	14	600	WH-RD	
127	S107	K108	14	600	WH-BR	
128	S109	K122	14	600	WH-OR	
129	S109	K122	14	600	WH-BLK	
130	S108	K109	14	600	WH-BL	
131	S108	K109	14	600	WH-BLK-BR	
132	I109	K109	18	600	WH-YEL	
133	I108	K108	18	600	WH-BR	
134	I107	K107	18	600	WH-BLK-RD	
135	I111	K120	18	600	WH-RD	
136	I106	K102	18	600	WH-YEL	
137	I104	K110	18	600	WH-OR	
138	I105	K105	18	600	WH-BLK-RD	
139	I110	K106	18	600	WH-YEL	
140	I102	K104	18	600	WH-BL	
141	I103	K111	18	600	WH-RD	
142	I101	K10	18	600	WH-BLK	
143	R169	M108	14	600	WH-BL	
144	R165	K120	14	600	WH-BLK-YEL	
145	R171	R172	14	2500	WH-GN-BLK	
146	J109	LINK "A"			RG-8/U	
147	J101	S116			RG-59/U	
148	J102	S116			RG-59/U	
149	J103	S116			RG-59/U	
150	J104	S117			RG-59/U	
151	J105	S117			RG-59/U	
152	J106	P302			RG-59/U	EXC. "A"
153	J107	P302			RG-59/U	EXC. "B"
154	T111	R169	14	600	WH-BL	
155	T113	R159	14	600	WH-BLK	
156	T107	I101	18	600	WH-BLK-RD	
157	TB 9	S101	8	600	WH-BLK	
158	TB 10	S101	8	600	WH-BR	
159	T120	R165	14	600	WH-YEL	
160	T115	S119	14	600	WH-BLK-BR	
161	T112	S118	14	600	WH-BLK-OR	
162	T105	S119	14	600	WH-BR	
163	S130	S103	14	600	WH-YEL	
164	C145	R191			EX 496	
165	T101	S104	14	600	WH-YEL	
166	C202	S116			RG-59/U	
167	R237	GND	14	600	WHITE	
168	T108	K123	14	600	WH-GN	
169	T108	S130	14	600	WH-GN	
170	T114	T106	14	600	WH-BR	
171	T114	T106	14	600	WH-BLK-OR	
172	T106	V106	8	600	WH-BLK	
173	T106	V106	8	600	WH-RD	
174	T106	V107	8	600	WH-OR	
175	T106	V107	8	600	WH-GN	
176	T105	V104	8	600	WH-YEL	SEPARATE
177	T105	V104	8	600	WH-RD	HARNESS
178	T105	V105	8	600	WH-BLK	
179	T105	V105	8	600	WH-GN	
180	T114	V116	14	7500	WH-RD	
181	T114	V116	14	7500	WH-RD	
182	S118	R225	14	600	WH-BLK-RD	
183	T117	C103	14	600	WH-BLK-BR	
184	T117	C104	14	600	WH-BLK-YEL	
185	T112	V119	12	600	WH-RD	
186	T112	V119	12	600	WH-GN	
187	T115	TERM. 10	12	600	WH-YEL	EXC. "B"
188	T115	TERM. 11	12	600	WH-BL	EXC. "B"
189	T112	F109	14	600	WH-OR	
190	BL101	F104	14	600	WH-BLK	
191	T120	F107	14	600	WH-BL	
192	T108	F102	14	600	WH-YEL	
193	T107	F103	14	600	WH-BR	
194	T118	J108	14	600	WH-BLK-BR	
195	T118	F101	14	600	WH-BLK-YEL	
196	C157	R164	14	600	WH-OR	
197	T116	R150	14	600	WH-BLK-RD	
198	T116	F108	14	600	WH-GN	
199	T110	F110	14	600	WH-BLK-OR	
200	BL102	F105	14	600	WH-BL	
201	T113	S102	14	600	WH-OR	
202	T113	F106	14	600	WH-RD	
203	C136	R189			EX 496	
204	C135	R189			EX 496	
205	R149	F105	8	600	WH-OR	
206	V114	TERM. 10	12	600	WH-GN	
207	V114	TERM. 11	12	600	WH-RD	
208	T104	C114	18	600	WH-BLK-RD	
209	T104	C147	18	600	WH-BLK-BR	
210	T104	C148	18	600	WH-GN	
211	T104	C116	18	600	WH-BL	
212	C146	LINK "B"			RG-8/U	
213	C146	R238			RG-8/U	
214	R104	M102	14	600	WH-RD	
215	R182	C160			EX 496	
216	C157	S119	14	600	WH-OR	
217	R146	S101	8	600	WH-RD	
218	R148	S101	8	600	WH-OR	
219	R159	S111	14	600	WH-GN	
220	R159	TERM. 14	14	600	WH-GN	EXC. "A"
221	R159	TERM. 14	14	600	WH-GN	EXC. "B"
222	R191	R192			EX 496	
223	R161	R162	14	600	WH-BLK	
224	R161	C101	14	600	WH-RD	
225	R171	C140	14	600	WH-BL	
226	R149	T102	8	600	WH-YEL	
227	R147	T102	8	600	WH-BLK	
228	S119	TERM. 13	14	600	WH-RD	EXC. "B"
229	S118	TERM. 13	14	600	WH-BLK-RD	EXC. "A"
230	S111	C101	14	600	WH-RD	
231	S111	C140	14	600	WH-BL	
232	S114	C147	14	600	WH-BLK-BR	
233	S114	C148	18	600	WH-GN	
234	M110	C102	14	600	WH-GN	
235	S120	TERM. 9	14	600	WH-YEL	EXC. "A"
236	S120	TERM. 1	14	600	WH-BLK-BR	EXC. "A"
237	S120	TERM. 2	14	600	WH-BLK-OR	EXC. "A"
238	S120	TERM. 3	14	600	WH-BLK-YEL	EXC. "A"
239	S120	TERM. 4	14	600	WH-BL	EXC. "A"
240	S120	TERM. 8	14	600	WH-BR	EXC. "A"
241	S120	TERM. 5	14	600	WH-OR	EXC. "A"
242	S120	TERM. 6	14	600	WH-BLK	EXC. "A"
243	S120	TERM. 7	14	600	WH-RD	EXC. "A"
244	S120	TERM. 9	14	600	WH-YEL	EXC. "B"
245	S120	TERM. 1	14	600	WH-BLK-BR	EXC. "B"
246	S120	TERM. 2	14	600	WH-BLK-OR	EXC. "B"
247	S120	TERM. 3	14	600	WH-BLK-YEL	EXC. "B"
248	S120	TERM. 4	14	600	WH-BL	EXC. "B"
249	S120	TERM. 8	14	600	WH-BR	EXC. "B"
250	S120	TERM. 5	14	600	WH-OR	EXC. "B"
251	S120	TERM. 6	14	600	WH-BLK	EXC. "B"
252	S120	TERM. 7	14	600	WH-RD	EXC. "B"
253	R197	C138	14	600	WH-YEL	
254	R196	C139	14	2500	WH-GN-BLK	
255	R107	R245			EX 496	
256	R181	S112	14	600	WH-OR	
257	R154	S129			EX 496	
258	R156	S129			EX 496	
259	R200	C134			EX 496	
260	K101	S110	14	600	WH-OR	
261	K101	S110	14	600	WH-RD	
262	R153	R131	14	600	WH-RD	
263	R157	R136	14	600	WH-GN	
264	C187	P303			RG-59/U	EXC. "B"
265	C186	P303			RG-59/U	EXC. "A"
266	K102	R150	14	600	WH-BLK-YEL	
267	K102	R150	14	600	WH-BLK-RD	
268	K102	R151	14	600	WH-BLK-BR	
269	K102	R151	14	600	WH-BLK-OR	
270	K101	F101	8	600	WH-OR	
271	R140	F106	14	600	WH-RD	
272	K120	F107	14	600	WH-BLK-RD	
273	R139	F107	14	600	WH-BL	
274	R138	F109	14	600	WH-OR	
275	R145	F110	14	600	WH-BLK-OR	
276	K121	F110	14	600	WH-GN	
277	K120	S102	14	600	WH-BLK-OR	
278	K120	S102	14	600	WH-BLK-BR	
279	K120	S102	14	600	WH-BLK-YEL	
280	K120	S102	14	600	WH-BR	
281	F106	S102	14	600	WH-GN	
282	K120	S102	14	600	WH-YEL	
283	S102	S122	14	600	WH-RD	
284	R164	S111	14	600	WH-OR	
285	R108	M105	14	600	WH-YEL	
286	R108	S111	14	600	WH-BLK	
287	R107	M104	14	600	WH-BR	
288	R105	S112	14	600	WH-RD	
289	S113	C149	14	600	WH-OR	
290	S113	C150	14	600	WH-BLK	
291	S113	C151	14	600	WH-BLK-YEL	
292	S113	C152	14	600	WH-GN	
293	M111	TC101			SUPPLIED	
294	M111	TC101			WITH METER	
295	C152	TY106	14	600	WH-GN	
296	C151	TY105	14	600	WH-BLK-YEL	
297	C150	TY104	14	600	WH-BLK	
298	C149	TY103	14	600	WH-OR	
299	TY102	C115	18	600	WH-GN	
300	TY101	C113	18	600	WH-BLK-BR	
301	C106	C139	14	2500	WH-GN-BLK	
302	C111	C141	14	2500	WH-GN-BL	
303	C141	R257	14	2500	WH-GN-BL	
304	C105	C138	14	600	WH-YEL	
305	C110	C140	14	600	WH-BL	
306	L116	S116			RG-59/U	
307	L115	S116			RG-59/U	
308	L114	S116			RG-59/U	
309	C176	P304			RG-59/U	
310	P111	P304			RG-59/U	
311	S116	R235			RG-59/U	
312	S116	R218			RG-59/U	
313	S116	R217			RG-59/U	
314	S116	R202			RG-59/U	
315	S116	R201			RG-59/U	
316	S116	R236			RG-59/U	
317	F101	J108	14	600	WH-BLK-YEL	
318	K121	M107	14	600	WH-GN	
319	K121	M107	14	600	WH-BR	
320	M107	S110	14	600	WH-BR	
321	M107	S110	14	600	WH-GN	
322	R153	K112	14	600	WH-YEL	
323	R157	K113	14	600	WH-OR	
324	R158	K114	14	600	WH-BR	
325	K111	K101	14	600	WH-OR	
326	K110	TERM. 7	14	600	WH-OR	
327	K120	K110	18	600	WH-BLK	
328	TERM. 18	K110	14	600	WH-GN	
329	T102	T103	14	600	WH-OR	
330	T102	T103	8	600	WH-BLK	
331	T102	T103	14	600	WH-GN	
332	L101	C157	14	600	WH-OR	
333	L101	C156	14	600	WH-RD	
334	T113	C157	14	600	WH-BLK	
335	T119	V118	14	600	WH-YEL	
336	T119	V118	14	600	WH-GN	
337	T113	V118	14	600	WH-BLK-RD	
338	T113	V118	14	600	WH-BLK-BR	
339	T111	V112	14	600	WH-BL	
340	T111	V112	14	600	WH-YEL	
341	R155	S127			EX 496	
342	TB. 4	S125	14	600	WH-GN	
343	T101	T102	8	600	WH-BLK	
344	S123	S131	14	600	WH-BL	
345	S127	S128			EX 496	
346	S127	S128			EX 496	
347	S127	S128			EX 496	
348	T103	S104	14	600	WH-BLK	
349	S104	K120	14	600	WH-BLK-BR	
350	T102	T101	8	600	WH-YEL	
351	TERM. 12	GND.	14	600	WHITE	EXC. "B"
352	TERM. 12	GND.	14	600	WHITE	EXC. "A"
353	T108	TB 1	14	600	WH-OR	
354	T108	TB 6	14	600	WH-GN	
355	T117	T115	14	600	WH-OR	
356	T118	T108	14	600	WH-RD	
357	T111	T109	14	600	WH-BR	
358	T111	T117	14	600	WH-OR	
359	T109	T106	14	600	WH-BLK-OR	
360	T109	T106	14	600	WH-BR	
361	T108	BL102	14	600	WH-RD	
362	T109	V108				
363	T109	V108				
364	T109	V109			¼" O.D. x 3/16" I.D.	
365	T109	V109			SOFT COPPER	
366	T110	V110			TUBING, CAD. PL.	
367	T110	V110				
368	T110	V111				
369	T110	V111				
370	T108	BL101	14	600	WH-RD	
371	BL102	R146	14	600	WH-RD	
372	C136	R182			EX 496	
373	T116	FEED THRU				
374	T116	FEED THRU				
375	T109	T116			¼" O.D. x 3/16" I.D.	
376	T109	T116			COPPER TUBING, CAD. PL.	
377	T116	R187				
378	C136	R155				
379	R256	R200			½" x 1/16" COPPER STRAP	
380	R200	R152			¼" O.D. x 3/16" I.D.	
381	R168	C143			SOFT COPPER TBG., CAD. PL.	
382	C143	R154			EX 496	
383	R256	T110			¼" O.D. x 3/16" I.D.	
384	T110	T110			SOFT COPPER TBG., CAD. PL.	
385	K112	K105	14	600	WH-BLK-YEL	
386	K112	K107	14	600	WH-GN	
387	K112	K107	14	600	WH-OR	
388	K114	K109	14	600	WH-BL	
389	K108	K114	14	600	WH-OR	
390	K107	K109	14	600	WH-GN	
391	K108	K111	18	600	WH-BLK	
392	K119	K108	14	600	WH-RD	
393	K105	K106	14	600	WH-BLK-BR	
394	(Not used)					
395	K104	K111	14	600	WH-OR	
396	K106	K111	14	600	WH-BLK-OR	
397	K105	K107	14	600	WH-BLK	
398	K106	K108	18	600	WH-BLK	
399	K108	K110	14	600	WH-GN	
400	TERM. 2	K109	14	600	WH-OR	
401	K122	K112	14	600	WH-BLK-BR	
402	K109	K107	14	600	WH-OR	
403	TERM. 1	K122	14	600	WH-GN	
404	TERM. 1	TERM. 9	14	600	WH-GN	
405	TERM. 9	TERM. 17	14	600	WH-GN	
406	TERM. 6	TERM. 14	14	600	WH-OR	
407	TERM. 8	K121	14	600	WH-BL	
408	TERM. 8	TERM. 13	14	600	WH-BL	
409	TERM. 12	TERM. 20	14	600	WH-BLK-RD	
410	TERM. 3	K122	14	600	WH-BLK	
411	TERM. 11	TERM. 12	14	600	WH-BLK-RD	
412	K103	K101	14	600	WH-GN	
413	TERM. 20	K103	14	600	WH-BLK-RD	
414	TERM. 15	K101	14	600	WH-BR	
415	K122	K121	14	600	WH-OR	
416	K102	K120	18	600	WH-BLK	
417	TERM. 19	K102	14	600	WH-YEL	
418	K121	K101	8	600	WH-YEL	
419	K101	K103	8	600	WH-YEL	
420	K120	K101	14	600	WH-GN	
421	K121	K102	14	600	WH-OR	
422	K102	K103	14	600	WH-BLK-YEL	
423	K102	K103	14	600	WH-BLK-BR	
424	R222	R106			EX 496	
425	R189	R190			EX 496	
426	R151	F108	14	600	WH-BLK-OR	
427	K104	K121	14	600	WH-BR	
428	R193	R220			EX 496	
429	C112	C111	14	2500	WH-GN-BL	
430	S124	S131	14	600	WH-GN	
431	R256	C144				
432	C145	GND.				
433	C143	GND.				
434	C144	GND.				
435	C135	GND.			¼" O.D. x 3/32 I.D.	
436	C136	GND.			SOFT COPPER	
437	TY113	FEED THRU			TUBING, CAD. PL.	
438	TY112	FEED THRU				
439	R152	R156				
440						
441	L101	T119	14	600	WH-BLK	
442	T112	T115	14	600	WH-OR	
443	T111	T119	14	600	WH-BR	
444	T109	T110	14	600	WH-BLK-OR	
445	T109	T110	14	600	WH-BR	
446	T110	T104	14	600	WH-BLK-OR	
447	T110	T104	14	600	WH-BR	
448	K123	GND.	14	600	WHITE	
449	TY107	GND.			⅜" x 1/32" STRAP	
450	S104	S104	14	600	WH-BLK	
451	S118	S119	14	600	WH-BR	
452	S118	S119	14	600	WH-OR	
453	S118	S119	14	600	WHITE	
454	S119	R237	14	600	WHITE	
455	T107	T118	14	600	WH-RD	
456	T105	T106	14	600	WH-BR	
457	T105	T106	14	600	WH-BLK-OR	
458	T114	T117	14	600	WH-BR	
459	(Not used)					
460	(Not used)					
461	COAX	R212	18	600	WHITE	
462	COAX	R211	18	600	WHITE	
463	K122	K122	14	600	WH-GN	
464	TERM. 4	K122	14	600	WH-RD	
465	K122	TERM. 10	14	600	WH-YEL	
466	K116	K119	14	600	WH-OR	
467	TERM. 16	K121	14	600	WH-OR	
468	TERM. 17	K120	14	600	WH-GN	
469	TERM. 5	TERM. 6	14	600	WH-OR	
470	TERM. 14	TERM. 16	14	600	WH-OR	
471	TERM. 17	TERM. 18	14	600	WH-GN	
472	R167	R168			⅜" x 1/32" STRAP	
473	R166	R255			¼" O.D. x 3/16" I.D.	
474	R167	FEED THRU			COPPER TUBING	
475	R188	C135			CAD. PL.	
476	R172	R173	14	2500	WH-GN-BLK	
477	R106	R193			EX 496	
478	R196	R195	14	2500	WH-GN-BL	
479	K121	K121				
480	R190	R192			⅜" x 1/32" COPPER STRAP	
481	F101	F105			CAD. PL.	
482	FD. THRU	R239				
483	V115	V120	14	600	WH-YEL	
484	V115	V120	14	600	WH-BL	
485	V114	V119	14	600	WH-GN	
486	V114	V119	14	600	WH-RD	
487	S122	S123	14	600	WH-BL	
488	S126	S127			EX 496	
489	S126	S127			EX 496	
490	S126	S127			EX 496	
491	S128	S129			EX 496	
492	S128	S129			EX 496	
493	S128	S129			EX 496	
494	S113	M106	14	600	WHITE	
495	S113	M106	14	600	WH-BLK	
496	M108	GRND.	14	600	WH-BLK	
497	M108	M104	14	600	WH-BL	
498	S112	M103	14	600	WH-GN	
499	M103	GRND.	14	600	WH-BLK	
500	M102	GRND.	14	600	WHITE	
501	S111	M105	14	600	WHITE	
502	S111	M104	14	600	WH-BL	
503	S110	M101	14	600	WH-BLK	
504	S110	M101	14	600	WH-GN	
505	S114	M109	14	600	WH-BLK	
506	S114	M109	14	600	WH-GN	
507	M110	GRND.	14	600	WH-BLK	
508	S121	M112	14	600	WH-RD-OR	
509	S121	M112	14	600	WH-BL	
510	S121	S120	14	600	WH-BL	
511	S121	S120	14	600	WH-OR	
512	S121	S120	14	600	WH-BLK-RD	
513	S121	S120	14	600	WH-GN	
514	C148	TY102	18	600	WH-GN	
515	C147	TY101	18	600	WH-BLK-BR	
516	S124	S125	14	600	WH-BL	
517	C119	STAND-OFF			EX 496	
518	C118	STAND-OFF			EX 496	
519	TY110	STAND-OFF				
520	TY111	STAND-OFF				
521	C165	V107				
522	C164	V104				
523	C165	L117-B				
524	C164	L117-A				
525	L109	L117-A			¼" O.D. x 3/16" I.D.	
526	L118	TC101			COPPER TUBING,	
527	L118	C200			CAD. PL.	
528	R122	S115				
529	R122	LINK "A"				
530	C166	C167				
531	C164	L109				
532	C167	LINK "A"				
533	TY105	TY106			⅜" x 1/32" COPPER	
534	TY103	TY104			STRAP CAD. PL.	
535	FD. THRU	V101	14	600	WHITE	
536	V103	C198	14	600	WHITE	
537	V102	C199	14	600	WHITE	
538	C161	L116	14	600	WH-RD	
539	C160	L116	14	600	WH-RD	
540	C118	L116	14	600	WH-RD	
541	C119	L116	14	600	WH-RD	
542	C166	L119	14	600	WH-RD	
543	C200	L119	14	600	WH-RD	
544	TBG.	L119	14	600	WH-BL	
545	C154	V104			½" x 1/16" COPPER STRAP	
546	C155	V106				
547	COAX. S	R122	18	600	WHITE	
548	(Not used)					
549	JUMPER		14	600	WHITE	
550	JUMPER		14	600	WH-GN	
551	JUMPER		18	600	WH-GN	
552	JUMPER		14	600	WH-BL	
553	JUMPER				RG-59/U	
554	JUMPER		18	600	WHITE	
555	T111	T119	14	600	WH-OR	
556	JUMPER		14	600	WH-BR	
557	TY107	STAND-OFF			¼" O.D. COPPER TUBING	
558	JUMPER				¼" O.D. COPPER TUBING	
559	JUMPER				⅜" x 1/32" COPPER STRAP	
560	R204	C184			RG-59/U	
561	R203	C185			RG-59/U	
562	C141	T123			RG-59/U	
563	T123	S110	14	600	WH-BR	
564	T123	F109	14	600	WH-OR	
565	R258	V122			RG-59/U	
566	R259	C146			RG-59/U	
567	T123	V121	18	600	WH-BLK	
568	T123	V121	18	600	WH-YEL	
569	V121	V122	18	600	WH-YEL	
570	V121	V122	18	600	WH-BLK	
571	K103	K103	14	600	WH-BLK-RD	
572	K103	K117 TERM. 10	14	600	WH-YEL	
573	STD. OFF	L116	14	600	WH-BL	
574	C180	V114	18	600	WH-BLK	
575	R229	V113	18	600	WH-GN	
576	V113	C196	18	600	WH-RD	
577	R225	V119	18	600	WH-BL	
578	R223	V119	18	600	WH-OR	
579	R207	V114	18	600	WH-BLK-RD	
580	C183	V115	18	600	WH-BLK	
581	R232	V120	18	600	WH-GN	
582	V120	C197	18	600	WH-RD	
583	R226	V120	18	600	WH-BL	
584	R224	V120	18	600	WH-OR	
585	R208	V115	18	600	WH-BLK-RD	
586	K111	K110	18		WH-RD	
587	K111	K110	18		WH-BLK	
588	K108	K109	18		WH-GR	
589	K109	K108	18		WH-BLK	
590	K107	K106	18		WH-BLK	
591	K106	K104	18		WH-OR	
592	K104	K105	18		WH-BLK	
593	K114	K113	18		WH-BLK-BRN	
594	K114	K112	18		WH-BLK-BRN	
595	K114	K113	18		WH-BL	
596	K114	K112	18		WH-GR	
597	K114	K113	18		WH-GR	
598	K113	K112	18		WH-OR	
599	CR101	S116 D-14			RG-58U	
600	C205	S116 B-15			RG-58U	

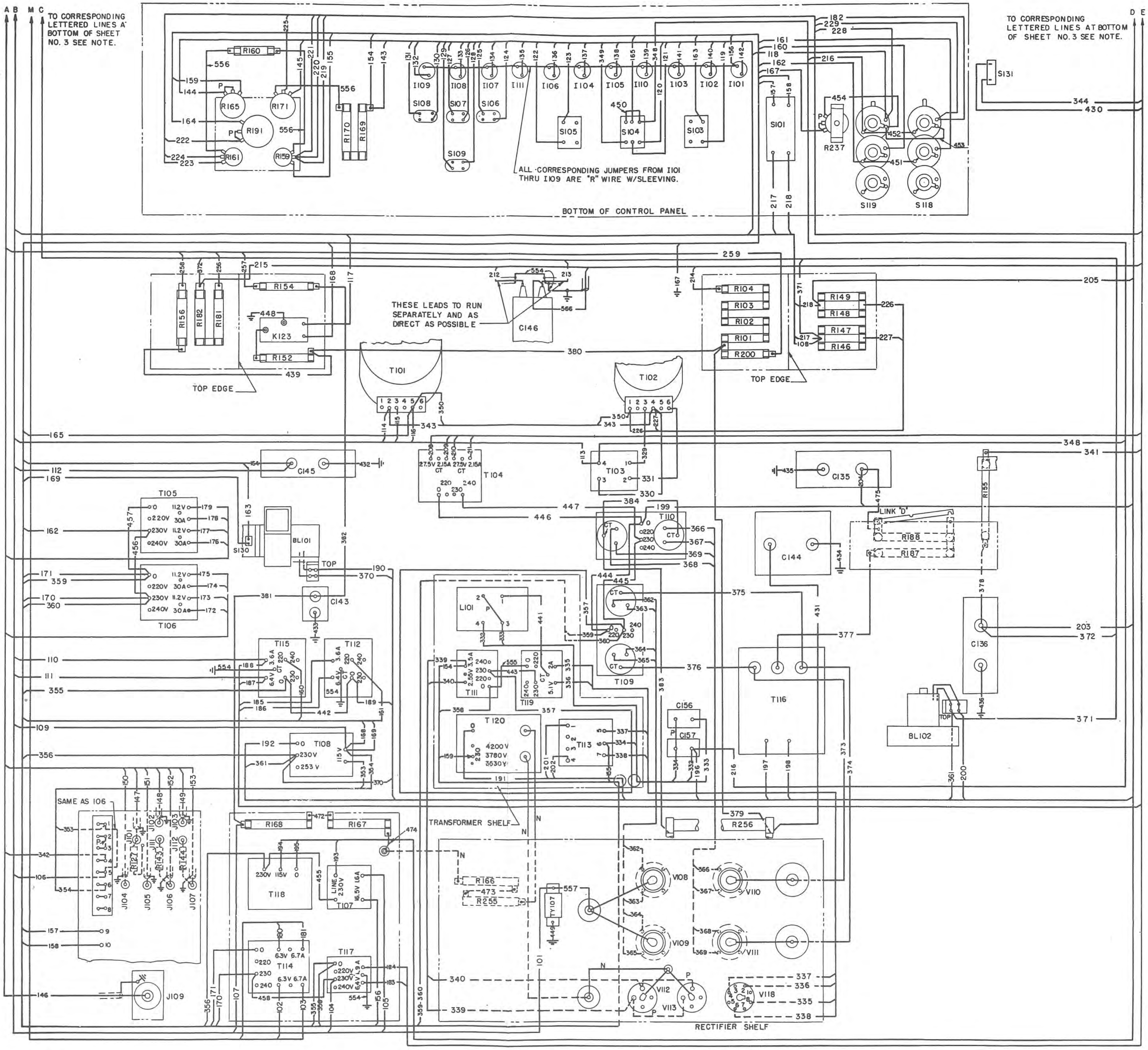
WIRING LEGEND:

N — NO. 10 AWG SOLID BARE TINNED COPPER WIRE
NS — NO. 10 AWG SOLID BARE TINNED COPPER WIRE W/GLASSFIBER SLEEVING
P — NO. 14 AWG SOLID BARE TINNED COPPER WIRE
PS — NO. 14 AWG SOLID BARE TINNED COPPER WIRE W/GLASSFIBER SLEEVING
R — NO. 18 AWG SOLID BARE TINNED COPPER WIRE
RS — NO. 18 AWG SOLID BARE TINNED COPPER WIRE W/GLASSFIBER SLEEVING

All color coded wires on Running List are stranded wires as per Spec. JAN-C-76.

EX 496 = FTR high-voltage cable, stranded copper wire, polyethylene covered with vinyl outer jacket.

Figure 7–44. Wiring Diagram Legend, Radio Transmitter Type T-325B/FPN



NOTE: LETTERS ON WIRING CHANNELS FOR REFERENCE ONLY.

Figure 7–45. Wiring Diagram, Radio Transmitter Type T–325B/FPN Power Supply and Control Panel Sections

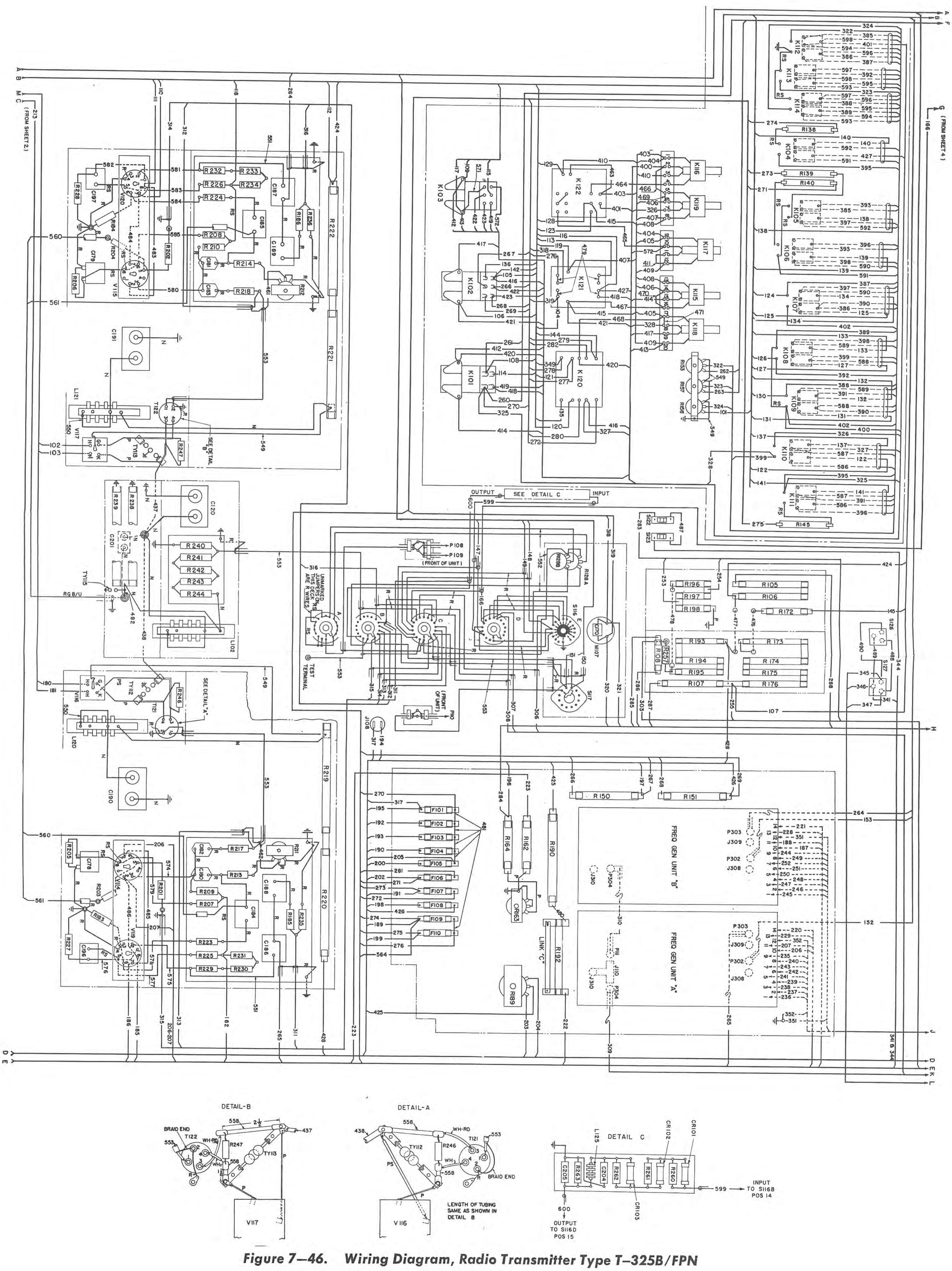


Figure 7—46. Wiring Diagram, Radio Transmitter Type T–325B/FPN Pulse-Forming and Relay Panel Sections

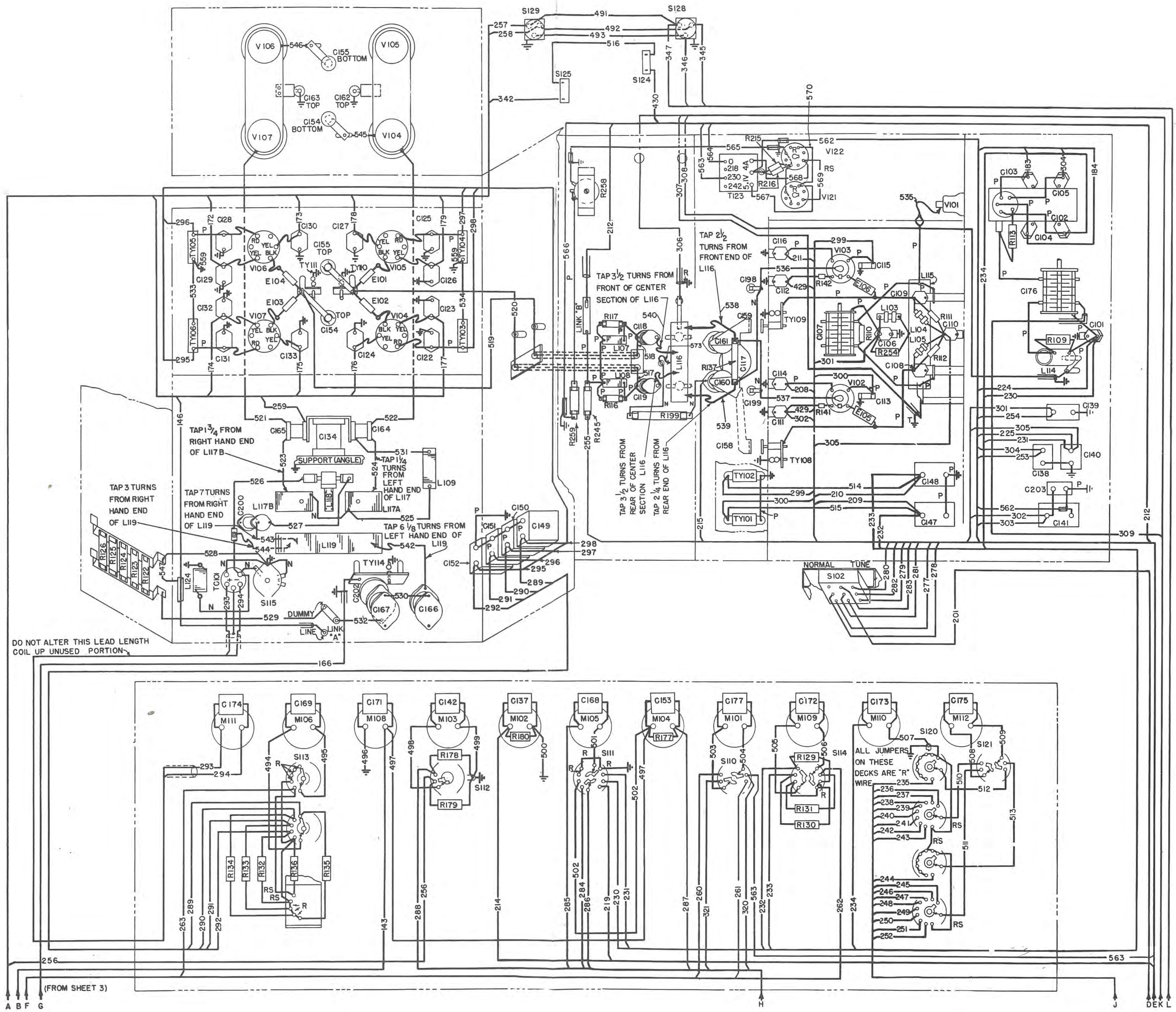


Figure 7–47. Wiring Diagram, Radio Transmitter Type T–325B/FPN IPA, PA, and Meter Panel Sections

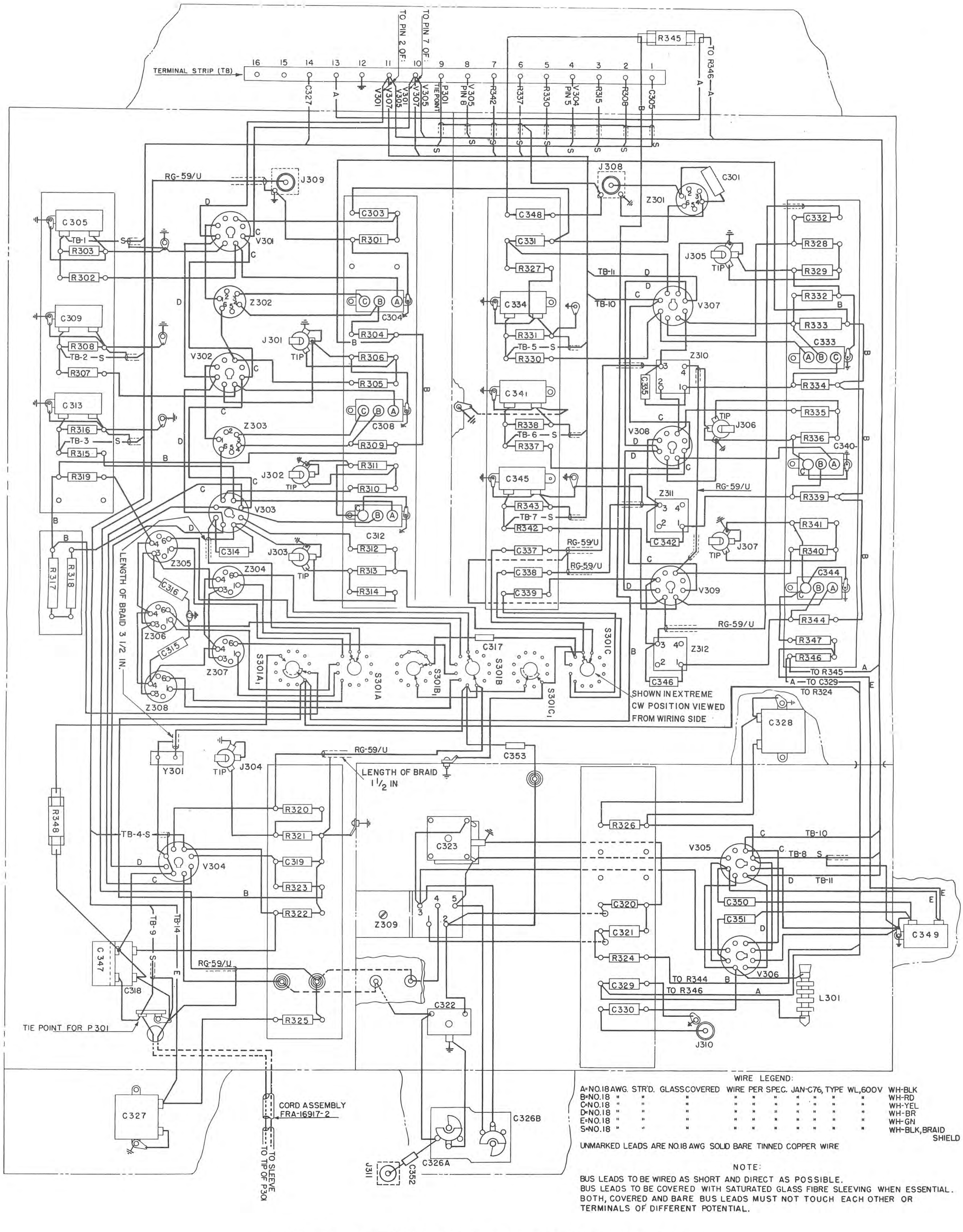


Figure 7—48. Wiring Diagram, Frequency Generating Unit

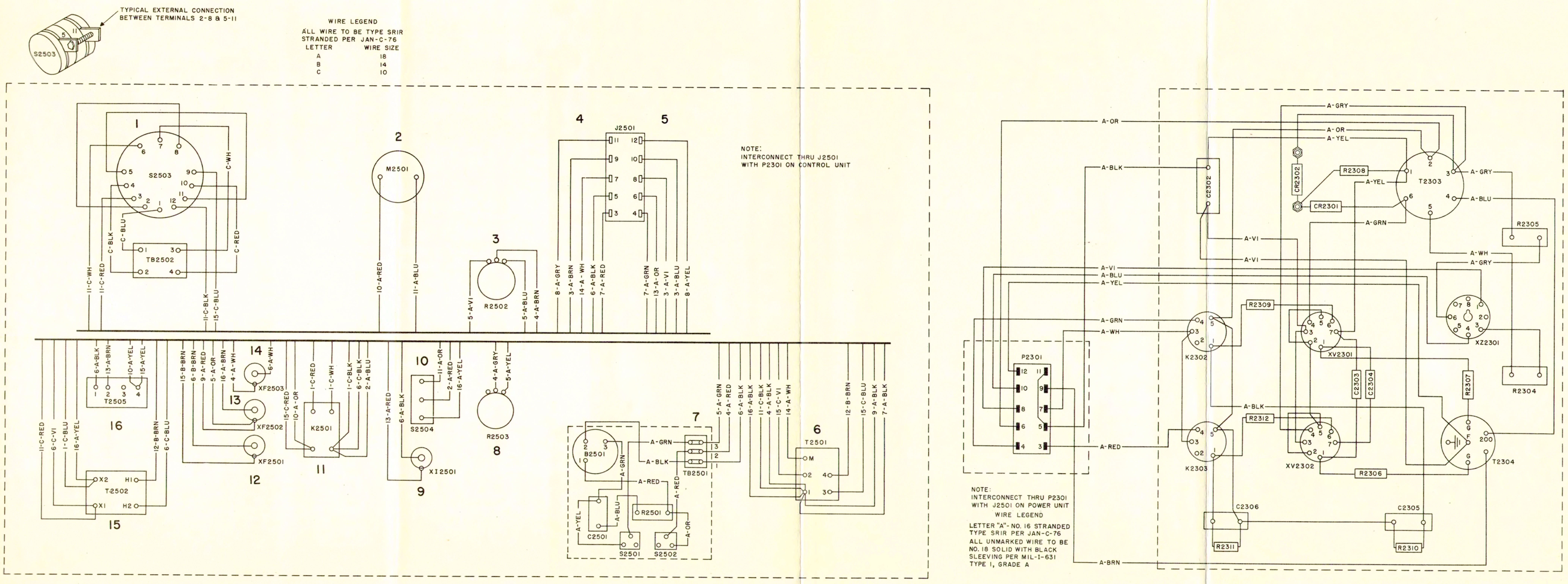


Figure 7-49. Wiring Diagram, Voltage Regulator

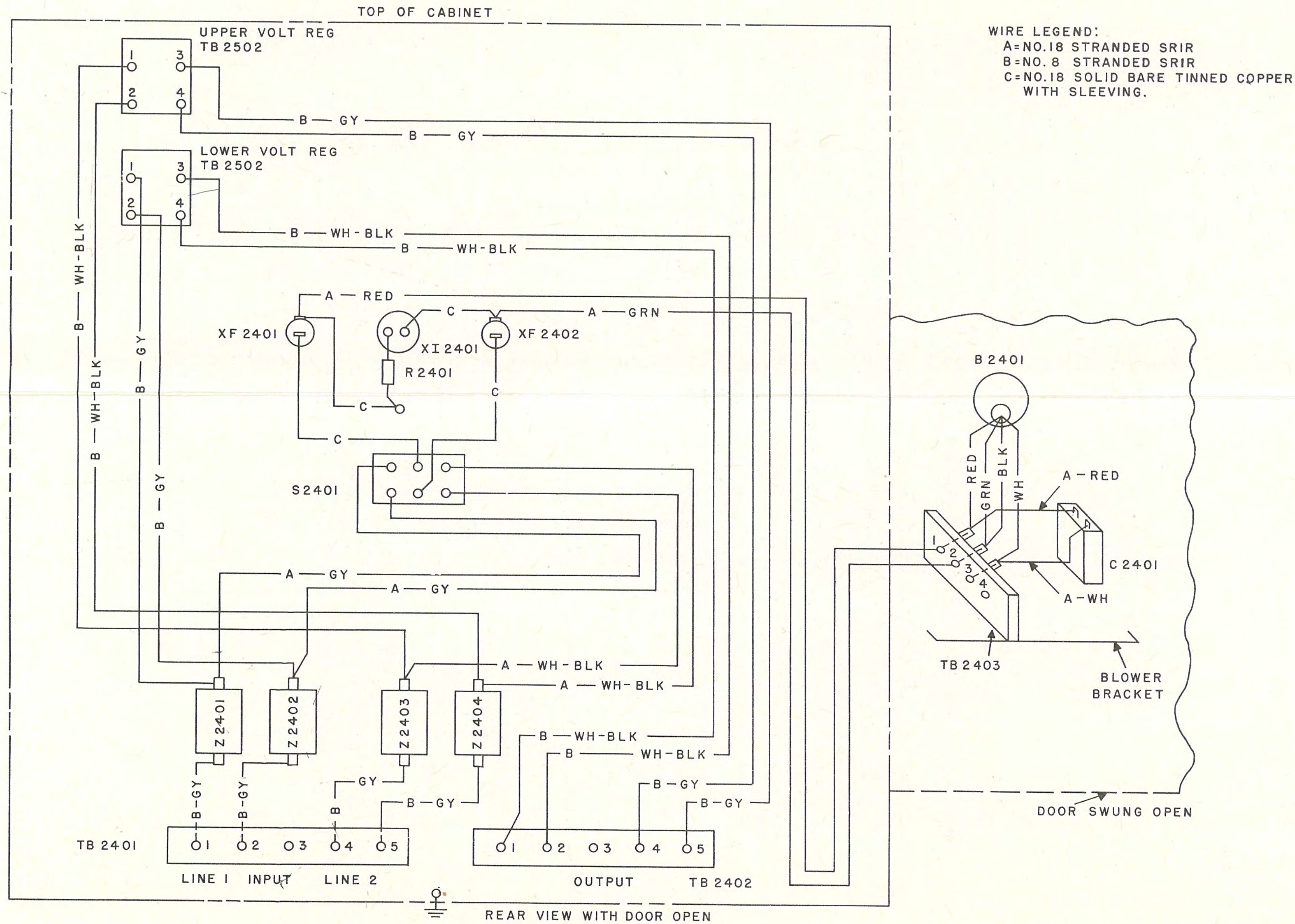
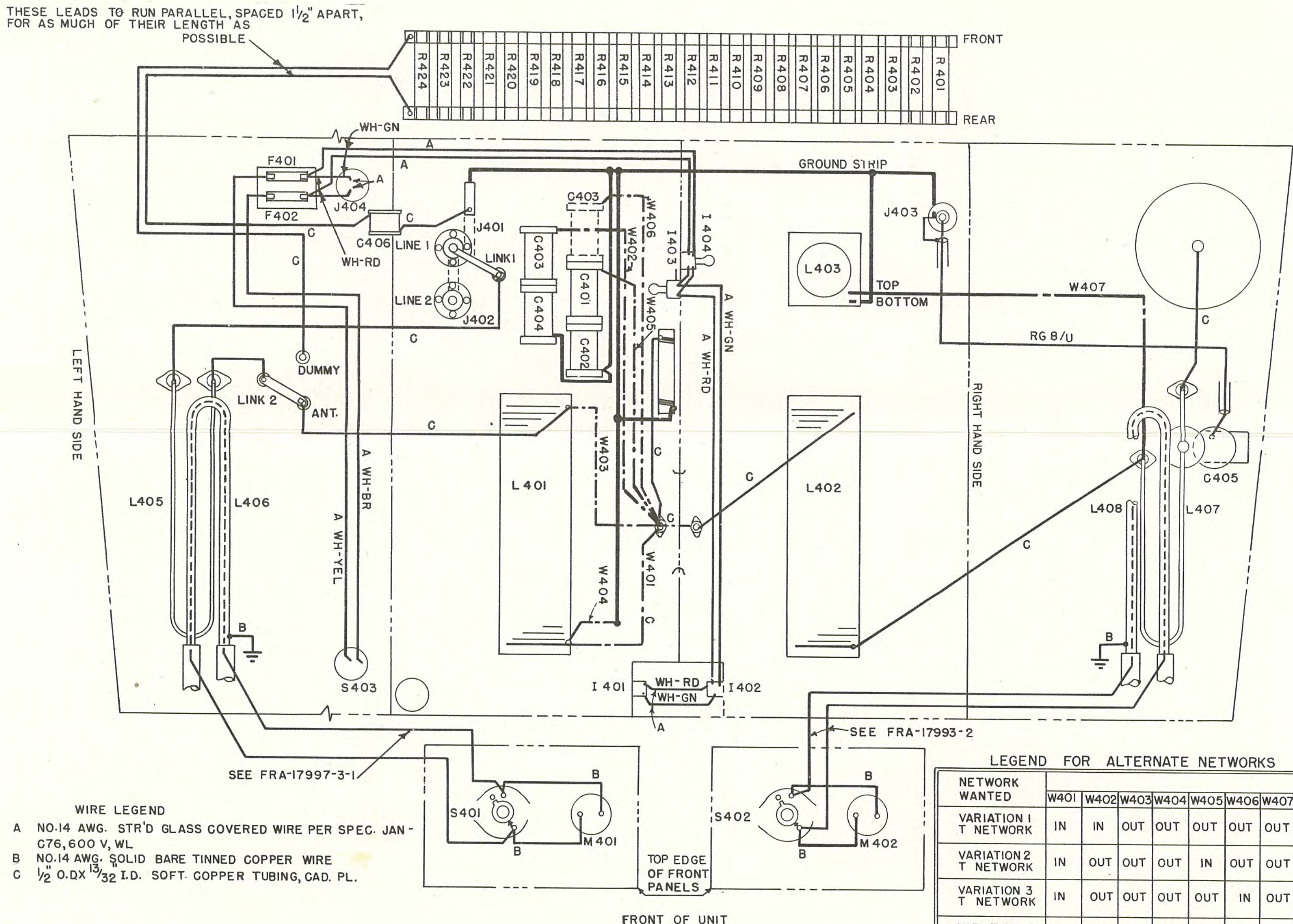


Figure 7–50. Wiring Diagram, Voltage Regulator Assembly CN–239/FPN



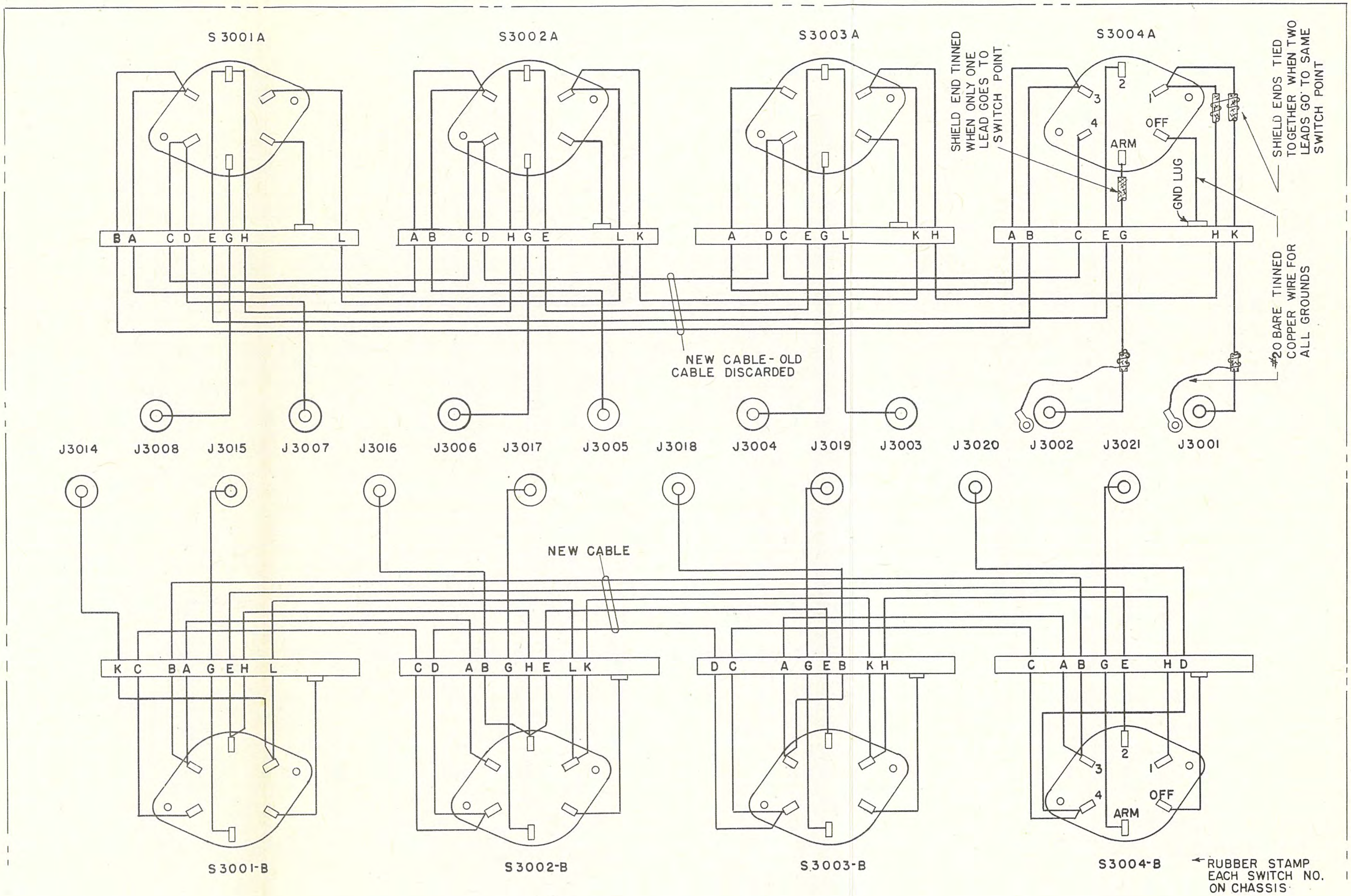
WIRE LEGEND

- A NO.14 AWG. STR'D GLASS COVERED WIRE PER SPEC. JAN-C76, 600 V, WL
- B NO.14 AWG. SOLID BARE TINNED COPPER WIRE
- C ½" O.D X $^{13}/_{32}$" I.D. SOFT COPPER TUBING, CAD. PL.

LEGEND FOR ALTERNATE NETWORKS

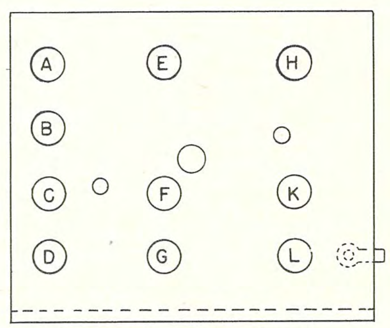
NETWORK WANTED	W401	W402	W403	W404	W405	W406	W407		
VARIATION 1 T NETWORK	IN	IN	OUT	OUT	OUT	OUT	OUT		
VARIATION 2 T NETWORK	IN	OUT	OUT	OUT	IN	OUT	OUT		
VARIATION 3 T NETWORK	IN	OUT	OUT	OUT	OUT	IN	OUT		
VARIATION 4 T NETWORK	IN	OUT	OUT	OUT	OUT	IN	IN		
L NETWORK	OUT	OUT	IN	IN	OUT	OUT	OUT		

Figure 7–51. Wiring Diagram, Antenna Coupling Unit



NOTES:

1- ALL LEADS ARE TO BE #18 STRANDED SHIELDED 600V. WIRE PER JAN-C-76 (WHITE-BLACK)
2- ALL GROUNDING JUMPERS TO BE #20 BARE TINNED COPPER WIRE
3- SHIELDS GROUNDED AS SHOWN ON SWITCH S3004
4- LETTERS ON PLATES ARE FOR PROPER HOLE IDENTIFICATION ONLY.
5- ALL SWITCH SECTIONS VIEWED FROM REAR
6- OTHER WIRING IN THIS UNIT TO REMAIN THE SAME



REAR VIEW OF SUPPORT PLATE SHOWING HOLE REFERENCE LETTERS USED ON BOTH SECTIONS FOR NEW CABLE

Figure 7–52. Wiring Diagram, Modifications to Loran Switching Equipment Navy Model UM

SECTION 8
PARTS AND SPARE PARTS LISTS (AND MISCELLANEOUS TABLES)

LIST OF TABLES

Note

Maintenance spare parts provided with the equipment are considered parts peculiar to this equipment. However, fuses and certain other parts common are also furnished with the equipment to insure an initial supply of expendable components.

TABLE 8–1. WEIGHTS AND DIMENSIONS OF SPARE PARTS BOXES

EQUIPMENT SPARES						STOCK SPARES					
SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT
	HEIGHT	WIDTH	DEPTH				HEIGHT	WIDTH	DEPTH		
1	43	15½	15½	8	123						
2	43	15½	15½	8	113						
3	43	15½	15½	8	159						
4	43	15½	15½	8	180						
5	16⅛	13⅝	17⅛	1.6	220						

TABLE 8–2. SHIPPING WEIGHTS AND DIMENSIONS OF SPARE PARTS BOXES

EQUIPMENT SPARES							STOCK SPARES						
SHIPPING BOX NUMBER	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT	SHIPPING BOX NUMBER	SPARE PARTS BOX	OVERALL DIMENSIONS			VOLUME	WEIGHT
		HEIGHT	WIDTH	DEPTH					HEIGHT	WIDTH	DEPTH		
1	1	45¾	19	18	9	222							
2	2	45¾	19	18	9	217							
3	3	45¾	19	18	9	270							
4	4	45¾	19	18	9	260							
5	5	20½	21¾	16¼	4	250							

TABLE 8–3. LIST OF MAJOR UNITS

SYMBOL GROUP	QUANTITY	NAME OF MAJOR UNIT	NAVY TYPE	DESIGNATION
101-299	2	Radio Transmitter Type T–325B/FPN		
101-299***	2	Monitor Oscilloscope		
301-399	4	Frequency Generating Unit		
501-599	1	Terminal Box Type J–455A/FPN		
2101-2199*	4	Modification Kit for Navy Model UE–1 Timer		
2300-2399	2	Voltage Regulator Control Unit		
2400-2499	1	Voltage Regulator Assembly Cabinet		
2500-2599	2	Voltage Regulator Less Control Unit		
3001-3999**	1	Modification of Switching Equipment, Navy Model UM		

*Not supplied under this contract.
**Modified under previous contracts.
***Parts and spare parts for Monitor Oscilloscope listed separately in table 8–5.

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101*)

PARTS									SPARE PARTS				
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP. BOX	EQUIP. QUAN.	STOCK BOX	STOCK QUAN.
A101-1 to A101-3	MOUNT, vibration: square mtg.; load rating 3-5 lbs. (shipboard) or 3-7 lbs. (mobile and other); 1¾" sq. x 1" h.; rubber cushion; stainless steel sleeve (¼" diam. hole) and holder; four 0.166" diam. mtg. holes on 1⅜" x 1⅜" ctrs.	Motor Mount		17-M-75007-6676	L. N. Barry LW-5203		A101	3					
A102-1 to A102-3	MOUNT, vibration: square mtg.; load rating 14-18 lbs. (shipboard) or 14-41 lbs. (other); 3" sq. x 1½" h.; rubber cushion; steel sleeve (5/16"-18 tapped hole) and holder; four 0.266" diam. mtg. holes on 2½" x 2½" ctrs.; metal cover on top	Motor Mount		17-M-75199-6776	L. N. Barry C-2015T		A102	3					
B2401	BLOWER: 110 cfm; motor, 1/40 hp; 230 v ±15%, 50-65 cps; single phase; capacitor start, cont operation; fungus proofed	Cabinet Cooling		17-B-21189-3370	Ripley #8432	A1016424-2	B2401	1					
B2501	MOTOR, AC: synchronous type; 115 v, 45-65 cps; single phase; 75 inch-ounce torque; 75 rpm CW or CCW rotation; dustproof; −55° C to +76° C ambient temp; rated for operation to 10,000 feet; 5-3/32" lg (excl. shaft) x 4⅛" diam o/a; shaft, plain, 0.375" diam x 13/16" lg from frame; 3 screw type term; fixed mtg base; 3 mtg holes, #10-32 tap ½" d, 120° apart on 1-½" rad from center of shaft.	Motor Drive for T2501		17-M-54310-2875		C1040751	B2501	1	1 VR	6	1		25
BL101	BLOWER: centrifugal vane; electric motor; non-portable; guarded; motor: 1/6 hp., 1425-1750 rpm., 50-60 cps., 1 phase, 115/230 vAC., 3.3/1.7 amp., 13" lg. x 12" wd. x 14½" h., o/a; 630 cfm. at 1750 rpm.; direct drive; counterclockwise upblast outlet, 8½" x 7¼"; cast iron housing; three ⅜" diam. holes in mtg. bracket form isosceles triangle w/5" lg. base and 5½" lg. sides	Tube Cooling		17-B-21188-6375	ILG Elec #B12 Discharge Position #6F**		BL101	1					

*The Type T-325B/FPN Transmitter and the Monitor Oscilloscope (OS101) both have circuit symbols in the 100-200, 200-300, and 300-400 series. To avoid confusion references to an oscilloscope circuit symbol should always indicate that it is part of the Monitor Oscilloscope.

**Tropicalized in accordance with Navy Dept., Bureau of Ships letter 3079C (930B), May 5, 1945 (paragraphs 1 and 2 only), entitled "Requirements for tropicalization," plus JAN-T-152 and JAN-C-173.

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
BL102	FAN: propeller; elec. motor oper.; four 10" diam. metal blades; non-portable; guarded by round metal housing, open at front; motor: 1/20 hp., 230v., 60 cps., 1 phase 460 ma., 1750 rpm., 55 deg. C temp. rise for continuous oper.; 10" lg. x 12¾" diam. o/a; 200 cfm. at ½" static pressure at 1750 rpm.; direct drive, single speed, 2 wire leads incl.; cast aluminum housing, silver color finish; two ¼" diam. holes on housing fl. ¾" c to c and two 9/32" diam. holes on mtg. bracket 4" c to c; non-reversible; tropicalized	Components Cooling		17-F-1068-150	Propell-air #10A4** (modified)	RC-483-12	BL102	1					
C101	CAPACITOR, fixed: mica; 0.033 μf ±10%; 600 vdcw.; spec. JAN-C-5	1st IPA Grid Bias By-pass	CM55-B333K	16-C-34783-4985			C101 to C105, C113 to C116	9	1	1	5		10
C102	Same as C101	1st IPA Cathode By-pass											
C103	Same as C101	1st IPA Fil By-pass											
C104	Same as C101	1st IPA Fil By-pass											
C105	Same as C101	1st IPA Screen By-pass											
C106	CAPACITOR, fixed: mica; 0.01 μf ±10%; 1200 vdcw.; spec. JAN-C-5	1st IPA Plate By-pass	CM55-B103K	16-C-33623-3642			C106, C110, C122 to C133	14	2	1	7		10

C107	CAPACITOR, variable: air dielectric; plate meshing type; dual section; 10 to 150 $\mu\mu$f ea. section; SLC characteristic; 0.030" air gap; 3-17/32" lg. x 3-5/32" wd. x 2-5/16" h. excluding shaft; shaft ¼" diam. x 1-5/32" lg. beyond bushing; bushing 11/32" lg. FMS; extension shaft adj.; 15 polished aluminum plates ea. section; 180 deg. CW rotation decrease capacitance; mycalex insulation; stud term; three ½" lg. hex mounting post w/ #6-32 tap spaced 90 deg. apart on ¼" rad.	1st IPA Plate Tuning		16-C-62794-1562	Cardwell MR-150-BD		C107	1					
C108	CAPACITOR, fixed: mica; 0.001 μf ±10%; 2500 vdcw.; spec. JAN-C-5	1st IPA-2nd IPA Coupling	CM55-B102K	16-C-31091-6667			C108, C109	2					
C109	Same as C108	1st IPA-2nd IPA Coupling											
C110	Same as C106	2nd IPA Grid Bias By-pass											
C111	CAPACITOR, fixed: mica; 0.015 μf ±10%; 2500 vdcw.; spec. JAN-C-5	2nd IPA Screen By-pass	CM60-B153K	16-C-34045-9588			C111, C112	2					
C112	Same as C111	2nd IPA Screen By-pass											
C113	Same as C101	2nd IPA Fil By-pass											
C114	Same as C101	2nd IPA Fil By-pass											
C115	Same as C101	2nd IPA Fil By-pass											
C116	Same as C101	2nd IPA Fil By-pass											
C117	CAPACITOR, fixed: mica; 0.0075 μf ±5%; 10,000 vdcw.; spec. JAN-C-5	2nd IPA Plate By-pass	CM85-B752J	16-C-33198 4192			C117	1					
C118	CAPACITOR, fixed: mica; 0.002 μf ±5%; 15,000 v. AC peak; spec. JAN-C-5	2nd IPA PA Coupling	CM85-B202J	16-C-31800 7698			C118, C119, C164, C165	4					

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C119	Same as C118	2nd IPA-PA Coupling											
C120	CAPACITOR, fixed: paper dielectric; 120,000 $\mu\mu f$ ±5%; 3000 vdcw.; HS metal case, 3¾" lg. x 3-3/16" wd. x 3-13/16" h. o/a less term. and mtg. bkts.; 2 stud term. mtd. on top, 2¼" h., on porcelain pillars; no internal ground connections; mtd. by standard removable capacitor mtg. bkts.	Pulse Forming Network		16-C-45820-6551	Cornell-Dubilier #PN101		C120	1	3	1	1		20
C121	Not used												
C122	Same as C106	PA Fil CT By-pass											
C123	Same as C106	PA Fil By-pass											
C124	Same as C106	PA Fil By-pass											
C125	Same as C106	PA Fil CT By-pass											
C126	Same as C106	PA Fil By-pass											
C127	Same as C106	PA Fil By-pass											
C128	Same as C106	PA Fil CT By-pass											
C129	Same as C106	PA Fil By-pass											
C130	Same as C106	PA Fil By-pass											

C131	Same as C106	PA Fil CT By-pass											
C132	Same as C106	PA Fil By-pass											
C133	Same as C106	PA Fil By-pass											
C134	CAPACITOR, fixed: mica; 5100 μμf ±5%; 25,000 vdcw.; spec. JAN-C-5	PA Plate By-pass	CM95-B512J	16-C-32724-4109			C134	1					
C135	CAPACITOR, fixed: paper; 2 μf ±10%; 10,000 vdcw.; spec. JAN-C-25	2nd IPA Plate Pulse By-pass	CP70-D1ES205K with CP07FM1 Brackets	16-C-49206-9972			C135, C136	2					
C136	Same as C135	2nd IPA Plate Pulse By-pass											
C137	CAPACITOR, fixed: mica; 0.01 μf ±20%; 600 vdcw.; spec. JAN-C-5	Meter (M102) By-pass	CM45-A103M	16-C-33628-1232			C137, C142, C153, C168 to C175, C177	12					
C138	CAPACITOR, fixed: paper; 2 μf ±10%; 600 vdcw.; spec. JAN-C-25	1st IPA Screen Pulse By-pass	CP54-B1EF-205K	16-C-49197-3897			C138, C140, C184, C185, C188, C189	6					
C139	CAPACITOR, fixed: paper; 2 μf ±10%; 1000 vdcw.; spec. JAN-C-25	1st IPA Plate Pulse By-pass	CP70-B1EG-205K with CP07FA6 Brackets	16-C-49200-7175			C139	1					
C140	Same as C138	2nd IPA Grid Bias Pulse By-pass											
C141	CAPACITOR, fixed: paper; 10 μf ±10%; 1500 vdcw.; spec. JAN-C-25	Compen-sator Coupling	CP70-E1EH-106K with CP07FG4 Brackets	16-C-51862-8985			C141	1					
C142	Same as C137	Meter (M103) By-pass											

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C143	CAPACITOR, fixed: paper; 4 μf ±10%; 4000 vdcw.; spec. JAN-C-25	PA Grid Bias Pulse By-pass	CP70-E1EM-405K with CP07FJ11 Brackets	16-C-49965-9391			C143, C146	2					
C144	CAPACITOR, fixed: paper; 2 μf ±10%; 20,000 vdcw.; HS metal case 12" lg. x 9½" wd. x 15" h., less term and mtg.; oil impr. and filled; two 7/16"-14 thd. stud term on 4-9/16" h. ribbed por. standoff insulators spaced 6" c to c on top of case; no internal gnd.; no mtg. provisions	PA Plate Pulse By-pass		16-C-49207-6436	Cornell-Dubilier TK-20020		C144	1					
C145	CAPACITOR, fixed: paper dielectric; 4 μf ±10%; 7500 vdcw.; HS. metal case 12" lg. x 4" wd. x 13" h., excluding term; oil impr. and filled; two 7/16"-14 thd. stud term on 2-5/16" h. ribbed por. standoff insulators spaced 6" c to c on top of case; no internal gnd.; no integral mtg. provisions	Pulse Forming Circuit HV		16-C-49966-7980	Cornell-Dubilier TK-70040		C145	1					
C146	Same as C143	PA Grid Pulse Coupling											
C147	CAPACITOR, fixed: paper; 15 μf ±10%; 1000 vdcw.; spec. JAN-C-25	2nd IPA Cathode Pulse By-pass	CP70-B1EG-156K with CP07FG2 Brackets	16-C-52051 2434			C147, C148	2					
C148	Same as C147	2nd IPA Cathode Pulse By-pass											
C149	CAPACITOR, fixed: paper; 10 μf ±10%; 600 vdcw.; spec. JAN-C-25	PA Fil Pulse By-pass	CP70-B1EF-106K with CP07FD3 Brackets	16-C-51858-2158			C149 to C152, C156, C157	6					

C150	Same as C149	PA Fil Pulse By-pass												
C151	Same as C149	PA Fil Pulse By-pass												
C152	Same as C149	PA Fil Pulse By-pass												
C153	Same as C137	Meter (M104) By-pass												
C154	CAPACITOR, variable: vacuum dielectric concentric type; 10-75 $\mu\mu$f; 40,000 v. AC peak; 11-7/16" lg. x 5" OD. o/a; 2 nickel plates; two 2" diam. silver pl. phosphor bronze term; term mtd.; 1/4-28 thd. adj. stud w/smooth aluminum cap	PA Neutralizing		16-C-65839-7021	Jennings Rad UH		C154, C155	2	4	1	1		10
C155	Same as C154	PA Neutralizing												
C156	Same as C149	LV—Bias Filter												
C157	Same as C149	LV—Bias Filter												
C158	CAPACITOR KIT: air dielectric, neutralizing capacitor; adjustable plate is silver plated brass disk 2" diam. x 1/8" thk. w/1-11/16" lg. x 1/4"-20 thd., silver pl. brass mtg. stud; fixed plate is silver plated brass, roughly "L" shape, 5 7/8" lg. x 2 3/4" wd. x 2 1/4" h. o/a; fixed plate is 1/8" thk. and has three 57/64" diam. mtg. holes 1 3/8" x 4 1/4" c to c	2nd IPA (V102) Neutralizing		16-C-66401-1008		Rotor FRA-17580-1 Stator FRB-17579-2-1	C158	1					
C159	CAPACITOR KIT: air dielectric; neutralizing capacitor; adjustable plate is silver plated brass disk 2" diam. x 1/8" thk. w/1-11/16" lg. x 1/4"-20 thd. silver pl. brass mtg. stud; fixed plate is silver plated brass, roughly "L" shape, 5 7/8" lg. x 4" wd. x 2 1/4" h. o/a; fixed plate is 1/8" thk. and has two 57/64" diam. mtg. holes 4 1/4" c to c	2nd IPA (V103) Neutralizing		16-C-66401-1010		Rotor: FRA-17580-1 Stator: FRB-17579-2-2	C159	1					
C160	CAPACITOR, fixed: mica; 680 $\mu\mu$f ±5%; 10,000 vdcw. (11 amp. at 3 mc., 8.2 amp. at 1 mc., 4.7 amp. at 0.3 mc., 1.8 amp. at 0.1 mc.); spec. JAN-C-5	2nd IPA Plate Tank	CM80-B681J	16-C-30534-2726			C160, C161	2					

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C161	Same as C160	2nd IPA Plate Tank											
C162	CAPACITOR, fixed: vacuum dielectric; 50 $\mu\mu f$ ±10%; 32,000 v. AC peak; 6½" lg. x 2¼" OD o/a; Pyrex encasement; one 23/32" lg. x 13/16" diam. stud term at ea. end of encasement; term mtg.	PA Plate Tank		16-C-56774-8351	Jennings Rad VC-50		C162, C163	2	5	1	1		10
C163	Same as C162	PA Plate Tank											
C164	Same as C118	PA Plate Tank											
C165	Same as C118	PA Plate Tank											
C166	CAPACITOR, fixed: mica; 680 $\mu\mu f$ ±5%; 30,000 vdcw. (15 amp. at 3 mc., 13 amp. at 1 mc., 8.2 amp. at 0.3 mc., 4.3 amp. at 0.1 mc.); spec. JAN-C-5	Output Tuning	CM90-B681J	16-C-30535-1851			C166, C167	2					
C167	Same as C166	Output Tuning											
C168	Same as C137	Meter (M105) By-pass											
C169	Same as C137	Meter (M106) By-pass											
C170	Same as C137	Meter (M107) By-pass											
C171	Same as C137	Meter (M108) By-pass											

C172	Same as C137	Meter (M109) By-pass											
C173	Same as C137	Meter (M110) By-pass											
C174	Same as C137	Meter (M111) By-pass											
C175	Same as C137	Meter (M112) By-pass											
C176	CAPACITOR, variable: air dielectric; plate meshing type; single section; 10 to 150 $\mu\mu$f; SLC characteristic; 0.030" air gap; 2-17/32" lg. x 3-5/32" wd. x 2-5/16" h. excluding shaft; shaft 1/4" diam. x 1-5/32" lg. beyond bushing; bushing 11/32" lg. FMS; extension shaft adj.; 15 polished aluminum plates; 180 deg. cw rotation decrease capacitance; mycalex insulation; stud term.; two brackets w/0.138" diam. mtg. hole spaced 2 3/8" c to c	1st IPA Grid Tuning		16-C-61222-8981	Cardwell MR-150-BS		C176	1	6	1	1		5
C177	Same as C137	Meter (M101) By-pass											
C178	CAPACITOR, fixed: paper dielectric; 2 μf ±10%; 200 vdcw.; spec. JAN-C-25	Trigger Generator Cath By-pass, Pulse Chain A	CP54-B1EC-205K	16-C-49190-4257			C178, C179	2					
C179	Same as C178	Trigger Generator Cath By-pass, Pulse Chain B											
C180	CAPACITOR, fixed: mica; 10,000 $\mu\mu$f ±10%; 1200 vdcw.; spec. JAN-C-25	Sq Wave Width Range Det, Pulse Chain A	CM56-B103K	16-C-33623-3640			C180 to C183	4					
C181	Same as C180	Sq Wave Width Range Det, Pulse Chain B											

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C182	Same as C180	Trig Generator Trig Width Det, Pulse Chain A											
C183	Same as C180	Trig Generator Trig Width Det, Pulse Chain B											
C184	Same as C138	1st Sq Amp Cath Coup, Pulse Chain A											
C185	Same as C138	1st Sq Amp Cath Coup, Pulse Chain B											
C186	CAPACITOR, fixed: paper dielectric; 1 μf $\pm$10%; 600 vdcw.; spec. JAN-C-25	2nd Sq Amp Out Coup, Pulse Chain A	CP54-B1EF-105K	16-C-48817-3912			C186, C187, C196 C197	4					
C187	Same as C186	2nd Sq Amp Out Coup, Pulse Chain B											
C188	Same as C138	Sq Wave Mon Circuit Coup Pulse Chain A											

C189	Same as C138	Sq Wave Mon Circuit Coup, Pulse Chain B											
C190	CAPACITOR, fixed: paper dielectric; 150,000 μμf ±5%; 7500 vdcw.; H.S. metal case; 3¾" lg. x 3-3/16" wd. x 4¾" h. o/a, less term. and mtg. bkts.; 2 stud terminals mtd. on top, 2¼" h. on porcelain pillars; no internal ground connections; mtd. by standard removable capacitor mtg. bkts.	Mod-Pulse Generator Plate, Pulse Chain A		16-C-45936-1010	Cornell-Dubilier #PN-100		C190, C191	2	7	1	2		20
C191	Same as C190	Mod-Pulse Generator Pl, Pulse Chain B											
C192	Not used												
C193	Not used												
C194	Not used												
C195	Not used												
C196	Same as C186	1st Sq. Amp Out Coup, Pulse Chain A											
C197	Same as C186	1st Sq Amp Out Coup, Pulse Chain B											
C198	CAPACITOR, fixed: vacuum dielectric; concentric type; 25 μμf ±10%; 17,000 v. peak working; 3¼" lg. x 1¼" diam. o/a; pyrex encasement; two 11/32" diam. x 11/32" lg. ferrule term.; term. mounted	2nd IPA Plate By-pass		16-C-56768-6526	Jennings Rad X		C198, C199	2	8	1	1		10
C199	Same as C198	2nd IPA Plate By-pass											
C200	CAPACITOR, fixed: mica; 0.002 μf ±5%; 10,000 vdcw. (16 amp. at 3 mc., 13 amp. at 1 mc., 8.2 amp. at 0.3 mc., 3.6 amp. at 3.6 mc.); spec. JAN-C-5	Output Coupling Coil Tuning	CM80-B202J	16-C-31800-3926			C200	1					

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C201	CAPACITOR, fixed: paper dielectric; 10,000 μμf ±5%; 4000 vdcw.; H.S. metal case; 2½" lg. x 1-3/16" wd. x 2⅝" h. o/a less terminals and mtgs.; Dykanol impregnated; 2 stud terminals 1⅝" h. located on top, on porcelain pillars; no internal ground connections; mtd. by standard removable capacitor mtg. bkts.	Pulse Forming Cathode Circuit		16-C-42703-7530	Cornell-Dubilier #PN-107		C201	1	9	1	1		10
C202	PLATE, capacitor: coupling; disk type; c/o 4½" diam. x ⅛" thk. ½-hard brass disk w/¼-20 thd. x 2½" lg. brass stud soldered perpendicular to plane of disk; 4½" diam. x 2-9/16" lg. o/a	Mon Oscilloscope Output Circuit		16-P-401281-148		FRA-19389-1	C202	1					
C203	CAPACITOR, fixed: paper dielectric; 500,000 μμf ±10%; 1500 vdcw; spec. JAN-C-25	2nd IPA Screen By-pass	CP70E1-EH504K with CP07FA3 Footed Brackets	16-C-47302-6348			C203	1					
C204	CAPACITOR, fixed: mica; 100 μμf ±10%, 500 vdcw; Spec JAN-C-5	Filter for CR101-CR103	CM20-B101K	16-C-28558-1676			C204, C303, C331, C337	7					
C205	CAPACITOR, fixed: mica 10 μμf ±10%, 500 vdcw; Spec JAN-C-5	Filter for CR101-CR103	CM20-B100K	16-C-26025-8276			C205	1					
C301	CAPACITOR, fixed: mica; 10,000 μμf ±10%; 300 vdcw.; spec. JAN-C-5	100 KC Input Tuned Circuit	CM35-B103K	16-C-33622-5222			C301, C315, C316, C319, C321, C329, C330, C348, C350, C351, C2106	21					

C302	CAPACITOR, fixed: mica; 0.00068 μf $\pm 10\%$; 500 vdcw.; spec. JAN-C-5	100 KC Input Tuned Circuit	CM35-B681K	16-C-30536 4808			C302	2					
C303	Same as C204	Trip (V301) Grid Coupling											
C304	CAPACITOR, fixed: paper dielectric; 3 sections, ea. 0.1 μf $+20\%$ -10%; 600 vdcw.; spec. JAN-C-25		CP54-B5EF-104V	16-C-54460-4496			C304, C308, C333	6					
C304A	Part of C304	Trip (V301) Cathode By-pass											
C304B	Part of C304	Trip (V301) Plate Tank By-pass											
C304C	Part of C304	Trip (V302) Grid Tank By-pass											
C305	CAPACITOR, fixed: paper; 0.5 μf $\pm 10\%$; 600 vdcw.; spec. JAN-C-25	Trip (V301) Cath Meter By-pass	CP53-B1EF-504K	16-C-47297-3175			C305, C309, C313, C318, C334, C341, C345, C347	16					
C306	CAPACITOR, fixed: mica; 270 $\mu\mu f$; $\pm 5\%$; 500 vdcw.; p/o Z302; spec. JAN-C-5	Trip (V301) Plate Tank	CM20-B271J	16-C-29608-2196			C306, C307	4					
C307	Same as C306	Trip (V302) Grid Tank											
C308	Same as C304												
C308A	Part of C308	Trip (V302) Cathode By-pass											
C308B	Part of C308	Trip (V302) Plate Tank By-pass											

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C308C	Part of C308	Mixer (V303) Grid #1 Tank By-pass											
C309	Same as C305	Trip (V302) Cathode Meter By-pass											
C310	CAPACITOR, fixed: mica; 51 μμf ±5%; 500 vdcw.; p/o Z303; spec. JAN-C-5	Trip (V302) Plate Tank	CM20-B510J	16-C-27656-2596			C310, C311, C314, C317, C320, C336	12					
C311	Same as C310	Mixer (V303) Grid #1 Coupling											
C312	CAPACITOR, fixed: paper; dual; 0.1/0.1 μf +20% −10%; 600 vdcw.; spec. JAN-C-25		CP54-B4EF-104V	16-C-53204-4120			C312, C340, C344	6					
C312A	Part of C312	Mixer (V303) Cathode By-pass											
C312B	Part of C312	Mixer (V303) Screen By-pass											
C313	Same as C305	Mixer (V303) Cathode Meter By-pass											
C314	Same as C310	Mixer (V303) Plate Tank											

C315	Same as C301	Mixer (V303) Tank By-pass											
C316	Same as C301	Lim-Ampl (V304) Grid Tank By-pass											
C317	Same as C310	Lim-Ampl (V304) Grid Tank											
C318	Same as C305	Lim-Ampl (V304) Cathode Meter By-pass											
C319	Same as C301	Lim-Ampl (V304) Screen By-pass											
C320	Same as C310	Lim-Ampl (V304) Plate Tank Padder											
C321	Same as C301	Lim-Ampl (V304) Plate Tank By-pass											
C322	CAPACITOR, variable: air dielectric; single section, plate meshing; 10-35 $\mu\mu$f max.; SLC.; 0.030" air gap; 1½" lg. x 1-13/32" wd. x 1-11/32" h. less shaft; shaft ¼" diam. x 19/32" lg.; mtg. bushing ⅜"-32 thd. x 7/16" lg.; extension shaft adjust.; 10 cad. plated brass plates; 360 deg. cont. rotation either direction; single hole panel mtg.	Lim-Ampl Plate Tank Tuning		16-C-59469-4001	Hammarlund HFA-35-B		C322	2	10	1	1		5
C323	CAPACITOR, variable: air dielectric; 2 section, plate meshing; split stator, 9-35 $\mu\mu$f max. per section; SLC.; 0.030" air gap; 2¾" lg. x 2¼" wd. x 2⅛" h. less shaft; shaft 9/16" lg. x ¼" diam.; mtg. bushing ⅜"-32 thd. x ⅜" lg. w/hardware; extension shaft adjust.; 18 cad. plated brass plates, 9 per section; 360 deg. cont. rotation either direction; Isolantite ins. lug term; single hole panel mtg. using bushing	Doubler (V305 and V306) Grid Tank Tuning		16-C-62339-9901	Hammarlund HFAD-35-B		C323	2	11	1	1		5

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C324	Not used												
C325	Not used												
C326	CAPACITOR, variable: air dielectric; 2 section; plate meshing type; 6-38 μμf, SLC.; 0.015" air gap; 1⅜" h. x 1-13/16" wd. x 1-13/16" lg. (excl. shaft); shaft 9/32" diam. x 9/32" lg. w/locking nut and end slot; screwdriver adjust.; 18 silver pl. brass plates; 360 deg. rotation; ceramic ins.; solder lug term; two 1⅛" diam. holes in ceramic ins. plate on diagonals in corners, and 4 others irregularly spaced			16-C-62364-1617	Sickles FW ATR-4 Dual		C326	2	12	1	1		5
C326A	Part of C326	Lim-Ampl (V304) Plate Padder											
C326B	Part of C326	Doubler (V305 and V306) Grid Padder											
C327	CAPACITOR, fixed: paper; 1 μf ±10%; 600 vdcw.; spec. JAN-C-25	Doubler (V305 and V306) Grid By-pass	CP53-B1EF-105K	16-C-48817-3883			C327, C328, C349	6					
C328	Same as C327	Doubler (V305 and V306) Cathode Meter By-pass											
C329	Same as C301	Doubler (V305 and V306) Plate By-pass											

C330	Same as C301	Doubler (V305 and V306) Output Coupling											
C331	Same as C204	Divider (V307) Grid #3 Coupling											
C332	CAPACITOR, fixed: mica; 30 μμf ±5%; 500 vdcw.; spec. JAN-C-5	Divider (V307) Grid #1 Coupling	CM20-B300J	16-C-27128-6596			C332	2					
C333	Same as C304												
C333A	Part of C333	Divider (V307) Cathode By-pass											
C333B	Part of C333	Divider (V307) Screen By-pass											
C333C	Part of C333	Divider (V307) Plate Tank By-pass											
C334	Same as C305	Divider (V307) Cathode Meter By-pass											
C335	CAPACITOR, fixed: mica; 3300 μμf ±10%; 500 vdcw.; spec. JAN-C-5	Divider (V307) Plate Tank	CM30-B332K	16-C-32250-9764			C335	2					
C336	Same as C310	Doubler (V308) Grid Coupling											
C337	Same as C204	Mixer (V303) #3 Coupling (25 KC)											
C338	CAPACITOR, fixed: mica; 27 μμf ±5%; 500 vdcw.; spec. JAN-C-5	Mixer (V303) Grid #3 Coupling (50 KC)	CM20-B270J	16-C-27075-8796			C338, C339	4					

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C339	Same as C338	Mixer (V303) Grid #3 Coupling (75 KC)											
C340	Same as C312												
C340A	Part of C340	Doubler Cathode (V308) By-pass											
C340B	Part of C340	Doubler (V308) Plate Tank By-pass											
C341	Same as C305	Doubler (V308) Cathode Meter By-pass											
C342	CAPACITOR, fixed: mica; 2200 $\mu\mu$f ±10%; 500 vdcw.; spec. JAN-C-5	Doubler (V308) Plate Tank	CM30-B222K	16-C-31908-1564			C342	2					
C343	CAPACITOR, fixed: mica; 1200 $\mu\mu$f ±10%; 500 vdcw.; p/o Z310; spec. JAN-C-5	Trip (V309) Grid Coupling	CM30-B122K	16-C-31274-9964			C343	2					
C344	Same as C312												
C344A	Part of C344	Trip (V309) Cathode By-pass											
C344B	Part of C344	Trip (V309) Plate Tank By-pass											

C345	Same as C305	Trip (V309) Cathode Meter By-pass											
C346	CAPACITOR, fixed: mica; 1000 $\mu\mu$f ±10%; 500 vdcw,; spec. JAN-C-5	Trip (V309) Plate Tank	CM30-B102K	16-C-31090-4164			C346	2					
C347	Same as C305	Grid Meter By-pass											
C348	Same as C301	+250V By-pass											
C349	Same as C327	Pulsed Doubler (V305, V306) Screen By-pass											
C350	Same as C301	Pulsed Doubler (V305) Screen By-pass											
C351	Same as C301	Pulsed Doubler (V306) Screen By-pass											
C352	CAPACITOR, fixed: ceramic; 1 $\mu\mu$f ±0.5 $\mu\mu$f; 500 vdcw; JAN-C-20A	Frequency Monitor Coupling	CC21-CK010D	16-C-15371-4454			C352	2					
C353	CAPACITOR, fixed: ceramic; 4 $\mu\mu$f ±0.5 $\mu\mu$f; 500 vdcw.; JAN-C-20A	Plate to Grid Feedback	CC21-CJ040D	16-C-15563-9967			C353	2					
C2101	Not used												
C2102	Not used												
C2103	Not used												
C2104	Not used												
C2105	Not used												
C2106	Same as C301	Input Coupling (In Timer)											

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C2302	CAPACITOR, fixed: paper; JAN type CP70E1EG405V; 4μf +20 — 10%, 1000 vdcw; spec JAN-C-25	Bias supply for V2301, V2302	CP70-E1EG-405V	16-C-49982-1020			C2302	1					
C2303	CAPACITOR, fixed: mica; JAN type CM35D472K; 4700 μμf ±10%, 500 vdcw; Spec JAN-C-5	Bias Supply Filter for V2301	CM35-D472K	16-C-32646-6818			C2303 C2304	2					
C2304	Same as C2303	Bias Supply Filter for V2302											
C2305	CAPACITOR, fixed: paper; JAN type CP70E1EF105V; 1 μf +20 — 10%, 600 vdcw; Spec JAN-C-25	Thyratron V2301 Current Storage	CP70-E1EF-105V	16-C-48841-9616			C2305 C2306	2					
C2306	Same as C2305	Thyratron V2302 Current Storage											
C2401	CAPACITOR, fixed: paper; 2 μf +20% — 10%, 330 vacw; HS metal case; 4-5/8" h x 1-1/16" wd x 1-3/16" d x 2-7/8" h; 2 solder lug c to c; fibre washer ins; mineral oil impreg and filled; no internal gnd; w/two L-type removable mtg. bkts; ea w/one 0.187" diam hole; holes 2-1/4" c to c	Blower (B2401) Motor Starting		16-C-49221-9836	Sprague Type 855P14	A1023951-2	C2401	1					
C2501	CAPACITOR, fixed: paper; 4.2 μf ±5%, 330 vacw; 2-1/2" wd. x 1-3/16" d x 2-7/8" h; 2 solder lug terms, 5/8" h, located on top, 1-1/8" c to c; oil impreg and filled; no internal gnd; 2 mtg feet, ea w/one 0.175 diam hole; holes 3" c to c	Motor (B2501) Phase Splitting		16-C-49999-5510	GE type #21F72 5G2	B1040746	C2501	1	2 VR	6	1		25

CR101	CRYSTAL UNIT, rectifying: JAN type 1N69; spec JAN-1A	Signal Detector	1N69	16-T-51769			CR101 CR102 CR103	3					
CR102	Same as CR101												
CR103	Same as CR101												
CR2301	CRYSTAL UNIT, rectifying: JAN type 1N34A; germanium type; crystal rectifier	Bias Supply Rectifier for V2301	1N34A	16-T-51734-10		#700652	CR2301 CR2302	2	3 VR	6	6		0
CR2302	Same as CR2301	Bias Supply Rectifier for V2302											
E101	SUPPRESSOR, parasitic: resistor and coil type; 1.76" lg. x 0.628" diam. max o/a excluding term; c/o 6 turns no. 14 bare tinned copper wire space wound on 100 ohm, 2 W composition resistor; uncased; terminal mounted; 2 axial wire lead terminals (incl R118)	PA Parasitic Suppressor		16-S-89859-2813		FRA-18394-1	E101 to E106	6	13	1	6		10
E102	Same as E101, except includes R119	PA Parasitic Suppressor											
E103	Same as E101, except includes R120	PA Parasitic Suppressor											
E104	Same as E101, except includes R121	PA Parasitic Suppressor											
E105	Same as E101, except includes R114	2nd IPA Parasitic Suppressor											
E106	Same as E101, except includes R115	2nd IPA Parasitic Suppressor											
E110-1 to E110-24	INSULATOR, standoff: cyl.; ⅝" lg. o/a; ½" diam., 8-32 tap; spec. JAN-I-8		NS-5W-0205	17-I-69173-7115			E110	24					
E111	INSULATOR, standoff: cyl., ¾" lg. o/a; ½" diam., 8-32 tap; spec. JAN-I-8		NS-5W-0206	17-I-69175-7136			E111	1					
E112-1 to E112-22	INSULATOR, standoff: cyl.; 1" lg. o/a; ½" diam., 8-32 tap; spec. JAN-I-8		NS-5W-0208	17-I-69178-7156			E112	22					

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
E113-1 to E113-6	INSULATOR, standoff: cyl.; 1½" lg. x ½" diam., 8-32 tap; spec. JAN-I-8		NS-5W-0212	17-I-69183-7055			E113	6					
E114-1 to E114-16	INSULATOR, standoff: cyl.; 2" lg. o/a; ½" diam., 8-32 tap; spec. JAN-I-8		NS-5W-0216	17-I-69185-7121			E114	16					
E115-1 to E115-32	INSULATOR, standoff: cyl.; 1" lg. o/a; ¾" diam., 10-32 tap; spec. JAN-I-8		NS-5W-0308	17-I-69210-9531			E115	32					
E116-1 to E116-64	INSULATOR, standoff: cyl.; 2" lg. o/a; ¾" diam., 10-32 tap; spec. JAN-I-8		NS-5W-0316	17-I-69215-9499			E116	64					
E117-1 to E117-16	INSULATOR, standoff: cyl.; 3" lg. o/a; ¾" diam., 10-32 tap; spec. JAN-I-8		NS-5W-0324	17-I-69218-9511			E117	16					
E118-1 to E118-16	INSULATOR, standoff: cyl.; 4" lg. o/a; ¾" diam., 10-32 tap; spec. JAN-I-8		NS-5W-0332	17-I-69220-9421			E118	16					
E119-1 to E119-10	INSULATOR, standoff: cyl.; 2" lg. o/a; 1" diam., ¼-20 tap; spec. JAN-I-8		NS-5W 0416	17-I-69231-9558			E119	10					
E120-1 to E120-5	INSULATOR, standoff: cyl.; 2" lg. o/a; 1¼" diam. ¼-20 tap; spec. JAN-I-8		NS-5W-0516	17-I-69250-9531			E120	5					
E121-1 to E121-4	INSULATOR, standoff: cyl.; pillar shape; white glazed steatite, grade L-4; 1½" lg. o/a; ½" diam., 6-32 mtg. tapped holes at ea. end			17-I-69183-6231	Alsimag #1002		E121	4					
E122	INSULATOR, bushing: conical; ⅞" lg. o/a x ⅞" diam., 15/32" diam. x ⅜" lg. shank w/3/16" hole; spec JAN-I-8		NS-5W-4103	17-I-48707-8821			E122	1					
E123	INSULATOR, bowl: conical; ½" lg. x ⅞" diam., ½" diam. x ⅜" d. ctb. w/0.200" hole; spec. JAN-I-8		NS-5W-4203	17-I-47380-8601			E123	1					

E124-1 to E124-2	INSULATOR, standoff: conically shaped corrugated beehive shape; spec. JAN-I-8		NS-5W-2501	17-I-68657-6021			E124	2					
E125-1 to E125-2	INSULATOR, standoff: conically shaped corrugated beehive; white glazed steatite, grade L5; 4" h x 3⅜" diam. o/a; mtg. flange at base 3⅜" diam. x ½" h. w/four 9/32" diam. mtg. holes equally spaced on 2⅝" diam. circle			17-I-68673-6300	Genceraco #1450-00		E125	2					
E126-1 to E126-25	INSULATOR, standoff: cyl.; 1½" lg. o/a; ¾" diam., #10-32 tap; spec. JAN-I-8		NS-5W-0312	17-I-69213-9489			E126	25					
E127-1 to E127-32	INSULATOR, standoff: cyl.; ⅝" lg. o/a; ⅜" diam., #6-32 tap; spec. JAN-I-8		NS-5W-0105	17-I-69156-6271			E127	32					
E128-1 to E128-8	INSULATOR, standoff: cyl.; 1" lg. o/a; ⅜" diam., #6-32 tap; spec. JAN-I-8		NS-5W-0108	17-I-69160-6215			E128	8					
E129-1 to E129-6	INSULATOR, standoff: cyl.; 4" lg. o/a; 1" diam. ¼-20 tap; spec. JAN-I-8		NS-5W 0432	17-I-69236-3511			E129	6					
E130-1 to E130-4	INSULATOR, standoff: cyl. shape w/metal base and metal cap; white glazed steatite, grade L-5; 4" o/a lg.; cap 1-3/16" diam x 1" h., insulator section, 1" diam. x 2¼" lg.; ¾" h. x 3" lg. base w/two 9/32" diam. holes on 2¼" ctrs., two 10/24" tapped holes in cap on ¾" ctrs.			17-I-70057-7101	Alsimag #1844		E130	4					
E131-1 to E131-4	INSULATOR, standoff: cyl. shape w/metal base and metal cap; white glazed steatite, grade L-5; 6" o/a lg., cap 1-3/16" diam. x 1" h., insulator section, 1" diam. x 4¼" lg.; ¾" h. x 3" lg. base w/two 9/32" diam. holes on 2¼" ctrs., two 10/24" tapped holes in cap on ¾" ctrs.			17-I-70059-7251	Alsimag #1846		E131	4					
E132-1 to E132-9	INSULATOR, standoff: cyl.; 3" lg. o/a; 1" diam., ¼-20 tap; spec. JAN-I-8		NS-5W-0424	17-I-69233-9561			E132	9					
E133-1 to E133-2	INSULATOR, standoff: cyl. pillar shape; white glazed steatite, grade L-5; 4½" lg. x ½" diam. o/a; 8-32 axial tapped mtg. hole at ea. end; ¾" deep			17-I-69190-3780	Alsimag #1008		E133	2					

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
E134	Not used												
E135-1 to E135-2	INSULATOR, bowl: round ctb.; 3/4" lg. x 1 1/8" o/a diam., 3/4" diam. x 9/16" d. ctb. w/0.200" hole; spec. JAN-I-8		NS-5W-4204	17-I-47388-7531			E135	2					
E136-1 to E136-2	INSULATOR, bushing: conical w/cyl. shank; 1-5/16" o/a lg. x 1 1/8" d., 23/32" d. x 9/16" lg. shank w/0.200" hole; spec. JAN-I-8		NS-5W-4104	17-I-48719-7756			E136	2					
E137-1 to E137-4	SOCKET, tube: 4 contacts, special for JAN 7C23 transmitting tube; contacts mtd. on grade L-4 white glazed steatite disk 2 1/2" diam. x 1/2" thk.; phosphor bronze silver plated clamping contacts w/knurled thumbscrew; 3 1/4" x 3" x 2" approximately o/a, less leads; 4 flexible wire leads; three 6" lg., one 4" lg., approximately; insulated w/ceramic beads; two contacts marked w/yellow dot, one w/black dot, and one w/red dot	Contacts for V104-V107		16-C-310501-103		FRA-14697-2	E137	4	14	1	2		4
E138	ADAPTER, connector: male one end, female other end; one cont. ea. end; angle type, 90 deg.; 1-7/32" lg. x 3/4" wd. x 1-3/16" h. o/a; low voltage; non-constant freq.-impedance characteristic 160 mc. peak freq.; polystyrene insert; 5/8"-24 ext. thd. female end, 5/8"-24 coupling nut male end; shielded "UHF" type	Adapter for J101		17-C-67444-1285	Amphenol 83-1AP		E138 to E146, E2101, E3014 to E3021	19					
E139	Same as E138	Adapter for J102											
E140	Same as E138	Adapter for J103											
E141	Same as E138	Adapter for J104											
E142	Same as E138	Adapter for J105											

E143	Same as E138	Adapter for J106											
E144	Same as E138	Adapter for J107											
E145	Same as E138	Adapter for J111											
E146	Same as E138	Adapter for J112											
E147	ADAPTER, connector: straight type; cable opening reducer; ½" OD x 1" lg. o/a; cylindrical; brass; silver pl. body; 0.255" diam. cable opening; mounts on end of Navy Type 49190 or 49195 plug to reduce cable opening to fit RG-62/U cable	Adapter for P108	UG-176/U	17-A-27451-1004	IPC 66500		E147 to E152, E303 to E305, E2102, E3022 to E3029, E3608, E3611, E3621, E3622, E3722 to E3725	30					
E148	Same as E147	Adapter for P109											
E149	Same as E147	Adapter for P110											
E150	Same as E147	Adapter for P111											
E151	Same as E147	Adapter for P112											
E152	Same as E147	Adapter for P113											
E301-1 to E301-5	INSULATOR, standoff: cyl. shape; white glazed steatite, grade L-4; ½" lg. o/a; ½" diam., 8-32 mtg. tapped holes at ea. end			17-I-69172-7151	Alsimag #1400		E301	10					
E302-1 to E302-4	INSULATOR SET: c/o two mating conical bushings; white glazed steatite; male ⅝" lg. x ½" diam.; female ⅜" lg. x ½" diam.; ¾" lg. x ½" diam. o/a; w/0.140" axial hole			17-I-81154-1121	Alsimag #1172		E302	8					
E303	Same as E147	Adapter for P302											
E304	Same as E147	Adapter for P303											
E305	Same as E147	Adapter for P304											

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
E2101	Same as E138	Adapter for P2104											
E2102	Same as E147	for P2104 Adapter											
E2401	TERMINAL, standoff: cyl melamine body with bifurcated tinned brass solder term at top, and #6-32 thrd x 7/32" d tapped brass insert bottom; 25/32" h x ¼" diam o/a; base molded to hex shape, ¼" betw flats.	Tie Point		17-T-28252-3591	Winchester #770	363969	E2401	1					
E3014	Same as E138	Adapter for J3014											
E3015	Same as E138	Adapter for J3015											
E3016	Same as E138	Adapter for J3016											
E3017	Same as E138	Adapter for J3017											
E3018	Same as E138	Adapter for J3018											
E3019	Same as E138	Adapter for J3019											
E3020	Same as E138	Adapter for J3020											
E3021	Same as E138	Adapter for J3021											
E3022	Same as E147	Adapter for P3014											
E3023	Same as E147	Adapter for P3015											
E3024	Same as E147	Adapter for P3016											

E3025	Same as E147	Adapter for P3017											
E3026	Same as E147	Adapter for P3018											
E3027	Same as E147	Adapter for P3019											
E3028	Same as E147	Adapter for P3020											
E3029	Same as E147	Adapter for P3021											
E3608	Same as E147	Adapter for P3608											
E3611	Same as E147	Adapter for P3611											
E3621	Same as E147	Adapter for P3621											
E3622	Same as E147	Adapter for P3622											
E3722	Same as E147	Adapter for P3722											
E3723	Same as E147	Adapter for P3723											
E3724	Same as E147	Adapter for P3724											
E3725	Same as E147	Adapter for P3725											
F101	FUSE, cartridge: 2.5 amp.; time delay; continuous at 110%; blow time 60 min. at 125%, 72 sec. at 200%, 13.5 sec. at 500%, 250 v. max.; non-renewable; fibre body; ferrule term; non-indicating; 9/16" diam. x 2" lg.; combination type w/thermal cut-out; Navy spec. 17F21 where applicable	Oscillo-scope Transf Pri	Navy Type TL	17-F-14350-30	Buss #4025		F101	1	15	1	10		
F102	FUSE, cartridge: 3.2 amp.; time delay; continuous at 110%; blow time 60 min. at 125%, 59 sec. at 200%, 13.3 sec. at 500%; 250 v. max.; non-renewable; fibre body; ferrule term; non-indicating; 9/16" diam. x 2" lg.; combination type w/thermal cut-out; Navy spec. 17F21 where applicable	Control Volt Transf Pri	Navy Type TL	17-F-14350-35	Buss #4032		F102	1	16	1	10		

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
F103	FUSE, cartridge: 0.3 amp.; time delay; continuous at 110%; blow time 60 min. at 125%, 60 sec. at 200%, 16.1 sec. at 500%; 250 v. max.; non-renewable; fibre body; ferrule term; non-indicating; 9/16" diam. x 2" lg.; combination type w/thermal cut-out; Navy spec. 17F21 where applicable	Pilot Light Transf Pri	Navy Type TL	17-F-14349-975	Buss #4003		F103	1	17	1	10		
F104	FUSE, cartridge: 2 amp.; time delay; continuous at 110%; blow time 60 min. at 125%, 12 sec. at 500%; 250 v. max.; one-time; fibre body; ferrule term; non-indicating; 2" lg. x 9/16" diam.; combination type w/thermal cut-out; Navy spec. 17F21 where applicable	Tube Blower	Navy Type TL	17-F-14350-25	Buss #402		F104	1	18	1	10		
F105	FUSE, cartridge: 0.6 amp.; time delay; continuous at 110%; blow time 60 min. at 125%; 60 sec. at 200%, 12.8 sec. at 500%; 250 v. max.; non-renewable; fibre body; ferrule term; non-indicating; 9/16" diam x 2" lg.; combination type w/thermal cut-out; Navy spec. 17F21 where applicable	Compartment Fan	Navy Type TL	17-F-14349-990	Buss #4006		F105	1	19	1	20		
F106	FUSE, cartridge: 1.25 amp.; time delay; continuous at 110%, blow time 60 min. at 125%, 78 sec. at 200%, 12.5 sec. at 500%; 250 v. max.; non-renewable; fibre body; non-indicating; 9/16" diam. x 2" lg.; combination type w/thermal cut-out; Navy spec. 17F21. where applicable	LV — Bias Transf Pri	Navy Type TL	17-F-14350-15	Buss #4012		F106	1	20	1	10		
F107	FUSE, cartridge; 1.0 amp.; time delay, continuous at 110%; blow time 60 min. at 125%; 250 v. max.; non-renewable; fibre body; non-indicating; 9/16" diam. x 2" lg.; combination w/thermal cut-out; Navy spec. 17F21 where applicable	HV Bias Supply Transf Pri	Navy Type TL	17-F-14350-10	Buss #401		F107	1	21	1	10		

F108	FUSE, cartridge: 12 amp.; time delay, continuous at 110%; blow time 60 min. at 125%, 15 sec. at 500%; 250 v. max.; non-renewable; fibre body; non-indicating; 9/16" diam. x 2" lg.; combination w/thermal cut-out; Navy spec. 17F21 where applicable	HV Transf Pri	Navy Type TL	17-F-14350-65	Buss #412		F108	1	22	1	10		
F109	FUSE, cartridge: 0.8 amp. rated continuous at 110% 60 min. at 135%, 60 sec. at 200%; 250 v; one time; fibre body; ferrule; non-indicating; 2" lg. x 9/16" diam.; NEC term.	Low Fil Transf Pri	Navy Type TL	17-F-14349-995	Buss #4008		F109	1	23	1	10		
F110	FUSE, cartridge: 10 amp.; time delay; continuous at 110%; blow time 60 min. at 125%, 108 sec. at 200%; 17 sec. at 500%; 250 v. max.; non-renewable; fibre body; non-indicating; 9/16" diam. x 2" lg.; combination w/thermal cut-out; Navy spec. 17F21 where applicable	High Power Fil Transf	Navy Type TL	17-F-14350-60	Buss #410		F110	1	24	1	10		
F2401	FUSE, cartridge: MIL type FO2D2-R00B; 2 amp 125 v; Spec MIL-F-15160	Blower (B2401) Protection	FO2D2-R00B	17-F-14308-200		#882025	F2401 F2402	2	4 VR	6	20		0
F2402	Same as F2401	Blower (B2401) Protection											
F2501	FUSE, cartridge: MIL type FO3G8-R00A; 8 amp 50 2v; Spec MIL-F-15160	T2501 Brush Circuit Protection	FO3G8-R00A	17-F-16340-65		#882151	F2501	1	5 VR	6	20		200
F2502	FUSE, cartridge: MIL type FO3G3-R00A; 3 amp 250 v; Spec MIL-F-15160	Control Circuit Protection	FO3G3-R00A	17-F-16340-25		#882149	F2502 F2503	2	6 VR	6	20		0
F2503	Same as F2502	B2501 Motor Protection											
H101-1 to H101-4	INSULATOR, disk: circular, flat; brown phenolic; 1/32" thk. x 7/8" ID x 2 1/8" OD o/a; three 5/32" diam. mtg. holes spaced 120 deg. apart on 27/32" rad.			17-I-57414-2596		FRP-14602-1	H101, H501	7					
H102	INSULATOR, disk: circular, flat; tan phenolic; 1/32" thk. x 1 3/8" ID x 3 3/8" OD o/a; four 9/32" diam. mtg. holes on 1 7/8" x 1 7/8" ctrs.			17-I-57417-9346		FRP-14606-1	H102 H502	2					
H103	GASKET: u/w ins.; rubber; one hole; round in shape; 1/4" thk. x 1-9/64" ID x 1 1/2" OD o/a			17-G-161397-467		FRR-14607-1-1	H103, H503	5					

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
H104-1 to H104-12	CLAMP: for locking pot shaft; c/o hex headed body and hex headed nut; brass nickel pl.; for ¼" shaft; ext. surface of shank is tapered and has ⅜-32 thd.; axial tapped hole ⅜-32 thd. on 3/16" lg.; ½" across flats on one end, 7/16" across flats of hex nut end; 37/64" lg. o/a.			16-C-300496-201	Millen #10061		H104	12					
H105	TOOL, alignment: fibre; 5-3/16" lg. x 3/16" diam.; 3/16" wd. x 0.035" thk. insulated screwdriver at one end; ⅛" wd. x 0.020" thk. brass screwdriver at other end.	Freq Gen Alignment		16-T-751482-196		FRA-18734-1	H105	1	25	1	1		20
H106	CHAIN: ladder type, assembled; links ¼" lg. x 7/64" wd.; 0.185" pitch; cad. plated brass; 68 ft. length w/loops one end and closed link at other			17-C-480710-404	Boston Gear #1A		H106	1					
H107-1 to H107-4	GROMMET: rubber; fits 11/16" hole; 17/32" hole diam. x ⅛" wd. groove; ¼" wd. x 13/16" diam o/a			17-G-900208-826	Atlan India Rub #2409		H107	4					
H108-1 to H108-2	GROMMET: black rubber; fits 13/16" diam. hole; 9/16" hole diam. x 3/16" wd. groove; 7/16" h. x 1" diam o/a			16-G-900246-319	Atlan India Rub #563		H108	2					
H109-1 to H109-14	PIN, taper: stainless steel, #5/0; 0.094" max. diam. x ⅝" o/a lg.			42-P-12798-550	Schnitzer #5/0 x ⅝"		H109	14					
H110-1 to H110-8	PIN, taper: stainless steel, #5/0; 0.094" max. diam. x ½" o/a lg.			42-P-12798-540	Schnitzer #5/0 x ½"		H110	8					
H111-1 to H111-4	PIN, taper: stainless steel; #5/0; 0.094" max. diam. x ⅜" o/a lg.			42-P-12798-530	Schnitzer #5/0 x ⅜"		H111	4					

H112	PULLER, fuse: fibre; 7½" lg. x 1⅜" wd. x 11/16" thk. o/a; for fuses 1-100 amp., 600 v., or 1-200 amp., 250 v.			17-P-91801-1012	Ideal Commtr "Pocket-Size"		H112	1					
H113	PIN, taper: stainless steel; #7/0; 0.0625" max. diam. x ⅜" o/a lg.			42-P-12798-30	Schnitzer #7/0 x ⅜"		H113	1					
H114-1 to H114-2	PIN, taper: stainless steel; #0; 0.156" max. diam. x 1" o/a lg.			42-P-12798-1580	Schnitzer #0 x 1"		H114	2					
H115-1 to H115-2	GROMMET: black rubber; fits ½" diam. hole; ⅜" ID x ⅝" OD x ¼" thk. x 1/16" wd. groove o/a			17-G-900152-701	Atlan India Rub #230		H115	2					
H116	EXTRACTOR, lamp: for T-2 lamp; rubber; funnel shaped; 1½" lg. x 9/16" max. diam. x ¼" min. diam.			17-E-850271-111		FRE-24950-1	H116	1	26	1	1		10
H117	ADJUSTER, spring: steel; 6⅛" lg. x ⅜" wd. x 5/16" h. o/a; ea. end slotted 0.040" wd.			17-A-250001-120	C. P. Clare #TM-3 (0.040")		H117	1					
H118	BURNISHER, contact: steel; 3⅝" lg. x 9/32" wd. x 3/64" thk. approx. o/a; 17 transverse ridges on one side, ea. 0.005" d. x 1/16" wd., and spaced ⅛" apart, c to c			17-B-795001-103	C. P. Clare #TM-1		H118	1					
H501-1 to H501-3	Same as H101												
H502	Same as H102												
H503-1 to H503-4	Same as H103												
H504-1 to H504-3	WASHER, flat: insulator cushion; rubber; single hole, circular; ¼" thk. x 7/16" ID x ¾" OD o/a			33-W-310-7600		FRR-14607-1-2	H504	3					
H2501	SHIELD, electron tube: miniature, copper or brass; spec JAN-S-28A	Hold-down & shield for V2301	TS102UO2	16-S-34557-8350			H2501 H2502	2					
H2502	Same as H2501	Hold-down & shield for V2302											

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
I101	LIGHT, indicator: w/¾" diam., smooth amber glass lens; for type T-2 telephone base bulb; encl. black aluminum shell; 3-3/32" lg. x ⅞" diam. o/a approximately; requires 11/16" diam. mtg. hole; 9/16" max panel thk.; horiz. mtd.; lamp replaceable from front; for thd. jewel; 2 solder lug term. on rear	Main Power Switch		17-L-76691-9981	Kirkland	FRE-24647-1	I101, I107 to I109, I111	5					
I101A	LAMP, incandescent: switchboard type; 18v, 90-110 ma.; type T-2 clear; 1-11/16" o/a lg.; slide base; tungsten filament; 1500 hrs. rated life; burns in horiz. pos.; cont. mtd. on bakelite strip.	Spares for I101 to I111		17-L-6502	G.E. Mazda T-2		I101A to I111A	11	27	1	11		
I101B	LIGHT, indicator: for type T-2 bulb w/telephone base; no lens; encl. black aluminum shell; 2-17/32" x ⅞" diam. o/a approx.; requires 11/16" diam. mtg. hole; 9/16" max. panel thk.; horiz. mtd.; lamp access from front; for thd. jewel; 2 solder lug term. on rear	Spares for I101 to I111		17-L-76664-1301	Kirkland Type T2SLC		I101B to I111B	11					
I101C	LENS, indicator light: amber; screw shank type; ⅞" OD knurled bezel; extends ½" from panel; smooth on outside, sandblasted on interior; satin-chrome finish	Spares for I101, I107 to I109, I111		17-L-250040-519	Kirkland Type T2SLC		I101C, I107C to I109C, I111C	5					
I102	LIGHT, indicator: w/¾" diam. smooth clear glass lens; for type T-2 telephone base bulb; encl. black aluminum shell; 3-3/32" lg. x ⅞" diam. o/a approximately; requires 11/16" diam. mtg. hole; 9/16" max. panel thk.; horiz. mtd.; lamp replaceable from front; for thd. jewel; 2 solder lug term. on rear	Low Power Filaments		17-L-76745-9401	Kirkland #T2SLC per FTRC spec FRE-24647-1	FRE-24647-1	I102, I103	2					

I102A	Same as I101A	Spare for I102						
I102B	Same as I101B	Spare for I102						
I102C	LENS, indicator light: clear screw shank type; ⅞" OD knurled bezel; extends ½" from panel; smooth on outside, sandblasted on interior; satin-chrome finish	Spares for I102, I103		17-L-250863-475	Kirkland Type T2SLC		I102C, I103C	2
I103	Same as I102	High Power Filaments						
I103A	Same as I101A	Spare for I103						
I103B	Same as I101B	Spare for I103						
I103C	Same as I102C	Spare for I103						
I104	LIGHT, indicator: w/¾" diam. smooth blue glass lens; for type T-2 telephone base bulb; encl. black aluminum shell; 3-3/32" lg. x ⅞" diam. o/a approximately; requires 11/16" diam. mtg. hole; 9/16" max. panel thk.; horiz. mtd.; lamp replaceable from front; for thd. jewel; 2 solder lug term. on rear	HV Time Delay		17-L-76719-8001	Kirkland #T2SLC per FTRC spec FRE-24647-1	FRE-24647-1	I104	1
I104A	Same as I101A	Spare for I104						
I104B	Same as I101B	Spare for I104						
I104C	LENS, indicator light: blue; screw shank type; ⅞" OD knurled bezel; extends ½" from panel; smooth on outside, sandblasted on interior; satin-chrome finish	Spare for I104		17-L-250116-146	Kirkland Type T2SLC		I104C	1
I105	LIGHT, indicator: w/¾" diam. smooth green glass lens; for type T-2 telephone base bulb; encl. black aluminum shell; 3-3/32" lg x ⅞" diam. o/a approximately; requires 11/16" diam. mtg hole; 9/16" max panel thk; horiz. mtd; lamp replaceable from front; for thd. jewel; 2 solder lug term. on rear	Bias		17-L-76786-2101	Kirkland #T2SLC per FTRC spec FRE-24647-1	FRE-24647-1	I105	1

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
I105A	Same as I101A	Spare for I105											
I105B	Same as I101B	Spare for I105											
I105C	LENS, indicator light: green; screw shank type; ⅞" OD knurled bezel; extends ½" from panel; smooth on outside, sandblasted on interior; satin-chrome finish	Spare for I105		17-L-250346-551	Kirkland Type T2SLC		I105C	1					
I106	LIGHT, indicator: w/¾" diam. smooth red glass lens; for type T-2 telephone base bulb; encl. black aluminum shell; 3-3/32" lg. x ⅞" diam. o/a approximately; requires 11/16" diam. mtg. hole; 9/16" max. panel thk.; horiz. mtd.; lamp replaceable from front; for thd. jewel; 2 solder lug term. on rear	HV		17-L-76871-9801	Kirkland #T2SLC per FTRC spec FRE-24647-1	FRE-24647-1	I106, I110	2					
I106A	Same as I101A	Spare for I106											
I106B	Same as I101B	Spare for I106											
I106C	LENS, indicator light: red; screw shank type; ⅞" OD knurled bezel; extends ½" from panel; smooth on outside, sandblasted on interior; satin-chrome finish	Spares for I106, I110		17-L-250666-101	Kirkland Type T2SLC		I106, I110C	2					
I107	Same as I101	IPA Plate Overload											
I107A	Same as I101A	Spare for I107											
I107B	Same as I101B	Spare for I107											

I107C	Same as I101C	Spare for I107											
I108	Same as I101	PA Plate Overload											
I108A	Same as I101A	Spare for I108											
I108B	Same as I101B	Spare for I108											
I108C	Same as I101C	Spare for I108											
I109	Same as I101	HV Supply Overload											
I109A	Same as I101A	Spare for I109											
I109B	Same as I101B	Spare for I109											
I109C	Same as I101C	Spare for I109											
I110	Same as I106	LV											
I110A	Same as I101A	Spare for I110											
I110B	Same as I101B	Spare for I110											
I110C	Same as I106C	Spare for I110											
I111	Same as I101	Door Interlock											
I111A	Same as I101A	Spare for I111											
I111B	Same as I101B	Spare for I111											
I111C	Same as I101C	Spare for I111											
I115-1 to I115-5	DRIVE, tuning; c/o fan-shaped front dial plate and cyl. rear plate used as case for drive gear; 2⅞" lg. x 5⅝" wd. x 5⅝" h. o/a; front dial plate steel w/lower portion black crackle finish and upper portion (for scale) smooth black finish; rear gear case cast aluminum w/360 deg. brass drive gear and brass pinion gear; nickel plated steel lock nut and pointer on front plate; knob shaft ¼" diam. x ¾" lg.; coupling shaft (rear) ¼" ID x ⅜" OD x ⅞" lg.	Tuning Dial		16-D-901161-127		F-16192-2-1	I115	5			0		5

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
I2401	LAMP, glow; 105-125v ¼ w; T-4½ envelope; DC bayonet candelabra base; spec JAN-1A	Blower "ON"	JAN type 991	17-L-6811		700538	I2401	1					
I2501	LAMP, glow; neon glow; 1/25w; T-3¼ clear bulb; min. S.C. bayonet base; 13/32" diam. x 1-3/16" lg o/a.	"ON-OFF" Indicator		17-L-6806-130	GE NE-51		I2501	1					
J101	CONNECTOR, receptacle: one round female cont.; straight type; 1-1/16" lg. x 1" wd. x 1" h.; 50 amp., no voltage specified; silver plated cyl. die cast zinc body; mica filled bakelite insert; four 0.125" diam. mtg. holes on 23/32" x 23/32" mgt. ctrs., ⅝-24 NEF thd. coupling (used with E138)	Mon Line Ant Coupling Unit		17-C-73108-5890	IPC 9700		J101 to J107, J111, J112, J308 to J311, J2104, J3014 to J3021	27					
J102	Same as J101 (see E139)	1000 KW Amp Grid Monit											
J103	Same as J101 (see E140)	1000 KW Amp Plate Monit											
J104	Same as J101 (see E141)	Trigger Pulse #1											
J105	Same as J101 (see E142)	Trigger Pulse #2											
J106	Same as J101 (see E143)	100 KC Source #1											
J107	Same as J101 (see E144)	100 KC Source #2											
J108	CONNECTOR, receptacle: two flat female polished cont.; straight type; 1½" lg. x 1¾" diam. o/a; 15 amp. at 125 v., 10 amp. at 250 v.; approx. cyl. shaped white glazed	AC for Monitor Oscilloscope		17-C-73137-4302	Bryant Elec #112		J108	1					

	por. body; white glazed por. insert; 5/16" diam. cable opening; two 3/16" diam. mtg. holes on ⅝" ctrs.; female receptacle c/o upper and lower por. sections keyed together and joined by ctr. screw; lower section is mtg. base for cont. and has recessed holes for mtg.												
J109	INSULATOR, standoff: steatite; conical beehive corrugated type; 5" h x 3-¾" OD o/a; c/o insulator with brass bushing in top containing brass insert drilled (0.098") to form pin jack, and incl cap nut and 2-9/16" diam inverted dish type corona shield; insulator 4" h with 3-¾" diam x ¼" d base flange and upper part tapered 2" diam to 1-½" diam; four 9.32" diam mtg holes in base flange spaced 90° on 2-⅝" diam circle.	50-ohm Output-Connection		17-I-68673-6255		FRA-14598-2-2	J109, J501 to J504	5	28	1	3		10
J110	CONNECTOR, adapter: T-shape; female 2 ends, male 1 end; single cont. ea. end; 1⅝" lg. x ⅝" wd. x 1-9/32" h. o/a; LV, non-constant freq. impedance; peak freq. is UHF; polystyrene inserts; ⅝"-24 ext. thd. ea. female end, ⅝"-24 coupling nut male end	Exc A and Exc B Outputs to 1st IPA		17-C-68722-3539	IPC 10000		J110	1					
J111	Same as J101 (see E145)	100 KC Isolating											
J112	Same as J101 (see E146)	100 KC Isolating											
J301	JACK, telephone: for ¼" diam. x 1-7/32" lg. 2-conductor plug; 1-7/32" lg. x 1" wd. x ¾" h. o/a; J4 cont. arr.; ⅜" mtg. hole; no locating pin	Trip (V302) Grid Meter		17-J-39254-1300	Switch-craft #12A*		J301 to J307	14					
J302	Same as J301	Mixer (V303) Grid #1 Meter											
J303	Same as J301	Mixer (V303) Grid #3 Meter											
J304	Same as J301	Lim-Ampl (V304) Grid Meter											

*Tropicalized in accordance with Navy Dept., Bureau of Ships letter 3079C (930B), May 5, 1945 (paragraphs 1 and 2 only), entitled "Requirements for tropicalization," plus JAN-T-152 and JAN-C-173.

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
J305	Same as J301	Divider (V307) Grid #1 Meter											
J306	Same as J301	Doubler (V308) Grid Meter											
J307	Same as J301	Trip (V309) Grid Meter											
J308	Same as J101	100 KC Input Connector											
J309	Same as J101	Keying Pulse Input											
J310	Same as J101	RF Output											
J311	Same as J101	Frequency Monitor Connector											
J501	Same as J109	Term Trans Line #1											
J502	Same as J109	Term Trans Line #2											
J503	Same as J109	Term Ant Line #1											
J504	Same as J109	Term Ant Line #2											

J505	INSULATOR, standoff: conically shaped corrugated beehive; white glazed steatite, grade L-5; 2-1/16" h. x 2⅛" diam. o/a; mtg. flange at base 2⅛" diam. x ¼" h. w/three 3/16" diam. mtg. holes spaced 120° on 1-11/16" diam. circle; 1-3/16" lg. x 3/32" I.D. female connector at top of ins., w/¼"-20 cap nut on top end	Term Monitor Line to Trans #1	NS-5W-2501 Mod	17-I-68656-1101		FRA-14594-1	J505 to J507	3	29	1	2		5
J506	Same as J505	Term Monitor Line to Trans #2											
J507	Same as J505	Term Monitor Line from Ant											
J2101	Not used												
J2102	Not used												
J2103	Not used												
J2104	Same as J101	Timer Output Connector (In Timer)											
J2301	CONNECTOR, receptacle: 10 contracts, female, flat, polarized straight type; 3-¼" lg. x 1⅜" wd. x 27/32" h. o/a; rectangular, steel black wrinkle enamel; molded melamine insert; two 0.187" diam. mtg. holes spaced 2-13/16" c to c.	Receiver Control Circuit		17-C-73287-8089	Jones HB S-2410-SB-B		J2301	1					
J3014	Same as J101; u/w adapter (see E3014 and P3014)	100 KC Input from Timer #1											
J3015	Same as J101 (see E3015 and P3015)	100 KC Output											
J3016	Same as J101 (see E3016 and P3016)	100 KC Input from Timer #2											
J3017	Same as J101 (see E3017 and P3017)	100 KC Output											

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
J3018	Same as J101 (see E3018 and P3018)	100 KC Input from Timer #3											
J3019	Same as J101 (see E3019 and P3019)	100 KC Output											
J3020	Same as J101 (see E3020 and P3020)	100 KC Input from Timer #4											
J3021	Same as J101 (see E3021 and P3021)	100 KC Output											
J3621	CONNECTOR, adapter: double-ended female, female cont. ea. end; JAN UG-363/U; straight; for connecting two PL-259 plugs thru a pressure bulkhead; 2" lg. x ⅝" diam. o/a excluding locknuts; 500 v., non-constant freq. impedance; peak freq. 200 mc; polystyrene insert; coupling thd. ⅝-24 ext. thd. for full lgth.; mts. in ⅝" hole w/2 locknuts; (see P3621)	100 KC Output to Trans #1 Exc B	Sig. C Type PL-274	17-C-67731-6722	IPC 30500		J3621, J3622	2					
J3622	Same as J3621; u/w P3622	100 KC Output to Trans #1 Exc A											
J3722	CONNECTOR, adapter: double-ended female; one cont. ea. end; straight type; connects to NT-49195 ea. end; 1⅜" lg x ⅝" diam. o/a excluding locknuts; 500 v., non-constant freq. impedance; peak freq. 200 mc; polystyrene insert; ⅝-24 ext. thd. for full lgth.; bulkhead mtg in ⅝" diam hole w/2 locknuts; pressurized; similar to Sig C PL-274 except 1⅜" lg; (see P3722)	100 KC from Timer #1	UG-224/U	17-C-67728-7317	IPC 29500		J3722 to J3725	4					

J3723	Same as J3722; u/w P3723	100 KC from Timer #2											
J3724	Same as J3722; u/w P3724	100 KC from Timer #3											
J3725	Same as J3722; u/w P3725	100 KC from Timer #4											
K101	RELAY, solenoid: contacts; DPST; normally open, 25 amp., 220 v. AC, silver; coil: single wnd., 115 v. AC, 47.5/63 cps, 28 ohms approx. DC resistance, ins; 2 stud term for coil; four for cont.; 7" lg. x 4⅝" wd. x 3½" h. o/a w/plunger in non-oper. position; mtd. by one teardrop hole on top, 7/16" and 3/16" diam. and two "U" shaped notches 3/16" lg. x 7/32" wd. 2" c to c in bottom of mtg. plate; fast acting; not encl. in metal box	Filament Step-start		17-R-70544-6596	Monitor Cont 6202V-2K*		K101	1	30	1	1		3
K101A	CONTACT, relay: rigid type; one rounded silver cont. ⅜" diam. x 1/16" h.; rated 220v., 25 amp.; "L" shaped, one arm 1" lg. x 7/16" wd. x 1/16" h., other arm ¾" lg. x 7/16" wd. x 1/16" h.; one 6-32 thd. hole for term screw provided on long arm; 7/16" distance of cont. from mtg. hole; single mtg. hole tapped 6-32 thd. located ¼" from end of short arm below cont.; p/o Monitor Cont. relay 6202V-2K	Spare for K101		17-C 81588-5001	Monitor Cont #7-48-1		K101A, K101B, K102A, K102B, K102C, K103A, K103B, K103C	8	31	1	3		6
K101B	Same as K101A	Spare for K101											
K101C	CONTACT, relay: rigid type; one ⅜" diam. x 1/16" h. silver cont.; 220 v., 25 amp.; "L" shaped, one arm 1" lg. x 7/16" wd. x 1/16" thk., other ¾" lg. x 7/16" wd. x 1/16" thk.; one #6-32 thd. hole for term. screw on long arm; cont. 7/16" from mtg. hole; single #6-32 thd. mtg. hole 11/16" from end of short arm, above cont.	Spare for K101		17-C-81588-5026	Monitor Cont #7-49-1		K101C, K101D, K102D, K102E, K102F, K103D, K103E, K103F	8	32	1	3		6

*Tropicalized in accordance with Navy Dept., Bureau of Ships letter 3079C (930B), May 5, 1945 (paragraphs 1 and 2 only), entitled "Requirements for tropicalization," plus JAN-T-152 and JAN-C-173.

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
K101D	Same as K101C	Spare for K101											
K101E	CONTACT, relay: rigid type, movable cont.; two ⅜" diam. x 1/16" h. silver cont.; 220 v., 25 amp.; curved; 1¾" lg. x ½" wd. x ¼" h.; cont. ea. ¾" from mtg. hole; two 3/32" diam. mtg. holes centered in cont. arm and spaced ¼" c to c	Spare for K101		17-C-81602-9326	Monitor #7-50-1 Cont		K101E, K101F, K102G, K102H, K102J, K103G, K103H, K103J	8	33	1	3		6
K101F	Same as K101E	Spare for K101											
K102	RELAY, solenoid: 3PST; normally open; cont. rating 25 amp., 220 v. AC; silver cont., ⅜" diam.; single wnd., 115 v. AC, 47.5 to 63 cyc., 28 ohms DC resistance approx.; ins.; two stud term. on coil, six on cont.; 7" lg. x 4⅝" wd. x 3½" h. o/a w/plunger in non-oper. position; mtd. by one teardrop hole in top, 7/16" and 3/16" diam. and two "U" shaped notches 3/16" lg. x 7/32" wd. 2" c to c, in bottom of base mtg. plate; fast acting; not encl. in metal box	High Voltage Step-Start		17-R-70544-6406	Monitor Cont #6202V-3K*		K102, K103	2	34	1	2		5
K102A	Same as K101A	Spare for K102											
K102B	Same as K101A	Spare for K102											
K102C	Same as K101A	Spare for K102											
K102D	Same as K101C	Spare for K102											
K102E	Same as K101C	Spare for K102											

K102F	Same as K101C	Spare for K102											
K102G	Same as K101E	Spare for K102											
K102H	Same as K101E	Spare for K102											
K102J	Same as K101E	Spare for K102											
K103	Same as K102	High Voltage Contactor											
K103A	Same as K101A	Spare for K103											
K103B	Same as K101A	Spare for K103											
K103C	Same as K101A	Spare for K103											
K103D	Same as K101C	Spare for K103											
K103E	Same as K101C	Spare for K103											
K103F	Same as K101C	Spare for K103											
K103G	Same as K101E	Spare for K103											
K103H	Same as K101E	Spare for K103											
K103J	Same as K101E	Spare for K103											
K104	RELAY, armature: contacts c/o two SPDT sensitive switches, ea. in a phenolic case, 5 amps, 250 v.; coil single wnd., 4000 turns #31 FMX, 110 v. AC, 0.120 amp., 90 ohms. DC resistance, ins.; 2 solder lug term. on coil, 6 on cont.; 4" lg. x 1¾" wd. x 2¼" h. o/a mtd. by two #8-32 tapped holes on ¾" mtg./c, fast acting; hdw. incl.	Low Power Fil Ind Light Control		17-R-64071-1001	Clare CP Type AMS*		K104 to K111,	8	35	1	7		18
K104A	SWITCH ASSEMBLY: 2 micro-switches, 250v. A.C., 5 amp., 6 screw-type term. on bottom, bakelite case, ea. switch SPDT; 2.4682" lg. x 1⅜" wd. x 1½" h.; mounted in L-shape bracket.	Spare for K104		17-S-90137-9431	Micro-switch Type B2-RL		K104A to K114A	11 Sets					

*Tropicalized in accordance with Navy Dept., Bureau of Ships letter 3079C (930B), May 5, 1945 (paragraphs 1 and 2 only), entitled "Requirements for tropicalization," plus JAN-T-152 and JAN-C-173.

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
K105	Same as K104	Bias Ind Light Control											
K105A	Same as K104A	Spare for K105											
K106	Same as K104	Low Voltage Ind Light Control											
K106A	Same as K104A	Spare for K106											
K107	Same as K104	2nd IPA Overload Ind Light Control											
K107A	Same as K104A	Spare for K107											
K108	Same as K104	PA Overload Ind Light Control											
K108A	Same as K104A	Spare for K108											
K109	Same as K104	HV Supply Overload Ind Light Control											
K109A	Same as K104A	Spare for K109											
K110	Same as K104	HV Time Delay Ind Light Control											

K110A	Same as K104A	Spare for K110											
K111	Same as K104	High Power Fil Ind Light Control											
K111A	Same as K104A												
K112	RELAY, armature: contacts c/o two SPDT sensitive switches, ea. in a phenolic case, 5 amp., 250 v.; coil: single wnd. 13,200 turns; 48 v. DC, 12.5 ma. approx. 1200 ohms DC resistance, ins.; 2 solder lug term. for coil, 6 for cont.; 4" lg. x 1¾" wd. x 2¼" h. o/a; mtd. by two #8-32 tapped holes on ¾" mtg./c; incl. hdw. and dust cover	2nd IPA Overload		17-R-65355-7638	Clare CP Type EMS*		K112 to K114	3	36	1	3		8
K112A	Same as K104A	Spare for K112											
K113	Same as K112	PA Overload											
K113A	Same as K104A	Spare for K113											
K114	Same as K112	HV Supply Overload											
K114A	Same as K104A	Spare for K114											
K115	RELAY, solenoid: contacts: 1 type A, mercury, 230 v., 1.5 amp. rating; coil: single wnd., 115 v. AC, 47.5-63 cps., 95 v. at 61 ma. oper., 47 v. at 71 ma. release, 350 ohms approx. DC resistance, ins.; 2 wire leads for coil, 2 for cont.; 5" lg. x 2-½" wd. x 2-⅝" h. o/a; mtd by four 3/16" diam. holes on 1-⅞" x 2-⅞" mtg. c; 15 sec. oper. time, 0.3 sec. release; cont. and plunger; sealed in fibre tube	Fil Step-start Time-Delay		17-R-70539-1101	Adlake Type 1101-8-95T*	FRJ-24284-2	K115, K116	2	37	1	2		5
K116	Same as K115	Over-load Count-ing Relay Reset											

*Tropicalized in accordance with Navy Dept., Bureau of Ships letter 3079C (930B), May 5, 1945 (paragraphs 1 and 2 only), entitled "Requirements for tropicalization," plus JAN-T-152 and JAN-C-173.

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
K115A and K116A	RELAY SUBASSEMBLY: contacts: p/o Adlake type 1101-8-95T (K115, K116); c/o cyl. fibre tube w/cont. and solenoid sealed in, and mtg. clamp around ctr.; to be inserted within 115 v. coil of relay; two 8" leads from cont.; sealed with tar; 230 v, 3 amp rating; normally open; cyl. shape; 5-⅝" lg x 1" diam. o/a less mtg. clamp; includes mtg. clamp	Spares for K115, K116		17-R-76490-1001	Adlake #P-465670T		K115A, K116A	2	38	1	2		4
K117	RELAY, solenoid: contacts: 1 type B, mercury, 230 v. and 3 amp. cont. rating; coil: single wnd, 115 v. AC, 47.5-63 cps., 65 v. and 70 ma. oper., 59 v. and 65 ma. release, 350 ohms approx. DC resistance; ins.; 2 wire leads for coil, 2 for cont.; 5" lg. x 2-½" wd. x 2-⅝" h. o/a; mtd. by four 3/16" diam. holes on 1-⅞" x 2-⅞" mtg./c; 0.3 sec. oper. time, 2 sec. release time; cont. and plunger sealed in fibre tube	Automatic Overload Reset Time Delay		17-R-70542-1001	Adlake Type 1101-34-63T*	FRJ-24283-2	K117	1	39	1	1		3
K117A	RELAY SUBASSEMBLY: Contacts; p/o Adlake type 1101-34-63T (K117) relay, solenoid type; c/o fibre type w/cont. and plunger sealed in and mtg. clamp around ctr.; to be inserted within 115 v coil of relay; two 8" leads from cont.; sealed w/tar; 230 v., 3 amp. cont. rating; normally closed; cyl. shape; 5-¼" lg. x 1" diam.; mtg. clamp; includes mtg. clamp	Spares for K117		17-R-76490-1020	Adlake #P-465417T		K117A	1	40	1	1		2
K118	RELAY, solenoid; contacts: SPST, normally open, mercury, 230 v. and 3 amp., cont. rating; coil: single wnd., 115 v AC, 47.5-63 cps, 95 v. at 61 ma. oper., 47 v. at 71 ma.	HV Step-start Time Delay		17-R-70539-1201	Adlake Type 1101-8-84T*	FRJ-24284-2	K118	1	41	1	1		3

	release, 350 ohms approx. DC resistance ins.; 2 wire leads from coil, 2 from cont.; 5⅝" lg. x 2½" wd. x 2-9/16" h.; mtd. by four 0.177" diam. holes on 1⅞" x 1-15/16" mtg/c; 1 sec. oper. time, 0.3 sec. release; cont. and plunger sealed in fibre tube												
K118A	RELAY SUBASSEMBLY: contacts; p/o Adlake type 1101-8-84T (K118) relay, solenoid type; c/o cyl. fibre tube w/cont. and plunger sealed in, and mtg. clamp around ctr.; to be inserted within 115 v. coil of relay; two 8" leads from cont.; sealed w/tar; 230 v., 3 amp. cont. rating; normally open; cyl. shaped; 5⅝" lg. x 1" diam. o/a less mtg. clamp; includes mtg. clamp	Spare for K118		17-R-76490-1010	Adlake # P-465342T		K118A	1	42	1	1		2
K119	RELAY, solenoid: contacts SPST normally open, mercury, 230 v. and 3 amp. cont. rating; coil: single wnd., 115 v. AC, 47.5-63 cps., 95 v. at 61 ma. oper., 47 v. at 71 ma. release, 350 ohms approx. DC resistance ins.; 2 wire leads from coil, 2 from cont.; 5⅝" lg. x 2½" wd. x 2-9/16" h. o/a; mtd. by four 0.177" diam. mtg. holes on 1⅞" x 1-15/16" mtg./c; 180 sec. oper. time, 0.3 sec. release; cont. and plunger sealed in fibre tube	HV Time-Delay		17-R-70539-1191	Adlake Type 1101-8-29T*	FRJ-24284-2	K119	1	43	1	1		3
K119A	RELAY SUBASSEMBLY: contacts; p/o Adlake type 1101-8-29T (K119) relay, solenoid type; c/o cyl. fibre tube w/cont. and plunger sealed in and mtg. clamp around ctr.; tube to be inserted in 115 v. oper. coil of relay; sealed w/tar; 230 v. and 3 amp. cont. rating, normally open; cyl. shaped; 5⅝" lg. x 1" diam. o/a less mtg. clamp; includes mtg. clamp	Spare for K119		17-R-76490-1030	Adlake # P-465668T		K119A	1	44	1	1		2
K120	RELAY, armature: 4PST, normally open; 230 v. AC, 30 amp. cont. rating; ⅜" diam. fine silver cont.; single wnd.; 115 v. AC at 47.5 to 63 cyc.; 0.11 amp. at 60 cyc.; 120 ohms DC resistance, ins.; screw term. w/slotted hex nuts for coil and cont.; 7" lg. x 5" wd. x 3" h. o/a; four 0.196" diam. mtg. holes on 3⅛" x 5¾" ctrs.; fast acting; tropicalized	Door Interlock		17-R-64253-6969	Dunco Type 8DXX-131*		K120	1	45	1	1		3

*Tropicalized in accordance with Navy Dept., Bureau of Ships letter 3079C (930B), May 5, 1945 (paragraphs 1 and 2 only), entitled "Requirements for tropicalization," plus JAN-T-152 and JAN-C-173.

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
K120A	CONTACT, relay: point type; one round silver cont. 3/8" diam. x 0.118" h.; rated 115 v. DC at 4 amp.; straight 17/32" h. x 3/8" diam. w/hex bottom 3/8" across flats; single hole mtg. #10/32 tap; p/o Dunco relay 8DXX131 and 8D-XX117 relay	Spare for K120		17-C-81505-9696	Dunco #600		K120A, K121A, K120B, K121B, K120C, K121C, K120D, K121D K122D K122E K122F	11	46	1	5		10
K120B	Same as K120A	Spare for K120											
K120C	Same as K120A	Spare for K120											
K120D	Same as K120A	Spare for K120											
K120E	CONTACT, relay: spring leaf type, flex.; one round silver cont. 3/8" diam. x 1/32" h.; 230 v., 30 amp.; straight w/45 deg. bend 1¼" from cont. and 3" lg. o/a x 3/8" wd. x 1/32" thk.; one wire lead 3" lg. w/lug term. on end; cont. 2½" from first mtg. hole; one 3/16" diam. mtg. hole and one mtg. slot ¼" lg. x 3/16" wd. on 1⅛" mtg./c; p/o Dunco relay type 8DXX117 and 8DXX131 relay	Spare for K120		17-C-81484-9112	Dunco #11899		K120E, K121E, K120F, K121F, K120G, K121G, K120H, K121H	8	47	1	5		10
K120F	Same as K120E	Spare for K120											
K120G	Same as K120E	Spare for K120											
K120H	Same as K120E	Spare for K120											

K121	RELAY, armature: 4 PST, normally open; 230 v. AC, 30 amp., 230 v. DC, 0.75 amp., cont. rating; silver cont. ⅜" diam.; single wnd., 115 v. AC, 47.5 to 63 cyc., approx. 90 ohms DC resistance, ins., 2 stud term. on coil, 8 on cont.; 5" lg. x 4" wd. x 2½" h.; four 3/16" diam. mtg. holes on 2½" x 3½" mtg./c; fast acting	Filament Contactor		17-R-64205-1001	Dunco Type 8DXX-117*		K121	1	48	1	1		3
K121A	Same as K120A	Spare for K121											
K121B	Same as K120A	Spare for K121											
K121C	Same as K120A	Spare for K121											
K121D	Same as K120A	Spare for K121											
K121E	Same as K120E	Spare for K121											
K121F	Same as K120E	Spare for K121											
K121G	Same as K120E	Spare for K121											
K121H	Same as K120E	Spare for K121											
K122	RELAY, armature: 3PDT contacts rated 5 amp. at 230 v. AC; ⅜" diam. silver contacts; two separate coils; operate coil 115 v. AC, 47.5 to 63 cyc., approx. 32 ohms DC resistance; reset coil 115 v. AC, 47.5 to 63 cyc., approx. 100 ohms DC resistance; 13 stud term. total, 2 for operate coil, 2 for release coil, 9 for contacts; 7" lg. x 5⅞" wd. x 3⅜" h. o/a; four 0.196" diam. mtg. holes on 4⅞" x 5¼" mtg./c; fast acting; three step ratchet type relay; one set of contacts close on first impulse; two sets of contacts close on third impulse; contacts released by reset coil energization	Elec Reset Relay		17-R-64205-6501	Dunco Type 99XCX-100*		K122	1	49	1	1		3
K122A	CONTACT, relay: spring leaf type; one round silver cont. ⅜" diam. x 1/32" h.; 5 amp. 230v.; straight 3¾" lg. x ⅜" wd. x 3/16" h.; 2⅝" distance of cont. from first mtg.	Spare for K122		17-C-81489-1521	Dunco #15850		K122A, K122B, K122C	3	50	1	3		6

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TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
	hole; two 3/16" diam. mtg. holes ¾" c to c; p/o Dunco relay 99-XCX100												
K122B	Same as K122A	Spare for K122											
K122C	Same as K122A	Spare for K122											
K122D	Same as K120A	Spare for K122											
K122E	Same as K120A	Spare for K122											
K122F	Same as K120A	Spare for K122											
K122G	CONTACT, relay: rigid type; one fine silver cont., ⅜" diam. face x 1/32" h.; cont. rated 5 amp., 230 v. AC; 1⅛" lg. x ⅜" wd. x 1¾" h. o/a; 13/16" approx. between cont. and mtg. hole; one 3/16" diam. mtg. hole; p/o Dunco type 99X-CX100 relay	Spare for K122		17-C-81603-3001	Part of Dunco #17286		K122G, K122H, K122J	3	51	1	3		6
K122H	Same as K122G	Spare for K122											
K122J	Same as K122G	Spare for K122											
K123	RELAY, armature: SPST., normally closed; cont. rating 10 amp. 15,000 v. peak; silver cont.; single wnd., 120 v.; 47.5 to 63 cyc., 0.194 amp., 55.4 ohms DC resistance, inductive wnd., ins.; 2 stud term. w/nuts for coil, 2 screw type term. for cont.; 8½" lg. x 4" wd. x 5¾" h. o/a; four 0.196" diam. holes on 7¾" x 3¾" mtg./c on base; fast acting	HV Bleeder Circuit Shorting		17-R-64412-1001	Dunco Type 90XXA-105*	FRJ-24285-12	K123	1	52	1	1		3

K123A	CONTACT, relay: rigid type; 1 silver cont., hex shaped w/silver button 7/16" diam. x 1/32" thk.; 15,000 v. at 10 amp. peak AC; 7" lg. x 13/16" wd. x 1-9/16" h. o/a; 1 wire term. from top w/1 ring type term. lug on end; 1 slotted hole 5/16" x 7/32" wd. and one 7/32" diam. hole 1-3/16" c to c on bakelite arm; p/o Dunco #90XXA105 relay	Spare for K123		17-C-81625-1001	Dunco # 15646		K123A	1	53	1	1		10
K123B	CONTACT, relay: stud type; 1 silver cont., ⅜" diam. by 1/32" h.; 15,000 v. at 10 amp. peak AC; straight, 27/32" lg. x ⅜" across flats of hex nut #10-32 thd. stud for mtg.; p/o Dunco relay #90-XXA105	Spare for K123		17-C-81581-8255	Dunco # 4892		K123B	1	54	1	1		10
K2301	Not Used												
K2302	RELAY, armature: contact arrangement 1C, single break AC-DC; 115-vAC, 24 vDC; 2 amp AC and DC; inductive winding; DC 5000 ohms resistance; 6 ma DC max operating current; 3 terminals on contacts; 2 terminals on coil; continuous duty, hermetically sealed; 1½" lg x 1½" wd x 3-13/32" h; mtd by two #6-32 studs 13/32" lg. on 1⅜" centers	Motor (B2501) Starting Relay		17-R-65241-6559	Sigma Instr # 41RJ, spec 90295	B1040763	K2302 K2303	2	7 VR	6	2		50
K2303	Same as K2302	Motor (B2501) Starting Relay											
K2501	CIRCUIT BREAKER: magnetic blowout arc quenching; DPST; continuous load rating, AC 250 v, 50-65 cps, 31 amp; 5000 amp interrupting capacity; armature trip release; tripping time: continuous for 101-125% rated load, 1 sec at 125%, 0.5 sec at 200% and 0.25 sec. at 300%; manual closing, automatic reset; phenolic case; silver main contacts; 3-21/32" d x 2" wd x 5¼" h o/a; front mtd by 4 brass inserts located on 1" x 3-1/16" ctrs, and tapped #8-32 thrd x 7/32" d; two holes (to clear #10-32 screw) 4-23/64" c to c on ctr line for surface mtg; four screw terms on 0.980" x 4-23/64" ctrs, on shoulders, on ends of case; 2-5/16" x 1¼" panel cutout required; fungus treated; current carrying parts silver plated	Input Line Breaker		17-C-51469-1751	Heinemann # 2263S-M6-31	C1040747-1	K2501	1	8 VR	6	1		25

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TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
L101	REACTOR: filter choke; dual; ea. sect. 5 hy. at 0.25 DC amp.; 72 ohms DC resistance; 3.5 kv. test; HS metal case; 8" lg. x 5⅛" wd. x 3⅞" h. o/a less term.; 2 mtg. flanges ea. w/two 0.2010 diam. mtg. holes; holes spaced 3½" x 4½" c to c; four solder lug term. on ¾" high por. pillars			16-R-29792-5397		FRE-16059-2	L101	1	55	2	1		3
L101A	Part of L101	LV-Bias Supply Filter											
L101B	Part of L101	LV-Bias Supply Filter											
L102	COIL, RF: 5 pie universal wound; unshielded; 2.7 MH total inductance w/slug centered in 5 pie; 7.5 ohm total DC resistance; 5.2 ohms DC resistance to tap; 11-13/16" lg. x 3" wd. x 2" h. o/a less stud screw term.; white glazed steatite coil form 8⅜" lg. x 1½" OD x 1⅛" ID w/powdered iron core; core adjustable by ¼"-20 thd. rod w/ knob; three 3/16" diam. mtg. holes ⅜" from bottom, spaced 120 deg.; 7½" lg. x ⅝" wd. x 3/16" thk. mycalex strip, ⅝" from side of coil form w/4 #8-32 screw term.; includes steel ruler calibrated from 0 to 2½", and indicating nut and washer on core adjustment stud	Pulse Forming Cathode		16-C-76756-6361		FRA-19218-3-3	L102	1	56	2	1		3
L103	COIL, RF.: choke coil; single wnd.; 4 pies., universal wnd.; unshielded; 2.5 mh. at 125 ma. ±15%; 50 ohms DC resistance; 1 μμf distr. capac.; 888 turns #35ES wire (222 turns per pie.); 2" lg. x ½" OD o/a, less term.; 2" lg. x 11/32" OD	1st IPA Plate Choke		16-C-74716-6606	Natl Co R-100		L103 to L105	3					

	isolantite form.; air core; term. mtg.; two radial wire lead term.; waxed, fungus proofed												
L104	Same as L103	2nd IPA Grid Choke											
L105	Same as L103	2nd IPA Grid Choke											
L106	Not used												
L107	COIL, RF: grid choke; single wnd, single layer wnd.; unshielded; 90 turns no. 24 bare tinned copper wire; 7½" lg. x 1½" diam. o/a excluding term.; steatite form, air core; term. mtg.; 2 radial stud term. located one ea. end.	PA Grid Choke		16-C-72666-6825		FRA-17956-2-1	L107 to L109	3	57	2	3		4
L108	Same as L107	PA Grid Ch											
L109	Same as L107	PA Plate Ch											
L110	Part of E101	Parasitic Suppressor											
L111	Part of E102	Parasitic Suppressor											
L112	Part of E103	Parasitic Suppressor											
L113	Part of E104	Parasitic Suppressor											
L114	COIL, RF: tank coil; single wnd., single layer wnd.; unshielded; 27 turns no. 18 bare tinned copper wire; 4" lg. x 2" diam. o/a excluding term.; steatite form, air core; term. or thru axial hole mtg.; 2 radial stud term. located one ea. end; form has 8 grooves running over entire lgth., also notched to accommodate wire	1st IPA Grid Tank		16-C-72419-7074		FRA-17951-2	L114	1	58	2	1		3
L115	COIL, RF.: one wnd., single layer wnd.; 82 turns #18 B&S bare tinned copper wire; 8¼" lg. x 2-1/16" diam. o/a; ceramic form, 8¼" lg. x 2" diam, air core; term. mtg.; 3 stud term.; one at ea. end and one at ctr. of coil	1st IPA Plate Tank		16-C-72666-5689		FRA-17954-2	L115	1	59	2	1		3

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
L116	TRANSFORMER, variable RF: plate tank coil; 3 section stator and two rotors; all edgewound w/¼" wd. x 0.054" thk. cadmium plated copper strap; 30 turns total stator, 6½ turns ea. rotor; unshielded; 13¾" lg. x 3¾" wd. x 6½" h. o/a; support form c/o 4 mycalex strips secured by metal brackets; each rotor has ¼" diam. x 1-1/16" lg. shaft; two ⅜" lg. x 3/16" wd. mtg. slots ea. end on 13⅛" x 1½" mtg./c	2nd IPA Plate Tank		17-T-84031-1301		FRA-19542-14	L116	1			0		2
L117A	TRANSFORMER, variable RF: power amplr. tank coil; 2-section stator, single rotor; all edgewound w/¼" wd. x 0.054" thk. cadmium plated copper strap; 8½ turns total stator, 4½ turns rotor; unshielded; 6¾" x 6½" x 6½" approximately o/a; support form c/o 4 mycalex bars spaced 90 deg. apart by two 270 deg. metal supporting arcs; rotor shaft ¼" diam. x ½" lg; 2 L-shaped mtg. brackets, ea. w/ as Fed. Tele. and Radio dwg. 3/16" hole spaced 6" c to c; same #FRA-17646-14-2 except lg. rotor shaft protrudes from space between mycalex bars numbered 2 and 3	PA Plate Tank		17-T-84015-5981		FRA-17646-14-1	L117A	1	60	2	1		5
L117B	TRANSFORMER, variable RF: power amplr. tank coil; 2-section stator, single rotor; all edgewound w/¼" wd. x 0.054" thk. cadmium plated copper strap; 8½ turns total stator, 4½ turns rotor; unshielded; 6¾" x 6½" x 6½" approximately o/a; support form c/o 4 mycalex bars spaced 90 deg. apart by two 270 deg. metal supporting arcs; rotor shaft ¼" diam. x ½" lg; 2 L	PA Plate Tank		17-T-84015-5983		FRA-17646-14-2	L117B	1	61	2	1		5

	shaped mtg. brackets, ea. w/3/16" hole spaced 6" c to c; same as Fed. Tele. and Radio dwg. #FRA-17646-14-1 except lg. rotor shaft protrudes from space between mycalex bars numbered 1 and 4												
L118	COIL, RF: output coupling; single wnd., single layer wnd.; unshielded; 5 turns of copper strap, cad. pl., ¼" wd. x 0.054" thk. closely wnd. edgewise, RH wnd., 3" ID; 8" lg. x 3½" diam. o/a; two mtg. ft. w/one 5/32" diam. hole ea., 1-9/16" c to c; four rectangular mycalex strips, 1¼" lg x ⅞" wd. fastened together 90 deg. apart by "L" bkt., used as spacers inside copper straps	Output Coupling		16-C-71819-9925		FRA-19333-2-2	L118	1					1
L119	TRANSFORMER, variable, RF: output tuning coil; 3 section stator and two rotors; all edgewound w/¼" wd. x 0.054" thk. cadmium plated copper strap; 40 turns total stator, 6½ turns each rotor; unshielded; 16-1/16" lg. x 6" wd. x 3¾" h. o/a; support form c/o 4 mycalex strips secured by metal brackets; each rotor has ¼" diam. x 9/16" lg. shaft; two ⅜" lg x 3/16" wd. mtg. slots ea. end on 15½" x 1-13/16" mtg./c	Output Tuning		17-T-84131-1401		FRA-19577-14	L119	1					1
L120	COIL, RF: 5 pie universal wound; unshielded; 6.0 MH total inductance w/slug centered in 5 pie; 11.6 ohms total DC resistance; 8.3 ohms DC resistance to tap; 11-13/16" lg. x 3" wd. x 2" h. o/a less stud screw term.; white glazed steatite coil form 8⅜" lg. x 1½" OD x 1⅛" ID w/powdered iron core; core adjustable by ¼"-20 thd. rod w/knob; three 3/16" diam. mtg. holes ⅜" from bottom, spaced 120 deg.; 7½" lg. x ⅝" wd. x 3/16" thk. mycalex strip, ⅝" from side of coil form w/4 #8-32 screw term.; includes steel ruler calibrated from 0 to 2½", and indicating nut and washer on core adjustment stud	Mod-Pulse Generator Plate #1		16-C-76899-4763		FRA-19218-3-1	L120, L121	2	62	2	2		6
L121	Same as L120	Mod-Pulse Generator Plate #2											

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
L122	Part of E105	Parasitic Suppressor											
L123	Part of E106	Parasitic Suppressor											
L124	COIL, RF: meter shunt; one single layer wnd.; unshielded; 8 full turns #10B and S gauge cadmium plated copper wire; 1-15/16" lg. x 1¼" diam. o/a; term. mtd.; ends of coil turned to form 3/16" ID term., spaced 1½" c to c along axis of coil	Meter (M111) Shunt		16-C-71953-8785		FRB-19411-1	L124	1					
L125	Same as L103	Filter											
L301	COIL, RF.: choke; single wnd., 4 pies universal wnd.; unshielded; 2.5 mh. at 125 ma.; 50 ohms DC resistance; 2-3/16" lg. x 0.525" diam., less leads; isolantite form, air core; one #6-32 thd. x ¼" lg. mtg. stud one end and one tinned wire lead term. ea. end; removable standoff insulator screwed on one end	Doubler (V305 and V306) Plate Choke		16-C-74723-3648	Natl Co. R-100U		L301	2					
M101	METER, voltmeter: AC; 25-125 cps.; range 0-300 v.; round, flush mtg. plastic case; spec. JAN-I-6	Line Volt-meter	MR35-W300AC VV	17-M-34284-4031			M101	1					
M102	METER, voltmeter: DC; 0-20 kv.; round plastic flush mtg. case; spec. JAN-I-6	PA Plate Voltage	MR35-W020DC KV	17-M-35935-6251			M102	1					
M103	METER, voltmeter: DC; 0-8 kv.; round plastic flush mtg. case; spec. JAN-I-6	Med Voltage	MR35-W008DC KV	17-M-35890-3001			M103	1					

M104	METER, voltmeter: DC; range 0-5 kv.; round, flush mtg. plastic case; spec. JAN-I-6	High Bias Supply	MR35-W005DC KV	17-M-35878-6476			M104	1					
M105	METER, voltmeter: DC; 0-1000v.; round plastic flush mtg. case; spec. JAN-I-6	Low Voltage Supply	MR35-W001DC KV	17-M-35767-6251			M105	1					
M106	METER, arbitrary scale: DC; range 0-1 ma.; scale 0-100 uniform; round flush mtg. plastic case; spec. JAN-I-6	PA Plate Current	MR35-W156 SPEC	17-M-19258-7001			M106	1					
M107	METER, time: elapsed time indicator; sync. self-starting elec. clock mechanism; direct reading; automatic start, stop; 2.75" max. bbl. diam. x 4.44" d. behind fl. (incl. motor) x 3.5" OD. fl.; 5 rotating drum counters ea. calibrated "0-9"; winding opening face; 0-9999.9 hr. range; tenths figure red, others black	High Power Filaments		17-M-32915-2138	Weston Model 691		M107	1					
M108	METER, ammeter: DC; 0-10 ma.; round, flush mtg. plastic case; spec. JAN-I-6	PA Grid Current	MR35-W010DC MA	17-M-19461-6691			M108	1					
M109	METER, ammeter: DC; 0-500 μa; normal; round, plastic flush mtg. case; spec. JAN-I-6	2nd IPA Plate Current	MR35-W108 SPEC	17-M-19170-3151			M109	1					
M110	METER, ammeter: DC; 0-5 ma.; round, flush mtg. plastic case: spec. JAN-I-6	1st IPA Plate Current	MR35-W005DC MA	17-M-19403-6651			M110	1					
M111	METER, ammeter: thermo-RF type; range 0-5 amp.; round, flush mtg. bakelite case; 2.75" bbl. diam. x 0.97" d. behind fl. x 3.5" diam. fl.; 2% accuracy full scale; 0.2 w/amp. power consumption; calibrated for non-magnetic panel; 5 deg. scale divisions, black markings on white external thermocouple included; three 0.156" diam. mtg. holes spaced 120 deg. apart on 1.58" rad.; two 1/4"-28 thd. x 0.69" lg. stud term.; linear expanded scale; 6 ft. shielded leads incl.	Transmission Line Current		17-M-18252-1051	Weston Model 425		M111	1	63	2	1		
M112	METER, arbitrary scale: DC type; range 0-200 μa; scale marked 0-100 uniform; round, flush mtg. plastic case; spec. JAN-I-6	Exciter Unit Current	MR35-W154 SPEC	17-M-21873-6151			M112	1	64	2	1		

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
M2501	METER, voltmeter: AC, 25-125 cps; range 0-300 v; rectangular, flange-mounted, black steel case; body 3.25" diam x 1.53" d behind flange, excl terms; flange 4.25" wd x 3.94" h x 0.72" thk; 2% accuracy for full-scale reading; sensitivity approx 167 ohms/volt; 0.8 watts pwr consumption; magnetically shielded; self-contained; scale marked 0-300 volts (CW), with 60 divisions, black markings on white background; four #6-32 thrd x ½" lg mtg studs on 3.04" x 2.67 ctrs on rear of flange; two ¼"-28 thrd x 0.89" lg screw terms on rear.	Output Voltage Indicator		17-M-34277-6656	Weston 964	B104-0752-2	M2501	1	9 VR	6	1		25
N101-1 to N101-5	SCALE: xmtr. panel dial scale; shaped in 180 deg. arc.; #20 B & S ga. German silver; 5½" lg. x 3-7/16" wd. x 1/32" thk. o/a; 100 scale divisions evenly divided w/ numerals and long radial lines ea. 10 divisions apart, from "0", medium lines ea. 5 divisions and short lines, all others; markings and border silver on black; four ctr. holes for #2 flat head screws located on ea. side of ctr. line by 0.937" and 1-15/16"			16-S-117101-250		F-16222-3-1	N101	5			0		5
N2401	PLATE, identification: black laminated thermosetting plastic; rectangular; 2½" lg x 1-5/16" wd x 1/32" thk; four #6-32 tap mtg holes, 0.421" x 2-3/16" c to c, marked "1, 2, 3, 4".	Blower (B2401) Terminals Marker Strip		16-P-403582-267	Jones HB #4-141 MSX	456656	N2401	1					
O101-1 to O101-40	CLIP: ferrule type; phosphor bronze; 13/16" lg. x ¾" wd. x ⅝" h. o/a; 250v, 30 amp. cap; connection made through mtg. screw; ½" max. jaw opening, approx.; includes retaining ears, has four points on mtg. surface to prevent turning			17-C-804681-176	Sq D SK-2371		O101, O301	44					

O102-1 to O102-42	CLIP: ferrule type; copper clip, steel spring; 31/32" lg. x 1" wd. x ¾" h. o/a; 250 v, 60 amp.; electrical connection made through mtg. screw; ¾" max. jaw opening, approx.; one mtg. hole ¼" diam.			17-C-804720-651	Sq D SK-2372		O102	42					
O103-1 to O103-22	CLIP: ferrule type; phosphor bronze; 1¼" lg. x 1-3/16" wd. x ¾" h o/a; 600 v., 60 amp. cap; connection made through mtg. screw; 1" max. jaw opening, approx.; reinforcing spring across one end to provide stiffness			17-C-804834-101		RA-2990-1	O103	22					
O104-1 to O104-4	CLIP: fuse; beryllium copper, silver pl.; 9/16" lg. x 13/32" wd. x ⅜" h. o/a; connection made by mtg. screw; 9/32" max. jaw opening; one mtg. hole 0.171" diam. w/fuse stops			17-C-804555-701	Littel-fuse #123001		O104	4					
O105	COUPLING, flexible: tuning shaft ins. coupling; tubular steatite ins. w/phosphor bronze disk spring and brass hub at ea. end; for ¼" diam. shafts w/two 6-32 Fil. H set screws in ea. hub; 1-13/16" lg. x 1-1/16" diam. o/a; 1" leakage path			17-C-98378-5073	Natl Co TX-1		O105	1					
O106	GEAR: bevel type; brass, cad. pl.; straight teeth; 16 teeth; 32 pitch; ½" pitch diam.; 17/32" diam. x ⅜" h. o/a approximately; 3/16" diam. bore; 13/32" diam. x 3/16" lg. hub; one 0.082" hole and one #4-36 tapped hole in hub, both holes 3/16" from bottom end of hub, spaced 90 deg.; Boston Gear Catalog #G 462 mod.			16-G-402211-887		FRB-17570-1	O106	1			0		3
O107-1 to O107-3	SPROCKET, chain: for ladder type chain; cadmium plated bronze; 0.71" pitch diam., 12 straight teeth; 13/16" diam. x 5/16" h. o/a; ¼" diam. bore; 7/16" diam. x 7/32" lg. hub; one 0.081" hole and one tapped hole w/setscrew in hub, both holes 7/64" from lower end of hub; Boston Gear Catalog #CBA 12 mod.			17-S-500031-801		FRC-18757-1	O107	3			0		3

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
O108	SPROCKET, chain: for ladder type chain; cadmium plated bronze; 0.60" pitch diam.; 10 straight teeth; ¾" diam. x 5/16" h. o/a; ⅛" diam. bore ⅜" diam. x 7/32" lg. hub; one 0.052" hole and one tapped hole w/setscrew in hub, both holes 7/64" from lower end of hub; Boston Gear Catalog #CBA 10 mod.			17-S-500026-551		FRC-22601-1	O108	1			0		1
O109-1 to O109-6	CLIP: electron tube; phosphor bronze; 1½" lg. x 13/16" wd x 13/16" h. o/a; ceramic ins. cap; one solder lug connection for #18 AWG wire; fits over 9/16" diam. contact			17-C-800970-201	Millen #36001		O109	6					
O110-1 to O110-3	CLIP: electron tube; phosphor bronze; 1⅛" lg. x ⅝" wd. x 9/16" h. o/a; ceramic ins. cap; one solder lug connection for #18 AWG wire; fits over ⅜" diam. contact			17-C-800645-101	Millen #36002		O110	3					
O111-1 to O111-4	CLEANER ELEMENT, air: fibre glass; for one-time use; 10" x 10" x 1"			17-C-794001-109	Owens--Corning "Dustop"		O111	4					
O112	Not used												
O113-1 to O113-12	SPROCKET, chain: for ladder type chain; cadmium plated bronze; 1.88" pitch diam., 32 straight teeth; 2" diam. x 13/32" h o/a; 0.378" diam. bore; ⅝" diam. x 5/16" lg. hub; one 0.078" diam. hole and one tapped hole w/setscrew in hub, both holes 5/32" from lower end of hub; Boston Gear Catalog #CBA 32 mod.			17-S-500092-183		FRC-22600-1	O113	12			0		12
O114	Not used												
O115-1 to O115-4	SPRING: helical compression type; 0.036" diam. cadmium plated phosphor bronze wire; ¾" lg. x 25/64" diam. o/a; 8 turns; ends of spring ground			17-S-46666-3966		FRB-18629-1	O115	4	65	2	4		20

O116-1 to O116-4	SPRING: helical compression type; 0.024" diam. cadmium plated music wire; 2⅛" lg. x 7/16" diam. o/a; 17 turns; ends not processed; to be free slide on ¼" diam. rod			17-S-46681-2674		FRB-18630-1	O116	4	66	2	4		20
O117-1 to O117-4	SPRING: helical extension type; 0.032" diam. cadmium plated phosphor bronze wire; 10½" lg. (approximately) x 3/16" diam. o/a; 300 turns approximately; ea. end formed to make open hook, indexed 90 deg.			17-S-46762-5051		FRB-19391-1-1	O117	4	67	2	4		20
O118-1 to O118-8	COUPLING, flexible: tuning shaft coupling; tubular ceramic ins. w/ phosphor bronze disk spring and brass hub at ea. end; for ¼" diam. shafts w/two set screws in ea. hub; 3⅜" lg. x 13/16" wd. x 13/16" h. o/a; 2½" leakage path			17-C-98378-5916	Johnson EF#104-259		O118	8					
O119	COUNTER, mechanical: direct drive; cad. pl. steel case; 1½" lg. x 1-13/32" wd. x 55/64" h. o/a; 3 digits; non-resetting; clockwise rotation; one count per revolution; subtracts in opposite direction; two 0.154" diam. mtg holes 1.125" c to c			18-R-269-3085		FRE-20865-1	O119	1			0		1
O120	COUPLING, rigid: sleeve type; ½" opening one end, 3/16" on other end; set screw mtg; 3¼" lg. x ¾" wd. x 2" h.; metal on hex micalex base; shafts ins. from ea. other by hex micalex base			17-C-98431-2501		FRA-18750-1	O120	1			0		2
O121-1 to O121-5	SPRING: helical extension type; 0.037" diam. cadmium plated music wire; 1½" lg. x ⅜" diam. o/a; 26 turns approximately; ea. end formed to make open hook, indexed 90 deg.			17-S-46742-9571		FRB-22461-1-1	O121	5	68	2	5		25
O122	SPRING: helical extension type; 0.037" diam. cadmium plated music wire; 1⅛" lg. x ⅜" diam. o/a; 16 turns approximately; ea. end formed to make open hook, indexed 90 deg.			17-S-46723-1936		FRB-22461-1-2	O122	1	69	2	1		5
O123-1 to O123-8	SPRING: flat type; for door gnd. contact; 0.010" cadmium plated beryllium copper; 2¾" lg. x ¼" wd. x ½" h. o/a; two 0.113" diam. mtg. holes spaced 5/16" c to c at ctr. of spring			17-S-46780-3601		FRB-18900-1	O123	8	70	2	8		40

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
O124	BEARING, ball: radial; bore diam. 0.3957"; OD 1.1811"; o/a wd. 0.500"; outer ring wd. 0.3540"; inner ring wd. 0.4800"	Spare for BL101		77-B-117-01015-3000	New Departure #8500		O124	1					
O125	BEARING, ball: radial; bore diam. 0.6693"; OD 1.5748"; o/a wd. 0.5630"; outer ring wd. 0.4720"; inner ring wd. 0.5380"	Spare for BL101		77-B-117-01715-3000	New Departure #8503		0125	1					
O126-1 to O-126-2	BEARING, sleeve: for fan; steel; 63/64" lg. x 5/8" OD x 15/32" ID w/cutout 7/16" wd. x 3/8" lg., 9/32" from end	Spare for BL102		17-B-200661-186	Rob & Myers #D-20303		O126	2					
O127-1 to O127-2	CLIP: electron tube; phosphor bronze, cad pl, .566" cap diam.	V102 Plate Cap			Johnson EF #119-854		O127	2					
O301-1 to O301-2	Same as 0101												
O2301	GEAR, spur: 0.100" thk x 0.754" bore; SAE-1045 steel; 192 straight teeth, 32 diametrical pitch; 14½° pressure angle, 6" pitch diam; four #17 DR size holes, three located 120° apart on ¾" rad, one on 2-19/32" rad on center line.	T2501 Drive Gear		17-G-43437-715	Superior Elec B821301		02301	1					
O2302	GEAR, spur: 0.812" OD x 0.375" bore; 5/16" lg x 21/32" diam hub; SAE-1045 steel, 24 teeth, 32 diametrical pitch, 14½° pressure angle, ¾" pitch diam; one radial #10-32 tap screw hole in hub.	B2501 Pinion Gear		17-G-431374-236	Superior Elec A821300		02302	1					
O2401	CLEANER, air: cartridge type; permanent (cleanable); crimped alum media in anodized alum frame; 9-15/16" h x 9-15/16" wd x ¾" thk incl ½" mtg flange all around.	Air Filter		17-C-794001-226	Air Maze Type R82A	B1012895-2	02401	1					
OS101	CATHODE-RAY OSCILLOGRAPH: See appended instruction book and table 8–5	Trans-mitter Monitoring			Dumont Type 256-D Cat #1296E		OS101	1					

P101	CONNECTOR, plug: one round male contact non-polarized; straight type; 1-9/16" lg. x 13/16" diam. o/a; cyl. brass body silver pl.; bakelite, mica-filled insert; cable opening for 13/32" diam. cable; multiple piece construction, tapered removable back shell, which provides extra cable clamp	Mon Line Ant Coupling Unit		17-C-71413-4752	IPC # 9750		P101 to P110, P112, P113, P305, P3014 to P3021, P3608, P3611, P3621, P3622, P3722 to P3725	30					
P102	Same as P101	1000 KW Amp Grid Monit											
P103	Same as P101	1000 KW Amp Plate Monit											
P104	Same as P101	Trigger Pulse #1											
P105	Same as P101	Trigger Pulse #2											
P106	Same as P101	100 KC Source #1											
P107	Same as P101	100 KC Source #2											
P108	Same as P101, but u/w adapter UG-176/U (see E147)	Video Input to Monit Osc											
P109	Same as P101 (u/w E148)	Direct Input to Monit Osc											
P110	Same as P101 (u/w E149)	Trigger Input to Monit Osc											
P111	CONNECTOR, plug: one round male cont. non-polarized; straight type; 1½" lg. x 23/32" diam. o/a; silver pl. zinc cyl. body; bakelite insert; 7/16" cable opening; u/w RG-8U cable and UG-176/U adapter	100 KC Input		17-C-71412-8709	IPC #58500		P111, P302 to P304, P2104	9					
P112	Same as P101 (u/w E151)	100 KC Isolating											
P113	Same as P101 (u/w E152)	100 KC Isolating											

TABLE 8-4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
P301	PLUG, telephone: 2 cond.; single shank; tubr., black bakelite shell; single shank 1-3/16" lg. x 1/4" diam., shell 1/2" diam. w/5/16" diam. cable hole, 2 7/8" lg. o/a; solder lug term.	Grid Meter	#PJ-O55B	17-P-61246-7616			P301	2					
P302	Same as P111 (u/w E303)	100 KC Input											
P303	Same as P111 (u/w E304)	Keying Pulse Input											
P304	Same as P111 (u/w E305)	RF Output											
P305	Same as P101 (u/w E138)	Freq. Monitor Connector											
P2104	Same as P111, but u/w two adapters (see E2101 and E2102)	Timer Output Connector											
P2301	CONNECTOR, receptacle: 10 contacts, male, flat, polarized; straight type; 3 1/4" lg x 1 3/8" wide x 1 3/8" h o/a; rectangular steel case; black wrinkle enamel; molded melamine resin insert; two 0.187" diam. mtg holes 2-13/16" c to c;	Control circuit con-nector		17-C-73571-1064	Jones HB P-2410-SB-B, except frame mtd in reverse position.		P2301	1					
P3014	Same as P101 (u/w E3022)	Cable Term (W3737) Connects to J3014											
P3015	Same as P101 (see E3023)	Cable Term (W3738) Connects to J3015											

P3016	Same as P101 (see E3024)	Cable Term (W3739) Connects to J3016											
P3017	Same as P101 (see E3025)	Cable Term (W3740) Connects to J3017											
P3018	Same as P101 (see E3026)	Cable Term (W3741) Connects to J3018											
P3019	Same as P101 (see E3027)	Cable Term (W3742) Connects to J3019											
P3020	Same as P101 (see E3028)	Cable Term (W3743) Connects to J3020											
P3021	Same as P101 (see E3029)	Cable Term (W3744) Connects to J3021											
P3608	Same as P101 (see E3608)	Cable Term (W3744)											
P3611	Same as P101 (see E3611)	Cable Term (W3742)											
P3621	Same as P101 (see E3621)	Cable Term (W3740) Connects to J3621											
P3622	Same as P101 (see E3622)	Cable Term (W3738) Connects to J3622											

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP. BOX	EQUIP. QUAN.	STOCK BOX	STOCK QUAN.
P3722	Same as P101 (see E3722)	Cable Term (W3737) Connects to J3722											
P3723	Same as P101 (see E3723)	Cable Term (W3739) Connects to J3723											
P3724	Same as P101 (see E3724)	Cable Term (W3741) Connects to J3724											
P3725	Same as P101 (see E3725)	Cable Term (W3743) Connects to J3725											
R101	RESISTOR, fixed: WW; 5 meg. ±0.5%; 5 w. at 110 deg. C continuous oper. temp.; spec. JAN-R-29 (supplied with M102)	Plate Voltmeter Multiplier	MFA-505	16-R-77623-8401			R101 to R104, R107	5					
R102	Same as R101	Plate Voltmeter Multiplier											
R103	Same as R101	Plate Voltmeter Multiplier											
R104	Same as R101	Plate Voltmeter Multiplier											
R105	RESISTOR, fixed: WW; 4 meg. ±0.5%; 4 w. max. oper. temp. 80 deg. C; spec. JAN-R-29; (supplied with M103)	Pulse Circuit Meter Multiplier	MFA-405	16-R-77621-3751			R105, R106, R181, R182	4					

R106	Same as R105	Pulse Circuit Meter Multiplier											
R107	Same as R101 (except supplied with M104)	High Bias Supply Meter Multiplier											
R108	RESISTOR, fixed: WW; 1 meg. ±0.5%; 110 deg. C max., 1 w.; spec. JAN-R-29; (supplied with M105)	Low Voltage Supply Meter Multiplier	MFC-105	16-R-77596-1901			R108	1					
R109	RESISTOR, fixed: comp.; 10,000 ohms ±10%, 2w; spec. JAN-R-11	1st IPA Grid Tank Loading	RC42-BF103K	16-R-50283-529			R109, R110, R143, R144, R183, R184, R223, R224	8					
R110	Same as R109	1st IPA Plate Tank Loading											
R111	RESISTOR, fixed: comp.; 100,000 ohms ±10%; 2 w; spec. JAN-R-11	2nd IPA Grid Choke Shunt	RC42-BF104K	16-R-50634-501			R111, R112, R201, R202, R207, R208	6					
R112	Same as R111	2nd IPA Grid Choke Shunt											
R113	RESISTOR, fixed: comp.; 100 ohms ±10%; 2w; spec. JAN-R-11	1st IPA Parasitic Suppressor	RC42-BF101K	16-R-49581-461			R113, R114, R115 R118 to R121, R141, R142, R217, R218	11					
R114	Same as R113 (p/o E105)	2nd IPA Parasitic Suppressor											
R115	Same as R113 (p/o E106)	2nd IPA Parasitic Suppressor											

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R116	RESISTOR, fixed: WW, non-inductive; 2500 ohms ±5%; 50 w, grade 1, class 1, 275 deg. max. oper. temp.; 4⅛" lg. x 1-1/16" OD less term.; vitreous E encl., salt water resistant; two ferrule term. 13/16" diam. x ½" lg.; term. mtg.; same as JAN RW13F252 except non inductive	PA Grid Choke Shunt		16-R-61867-1398	Ward Leonard M-13-SN		R116, R117	2	71	3	2		10
R117	Same as R116	PA Grid Choke Shunt											
R118	Same as R113 (p/o E101)	PA Parasitic Suppressor											
R119	Same as R113 (p/o E102)	PA Parasitic Suppressor											
R120	Same as R113 (p/o E103)	PA Parasitic Suppressor											
R121	Same as R113 (p/o E104)	PA Parasitic Suppressor											
R122	RESISTOR, fixed: WW, non-inductive; 250 ohms ±5%; 116w, grade 1, class 1, 275 deg. C max. oper. temp.; 8⅝" lg. x 1-5/16" OD less term; vitreous E encl.; two ferrule term. 1⅛" diam. x ½" lg.; term. mtg.; has ceramic core w/two flat surfaces 180 deg. apart along 8⅝" lg.; same as JAN RW11F251 except non-inductive	Dummy Load		16-R-61580-9497	Ward Leonard M-11-SN		R122 to R126	5	72	3	5		25
R123	Same as R122	Dummy Load											
R124	Same as R122	Dummy Load											

R125	Same as R122	Dummy Load											
R126	Same as R122	Dummy Load											
R127	RESISTOR, fixed: comp.; 51 ohms ±5%; 2w; spec. JAN-R-11	Ant Monit Line Termination	RC42-BF510J	16-R-49445-103			R127	1					
R128	RESISTOR, variable: dual; comp; 10,000/500 ohms ±10%; 2w; 3 solder lug term. per section; encl. case; 1-1/16" diam. x 1-3/16" thk. plastic body w/metal cover; 1/4" diam. x 1" lg. FMS, rounded metal shaft; linear taper; insulated cont. arm; no off positions; normal torque; mtd by 3/8-32 thd. x 3/8" lg. bushing w/locating pin at 9 o'clock and 3 o'clock on 17/32" radius			16-R-88913-9089	AB Type J-Dual		R128	1					
R128A	Part of R128	Monit Osc Gain Adj											
R128B	Part of R128	Monit Osc Gain Adj											
R129	RESISTOR, fixed: WW; 5 ohms ±1%; 1 w at 105 deg. C max. continuous oper. temp.; spec. JAN-R-93	2nd IPA Cathode Metering	RB30-B5R000F	16-R-81926-5139			R129 to R131	3					
R130	Same as R129	2nd IPA Cathode Metering											
R131	Same as R129	2nd IPA Cathode Metering											
R132	RESISTOR, fixed: WW; 1 ohm ±1%; 1w at 105 deg. C max. continuous oper. temp.; spec. JAN-R-93	PA Cathode Metering	RB30-B1R000F	16-R-81917-1001			R132 to R136	5					
R133	Same as R132	PA Cathode Metering											
R134	Same as R132	PA Cathode Metering											
R135	Same as R132	PA Cathode Metering											

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R136	Same as R132	PA Cathode Metering											
R137	RESISTOR, fixed: WW, non-inductive; 10,000 ohms ±5%; 86w, grade 1, class 1, 275 deg. C max. continuous oper. temp.; 6-7/16" lg. x 1-5/16" OD less term.; vitreous E encl.; two ferrule term. 1⅛" diam. x ½" lg.; term. mtg.; same as JAN RW12F103 except non-inductive	2nd IPA Plate Tank Loading		16-R-62073-3677	Ward Leonard M-12-SN		R137	1	73	3	1		5
R138	RESISTOR, fixed: WW; 1600 ohms ±5%; 40 w at 275 deg. C max. continuous oper. temp.; spec. JAN-R-26	K104 Voltage Dropping	RW14-F162	16-R-61822-5075			R138 to R140, R145	4					
R139	Same as R138	K105 Voltage Dropping											
R140	Same as R138	K106 Voltage Dropping											
R141	Same as R113	Parasitic Suppressor											
R142	Same as R113	Parasitic Suppressor											
R143	Same as R109	100 KC Isolating Resistor											
R144	Same as R109	100 KC Isolating Resistor											
R145	Same as R138	K111 Voltage Dropping											

R146	RESISTOR, fixed: WW; 12 ohms ±5%; 116w at 275 deg. C max. continuous oper. temp.; spec. JAN-R-26	Fil Step-Start	RW11-F120	16-R-61234-7395			R146 to R149	4					
R147	Same as R146	Fil Step-Start											
R148	Same as R146	Fil Step-Start											
R149	Same as R146	Fil Step-Start											
R150	RESISTOR, fixed: WW; 8 ohms ±5%; 116w at 275 deg. C max. continuous oper. temp.; spec. JAN-R-26	HV Step-Start	RW11-F8R0	16-R-61175-7995			R150, R151	2					
R151	Same as R150	HV Step-Start											
R152	RESISTOR, fixed: WW; 20,000 ohms ±5%; 116w; spec. JAN-R-26	HV Discharging	RW11-F203	16-R-62138-7495			R152	1					
R153	RESISTOR, variable: WW; 2500 ohms ±10%; 25w 340 deg. C max. continuous oper. temp.; spec. JAN-R-22	2nd IPA Overload Relay Shunt	RP101-SD252KK	16-R-90870-9198			R153	1					
R154	RESISTOR, fixed: WW; 100 ohms ±5%; 116w; spec. JAN-R-26	HV Bias Mech Grounding	RW11-F101	16-R-61499-9195			R154 to R156, R199	4					
R155	Same as R154	HV Mech Grounding											
R156	Same as R154	HV Mech Grounding											
R157	RESISTOR, variable: WW; 250 ohms ±10%; 25w at 340 deg. C max. continuous oper. temp.; spec. JAN-R-22	PA Overload Relay Shunt	RP101-SD251KK	16-R-90333-7758			R157, R159	2					
R158	RESISTOR, variable: WW; 100 ohms ±10%; 25w at 340 deg. C max. continuous oper. temp.; spec. JAN-R-22	HV Overload Relay Shunt	RP101-SD101KK	16-R-90219-8210			R158	1					
R159	Same as R157	Pulse Doubler Bias Adj											
R160	RESISTOR, fixed: WW; 400 ohms ±5%; 40w at 275 deg. C max. continuous oper. temp.; spec. JAN-R-26A	LV-Bias Divider	RW14-F401	16-R-61630-9275			R160, R259	2					

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R161	RESISTOR, variable: WW; 200 ohms ±10%; 25w at 340 deg. C max. continuous oper. temp.; spec. JAN-R-22	1st IPA Grid Bias Adj	RP101-SD201KK	16-R-90301-2728			R161	1					
R162	RESISTOR, fixed: WW; 160 ohms ±5%; 40w at 275 deg. C max. continuous oper. temp.; spec. JAN-R-26	LV-Bias Divider	RW14-F161	16-R-61542-5675			R162	1					
R163	RESISTOR, variable: WW; 1500 ohms ±10%; 25w at 340 deg. max. continuous oper. temp.; spec. JAN-R-22	LV-Adj	RP101-SD152KK	16-R-90805-8223			R163	1					
R164	RESISTOR, fixed: WW; 2500 ohms ±5%; 40w; spec. JAN-R-26	LV Bleeder	RW14-F252	16-R-61866-6875			R164	1					
R165	RESISTOR, variable: WW; 100 ohms ±10%; 50 w, 340 deg. C max. continuous temp.; spec. JAN-R-22	High Bias Adj	RP151-SD101KK	16-R-90220-3760			R165	1					
R166	RESISTOR, fixed: WW; 10,000 ohms ±5%; 40w at 275 deg. C max. continuous oper. temp.; spec. JAN-R-26	High Bias Filter Surge Limiting	RW14-F103	16-R-62072-1995			R166 to R168, R196 R198, R245, R255	7					
R167	Same as R166	High Bias Filter Surge Limiting											
R168	Same as R166	High Bias Filter Surge Limiting											
R169	RESISTOR, fixed: WW; 16,000 ohms ±5%; 40w; spec. JAN-R-26	High Bias Divider	RW14-F163	16-R-62122-7135			R169, R170, R197	3					
R170	Same as R169	High Voltage Bias Divider											

R171	RESISTOR, variable: WW; 10,000 ohms ±10%; 50w at 340 deg. C max. continuous oper. temp.; spec. JAN-R-22	2nd IPA Bias Adj	RP151-SD103KK	16-R-91294-7035			R171	1					
R172	RESISTOR, fixed: WW; 25,000 ohms ±5%; 50w max. oper. temp.; 275 deg. C; spec. JAN-R-26	HV Bias Divider	RW13-F253	16-R-62159-1135			R172	1					
R173	RESISTOR, fixed: WW; 50,000 ohms ±5%; 86w at 275 deg. C max. continuous oper. temp.; spec. JAN-R-26	HV Bias Divider	RW12-F503	16-R-62235-7670			R173 to R176 R193 to R195	7					
R174	Same as R173	HV Bias Divider											
R175	Same as R173	HV Bias Divider											
R176	Same as R173	HV Bias Divider											
R177	RESISTOR, fixed: comp.; 51,000 ohms ±5%; 2w; spec. JAN-R-11	M104 Shunt	RC42-BF513J	16-R-50497-945			R177 to R180	4					
R178	Same as R177	M103 Shunt											
R179	Same as R177	M103 Shunt											
R180	Same as R177	M102 Shunt											
R181	Same as R105	2nd IPA Plate Volt Multiplier											
R182	Same as R105	2nd IPA Plate Volt Multiplier											
R183	Same as R109	1st Sq Amp Control Bias Pulse Chain #1											
R184	Same as R109	1st Sq Amp Control Bias Pulse Chain #2											
R185	RESISTOR, fixed: comp.; 430,000 ohms ±5%; 2w; spec. JAN-R-11	Sq Wave Mon Div Pulse Chain #1	RC42-BF434J	16-R-50803-937			R185, R186	2					

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP. BOX	EQUIP. QUAN.	STOCK BOX	STOCK QUAN.
R186	Same as R185	Sq Wave Mon Div, Pulse Chain #2											
R187	RESISTOR, fixed: WW; 1600 ohms ±5%; 116w at 275 deg. C max. continuous oper. temp.; spec. JAN-R-26	High Volt Filter Surge Limiting	RW11-F162	16-R-61824-1395			R187, R188	2					
R188	Same as R187	High Volt Filter Surge Limiting											
R189	RESISTOR, variable: WW; 5000 ohms ±10%; 150w at 390 deg. C max. continuous oper. temp.; spec. JAN-R-22	2nd IPA Pl Volt Adjust	RP301-SD502KK	16-R-91036-1501			R189	1					
R190	RESISTOR, fixed: WW; 12,000 ohms ±5%; 116w; spec. JAN-R-26	High Voltage Divider	RW11-F123	16-R-62095-4375			R190, R192	2					
R191	RESISTOR, variable: WW; 10,000 ohms ±10%; 100w; spec. JAN-R-22	Pulse Network Charging Voltage Adjust	RP251-SD103KK	16-R-91295-5101			R191	1					
R192	Same as R190	High Voltage Divider											
R193	Same as R173	High Voltage Divider											
R194	Same as R173	High Voltage Divider											
R195	Same as R173	High Voltage Divider											

R196	Same as R166	High Voltage Divider											
R197	Same as R169	High Voltage Divider											
R198	Same as R166	High Voltage Divider											
R199	RESISTOR, fixed: WW, non-inductive; 100 ohms ±5%; 116 w at 275 deg. C max. continuous oper. temp.; 8⅝" lg. x 1-1/16" diam. excluding term.; glass enclosure; resistant to humidity and salt water immersion; 2 ferrule term. 1-9/64" diam. x 33/64" lg.; term. mtg.	2nd IPA Flash Arc Current Limiting		16-R-61499-9715	Sprague #120NIF		R199	1					
R200	RESISTOR, fixed: WW; 10 ohms ±5%; 116 w max. continuous oper. temp. 275 deg. C; spec. JAN-R-26	PA Flash Arc Current Limiting	RW11F-100	16-R-61219-9795			R200	1					
R201	Same as R111	Trig Thyratron Grid Current Limiting, Pulse Chain A											
R202	Same as R111	Trig Thyratron Grid Current Limiting, Pulse Chain B											
R203	RESISTOR, fixed: comp.; 1 megohm ±10%; 2w; spec. JAN-R-11	Trig Pulse Thyratron Grid Leak, Pulse Chain A	RC42-BF105K	16-R-50976-506			R203, R204	2					
R204	Same as R203	Trig Pulse Thyratron Grid Leak, Pulse Chain B											
R205	RESISTOR, fixed: comp.; 1600 ohms ±5%; 2w; spec. JAN-R-11	Trig Thyratron Cath Bias, Pulse Chain A	RC42-BF162J	16-R-49976-126			R205, R206	2					

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R206	Same as R205	Trig Thyratron Cath Bias, Pulse Chain B											
R207	Same as R111	Trig Thyratron Bias Div, Pulse Chain A											
R208	Same as R111	Trig Thyratron Bias Div, Pulse Chain B											
R209	RESISTOR, fixed: comp.; 470,000 ohms ±10%; 2w; spec. JAN-R-11	Trig Thyratron Pl Charging, Pulse Chain A	RC42-BF474K	16-R-50823-465			R209, R210	2					
R210	Same as R209	Trig Thyratron Pl Charging, Pulse Chain B											
R211	RESISTOR, variable: WW; 5000 ohms ±10%; 2w; spec. JAN-R-19	Sq Wave Width Adj, Pulse Chain B	RA20-A1SD-502AK	16-R-91031-1140			R211, R212	2					
R212	Same as R211	Sq Wave Width Adj, Pulse Chain B											
R213	RESISTOR, fixed: comp.; 2200 ohms ±10%; 2w; spec. JAN-R-11	Sq Wave Width Range Det, Pulse Chain B	RC42-BF222K	16-R-50013-461			R213, R214, R246 R247	4					

R214	Same as R213	Sq Wave Width Range Det, Pulse Chain B											
R215	RESISTOR, fixed; comp; 56,000 ohms ±10%; 2 w; spec. JAN-R-11	V121, V122 Shunt	RC42-BF563K	16-R-50517-475			R215, R216, R257	3					
R216	Same as R215	V121, V122 Shunt											
R217	Same as R113	V114 Cur Limiting											
R218	Same as R113	V115 Cur Limiting											
R219	RESISTOR, fixed: WW; 25,000 ohms ±5%; 116w at 275 deg. C max. continuous temp.; spec. JAN-R-26	Pulse Forming Network Charging, Pulse Chain A	RW11-F253	16-R-62160-2935			R219 to R222	4					
R220	Same as R219	Pulse Forming Network Charging, Pulse Chain A											
R221	Same as R219	Pulse Forming Network Charging, Pulse Chain A											
R222	Same as R219	Pulse Forming Network Charging, Pulse Chain B											
R223	Same as R109	Pulse Forming Input Chain A Div, Pulse											
R224	Same as R109	Pulse Forming Input Div Pulse Chain B											

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R225	RESISTOR, fixed: comp.; 47,000 ohms ±10%; 2w; spec. JAN-R-11	1st Sq Amp Pl Load	RC42-BF473K	16-R-50481-457			R225, R226	2					
R226	Same as R225	1st Sq Amp Pl Load											
R227	RESISTOR, fixed: comp.; 4700 ohms ±10%; 2w; spec. JAN-R-11	2nd Sq Amp Grid Leak, Pulse Chain A	RC42-BF472K	16-R-50130-469			R227, R228, R246 R247	4					
R228	Same as R227	2nd Sq Amp Grid Leak, Pulse Chain B											
R229	RESISTOR, fixed: comp.; 3300 ohms ±5%; 2w; spec. JAN-R-11	2nd Sq Amp Pl Load, Pulse Chain A	RC42-BF332J	16-R-50066-121			R229 to R234	6					
R230	Same as R229	2nd Sq Amp Pl Load, Pulse Chain A											
R231	Same as R229	2nd Sq Amp Pl Load, Pulse Chain A											
R232	Same as R229	2nd Sq Amp Pl Load, Pulse Chain B											

R233	Same as R229	2nd Sq Amp Pl Load, Pulse Chain B											
R234	Same as R229	2nd Sq Amp Pl Load, Pulse Chain B											
R235	RESISTOR, fixed: comp.; 10,000 ohms ±5%; 2w; spec. JAN-R-11	Sq Wave Mon Div, Pulse Chain A	RC42-BF103J	16-R-50282-129			R235, R236, R240	3					
R236	Same as R235	Sq Wave Mon Div, Pulse Chain B											
R237	RESISTOR, variable: WW; 5000 ohms ±10%; 50w; spec. JAN-R-22	300 Volt Supply Load	RP151-SD502KK	16-R-91034-3020			R237	1					
R238	RESISTOR, fixed: WW; 200 ohms ±5%; 116w; max. continuous oper. temp. 275 deg. C; spec. JAN-R-26	Pulse Mod Out Load	RW11-F201	16-R-61558-8595			R238, R239	2					
R239	Same as R238	Pulse Mod Out Load											
R240	Same as R235	Mod Pulse Mon Divider											
R241	RESISTOR, fixed: comp.; 11,000 ohms ±5%; 2w; spec. JAN-R-11	Mod Pulse Mon Divider	RC42-BF113J	16-R-50299-945			R241 to R244	4					
R242	Same as R241	Mod Pulse Mon Divider											
R243	Same as R241	Mod Pulse Mon Divider											
R244	Same as R241	Mod Pulse Mon Divider											
R245	Same as R166	PA Grid Leak											

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R246	Same as R213	Mod Pulse Thyratron Grid Loading, Pulse Chain A											
R247	Same as R213	Mod Pulse Thyratron Grid Loading, Pulse Chain B											
R248	Not used												
R249	Not used												
R250	Not used												
R251	Not used												
R252	Not used												
R253	Not used												
R254	RESISTOR, fixed: comp.; 470 ohms ±10%; 2w; spec. JAN-R-11	2nd IPA Plate	RC42-BF471K	16-R-49770 516			R254	1					
R255	Same as R166	High Bias Filter Surge Limiting											
R256	RESISTOR, fixed: WW; 2500 ohms ±5%; 116w at 275 deg. C max. continuous oper. temp.; spec. JAN-R-26	High Voltage Filter Surge Limiting	RW11-F252	16-R-61868-3195			R256	1					
R257	Same as R215	2nd IPA Screen Dropping											
R258	RESISTOR, variable: WW; 1000 ohms ±10%; 50 w, 340 deg. C max. continuous temp.; spec. JAN-R-22	Double Pulse Regulation Compensation (Adjust)	RP151-SD102KK	16-R-90757-5415			R258	1					

R259	Same as R160	Double Pulse Regulation Compensation											
R260	RESISTOR, fixed: comp; 68,000 ohms ±10%, 2 w; spec JAN-R-11	Voltage Divider	RC42BF-683K	16-R-50553-506			R260 R261 R262	3					
R261	Same as R260	Voltage Divider											
R262	Same as R260	Voltage Divider											
R263	RESISTOR, fixed: comp; 33,000 ohms ±10%, 2 w; spec JAN-R-11	Load Resistor	RC42BF-333K	16-R-50418-457			R263 R346	3					
R301	RESISTOR, fixed: comp.; 100,000 ohms ±10%; 1w; spec. JAN-R-11	Trip (V301) Grid	RC30-BF104K	16-R-50634-231			R301, R305, R313, R323, R327, R335, R340 R2306 R2307	16					
R302	RESISTOR, fixed: comp.; 4700 ohms ±10%; 1w; spec. JAN-R-11	Trip (V302) Cathode	RC30-BF472K	16-R-50130-231			R302, R306, R307, R314, R319, R334, R342	14					
R303	RESISTOR, fixed: comp.; 22 ohms ±5%; 1w; spec. JAN-R-11	Trip (V303) Cathode Meter Shunt	RC30-BF220J	16-R-49318-751			R303, R308, R316, R322, R343	12					
R304	RESISTOR, fixed: comp.; 2700 ohms ±10%; 1w; spec. JAN-R-11	Trip (V304) Plate Dropping	RC30-BF272K	16-R-50040-231			R304, R309, R326, R337	8					
R305	Same as R301	Trip (V305) Grid											
R306	Same as R302	Trip (V306) Grid Meter Shunt											
R307	Same as R302	Trip (V307) Cathode											

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R308	Same as R303	Trip (V302) Cathode Meter Shunt											
R309	Same as R304	Trip (V302) Plate Dropping											
R310	RESISTOR, fixed: comp; 20,000 ohms ±5%; 1w; spec. JAN-R-11	Mixer (V303) Grid #1	RC30-BF203J	16-R-50362-751			R310	2					
R311	RESISTOR, fixed: comp.; 120 ohms ±10%; 1w; spec. JAN-R-11	Mixer (V303) Grid #1 Meter Shunt	RC30-BF121K	16-R-49599-231			R311	2					
R312	RESISTOR, fixed: comp.; 470 ohms ±10%; 1w; spec. JAN-R-11	Mixer (V303) Grid #3	RC30-BF471K	16-R-49770-231			R312	2					
R313	Same as R301	Mixer (V303) Grid #3											
R314	Same as R302	Mixer (V303) Grid #3 Meter Shunt											
R315	RESISTOR, fixed: comp.; 560 ohms ±10%; 1w; spec. JAN-R-11	Mixer (V303) Cathode	RC30-BF561K	16-R-49806-231			R315	2					
R316	Same as R303	Mixer (V303) Cathode Meter Shunt											

R317	RESISTOR, fixed: comp.; 27,000 ohms ±10%; 2w; spec. JAN-R-11	Mixer (V303) Screen Bleeder	RC42-BF273K	16-R-50400-499			R317, R318	4					
R318	Same as R317	Mixer (V303) Screen Bleeder											
R319	Same as R302	Mixer (V303) Plate Dropping											
R320	RESISTOR, fixed: comp.; 220,000 ohms ±10%; 1w; spec. JAN-R-11	Lim-Amp (V304) Grid	RC30-BF224K	16-R-50715-231			R320	2					
R321	RESISTOR, fixed: comp.; 1200 ohms ±10%; 1w.; spec. JAN-R-11	Lim-Amp (V304) Grid Meter Shunt	RC30-BF122K	16-R-49941-231			R321, R329	4					
R322	Same as R303	Lim-Ampl (V304) Cathode Meter Shunt											
R323	Same as R301	Lim-Ampl (V304) Screen											
R324	RESISTOR, fixed: comp.; 22,000 ohms ±10%; 1w; spec. JAN-R-11	Lim-Ampl (V304) Plate Dropping	RC30-BF223K	16-R-50373-231			R324	2					
R325	RESISTOR, fixed: comp.; 68,000 ohms ±10%; 1w; spec. JAN-R-11	Pulsed Doubler Grid (V305, V306)	RC30-BF683K	16-R-50553-231			R325, R328	4					
R326	Same as R304	Pulsed Doubler (V305, V306) Cath Meter Shunt											
R327	Same as R301	Divider (V307) Grid #3											
R328	Same as R325	Divider (V307) Grid #1											

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R329	Same as R321	Divider (V307) Grid #1 Meter Shunt											
R330	RESISTOR, fixed: comp.; 1000 ohms ±10%; 1w; spec. JAN-R-11	Divider (V307) Cathode	RC30-BF102K	16-R-49923-231			R330, R344,	4					
R331	RESISTOR, fixed: comp.; 15 ohms ±5%; 1 w; spec JAN-R-11	Divider (V307) Cathode Meter Shunt	RC30-BF150J	16-R-49282-751			R331	1					
R332	RESISTOR, fixed: comp.; 33,000 ohms ±10%; 1w; spec. JAN-R-11	Divider (V307) Screen Divider	RC30-BF333K	16-R-50418-231			R332	2					
R333	RESISTOR, fixed: comp.; 22,000 ohms ±10%; 2w; spec. JAN-R-11	Divider (V307) Screen Divider	RC42-BF223K	16-R-50373-421			R333	2					
R334	Same as R302	Divider (V307) Plate Dropping											
R335	Same as R301	Doubler (V308) Grid											
R336	RESISTOR, fixed comp.; 4700 ohms ±5%; lw; spec. JAN-R-11	Doubler (V308) Grid Meter Shunt	RC30-BF472J	16-R-50128-751			R336, R341	4					
R337	Same as R304	Doubler (V308) Cathode											

R338	RESISTOR, fixed: comp; 33 ohms ±5%; 1w; spec. JAN-R-11	Doubler (V308) Cathode Meter Shunt	RC30-BF330J	16-R-49363-0751			R338	1					
R339	RESISTOR, fixed: comp.; 27,000 ohms ±10%; 1w; spec. JAN-R-11	Doubler (V308) Plate Dropping	RC30-BF273K	16-R-50400-231			R339 R2310 R2311	4					
R340	Same as R301	Trip (V309) Grid											
R341	Same as R336	Trip (V309) Grid Meter Shunt											
R342	Same as R302	Trip (V309) Cathode											
R343	Same as R303	Trip (V309) Cathode Meter Shunt											
R344	Same as R330	Trip (V309) Plate Dropping											
R345	RESISTOR, fixed: WW; 1000 ohms ±5%; 14w max. oper. temp. 275 deg. C; spec. JAN-R-26	Plate & Screen Voltage Dropping	RW16-F102	16-R-61777-2995			R345	2					
R346	Same as R263	Pulsed Doub (V305, V306) Screen Volt Div											
R347	RESISTOR, fixed: comp.; 62,000 ohms ±5%; 2w; spec. JAN-R-11	Pulsed Doub (V305, V306) Screen Volt Div	RC42-BF623J	16-R-50533-935			R347	2					
R348	RESISTOR, fixed: WW, 5600 ohms ±5%; 20 w; 275 deg. C max continuous oper. temp.; spec JAN-R-26A	Pwr. Supply Loading	RW15-F562	16-R-61976-2225			R348	1					

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R2112	RESISTOR, fixed: comp.; 47,000 ohms ±10%; 1w; spec. JAN-R-11	Input Isolation (In Timer)	RC30-BF473K	16-R-50481-0231			R2112	2					
R2301	Not Used												
R2302	Not Used												
R2303	Not Used												
R2304	RESISTOR, fixed: WW; 2.5 ohms ±1%, ½ w; spec JAN-R-93	P/O Error Detector Bridge Network	RB12-B2R-500F	16-R-78610-4500		#570243	R2304 R2305	2	10VR	6	2		50
R2305	Same as R2304	P/O Error Detector Bridge Network											
R2306	Same as R301	Grid Circuit Filter, Pin #1 of V2301											
R2307	Same as R2306	Grid Circuit Filter, Pin #1 of V2302											
R2308	RESISTOR, fixed: comp; 5100 ohms ±5%, 1 w; spec. JAN-R-11	Bias Supply Filter for V2301 and V2302	RC30-BF512J	16-R-50146-751			R2308	1					
R2309	RESISTOR, fixed: comp; 220 ohms ±10%, 1 w; spec JAN-R-11	Diode Current Limiting, Pin #6 of V2301	RC30-BF221K	16-R-49662-0231			R2309 R2312	2					
R2310	Same as R339	Relay K2302 Stabilizing											

R2311	Same as R339	Relay K2303 Stabili-zing											
R2312	Same as R2309	Diode Current Limiting, Pin #6 of V2302											
R2401	RESISTOR, fixed: comp; 100,000 ohms ±10%, ½ w; spec JAN-R-11	Pilot Lamp Dropping	RC20-BF104K	16-R-50633-811		#500467	R2401	1			1		25
R2501	RESISTOR, fixed: WW; 200 ohms ±5%, 30 w; spec. JAN-R-26	Motor B2501 Phase Splitting	RW34-F201	16-R-65754-5646		#535178	R2501	1	11 VR	6	1		25
R2502	RESISTOR, variable: WW; 100 ohms ±10%, 2 w; spec. JAN-R-19	Output Voltage Control	RA20-A2SD-101AK	16-R-90217 1973			R2502	1					
R2503	RESISTOR, variable: WW; 10,000 ohms ±10%, 2 w; spec. JAN-R-19	Sensi-tivity Control, Thyratron Grid Bias Adjust.	RA20-A2SD-103AK	16-R-91291 4992			R2503	1					
S101	CIRCUIT BREAKER: magnetic arc-quenching; 2 pole; 1 throw; 600 v. AC at 25 amp. continuous, 5000 amp. interrupting capacity; armature trip release, manual trip release; 30 to 80 amp. adjust range, instantane-ous; manual reset; black moldarata case; 9⅜" lg. x 2¾" wd. x 4-13/16" h. o/a; two 9/32" diam. holes (½" counterbore) 7¼" c to c on long axis; 4 screw type term., 2 ea. end; silver alloy main cont. only	Main Line Protection		17-C-51462-7764	Wemco #1222-063*		S101	1	74	2	1		0
S102	SWITCH, toggle: 3PDT; 10 amp 250v AC; bakelite body w/metal cover; 2-3/16" lg. x 1½" wd. x 1⅝" d. o/a; non-shorting; ⅞" lg. bat-type handle; locking action, one side normally open, other side closed; screw term; two tapped holes on metal cover for #6-32 screws 1⅞" c to c.	Exc Unit Tune-Normal		17-S-75123-8509	C-H #8795		S102	1					

*Tropicalized in accordance with Navy Dept., Bureau of Ships letter 3079C (930B), May 5, 1945 (paragraphs 1 and 2 only), entitled "Requirements for tropicalization," plus JAN-T-152 and JAN-C-173.

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
S103	SWITCH, toggle; DPST; 8 amp., 250v AC; plastic term. mtg. on back, metal body; 2-5/32" max. lg. x 1-33/64" max. wd. x 1⅜" max. d. o/a; non-shorting type; ⅞" lg., bat-type actuating handle; locking action; screw-type term.; two 6-32 tapped holes 1-13/16" c to c, flush mtg.; spec. JAN-S-23	Power Fil ON-OFF	ST55K	17-S-72831-1101			S103, S105	2					
S104	SWITCH, toggle; 3PST; 10 amp., 250v AC; bakelite body, metal cover; 2⅛" lg. x 1½" wd. x 1-5/16" d. o/a; non-shorting type; ⅞" lg. bat-type handle; locking action; screw-type term.; mtd. by two tapped holes for 6-32 screws on metal cover 1⅞" c to c	LV-Bias ON-OFF		17-S-75018-3401	C-H #8794		S104	1					
S105	Same as S103	HV ON-OFF											
S106	SWITCH, push: SPDT, double break; 10 amp. at 220 v AC cont., 600v max.; phenolic body 2¼" lg. x 13/16" wd. x 1-11/16" d. o/a incl. button (black) and term. bracket on rear; non-shorting; momentary action; 1 normally open and 1 normally closed cont.; screw type term.; two 5/32" diam. mtg. holes spaced 1⅞" c to c; flush mtg.	2nd IPA Overload Ind Lamp Reset		17-S-57441-4829	C-H #10250-H2532		S106 to S109	4					
S107	Same as S106	PA Over-load Ind Lamp Reset											
S108	Same as S106	HV Supply Overload Ind Lamp Reset											

S109	Same as S106	"3 Strike" Overload Circuit Reset											
S110	SWITCH, rotary: 2 pole, 2 position; 1 sect.; solid silver alloy cont.; ceramic wafer; 15/16" lg. x 1-15/16" diam.; non-shorting type cont.; locking action; solder lug term.; 3/8-32 thd. x 5/8" lg. bushing w/ round shaft 1/4" diam. x 1 1/4" lg. FMS; 30 deg. between positions; tropicalized	Line Voltmeter Change-over		17-S-60905-2451		FRE-18150-1	S110, S121	2	75	2	1		2
S111	SWITCH, rotary: 2 pole, 4 position; 1 sect.; solid silver alloy cont.; ceramic wafer; 15/16" lg. x 1-15/16" diam.; non-shorting type cont.; locking action; solder lug term.; 3/8-32 thd. x 5/8" lg. bushing w/ round shaft 1/4" diam. x 1 1/4" lg. FMS; 30 deg. between positions; tropicalized	M105 Circuit Selector		17-S-61361-3531		FRE-18151-1	S111	1	76	2	1		1
S112	SWITCH, rotary: 1 pole, 2 position; 1 sect.; solid silver alloy cont.; ceramic wafer; 15/16" lg. x 1-15/16" diam.; non-shorting type cont.; locking action; solder lug term.; 3/8-32 thd. x 5/8" lg. bushing w/ round shaft 1/4" diam. x 1 1/4" lg. FMS; 30 deg. between positions; tropicalized	M103 Circuit Selecting		17-S-59673-4171		FRE-18152-1	S112	1	77	2	1		1
S113	SWITCH, rotary: 2 pole, 5 position; 2 sect.; solid silver alloy cont.; ceramic body; 1 3/4" lg. x 1-15/16" diam.; non-shorting type cont.; locking action; solder lug term.; 3/8-32 thd. x 5/8" lg. bushing w/ round shaft 1/4" diam. by 1 1/4" lg. FMS; 30 deg. between positions, tropicalized	M106 Circuit Selecting		17-S-64557-9741		FRE-18569-1	S113	1	78	2	1		1
S114	SWITCH, rotary: 2 pole, 3 positions; 1 sect.; solid silver alloy cont.; ceramic wafer; 15/16" lg. x 1-15/16" diam.; non-shorting type cont.; locking action; solder lug term. 3/8-32 thd. x 5/8" lg. bushing w/ round shaft 1/4" diam. x 1 1/4" lg. FMS; 30 deg. between positions, tropicalized	M109 Circuit Selecting		17-S-61164-5641		FRE-18153-1	S114	1	79	2	1		1

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
S115	SWITCH, rotary: 1 pole, 2 position, 2 throw, 3 cont., no off position 1 sect.; unrated; pure silver cont.; ceramic body; 2-15/16" lg. x 2-9/16" wd. x 3⅜" h. o/a; non-shorting type; locking action; solder lug term.; single hole mtg. for shaft through panel, two tapped struts accommodating 8-32 screws, 2⅞" c to c for mtg. to rear of panel, no bushing, shaft 1-9/16" lg. x ¼" diam., flush mtg.; 30 deg. between positions	Ant Meter Shunt		17-S-59675-1081	Comm-Prod Type 86S		S115	1					
S116	SWITCH, rotary: 5 pole, 16 position; 5 sect.; solid silver alloy cont.; mycalex wafers; 5-11/32" lg. x 2-11/64" wd. x 2-5/16" h.; non-shorting type cont.; locking action; solder lug term.; ⅜-32 thd. x ⅜" lg. bushing w/round shaft ¼" diam. x ⅞" lg. FMS; sect. 1 is ckt. opening type, switch is tropicalized	Monit Osc Circuit Selector		17-S-66834-3601	Oak type DL	B1022295	S116	1	80	2	1		1
S117	SWITCH, rotary: 1 pole, 2 position; 1 sect.; solid silver alloy cont.; ceramic wafer; 15/16" lg. x 1-15/16" diam.; non-shorting type cont.; locking action; solder lug term; ⅜-32 thd. x ⅜" lg. bushing w/ round shaft ¼" diam. x ⅞" lg. FMS; 30 deg. between positions; tropicalized	Monit Osc Trigger Selector		17-S-59673-4151		FRE-18167-1	S117	1	81	2	1		1
S118	SWITCH, rotary: 3 pole, 2 position, 9 cont., normally closed; 3 sect.; unrated; pure silver cont.; ceramic body; 4⅞" lg. x 2⅝" wd. x 3-5/16" h. o/a; non-shorting type; locking action; solder lug term.; single hole mtg. for shaft through panel, two tapped struts for 8-32 screws for mtg. in rear of panel	Exc #1 ON-OFF		17-S-65911-2151	Comm-Prod Type 86S		S118, S119	2	82	2	1		2

S119	Same as S118	Exc #2 ON-OFF											
S120	SWITCH, rotary: 4 pole, 9 position; 4 sect.; solid silver alloy cont.; ceramic wafers; 3-5/16" lg. x 1-15/16" diam.; non-short type cont.; locking action; solder lug term.; ⅜-32 thd. x ⅝" lg. bushing w/ round shaft ¼" diam. x 1¼" lg.; 30 deg. between positions	Exc Meter Circuit Selector		17-S-66534-2101		FRE-18154-1	S120	1	83	2	1		1
S121	Same as S110	Exc Meter Exc Selector											
S122	SWITCH, interlock: SPST, double break; 10 amp. carrying 220 v. AC/DC, 7½ amp. interrupting at 220 v. AC; 5 amp. interrupting at 125 v. DC, 2½ amp. interrupting at 250 v. DC; 2 brass contacts; 2 piece bakelite body; c/o male door mtg. part w/brass disc contact and female frame mtg. part w/brass "V" shape contact; 2-5/16" lg. x 11/16" wd. x 1-19/32" d. o/a; frame mtg. part 2-5/16" lg. x 11/16" wd. x 15/16" d. o/a; door mtg. part 1⅞" lg. x 11/16" wd. x ⅝" d. o/a; screw term.; frame part mtd. by 2 holes for #6 screws, 1-13/16" c to c; door part mtd. same except holes 1¼" c to c	Door Interlock		17-S-53417-3611	G.E. 7460330-G4		S122 to S125, S131, S501, S502	7					
S123	Same as S122	Door Interlock											
S124	Same as S122	Door Interlock											
S125	Same as S122	Door Interlock											
S126	SWITCH, push: SPST, triple break; cad. plated brass; 9¼" lg. x 2⅜" wd. x 2⅜" h. o/a; shorting type; momentary, normally closed; screw term.; three 0.221" (#2 drill) mtg. holes in rear of "U" bracket located ½" above and ½" below ea. side of horiz. ctr. line, and ⅝" ea. side of vert. ctr. line; has also supplemental angle mtg. bracket 2½" wd. x ⅛" thk. x 1⅞" one leg x 1" other leg	HV Grounding		17-S-56382-9291		FRA-18628-12-1	S126, S127	2					
S127	Same as S126	HV Grounding											

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
S128	Same as S126, except less mtg. bracket	HV Grounding		17-S-56382-9291		FRA-18628-12-2	S128, S129	2					
S129	Same as S128	HV Grounding											
S130	SWITCH, pressure: SPST; 3 amp. 220v AC; normally opened at 1000 ft./min.; metal frame encl. for bakelite switch w/rectangular metal actuating fin on one end and cable fitting on other; 5⅜" lg. x 1¼" wd. x 1-9/16" h. o/a incl. fin; non-shorting type; solder lug term.; one ⅝" diam. mtg. collar, one 3/16" diam. mtg. hole; "air-flow" switch marked on metal cover	Air Flow Interlock		17-S-56230-9121	Rotron B-1000		S130	1					
S131	Same as S122	Control Panel Interlock											
S301	SWITCH, rotary: 6 pole, 6 position, 13/32" wd. x 1-17/32" h.; o/a body dim.; non-shorting type cont.; locking action; solder lug term.; single hole mtg., bushing ⅜-32 x ⅜" lg., shaft 3¾" lg. ¼" diam., w/flat ½" lg. flush mtg.; 30 deg. between positions, aluminum shields between wafers; Oak type J	Frequency Selector		17-S-65467-9080		A1015507	S301	2	84	2	1		2
S501	Same as S122	Removable Front Panel Interlock											
S502	Same as S122	Removable Front Panel Interlock											
S2401	SWITCH, toggle: DPDT; 9 amp at at 250 v AC; Spec JAN-S-23	Blower "ON"	ST50P	17-S-74692-4496		#828232	S2401	1					

S2501	SWITCH, sensitive: SPDT; 125 v, 10 amp; bakelite case; 1-5/16" lg x 11/16" wd x 1-3/64" h; roller leaf actuator, 2⅛" lg. approx. with ⅜" diam x 5/32" wd roller; 1 to 3½ oz operating pressure; 0.012" to 0.078" movement differential; 0.141" overtravel; momentary action, normally closed; solder lug term; two 0.139" diam mtg holes 1" c to c; ¼ oz to 1 oz pressure differential; spec JAN-S-63	Transformer T2501 Brush Travel Limiting	SS07A20	17-S-69419 7880		#834066	S2501 S2502	2	12VR	6	1		0
S2502	Same as S2501	Transformer T2501 Brush Travel Limiting											
S2503	SWITCH, rotary: 4 sect, 3 positions, 4 poles, 2 throws; center pos. "off"; 250 v AC or DC, 60 amp, brass contacts; cont and current-carrying parts silver pl.; phenolic body 5¼" lg x 4¾" square, excl terms; panel mtd; four 13/32" diam mtg holes thru top plate and 1⅛ lg spacers on 3-25/32" square mtg ctrs; round shaft ⅜" diam x 1-1/16" lg FMS; ⅝" x ⅝" brass lug terms with 17/64" diam holes	Line Transfer		17-S-66509-7801		C1040744	S2503	1	13VR	6	0		10
S2504	SWITCH, toggle: SPDT; 6 amps at 250 v AC; JAN type ST42F; spec JAN-S-23	Meter M2501 Input Transfer	ST42F	17-S-71894-12891		#828217	S2504	1	14VR	6	1		50
*S3001A	SWITCH, rotary: 1 section, 5 positions, 1 pole, 5 throws; solid silver alloy cont; ceramic wafer; 2-9/16" lg x 1-15/16" wd x 2-9/16" h o/a; solder lug term; 2 holes 2⅛" c to c for #8-32 screw	Trans 1, Exc A Excitation Selection		17-S-60264-6846	Oak Type DHC	FRE-14698-1	S3001A, S3002A, S3003A, S3004A	4					
S3001B	SWITCH, rotary: 1 pole, 5 position; 1 sect.; solid silver alloy cont.; ceramic wafer; 1-13/16" lg. x 1-15/16" diam.; non-shorting type cont.; locking action; solder lug term; ⅜-32 thd. x ⅜" lg. bushing; flatted round shaft ¼" diam. x ⅞" lg. FMS, shaft extends 7¼" behind wafer; 60 deg. between positions	Trans 1, Exc A 100 kc Excitation Selection		17-S-60264-7121	Oak Type DHC per FTRC Dwg FRE-14698-1	FRE-14698-1	S3001B, S3002B, S3003B, S3004B	4					
*S3002A	Same as S3001A	Trans 1, Exc B Excitation Selection											

*Part of existing switch in Excitation Switching Unit of Loran Switching Equipment Navy Model UM.

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
S3002B	Same as S3001B	Trans 1, Exc B 100 kc Excitation Selection											
*S3003A	Same as S3001A	Trans 2, Exc A Excitation Selection											
S3003B	Same as S3001B	Trans 2, Exc A 100 kc Excitation Selection											
*S3004A	Same as S3001A	Trans 2, Exc B Excitation Selection											
S3004B	Same as S3001B	Trans 2, Exc B 100 kc Excitation Selection											
T101	TRANSFORMER, variable power: input 230/130v AC, 1 ph 50/60 cps., output 0-260v, 2.86 kva., 11 amp.; varied by 3½" diam. handwheel; scale 0-110v in 10v steps; air cooled open frame; 10⅜" diam. x 7⅜" h., less mtg. feet and handwheel; 12" diam. incl. mtg. feet; 6 stud term. on bottom; 4 mtg. feet ea. w/one ⅜" diam. hole; holes spaced 7¾" x 7¾" c to c	HV Control		17-T-83767-7501	Superior Electric Type S1299**	FRE-31964-2	T101	1	85	2	1		3
T101A	BRUSH, electrical cont: auto. transf. brush; BP117GR2 carbon brush; rectangular brush ½" lg. x ⅛" wd. x 9/32" thk., supplied w/holder ½" lg. x ½" wd. x ⅞" h.; two 1⅞" lg. braided copper pigtails w/solder lug term.; flat contact end	Spare for T101		17-C-82789-6495	Superior Electric BP515G2		T101A	1	86	2	1		10

T102	TRANSFORMER, variable power: input 230/115 v. AC, 1 ph. 47.5 to 63 cps.; output 0-260 v.; 11 amp., 2.5 kva.; varied by 3" diam. handwheel; 2500 v. ins.; air cooled; open frame, 10¼" lg. x 7⅝" wd. x 5-3/16" h. less handwheel and shaft; six #8-32 stud term. on side; three ⅜" diam. mtg. holes on 4⅝" radius spaced 120 deg. apart; shaft and handwheel 3½" lg.	Filament Voltage Control		17-T-83746-1001	Superior Electric Type S1300	FRE-13859-1	T102	1	87	2	1		3
T102A	BRUSH, electrical contact: variable power transf. brush; BP8739G2 carbon brush; rectangular brush ¼" sq. x ¼" thk. supplied w/ holder 1⅜" lg. x ½" wd. x 15/16" h.; includes pressure spring and screw term.; flat contact end	Spares for T102		17-B-86441-8405	Superior Electric #BP8740G2		T102A	1	88	2	1		10
T103	TRANSFORMER, power: fil. type; input: 106v, 47.5 to 63 cyc., 1 ph.; one output wnd.; secd. 23v (transf.) rated 290 va.; 2500v ins.; air cooled; HS metal case; 6⅞" lg. x 4-5/16" wd. x 5⅝" h. less term.; four #10-32 thd. stud. term. mtd. on ⅝" h. por. ins.; four ¼" diam. mtg. holes on 6⅜" x 3-9/16" mtg./c; pri. c/o 116 turns #15 E wire, 0.39 ohms, secd. c/o 26 turns #11 sq. wire, 0.307 ohms			17-T-70131-5001	Superior Electric Type S1300	FRE-13861-1	T103	1	89	3	1		3
T104	TRANSFORMER, power: fil. type; input 220/230/240v, 47.5 to 63 cyc., 1 ph.; 2 output wnd.; secd. #1, 27.5v, 2.15 amp. CT., secd. #2, 27.5v, 2.15 amp. CT.; 2.5 kv. test; air cooled; HS metal case; 5-11/16" lg. x 4¾" wd. x 5⅛" h. excluding term.; 10 solder lug term. glass ins.; 2 integral mtg. fl. ea. w/two 0.201" diam. holes on 5⅛" x 3⅛" mtg./c	V102, V103 Filament Supply		17-T-72918-9101		FRE-13831-2	T104	1	90	1	1		3
T105	TRANSFORMER, power: fil.; 0.672 kva.; 240v input, tapped at 220v and 230v., 60 cyc., 1 ph.; 2 output wnd. ea. w/CT.; 11.2v, 30 amp. ea. wnd.; pitch impr.; air coolant; potted metal case; 9¼" lg. x 7¾" wd. x 6⅛" h. less term.; six #8-32 thd. stud term. on ½" diam. x ½" h. conical shaped por. ins., four 5/16"-18 thd. studs on 1" diam. x ½" h. por. ins. all located on top; four ¼" holes 7⅛" x 8⅝" mtg./c	V104, V105 Filament Supply		17-T-73007-2639		FRE-13827-12	T105, T106	2	91	4	1		2

*Part of existing switch in Excitation Switching Unit of Loran Switching Equipment Navy Model UM.
**Tropicalized in accordance with Navy Dept., Bureau of Ships letter 3079C (930B), May 5, 1945 (paragraphs 1 and 2 only), entitled "Requirements for tropicalization," plus JAN-T-152 and JAN-C-173.

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
T106	Same as T105	V106, V107 Filament Supply											
T107	TRANSFORMER, power: fil. type; 230v input, 47.5 to 63 cyc., 1 ph.; one output wnd.; output 16.5v, 1.6 amp.; 1.5 kv. test; air cooled; HS metal case; 4" lg. x 3¼" wd. x 4" h. less term.; 4 solder lug term. on por. pillars; 2 integral mtg. bkt. ea. w/two 0.201" diam. mtg. holes on 3½" x 1⅞" mtg./c	Pilot Lights		17-T-73047-1653		FRE-13821-2	T107	1	92	3	1		3
T108	TRANSFORMER, power: distribution type; 0.460 kva., 47.5 to 63 cyc., single ph.; input 253v tapped at 230v; 1 output wnd.; 115v output at 4 amp.; pitch impr.; air coolant; potted metal case 6⅝" lg. x 6" wd. x 6⅜" h. less term.; five #8-32 thd. stud term. on ½" h. x ½" diam. conical por. standoffs; base mtg. w/four 17/64" diam. mtg. holes on 5⅝" x 5-7/16" mtg./c	Control Circuits Supply		17-T-68855-3001		FRE-13847-2	T108	1	93	4	1		3
T109	TRANSFORMER, power: fil. type; input 220/230/240v, 47.5 to 63 cyc., 1 ph. 0.066 kva.; 2 output wnd.; secd. #1, 5.1v at 6.5 amp. CT., secd. #2, 5.1v at 6.5 amp. CT; pri. wnd. 2.5 kv test, secd. wnd. 37 kv. test; air coolant pitch impr., HS case; 11½" lg. 7-15/16" wd. x 6¼" h. less term.; 2 corrugated ceramic standoffs 4" h. x 3½" diam. w/three No. 8-32 stud term. on ea. and 4 pin type solder lug term. 9/16" h. on 1-3/16" h. ceramic standoffs located on top of case; 2 integral mtg. fl. ea. w/two 13/32" diam. holes on 7" x 7-1/16" mtg./c	V108, V109 Filament Supply		17-T-72918-4481		FRE-13833-12	T109, T110	2	94	4	1		3

T110	Same as T109	V110, V111 Filament Supply											
T111	TRANSFORMER, power: fil. type; input 220/230/240v, 47.5 to 63 cps., 1 ph.; one output wnd.; output 2.55 v. CT 3.5 amp.; 1.5 kv. pri. test, 6.5 kv. secd. test; air cooled HS metal case; 2⅞" lg. x 3¾" wd. x 4-1/16" h. less term.; 7 solder lug term. on glass ins. on top; 2 integral mtg. bkt. ea. w/two 0.177" diam. holes 3-5/16" x 2" mtg./c	V112, V113 Filament Supply		17-T-72918-2863		FRE-13851-2	T111	1	95	3	1		3
T112	TRANSFORMER, power: fil. type; input 220/230/240 v.; 47.5 to 63 cps., 1 ph. one output wnd.; output 6.4 v CT., 3.6 amp.; 1.5 kv. test; air cooled; HS metal case; 3¾" lg. x 2⅞" wd. x 4-1/32" h, less term.; 7 glass ins. solder lug term. 15/32" h on top; 2 integral mtg. bkt., ea. w/two 0.177" diam. holes, holes on 3-5/16" x 1-13/16" ctrs.	V114, V119 Filament Supply		17-T-72918-3697		FRE-13823-2	T112, T115	2	96	3	1		3
T113	TRANSFORMER, power: plate type; input 230 v at 47.5 to 63 cps., single ph.; one output wnd.; output w/input to term. 1 and 3, 1500 v CT. at 0.177 amp.; output w/input to term 1 and 2, 1650 v CT at 0.177 amp.; output w/input to term 1 and 4, 1350 v CT. at 0.177 amp.; 2.5 kv. test; air cooled; HS metal case; 5⅝" lg x 5" wd. x 5-9/32" h, less terminals; 7 solder lug term. mtd. on por, pillars; 2 integral mtg. bkt. ea. w/two 17/64" diam holes; holes on 3⅞" x 4-15/16" mtg./c	LV Bias Supply		17-T-78159 5001		FRE-16049-2	T113	1	97	3	1		3
T114	TRANSFORMER, power: fil. type; input 220/230/240 v, 47.5 to 63 cps, 1 ph.; 2 output wnd.; sced. #1, 6.3 v CT, 6.7 amp.; secd. #2, 6.3 v CT, 6.7 amp.; pri 2.5 kv test, secd 6 kv test; air cooled; HS metal case; 5-11/16" lg x 4¾" wd x 5½" h, less terminals; 10 solder lug term. on glass ins. on top; 2 integral mtg. bkt, ea. w/two 0.201" diam. holes; holes on 3⅛" x 5-3/16" mtg./c.	V116, V117 Filament Supply		17-T-72918-4782		FRE-13849-2	T114	1	98	3	1		3
T115	Same as T112	V115, V120 Filament Supply											

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
T116	TRANSFORMER, power: plate type; input 230 v, 47.5 to 63 cps., single ph.; one wnd.; secd. 14,000 v CT at 0.169 amp.; 37 kv. test; air cooled; HS metal can; 16⅛" lg x 13-35/64" wd x 13-7/16" h, less term.; 2 pin type solder lug terminals on steatite pillars for pri., 1-13/16" h x ⅝" diam. o/a; 3 stud term. on steatite stand-off ins. for secondary, 4-7/16" h x 2⅜" diam. o/a; 4 integral mtg. bkts., ea. w/½" x ⅜" slot; slots on 15" x 8½" mtg./c	PA Plate Supply		17-T-78319-9101		FRE-13829-12	T116	1	99	5	1		3
T117	TRANSFORMER, power: fil. type; input 220/230/240 v., 47.5 to 63 cyc.; single phase; single output winding; output 6.4 v CT, 0.9 amp.; 2.5 kv. test; air cooled; HS metal case; 3" lg. x 3½" wd. x 3-5/32" h. less term.; 7 glass ins. solder lug term. on top; 2 integral mtg brackets ea. w/two 3/16" diam. mtg. holes on 3-1/16" x 1-13/16" mtg./c	V101 Filament Supply		17-T-72918-3671		FRE-14519-2	T117	1	100	3	1		3
T118	TRANSFORMER, power: fixed autotransformer; input 230 v., 47.5 to 63 cyc.; single phase; output 115 v., 3 amp.; 2.5 kv test air cooled; HS metal case; 5-11/16" lg. x 4¾" wd. x 5-3/32" h. less term., 3 glass ins. solder lug term. on top; 2 integral mtg. bkt. ea. w/two 0.201" diam. mtg. holes on 3⅛" x 5-3/16" mtg./c	Oscillograph Operation		17-T-76443-9101		FRE-14517-2	T118	1	101	3	1		3
T119	TRANSFORMER, power: fil. type, input 220/230/240 v., 47.5 to 63 cyc., 1 ph.; one output wnd.; 5.1 v. CT; 2 amp.; 2.5 kv. test; air cooled; HS metal case; 3½" lg. x 2½" wd. x 3-1/16" h. less term.; 7 pin type solder lug term. on por. base on	V118 Filament Supply		17-T-72918-3343		FRE-16051-2	T119	1	102	3	1		3

	top; 2 integral mtg. bkt. ea. w/two 0.177" diam. holes on 1⅝" x 3⅛" mtg./c												
T120	TRANSFORMER, power: plate type; input 230 v ±10%, 47.5 to 63 cps, 1 ph.; 1 output wnd.; sec. 4200, 3780, 3530 volts at 37.5 ma as selected by pri taps; pri 2.5 kv test, secd. 11 kv test; air coolant; HS metal case, 6¼" lg. x 5⅞" wd. x 7½" h, less term; 4 pin type solder lug term. ⅜" h on 7/16" h ceramic standoffs for pri., and 2 pin type solder lug term. ¾" h on 1⅜" h ceramic standoffs for secd. all on top; 2 integral mtg. bkt. ea. w/two 5/16" diam holes; holes on 5-9/16" x 4⅛" mtg/c on bottom	Bias HV		17-T-78319-3755		FRE-16047-2	T120	1	103	4	1		3
T121	TRANSFORMER, pulse: blocking osc. type; single pri. wnd. 2500 v. AC ins. test; single secd. wnd. 600 ohms impedance measured at 4 v. 60 cyc., 4500 v. AC ins. test; HS sealed metal case; 2¼" lg. x 1½" wd. x 2-23/32" h. o/a excluding term. and mtg. studs; 2 pin type solder lug term. 3/16" h. on 9/32" h. x 5/16" diam. ceramic standoff ins. 15/16" c to c on top of case for pri.; 2 pin type solder lug term. 5/16" h. on 7/16" h. x ½" diam. ceramic standoff ins. 1¼" c to c on top of case for secd.; two #6-32 mtg. studs on bottom of case, 1-25/32" c to c	Pulse Transformer		17-T-80103-9137		FRE-17329-1	T121, T122	2	104	3	2		6
T122	Same as T121	Pulse Transformer											
T123	TRANSFORMER, power: fil. type; input 218/230/242 v AC, 47.5 to 63 cyc., 1 ph.; one output wnd.; output 5.1 v at 4 amp. CT; pri. 2500 v RMS, secd. 4500 v RMS; potted w/SR-1951 compound; HS. metal case; case excluding term. 3⅜" lg. x 3¼" wd. x 4-3/32" h.; seven post type solder lug term. on top, all on cyl. por. ins., four pri. term. 7/16" diam. x 19/32" h., three secd. term. ½" diam. x 25/32" *h.;* four tapped mtg. holes on bottom of case, 8-32 thd. x 5/16" d. on 2-9/16" x 2-11/16" mtg./c	Filament Supply for V121, V122		17-T-72898-3001		FRE-25431-2	T123	1	105	3	1		3

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
T2301	Not Used												
T2302	Not Used												
T2303	TRANSFORMER, power, stepdown: hermetically sealed cyl. steel case; 115 v, 45-65 cps, single phase; 1 output wdg, 12.4 volts tapped at 11.5 v and 5.8 v; current 0.6 amp at 12.4 volts, 0.25 amp at 11.5 volts and at 5.8 volts; 1500 volts test; natural air cooled; potting compound; 3¾" lg x 3" diam w/3" square mtg flange; 6 terminals, ceramic bushing type w/solder lugs, located on bottom; four 0.170" diam mtg holes on 2⅜" x 2⅜" ctrs, in flange.	Control Unit: Heater and Bias Supply for V2301 and V2302	1	17-T-70568-8121	UTC # M1566	A1040537	T2303	1	15VR	6	1		50
T2304	TRANSFORMER, audio frequency: audio input type; primary 200 ohms; secondary 980,000 ohms CT; no DC rating; 1500 v RMS test; hermetically sealed steel case 2¼" lg 1⅝" diam, with 1⅝" square mounting flange; 1 to 70 ratio pri. to sec; 45-65 cps. freq. response; not tuned; 6 terminals, ceramic bushing type with solder lugs, located on bottom; four 0.144" diam. holes on 1-5/16" x 1-5/16" mtg. ctrs.; electrostatic shield gnd to core and case.	Control Unit: V2301 and V2302 Grid-input-transformer	1	17-T-61095-5901	UTC # M1565	A1040538	T2304	1	16VR	6	1		50
T2501	TRANSFORMER, variable power: pri., 195-255 v, 50-65 cps, single phase; secd., 0/130/180/270 v fixed taps and 0-270 v variable, 7.0 amp; 1.8 kva; voltage varied by motor (B2501) drive; 1500 v RMS test; varnish impregnated, air-cooled, open frame; 8-1/16" diam x 6-15/16" h; 5 terminals, stud type located on side; three ⅜"-24 studs, 120 degrees apart on 3⅜" radius; fungicided, resistant to salt spray.	Exciter T2502		17-T-83786-5389		C1040750	T2501	1	17VR	6	0		10

T2502	TRANSFORMER, power stepdown: open frame; primary, 145 v, 50-65 cps single phase; 1 output winding, 36 v, 26 amp; 1500 v RMS test; air-cooled; varnish impregnated; 7½" lg x 7" wd x 6-15/16" h; 4 terminals, stud type, located on top; four mtg slots on 5¾" x 5-9/16" mtg centers; no internal shielding.	Line Voltage Buck or Boost		17-T-72675-8779		C1040748	T2502	1	18VR	6	1		25
T2503	Not Used												
T2504	Not Used												
T2505	TRANSFORMER POWER: fixed auto transformer; open frame; 230/208 v, 50-65 cps, single phase; 115 v, 2 amp. 0.23 kva; 1500 v RMS test; 4¾" lg x 3¾" wd x 4-9/32" h; 4 terminals, stud type, located on top; 4-15/16" x 13/64" slots on 3⅛" x3¾" mtg. ctrs.; silver plated terminals.	Control Unit Voltage Step-Down		17-T-76448-4125	Superior Elec T5258 dwg C847001	C1040749	T2505	1	19VR	6	1		25
TB2401	TERMINAL BOARD: natural laminated thermosetting plastic; 5 term, single stud w/nuts and lug; w/o barrier 7¼" lg x 2" wd x 3/16" thk; six #2 (0.221" drill) mtg holes, ⅝" x ⅝" x 6½" c to c, marked "TB2401, 1, 2, 3, 4, 5".	AC Line input		17-B-77699-2146		A1023-404-1	TB2401	1					
TB2402	TERMINAL BOARD: same as TB-2401, except marked "TB2402".	AC Line output		17-B-77699-2136		A1023-404-2	TB2402	1					
TB2403	TERMINAL BOARD: plastic; 4 screw lug term, w/barrier; 2½" lg x 1⅛" wd x ½" thk; four 0.175" diam. mtg holes 0.421" x 2-3/16" c to c.	Blower terminals		17-B-77637-3411	Jones HB #4-141Y	#355463	TB2403	1					
TB2501	TERMINAL BOARD: molded melamine resin; incl 3 double-screw type terms, nickel pl.; barrier type; 2-21/32" lg x 1-5/16" wd x ⅝" thk; four 0.209" diam mtg holes spaced 2¼" x½" c to c;	Terminal Board for B2501 Circuit		17-B-77587-6241	Jones HB # 3-142-B		TB2501	1					
TC101	Supplied with M111	Thermocouple											
TY101	ARRESTER, lightning: rare gas type; indoor use; 4¾" lg. x 1" wd. x 2¼" h. o/a; 200-400v breakdown; withstand 5 DC amp. for 2 min.; por. base; two ¼" diam. mtg. holes spaced 1-1/16" c to c; two #10-32 thd. screw term.	Protects Coil of K112		17-A-85886-8401	Brach #36		TY101 to TY107	7					

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
TY102	Same as TY101	Protects Coil of K112											
TY103	Same as TY101	Protects Coil of K113											
TY104	Same as TY101	Protects Coil of K113											
TY105	Same as TY101	Protects Coil of K113											
TY106	Same as TY101	Protects Coil of K113											
TY107	Same as TY101	Protects Coil of K114											
TY108	ELECTRODE SET: protective spark gap; one ½" diam. cad. pl. brass ball w/15/16" lg. #8-32 brass mtg. stud; one ½" diam. cad. pl. brass ball w/⅜" lg. #8-32 brass mtg. stud	V102 Grid Protection		17-E-28601-1003		FRA-17581-1-1	TY108, TY109	2					
TY109	Same as TY108	V103 Grid Protection											
TY110	ELECTRODE SET: protective spark gap; set c/o two electrodes; ea. electrode ½" diam. cad. pl. brass ball w/15/16" lg. #8-32 brass mtg. stud	V104, V105 Grid Protection		17-B-50440-1001		FRA-19301-1-1	TY110, TY111, TY114 TY115	4					
TY111	Same as TY110	V106, V107 Grid Protection											

TY112	ELECTRODE SET: protective spark gap; brass; c/o three ½" diam. spheres, two of them have no. 8-32 by 7/16" lg. mtg. stud, other one has no. 8-32 by 13/16" lg. mtg. stud; spheres are cadmium pl.	V116 Grid Protection		17-E-28601-1002		FRA-18947-1-1	TY112, TY113	2
TY113	Same as TY112	V117 Grid Protection						
TY114	Same as TY110	Mon Osc Output		17-B-50440-1001		FRA-19301-1-2	TY114	1
TY115	Same as TY110	Modulator Output						
V101	TUBE, electron: JAN-807; beam power amplifier	1st IPA	JAN-807	16-T-68070			V101	1
V102	TUBE electron: JAN-4PR60A; tetrode (pulse amplifier)	2nd IPA	JAN-4PR60A	16T-54047-40			V102, V103	2
V103	Same as V102	2nd IPA						
V104	TUBE, electron: JAN-7C23; triode	PA	JAN-7C23	16-T-57313		FTR-7C23	V104 to V107	4
V105	Same as V104	PA						
V106	Same as V104	PA						
V107	Same as V104	PA						
V108	TUBE, electron; JAN-8020; high vacuum rectifier	HV Rectifier	JAN-8020	16-T-78020			V108 to V111	4
V109	Same as V108	HV Rectifier						
V110	Same as V108	HV Rectifier						
V111	Same as V108	HV Rectifier						
V112	TUBE, electron: JAN-2X2A; high vacuum rectifier	Bias Rectifier	JAN-2X2A	16-T-52822			V112, V113	2
V113	Same as V112	Bias Rectifier						
V114	TUBE, electron: JAN-2050; thyratron tetrode	Trigger Generator Exc A	JAN-2050	16-T-72050			V114, V115	2
V115	Same as V114	Trigger Generator Exc B						
V116	TUBE, electron: JAN-4C35; hydrogen thyratron	Mod-Pulse Gen Exc A	JAN-4C35	16-T-54335			V116, V117	2
V117	Same as V116	Mod-Pulse Gen Exc B						

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
V118	TUBE, electron: JAN-5R4GY; full-wave rectifier	LV Bias Supply Rectifier	JAN-5R4GY	16-T-55444			V118, V121, V122	3					
V119	TUBE, electron: JAN-6SN7W; twin triode amplifier	Squaring Amp, Exciter A	JAN-6SN7W	16-T-56684			V119, V120	2					
V120	Same as V119	Squaring Amp, Exciter B											
V121	Same as V118	Compensat-ing Circuit											
V122	Same as V118	Compensat-ing Circuit											
V301	TUBE, electron: JAN-6J5; triode amplifier	Tripler	JAN-6J5	16-T-56350			V301, V302, V308, V309	8					
V302	Same as V301	Tripler											
V303	TUBE, electron: JAN-6SA7; penta-grid converter	Mixer	JAN-6SA7	16-T-56611			V303, V307	4					
V304	TUBE, electron: JAN-6SJ7, pentode	Limiter Amplifier	JAN-6SJ7	16-T-56665			V304	2					
V305	TUBE, electron: JAN-6V6GT/G; beam-power amplifier	Pulsed Doubler	JAN-6V6GT/G	16-T-56768			V305, V306	4					
V306	Same as V305	Pulsed Doubler											
V307	Same as V303	Divider											
V308	Same as V301	Doubler											
V309	Same as V301	Tripler											
V2301	TUBE, electron: JAN type 2D21W; thyratron; spec JAN-1A	Relay K2302 Control	2D21W	16-T-52421-50		#700253	V2301 V2302	2	20VR	6	6		0

V2302	Same as V2301	Relay K2303 Control											
W101	Not used												
W102	CABLE, RF: RG-19/U; coax.; 52 ohms impedance, 29.5 $\mu\mu$f/ft.; 14,000v RMS; single 0.250" solid plain copper cond.; outer cond. single plain copper braid, 0.990" OD; polyethylene dielectric, 0.910" OD; non-contaminating synthetic resin jacket and spcl. spiral armor as per Coast Guard specs. RS-308 and S-207; spec. JAN-C-17A			15-C-12160-485		FRA-14586-2-2	W102						
W2103	CABLE ASSEMBLY, RF: JAN RG-62/U cable; coax., nominal impedance 93 ohms, max. oper. v 750 RMS, #22 AWG plain copperweld., max. OD 0.191" single braid, dielectric type A or B, outer cover, type I synthetic resin 0.242" diam.; 65" lg. excluding term.; 70" lg. o/a; one UG-176/U adapter, one NT-49190 connector and one NT-49192 right angle adapter at ea. end; one end marked "P2600, W2103", other end marked "P2104, W2103"			16-C-11987-7324		FRA-15204-2-3	W2103	2					
W2501	WIRING HARNESS: 10 conductors, stranded wire SR1R per spec JAN-C-76; "F" insulation per MIL-I-631; 3' lg main body; nylon lacing cord; one H. B. Jones type P2410-CCE-B plug one end, one H. B. Jones type S–2410-CCE-B receptacle other end; color coded conductors.	Power test cable		Non-Support item	Superior Electric dwg. # C-805800		W2501 W2502	2					
W2502	Same as W2501												
W3737	CABLE ASSEMBLY, RF: AN type RG-62/U cable; coax., 93 ohms impedance, 750 v RMS, one #22 AWG plain copperweld wire braid shield, 0.191" OD, polyethylene ins. 0.146" OD; black vinyl jacket o/a, 0.242" OD; 46" lg. less terminations; 50" lg. o/a; one UG-176/U adapter and one NT-49195 connector at ea. end	Spares for Switching Equipment		16-C-11987-6201		FRA-15330-2-7	W3737, W3739, W3741, W3743	4					

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
W3738	CABLE ASSEMBLY, RF: AN type RG-62/U cable, coax., 93 ohms impedance, 750 v RMS, one #22 AWG plain copperweld wire, plain copper wire braid shield, 0.191" OD, polyethylene ins. 0.146" OD, black vinyl jacket o/a, 0.242" OD; 81⅞" lg less terminations; 85" lg. o/a; one UG-176/U adapter and one NT-49195 connector at ea. end	Spares for Switching Equipment		16-C-11987-9655		FRA-15330-2-8	W3738, W3740, W3742, W3744	4					
W3739	Same as W3737												
W3740	Same as W3738												
W3741	Same as W3737												
W3742	Same as W3738												
W3743	Same as W3737												
W3744	Same as W3738												
XF2401	FUSEHOLDER: extractor post type: 250 v 15 amp; one type 3A6 cartridge, ¼" diam. x 1¼" lg; phenolic body (black bakelite); beryllium copper contacts, spring clip type; 1.672" lg x 0.690" diam; 2 term, solder lug type; mounts thru panel hole by ½"-16 thd shank and hex nut.	Holder for Blower Fuse (F2401)		17-F-74266-9053	Littelfuse # 342003	#746063	XF2401 XF2402	2					
XF2402	Same as XF2401	Holder for Blower Fuse (F2402)											
XF2501	FUSEHOLDER: extractor post type; 250 v 15 amp; for one ¼" diam. x 1¼" lg cartridge fuse; phenolic body; brass contacts; coil spring type; 2-9/64" lg x 11/16" daim; ½"-24 thrd on body for panel hole mtg.	Holder for F2501		17 F-74267-5075	Bussman type HKP		XF2501 XF2502 XF2503	3					
XF2502	Same as XF2501	Holds F2502											

XF2503	Same as XF2501	Holds F2503						
XI2401	LIGHT, INDICATOR: supplied with 1" diam. clear amber lens; accommodates T-4½' neon lamp; bayonet base; material nonferrous, dull black finish, enclosed; 2-11/16" lg x 1¼" diam; one mtg hole, 1" diam; for ⅝" max thick panel; mounts any position; lamp replaceable from front; 2 solder lug terms on bottom, both ins from shell.	Blower "ON"		17-L-76696-8919	Dialco # 51206-113	A1023602	XI2401	1
XI2501	LIGHT, INDICATOR: supplied with 15/32" diam clear lens; smooth; male threads; accommodates T-3-¼ lamp; miniature bayonet base; 115 or 230 v, 1/25 watts; brass shell with melamine insert, satin chrome finish; 2-5/16" lg x 11/16" diam; 1 mtg hole 23/32" diam; for 5/16" max thick panel; mtd any position; lamp replaceable from front of panel; 2 solder lug type terms on end, both insulated from frame.	Holds I2501		17-L-76737-2481	Dialco # 88408-13		XI2501	1
XV101	SOCKET, tube: 5 cont.; assembled w/retainer ring to steel mtg. saddle; two mtg. slots to fit 1½" to 1⅞" mtg. centers; 1¼" diam. chassis cutout required; round steatite body 1¼" diam. x 0.420" thk.; phos-bronze, silver pl. cont.	Socket for V101		16-S-61703-9551	Amphenol RSS5		XV101	1
XV102	SOCKET, tube: 4 cont., RCA type #M422736 transmitter modulator tube; under chassis wafer mtg.; 3 mtg. holes, 7/32" diam, spaced 180 deg., 90 deg., 90 deg. apart, 1-27/64" rad, from ctr. mtg., 2" c to c; round, ceramic, 3¼" diam. x 5/16" thk.; phosphor bronze, silver plated cont.; special ground stud term.	Socket for V102		16-S-60904-5953	Johnson EF 122-234		XV102, XV103	2
XV103	Same as XV102	Socket for V103						
XV104	CONTACT, electron tube: c/o glazed white steatite tube, nickel pl-brass fl. and nickel pl. brass cont. collar; cylindrical, 7⅞" lg. x 6-5/16" diam. o/a; four 7/32" diam. mtg. holes located 90 deg. apart on 5⅝" diam. bolt circle on fl.; cont. collar has spring fingers to acommodate plate cont. of tube; no. 10-32 x 9/16" lg. threaded stud term.	Socket for V104		17-I-70118-9526		FRE-14409-3	XV104 to XV107	4

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
XV105	Same as XV104	Socket for V105											
XV106	Same as XV104	Socket for V106											
XV107	Same as XV104	Socket for V107											
XV108	SOCKET, tube: four cont. med.; above chassis base mtg., four 7/32" diam. mtg. holes spaced 90 deg. apart on 2-5/16" diam. bolt circle; round steatite body w/metal bayonet shell; body 2-13/16" diam. x 11/16" thk., shell 1.386" diam., 1-27/32" h. o/a; beryllium copper contacts	Socket for V108		16-S-60856-3001	Johnson EF 123-209SB		XV108 to XV111	4					
XV109	Same as XV108	Socket for V109											
XV110	Same as XV108	Socket for V110											
XV111	Same as XV108	Socket for V111											
XV112	SOCKET, tube: 4 cont. one-piece saddle mtg w/retainer ring; two 5/16" lg. x 5/32" wd. mtg. slots spaced 1½" to 1⅞" c to c; oval ceramic body 1¼" diam. x 27/64" thk.; 2⅛" lg. x 1⅜" wd. x 27/64" thk. o/a less term. silver plated phosphor bronze cont.	Socket for V112		16-S-60853-7501	Amphenol RSS4		XV112, XV113	2					
XV113	Same as XV112	Socket for V113											
XV114	SOCKET, tube: 8 cont. octal.; assembled w/retainer ring to steel mtg. saddle; two mtg. slots to fit 1½" to 1⅞" mtg. centers; 1¼" diam. chassis hole required; round steatite body 1¼" diam. x 0.490" thk.; phos-bronze, silver pl. cont.	Socket for V114		16-S-63524-6510	Amphenol RSS8		XV114, XV115, XV118 to XV122	7					

XV115	Same as XV114	Socket for V115											
XV116	SOCKET, tube: 4 jumbo long cont.; under chassis wafer mtg.; four 0.174" diam. mtg. holes on 1.875" x 1.875" mtg. ctrs.; square ceramic body w/rounded corners, 2⅝" lg. x 2⅝" wd. x 0.292" h.; silver plated phosphor-bronze spring cont.	Socket for V116		16-S-60992-4241	Johnson EF 122-244		XV116, XV117	2					
XV117	Same as XV116	Socket for V117											
XV118	Same as XV114	Socket for V118											
XV119	Same as XV114	Socket for V119											
XV120	Same as XV114	Socket for V120											
XV121	Same as XV114	Socket For V121											
XV122	Same as XV114	Socket for V122											
XV301	SOCKET, tube: 8 cont., octal.; mts., w/retainer ring; 1¼" diam. chassis hole required; round steatite body 1¼" diam. x 0.490" thk.; phos-bronze silver pl. cont.; spcl. finish for military use	Socket for V301		16-S-63462-8178	Amphenol 49-SS8M		XV301 to XV309	18					
XV302	Same as XV301	Socket for V302											
XV303	Same as XV301	Socket for V303											
XV304	Same as XV301	Socket for V304											
XV305	Same as XV301	Socket for Y305											
XV306	Same as XV301	Socket for V306											
XV307	Same as XV301	Socket for V307											
XV308	Same as XV301	Socket for V308											
XV309	Same as XV301	Socket for V309											

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
XV2301	SOCKET, tube: 7 contacts; miniature; includes metal shock shield; oval; spec. JAN-S-28A	Holds V2301	TS102C01	16-S-62603-6700			XV2301 XV2302	2					
XV2302	Same as XV2301	Holds V2302											
XY301	SOCKET, crystal: two phosphor cont. nickel pl.; accommodates two 0.050" diam. pins spaced 0.487" c to c; oval shape; steatite body; 13/16" lg. x 5/16" wd. x 5/16" h; one # 26 drill mtg. hole in center	Socket for Y301A, B, C, D, or E		16-S-54423-5573	Millen #K33302		XY301	2					
XZ2301	SOCKET, tube: 8 cont. miniature; one-piece brass saddle mtg; 1⅛" diam chassis cutout required; ceramic body 1-7/64" diam x 11/16" lg, less cont.; solder terms; silver pl copper cont., 5 amps 1250 vac rating; 1⅞" lg x 1⅜" d x 1" ho/a; two 5/32" diam mtg holes spaced 1½" c to c; spec JAN-S-28A.	Holds Z2301	TS101C01	16-S-63515-4156			XZ2301	1					
*Y301A	CRYSTAL UNIT, quartz: 925 kc; type CR-18/U; crystal; one plate; type HC-6/U holder; 2 pins on bottom 0.486" c to c; oval metal body 0.750" lg x 0.343" wd x 0.765" h; spec MIL-C-3098A	1850 kc Carrier Frequency Control	CR-18/U Xtal, HC-6/U Holder	16-C-96733-4001			Y301A	2					
*Y301B	CRYSTAL UNIT, quartz: Same as Y301A, except 975 kc.	1950 kc Carrier Frequency Control	CR-18/U Xtal, HC-6/U Holder	16-C-96766-7001			Y301B	2					
*Y301C	CRYSTAL UNIT, quartz: Same as Y301A, except 875 kc.	1750 kc Carrier Frequency Control	CR-18/U Xtal, HC-6/U Holder	16-C-96700--1035			Y301C	2					
*Y301D	CRYSTAL UNIT, quartz: Same as Y301A, except 900 kc.	1800 kc Carrier Frequency Control	CR-18/U Xtal, HC-6/U Holder	16-C-96716-7035			Y301D	2					

*Y301E	CRYSTAL UNIT, quartz: Same as Y301A, except 950 kc.	1900 kc Carrier Frequency Control	CR-18/U Xtal, HC-6/U Holder	16-C-96750-1035			Y301E	1					
Z301	TRANSFORMER, RF: 100 kc input transf; 2 wnd; duolateral wnd; aluminum shield can; pri./secd. rated 280 μh/4.84 mh nominal inductance at 1000 cycles, 3.3/23 ohms DC resistance; 1-7/16" sq. x 3½" h. o/a excluding mtg. studs, term, and adj. stud; fibre form; powdered iron core tuning, adjusted by scdr. thru top and bottom of can; two #4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. on same end as mtg. studs, only 4 term. used; stamped "Z301, C302"; incl. 680 μμf capacitor	100 kc Input Transformer		17-T-81578-5423		FRA-15723-2	Z301	2					
Z301A	TRANSFORMER, RF: 100 kc. input transf.; 2 wnd., duolateral wnd.; unshielded; pri./secd. rated 280 uh/4.84 mh. nominal inductance at 1000 cycles, 3.3/23 ohms DC resistance; 1¼" sq. x 2⅞" h. o/a excluding mtg. studs, term. and adj. stud; fibre form; powdered iron core tuning adjusted by scdr. on top and bottom of form; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. on same end as mtg. studs, only 4 term. used; stamped "C302"; incl. 680μμf capacitor; identical w/Z301 except that shield can is not incl.	Spares for Z301		17-T-82470-5677		FRA-15723-2 less Item 3			106	3	2		6
Z302	TRANSFORMER, RF: 300 kc interstage transf.; 2 wnd., duolateral wnd.; aluminum shield can; pri./-secd. rated 1.30/1.24 mh nominal inductance at 1000 cycles, 8.3/8.3 ohms DC resistance; 1-7/16" sq. x 3½" h. o/a excluding mtg. studs, term. and adj. stud; fibre form; powdered iron core tuning adjusted by scdr. thru top and bottom of can; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug. term. located on same end as mtg. studs, only 4 term. used; stamped "Z302, C306, C307"; incl. two 270 μμf mica capacitors	300 KC Interstage Transformer (V301-V302)		17-T-81600-8875		FRA-15724-2	Z302	2					

*Used alternatively to obtain the frequencies indicated in "Function" column.

TABLE 8—4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
Z302A	TRANSFORMER, RF: 300 kc interstage transf.; 2 wnd.; duolateral wnd.; unshielded.; pri./secd. rated 1.30/1.24 mh. nominal inductance at 1000 cycles, 8.3/8.3 ohms DC resistance; 1¼" sq. x 2⅞" h. o/a excluding mtg. studs, term. and adj. stud; fibre form; powdered iron core tuning adjusted by scdr. on top and bottom of form; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. located on same end as mtg. studs, only 4 term. used; stamped "C306, C307"; incl. two 270 μμf mica capacitors, identical w/Z302 except that shield can is not incl.	Spares for Z302		17-T-82496-5521		FRA-15724-2 less Item 3			107	3	2		6
Z303	TRANSFORMER, RF: 900 kc interstage transf.; 2 wnd.; duolateral wnd.; aluminum shield can; pri./secd. rated 625/635 uh. nominal inductance at 1000 cycles 5.3/5.3 ohms DC resistance; 1-7/16" sq. x 3½" h. o/a excluding mtg. studs, term. and adj. stud; fibre form; powdered iron core tuning adjusted by scdr. thru top and bottom of can; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. on same end as mtg. studs, only 4 term. used; stamped "Z303, C310, C311"; incl. two 51 μμf mica capacitors	900 KC Interstage Transformer (V302-V303)		17-T-81588-8917		FRA-15725-2	Z303	2					
Z303A	TRANSFORMER, RF: 900 kc interstage transf.; 2 wnd., duolateral wnd., unshielded pri./secd. rated 625/635 uh. nominal inductance at 1000 cycles, 5.3/5.3 ohms DC resistance; 1¼" sq. x 2⅞" h. o/a excluding mtg. studs, term. and adj. stud; fibre form; powdered iron core tuning adjusted by scdr. on top	Spares for Z303		17-T-82488-5677		FRA-15725-2 less Item 3			108	3	2		6

	and bottom of form; two no 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. on same end as mtg. studs, only 4 term. used; stamped "C310, C311"; incl. two 51 $\mu\mu$f mica capacitors, identical w/Z303 except that shield can is not incl.												
Z304	TRANSFORMER, RF: 875 kc interstage transf.; 2 wnd., duolateral wnd.; aluminum shield can; pri./secd. rated 286/268 uh min. to 497/477 uh max. at 1000 cycles, 4.4/4.4 ohms DC resistance; 1-7/16" sq. x 3½" h. o/a excluding mtg. studs, term. and adj. stud; phenolic form; adj. brass slugs w/scdr. adj. thru top and bottom of can; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. on same end as mtg. studs, only 4 term. used; stamped "Z304, 1750 kc."	875 KC Interstage Transformer (V303-V304)		17-T-81578-7151		FRA-15726-2-1	Z304	2					
Z304A	TRANSFORMER, RF: 875 kc interstage transf.; 2 wnd., duolateral wnd.; unshielded, pri./secd. rated 286/268 uh min. to 497/477 uh max. at 1000 cyc. 4.4/4.4 ohms DC resistance; 1¼" sq. x 2-13/16" h. o/a excl. mtg. studs, term. and adj. studs; phenolic form; adj. brass slugs w/scdr. adj. on top and bottom of form; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. on same end as mtg. studs, only 4 term. used; identical w/Z304 except can is not incl.	Spares for Z304		17-T-82480-4771		FRA-15726-2-1 less Item 3			109	3	2		6
Z305	TRANSFORMER, RF: 900 kc interstage transf.; 2 wnd., duolateral wnd., aluminum shield can; pri./secd. rated 286/268 uh min. to 497/477 uh max. at 1000 cycles, 4.4/4.4 ohms DC resistance; 1-7/16" sq. x 3½" h. o/a excluding mtg. studs, term. and adj. stud; phenolic form; adj. brass slugs w/scdr. adj. thru top and bottom of can; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. on same end as mtg. studs, only 4 term. used; stamped "Z305, 1800 kc."	900 KC Interstage Transformer (V303-V304)		17-T-81578-7153		FRA-15726-2-2	Z305	2					

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
Z305A	TRANSFORMER, RF: 900 kc inter-stage transf.; 2 wnd., duolateral wnd.; unshielded, pri./secd. rated 286/268 uh min. to 497/477 uh max. at 1000 cyc. 4.4/4.4 ohms DC resistance; 1¼" sq. x 2-13/16" h. o/a; excl. mtg. studs term. and adj. studs; phenolic form adj. brass slugs w/scdr. adj. on top and bot-tom of form; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. on same end as mtg. studs, only 4 term. used; identical w/Z305 except that shield can is not incl.	Spares for Z305		17-T-82480-4773		FRA-15726-2-2 less Item 3			110	3	2		6
Z306	TRANSFORMER, RF: 925 kc. inter-stage transf.; 2 wnd., duolateral wnd.; aluminum shield can; pri./secd. rated 286/268 uh min. to 497/477 uh max. at 1000 cycles, 4.4/4.4 ohms DC resistance; 1-7/16" sq. x 3½" h. o/a excluding mtg. studs, term. and adj. stud; phenolic form; adj. brass slugs w/scdr. adj. thru top and bottom of can; two No. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. on same end as mtg. studs, only 4 term. used; stamped "Z306, 1850 kc."	925 KC Interstage Trans-former (V303-V304)		17-T-81578-7155		FRA-15726-2-3	Z306	2					
Z306A	TRANSFORMER, RF: 925 kc inter-stage transf.; 2 wnd., duolateral wnd.; unshielded, pri./secd. rated 286/268 uh min. to 497/477 uh max. at 1000 cyc., 4.4/4.4 ohms DC resistance; 1¼" sq. x 2-13/16" h. o/a excl. mtg. studs term. and adj. studs; phenolic form; adj. brass slugs w/scdr. adj. on top and bot-tom of form; two no. 4-40 thd. mtg. studs diagonally located on	Spares for Z306		17-T-82480-4775		FRA-15726-2-3 less Item 3			111	3	2		6

	15/16" x 15/16" mtg./c; 6 solder lug term on same end as mtg. studs, only 4 term. used; identical w/Z306 except that shield can is not incl.												
Z307	TRANSFORMER, RF: 950 kc. interstage transf.; 2 wnd., duolateral wnd.; aluminum shield can; pri./secd. rated 286/268 uh min. to 497/477 uh max. at 1000 cycles, 4.4/4.4 ohms DC resistance; 1-7/16" sq. x 3½" h. o/a excluding mtg. studs, term. and adj. stud; phenolic form; adj. brass slugs w/scdr. adj. thru top and bottom of can; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. on same end as mtg. studs, only 4 term. used; stamped "Z307, 1900 kc."	950 KC Interstage Transformer (V303-V304)		17-T-81578-7157		FRA-15726-2-4	Z307	2					
Z307A	TRANSFORMER, RF: 950 kc. interstage transf.; 2 wnd., duolateral wnd.; unshielded; pri./secd. rated 286/268 uh min. to 497/477 uh max. at 1000 cyc., 4.4/4.4 ohms DC resistance; 1¼" sq. x 2/13/16" h. o/a excl. mtg. studs term. and adj. studs; phenolic form; adj. brass slugs w/scdr. adj. on top and bottom of form; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term on same end as mtg. studs, only 4 term. used; same as Z307 except that shield can is not incl.	Spares for Z307		17-T-82480-4777		FRA-15726-2-4 less Item 3			112	3	2		6
Z308	TRANSFORMER, RF: 975 kc. interstage transf.; 2 wnd., duolateral wnd.; aluminum shield can; pri./secd. rated 286/268 uh min. to 497/477 uh max. at 1000 cycles; 4.4/4.4 ohms DC resistance; 1-7/16" sq. x 3½" h. o/a excluding mtg. studs, term. and adj. stud; phenolic form; adj. brass slugs w/scdr. adj. thru top and bottom of can; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term. on same end as mtg. stud, only 4 term. used; stamped "Z308, 1950 kc."	975 KC Interstage Transformer (V303-V304)		17-T-81578-7159		FRA-15726-2-5	Z308	2					

TABLE 8–4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
Z308A	TRANSFORMER, RF: 975 kc. interstage transf.; 2 wnd., duolateral wnd.; unshielded, pri./secd. rated 286/268 uh min. to 497/477 uh max. at 1000 cyc., 4.4/4.4 ohms DC resistance; 1¼" sq. x 2-13/16" h. o/a excl. mtg. studs term. and adj. studs; phenolic form; adj. brass slugs w/scdr. adj. on top and bottom of form; two no. 4-40 thd. mtg. studs diagonally located on 15/16" x 15/16" mtg./c; 6 solder lug term on same end as mtg. studs, only 4 term. used; identical w/Z308 except that shield can is not incl.	Spares for Z308		17-T-82480-4779		FRA-15726-2-5 less Item 3			113	3	2		6
Z309	TRANSFORMER, RF: 875 kc. interstage transf.; 2 wnd., universal wnd.; unshielded; pri./secd. rated 247/620 uh at 1000 cyc., 4.2/9.6 ohms, DC resistance, secd. has CT; 3¼" lg. x 2¼" wd. x 1½" h. o/a excl. term.; phenolic form; two #6-32 thd. holes on 1⅛" mtg./c on bottom; 5 solder lug term. on top	875-975 KC Interstage Transformer (V304-V305, V306)		17-T-81202-5395		FRA-15994-2	Z309	2	114	3	2		6
Z310	COIL, RF: p/o 25 kc. tuned circuit; single wnd., universal wnd., aluminum shield can; 14.2 mh inductance at 1000 cycles, 38 ohms DC resistance; 2-9/32" lg. x 1-55/64" wd. x 1-27/64" h. o/a excluding mtg. studs, term. and adj. stud; phenolic form; adj. iron core w/scdr. adj. thru end of can; two no. 4-40 thd. mtg. studs spaced 1-7/16" c to c; 4 solder lug term. on same end as mtg. studs; stamped "Z310, C336, C343"; incl. one 51 $\mu\mu f$ and one 1200 $\mu\mu f$ mica capacitor	25 KC Tuned Circuit		16-C-76778-5217		FRA-15647-2-2	Z310	2					

Z310A	COIL, RF: p/o 25 kc tuned circuit; single wnd., universal wnd.; unshielded; 14.2 mh at 1000 cyc., 38 ohms DC resistance; 2-27/64" lg. x 1-25/32" wd. x 1-11/32" h. o/a; excluding term. and mtg. studs; phenolic form; adj. iron core w/ scdr. adj. on top of coil support; two no. 4-40 thd. mtg. studs spaced 1-7/16" c to c; 4 solder lug term. on same end as mtg. studs; incl. one 51 $\mu\mu$f and one 1200 $\mu\mu$f mica capacitor; stamped "Z310, C336, C343" on base; identical w/Z310 except shield can is not incl.	Spares for Z310		16-C-76778-4996		FRA-15647-2-2 less Item 4			115	3	2		6
Z311	COIL, RF: p/o 50 kc. tuned circuit; single wnd., universal wnd.; aluminum shield can; 6.38 mh inductance at 1000 cycles, 24 ohms DC resistance; 2-1/32" lg. x 1-13/32" wd. x 2-9/32" h. o/a excluding mtg. studs, term. and adj. stud; phenolic form; adj. iron core w/ scdr. adj. thru end of can; two no. 4-40 thd. mtg. studs spaced 1-7/16" c to c; 4 solder lug term. on same end as mtg. studs; stamped "Z311"	50 KC Tuned Circuit		16-C-76601-4799		FRA-15648-2	Z311	2					
Z311A	COIL, RF: p/o 50 kc. tuned circuit; single wnd., universal wnd.; unshielded; 6.38 mh inductance at 1000 cyc., 24 ohms DC resistance; 1-29/32" lg. x 1-9/32" wd. x 2-5/16" h. o/a; phenolic form; adj. iron core w/scdr. adj. on top of coil support; two no. 4-40 thd. mtg. studs spaced 1-7/16" c to c; 4 solder lug term. on same end as mtg. studs; stamped "Z311" on core; identical w/Z311 except shield can is not incl.	Spares for Z311		16-C-76762-8969		FRA-15648-2 less Item 4			116	3	2		6
Z312	COIL, RF: p/o 75 kc. tuned circuit; single wnd., universal wnd.; aluminum shield can; 4.5 mh inductance at 1000 cycles, 19.6 ohms DC resistance; 2-1/16" lg. x 1-7/16" wd. x 2-9/32" h. o/a excluding mtg. studs, term. and adj. stud; phenolic form; adj. iron core w/scdr. adj. thru end of can; two no. 4-40 thd. mtg. studs spaced 1-7/16" c to c; 4 solder lug term. on same end as mtg. studs; stamped "Z312"	75 KC Tuned Circuit		16-C-76756-5901		FRA-15649-2	Z312	2					

TABLE 8-4. COMBINED PARTS AND SPARE PARTS LIST (LESS MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
Z312A	COIL, RF: p/o 75 kc. tuned circuit; single wnd.; universal wnd.; unshielded; 4.5 mh inductance at 1000 cyc., 19.6 ohms DC resistance; 1-29/32" lg. x 1-9/32" wd. x 2-5/16" h. o/a; phenolic form; adj. iron core w/scdr. adj. on top of coil support; two no. 4-40 thd. mtg. studs spaced 1-7/16" c to c; 4 solder lug term. on same end as mtg. studs; stamped "Z312" on core; identical w/Z312 except shield can is not incl.	Spares for Z312		16-C-76581-2869		FRA-15649-2 less Item 4			117	3	2		6
Z2301	NETWORK, temperature compensating: c/o 3 resistances mounted in a sealed case, and internally interconnected and wired to pins in octal type base; 1⅝" wd x 1-13/32" d x 2⅛" max above mtg surface, 2¾" max o/a height; plug-in mtg. R1: fixed wirewound; 2.5 ohms ±1%; R2: fixed wirewound; 23.5 ohms ±1%; R3: special lamp; 5 ohms;	Part of Control Unit Bridge Circuit	16-N-66976-1008		Superior Elec. # BU-3-B805001-C Shallcross # 222 Shallcross # 22QR Superior Elec. # AR7719	A1040539	Z2301	1	21VR	6	2		50
Z2401	SUPPRESSOR, electrical noise: coil and capacitor type; 6.2 mfd each line to case at 250 v AC; 115 μh iron core coil inductor; 250 v AC/DC, 30 amp; 6½" lg x 2⅞" wd x 2-9/64" h o/a; encl in hot-tinned rectangular steel case; terminal mtd; one hex stud term ea end, 9/16" lg w/#10-32 Sems fastener, located ⅝" above ctr line one end and ⅝" below, other end; fungus proofed	Input Line #1 Filter		17-S-50984-6148	TOBE # 1166-A	A1003951	Z2401 Z2402 Z2403 Z2404	4	22VR	6	2		50
Z2402	Same as Z2401	Input Line #1 Filter											

Z2403	Same as Z2401	Input Line #2 Filter
Z2404	Same as Z2401	Input Line #2 Filter

Addendum Sheet
To Operating and Maintenance Manual
For Du Mont Type 256-D Cathode-Ray Oscillograph

The type 256-D oscilloscope furnished with Radio Transmitter Type T-325B/FPN incorporates an illuminated rectangular coordinate scale which is not described elsewhere in this book. The degree of scale illumination may be varied to adjust scale visibility to meet the requirements at hand. The luminescence of the coordinate scale may be controlled by the SCALE ILLUMINATION knob located on the upper right side of the oscilloscope control panel.

The schematic diagram, shown below, illustrates the additional connections provided for this feature. The parts are listed in the Monitor Oscilloscope section of the T-325B/FPN parts list.

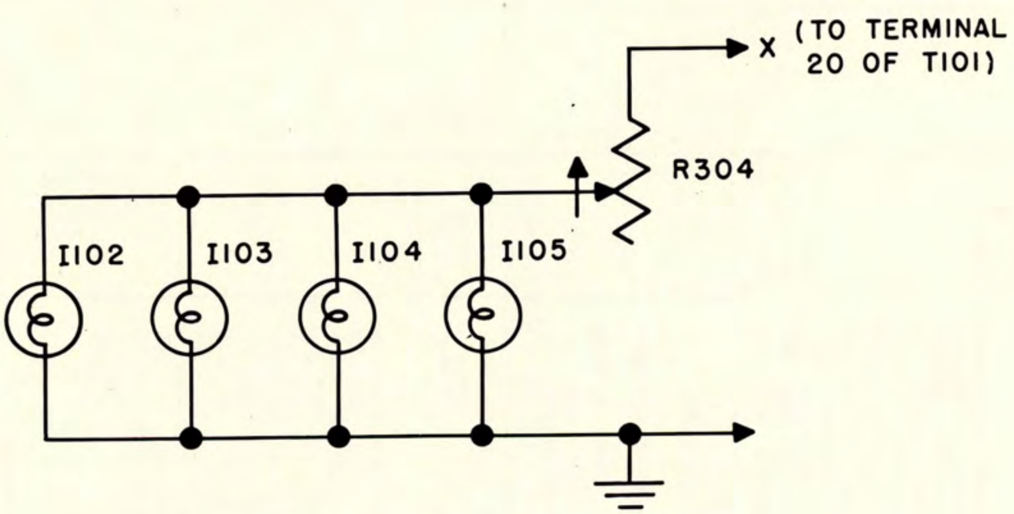

TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
A101	RING, retainer: CRT socket mounting; 0.062" spring steel; circular; 3-3/32" O.D. x 2.234" I.D. x 0.069" thk. o/a; 4 mtg. slots 30 deg. arc by 9/64" wd. spaced 90 deg apart on 2¾" diam. bolt circle; 4 gripping prongs 90 deg. apart on inside of ring	CRT Socket Mounting Ring		16-R-651341-104	Cinch #8593		A101	1					
C101	CAPACITOR, fixed: mica; 2400μμf ±5%; 500 vdcw.; spec. JAN-C-5	1000μ Sec A Gate Capacitor	CM30-B242J	16-C-31982-2284			C101	1					
C102	CAPACITOR, fixed: mica; 240μμf ±5%; 500 vdcw.; spec. JAN-C-5	100μ-Sec A Gate Capacitor	CM20-B241J	16-C-29449-8796			C102, C141 C146	3					
C103	CAPACITOR, fixed: mica; 10,000 μμf ±5%; 300 vdcw.; spec. JAN-C-5	4500μ-Sec A Gate Capacitor	CM40-B103J	16-C-33617-5109			C103, C138	2					
C104	CAPACITOR, fixed: mica; 24μμf ±5%; 500 vdcw.; spec. JAN-C-5	A Gate Grid Coupling Capacitor	CM20-B240J	16-C-26917-6396			C104, C135, C214	3					
C105	CAPACITOR, fixed: mica; 51μμf ±5%; 500 vdcw.; spec. JAN-C-5	A Gate Trigger Coupling Capacitor	CM20-B510J	16-C-27656-2596			C105, C207	2					
C106	CAPACITOR, fixed: paper dielectric; 250,000 μμf +20 −10%; 600 vdcw; HS metal case; 1¾" lg. x 1" wd. x ¾" h.; mineral oil impr. and filled; 2 solder lug term. on side of case spaced 1" c to c; 2 integral mtg. ears w/ 3/16" diam. hole spaced 2⅛" c to c	Delay Sawtooth Input Coupling Capacitor		16-C-46371-9907	Sprague #PBTS-398		C106, C132, C175	3	118	3	3		8
C107	CAPACITOR, fixed: mica 750μμf ±5%; 500 vdcw.; spec. JAN-C-5	100μ-Sec Delay Sawtooth Charging Capacitor #1	CM35-E751J	16-C-30663-3343			C107, C110	2					

C108	CAPACITOR, fixed: ceramic dielectric; 360$\mu\mu$f $\pm$5%; neg. temp. coef. 150$\mu\mu$f ($\pm$60$\mu\mu$f) /μf/°C; 500 vdcw.; 1.5" lg. x 0.290" diam.; two 1¾" lg. radial wire lead term.; term. mtg.; bakelite ins.	100μ-Sec Delay Sawtooth Charging Capacitor #2		16-C-17971-1900	Muter Co 51N150		C108, C111	2	119	3	1		2
C109	CAPACITOR, fixed: ceramic dielectric, 150$\mu\mu$f $\pm$5%; neg. temp. coef. 80$\mu\mu$f ($\pm$60$\mu\mu$f) /μf/°C; 500 vdcw.; 1.165" lg. x 0.315" diam.; 2 radial wire lead term.; term. mtg.; bakelite ins.	100μ-Sec Delay Sawtooth Charging Capacitor #3		16-C-17394-6667	Muter Co 41N080		C109, C112	2	120	3	1		2
C110	Same as C107	100μ-Sec Delay Sawtooth Charging Capacitor #4											
C111	Same as C108	100μ-Sec Delay Sawtooth Charging Capacitor #5											
C112	Same as C109	100μ-Sec Delay Sawtooth Charging Capacitor #6											
C113	CAPACITOR, fixed: mica; 5600$\mu\mu$f $\pm$5%; 500 vdcw.; spec. JAN-C-5	1000μ-Sec Delay Sawtooth Charging Capacitor #1	CM35-E562J	16-C-32826-3143			C113, C114, C117, C118	4					
C114	Same as C113	1000μ-Sec Delay Sawtooth Charging Capacitor #2											
C115	CAPACITOR, fixed: ceramic dielectric; 1000$\mu\mu$f $\pm$5%; neg. temp. coef. 750$\mu\mu$f ($\pm$150$\mu\mu$f) /μf/°C; 500 vdcw.; 1.875" lg. x 0.285" diam.; two 2-1/16" lg. radial wire leads, bakelite ins.	1000μ-Sec Delay Sawtooth Charging Capacitor #3		16-C-18645-1464	Muter Co 61N750		C115, C119	2	121	3	1		2

The Type T-325B/FPN Transmitter and the Monitor Oscilloscope (OS101) both have circuit symbols in the 100-200, 200-300, and 300-400 series. To avoid confusion references to an oscilloscope circuit symbol should always indicate that it is part of the Monitor Oscilloscope.

TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C116	CAPACITOR, fixed: ceramic; 510$\mu\mu$f ±5%; temp. coef. neg. 750$\mu\mu$f (±104$\mu\mu$f) /μf/°C; 500 vdcw; 1.165" lg. x 0.315" diam.; 2 radial wire lead term. 2" lg.; term. mtg.; bakelite ins.	1000μ-Sec Delay Sawtooth Charging Capacitor #4		16-C-18228-9846	Muter Co 41N750		C116, C120	2	122	3	1		2
C117	Same as C113	1000μ-Sec Delay Sawtooth Charging Capacitor #5											
C118	Same as C113	1000μ-Sec Delay Sawtooth Charging Capacitor #6											
C119	Same as C115	1000μ-Sec Delay Sawtooth Charging Capacitor #7											
C120	Same as C116	1000μ-Sec Delay Sawtooth Charging Capacitor #8											
C121	CAPACITOR, fixed: mica; 24,000 $\mu\mu$f ±5%; 600 vdcw.; spec. JAN-C-5	Delay Sawtooth Linearity Feedback Capacitor #1	CM50-B243J	16-C-34514-5977			C121, C122	2					
C122	Same as C121	Delay Sawtooth Linearity Feedback											

		Capacitor #2											
C123	CAPACITOR, fixed: mica; 10,000 μμf ±20%; 300 vdcw.; spec. JAN-C-5	Helipot By-pass Capacitor	CM40-B103M	16-C-33627-8069			C123, C127, C131, C148, C149, C151, C152, C155, C156, C176	10					
C124	CAPACITOR, fixed: paper dielectric; 2 sect. ea. 100,000 μμf +20% −10%; 600 vdcw.; HS case, 1⅝" h. x 1¾" lg. x 9/16" wd.; mineral oil impr.; 3 solder lug term. spaced ½" c to c on bottom of case; no internal gnd.; mtg. bracket soldered to bottom of case has two 0.144" diam. holes spaced 2⅛' c to c			16-C-53204-4080	Aerovox 618 MCB-0.1+0.1		C124, C126	2	123	3	2		5
C124A	Part of C124	1st Delay Amp Cathode By-pass Capacitor											
C124B	Part of C124	R Trigger Amp Cathode By-pass											
C125	CAPACITOR, fixed: mica; 510μμf ±5%; 500 vdcw.; spec. JAN-C-5	Pickoff Output Coupling Capacitor	CM20B-511J	16-C-30188-4996			C125, C145	2					
C126	Same as C124												
C126A	Part of C126	Helipot Bleeder By-pass Capacitor											
C126B	Part of C126	Trigger Output Cathode Follower By-pass Capacitor											
C127	Same as C123	2nd Delay Amp Input Coupling Capacitor											

The Type T-325B/FPN Transmitter and the Monitor Oscilloscope (OS101) both have circuit symbols in the 100-200, 200-300, and 300-400 series. To avoid confusion references to an oscilloscope circuit symbol should always indicate that it is part of the Monitor Oscilloscope.

TABLE 8—5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C128	CAPACITOR, fixed: mica; 150 $\mu\mu$f ±5%; 500 vdcw.; spec. JAN-C-5	R Trigger Amp Input Capacitor	CM20-B151J	16-C-28975-1596			C128, C144, C217	3					
C129	CAPACITOR, fixed: paper dielectric; 0.5 μf ±20%; 600 vdcw.; HS metal case 1-27/32" lg. x 1⅜" wd. x ⅝" h.; mineral oil impr.; no internal gnd.; mtg. bracket w/two #6-32 thd. spade bolts	R Gate Grid Capacitor		16-C-47327-7500	Tobe #MM-650		C129, C209	2	124	3	2		5
C130	CAPACITOR, fixed: mica; 1000 $\mu\mu$f ±20%; 500 vdcw.; spec. JAN-C-5	R Gate To Sweep Coupling Capacitor	CM25-B102M	16-C-31095-6952			C130, C143, C150, C153	4					
C131	Same as C123	A Gate To Sweep Coupling Capacitor											
C132	Same as C106	Sweep Linearity Feedback Capacitor											
C133	CAPACITOR, fixed: mica; 2000 $\mu\mu$f ±5%; 500 vdcw.; spec. JAN-C-5	100μ-Sec A Sweep Charging Capacitor	CM30-B202J	16-C-31797-5484			C133	1					
C134	CAPACITOR, fixed: mica; 300 $\mu\mu$f ±5%; 500 vdcw.; spec. JAN-C-5	25μ-Sec R Sweep Charging Capacitor	CM20-B301J	16-C-29660-8996			C134, C140	2					
C135	Same as C104	4μ-Sec R Sweep Charging Capacitor											
C136	CAPACITOR, fixed: mica; 100 $\mu\mu$f ±5%; 500 vdcw.; spec. JAN-C-5	10μ Sec R Sweep Charging Capacitor	CM20-B101J	16-C-28553-1196			C136, C142	2					

C137	CAPACITOR, fixed: mica; 6200 $\mu\mu$f ±5%; 500 vdcw.; spec. JAN-C-5	1000μ-Sec A Sweep Charging Capacitor #1	CM35-B622J	16-C-32905-4328			C137	1					
C138	Same as C103	1000μ-Sec A Sweep Charging Capacitor #2											
C139	CAPACITOR, fixed: paper dielectric; 0.05μf +20% −10%; 600 vdcw.; tubular metal case; 1-7/16" lg. x 9/16" diam.; mineral oil impr.; two 2¼" lg. axial wire leads; no internal gnd.; term. mtg.	4500μ-Sec A Sweep Charging Capacitor		16-C-44281-9036	Sprague KPX24-B17-+20-10		C139, C159, C160, C208, C211	5	125	3	5		10
C140	Same as C134	Sweep Paraphase Amp Input Coupling Capacitor											
C141	Same as C102	Sweep Paraphase Amp Feedback Capacitor											
C142	Same as C136	Crystal Oscillator Tank Circuit Capacitor											
C143	Same as C130	Crystal Oscillator Cathode By-pass Capacitor											
C144	Same as C128	50μ-Sec Marker Generator Grid Capacitor											
C145	Same as C125	100μ-Sec Marker Generator Grid Capacitor											
C146	Same as C102	Trig Divider Gate Sync Input Capacitor											

The Type T-325B/FPN Transmitter and the Monitor Oscilloscope (OS101) both have circuit symbols in the 100-200, 200-300, and 300-400 series. To avoid confusion references to an oscilloscope circuit symbol should always indicate that it is part of the Monitor Oscilloscope.

TABLE 8-5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C147	CAPACITOR, fixed: paper dielectric; 0.04μf ±10%; 400 vdcw.; tubular, metal case w/cardboard sleeve; 1-5/16" lg. x 11/16" diam.; mineral oil impr.; two 2⅜" lg. axial wire leads; no internal gnd., term. mtg.	Trig Divider Gate Grid Capacitor		16-C-43873-7469	Sprague KPX24B		C147	1	126	3	1		3
C148	Same as C123	Trig Divider Gate Output Capacitor											
C149	Same as C123	Trigger Amp By-pass Capacitor											
C150	Same as C130	External Trigger Input Capacitor											
C151	Same as C123	Trigger Generator Cathode By-pass Capacitor #1											
C152	Same as C123	Trigger Generator Cathode Capacitor #2											
C153	Same as C130	Trigger Generator Grid Capacitor											
C154	CAPACITOR, fixed: paper dielectric; 2 sect., ea. 0.5 μf +20% −10%; 600 vdcw.; HS case, 3" h. x 1¾" lg. x 9/16" wd.; mineral oil impr.; 3 solder lug term. spaced ½" c to c on bottom of case; no internal			16-C-53697-7130	Aerovox 618MCB-0.5+0.5		C154	1	127	3	1		3

	gnd.; channel mtg. bracket soldered to bottom of case has 2 mtg. holes spaced 2⅛" c to c												
C154A	Part of C154	A Gate Cathode By-pass Capacitor											
C154B	Part of C154	Sweep Paraphase Amplifier Cathode By-pass Capacitor											
C155	Same as C123	+Trigger Output Capacitor											
C156	Same as C123	− Trigger Output Capacitor											
C157	CAPACITOR, fixed: paper dielectric; 2 sect.; 0.05µf/0.05µf +20%, −10%; 600 vdcw.; 1¾" lg. x 1" wd. x 13/16" h.; mineral oil impr.; 3 solder lug term. spaced ½" c to c on one side of case; no internal gnd.; two fixed riveted lug type fl. on 2⅛" mtg. ctrs.			16-C-53010-6065	Aerovox 630M-.05+.05		C157	1	128	3	1		3
C157A	Part of C157	Horizontal Centering Control By-pass Capacitor #1											
C157B	Part of C157	Vertical Centering Control By-pass Capacitor #1											
C158	CAPACITOR, fixed: paper dielectric; 3 sect.; ea. sect. 0.05µf +20%, −10%; 600 vdcw.; 1¾" lg. x 1" wd. x 13/16" h. HS case; mineral oil impr.; 3 solder lug term spaced ½" c to c on side of case; internal gnd.; 2 fixed riveted lug type fl. on 2⅛" mtg. ctrs.			16-C-54400-6368	Aerovox 630M-.05+.05+.05		C158	1	129	3	1		3

The Type T-325B/FPN Transmitter and the Monitor Oscilloscope (OS101) both have circuit symbols in the 100-200, 200-300, and 300-400 series. To avoid confusion references to an oscilloscope circuit symbol should always indicate that it is part of the Monitor Oscilloscope.

TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C158A	Part of C158	Horizontal Centering Control By-pass Capacitor #2											
C158B	Part of C158	Vertical Centering Control By-pass Capacitor #2											
C158C	Part of C158	Auxiliary Focus Control By-pass Capacitor											
C159	Same as C139	Video Output Coupling Capacitor											
C160	Same as C139	Vertical Direct Coupling Capacitor											
C161	CAPACITOR, fixed: paper; 0.05μf +20%, −10%; 600 vdcw.; HS case 1¾" lg. x 1" wd. x ¾" h.; mineral oil impr.; 2 solder lug term. spaced 1" c to c on side of case; no internal gnd.; two fixed fl. on 2⅛" mtg. ctrs.	+Sweep Output Coupling Capacitor		16-C-44281-9295	Sprague PBTS-396		C161, C162	2	130	3	2		5
C162	Same as C161	—Sweep Output Coupling Capacitor											

C163	CAPACITOR, fixed: paper dielectric; 100,000 $\mu\mu$f +20 −10%; 3000 vdcw;. tin plated and gray lacquered metal case; 2½" lg. x 1-3/16" wd. x 2" h.; mineral oil impr. and filled; two no. 10-32 thd. x 1⅛" h. stud term. spaced 1⅛" c to c on por. pillars on top w/ spade lug term. and 2 hex nuts on ea.; no internal gnd.; no integral mtg. provisions supplied	CRT Blanking Input Capacitor		16-C-45801-9959	Aerovox 3009M-0.1		C163, C165	2	131	3	2		5
C164	CAPACITOR, fixed: mica; 5100 $\mu\mu$f ±5%; 2500 vdcw.; spec. JAN-C-5	CRT Marker Input Capacitor	CM60-B512J	16-C-32722-1111			C164	1					
C165	Same as C163	CRT Cathode By-pass Capacitor											
C166	CAPACITOR, fixed: paper dielectric; 100,000 $\mu\mu$f +20% −10%; 600 vdcw. HS metal case w/ external cardboard insulating tube; 1⅞" lg. x 11/16" diam.; mineral oil impr.; 2 axial wire lead term.; no internal gnd.; term. mtd.	CRT Grid By-pass Capacitor		16-C-45801-9559	Sprague KPX24B20		C166, C213	2	132	3	2		5
C167	CAPACITOR, fixed: mica; 390 $\mu\mu$f ±10%; 500 vdcw.; spec. JAN-C-5	Sweep Triode Grid By-pass Capacitor	CM20-B391K	16-C-29903-4076			C167	1					
C168	CAPACITOR, fixed: paper dielectric; 4μf +10% −3%; 600 vdcw.; cylindrical metal can; 1½" diam. x 4½" lg. excluding term.; oil impr. and filled; one no. 10-32 thd. stud term. w/solder lug on one end of can; internal gnd.; no integral mtg. provisions supplied	+400 Volt Filter Capacitor #1		16-C-49937-5160	Cornell Dubilier TLA-6040		C168, C169, C170, C171, C180, C210	6					
C169	Same as C168	+400 Volt Filter Capacitor #2											
C170	Same as C168	+400 Volt Filter Capacitor #3											
C171	Same as C168	+250 Volt Filter Capacitor											

The Type T-325B FPN Transmitter and the Monitor Oscilloscope (OS101) both have circuit symbols in the 100-200, 200-300, and 300-400 series. To avoid confusion references to an oscilloscope circuit symbol should always indicate that it is part of the Monitor Oscilloscope.

TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C172	CAPACITOR, fixed: paper dielectric; 250,000 μμf ±10%; 3000 vdcw.; tin plated and gray lacquered metal case; 2½" lg. x 1-3/16" wd. x 3¼" h.; mineral oil impr. and filled; two no. 10-32 thd. x 1⅛" h. stud term. on por. pillars spaced 1⅛" c to c on top w/spade lug and two hex nuts on ea.; two spade type brackets w/ no. 10-32 thd. x ½" lg. stud spaced 2¾" c to c	−2000 Volt Filter Capacitor #1		16-C-46355-5387	C-D #TJH-300025		C172, C173, C174	3	133	3	3		8
C173	Same as C172	−2000 Volt Filter Capacitor #2											
C174	Same as C172	+2000 Volt Filter Capacitor											
C175	Same as C106	Low Voltage Filter Capacitor											
C176	Same as C123	Marker Output Capacitor											
C177	CAPACITOR, fixed: paper dielectric; single sect.; 10,000 μμf +20%, −10%; 600 vdcw.; tubr. metal case; 1-1/16" lg. x 7/16" diam.; mineral oil impr.; 2 axial wire leads, 2¾" lg.; no int. gnd.; term. mtd.	AC Line Filter Capacitor #1		16-C-42761-9014	Sprague KPX24-B13±10		C177, C178, C179	3	134	3	3		8
C178	Same as C177	AC Line Filter Capacitor #2											
C179	Same as C177	Movable Marker Output Capacitor											

C180	Same as C168	+400 Volt Filter Capacitor #4											
C201	CAPACITOR, variable: ceramic rotary; single sect.; 3-12 μμf; 500 vdcw.; zero temp. coef.; 27/32" lg. x 41/64" wd. x 13/32" thk. o/a; solder lug term.; two 0.120" diam. holes in case on 0.438" mtg. ctrs.; screwdriver adjust.; steatite base	3:1 Video Attenuator Capacitor		16-C-63934-8139	Erie NPO TS2A		C201, C202, C203, C204	4	135	3	2		4
C202	Same as C201	10:1 Video Attenuator Capacitor #1											
C203	Same as C201	30:1 Video Attenuator Capacitor #1											
C204	Same as C201	100:1 Video Attenuator Capacitor #1											
C205	CAPACITOR, fixed: mica; 750 μμf ±5%; 500 vdcw.; spec. JAN-C-5	100:1 Video Attenuator Capacitor #2	CM30-B751J	16-C-30663-3284			C205	1					
C206	CAPACITOR, fixed: mica; 200 μμf ±5%; 500 vdcw.; spec. JAN-C-5	30:1 Video Attenuator Capacitor #2	CM20-B201J	16-C-29265-2996			C206	1					
C207	Same as C105	10:1 Video Attenuator Capacitor #2											
C208	Same as C139	Video Input Coupling Capacitor											
C209	Same as C129	Video 1st Stage Screen By-pass Capacitor											

The Type T-325B/FPN Transmitter and the Monitor Oscilloscope (OS101) both have circuit symbols in the 100-200, 200-300, and 300-400 series. To avoid confusion references to an oscilloscope circuit symbol should always indicate that it is part of the Monitor Oscilloscope.

TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
C210	Same as C168	Video 1st Stage Plate Filter Capacitor											
C211	Same as C139	Video 2nd Stage Input Coupling Capacitor											
C212	CAPACITOR, fixed: paper dielectric; single sect.; 2µf +20%, −10%; 600 vdcw.; HS metal case; 1¼" lg. x 1-3/16" wd. x 2¼" h.; mineral oil impr.; 2 solder lugs on top ½" c to c on bakelite pillars; no int. gnd.; mtg. bkt. fits over case, c/o two spade bolts #6-32 thd.	Video 2nd Stage Screen By-pass Capacitor		16-C-49921-9855	Tobe OM-602		C212	1	136	3	1		3
C213	Same as C166	Video Output Stage Input Coupling Capacitor											
C214	Same as C104	Video Output Stage Cathode Capacitor											
C215	CAPACITOR, fixed: electrolytic; 40 µf +75%, −25%; 450 vdcw.; −60 deg. C to +85 deg. C wkg. temp.; 2¾" lg. x 1⅜" diam.; HS metal can; two solder lug term. on bottom; both term ins. from can; ring type mtg. clamp w/two mtg. feet spaced 180 deg.; ea. foot one ¼" x 1/16" hole	Video Supply #1 Filter Capacitor #1		16-C-19918-9065	Sprague DEC		C215	1	137	3	2		3
C216	CAPACITOR, fixed: paper dielectric; 0.05µf +20%, −10%; 1000 vdcw.; tubular metal case w/cardboard	Vertical Direct Input		16-C-44281-9704	Sprague KPX24B66		C216	1	138	3	1		3

	sleeve 1-11/16" lg. x 11/16" diam.; mineral oil impr.; two 2" lg. axial wire leads; no internal gnd.; term mtg.	Capacitor											
C217	Same as C128	Video 1st Stage Cathode Capacitor											
E101	FUSEHOLDER: extractor post type; holds one 3AG fuse 1¼" lg. x ¼" OD; c/o molded black bakelite tube w/knob; 2-7/32" lg. x 23/32" diam. o/a; ½"-24 thd. body for ½" diam. panel hole mtg.; 2 ring type solder lug term.; finger operated			17-F-74267-5401	Littel-fuse #342001		E101, E102	2					
E102	Same as E101												
E103	INSULATOR, standoff: conical pillar; grade L-2 por., L-3 steatite; ⅝" h. x ⅝" base diam. x 7/16" top diam. w/#6-32 thd. x ¼" d. axial holes ea. end			17-I-68753-5001	Bud Rad I-300		E103	1					
F101	FUSE, cartridge: 2 amp.; time delay; continuous at 110%; blow time 60 min. at 135%; 250v; 1 time; glass body; ferrule term.; non-indicating; 1¼" lg. x ¼" diam. o/a	Fuse		17-F-16302-100	Buss 3AG		F101, F102	2					
F102	Same as F101												
H101	CLAMP: tube holder; stainless steel, 2" lg. x 1½" wd. x ⅞" h. approx.; fits 1⅜" diam. tube base; incl. locking latch; 200 hr. salt spray test			16-C-302837-594	G.S. Thompson #926C		H101	1					
H102-1 to H102-3	GROMMET: rubber; fits ⅜" diam. hole; 7/32" hole diam.; 1/16" wd. groove; ½" diam. x ¼" thk. o/a excluding points; has 4 rubber molded points on ea. side spaced 90° apart			16-G-900115-133	Goodyear Sundries #2648		H102	3					
H103	WRENCH: Allen set screw type; 0.050" wd. across flats; long arm 1-27/32" lg.; short arm 21/32" lg.; steel; right angle type; for no. 4 Allen set screw			41-W-2444	Allen Mfg #4		H103	1					
H104	WRENCH: Allen set screw type; 1/16" wd. across flats; long arm 1-27/32" lg., short arm 21/32" lg.; steel; right angle type; for no. 6 Allen set screw			41-W-2445	Allen Mfg #6		H104	1					

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TABLE 8—5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	EQUIP. BOX	EQUIP. QUAN.	STOCK BOX	STOCK QUAN.
H105	WRENCH: Allen set screw type; 5/32" wd. across flats; long arm 2-3/32" lg., short arm ¾" lg.; steel; right angle type; for no. 10 Allen set screw			41-W-2449	Allen Mfg #10		H105	1					
I101	DIAL: panel type vernier; c/o black bakelite knurled knob, main dial and vernier dial black face w/ white engraved numerals and divisions visible through glass window, dial light holder and lamp type GE #44, ins. shaft coupling and bkt.; metal, black finish; main dial calibrated from 0 to 100 in 10 divisions over 360 deg. range, vernier calibrated from 0 to 10 in 100 divisions over 360 deg. range, direct drive, ratio of main dial to vernier 1:10; round; 3¾" lg. x 4⅝" diam. o/a flex. coupling accommodates ¼" OD shaft; three 3/16" diam. holes spaced 120 deg. apart on 2-5/16" mtg. rad.; comes w/dial light			16-D-46587-5243	Du Mont 15C-12268		I101	1					
I102	LAMP, incandescent: miniature bayonet base; G-3½ envelope; 6-8 volts; 0.25 amp.	Scale Illumination		17-L-6302-25	Mazda 51		I102, I103, I104, I105	4					
I103	Same as I102	Scale Illumination											
I104	Same as I102	Scale Illumination											
I105	Same as I102	Scale Illumination											
J101	CONNECTOR, receptacle: one round female cont.; straight type; 1-1/16" lg. x 1" wd. x 1" h. o/a; 50 amp. rating; cyl. die-cast zinc body, silver plated; mica filled bakelite insert; four 0.125" diam. mtg holes on 23/32" x 23/32" mtg. ctrs.; ⅝"-24 NEF-2 thd. coupling; Navy dwg. RE49A167; Sig. C socket SO-239	Ext Trig Input Jack		17-C-73108-5890			J101, J102, J103, J104, J105, J106, J107	7					

J102	Same as J101	+Trig Output Jack											
J103	Same as J101	−Trig Output Jack											
J104	Same as J101	Movable Marker Output Jack											
J105	Same as J101	Vert Direct Input Jack											
J106	Same as J101	Marker Output-Z Input Jack											
J107	Same as J101	Video Input Jack											
J108	CONNECTOR, receptacle: single female banana type cont.; straight type; black bakelite head; ⅝" diam. x 1-9/64" lg. o/a w/ ⅝" wide hex nut; brass body; panel mtd. by 7/16-24 by 7/16" lg. body thd. w/ ⅝" wide hex nut and ¼-32 by 9/16" lg. body stud w/ 2 washers and ⅜" wd. hex nut.	Vert Calib Voltmeter Jack #1		17-C-73109 9101	Standard Elec Time DF-10FJ		J108, J109	2					
J109	Same as J108	Vert Calib Voltmeter Jack #2											
J110	CONNECTOR, receptacle: two flat male cont., unpolished; straight type; 2-5/16" lg. x 1¾" wd. x 1¼" h. o/a; 125/250 v., 10/15 amp.; cyl. metal body; black phenolic insert; two 5/32" diam. mtg. holes spaced 1-15/16" c to c; salt spray test; shielded	AC Input Receptacle		17-C-73448-7320	Hubbell #4891		J110	1					
L101	COIL, RF: one wnd., universal wnd.; unshielded; 10 mh ±5%, 125 ma., 61.26 ohms DC resistance; 790 turns no. 36 AWG SSE wire; 1-1/64" lg. x 1-1/16" diam. o/a excl. term.; steatite form, air core; ½" diam. x 53/64" lg. form; two 5/32" diam. mtg. holes spaced 13/16" c to c; 2 radial solder lug term. on base spaced 180 deg. apart; wax. impr.	Crystal Oscillator Tank Circuit Inductor		16-C-75088-6104	Sickles FW #12947		L101	1	139	3	1		3

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TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
L102	REACTOR: filter choke; 12 hy., 200 ma.; 180 ohms DC resistance; 2500v ins. test; potted; 4¼" lg. x 3-7/32" wd. x 2-15/16" h. less term. and mtg.; four #8-32 thd. x 7/16" lg. mtg. studs spaced 2⅛" x 2⅜" c to c; two #8-32 thd. x ⅜" h. stud term. on por. pillars spaced 9/16" c to c	Filter Choke #1		16-R-29272-6719	Chi Trans #16386		L102, L103	2	140	3	2		6
L103	Same as L102	Filter Choke #2											
L201	COIL, RF: one wnd., universal wnd.; unshielded; 10 μh ±10%; approx. 0.808 ohms DC resistance; 1.774 $\mu\mu$f; 40 turns #34 EDS; ⅜" diam. x ⅝" lg. o/a less term.; 11/16" lg. x ¼" diam. solid bakelite form and core; 2 wire lead mtg. term., one ea. end of coil form	Video 1st Stage Peaking Coil		16-C-73093-3809	Sickles FW #13248		L201, L202, L204	3	141	3	3		9
L202	Same as L201	Video 2nd Stage Peaking Coil											
L203	COIL, RF: 1 wnd.; unshielded; 5.9 μh ±10%, approx. 0.578 ohms DC resistance; 36 turns #34 DSE wire; ⅜" diam. o/a less term. x ⅝" lg.; solid ceramic form and core; coil form ⅝" lg. x 3/16" OD; mts. w/2 wire lead term 1 on ea. end of coil form; 2 wire leads; wax impr.	Video Output Stage Shunt Peaking Coil		16-C-73028-4077	Sickles FW #13249		L203, L205	2	142	3	1		3
L204	Same as L201	Video Output Stage Series Peaking Coil											
L205	Same as L203	Series Peaking Coil											
O101	COUPLING, flexible: tuning shaft coupling; 1-9/32" lg. x 1-9/32"			16-C-92355-5511	Cardwell PL-5210		O101	1					

	wd. x ¾" h. o/a; c/o single ceramic disk, 2 brass hubs and connecting phosphor-bronze springs; hubs for ¼" diam. shafts w/two #6-32 set screws in ea.			5511				
O102	COUPLING, flexible: universal joint; cad. pl. steel; two cyl. hubs universally connected; two hubs 1⅛" lg. x ½" OD; ID of hubs ¼", two 6-32 thd. hole for set screws in ea. hub			17-C-98373-2307	Du Mont 30027981		O102	1
O103	RETAINER, crystal holder: cad. plated phosphor bronze spring 0.03" thk. x 5/16" wd.; 1¾" lg. x 5/16" wd. x 9/32" o/a; secures xtal holder in socket by spring action; one 0.144" diam. mtg. hole in one end	Crystal Unit Clamp		16-R-501081-110	DuMont 64006411		O103	1
P101	CONNECTOR, plug: 2 parallel spring blade type; male cont.; straight type; 1¼" lg. x 1-9/32" diam. o/a excluding cont.; 125 v.; 15 amp.; round black rubber body w/ grip handle; ⅜" in. diam. cable opening	Power Cable Line Plug		17-C-71432-9433	Allied Elec #108		P101	1
P102	CONNECTOR, plug: two "T" slot female cont.; straight type; 1.531" diam. x 1⅜" lg. excluding cable clamp; 10/15 amp., 250/125 v.; cylindrical black composition body w/ steel cap and adj. cable clamp on top; 0.296" to 0.562" diam. cable opening	Power Cable Unit Plug		17-C-71133-4889	Hubbell #7084		P102	1
R101	RESISTOR, fixed: comp.; 1.1 meg. ±5%; ½w; spec. JAN-R-11	+A Gate Grid Resistor	RC20-BF115J	16-R-50983-0431			R101	1
R102	RESISTOR, fixed: comp.; 8200 ohms ±5%, ½w; spec. JAN-R-11	+A Gate Plate Resistor #1	RC20-BF822J	16-R-50236-0431			R102	1
R103	RESISTOR, fixed: comp.; 18,000 ohms ±5%; 2w; spec. JAN-R-11	+A Gate Plate Resistor #2	RC42-BF183J	16-R-50353-940			R103	1
R104	RESISTOR, fixed: comp.; 240,000 ohms ±5%; ½w; spec. JAN-R-11	−A Gate Grid Bias Resistor	RC20-BF244J	16-R-50722-0431			R104	1
R105	RESISTOR, fixed: comp.; 10,000 ohms ±5%; 1w; spec. JAN-R-11	−A Gate Plate Resistor #1	RC30-BF103J	16-R-50281-0751			R105	1
R106	RESISTOR, fixed: comp.; 12,000 ohms ±5%; 1w; spec. JAN-R-11	−A Gate Plate Resistor #2	RC30-BF123J	16-R-50308-0751			R106	1
R107	RESISTOR, fixed: comp.; 15,000 ohms ±5%; 1w; spec. JAN-R-11	A Gate Cathode Resistor	RC30-BF153J	16-R-50335-0751			R107	1

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TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R108	RESISTOR, fixed: comp.; 200,000 ohms ±5%; ½w; spec. JAN-R-11	—A Gate Grid Resistor	RC20-BF204J	16-R-50704-0431			R108	1					
R109	RESISTOR, fixed: comp.; 330,000 ohms ±5%; 1w; spec. JAN-R-11	Delay Sawtooth Grid Resistor	RC30-BF334J	16-R-50758-0751			R109	1					
R110	RESISTOR, fixed: WW, non-inductive; 250,000 ohms ±½%; 1 w, 105 deg. C max. cont. oper. temp.; ½" diam. x 1" lg., ceramic enclosed; two axial wire lead term., both term. protrude from same end of resistor; term. mtd. or thru axial hole mtg.	Delay Sawtooth Constant Current Resistor		16-R-80492-7001	IRC Type SL		R110, R112	2	143	3	2		10
R111	RESISTOR, fixed: WW; 7500 ohms ±5%; 4 w at 155 deg. C max continuous oper temp.; 1¾" lg. x 5/16" diam.; cement coating, RSW; two radial solder lug term w/ wire leads; term mtd.	Delay Sawtooth Triode Plate Resistor		16-R-70719-5541	IRC #1¾A-13C		R111, R116	2	144	3	2		10
R112	Same as R110	1000μ-Sec Integrating Resistor											
R113	RESISTOR, fixed: comp.; 560,000 ohms ±5%; ½w; spec. JAN-R-11	100μ-Sec Integrating Resistor	RC20-BF564J	16-R-50857-0431			R113	1					
R114	RESISTOR, fixed: WW; 10,000 ohms ±5%; 4w at 155 deg. max. oper. temp.; 1¾" lg. x 5/16" diam.; cement coating, RSW; two radial solder lug term w/wire leads attached to them; term. mtd.	Delay Cathode Follower Cathode Resistor		16-R-70740-1126	IRC #1¾A-13-C		R114	1	145	3	1		5
R115	RESISTOR, fixed: comp.; 22,000 ohms ±10%; ½w; spec. JAN-R-11	Pickoff Diode Cathode Decoupling Resistor	RC20-BF223K	16-R-50372-0811			R115, R122	2					

R116	Same as R111	Sweep Helipot Bleeder Resistor											
R117	RESISTOR, variable: WW; 10,000 ohms ±5%; 4w; 3 solder lug term.; case 1-25/32" diam. x 31/32" thk., bakelite w/metal cover, closed; shaft; slotted metal, 1/4" diam. x 1/2" lg.; linear taper; cont. arm; ins., no off position, normal torque; mtg.: 3/8"-32 x 3/8" lg. bushing; stop at 9 o'clock on 17/32" radius	100μ-Sec Slope Adjustment		16-R-91288-5720	Wirt #GCA		R117, R118	2	146	3	2		10
R118	Same as R117	1000μ-Sec Slope Adjustment											
R119	RESISTOR, variable: WW; 20,000 ohms ±5%; 5 w; 3 solder lug term.; enclosed bakelite case 1 3/4" diam. x 2 1/8" lg.; max.; round metal shaft 1/4" diam. x 13/16" lg. FMS; lin. taper; ins. cont. arm; w/o "off" position; normal torque; 3/8-32 thd. x 3/8" lg. mtg. bushing; non-turn device on 17/32" rad. at 12 o'clock; 3600 deg. rotation; linearity tolerance of ±0.1%	Sweep Helipot		16-R-91370-1815	Helipot 20000-A1		R119	1	147	3	1		5
R120	RESISTOR, variable: WW; 5000 ohms ±5%; 4w; encl. bakelite case 1-25/32" diam. x 31/32" thk., w/metal cover; 1/4" diam. x 1/2" lg. slotted metal shaft; linear taper; cont. arm ins., no off position; normal torque; 3/8"-32 thd. x 3/8" lg. mtg. bushing; non-turn device at 9 o'clock pos. in 17/32" radius, 3 solder lug term.	100μ-Sec Zero Adjustment		16-R-91028-1700	Wirt #GCA		R120, R121	2	148	3	2		10
R121	Same as R120	1000μ-Sec Zero Adjustment											
R122	Same as R115	1st Delay Amp Grid Resistor											
R123	RESISTOR, fixed: comp.; 1000 ohms, ±10%; 1/2w; spec. JAN-R-11	1st Delay Amp Cathode Resistor	RC20-BF102K	16-R-49922-0811			R123, R168, R198, R200, R301, R302	6					

The Type T-325B/FPN Transmitter and the Monitor Oscilloscope (OS101) both have circuit symbols in the 100-200, 200-300, and 300-400 series. To avoid confusion references to an oscilloscope circuit symbol should always indicate that it is part of the Monitor Oscilloscope.

TABLE 8—5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R124	RESISTOR, fixed: comp.; 27,000 ohms ±10%; 1w; spec. JAN-R-11	1st Delay Amp Plate Resistor	RC30-BF273K	16-R-50400-0231			R124	1					
R125	RESISTOR, fixed: comp.; 2.2 megs. ±10%; ½w; spec. JAN-R-11	2nd Delay Amp Grid Resistor	RC20-BF225K	16-R-51065-0811			R125, R146, R197, R303	4					
R126	RESISTOR, fixed: comp.; 47,000 ohms ±10%; 1w; spec. JAN-R-11	2nd Delay Amp Plate Resistor #1	RC30-BF473K	16-R-50481-0231			R126, R127, R141, R145	4					
R127	Same as R126	Resistor Amp Plate 2nd Delay #2											
R128	RESISTOR, fixed: comp.; 27,000 ohms ±10%; ½w; spec. JAN-R-11	2nd Delay Amp Grid Damping Resistor	RC20-BF273K	16-R-50399-0811			R128, R151, R152, R161, R165, R169, R177, R199	8					
R129	RESISTOR, fixed: comp.; 22,000 ohms ±5%; ½w; spec. JAN-R-11	R Trig Amp Grid Resistor	RC20-BF223J	16-R-50371-0431			R129	1					
R130	RESISTOR, fixed: comp.; 5600 ohms ±10%; ½w; spec. JAN-R-11	R Trig Amp Cathode Resistor	RC20-BF562K	16-R-50165-0811			R130, R162	2					
R131	RESISTOR, fixed: comp.; 910 ohms ±5%; 1w; spec. JAN-R-11	R Gate Cathode Resistor #1	RC30-BF911J	16-R-49903-0751			R131, R216	2					

R132	RESISTOR, fixed: comp.; 2200 ohms ±5%; 1w; spec. JAN-R-11	R Gate Cathode Resistor #2	RC30-BF222J	16-R-50011-0751			R132, R135, R136	3					
R133	RESISTOR, fixed: comp.; 51,000 ohms ±5%; 2w; spec. JAN-R-11	R Gate Cathode Bleeder #1	RC42-BF513J	16-R-50497-945			R133, R134, R139	3					
R134	Same as R133	R Gate Cathode Bleeder #2											
R135	Same as R132	R Gate Plate Resistor #1											
R136	Same as R132	R Gate Plate Resistor #2											
R137	RESISTOR, fixed: comp.; 68 ohms ±10%; ½w; spec. JAN-R-11	Movable Marker Current Resistor	RC20-BF680K	16-R-49499-0811			R137, R149	2					
R138	RESISTOR, fixed: comp.; 56,000 ohms ±5%; 2w; spec. JAN-R-11	Sweep Triode Plate Resistor #1	RC42-BF563J	16-R-50515-976			R138	1					
R139	Same as R133	Sweep Triode Plate Resistor #2											
R140	RESISTOR, fixed: comp.; 1 meg. ±10%; ½w; spec. JAN-R-11	Sweep Triode Grid Resistor	RC20-BF105K	16-R-50975-0811			R140, R144, R170, R171, R173, R174	6					
R141	Same as R126	Sweep Cathode Follower Cathode Resistor											
R142	RESISTOR, fixed: comp.; 10 megs. ±10%; ½w; spec. JAN-R-11	Sweep Paraphase Coupling Resistor	RC20-BF106K	16-R-51326-0811			R142	1					

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TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R143	RESISTOR, fixed: comp.; 18,000 ohms ±10%; ½w; spec. JAN-R-11	Sweep Paraphase Amp Cathode Resistor	RC20-BF183K	16-R-50354-0811			R143	1					
R144	Same as R140	Sweep Paraphase Amp Grid Resistor											
R145	Same as R126	Sweep Paraphase Amp Plate Resistor											
R146	Same as R125	Crystal Osc Grid Resistor											
R147	RESISTOR, fixed: comp.; 8200 ohms ±10%; ½w; spec. JAN-R-11	Crystal Osc Cathode Resistor	RC20-BF822K	16-R-50237-0811			R147, R222, R223	3					
R148	RESISTOR, fixed: comp.; 56 ohms ±10%; ½w; spec. JAN-R-11	-50μ-Sec Marker Current Resistor	RC20-BF560K	16-R-49463-0811			R148, R153	2					
R149	Same as R137	$+50\mu$-Sec Marker Current Resistor											
R150	RESISTOR, variable: comp.; 25,000 ohms ±20%; 2 w; enclosed bakelite case w/ metal end plate 1-1/16" diam. x 9/16" d.; slotted metal shaft ¼" diam. x ⅞" lg. FMS; linear taper; ins. cont. arm, no "off" position; normal torque; ⅜-32 thd. by ¼" lg. mtg. bushing; non-turn device located on 17/32" rad. at 9 o'clock	5:1 Divider Adjustment		16-R-87752-5385	A-B JU-2532		R150	1					

R151	Same as R128	100μ-Sec Marker Generator Grid Resistor						
R152	Same as R128	50μ-Sec Marker Generator Grid Resistor						
R153	Same as R148	−100μ-Sec Marker Current Resistor						
R154	RESISTOR, fixed: comp.; 33 ohms ±10%; ½w; spec. JAN-R-11	+100μ-Sec Marker Current Resistor	RC20-BF330K	16-R-49364-0811			R154	1
R155	RESISTOR, fixed: comp.; 11,000 ohms ±5%; ½w; spec. JAN-R-11	100μ-Sec Rep Plate Resistor	RC20-BF113J	16-R-50299-431			R155	1
R156	RESISTOR, fixed: comp.; 51,000 ohms ±5%; ½w; spec. JAN-R-11	1000μ-Sec Rep Rate Resistor	RC20-BF513J	16-R-50497-0431			R156	1
R157	RESISTOR, variable: comp.; 250,000 ohms ±10%; 2w; 3 tab. term.; encl. case; 1-1/16" diam. x 9/16" thk. bakelite case w/metal cover; shaft ¼" diam. x ¾" lg. FMS; linear taper; ins.; no off position; normal torque; mtg. bushing ⅜" diam. x 32 thd. x ⅜" lg. w/locating pin at 9 o'clock and at 3 o'clock pos. on 17/32" radius	Repetition Rate Control		16-R-88079-4240	A-B JU-2541		R157	1
R158	RESISTOR, fixed: comp.; 220 ohms ±10%; ½w; spec. JAN-R-11	Trig Divider Gate Current Resistor	RC20-BF221K	16-R-49661-0811			R158	1
R159	RESISTOR, fixed: comp.; 220,000 ohms ±10%; 1w; spec. JAN-R-11	Trig Amp Cathode Bleeder	RC30-BF224K	16-R-50715-0231			R159	1
R160	RESISTOR, fixed: comp.; 100,000 ohms ±10%; ½w; spec. JAN-R-11	Trig Amp Grid Resistor	RC20-BF104K	16-R-50633-0811			R160, R186, R188, R190, R217	5

The Type T-325B/FPN Transmitter and the Monitor Oscilloscope (OS101) both have circuit symbols in the 100-200, 200-300, and 300-400 series. To avoid confusion references to an oscilloscope circuit symbol should always indicate that it is part of the Monitor Oscilloscope.

TABLE 8—5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R161	Same as R128	Trig Amp Cathode Resistor											
R162	Same as R130	Trig Gen. Cathode Resistor											
R163	RESISTOR, fixed: WW; 15,000 ohms ±5%; 10w at 240 deg. C max cont. oper. temp.; 1-27/32" lg. x 15/32" diam.; encl. in ceramic jacket; resistant to humidity; 2 axial solder lug term. 9/16" lg. x 5/32" wd.; strap type mtg. bkt. w/one 1/8" diam. mtg. hole	External Trig Bleeder		16-R-64162-4274	Sprague 10KT-Style B Mtg. Bkt.		R163, R226	2	149	3	2		10
R164	RESISTOR, fixed: comp.; 68,000 ohms ±10%; 2w; spec. JAN-R-11	Trig Gen Cathode Bleeder	RC42-BF683K	16-R-50553-506			R164	1					
R165	Same as R128	Trig Gen Grid Resistor											
R166	RESISTOR, fixed: comp.; 390,000 ohms ±10%; 1/2w; spec. JAN-R-11	Trig Cathode Follower Cathode Bleeder	RC20-BF394K	16-R-50786-0811			R166	1					
R167	RESISTOR, fixed: comp.; 2200 ohms ±10%; 1/2w; spec. JAN-R-11	Trig Cathode Follower Plate Resistor	RC20-BF222K	16-R-50012-0811			R167	1					
R168	Same as R123	Trig Cathode Follower Cathode Resistor #1											

R169	Same as R128	Trig Cathode Follower Cathode Resistor #2											
R170	Same as R140	CRT Hor Defl Plate Decoupling Resistor #1											
R171	Same as R140	CRT Hor Defl Plate Decoupling Resistor #2											
R172	RESISTOR, variable: comp.; 1 meg/ 1 meg ±20%; ½w ea. sect.; 3 solder lug term. ea. sect.; encl. case; 1⅛" diam. x 0.945" thk. plastic body w/metal cover; ¼" diam. x 23/32" FMS lg. rounded metal shaft; linear taper; ins. cont. arm, no off position; normal torque; ⅜"-32 thd. x ⅜" lg. mtg. bushing w/locating pin at 9 o'clock pos. on 17/32" radius	Hor Centering Control		16-R-89228-4729	Chic. Tel. Supply Series 2-35		R172, R175	2	150	3	2		10
R173	Same as R140	Vert Defl Plate Decoupling Resistor #1											
R174	Same as R140	Vert Defl Plate De-Coupling Resistor #2											
R175	Same as R172	Vert Centering Control											
R176	RESISTOR, variable: comp.; 1 meg. ±20%; ½ w; 3 solder lug term.; encl. plastic case w/metal end cover 1⅛" diam. x 0.491" d.; round metal shaft ¼" diam. x ¾" lg. FMS; lin. taper; ins. cont. arm, no "off" position; normal torque; ⅜-32 thd. x ⅜" lg. mtg. bushing; non-turn device located on 17/32" rad. at 9 o'clock	Aux Focus Control		16-R-88341-8685	Chic. Tel. Supply Series 35		R176	1	151	3	1		5

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TABLE 8—5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R177	Same as R128	Video Neg Supply Bleeder Resistor #1											
R178	RESISTOR, fixed: comp.; 560,000 ohms ±10%; 1w; spec. JAN-R-11	HV Neg Bleeder Resistor #1	RC30-BF564K	16-R-50859-0231			R178, R179, R180, R181	4					
R179	Same as R178	HV Neg Bleeder Resistor #2											
R180	Same as R178	HV Neg Bleeder Resistor #3											
R181	Same as R178	HV Neg Bleeder Resistor #4											
R182	RESISTOR, variable: comp.; 500,000 ohms ±10%; ½w; encl. plastic case 1⅛" diam. x 0.491" thk., w/. metal cover; ¼" diam. x 2-5/16" lg. (FMS) rounded metal shaft; linear taper; cont. arm ins., no off position, normal torque; ⅜"-32 thd. x ⅜" lg. mtg. bushing; non-turn device at 9 o'clock pos. on 17/32" radius; 3 solder lug. term.	Focus Control		16-R-88178-7615		FRE-28297-1-2	R182	1					
R183	RESISTOR, fixed: comp.; 820,000 ohms ±10%; 1w; 2 axial wire lead term.; spec. JAN-R-11	HV Neg Bleeder Resistor #5	RC30-BF824K	16-R-50931-231			R183	1					

R184	RESISTOR, variable: comp.; 250,000 ohms ±20%; ½w; linear taper; 3 solder lug term.; encl. case; 1⅛" diam. x 0.491" thk. plastic body w/metal cover; ¼" diam. x ⅞" lg. nylon shaft; ins., cont. arm, no off position; normal torque ⅜"-32 thd. x ⅜" lg. mtg. bushing w/locating pin at 9 o'clock pos. on 17/32" radius	Intensity Control		16-R-88081-1470		FRE-28297-1-1	R184	1	152	3	1		5
R185	RESISTOR, fixed: comp.; 47,000 ohms ±10%; ½w; spec. JAN-R-11	CRT Cathode Filament Decoupling Resistor	RC20-BF473K	16-R-50480-0811			R185	1					
R186	Same as R160	CRT Cathode Filter Resistor											
R187	RESISTOR, fixed: comp.; 470,000 ohms ±10%; ½w; spec. JAN-R-11	CRT Grid Decoupling Resistor	RC20-BF474K	16-R-50822-0811			R187	1					
R188	Same as R160	CRT Grid Filter Resistor											
R189	RESISTOR, fixed: WW; 2500 ohms ±5%; 25w at 250 deg. C max. continuous oper. temp.; 2⅞" lg. x 23/32" diam.; ceramic tube, resistant to humidity; 2 axial solder lug term.; no mtg. provisions	+250 Volts Supply Dropping Resistor		16-R-64120-5241	Sprague 25 KT		R189	1	153	3	1		5
R190	Same as R160	HV Pos Supply Filter Resistor											
R191	RESISTOR, fixed: comp.; 1 meg. ±10%; 1w; spec. JAN-R-11	HV Pos Bleeder Resistor #1	RC30-BF105K	16-R-50976-0231			R191, R192, R193, R194, R195	5					
R192	Same as R191	HV Pos Bleeder Resistor #2											

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TABLE 8—5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R193	Same as R191	HV Pos Bleeder Resistor #3											
R194	Same as R191	HV Pos Bleeder Resistor #4											
R195	Same as R191	HV Pos Bleeder Resistor #5											
R196	RESISTOR, fixed: comp.; 470,000 ohms ±10%; 1w; spec. JAN-R-11	HV Neg Filter Supply Resistor	RC30-BF474K	16-R-50823-0231			R196	1					
R197	Same as R125	HV Pos Current Limiter Resistor											
R198	Same as R123	Delay Sawtooth Damping Resistor											
R199	Same as R128	Sweep Triode Damping Resistor											
R200	Same as R123	Sweep Paraphase Amp Damping Resistor											
R201	RESISTOR, fixed: comp.; 680,000 ohms ±5%; ½w; spec. JAN-R-11	3:1 Video Attenuator Resistor #1	RC20-BF684J	16-R-50893-0431			R201	1					

R202	RESISTOR, fixed: comp.; 910,000 ohms ±5%; ½w; spec. JAN-R-11	10:1 Video Attenuator Resistor #1	RC20-BF914J	16-R-50956-431			R202	1					
R203	RESISTOR, fixed: comp.; 1 megohm ±5%; ½w; spec. JAN-R-11	30:1 Video Attenuator Resistor #1	RC20-BF105J	16-R-50974-431			R203, R204, R209	3					
R204	Same as R203	100:1 Video Attenuator Resistor #1											
R205	RESISTOR, fixed: comp.; 10,000 ohms ±5%; ½w; spec. JAN-R-11	100:1 Video Attenuator Resistor #2	RC20-BF103J	16-R-50281-0431			R205	1					
R206	RESISTOR, fixed: comp.; 33,000 ohms ±5%; ½w; spec. JAN-R-11	30:1 Video Attenuator Resistor #2	RC20-BF333J	16-R-50416-431			R206	1					
R207	RESISTOR, fixed: comp.; 100,000 ohms ±5%; ½w; spec. JAN-R-11	10:1 Video Attenuator Resistor #2	RC20-BF104J	16-R-50632-431			R207	1					
R208	RESISTOR, fixed: comp.; 330,000 ohms ±5%; ½w; spec. JAN-R-11	3:1 Video Attenuator Resistor #2	RC20-BF334J	16-R-50758-0431			R208	1					
R209	Same as R203	1:1 Video Attenuator Resistor											
R210	RESISTOR, fixed: comp.; 91 ohms ±5%; ½w; spec. JAN-R-11	Video 1st Stage Cathode Resistor	RC20-BF910J	16-R-49561-0431			R210	1					
R211	RESISTOR, fixed: comp.; 33,000 ohms ±10%; ½w; spec. JAN-R-11	Video 1st Stage Screen Resistor	RC20-BF333K	16-R-50417-0811			R211	1					
R212	RESISTOR, fixed: comp.; 6800 ohms ±10%; 2w; spec. JAN-R-11	Video 1st Stage Plate Filter Resistor	RC42-BF682K	16-R-50202-0511			R212	1					

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TABLE 8—5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
R213	RESISTOR, fixed: comp.; 910 ohms ±5%; ½w; spec. JAN-R-11	Video 1st Stage Plate Load Resistor	RC20-BF911J	16-R-49903-0431			R213	1					
R214	RESISTOR, fixed: comp.; 220,000 ohms ±10%; ½w; spec. JAN-R-11	Video 2nd Stage Grid Resistor	RC20-BF224K	16-R-50714-0811			R214	1					
R215	RESISTOR, fixed: comp.; 18,000 ohms ±10%; 2w; spec. JAN-R-11	Video 2nd Stage Screen Resistor	RC42-BF183K	16-R-50355-491			R215	1					
R216	Same as R131	Video 2nd Stage Plate Load Resistor											
R217	Same as R160	Video Output Stage Grid Resistor											
R218	RESISTOR, fixed: comp.; 110 ohms ±5%; 2w; spec. JAN-R-11	Video Output Stage Cathode Resistor	RC42-BF111J	16-R-49588-993			R218	1					
R219	RESISTOR, fixed: WW, non-inductive; 600 ohms ±5%; 10 w, 240 deg. C max. cont. oper. temp.; 1-27/32" lg. x 15/32" diam.; ceramic tube; 2 axial wire lead term.; term. mtd.	Video Output Stage Plate Load Resistor #1		16-R-68386-5246	Sprague 10N1T		R219, R220	2	154	3	2		10
R220	Same as R219	Video Output Stage Plate Load Resistor #2											

R221	RESISTOR, fixed: WW; 1500 ohms ±5%; 25w, 225 deg. C max. temp. rise; 2⅞" lg. x 23/32" diam.; encl. in ceramic jacket; two axial solder lug term., one on ea. end of resistor; Koolohm type	Video Amp Supply Dropping Resistor		16-R-64111-9891	Sprague 25 KT		R221	1	155	3	1		5
R222	Same as R147	Series Peaking Damping Resistor											
R223	Same as R147	Video Neg Supply Bleeder Resistor #2											
R224	RESISTOR, fixed: comp.; 3300 ohms ±10%; ½w; spec. JAN-R-11	Video Neg Supply Bleeder Resistor #3	RC20-BF332K	16-R-50066-0811			R224	1					
R225	RESISTOR, fixed: comp.; 47 ohms ±10%; ½w; spec. JAN-R-11	Video 1st Stage Grid Damping Resistor	RC20-BF470K	16-R-49427-0811			R225	1					
R226	Same as R163	Video Supply Filter Surge Protection Resistor											
R301	Same as R123	CRT Grid Decoupling Resistor											
R302	Same as R123	2nd Delay Amp Cathode Resistor											
R303	Same as R125	CRT Cathode Input Load Resistor											
R304	RESISTOR, variable; WW; 1 section, 6 ohms ± 10%; 2 w; linear taper; 0.620" lg. x 1-17/64", diam. excluding term.; mtg. bushing ⅜-32 thd. ⅜" lg.; ¼" diam. shaft, ¾" lg.	Scale Illumination		16-R-89652-3842	Chicago Tel. Supply Corp. Type 252 spec. 483		R304	1					

The Type T-325B/FPN Transmitter and the Monitor Oscilloscope (OS101) both have circuit symbols in the 100-200, 200-300, and 300-400 series. To avoid confusion references to an oscilloscope circuit symbol should always indicate that it is part of the Monitor Oscilloscope.

TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
S101	SWITCH KIT: c/o 7 ceramic wafers, two mtd. on small shaft 2-15/16" lg. o/a x 1/4" diam. bushing 3/8"-32 x 3/8" lg., 5 wafers unassembled, all Oak type DHC; one 1/4" diam. shaft, 10 3/4" lg., flatted two sides, assorted hardware; if wafers assembled by coupling both shafts sw. would be 11 poles, 8 positions, 6 throws, 47 cont., 7 sect., 7 circuits shorting type, 4 circuits non-shorting type, shaft 1/4" diam. x 7/8" lg. FMS, 13-15/16" lg. o/a	Sweep Selector Switch		17-S-91451-1005	Oak Type DHC	FRE-26470-1	S101	1	156	3	1		1*
S102	SWITCH, toggle: SPDT; 1 amp., 250v, 3 amp., 125v; bakelite body; 1-1/16" lg. x 1/2" wd. x 1/2" h. o/a excluding term., bushing and handle; bat type handle 1/2" lg.; locking action; normally closed; solder lug term.; 15/32-32 x 15/32" lg. mtg. bushing	Sweep Delay Switch		17-S-71955-6401	C-H 8282K14	FRE-26469-1	S102	1					
S103	SWITCH, rotary: 3 pole, 3 position, 3 throw, 12 cont., single sect.; unrated; silver pl. brass cont.; ceramic wafer; 1 1/8" lg. x 1 5/8" wd. x 1 7/8" h.; non-shorting cont.; locking action, normally closed; solder lug term.; mtd. by 3/8-32 thd. bushing 3/8" lg. w/rounded shaft 1/4" diam. x 7/8" lg.; 30 deg. between throws	Trigger Selector Switch		17-S-62121-2811	Centralab BHXC7852 XT		S103	1					
S104	SWITCH, rotary: 1 pole, 6 position, 6 throw, 7 cont.; single sect.; unrated; silver pl. brass cont.; ceramic wafer; 1 1/8" lg. x 1 5/8" wd. x 1 7/8" h.; non-shorting cont.; locking action, normally closed; solder lug term.; mtd. by 3/8-32 thd. bushing 3/8" lg., w/rounded shaft 1/4" diam. x 7/8" lg.; one dummy lug, 30 deg. between throws	Marker Selector Switch		17-S-60375-3616	Centralab BHXC7851 XT		S104	1					

S105	SWITCH, toggle: DPST; 250v, 3 amp.; bakelite body; 1-5/32" lg. x 11/16" wd. x 21/32" h.; bat handle ½" lg.; solder lug term.; single hole mtg., bushing 15/32"-32 thd. x 15/32" lg., flush mtg.	Power Switch		17-S-73533-2347	C-H 8360		S105	1					
S106	SWITCH, push: DPST; 3 amp. 250 v., 6 amp. 125 v.; laminated phenolic body; 1¼" lg. x 11/16" wd. x 11/16" h. o/a excluding term., bushing and push button; momentary action, normally off; solder lug term., 15/32-32 thd. x ½" lg. mtg. bushing; push button 13/32" diam. x 9/32" h. in normal position, 5/32" h. when depressed	Safety Switch		17-S-57681-5062	AH & H 81084		S106	1					
S201	SWITCH, rotary: 1 pole, 6 position; single section; silver pl. brass cont.; ceramic wafer; 1⅛" lg. x 1⅝" wd. x 1⅞" h. excluding shaft and bushing; non-shorting type cont.; locking action; solder lug term.; ⅜-32 thd. x ⅜" lg. mtg. bushing, shaft ¼" diam. x ⅞" lg. FMS; shaft extends thru back of switch for ¾"; one dummy lug	Video Attenuator Switch, Vert Direct Input Section		17-S-60375-3536	Centralab BHXC7850 XT		S201	1					
S202	SWITCH, rotary: 2 pole, 6 position; 2 sect.; silver pl. brass cont.; ceramic wafers; 3" lg. x 1⅝" wd. x 1⅞" h.; shorting type cont.; locking action; solder lug term.; ⅜-32 thd. x ⅜" lg. bushing w/round shaft ¼" diam. x 1½" lg. FMS; two dummy lugs, 30 deg. between throws; Dumont Spec DE-1526	Video Attenuator Switch, Attenuator Section		17-S-64603-3776	DuMont 05005651/5-233	FRE-26469-1	S202	1	157	3	1		1
T101	TRANSFORMER, power: fil. and plate type; input 115 v., 60 cps, 1 phase; 8 output wnd.; (1) 6.3 v., 0.6 amp. (2 and 3) 2.5 v., 1.75 amp. (4) 900 v. CT, 0.2 amp., 1300 v., 5 ma. w/ one side common to 900 v. wnd., (5) 5 v., 3 amp. (6) 6.3 v. CT, 10 amp. (7 and 8) 6.3 v., 1.5 amp.; interwinding test voltage is twice rated voltage plus 1000 v.; air cooled, vacuum-varnish impr.; HS metal case; 6⅛" lg. x 5-5/16" wd. x 7-1/16" h. o/a excluding term. and mtg. studs; 22 stud term. on por. pillars ⅜" h. on bottom; four ¼-20 thd. mtg. studs on 4-9/16" x 3-11/16" mtg./c on bottom	Power Transformer		17-T-75666-2261	Du Mont 20003731/20-373		T101	1	158	3	1		3

The Type T-325B/FPN Transmitter and the Monitor Oscilloscope (OS101) both have circuit symbols in the 100-200, 200-300, and 300-400 series. To avoid confusion references to an oscilloscope circuit symbol should always indicate that it is part of the Monitor Oscilloscope.

*Furnished disassembled. The following are supplied: six wafers, one shaft 10¾ inches long, 20 bakelite shock-absorbing washers, ten 13/16 inch spacers, ten 13/16 inch x 5-40 R.H. strut screws, ten #5 lockwashers.

TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
T102	TRANSFORMER, pulse: blocking osc. type; 150-300 cps pulse rate, 1.5 μsec. pulse duration; impedance 2000 ohms min. between term. 1-4; DC resistance, 13.7 ohms term. 1-4 7 ohms term. 5-6, 6.7 ohms term. 7-8; 1500 v. insulation test; HS metal case; 1⅜" lg. x 1⅛" wd. x 1¾" h. o/a excluding term. and mtg. studs; potted w/ #745 Bi wax; 6 wire hook term. on glass insulators 13/32" lg. located 3 on ea. side; two no. 6-32 x 9/16" lg. mtg. studs spaced ¾" c to c; turns ratio 2:1:1	R Gate Transformer		17-T-79567-1301	Chi. Trans. Co. #13485		T102, T105	2	159	3	2		5
T103	TRANSFORMER, pulse: blocking osc type; 100,000 pulse/sec., 1 μsec. duration; 3 wnd.; 1000 ohms imped. ea. wnd.; DC resistance, 4 ohms term. 1 and 4, 4.3 ohms term. 2 and 5, 4.6 ohms term. 3 and 6; 200 v. oper. all wnd.; 400 v. wkg.; HS metal case; 1-53/64" h. x 1⅛" lg. x ⅝" wd. o/a, less studs and terms.; impr. w/Harvel #612C and potted in Biwax #745; 3 solder type wire hook term. ea. side; two #6-32 thd. mtg. studs spaced 7/16" c to c	50μ-Sec BO Transformer		17-T-79735-9501	Chi. Trans. Co. #10111-XX		T103, T104, T106	3	160	3	3		9
T104	Same as T103	100μ-Sec BO Transformer											
T105	Same as T102	Trig Div Gate Transformer											
T106	Same as T103	Trig BO Transformer											

V101	TUBE, electron: RMA #6SN7GT; twin triode; spec. JAN-1-A		JAN-6SN7GT	16-T-56682			V101, V103, V105 to V111	9					
V101A	Part of V101	A Gate Generator											
V101B	Part of V101	A Gate Generator											
V102	TUBE, electron: RMA #6H6; twin diode; spec. JAN-1-A		JAN-6H6	16-T-56346			V102, V104	2					
V102A	Part of V102	Delay Generator Constant Current Diode											
V102B	Part of V102	Pickoff Diode											
V103	Same as V101												
V103A	Part of V103	Delay Sawtooth Diode											
V103B	Part of V103	Delay Cathode Follower											
V104	Same as V102	Delay Sawtooth Discharge Tube											
V105	Same as V101												
V105A	Part of V105	1st Delay Amplifier											
V105B	Part of V105	2nd Delay Amplifier											
V106	Same as V101												
V106A	Part of V106	R Gate Generator											
V106B	Part of V106	R Trigger Amplifier											
V107	Same as V101												
V107A	Part of V107	Sweep Paraphase Amplifier											

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TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
V107B	Part of V107	Sweep Generator											
V108	Same as V101												
V108A	Part of V108	Sweep Cathode Follower											
V108B	Part of V108	Trig Output Cathode Follower											
V109	Same as V101												
V109A	Part of V109	10μ-Sec Marker Generator											
V109B	Part of V109	Crystal Oscillator											
V110	Same as V101												
V110A	Part of V110	50μ-Sec Marker Generator											
V110B	Part of V110	Trig Divider Gate Generator											
V111	Same as V101												
V111A	Part of V111	Trigger Amplifier											
V111B	Part of V111	Trigger Generator											
V112	TUBE, electron: RMA #5U4G; diode rectifier; spec. JAN-1-A	Low Voltage Rectifier	JAN-5U4G	16-T-55464			V112	1					

V113	TUBE, electron: RMA #2X2A; diode rectifier; spec. JAN-1-A	HV Neg Rectifier	JAN-2X2A	16-T-52822			V113, V114	2					
V114	Same as V113	HV Pos Rectifier											
V115	TUBE, electron: RMA #5CP1A; cathode ray; spec. JAN-1-A	Cathode-Ray Tube	JAN-5CP1A	16-T-55132			V115	1					
V116	TUBE, electron: RMA #6AL5; duo diode; spec. JAN-1-A		JAN-6AL5	16-T-56195			V116	1					
V116A	Part of V116	D-c Clamper											
V116B	Part of V116	D-c Clamper											
V201	TUBE, electron: RMA #6AC7; amplifier pentode; spec. JAN-1-A	Video 1st Stage Amplifier	JAN-6AC7	16-T-56138			V201	1					
V202	TUBE, electron: RMA #6AG7; power amplifier pentode; spec. JAN-1-A	Video 2nd Stage Amplifier	JAN-6AG7	16-T-56117			V202	1					
V203	TUBE, electron: RMA #807; beam-power tube; spec. JAN-1-A	Video Output Amplifier	JAN-807	16-T-68070			V203	1					
XI101	LIGHT, panel: miniature bayonet base; lamp not included; brass shell, chromium plated clip mtd.; for right-handed mtg.; 29/32" lg. x 5/8" wd. x 15/16" h. o/a excluding term.; 2 solder lug type term. located on back.	Scale Illumination		17-L-51621-7348	Du Mont No. R-125460		XI101, XI102	2					
XI102	Same as XI101	Scale Illumination											
XI103	LIGHT, panel: miniature bayonet base; lamp not included; brass shell, chromium plated clip mtd.; for left-handed mtg.; 29/32" lg. x 5/8" wd. x 15/16" h. o/a excluding term.; 2 solder lug type term. located on back.	Scale Illumination		17-L-51621-7323	Du Mont No. L-125460		XI103, XI104	2					
XI104	Same as XI103	Scale Illumination											
XV101	SOCKET, tube: 8 cont. octal.; below chassis saddle mtg.; two 0.143" diam. mtg. hole in saddle spaced 1½" c to c; 1⅛" diam. chassis cutout required; round mica filled bakelite body 1¼" diam. x ½" h. w/oval saddle 1-13/16" lg.; phosphor bronze silver pl. cont.	A Gate Generator Socket		16-S-63519-2061	Cinch 51B11936		XV101 to XV112, XV201, XV202	14					

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TABLE 8—5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CONTRACTOR'S DRAWING & PART NO.	ALL SYMBOL DESIGNATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
XV102	Same as XV101	Delay Generator Constant Current Tube and Pick-off Diode Socket											
XV103	Same as XV101	Delay Sawtooth Triode and Cathode Follower Socket											
XV104	Same as XV101	Delay Sawtooth Discharge Tube Socket											
XV105	Same as XV101	1st and 2nd Delay Amplifier Socket											
XV106	Same as XV101	R Trig Amplifier and R Gate Generator Socket											
XV107	Same as XV101	Sweep Generator and Paraphase Amp Socket											
XV108	Same as XV101	Sweep Cathode Follower and Trig Output Cathode Follower Socket											

XV109	Same as XV101	Crystal Oscillator and 10μ-Sec Marker Generator Socket											
XV110	Same as XV101	50μ-Sec Marker Gen and Trig Div Gate Gen Socket											
XV111	Same as XV101	Trig Amp and Trig Gen Socket											
XV112	Same as XV101	Low Voltage Rect Socket											
XV113	SOCKET, tube: 4 small cont.; saddle mtg.; two 5/16" lg. x 1/8" wd. mtg. slots 1½" to 1⅞" c to c; round ceramic body 1¼" diam. x ⅝" thk., less cont.; mtg. feet incl.; 2-5/32" lg. x 1⅜" wd. o/a; silver plated phosphor-bronze cont.; unmarked	HV Neg Rect Socket		16-S-60853-7511	Millen 33004		XV113, XV114	2					
XV114	Same as XV113	HV Pos Rect Socket											
XV115	SOCKET, tube: 14 cont.; diheptal; retainer ring mtg. w/ Cinch No. 8593 ring; 2.093" diam. chassis cutout required; round mica filled phenolic body 2-7/32" diam. x 1⅛" h. o/a; solder coated phosphor bronze contacts; incl. bakelite term. ins. barrier	CRT Socket		16-S-64378-3782	Cinch 9463-14		XV115	1					
XV116	SOCKET, tube: 7 cont., miniature; below chassis wafer mtg.; two 0.098" diam. mtg. holes spaced 1" c to c; oval grade XP laminated phenolic body; 1¼" lg. x 29/32" wd. x 5/64" thk.; brass alloy, solder coated cont.; w/o shield	D-c Clamper Socket		16-S-62601-3075	Cinch 56F12865		XV116	1					
XV201	Same as XV101	Video 1st Stage Amp Socket											
XV202	Same as XV101	Video 2nd Stage Amp Socket											

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TABLE 8–5. COMBINED PARTS AND SPARE PARTS LIST (MONITOR OSCILLOSCOPE OS101) (Cont'd)

PARTS									SPARE PARTS				
										EQUIP.		STOCK	
SYMBOL DESIG.	NAME OF PART AND DESCRIPTION	FUNCTION	JAN AND (AWS) NO.	STANDARD NAVY STOCK NO.	MFR. AND MFR'S. DESIG.	CON-TRACTOR'S DRAW-ING & PART NO.	ALL SYMBOL DESIG-NATIONS INVOLVED	TOTAL NO. PER EQUIP.	ITEM NO.	BOX	QUAN.	BOX	QUAN.
XV203	SOCKET, tube: 5 std. cont.; under chassis saddle mtg.; two 5/32" diam. holes spaced 1½" c to c, in steel mtg. plate; round black bakelite body 1-7/64" diam. x 31/64" h.; cont. springs silver plated phosphor bronze	Video Output Amp Socket		16-S-61717-4621	Amphenol MIP-5M		XV203	1					
XY101	SOCKET, crystal: two 3/16" x 9/64" rectangular cont. for ⅛" diam. pins spaced ¾" c to c; single 5/32" diam. mtg. hole thru ctr. of socket body; oval ceramic body 1¼" lg. x ½" wd. x ⅜" thk. excluding term.; silver pl. phos-bronze cont.	Crystal Socket		16-S-54524-6501	Millen 33002		XY101	1					
Y101	CRYSTAL UNIT, quartz: single plate; 100 kc; 2.5 cyc/mc/°C drift over 0°75°C temp. range; holder c/o 1¾" diam. x 15/16" h. HS nickel plated body w/two 0.125" diam. x ½" lg. pins on bottom spaced ¾" c to c; no adjust; calibrated at 28 deg. C	Crystal		16-C-96176-8321	Valpey XL-100		Y101	1	161	3	1		1

TABLE 8–6. CROSS REFERENCE PARTS LIST

JAN (OR AWS) DESIGNATION	KEY SYMBOL	JAN (OR AWS) DESIGNATION	KEY SYMBOL	JAN (OR AWS) DESIGNATION	KEY SYMBOL	JAN (OR AWS) DESIGNATION	KEY SYMBOL
CC21CJ4040D	C353	CP07FG2	C147	JAN-807	V101	RC20BF106K	R142*
CC21CK010D	C352	CP07FG4	C141	JAN-807	V203*	RC20BF113J	R155*
CM20B100K	C205	CP07FJ11	C143	JAN-991	I2401	RC20BF115J	R101*
CM20B101J	C136*	CP53B1EF105K	C327	MFA-405	R105	RC20BF183K	R143*
CM20B101K	C204	CP53B1EF504K	C305	MFA-505	R101	RC20BF204J	R108*
CM20B151J	C128*	CP54B1EC205K	C178	MFC-105	R108	RC20BF221K	R158*
CM20B201J	C206*	CP54B1EF105K	C186	MR35W001DCKV	M105	RC20BF222K	R167*
CM20B240J	C104*	CP54B1EF205K	C138	MR35W005DCKV	M104	RC20BF223J	R129*
CM20B241J	C102*	CP54B4EF104V	C312	MR35W005DCMA	M110	RC20BF223K	R115
CM20B270J	C338	CP54B5EF104V	C304	MR35W008DCKV	M103	RC20BF224K	R214*
CM20B271J	C306	CP70B1EF106K[1]	C149	MR35W010DCMA	M108	RC20BF225K	R125*
CM20B300J	C332	CP70B1EG156K[2]	C147	MR35W020DCKV	M102	RC20BF244J	R104*
CM20B301J	C134*	CP70B1EG205K[3]	C139	MR35W108SPEC	M109	RC20BF273K	R128*
CM20B391K	C167*	CP70D1ES205K[4]	C135	MR35W154SPEC	M112	RC20BF330K	R154*
CM20B510J	C310	CP70E1EF105V	C2305	MR35W156SPEC	M106	RC20BF332K	R224*
CM20B510J	C105*	CP70E1EG405V	C2302	MR35W300ACVV	M101	RC20BF333J	R206*
CM20B511J	C125*	CP70E1EH106K[5]	C141	NS-5W-0105	E127	RC20BF333K	R211*
CM25B102M	C130*	CP70E1EH504K[6]	C203	NS-5W-0108	E128	RC20BF334J	R208*
CM30B102K	C346	CP70E1EM405K[7]	C143	NS-5W-0205	E110	RC20BF394K	R166*
CM30B122K	C343	CR-18/U	Y301A,	NS-5W-0206	E111	RC20BF470K	R225*
CM30B202J	C133*		B,C,D,E	NS-5W-0208	E112	RC20BF473K	R185*
CM30B222K	C342	FO2D2R00B	F2401	NS-5W-0212	E113	RC20BF474K	R187*
CM30B242J	C101*	FO3G3R00A	F2502	NS-5W-0216	E114	RC20BF513J	R156*
CM30B332K	C335	FO3G8R004	F2501	NS-5W-0308	E115	RC20BF560K	R148*
CM30B751J	C205*	HC-6/U	Y301A,	NS-5W-0312	E126	RC20BF562K	R130*
CM35B103K	C301		B,C,D,B	NS-5W-0316	E116	RC20BF564J	R113*
CM35B622J	C137*	JAN-1N34A	CR2301	NS-5W-0324	E117	RC20BF680K	R137*
CM35B681K	C302	JAN-1N69	CR101	NS-5W-0332	E118	RC20BF684J	R201*
CM35D472K	C2303	JAN-2D21W	V2301	NS-5W-0416	E119	RC20BF822J	R102*
CM35E562J	C113*	JAN-2X2A	V112	NS-5W-0424	E132	RC20BF822K	R147*
CM35E751J	C107*	JAN-2X2A	V113*	NS-5W-0432	E129	RC20BF910J	R210*
CM40B103J	C103*	JAN-2050	V114	NS-5W-0516	E120	RC20BF911J	R213*
CM40B103M	C123*	JAN-4C35	V116	NS-5W-2501	E124	RC20BF914J	R202*
CM45A103M	C137	JAN-4PR60A	V102	NS-5W-4103	E122	RC30BF102K	R330
CM50B243J	C121*	JAN-5CP1A	V115*	NS-5W-4104	E136	RC30BF103J	R105*
CM55B102K	C108	JAN-5R4GY	V118	NS-5W-4203	E123	RC30BF104K	R301
CM55B103K	C106	JAN-5U4G	V112*	NS-5W-4204	E135	RC30BF105K	R191*
CM55B333K	C101	JAN-6AC7	V201*	RA20A1SD502AK	R211	RC30BF121K	R311
CM56B103K	C180	JAN-6AG7	V202*	RA20A2SD101AK	R2502	RC30BF122K	R321
CM60B153K	C111	JAN-6AL5	V116	RA20A2SD103AK	R2503	RC30BF123J	R106*
CM60B512J	C164*	JAN-6H6	V102*	RB12B2R500F	R2304	RC30BF150J	R331
CM80B202J	C200	JAN-6J5	V301	RB30B1R000F	R132	RC30BF153J	R107*
CM80B681J	C160	JAN-6SA7	V303	RB30B5R000F	R129	RC30BF203J	R310
CM85B202J	C118	JAN-6SJ7	V304	RC20BF102K	R123*	RC30BF220J	R303
CM85B752J	C117	JAN-6SN7GT	V101*	RC20BF103J	R205*	RC30BF221K	R2309
CM90B681J	C166	JAN-6SN7W	V119	RC20BF104J	R207*	RC30BF222J	R132*
CM95B512J	C134	JAN-6V6GT/G	V305	RC20BF104K	R160*	RC30BF223K	R324
CP07FA3	C203	JAN-7C23	V104	RC20BF104K	R2401	RC30BF224K	R159*
CP07FA6	C139	JAN-715C	V102	RC20BF105J	R203*	RC30BF224K	R320
CP07FD3	C149	JAN-8020	V108	RC20BF105K	R140*	RC30BF272K	R304

*Refer to Table 8—5. Combined Parts and Spare Parts List, Monitor Oscilloscope OS101

[1]With CP07FD3 brackets.
[2]With CP07FG2 brackets.
[3]With CP07FA6 brackets.
[4]With CP07FM1 brackets.
[5]With CP07FG4 brackets.
[6]With CP07FA3 brackets.
[7]With CP07FJ11 brackets.

TABLE 8–6. CROSS REFERENCE PARTS LIST (Cont'd)

JAN (OR AWS) DESIGNATION	KEY SYMBOL	JAN (OR AWS) DESIGNATION	KEY SYMBOL	STANDARD NAVY STOCK NO.	KEY SYMBOL	STANDARD NAVY STOCK NO.	KEY SYMBOL
RC30BF273K	R124*	RP301SD502KK	R189	16-C-27128-6596	C332	16-C-46371-9907	C106*
RC30BF273K	R339	RW11F100	R200	16-C-27656-2596	C105*	16-C-47297-3175	C305
RC30BF330J	R338	RW11F101	R154	16-C-27656-2596	C310	16-C-47302-6348	C203
RC30BF333K	R332	RW11F120	R146	16-C-28553-1196	C136*	16-C-47327-7500	C129*
RC30BF334J	R109*	RW11F123	R190	16-C-28558-1676	C204	16-C-48817-3883	C327
RC30BF372J	R336	RW11F162	R187	16-C-28975-1596	C128*	16-C-48817-3912	C186
RC30BF471K	R312	RW11F201	R238	16-C-29265-2996	C206*	16-C-48841-9616	C2305
RC30BF472K	R302	RW11F203	R152	16-C-29449-8796	C102*	16-C-49190-4257	C178
RC30BF473K	R126*	RW11F252	R256	16-C-29608-2196	C306	16-C-49197-3897	C138
RC30BF473K	R2112	RW11F253	R219	16-C-29660-8996	C134*	16-C-49200-7175	C139
RC30BF474K	R196*	RW11F8R0	R150	16-C-29903-4076	C167*	16-C-49206-9972	C135
RC30BF512J	R2308	RW13F253	R172	16-C-300496-201	H104	16-C-49207-6436	C144
RC30BF561K	R315	RW14F103	R166	16-C-30188-4996	C125*	16-C-49221-9836	C2401
RC30BF564K	R178*	RW14F161	R162	16-C-302837-594	H101*	16-C-49921-9855	C212*
RC30BF683K	R325	RW14F162	R138	16-C-30534-2726	C160	16-C-49937-5160	C168*
RC30BF824K	R183*	RW14F163	R169	16-C-30535-1851	C166	16-C-49965-9391	C143
RC30BF911J	R131*	RW14F252	R164	16-C-30536-4808	C302	16-C-49966-7980	C145
RC42BF101K	R113	RW14F401	R160	16-C-30663-3284	C205*	16-C-49982-1020	C2302
RC42BF103J	R235	RW15F562	R348	16-C-30663-3343	C107*	16-C-49999-5510	C2501
RC42BF103K	R109	RW16F102	R345	16-C-310501-103	E137	16-C-51858-2158	C149
RC42BF104K	R111	RW34F201	R2501	16-C-31090-4164	C346	16-C-51862-8985	C141
RC42BF105K	R203	SS07A20	S2501	16-C-31091-6667	C108	16-C-52051-2434	C147
RC42BF111J	R218*	ST42F	S2504	16-C-31095-6952	C130*	16-C-53010-6065	C157*
RC42BF113J	R241	ST50P	S2401	16-C-31274-9964	C343	16-C-53204-4080	C124*
RC42BF162J	R205	ST55K	S103	16-C-31797-5484	C133*	16-C-53204-4120	C312
RC42BF183J	R103*	TS101C01	XZ2301	16-C-31800-3926	C200	16-C-53697-7130	C154*
RC42BF183K	R215*	TS102C01	XV2301	16-C-31800-7698	C118	16-C-54400-6368	C158*
RC42BF222K	R213	TS102U02	H2501	16-C-31908-1564	C342	16-C-54460-4496	C304
RC42BF223K	R333	**ARMY-NAVY TYPE**	**KEY SYMBOL**	16-C-31982-2284	C101*	16-C-56768-6526	C198
RC42BF273K	R317			16-C-32250-9764	C335	16-C-56774-8351	C162
RC42BF332J	R229			16-C-32646-6818	C2303	16-C-59469-4001	C322
RC42BF333K	R263	UG-176/U	E147	16-C-32722-1111	C164*	16-C-61222-8981	C176
RC42BF434J	R185	UG-224/U	J3722	16-C-32724-4109	C134	16-C-62339-9901	C323
RC42BF471K	R254			16-C-32826-3143	C113*	16-C-62364-1617	C326
RC42BF472K	R227	**SIGNAL CORPS TYPE NO.**	**KEY SYMBOL**	16-C-32905-4328	C137*	16-C-62794-1562	C107
RC42BF473K	R225			16-C-33198-4192	C117	16-C-63934-8139	C201*
RC42BF474K	R209			16-C-33617-5109	C103*	16-C-65839-7021	C154
RC42BF510J	R127	PL-274	J3621	16-C-33622-5222	C301	16-C-66401-1008	C158
RC42BF513J	R133*			16-C-33623-3640	C180	16-C-66401-1010	C159
RC42BF513J	R177	**STANDARD NAVY STOCK NO.**	**KEY SYMBOL**	16-C-33623-3642	C106	16-C-71819-9925	L118
RC42BF563J	R138*			16-C-33627-8069	C123*	16-C-71953-8785	L124
RC42BF563K	R215			16-C-33628-1232	C137	16-C-72419-7074	L114
RC42BF623J	R347	15-C-12160-485	W102	16-C-34045-9588	C111	16-C-72666-5689	L115
RC42BF682K	R212*	16-C-11987-6201	W3737	16-C-34514-5977	C121*	16-C-72666-6825	L107
RC42BF683K	R164*	16-C-11987-7324	W2103	16-C-34783-4985	C101	16-C-73028-4077	L203*
RC42BF683K	R260	16-C-11987-9655	R3738	16-C-42703-7530	C201	16-C-73093-3809	L201*
RP101SD101KK	R158	16-C-15371-4454	C352	16-C-42761-9014	C177*	16-C-74716-6606	L103
RP101SD152KK	R163	16-C-15563-9967	C353	16-C-43873-7469	C147*	16-C-74723-3648	L301
RP101SD201KK	R161	16-C-17394-6667	C109*	16-C-44281-9036	C139*	16-C-75088-6104	L101*
RP101SD251KK	R157	16-C-17971-1900	C108*	16-C-44281-9295	C161*	16-C-76756-6361	L102
RP101SD252KK	R153	16-C-18228-9846	C116*	16-C-44281-9704	C216*	16-C-76581-2869	Z312A
RP151SD101KK	R165	16-C-18645-1464	C115*	16-C-45801-9559	C166*	16-C-76601-4799	Z311
RP151SD102KK	R258	16-C-19918-9065	C215*	16-C-45801-9959	C163*	16-C-76756-5901	Z312
RP151SD103KK	R171	16-C-26025-8276	C205	16-C-45820-6551	C120	16-C-76762-8969	Z311A
RP151SD502KK	R237	16-C-26917-6396	C104*	16-C-45936-1010	C190	16-C-76778-4996	Z310A
RP251SD103KK	R191	16-C-27075-8796	C338	16-C-46355-5387	C172*	16-C-76778-5217	Z310

*Refer to Table 8—5. Combined Parts and Spare Parts List, Monitor Oscilloscope OS101

TABLE 8—6. CROSS REFERENCE PARTS LIST (Cont'd)

STANDARD NAVY STOCK NO.	KEY SYMBOL	STANDARD NAVY STOCK NO.	KEY SYMBOL	STANDARD NAVY STOCK NO.	KEY SYMBOL	STANDARD NAVY STOCK NO.	KEY SYMBOL
16-C-76899-4763	L120	16-R-50281-0431	R205*	16-R-50931-231	R183*	16-R-90219-8210	R158
16-C-92355-5511	O101*	16-R-50281-0751	R105*	16-R-50956-431	R202*	16-R-90220-3760	R165
16-C-96176-8321	Y101*	16-R-50282-129	R235	16-R-50974-431	R203*	16-R-90301-2728	R161
16-C-96700-1035	Y301C	16-R-50283-529	R109	16-R-50975-0811	R140*	16-R-90333-7758	R157
16-C-96716-7035	Y301D	16-R-50299-431	R155*	16-R-50976-0231	R191*	16-R-90757-5415	R258
16-C-96733-4001	Y301A	16-R-50299-945	R241	16-R-50976-506	R203	16-R-90805-8223	R163
16-C-96750-1035	Y301E	16-R-50308-0751	R106*	16-R-50983-0431	R101*	16-R-90870-9198	R153
16-C-96766-7001	Y301B	16-R-50335-0751	R107*	16-R-51065-0811	R125*	16-R-91028-1700	R120*
16-D-46587-5243	I101*	16-R-50354-0811	R143*	16-R-51326-0811	R142*	16-R-91031-1140	R211
16-D-901161-127	I115	16-R-50355-491	R215	16-R-61175-7995	R150	16-R-91034-3020	R237
16-G-402211-887	O106	16-R-50362-751	R310	16-R-61219-9795	R200	16-R-91036-1501	R189
16-G-900115-133	H102*	16-R-50371-0431	R129*	16-R-61234-7395	R146	16-R-91288-5720	R117*
16-G-900246-319	H108	16-R-50372-0811	R115*	16-R-61499-9195	R154	16-R-91291-4992	R2503
16-N-66976-1008	Z2301	16-R-50373-231	R324	16-R-61499-9715	R199	16-R-91294-7035	R171
16-P-401281-148	C202	16-R-50373-421	R333	16-R-61542-5675	R162	16-R-91295-5101	R191
16-P-403582-267	N2401	16-R-50399-0811	R128*	16-R-61558-8595	R238	16-R-91370-1815	R119*
16-R-29272-6719	L102*	16-R-50400-231	R124*	16-R-61580-9497	R122	16-S-117101-250	N101
16-R-29792-5397	L101	16-R-50400-231	R339	16-R-61630-9275	R160	16-S-34557-8351	H2501
16-R-49318-751	R303	16-R-50400-499	R317	16-R-61777-2995	R345	16-S-54423-5573	XY301
16-R-49363-0751	R338	16-R-50416-431	R206*	16-R-61822-5075	R138	16-S-54524-6501	XY101*
16-R-49364-0811	R154*	16-R-50417-0811	R211*	16-R-61824-1395	R187	16-S-60853-7501	XV112
16-R-49427-0811	R255*	16-R-50418-231	R332	16-R-61866-6875	R164	16-S-60853-7511	XV113*
16-R-49445-103	R127	16-R-50418-457	R263	16-R-61867-1398	R116	16-S-60856-3001	XV108
16-R-49463-0811	R148*	16-R-50480-0811	R185*	16-R-61868-3195	R256	16-S-60904-5953	XV102
16-R-49499-0811	R137*	16-R-50481-231	R126*	16-R-61976-2225	R348	16-S-60992-4241	XV116
16-R-49561-0431	R210*	16-R-50481-231	R2112	16-R-62072-1995	R166	16-S-61703-9551	XV101
16-R-49581-461	R113	16-R-50481-457	R225	16-R-62073-3677	R137	16-S-61717-4621	XV203*
16-R-49588-9973	R218*	16-R-50497-0431	R156*	16-R-62095-4375	R190	16-S-62601-3075	XV116
16-R-49599-231	R311	16-R-50497-945	R133*	16-R-62122-7135	R169	16-S-62603-6700	XV2301
16-R-49661-0811	R158*	16-R-50497-945	R177	16-R-62138-7495	R152	16-S-63462-8178	XV301
16-R-49662-0231	N2309	16-R-50515-976	R138*	16-R-62159-1135	R172	16-S-63515-4156	XZ2301
16-R-49707-499	R217	16-R-50517-475	R215	16-R-62160-2935	R219	16-S-63519-2061	XV101*
16-R-49770-231	R312	16-R-50533-935	R347	16-R-62235-7670	R173	16-S-63524-6510	XV114
16-R-49770-516	R254	16-R-50553-231	R325	16-R-64111-9891	R221*	16-S-64378-3782	XV115*
16-R-49806-231	R315	16-R-50553-506	R164*	16-R-64120-5241	R189*	16-S-89859-2813	E101
16-R-49903-0431	R213	16-R-50553-506	R260	16-R-64162-4274	R163*	16-T-51734-10	CR2301
16-R-49903-0751	R131*	16-R-50632-431	R207*	16-R-651341-104	A101*	16-T-51769	CR101
16-R-49922-0811	R123*	16-R-50633-0811	R160*	16-R-65754-5646	R2501	16-T-52421-50	V2301
16-R-49923-231	R330	16-R-50633-811	R2401	16-R-68386-5246	R219*	16-T-52822	V112
16-R-49941-231	R321	16-R-50634-231	R301	16-R-70719-5541	R111*	16-T-52822	V113*
16-R-49976-126	R205	16-R-50634-501	R111	16-R-70740-1126	R114*	16-T-54047-40	V102
16-R-50011-0751	R132*	16-R-50704-0431	R108*	16-R-77596-1901	R108	16-T-54335	V116
16-R-50012-0811	R167*	16-R-50714-0811	R214*	16-R-77621-3751	R105	16-T-55132	V115*
16-R-50013-461	R213	16-R-50715-231	R159*	16-R-77623-8401	R101	16-T-55444	V118
16-R-50040-231	R304	16-R-50715-231	R320	16-R-78610-4500	R2304	16-T-55464	V112*
16-R-50066-121	R229	16-R-50722-0431	R104*	16-R-80492-7001	R110*	16-T-56117	V202*
16-R-50066-0811	R224*	16-R-50758-0431	R208*	16-R-81917-1001	R132	16-T-56138	V201*
16-R-501081-110	O103*	16-R-50758-0751	R109*	16-R-81926-5139	R129	16-T-56195	V116
16-R-50128-751	R336	16-R-50786-0811	R166*	16-R-87752-5385	R150*	16-T-56346	V102*
16-R-50130-231	R302	16-R-50803-937	R185	16-R-88079-4240	R157*	16-T-56350	V301
16-R-50130-469	R227	16-R-50822-0811	R187*	16-R-88081-1470	R184*	16-T-56611	V303
16-R-50146-751	R2308	16-R-50823-0231	R196*	16-R-88178-7615	R182*	16-T-56665	V304
16-R-50165-0811	R130*	16-R-50823-465	R209	16-R-88341-8685	R176*	16-T-56682	V101*
16-R-50202-0511	R212*	16-R-50857-0431	R113*	16-R-88913-9089	R128	16-T-56684	V119
16-R-50236-0431	R102*	16-R-50859-0231	R178*	16-R-89228-4729	R172*	16-T-56768	V305
16-R-50237-0811	R147*	16-R-50893-0431	R201*	16-R-90217-1973	R2502	16-T-57313	V104

*Refer to Table 8—5. Combined Parts and Spare Parts List, Monitor Oscilloscope OS101

TABLE 8–6. CROSS REFERENCE PARTS LIST (Cont'd)

STANDARD NAVY STOCK NO.	KEY SYMBOL	STANDARD NAVY STOCK NO.	KEY SYMBOL	STANDARD NAVY STOCK NO.	KEY SYMBOL	STANDARD NAVY STOCK NO.	KEY SYMBOL
16-T-67132	V102	17-C-98378-5916	O118	17-I-69236-3511	E129	17-R-76490-1001	K115A
16-T-68070	V101	17-C-98431-2501	O120	17-I-69250-9531	E120	17-R-76490-1010	K118A
16-T-68070	V203*	17-E-28601-1002	TY112	17-I-70057-7101	E130	17-R-76490-1020	K117A
16-T-72050	V114	17-E-28601-1003	TY108	17-I-70059-7251	E131	17-R-76490-1030	K119A
16-T-751482-196	H105	17-E-850271-111	H116	17-I-70118-9526	XV104	17-S-46666-3966	O115
16-T-78020	V108	17-F-1068-150	BL102	17-I-81154-1121	E302	17-S-46681-2674	O116
17-A-250001-120	H117	17-F-14308-200	F2401	17-J-39254-1300	J301	17-S-46723-1936	O122
17-A-27451-1004	E147	17-F-14349-975	F103	17-L-250040-519	I101C	17-S-46742-9571	O121
17-A-85886-8401	TY101	17-F-14349-990	F105	17-L-250116-146	I104C	17-S-46762-5051	O117
17-B-200661-186	O126	17-F-14349-995	F109	17-L-250346-551	I105C	17-S-46780-3601	O123
17-B-21188-6375	BL101	17-F-14350-10	F107	17-L-250666-101	I106C	17-S-500026-551	O108
17-B-21189-3370	B2401	17-F-14350-15	F106	17-L-250863-475	I102C	17-S-500031-801	O107
17-B-50440-1001	TY110	17-F-14350-25	F104	17-L-51621-7323	XI103*	17-S-500092-183	O113
17-B-77587-6241	TB2501	17-F-14350-30	F101	17-L-51621-7348	XI101*	17-S-50984-6148	Z2401
17-B-77637-3411	TB2403	17-F-14350-35	F102	17-L-6302-25	I102*	17-S-53417-3611	S122
17-B-77699-2136	TB2402	17-F-14350-60	F110	17-L-6502	I101A	17-S-56230-9121	S130
17-B-77699-2146	TB2401	17-F-14350-65	F108	17-L-6806-130	I2501	17-S-56382-9291	S126
17-B-795001-103	H118	17-F-16302-100	F101*	17-L-6811	I2401	17-S-57441-4829	S106
17-B-86441-8405	T102A	17-F-16340-25	F2502	17-L-76664-1301	I101B	17-S-57681-5062	S106*
17-C-480710-404	H106	17-F-16340-65	F2501	17-L-76691-9981	II01	17-S-59673-4151	S117
17-C-51462-7764	S101	17-F-74266-9053	XF2401	17-L-76696-8919	XI2401	17-S-59673-4171	S112
17-C-67444-1285	E138	17-F-74267-5075	XF2501	17-L-76719-8001	I104	17-S-59675-1081	S115
17-C-67728-7317	J3722	17-F-74267-5401	E101*	17-L-76737-2481	XI2501	17-S-60264-6846	S3001A
17-C-67731-6722	J3621	17-G-161397-467	H103	17-L-76745-9401	I102	17-S-60264-7121	S3001B
17-C-68722-3539	J110	17-G-431374-236	O2302	17-L-76786-2101	I105	17-S-60375-3536	S201*
17-C-71133-4889	P102*	17-G-43437-715	O2301	17-L-76871-9801	I106	17-S-60375-3616	S104*
17-C-71412-8709	P111	17-G-900152-701	H115	17-M-18252-1015	M111	17-S-60905-2451	S110
17-C-71413-4752	P101	17-G-900208-826	H107	17-M-19170-3151	M109	17-S-61164-5641	S114
17-C-71432-9433	P101*	17-I-47380-8601	E123	17-M-19258-7001	M106	17-S-61361-3531	S111
17-C-73108-5890	J101	17-I-47388-7531	E135	17-M-19403-6651	M110	17-S-62121-2811	S103*
17-C-73108-5890	J101*	17-I-48707-8821	E122	17-M-19461-6691	M108	17-S-64557-9741	S113
17-C-73109-9101	J108*	17-I-48719-7756	E136	17-M-21873-6151	M112	17-S-64603-3776	S202*
17-C-73137-4302	J108	17-I-57414-2596	H101	17-M-32915-2138	M107	17-S-65467-9080	S101
17-C-73287-8089	J2301	17-I-57417-9346	H102	17-M-34277-6656	M2501	17-S-65911-2151	S118
17-C-73448-7320	J110*	17-I-68656-1101	J505	17-M-34284-4031	M101	17-S-66509-7801	S2503
17-C-73571-1064	P2301	17-I-68657-6021	E124	17-M-35767-6251	M105	17-S-66534-2101	S120
17-C-794001-109	O111	17-I-68673-6255	J109	17-M-35878-6476	M104	17-S-66834-3339	S116
17-C-794001-226	O2401	17-I-68673-6300	E125	17-M-35890-3001	M103	17-S-69419-7880	S2501
17-C-800645-101	O110	17-I-68753-5001	E103*	17-M-35935-6251	M102	17-S-71894-12891	S2504
17-C-800970-201	O109	17-I-69156-6271	E127	17-M-54310-2875	B2501	17-S-71955-6401	S102*
17-C-804555-701	O104	17-I-69160-6215	E128	17-M-75007-6676	A101	17-S-72831-1101	S103
17-C-804681-176	O101	17-I-69172-7151	E301	17-M-75199-6776	A102	17-S-73533-2347	S105*
17-C-804720-651	O102	17-I-69173-7115	E110	17-P-61246-7616	P301	17-S-74692-4496	S2401
17-C-804834-101	O103	17-I-69175-7136	E111	17-P-91801-1012	H112	17-S-75018-3401	S104
17-C-81484-9112	K120E	17-I-69178-7156	E112	17-R-64071-1001	K104	17-S-75123-8509	S102
17-C-81489-1521	K122A	17-I-69183-6231	E121	17-R-64205-1001	K121	17-S-91451-1005	S101
17-C-81505-9696	K120A	17-I-69183-7055	E113	17-R-64205-6501	K122	17-T-28252-3591	E2401
17-C-81581-8255	K123B	17-I-69185-7121	E114	17-R-64253-6969	K120	17-T-61095-5901	T2304
17-C-81588-5001	K101A	17-I-69190-3780	E133	17-R-64412-1001	K123	17-T-68855-3001	T108
17-C-81588-5026	K101C	17-I-69210-9531	E115	17-R-65355-7638	K112	17-T-70131-5001	T103
17-C-81602-9326	K101E	17-I-69213-9489	E126	17-R-70539-1101	K115	17-T-70568-8121	T2303
17-C-81603-3001	K122G	17-I-69215-9499	E116	17-R-70539-1191	K119	17-T-72675-8779	T2502
17-C-81625-1001	K123A	17-I-69218-9511	E117	17-R-70539-1201	K118	17-T-72898-3001	T123
17-C-82789-6495	T101A	17-I-69220-9421	E118	17-R-70542-1001	K117	17-T-72918-2863	T111
17-C-98373-2307	O102*	17-I-69231-9558	E119	17-R-70544-6406	K102	17-T-72918-3343	T119
17-C-98378-5073	O105	17-I-69233-9561	E132	17-R-70544-6596	K101	17-T-72918-3671	T117

*Refer to Table 8–5. Combined Parts and Spare Parts List, Monitor Oscilloscope OS101

TABLE 8–6. CROSS REFERENCE PARTS LIST (Cont'd)

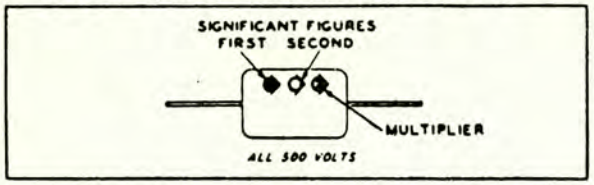
STANDARD NAVY STOCK NO.	KEY SYMBOL	STANDARD NAVY STOCK NO.	KEY SYMBOL	STANDARD NAVY STOCK NO.	KEY SYMBOL	STANDARD NAVY STOCK NO.	KEY SYMBOL
17-T-72918-3697	T112						
17-T-72918-4481	T109						
17-T-72918-4782	T114						
17-T-72918-9101	T104						
17-T-73007-2639	T105						
17-T-73047-1653	T107						
17-T-75666-2261	T101*						
17-T-76443-9101	T118						
17-T-76448-4125	T2505						
17-T-78159-5001	T113						
17-T-78319-3755	T120						
17-T-78319-9101	T116						
17-T-79567-1301	T102*						
17-T-79735-9501	T103*						
17-T-80103-9137	T121						
17-T-81202-5395	Z309						
17-T-81578-5423	Z301						
17-T-81578-7151	Z304						
17-T-81578-7153	Z305						
17-T-81578-7155	Z306						
17-T-81578-7157	Z307						
17-T-81578-7159	Z308						
17-T-81588-8917	Z303						
17-T-81600-8875	Z302						
17-T-82470-5677	Z301A						
17-T-82480-4771	Z304A						
17-T-82480-4773	Z305A						
17-T-82480-4775	Z306A						
17-T-82480-4777	Z307A						
17-T-82480-4779	Z308A						
17-T-82488-5677	Z303A						
17-T-82496-5521	Z302A						
17-T-83746-1001	T102						
17-T-83767-7501	T101						
17-T-83786-5389	T2501						
17-T-84015-5981	L117A						
17-T-84015-5983	L117B						
17-T-84031-1301	L116						
17-T-84131-1401	L119						
18-R-269-3085	O119						
33-W-310-7600	H504						
41-W-2444	H103*						
41-W-2445	H104*						
41-W-2449	H105*						
42-P-12798-1580	H114						
42-P-12798-30	H113						
42-P-12798-530	H111						
42-P-12798-540	H110						
42-P-12798-550	H109						
77-B-117-01015-3000	O124						
77-B-117-01715-3000	O125						

*Refer to Table 8—5. Combined Parts and Spare Parts List, Monitor Oscilloscope OS101

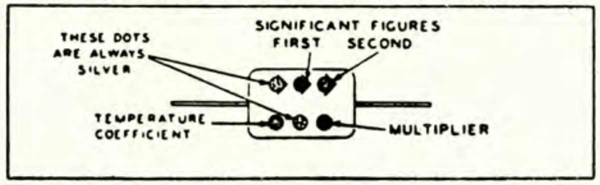
TABLE 8–7. APPLICABLE COLOR CODES AND MISCELLANEOUS DATA

CAPACITOR COLOR CODES

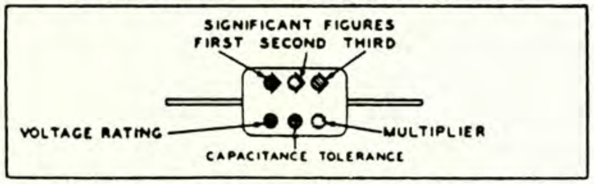
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



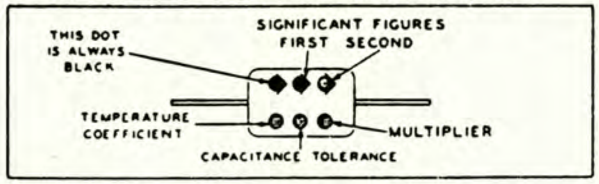
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



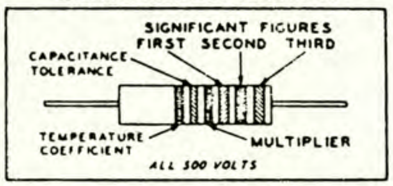
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

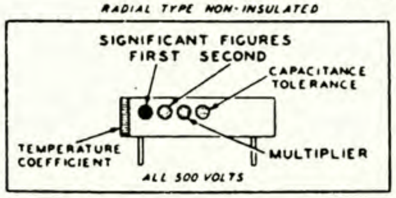


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

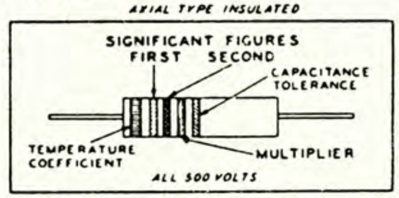


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



AXIAL TYPE INSULATED



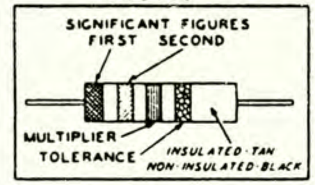
RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

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
	1000	3	ORANGE	1000	1000	1000	300	D
	10000	4	YELLOW	10000			400	E
	100000	5	GREEN	100000			500	F
	1000000	6	BLUE	1000000			600	G
	10000000	7	VIOLET	10000000			700	
	100000000	8	GRAY	100000000		0.01	800	
	1000000000	9	WHITE	1000000000		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	

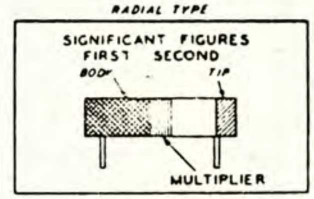
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

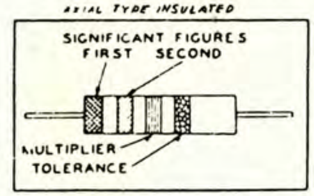


RADIAL TYPE



JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED

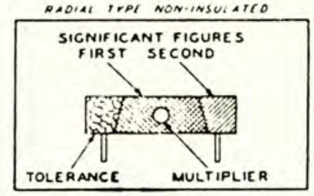


TABLE 8-8. LIST OF MANUFACTURERS

ABBREVIATION	PREFIX	NAME	ADDRESS
A-B	CBZ	Allen-Bradley Co.	118 W. Greenfield Ave. Milwaukee 4, Wis.
Adlake	CWE	Adams & Westlake Co.	Warren and Milar Sts. Elkhart, Ind.
Aerovox	CAW	Aerovox Corp.	742 Belleville Ave. New Bedford, Mass.
Air-Maze	CBEN	Air-Maze Corp.	5200 Harvard Ave. Cleveland, Ohio
AH&H	CHH	The Arrow-Hart & Hageman Electric Co.	Laurel and Peck Sts. Hartford 6, Conn.
Allen Mfg.	CAYT	The Allen Mfg. Co.	133 Sheldon St. Hartford 1, Conn.
Allied Elec.		Allied Electric Products Co.	76 Coit St. Irvington, N. J.
AlSiMag	CAS	American Lava Corp.	219 Kruesi Bldg. Chattanooga, Tenn.
Amphenol	CPH	American Phenolic Corp.	1850 S. 54th Ave. Chicago 50, Ill.
Atlan India Rub		Atlantic India Rubber Works	1455 W. Van Buren St. Chicago 7, Ill.
Billings		The Billings & Spencer Co.	12 Laurel St. Hartford 6, Conn.
Boston Gear	CBH	Boston Gear Works, Inc.	3200 Kerr St. North Quincy 71, Mass.
Brach	CLS	L. S. Brach Mfg. Co.	55 Dickerson St. Newark, N. J.
Bryant Elec.	CYD	Bryant Electric Co.	Barnum Station Bridgeport, Conn.
Bud Rad	CDB	Bud Radio, Inc.	2118 E. 55th St. Cleveland, Ohio
Buss	CFA	Bussman Mfg. Co.	2538 W. University St. St. Louis 7, Mo.
Cardwell	CBK	Allen D. Cardwell Mfg. Corp.	97 Whiting St. Plainville, Conn.
Centralab	CBN	Centralab Div., Globe Union, Inc.	932 E. Keefe Ave. Milwaukee 1, Wis.
C-H	CAE	Cutler-Hammer, Inc.	1333 W. St. Paul Ave. Milwaukee 1, Wis.
Chi Trans	CTR	Chicago Transformer Corp.	3503 W. Addison St. Chicago, Ill.
Cinch	CMG	Cinch Mfg. Corp.	2339 W. Van Buren St. Chicago, Ill.
Clare CP	CRY	C. P. Clare & Co.	4719 Sunnyside Ave. Chicago 30, Ill.

TABLE 8–8. LIST OF MANUFACTURERS (Cont'd)

ABBREVIATION	PREFIX	NAME	ADDRESS
Clarostat	CMC	Clarostat Mfg. Co., Inc.	280 N. 6th St. Brooklyn, N. Y.
Comm-Prod	CPD	Communication Products Co., Inc.	744 Broad St. Newark, N. J.
CTS	CTC	Chicago Telephone Supply Co.	Elkhart, Ind.
Dubilier	CD	Cornell-Dubilier Electric Corp.	1000 Hamilton Blvd. South Plainfield, N. J.
DuMont	CDU	Allen B. DuMont Labs., Inc.	4 Main Ave. Passaic, N. J.
Dunco	CSD	Struthers-Dunn, Inc.	1323 Arch St. Philadelphia 7, Pa.
Dustop		Owens-Corning Fiberglas Corp.	1833 Nicholas Bldg. Toledo 1, Ohio
Erie	CER	Erie Resistor Corp.	640 W. 12th St. Erie, Pa.
Fed Tele & Rad	CFT	Federal Telephone & Radio Corp.	100 Kingsland Road Clifton, N. J.
GE	CG	General Electric Co.	Schenectady 5, N. Y.
Genceraco	CDP	General Ceramics Co.	Keasbey, N. J.
Goodyear Sundries	CGR	Goodyear Sundries & Mechanical Co., Inc.	85 Chambers St. New York, N. Y.
GS Thompson	CBIU	George S. Thompson Corp.	5240 Huntington Drive Los Angeles, Calif.
Hammarlund	CHC	Hammarlund Mfg. Co., Inc.	460 W. 34th St. New York 1, N. Y.
Heinemann	CHN	Heinemann Circuit Breaker Co.	939 Plum St. Trenton, N. J.
Helipot		The Helipot Corp.	1101 Mission St. South Pasadena 2, Cal.
Hubbell	CHU	Harvey Hubbell, Inc.	State and Thomas Sts. Bridgeport, Conn.
Ideal Commtr	CBBQ	Ideal Commutator Dresser Co.	1270 Park Ave. Sycamore, Ill.
Ilg Elec	CATC	Ilg Electric Ventilating Co.	2891 N. Crawford Ave. Chicago 41, Ill.
Inst Res	CATE	Instrument Resistor Co.	30 Amity St. Little Falls, N. J.
IRC	CIR	International Resistance Corp.	1100 Terminal Commerce Bldg Philadelphia 8, Pa.
IPC	CARO	Industrial Products Co.	Danbury, Conn.

TABLE 8–8. LIST OF MANUFACTURERS (Cont'd)

ABBREVIATION	PREFIX	NAME	ADDRESS
Jennings Rad	CAZG	Jennings Radio Mfg. Co.	1098 E. William St. San Jose, Cal.
Johnson EF	CEJ	E. F. Johnson Co.	Waseca, Minn.
Jones H B	CJC	Howard B. Jones	2300 Wabansia Ave. Chicago, Ill.
Kirkland		H. R. Kirkland Co.	810 King St. Morristown, N. J.
Lapp	CBO	Lapp Insulator Co., Inc.	Gilbert and Mills Sts. LeRoy, N. Y.
Littelfuse	CLF	Littelfuse, Inc.	4765 N. Ravenswood Ave. Chicago 40, Ill.
LN Barry	CAYU	L. N. Barry Co.	179 Sidney St. Cambridge 42, Mass.
Millen	CJA	James Millen Mfg. Co.	150 Exchange St. Malden, Mass.
Monitor Cont	CAUS	Monitor Controller Co.	51 S. Gay St. Baltimore 2, Md.
Muter	CAKD	Muter Co.	1255 S. Michigan Ave. Chicago, Ill.
Natl Co	CNA	National Co., Inc.	61 Sherman St. Malden, Mass.
ND	CGM	New Departure Div., G. M. Corp.	Bristol, Conn.
Oak		Oak Mfg. Co.	1200 N. Clybourne Ave. Chicago, Ill.
Propellair		Propellair, Inc.	Lagonda and Sharpe Sts. Springfield, Ohio
Ripley	CBQS	Ripley Co., Inc.	48 Factory St. Middletown, Conn.
Rob & Myers	CAQ	Robbins & Myers, Inc.	Springfield, Ohio
Rotron	CBMX	Rotron Div., Jenckes Knitting Machine Co.	180 Weeden St. Pawtucket, R. I.
R&S	CBR	Russell & Stoll Co.	125 Barclay St. New York 7, N. Y.
Schnitzer		Schnitzer Alloy Products Co.	153 Broadway Elizabeth 1, N. J.
Sickles FW	CFW	The F. W. Sickles Co.	Front St. and River Springfield, Mass.
Sprague	CSF	Sprague Electric Co.	201 Beaver St. North Adams, Mass.
Sq D	CSZ	Square D Co.	6000 Rivard St. Detroit 11, Mich.

TABLE 8–8. LIST OF MANUFACTURERS (Cont'd)

ABBREVIATION	PREFIX	NAME	ADDRESS
Standard Elec Time		Standard Electric Time Co.	85 Logan St. Springfield 2, Mass.
Superior Electric	CABU	Superior Electric Co.	32 Harrison St. Bristol, Conn.
Switchcraft	CMIM	Switchcraft, Inc.	1328 N. Halstead St. Chicago 22, Ill.
Tobe	CTD	Tobe Deutschman Corp.	Washington Ave. Canton, Mass.
Utrad	CRA	Utah Radio Products Co.	Orleans St. and Institute Place Chicago 10, Ill.
Valpey	CAMU	Valpey Crystal Corp.	P. O. Box 321 Holliston, Mass.
WL	CAO	Ward Leonard Electric Co.	6 South St., Mt. Vernon, N. Y.
Wemco	CAY	Westinghouse Electric & Mfg. Co.	East Pittsburgh, Pa.
Weston	CV	Weston Electrical Instrument Co.	619 Frelinghuysen Ave. Newark 5, N. J.
Winchester		Winchester Electronics Co.	Glenbrook, Conn.
Wirt	CWC	Wirt Co.	5222 Greene St. Philadelphia 44, Pa.

INDEX

INSTALLATION INSTRUCTIONS FOR MODIFYING
THE T-137 AND T-325/FPN SERIES LORAN TRANSMITTERS

Before proceeding with this modification read and thoroughly familiarize yourself with these instructions. Approximately six (6) man hours are required to accomplish this modification.

A. The purpose of this modification is to improve the line current metering accuracy and to recess the line current meter for safety purposes.

B. References

T-137	Technical Manual, PPS 7-67/7-68, Figure 7-51
T-137-A	Technical Manual, PPS 7-65/7-66, Figure 7-49
T-325A	Technical Manual, PPS 7-65/7-66, Figure 7-49
T-325A	Technical Manual, PPS 7-61/7-62, Figure 7-43
T-325B	Technical Manual, PPS 7-67/7-68, Figure 7-47
T-325C	Technical Manual, PPS 7-63/7-64, Figure 7-46

Photos and corrected schematic diagram enclosed.

C. Procedure

1. Secure all power to transmitter.

2. Remove upper right side panel and top right cover panel to expose upper right hand area of transmitter.

NOTE:

Safety precautions are to be observed. Thoroughly ground the equipment before proceeding with the following steps.

3. Referring to the appropriate referenced figure, disconnect lines 532, 529, and 146 from "Link-A" (Dummy Load-Like Switch). Discard line 529 (connected between "Link-A" and top of dummy load). Retain all hardware for future use.

4. Reposition the stand off bracket of "Link-A" as follows:

a) Remove bottom and left side screws and loosen upper screw.

b) Rotate entire assembly counter clockwise, pivoting on upper screw, to a new position 90 degrees from its former position.

c) Tighten upper screw to hold bracket in position. (See figure #1).

5. Using the base of the bracket as a template, spot two holes on the rear wall for securing the bracket. Remove the bracket and drill the holes, using caution to prvent damage to the cable on the rear of the panel.

6. Replace the bracket using the hardware removed in step #4-a. Tighten all screws.

7. Remove all connections to, and remove thermocouple TC-101. Remove and discard shunt coil L-124 and its porcelain stand-off insulator. Move metalic standoff to position vacated by porcelain insulator.

8. Connect free end of line #526 (tubing formerly connected to TC-101) to the metalic standoff. (NOTE: The bend in this tubing will have to be carefully straightened before connecting it to the stud). Tighten this ground connection.

9. On S115 (short-unshort switch). Disconnect and discard the lead previously connected to the thermocouple and the ground lead (leads marked "N" on reference figure).

10. Solder 5" lead (supplied) to the lower left hand terminal of S115 (formerly grounded) secure solder lug under the lower mounting screw which secures capacitor C-167 to its stand off insulator.

11. Solder 10" lead (supplied) to lower right hand terminal (formerly tied to TC-101) and secure lug to the common terminal of "Link-A" (See figure #2).

12. As shown in figure #2 affix the thermocouple straphanger (supplied) to the heater terminal of the replacement thermocouple (supplied) and mount the hanger on the common terminal of "Link-A".

13. Connect the free end of lead #532 (tubing connected to C-167) to the opposite heater terminal of the thermocouple. (This tubing may also require careful bending).

14. Using original hardware, reconnect lead #146 to the "line" side of "Link-A".

15. Install the 3-1/2" lead (supplied) from the "Dummy" terminal of "Link-A". Use original hardware.

16. Disconnect thermocouple wiring harness (leads #293-294 and shield) from M-111 (transmission line current meter). Remove wiring harness from transmitter and discard. Remove M-111 from panel.

17. The following steps should be performed carefully to avoid breakage of safety window and insulators during installation of the replacement meter.

The holes in the panel have hardened inserts tapped for 6-32 screws for mounting the meter. Mount the safety window (supplied) to the outside of the panel with three 6-32 X 3/4" binder head screws supplied. (Caution, do not overtighten as the 1/8" plexiglass window will easily crack).

From the rear of the panel, thread the three stand-off insulators (supplied) over the projecting studs of the 6-32 X 3/4" binder head screws. Use the fiber washers (supplied) between the insulators and the panel.

Carefully tighten the stand-offs from the rear using a screwdriver on the binder heads to prevent the screw from turning.

Mount the replacement meter, (supplied), flange forward, on the stand-offs using the small metal pillars between the meter flange and the insulators. NOTE: the small end of the pillar should butt against the meter flange.

18. Re-install the original meter shunt (C-174) on the new meter (See figure #3).

19. Connect thermocouple wiring harness (supplied) between the meter and TC-101, observing the correct polarities and color coding (connect + on TC-101 to + on M-111 & - on TC-101 to - on M-111.

NOTE: Insure that the braid is clear of all surrounding objects as it is at transmission line potential.

20. Check with modified schematic, figure #4 to insure that all steps have been completed correctly.

21. Be sure that <u>all</u> metal drill chips are removed.

22. Replace and secure transmitter panels.

23. This modification is now complete.

D. Comments:

1. Under normal operation it is recommended that meter shorting switch (S-115) remain closed to increase life of thermocouple and prevent off-air time in the event of a thermocouple burn out.

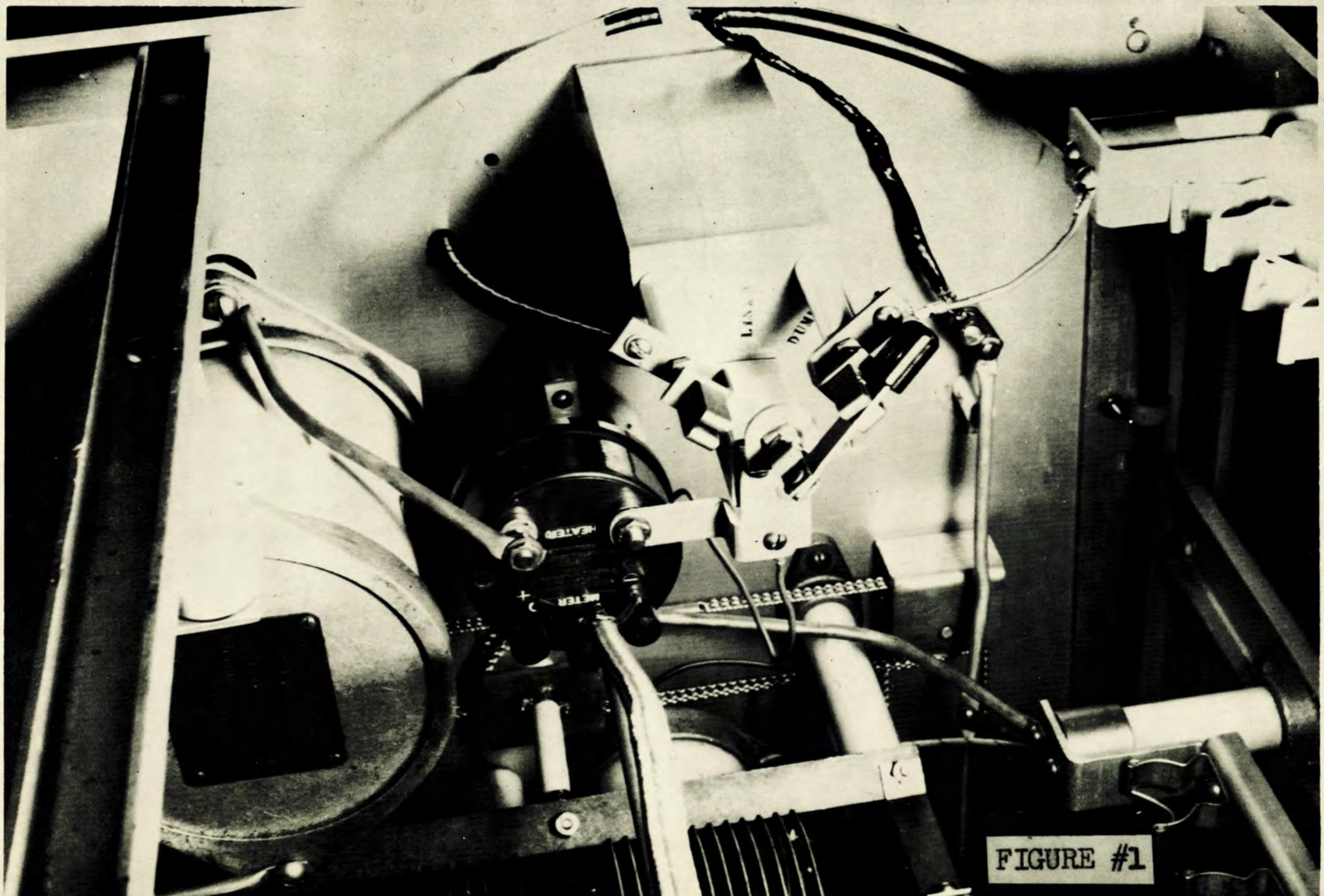


FIGURE #1

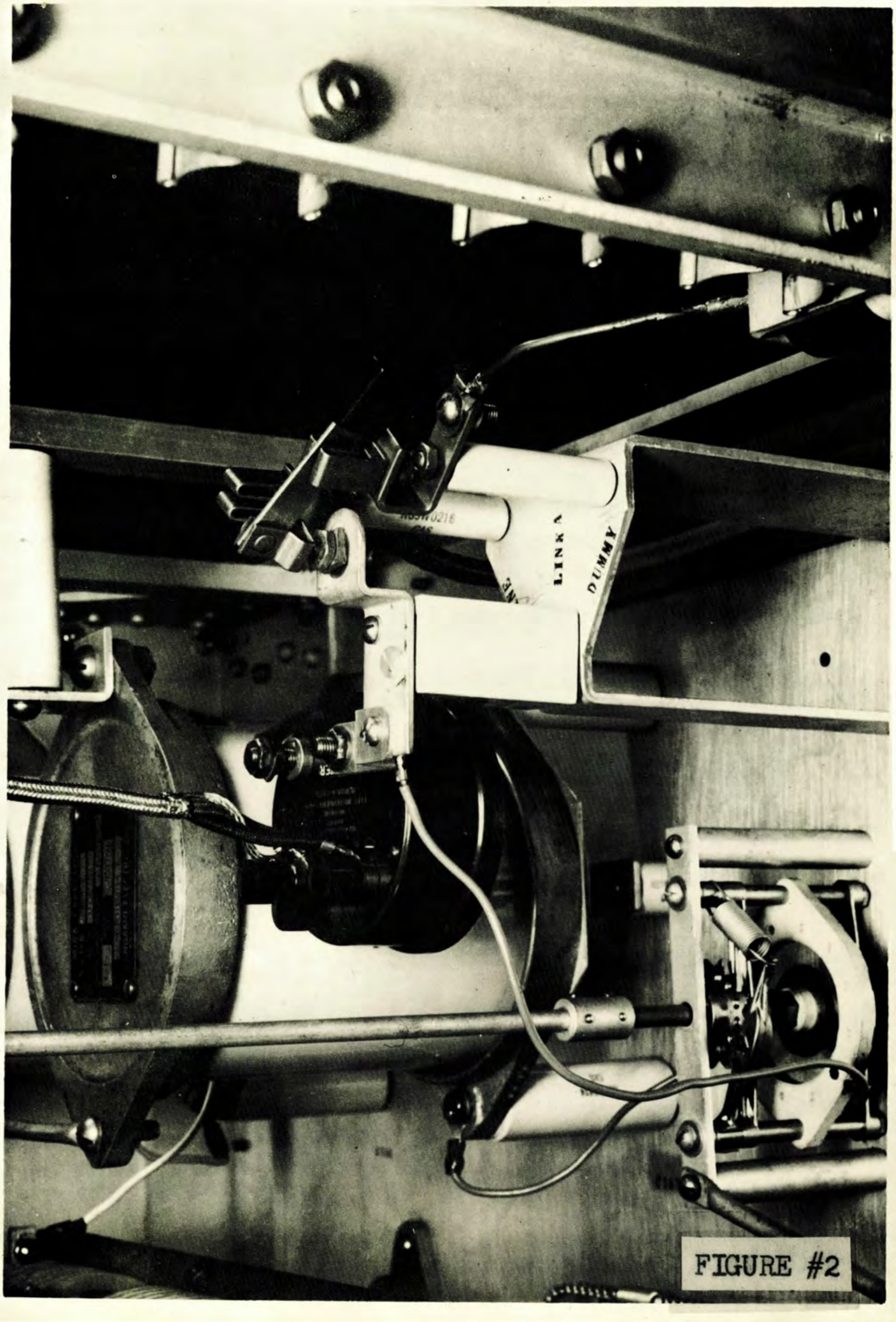


FIGURE #2

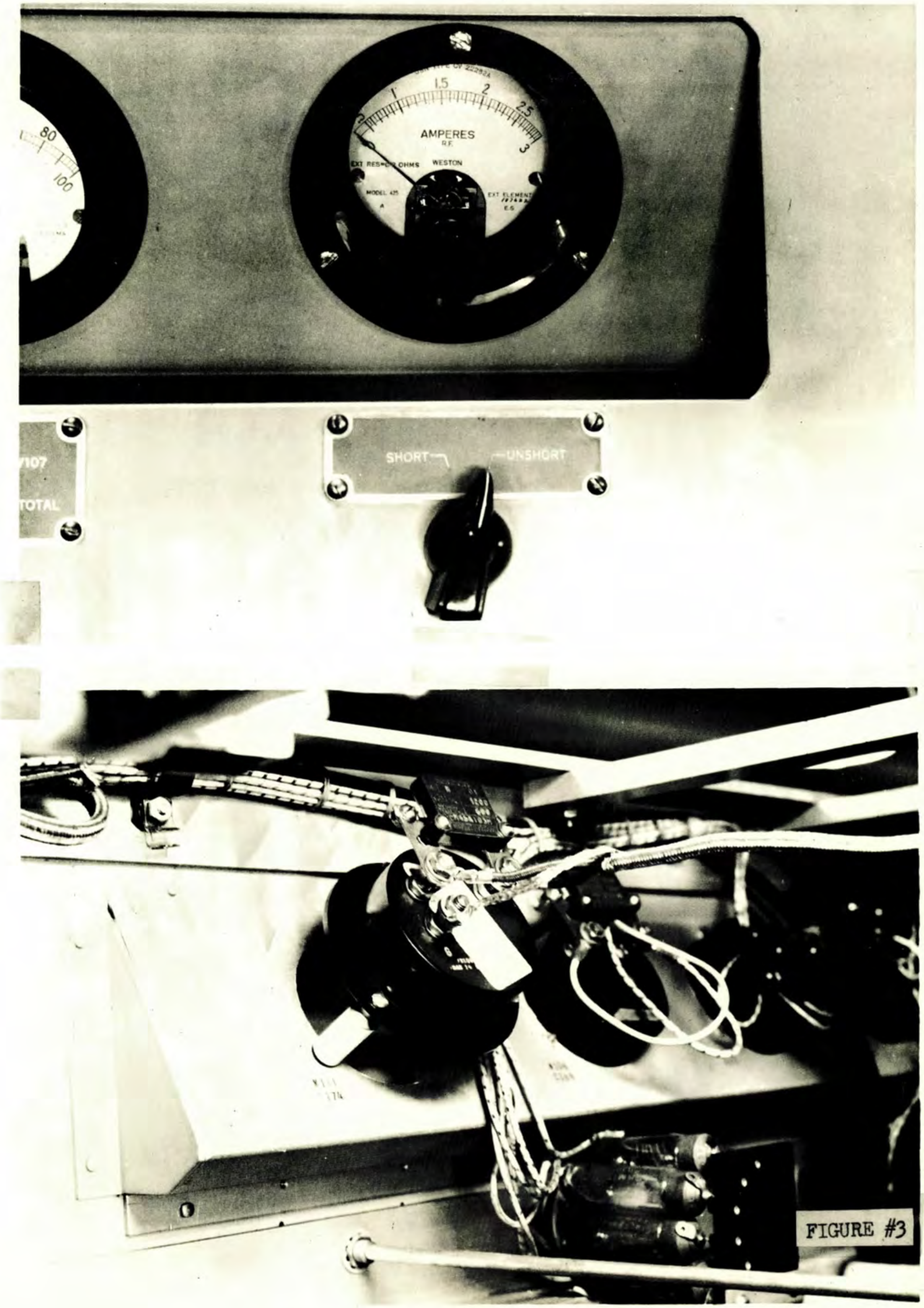


FIGURE #3

T-137, T-325A/FPN LORAN TRANSMITTERS
SCHEMATIC DIAGRAM SHOWING RELOCATED
THERMOCOUPLE TC-101

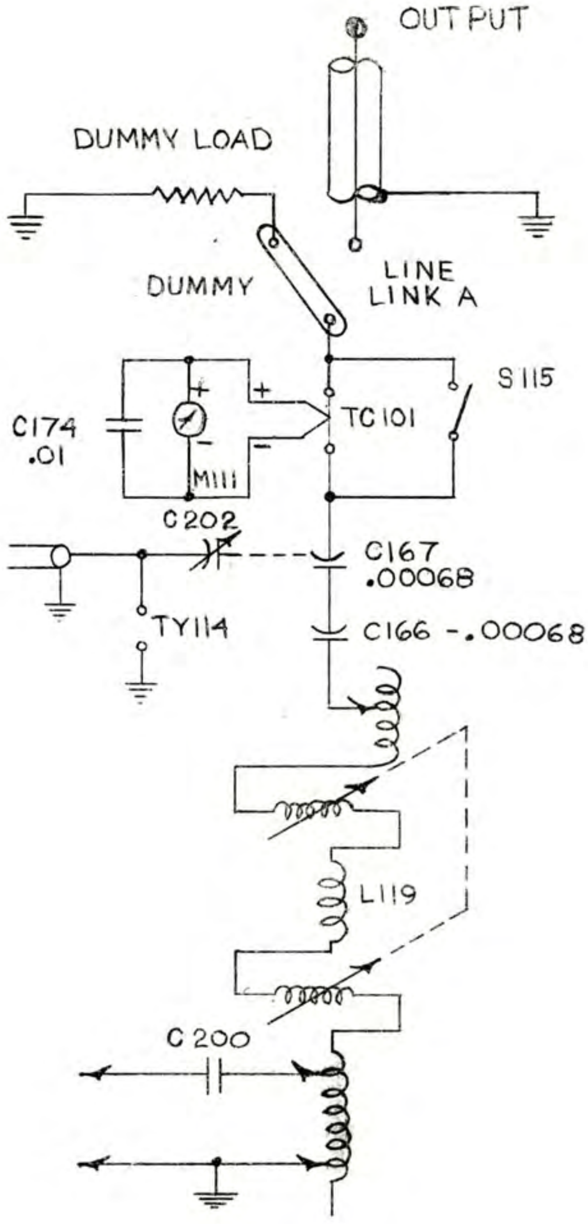


FIGURE # 4

MATERIAL SUPPLIED FOR COMPLETION OF THERMOCOUPLE - AMMETER MODIFICATION OF T-137, T-325 SERIES LORAN TRANSMITTERS.

1. Ammeter (M-111) Weston type 308 (standard scale) 0-3 amps RF, 3-1/2" round flush mounting, supplied with:

   a) round type external thermocouple
   b) thermocouple wiring harness c/w lugs
   .... 1 SET.

2. Thermocouple strap hanger, fabricated locally .... 1 EA.

3. Plexiglass safety window, fabricated locally ..... 1 EA.

4. Insulator, standoff, Birnbach Cat. #450 .... 3 EA.

5. Lead Wire, #10 stranded, white thermoplastic insulated, 3-1/2" in length c/w solder lugs .... 1 EA.

6. Lead Wire, #10 stranded, white thermoplastic insulated, 10" in length c/w solder lug .... 1 EA.

7. Lead Wire, #10 stranded, white thermoplastic insulated, 5" in length c/w solder lug .... 1 EA.

8. screw, L-32x5/8 binder head, chrome pltd brass .... 3 EA.

9. Screw, 6-32x5/8 binder head, chrome pltd brass .... 3 EA.

10. Washer, Fiber #6 .... 3 EA.

11. Snap Hole Plug, 1/4", H. H. Smith Cat# 650 .... 1 EA.

STOCK NUMBER INFORMATION

MODIFICATION KIT	FSN CG5825-L70-1614
AMMETER & SHUNT AS SUPPLIED ITEM #1	FSN CG6625-L01-6000
STANDOFF INSULATOR AS SUPPLIED ITEM #4	FSN CG5970-L01-6001