TM 11-261/TO 16-35CV31-15

This manual supersedes so much of TM 11-278, 23 October 1946, including C 1, 12 November 1947; C 2, 14 April 1948; and C 3, 17 February 1949; as pertains to Dual Diversity Converters CV-31/TRA-7 and CV-31A/TRA-7

DUAL DIVERSITY CONVERTERS

CV-31/TRA-7, CV-31A/TRA-7 CV-31B/TRA-7, CV-31C/TRA-7 AND CV-31D/TRA-7

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DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *11 June 1952*

TM 11-261/TO 16-35CV31-15 is published for the information and guidance of all concerned.

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For explanation of distribution formula, see SR 310-90-1.

CONTENTS

SAFETY NOTICE

Voltages as high as 675 volts are used in the operation of this equipment. These voltages are dangerous to life. *Do not* change tubes or make adjustments inside the set with the AC SUPPLY switch ON. A few service checks must be made inside the set with the high voltage on. When making these checks, always have present another person capable of rendering aid. Keep one hand in your pocket while making high-voltage measurements. This precaution will prevent touching the electrical circuit with more than one part of the body at one time.

First Aid for Electric Shock

RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire. Use extreme caution to avoid the resulting electric flash.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a medical officer, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only,* remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. If the method of transportation prohibits the use of the Shaeffer prone pressure method, other methods of resuscitation may be used. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing.

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such manner that:

(*1*) the operator's arms and thighs will be vertical while applying pressure on the small of the victim's back;

(*2*) the operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib;

(*3*) the heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim;

(*4*) the operator's elbows are straight and locked.

f. The resuscitation procedure is as follows:

(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*2*) Swing back, suddenly releasing pressure, and sit up on the heels.

(*3*) After 2 seconds rest, swing forward again, positioning the hands exactly as before, and apply pressure for another second.

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2-second rest makes a total of 4

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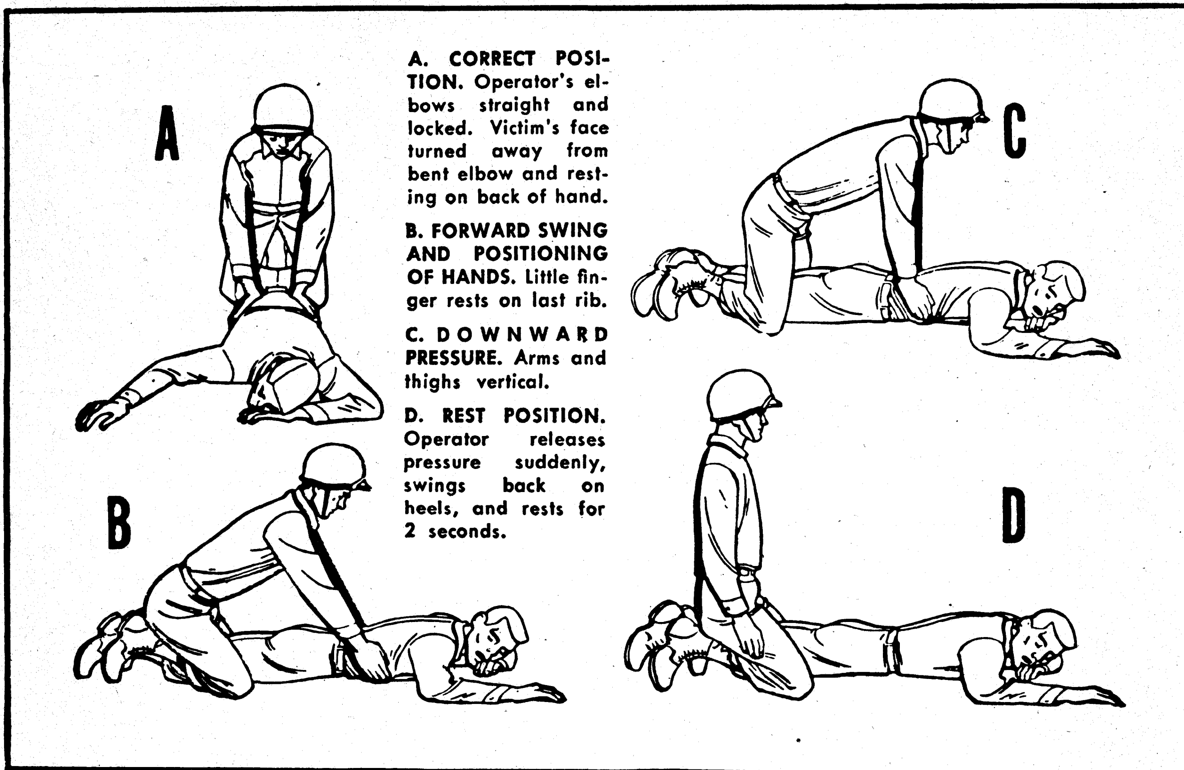

A. CORRECT POSITION. Operator's elbows straight and locked. Victim's face turned away from bent elbow and resting on back of hand.

B. FORWARD SWING AND POSITIONING OF HANDS. Little finger rests on last rib.

C. DOWNWARD PRESSURE. Arms and thighs vertical.

D. REST POSITION. Operator releases pressure suddenly, swings back on heels, and rests for 2 seconds.

seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

h. Artificial respiration should be continued until the victim regains normal breathing or is pronounced dead by a medical officer. Since it may be necessary to continue resuscitation for several hours, relief operators should be used if available.

RELIEVING OPERATOR.

The relief operator kneels beside the operator and follows him through several complete cycles. When the relief operator is sure he has the correct rhythm, he places his hands on the operator's hands without applying pressure. This indicates that he is ready to take over. On the backward swing, the operator moves and the relief operator takes his position. The relieved operator follows through several complete cycles to be sure that the new operator has the correct rhythm. He remains alert to take over instantly if the new operator falters or hesitates on the cycle.

STIMULANTS.

a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then for only 1 or 2 seconds every minute.

b. After the victim has regained consciousness, he may be given hot coffee, hot tea, or a glass of water containing ½ teaspoon of aromatic spirits of ammonia. *Do not give any liquids to an unconscious victim.*

CAUTIONS.

a. After the victim revives, keep him LYING QUIETLY. Any injury a person may have received may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. keep the victim lying flat on his back, with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully as he may suddenly stop breathing. *Never leave a resuscitated person alone until it is CERTAIN that he is fully conscious and breathing normally.*

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Figure 1. Dual Diversity Converter CV–31D/TRA–7, front view.

This manual supersedes so much of TM 11–278; 23 October 1946, including C1, 12 November 1947; C2, 14 April 1948; and C3, 17 February 1949; as pertains to Dual Diversity Converters CV–31/TRA–7 and CV–31A/TRA–7.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains a description of Dual Diversity Converter CV–31(*)/TRA–7 and its operating controls, a chapter on theory of operation, and instructions for field maintenance and repair of the equipment. In addition, this manual contains two appendixes covering a list of references and an identification table of parts.

b. Since the converter unit is normally installed in one of several different systems, installation and operation instructions are omitted from this manual and are included in the technical manuals covering the particular system. Specialized organizational maintenance information, such as techniques for isolating trouble to the particular system unit, are also omitted from this manual and included in the various systems manuals.

c. Official nomenclature followed by (*) is used to indicate all models of the item of equipment discussed in this manual. For example, Dual Diversity Converter CV–31(*)/TRA–7 indicates Dual Diversity Converters CV–31/TRA–7, CV–31A/TRA–7, CV–31B/TRA–7, CV–31C/TRA–7, and CV–31D/TRA–7 (fig. 1). Rectifier Power Unit PP–193(*)/TRA–7 and Oscillator O–41(*)/TRA–7 were not nomenclatured separately when issued with Dual Diversity Converter CV–31/TRA–7, but do have separate nomenclature in the A through D models and, retroactively, in the basic model.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army matériel and equipment.

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army), NAV DEPT SERIAL 85P00 (Navy), and AFR 71–4 (Air Force).

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer as prescribed in SR 700–45–5.

c. USAF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700–45–5 and AFR 65–26.

d. DA AGO Form 11–238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form.

e. DA AGO Form 11–239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form.

f. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATE

3. Purpose and Use

a. Dual Diversity Converter CV–31(*)/TRA–7 is a unit used in conjunction with two radio receivers (designated as Receiver A and Receiver B) at an RTT (radioteletype) terminal. The i-f (intermediate-frequency) output of these receivers is fed to the dual diversity converter unit, which converts it into polar and neutral d-c (direct-current), TT (teletypewriter), or telegraph signals. One of the features of the output circuit is the frequency-drift compensator, which is controlled by the DRIFT COMPENSATOR switch. The compensator circuit tends to minimize the signal bias (waveform distortion) if the received signals drift away from normal.

b. The converter unit has self-contained meters for measuring various currents and voltages throughout the unit. The d-c output circuit in the converter includes amplifiers and controls to produce unbiased TT or telegraph signals for transmission over local loops or extension circuits. Either polar or neutral loop operation is possible. The converter unit also has facilities to permit reversing the polarities of the output mark and space signals, and for establishing test mark and space output signals for adjustment purposes.

4. System Application

a. Dual Diversity Converter CV-31(*)/TRA-7 is a unit of radioteletype equipment housed in either one or three shelters which comprise a medium or high-powered, mobile RTT terminal. Two RTT terminals operating together provide full-duplex, half-duplex, or one-way reversible teletypewriter operation. Emergency FS (frequency-shift) or c-w (continuous-wave) code operation is also possible with this equipment.

b. Figure 2 is a block diagram showing the relationship between the receiving section, the operating section, and the transmitting section located at one radioteletype terminal.

(1) The receiving section consists of two radio receivers and the dual diversity converter. Two antennas, spaced several wavelengths apart, are connected one to each receiver. This system of diversity reception reduces the effects of selective fading which may occur in both at the same time. The output of each receiver is applied to the dual diversity converter, which combines the received frequency-shifted signals and converts the stronger receiver output into d-c neutral and polar signals. The neutral signals operate the printing mechanism of the monitoring teletypewriter in the receiving section (or shelter), and the polar signals are sent to the operating section (or shelter).

(2) The operating section (or shelter) contains the control unit and teletypewriter equipment on which messages are received and transmitted. The control unit receives the polar signals from the dual diversity converter and produces neutral signals which operate the receiving TT printers. The control unit receives neutral signals from the sending contacts of the teletypewriters and produces polar signals which are sent over a line to key frequency-shift

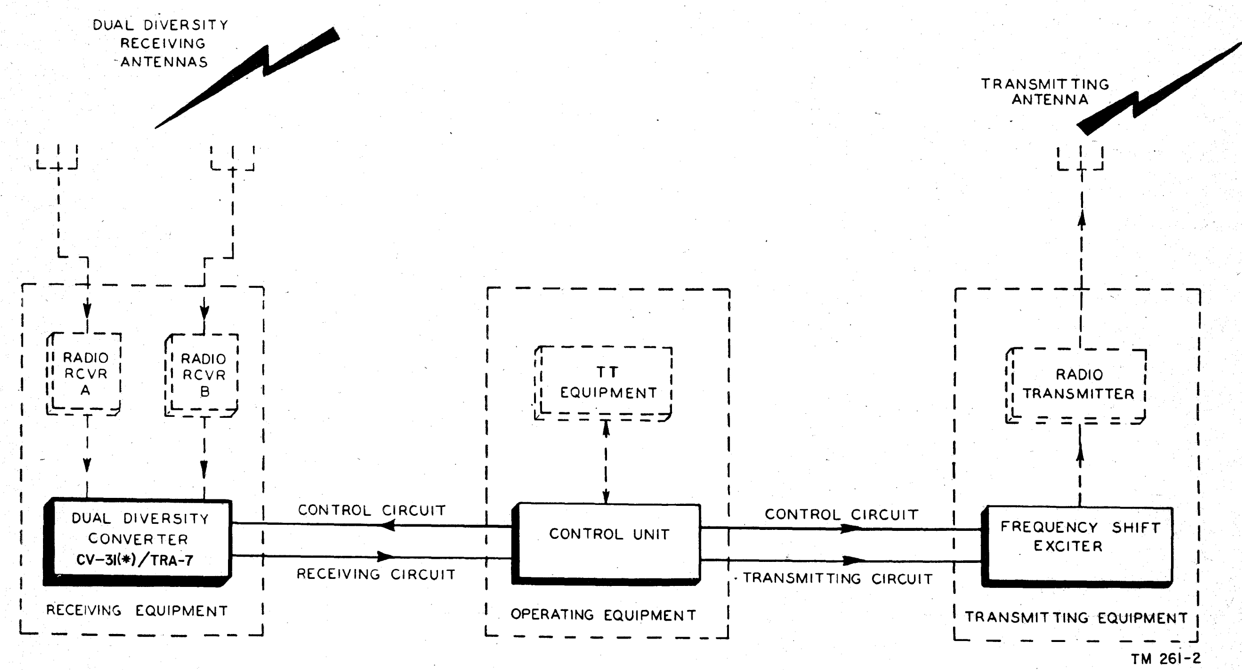


Figure 2. Block diagram of components comprising one terminal of radioteletype equipment.

exciter in the transmitting section or shelter. For one-way reversible operation, where transmission occurs in only one direction at a time, hand-operated key control is provided on the control unit to permit the operator to disable the transmitter while receiving and to disable the receiver when transmitting. The control unit also is designed to provide for emergency hand-keying of the frequency-shift exciter (FS or c-w signals) from the operating shelter.

(3) The transmitting section or shelter contains the frequency-shift exciter and the radio transmitter which it excites and controls. The polar signals from the control unit in the operating shelter are applied to the frequency-shift exciter. The nominal carrier frequency, to which the transmitter is set, is that produced by the marking signal. When a spacing signal is received from the control unit, the exciter signal frequency is lowered sufficiently to reduce the transmitter carrier by 850 cycles. The transmitter signal is radiated from the antenna connected to the transmitting shelter.

5. Technical Characteristics

Input frequency:	
Unlettered, A, B, and early C.	400 to 470 kc (kilocycles).
Late C and D models	440 to 510 kc.
Input impedance	108 ohms (approx).
Required minimum input voltage.	500 uv (microvolts).
Converter intermediate frequencies:	
Channel A frequency	50 kc +425 cycles.
Channel B frequency	29.3 kc +425 cycles.
Pass band:	
Narrow	1,500 cycles.
Wide	3,000 cycles.
Output:	
Neutral	Mark .060 ampere. Space .0 ampere.
Polar	Mark +.025 ampere. Space −.025 ampere.
Number of tubes	18.
Power source required	115-volt, 50 to 60 cps cycles per second).
Power consumption	175 watts.

6. Description of Dual Diversity Converter (fig. 1)

a. The converter unit is assembled on a single chassis and is mounted in a metal cabinet equipped with shock mounts which make it possible for the equipment to withstand vibration during transportation. The converter chassis is assembled in a cradle which is supported in such a way that, for maintenance and adjustment purposes, it can be pulled out approximately 8 inches from the cabinet. The chassis can be completely removed from the cabinet by releasing the stop latches on each side of the converter. The converter front panel has two hinged doors. The upper door is held in place by two Dzus fasteners and the lower door is kept closed by a single knurled lockscrew. When the upper door is opened, the fuses and transformer connections can be reached. The lower door conceals adjustment controls and switches which are used in preparing the unit for operation. All connections to the dual diversity converter are made through connectors located at the rear of the unit.

b. The dual diversity converter unit consists of three chassis—the main chassis which contains most of the circuits; a subchassis (Rectifier Power Unit PP–193(*)/TRA–7) which furnishes all B+, B−, and filament voltages; and another subchassis (Oscillator O–41(*)/TRA–7) which provides an audible means of indicating mark and space signals when required.

7. Differences in Models

a. Dual Diversity Converter CV–31/TRA–7 is 19⅝₂ inches high, 18½ inches deep, 19 inches wide, and weighs 220 pounds. The power unit and the tone oscillator were not nomenclatured individually in this model.

b. Dual Diversity Converter CV–31A/TRA–7 is 25¼ inches high, 20⅝ inches deep, and 22 inches long (mounted in cabinet). This model includes a disabling switch (S106) actuated by a cam on the MARK HOLD LEVEL adjustment which, when required, serves to make the mark-hold circuit inoperative (fig. 21). After serial number 203, Order No. 11779–P–48, of the A model, R118 is 47,000 ohms and dual 1-uf (microfarad) capacitor C131 has been added.

c. Dual Diversity Converter CV–31B/TRA–7, when used in Radio Set AN/GRC–26, is mounted in a special cabinet 20⅞ inches high, 17⁵⁄₁₆ inches deep, and 19¼ inches long, permitting it to fit into a smaller space. No cradle is used with the special cabinet, but the chassis and front panel assembly slides into the cabinet on guard rails and is held in place by eight knurled thumbscrews. The mounting dimensions of several electrical components have been changed and front panel designations are on an etched aluminum plate. For increased flexibility of connection to other equipment, three additional binding posts are added to the rear of the unit. This model includes the modification of limiter amplifiers V107 and V108 (type 6SJ7 tubes) for improved circuit stability. The modification consists of the addition of resistors R214 and R215 between pin 4 (control grid) and ground of both tubes.

d. Dual Diversity Converter CV–31C/TRA–7 has several additional changes.

(1) Disabling switches for each channel have been added to the front panel immediately below the panel meters. These are labeled CHANNEL A DISABLING (S107) and CHANNEL B DISABLING (S108). Late C models are marked DISABLED and OPERATE.

(2) The input transformer and oscillator network tuning capacitors for each channel (capacitors C101, C103, C105, and C106) have been moved from their chassis locations and mounted behind the lower hinged door (compare figures 4 and 5).

(3) Resistor R216 (820 ohms) has been added as part of the bias voltage divider for the grid of tube V104.

e. Dual Diversity Converter CV–31D/TRA–7 has the CHANNEL A and CHANNEL B disabling switches labeled OPERATE and DISABLED (fig. 3). This unit is practically identical to the C model but has been made by another manufacturer.

f. Except for the minor electrical and mechanical differences indicated in *a* through *e* above, there are no important differences in the unlettered through D models of the dual-diversity converter. Certain components in earlier models of equipment have been replaced with JAN components in the later models. The color coding used in wiring the units has been changed as shown in figures 65 through 70.

8. Controls

(figs. 3 through 6)

Haphazard operation or improper setting of the controls can cause damage to electronic equipment. For this reason, it is important to know the function of every control.

a. Front Panel Controls. The following chart lists the front panel controls and indicates their functions.

Controls	Functions
AC SUPPLY switch (S303) and indicator lamp (I301).	The switch connects 115-volt ac from input jack J104 to transformer T302 and PLATE switch S204 in Rectifier Power Unit PP–193 (*)/TRA–7. The lamp lights up a white-face jewel to indicate that power has been applied.
PLATE switch (S304) and indicator lamp (I302).	The switch connects 115-volt ac from AC SUPPLY switch S303 to transformer T301 in Rectifier Power Unit PP–193 (*)/TRA-7. The power unit then supplies plate and bias voltages for tubes in the main chassis and Oscillator O–41(*)/ TRA–7 and the lamp lights up a red-face jewel.
Meter A (M101)	Indicates the output of the discriminator circuit in microamperes for channel A.
OUTPUT switch (S102).	Selects the polarities of the output mark and space signals, and establishes test mark and space output signals for adjustment purposes.
CHANNEL A FINE TUNING control (C102).	Provides for fine adjustment of the bfo (beat frequency oscillator) for channel A. It is adjusted until output of V101 is 50 kc.
CHANNEL B FINE TUNING control (C104).	Provides for fine adjustment of the bfo for channel B. It is adjusted until output of V102 is 29.3 kc.
Meter B (M102)	Indicates the output of various circuits as selected by METER B switch.
METER B switch (S105).	Connects various circuits to meter B. Positions and functions as follows:

Position	*Function*
CHAN B	Indicates the output of the discriminator circuit (in microamperes) for channel B.
CHAN A+B	Indicates the combined output of the two channels.
POLAR	Indicates the polar loop current.
NEUTRAL	Indicates the neutral loop current.
INPUT	Indicates the input voltage applied to the mark-hold circuit.
COMP AMP	Indicates the feedback voltage from the drift compensator circuit.

Controls	Functions
	Position — *Function* Five voltage positions. — Indicate the voltages supplied by Rectifier Power Unit PP-193 (*)/TRA-7. These are the +275-volt supply (+275V), the regulated +150-volt supply (REG +150V), the regulated −150-volt supply (REG −150V), the −150-volt unregulated supply (−150V), and the −400-volt unregulated supply (−400V).
CHANNEL A OPERATE-DISABLED (D model) or CHANNEL A DISABLING (C model) switch (S107).	Disables channel A input so that channel B may be alined separately.
CHANNEL B OPERATE-DISABLED (D model) or CHANNEL B DISABLING (C model) switch (S108).	Disables channel B input so that channel A may be alined separately.
PHONES KEYED TONE jack (J105).	Provides for the connection of a headset for monitoring the keyed tone output of Oscillator O-41 (*)/TRA-7.

b. Controls Behind Panel Door. The following chart lists the controls behind the lower front panel door, and indicates their functions.

Controls	Functions
DRIFT COMPENSATOR switch (S104).	Connects the drift compensator circuit to the output of the channel A and channel B discriminator tubes when switch is in the IN position. Distortion in output TT signals, because of drift of the received signals is thereby minimized.
LIMITER control (R152).	Varies the linited bias of the drift compensator circuit by regulating amount of conduction of V112; effective only when S104 is in IN position.
AMP GAIN control (R207).	Varies the amount of signal fed to drift compensator a-c amplifier tube V104 from discriminator tubes V109 and V110. Effective only when S104 is in IN position.
NEUTRAL OUTPUT control (R182).	Adjusts loop current to a normal value of about 60 ma (milliamperes) when OUTPUT switch S102 is on MARK.
BAND WIDTH switch (S101)	Connects either NARROW (1,500 cycles) or WIDE (3,000 cycles) band-pass filters into output of channels A and B converters. These filters help to exclude noise and interfering frequencies.
MARK HOLD LEVEL control (R109) and OFF switch (S106).	Adjusts the level of the rectified carrier necessary to nullify the carrier-control mark-hold feature while a signal is being received. This control, when rotated to its extreme counterclockwise position in the lettered models operates switch S106. The switch disables the mark-hold circuit and increases the sensitivity of the converter. This condition of higher sensitivity is necessary when making adjustments and it is useful also when receiving weak signals.
POLAR OUTPUT SPACE control (R174).	Adjusts polar loop space current to −25 ma.
POLAR OUTPUT MARK control (R171).	Adjusts polar-loop mark current to +25 ma.
LP FILT switch (S103).	Connects additional capacitors to the filter in the output of the discriminators for low-signaling speeds.

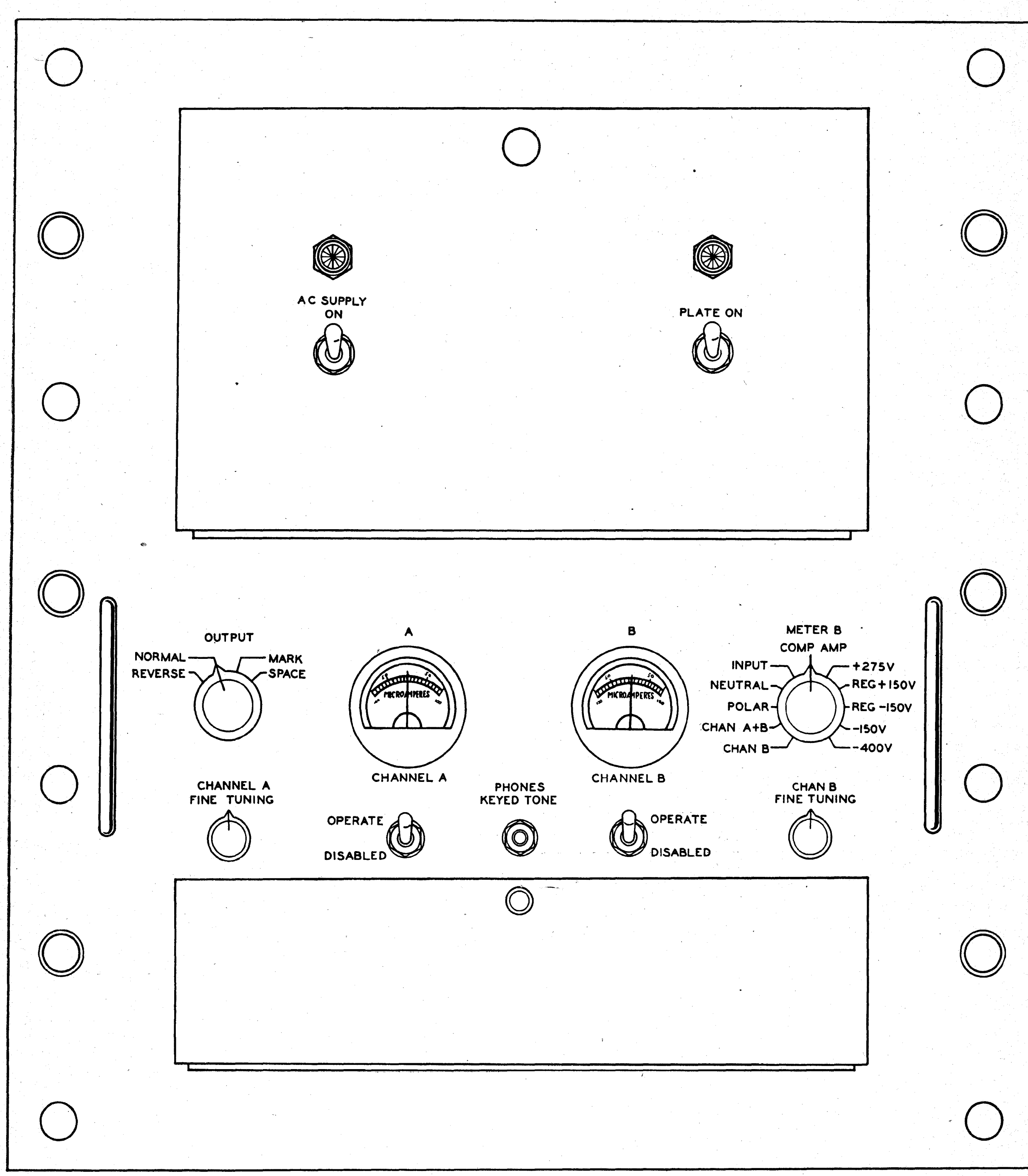


Figure 3. Dual Diversity Converter CV–31D/TRA–7, location of front panel controls, hinged panels closed.

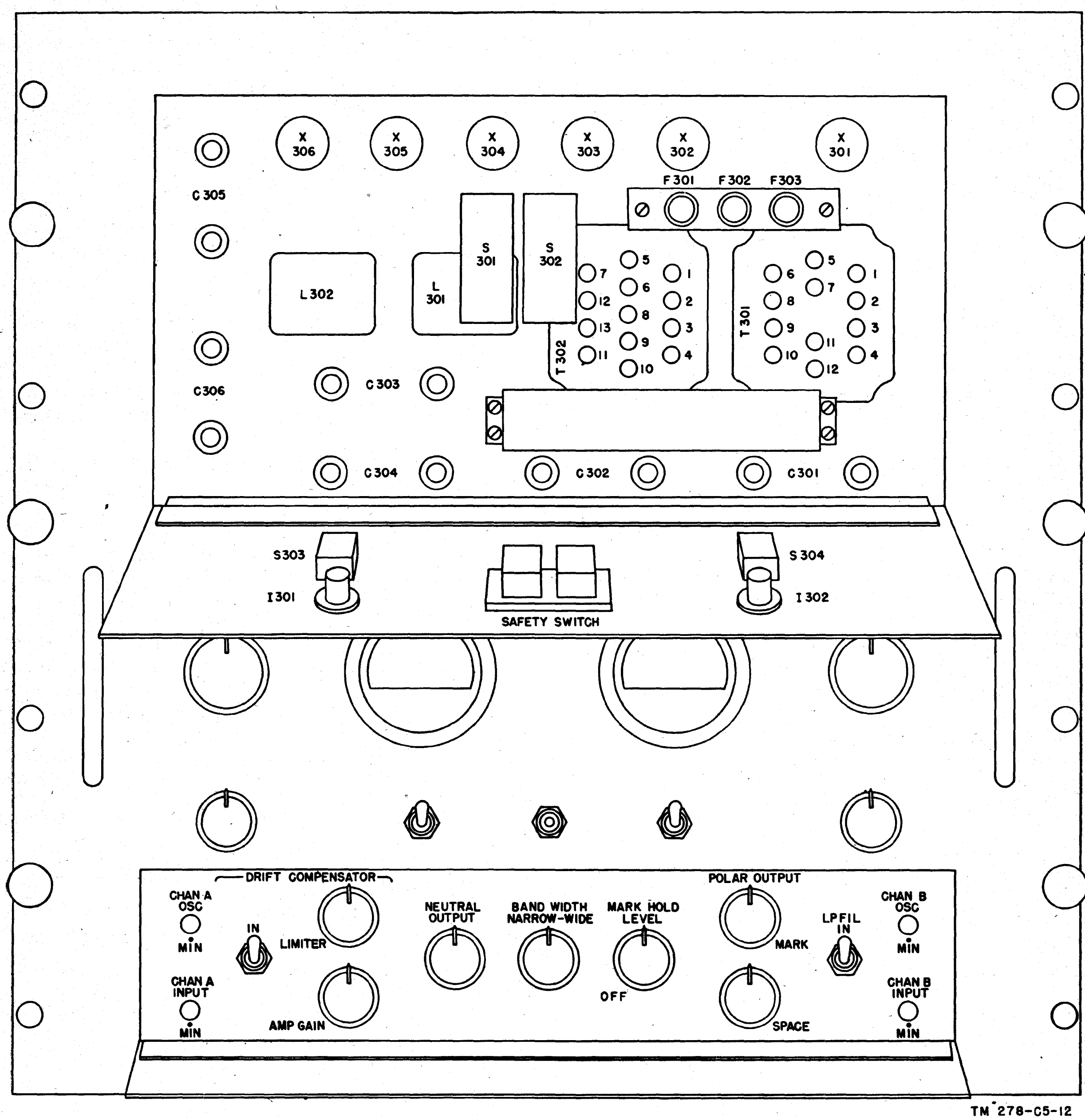


Figure 4. Dual Diversity Converter CV–31C/TRA–7, location of controls under hinged panels.

c. *Chassis-Mounted Screw-Driver Controls.* The following chart lists the screw-driver controls on the top of the converter chassis (fig. 5) and indicates their functions. (The channel A and B input and oscillator tuning capacitors listed are front panel controls in the C and D models (fig. 4).)

Controls	Functions
COMP AMP control (R145).	Adjusts amount of feedback to the drift-compensating circuit.
BIAS A control (R155)	Adjusts grid bias of the V113 driver amplifier tube so that polar output signals have equal positive and negative amplitudes.
BIAS B control (R160)	Adjusts bias of the V114 d-c amplifier tube to give correct drift compensator input and to key tone oscillator.
COMP BAL control (R194)	Adjusts plate voltage of the V114 d-c amplifier to balance mark and space voltage changes for equal swings in the drift compensator circuit. Works in conjunction with COMP AMP control.
Channel A input tuning capacitor (C101) (CHAN A INPUT).	Adjusts input frequency of channel A converter for maximum response to incoming i. f.
Channel B input tuning capacitor (C103) (CHAN B INPUT).	Adjusts input frequency of channel B converter for a maximum response to incoming i. f.
Channel A oscillator tuning capacitor (C105) (CHAN A OSC).	Adjusts oscillator section of channel A converter, to produce a second i. f. of 50 kc. Is a coarse tuning control that works in conjunction with the front panel CHANNEL A FINE TUNING control.
Channel B oscillator tuning capacitor (C106) (CHAN B OSC).	Adjusts oscillator section of channel B converter, to produce a second i. f. of 29.3 kc. Is a coarse tuning control that works in conjunction with the front panel CHANNEL B FINE TUNING control.

d. *Chassis-Mounted Connectors.* The following connectors are located on the rear of the chassis (fig. 6):

Control	Function
Channel A input jack J101.	Connects channel A receiver i-f output to mixer V101 input.
Channel B input jack J102.	Connects channel B receiver i-f output to mixer V102 input.
Signal output jack J103.	Connects converter output (both neutral and polar) to external circuit.
A-c power input jack J104.	Connects 115-volt input power to power supply section.
Power connection jack J106.	Input for operating voltages from converter to the tone oscillator.
External receiver disabling jack J401.	Breaks external receiver disabling line through relay K401 contacts.
Receiver disabling jack J402.	Applies a positive voltage through pin B to the receiver disabling relay circuit.
Receiver disabling jack J403.	Applies a positive voltage through pin B to the receiver disabling relay circuit.
Control circuit input jack J404.	Input for disabling-relay operation and hand keying.
Plug P405	Connects tone oscillator to converter through jack J106.
Fuse F401	Fuses the tone oscillator section.
Binding posts E122, E123, and E124.	Connected to pin B of J103, ground, and pin D of J103 to provide direct wire connections for polar and neutral loops.

e. *Power Supply Fuses and Safety Switches.* Fuses F301 and F302, which fuse the 115-volt, 60-cycles supply to Rectifier Power Unit PP–193 (*)/TRA–7 are behind the top panel door (fig. 4). F303 is a spare fuseholder, and is not wired into any circuits. Safety interlock switches S301 and S302 are so mounted in the upper panel door that the 115-volt, 60-cycle supply voltage is cut out automatically if the door is not securely fastened.

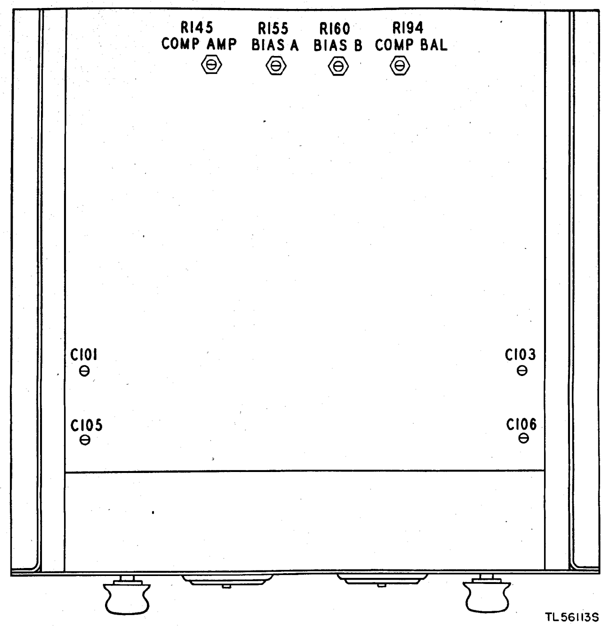


Figure 5. Dual Diversity Converter CV–31/TRA–7, location of screw-driver adjustment controls.

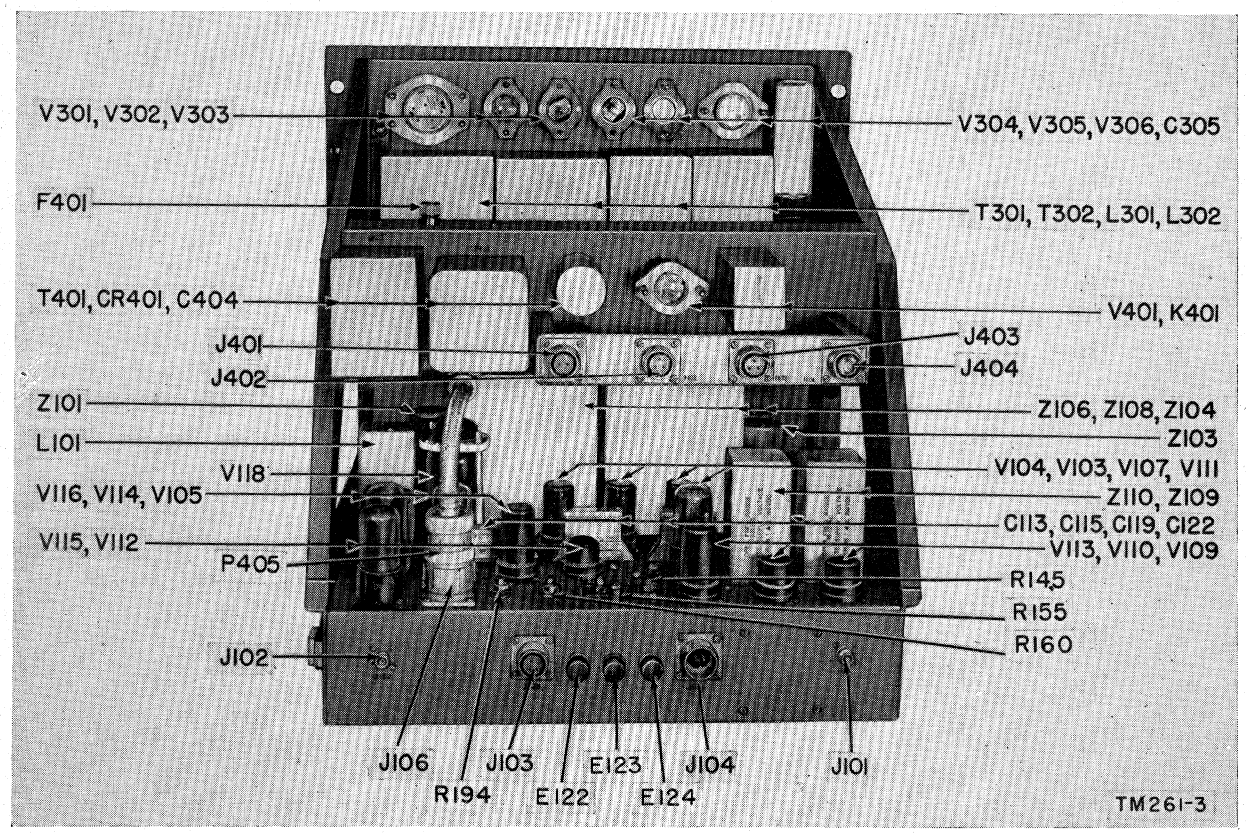


Figure 6. Controls on rear.

CHAPTER 2

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

9. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in such good working order that break-downs and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair, since its object is to prevent certain troubles from occurring.

10. Organizational Tools and Equipment

Tools and materials that should be available at the organizational level are listed in *a* and *b* below. The pertinent tool kit is listed in SIG 6–TE–113.

a. Tool Equipment.

Tool Equipment TE–113. (Organizations which have fixed plant Tool Equipments TE–87–(*) and TE–88–(*) available can dispense with Tool Equipment TE–113.)

b. Materials.

Orangestick.

Cheesecloth, bleached, lint-free.

Cloth, crocus, 9- by 11-inch sheets (spec No. 42056-Navy).

Carbon tetrachloride.

Paper, sand, No. 000 and No. 0000 (Fed spec No. P–P–111).

Solvent, dry-cleaning (SD) (Fed spec No. P–S–661s).

11. General Preventive Maintenance Techniques

a. Use No. 0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with solvent (SD); then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a cloth.

Caution: Repeated contact of carbon tetrachloride with the skin, or prolonged breathing of fumes is dangerous. Make sure adequate ventilation is provided.

c. If available, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result.

d. For further information on preventive maintenance techniques, refer to TB SIG 178.

12. Use of Forms in Performing Preventive Maintenance

(figs. 7 and 8)

a. The information in this paragraph is presented as a guide to the individual making an inspection of equipment in accordance with instructions on DA AGO Forms 11–238 and 11–239. The decision as to which items on the forms are applicable to this equipment is a tactical decision to be made, in the case of First Echelon Maintenance, by the Communication Officer/Chief or his designated representative, and in the case of Second and Third Echelon Maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. The first two columns of the chart in this paragraph serve as a cross reference between the item numbers of DA AGO Forms 11–238 and 11–239 and the preventive maintenance information in this manual. Circled items on figures 7 and 8 are either partially or totally applicable to Dual Diversity Converter CV–31(*)/TRA–7.

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; ⓧ Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories*).							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS.							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS.							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION.							
6	CHECK FOR NORMAL OPERATION.							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS.		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE.		14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN.		15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES.		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA AGO FORM 1 MAY 51 11-238 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

Figure 7. DA AGO Form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).*		19	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS: INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES.	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.		20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS.		21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION.	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS.		22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS.	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION.		23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS.	
6	CHECK FOR NORMAL OPERATION.		24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE.	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS.		25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS.	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE.		26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE.	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN.		27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.		28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES.		30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.		31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS.	
14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.		32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE.	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES.		33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.		34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.		35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.		36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS.	
			37	MOISTURE AND FUNGIPROOF.	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.				

DA AGO FORM 1 MAY 51 11-239 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 261-45

Figure 8. DA AGO Form 11-239.

c. The following preventive maintenance operations should be performed at the intervals indicated, unless these intervals are reduced by the local commander.

Caution: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

DA AGO Form 11–238 Item No.	DA AGO Form 11–239 Item No.	Procedure
		DAILY
1	1	Check for completeness and satisfactory condition of the control unit.
2	2	Check suitability of location and installation for normal operation.
3	3	Remove dirt and moisture from cords, jacks, plugs, and panels of the component parts.
4	4	Inspect the seating of the fuses (figs. 4 and 6) and all plugs and connectors.
5	5	Inspect all controls for binding, scraping, excessive looseness, worn shafts, misalinement, and positive action.
6	6	Check for normal operation.
		WEEKLY
		Caution: Disconnect all power before performing the following operations. Upon completion, reconnect power and check for satisfactory operation.
7	7	Clean and tighten the panel mountings.
8	8	Inspect case, mounting, and exposed metal surfaces for rust, corrosion, and moisture.
		WEEKLY—Continued
9	9	Inspect cords, cables, wires, and shock mounts for cuts, breaks, fraying, deterioration, kinks, and strain.
11	11	Inspect TM 11–261 for tears, mildew, or fraying.
		MONTHLY
	19	Inspect electron tubes for loose envelopes, loose cap connectors, cracked sockets, and insufficient socket spring tension; check emission of tubes. *Note.* Tubes with suffix letters Y or W may be substituted for their prototypes; i. e., 6SJ7Y may be used for a 6SJ7.
	21	Inspect fixed capacitors for leaks, bulges, and discoloration.
	24	Inspect resistors, bushings, and insulators for cracks, chippings, blistering, discoloration, and moisture.
	25	Inspect terminals of large fixed capacitors and resistors for corrosion, dirt, and loose contacts.
	26	Clean and tighten switches, terminal blocks, relay, and interior of chassis.
	27	Inspect terminal blocks for loose connections, cracks, and breaks.
	31	Clean and tighten connections and mountings for transformers, potentiometers, and rheostats.
	32	Inspect transformers, potentiometers, and rheostats for overheating and oil leakage.
	37	Check adequacy of moisture and fungiproof treatment.
	38	If deficiencies noted are not corrected during inspection, indicate what action was taken to correct the deficiencies.

Section II. LUBRICATION AND WEATHERPROOFING

13. Lubrication

The lubrication of the converter is relatively simple. Clean the shafts and areas adjacent to the switch shaft bearings. Apply one or two drops of special preservative (PL) lubricating oil to the bearings. Wipe off excess oil.

14. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moisture-proofing and fungi-proofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13 and TB SIG 72.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66 and TB SIG 219.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are ex-explained in TB SIG 75.

e. Lubrication. The effects of extreme cold and heat on lubricating materials and lubricants are explained in TB SIG 69. Observe all precautions outlined in TB SIG 69 and pay strict attention to all lubrication orders when operating equipment under conditions of extreme cold or heat.

15. Rustproofing and Painting

a. When the finish on the case has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal. Obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. When numerous scars and scratches warrant complete repainting, remove the panels and chassis, and spray paint over the entire case. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations. Refer to TM 9–2851.

CHAPTER 3
THEORY

Section I. SYSTEM THEORY

16. Scope

Dual Diversity Converter CV–31(*)/TRA–7 is used with a combination of *radio* and *wire* equipments working as a unit and involving practices and theory of both. For this reason, a few of the basic principles of teletypewriter theory will be discussed in this section. For detailed data on the theory of teletypewriter components, refer to TM 11–680. The functions of the converter unit in a representative RRT system is covered in paragraph 24.

17. Signaling Currents

Radioteletype systems use teletypewriters (telegraph printers) that will operate normally over 10 to 20 miles of unloaded (no extra inductances added) field Wire W–110–B without repeaters or line relays. The distance depends on whether battery (current) is supplied at one or both ends of the line.

a. Methods. Two methods of transmitting TT signals on wire lines are normally used—the *neutral* system and the *polar* system. In the neutral system, use is made of *current on* and *current off* square-wave pulses of one polarity. The polar system uses positive and negative square-wave pulses. Figure 9 shows ideal and practical signal pulses. The transitions from one signal condition to the other and the timing of the transitions, determine the intelligence conveyed.

b. Neutral System. In the neutral system, current is sent over the line to operate the receiving TT selector mechanisms to a marking position, and the current is stopped to operate the selecting magnets to a spacing position. A marking current

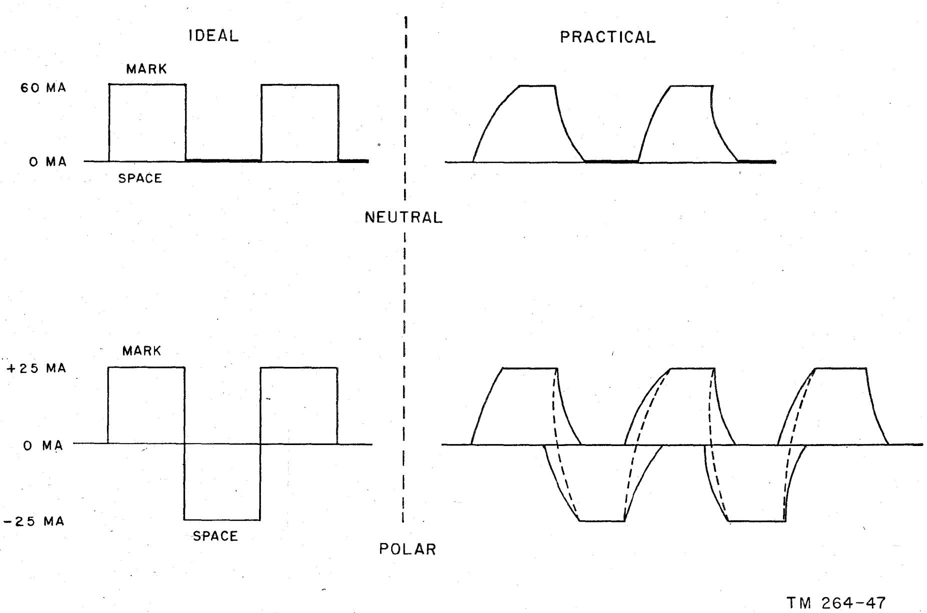


Figure 9. Neutral and polar waveshapes.

of 60 ma normally is used. Neutral operation is used in the monitor loop circuit of this unit (connections are made through D and E of J103).

c. Polar System. In the polar system, current is sent over the wire in one direction for the marking impulses and in the opposite direction for the spacing impulses. Polar operation possesses a number of advantages over the neutral system and is used in the extension circuits (A and B, J103) of this unit. Two of the major advantages are—

(1) *Apparent voltage gain.* The transmission of current in the opposite direction for spacing gives the effect of increased voltage without increasing the current values in any part of the circuit. Therefore, the circuit is not subjected to as high working voltages as in the neutral system.

(2) *Decreased bias.* The presence of *bias* (lengthening or shortening of the signal wave) on the line has little effect on the resulting waveform of the signal transmitted with polar operation. If the mark and space currents have been adjusted correctly at the sending end of the circuit, the electrostatic charges remaining in the transmission line from the positive and negative impulses cancel, leaving the waveform undisturbed.

d. Use. Neutral operation is used satisfactorily for short lines; it is used also to operate the selector magnets of the TT equipments. Polar operation is invariably used where long lines or highly-capacitive circuits are involved.

18. Teletypewriter Code

a. Assuming that two typewriters are to be connected together by a wire or wires so that messages typed on one would be automatically and simultaneously typed on the other, the first method of accomplishment might be to have each key of the sending typewriter connected by an individual wire to a magnet for a corresponding type bar of the receiving typewriter. Such an arrangement would be very simple in theory, but obviously uneconomical in the amount of material used. An economical method of solving the problem is by sending a sequence of signals, or *code,* for each character as is done in the case of manual Morse telegraphy. This is the general method used with teletypewriters although the code is considerably altered to adapt it for best machine operation.

b. In selecting a satisfactory code for TT operation, several factors had to be considered, including the following:

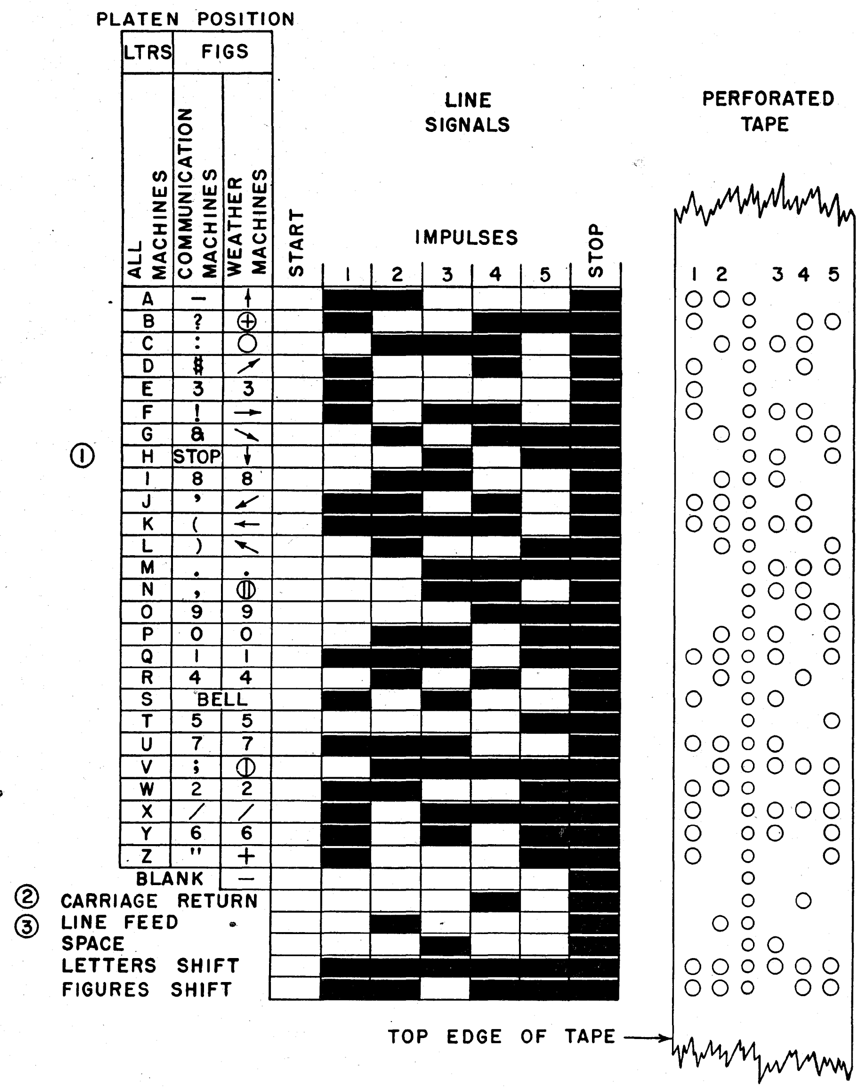
(1) The code should preferably use only two line conditions, such as current and no current.

(2) The number of code elements per character should be a minimum in order to permit high-speed operation over relatively narrow-band telegraph circuits. (A greater keying speed is equivalent to more information per unit time; the more information transmitted in a given time, the greater the necessary bandwidth.)

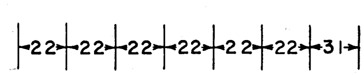
(3) The number of code units per character should preferably be uniform in order to give simple machine design.

c. A code answering the general requirements is the one used in our present teletypewriters; it is usually called the five-unit selecting code. There are 32 possible ways of arranging two current values with respect to five divisions of time, making possible the selection of any one of 32 type bars or other operating mechanisms. By using each type bar for two characters, this code is sufficient to provide for the 26 letters of the alphabet, the ten numerals, and the usual punctuation marks. It is the shortest practical code for two-line conditions.

d. The mark and space impulses used to operate a teletypewriter are pulses of direct current of uniform intensity (figs. 9 and 10). If oscilloscope test prods were connected across a line carrying these mark and space impulses, they would appear as a square waveform (fig. 9). It is very important that the transmitted impulse maintain its waveform when it reaches the receiving apparatus, since a steady impulse is necessary for correct operation of the receiving machine. When sending at 60 wpm (words per minute), assuming a standard five-letter word, the time for each unit signal impulse is 22 ms (milliseconds) (fig. 10). When the selecting mechanism of the receiving teletypewriter is adjusted correctly, it operates only during the central portion of the received signal impulse, requiring only 20 percent of the unit interval, or approximately 4 ms. It is apparent from the above that there are many factors that may cause false operation of the receiving teletypewriter. Improper adjustment of receiving and sending equipment may result in improper synchronization and consequent false operation. Link (connecting wire) leakage, line



SIGNAL LENGTHS IN MILLISECONDS. STANDARD SPEED 60 WORDS PER MIN



SPACING IMPULSES
MARKING IMPULSES

① FIGS BLANK H FOR MOTOR STOP ON WEATHER MACHINES

② COMMA IS PRINTED ON TAPE-PRINTING TELETYPEWRITERS

③ PERIOD IS PRINTED ON TAPE-PRINTING TELETYPEWRITERS

TL 9177 A

Figure 10. Teletypewriter code.

resistance, ground resistance, ground potentials (caused by earth currents), and changes in electrical constants in the involved components may all create waveshape distortion.

19. Transmitter-distributor

Instead of transmitting from a teletypewriter keyboard, it is frequently of advantage to transmit automatically by means of perforated tape. (Portions of this tape are shown in the right side of fig. 10 and in fig. 12.) With this type of transmission, one or more operators may perforate tape as fast as it is convenient, and the previously prepared tape may be hand-fed through the automatic transmitter at a uniform rate, making use of the maximum speed capabilities of the circuits. The machine used for automatically transmitting from perforated tape is called a *transmitter-distributor*, normally abbreviated TD. In the TD, a tape transmitter, using the perforated tape, sets up the code combinations to be transmitted on a set of five contacts (fig. 11). A commutator distributor (which corresponds to a distributor in an automobile) connects the line of each of these contacts in proper sequence at a speed of 60 wpm. The signals are transferred to the line through a distributor brush revolving around a commutator face which is split into seven segments. The brush first passes over the start segment, sending a space impulse over the line. As it continues to revolve, it successively connects the five code segments to the line for a character. Then the brush reaches the stop segment and sends out the stop impulse, a mark. Thus, one character is sent per revolution of the commutator brush. The output signals of a TD are neutral; that is, current flows during a mark impulse and no current flows during a space impulse. With the TD connected to a line circuit and in its idle (not transmitting) condition, its distributor brush will remain on the stop segment, sending a steady mark. For a detailed discussion of the TD, refer to TM 11-2222.

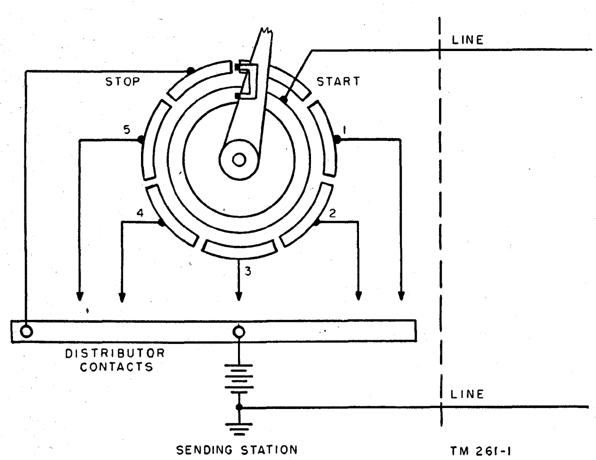


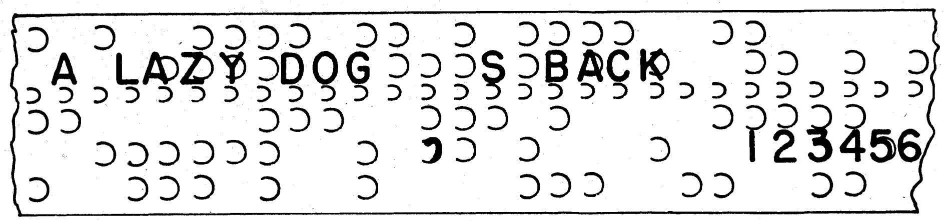
Figure 11. TD signal circuit.

20. Typing Reperforator

a. The typing reperforator is a motor-driven mechanism for receiving and recording the messages in both code perforations and typewritten characters on the same tape. When used with a keyboard in local circuits, it serves the purpose of a keyboard tape perforator and TT transmitter. Receiving units of this kind are particularly adaptable for use at message centers, because the perforated tape may be prepared and later used to retransmit the message to one or more stations by means of a TD. This eliminates the necessity for manual transmission by direct keyboard or manual preparation of perforated tape. The typewritten characters on the tape facilitate identification and distribution at the message center.

b. The typing reperforator uses a standard perforator tape which is $^{11}/_{16}$ inch wide. A method of tape perforating known as *chadless perforating* is used to permit perforation of the tape in the same space that is occupied by the typewritten characters. The punchings, or chads, are not completely severed from the tape but remain attached to it at their leading edges to form lids over the holes (fig. 12). The legibility of the typewritten character is not impaired by this type of perforating because the perforating does not eliminate any portion of the tape.

c. Typing and perforating occur simultaneously, but since the typing platen is to the right of the perforator die block, characters are typed at the right of their respective perforation. *The separation between the typewritten character and its associated perforation is six character spaces.* This separation must be taken into account when tearing message tapes from the unit or in cutting the tape. When the tape is to be used for transmission by means of the TD, the end of the tape should include all the typewritten characters in the message, and the first typewritten messages must be preceded by at least six sets of code perforations in order to transmit the entire message. Detailed information covering the typing reperforator can be found in TM 11-2223.



TL 53221 S

Figure 12. Chadless tape.

21. Perforator

The TD can handle both the chad and chadless types of tape. Chad tape (right side of figure 10) is produced by a perforator with a standard teletypewriter keyboard. When a key is depressed, the desired code combination is recorded on the tape by perforating for the mark impulses and by not perforating for the space impulses. The start and stop impulses are not recorded on either type of tape. The small continuous line of holes in the tape (both chad and chadless types) are used to feed the tape through the perforator and the TD. The tape is read by moving it from right to left with two recorded impulses above the feed line and three below the feed line. The perforating mechanism consists essentially of a set of punches for perforating tape, a pair of punch magnets, and a punch hammer for operating the punches. Depressing a key positions six selector bars, five of which, through a series of lever actions, select the punches that are to be operated. The sixth selector bar closes the electrical circuit through the punch magnet, resulting in the punches being operated by the punch hammer. This type of perforator punches the tape clean.

22. System Functioning

a. Figure 13 is a block diagram of equipment at two radioteletype terminals set up to permit full-duplex operation. Each terminal consists of a receiving section, an operating section, and a transmitting section. The three sections may be in separate shelters or all in one shelter. The diagram shows a sending and receiving teletypewriter at each operating shelter, and monitor TT's in the receiving shelters. This RTT system uses frequency-shifted r-f (radio-frequency) signals of constant amplitude. C-w telegraph signals may be originated, using a hand telegraph key or a code tape transmitter. The receiving station may be equipped to receive keyed tones or neutral signals which may be copied manually or recorded automatically on a typing reperforator.

b. Opening and closing of the sending contacts at the TT operating station produces signals which are transformed electronically in the control unit into polar signals. The polar signals are transmitted over field wire to control the operation of a tube in the FS exciter which, in turn, controls the mark and space frequencies of the transmitted signals. During mark intervals, the usual radio transmitter operates on a normal frequency between 2 and 18 mc (megacycles). During space intervals, the transmitter frequency is reduced by 850 cycles. (Low-frequency transmitters (below 2 kc) use a shift of 170 cycles.)

c. At the receiving station, duplicate incoming r-f signals are received on two different antennas spaced several wavelengths apart. Each antenna is connected to a separate superheterodyne receiver located in the receiving shelter. The use of two antennas and two associated radio receivers minimizes the effects of fading which tends to weaken the signal at one receiving location, but not at another. The transmission paths to each antenna are not normally affected at the same time or to the same extent and, consequently, the combined output from both receivers produces a signal of relatively constant strength. The i-f outputs of both receivers are applied to the dual-diversity converter. In this unit, the i-f signals are converted to lower frequencies which, in turn, are demodulated by two frequency-discriminating networks. The demodulated output of the FS converter consists of both neutral and polar teletype signals. The neutral signal operates a monitor TT located at the receiving position. The polar signal is sent over land lines to the control unit where it is converted into a neutral signal which operates receiving teletypewriters at the operating shelter. The polar signal can be applied directly to an FS exciter for relay transmission.

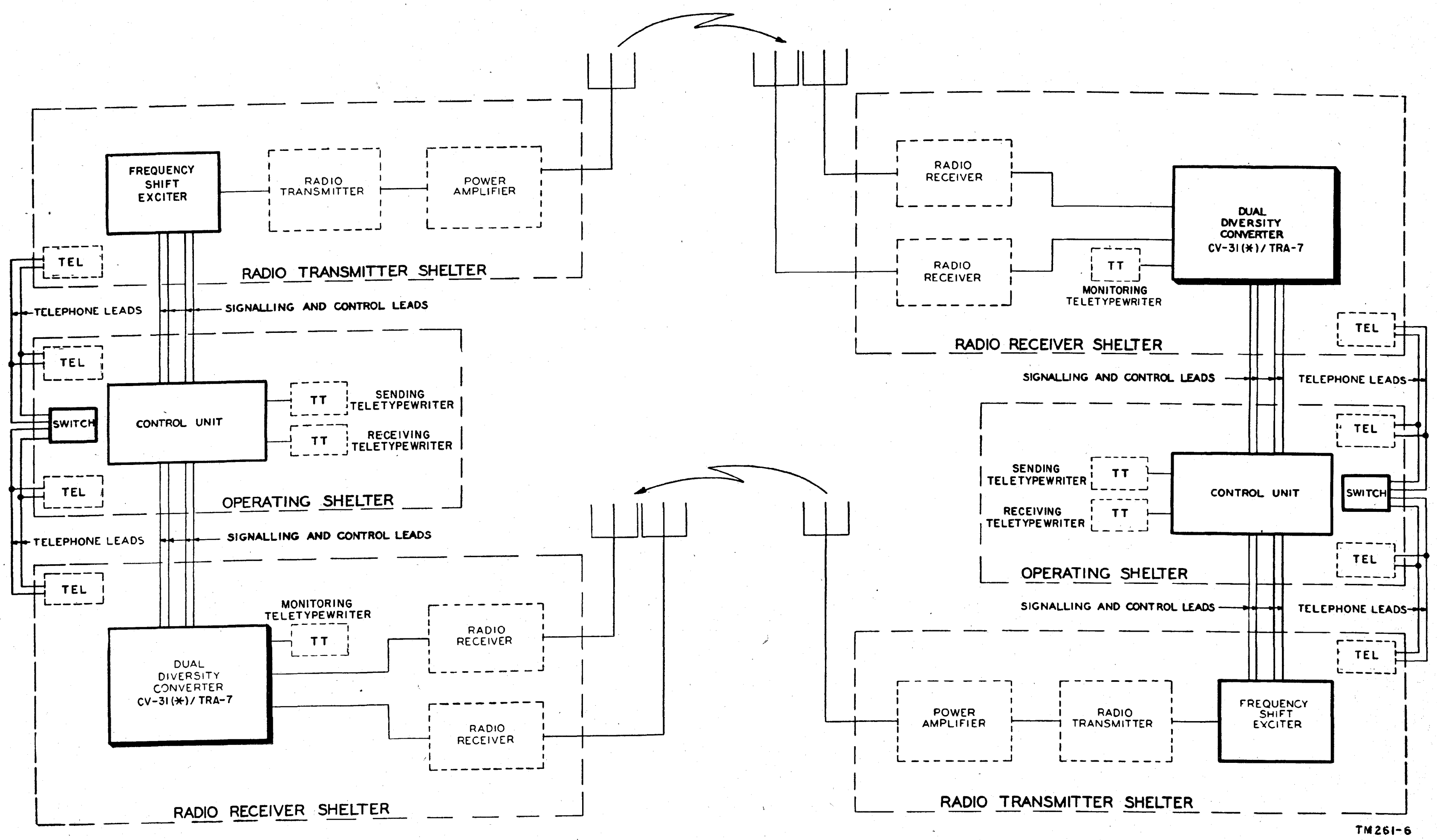


Figure 13. Block diagram of two radioteletype terminals arranged for full-duplex operation.

Section II. THEORY OF DUAL DIVERSITY CONVERTER

23. Block Diagram

a. The major circuit components of Dual Diversity Converter CV–31(*)/TRA–7 are shown in the block diagram of figure 14. The main chassis contains the frequency converters, limiter amplifiers, clippers, frequency discriminators, frequency drift compensators, carrier-control mark-hold circuit, driver circuit, and d-c output circuits. Two subchassis, Rectifier Power Unit PP–193(*)/TRA–7 and Oscillator O–41(*)/TRA–7, are mounted on the main chassis and complete the unit.

b. The i-f outputs of two radio receivers are sent through separate converter channels, combined, and sent through a peak-clipping limiter circuit, and detected in a frequency-discriminator circuit. The output of the discriminator circuit is sent to the output stages of the unit where the waveform required for neutral and polar signals is produced. The frequency-drift compensator circuit minimizes the effects of frequency variations that may occur, due to atmospheric or other conditions, in the i-f signals fed to the converters. The carrier-control mark-hold circuit maintains a steady marking condition automatically, should the transmitter carrier frequency disappear or fail. The power unit supplies all filament, plate, and bias voltages required by the main chassis and the oscillator unit. The oscillator unit, in conjunction with a headset, when required, converts the mark radiotelegraph signals into audible tones.

c. The two receivers used in conjunction with the dual diversity converter are designated as the channel A and channel B receivers. The i-f outputs of these receivers are frequencies within the band of 400 to 470 kc (or 440 to 510 kc in the late C and D models) on mark signals, and 850 cycles lower on space signals. The signal voltage then, is a frequency-shifted voltage which changes from a nominal frequency for mark signals to another (lower) frequency for space signals.

24. Input Circuit
(fig. 15)

a. The signal voltage from the channel A receiver is connected to input jack J101, and the signal voltage from the channel B receiver is connected to input jack J102. After the signals are applied to the input jacks, the signals are stepped up by the transformer action of input networks Z101 and Z103 to match the grid impedance levels of V101 and V102. These networks are tunable through the range of 400 to 470 kc or, in late C and D models, from 440 to 510 kc. Capacitor C101 is screw-driver adjustable and tunes Z103 for channel A. Capacitor C103 is screw-driver adjustable and tunes Z101 for channel B. When once adjusted to the receiver i-f frequency, no further adjustments are ordinarily required. From the input networks, the signals are applied to penta-grid converter tubes V101 and V102 (types 6SA7).

b. The signals applied to tubes V101 and V102 are amplified and heterodyned to a lower frequency. The frequency conversion provides additional gain and improved selectivity. The incoming channel A signals are converted by V101 to a 50-kc signal, and the incoming channel B signals are converted by V102 to a 29.3-kc signal.

c. The conversion of frequency for channel A is effected in the following manner. The screen grid, control grid, and cathode (pins 4, 5, and 6) of tube V101, together with tuned circuit Z104 and capacitors C102 and C105, comprise a Hartley oscillator, having a frequency range of 450 to 520 kc (490 to 560 kc in late C and D models). The screen grid acts as the plate of the oscillator, and is held at r-f ground potential by capacitor C109. When used with radio receivers having a 470-kc intermediate frequency, this oscillator is tuned to 520 kc which, when mixed with the 470-kc incoming intermediate frequency (connected to the injector grid (pin 8)), produces a 50-kc output signal. For channel B, the screen grid, control grid, and cathode (pins 4, 5, and 6) of tube V102, together with tuned circuit Z102 and capacitors C104 and C106, form a similar oscillator having a frequency range of 425 to 525 kc (470 to 540 kc in late C and D models). When used with receivers having a 470-kc intermediate frequency, the channel B oscillator is tuned to 499.3 kc which, when mixed with the incoming i. f. (connected to the injector grid (pin 8)), produces a 29.3-kc output signal. To prevent any inversion of the mark and space signals, these oscillators are always tuned to a frequency higher than the incoming intermediate frequency.

d. Capacitors C105 and C106 are the coarse adjustments for their respective oscillators (fig. 5). Capacitor C105, associated with the oscillator of channel A, is screw-driver adjustable and is located

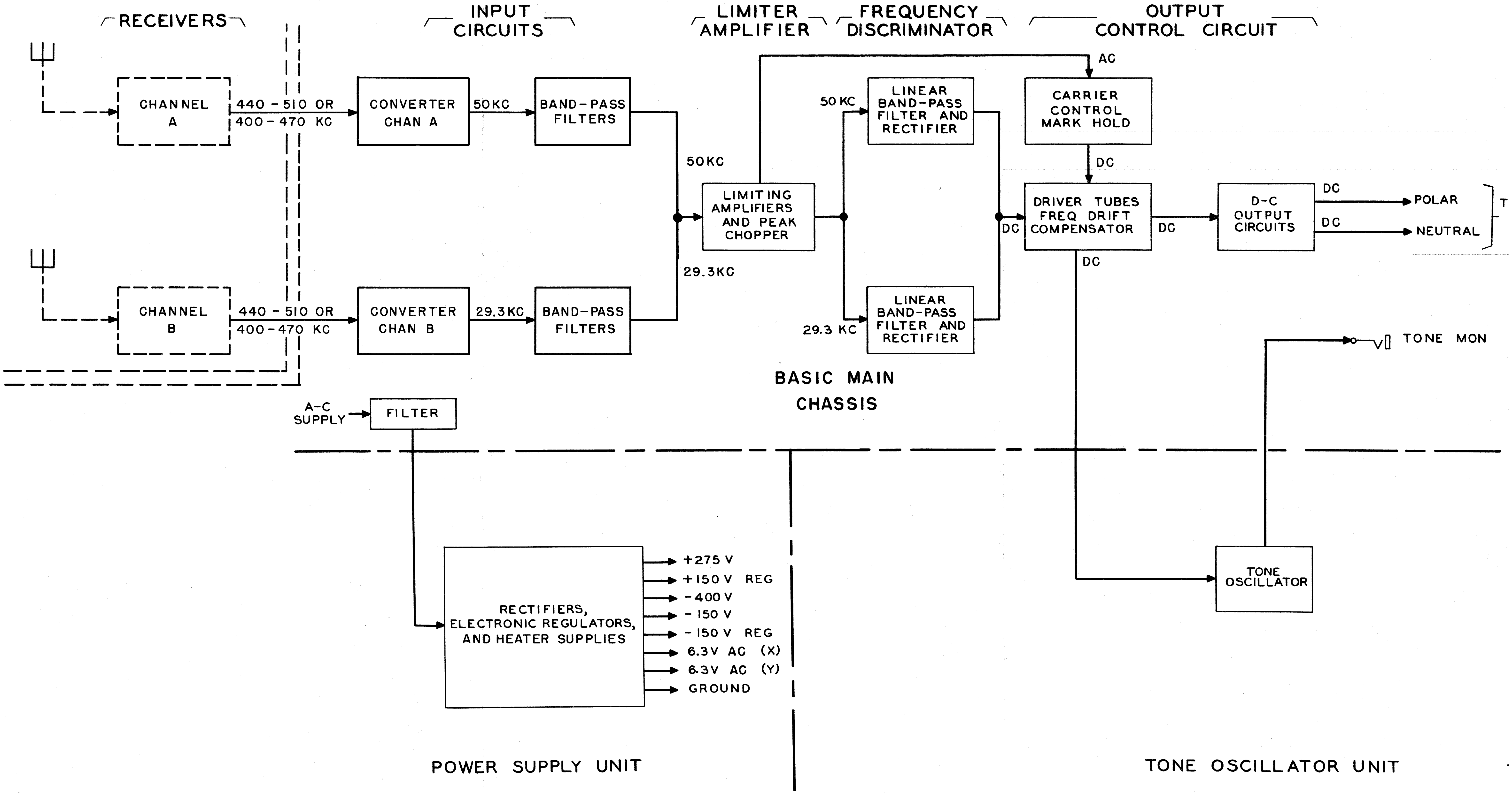


Figure 14. Functional block diagram.

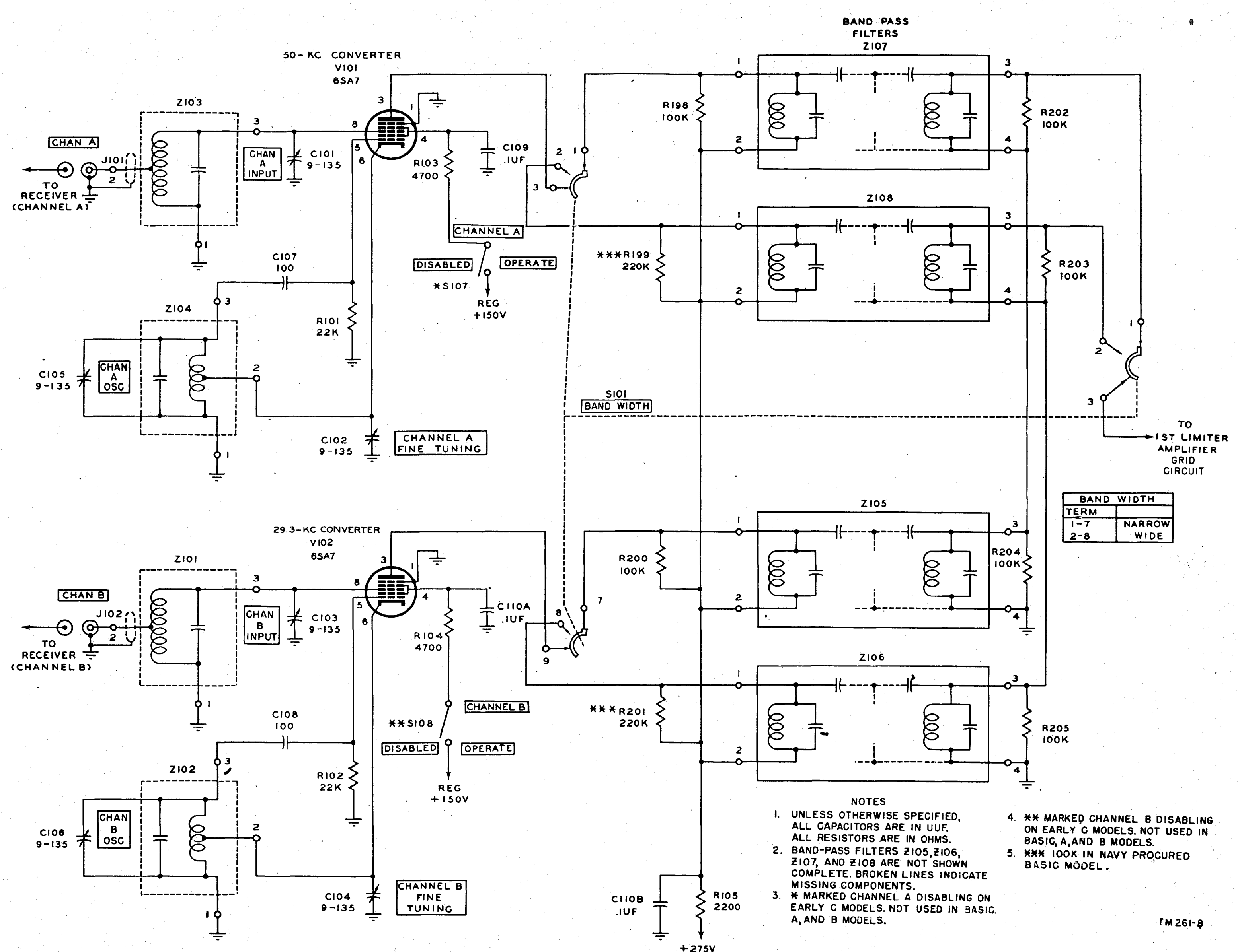


Figure 15. Input circuit, simplified schematic diagram.

adjacent to capacitor C101. Capacitor C106, associated with the oscillator of channel B, is also screw-driver adjustable and is located adjacent to capacitor C103. The CHANNEL A FINE TUNING and CHANNEL B FINE TUNING controls are capacitors C102 and C104 respectively. These are controlled by knobs on the front panel of the converter (fig. 3). The range of adjustment of these controls in the basic through B models is as follows:

Oscillator frequency	Range of adjustment in cycles	
	Channel A (C102)	Channel B (C104)
395 kc	1,560	920
470 kc	More than 2,000	1, 460
475 kc	More than 2,000	1, 660

e. To reject certain noise frequencies and interference from nearby transmitting stations, the bandwidth should be limited to a value not to exceed that which is adequate for the particular signals received. Accordingly, by turning BAND WIDTH switch S101 to NARROW or WIDE, the outputs of mixer tubes V101 and V102 are connected to either a narrow-band or a wide-band filter. The association of the switch positions, the channels, the filters, and the frequency bandwidths are as follows:

Channel	S101 switch position	Filter	Frequency range
A	NARROW	Z107	50 kc$\pm$750 cps.
A	WIDE	Z108	50 kc$\pm$1500 cps.
B	NARROW	Z105	29.3 kc$\pm$750 cps.
B	WIDE	Z106	29.3 kc$\pm$1500 cps.

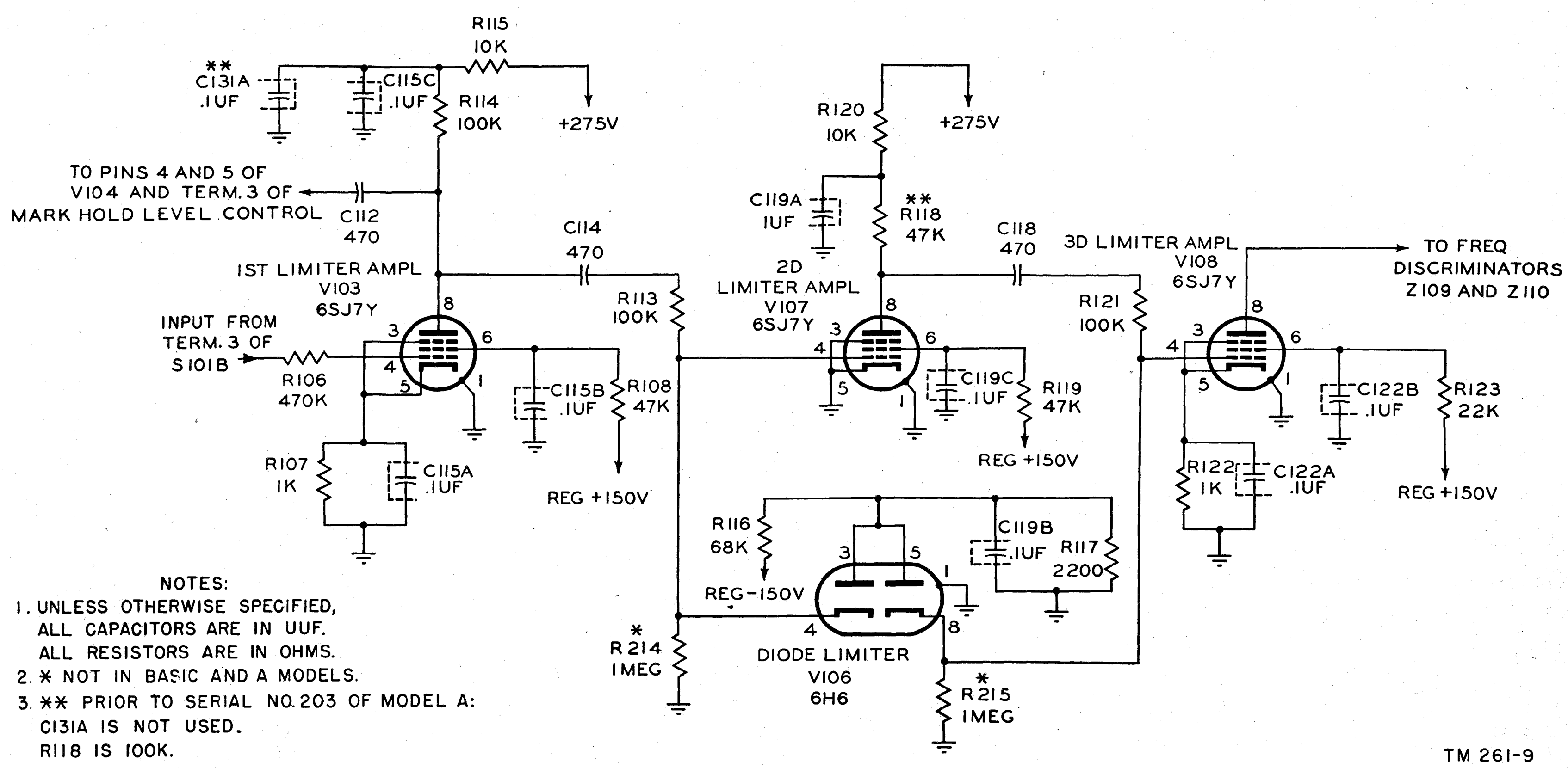
f. Channel A and channel B are separate and distinct through the band-pass filters and up to the grid circuit of first limiter amplifier tube V103 (type 6SJ7). The two frequencies of channels A and B are combined across the grid resistor (of V103), which is comprised of resistor R203 in series with R205 (WIDE bandwidth) or resistor R202 in series with R204 (NARROW bandwidth).

25. Limiter Amplifier
(fig. 16)

a. Frequency-shifted telegraph signals, radiated from the transmitting antennas, vary in frequency in accordance with the original d-c marking and spacing telegraph signals, but are virtually constant and amplitude. In the radio link between the transmitter and the receiver, these signals may encounter static disturbances, noise, and fading effects which produce variations in signal amplitudes. Another source of variations in signal amplitudes is the oscillator drift of the receiver. A limiter amplifier is provided in the dual diversity converter circuit to eliminate undesirable amplitude variations in the incoming signals before they are connected to the discriminator for detection. The limiter amplifier circuit produces relatively square waves of a constant magnitude by cut-off action and plate-current saturation which prevent the signals from being amplified beyond an established limit.

b. The combined signals of channels A and B are received from the input circuit and consist of 50-kc and 29.3-kc carrier currents, each frequency-shifted by the same original telegraph signals. These combined signal outputs from the tubes V101 and V102 are applied to the grid (pin 4) of tube V103 through grid-current-limiting resistor R106. The tube is operated at a point on the characteristic curve that allows the positive and negative peaks, between plate saturation and cut-off of this tube, to be amplified. Low-level positive and negative signal, therefore, are amplified by V103. The high-level signals, however, cause tube V103 to be driven to cutoff and plate saturation on negative and positive peaks, respectively. At the point of plate saturation, grid current flows through resistor R106 and develops a negative bias which effectively reduces positive peak input signals. On high negative peaks, the tube is cut off. Therefore, any undesired voltage peaks impressed on the carrier are clipped.

c. The output from the plate of tube V103 is coupled to the carrier-control mark-hold and frequency-compensating circuits through capacitor C112. The functions of these circuits are to keep steady marking signals on the b-c telegraph loops when the carrier is shut down or when no signal is coming through, and to minimize signal bias during drift. These circuits are discussed more fully in paragraphs 29 and 30. The output from the plate of tube V103 is also applied to the grid (pin 4) and cathode (pin 4) of tubes V107 and V106, respectively, through coupling capacitor C114 and resistor R113. Tube V107 (type 6SJ7Y) is a sharp cut-off pentobe, and tube V106 (type 6H6) is a duo-diode with the plates connected together.



NOTES:
1. UNLESS OTHERWISE SPECIFIED,
ALL CAPACITORS ARE IN UUF.
ALL RESISTORS ARE IN OHMS.
2. * NOT IN BASIC AND A MODELS.
3. ** PRIOR TO SERIAL NO. 203 OF MODEL A:
C131A IS NOT USED.
R118 IS 100K.

Figure 16. Limiter amplifier, simplified schematic diagram.

d. The low-level signals, too small to cause plate saturation or cutoff, are amplified by tube V107. The higher level signals have the undesired negative peaks clipped by the operation of one section of tube V106. A negative voltage is applied to the plates of this tube through resistor R116. A strong negative peak from the plate of tube V103 causes the cathode (pin 4) to become more negative than the plate. This condition causes current to flow and thus remove the negative peaks. The positive peaks, after amplification in tube V107, become negative peaks at the plate of V107 because of the 180° phase reversal between the control grid and plate. This strong negative peak is applied to the other cathode (pin 8) of tube V106 through coupling capacitor C118 and resistor R121. The negative peaks make the cathode more negative than the plate, causing current to flow through the tube and thus remove the negative peaks. All the signals, now at approximately the same level, are applied to the grid (pin 4) of tube V108.

Note. Grid resistor R214, which prevents a floating-grid condition in V107, is not included in the basic and A models; MWO SIG 11-278-1 authorizes its addition to these models.

e. The third limiter amplifier, V108 (type 6SJ7Y), functions in the same general manner as V103 and V107 but provides limiting action only on extremely high-level signals. The output, consisting of 50-kc and 29.3-kc frequency-modulated signals, is applied to discriminator networks Z109 and Z110 for demodulation.

Note. Grid resistor R215, which prevents a floating-grid condition in V108, is not included in the basic and A models; MWO SIG 11-278-1 authorizes its addition to these models.

26. Linear Discriminator

a. The discriminator circuit interprets the frequency variations of the FS signals in terms of d-c telegraph marking and spacing signals. One of the two discriminators interprets the frequency-shifted signals received over channel A, and the other interprets the FS signals received over channel B.

b. Referring to the 50-kc discriminator used for channel A (fig. 17), the upper and lower secondary windings of input transformer of Z109 are tuned to resonate, respectively, at a few kilocycles above and below 50 kc. The upper winding, T1 (A of fig. 18), is connected in series with resistor AB and one section of duo-diode tube V109 (type 6H6). The lower winding, T2, is connected in series with resistor BC and the other section of duo-diode tube V109. With the two diode sections connected as illustrated (A of fig. 18), the currents of the two circuits flow in the direction indicated by the arrows. The polarities of the voltage drops across resistors AB and BC are positive at the ends toward the cathodes of V109, and negative at the ends toward the plates of V109. Both resistors are joined at point B, which is the negative side of each resistor. The two voltage drops, therefore, oppose each other, and the resultant voltage between points A and C is the difference between the two voltages. The resultant polarity depends on which of these two voltages is the greater.

c. A frequency-response characteristic curve (B of fig. 18) indicates general voltage levels for tuned windings T1 and T2 of Z109 for frequencies centering around 50 kc. The curves designated as MARK and SPACE represent the voltages across resistors AB and BC, respectively. Since the voltage drops across these resistors are connected series-opposing, the resultant voltage across the two resistors (A to C) may be illustrated as shown under Z109 (A of fig. 19), when ground is connected to point A and the output is connected to point C. From this curve it will be noted that the resultant voltage increases gradually in a positive direction as the frequency changes from 50 kc to low frequencies and becomes gradually more negative as the frequency changes from 50 kc to high frequencies. Throughout the greater part of the frequency range involved in signaling, there is essentially a linear relation between the magnitude of the resultant voltage and the frequency change.

d. A similar demodulation takes place in network Z110 of the other discriminator, which responds to frequencies centering around 29.3 kc. The theory of operation is similar and also is covered by figures 18 and 19. It should be noted from these figures that the outputs of both discriminators are connected in series, so that the d-c output signals from both the discriminators add algebraically. Switch S102 in the output of the two discriminators allows for reversing the polarity of the output signals.

e. For the purpose of illustration, it is assumed in A of figure 19 that a positive mark signal results from the lower frequencies centering around 29.3 kc and 50 kc. Depending on the relative locations of the frequencies, a larger voltage E is pro-

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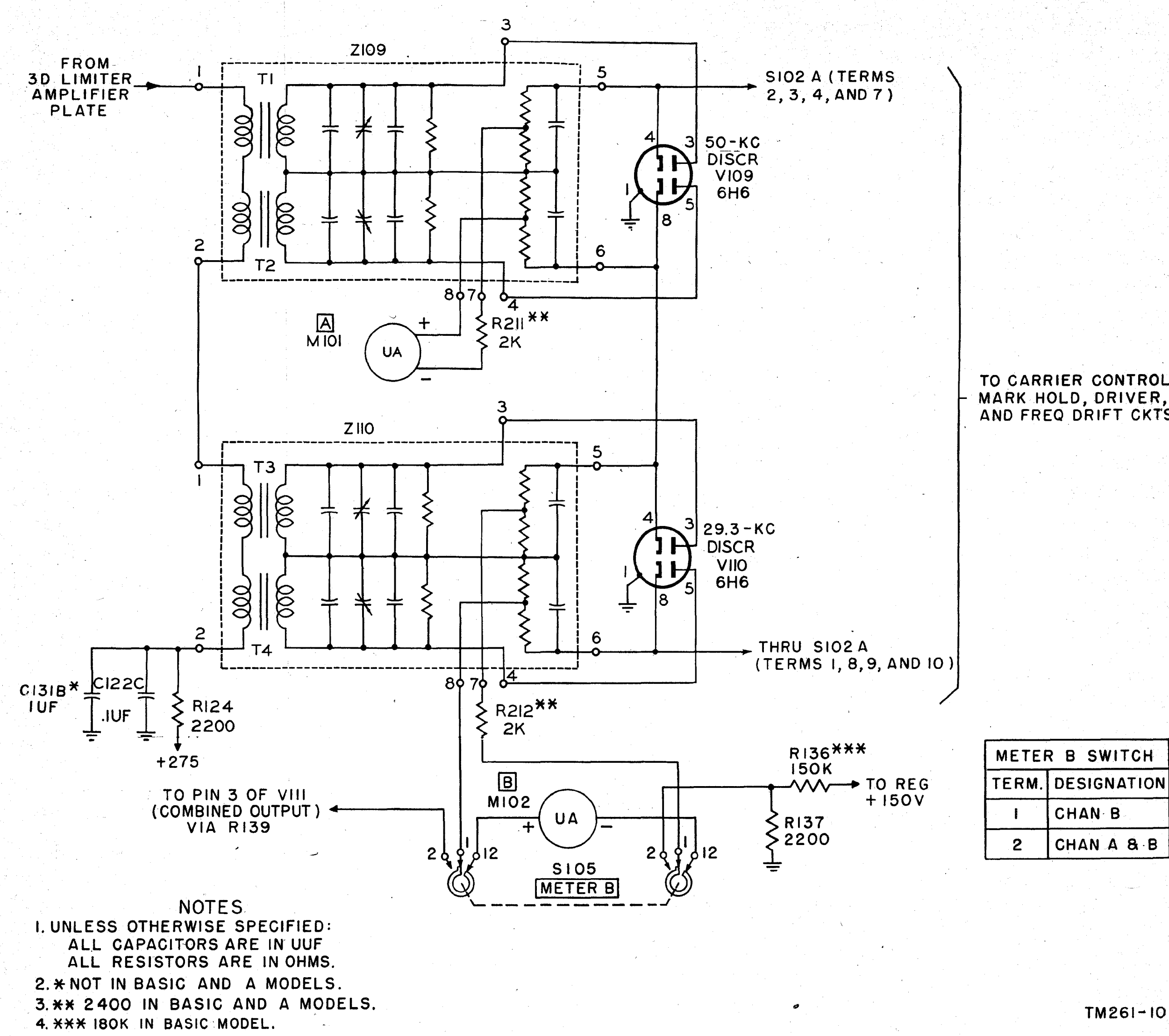


Figure 17. Linear discriminator stage.

duced in the lower part of each discriminator and a smaller voltage e is produced in the upper part. The voltages add to produce a net positive voltage (+2E−2e) or a net negative voltage (−2E+2e). Under the conditions assumed for this illustration, the positive voltage represents a mark and the negative voltage a space.

f. The effects of reversing the connections of the discriminators to provide a net negative voltage for a mark and a net positive voltage for a space are illustrated in B of figure 19.

g. The NORMAL and REVERSE positions of the OUTPUT switch thus provide for the d-c mark and space output signals of the proper polarities if the higher frequency components of the i-f carrier represent a mark with some receivers or a space with other receivers. It is also necessary to reverse the output of the discriminators, depending on whether or not the drift-compensator feature is used. This drift-compensator feature is described in paragraph 29.

h. Meter M101 is connected across the output of the discriminator Z109, and an identical meter M102 is connected across the output of discriminator Z110 through contacts of METER B switch S105 (in the CHAN B position), to allow for observing the operation of the discriminators. Meter M102 also is used for other electrical

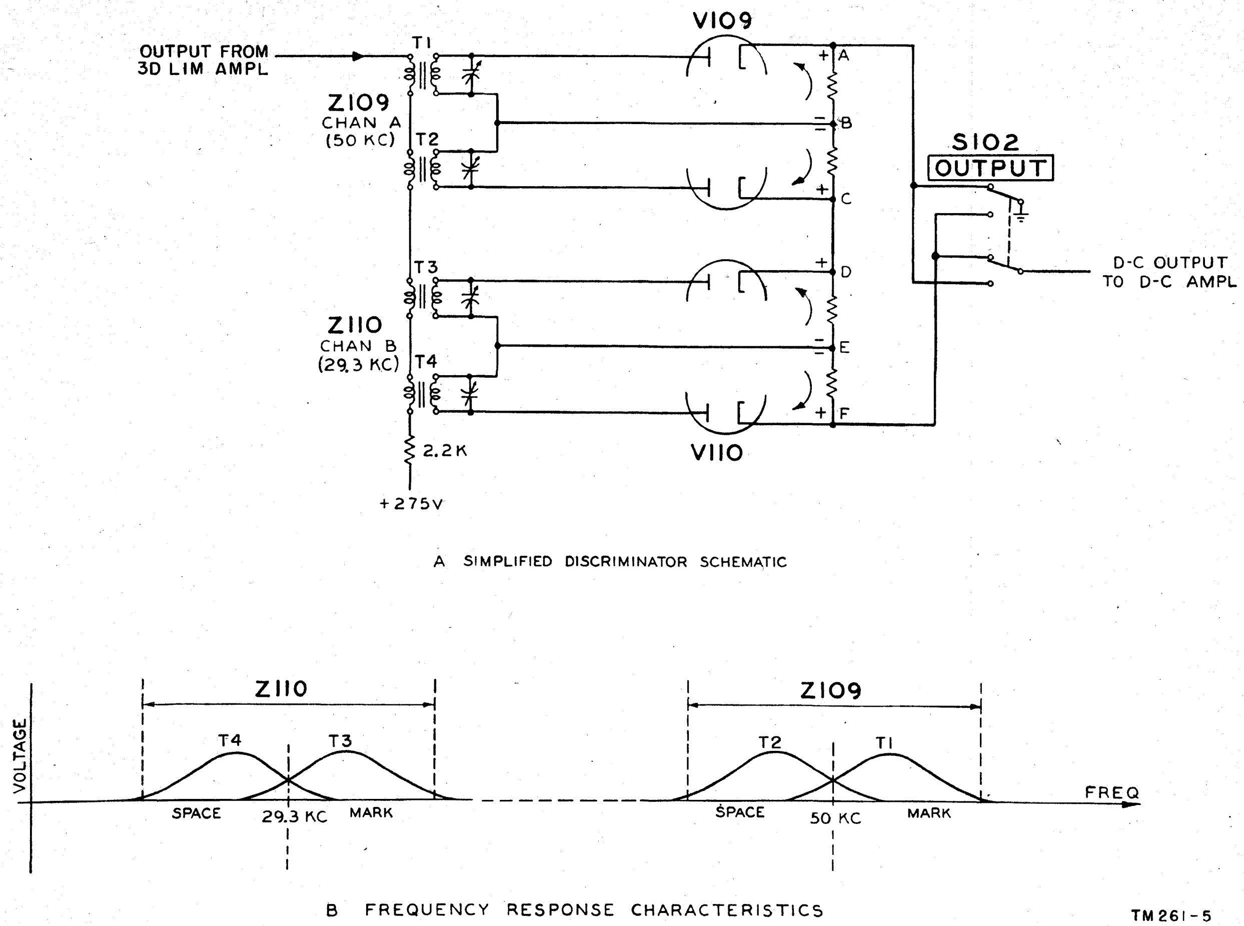


Figure 18. Linear discriminator operation.

measurements in the converter circuit, and is connected to the various circuits by means of switch S105.

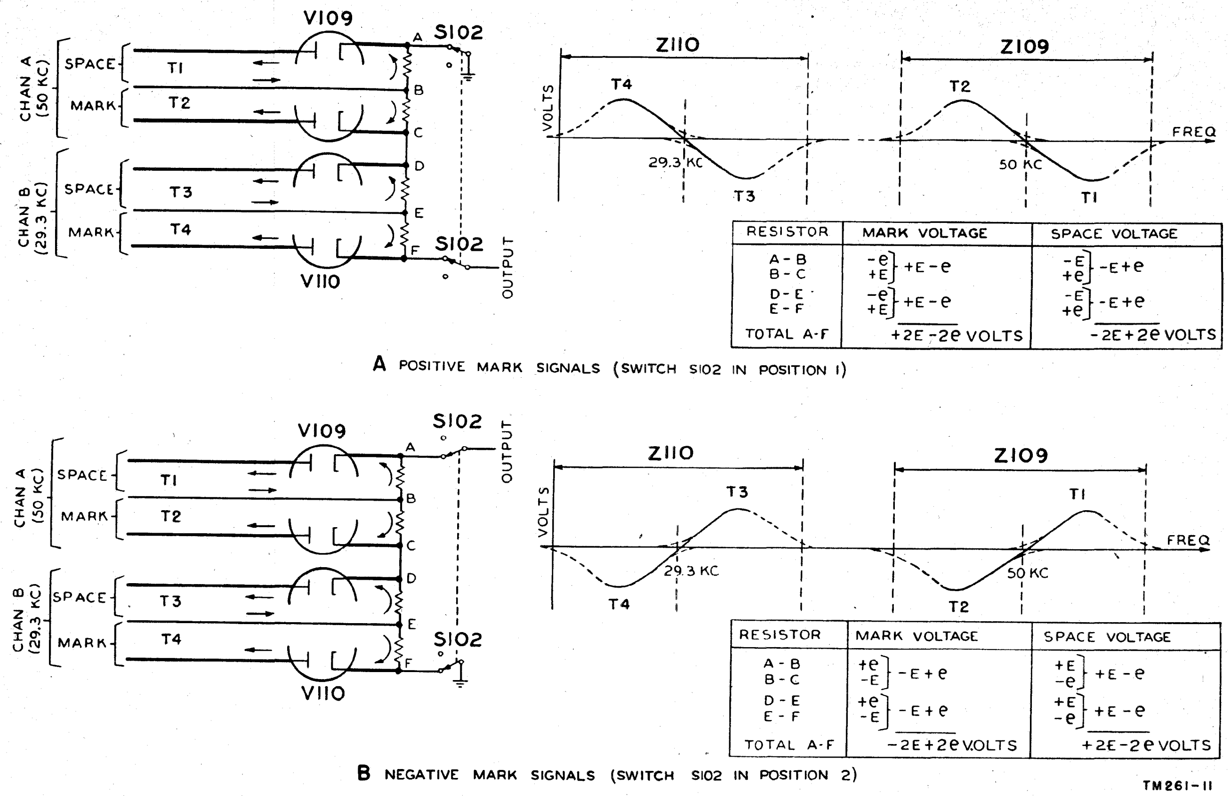
27. Switches S102 and S103

(fig. 20)

The algebraic sum of the positive voltages developed in the output of Z109 and Z110 (mark signal) or the algebraic sum of the negative voltages developed in the outputs of Z109 and Z110 (space signal) are applied to switch S102A. The TT messages, consisting of space or mark signals, produce a net negative or positive voltage at point A (A of fig. 18). The d-c polarity from the output applied to switch S102 can be reversed by turning this switch to the REVERSE position.

a. In the NORMAL position of OUTPUT switch S102, one side of the output (cathode, pin 8, of tube V110) is grounded through switch S102A (terminals 8 and 11). The other side of the output (cathode, pin 4, of tube V109) is grounded through switch S102A (terminals 7 and 11) in the REVERSE position. The other two positions of switch S102 are MARK and SPACE. The output from the cathode (pin 8) of tube V110 is grounded in these two positions of switch S102A (terminals 11 and 9 or 10).

b. The ungrounded output of the discriminators is applied to the grid (pin 2) of tube V104 through choke L101, capacitor C129, and AMP GAIN control R207, for any setting of switch S102A. Switch S102, in the NORMAL position, parallels the plates of mark-hold tube V105 and driver amplifier tube V113 through terminals 5 and 2, and connects these paralleled plates to terminal N of jack J106. Terminal N of jack J106 is connected to pin N of plug P405 in the tone oscillator (fig. 31). At the same time, the common terminals of DPDT (double-pole double-throw)



RESISTOR	MARK VOLTAGE	SPACE VOLTAGE
A-B, B-C	-e, +E } +E-e	-E, +e } -E+e
D-E, E-F	-e, +E } +E-e	-E, +e } -E+e
TOTAL A-F	+2E-2e VOLTS	-2E+2e VOLTS

A POSITIVE MARK SIGNALS (SWITCH S102 IN POSITION 1)

RESISTOR	MARK VOLTAGE	SPACE VOLTAGE
A-B, B-C	+e, -E } -E+e	+E, -e } +E-e
D-E, E-F	+e, -E } -E+e	+E, -e } +E-e
TOTAL A-F	-2E+2e VOLTS	+2E-2e VOLTS

B NEGATIVE MARK SIGNALS (SWITCH S102 IN POSITION 2)

Figure 19. Linear discriminator theory diagram.

switch S104 are connected to the grid (pin 1) of tube VIII through switch S102B (terminals 8 and 11). Switch S102, in the MARK position, applies a positive voltage from a regulated +150-volt source to the grid (pin 1) of tube V111 through resistor R127 and terminals 9 and 11 of switch S102B. Switch S102, in the SPACED position, applies a positive voltage from a +275-volt source to terminal M of jack J106 through terminals 4 and 5 of switch S102B, and also applies a negative voltage to the grid (pin 1) of tube V111 from a regulated −150-volt source through resistor R128 and terminals 10 and 11 of switch S102B.

c. The d-c mark and space signals from the linear discriminator are connected through OUTPUT switch S102 to the output control circuit (fig. 20) where they produce signals for transmission over a d-c polar or neutral telegraph loop or over a voice-frequency carrier telegraph channel. The output control circuit (fig. 21) consists of a driver circuit, a frequency-drift compensator circuit, and a carrier-control mark-hold circuit. A filter is connected in the input to the driver input circuit (fig. 20) to minimize the effect of noise on the mark and space signals. Two capacitors, C125 and C126, provide for conditions of low and high signaling speed, and are added or removed from the filter by means of the LP FIL switch S103. These capacitors are connected in the circuit for low signaling speeds by operating switch S103 to the IN position. For high signaling speeds, these capacitors are disconnected from the circuit by operating switch S103 to its OUT position (down).

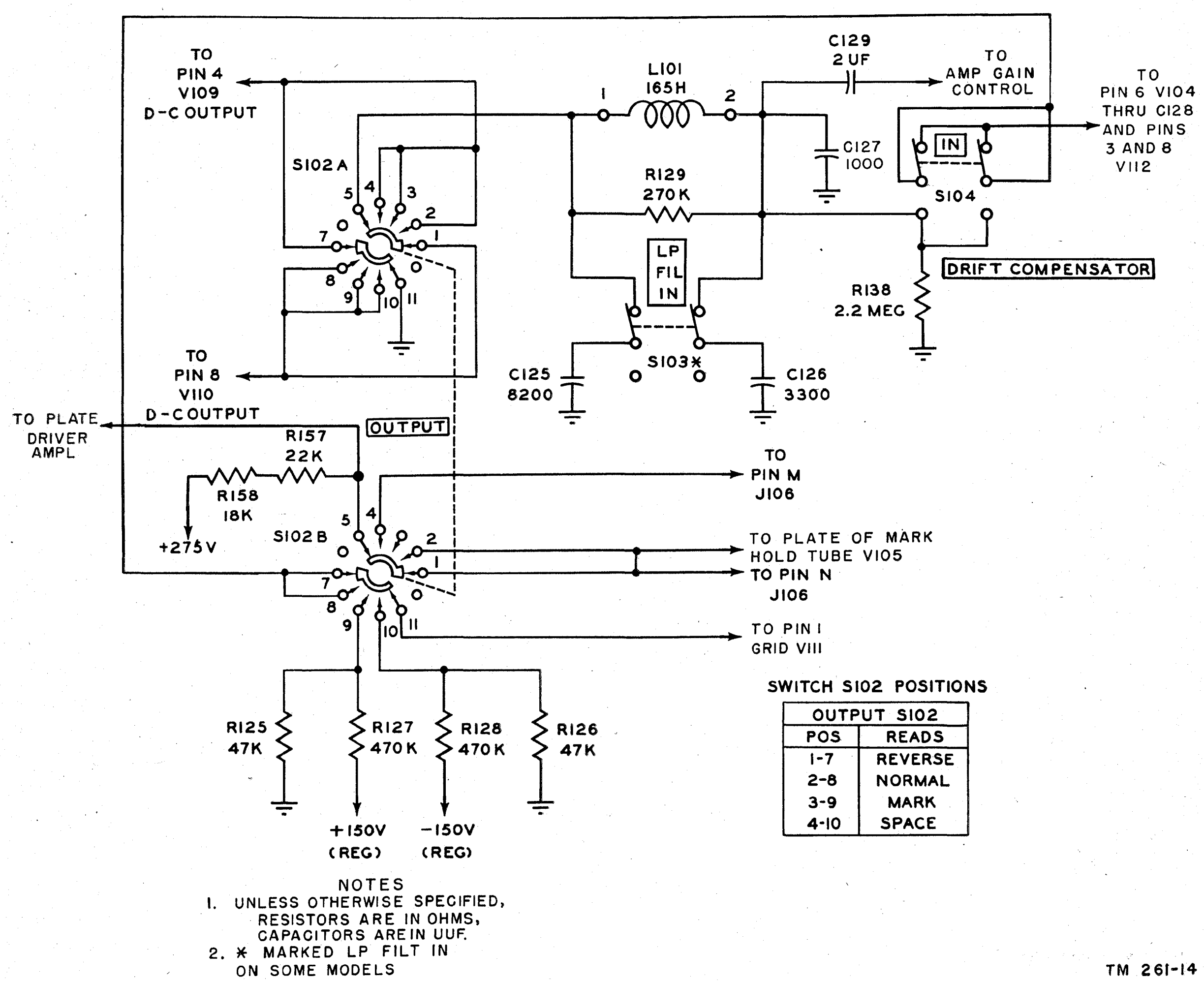
28. Driver Circuit

(fig. 21)

a. The frequency-drift compensator circuit is connected by operating DRIFT COMPENSATOR switch S104 to the IN position. The drift-compensator circuit eliminates bias effects caused by frequency drifts when the drifts in both channels are in the same direction.

b. If the drift-compensator circuit is not used, the mark and space signals from the discriminator are connected from the contacts of OUTPUT switch S102 to grid 1 of dual-triode tube V111 (type 6SL7GT). Assuming OUTPUT switch S102 is on position 1 (REVERSE), as shown in figure 21 and B, figure 22, a positive signal from the discriminator produces a positive potential on grid (pin 1) of tube V111. Section 1–2–3 of tube V111 is connected as a cathode follower. Hence, when the grid is driven positive, the cathode voltage changes in a positive direction to produce a positive potential on grid 4 of tube V113 (type 6SJ7Y). This tube in turn conducts to produce a negative swing of the voltage on its plate (pin 8). The negative swing of the polarity on pin 8 of V113 is developed across two parallel voltage dividers in the plate circuit. A point on the higher-resistance divider (fig. 21) is connected to grids 1 and 4 of tube V114 (type 6SL7GT) and a point on the lower-resistance voltage divider is connected to the d-c output amplifiers for producing polar and neutral signals. The contact arm of potentiometer R160 (BIAS B) is set to the point on the upper voltage divider (R159, R160, and R161) that will produce approximately equal negative (mark) and positive (space) voltage alternations (in V114) with respect to a cathode potential of −150 volts. The voltage changes are produced by the changes in voltage at plate 8 of tube V113, which is connected to one end of the voltage divider.

c. The pin 5 plate of tube V114 is normally at a 0-volt potential, with no current flowing through resistors R196 and R197, to ground. When a mark signal is received, the voltage on the pin 4 grid of V114 is negative with respect to the cathode



SWITCH S102 POSITIONS

OUTPUT S102	
POS	READS
1-7	REVERSE
2-8	NORMAL
3-9	MARK
4-10	SPACE

NOTES
1. UNLESS OTHERWISE SPECIFIED, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2. * MARKED LP FILT IN ON SOME MODELS

Figure 20. Circuit of switches S102 and S103.

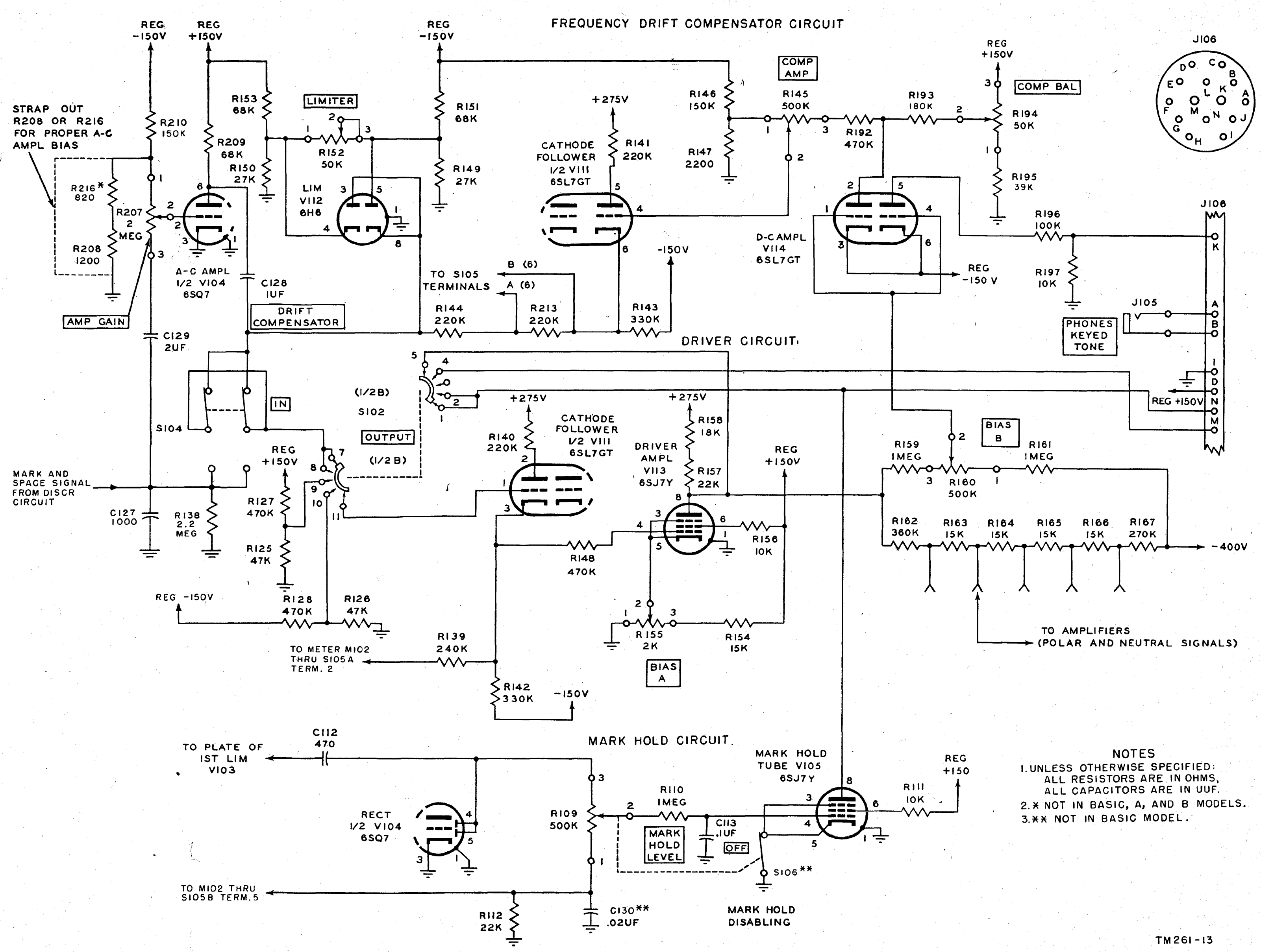


Figure 21. Output circuit.

(pin 6) (from contact arm 2 of the BIAS B potentiometer). This causes V114 to remain cut off. When the grid voltage is positive with respect to the cathode (space signal), tube V114 conducts. Plate current from pin 5 of V114, flowing through resistors R196 and R197, produces a voltage drop across R197. This causes the voltage at pin K of receptacle J106 to increase in a negative direction. The voltage alternations at pin K, arising from mark and space signals, can cause an *external tone-oscillator* circuit (similar to the oscillator shown in figure 30) to conduct and transmit tone for a mark signal, and to cut off tone for a space signal. Similar voltage variations are impressed on the lead from the lower resistance voltage divider, which includes resistors R162 to R167, inclusive. In this case, a potentiometer is not used to adjust the voltage swings, but the lead is soldered to a point in the voltage divider at which the alternations are plus or minus with respect to a −150 volt potential on the cathode of V116. The approximately equal voltage swings from the lead connected to the lower resistance voltage divider control the d-c output circuit.

d. The polarity relationships at the grids, cathodes and plates of the tubes in the driver circuit from a mark signal are illustrated in B of figure 22. The diagram assumes that the lower portion of each discriminator produces a positive mark output. Opposite polarities are produced for a spacing signal. OUTPUT switch S102 is turned to position 2 (NORMAL) if the upper portion of each discriminator produces a positive mark signal. The cathode potential of driver amplifier tube V113 can be adjusted from 0 volt to about +17 volts by BIAS A potentiometer R155 (fig. 21). The adjustment is made to produce the 0-volt transition between output mark and space signals when the grid input to V113 is 0 volt.

29. Frequency-Drift Compensator Circuit

a. Under operating conditions, the 50- and 29.3-kc carrier frequencies may tend to drift from normal. If no compensator equipment were provided under such conditions, the telegraphic d-c output signals would be biased (distorted in relative length). To minimize the biasing effect, the output control circuit is equipped with a frequency-drift compensator circuit which may be connected to the driver circuit by operating DRIFT COMPENSATOR switch S104 to its IN position (fig. 21). To connect the drift-compensator circuit, OUTPUT switch S102 must be turned to a position (NORMAL OR REVERSE) which is opposite to the regular position when the circuit is not used. This is because of the voltage reversal introduced by the a-c amplifier (section 2–3–6 of tube V104) which is part of the drift-compensator circuit

b. When switch S104 is turned to the IN position 2–3–6 of tube V104 is connected to the output of the discriminator ahead of the driver circuit to amplify the mark and space signals. The input to the grid (pin 2) of tube V104 is through coupling capacitor C129, and the output (pin 6) of this tube to grid 1 of tube V111 is through capacitor C128. With this circuit arrangement, the d-c component of the discriminator output is removed so the voltage differences corresponding to mark and space signals can be made symmetrical, establishing a 0-volt level, approximately midway between the upper and lower voltage limits.

c. A voltage pulse corresponding to a mark or space signal is connected to the driver tubes, and is fed back to the input of the driver tubes to maintain the voltage conditions until the pulse of the opposite polarity (a space or mark signal) is delivered from the discriminator. The feedback circuits for locking in a signal condition include section 1–2–3 of tube V114 and section 4–5–6 of tube V111. The voltage pulses produced by the discriminator are connected through the AMP GAIN potentiometer R207 to the grid of tube V104. The grid is biased a few volts negative by the voltage divider consisting of resistors R208 and R210 (and R216 in the C and D models). The AMP GAIN potentiometer is set at a point to provide proper voltage changes at the grid (pin 2) of V104; for example, +.25 volt for a mark and −.25 volt for a space. The amplified plate-voltage variations might be, for example, ±15 volts, centered about a potential of +80 volts.

d. Capacitor C128 eliminates the d-c component of the voltage changes at the plate of V104, thus impressing pulses in the order of ±15 volts on grid 1 of tube V111. The pulses at the cathode of tube V111 are coupled to the grid (pin 4) of V113 through resistor R148, thereby driving the grid of tube V113 momentarily positive. When the grid of tube V113 is driven more positive, the tube plate current will increase, thereby lowering the voltage at the plate and, in turn, causing the potential at the slide arm of potentiometer R160 (BIAS B) to become more negative.

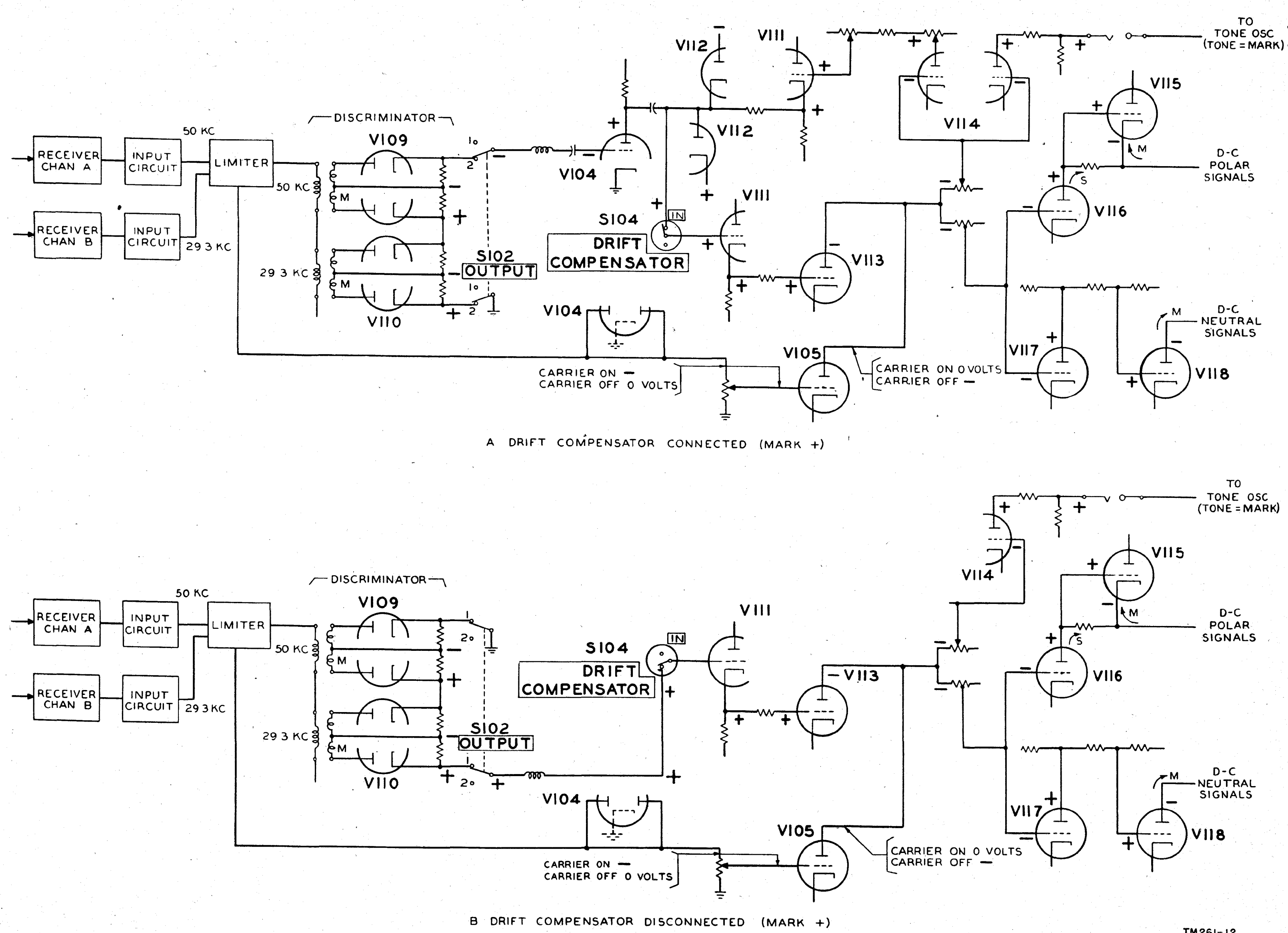


Figure 22. Polarity relationships.

Because the slider arm of potentiometer R160 is directly connected to grid 1 of tube V114, this tube will conduct less, and the voltage at its plate and at the slider arm of potentiometer R145 (COMP AMP) will increase. The slider arm of potentiometer R145 is connected to grid 4 of tube V111, a cathode follower. When the grid of the cathode follower is driven positive, the cathode will also be more positive and because the cathode is connected to grid 1 of tube V111 through resistors R213 and R144 and through switches S104 and S102, the grid (pin 1) of tube V111 will be held positive, even after the duration of the positive pulse from the plate of tube V104. Thus, the positive pulse, corresponding to a mark signal, will lock the driver circuit in the mark condition until a negative (space) signal is received. The negative pulse output from the plate (pin 6) of tube V104, corresponding to a space signal, will drive grid 1 of tube V111 negative, thereby reversing the polarities througout the drift compensator circuit, and providing a negative voltage at cathode 6 of tube V111 to hold the driver circuit in the space condition.

e. The COMP BAL and COMP AMP potentiometers are adjusted to produce ±15-volt variations at grid 1 of tube V111 (assuming that signal pulses in the order of ±15 volts are transmitted through capacitor C128). The COMP BAL potentiometer adjusts the voltage variations on plate 2 of V114 to produce equal mark and space swings, while the COMP AMP potentiometer adjusts the gain through section 4–5–6 of tube V111 to provide the proper voltage levels at cathode 6; for example, ±15 volts for mark and space signals. Meter B is connected across resistor R213 when METER B switch S105 is turned to the COMP AMP position. If the drift-compensator circuit is adjusted properly, the plate swings of tube V104 and the feedback voltage at cathode 6 of V111 are equal, as indicated by zero or small deflections of meter B when miscellaneous signals are received.

f. The foregoing information shows that, in response to a momentary pulse of mark-signal voltage (+15 volts), the feedback path produces a steady state potential of about +15 volts which locks until a space voltage pulse of the same magnitude, but of opposite polarity (−15 volts), is received. The circuit then locks in a similar manner for the space condition and awaits a mark pulse to unlock it. It is possible occasionally for a transmitted steady signaling condition (either mark or space) to change without unlocking the voltage established by the drift-compensator circuit. This can occur during testing or adjusting procedures, and results in the first signal-voltage pulse being of the same polarity as the locked-in voltage. The first signal-voltage pulse is, therefore, ineffective. Because of the time constant of the circuit, a comparatively long time is required to discharge capacitor C128 to a voltage low enough for a single-voltage transition to unlock the circuit. Several voltage transitions, therefore, may be lost if the signal speed is rapid. Limiter V112 (type 6H6) a duo-diode, protects the circuit against such a condition by clipping the peaks of pulses exceeding a maximum value of about ±15 volts, as determined by the setting of the LIMITER potentiometer. This arrangement of limiting the maximum voltage of the pulse signals minimizes the length of time required to resume normal keying. The LIMITER potentiometer is connected across the cathode (pin 4) and plate (pin 5) of tube V112, and between positive and negative voltages of two voltage dividers consisting of resistors R150 and R153, and resistors R149 and R151, respectively.

30. Carrier-Control Mark-Hold Circuit

a. The purpose of the carrier-control mark-hold circuit shown in the lower part of figure 21 is to hold a mark signal on the TT loop circuit should the incoming carrier fail or be shut off for any reason. As long as an incoming carrier signal is received over the radio link, a 50- and 29.3-kc frequency-shifted signal voltage will appear at the output of tube V103. The carrier voltage is applied to the duo-diode portion of dual-purpose tube V104. The diode elements of V104 shunt the positive peaks of the 50- and 29.3-kc carrier to ground, and establish a negative potential on grid 4 of V105 (type 6SJ7Y). Under this condition, no plate current flows in tube V105 and the tube has no effect upon the mark and space signals produced by driver tube V113. If, for any reason, the r-f carrier fails, the 50- and 29.3-kc carriers reduce to zero and the negative voltage on grid 4 of tube V105 is reduced to zero. Tube V105, therefore, will conduct and produce the same effect at the plate (pin 8) of driver tube V113 as exists when a mark signal is transmitted through the driver circuit. This condition is maintained as long as the carrier is shut off, but is removed automatically as soon as the carrier is again received.

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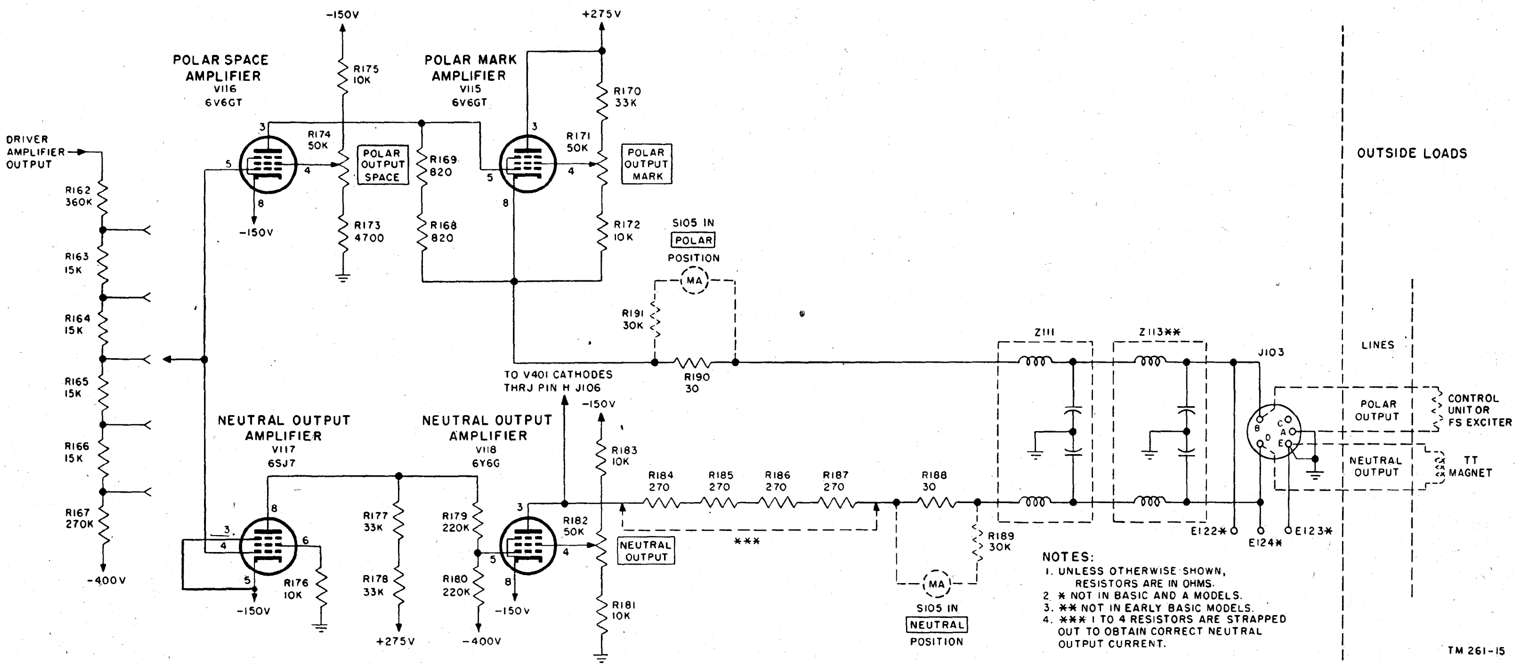


Figure 23. Output amplifiers.

b. In the lettered models, switch S106 is provided to disable the mark-hold circuit. It is operated by a cam mechanism on the shaft of MARK HOLD LEVEL control (R109). Turning the control fully counterclockwise opens S106. Normally, S106 is in the closed position, and in this position the cathode of tube V105 is connected to ground. Operating this switch to the open position opens the cathode circuit of V105 and makes the tube inoperative. This position of the switch is desirable during adjustment of the equipment and when receiving weak signals, for at these times increased sensitivity is required.

31. D-C Output Circuit

a. *General*. The d-c output amplifier tubes (fig. 23) convert the output of the driver circuit into polar and neutral telegraph signals. Two tubes, V115 and V116 (type 6V6GT), are used to produce the polar signals and two other tubes, V117 (type 6SJ7) and V118 (type 6Y6G), are used to produce the neutral signals. The input to the control grids of tubes V116 and V117 is from a point on the voltage divider in the plate circuit of tube V113 (fig. 21) where essentially equal plus and minus alternations are produced. This point on the voltage divider is determined by voltmeter tests. The voltage on this lead is negative with respect to the −150-volt potential on the cathode of the two tubes when a mark signal is transmitted, and positive with respect to this potential when a space signal is transmitted (fig. 22). The alternation of the voltage from plus to minus is controlled by driver tube V113.

b. *Polar Signals*.

(1) Polar output tubes V116 and V115 are connected in such a manner that one tube conducts while the other tube is cut off and vice versa. The voltage on control grid 5 of tube V116, as shown in figure 22, is minus (−) for a mark signal and plus (+) for a space signal.

(2) When a mark signal is transmitted, the minus potential on the control grid of tube V116 cuts off this tube. Therefore, the plate current from V116 stops flowing through resistors R169 and R168 (fig. 23), putting both ends of these resistors at the same potential. Since the control grid and the cathode of tube V115 are connected to the ends of these resistors, tube V115 conducts. The electron path is from the +275-volt supply to ground (pin A of J103), through the line to the outside load (or control unit), and back to pin B of J103, thence through filters Z113 and Z111 and resistor R190 to the cathode of V115, and through the tube to the +275-volt supply. When V115 conducts, it presents a relatively low resistance to the flow of electrons from the ground to the +275-volt supply. This effectively places approximately +275-volts at pin B at J103. The screen-grid voltage of tube V115 is varied by potentiometer R171 (POLAR OUTPUT MARK), which is connected as part of a voltage-divider circuit with resistors R170 and R172. This potentiometer is adjusted to produce a mark output current of approximately +25 ma.

(3) When a space signal is transmitted, the d-c output voltage from V113 is positive with respect to the −150 volts on the cathode of V116 so that tube V116 conducts. The plate-current flow is from the −150-volt supply to the V116 cathode, through V116, from plate pin 3 through resistors R169, R168, and R190, through filters Z111 and Z113 to pin B of J103, out over the line to the load (or control unit), then back over the line to pin A of J103, and thence to ground in the power supply of the converter unit. The voltage drop through resistors R168 and R169 produces a negative grid bias for tube V115 sufficiently high to cut off that tube. The screen voltage of tube V116 is adjusted by potentiometer R174 (POLAR OUTPUT SPACE) which is connected as part of a voltage-divider circuit which includes resistors R173 and R175. This potentiometer is adjusted to produce a space output current of approximately 25 ma.

(4) The polar currents which flow through filter Z111 (in the C and D models, to a second filter, Z113) to pin B of J103 also pass through shunt resistor R190 which is across meter M102. Meter M102 is connected in series with resistor R191 and will read milliamperes directly when METER B switch S105 is set in the POLAR position. The

function of filters Z111 and Z113 is to reduce any extraneous noise that may be picked up by the control line between J103 and the load or control unit.

c. Neutral Signals.

(1) Tubes V117 and V118 alternately conduct and cut off to produce neutral telegraph signals. When a mark signal is transmitted, a negative voltage potential is connected from the output of driver tube V113 to the control grid of tube V117. This voltage is sufficient to cut off tube V117. The plate voltage for tube V117 and the grid voltage for tube V118 are obtained from separate points on a voltage divider consisting of resistors R177, R178, R179, and R180 in series across the +275-volt and −400-volt supplies. This arrangement produces a voltage at the control grid of V118 which is positive with respect to the cathode voltage when tube V117 is cut off, and negative when tube V117 is conducting.

(2) When tube V117 is cut off, tube V118 conducts. The electron flow leaves the −150-volt supply, flows through V118 and then, from the plate (pin 3) of V118, flows through resistors R184, R185, R186, R187, and R188, then through filters Z111 and Z113 to pin D of J103, out through the line to the TT equipment, back through the line to pin E of J103, and thence through ground in the converter unit to the −150-volt supply. When tube V118 conducts, it presents a very small resistance to the flow of plate current, and because its cathode is tied to −150 volts, pin D at J103 in effect assumes the same potential of −150 volts. The four resistors, R184 to R187 inclusive, are not strapped out if the TT is located within the radio receiving station. By strapping out resistors R184 to R187, the station can be located at the end of a circuit not exceeding 1,800 ohms resistance (equivalent to about a mile of 19-gage cable). Resistor R188 acts as a meter shunt for meter M102. M102, in series with multiplier R189, is connected across meter shunt R188 to indicate directly in milliamperes when METER B switch S105 is set on NEUTRAL (position 4). The screen-grid voltage of tube V118 is adjustable by means of potentiometer R182 (NEUTRAL OUTPUT) which is connected as part of a voltage-divider circuit (in series with resistors R181 and R183). This control is provided to adjust the neutral loop current to a value of approximately 60 ma for mark signals.

(3) When a space signal is transmitted, tube V117 conducts, causing the voltage at the grid of V118 to go sufficiently negative to cut off the tube. With V118 cut off, no current flows in the neutral output circuit.

d. Connections. In the B through D models, three additional binding posts are added on the rear of the unit. These binding posts, E122, E123, and E124, are connected respectively to terminal 2 of suppressor filter Z113, pins A and E of jack J103, and to terminal 4 of suppressor filter Z113. Neutral and polar connections can be made directly to the converter through these connections. When the special cords for the converter unit (such as those included with Radio Set AN/MRC–2) are unavailable, these binding posts may be used.

32. Metering Circuits

The frequency-shift converter is provided with microammeters M101 and M102 for checking the operation of the various circuits. Meter M101 is connected permanently, in series with current limiting resistor R211, across terminals 7 and 8 (output) of discriminator Z109. This meter measures the channel A discriminator output current (fig. 17). Meter M102 is connected to terminals 12 of the A and B sections of METER B switch S105. This switch has the following 11 positions (fig. 24):

a. CHAN B Position. In position 1, meter M102 measures the relative discriminator output from channel B (transformer Z110). It is connected, in series with current limiting resistor R212, across terminals 7 and 8 of Z110.

b. CHAN A + B Position. In position 2, meter M102 provides a relative indication of the cathode current of V111A. This current is composed of the added outputs of both the A and B channels. The voltage applied to the grid of driver amplifier V113 is directly proportional to this cathode current.

c. POLAR Position. In position 3, meter M102

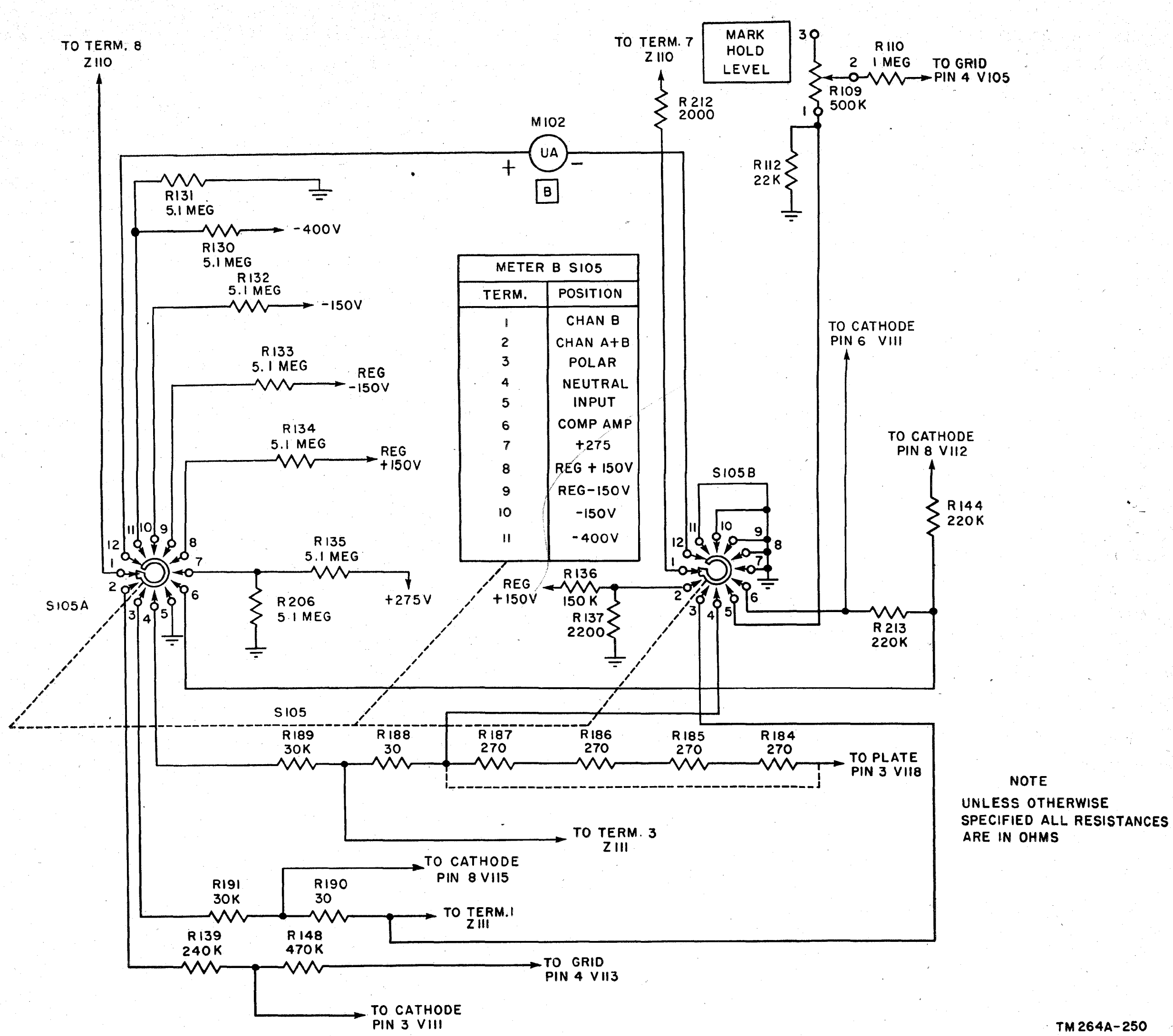


Figure 24. Metering circuits.

measures the d-c current of the polar output loop. Terminals 3 of switch S105 are connected across the meter in series with shunt R190 and multiplier R191. The full polar output current flows through R190.

d. NEUTRAL Position. In position 4, meter M102 measures the d-c neutral loop current. The meter, in series with multiplier R189, parallels shunt R188. The full neutral loop current (60 ma) flows through R188.

e. INPUT Position. In position 5, meter M102 is shunted across resistor R112 in the grid circuit of the mark hold tube (V105). It indicates the input voltage applied to the mark hold circuit.

f. COMP AMP Position. In position 6, meter M102 is connected across resistor R213. If the drift-compensator circuit is adjusted properly, the voltages at the cathode of V111B and at the R213 end of R144 will be equal. This will show up as zero (or small) deflection on meter M102 while miscellaneous (or RY tape) signals are being received.

g. +275 V Position. In position 7, meter M102 is connected across meter shunt R206 and, through multiplier R135, to the positive 275-volt supply. The meter indicates the output voltage of this supply.

h. REG +150 V Position. In position 8, meter M102 is connected to the regulated +150-volt supply through multiplier R134. It indicates the output voltage of this supply.

i. REG −150 V Position. In position 9, meter M102 is connected to the regulated −150-volt supply through multiplier R133. It indicates the output voltage of this supply.

j. −150 V Position. In position 10, meter M102 is connected to the unregulated −150-volt supply through multiplier R132. It indicates the output voltage of this supply.

k. −400 V Position. In position 11, meter M102 is connected across meter shunt R131 and through multiplier R130, to the negative 400-volt supply. It indicates the output voltage of this supply.

Section III. POWER SUPPLY AND TONE OSCILLATOR

33. Block Diagram

Rectifier Power Unit PP–193(*)/TRA–7 furnishes all operating power for the dual diversity converter and Oscillator O–41(*)/TRA–7. A block diagram of the power supply and of the tone oscillator is shown in figure 25. The power supply uses three rectifier tubes and two regulator tubes to give d-c outputs of −150 volts, +275 volts, −400 volts, regulated +150 volts, and regulated −150 volts. The tone oscillator uses a single tube and provides a circuit for indicating mark intervals by means of audible tones in a headset. It also provides circuits for disabling the radio receivers associated with the converter when transmission is taking place on or near the receiving frequency. A complete schematic diagram of the power supply is shown in figure 73, and a schematic diagram of the oscillator unit in figure 74.

34. Power Input Circuit
(fig. 26)

a. The 115-volt, 50- to 60-cycle primary power supply is connected by a cable assembly (such as Cord CX–954/TRA–7) to receptacle J104 on the converter. The power leads then are connected through filter Z112, located in the converter unit, to terminals 7 and 8 of E301 in the power supply, through contacts of safety interlocks

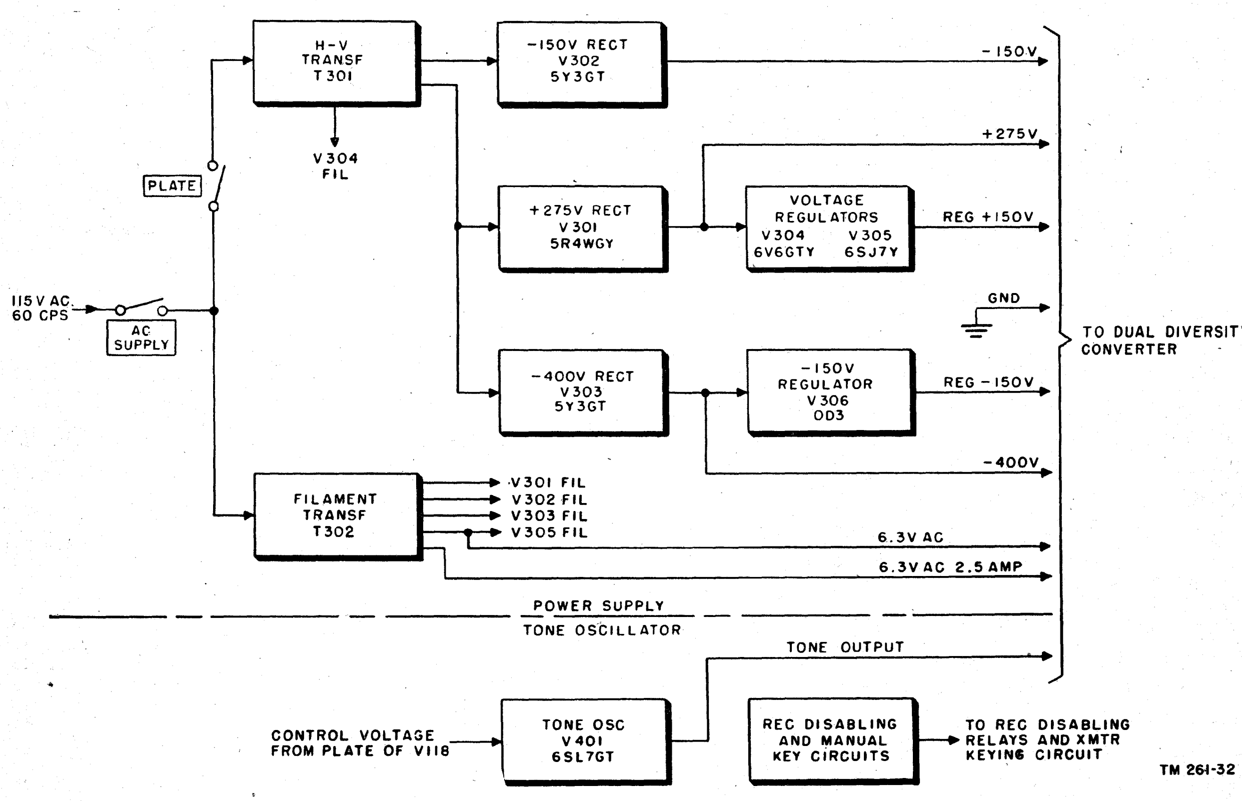
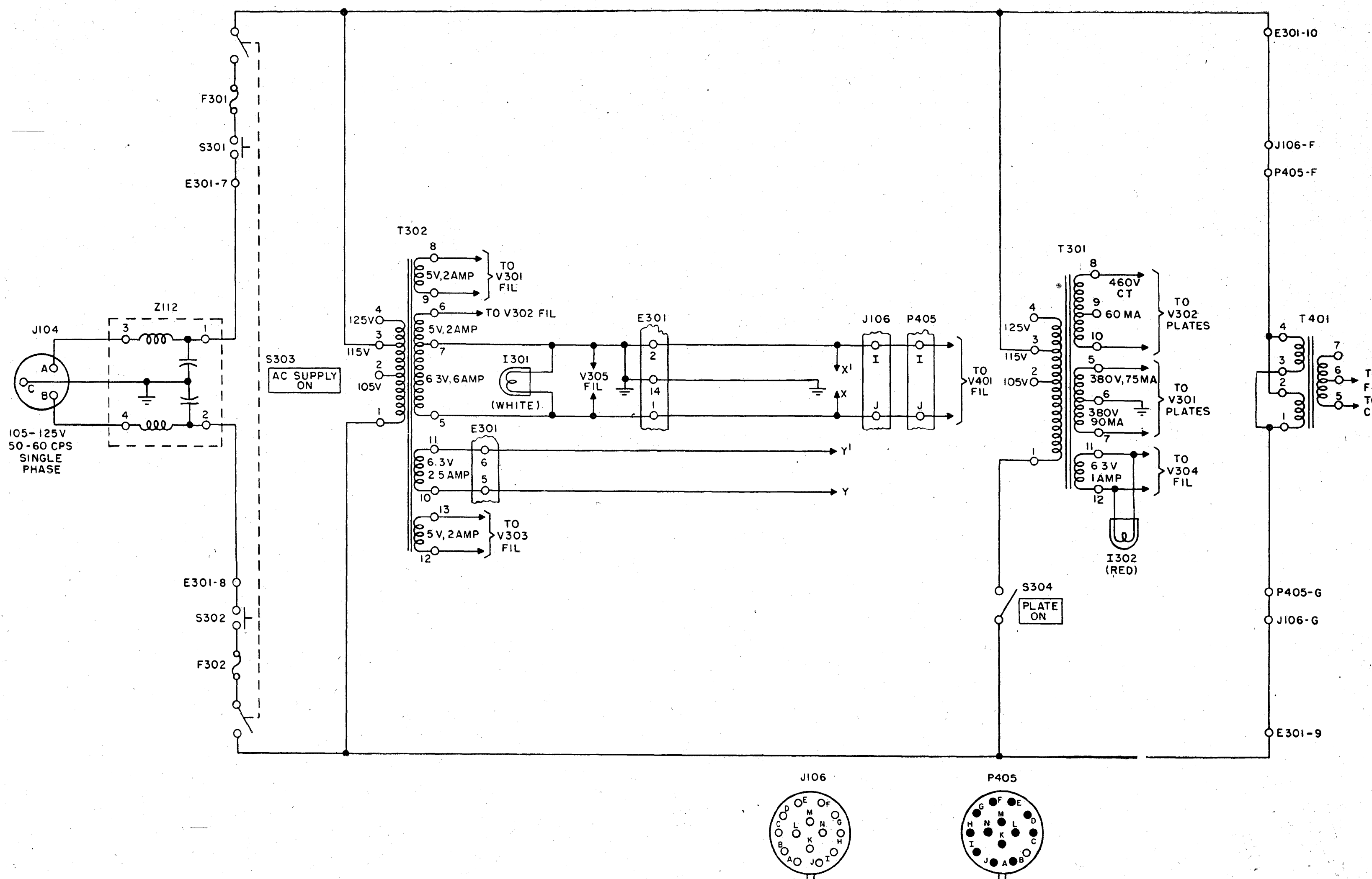


Figure 25. Block diagram of power unit and tone oscillator.



NOTES:

1. PARTS HAVE A DIFFERENT SERIES OF REFERENCE SYMBOLS, DEPENDING UPON THE UNIT IN WHICH THEY ARE LOCATED THE LEGEND IS AS FOLLOWS
   - 100 SERIES – CONVERTER UNIT
   - 300 SERIES – POWER SUPPLY UNIT
   - 400 SERIES – TONE OSCILLATOR SECTION
2. FOR PURPOSES OF SIMPLICITY, JACK, PLUG, AND TERMINAL CONNECTIONS ARE NOT SHOWN COLLECTIVELY P405-G IS TERMINAL "G" ON P405, E301-9 IS TERMINAL "9" ON TERMINAL STRIP E301, ETC.

TM 261-36

Figure 26. Power input circuit.

S301 and S302, and through the two 3-ampere fuses, F301 and F302, to the contacts of AC SUPPLY switch S303. When the AC SUPPLY switch is closed, the primary power voltage is connected to the primary winding of transformer T302, to contacts of PLATE switch S304, and to transformer T401 in the oscillator unit.

b. Winding 8–9 of transformer T302 supplies 6.3 volts for the filaments of the 275-volt rectifier, V301. Winding 6–7 supplies 5 volts for the −150-volt rectifier. Winding 5–7 energizes the white AC SUPPLY indicator lamp, I103, supplies filament voltage (6.3 volts) to d-c amplifier V305, to tone oscillator V401, and to various tubes in the converter unit (marked X–X′ on figures 71 and 72). Winding 10–11 supplies filament voltage (6.3 volts) to various tubes in the converter unit (marked Y–Y′ on figures 71 and 72). Winding 13–14 supplies 5 volts to the filaments of the −400-volt rectifier, V303.

c. Transformer T401 supplies approximately 23 volts to the disk-type rectifier, CR401, which is used in the receiver disabling circuits (par. 39).

d. When PLATE switch S304 is placed in the ON position, transformer T301 is energized, secondary winding 11–12 supplies 6.3 volts to the red PLATE indicating lamp, I302, and to the filaments of the +150-volt regulator tube, V304. Winding 5–6–7 supplies approximately 760 volts a-c to the plates of the +275-volt rectifier, V301, and approximately 380 volts a-c to the filaments of the −400 volt rectifier, V303. Winding 8–9–10 supplies approximately 460 volts a-c to the plates of the −150-volt rectifier, V302.

35. +275-, −400-, and Regulated −150-volt Supplies

(fig. 27)

a. Full-Wave Rectifier for +275-Volt Supply. Rectifier V301 (a type 5R4GY tube), winding 8–9 of transformer T302, and winding 5–6–7 of transformer T301 are connected to provide a nonregulated +275-volt supply. This supply is filtered by series choke coil L301 and capacitors C301 and C302. The output of the supply is connected through terminal 3 of terminal board E301 to all points in the converter requiring +275 volts (marked +275 V on figures 71 and 72). The 275-volt potential is supplied also to V304 to derive a regulated +150-volt supply (par. 36).

b. Half-Wave Rectifier for −400-Volt and Regulated −150-Volt Supplies. Rectifier V303 (a type 5Y3GT tube), winding 12–13 of transformer T302, and winding 6–7 of transformer T301 are con-

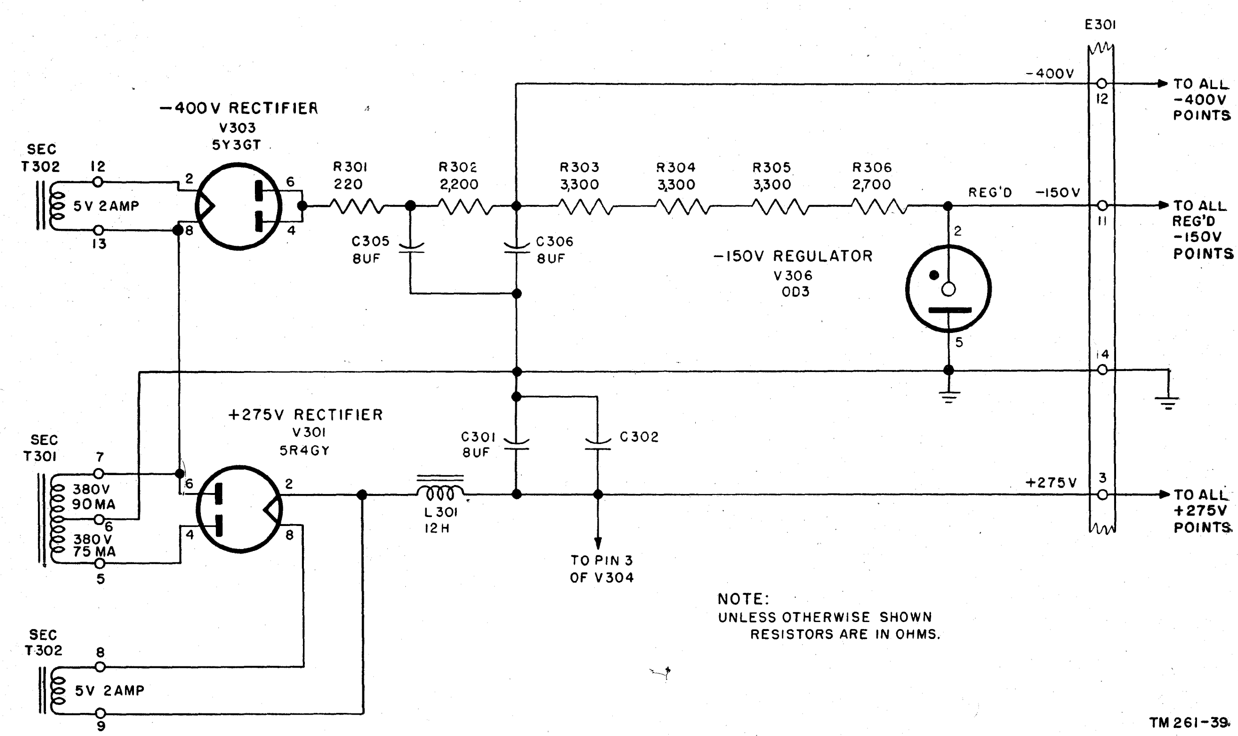


Figure 27. +275-, −400-, and regulated −150-volt supplies.

nected in a half-wave rectifier circuit to provide two negative supplies: a −400-volt supply, and a regulated −150-volt supply. The output of tube V303 is filtered by resistors R301 and R302 and capacitors C305 and C306. The −400-volt output from the filter is connected through terminal 12 of E301 to the converter unit. Resistors R303 through R306 are connected as current limiters in series with V306 across the −400 volt supply. Tube V306 (a type OD3) is a gas regulator tube. The regulated −150-volt potential at the cathode of V306 is connected through terminal 11 of E301 to the converter unit.

36. Regulated +150-volt Supply

(fig. 28)

a. A regulated +150 volts is obtained from the +275-volt supply through the parallel circuits consisting of resistors R318 through R321 and variable impedance tube V304 (a type 6V6). The impedance of tube V304 varies in proportion to its plate current, which in turn is controlled by the grid voltage. The potential connected to control grid 5 of tube V304 is influenced by the plate output of d-c amplifier control tube V305 (a type 6SJ7), which, in turn, is affected by the voltages on its screen grid and control grid.

b. The screen grid of tube V305 is connected to the junction of voltage divider resistors R309 and R310, which are connected from the +275-volt supply lead to ground. The control grid of V305 is connected to a voltage divider consisting of resistors R311 to R317, inclusive, which are in series between the regulated +150-volt and regulated −150-volt supply leads. This circuit arrangement maintains the required voltage difference between the regulated +150- and the regulated −150-volt outputs.

c. A tendency for the voltage of the screen or the control grid to become more positive results in a larger plate current for tube V305. The increased plate current produces a larger voltage drop across plate load resistor R308, which re-

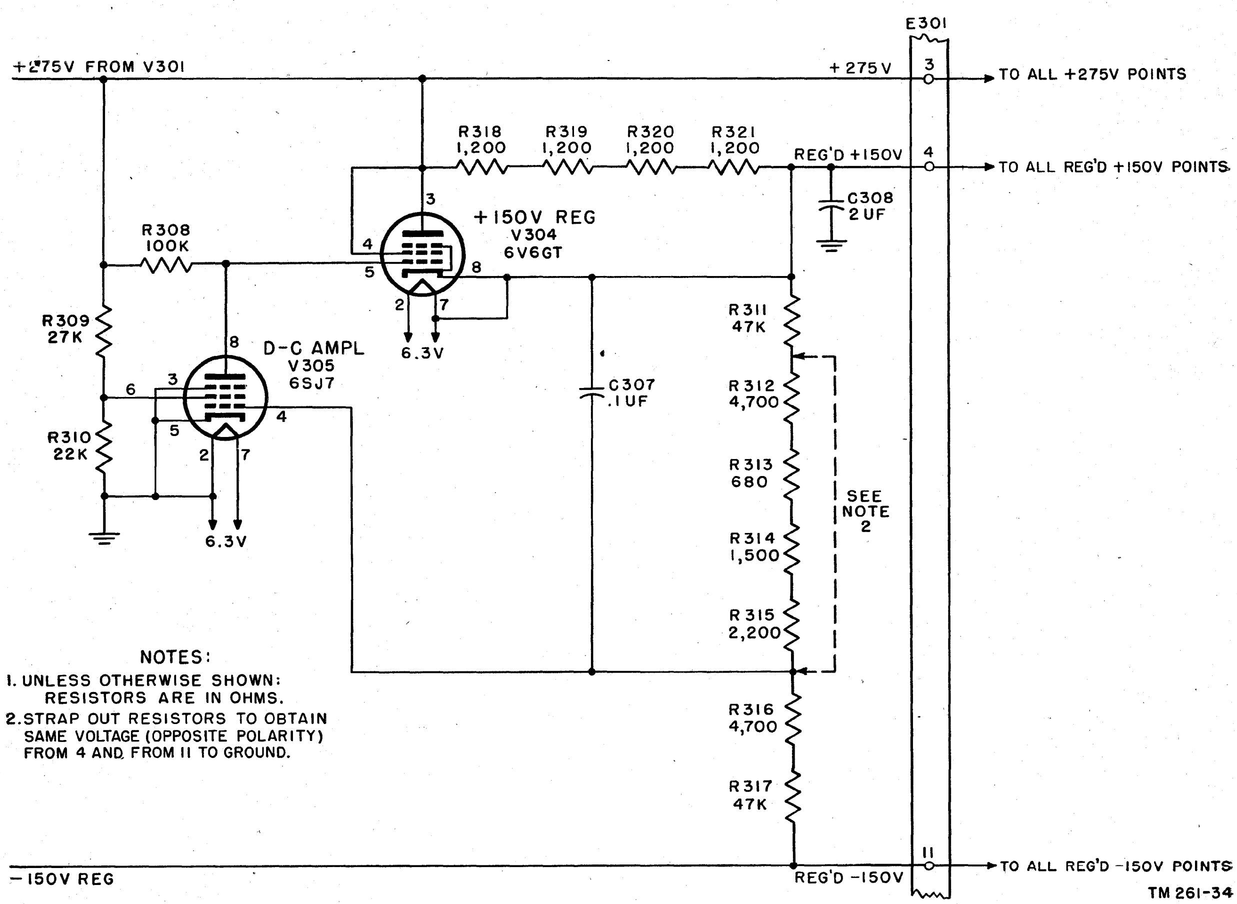


Figure 28. Regulated +150-volt supply.

sults in a less positive voltage on the control grid of tube V304. The reduction of the control-grid voltage on tube V304 is accompanied by a decreased plate current for this tube, or, conversely, an increase in impedance. This reduces the tendency of the regulated +150-volt supply output to increase.

d. The preceding sequence of events occurs if the +275 volts tends to increase in a positive direction, or if the difference between the regulated +150-volt and the regulated −150-volt supply voltages tends to increase. The changes occur almost instantaneously, thereby holding the regulated +150 volts virtually constant.

e. An opposite effect is produced if the +275 volts tend to decrease, or if the regulated −150 or regulated +150-volt potentials tend to change in a direction that reduces the difference in voltage between the two. When this happens, however, the plate current of amplifier tube V305 is reduced, resulting in a higher plate voltage, which subsequently produces a higher grid voltage at tube V304. This increases the plate current of tube V304 and reduces the impedance of the tube, thus reducing the tendency of the regulated +150-volt supply to decrease. Capacitor C307 is connected from the regulated +150-volt lead to the control grid of tube V305 to provide a low-impedance path for a-c variations. Accordingly, the regulating circuit tends to smooth out any a-c ripple and low-frequency variations arising from power-line voltage changes, load changes, etc.

f. Resistors R312 to R316, inclusive, are strapped in the factory to provide a regulation which maintains the difference between the regulated +150-volt supply and the regulated −150-volt supply within ±3 volts. If necessary—as a result of replacing parts in the circuit, for example—these resistors can be strapped differently in the field to establish the regulation of +150-volt supply within the required limit. If the +150-volt supply voltage is too high, resistors R312 to R315 may be strapped out as required to meet the 3-volt limit. If the voltage is too low, the voltage may be raised by short-circuiting resistor R316. Then resistors R312 to R315 may be shorted out, as required, to meet the 3-volt tolerance.

37. −150-volt Supply

Rectifier V302 (a type 5Y3GT tube), winding 6–7 of transformer T302, and winding 8–9–10 of transformer T301 are connected to provide a nonregulated −150-volt supply (fig. 29). This supply is filtered by series choke L302 and capacitors C303 and C304, which are connected in a choke-input circuit. A bleeder load of 33,000 ohms (R307) is connected permanently across the −150-volt supply. The output of this supply is connected through terminal 13 of E301 to the converter unit.

38. Tone Oscillator and Emergency Keying Circuits
(figs. 30 and 31)

a. General. The tone oscillator provides an audible means of indicating mark intervals by tones in a headset. The components of the tone oscillator and the disabling-relay circuit (par. 39)

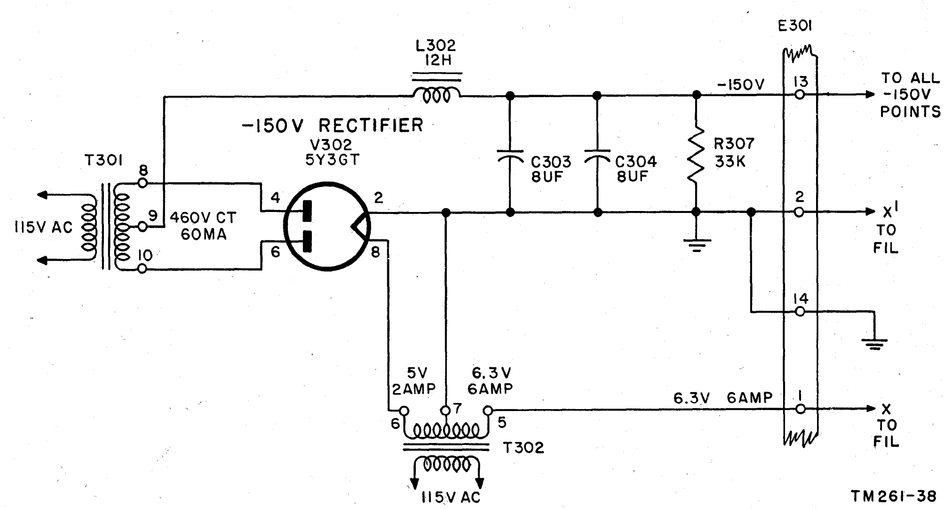


Figure 29. −150-volt supply.

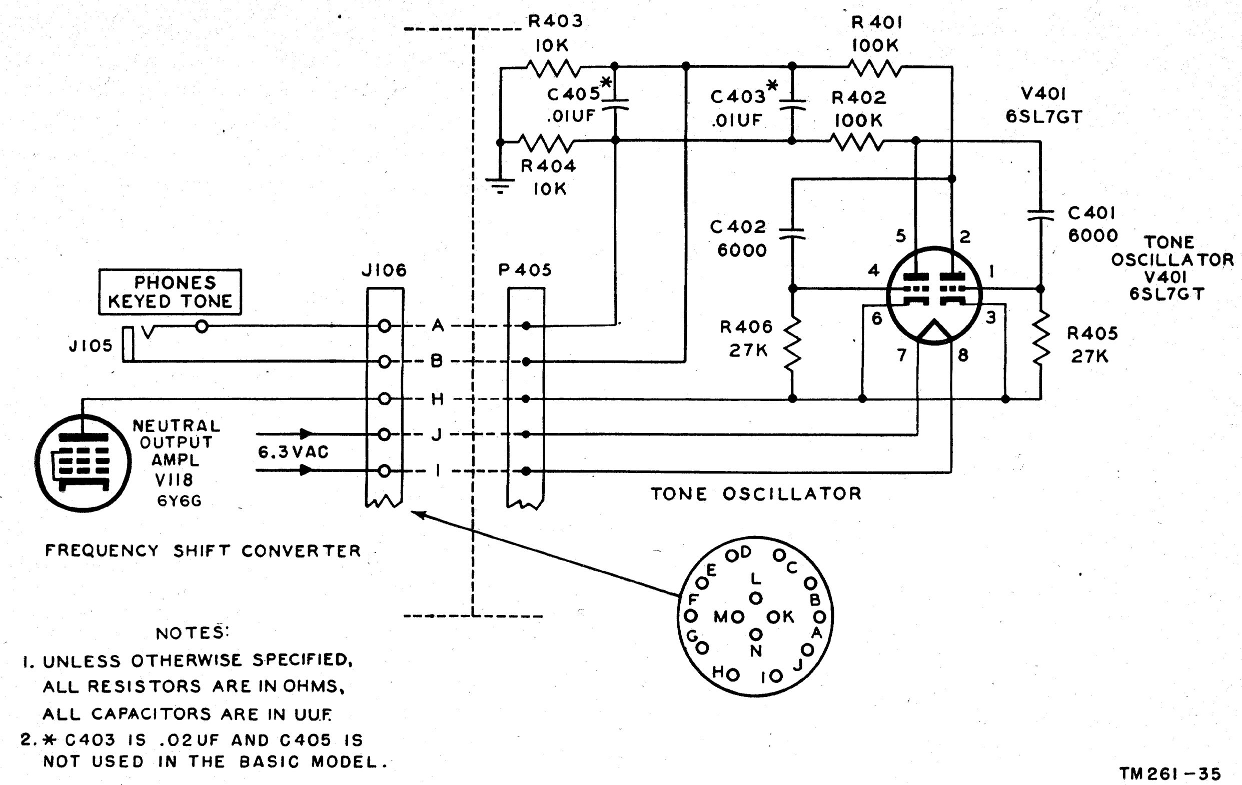


Figure 30. Tone oscillator.

are mounted as a separate subunit of the dual diversity converter. This subunit has been assigned nomenclature Oscillator O–41(*)/TRA–7, but was issued with the basic model of the converter without separate nomenclature. The oscillator is connected to the main chassis by plug P405 and receptacle J106. Three receptacles on the subunit can be extended by cable assemblies to other equipment in system applications. For example, in Radio Set AN/GRC–26 and AN/MRC–2 as follows:

(1) Receptacle J402 connects the equipment to the disabling relay of radio receiver A.

(2) Receptacle J403 connects the equipment to the disabling relay, of radio receiver B.

(3) Receptacle J404 connects the equipment to a telegraph key for emergency hand keying and to the radio receiver disabling key of a control unit (such as Control Unit C–292(*)/TRA–7).

(4) Receptacle J401 is not used normally.

b. Tone Oscillator.

(1) During normal operation, the mark and space signals at the plate of tube V118 (figs. 23 and 30) cause dual-triode relaxation oscillator V401 to produce tone when a mark signal is received, and to cut off during a space interval. During the space interval, tube V401 is cut off, because its plates, grids, and cathode terminals are all at ground or 0-volt potential. During a marking interval, the negative voltage pulse on the plate of neutral output amplifier tube V118 appears on the cathodes of tube V401. Because the plate is at ground potential, it is positive with respect to the cathode and the tube conducts, thus causing oscillations to start. Feedback for oscillation is from the plate of one section of the twin triode to the grid of the other section. and vice versa, as in a basic free-running multivibrator. The frequency of oscillation is determined by the R-C (resistance-capacitance) time constant of feedback capacitors C401 and C402 and grid-leak resistors R405 and R406.

(2) A portion of the output voltage of V401, at the junctions of resistors R401 and R403 and R402 and R404 in the plate circuit of the oscillator, is connected

through terminals A and B of P405 and J106 to PHONES KEYED TONE jack J105. Capacitor C403 (C403 and C405 in the A model), which is bridged across the monitoring leads, bypasses the higher harmonics of the relatively square-wave output of relaxation oscillator V401 to produce a more nearly sine-wave voltage in the monitoring headphones.

c. Emergency Hand Keying.

(1) For emergency hand keying, OUTPUT switch S102 of the converter unit (fig. 31) must be set to the SPACE position (contacts 4 and 5 together). This position of switch S102 connects the grid (pin 1) of tube V111 to the junction point of resistors R126 and R128, which are connected in series between ground and the regulated −150-volt supply. The negative voltage across resistor R126 cuts off tube V111 which, in turn, cuts off tube V113, causing a space signal to be transmitted over the d-c loops. As shown in figures 31, 71, and 72, the plate of tube V113 is connected through contacts 4 and 5 of switch S102 (bank B) to the contacts of a telegraph key. The plate circuit of carrier-control mark-hold tube V105 is opened when the OUTPUT switch is in the SPACE position. This prevents tube V105 from establishing a steady mark on the d-c loops when the carrier is shut off.

(2) The operation of a telegraph key places ground on the plate pin of driver tube V113 (if switch S102 is in the SPACE position), thus changing the plate potential from a positive value to a less positive value in approximately the same manner as though tube V113 was changing from a nonconducting condition to a conducting condition in response to a received mark signal. Accordingly, the operation of the telegraph key results in the keying of the polar and neutral output amplifiers. Polar space amplifier V116 conducts for the key-up condition; polar mark amplifier V115 conducts for the key-down condition. Neutral output amplifier V118 conducts for the key-down condition and cuts off for the key-up condition. The polar loop can be used for frequency-shift hand keying (by connection to an exciter such as Frequency Shift Exciter 0–39(*)/TRA–7); the neutral loop can be used for c-w hand keying in any application which requires an on-off current condition for keying.

39. Disabling of Radio Receivers
(fig. 31).

a. Relay K401 and the disabling relays of the two radio receivers normally are not operated. In this state, the radio receivers are connected for reception. With one-way reversible operation, the *service switch* on the control unit is set at *one way* before operation is started. One end of the winding of relay K401 is connected to the regulated +150-volt supply through current limiting resistor R409. The other end of the winding is connected through pins C and D of jack J404 and through the contacts of the *service* switch in the control unit to ground. Relay K401, therefore, will operate, and its contacts connect the disabling relays of the two radio receivers to about 20 volts, developed across resistor R410 by the output of a small, full-wave, disk-type rectifier, CR401. The disabling relays in the radio receivers thus are operated to short-circuit the receiving antennas. This is necessary to protect the sensitive receiver circuits, since, in one-way operation, the same carrier frequency that is used for reception is used also for transmission to the distant radio receiving station.

b. Disk-type rectifier CR401 is connected to the 50- to 60-cycle secondary voltage of transformer T401, when the contacts of relay K401 are closed in the operated (energized) position. The a-c secondary supply is protected by fuse F401. The primary a-c voltage for transformer T401 is tapped off the normal 115-volt, 50- to 60-cycle supply to the converter unit at terminals 9 and 10 of terminal board E301. This 115-volt supply is opened and closed by the contacts of the a-c supply switch of the converter unit. The lower contact (4) of relay K401 places ground on plate pin 8 of tube V105, through the N contacts of P405 and J106, when this relay is operated. This insures that a steady marking condition is established on the line to the operating shelter when the receiving circuits are cut off.

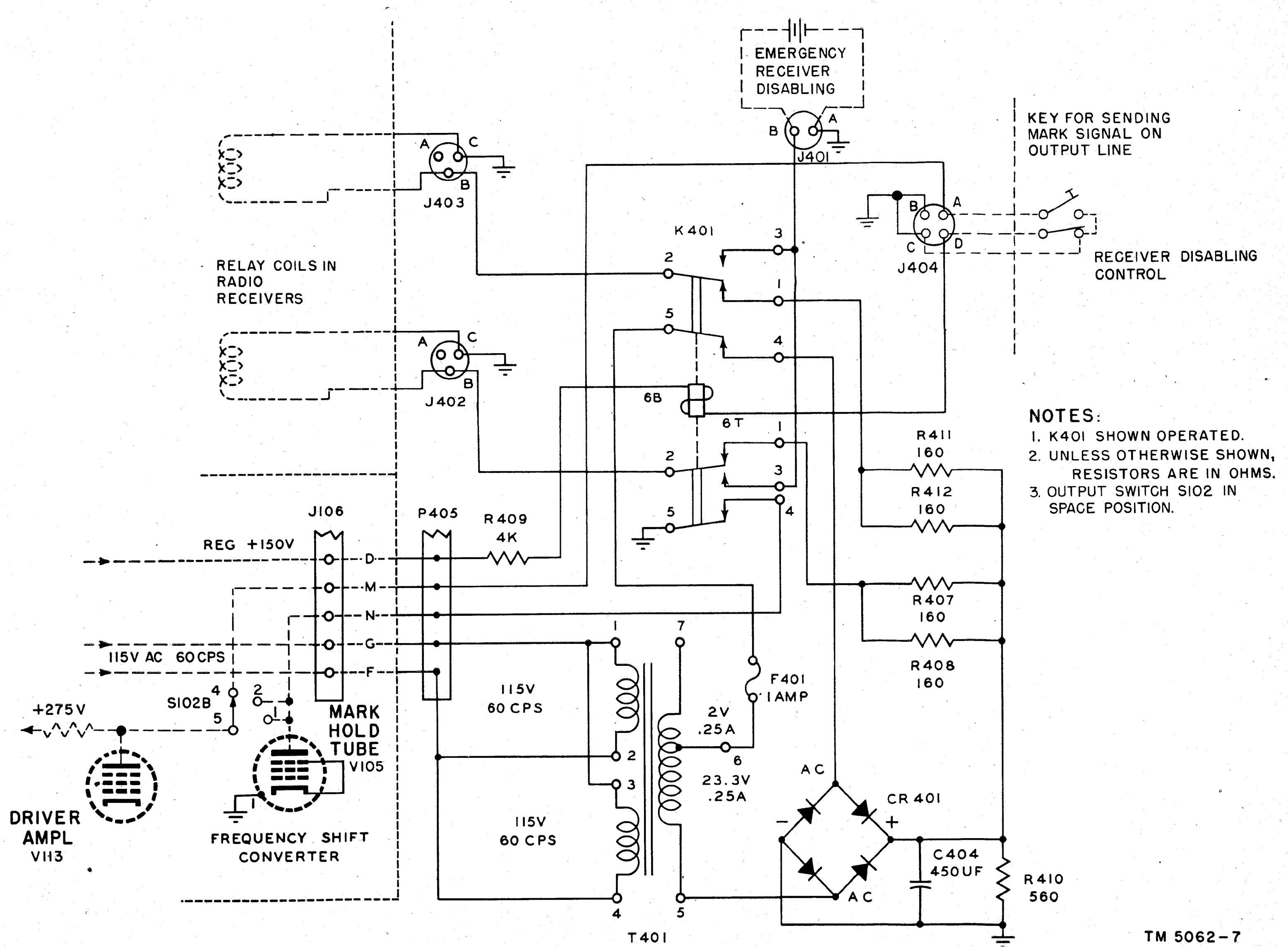


Figure 31. Disabling circuit of Oscillator O–41(*)/TRA–7.

CHAPTER 4

FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available, and by the skill of the repairman.

Section I. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

Warning: Certain precautions must be followed when measuring voltages above a few hundred volts. High voltages can cause a fatal accident. When it is necessary to measure high voltages, observe the following rules: First, connect the proper voltmeter lead to the circuit ground. Then place one hand in pocket. This will eliminate the possibility of making accidental contact with another part of the circuit, thus causing the electricity to travel from one hand to the other through the body. If the voltage is less than 300 volts, connect the remaining test lead to the hot terminal (which may be either positive or negative with respect to ground). If the voltage is greater than 300 volts, shut off the power; then connect the hot lead, turn on the power, and note the reading on the voltmeter. Do not touch any part of the voltmeter, particularly when it is necessary to measure the voltage between two points both of which are at some potential with respect to ground. Before touching any part after the power is shut off, short the part to ground.

40. Trouble-shooting Procedures

The first step in trouble shooting a defective dual diversity converter is to sectionalize the fault. To sectionalize means to trace the fault to the *major circuit* responsible for the abnormal operation of the equipment. The second trouble-shooting step is to localize the fault. To localize means to trace the fault to the defective *part* responsible for the abnormal operation. Some faults, such as burned-out resistors, r-f arcing, and shorted transformers, often can be located by sight, smell, and hearing. The majority of troubles, however, must be located by checking voltage and resistance and then comparing the observed results with the voltage and resistance charts.

41. Test Equipment Required for Trouble Shooting

The test equipment require for trouble-shooting Dual Diversity Converter CV-31(*)/TRA-7 is listed below. The technical manuals associated with the test equipment are listed also.

Test equipment	Technical manual
Tube Tester I-177, or equal	TM 11-2627.
Electronic Multimeter TS-505/U, or equal.	TM 11-5511.
Signal Generator SG-15/PCM, or equal.	TM 11-2096.
Signal Generator I-72, or equal	TM 11-307.
Oscilloscope OS-8A/U, or equal	NAVSHIPS 91, 272.
Decibel Meter TS-399/U, or equal	TM 11-2045.
Frequency Meter Set SCR-211-(*), or equal.	TM 11-300.

42. Visual Inspection

a. Failure of the equipment to operate properly usually will be caused by one or more of the following faults:

(1) Defective power cable.
(2) Worn, broken, or disconnected cords or plugs.
(3) Burned-out fuse.
(4) Wires broken because of excessive vibration.
(5) Loose or defective tubes.

b. When failure is encountered, and the cause is not immediately apparent, check as many of the items above as is practicable before disassembling the equipment for detailed examination. If possible, obtain information from the operator regarding performance at the time trouble occurred.

43. Checking B+ Circuits for Shorts

a. Trouble within the dual diversity converter often may be detected by checking the resistance of the high-voltage circuits to ground before applying power to the equipment, thus preventing damage to the power supply. Check for the following resistance readings between terminals of E301 and ground before attempting to put the unit into operation; leave the main power cable disconnected while taking the measurements.

(1) From terminal 3 (+275-volt supply), the resistance should be 10,000 ohms.

(2) From terminal 4 (regulated +150-volt supply), the resistance should be 8,000 ohms.

(3) From terminal 11 (regulated −150-volt supply), the resistance should be 19,000 ohms.

(4) From terminal 13 (−150-volt supply), the resistance should be 15,000 ohms.

(5) From terminal 14 (ground), the resistance should be zero.

(6) From terminal 12 (−400-volt supply), the resistance should be 30,600 ohms.

b. If the measured resistances differ materially from the values listed, first check the filter capacitors associated with the particular supply. Then look in the associated equipment circuits for leaky or shorted capacitors, or for resistors that have changed values.

44. Test Set-up and Operational Check

a. General. A bench check of the dual diversity converter unit, for observation and for determination of faulty operation, can be accomplished with a minimum of equipment and parts. The test set-up shown in figure 32 is required.

b. Meter B Checks. The satisfactory operation of the converter depends upon the proper voltages being applied to the various tube elements. These voltages may be checked regularly by observing the rectified output voltages of the power supply.

(1) Measure the input voltage to the primary of power transformers T301 and T302 and adjust this voltage at the time of installation to 105, 115, or 125 volts. Check to see that connections are made to the proper taps on the primaries of these transformers so that the voltage will correspond to the voltage actually supplied to the equipment when in use.

(2) To check the output voltages of the power supply unit, turn the METER B knob successively to the position indicated and see that the readings are within the limits shown below.

METER B switch position	E301 terminal No. to ground	Actual voltage E	METER B reading
+275V	3	+280 ±15	E/5 ±9.
REG +150V	4	(*)	E/5 ±10.
REG −150V	11	−145 to −160	E/5 ±10.
−150V	13	−150 ±10	E/5 ±10.
−400V	12	−400 ±20	E/5 ±15.

* Within ±3 volts of the REG −150 volts, but of a positive polarity.

c. Input Circuit. Set CHANNEL A and CHANNEL B FINE TUNING capacitors C102

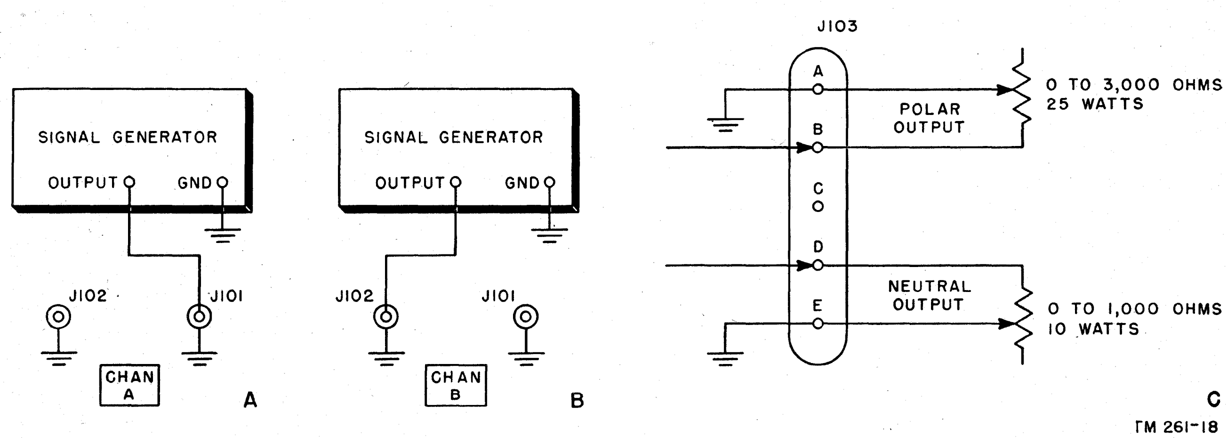


Figure 32. Test set-up for bench check of dual diversity converter.

and C104 at their midpositions. The locations of screw driver controls C101, C105, C103, and C106 involved in the procedures which follow are shown in figures 4 and 5.

(1) Connect the signal generator to CHAN A receptacle J101 of the converter and set the signal generator frequency to a value corresponding to that of the i-f input from the radio receivers (470 kc for Radio Receiver R–182(*)/MRC–2 and 500 kc for Radio Receiver R–388/URR). Set the input at 1 volt. This voltage requirement is based on the use of a signal generator of 100-ohm output impedence. Do not connect an input to CHAN B receptacle J102 while making tests on channel A.

(2) Connect a VTVM (vacuum tube voltmeter) from terminal 3 of network Z103 to ground and adjust the tuning capacitor to C101 with a screw driver for maximum indication on the voltmeter (13 to 22 volts).

(3) Connect the VTVM from terminal 2 of network Z104 to ground, and check to see that the voltage at this point is 1.75 to 3.5 volts throughout the complete range of tuning capacitor C105.

(4) Connect the VTVM from terminal 3 of BAND WIDTH switch S101B to ground, or from terminal 4 of E103. Turn the BAND WIDTH knob to NARROW. Set the test oscillator output at .1 volt and adjust tuning capacitor C105 to give a maximum voltage indication (10 to 25 volts).

(5) Repeat step (4), but turn the BAND WIDTH knob to WIDE. Check to determine that the voltage indication is between 20 and 40 volts.

(6) Connect the signal generator to CHAN B receptacle J102 of the converter and set the signal frequency to a value corresponding to that of the i-f input from the radio receiver. Set the signal generator output at 1 volt. Do not connect an input to CHAN A receptacle J101 while making tests on channel B.

(7) Connect a VTVM from terminal 3 of network Z101 to ground and adjust tuning capacitor C103 for a maximum indication on the voltmeter (13 to 22 volts).

(8) Connect the VTVM from terminal 2 of network Z102 to ground and check to see that the voltage at this point is 1.75 to 3.5 volts throughout the complete range of tuning capacitor C106.

(9) Connect the VTVM from terminal 3 of BAND WIDTH switch S101B to ground. Turn the BAND WIDTH knob to NARROW. Set the test oscillator output at .1 volt and adjust tuning capacitor C106 to give a maximum voltage indication (8 to 25 volts).

(10) Repeat step (9), but turn the BAND WIDTH knob to WIDE. Check to see that the voltage indication is between 15 and 40 volts.

d. Limiter Circuit. After alining and checking the input circuit according to the procedures above, check the limiter circuit in accordance with the following:

(1) Connect the signal generator to channel A and adjust its frequency to the i. f. of the receiver normally used in conjunction with this equipment. Do not conconnect any input to channel B. Turn the BAND WIDTH knob to WIDE and the METER B knob to INPUT. Adjust the signal generator output level to give a meter indication of +50.

(2) See that the input voltage to the limiter, as measured by the VTVM, from terminal 3 of BAND WIDTH switch S101B (or from terminal 4 of V103) to ground, is not greater than 6 volts.

(3) Connect the VTVM from terminal 4 of tube V108 (or from terminal 42 of mounting strip E103), to ground, and check to see that the voltage is 6 ± 2 volts.

(4) Set the output level of the test oscillator at .5 mv (millivolts). If the VTVM indicates at least 4 volts, raise the output level of the test oscillator to 500 mv and check to see that the VTVM indicates between 4 and 8 volts.

(5) Connect an oscilloscope from terminal 4 of tube V108 (or from terminal 42 of mounting strip E103) to ground. Use a saw-tooth sweep frequency suitable to obtain a 3-cycle pattern. Observe that the waveform of the 50-kc signal is approximately as shown in A of figure 33.

(6) Transfer the signal generator from channel A input to channel B input. Do not connect any input to channel A. Repeat

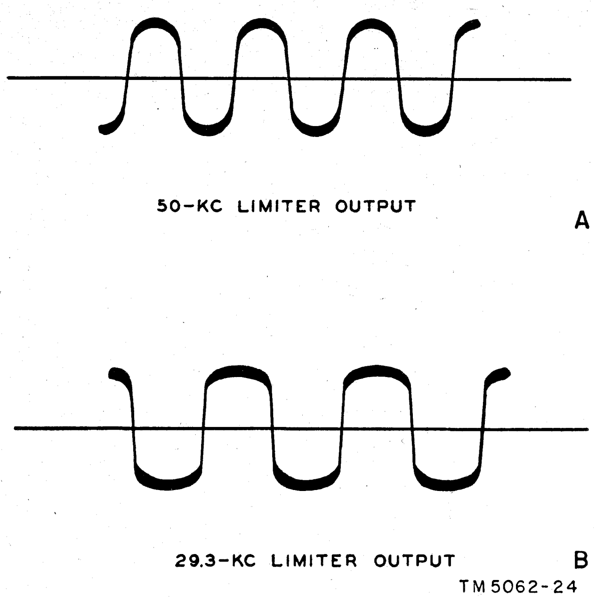


Figure 33. Signal waveform of limiter output circuits.

steps (1) through (5) above. The oscilloscope pattern should now change, approximately, to that shown in B, figure 33.

e. Discriminator Circuit.

(1) Connect the signal generator to channel A. Set the signal generator to the operating frequency and adjust its output to 50 mv. Set the CHANNEL A FINE TUNING knob to the middle of its range. Adjust tuning capacitor C105 until a point is found where a slight movement in either direction causes meter A to go off scale. Set capacitor C105 at the position that gives a 0 indication on meter A.

(2) Transfer the signal generator to channel B. Turn the METER B knob to CHAN B and check to see that the CHANNEL B FINE TUNING knob is set at the middle of its range. Adjust capacitor C106 to give a 0 indication on meter B.

(3) In the following tests, it is necessary to use a source of frequency that can be changed by 850 cycles. Frequency Meter BC–221–(*) may be used; however, the dial on it must be reset each time the frequency is changed. Alternately a Frequency Shift Exciter O–39(*)/-TRA–7 may be used as a signal generator to accomplish the desired results. When using the latter unit, couple the output of the frequency shift exciter to the radio receiver. Tune the exciter to 2.0 mc and set the SHIFT dial for an 850-cycle shift; then tune the radio receiver to the exciter output with the TEST key of the exciter thrown to MARK.

(4) Connect the frequency meter (or the radio receiver output) to channel A. Decrease the frequency of the applied signal by 425 cycles (or to 2 mc −425 cycles) to simulate a spacing signal. Check to determine that meter A indicates 50 (+10) to the left of 0. Increase the applied frequency 850 cycles (or 2 mc +425 cycles) for a marking signal. Check to be sure that the marking signal causes meter A to indicate 50 (±10) to the right of 0.

(5) Transfer the output from the frequency meter or the radio receiver to channel B. Repeat steps (3) and (4) above, using meter B in the CHAN B position.

f. Output Circuit. The locations of the screw driver controls (COMP AMP, BIAS A, BIAS B, and COMP BAL) involved in the following procedures are shown in figures 4 through 6. The four controls can be adjusted from the top by using the potentiometer adjusting tool or a screw driver.

(1) Turn the OUTPUT knob to MARK. Turn the METER B knob to CHAN A + B and check to see that meter B indicates +55 ±10.

(2) Turn the OUTPUT knob to SPACE and check to see that meter B indicates −55 ±10.

(3) Turn the BIAS A screw driver control fully counterclockwise. Turn the OUTPUT knob to SPACE. Using a voltmeter having a resistance of 20,000 ohms per volt, check the voltage from pin 8 of tube V113 to ground. It should be +250 ±20 volts.

(4) Turn the OUTPUT knob to MARK. Check the voltage from pin 8 of tube V113 to ground. It should be less than +20 volts. Check the voltage between pin 4 and pin 5 of tube V117. If the voltage between pins 4 and 5 of tube V117 is not −65 ±10 volts (or −55 ±10 volts in Dual Diversity Converter CV–31A/TRA, serial numbers 11 through 162 on Order No. 8975–P–46), reconnect

the lead from pin 4 of tube V117 (which is also connected to pin 5 of tube V116) to the junction of the two resistors (R162 through R167) that provides a voltage nearest to −65 volts (or −55 volts in the aforementioned model numbers).

(5) Remove tube V105 from its socket and check the voltage from pin 8 of tube V117 to ground. It should be +185 ±20 volts. Next, turn the OUTPUT knob to SPACE and check to see that the voltage changes to −145 ±10 volts. Replace tube V105 in its socket.

(6) Check to determine that the operation of the OUTPUT switch to MARK and to SPACE results in keying the polar and neutral loop circuits. To do this, attach two rheostats to J103, as shown in C, figure 32. These rheostats simulate the output loops, so that the dual diversity converter may be tested under simulated operating conditions.

(*a*) With the METER B knob at POLAR, determine that the POLAR OUTPUT MARK and SPACE potentiometers can be adjusted to produce loop currents as follows:

Simulated loop resistance in ohms between terminals A and B of jack J103	Meter indication in ma*
0	Less than ±20.
2,000 approximately	More than ±25.

*Deflection to the right for MARK and deflection to the left for SPACE.

(*b*) Turn the METER B switch to NEUTRAL. With the rheostat across pins D and E of jack J103 adjusted as in the chart below, determine that the NEUTRAL OUTPUT potentiometer can be adjusted to produce neutral currents as follows:

Simulated loop resistance in ohms between terminals D and E of jack J103	Meter indication in ma
0	Less than +40.
800	More than +60.

g. Drift Compensator Circuit. To test this circuit, set the controls and make the adjustments as follows:

(1) Turn the OUTPUT knob to NORMAL, and the AMP GAIN knob fully counterclockwise. Operate the DRIFT COMPENSATOR switch to IN. Turn the LIMITER knob fully clockwise. Turn the COMP AMP screw driver control fully counterclockwise. Turn the METER B switch to CHAN A + B; then check to see that meter B indicates 0± 5 volts.

(2) Turn the METER B switch to POLAR, and adjust the BIAS A screw driver control to the two positions where a slight movement of the control changes the loop condition from a mark to a space, and from a space to a mark. Leave the BIAS A control midway between the two positions.

(3) Turn Meter B switch to CHAN A + B. Turn the COMP AMP screw driver control in a clockwise direction until the meter B reading is increased by 5 to the right or to the left, depending on whether the indication in step (1) above is to the right or to the left. Adjust the BIAS B screw driver control to a position where, with a slight movement of the control, the meter B reading just mentioned changes back and forth between positive and negative readings.

(4) Set the COMP AMP screw driver control at its midposition. Turn the AMP GAIN control clockwise until the d-c loop currents can be changed from a mark to a space by the CHANNEL A (or B) FINE TUNING knob, when an i-f input is connected to the CHAN A (or CHAN B) receptacle (J101 or J102).

(5) Adjust the screw driver controls COMP BAL and COMP AMP until meter B indicates +70 ±5 for a mark (OUTPUT switch at MARK) and −70 ±5 for a space (OUTPUT switch at SPACE) These readings should be steady. Wait several seconds, if necessary, to obtain steady meter indications. Slowly turn the LIMITER knob counterclockwise until the meter reading of +70 for a mark is reduced to +50 and, at the same time, the meter reading of −70 for a space reduces to a value between −40 and −60. Turn the LIMITER knob fully clockwise; then turn the knob slowly counterclockwise until the meter indication is just on the verge of being de-

creased. Leave the LIMITER knob at this setting.

h. Tone Oscillator Circuit. Turn the OUTPUT knob to MARK. Connect a headphone to the PHONES KEYED TONE jack, J105, and make sure that there is a tone output. Turn the output knob to SPACE and check to see that there is no tone output.

i. Mark-Hold Circuit. In testing this circuit, a frequency shift exciter and a radio receiver may be used as a source of frequency shift signals. Connect the i-f output from the receiver to channel A and operate the DRIFT COMPENSATOR switch to OUT and the OUTPUT switch to REVERSE. Tune the frequency shift exciter to 2.0 mc and set the SHIFT dial for an 850-cycle shift. Then tune the radio receiver to the exciter output with the TEST key of the exciter thrown to MARK. Turn the METER B switch to INPUT and adjust the input to the converter to give an indication of 50 on meter B. Adjust the MARK-HOLD LEVEL knob until the output circuit just remains spacing. Check to determine that the output restores to marking when the input from the radio receiver is reduced to zero. Connect the i-f output from the radio receiver to channel B and adjust the i-f input from the radio receiver to channel B to give an indication of 50 on meter B. Check to see that the output circuit just remains spacing. Reduce the input from the radio receiver to zero and make sure that the output restores to marking.

45. Trouble-Shooting Chart

When the indicated results are not obtained during one or more of the operational checks described in the preceding paragraph, consult the trouble-shooting chart below. Connect a signal generator to J101 or J102 as shown in A or B, figure 32. Also, make the connections to J103 with rheostats as shown in C, figure 32. These rheostats simulate the output loops so that the dual diversity converter may be tested under simulated operating conditions. The signal generator should be set to the frequency normally fed to input jacks J101 and J102 by the radio receivers used with the converter in actual operation.

Symptom	Probable trouble	Corrections
1. White pilot fails to light when AC SUPPLY switch is turned to ON.	1. A-c line, safety switches S301 and S302, transformer T302, fuses F301 and F302, AC SUPPLY switch S303, receptacle J104, pilot lamp I301, or filter Z112.	1. Check wiring and repair or replace defective apparatus.
2. Red pilot fails to light when PLATE switch is turned to ON.	2. Pilot lamp I302, transformer T301, or plate switch S304.	2. Check wiring and repair or replace defective apparatus.
3. All voltages too high or too low.	3. Meter B, or tap connections on transformers T301 and T302.	3. Check and replace defective apparatus.
4. +275V does not read in range of +47 to +65 on meter B.	4. T301 winding 5–6–7, choke L301, T302 winding 8–9, capacitors C301 and C302, or tube V301.	4. Check and replace defective apparatus.
5. REG +150V does not read +20 to +40 on meter B.	5. Tubes V304 or V305, capacitors C307 or C308, T301 winding 11–12, T302 winding 5–7, or resistors R308 to R321.	5. Check and replace defective apparatus.
6. REG −150V indication not −20 to −40 on meter B.	6. Tubes V303 or V306, capacitors C305 or C306, T302 winding 12–13, or resistors R301 to R306.	6. Check and replace defective apparatus.
7. −150V indication not −20 to −40 on meter B.	7. Tube V302, resistor R307, T301 winding 8–9–10, capacitors C303 or C304, choke L302, or T302 winding 6–7.	7. Check and replace defective apparatus.
8. −400V indication not −65 to −95 on meter B.	8. Circuit wiring. V303, R301, R302, C305, C306, T302 winding 12–13, T301 winding 6–7.	8. Check continuity.
9. Meter B on INPUT fails to give an indication.	9. Tubes V104 (section 3–4–5), V103, or V101 and V102, or associated circuit elements.	9. Check wiring and repair or replace defective apparatus.

Symptom	Probable trouble	Corrections
10. Meter B switched to INPUT gives an indication, but no output is indicated on meter A or meter B when the latter meter is switched to CHAN B.	10. Limiter amplifier tubes V106, V107, V108 or the associated circuits.	10. Check circuits and apparatus and replace defective apparatus.
11. Meter A (or meter B on CHAN B) indicates an output while meter B (or meter A) indicates no output.	11. Tubes V101 (or V102) and V109 (or V110), or the associated circuits. If meter A (or meter B on CHAN B) deflects only to the right or only to the left, one section of V109 (or V110) or one-half of Z109 (or Z110) may be the cause of the trouble.	11. Check circuits and apparatus and replace defective equipment.
12. Meter B on CHAN A + B fails to indicate a output while an output is obtained on meter A or meter B on CHAN B.		12. Check circuit and apparatus and replace defective equipment.
a. DRIFT COMPENSATOR turned off.	*a.* Tube V111 (section 1–2–3), OUTPUT switch S102, DRIFT COMPENSATOR switch S104, or associated circuits.	
b. DRIFT COMPENSATOR turned to ON after meter indication for *a* above is found to be satisfactory.	*b.* Tube V104 (section 2–3–6) or other circuit elements associated with V104.	
13. Meter B on CHAN A + B deflects near zero on a steady mark and steady space (drift compensator circuit fails to lock in).	13. Tubes V113, V114 (section 2–3), V111 (section 4–5–6), and V112, OUTPUT switch S104, DRIFT COMPENSATOR switch S102, or associated circuit.	13. Check circuit and apparatus and replace defective equipment.
14. No output indication with meter B at POLAR or NEUTRAL, and no tone with OUTPUT switch at MARK.	14. Tubes V111 (section 1–2–3), V113, or associated circuit elements. (If meter B on CHAN A + B indicates an output from V111, the trouble may be with V113 or its associated circuit.)	14. Check circuit and apparatus and replace defective equipment.
15. Steady mark (d-c indication on meter B at POLAR and NEUTRAL, and steady tone) with OUTPUT switch at SPACE and an i-f input connected to J101 or J102.	15. Tube V105 or associated circuit elements.	15. Check circuit and apparatus and replace defective equipment.
16. D-c neutral (or polar) output, but no polar (or neutral) output.	16. Tubes V115 and V116 (or V117 and V118) or associated circuit elements.	16. Check circuit and apparatus and replace defective equipment.
17. Imperfect polar output__________	17. Neutral loop open________________	17. Check to see that a monitoring teletypewriter is connected to the TT RED and BLACK jacks or that the normally made contacts of these jacks are closed.
18. With tube V114 in its socket and OUTPUT switch operated alternately to MARK and SPACE, alternate tone on and tone off signals are not produced.	18. Tube V401 or associated circuit elements.	18. Check circuit and apparatus and replace defective equipment.

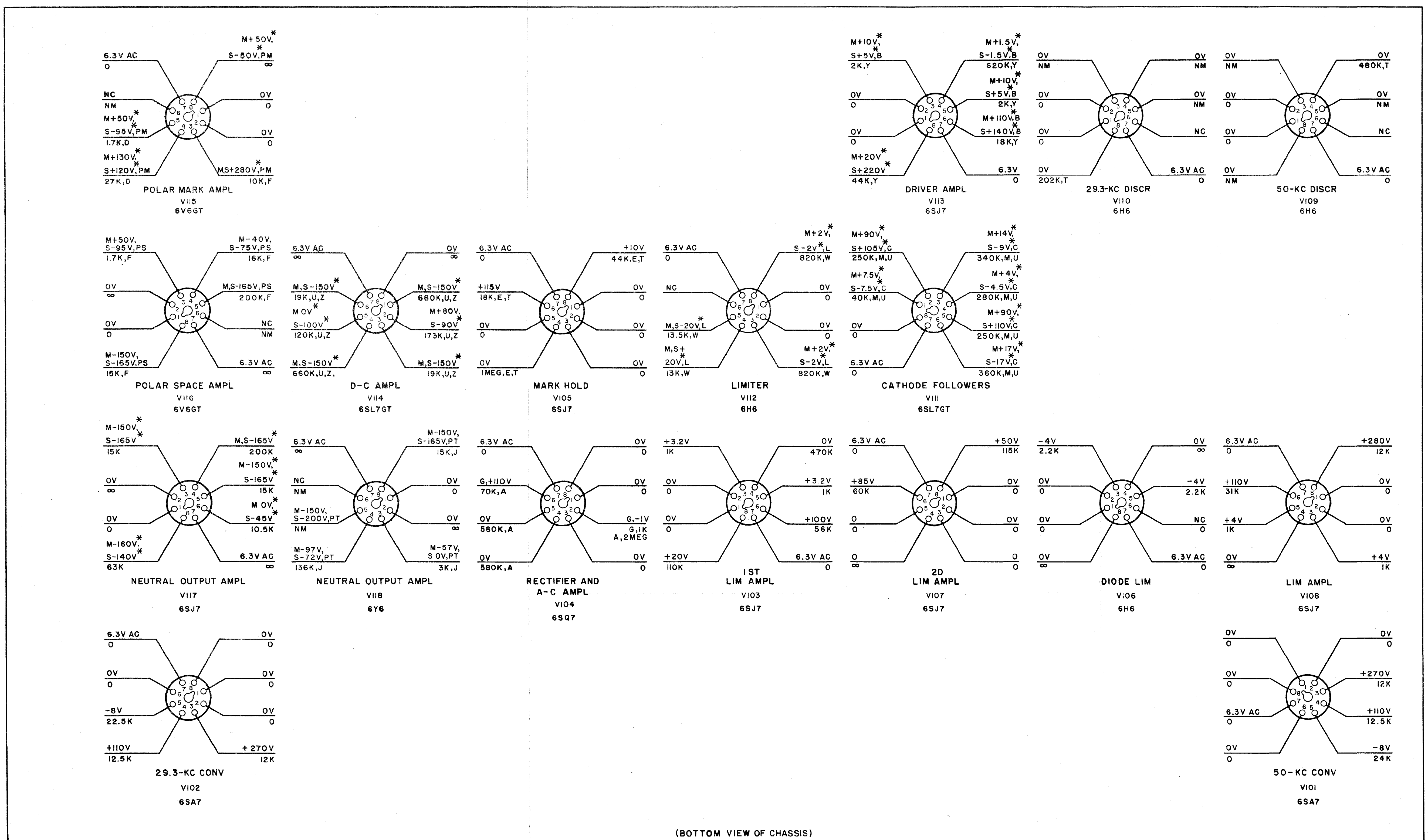
46. Aids for Rapid Servicing

To assist maintenance personnel in rapid servicing of defective units, tube socket voltage, and resistance diagrams, a supplementary voltage measurement chart, terminal board diagrams, and photographs of the interior of the dual diversity converter unit are included in this manual.

a. Tube Socket Voltage and Resistance Diagrams (figs. 34 through 37). To check the voltages in the dual diversity converter, remove the input cables from the two radio receivers connected to receptacles J101 and J102. Operate the AC SUPPLY switch to ON the PLATE switch to ON, the DRIFT COMPENSATOR switch to IN, and the OUTPUT switch to NORMAL or REVERSE. All other switches may be set at any of the designated positions. All values given are positive d-c voltages unless otherwise noted, and are measured to ground. For making resistance measurements, all external cables must be disconnected.

b. Supplementary Resistance Measurements

Connections and junctions	Measurements (ohms)	Connections and junctions	Measurements (ohms)
Pin 4 of V101 to terminal 4 of E301	4, 700	LIMITER control in midposition—Continued	
Pin 4 of V102 to terminal 4 of E301	4, 700	Pin 5 of V112 to terminal 11 of E301	2, 500
AMP GAIN control at minimum		BIAS A at maximum	
Pin 2 of V104 to ground	1, 300	Pin 8 of V113 to terminal 12 of E301	70, 000
OUTPUT switch at NORMAL		BIAS B at minimum	
Betweens pins 3 and 5 of V109	5	Pins 1 and 4 of V114 to terminal 12 of E301	62, 000
Between pins 4 and 8 of V109	200, 000	COMP BAL at minimum	
Between pins 3 and 5 of V110	16	Pin 2 of V114 to terminal 4 of E301	18, 000
Between pins 4 and 8 of V110	200, 000	Pin 2 of V114 to terminal 11 of E301	200, 000
OUTPUT switch at MARK or SPACE		NEUTRAL OUTPUT at minimum	
COMP AMP control at maximum		Pin 4 of V118 to terminal 13 of E301	10, 000
Between pin 4 of V111 and terminal 14 of E301	470, 000	Pin 5 of V118 to terminal 12 of E301	140, 000
LIMITER control in midposition		Pins 4 and 6 of V303 to terminal 12 of E301	2, 400
Pin 4 of V112 to terminal 4 of E301	1, 700		



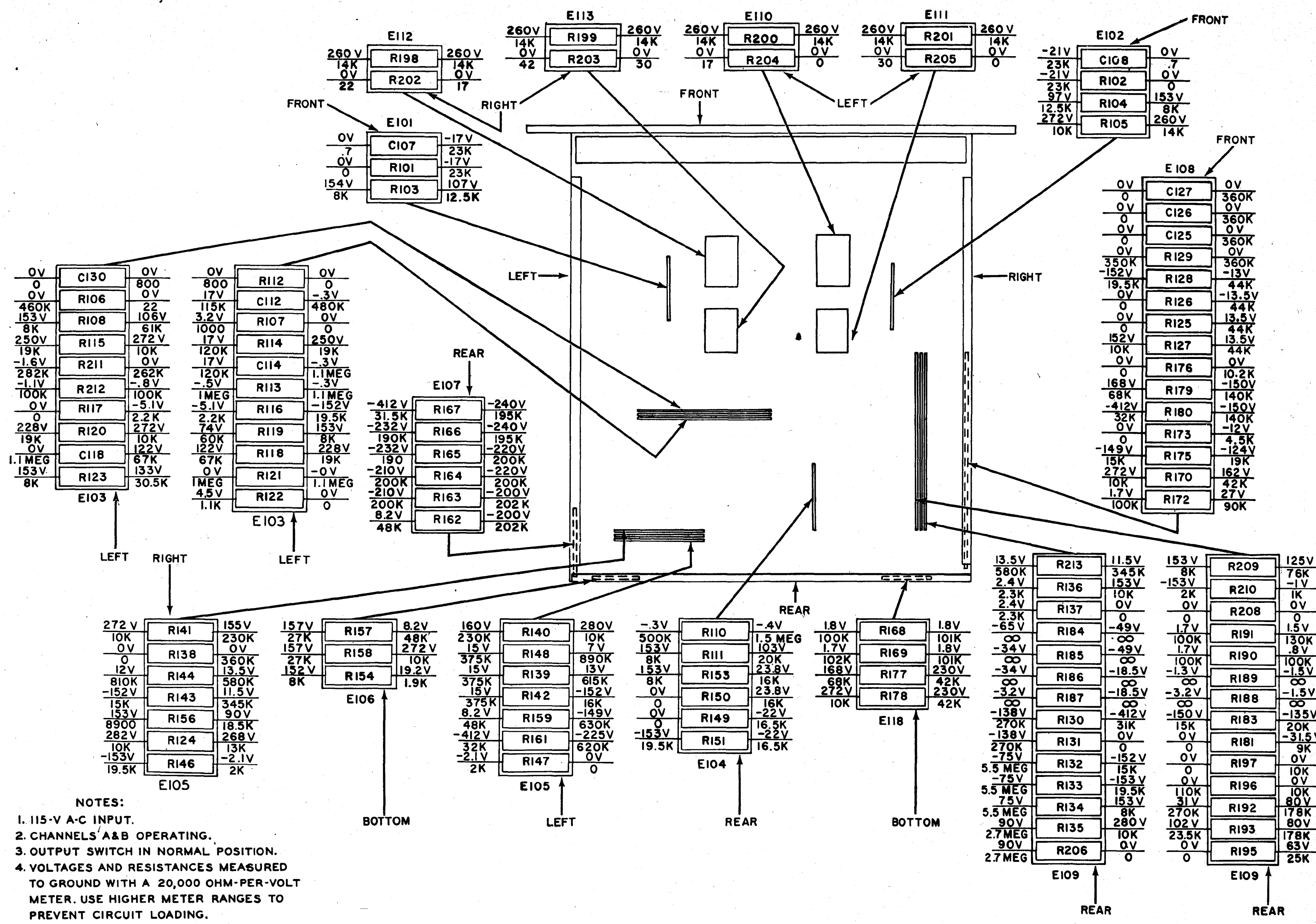
FRONT OF CHASSIS

NOTES:

1. VOLTAGES MEASURED TO GROUND WITH A 1,000 PER-VOLT METER. USE HIGHER RANGES TO PREVENT LOADING.
2. A AMP GAIN AT MAX RESISTANCE.
   B BIAS A AT NORMAL SETTING.
   C COMP AMP SET FOR ±70 ON METER B.
   D POLAR OUTPUT MARK AT MAX.
   E MARK HOLD LEVEL AT MIN RESISTANCE.
   F POLAR OUTPUT SPACE AT MAX.
   G AMP GAIN AT MIN RESISTANCE.
   J NEUTRAL OUTPUT AT MAX.
   L LIMITER AT MAX RESISTANCE.
   M OUTPUT SWITCH AT MARK.
   NC NO CONNECTION.
   NM NOT MEASURED.
   PM POLAR OUTPUT MARK SET TO GIVE +25MA INTO 2,000 - OHM LOAD.
   PS POLAR OUTPUT SPACE SET TO GIVE -25MA INTO 2,000 - OHM LOAD.
   PT NEUTRAL OUTPUT SET TO GIVE +60MA INTO 1,800 - OHM LOAD.
   S OUTPUT SWITCH AT SPACE.
   T OUTPUT SWITCH AT NORMAL.
   U COMP AMP SET AT MAX RESISTANCE.
   W LIMITER AT MIDPOSITION.
   Y BIAS A AT MAX.
   Z BIAS B AT MAX.
   * TUBE V105 REMOVED FROM SOCKET FOR THESE MEASUREMENTS.
3. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.

TM 261

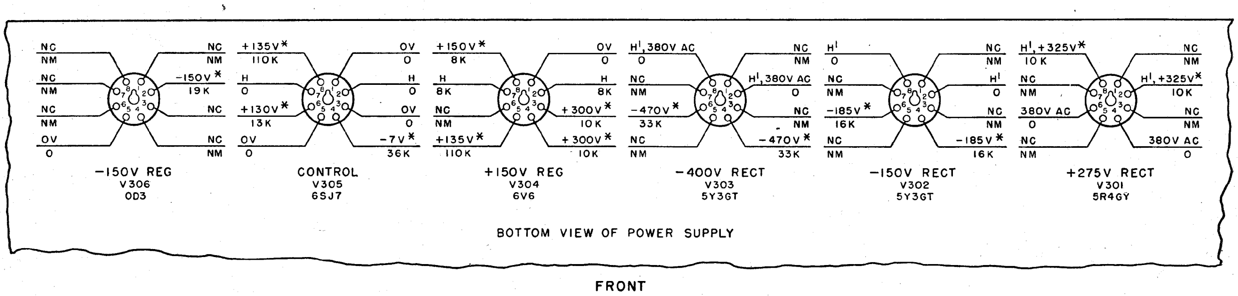
Figure 34. Converter tube socket resistance and voltage diagram.



NOTES:
1. 115-V A-C INPUT.
2. CHANNELS A&B OPERATING.
3. OUTPUT SWITCH IN NORMAL POSITION.
4. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH A 20,000 OHM-PER-VOLT METER. USE HIGHER METER RANGES TO PREVENT CIRCUIT LOADING.

TM261-40

Figure 35. Converter resistor and capacitor board voltages and resistances to ground, C and D models.



NOTES:

VOLTAGES MEASURED TO GROUND WITH A 1,000 OHM-PER-VOLT METER. USE HIGHER RANGES TO PREVENT LOADING.

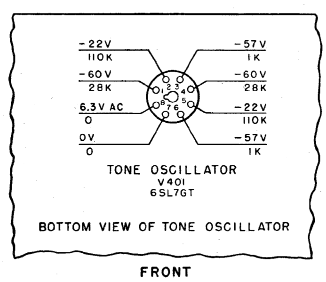
H 6.3 VOLTS AC BETWEEN HEATER TERMINALS.

H' 5 VOLTS AC BETWEEN HEATER TERMINALS.

NC NO CONNECTION.

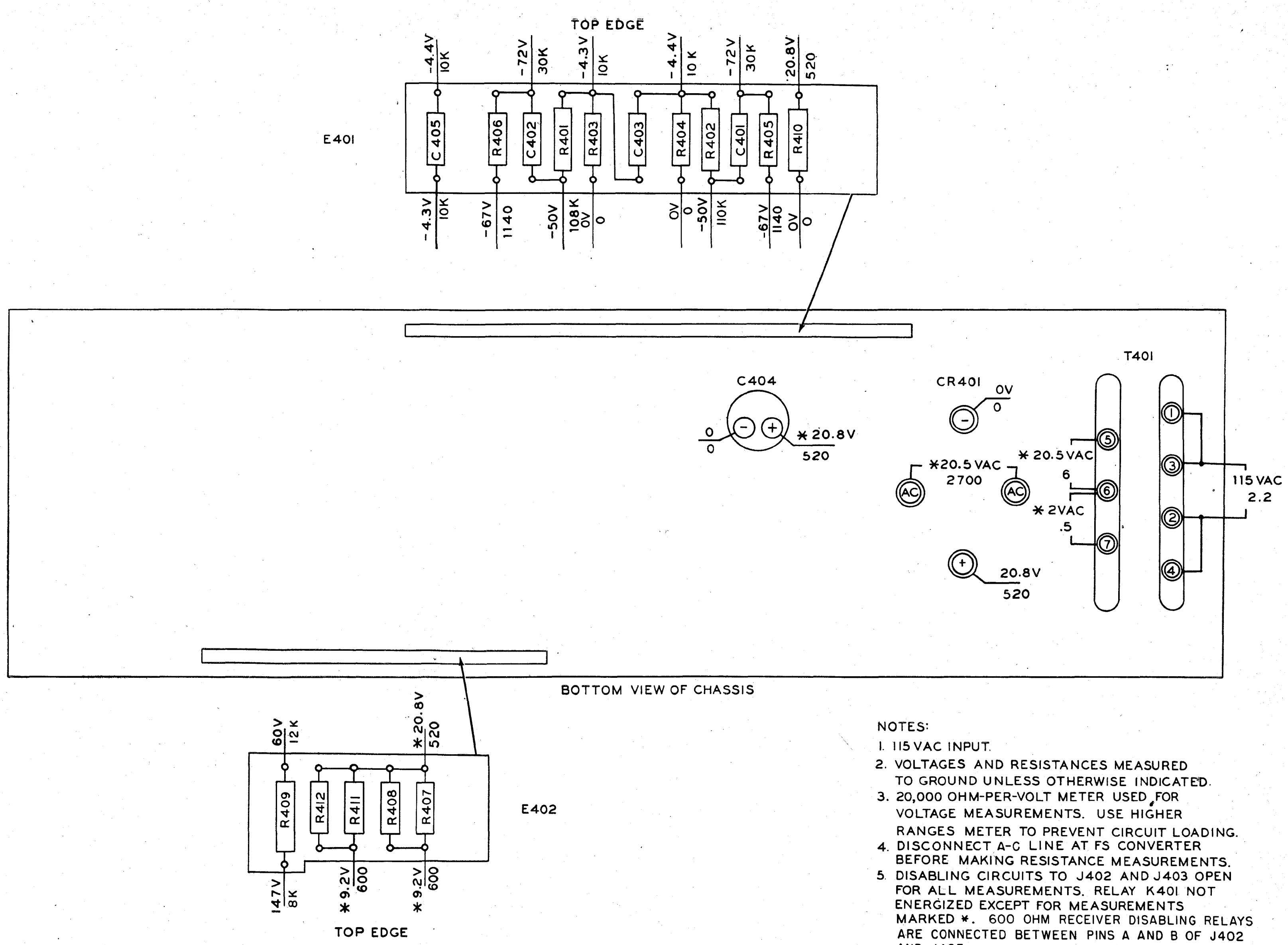
NM NOT MEASURED.

* TUBE V105 REMOVED FROM ITS SOCKET FOR THESE MEASUREMENTS.



TM261-21

Figure 36. Rectifier Power Unit PP-193(*)/TRA-7 and Oscillator O-41(*)/TRA-7, tube socket resistance and voltage diagram.



NOTES:
1. 115 VAC INPUT.
2. VOLTAGES AND RESISTANCES MEASURED TO GROUND UNLESS OTHERWISE INDICATED.
3. 20,000 OHM-PER-VOLT METER USED FOR VOLTAGE MEASUREMENTS. USE HIGHER RANGES METER TO PREVENT CIRCUIT LOADING.
4. DISCONNECT A-C LINE AT FS CONVERTER BEFORE MAKING RESISTANCE MEASUREMENTS.
5. DISABLING CIRCUITS TO J402 AND J403 OPEN FOR ALL MEASUREMENTS. RELAY K401 NOT ENERGIZED EXCEPT FOR MEASUREMENTS MARKED ∗. 600 OHM RECEIVER DISABLING RELAYS ARE CONNECTED BETWEEN PINS A AND B OF J402 AND J403.

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Figure 37. Oscillator O–41A/TRA–7, resistor board voltages and resistances to ground.

210961—52——5

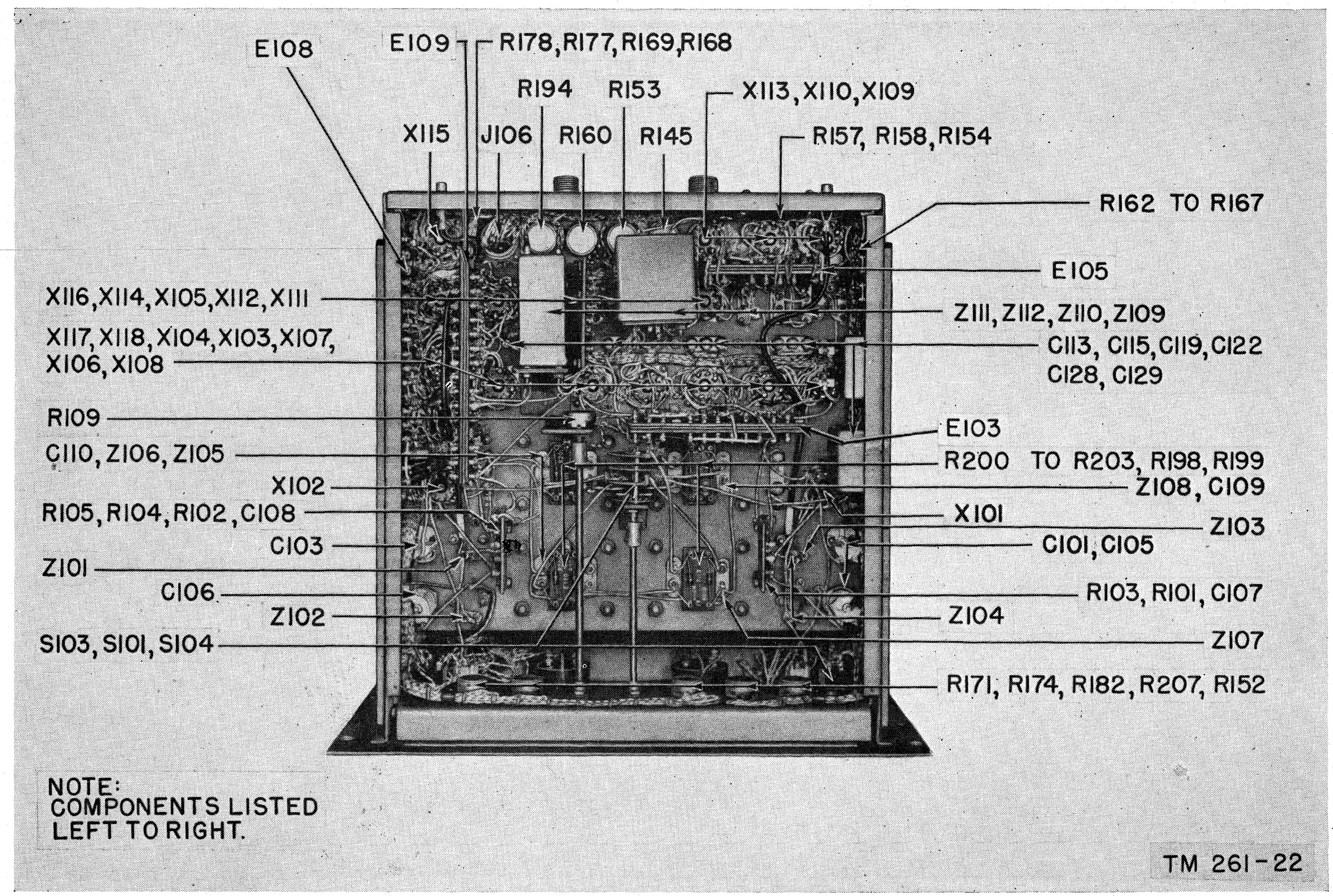


Figure 38. Dual Diversity Converter CV–31/TRA–7, bottom view of chassis.

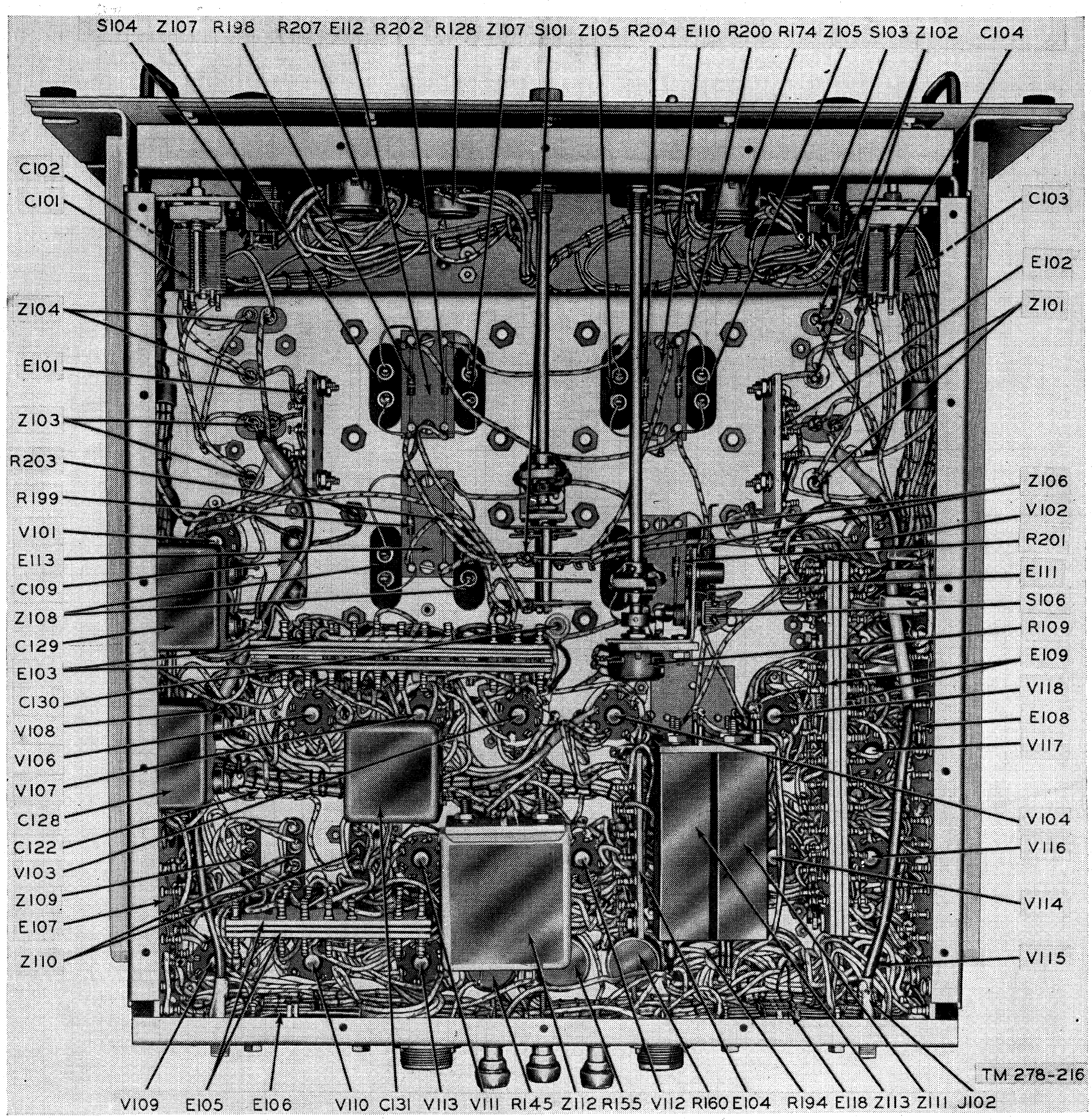


Figure 39. Dual Diversity Converter CV–31D/TRA–7, bottom view.

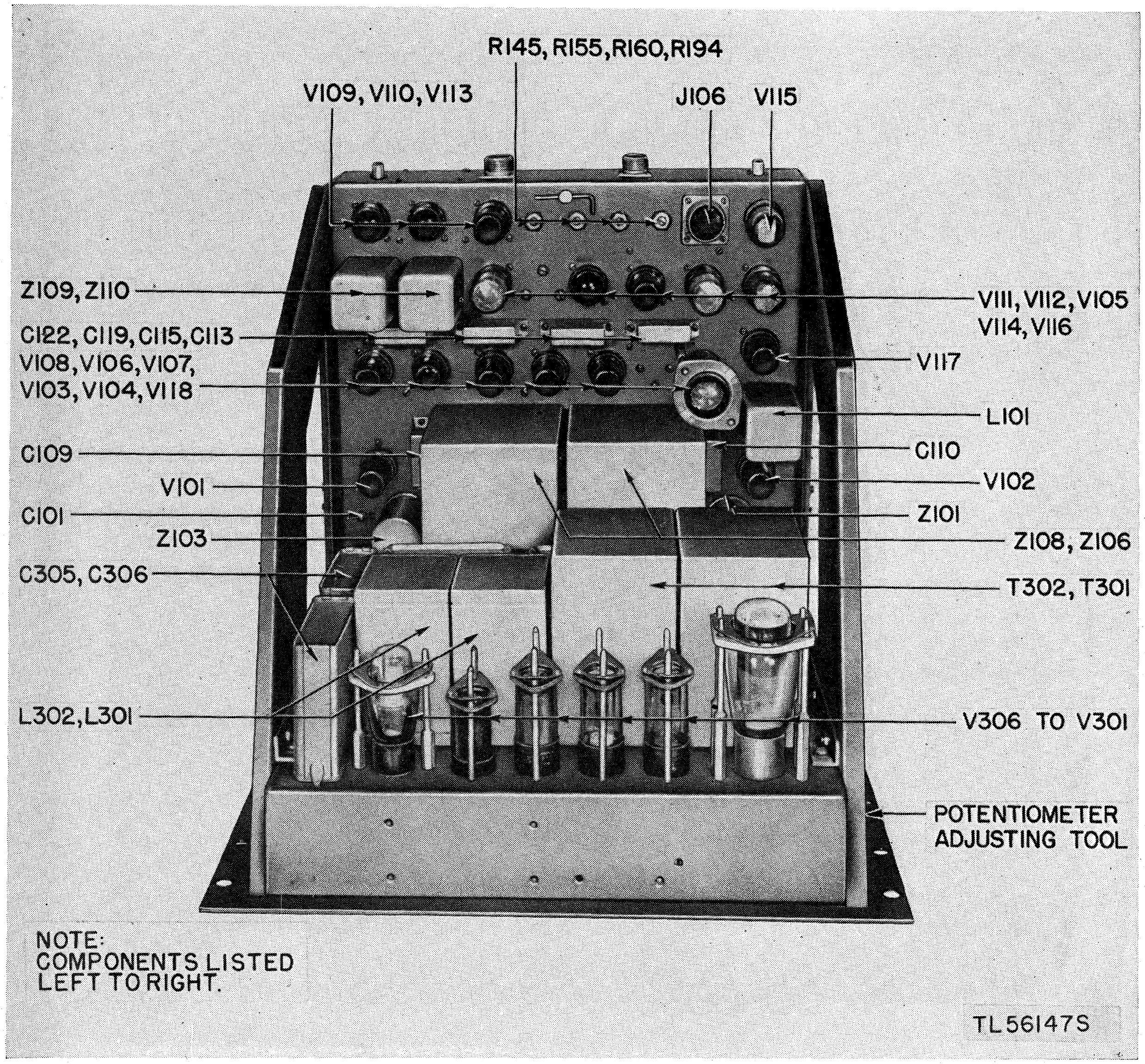


Figure 40. Dual Diversity Converter CV–31/TRA–7, top view of chassis with tone oscillator unit removed.

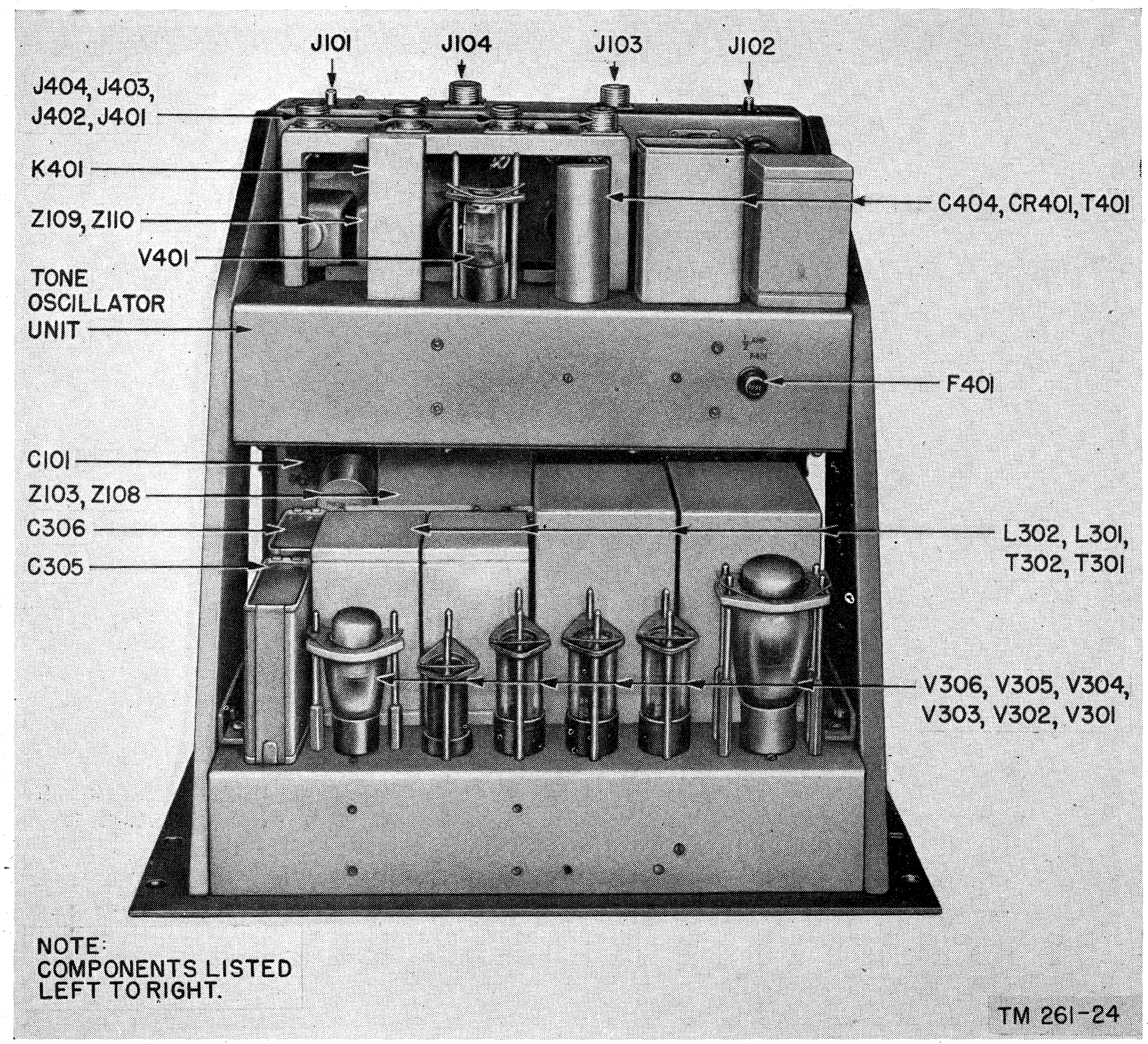


Figure 41. Dual Diversity Converter CV–31/TRA–7, top view of chassis with tone oscillator unit in place.

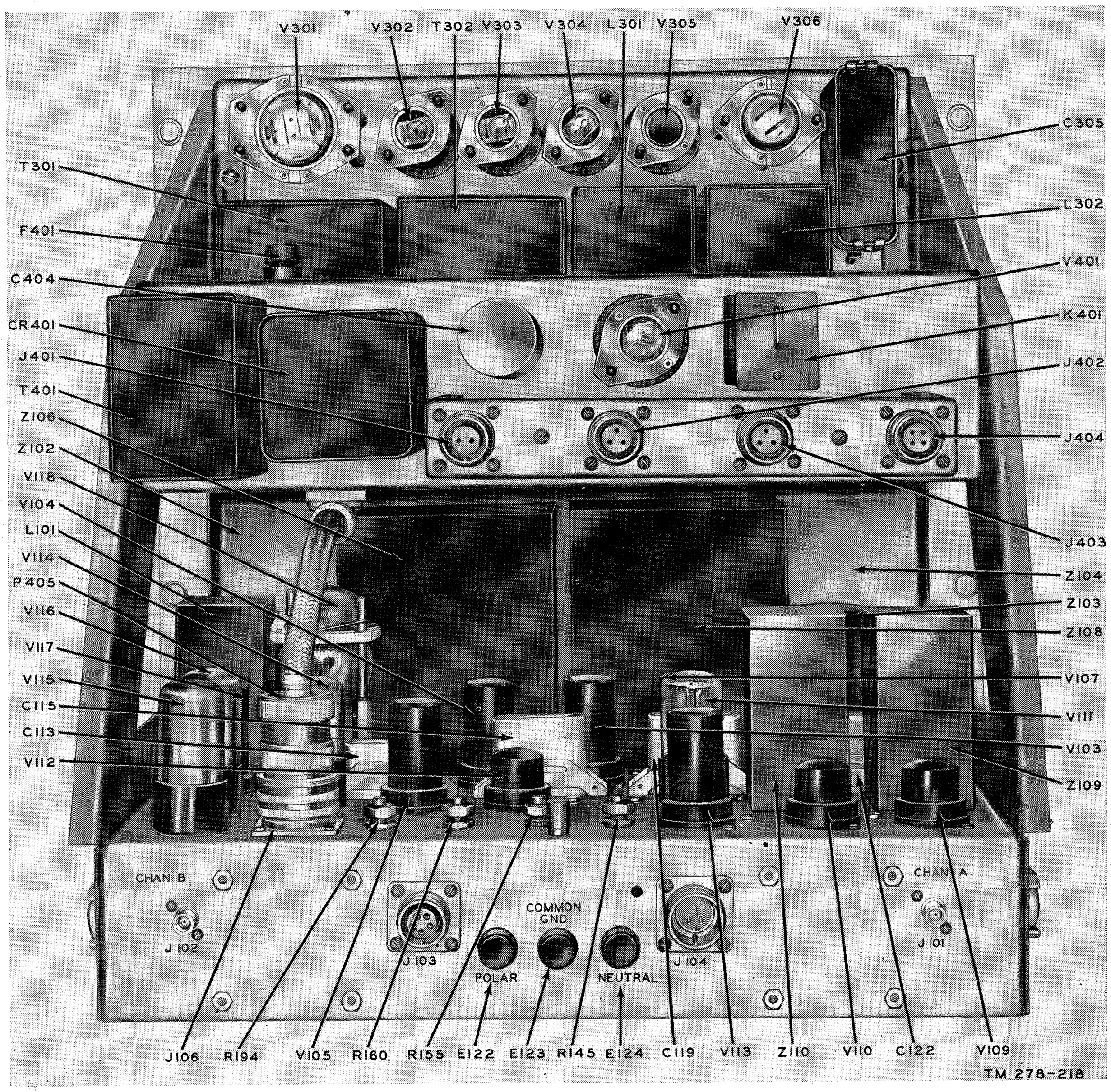


Figure 42. Dual Diversity Converter CV-31D/TRA-7, rear view.

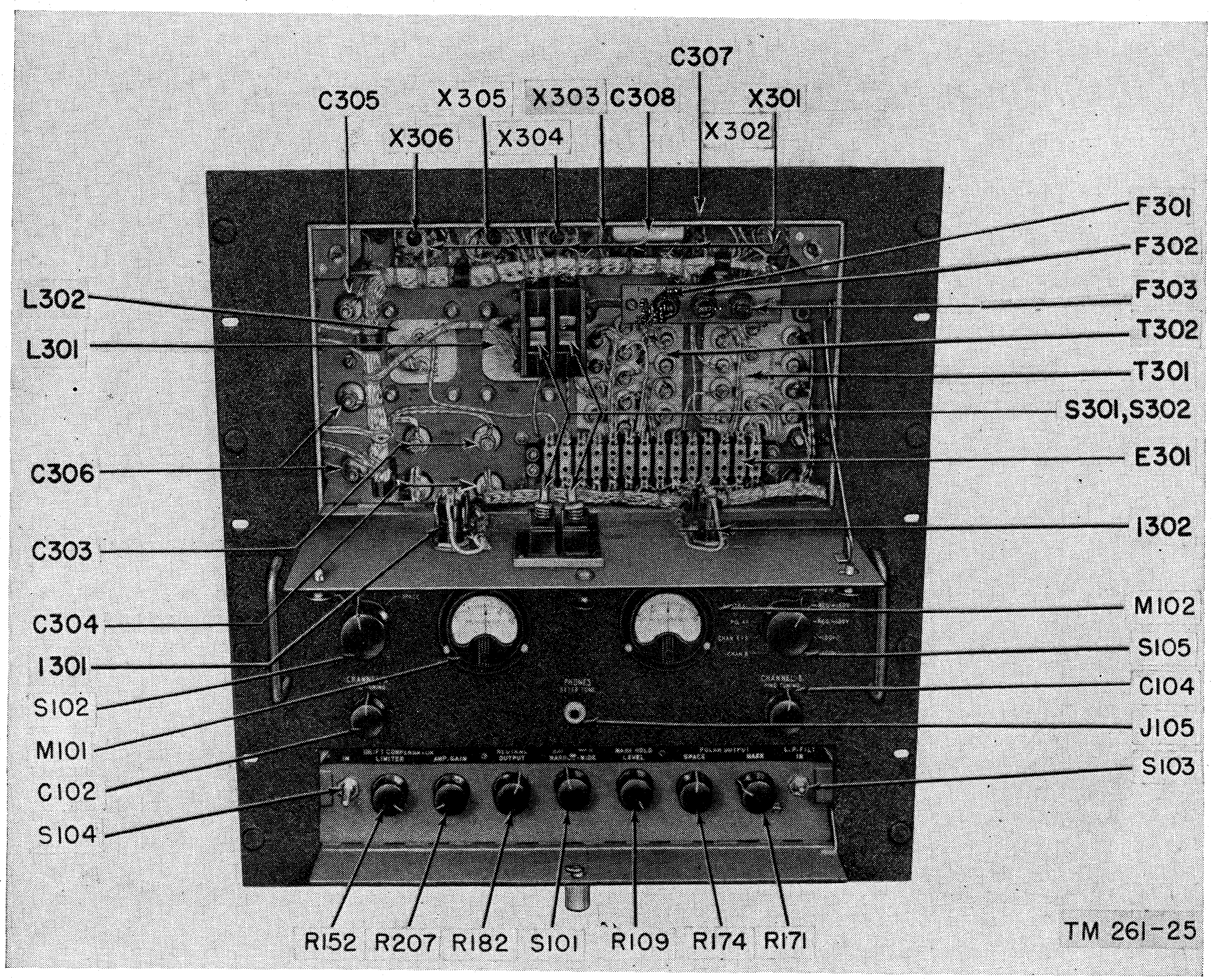


Figure 43. Dual Diversity Converter CV-31/TRA-7, front view of chassis.

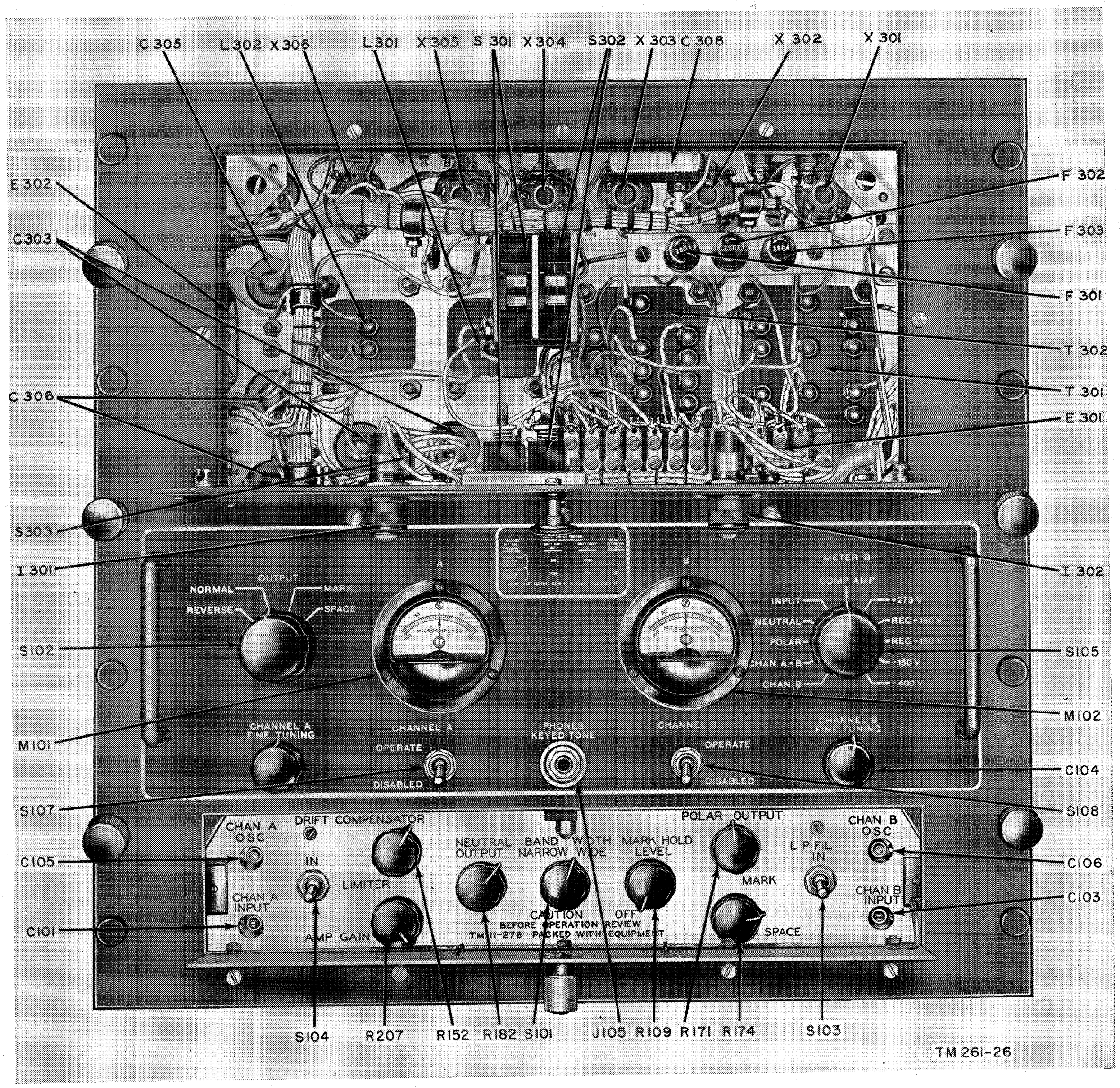


Figure 44. Dual Diversity Converter CV-31D/TRA-7, front view of chassis.

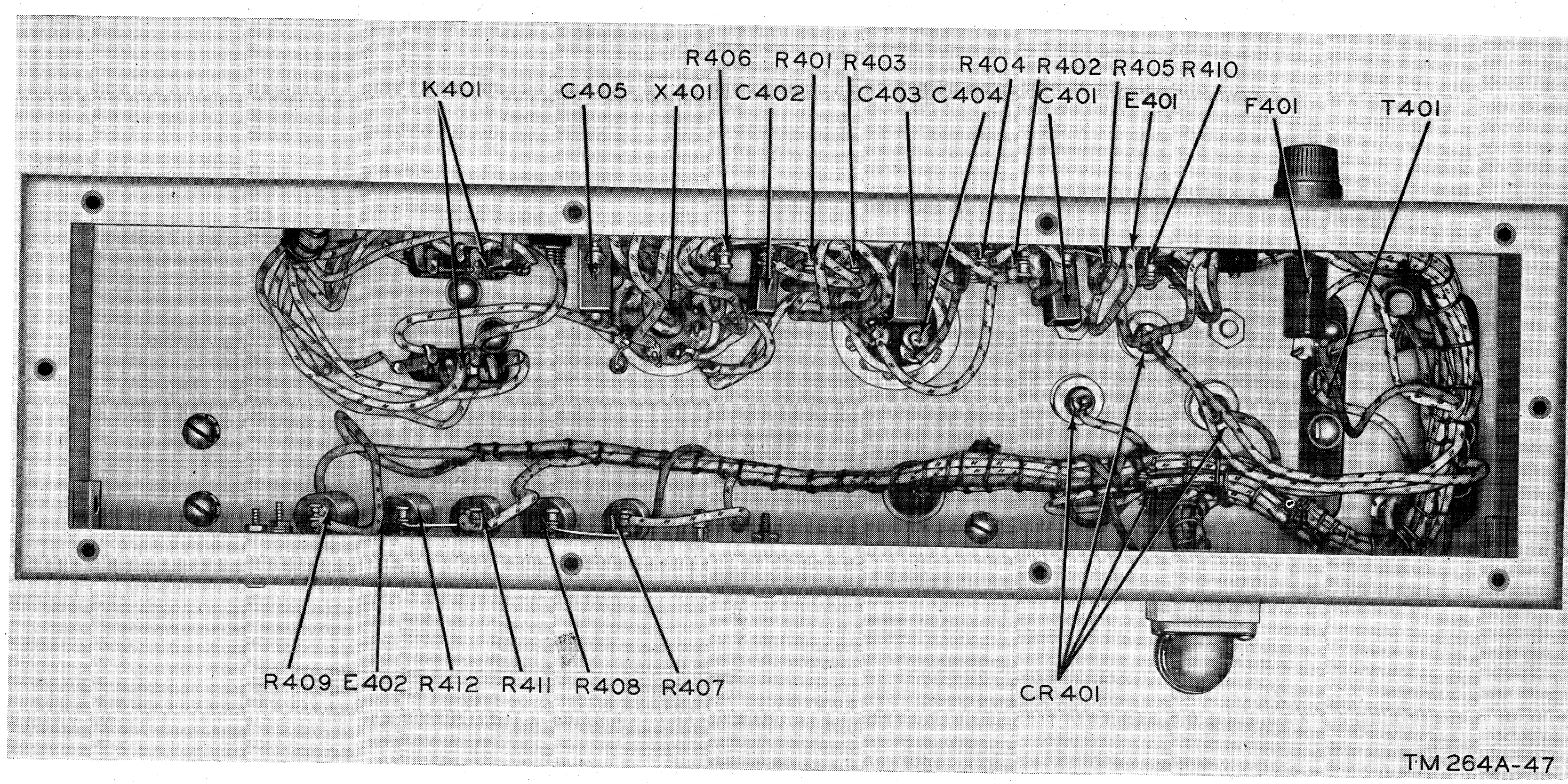
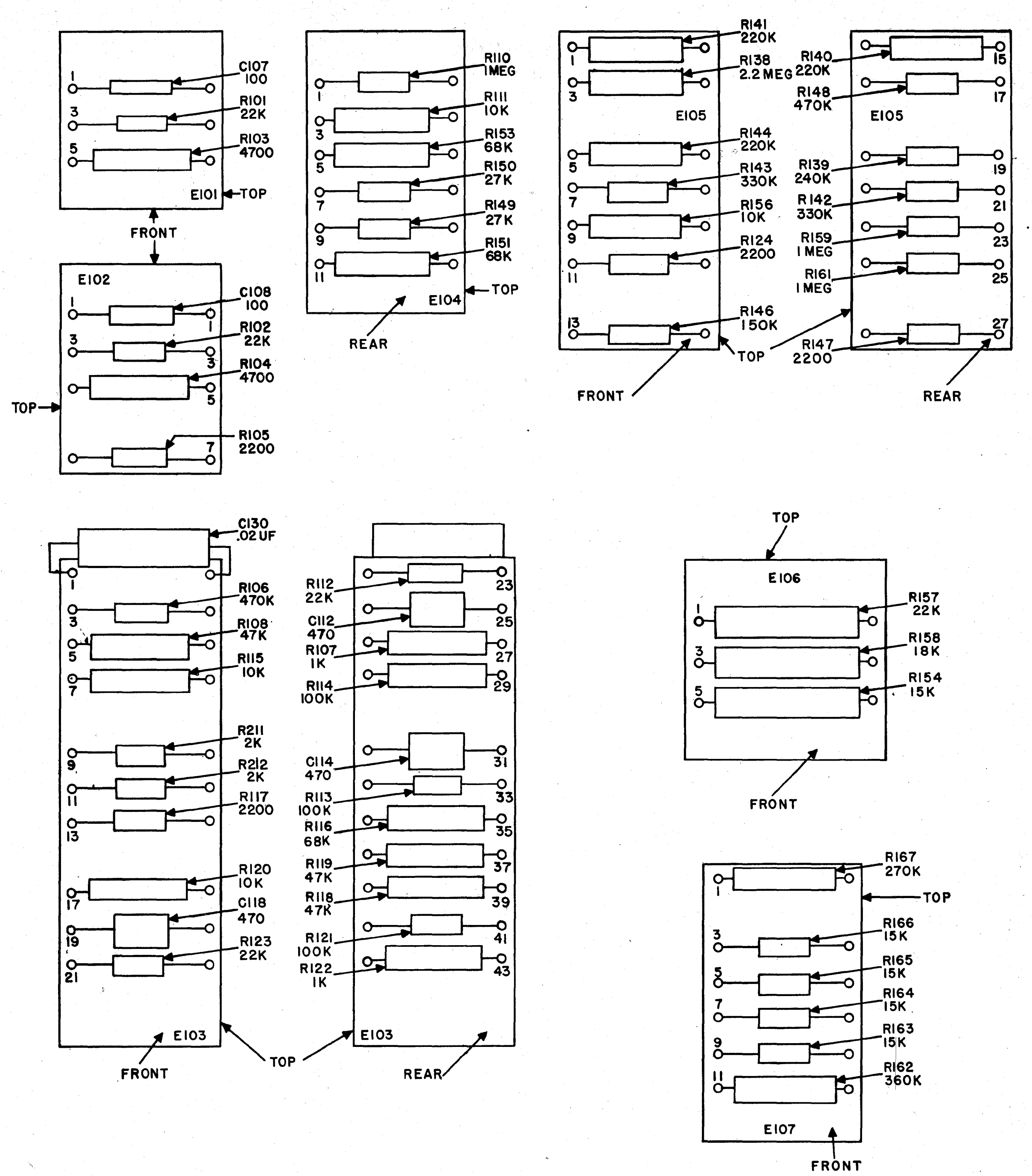


Figure 45. Oscillator O–41A/TRA–7, bottom view.



NOTES:
UNLESS OTHERWISE NOTED,
1. RESISTORS ARE IN OHMS.
2. CAPACITORS ARE IN UUF.
3. BOARDS ARE VIEWED FROM BOTTOM OF CHASSIS, FACING FRONT PANEL.
4. EACH EVEN NUMBERED TERMINAL IS LOCATED OPPOSITE THE NEXT LOWEST ODD NUMBERED TERMINAL ON THE SAME BOARD.

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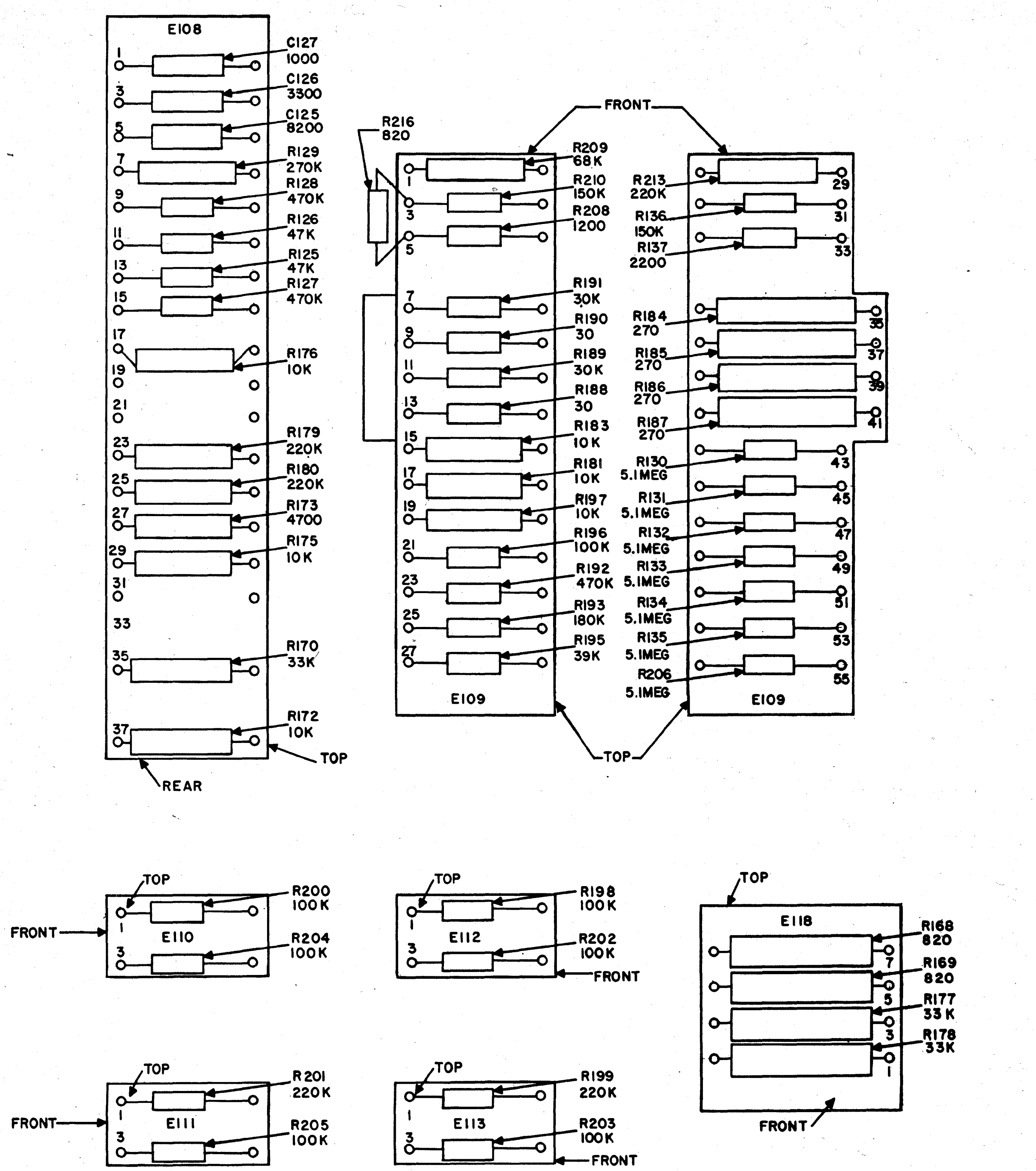
Figure 46. Identification of parts on terminal boards E101 through E107.



NOTE:
UNLESS OTHERWISE NOTED:
1. RESISTORS ARE IN OHMS.
2. CAPACITORS ARE IN UUF.
3. BOARDS ARE VIEWED FROM BOTTOM OF CHASSIS, FACING FRONT PANEL.
4. EACH EVEN NUMBERED TERMINAL IS LOCATED OPPOSITE THE NEXT LOWEST ODD NUMBERED TERMINAL ON THE SAME BOARD.

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Figure 47. Identification of parts on terminal boards E108 through E113 and E118.

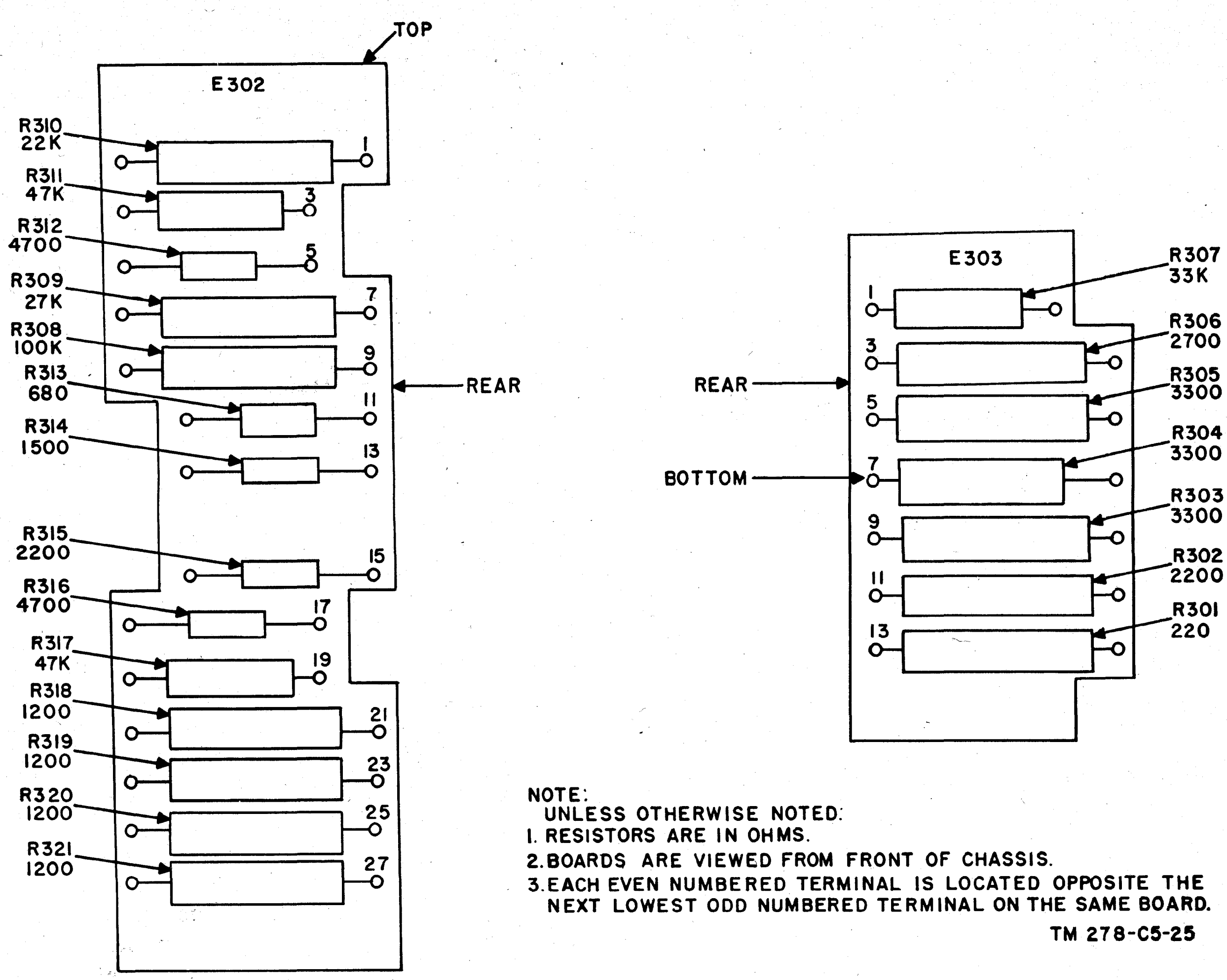


Figure 48. Identification of parts on terminal boards E302 and E303.

Section II. REPAIRS

47. Replacement of Parts

a. Whenever the unit is serviced, observe the following precautions:

(1) Be careful when covers are removed. Dangerous voltages are exposed.

(2) Careless replacement of parts often makes new faults inevitable. Observe the following points:

(*a*) Before a part is unsoldered, note the position of the leads. If the part (such as a transformer) has a number of connections, tag each of the leads to it.

(*b*) Be careful not to damage other leads by pulling or pushing them out of the way.

(*c*) Do not allow drops of solder to fall into the set, because they may cause short circuits.

(*d*) A carelessly soldered connection may create a new fault. It is very important to solder the joints well. A poorly soldered joint is one of the most difficult faults to find.

(*e*) When a part is replaced, it should be placed exactly as the original. A part which has the same electrical value, but different physical size, may cause trouble in high-frequency circuits. Give particular attention to proper grounding when replacing a part. Use the same ground as in the original wiring.

b. The following repair instructions pertain specifically to Dual Diversity Converter CV–31 (*)/TRA–7:

(1) To replace either of the two band-pass filters (Z105 or Z107) which are close to the front panel of the unit, it is necessary to remove the adjacent band-pass filter (either Z106 or Z108). To replace any of the apparatus in the power unit (other than the vacuum tubes), it is necessary to remove the tone oscillator unit (figs. 42 and 43) completely. This can be accomplished readily by loosening the two supporting bolts with hexagonal heads located on either side of the panel. In addition, it is necessary to disconnect the cable assemblies attached to the rear of the tone oscillator unit.

(2) When replacing the CHANNEL A and CHANNEL B FINE TUNING knobs, aline shaft slot with dot on front panel. then fasten knob on shaft with pointer to the right.

48. Special Tools

Two types of special tools are provided as part of Dual Diversity Converter CV–31(*)/TRA–7.

a. One special potentiometer adjusting tool is provided to adjust the various screw-driver potentiometer controls shown in figure 5. It is located along the right-hand side of the panel of the chassis. These controls also may be adjusted by means of a screw driver.

b. Two hexagonal wrenches are provided to adjust the setscrews which retain the various control knobs to their shafts. One of these wrenches is located under the lower hinge cover which covers the controls on the front of the panel. The other is located at the extreme rear of the chassis. A third wrench is supplied with the lettered models; it is located on the under side of the chassis, adjacent to the switch actuating cam with which it is associated.

c. Special tools for maintaining relay K401 are listed in paragraph 50*a*(4).

49. Wiring Diagrams

The wiring diagrams for the dual diversity converter are shown in figures 63 through 70.

a. In figures 63, 64, and 67, each piece of apparatus has the same designation as that stamped on the equipment, and the wiring terminals on each piece of apparatus are shown in their proper relative locations as viewed from the wiring side. The diagrams use the airline system of showing connections. With this system, each piece of apparatus is numbered arbitrarily, and feed lines representing the individual wires are carried a short distance and terminated at a common line running at right angles to the feed lines. These feed lines are marked with the color of the wire and have a number near the base line. This number is the same as the number of the piece of apparatus to which the other end of the wire connects. It is not necessary to trace a connection through the common or base line, and no provision is made for doing so. By observing the color and the identification number, it is possible to move directly to the other end of the wire.

b. In figures 65, 66, 68, and 70, a modified airline system is used to show connections. Each jumper wire that is not included as a part of a component subassembly is designated by a symbol and is represented by a line running from terminal to terminal. The description and the method of dressing each wire is indicated in a table on the diagram. In the diagram, a cable harness assembly is represented by parallel lines with cross hatching. Points where a wire or wires emerge from the cable harness assembly are designated *stations* and are numbered in sequence along the cable. At the point where a wire emerges from a *station*, its color code is indicated, and there is a number which indicates the distant station from which the other end of the wire ultimately emerges. By observing the color code and station reference designations at one end of the wire, it is possible to locate the other end quickly. This is also true for all wires which are a part of a cable harness assembly.

50. General Information and Cleaning

Note. Keep the cover on the relay except when it is necessary to remove it for trouble shooting or repair.

a. *General.*

(1) Relay K401 is a quick operating U-type relay. The adjustment requirements for U-type relays are both mechanical and electrical. The mechanical requirements include the proper position of springs, armature travel, spring tensions, etc. The electrical requirements are the specified currents through the winding which should cause the relay to operate or to release from the operated position. Different requirements are usually specified for test and for readjustment. Use the test values if it is necessary to check the relay when trouble shooting, otherwise use the readjustment requirements.

(2) Relay K401 is equipped with twin sets of contacts on each pair of mating springs. One spring each pair is split (bifurcated) near the contact end to permit means for setting the contacts so that both pairs make and break at approximately the same point of spring travel. Use of twin contacts provides much greater protection against failure caused by lint or dirt between the contacts, provided the springs are adjusted properly so that parallel contacts make at the same time. The armatures of these relays are not fastened rigidly at the rear as in other types of relays, but are held in place by hinge pins (bearings) (figs. 49 and 51). In this method of construction, the armature is not fixed rigidly as to position unless the relay is energized. Therefore, when checking the requirements requiring that the armature be in the operated position, the armature must be operated electrically rather than mechanically to insure accuracy of gaging.

(3) The relay winding and spring terminals are numbered on the schematic diagrams. The numbering plan for a typical U-type relay is shown in figure 51. The contact spring and winding terminals are numbered consecutively from right to left, facing the terminal side of the relay. The top and bottom spring assemblies of the relay each are numbered in sequence. The schematic diagrams show the top and bottom relay spring pile-ups, respectively, above and below the relay core and winding. A relay-winding terminal is followed by the letter T or B to indicate whether it is alined with the top or bottom spring-terminal pile-ups.

(4) The tools and gages used for adjusting relay K401, or burnishing its contacts, are given in the chart below. All codes are Western Electric.

Tools and gages	Description
474A	Hexagonal closed-end offset wrench (3/16″ x 1/4″).
505A	Spring adjuster for thin (.013″) springs.
507A (2 required).	Spring adjuster for springs other than .013″.
265C	Contact burnisher.
70D	50–0–50 gram gage.
132–type	Thickness gage.
KS–6528	Cleaning tape.
KS–6320	Orange stick.

b. *Cleaning.*

(1) Failure of a circuit may be traced to particles of dirt or lint between contacts, or to dirty parts of a relay. A cover is provided to reduce, as far as possible, the entry of foreign materials and their accumulation on the working parts of the relay. When the cover is replaced on the relay, it should be replaced right side up, as determined by the designations on the cover, so as to avoid depositing dirt and lint from the bottom of the cover on the relay contacts and parts. When relays are cleaned, the inside of the cover should be wiped clean with a lint-free cloth.

(2) Carbon tetrachloride may be used, if available, to remove grease or oil from contacts. Deposit small drops of the carbon tetrachloride on the contacts with a toothpick. Do not rub. Be careful not to spill any of the liquid on the spoolheads and insulators. After contacts have thoroughly dried, burnish them to remove all foreign matter.

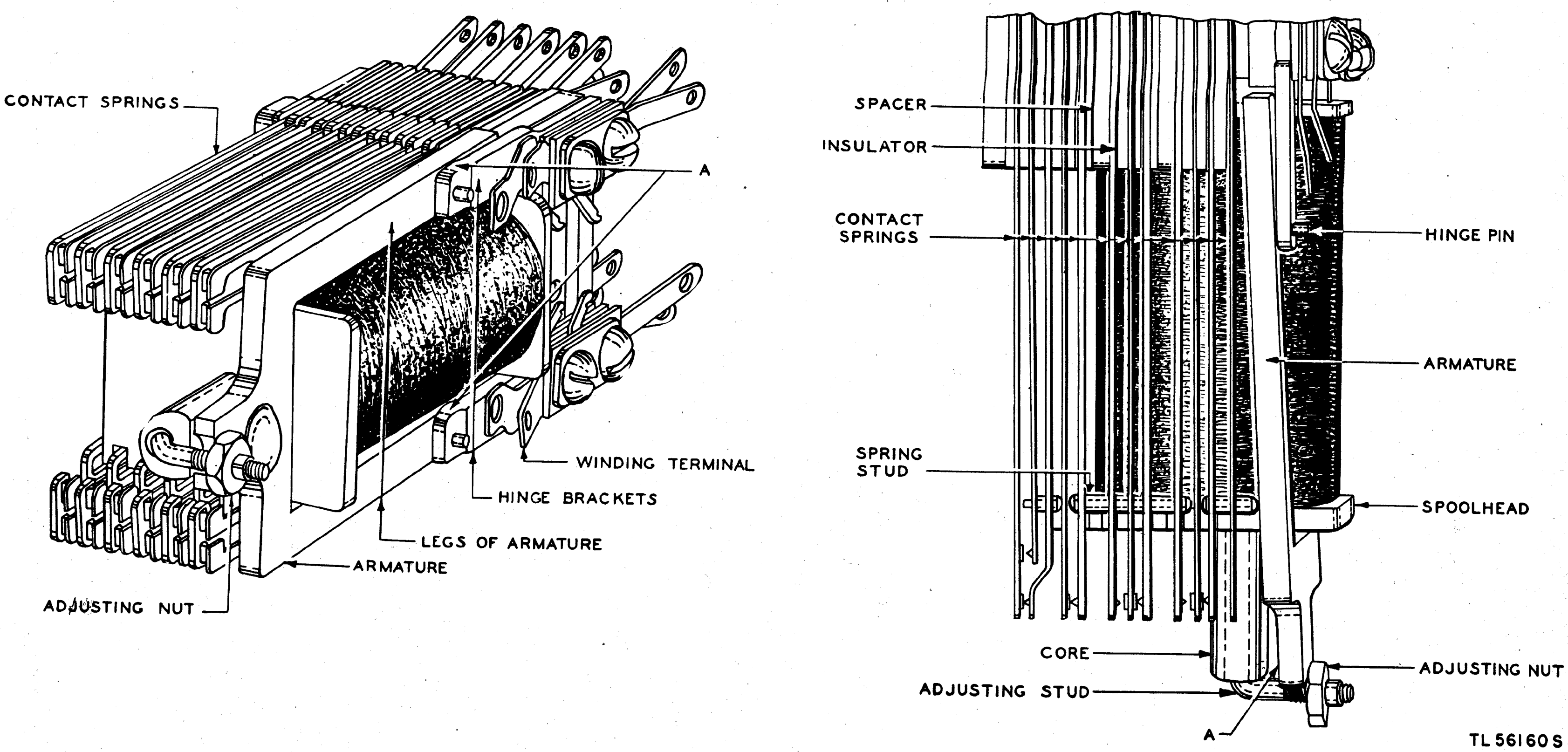


Figure 49. Top and side views of a typical U-type relay without cover spring and cover guide.

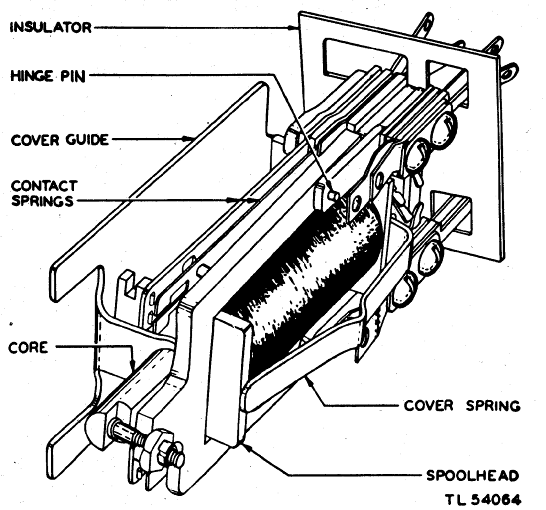


Figure 50. Side view of typical U-type relay with cover spring.

(3) Clean the armature and adjusting nut by passing a piece of WE No. KS–6528 cleaning tape back and forth between the armature and adjusting nut and around the adjusting stud.

c. Burnishing.

(1) To burnish the contacts, use a clean No. 266 blade of the 265C contact burnisher. It is very important to keep clean the blades of contact burnishers and any thickness gages which are used for the contacts. These tools should be wiped off frequently with a clean, dry cloth before being placed against each contact, and if the contacts are greasy, the tools should be wiped off frequently with a clean cloth dampened with carbon tetrachloride.

(2) To burnish normally open contacts, place the blade of the burnisher between the contacts, and press the contacts together with the KS–6320 orange stick (fig. 52) to give a slight pressure against the blade of the burnisher. At the same time, move the blade back and forth. The desired result usually is obtained by rubbing the burnisher between the contacts two or three times. In the case of normally closed contacts, the tension of the springs themselves usually will furnish sufficient pressure against the burnisher. On springs having heavy tension, lift one of the springs away to insert the burnisher. After burnishing, note whether the requirements covering contact make and break contact separation are still met, since repeated burnishing tends to increase the contact separation and to reduce the contact make. If necessary, correct as outlined in paragraph 53.

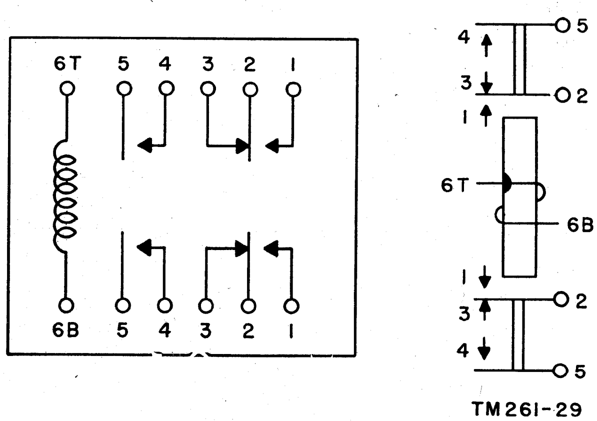


Figure 51. Relay K401, terminal numbering.

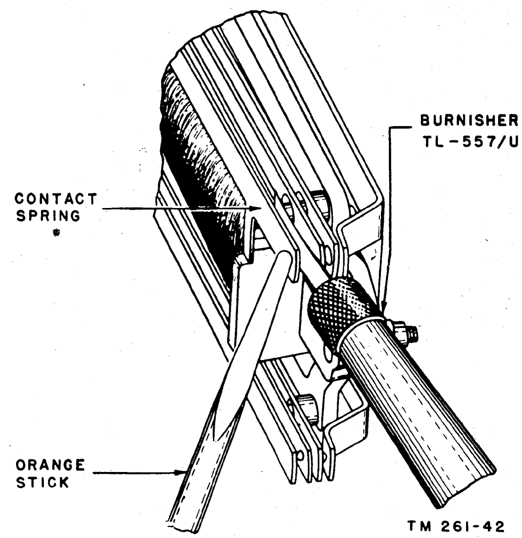


Figure 52. Burnishing the contacts.

51. Adjustments of Relay

a. Armature Back Tension.

(1) Apply the TL–560/U gage as shown in figure 53. If the back tension is not as specified in figure 56, adjust the armature.

(2) If the armature is not held against the adjusting nut with the pressure specified in figure 56 or if the portion of this pressure in one spring combination is more than two and one-half times that of the other spring combination, alter as necessary, the tension of the *A* springs which are tensioned against the armature; use the

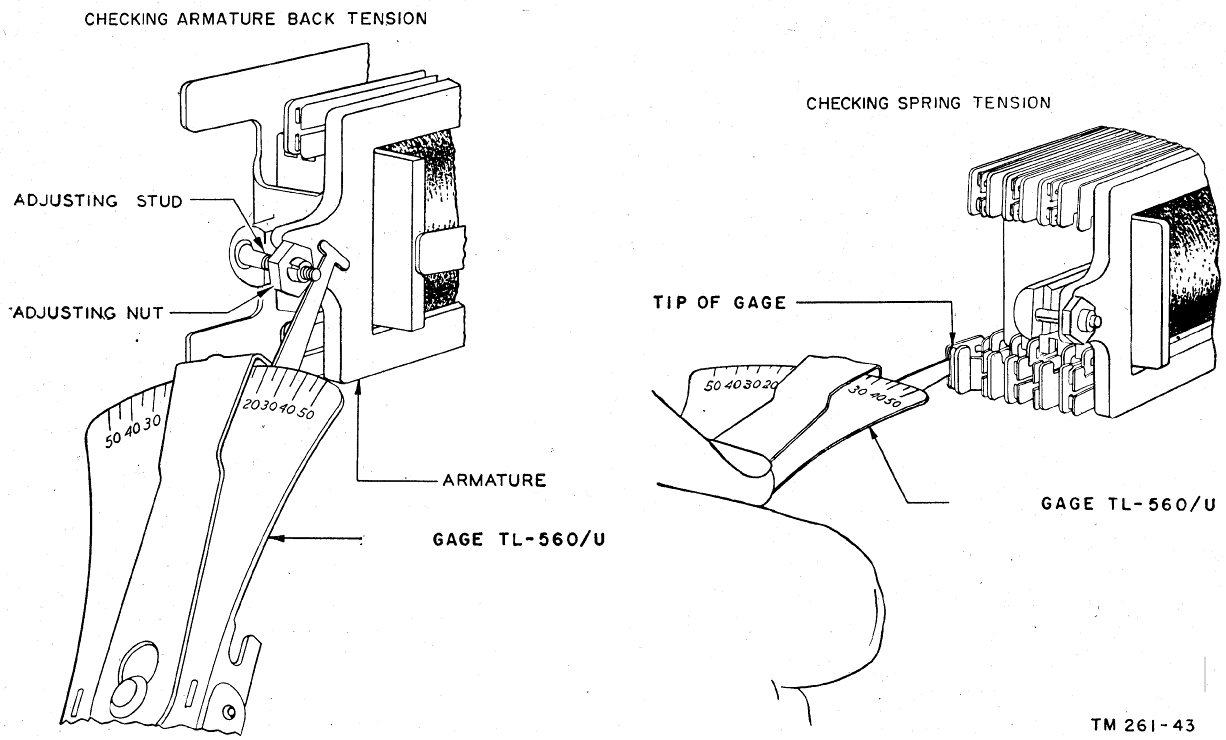


Figure 53. Use of TL–560/U gage.

505A or 507A spring adjuster. In making this adjustment, first increase the tension of the *A* spring (farthest from the armature) whose tension is transmitted to the armature through one or more studs. If the requirement cannot be met by this means alone, adjust the other springs (as required) which hold the armature

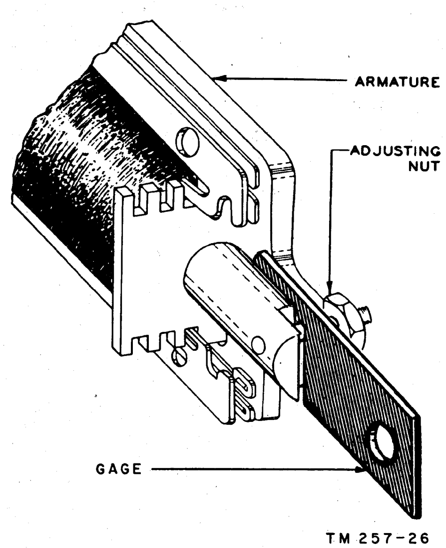


Figure 54. Armature travel adjustment.

against the adjusting nut. It is not necessary to distribute the tensions of the *A* springs equally, but the combined pressure of the studs against the top and bottom legs of the armature should meet the specified requirement.

b. Armature Travel (fig. 54). The armature travel (or gap between the core and the armature when the relay is in the unoperated position) is .047 inch. To adjust the armature travel, insert the 132R (.047-inch) gage between the armature and core with the long axis of the gage parallel to the axis of the core. Turn the adjusting nut with the 474A wrench until the gage fits snugly but does not bend.

c. Stud Clearance.

(1) There should be a clearance between the armature and the adjusting stud in all positions of travel of the armature. To adjust, use a pair of long-nosed pliers and bend the adjusting stud as required.

(2) The stud gaps labeled T in figure 56 should be a minimum of .006 inch. This insures that normally closed contacts close before the armature reaches the end of its travel when the relay releases.

52. Spring Adjustments

Note. Use the 505A spring adjuster for adjusting the thin springs, and use the 507A spring adjuster for the thicker springs.

a. Straightness of and Separation Between Springs.

(1) All springs should be free of sharp bends or kinks. A gradual bow in a spring is permissible. There should be a minimum clearance of .008 inch between adjacent springs whether in the unoperated or electrically operated position of the relay.

(2) If a spring is excessively bowed or bent, or if there is not the proper clearance between the springs, straighten the spring before adjusting to meet the spring tension requirements. To straighten a spring, span it with the slotted end of the proper spring adjuster just back of the bow or bend and, while exerting pressure to the right or left as required, draw the spring adjuster forward the length of the bow. Repeat this operation until the spring is approximately straight. Be careful when making this adjustment to avoid tilting the spring to either side.

b. Spring Tension.

(1) Spring tensions are specified in figure 56 on a minimum basis. Use of a TL–560/U gage for this check is shown in figure 53. Spring tensions have, in the case of moving springs (springs which do not rest against the spoolhead), a direct bearing on the electrical performance of the relay. If they are greatly in excess of the specified minimum, the relay may fail to meet its electrical requirements, in which case the tension will have to be reduced. In readjusting, have as much tension in the moving springs as is consistent with meeting the other requirements. Attempt to distribute the tension of the moving springs proportionately between the top and bottom spring combination.

(2) To adjust a spring for tension, span it with the slotted end of the proper spring adjuster just back of the stud and slide the adjuster to the base of the spring (fig. 55). Adjust the spring by applying, at the handle end of the tool, slight sidewise pressure to the right or left as required, thus tending to bend the spring at its base. Do not disturb adjacent springs and avoid twisting the spring.

(3) If the desired tension cannot be obtained by adjusting as outlined in (2) above without bowing the spring too much, apply the proper spring adjuster to the spring just back of the stud and slide it back to the base of the spring. Draw the adjuster forward the length of the spring, meanwhile applying pressure as required so the the spring is formed into a slight gradual bow with its concave surface facing the armature. Then move the adjuster to the base of the spring and adjust as described in (2) above. The magnitude of the bow to be formed in the spring must be learned by expe-

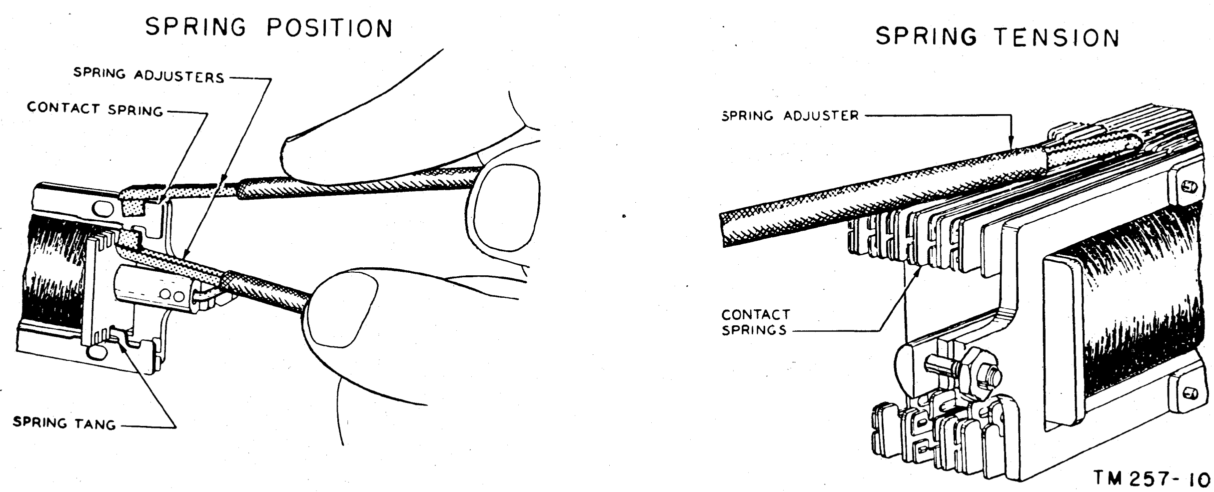


Figure 55. Spring adjustments.

rience and should be such that when the final tension adjustment is made at the base, the spring will be approximately straight.

c. Spring Tang.

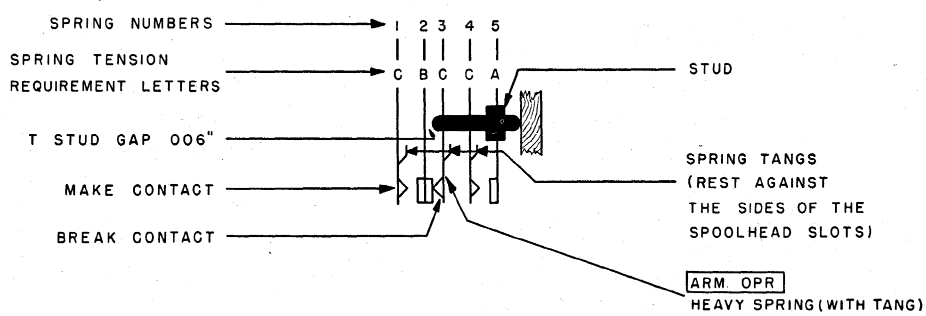
(1) The tang is the offset portion of a spring which rests against the side of the slots in the spoolhead. The tang should be positioned so that the free end extends behind the front face of the spoolhead, with the full width of the tang within the spoolhead slot when the spring moves.

(2) If the spring tangs do not engage the spoolhead satisfactorily, replace the relay.

(3) To adjust the position of springs to meet contact-separation, stud-gap, and contact-make requirements, adjust the spring tangs resting against the spoolhead. To do this, hold the spring with one 507A spring adjuster placed above the spring tang and adjust the tang to the right or left, as required, with another 507A adjuster as shown in figure 55.

53. Contact Adjustments

a. Contact Alinement. If the centers of the contacts are directly opposite each other, the contacts are alined. If contacts are out of alinement, attempt to correct by applying pressure to the free ends of the springs with either the 505A or 507A spring adjuster. Use as little pressure as possible to avoid damaging the springs. Do not attempt alinement of the springs as one operation, but preferably as a successive series of twists which will bring the contacts into alinement gradually. Figure 55 shows the spring adjusting tools in use. If contacts are excessively misalined, replace the relay.



TENSION ALL SPRINGS TOWARD THE ARMATURE. MEASURE TENSION WITH GAGE TL-560/U. APPLY THE GAGE TO THE THIN SPRINGS SO THAT THE TIP OF THE GAGE ENGAGES BOTH PRONGS OF THE FORKED END OF THE SPRING. APPLY THE GAGE TO THE HEAVY SPRING IN FRONT OF THE CONTACT. MEASURE TENSION OF SPRING MARKED ARM. OPR WITH THE ARMATURE IN THE OPERATED POSITION; MEASURE TENSION OF ALL OTHER SPRINGS WITH THE ARMATURE IN THE NON-OPERATED POSITION.	MINIMUM TENSION (GRAMS)	
	TEST	READJUST
ARMATURE BACK TENSION MEASURED AS THE ARMATURE LEAVES THE ADJUSTING NUT	18	22
THE SPRINGS DESIGNATED "A" HAVE NO DEFINITE TENSION REQUIREMENT, OTHER THAN THAT THE COMBINED PRESSURES OF THE TOP AND BOTTOM "A" SPRINGS WHICH PRODUCE PRESSURE AGAINST THE ARMATURE SHALL BE SUFFICIENT TO MEET THE ARMATURE BACK TENSION REQUIREMENT ABOVE		
TENSION OF "B" SPRINGS MEASURED AS THE CONTACTS BREAK.	18	20
TENSION OF "C" SPRINGS MEASURED AS THE SPRING TANGS LEAVE THE SIDES OF THE SPOOLHEAD SLOTS.	25	30

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Figure 56. Spring arrangements and spring tension requirements.

b. Contact Make.

(1) Both contacts on the forked springs should make with their associated contacts when the relay is in the electrically operated position for normally open contacts and in the unoperated position for normally closed contacts.

(2) For reliable operation of the relay, make contacts must make *before* the armature has reached its operated position fully when the relay is operated electrically. This is provided for by the contact make requirement. Check to see that the contact makes, as follows: Insert the .008-inch blade of the thickness gage between the armature and the core and at least one of the twin contacts of each pair of contacts should make when the relay is energized electrically. If the requirement is not met, readjust the springs. After the adjustment is made, insert the .004-inch blade of the thickness gage between the armature and the core and electrically energize the relay; both twin contacts should make. To make sure that the contacts are made, press the top of the solid spring toward its mating spring with the KS–6320 orange stick (fig. 57). If the solid spring moves perceptibly without moving its mating spring, the contact is not made.

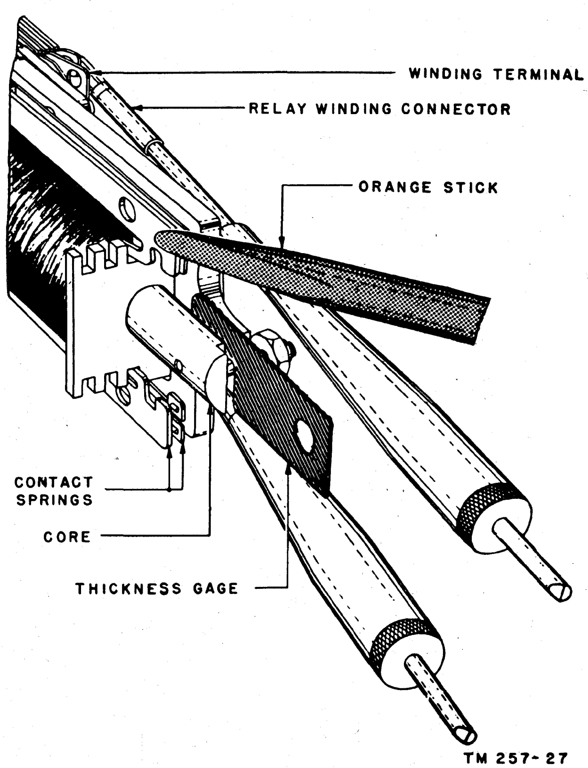

Figure 57. Contact make check.

c. Contact Separation.

(1) There should be a minimum separation of .005 inch between normally open contacts when the relay is energized electrically. To check the requirement, insert a .004-inch blade between the armature and the core and operate the relay electrically. With the gage in position, all break contacts should break and clear by .005 inch.

(2) If the requirement is not met, adjust as outlined in paragraph 52*c*.

54. Electrical Requirements and Adjustments

a. The electrical requirements for relay K401 are as follows:

Relay	Check for	Readjust (ma)	Test (ma)
K101	Operate	14. 4	15. 5
	Release	4. 9	4. 6

b. Use Test Set I–181, if available, to apply the above current values to the relay. If a test set is not available, connect a d-c milliammeter and a variable resistance in series with the winding of the relay and a dry-cell battery (about 15 volts). Adjust the current to the operate value; the relay should operate. Reduce the current to the release value; the relay should release.

c. If the relay fails to meet the test current requirements, adjust it. Always make the relay meet the readjust current requirements, if any adjustments are changed.

d. If the relay fails to meet the operate requirements after the mechanical adjustments have been made, decrease the tension of the moving springs toward the minimum. If the relay still does not operate, increase the stud gap. If the relay fails to meet the release requirements, increase the tension of the moving springs. In all cases, keep the tensions within the requirements given in figure 56.

Section IV. ALINEMENT

55. Basic Through B Converter Models

a. General.

(1) The basic through B models of the dual diversity converter are normally used with Radio Receiver Assembly OA–65(*)/MRC–2 or with two Radio Receivers R–336/GRC–26. Radio Receiver Assembly OA–65(*)/MRC–2 consists of a common oscillator (Oscillator-Amplifier O–59/MRC) and two receivers. These may be Radio Receivers R–182(*)/MRC–2 or modified Radio Receivers BC–342–N.

(2) Frequency Meter BC–221–(*) or any standard r-f signal generator may be used to inject a test signal into either J101 or J102, the input jacks for channel A and channel B, respectively. For greatest accuracy use a spare Frequency Shift Exciter O–39(*)/TRA–7 in conjunction with a spare radio receiver as a source of r-f signals. The initial input should be approximately .1 volt if the converter is badly misalined. Because Frequency Meter BC–221–(*) provides only about 8 mv, it is not suitable for initial alinement. Instead, use any signal generator capable of providing .1 volt. Frequency Meter BC–221–(*) may be used for determining the exact frequency of the receiver i. f. and for setting a signal generator to that frequency. Final alinement should be performed, using the receivers that will be associated with the converter during actual use. The following instructions assume that the receivers have already been alined and the receiver intermediate frequencies are peaked at 470 kc.

b. Alinement of Channel A Input Circuit. Tune in a strong r-f carrier with receiver A. Reduce the volume of receiver B to zero. Set the receiver on MVC, the CRYSTAL PHASING control fully clockwise to OUT, and the C. W.-OSC. switch to OFF. The bandwidth control (if provided in the receiver) should be at 8 kc.

(1) Tune the VERNIER of receiver A for the exact center of the 470-kc i-f pass band. To find the center of the pass band, use one of the following methods:

(*a*) Inject a modulated r-f signal into the receiver antenna terminals, noting the output on the output power meter; the output meter should be connected across the loudspeaker input terminals. The signal generator frequency is rocked for maximum indication on the output power meter. After this is accomplished, the modulation is switched off for subsequent tests.

(*b*) Determine the VERNIER readings for the outsides of the pass band and set the VERNIER control midway between these limits.

(*c*) The following accurate method involves the use of the CRYSTAL PHASING control on the receiver and can be used only if a strong r-f carrier is present.

1. Find the approximate center of the i-f pass band of the receiver with the VERNIER control. The c-w oscillator may be used to locate the signal but should be turned off for all subsequent adjustments.

2. Turn the CRYSTAL PHASING control counterclockwise until the audio output is at a minimum. Keep the volume control at maximum.

3. Rock the VERNIER control until characteristic chirps or beats are heard in the output, indicating that the i-f input frequency is in resonance with the 470-kc crystal in the crystal phasing circuit. The loudspeaker may be used; however, at times the use of a headset with lower resultant volume may be desirable.

4. After the center of the i-f pass band is found, turn the CRYSTAL PHASING control clockwise to the OUT position and leave it there for all later operations.

(2) Turn METER B switch to INPUT and be sure CHANNEL A FINE TUNING control is straight up.

(3) Adjust capacitor C105 (fig. 5) to obtain a maximum indication on meter B and a zero indication on meter A, indicating the center of the 50-kc discriminator characteristic. This center point can be verified on meter A by rotating the CHANNEL A FINE TUNING control 90° to both sides of the straight up

position. The pointer should deflect approximately the same amount either side of zero and in the same direction that the knob is turned. The red markers on both oscillator capacitors C105 and C106 and input capacitors C101 and C103, when adjacent to the black dot on the chassis, indicate that the capacitor is at minimum capacitance. The plates of these capacitors should be almost completely unmeshed when the i. f. of the receiver is 470 kc. The oscillator of channel B may give a spurious response which will show up as input on meter B when the above adjustments are made. To guard against this trouble, remove tube V102 from its socket while making oscillator adjustments on channel A. The condition just described is a normal one, and should not cause concern on the part of the operator. This condition does not exist when final adjustments have been accomplished correctly. The input meter reading for input signals to the converter up to approximately .1 volt depends on the setting of BAND WIDTH switch. WIDE band position will give about half-scale reading with .02 to .025-volt input while NARROW band position requires approximately twice this value for an equivalent meter reading.

(4) After the proper oscillator frequency has been found, adjust the input circuit of the converter unit by means of capacitor C101 for a maximum indication on meter B. If meter B goes off scale, decrease the volume of receiver A.

(5) Repeat the alinement of capacitor C105 as in (3) above. If proper adjustments have been made, it should be possible to swing the CHANNEL A FINE TUNING control to either side of straight up and down and obtain deflections on meter A. The input level shown on meter B should be maximum when meter A is at zero. The level should decrease slightly as meter A travels away from zero in either direction. The same results should be obtained when the receiver VERNIER control is rotated to both sides of the position of exact frequency. Check to see that meter A deflects to the left when the CHANNEL A FINE TUNING control is turned to the left, and deflects to the right when the FINE TUNING control is turned to the right.

c. Alinement of Channel B Input Circuit. The method of adjustment for channel B is identical to that used for channel A, except that the input level and the discriminator output cannot be read simultaneously. Both are read on meter B, depending on the position of the METER B switch:

(1) Turn the volume control of receiver B to maximum and the volume control of receiver A to minimum.

(2) Locate the center of the i-f pass band as described in *a*(1) above.

(3) Reinstall tube V102 if it was removed.

(4) Set METER B switch at INPUT and locate the approximate oscillator frequency by adjusting capacitor C106 to obtain a maximum reading on meter B. The oscillator of channel A may give a spurious response which will show up as input on meter B when adjusting. To guard against this trouble, remove tube V101 from channel A while making oscillator adjustments on channel B. The condition is a normal one, and should not cause concern on the part of the operator. This condition does not exist when the final adjustments have been correctly accomplished.

(5) Adjust capacitor C103 for maximum reading on meter B.

(6) Turn METER B switch to CHAN B.

(7) Set CHANNEL B FINE TUNING control in a straight up position.

(8) Readjust oscillator capacitor C106 to obtain a zero reading on meter B, thus indicating the center of the 29.3-kc discriminator characteristic. Vary the FINE TUNING control 90° to either side and note that meter B swings approximately equal distances either side of zero. The meter swing should be in the same direction in which the CHANNEL B FINE TUNING control is turned.

(9) Return METER B switch to INPUT and again vary the CHANNEL B FINE TUNING control 90° to both sides of straight up. Note that the input level is maximum when the control is straight

up, and decreases only a small amount when the control is moved 90° to either side of straight up position.

(10) Reinstall tube V101 if it was removed.

d. Alinement of Output Circuit. The alining adjustments should be made with a strong i-f signal input to the dual diversity converter (0.02 volt or more). The alinement steps indicated in (1) through (4) below can be performed with no signal input if tube V105 is removed from Dual Diversity Converter CV–31/TRA–7 or if the MARK-HOLD LEVEL control is turned completely counterclockwise in Dual Diversity Converters CV–31A/TRA–7 and CV–31B/TRA–7, to disable the mark-hold circuit while adjustments are made.

(1) Turn the OUTPUT switch to MARK and the METER B switch to NEUTRAL.

(2) Adjust the NEUTRAL OUTPUT control knob for a reading of +60 on meter B.

(3) Turn the METER B switch to POLAR and adjust the POLAR OUTPUT MARK control knob for a reading of +25 on meter B.

(4) Turn the OUTPUT knob to SPACE and adjust the POLAR OUTPUT SPACE knob for a reading of −25 on meter B.

(5) Turn the OUTPUT knob to NORMAL or REVERSE, and throw the DRIFT COMPENSATOR switch to IN.

(6) Turn the limiter knob to maximum clockwise position, and turn the AMP GAIN knob and the COMP AMP screw driver control fully counterclockwise.

(7) Feed a strong steady 470-kc signal into channel A of the converter, and adjust the signal strength so that with the CHANNEL A FINE TUNING control in the straight up position, meter A will read zero (center of discriminator output).

(8) Return the METER B switch to POLAR and adjust the BIAS A screw driver control (R155) to a point where the polar output current indicated on meter B just changes from mark to space and then vice versa. Set the control to mid-position between the two points found. This adjusts the d-c output loop to have an operating point corresponding to about 0 volt from the discriminator.

(9) Turn the METER B switch to CHAN A+B. Meter B should read 0 within ±10.

(10) Turn the COMP AMP control (R145) slightly clockwise until meter B indicates about 5 divisions higher than the reading obtained in (9) above.

(11) Turn the BIAS B screw driver control (R160) back and forth until the meter B reading just changes from 5 below the reading established in (9) above to 5 above the reading established in (10) above. For instance, if the reading obtained in (9) above was +6 and the adjustment of the COMP AMP control gave +11, the limits are +1 and +11.

(12) Set the BIAS B control halfway between the points which provide the limit readings. With the BIAS A and BIAS B screw driver controls set, and the METER B knob at CHAN A + B, turn the COMP AMP screw driver control until meter B indicates +70 or −70.

(13) Turn the AMP GAIN knob clockwise until the output can be changed from a mark to a space or vice versa by a fast movement of the CHANNEL A (or CHANNEL B) FINE TUNING knob. Restore the CHANNEL A (or CHANNEL B) FINE TUNING knob to a straight up position (zero reading on meter A).

(14) Turn the COMP AMP screw driver control (R145) for a +70 or −70 reading on meter B; then turn the COMP BAL screw driver control (R194) for a balance. Repeat until alternate equal indications are obtained at +70 and −70 when CHANNEL A FINE TUNING is given a fast movement.

(15) Slowly turn the LIMITER knob counterclockwise until the indication on meter B starts to drop below 70. Set the LIMITER knob at the point where the meter reading just barely starts to reduce.

56. Converter Models C and D

The following instructions assume that the radio receivers already have been alined so that the i-f output stages of the receivers are peaked at 500 kc. The following alinement procedures will be based on a steady r-f carrier being fed into receiver A (or receiver B, if desired) and that the receiver has been calibrated so that the i-f input to the converter is exactly 500 kc. For bench tests, a suitable signal generator or Frequency Meter BC–221–(*) can be used to inject a strong i-f carrier into the input connections of the dual diversity converter. However, final alinement should be performed, using the associated receivers. Connect channel A and channel B receivers to jacks J101 and J102. The AC SUPPLY and PLATE switches are set to their ON positions.

a. Alinement and Adjustment Equipment. The equipments necessary for the alinement and adjustment of the dual diversity converter are Radio Receivers R–388–/URR, normally used with these converter models, and a screw driver.

b. Channel A Input Circuit.

(1) Set CHANNEL A disabling switch to OPERATE and CHANNEL B disabling switch to DISABLED.

(2) Turn the METER B switch to the INPUT position with the CHANNEL A FINE TUNING control pointer in the straight up position.

(3) Open the hinged door on the front panel (fig. 4) and adjust capacitor C105 (CHAN A OSC) with a screw driver for a maximum indication on meter B and a zero indication on meter A. This indicates the center of the 50-kc discriminator characteristics and may be verified on meter A by rotating the CHANNEL A FINE TUNING control 90° to the left and to the right of the straight up position. The meter indicator will deflect approximately equal amounts to the left and to the right of zero in unison and in phase with the control pointer.

(4) After the oscillator frequency adjustment has been made, adjust the CHANNEL A input circuit. With a screw driver, adjust capacitor C101, CHAN A INPUT, for a maximum indication on meter B. If meter B goes off scale, decrease the RF GAIN of receiver A.

(5) Repeat the alinement of capacitor C105 as in (3) above.

(6) When proper adjustments have been made, it will be possible to turn the CHANNEL A FINE TUNING control to either side of the straight up position and obtain deflections on meter A. The input-level indication on meter B should be maximum when meter A indicates zero. The level should decrease slightly as meter A travels away from zero in in either direction. The same results should be obtained when the receiver tuning control is rotated to either side of the position of exact frequency.

(7) Check to see that meter A deflects to the left when the CHANNEL A FINE TUNING control is turned to the left and deflects to the right when the FINE TUNING control is turned to the right. If the meter deflections are reversed, it will be necessary to repeat (3) through (7) using a different setting of C105. The correct setting of C105 is the place where a second maximum peak is shown on meter B.

c. Channel B Input Circuit. The method of adjusting channel B is identical to that used for channel A except that the input level and the discriminator output cannot be read simultaneously. Both are read on meter B, depending on the position of the METER B switch.

(1) Turn the RF GAIN control of receiver B to maximum and CHANNEL A disabling switch to DISABLED and the CHANNEL B disabling switch to OPERATE.

(2) Set METER B switch to INPUT and locate the approximate oscillator frequency by adjusting capacitor C106, CHAN B OSC (fig. 4), to obtain a maximum reading on meter B.

(3) With a screw driver, adjust capacitor C103 (CHAN B INPUT) to obtain a maximum reading on meter B.

(4) Turn METER B switch to CHAN B. Set the CHANNEL B FINE TUNING control to a straight up position. Readjust oscillator capacitor C106 (CHAN B OSC) to obtain a zero reading on meter B, thus indicating the center of the 29.3-kc discriminator characteristic. Vary the FINE TUNING control 90° to either side of zero. Check to see that the indicator of meter B deflects to the right of zero when the CHANNEL B FINE TUNING control is turned to the right and deflects to the left of zero when the CHANNEL B FINE TUNING control is turned to the left.

(5) Return METER B switch to INPUT and again vary the CHANNEL B FINE

TUNING control 90° to either side and note that the input level is maximum when the control is straight up and decreases only a small amount as the control is moved 90° to either side of the straight up position.

(6) Restore operation of channel A by placing the CHANNEL A disabling switch in the OPERATE position.

d. Output Circuits. The following adjustments should be made with a strong i-f signal input to the dual diversity converter. The alinement covered in the steps indicated in (1) through (3) below, however, can be performed with no signal input if the MARK HOLD LEVEL switch is set to the OFF position.

(1) Set the OUTPUT switch at MARK and the METER B switch at NEUTRAL. Adjust the NEUTRAL OUTPUT control knob for a reading of +60 on meter B.

(2) Turn the METER B switch to POLAR and adjust the POLAR OUTPUT MARK control knob for a reading to +25 on meter B.

(3) Turn the OUTPUT knob to SPACE and adjust the POLAR OUTPUT SPACE knob for a reading of −25 on meter B.

(4) Turn the OUTPUT knob to NORMAL or REVERSE, and turn the DRIFT COMPENSATOR switch to IN. Turn the LIMITER knob to the maximum clockwise position, and turn the AMP GAIN knob and the COMP AMP screw driver control fully counterclockwise.

(5) Feed a strong, steady 500-kc signal into channel A of the converter and adjust the signal strength so that with the CHANNEL A FINE TUNING control pointer in the straight up position, meter A will indicate zero (center of discriminator output).

(6) Return the METER B switch to POLAR and adjust BIAS A screw driver control R155 (fig. 5) to a point where the polar output current indicated on meter B just changes from mark to space, and then vice versa. Set the control to midposition between the two points found.

Note. This adjusts the d-c output loop to have an operating point corresponding to about a 0-volt output from the discriminator.

(7) Turn the METER B switch to CHAN A + B. Meter B should read 0 within ±10.

(8) Turn the COMP AMP control (fig. 5) slightly clockwise until meter B indicates about five divisions higher than the reading obtained in (7) above.

(9) Turn BIAS B screw driver control R160 (fig. 5) back and forth until the meter B reading just changes from 5 below the reading established in (7) above to 5 above the reading established in (8) above. For instance, if the reading obtained in (7) above was +6 and the adjustment of the COMP AMP control (8 above) gave +11, the limits are +1 and +11.

(10) Set the BIAS B control halfway between the points which provide the limit readings. With the BIAS A and BIAS B screw driver controls set and the METER B knob at CHAN A + B, turn the COMP AMP screw driver control until meter B indicates +70 or −70.

(11) Turn the AMP GAIN knob clockwise until the output can be changed from a mark to space, or vice versa, by a fast movement of the CHANNEL A (or CHANNEL B) FINE TUNING knob. Restore the CHANNEL A (or CHANNEL B) FINE TUNING knob to straight up position (zero reading on meter A).

(12) Turn the COMP AMP screw driver control (R145) to +70 or −70 on meter B, then turn the COMP BAL screw driver control (R194) for balance. Repeat until alternate equal indications are obtained of +70 and −70 when CHANNEL A FINE TUNING knob is given a fast movement.

(13) Slowly turn the LIMITER knob counterclockwise until the indication on meter B starts to drop below 70. Set the LIMITER knob at the point where the meter reading is just barely starting to reduce.

(14) The final adjustment of the AMP GAIN control requires an input of miscellaneous keying.

(*a*) Turn the METER B switch to COMP AMP position.

(*b*) Turn the AMP GAIN knob fully counterclockwise and then, when miscellaneous signals are being received, slowly turn the knob clockwise while observing METER B for a minimum of irregular deflections or kicks. The normal setting will usually be 30° or 40° from the counterclockwise stop for 850-cycle frequency shift. Set the AMP GAIN knob in a position which provides a keyed tone output from the converter and results in minimum kicks on METER B. A more accurate setting of the AMP GAIN knob may be found if the LIMITER knob is first turned fully clockwise.

(*c*) Turn the METER B switch to the CHAN A + B position.

(*d*) Verify that the deflection on meter B, on a steady mark signal, is 70 to the right of zero, and during a steady mark signal, reset the LIMITER knob to a position which causes the 70 indication to just start to decrease.

(*e*) Connect a headphone to the PHONES KEYED TONE jack, and verify that clear distinct tones are produced. Clear distinct tones indicate the absence of noise peaks or distortion caused by improper tuning.

57. Adjustment of Power Supply

The power supply and the converter are connected together by means of E301; 115-volt a-c (alternating-current) power input jack J104 is located at the rear of the converter. The input power is connected to the power transformers and all power for the operation of the converter is obtained from the power supply. Connect the 115-volt a-c source to jack J104 of the converter by means of a cord such as Cord CX–954/TRA–7. Make sure that the a-c power is connected to the proper terminals of transformers T301 and T302. Set the AC SUPPLY power switch to ON and the PLATE switch to ON. A 20,000-ohm-per-voltmeter is used for measuring the voltages of the power supply.

a. Regulated −150-Volt Supply.

(1) In the converter, connect a 2,000-ohm resistor between binding posts E122 and E123 (or pins A and B of J103). Connect an 1,800-ohm resistor between binding posts E124 and E123 (or pins D and E of J103); strap out resistors R184 through R187.

(2) Set the OUTPUT switch to MARK and METER B switch to POLAR, and adjust the POLAR OUTPUT MARK control so that meter B registers +25. Set the OUTPUT switch to SPACE and METER B switch to NEUTRAL, and adjust the NEUTRAL OUTPUT control so that meter B registers +60.

(3) Connect the voltmeter between terminal 11 of terminal strip E301 and ground of the power supply.

(4) The voltmeter should indicate between −145 and −160 volts when the two conditions indicated in (1) and (2) above are satisfied.

b. Regulated +150-Volt Supply.

(1) Repeat *a*(1) and *a*(2) above.

(2) In the converter, set the CHANNEL A and CHANNEL B disabling switches to operate (C and D models).

(3) Connect the voltmeter between terminal 4 of terminal strip E301 and ground.

(4) If the voltage is more than 3 volts greater than (disregarding the polarity) the voltages indicated in *a*(4) above, strap out portions of resistance provided by resistors R312 through R315 until the terminal 4 voltage matches the terminal 11 voltage within 3 volts.

(5) If the voltage is more than 3 volts less than (disregarding the polarity) the voltage indicated in *a*(4) above, strap out resistor R316 first and then strap out resistors R312 through R315 as required to match the voltages.

c. Bias Voltage for Output Tubes.

(1) Connect the voltmeter between pin 5 of V116 and the junction point of two of the series of resistors (R162 through R167). Check for equal readings when S102 is switched from SPACE to MARK.

(2) Repeat the above procedure at different junction points until the equal readings are obtained.

(3) Move the lead coming from the grids of V116 and V117 to junction point determined by the above tests.

Section V. FINAL TESTING

58. General

This section is intended as a guide to be used in determining the quality of a Dual Diversity Converter CV–31(*)/TRA–7 repaired at higher echelon levels. The minimum test requirements outlined in the following paragraphs may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting the specifications in the paragraphs below will furnish uniformly satisfactory results during operation. The tests given in paragraphs 62 through 73 should be performed in the order given.

59. Test Equipment Required

a. The following items of test equipment are required to perform the tests in this section:

- Multimeter TS–352/U or equal.
- Electronic Multimeter ME–6A/U or equal.
- Audio Oscillator TS–382A/U or equal.
- Signal Generator TS–588/U or equal.
- Headset of 2,000 to 4,000 ohms impedance.
- Oscilloscope OS–8A/U or equal.
- Distortion Test Set TS–383/GG or equal.
- Variac (variable primary power source for the converter) capable of supplying 175 watts.
- Teletypewriter TT–55/MGC or equal.

b. If a large number of converter units are to be tested, consideration should be given to obtaining the following additional equipments:

- Converter test cabinet, WE #SID–107077 or equal.
- Transmitter-distributor, Teletype #14–F or equal.
- Transmission measuring set, WE #SID–107040 or equal.
- Set of patch cords, consisting of—
  - One WE #SID–117103AM, three conductor, with Hubbell plug and twist lock ends.
  - Four WE #SID–117102E, two conductor, with WE #347 ends.
  - One WE #SID–117113B, five conductor, with AN–14S–5P ends.
  - One WE #SID–117113M, four conductor, with AN–14S–10P and AN–14S–10S ends.
  - One WE #SID–117113N, four conductor, with AN–14S–11P and AN–14S–11S ends.

60. Preliminary Operations

a. Check to see that all switch detents operate properly.

b. The pointers on the C102 and C104 knobs should point to the left when the capacitors are meshed fully.

c. Check to see that T301 and T302 are connected for 115-volt operation.

d. Make up the leads shown in figure 58. Resistors should be of at least 5-watt size.

61. Converter Stage Voltage Tests

a. Connect the input power cord of the variac to a 115-volt source. Connect J104 to the variac. Throw the AC SUPPLY switch to the ON position. The white pilot lamp should light. Adjust the converter line voltage to 115 volts by means of the variac.

b. Place a shorting clip between terminal 4 of V117 and terminal 12 of terminal strip E301 (−400-volt input lead). Leave terminal 4 of V117 connected to terminal 5 of V116 but remove the connection between these grid leads and the R162 to R167 resistor string.

c. Throw the PLATE switch to ON. The red pilot lamp should light.

d. Connect the test set-up shown for J103 in figure 58. Open switches S1 and S2. Strap out resistors R184 through R187. Connect the external milliammeter to the POLAR LOOP jack. Adjust the POLAR OUTPUT MARK control (on the converter unit) for a current of +25 ma while the OUTPUT switch is at MARK. Transfer the milliammeter to the NEUTRAL LOOP jack and adjust the NEUTRAL OUTPUT control for a 60-ma reading.

e. Set the OUTPUT switch at MARK and measure the voltage from terminal 11 of E301 to the chassis (ground). The voltage should be between −145 and −160 volts. Make a note of this voltage.

f. Measure the voltage from terminal 4 of E301 to the chassis. This voltage should be within ±3 volts of that measured in *e* above, but of positive polarity. Make a note of this voltage.

(1) If the voltage difference is too high, strap out enough of resistors R312 through R315 to bring the voltage within the 3-volt limit.

(2) If the voltage is too low, first strap out

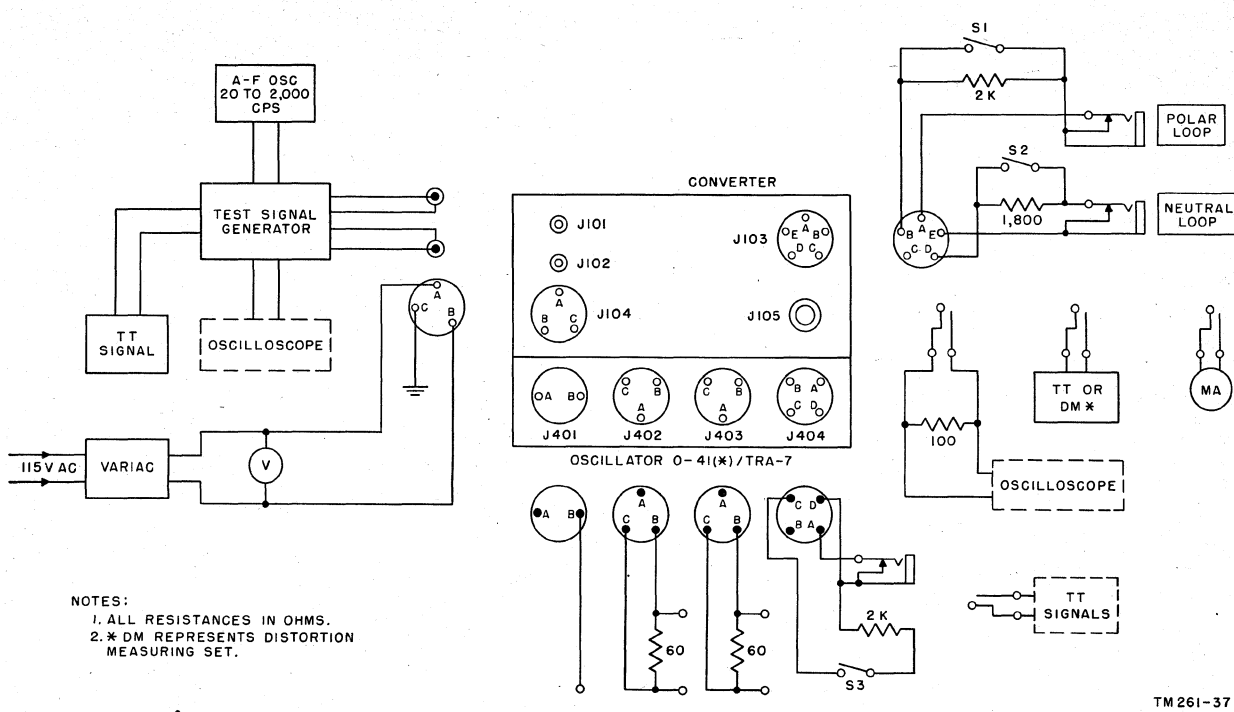

Figure 58. Test set-up for final testing.

resistor R316; then strap out enough of resistors R312 through R315 to bring the voltage within limits.

g. Vary the converter input voltage by means of the variac between the limits of 103 and 127 volts. The +150-volt supply (terminal 4 of E301 to ground) should not vary more than ±3 volts from the value obtained with a line voltage of 115.

h. Adjust the line voltage to 115 volts and record the voltages measured between the following points and chassis:

(1) Terminal 3 of E301; this should be 280 ±15 volts.

(2) Terminal 13 of E301; this should be between −145 and −160 volts.

(3) Terminal 12 of E301; this should be −400 ±20 volts.

i. Turn the METER B switch to the following positions and observe that the following readings on meter B are obtained. The readings on meter B should be within ±5.0 divisions, or ±10%, whichever is greater, of the voltage values recorded in *e*, *f*, and *h* above.

(1) METER B switch at +275V; nominal reading should be +55 ±6.

(2) METER B switch at REG +150V; nominal reading should be +30 ±5.

(3) METER B switch at REG −150V; nominal reading should be −30 ±5.

(4) METER B switch at −150V; nominal reading should be −30 ±5.

(5) METER B switch at −400V; nominal reading should be −80 ±8.

62. Output Circuit Tests

a. Turn the OUTPUT switch to MARK and the METER B switch to CHAN A + B. METER B should indicate +55 ±10. Turn the OUTPUT switch to SPACE. METER B should indicate −55 ±10.

b. Set the BIAS A control to the maximum counterclockwise position. Turn the OUTPUT switch to SPACE. Measure the voltage from terminal 8 of V113 to ground. This voltage should be +250 ±20. Turn the OUTPUT switch to MARK. The voltage from terminal 8 of V113 to ground should be less than +20 volts. Leave the OUTPUT switch on MARK and measure the voltage from terminal 5 of V117 to the various points of the voltage divider consisting of resistors R162 through R167. Use the 250-volt range of a 20,000-ohm-per-volt meter. Select the point having the voltage nearest to −65 and solder the lead from terminal 4 of V117 and terminal 5 of V116 to this point.

c. Rotate the MARK HOLD LEVEL control counterclockwise to the OFF position. Remove the shorting clip between terminal 4 of V117 and terminal 12 of E301 (this was inserted during the operation in paragraph 61*b*). Readjust the POLAR OUTPUT MARK control for a reading of +25 ma at the POLAR LOOP jack. Readjust the POLAR OUTPUT SPACE control for a reading of −25 ma. Measure the voltage to ground from terminal 8 of V117. With the OUTPUT switch at MARK, this should be between +210 and +165 volts. With the OUTPUT switch at SPACE, it should be between −135 and −160 volts.

d. Readjust the NEUTRAL LOOP current to 60 ma with the NEUTRAL OUTPUT control (OUTPUT switch at MARK). Operate the METER B switch to POLAR; it should indicate 25 ±3. With the OUTPUT switch at SPACE, it should indicate to the left and for mark signals it should indicate to the right.

e. Operate the METER B switch to NEUTRAL. The neutral output current should be indicated on meter B by a reading of 60 ±5 for a mark and 0 for a space. The mark reading should be to the right.

f. With switch S1 of the J103 circuit open, it should be possible to adjust for a polar output current of ±30 ma or greater. With the OUTPUT switch on MARK, switch S2 of the J103 circuit open, and resistors R184 through R187 strapped out, it should be possible to adjust for a neutral output current of 63 ma or greater. Remove the strap from across R184 through R187 (applied during the operations in paragraph 61*d*).

g. Close switches S1 and S2 of the J103 circuit. It should be possible to adjust the polar output currents to ±20 ma or less. With the OUTPUT switch on MARK, it should be possible to adjust the neutral output current to +40 ma or less. Readjust the polar and neutral loop currents for ±25 ma and +60 ma, respectively.

63. Channel A Converter Tests

a. Apply no input to J102 while testing channel A. Set the r-f signal generator to 395 kc (440 kc for the C and D models) with a 1,000-mv output. Connect it to channel A input jack J101. Connect the VTVM from terminal 3 of Z103 to ground. Adjust capacitor C101 for a maximum indication on the VTVM; this should be between 13 and 22 volts.

b. Connect the VTVM from terminal 2 of Z104 to ground. The voltage should be between 1.5 and 3.5 volts over the complete range of capacitor C105.

c. Connect the VTVM from terminal 4 of E103 to ground. Set the BAND WIDTH switch to NARROW. Adjust capacitor C105 to give a 0 reading on meter A. This should occur with the converter A oscillator section operating at 445 kc (490 kc in the C and D models) and capacitor C105 set at nearly maximum capacitance. Set the r-f oscillator to 100-mv output. The voltage read on the VTVM should be between 10 and 25 volts. Move the BAND WIDTH switch to WIDE. The VTVM should read between 20 and 40 volts.

d. Set the r-f signal generator to 475 kc (520 kc for the C and D models). Set the BAND WIDTH switch to NARROW. Adjust tuning capacitors C105 and C101 to give a maximum votage reading. This should occur at a converter A oscillator frequency of 525 kc (565 kc for the C and D models). With an r-f input of 100 mv, the VTMV should read between 10 and 25 volts.

64. Channel B Converter Tests

Apply no input to J101 while testing channel B.

a. Apply the 1,000-mv, 395-kc (440 kc for the C and D models) signal to J102. Connect the VTVM from terminal 3 of Z101 to ground. Adjust capacitor C 103 for maximum on the VTVM; this should be between 13 and 22 volts.

b. Connect the VTVM between terminal 2 of Z102 and ground. The voltage should be between 1.5 and 3.5 volts over the complete range of capacitor C106.

c. Connect the VTVM from terminal 4 of E103 to ground. Set the BAND WIDTH switch to NARROW. Turn the METER B switch to CHAN B. Adjust capacitor C106 to give a 0 reading on meter B. This should occur with the converter B oscillator section operating at 424.3 kc. (469.3 kc. in the C and D models) and capacitor C106 set at nearly maximum capacitance. Set the r-f oscillator at 100 mv. The voltage reading on the VTVM should be between 10 and 25 volts. Move the BAND WIDTH switch to WIDE; the VTVM should read beteeen 20 and 40 volts.

d. Set the r-f signal generator to 475 kc (520 kc for the C and D models). The converter B oscillator section will give a 29.3-kc i.f. at two points: 504.3 kc (549.3 kc in the C and D models) and 445.7 kc (490.7 kc for the C and D models). The higher oscillator frequency is used; this will be near the minimum capacitance settings of C106 and C103. Adjust these two capacitors for maximum voltage reading on the VTVM; with the BAND WIDTH switch at NARROW, this should be between 10 and 25 volts; with the switch at WIDE, the reading should be between 20 and 40 volts.

65. Limiter Tests

a. Adjust the r-f signal generator to 450 kc (495 kc for the C and D models).

b. Set the BAND WIDTH switch at NARROW. Aline the channel A input and oscillator tuning as in paragraph 63, using the frequency specified in *a* above. Aline the channel B input and oscillator tuning as in paragraph 63, using the frequency specified in *a* above.

c. Set the METER B switch at INPUT. Adjust the output level of the r-f signal generator to give a meter B indication of +50. There should be no input to channel B. The voltage measured at terminal 4 of E103 should not be greater than 6 volts. The signal required for the meter B reading of +50 should not be greater than 20 mv.

d. Without changing the input level to channel A connect the VTVM from terminal 42 of E103 to ground. The reading should be 6 ±2 volts.

e. Adjust the signal input to channel A to 0.5 mv. The VTVM should read more than 3.5 volts. Adjust the signal input to 500 mv; the VTVM should read 6 ±2 volts.

f. Connect the oscilloscope from terminal 42 of E103 to ground. Make certain that the high input side of the oscilloscope is connected to terminal 42. Shunt the vertical input with a 100-ohm resistor. Use a saw-tooth sweep frequency suitable to obtain a 3-cycle pattern. Observe that the waveform of the 50-kc signal output from the limiter is close to that shown in A, figure 35.

g. Repeat the tests in *c* through *f* above on channel B. Observe that the waveform of the 29.3-kc signal output from the limiter is close to that shown in B, figure 35. Remove the oscilloscope connections from terminal 42 of E103.

66. Discriminator Tests

a. Apply an input of 50 mv at 450 kc to channel A. Set trimmer capacitor C102 at half capacitance. Adjust capacitor C105 to give a zero indication on meter A (center of discriminator range).

b. Apply an input of 50 mv at 450 kc to channel B (no input to channel A). Set trimmer capacitor C104 to half capacitance and adjust tuning capacitor C106 to give a zero indication on meter B. Make certain that the higher channel B, local oscillator frequency is the one used to avoid inversion of the discriminator output in this channel. Have METER B switch at the CHAN B position.

c. Operate the test signal circuit to spacing with a frequency shift of 850 cps. By readjustment of the test oscillator frequency, center the mark and space readings of meter B around zero. Meter B will give equal indication of 50 ±10 either side of zero and will indicate to the left for space. Shift the input from CHAN B to CHAN A, without readjustment of the r-f signal generator tuning controls, and check to see that the above limits are met on meter A.

67. Drift Compensator Circuit

a. Adjust the signal generator for an input of 50 mv to CHAN A and no input to CHAN B.

b. With the DRIFT COMPENSATOR switch at IN, the OUTPUT switch at NORMAL, and the AMP GAIN control at its maximum counterclockwise position, turn the COMP AMP control to its extreme counterclockwise position. Turn the LIMITER control to its maximum clockwise position. Set the METER B switch at CHAN A + B. Meter B will read 0 ±5. Note this reading. Adjust the BIAS A control to a point where a marking or spacing loop condition may be obtained by just a slight movement of the BIAS A control as observed on meter B in the POLAR loop circuit. Adjust the BIAS A control to a point about halfway between the positions where the polar output changes from mark to space and from space to mark.

c. Set the METER B switch at CHAN A + B. Turn the COMP AMP control in a clockwise direction until the meter B reading is increased by 5 to the right or left depending on whether the circuit is in a marking or spacing condition. This reading will be to the right or left depending on the condition of the output circuits at the time the adjustment is made.

d. Turn the BIAS B control slowly to the two positions where meter B deflects to the right and to the left of the readings noted in *b* above. Set the BIAS B control midway between these two positions.

e. Set the COMP AMP control at midposition. Advance the AMP GAIN control until sending a mark or space from the test signal generator results in keying of the output loops. The output switch should be at NORMAL. With METER B switch at CHAN A + B, meter B shall indicate to the right for mark and left for space.

f. Adjust the COMP BAL and COMP AMP controls to provide steady meter B readings of

$+70 \pm 5$ for mark and -70 ± 5 for space. (Allow several seconds for each reading to stabilize.)

g. With the LIMITER control at maximum clockwise position, measure the voltage to ground from terminals 4 and 5 of V112 (use a d-c voltmeter). These voltages will be plus and minus 24 ± 3 volts, respectively. With the COMP AMP control adjusted to give meter B indications of plus and minus 70 ± 5 for mark and space, respectively, slowly reduce the LIMITER control until the meter B reading drops to $+50$ for mark. With this setting the reading for space will be -50 ± 10. Turn the LIMITER control f lly clockwise and then slowly counterclockwise until the meter B reading just begins to decrease.

h. Operate the DRIFT COMPENSATOR switch to OUT, the OUTPUT switch to REVERSE, and METER B switch to CHAN B. Set the test set sending circuit to give centered deflections of the meters in the discriminator outputs. Set the MARK HOLD LEVEL switch in the *on* position. Send a steady space into either CHAN A or CHAN B at such a level to give a reading of 50 on meter B with the METER B switch at INPUT. Adjust the MARK HOLD LEVEL control until the output circuit just remains spacing. Set the input levels into A and B so that an input reading of 50 on meter B is obtained from either input alone. Apply this level to both channels A and B. Observe that the loop circuit is in a spacing condition but restores to a marking condition when the inputs to both A and B are reduced to zero.

i. With the converter adjusted for diversity balance as in *f* above, connect a receiving TT to the neutral loop circuit. Send miscellaneous signals from test generator on channel A, channels A + B, and channel B alone. Observe that the TT prints correct copy as the neutral loop current is varied between 55 and 65 ma at a converter input line voltage of 115 volts. Repeat for line voltages of 103 and 127 volts.

j. Place the OUTPUT switch at MARK and with neutral loop currents of 55 and 65 ma, operate the receiving TT keyboard and see that correct copy is printed. Repeat for line voltages of 103 and 127 volts.

Note. If the requirements of *i* and *j* above cannot be met, refer to paragraph 61*b* and select the point on the voltage divider to provide the next lower voltage on terminal 4 of V117. Connect the lead to this point and recheck as in *i* and *j* above.

68. Over-all Transmission Tests

The following test requires the equipment listed in paragraph 59*b* or an equivalent test set-up.

a. Check that the converter circuit is adjusted for normal operation. Set the MARK HOLD LEVEL control to the OFF position. Check the test signal generator for a frequency shift of 850 cps at 450 kc. Adjust the input level to 50 mv. Check that the converter oscillators are alined correctly for the mean frequency to be used. Check that each input, channels A and B, in turn produces equal plus and minus discriminator output readings on meters A and B when the signal input is changed from M to S. Set the BAND WIDTH switch at NARROW.

b. Connect the oscilloscope from terminal 3 of V111 to ground. Remove the 100-ohm load resistor from across the vertical plates of the oscilloscope. Operate the DRIFT COMPENSATOR switch to OUT and the LP FIL to *out*. Set the OUTPUT switch at REVERSE. Set the signal switch on the test cabinet at DOTS. Patch from the output jack on the SID–107040 Decade Oscillator to the a-f (audio-frequency) oscillator jack on the test cabinet. Check the signal generator bias by patching the vertical input of the oscilloscope to the SCOPE jack on the generator. With the decade oscillator set at 20 cycles, observe the waveform on the scope using a suitable sweep frequency on the horizontal plates. By adjusting the decade oscillator output to approximately 0 dbm (decibels referred to a milliwatt in 600 ohms), and adjusting the generator's bias control, and the sweep frequency (with no synchronization), it should be possible to obtain a pattern similar to A, figure 61. In making the check, use 20 cps for 20 reversals (dots), 65 cps for 65 reversals, and 130 cps for 130 reversals.

c. Send 20-cycle reversals from the test circuit first on channel A only, and then on channel B only. Observe their waveshapes on the oscilloscope. They should be nearly square as indicated in A, figure 59. Raise the dot frequency to 65. The waveform will appear as in B, figure 59. Observe the change in waveform when the LP FIL switch is operated to IN. This change should appear as in C, figure 59. Raise the dot frequency to 130. With the LP FIL switch at *out* the waveform should appear as in D, figure 59. Check that

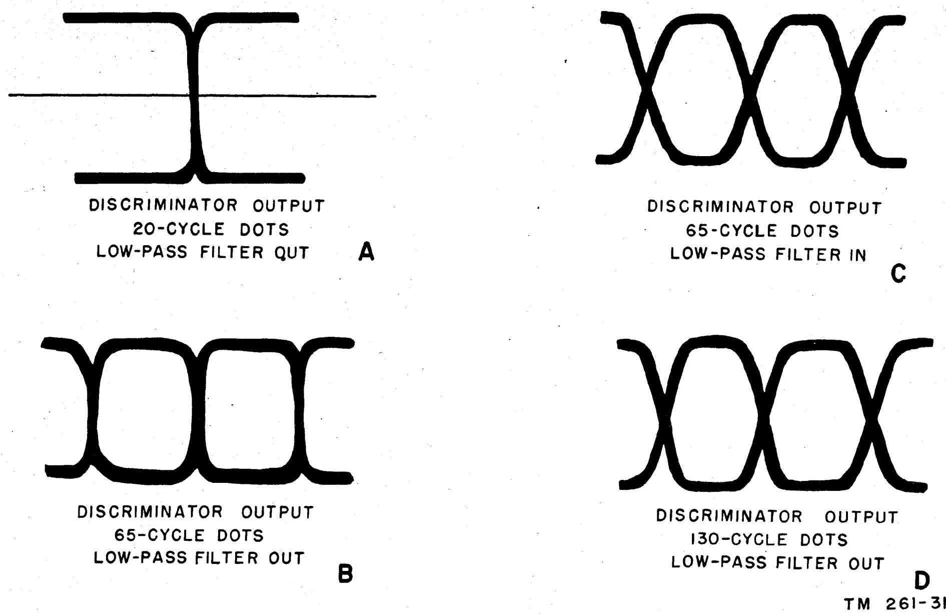

Figure 59. Discriminator output waveforms.

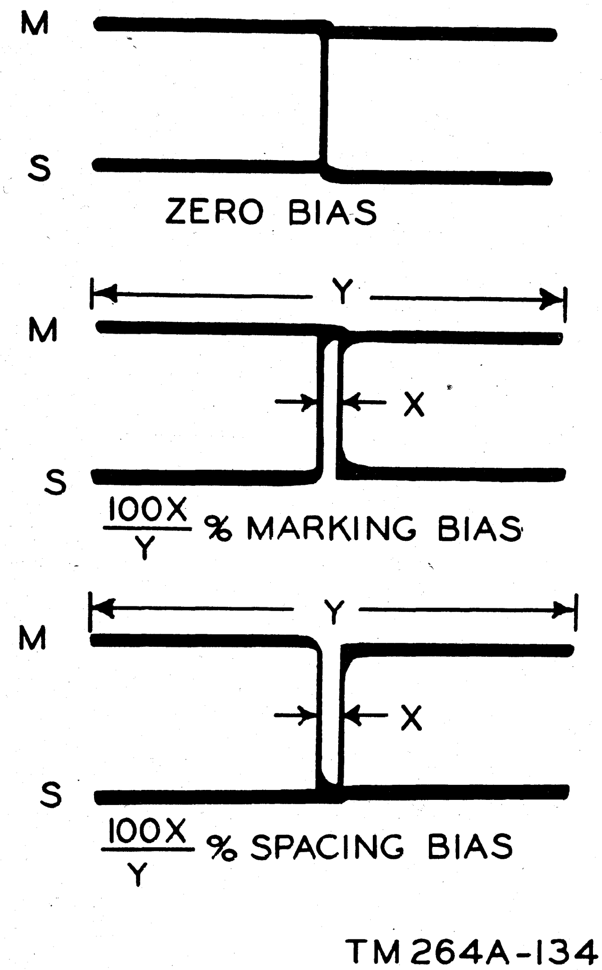

Figure 60. Bias check waveforms.

both inputs A and B give about the same waveshape.

d. Patch the oscilloscope vertical plates to the respective T or R oscilloscope jack on the test cabinet to observe the polar and neutral loop current waveshapes. These should be nearly square at dot frequencies of 20 and 200 cycles. With a dot frequency of 20, adjust the oscilloscope sweep to obtain a pattern as shown in figure 60 which will indicate if bias exists. With the LP FIL at *out* and with the input frequencies set to give equal plus and minus discriminator outputs, bias will not exceed 6 percent as measured on the oscilloscope. Repeat for 200-cycle dots. Bias will not exceed 10 percent. Disconnect the oscilloscope.

e. Send a steady mark from the test circuit. Set the level to CHAN A at 10 mv. Slowly raise the level into CHAN B until meter B reads equal to meter A. (The output of CHAN A will be found to fall as that of B rises.) Check to see that the meter A and B readings are also approximately equal on space. (A 2:1 ratio is considered satisfactory.) Operate the filter switch to IN.

f. Calibrate the distortion measuring set, using the local d-c loop of the TT for minimum distortion at 60-ma loop current. Two percent or less is considered satisfactory and the set should be free of erratic operation. Patch the signal plug of the TT to the TT signal jack on the signal generator. Operate the signal switch to TT. Measure the total distortion in the loop circuits with the distortion measuring set by patching into the respective REC jacks on the test cabinet. Use corresponding jacks on the test set, that is, use POLAR when testing the polar loop. Send the test sentence and record the distortion in both polar and neutral loops for channels A, A + B, and B. The distortion will not exceed 6 percent. In each case the maximum distortion observed over any half-minute period will be recorded as the distortion.

g. Operate the DRIFT COMPENSATOR switch to IN and the OUTPUT switch to NORMAL. Set the METER B switch at COMP AMP and note that minimum kicks are indicated in meter B when the test sentence is being transmitted. Move the METER B switch from the COMP AMP position. Measure the distortion in the polar and neutral loops for channels A, A + B, and B while the test sentence is being transmitted. The distortion will not exceed 6 percent. Measure the distortion in the polar loop for repeated BL and LTRS characters. These tests will indicate not more than 6 percent distortion.

h. Operate the BAND WIDTH control to WIDE. Check that the DRIFT COMPENSATOR switch is at IN and the OUTPUT switch at NORMAL. Set the test oscillator to have frequencies 1,000 cps above and below the centered frequencies used in *g* above. The shift should remain at 850 cps. Make distortion measurements of the test sentence and repeated BL and LTRS characters for frequencies 1,000 cps above and below the original centered frequency settings. In each case the distortion will not exceed 6 percent. Return the BAND WIDTH switch to NARROW.

i. Repeat the tests of *h* above for channel A alone, channel B alone, and channel A + B with the BAND WIDTH switch at NARROW for frequencies +300 cycles and −300 cycles removed from the center operating frequency. The distortion will not exceed 5 percent.

69. Low Signal Input Tests

a. Make the adjustments specified in paragraph 68*a*, at a signal input level of .5 mv for channel A and channel B. Complete the tests described in paragraph 68*b* and *c*. Use a test signal-generator frequency of 470 kc in the basic through A models and a 500-kc frequency for the C and D models for final alinement.

b. Without changing the input-level settings, connect the test generator circuit to both CHAN A and CHAN B, operate the LP FIL switch to IN, and make the tests of TT signal distortion (miscellaneous signals only) specified in paragraph 68*f* through *h*. The distortion will not exceed 6 percent. Measure the distortion for channel A and for channel B also.

70. Low Frequency Shift Tests

Make the test specified in paragraph 68*f* and *g* for channel A only and then for channel B only, using a 100-cycle frequency shift instead of an 850-cycle shift. Use miscellaneous signals only. The distortion will not exceed 5 percent. The output from the test signal generator should be 2.0 mv for channel A and channel B.

71. Tone Oscillator and Control Relay Tests

a. Adjust relay K401 to operate on a current of 15 to 17 ma and release on a current of 9.0 to 11.5 ma. Connect a 2,000-ohm resistance across the control loop leads from connector J401. If the equipment in paragraph 59*b* is used, the following patching arrangements should be made:

(1) Place a dummy plug in the CON jack.
(2) From J404 on test cabinet to J404 on the tone oscillator.
(3) From J403 on test cabinet to J403 on the tone oscillator.
(4) From J402 on test cabinet to J402 on the tone oscillator.
(5) From J401 on test cabinet to J401 on the tone oscillator.

b. The CON lamp in the test set should be lighted. Place the test cabinet meter switch at CON RELAY. Operate the CON KEY. Relay K401 should operate. The test set meter should read 90 ± 10 which is equivalent to 45 ± 5 volts. The CON LAMP should be extinguished.

c. Read the receiver disabling relay circuit voltages across the 60-ohm resistances connected across J402 and J403. This is done by closing the CON KEY and setting the test cabinet meter at CON–1 and then CON–2. In each case the meter should read between 9.0 and 10.25 when the a-c line voltage is 115 volts. Release the CON KEY.

d. Connect a 2,000-ohm headset to the PHONES KEYED TONE jack on the converter. Observe that a tone signal is obtained when the 60-ma loop of the converter is in a marking condition. No tone will be heard for a space condition. Measure the tone voltage obtained at the PHONES KEYED TONE jack with the VTVM. The voltage will be 1 ± 0.5 volts. Check both sides to ground. Measure the frequency of the tone output by comparison with an audio oscillator on an oscilloscope. The frequency will be 850 ± 100 cps.

e. Send a space from the test circuit at a level of 50 mv to both channel A and channel B. Set the OUTPUT switch at REVERSE and the DRIFT COMPENSATOR switch at *out*. Operate relay K401 as in *b* above. The loops will change to marking condition. Set the DRIFT COMPENSATOR at IN and the OUTPUT switch at NORMAL (in this order). Operating relay K401 shall again change the loops from space to mark. This last test cannot be repeated again without first restoring the circuit by operating the OUTPUT switch to Reverse and back to NORMAL.

f. Operate the OUTPUT switch to SPACE. Connect the source of TT signals to the CON jacks on the test panel. The distortion measured in the polar and neutral loops will not exceed 5 percent.

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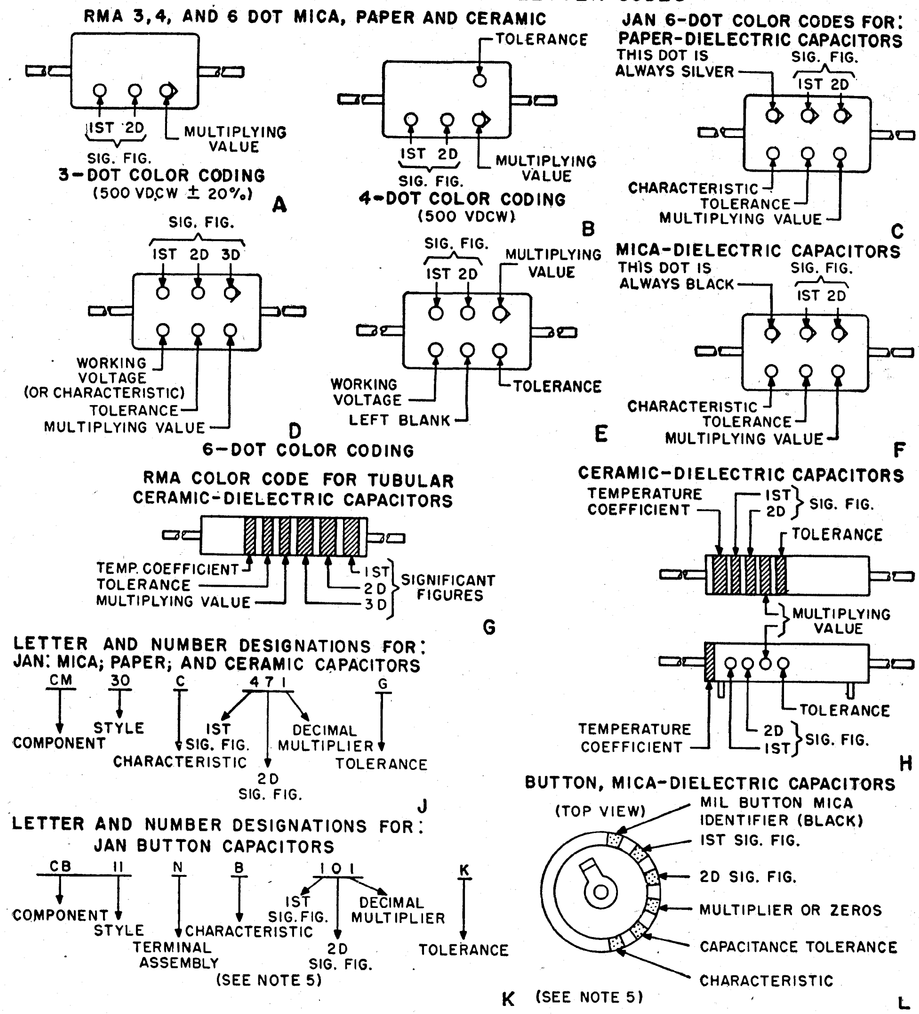
CAPACITOR COLOR AND LETTER CODES



- STANDARDS -					JAN MICA-CM		JAN PAPER-CN		JAN CERAMIC-CC					
										CAP. TOL. FOR MORE THAN 10 UUF		CAP. TOL. FOR 10 UUF OR LESS		
COLOR	SIG. FIG.	DECIMAL MULTIPLIER	% TOL.	VDCW	LETTER TOL.	CHARAC-TERISTIC	LETTER TOL.	CHARAC-TERISTIC	DEC. MULT.	%	LETTER DESIG-NATION	UUF	LETTER DESIG-NATION	CHARAC-TERISTIC
BLACK	0	1	±20	500	M	A	M	A	1	±20	M	±2.0	G	C
BROWN	1	10	± 1	100	-	B	-	E	10	± 1	F	-	-	H
RED	2	100	± 2	200	G	C	-	H	100	± 2	G	-	-	L
ORANGE	3	1,000	± 3	300	-	D	N*	J	1,000	-	-	-	-	P
YELLOW	4	10,000	± 4	400	-	E	-	P	-	-	-	-	-	R
GREEN	5	100,000	± 5	500	-	F	-	R	-	± 5	J	±0.5	D	S
BLUE	6	1,000,000	± 6	600	-	G	-	S	-	-	-	-	-	T
VIOLET	7	10,000,000	± 7	700	-	-	-	T	-	-	-	-	-	U
GRAY	8	100,000,000	± 8	800	-	-	-	-	0.01	-	-	±0.25	C	B
WHITE	9	1,000,000,000	± 9	900	-	-	-	-	0.1	± 10	K	±1.0	F	SL
GOLD	-	0.1	± 5	1,000	J	-	-	-	-	-	-	-	-	A
SILVER	-	0.01	±10	2,000	K	-	K	-	-	-	-	-	-	-
NO COLOR	-	-	±20	500	-	-	-	-	-	-	-	-	-	-
* THE TOLERANCE OF THIS CAPACITOR IS ±30%, NOT ±3%														

NOTES

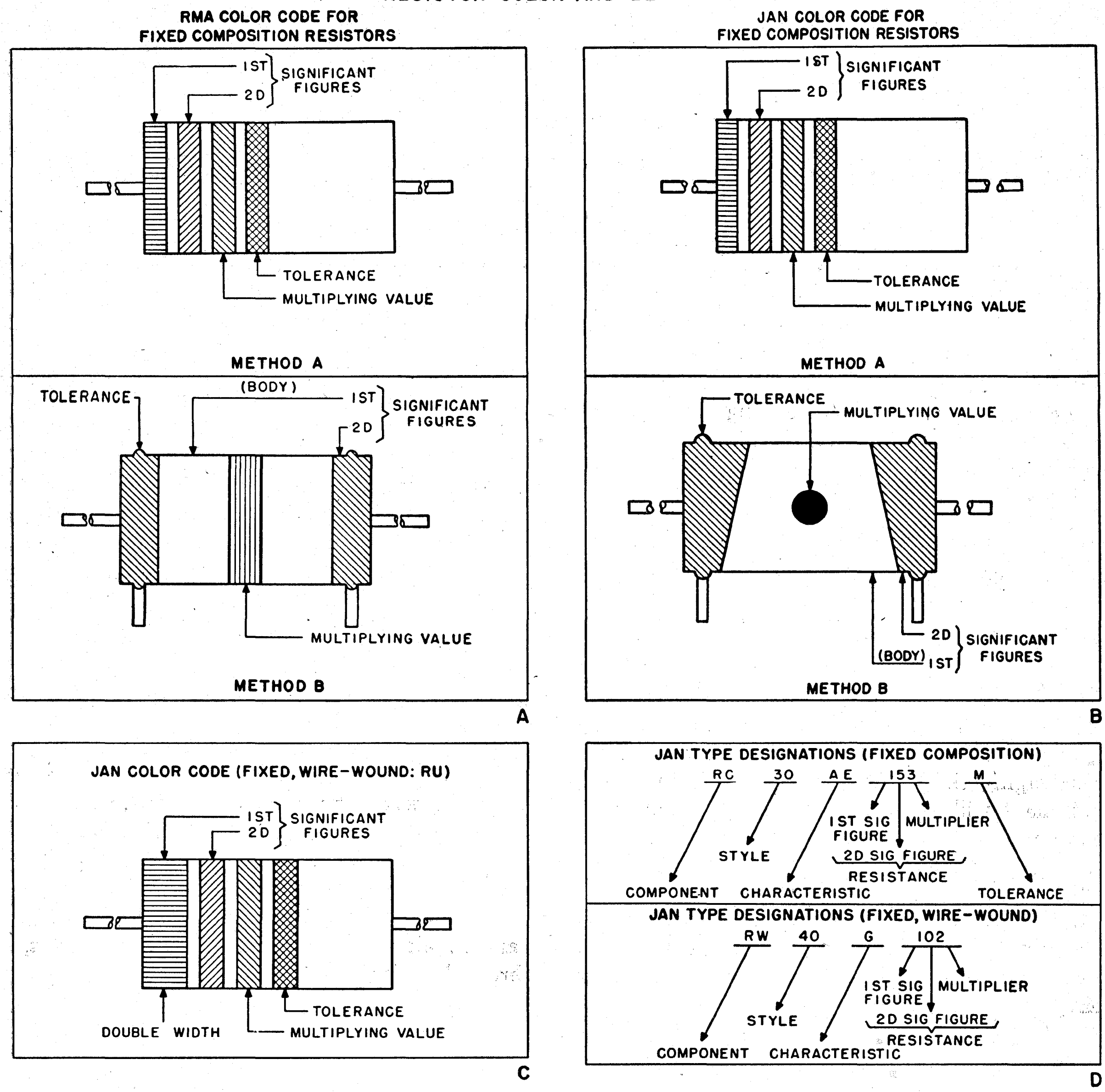
JAN: JOINT ARMY-NAVY
RMA: RADIO MANUFACTURERS ASSOCIATION

1. THESE COLOR AND LETTER CODES GIVE CAPACITANCES IN MICROMICROFARADS
2. THIS TABLE IS ADAPTED FOR JAN AND RMA COLOR AND JAN LETTER TYPE DESIGNATIONS
3. CERAMIC AND MICA CAPACITORS, BOTH JAN AND RMA, ARE GENERALLY 500 VDCW
4. BUTTON CAPACITORS ARE GENERALLY 300 VDCW
5. READ BUTTON CAPACITOR TOLERANCE UNDER CERAMICS OF MORE THAN 10 UUF
6. CHARACTERISTICS ARE AVAILABLE IN JAN CAPACITOR SPECIFICATION MANUALS
7. THE COMPONENTS USED ABOVE FOR JAN LETTER TYPE DESIGNATIONS ARE:
   CB MICA BUTTON: *CC* CERAMIC; *CM* MICA MOULDED: *CN* PAPER MOULDED

TM CC

Figure 61. Capacitor color and letter codes.

RESISTOR COLOR AND LETTER CODE



STANDARDS				
COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)	JAN LETTER TOLERANCE
BLACK	0	1	—	—
BROWN	1	10	± 1	F
RED	2	100	± 2	G
ORANGE	3	1,000	± 3	—
YELLOW	4	10,000	± 4	—
GREEN	5	100,000	± 5	—
BLUE	6	1,000,000	± 6	—
VIOLET	7	10,000,000	± 7	—
GRAY	8	100,000,000	± 8	—
WHITE	9	1,000,000,000	± 9	—
GOLD	—	0.1	± 5	J
SILVER	—	0.01	±10	K
NO COLOR	—	—	±20	M

NOTES:

1. RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.
2. RMA: RADIO MANUFACTURERS ASSOCIATION.
3. JAN: JOINT ARMY - NAVY.
4. THESE COLOR AND NUMBER CODES GIVE ALL RESISTANCE VALUES IN OHMS.
5. RESISTIVE COMPONENTS USED FOR LETTER TOLERANCES ARE: RC, RN, AND RU.
6. WATTAGE FOR RW TYPES IS FOUND IN THE JAN SPECIFICATIONS UNDER CHARACTERISTICS.

TMRC

Figure 62. Resistor color and letter codes.

CHAPTER 5

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

72. General

The exact procedure in repacking for shipment or limited storage depends upon the material available and the conditions under which the equipment is to be shipped or stored.

73. Repacking for Shipment or Limited Storage

Whenever practicable, place a dehydrating agent such as silica gel inside the chests or packing boxes. Protect the chests (or boxes) with a waterproof paper barrier. Seal the seams of the paper barrier with waterproof sealing compound or tape. Pack the protected chests in a padded wooden case, providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the packing case.

Section II. DEMOLITION OF MATÉRIEL TO PREVENT ENEMY USE

74. General

The demolition procedures outlined in paragraph 75 will be used to prevent the enemy from using or salvaging the equipment. Demolition of the equipment will be accomplished *only* upon order of the commander.

75. Methods of Destruction

a. Smash. Smash the controls, tubes, switches, capacitors, transformers, and case, using sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut chassis wiring, using axes, handaxes, or machetes.

c. Burn. Burn resistors, capacitors, wiring, and technical manuals, using gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend panels, cabinet, and chassis.

e. Explosives. If explosives are necessary, use firearms, grenades, or TNT.

f. Disposal. Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

g. Other. Destroy everything.

APPENDIX I
REFERENCES

Note. For availability of items listed, check SR 310-20-3, SR 310-20-4, and SR 310-20-5. Check Department of the Army Supply Catalog SIG 1 for Signal Corps Supply Catalogs.

1. Army Regulations

AR 380-5	Military Security (Safeguarding Military Information).
AR 750-5	Maintenance of Supplies and Equipment (Maintenance Responsibilities and Shop Operation).

2. Supply Bulletins

SB 11-6	Dry Battery Supply Data.
SB 11-47	Preparation and Submission of Requisitions for Signal Corps Supplies.
SB 11-76	Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

3. Technical Manuals on Test Equipment

NAVSHIPS 91, 254	Instruction Book for Tube Tester TV-3/U.
NAVSHIPS 91, 269	Electronic Multimeter ME-6A/U.
NAVSHIPS 91, 272	Oscilloscope OS-8/U.
TM 11-300	Frequency Meter Sets SCR-211-A,-B,-C,-D, -E, -F, -J,- K, -L, -M, -N, -O, -P, -Q, -R, -T, -AA, -AC, -AE, - AF, -AG, -AH, -AJ, -AK, -AL.
TM 11-307	Signal Generators I-72-G,-H,-J,-K, and -L.
TM 11-472	Repair and Calibration of Electrical Measuring Instruments.
TM 11-2045	Decibel Meters TS-399/U and TS-399A/U.
TM 11-2217	Distortion Test Sets TS-383/GG and TS-383A/GG.
TM 11-2526	Oscilloscope BC-1060-A.
TM 11-2613	Voltohmmeter I-166.
TM 11-2624B	Voltohmmeters, TS-294/U, TS-294B/U, and TS-294C/U.
TM 11-2626	Test Units I-176, I-176-A, and I-176-B.
TM 11-2627	Tube Testers I-177 and I-177-A.
TM 11-2673	Multimeter TS-389/U (Hickok Models 202 and 202-NX).
TM 11-2684A	Audio Oscillator TS-382A/U.
TM 11-4052	Signal Generators I-72-A, -B, -C, -D, -E, -F, -G, -H, -J, and -K. Repair Instructions.
TM 11-5511	Electronics Multimeter TS-505/U.
TM 11-5527	Multimeter TS-352/U.

4. Painting, Preserving, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 69	Lubrication of Ground Signal Equipment.
TM 9-2851	Painting Instructions for Field Use.

5. Camouflage, Decontamination, and Demolition

FM 5-20	Camouflage, Basic Principles.

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FM 5–25	Explosives and Demolitions.
TM 3–220	Decontamination.
TM 5–267	Camouflage.

6. Other Publications

FM 24–18	Field Radio Techniques.
SR 310–20–3	Index of Training Publications.
SR 310–20–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.
SR 310–20–5	Index of Administrative Publications.
SR 700–45–5	Unsatisfactory Equipment Report (Reports Control Symbol CSGLD-247).
SR 745–45–5 AFR 71–4	Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD–66 (Army) and AF–MC–U2 (Air Force)).
TB SIG 25	Preventive Maintenance of Power Cords.
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 123	Preventive Maintenance Practices for Ground Signal Equipment.
TB SIG 178	Preventive Maintenance Guide for Radio Communication Equipment.
TB SIG 219	Operation of Signal Equipment at Low Temperatures.
TM 11–257	Frequency Shift Exciters O–39/TRA–7, O–39A/-TRA–7, O–39B/TRA–7, and O–39C/TRA–7.
TM 11–262	Control Units C–292/-TRA–7, C–292A/TRA–7, and C–292B/TRA–7.
TM 11–264	Radio Set AN/GRC–26.
TM 11–333	Telephones EE–8, EE–8–A, and EE–8–B.
TM 11–359	Line Units BE–77, BE–77–A, BE–77–B, and BE–77–C.
TM 11–415	Dry Batteries.
TM 11–430	Batteries for Signal Communication. Except those pertaining to Aircraft.
TM 11–453	Shop Work.
TM 11–455	Radio Fundamentals.
TM 11–466	Radar Electronic Fundamentals.
TM 11–483	Suppression of Radio Noises.
TM 11–486	Electrical Communication Systems Engineering.
TM 11–499	Radio Propagation Handbook.
TM 11–624	Radio Sets AN/MRC–2 and –2A.
TM 11–661	Electrical Fundamentals (Direct Current).
TM 11–680	Teletypewriter Circuits and Equipment (Fundamentals).
TM 11–681	Electrical Fundamentals (Alternating Current).
TM 11–850	Radio Receivers BC–312–A, –C, –D, –E, –F, –G, –J, –L, –M, –N, –HX, and –NX, BC–342–A, –C, –D, –F, –J, –L, –M, and –N, BC–314–C, –D, –E, –F, and –G, BC–344, and –D.
TM 11–854	Radio Receiver R–388/-URR.

TM 11–2205	Exciter Units O–5/FR and O–5A–FR and RF Oscillator O–86/FRT.
TM 11–2222	Transmitter Distributors, Teletype Model 14.
TM 11–2223	Typing and Nontyping Reperforators Teletype Model 14.
TM 11–4000	Trouble Shooting and Repair of Radio Equipment.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Note. The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O&E, T/A, SIG 7 & 8, list of allowances of expendable material, or other authorized supply basis. The Department of the Army Supply Catalog applicable to the equipment covered in this manual is SIG 7 & 8 CV–31/TRA–7. For an index of available supply catalogs, in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1.

1. Identification Table of Parts for Dual Diversity Converter CV–31(*)/TRA–7

Ref. symbol	Model (U)	A	B	C	D	Name of part and description	Function of part	Signal Corps stock No.
						DUAL DIVERSITY CONVERTER CV–31/TRA–7, CV–31A, B, C/TRA–7: 400 to 470 kc input; 115 v, 50 to 60 cyc, single ph, 170 w; 100-ohm input impedance; mts in std rack or cabinet; 19″ wd x 19⅝₃₂″ h x 18½″ d.	Demodulates and combines signals from two radio receivers for dual diversity operation; has d-c pulse output for TT machine operation.	2C720–31
						DUAL DIVERSITY CONVERTER CV–31D/TRA–7; 440 to 510 kc input at 53. 5-ohm impedance; 115 v, 50 to 60 cyc, single ph; mts in std rack or cabinet; 19″ wd 19⅝₃₂″ h x 18½″ d.	Demodulates and combines signals from two radio receivers for dual diversity operation; has d-c pulse output for TT machine operation.	2C720–31D
						Technical Manual 11–261	Describes basic through D models.	Order through AGO.
						Technical Manual 11–264	Describes use of B model in Radio Set AN/GRC–26.	Order through AGO.
						Technical Manual 11–624	Describes use of converters in Radio Set AN/MRC–2.	Order through AGO.
	(*)	(*)	(*)	(*)	(*)	ADJUSTER, spring: single end, 90° bend; w/.015″ wd slot in end.	Adjusts U-type relay	6R41305A
	(*)	(*)	(*)	(*)	(*)	ADJUSTER, spring: single end, 90° bend; w/.032″ wd slot in end.	Adjusts U-type relay	6R41307A
	(*)	(*)	(*)	(*)	(*)	BLADE, contact burnisher	For cleaning pits on relay contacts.	6R41066C
	(*)	(*)	(*)	(*)	(*)	BLADE, contact burnisher	For cleaning surface of relay contacts.	6R41066B
E112	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 4 brass tin pl term.; 2″ lg x 1″ wd x ½″ thk.	Mounts resistors R198 and R202.	2Z9404.261
E113	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 4 brass tin pl term.; 2″ lg x 1″ wd x ½″ thk.	Mounts resistors R199 and R203.	2Z9404.262
E111	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 4 brass tin pl term.; 2″ lg x 1″ wd x ½″ thk.	Mounts resistors R201 and R205.	2Z9404.263
E110	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 4 brass tin pl term.; 2″ lg x 1″ wd x ½″ thk.	Mounts resistors R200 and R204.	2Z9404.264
E101	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 6 brass term.; 2⅛″ lg x 2″ wd x ½″ thk.	Mounts components	2Z9406.250
E106	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 6 brass silver pl term.; 2½″ lg x 2½″ wd x ½″ thk.	Mounts components	2Z9406.251
E102	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 8 brass tin pl term.; 2⁹⁄₁₆″ lg x 2″ wd x ½″ thk.	Mounts resistors and capacitors.	2Z9408.192

Ref. symbol	Model (U)	A	B	C	D	Name of part and description	Function of part	Signal Corps stock No.
E118	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 8 brass tin pl term.; 2½″ lg x 2½″ wd x ½″ thk.	Mounts resistors	2Z9408.194
E104	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 12 brass tin pl term.; 3$\frac{7}{16}$″ lg x 2″ wd x ½″ thk.	Mounts resistors R110, R111, R149, R150, R151, and R153.	2Z9412.199
E107	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 12 brass tin pl term.; 3$\frac{7}{16}$″ lg x 2″ wd x $\frac{3}{32}$″ thk.	Mounts resistors R162, R163, R164, R165, R166, and R167.	2Z9412.200
p/o E105	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 14 brass silver pl turret term.; 3⅞″ lg x 2″ wd x ½″ thk (mts back to back w/board, terminal, Sig C stock No. 2Z9422.23).	Mounts resistors R139, R140, R142, R147, R148, R159, and R161.	3Z12531–2.31
p/o E105	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 14 brass silver pl turret term.; 3⅞″ lg x 2″ wd x ½″ thk (mts back to back w/board, terminal, Sig C stock No. 3Z12531–2.31).	Mounts resistors R124, R138, R141, R143, R144, R146, and R156.	2Z9422.23
p/o E103	(*)	(*)	(*)	---	(*)	BOARD, terminal: 22 turret term.; 5⅝ lg x 2″ wd x ½″ thk (mts back to back w/board, terminal, Sig C stock No. 2Z9422.22).	Mounts resistors R107, R112, R113, R114, R116, R118, R119, R121, and R122 and capacitors C112 and C114.	3Z12531–45
p/o E103	(*)	(*)	(*)	---	(*)	BOARD, terminal: 22 turret term.; 5⅝″ lg x 2″ wd x ½″ thk (mts back to back w/board, terminal, Sig C stock No. 3Z12531–45).	Mounts resistors R106, R108, R115, R117, R120, R121, R123, and R211 and capacitors C118 and C130.	2Z9422.22
p/o E103	----	---	---	(*)	---	BOARD, terminal: 24 brass silver pl turret term.; 6$\frac{1}{16}$″ lg x 2″ wd x ½″ thk (mts back to back w/board, terminal, Sig C stock No. 3Z770–24.37).	Mounts resistors R107, R112, R113, R114, R116, R118, R119, R121, and R122.	3Z770–24.42
p/o E103	----	---	---	(*)	---	BOARD, terminal: 24 brass silver pl turret term.: 6$\frac{1}{16}$″ lg x 2″ wd x ½″ thk (mts back to back w/board, terminal, Sig C stock No. 3Z770–24.42).	Mounts resistors R106, R108, R115, R117, R120, R121, R123, and R211.	3Z770–24.37
p/o E109	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 28 brass pl solder term.; 6$\frac{15}{16}$″ lg x 2″ wd x ½″ thk (mts back to back w/board, terminal, Sig C stock No. 2Z9428–30).	Mounts resistors R181, R183, R188 through R195, R197, R208, and R210.	2Z9428–29
p/o E109	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 28 brass pl term.; 6$\frac{15}{16}$″ lg x 2″ wd x ½″ thk (mts back to back w/board, terminal, Sig C stock No. 2Z9428–29).	Mounts resistors R130 through R137, R184 through R187, R206, and R213.	2Z9428–30
E108	(*)	(*)	(*)	(*)	(*)	BOARD, terminal: 32 turret term. lugs; 9⅛″ lg x 2″ wd x ½″ thk.	Mounts resistors and capacitors.	2Z9438–17
	(*)	(*)	(*)	(*)	(*)	BURNISHER TL–557/U: 4$\frac{31}{32}$″ lg x $\frac{13}{32}$″ dia.	For cleaning and dressing relay contacts.	6R41065C
	(*)	(*)	(*)	(*)	(*)	CABLE, power: UL type SJ mod, 3 #18 AWG stranded cond.	To make up power cable	1B818.56
	(*)	(*)	(*)	(*)	(*)	CABLE RG–58C/U: coax; 52 ohms impedance; 28.5 μμf/ft.	For making up r-f cables	1F425–58C.
C107, C108	(*)	(*)	(*)	(*)	(*)	CAPACITOR, fixed: mica; 100 μμf ±5%; 500 vdcw; JAN type CM20C101J.	C107: V101 grid coupling and d-c blocking. C108: V102 grid coupling and d-c blocking.	3K2010132

Ref. symbol	Model					Name of part and description	Function of part	Signal Corps stock No.
	(U)	A	B	C	D			
C112, C114, C118	(*)	(*)	(*)	(*)	(*)	CAPACITOR, fixed: mica; 470 μμf ±5%; 500 vdcw; JAN type CM20D471J.	C112: V104 rectifier plate coupling. C114: V107 grid coupling. C118: V108 grid coupling.	3K2047142
C127	(*)	(*)	(*)	(*)	(*)	CAPACITOR, fixed: mica; 1000 μμf ±5%; 500 vdcw; JAN type CM30D102J.	Part of signal speed filter---	3K3010242
C126	(*)	(*)	(*)	(*)	(*)	CAPACITOR, fixed: mica; 3300 μμf ±5%; 500 vdcw; JAN type CM30D332J.	Part of low-pass filter for slow signaling speeds.	3K3033242
C125	(*)	(*)	(*)	(*)	(*)	CAPACITOR, fixed: mica; 8200 μμf ±10%; 500 vdcw; JAN type CM40C822K.	Part of low-pass filter for slow signaling speeds.	3K4082231
C130	----	(*)	(*)	(*)	(*)	CAPACITOR, fixed: paper; 20,000 μμf ±10%; 600 vdcw; JAN type CP26A1EF203K.	S105 r-f bypass, position 5--	3DA20-167
C109, C113	(*)	(*)	(*)	(*)	(*)	CAPACITOR, fixed: paper; 100,000 μμf +20% −10%; 600 vdcw; JAN type CP69B1EF104V.	C109: V101 oscillator anode bypass. C113: V105 grid filter------	3DA100-535
C110A, B	(*)	(*)	(*)	(*)	(*)	CAPACITOR, fixed: paper; 2 sect.; 100,000 μμf ea sect.; +20% −10%; 600 vdcw; JAN type CP69B4EF104V.	C110A: V102 oscillator anode bypass. C110B: Z105 through Z108 filters input bypass.	3DA100-533
C115A, B, C, C119A, B, C, C122A, B, C	(*)	(*)	(*)	(*)	(*)	CAPACITOR, fixed: paper; 3 sect.; 100,000 μμf ea sect.; +20% −10%; 600 vdcw; JAN type CP69B5EF104V.	C115A: V103 cathode bypass. C115B: V103 screen bypass. C115C: V103 plate circuit decoupling. C119A: V107 plate circuit decoupling. C119B: V106 plate bypass. C119C: V107 screen bypass. C122A: V108 cathode bypass. C122B: V108 screen bypass. C122C: V108 plate circuit decoupling.	3DA100-673
C131A, B	----	(*)	(*)	(*)	(*)	CAPACITOR, fixed: paper; 2 sect.; 1 μf +20% −10% ea sect.; 600 vdcw ea sect.; JAN type CP53B4EF105V.	C131A: V103 plate circuit decoupling. C131B: V108 plate circuit decoupling.	3DB1-186
C128	(*)	(*)	(*)	(*)	(*)	CAPACITOR, fixed: paper; 1 μf +20% −10%; 600 vdcw; JAN type CP54B1EF105V.	V104 plate (pin 6) output coupling.	3DB1-91
C129	(*)	(*)	(*)	(*)	(*)	CAPACITOR, fixed: paper; 2 μf +20% −10%; 600 vdcw, JAN type CP54B1EF205V.	V104 grid (pin 2) input coupling.	3DB2-146
C101, C103, C105, C106	(*)	(*)	(*)	(*)	(*)	CAPACITOR, variable: air, 9 to 135 μμf; JAN type CT1C135; plate meshing type.	C101: V101 signal input tuning. C103: V102 signal input tuning. C105: V101 (channel A) oscillator alinement. C106: V102 (channel B) oscillator alinement.	3D9135V-4

Ref. symbol	Model					Name of part and description	Function of part	Signal Corps stock No.
	(U)	A	B	C	D			
C102, C104	(*)	(*)	(*)	(*)	(*)	CAPACITOR, variable: air; 9 to 135 μμf; JAN type CT1E135; plate meshing type.	C102: CHANNEL A FINE TUNING. C104: CHANNEL B FINE TUNING.	3D9135V-5
L101	(*)	(*)	(*)	(*)	(*)	COIL, telephone retardation: single wnd; HS metal case.	Part of signal speed filter	3C1988-85
	(*)	(*)	(*)	(*)	(*)	CONNECTOR, plug: 3 curved male cont; straight; Hubbell #7572.	Power cable connection	6Z7591-12
	(*)	(*)	(*)	(*)	(*)	CONNECTOR, plug: 3 round female cont; 90° angle type; AN #AN-3108-16S-6S.	Power cord termination	2Z3064-86
J101, J102	(*)	(*)	(*)	(*)	(*)	CONNECTOR, receptacle: Radio-frequency Receptacle UG-87/U; 1 female cont; straight type.	Receive input cords from receivers.	2Z7390-87
J104	(*)	(*)	(*)	(*)	(*)	CONNECTOR, receptacle: 3 round male cont, pol; straight; AN #AN-3102A-16S-6P.	Receives power input cable	2Z3023-3
J106	(*)	(*)	(*)	(*)	(*)	CONNECTOR, receptacle: 14 round female cont, pol; straight; AN #AN-3102A-20-27S.	Receives cable from tone oscillator.	2Z8684-5
J103	(*)	(*)	(*)	(*)	(*)	CONNECTOR, receptacle: 5 round female cont, pol; straight; AN #AN-3102A-14S-5S.	Receives signal output cord	2ZK7409-20
	(*)	(*)	(*)	(*)	(*)	COUPLING, flexible		2Z3295-170
	(*)	(*)	(*)	(*)	(*)	FASTENER, spring lock: 1 31/32" lg x 1 11/16" wd; flush panel ring type.	For cabinet	6Z1747-12
Z106	(*)	(*)	(*)	(*)	(*)	FILTER, band pass: 27.8 to 30.8 kc	Wide bandwidth for 29.3-kc discriminator.	2Z4376.28
Z105	(*)	(*)	(*)	(*)	(*)	FILTER, band pass: 28.55 to 30.05 kc.	Narrow bandwidth for 29.3-kc discriminator.	2Z4376.27
Z108	(*)	(*)	(*)	(*)	(*)	FILTER, band pass: 48.5 to 51.5 kc	Wide bandwidth for 50-kc discriminator.	2Z4376.25
Z107	(*)	(*)	(*)	(*)	(*)	FILTER, band pass: 49.25 to 50.75 kc.	Narrow bandwidth for 50-kc discriminator.	2Z4376.26
	(*)	(*)	(*)	(*)	(*)	GAGE TL-560/U	Measures tension of relay springs.	6R40870D
	(*)	(*)	(*)	(*)	(*)	GAGE, thickness: flat type, single leaf .008" thk.	Measures relay clearances	6R40932A
	(*)	(*)	(*)	(*)	(*)	GAGE, thickness: flat type, single leaf .010" thk.	Measures relay clearances	6R40932B
	(*)	(*)	(*)	(*)	(*)	GAGE, thickness: flat type, single leaf .013" thk.	Measures relay clearances	6R40932C
	(*)	(*)	(*)	(*)	(*)	GAGE, thickness: flat type, single leaf .015" thk.	Measures relay clearances	6R40932D
	(*)	(*)	(*)	(*)	(*)	GAGE, thickness: flat type, single blade .017" thk.	Measures relay clearances	6R40932E
	(*)	(*)	(*)	(*)	(*)	GAGE, thickness: flat type, single leaf .047" thk.	Measures relay clearances	6R40932R
J105	(*)	(*)	(*)	(*)	(*)	JACK JJ-034: for 2 cond plug, 1.218" lg x .205" dia.	PHONES KEYED TONE output.	2Z5534
	(*)	(*)	(*)	(*)	(*)	KNOB: round; black bakelite; for 1/4" dia shaft; white indicator line; 1" dia.	Operates controls (nine used).	2Z5822-167
	(*)	(*)	(*)	(*)	(*)	KNOB: round; black bakelite; for 1/4" dia shaft; white indicator line; 1 1/2" dia.	Operates OUTPUT and METER B controls.	2Z5822-166

Ref. symbol	Model (U)	A	B	C	D	Name of part and description	Function of part	Signal Corps stock No.
M101, M102	(*)	(*)	(*)	(*)	(*)	METER, ammeter: DC; 100–0–100 ua; JAN type MR26W101.	M101: Measures output of channel A (50-kc discriminator). M102: Measures output of channel B (29.3-kc discriminator) or gives any of 10 other readings, depending on METER B switch setting.	3F910-63
	(*)	(*)	(*)	(*)	(*)	MOUNT, vibration: Shock Mount M–449; sq mtg; 2⅝" sq o/a.	Prevents damage due to vibration.	2Z8415-499
	(*)	(*)	(*)	(*)	(*)	OSCILLATOR O–41/TRA–7, O–41A/TRA–7: fixed freq, 750 cps ±10%.	Give monitoring tone on mark signal.	2C2710-41
E122, E123, E124	----	---	(*)	(*)	(*)	POST, binding: Binding Post TM–186; screw type.	Terminations for extension circuits.	3Z286
				(*)	---	POST, supporting	Supports electron tube retaining clip.	2Z7259-86
	(*)	(*)	(*)	(*)	(*)	RECEPTACLE HOOD MX–195/U: Connector shield: u/w Radio Frequency Receptacle UG–87/U.	For input Cable CC–407/TRA–7.	2Z7415-195
	(*)	(*)	(*)	(*)	(*)	RECTIFIER POWER UNIT PP–193/TRA–7, PP–193A/TRA–7: electronic type; DC output, +275 v, 60 ma unregulated; −150 v, 10 ma regulated; +150 v, 40 ma regulated; −150 v, 85 ma unregulated; −400 v, 3 ma unregulated; AC output, 6.3 v, 6 amp unregulated; input 105, 115 or 125 v, 50/60 cyc single ph.	Supplies all power needed by the dual diversity converter.	3H4870
R188, R190	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 30 ohms ±5%; ½ w; JAN type RC21BF 300J.	R188: Meter M102 shunt in NEUTRAL position. R190: Meter M102 shunt in POLAR position.	3RC21BF300J
R184 through R187	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 270 ohms ±10%; 2 w; JAN type RC42BE 271K.	Neutral loop current adjusting.	3RC42BE271K
R216	----	---	---	(*)	(*)	RESISTOR, fixed: comp; 820 ohms ±10%; ½ w; JAN type RC20BF821K.	For adjusting control grid bias of V104.	3RC20BF821K
R168, R169	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 820 ohms ±10%; 2 w; JAN type RC42BE821K.	V116 plate polar current limiting.	3RC42BE821K
R107, R122	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 1000 ohms ±10%; 1 w; JAN type RC30BF102K.	R107: V103 cathode bias. R122: V108 cathode bias.	3RC30BF102K
R208	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 1200 ohms ±10%; ½ w; JAN type RC20BF122K.	V104 grid bias voltage divider.	3RC20BF122K
R105, R117, R124, R137, R147	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 2200 ohms ±10%; ½ w; JAN type RC20BF222K.	R105: V101 and V102 plate load decoupling. R117: V106 plate biasing. R124: V108 plate circuit decoupling. R137: M102 voltage divider in CHAN A+B position. R147: V111 grid (pin 4) bias voltage divider.	3RC20BF222K

Ref. symbol	Model (U)	A	B	C	D	Name of part and description	Function of part	Signal Corps stock No.
R211, R212	----	---	(*)	(*)	(*)	RESISTOR, fixed: comp; 2000 ohms ±5%; ½ w; JAN type RC20BF202J (for use as multiplier with JAN type MR26W101 meters).	R211: Meter M101 multiplier. R212: Meter M102 multiplier in CHAN B position.	3RC20BF202J
R211, R212	(*)	(*)	---	---	---	RESISTOR, fixed: comp; 2400 ohms ±5%; ½ w; JAN type RC20BF242J (for use with original equipment meters).	R211: Meter M101 multiplier. R212: Meter M102 multiplier in CHAN B position.	3RC20BF242J
R103, R104, R173	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 4700 ohms ±10%; 1 w; JAN type RC30BF472K.	R103: V101 oscillator anode decoupling. R104: V102 oscillator anode decoupling. R173: Part of V116 screen grid voltage divider.	3RC30BF472K
R111, R115, R120, R156, R172, R175, R176, R181, R183, R197	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 10,000 ohms ±10%; 1 w; JAN type RC30BF103K.	R111: V105 screen voltage dropping. R115: V103 plate circuit decoupling. R120: V107 plate circuit decoupling. R156: V113 screen voltage dropping. R172: Part of V115 screen voltage divider. R175: Part of V116 screen voltage divider. R176: V117 screen voltage dropping. R181 and R183: Part of V118 screen voltage divider. R197: Part of V114 plate output voltage divider.	3RC30BF103K
R163 through R166	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 15,000 ohms ±10%; ½ w; JAN type RC20BF153K.	Part of V113 plate output voltage divider.	3RC20BF153K
R154	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 15,000 ohms ±10%; 2 w; JAN type RC42BE153K.	Part of V113 cathode bias voltage divider.	3RC42BE153K
R158	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 18,000 ohms ±10%; 2 w; JAN type RC42BE183K.	Part of V113 plate load_____	3RC42BE183K
R101, R102, R112, R123	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 22,000 ohms ±10%; ½ w; JAN type RC20BF223K.	R101: V101 oscillator grid__ R102: V102 oscillator grid. R112: M102 shunt in INPUT position. R123: V108 screen voltage dropping.	3RC20BF223K
R157	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 22,000 ohms ±10%; 2 w; JAN type RC42BE223K.	Part of V113 plate load_____	3RC42BE223K
R149, R150	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 27,000 ohms ±5%; ½ w; JAN type RC20BF273J.	R149: V112 plate (pin 5) bias voltage divider. R150: V112 cathode (pin 4) bias voltage divider.	3RC20BF273J

Ref. symbol	Model					Name of part and description	Function of part	Signal Corps stock No.
	(U)	A	B	C	D			
R189, R191	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 30,000 ohms ±5%; ½ w; JAN type RC20BF303J.	R189: Meter M102 multiplier NEUTRAL position. R191: Meter M102 multiplier POLAR position.	3RC20BF303J
R170	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 33,000 ohms ±10%; 1 w; JAN type RC30BF333K.	Part of V115 screen voltage divider.	3RC30BF333K
R177, R178	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 33,000 ohms ±10%; 2 w; JAN type RC42BE333K.	V117 plate loads	3RC42BE333K
R195	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 39,000 ohms ±10%; ½ w; JAN type RC20BF393K.	Part of V114 plate (pin 2) voltage divider.	3RC20BF393K
R125, R126	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 47,000 ohms ±10%; ½ w; JAN type RC20BF473K.	Part of V111 grid (pin 1) bias voltage dividers.	3RC20BF473K
R108, R118, R119	(*) ---- (*)	(*) --- (*)	(*) (*) (*)	(*) (*) (*)	(*) (*) (*)	RESISTOR, fixed: comp; 47,000 ohms ±10%; 1 w; JAN type RC30BF473K.	R108: V103 screen voltage dropping. R118: Second limiter amplifier V107 plate load. R119: V107 screen voltage dropping.	3RC30BF473K
R116, R151, R153, R209	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 68,000 ohms ±5%; 1 w; JAN type RC30BF683J.	R116: Diode plate biasing, V106. R151: Part of V112 plate (pin 5) voltage divider. R153: Part of V112 cathode (pin 4) voltage divider. R209: V104 plate load.	3RC30BF683J
R113, R121, R196, R198, R200, R202, through R205	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 100,000 ohms ±10%; ½ w; JAN type RC20BF104K.	R113: V107 grid limiting R121: V108 grid limiting. R196: V114 plate (pin 5) output voltage divider. R198: Z107 input loading. R200: Z105 input loading. R202: Z107 output loading. R203: Z108 output loading. R204: Z105 output loading. R205: Z106 output loading.	3RC20BF104K
R114, R118	(*) (*)	(*) (*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 100,000 ohms ±10%; 1 w; JAN type RC30BF104K.	R114: V103 plate load R118: Second limiter amplifier (V107) plate load.	3RC30BF104K
R136, R146, R210	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 150,000 ohms ±10%; ½ w; JAN type RC20BF154K.	R136: Part of V111 cathode (pin 3) bias voltage divider during CHAN A+B metering. R146: Part of V111 grid (pin 4) bias voltage divider. R210: Part of V104 grid bias voltage divider.	3RC20BF154K
R193	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 180,000 ohms ±10%; ½ w; JAN type RC20BF184K.	V114 plate (pin 2) load	3RC20BF184K

Ref. symbol	Model (U)	A	B	C	D	Name of part and description	Function of part	Signal Corps stock No.
R140, R141, R144, R179, R180, R213	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 220,000 ohms ±5%; 1 w; JAN type RC-30BF224J.	R140: V111 plate (pin 2) voltage dropping. R141: V111 plate (pin 5) voltage dropping. R144: Coupling V111 cathode (pin 6) to V112 cathode (pin 8). R179: V118 grid coupling. R180: Part of V118 grid biasing. R213: Meter M102 shunt in COMP AMP position.	3RC30BF224J
R199, R201	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 220,000 ohms ±10%; 1½ w; JAN type RC20-BF224K (100,000 ohms in Navy procurement of basic model).	R199: Z108 input loading. R201: Z106 input loading.	3RC20BF224K
R139	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 240,000 ohms ±5%; ½ w; JAN type RC20BF244J.	Meter M102 multiplier (position 2).	3RC20BF244J
R129, R167	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 270,000 ohms ±5%; 1 w; JAN type RC30BF274J.	R129: Part of signal speed filter. R167: Part of V113 plate output voltage divider.	3RC30BF274J
R142, R143	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 330,000 ohms ±10%; ½ w; JAN type RC20BF334K.	R142: V111 cathode (pin 3) load. R143: V111 cathode (pin 6) load.	3RC20BF334K
R162	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 360,000 ohms ±5%; 1 w; JAN type RC30 BF364J.	Part of V113 plate output voltage divider.	3RC30BF364J
R106, R127, R128, R148, R192	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 470,000 ohms ±10%; ½ w; JAN type RC20BF474K.	R106: V103 grid limiting. R127 and R128: Part of V111 grid (pin 1) bias voltage dividers. R148: Couples V111 cathode (pin 3) output to V113 grid. R192: Couples V114 plate (pin 2) to COMP AMP control.	3RC20BF474K
R110, R159, R161, R214, R215	(*) (*) (*) ---- ----	(*) (*) (*) --- ---	(*) (*) (*) (*) (*)	(*) (*) (*) (*) (*)	(*) (*) (*) (*) (*)	RESISTOR, fixed: comp; 1 meg ±10%; ½ w; JAN type RC20-BF105K (MWO SIG 11-278-1 authorizes use of R214 and R215 in the basic and A models).	R110: V105 grid limiting. R159 and R161: Part of V113 plate output voltage divider. R214: V107 grid return. R215: V108 grid return.	3RC20BF105K
R138	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 2.2 meg ±10%; 1 w; JAN type RC30-BF225K.	V111 grid (pin 1) return when DRIFT COMPENSATOR is IN.	3RC30BF225K
R130 through R135, R206	(*)	(*)	(*)	(*)	(*)	RESISTOR, fixed: comp; 5.1 meg ±5%; ½ w; JAN type RC20BF-515J.	R130: Meter M102 multiplier, −400 V position. R131: Meter M102 shunt, −400 V position. R132: Meter M102 multiplier, −150 V position. R133: Meter M102 multiplier, REG −150 V position.	3RC20BF515J

Ref. symbol	Model (U)	A	B	C	D	Name of part and description	Function of part	Signal Corps stock No.
R130 through R136, R206—Con.						RESISTOR, fixed, etc.—Continued	R134: Meter M102 multiplier, REG +150 V position. R135: Meter M102 multiplier, +275 V position. R206: Meter M102 shunt, +275 V position.	
R155	(*)	(*)	(*)	(*)	(*)	RESISTOR, variable: comp; 2,500 ohms ±20%; 2 w; JAN type RV4ANSA252A (2,000 ohms in original equipment).	V113 cathode BIAS A	3RV32518
R152, R171, R174, R182	(*)	(*)	(*)	(*)	(*)	RESISTOR, variable: comp; 50,000 ohms ±20%; 2 w; type RV4ANFK-5 3A.	R152: V112, LIMITER R171: V115 screen, POLAR OUTPUT MARK. R174: V116 screen POLAR OUTPUT SPACE. R182: V118 screen, NEUTRAL OUTPUT.	3RV45033
R194	(*)	(*)	(*)	(*)	(*)	RESISTOR, variable: comp; 50,000 ohms ±20%; 2 w.	V114 plate (pin 2) COMP BAL.	3Z7450-55
R109	(*)	(*)	(*)	(*)	(*)	RESISTOR, variable: comp; 500,000 ohms ±10%; 2 w; JAN type RV4ANFK504A.	V105, grid, MARK HOLD LEVEL.	3RV55047
R145, R160	(*)	(*)	(*)	(*)	(*)	RESISTOR, variable: comp; 500,000 ohms ±20%; 2 w; JAN type RV4APFK504B.	R145: V111 grid (pin 4), COMP AMP. R160: V114 grid (pin 4), BIAS B.	3RV55002
R207	(*)	(*)	(*)	(*)	(*)	RESISTOR, variable: comp; 2.5 meg ±10%; 2 w; JAN type RV4-ANFK255C (2 meg in original equipment).	V104 grid, AMP GAIN	3RV62522
	(*)	(*)	(*)	---	(*)	RETAINER: electron tube; phosphor bronze.	Holds tubes in sockets	2Z7780-37
				(*)	---	RETAINER: electron tube; SS	Holds tubes in sockets	2Z2643.138
	(*)	(*)	(*)	(*)	(*)	RING, key	Holds thickness gages	6Z7863
					(*)	SCREW, thumb: knurled thumb head; #12-24 NC-2 thd; 31/64″ lg; Hallicrafters part/dwg #73B69.	For mounting	6L17112-14.8K
X101 through X118	(*)	(*)	(*)	(*)	(*)	SOCKET, electron tube: octal; 1 piece, saddle mtg; w/4 gnd lugs; type TS101P2.	Sockets for tubes V101 through V118.	2Z8678.326
Z112	(*)	(*)	(*)	(*)	(*)	SUPPRESSOR, electrical noise; capacitor and coil type; 2 7/16″ lg x 1 19/32″ wd x 2 1/2″ h.	Attenuates electrical interference.	3Z1891-47.39
Z111, Z113	----	(*)	(*)	(*)	(*)	SUPPRESSOR, electrical noise: capacitor and coil type; 3 7/16″ lg x 1 13/32″ wd x 25/32″ h (used in some basic models).	Attenuates electrical interference.	3Z1892-5.1
S101	(*)	(*)	(*)	(*)	(*)	SWITCH, rotary: 3 pole, 2 position; 2 sect.	BAND WIDTH	3Z9825-66.110
S102	(*)	(*)	(*)	(*)	(*)	SWITCH, rotary: 4 pole, 4 position, 2 sect.	OUTPUT polarity reversing.	3Z9825-66.109
S105	(*)	(*)	(*)	(*)	(*)	SWITCH, rotary: 2 pole, 11 position, 2 sect.	METER B	3Z9825-66.111
S103, S104	(*)	(*)	(*)	(*)	(*)	SWITCH, toggle: DPDT; JAN type ST-2.	2N.S103: LP FILT. S104: DRIFT COMPENSATOR.	3Z9849.135

Ref. symbol	Model (U)	A	B	C	D	Name of part and description	Function of part	Signal Corps stock No.
S106	(*)	(*)	(*)	(*)	(*)	SWITCH, toggle: SPST; JAN type ST–12A.	MARK HOLD DISABLING.	3Z9863–12A
S107, S108	----	---	---	(*)	(*)	SWITCH, toggle: SPST; JAN type ST–42A.	S107: Channel A disabling S108: Channel B disabling	3Z9863–42A
Z110	(*)	(*)	(*)	(*)	(*)	TRANSFORMER, IF: 27.3 to 31.3 kc.	29.3-kc discriminator network.	2Z9641.247
Z109	(*)	(*)	(*)	(*)	(*)	TRANSFORMER, discriminator: 48 to 52 kc.	50-kc discriminator network.	2Z9641.246
Z101, Z103	(*)	(*)	---	---	---	TRANSFORMER, IF: 400 to 470 kc.	Z101: Input to V102 Z103: Input to V101.	2Z9641.248
Z101, Z103	----	---	(*)	(*)	---	TRANSFORMER, IF: 400 to 470 kc.	Z101: Input to V102 Z103: Input to V101.	2Z9641. 312
Z102	(*)	(*)	---	---	---	TRANSFORMER, IF: 430 to 500 kc.	V102 oscillator	2Z9641. 250
Z102	----	---	(*)	(*)	---	TRANSFORMER, IF: 430 to 500 kc.	V102 oscillator	2Z9641. 310
Z101, Z103	----	---	---	---	(*)	TRANSFORMER, IF: 440 to 510 kc.	Z101: Input to V102 Z103: Input to V101.	2Z9641. 335
Z104	(*)	(*)	---	---	---	TRANSFORMER, IF: 450 to 520 kc.	V101 oscillator	2Z9641. 249
Z104	----	---	(*)	(*)	---	TRANSFORMER, IF: 450 to 520 kc.	V101 oscillator	2Z9641. 311
Z102	----	---	---	---	(*)	TRANSFORMER, IF: 470 to 540 kc; 1²³⁄₃₂″ dia x 2¹³⁄₁₆″ h; B & W 70–2–152C.	V102 oscillator	2Z9641. 325
Z104	----	---	---	---	(*)	TRANSFORMER, IF: 490 to 560 kc; 1²³⁄₃₂″ dia x 2¹³⁄₁₆″ h; B & W 70–2–153C.	V101 oscillator	2Z9642. 142
V106, V109, V110, V112	(*)	(*)	(*)	(*)	(*)	TUBE, electron: duo-diode; type 6H6.	V106: Diode limiter V109: 50-kc discriminator. V110: 29.3-kc discriminator. V112: Limiter (for drift compensator circuit).	2J6H6
V101, V102	(*)	(*)	(*)	(*)	(*)	TUBE, electron: pentode; type 6SA7GTY.	V101: 50-kc converter V102: 29.3-kc converter.	2J6SA7GTY
V103, V105, V107, V108, V113, V117	(*)	(*)	(*)	(*)	(*)	TUBE, electron: pentode; type 6SJ7Y.	V103: First limiter amplifier. V105: Mark hold tube. V107: Second limiter amplifier. V108: Third limiter amplifier. V113: Driver amplifier. V117: Neutral output amplifier.	2J6SJ7Y
V111, V114	(*)	(*)	(*)	(*)	(*)	TUBE, electron: dual triode; type 6SL7GT.	V111: Cathode folloeers V114: D-c amplifier.	2J6SL7GT
V104	(*)	(*)	(*)	(*)	(*)	TUBE, electron: duo-diode triode; type 6SQ7.	Mark-hold signal rectifier and a-c amplifier.	2J6SQ7
V115, V116	(*)	(*)	(*)	(*)	(*)	TUBE, electron: beam power pentode; type 6V6GTY.	V115: Polar mark amplifier V116: Polar space amplifier.	2J6V6GTY
V118	(*)	(*)	(*)	(*)	(*)	TUBE, electron: beam power pentode; type 6Y6G.	Neutral output amplifier	2J6Y6G
	(*)	(*)	(*)	(*)	(*)	WRENCH: for #4 Allen socket-head setscrew.	Loosen and tighten setscrews.	6R55499
	(*)	(*)	(*)	(*)	(*)	WRENCH: Allen type hex. key; for #5 and #6 Allen-head setscrews; ½″ lg short arm; 1¾″ lg long arm; Allen Mfg ¹⁄₁₆″ Short Arm Series.	Loosen and tighten setscrews.	6R57400–6
	(*)	(*)	(*)	(*)	(*)	WRENCH: for #8 Allen socket-head setscrew.	Loosen and tighten setscrews.	6R57400
	(*)	(*)	(*)	(*)	(*)	WRENCH, double end box: ³⁄₁₆″ and ¼″ hex. openings.	Loosen and tighten control locknuts.	6R41274A

2. Identification Table of Parts for Rectifier Power Unit PP–193(*)/TRA–7

Note. Model column 1 refers to the basic model; column 2 refers to A model, Order No. 8975–PH–46; column 3 refers to A model, Order Nos. 18723-PH–49 and 19624–PH–50; column 4 refers to A model, Order No. 1908–PH–51.

Ref. symbol	Model				Name of part and description	Function of part	Signal Corps stock No.
	1	2	3	4			
					RECTIFIER POWER UNIT PP–193/TRA–7, PP–193A/TRA–7: electronic type; output, +275 v, 60 ma DC; +150 v, 40 ma DC; −150 v, 10 ma DC; −150 v, 85 ma DC; −400 v, 3 ma DC; 6.3 v, 6 amp AC, and 6.3 v, 2.5 amp AC; input 105, 115, or 125 v, 50/60 cyc AC.	Furnishes all power for Dual Diversity Converter CV–31(*)/TRA–7.	3H4870
	(*)	(*)	(*)	(*)	TECHNICAL MANUAL (TM 11–261).	Covers basic and A models	Order through AGO
	(*)	(*)	(*)	(*)	BRACKET: capacitor mtg; approx 5'' lg x $2\frac{9}{32}$'' wd; JAN type CP07–SC3.		2Z1239.154
C307	(*)	(*)	(*)	(*)	CAPACITOR, fixed: paper dielectric; 100,000 $\mu\mu$ +20% −10%; 600 vdcw; JAN type CP541EF104V.	V305 grid input	3DA100–744
C308	(*)	(*)	(*)	(*)	CAPACITOR, fixed: paper dielectric; 2 μf +20% −10%; 600 vdcw; JAN type CP54B1EF205V.	Regulated +150-volt output filter.	3DB2–146
C301 through C306	(*)	(*)	(*)	(*)	CAPACITOR, fixed: paper dielectric; 8 μf +20% −10%; 600 vdcw; JAN type CP70B1EF805V.	C301 and C302: +276-volt output filters. C303 and C304: −150-volt output filters. C305 and C306: −400-volt output filters.	3DB8–183
	---	---	(*)	---	CLAMP: electron tube retainer; $2\frac{3}{16}$'' lg x $1\frac{9}{16}$'' wd x $\frac{11}{16}$'' h; Times Facsimile #3T Hat.	Retains V306 in socket	2Z2712.228
	---	---	(*)	---	CLAMP: electron tube retainer; $2\frac{7}{16}$'' lg x $1\frac{7}{8}$'' wd x $\frac{3}{4}$'' h; Times Facsimile #4T Hat.	Retains V301 in socket	2Z2643.138
	(*)	(*)	(*)	(*)	CLAMP, electrical: accom $\frac{3}{8}$'' OD; $\frac{1}{2}$'' wd x 1'' lg; B&W #CPC–6.	Secures cable	2Z2643.55
	(*)	(*)	(*)	(*)	CLAMP, electrical: accom $\frac{1}{2}$'' OD; $\frac{1}{2}$'' wd x $1\frac{3}{32}$'' lg; B&W #CPC–8.	Secures cable	2Z2643.53
	(*)	(*)	---	---	CLAMP, electrical: accom $\frac{11}{16}$'' diam cable.	Secures cable	3Z1003–4.4
			(*)	(*)	CLAMP, electrical: approx 1'' lg x $\frac{3}{8}$'' wd; accom $\frac{1}{4}$'' dia cable; Tinnerman A30491–4.	Holds cable harness	2Z2636–159
L301, L302	(*)	(*)	(*)	(*)	COIL, telephone retardation: single wnd; $2\frac{9}{16}$'' lg x $3\frac{11}{32}$'' wd x $4\frac{3}{8}$'' h; HS; Chicago Transf 14305.	L301: +275-volt filter choke. L302: −150-volt filter choke.	3C1988–88
V306	(*)	(*)	(*)	(*)	TUBE, electron: type OD3; glow discharge type.	−150-volt regulator	2JOD3
V301	(*)	(*)	(*)	(*)	TUBE, electron: type 5R4WGY; full wave rectifier.	+275-volt rectifier	2J5R4WGY
V302, V303	(*)	(*)	(*)	(*)	TUBE, electron: type 5Y3GT; full wave rectifier	V302: −150-volt rectifier. V303: Half-wave rectifier in −400-volt power supply.	2J5Y3GT
V305	(*)	(*)	(*)	(*)	TUBE, electron: type 6SJ7 pentode.	Voltage regulator V304 control.	2J6SJ7

Ref. symbol	Model 1	Model 2	Model 3	Model 4	Name of part and description	Function of part	Signal Corps stock No.
V304	(*)	(*)	(*)	(*)	TUBE, electron: type 6V6GTY; pentode.	Regulated +150-volt supply series regulator.	2J6V6GTY
F301, F302	(*)	(*)	(*)	(*)	FUSE FU-37: 3 amp, 250 v; 1¼" lg x 9⁄32" dia; Littlelfuse 413003.	Line fuses	3Z1937-37
X309, X310, X311	(*)	(*)	(*) (*)	--- (*)	FUSEHOLDER FU-39: extractor post type; for single type 4AG fuse; 2⅜" lg x ¾ wd o/a; Bussman type HCM.	X309 and X310: Hold line fuses F301 and F302. X311: Holds a spare fuse.	3Z1939
I-301, I-302	(*)	(*)	(*)	(*)	LAMP LM-52: 6-8 .15 amp; miniature bayonet base; Mazda #47.	I-301: Bull for AC SUPPLY indicator. I-302: Bulb for PLATE indicator.	2Z5952
	(*)	(*)	(*)	(*)	LENS, indicator light: rec; 1¼" lg x .828" dia; Dialco #DP-H Red.	Light lens for PLATE indicator.	2Z5991-83
	(*)	(*)	(*)	(*)	LENS, indicator light: white; 1¼" lg x .828" dia; Dialco #DP-H White.	Light lens for AC SUPPLY indicator.	2Z5991-79
X307	(*)	(*)	(*)	(*)	LIGHT, indicator: for miniature bayonet base T-3¼ bulb; 1" dia x 25⁄16" lg; Dialco Series DP90.	AC SUPPLY indicator lamp housing.	2Z5991-81
X308	(*)	(*)	(*)	(*)	LIGHT, indicator: for miniature bayonet base T-3¼" bulb 1" dia x 25⁄16" lg; Dialco Series DP90.	PLATE indicator lamp housing.	2Z5991-82
			(*)	---	POST, supporting: u/w Times Facsimile #3T Hat; .164" dia x 2⅞" lg; Times Facsimile #32 Post.	Supports tube-retaining clip.	2Z7259-85
			(*)	---	POST, supporting: u/w Times Facsimile #4T Hat; .164" dia x 4⅞" lg; Times Facsimile #52 Post.	Supports tube-retaining clip.	2Z7259-120
R301	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 220 ohms ±10%; 2 w; JAN type RC-42BE221K.	−400-volt supply filter surge limiting.	3RC42BE221K
R313	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 680 ohms ±10%; ½ w; JAN type RC20BF681K.	Part of voltage divider between the regulated +150- and regulated −150-volt outputs.	3RC20BF681K
R318 through R321.	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 1200 ohms ±10%; 2 w; JAN type RC42BE122K.	Bypass portion of load current of regulated +150-volt supply around V304.	3RC42BE122K
R314	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 1500 ohms ±10%; ½ w; JAN type RC20BF152K.	Part of voltage divider between regulated +150- and regulated −150-volt supply outputs.	3RC20BF152K
R315	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 2200 ohms ±10%; ½ w; JAN type RC20BF222K.	Part of voltage divider between regulated +150- and regulated −150-volt supply outputs.	3RC20BF222K
R302	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 2200 ohms ±10%; 2 w; JAN type RC42BE22K.	Part of −400-volt supply filter circuit.	3RC42BE222K
R306	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 2700 ohms ±10%; 2 w; JAN type RC42BE272K.	Part of voltage divider, regulated −150-volt supply.	3RC42BE272K
R303, R304, R305	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 3300 ohms ±10%; ½ w; JAN type RC20BF332K.	Part of voltage divider, regulated −150-volt supply.	3RC20BF332K

Ref. symbol	Model				Name of part and description	Function of part	Signal Corps stock No.
	1	2	3	4			
R312, R316	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 4700 ohms ±10%; ½ w; JAN type RC20BF472K.	Part of voltage divider between regulated +150- and regulated −150-volt supply outputs.	3RC20BF472K
R310	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 22,000 ohms ±10%; 2 w; JAN type RC42BE223K.	Part of voltage divider, V305 screen.	3RC42BE223K
R309	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 27,000 ohms ±10%; 2 w; JAN type RC42BE273K.	Part of voltage divider, V305 screen.	3RC42BE273K
R307	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 33,000 ohms ±10%; 1 w; JAN type RC30BF333K.	Bleeder for −150-volt supply.	3RC30BF333K
R311, R317	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 47,000 ohms ±10%; 1 w; JAN type RC30BF473K.	Part of voltage divider between regulated +150- and regulated −150-volt supply outputs.	3RC30BF473K
R308	(*)	(*)	(*)	(*)	RESISTOR, fixed: composition; 100,000 ohms ±10%; 2 w; JAN type RC42BE104K.	V305 plate load	3RC42BE104K
	(*)	(*)	---	(*)	RETAINER, electron tube: 2¼" wd x 2⅝" lg x 4⅜" h o/a; WECo #D–152560.	Retains V301 in socket	2Z7780–19
	(*)	(*)	---	(*)	RETAINER, electron tube: 1⅞" wd x 2⅜" lg x 3⅜" h o/a; WECo #D–152558–B.	Retains V306 in socket	2Z7780–20
	(*)	(*)	(*)	(*)	RETAINER, electron tube: WECo #D–152370FF.	Retains V305 in socket	2Z7780–41
	(*)	(*)	(*)	(*)	RETAINER, electron tube: WECo #D–152370KK.	Retains tubes V302 through V304 in sockets.	2Z7780–38
X301 through X306	(*)	(*)	(*)	(*)	SOCKET, electron tube: 8 cont; 1 piece saddle mtg; type TS101P02.	X301: Socket for V301 X302: Socket for V302. X303: Socket for V303. X304: Socket for V304. X305: Socket for V305. X306: Socket for V306.	2Z8678.326
			(*)	(*)	SPRING: loop type; 1½" lg x ½" wd o/a.	Locks Dzus type fastener	2Z8879–38
	(*)	(*)	(*)	(*)	STUD ASSEMBLY: ⅝" lg x ¼" dia o/a; AN #AN–O–5–22.	Cowl fastener	6L31516
S301, S302	(*)	(*)	(*)	(*)	SWITCH, interlock: SPST; normally open; c/o frame sect, and door sect.	Opens a-c primary circuit when upper front door is opened.	3Z9560–7
S303	(*)	(*)	(*)	(*)	SWITCH, toggle: DPST; JAN type ST52K.	AC SUPPLY	3Z9863–52K
S304	(*)	(*)	(*)	(*)	SWITCH, toggle: SPST; JAN type ST42A.	PLATE	3Z9863–42A
E301	---	(*)	(*)	(*)	BOARD, terminal: general purpose; 14 solder lug term. w/#6–32 screws; 6⅞" lg x 1[11]⁄32" wd x ½" thk; Jones HB #14–141–¾ W–MS.	For connections between set components and J306.	3Z12531–40.1
E301	(*)	---	---	---	BOARD, terminal: general pupose; 14 solder lug term.; 7¾" lg x 1⅛" wd ½" thk o/a; Jones HB #4–241–MS.	For connections between set components and J306	2Z9414.103
E303	(*)	(*)	(*)	(*)	BOARD, terminal: general purpose; 14 turret type term., w/o barriers; 4⅜" lg x 2½" wd x ⅜" thk; B&W #WE–A–2631.	Component mounting	2Z9414.102

Ref. symbol	Model				Name of part and description	Function of part	Signal Corps stock No.
	1	2	3	4			
E302	(*)	(*)	(*)	(*)	BOARD, terminal: general purpose; 28 turret type term. w/o barriers; 7⅞'' lg x 2½'' wd x ³⁄₃₂'' thk; B&W #WE-B-2621.	Component mounting	2Z9428-32
T302	(*)	(*)	(*)	(*)	TRANSFORMER, power: step-down; fil type; single ph; 105/115/125 v, 50/60 cyc; sec, term. (5-7), 6.3 v at 6 amp, term. (6-7), 5.0 v at 2 amp, term. (8-9), 5.0 v at 2 amp, term. (10-11), 6.3 v at 2.5 amp, term. (12-13,) 5.0 v at 2 amp; HS metal case; Chicago Transf #14304.	Filament transformer for rectifier tubes in power supply and all tubes in converter.	2Z9611.423
T301	(*)	(*)	(*)	(*)	TRANSFORMER, power: step-down; and step-up; fil and plate type; single ph; 105/115/125 v, 50/60 cyc; sec, term. (5-7), 760 v ct at .1 amp, term. (8-10), 460 v ct at .060 amp, term. (11-12), 6.3 v at 1.0 amp; HS metal case; Chicago Transf #14303.	Supplies plate voltages to rectifier tubes and filament voltage to V304.	2Z9613.512

3. Identification Table of Parts for Oscillator O-41(*)/TRA-7

Note. Model column 1 refers to the basie model; column 2 refers to A model, order Nos. 8975-PH-46, 12702-PH-47, 18723-PH-49, and 1908-PH-51; column 3 refers to A model, order No. 19624-PH-50.

Ref. symbol	Model				Name of part and description	Function of part	Signal Corps stock No.
	1	2	3	4			
					OSCILLATOR O-41/TRC-7, .0-41A/TRA-7: fixed freq 750-cps ±10%; not xtal controlled; 15½'' lg x 7½'' wd x 4'' h o/a; integral coils; input 115 v AC, 50/60 cyc; plug-in unit.	Furnishes tone signal when converter is on mark.	2C2710-41
E402	(*)	(*)	(*)	---	BOARD, terminal: 12 brass tin pl screw term.; 5½'' lg x 3'' wd x ³⁄₃₂'' thk.	Mounts 5 resistors	2Z9412.201
E401	(*)	(*)	(*)	---	BOARD, terminal: 24 brass tin pl screw term.; 7⅜'' lg x 2'' wd x ³⁄₃₂'' thk.	Mounts resistors and capacitors.	2Z9424-42
C401, C402	(*)	(*)	(*)	---	CAPACITOR, fixed: paper; 6,000 μμf ±20%; 660 vdcw; JAN type CN35A602M.	C401: Coupling between plate (pin 5) and grid (pin 1) of V401. C402: Coupling between plate (pin 2) and grid (pin 4) of V401.	3DA6-67
C403, C405	---	(*)	(*)	---	CAPACITOR, fixed: paper; 10,000 μμf ±20%; 400 vdcw; JAN type CN35A103M.	Monitor filtering in multivibrator output.	3DA10-367
C403	(*)	---	---	---	CAPACITOR, fixed: paper; 20,000 μμf ±20%; 100 vdcw; JAN type CP16A1HB203M.	Monitor filtering in multivibrator output.	3DA20-199
C404	(*)	(*)	(*)	---	CAPACITOR, fixed: electrolytic; 450 μf; 50 vdcw; JAN type CE41C451G.	Rectifier CR401 output filter	3DB450-3

Ref. symbol	Model 1	Model 2	Model 3	Model 4	Name of part and description	Function of part	Signal Corps stock No.
C404—Con.	(*)	(*)	(*)	---	CLAMP: cable; holds ¼″ OD cable	Holds cable in place	2Z2636-159
	(*)	(*)	(*)	---	CLAMP: conduit; holds ⅜″ OD cable.	Holds cable in place	2Z2643.55
	(*)	(*)	(*)	---	CONDUIT: ⅜″ ID	Shielding	6Z2252.5
	(*)	(*)	---	---	CONDUIT ASSEMBLY: ⅜″ ID	Shielding	6Z2249-4
P401	---	---	(*)	---	CONNECTOR, plug: 2 round male cont, pol; 90° angle type; 2⁵⁄₃₂″ lg x 1²³⁄₃₂″ wd x 1⅛″ dia shell; AN-3108A-14S-9P.	Provides for connection of external circuit for receiver disabling purposes.	2Z3022-2
P405	(*)	(*)	---	---	CONNECTOR, plug: 14 round male cont, pol; straight.	Electrical connection to converter cable.	2Z7124.6
P405	---	---	(*)	---	CONNECTOR, receptacle: 14 round male cont, pol; straight.	Electrical connection to converter cable.	2ZK7130.7
J404	(*)	(*)	(*)	---	CONNECTOR, receptacle: Sig Socket SO-213; four #20 round female cont; straight.	Control circuit input to relay	2Z8799-231
J401	(*)	(*)	---	---	CONNECTOR, receptacle: 2 round female cont; straight wall type.	External connection to external receiver disabling.	2Z3063-8
J402, J403	(*)	(*)	(*)	---	CONNECTOR, receptacle: 3 round female cont, pol; straight.	Electrical connection to external receiver disabling circuits.	2Z8673.20
	(*)	(*)	(*)	---	COVER: steel; rectangular	Protective cover for relay	4Z3504
	(*)	(*)	(*)	---	FERRULE: u/w conduit coupling nut in electrical fitting; for ⅜″ conduit.	Terminates flexible conduit at connector shell, part of cable shield assembly.	6ZK3821-5
	(*)	(*)	(*)	---	FERRULE: u/w conduit coupling nut in electrical fitting; for ¾″ flex conduit.	Terminates flexible conduit at connector shell, part of cable shield assembly.	6ZK3821-2
	(*)	(*)	(*)	---	FITTING, conduit: coupling nut; for ⅜″ max conduit size; thd connection for holding ferrules to connectors or fittings.	Couples flexible conduit to connector shell.	6Z7249-5
	(*)	(*)	(*)	---	FITTING, conduit: coupling nut; for ¾″ conduit size; thd connection.	Couples flexible conduit to connector.	6ZK7249-11
F401	(*)	(*)	(*)	---	FUSE FU-64: 1 amp; ferrule type	Overload protection for T401	3Z1964
X402	(*)	(*)	(*)	---	FUSEHOLDER: extractor post type; for single cartridge fuse.	Holds F401	3Z3282-42.7
CR401	(*)	(*)	(*)	---	RECTIFIER, metallic: selenium; 36 v rms max input; .5 amp max DC output.	Converts ac to dc for disabling relay coil supply.	3H4860-46
K401	(*)	(*)	(*)	---	RELAY, armature: 2 sets 1A1C; single wnd coil, 48 vdc operating; .018 amp; 700 ohm DC resistance.	Receiver disabling relay	2Z7589-145
R407, R408, R411, R412	(*)	(*)	(*)	---	RESISTOR, fixed: WW; 160 ohms ±5%; 5 w; JAN type RW55J161.	Current limiting, K401 circuit	3RW19516
R409	(*)	(*)	(*)	---	RESISTOR, fixed: WW; 4000 ohms ±5%; 10 w; JAN type RW56J402.	Voltage dropping for K401 coil.	3RW27925
R410	(*)	(*)	(*)	---	RESISTOR, fixed: comp; 560 ohms ±10%; 1 w; JAN type RC30BF-561K.	Bleeder for CR401 output	3RC30BF561K
R403, R404	(*)	(*)	(*)	---	RESISTOR, fixed: comp; 10,000 ohms ±10%; ½ w; JAN type RC20BF103K.	Filtering, oscillator output	3RC20BF103K
R405, R406	(*)	(*)	(*)	---	RESISTOR, fixed: comp; 27,000 ohms ±10%; ½ w; JAN type RC20BF273K.	Grid bias for V401	3RC20BF273K

Ref. symbol	Model				Name of part and description	Function of part	Signal Corps stock No.
	1	2	3	4			
R401, R402	(*)	(*)	(*)	---	RESISTOR, fixed: comp; 100,000 ohms ±10%; 1 w; JAN type RC30BF104K.	Plate load V401	3RC30BF104K
	(*)	(*)	(*)	---	RETAINER, tube	Holds V401 in socket	2Z7780-38
	(*)	(*)	(*)	---	SHELL, connector: junction shell, 90° angle.	Shields bend in connector cable.	2Z8276-7
X401	(*)	(*)	(*)	---	SOCKET, tube: octal; 1 piece under chassis mtg; type TSB8T101.	Mounts V401	2Z8678.326
T401	---	(*)	(*)	---	TRANSFORMER, power: fil type; input 115 v or 230 v, 50/60 cyc, single ph; sec 24 v at .25 amp, tapped at 22 v; HS metal case.	Steps down voltage for CR401 input.	2Z9607-27
T401	(*)	---	---	---	TRANSFORMER, power: fil type; input 115 v or 230 v, 50/60 cyc, single ph; sec 24 v at .25 amp, tapped at 22 v; encl metal case.	------------------------	2Z9608-58
V401	(*)	(*)	(*)	---	TUBE, electron: type 6SL7GT; twin triode.	Multivibrator-type tone oscillator.	2J6SL7GT

GLOSSARY

Section I. ABBREVIATIONS

a-c	alternating-current.
a-f	audio-frequency.
bfo	beat-frequency oscillator.
cps	cycles per second.
c-w	continuous-wave
cyc	cycles.
db	decibels.
dbm	decibels referred to 1 milliwatt in 600 ohms.
d-c	direct-current.
DPDT	double-pole, double-throw.
DX	duplex.
f-m	frequency-modulated.
FS	frequency shift.
h-f	high-frequency.
h-v	high-voltage.
i-f	intermediate-frequency.
K	kilo or 1,000.
kc	kilocycle.
l-f	low-frequency.
ma	milliampere.
mc	megacycle.
meg	megohm.
mh	millihenry.
ms	millisecond.
mv	millivolt.
mw	milliwatt.
pl	plated.
psi	pounds per square inch.
r-f	radio-frequency.
rms	root mean square.
RTT	radioteletype.
SD	Solvent, dry-cleaning.
SLC	straight line capacity.
SOP	standing operating procedure.
SPST	single-pole, single-throw.
TD	transmitter-distributor.
term	terminal.
TT	teletypewriter.
ua	microampere.
UF or uf	microfared.
UUF or uuf	micromicrofared.
uv	microvolt.
v or V	volt.
VTVM	vacuum-tube voltmeter.
w	watt.
wpm	words per minute.

Section II. DEFINITIONS

For explanation of the terms used in this manual, refer to TM 11–455, TM 11–499, TM 11–680, and the following list:

Ambient humidity.—The humidity of the surrounding air; the room humidity.

Ambient temperature.—The temperature of the air surrounding the test set-up.

Anodizing.—An electrical treatment given to aluminum and other metals for the purpose of increasing the corrosion and oxidation resistance of the metal. The treatment is similar to electro-plating but there is no deposition of other metal

Balanced mixer.—Also called a balanced modulator. An amplifier in which the tube control grids are connected for push-pull operation and the cathode circuit has parallel input. The plates are operated in push-pull, and the signal applied to the grids is balanced out and does not appear in the output.

Bias distortion.—This term is used in relation to the distortion of the square-wave teletypewriter keying signal. If the positive and negative d-c pulses are not of equal length and of square shape, they are said to have bias distortion. See TM 11–680.

Carrier shift keying.—An elementary form of frequency modulation in which a c-w (continuous-wave) signal is shifted in frequency a small number of cycles. One frequency corresponds to key closed and the other frequency to key open.

Centigrade.—The temperature scale in which water boils at 100° and freezes at 0°; ordinarily abbreviated as C.

Current limiting resistor.—A series resistor which will take almost the full voltage drop of the power source if the component with which it is in series drops to a low impedance.

Dot cycles per second.—A measure of the equivalent frequency band covered by the keying of teletypewriter code signals.

Decoupling capacitor.—A bypass capacitor so placed in a circuit that the a-f or r-f currents of that circuit are prevented from going into the power supply or to another stage on the common voltage supply.

Decoupling resistor.—A resistor used in a filter network to prevent the a-f or r-f currents in the network from appearing in the B+ or common voltage supply lead.

Dynamic mutual conductance tube tester.—A tube checker that tests tubes with an a-c signal applied to the grid and gives readings directly related to the mutual conductances of the tube. This is not the same as the check of an emission type tester.

Frequency shift keying.—A method of sending c-w signals where one frequency corresponds to key-closed conditions and another, separated by an audio amount, to key-open conditions. Usually the keying is by teletypewriter. (This is similar to carrier shift keying.)

Full DX.—An extension circuit that can be operated in both directions simultaneously.

Gating tube.—A tube which will not allow another tube to be keyed unless it has the proper bias applied.

Hypersil core.—A special silicon steel transformer core.

Keying polarity.—The d-c pulses arriving from a teletypewriter keyboard (or tape transmitter) are either positive with respect to ground or negative with respect to ground, in neutral keying. This is their polarity.

Lissajous figures.—Symmetrical designs on an oscilloscope screen showing the frequency ratio of two applied voltages.

Low-pass filter.—An r-f filter circuit which strongly attenuates all frequencies above a certain frequency. Often used for harmonic suppression.

Loop.—A closed extension circuit, generally containing one or more TT components.

Mark.—Closed-key condition on a teletypewriter circuit.

Mark frequency.—The frequency of the signal emitted by a frequency-shifting oscillator or a transmitter which corresponds to the closed-key condition of the teletypewriter circuit.

Neon coupling tube.—A neon bulb used for coupling between two stages. When the neon tube is ionized, a high positive voltage is applied to the grid of the second tube. When the neon tube is deionized, there is no coupling between the two stages.

Neutral keying.—Square-wave d-c pulses which have a single polarity with respect to ground. The individual pulses correspond to the mark contact closures of the associated teletypewriter equipment.

1/2 DX.—A series extension circuit that can receive or transmit at one position; cannot do both simultaneously.

Oven cycling.—The heater off and on switching by the thermostatic control.

Polar keying.—A system of d-c keying where pulses of one polarity (with respect to ground) are mark signals (closed-key) and pulses of the opposite polarity are space signals (open-key).

Reactance tube.—A tube across an oscillator circuit which effectively puts capacitive reactance into the oscillator frequency-determining section to change the output frequency of the oscillator. The reactance tube is keyed by changing the bias on it.

Shift.—The number of cycles between the mark and space (closed- and open-key) frequencies.

Solvent (SD).—A dry-cleaning solvent used for cleaning greasy surfaces.

Space.—The keying line condition corresponding to open key on a teletypewriter circuit.

Space frequency.—The frequency of the signal emitted by a frequency-shifting oscillator or a transmitter which corresponds to the open-key condition of the teletypewriter circuit.

Spurious output.—Harmonics, parasitics, and other undesired frequencies in the r-f output of an r-f oscillator, signal generator, or transmitter.

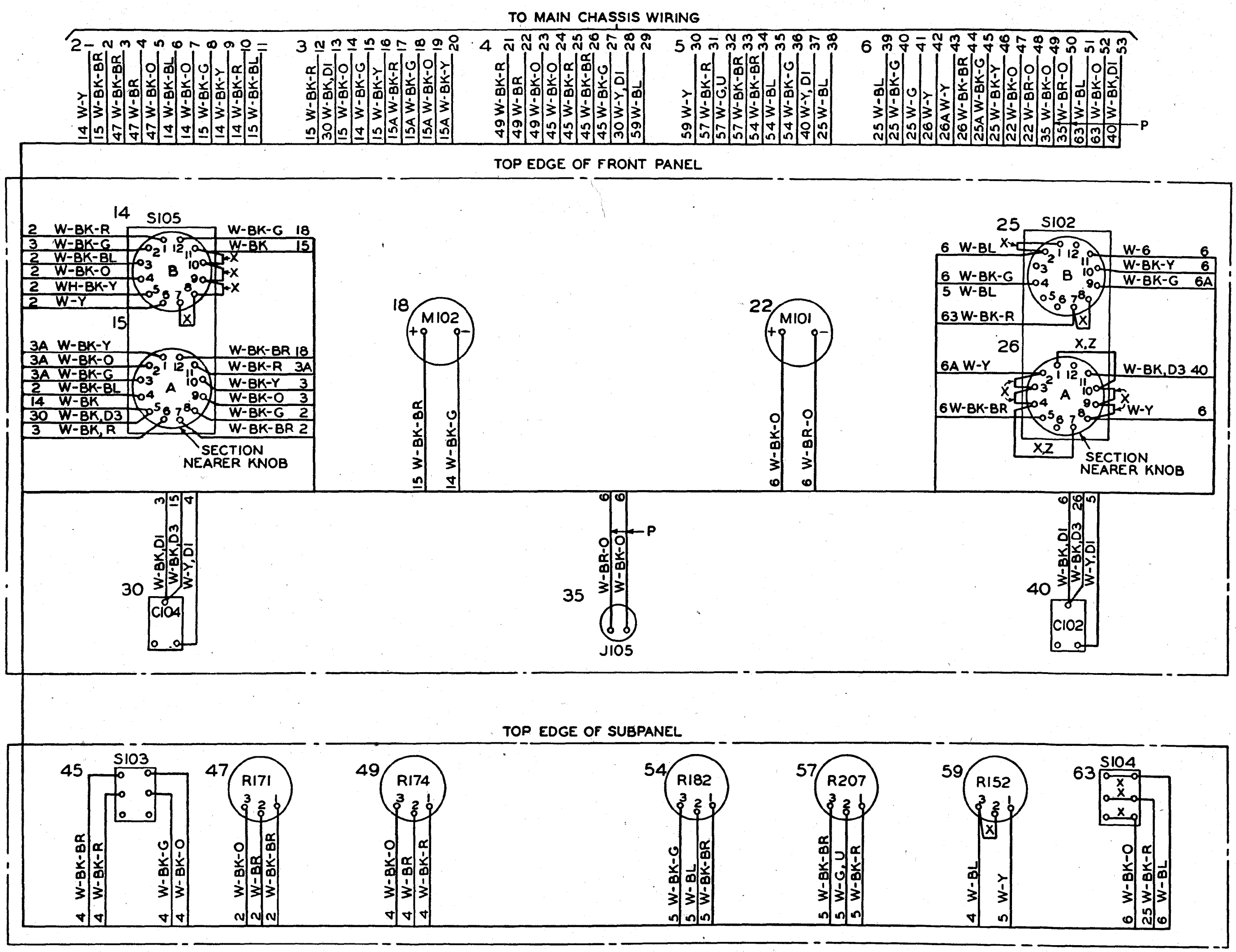
Striking voltage.—The voltage at which a gas-filled tube ionizes.

Stripping.—The removal of all plug-in parts before checking a unit. If the unit is to be salvaged, this means removal of all units (including wired-in and bolted-in units) that may be useful for replacement purposes.

Test key.—A key on the front panel of an equipment used to key an oscillator or a transmitter. The keying circuit may simulate a long external line or a special keying voltage, and should result in the same transmitted output as would be caused by the remote keying device.

Varistor.—A resistor which changes resistance when the applied voltage is changed.

Voltage reference tube.—A gaseous regulator tube that is used to give an unvarying voltage to a tube element, such as a grid or cathode; replaces a bias battery.



NOTES:

1 WIRES NOT OTHERWISE SPECIFIED SHALL BE 22 GA. STRANDED, RUN IN CABLE.

2 "P" DENOTES PAIR.

3 "X" DENOTES 20 GA. BARE TINNED STRAP WIRE.

4 "Z" DENOTES LEADS SHALL BE FURNISHED WITH IRV-O-LITE NO. 18 BLACK XTE-30 TUBING.

5 TERMINAL NUMBERS AND DESIGNATIONS SHOWN ON APPARATUS ON THIS DRAWING WHICH ARE NOT STAMPED ARE FOR REFERENCE ONLY.

6 "U" DENOTES 22 GA STRANDED WIRE.

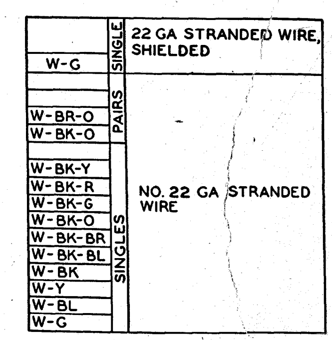


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Figure 64. Dual Diversity Converter CV–31/TRA–7, basic unit front and control panels wiring diagram.

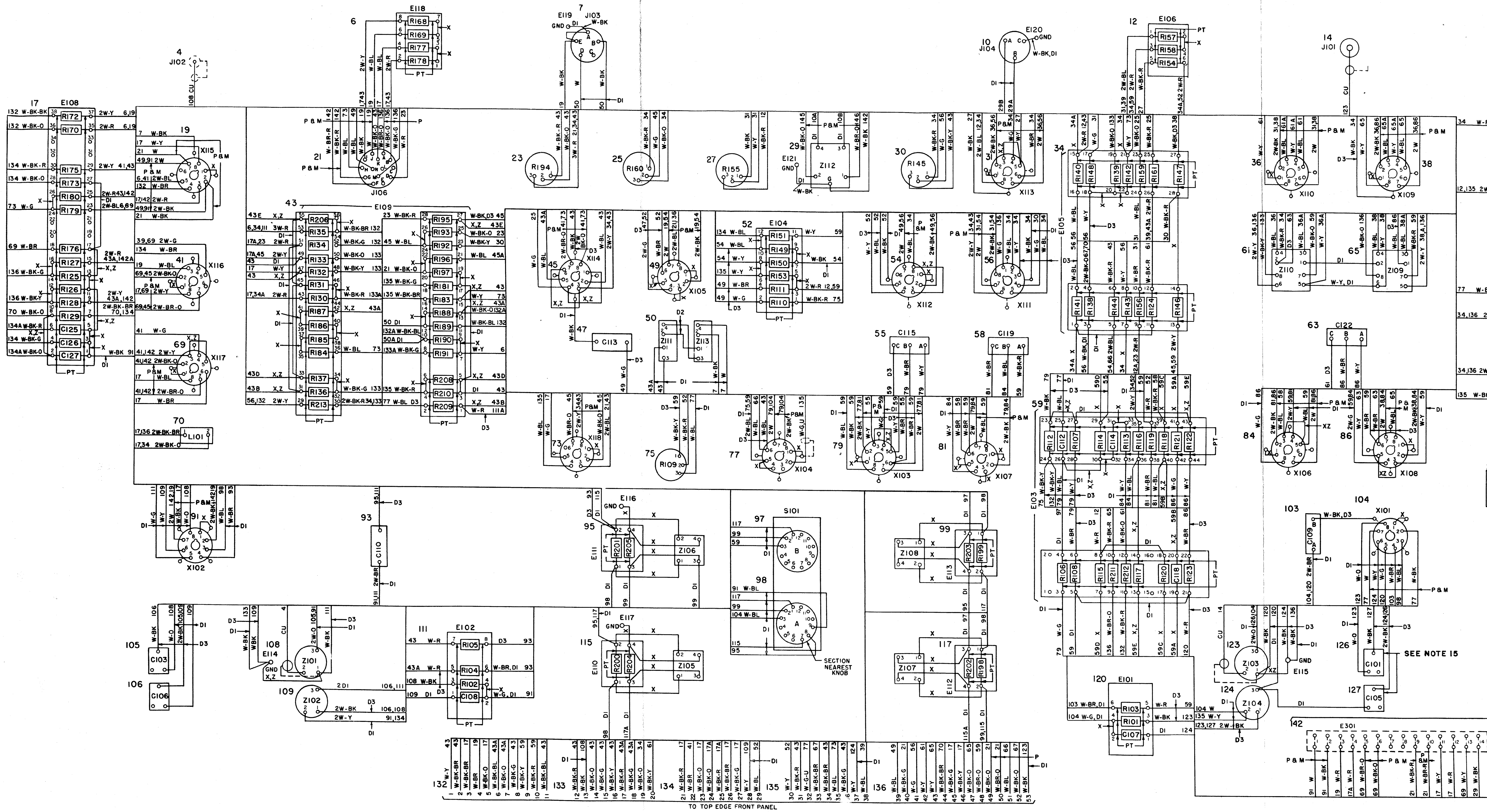

Figure 63. Dual Diversity Converter CV-31/TRA-7, basic main unit chassis wiring diagram.

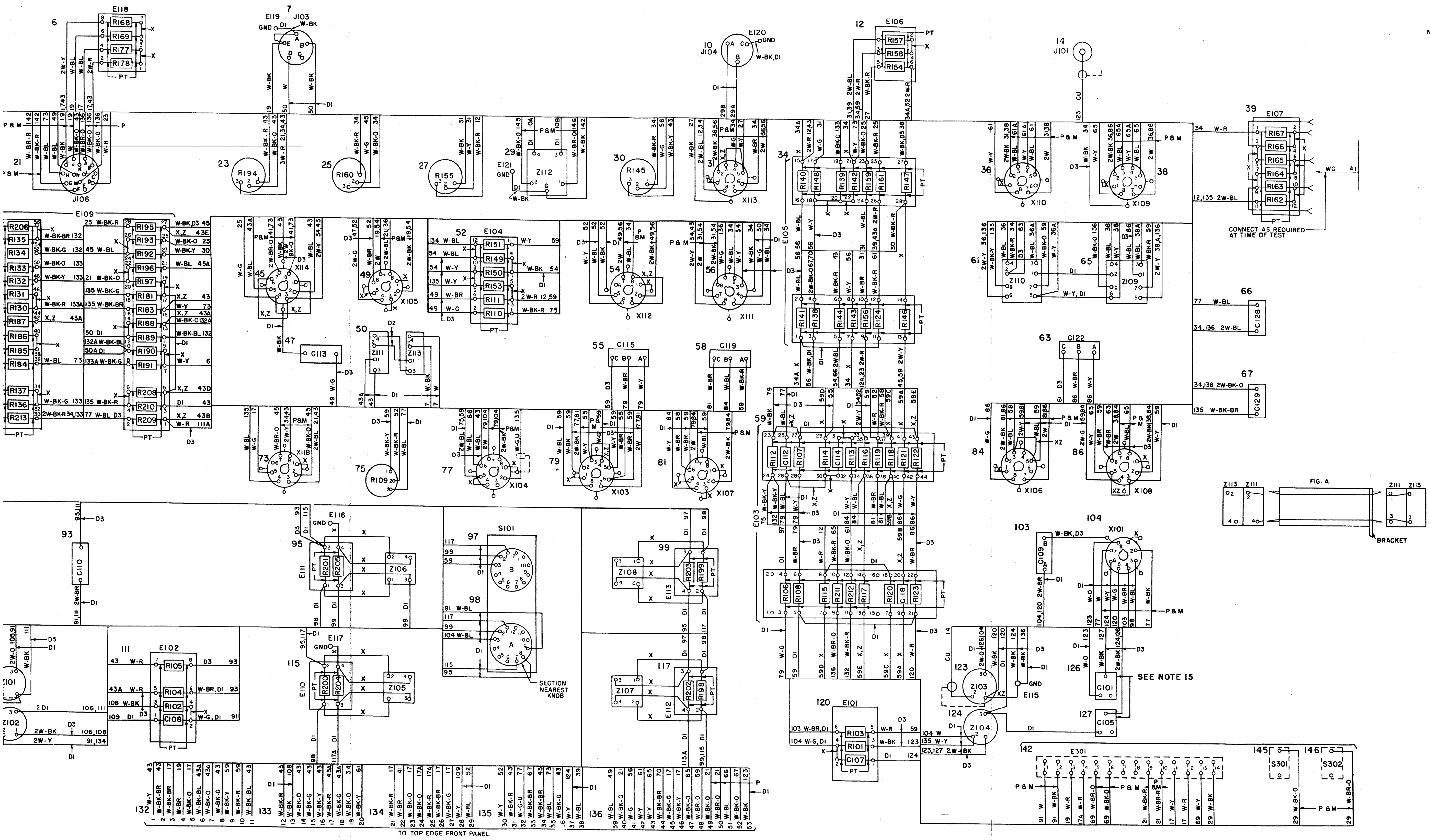

Figure 63. Dual Diversity Converter CV-31/TRA-7, basic main unit chassis wiring diagram.

NOTES:

1. ALL WIRING, UNLESS OTHERWISE SPECIFIED, SHALL BE 22 GA STRANDED WIRE RUN IN CABLE.
2. "PT" DENOTES LEADS FURNISHED AS PART OF APPARATUS.
3. "X" DENOTES BARE TINNED STRAP WIRE.
4. "Z" DENOTES LEADS SHALL BE COVERED WITH NO. 18 BLACK IRV-O-LITE XTE-30 TUBING. THIS TUBING SHALL BE SPACED AT LEAST 1/8" FROM OTHER SOCKET TERMINALS.
5. "DI" WIRING SHALL BE W. 22 GA. STRANDED UNLESS OTHERWISE SPECIFIED. RUN DIRECTLY FROM TERMINAL TO TERMINAL IN THE SHORTEST POSSIBLE MANNER WITH SUFFICIENT SLACK TO PREVENT BREAKING UNDER VIBRATION.
6. "D3" WIRING SHALL BE W, 22 GA. STRANDED UNLESS OTHERWISE SPECIFIED. RUN LOOSE AND DRESS BACK AGAINST THE PANEL IN THE MOST CONVENIENT MANNER.
7. ALL STRAPS SHALL BE RUN AS SHORT AND DIRECT AS POSSIBLE.
8. "P" DENOTES PAIR.
9. "CU" DENOTES COAXIAL SHIELDED CABLE SUPPLIED WITH ASSEMBLY.
10. ○--- DENOTES COAXIAL SHIELD CONNECTION.
11. "M" DENOTES 20 GA. STRANDED WIRE.
12. "U" DENOTES 22 GA. STRANDED WIRE, SHIELDED.
13. ⬭--- DENOTES SHIELD CONNECTION.
14. "D2" WIRING TO BE 22 GAUGE, STRANDED, COLORED WHITE AND RUN IN PATH AND LOCATION AS SHOWN IN FIG. A.

15. 22 GA. STRANDED

W-G		NO. 22 GA. STRANDED WIRE, SHIELDED
W-BK-R W-BR-R	PAIRS	NO. 20 GA. STRANDED WIRE
W W-BK		
W-BK-O W-BR-O		
W-BK-O W-BR-O	PAIRS	NO. 22 GA. STRANDED WIRE
W	SINGLES	
W-BR-O		
W-BK-BL		
W-BK-R		
W-BK-Y		
W-BK-G		
W-BK-O		
W-BK-BR		
W-G		
W-BL		
W-Y		
W-BR		
W-BK		
W-R		

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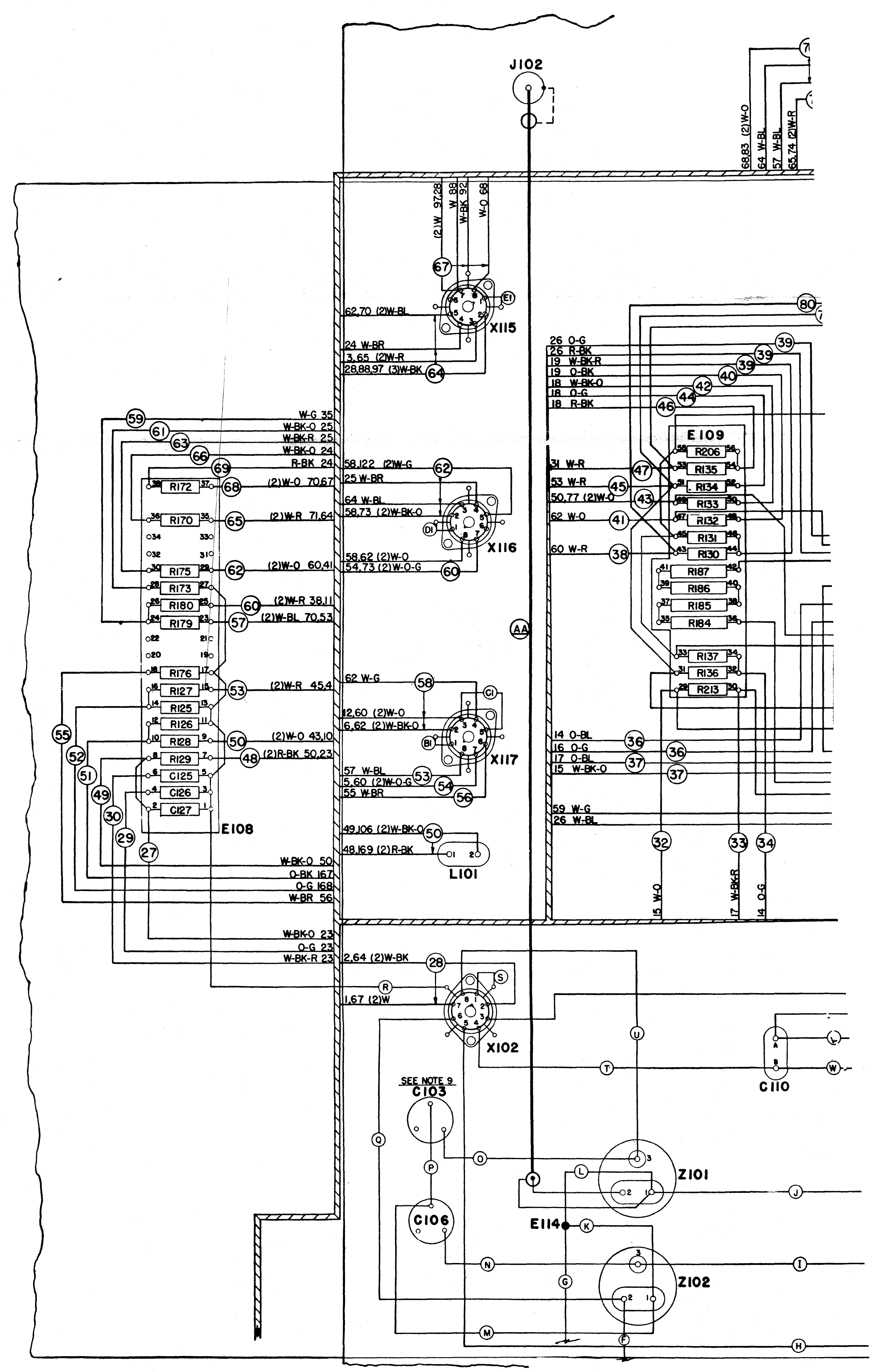
J102
X115
X116
X117
E108
E109
L101
X102
SEE NOTE 9
C103
C106
Z101
Z102
E114
C110
R172
R170
R175
R173
R180
R179
R176
R127
R125
R126
R128
R129
C125
C126
C127
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R184
R137
R136
R213

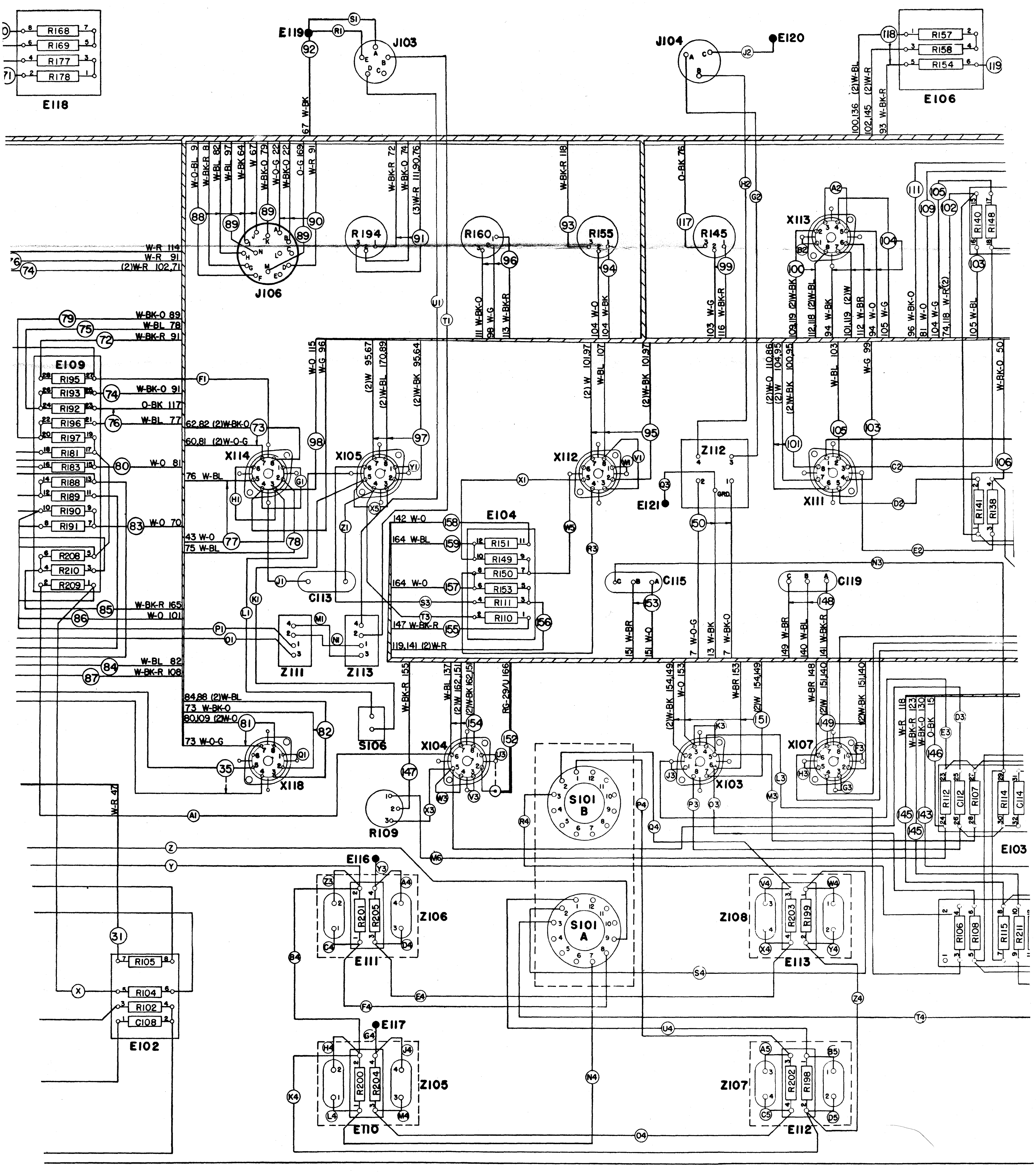
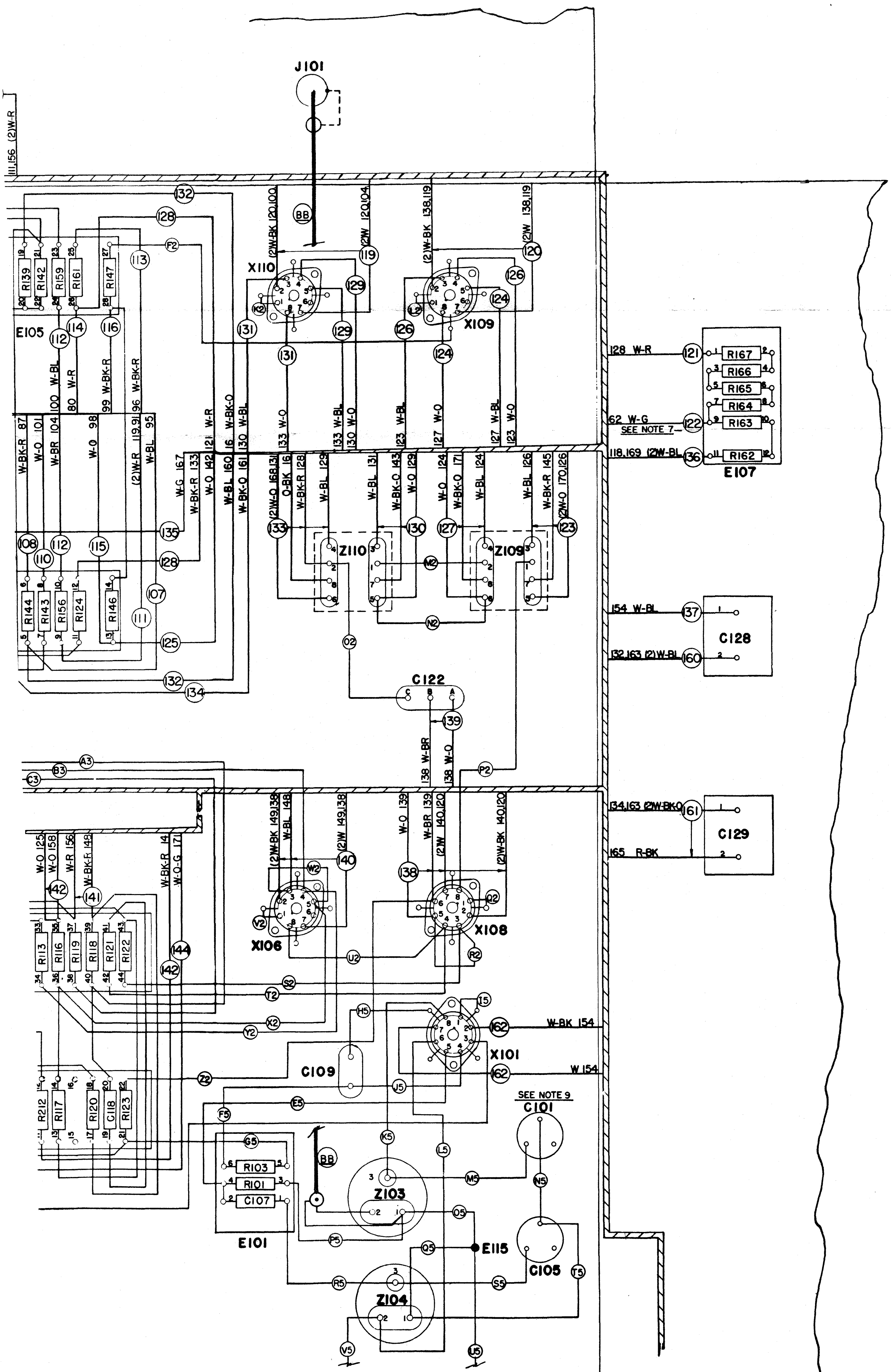


Figure 65. Dual Diversity Convert



'ers CV–31A/TRA–7 and CV–31B/TRA–7, basic main unit chassis wiring diagram.

STATION	APPARATUS DESIGNATION	TERMINAL	DESCRIPTION
1	E301	1	W (16 GA. WIRE)
2	"	2	W-BK "
3	"	3	W-R (22 GA. WIRE)
4	"	4	W-R "
5	"	5	W-O-G (16 GA. WIRE)
6	"	6	W-BK-O "
7	"	7	" (22 GA. WIRE)
"	"	8	W-O-G "
8	"	9	W-BK-R (22 GA. WIRE)
9	"	10	W-O-BL "
10	"	11	W-O "
11	"	12	W-R "
12	"	13	W-O "
13	"	14	W-BK "
14	S105	1B	W-BK-R "
"	"	2	O-G "
"	"	3	O-BL "
15	"	4	W-BK-O "
"	"	5	O-BK "
"	"	6	W-O "
16	"	1A	O-BK "
"	"	2	W-BK-O "
"	"	3	O-G "
17	"	4	O-BL "
"	"	5	W-BK "
"	"	6	W-BK-R "
18	"	7	R-BK "
"	"	8	O-G "
"	"	9	W-BK-O "
19	"	10	O-BK "
"	"	11	W-BK-R "
"	"	12	R-BK "
20	"	11B	W-BK "
"	"	12	O-G "
21	M102	+	R-BK "
"	"	–	O-G "
22	J105		W-BK-O "
"	"		W-O-G "
23	S103	4	R-BK "
"	"	1	W-BK-O "
"	"	2	O-G "
"	"	5	W-BK-R "
24	R171	1	R-BK "
"	"	2	W-BR "
"	"	3	W-BK-O "
25	R174	1	W-BK-R "
"	"	2	W-BR "
"	"	3	W-BK-O "
26	R182	1	R-BK "
"	"	2	W-BL "
"	"	3	O-G "
27	E108	2	W-BK-O "
28	X102	2	(2)W-BK (16 GA. WIRE)
"	"	7	(2)W "
29	E108	4	O-G (22 GA. WIRE)
30	"	6	W-BK-R "
31	E102	7	W-R "
32	E109	29	W-O "
33	"	30	W-BK-R "
34	"	32	O-G "
35	X118	4	W-BL "
"	"	5	W-G "
36	E109	8	O-G "
"	"	10	O-BL "
37	"	11	" "
"	"	13	W-BK-O "
38	"	43	W-R "
39	"	16	R-BK "
"	"	18	O-G "
"	"	44	W-BK-R "
40	"	48	O-BK "
41	"	47	W-O "
42	"	50	W-BK-O "
43	"	49	(2)W-O "
44	"	52	O-G "
45	"	51	W-R "
46	"	54	R-BK "
47	"	53	W-R "
48	E108	7	R-BK "
49	"	8	W-BK-O "
50	"	9	W-O (2) "
"	L101	1	(2)R-BK "
"	"	2	(2)W-BK-O "
51	E108	10	O-BK "
52	"	14	O-G "
53	"	15	(2)W-R "
"	X117	8	W-BL "
54	"	7	(2)W-O-G (16 GA. WIRE)
55	E108	18	W-BR (22 GA. WIRE)
56	X117	6	W-BR "
57	E108	23	(2)W-BL "
58	X117	2	(2)W-BK-O (16 GA. WIRE)
"	"	3	(2)W-O (22 GA. WIRE)
"	"	4	W-G "
59	E108	24	" "
60	"	25	(2)W-R "
"	X116	7	(2)W-O-G (16 GA. WIRE)
"	"	8	(2)W-O (22 GA. WIRE)
61	E108	28	W-BK-O "
62	"	29	(2)W-O "
"	X116	2	(2)W-BK-O (16 GA. WIRE)
"	"	3	W-BL (22 GA. WIRE)
"	"	4	W-BR "
"	"	5	(2)W-G "

CABLE WIRE TABLE

STATION	APPARATUS DESIGNATION	TERMINAL	DESCRIPTION
63	E108	30	W-BK-R (22 GA. WIRE)
64	X115	2	(3)W-BK (16 GA. WIRE)
"	"	3	(2) W-R (22 GA. WIRE)
"	"	4	W-BR "
"	"	5	(2)W-BL "
65	E108	35	(2)W-R "
66	"	36	W-BK-O "
67	X115	7	(3) W (16 GA. WIRE)
"	"	8	W-O (22 GA. WIRE)
"	"	GRD.	W-BK "
68	E108	37	(2)W-O "
69	"	38	R-BK "
70	E118	6	W-BL "
"	"	8	(2)W-O "
"	"	4	W-BL "
71	"	2	(2) W-R "
72	E109	28	W-BK-R "
73	X114	7	(2)W-O-G (16 GA. WIRE)
"	"	8	(2)W-BK-O "
74	E109	25	W-BK-O (22 GA. WIRE)
"	"	53	(2)W-R "
75	"	24	W-BL "
76	"	21	" "
"	"	23	O-BK "
"	"	51	W-R "
77	X114	3	W-O "
"	"	5	W-BL "
78	"	2	" "
79	E109	20	W-BK-O "
80	"	15	W-O "
"	"	43	W-R "
81	X118	7	W-O-G (16 GA. WIRE)
"	"	8	(2)W-O (22 GA. WIRE)
82	"	2	W-BK-O (16 GA. WIRE)
"	"	3	(2)W-BL (22 GA. WIRE)
83	E109	7	W-O "
84	"	36	W-BL "
85	"	4	W-BK-R "
86	"	29	W-O "
87	"	30	W-BK-R "
88	J106	F	W-O-BL "
"	"	G	W-BK-R "
"	"	H	W-BL "
"	"	I	W-BK (16 GA. WIRE)
"	"	J	W "
89	"	K	W-BK-O (22 GA. WIRE)
"	"	M	O-G "
"	"	N	W-BL "
90	"	A	W-O-G "
"	"	B	W-BK-O "
"	"	D	W-R "
91	R194	1	W-BK-R "
"	"	2	W-BK-O "
"	"	3	(3)W-R "
92	E119	GRD.	W-BK "
93	R155	3	W-BK-R "
94	"	1	W-BK "
"	"	2	W-O "
95	X112	2	(2)W-BK (16 GA. WIRE)
"	"	7	(2)W "
"	"	8	W-BL (22 GA. WIRE)
96	R160	1	W-BK-R "
"	"	2	W-G "
"	"	3	W-BK-O "
97	X105	2	(2)W-BK (16 GA. WIRE)
"	"	7	(2)W "
"	"	8	(2)W-BL (22 GA. WIRE)
98	X114	3	W-O "
"	"	4	W-G "
99	R145	1	W-BK-R "
"	"	2	W-G "
100	X113	2	(2)W-BK (16 GA. WIRE)
"	"	8	(2)W-BL (22 GA. WIRE)
101	X111	6	(2)W-O "
"	"	7	(2)W (16 GA. WIRE)
"	"	8	(2) W-BK "
102	E105	15	(2)W-R (22 GA. WIRE)
103	"	16	W-BL "
"	X111	4	W-G "
104	X113	4	" "
"	"	5	W-O "
"	"	6	W-BR "
"	"	7	(2)W (16 GA. WIRE)
"	"	GRD.	W-BK (22 GA. WIRE)
105	E105	17	W-G "
"	X111	2	W-BL "
106	E105	4	W-BK-O "
107	"	5	W-BL "
108	"	6	W-BK-R "
109	"	21	W-O "
110	"	8	" "
111	"	23	W-BK-O "
"	"	9	(2)W-R "
112	"	10	W-BR "
"	"	24	W-BL "
113	"	25	W-BK-R "
114	"	26	W-R "
115	"	13	W-O "
116	"	28	W-BK-R "
117	R145	3	O-BK "
118	E106	1	(2)W-BL "
"	"	3	(2)W-R "
"	"	5	W-BK-R "

STATION	APPARATUS DESIGNATION	TERMINAL	DESCRIPTION
119	X110	2	(2)W-BK (16 GA. WIRE)
"	"	7	(2)W "
"	E106	6	(2)W-R (22 GA. WIRE)
120	X109	2	(2)W-BK (16 GA. WIRE)
"	"	7	(2)W "
121	E107	1	W-R (22 GA. WIRE)
122	"	SEE NOTE 7	W-G "
123	Z109	3	W-BL "
"	"	7	W-BK-R "
"	"	5	(2)W-O "
124	X109	5	W-BL "
"	"	8	W-O "
125	E105	13	" "
126	X109	3	W-BL "
"	"	4	W-O "
127	Z109	4	W-BL "
"	"	8	W-BK-O "
"	"	6	W-O "
128	E105	12	W-BK-R "
"	"	26	W-R "
129	X110	4	W-O "
"	"	5	W-BL "
130	Z110	3	" "
"	"	7	W-BK-O "
"	"	5	W-O "
			"
131	X110	3	W-BL "
"	"	8	W-O "
132	E105	5	W-BL "
"	"	19	W-BK-O "
133	Z110	4	W-BL "
"	"	2	W-BK-R "
"	"	8	O-BK "
"	"	6	(2)W-O "
134	E105	4	W-BK-O "
135	X111	1	W-G "
136	E107	11	(2)W-BL "
137	C128	1	W-BL "
138	X108	2	(2)W-BK (16 GA. WIRE)
"	"	5	W-O (22 GA. WIRE)
"	"	6	W-BR "
"	"	7	(2)W (16 GA. WIRE)
139	C122	A	W-O (22 GA. WIRE)
"	"	B	W-BR "
140	X106	2	(2)W-BK (16 GA. WIRE)
"	"	3	W-BL (22 GA WIRE)
"	"	7	(2)W (16 GA. WIRE)
141	E103	37	W-R (22 GA. WIRE)
"	"	39	W-BK-R "
142	"	11	" "
"	"	35	(2)W-O "
143	"	12	W-BK-O "
144	"	9	W-O-G "
145	"	8	W-R "
"	"	10	W-BK-R "
146	"	24	O-BK "
147	R109	2	W-BK-R "
148	C119	A	" "
"	"	B	W-BL "
"	"	C	W-BR "
149	X107	2	(2)W-BK (16 GA. WIRE)
"	"	6	W-BR (22 GA. WIRE)
"	"	7	(2) W (16 GA. WIRE)
150	Z112	2	W-O-G (22 GA. WIRE)
"	"	1	W-BK-O "
"	"	GRD.	W-BK (22 GA. WIRE)
151	X103	2	(2)W-BK (16 GA. WIRE)
"	"	3	W-O (22 GA. WIRE)
"	"	6	W-BR "
"	"	7	(2)W (16 GA. WIRE)
152	X104	2 & GRD.	RG-29/U (COAXIAL CABLE)
153	C115	A	W-O (22 GA. WIRE)
"	"	B	W-BR "
154	X104	6	W-BL "
"	"	7	(2)W (16 GA. WIRE)
"	"	8	(2)W-BK "
155	E104	1	W-BK-R (22 GA. WIRE)
156	"	3	(2)W-R "
157	"	6	W-O "
158	"	11	" "
159	"	12	W-BL "
160	C128	2	(2)W-BL "
161	C129	1	W-BK-O (2) "
"	"	2	R-BK "
162	X101	2	W-BK (16 GA. WIRE)
"	"	7	W "
163	S104	1	W-BL (22 GA. WIRE)
"	"	2	W-BK-R "
"	"	3	W-BK-O "
164	R152	1	W-O "
"	"	3	W-BL "
165	R207	1	W-BK-R "
"	"	3	R-BK "
166	"	2	RG-29/U (COAXIAL CABLE)
167	S102	10B	O-BK (22 GA. WIRE)
"	"	11 B	W-G "
168	"	8 A	W-O "
"	"	9 B	O-G "
169	"	5 A	R-BK "
"	"	4 B	O-G "
"	"	5 B	W-BL "
"	"	7 B	W-BK-R "
170	"	2 A	W-O "
"	"	2 B	W-BL "
171	M101	+	W-BK-O "
"	"	−	W-O-G "

NOTES

1. STATION NUMBERS SHOWN ARE FOR REFERENCE ONLY
2. JUMPER WIRE SYMBOLS ARE FOR REFERENCE ONLY.
3. RUN WIRE DIRECTLY FROM TERMINAL TO TERMINAL IN THE SHORTEST POSSIBLE MANNER WITH SUFFICIENT SLACK TO PREVENT BREAKING UNDER VIBRATIONS.
4. RUN WIRE LOOSE & DRESSED BACK AGAINST THE PANEL IN THE MOST CONVENIENT MANNER.
5. ALL STRAPS SHALL BE RUN AS SHORT & DIRECT AS POSSIBLE.
6. CARE SHALL BE TAKEN WHEN SOLDERING TO VACUUM TUBE SOCKETS THAT THE SOLDER DOES NOT RUN ON CONTACT SURFACES.
7. THE WHITE-GREEN WIRE AT STATION 122 CONNECTS TO TERMINAL AS REQUIRED AT THE TIME OF TEST.
8. ALL WIRES ARE STRANDED, EXCEPT BARE WIRES.
9. AFTER WIRING, BEND ROTOR LUG OUT SO THAT END CLEARS STATOR PLATES BY 3/16".
10. IN DUAL DIVERSITY CONVERTER CV-31A/TRA-7, SERIAL NUMBERS 203 THROUGH 209 ON ORDER NO. 11779-P-48, TERMINAL A OF FIXED CAPACITOR C131 IS CONNECTED TO TERMINAL 29 OF E103, AND TERMINAL B OF C131 IS CONNECTED TO TERMINAL C OF C122. IN OTHER SERIAL NUMBERS OF THIS MODEL, AND IN THE B MODEL, TERMINAL A OF CAPACITOR C131 IS CONNECTED TO A GROUND LUG ON SOCKET X111, TERMINAL B OF C131 IS CONNECTED TO TERMINAL C OF C122, AND TERMINAL C OF C131 IS CONNECTED TO TERMINAL 29 OF E103.
11. IN THE B MODEL, R214 AND R215 ARE ADDED BETWEEN PINS 4 AND GROUND OF V107 AND V108, RESPECTIVELY. BINDING POSTS E122, E123, AND E124, ARE CONNECTED AS FOLLOWS: TERM. A AND E OF J103; TERM. 2 OF Z113; AND TERM. 4 OF Z113.

JUMPER WIRE TABLE

WIRE SYMBOL	DESCRIPTION	NOTES
A	W-BK (22 GA. WIRE)	SEE NOTE 4
B	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
C	" "	"
D	" "	"
E	" "	"
F	W-O (22 GA. WIRE)	SEE NOTE 3
G	W-BK "	"
H	W-G "	"
I	" "	"
J	W-BK (22 GA. WIRE)	SEE NOTE 4
K	" "	"
L	" "	"
M	" "	"
N	W-G "	SEE NOTE 3
O	W-G (22 GA. WIRE)	SEE NOTE 3
P	W-BK "	SEE NOTE 4
Q	W-O "	SEE NOTE 3
R	W-BK "	"
S	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
T	W-BR (22 GA. WIRE)	SEE NOTE 3
U	W-G "	"
V	W-BK-R "	SEE NOTE 4
W	W-BR (22 GA. WIRE)	SEE NOTE 3
X	W-R "	SEE NOTE 4
Y	W-BK-R "	"
Z	W-BL (22 GA. WIRE)	SEE NOTE 4
A1	" "	"
B1	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
C1	W-O (22 GA. WIRE)	SEE NOTE 4
D1	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
E1	" "	"
F1	W-BK (22 GA. WIRE)	SEE NOTE 4
G1	W-G "	"
H1	" "	"
J1	W-BK "	SEE NOTE 3
K1	W-O "	"
L1	W-BK "	"
M1	O-G "	"
N1	O-BL "	"
O1	O-G "	"
P1	O-BL (22 GA. WIRE)	SEE NOTE 3
Q1	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
R1	W-BK (22 GA. WIRE)	SEE NOTE 3
S1	" "	"
T1	O-BL "	"
U1	O-G "	"
V1	W-BL "	"
W1	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
X1	W-BL (22 GA. WIRE)	SEE NOTE 4
Y1	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
Z1	W-G (22 GA. WIRE)	SEE NOTE 4
A2	W-O "	"
B2	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
C2	W-O (22 GA. WIRE)	SEE NOTE 4
D2	W-BL "	"
E2	W-BK "	SEE NOTE 3
F2	" "	SEE NOTE 4
G2	W-BK-O "	SEE NOTE 3
H2	W-O-G "	"
J2	W-BK (22 GA. WIRE)	SEE NOTE 3
K2	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
L2	" "	"
M2	W-BK-R (22 GA. WIRE)	SEE NOTE 3
N2	W-O (22 GA. WIRE)	SEE NOTE 3
O2	W-BK-R "	SEE NOTE 4
P2	W-BL "	"
Q2	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
R2	W-O (22 GA. WIRE)	SEE NOTE 3
S2	" "	"
T2	W-G "	"
U2	" "	"
V2	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
W2	W-BL (22 GA. WIRE)	SEE NOTE 3
X2	" "	"
Y2	W-O "	"
Z2	W-BR "	SEE NOTE 4
A3	W-BL "	SEE NOTE 3
B3	W-O "	"
C3	W-BR "	"
D3	W-BL "	"
E3	W-BK "	SEE NOTE 4
F3	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
G3	" "	"
H3	" "	"
J3	" "	"
K3	W-O (22 GA. WIRE)	SEE NOTE 4
L3	W-G "	SEE NOTE 3
M3	W-O "	SEE NOTE 4
N3	W-BK-R "	"
O3	W-BR "	"

WIRE SYMBOL	DESCRIPTION	NOTES
P3	W-BL (22 GA. WIRE)	SEE NOTE 3
Q3	W-BK "	"
R3	W-O "	SEE NOTE 4
S3	W-BR "	"
T3	W-G "	"
U3	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
V3	" "	"
W3	" "	"
X3	W-BL (22 GA. WIRE)	SEE NOTE 3
Y3	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
Z3	" "	"
A4	" "	"
B4	W-BK-R (22 GA. WIRE)	SEE NOTE 3
C4	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
D4	" "	"
E4	W-G (22 GA. WIRE)	SEE NOTE 3
F4	W-BL "	"
G4	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
H4	" "	"
J4	" "	"
K4	W-BK-R (22 GA. WIRE)	SEE NOTE 3
L4	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
M4	" "	"
N4	W-BL (22 GA WIRE)	SEE NOTE 3
O4	W-G "	"
P4	" "	"
Q4	" "	"
R4	" "	"
S4	W-BL "	"
T4	W-BL (22 GA. WIRE)	SEE NOTE 3
U4	" "	"
V4	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
W4	" "	"
X4	" "	"
Y4	" "	"
Z4	W-BK-R (22 GA. WIRE)	SEE NOTE 3
A5	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
B5	" "	"
C5	" "	"
D5	" "	"
E5	W-G (22 GA. WIRE)	SEE NOTE 3
F5	W-BR "	"
G5	W-R "	SEE NOTE 4
H5	W-BK "	"
I5	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
J5	W-BR (22 GA. WIRE)	SEE NOTE 3
K5	W-G "	"
L5	W-O "	"
M5	W-G "	"
N5	W-BK "	SEE NOTE 4
O5	" "	"
P5	" "	"
Q5	" "	"
R5	W-G "	SEE NOTE 3
S5	" "	"
T5	W-BK (22 GA. WIRE)	SEE NOTE 4
U5	" "	SEE NOTE 3
V5	W-O "	"
W5	W-BK "	"
X5	W-O "	SEE NOTE 3
Y5	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
Z5	" "	"
A6	" "	"
B6	" "	"
C6	BARE "	"
D6	" "	"
E6	W-BK (22 GA. WIRE)	SEE NOTE 4
F6	W-O "	"
G6	W-O "	"
H6	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
J6	" "	"
K6	" "	"
L6	" "	"
M6	O-BK (22 GA. WIRE)	SEE NOTE 4
AA	RG-29/U (COAXIAL CABLE)	
BB	RG-29/U (COAXIAL CABLE)	

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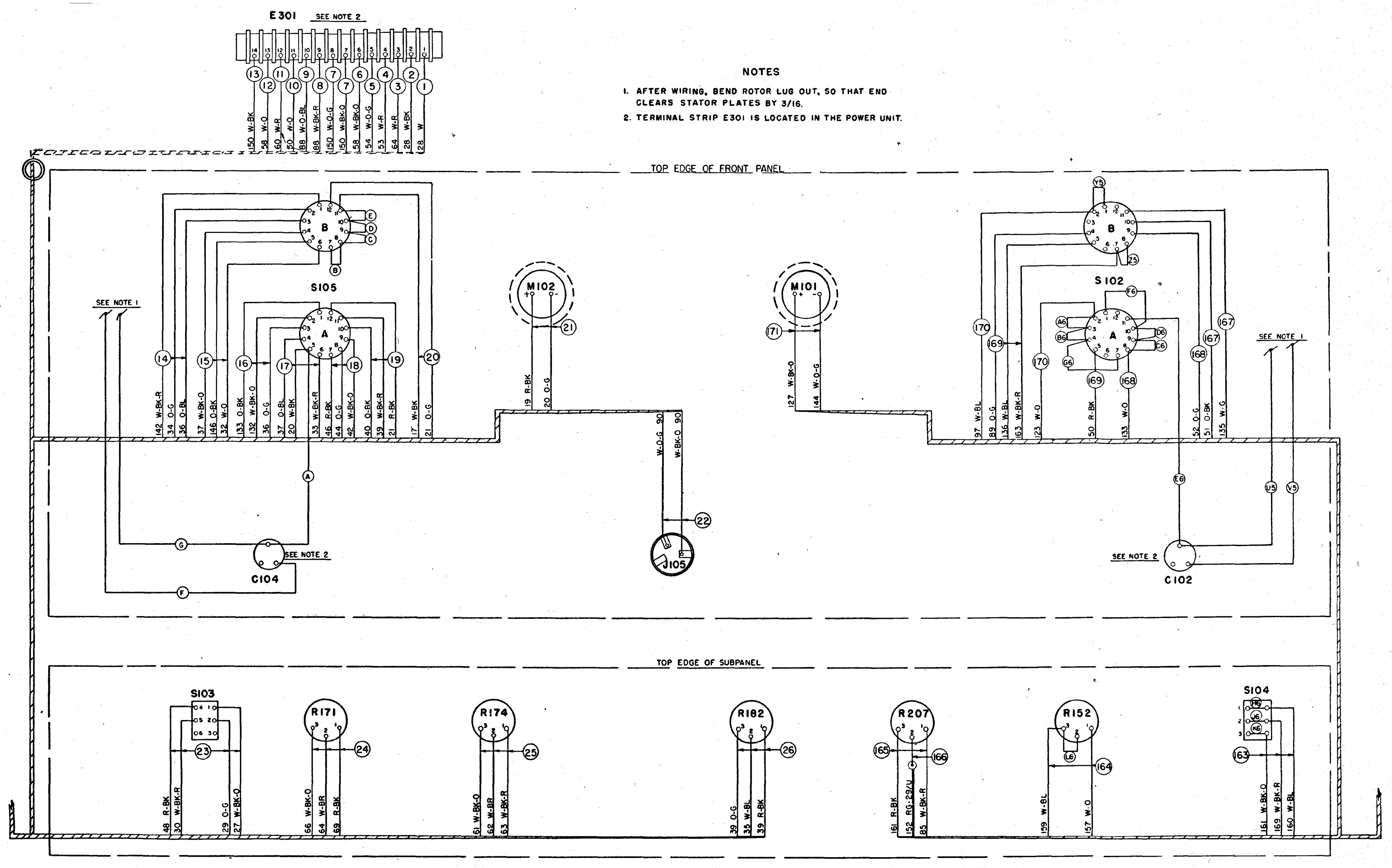
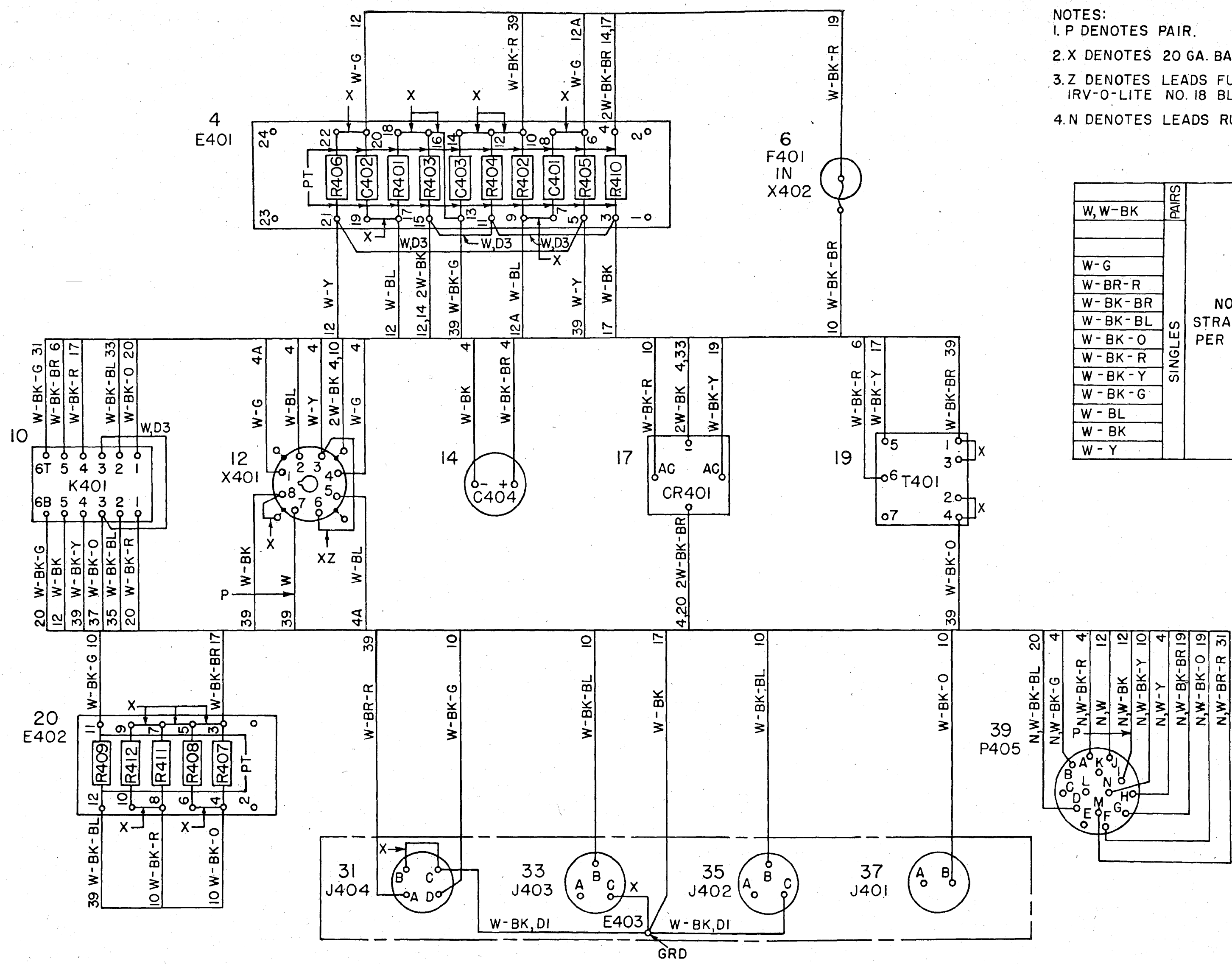


Figure 66. Dual Diversity Converters CV–31A/TRA–7 and CV–31B/TRA–7, basic unit front and control panels wiring diagram.



NOTES:
1. P DENOTES PAIR.
2. X DENOTES 20 GA. BARE TINNED STRAP WIRE.
3. Z DENOTES LEADS FURNISHED WITH IRV-O-LITE NO. 18 BLACK XTE-30 TUBING.
4. N DENOTES LEADS RUN IN SHIELD.

W, W-BK	PAIRS	NO. 22 GA. STRANDED WIRE PER KS-9819
W-G	SINGLES	
W-BR-R		
W-BK-BR		
W-BK-BL		
W-BK-O		
W-BK-R		
W-BK-Y		
W-BK-G		
W-BL		
W-BK		
W-Y		

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Figure 67. Oscillator O-41/TRA-7, wiring diagram.

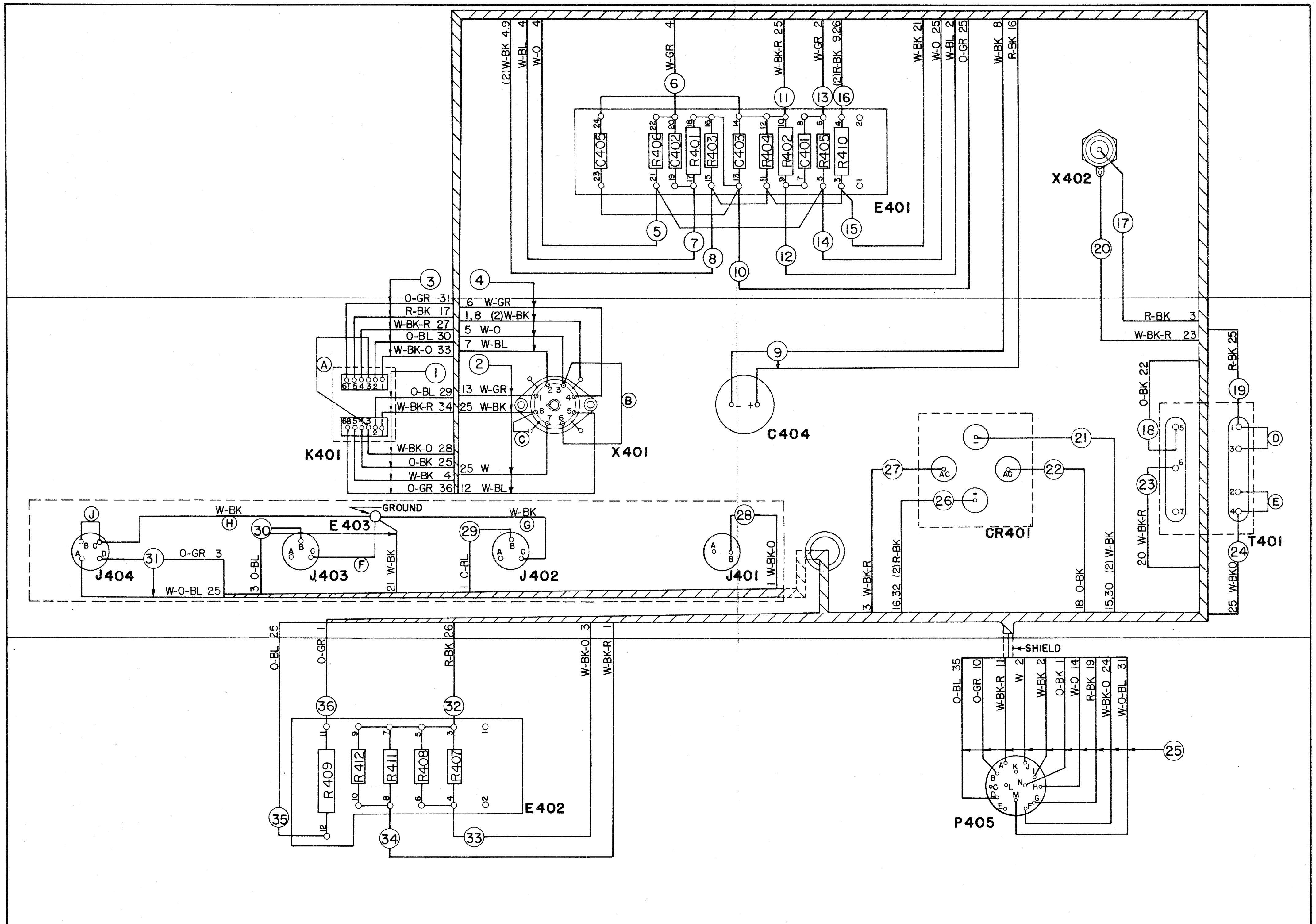

Figure 68. Oscillator O-41A/TRA-7, wiring diagram.

NOTES

1. STATION NUMBERS SHOWN ARE FOR REFERENCE ONLY.
2. JUMPER WIRE SYMBOLS ARE FOR REFERENCE ONLY.
3. RUN WIRE DIRECTLY FROM TERMINAL TO TERMINAL IN THE SHORTEST POSSIBLE MANNER WITH SUFFICIENT SLACK TO PREVENT BREAKING UNDER VIBRATIONS.
4. RUN WIRE LOOSE & DRESSED BACK AGAINST THE PANEL IN THE MOST CONVENIENT MANNER.
5. ALL STRAPS SHALL BE RUN AS SHORT & DIRECT AS POSSIBLE.
6. ALL WIRES ARE STRANDED, EXCEPT BARE WIRES.

JUMPER WIRE TABLE

WIRE SYMBOL	DESCRIPTION	NOTES
A	W-BK-O (22 GA. WIRE)	SEE NOTE 4
B	W-O "	SEE NOTE 3
C	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
D	" "	"
E	" "	"

WIRE SYMBOL	DESCRIPTION	NOTES
F	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
G	W-BK (16 GA. WIRE)	SEE NOTE 3
H	" "	"
J	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5

CABLE WIRE TABLE

STATION	APPARATUS DESIGNATION	TERMINAL	DESCRIPTION
1	K401	1B	W-BK-R (22 GA. WIRE)
"	"	2B	O-BL "
"	"	3B	W-BK-O "
"	"	4B	O-BK "
"	"	5B	W-BK (16 GA. WIRE)
"	"	6B	O-GR (22 GA. WIRE)
2	X401	1	W-GR "
"	"	5	W-BL "
"	"	7	W (16 GA. WIRE)
"	"	8	W-BK "
3	K401	1T	W-BK-O (22 GA. WIRE)
"	"	2T	O-BL "
"	"	4T	W-BK-R "
"	"	5T	R-BK "
"	"	6T	O-GR "
4	X401	2	W-BL "
"	"	3	W-O "
"	"	4	W-GR "
"	"	GRD.	(2)W-BK (16 GA. WIRE)
5	E401	21	W-O (22 GA. WIRE)
6	"	20	W-GR "
7	"	17	W-BL "
8	"	15	(2)W-BK (16 GA. WIRE)
9	C404	(−)	W-BK "
"	"	(+)	R-BK (22 GA. WIRE)
10	E401	13	O-GR "
11	"	10	W-BK-R "
12	"	9	W-BL "
13	"	6	W-GR "
14	"	5	W-O "
15	"	3	W-BK (16 GA. WIRE)

STATION	APPARATUS DESIGNATION	TERMINAL	DESCRIPTION
16	E401	4	(2)R-BK (22 GA. WIRE)
17	X402		R-BK "
18	T401	5	O-BK "
19	"	1	R-BK "
20	X402		W-BK-R "
21	CR401	(−)	(2)W-BK (16 GA. WIRE)
22	"	(AC)	O-BK (22 GA. WIRE)
23	T401	6	W-BK-R "
24	"	4	W-BK-O "
25	P405	A	W-BK-R "
"	"	B	O-GR "
"	"	D	O-BL "
"	"	F	W-BK-O "
"	"	G	R-BK "
"	"	H	W-O "
"	"	I	W-BK (16 GA. WIRE)
"	"	J	W "
"	"	M	W-O-BL (22 GA. WIRE)
"	"	N	O-BK "
26	CR401	(+)	(2)R-BK "
27	"	(AC)	W-BK-R "
28	J401	B	W-BK-O "
29	J402	B	O-BL "
30	J403	B	O-BL "
	E403	GRD.	W-BK (16 GA. WIRE)
31	J404	A	W-O-BL 22 GA. WIRE)
"	"	D	O-GR "
32	E402	3	R-BK "
33	"	4	W-BK-O "
34	"	8	W-BK-R "
35	"	12	O-BL "
36	"	11	O-GR "

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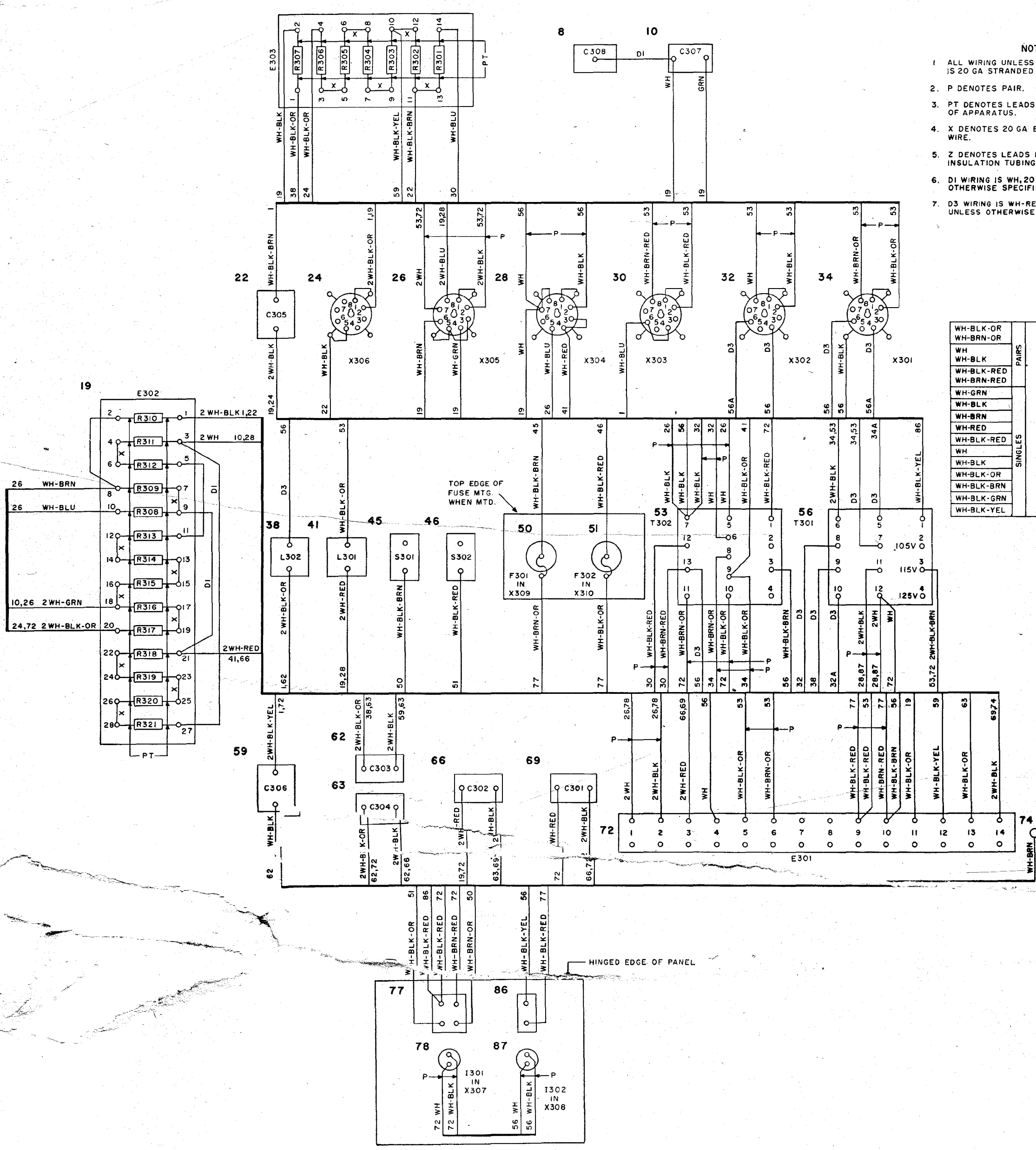
210961 O - 52 (Face p. 116)

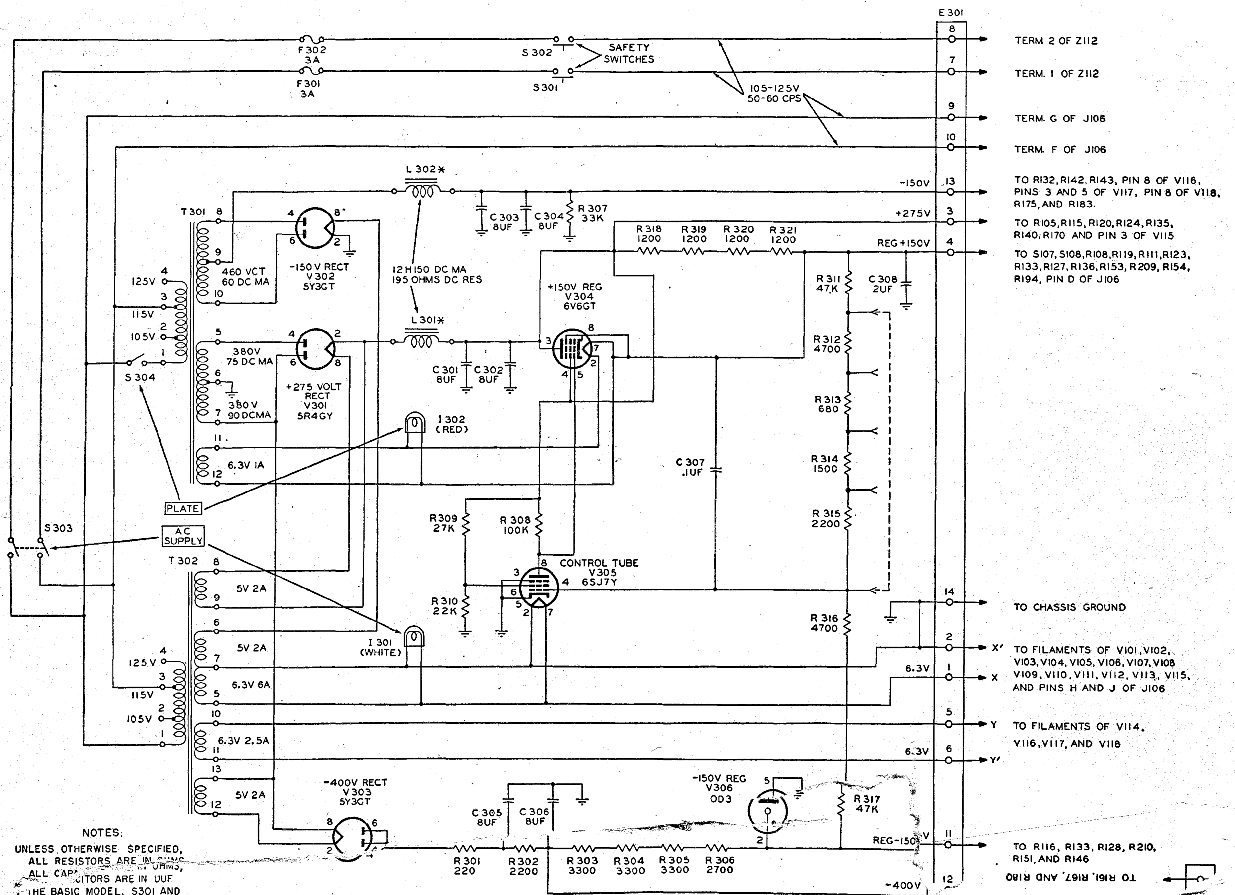


NOTES:

1. ALL WIRING UNLESS OTHERWISE SPECIFIED IS 20 GA STRANDED WIRE.
2. P DENOTES PAIR.
3. PT DENOTES LEADS FURNISHED AS PART OF APPARATUS.
4. X DENOTES 20 GA BARE TINNED STRAP WIRE.
5. Z DENOTES LEADS IS COVERED WITH INSULATION TUBING.
6. DI WIRING IS WH, 20 GA STRANDED UNLESS OTHERWISE SPECIFIED.
7. D3 WIRING IS WH-RED, 20 GA STRANDED UNLESS OTHERWISE SPECIFIED.

WH-BLK-OR WH-BRN-OR	PAIRS	NO. 20 GA STRANDED WIRE PER WE DWG KS-9819
WH WH-BLK		
WH-BLK-RED WH-BRN-RED		
WH-GRN	SINGLES	
WH-BLK		
WH-BRN		
WH-RED		
WH-BLK-RED		
WH		
WH-BLK		
WH-BLK-OR		
WH-BLK-BRN		
WH-BLK-GRN		
WH-BLK-YEL		

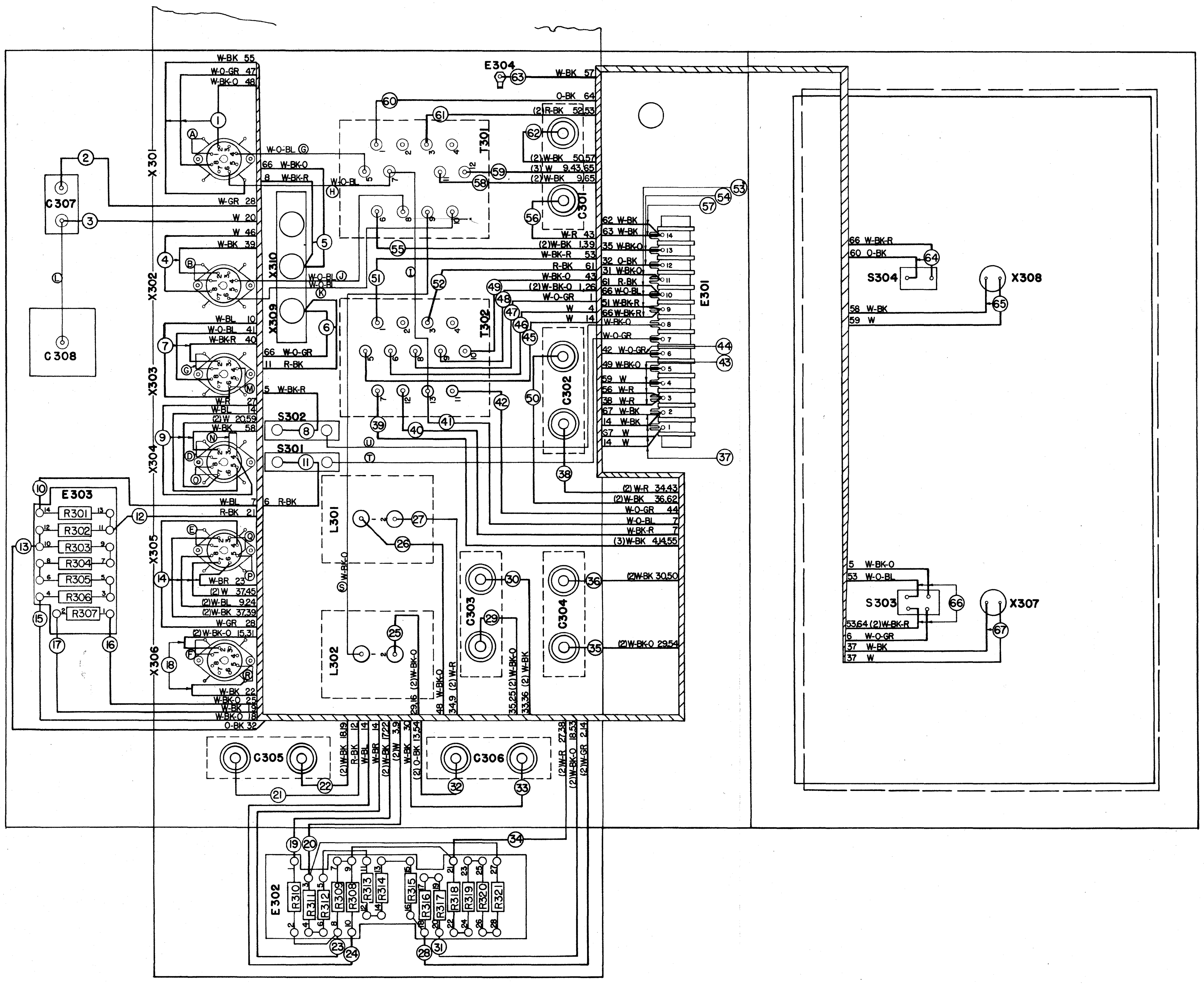
Figure 69. Rectifier Power Unit PP–193/TRA–7, used with basic model of converter; wiring diagram.



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS, ALL CAPACITORS ARE IN UUF [illegible]
2. IN THE BASIC MODEL, S301 AND S302 ARE CONNECTED DIRECTLY TO J104.
3. CONNECTIONS FROM TERMINAL BOARD E301 TERMINATE IN DUAL DIVERSITY CONVERTER CV-31(*)/TRA-7.
4. * 13H IN BASIC AND EARLY A MODELS.

Figure 73. Rectifier Power Units PP–193/TRA–7 and PP–193A/TRA–7, schematic diagram.



NOTES

1. STATION NUMBERS SHOWN ARE FOR REFERENCE ONLY.
2. JUMPER WIRE SYMBOLS ARE FOR REFERENCE ONLY.
3. RUN WIRE DIRECTLY FROM TERMINAL TO TERMINAL IN THE SHORTEST POSSIBLE MANNER WITH SUFFICIENT SLACK TO PREVENT BREAKING UNDER VIBRATIONS.
4. RUN WIRE LOOSE & DRESSED BACK AGAINST THE PANEL IN THE MOST CONVENIENT MANNER.
5. ALL STRAPS SHALL BE RUN AS SHORT & DIRECT AS POSSIBLE.
6. SHORT OUT THE NECESSARY RESISTORS (R312, R313, R314, R315 & R316) TO ADJUST REGULATED (+) 150 VOLT SUPPLY USE 20 GA. WIRE.
7. ALL WIRES ARE STRANDED, EXCEPT BARE WIRES.

CABLE WIRE TABLE

STATION	APPARATUS DESIGNATION	TERMINAL	DESCRIPTION
1	X301	2	W-BK-O (20 GA. WIRE)
"	"	8	W-O-GR "
"	"	GRD.	W-BK (16 GA. WIRE)
2	C307		W-GR (20 GA. WIRE)
3	"		W (16 GA. WIRE)
4	X302	2	W-BK "
"	"	8	W "
5	X310		W-BK-O (20 GA. WIRE)
"	X310		W-BK-R "
6	X309		W-O-GR "
"	"		R-BK "
7	X303	8	W-O-BL "
"	"	2	W-BK-R "
"	"	6	W-BL "
8	S302		W-BK-R "
9	X304	7	(2) W (16 GA. WIRE)
"	"	2	W-BK "
"	"	4	W-R (20 GA. WIRE)
"	"	5	W-BL "
10	E303	14	W-BL "
11	S301		R-BK "
12	E303	11	R-BK "
13	"	10	O-BK "
14	X305	2	(2)W-BK (16 GA. WIRE)
"	"	7	(2)W "
"	"	4	W-GR (20 GA. WIRE)
"	"	6	W-BR "
"	"	8	(2)W-BL "
15	E303	4	W-BK-O "
16	"	1	W-BK-O "
17	"	2	W-BK (16 GA. WIRE)
18	X306	2	(2)W-BK-O (20 GA. WIRE)
"	"	GRD.	W-BK (16 GA. WIRE)
19	E302	1	(2)W-BK "
20	"	3	(2)W "
21	C305		R-BK (20 GA. WIRE)
22	"		(2)W-BK (16 GA. WIRE)
23	E302	8	W-BR (20 GA. WIRE)
24	"	10	W-BL "
25	L302	2	(2)W-BK-O "
26	L301	1	W-BK-O "
27	L301	2	(2) W-R "
28	E302	18	(2)W-GR "
29	C303		(2)W-BK-O "
30	"		(2)W-BK (16 GA. WIRE)
31	E302	20	(2)W-BK-O (20 GA. WIRE)
32	C306		(2) O-BK "
33	"		W-BK (16 GA. WIRE)

STATION	APPARATUS DESIGNATION	TERMINAL	DESCRIPTION
34	E302	21	(2)W-R (20 GA. WIRE)
35	C304		(2)W-BK-O "
36	C304		(2)W-BK (16 GA. WIRE)
37	E301	1	(2)W "
"	"	2	(2) W-BK "
38	C302		(2) W-R (20 GA. WIRE)
39	T302	7	(3) W-BK (16 GA. WIRE)
40	"	12	W-BK-R (20 GA. WIRE)
41	"	13	W-O-BL "
42	"	11	W-O-GR "
43	E301	3	(2) W-R "
"	"	4	W (16 GA. WIRE)
"	"	5	W-BK-O (20 GA. WIRE)
44	"	6	W-O-GR "
45	T302	5	W (16 GA. WIRE)
46	"	6	W "
47	"	8	W-O-GR (20 GA. WIRE)
48	"	9	(2)W-BK-O "
49	"	10	W-BK-O "
50	C302		(2)W-BK (16 GA. WIRE)
51	T302	1	W-BK-R (20 GA. WIRE)
52	"	3	R-BK "
53	E301	9	(2)W-BK-R "
"	"	10	W-O-BL "
"	"	10	R-BK
"	"	11	W-BK-O
54	"	12	O-BK
54	"	13	W-BK-O "
55	T301	6	(2)W-BK (16 GA. WIRE)
56	C301		W-R (20 GA. WIRE)
57	E301	14	(2)W-BK (16 GA. WIRE)
58	T301	11	(2)W-BK "
59	"	12	(3)W "
60	"	1	O-BK (20 GA. WIRE)
61	"	3	(2)R-BK "
62	C301		(2)W-BK (16 GA. WIRE)
63	E304		W-BK "
64	S304		O-BK (20 GA. WIRE)
"	"		W-BK-R (")
65	X308		W (16 GA. WIRE)
"	"		W-BK "
66	S303		W-BK-O (20 GA. WIRE)
"	"		(2)W-BK-R "
"	"		W-O-BL "
"	"		W-O-GR "
67	X307		W (16 GA. WIRE)
"	"		W-BK "

JUMPER WIRE TABLE

WIRE SYMBOL	DESCRIPTION	NOTES
A	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
B	" "	"
C	" "	"
D	" "	"
E	" "	"
F	" "	"
G	W-O-BL (20 GA. WIRE)	SEE NOTE 4
H	" "	"
I	" "	"
J	" "	"
K	" "	"

WIRE SYMBOL	DESCRIPTION	NOTES
L	W (16 GA. WIRE)	SEE NOTE 3
M	W-BL (20 GA. WIRE)	SEE NOTE 4
N	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
O	" "	"
P	" "	"
Q	W-BK (16 GA. WIRE)	SEE NOTE 4
R	BARE (20 GA. TINNED STRAP WIRE)	SEE NOTE 5
S	W-BK-O (20 GA. WIRE)	SEE NOTE 4
T	W-O-GR "	"
U	W-BK-O "	"
V	(AS REQ'D) "	SEE NOTE 6

TL72369S

Figure 70. Rectifier Power Unit PP-193/TRA-7, used with A model of converter wiring diagram.

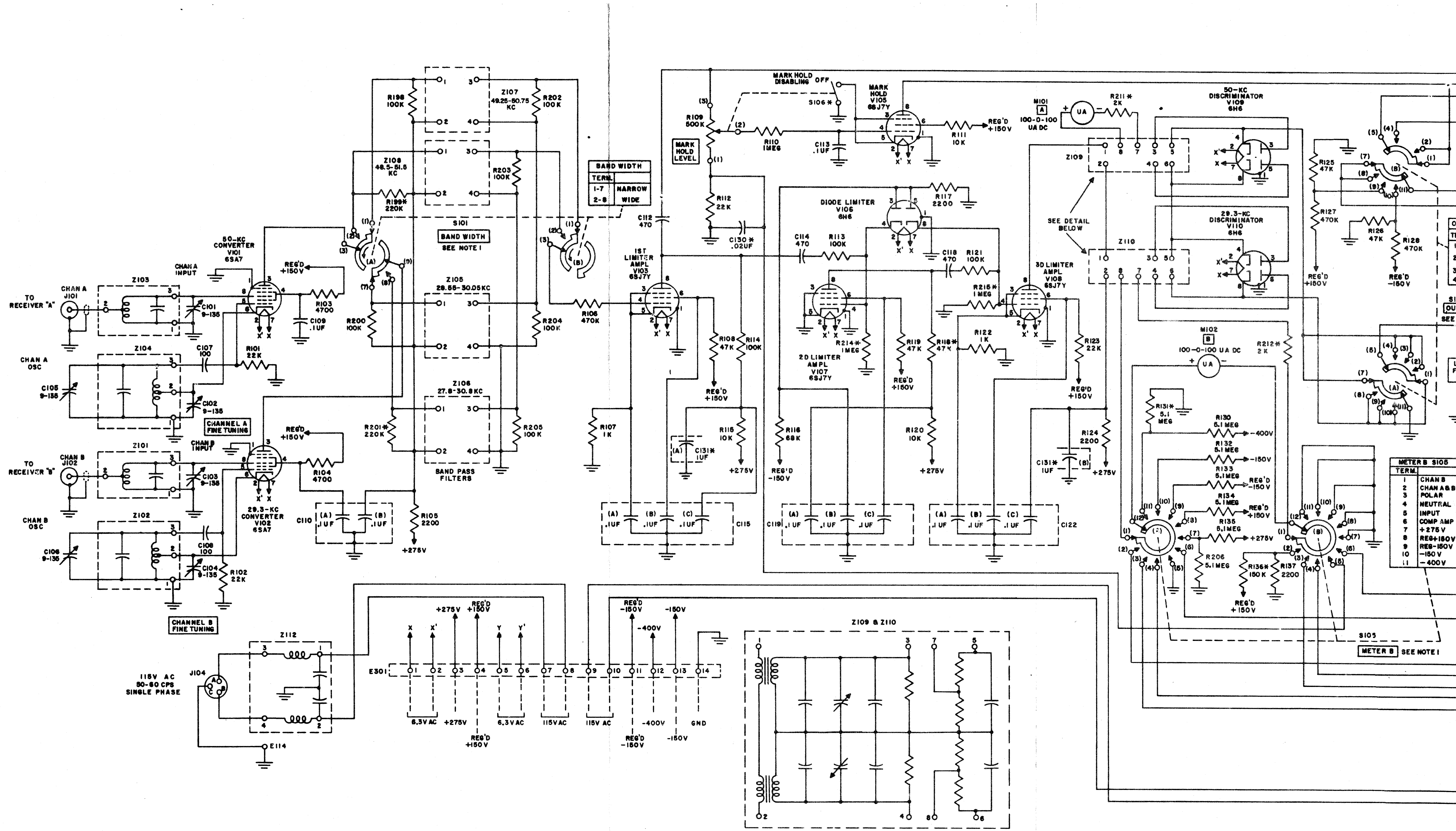
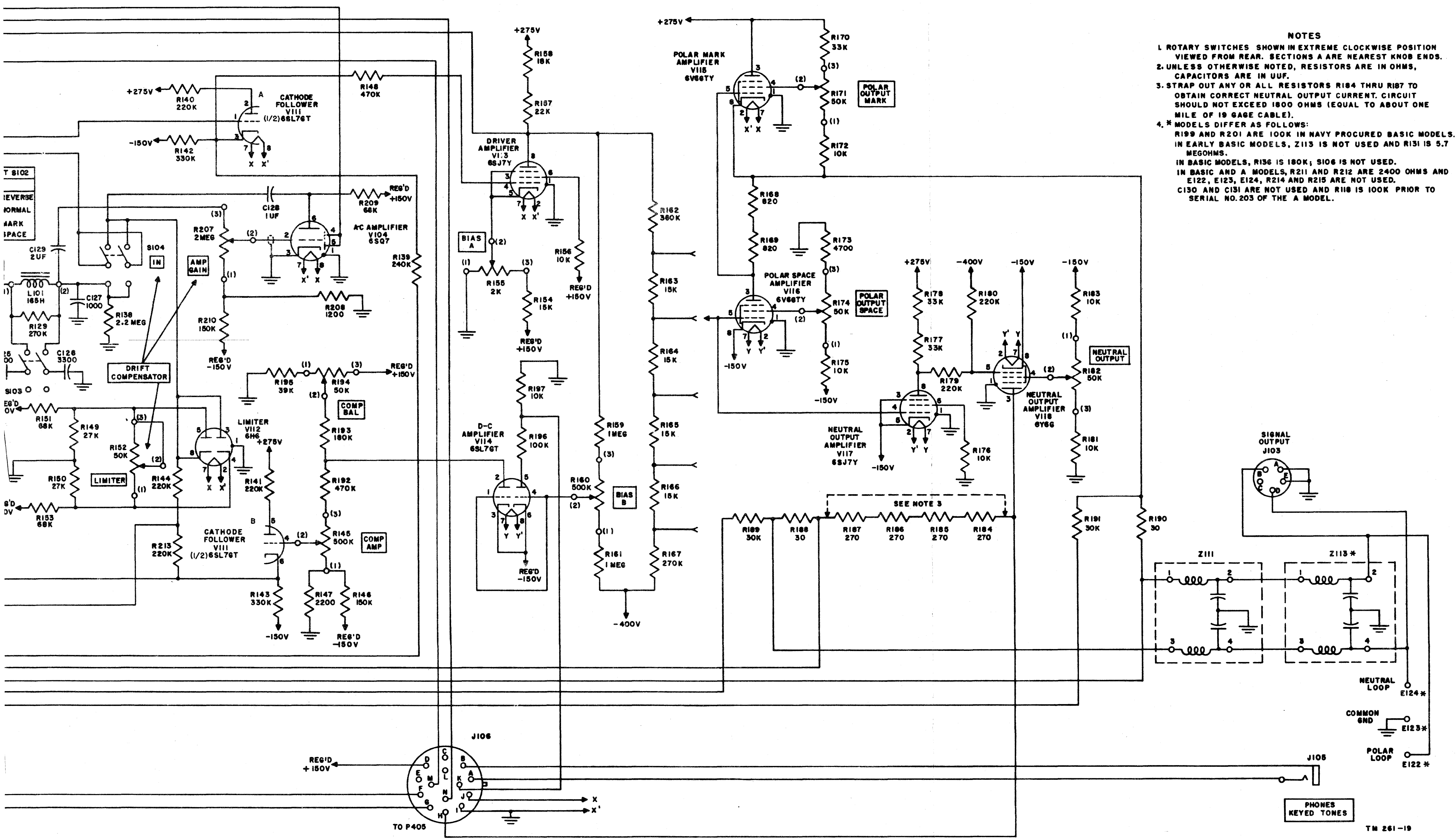


Figure 71. Dual Diversity Converters CV-31/TRA-7, CV-31A/TRA-



NOTES

1. ROTARY SWITCHES SHOWN IN EXTREME CLOCKWISE POSITION VIEWED FROM REAR. SECTIONS A ARE NEAREST KNOB ENDS.
2. UNLESS OTHERWISE NOTED, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
3. STRAP OUT ANY OR ALL RESISTORS R184 THRU R187 TO OBTAIN CORRECT NEUTRAL OUTPUT CURRENT. CIRCUIT SHOULD NOT EXCEED 1800 OHMS (EQUAL TO ABOUT ONE MILE OF 19 GAGE CABLE).
4. * MODELS DIFFER AS FOLLOWS:
   R199 AND R201 ARE 100K IN NAVY PROCURED BASIC MODELS.
   IN EARLY BASIC MODELS, Z113 IS NOT USED AND R131 IS 5.7 MEGOHMS.
   IN BASIC MODELS, R136 IS 180K; S106 IS NOT USED.
   IN BASIC AND A MODELS, R211 AND R212 ARE 2400 OHMS AND E122, E123, E124, R214 AND R215 ARE NOT USED.
   C130 AND C131 ARE NOT USED AND R118 IS 100K PRIOR TO SERIAL NO. 203 OF THE A MODEL.

, and *CV-31B/TRA-7, schematic diagram.*

NOTES:
1. ROTARY SWITCHES ARE SHOWN IN EXTREME CLOCKWISE POSITION VIEWED FROM REAR. SECTIONS DESIGNATED A ARE NEAREST KNOB END.
2. STRAP OUT RESISTORS R184 THRU R187, ONE AT A TIME, UNTIL THE REQUIRED NEUTRAL OUTPUT CURRENT IS OBTAINED. CIRCUIT SHOULD NOT EXCEED 1800 OHMS OR EQUIVALENT OF ABOUT 1 MILE OF 19 GAUGE WIRE.
3. UNLESS OTHERWISE SHOWN; RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
4. STRAP OUT R208 OR R216 TO SECURE PROPER A-C AMPL BIAS.
5. S107 AND S108 ARE MARKED DISABLING IN THE C MODEL.

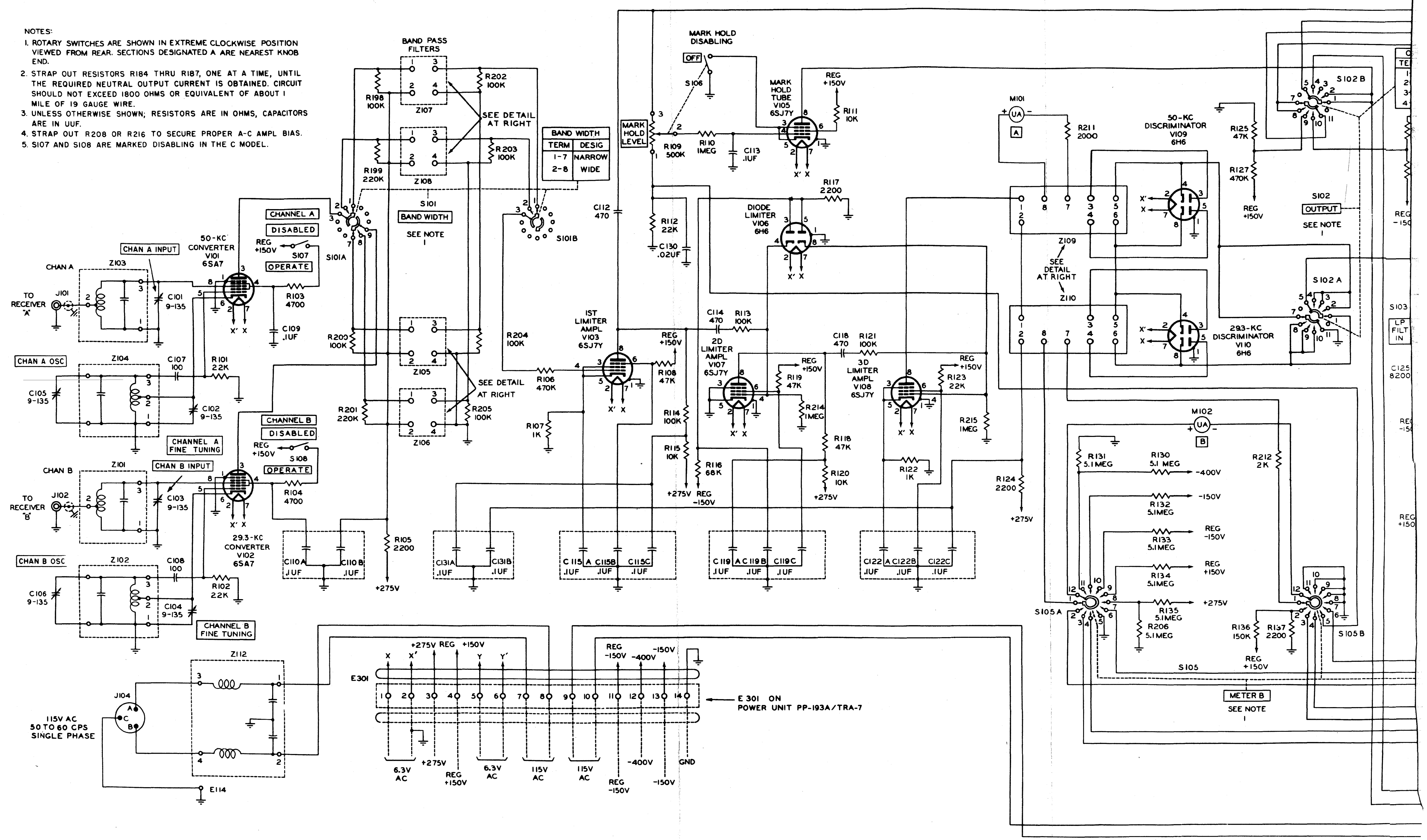
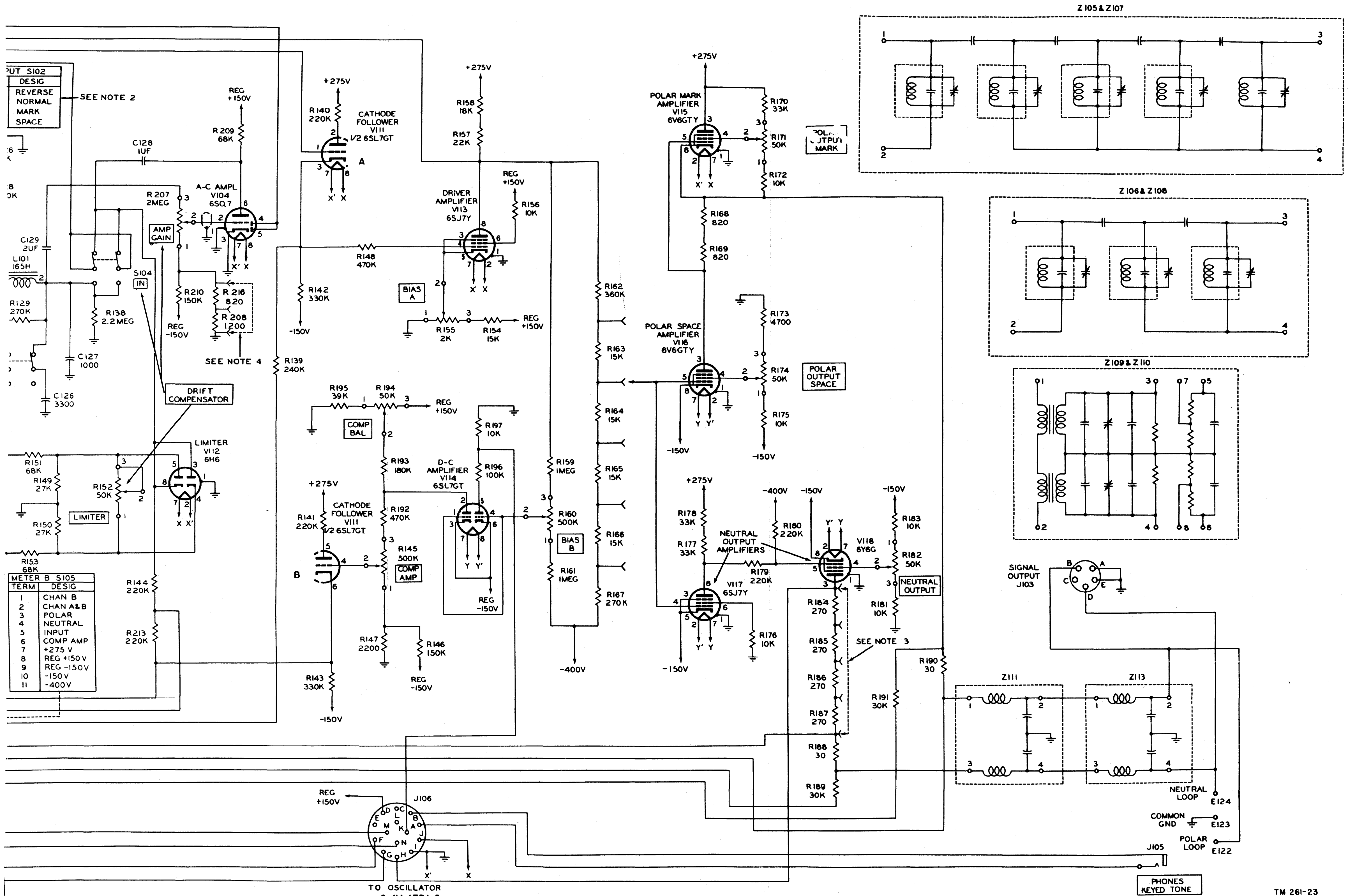
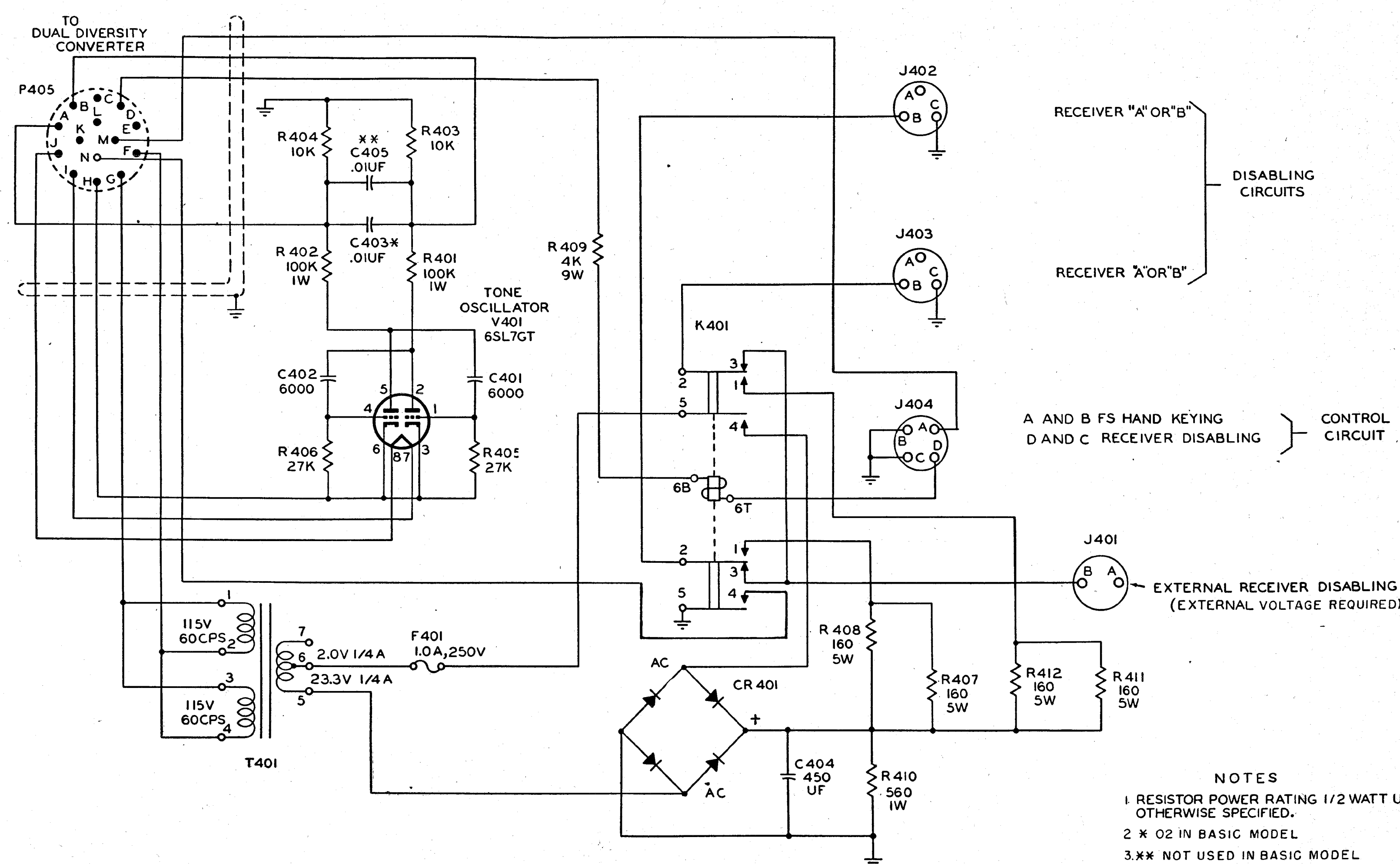


Figure 72. Dual Diversity Converters CV-31C/TRA-7 and



CV-31D/TRA-7, schematic diagram.



NOTES
1. RESISTOR POWER RATING 1/2 WATT UNLESS OTHERWISE SPECIFIED.
2 * 02 IN BASIC MODEL
3. ** NOT USED IN BASIC MODEL
4 UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF

TM 261-16

Figure 74. Oscillators O–41/TRA–7 and O–41A/TRA–7, schematic diagram.

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