TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

CONVERTERS, TELEPHONE SIGNAL CV-1548/G and CV-1548A/G

This copy is a reprint which includes current pages from Changes 1 through 4.

HEADQUARTERS, DEPARTMENT OF THE ARMY

31 AUGUST 1973

WARNING

HIGH VOLTAGE

is used in this equipment

DEATH ON CONTACT

MAY RESULT IF SAFETY PRECAUTIONS

ARE NOT OBSERVED

CAUTION

This equipment is transistorized. Do not make resistance measurement. Consult the maintenance section of this manual before making voltage or waveform measurements.

Change No. 4

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 15 June 1987

Direct Support and General Support Maintenance Manual CONVERTERS, TELEPHONE SIGNAL CV-15481G AND CV-1548A/G (NSN 5805-00-069-8795

TM 11-5805-367-34-5, 31 August 1973, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page. Added or revised illustrations are indicated by a vertical bar adjacent to the identification number.

Remove pages	*Insert pages*
i and ii	i and ii
3-1 and 3-2	3-1 and 3-2
None	3—2.1 and 3-2.2
Figure FO-14 ②	Figure FO-14 ②
Figure FO-14 ③	Figure FO-14 ③
Figure FO-14 ④	Figure FO-14 ④
Figure F-19 ①	Figure FO-19 ①

2. File this change sheet in front of the publication for reference purposes.

By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

Official:

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Change

No. 3

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DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL CONVERTERS, TELEPHONE SIGNAL CV-1548/G AND CV-1548A/G (NSN 5805-00-069-8795)

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Remove pages	*Insert pages*
i and ii	i and ii
1-1/(1-2 blank)	1-1/(1-2 blank)
2-1 and 2-2	2-1 and 2-2
None	2-2.1/(2-2.2 blank)
3-1 and 3-2	3-1 and 3-2
3-5 through 3-8	3-5 through 3-8
5-15 and 5-16	5-15 and 5-16
5-19 and 5-20	5-19 and 5-20
A-1	A-1(A-2 blank)

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CHANGE NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 25 June 1984

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL CONVERTERS, TELEPHONE SIGNAL CV-1548/G AND CV-1548A/G (5805-00-069-8795)

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2. New or changed material is indicated by a vertical bar in the margin.
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Remove pages	*Insert pages*
	A and B
i and ii	i through iii/(iv blank)
1-1	1-1/(1-2 blank)
2-1 and 2-2	2-1 and 2-2
3-1 and 3-2	3-1 and 3-2
3-5 through 3-8	3-5 through 3-8
4-1 through 4-4	4-1 through 4-4
5-1 through 5-6	5-1 through 5-6
5-9 through 5-14	5-9 through 5-14.5/(5-14.6 blank)
5-15 and 5-16	5-15 and 5-16
A-1	A-1
None	FO-9.1
FO-10	FO-10
FO-12	FO-12
None	FO-15.1
FO-16	FO-16

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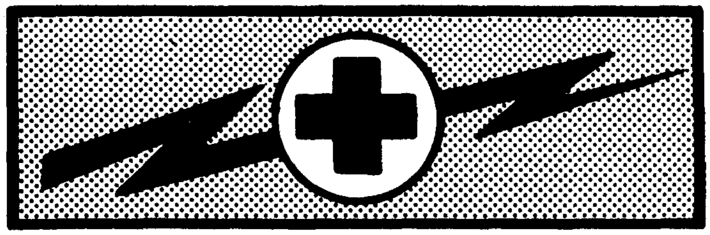
WARNING



WARNING

HIGH VOLTAGE

IS USED IN THE OPERATION OF THIS EQUIPMENT

DEATH ON CONTACT

MAY RESULT IF PERSONNEL FAIL TO OBSERVE SAFETY PRECAUTIONS

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When the technician is aided by operators, a warning must be issued about dangerous areas.

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Take particular care to ground every capacitor iikely to hold a dangerous potential. When working inside the equip ment, after the power has been turned off, always ground every part before touching it.

Be careful not to contact high-voltage connections of 115 volt ac input connections when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

WARNING Do not be misled by the term “low voltage”. Potentials as low as 50 volts may cause death under adverse conditions.

For Artificial Respiration, refer to FM 21-11.

5 SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

1. DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL

2. IF POSSIBLE, TURN OFF THE ELECTRICAL POWER

3. IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A WOODEN POLE OR A ROPE OR SOME OTHER INSULATING MATERIAL

4. SEND FOR HELP AS SOON AS POSSIBLE

5. AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION

TECHNICAL MANUAL
No. 11-5805-367-34-5

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, *31 August 1973*

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL
CONVERTER, TELEPHONE SIGNAL CV-1548/G AND CV-1548A/G
(NSN 5805-00-069-8795)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-ME-MP, Fort Monmouth, New Jersey 07703-5000. A reply will be sent to You.

*This manual supersedes TM 11-5805-367-35-5, 30 December 1966, including C1, 25 October 1968; C2, 23 December 1970; and C3, 8 February 1972.

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont)

LIST OF FOLDOUTS

CHAPTER 1

INTRODUCTION

1-1. Scope

a. This manual covers Converters, Telephone Signal CV-1548/G and CV-1548A/G. Due to the similarity of the CV-1548/G and CV-1548A/G, the official nomenclature and inclusion of ( ) is used to indicate both models of the equipment unless a specific model is designated.

b. This manual covers direct and general support maintenance for Converter, Telephone Signal CV-1548( )/G. It includes instructions for troubleshooting, testing, and repair of the CV-1548 ( )/G, and lists the tools, materials, and test equipment required for direct and general support maintenance.

c. The functioning of the CV-1548( )/G is covered in chapter 2. Familiarity with equipment, how it works, and why it works that way are valuable aids for troubleshooting the equipment rapidly and effectively.

1-2. Consolidated Index of Army Publications and Blank Forms

Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes or additional publications pertaining to the equipment.

1-3. Maintenance Forms, Records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750 as contained in Maintenance Management Update.

b. Report of Packaging and Handling Deficiencies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) and prescribed in AR 735-11-2/DLAR 4140.55 /NAVMATINST 4355.73B/AFR 400-54/MCO 4430.3H.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33C/AFR 75-18/MCOP4610.19D/DLAR 4500.15.

1-4. Administrative Storage

Administrative Storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the PMCS charts before storing. When removing the equipment from administrative storage the PMCS should be performed to assure operational readiness.

1-5. Destruction of Army Electronics Materiel

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

1-6. Reporting Equipment Improvement Recommendations (EIR)

If your Converters, Telephone Signal CV-1548\G and CV-1548A/G need improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to: Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-PA-MA-D, Fort Monmouth, New Jersey 07703-5000, We'll send you a reply.

CHAPTER 2

FUNCTIONING

2-1. General

a. The CV-1548/G and CV-1548A/G are similar except that the TEST ALIGN meter and meter selector switch are not installed on the CV-1 548A/G, and power supply assembly 18A1 is modified, changing its reference designation to 18A1A or 18A1B. If the modified power supplies are used in the CV-1548/G, the TEST ALIGN meter will not function and should not be used. In this manual, 18A1( ) applies to all models unless otherwise specified.

b. Power supply assembly 18A1, 18A1A and 18A1B are similar except that:

(1) Reference control (REF) is not used on the 18A1A or 18A1B power supply assembly.

(2) Test jacks (J1 and J2) monitor different power supply potentials.

c. The CV-1548( )/G utilizes circuit plug-in panels 18A3A and 18A3B which have similar characteristics and are interchangeable. In this manual, 18A3( ) applies to both panels unless a specific model is designated.

d. The CV-1548( )/G is used with multiplex equipment to provide signaling conversion and two-wire/four-wire interface facilities.

e. The CV-1548( )/G contains 12 independent two-way channels. One of two types (18A3( ) or 18A4) of circuit plug-in panels is used optionally in each channel. When using panel 18A3( ), the channel provides one way supervision or ring-down signaling conversion, and when using panel 18A4, the channel provides two-way plug supervision. Each channel supplies a hybrid for converting between two- and four-wire circuits, four-wire straight through patching and in addition, the 18A3( ) provides signaling mode selection. The CV-1548( )/G circuits are compatible with Manual Telephone Switchboard SB-86/P, Manual Telephone Central Office AN/TTC-7, and Telephone Sets TA-43/PT and TA-312/PT.

2-2. Block Diagram Analysis

a. The separate 12-channel circuits interfacing the multiplex equipment and the local voice frequency equipment is shown in figure FO-8. Each of the channels contains circuits similar to channel 1, which is shown in detail. When switch S1 is operated to 4W, the four-wire voice frequency equipment is connected straight through to the multiplex equipment, and no signaling or two-to-four wire conversion is performed by the CV-1548( )/G for a channel that is so connected. When switch S1 is operated to 2W, panel 18A3( ) or 18A4 interfaces the two-wire switchboard or telephone equipment with the four-wire circuits of the multiplex equipment. Panel 18A3( ) or 18A4 always provides two-to-four wire conversion for voice signals by means of a hybrid transformer. In addition, panel 18A3( ) provides three signaling options selectable by the mode selector switch. When the signaling mode switch is operated to AC, panel 18A3( ) provides conversion of 20-Hertz (Hz) loop signaling to 1,600-Hz signals used through the multiplex equipment for both originate and terminate calls. When the signaling mode switch is operated to OR, panel 18A3( ) permits orignate plug supervision. When the switch is operated to TE, panel 18A3( ) permits terminate plug supervision. Normal operation for plug supervision is one terminal set to OR, and the other terminal set to TE for a given channel. When the switch is operated to OFF, no provision is made for signaling. Panel 18A4 provides two-way conversion between plug supervision trunk direct-current (dc) switching signals and 1,600-Hz signaling through the multiplex equipment.

b. The CV-1548( )/G contains an internal power supply, contained in power supply assembly 18A1( ), that supplies the direct-current operating voltages required internally by the CV–1548( )/G and the signal battery voltage required by the 18A3( ) panel when in (OR) originate mode and the 18A4 panel for two-way plug supervision. Power supply assembly 18A1( ) produces three output voltages. The —24-volt dc output is used as the supply for the circuits of panels 18A2, 18A3( ), and 18A4. The +24-volt dc output is used as the supply for circuits of panel 18A2. The signal battery supply, a —30-volt dc output, is applied to the 18A3( ) and 18A4 panels to interface the switchboard for originate plug supervision signaling and two-way plug supervision signaling. The reference output of the 18A1 power supply assembly is an adjustable regulated voltage used by the meter circuit of the CV-1548/G to calibrate the TEST ALIGN meter in the 1,600-Hz position.

c. Panel 18A2 provides a 20-Hz and a 1,600-Hz oscillator circuit. Both oscillator outputs are applied to channel 1 through channel 12 connectors of panel 18A3( ) or 18A4. The 20-Hz signal is only used by the 18A3( ) panel for local ring signals when operated in the AC mode. The 1,600-Hz signal is sent through the multiplex system to convey ring or supervisory signals and also to test the 18A3( ) or 18A4 panel.

d. The metering circuits, located on the CV-1548/G chassis, monitor five critical voltages or signals selected by the selector switch. The monitored voltages are the positive and negative output voltages from power supply assembly 18A1, while the monitored signals are the 20- and 1,600-Hz signals of panel 18A2.

2-3. Circuit Analysis

NOTE

Power Supply 18A1, NSN 5805-00-935-2712 has been superseded by Power Supply 18A1B, NSN 6130-00-466-0158 and can be used in both the CV-1548/G and CV-1548A/G.

The difference between CV-1548/G and CV-1548A/G is that the CV-1548/G front panel contains a meter that monitors the referenced voltage of the 18A1 Power Supply, and the 1600 Hz, 20 Hz and 20 Hz drive of the 18A2 panel. The 18A1B Power Supply does not provide output monitoring capabilities. This change in design was incorporated since it was found that there is no need to monitor the referenced voltage of the 18A1 Power Supply and the 1600 Hz, 20 Hz and 20 Hz drive of the 18A2 Panel.

a. Power Supply Assembly 18Al ( ) (Fig. FO-9)

(1) Power supply assembly 18A1( ) converts 116-volt, 47- to 420-Hz ac input power to the dc power required by the CV-1548( )/G. The chart below lists the dc voltages provided by the power supply assembly, the terminals of connector J3 used for the different voltages, and the application of the various output voltages.

Voltage	Positive terminal	Negative terminal	Use
−30 volts	14	12	Provides signal battery power to panels 18A3 ( ) and 18A4.
−24 volts	14	4	Provides power for circuits on panels 18A2, 18A3 ( ), and 18A4.
+24 volts	6	14	Provides power for 20-Hz generator output circuit on panel 18A2.
*REF	14	11	Provides dc voltage adjustable between 0 and −6.2 volts for calibration of the CV-1548/G TEST ALIGN meter circuit when in the 1,600 ~ position.

*REF (reference) not used on the 18A1A or 18A1AB power supply assembly.

(2) The power supply contains two power transformers that apply their secondary voltages to bridge rectifiers. Shunt capacitors filter the dc output of the bridge rectifiers. Capacitors C7, C8, and C9 across the transformer secondaries function as radio-frequency interference (rfi) suppressers. The +24-volt output is fused. The reference voltage of power supply assembly 18A1 is developed across breakdown diode VR1, and resistor R3 permits the reference voltage level to be adjusted.

b. Panel 18A2 (Fig, FO-10), Panel 18A2 contains two separate circuits: a 1,600-Hz generator and a 20-Hz generator. The 1,600-Hz generator provides tone for ringing or plug supervision over the multiplex equipment. The 20-Hz generator provides the local 20-Hz ringing signal.

(1) *Typical transistor biasing circuit.* Figure 2-1 shows a typical transistor common emitter circuit configuration used in panels 18A2, 18A3( ), and 18A4. Voltage divider R3-R4 provides base bias voltage, resistor R1 determines the emitter current, and together they determine the transistor's operating point. Resistor R2 and capacitor C1 form the emitter circuit audio signal path. Resistor R2 is a gain determining component; capacitor C1 blocks the dc emitter bias current from resistor R2.

(2) *1,600-Hz generator.*

(a) This circuit consists of 1,600-Hz oscillator transistor Q1, emitter-follower transistor Q2, driver transistor Q3, and output transistors Q4 and Q5.

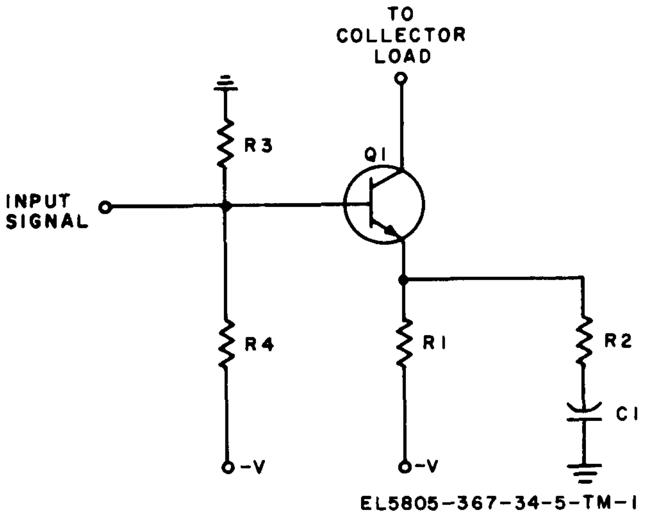


Figure 2-1. Typical biasing circuit.

(b) Transistor Q1 and associated components form a highly stable, tuned-collector oscillator, with transformer T1 primary and capacitor C3 the resonant elements operating at 1,600 Hz. The regenerative feed-back is developed by the transformer secondary and applied to the base. (Refer to (1) above for a description of the common-emitter circuit.) Capacitor C2 completes the transformer secondary ac signal circuit. Resistor R2 and breakdown diodes CR1 and CR2 provide a —18-volt local shunt-regulated supply for transistors Ql, Q2, and Q3 to stabilize the oscillator signal and frequency.

(c) The 1,600-Hz sine wave is applied to transistor Q2, which provides isolation and a low-impedance drive to transistor Q3. Variable emitter resistor R9 is used to adjust the signal level. Capacitor C6 bypasses high-frequency spurious oscillations.

(d) Transistor Q3 provides amplification and, in conjunction with transformer T2, a push-pull signal to drive transistors Q4 and Q5. (Refer to (1) above for a description of transistor Q3's common-emitter circuit.) Resistors R15 and R16 determine the base bias voltage for transistors Q4 and Q5.

(e) Transistors Q4 and Q5 comprise a push-pull amplifier, developing an output across the l5-ohm secondary of transformer T3. Resistor R17 and capacitors C10 and C11 provide high-frequency shaping (rolloff) to prevent oscillation in the driver and output stages due to feedback.

(f) Gain-stabilizing feedback is provdied for the output and driver stages from the secondary of transformer T3 through resistor R21 and blocking capacitor C9. Resistors R21 and R11 form a precision divider for the voltage feedback applied to the base of transistor Q3. The 1,600-Hz sine-wave output is derived from panel 18A2 through terminals 5 and 6 of J16 for distribution to the channel units.

(g) A 1,600-Hz metering signal is made available for level monitoring. The 1,600-Hz voltage is taken from the collector of transistor Q5 for level metering and is applied to a voltage doubler circuit consisting of diodes CR3 and CR4 and capacitors C12 and C13. Voltage divider R22 and R23 provides the required dc voltage at terminal 19 of J16 to drive the external metering circuit on the CV-1548/G.

(3) *20-Hz generator.*

(a) This circuit consists of 20-Hz oscillator transistor Q6, emitter-follower transistor Q7, phase-splitter transistors Q8 and Q9, driver transisters Q10 and Q11, and output transistors Q12 and Q13.

(b) Transistor Q6 and associated circuitry form a series-fed Hartley oscillator, with inductor L1 and capacitor C14 providing the resonant circuit operating at 20 Hz. Regenerative feedback is applied through blocking capacitor C15 to the base of Q6. Resistor R29 and capacitor C18 provide decoupling for transistors Q6 and Q7 to remove any low-frequency components in the power supply line. Resistor R27 isolates the oscillator transistor from the input circuit of transistor Q7.

(c) Transistor Q7 isolates the oscillator output circuit and capacitor C19 couples the signal to the input of the phase splitter. Resistors R35 and R39 isolate the input of the phase splitter from the emitter follower.

(d) Phase splitter transistors Q8 and Q9 make up a differential amplifier which converts the 20-Hz input from transistor Q7 into two balanced outputs of opposite polarity. Also, the differential amplifier provides peak clipping, causing the output to approximate square waves. These outputs provide the necessary push-pull input to the driver stages. The input from transistor Q7 drives transistor Q8, and is then bypassed through capacitor C20 to ground. This arrangement provides the proper ac input to the differential amplifier, while supplying both transistors with the same dc base bias voltage from divider resistors R33 and R34. The 20-Hz square wave produced at the collector of transistor Q8 is of opposite phase to that at the base. A 20-Hz square wave having the same phase as that at the base of transistor Q3, appears across common emitter resistor R38. This 20-Hz square wave drives transistor Q9 to produce a 20-Hz square wave at its collector, having the same phase as that at the base of transistor Q8. Resistors R44 and R40 prevent the driver transistors from loading phase-splitter transistors Q8 and Q9.

(e) Driver transistors Q10 and Q11 are emitter followers that are operated in push-pull by the push-pull input signal. A positive signal swing at the base turns on the transistor, a negative swing cuts it off. Double limiting is provided by diode CR6, resistor R44, and the base-to-emitter junction of transistor Q11, and also by diode CR5, resistor R40, and the base-to-emitter junction of transistor Q10. The 20-Hz square-wave output of the driver stage is applied to the output stage.

(f) Output transistors Q12 and Q13 further limit and amplify the input square wave.

Limiting results from the action of diode CR8 (negative alternation) and the base-to-emitter junction of transistor Q12 (positive alternation), and diode CR7 and the base-to-emitter junction of transistor Q13. The output circuit is completed through the primary of transformer T1, which is mounted on the CV-1548( )/G chassis (fig. FO-14①). Capacitor C23 reduces undesirable switching spikes which are developed by the leakage inductance of the transformer.

(g) The 20-Hz square-wave signal is returned to assembly 18A2 from the secondary of transformer T1 at terminal 13 of connector J16. Inductor L2 and capacitor C26 make up an rfi filter. Indicator DS1 monitors the 20-Hz signal. The 20-Hz signal is made available at terminal 9 of connector J16.

(h) Two monitoring signals are supplied to the metering circuit of the CV-1548/G by the 20-Hz generator. The 20-Hz drive monitor signal is taken from the collector of phase splitter Q9. The ac signal at the collector is rectified by the voltage doubler circuit made up of diodes CR9 and CR10 and capacitors C24 and C26. The 20-Hz drive monitor signal is made available at terminal 25 of connector J16. The 20-Hz output signal is sampled by voltage divider R52 and R53. The sample voltage is rectified by diode CR11, filtered by capacitor C27, and made available at terminal 1 of connector J16.

c. Panel 18A3( ) (Figs. FO-11 and FO-12). Panel 18A3( ) provides two- to four-wire conversion for voice communications and signal transformations for ringing or plug supervision. Panel 18A3( ) contains a 1,600-Hz signal detector circuit consisting of transistors Q1 through Q4. This circuit is used in the AC and TE modes to operate relay K2 when a 1,600-Hz tone is detected. Since it applies to more than one mode, the functioning of this circuit is discussed before the different modes of operation for panel 18A3( ) are discussed. The voice path remains the same for all modes of operation, and is discussed next. Finally, the different signaling modes are discussed on the basis of simplified schematic diagrams.

(1) *Signaling detector*. The signaling detector functions in the 20-Hz signaling (AC) or terminate plug supervision signaling (TE) mode to provide the incoming (from the distant terminal) telephone signaling conversion.

(a) The circuit consists of a signaling detector and signaling receive relay K2. The signaling detector consists of tone amplifier transistor Q1, detector-driver transistor Q2, a tone circuit, a guard circuit, emitter-follower transistor Q3, and relay-driver transistor Q4.

(b) The circuit controls the application of the 20-Hz ringing voltage to the switchboard magneto trunk or field telephone in the AC mode, or controls switch closures to the supervisory indicators on the switchboard trunk while in the TE mode. The circuit does this by detecting the presence or absence of a 1,600-Hz tone at the input of tone amplifier Q1. When the tone is absent, relay K2 is deenergized; when the tone is present, relay K2 is energized.

(c) The tone is applied through capacitor C6 to the base of audio amplifier transistor Q1. Breakdown diode VR5 and capacitor C8 limit the audio signal peaks to prevent overdriving the tone circuit and the guard circuit.

(d) Detector-driver transistor Q2 is a tuned audio amplifier with its collector tuned to resonance by capacitor C10 and transformer T2. The circuit provides amplification in a broadband around 1,600-Hz.

(e) The output from the detector-driver, at the secondary of transformer T2, is applied across the tone and guard circuits. These circuits provide selectivity at the 1,600-Hz signaling frequency while guarding against the possibility of false signaling due to signaling frequency speech and noise voltages present in the input. Figure 2-2 shows the frequency response curve of the typical signal output of the tone circuit, the guard circuit and their series-added resultant, at a —20decibel (dBm) (referred to 1 milliwatt into 600 ohms) tone amplifier input level. Higher level tones produce clipped peaks to maintain proper frequency characteristics.

(f) The tone circuit consists of inductor L2 and capacitor C12 in parallel resonance, rectifier diode CR3, and filter capacitor C13. The tone circuit produces a response giving a maximum positive voltage at 1,600 Hz as shown in figure 2-2. The guard circuit consists of damping resistor R19, rectifier diode CR4, and filter capacitor C14. The guard circuit produces a maximum negative voltage on either side of the 1,600-Hz frequency limits as shown in figure 2-2. The output of the tone circuit adds in series with that of the guard circuit to produce the resultant response, shown in figure 2-2, which is applied to the base of transistor Q3.

(g) Capacitors C15 and C16 provide a time delay to prevent intermittent false signaling due to 1,600-Hz speech and noise voltages present in

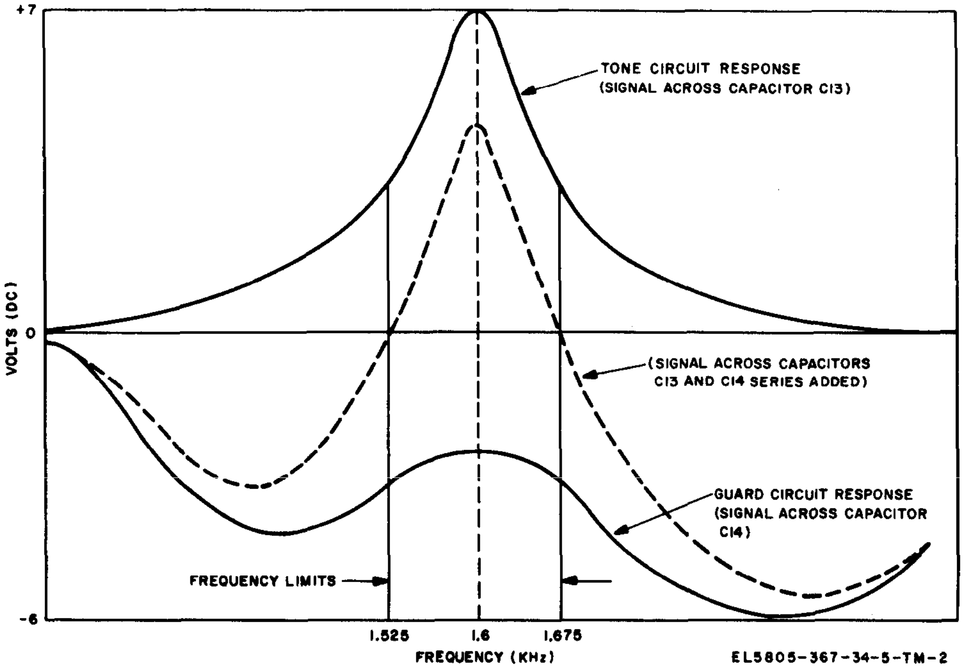


Figure 2-2 Panel 18A3( ) or 18A4 signal detector response curves.

the input. Breakdown diodes VR6 and VR7 maintain the base of transistor Q3 within a narrow region around the cutoff point to control the time delay.

(h) When a continuous tone within the frequency limits shown in figure 2-2 appears at the input of transistor Q1, the dc voltage at the base of transistor Q3 swings less negative. This voltage swing is applied to the base of relay switch transistor Q4, turning on transistor Q4, and causing relay K2 to energize. Diode CR5 and resistor R25 damp out the voltage transient generated whenever the solenoid of relay K2 is deenergized. Diodes CR6 and CR7 and resistor R27 provide a —1.5-volt reverse bias to set the operating point of transistor Q4.

(i) The guard circuit prevents false operation of the signaling detector. When tones having frequencies outside the frequency limits shown on figure 2-2 are applied to the input of transistor Q1, the negative dc voltage produced at the base of transistor Q3 will keep transistor Q3 and Q4 cut off and keep relay K2 deenergized. The guard circuit also prevents false operation of the signaling detector which could occur due to the presence of speech at the input of transistor Q1. Speech, which occupies a band of frequencies, puts more energy into the guard circuit than the tone circuit, preventing any 1,600-Hz short term frequency component from producing a positive output and relay K2 from being energized.

(2) *Only hybrid in use (OFF) mode, 18A3( ) panel.* In the OFF mode, the circuit is as shown in simplified schematic diagrams (18A3A, fig. 2-3 or 18A3B, fig. 2-4). When only the voice path is to be used for two-wire to four-wire conversion, signaling mode switch S1 is operated to OFF. In this mode of operation, the signaling detector input circuit is grounded through contacts 1-5 of switch S1D on 18A3A panel (contacts 6-10 of switch S1D on 18A3B panel), insuring that relay K2 remains deenergized. Connections to the loop are made through contacts 27 (tip) and 26 (ring) of connector J14. These contacts are connected across capacitor C2 and hybrid transformer T1. All other circuits are disconnected from the local line by the various sections of signaling mode switch S1. The receive line from the multiplex equipment is connected through contacts 5 and 6 of connector J14 to terminals 5 and 6 of hybrid transformer T1. The send line to the multiplex equipment is connected from terminals 7 and 8 of hybrid transformer T1 to contacts 3 and 4 of connector J14. The same voice path is used for all signaling modes discussed below. Capacitor C2 on the loop side of hybrid transformer T1 blocks dc loop current from the transformer. Breakdown diodes VR3 and VR4 safeguard the hybrid transformer windings from high ac voltages in the loop.

(3) *AC signaling mode, 18A9( ) panel.*

(a) In the ac signaling mode, with the sig-

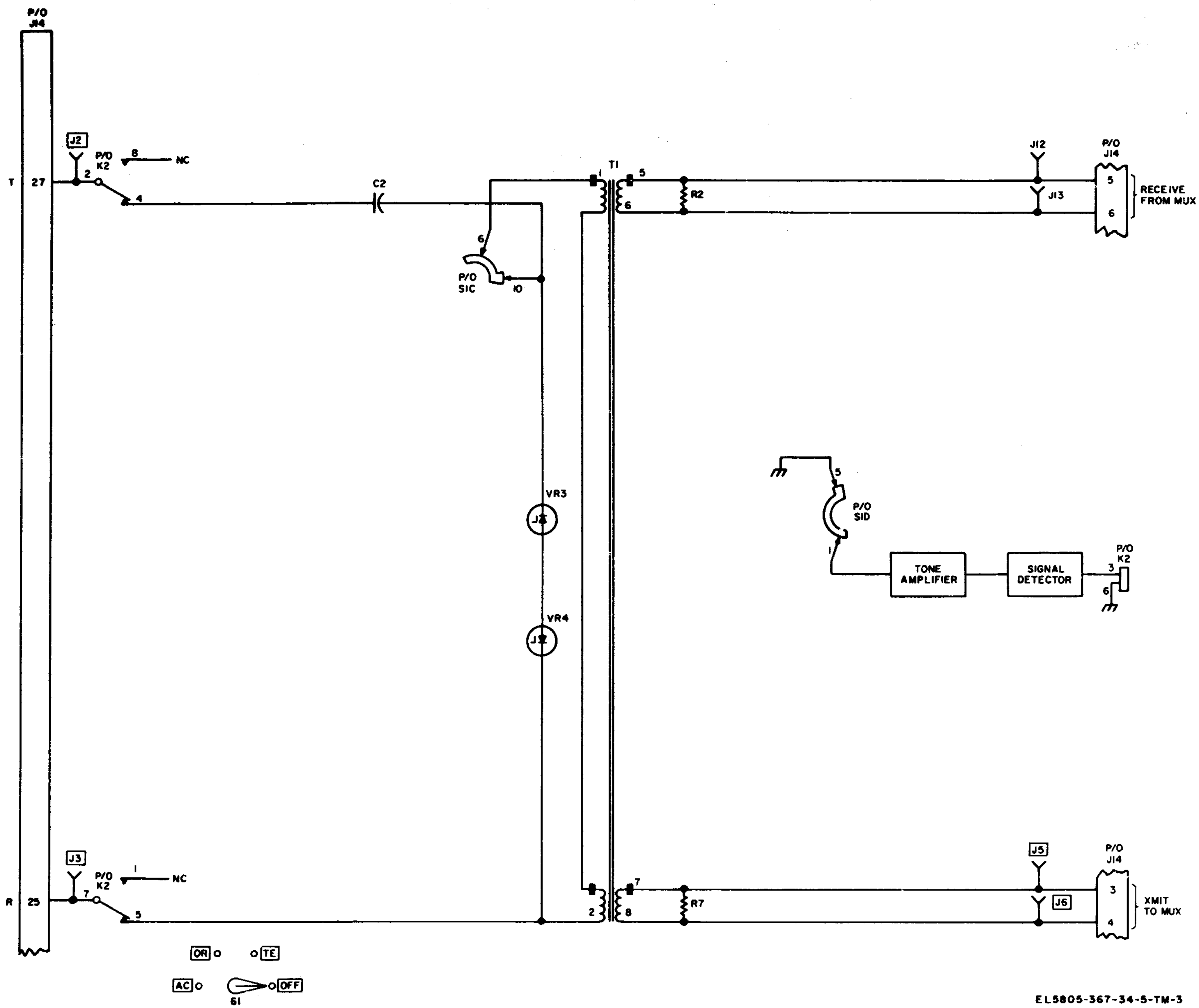


Figure 2–3. Panel 18A3A, OFF signaling mode, simplified schematic diagram.

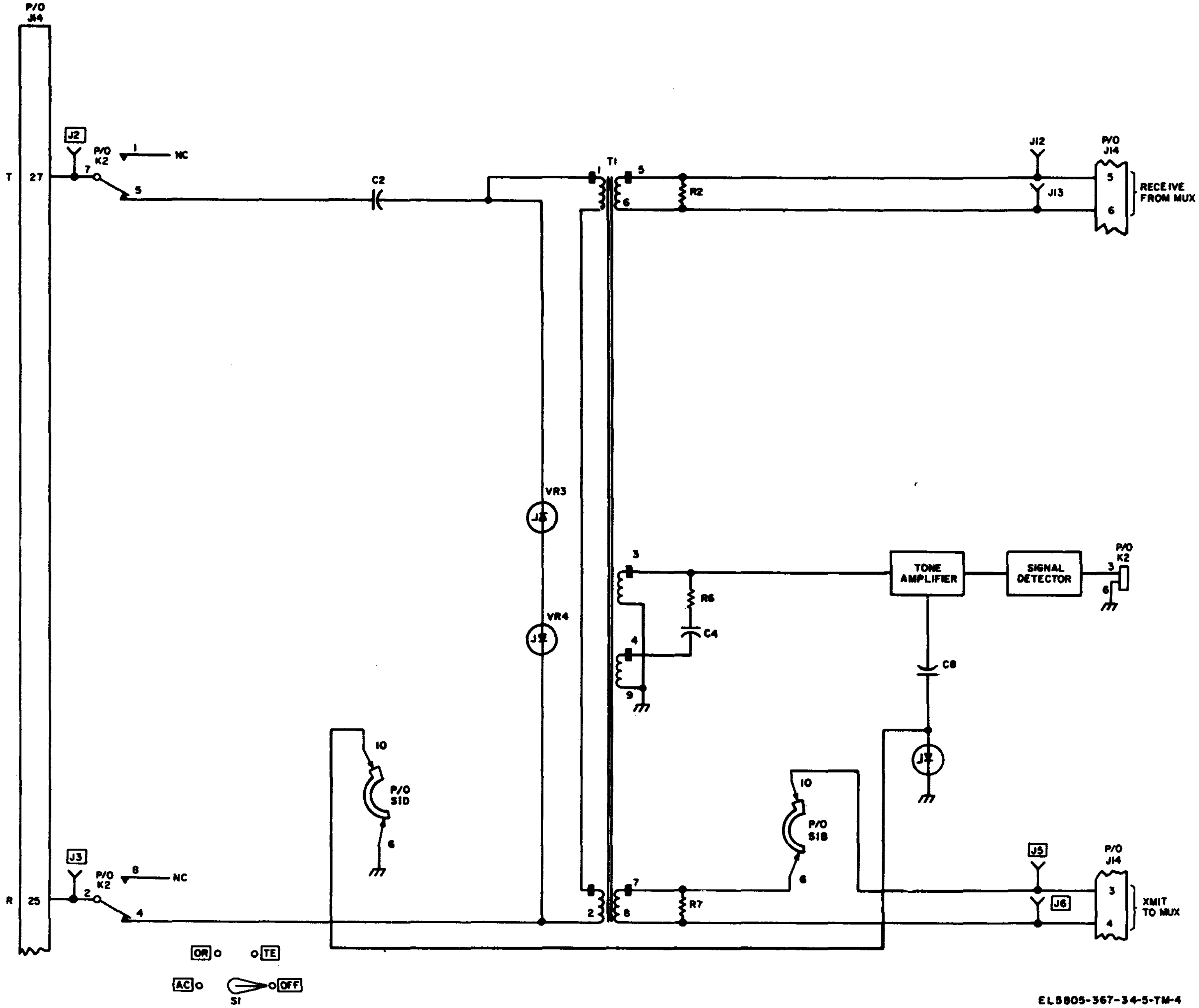


Figure 2-4. Panel 18A3B, OFF signaling mode, simplified schematic diagram.

naling mode switch set to AC, the circuit is as shown in simplified schematic diagrams (18A3A, fig. 2-5 or 18A3B, fig. 2-6). When a call is to be made, the originating terminal applies a 20-Hz ring signal between contacts 25 and 27 of connector J14, energizing relay K1 which sends the 1,600-Hz ring signal to the distant terminal.

(b) On panel 18A3A (fig. 2-5), the ring signal is applied through the series circuit consisting of contact 25 of J14, normally closed contacts 5-7 of relay K2, inductor Ll, switch S1A contacts 6-7, resistor R3, switch S1B contacts 1-2, across bridge rectifier circuit consisting of breakdown diodes VR1 and VR2, diodes CR1 and CR2, and relay K1 (load), through inductor Ll, normally closed contacts 2-4 of relay K2, to contact 27 of J14. Beakdown diodes VR1 and VR2 are used in the bridge circuit to protect relay K1 by limiting the voltage that can be developed across the relay. Diodes VR9 and VR10, along with capacitor C17, limit and filter the 20-Hz signal. Opening of relay K1 contacts 5-7 keeps the 20-Hz signal from flowing in the 1-2 windings of transformer T1.

(c) On panel 18A3B (fig. 2-6), the ring signal is applied through series circuit consisting of contact 25 of J14, normally closed contacts 2-4 of relay K2, inductor Ll, switch S1D contacts 1-2, resistor R3, switch S1A contacts 6-7, across bridge rectifier consisting of breakdown diodes VR1 and VR2, diodes CR1 and CR2, and relay K1 (load), through inductor Ll, normally closed contacts 5-7 of relay K2, to contact 27 of J14. Breakdown diodes VR1 and VR2 protect relay K1 by limiting the voltage across the relay winding.

(d) With relay K1 energized, the 1,600-Hz signal from panel 18A2 which is applied to contact 1 of J14 is connected through resistor R8: on panel 18A3A figure 2-5, switch S1B contacts 6-7, contacts 2-8 of relay Kl, to windings 3 and 9 of transformer Tl, coupled to contacts 7-8 of transformer T1 which applies the 1,600 Hz signal across output terminals 3 and 4 of J14, from which it is routed to a multiplex channel for transmission to the distant terminal and on panel 18A3B (fig. 2-6), to transformer T3. Transformer T3 contact 2 is direct-connected to contact 4 of J14, while transformer T3 contact 1 is routed through switch S1C contacts 6-7, contacts 2-8 of relay Kl, to contact 8 of J14. Contacts 3 and 4 of J14 are routed to a multiplex channel for transmission to the distant terminal.

(e) At the distant terminal, the incoming 1,600-Hz ring signal is applied from the multiplex (mux) equipment through contacts 5 and 6 of J14 to four-wire receive terminals 5 and 6 of hybrid transformer T1. On panel 18A3A (fig. 2-5), the incoming 1,600-Hz signal is coupled through transformer T1 to contacts 3 and 9, through relay K1 contacts 2-4, switch S1D contacts 1-2, into the tone amplifier-detector circuit, causing relay K2 to energize. On panel 18A3B (fig. 2-6), the incoming 1,600-Hz signal is coupled through transformer T1 to contacts 3-9, into the tone amplifier-detector circuit, causing relay K2 to energize.

(f) With relay K2 energized, the 20-Hz signal supplied from panel 18A2 to contacts 29 and 31 of J14 is applied through the 18A3A panel (fig. 2-5) series circuit consisting of ground to switch S1A contacts 1-2, contacts 1-7 of relay K2, to contact 25 (ring) of J14, through the local switchboard and back to contact 27 (tip) of J14, contacts 2-8 of relay K2, switch S1C contacts 1-2, through resistor R5 to the source; and the series circuit on panel 18A3B (fig. 2-6), ground to switch S1D contacts 6-7, contacts 2-8 of relay K2, to contact 25 (ring) of J14, through the local switchboard and back to contact 27 (tip) of J14, contacts 1-7 of relay K2, switch S1A contacts 1-2, through resistor R5 to the source. Resistor R5 and capacitor C3 decoup!e any signals in the loop circuit from the CV-1548( )/G 20-Hz bus.

(g) When voice communications are established as a result of the signaling between the originating and terminating terminals, the voice circuits are as described in (2) above. Inductor L1 serves to isolate the voice frequencies from the signaling circuits.

(h) In the AC signaling mode, the test function, exercised by depressing TEST switch S2, tests the tone amplifier-detector circuit, sends a 20-Hz ring signal to local switchboard, and a 1,600-Hz ring signal to distant mux terminal; it also tests the DS1 lamp circuit of panel 18A3B. On panel 18A3A (fig. 2-5), when switch S2 is depressed, the 1,600-Hz tone is applied through contacts 1-3 of switch S2, resistor Rl, to the input of tone amplifier-detector circuit, energizing relay K2 which sends a 20-Hz ring signal to local switchboard; it is also routed through switch S1D contacts 1-2, relay K1 contacts 2-4, to hybrid transformer Tl, coupled to output winding contacts 7-8 of transformer T1 and is then routed to contacts 3 and 4 of J14. On panel 18A3B (fig. 2-6) when switch S2 is depressed, the 1,600-Hz tone is applied through contacts 1-3 of switch S2, resistor Rl, to input of tone amplifier-detector circuit, energizing relay K2 which sends a 20-Hz ring signal to local switchboard. The 1,600-Hz

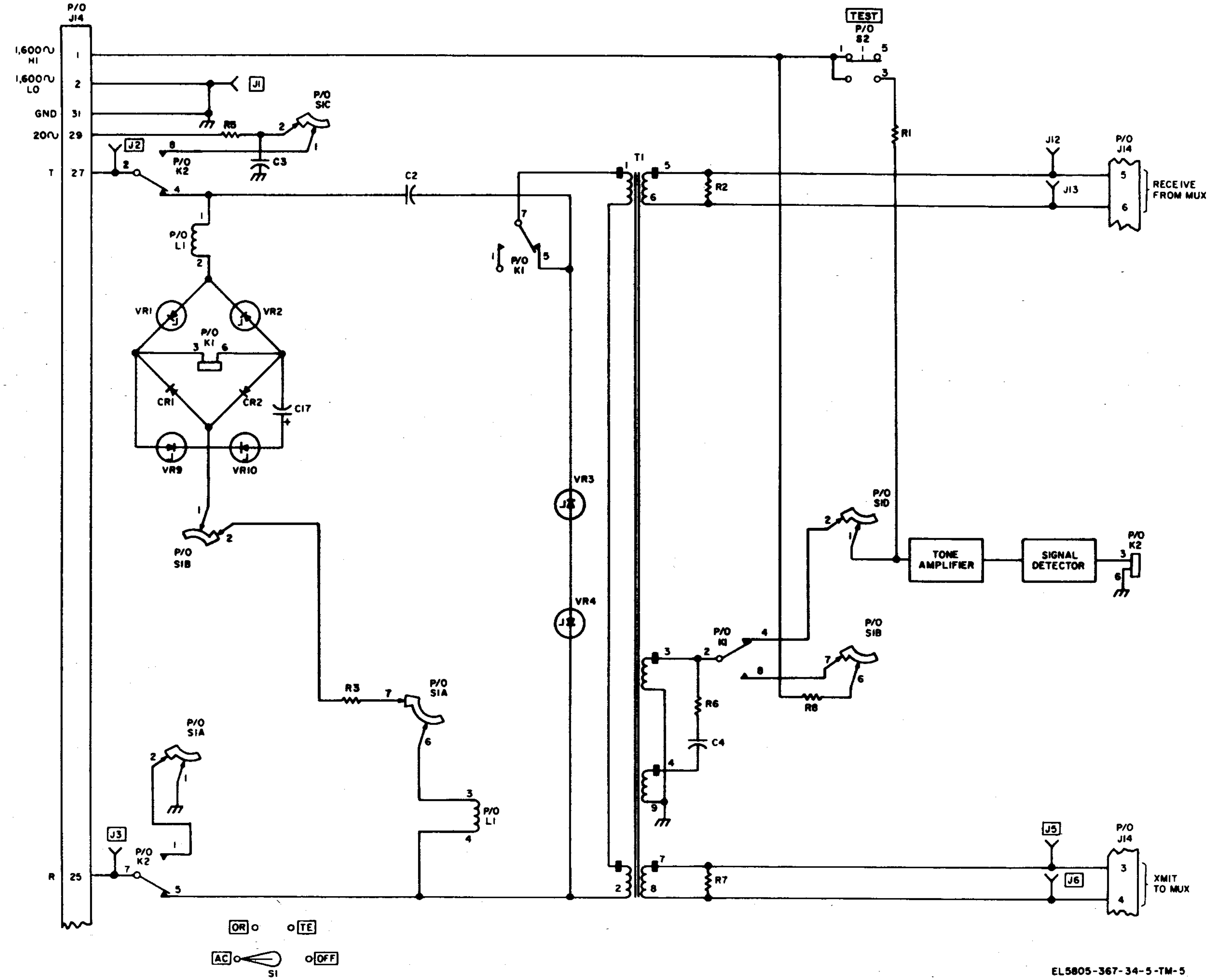


Figure 2–5. Panel 18A3A, AC signaling mode, simplified schematic diagram.

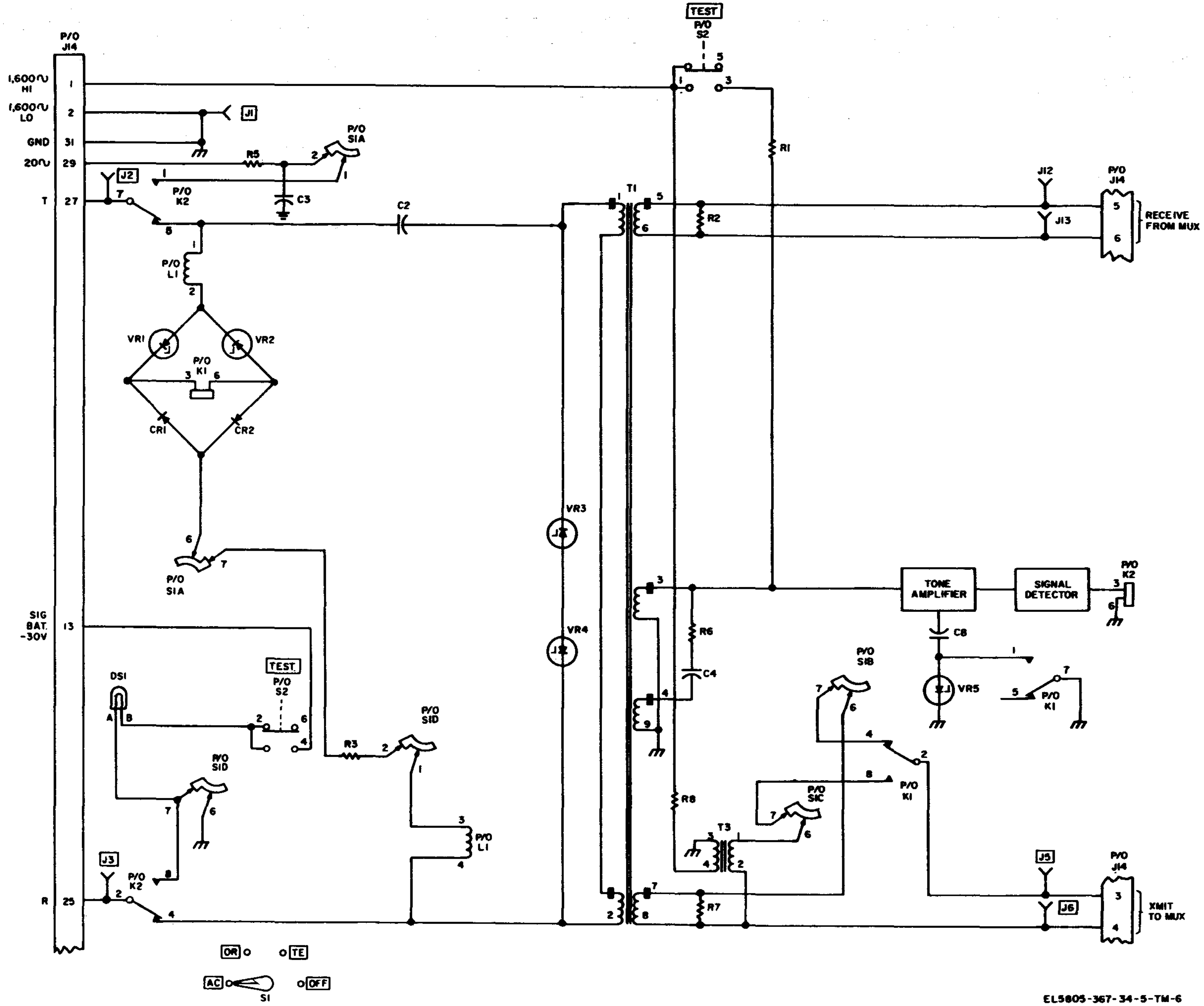


Figure 2-6. Panel 18A3B, AC signaling mode, simplified schematic diagram.

tone is also routed to hybrid transformer T1, coupled to output winding contacts 7-8 of transformer T1 and is then routed to contacts 3 and 4 of J14. Lamp circuit DS1 is also checked when —30V SIG BAT is applied through the series circuit consisting of ground through contacts of DS1, contact 2-4 of switch S2, to contacts 13 of connector J14. With relay K2 energized, the 20-Hz ring signal will be applied to contacts 25 (ring) and 27 (tip) of connector J14 as stated in (c) above for incoming 1,600-Hz signals.

(4) *Originate plug supervision (OR) mode.*

(a) In the idle condition (OR) plug supervision mode, the active circuits are shown in simplified schemtic diagrams (18A3A, fig. 2–7 or 18A3B, fig. 2-8). So long as the channel is idle, loop circuit open, relay K1 remains deenergized and a 1,600-Hz supervisory signal is transmitted over the multiplex equipment to the distant terminal. On panel 18A3A (fig. 2-7), the 1,600-Hz signal is applied through contact 1 of connector J14, resistor R8 switch S1B contacts 6-8, relay K1 contacts 2-4, transformer T1 contacts 3-9, and coupled to contacts 7-8 of transformer T1, which applies the 1,600-Hz signal to output terminals 3 and 4 of connector J14. Lamp circuit DS1 can be checked at this time by depressing TEST switch S2. On panel 18A3B (fig. 2-8), the 1,600-Hz signal is applied through contact 1 of connector J14, resistor R8, to transformer T3. Transformer T3 contact 2 is direct-connected to contact 4 of connector J14, while contact 1 is routed through switch S1C contacts 6-8, relay K1 contacts 2–4, to contact 3 of connector J14. Contacts 3 and 4 of connector J14 are routed to a multiplex channel for transmission to the distant terminal.

(b) A call is initiated by the establishment of continuity between tip and ring terminals at the local switchboard. When continuity is established, signal battery will energize relay K1 and remove the 1,600-Hz supervisory signal being sent to the distant terminal. The —30V SIG BAT from power supply assembly 18A1 ( ) is applied to contacts 13 and 31 of connector J14. On panel 18A3A (fig. 2-7), the current flow is from connector J14 contact 13, through switch S1B contacts 1-3, diode CR2, relay winding K1 (load) contacts 3–6, breakdown diode VR1, inductor Ll, relay K2 contacts 2-4, contact 27 (tip) of connector J14, through the local switchboard and back to contact 25 (ring) of connector J14, through relay K2 contacts 5-7, inductor L1, switch S1A contacts 6-8, resistor R4 switch S2 contacts 2-6, lamp DS1, and switch S1A contacts 1-3 to ground. To prevent unwanted operation of local relay K2, switch S1D (contacts 1–3) grounds the input of the tone amplifier-detector circuit. Capacitor Cl and resistor R4 improve the T and R longitudinal balance, and breakdown diode VR8 protects the capacitor in the event the 20-Hz ring signal is applied from the switchboard. On panel 18A3B (fig. 2-8), the current flow is from connector J14 contact 13, through switch S1A contacts 6-8, diode CR2, relay K1 (load) contacts 3-6, breakdown diode VR1, inductor Ll, relay K2 contacts 5-7, contact 27 (tip) of connector J14, through the local switchboard and back to contact 25 (ring) of connector J14, through relay K2 contacts 24, inductor Ll, switch S1D contacts 1-3, and resistor R4 to ground. To prevent, unwanted operation of local relay K2, switch S1D (contacts 6-8) grounds the junction of capacitor C8 and breakdown diode VR5 of the tone amplifier-detector circuit. Capacitors Cl and C21 and resistor R4 improve the T and R lead longitudinal current balance, and breakdown diode VR8 protects the capacitors in the event the 20-Hz ring signal is applied from the switchboard.

(5) *Terminate plug supervision (TE) mode.*

(a) In the terminate plug supervision mode, the active circuits are as shown in simplified schematic diagrams (18A3A, fig. 2-9 or 18A3B, fig. 2-10). For an idle channel, the originating terminal sends a 1,600-Hz supervisory signal over the multiplex equipment ((4) (a) above). At the terminating terminal, the l, 600-HZ signal, indicating an idle channel, is applied to contacts 5 and 6 of connector J14, which is connected to contacts 5 and 6 of hybrid transformer T1. The signal is coupled to the signal detector windings and applied to the tone amplifier-detector input circuit, keeping relay K2 energized. With relay K2 energized, an open circuit is maintained between the tip and ring leads of the local switchboard line (contacts 25 and 27 of connector J14), indicating an idle channel. On panel 18A3A (fig. 2-9), the supervisory signal is routed through normally closed contacts 2-4 of relay K1 and switch S1D contacts 1-4. On panel 18A3B (fig. 2–10), the supervisory signal is direct-coupled into the tone amplifier-detector circuit.

(b) When the 1,600-Hz supervisory signal is discontinued, indicating a request for service, relay K2 deenergizes. With relay K2 deenergized, the series circuit, consisting of inductor L1 and indicator lamp DS1, is placed across the local line. The local switchboard will indicate a request for service, and indicator lamp DS1 will be lighted by switchboard battery power.

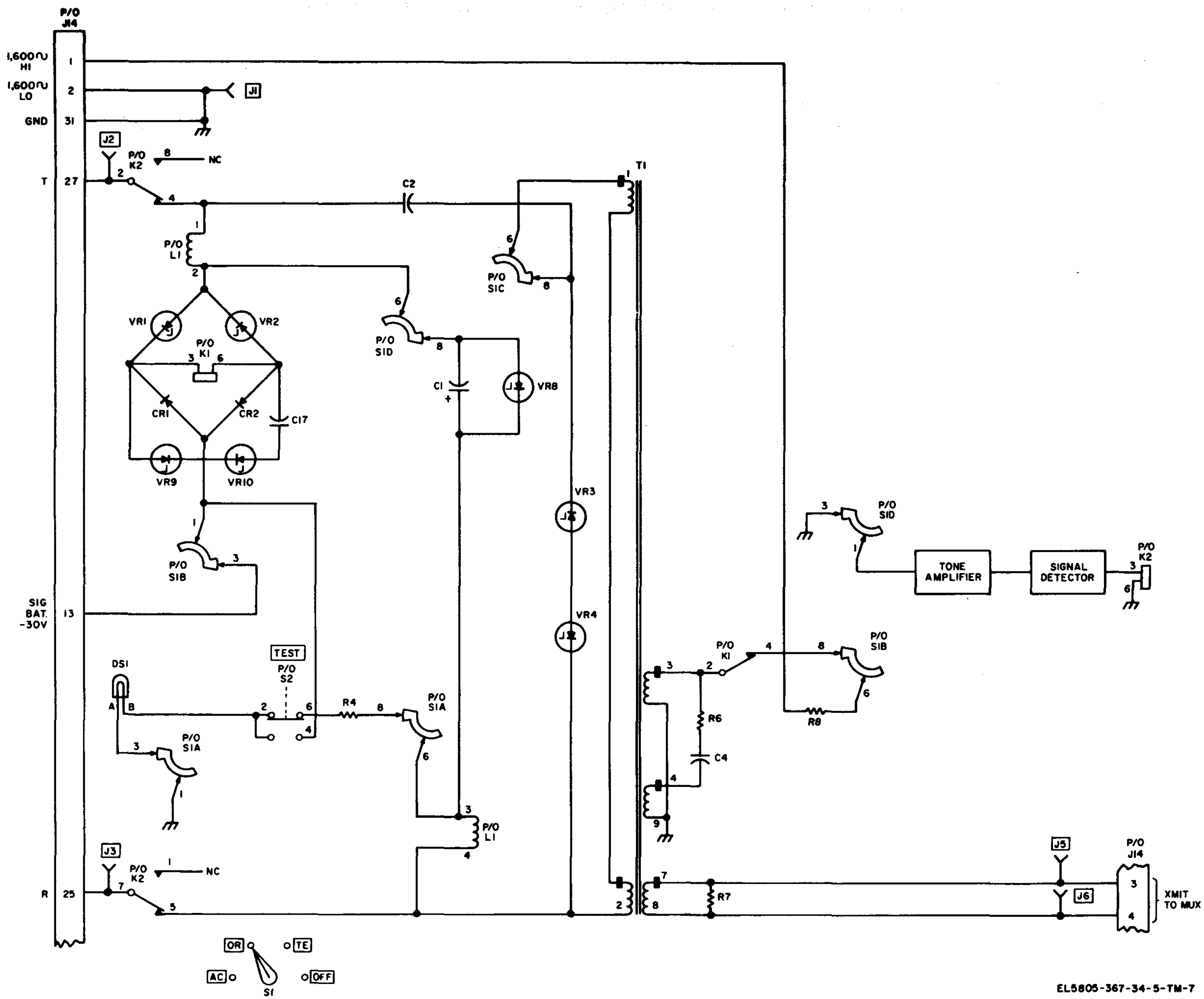


Figure 2–7. Panel 18A3A, OR signaling mode, simplified schematic diagram.

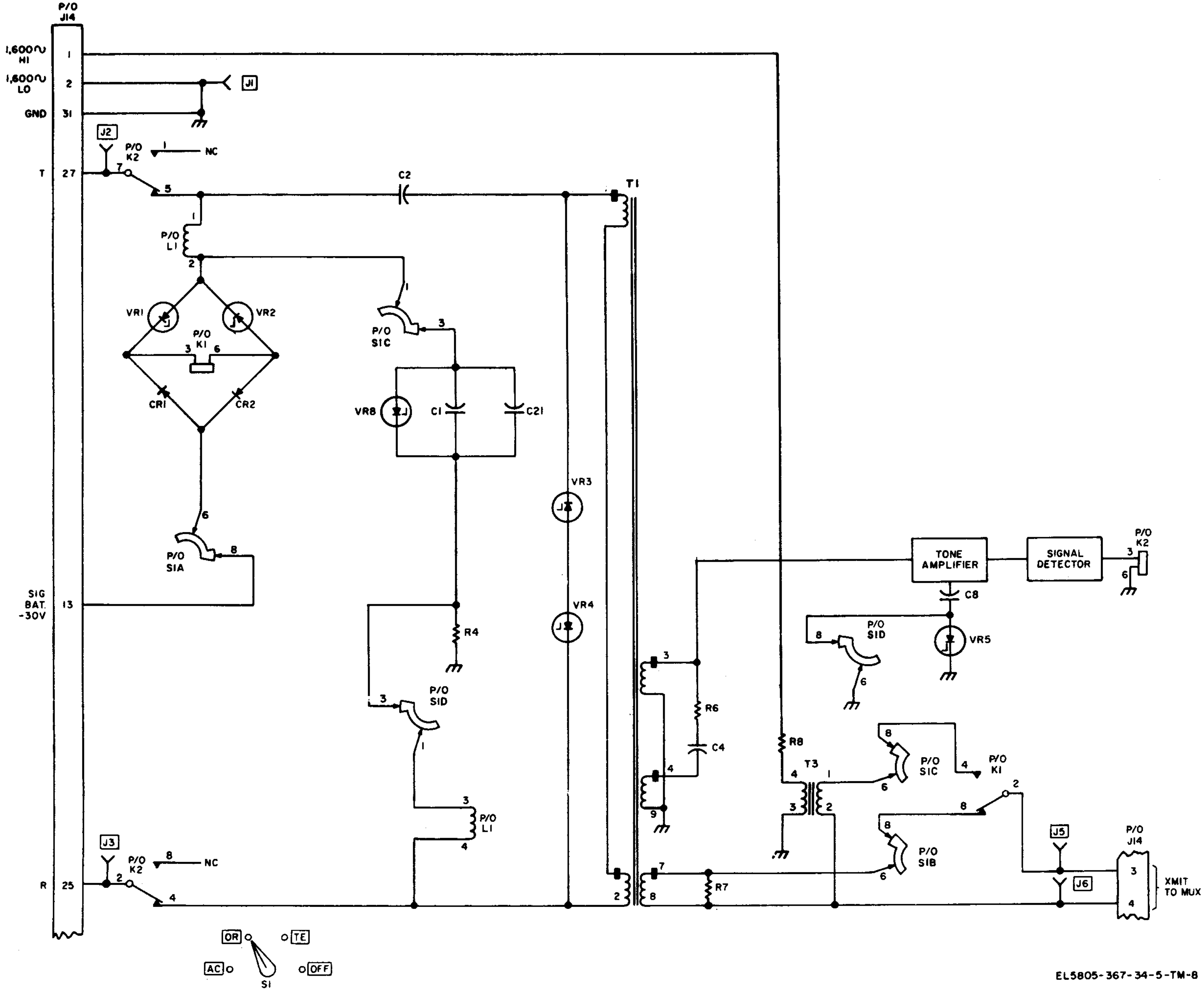


Figure 2–8. Panel 18A3B, OR signaling mode, simplified schematic diagram.

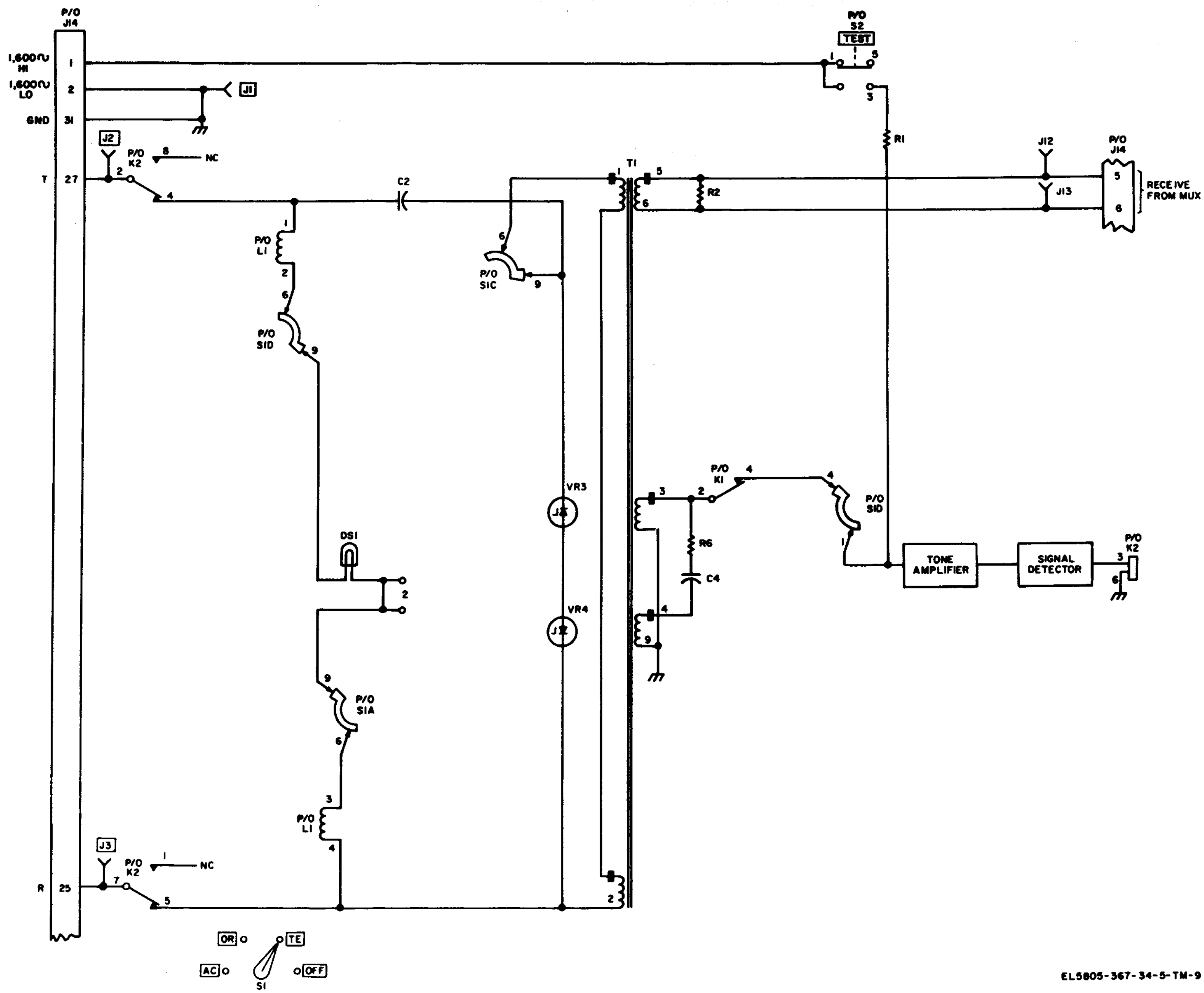


Figure 2–9. Panel 18A3A, TE signaling mode, simplified schematic diagram.

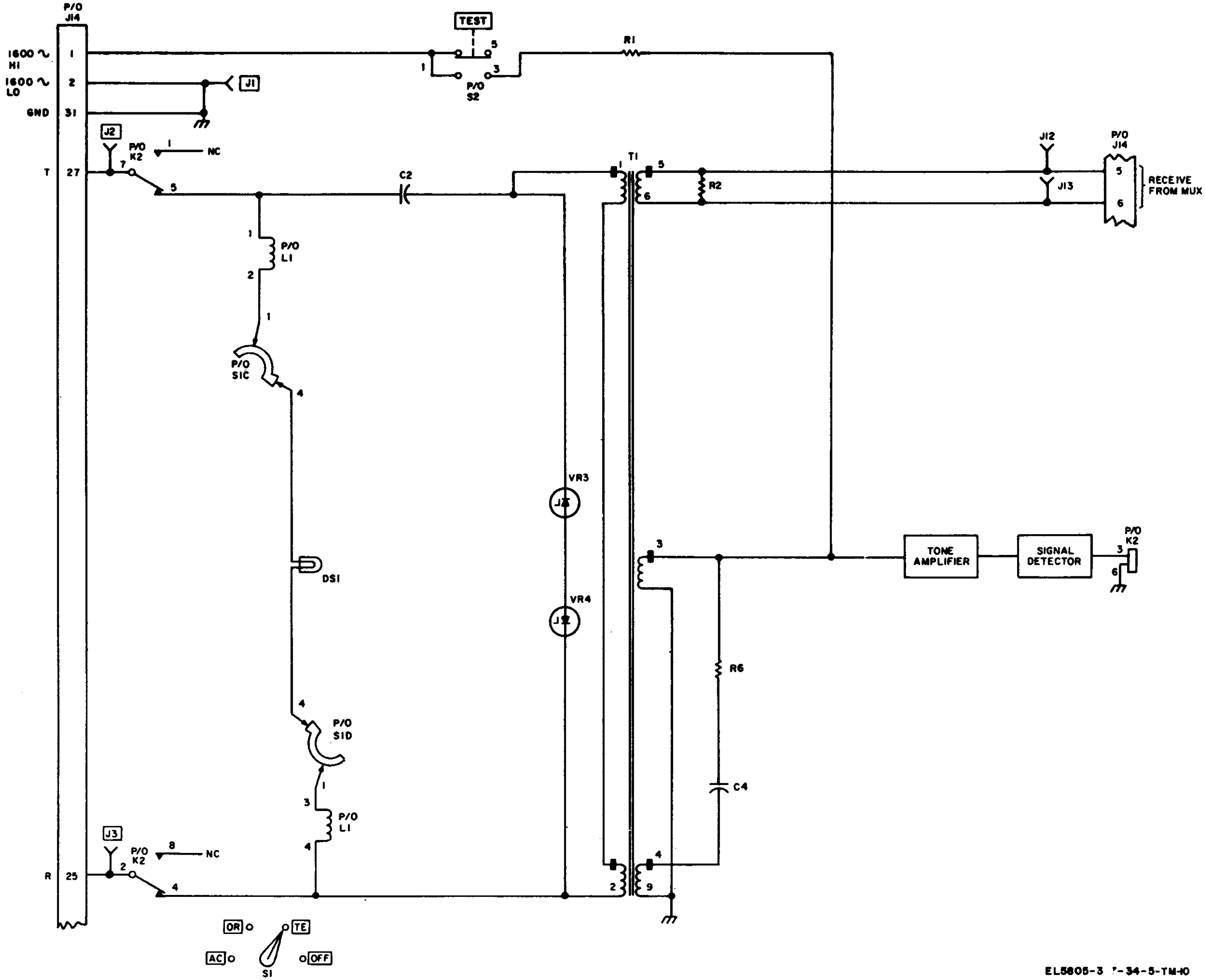


Figure 2-10. ***Panel 18A3B, TE signaling mode, simplified schematic diagram.***

(c) When distant ((OR) terminal) switchboard disconnects, the 1,600-Hz supervisory signal is reinserted to the (TE) terminal. The (TE) terminal detects the 1,600-Hz signal, energizing relay K2 which opens its 2-4 and 5-7 contacts. The (TE) terminal switchboard then indicates the disconnect due to the T and R lead open circuit.

NOTE

When using panel 18A4 on a given channel of the system, both terminals must have panel 18A4 installed into that channel.

d. Panel 18A4 (Fig. FO-l3), Panel 18A4 provides two-way plug supervision signaling conversion and connection between a four-wire multiplex channel and a two-wire telephone switchboard circuit. Modules Z1 through Z3 are driven to tip (T); lead detector transistors Q2 and Q4; and 1,600-Hz signaling detector transistors Q6, Q7, and Q8. The signaling detector transistors provide the logic functions required for response to incoming or outgoing calls. No switch settings are required to place the 18A4 panel in an operating mode before transmitting to a terminating terminal, and no 20-Hz ring signal is necessary to alert the terminating terminal. However, 18A4 panels are required at both terminals for any given channel. The panel operation at both stations is identical.

(1) *Basic operation.*

(a) The 18A4 panel provides a continuous 1,600-Hz tone from station A (originating terminal) to station B (terminating terminal) and from station B to station A. A call is placed when an operator at one of the terminals (i.e., station A) inserts a call cord into the switchboard. This action interrupts the 1,600-13z tone to station B. With loss of the 1,600-Hz input to station B, two circuit functions occur: relay K1 is energized and the voice circuit is connected, and the switchboard indicator is changed from black to white, which alerts the station B operator to an incoming call.

(b) Answering the call, station B inserts its answer cord, interrupting the 1,600-Hz tone to station A. At station A with the loss of the 1,600-Hz signal, two circuit functions occur: relay K1 is energized and the voice circuit is connected, and the switchboard indicator is changed from black to white, indicating that station B has answered. Voice communications can now take place between both stations.

(c) When the call is completed, station A disconnects its call cord and the 1,600-Hz tone resumes transmission to station B. At station B, the incoming tone changes the switchboard indicator to black, indicating that station A has disconnected. Station B then disconnects its answer cord, deenergizing relay K1 which disconnects the voice circuit, and the 1,600-Hz tone resumes transmission to station A.

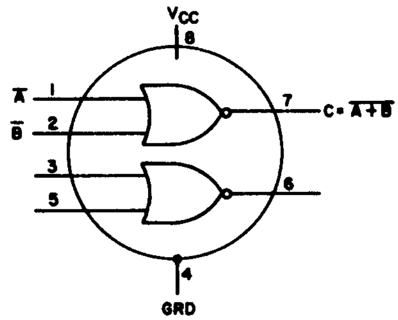
(d) Arriving at station A, the 1,600-Hz tone changes the switchboard indicator to black, indicating that station B has disconnected, thus deenergizing relay Kl, and disconnects the voice circuit. Both stations are now in an idle condition and are ready for the next call.

(e) The functioning of the 18A4 panel circuitry will be described for the following conditions: idle-no calls being placed; station A calls station B; station B answers station A’s call; station A’s response to station B’s answer. To insure an understanding of the 18A4 panel logic functions, refer to (2) below for a description of basic logic elements and their functions.

(2) *Dual NOR gate MC914G.* Three MC914G integrated modules are used in panel 18A4. The integrated circuit elements used in each module consist of a circuit built into a single chip of silicon mounted in an eight-lead TO-99 package. The circuit contains a pair of two-input, high-speed, low-power NOR gates. As shown in application C, figure 2-11, each gate input drives the base of one transistor, When the gate input is at a logic zero (O) level (defined as approximately —27 volts in the circuit), the transistor is cut off. When the gate input is at a logic one (1) level (defined as approximately —24 volts in the circuit), the transistor conducts. When both inputs of a gate are logic 0’s, the associated transistors are cut off, giving —24 volts (logic 1) at the gate output. If a logic is applied to either gate input, the transistor conducts and the gate output becomes approximately —27 volts (logic 0). Thus, the output of a gate will be logic 1 if, and only if, both gate inputs are at the logic 0 level.

(a) NOR gate application. NO gate, application A in figure 2-11, illustrates the MC914G used as a dual NOR gate. Consider the top NOR gate symbol. Input A is connected to pin 1 and input B is connected to pin 2. The NOR gate output at pin 7 is equal to a logic 1 or 0 according to the input levels. The truth table provided in application A indicates the C or gate output under different input conditions.

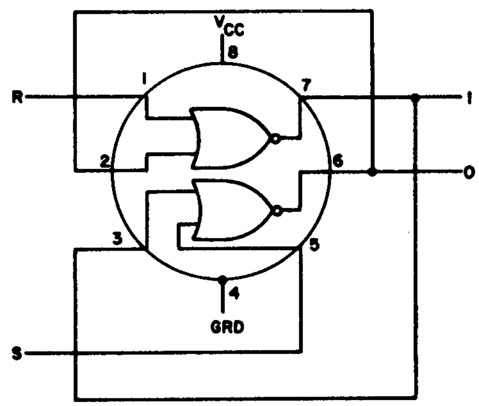
(b) Set-reset flip-flop. Application B, figure 2-11, illustrates the MC914G used as a bistable multivibrator. This configuration is formed when



TRUTH TABLE

$\overline{A}$-INPUT	$\overline{B}$-INPUT	C-OUTPUT
0	0	1
1	1	0
0	1	0
1	0	0

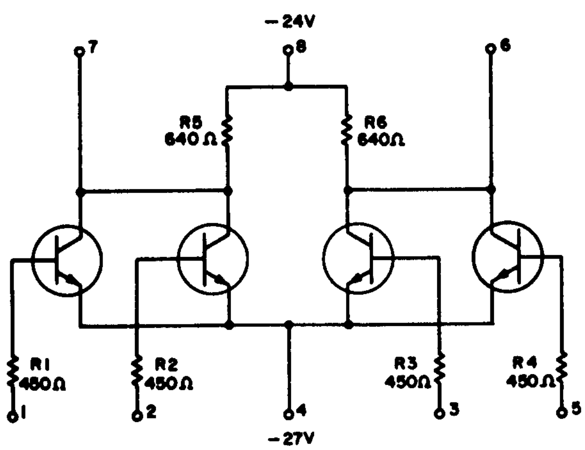
A

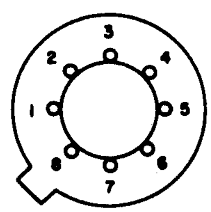


TRUTH TABLE

S-INPUT PIN 5	R-INPUT PIN 1	I-OUTPUT PIN 7	O-OUTPUT PIN 6
1	0	1	0
0	1	0	1

B





BASE DIAGRAM
(BOTTOM VIEW)

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Figure 2-11. Dual NOR gate logic and schematic diagram.

each NOR gate output (pin 6 and 7) is externally connected as an input to the opposite gate (pins 2 and 3). A set (S) input (logic 1) at pin 5 produces a logic 0 at output pin 6. Applied to pin 2, the reset gate is cut off, thus producing a logic 1 at output pin 7. With logic 1 applied to pin 3 from pin 7, the set gate is kept in a conducting state. The gate will remain in this SET state until a reset pulse is applied to pin 1 to reverse conditions. The truth table, given in application B, indicates the logic levels at output pins 6 and 7 with SET (S) and RESET (R) inputs applied to pins 5 and 1, respectively. These levels are in agreement with the truth table given for application A.

(3) *Signaling detector.* The signaling detector provides the proper logic output in response to the operator's actions. The circuit consists of tone amplifier Q6, detector-driver transistor Q7, a tone circuit, a guard circuit, and emitter-follower transistor Q8.

(a) The circuit controls the logic function which activates or deactivates the voice circuit by operating relay K1. The circuit does this by detecting the presence or absence of the 1,600-Hz tone transmitted and received between stations.

(b) The tone is applied to the base of transistor Q6 from terminal 3 of transformer T1. Transistor Q6 is an audio amplifler. Breakdown diode VR6 and capacitor C11 limit the audio peaks to prevent overdriving the tone circuit and the guard circuit. (Refer to *b(1)* above for a description of the transistor biasing.)

(c) Detector-driver transistor Q7 is a tuned audio amplifier with its collector circuit tuned to resonance by capacitor C13 and transformer T1, The circuit provides amplification in a broad band around 1,600 Hz.

(d) The output from the detector driver, at the secondary of transformer T2, is applied across the tone and guard circuits. These tuned circuits provide selectivity at the 1,600-Hz signaling frequency while guarding against the possibility of false signaling due to speech frequencies and noise voltages present in the input. Figure 2-2 (identical for 18A4 panel except for capacitor changes) illustrates the frequency response curve with the typical signal output of the tone circuit, the guard circuit, and their series-added resultant, at a —20-dBm tone amplifler input level. Higher level tones produce clipped peaks to maintain proper frequency characteristics.

(e) The tone circuit consists of inductor L2 and capacitor C15 in parallel resonance, rectifier diode CR10, and filter capacitor C16. The tone circuit provides a maximum positive voltage response at 1,600 Hz as in figure 2-2. The guard circuit consists of damping resistor R34, rectifier diode CR11, and filter capacitor C17. The guard circuit provides maximum negative voltage on either side of the 1,600-Hz frequency limit as in figure 2-2. The output of the tone circuit adds in series with that of the guard circuit to produce the resultant response, shown in figure 2-2, which is applied to the base of transistor Q8.

(f) Capacitors C18 and C19 provide a time delay to prevent intermittent false signaling due to 1,600-Hz speech or noise voltages present in the input. Breakdown diodes VR7 and VR8 maintain the base of transistor Q8 within a narrow region near cutoff. Transistor Q8 remains in an on condition and produces a logical 1 output when a continuous 1,600-Hz signal is received.

(g) When the continuous tone to the signal detector is interrupted, capacitors C18 and C19 discharge, removing the positive voltage from the base of Q8. Without a positive voltage at the base, Q8 cuts off and produces a logic 1 at the output.

(h) The logic 1 or 0 output from transistor Q8 provides the proper response to activate 18A4 circuitry in response to operator actions.

(4) *Idle-no Calls being placed.* Refer to figures FO-2 and FO-13. In an idle condition, the 1,600-Hz signal applied to pin 1 of connector J16 is coupled through capacitor C20; resistor R45, and diode gate CR15 to terminals 1 and 2 of transformer T3. The output from transformer T3 is connected through contacts 2 and 4 of relay K1 to terminal 3 and 4 of connector J16 for transmission by multiplex equipment to the terminating terminal. The 1,600-Hz incoming signal from the multiplex equipment is received at terminals 5 and 6 of connector J16 and applied to terminals 5 and 6 of transformer T1. Coupled to the signal detector winding, the incoming 1,600-Hz signal is amplified by the signal detector which produces a logical 1 output. Supplied to gates Z2B (pin 5) and Z3B (pin 3), the logic 1 has no effect on gate Z3B at this time because of a logic 1 present on pin 5 from transistor Q10, The logic 0 on pin 6 of Z3B maintains transistor Q12 cut off and relay K1 deenergized. However, the logic 1 applied to gate Z2B pin 5 activates the gate and produces a logic 0 at the output, pin 6. Applied to the base of transistor Q9, the transistor is held in cutoff, thus preventing any voltage from being placed on the R lead.

(a) With the T lead disconnected during the idle condition, the remaining 18A4 panel cir-

cuitry will maintain the following conditions: A negative voltage will be present at the input to detector A and the collector of Q5 from the switchboard battery supply. Under this condition, the detector A output is a logical 0 which is applied to transistor Q3 and detector B. Activated by the logic 0 transistor Q3 produces a logic 1 at its output. NOR gates Z1A and Z1B, connected in a flip-flop configuration, are placed in a reset condition when the logic 1 from Q3 is applied to the input of gate Z1A (pin 1). The logic 1 from Q3 is also applied to gate Z3A, turning Z3A on and producing a logic 0 at its output. The Z3A output prevents transistors Q10 and Q11 from conducting at this time.

(b) With a logic 0 at the input to detector B, a logic 0 is produced at the output. Applied to gate Z2A (pin 1), the gate is turned off and produces a logic 1 at the output (pin 7) which is applied to gate Z1B (pin 5).

(c) Both gates Z1A and Z1B now have inputs. The logic 1 applied to pin 1 of gate Z1A, turns on the gate and produces a logic 0 at the output (pin 7), which is applied to gate Z1B, but has no effect at this time. With gate Z1B activated by logic 1 at pin 5, a logic 0 is produced at the output. The logic 0 applied to pin 2 of Z1A, the base of transistor Q5 and gate Z2A (pin 2), acts as a preconditioning level, but has no effect at this time.

(d) The logic 0 output from gate Z1B is applied as an input to gate Z1A (pin 2), gate Z2B (pin 3), and gate Z3A (pin 2). The input to gate Z1A (pin 2) has no effect at this time since gate Z1A has been previously activated by the logic 1 from transistor Q3.

(e) The logic 0 input applied to gate Z2B has no effect at this time as the gate was previously activated by a logic 1 from the signal detector. With a logic 0 output from gate Z2B applied to transistor Q9, transistor Q9 is unable to conduct. Gate Z3A has been previously activated by a logic 1 input to pin 1 and is not affected at this time by the logic 0 input to pin 2. The output from Z3A is a logic 0 which maintains transistors Q10 and Q11 in an off condition. The output logic 1 from transistor Q10 turns on gate Z3B which, in turn, produces a logic 0 and maintains transistor Q12 in an off condition. Table 2-1 illustrates the logic levels applied to the 18A4 circuitry for various conditions of operation.

(5) *Station A calls station B.* Refer to figures FO)-2 and FO-13. When station A places a call to station B, the 1,600-Hz tone being sent to station B is interrupted. This is the only action required at this time, and it will alert the station B operator to an incoming call. To accomplish this, station A inserts a call cord into the switchboard, grounding the T lead. A change in the input voltage level to the A detector will occur, this changes the detector output level to a logic 1. With a logic 1 input to transistor Q3, a logic 0 is produced in the output and applied to both gates Z1A and Z3A. Gate Z3A activates and produces a logic 1 at its output which turns transistors Q10 and Q11 on. With Q10 activated, gate Z3B is preconditioned by a logic 0 for the return call from station B. Note that with a logic 1 from the signal detector at pin 3 of Z3B, Z3B'S output remains at a logic 0. Transistor Q12 cannot conduct at this time to energize relay K1 and interrupt the 1,600-Hz tone being sent to station B. However,

Table 2-1. 18A4 Logic Levels for Operational Conditions

	DET A out-	DET B out-	Z1A gate In	Z1A gate Out	Z1B gate In	Z1B gate Out	Z2A gate In	Z2A gate Out	Z2B gate In	Z2B gate Out	Z3A gate In	Z3A gate Out	Z3B gate In	Z3B gate Out	Signaling detector output
Idle	0	0	1 0	0	0 1	0	0 0	1	0 1	0	1 0	0	1 1	0	1
Station A calls station B	1	1	0 0	1	1 0	0	1 1	0	0 1	0	0 0	1	1 0	0	1
Station B answers station A's call	1	1	0 0	1	1 0	0	1 1	0	0 0	1	0 0	1	0 0	1	0
Station A disconnects	0	0	1 0	0	0 1	0	0 0	1	0 0	1	1 0	0	0 1	0	0
Station B disconnects	0	0	1 0	0	0 1	0	0 0	1	0 1	0	1 0	0	1 1	0	1

with Q11 activated, a —27-volt level is applied to the anode of diode CR15. Back-biased, the diode is unable to conduct, and the 1,600-Hz tone to transformer T3 and subsequently to station B is cut off. Gate Z1A activated by the logic 0 produces a logic 1 at its output which is applied to gate Z1B, which remains activated, and to the base of transistor Q5, Transistor Q5 and associated components make up a voltage control network which controls the current supplied to the T lead. Station A now waits for station B to return its call.

(6) *Station B answers station A's call.* Refer to figures FO-2 and FO-13. Station B is in an idle condition at the time station A places a call. When the 1,600-Hz tone is interrupted, the 18A4 panel circuitry alerts the station B operator to an incoming call by changing the switchboard indicator from black to white. When station B inserts an answer cord into the switchboard, the 1,600-Hz signal being sent to station A is interrupted and station B's voice circuit is activated.

(a) With no 1,600-Hz input to pins 5 and 6 of transformer T1, transistors Q6 and Q7 operate in a quiescent state. Tone and guard circuit capacitors discharge and cut off transistor Q8 which changes its output to a logic 0. The logic 0 is applied to gate Z2B (pin 5) and gate Z3B (pin 3). Gate Z2B cuts off and produces a logic 1 at its output, pin 6, this logic 1 turns on transistor Q9, which supplies voltage to the switchboard indicator via the R lead.

(b) When operator B inserts his answer cord into the switchboard, Z3A output (pin 7) goes to logic 1 and transistor Q10'S output goes to logic 0 as stated in (5) above. Gate Z3B now has logic 0's at the 3 and 5 input and the output (pin 6) goes to a logic 1, which turns transistor Q12 on, energizing relay K1. Relay K1 energizing, disconnects the 1,600-Hz tone being sent to station A (which indicates station B's response) and connects the voice circuit due to K1A contact switching.

(7) *Station A's response to station B's answer.* Refer to figures FO-2 and FO-13. When station B answered station A's call, the 1,600-Hz tone was interrupted. The 18A4 panel circuitry at station A alerts the operator that station B has answered his call by changing the switchboard indicator from black to white (due to transistor Q9 conducting) and connecting the voice circuit by energizing relay K1. Since the circuitry in both panels performs identically at both stations, refer to (6) above for circuit description.

(8) *Station A disconnects.* Refer to figures FO-2, FO-3, and FO-13. When station A disconnects, relay K1 deenergizes to disconnect the voice circuit and reinsert the 1,600-Hz tone to station B. When call or answer cord is removed from switchboard, the tip level reverts to a logic 0. With logic 0 input, Q1 detector A applies a logic 0 to Q2 detector B and transistor Q3. Transistor Q2 detector B supplies a logic 0 conditioning signal to gate Z2A pin 1, and transistor Q3 produces a logic 1 which is applied to pin 1 of Z1A and Z3A. With a logic 1 at pin 1 Z1A, NOR flip-flop Z1 is placed in the reset (idle) condition. Logic 0 at Z1 pin 7 places a cutoff bias on transistor Q5, conditions Z1B pin 3, and causes Z2A output (pin 7) to change from logic 0 to logic 1. Gate Z2A logic 1 output connected to Z1B pin 5 maintains the Z1B output (pin 6) at logic 0. Gate Z1B pin 6 logic 0 conditioning signal is applied to Z1A pin 2, Z3A pin 2, and Z2B pin 3. The logic 1 from transistor Q3, connected to Z3A pin 1, switches Z3A output pin 7 to a logic 0 cutting off transistors Q10 and Q11. When transistor Q11 cuts off, the —27-volt back bias is removed from the anode of diode CR15; this enables the 1,600-Hz tone to transformer T3 primary. Transistor Q10 (in cutoff) produces a logic 1 at Z3B pin 5, switching Z3B'S output pin 6 to logic 0 and cutting off transistor Q12. Transistor Q12 in cutoff deenergizes relay K1, breaking the voice circuit contacts and making the tone insert contacts. The insertion of 1,600-Hz tone alerts station B that station A has disconnected by changing the switchboard indicator.

(9) *Station B's response to station A's disconnect.* Refer to figures FO-2, FO-3, and FO-13. When station A disconnects, the 1,600-Hz tone is reinserted to station B. This tone is applied to contacts 5 and 6 of transformer T1 and coupled into the signal detector circuit. Signal detector output, logic 1 with tone present, is connected to Z3B pin 3, which does not affect circuit output, and to Z2B pin 5. The output of gate Z2B pin 6, logic 0, cuts off transistor Q9, removing the —27-volt signal from the R lead. This changes the switchboard supervisory indicator to alert station B of station A's disconnect.

(10) Since the circuitry and response are the same for a given function, the procedure in (8) and (9) above will remain valid for station B disconnect by interchanging A's and B's.

e. CV-1548( )/G chassis (fig. FO-14). The CV-1548( )/G chassis mounts the input power controls, the 2W-4W selector switches for the 12 channels, the output transformer for the 20-Hz generator on panel 18A2, and the connectors to interconnect the panels with each other and with external circuits. Filter FL1 is provided on the power input leads to suppress rfi carried by the powerline. Switches S1 through S12 each allows its associated channel to be connected straight through for four-wire operation or through panels 18A3( ) or 18A4 for two-wire to four-wire conversion. In addition to the above, the CV-1548/G units contain the metering circuit. The metering circuit includes a selector switch (TEST ALIGN meter switch S14) that permits the meter to be connected to five different points for monitoring.

CHAPTER 3
DIRECT SUPPORT MAINTENANCE

Section I. GENERAL MAINTENANCE INFORMATION

WARNING

Voltages as high as 115 volts ac exist in the CV-1548( )/G when power is applied. Be careful not to contact any terminals carrying this voltage when testing the unit. Disconnect the unit from the power source whenever the CV-1548( )/G is not being operated.

NOTE

In this manual, 18A1 ( ) applies to the 18A1, 18A1A and 18A1B power supplies unless otherwise indicated.

3-1. Scope of Maintenance

Direct support maintenance consists of troubleshooting the CV-1548(**)/G** down to the chassis mounted part, the circuit card or part of power supply assembly 18A1( ), or panels 18A2, 18A3( ), and 18A4. Direct support maintenance can repair all causes of trouble down to the level to which troubleshooting is authorized, except that replacement of the 31-pin connectors into which the panels plus is not authorized. Direct support maintenance also includes adjusting the 1,600-Hz signal level and the power supply reference voltage of the 18A1 power supply. The procedures contained herein are not complete in themselves, but complement the procedures for operator and organizational maintenance given in TM 11-5805-367-12 sofar as they pertain to the CV-1548( )/G. Whenever possible, the organizational maintenance procedures should be exhausted before proceeding with direct support maintenance. Figures 3-1, 3-2, and FO-15 through FO-17 show the parts locations for power supply assembly 18A1( ); panels 18A2, 18A3( ), and 18A4; and the CV-1548( )/G chasis. Figures FO-18 and FO-19, respectively, are wiring diagrams for the power supply assembly 18A1( ) and the CV-1548( )/G.

3-2. Test Equipment and Tools Required

The chart below lists the test equipment and tools required for direct support maintenance.

Test equipment and tools	*Associated technical manual*
Multimeter TS-352B/U	TM 11-6625-366-15.
Voltmeter, Electronic ME-30B/U	TM 11-6625-320-12.
Test Set, Transistor TS-1836/U	TM 11-6625-539-15.
Tool Equipment TE-123 or Tool Kit, Radio Repairman TK-115/U.	Not applicable.

3-2.1. Rewiring of Rotary Switch

NOTE

A wiring error exists that causes a malfunction when the CV-1549( )/G is in the data mode. A rewiring change must be performed whenever a CV-1548( )/G is evacuated to direct support for repair. This change is to be performed on six channels: 3, 4, 7, 8, 11, and 12 (fig. 3-2.1).

a. Loosen the captive screws that secure the top cover and remove the top cover.

(1) Loosen the two loop clamps behind the 2W-4W switches that secure the wiring harness and the loop clamp on the side of the unit.

(2) Loosen the hex nut that secures the 2W-4W switch to the front panel and remove the 2W-4W switch from the panel.

b. Unsolder the wires from tabs 3 and 6 on wafer A (fig. 3-2.2) for channel 3. Resolder the wires to the opposite tabs as follows:

(1) Unsolder and remove wire from tab 3.
(2) Unsolder and remove wire from tab 6.
(3) Resolder wire from tab 3 to tab 6.
(4) Resolder wire from tab 6 to tab 3.

c. Repeat *b* above for channels 4, 7, 8, 11 and 12.

d. Replace the rewired switch and tighten the hex nut securing the switch. Retighten the cable clamps and replace and screw down the top cover.

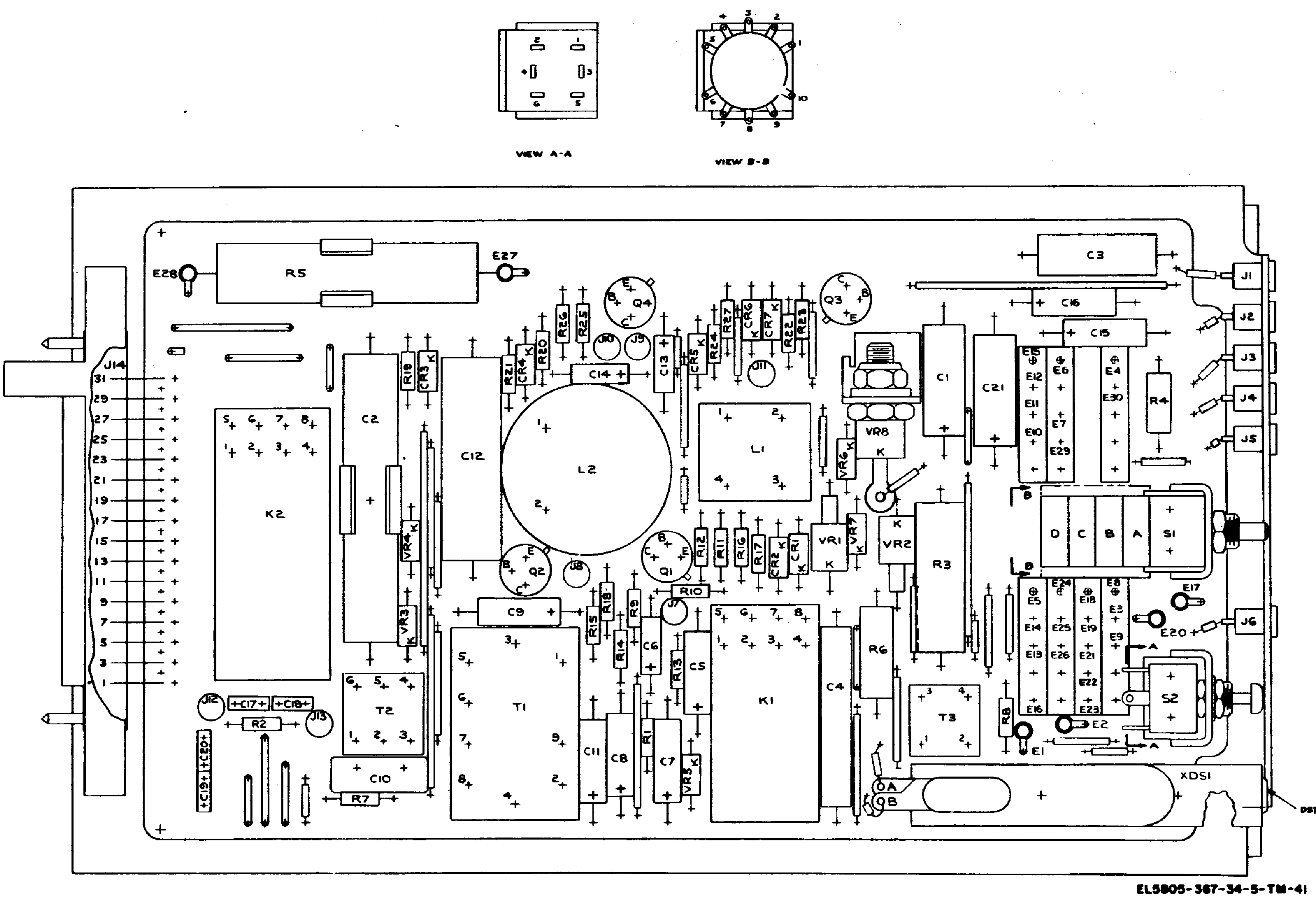


Figure 3-1. Panel 18A3, parts location diagram.

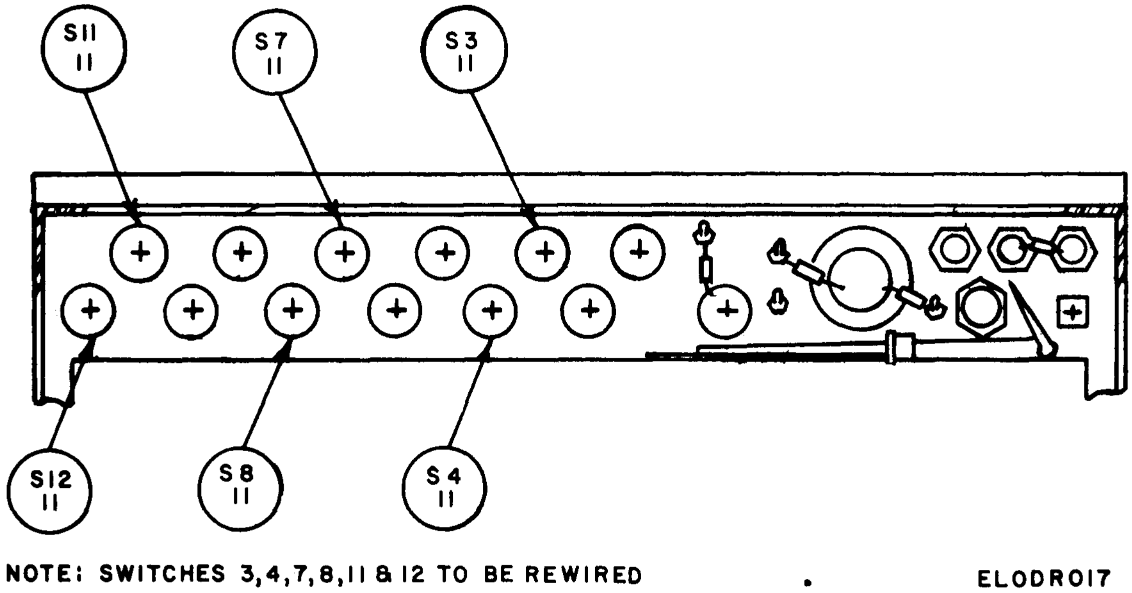


Figure 3-2.1. Converter, Telephone Signal CV-1548/G, Rear View of Front Panel.

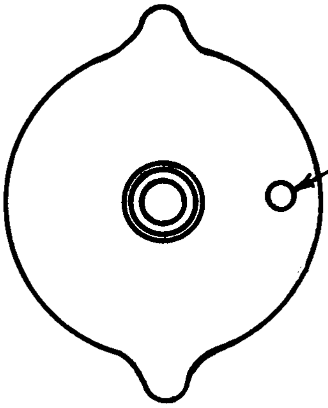
3-3. Fabrication of Power Supply Assembly Test Cable

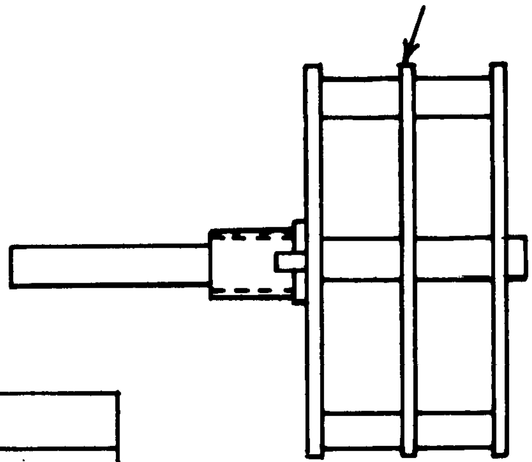
To gain troubleshooting access to parts mounted on power supply assembly 18A1( ), an extension cable must be used that permits the power supply assembly to function while the assembly is withdrawn from its mounting location in the CV-1548( )/G. This cable must be fabricated in accordance with the instructions given in *a* below.

a. The following materials are required for the fabrication of the test cable:

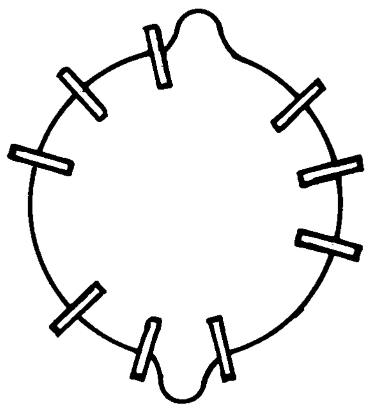
Item	*Quantity*	*National stock No.*
Connector, male	1	5935-00-577-0008
Connector, female	1	5935-00-577-0011
Wire, No. 16 AWG, solid insulated	45 ft	6145-00-893-6471

b. Assemble the materials as indicated in figure 3-3. After completing assembly, identify the cable as power supply assembly 18A1( ) test cable.





2W-4W SWITCH	COLOR OF WIRE			
	BEFORE		AFTER	
	TAB 3	TAB 6	TAB 3	TAB 6
CH 3	WHITE	PURPLE	PURPLE	WHITE
CH 4	"	ORANGE	ORANGE	"
CH 7	"	PURPLE	PURPLE	"
CH 8	"	ORANGE	ORANGE	"
CH 11	"	PURPLE	PURPLE	"
CH 12	"	ORANGE	ORANGE	"



ELODR018

Figure 3-3.2. *Rotary Switch, NSN 5805-00-930-4837.*

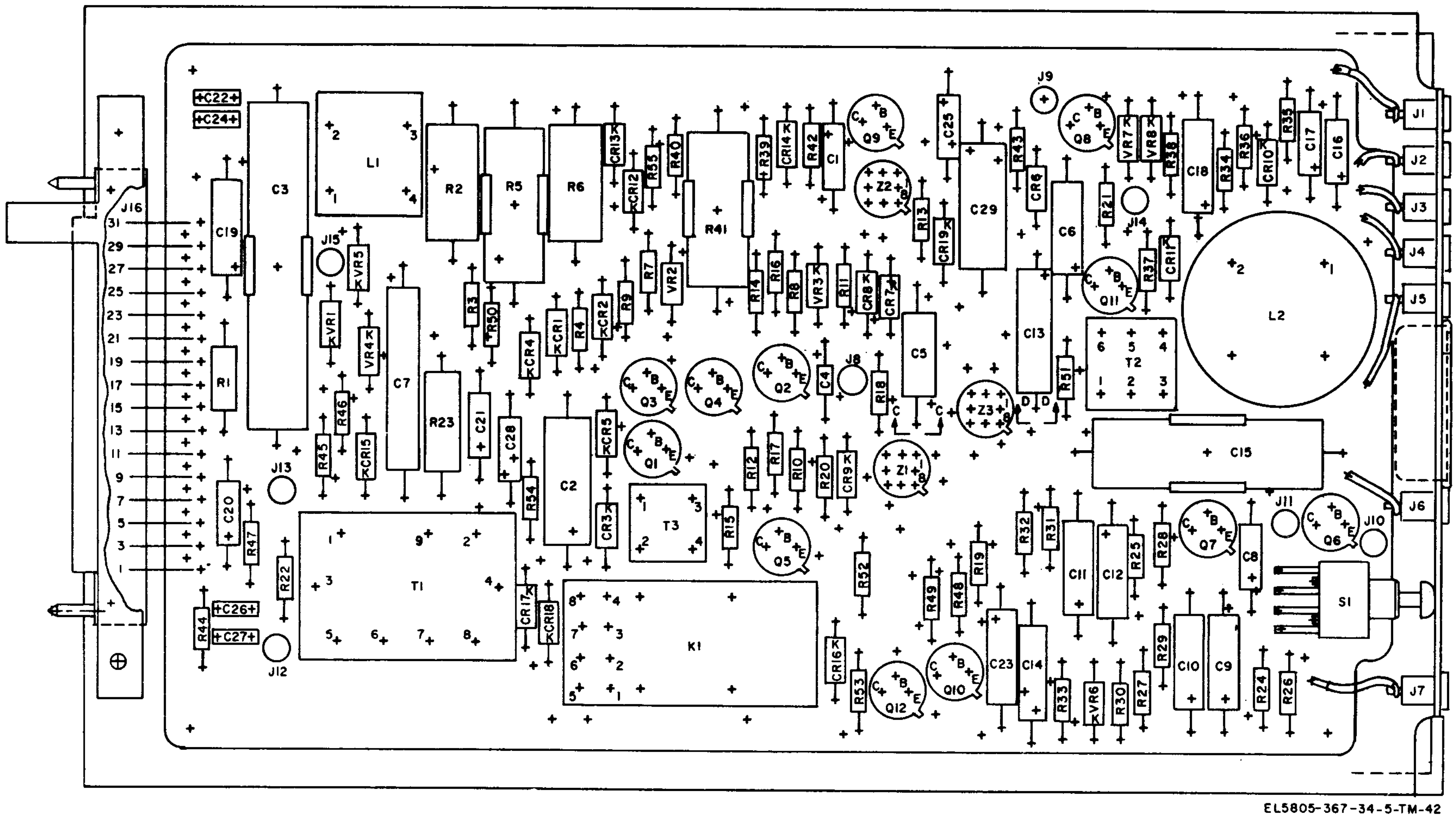


Figure 3–2. Panel 18A4, parts location diagram.

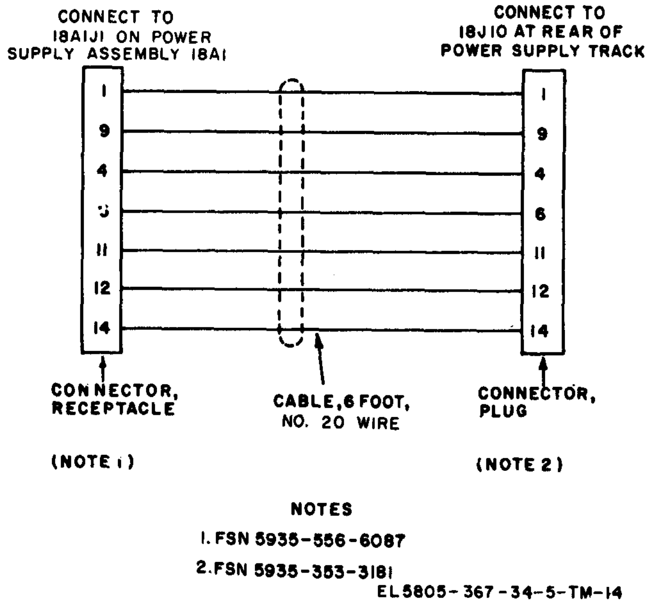


Figure 3-3. Power supply assembly 18A1( ) electrical test cable assembly, schematic diagram.

Section II. TROUBLESHOOTING

3-4. Introduction

Troubleshooting at direct support isolates troubles caused by parts mounted on the CV-1548( )/G chassis, with the exception of the 31-pin connectors, or parts of power supply assembly 18A1( ), with the exception of those parts of the power supply assembly that are mounted to printed circuit card 18A1A1. Direct support troubleshooting is a continuation of the troubleshooting begun by the operator when he became aware of a malfunction during operation or when performing preventive maintenance. Operator and organizational maintenance instructions are contained in TM 11-5805-367-12. It is assumed that these earlier troubleshooting procedures have failed to restore the CV-1548( )/G to operation. Direct support troubleshooting information is presented in a troubleshooting chart and as additional troubleshooting information that supplements the information in the chart. The background information contained in the functioning chapter will also prove to be a valuable tool for troubleshoooting the equipment rapidly and effectively, and maximum use should be made of this information.

3-5. Troubleshooting Chart

The chart below lists symptoms which indicate trouble in the CV-1548( )/G. The symptoms listed in the chart are obtained from the built-in monitor circuits in the equipment. The *Possible trouble* column of the chart lists the most likely cause or causes of the noted symptom. Standard troubleshooting techniques should be applied to determine which possible trouble is causing the symptom. The *Corrective measure* column of the chart states steps to be taken to eliminate the trouble.

NOTE

Replacement of 31-pin connectors is not authorized at direct support. If a wiring defect is traced to a defective connector, the CV-1548( )/G must be forwarded to higher category of maintenance for the required repair.

Item No.	*Symptom*	*Possible trouble*	*Corrective measure*
1	1/2ASB fuse keeps blowing, fault not on panel 18A2, 18A3( ), or 18A4.	*a.* Shorted filter capacitor 18A1-C1-18A1C6 in one of the outputs of the power supply.	*a.* Identify and replace defective capacitor.
		b. Short circuit, or shorted part on circuit board 18A1A1.	*b.* Replace circuit board 18A1A1.

Item No.	Symptom	Possible trouble	Corrective measure
		c. Shorted winding on power transformer 18A1T1 or 18A1T2.	*c.* Identify and replace defective power transformer.
		d. Short circuit in wiring of power supply assembly 18A1( ).	*d.* Check wiring of assembly against wiring diagram (fig. FO-18) and correct short circuit.
		e. Short circuit in ac or dc power distribution wiring of CV-1548( )/G.	*e.* Check wiring against wiring diagram (fig. FO-19) and correct short circuit.
2	CV-1548( )/G fails to operate when power is applied and POWER switch is at ON.	*a.* POWER switch 18S13 is defective. *b.* Filter 18FL1 is defective *c.* Defective wiring	*a.* Replace defective switch. *b.* Replace defective filter. *a.* Check wiring against wiring diagram (fig. FO-19) and repair defect.
3	POWER indicator 18DS1 does not light, but TEST ALIGN meter 18M1 indicates power is available.	*a.* Resistor 18R1 defective *b.* Lamp socket 18XDS1 defective *c.* Defective wiring	*a.* Replace defective resistor. *b.* Replace lamp socket. *c.* Check wiring against wiring diagram (fig. FO-19) and repair defect.
4	Erroneous TEST ALIGN meter indication in 20~ DRIVE, 20~, and 1600~ not due to panel 18A2.	Defective capacitor 18C18	Replace defective capacitor.
5	Erroneous TEST ALIGN meter indication in + and 1600~.	Defective capacitor 18C17	Replace defective capacitor.
6	Erroneous TEST ALIGN meter indication in −, not due to power supply assembly 18A1( ).	*a.* Defective resistor 18R2 *b.* Defective meter selector switch 18S14. *c.* Defective wiring	*a.* Replace defective resistor. *b.* Replace defective switch. *c.* Check wiring against wiring diagram (fig. FO-19) and repair defect.
7	Erroneous TEST ALIGN meter indication in +, not due to power supply assembly 18A1( ).	*a.* Defective resistor 18R3 *b.* Defective meter selector switch 18S14. *c.* Defective wiring	*a.* Replace defective resistor. *b.* Replace defective switch. *c.* Check wiring against wiring diagram (fig. FO-19) and repair defect.
8	Erroneous TEST ALIGN meter indication in all positions of the meter selector switch.	*a.* Defective TEST ALIGN meter 18M1. *b.* Defective meter selector switch 18S14. *c.* Defective wiring	*a.* Remove defective meter. Do not replace. *b.* Repair or replace meter selector switch. *c.* Check wiring against wiring diagram (fig. FO-19) and repair defect.
9	No 20-Hz output on any channel, not due to panel 18A2.	*a.* Transformer 18T1 defective *b.* Defective wiring	*a.* Replace defective transformer. *b.* Check wiring against wiring diagram (fig. FO-19) and repair defect.
10	+24-volt output voltage from power supply assembly 18A1 defective.	*a.* Transformer 18A1T1 defective *b.* Circuit card 18A1A1 defective *c.* Defective capacitor 18A1C4–18A1C6. *d.* Defective wiring	*a.* Replace defective transformer. *b.* Replace defective circuit card. *c.* Replace defective capacitor. *d.* Check wiring against wiring diagram (fig. FO-18) and repair defect.
11	−24-volt output voltage from power supply assembly 18A1 defective.	*a.* Defective transformer 18A1T2 *b.* Defective circuit card 18A1A1 *c.* Defective capacitors 18A1C2 and 18A1C3. *d.* Defective wiring	*a.* Replace defective transformer. *b.* Replace defective circuit card. *c.* Replace defective capacitor. *d.* Check wiring against wiring diagram (fig. FO-18) and repair defect.
12	Defective reference voltage output from power supply assembly 18A1. (No reference voltage output, reference voltage erratic, TEST ALIGN meter difficult to adjust or keep in adjustment in 1600~.)	*a.* Defective circuit card 18A1A1 *b.* Defective REF control 18A1R1 *c.* Defective wiring	*a.* Replace defective circuit card. *b.* Replace defective control. *c.* Check wiring against wiring diagram (fig. FO-18) and repair defect.

Item No.	Symptom	Possibble trouble	Corrective measure
13	Defective –30-volt (signal battery) output from power supply aasembly 18A1( ).	*a.* Defective transformer 18A1T2 ----- *b.* Defective circuit card 18A1A1 ----- Defective capacitor 18A1C1 --------- *c.* Defective wiring ------------------------	*a.* Replace defective transformer. *b.* Replace defective circuit card. *c.* Replace defective capacitor. *d.* Check wiring against wiring diagram (fig. FO-18) and repair defect.
14	Defective functioning of a single channel. (If channel is operating 2W, malfunction is not due to panel 18A3( ) or 18A4.)	*a.* CH 2W-4W selector switch associated with malfunctioning channel defective. (Switch reference designation corresponds to channel number.) *b.* Defective wiring --------------------	*a.* Repair or replace defective switch. *b.* Check wiring against wiring diagram (fig. FO-19) and repair defect.

NOTE

The troubleshooting chart is used to troubleshoot the CV-1548 and CV-1548A/G. Steps or parts of steps which use the TEST ALIGN meter or meter selector switch cannot be used on the CV-1548A/G or a CV-1548/G using power supplies 18A1A or 18A1B. References to 18A1 also apply to 18A1A and 18A1B power supply assemblies unless otherwise indicated.

3-6. Additional Troubleshooting Data

a. Transformer 18T1. The chart below lists the resistance of transformer 18T1 windings.

Transformer terminals	Resistance (ohms)
18T1-1-18T1-2	2.5
18T1-1-18T1-3	5.0
18T1-4-18T1-6	55.0

b. Transformer 18A1T1. The chart below lists the resistance of transformer 18A1T1 windings. The resistance is measured with the windings disconnected from external circuits.

Transformer terminals	Resistance (ohms)
18A1T1-1-18A1T1-2	6.0
18A1T1-3-18A1T1-5	0.5

c. Transformer 18A1T2. The chart below lists the resistance of transformer 18A1T2 windings. The resistance is measured with the windings disconnected from external circuits.

Transformer terminals	Resistance (ohms)
18A1T2-1-18A1T2-2	6.0
18A1T2-3-18A1T2-4	0.5
18A1T2-5-18A1T2-6	0.2

Section III. ADJUSTMENTS

3-7. General

There are two adjustments on the CV-1548/G: the output level of the 1600-Hz signal and TEST ALIGN meter calibration. TEST ALIGN meter calibration (REF control on 18A1) is deleted for CV-1548A/G, as no meter is installed. The 1600-Hz output level must always be checked prior to reference voltage level adjustment. The reference voltage level adjustment is required whenever the 1600-Hz output level is changed, or if power supply 18A1 or panel 18A2 is changed.

3-8. Adjustment of 1,600-Hz Output level

a. Remove panel 18A2 from the CV-1548( )/G.

b. Connect removed panel 18A2 to the extender panel and insert the assembly into the slot from which the 18A2 panel was removed.

c. Connect test leads of the ME-30B/U to terminals 5 and 6 of connector 18A2J16 and operate the meter to the 1-volt range.

d. On the CV-1548( )/G, operate the POWER ON-OFF switch to ON.

e. Use the screwdriver supplied with the CV-1548( )/G to adjust the ADJ 1600 control on panel 18A2 to obtain an indication of 360 millivolts (mv) on the ME-30B/U.

NOTE

The adjustment can be set to any level between 0 and 760 mv. If a level different from that specified in *e* above is desired, set the ADJ control accordingly and note the level to which the control is set on panel 18A2.

f. Operate the CV-1548( )/G POWER ON-OFF switch to OFF, remove the extender panel, and reinsert panel 18A2 in the CV-1548( )/G.

3-9. Power Supply Assembly 18A1 REF Control Adjustment

NOTE

> Before proceeding with the adjustments below, make sure that the 1,600-Hz output is adjusted to the correct level. Adjustment not applicable to 18A1A or 18A1B.

a. Operate the TEST ALIGN meter selector switch to 1,600.

b. Operate the POWER ON-OFF switch to ON. If the TEST ALIGN meter indicates at the hairline, the REF control is adjusted correctly and no further adjustment is required. If the TEST ALIGN meter indicates off the hairline, perform the procedures given in c, *d*, and e below,

c. Unsnap the cover from the access hole to the REF control on the power supply assembly 18A1 front panel.

d. Use a 9/16-inch open-end wrench to loosen the shaft locknut on the REF control and, with the screwdriver supplied with the CV-1548/G, adjust the REF control so that the TEST ALIGN meter indicates on the hairline on the meter face.

e. Tighten the shaft locknut on the REF control; check to see that the TEST ALIGN meter indication is not disturbed and replace the cover in the access hole.

Section IV. REPLACEMENT PROCEDURES

3-10. Transformer 18T1

a. Loosen the 14 captive screws that secure the CV-1548( )/G rear cover and remove the rear cover.

CAUTION

> To avoid mistakes in connecting the replacement transformer, mark each wire connected to terminals on the transformer with the identity of the terminal before disconnecting the wire.

b. Disconnect the wires from the terminals of transformer 18T1.

c. Loosen the 10 captive screws that secure the perforated inner front cover and remove the cover from the CV-1548 ( )/G.

d. Loosen the two captive screws that secure power supply assembly 18A1 ( ) and remove power supply assembly 18A1 ( ).

e. Loosen the 14 captive screws that secure the CV-1548( )/G top cover and remove the top cover.

f. Remove the six screws that secure the power supply assembly mounting bracket to the bottom of the CV-1548 ( )/G case; remove the bracket.

g. Remove the two screws that secure the bottom transformer mounting flange to the CV-1548 ( )/G case.

h. Remove the two screws that secure the top transformer mounting flange to the' CV-1S48( ) / G CU.

i. Tilt the transformer forward as required, and remove the transformer through the rear of the CV-1548( ) /G.

j. To install the replacement transformer, reverse the removal procedure outlined in a through i above. When inserting the transformer in the CV-1548( )/G case, check to be sure that the transformer is positioned so that terminal 1 on the transformer is the uppermost terminal. When installing the power supply assembly mounting bracket, be sure to install the plastic tracks with the front bevel on top.
installing the power supply assembly mounting bracket, be sure to install the plastic tracks with the front bevel on top.

3-11. Meter 18M1

a. Loosen the 14 captive screws that secure the top cover of the CV-1548/G; remove the top cover.

b. Remove the nuts that secure the solder lugs to the meter terminals.

c. From the front of the CV-1548/G, remove the three screws that secure the meter case to the CV-1548/G. Remove the meter mounting.

d. Remove the meter mounting washer from the rear while removing the meter from the front of the unit.

NOTE

> Do not replace meter. All electrical tests using meter 18M1 (also known as the TEST ALIGN meter) are not applicable once the meter fails or an 18AIA or 18A1B power supply is installed.

3-12. Filter 18FL1

a. Loosen the 14 captive screws that secure the top cover of the CV-1548( )/G; remove the top cover.

b. Unsolder and disconnect the wires from the rear of the filter, tagging the wires for ease of replacement.

c. Remove the receptacle for the top cover screw which is directly to the rear of the filter.

d. From the rear of the CV-1548( )/G, remove the screw that secures the filter; then remove the nuts from the neck of jacks J7 and J8. and remove the filter from the CV-1548 ( )/G.

e. Install the replacement filter by reversing the removal procedure.

3-13. Connector 18J10

a. Remove the power supply assembly mounting bracket as indicated in paragraph 3-9 *c* through e.

b. Unsolder the leads from connector 18J10; tag the wires for ease of replacement.

c. Remove the two screws that secure the connector to the power supply assembly mounting bracket and remove the connector.

d. Install the replacement connector by reversing the removal procedure.

CHAPTER 4

GENERAL SUPPORT MAINTENANCE

WARNING

Voltages as high as 115 volts ac exist in the CV-1548 ( )/G when power is applied. Be careful not to contact any terminals carrying this voltage when testing the unit. Disconnect the unit from the power source whenever the CV-1548( )/G is not being operated.

NOTE

Except for references to the TEST ALIGN meter and meter selector switch, general support maintenance information in chapter 4 is applicable to maintaining the CV-1548A/G or CV-1548/G using the 18A1A or 18A1B power supplies. In this manual, 18A1 also applies to 18A1A or 18A1B unless otherwise specified.

4-1. General Troubleshooting Information

a. General support maintenance troubleshooting is a continuation **of** organizational and direct support "maintenance troubleshooting. General support maintenance troubleshooting is restricted to finding a defect on circuit card Al of power supply assembly 18A1 ( ), or on panel 18A2, 18A3( ), or 18A4. Troubleshooting of the CV-1548( )/G chassis is restricted to locating a defective 31-pin connector into which the panels plug. This troubleshooting consists of visual inspection and continuity checks made in accordance with the schematic diagram (fig. FO-14) and the wiring diagram (fig. FO-19).

b. General support troubleshooting is performed by the use of a standard CV-1548( )/G that is known to be in working order as a test jig. When troubleshooting is to be performed on a defective panel, the corresponding working panel is removed from the standard CV-1548 ( )/G. The defective panel is first plugged into an extender panel, and the combination is then inserted into the standard CV-1548( )/G. For power supply assembly 18A1( ), an extension cable is used instead of the extender panel.

c. General support maintenance troubeshooting consists of localization and isolation. Localization means tracing the fault to the defective circuit, and isolation means tracing the fault to the defective part. Some faults can be isolated by sight, touch. smell, or hearing. The majority of faults, however, will require waveform checks and voltage measurements. Systematic procedures are provided for localizing and isolating trouble in the circuit card of power supply assembly 18A1( ) (para 4-3), panel 18A2 (para 4-4), panel 18A3( ) (para 4-5), and panel 18A4 (para 4-6).

4-2. Test Equipment, Tools, and Material Required

a. *Test Equipment.*

(1) Multimeter TS-352B/U.

(2) Oscilloscope AN/USM-140A.

(3) Converter, Telephone Signal CV-1548/G.

(4) Test Set, Transistor TS-1836/U.

(5) Voltmeter, Electronic ME-30B/U.

(6) Multimeter ME-26B/U.

b. Tools.

(1) Tool Equipment TE-123 or Tool Kit, Radio Repairman TK-115/U.

(2) Tool Kit, Electronic Equipment TK-l05/G.

c. Materials.

(1) Electrical test panel (extender panel).

(2) Power supply assembly teat cable. (Refer to para 3-3 for fabrication instructions.)

(3) Resistor, 600 ohms ±1 percent (two each).

4-3. Troubleshooting Circuit Card A1 of Power Supply Assembly 18A1( )

a. General. The symptoms listed in the troubleshooting chart (*c* below) are based on voltage measurements made with the TS-352B/U, with the power supply assembly operating in the standard CV-1548 ( )/G. The possible troubles listed indicate defective parts that may cause each symptom. The corrective measures indicate procedures used to localize the trouble to a defective circuit or to isolate the trouble to the defective part.

b. Test Setup.

(1) Remove power supply assembly 18A1( ) from the standard CV-1548 ( )/G.

(2) Using the power supply assembly test cable, connect jack 18A1J3 of the power supply assembly to be troubleshoot to connector 18J10 of the CV-1548( )/G.

(3) On the CV-1548( )/G, operate the POWER ON-OFF switch to ON.

(4) Use the TS-352B/U to check the voltages obtained on circuit card 18A1 ( ) against the values given in the chart below. Check the voltages in the order in which they are listed in the chart. For the first voltage that is not obtained in making the measurements, look up the corresponding symptom in the troubleshooting chart (c below).

NOTE

The output voltages of the power supply are interdependent. Be sure to check the voltages in the listed order and to start troubleshooting with the first abnormal reading obtained.

Meter connection (−)	Meter connection (+)	Voltage (vdc)
E10	E11	+24 ±20% (+19.2 − +28.8)
E6	E10	−24 ±20% (−19.2 − −28.8)
E3	E10	−30 ±20% (−24 − −36)
*E7	E10	− 6.2 ±5% (−5.9 − −6.5)

*Not applicable to 18A1A or 18A1B.

c. Troubleshooting Chart.

Item No.	Sympton	Possible trouble	Corrective measure
1	Primary power fuses 18F1 and 18F2 keep blowing when POWER ON-OFF switch is operated to ON after power supply assembly 18A1 is installed.	Short circuit or short circuited part on circuit card A1.	Examine the card carefully to find short circuit. Check capacitor C7, C8, and C9 and rectifiers CR1 through CR12 for short circuit.
2	Incorrect +24-volt dc output	Defective rectifier CR9 through CR12-	Check rectifiers CR9 through CR12 (para 4-3d).
3	Incorrect -24-volt dc output	Defective rectifier CR5 through CR8--	Check rectifiers CR5 through CR8 (para 4-3d).
4	Incorrect-30-volt dc output	Defective rectifier CR1 through CR4--	Check rectifiers CR1 through CR4 (para 4-3d).
*1 5	Incorrect voltage at terminal E7	Defective breakdown diode VR1 or resistor R2.	If voltage reads high (approximately 14 volts), diode VR1 is defective. Otherwise, check value of resistor R2 with an ohmmeter. Replace resistor if value is other than 2K ohms ±10 percent. If the resistance is as specified, replace diode VR1.

*1 Not applicable to 18A1A.

d. Additional Troubleshooting Data. Check rectifier diodes by measuring the forward and reverse resistance after disconnecting the diode *from* the circuit. The forward resistance should be approximately 10 ohms, and the reverse resistance should be greater than 10K ohms.

4-4. Troubleshooting Panel 18A2

a. General. The troubleshooting procedure for panel 18A2 first sectionalizes the trouble to either the 1,600-hertz circuit or the 20-hertz circuit by means of the TEST ALIGN meter of the standard

CV-1548( )/G. The procedure then localizes the trouble to the faulty stage by means of a trouble-shooting chart. Additional troubleshooting data in the form of voltage and resistance data are provided to help in isolating the defective part.

b. Test Setup.

(1) Remove panel 18A2 from the standard CV-1548( )/G.

(2) Install the 18A2 panel to be tested in the extender panel.

(3) Install the extender panel in the standard CV-1548( )/Gin the slot from which panel 18A2 was removed in (1) above.

(4) On the CV-1548( )/G, operate the POWER, ON-OFF switch to ON.

(5) On the CV-1548/G, operate the TEST ALIGN meter selector switch in sequence to 20~ DRIVE, 20~, and 1600~, and also observe whether the 20~ indicator is lighted on the panel being tested. Compare the indications obtained with the indications listed in the chart below. The chart lists different combinations of indications of trouble that may be obtained, and references the appropriate item number in the troubleshooting chart to which to proceed for a given combination of indications.

TEST ALIGN meter indications			20 indi-cator	Proceed to item No.
1600~	20~	20~ DRIVE		
Not green	Not yellow	Not yellow	Off	1
Not green	Yellow	Yellow	On	2
Green	Not yellow	Yellow	Off	6
Green	Not yellow	Yellow	On	9
Green	Yellow	Yellow	Off	10
Green	Yellow	Not yellow	Or	11
Green	Not yellow	Not yellow	Off	12

NOTES

1. When troubleshooting panel 18A2, make sure that at least one panel 18A3( ) is plugged in to the standard CV-1548( )/G.

2. The meter indications above do not pertain to CV-1548A/G or to CV-1548/G using the 18A1A or 18A1B power supply.

c. Troubleshooting Chart.

Item No.	Symptom	Possible trouble	Corrective measure
1	Panel 18A2 dead; may cause fuse to blow in CV-1548( )/G or Dower supply assembly 18A1( ).	Defective +24- or -24-volt dc circuit.	Visually impact the dc circuits and return for open or short circuit. Check capacitor 18A2C1 for short circuit.
2	TEST ALIGN meter doea not indicate in green sector for 1600 ~. (For CV-1548A/G, or CV-1548/G using modified power supplies 18A1A or 18A1B, perform corrective measures a and c only if the output at pins 5 and 6 is not 360 mv.	a. ADJ 1600 control incorrectly adjusted.	a. Connect ME-30B/U between pins 5 and 6 of the extender panel and adjust ADJ 1660 control to obtain an indication of 860 mv rms on the meter.
		b. Faulty metering circuit	*b.* Connect ME-30B/U between pins 6 and 6 or the extender panel. If meter indicates 360 mv or more, adjust REF adjustment on Power supply assembly 18A1 (para 3-9) so that TEST ALIGN meter indicates in green sector. If adjustment cannot be made, check capacitor C12 and C13, resistors R22 and R23, and diodes CR3 and CR4.
		c. Faulty 1,600-Hz generator circuit.	*c.* Check waveform at jack J6. If normal, check driver, output circuit, and feedback loop. If not normal, refer to item 8.
8	Incorrect waveform at jack J6	*a.* Defective- 18-volt regulator	*a.* Check voltage at jack J7 with TS-352B/U. If voltage is greater than -19 volts or less than -17 volts, refer to item 6.
		b. Defective emitter follower	*b.* Check waveform at jack J8. If normal, check emitter follower Q2 and associated parts. If not normal, refer to item 4.

Item No.	Symptom	Possible trouble	Corrective measure
4	Incorrect waveform at jack J8	*a.* Defective - 18-volt regulator *b.* Defective 1,600-Hz Oscillator	*a.* Check voltage at jack J7 with TS-352B/U. If voltage is other than -18 volts ±1, refer to item 6. *b.* Check 1,600-Hz oscillator Q1 and associated parts.
5	Voltage at jack J7 is not -18 volts dc ±1.	Faulty breakdown diodes CR1 and CR2.	Check both diodes and replace if faulty.
6	Incorrect waveform at jack J4 and/or J8.	Defective output stage Q12-Q13	Check waveform at jacks J1 and J15. If both are normal, check output stage Q12-Q13 and associated parts. If either waveform is not normal, refer to item 7.
7	Incorrect waveform at jacks J1 and/or 316.	Defective driver stage Q10-Q11	Check waveform at jacks J2 and J5. If both are normal, check driver stage Q10-Q11 and associated parts. If either waveform is not normal, refer to item 8.
8	Incorrect waveform at jacks J2 and/or J5.	Defective phase-splitter stage Q8 and Q9.	Check waveform at emitter of transistor Q8. If normal, check phase-splitter stage Q8 and Q9 and associated parts. If waveform is not normal, refer to item 12.
*9	20~ indicator lighted, but TEST ALIGN meter does not indicate in yellow sector for 20~.	Defective metering circuit	Check waveform at terminal 9 of jack J16, If normal, check resistors R52 through R55, diode CR11, and capacitor C27. If not normal, refer to item 6.
*10	TEST ALIGN meter indicates in yellow sector for 20 ~ but 20 ~ indicator is off.	Defective indicator circuit	Check indicator lamp DS1 and resistor R51, and make necessary repairs.
*11	TEST ALIGN meter indicates in yellow sector for 20 ~, 20~ indicator is on, but meter does not indicate in yellow sector for 20~ DRIVE.	Defective metering circuit	Check capacitor C24 and C25, diodes CR9 and CR10, and resistor R50, and make necessary repairs.
12	Incorrect waveform at emitter of transistor Q8.	Defective phase splitter	Check waveform at jack J4, If normal, check phaae-splitter Q8-Q9 and associated parts. If not normal, refer to item 19.
13	Incorrect waveform at jack J4	Defective emitter follower Q7	Check waveform at jack J13. If normal, check emitter follower Q7 and associated parts. If not normal, refer to item 14.
14	Incorrect waveform at jack J13	Defective 20-Hz oscillator Q6	Check 20-Hz oscillator Q6 and associated parts, and make necessary repairs.

*These tests pertain to CV-1548/G when using power supply 18A1 only.

d. Additional Troubleshooting Data.

(1) *Transistor terminal voltage data.* The chart below lists voltages obtained at transistor terminals on panel 18A2. Except as otherwise noted, the voltages were obtained by the use of TS-352B/U. Waveforms of figure FO-10 are referenced whenever dc measurements are not significant. For waveform measurements, use the AN/USM-140A. The chart below indicates when waveform measurements also are not significant.

Transistor	Base	Emitter	Collector
Q1	See note	−5	See note
Q2	−8	−8	0
Q3	−16.6[a]	−16.7	−0.08
Q4	−19	+5	−1.1
Q5	−19	+5	−1.1
Q6	−17	Waveform	See note
Q7	−18	Waveform	0
Q8	−1.1 [a, b]	Waveform	See note
Q9	−0.4 [a, b]	Waveform	See note
Q10	Waveform	Waveform	Waveform
Q11	Waveform	Waveform	Waveform
Q12	Waveform	Waveform	Waveform
Q13	Waveform	Waveform	Waveform

[a] Use ME-26B/U for measurement.
[b] Measure with respect to emitter Q8.

NOTE

Measurement is not significant.

(2) *Resistance data.*

Part	Measure across terminals	Dc resistance (ohms)
L1	1–2	40
	1–3	128
L2	1–2	10 (max)
T1	1–2	6
	3–4	0.2
T2	1–3	800
	4–6	110
T3	1–3	165
	4–5	2

4-5. Troubleshooting Panel 18A3( )

a. General. The symptoms listed in the troubleshooting chart (*c* below) are obtained with panel 18A8( ) installed in the standard CV-1548( )/G. The symptoms are based on the general support testing procedures and a failure to obtain the performance standads specified in the procedure. The troubleshooting chart is based on the assumption that the steps of the general support testing procedure given in paragraph 5-8 are performed consecutively in the sequence of the testing procedure. Before performing the procedures of the general support testing procedures, the operation of the 1,600-Hz signal detector is checked.

b. Test Setup.

(1) Remove panel 18A3 ( ) for channel 1 from the standard CV-1548( )/G.

NOTE

At least one standard 18A3 ( ) panel for another channel must be left installed in the CV-1548 ( )/G to complete the test procedures.

(2) Install the 18A3( ) panel to be tested in the extender panel.

(3) Install the extender panel in the channel 1 panel 18A3 ( ) slot of the standard CV-1548 ( )/G.

(4) On channel 1 18A3 ( ) panel, operate the signaling mode switch to AC.

(5) On channel 1 18A3 ( ) panel, connect the TS-352B/U, set to check continuity, between jacks J1 and J3.

(6) On the CV-1548( )/G, operate the POWER ON-OFF switch to ON.

(7) On channel 1 18A3 ( ) panel, operate the TEST switch,

(8) Note that the TS-352B/U indicates continuity while TEST switch is operated.

(9) Perform the general support testing procedure given in paragraph 5-8.

c. Troubleshooting Chart.

Item No.	Symptom	Possible trouble	Corrective measure
1	With signaling mode switch sat to AC, continuity is indicated at all times between jacks J1 and J3.	Defective relay K2	Check dc voltage at jack J4. If voltage is 0 vdc, replace defective relay K2. If voltage is more negative than -6 vdc, refer to item 2.
2	With signaling mode switch set at AC, voltage at jack J4 is not 0 vdc.	Defective relay driver Q4	Check dc voltage at jack J11 with respect to jack J10. If the voltage is approximately 1 volt dc, check relay driver Q4; if not, refer to item 8.
3	With signaling mode switch set at AC, voltage at jack J11 with respect to jack J10 is not between 0.6 and 1.5 vdc.	Defective emitter follower Q3	Check dc voltage at jack J9 with respect to jack J10. If the voltage is lees than approximately -1 vdc, check emitter follower Q3 and associated parts. If the voltage is more than -1 Svdc, check guard and tone circuits and associated parts.

Item No.	Symptom	Possible trouble	Corrective measure
4	With signaling mode switch to AC and TEST switch operated, contiguity is not indicated between jacks J1 and J3.	a. Defective tone amplifier Q1------ *b.* Defective relay K2----------------	*a.* Check waveform at jack J7. If normal, refer to items 5 through 8. If not normal, check TEST switch, resistor R1, and tone amplifier Q1 and associated parts. *b.* Check relay K2 and replace if defective.
5	Incorrect waveform at jack J8-----	Defective detector driver Q2---------	Check detector driver and associated parts.
6	With signaling mode switch in AC and TEST switch operated, voltage at jack J9 with respect to jack J10 is not between -5.8 and -7.2 vdc.	Defective guard and/or tone circuit---	Check transformer T2, inductor L2, diodes CR3 and CR4, capacitors C12 through C16, and resistors R19 through R21 .
7	With signaling mode switch in AC and TEST switch operated, voltage at jack J11 with respect to J10 is not between +5 and +7.7 vdc.	Defective emitter follower Q3 -------	Check emitter follower Q3 and associated parts.
8	With signaling mode switch in AC and TEST switch operated, voltage at jack J4 is not -22 vdc with respect to jack J1.	Defective relay driver Q4-----------	Check relay driver Q4 and associated parts.
9	Continuity is not indicated in step 1 of the performance testing procedures (para 5-8c).	*a.* Defective transformer T1 --------- *b.* Defective relay K1-------------- *c.* Defective signaling mode switch switch S1.	*a.* Check transformer T1 and replace if necessary. *b.* Check contacts of relay K1 and replace relay if contacts are defective. *c.* Check switch contacts and repair or replace switch.
10	TS-352B/U connected to standard panel 18A3 does not indicate continuity as specified in step *2b* of the performance testing procedures (para 5-8c).	*a.* Defective transformer T1 --------- *b.* Defective inductor L1------------ *c.* Defective diode CR1 or CR2 ----- *d.* Defective breakdown diode VR1, VR2, VR3, or VR4. *e.* Defective signaling mode switch S1. *f.* Defective transformer T3 --------- *g.* Defective relay K1-------------- *h.* Defective resistor R3--------------	*a.* Check transformer T1 and replace if necessary. *b.* Check inductor L1 and replace if necessary. *c.* Check diodes CR1 and CR2, and replace if defective. *d.* Check breakdown diodes VR1 through VR4, and replace if defective. *e.* Check switch contacts and repair or replace switch. *f.* Check transformer T3 and replace if necessary. *g.* Replace if necessary. *h.* Replace if necessary.
11	TS-352B/U connected to standard panel 18A3 does not indicate open circuit as specified in step *2d* of the general support testing procedures (para 5-8c).	Defective relay K1------------	Check relay and replace if defective.
12	ME-30B/U does not indicate at least 75 volts as specified in step 3c of the general support testing procedures (para 5-8c).	a. Defective contact on relay K2 ---- *b.* Defective signaling mode switch S1. *c.* Defective resistor R5------------ *d.* Defective capacitor C3----------- *e.* Defective TEST switch S2 or resistor R1.	*a.* Check contacts 7 and 8 of relay K2. Replace relay if contacts are defective. *b.* Check contacts 6 and 7 on switch S1D. Repair contacts or replace switch if d.f ctive. c. Check resistor and replace if defective. *d.* Check capacitor and replace if defective. *e.* Check switch S2 and resistor R1.

Item No.	Symptom	Possible trouble	Corrective measure
13	Indicator lamp DS1 does not lighten panel 18A3 when TEST switch is operated as specified in step 3c of the general support testing procedures (para 5-8c).	*a.* Defective indicator lamp DS1 ---- *b.* Defective TEST switch S2-------- *c.* Defective signaling mode switch S1.	*a.* Check indicator lamp and replace if defective. *b.* Check switch and replace if defective. *c.* Check contacts 6 and 7 of switch S1D, and repair or replace switch if defective.
14	ME-30B/U does not indicate 140 mv as specified in step 4a of the general support testing procedures (para 5-8c).	*a.* Defective contact on relay K1 ---- *b.* Defective signaling mode switch S1.	a. Check contacts 1 and 3 of relay K1. Replace relay if contacts are defective. *b.* Check contacts 6 and 8 on switch S1. Repair contacts or replace switch if defective.
15	ME-30B/U does not indicate O volt as specified in step 4b of the general support testing procedures (para 5-8c).	*a.* Defective resistor R4 ---------- *b.* Defective mode switch S1 -------- *c.* Defective relay K1 -------------- *d.* Defective dc blocking capacitor Cl, C2, or C21.	a. Check resistor R4. *b.* Check contacts of switch S1. *c.* Check relay K1. *d.* Operate TEST switch. If ME-30B/U indicates 140 mv while switch is operated, check capacitors Cl, C2, and C21 for short circuits and replace defective capacitor.
16	TS-352B/U does not indicate continuity as specified in step 5 of the general support testing procedures (pars 5-8c).	Defective signaling mode switch S1 ----	Check contacts 6 and 9 of switch S1A and S1D, and repair or replace switch if defective.
17	ME-30B/U fails to indicate more than 300 mv as specified in step 6 of the general support teat procedures (para 5-8c).	a. Defective inductor L1 ------------ b. Defective hybrid transformer circuit.	*a.* Operate signaling mode switch to OFF. If ME-30B /U indication increases above 350 mv, replace inductor L1. *b.* Check hybrid transformer T1, capacitor C 2, and breakdown diodes VR3 and VR4. Replace defective parts.

d. Additional Troubleshooting Data.

(1) ***Transistor terminal voltage data.*** The chart below lists voltages obtained at transistor terminals on panel 18A3 ( ). Except as otherwise noted, the voltages were obtained using the TS-352B/U. Two sets of voltages are given for each transistor, The upper voltage is obtained with. 1,600-Hz tone applied to the circuit; the lower voltage is obtained without tone applied. To apply tone, operate the TEST switch with the signaling mode switch in AC or TE.

Transistor	Base	Emitter	Collector
Q1	See note	See note	See note
	+0.6 [a, b]	+6 [c]	−12
Q2	See note	See note	See note
	+0.6 [a, b]	+5 [c]	−2.5
Q3	−0.6 [a, b]	+6.5 [c]	0
	−6 [a, c]	+0.8 [c]	0
Q4	+0.7 [b]	See note	−22
	−4 [b]	See note	0

[a] Use ME-26B/U for measurement.
[b] Measure with respect to emitter of transistor.
[c] Measure with respect to jack J10.

NOTE

Measurement is not significant.

Part	Measure across terminals	Dc resistance (ohms)
K1	2-4	2,500
K2	[a] 3-6	2,600
L1	1-2	250
	3-4	250
T1	1-2	40
	3-4	150
	5-6	35
	7-8	35
T2	1-3	1,100
	4-6	1,200

[a] Connect positive lead of TS-352B/U to terminal 6.

4-6. Troubleshooting Panel 18A4

NOTE

When testing an 18A4 panel in a loop configuration (channel 1 connected to channel 2) or as an east-west terminal (channel 1 connected to channel 1), panels tested must be compatible (18A4 to 18A4, 18A3( ) to 18A3( )) but not interchanged.

a. General. The symptoms listed in the troubleshooting chart (*c* below) are obtained with panel 18A4 installed in a standard CV-1548( )/G. The symptoms are based on the general support testing procedures and a failure to obtain the performance standards specified in the procedure. The troubleshooting chart is based on the assumption that the steps of the general support testing procedure given in paragraph 5-10 are performed consecutively in the sequence of the testing procedure. Before performing the procedures of the general support testing procedures, the operation of the 1600-Hz signal detector is checked.

b. Test Setup.

(1) Remove panel 18A4 for channel 1 from the standard CV-1548( )/G.

NOTE

At least one standard 18A4 panel for another chanel must be left installed in the CV-1548( )/G to complete the test procedure.

(2) Install the 18A4 panel to be tested in the extender panel.

(3) Install the extender panel in the channel 1 panel 18A4 slot of the standard CV-1548 ( )/G.

(4) On channel 1 18A4 panel, connect Oscilloscope AN/USM-140 to jacks J5 and J6.

(5) On the CV-1548( )/G, operate the POWER ON-OFF switch to ON.

(6) Observe 1600-Hz on oscilloscope at jacks J5 and J6.

(7) Connect jumper from jack J16 pin 15 (-24 volts) to the base of transistor Q12.

(8) Observe oscilloscope, the 1600 Hz should be missing.

(9) Move jumper lead from the base of transistor Q12 to the base of transistor Q11.

(10) Observe oscilloscope, the 1600 Hz should be missing.

NOTE

The 1600 Hz will be removed; however, relay K1 does not energize during this test.

c. Troubleshooting Chart.

Item No.	Symptom	Possible trouble	Corrective measure
		CAUTION must be observed when signals and voltages are measured at integrated circuits. Use jack J15 for negative terminal.	
1	With S1 TEST switch pressed, waveform at jack J10 is incorrect.	Defective tone amplifier Q6----------	Check detector driver and associated parts.
2	With S1 TEST switch pressed, waveform at jack J11 is incorrect.	Defective detector driver Q7--------	Check detector driver and associated parts.
3	Observe voltage change between jacks J14 and J16 with S1 TEST switch pressed ON and OFF.	Defective guard and/or tone circuit ---	Check transformer T2, indicator L2, diodes CR10 and CR11, capacitors C15 and C19, and resistore R34 through R36.
4	Observe voltage change at jack J4 with S1 TEST switch pressed ON and OFF.	Defective emitter follower Q8--------	Check emitter follower Q8 and associated parts.
5	Observe the voltage charge at J7 with pin 27 and pin 15 of J16 connected together.	Defective transistor Q5------------	Check transistor Q5 and parts.
6	Observe the voltage change at J8 with pin 27 and pin 15 of J16 connected together.	Defective transistors Q1 and/or Q3---	Change transistor Q1 and/or Q8 and associated parts.
7	Observe the voltage charge at J9 with pin 27 and pin 15 of J16 connected together.	Defective transistor Q2-------------	Check transistor Q2 and/or associated parts.

Item No.	Symptom	Possible trouble	Corrective measure
8	With pin 27 and pin 15 of J16 connetted together and an oscilloscope to jack J5 and J6, press the S1 TEST switch; waveform should be removed.	Defective NOR gate Z1B, Z3A, transistor Q11 and/or associated parts.	Check gates Z1B, Z3A, and transistor Q11 and/or associated parts.
9	With pin 27 and pin 16 of J16 connetted together, press S1 TEST switch and observe the change at the collector of Q9.	Defective transistor Q9, NOR gate Z1B.	Check Q9, gate Z2B, and associated parts.

CHAPTER 5

GENERAL SUPPORT TESTING PROCEDURES

Section I. PERFORMANCE TESTING

NOTE

Except for references to the TEST ALIGN meter and meter selector switch, general support testing procedures information in this chapter are applicable to maintaining the CV-1548A/G. In this manual, 18A1 also applies to 18A1A and 18A1B unless otherwise specified.

5-1. General

a. These testing procedures are prepared for use by General Support Maintenance Shops and service organizations responsible for general support maintenance of electronics equipment to determine the acceptability of repaired electronic equipment. These procedures set forth specific requirements that repaired equipment *must* meet before it is returned to the using organization. Perform the physical tests and inspection (para 5-5) on the CV-1548( )/G. Refer to paragraphs 5-6, 5-7, and 5-8 for the performance tests. A summary of performance standards is provided in paragraph 5-9.

b. Each test depends on the preceding test for certain operating procedure. Comply with the instructions preceding the body of the chart before proceeding to the chart Perform each test in sequence. Do not vary the sequence. For each step, perform all actions required in the Control *settings* column, and then perform each specific test procedure, and check the results obtained against the performance standard,

5-2. Test Equipment, Materials, and Other Equipment

a. General. All test equipment materials, and other equipment required to perform the testing procedure are listed in the charts below.

b. Test Equipment.

Nomenclature	*National stock No.*	*Technical manual*
Audio Oscillator TS-421A/U.	6625-00-669-0228	TM 11-6625-355-12
Converter, Telephone Signal CV-1548	5805-00-069-8795	TM 11-5805-367-12
Oscilloscope AN/USM-140A.	6625-00-987-6603	TM 11-6625-535-15
Voltmeter, Electronic ME-30B/U.	6625-00-669-0742	TM 11-6625-320-12
Multimeter TS-352B/U	6625-00-553-0142	TM 11-6625-366-15

c. Materials.

Quantity (ea)	Description	National stock No.
1	Capacitor, 2µf, 100v	5910-00-690-9562
2 ft	Hookup wire, No. 24 AWG	6145-00-295-1293
1	Ligt Assembly, Electrical MX-1292/PAQ.	6695-00-378-5449
2	Printed wiring board, extender (extender panel).	5805-00-952-9834
1	Resistor, 75 ohms ±5%, ½-watt	5905-00-843-7051
1	Resistor, 390 ohms ±5%, 48-watt	5905-00-814-1524
1	Resistor, 604 ohms ±1%, ¼-watt	5905-00-752-3956
2	Resistor, 604 ohms ±1%, ½-watt	5905-00-984-3221
1	Resistor, 806 ohms ±1%, ½-watt	5905-00-823-3543
1	Resistor, 1000 ohms ±1%, ¼-watt	5905-00-542-8278
1	Resistor, 2.4K ohms ±5%, ½-watt	5905-00-279-1877
1	Resistor, 2.4K ohms ±5%, 7-watt	5905-00-852-7002
2	Resistor, 4.7K ohms ±1%, ¼-watt	5905-00-660-4128
1	Resistor, 100K ohms ±10%, ½-watt	5905-00-513-9941
1	Terminal board, 4-terminal	5904-00-193-0732
1	Terminal board, 6-terminal	5940-00-192-9990
1	Test lead set CX-1331A/U	6625-00-395-9313
6	Test lead set	6625-00-356-0223
1	Toggle, switch, spdt	5930-00-655-1515
1	Toggle switch, spst	5930-00-526-0587

5-3. Modification Work Orders

The performance standards listed in the tests assume that no modification work orders have been performed. A list of current modification work orders is provided in DA Pam 310-1.

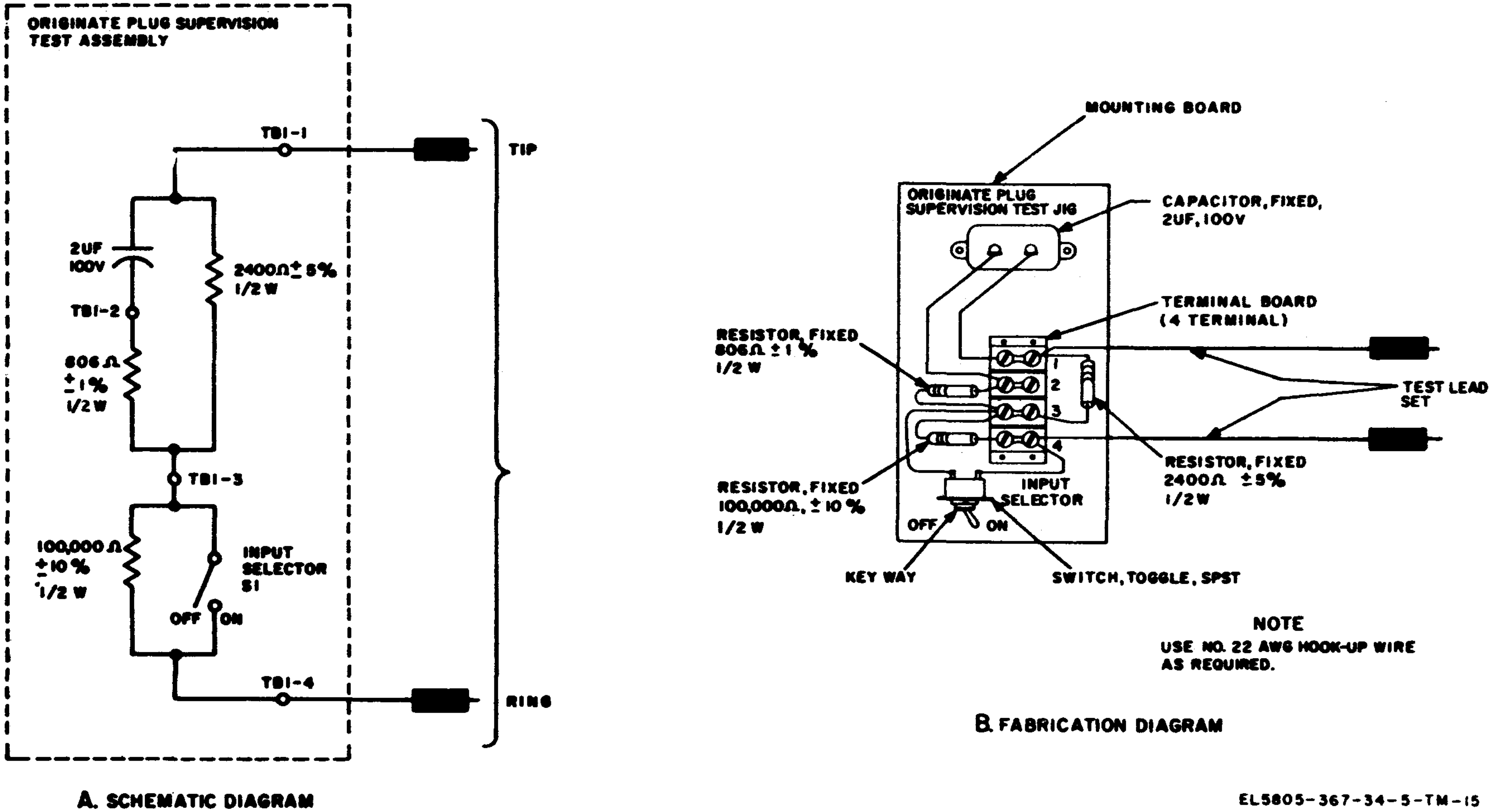


Figure 5-1. Originate plug supervision test jig, fabrication diagram.

5-4. Test Jig Fabrication

a. Originate Plug Supervision Test Jig. Obtain the materials listed in (1) below, and fabricate the originate plug supervision test jig ((2) below).

(1) *Materials.*

Quantity (ea)	Description	Federal stock No.
1	Capacitor, 2μf, 100 volts	5910-690-9562
1	Resistor, 806 ohms ±1%, ½-watt	5905-823-3543
1	Resistor, 1000 ohms ±1%, ¼-watt	5905-542-8278
1	Resistor, 100K ohms ±10%, ½-watt	5905-513-9941
1	Toggle switch, spst	5930-526-0587
1 ft	Hookup wire No. 24 AWG	6145-295-1293
1	Test lead set	6625-356-0223
1	Terminal board, 4-terminal	5940-193-0732

(2) *Fabrication.*

(a) Obtain the material listed in (1) above.

(b) Mount and interconnect the parts as shown in figure 5-1.

(c) Label the test jig as indicated in figure 5-1.

b. Audio Loss Measuring Test Jig. Obtain the materials listed in (1) below, and fabricate the audio loss measuring test jig ((2) below).

(1) *Materials.*

Quantity (ea)	Description	Federal stock No.
1	Resistor, 604 ohms ±1%, ¼-watt	5905-752-3956
1	Resistor, 1000 ohms ±1%, ¼-watt	5905-542-8278
2	Resistor, 4.7K ohms ±1%, ¼-watt	5905-660-4128
1	Toggle switch, spdt	5930-822-5194
1 ft	Hookup wire No. 24 AWG	6145-295-1293
5	Test lead set	6625-356-0223
1	Terminal board, 6-terminal	5940-192-9990

(2) *Fabrication.*

(a) Obtain the material listed in (1) above.

(b) Mount and interconnect the parts as shown in figure FO-4.

(c) Label the test jig as indicated in figure FO-4.

5-5. Physical Tests and Inspections

a. Test Equipment and Materials. Light Assembly, Electric MX-1292/PAQ.

b. Teat Connections and *Condition.*

(1) Do not make any connections to the equipment.

(2) When repairs are completed, perform the checks given in c below.

(3) Connect the MX-1292/PAQ to a 115-volt, 60-Hz power source, and install the wide band transmission filter.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	N/A	Control may be in any position.	*a.* Inspect front panel for evidence of physical damage, loose or missing parts, screws, or panel faseteners.	*a.* Front panel is complete and and not damaged.
			b. Inspect connectors and plugs for cleanliness and evidence of physical damage.	*b.* Connectors and plugs are clean and not damaged.
			c. Remove and cheek all fuses for proper amperage rating.	*c.* Fuses are properly rated as indicated on panel marking.
			d. Check all filter capacitors *for* evidence of overheating.	*d.* Capacitors show no evidence of leakage.
			e. Check all resistors for evidence of overheating.	*e.* Resistors show no signs of discoloration due to overheating.
			f. Inspect all wiring and cabling for worn or frayed insulation.	*f.* Wiring and cabling are free of cute and frays.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
			g. Inspect all metal surfaces for condition of finish. Note Touchup paint is recommended instead of refinishing whenever practical.	*g.* All metal surfaces intended to be painted do not show bare metal. Panel lettering is legible.
2	N/A	Controls maybe in any position.	Check the equipment for applicable modification work orders (MWO's). (See DA Pam 310-1 for a list of MWO's.)	If MWO is performed, MWO number appears on equipment.
8	*MX-1298/PAQ:* 245V FOR M. V. LAMP: ON.	Controls maybe in any position.	*a.* Explose equipment to direct rays of MX-1292/PAQ. Inspect condition *of* moisture and fungiproofing (mfp). Varnish and conformal coating on panels. **Note** Mfp epoxy appears blue-green under rays of MX-1292/PAQ. Conformal coating on panels appears milky-white under rays of MX-1292/PAQ. A blue-gray appearance indicates inadequate mating. *b.* Operate MX-1292/PAQ 245V FOR M.V. LAMP switch OFF.	*a.* All components, wiring, and chassis surfaces are comletely covered with mfp varnish, with no evidence of mfp varnish on connector or switch contacts. All panels are completely covered with conformal coating. **Note** Do not apply mfp varnish to parts that were not originally treated with mfp varnish. *b.* None.

5-6. Power Supply Assembly 18A1 Tests
(fig. FO-5)

a. Test Equipment and Materials.

(1) Multimeter TS-352B/U.

(2) Converter, Telephone Signal CV-1548 ( )/G.

b. Test Connections and Conditions. Remove power supply 18A1 from the test CV-l548/G and set it aside. Install power supply 18A1 to be tested in the test CV-1548/G. Connect the equipment as shown in figure FO-5. Do not apply power. Be sure that the CV-1548/G used for testing is fully operational and correctly adjusted,

c. Test procedures.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*TS-352B/U:* FUNCTION : DIRECT CV-1548( )/G: POWER ON-OFF: ON.	Be aura that a 1½-ampere fuse is installed in the 1 ½-ampere fuseholder on the front panel.	Output voltage tests (See Note 1). *a.* Operate meter selector switch on front panel of CV-1548/G to - (negative) position. *b.* 0perate meter selector switch on front panel of CV-1548/G to + (positive) position.	*a.* TEST ALIGN meter on CV-1548/G indicates in yellow area. *b.* TEST ALIGN meter on CV-1548/G indicates in yellow area.
2	No changes required	No changes required	*1,600-cps reference supply test* (See Note 2).	

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
			a. Unsnap REF control on 18A1 assembly front panel.	*a.* None.
			b. Adjust REF control on 18A1 assembly front panel fully ccw.	*b.* TS-352B/U indicates between 5.9 and 6.5 volts.
			c. Operate meter selector switch on front panel to 1600~ position.	*c.* None.
			d. Adjust REF control on power supply 18A1.	*d.* CV-1548/G TEST ALIGN meter indicates center scale reading in green area.

NOTE

1. For 18A1A and 18A1B, use TS-352B/U and measure the voltages at test points J1 and J2:
   J1 = +24 volts
   J2 = -30 volts
2. 1600-Hz reference supply test not applicable to 18A1A or 18A1B.

5-7. Panel 18A2 Tests
(fig. FO-6)

a *Teat Equipment and Materials.*

(1) Multimeter TS-352B/U.
(2) Oscilloscope AN/USM-140A.
(3) Voltmeter, Electronic ME-30B/U.
(4) Electrical test panel (extender).
(5) Converter, Telephone Signal CV-1548 ( )/G.
(6) Resistor, fixed, 75-ohm, ±5 percent, ½-watt
(7) Resistor, fixed, 390-ohm, ±5 percent, 43-watt.

b. Test Connective and Conditions. Remove panel 18A2 from the test CV-1548 ( )/G and set it aside. Plug the 18A2 panel to be tested into the extender panel and plug this assembly in the panel 18A2 slot in the test CV-1548 ( )/G. Connect the equipment as shown in A, figure FO-6. Do not apply power. Be sure that the CV-1548 ( )/G used for testing is fully operational and correctly adjusted.

c. Test Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*TS 352B/U:* FUNCTION: AC VOLTS CV-1548( )/G: POWER: ON TEST ALIGN: -DC ME-30B/U: ON-OFF: ON Range selector:1 volt. *AN/USM-140A:* INTENSITY MODULATION: NORMAL. SWEEP OCCURRENCE: NORMAL. HORIZONTAL DISPLAY: X1 SWEEP TIME: 1 MILLISECOND/CM VERNIER: Fully cw SWEEP MODE: PRESET CHANNEL A SENSITIVITY: .1.		*1,600-Hz output* and *metering output test* (A, fig. FO-6). *a.* On front strip of panel 18A2, adjust ADJ 1600 control for 720-mv indication on ME-30B/U. *b.* Adjust AN/USM-140A POSITION and TRIGGER LEVEL controls to obtain symmetrical waveform *c.* Disconnect Teat Prod MX-2817/U from extender panel.	a. None. *b.* AN/USM-140A indicates 1,600 ±30 Hz sine wave, 2 volts peak-to peak. Slight ripple on sine wave is normal. *c.* None.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
	CHANNEL A AC-DC: AC CHANNEL A VERNIER: Fully cw.		*d.* On AN/USM-140A, operate CHANNEL A controls as follows: AC-DC : DC SENSITIVITY: 2. *e.* Adjust AN/USM-140A for flat trace line on top horizontal scale line. *f.* Connect MX-2817/U to pin 19 and associated alligator clip to pin 18 on extender panel. *g.* On ME-30B/U, operate range selector to 1.0 position. *h.* On front strip of panel 18A2, adjust ADJ 1600 control for 360-mv indication on ME-30B/U. *i.* On AN/USM-140A, operate CHANNEL A SENSITIVITY control to .2 position. *j.* Observe trace line on AN/USM-140A. *k.* Remove 75-ohm resistor from extension panel. *l.* Observe ME-30B/U indication.	*d.* None. *e.* None. *f.* AN/USM-140A trace line deflects downward between -4.8 and -5.9 volts. *g.* None. *h.* None. *i.* None. *j.* AN/USM-140A trace line deflects to between -2.0 and -2.6 volts from top horizontal scale line. *k.* None. *l.* ME-30B/U indicates no higher than 370 mv.
2	No change required except: *ME-30B/U:* Range selector: 300 +50 *AN/USM-140A:* HORIZONTAL DISPLAY: X1. SWEEP TIME: 10 MILLISECONDS/CM. CHANNEL A SENSITIVITY: 20. CHANNEL A AC-DC: AC		*20-Hz output and metering output tests* (A, fig. FO-6). *a.* Connect test equipment to extender panel as shown in B, figure FO-6. *b.* Observe 20~ lamp on front strip of panel 18A2. *c.* Observe meter on ME-30B/U. *d.* Adjust AN/USM-140A POSITION and TRIGGER LEVEL controls to obtain suitable waveform. *e.* Disconnect MX-2817/U from electrical test extender pand *f.* Operete CV-1548( )/G POWER ON-OFF switch to OFF and connect 390-ohm re-	*a.* None. *b.* 20 ~ lamp is lighted. *c.* ME-30B/U indicates at least 118 volts. *d.* AN/USM-140A displays 20-Hz symmetrical square wave as shown in waveform of B, figure FO-6, with the shorter half hertz no less than 40 percent of the total hertz at the zero cossing. Frequency should be between 18 and 22 Hz. *e.* None. *f.* None.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
			sister across pins 9 and 18 of extender panel.	
			g. Operate CV-1548( )/G POWER ON-OFF switch to ON and operate range selector switch on ME-30B/U to the 100 +40 position.	*g.* ME-30B/U indicates at least 60 volts.
			h. On AN/USM-140A, operate CHANNEL A controls as follows: AC-DC: DC SENSITIVITY: .2.	*h.* None.
			i. Adjust AN/USM-140A for flat trace line on the top horizontal scale line.	*i.* None.
			j. Connect MX-2817/U to pin 1 and associated alligator clip to pin 18 on extender panel.	*j.* AN/USM-140A trace line deflects downward between -5.3 and -8.3 volts.
			k. Disconnect MX-2817/U from pin 1 on electrical test extender panel and reconnect MX-2817/U to pin 25 on extender panel.	*k.* AN/USM-140A trace line deflects to between -7.4 and -9.6 volts.

5-8. Panel 18A3( )Tests

(fig. FO-7)

a. Test Equipment and Materials.

(1) Multimeter TS-352B/U.

(2) Originate plug supervision test jig (para 5-4a).

(3) Audio loss measuring jig (para 5-4b).

(4) Resistor, fixed, 604 ohms, ±1 percent, ½-watt (two each).

(5) Resistor, fixed, 2,400 ohms, ±5 percent, 7 watts.

(6) Voltmeter, Electronic ME-30B/U.

(7) Audio Oscillator TS-421A/U.

(8) Electrical test (extender) panel.

(9) Converter, Telephone Signal CV-1548 ( )/G.

b. Test Connections and Conditions. Remove panel 18A3( ) from the channel 1 slot in the test CV-1548( )/G and set it aside. Plug the 18A3( ) panel to be tested into the extender panel and plug this assembly in the channel 1 slot in the test CV-1548( )/G. Connect the equipment as shown in A, figure FO-7. Do not apply power. Be sure that the CV-1548( )/G used for testing is fully operational and correctly adjusted.

c. Test Procedures.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*TS-352B/U:* FUNCTION: OHMS Range: RX1 OHMS ZERO ADJ: zero ohm indication with teat probes shorted. *TS-421A/U:* POWER ON-OFF: ON FREQUENCY RANGE: X10.	Signaling mode switch: AC.	*Signaling detector sensitivity test* (A, fig. FO-7). Observe TS-352B/U. ------	 TS-352B/U indicates continuity.

Step No.	Control settings		Test procedure	Performance standard
		Equipment under test		
	FREQUENCY dial: 160 IMPEDANCE: 600 OUTPUT ATTENUATOR (DB): 0-100: 50 0-10: 5 AMPLITUDE: adjust for -25 dB as measured at OUTPUT with terminals connected to 18A3( ) panel. LOAD ON: Off *CV-1548( )/G:* POWER ON-OFF: ON			
2	No changes required except: *TS-421A/U:* FREQUENCY RANGE: X1 FREQUENCY dial: 20 IMPEDANCE: 200 LOAD ON: ON OUTPUT ATTENUATOR (DB): 0-100: 0 0-10: 0 AMPLITUDE: Adjust for 16 volts on OUTPUT terminals of TS-421A/U.	No changes required ------	*20-Hz signaling (AC) tests, outgoing calls* (B, fig. FO-7) *a.* Connect equipment as shown in B, figure FO-7. Make certain signaling mode switch on panel 18A3( ) under test is set to AC. *b.* Observe TS-352B/U ------ *c.* Disconnect TS-421A/U output lead from pin 27 on extender panel of panel 18A3( ) under test. *d.* Observe TS-352B/U -----	*a.* None. *b.* TS-352B/U indicates continuity. *c.* None. *d.* TS-352B/U indicates infinity.
3	No Changes required except: *ME-30B/U:* Range selector: 100 +40 ON-OFF: ON	No changes required ------	*20-Hz signaling (AC) tests, incoming calls* (C, fig. FO-7). *a.* Connect equipment as shown in C, figure FO-7. *b.* Observe ME-30B/U. *c.* On panel 18A3( ) under test, operate and hold TEST button.	*a.* None. *b.* ME-30B/U indicates zero. *c.* ME-30B/U indicates at least 75 volts and lamp on 18A3B panel under test lights.
4	No changes required except: Plug supervision test assembly INPUT SELECTOR: OFF. *ME-30B/U:* Range selector: -10.3	No changes required except: Panel 18A3( ) signaling mode switch: OR.	*One-way plug supervision tests, originate (OR) operation.* *a.* Set up equipment as shown in D, figure FO-7. *b.* On plug supervision test assembly, operate INPUT SELECTOR switch to ON. *c.* On panel 18A3A under test, operate and hold TEST button.	*a.* ME-30B/U indicates 121 to 157 mv. *b.* ME-30B/U indicates 0 volt. *c.* Lamp on 18A3A panel under test lights.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
5	No changes required except: *TS-352/BU:* FUNCTION: OHMS Range: X10 OHMS ZERO ADJ: Zero Ohm indication with test probes shorted.	No changes required except: Panel 18A3( ) signaling mode twitch: TE.	*One-way plug supervision tests, terminate (TE) operation.* *a.* Set up equipment as shown in E, figure FO-7. *b.* Observe indication on TS-352B/U. *c.* On 18A3 panel under test, push and hold TEST button. *d.* Release TEST button and note time until TS-352B/U indicates low resistance.	*a.* None. *b.* TS-352B/U indicates between 250 and 500 ohms. *c.* TS-352B/U indicates infinity. *d.* Delay between 1 and 3 seconds.
	No changes required except: *ME-30B/U:* ON-OFF: ON Range selector: -10.3 *TS-421A/U:* FREQUENCY RANGE: X10. FREQUENCY dial: 100 LOAD ON: Off Audio lose measuring assembly: METER SELECTOR: A	No changes required except: Panel 18A3( ) signaling mode switch: OFF.	*Audio loss test* (F, fig. FO-7) *a.* Set up equipment as shown in F, figure FO-7. *b.* On TS-421A/U, adjust AMPLITUDE control for a precise 300-mv indicatior on ME-30B/U. *c.* On audio low measuring assembly, set METER SELECTOR to B.	*a.* None. *b.* None. *c.* ME-30B/U indicates no lower than 300 mv.

5-9. Summary of Performance Standards

Test No.	Description	Performance standard
	Output voltage tests (para 5-6c):	
1a	- (negative) supply output voltage --------------------------------	For 18A1, TEST ALIGN meter on CV-1548/G indicates in yellow area. For 18A1A and 18A1B, measure -30 volts at J2, using TS-352B/U.
1b	+ (positive) supply output voltage ------------------------------------	For 18A1, TEST ALIGN meter on CV-1548/G indicates in yellow area. For 18A1A and 18A1B, measure +24 volts at J1, using TS-352B/U.
	1,600-Hz referencs supply test (para 5-6c):	
2b	Maximum output voltage --	Between 5.9 and 6.5 volts.
2d	Typical reference setting --	Meter indicates center scale within green area.
	1,600-Hz output and metering output tests (para 5-7c):	
1b	Waveform across pine 5 and 6 of extender panel (1,600-Hz output at 730 mv).	1,600 ±30 Hz sine wave, 2 volts peak to peak as shown in waveform of A, figure FO-6 (slight ripple is normal).
1f	Dc voltage across pins 19 and 18 of extender panel (1,600-Hz output at 720 millivolts).	AN/USM-140A trace line deflects to between -4.8 and -5.9 volts.
1j	Dc voltage across pins 19 and 18 of extender panel (1,600-Hz output at 360 millivolts).	AN/USM-140A trace line deflects to between -2.0 and **−2.6 volts.**
1l	1,600-Hz unloaded output across pins 5 and 6 of extender panel.	No more than 370 mv.
	20-Hs output and metering output tests (para 5-7c):	
2b	20-Hz output monitoring lamp --------------------------------------	20 ~ lamp on front strip of panel 18A2 is lighted.
2c	20-Hz unloaded output voltage across pins 9 and 19 of extender panel.	At least 118 volts rms.

Test No.	Description	Performance standard
2d	Waveform across pins 9 and 18 of extender panel ---------	20 ±2Hz symmetrical square wave with the shorter half of the waveform not lees than 40 percent of the total period at the zero crossing as shown in waveform of B, figure FO-6.
2g	20-Hz loaded output voltage across pins 9 and 18 of extender panel.	At lesat 60 volts rms.
2j	Dc voltage across pins 1 and 18 of extender panel --------	AN/USM-140A trace line deflects to between -5.3 and -8.3 volts.
2k	Dc voltage across pins 25 and 18 of extender panel -------	AN/USM-140A trace line deflects to between -7.4 and -9.6 volts.
	Signaling detector sensitivity test (para 5-8c):	
1a	Measure for continuity across extender panel pins 25 and 31	Continuity.
	20-Hz signaling (AC) test, outgoing calls (para 5-8c):	
2b	With 20-Hz input from TS-421A/U, measure for continuity across pins 31 and 25 on extender panel test panel 18A3( ).	Continuity.
2d	With 20 Hz input cut off, measure for open circuit across pins 31 and 25 on extender panel of test panel 18A3( ).	Infinity.
	20-Hz signaling (AC) tests, incoming calls (para 5-8c):	
3b	With no incoming 1,600-Hz tone, measure output across test jacks J2 and J3 on panel 18A3( ) under test.	0 volt.
3c	With TEST button operated, measure 20-Hz loaded output across test jacks J2 and J3 on panel 18A3( ) under test.	At least 75 volts, and lamp lights on 18A3B panel under test.
	One-way plug supervision tests, originals (OR) operation (para 5-8c):	
4a	With INPUT SELECTOR switch opened on plug supervision test assembly, meaeure 1,600-Hz loaded output voltage across extender panel pins 2 and 4.	Between 121 and 157 mv.
4b	With INPUT SELECTOR switch closed on plug supervision test assembly, measure output voltage across extender panel pins 3 and 4.	0 volt.
4c	With TEST button operated on panel 18A3A -----------------	Lamp lights on 18A3A panel under test.
	One-way plug supervision tests, terminate (TE) operation (para 5-8c):	
5b	Measure for low resistance across test jacks J2 and J3 on panel 18A3( ) under test.	250 to 500 ohms.
5c	With TEST button depressed on panel 18A3( ) under test, measure for open circuit across test jacks J2 and J3.	Infinity.
5d	Relay K2 release time-------------------------------------	Between 1 and 3 seconds.
	Audio loss test (para 5-8c):	
6c	1,000-Hz output voltage across extender panel pins 3 and 4	Not less than 300 mv.

5-10. Panel 18A4 Tests

a. Test Equipment and Materials.

(1) Multimeter TS-352B/U.

(2) Multimeter ME-26/U.

(3) Two (2) Audio Oscillators TS-421A/U.

(4) Power Supply, 24-volt ±2%.

(5) Power Supply, 5-volt ±5%.

(6) Power Supply, 20-volt ±2%.

(7) Converter, Telephone Signal CV-1548( )/G.

(8) Electrical test (extender) panel.

(9) Resistor, fixed, 1500 ohms.

(10) Resistor, fixed, 10K ohms.

(11) Resistor, fixed, 2400 ohms.

(12) Three Resistors, fixed, 604 ohms, ±1 percent, or two 301 ohm resistors, ±l percent.

(13) Telephone Set TA-312/PT.

(14) Two Resistors, fixed, 4700 ohms, ±1 percent.

(15) Two Resistors, fixed, 300 ohms, ±1 percent.

b. Test Connections and Conditions. Remove panel 18A4 from the channel 2 slot in the test CV-1548( )/G and set it aside. Plug the 18A panel to be tested into the extender panel and plug this assembly into the channel 2 slot in the test CV-1548( )/G. Connect the equipment as shown in figure 5-2 and 5-2.1. Do not apply power. Be sure that the CV-1548( )/G used for testing is fully operational and correctly adjusted.

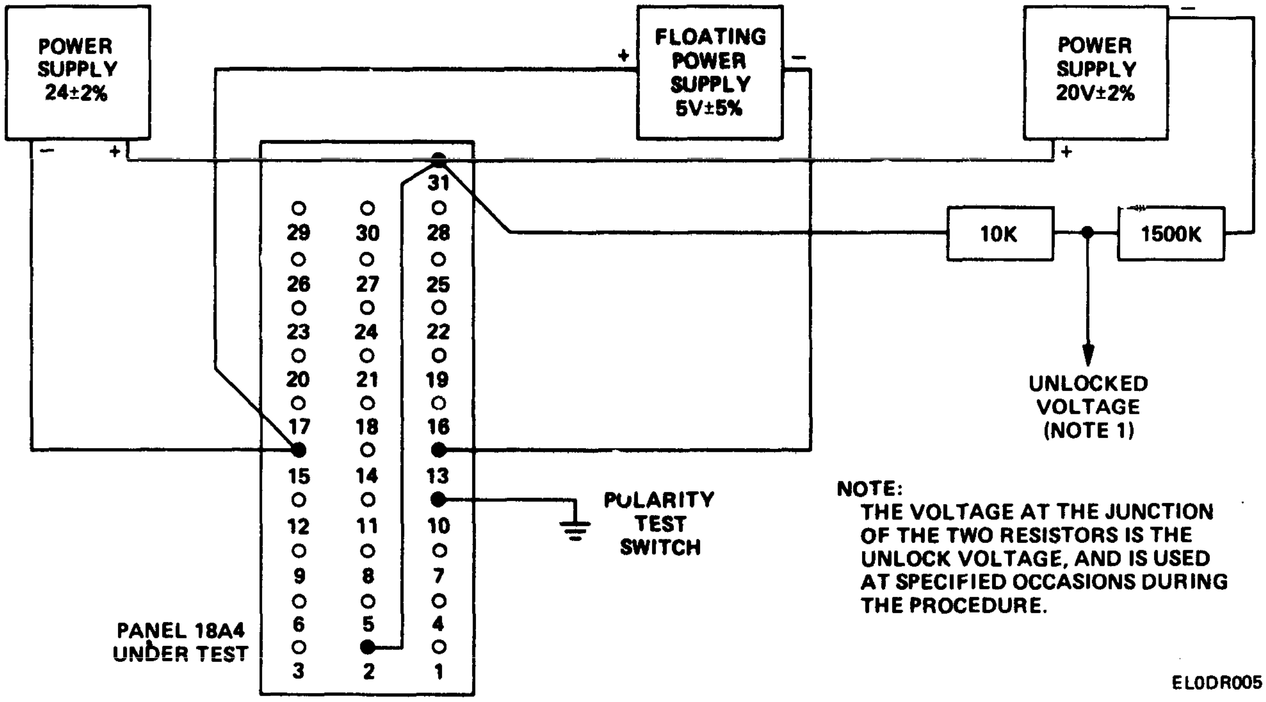


Fig. 5-2. Power Supply Test Setup for Panel 18A4 Electrical Tests.

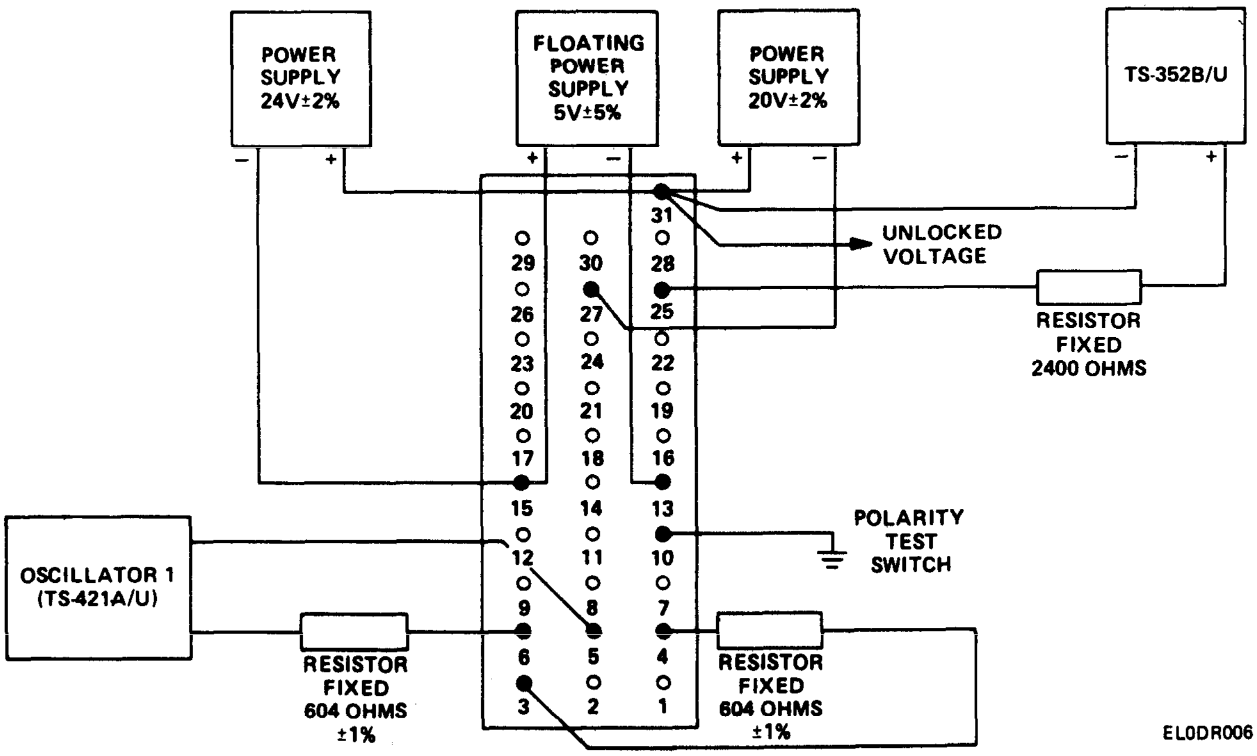


Fig. 5-2.1. Signaling Detectors Setup for Panel 18A4 Electrical Tests.

c. Test Procedures.

Step No.	Control settings, test equipment	Test procedure	Performance standard
1	AUDIO OSCILLATOR No. 1 MULTIMETER TS-352B/U, DIGITAL READOUT ELECTRICAL COUNTER AN/USM-207 FREQUENCY RANGE: X10 FREQUENCY DIAL : 157	NOTE Make sure frequencies are within ±2 cps and voltages within ±5% when performing the signalling detector electrical tests. *Signaling detector, electrical tests.* NOTE Table 5-1 includes all voltage and frequency limits.	
		a. Apply power with no frequency input.	*a.* Observe current meter for indication.
		b. Adjust amplitude control for 2.75 volt as indicated on voltmeter 1.	*b.* Observe voltmeter 1 for 2.75 volts. Observe current meter for zero indication. Observe counter for 1570-Hz reading.
		c. Adjust amplitude control on oscillator 1 for .087 volt (-19 dBm) as indicated on voltmeter 1.	*c.* Observe current meter for zero indication. Observe voltmeter 1 for .087 volt.
		d. Adjust frequency dial on oscillator 1 to 163.	*d.* Current meter shows no current. Observe frequency counter for 1630-Hz reading.
		e. Adjust amplitude control on oscillator 1 for 2.75 volts as indicated on voltmeter 1.	*e.* Observe voltmeter 1 for 2.75 volts. Observe current meter for zero indication.
		f. Adjust frequency control on oscillator 1 to 145.	*f.* Observe indication on current meter. Observe counter for 1450-Hz reading.
		g. Adjust amplitude control on oscillator 1 for 0.49 volt es indicated on voltmeter 1.	*g.* Observe voltmeter 1 for 0.49 volt. Observe indication on current meter.
		h. Adjust frequency dial on oscillator to 175.	*h.* Observe current meter for indication. Observe counter for 1750-Hz reading.
		i. Adjust amplitude control on oscillator 1 for 2.75 volts es indicated on voltmeter 1.	*i.* Observe voltmeter 1 for 2.75 volts. Observe current meter for indication.
		j. Adjust amplitude control on oscillator 1 for 0.49 volt as indicated on voltmeter 2. NOTE Apply the following voltage and frequency between pin 1 and ground. Push test button.	j. Observe voltmeter 1 for 0.49 volt. Obsswe current meter for indication.

Step No.	Control settings, test equipment	Test procedure	Performance standard
1		*k.* Adjust amplitude control for 0.36 volt as indicated on voltmeter 1. Adjust frequency dial to 160 or 157.	*k.* Observe counter for 1600-Hz or 1570-Hz reading. Observe voltmeter 1 for 0.36 volt. Observe current meter for zero indication.
2	TELEPHONE SET, MULTIMETER ME-26/U: DC-Voltmeter, 50-volts	*Operational inspection.* **NOTE** This test must be performed in sequence. Setup as shown in figure 5-2.2.	
		a. Adjust amplitude control on oscillator 1 for 0.36 volt as indicated on voltmeter 1. Adjust frequency dial to 160. **NOTE** This same tone is connected directly between pin 1 and ground for the duration of this test.	*a.* Observe counter for 1600-Hz reading. Observe voltmeter 1 for 0.36 volt.
		b. Adjust frequency dial on oscillator 2 to 1-KC. Adjust input attenuator (dBm) to zero. **NOTE** In the following tests, the tip and ring currents when on, must be at least 5 mA. The switch on the tip lead must be of the shorting type.	*b.* None
		c. Perform tests es indicated in Table 5-2.	
3		*Outgoing tone level/loss supply voltage test.*	
		a. Disconnect phone. Measure the 1600 cps tone across a 604-ohm resistor between pins 3 and 4.	*a.* Observe voltmeter for a reading. between 130 and 150 mv.
		Logic supply voltage test. **NOTE** Meter should be at least 5000 ohms/volts.	
		b. Measure voltage between J15 (negative) and pin 15 of J16 (positive).	*b.* Observe voltage for a reading between 3.12 and 3.48 volts.
4		*Audio quality, input impedance test.* **NOTE** If voltage on lock meter drops to zero during test, the panel is locked. To unlock, temporarily connect tip lead to the unlock power supply.	

Step No.	Control settings, test equipment	Test procedure	Performance standard
4		*a.* Connect an adaptor as shown in figure 5.2.3 to the tip and ring leads, pins 27 and 25 respectively. Setup test as in figure 5-2.4.	*a.* None
		b. Adjust amplitude control on oscillator 1 for 0.60 volt as indicated on voltmeter 1. Adjust frequency dial to 25.	*b.* Observe voltmeter 1 for a reading of 0.60 volt. Observe counter for 250-Hz reading. Observe voltmeter 2. Reading indicates ratio of 1 ohm per millivolt. Reading should be 540 ohms to 660 ohms.
		c. Adjust frequency dial to 100.	*c.* Observe counter for a reading of 1000 Hz. Observe voltmeter 2 reading between 540 ohms to 660 ohms.
		d. Adjust frequency dial to 350.	*d.* Observe counter for 3500-Hz reading. Observe voltmeter 2 reading between 540 ohms to 660 ohms.
5		*Audio quality, output impedance.* **NOTE** Use same procedure and test limits above but set up test as in figure 5-2.5.	
		Longitudinal balance test. **NOTE** Set up test as in figure 5-2.6.	
		a. Adjust amplitude control on oscillator 1 to +6 dBm as indicated on voltmeter 1. Adjust frequency dial to 25.	*a.* Observe voltmeter 1 for a +6 dBm reading. Observe counter for a 250-Hz reading. Observe voltmeter 2 for a reading less than -45 dBm.
		b. Adjust frequency dial to 100.	*b.* Observe voltmeter 1 for a +6 dBm reading. Observe frequency reading of 1000 Hz. Observe voltmeter 2 for a reading less than -45 dBm.
		c. Adjust frequency dial to 350.	*c.* Observe voltmeter 1 for a +6 dBm reading. Observe frequency reading of 3500 Hz.
6		*Loss and frequency response test.* **NOTE** Oscillator 2 and voltmeter 2 must not be grounded.	

Step No.	Control settings, test equipment	Test procedure	Performance standard
		NOTE V1 can be eliminated if the oscillator has a short-term level stability of ±0.05 db or better. Set up test as in figure 5-2.7. *a.* Put switch in position A.	
		b. Adjust amplitude control on oscillator 2 to +4.6 dBm as indicatad on voltmeter 2, keeping V1 constant. Adjust frequency dial to 25,100 and 350.	*b.* Observe voltmeter 2 for -4.6 dBm reading. Observe counter for a reading of 250, 1000 and 3500 Hz.
		c. Switch V2 to position B, and read V2.	*c.* Observe a reading no lower than the position "A" reading at 250, 1000 and 3500 Hz.

Table 5-1. Signaling Detector Limits for Panel 18A4.

FREQUENCY, CPS	RMS VOLTS	CURRENT INDICATION
NO INPUT		YES
1570	2.75	NO
1570	0.087	NO
1630	2.75	NO
1630	0.087	NO
1450	2.75	YES
1450	0.49	YES
1750	2.75	YES
1750	0.49	YES
1600 OR 1570	0.36	NO

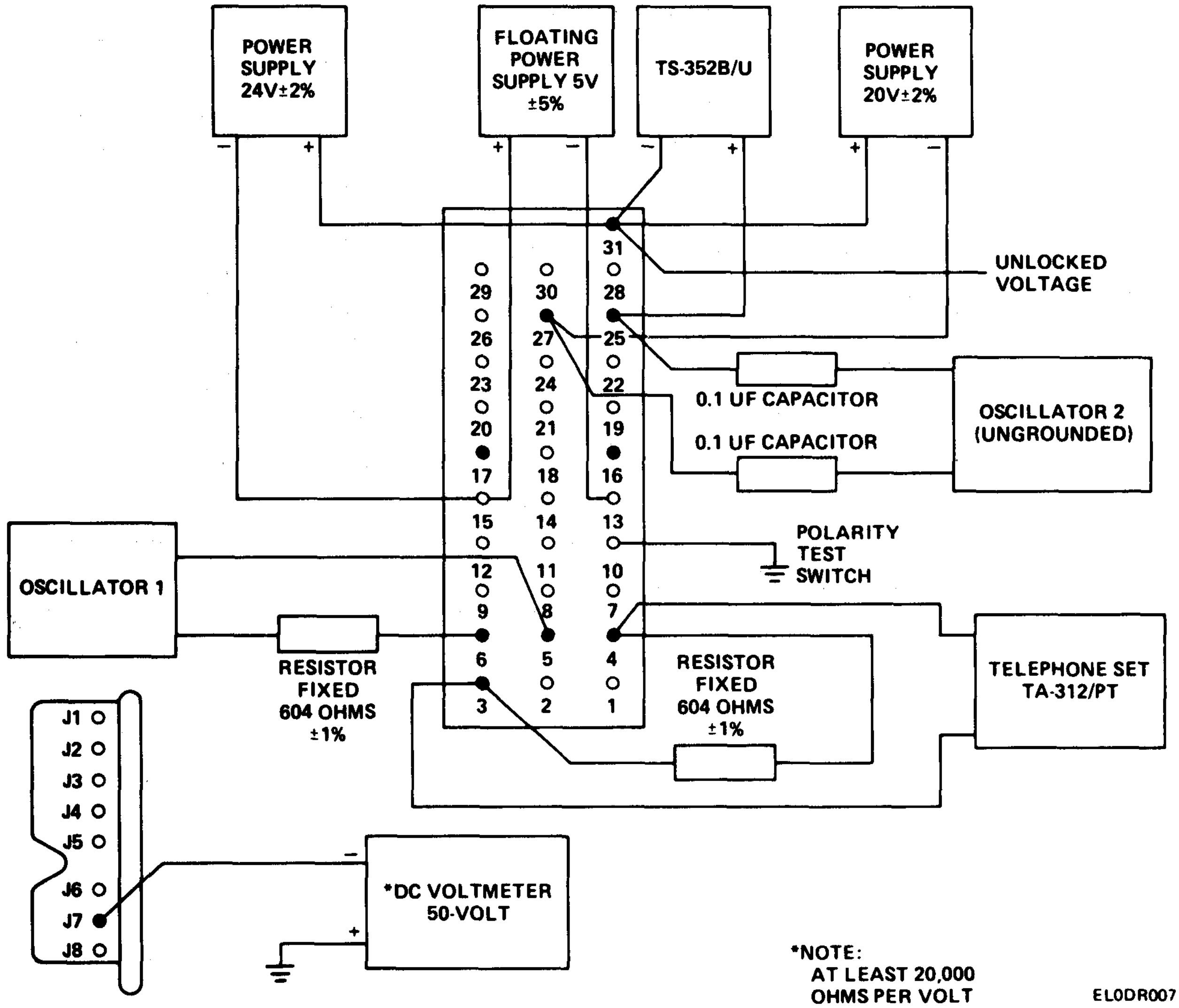


Fig. 5-2.2. Operational Test Setup for Panel 18A4.

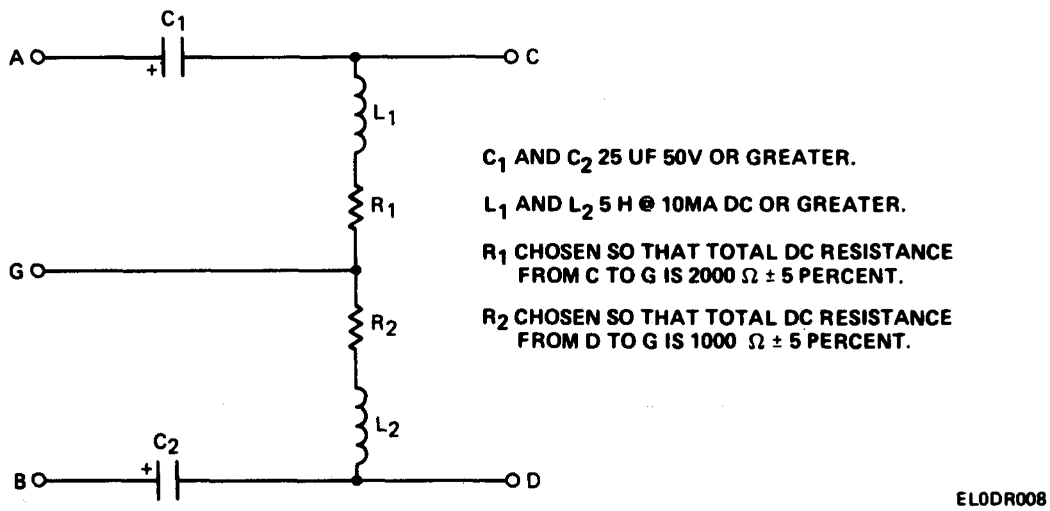


Fig. 5-2.3. Adapter Test Setup for Panel 18A4.

TM 11-5805-367-34-5

Table 5-2. Operational Inspection Test for Panel 18A4.

STEP	CONDITIONS		RESULTS			
	TIP CONN.	INCOMING 1600 CPS TONE	OUTGOING SIGNAL	RING CURRENT	LOCK METER	TIP CURRENT
1. IDLE	UNLOCK	ON	1600	OFF	ON	—
2. CALL OUT	2400 OHMS	ON	*	OFF	ON	—
3. AMS.	2400 OHMS	OFF	1000	ON	ON	ON
4. DISC.	UNLOCK	OFF	1600	ON	ON	—
5. IDLE	UNLOCK	ON	1600	OFF	ON	—
6. CALL IN	UNLOCK	OFF	1600	ON	ON	—
7. AMS.	2400	OFF	1000	ON	ON	—
8. DISC.	2400	ON	*	OFF	ON	—
9. LOCK	10 K	ON	1600	OFF	OFF	—
10. RECALL	10 K	OFF	1600	OFF	OFF	—
11. DISC.	UNLOCK	OFF	1600	ON	ON	—
12. AMS.	2400	OFF	1000	0N	ON	—
**13. POLARITY TEST	UNLOCK	ON	1600	ON	ON	—

*POWER SUPPLY HUM MAY BE PRESENT AT THESES STEPS.
**OPEN POLARITY TEST SWITCH FOR THIS STEP ONLY.

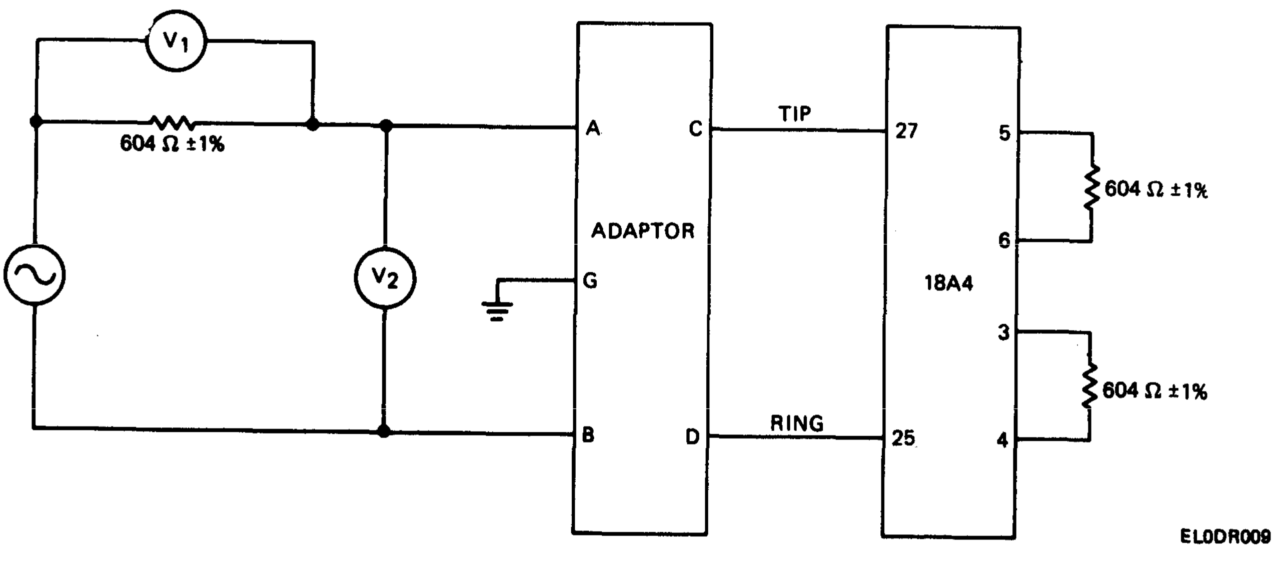


Fig. 5-2.4. Input Impedance Test Setup for Panel 18A4.

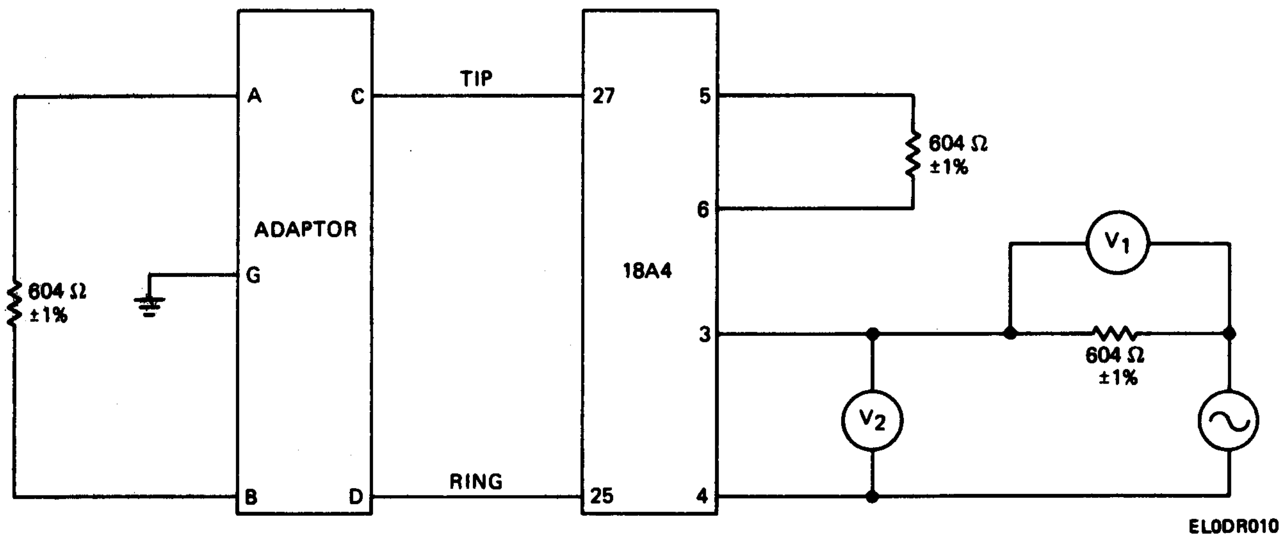


Fig. 5-2.5. Output Impedance Test Setup for Panel 18A4 Electrical Tests.

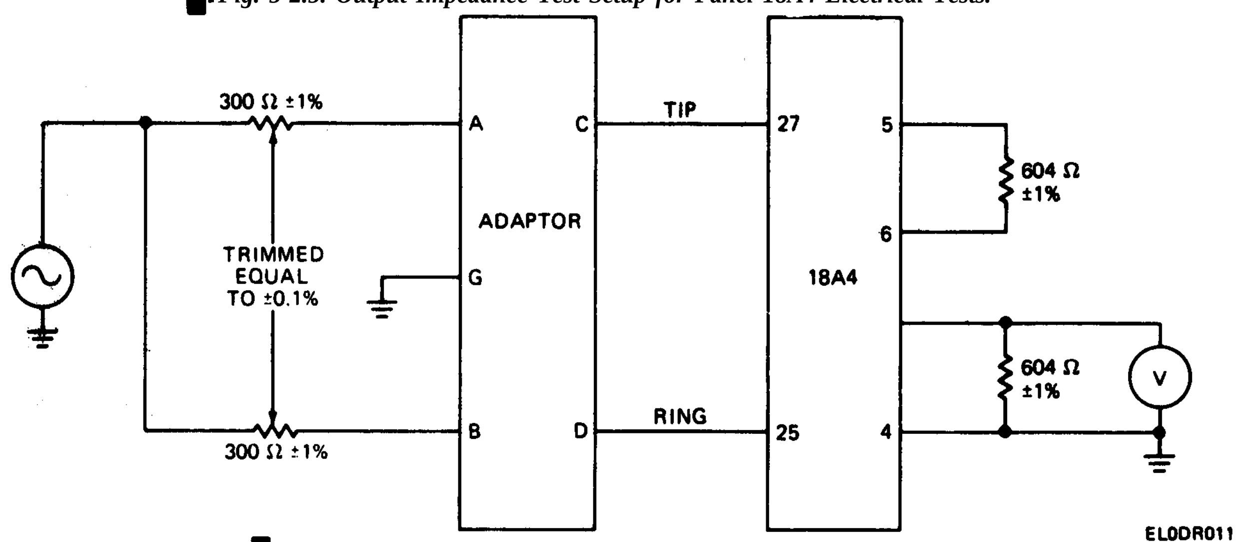


Fig. 5-2.6. Longitudinal Balance Test Setup for Panel 18A4.

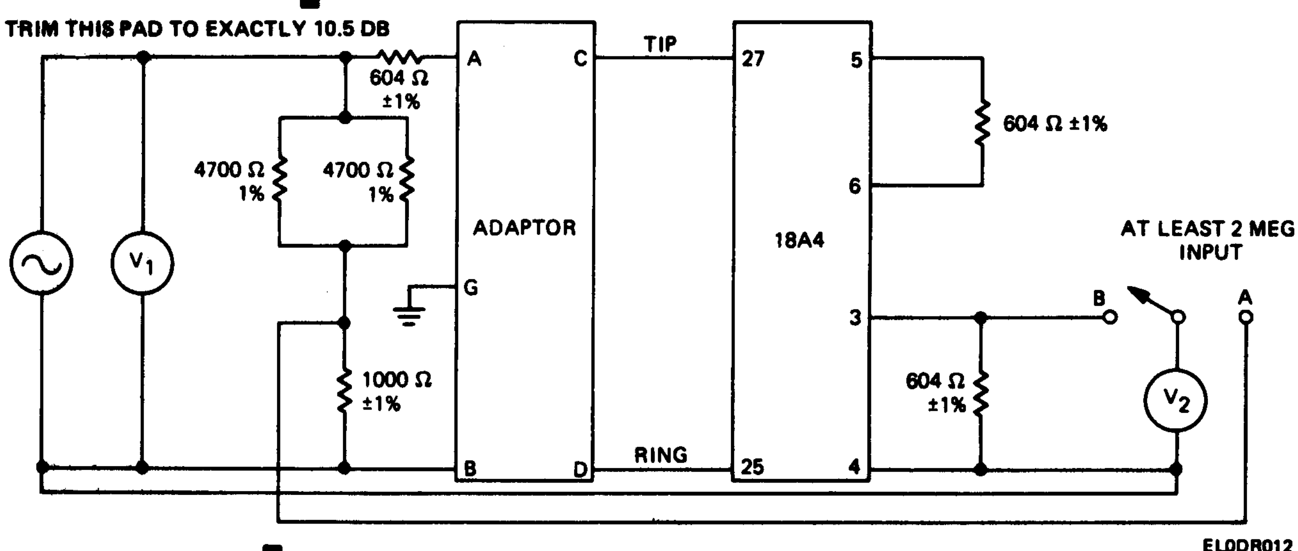


Fig. 5-2.7. Loss Frequency Response Test Setup for Panel 18A4.

5-11. Summary of Performance Standards for Panal 18A4

Test	Description	Performance standard
	Signaling detector, electrical tests:	
1a.	No frequency input to oscillator 1.	Current meter indication.
1b.	Oscillator 1 adjustment.	2.75 volts, 1570 Hz, current meter indicates zero.
1c.	Oscillator 1 adjustment.	Current meter indicates zero, .087 volts.
1d.	Oscillator 1 adjustment.	Current meter zero, 1630 Hz.
1e.	Oscillator 1 adjustment.	2.75 volts, current meter zero.
1f.	Oscillator 1 adjustment.	1450 Hz, current meter indication.
1g.	Oscillator 1 adjustment.	0.49 volt, current meter indication.
1h.	Oscillator 1 adjustment.	1750 Hz, current meter indication.
1i.	Oscillator 1 adjustment.	2.75 volts, current meter indication.
1j.	Oscillator 1 adjustment.	0.49 volt, current meter indication.
1k.	Oscillator 1 adjustment.	0.36 volt, current meter indication.
	Operational inspection test:	
2a.	Oscillator 1 adjustment.	0.36 volt, 1600 Hz.
2b.	Oscillator 2 adjustment.	None
	Outgoing tone level/logic supply voltage test:	
3a.	Disconnect phone. Measure tone.	0.13 to 0.15 volt.
3b.	Measure voltage.	3.12 to 3.48 volt.
	Audio quality, input impedance test:	
4b.	Oscillator 1 adjustment.	0.60 volt, 250 Hz, 540 ohms to 660 ohms on voltmeter 2.
4c.	Oscillator 1 adjustment.	0.60 volt, 1000 Hz, 540 ohms to 660 ohms on voltmeter 2.
4d.	Oscillator 1 adjustment.	0.60 volt, 3500 Hz, 540 ohms to 660 ohms on voltmeter 2.
	Longitudinal balance test:	
5a.	Oscillator 1 adjustment.	+6 dbm, 250 Hz, less than -45 dbm on voltmeter 2. Voltmeter 2 less than -45 dbm.
5b.	Oscillator 1 adjustment.	+6 dbm, 1000 Hz.
5c.	Oscillator 1 adjustment.	+6 dbm, 3500 Hz.
	Loss and frequency response test:	
6b.	Oscillator 2 adjustment.	-4.6 dbm, 250 Hz, 1000 Hz, 3500 Hz.
6c.	Switch position change.	No less than -4.6 dbm at 250 Hz, 1000 Hz and 3500 Hz.

Section II. FINAL TESTING

5-12. General

The tests outlined in this section are designed to measure the performance capability of a repaired CV-1548( )/G before it is returned to the user or to stock. The CV-1548( )/G that meets the minimum standards stated in the tests will have performance capability equivalent to that of new equipment. Tests are given for all circuits that can be corrected by adjustments or exchange of plug-in panels or assemblies.

5-13. Applicable References

Paragraph ***a*** deleted.

b. Technical Publications. The following technical publications are related to this equipment.

(1) TM 11-5805-367-12, Operator and Organizational Maintenance: Multiplexers TD–202/U, TD-203/U, TD-204/U, TD-352/U, TD-353/U; Restorer, Pulse Form TD–206/G, and Converters, Telephone Signal CV-1548/G and CV-1548A/G.

(2) TM 11-5805-367-34-5, Direct Support and General Support Maintenance Manual: Converters, Telephone Signal CV–1548/G and CV-1548A/G.

c. Modification Work Orders. Perform all applicable modification work orders (MWO's) pertaining to the CV-1548( )/G before making the tests specified. DA Pam 310–1 lists current MWO's.

5-14. Test Facilities Required

The following equipment or suitable equivalents and materials are required to perform the tests. For information pertaining to the construction and wiring of the test junction box, refer to figure 5-3.

a. Test Equipment.

National stock No.	Nomenclature	Quantity
	Ac power source, variable 109–121 VRMS, 47–420 Hz.	2
	Voltmeter, Electronic ME–30E/U	2
6625-00-553-0142	Multimeter TS–352B/U	1
6625-00-752-8678	Signal Generator TS–312B/FSM–1	1
6625-00-911-6368	Counter, Electronic Digital Readout AN/USM–207.	2
6625-00-215-4931	Attenuator, Variable CN–1000/G	1
	Analyzer, Distortion Hewlett-Packard HP 334–A.	1

b. Material.

National stock No.	Nomenclature	Quantity
	Extender board for panel assemblies SM–E–528518.	1
	Extender board for 18A1 ( ) Power Supply Assembly Bowmar/Ali C5832.	1
	Test junction box	3
	Resistor, 10 K-ohm ±10%, ½-watt	1
	Resistor, 2.5 K-ohm ±10%, 5-watt	4
	Resistor, 600-ohm ±1%, ½-watt	24
	Patch cable, power, SM–D–531004	1
	Patch cable, 3 ft, GR–GR	6
	Patch cable, 2 ft, GR–BNC	2
	Patch cable, 1 ft, GR–GR	18
	Resistor, series 600-ohm ±1	1
	Shorting plug; GR double plug with terminals shorted.	1

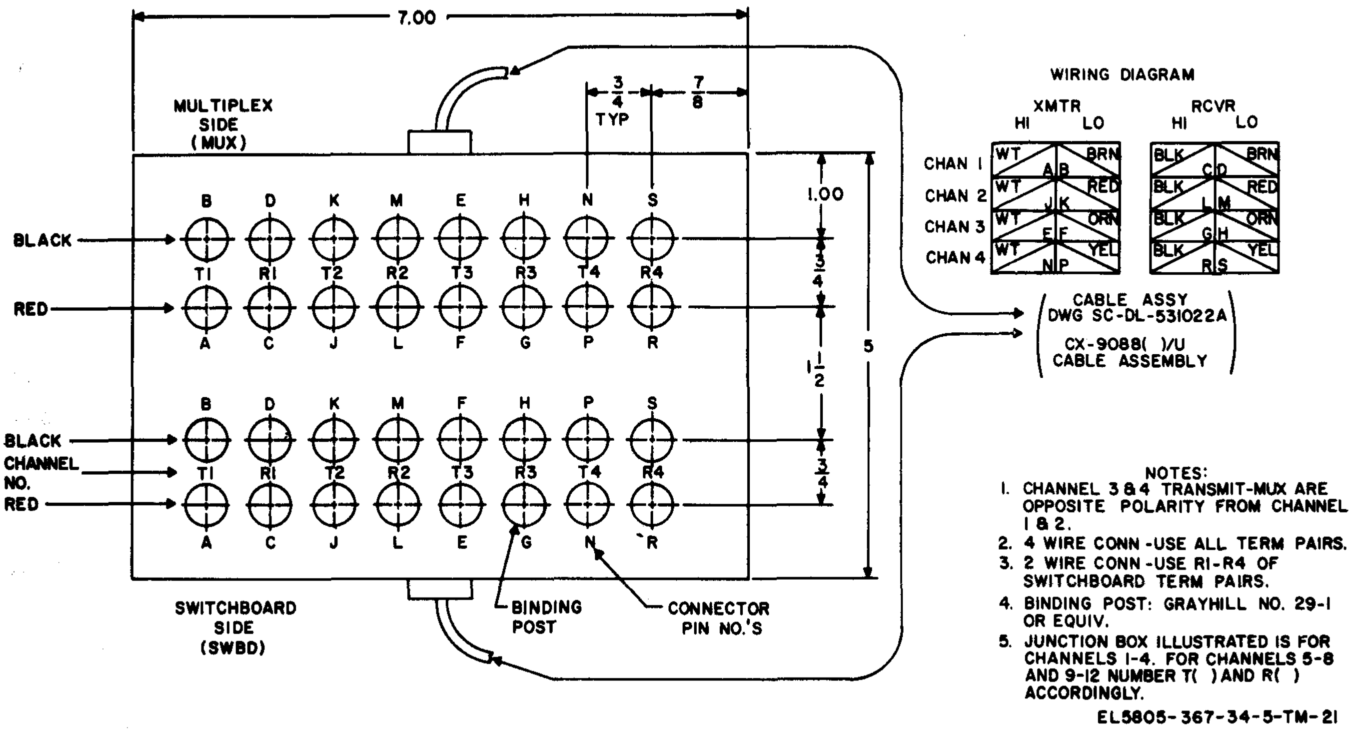


Figure 5-3. Test junction box.

5-15. Test Requirements

Perform all tests in the sequence listed and comply with preparatory instructions. Before performing any actual testing, be sure that all ground terminals of the test equipment and the unit under test are properly connected unless otherwise stated in the test setup notes.

5-16. Aligment Procedure and Operational Tests

a. General. The alignment procedure determines the proper alignment of the panel meter and satisfactory operation of the 1600-Hz oscillator. The remainder of the operational tests assure that all major subassemblies and panels are operational.

NOTE

1. TEST ALIGN meter selector switch and TEST ALIGN meter are common to the CV-1548/G only.

2. Reference (REF) control is common to power supply assembly 18A1 only.

8. Meter indications required in the following tests are available on CV-1548/G when using power supply assembly 18A1.

b. Alignmet and Test.

(1) On the unit under test (CV-1548( )/G, set the controls as follows:

Control	*Position*
POWER switch	OFF
TEST ALIGN meter selector switch	Any position
Channel (CH ( )) switches (1-12)	2W
18A8 ( ) mode switches (1-12)	AC

(2) Remove 18A1 power supply assembly and connect extender board to the rear of the power supply; then reinstall into CV-1548/G.

(3) Remove 18A2 panel and connect extender board to rear of panel; then reinstall into CV-1548( )/G (fig. 5-4).

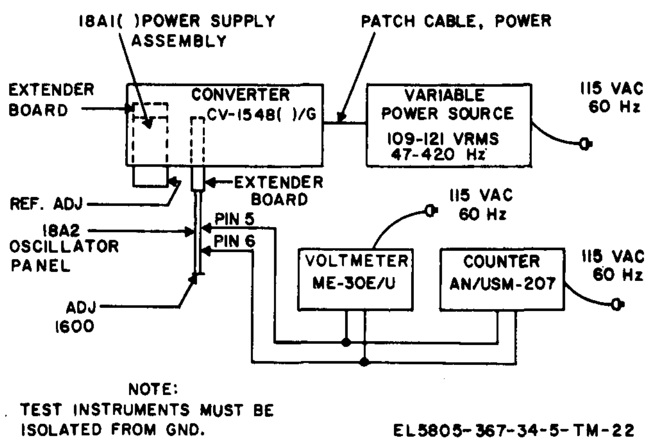


Figure 5-4. Alignment and operational tests, bench setup.

(4) Connect the test setup as shown in figure 5-4 and adjust the VARIABLE POWER SOURCE for 115 volts, 60 Hz.

(5) Turn CV-1548( )/G POWER switch to ON. The power lamp and the 20-Hz lamp on 18A2 panel should light.

(6) Adjust the ADJ 1600 control on the 18A2 panel to give an indication of 360 millivolts on VOLTMETER. The frequency indicated on COUNTER must be 1600 Hz ±30.

(7) Turn CV-1548( )/G POWER switch to OFF. Power lamp and 20-Hz lamp should extinguish. Remove 18A2 panel and extender board and meter leads. Reinsert 18A2 panel and turn CV-1548( )/G POWER switch to ON.

(8) Set the TEST ALIGN meter selector switch to the 1600~ position. Adjust the REF control on the side of power supply assembly 18A1 to give a center scale indication on the TEST ALIGN meter. Rotate the TEST ALIGN meter selector switch through its positions and note that the color of the meter indication matches the color of the switch position.

(9) Turn CV-1548/G POWER switch to OFF and remove power supply assembly and extender board. Reinstall power supply assembly and secure.

(10) In case of failure of the above tests, replace the 18A2 panel and then the 18A1 ( ) **power supply assembly. If the trouble still persists**, refer to chapter 4 for major troubleshooting and repair procedures.

NOTE

Repeat paragraph 5-16 whenever power supply assembly 18A1( ) or oscillator panel 18A2 has been replaced.

5-17. Sensitivity and Frequency Selectivity Test, 20-Hz Generator and Receiver

a. General. These tests determine the correct performance of the 20-Hz generator and ring circuits, and the sensitivity and selectivity of the 1600-Hz multiplexer (MUX) receiver circuits.

b. Tests.

(1) On the unit under test (CV-1548( )/G), set the controls as follows.

Control	*Position*
POWER switch	OFF
TEST ALIGN meter selector switch	Any position
Channel (CH ( )) switches (1-12)	2W
18A3 ( ) mode switches (1-12)	AC

(2) Connect the MUX cable of the test junction box to MUX connector 1-4 (1-4 indicates channels 1 through 4) at the rear of the CV-1548( )/G. Connect the SWBD cable of the test junction box to SWBD connector 1-4 at the rear of the CV-1548 ( )/G. Connect MUX cables

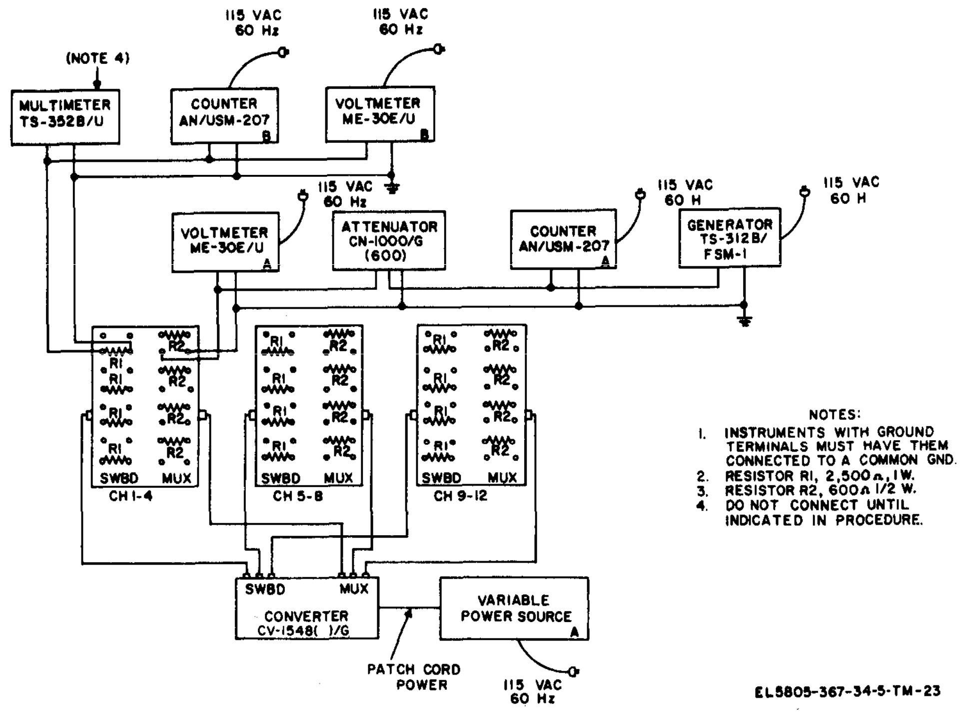


Figure 5-5. 20-Hz generator and 1600-Hz receiver sensitivity and selectivity test.

5-8 and 9-12, and SWBD cables 5-8 and 9-12 in the same manner.

(3) Connect the unit under test and the test equipment as shown in figure 5-5 (channel No. 1 test illustrated).

(4) Perform the following equipment setp procedures.

(a) Turn VARIABLE POWER SOURCE to ON and adjust the AC line for 121 volts, 47 Hz.

(b) Turn CV-1548 ( )/G POWER switch to ON.

(c) Set CN-1000/G ATTENUATOR controls to 0-dB attenuation.

(d) Adjust signal GENERATOR output for an indication of 0 dBm on VOLTMETER A.

(e) Adjust signal GENERATOR frequency for an indication of 1600 Hz ±10 on COUNTER A.

(5) Place the shorting plug across the 2500-ohm SWBD channel load R1 for a period of 15 seconds.

(6) After 16 seconds, adjust the VARIABLE POWER SOURCE to 116 volts, 60 Hz and remove the shorting plug from the 2500-ohm load. Measure voltage and frequency across the previously shorted terminals.

(a) VOLTMETER B should indicate not less than 75 VAC.

(b) COUNTER B should indicate 20 Hz ± 2 .

(7) Turn CV-1548( )/G POWER switch to OFF, and replace the 2500-ohm resistor of channel under test with a 10 K-ohm resistor.

(8) Turn CV-1548( )/G POWER switch to ON, and measure the voltage and frequency across the 10K-ohm load. Indications should be within the limits given in (6) above.

(9) In case of failure of (6) or (8) above, inspect fuses and replace the 18A3 ( ) panel of channel under test, the 18A2 panel, and finally the 18A1 ( ) power supply assembly.

(10) Turn CV-1548( )/G POWER switch to OFF and replace the 10K-ohm load with a 2500-ohm load. Turn POWER switch back to ON.

(11) Adjust the signal GENERATOR frequency for an indication of 1450 Hz ±1 on COUNTER A and +5 dBm as indicated on VOLTMETER A. Observe COUNTER B and VOLTMETER B, and note that no 20-Hz signal is present across the 2500-ohm load.

(12) Adjust the signal GENERATOR frequency for an indication of 1570 Hz ±1 on COUNTER A and -25 dBm as indicated on VOLTMETER A.

(13) Measure voltage and frequency across the 2500-ohm load.

(a) VOLTMETER B should indicate no less than 75 VAC.

(b) COUNTER B should indicate 20 Hz ±2.

(14) Adjust the signal GENERATOR frequency for an indication of 1630 Hz ±1 on COUNTER A and -25 dBm as indicated on VOLTMETER A,

(15) Measure voltage and frequency across the 2500-ohm load.

(a) VOLTMETER B should indicate no less than 75 VAC.

(b) COUNTER B should indicate 20 Hz ±2.

(16) Adjust the signal GENERATOR frequency for an indication of 1750 Hz ±1 on COUNTER A and +5 dBm as indicated on VOLTMETER A. Observe COUNTER B and VOLTMETER B, and note that no 20-Hz signal is present across the 2500-ohm load.

(17) Repeat (11) through (16) above for channels 2-4, 5-8, and 9-12.

(18) Set all 18A3 ( ) mode switches to TE.

(19) Remove COUNTER B, VOLTMETER B, and the 2500-ohm load.

(20) Connect Multimeter TS-352B/U with control switches set to measure OHMS, X 10,000.

(21) Repeat (11) and (12) above for all channels while observing the MULTIMETER.

(a) MULTIMETER indicates continuity in (11) above.

(b) MULTIMETER indicates an open circuit in (12) above.

(22) Disconnect MULTIMETER.

(23) In case of failure of a specific channel, replace the corresponding 18A3 ( ) panel, If failure occurs on all channels, replace the 18A1( ) power supply assembly.

5-18. Sensitivity Test, 1600-Hz Generator and 20-Hz Detector

a. General. These tests determine the correct outputs of the 1600-Hz generator and the multiplex output circuitry, and the sensitivity and selectivity of the 20-Hz detector circuits.

b. Tests.

(1) On the unit under test (CV-1548( )/G), set the controls as follows:

Control	*Position*
POWER switch	ON
TEST ALIGN meter selector switch	Any position
Channel (CH ( )) switches (1-12)	2W
18A3( ) mode switches (1-12)	OR

(2) Connect test equipment and resistors as shown in figure 5-6, and adjust VARIABLE POWER SOURCE for 115 volts, 60 Hz.

(3) Measure the 1600-Hz signal voltage across each of the transmit MUX terminals (T1 through T12) of the test j unction boxes.

(a) COUNTER should indicate 1600 Hz ±30.

(b) VOLTMETER should indicate -15 dBm ±1.

(4) Connect test circuit as shown in figure 5-7.

(5) Set all 18A3( ) mode switches to AC.

(6) Adjust VARIABLE POWER SOURCE B for an indication of 25 Hz on COUNTER and 16 volts on VOLTMETER A.

(a) VOLTMETER B should indicate -15 dBm ±l.

(b) Repeat measurement on all MUX transmit channels (T2 through T12).

(7) Adjust VARIABLE POWER SOURCE B for an indication of 15 Hz on COUNTER and 16 volts on VOLTMETER A.

(8) VOLTMETER B should measure the 1600-Hz ring signal at -15 dBm ±1 dBm on all MUX transmit channels (T1 through T12).

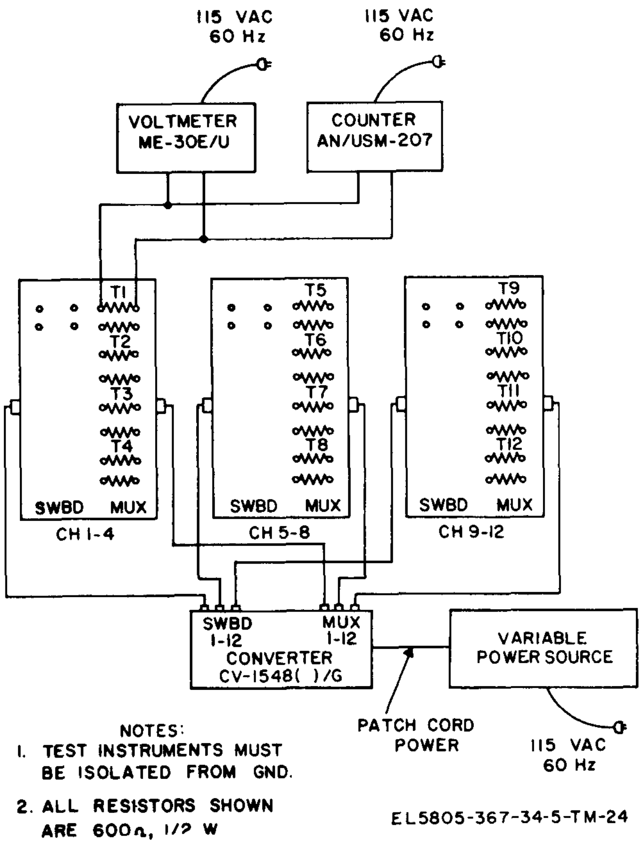


Figure 5-6. 1600–Hz generator test, bench setup.

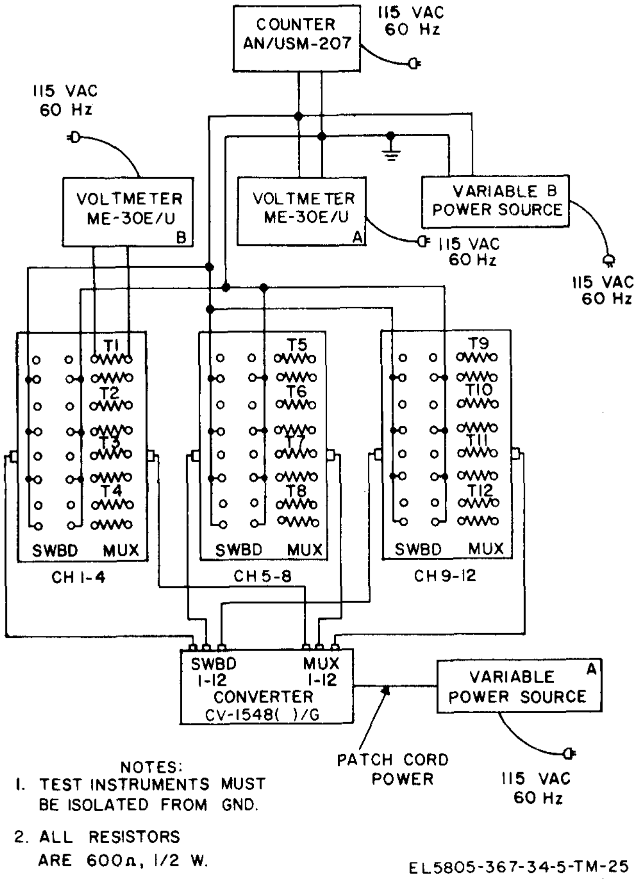


Figure 5-7. 20-Hz detector sensitivity test, bench setup.

(9) In case of failure of a specific channel, change the corresponding 18A3 ( ) panel. If all channels are bad, change the 18A2 oscillator panel and then 18A1 ( ) power supply assembly.

5-19. Harmonic Distortion Test

a. General. These tests determine the distortion level of the audio transmission during 4-wire to 2-wire conversion.

b. Distortion Test.

(1) On the unit under test (CV-1548( )/G), set the controls as follows:

Control	*Position*
POWER switch -----------------------	ON
TEST ALIGN meter selector switch	Any position
Channel (CH ( )) switches (1-12) --------	2W
18A3( ) mode switches (1-12) ----------------	AC

(2) Connect the test setup as shown in figure 5–8.

(3) Adjust the VARIABLE POWER SOURCE for 115 volts, 60 Hz.

(4) Set the signal GENERATOR frequency to 1 kHz and adjust the output for an indication

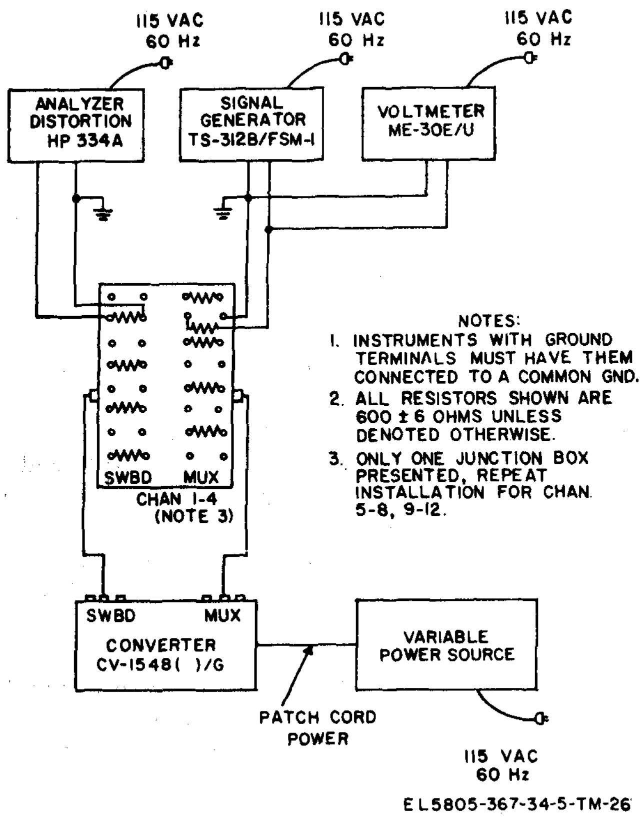


Figure 5-8. Harmonic distortion test, bench setup.

of +7 dBm on VOLTMETER, Note this gives an insertion level of +1 dBm to channel under test.

(5) Measure the channel output with ANALYZER DISTORTION HP 334A. A distortion level of at least 35 dB below the inserted fundamental frequency is required for compliance.

(6) Repeat test for all channels, In case of failure, change corresponding 18A3 ( ) panel.

5-20. Channel Continuity Test 4 Wire to 4 Wire (Patch Thru)

a. General. This test determines the continuity of the 4-wire to 4-wire (patch thru) circuits.

b. Continuity Test.

(1) On the unit under test (CV-1548( )/G), set the controls as follows:

Control	Position
POWER switch	ON
TEST ALIGN meter selector switch	Any position
Channel (CH ( )) switches (1-12)	4W
18A3( ) mode switches	any position

(2) Connect the test circuit as shown in figure 5-9.

(3) Adjust the VARIABLE POWER SOURCE for 115 volts, 60 Hz.

(4) Set the signal GENERATOR frequency to 1 kHz and adjust the output for an indication of +7 dBm on VOLTMETER A.

(5) VOLTMETER B should indicate 1 $^{+0.0}_{-0.5}$ dBm.

(6) Repeat the above test for each transmit (T) and each receive (R) circuit on all channels.

(7) In case of low reading, check the wiring between connectors J1 and J4, J2 and J5, and J3 and J6 for continuity and for leakage to ground.

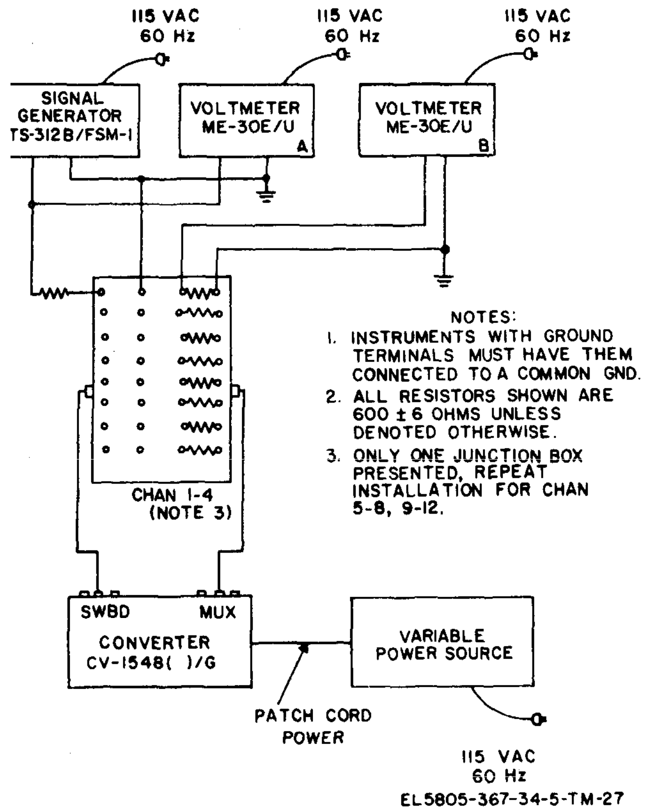
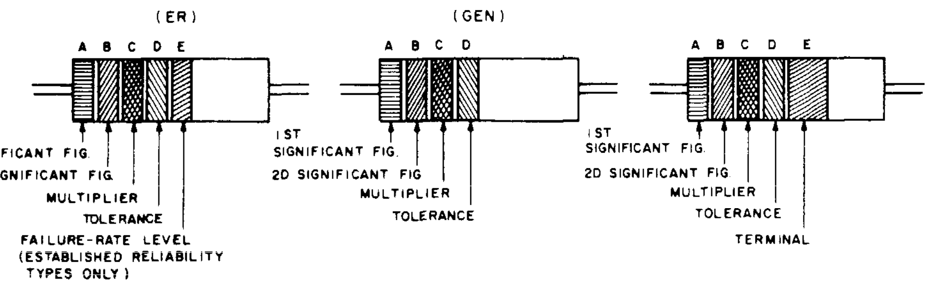


Figure 5-9. 4w/4w continuity test, bench setup.

APPENDIX A

REFERENCES

DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms.
DA Pam 738-750	The Army Maintenance Management System (TAMMS).
TB SIG 222	Solder and Soldering
TM 11-5805-367-12	Operator's and Organizational Maintenance Manual: Multiplexer, TD-202/U (NSN 5805-00-884-2176), TD-203/U (5805-00-884-2177), TD-204/U (5805-00-900-8200), TD-352/U (5805-00-900-8199) and TD-353/U (5805-00-985-9153); Restorers, Pulse Form, TD-206/G (5805-00-868-8078) and TD-206B/G (5805-01-020-225 1); and Converters, Telephone Signal, CV-1548/G (5805-00-069-8795) and CV-1548A/G (5805-00-069-8795).
TM 11-5805-367-34P-5	Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Converters, Telephone Signal CV-1548/G and CV-1548A/G (NSN 5805-00-069-8795).
TM 11-6625-320-12	Operator and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U, ME-30C/U and ME-30E/U.
TM 11-6625-355-12	Operator's and Organizational Maintenance Manual: Audio Oscillators TS-421/U and TS-421A/U (NSN 6625-00-669-0228).
TM 11-6625-366-10	Operator's Manual Multimeter TS-352B/U (NSN 6625-00-553-0142).
TM 11-6625-366-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Multimeter TS-352B/U (NSN 6625-00-553-0142).
TM 11-6625-535-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Oscilloscope AN/USM-140A.
TM 11-6625-539-15	Operator, Organizational, Field and Depot Maintenance Manual for Transistor Test Set TS-1836/U (NSN 6625-00-168-0954).
TM 740-90-1	Administrative Storage of Equipment
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use



COLOR CODE MARKING FOR COMPOSITION TYPE RESISTORS.

COLOR-CODE MARKING FOR FILM-TYPE RESISTORS.

TABLE I
COLOR CODE FOR COMPOSITION TYPE AND FILM TYPE RESISTORS.

BAND A		BAND B		BAND C		BAND D		BAND E		
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)	COLOR	FAILURE RATE LEVEL	TERM.
BLACK	0	BLACK	0	BLACK	1			BROWN	M=1.0	
BROWN	1	BROWN	1	BROWN	10			RED	P=0.1	
RED	2	RED	2	RED	100			ORANGE	R=0.01	
ORANGE	3	ORANGE	3	ORANGE	1,000			YELLOW	S=0.001	
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	±10 (COMP. TYPE ONLY)	WHITE		SOLDERABLE
GREEN	5	GREEN	5	GREEN	100,000	GOLD	±5			
BLUE	6	BLUE	6	BLUE	1,000,000	RED	±2 (NOT APPLICABLE TO ESTABLISHED RELIABILITY).			
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7							
GRAY	8	GRAY	8	SILVER	0.01					
WHITE	9	WHITE	9	GOLD	0.1					

BAND A — THE FIRST SIGNIFICANT FIGURE OF THE RESISTANCE VALUE (BANDS A THRU D SHALL BE OF EQUAL WIDTH.)

BAND B — THE SECOND SIGNIFICANT FIGURE OF THE RESISTANCE VALUE.

BAND C — THE MULTIPLIER (THE MULTIPLIER IS THE FACTOR BY WHICH THE TWO SIGNIFICANT FIGURES ARE MULTIPLIED TO YIELD THE NOMINAL RESISTANCE VALUE.)

BAND D — THE RESISTANCE TOLERANCE.

BAND E — WHEN USED ON COMPOSITION RESISTORS, BAND E INDICATES ESTABLISHED RELIABILITY FAILURE-RATE LEVEL (PERCENT FAILURE PER 1,000 HOURS) ON FILM RESISTORS, THIS BAND SHALL BE APPROXIMATELY 1-1/2 TIMES THE WIDTH OF OTHER BANDS, AND INDICATES TYPE OF TERMINAL.

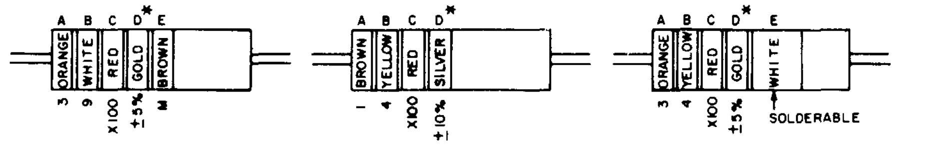
RESISTANCES IDENTIFIED BY NUMBERS AND LETTERS
(THESE ARE NOT COLOR CODED)

SOME RESISTORS ARE IDENTIFIED BY THREE OR FOUR DIGIT ALPHA NUMERIC DESIGNATORS. THE LETTER R IS USED IN PLACE OF A DECIMAL POINT WHEN FRACTIONAL VALUES OF AN OHM ARE EXPRESSED. FOR EXAMPLE:

2R7 = 2.7 OHMS 10R0 = 10.0 OHMS

FOR WIRE-WOUND-TYPE RESISTORS COLOR CODING IS NOT USED, IDENTIFICATION MARKING IS SPECIFIED IN EACH OF THE APPLICABLE SPECIFICATIONS.

EXAMPLES OF COLOR CODING



NOMINAL RESISTANCE 3,900 OHMS
RESISTANCE TOLERANCE ±5%
FAILURE RATE LEVEL M

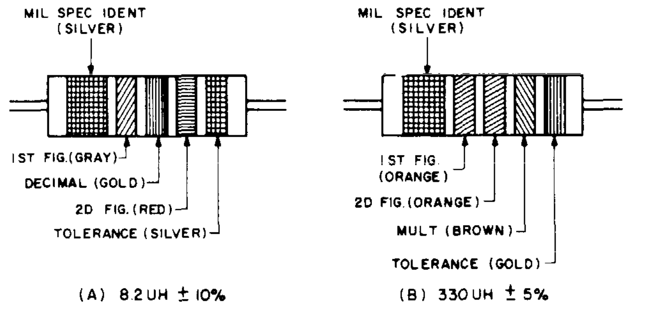
NOMINAL RESISTANCE 1,400 OHMS
RESISTANCE TOLERANCE ±10%

NOMINAL RESISTANCE 3,400 OHMS
RESISTANCE TOLERANCE ±5%
TERMINAL SOLDERABLE

COMPOSITION-TYPE RESISTORS FILM-TYPE RESISTORS

* IF BAND D IS OMITTED, THE RESISTOR TOLERANCE IS ± 20% AND THE RESISTOR IS NOT MIL-STD.

A. COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS.



(A) 8.2 UH ± 10% (B) 330 UH ± 5%

COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES. AT A, AN EXAMPLE OF OF THE CODING FOR AN 8.2 UH CHOKE IS GIVEN. AT B, THE COLOR BANDS FOR A 330 UH INDUCTOR ARE ILLUSTRATED.

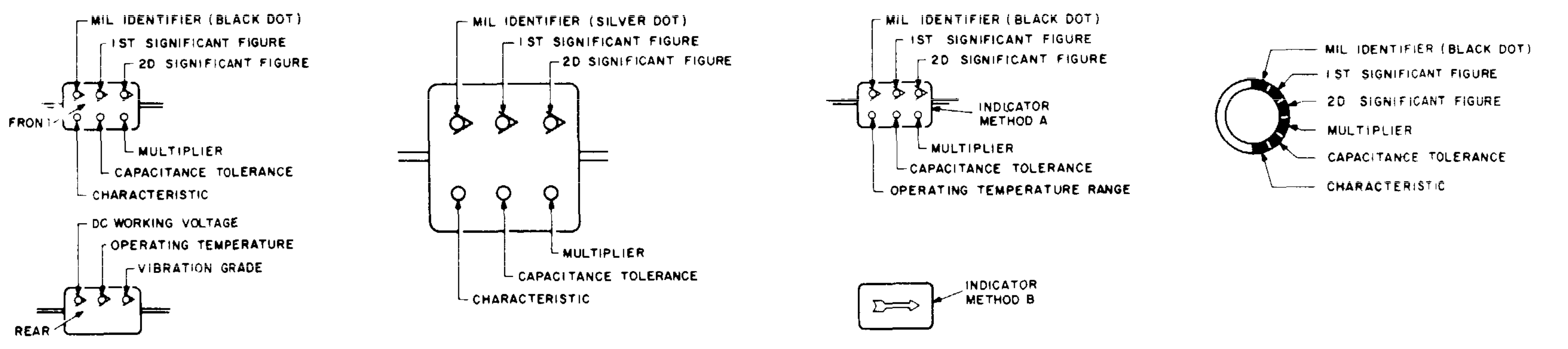
TABLE 2
COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES.

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	INDUCTANCE TOLERANCE (PERCENT)
BLACK	0	1	
BROWN	1	10	1
RED	2	100	2
ORANGE	3	1,000	3
YELLOW	4		
GREEN	5		
BLUE	6		
VIOLET	7		
GRAY	8		
WHITE	9		
NONE			20
SILVER			10
GOLD	DECIMAL POINT		5

MULTIPLIER IS THE FACTOR BY WHICH THE TWO COLOR FIGURES ARE MULTIPLIED TO OBTAIN THE INDUCTANCE VALUE OF THE CHOKE COIL.

B. COLOR CODE MARKING FOR MILITARY STANDARD INDUCTORS.

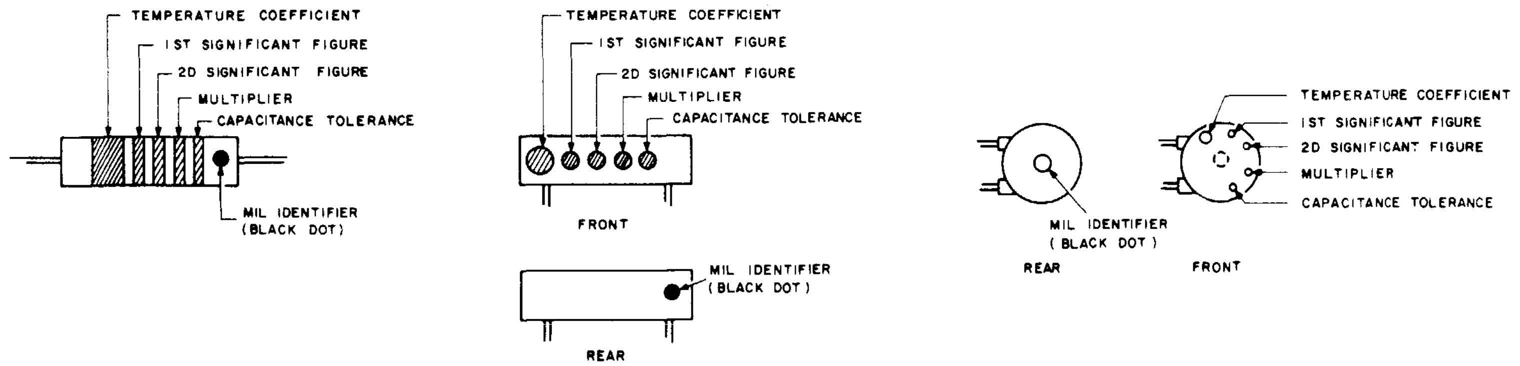
CAPACITORS, FIXED, VARIOUS-DIELECTRICS, STYLES CM, CN, CY, AND CB.



MICA-DIELECTRIC PAPER-DIELECTRIC GLASS-DIELECTRIC, GLASS CASE MICA, BUTTON TYPE

TABLE 3 — FOR USE WITH STYLES CM, CN, CY AND CB.

COLOR	MIL ID	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER[1]	CAPACITANCE TOLERANCE				CHARACTERISTIC[2]			DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CB	CM	CY, CM	CM
BLACK	CM, CY CB	0	0	1			±20%	±20%		A			-55° TO +70°C	10-55 HZ
BROWN		1	1	10					B	E	B			
RED		2	2	100	±2%		±2%	±2%	C				-55° TO +85°C	
ORANGE		3	3	1,000		±30%			D		D	300		
YELLOW		4	4	10,000					E				-55° TO +125°C	10-2,000HZ
GREEN		5	5		±5%				F			500		
BLUE		6	6									0	-55° TO +150°C	
PURPLE (VIOLET)		7	7											
GREY		8	8											
WHITE		9	9											
GOLD				0.1			±5%	±5%						
SILVER	CN			0.01	±10%	±10%	±10%	±10%						



AXIAL LEAD RADIAL LEAD DISK-TYPE

TABLE 4 — TEMPERATURE COMPENSATING, STYLE CC.

COLOR	TEMPERATURE COEFFICIENT[4]	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					CAPACITANCES OVER 10 UUF	CAPACITANCES 10 UUF OR LESS	
BLACK	0	0	0	1		± 2.0 UUF	CC
BROWN	−30	1	1	10	±1%		
RED	−80	2	2	100	±2%	±0.25 UUF	
ORANGE	−150	3	3	1,000			
YELLOW	−220	4	4				
GREEN	−330	5	5		±5%	±0.5 UUF	
BLUE	−470	6	6				
PURPLE (VIOLET)	−750	7	7				
GREY		8	8	0.01 *			
WHITE		9	9	0.1*	±10%		
GOLD	+100			0.1		±1.0 UUF	
SILVER				0.01			

1. THE MULTIPLIER IS THE NUMBER BY WHICH THE TWO SIGNIFICANT (SIG) FIGURES ARE MULTIPLIED TO OBTAIN THE CAPACITANCE IN UUF.
2. LETTERS INDICATE THE CHARACTERISTICS DESIGNATED IN APPLICABLE SPECIFICATIONS: MIL-C-5, MIL-C-25D, MIL-C-11272B, AND MIL-C-10950C RESPECTIVELY.
3. LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-11015D.
4. TEMPERATURE COEFFICIENT IN PARTS PER MILLION PER DEGREE CENTIGRADE.

* OPTIONAL CODING WHERE METALLIC PIGMENTS ARE UNDESIRABLE.

C. COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS.

ESC-FM 1794-71

Figure FO-1. Color code making for MIL STD capacitors, inductors, and resistors.

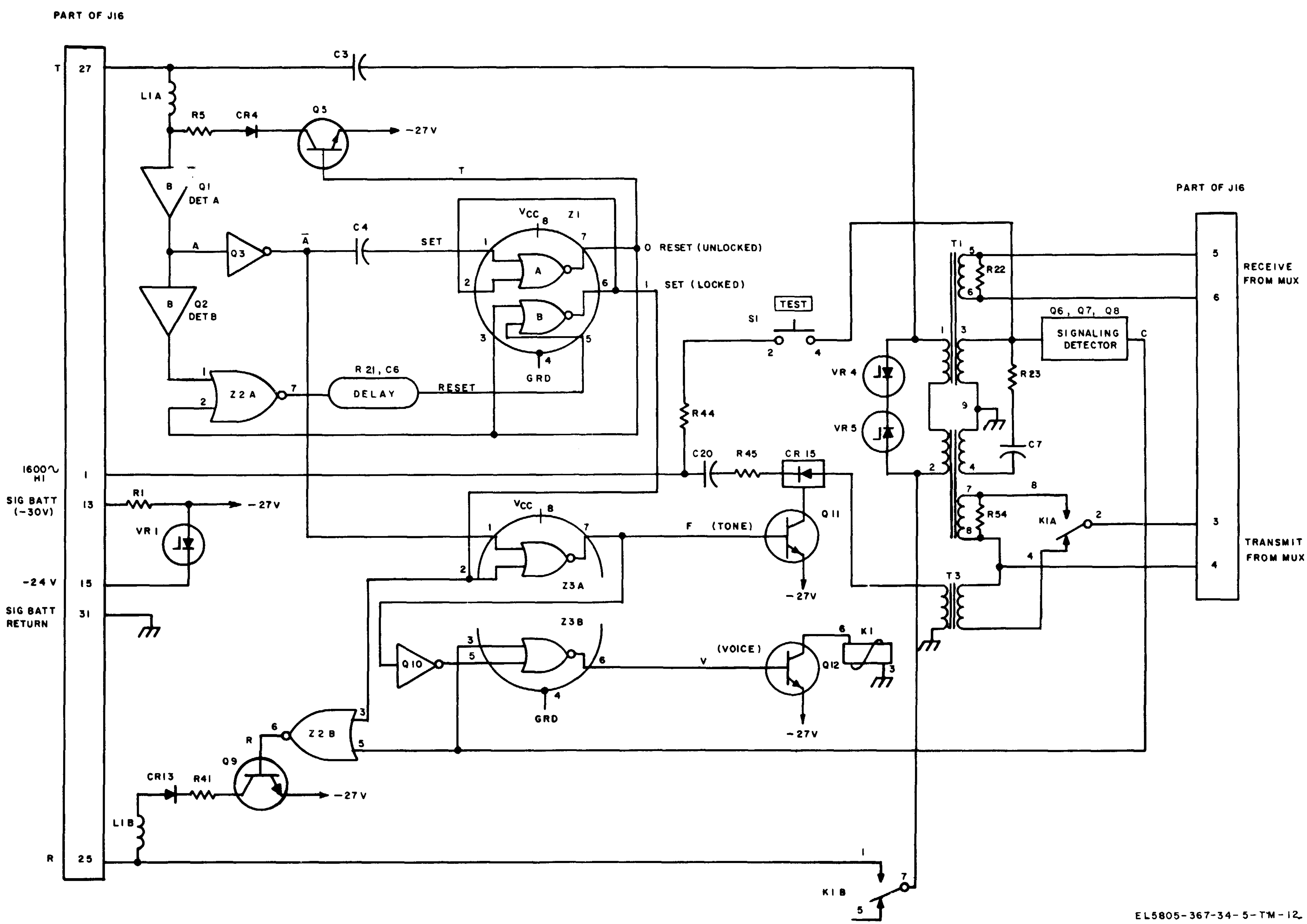


Figure FO-2. Panel 18A4, simplified functional diagram.

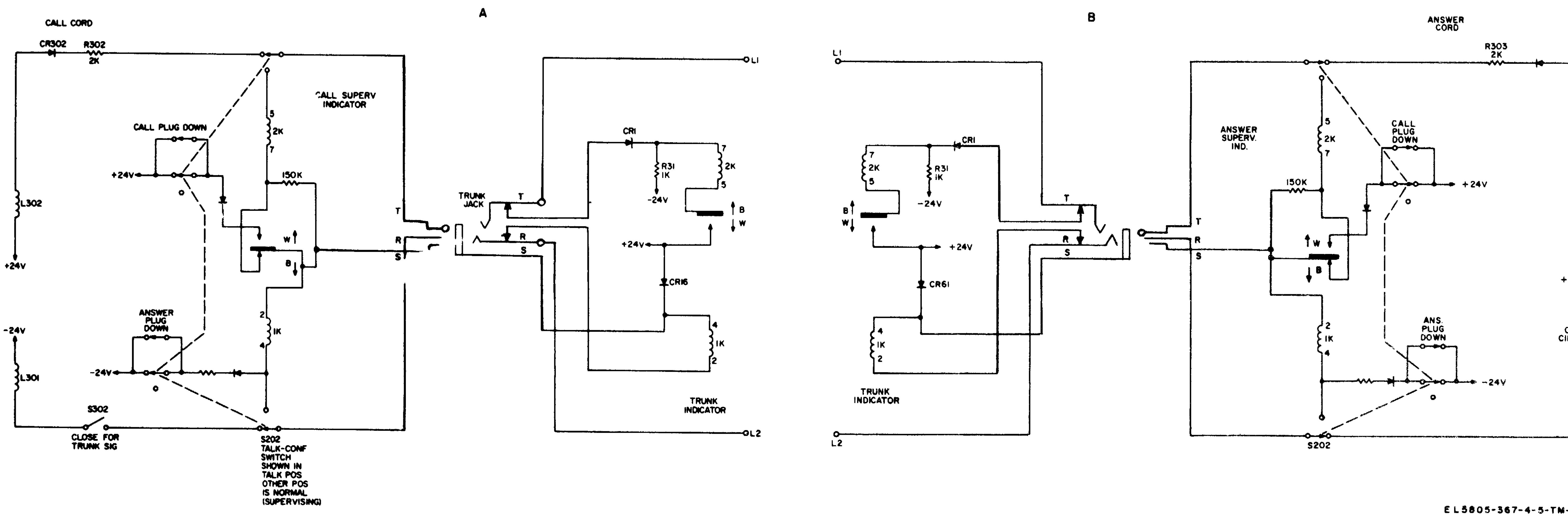
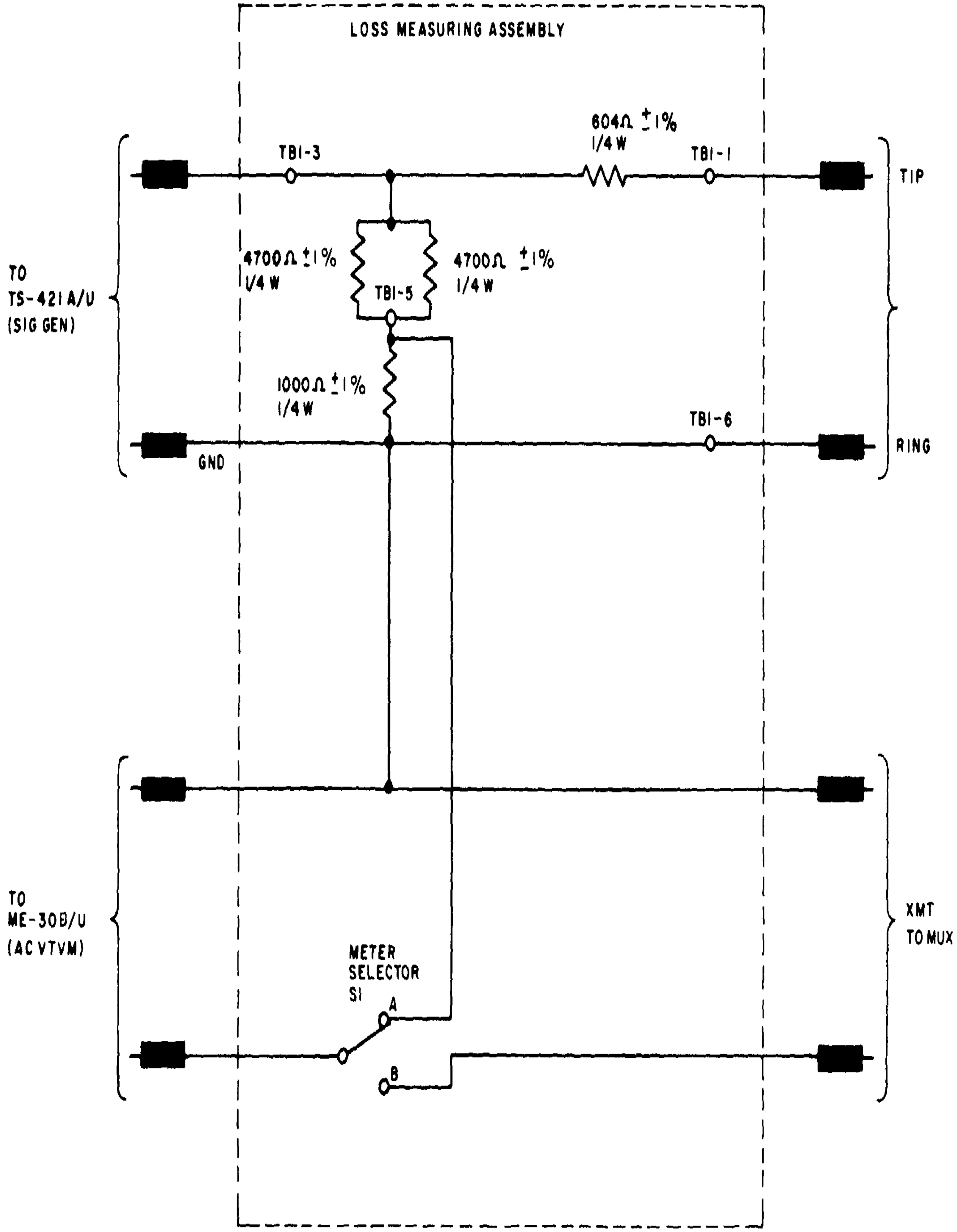
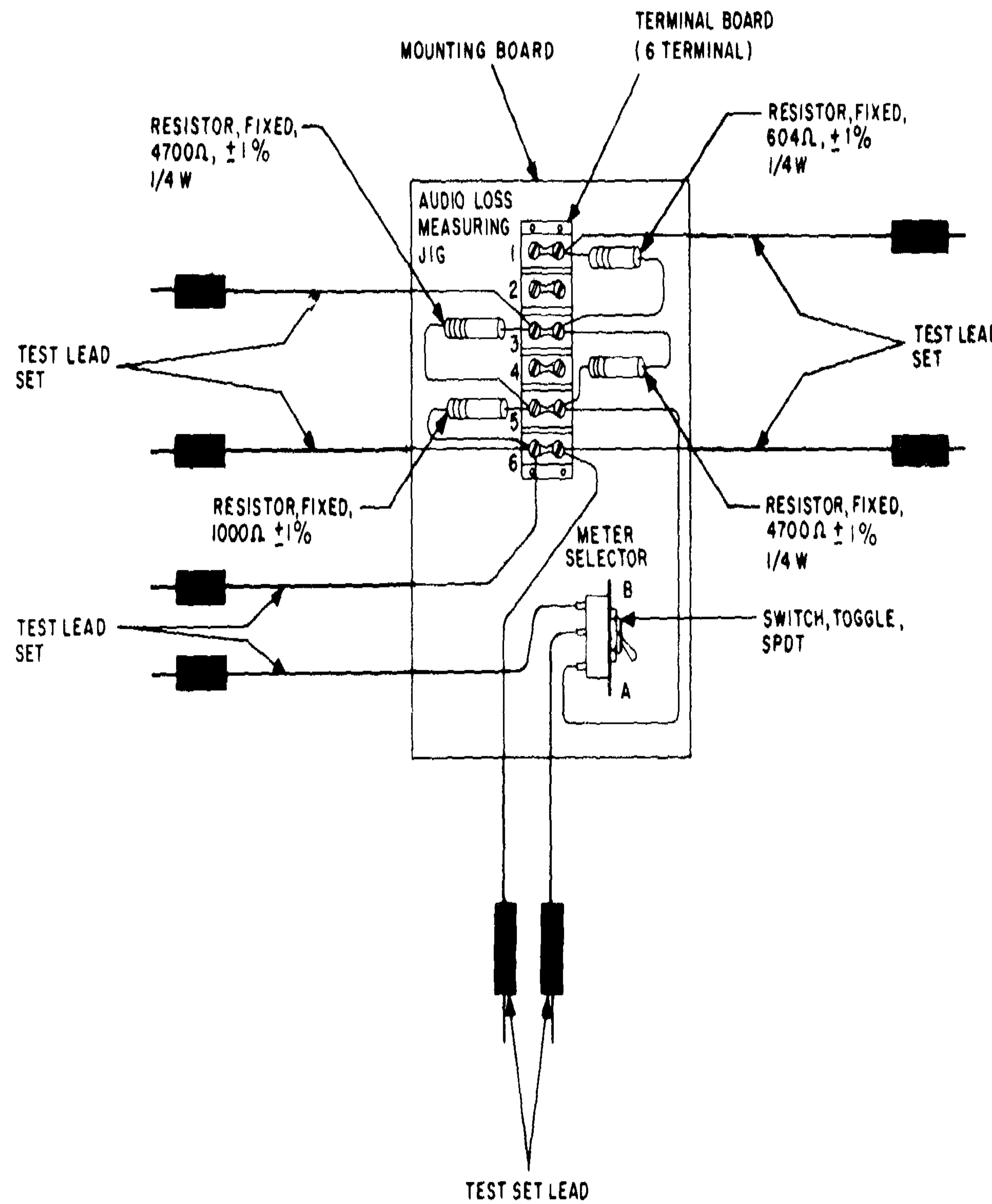


Figure FO-3. Common battery trunk signaling diagram.



A. SCHEMATIC DIAGRAM



B. FABRICATION DIAGRAM

EL5805-367-35-5-TM-16

Figure FO-4. Audio loss measuring test jig, fabrication diagram.

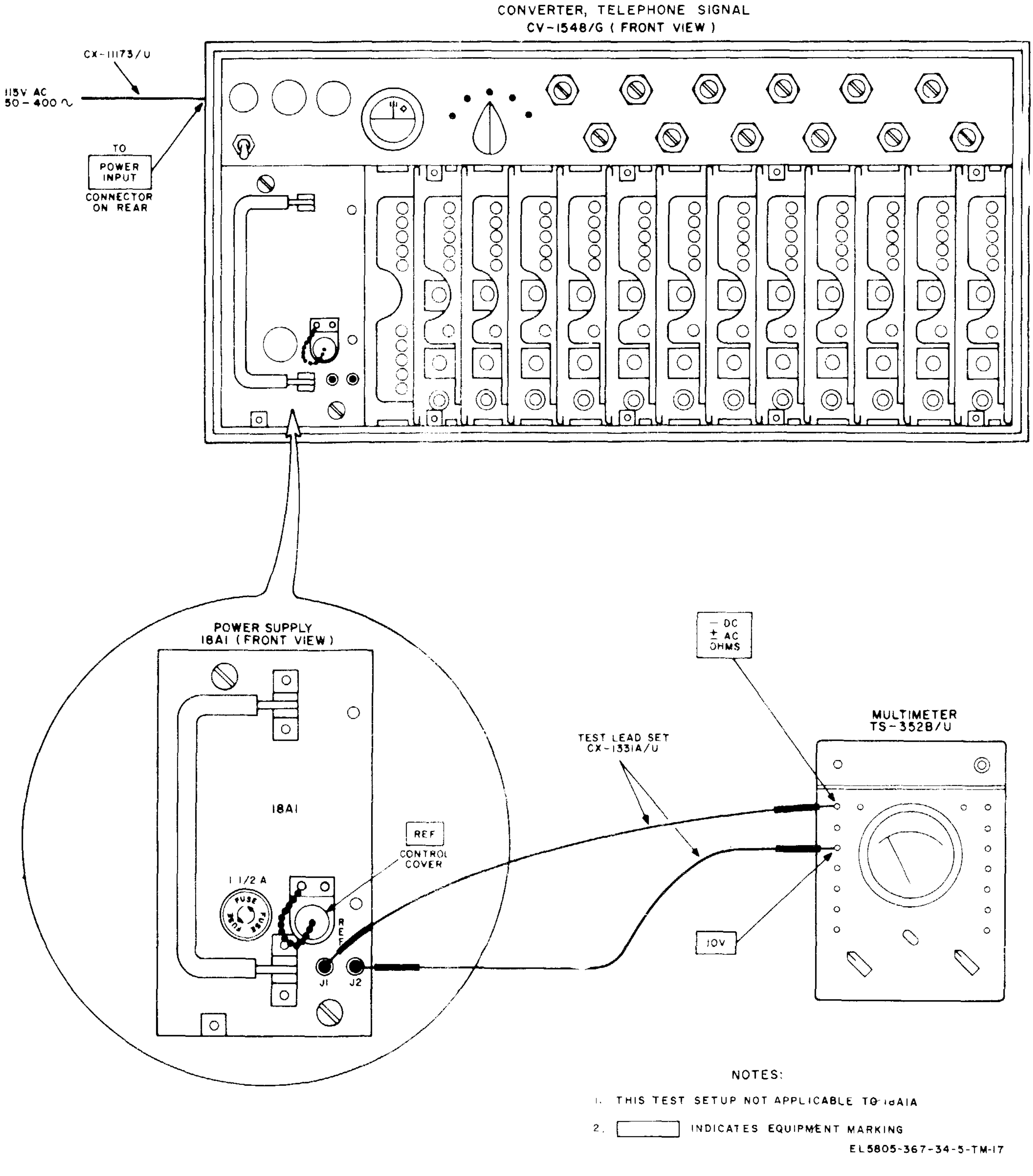


Figure FO-5. Test setup for power supply assembly, 18A1 electrical tests.

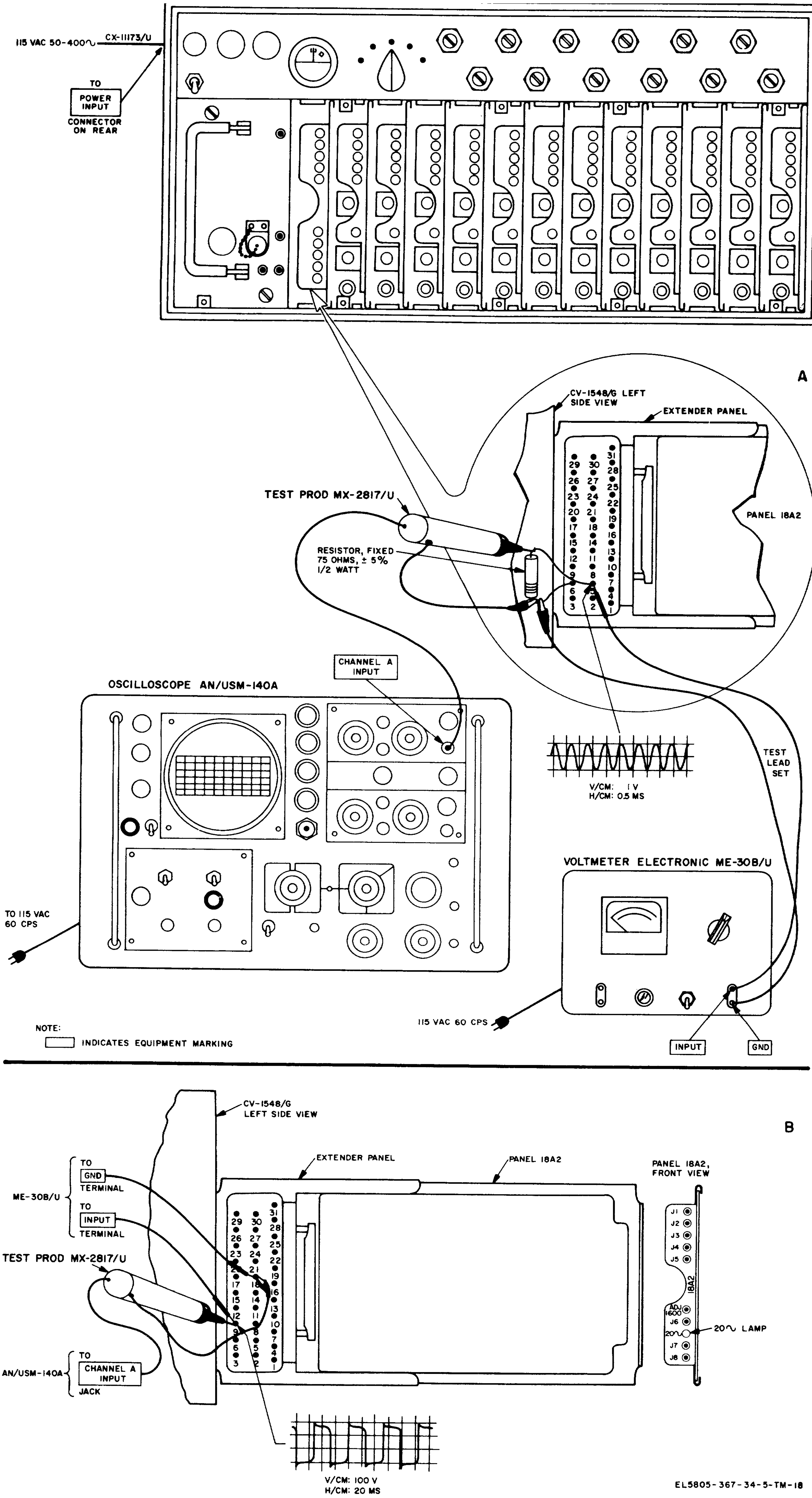


Figure FO-6. Test setup for panel 18A2 electrical tests.

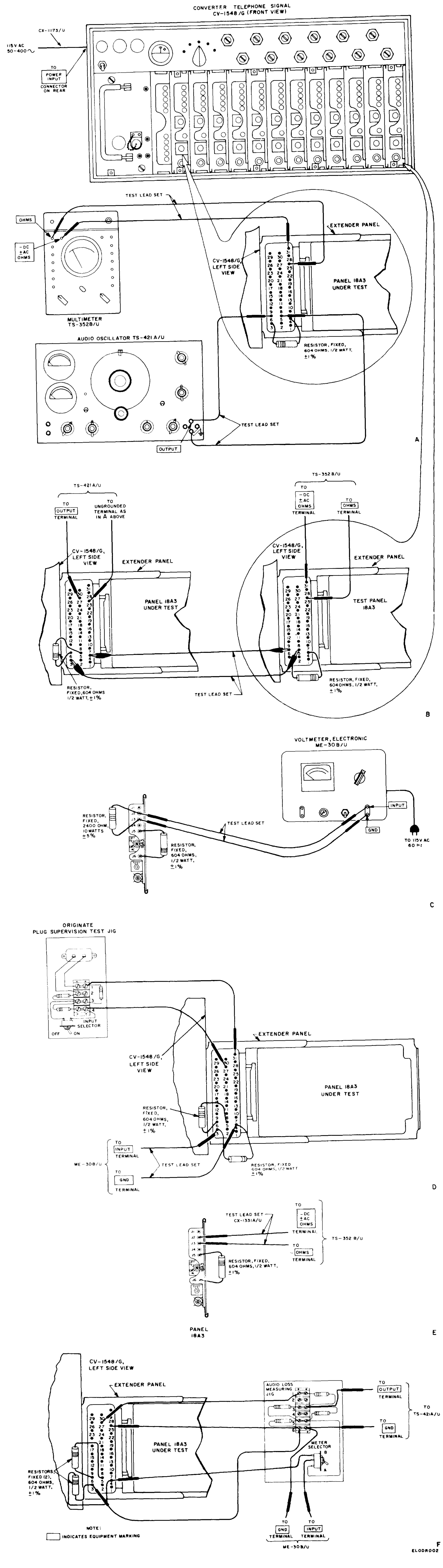


Figure FO-7. Test setup for panel 18A3 ( ) electrical tests.

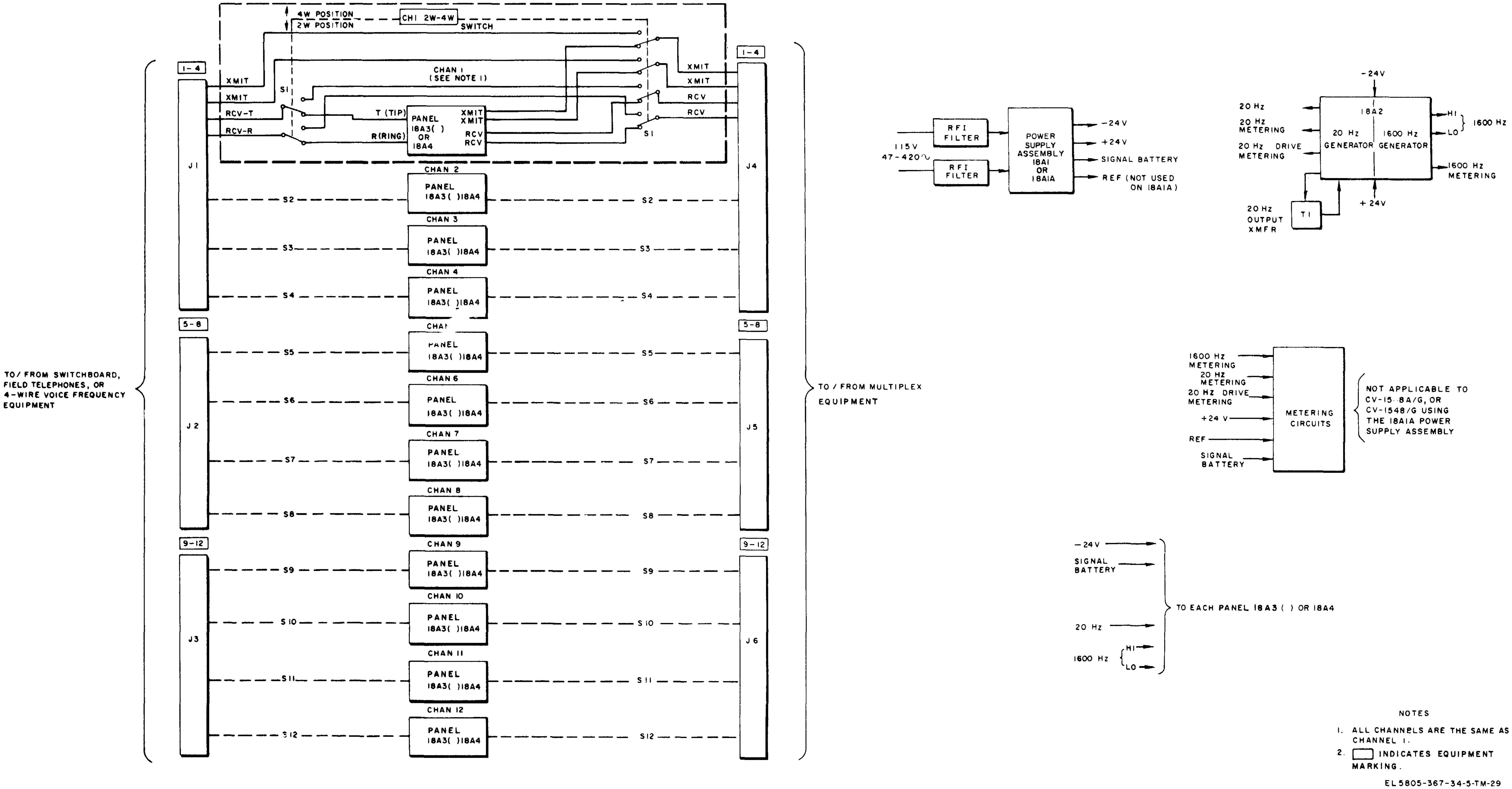
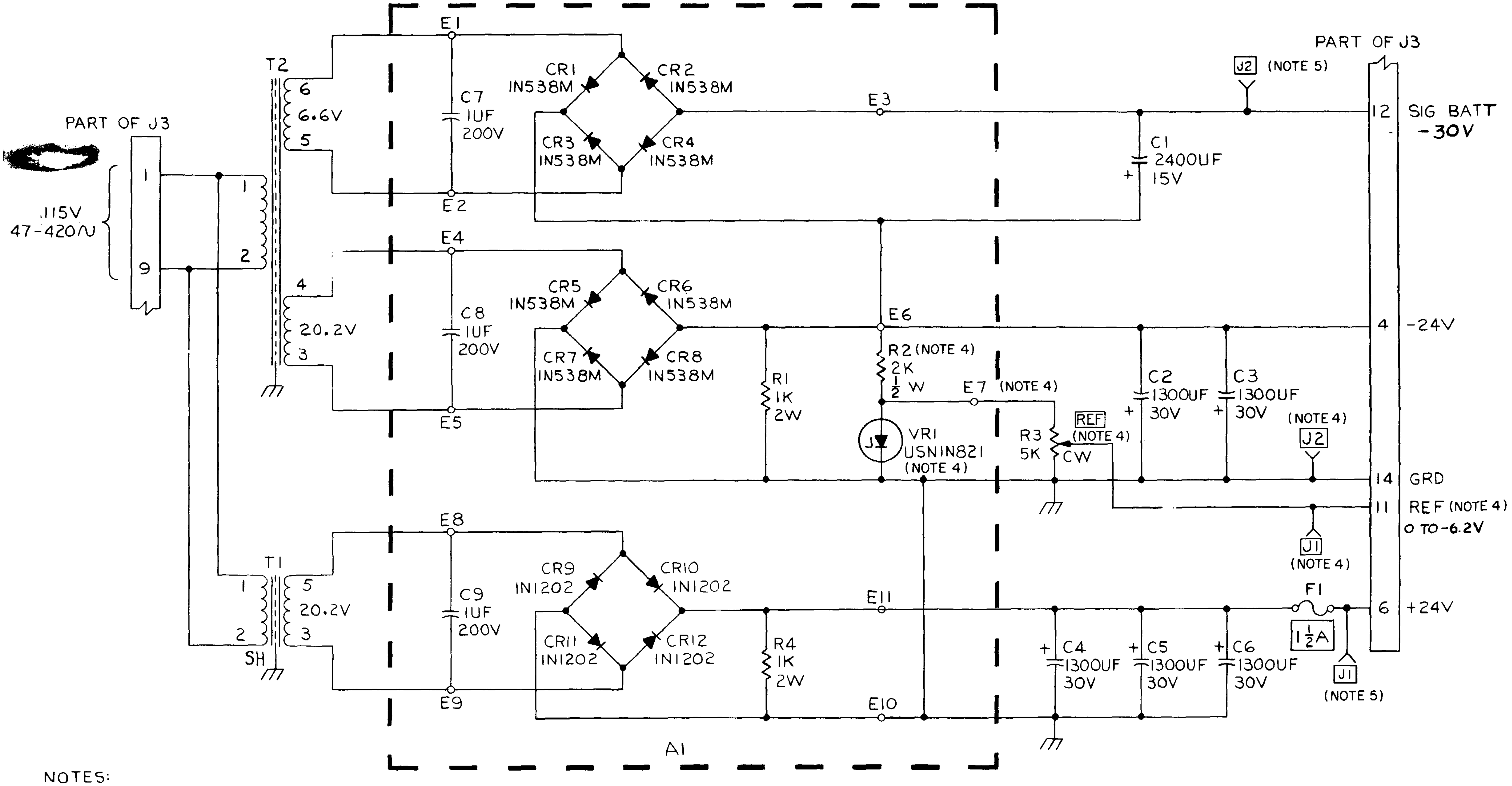


Figure FO-8. Converter, Telephone Signal CV-1548( )/G, block diagram.



NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S)
2. THE VALUE OF ALL RESISTORS IS EXPRESSED IN OHMS
3. ▭ INDICATES EQUIPMENT MARKING
4. NOT USED IN MODEL 18A1A.
5. NOT USED IN MODEL 18A1.

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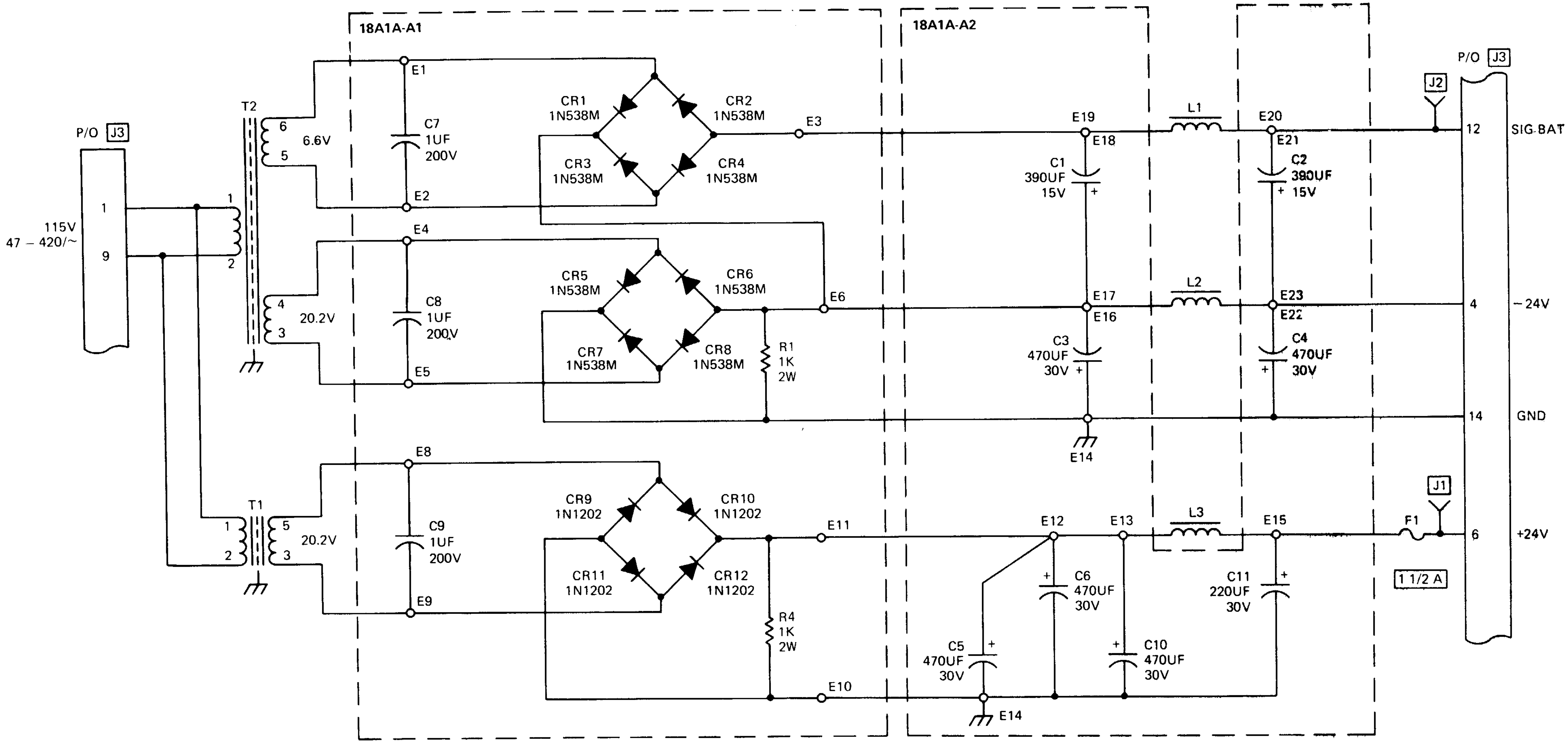
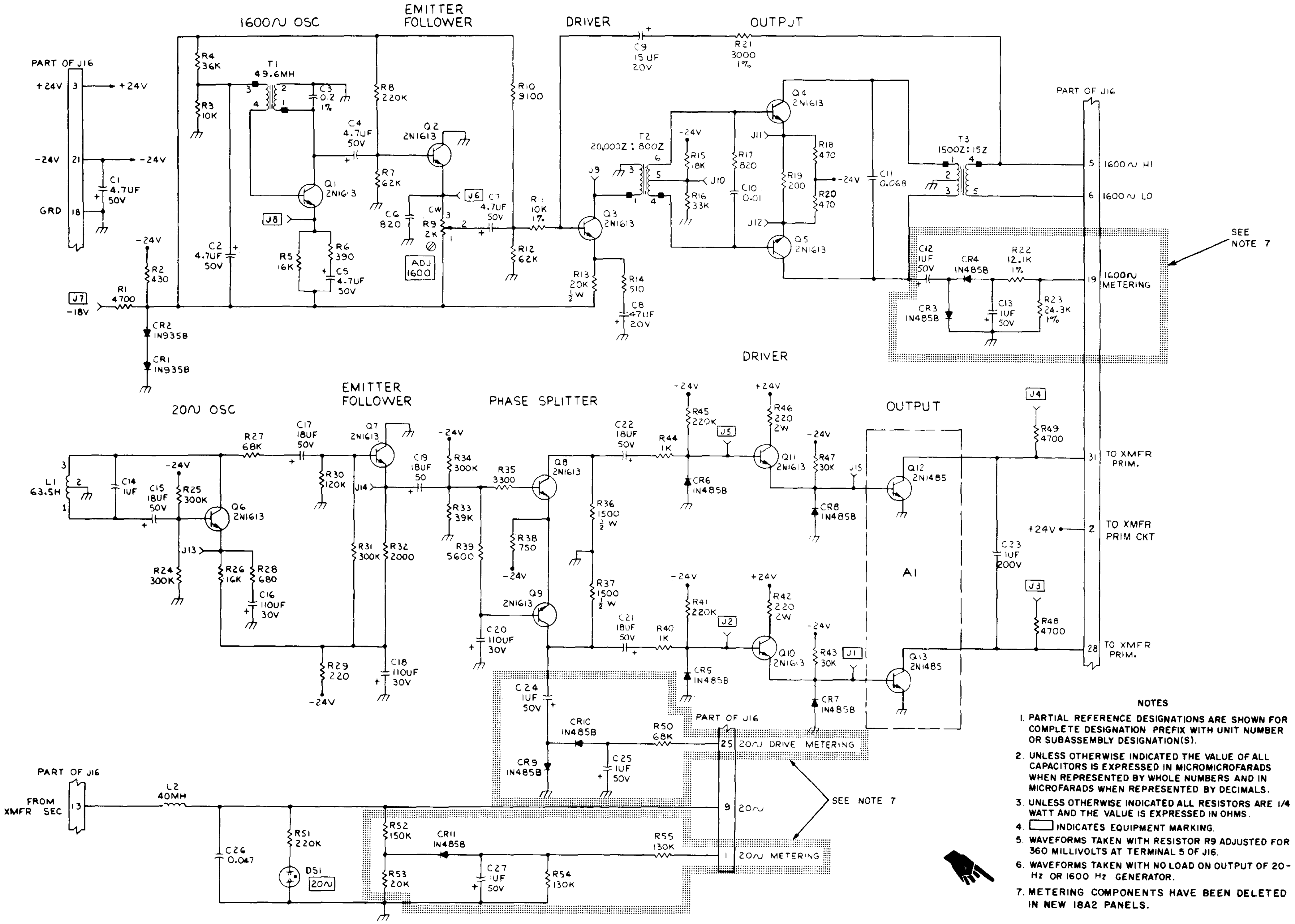
Figure FO-9. Power supply assembly 18A1( ) schematic diagram.

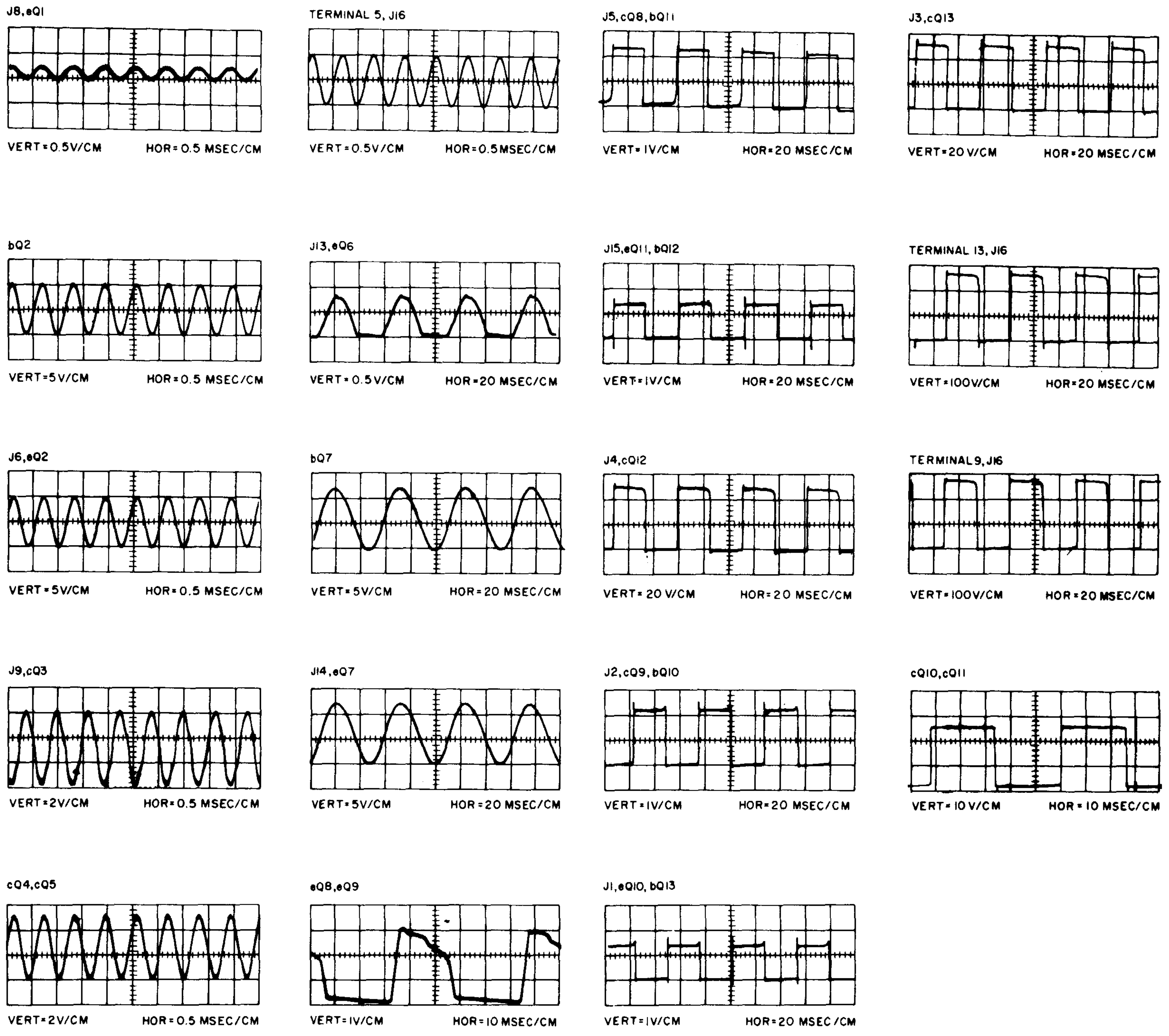


NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S)
2. THE VALUE OF ALL RESISTORS IS EXPRESSED IN OHMS
3. ☐ INDICATES EQUIPMENT MARKING

EL0DR013

Figure FO-9.1. Power supply assembly 18A1B, schematic diagram.





NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S).
2. UNLESS OTHERWISE INDICATED THE VALUE OF ALL CAPACITORS IS EXPRESSED IN MICROMICROFARADS WHEN REPRESENTED BY WHOLE NUMBERS AND IN MICROFARADS WHEN REPRESENTED BY DECIMALS.
3. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT AND THE VALUE IS EXPRESSED IN OHMS.
4. ▭ INDICATES EQUIPMENT MARKING.
5. WAVEFORMS TAKEN WITH RESISTOR R9 ADJUSTED FOR 360 MILLIVOLTS AT TERMINAL 5 OF J16.
6. WAVEFORMS TAKEN WITH NO LOAD ON OUTPUT OF 20-Hz OR 1600 Hz GENERATOR.
7. METERING COMPONENTS HAVE BEEN DELETED IN NEW 18A2 PANELS.

EL0DR014

Figure FO-10. Panel 18A2, schematic diagram.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUB-ASSEMBLY DESIGNATION (S).
2. UNLESS OTHERWISE INDICATED, THE VALUE OF ALL CAPACITORS IS EXPRESSED IN MICROMICROFARADS WHEN REPRESENTED BY WHOLE NUMBERS, AND IN MICROFARADS WHEN REPRESENTED BY DECIMALS.
3. UNLESS OTHERWISE INDICATED, RESISTORS ARE 1/4 WATT AND THEIR VALUE IS EXPRESSED IN OHMS.
4. ▭ INDICATES EQUIPMENT MARKING.

HIGHEST REFERENCE DESIGNATIONS USED				
R27	C17	CR7	VR10	Q4
L2	S2	T2	K2	DS1
J14	E30			
REFERENCE DESIGNATIONS NOT USED				
E21	E16	E17	E18	E29

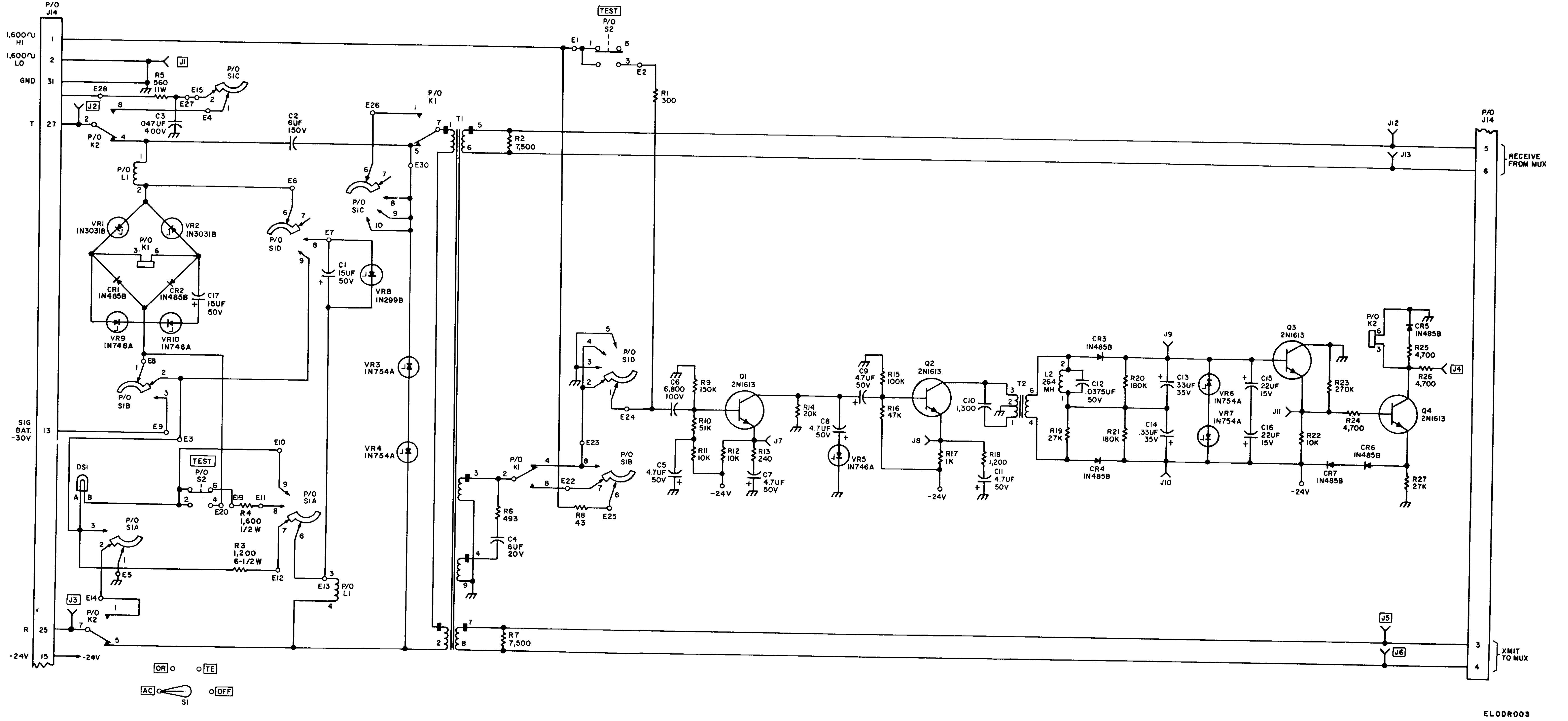
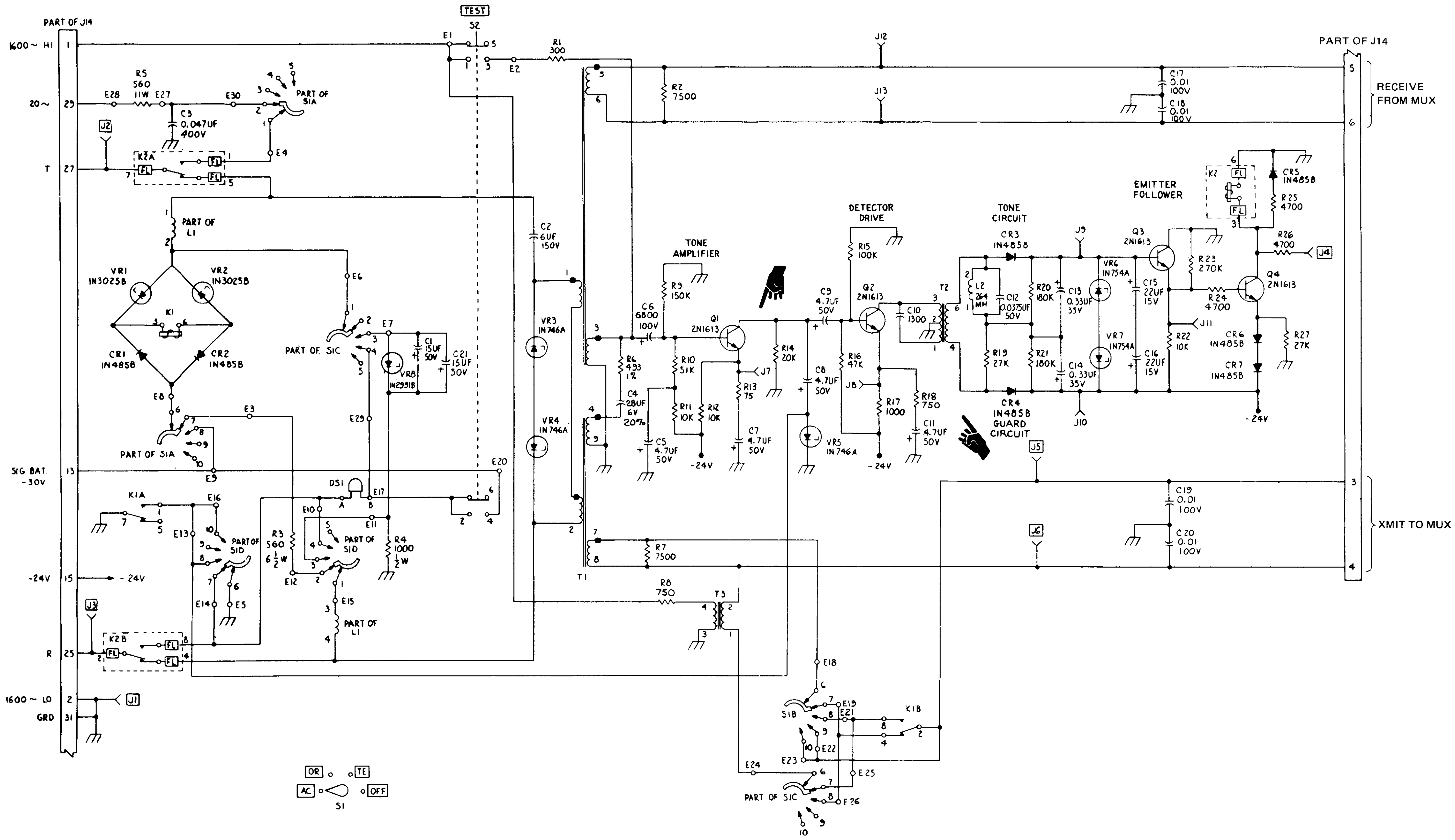
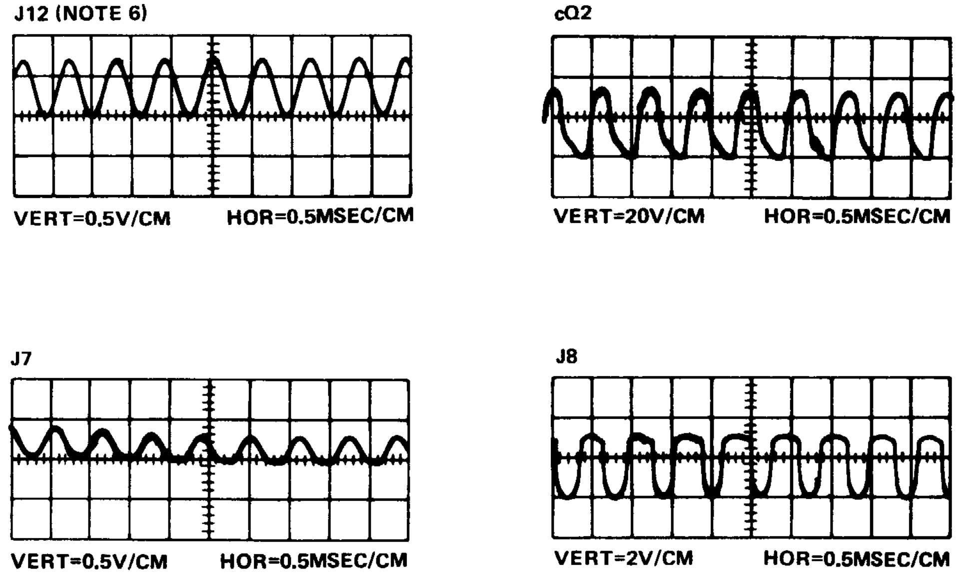
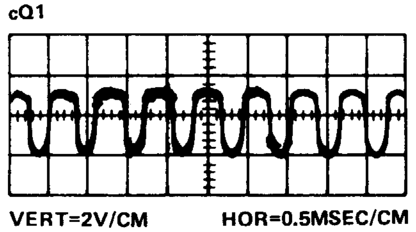


Figure FO-11. Panel 18A3A, schematic diagram.





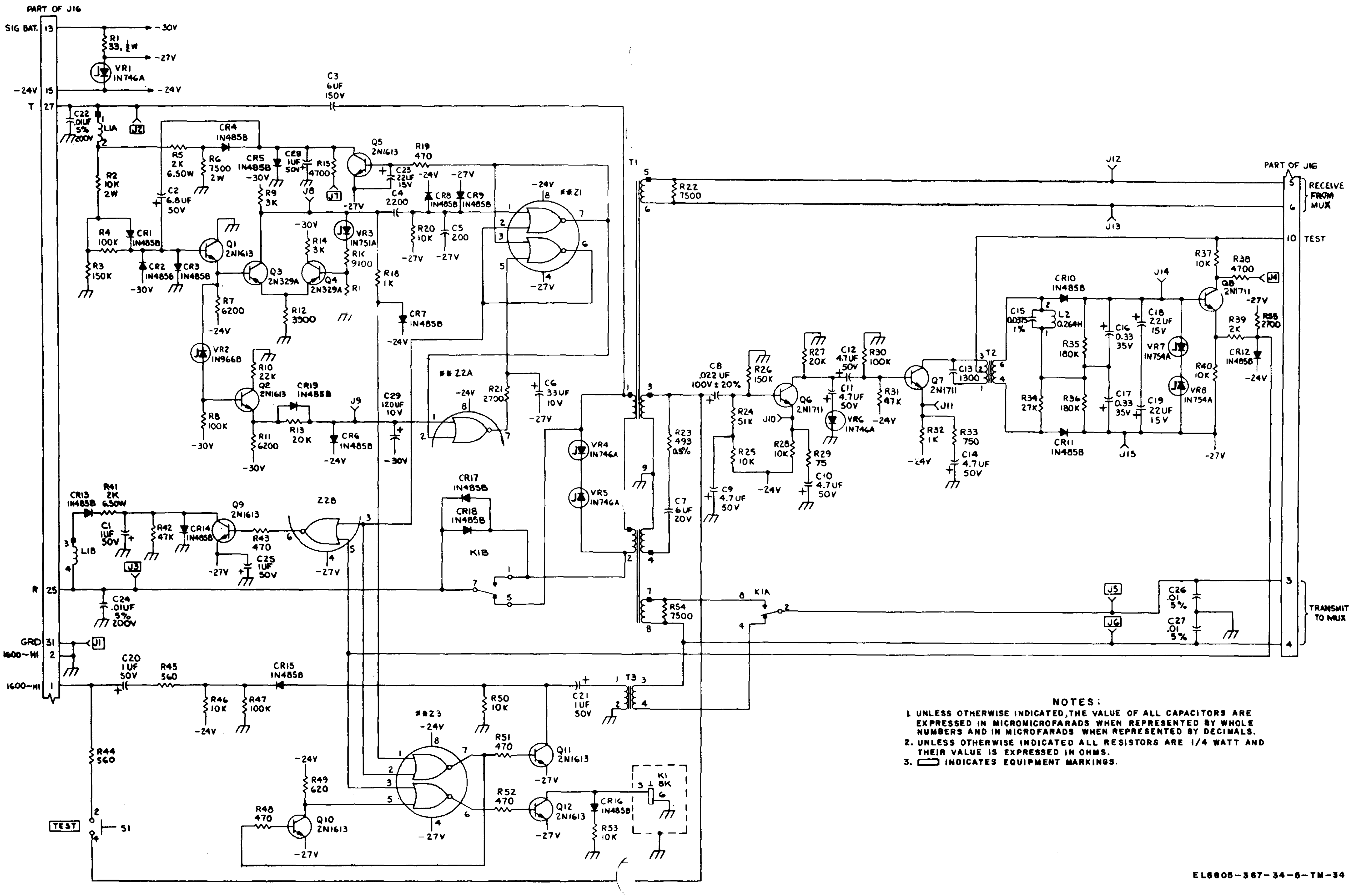


NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION(S).
2. UNLESS OTHERWISE INDICATED THE VALUE OF ALL CAPACITORS IS EXPRESSED IN MICROMICROFARADS WHEN REPRESENTED BY WHOLE NUMBERS AND IN MICROFARADS WHEN REPRESENTED BY DECIMALS.
3. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT AND THEIR VALUE IS EXPRESSED IN OHMS.
4. ▭ INDICATES EQUIPMENT MARKING.
5. WAVEFORMS TAKEN WITH 1600-Hz 250 MILLIVOLT RMS INPUT ACROSS TERMINALS 5 AND 6 OF J14.
6. REFERENCE J13.
7. SWITCH 18A3S1 OPERATED TO TE.

EL0DR004

Fig. FO-12. Panel 18A3B, schematic diagram.

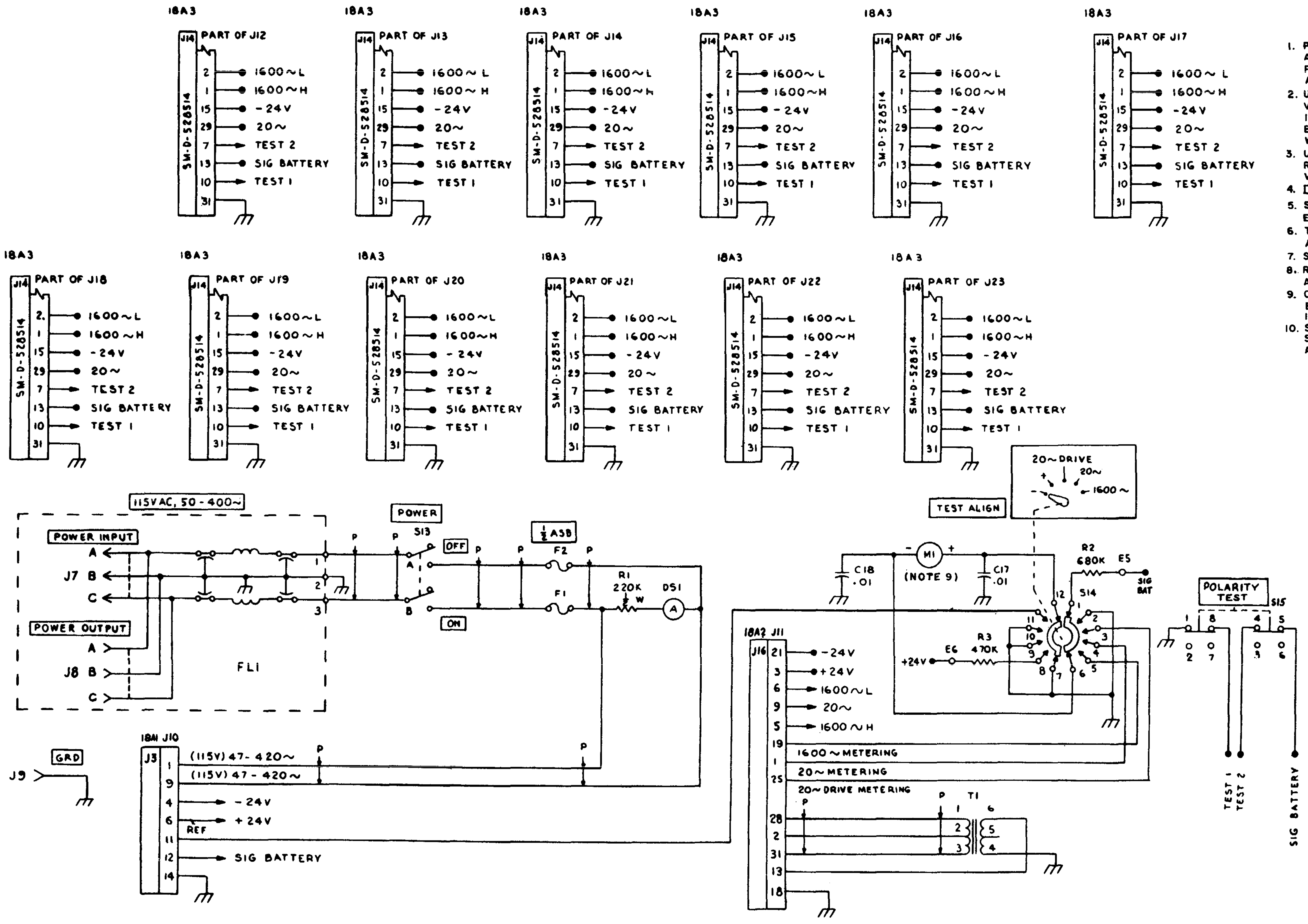


NOTES:

1. UNLESS OTHERWISE INDICATED, THE VALUE OF ALL CAPACITORS ARE EXPRESSED IN MICROMICROFARADS WHEN REPRESENTED BY WHOLE NUMBERS AND IN MICROFARADS WHEN REPRESENTED BY DECIMALS.
2. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT AND THEIR VALUE IS EXPRESSED IN OHMS.
3. ▭ INDICATES EQUIPMENT MARKINGS.

EL5805-367-34-5-TM-34

Figure FO-13. Panel 18A4, schematic diagram.



NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUB-ASSEMBLY DESIGNATION(S).
2. UNLESS OTHERWISE INDICATED, THE VALUE OF ALL CAPACITORS IS EXPRESSED IN MICROMICROFARADS WHEN REPRESENTED BY WHOLE NUMBERS; AND IN MICROFARADS WHEN REPRESENTED BY DECIMALS.
3. UNLESS OTHERWISE INDICATED, ALL RESISTORS ARE 1/4 WATT AND THEIR VALUE IS EXPRESSED IN OHMS.
4. ▭ INDICATES EQUIPMENT MARKING.
5. S1 THRU S12 AND S14 SHOWN FROM KNOB END.
6. TEST 1, TEST 2 AND SQUELCH CONNECTIONS ARE FOR FUTURE USE.
7. S1 THRU S12 ARE SHOWN IN 2W POSITION.
8. REFERENCE DESIGNATIONS C1 THRU C16 ARE NOT USED.
9. COMPONENTS M1, S14, R2, R3, C17, C18, E5, E6 AND ASSOCIATED WIRING ARE NOT INSTALLED IN MODEL CV-1548A/G.
10. SHIELDS NOT INSTALLED ON CV-1548/G SERIAL NUMBERS 2126 AND ABOVE, AND ALL CV-1548A/G MODELS.

EL5805-367-34-5-TM-35

Figure FO-14①. Converter, Telephone Signal CV-1548( )/G, schematic diagram (part 1 of 4).

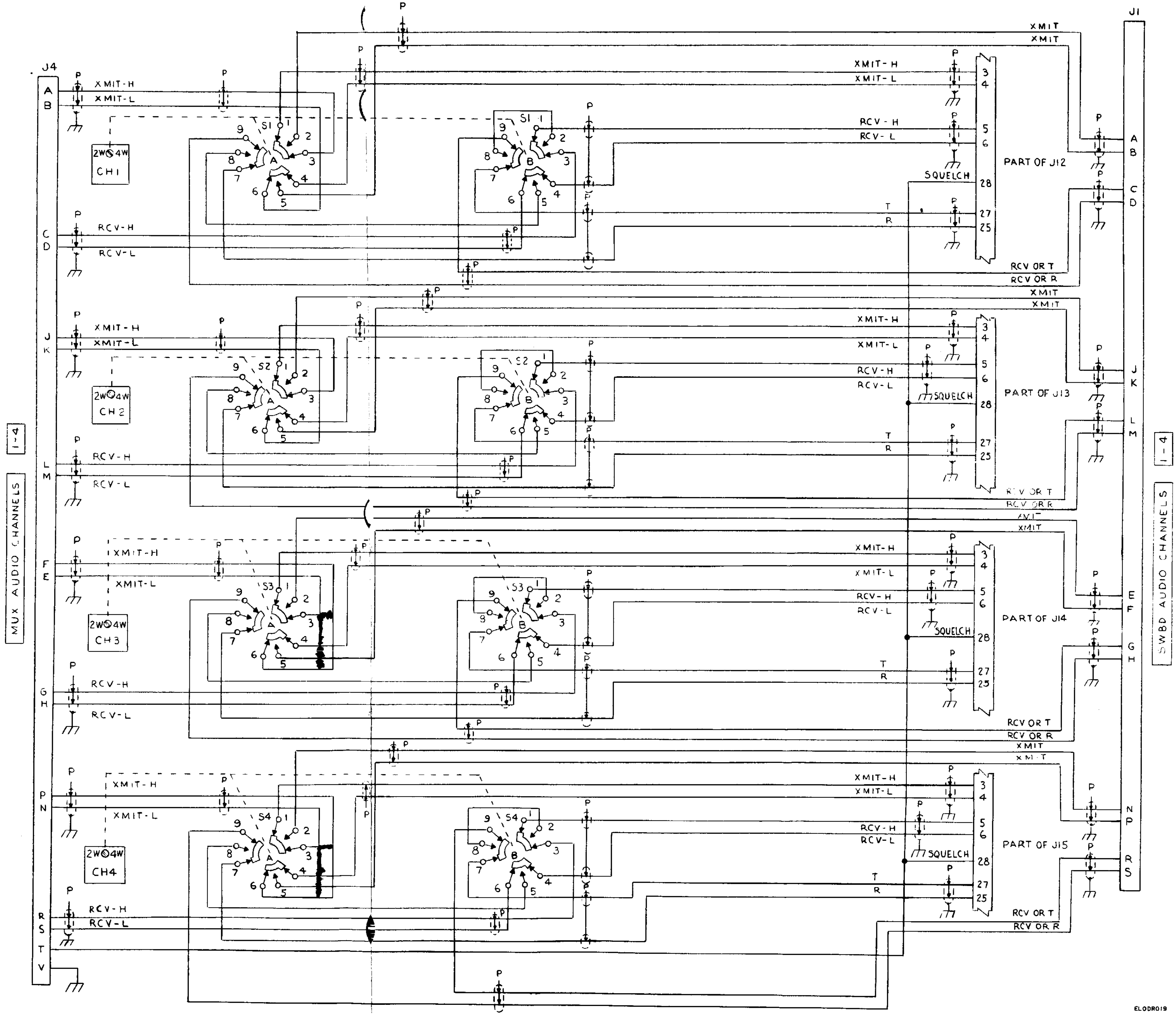


Figure FO-14②. Converter, Telephone Signal CV-1548( )/G, schematic diagram (part 2 of 4).

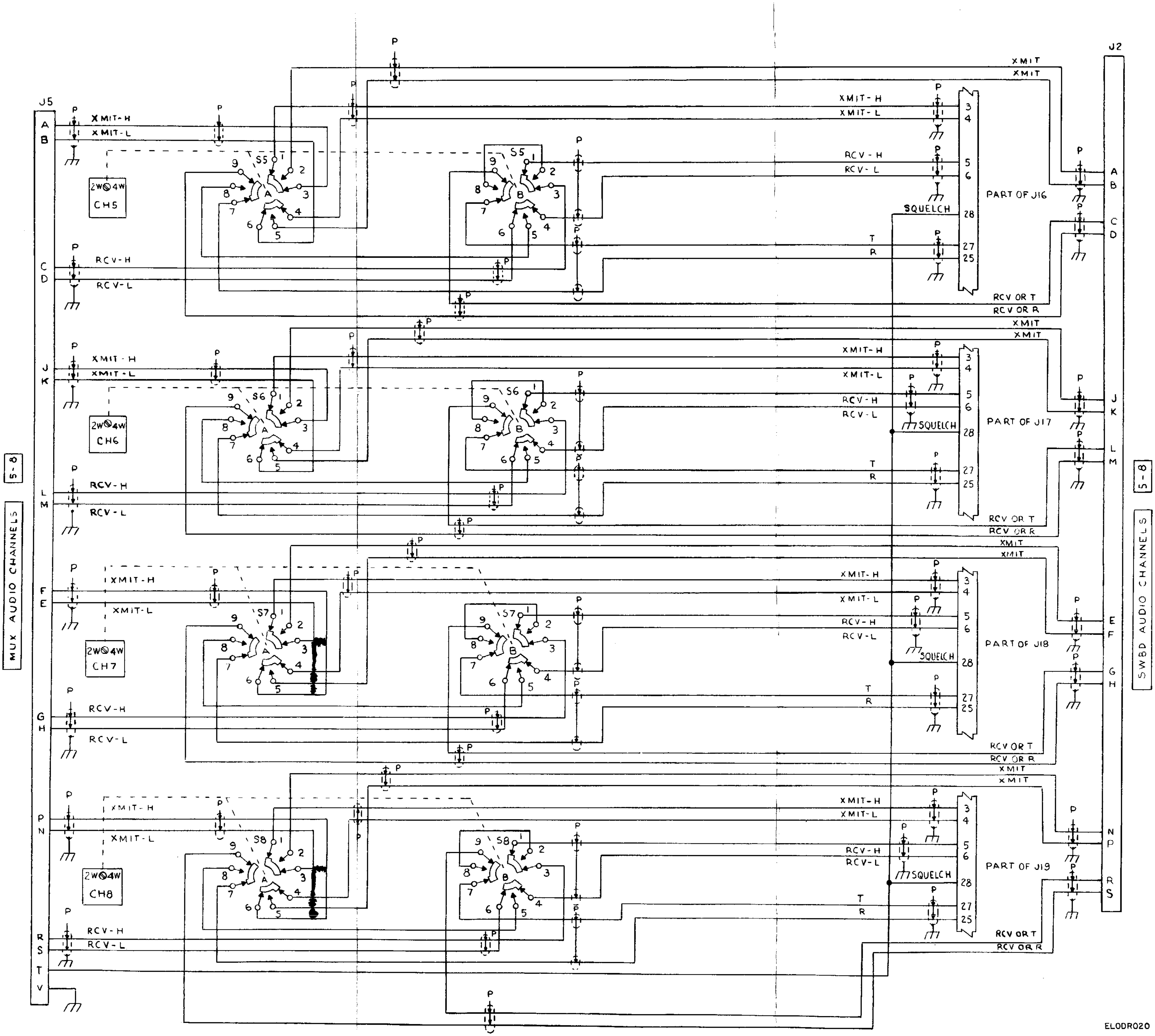


Figure FO-14③ .Converter, Telephone Signal CV-1548( )/G, schematic diagram (part 3 of 4).

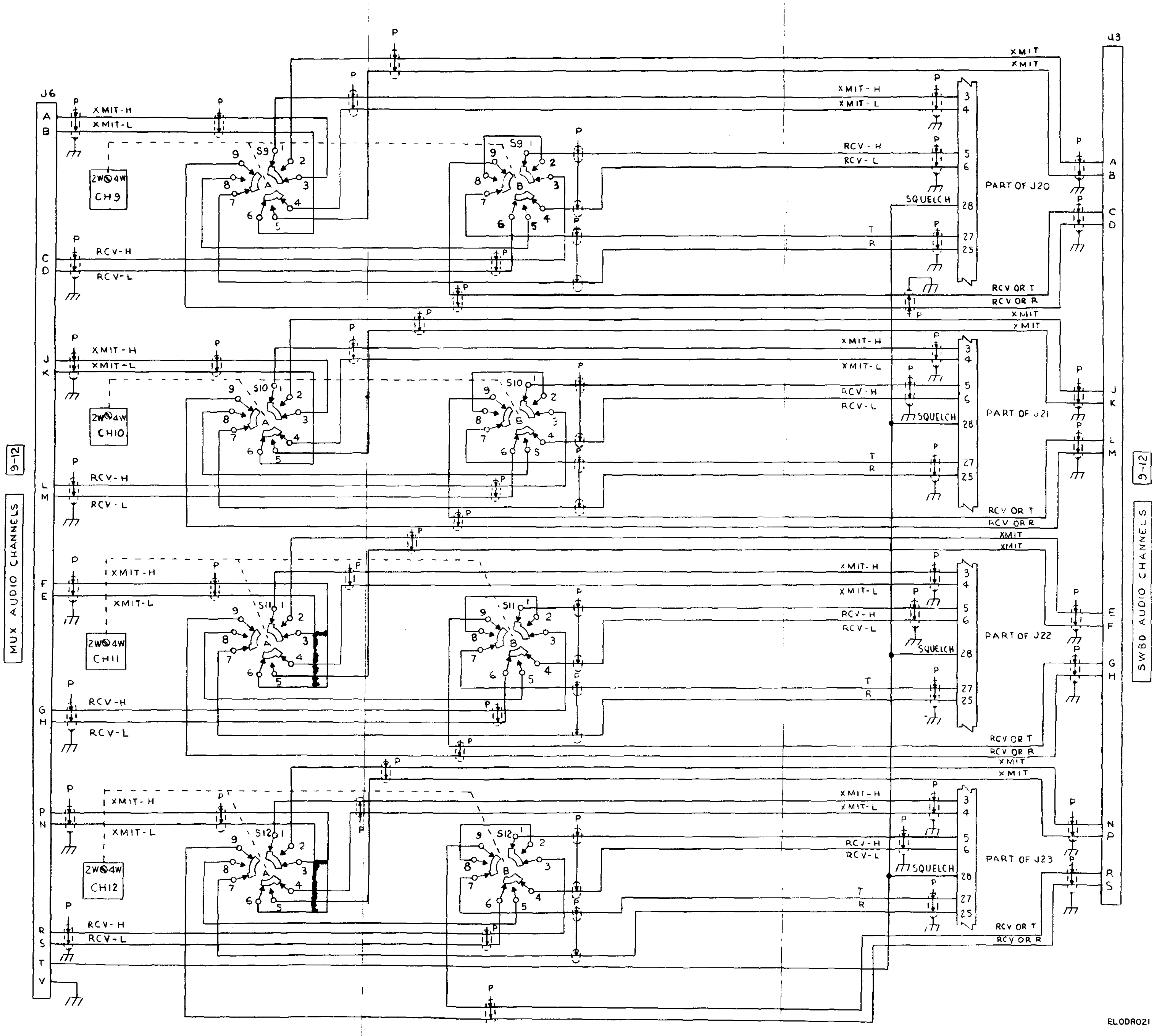


Figure FO-14④. Converter, Telephone Signal CV-1548( )/G, schematic diagram (part 4 of 4).

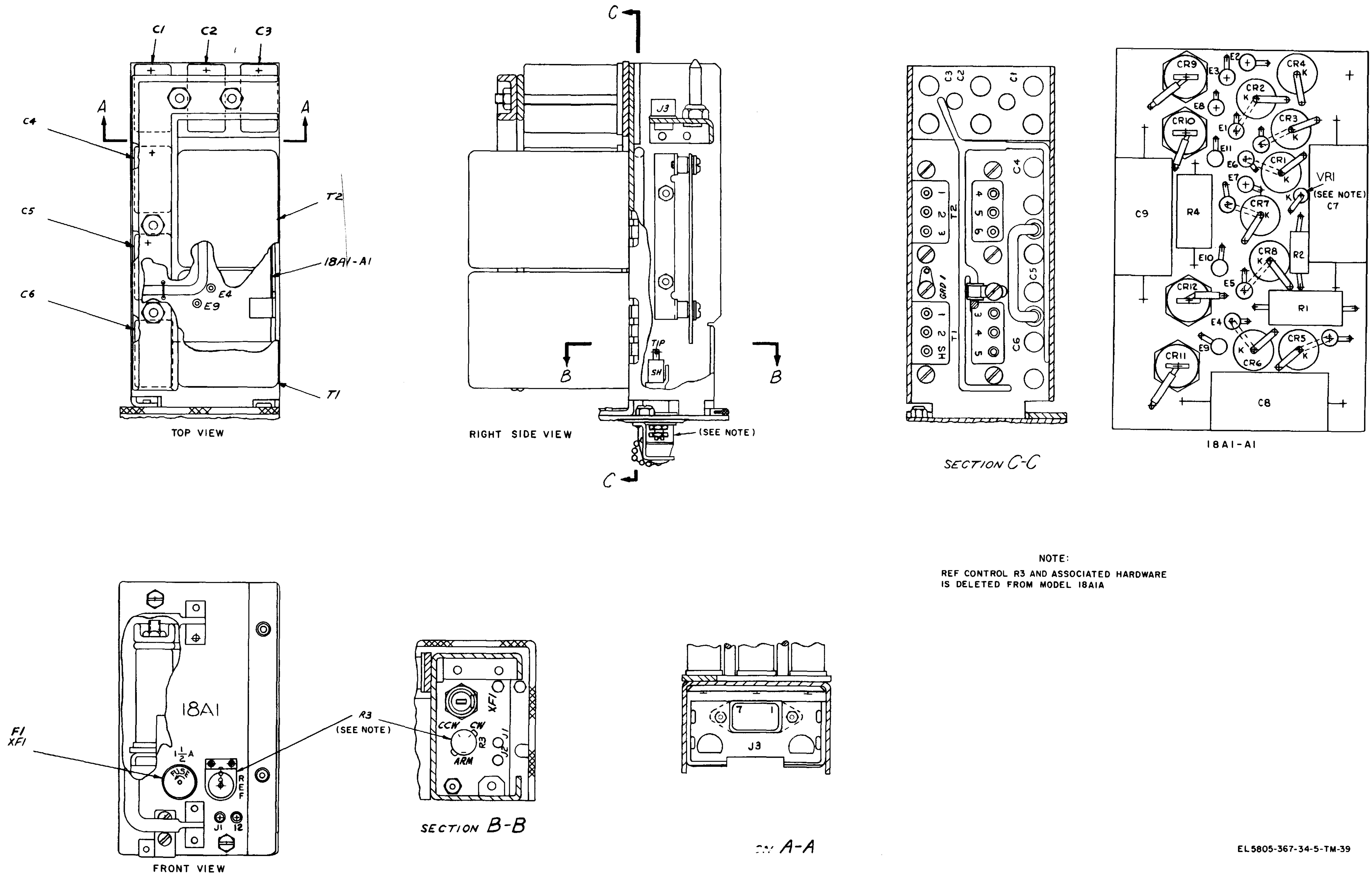
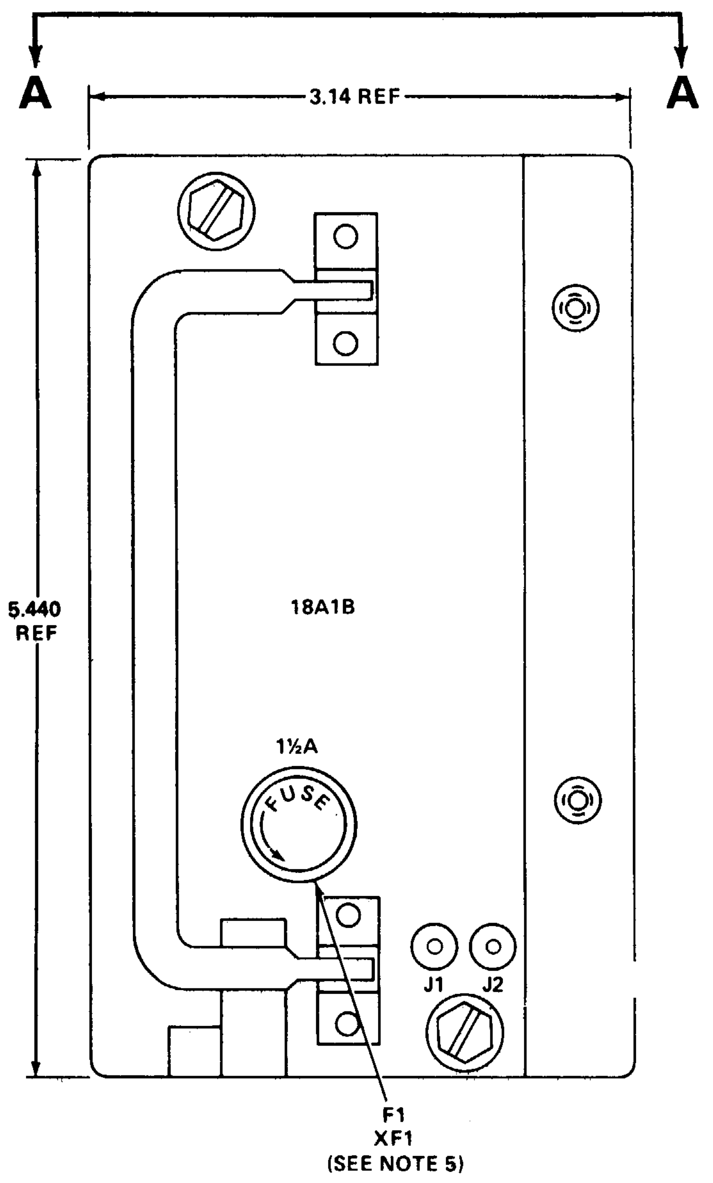


Figure FO-15. Power supply assembly 18A1( ), parts location diagram.



NOTES:
1. SCHEMATIC SM D 984487
2. TEST PER SM B 528731
3. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUBASSEMBLY DESIGNATION
4. WHEN REQUIRED HAND SOLDER PER SM C 526772 SOLDER WITH ITEM 8
5. APPLY ITEM 4 TO THD OF ITEM 2 MTG HDW
6. LACE HARNESS ITEM 26 TO ITEM 11 THROUGH HOLES PROVIDED
7. ADJUST ASSEMBLY TO DIMENSIONS SHOWN
8. SOME COMPONENTS AND TERMINATION POINTS ARE NOT ACTUALLY MARKED BUT ARE SHOWN FOR INFORMATION ONLY
9. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED

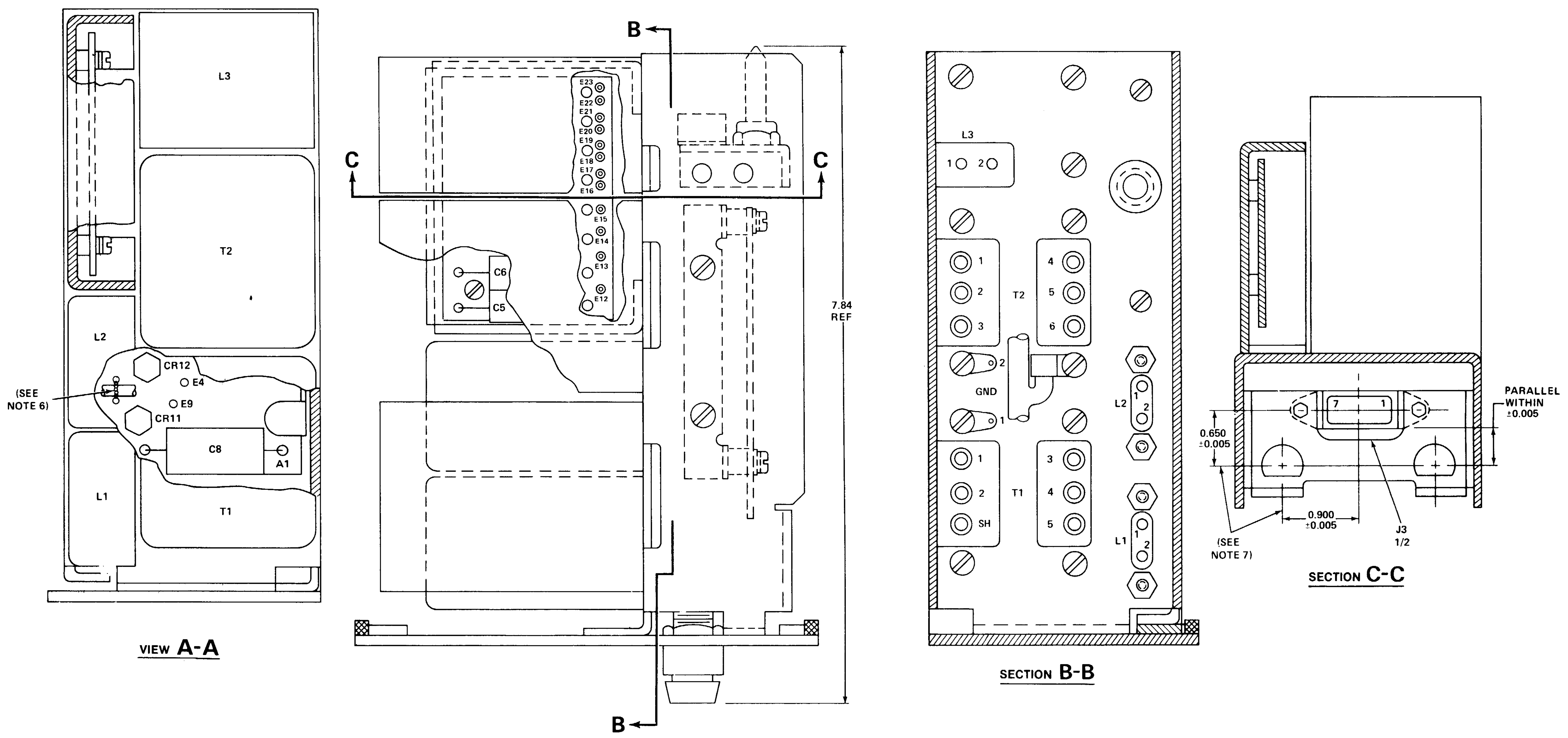
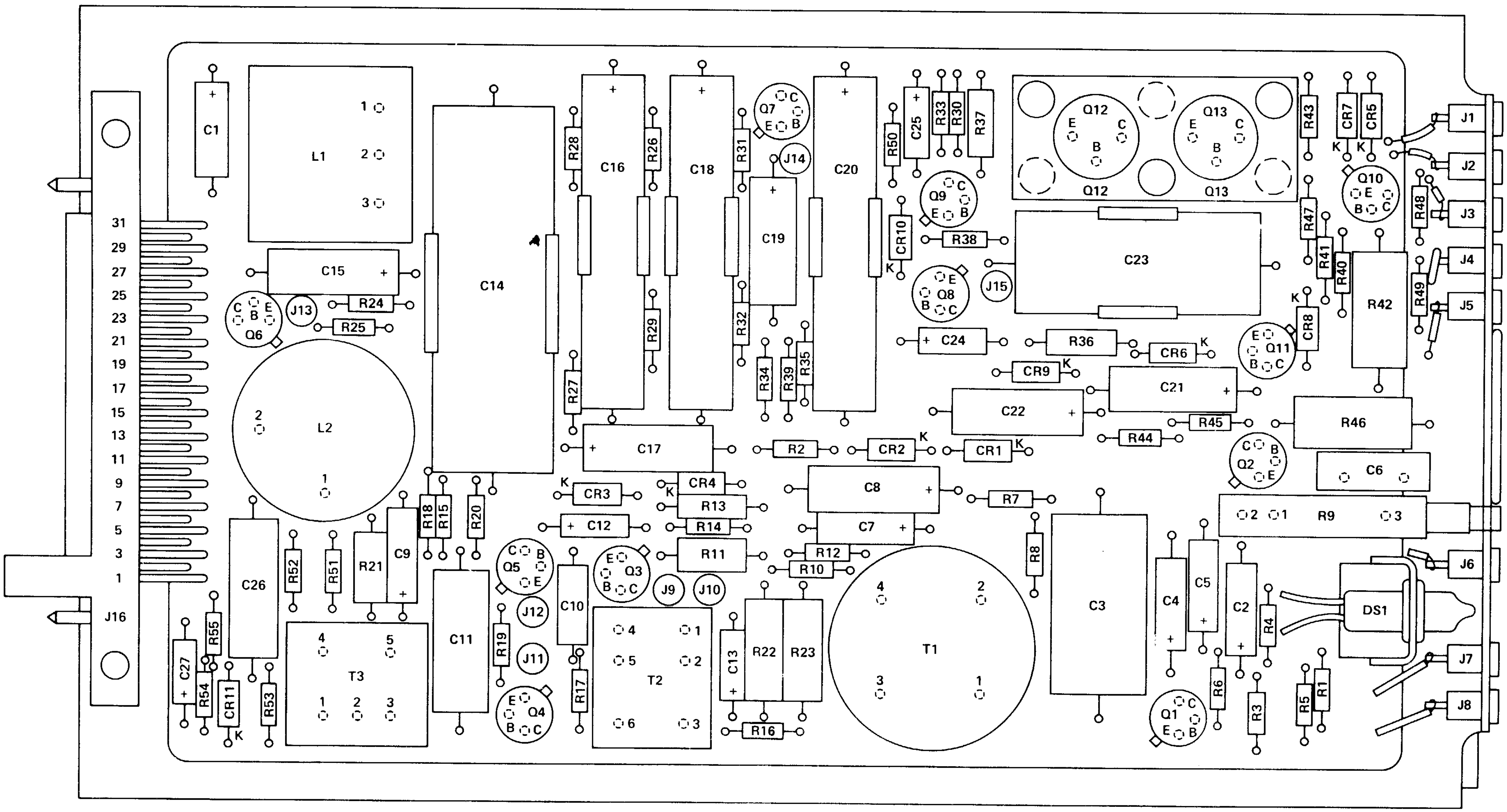
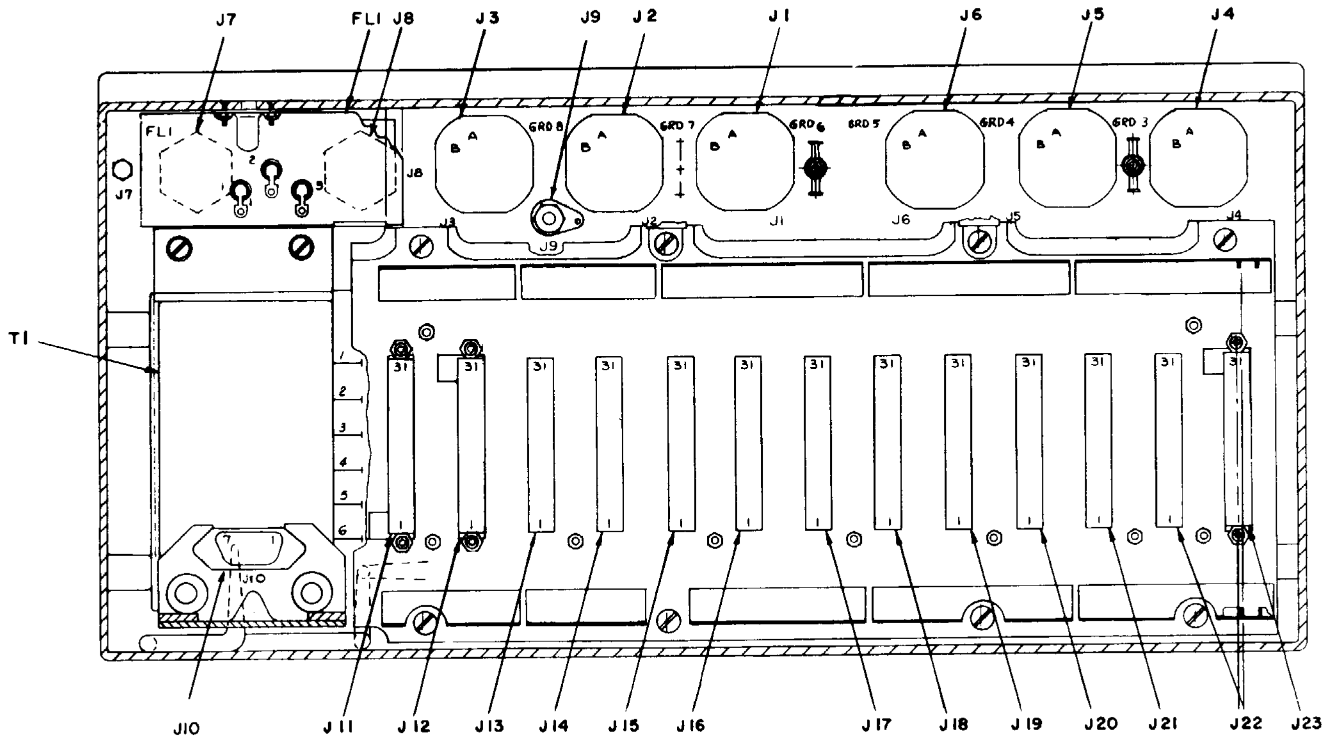


Fig. FO-15.1 Power supply assembly 18A1B, parts location diagram.

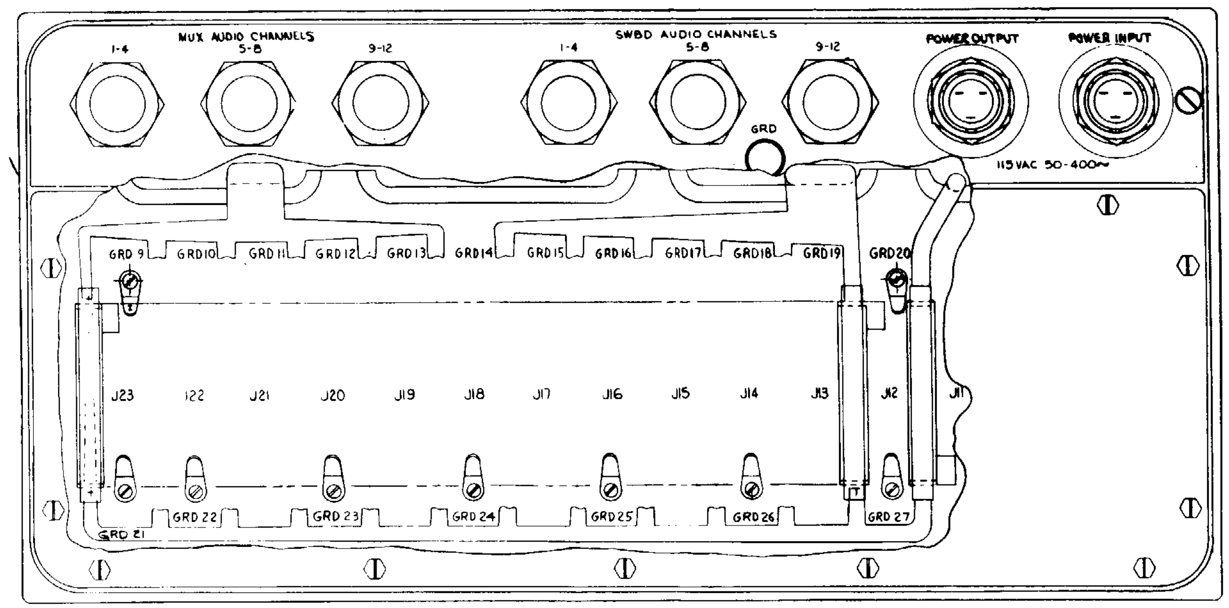


NOTE:
R22, R23, R50, R52, R53, R54, R55, C12, C13, C24, C25, C27, CR3, CR4, CR9, CR10, CR11 WILL BE DELETED FROM NEW 18A2 PANELS.

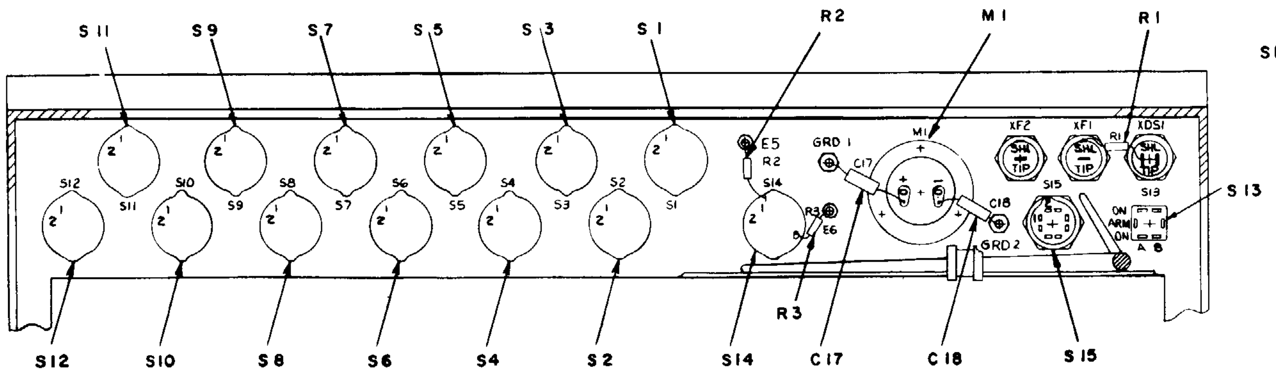
Fig. FO-16. Panel 18A2, parts location diagram.



FRONT VIEW OF BACK SECTION



REAR VIEW



REAR OF FRONT PANEL

NOTE:

COMPONENTS M1, S14, R2, R3, C17, C18, AND ASSOCIATED HARDWARE ARE NOT PART OF CV-1548A/G

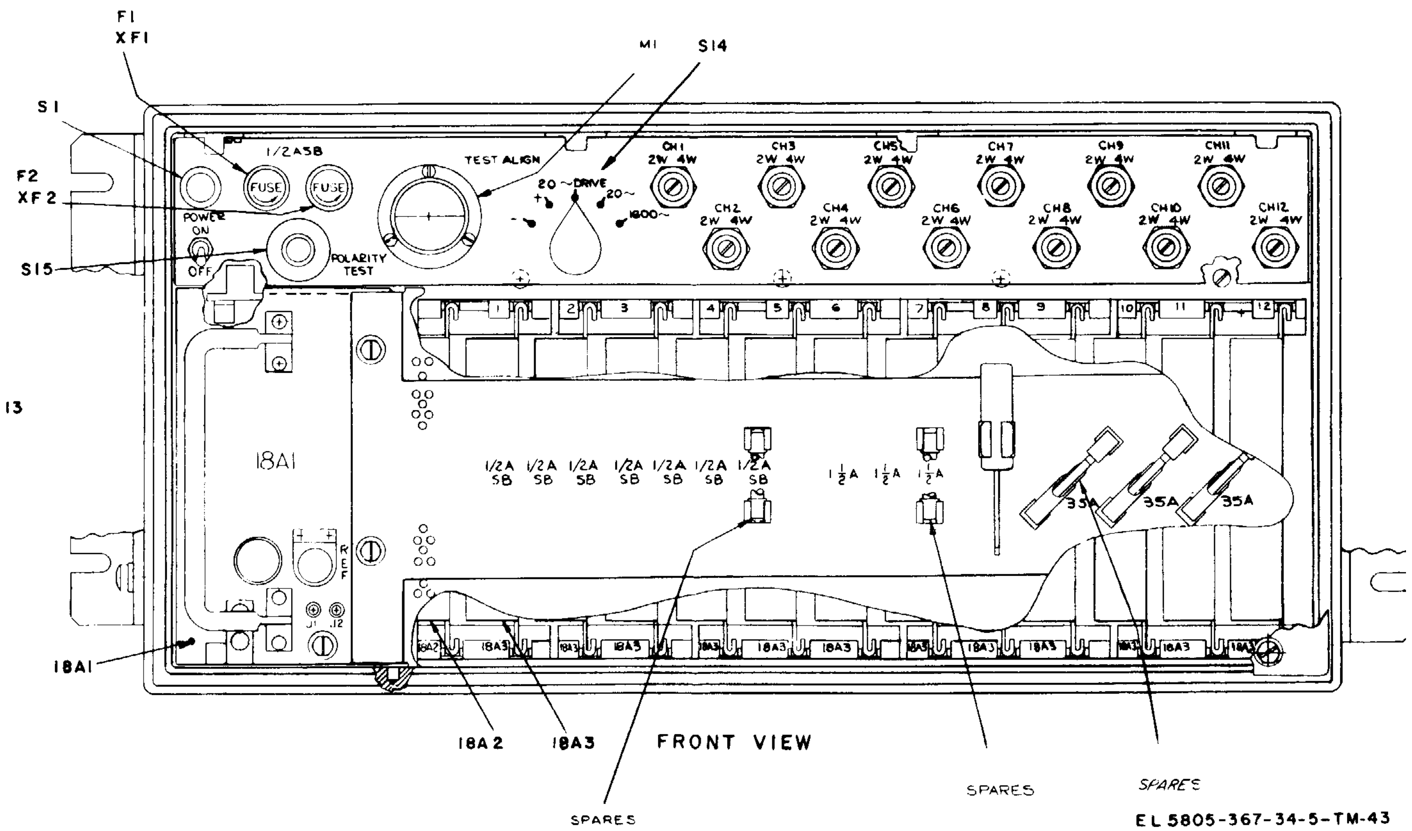


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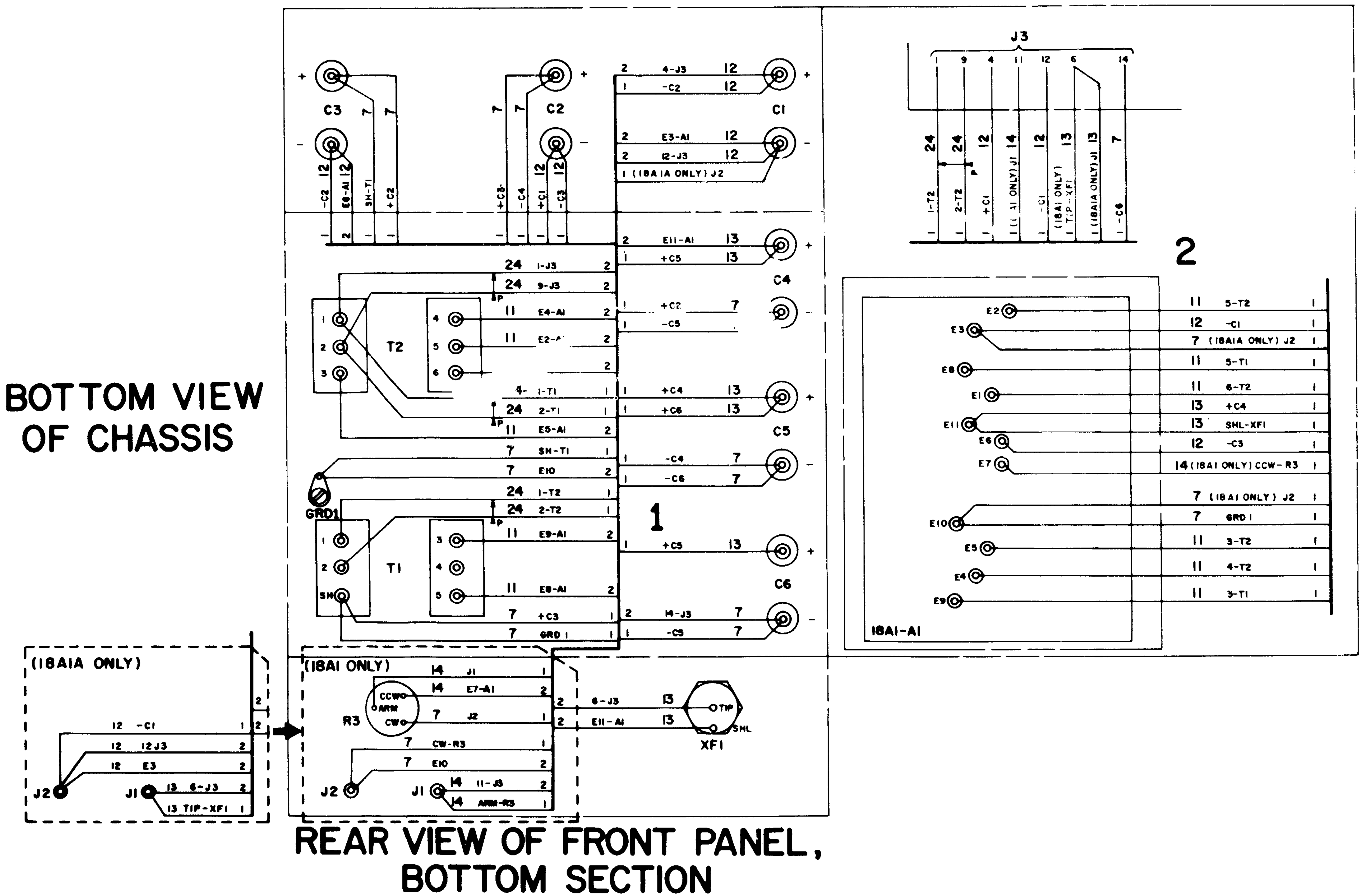
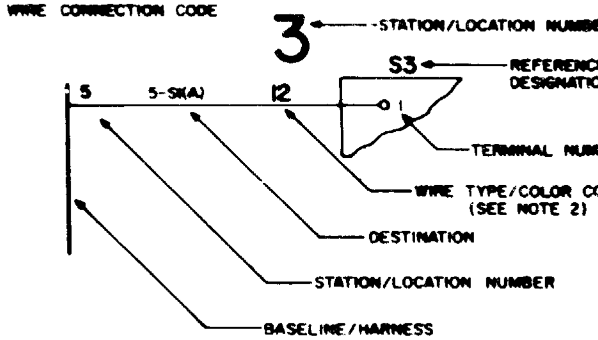
Figure FO-17. Converter, Telephone Signal CV-1548( )/G, parts location diagram.



NOTES:

1. WIRE CONNECTION CODE



2. WIRE TYPE/COLOR CODE

CODE	TYPE/COLOR
1	RG-188A/U COAXIAL
2	3-CONDUCTOR TWISTED (WHT/GRN/BLK/SHLD)
3	24 AWG YELLOW
4	24 AWG WHITE
5	20 AWG PURPLE
6	20 AWG RED
7	22 AWG BLACK
8	20 AWG BLACK
9	RG-196A/U COAXIAL
10	2-CONDUCTOR TWISTED (WHT/BLK/SHLD)
11	22 AWG GREY
12	22 AWG PURPLE
13	22 AWG RED
14	22 AWG WHITE
15	22 AWG YELLOW
16	18 AWG BARE WIRE
17	22 AWG BARE WIRE
18	YEL/GRN TWISTED PAIR 24 AWG
19	ORN/BRN TWISTED PAIR 24 AWG
20	RG 180B/U COAXIAL
21	24 AWG PURPLE
22	24 AWG RED
23	24 AWG BLACK
24	20 AWG GREY
25	20 AWG WHITE
S	SLEEVE

3. P DENOTES TWISTED PAIR (CODE 24, NOTE 2) $1\frac{1}{4} \pm \frac{1}{4}$ TURNS PER INCH.

4. TERMINAL DESTINATION IDENTIFIED AS E1-A1, E2-A1, ETC. ARE E1 OF PANEL 18A1-A1, E2 OF PANEL 18A1-A1, ETC.

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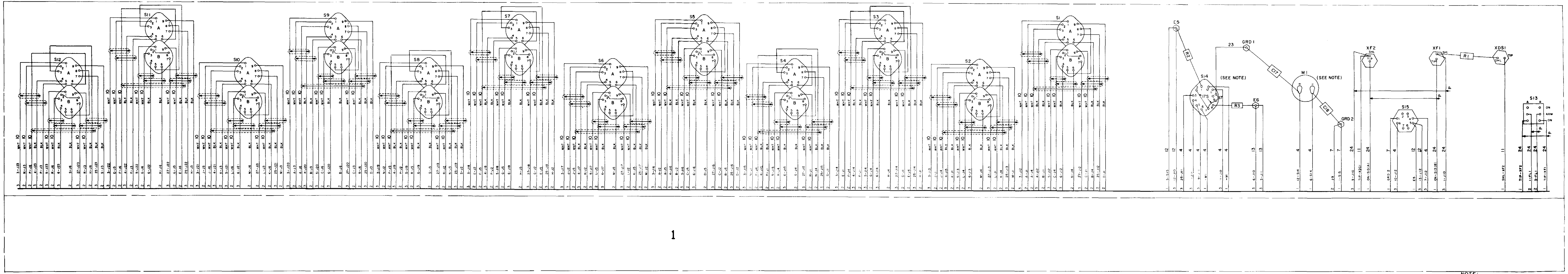
Figure FO-18. Power supply assembly 18A1( ), wiring diagram.

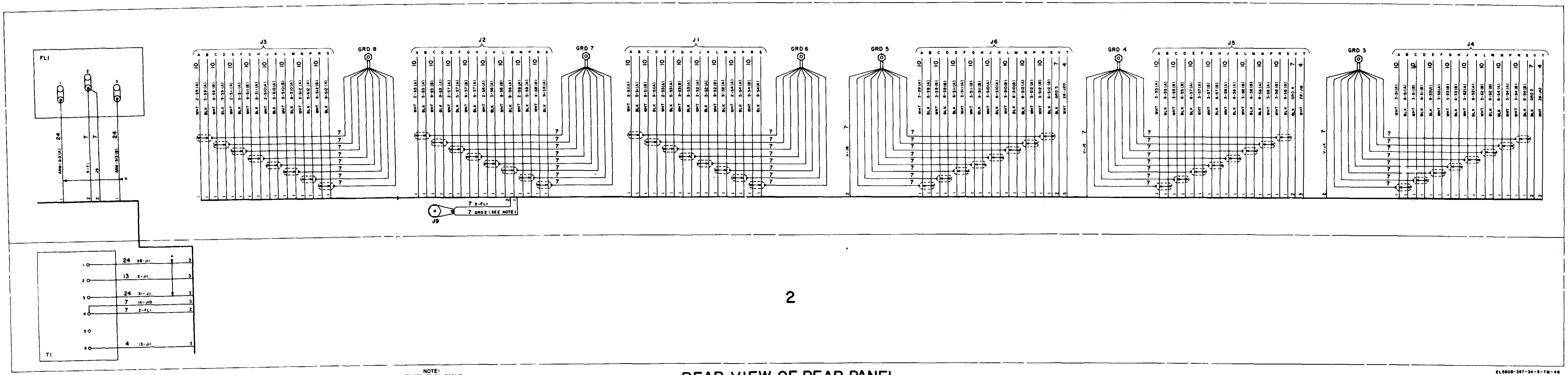


REAR VIEW OF FRONT PANEL

NOTE:
COMPONENTS M1, S14, R2, R3, C17, C18 AND ASSOCIATED WIRING NOT USED ON CV-1548A/G.

EL0DR022

Figure FO-19.1 Converter, Telephone Signal CV-1548( )/G, wiring diagram (part 1 of 3).



REAR VIEW OF REAR PANEL

EL5805-367-34-5-TM-46

Figure FO-19②. Converter, Telephone Signal CV-1548( )/G, wiring diagram (part 2 of 3).

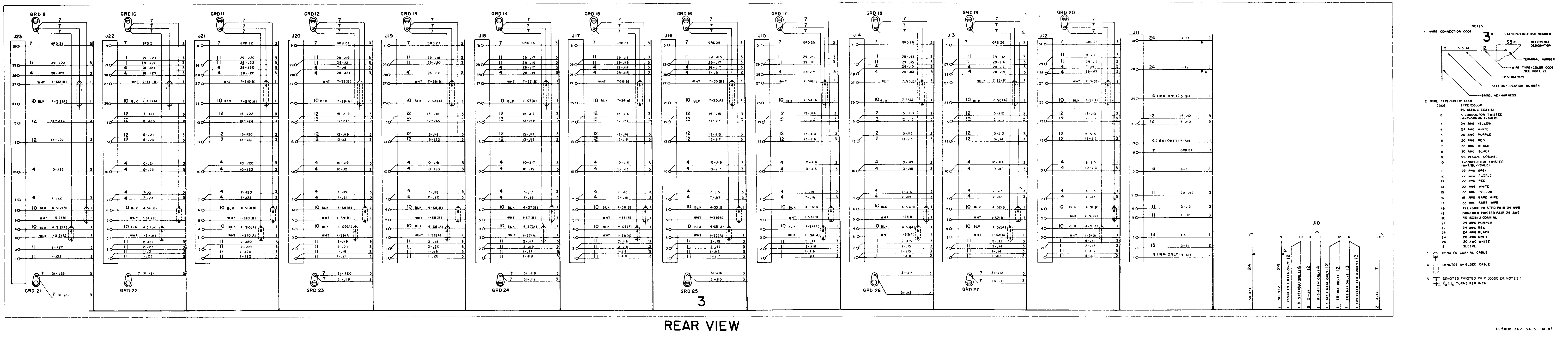


Figure FO-19③. Converter, Telephone Signal CV-1548( )/G, wiring diagram (part 3 of 3)

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11-237
11-302
11-327
11-345
11-347
11-357
11-367
11-377
11-368
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29-136

NG: None

USAR: None

For explanation of abbreviations used, see AR 310-50.

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*
inches	centimeters	2.540
feet	meters	.305
yards	meters	.914
miles	kilometers	1.609
square inches	square centimeters	6.451
square feet	square meters	.093
square yards	square meters	.836
square miles	square kilometers	2.590
acres	square hectometers	.405
cubic feet	cubic meters	.028
cubic yards	cubic meters	.765
fluid ounces	milliliters	29,573
pints	liters	.473
quarts	liters	.946
gallons	liters	3.785
ounces	grams	28.349
pounds	kilograms	.454
short tons	metric tons	.907
pound-feet	newton-meters	1.356
pound-inches	newton-meters	.11296

To change	*To*	*Multiply by*
ounce-inches	newton-meters	.007062
centimeters	inches	.394
meters	feet	3.280
meters	yards	1.094
kilometers	miles	.621
square centimeters	square inches	.155
square meters	square feet	10.764
square meters	square yards	1.196
square kilometers	square miles	.386
square hectometers	acres	2.471
cubic meters	cubic feet	35.315
cubic meters	cubic yards	1.308
milliliters	fluid ounces	.034
liters	pints	2.113
liters	quarts	1.057
liters	gallons	.264
grams	ounces	.035
kilograms	pounds	2.205
metric tons	short tons	1.102

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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