Broadcast Equipment

Volume III Operating Instructions

FL-Line

VHF TV Transmitter

Sub-Systems

Communications Systems Division/Front and Cooper Streets/Camden, New Jersey, U.S.A. 08102

DL764M

IB-8027596

LIST OF REVISED, ADDED OR DELETED PAGES

The following is a list of the pages in this Instruction Book that have been Revised, Added, or Deleted with their effective date of change:

Page	Issue	Date
Title	Original	5/74
A	Original	5/74
First Aid	Original	5/74
OPER HAZ	Original	5/74
i thru vi	Original	5/74
1-1 thru 1-70	Original	5/74
2-1 thru 2-60	Original	5/74
3-1 thru 3-22	Original	5/74
4-1 thru 4-38	Original	5/74
5-1 thru 5-76	Original	5/74
6-1 thru 6-58	Original	5/74
7-1	Original	5/74

OPERATING HAZARDS

This equipment is designed to fully safeguard all personnel from operating hazards. Labels and warning notices on the equipment and warning and caution notices in the Instruction Book clearly point out these potential hazards and hazards that necessarily exist.

Before operating this equipment, read the following comments and take the necessary precautions to protect operating personnel. Safe operating practices are the responsibility of the station personnel.

HIGH VOLTAGE

High Voltages are present in this equipment which can cause serious injury or loss of life. High voltage circuits are enclosed to prevent accidental contact by personnel and have interlock switch circuits which open the primaries of power supply transformers and discharge high voltage capacitors whenever access to the equipment is required.

MICROWAVE RADIATION

Exposure of the human body to microwave radiation in excess of 10 mW/cm^2 (See Ref. A) may be unsafe and can result in blindness or other injury. Personnel must be fully protected from the microwave energy which may radiate from tubes or transmission line connections. All input and output R F connections, gaskets, and flanges must be leakproof and properly installed. Unless connected to an antenna, NEVER OPERATE MICROWAVE RADIATING EQUIPMENT WITHOUT A RADIATION ENERGY ABSORBING LOAD ATTACHED. Personnel must be prevented from looking into an open antenna while the equipment is operating.

X-RAYS

X-Ray radiation may be produced by energized VHF and UHF equipment. Personnel must be protected by appropriate shielding. Adequate shielding on all sides of the tubes and equipment is provided as well as on the auxiliary equipment. X-Ray Warning signs or labels are permanently attached to the equipment (where necessary) directing personnel not to operate the equipment witnout proper X-Ray shielding.

Reference A:

Federal Communications Report No. 7104
VHF-UHF Radiation Hazards and Safety Guidelines
July 19, 1971

EMERGENCY
FIRST AID INSTRUCTIONS

WARNING

VOLTAGES THAT ARE DANGEROUS TO LIFE ARE INVOLVED IN THE OPERATION OF THIS ELECTRONIC EQUIPMENT. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE THE EQUIPMENT WITH VOLTAGES APPLIED. DANGEROUS CONDITIONS MAY EXIST IN CIRCUITS WITH POWER CONTROLS IN THE OFF POSITION DUE TO CHARGES RETAINED BY CAPACITORS, ETC. ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM TO AVOID PERSONAL INJURY OR LOSS OF LIFE.

Personnel engaged in the installation, operation, or maintenance of this equipment or similar equipment are urged to become familiar with the following rules both in theory and practice. It is the duty of all operating personnel to be prepared to give adequate Emergency First Aid and thereby prevent avoidable loss of life.

RESCUE BREATHING

GENERAL INFORMATION

A. START IMMEDIATELY, SECONDS COUNT

Do not move victim unless absolutely necessary to remove from danger. Do not wait or look for help or stop to loosen clothing. Warm the victim or apply stimulants. The main purpose is to GET AIR INTO THE VICTIM'S LUNGS.

B. WIPE OUT VICTIM'S MOUTH

Wipe out quickly any mucus, food, or any foreign matter in the victim's mouth using your fingers or a cloth wrapped around your fingers.

C. LOOSEN CLOTHING - KEEP WARM

Do this when the victim is breathing by himself or help is available. Keep him quiet as possible and from becoming chilled. Otherwise, treat him for shock.

D. DON'T GIVE UP

Continue emergency rescue breathing without interruption until victim is breathing without help or until all hope of reviving him as determined by a physician is gone.

E. CALL A PHYSICIAN

Have someone summon medical aid since respiratory and other disturbances may develop as a aftermath. A physician is necessary during the recovery period.

PROCEDURE

FIG. A

FIG. B

FIG. C

TILT HEAD BACK - Lift neck and point chin up to open air passage.

EXTEND JAW - Pull or push jaw into jutting out position (Fig. A).

PINCH NOSE - Close nostrils to prevent air leakage, or close mouth when using mouth-to-nose breathing.

BLOW - Seal victim's mouth or nose with your mouth. (Fig. B) Blow until chest rises.

REMOVE MOUTH - Listen for exchange of air; if none, check throat for obstruction. To remove it, place victim in position shown in Fig. C, and slap sharply between shoulder blades.

REPEAT - 12 times per minute for adults; at least 20 times per minute for children.

BURNS

SKIN REDDENED: Apply ice cold water to burned area to prevent burn from going deeper into skin tissue. Cover area with clean sheet or cloth to keep away air. Consult a physician.

SKIN BLISTERED OR FLESH CHARRED: Apply ice cold water to burned area to prevent burn from going deeper into skin tissue. Cover area with clean sheet or cloth to keep away air. Treat victim for shock and take to Hospital.

EXTENSIVE BURN-SKIN BROKEN: Cover area with clean sheet or cloth to keep away air. Treat victim for shock and take to hospital.

TABLE OF CONTENTS

SECTION I
CONTROL CABINET MI-560599A/MI-560576

SECTION II
AMPLIFIER CABINET MI-560577A

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

List of Illustrations

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Continued)

LIST OF TABLES

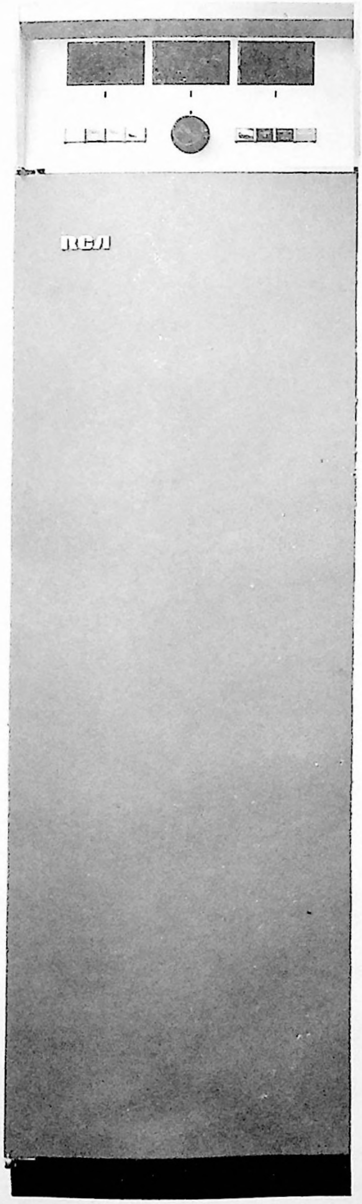

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Figure 1-1. TT-15FL/25FL Control Cabinet, MI-560599A

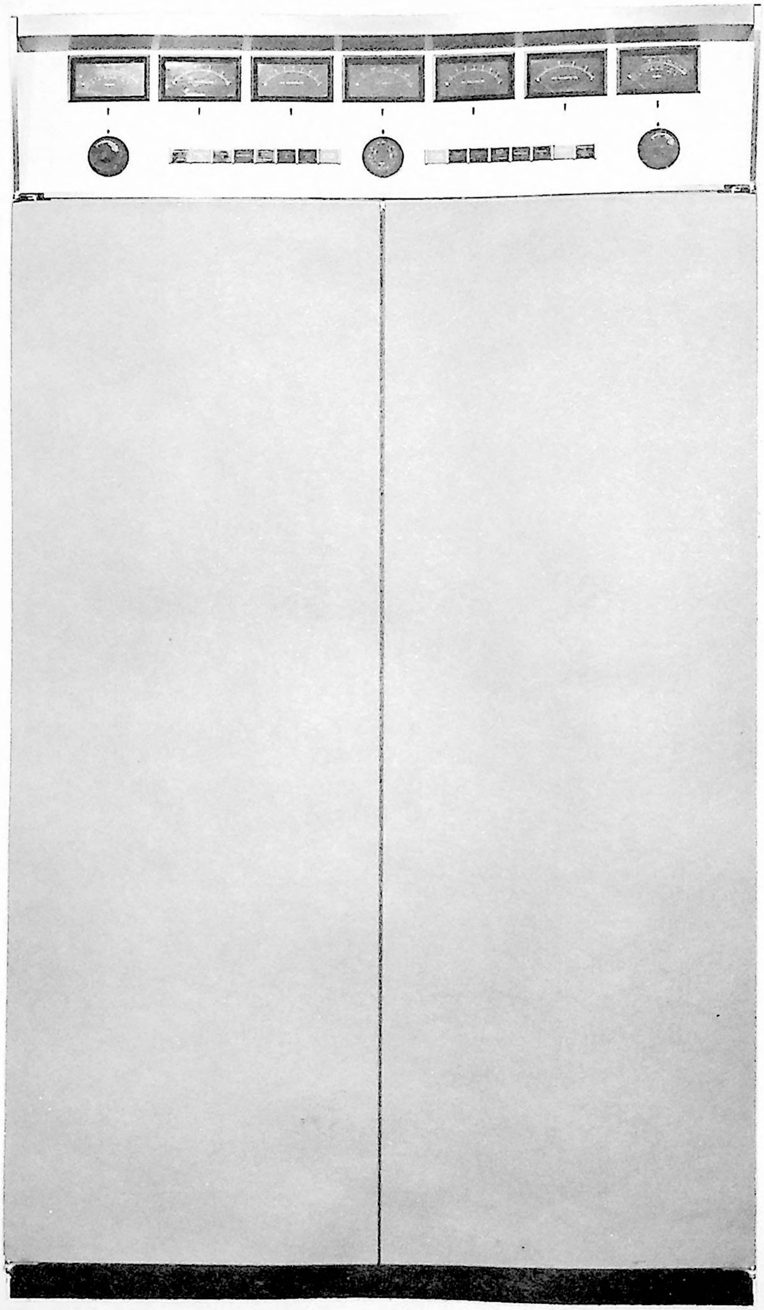

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Figure 1-2. TT-30FL Control Cabinet, MI-560576

CONTROL CABINET

GENERAL DESCRIPTION

The Control Cabinet, MI-560576, for a TT-30FL transmitter is approximately equivalent to two of the Control Cabinets, MI-560599A, for a TT-15FL/25FL transmitter. Where the MI-560599A unit has two magnetically-latched, sound-insulated front doors, the MI-560599A has only one. Above the front doors of either cabinet is a meter panel which hinges upward, giving access to the wiring on the reverse side.

Mechanical latches on the sound-insulated rear doors ensure actuation of the interlock switches, yet permit full access to internal equipment. Filters mounted in the rear doors pass clean air to the blower intakes. A special air-handling door, used on the Control Cabinet of the TT-25FL, provides an extra measure of acoustical damping for the greater air requirements here.

The equipment in the Control Cabinet provides three supporting functions for the transmitter: (1) control, (2) metering, and (3) cooling. The following descriptions cover the MI-560599A cabinet or either half of the MI-560576 unit as they are closely similar. Differences that do exist are pointed out.

Component prefix numbers are not used in the descriptions except where they are needed for clarity. It should be understood that prefix 2 applies to all components in the MI-560599A unit and to those in the left half of the MI-560576 cabinet. Prefix 3 applies to components in the right half of the MI-560576 unit.

CIRCUIT DESCRIPTIONS

Control Circuits

The control functions in the transmitter are of two types. The primary functions are those that control the normal operation of the transmitter, and the supervisory controls are those that monitor the various circuits and interrupt transmitter operation if a serious fault (such as excessive VSWR or a circuit overload) should develop.

The TT-30FL, because of its parallel operating mode, requires an additional set of controls which are found in the RF and Exciter Switching Panel. This subsystem is described fully in the TT-30FL System Operating Instruction book (IB-8027541-1) and, therefore, will not be described here.

The easiest way to gain an understanding of an extensive system, such as the FL control, is to follow it through its various operations. The description given here demonstrates a three step approach to starting up the transmitter: (1) presetting of sub-system switches and circuit breakers, (2) pressing the TRANSMITTER ON/AIR ON pushbutton indicator, and (3) pressing the PLATE ON pushbutton indicator.

References

1. Figure 1-17, Schematic, TT-15FL/25FL Control Cabinet
2. Figure 1-3, Control Cabinet Indicators
3. Figure 1-4, Control Cabinet Front Panel
4. Table 1-1, Summary of Relay Functions
5. Table 1-2, Control Switches and Circuit Breakers

The schematic for the TT-15FL/25FL Control Cabinet and the one for the TT-30FL bear only minor differences. For the purpose of this discussion, the TT-15FL/25FL schematic will be used throughout.

Transmitter Startup

Presetting of sub-system switches and circuit breakers. The main and distribution circuit breakers in the Power Supply Cabinet are set to ON, placing 230 Vac, 3-Ø, on terminals E26, E28, and E30 in the Control Cabinet. The presence of all three phases energizes relays K17, K18, and K32, each closing a link in the blower interlock. The three phase interlock relays prevent or interrupt transmitter operation should power be absent from any phase.

All interlocked doors, meter panels, and access panels must be closed or in their secured positions; all Video Modulator modules must be in place. These interlocks are a series of switch contacts which prevent application of power to high-voltage circuits should any one of them be left open.

Place the following controls in the positions indicated:

1. FILAMENTS circuit breaker (S25) — ON
2. CONTROL circuit breaker (S19) — ON (this applies 230 Vac to the primary of the control transform-

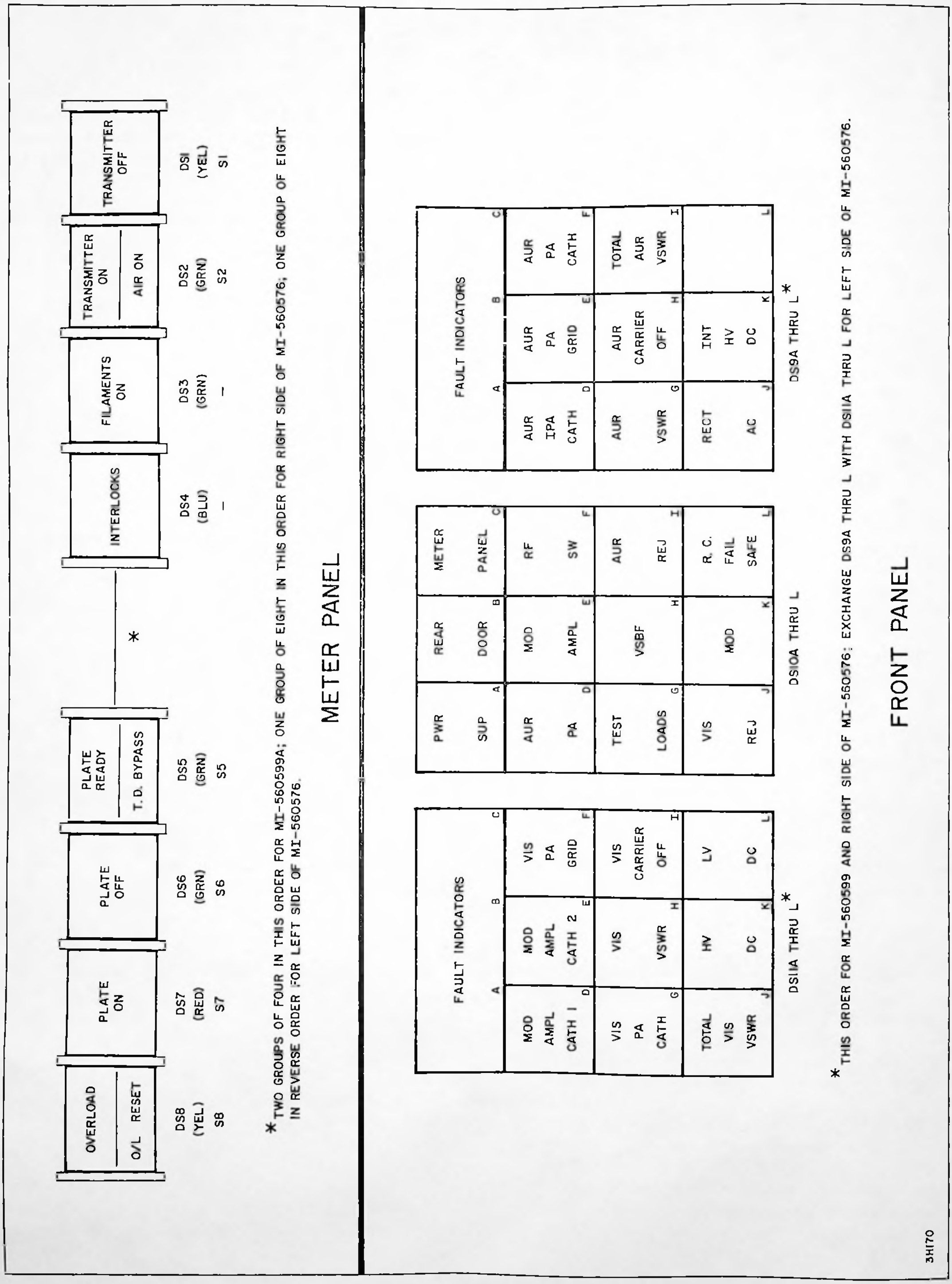


Figure 1-3. Control Cabinet Indicators

er T1 which in turn supplies 115 Vac to the control circuits)

3. 115 V BUS circuit breaker (S20) – ON (this applies 230 Vac to the primary of the distribution transformer T2 which in turn supplies 115 Vac for the modular sub-systems and the screen power supply)

4. MODULATOR circuit breaker (2S21) – ON

5. EXCITER circuit breaker (S22) – ON

6. 20 W AMPL circuit breaker (S23) – ON

7. SCREEN SUPPLY circuit breaker (S24) – ON

8. O/L MODE switch (S14) – SINGLE

9. EXCITER switch (S15) – NORMAL

10. HIGH VOLTAGE switch (S18) – NORMAL

11. INDICATORS switch (S16) – ON (this controls the indicator lamps on the meter panels of both the Control and the Amplifier Cabinets)

12. Set the circuit breakers on the power supplies of the three modular sub-systems in the Amplifier Cabinet to ON.

At this point, the following conditions should be observed:

1. All INTERLOCKS indicators (DS10A thru L) should be lit. These lamps light in a series from left to right, top to bottom. If they are not all lit, check the interlock indicated by the first unlighted position. Note that all Visual Modulator modules, including the power supply, must be in place to operate the MOD interlock indicator. Relay K11 serves as an interface between the modules and the interlock circuit.

2. The words FAULT INDICATORS (DS9A thru C and DS11A thru C), located on either side of the INTERLOCKS indicator cluster, should be lit; the individual fault indicators (DS9D thru L and DS11D thru L) should not be lit.

3. On the Control Cabinet meter panel, the TRANSMITTER OFF indicator (DS1A and C), the PLATE OFF indicator (DS6A and C), and the INTERLOCK indicator (DS4A and C) should be lit; all other meter panel indicators should not be lit.

Pressing the TRANSMITTER ON/AIR ON pushbutton indicator. The following outlines the sequence of events that occur when the TRANSMITTER ON/AIR ON pushbutton indicator is pressed.

NOTE: On a TT-30FL transmitter there are two TRANSMITTER ON/AIR ON pushbutton indicators (2S2 and 3S2). These may be pressed either one at a time or simultaneously without adverse effects.

1. Memory-latch relay K1 moves to the latched position.

2. Contacts of K1 –

a. energize grounding relay K3 in the Power Supply Cabinet (a contact of K3 closes a link to plate contactor K1, Power Supply Cabinet),

b. extinguish TRANSMITTER OFF indicator DS1A and C,

c. close the final link to BLOWER contactor K2, and

d. close a link to LV (low voltage) relay K12.

3. BLOWER contactor K2 energizes and starts the blower motor. Air pressure gauges on the Amplifier Cabinet should indicate proper blower operation. Another contact of K2 closes a link to FILAMENT contactor K3.

4. The presence of sufficient air pressure closes air interlock switches in the aural and visual PA cavities, each closing a link to FILAMENT contactor K3.

5. FILAMENT contactor K3 energizes, applying 230 Vac, 3-Ø to the filament regulation transformers in the Power Supply Cabinet. Another contact of K3 closes a link to MODULATOR relay K8.

6. Filament voltage is fed back from the Power Supply Cabinet to energize FILAMENT INTERLOCK relay K4.

7. A contact of K4 –

a. lights the FILAMENTS ON indicator DS3A and C,

b. energizes FILAMENT HOURS indicator M5, and

c. energizes PLATE TD relay K5.

8. PLATE TD relay K5 begins a delay of 120 seconds, after which a contact closes, energizing PLATE TD OFF relay K10 and PLATE TD AUX relay K6.

The purpose of K10 is to provide a hold on the status of the high-voltage circuits during AC power interruptions of 4 seconds or less. Power faults of longer duration allow relay K10 to drop out, and the 120 second delay of relay K5 again takes effect. This 120 second delay is inserted to provide tube filaments with sufficient time to reach a degree of thermal stability. K10 may be adjusted for a greater timing interval if

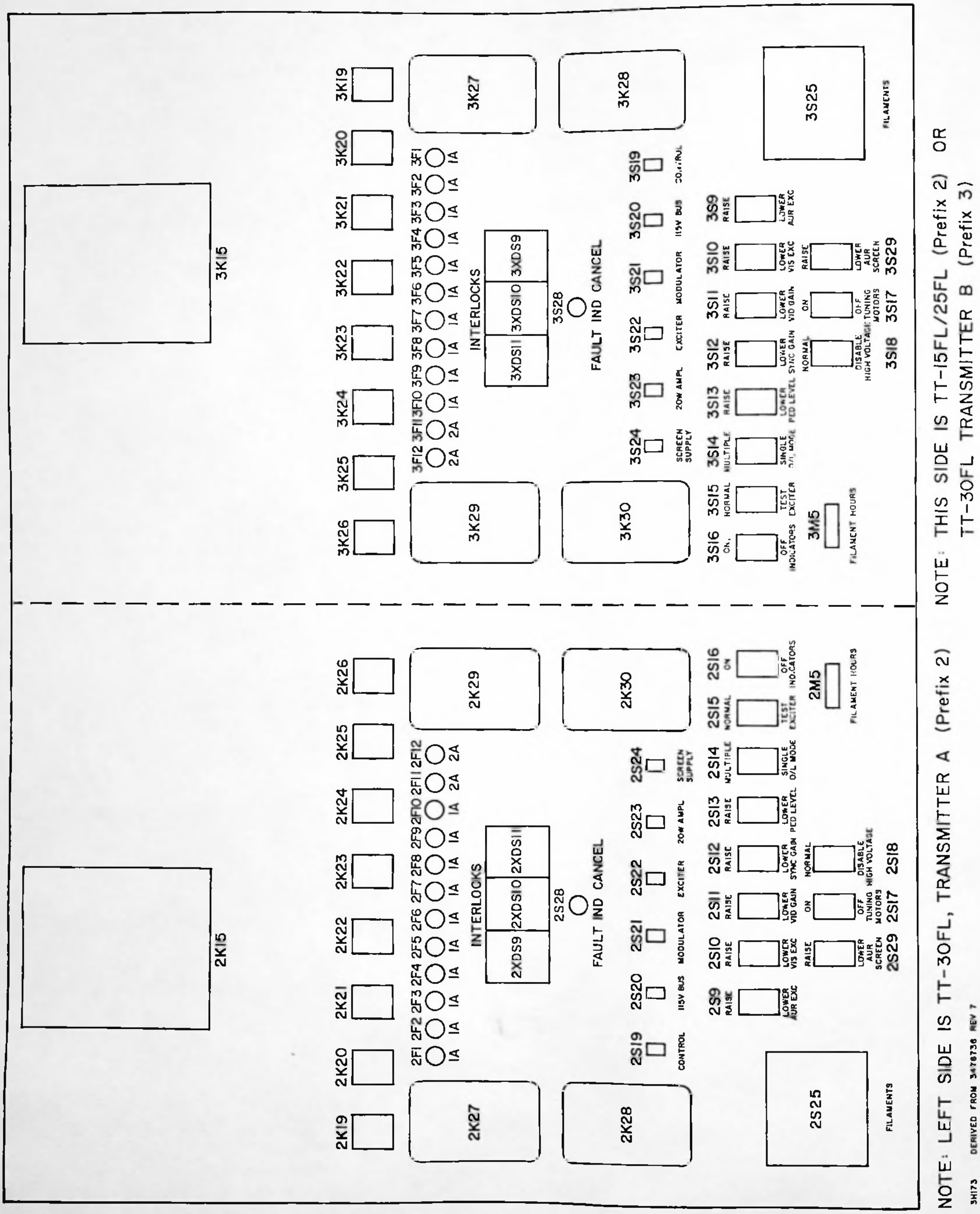


Figure 1-6. Rear View, TT-15FL/25FL Control Cabinet

desired; it would normally be set to cover reclosure time of the station supply breaker.

The TD BYPASS pushbutton indicator (S5) may be pressed to bypass the 120 second delay; however, unnecessary use of this function should be avoided as this could shorten tube life. For more information on this, see the "Tube Life" article in the System Operating Instructions book.

9. A contact of PLATE TD AUX relay K6 lights the PLATE READY indicator DS5A and C, and closes a link to PLATE AUX relay K9.

As soon as the PLATE READY indicator lights, the PLATE ON pushbutton indicator may be pressed, or the transmitter may be left in this ready condition for as long as desired.

Pressing the PLATE ON pushbutton indicator. The following outlines the sequence of events that occur when the PLATE ON pushbutton indicator (S6) is pressed.

NOTE: On a TT-30FL transmitter there are two PLATE ON pushbutton indicators (2S6 and 3S6). These may be operated either one at a time or simultaneously without adverse effects.

1. Memory-latch relay K7 moves to the latched position.

2. Contacts of K7 –

a. extinguish the PLATE OFF indicator DS5A and C,

b. close the final link to MODULATOR relay K8,

c. close a link to LV relay K12, and

d. open a contact parallel to the closed contact of CLAMP DISABLE TD relay K31.

3. Contacts of MODULATOR relay K8 close a link to PLATE AUX relay K9 and apply 115 Vac to the Video Modulator power supply.

4. The Video Output module of the Video Modulator supplies control grid bias to the visual IPA. This bias voltage energizes a sensing relay in the Amplifier Cabinet which closes the final link to PLATE AUX relay K9. The same contact lights the MOD AMP BIAS indicator on the Amplifier Cabinet meter panel.

5. Contacts of K9 –

a. close the final link to the plate contactor K1 in the Power Supply Cabinet (the plate contactor energizes the plate transformers),

b. light PLATE ON indicator DS7A and C, and

c. couple the VSWR protection circuit to the O/L circuit.

6. The high-voltage interlock contact on the plate contactor closes the final link to LV relay K12.

7. One contact of K12 energizes EXCITER relay K13, the surge suppressor relay in the Power Supply Cabinet, and the CLAMP DISABLE TD relay K31. Two other contacts of K12 apply 115 Vac to the screen power supply.

8. At the end of a 2 second time delay, CLAMP DISABLE TD relay K31 opens a contact and enables the video clamp circuit in the Video Modulator.

9. One contact of EXCITER relay K13 lights the EXCITER indicator on the Amplifier Cabinet meter panel. Two other contacts apply 115 Vac to the power supplies of the Exciter and the 20 Watt Amplifier.

The transmitter should now be operating normally. Except for the deliberately-inserted time delays, all other steps may be considered as instantaneous. Many of the relays provide supervisory functions to ensure that all circuits are energized in proper sequence, and to stop the sequence if any step should fail to operate satisfactorily.

This description gives only details regarding the operation of the control circuits within the Control Cabinet. During transmitter startup, the operator may wish to follow a different procedure.

For example, in presetting the controls before startup, the PLATE ON pushbutton indicator S7 may be pressed. This would move memory-latch relay K7 to the latched position. Using this alternate method, only the TRANSMITTER ON/AIR ON pushbutton indicator S2 need be pressed to bring the transmitter up to full operation. The 120 second delay still allows for filament warm-up time. Note that with memory-latch relay K7 preset to the latched position, PLATE OFF indicator DS6A and C will not be lit.

Other alternatives may involve stepping the control circuit sequence manually, adjusting aural and visual drives to full power after the transmitter is operating, and so forth.

Transmitter Shutdown

The transmitter may be shutdown by simply pressing the TRANSMITTER OFF pushbutton indicator S1; however, the blower will also shutdown. An alternate procedure would be to press the PLATE OFF pushbutton indicator S6 first, and then open the filament circuit breaker, thereby allowing the blower to cool the power tubes for a time before pressing the TRANSMITTER OFF pushbutton indicator.

Other Control Devices

Some switches are not involved directly with controlling normal transmitter operations. These are discussed here.

Alternate positions of S14, S15, and S18. These switches provide alternate modes for overload faults, Exciter testing, and high-voltage disabling.

O/L MODE switch S14 may be set to either the SINGLE or the MULTIPLE position. In the SINGLE position, the transmitter must be reset manually after each overload has occurred. The MULTIPLE position automatically returns the transmitter to normal operation after the first and second faults, but not after the third. This allows for resuming operation after an instantaneous fault has cleared itself, and termination of operation for a continuous or a repeating overload.

EXCITER switch S15 placed in the TEST position permits turning the Exciter on while the IPA's and PA's are not operating. This position is useful when tuning or adjustments are required in the Exciter or 20 Watt Amplifier.

HIGH VOLTAGE switch S18 may be placed in the DISABLE position when certain tests are to be performed. For example, the Video Modulator may be turned on by pressing the TRANSMITTER ON/AIR ON and the PLATE ON pushbutton indicators without turning on plate and screen voltages. Since this would also turn on the tube filaments supplies, it may be desirable to temporarily set FILAMENTS circuit breaker S25 to OFF.

Tuning motor rocker switches. A group of rocker switches located on the Control Cabinet panel are to operate motor driven controls for adjusting the levels of various signal and bias voltages in the transmitter. These are marked with positions RAISE and LOWER and are as follows:

1. AUR EXC (S9) — this adjusts the aural drive level.

2. VIS EXC (S10) — this adjusts the visual drive level.

3. VID GAIN (S11) — this adjusts the gain control in the Video Output module.

4. SYNC GAIN (S12) — this adjusts the sync gain control in the Video Processor module.

5. PED LEVEL (S13) — this adjusts the video pedestal level in the Video Output Module.

6. AUR SCREEN (S29) — this adjusts the aural IPA screen voltage control.

Another rocker switch, TUNING MOTORS (S17), is provided to turn-on/off the power to the tuning motor drives in the transmitter.

Fuses. In addition to the overload relays and circuit breakers, a group of fuses are provided on the front panel to protect various circuits. These are as follows:

1. F1 through F9, AC metering.

2. F10, indicators.

3. F11, tuning motors.

4. F12, Exciter crystal ovens.

Overload Operation

Each overload (O/L) relay, K19 through K30, will trip when the current in the circuit that it is protecting rises above a preset level. With O/L MODE switch S14 in the SINGLE position, the following sequence will result when any one of the O/L relays trip:

1. One contact of the O/L relay fires the respective SCR on the Fault Indicator Switching circuit board, lighting the related fault indicator; a second contact energizes OVERLOAD AUX relay K14 and O/L TD relay K16, and also steps ratchet relay K15 one position.

2. Contacts of OVERLOAD AUX relay K14:

a. connect the self-sustain

b. de-energize LV relay K12

c. de-energize PLATE AUX relay K9

d. disable video clamp circuit.

3. A contact of LV relay K12 turns off the screen power supply and de-energizes EXCITER relay K13.

4. PLATE AUX relay K9 opens the high voltage interlock and shuts down the plate power supplies in the Power Supply Cabinet.

5. After 2 seconds, O/L TD relay K16 opens the self-sustain and de-energizes OVERLOAD AUX relay K14 and ratchet relay K15.

6. a contact of ratchet relay K15 remains open, keeping the transmitter off; a second contact lights OVERLOAD indicator DS8A and C.

After the cause of the overload fault has been removed, the transmitter can be returned to operation by pressing the OVERLOAD RESET pushbutton indicator S8. Pressing the FAULT IND CANCEL pushbutton S28 extinguishes the fault indicator.

With the O/L MODE switch S14 in the MULTIPLE position, an overload will produce the same switching sequence. The difference here is that S14 bypasses the contact of ratchet relay K15, and the transmitter returns automatically to full operation after a 2 second delay.

Sub-Assemblies

Neon Ballast PWB (A1). The Neon Ballast printed wiring board provides a ballast resistor for each of the twelve neon lamps in the INTERLOCKS indicator block. This board plugs into a 22, contact, card-edge connector and is mounted on the rear of the Control Cabinet front panel, above the INTERLOCKS indicator block. See figure 1-9, Printed Wiring Board Assemblies.

Fault Indicator Switching PWB (A2/A3). On each of the two Fault Indicator Switching printed wiring boards are ten SCR switching circuits. The boards plug into separate 22, contact, card-edge connectors and are mounted behind the front panel, adjacent to the block of FAULT INDICATORS which it operates. See figure 1-9, Printed Wiring Board Assemblies.

When an overload relay operates, one of its contacts applies +28 Vdc to the gate circuit of the respective SCR. The SCR fires and lights the fault indicator lamp in series with its anode. Once the SCR has fired, the lamp remains lit until the FAULT IND CANCEL switch (S28) is pressed. This switch opens the +28 volt line to the lamp circuits, allowing the SCR's to return to their voltage blocking state. Pressing S28 resets all of the SCR's on both boards at one time.

Control Power Supply (A4). The Control Power Supply provides 28 volts DC for operating the crystal heater ovens, the tuning motors, and the fault indicator lamp circuits. Figure 1-20 is a schematic diagram of the unit, and figure 1-10 shows a pictorial view to aid in locating and identifying component parts.

A single SCR serves as a series switching regulator. Transistors Q3 and Q4 are connected as a differential amplifier. A zener diode, CR7, provides a reference voltage at the base of Q2, and the output voltage divider applies an error signal to the base of Q3.

The collector of Q4 controls the operation of the UJT, Q1, which develops gating pulses to fire the output SCR. When the output voltage rises above the value set by potentiometer R12, transistor Q3 conducts and turns off the UJT. A drop in output voltage turns Q3 off, allowing the UJT to turn on and supply gating pulses to fire the SCR. Filter capacitors C6 and C7 smooth output variations caused by the switching output of the SCR. Hence, a low ripple, regulated output voltage is produced.

VSWR Protective Unit (A5). The VSWR Protective Unit is used to sense undesirably high levels of VSWR, as detected by the transmission-line-mounted reflectometers, and to shut the transmitter down when this condition exists.

Figure 1-21 provides a schematic diagram of the unit as well as views of the printed wiring board. Figure 1-11 shows pictorial views of the unit to aid in locating and identifying component parts.

The VSWR Protective Unit employs two identical high-gain operational amplifiers, connected as voltage comparators. One comparator is used for sensing aural reflected power, and the other, visual reflected power. Each circuit has a variable sensitivity control.

The outputs of the comparators drive separate relays, each having one contact to operate their respective VSWR interlock circuits, and one to fire the related SCR on the Fault Indicator Switching circuit board.

The unit has a ±15 volt regulated power supply, operating from 115 Vac, 50/60 Hz. The power supply outputs are common to both comparator circuits.

Metering Circuits

Refer to figure 1-18, Schematic, TT-15FL/25FL Control Cabinet Meter Panel; figure 1-19, Schematic, TT-30FL Control Cabinet Meter Panel.

TT-15FL/25FL Control Cabinet Meter Panel

There are three meters on the meter panel of the MI-560599A Control Cabinet. The AUR PA PLATE meter M2 reads aural PA plate voltage in kilovolts DC, and the VIS PA PLATE meter M3 reads visual PA plate voltage in kilovolts DC.

A third meter provides an indication of various AC line voltages when they are present in the transmitter. This is LINE VOLTAGE meter M4 and its associated selector switch S26. This meter selector switch has the following positions:

1. LINE 1, 2, and 3. These provide a reading for each of the three phases of incoming line voltage;

2. DIST 1, 2, and 3. These provide a reading for each of the three phases of the distribution voltage in the Control Cabinet;

3. FIL BUS 1, 2, and 3. These provide a reading for each of the three phases at the outputs of the filament regulation transformers.

TT-30FL Control Cabinet Meter Panel

There are seven meters the meter panel of the MI-

560576 Control Cabinet. AUR PA PLATE LEFT (2M2) reads the aural PA plate voltage of transmitter A, and AUR PA PLATE RIGHT (3M2) reads the aural PA plate voltage of transmitter B; VIS PA PLATE LEFT (2M3) reads the visual PA plate voltage of transmitter A, and VIS PA PLATE RIGHT (3M3) reads the visual PA plate voltage of transmitter B; all read in kilovolts DC.

The AURAL REFLECTOMETER (2M1) has a selector switch (2M30) with positions:

1. PWR, combined aural forward power;

2. VSWR, combined aural VSWR;

3. VSWR CAL, a provision for calibrating the VSWR reading using forward power as a reference;

4. REJ, power being dissipated in the load at the reject port of the aural combiner.

The VISUAL REFLECTOMETER (3M1) has a selector switch (3S30) with positions:

1. PWR, combined visual forward power;

2. VSWR, combined visual VSWR;

3. VSWR CAL, a provision for calibrating the VSWR reading using forward power as a reference;

4. REJ, power being dissipated in the load at the reject port of the visual combiner.

The LINE VOLTAGE meter (2M4) provides an indication of various AC voltages when they are present in the transmitters. The associated meter selector switch (2S26) selects between:

1. LINE 1A (1B), 2A (2B), and 3A (3B) — transmitter A (B) 3-Ø input line voltages;

2. DIST 1A (1B), 2A (2B), and 3A (3B) — transmitter A (B) 3-Ø distribution voltages in the Control Cabinet;

3. FIL BUS 1A (1B), 2A (2B), and 3A (3B) — 3-Ø output of filament regulation transformers in transmitter A (B).

Cooling Circuit

A centrifugal blower mounted on the floor inside the Control Cabinet supplies cooling air to the transmitter power tubes. The TT-30FL transmitter requires one blower for each side of the Control Cabinet.

The unit in the right-hand side of the TT-30FL Control Cabinet and the one in the TT-15FL/25FL Control Cabinet has a bottom-horizontal discharge. In the left-hand side of the TT-30FL cabinet, the blower has a top-horizontal discharge.

A small portion of the output from each blower is fed through flexible hoses to provide cooling for other items in the transmitter.

ADJUSTMENTS

Adjustment information is provided in the following paragraphs to ensure proper operation of the Control Cabinet. The information includes preliminary adjustment and control settings for proper signal transmission.

Control and 115 V Bus Transformers

The control and 115 V Bus transformers (T1 and T2 respectively) step-down the 230 Vac entering the Control Cabinet to supply voltages for the control circuits, the modular sub-system power supplies, and the screen power supply. Table 1-3 shows the terminal designations for these transformers.

Overload Relays

NOTE: The settings indicated in table are for operating at maximum rated power. When operating at a lower power level, the settings should be reduced correspondingly.

The overload relays in the Control Cabinet are adjusted to ensure circuit protection in the event of an overloaded circuit. To adjust the small overload relays (K19 thru K26), a DC power supply, adjustable from 0.5 to 2.0 Vdc and capable of delivering up to 8 amps, is needed. Adjust the power supply for minimum voltage and connect it across the shunt resistor of the relay to be adjusted. Connect an ammeter in series with the power supply. Slowly increase the voltage to obtain the reading specified in table 1-4.

Adjust the relay spring tension so it just pulls in at that current. Decrease and increase the voltage several times to check for proper operation. Replace the relay covers after making the adjustments. Overload relays K27 through K30 are set by rotating the thumbscrew on the calibrated plunger.

MAINTENANCE

General

With ordinary care, a minimum of service will be required to keep the Control Cabinet in operation. The following recommended schedule of maintenance can be correlated with other equipment maintenance programs.

WARNING

For personal safety, make certain that all equipment is turned off and that all filter capacitors have been discharged with a grounding stick.

Daily

1. Make a general visual inspection for abnormalities after shutdown.

2. At startup, check the meter readings for the proper operating values.

3. If overloads have occurred, examine each component concerned during shutdown and repair or replace if necessary.

Weekly

1. Clean the internal parts of the Control Cabinet. Use a clean soft cloth and a solvent, such as trichlorethylene, where needed. A vacuum cleaner is best for removing dust or dirt; a blower will suspend dirt and allow it to settle on the equipment again.

2. Inspect the air filters for clogging and replace if necessary.

Monthly

Check the condition of the relay contacts and service if necessary.

Semi-Annually

1. Inspect the relay contacts and service or replace them where required.

2. Clean the pole faces on the contactors.

3. Check all connections for tightness, paying especial attention to all pressure type terminals.

Relays and Contactors

Periodically inspect all relays and contactors. All contacts should be cleaned and adjusted if necessary. Manually check the operation and check for any loose hardware.

Small relays having silver-to-silver contacts require little attention, but they may have to be replaced if tip wear becomes excessive. Filing or other methods of dressing the tip results in loss of silver and is of no advantage.

Relay contacts, in general, should be cleaned with trichlorethylene applied with a stiff brush, followed by a burnishing tool such as RCA Contact Cleaning Tool, stock number 22963. Finally, wipe the contacts with clean bond paper.

Fuses

The fuses used to protect the various circuits of the transmitter are listed in table 1-5.

Blower

The blower motors used in the FL Control Cabinets have sealed bearings and are lubricated for the life of the unit. Keep all air filters clean and inspect the cooling circuit periodically for leaks and loose hardware.

REPLACEMENT PARTS LIST

The components listed in the replacement parts list are identified by one of two methods, depending on whether the component is a mechanical or an electrical part. Electrical parts are assigned a standard electrical symbol and are listed in alphanumerical sequence. Mechanical parts are assigned a numerical symbol (8, 17, 25, etc.) that corresponds to the item number on the mechanical assembly drawing where that particular part is located.

REPLACEMENT PARTS

Symbol	Stock No.	Drawing No.	Description
			Control Cabinet MI-560599
			USED ON TT-15FL (S/N 2344-042) AND EARLIER
			M/L 3459833-503 REV. 29
Electrical (Prefix 2)			
A1		3459918-501	PRINTED BOARD NEON BALLAST
A2		3459919-501	PRINTED BOARD FAULT INDICATOR SWITCHING
A3		3459919-501	PRINTED BOARD FAULT INDICATOR SWITCHING
A4		3730522-001	POWER SUPPLY - MI-561341A
A5		3720545-503	VSWR PROTECTIVE UNIT
B1			BLOWER - MI-560579
C2	205656	1510003-037	CAPACITOR-METER BYPASS
C3	205656	1510003-037	CAPACITOR-METER BYPASS
C4	205656	1510003-037	CAPACITOR-METER BYPASS
C5	418055	3455547-025	CAPACITOR, 1UF 440VAC
DS1A TO DS8C	236278	3452325-015	LAMP INDICATOR
DS9A TO DS9L	207712	849546-025	LAMP - INDICATOR
DS10A TO DS10L	115929	872291-017	LAMP - INDICATOR, NEON
DS11A TO DS11L	207712	849546-025	LAMP - INDICATOR
F1 TO F9	426973	990157-008	FUSE - AC METERING, 1 AMP
F10	426973	990157-008	FUSE - INDICATORS, 1 AMP
F11	426968	990157-010	FUSE - TUNING MOTORS, 2 AMP
F12	426968	990157-010	FUSE - EXCITER CRYSTAL OVENS, 2 AMP
HR1	248721	3730501-011	HEATER - BLOWER, THERMAL OVERLOAD
HR2	248721	3730501-011	HEATER - BLOWER, THERMAL OVERLOAD
J1	230572	8490041-002	CONNECTOR
J2	230572	8490041-002	CONNECTOR
J3	230572	8490041-002	CONNECTOR
J7	246732	1510013-151	CONNECTOR - BNC
J8	246732	1510013-151	CONNECTOR - BNC
K1		3730692-501	CONTACTOR - MEMORY LATCH
	247415	8459831-001	RELAY
	247416	8459831-021	MEMORY LATCH
K2	425747	3730501-004	CONTACTOR - 3 PHASE
K3	247413	3730501-002	CONTACT - 3 PHASE
K4	247420	3459831-081	CONTACT - 2 POLE
K5	247418	3459831-061	CONTACTOR - SOLID STATE TIMING, ON DELAY
K6	247415	3459831-001	CONTACTOR - 4 POLE
K7		3730692-501	CONTACTOR - MEMORY LATCH
	247415	8459831-001	RELAY
	247416	8459831-021	MEMORY LATCH
K8	247414	3730501-003	CONTACTOR - 3 PHASE
K9	247415	3459831-001	CONTACTOR - 4 POLE
K10	247419	3459831-062	CONTACTOR - SOLID STATE TIMING, OFF DELAY
K11	247421	3459917-001	RELAY - INTERLOCK
K12	247414	3730501-003	CONTACTOR - 3 PHASE
K13	247413	3730501-002	CONTACTOR - 3 PHASE
K14	247415	3459831-001	CONTACTOR - 4 POLE
K15	210400	445100-005	RELAY - NOTCHING AND RESET
	212241	445100-021	COIL-RELEASE
	212242	445100-011	COIL - OPERATING
K16		3730691-501	RELAY - SOLID STATE TIMING ASSEMBLY
	247415	3459831-001	RELAY
	247417	3459831-041	RELAY - TIMER, 0.1 TO 30 SEC.

Symbol	Stock No.	Drawing No.	Description
K17	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K18	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K19 TO			
K26	210404	754291-001	RELAY - ADJUSTABLE
K27	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K28	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K29	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K30	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K31	247436	3731069-002	RELAY - TIME DELAY
K32	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K33	239680	8971187-006	RELAY - DPDT 10 A 120 VAC
K34	239680	8971187-006	RELAY - DPDT 10 A 120 VAC
K35	247415	3459831-001	RELAY INTERLOCK AUX
M2	230797	993053-175	METER - AUR PA PLATE
M3	229784	993053-176	METER - VIS PA PLATE
M4	420835	993058-116	METER - AC VOLTAGE
M5	229785	8489369-002	ELAPSED - TIME, INDICATOR
60P1	242444	3456541-001	CONNECTOR - MALE, BNC
60P2	242444	3456541-001	CONNECTOR - MALE, BNC
P1			PLUG - PART OF A1
P2			PLUG - PART OF A2
P3			PLUG - PART OF A3
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1 TO			
R8	230163	993007-086	WIREWOUND, 1900 OHMS 10% 5 W
R13	512310	90496-074	10,000 OHMS 10% 1/2 W
S1	229798	8543376-001	SWITCH - PUSHBUTTON, TRANSMITTER OFF
S2	229798	8543376-001	SWITCH - PUSHBUTTON, TRANSMITTER ON
S5	229798	8543376-001	SWITCH - PUSHBUTTON, T.D. BYPASS
S6	229798	8543376-001	SWITCH - PUSHBUTTON, PLATE, ON
S7	229798	8543376-001	SWITCH - PUSHBUTTON, PLATE, OFF
S8	229798	8543376-001	SWITCH - PUSHBUTTON, O.L. RESET
S9	247495	8498764-006	SWITCH - AURAL EXCITATION
S10	247495	8498764-006	SWITCH - VISUAL EXCITATION
S11	247495	8498764-006	SWITCH - VIDEO GAIN
S12	247495	8498764-006	SWITCH - SYNC GAIN
S13	247495	8498764-006	SWITCH - PEDESTAL LEVEL
S14	230828	8498764-004	SWITCH - OVERLOAD SELECT
S15	230828	8498764-004	SWITCH - EXCITER TEST
S16	230828	8498764-004	SWITCH - INDICATORS
S17	427959	8498764-007	SWITCH - TUNING MOTORS
S18	230828	8498764-004	SWITCH - HIGH VOLTAGE DISABLE
S19	418321	3730502-003	CIRCUIT BREAKER - CONTROL
S20	418321	3730502-003	CIRCUIT BREAKER - 115 V BUS
S21	247426	3730502-002	CIRCUIT BREAKER - MODULATOR
S22	247426	3730502-002	CIRCUIT BREAKER - EXCITER
S23	247426	3730502-002	CIRCUIT BREAKER - 20 W AMPL
S24	247426	3730502-002	CIRCUIT BREAKER - SCREEN SUPPLY
S25	420845	3730271-005	CIRCUIT BREAKER - FILAMENT
S26	230786	8494423-002	SWITCH - METERING
S28	230770	8520610-002	SWITCH - PUSHBUTTON, RESET
S29	247495	8498764-006	SWITCH - AURAL SCREEN
T1	247429	3730519-001	TRANSFORMER - CONTROL
T2	247428	3730518-001	TRANSFORMER - 115 V BUS
XDS1	418284	3455201-004	SOCKET INDICATOR LAMP

Symbol	Stock No.	Drawing No.	Description
XDS2	418284	3455201-004	SOCKET INDICATOR LAMP
XDS3	236360	3455201-001	SOCKET INDICATOR LAMP
XDS4	236360	3455201-001	SOCKET INDICATOR LAMP
XDS5			
TO			
XDS8	418284	3455201-004	SOCKET INDICATOR LAMP
XDS9	247434	3730503-001	STATUS INDICATOR - 12 POSITION
XDS10	247435	3730503-002	STATUS INDICATOR - 12 POSITION
XDS11	247434	3730503-001	STATUS INDICATOR - 12 POSITION
XFS1			
TO			
XFS10	211618	8817617-001	SOCKET - FUSE
XFS11	419013	8817617-002	SOCKET - FUSE
XFS12	419013	8817617-002	SOCKET - FUSE
XK33	68590	99100-005	SOCKET - TUBE, OCTAL
XK34	68590	99100-005	SOCKET - TUBE, OCTAL
			ML/3720595-501 REV. 22
Mechnical			
48	426290	8522915-001	BARRIER - MOUNTING, SHORT
72	242872	1510032-029	GROMMET
73	229166	1510032-011	GROMMET
82	231762	8540935-001	KEY
58	418042	8765773-511	KNOB ASSEMBLY
50	235853	8494089-053	SCREEN - DISPLAY
51	231042	8494089-036	SCREEN - DISPLAY
52	231045	8494089-034	SCREEN - DISPLAY
53	231046	8494089-035	SCREEN - DISPLAY
54	235854	8494089-054	SCREEN - DISPLAY
55	229892	8494089-004	SCREEN - DISPLAY
56	229893	8494089-005	SCREEN - DISPLAY
57	231044	8494089-032	SCREEN - DISPLAY
74	247431	3459920-001	SCREEN - DISPLAY
84	231765	8540937-006	SPRING - PRESSURE
62	231146	8544613-001	STUD
83	231766	8540937-013	TERMINAL
77	247445	3459814-001	TERMINAL BLOCK
			Neon Ballast PWB (2A1)
			ML 3459918-501 REV 1
R201			
TO			
R212	502333	82283-080	33,000 OHMS 10% 1/2 W
			Fault Indicator Switching PWB (2A2, 2A3)
			ML 3459919-501 REV 1
C101			
TO			
C110	205656	1510003-037	CERAMIC, .01 MF 500 V
Q101			
TO			
Q110	247582	3730560-001	TRANSISTOR - SCR - 2N3528
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R101	502310	82283-074	10,000 OHMS 1/2 W
R102	512215	90496-064	1500 OHMS 10% 1 W
R103	502310	82283-074	10,000 OHMS 1/2 W
R104	512215	90496-064	1500 OHMS 10% 1 W
R105	502310	82283-074	10,000 OHMS 1/2 W
R106	512215	90496-064	1500 OHMS 10% 1 W
R107	502310	82283-074	10,000 OHMS 1/2 W
R108	512215	90496-064	1500 OHMS 10% 1 W
R109	502310	82283-074	10,000 OHMS 1/2 W

Symbol	Stock No.	Drawing No.	Description
R110	512215	90496-064	1500 OHMS 10% 1 W
R111	502310	82283-074	10,000 OHMS 1/2 W
R112	512215	90496-064	1500 OHMS 10% 1 W
R113	502310	82283-074	10,000 OHMS 1/2 W
R114	512215	90496-064	1500 OHMS 10% 1 W
R115	502310	82283-074	10,000 OHMS 1/2 W
R116	512215	90496-064	1500 OHMS 10% 1 W
R117	502310	82283-074	10,000 OHMS 1/2 W
R118	512215	90496-064	1500 OHMS 10% 1 W
R119	502310	82283-074	10,000 OHMS 1/2 W
R120	512215	90496-064	1500 OHMS 10% 1 W
			Power Supply MI-561341A (2A4)
			M/L 3730522-001
			CAPACITORS
C1	247657		0.15 MFD 200 V
C2	243854		.047 MFD 200 V
C3	247659		20 MFD 150 V
C4	230235		3.3 MFD 35 V
C5	247656		0.22 MFD 200 V
C6	246593		20,000 MFD 35 V
C7	246594		5000 MFD 50 V
CR2	235220		DIODE - TYPE 366D, SILICON RECTIFIER
CR4	235220		DIODE - TYPE 366D, SILICON RECTIFIER
CR5	249742		DIODE - TYPE 1N759, ZENER, 12 V
CR6	217784		DIODE - TYPE 1N645, SILICON RECTIFIER
CR7	235996		DIODE - TYPE 1N708A, ZENER 5.6 V
CR8	217784		DIODE - TYPE 1N645, SILICON RECTIFIER
F1	12958		FUSE - 6 AMP
Q1	235136		TRANSISTOR - TYPE 2N1671B
Q2	231379		TRANSISTOR - TYPE 2N2349
Q3	231379		TRANSISTOR - TYPE 2N2349
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1	522182		820 OHMS 10% 2 W
R2	502210		1000 OHMS 10% 1/2 W
R4	502115		150 OHMS 10% 1/2 W
R5	502339		39,000 OHMS 10% 1/2 W
R6	427960		WIREWOUND, 4000 OHMS 5% 2 W
R7	502127		270 OHMS 10% 1/2 W
R8	502282		8200 OHMS 10% 1/2 W
R9	502212		1200 OHMS 10% 1/2 W
R10	502222		2200 OHMS 10% 1/2 W
R11	502256		5600 OHMS 10% 1/2 W
R12	247660		WIREWOUND, POT 5000 OHMS
R13	225733		WIREWOUND, 1000 OHMS 5% 2 W
R14	502110		100 OHMS 10% 1/2 W
R15	225733		WIREWOUND, 1000 OHMS 5% 2 W
R16	502110		100 OHMS 10% 1/2 W
R17	522168		680 OHMS 10% 2 W
SCR1	246595		RECTIFIER - SILICON CONT.
T1	246596		TRANSFORMER
			VSWR Protective Unit (2A5)
			M/L 3720545-501, 502 REV 6
C1	219195	993025-261	MICA, 1000 PF 10% 100 V
C2	219195	993025-261	MICA, 1000 PF 10% 100 V
C3 TO			
C6	235152	3720527-009	CERAMIC, 10,000 PF 150 V
C7	219195	993025-261	MICA, 1000 PF 10% 100 V
C8	219195	993025-261	MICA, 1000 PF 10% 100 V

Symbol	Stock No.	Drawing No.	Description
C9 TO C12	235152	3720527-009	CERAMIC, 10,000 PF 150 V
C13 TO C22	243374	1215657-001	FEED THRU, 1000 PF 500 V
CR1 TO CR4	227720	3720130-001	DIODE - TYPE 1N3254
J1	54890	1510013-161	CONNECTOR - BNC
J2	54890	1510013-161	CONNECTOR - BNC
J3	248724	8001556-002	CONNECTOR
K1	431260	3734114-001	RELAY
K2	431260	3734114-001	RELAY
PS1	248722	3732000-002	POWER SUPPLY
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1	236096	3720533-004	FILM, 27,400 OHMS 1% 1/4 W
R2	236087	3720533-003	FILM, 10,000 OHMS 1% 1/4 W
R3	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R4	428085	3721146-009	VARIABLE, 5000 OHMS 5% 1 W
R5	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R6	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R7	249112	3720533-002	FILM, 4990 OHMS 1% 1/4 W
R8	248720	3720533-001	FILM, 22.1 OHMS 1% 1/4 W
R9	236096	3720533-004	FILM, 27,400 OHMS 1% 1/4 W
R10	236087	3720533-003	FILM, 10,000 OHMS 1% 1/4 W
R11	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R12	428085	3721146-009	VARIABLE, 5000 OHMS 5% 1 W
R13	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R14	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R15	249112	3720533-002	FILM, 4990 OHMS 1% 1/4 W
R16	248720	3720533-001	FILM, 22.1 OHMS 1% 1/4 W
R17	502510	82283-231	1 MEG 5% 1/2W
R18	502510	82283-231	1 MEG 5% 1/2W
U1	248725	3720537-001	CIRCUIT - INTEGRATED
U2	248725	3720537-001	CIRCUIT - INTEGRATED
XU1	248723	3720534-001	SOCKET
XU2	248723	3720534-001	SOCKET
			Blower Unit MI-560869B (2B1)
		3746642-002	BLOWER
	424929	3746642-003	MOTOR
	246264	3746642-004	MOUNT - SHOCK MOUNT

Symbol	Stock No.	Drawing No.	Description
			Control Cabinet MI-560599A
			USED ON TT-15FL (AFTER S/N 2344-042) TT25FL M/L 3459833-504 REV 29
Electrical (Prefix 2)			
A1		3459918-501	PRINTED BOARD NEON BALLAST
A2		3459919-501	PRINTED BOARD FAULT INDICATOR SWITCHING
A3		3459919-501	PRINTED BOARD FAULT INDICATOR SWITCHING
A4		3730522-001	POWER SUPPLY - MI-561341A
A5		3720545-503	VSWR PROTECTIVE UNIT
B1			BLOWER - MI-560579 - TT-15FL/30FL
B1			BLOWER - MI-561274 - TT-25FL
C2	205656	1510003-037	CAPACITOR-METER BYPASS PART OF POWER DET KIT MI-561272 TT-25FL
C2	205656	1510003-037	CAPACITOR-METER BYPASS PART OF POWER DET KIT MI-561273 TT-15FL
C3	205656	1510003-037	CAPACITOR-METER BYPASS
C4	205656	1510003-037	CAPACITOR-METER BYPASS
C5	418055	3455547-025	CAPACITOR 1UF 440VAC
DS1A TO DS8C	236278	3452325-015	LAMP INDICATOR
DS9A TO DS9L	207712	849546-025	LAMP - INDICATOR
DS10A TO DS10L	115929	872291-017	LAMP - INDICATOR, NEON
DS11A TO DS11L	207712	849546-025	LAMP - INDICATOR
F1 TO F9	426973	990157-008	FUSE - AC METERING, 1 AMP
F10	426973	990157-008	FUSE - INDICATORS, 1 AMP
F11	426968	990157-010	FUSE - TUNING MOTORS, 2 AMP
F12	426968	990157-010	FUSE - EXCITER CRYSTAL OVENS, 2 AMP
HR1			PT OF MI-561273 TT-15FL CONT CAB POW DET KT
HR2			PT OF MI-561273 TT-15FL CONT CAB POW DET KT
HR1			PT OF MI-561272 TT-25FL CONT CAB POW DET KT
HR2			PT OF MI-561272 TT-25FL CONT CAB POW DET KT
J1	230572	8490041-002	CONNECTOR
J2	230572	8490041-002	CONNECTOR
J3	230572	8490041-002	CONNECTOR
J7	246732	1510013-151	CONNECTOR - BNC
J8	246732	1510013-151	CONNECTOR - BNC
K1		3730692-501	CONTACTOR - MEMORY LATCH
	247415	8459831-001	RELAY
	247416	8459831-021	MEMORY LATCH
K2	425747	3730501-004	CONTACTOR - 3 PHASE
K3	247413	3730501-002	CONTACT - 3 PHASE
K4	247420	3459831-081	CONTACT - 2 POLE
K5	247418	3459831-061	CONTACTOR - SOLID STATE TIMING, ON DELAY
K6	247415	3459831-001	CONTACTOR - 4 POLE
K7		3730692-501	CONTACTOR - MEMORY LATCH
	247415	8459831-001	RELAY
	247416	8459831-021	MEMORY LATCH
K8	247414	3730501-003	CONTACTOR - 3 PHASE
K9	247415	3459831-001	CONTACTOR - 4 POLE
K10	247419	3459831-062	CONTACTOR - SOLID STATE TIMING, OFF DELAY
K11	247421	3459917-001	RELAY - INTERLOCK
K12	247414	3730501-003	CONTACTOR - 3 PHASE
K13	247413	3730501-002	CONTACTOR - 3 PHASE
K14	247415	3459831-001	CONTACTOR - 4 POLE
K15	210400	445100-005	RELAY - NOTCHING AND RESET
	212241	445100-021	COIL-RELEASE
	212242	445100-011	COIL - OPERATING
K16		3730691-501	RELAY - SOLID STATE TIMING ASSEMBLY

Symbol	Stock No.	Drawing No.	Description
	247415	3459831-001	RELAY
	247417	3459831-041	RELAY - TIMER, 0.1 TO 30 SEC.
K17	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K18	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K19 TO			
K26	210404	754291-001	RELAY - ADJUSTABLE
K27	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K28	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K29	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K30	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K31	247436	3731069-002	RELAY - TIME DELAY
K32	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K33	239680	8971187-006	RELAY - DPDT 10 A 120 VAC
K34	239680	8971187-006	RELAY - DPDT 10 A 120 VAC
K35	247415	3459831-001	RELAY INTERLOCK AUX
M2			PT OF MI-561273 TT-15FL CONT CAB POW DET KT
M2			PT OF MI-561272 TT-25FL CONT CAB POW DET KT
M3	229784	993053-176	METER - VIS PA PLATE
M4	420835	993058-116	METER - AC VOLTAGE
M5	229785	8489369-002	ELAPSED - TIME, INDICATOR
60P1	242444	3456541-001	CONNECTOR - MALE, BNC
60P2	242444	3456541-001	CONNECTOR - MALE, BNC
P1			PLUG - PART OF A1
P2			PLUG - PART OF A2
P3			PLUG - PART OF A3
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1 TO			
R8	230163	993007-086	WIREWOUND, 1800 OHMS 10% 5 W
R13	512310	90496-074	10,000 OHMS 10% 1/2 W
S1	229798	8543376-001	SWITCH - PUSHBUTTON, TRANSMITTER OFF
S2	229798	8543376-001	SWITCH - PUSHBUTTON, TRANSMITTER ON
S5	229798	8543376-001	SWITCH - PUSHBUTTON, T.D. BYPASS
S6	229798	8543376-001	SWITCH - PUSHBUTTON, PLATE, ON
S7	229798	8543376-001	SWITCH - PUSHBUTTON, PLATE, OFF
S8	229798	8543376-001	SWITCH - PUSHBUTTON, O.L. RESET
S9	247495	8498764-006	SWITCH - AURAL EXCITATION
S10	247495	8498764-006	SWITCH - VISUAL EXCITATION
S11	247495	8498764-006	SWITCH - VIDEO GAIN
S12	247495	8498764-006	SWITCH - SYNC GAIN
S13	247495	8498764-006	SWITCH - PEDESTAL LEVEL
S14	230828	8498764-004	SWITCH - OVERLOAD SELECT
S15	230828	8498764-004	SWITCH - EXCITER TEST
S16	230828	8498764-004	SWITCH - INDICATORS
S17	427959	8498764-007	SWITCH - TUNING MOTORS
S18	230828	8498764-004	SWITCH - HIGH VOLTAGE DISABLE
S19	418321	3730502-003	CIRCUIT BREAKER - CONTROL
S20	418321	3730502-003	CIRCUIT BREAKER - 115 V BUS
S21	247426	3730502-002	CIRCUIT BREAKER - MODULATOR
S22	247426	3730502-002	CIRCUIT BREAKER - EXCITER
S23	247426	3730502-002	CIRCUIT BREAKER - 20 W AMPL
S24	247425	3730502-004	CIRCUIT BREAKER - SCREEN SUPPLY LESS HEATER
	426976		HEATER - 3.4A
S25	420845	3730271-005	CIRCUIT BREAKER - FILAMENT
S26	230786	8494423-002	SWITCH - METERING
S28	230770	8520610-002	SWITCH - PUSHBUTTON, RESET

Symbol	Stock No.	Drawing No.	Description
S29	247495	8498764-006	SWITCH - AURAL SCREEN
T1	247429	3730519-001	TRANSFORMER - CONTROL
T2	247428	3730518-001	TRANSFORMER - 115 V BUS
XDS1	418284	3455201-004	SOCKET INDICATOR LAMP
XDS2	418284	3455201-004	SOCKET INDICATOR LAMP
XDS3	236360	3455201-001	SOCKET INDICATOR LAMP
XDS4	236360	3455201-001	SOCKET INDICATOR LAMP
XDS5			
TO			
XDS8	418284	3455201-004	SOCKET INDICATOR LAMP
XDS9	247434	3730503-001	STATUS INDICATOR - 12 POSITION
XDS10	247435	3730503-002	STATUS INDICATOR - 12 POSITION
XDS11	247434	3730503-001	STATUS INDICATOR - 12 POSITION
XFS1			
TO			
XFS10	211618	8817617-001	SOCKET - FUSE
XFS11	419013	8817617-002	SOCKET - FUSE
XFS12	419013	8817617-002	SOCKET - FUSE
XK33	68590	99100-005	SOCKET - TUBE, OCTAL
XK34	68590	99100-005	SOCKET - TUBE, OCTAL
			M/L 3720595-502 REV 22
Mechanical			
48	426290	8522915-001	BARRIER - MOUNTING, SHORT
72	242872	1510032-029	GROMMET
73	229166	1510032-011	GROMMET
82	231762	8540935-001	KEY
58	418042	8765773-511	KNOB ASSEMBLY
50	235853	8494089-053	SCREEN - DISPLAY
51	231042	8494089-036	SCREEN - DISPLAY
52	231045	8494089-034	SCREEN - DISPLAY
53	231046	8494089-035	SCREEN - DISPLAY
54	235854	8494089-054	SCREEN - DISPLAY
55	229892	8494089-004	SCREEN - DISPLAY
56	229893	8494089-005	SCREEN - DISPLAY
57	231044	8494089-032	SCREEN - DISPLAY
74	247431	3459920-001	SCREEN - DISPLAY
84	231765	8540937-006	SPRING - PRESSURE
62	231146	8544613-001	STUD
83	231766	8540937-013	TERMINAL
77	247445	3459814-001	TERMINAL BLOCK
			TT-15FL Power Determining Kit MI-561273
			M/L 3724598-501 REV 2
C2		3724573-501	CAPACITOR ASSEMBLY
	205656	1510003-037	CER.DISC., 10,000 PF 500V, CAPACITOR ONLY
HR1	248721	3730501-011	HEATER - BLOWER, THERMAL OVERLOAD
HR2	248721	3730501-011	HEATER - BLOWER, THERMAL OVERLOAD
M2	230797	993053-175	METER - AURAL PA PLATE, 5000 V
			TT-25FL Power Determining Kit MI-561272
			M/L 3724598-502 REV 2
C2		3724573-501	CAPACITOR ASSEMBLY
	205656	1510003-037	CER.DISC., 10,000 PF 500V, CAPACITOR ONLY
HR1	424450	3730501-019	HEATER - BLOWER, THERMAL OVERLOAD
HR2	424450	3730501-019	HEATER - BLOWER, THERMAL OVERLOAD
M2	229784	993053-176	METER - AURAL PA PLATE, 8000 V
			Neon Ballast PWB (2A1)
			ML 3459918-501 REV 1
R201			
TO			
R212	502333	82283-080	33,000 OHMS 10% 1/2 W

Symbol	Stock No.	Drawing No.	Description
			Fault Indicator Switching PWB (2A2,2A3)
			ML 3459919-501 REV 1
C101 TO C110	205656	1510003-037	CERAMIC, .01 MF 500 V
Q101 TO Q110	247582	3730560-001	TRANSISTOR - SCR - 2N3528
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R101	502310	82283-074	10,000 OHMS 1/2 W
R102	512215	90496-064	1500 OHMS 10% 1 W
R103	502310	82283-074	10,000 OHMS 1/2 W
R104	512215	90496-064	1500 OHMS 10% 1 W
R105	502310	82283-074	10,000 OHMS 1/2 W
R106	512215	90496-064	1500 OHMS 10% 1 W
R107	502310	82283-074	10,000 OHMS 1/2 W
R108	512215	90496-064	1500 OHMS 10% 1 W
R109	502310	82283-074	10,000 OHMS 1/2 W
R110	512215	90496-064	1500 OHMS 10% 1 W
R111	502310	82283-074	10,000 OHMS 1/2 W
R112	512215	90496-064	1500 OHMS 10% 1 W
R113	502310	82283-074	10,000 OHMS 1/2 W
R114	512215	90496-064	1500 OHMS 10% 1 W
R115	502310	82283-074	10,000 OHMS 1/2 W
R116	512215	90496-064	1500 OHMS 10% 1 W
R117	502310	82283-074	10,000 OHMS 1/2 W
R118	512215	90496-064	1500 OHMS 10% 1 W
R119	502310	82283-074	10,000 OHMS 1/2 W
R120	512215	90496-064	1500 OHMS 10% 1 W
			Power Supply MI-561341A (2A4)
			M/L 3730522-001
			CAPACITORS
C1	247657		0.15 MFD 200 V
C2	243854		.047 MFD 200 V
C3	247659		20 MFD 150 V
C4	230235		3.3 MFD 35 V
C5	247658		0.22 MFD 200 V
C6	246593		20,000 MFD 35 V
C7	246594		5000 MFD 50 V
CR2	235220		DIODE - TYPE 366D, SILICON RECTIFIER
CR4	235220		DIODE - TYPE 366D, SILICON RECTIFIER
CR5	257264		DIODE - TYPE 1N759, ZENER, 12 V
CR6	217784		DIODE - TYPE 1N645, SILICON RECTIFIER
CR7	235996		DIODE - TYPE 1N708A, ZENER 5.6 V
CR8	217784		DIODE - TYPE 1N645, SILICON RECTIFIER
F1	12958		FUSE - 6 AMP
Q1	235136		TRANSISTOR - TYPE 2N1671B
Q2	231379		TRANSISTOR - TYPE 2N2349
Q3	231379		TRANSISTOR - TYPE 2N2349
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1	522182		820 OHMS 10% 2 W
R2	502210		1000 OHMS 10% 1/2 W
R4	502115		150 OHMS 10% 1/2 W
R5	502339		39,000 OHMS 10% 1/2 W
R6	428011		WIREWOUND, 4000 OHMS 5% 2 W
R7	502127		270 OHMS 10% 1/2 W

Symbol	Stock No.	Drawing No.	Description
R8	502282		8200 OHMS 10% 1/2 W
R9	502212		1200 OHMS 10% 1/2 W
R10	502222		2200 OHMS 10% 1/2 W
R11	502256		5600 OHMS 10% 1/2 W
R12	247660		WIREWOUND, POT 5000 OHMS
R13	225733		WIREWOUND, 1000 OHMS 5% 2 W
R14	502110		100 OHMS 10% 1/2 W
R15	225733		WIREWOUND, 1000 OHMS 5% 2 W
R16	502110		100 OHMS 10% 1/2 W
R17	522168		680 OHMS 10% 2 W
SCR1	246595		RECTIFIER - SILICON CONT.
T1	246596		TRANSFORMER
			VSWR Protective Unit (2A5)
			M/L 3720545-501, 502 REV 6
C1	219195	993025-261	MICA, 1000 PF 10% 100 V
C2	219195	993025-261	MICA, 1000 PF 10% 100 V
C3 TO C6	235152	3720527-009	CERAMIC, 10,000 PF 150 V
C7	219195	993025-261	MICA, 1000 PF 10% 100 V
C8	219195	993025-261	MICA, 1000 PF 10% 100 V
C9 TO C12	235152	3720527-009	CERAMIC, 10,000 PF 150 V
C13 TO C22	243374	1215657-001	FEED THRU, 1000 PF 500 V
CR1 TO CR4	227720	3720130-001	DIODE - TYPE 1N3254
J1	54890	1510013-161	CONNECTOR - BNC
J2	54890	1510013-161	CONNECTOR - BNC
J3	248724	8001556-002	CONNECTOR
K1	431260	3734114-001	RELAY
K2	431260	3734114-001	RELAY
PS1	248722	3732000-002	POWER SUPPLY
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1	236096	3720533-004	FILM, 27,400 OHMS 1% 1/4 W
R2	236087	3720533-003	FILM, 10,000 OHMS 1% 1/4 W
R3	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R4	428085	3721146-009	VARIABLE, 5000 OHMS 5% 1 W
R5	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R6	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R7	249112	3720533-002	FILM, 4990 OHMS 1% 1/4 W
R8	248720	3720533-001	FILM, 22.1 OHMS 1% 1/4 W
R9	236096	3720533-004	FILM, 27,400 OHMS 1% 1/4 W
R10	236087	3720533-003	FILM, 10,000 OHMS 1% 1/4 W
R11	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R12	428085	3721146-009	VARIABLE, 5000 OHMS 5% 1 W
R13	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R14	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R15	249112	3720533-002	FILM, 4990 OHMS 1% 1/4 W
R16	248720	3720533-001	FILM, 22.1 OHMS 1% 1/4 W
R17	502510	82283-231	1 MEG 5% 1/2W
R18	502510	82283-231	1 MEG 5% 1/2W
U1	248725	3720537-001	CIRCUIT-INTEGRATED - TYPE CA3033A
U2	248725	3720537-001	CIRCUIT-INTEGRATED - TYPE CA3033A
XU1	248723	3720534-001	SOCKET
XU2	248723	3720534-001	SOCKET
			TT-15FL Blower Unit MI-560869B (2B1)
		3746642-002	BLOWER
	424929	3746642-003	MOTOR

Symbol	Stock No.	Drawing No.	Description
	246264	3746642-004	MOUNT - SHOCK MOUNT
			TT-25FL Blower Unit MI-561274 (2B1)
		3724578-001	BLOWER
	427987	3724578-003	MOTOR
	246264	3724578-004	MOUNT - SHOCK MOUNT

Symbol	Stock No.	Drawing No.	Description
			Control Cabinet MI-560576
Electrical (Prefix 2)			M/L 3459833-501 REV 29
A1		3459918-501	PRINTED BOARD NEON BALLAST
A2		3459919-501	PRINTED BOARD FAULT INDICATOR SWITCHING
A3		3459919-501	PRINTED BOARD FAULT INDICATOR SWITCHING
A4		3730522-001	POWER SUPPLY - MI-561341A
A5		3720545-503	VSWR PROTECTIVE UNIT
B1			BLOWER - MI-560579
C1 TO			
C4	205656	1510003-037	CAPACITOR - CERAMIC, .01 UF, METER BYPASS
C5	418055	3455547-025	CAPACITOR - 1 UF 10% 440 VAC
DS1A/C			
TO			
DS8A/C	236278	3452325-015	LAMP INDICATOR
DS9A			
TO			
DS9L	207712	849546-025	LAMP - INDICATOR
DS10A			
TO			
DS10L	115929	872291-017	LAMP - INDICATOR, NEON
DS11A			
TO			
DS11L	207712	849546-025	LAMP - INDICATOR
F1 TO			
F9	426973	990157-008	FUSE - AC METERING, 1 AMP
F10	426973	990157-008	FUSE - INDICATORS, 1 AMP
F11	426968	990157-010	FUSE - TUNING MOTORS, 2 AMP
F12	426968	990157-010	FUSE - EXCITER CRYSTAL OVENS, 2 AMP
HR1	248721	3730501-011	HEATER - BLOWER, THERMAL OVERLOAD
HR2	248721	3730501-011	HEATER - BLOWER, THERMAL OVERLOAD
J1	230572	8490041-002	CONNECTOR
J2	230572	8490041-002	CONNECTOR
J3	230572	8490041-002	CONNECTOR
J4	246732	1510013-151	CONNECTOR - BNC
J5	246732	1510013-151	CONNECTOR - BNC
J6	246732	1510013-151	CONNECTOR - BNC
J7	246732	1510013-151	CONNECTOR - BNC
J8	246732	1510013-151	CONNECTOR - BNC
K1		3730692-501	CONTACTOR - MEMORY LATCH
	247415	8459831-001	RELAY
	247416	8459831-021	MEMORY LATCH
K2	247412	3730501-001	CONTACT - 3 PHASE
K3	247413	3730501-002	CONTACT - 3 PHASE
K4	247420	3459831-081	CONTACT - 2 POLE
K5	247418	3459831-061	CONTACTOR - SOLID STATE TIMING, ON DELAY
K6	247415	3459831-001	CONTACTOR - 4 POLE
K7		3730692-501	CONTACTOR - MEMORY LATCH
	247415	8459831-001	RELAY
	247416	8459831-021	MEMORY LATCH
K8	247414	3730501-003	CONTACTOR - 3 PHASE
K9	247415	3459831-001	CONTACTOR - 4 POLE
K10	247419	3459831-062	CONTACTOR - SOLID STATE TIMING, OFF DELAY
K11	247421	3459917-001	RELAY - INTERLOCK
K12	247414	3730501-003	CONTACTOR - 3 PHASE
K13	247413	3730501-002	CONTACTOR - 3 PHASE
K14	247415	3459831-001	CONTACTOR - 4 POLE
K15	210400	445100-005	RELAY - NOTCHING AND RESET
	212242	445100-011	COIL - OPERATING
	212241	445100-021	COIL - RELEASE
K16		3730691-501	RELAY - SOLID STATE TIMING ASSEMBLY
	247415	3459831-001	RELAY
	247417	3459831-041	RELAY - TIMER, 0.1 TO 30 SEC.
K17	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K18	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K19 TO			
K26	210404	754291-001	RELAY - ADJUSTABLE

Symbol	Stock No.	Drawing No.	Description
K27	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K28	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K29	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K30	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K31	247436	3731069-002	RELAY - TIME DELAY
K32	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K33	239680	8971187-006	RELAY - DPDT 10 A 120 VAC
K34	239680	8971187-006	RELAY - DPDT 10 A 120 VAC
K35	247415	3459831-001	RELAY-INTERLOCK AUX
M1	235857	993064-007	REFLECTOMETER
M2	230797	993053-175	METER - AUR PA PLATE
M3	229784	993053-176	METER - VIS PA PLATE
M4	420835	993058-116	METER - AC VOLTAGE
M5	229785	8489369-002	ELAPSED - TIME, INDICATOR
60P1	242444	3456541-001	CONNECTOR - MALE, BNC
60P2	242444	3456541-001	CONNECTOR - MALE, BNC
P1			PLUG - PART OF A1
P2			PLUG - PART OF A2
P3			PLUG - PART OF A3
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1 TO			
R8	230163	993007-086	WIREWOUND, 1800 OHMS 10% 5 W
R9			PART OF S27
R10	222928	8868256-082	VARIABLE, COMPOSTION, 1.0 MEGOHM 1/2 W
R11	234737	8868256-047	VARIABLE, COMPOSTION, 50,000 OHMS 1/2 W
R12	223725	8868256-050	VARIABLE, COMPOSITION, 500,000 OHMS 1/2 W
R13	512310	90496-074	10,000 OHMS 10% 1/2 W
R14	502447	82283-223	470,000 OHMS 5% 1/2 W
R15	502447	82283-223	470,000 OHMS 5% 1/2 W
R17	228997	8868256-044	VARIABLE, 5000 OHMS 1/2 W
R18	502510	82283-231	1 MEGOHM 1/2 W
R20A			PART OF S30
R20B			PART OF S30
R21	235877	990477-301	1000 OHMS 1% 1 W
S1	229798	8543376-001	SWITCH - PUSHBUTTON, TRANSMITTER OFF
S2	229798	8543376-001	SWITCH - PUSHBUTTON, TRANSMITTER ON
S5	229798	8543376-001	SWITCH - PUSHBUTTON, T.D. BYPASS
S6	229798	8543376-001	SWITCH - PUSHBUTTON, PLATE, ON
S7	229798	8543376-001	SWITCH - PUSHBUTTON, PLATE, OFF
S8	229798	8543376-001	SWITCH - PUSHBUTTON, O.L. RESET
S9	247495	8498764-006	SWITCH - AURAL EXCITATION
S10	247495	8498764-006	SWITCH - VISUAL EXCITATION
S11	247495	8498764-006	SWITCH - VIDEO GAIN
S12	247495	8498764-006	SWITCH - SYNC GAIN
S13	247495	8498764-006	SWITCH - PEDESTAL LEVEL
S14	230828	8498764-004	SWITCH - OVERLOAD SELECT
S15	230828	8498764-004	SWITCH - EXCITER TEST
S16	230828	8498764-004	SWITCH - INDICATORS
S17	427959	8498764-007	SWITCH - TUNING MOTORS
S18	230828	8498764-004	SWITCH - HIGH VOLTAGE DISABLE
S19	247425	3730502-003	CIRCUIT BREAKER LESS HEATERS - CONTROL
	233457		HEATER 2.8A
S20	247425	3730502-003	CIRCUIT BREAKER LESS HEATERS - 115V BUS
	233457		HEATER 2.8A
S21	247425	3730502-002	CIRCUIT BREAKER LESS HEATERS - MODULATOR

Symbol	Stock No.	Drawing No.	Description
	422033		HEATER 1.9A
S22	247425	3730502-002	CIRCUIT BREAKER LESS HEATERS - EXCITER
	422033		HEATER 1.9A
S23	247425	3730502-002	CIRCUIT BREAKER LESS HEATERS - 20W AMPL
	422033		HEATER 1.9A
S24	247425	3730502-004	CIRCUIT BREAKER LESS HEATERS - SCREEN SPLY
	422033		HEATER 1.9A
S25	420845	3730271-005	CIRCUIT BREAKER - FILAMENT
S26	247430	8431807-006	SWITCH - METERING
S28	230770	8520610-002	SWITCH - PUSHBUTTON, RESET
S29	247495	8498764-006	SWITCH - AURAL SCREEN
S30	418045	3732079-001	SWITCH - TOTAL AURAL POWER
T1	247429	3730519-001	TRANSFORMER - CONTROL
T2	247428	3730518-001	TRANSFORMER - 115 V BUS
XDS1	418284	3455201-004	SOCKET - INDICATOR, LAMP
XDS2	418284	3455201-004	SOCKET - INDICATOR, LAMP
XDS3	236360	3455201-001	SOCKET - INDICATOR, LAMP
XDS4	236360	3455201-001	SOCKET - INDICATOR, LAMP
XDS5 TO XDS8	418284	3455201-004	SOCKET - INDICATOR, LAMP
XDS9	247434	3730503-001	STATUS INDICATOR - 12 POSITION
XDS10	247435	3730503-002	STATUS INDICATOR - 12 POSITION
XDS11	247434	3730503-001	STATUS INDICATOR - 12 POSITION
XFS1 TO XFS10	211618	8817617-001	SOCKET - FUSE
XFS11	419013	8817617-002	SOCKET - FUSE
XFS12	419013	8817617-002	SOCKET - FUSE
XK33	68590	99100-005	SOCKET - TUBE, OCTAL
XK34	68590	99100-005	SOCKET - TUBE, OCTAL
			M/L 3459833-502 REV 29
Electrical (Prefix 3)			
A1		3459918-501	PRINTED BOARD NEON BALLAST
A2		3459919-501	PRINTED BOARD FAULT INDICATOR SWITCHING
A3		3459919-501	PRINTED BOARD FAULT INDICATOR SWITCHING
A4		3730522-001	POWER SUPPLY
A5		3720545-503	VSWR PROTECTION UNIT
B1			BLOWER - MI-560579
C1	205656	1510003-037	CAPACITOR - CERAMIC, .01 UF, METER BYPASS
C2	205656	1510003-037	CAPACITOR - CERAMIC, .01 UF, METER BYPASS
C3	205656	1510003-037	CAPACITOR - CERAMIC, .01 UF, METER BYPASS
C5	418055	3455547-025	CAPACITOR - 1 UF 10% 440 VAC
DS1A/C TO DS8A/C	236278	3452325-015	LAMP - INDICATOR
DS9A TO DS9L	207712	849546-025	LAMP - INDICATOR
DS10A TO DS10L	115929	872291-017	LAMP - INDICATOR, NEON
DS11A TO DS11L	207712	849546-025	LAMP - INDICATOR
F1 TO F9	426973	990157-008	FUSE - AC METERING, 1 AMP
F10	426973	990157-008	FUSE - INDICATORS, 1 AMP
F11	426968	990157-010	FUSE - TUNING MOTORS, 2 AMP
F12	426968	990157-010	FUSE - EXCITER CRYSTAL OVENS, 2 AMPS
HR1	248721	3730501-011	HEATER - BLOWER, THERMAL OVERLOAD
HR2	248721	3730501-011	HEATER - BLOWER, THERMAL OVERLOAD
J1	230572	8490041-002	CONNECTOR
J2	230572	8490041-002	CONNECTOR
J3	230572	8490041-002	CONNECTOR
J4	246732	1510013-151	CONNECTOR - BNC
J5	246732	1510013-151	CONNECTOR - BNC

Symbol	Stock No.	Drawing No.	Description
J6	246732	1510013-151	CONNECTOR - BNC
J7	246732	1510013-151	CONNECTOR - BNC
J8	246732	1510013-151	CONNECTOR - BNC
K1		3730692-501	CONTACTOR - MEMORY LATCH
	247415	8459831-001	RELAY
	247416	8459831-021	MEMORY LATCH
K2	247412	3730501-001	CONTACT - 3 PHASE
K3	247413	3730501-002	CONTACT - 3 PHASE
K4	247420	3459831-081	CONTACT - 2 POLE
K5	247418	3459831-061	CONTACTOR - SOLID STATE TIMING, ON DELAY
K6	247415	3459831-001	CONTACTOR - 4 POLE
K7		3730692-501	CONTACTOR - MEMORY LATCH
	247415	8459831-001	RELAY
	247416	8459831-021	MEMORY LATCH
K8	247414	3730501-003	CONTACTOR - 3 PHASE
K9	247415	3459831-001	CONTACTOR - 4 POLE
K10	247419	3459831-062	CONTACTOR - SOLID STATE TIMING, OFF DELAY
K11	247421	3459917-001	RELAY - INTERLOCK
K12	247414	3730501-003	CONTACTOR - 3 PHASE
K13	247413	3730501-002	CONTACTOR - 3 PHASE
K14	247415	3459831-001	CONTACTOR - 4 POLE
K15	210400	445100-005	RELAY - NOTCHING AND RESET
	212242	445100-011	COIL - OPERATING
	212241	445100-021	COIL - RELEASE
K16		3730691-501	RELAY - SOLID STATE TIMING ASSEMBLY
	247415	3459831-001	RELAY
	247417	3459831-041	RELAY - TIMER, 0.1 TO 30 SEC.
K17	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K18	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K19 TO			
K26	210404	754291-001	RELAY - ADJUSTABLE
K27	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K28	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K29	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K30	247422	8494429-002	RELAY - CURRENT
	247423		COIL
	232566		CONTACT
	232567		CONTACT
K31	247436	3731069-002	RELAY - TIME DELAY
K32	248730	3459831-091	CONTACTOR - 4 POLE PHASE PROTECTION
K33	239680	8971187-006	RELAY - DPDT 10 A 120 VAC
K34	239680	8971187-006	RELAY - DPDT 10 A 120 VAC
K35	247415	3459831-001	RELAY-INTERLOCK AUX
M1	235857	993064-007	REFLECTOMETER
M2	230797	993053-175	METER - AUR PA PLATE
M3	229784	993053-176	METER - VIS PA PLATE
M5	229785	8489369-002	ELAPSED - TIME, INDICATOR
60P1	242444	3456541-001	CONNECTOR - MALE, BNC
60P2	242444	3456541-001	CONNECTOR - MALE, BNC
P1			PLUG - PART OF A1
P2			PLUG - PART OF A2
P3			PLUG - PART OF A3
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1 TO			
R8	230163	993007-086	WIREWOUND, 1800 OHMS 10% 5 W
R9			PART OF S27
R10	222928	8868256-082	VARIABLE, COMPOSITION, 1.0 MEGOHM 1/2 W
R11	234737	8868256-047	VARIABLE, COMPOSITION, 50,000 OHMS 1/2 W
R12	223725	8868256-050	VARIABLE COMPOSITION, 500,000 OHMS 1/2 W

Symbol	Stock No.	Drawing No.	Description
R13	512310	90496-074	COMPOSITION, 10,000 OHMS 10% 1 W
R14	502447	82283-223	470,000 OHMS 5% 1/2 W
R15	502447	82283-223	470,000 OHMS 5% 1/2 W
R17	228997	8868256-044	VARIABLE, 5000 OHMS 1/2 W
R18	502510	82283-231	1 MEGOHM 1/2 W
R20A			PART OF S30
R20B			PART OF S30
R21	235877	990477-301	1000 OHMS 1% 1 W
S1	229798	8543376-001	SWITCH - PUSHBUTTON, TRANSMITTER OFF
S2	229798	8543376-001	SWITCH - PUSHBUTTON, TRANSMITTER ON
S5	229798	8543376-001	SWITCH - PUSHBUTTON, T.D. BYPASS
S6	229798	8543376-001	SWITCH - PUSHBUTTON, PLATE, ON
S7	229798	8543376-001	SWITCH - PUSHBUTTON, PLATE, OFF
S8	229798	8543376-001	SWITCH - PUSHBUTTON, O.L. RESET
S9	247495	8498764-006	SWITCH - AURAL EXCITATION
S10	247495	8498764-006	SWITCH - VISUAL EXCITATION
S11	247495	8498764-006	SWITCH - VIDEO GAIN
S12	247495	8498764-006	SWITCH - SYNC GAIN
S13	247495	8498764-006	SWITCH - PEDESTAL LEVEL
S14	230828	8498764-004	SWITCH - OVERLOAD SELECT
S15	230828	8498764-004	SWITCH - EXCITER TEST
S16	230828	8498764-004	SWITCH - INDICATORS
S17	427959	8498764-007	SWITCH - TUNING MOTORS
S18	230828	8498764-004	SWITCH - HIGH VOLTAGE DISABLE
S19	247425 233457	3730502-003	CIRCUIT BREAKER LESS HEATERS - CONTROL HEATER 2.8A
S20	247425 233457	3730502-003	CIRCUIT BREAKER LESS HEATERS - 115V BUS HEATER 2.8A
S21	247425 422033	3730502-002	CIRCUIT BREAKER LESS HEATERS MODULATOR HEATER 1.9A
S22	247425 422033	3730502-002	CIRCUIT BREAKER LESS HEATERS - EXCITER HEATER 1.9A
S23	247425 422033	3730502-002	CIRCUIT BREAKER LESS HEATERS - 20W AMPL HEATER 1.9A
S24	247425 422033	3730502-504	CIRCUIT BREAKER LESS HEATERS - SCREEN SPLY HEATER 1.9A
S25	420845	3730271-005	CIRCUIT BREAKER - FILAMENT
S28	230770	8520610-002	SWITCH - PUSHBUTTON, RESET
S29	247495	8498764-006	SWITCH - AURAL SCREEN
S30	418045	3732079-001	SWITCH - TOTAL VISUAL POWER
T1	247429	3730519-001	TRANSFORMER - CONTROL
T2	247428	3730518-001	TRANSFORMER - 115 V BUS
XDS1	418284	3455201-004	SOCKET - INDICATOR, LAMP
XDS2	418284	3455201-004	SOCKET - INDICATOR, LAMP
XDS3	236360	3455201-001	SOCKET - INDICATOR, LAMP
XDS4	236360	3455201-001	SOCKET - INDICATOR, LAMP
XDS5 TO XDS8	418284	3455201-004	SOCKET - INDICATOR, LAMP
XDS9	247434	3730503-001	STATUS INDICATOR - 12 POSITION
XDS10	247435	3730503-002	STATUS INDICATOR - 12 POSITION
XDS11	247434	3730503-001	STATUS INDICATOR - 12 POSITION
XFS1 TO XFS10	211618	8817617-001	SOCKET - FUSE
XFS11	419013	8817617-002	SOCKET - FUSE
XFS12	419013	8817617-002	SOCKET - FUSE
XK33	68590	99100-005	SOCKET - TUBE, OCTAL
XK34	68590	99100-005	SOCKET - TUBE, OCTAL
			M/L 3459832-501 REV. 31
Mechanical			
66	426290	8522915-001	BARRIER - MOUNTING, SHORT
93	242872	1510032-029	GROMMET
79	418043	3720270-001	CARD GUIDE

Symbol	Stock No.	Drawing No.	Description
94	229166	1510032-011	GROMMET
103	231762	8540935-001	KEY
76	235859	3467690-502	KNOB ASSEMBLY
77	231058	8549962-501	KNOB ASSEMBLY
78	246730	8765773-508	KNOB ASSEMBLY
68	235853	8494089-053	SCREEN - DISPLAY TRANSMITTER OFF
69	231042	8494089-036	SCREEN - DISPLAY TRANSMITTER ON AIR ON
70	231045	8494089-034	SCREEN - DISPLAY FILAMENT ON
71	231046	8494089-035	SCREEN - DISPLAY INTERLOCKS
72	235854	8494089-054	SCREEN - DISPLAY PLATE READY T.D. BYPASS
73	229892	8494089-004	SCREEN - DISPLAY PLATE OFF
74	229893	8494089-005	SCREEN - DISPLAY PLATE ON
75	231044	8494089-032	SCREEN - DISPLAY OVERLAOD OL RESET
95	247431	3459920-001	SCREEN - DISPLAY
105	232819	8540937-016	SPRING - PRESSURE
82	231146	8544613-001	STUD
104	231766	8540937-013	TERMINAL
98	247445	3459814-001	TERMINAL BLOCK
			Neon Ballast PWB (2A1/3A1)
			ML 3459918-501 REV 1
R201 TO R212	502333	82283-080	33,000 OHMS 10% 1/2 W
			Fault Indicator Switching PWB (2A2/3A2, 2A3/3A3)
			ML 3459919-501 REV 1
C101 TO C110	205656	1510003-037	CERAMIC, .01 MF 500 V
Q101 TO Q110	247582	3730560-001	TRANSISTOR - SCR - 2N3528
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R101	502310	82283-074	10,000 OHMS 1/2 W
R102	512215	90496-064	1500 OHMS 10% 1 W
R103	502310	82283-074	10,000 OHMS 1/2 W
R104	512215	90496-064	1500 OHMS 10% 1 W
R105	502310	82283-074	10,000 OHMS 1/2 W
R106	512215	90496-064	1500 OHMS 10% 1 W
R107	502310	82283-074	10,000 OHMS 1/2 W
R108	512215	90496-064	1500 OHMS 10% 1 W
R109	502310	82283-074	10,000 OHMS 1/2 W
R110	512215	90496-064	1500 OHMS 10% 1 W
R111	502310	82283-074	10,000 OHMS 1/2 W
R112	512215	90496-064	1500 OHMS 10% 1 W
R113	502310	82283-074	10,000 OHMS 1/2 W
R114	512215	90496-064	1500 OHMS 10% 1 W
R115	502310	82283-074	10,000 OHMS 1/2 W
R116	512215	90496-064	1500 OHMS 10% 1 W
R117	502310	82283-074	10,000 OHMS 1/2 W
R118	512215	90496-064	1500 OHMS 10% 1 W
R119	502310	82283-074	10,000 OHMS 1/2 W
R120	512215	90496-064	1500 OHMS 10% 1 W
			Power Supply MI-561341A (2A4/3A4)
			M/L 3730522-001
			CAPACITORS
C1	247657		0.15 MFD 200 V

Symbol	Stock No.	Drawing No.	Description
C2	243854		.047 MFD 200 V
C3	247659		20 MFD 150 V
C4	230235		3.3 MFD 35 V
C5	247658		0.22 MFD 200 V
C6	246593		20,000 MFD 35 V
C7	246594		5000 MFD 50 V
CR2	235220		DIODE - TYPE 366D, SILICON RECTIFIER
CR4	235220		DIODE - TYPE 366D, SILICON RECTIFIER
CR5	249742		DIODE - TYPE 1N759, ZENER, 12 V
CR6	217784		DIODE - TYPE 1N645, SILICON RECTIFIER
CR7	235996		DIODE - TYPE 1N708A, ZENER 5.6 V
CR8	217784		DIODE - TYPE 1N645, SILICON RECTIFIER
F1	12958		FUSE - 6 AMP
Q1	235136		TRANSISTOR - TYPE 2N1671B
Q2	231379		TRANSISTOR - TYPE 2N2349
Q3	231379		TRANSISTOR - TYPE 2N2349
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1	522182		820 OHMS 10% 2 W
R2	502210		1000 OHMS 10% 1/2 W
R4	502115		150 OHMS 10% 1/2 W
R5	502339		39,000 OHMS 10% 1/2 W
R6	428011		WIREWOUND, 4000 OHMS 5% 2 W
R7	502127		270 OHMS 10% 1/2 W
R8	502282		8200 OHMS 10% 1/2 W
R9	502212		1200 OHMS 10% 1/2 W
R10	502222		2200 OHMS 10% 1/2 W
R11	502256		5600 OHMS 10% 1/2 W
R12	247660		WIREWOUND, POT 5000 OHMS
R13	225733		WIREWOUND, 1000 OHMS 5% 2 W
R14	502110		100 OHMS 10% 1/2 W
R15	225733		WIREWOUND, 1000 OHMS 5% 2 W
R16	502110		100 OHMS 10% 1/2 W
R17	522168		680 OHMS 10% 2 W
SCR1	246595		RECTIFIER - SILICON CONT.
T1	246596		TRANSFORMER
			VSWR Protective Unit (2A5/3A5)
			M/L 3720545-501-502 REV. 6
C1	219195	993025-261	MICA, 1000 PF 10% 100 V
C2	219195	993025-261	MICA, 1000 PF 10% 100 V
C3 TO C6	235152	3720527-009	CERAMIC, 10,000 PF 150 V
C7	219195	993025-261	MICA, 1000 PF 10% 100 V
C8	219195	993025-261	MICA, 1000 PF 10% 100 V
C9 TO C12	235152	3720527-009	CERAMIC, 10,000 PF 150 V
C13 TO C22	243374	1215657-001	FEED THRU, 1000 PF 500 V
CR1 TO CR4	227720	3720130-001	DIODE - TYPE 1N3254
J1	54890	1510013-161	CONNECTOR - BNC
J2	54890	1510013-161	CONNECTOR - BNC
J3	248724	8001556-002	CONNECTOR
K1	431260	3734114-001	RELAY
K2	431260	3734114-001	RELAY
PS1	248722	3732000-002	POWER SUPPLY
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1	236096	3720533-004	FILM, 27,400 OHMS 1% 1/4 W
R2	236087	3720533-003	FILM, 10,000 OHMS 1% 1/4 W
R3	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R4	428085	3721146-009	VARIABLE, 5000 OHMS 5% 1 W

Symbol	Stock No.	Drawing No.	Description
R5	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R6	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R7	249112	3720533-002	FILM, 4990 OHMS 1% 1/4 W
R8	248720	3720533-001	FILM, 22.1 OHMS 1% 1/4 W
R9	236096	3720533-004	FILM, 27,400 OHMS 1% 1/4 W
R10	236087	3720533-003	FILM, 10,000 OHMS 1% 1/4 W
R11	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R12	428085	3721146-009	VARIABLE, 5000 OHMS 5% 1 W
R13	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R14	236097	3720533-005	FILM, 39,200 OHMS 1% 1/4 W
R15	249112	3720533-002	FILM, 4990 OHMS 1% 1/4 W
R16	248720	3720533-001	FILM, 22.1 OHMS 1% 1/4 W
R17	502510	82283-231	COMPOSITION, 1 MEGOHM 5% 1/2W
R18	502510	82283-231	COMPOSITION, 1 MEGOHM 5% 1/2W
U1	248725	3720537-001	CIRCUIT - INTEGRATED
U2	248725	3720537-001	CIRCUIT - INTEGRATED
XU1	248723	3720534-001	SOCKET
XU2	248723	3720534-001	SOCKET
			Blower Unit MI-560579A (2B1, belt-drive)
			Blower Unit MI-560579B (3B1, belt-drive)
			ML-3469668-1 AND -10 REV 3
	246271	3469668-009	BEARING
	246269	3469668-007	BELT - 0 TO 2500 FT. ELEV.
	246270	3469668-008	BELT - 5000 TO 7500 FT. ELEV.
	246265	3469668-003	MOTOR - 1 1/2 HP, 230/240 V 60 CYC 3 PHASE
	246264	3469668-002	MOUNT - SHOCK
	246266	3469668-004	PULLEY - FAN
	246267	3469668-005	PULLEY - MOTOR, 0 TO 2500 FT. ELEV.
	246268	3469668-006	PULLEY - MOTOR, 5000 TO 7500 FT. ELEV.
			Blower Unit MI-560869B (2B1, direct-drive)
		3746642-002	BLOWER
	424929	3746642-003	MOTOR
	246264	3746642-004	MOUNT - SHOCK MOUNT
			Blower Unit MI-560869A (3B1, direct-drive)
		3746642-001	BLOWER
	424929	3746642-003	MOTOR
	246264	3746642-004	MOUNT - SHOCK MOUNT
			RF and Exciter Switching Panel
Electrical (Prefix 70)			M/L 3720375-501 REV 11
A1 TO A4	247856	3720282-001	OPERATIONAL AMPLIFIER
A5 TO A8	247864	3720317-001	MAGSENSE COMPARATOR
C1	224570	3456811-002	CERAMIC, .01 MFD 50 V
C2	227444	3720316-004	CERAMIC, 0.1 MFD 25 V
C3	231320	8539054-002	FEED THRU, .001 MFD 500 V
C4	231320	8539054-002	FEED THRU, .001 MFD 500 V
C5	231320	8539054-002	FEED THRU, .001 MFD 500 V
C6	224570	3456811-002	CERAMIC, .01 MFD 50 V
C7	227444	3720316-004	CERAMIC, 0.1 MFD 25 V
C8	231320	8539054-002	FEED THRU, .001 MFD 500 V
C9	224570	3456811-002	CERAMIC, .01 MFD 50 V
C10	227444	3720316-004	CERAMIC, 0.1 MFD 25 V
C11	231320	8539054-002	FEED THRU, .001 MFD 500 V

Symbol	Stock No.	Drawing No.	Description
C12	224570	3456811-002	CERAMIC, .01 MFD 50 V
C13	227444	3720316-004	CERAMIC, 0.1 MFD 25 V
C14	231320	8539054-002	FEED THRU, .001 MFD 500 V
C15	231320	8539054-002	FEED THRU, .001 MFD 500 V
C17	245996	3410170-560	ELECTROLYTIC, 20 MFD 50 V
C18	245996	3410170-560	ELECTROLYTIC, 20 MFD 50 V
C19	235500	3450155-005	CERAMIC, .05 MF 100 V
CR1			
TO			
CR4	236715	3454179-001	DIODE - TYPE 1N914
CR5	247855	3720312-002	DIODE - ZENER, 12 VOLT 5%
CR6	247854	3720312-001	DIODE - ZENER, 22 VOLT 5%
CR7	424281	3724498-019	DIODE - TYPE SCPA1M
DS1A	236278	3452325-015	LAMP - AUTOMATIC
DS1C	236278	3452325-015	LAMP - AUTOMATIC
DS2A	236278	3452325-015	LAMP MANUAL
DS2C	236278	3452325-015	LAMP MANUAL
DS3A	236278	3452325-015	LAMP EXCITER A
DS3C	236278	3452325-015	LAMP EXCITER A
DS4A	236278	3452325-015	LAMP EXCITER B
DS4C	236278	3452325-015	LAMP EXCITER B
DS5A	236278	3452325-015	LAMP A/B PARALLEL
DS5C	236278	3452325-015	LAMP A/B PARALLEL
DS6A	236278	3452325-015	LAMP A AIR B TEST
DS6C	236278	3452325-015	LAMP A AIR B TEST
DS7A	236278	3452325-015	LAMP B AIR A TEST
DS7C	236278	3452325-015	LAMP B AIR A TEST
J1			
TO			
J8	246732	1510013-151	CONNECTOR - BNC
J9			
TO			
J12			CONNECTOR - PART OF K15
J13			
TO			
J16			CONNECTOR - PART OF Z3
J17			CONNECTOR - PART OF Z1
J18			CONNECTOR - PART OF Z1
J19			CONNECTOR - PART OF Z2
J20			CONNECTOR - PART OF Z2
J21			
TO			
J24			CONNECTOR - PART OF Z4
J25			
TO			
J28			CONNECTOR - PART OF K16
J29			
TO			
J32	247853	3720293-001	JACK - AUDIO
J33	211510	481799-002	CONNECTOR - AUDIO
J34	211510	481799-002	CONNECTOR - AUDIO
J35	211510	481799-002	CONNECTOR - AUDIO
J36			
TO			
J39	234087	3463371-002	CONNECTOR - PRINTED CIRCUIT BOARD
J40	9915	3720291-001	CONNECTOR - POWER SUPPLY
K1	418006	3720289-002	RELAY - LATCHING
K2	418006	3720289-002	RELAY - LATCHING
K3			
TO			
K6	247851	3720231-001	RELAY - 3 PDT 24 V DC
K7	247850	3731069-001	RELAY - TIME DELAY
K8			COIL - PULL-IN, PART OF XDS5
K9			COIL - PULL-IN, PART OF XDS6
K10			COIL - PULL-IN, PART OF XDS7
K11	247850	3731069-001	RELAY - TIME DELAY
K12	418572	3720489-004	RELAY - 6 PST 115 VAC
K13	418572	3720489-004	RELAY - 6 PST 115 VAC
K14	418572	3720489-004	RELAY - 6 PST 115 VAC
K15		3732671-002	RELAY - COAX VISUAL

Symbol	Stock No.	Drawing No.	Description
K16		3732671-002	RELAY - COAX VISUAL
K17	241680	3720230-001	RELAY - 4 PDT
K18	241680	3720230-001	RELAY - 4 PDT
K19	247841	3720305-003	RELAY - 2 PDT
PS1	247865	3720279-001	POWER SUPPLY
P1			
TO			
P11			CONNECTOR - PART OF CABLE ASSEMBLY
P12			CONNECTOR - PART OF R56
P13			CONNECTOR - PART OF CABLE ASSEMBLY
P14			CONNECTOR - PART OF R54
P15			
TO			
P21			CONNECTOR - PART OF CABLE ASSEMBLY
P22			CONNECTOR - PART OF R55
P23			
TO			
P27			CONNECTOR - PART OF CABLE ASSEMBLY
P28			CONNECTOR - PART OF R57
P33			CONNECTOR - PART OF AUDIO CABLE ASSEMBLY
P35			CONNECTOR - PART OF AUDIO CABLE ASSEMBLY
P36			CONNECTOR - PART OF A5
P37			CONNECTOR - PART OF A6
P38			CONNECTOR - PART OF A7
P39			CONNECTOR - PART OF A8
P40			PLUG - PART OF PS1
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1	502218	82283-165	1800 OHMS 5% 1/2 W
R2	502312	82283-185	12,000 OHMS 5% 1/2 W
R3	234737	8868256-047	VARIABLE, 50,000 OHMS
R4	502022	82283-119	22 OHMS 5% 1/2 W
R5	502218	82283-165	1800 OHMS 5% 1/2 W
R6	502310	82283-183	10,000 OHMS 5% 1/2 W
R7	228997	8868256-044	VARIABLE, 5000 OHMS
R8	502218	82283-165	1800 OHMS 5% 1/2 W
R9	502312	82283-185	12,000 OHMS 5% 1/2 W
R10	234737	8868256-047	VARIABLE, 50,000 OHMS
R11	502022	82283-119	22 OHMS 5% 1/2 W
R12	502218	82283-165	1800 OHMS 5% 1/2 W
R13	502310	82283-183	10,000 OHMS 5% 1/2 W
R14	228997	8868256-044	VARIABLE, 5000 OHMS
R15	502218	82283-165	1800 OHMS 5% 1/2 W
R16	502312	82283-185	12,000 OHMS 5% 1/2 W
R17	234737	8868256-047	VARIABLE, 50,000 OHMS
R18	502022	82283-119	22 OHMS 5% 1/2 W
R19	502218	82283-165	1800 OHMS 5% 1/2 W
R20	502310	82283-183	10,000 OHMS 5% 1/2 W
R21	228997	8868256-044	VARIABLE, 5000 OHMS
R22	502218	82283-165	1800 OHMS 5% 1/2 W
R23	234737	8868256-047	VARIABLE, 50,000 OHMS
R24	502312	82283-185	12,000 OHMS 5% 1/2 W
R25	502022	82283-119	22 OHMS 5% 1/2 W
R26	502218	82283-165	1800 OHMS 5% 1/2 W
R27	502310	82283-183	10,000 OHMS 5% 1/2 W
R28	228997	8868256-044	VARIABLE, 5000 OHMS
R29	247848	3464766-005	WIREWOUND, 90 OHMS 12.5 W
R30	247847	3464766-004	WIREWOUND, 30 OHMS 12.5 W
R31	502412	82283-209	120,000 OHMS 5% 1/2 W
R32			
TO			
R38	230163	993007-086	WIREWOUND, 1800 OHMS 7 W
R39	502333	82283-195	33,000 OHMS 5% 1/2 W
R40	502024	82283-120	24 OHMS 5% 1/2 W
R41	502024	82283-120	24 OHMS 5% 1/2 W
R42			
TO			
R47	502075	82283-132	75 OHMS 5% 1/2 W
R48			

Symbol	Stock No.	Drawing No.	Description
TO			
R51	502024	82283-120	24 OHMS 5% 1/2 W
R52	502162	82283-154	620 OHMS 5% 1/2 W
R53	502162	82283-154	620 OHMS 5% 1/2 W
R54	247846	3720300-001	LOAD 50 OHM 5W MI-560576 ITEM 2
R55	247846	3720300-001	LOAD 50 OHM 5W MI-560576 ITEM 2
R56	247846	3720300-001	LOAD 50 OHM 5W
R57	247846	3720300-001	LOAD, 50 OHMS 5 W
R58			
TO			
R61	502318	82283-189	18,000 OHMS 5% 1/2 W
S1	231732	8522914-008	SWITCH - MANUAL
S2	231732	8522914-008	SWITCH - AUTOMATIC
S3	231732	8522914-008	SWITCH - EXCITER A
S4	231732	8522914-008	SWITCH - EXCITER B
S5	427509	8522914-003	SWITCH - A/B PARALLEL
S6	427509	8522914-003	SWITCH - A AIR B TEST
S7	427509	8522914-003	SWITCH - B AIR A TEST
XA1			
TO			
XA4	247845	3720232-001	SOCKET - OPERATIONAL AMP
XDS1	424409	3720274-101	INDICATOR - AUTOMATIC
XDS2	424409	3720274-101	INDICATOR - MANUAL
XDS3	424409	3720274-101	INDICATOR - EXCITER A
XDS4	424409	3720274-101	INDICATOR - EXCITER B
XDS5	424408	3720274-109	INDICATOR - A/B PARALLEL
XDS6	424408	3720274-109	INDICATOR - A AIR B TEST
XDS7	424408	3720274-109	INDICATOR - B AIR A TEST
XK3			
TO			
XK6	9915	3720291-001	SOCKET - RELAY, 11 PIN
XK7	247842	3720272-001	SOCKET - RELAY
XK11	247842	3720272-001	SOCKET - RELAY
XK12	248728	3720490-001	SOCKET - RELAY, 14 PIN
XK13	248728	3720490-001	SOCKET - RELAY, 14 PIN
XK14	248728	3720490-001	SOCKET - RELAY, 14 PIN
Z1	MI560462		PHASE SHIFTER - AURAL
Z2	MI560462		PHASE SHIFTER - VISUAL
Z3	MI560462		HYBRID COUPLER - AURAL
Z4	MI560462		HYBRID COUPLER - VISUAL
			ML/3720313-501 REV. 10
Mechnical			
27	239142	8547246-001	BARRIER - SPACING
48		3730232-501	CABLE ASSEMBLY
4	242444	3456541-001	CONNECTOR - BNC
5	246732	1510013-151	CONNECTOR - BNC
49		3730232-502	CABLE ASSEMBLY
4	242444	3456541-001	CONNECTOR - BNC
50		3730232-503	CABLE ASSEMBLY
4	242444	3456541-001	CONNECTOR - BNC
5	246732	1510013-151	CONNECTOR - BNC
51		3730232-504	CABLE ASSEMBLY
4	242444	3456541-001	CONNECTOR - BNC
52		3730232-505	CABLE ASSEMBLY
4	242444	3456541-001	CONNECTOR - BNC
5	246732	1510013-151	CONNECTOR - BNC
53		3730232-506	CABLE ASSEMBLY
4	242444	3456541-001	CONNECTOR - BNC
5	246732	1510013-151	CONNECTOR - BNC
54		3730232-507	CABLE ASSEMBLY
4	242444	3456541-001	CONNECTOR - BNC
55		3730232-508	CABLE ASSEMBLY
4	242444	3456541-001	CONNECTOR - BNC
5	246732	1510013-151	CONNECTOR - BNC
56		3730232-509	CABLE ASSEMBLY
4	242444	3456541-001	CONNECTOR - BNC
5	246732	1510013-151	CONNECTOR - BNC

Symbol	Stock No.	Drawing No.	Description
57		3730232-510	CABLE ASSEMBLY
	242444	3456541-001	CONNECTOR - BNC
58		3730232-511	CABLE ASSEMBLY
	242444	3456541-001	CONNECTOR - BNC
	246732	1510013-151	CONNECTOR - BNC
59		3730232-512	CABLE ASSEMBLY
	242444	3456541-001	CONNECTOR - BNC
	246732	1510013-151	CONNECTOR - BNC
41	247528	8811154-006	CLAMP - PLASTIC
42	213250	8811154-007	CLAMP - PLASTIC
71	242871	1510013-222	CONNECTOR - RIGHT ANGLE
24	418779	3740009-001	CONTACT, STICKY FINGER
25	418039	3740009-002	CONTACT, STICKY FINGER
29	247866	8494089-113	SCREEN - DISPLAY A/B PARALLEL
30	247867	8494089-114	SCREEN - DISPLAY A AIR B TEST
31	247868	8494089-115	SCREEN - DISPLAY B AIR A TEST
32	247869	8494089-116	SCREEN - DISPLAY AUTOMATIC
33	247870	8494089-117	SCREEN - DISPLAY MANUAL
34	247871	8494089-118	SCREEN - DISPLAY EXCITER A
35	247872	8494089-119	SCREEN - DISPLAY EXCITER B
			Exciter Switcher Assembly
			ML-3720271-501 REV 2
10	242882	1510032-004	GROMMET
11	239077	1510032-024	GROMMET

TABLE 1-1. SUMMARY OF RELAY FUNCTIONS

Relay (Note 1)	Control Functions	Supervisory Functions
K1 (C18-F12)	TX ON/OFF (memory-latch – Energizes grounding relay in P/S Cabinet	Extinguishes TX OFF indicator. Closes link in blower interlock. Closes link in LV interlock
K2 (E18-D20)	BLOWER – closes link in 230 Vac, 3-Ø, to blower	Closes link in filament interlock
K3 (G16-E20)	FILAMENTS – closes link in 230 Vac, 3-Ø, to filament regulation transformers in P/S Cabinet	Closes link in interlock to Modulator relay K8
K4 (B17)	FILAMENT INTERLOCK – (energized from filament voltage in P/S Cabinet) Energizes PLATE TD relay K5	Lights FILAMENT ON indicator Energizes FILAMENT HOURS indicator
K5 (F18)	PLATE TD ON – inhibits HV turn-on for 120 seconds to allow filament warm up	
K6 (F17)	PLATE TD AUX	Lights PLATE READY indicator and closes link in interlock to Plate Aux Relay K9
K7 (F14)	PLATE ON/OFF (memory latch)	Extinguishes PLATE OFF indicator. Closes link in interlock to Modulator relay K8. Closes link in LV interlock
K8 (G15-G20)	MODULATOR – closes link in 115 Vac to Modulator	Closes link in interlock to Plate Aux relay K9
K9 (G13)	PLATE AUX	Closes link to HV interlock relay in P/S Cabinet Lights PLATE ON indicator. Links VSWR protection into O/L protection
K10 (F17)	PLATE TD OFF – provides 4 sec. hold on HV circuits during short AC power interruptions	
K11 (F11)	MODULATOR INTERLOCK	Links Visual Modulator module interlocks to door interlocks
K12 (G12-G19)	LV – closes link in 115 Vac to screen p/s Energizes Surge Suppressor contactor Energizes Exciter Relay K13 when Exciter switch S15 is in NORMAL position	
K13 (E11-F19)	EXCITER – closes link in 115 Vac to Exciter and 20 W Amplifier sub-system	Lights EXCITER indicator on Amplifier Cabinet meter panel
K14 (C12)	OVERLOAD AUX – (energized by any of O/L relays)	Removes HV via K9. Breaks LV interlock. De-energizes Modulator relay K8. Connects self-sustain. Disables video clamp. Energizes O/L TD relay K16. Lights OVERLOAD indicator
K15 (D11)	O/L Notching Relay – Steps 1 & 2 (O/L Mode switch S14 in MULTIPLE position) Step 3	 Lights OVERLOAD indicator. Maintains break in LV interlock. Maintains K9 in de-energized state
K16 (C12)	O/L TD	Breaks self-sustain of K14 after 2 second delay
K17 (D20)	3-Ø Interlock	Monitors incoming AC Ø's. Closes a link in blower interlock
K18 (D19)	3-Ø interlock	Same as K17
K19 (B9)	AUR IPA CATH O/L	Note 2
K20 (B9)	AUR PA GRID O/L	Note 2

TABLE 1-1. SUMMARY OF RELAY FUNCTIONS (Continued)

Relay (Note 1)	Control Functions	Supervisory Functions
K21 (C9)	AUR PA CATH O/L	Note 2
K22 (E9)	VIS IPA CATH 1 O/L	Note 2
K23 (E9)	VIS IPA CATH 2 O/L	Note 2
K24 (F9)	VIS PA GRID O/L	Note 2
K25 (F9)	SPARE O/L	Note 2
K26 (G9)	LV DC O/L	Note 2
K27 (C9)	AC O/L	Note 2
K28 (C9)	AC O/L	Note 2
K29 (D9)	INTERMEDIATE HV DC O/L	Note 2
K30 (G9)	HV DC O/L	Note 2
K31 (D12)	CLAMP DISABLE TD	Enables Video clamp after a time delay of 2 seconds
K32 (C20)	3-Ø Interlock	Same as K17
K33 (D9)	VSWR Protection, Visual	Operates O/L circuits for high visual VSWR – Note 2
K34 (H9)	VSWR Protection, Aural	Operates O/L circuits for high aural VSWR – Note 2
K35 (F15)	Interlock Auxiliary	Links door interlocks into HV interlock system
Note 1.	The notation in parentheses under the relay number refers to the location of the relay on figure 1-17, Schematic, TT-15FL/25FL Control Cabinet. The schematic is shown with locating indexes for horizontal (letters) and vertical (numbers) coordinates. These location indexes are the same for RCA Drawing No. 3477485, Schematic Diagram, TT-15FL/25FL Control. See the text regarding the TT-30FL Control Cabinet schematic.	
Note 2.	Overload relays K19 thru K30 and VSWR protection relays K33 and K34 are energized by a fault in the circuits that they monitor. For a description of the overload function, refer to the text.	

TABLE 1-2. CONTROL SWITCHES AND CIRCUIT BREAKERS

Switch (Note 1)	Description	Function
S1 (B18)	TRANSMITTER OFF pushbutton indicator	Operates trip coil of memory-latch relay K1
S2 (B18)	TRANSMITTER ON/AIR ON push-button indicator	Operates latch coil of memory-latch relay K1
S5 (E17)	T.D. BYPASS pushbutton indicator	Bypasses contact of PLATE TD relay K5
S6 (B14)	PLATE OFF pushbutton indicator	Operates trip coil of memory-latch relay K7
S7 (B14)	PLATE ON pushbutton indicator	Operates latch coil of memory-latch relay K7
S8 (B11)	OVERLOAD RESET pushbutton indicator	Resets overload notch relay K15
S9 (A18)	AUR EXC rocker Switch	RAISE/LOWER, aural drive control motor, 20 W Ampl
S10 (A18)	VIS EXC rocker switch	RAISE/LOWER, aural drive control motor, 20 W Ampl
S11 (A18)	VID GAIN rocker switch	RAISE/LOWER, aural drive control motor, 20 W Ampl frame
S12 (A17)	SYNC GAIN rocker switch	RAISE/LOWER, visual drive control motor, 20 W Ampl frame
S13 (A17)	PED LEVEL rocker switch	RAISE/LOWER, pedestal level control motor, Visual Mod
S14 (C13)	O/L MODE rocker switch	Selects SINGLE or MULTIPLE overload mode
S15 (E11)	EXCITER rocker switch	Selects NORMAL or TEST Exciter operating mode
S16 (G18)	INDICATORS rocker switch	ON/OFF for meter panel indicators
S17 (A19)	TUNING MOTORS rocker switch	ON/OFF for tuning motors
S18 (G13)	HIGH VOLTAGE rocker switch	Selects NORMAL or DISABLE high voltage mode
S19 (D19)	CONTROL circuit breaker	ON/OFF for control distribution transformer T1
S20 (D19)	115 V BUS circuit breaker	ON/OFF for 115 Vac distribution transformer T2
S21 (G20)	MODULATOR circuit breaker	ON/OFF for 115 Vac to Visual Modulator
S22 (G19)	EXCITER circuit breaker	ON/OFF for 115 Vac to Exciter
S23 (G19)	20 W AMPL circuit breaker	ON/OFF for 115 Vac to 20 W Ampl
S24 (G19)	SCREEN SUPPLY circuit breaker	ON/OFF for 115 Vac to screen power supply
S25 (D20)	FILAMENTS circuit breaker	ON/OFF for 230 Vac, 3-Ø to regulation transformers T2, T3, & T4 in the P/S Cabinet
2S26 (–)	Metering switch, meter panel	Note 2
S28 (A8)	FAULT IND CANCEL pushbutton switch	Extinguishes fault indicator lamps if fault is cleared
S29 (A17)	AUR SCREEN rocker switch	RAISE/LOWER aural screen voltage control motor
2S30 (–)	Total Aural Power, meter panel, TT-30FL, prefix 2	Note 2
3S30 (–)	Total Visual Power, meter panel, TT-30FL, prefix 3	Note 2
Note 1.	The notation in parentheses under the switch number refers to the location of the switch on figure 1-17, Schematic, TT-15FL/25FL Control Cabinet. The schematic is shown with locating indexes for horizontal (letters) and vertical (numbers) coordinates.	
Note 2.	Switch 2S26 is located on the meter panels of all FL Control Cabinets; 2S30 and 3S30 are on the TT-30FL Control Cabinets only. Refer to the text for a description of their functions.	

TABLE 1-3. CONTROL AND DISTRIBUTION TRANSFORMER TAPS

Symbol	Input Terminals	Input Voltage	Output Terminals	Output Voltage
T1	H1-H2	230 V, 60 Hz	X1-X2	115 V, 60 Hz
T2	H1-H2	230 V, 60 Hz	X1-X2	110 V, 60 Hz
			X1-X3	120 V, 60 Hz

TABLE 1-4. OVERLOAD RELAY SETTINGS

Relay	Shunt	Circuit	Settings	
			TT-15FL/30FL	TT-25FL
K19	1R105	Aural IPA Cathode	0.8 A	0.8 A
K20	1R114	Aural PA Grid	0.6 A	0.6 A
K21	1R111	Aural PA Cathode	1.5 A	1.8 A
K22	—	Visual IPA Cathode 1	0.9 A	0.9 A
K23	—	Visual IPA Cathode 2	0.9 A	0.9 A
K24	1R305	Visual PA Grid	1.0 A	1.0 A
K25	—	Spare	—	—
K26	1R62	Low Voltage DC	200 mA	300 mA
K27*	—	Rectifier AC	2.75 A	4.5 A
K28*	—	Rectifier AC	2.75 A	4.5 A
K29*	5R20	Intermediate HV DC	5.0 A	5.0 A
K30*	5R4	High Voltage DC	8.0 A	8.0 A

*Relays K27 thru K30 are set with a calibrated plunger.

TABLE 1-5. FUSES

Symbol	Circuit	Fuse Size
F1 thru F9	Metering Circuits on Meter Panels	1 A
F10	Indicator Lamps	1 A
F11	Tuning Motors	2 A
F12	Crystal Heater Ovens	2 A
A4F1	28 Vdc Power Supply — output	6 A
A4F2	28 Vdc Power Supply — input (Not used in some units)	4 A

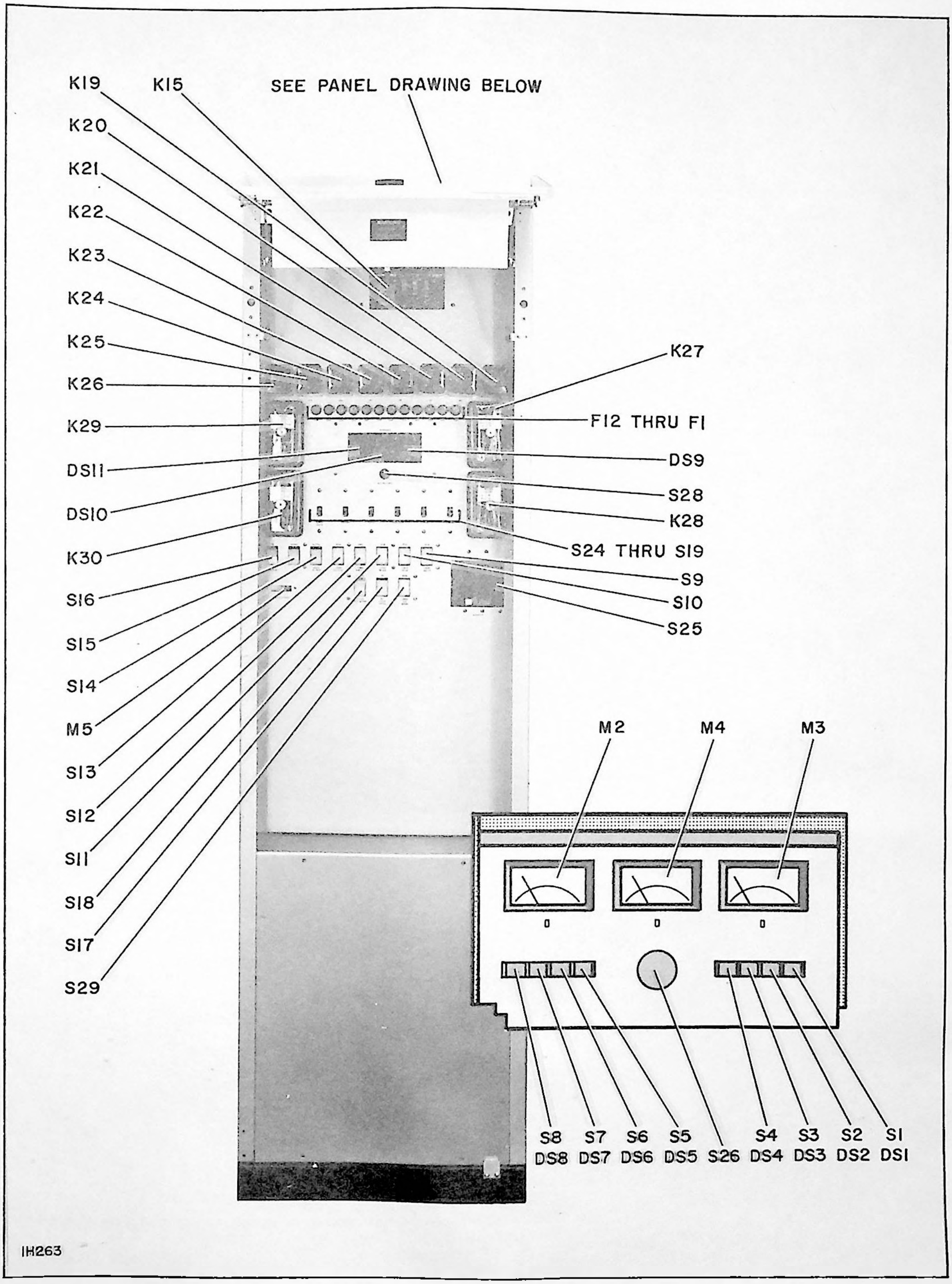
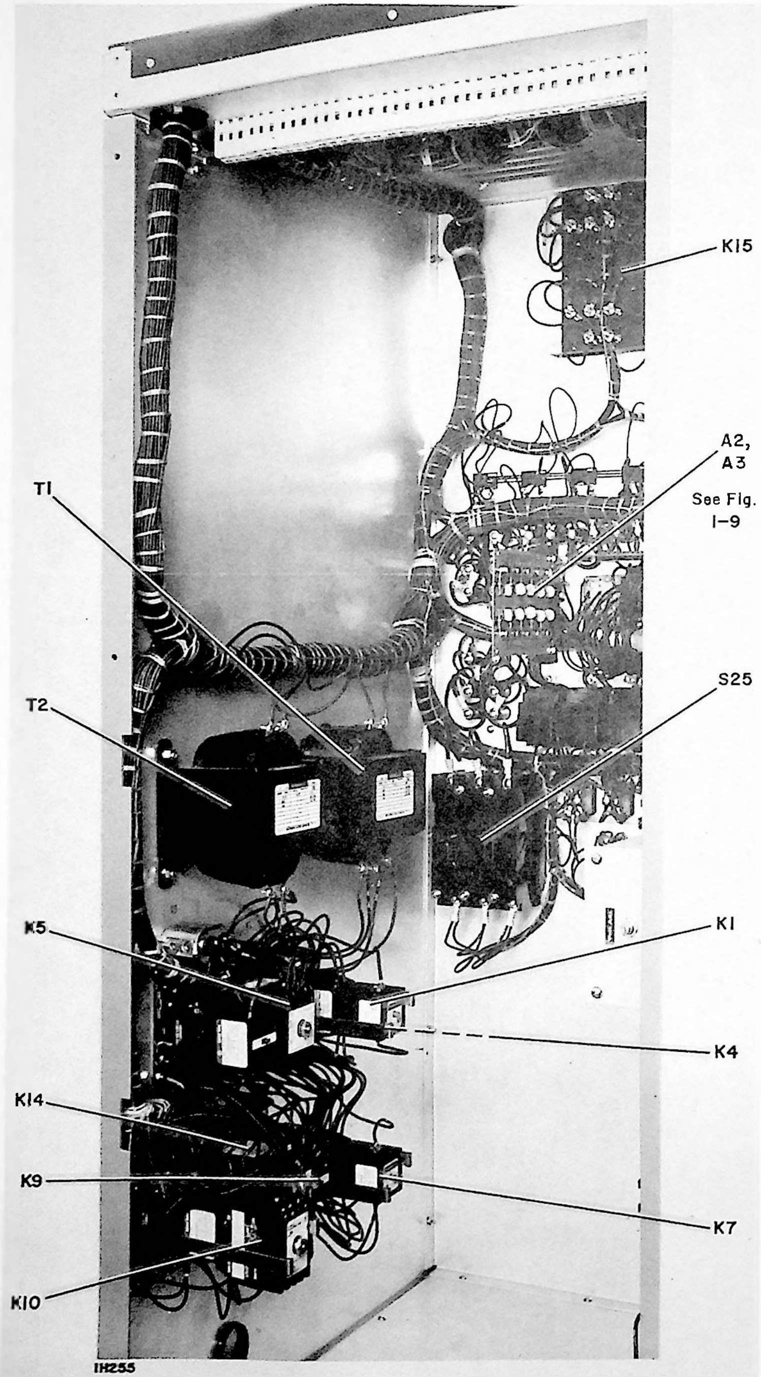
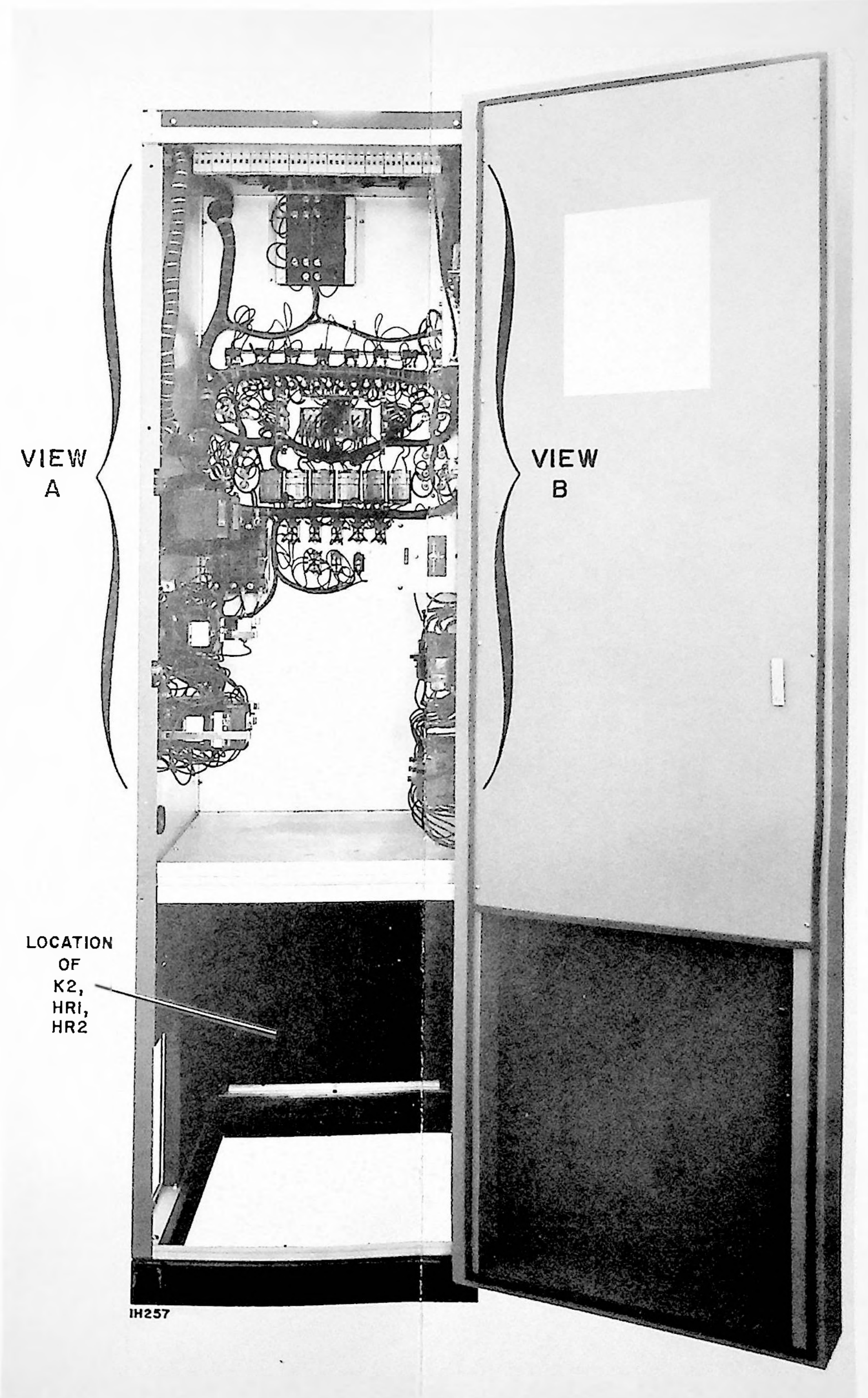
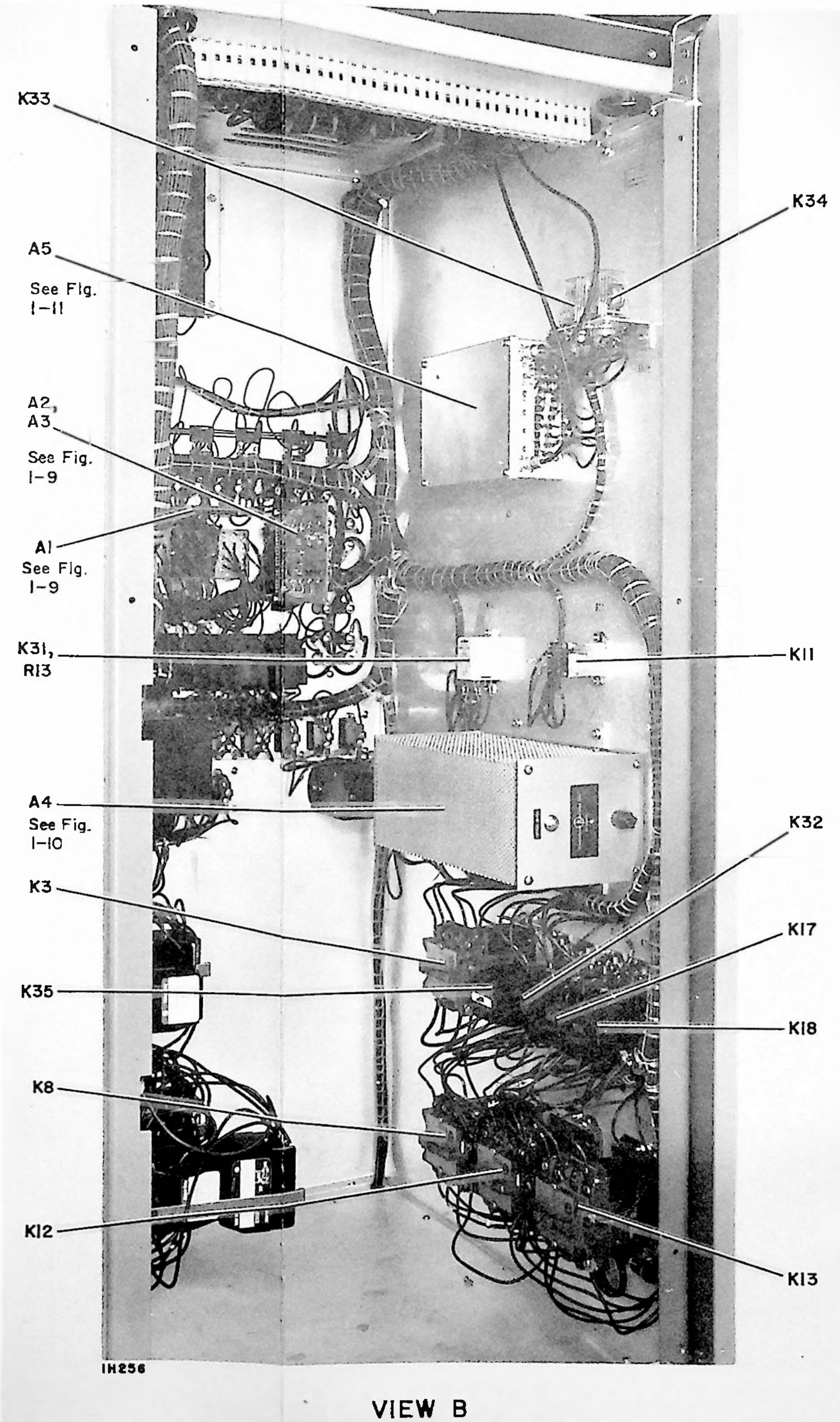


Figure 1-5. Front View, TT-15FL/25FL Control Cabinet


K15
A2,
A3
See Fig.
1-9
T1
S25
T2
K5
K1
K4
K14
K9
K7
K10
1H255

VIEW A


VIEW
A
VIEW
B
LOCATION
OF
K2,
HR1,
HR2
1H257



VIEW B

Figure 1-6. Rear View, TT-15FL/25FL Control Cabinet

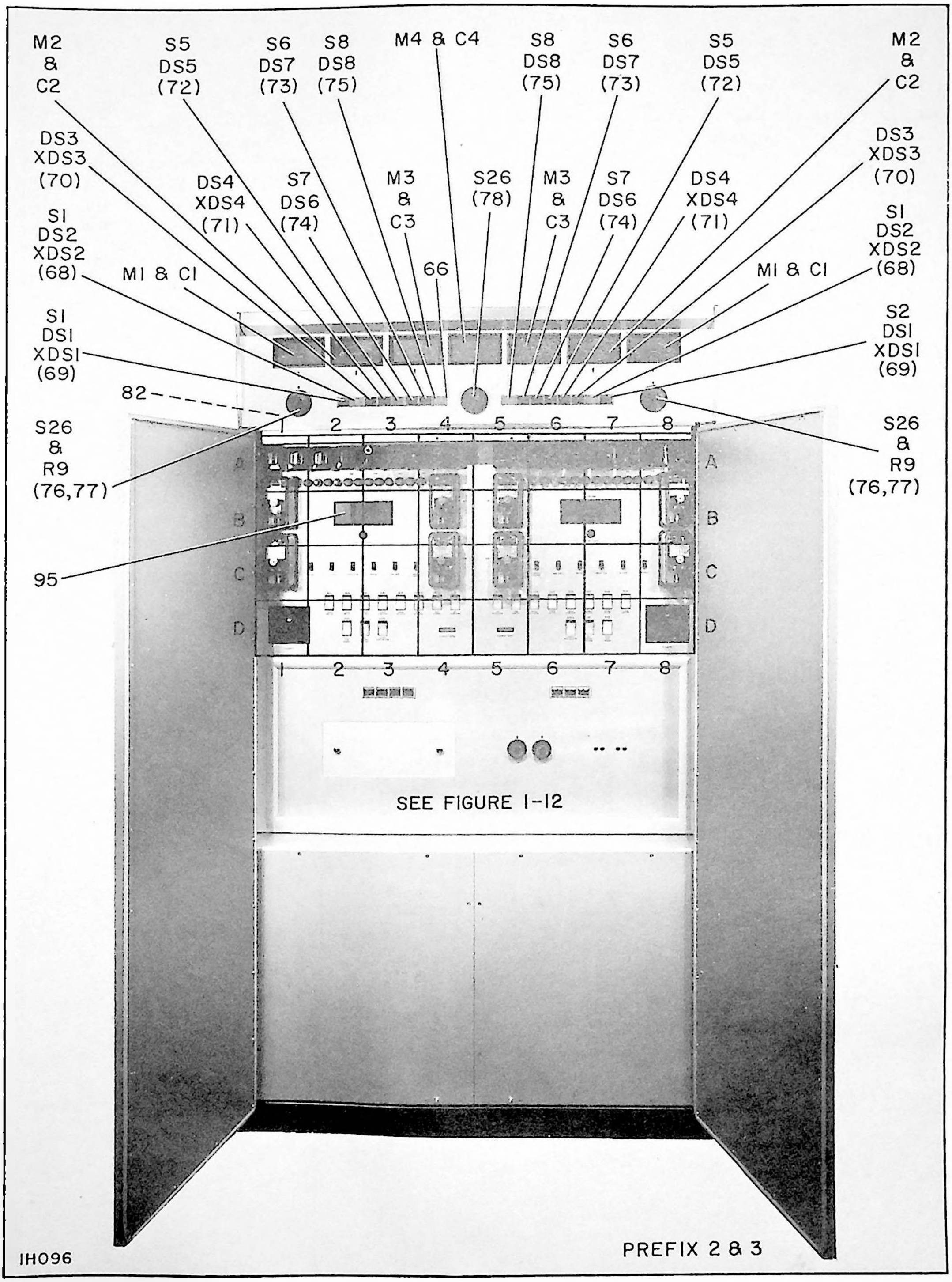


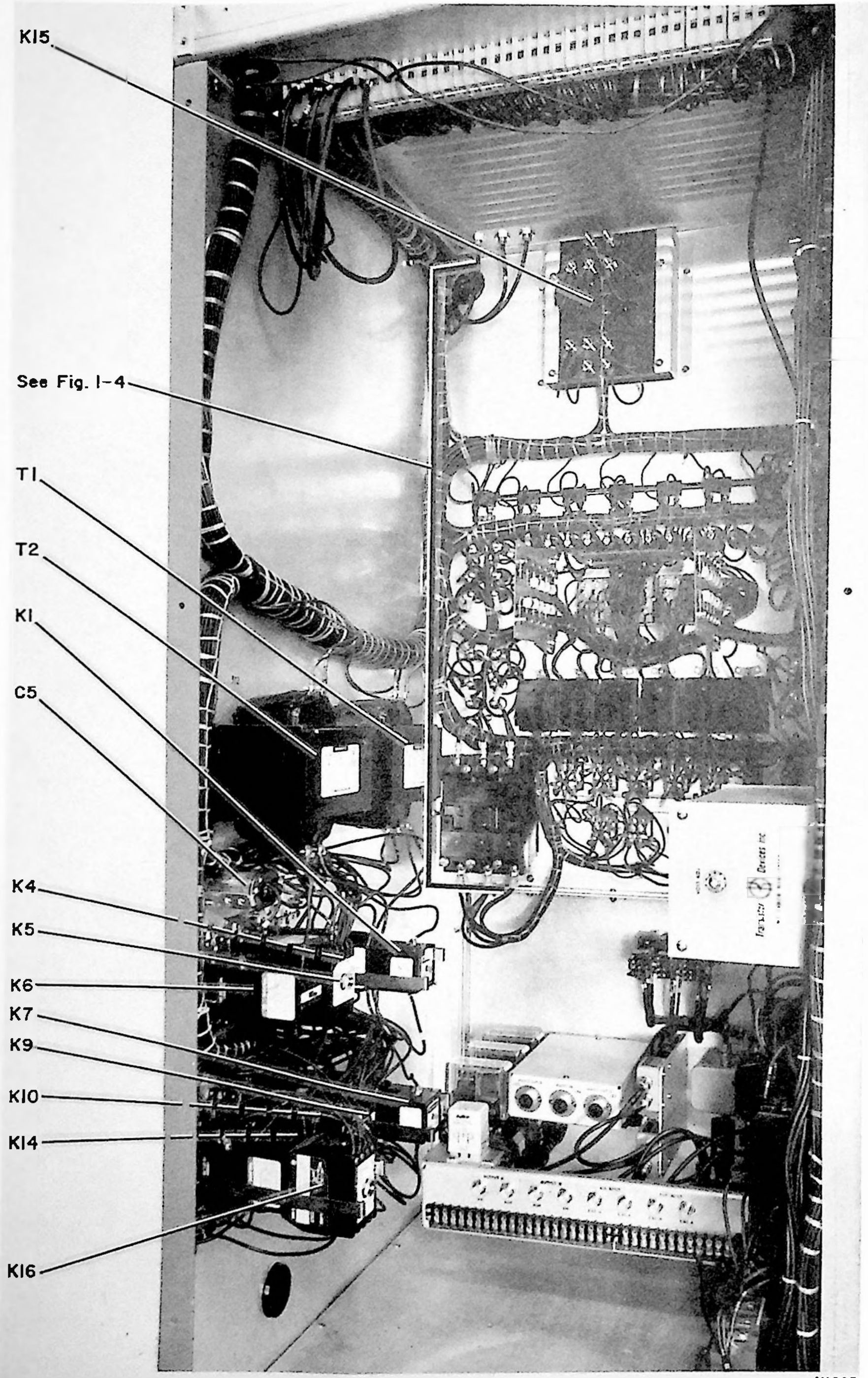
Figure 1-7. Front View, TT-30FL Control Cabinet (Sheet 1 of 2)

COMPONENT LOCATION TABLE

By Symbol	
F1 - A1	K30 - C5
F1 - A8	M5 - D4
F2 - A2	M5 - D5
F2 - A7	S9 - D2
F3 - A2	S9 - D7
F3 - A7	S10 - D2
F4 - A2	S10 - D7
F4 - A7	S11 - D3
F5 - A2	S11 - D7
F5 - A7	S12 - D3
F6 - A2	S12 - D6
F6 - A7	S13 - D3
F7 - A3	S13 - D6
F7 - A7	S14 - D4
F8 - A3	S14 - D6
F8 - A6	S15 - D4
F9 - A3	S15 - D5
F9 - A6	S16 - D4
F10 - A3	S16 - D5
F10 - A6	S17 - D3
F11 - A3	S17 - D7
F11 - A6	S18 - D3
F12 - A4	S18 - D7
F12 - A6	S19 - C2
K19 - A1	S19 - C8
K19 - A8	S20 - C2
K20 - A1	S20 - C7
K20 - A8	S21 - C2
K21 - A2	S21 - C7
K21 - A7	S22 - C3
K22 - A2	S22 - C6
K22 - A7	S23 - C3
K23 - A3	S23 - C6
K23 - A6	S24 - C3
K24 - A3	S24 - C6
K24 - A6	S25 - D1
K25 - A4	S25 - D8
K25 - A5	S28 - B3
K26 - A4	S28 - B7
K26 - A5	S29 - D2
K27 - B1	S29 - D7
K27 - B8	XDS9 - B2
K28 - C1	XDS9 - B7
K28 - C8	XDS10 - B2
K29 - B4	XDS10 - B7
K29 - B5	XDS11 - B3
K30 - C4	XDS11 - B6

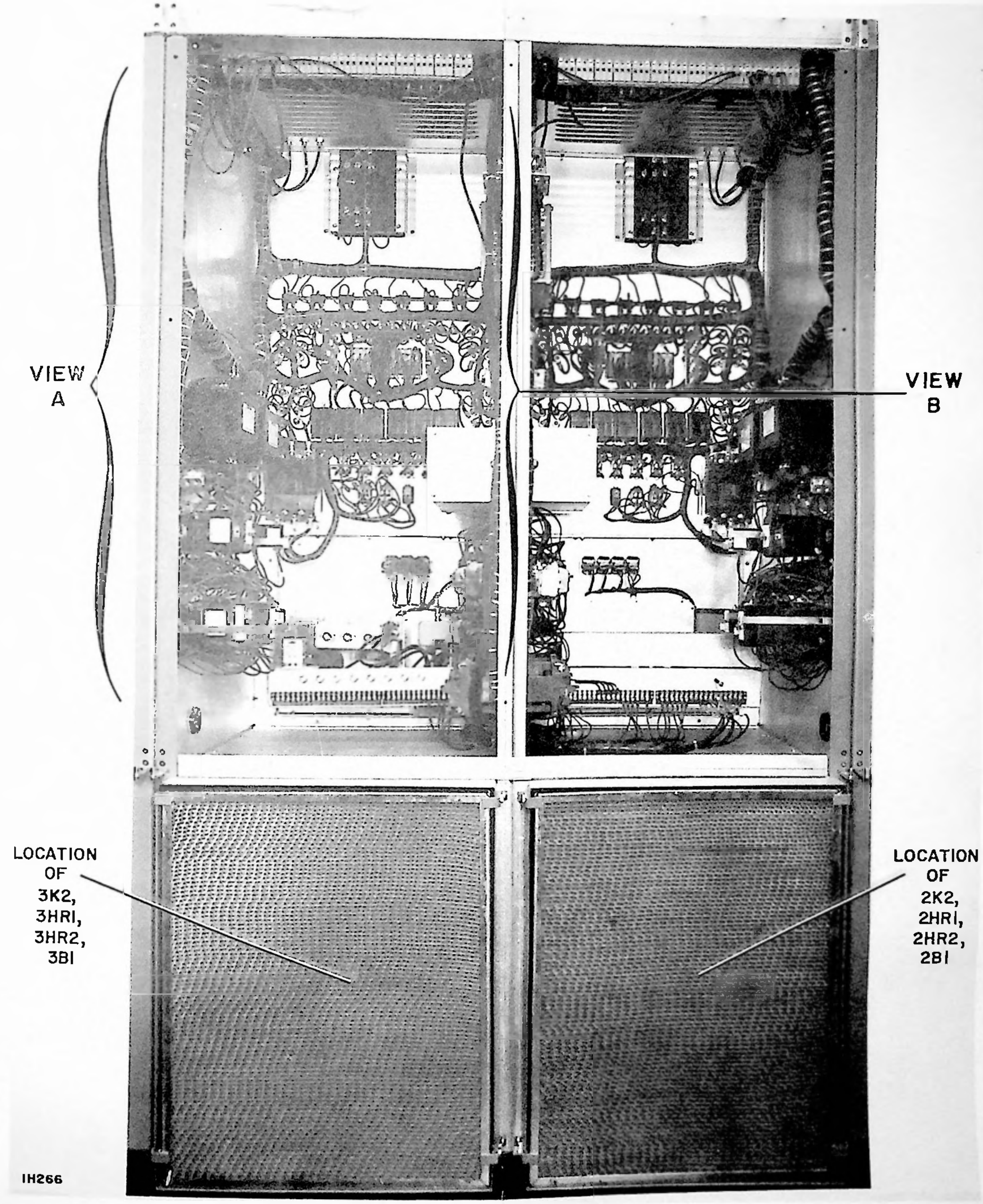
By Coordinate	
A1 - K19	B6 - XDS11
A1 - K20	B7 - XDS10
A1 - F1	B7 - XDS9
A2 - K21	B7 - S28
A2 - K22	B8 - K27
A2 - F2	C1 - K28
A2 - F3	C2 - S19
A2 - F4	C2 - S20
A2 - F5	C2 - S21
A2 - F6	C3 - S22
A3 - K23	C3 - S23
A3 - K24	C3 - S24
A3 - F7	C4 - K30
A3 - F8	C5 - K30
A3 - F9	C6 - S24
A3 - F10	C6 - S23
A3 - F11	C6 - S22
A4 - K25	C7 - S21
A4 - K26	C7 - S20
A4 - F12	C8 - S19
A5 - K26	C8 - K28
A5 - K25	D1 - S25
A6 - K24	D2 - S9
A6 - K23	D2 - S10
A6 - F12	D2 - S29
A6 - F11	D3 - S11
A6 - F10	D3 - S12
A6 - F9	D3 - S13
A6 - F8	D3 - S17
A7 - K22	D3 - S18
A7 - K21	D4 - S14
A7 - F7	D4 - S15
A7 - F6	D4 - S16
A7 - F5	D4 - M5
A7 - F4	D5 - S16
A7 - F3	D5 - S15
A7 - F2	D5 - M5
A8 - K20	D6 - S14
A8 - K19	D6 - S13
A8 - F1	D6 - S12
B1 - K27	D6 - S18
B2 - XDS9	D7 - S11
B2 - XDS10	D7 - S10
B3 - XDS11	D7 - S9
B3 - S28	D7 - S17
B4 - K29	D7 - S29
B5 - K29	D8 - S25

Figure 1-7. Front View, TT-30FL Control Cabinet (Sheet 2 of 2)

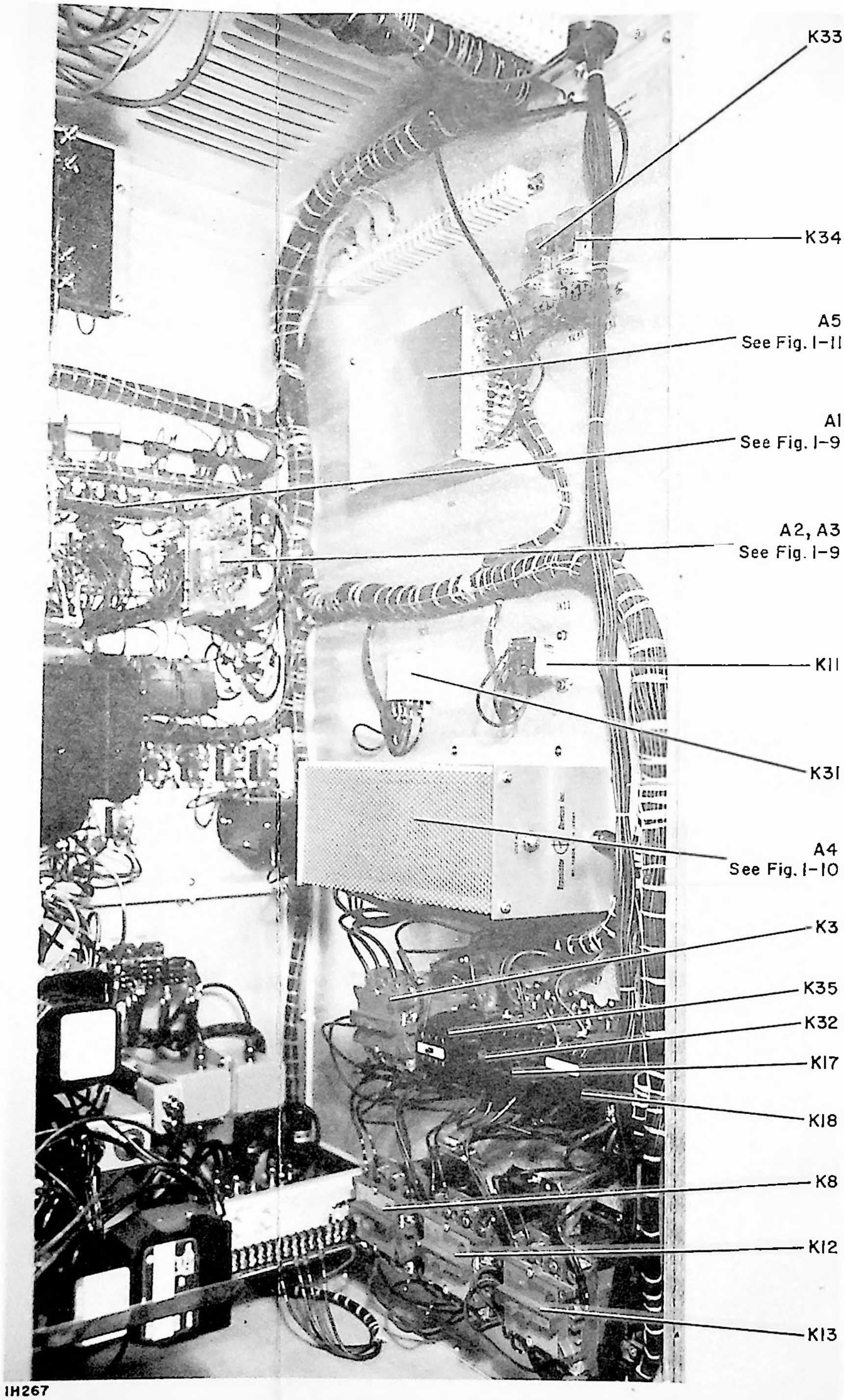


K15
See Fig. 1-4
T1
T2
K1
C5
K4
K5
K6
K7
K9
K10
K14
K16
1H265

VIEW A

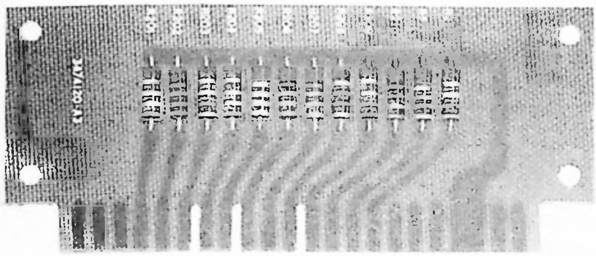


VIEW A
VIEW B
LOCATION OF 3K2, 3HR1, 3HR2, 3B1
LOCATION OF 2K2, 2HR1, 2HR2, 2B1
1H266

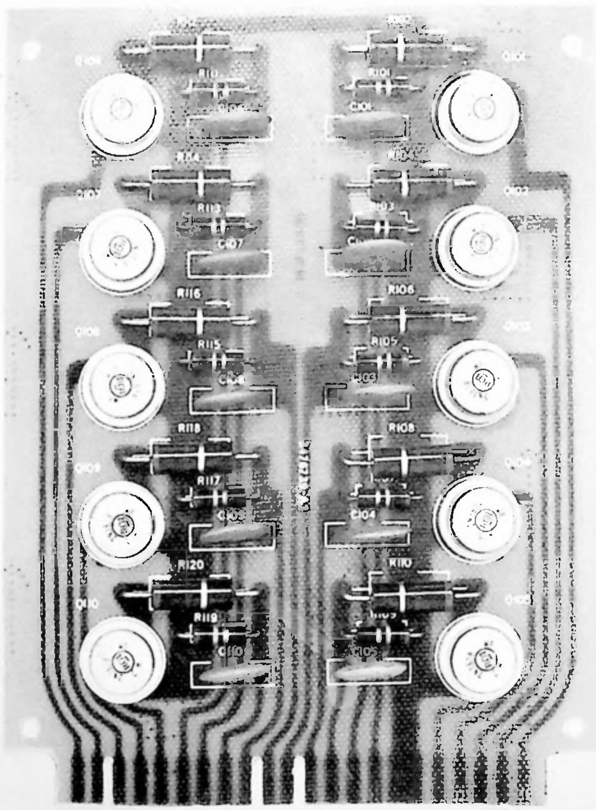


VIEW B

Figure 1-8. Rear View, TT-30FL Control Cabinet

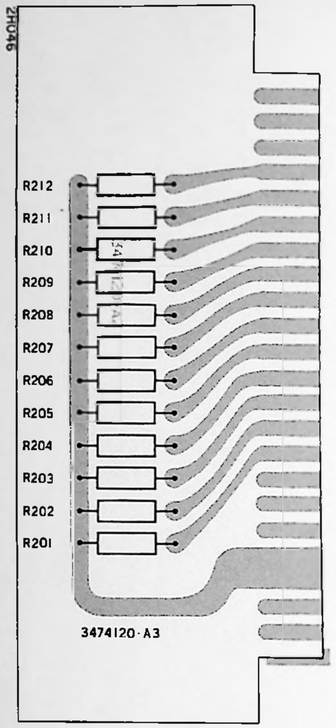


A1

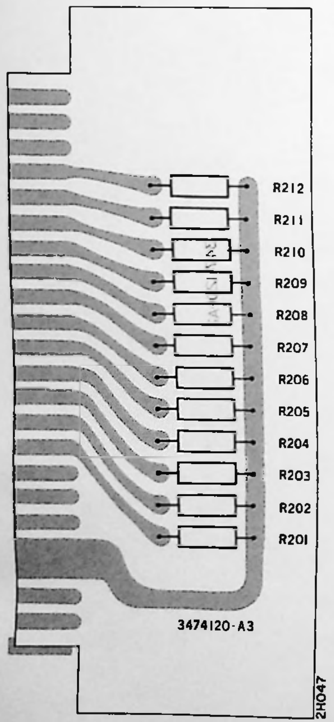


A2 / A3

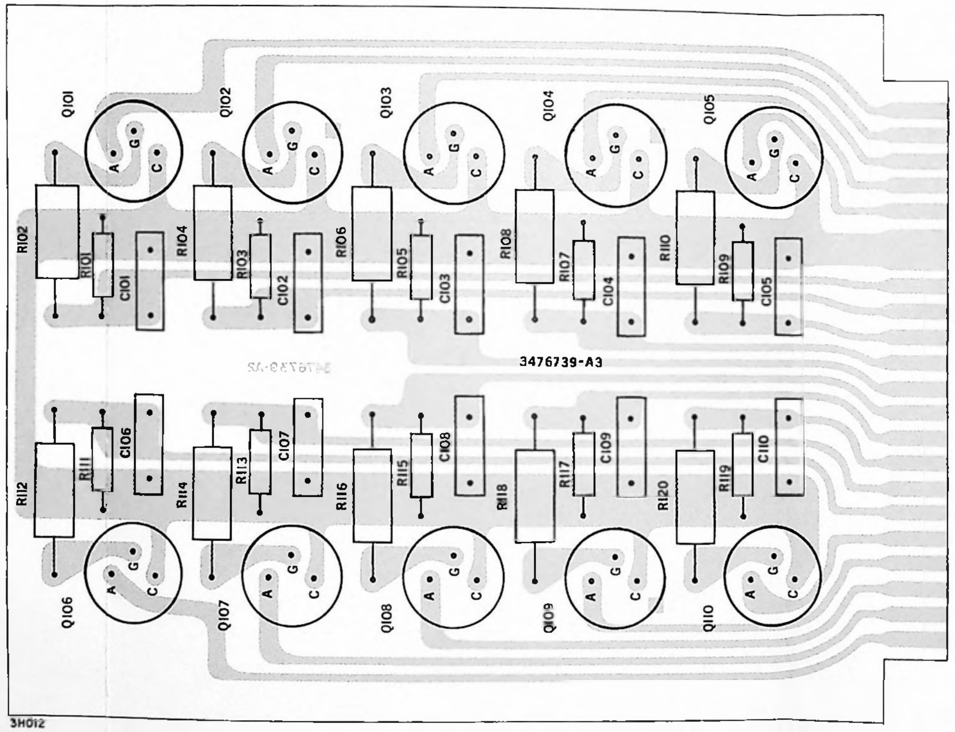
1H062



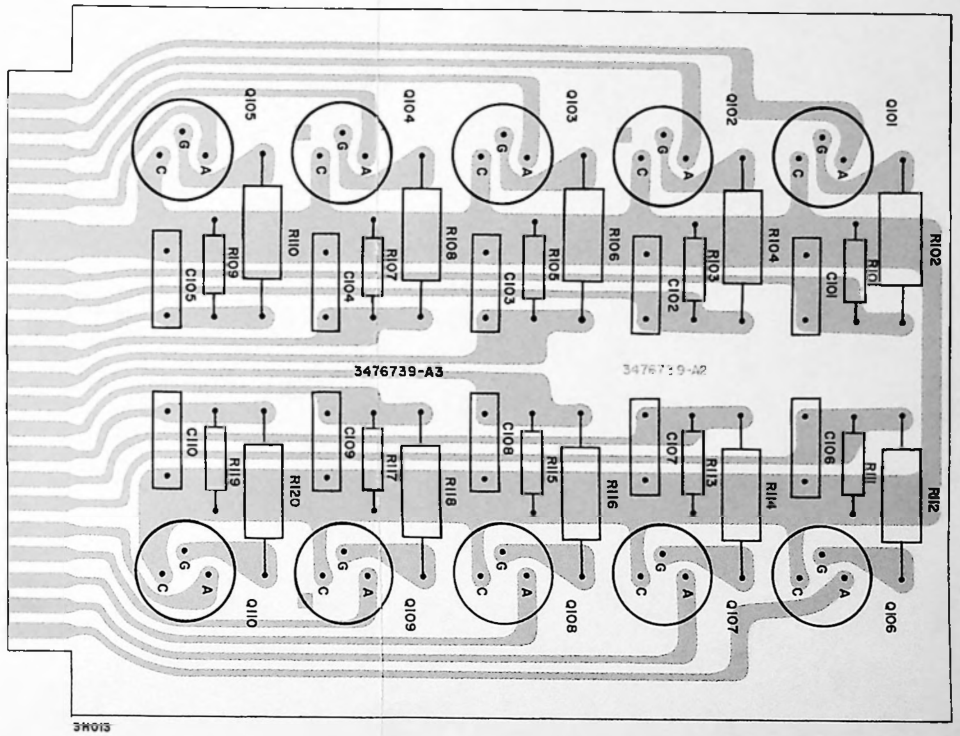
A1 — TOP VIEW



A1 — BOTTOM VIEW



A2/A3 — TOP VIEW



A2/A3 — BOTTOM VIEW

Figure 1-9. Printed Wiring Board Assemblies (A1, A2/A3)

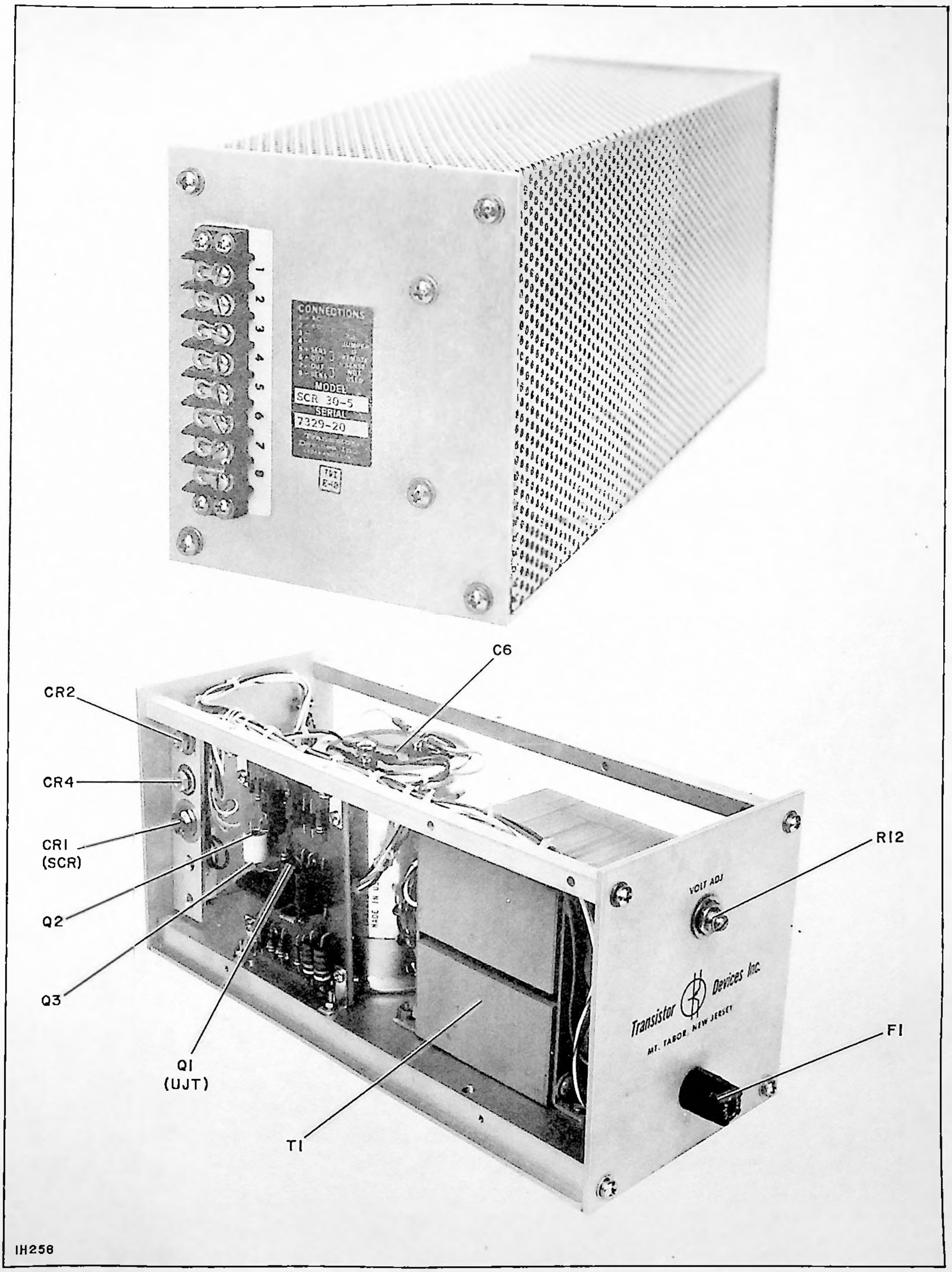


Figure 1-10. Control Power Supply (A4)

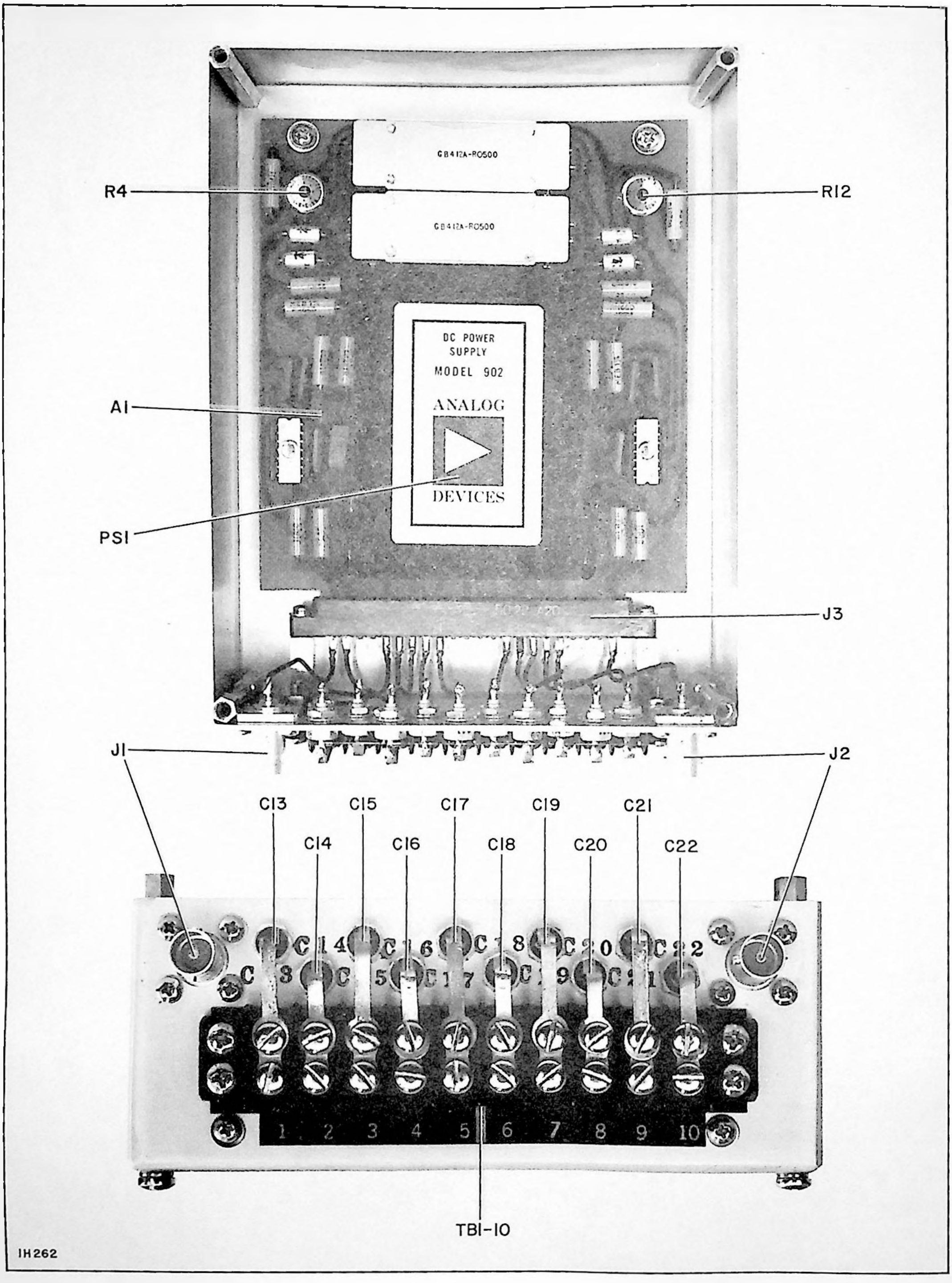


Figure 1-11A. VSWR Protective Unit (A5, earlier version)

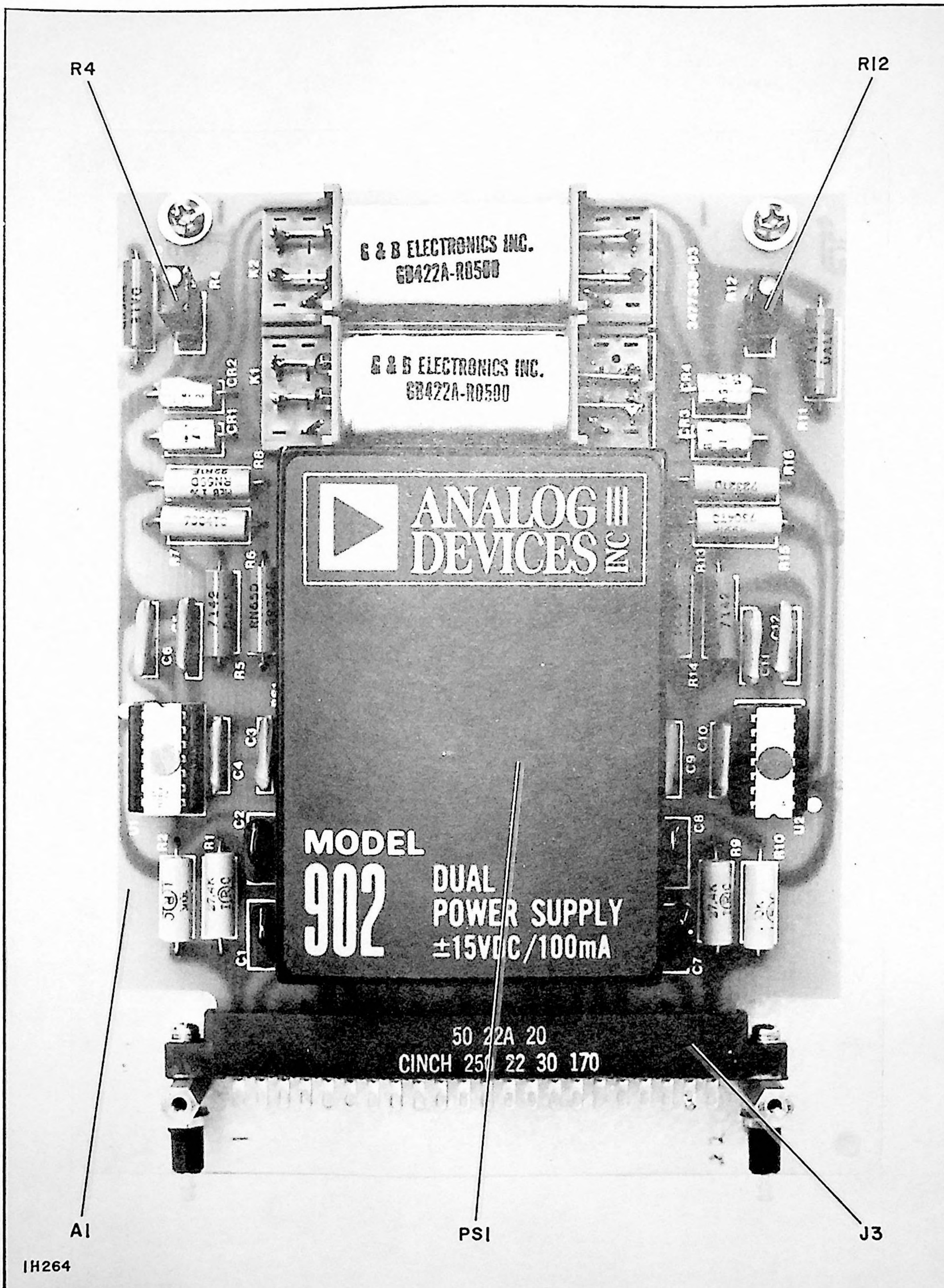


Figure 1-11B. VSWR Protective Unit (A5, later version)

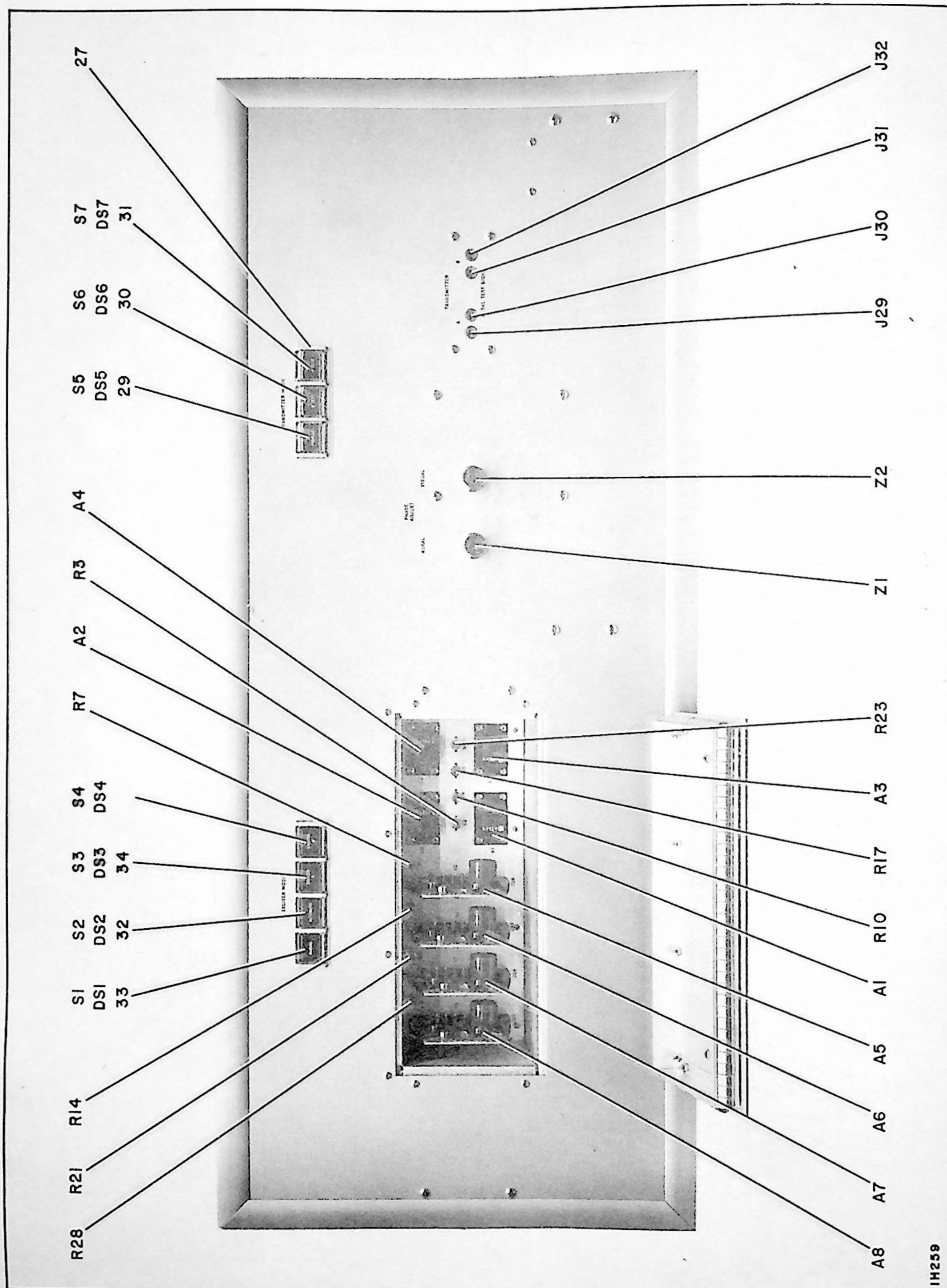


Figure 1-12. Front View, RF and Exciter Switching Panel

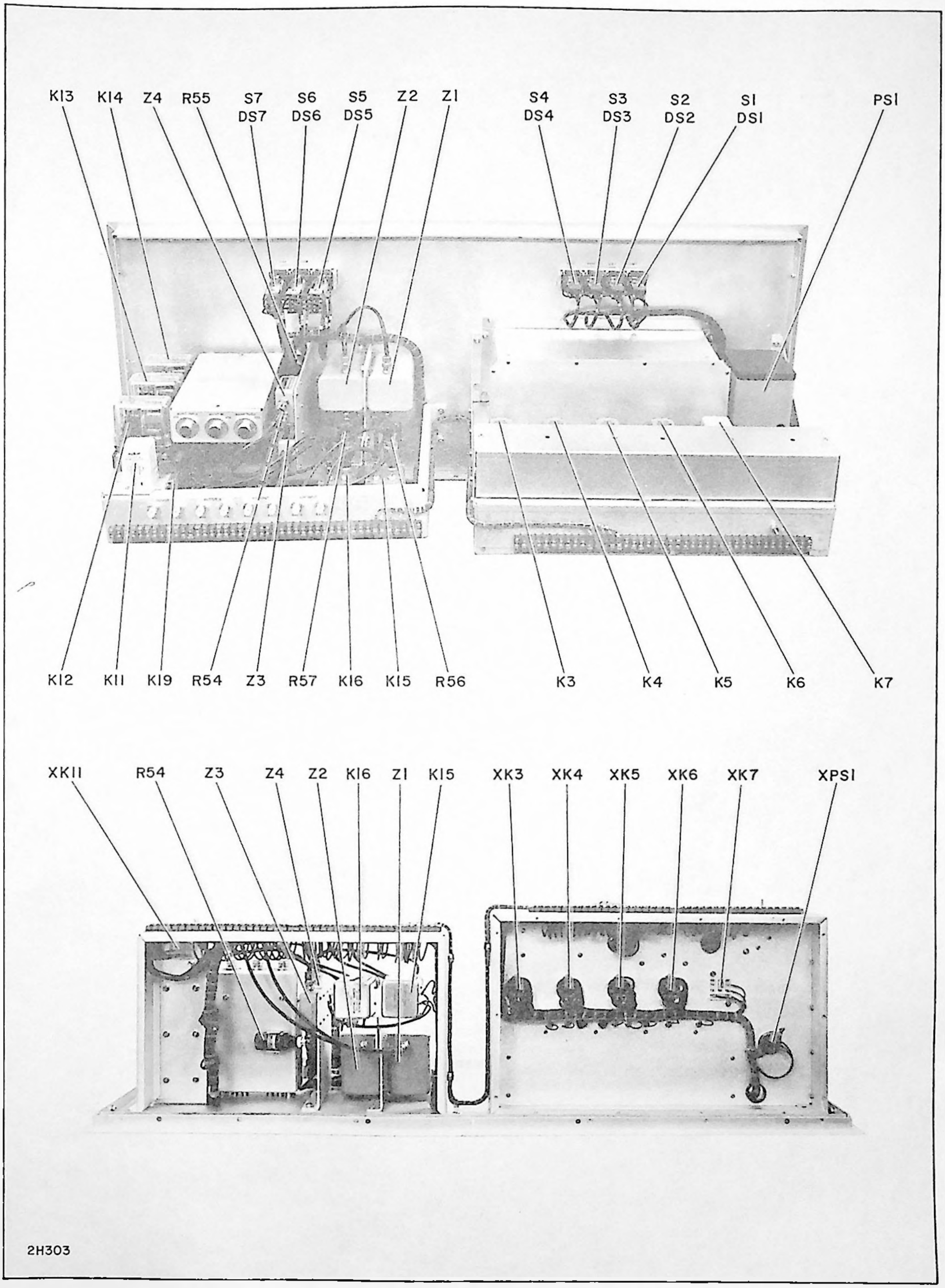
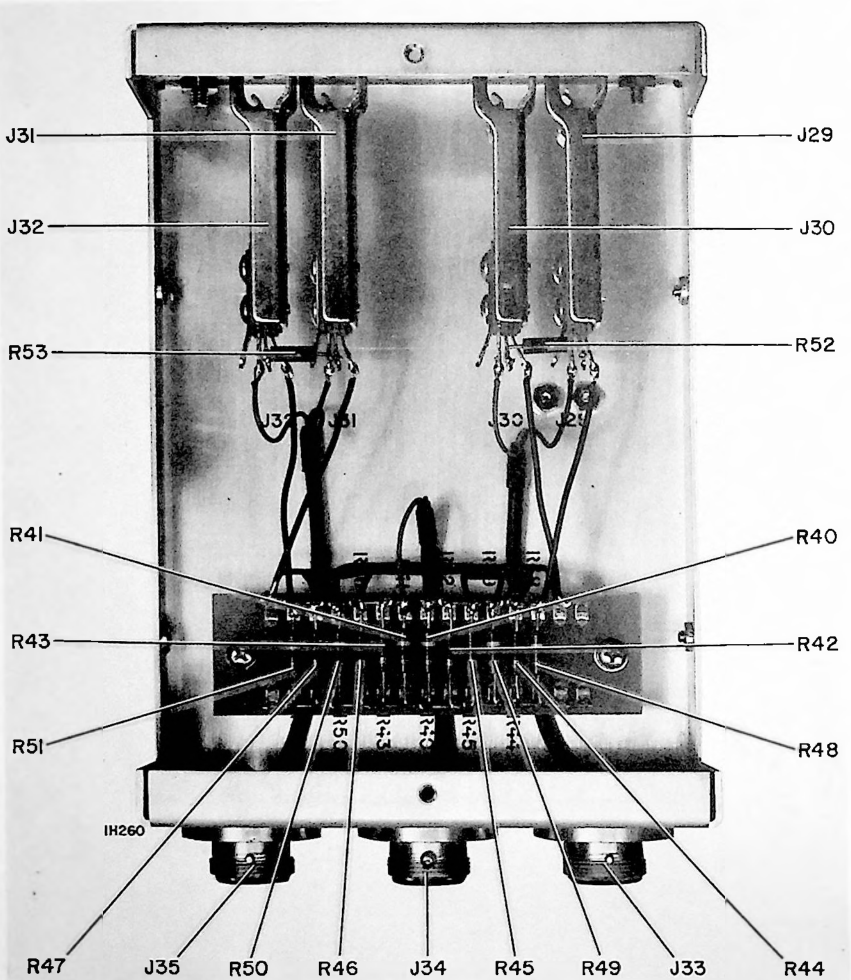
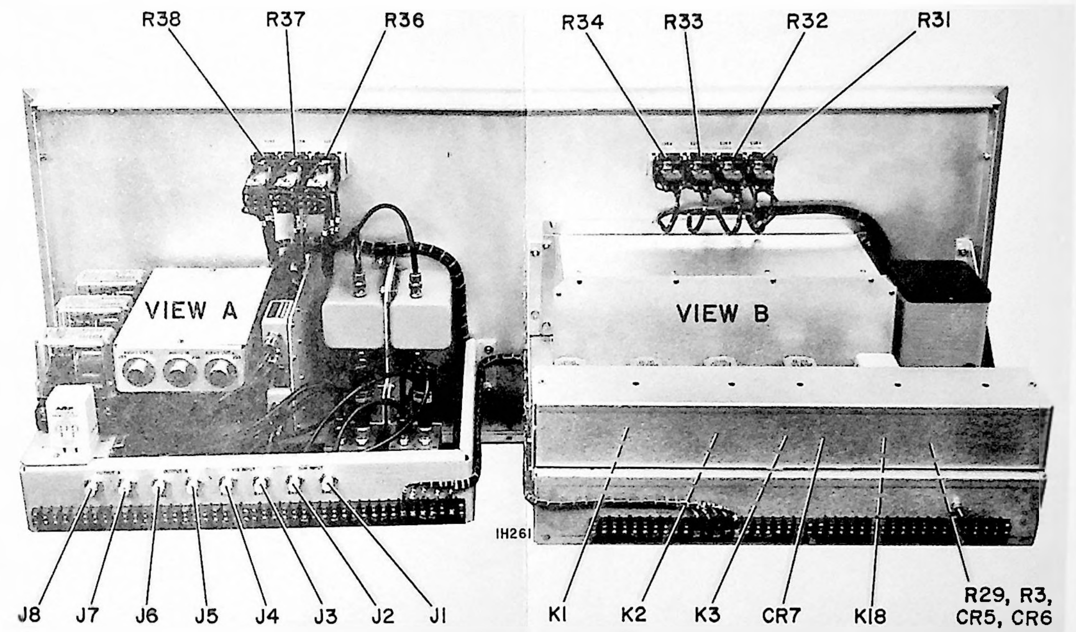


Figure 1-13. Top and Bottom Views, RF and Exciter Switching Panel


J31
J29
J32
J30
R53
R52
R41
R40
R43
R42
R51
R48
IH260
R47
J35
R50
R46
J34
R45
R49
J33
R44
VIEW A


R38
R37
R36
R34
R33
R32
R31
VIEW A
VIEW B
IH261
J8
J7
J6
J5
J4
J3
J2
J1
K1
K2
K3
CR7
K18
R29, R3, CR5, CR6

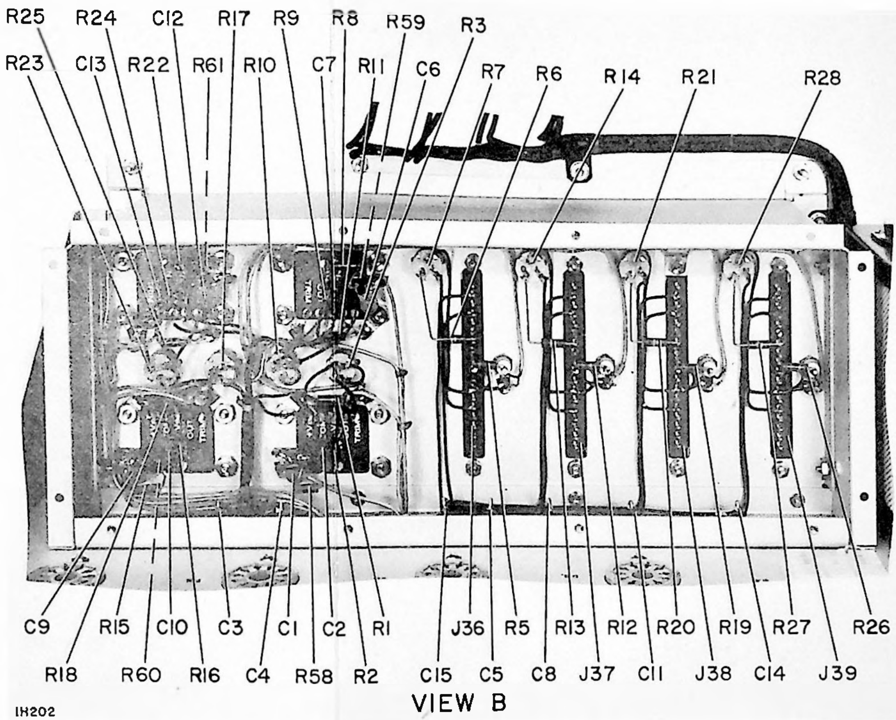


Figure 1-14. Rear View, RF and Exciter Switching Panel

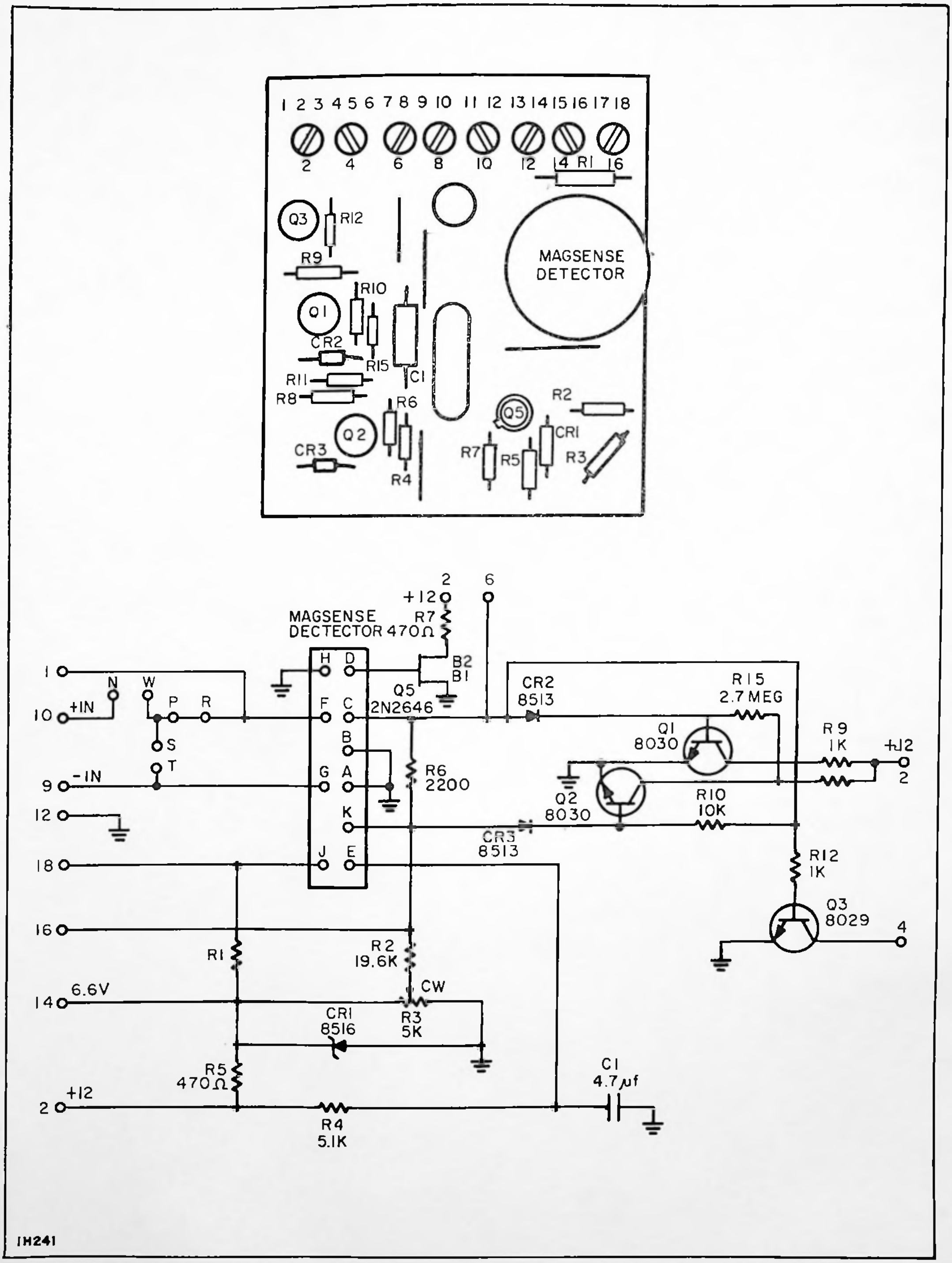
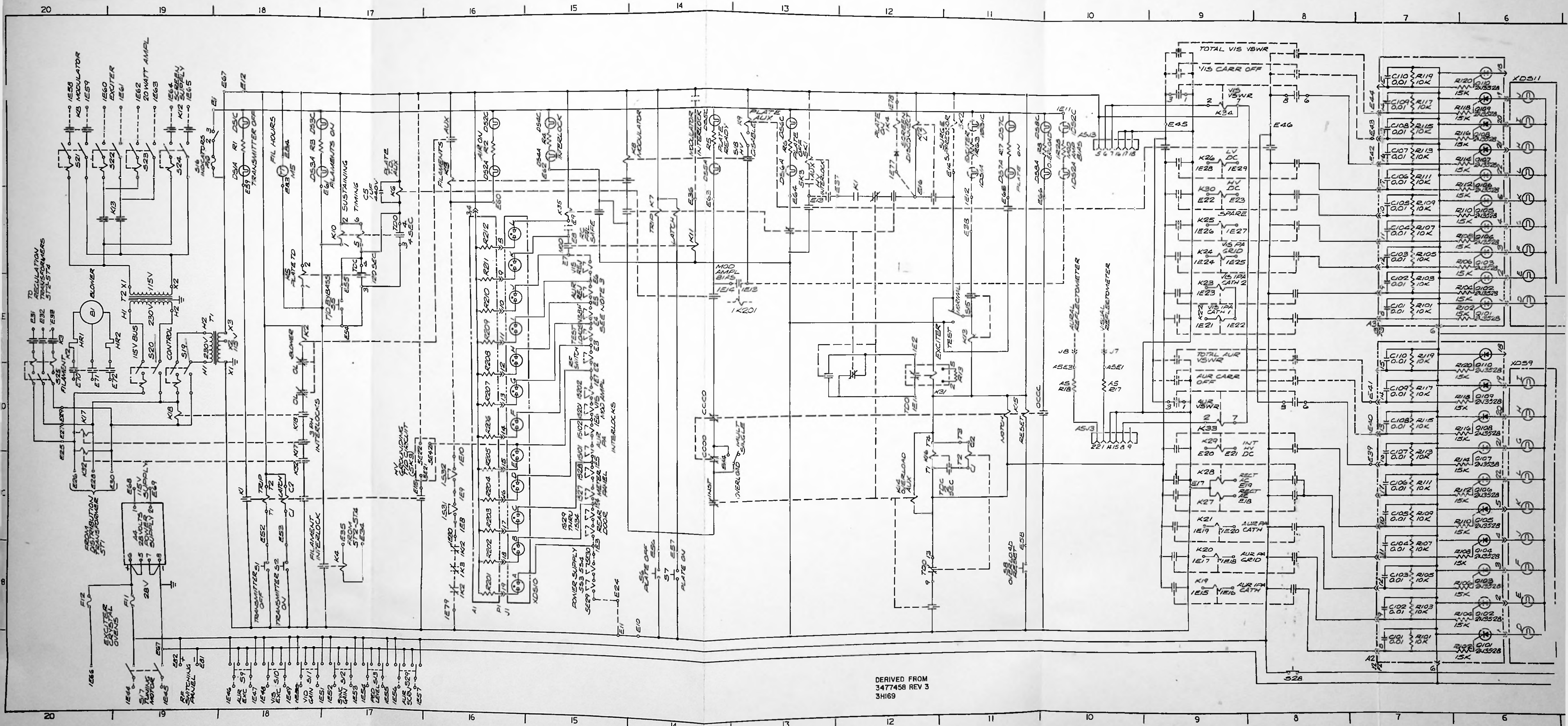


Figure 1-15. Operational Amplifier, RF and Exciter Switching Panel



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3477458 REV 3
3H169

Figure 1-16. Schematic, TT-15F

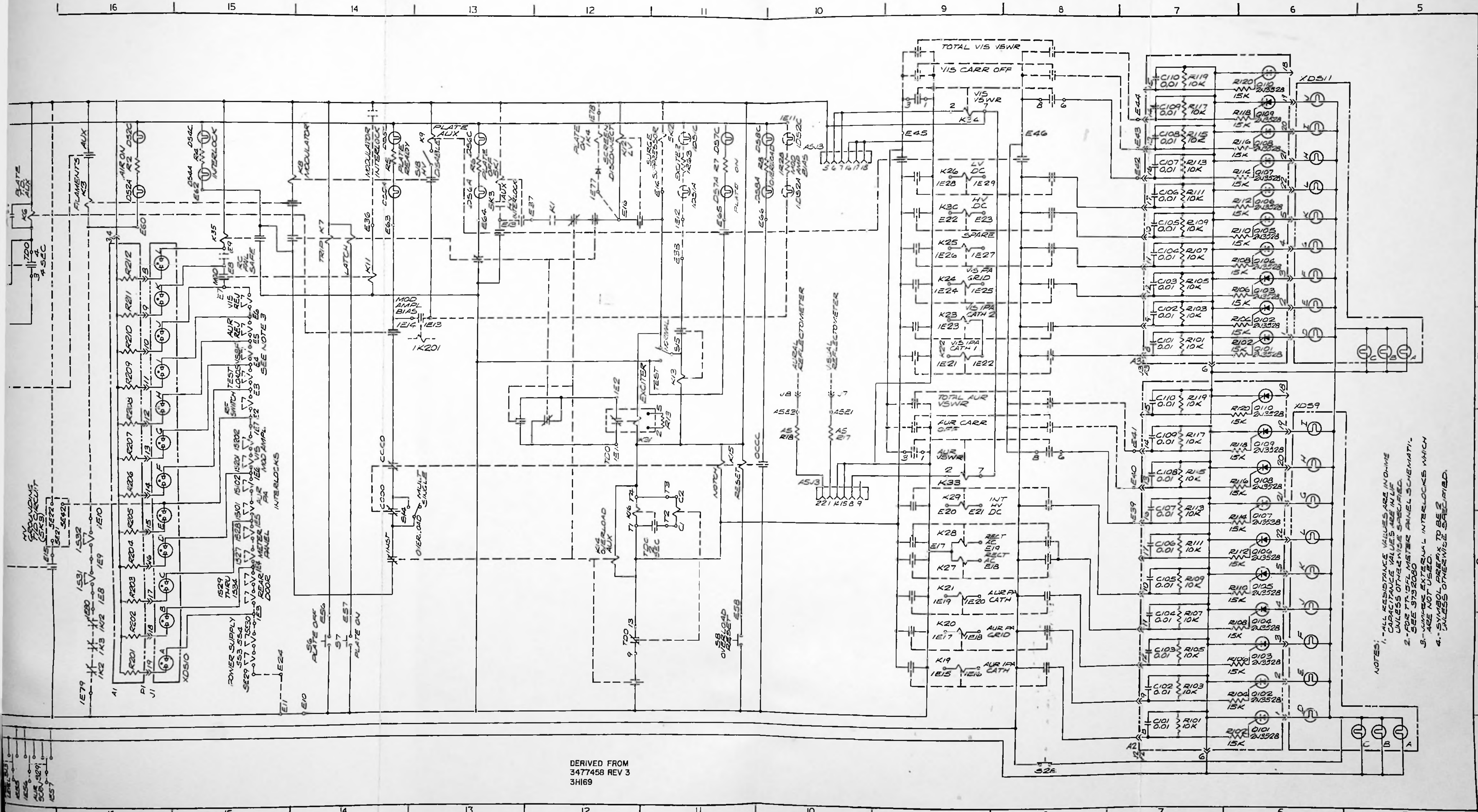


Figure 1-16. Schematic, TT-15FL/25FL Control Cabinet

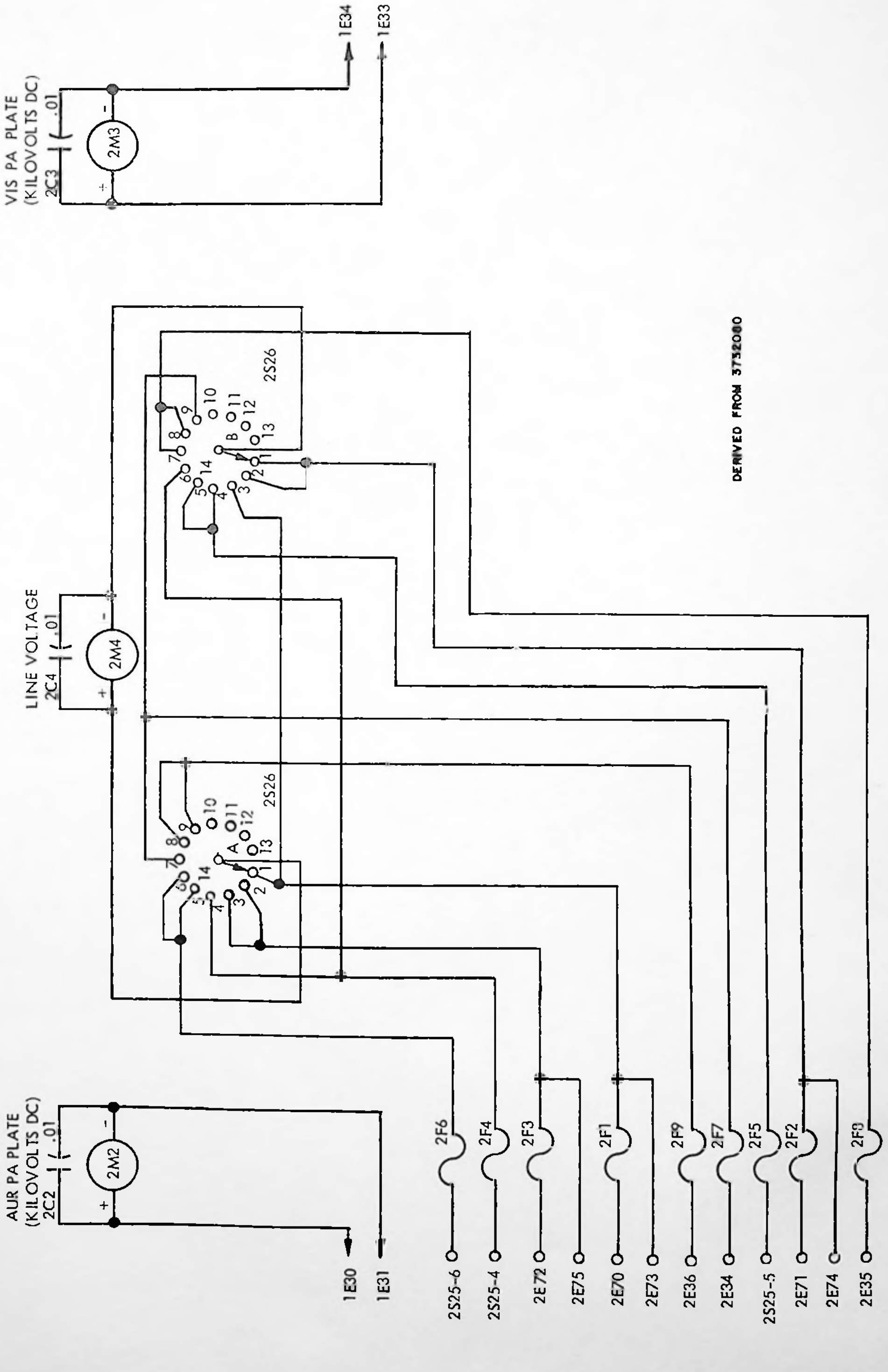
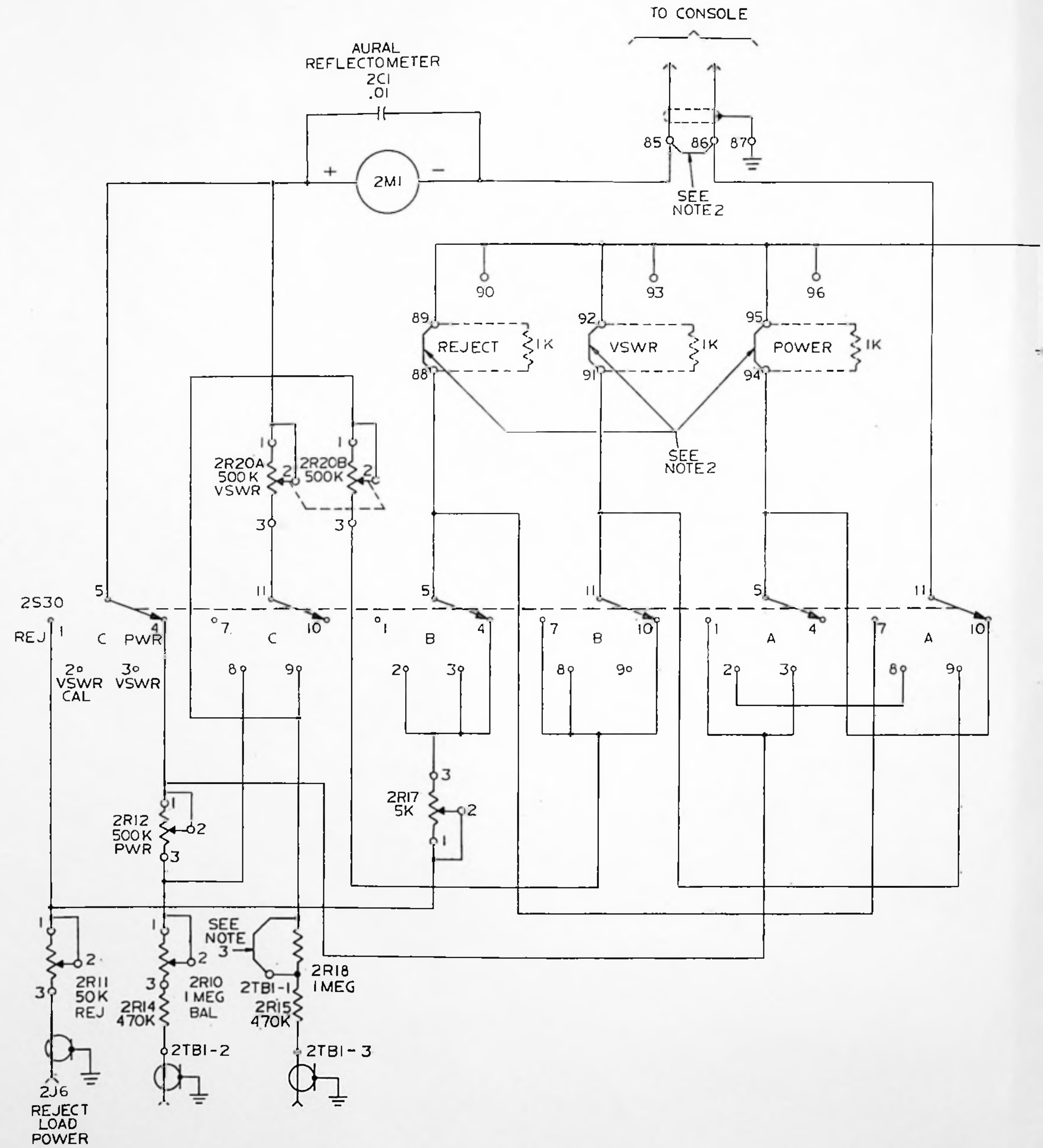
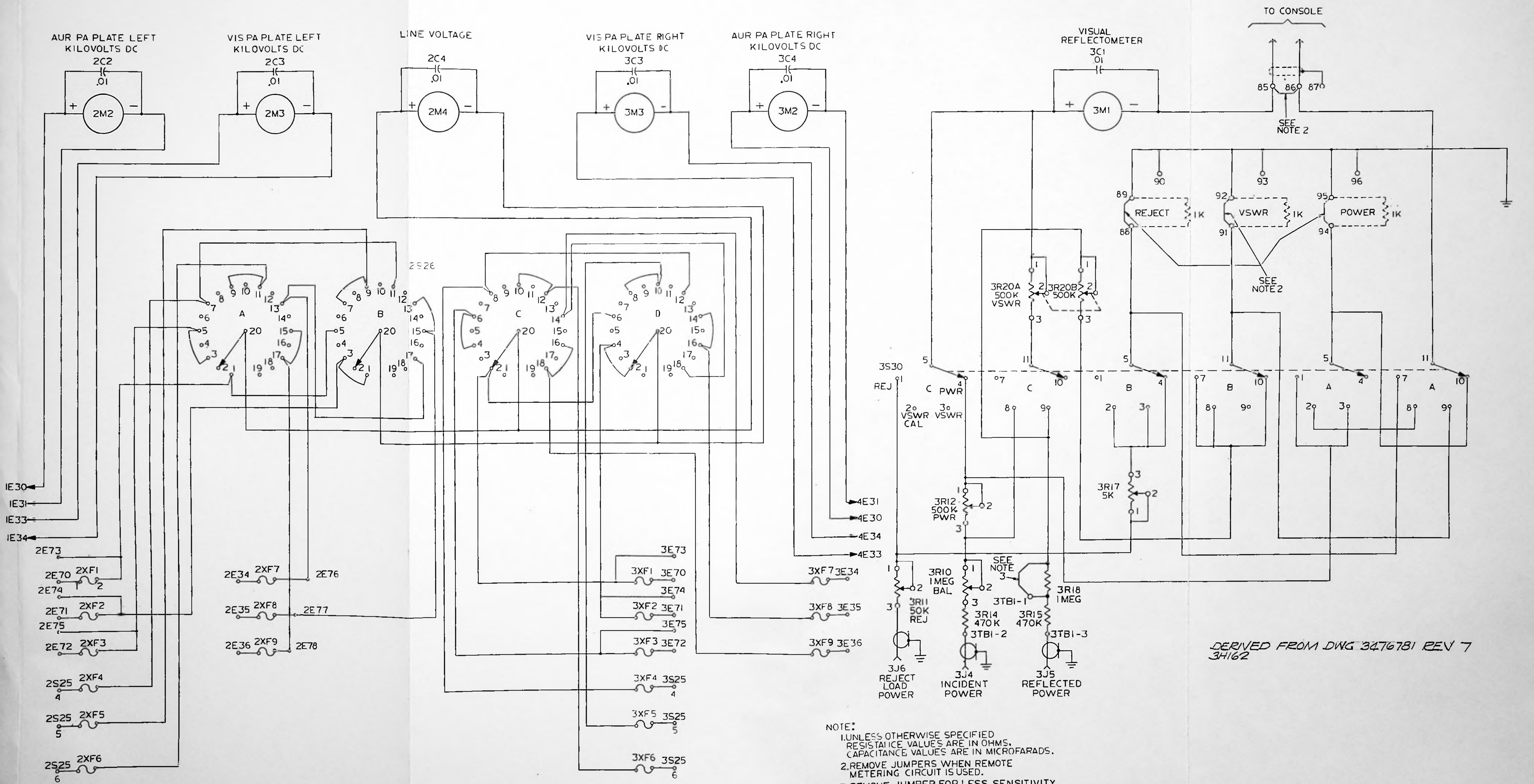


Figure 1-18. Schematic, TT-15FL/25FL Control Cabinet Meter Panel



TO CONSOLE
AURAL REFLECTOMETER
2C1 .01
2M1
85 86 87
SEE NOTE 2
90 93 96
89 REJECT 1K 88
92 VSWR 1K 91
95 POWER 1K 94
SEE NOTE 2
2R20A 500K VSWR
2R20B 500K
2S30
REJ 1
C PWR 4
2 VSWR CAL
3 VSWR
7 C 10
8 9
1 B 4
2 3
7 B 10
8 9
1 A 4
2 3
7 A 10
8 9
2R17 5K
2R12 500K PWR
SEE NOTE 3
2R11 50K REJ
2R10 1 MEG BAL
2R14 470K
2TB1-1
2R15 470K
2R18 1MEG
2TB1-2
2TB1-3
2J6 REJECT LOAD POWER



NOTE:
1. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS.
2. REMOVE JUMPERS WHEN REMOTE METERING CIRCUIT IS USED.
3. REMOVE JUMPER FOR LESS SENSITIVITY

Figure 1-19. Schematic, TT-30FL Control Cabinet Meter Panel

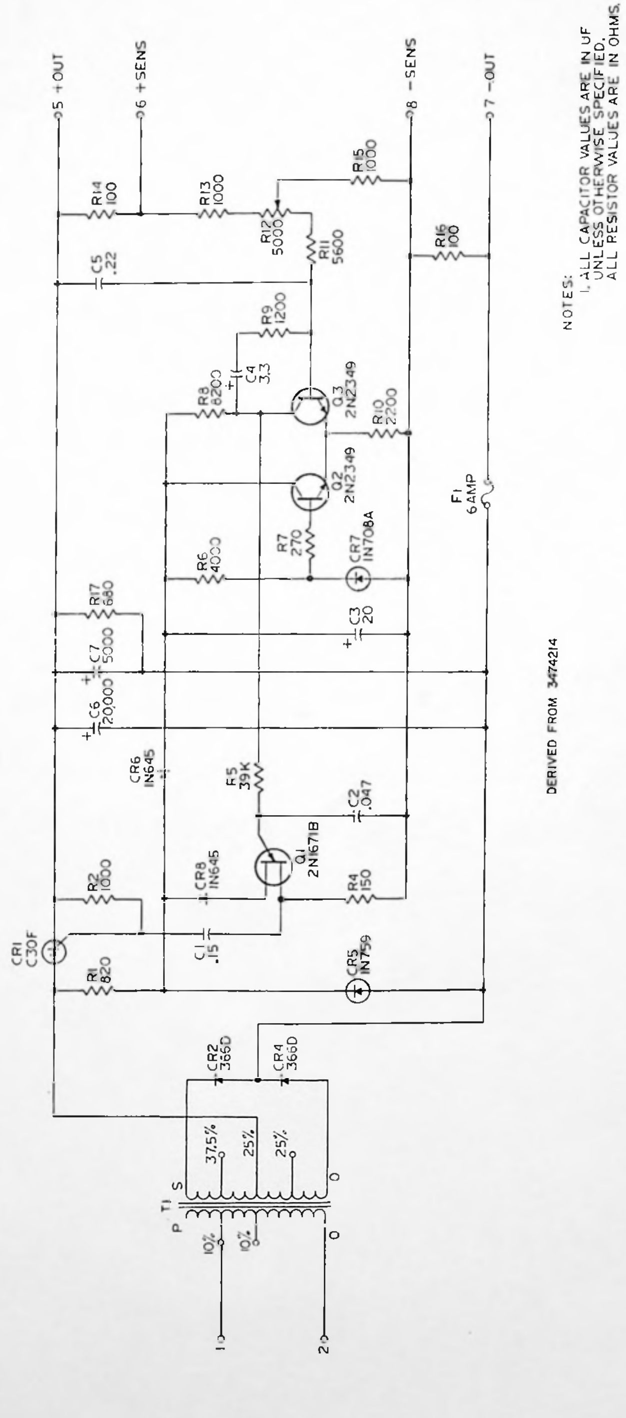
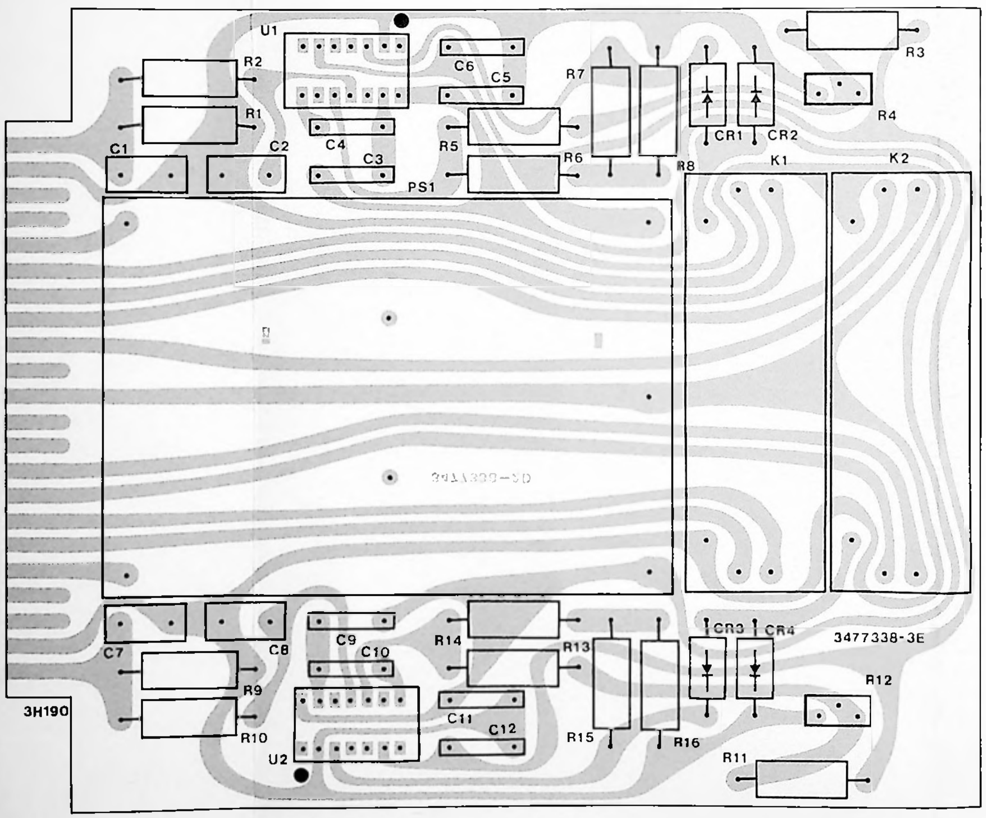
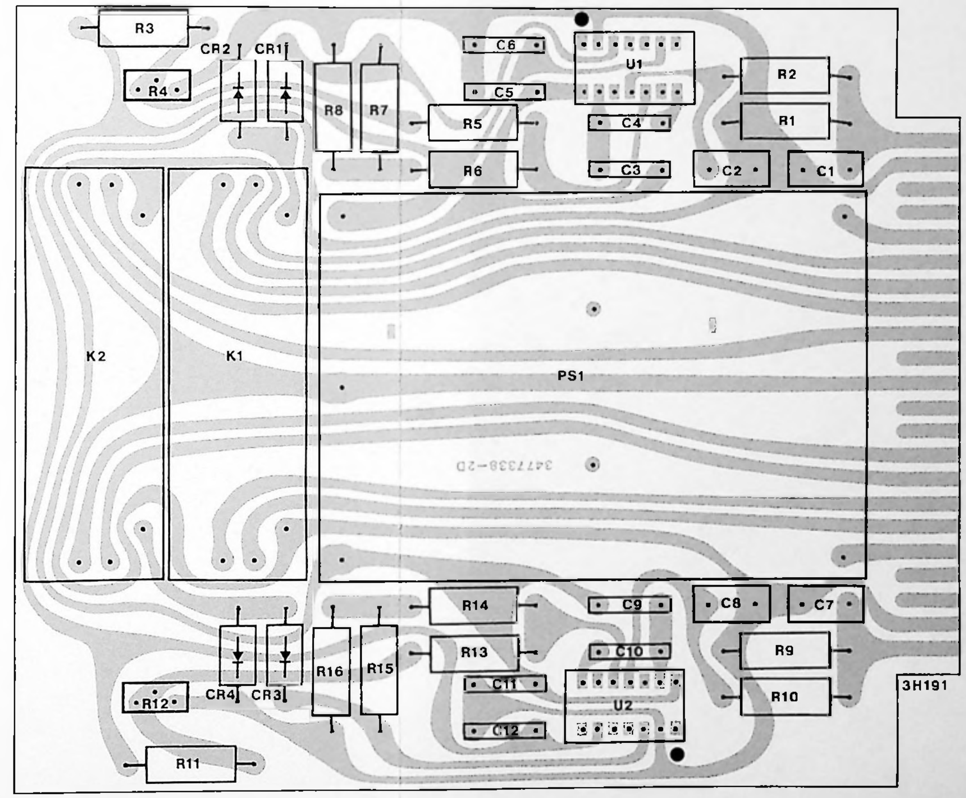


Figure 1-20. Schematic, Control Power Supply (A4)

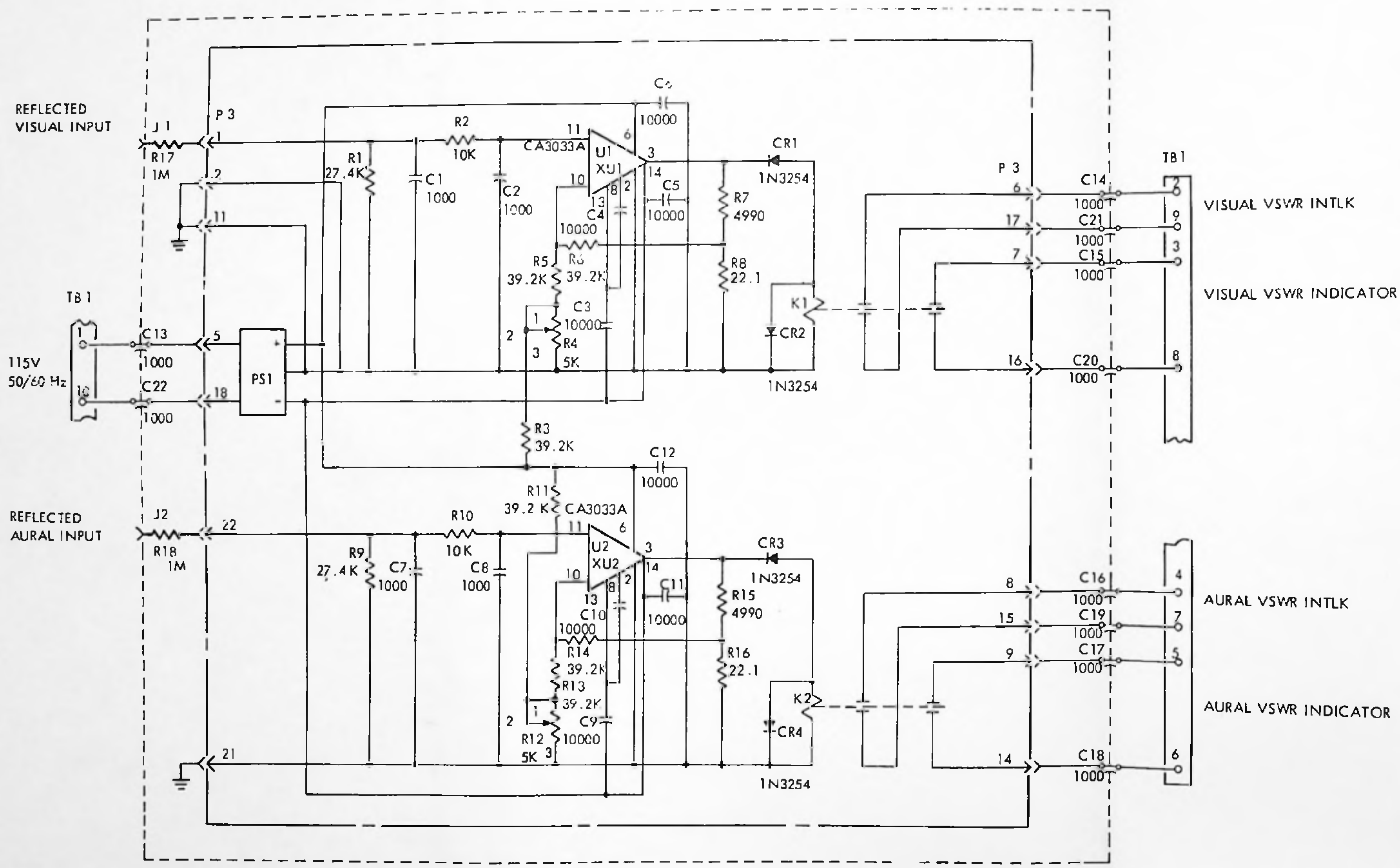


A5A1 — TOP VIEW



A5A1 — BOTTOM VIEW

Figure 1-21. Schematic and Printed Wiring Board, VSWR Protective Unit



NOTES:

1. ALL RESISTOR VALUES IN OHMS ± 1%, 1/4W UNLESS OTHERWISE NOTED
2. ALL CAPACITOR VALUES IN PF UNLESS OTHERWISE NOTED

DERIVED FROM 3732029

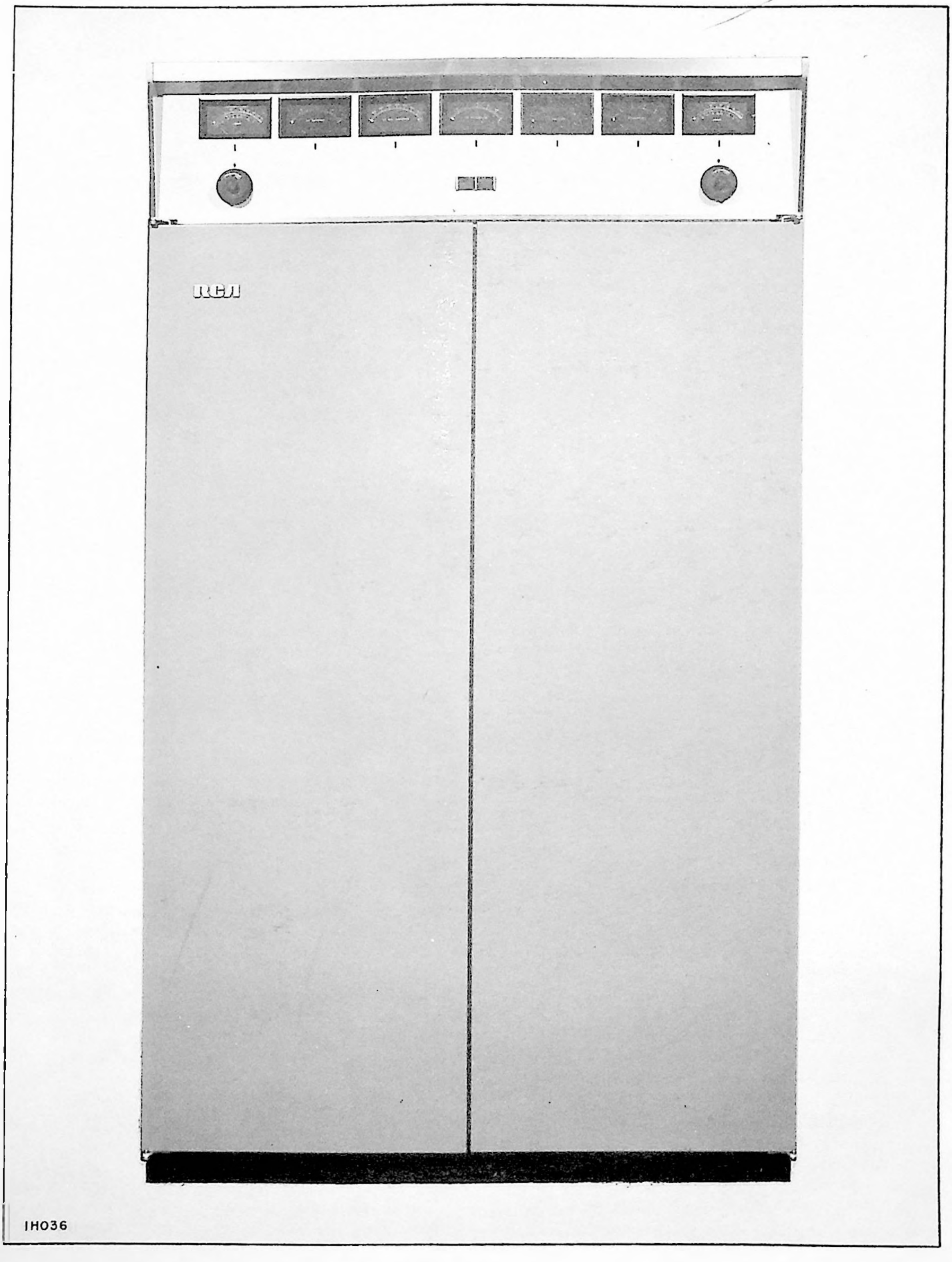


Figure 2-1. Amplifier Cabinet, MI-560577A

AMPLIFIER CABINET

GENERAL DESCRIPTION

The Cabinet

The Amplifier Cabinet MI-560577A houses the power amplifiers, the exciters, and the audio and video signal processing circuits of the transmitter. The sound-insulated, magnetically-latched front doors open to provide access to tuning and adjustment controls.

Above the front doors, a hinged meter panel swings upward, exposing the wiring on the reverse side. Because of the voltages present behind the meter panel, a pair of high-voltage interlock switches are opened when the panel is lifted.

At the rear of the Amplifier Cabinet, a pair of sound-insulated, mechanically-latched doors provide access to the internal circuits. Opening either door actuates a switch, breaking the high-voltage interlock.

In the descriptions that follow, prefix numbers are not used, except where they are needed for clarity. It should be understood that prefix number 1 refers to component parts in the one Amplifier Cabinet of a TT-15FL or a TT-25FL, or the left Amplifier Cabinet (transmitter A) of a TT-30FL. The right Amplifier Cabinet of a TT-30FL (transmitter B) is assigned prefix number 4. These prefix numbers are used to help locate the proper assembly when refering to the "Replacement Parts List."

The Equipment

Power Amplifiers

Located on the right side of the cabinet, behind the front panel, are the visual PA and IPA units.

> NOTE: The terms "visual IPA" and "visual modulated amplifier" may be used interchangeably in some instances; both refer to the same circuit. When grid modulation is used, the stage is more correctly called a modulated amplifier (visual MOD AMP); when the optional diode modulation is used, the stage becomes a linear, broadband, intermediate power amplifier (visual IPA). (See IB-8025100, Diode Modulator.)

Two access panels, one at the top for the PA and one near the bottom for the IPA, are opened by rotating a pair of twist-lock latches. These panels provide access to the power tubes for servicing. Opening the visual IPA panel actuates a pair of switches which open the high-voltage interlock. Before the visual PA panel can be opened, the meter panel must first be raised; raising the meter panel opens a pair of high-voltage interlock switches.

One similar access panel, on the left side of the cabinet front panel, opens with three twist-lock latches, exposing the aural IPA and PA tubes. Opening this panel also breaks the high-voltage interlock.

Modular Sub-Systems

Three modular sub-systems are located on the left side of the front panel, near the bottom. These are (1) the 20 Watt Amplifier, (2) the 5 Watt Exciter, and (3) the Video Modulator. Descriptions of these three items are located in separate sections of this manual.

Filament and Screen Power Supplies

The transformer and rectifiers that supply DC filament power to the visual PA tube are located on the floor of the Amplifier Cabinet within the cooling-air plenum chamber; the rectifiers for the aural PA are also located on the floor and the transformer is mounted on the rear shelf. Voltage-adjusting rheostats for these supplies are located on the front panel.

AC filament power for the visual and aural IPA tubes is derived from three transformers located on a small shelf in the rear of the Amplifier Cabinet. Each transformer is provided with a voltage-adjusting rheostat, located adjacent to the respective transformer.

Behind the bottom right-hand panel at the front of the Amplifier Cabinet is the dual-output screen power supply. This supply delivers screen voltages to the aural and visual IPA tubes.

Metering and Controls

Meter Panel. The meter panel, located above the front panel of the Amplifier Cabinet, provides metering for seven transmitter parameters. These are (1) aural reflectometer, (2) aural PA plate current, (3) aural IPA plate current, (4) visual IPA plate volts, (5) visual IPA plate current, (6) visual PA plate current, and (7) visual reflectometer. (Meters for the aural and visual PA plate voltages are located on the Control Cabinet meter panel.)

Also on the meter panel are the EXCITER and the VISUAL IPA BIAS indicator lamps.

Tuning multimeter panel. The tuning multimeter panel is located near the center of the Amplifier Cabinet front panel, just below the meter panel. The multimeter portion of this panel includes a meter, a 20-position selector switch, a meter calibration switch and potentiometer, and a meter reversing switch.

The lower portion of this panel includes the tuning indication pushbutton selectors, and the tuning motor rocker switches. These provide a central location for several tuning control functions.

Two twist-lock latches at the top of this panel allow it to swing downward when access to the wiring on the reverse side is desired. This panel cannot be lowered without first lifting the meter panel which, when raised, opens the high-voltage interlock.

Cooling-air pressure gauges. The cooling-air pressure gauges are located below the tuning multimeter panel. The left gauge indicates AURAL AIR PRESSURE, and the right one, VISUAL AIR PRESSURE.

Excitation reflectometer meters. Below the cooling-air pressure gauges are the two excitation reflectometer meters. The left meter and selector switch indicate drive and VSWR levels for the aural Exciter and 20 Watt Amplifier stages; the right meter and selector switch provide the same indications for the visual Exciter and 20 Watt Amplifier stages. There are four calibrating potentiometers used with each of the two meter circuits. Calibration of these meter circuits is covered in the "Adjustments and Tuning" section of the System Operating Instructions book.

Filament voltage adjustments. The filament voltage adjustments are located below the excitation reflectometer meters. The left control adjusts the AURAL PA FILAMENTS and the right one, the VISUAL PA FILAMENTS.

Options panel. A blank panel below the modular sub-systems may be removed to provide a location for the optional Diode Modulator tray.

CIRCUIT DESCRIPTIONS

Power Amplifiers

Visual IPA

The visual IPA is a broadbanded, push-pull RF Amplifier, using a pair of 8791 beam power tubes. Both input and output circuits are double-tuned to permit broadbanding. Variable capacitive coupling between the grid of each tube and the plate of its complement provide cross-neutralization for the stage. With proper broadbanding adjustments, the IPA has a bandwidth of approximately 7 MHz at the 0.5 dB points.

References. Figure 2-4 is a schematic diagram of the visual IPA, and figure 2-10 shows an assembly view of the unit. An assembly view of the input sub-assembly is given in figure 2-11.

RF input. An RF signal is fed to the visual IPA via P203. This type-BNC connector is located on the underside of the visual IPA assembly. Adjustable input coupling is provided by L201 and L202. This coupling, along with input broadbanding capacitors C204 and variable C202, input tuning capacitors C231 and variable C203, and grid tuning capacitor C201, establish input broadbanding and grid-to-source impedance matching.

The RF input circuit applies the unmodulated carrier from the 20 watt visual solid-state amplifier, to each tube grid. The RF levels at each grid are equal in Amplitude but of opposite phase (i.e., 180° apart).

Input tuning and broadbanding can be monitored at each grid of the IPA independently. The combination of resistors R223 and R218, along with DC blocking capacitor C234, provide a -40 dBm representation of the signal at the grid of V201, via J209, with a source impedance of about 51 ohms. R224, R219, and C235 accomplish the same results from the grid of V202 via J210.

Input sub-assembly A202. A second input to the IPA tube grids is provided by the input sub-assembly.

The composite video signal (about 40 Vp-p) is fed from the Video Output module to the input sub-assembly via a feed-thru connector. At this same point, an adjustable grid-bias voltage is established by the PEDESTAL level control on the Video Output module. The video signal and the DC bias voltage are applied to the tube grids via P205 and resistors R230 and R231. The effective parallel resistance of R230 and R231 present a constant 75 ohm load to the Video Output module.

The video levels applied to the tube grids are in phase with respect to each other. Appearing at the tube grids then is an RF voltage, equal in amplitude but 180° out of phase, superimposed on the composite video signal. In comparison with the RF voltage, the video signal is a slowly varying DC bias.

To prevent RF from feeding back to the video or the bias source, inductor L209 and variable capacitor C230 provide a tunable carrier trap. Diode CR3 clips any positive voltage transients that may occur at the grid input, protecting the source circuitry.

Insufficient grid biasing would result in excessive plate current. To prevent this condition from occurring, the grid voltage is fed to the coil of a sensitive relay, K201, via resistors R225 and R227. This relay supervises the turning-on of plate and screen power supplies. Resistor R227 adjusts the sensitivity of K201 for a pull-in at -35 volts, and a drop-out at -28 volts.

Resistor R226 serves as a meter multiplier, providing a grid voltage indication on the tuning multimeter. (See "Metering and Auxiliary Circuits, Tuning Multimeter.")

Modulated output. The double-tuned, pushpull output of the visual IPA provides for broadbanding and for plate-to-load impedance matching.

Variable plate-to-output coupling is accomplished by the spacing between inductors L205 and L206. This coupling, along with variable plate tuning capacitor C228, variable output tuning capacitor C225, and variable output broadbanding capacitor C226, produces the desired output impedance match and bandwidth. Each of the three variable capacitors is mechanically coupled to a drive motor. These motors are operated from the tuning multimeter panel. (See "Tuning Motor Controls.")

At J204 on the visual IPA assembly, a small coupling loop, loaded by R215, provides a monitoring point for the RF output of the stage.

Neutralization. Variable capacitors C221 and C222 are adjusted to cross-neutralize the two visual IPA plates, preventing spurious oscillations.

Screen grid voltages. Screen grid voltages originate from a dual-output power supply, and are conveyed via feed-thru capacitors C241 and C211. These voltages are independently adjustable so that cathode currents for the two tubes may be balanced. Capacitors C219, C220, C229, and C242, along with resistors R212 and R213, provide the necessary RF decoupling.

Resistors R214 and R229 serve as screen current meter shunts for the tuning multimeter. (See "Metering and Auxiliary Circuits, Tuning Multimeter.")

Plate voltage. Plate voltage is fed into the visual IPA from the intermediate-high-voltage section of the Power Supply Cabinet, via feed-thru capacitor C223. This capacitor, along with capacitor C224 and inductor L208, provide the necessary decoupling. For plate voltage and current metering, see "Metering and Auxiliary Circuits, Meter Panel."

Filament voltage. Individual filament supplies in the Amplifier Cabinet provide separate filament voltages to each of the 8791 tubes. V201 receives its filament voltage via feed-thru capacitors C205 and C206; V202, via C207 and C208.

The 8791 tube has an indirectly-heated cathode which is internally connected to one of the filament terminals. To provide a high-voltage return for the cathode, three resistors are connected in parallel from the filament/cathode contact to ground. The three cathode resistors for V201 are R206, R207, and R208; for V202, R209, R210, and R211. These resistors also provide a shunt for metering cathode current. (See "Metering and Auxiliary Circuits, Tuning Multimeter.")

RF decoupling is accomplished for the V201 filament supply by capacitors C237 and C234; for the V202 filament supply, by C238 and C224.

Visual PA

The FL visual PA uses a power triode (V301) in a grounded-grid, tuned resonant cavity circuit. The PA triode for a TT-15FL/30FL is a type 3CX10,000A7, and for a TT-25FL, a type 3CX20,000A7.

References. The following illustrations may be referred to as aids in understanding the visual PA circuit descriptions:

1. Figure 2-5, Schematic, TT-15FL/30FL Visual PA

2. Figure 2-6, Schematic, TT-25FL Visual PA

3. Figure 2-2, Simplified Details, Visual PA Cavity

4. Figure 2-12, Assembly, Visual PA

5. Figure 2-13, Exploded View, Visual PA Tube Socket and Plate Contact Assembly.

Circuit description. The directly-heated cathode input circuit of the visual PA is made up of rigid coaxial line sections L303 and L304. These line sections are mounted inside a metal sleeve (L301) which runs downward from the grid contact of the tube.

The center conductors of L303 and L304 connect to the two filament contacts. Capacitors C308 and C309 ensure that both filament contacts are kept at the same RF potential.

The lower end of L303 terminates in P301, a type-N connector. A frequency determined length of coaxial cable, W6, conveys the RF drive from the IPA Output to P301 and, in conjunction with L303, serves as an impedance transformation between the two stages. This transformation allows for proper tuning, provides efficient interstage coupling, and minimizes impedance variations due to changes in power level.

Capacitor C315, at the lower end of L304, places this point at RF ground via resistors R303 and R304. These two resistors provide a DC high-voltage return for the cathode circuit of V302. The length of L304 places C315 less than one-quarter wavelength away from the filament contact at the visual carrier frequency. At the carrier frequency, the resulting inductance of L304 tends to minimize the effects of distributed input capacitance.

DC power is applied to the filaments via the center conductors of L303 and L304. RF choke L305 and feed-thru capacitors C302 and C303 decouple the RF from the filament power leads. Resistors R313 thru R318 (also R319 thru R324 in a TT-25FL PA), along

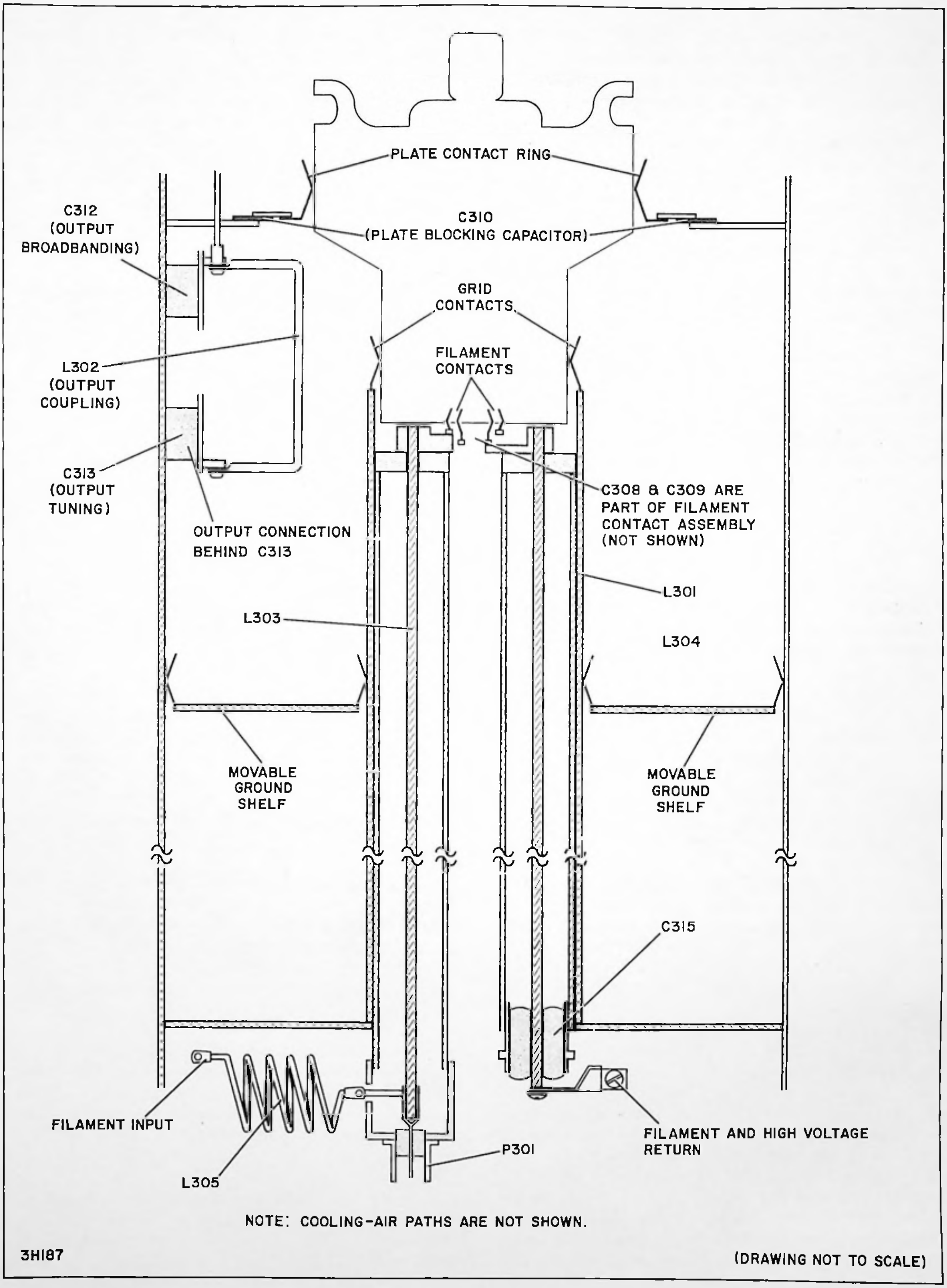


Figure 2-2. Simplified Details, Visual PA Cavity

with capacitors C304, C305, and C317 (also C319, TT-25FL), ensure adequate decoupling over the video frequency range. Additional video decoupling is provided by R309 and C318 outside the PA cavity.

The grid of V302 is at DC ground; however, a movable short places the grid less than one-quarter wavelength from RF ground at carrier frequency. The effect produced is a variable inductance, L301.

Blocking capacitor assembly C310 places the plate of the tube at RF ground. L301 and the grid-to-plate capacitance of the tube form a parallel resonant circuit which develops a high-energy RF field within the cavity.

This RF energy is coupled to the output transmission line via adjustable coupling loop L302. Bandwidth capacitor C313 and output tuning capacitor C312 adjust the Q and the resonant frequency of the output circuit. Proper adjustment of L302, C313, and C312 provides adequate bandwidth and matches the PA output to the load impedance.

Aural RF Unit

The aural RF unit uses a type 8791 beam power tube as an IPA, operating class C. The PA is a type 3CX3000A7 power triode in a grounded-grid, tuned resonant cavity circuit.

References. Figure 2-7 is a schematic diagram of the RF unit. Figure 2-14 shows an assembly view of the unit, and figure 2-15, an exploded view of the aural PA cavity tuning assembly to aid in identifying and locating component parts.

Aural IPA. The FM aural drive from the 20 Watt Amplifier module is fed to the input of the IPA circuit via J102. Inductor L101, variable capacitors C101 and C102, and the grid-to-cathode capacitance of the 8791 tube (V101) forms a pi-network circuit. (An additional capacitor, C129, is required only for channel 2 operation.)

Resistors R101, R102, and R125 return grid current to ground through resistor R103. R103 is RF decoupled by capacitor C103, and serves as a metering shunt for measuring aural IPA grid current. (See "Metering and Auxiliary Circuits, Tuning Multimeter.")

Filament power is supplied to the IPA via feed-thru capacitors C113 and C114. One filament lead is common to the indirectly-heated cathode of the tube. This lead is RF decoupled by capacitors C104, C105, and C106, and is returned to ground through resistor R104 (cathode biasing resistor), the cathode current meter, and overload relay shunt resistors R117 and R105. (See "Metering and Auxiliary Circuits, Meter Panel;" also, for a description of the overload function, see the Control Cabinet section of this manual.)

A voltage divider, consisting of R45 and R49 and potentiometer R48, provides an adjustable screen voltage from output #1 of the dual-output screen power supply. These resistors are wired to TB6 which facilitates rearranging the divider. Normally, the higher screen voltage needed in a TT-25FL IPA would require placing the potentiometer at the upper end of the divider; the lower screen voltages needed in a TT-15FL/30FL (depending on licensed station power levels) would require placing the potentiometer either at the center or at the lower end of the divider.

Resistors R107, R108, and R116 divide down the screen voltage for metering of the aural IPA screen volts. (See "Metering and Auxiliary Circuits, Tuning Multimeter.")

The aural IPA plate tuning is accomplished by variable inductor L102 and variable capacitor C108. Inductor L102 is mechanically coupled to a drive motor which is operated from the tuning multimeter panel. (See "Tuning Motor Controls.")

Aural PA. The output of the IPA is AC coupled to the directly-heated cathode of PA tube V102 via capacitor C121. Capacitors C122 and C123 ensure that both sides of the filament are at the same RF potential. RF chokes L105 and L106, along with feed-thru capacitors C117 and C118, decouple the RF from the filament supply.

Resistors R109 and R110 balance cathode-to-plate current between the two filament leads. The cathode circuit is returned to ground through the plate current meter, resistors R119 and R115, and overload relay shunts R118 and R111. (See "Metering and Auxiliary Circuits, Meter Panel;" also, for a description of the overload function, see the Control Cabinet section of this manual.)

Capacitor C109 connects the PA grid to RF ground. The grid is returned to the cathode via tapped resistor R112, grid current metering shunts R113 and R124, and the overload relay shunts R114 and R123. (See "Metering and Auxiliary Circuits, Tuning Multimeter;" also, for a description of the overload function, see the Control Cabinet section of this manual.)

Plate voltage is applied to the aural PA via feed-thru capacitor C120 and RF choke L107, the center conductor of a length of rigid coaxial line. A sleeve of dielectric material between the lower portion of L107 and the outer conductor forms coupling capacitor C110.

Plate tuning for the stage is accomplished by varying the electrical length of the cavity (less than one-quarter wavelength at aural carrier frequency). The outer conductor of the rigid coaxial line, in conjunction with a movable short, produces the effect of a variable inductor, L109, across the grid-to-plate capacitance of the tube, V102. The resulting parallel resonant circuit develops a high-energy RF field within the cavity.

This RF energy is coupled to the output transmission line via adjustable coupling loop L108, a frequency determined part. Output tuning capacitor C111 and fixed capacitor C126, along with L108, match the PA output to the load impedance. Resistor R126 absorbs circulating harmonic energy developed within the cavity.

The movable short which varies the inductance of L109, and output tuning capacitor C111 are each mechanically coupled to drive motors. These motors are operated from the tuning multimeter panel. (See "Tuning Motor Controls.")

Power Supplies

Filament Power Supplies

References. The circuits for the filament power supplies are shown in figure 2-3, Schematic, Amplifier Cabinet; locations of component parts are shown in figure 2-9, Assembly, Amplifier Cabinet. The filament power supply circuits are protected against shorts and excessive current demands by thermal overload relays K2, K3, and K12. See "Metering and Auxiliary Circuits, Auxiliary Circuits" for a description.

Visual PA filament power supply. The three-phase, 236 Vac output of the regulation transformers (in the Power Supply Cabinet) is applied to the wye-connected (4-wire) primary of transformer T1. A three-phase, full-wave rectifier (CR1A thru F) at the delta-connected secondary of T1 develops a regulated, low ripple DC power source for the PA Tube filament.

One of the three ganged rheostats, R22A, R22B, and R22C, is connected in series with each leg of the output circuit; these rheostats provide a filament voltage adjustment range of about ±10%. Thus, the filament voltage may be set as desired for best tube performance.

Aural PA filament power supply. The operation of this power supply is the same as that of the visual PA filament power supply. This circuit uses transformer T2, rectifier diodes CR24 thru F, and ganged rheostats R23A, R23B, and R23C.

Visual IPA filament power supplies. The single-phase primaries of transformers T3 and T4 are each connected across a separate phase of the regulated, 236 Vac, three-phase source. The AC filament voltages are taken directly from the secondaries of T3 and T4.

Rheostats R24, in series with the primary of T3, and R25, in series with the primary of T4, provide separate AC filament voltage adjustments for each of the two visual IPA tubes.

Aural IPA filament power supply. The single phase primary of transformer T5 is connected across one phase of the regulated 236 Vac, three-phase source. The AC filament voltage is taken directly from the secondary of T5.

Rheostat R26, in series with the primary of T5, provides an AC filament voltage adjustment for the aural IPA tube.

Dual-Output Screen Power Supply

The dual-output screen power supply has two identical regulator circuits. Both DC outputs are adjustable from 475 to 650 volts. Rated load current for output #1 is 250 mA; for output #2, 125 mA. Current limiting is set at 320 mA and 175 mA respectively.

References. Figure 2-8 is a schematic diagram of the power supply, and figure 2-16 shows a pictorial view to help locate and identify component parts.

Circuit description. Because the two regulators are nearly identical, the following description of output #1 regulator circuit applies equally to output #2. Components for output #2 are indicated in parentheses.

Rectifier diodes CR9 thru CR16 and filter capacitors C6 and C7 supply approximately 800 volts DC between the negative output terminal and the output transistors Q6 and Q7 (Q10), via power resistors R52, R53, and R54. Emitter resistors R15 and R16 (R33) ensure that the two transistors share the load current equally and provide output sensing for the current-limit circuit (described later).

An auxiliary supply, comprised of rectifier diodes CR1 and CR2 (CR20 and CR21), resistor R3 (R24), and filter capacitor C1 (C8), supply a boost of about 25 volts to the output driver transistors, Q1 and Q2 (Q8 and Q9). From the same supply, resistor R4 (R25) and zener diode VR1 (VR4) provide a regulated 12 volt boost for the comparator-amplifier transistors Q4 and Q5 (Q13 and Q14).

Zener diode VR2 (VR5) maintains the top of output voltage divider R21, R22, R9, R46, and potentiometer R8 (R42, R43, R30, R55, and potentiometer R29) a regulated 6.2 volts above the output voltage sampling point. The base of Q4 (Q13) is tied directly to the output sampling point via resistor R12 (R38); the base of Q5 (Q14) receives a regulator-boosted, divided-down version of the output voltage via resistor R13 (R39).

Under these conditions, any change in the output voltage produces a greater effect at the base of Q4 (Q13) than at the base of Q5 (Q14). This results in an amplified and inverted voltage change at the collector of Q4 (Q13); driver transistors Q1 and Q2 (Q8 and Q9) are biased in the direction necessary to correct the output deviation.

Diodes CR4 and CR5 (CR26 and CR27), at the base of Q5 (Q14), prevent large voltage swings from damaging the transistor. Resistor R6 (R27) and capacitor C2 (C11) are placed across the collector resistor of Q4 (Q13) to prevent oscillations in the high-gain voltage amplifier.

Output capacitors C4 and C5 (C9 and C10) aid the transient response of the regulator, and resistors R17 and R18 (R35 and R36) help to maintain a voltage balance across the two capacitors.

Transistor Q3 (Q12) serves as an output current limiter by sensing the voltage drop across the emitter resistor of Q6 (Q10), via potentiometer R1 (R2) and the base-emitter diode of Q17 (Q18). This diode, biased on by a small current through R47 (R56), counteracts temperature drifts in the base-emitter circuit of Q3 (Q12).

R1 (R2) sets the point at which Q3 (Q12) begins to conduct. When this point is reached, any further increase in output loading causes Q3 (Q12) to pull the output drivers toward cutoff; the output voltage begins to decrease.

Normally, the current through resistor R20 (R41) is enough to keep zener diode VR3 (VR6) in conduction; however, if a heavy load causes Q3 (Q12) to pull the voltage below 460 volts, VR3 (VR6) stops conducting. This results in increased drive to Q3 (Q12) which accelerates the current limiting effect.

Transistors Q15 and Q16 (Q11) are part of a power shifting network, which reduces the burden on output transistors Q6 and Q7 (Q10). Because of the large output voltage adjustment range, and to allow for line voltage variations, a fairly large voltage may be dropped across the output circuit under certain conditions. The worst case should be with the output voltage at its lowest setting, and line voltage at its highest level. Under these conditions, the output circuit would have to dissipate power equal to the product of the output current and a drop of greater than 300 volts.

The key component in the operation of this circuit is diode CR3 (CR25), and most of the dissipation is handled by power resistors R52, R53, and R54 (R59 and R60). To understand the significance of the circuit, only two conditions need be observed.

Initially, assume that the worst case conditions, as described above, are in effect. With no current demand at the output, the power resistors would not drop any voltage; the full excess voltage (greater than 300 volts) would appear across output transistors Q6 and Q7 (Q10).

From the auxiliary supply, CR3 (CR25) would have about 25 volts (positive) at its anode. (Note that the negative end of the auxiliary supply is connected to the main supply's positive output line.) The drop across the output transistors would place the excess voltage (positive) at the cathode of CR3 (CR25). CR3 is heavily reverse biased, and no base current is available to turn the power shifting transistors on.

The second condition would be at maximum output current demand. As the current increases, more and more voltage is dropped across the power resistors, and less across the output transistors. When the voltage across the output transistors drops below 25 volts, CR3 (CR25) becomes forward biased, and the power shifting transistors begin to turn on. Any further increase in current is shunted by the power shifting transistors, thus, maintaining a reserve of about 25 volts across the output transistors.

To further protect the output transistors against overloads, diode CR18 (CR24) places a short circuit across the transformer secondary when the output voltage is pulled below 400 volts. Before this point is reached, however, the screen overload relay in the Control Cabinet should have operated, shutting down the screen power supply. Otherwise, the SCREEN SUPPLY circuit breaker, also in the Control Cabinet, will trip. (See the Control Cabinet section of this book for more details regarding the screen current overload function.)

CAUTION

The power supply should never be operated without a fuse or a circuit breaker (5 Amp rating) in the AC input line.

Tuning Motor Controls

The variable components of nine major tuning functions are mechanically coupled to geared-down, 28 Vdc operated, reversible motors. These motors are operated by individual rocker switches, located on the tuning multimeter panel. A means is also provided for indicating the relative positions of the driven controls.

References

1. Figure 2-3, Schematic, Amplifier Cabinet MI-560577A

2. Figure 2-17, Front View, Tuning Multimeter Panel

3. Figure 2-18, Rear View, Tuning Multimeter Panel

4. Table 2-1, Motor Operated Tuning Controls

Circuit Descriptions

Tuning functions. Each tuning motor is mechanically coupled to the variable tuning component which it operates. Eight of the nine motors are each fitted with a 10-turn travel limiting device, and a slip clutch. The remaining unit (visual IPA plate tuning) is direct drive, continuously operable in either direction.

On the tuning multimeter panel, a rocker switch is provided for operating each motor (S5 thru S13). Pressing a rocker switch toward INCREASE or DECREASE determines the direction of motor rotation, hence, the direction of movement for the variable tuning component involved.

Tuning indicators. Each motor, except for the one which operates the visual IPA plate tuning capacitor, also drives a 10-turn tuning indication potentiometer. With 28 Vdc applied across each potentiometer, the voltages between the wipers and the negative ends provide meterable indications of the relative positions of each of the driven tuning components.

Pushbutton switches S14 thru S20 select which function is to be indicated by the tuning multimeter. (See "Metering and Auxiliary Circuits, Tuning Multimeter.")

Contacts of these switches are wired in series so that the voltage from only one tuning indication potentiometer can be applied to the meter at one time. As a selector switch is pressed, and indicator lamp and a latching coil, both built into the switch, are energized. The latching coil maintains the contacts of the operated switch in the actuated position after the pushbutton has been released.

The series contact arrangement opens the circuit to the indicator lamps and latching coils of all other selector switches; thus, previously operated switches are de-actuated electrically. Pressing the CLEAR INDICATION switch (S3) "clears" any selector switch which has been actuated.

Tuning indicator calibration. A switch (S2) and a potentiometer (R32) are provided for calibrating the meter circuit. Before checking the calibration, any actuated selector switch must be "cleared" by pressing the CLEAR INDICATION switch.

To calibrate the tuning indications meter circuit, the tuning multimeter selector switch (S1) must be placed in position 10, TUNING INDICATION. Then, pressing S2 places the potentiometer (R32) and a series resistor (R31) across the 28 Vdc source. While holding the switch, adjust R31 for a reading of 100 on the meter. The meter pointer should fall to zero when the switch is released.

The meter will now indicate the position and the direction of movement for any selected driven tuning component (excepting the visual IPA plate tuning capacitor).

Metering and Auxiliary Circuits

Meter Panel

References. The various circuits of the meter panel are shown in figure 2-3, Schematic, Amplifier Cabinet MI-560577A; figure 2-19 shows a pictorial view to aid in identifying and locating component parts.

Circuit description. There are seven meters on the Amplifier Cabinet meter panel.

1. AURAL REFLECTOMETER, M1 – this meter has a 4-position selector switch (S36) with the following positions:

   a. OFF

   b. PWR – indicates forward aural power as detected by the incident coupler of the aural reflectometer (refer to the System Operating Instructions book, "Aural Output Reflectometer Calibration," for setting up the reflectometer).

   c. VSWR – indicates aural VSWR as detected by the reflected coupler of the aural reflectometer.

   d. VSWR CAL – provides a means for calibrating the VSWR indicating circuit (refer to the System Operating Instructions book, "Aural Output Reflectometer Calibration").

2. AUR PA PLATE, M2 – installed in the cathode circuit of the aural PA tube, this meter indicates plate current for the stage.

3. AUR IPA PLATE, M3 – in series with the cathode return of the aural IPA tube, this meter reads plate current for the stage.

4. VIS IPA PLATE, M4 – connected across the lower half of a resistive voltage divider (R11 and R12), this meter indicates plate voltage for the visual IPA.

5. VIS IPA PLATE, M5 – in series with the high-voltage lead to the visual IPA, this meter reads plate current for the stage.

6. VIS PA PLATE, M6 – in series with the high-voltage return for the visual PA cathode, this meter reads plate current for the stage.

7. VISUAL REFLECTOMETER, M7 – this meter has a 4-position selector switch (S37) with the following positions:

   a. OFF

b. PWR – indicates forward visual power as detected by the incident coupler of the visual reflectometer (refer to the System Operating Instructions book, "Visual Output Reflectometer Calibration," for setting up the reflectometer).

c. VSWR – indicates visual VSWR as detected by the reflected coupler of the visual reflectometer.

d. VSWR CAL – provides a means for calibrating the VSWR indicating circuit (refer to the System Operating Instructions book, "Visual Output Reflectometer Calibration").

In addition to the seven meters, there are two indicator lamps located on the meter panel. The EXCITER indicator is lit when the 5 Watt Exciter and the 20 Watt Amplifier are energized; the VIS IPA BIAS indicator lights when the proper level of grid biasing has been applied to the visual IPA tube.

Tuning Multimeter

The tuning multimeter consists of a meter (M8), a meter reverse switch (S4), and a 20-position selector switch (S1A and B).

References. The circuit of the tuning multimeter is shown in figure 2-3, Schematic, Amplifier Cabinet MI-560577A; front and rear pictorial views are shown in figure 2-17 and figure 2-18, respectively, to aid in identifying and locating component parts.

Circuit description. Various voltage multipliers and current shunts are connected to the selector switch of the tuning multimeter. Any one of 16 transmitter parameters may be read from the multimeter by setting the selector switch to the respective position; there are four unused positions designated as OFF.

The selector switch positions and the corresponding meter ranges are as follows:

1. AURAL PA FIL VOLTS . . . . 0 - 10 V
2. VISUAL PA FIL VOLTS . . . . 0 - 10 V
3. 28 VOLT SUPPLY . . . . 0 - 30 V
4. AURAL IPA GRID CUR . . . . 0 - 100 mA
5. AURAL IPA SCREEN VOLTS . . . . 0 - 1000 V
6. OFF
7. AURAL IPA SCREEN CUR . . . . 0 - 30 mA
8. OFF
9. AURAL PA GRID CUR . . . . 0 - 1 A
10. TUNING INDICATION . . . . 0 - 100
11. VISUAL IPA BIAS . . . . 0 - 100 V
12. VISUAL IPA CATH CUR (1) . . . . 0 - 1 A
13. VISUAL IPA CATH CUR (2) . . . . 0 - 1 A
14. VISUAL IPA SCREEN VOLTS (1) . . . . 0 - 1000 V
15. VISUAL IPA SCREEN VOLTS (2) . . . . 0 - 1000 V
16. VISUAL IPA SCREEN CUR (1) . . . . 0 - 100 mA
17. VISUAL IPA SCREEN CUR (2) . . . . 0 - 100 mA
18. VISUAL PA GRID CUR . . . . 0 - 1 A
19. OFF
20. OFF

Excitation Reflectometers

The excitation reflectometers provide incident and reflected output power metering for the 5 Watt Exciter and the 20 Watt Amplifier modular sub-systems. These metering circuits are located on the Amplifier Cabinet front panel, below the tuning multimeter panel.

References. The circuits of the two excitation reflectometers are shown in figure 2-3, Schematic, Amplifier Cabinet MI-560577A; figure 2-18 shows a pictorial view to aid in identifying and locating component parts.

Circuit descriptions. The aural excitation reflectometer includes a meter (M9), a 4-position selector switch (S25), and calibration potentiometers (R33, R34, R35, and R36). The selector switch determines which parameter is to be read on the meter, and the calibration resistors are used as adjustable meter multipliers.

In switch position 1 (5W-PWR), the incident output port of directional coupler Z1 is applied to the meter via R33; position 2 (5W-VSWR), reflected port of Z1, via R34; position 3 (20W-PWR), incident port of Z2, via R35; position 4 (20W-VSWR), reflected port of Z2, via R36.

The visual excitation reflectometer includes a meter (M10), a 4-position selector switch (S26), and calibration potentiometers (R37, R38, R39, and R40). The selector switch determines which parameter is to be read on the meter, and the calibrating resistors are used as adjustable meter multipliers.

In switch position 1 (5W-PWR), the incident output port of directional coupler Z3 is applied to the meter via R37; position 2 (5W-VSWR), reflected port of Z3, via R38; position 3 (20W-PWR), incident port of Z4, via R39; position 4 (20W-VSWR), reflected port of Z4, via R40.

The procedure for adjusting the calibration potentiometers of the excitation reflectometers is given in the System Operating Instructions book, "Exciter /20 Watt Amplifier Reflectometer Calibration."

Auxiliary Circuits

A number of auxiliary circuits are located in the Amplifier Cabinet for the protection of the equipment as well as for the protection and convenience of the operator. These circuits are shown in various locations on the Amplifier Cabinet schematic, figure 2-3, and assembly view, figure 2-9.

Electrical Interlocks. To ensure adequate cooling for the power tubes in the Amplifier Cabinet, a differential-pressure switch (S31) is located in the cooling air path, inside the aural PA cavity; another differential-pressure switch (S32) is similarly located in the visual PA cavity.

The differential-pressure switch for the aural PA cavity air-interlock (S31) has an adjustable actuating range of 0.5 to 2.0 in. H_2O; for the visual PA cavity air-interlock, the adjustable range is 1.2 to 5.0 in. H_2O. These switches are set during factory testing of the transmitter; however, they may be adjusted for closer settings according to the elevation of the geographic location of the transmitter. For air pressure requirements at various altitudes, refer to the table in the System Operating Instructions book, "Adjustments and Tuning."

Any doors or access panels which, when opened, would expose personnel to lethal voltages, are fitted with a high-voltage interlock switch. These switches are wired in series so that opening any one of them breaks the interlock string, shutting down the transmitter high-voltage circuits.

WARNING

These interlock switches do *not* eliminate the need for using a grounding stick. Before doing any work inside the cabinet *use the grounding stick* on all high-voltage components.

The following high-voltage interlock switches are located in the Amplifier Cabinet:

1. Meter panel – S27 and S28
2. Rear cabinet doors – S29, S30, S33, and S34
3. Aural RF unit access panel – S101 and S102
4. Visual IPA access panel – S201 and S202

Because the meter panel must be raised before the visual PA access panel can be opened, the meter panel high-voltage interlock switches guard this area.

Exhaust fan and overtemperature alarm. An exhaust fan (B1) is located in the top panel of the Amplifier Cabinet. This fan draws air through the cabinet, preventing the build up of heat.

The FL transmitters are designed to operate properly with surrounding air temperatures up to 113°F (45°C). To avoid component damage due to excessively high internal cabinet temperatures, a temperature actuated switch (S35) is located in the cabinet air stream. The switch is provided for operating an alarm. (The alarm may be any device, such as a buzzer or a flashing light, but it is not supplied with the transmitter.)

The overtemperature alarm switch is rated to open a contact when the air inside the cabinet reaches a temperature of 128±5°F (53±3°C), and to reopen the contact when the temperature drops to 118±5°F (48±3°C). The switch contact rating is 25 amperes at 120/240 volts AC.

Screen voltage interlock. When the transmitter is turned on, relay K4 is energized. Contacts of K4 connect the two outputs of the dual-output screen power supply to the screen-grid circuits.

The coil of K4 is energized via the module-interlock system in the Video Modulator frame. Should any one of the modules be removed from the frame, the interlock is broken, and K4 is de-energized. The contacts of K4 transfer the outputs of the screen supply to a pair of 500 ohm resistors (R64 and R402).

These resistors will momentarily draw excessive current from the screen supply which will actuate the LV (low voltage) overload relay in the Control Cabinet. Resistor R62 serves as a current shunt for the relay. This function will shut down the plate and screen power supplies of the transmitter. (Refer to the Control Cabinet section of this book for a description of the overload function.)

Video feedback clamp. A small probe, mounted on the side wall of the visual PA cavity, samples the modulated output of the final amplifier. This sample is detected by diode CR16 and fed through a low-pass filter, consisting of Capacitors C17 and C18 and resistor R68. The detected video is then "fed-back" to the video output module, forming a closed-loop output power regulator.

Potentiometer R70 provides a means for adjusting the level of fed-back video. For an adjustment procedure, refer to the System Operating Instructions book, "Video Performance Adjustments."

Filament overload relays. There are three thermal overload relays protecting the filament power supplies: K3 for the visual PA circuit, K12 for the aural PA circuit, and K2 for the three visual and aural IPA circuits.

Each relay consists of three heater elements, one placed in each of the three-phase power lines, and one normally closed contact. Should any filament circuit draw excessive current for any reason, the heater elements involved will open the related contact. Tied in with circuitry in the Control Cabinet, the opening of any one of the filament overload relay contacts will shut down the transmitter. Refer to the Control Cabinet section of this manual for details regarding this function.

Utility outlets. A pair of standard AC utility outlets are made available at the front and rear of the Amplifier Cabinet. They are intended to provide AC power for test equipment.

ADJUSTMENTS

Filament Transformers

Wiring connections and output ratings for the filament transformers are shown in table 2-2. For a description of how these transformers are used, refer to "Power Supplies, Filament Power Supplies."

Tuning Motor Clutch Adjustment

The tuning motor slip clutches used in the Amplifier Cabinet are initially adjusted for proper performance during factory testing of the transmitter. Typical torque settings are given in table 2-3. If a clutch should begin to slip excessively, it can be readjusted as follows:

1. Locate the faulty tuning motor assembly in the cabinet. (See figure 2-13, Assembly, Aural RF Unit; figure 2-9, Assembly, Visual IPA; figure 2-11, Assembly, Visual PA.)

2. Using special wrenches (RCA part no. 3730278-1 – item 6, Installation Material, MI-560585 or MI-560588), loosen the large nut furthest from the clutch.

3. Tighten the nut closest to the clutch a fraction of a turn. Do not compress the spring washer more than 0.02" at one time.

4. Retighten the lock nut that was loosened in step 2.

5. Operate the tuning motor and determine whether the problem has been corrected. If it has not, repeat the procedure as required.

MAINTENANCE

General

With ordinary care, a minimum of service will be required to keep the Amplifier Cabinet in operation. The following recommended schedule can be correlated with other equipment maintenance programs.

WARNING

For personal safety, make certain that all equipment is turned off and that all filter capacitors have been discharged with a grounding stick.

Daily

1. Make a general visual inspection for abnormalities after each shutdown.

2. At startup, check the meter readings for the proper operating values.

3. If overloads have occurred, examine each component concerned, during shutdown, and repair or replace as required.

4. Check regularly for proper filament voltages.

Weekly

Clean the internal parts of the Amplifier Cabinet. Use a clean, soft cloth and a solvent, such as trichlorethylene, where needed. A vacuum cleaner is best for removing dust or grit; a blower will only suspend the particles and allow them to resettle on the equipment.

Monthly

Check condition of relay contacts where accessible, and inspect tuning motor drives for signs of wear; service or replace as necessary.

Semi-Annually

1. Inspect the relay contacts and service or replace them as required.

2. Check all connections for tightness, paying special attention to all pressure-type terminals.

3. Lubricate the tuning-motor right-angle and roller-chain drive trains. A dry lubricant, such as powdered molybdenum disulphide (RCA stock no. 208040), is recommended. This can be mixed with either xylene or carbon tetrachloride for application to the drive trains.

Relays

Periodically inspect all relays. Small relays having silver-to-silver contacts require little attention, but they may have to be replaced if tip wear becomes excessive. Filing or other methods of dressing the tip results in loss of silver, and is to no advantage.

Relay contacts should be cleaned with trichlorethylene applied with a stiff brush. Follow with a burnishing tool, such as RCA Contact Cleaning Tool, part no. 22963. Finally, wipe the contacts with clean bond paper.

Cleaning Silver-Plated Surfaces

Take care when removing dust from silver-plated surfaces as they are easily scratched. Oxidized silver is a good electrical conductor and does not require cleaning, unless it becomes contaminated by a foreign substance.

If the oxidation must be removed, use a non-abrasive polish. Apply the polish over a small area at a time, carefully removing all residue with a clean, soft cloth.

TABLE 2-1. MOTOR OPERATED TUNING CONTROLS

Function	Motor	Rocker Switch	Tuning Indication Potentiometer
AUR PA PLATE	B102	S5	R121
AUR PA OUTPUT	B103	S6	R122
AUR IPA PLATE	B101	S7	B120
VIS MOD AMPL PLATE	B201	S8	–
VIS PA PLATE	B301	S9	R310
VIS PA OUTPUT	B303	S10	R312
VIS PA BANDWIDTH	B302	S11	R311
VIS MOD AMPL OUTPUT	B203	S12	R222
VIS MOD AMPL BANDWIDTH	B202	S13	R221

TABLE 2-2. FILAMENT TRANSFORMERS

Symbol	Terminals	Primary Voltage	Current	Terminals	Secondary Voltage	Current
T1[1]	H1,H2,H3	230[3]	3.0[4]	X1,X2,X3	7.6[3]	85.0[4]
T1[2]	H1,H2,H3	230[3]	4.2[4]	X1,X2,X3	6.9[3]	140.0[4]
T2	H1,H2,H3	230[3]	1.6[4]	X1,X2,X3	7.6[3]	45.0[4]
T3	1,6[5]	230[6]	–	7,11	7.5[6]	10.0[6]
T4	1,6[5]	230[6]	–	7,11	7.5[6]	10.0[6]
T5	1,6[5]	230[6]	–	7,11	7.5[6]	10.0[6]

1. TT-15FL/30FL.
2. TT-25FL.
3. Three-phase, volts AC, each line.
4. Each line, amps AC.
5. Terminals 3 and 4 tied together.
6. Single-phase, volts/amps AC.

TABLE 2-3. TYPICAL TUNING MOTOR CLUTCH TORQUE SETTINGS

Motor Number	Torque Setting
B101	6.0 in. lb.
B102	8.0 in. lb.
B103	4.5 in. lb.
B201	No Clutch
B202	4.0 in. lb.
B203	4.0 in. lb.
B301	10.0 in. lb.
B302	4.5 in. lb.
B303	6.5 in. lb.

REPLACEMENT PARTS LIST

The components listed in the replacement parts list are identified by one of two methods, depending on whether the component is a mechanical or an electrical part. Electrical parts are assigned a standard electrical symbol, and are listed in alphanumerical sequence. Mechanical parts are assigned a numerical symbol (8, 17, 25, etc.) that corresponds with the item number on the mechanical assembly drawing where that particular part is located.

REPLACEMENT PARTS LIST

Symbol	*Stock No.*	*Drawing No.*	*Description*
			Amplifier Cabinet MI-560577A
			M/L 3459976-505 REV 33
Electrical			
A1		3732684-001	POWER SUPPLY
B1	247475	3730660-001	FAN - EXHAUST
B2	246040	3459943-004	MOTOR - PLANETARY GEAR
	246041	3459943-102	BRUSH
	246042	3459943-101	SPRING
			CAPACITORS
C1 TO			
C10	205656	1510003-037	CERAMIC, .01 UF, METER BYPASS
C11	430227	3726200-028	3.2 MF 7500 V
C12	205656	1510003-037	CERAMIC, .01 MF
C13	205656	1510003-037	CERAMIC, .01 MF
C17	99162	993026-420	SILVER MICA, 20 PF 500 V
C18	79191	993026-449	SILVER MICA, 330 PF 500 V
CR1		3732748-001	RECTIFIER ASSEMBLY - FILAMENT
	218600		RECTIFIER - TYPE 1N4587, SILICON
	218599		RECTIFIER - TYPE 1N4587R, SILICON
CR1A			
TO			
CR1F			RECTIFIER - SILICON, PART OF CR1
CR2		3732748-001	RECTIFIER ASSEMBLY - FILAMENT
	218600		RECTIFIER - TYPE 1N4587, SILICON
	218599		RECTIFIER - TYPE 1N4587R, SILICON
CR2A			
TO			
CR2F			RECTIFIER - SILICON, PART OF CR2
CR4	421933		DIODE - TYPE 1N21WE, PART OF Z1
CR5	421933		DIODE - TYPE 1N21WE, PART OF Z1
CR6	421933		DIODE - TYPE 1N21WE, PART OF Z2
CR7	421933		DIODE - TYPE 1N21WE, PART OF Z2
CR8	421933		DIODE - TYPE 1N21WE, PART OF Z3
CR9	421933		DIODE - TYPE 1N21WE, PART OF Z3
CR10	421933		DIODE - TYPE 1N21WE, PART OF Z4
CR11	421933		DIODE - TYPE 1N21WE, PART OF Z4
CR16	229936		DIODE - TYPE 1N914, DETECTOR FEEDBACK CLAMP
CR17	431463	3726161-016	RECTIFIER - SILICON
DS1A	236278	3452325-015	LAMP INDICATOR 28 V
DS1C	236278	3452325-015	LAMP INDICATOR 28 V
DS2A	236278	3452325-015	LAMP INDICATOR 28 V
DS2C	236278	3452325-015	LAMP INDICATOR 28 V
DS14			
TO			
DS22	223402	8890654-010	LAMP - INDICATOR, 28 V
HR1	427769	3730501-023	HEATER - IPA FILAMENT OVERLOAD
HR2	427769	3730501-023	HEATER - IPA FILAMENT OVERLOAD
HR3	427769	3730501-023	HEATER - IPA FILAMENT OVERLOAD
HR4	427770	3730501-024	HEATER - AUR PA FILAMENT OVERLOAD
HR5	427770	3730501-024	HEATER - AUR PA FILAMENT OVERLOAD
HR6	427770	3730501-024	HEATER - AUR PA FILAMENT OVERLOAD
HR7			HEATER - VIS PA FIL O/L, PART OF PD KIT
HR8			HEATER - VIS PA FIL O/L, PART OF PD KIT
HR9			HEATER - VIS PA FIL O/L, PART OF PD KIT
J1			CONNECTOR - RECEPTACLE, PART OF Z1
J2			CONNECTOR - RECEPTACLE, PART OF Z1
J3			CONNECTOR - RECEPTACLE, PART OF Z2
J4			CONNECTOR - RECEPTACLE, PART OF Z2
J5			CONNECTOR - RECEPTACLE, PART OF Z3
J6			CONNECTOR - RECEPTACLE, PART OF Z3
J7			CONNECTOR - RECEPTACLE, PART OF Z4
J8			CONNECTOR - RECEPTACLE, PART OF Z4

Symbol	Stock No.	Drawing No.	Description
J9			CONNECTOR - RECEPTACLE, PART OF Z1
J10			CONNECTOR - RECEPTACLE, PART OF Z3
J11			CONNECTOR - RECEPTACLE, PART OF Z1
J12			CONNECTOR - RECEPTACLE, PART OF Z5
J13			CONNECTOR - RECEPTACLE, PART OF Z2
J14			CONNECTOR - RECEPTACLE, PART OF Z2
J15			CONNECTOR - RECEPTACLE, PART OF Z3
J16			CONNECTOR - RECEPTACLE, PART OF Z6
J17			CONNECTOR - RECEPTACLE, PART OF Z4
J18			CONNECTOR - RECEPTACLE, PART OF Z4
J21 TO			
J24	430034	993150-201	CONNECTOR - RECEPTACLE, BNC FEMALE
J25 TO			
J29	51800	1510021-111	CONNECTOR - RECEPTACLE, UHF FEMALE
J30	211510	481799-002	CONNECTOR - RECEPTACLE, 2 PIN, FEMALE
J31	223652	3532127-001	CONNECTOR - RECEPTACLE, UHF FEMALE
J102	430034	993150-201	JACK - BNC
J203	430034	993150-201	JACK - BNC
K2	243454	3720472-001	RELAY FILAMENT OVERLOAD
K3	243454	3720472-001	RELAY FILAMENT OVERLOAD
K4	427188	3724678-001	RELAY - SCREEN
K12	243454	3720472-001	RELAY - FILAMENT OVERLOAD
M1	235857	993064-007	REFLECTOMETER - AURAL
M2	229895	993052-153	METER - AUR PA PLATE CURRENT 0-2A
M3	247478	993051-118	METER - AUR IPA PLATE CURRENT 0-800 MA
M4	238035	993053-123	METER - VIS MOD AMPL PLATE VOLTS 0-3000 V
M5	247477	993052-103	METER - VIS MOD AMPL PLATE CURRENT 0-2A
M6	230072	993052-155	METER - VIS PA PLATE CURRENT 0-5A
M7	235857	993064-007	REFLECTOMETER - VISUAL
M8	235835	993064-005	MULTIMETER
M9	247499	993084-002	REFLECTOMETER - AURAL EXCITER
M10	247499	993084-002	REFLECTOMETER - VISUAL EXCITER
P1			PLUG - PART OF Z1
P2			PLUG - PART OF Z1
P3			PLUG - PART OF Z2
P4			PLUG - PART OF Z2
P5			PLUG - PART OF Z3
P6			PLUG - PART OF Z3
P7			PLUG - PART OF Z4
P8			PLUG - PART OF Z4
P9	242871	1510013-222	ADAPTER - RIGHT ANGLE BNC
P10	242871	1510013-222	ADAPTER - RIGHT ANGLE BNC
P11 TO			
P18	430033	993150-002	PLUG - MALE, BNC
P19			PLUG - PART OF Z5
P20			PLUG - PART OF Z6
P29	431268	993208-001	PLUG - MALE, UHF
P31	431268	993208-001	PLUG - MALE, UHF
10P5	431268	993208-001	CONNECTOR - UHF
10P6	431268	993208-001	CONNECTOR - UHF
10P7	431268	993208-001	CONNECTOR - UHF
10P8	431268	993208-001	CONNECTOR - UHF
10P10	428029	3720240-012	CONNECTOR - RECEPTACLE, 15 CONTACT
20P12	428029	3720240-012	CONNECTOR - RECEPTACLE, 15 CONTACT
20P13	430033	993150-002	CONNECTOR - BNC
10P16	431468	993150-061	CONNECTOR - BNC
20P14	430033	993150-002	CONNECTOR - BNC
20P15	211509	481799-001	CONNECTOR - MALE, 2 CONDUCTOR
30P9	428029	3720240-012	CONNECTOR - RECEPTACLE, 15 CONTACT
30P10			
TO			
30P13	430033	993150-002	CONNECTOR - BNC
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1 TO			
R6	247485	3459807-002	WIREWOUND, 16 OHMS 300 W
R7	247486	3459807-003	WIREWOUND, 20 OHMS 300 W

Symbol	Stock No.	Drawing No.	Description
R8	247485	3459807-003	WIREWOUND, 20 OHMS 300 W
R10	247483	3459805-006	WIREWOUND, 100 OHMS 225 W
R11	230816	8702674-506	RESISTOR ASSEMBLY - 3 MEGOHM
R12	522422	99126-090	220,000 OHMS 10% 2 W
R13	229791	8702674-511	RESISTOR ASSEMBLY - 8 MEGOHM
R14	522422	99126-090	220,000 OHMS 10% 2 W
R15	217614	8871557-053	WIREWOUND, 1250 OHMS 1 W
R16	229791	8702674-511	RESISTOR ASSEMBLY - 8 MEGOHM
R17	522422	99126-090	220,000 OHMS 10% 2 W
R18	217614	8871557-053	WIREWOUND, 1250 OHMS 1 W
R19	247482	3459805-005	WIREWOUND, 100,000 OHMS 225 W
R20	247482	3459805-005	WIREWOUND, 100,000 OHMS 225 W
R21	247482	3459805-005	WIREWOUND, 100,000 OHMS 225 W
R22	427768	3730568-005	RESISTOR ASSEMBLY
R22A			5 OHMS, PART OF R22
R22B			5 OHMS, PART OF R22
R22C			5 OHMS, PART OF R22
R23	247723	3730568-002	RESISTOR TANDEM ASSEMBLY
R23A			25 OHMS, PART OF R23
R23B			25 OHMS, PART OF R23
R23C			25 OHMS, PART OF R23
R24	239400	8946290-002	WIREWOUND, VARIABLE, 250 OHMS 25 W
R25	239400	8946290-002	WIREWOUND, VARIABLE, 250 OHMS 25 W
R26	239400	8946290-002	WIREWOUND, VARIABLE, 250 OHMS 25 W
R27	230163	993007-086	WIREWOUND, 1800 OHMS 10% 5 W
R28	230163	993007-086	WIREWOUND, 1800 OHMS 10% 5 W
R31	502413	82283-210	130,000 OHMS 5% 1/2 W
R32	231325	8868256-059	VARIABLE, 25,000 OHMS 1/2 W
R33 TO R40	234737	8868256-047	VARIABLE, 50,000 OHMS 1/2W
R41			VARIABLE, 500,000 OHMS, PART OF S23
R42			VARIABLE, 500,000 OHMS, PART OF S24
R43	222928	8868256-082	VARIABLE, 1 MEGOHM 1/2 W
R44	222928	8868256-082	VARIABLE, 1 MEGOHM 1/2 W
R45			PART OF A201, L/P 3459972
R46			PART OF A201, L/P 3459972
R47	248756	3720483-026	WIREWOUND, 3000 OHMS 5% 25 W
R48	18954	204777-023	WIREWOUND, 5000 OHMS 10% 50 W
R49	248756	3720483-026	WIREWOUND, 3000 OHMS 5% 25 W
R51	512022	90496-042	22 OHMS 10% 1 W
R52	512022	90496-042	22 OHMS 10% 1 W
R53			PART OF A201, L/P 3459972
R54	247490	3720145-202	WIREWOUND, 0.4 OHMS 1% 10 W
R55	247490	3720145-202	WIREWOUND, 0.4 OHMS 1% 10 W
R56	223725	8868256-050	VARIABLE, 500,000 OHMS 1/2 W
R57	223725	8868256-050	VARIABLE, 500,000 OHMS 1/2 W
R58 TO R61	240497	990475-435	FILM, 22,600 OHMS 1% 1/4 W
R62	213105	90496-567	4.7 OHMS 5% 1 W
R63	233934	3459805-009	WIREWOUND, 5000 OHMS 10% 225 W
R64	248747	3459805-010	WIREWOUND, 500 OHMS 10% 225 W
R65	248746	990476-517	FILM, 147,000 OHMS 1% 1/2 W
R66	233301	993007-045	WIREWOUND, 16 OHMS 6.5 W
R67	522051	99126-128	51 OHMS 5% 2 W
R68	502112	82283-137	120 OHMS 5% 1/2 W
R69	502310	82283-183	10,000 OHMS 5% 1/2 W
R70	223975	8868256-042	VARIABLE, 1000 OHMS 1/2 W
R71 TO R74	502447	82283-223	470,000 OHMS 5% 1/2 W
R91A			PART OF S36
R91B			PART OF S36
R92	502510	82283-231	1 MEGOHM 1/2 W
R95A			PART OF S37
R95B			PART OF S37
R96	502510	82283-231	1 MEGOHM 1/2 W
R401	233934	3459805-009	WIREWOUND, 5000 OHMS 10% 225 W
R402	248747	3459805-010	WIREWOUND, 500 OHMS 10% 225 W
R403			PART OF A201, L/P 3459972
R404			PART OF A201, L/P 3459972
R405			PART OF A201, L/P 3459972

Symbol	Stock No.	Drawing No.	Description
S1	248749	3720477-001	SWITCH - METERING
S2	230770	8520610-002	SWITCH - PUSHBUTTON, CALIBRATE
S3	230770	8520610-002	SWITCH - PUSHBUTTON, CLEAR
S4	247496	3459945-001	SWITCH - PUSHBUTTON, METER REVERSE
S5	247495	8498764-006	SWITCH - AUR PA PLATE TUNE
S6	247495	8498764-006	SWITCH - AUR PA OUTPUT TUNE
S7	247495	8498764-006	SWITCH - AUR IPA PLATE TUNE
S8	247495	8498764-006	SWITCH - VIS MOD AMPL PLATE TUNE
S9	247495	8498764-006	SWITCH - VIS PA PLATE TUNE
S10	247495	8498764-006	SWITCH - VIS PA OUTPUT TUNE
S11	247495	8498764-006	SWITCH - VIS PA BANDWIDTH
S12	247495	8498764-006	SWITCH - VIS MOD AMPL OUTPUT TUNE
S13	247495	8498764-006	SWITCH - VIS MOD AMPL BANDWIDTH
S14 TO S22	247494	3459947-001	SWITCH - SELECT TUNING
	223402	8890654-010	LAMP - FOR S14 TO S22
S25	247497	3730493-001	SWITCH - AUR EXC REFLECTOMETER
S26	247497	3730493-001	SWITCH - VIS EXC REFLECTOMETER
S27	246033	449258-002	SWITCH - INTERLOCK METER PANEL
S28	246033	449258-002	SWITCH - INTERLOCK METER PANEL
S29	246033	449258-002	SWITCH - INTERLOCK REAR DOOR
S30	246033	449258-002	SWITCH - INTERLOCK REAR DOOR
S31	234486	3467618-003	SWITCH - AIR INTERLOCK AUR PA
S32	235838	3467618-001	SWITCH - AIR INTERLOCK VIS PA
S33	246033	449258-002	SWITCH - INTERLOCK REAR DOOR
S34	246033	449258-002	SWITCH - INTERLOCK REAR DOOR
S35	209623	8868062-005	SWITCH - OVER TEMPERATURE
S36	418045	3732079-001	SWITCH - AURAL REFLECTOMETER
S37	418045	3732079-001	SWITCH - VISUAL REFLECTOMETER
T1			TRANSFORMER - VIS PA FIL, PART OF PD KIT
T2	427935	3732706-001	TRANSFORMER - AURAL PA FILAMENT
T3	247493	3458408-001	TRANSFORMER - FILAMENT, VIS MOD AMPL 1
T4	247493	3458408-001	TRANSFORMER - FILAMENT, VIS MOD AMPL 2
T5	247493	3458408-001	TRANSFORMER - FILAMENT, AUR IPA
TB1		990604-128	TERMINAL - BOARD
TB2		990604-128	TERMINAL - BOARD
TB3		990607-053	TERMINAL - BOARD
TB4	921953	430313-007	TERMINAL - BOARD, BARRIER TYPE
TB5		990603-101	TERMINAL - BOARD
TB6		3458888-004	TERMINAL - BOARD
TB7		990602-136	TERMINAL - BOARD
W6			CABLE ASSEM. - P/O FD KIT MI-561283
XDS1	236360	3455201-001	SOCKET - INDICATOR, EXCITER
XDS2	236360	3455201-001	SOCKET - INDICATOR, MOD AMPL BIAS
XDS14			SOCKET - INDICATOR, PART OF S14
XDS15			SOCKET - INDICATOR, PART OF S15
XDS16			SOCKET - INDICATOR, PART OF S16
XDS17			SOCKET - INDICATOR, PART OF S17
XDS18			SOCKET - INDICATOR, PART OF S18
XDS19			SOCKET - INDICATOR, PART OF S19
XDS20			SOCKET - INDICATOR, PART OF S20
XDS21			SOCKET - INDICATOR, PART OF S21
XDS22			SOCKET - INDICATOR, PART OF S22
XV1A/B		3724988-001	RECEPTACLE - UTILITY OUTLET
XV2A/B		3724988-001	RECEPTACLE - UTILITY OUTLET
Z1	247491	3459941-001	DIRECTIONAL - COUPLER, 5 W
Z2	248753	3459941-002	DIRECTIONAL - COUPLER, 20 W
Z3	247491	3459941-001	DIRECTIONAL - COUPLER, 5 W
Z4	248753	3459941-002	DIRECTIONAL - COUPLER, 20 W
Z5	422601	3454871-001	ATTENUATOR COAXIAL, 15 WATTS
Z6	422601	3454871-001	ATTENUATOR COAXIAL, 15 WATTS

Symbol	Stock No.	Drawing No.	Description
			M/L 3720009-504 REV 51
Mechanical			
23	235844	3467690-506	KNOB ASSEMBLY
25	231058	8549962-501	KNOB ASSEMBLY
39	426290	8522915-001	MOUNTING BARRIER - SHORT
40	231128	8494089-011	DISPLAY SCREEN
41	235846	8494089-056	DISPLAY SCREEN
44	231146	8544613-001	STUD
59	210281	426767-009	INSULATOR - 0.75 DIA X 1.50 LG
61	208116	426765-012	INSULATOR - 0.38 DIA X 1.00 LG
62	231037	8544755-001	LENS
82	247476	3730660-002	GUARD - SCREEN
88	247453	3469644-004	BRACKET ASSEMBLY
	419636	3469644-009	BUSHING, PORCELAIN CORE SZ 1.12 OD X .75 ID
	418453	3469644-010	BUSHING, PORCELAIN SIZE .75 OD X .50 ID
93	210376	426766-009	INSULATOR - 0.50 DIA X 1.00 LG
94	246052	3730418-004	HOSE - AIR, 0.88 I.D. X 1.25 O.D. 11 IN LG
95	246053	3730418-005	HOSE - AIR, 2.00 I.D. X 2.50 O.D. 7 IN LG
96	246054	3730418-006	HOSE - AIR, 2.00 I.D. X 2.50 O.D. 15.50 IN LONG
97	246049	3730417-001	FITTING - AIR HOSE
99	246051	3730417-003	FITTING - AIR HOSE
111	418059	3456825-001	CONNECTOR
114	418454	3450427-003	WASHER - SPRING
116	51411	8888539-124	SCREW - SET, 6-32 X 0.31 LG
117	70527	8888539-122	SCREW - SET, 6-32 X 0.19 LG
130	242872	1510032-029	GROMMET
131	94418	897258-004	CLAMP - HOSE
133	56964	897258-006	CLAMP - HOSE
134	236254	480099-503	TUBE ASSEMBLY
135	240123	480099-510	TUBE ASSEMBLY
199	248849	3467690-512	KNOB ASSEMBLY
200	246048	3730445-501	KNOB ASSEMBLY
201	235843	3467690-507	KNOB ASSEMBLY
202	233871	480368-008	STUD - TURNLOCK FASTENER
204	94641	8914329-001	RECEPTACLE
211	233726	897258-005	CLAMP - HOSE
212			MI-27791-K2A ELBOW, 90 DEGREE
213			MI-27791-K4A COUPLING ASSEMBLY
217	55913	897258-003	CLAMP - HOSE
244	246055	3730411-001	FLEX - BOLT MOUNTING
262	242704	8895491-501	CONNECTOR ASSEMBLY
263	97902	897258-011	CLAMP - HOSE
274	418063	8549962-502	KNOB ASSEMBLY
475	249389	8811154-031	CLAMP - CABLE CLAMP
276			MI-561565-A 4A COUPLING 1 5/8
289	247898	3467668-003	GAUGE - PRESSURE AUR.
416	235849	3467668-002	GAGE - PRESSURE, VIS
463		1215610-019	CHANNEL - RUBBER
468	68349	1510021-161	HOOD
275			MI-561565-A 2A ELBOW 90 DEGREE 1 5/8
480	55803A	426768-103	INSULATOR, STANDOFF 1/4-20 THD. 1.25 LG.
484	208115	426765-109	INSULATOR
			TT-15FL/30FL Power Determining Kit MI-561289
			M/L 3724804-501 REV 2
HR7	427989	3730501-018	HEATER - OVLD VISUAL PA FIL (H28)
HR8	427989	3730501-018	HEATER - OVLD VISUAL PA FIL (H28)
HR9	427989	3730501-018	HEATER - OVLD VISUAL PA FIL (H28)
T1	427985	3732705-001	TRANSFORMER - VISUAL PA FIL
V301			TUBE 30X10000A7 (MI-34720)
6		3740161-502	CAPACITOR AND CONTACT ASSY VISUAL PA CAVITY

Symbol	Stock No.	Drawing No.	Description
		3740161-501	ASSEMBLY, CAPACITOR (PLATE)
	424571	3469816-001	CAPACITOR - 2 REQUIRED
	426138	3720450-001	INSULATOR - 8 REQUIRED
	426139	3724365-001	BUSHING - 8 REQUIRED
	427986	3742037-501	ASSEMBLY, CONTACT
			TT-25FL Power Determining Kit MI-561288
			M/L 3724804-502 REV 2
HR7	427988	3730501-025	HEATER - OVLD VISUAL PA FIL (H33)
HR8	427988	3730501-025	HEATER - OVLD VISUAL PA FIL (H33)
HR9	427988	3730501-025	HEATER - OVLD VISUAL PA FIL (H33)
T1	427984	3732704-001	TRANSFORMER - VISUAL PA FIL
V301			TUBE 30X2000A7 (MI-561277)
7		3740161-503	CAPACITOR AND CONTACT ASSY VISUAL PA CAVITY
		3740161-501	ASSEMBLY, CAPACITOR (PLATE)
	424571	3469816-001	CAPACITOR - 2 REQUIRED
	426138	3720450-001	INSULATOR - 8 REQUIRED
	426139	3724365-001	BUSHING - 8 REQUIRED
	424568	3469891-501	ASSEMBLY, CONTACT (LARGE TUBE)
			Visual Modulated Amplifier/IPA
			M/L 3459972-505 REV 17
Electrical			
A201		3732793-501	TERMINAL BOARD ASSEMBLY SEE BREAKDOWN OF DWG 3732793-501
A202		3459951-504	INPUT ASSEMBLY SEE BREAKDOWN OF DWG 3759951-504
B201	246040	3459943-004	MOTOR - PLATE TUNING
	246041	3459943-102	BRUSH
	246042	3459943-101	SPRING
B202	246039	3459943-002	MOTOR - OUTPUT TUNING
	246041	3459943-102	BRUSH
	246042	3459943-101	SPRING
B203	246039	3459943-002	MOTOR - BANDWIDTH TUNING
	246041	3459943-102	BRUSH
	246042	3459943-101	SPRING
			CAPACITORS
C201	246047	3459944-001	VARIABLE, 42-3.6 PF
C202	247880	3720298-004	VARIABLE, 78.4 PF
C203	247880	3720298-004	VARIABLE, 78.4 PF
C204	426152	993026-430	MICA, 51 PF 5%
C205 TO C211	224210	3401521-001	FILTER, FEED-THRU, 2500 PF
C219			SCREEN BY-PASS, PART OF XV201
C220			SCREEN BY-PASS, PART OF XV202
C221		3720451-501	CAPACITOR - NEUTRALIZING
C222		3720451-501	CAPACITOR - NEUTRALIZING
C223	242455	3456447-001	FEED THRU, 1000 PF 5 KV
C224	241487	3455474-026	FILM, .05 MF 5 KV
C225	921365	8849438-026	VACUUM VARIABLE, 4-250 PF 3KV
C226	921365	8849438-026	VACUUM VARIABLE, 4-250 PF 3KV
C228	248750	3732001-501	CAPACITOR - BUTTERFLY
C229	248754	3455474-011	FILM, .05 MF 2 KV
C231	426152	993026-430	MICA, 51 PF 5%
C234	426868	993026-468	MICA, 2000 PF 5% 500 V
C235	426868	993026-468	MICA, 2000 PF 5% 500 V
C237	418455	8524038-025	PAPER, 1 MF 200 V DC
C238	418455	8524038-025	PAPER, 1 MF 200 V DC
C241	224210	3401521-001	FILTER, FEED-THRU, 2500 PF

Symbol	Stock No.	Drawing No.	Description
C242	248754	3455474-011	FILM, .05 MF 2000 V
C243	223209	3720484-004	CERAMIC, 1000 PF 5000 V
C244	223209	3720484-004	CERAMIC, 1000 PF 5000 V
J201	209671	8414862-053	CONNECTOR - RECEPTACLE, FEMALE
J202	229115	1510020-172	CONNECTOR - TYPE N
J203	922928	1510013-133	CONNECTOR - TYPE BNC
J204	98261	1510013-172	CONNECTOR - TYPE BNC
J205	225222	3402822-003	CONNECTOR
J209	921358	1510013-162	CONNECTOR - TYPE BNC
J210	921358	1510013-162	CONNECTOR - TYPE BNC
K201	247500	3720263-001	RELAY - UNDER BIAS
L201			COIL - PART OF FD MI-561283-2 THRU 6
L202			COIL - PART OF FD MI-561283-2 THRU 6
L205			COIL - PART OF FD MI-561283-2 THRU 6
L206			COIL - PART OF FD MI-561283-2 THRU 6
L208		3724808-501	RF PLATE CHOKE
P201	217375	8414862-003	CONNECTOR - PLUG, MALE
P202	214000	1510020-104	CONNECTOR - PLUG
P203	242444	3456541-001	CONNECTOR - BNC UNICUT
P204	242444	3456541-001	CONNECTOR - BNC UNICUT
P205	247882	3720267-001	PLUG
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R206 TO			
R211	246034	90496-563	3.3 OHMS 5% 1 W
R212	522010	99126-038	10 OHMS 10% 2 W
R213	522010	99126-038	10 OHMS 10% 2 W
R214			PART OF A201
R215	512051	90496-128	51 OHMS 5% 1 W
R218	512256	90496-177	5600 OHMS 5% 1 W
R219	512256	90496-177	5600 OHMS 5% 1 W
R221	248741	3720396-003	POTENTIOMETER, 5000 OHMS 5%
R222	248741	3720396-003	POTENTIOMETER, 5000 OHMS 5%
R223	512051	90496-128	51 OHMS 5% 1 W
R224	512051	90496-128	51 OHMS 5% 1 W
R227	428016	3462448-124	WIREWOUND, VARIABLE, 10,000 OHMS 2 W
R228	95059	8888772-004	WIREWOUND, 50 OHMS 200 W
R229			PART OF A201
R230	423567	993120-105	150 OHMS 5% 7 W
R231	423567	993120-105	150 OHMS 5% 7 W
S201	246033	449258-002	SWITCH - INTERLOCK
S202	246033	449258-002	SWITCH - INTERLOCK
TB201		8441358-010	TERMINAL - BOARD
TB202		8441358-014	TERMINAL - BOARD
XK201	208505	99393-001	SOCKET - OCTAL
XV201	246046	3469704-001	SOCKET - TUBE TYPE 8791
	422045	3469704-002	SCREEN BYPASS ASSEMBLY-ONLY
	422046	3469704-003	CONTACT RING-GRID
	422047	3469704-004	CONTACT RING-OUTER FILAMENT
	422048	3469704-005	CONTACT-INNER FILAMENT
	422049	3469704-006	INSULATOR
XV202	246046	3469704-001	SOCKET - TUBE TYPE 8791
	422045	3469704-002	SCREEN BYPASS ASSEMBLY-ONLY
	422046	3469704-003	CONTACT RING-GRID
	422047	3469704-004	CONTACT RING-OUTER FILAMENT
	422048	3469704-005	CONTACT-INNER FILAMENT
	422049	3469704-006	INSULATOR

Symbol	Stock No.	Drawing No.	Description
			M/L 3459951-506 REV 30
Mechanical			
13	247595	3456875-001	BLOCK
14	247594	3456876-001	BLOCK
15	247593	3730609-001	BLOCK
16	247592	3730615-001	BLOCK
	430523		KIT, BLOCK - INCLUDES ITEMS 13, 14, 15, 16
21	233872	480368-007	STUD - TURNLOCK FASTENER
22	233869	8886047-003	WASHER - RETAINER
23		8914329-003	RECEPTACLE - TURNLOCK FASTENER
28	247601	748586-015	DRIVE
50	211160	8914845-501	CONTACT ASSEMBLY
52	97821	486041-010	TERMINAL - STUD
53	248850	3720179-501	CONTACT ASSEMBLY
54	248851	3720179-502	CONTACT ASSEMBLY
56	211247	426764-003	INSULATOR - BUSHING
57	211245	426764-053	INSULATOR - BUSHING
72	418059	3456825-001	CONNECTOR
76	418454	3450427-003	WASHER - SPRING
83	211371	426766-106	INSULATOR - 0.500 DIA X 0.75 LG
147	210376	426766-009	INSULATOR - 0.50 DIA X 1.00 LG
150	241121	7862770-009	CLIP - FUSE CLIP
152	210084	426773-003	INSULATOR - 0.75 SQ. X 1.00 LG.
181	213250	8811154-007	CLAMP
			Terminal Board Assembly (A201)
			M/L 3732793-501 REV 1
			RESISTORS
R45	246029	990477-639	2.49 MEGOHM 1% 1 W
R46	246029	990477-639	2.49 MEGOHM 1% 1 W
R53	512447	90496-094	470,000 OHMS 10% 1 W
R214	426649	3456544-004	10 OHMS 5% 11 W
R229	426649	3456544-004	10 OHMS 5% 11 W
R403	246029	990477-639	2.49 MEGOHM 1% 1 W
R404	246029	990477-639	2.49 MEGOHM 1% 1 W
R405	512447	90496-094	470,000 OHMS 10% 1 W
			Input Subassembly (A202)
			M/L 3459972-504 REV 17
Electrical			
C230	248752	3720296-001	CAPACITOR, VARIABLE 1-10PF
C239	224210	3401521-001	CAPACITOR, FILTER FEED-THRU 2500PF
C240	224210	3401521-001	CAPACITOR, FILTER FEED-THRU 2500PF
CR201	223462	3459955-001	DIODE, TYPE 1N2860
L209	57239	8890641-002	COIL, 0.84UH 1 AMP
R225	512256	90496-071	RESISTOR, 5600 OHM 10%, 1W
R226	247498	990475-568	RESISTOR, FILM 499K 1% 1/4W
			M/L 3459951-504 REV 30
Mechanical			
139	97902	897258-011	CLAMP-HOSE CLAMP
			Visual PA
			M/L 3459977-503 REV 14
Electrical			
B301	246038	3459943-001	MOTOR - PLATE TUNING
	246041	3459943-102	BRUSH
	246042	3459943-101	SPRING
B302	246038	3459943-002	MOTOR - OUTPUT TUNING

Symbol	Stock No.	Drawing No.	Description
	246041	3459943-102	BRUSH
	246042	3459943-101	SPRING
B303	246038	3459943-002	MOTOR - BANDWIDTH TUNING
	246041	3459943-102	BRUSH
	246042	3459943-101	SPRING
			CAPACITORS
C301	221716	8889785-003	FEED THRU, 1000 PF 3000 V
C302	54643	8881825-001	FEED THRU, .01 MF 250 V
C303	54643	8881825-001	FEED THRU, .01 MF 250 V
C304	246037	3455474-005	FILM, 0.25 MF 1000 V
C305	246037	3455474-005	FILM, .025 MFD 1000 V
C308			PART OF MI-561283-2 THRU 6
C309			PART OF MI-561283-2 THRU 6
C310			PART OF MI-561288/MI-561289
C311	230419	8494421-001	HIGH VOLTAGE FEED THRU, 1500 PF 15,000 VDC
C312	246031	3456325-002	VACUUM VARIABLE, 10-100 PF 7.5KV
C313	246031	3456325-002	VACUUM VARIABLE, 10-100 PF 7.5KV
C314	239169	3455474-041	FILM, .05 MF 10KV
C317	246037	3455474-005	FILM, .025 MFD 1000 V
C318	247857	3731187-006	ELECTROLYTIC, 1000 MF 50 V
C319	427767	3455474-003	.05 MFD 1000 V
L301			PA BOX CAVITY, PART OF 3720150
L302			PART OF MI-561283-2 THRU 6
L303			COIL - PART OF 3720150-163/137
L304			PART OF MI-561283-2 THRU 6
L305			PART OF MI-561283-2 THRU 6
P301	229115	3720164-001	CONNECTOR - TYPE N MPL 3720150-127-128
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R303	246043	3459978-001	3 OHMS 13 W
R304	246043	3459978-001	3 OHMS 13 W
R305	522012	99126-113	12 OHMS 5% 2 W
R308	522012	99126-113	12 OHMS 5% 2 W
R309	248739	993006-021	WIREWOUND, 1 OHMS 5% 12 W
R310	248741	3720396-003	RESISTOR - 5000 OHMS 5%
R311	248741	3720396-003	RESISTOR - 5000 OHMS 5%
R312	248741	3720396-003	RESISTOR - 5000 OHMS 5%
R313			
TO			
R327	522010	99126-111	10 OHMS 5% 2 W
V301			TUBE - 3CX2000, A7 MI-561277
XV301			SOCKET - MECHANICAL PARTS LIST 3720150 COMPOSED OF
	247596		3720150-029 INNER FILAMENT RING
	247600		3720150-031 OUTER FILAMENT RING
	247599		3720150-042 GRID RING
			M/L 3720150-503 REV 28
Mechanical			
29	247596	3730586-002	CONTACT ASSEMBLY - FILAMENT
31	247600	3730588-002	CONTACT ASSEMBLY - CATHODE
36	242701	8432395-502	COUPLING ASSEMBLY
41	418061	8914845-502	CONTACT ASSEMBLY
42	247599	3730460-002	GRID - CONTACT
46	418059	3456825-001	CONNECTOR
49	418454	3450427-003	WASHER - SPRING
52	418062	3730431-002	SCREW - LEAD
54	418452	8945205-001	BEARING
67	418456	3720241-001	SHAFT
84	247597	8413444-515	CONTACT ASSEMBLY

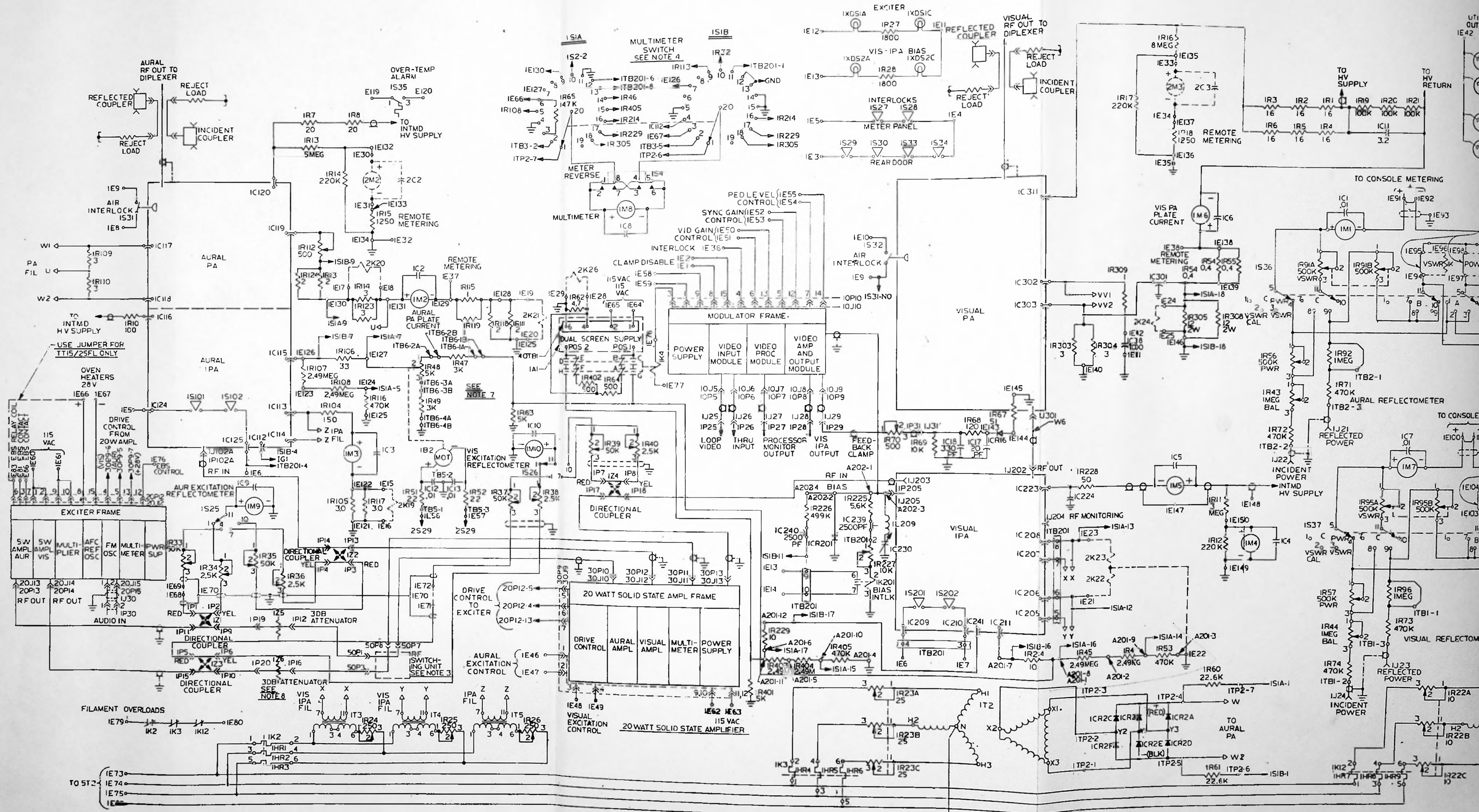
Symbol	Stock No.	Drawing No.	Description
85	248853	3720179-504	CONTACT ASSEMBLY
87	242040	897156-004	COUPLING
88	246083	3720111-001	COUPLING
89	418760	8946214-103	DRIVE - RIGHT ANGLE
101	418451	3456565-001	SHAFT
114	94426	897258-002	CLAMP - HOSE, MI-560577A ITEM 4
117	247598	3731015-501	CONTACT ASSEMBLY
129	236463	8880670-031	CHAIN
130	236462	8811014-002	LINK
135	94641	8914329-001	RECEPTACLE
143	246087	748586-017	DRIVE - RIGHT ANGLE
147	99049	8824482-001	DISK
150	217725	8956364-501	CONTACT ASSEMBLY
151	217727	8956364-503	CONTACT ASSEMBLY
157	211297	8910643-002	JOINT
158	418781	8946214-106	DRIVE - RIGHT ANGLE
165	246056	3720110-001	WASHER - CENTERING
168	223422	644382-008	SPRING
169	431434	3720381-001	STOP - COLLAR
170	431435	3720381-002	COLLAR
173	229166	1510032-011	GROMMET
175	239077	1510032-024	GROMMET
176	418457	3720485-001	COLLAR
184	248850	3720179-501	CONTACT ASSEMBLY
			Aural RF Unit
			M/L 3459969-503 REV 15
Electrical			
B101	246039	3459943-002	MOTOR - DRIVER TUNING
	246041	3459943-102	BRUSH
	246042	3459943-101	SPRING
B102	246038	3459943-001	MOTOR - PLATE TUNING
	246041	3459943-102	BRUSH
	246042	3459943-101	SPRING
B103	246039	3459943-002	MOTOR - OUTPUT TUNING
	246041	3459943-102	BRUSH
	246042	3459943-101	SPRING
			CAPACITORS
C101	96511	8946284-004	VARIABLE, 102-5.3 PF
C102	425723	8946284-005	VARIABLE, 102-5.3 PF
C103	223209	1215561-008	CERAMIC, 1000 PF 5000 V
C104	113931	3450092-002	STAND-OFF, 1000 PF 500 V
C105	113931	3450092-002	STAND-OFF, 1000 PF 500 V
C106	113931	3450092-002	STAND-OFF, 1000 PF 500 V
C107			SCREEN BY-PASS, PART OF XV101
C108	427934	8849438-043	VARIABLE, 5-100 PF 7500 V
C109			GRID BY-PASS, ITEM 10 ON MPL 3720065
C110			PLATE BY-PASS ITEM 15 ON 3720065
C111	246031	3456325-002	VARIABLE, 10-100 PF 7.5KV
C112			
TO			
C115	224210	3401521-001	FILTER, FEED-THRU, 2500 PF
C116	242455	3456447-001	FEED-THRU, 1000 PF 5 KV
C117	54643	8881825-001	FEED-THRU, .01 MF 250 V
C118	54643	8881825-001	FEED-THRU, .01 MF 250 V
C119	224210	3401521-001	FILTER, FEED-THRU, 2500 PF
C120	230419	8494421-001	FEED-THRU, 1500 PF 15 KV DC
C121	223209	1215561-008	CERAMIC, 1000 PF 5KV
C122	223209	1215561-008	CERAMIC, 1000 PF 5KV
C123	223209	1215561-008	CERAMIC, 1000 PF 5KV
C124	224210	3401521-001	FILTER, FEED-THRU, 2500 PF
C125	224210	3401521-001	FILTER, FEED-THRU, 2500 PF
C126	427766	3724789-001	TEFLON COAXIAL, 40 PF
C129	427634	993026-430	MICA, 51 PF 5% 500 V DC CH. 2

Symbol	Stock No.	Drawing No.	Description
CP102	242871	1510013-222	ADAPTER, ANGLE, BNC
J101	209671	8414862-053	CONNECTOR - RECEPTACLE, FEMALE
J102	247504	1510013-192	CONNECTOR - ADAPTER BNC
L101		8914484-067	COIL - FREQUENCY DET. CHANNEL 2-3
L101		8914484-068	COIL - FREQ. DET. CHANNEL 4-5-6
L102			COIL - PLATE TUNING FREQ. DET.
L104		3455574-502	COIL
L105	420039	3731084-502	FILAMENT CHOKE
L106	248742	3731084-501	FILAMENT CHOKE
L108			COUPLING - LOOP FREQ. DET.
L109	423677	3730494-501	COIL - FREQUENCY DET. CHANNEL 2-3
L109		3721098-001	COIL - FREQ. DET. CHANNEL 4-5-6
P101	217375	8414862-003	CONNECTOR - PLUG, MALE
P102	242444	3456541-001	CONNECTOR - BNC UNICUT
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R101	246030	993120-115	FILM, 390 OHMS 5% 7 W
R102	246030	993120-115	FILM, 390 OHMS 5% 7 W
R103	522010	99126-111	10 OHMS 5% 2 W
R104	427765	3720486-002	WIREWOUND, 150 OHMS 5% 50 W
R105	248738	3465422-031	WIREWOUND, 3 OHMS 5% 20 W
R106	248751	3456544-005	WIREWOUND, 33 OHMS 5% 20 W
R107	246029	990477-639	FILM, 2.49 MEGOHMS 1% 1 W
R108	246029	990477-639	FILM, 2.49 MEGOHMS 1% 1 W
R109	246043	3459978-001	WIREWOUND, 3 OHMS 13 W
R110	246043	3459978-001	WIREWOUND, 3 OHMS 13 W
R111	428017	3465422-030	WIREWOUND, 2 OHMS 5% 20 W
R112	19671	890015-004	500 OHMS 5% 200 W
R113	428018	3465422-033	WIREWOUND, 2 OHMS 5% 12 W
R114	248740	3465422-034	WIREWOUND, 3 OHMS 5% 12 W
R115	248739	3465422-032	WIREWOUND, 1 OHMS 5% 12 W
R116	512447	90496-094	470,000 OHMS 10% 1 W
R117	248738	3465422-031	WIREWOUND, 3 OHMS 5% 20 W
R118	428017	3465422-030	WIREWOUND, 2 OHMS 5% 20 W
R119	248739	3465422-032	WIREWOUND, 1 OHM 5% 1/2 W
R120	248741	3720396-003	POTENTIOMETER, 5000 OHMS 5%
R121	248741	3720396-003	POTENTIOMETER, 5000 OHMS 5%
R122	248741	3720396-003	POTENTIOMETER, 5000 OHMS 5%
R123	248740	3465422-034	WIREWOUND, 3 OHMS 5% 12 W
R124	428018	3465422-033	WIREWOUND, 2 OHMS 5% 12 W
R125	246030	993120-115	390 OHMS 5% 7 W
R126	922527	8849447-008	WIREWOUND, 75 OHMS 10% 36 W
S101	246033	449258-002	SWITCH - INTERLOCK
S102	246033	449258-002	SWITCH - INTERLOCK
XV101	246046	3469704-001	SOCKET - TUBE TYPE 8791
	422045	3469704-002	SCREEN BYPASS ASSEMBLY-ONLY
	422046	3469704-003	CONTACT RING-GRID
	422047	3469704-004	CONTACT RING-OUTER FILAMENT
	422048	3469704-005	CONTACT-INNER FILAMENT
	422049	3469704-006	INSULATOR
XV102			SOCKET - PART OF 3720065, COMPOSED OF
	246074		3720065-50 CONTACT RING ASSEMBLY
	246073		3720065-52 CONTACT ASSEMBLY
			3720065-189 PLATE ASSEMBLY
			M/L 3720065-503 REV 24
Mechanical			
10	246070	3730450-501	CAPACITOR ASSEMBLY - GRID
	246069	3730851-001	CAPACITOR
	217719	426763-009	INSULATOR - BUSHING
15	419637	3474000-501	TUBE ASSEMBLY

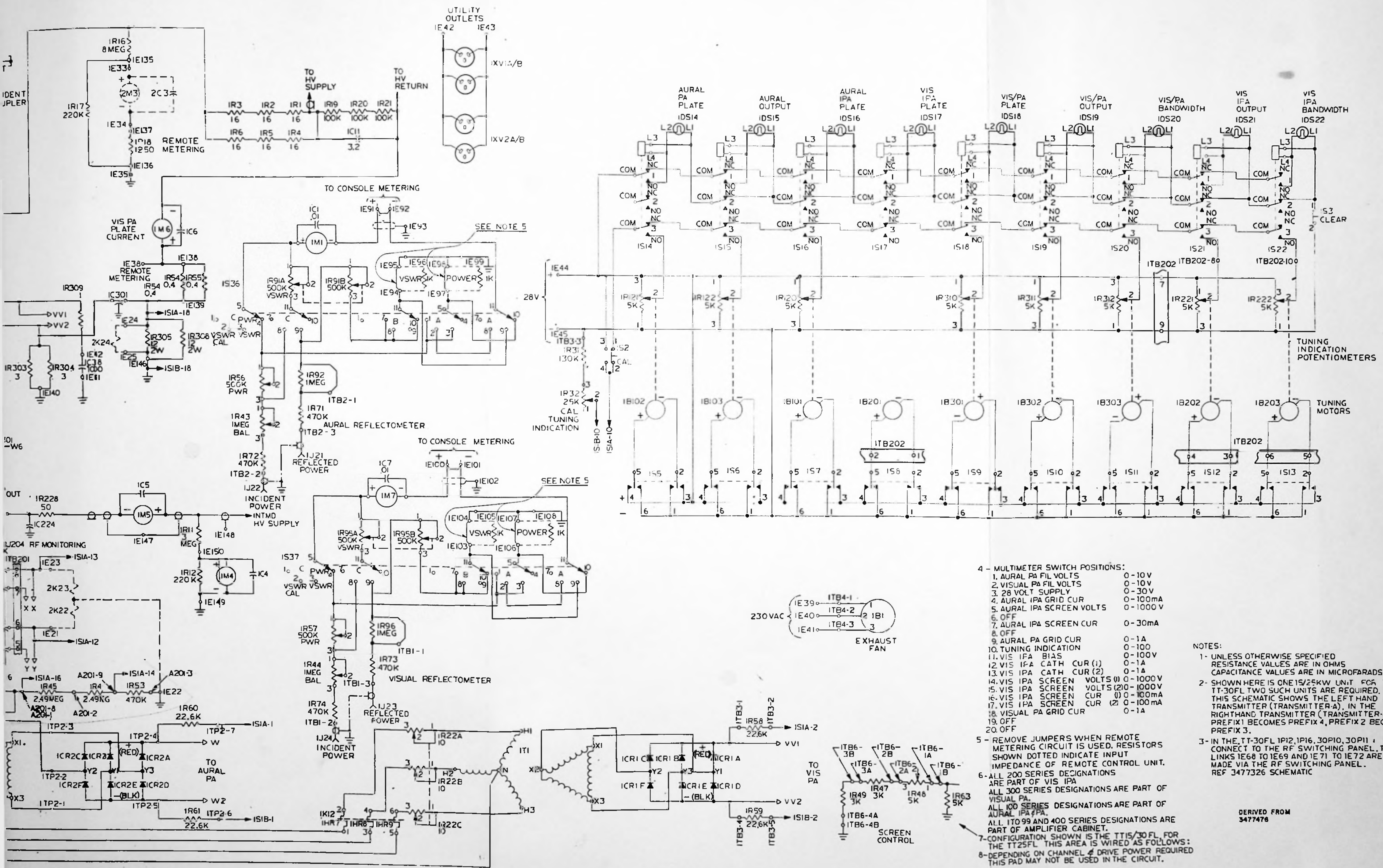
Symbol	Stock No.	Drawing No.	Description
17	246090	8413444-514	CONTACT ASSEMBLY
18	427933	3732661-501	CONTACT ASSEMBLY
34	430522	3720026-001	SUPPORT - KIT
			CONSISTS - QTY 2 OF ITEM 34 (QTY 2 ITEM 42
42	430522	3720016-001	SUPPORT - KIT
			CONSISTS - QTY 2 OF ITEM 42 (QTY 2 ITEM 34
45	246071	3720030-001	SHAFT - 0.50 X 1.25
46	246072	3720030-002	SHAFT - 0.50 X 0.84
50	246074	3730590-501	CONTACT RING ASSEMBLY
52	246073	3730589-501	CONTACT ASSEMBLY
56	246077	3720038-001	SHAFT - EXTENSION
63	246087	748586-017	DRIVE - RIGHT ANGLE
64	418059	3456825-001	CONNECTOR
72	211079	426766-018	INSULATOR - STANDOFF, 0.500 IDA POST
73	211160	8914845-501	CONTACT ASSEMBLY
78	246079	3459990-001	GUIDE - LEAD SCREW
80	246078	3730424-501	CONTACT RING ASSEMBLY
81	246084	8956364-506	CONTACT ASSEMBLY
82	246085	8956364-507	CONTACT ASSEMBLY
83	246080	3730431-001	LEAD SCREW
88	418452	8945205-001	BEARING
97	418780	8946214-103	DRIVE - RIGHT ANGLE
98	242040	897158-004	COUPLING
101	419638	3456625-001	INSULATOR, TEFLON
110	211371	426766-006	INSULATOR
112	246075	3730582-501	CONNECTOR ASSEMBLY
123		3720109-002	COLLAR
124	246081	3720023-001	LINK
126	209711	426773-009	INSULATOR - STANDOFF, 0.750 SQ POST
127	208116	426765-012	INSULATOR - STANDOFF, 0.375 DIA
129	233871	480368-008	STUD - TURNLOCK FASTENER
131	94641	8914329-001	RECEPTACLE - TURNLOCK FASTENER
133	418454	3450427-003	WASHER - SPRING
135	241121	7862770-009	CLIP - FUSE
139	246083	3720111-001	COUPLING
143	30680	99017-104	THUMB - SCREW
144	236463	8880670-031	CHAIN
145	236462	8811014-002	LINK
148	208115	426765-009	INSULATOR - 0.375 DIA X 0.75 LG
152	242704	8895491-501	CONNECTOR ASSEMBLY
153	248852	3720179-503	CONTACT ASSEMBLY
161	431434	3720381-001	STOP - COLLAR
162	431435	3720381-002	STOP - COLLAR
167	418458	3720485-002	COLLAR
180		3726237-001	CORE - COIL
193	246055	3720110-001	INSULATION
			Dual-Output Screen Power Supply (1A1/2A1)
			M/L 3732684-1 REV 3
C1	421398		ELECTROLYTIC, 400 MF 40 V
C2	249619		FILM, .01 MF 200 V
C4	426688		ELECTROLYTIC, 180 MF 450 V
C5	426683		ELECTROLYTIC, 180 MF 450 V
C6	427945		ELECTROLYTIC, 370 MF 450 V
C7	427945		ELECTROLYTIC, 370 MF 450 V
C8	421398		ELECTROLYTIC, 400 MF 40 V
C9	426688		ELECTROLYTIC, 180 MF 450 V
C10	426688		ELECTROLYTIC, 180 MF 450 V
C11	249619		FILM, .01 MF 200 V
CR1	217784		DIODE - TYPE 1N645, SILICON
CR2	217784		DIODE - TYPE 1N645, SILICON
CR3	427946		DIODE - TYPE 1N4247, SILICON
CR4	217784		DIODE - TYPE 1N645, SILICON
CR5	217784		DIODE - TYPE 1N645, SILICON
CR6	427947		DIODE - TYPE 1N4249, SILICON
CR7	427947		DIODE - TYPE 1N4249, SILICON

Symbol	Stock No.	Drawing No.	Description
CR8	427947		DIODE - TYPE 1N4249, SILICON
CR9 TO			
CR19	427946		DIODE - TYPE 1N4247, SILICON
CR20	217784		DIODE - TYPE 1N645, SILICON
CR21	217784		DIODE - TYPE 1N645, SILICON
CR22			
TO			
CR25	427946		DIODE - TYPE 1N4247, SILICON
CR26	217784		DIODE - TYPE 1N645, SILICON
CR27	217784		DIODE - TYPE 1N645, SILICON
CR28	427947		DIODE - TYPE 1N4249, SILICON
CR29	427947		DIODE - TYPE 1N4249, SILICON
CR30	427947		DIODE - TYPE 1N4249, SILICON
Q1 TO			
Q5	241302		TRANSISTOR - TYPE 2N1711
Q6	427948		TRANSISTOR - TYPE DTS-802
Q7	427948		TRANSISTOR - TYPE DTS-802
Q8	241302		TRANSISTOR - TYPE 2N1711
Q9	241302		TRANSISTOR - TYPE 2N1711
Q10	427948		TRANSISTOR - TYPE DTS-802
Q11	427948		TRANSISTOR - TYPE DTS-802
Q12	241302		TRANSISTOR - TYPE 2N1711
Q13	241302		TRANSISTOR - TYPE 2N1711
Q14	241302		TRANSISTOR - TYPE 2N1711
Q15	427948		TRANSISTOR - TYPE DTS-802
Q16	427948		TRANSISTOR - TYPE DTS-802
Q17	241302		TRANSISTOR - TYPE 2N1711
Q18	241302		TRANSISTOR - TYPE 2N1711
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1	424980		POTENTIOMETER, 2500 OHMS
R2	424980		POTENTIOMETER, 2500 OHMS
R3	502047		47 OHMS 10% 1/2 W
R4	512168		680 OHMS 10% 1 W
R5	502168		680 OHMS 10% 1/2 W
R6	502110		100 OHMS 10% 1/2 W
R7	502312		12,000 OHMS 10% 1/2 W
R8	427949		POTENTIOMETER, 1000 OHMS
R9	249626		WIREWOUND, 1210 OHMS 1% 3 W
R10	502168		680 OHMS 10% 1/2 W
R11	502368		68,000 OHMS 10% 1/2 W
R12	502210		1000 OHMS 10% 1/2 W
R13	502147		470 OHMS 10% 1/2 W
R14	502210		1000 OHMS 10% 1/2 W
R15	427574		2.7 OHMS 10% 1/2 W
R16	427574		2.7 OHMS 10% 1/2 W
R17	522410		100,000 OHMS 10% 2 W
R18	522410		100,000 OHMS 10% 2 W
R19	502327		27,000 OHMS 10% 1/2 W
R20	522433		330,000 OHMS 10% 2 W
R21	231364		WIREWOUND, 80,000 OHMS 5% 7 W
R22	231364		WIREWOUND, 80,000 OHMS 5% 7 W
R23	522433		330,000 OHMS 10% 2 W
R24	502047		47 OHMS 10% 1/2 W
R25	512169		680 OHMS 10% 1 W
R26	502168		680 OHMS 10% 1/2 W
R27	502110		100 OHMS 10% 1/2 W
R28	502312		12,000 OHMS 10% 1/2 W
R29	427949		POTENTIOMETER, 1000 OHMS
R30	249626		WIREWOUND, 1210 OHMS 1% 3 W
R31	502168		680 OHMS 10% 1/2 W
R32	502210		1000 OHMS 10% 1/2 W
R33	427574		2.7 OHMS 10% 1/2 W
R35	522410		100,000 OHMS 10% 2 W
R36	522410		100,000 OHMS 10% 2 W
R37	502368		68,000 OHMS 10% 1/2 W
R38	502210		1000 OHMS 10% 1/2 W

Symbol	Stock No.	Drawing No.	Description
R39	502147		470 OHMS 10% 1/2 W
R40	502327		27,000 OHMS 10% 1/2 W
R41	522433		330,000 OHMS 10% 2 W
R42	231364		WIREWOUND, 80,000 OHMS 5% 7 W
R43	231364		WIREWOUND, 80,000 OHMS 5% 7 W
R44	522433		330,000 OHMS 10% 2 W
R45	522415		150,000 OHMS 10% 2 W
R46	427952		WIREWOUND, 205 OHMS 1% 3 W
R47	502315		15,000 OHMS 10% 1/2 W
R48	522147		470 OHMS 10% 2 W
R49	502210		1000 OHMS 10% 1/2 W
R50	427574		2.7 OHMS 10% 1/2 W
R51	427574		2.7 OHMS 10% 1/2 W
R52	427951		4000 OHMS 55 W
R53	427951		4000 OHMS 55 W
R54	427951		4000 OHMS 55 W
R55	427952		WIREWOUND, 205 OHMS 1% 3 W
R56	502315		15,000 OHMS 10% 1/2 W
R57	522147		470 OHMS 10% 2 W
R58	502210		1000 OHMS 10% 1/2 W
R59	427951		4000 OHMS 55 W
R60	427951		4000 OHMS 55 W
VR1	231343		DIODE - TYPE 1N963B, ZENER
VR2	225588		DIODE - TYPE 1N821, ZENER
VR3	426699		DIODE - TYPE 1N971B, ZENER
VR4	231343		DIODE - TYPE 1N963B, ZENER
VR5	225588		DIODE - TYPE 1N821, ZENER
VR6	426699		DIODE - TYPE 1N971B, ZENER
	427954		SHAFT - RESISTOR
TB1	427953		TERMINAL - BLOCK



AURAL RF OUT TO DIPLEXER
REFLECTED COUPLER
REJECT LOAD
INCIDENT COUPLER
OVER-TEMP ALARM
TO INTMD HV SUPPLY
REMOTE METERING
AIR INTERLOCK
AURAL PA
PA FIL
AURAL IPA
USE JUMPER FOR TT15/25FL ONLY
OVEN HEATERS 28V
DRIVE CONTROL FROM 20W AMPL
115 VAC
EXCITER FRAME
5W AMPL AUR
5W AMPL VIS
MULTI-PLIER
AFC REF OSC
FM OSC
MULTI-METER
PWR SUP
RF OUT
AUDIO IN
AUR EXCITATION REFLECTOMETER
DIRECTIONAL COUPLER
3DB ATTENUATOR
SWITCHING UNIT SEE NOTE 3
SEE NOTE 8
SEE NOTE 7
FILAMENT OVERLOADS
TO ST2
VIS IPA FIL
IPA FIL
MULTIMETER SWITCH SEE NOTE 4
METER REVERSE
MULTIMETER
DUAL SCREEN SUPPLY
VIS EXCITATION REFLECTOMETER
MODULATOR FRAME
POWER SUPPLY
VIDEO INPUT MODULE
VIDEO PROC MODULE
VIDEO AMP AND OUTPUT MODULE
LOOP VIDEO
THRU INPUT
PROCESSOR MONITOR OUTPUT
VIS IPA OUTPUT
FEED-BACK CLAMP
PED LEVEL CONTROL
SYNC GAIN CONTROL
VID GAIN CONTROL
INTERLOCK
CLAMP DISABLE
DRIVE CONTROL TO EXCITER
20 WATT SOLID STATE AMPL FRAME
DRIVE CONTROL
AURAL AMPL
VISUAL AMPL
MULTI-METER
POWER SUPPLY
AURAL EXCITATION CONTROL
VISUAL EXCITATION CONTROL
20 WATT SOLID STATE AMPLIFIER
EXCITER
VIS-IPA BIAS
INTERLOCKS
METER PANEL
REAR DOOR
VISUAL RF OUT TO DIPLEXER
VISUAL PA
VISUAL IPA
RF OUT
RF IN
BIAS
RF MONITORING
BIAS INTLK
VIS PA PLATE CURRENT
TO HV SUPPLY
TO HV RETURN
TO CONSOLE METERING
VSWR CAL
AURAL REFLECTOMETER
REFLECTED POWER
INCIDENT POWER
VISUAL REFLECTOMETER
TO AURAL PA



4 - MULTIMETER SWITCH POSITIONS:

1. AURAL PA FIL VOLTS	0 - 10 V
2. VISUAL PA FIL VOLTS	0 - 10 V
3. 28 VOLT SUPPLY	0 - 30 V
4. AURAL IPA GRID CUR	0 - 100mA
5. AURAL IPA SCREEN VOLTS	0 - 1000 V
6. OFF	
7. AURAL IPA SCREEN CUR	0 - 30mA
8. OFF	
9. AURAL PA GRID CUR	0 - 1A
10. TUNING INDICATION	0 - 100
11. VIS IPA BIAS	0 - 100V
12. VIS IPA CATH CUR (1)	0 - 1A
13. VIS IPA CATH CUR (2)	0 - 1A
14. VIS IPA SCREEN VOLTS (1)	0 - 1000 V
15. VIS IPA SCREEN VOLTS (2)	0 - 1000 V
16. VIS IPA SCREEN CUR (1)	0 - 100mA
17. VIS IPA SCREEN CUR (2)	0 - 100 mA
18. VISUAL PA GRID CUR	0 - 1A
19. OFF	
20. OFF	

5 - REMOVE JUMPERS WHEN REMOTE METERING CIRCUIT IS USED. RESISTORS SHOWN DOTTED INDICATE INPUT IMPEDANCE OF REMOTE CONTROL UNIT.

6 - ALL 200 SERIES DESIGNATIONS ARE PART OF VIS IPA
ALL 300 SERIES DESIGNATIONS ARE PART OF VISUAL PA.
ALL 100 SERIES DESIGNATIONS ARE PART OF AURAL IPA & PA.
ALL 1 TO 99 AND 400 SERIES DESIGNATIONS ARE PART OF AMPLIFIER CABINET.

7 - CONFIGURATION SHOWN IS THE TT15/30 FL, FOR THE TT25FL THIS AREA IS WIRED AS FOLLOWS:

8 - DEPENDING ON CHANNEL & DRIVE POWER REQUIRED THIS PAD MAY NOT BE USED IN THE CIRCUIT.

NOTES:

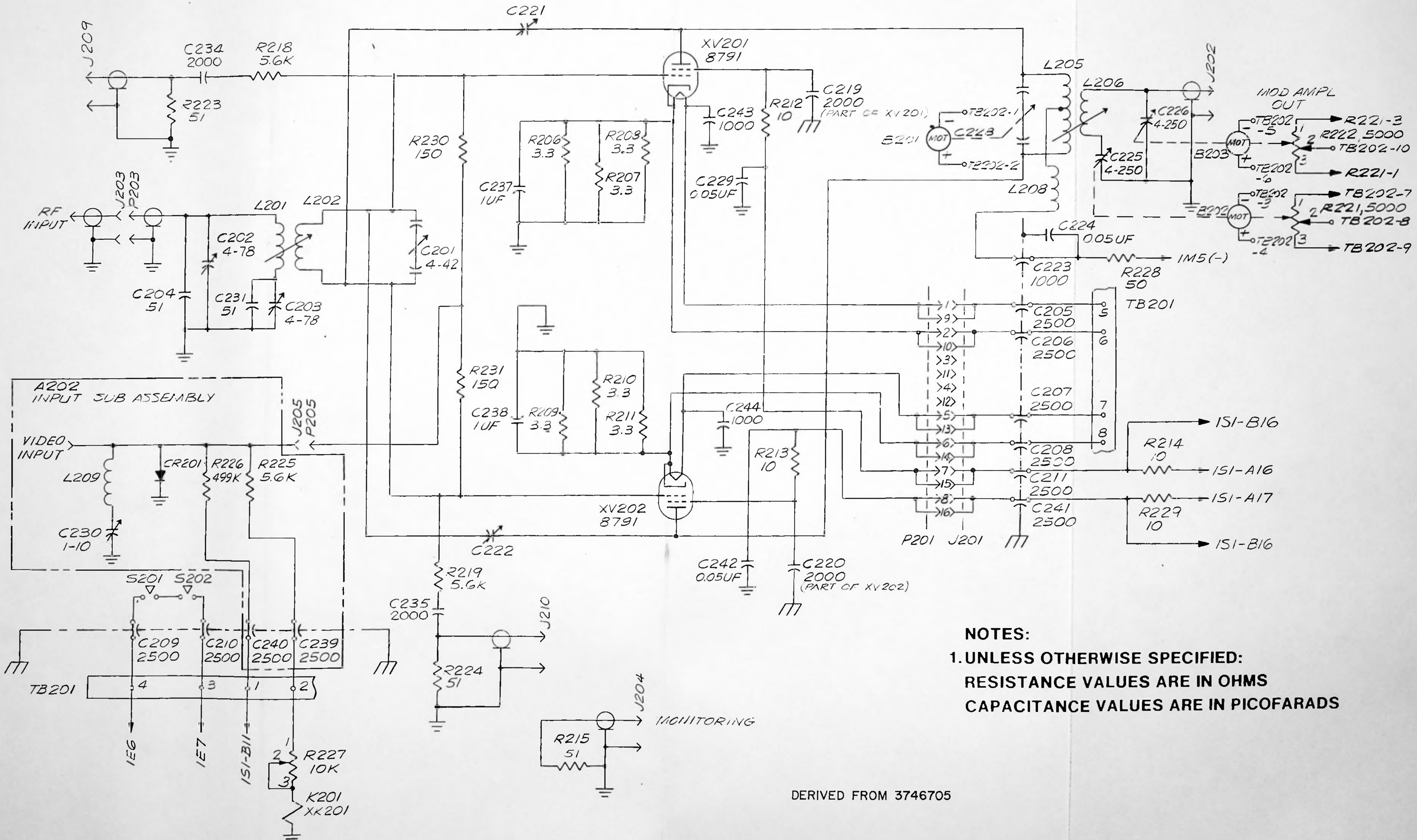
1 - UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS CAPACITANCE VALUES ARE IN MICROFARADS.

2 - SHOWN HERE IS ONE 15/25KW UNIT FOR THE TT-30FL TWO SUCH UNITS ARE REQUIRED. THIS SCHEMATIC SHOWS THE LEFT HAND TRANSMITTER (TRANSMITTER-A). IN THE RIGHTHAND TRANSMITTER (TRANSMITTER-B) PREFIX 1 BECOMES PREFIX 4, PREFIX 2 BECOMES PREFIX 3.

3 - IN THE TT-30FL 1P12, 1P16, 30P10, 30P11 CONNECT TO THE RF SWITCHING PANEL. THE LINKS 1E68 TO 1E69 AND 1E71 TO 1E72 ARE MADE VIA THE RF SWITCHING PANEL.
REF 3477326 SCHEMATIC

DERIVED FROM
3477476

Figure 2-3. Schematic, Amplifier Cabinet



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
RESISTANCE VALUES ARE IN OHMS
CAPACITANCE VALUES ARE IN PICOFARADS

DERIVED FROM 3746705

Figure 2-4. Schematic, Visual IPA

NOTES:
1. ALL CAPACITANCE VALUES ARE IN UF UNLESS OTHERWISE SPECIFIED.
2. PREFIX FOR THIS UNIT IS 1 EXAMPLE 1C305 UNLESS OTHERWISE NOTED.
3. C308, C309 1000 PF CH.2
   750 PF CH.3&4
   600 PF CH.5
   500 PF CH.6
4. PART OF FD KIT MI-561283-CH
5. MI-560577-A ITEM 11
6. PART OF PD KIT MI-561288

DERIVED FROM 3740020

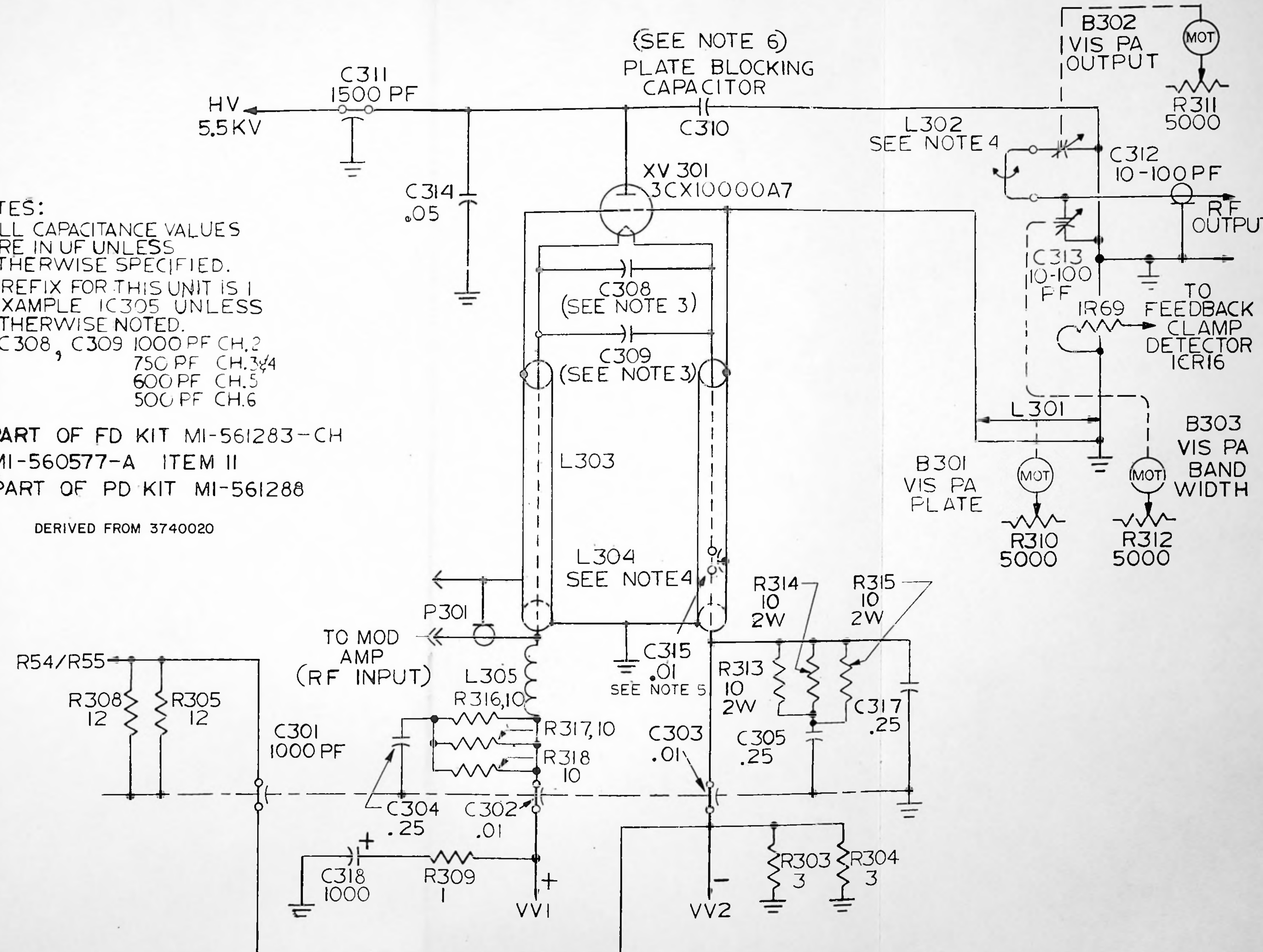
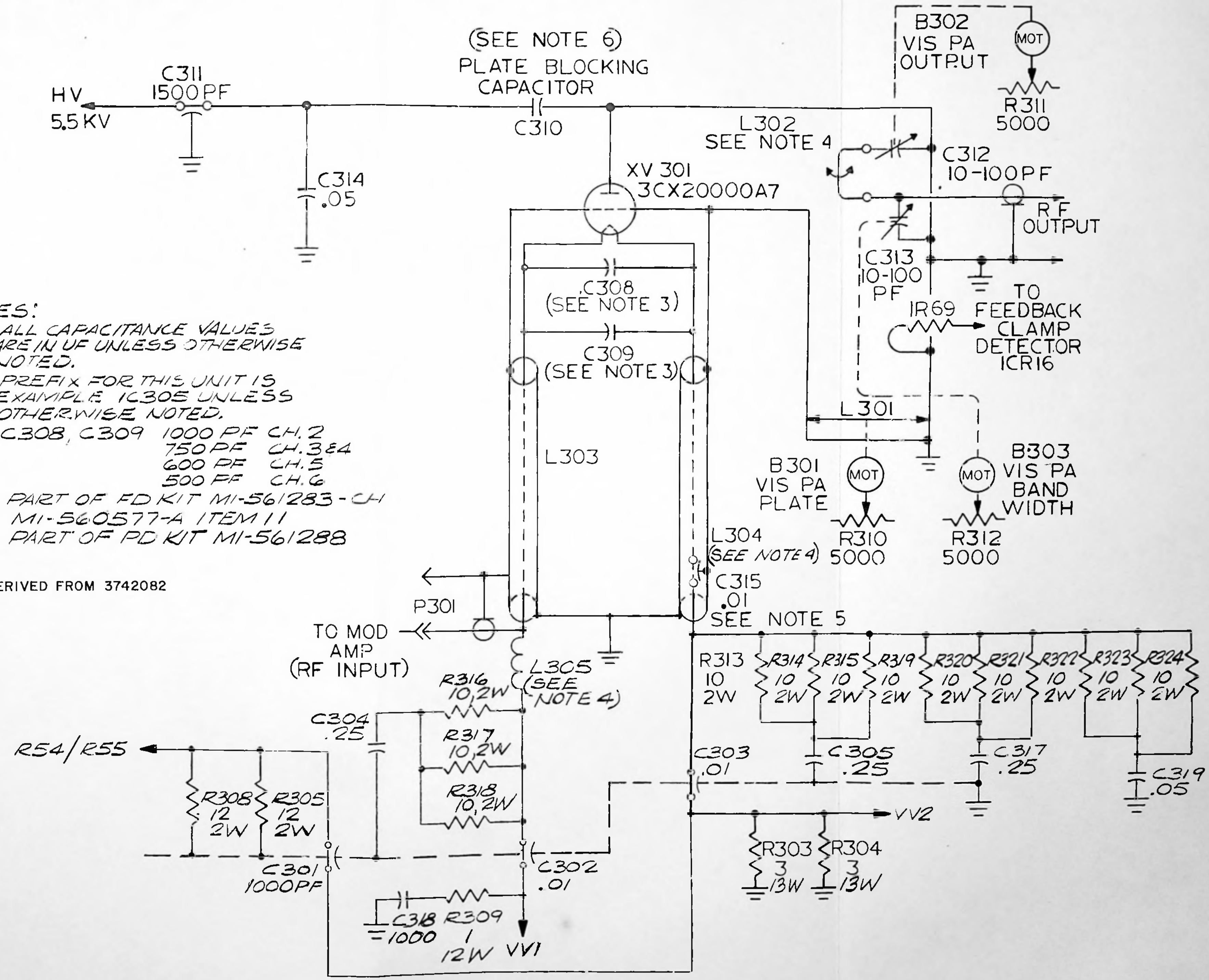


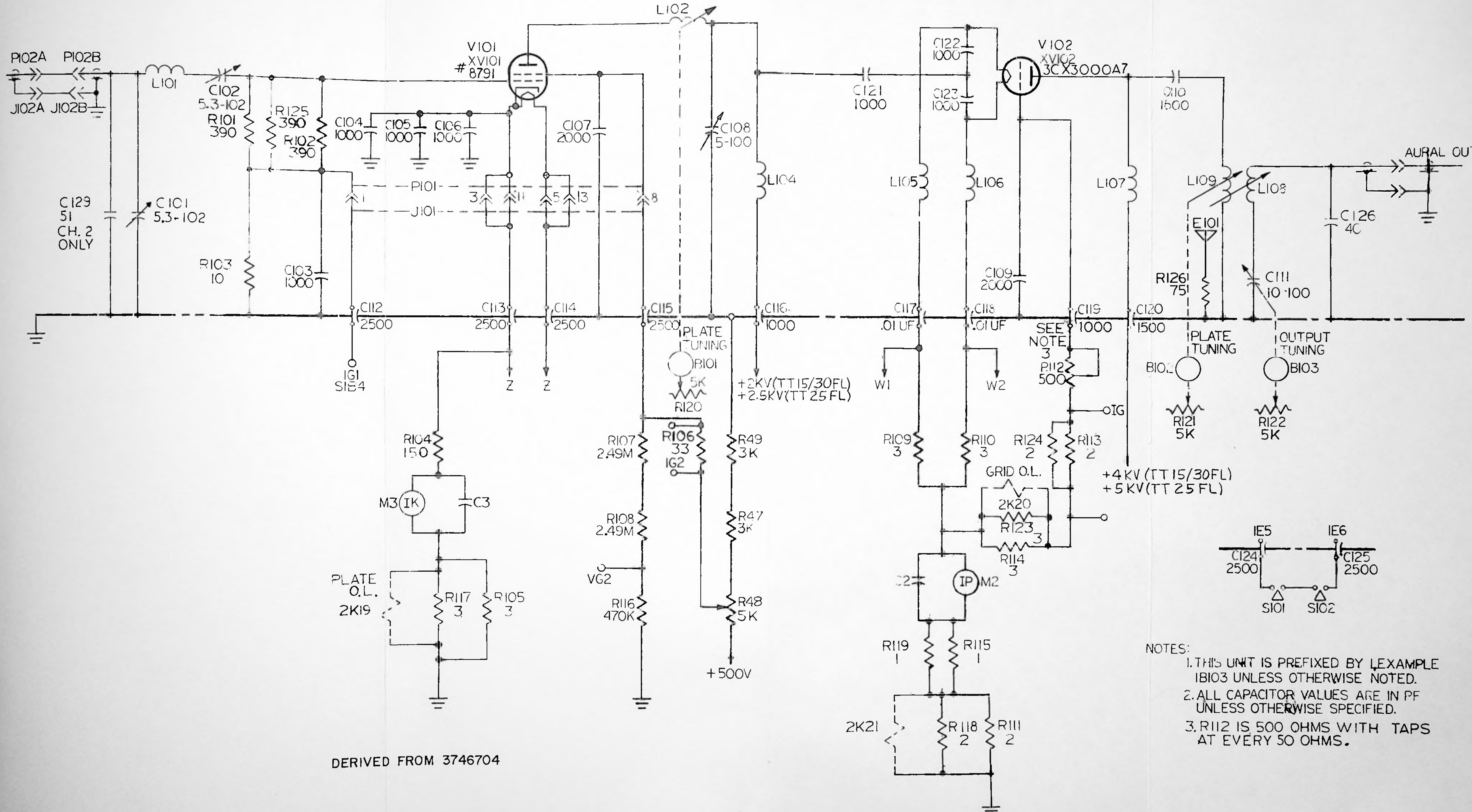
Figure 2-5. Schematic, TT-15FL/30FL Visual PA



OTES:
1. ALL CAPACITANCE VALUES ARE IN UF UNLESS OTHERWISE NOTED.
2. PREFIX FOR THIS UNIT IS EXAMPLE 1C305 UNLESS OTHERWISE NOTED.
3. C308, C309 1000 PF CH. 2
750 PF CH. 3&4
600 PF CH. 5
500 PF CH. 6
4. PART OF FD KIT MI-561283-CH
5. MI-560577-A ITEM 11
6. PART OF PD KIT MI-561288

DERIVED FROM 3742082

Figure 2-6. Schematic, TT-25FL Visual PA

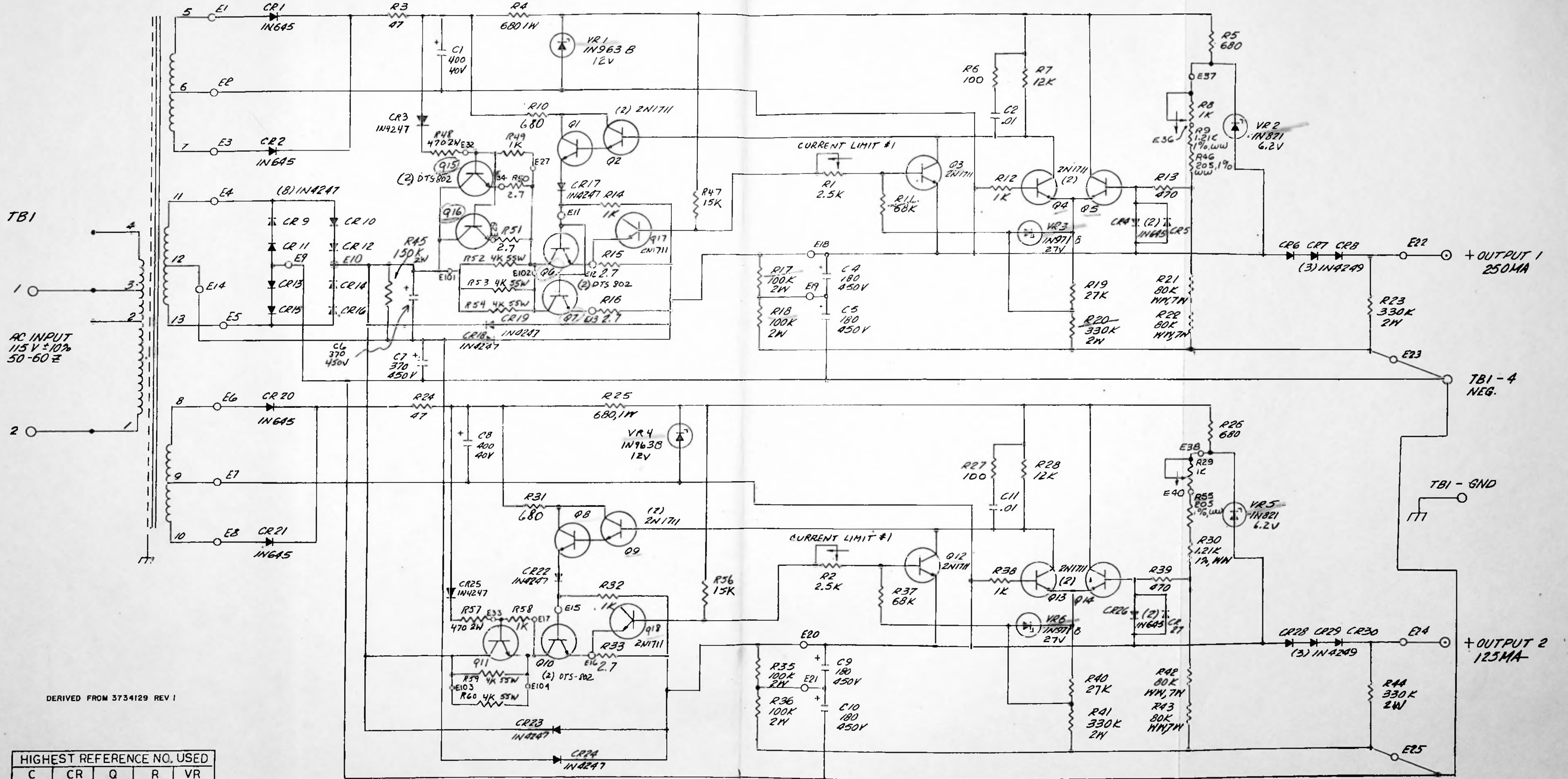


NOTES:

1. THIS UNIT IS PREFIXED BY 1, EXAMPLE 1B103 UNLESS OTHERWISE NOTED.
2. ALL CAPACITOR VALUES ARE IN PF UNLESS OTHERWISE SPECIFIED.
3. R112 IS 500 OHMS WITH TAPS AT EVERY 50 OHMS.

DERIVED FROM 3746704

Figure 2-7. Schematic, Aural RF Unit

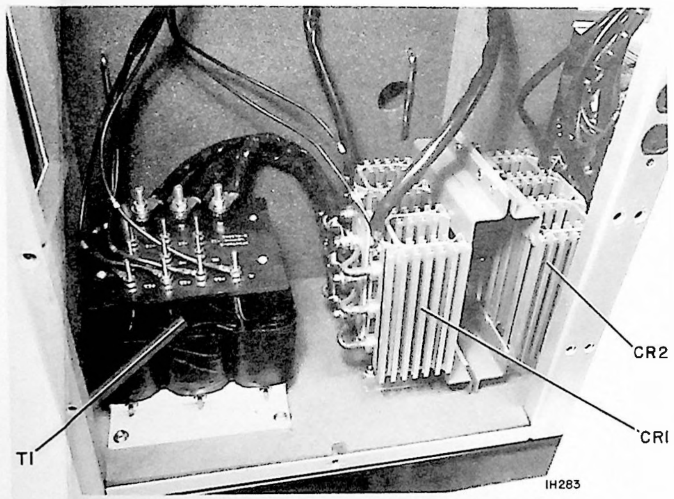


DERIVED FROM 3734129 REV I

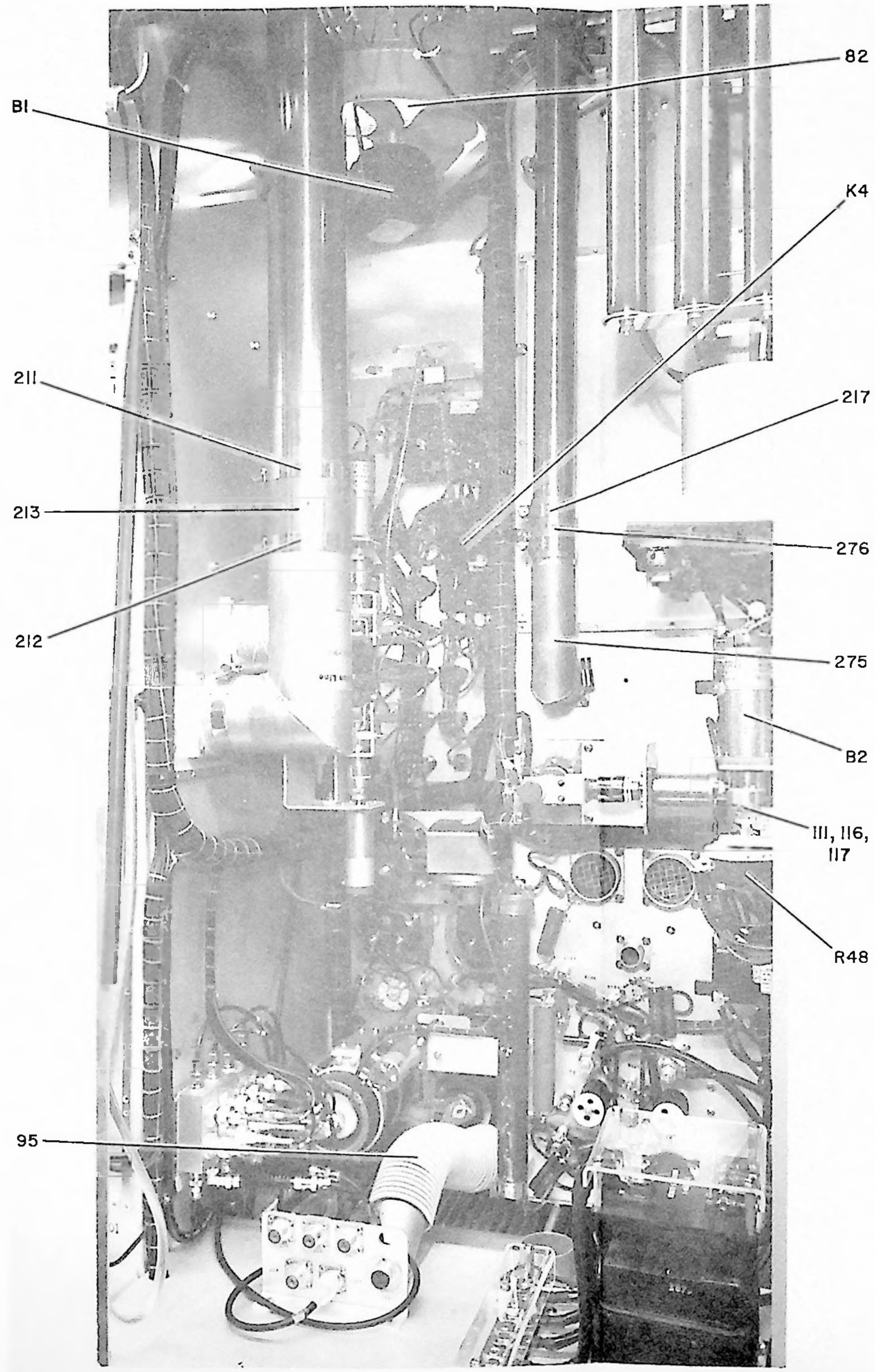
HIGHEST REFERENCE NO. USED				
C	CR	Q	R	VR
C11	CR30	Q18	R60	VR6
REFERENCE NO. NOT USED				
C	CR	Q	R	VR
C3,	–	–	R34	–

Technical description Pg. 2-7

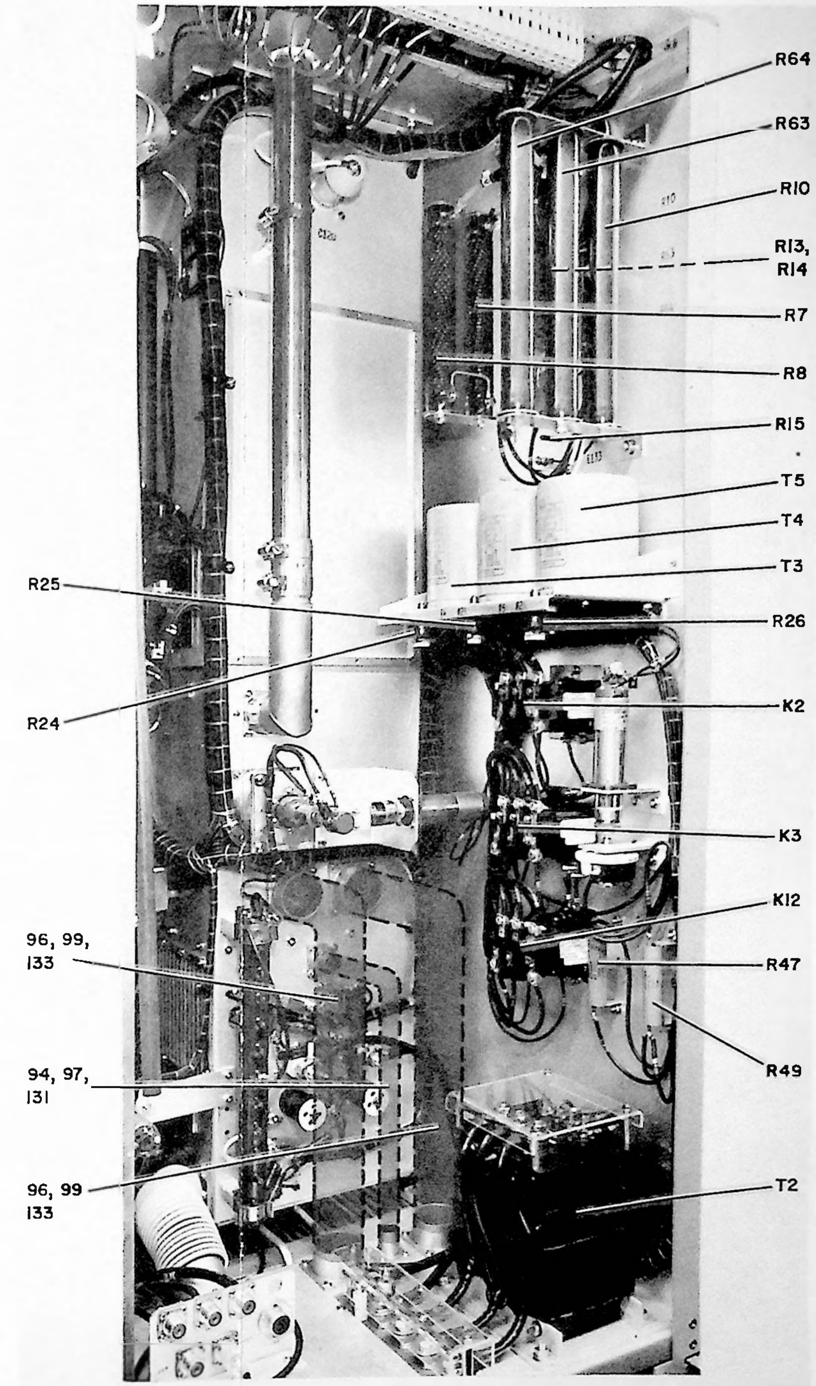
Figure 2-8. Schematic, Dual-Output Screen Power Supply



VIEW B – under shelf, below VIEW A –

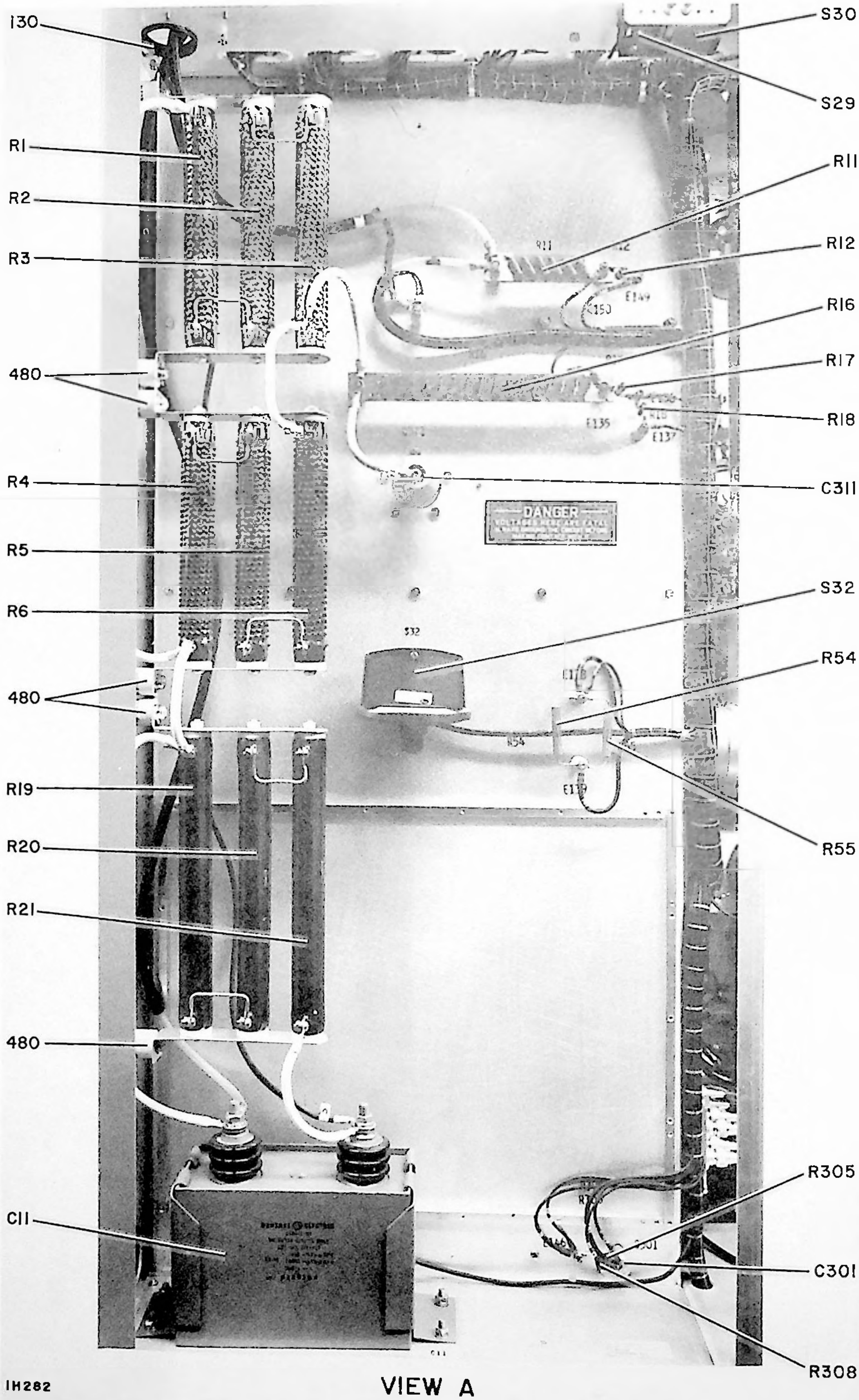


VIEW C



VIEW D

Figure 2-9. Assembly, Amplifier Cabinet


130
S30
S29
R1
R2
R3
R11
R12
R16
R17
R18
480
R4
C311
DANGER
R5
R6
S32
R54
480
R19
R55
R20
R21
480
R305
C11
C301
R308

1H282

VIEW A

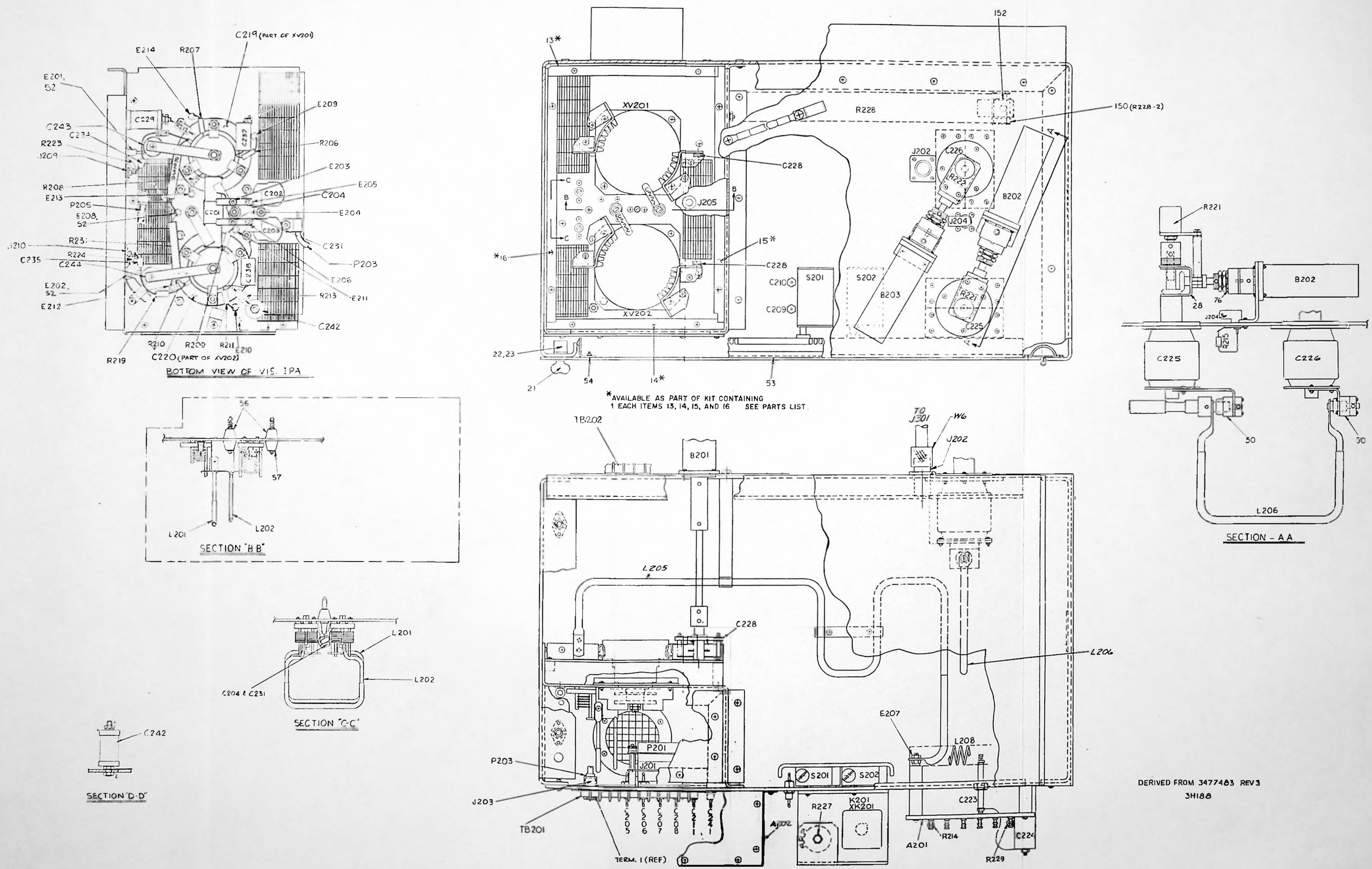


Figure 2-10. Assembly, Visual IPA

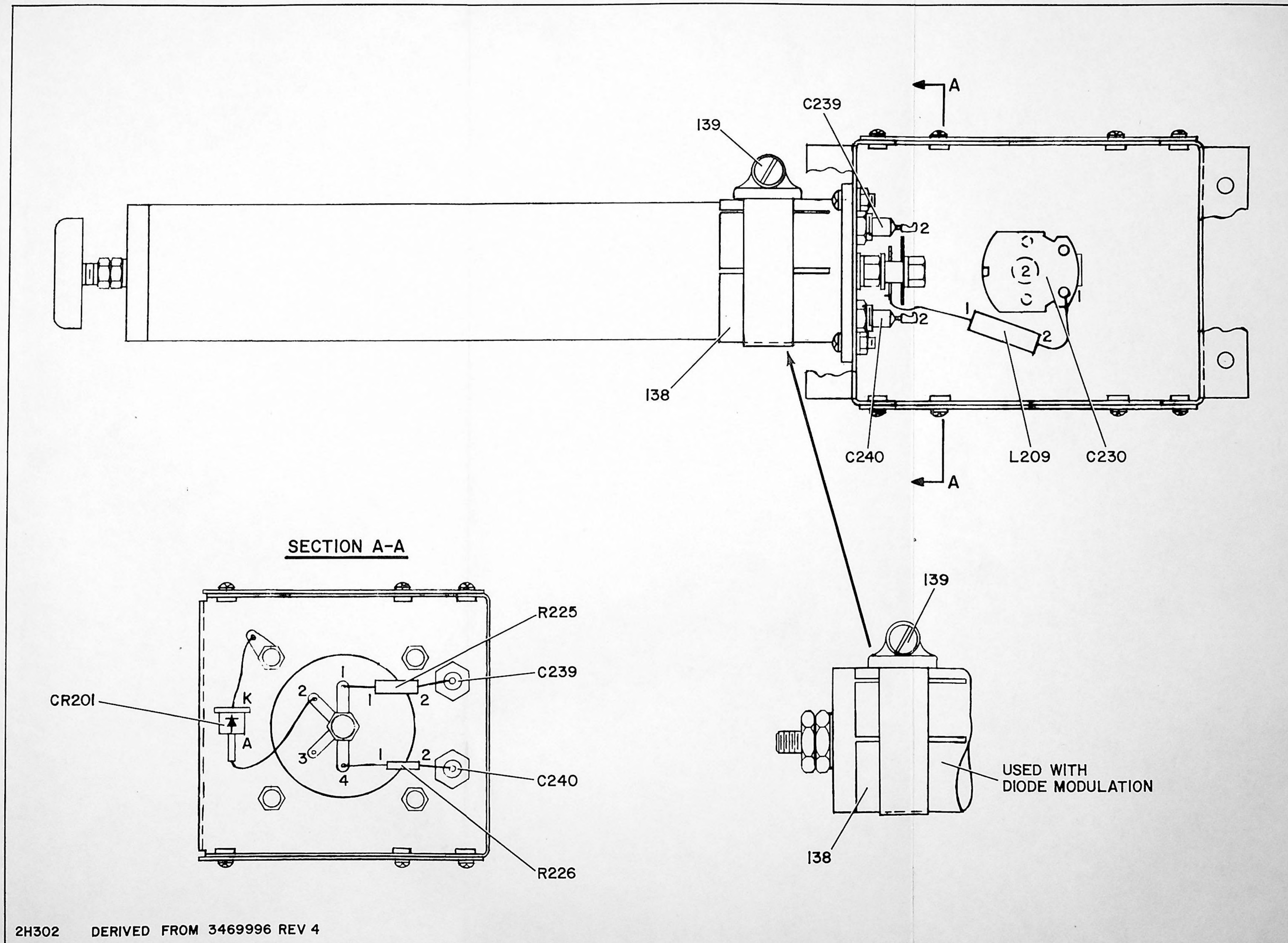
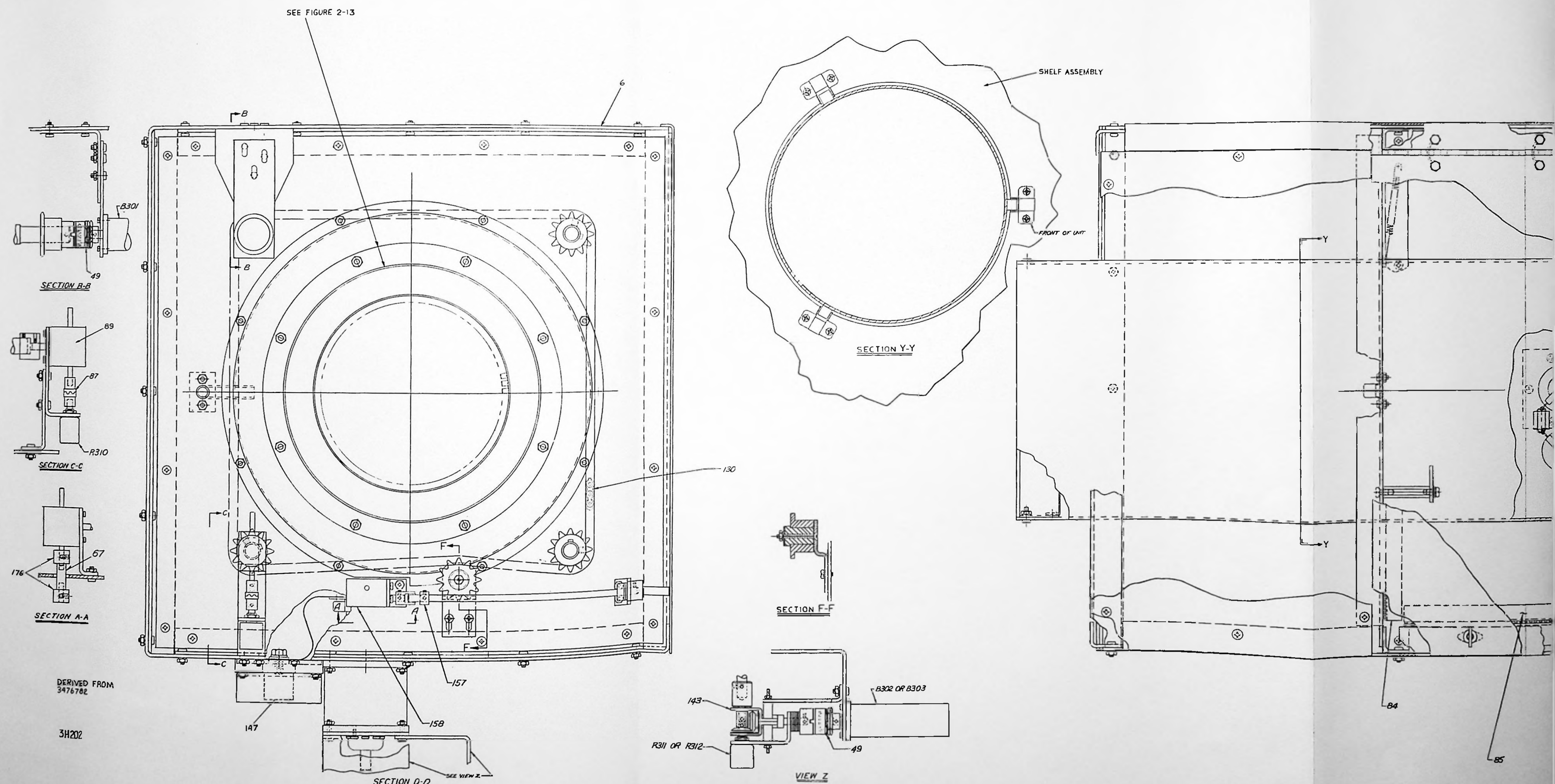


Figure 2-11. Assembly, Visual IPA Input Sub-Assembly



DERIVED FROM
3476782

3H202

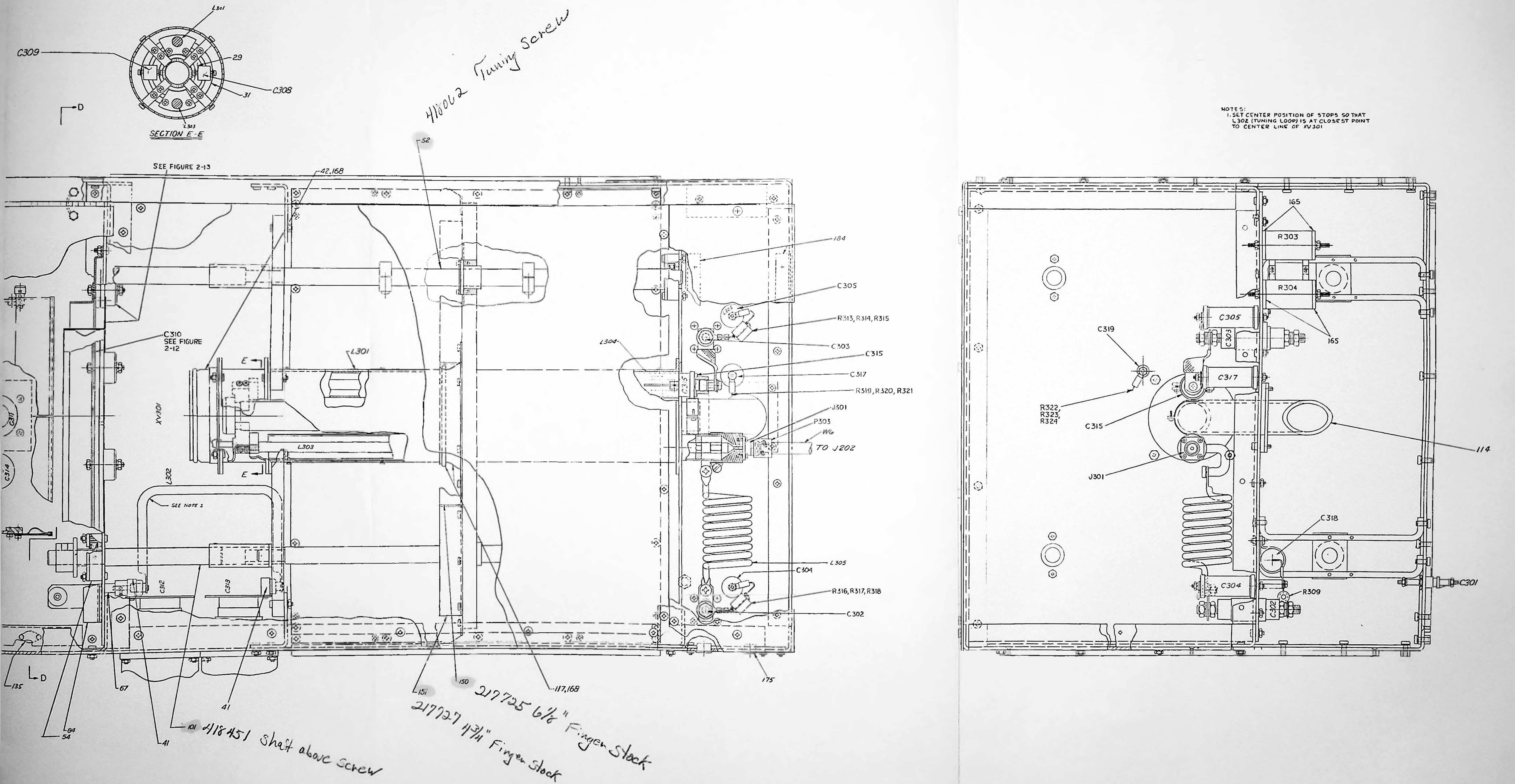
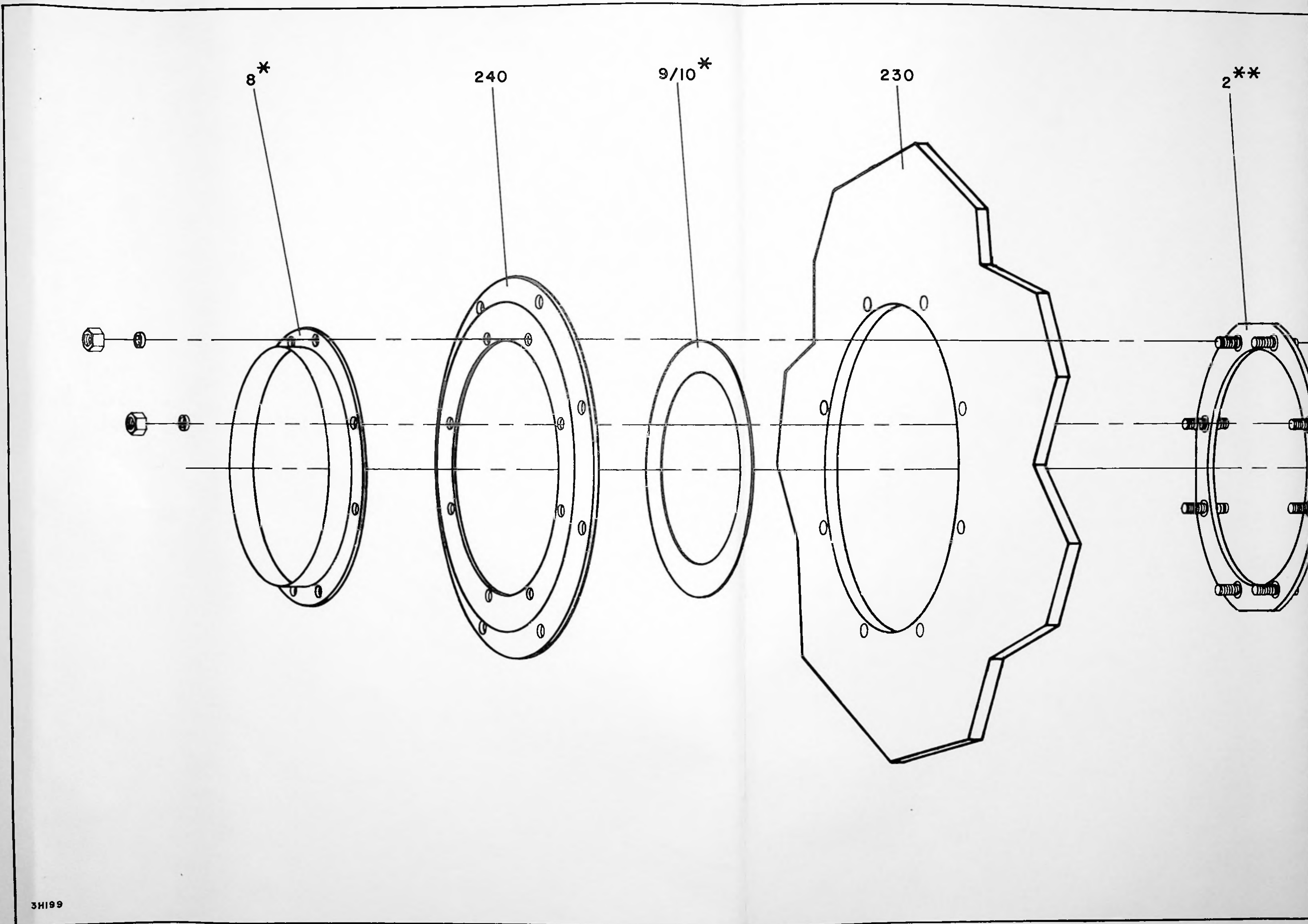
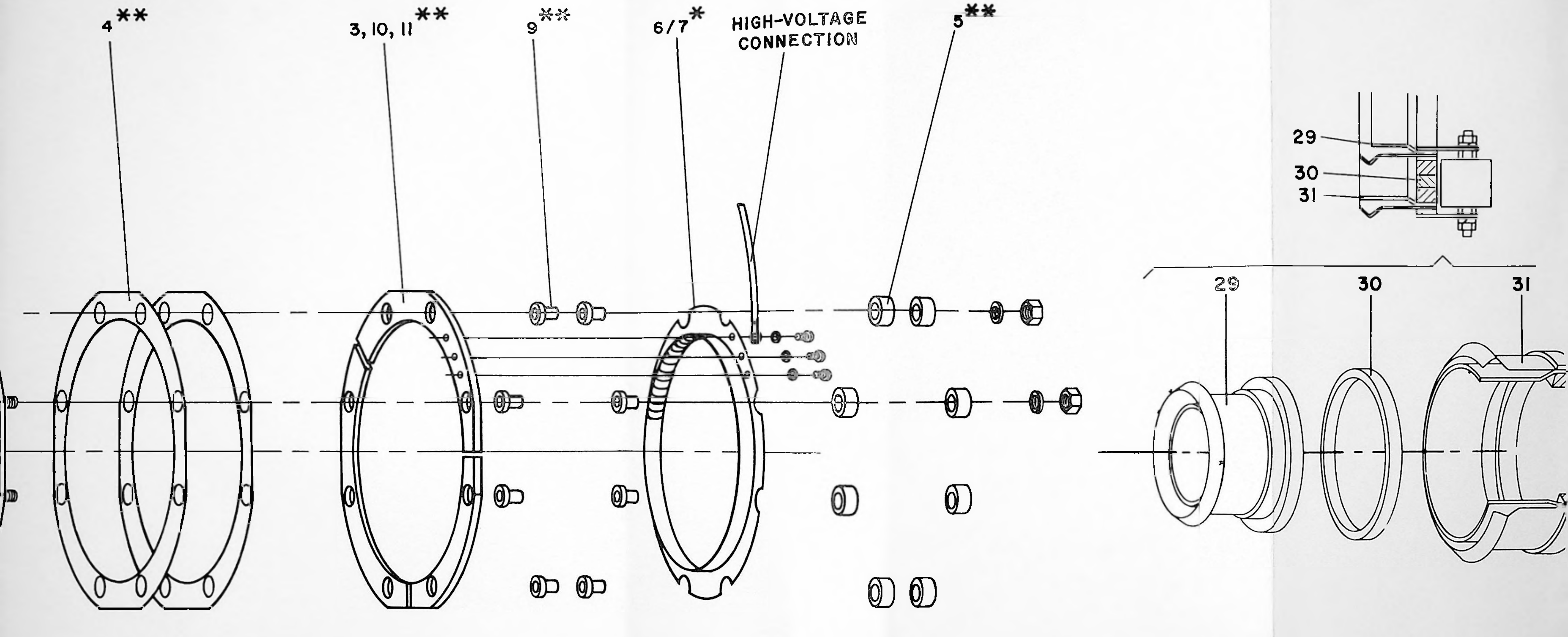


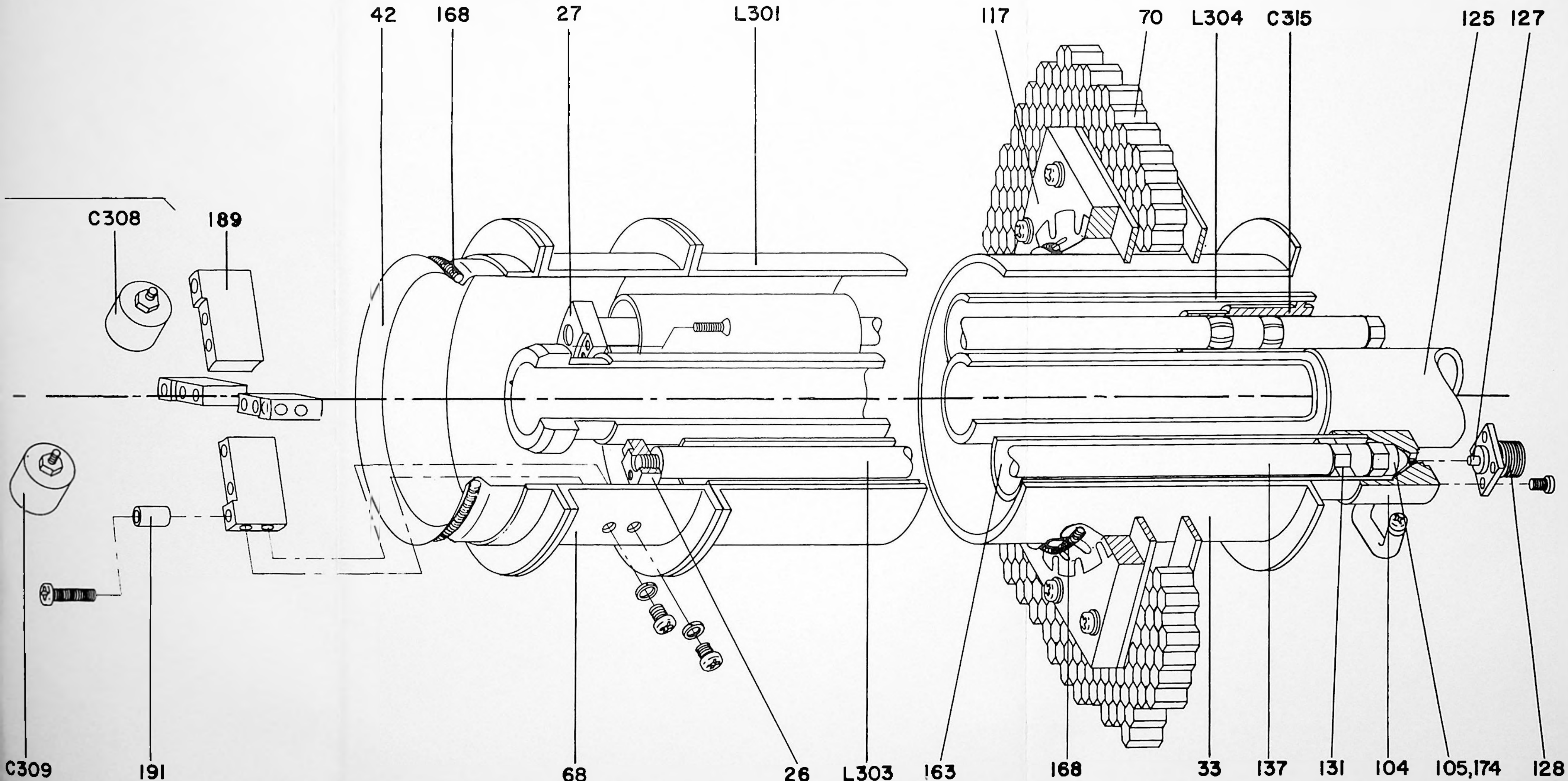
Figure 2-12. Assembly, Visual PA


8*
240
9/10*
230
2**
3H199



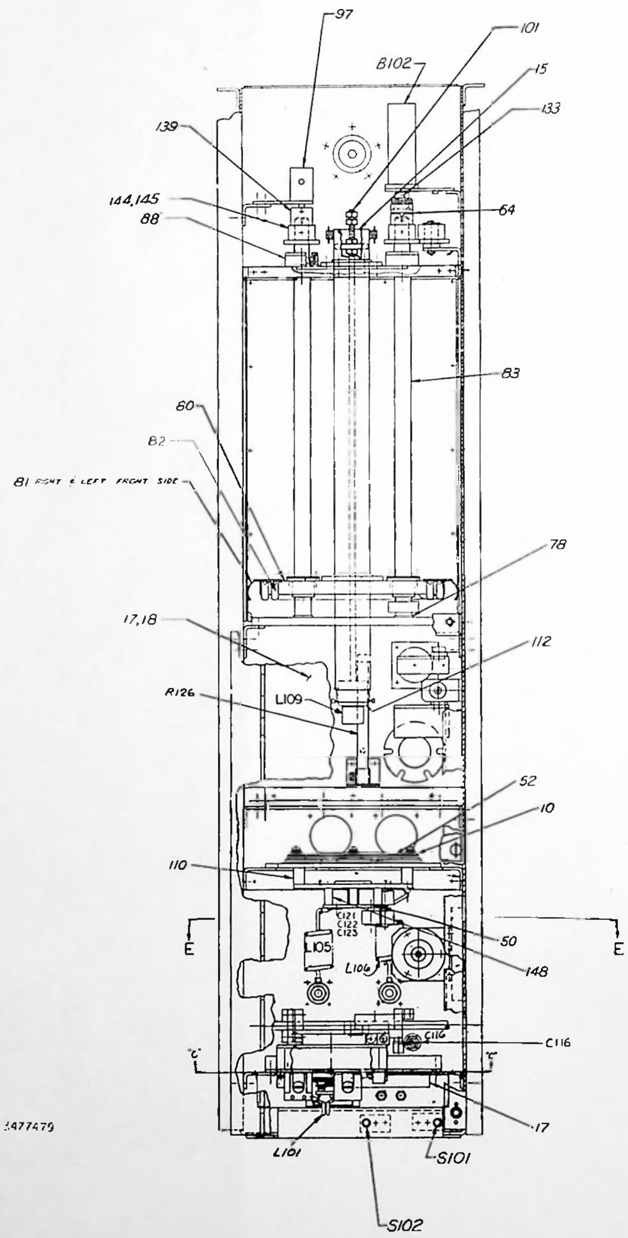
* ITEM FROM POWER DETERMINING KIT (3724804)

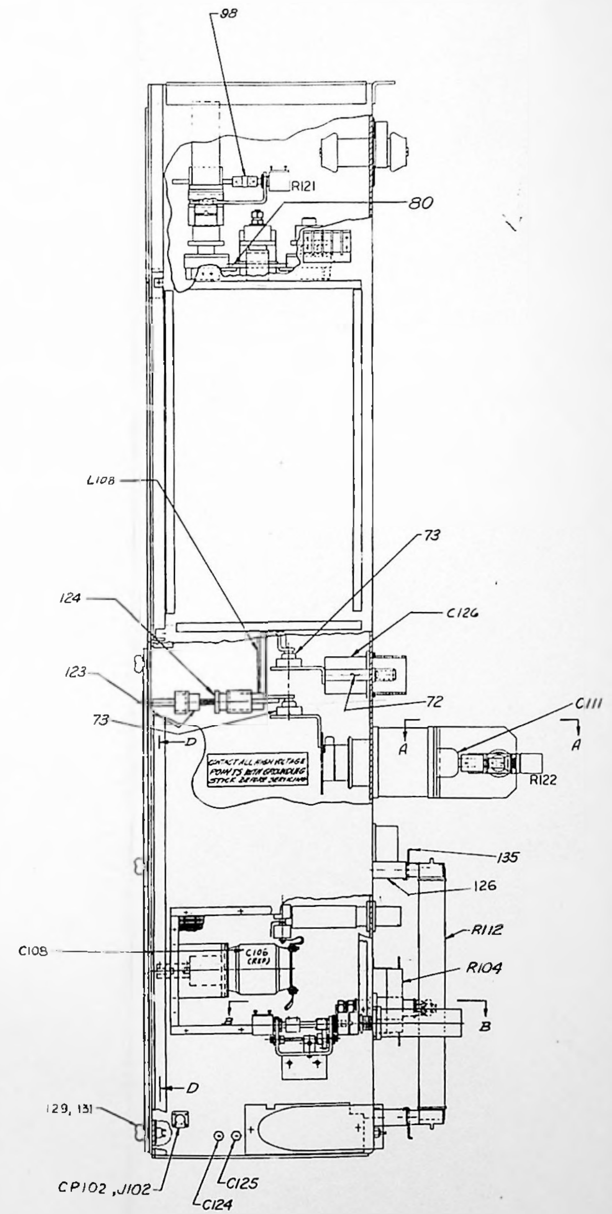
** ITEM FROM POWER DETERMINING KIT (3724804), BUT ITEM NUMBER FROM ASSEMBLY DRAWING (3740161).



NOTE:
NOT TO SCALE

Figure 2-13. Exploded View, Visual PA Tube Socket and Plate Contact Ring





DERIVED FROM 3477479

3H203

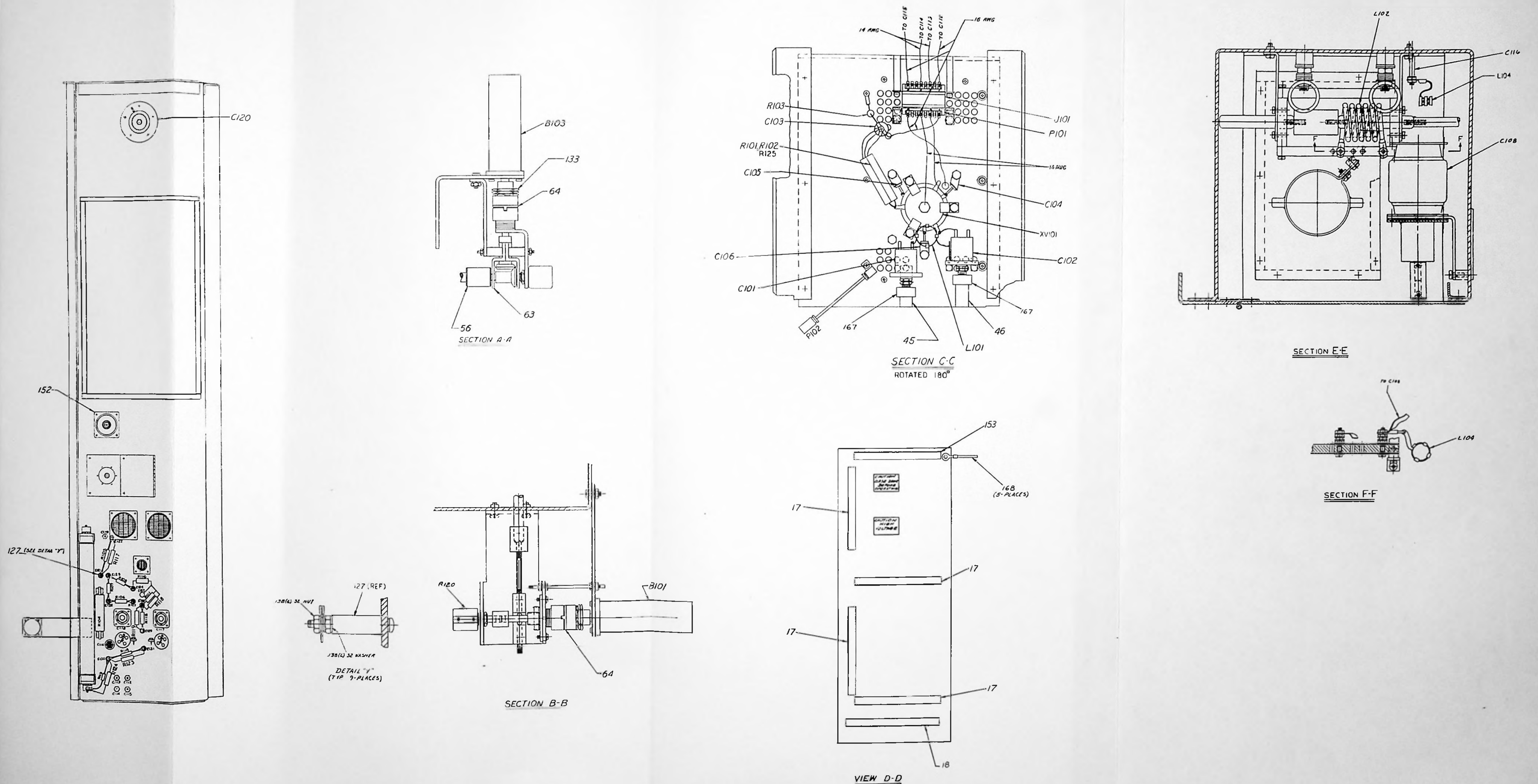


Figure 2-14. Assembly, Aural RF Unit

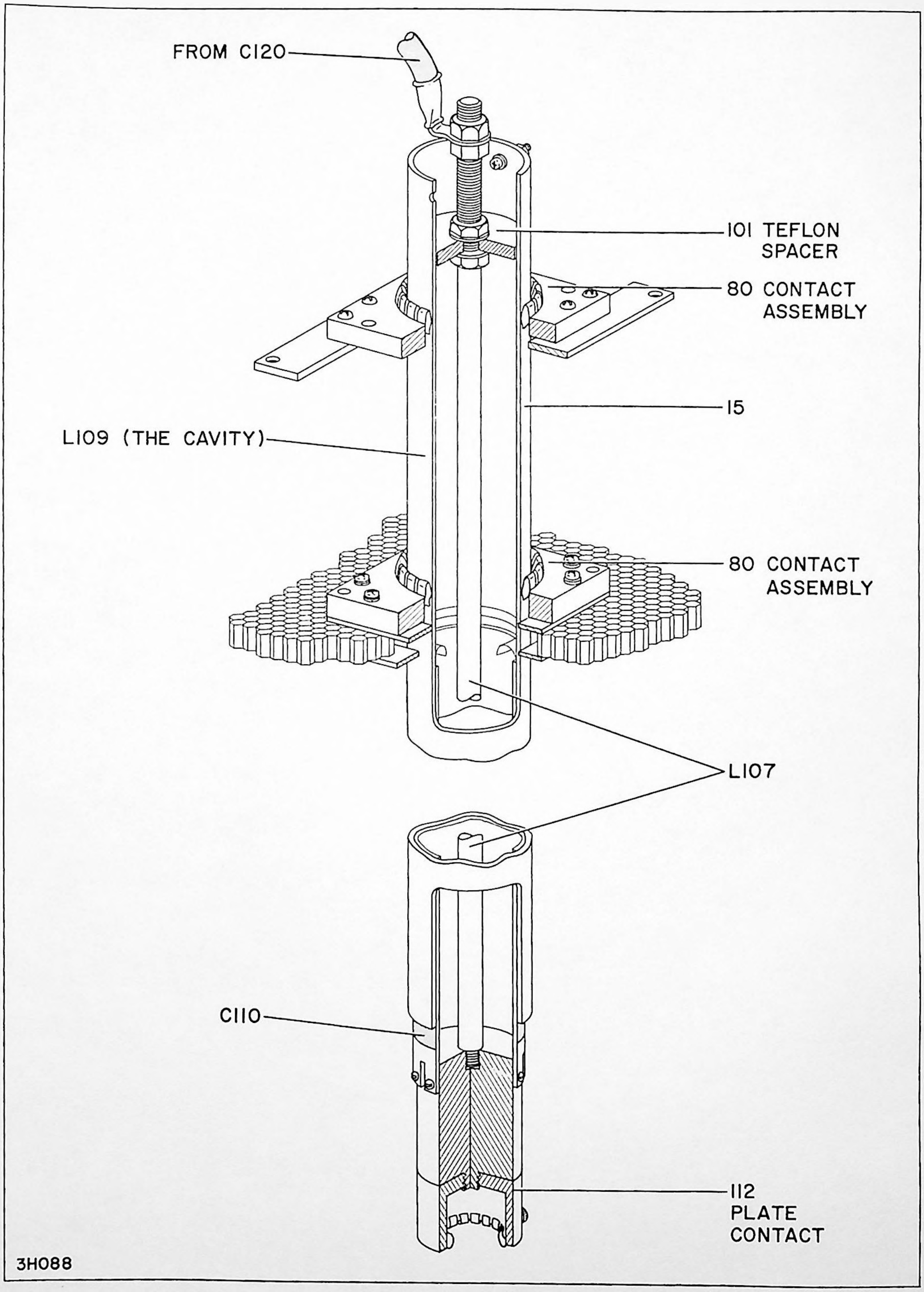
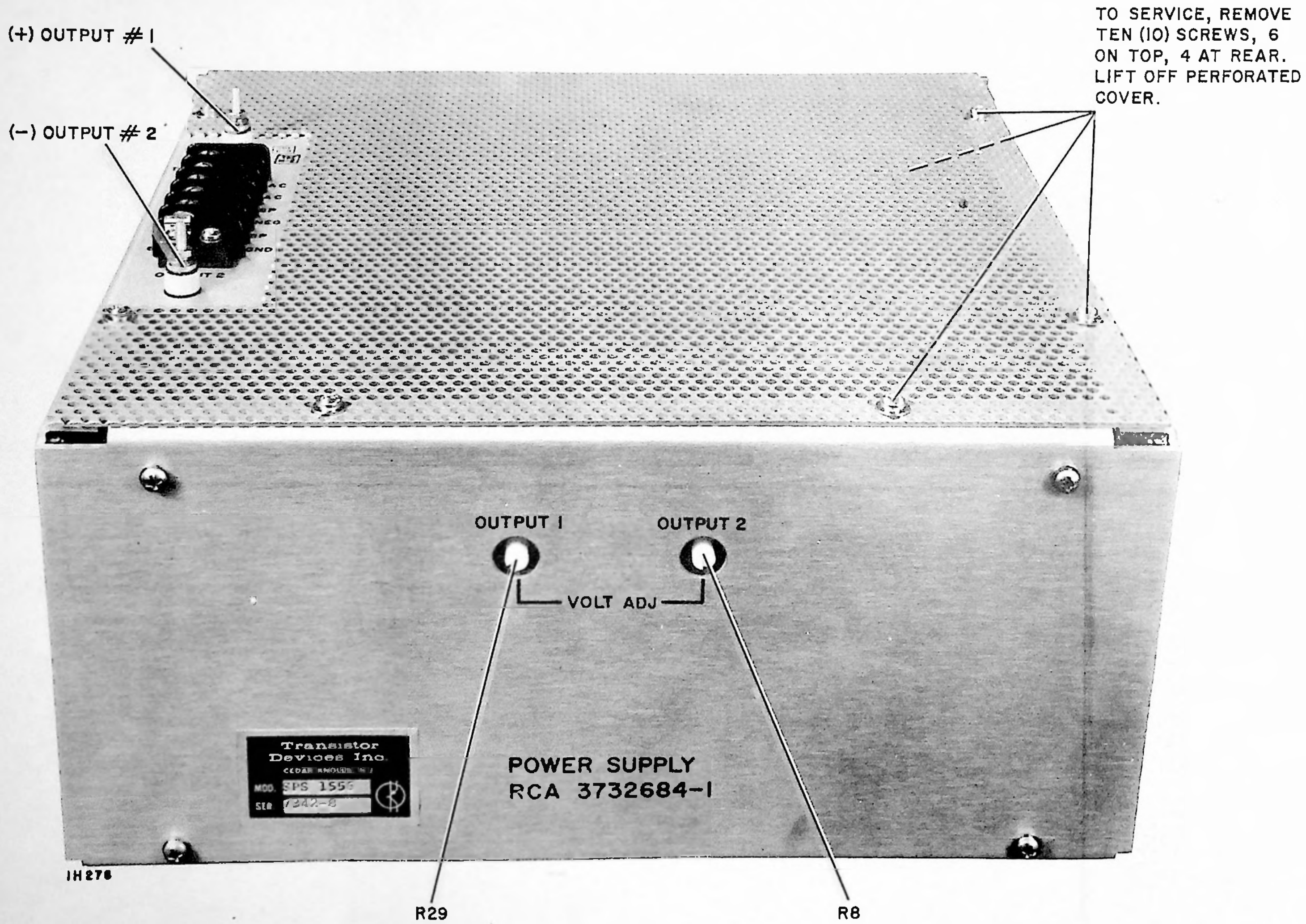
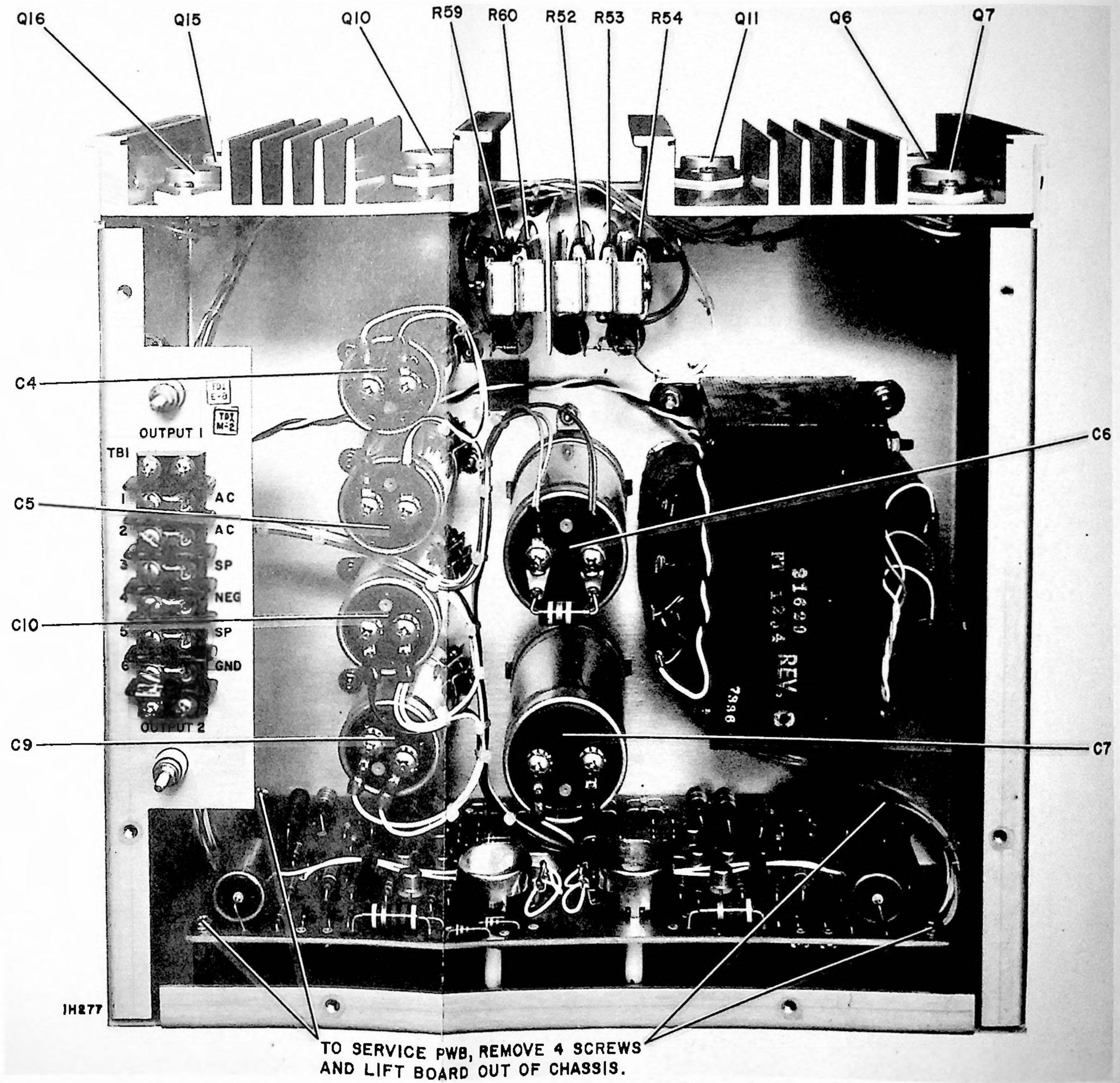


Figure 2-15. Exploded View, Aural PA Cavity Tuning Assembly



(+) OUTPUT # 1
(−) OUTPUT # 2
TO SERVICE, REMOVE TEN (10) SCREWS, 6 ON TOP, 4 AT REAR. LIFT OFF PERFORATED COVER.
OUTPUT 1
OUTPUT 2
VOLT ADJ
Transistor Devices Inc.
POWER SUPPLY
RCA 3732684-1
R29
R8
1H276



Q16
Q15
Q10
R59
R60
R52
R53
R54
Q11
Q6
Q7
C4
C5
C10
C9
C6
C7
OUTPUT 1
TB1
AC
AC
SP
NEG
SP
GND
OUTPUT 2
1H277
TO SERVICE PWB, REMOVE 4 SCREWS AND LIFT BOARD OUT OF CHASSIS.

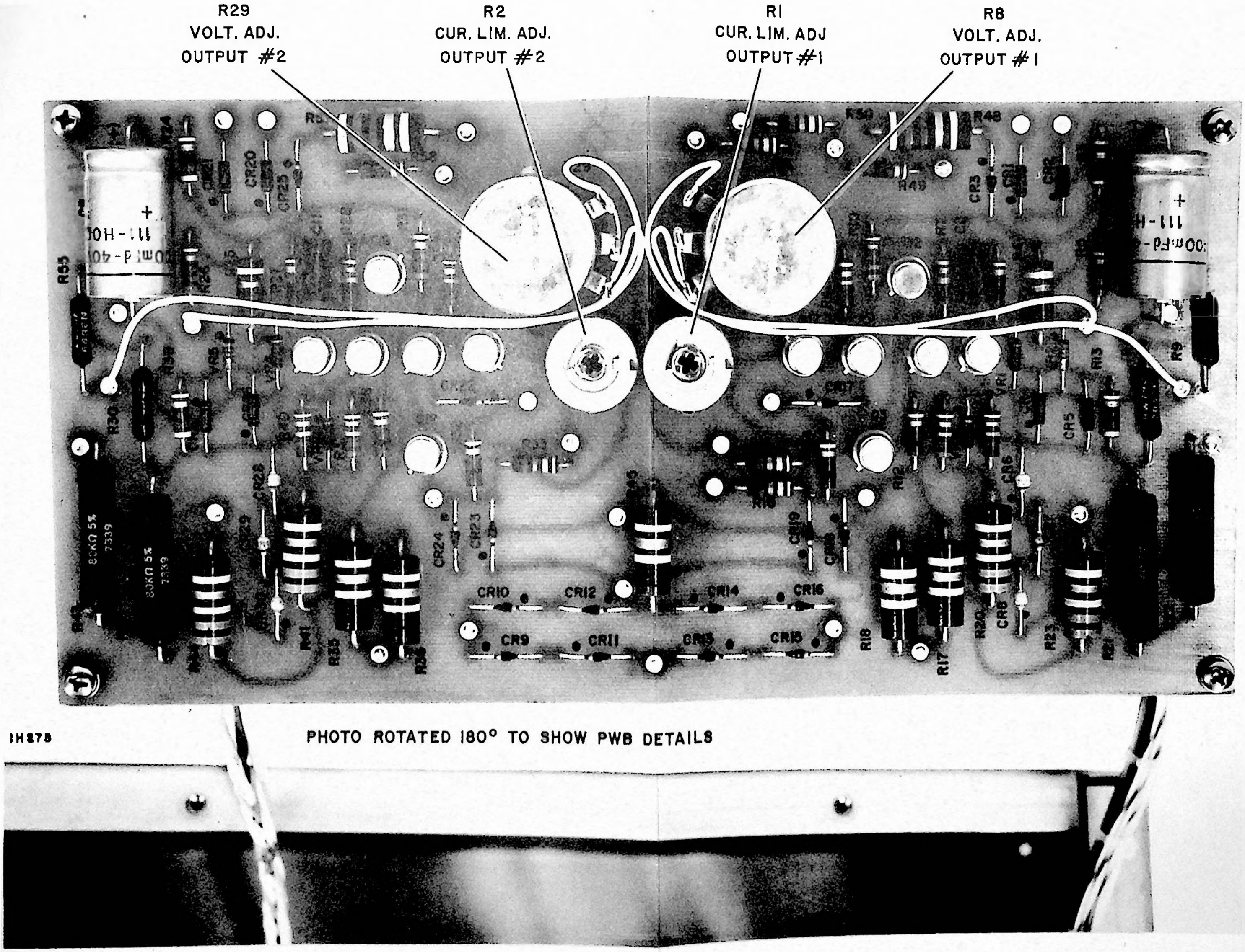


Figure 2-16. Pictorial View, Dual-Output Screen Power Supply

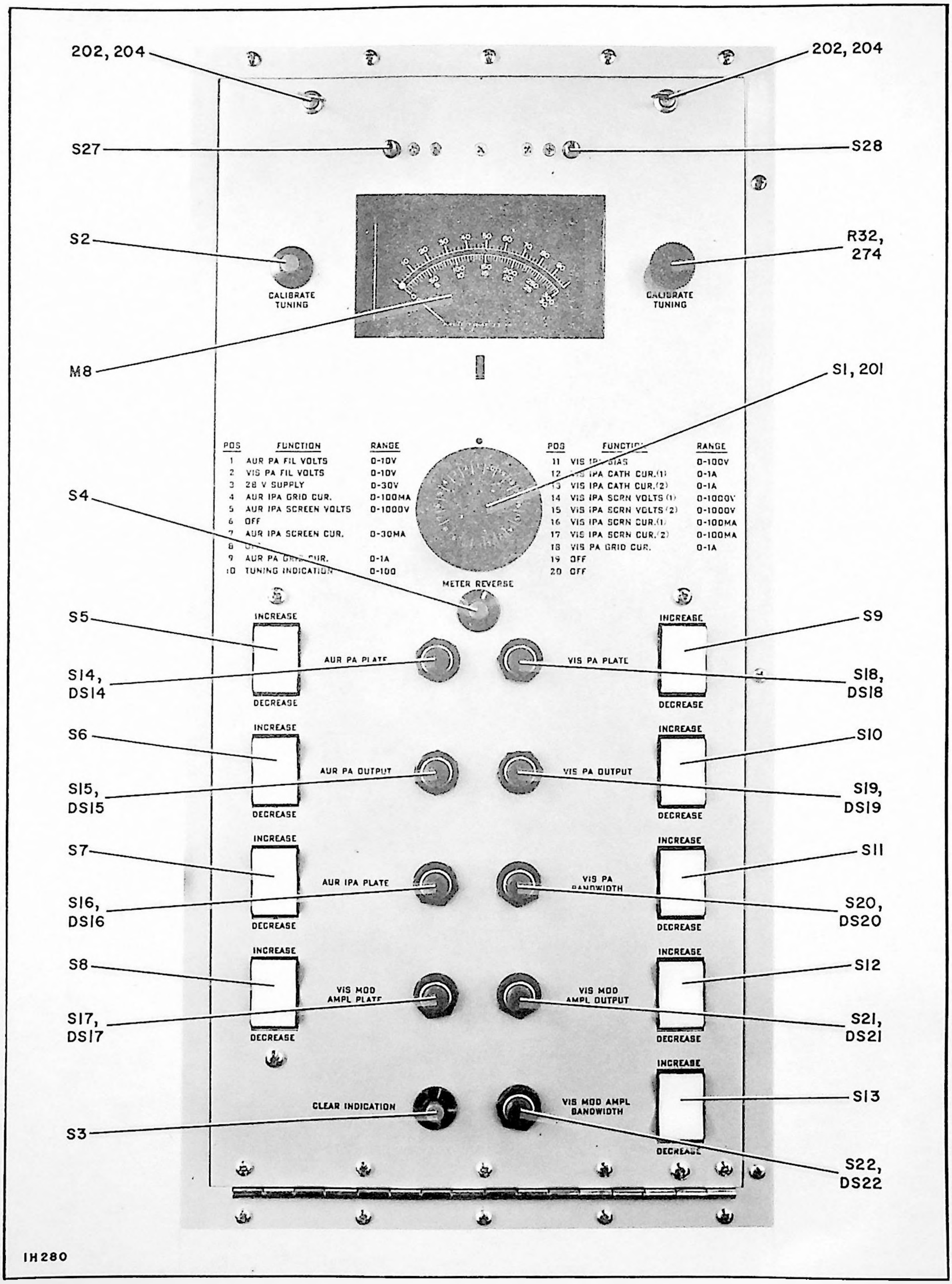


Figure 2-17. Front View, Tuning Multimeter Panel

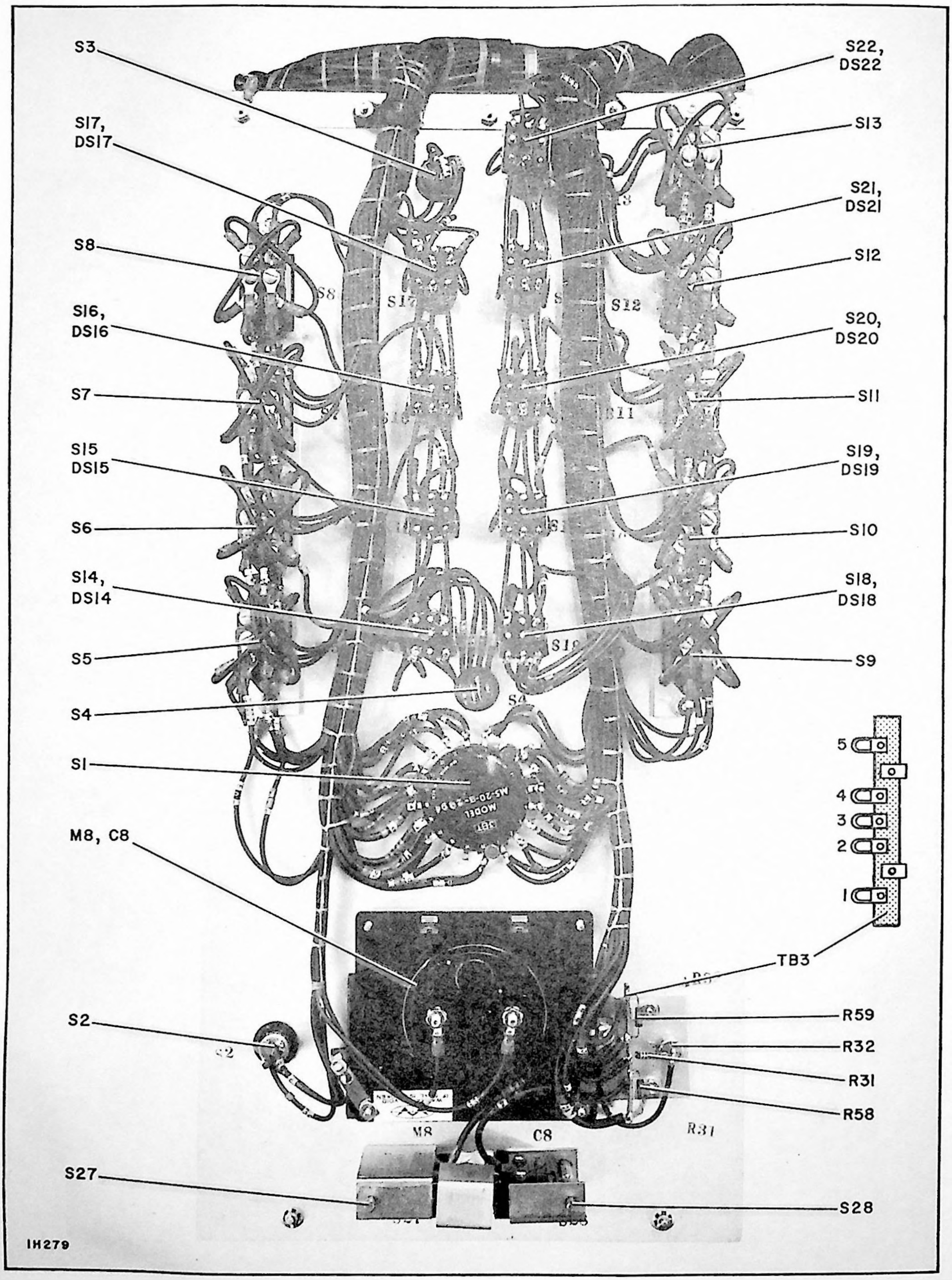


Figure 2-18. Rear View, Tuning Multimeter Panel

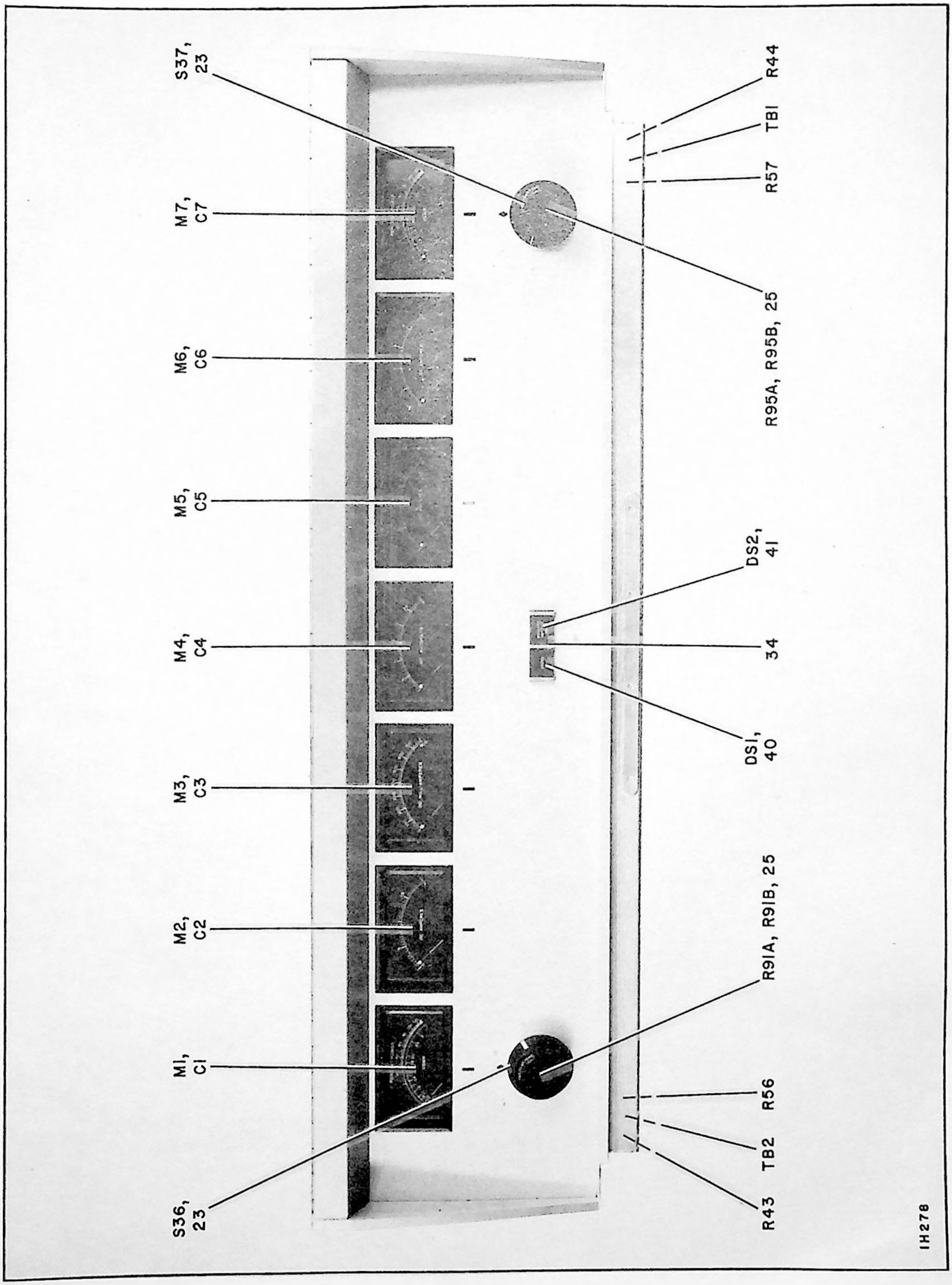


Figure 2-19. Pictorial View, Meter Panel

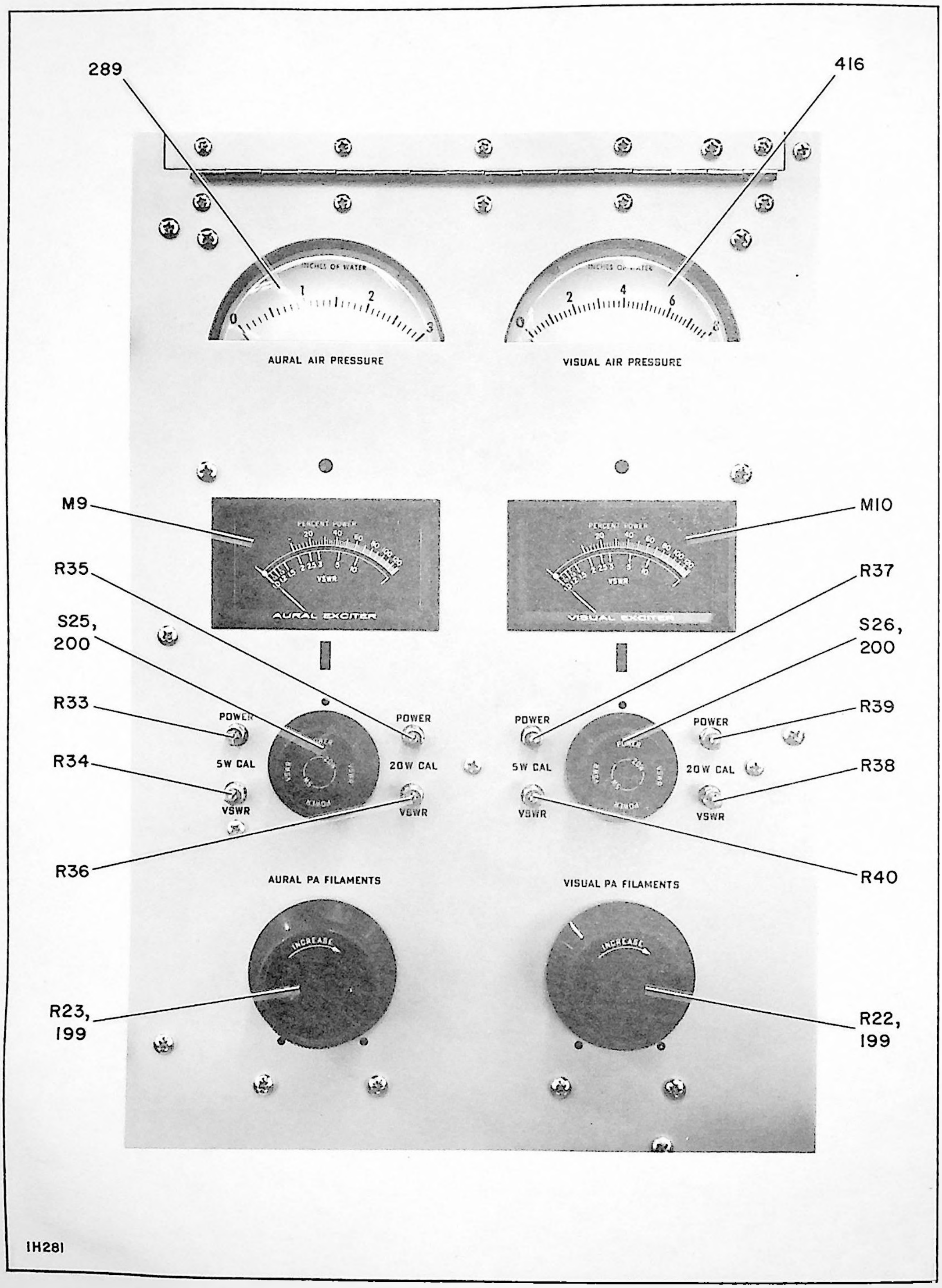


Figure 2-20. Pictorial View, Excitation
Reflectometer Meters

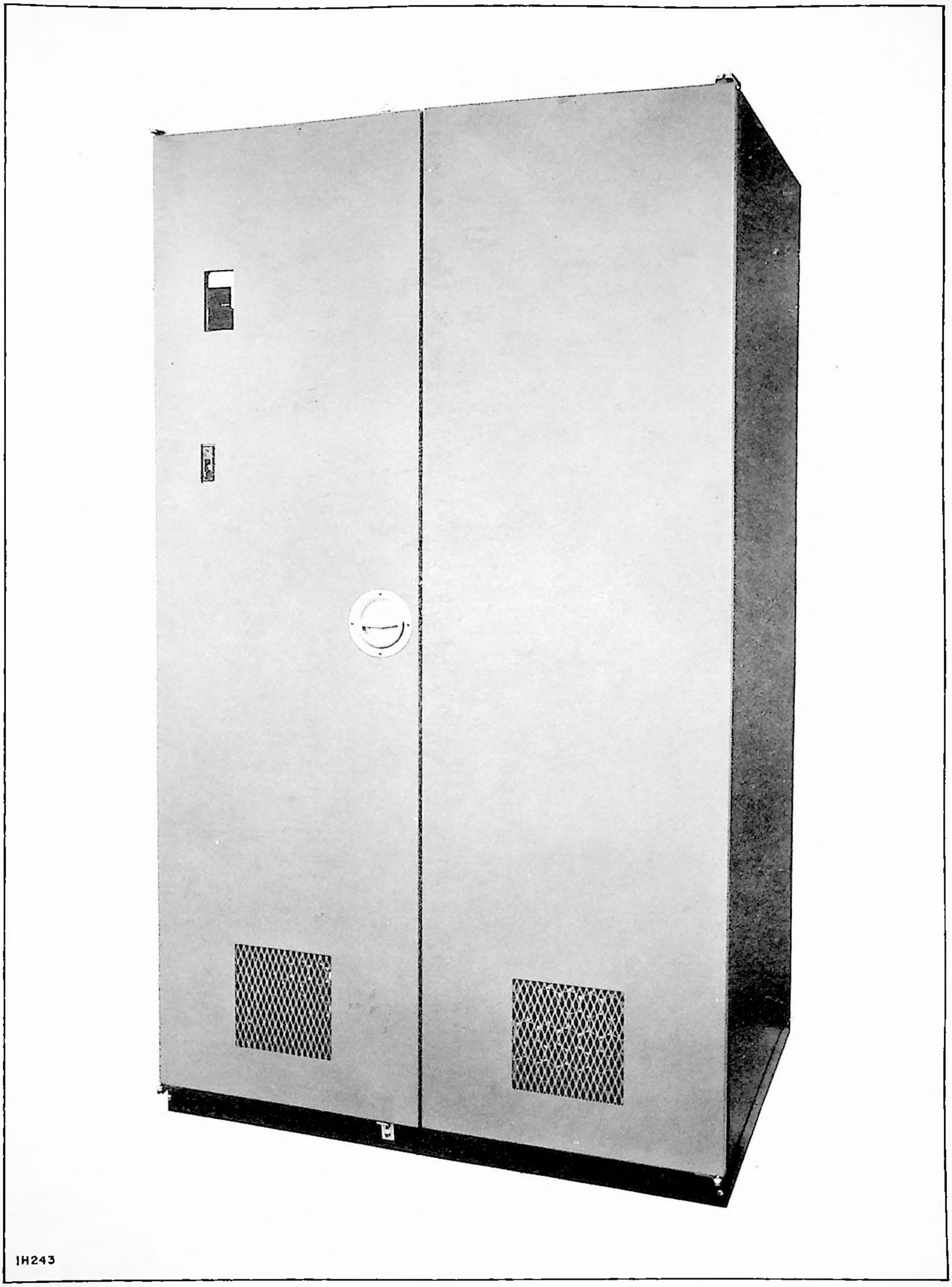


Figure 3-1. Power Supply Cabinet MI-560578-A

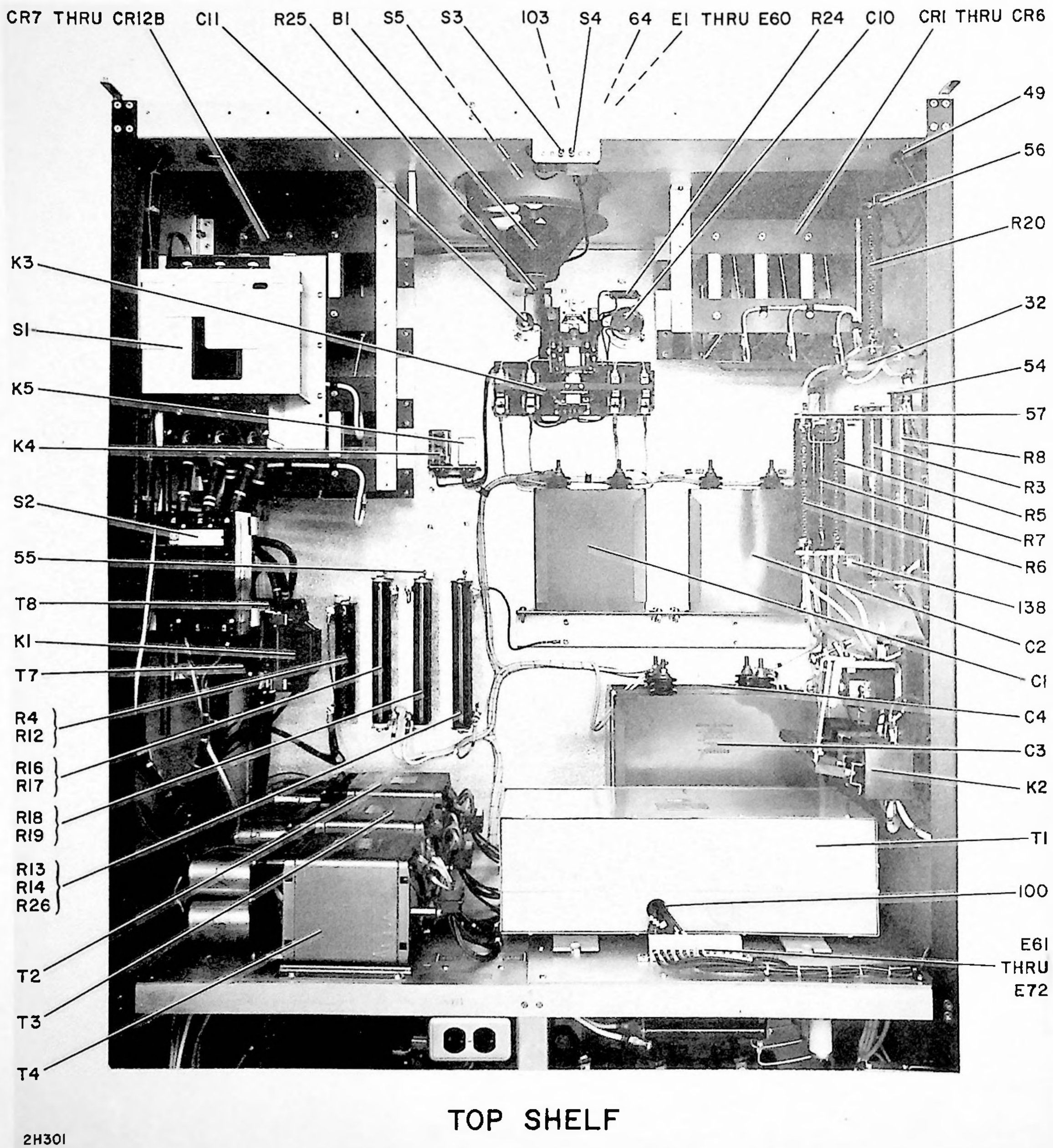
TECHNICAL SUMMARY

	TT-15FL/30FL	TT-25FL
Input Specifications		
Voltage	208/240 V, 3 Phase	208/240 V, 3 Phase
Frequency	50/60 Hz	50/60 Hz
Line Variations:		
Slow	±5%	±5%
Fast	±3%	±3%
Power Consumption:		
Black Picture	37 KW*	55 KW
Average Picture	25 KW*	40 KW
Power Factor	90%	90%
Line Regulation	3%	3%
Output Specifications		
3-Phase, 50/60 Hz:		
Regulated Line	236V, 3.0 KVA	236V, 3.0 KVA
Unregulated Line	230V, 5.5 KVA	230V, 5.5 KVA
High Voltage	6.0 KV, 4.0A	7.0 KV, 5.0A
	4.0 KV, 1.5A	5.0 KV, 2.0A
	2.0 KV, 1.5A	2.5 KV, 1.75A
	2.0 KV, 0.5A	2.5 KV, 0.75A

*Power Consumption Per Cabinet

EQUIPMENT LIST

Quantity	Item	TT-15FL/30FL	TT-25FL
1	Power Supply Cabinet	MI-560578-A	MI-560578-A
1	Power Determining Parts	MI-561287	MI-561286
1	High Voltage Transformer	MI-560581	MI-561276
1	Intermediate HV Transformer	MI-560582	MI-561275
1	Filter Reactor Assembly	MI-560853	MI-561280
3	Constant Voltage Transformer	MI-561281	MI-561281
1	Distribution Transformer	MI-561278	MI-561278



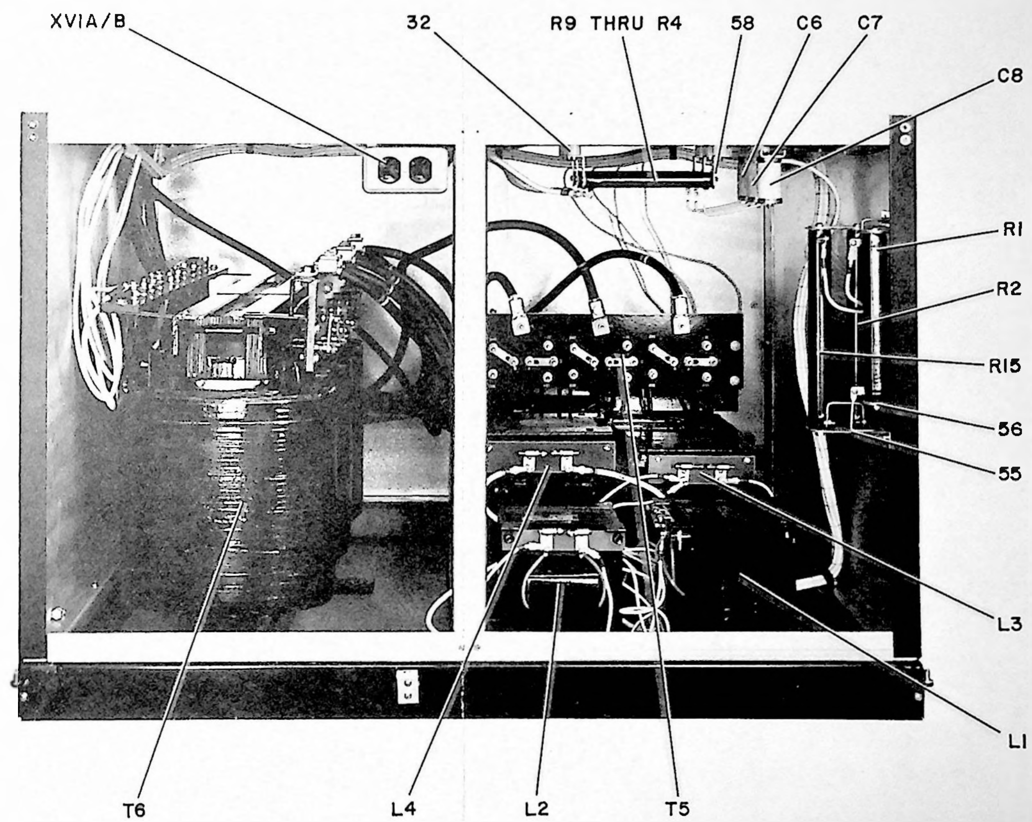


Figure 3-2. Power Supply Cabinet Major Components

DESCRIPTION

PHYSICAL DESCRIPTION

The Power Supply Cabinet MI-560578A (see Figure 3-1) is a self-contained unit that houses the major power sources for the transmitter. The cabinet has two-double interlocked front doors each encompassed with sound insulated gasket material to ensure quiet operation. The doors are held in position by spring latches located on the top and bottom of the left hand door and can only be opened when the source power is removed. This is accomplished by the interaction of the circuit breaker switch mounted on the top of the left-hand door which engages the AC MAIN LINE circuit breaker (S1) and the door handle (3-point bail) mounted in the middle of the left-hand door. When the doors are closed, the door handle must be in the locked position (clockwise direction) before the circuit breaker switch can be set to the ON position. Thus, the interaction of the two provide both a mechanical lock in preventing the doors from opening and an electrical interlock by removing power from the transmitter when the circuit breaker is set to the OFF or RESET position. In the OFF or RESET position, the circuit breaker switch disengages permitting the door handle to disengage. The left-hand door can then be opened by turning the door handle in the counterclockwise direction which releases the latches on the top and bottom of the door. The right-hand door then opens which releases (opens) the double interlocks (S3 and S4), de-energizing the interlock circuit.

The AC Main Line circuit breaker (S1) has both a magnetic and thermal overload. The magnetic overload operates very rapidly for heavy overloads whereas the thermal overload will sustain small percentage overloads.

The high voltage transformer (T6), intermediate high voltage transformer (T5), and filter chokes (L1 thru L4) are floor mounted (see Figure 3-2). The 3-inch base section of the cabinet is removable to easily permit these heavy components to slide into position. The middle shelf contains the filament constant voltage transformers (T2 thru T4), distribution transformer (T1), and filter capacitors (C3 and C4). The silicon rectifier stacks (CR 1 thru CR12B) for the high voltage supplies are mounted in the top left and right-hand corner of the cabinet. The rear wall of the cabinet contains the high voltage grounding time delay circuit along with the various resistors and filter capacitors C1 and C2. The left and right-hand walls of the cabinet contain the current transformers (T7 and T8), Distribution circuit breaker (S2), AC Main Line circuit breaker (S1), high voltage contactor (K1), surge suppressor contactor (K2), and various resistors. A small exhaust fan (B1), located at the top of the power supply cabinet, continually draws air up through the power supply cabinet and exhausts it through an opening at the top. Filters mounted on each of the front doors ensure that clean air is exhausted through the cabinet.

ELECTRICAL DESCRIPTION (See Figure 3-3)

The 208/240 V, 3-phase, 60 Hz input power source is applied through the AC Main Line circuit breaker (S1) and contactor K1 to the High Voltage Transformer (T6), Intermediate High Voltage Transformer (T5), and through the Distribution circuit breaker (S2) to the Distribution Transformer (T1).

The high voltage power supply uses silicon diodes in a three-phase, full wave rectifier circuit to provide voltage for the plate of the Visual Power Amplifier Tube from High Voltage Transformer (T6). The intermediate high voltage power supply also employs silicon diodes in a three-phase, full wave rectifier circuit to provide voltage for the plates of the 3CX30000A7 Aural PA tube from Intermediate High Voltage Transformer (T5). A center tap on T5 and separate filters provide a three-phase, half wave rectifier circuit to supply voltage for the plates of the 8791 Aural IPA and Visual modulated amplifier tubes. All of these voltages can be varied over a limited range by adjustment of the transformer taps (refer to Transformer Primary Tap Check).

The Distribution Transformer (T1) supplies 230 V, three-phase, 60 Hz to the blowers used in the transmitter and to the Regulation Transformers (T2 thru T4). The regulation transformers supply 236 V, three-phase for an input line varying between 190-260 V. This regulates the line that supplies all filament transformers, thereby ensuring a constant filament voltage. The transformer (T1) also supplies 115 V, 1-phase, 60 Hz to the control circuits in the Control Cabinet through a stepdown transformer and also to the 115 V, 1-phase, 60 Hz Bus Line in the transmitter. Remote terminals are provided in the power supply for monitoring the AC voltages.

Current Sensing Transformers (T7 and T8) are connected in the primary lines of the Intermediate High Voltage (T5) and High Voltage (T6) transformers. The outputs from T7 and T8 are connected across AC overload relays in the control cabinet which energize whenever the input current exceeds its limitations. The outputs from the rectifier stacks are connected across load resistor R4 for the high voltage supply and load resistor R20 for the intermediate high voltage supply. These resistors are in parallel with DC overload relays in the control cabinet which protects the two high voltage supplies. The primary line for the Intermediate High Voltage (T5) transformer is in effect triple looped through T7 and T8 for extra sensitivity whereas, the primary line for the High Voltage (T6) transformer is single looped and in opposite sense from transformer T5.

The reason is to make the overload relays operate as a differential overload. Initial surges oppose each other. Overloads in either transformer will cause the AC overload relay to operate.

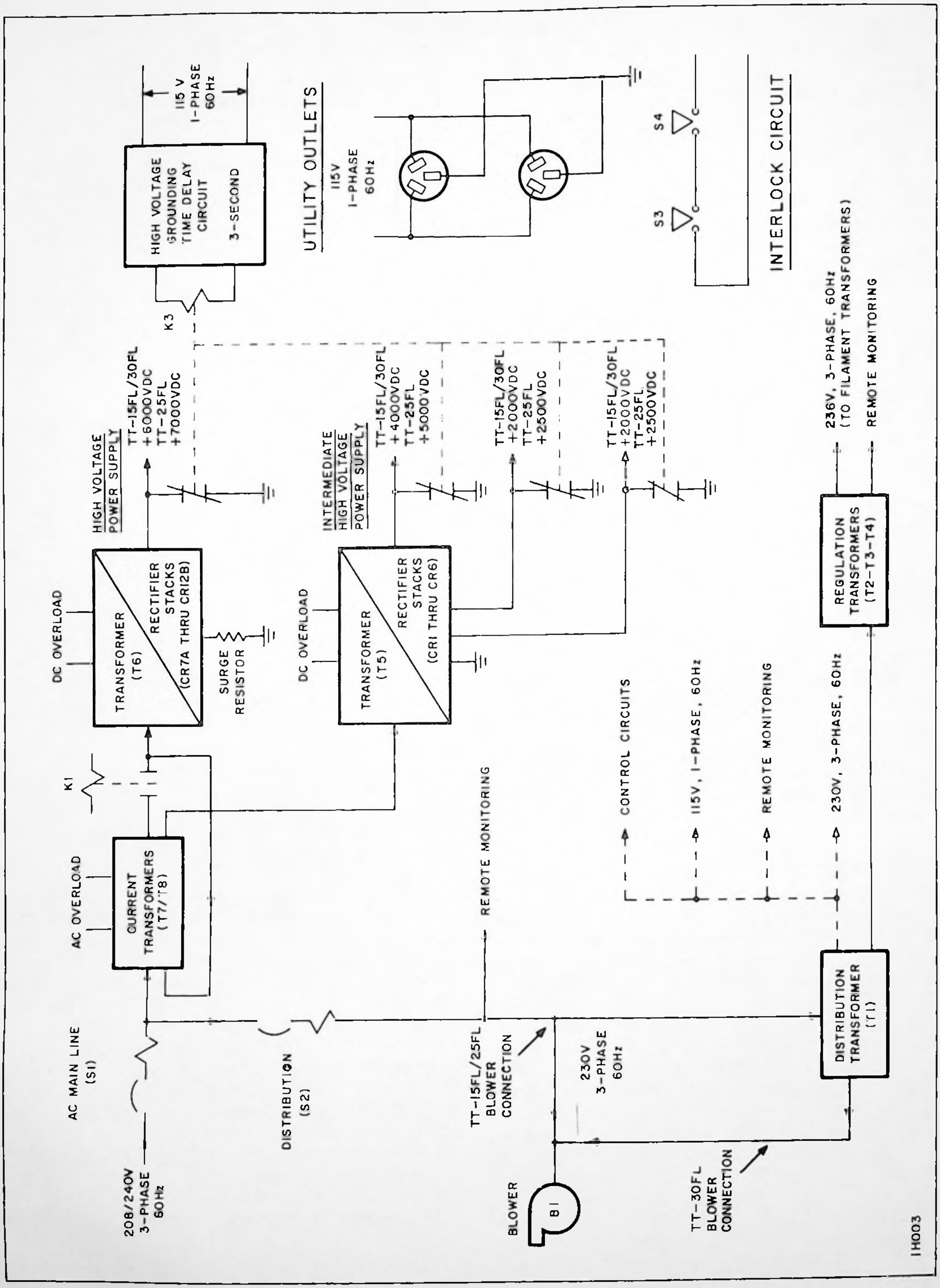


Figure 3-3. Power Supply Cabinet Functional/Signal Block Diagram

A grounding contactor K3 is provided to discharge the filter capacitors in the event that an interlock is opened, or the AC line fails. The bridge rectifier circuit incorporated as part of K3 is energized whenever the transmitter ON pushbutton is depressed, provided that the interlock circuit is completed. In the event that an interlock is opened, C11 will hold K3 open for approximately 2 seconds; if the AC line should fail during transmitter operation, capacitors C10 and C11 will hold K3 open for between 7 and 15 seconds. At the end of the indicated time delays, K3 will de-energize, discharging the filter capacitors.

Convenience outlets are provided on the lower front of the cabinet for use during servicing and repair. These should be connected to an external 115 VAC, 15 A circuit breaker. K2 is the surge suppression relay which is energized until the low voltage contactor (K12) in control cabinet is energized. Until K2 is de-energized, resistors R8 and R3 are in the circuit and limit the rise in current of the filter capacitors.

Bleeder resistors are included in the circuit to dissipate the stored energy of the filter capacitors and thereby prevent damage to the high voltage grounding contactor K3.

Two, 50-ohm resistors R1 and R7 are included in the filter circuit for the Visual modulated amplifier plate and the Visual Power Amplifier plate to terminate the high voltage cables.

Capacitors C6, C7, and C8 and resistors R9, R10, and R11 are included on the secondary of T6 to eliminate the transients and interference which might be present on incoming supply lines.

An over temperature switch (5S5) with normally open contacts rated 24 amperes at 120V, is located at the top of the cabinet as a customer convenience to be used as an alarm system switch to warn when the cabinet temperature rises above 128°F. The alarm (customer supplied) is connected between terminals 5E43 and 5E44.

ADJUSTMENTS

WARNING

Ensure that the input circuit breaker (5S1) and the distribution circuit breaker (5S2) are in the OFF position. Failure to do so may result in serious personal injury or loss of life.

TRANSFORMER PRIMARY TAP CHECK

The transformer primary tap check is performed to ensure that proper connection is made to the transformers in the Power Supply Cabinet. Check the transformer primary leads for connection to the proper taps as listed in Table 3-1.

TABLE 3-1. TRANSFORMER PRIMARY TAPS AND LINK CONNECTIONS

Symbol	197	208	219	229	240	251
T1	-11 to F 208 to G	0 to F 208 to G	+11 to F 208 to G	-11 to F 240 to G	0 to F 240 to G	+11 to F 240 to G
T2	C and F D and G	B and F D and G	A and F D and G	C and F E and G	B and F E and G	A and F E and G
T3	-11 to F 208 to G	0 to F 208 to G	+11 to F 208 to G	-11 to F 240 to G	0 to F 240 to G	+11 to F 240 to G

HIGH VOLTAGE REACTOR ADJUSTMENT

The spacing of the protection gap on the high-voltage reactors (L1 thru L4) must be adjusted depending on: elevation of the transmitter location, type of transmitter, and manufacturer of the reactor in accordance with either Table 3-2 or Table 3-3. Use a feeler gauge to measure dimensions.

TABLE 3-2. REACTOR ADJUSTMENT (TT-15FL/30FL)

		Protection Gap Dimension (inches)		
Reactor	Manufacturer	Sea Level	3500 ft.	7000 ft.
L1	Electro Vector	0.060	0.065	0.076
L2	Electro Vector	0.060	0.065	0.076
L2	Basler Elect.	0.055	0.056	0.062
L3	Electro Eng.	0.040	0.043	0.051
L3	Basler Elect.	0.055	0.056	0.062
L4	Electro Eng.	0.040	0.043	0.051
L4	Basler Elect.	0.076	0.077	0.086

TABLE 3-3. REACTOR ADJUSTMENT (TT-25FL)

		Protection Gap Dimension (inches)		
Reactor	Manufacturer	Sea Level	3500 ft.	7000 ft.
L1	Electro Vector	0.094	0.102	0.119
L2	Electro Vector	0.063	0.068	0.080
L3	Magnetran	0.125	0.135	0.158
L4	Magnetran	0.438	0.476	0.554

HIGH VOLTAGE SILICON RECTIFIER STACK CHECK

A short-circuited silicon rectifier cell may be detected by simple resistance checks using a volt-ohmmeter such as a Simpson Model 260. With the diode removed from the circuit (if the diode is part of a series "stack" of diodes, the connections to the "stacks" should be removed), measure the diode resistance. Reverse the ohmmeter leads and measure the diode resistance. If both readings are low, the diode should be replaced.

The condition of individual cells (CR1 through CR12B) may be checked by applying an external voltage to the individual cells and measuring the resultant current flow through the cell. A simple test circuit as shown in Figure 3-4 can be used to perform the individual cell checks. It should be noted that some other value of voltage can be used in the test circuit; however, 50 volts was selected because it is low enough to be safe for testing, but is also sufficient to present a good indication of cell degradation. A lower voltage, such as that available in a vacuum-type voltmeter, will not isolate defective cells unless they are almost complete shorts. Also note

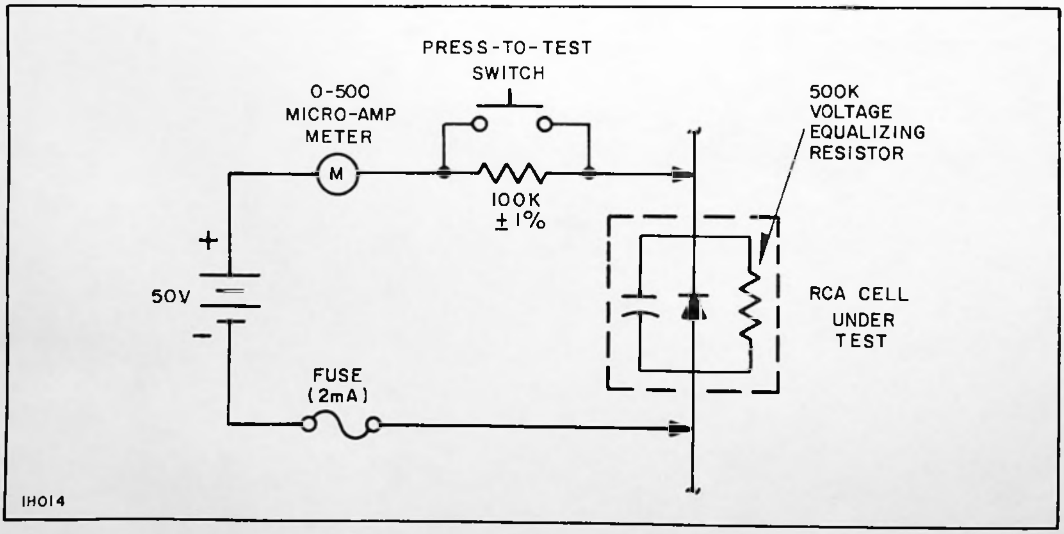


Figure 3-4. Silicon Rectifier Test Circuit

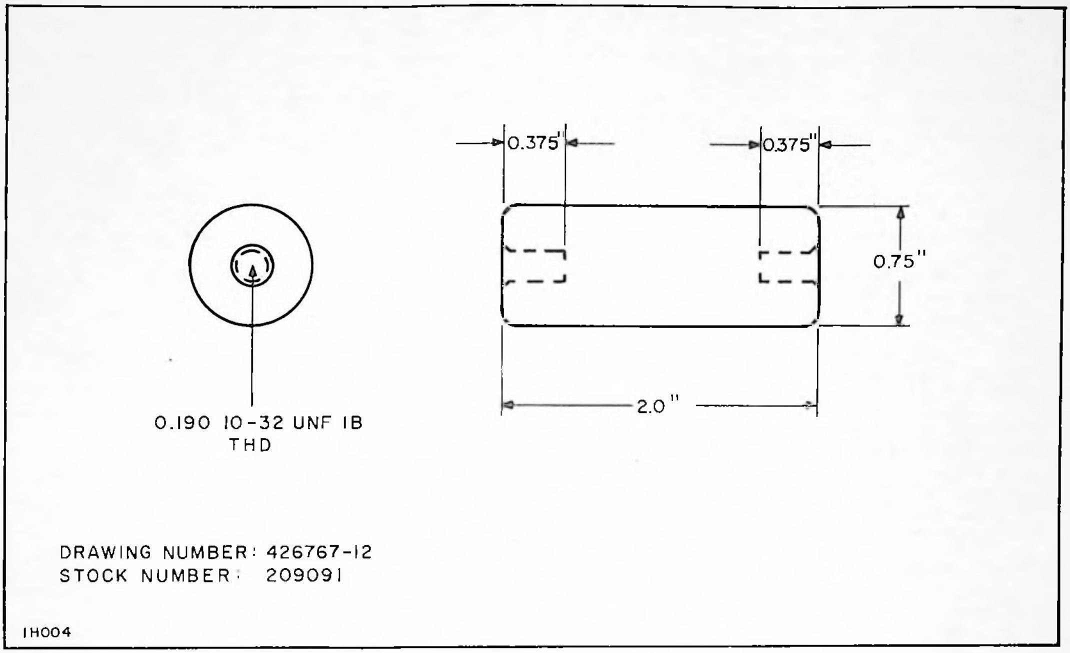


Figure 3-5. Insulator Data

that the 100 kilohm resistor and the "press-to-test" switch have been included in the test circuit to protect the meter from shorted and incorrectly connected (reversed) diodes. This test is based on the use of 500 K equalizing resistors across the cells. Connect the test circuit across the cell to be tested, observing the polarity as shown in the diagram. It should be noted that an area on each of the fins of an RCA type CR304 series stack has been left unpainted to facilitate this connection.

If the cell under test is shorted (or connected with reversed polarity) the meter will indicate approximately 500 μA. If this indication is observed, do not depress the "press-to-test" switch.

When the "press-to-test" switch is operated, a good cell will provide an indication of approximately 100 microamperes, while a cell that has degraded will indicate several hundred microamperes.

Reverse the connections to the cell. A good cell should indicate approximately 500 microamperes. A low reading indicates poor forward conduction, or an open cell.

MAINTENANCE

GENERAL

With ordinary care, a minimum of service will be required to keep the Power Supply Cabinet MI-560578A in operation. Table 3-3 includes a recommended schedule of maintenance that can be correlated with other equipment maintenance programs to promote overall peak efficiency.

WARNING

Always open the AC Main Line circuit breaker (S1) and discharge the high voltage DC circuits with the grounding stick provided before engaging any form of maintenance to prevent possible serious injury or loss of life.

TABLE 3-4. MAINTENANCE SCHEDULE

Daily
1. Make a general visual inspection for abnormalities after shutdown. 2. If overloads have occurred, examine each component concerned during shutdown and repair or replace if necessary.
Weekly
1. Clean the internal parts of the Power Supply Cabinet. Use a clean, soft cloth on all insulators and solvent, such as trichlorethylene, where needed. A vacuum cleaner is best for removing dust or dirt; a blower will suspend dirt allowing it to settle on the components again. 2. Check the interlocks (S3 and S4) and grounding time delay circuit for proper functioning. 3. Inspect the air filters for clogging and replace if necessary.
Monthly
1. Check the condition of the relay contacts and service if necessary. 2. Check for loose connections.
Quarterly
1. Make a detailed inspection of the Power Supply Cabinet. 2. Inspect and service all contactors if necessary. 3. Tighten all connections in the Power Supply Cabinet.
Semi-Annually
1. Inspect the relay contacts and replace them where required. 2. Clean the pole faces on the contactors.

RELAYS AND CONTACTORS

Periodic inspection of all relays and contactors should be made and at such time all contacts should be cleaned and adjustments made if necessary.

The High Voltage contactor K1 in the power supply cabinet has contacts which do not require dressing even though severely pitted. Contacts of relays K2 and K3 should be cleaned with trichlorethylene and a soft cloth. Keep the pole faces clean and see that they set securely. Check the operation manually, and tighten any loose screws.

The relays and contactors utilizing silver-to-silver contacts require little attention, but should be replaced if tip wear becomes excessive. Contacts may be cleaned with trichlorethylene applied with a soft brush, after which they should be burnished with a tool such as the RCA Stock No. 22963 Contact Cleaning Tool. Finally, they should be wiped clean with a piece of bond paper. Servicing notes for the relays and contactors are supplied in the MANUFACTURER'S BULLETINS section of this book.

HIGH-VOLTAGE GROUNDING CIRCUIT

High-voltage grounding circuit should be carefully inspected and maintained in proper operating condition. The ground arm should fall smoothly when released and should settle into contact with all high-voltage contacts every time. The arm bearing should be loose enough to permit some side movement of the arm. This movement permits the ground contact to settle into position properly.

INSULATORS

The one type of insulator used in the Power Supply Cabinet is shown in Figure 3-5. The figure presents an outline drawing of the insulator with dimensions, drawing and stock number, and tap size.

REPLACEMENT PARTS LIST

GENERAL

The components listed in the replacement are identified by one of two methods depending on whether the component is a mechanical or electrical part. Electrical parts are assigned a standard electrical symbol and are listed in alphanumerical sequence. Mechanical parts are assigned a numerical symbol (8, 17, 25, etc.) that corresponds to the item number on the mechanical assembly drawing where that particular part is located.

REPLACEMENT PARTS LIST

Symbol	Stock No.	Drawing No.	Description
			POWER SUPPLY CABINET MI-560578-A
			PREFIX 5 (TT-15FL/25FL)
			PREFIX 5 AND 6 (TT-30FL)
			USED ON TT-15FL (AFTER S/N 2269-080) TT25FL
			USED ON TT-30FL (AFTER S/N 2269-080)
Electrical			M/L 3459802-502 REV 13
B1	247475	3730660-001	FAN - EXHAUST
C1	430008	3726200-002	18 MF 5000 V
C2	430008	3726200-002	18 MF 5000 V
C3	430090	3726200-005	46 MF 5000 V
C4	430226	3726200-024	35.0 MF 7500 V
C6	418484	3455474-047	0.01 MF 15,000 V
C7	418484	3455474-047	0.01 MF 15,000 V
C8	418484	3455474-047	0.01 MF 15,000 V
C10	422767	3464719-008	ELECTROLYTIC, 1300UF 250V
C11	422766	3464719-007	ELECTROLYTIC, 375UF 250V
CR1 TO CR6	230914	3462541-001	DIODE - RECTIFIER, PART OF 3474059-501
CR7A TO CR12A	230914	3462541-001	DIODE - RECTIFIER, PART OF 3474058-501
CR7B TO CR12B	230914	3462541-001	DIODE - RECTIFIER, PART OF 3474058-501
	235119		MODULE - RIGHT HAND UNIT
	235120		MODULE - LEFT HAND UNIT
K1			PART OF PD KIT MI-561287, TT15/30FL
K1			PART OF PD KIT MI-561286, TT25FL
K2	217738	8434064-001	CONTACTOR-SURGE M.C.
K2	217738	3740246-001	CONTACTOR - SURGE, G.E.
	217738	3740246-001	CONTACTOR G.E.
	422929		COIL 110/120 VAC 60 CY
	422930		RECTIFIER
	422931		RESISTOR 10 OHMS
	422932		CONTACT, STATIONARY, 8 REQUIRED
	422933		CONTACT, MOVEABLE, 4 REQUIRED
	422934		SWITCH
K3	247448	3730553-001	CONTACTOR-HIGH VOLTAGE GROUNDING M.C.
	247873		CONTACT ASSEMBLY - STATIONARY
	209599		CONTACT ASSEMBLY - MOVABLE
	247874		SPRING - CONTACT
	247875		RELAY - CUTOUT, N.C.
	247876		SWITCH - MICRO NO/NC AUX.
	247877		COIL - MAGNET, 145 VOLT DC
K3	247448	3740276-001	CONTACTOR - HIGH VOLTAGE GROUNDING, G.E.
	247448	3740276-001	CONTACTOR G.E.
	422930		RECTIFIER
	422931		RESISTOR 10 OHMS
	422932		CONTACT, STATIONARY, 8 REQUIRED
	422933		CONTACT, MOVEABLE, 4 REQUIRED
	426984		COIL - 150 V
	422934		SWITCH
K4	248731	3720567-001	RELAY TIME DELAY
K5	248732	3720566-001	RELAY
L1			REACTOR - 2 H, PART OF MI-560583
L2			REACTOR - 10 H, PART OF MI-560583
L3			REACTOR - 3 H, PART OF MI-560583
L4			REACTOR - 0.5 H, PART OF MI-560583 FOR TT15/30FL
L1			REACTOR - 2H, PART OF MI-561280
L2			REACTOR - 10H, PART OF MI-561280
L3			REACTOR - 3H, PART OF MI-561280
L4			REACTOR - 0.5H, PART OF MI-561280 FOR TT25FL
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED

Symbol	Stock No.	Drawing No.	Description
R1	247443	3459806-001	WIREWOUND, NONIND, 50 OHMS 175 W
R2	248734	3459805-007	WIREWOUND, 50 OHMS 225 W
R3	247480	3459805-002	WIREWOUND, 1000 OHMS 225 W
R4	247484	3459807-001	CORRIB, 3.1 OHMS 300 W
R5	428010	3459807-004	CORRIB, 8 OHMS 300 W
R6	428010	3459807-004	CORRIB, 8 OHMS 300 W
R7	247443	3459806-001	WIREWOUND, NONIND, 50 OHMS 175 W
R8	247480	3459805-002	WIREWOUND, 1000 OHMS 225 W
R9	418778	3459809-004	WIREWOUND, 10,000 OHMS 100 W
R10	418778	3459809-004	WIREWOUND, 10,000 OHMS 100 W
R11	418778	3459809-004	WIREWOUND, 10,000 OHMS 100 W
R12	247486	3459807-003	CORRIB, 20 OHMS 300 W
R13	418299	3459805-008	WIREWOUND, 30,000 OHMS 225 W
R14	418299	3459805-008	WIREWOUND, 30,000 OHMS 225 W
R15	247482	3459805-005	WIREWOUND, 100,000 OHMS 225 W
R16 TO R19	427760	3459805-015	WIREWOUND, 40,000 OHMS 225 W
R20	247484	3459807-001	CORRIB, 3.1 OHMS 300 W
R24	18376	3722745-028	WIREWOUND, 10,000 OHMS 25W
R25	425743	3465422-038	WIREWOUND, 50 OHMS 20 W
R26	418299	3459805-008	WIREWOUND, 30,000 OHMS 225 W
S1			CIRCUIT BREAKER - MAIN PART OF PD KIT MI-561286, TT25FL
S1			CIRCUIT BREAKER - MAIN PART OF PD KIT MI-561287, TT15/30FL
S2	247440	3471761-005	CIRCUIT BREAKER - DISTRIBUTION
S3	246033	449258-002	SWITCH - INTERLOCK
S4	246033	449258-002	SWITCH - INTERLOCK
S5	209623	8868062-005	SWITCH - OVER TEMPERATURE
T1			TRANSFORMER - DISTRIBUTION, MI-561278
T2			TRANSFORMER - CONST. VOLTAGE, MI-561281
T3			TRANSFORMER - CONST. VOLTAGE, MI-561281
T4			TRANSFORMER - CONST. VOLTAGE, MI-561281
T5			TRANSFORMER - 1HV MI-560582, TT15/30FL
T5			TRANSFORMER - 1HV MI-561276, TT25FL
T6			TRANSFORMER - HV MI-560581, TT15/30FL
T6			TRANSFORMER - HV MI-561275, TT25FL
T7	246281	3462588-003	TRANSFORMER - CURRENT
T8	246281	3462588-003	TRANSFORMER - CURRENT
XK4	68590	99100-004	SOCKET - OCTAL
XK5	68590	99100-004	SOCKET - OCTAL
XV1A/B		1510016-005	RECEPTACLE - UTILITY OUTLET
Mechanical			
			M/L 3456992-503 REV 20
54	247450	3469644-001	BRACKET ASSEMBLY
55	247451	3469644-002	BRACKET ASSEMBLY
56	247452	3469644-003	BRACKET ASSEMBLY
57	247453	3469644-004	BRACKET ASSEMBLY
58	247454	3469644-005	BRACKET ASSEMBLY
	419636	3469644-009	BUSHING, PORCELAIN CORE SZ 1.12 OD X .75 ID
	418453	3469644-010	BUSHING, PORCELAIN CORE SZ .75 OD X .50 ID
49	242872	1510032-029	GROMMET - PLASTIC
100	239077	1510032-024	GROMMET
103	239141	1510032-006	GROMMET
32	209091	426767-012	INSULATOR - 0.75 DIA. X 2.00 LONG
138	97458	426767-106	INSULATOR, STANDOFF
64	247445	3459814-001	TERMINAL BLOCK
			M/L 3474058-501 REV 3
CR7A/B THRU CR12AB	230914	3462541-001	RECTIFIER ASSEMBLY
	235119		MODULE - RIGHT HAND UNIT
	235120		MODULE - LEFT HAND UNIT

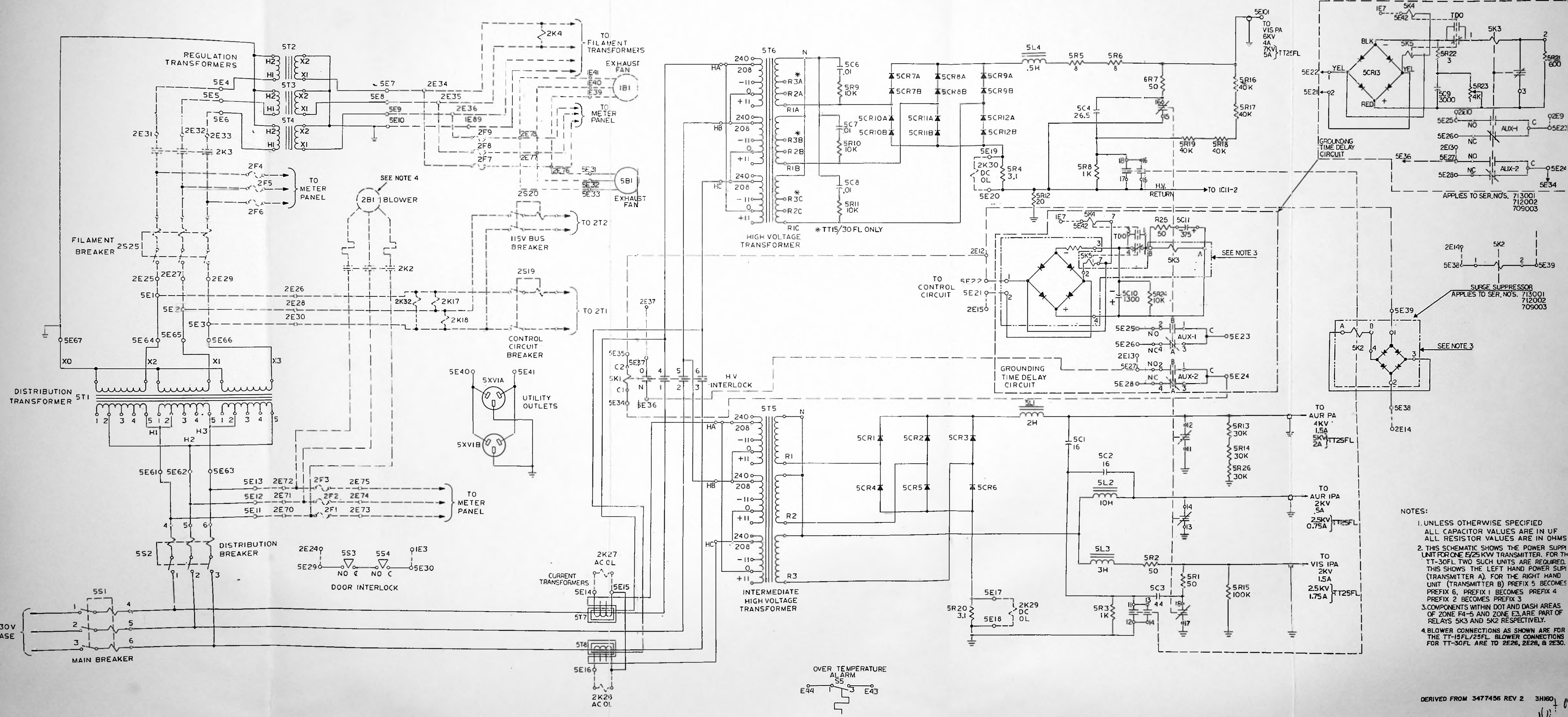
Symbol	Stock No.	Drawing No.	Description
			ML/3474059-501 REV 3
CR1 THRU CR6	230914	3462541-001	RECTIFIER ASSEMBLY
	235119		MODULE - RIGHT HAND UNIT
	235120		MODULE - LEFT HAND UNIT
			POWER DETERMINING PARTS (TT-15FL/30FL) MI-561287
			M/L 3724734-501 REV 1
K1	247449	3730651-	CONTACTOR - HIGH VOLTAGE
S1	247447	8838004-017	CIRCUIT BREAKER - MAIN
T5			TRANSFORMER - H V MI-560582
T6			TRANSFORMER - H V MI-560581
			FILTER REACTOR ASSEMBLY MI-560583
			HV PLATE TRANSFORMER (TT-15FL/30FL) MI-560581
	247456	3730671-001	TRANSFORMER
	230914		RECTIFIER STACK RCA CR304
	418002		MODULE RH RCA QR2900
	418003		MODULE LH RCA QR2901
			INTERMEDIATE HV TRANSFORMER (TT-15FL/30FL) MI-560582
	247457	3730806-001	TRANSFORMER
	230914		RECTIFIER STACK RCA CR304
	418002		MODULE RH RCA QR2900
	418003		MODULE LH RCA QR2901
			FILTER REACTOR ASSEMBLY (TT-15FL/30FL) MI-560583
		3469780-001	FILTER REACTOR ASSEMBLY
L1	247460	3730799-001	REACTOR
L2	247461	3730797-001	REACTOR
L3	247459	3730798-001	REACTOR
L4	247458	3730796-001	REACTOR
			POWER DETERMINING PARTS (TT-25FL) MI-561286
			M/L 3724734-502 REV 1
K1	427778	3732540-003	CONTACTOR - HIGH VOLTAGE
S1	427932	3724594-001	CIRCUIT BREAKER - MAIN
T5			TRANSFORMER - H V MI-561276
T6			TRANSFORMER - H V MI-561275
			FILTER REACTOR ASSEMBLY MI-561280
			HV PLATE TRANSFORMER (TT-25FL) MI-561276
		3732720-001	TRANSFORMER MI-561276
			INTERMEDIATE HV TRANSFORMER (TT-25FL) MI-561275
		3732721-001	TRANSFORMER MI-561275
			FILTER REACTOR ASSEMBLY (TT-25FL) MI-561280
			M/L 3742078-501 REV 1
L1	427764	3732719-001	REACTOR - 2H
L2	427763	3732717-001	REACTOR - 10H
L3	427762	3732718-001	REACTOR - 3H
L4	427761	3732716-001	REACTOR - 0.5H

Symbol	Stock No.	Drawing No.	Description
			CONSTANT VOLTAGE TRANSFORMER MI-561281
	427983	3732707-001	TRANSFORMER - CONSTANT VOLTAGE
			DISTRIBUTION TRANSFORMER MI-561278
		3732713-001	TRANSFORMER - DISTRIBUTION

Symbol	Stock No.	Drawing No.	Description
			POWER SUPPLY CABINET MI-560578 PREFIX 5 (TT-15FL) PREFIX 5 AND 6 (TT-30FL) USED ON TT-15FL (S/N 2269-080 AND EARLIER) USED ON TT-30FL (S/N 2269-080 AND EARLIER) M/L 3459802-501 REV. 13
Electrical			
B1	247475	3730660-001	FAN - EXHAUST
			CAPACITORS
C1	430008	3726200-002	18 MF 5000 V
C2	430008	3726200-002	18 MF 5000 V
C3	247437	3462543-009	44 MF 2500 V
C4	430226	3726200-024	35.0 MF 7500 V
C5	240706	3471769-021	26.5 MF 7500 V
C6	418484	3455474-047	0.01 MF 15,000 V
C7	418484	3455474-047	0.01 MF 15,000 V
C8	418484	3455474-047	0.01 MF 15,000 V
C10	422767	3464719-008	ELECTROLYTIC, 1300UF 250V
C11	422766	3464719-007	ELECTROLYTIC, 375UF 250V
CR1 TO CR6	230914	3462541-001	DIODE - RECTIFIER, PART OF 3474059-501
CR7A TO CR12A	230914	3462541-001	DIODE - RECTIFIER, PART OF 3474058-501
CR7B TO CR12B	230914	3462541-001	DIODE - RECTIFIER, PART OF 3474058-501
	235119		MODULE - RIGHT HAND UNIT
	235120		MODULE - LEFT HAND UNIT
K1	247449	3730651-001	CONTACTOR - MAIN
	422215		CONTACT KIT, CONSISTING OF 6 STATIONARY AND 3 MOVEABLE CONTACTS.
K2	217738	8434064-001	CONTACTOR-SURGE M.C.
K2	217738	3740246-001	CONTACTOR - SURGE, G.E.
	217738	3740246-001	CONTACTOR G.E.
	422929		COIL 110/120 VAC 60 CY
	422930		RECTIFIER
	422931		RESISTOR 10 OHMS
	422932		CONTACT, STATIONARY, 8 REQUIRED
	422933		CONTACT, MOVEABLE, 4 REQUIRED
	422934		SWITCH
K3	247448	3730553-001	CONTACTOR-HIGH VOLTAGE GROUNDING M.C.
	247873		CONTACT ASSEMBLY - STATIONARY
	209599		CONTACT ASSEMBLY - MOVABLE
	247874		SPRING - CONTACT
	247875		RELAY - CUTOUT, N.C.
	247876		SWITCH - MICRO NO/NC AUX.
	247877		COIL - MAGNET, 145 VOLT DC
K3	247448	3740276-001	CONTACTOR - HIGH VOLTAGE GROUNDING, G.E.
	247448	3740276-001	CONTACTOR G.E.
	422930		RECTIFIER
	422931		RESISTOR 10 OHMS
	422932		CONTACT, STATIONARY, 8 REQUIRED
	422933		CONTACT, MOVEABLE, 4 REQUIRED
	426984		COIL - 150 V
	422934		SWITCH
K4	248731	3720567-001	RELAY TIME DELAY
K5	248732	3720566-001	RELAY
L1			REACTOR - 2 H, PART OF MI-560583
L2			REACTOR - 10 H, PART OF MI-560583
L3			REACTOR - 3 H, PART OF MI-560583
L4			REACTOR - 0.5 H, PART OF MI-560583
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1	247443	3459806-001	WIREWOUND, NONIND, 50 OHMS 175 W

Symbol	Stock No.	Drawing No.	Description
R2	248734	3459805-007	WIREWOUND, 50 OHMS 225 W
R3	247480	3459805-002	WIREWOUND, 1000 OHMS 225 W
R4	247484	3459807-001	CORRIB, 3.1 OHMS 300 W
R5	428010	3459807-004	CORRIB, 8 OHMS 300 W
R6	428010	3459807-004	CORRIB, 8 OHMS 300 W
R7	247443	3459806-001	WIREWOUND, NONIND, 50 OHMS 175 W
R8	247480	3459805-002	WIREWOUND, 1000 OHMS 225 W
R9	418778	3459809-004	WIREWOUND, 10,000 OHMS 100 W
R10	418778	3459809-004	WIREWOUND, 10,000 OHMS 100 W
R11	418778	3459809-004	WIREWOUND, 10,000 OHMS 100 W
R12	247486	3459807-003	CORRIB, 20 OHMS 300 W
R13	247481	3459805-004	WIREWOUND, 50,000 OHMS 225 W
R14	247481	3459805-004	WIREWOUND, 50,000 OHMS 225 W
R15 TO			
R19	247482	3459805-005	WIREWOUND, 100,000 OHMS 225 W
R20	247484	3459807-001	CORRIB, 3.1 OHMS 300 W
R24	18376	3722745-028	WIREWOUND, 10,000 OHMS 25W
R25	425743	3465422-038	WIREWOUND, 50 OHMS 20 W
S1	247447	8838004-017	CIRCUIT BREAKER - MAIN
S2	247440	3471761-005	CIRCUIT BREAKER - DISTRIBUTION
S3	246033	449258-002	SWITCH - INTERLOCK
S4	246033	449258-002	SWITCH - INTERLOCK
S5	209623	8868062-005	SWITCH - OVER TEMPERATURE
T1			TRANSFORMER - DISTRIBUTION, MI-560580
T2			TRANSFORMER - CONST. VOLTAGE, MI-560584
T3			TRANSFORMER - CONST. VOLTAGE, MI-560584
T4			TRANSFORMER - CONST. VOLTAGE, MI-560584
T5			TRANSFORMER - HIGH VOLTAGE, MI-560582
T6			TRANSFORMER - HIGH VOLTAGE, MI-560581
T7	246281	3462588-003	TRANSFORMER - CURRENT
T8	246281	3462588-003	TRANSFORMER - CURRENT
XK4	68590	99100-004	SOCKET - OCTAL
XK5	68590	99100-004	SOCKET - OCTAL
XV1A/B		3724988-001	RECEPTACLE - UTILITY OUTLET
Mechanical			
			M/L 3456992-501 REV 20
54	247450	3469644-001	BRACKET ASSEMBLY
55	247451	3469644-002	BRACKET ASSEMBLY
56	247452	3469644-003	BRACKET ASSEMBLY
57	247453	3469644-004	BRACKET ASSEMBLY
58	247454	3469644-005	BRACKET ASSEMBLY
	419636	3469644-009	BUSHING, PORCELAIN CORE SZ 1.12 OD X .75 ID
	418453	3469644-010	BUSHING, PORCELAIN CORE SZ .75 OD X .50 ID
49	242872	1510032-029	GROMMET - PLASTIC
100	239077	1510032-024	GROMMET
103	239141	1510032-006	GROMMET
32	209091	426767-012	INSULATOR - 0.75 DIA. X 2.00 LONG
138	97458	426767-106	INSULATOR, STANDOFF
64	247445	3459814-001	TERMINAL BLOCK
			M/L 3474058-501 REV 3
CR7A/B			
THRU			
CR12AB	230914	3462541-001	RECTIFIER ASSEMBLY
	235119		MODULE - RIGHT HAND UNIT
	235120		MODULE - LEFT HAND UNIT
			ML/3474059-501 REV 3
CR1			
THRU			
CR6	230914	3462541-001	RECTIFIER ASSEMBLY
	235119		MODULE - RIGHT HAND UNIT
	235120		MODULE - LEFT HAND UNIT

Symbol	Stock No.	Drawing No.	Description
			HV PLATE TRANSFORMER MI-560581
	247456	3730671-001	TRANSFORMER
	230914		RECTIFIER STACK RCA CR304
	418002		MODULE, R.H. RCA QR2900
	418003		MODULE, L.H. RCA QR2901
			INTERMEDIATE HV PLATE TRANSFORMER MI-560582
	247457	3730806-001	TRANSFORMER
	230914		RECTIFIER STACK RCA CR304
	418002		MODULE, R.H. RCA QR2900
	418003		MODULE, L.H. RCA QR2901
			FILTER REACTOR ASSEMBLY MI-560583
		3469780-001	FILTER REACTOR ASSEMBLY
L1	247460	3730799-001	REACTOR
L2	247461	3730797-001	REACTOR
L3	247459	3730798-001	REACTOR
L4	247458	3730796-001	REACTOR
			CONSTANT VOLTAGE TRANSFORMER MI-560584
	247462	3732017-001	TRANSFORMER (60 Hz ONLY)
			DISTRIBUTION TRANSFORMER MI-560580
	247455	3730668-001	TRANSFORMER - DISTRIBUTION

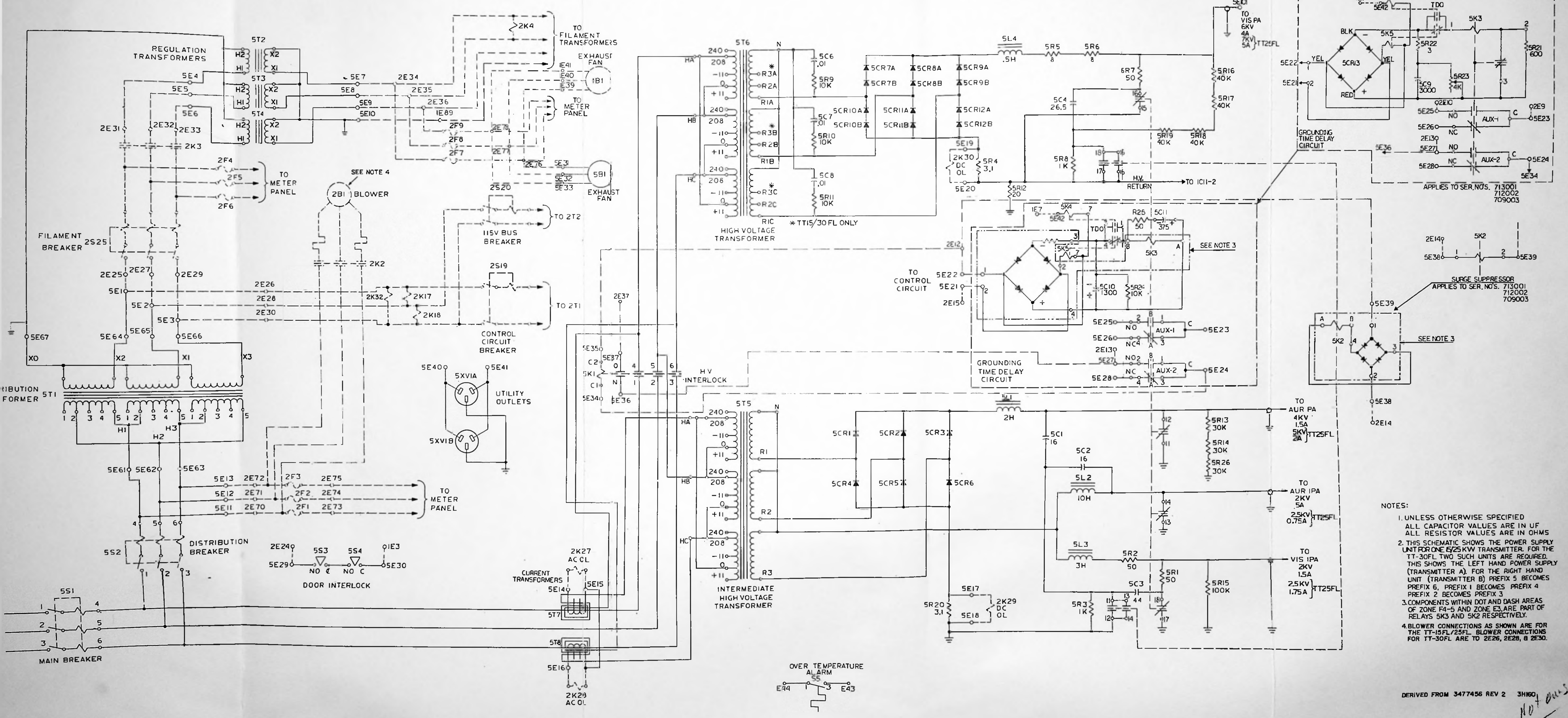


NOTES:

1. UNLESS OTHERWISE SPECIFIED
ALL CAPACITOR VALUES ARE IN UF
ALL RESISTOR VALUES ARE IN OHMS
2. THIS SCHEMATIC SHOWS THE POWER SUPP UNIT FOR ONE 15/25 KW TRANSMITTER. FOR TH TT-30FL TWO SUCH UNITS ARE REQUIRED. THIS SHOWS THE LEFT HAND POWER SUP (TRANSMITTER A). FOR THE RIGHT HAND UNIT (TRANSMITTER B) PREFIX 5 BECOMES PREFIX 6, PREFIX 1 BECOMES PREFIX 4 PREFIX 2 BECOMES PREFIX 3
3. COMPONENTS WITHIN DOT AND DASH AREAS OF ZONE F4-5 AND ZONE E3 ARE PART OF RELAYS 5K3 AND 5K2 RESPECTIVELY.
4. BLOWER CONNECTIONS AS SHOWN ARE FOR THE TT-15FL/25FL. BLOWER CONNECTIONS FOR TT-30FL ARE TO 2E26, 2E28, & 2E30.

DERIVED FROM 3477456 REV 2 3H160

Figure 3-6. Power Supply Cabinet MI-560578 Schematic Diagram (3477456)



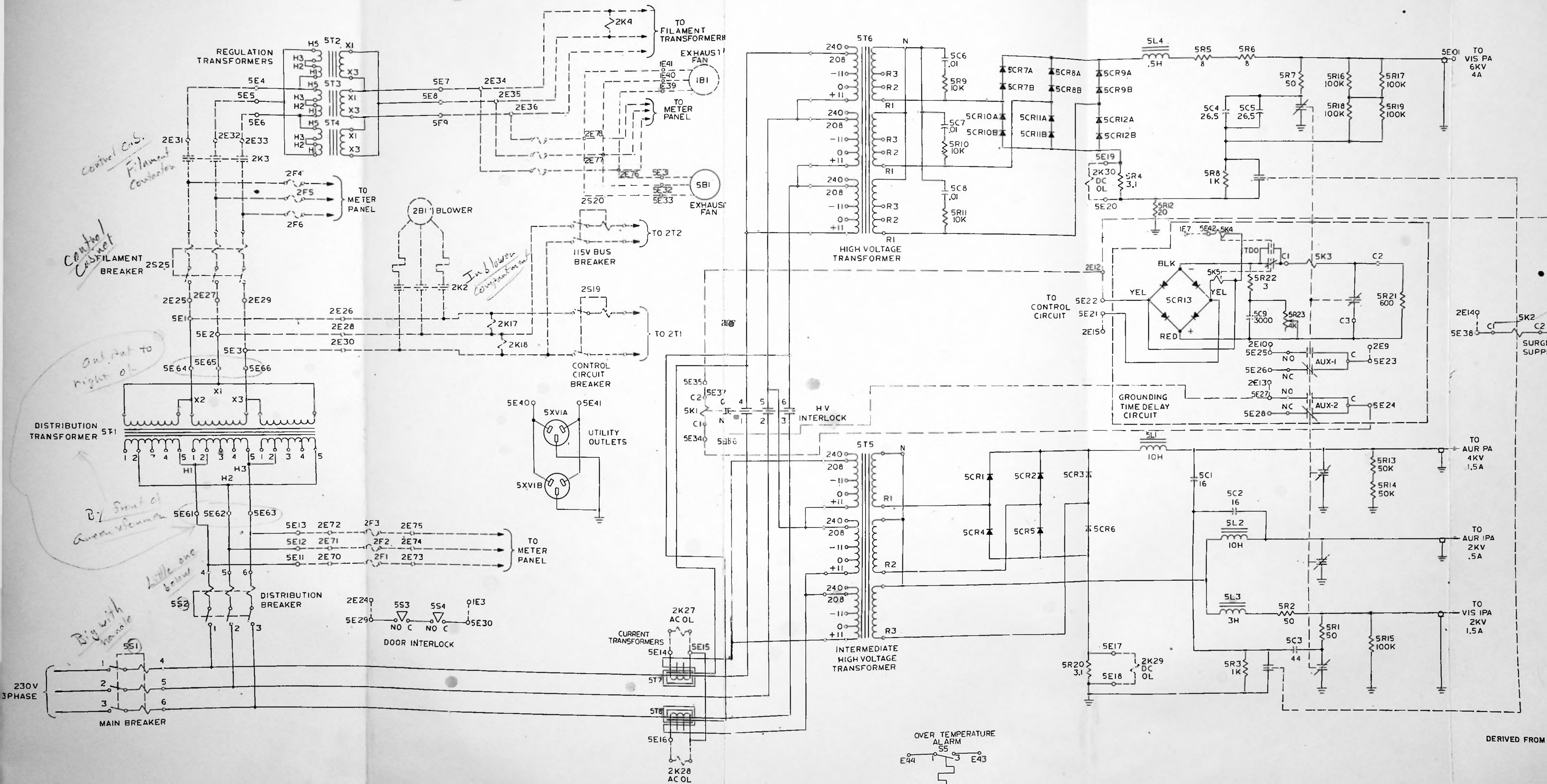
NOTES:

1. UNLESS OTHERWISE SPECIFIED
ALL CAPACITOR VALUES ARE IN UF
ALL RESISTOR VALUES ARE IN OHMS
2. THIS SCHEMATIC SHOWS THE POWER SUPPLY UNIT FOR ONE 15/25 KW TRANSMITTER. FOR THE TT-30FL TWO SUCH UNITS ARE REQUIRED. THIS SHOWS THE LEFT HAND POWER SUPPLY (TRANSMITTER A). FOR THE RIGHT HAND UNIT (TRANSMITTER B) PREFIX 5 BECOMES PREFIX 6, PREFIX 1 BECOMES PREFIX 4 PREFIX 2 BECOMES PREFIX 3
3. COMPONENTS WITHIN DOT AND DASH AREAS OF ZONE F4-5 AND ZONE E3, ARE PART OF RELAYS 5K3 AND 5K2 RESPECTIVELY.
4. BLOWER CONNECTIONS AS SHOWN ARE FOR THE TT-15FL/25FL. BLOWER CONNECTIONS FOR TT-30FL ARE TO 2E26, 2E28, & 2E30.

DERIVED FROM 3477456 REV 2 3H160

Not ours

Figure 3-6. Power Supply Cabinet MI-560578-A Schematic Diagram (3477456)

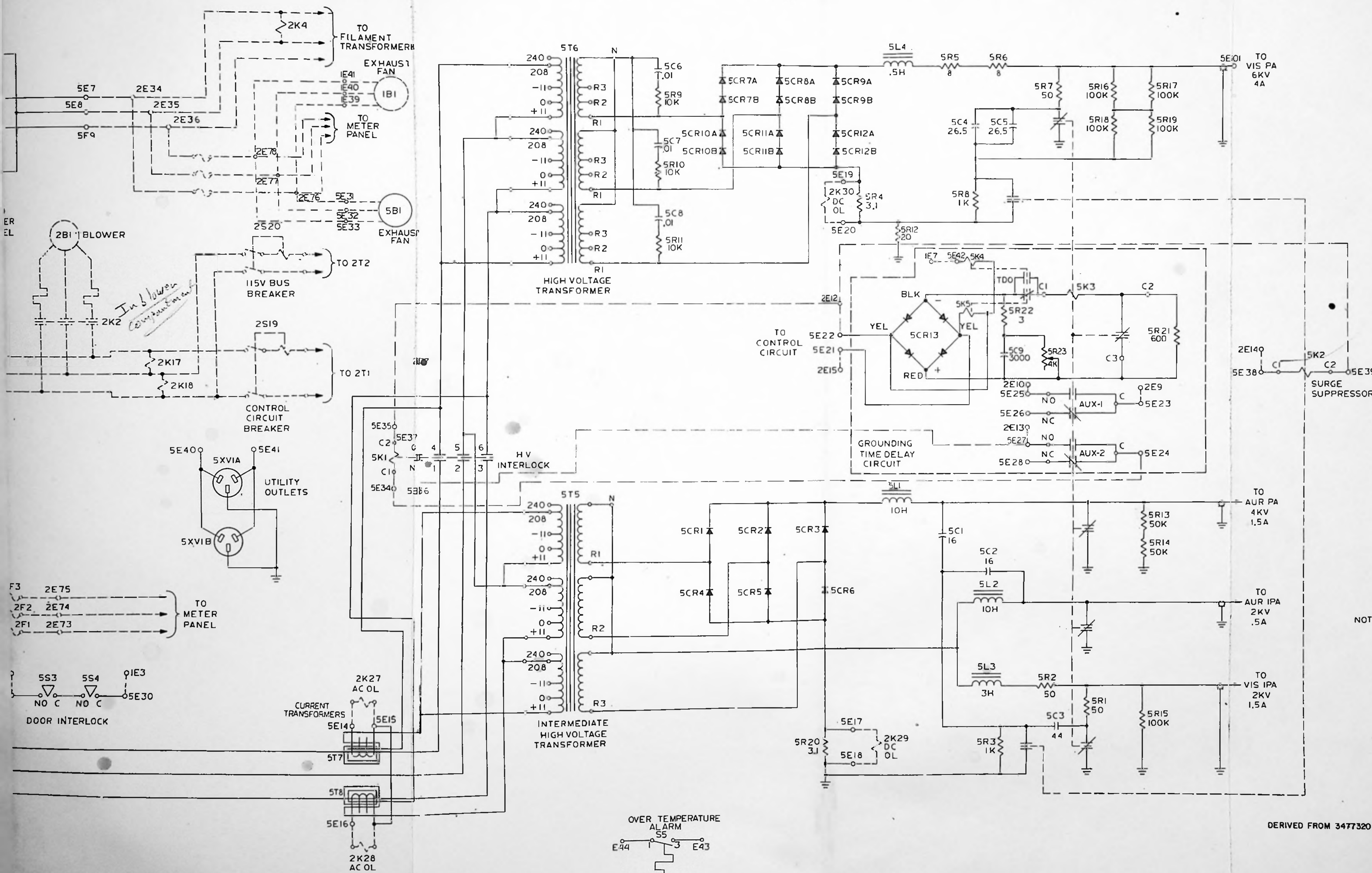


NOTES:

1. UNLESS OTHERWISE
ALL CAPACITOR VAL
ALL RESISTOR VAL

2. THIS SCHEMATIC SHOW
UNIT FOR ONE 15KW T
TT-30FL. TWO SUCH U
THIS SHOWS THE LEF
(TRANSMITTER A). FO
UNIT (TRANSMITTER
PREFIX 6, PREFIX 1 B
PREFIX 2 BECOMES P

Figure 3-7. Power Supply Schematic Diagra



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL CAPACITOR VALUES ARE IN UF ALL RESISTOR VALUES ARE IN OHMS
2. THIS SCHEMATIC SHOWS THE POWER SUPPLY UNIT FOR ONE 15KW TRANSMITTER. FOR THE TT-30FL TWO SUCH UNITS ARE REQUIRED. THIS SHOWS THE LEFT HAND POWER SUPPLY (TRANSMITTER A). FOR THE RIGHT HAND UNIT (TRANSMITTER B) PREFIX 5 BECOMES PREFIX 6, PREFIX 1 BECOMES PREFIX 4 PREFIX 2 BECOMES PREFIX 3

DERIVED FROM 3477320 REV 4

3H172

Figure 3-7. Power Supply Cabinet MI-560578 Schematic Diagram (3477320)

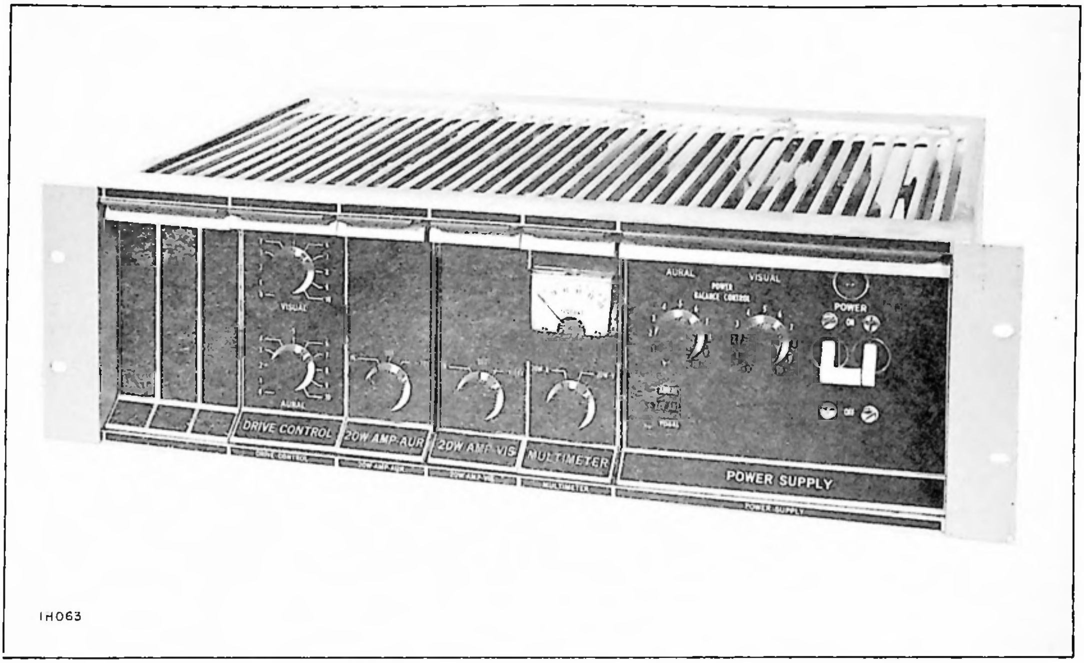


Figure 4-1. 20W Aural and Visual RF Amplifier

EQUIPMENT LIST

Quantity	Item	Reference
2	20W Amplifier Modules Aural/Visual:	MI-560590 or MI-560591
1	20W Amplifier Power Supply Module	MI-560592-B
1	Multimeter Module	MI-560593
1	Drive Control Module	MI-560594
1	Blank Module Assembly	MI-557302-6
1	Module Frame Assembly	MI-560595
1	Module Extender	MI-560541-B

DESCRIPTION

GENERAL

The 20W Aural and Visual RF Amplifier (see Figure 4-1) is a modularized solid state unit used to amplify a 1 to 2.5 watt (depending on the particular channel) aural or visual carrier signal to a power output of 20 watts. The module assemblies in the 20W aural and visual RF amplifier employ the latest design techniques for reliability and ease of adjustment and operation. A built-in meter on the Multimeter Module MI-560593 can be used as a tuning indicator for the 20W aural or visual RF amplifier or as a monitor for the 20W Amplifier Power Supply Module MI-560592-B output voltages. The amplifier includes a Drive Control Module MI-560594, a 20W Amplifier-Aural Module and a 20W Amplifier-Visual Module MI-560590 or MI-560591, a Multimeter Module MI-560593, a 20W Amplifier Power Supply Module MI-560592-B, and a Blank Module Assembly MI-557302-6. Figure 4-2 is the 20W Aural and Visual RF Amplifier signal flow block diagram.

MODULE CIRCUIT DESCRIPTION

Drive Control Module MI-560594 — Prefix 32

Drive Control Module MI-560594 (see Figures 4-5 and 4-6) is a modularized unit consisting of two manual or motor-operated potentiometers (R1 and R2). Functionally, whenever the AUR EXC switch (S9) or the VIS EXC switch (S10) on the Control Cabinet is pressed, the associated motor-operated potentiometer (R1 and R2) is activated which varies the collector voltage to transistor A2Q1 in the respective 5W Amplifier Module-Aural/Visual MI-560531 in the 5W Exciter. This action varies the RF drive to the 20W aural and visual amplifiers from 0 to 2.5 watts, thus, controlling the output power from the 20W amplifier modules from 0 to 20 watts.

20W Amplifier Modules-Aural/Visual MI-560590 or MI-560591-Prefix 33A/33V

The 20W Amplifier Module-Aural/Visual (see Figures 4-7 thru 4-10) are two identical solid state units each consisting of either a 20 watt amplifier (A1) MI-560590 or a 5 watt (A2) and a 20 watt (A1) amplifier MI-560591. MI-560590 is used in the TT-15FL/25FL for channels 2 thru 6 and in the TT-30FL for channels 2 and 3. MI-560591 is used in the TT-30FL for channels 4, 5, and 6.

The aural input signal is applied to the 20W amplifier-aural module from the 5W Exciter through the switching circuits, power splitter, and the phase shifter. The signal is then coupled to the base-emitter circuit of transistor A1Q4. A T-matching network is utilized in both the input and output circuits. The collector lead contains a two-section low pass filter consisting of A1L20, A1C33, A1L19, and A1C32 to minimize RF leakage. Diodes A1CR5 and A1CR6 rectify an RF sample which is then applied to the Multimeter Module MI-560593 through switch S1 for monitoring purposes. Maximum deflection of the meter indicates proper tuning of the 20W amplifier-aural module input and output circuits. A feature of the 20W RF Amplifier is that it will tolerate load mismatches from short-circuit to open circuit without causing damage to the output transistor. To properly cool the transistor a small amount of cooling air has been provided in the frame assembly. When the Module Extender MI-560541B is utilized, the cooling air will not be directed on the amplifier, therefore, extended periods of operation in this manner should be avoided. Frequency determining parts for the amplifier consist of coils A1L17 and AR13. The RF output from the 20W Amplifier-Aural Module drives the Aural IPA stage.

For Channels 4, 5, 6, (for the TT-30FL Only) an additional 5 watt assembly (A2) is provided with the 20 watt amplifier assembly for increased gain at the highest frequencies. The 5 watt amplifier assembly amplifies the 1 to 2.5 watt (depending on the particular channel) carrier signal to approximately 5 watts. The RF output from the additional 5 watt stage provides sufficient drive to the 20 watt amplifier assembly (A1) on Channels 4, 5 and 6 to produce a nominal 20 watts of output power. The 5 watt amplifier assembly (A2) consists of a common-emitter circuit and utilizes a T-matching network to match the input and output circuits. Frequency determining parts consist of coils A2L12 and A2L16. The collector lead of transistor A2Q3 contains a two-section low pass filter consisting of A2L15, A2C21, A2L14, and A2C19 to minimize RF leakage. The amplifier circuits are shielded to minimize stray RF fields. Diode A2CR4 rectifies an RF sample. This signal is then applied to the Multimeter Module MI-560539 for monitoring purposes. A front panel selector switch (S1) is provided to select the circuit under test. The switch designations for the MI-560590 modules are IN, OUT, +24V and for the MI-560591 modules are 5W AMP-IN, OUT, +24 and 20W AMP-IN, OUT, and 19/24V.

Multimeter Module MI-560593 — Prefix 34

The Multimeter Module MI-560593 (see Figures 4-11 and 4-12) is designed to monitor the operation of the 20W Aural and Visual RF Amplifier circuits including the input and output circuits and power supply circuit. These circuits can be checked during operation without affecting equipment performance. Maximum deflection of the meter indicates proper tuning of the input and output circuits and a deflection of approximately 52% indicates 24VDC out of the power supply. The module contains a built-in meter (M1) and a 2-position selector switch to measure the functions of either the Aural Amplifier or the Visual Amplifier Module MI-560590/MI-560591.

20W Amplifier Power Supply Module MI-560592-B — Prefix 35

The 20W Amplifier Power Supply Module MI-560592-B (see Figures 4-13 and 4-14) provides all of the operating voltages used in the 20W Aural and Visual RF Amplifier except the +28VDC for the motor-operated potentiometers in the Drive Control Module MI-560594. These voltages include four 24VDC outputs that are adjustable from the front panel. All four of the voltages are utilized in MI-560591, where only two are utilized in MI-560590. The two voltages that supply the 20W amplifier assembly (A1) are adjustable from approximately +19 to +24 VDC by rotating the AURAL or VISUAL POWER BALANCE CONTROL knobs. The two voltages that supply the 5W amplifier assembly (A2) are screwdriver adjustments (AURAL and VISUAL +24V ADJ) which can be adjusted ±5%. On the TT-30FL only, the POWER BALANCE CONTROL also enables the output power of the associated amplifier to vary with the voltage. Functionally, the controls adjust each diplexed power amplifier for equal power output. It is desirable to initially set the POWER BALANCE CONTROL to maximum (full clockwise position). If the output from

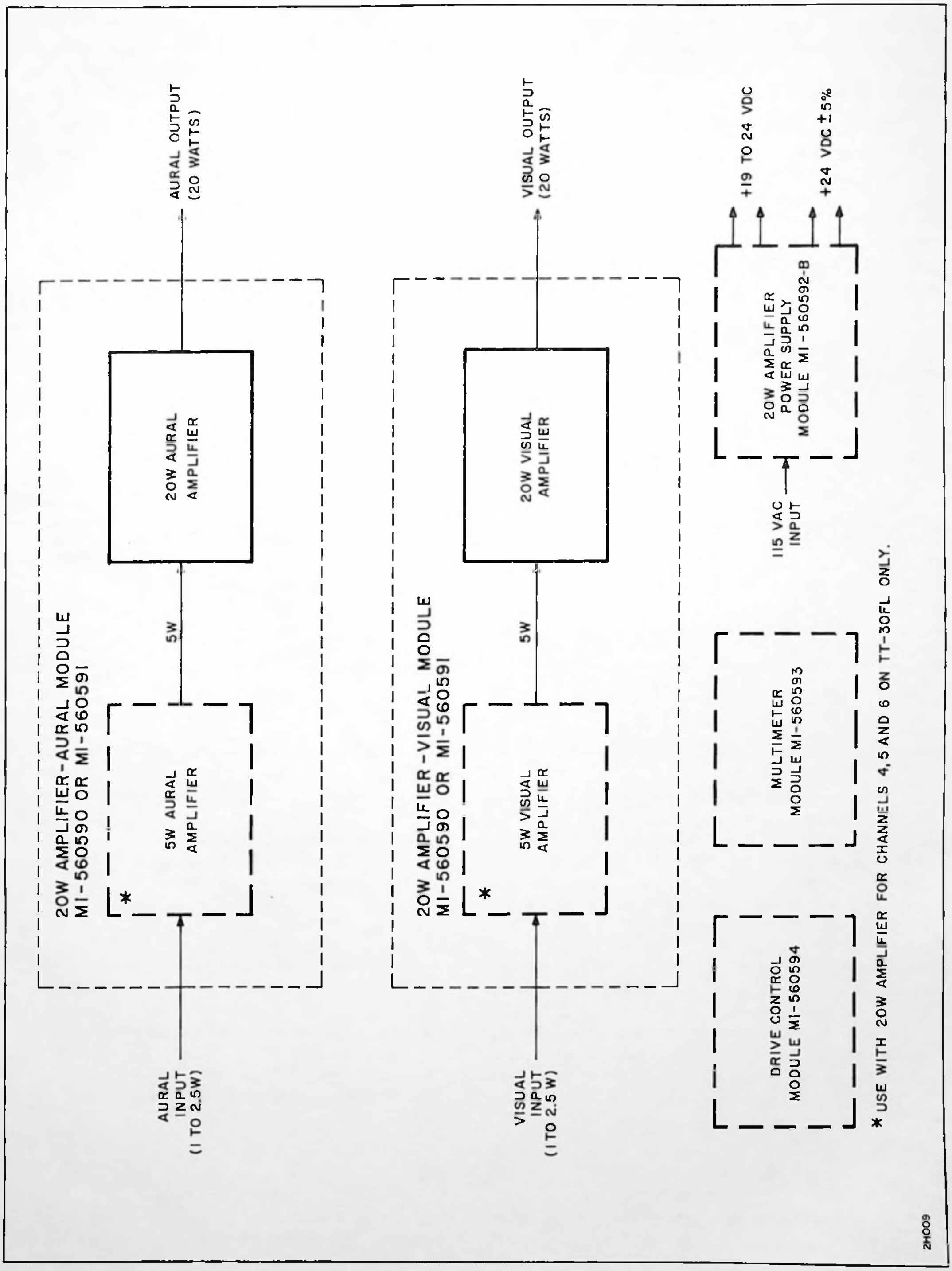


Figure 4-2. 20W Aural and Visual RF Amplifier Signal Flow Block Diagram

one diplexed aural PA is higher than the other proceed to reduce the POWER BALANCE CONTROL on the higher reading amplifier until the two diplexed power amplifiers are equal in power as indicated on the AURAL REFLECTOMETER 1/4M1 in the Amplifier Cabinet MI-560577-A.

The power supply includes short-circuit protection in which the circuit breaker CB1 removes primary AC voltage in the event of a fault condition. The power supply will automatically recover when the fault is removed and the circuit breaker reset. When the circuit breaker is set to the ON position, the POWER indicator lamp (DS1) lights giving visual indication that the power supply is energized.

The circuits utilize a series type regulator with built-in current limiting circuits. Briefly explained, emitter-coupled differential amplifiers are used as a comparison element. The purpose of the comparison element is to sample the output voltage, compare it with a referenced voltage, and generate an error signal proportional to the output variation. The reference voltage source is a temperature compensated zener diode. Next, a DC amplifier is used to amplify the error signal. This amplifier signal, in turn, is fed to a series control transistor which returns the output voltage to its correct value. In case of an over-current or short circuit condition, the base drive current available to the series control transistor is limited by a control circuit which limits the current to no more than 140% of its maximum current rating. As the loading increases, a foldback characteristic will limit the current additionally so that with a direct short, the output will deliver no more than 50% of its maximum current rating. The supply will automatically recover when the overload is removed.

The current limiting potentiometers are preset at the factory and should not normally be readjusted. If the current limiting is to be checked, a test fixture would be required to facilitate correct loading and measurement of load current. Refer to Table 4-1 for current settings and adjustment potentiometers.

Output voltages remain essentially constant over a temperature range of -20°C to +60°C.

Table 4-1. Power Supply Adjustments

Function	Voltage	Voltage Adj.	Current Limiting	Current Adj.
5W Visual*	24V	R72	0.7A	R59
5W Aural*	24V	R54	0.7A	R41
20W Visual	19/24V	R36	2.5A	R23
20W Aural	19/24V	R18	2.5A	R5

Note: * Used on TT-30FL Channels 4, 5, and 6 only.

Module Extender MI-560541-B

The Module Extender MI-560541-B (see Figure 4-4) is available to permit servicing the 20W Aural and Visual RF Amplifier under operating conditions. The unit to be serviced is removed from the module frame and then inserted into the module extender which then plugs into the module frame assembly. All components are then conveniently accessible for measurements. When the module extender is placed into service, the additional length of coaxial line on the module extender will normally detune the amplifier. In the case of the TT-30FL (assuming power is applied to the aural power amplifiers), the additional length of coaxial cable will cause a phase differential between the two aural power amplifiers so that some portion of the output power would go into the reject load.

To minimize this, cables (one input and one output) equal in length to that on the module extender have been provided on the input and output connectors of the module assembly. This added length of cable on the module assembly can be bypassed by means of RF connectors when the module extender is in use, thus keeping the line length and phase the same.

On the visual side of the transmitter, keeping the line lengths the same when the module extender is in use will also eliminate variation in overall frequency response. It should be noted that when the module extender is removed, the additional input and output cable lengths previously bypassed should be replaced before the module is plugged into the module frame assembly.

TUNING

The modules in the 20W Aural and Visual RF Amplifier are factory tuned and adjusted and should not require any additional adjustment or retuning unless indicated during system tests or if a frequency determining part (refer to Table 4-2) is replaced. To aid in adjusting and tuning, tuning tools have been provided and are attached to the inside frame of the Multimeter Module MI-560537 in the 5W Exciter frame assembly. The adjustment and the tuning procedures are performed with the 20W Aural and Visual RF Amplifier installed in the system.

Since both the aural and visual modules are identical, only the tuning of the 20W Aural Module is described in the following procedure:

Table 4-2. Frequency Determining Parts

20 W Ampl module MI-560590/MI-560591		
Component	Channel	Reference No.
L17	2 and 3	3469623-17
L17	4	3469623-18
L17	5	3469623-8
L17	6	3469623-20
R13	2, 3 and 4	90496-111
R13	5 and 6	90496-119
L12	2	3469623-12
L12	3 and 4	3469623-24
L12	5	3469623-25
L12	6	3469623-19
L16	2 and 3	3469623-16
L16	4, 5, and 6	3469623-15

CAUTION

Do not keep the module on the module extender for an extended period of time. Damage to the transistors can occur due to inadequate ventilation.

1. Set POWER circuit breaker (CB1) to OFF on 20W Amplifier Power Supply Module MI-560592-B. Remove 20W aural amplifier module from module frame assembly and insert into Module Extender MI-560541-B.

NOTE: Because of the extra line length introduced in the circuit due to the length of the Module Extender MI-560541-B, perform steps 2 and 3 for MI-560590 and steps 4 and 5 for MI-560591 to remove the coiled up cables on the amplifier module.

FOR MI-560590 ONLY (see Figure 4-7)

2. Disconnect P10 (BNC male) RF input connector from J10 connector attached to RG 58A/U cable coiled up on the module. Then connect P10 to P9 (BNC right angle adapter) on 20W amplifier assembly (A1) after disconnecting from P9 the P5 (BNC male) connector attached to the coiled cable.

3. Disconnect P11 (female) RF input connector from J11 (male) connector attached to the RG 174/U cable coiled up on the module. Then connect P11 to J5 on 20W amplifier assembly (A1) after disconnecting from J5 the P5 (female) RF connector attached to the coiled cable.

FOR MI-560591 ONLY (see Figure 4-9)

4. Same as step 2 above.

5. Disconnect P11 (female) RF input connector from J11 (male) connector attached to the RG 174/U cable coiled up on the module. Then connect P11 to J3 on 5W amplifier assembly (A2) after disconnecting from J3 the P3 (female) RF connector attached to the coiled cable.

6. Install module extender with attached module in module frame assembly.

7. Set multimeter selector switch (34S1) on Multimeter Module MI-560593 to 20W-A position.

CAUTION

During tune-up of the 20W amplifier module, always begin with a low level of input (approximately 10% indication on the Multimeter with the multimeter selector switch 34S1 in the 20W AMP-IN position). Then gradually increase the drive after tuning the input and output circuit until the rated power is obtained.

8. Set selector switch 33AS1 to 20W AMP

19/24V position on MI-560591 or to +24V position on MI-560590.

9. Set POWER circuit breaker (CB1) on MI-560592-B to ON and observe that POWER indicator lamp (DS1) lights. Rotate AURAL POWER BALANCE CONTROL potentiometer to 10 (full clockwise position) and observe an approximate 52% indication on multimeter (34M1).

NOTE: Perform step 10 only for MI-560591 modules to check 5W amplifier assembly (A2) voltages.

10. Set selector switch 33AS1 on 20W Aural Amplifier module MI-560591 to 5W AMP/+24V position and observe a 52% indication on multimeter (34M1). If a 52% indication is not observed, adjust AURAL/+24V ADJ adjustment on power supply module until a 52% indication is observed.

11. Set selector switch S1 to the positions indicated and tune indicated capacitor(s) for maximum deflection on multimeter 34M1.

NOTE: See Table 4-3 and perform Steps 1 and 2 for MI-560591, Step 2 only for MI-560590, and Step 3 as indicated.

12. Set POWER circuit breaker (CB1) to OFF and reconnect the RF connector cables (if disconnected in steps 2/3 or 4/5) to their original connections.

Table 4-3. Tuning Adjustments

Step	Selector Switch 33AS1 Position	Adjustment
1	5W AMP:	
	IN	C18
	OUT	C22
2	20W AMP:	C29
	IN	C35/C36
	OUT	
3	20W AMP:	
	OUT	C18/C22*
		C29/C35/C36**
*For MI-560590 only. **For MI-560590 or MI-560591		

13. Remove 20W aural amplifier module from module extender and replace in module frame assembly.

After the 20W Aural Amplifier Module(s) are tuned, the 20W Visual Amplifier Module(s) should be tuned. It should also be noted that on the visual side a slight change in overall frequency response occurs when the module is inserted in either amplifier chain because of the change in line length. For this reason, it is recommended that the input and output RF extension cables coiled on the module(s) be disconnected when the module extender is in service on the visual side and connected as indicated in steps 2 thru 5 in the above procedure. Since the length of lines removed (coiled cables) are equal in length to those on the extender, there is no net change in line length. Therefore, the phase and frequency response are not affected.

REPLACEMENT PARTS LIST

GENERAL

The components listed in the replacement are identified by one of two methods depending on whether the component is a mechanical or electrical part. Electrical parts are assigned a standard electrical symbol and are listed in alphanumerical sequence. Mechanical parts are assigned a numerical symbol (8, 17, 25, etc.) that corresponds to the item number on the mechanical assembly drawing where that particular part is located.

REPLACEMENT PARTS LIST

Symbol	Stock No.	Drawing No.	Description
PREFIX 30			**MODULE FRAME ASSEMBLY MI-560595**
			M/L 3459995-502 REV 26
Electrical			
30J2 TO 30J6	229215	8490041-001	CONNECTOR - 22 DUAL AMP., LEAF
30AJ7	420033	3721894-006	CONNECTOR - 7 PIN FEMALE HOUSING
30VJ7	420033	3721894-006	CONNECTOR - 7 PIN FEMALE HOUSING
30J9	247838	3720240-002	CONNECTOR - PLUG, 15 CONTACT
30J10	244084	993147-221	CONNECTOR - BNC, PART OF W1
30J11	244084	993147-221	CONNECTOR - BNC, PART OF W2
30J12	246732	1510013-151	CONNECTOR - BNC, PART OF W3
30J13	246732	1510013-151	CONNECTOR - BNC, PART OF W4
30P9	428029	3720240-012	CONNECTOR - RECEPTACLE, 15 CONTACT
30P10 TO 30P13	242444	3456541-001	CONNECTOR - BNC
Mechanical			
18	231762	8540935-001	KEY
15	420034	3721894-009	PIN - GUIDE PIN
16	420035	3721894-010	SOCKET - GUIDE
74	420031	3721894-004	SPRING - RETENTION
11	237823	896536-120	SCREW - SHOULDER
10	237824	1510029-132	SPRING COMPRESSION
36	232819	8540937-016	SPRING - PRESSURE
PREFIX 32			**DRIVE CONTROL MODULE ASSEMBLY MI-560594**
Electrical			ML 3459971-501 REV 8
32A1		3459942-501	PRINTED CIRCUIT BOARD
32B1	246040	3459943-004	MOTOR - 1 RPM
	246042	3459943-101	SPRING
	246041	3459943-102	BRUSH
32B2	246040	3459943-004	MOTOR - 1 RPM
	246042	3459943-101	SPRING
	246041	3459943-102	BRUSH
32C1 TO 32C4	205656	1510003-037	CERAMIC, .01 MF 500 V
32R1	418046	457995-037	5000 OHMS 2 WATT
32R2	418046	457995-037	5000 OHMS 2 WATT
32R3	522220	99126-166	2000 OHMS 5% 2 W
32R4	522220	99126-166	2000 OHMS 5% 2 W
32R6 TO 32R9	502022	82283-042	22 OHMS 10% 1/2 W, PART OF A1
32R10	502247	82283-070	4700 OHMS 10% 1/2 W
32R11	502247	82283-070	4700 OHMS 10% 1/2 W
Mechanical			
41	418784	3730663-503	CONTACT - BRACKET ASSEMBLY
33	418181	8518074-010	COUPLING
9	229940	1510924-105	KNOB
52	266641	486041-011	TERMINAL - E14, E15
			ML 3459942-501 REV 2
32R6 TO			

Symbol	Stock No.	Drawing No.	Description
32R9	502022	82283-042	22 OHMS 10% 1/2 W
PREFIX 33			
Electrical			**20W AURAL/VISUAL AMPLIFIER MODULE MI-560590**
			ML 3459870-501 REV 8
A1		3459869-501	20 WATT AMPLIFIER
J9	242871	1510013-222	ADAPTER - COAXIAL, PART OF ITEM 49
J10	226550	1510013-121	CONNECTOR - COAXIAL, PART OF ITEM 47
J11	248735	3720560-001	CONNECTOR - COAXIAL, PART OF ITEM 46
P5	245963	3456215-001	CONNECTOR - COAXIAL, PART OF ITEM 46
P6	242871	1510013-222	ADAPTER - COAXIAL, ITEM 49
P7	420032	3721894-005	CONNECTOR - 7 PIN MALE HOUSING
P9	242444	3456541-001	CONNECTOR - COAXIAL, PART OF ITEM 47
P10	242444	3456541-001	CONNECTOR - COAXIAL, PART OF W2
P11	245963	3456215-001	CONNECTOR - COAXAIL, PART OF W1
S1	245980	3464073-001	SWITCH - ROTARY
Mechanical			
49	242871	1510013-222	ADAPTER - RIGHT ANGLE
46		3730525-503	CABLE ASSEMBLY
14	245963	3456215-001	CONNECTOR
15		3720560-001	CONNECTOR
47		3730525-504	CABLE ASSEMBLY
6	242444	3456541-001	CONNECTOR - BNC
11	226550	1510013-121	CONNECTOR
35	418783	3730663-502	CONTACT - BRACKET ASSEMBLY
13	229940	1510924-105	KNOB
30	420034	3721894-009	PIN - GUIDE PIN
31	420035	3721894-010	SOCKET - GUIDE
51	420031	3721894-004	SPRING - RETENTION
		3459930-501	PRINTED CIRCUIT BOARD
Electrical			ML 3459930-501 REV 0
R17	502533	82283-243	3.3 MEGOHM 5% 1/2 W
			ML/ 3459869-501 REV 11
C27	224181	993025-425	MICA, 33 PF 5% 100 V
C28	224181	993025-425	MICA, 33 PF 5% 100 V
C29	226643	3468015-002	VARIABLE, 65-340 PF
C30	109595	3450097-002	FEED-THRU, 1000 PF GMV 500 V
C31	223142	3456811-007	CERAMIC, 0.1 MF 50 V
C32	109595	3450097-002	FEED-THRU, 1000 PF GMV 500 V
C33	113931	3450092-002	STAND-OFF, 1000 PF GMV 500 V
C34	109595	3450097-002	FEED-THRU, 1000 PF GMV 500 V
C35	921455	3468015-001	VARIABLE, 15-130 PF
C36	921455	3468015-001	VARIABLE, 15-130 PF
C37	223142	3456811-007	CERAMIC, 0.1 MF 50 V
C38	99681	442905-017	CERAMIC, 2.2 PF 10% 500 V
CR5	236715	3454179-001	DIODE
CR6	236715	3454179-001	DIODE
J5	245964	3456215-010	CONNECTOR
J6	223973	1510013-181	CONNECTOR - FEMALE, BNC
L17	247463	3469623-017	COIL - USED FOR CHANNELS 2 AND 3
L17	247464	3469623-018	COIL - USED FOR CHANNEL 4
L17	246005	3469623-008	COIL - USED FOR CHANNEL 5
L17	247466	3469623-020	COIL - USED FOR CHANNEL 6
L18	232645	3467000-003	CHOKE - RF
L19	247469	3469623-023	COIL
L20	247467	3469623-021	COIL
L21	247468	3469623-022	COIL
Q4	418450	3457210-002	TRANSISTOR
R12	502522	82283-239	2.2 MEGOHM 5% 1/2 W

Symbol	Stock No.	Drawing No.	Description
R13	512010	90496-111	10 OHMS 5% 1 W FOR CHANNELS 2-3-4
R13	512022	90496-119	22 OHMS 5% 1 W FOR CHANNELS 5-6
R14	502010	82283-111	10 OHMS 5% 1/2 W
R15	502010	82283-111	10 OHMS 5% 1/2 W
R16	502533	82283-243	3.3 MEGOHM 5% 1/2 W
R17	512168	90496-155	680 OHMS 5% 1 W
Mechanical			
13	244460	3457758-001	SOCKET - TRANSISTOR
2	247463	3469623-017	COIL - L17, 20W AMP FOR CHANNELS 2 AND 3
3	247464	3469623-018	COIL - L17, 20W AMP FOR CHANNEL 4
4	246005	3469623-008	COIL - L17, 20W AMP FOR CHANNEL 5
5	247466	3469623-020	COIL - L17, 20W AMP FOR CHANNEL 6
6	512010	90496-111	10 OHMS 5% 1W R13, FOR CHANNELS 2, 3, & 4
7	502082	90496-119	22 OHMS 5% 1W R13, FOR CHANNELS 5 & 6
			20W AURAL/VISUAL AMPLIFIER MODULE MI-560591
Electrical			MI-560591 MODULE ASSEMBLY 20 WATT R.F. AMP. ML/3459870-502 REV 6
A1		3459869-501	AMPLIFIER - 20 WATT
A2		3456993-501	AMPLIFIER - 5 WATT
J9	242871	1510013-222	ADAPTER - COAXIAL, PART OF ITEM 49
J10	226550	1510013-121	CONNECTOR - COAXIAL, PART OF ITEM 47
J11	248735	3720560-001	CONNECTOR - COAXIAL, PART OF ITEM 46
P3	245963	3456215-001	CONNECTOR - COAXIAL, PART OF ITEM 46
P4	245963	3456215-001	CONNECTOR - COAXIAL
P5	245963	3456215-001	CONNECTOR - COAXIAL
P6	242871	1510013-222	ADAPTER - COAXIAL, ITEM 49
P7	420032	3721894-005	CONNECTOR - 7 PIN MALE HOUSING
P9	242444	3456541-001	CONNECTOR - COAXIAL, PART OF ITEM 47
P10	242444	3456541-001	CONNECTOR - COAXIAL, PART OF W2
P11	245963	3456215-001	CONNECTOR - COAXIAL, PART OF W1
S1	245980	3464073-001	SWITCH - ROTARY FOR CONTINUATION OF ELECTRICAL PARTS LIST SEE M/L 3459869 UNDER MI-560590
Mechanical			
49	242871	1510013-222	ADAPTER - RIGHT ANGLE
46		3730525-503	CABLE ASSEMBLY
14	245963	3456215-001	CONNECTOR
15	248735	3720560-001	CONNECTOR
47		3730525-504	CABLE ASSEMBLY
6	242444	3456541-001	CONNECTOR - BNC
11	226550	1510013-121	CONNECTOR - BNC
35	418783	3730663-502	CONTACT - BRACKET ASSEMBLY
13	229940	1510924-105	KNOB
30	420034	3721894-009	PIN - GUIDE PIN
31	420035	3721894-010	SOCKET - GUIDE
51	420031	3721894-004	SPRING - RETENTION
Electrical			MI-560591 20 WATT RF AMPLIFIER PRINTED CIRCUIT BOARD ML/3459930-502 REV 0
R17	502533	82283-243	3.3 MEGOHM 5% 1/2 W
R18	502533	82283-243	3.3 MEGOHM 5% 1/2 W
			5 WATT AMPLIFIER ML/3456993-501 REV. 9
C16	215197	993025-433	MICA, 68 PF 5% 100 V
C17	109595	3450097-002	CERAMIC, FEED-THRU, 1000 PF GMV 500 V

Symbol	Stock No.	Drawing No.	Description
CR8	225588		ZENER DIODE - TYPE 1N821
CR9	228458		ZENER DIODE - TYPE 1N756A
CR10	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR11	217784		SILICON RECTIFIER - TYPE 1N645
CR12	217784		SILICON RECTIFIER - TYPE 1N645
CR13	231343		ZENER DIODE - TYPE 1N963B
CR14	225588		ZENER DIODE - TYPE 1N821
CR15	228458		ZENER DIODE - TYPE 1N756A
CR16	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR17	217784		SILICON RECTIFIER - TYPE 1N645
CR18	217784		SILICON RECTIFIER - TYPE 1N645
CR19	231343		ZENER DIODE - TYPE 1N963B
CR20	225588		ZENER DIODE - TYPE 1N821
CR21	228458		ZENER DIODE - TYPE 1N756A
CR22	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR23	217784		SILICON RECTIFIER - TYPE 1N645
CR24	217784		SILICON RECTIFIER - TYPE 1N645
CR25	231343		ZENER DIODE - TYPE 1N963B
CR26	225588		ZENER DIODE - TYPE 1N821
CR27	228458		ZENER DIODE - TYPE 1N756A
CR28	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
DS1	426156		LAMP, INDICATOR #327
Q1	232359		TRANSISTOR - TYPE 2N3055
Q2	232359		TRANSISTOR - TYPE 2N3055
Q3	241302		TRANSISTOR - TYPE 2N1711
Q4	231375		TRANSISTOR - TYPE 2N1613
Q5	241302		TRANSISTOR - TYPE 2N1711
Q6	241302		TRANSISTOR - TYPE 2N1711
Q7	241302		TRANSISTOR - TYPE 2N1711
Q8	232359		TRANSISTOR - TYPE 2N3055
Q9	232359		TRANSISTOR - TYPE 2N3055
Q10	241302		TRANSISTOR - TYPE 2N1711
Q11	231375		TRANSISTOR - TYPE 2N1613
Q12	241302		TRANSISTOR - TYPE 2N1711
Q13	241302		TRANSISTOR - TYPE 2N1711
Q14	241302		TRANSISTOR - TYPE 2N1711
Q15	233945		TRANSISTOR - TYPE 2N657
Q16	232359		TRANSISTOR - TYPE 2N3055
Q17	241302		TRANSISTOR - TYPE 2N1711
Q18	231375		TRANSISTOR - TYPE 2N1613
Q19	241302		TRANSISTOR - TYPE 2N1711
Q20	241302		TRANSISTOR - TYPE 2N1711
Q21	241302		TRANSISTOR - TYPE 2N1711
Q22	233945		TRANSISTOR - TYPE 2N657
Q23	232359		TRANSISTOR - TYPE 2N3055
Q24	241302		TRANSISTOR - TYPE 2N1711
Q25	241302		TRANSISTOR - TYPE 2N1711
Q26	241302		TRANSISTOR - TYPE 2N1711
Q27	241302		TRANSISTOR - TYPE 2N1711
Q28	241302		TRANSISTOR - TYPE 2N1711
R1	522222		RESISTOR, 2.2K OHMS 2W 10%
R2	502139		RESISTOR, 390 OHMS 1/2W 10%
R3	502147		RESISTOR, 470 OHMS 1/2W 10%
R4	430700		RESISTOR, 0.22 OHMS 3W 1%, WIREWOUND
R5	249624		RESISTOR, 10K OHMS POTEMTIOMETER
R6	502247		RESISTOR, 4.7K OHMS 1/2W 10%
R7	502110		RESISTOR, 100 OHMS 1/2W 10%
R8	502282		RESISTOR, 8.2K OHMS 1/2W 10%
R9	502347		RESISTOR, 47K OHMS 1/2W 10%
R10	502318		RESISTOR, 18K OHMS 1/2W 10%
R11	502127		RESISTOR, 270 OHMS 1/2W 10%
R12	502222		RESISTOR, 2.2K OHMS 1/2W 10%
R13	502147		RESISTOR, 470 OHMS 1/2W 10%
R14	249629		RESISTOR, 2.49K OHMS WW. 3W 1%
R15	502239		RESISTOR, 3.9K OHMS 1/2W 10%
R16	249628		RESISTOR, 825 OHMS WW 2W
R17	249627		RESISTOR, 1.5K OHMS WW 2W

Symbol	Stock No.	Drawing No.	Description
C18	226643	3468015-002	MICA, VARIABLE, 65-340 PF
C19	109595	3450097-002	CERAMIC, FEED-THRU, 1000 PF GMV 500 V
C20	235500	3450155-005	CERAMIC, 0.05 MF 100 V
C21	113931	3450092-002	CERAMIC, STAND-OFF, 1000 PF GMV 500 V
C22	921455	3468015-001	MICA, VARIABLE, 15-130 PF
C23	109595	3450097-002	CERAMIC, FEED-THRU, 1000 PF GMV 500 V
C24	99681	442905-017	CERAMIC, 2.2 PF 10% 500 V
C25	224181	993025-425	MICA, 33 PF 5% 100 V
C26	223142	3456811-007	CERAMIC, 0.1 MF 50 V
CR4	236715	3454179-001	DIODE - TYPE 1N914
J3	245964	3456215-010	CONNECTOR
J4	245964	3456215-010	CONNECTOR
L12	246009	3469623-012	COIL - USED FOR CHANNEL 2
L12	248736	3469623-024	COIL - USED FOR CHANNELS 3 AND 4
L12	248737	3469623-025	COIL - USED FOR CHANNEL 5
L12	247465	3469623-019	COIL - USED FOR CHANNEL 6
L13	232645	3467000-003	CHOKE - R.F.
L14	246010	3469623-013	COIL
L15	246011	3469623-014	COIL
L16	246013	3469623-016	COIL - USED FOR CHANNELS 2 AND 3
L16	246012	3469623-015	COIL - USED FOR CHANNELS 4, 5 AND 6
Q3	236577	3457118-001	TRANSISTOR
R7	502382	82283-205	82,000 OHMS 5% 1/2 W
R8	502022	82283-119	22 OHMS 5% 1/2 W
R9	512168	90496-155	680 OHMS 5% 1 W
R10	502518	82283-237	1.8 MEGOHM 5% 1/2 W
R11	502010	82283-111	10 OHMS 5% 1/2 W
12	244460	3457758-001	TRANSISTOR SOCKET
PREFIX 34			**MULTIMETER MODULE MI-560593** 20 WATT AMPLIFIER ML 3456814-502 REV 6
Elec/Mech			
34A1		3459924-501	PRINTED CIRCUIT BOARD
34C1	205656	1510003-037	CERAMIC, .01 MF 500 V
34M1	245948	3730625-001	METER - 0-15 UA
34S1	245980	3464073-001	SWITCH - ROTARY
8	229940	1510924-105	KNOB
PREFIX 35 Electrical			**POWER SUPPLY MODULE MI-560592-B** SPS1356 M/L 3721843-1
C1	242786		CAPACITOR, 22MFD 150V
C2	249619		CAPACITOR, .01MFD 200V
C3	428025		CAPACITOR, 2000MFD 40V
C4	249619		CAPACITOR, .01MFD 200V
C5	428025		CAPACITOR, 2000MFD 40V
C6	249619		CAPACITOR, .01MFD 200V
C7	242787		CAPACITOR, 68MFD 50V
C8	249619		CAPACITOR, .01MFD 200V
C9	242787		CAPACITOR, 68MFD 50V
C10	249631		CAPACITOR, 12,000MFD 60V
C11	249620		CAPACITOR, 22MFD 50V
C12	249620		CAPACITOR, 22MFD 50V
CB1	249621		CIRCUIT BREAKER
CR1	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR2	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR3	426695		SILICON RECTIFIER - TYPE 1N1202A
CR4	426695		SILICON RECTIFIER - TYPE 1N1202A
CR5	217784		SILICON RECTIFIER - TYPE 1N645
CR6	217784		SILICON RECTIFIER - TYPE 1N645
CR7	231343		ZENER DIODE - TYPE 1N963B

Symbol	Stock No.	Drawing No.	Description
R18	249625		RESISTOR, 1K OHMS POTENTIOMETER
R19	522222		RESISTOR, 2.2K OHMS 2W 10%
R20	502139		RESISTOR, 390 OHMS 1/2W 10%
R21	502147		RESISTOR, 470 OHMS 1/2W 10%
R22	430700		RESISTOR, 0.22 OHMS 3W 1%, WIREWOUND
R23	249624		RESISTOR, 10K OHMS POTEMTIOMETER
R24	502247		RESISTOR, 4.7K OHMS 1/2W 10%
R25	502110		RESISTOR, 100 OHMS 1/2W 10%
R26	502282		RESISTOR, 8.2K OHMS 1/2W 10%
R27	502347		RESISTOR, 47K OHMS 1/2W 10%
R28	502318		RESISTOR, 18K OHMS 1/2W 10%
R29	502127		RESISTOR, 270 OHMS 1/2W 10%
R30	502222		RESISTOR, 2.2K OHMS 1/2W 10%
R31	502147		RESISTOR, 470 OHMS 1/2W 10%
R32	249629		RESISTOR, 2.49K OHMS WW 3W 1%
R33	502239		RESISTOR, 3.9K OHMS 1/2W 10%
R34	249628		RESISTOR, 825 OHMS WW 2W
R35	249627		RESISTOR, 1.5K OHMS WW 3W 1%
R36	249625		RESISTOR, 1K OHMS POTEMTIOMETER
R37	522233		RESISTOR, 3.3K OHMS 2W 10%
R38	502210		RESISTOR, 1K OHMS 1/2W 10%
R39	502147		RESISTOR, 470 OHMS 1/2W 10%
R40	422222		RESISTOR, 2.2 OHMS WW
R41	249624		RESISTOR, 10K OHMS POTENTIOMETER
R42	502282		RESISTOR, 8.2K OHMS 1/2W 10%
R43	502133		RESISTOR, 330 OHMS 1/2W 10%
R44	502247		RESISTOR, 4.7K OHMS 1/2W 10%
R45	502347		RESISTOR, 47K OHMS 1/2W 10%
R46	502318		RESISTOR, 18K OHMS 1/2W 10%
R47	502127		RESISTOR, 270 OHMS 1/2W 10%
R48	502222		RESISTOR, 2.2K OHMS 1/2W 10%
R49	502147		RESISTOR, 470 OHMS 1/2W 10%
R50	249629		RESISTOR, 2.49K WW 3W 1%
R51	502239		RESISTOR, 3.9K OHMS 1/2W 10%
R52	249626		RESISTOR, 1K OHMS WW 3W 1%
R53	249629		RESISTOR, 2.49K OHMS WW 3W 1%
R54	249632		RESISTOR, 1K OHMS POTENTIOMETER
R55	522233		RESISTOR, 3.3K OHMS 2W 10%
R56	502210		RESISTOR, 1K OHMS 1/2W 10%
R57	502147		RESISTOR, 470 OHMS 1/2W 10%
R58	422222		RESISTOR, 2.2 OHMS WW
R59	249624		RESISTOR, 10K OHMS POTENTIOMETER
R60	502282		RESISTOR, 8.2K OHMS 1/2W 10%
R61	502133		RESISTOR, 330 OHMS 1/2W 10%
R62	502247		RESISTOR, 4.7K OHMS 10%
R63	502347		RESISTOR, 47K OHMS 1/2W 10%
R64	502318		RESISTOR, 18K OHMS 1/2W 10%
R65	502127		RESISTOR, 270 OHMS 1/2W 10%
R66	502222		RESISTOR, 2.2K OHMS 1/2W 10%
R67	502147		RESISTOR, 470 OHMS 1/2W 10%
R68	249629		RESISTOR, 2.49K OHMS WW 3W 1%
R69	502239		RESISTOR, 3.9K OHMS 1/2W 10%
R70	249626		RESISTOR, 1K OHMS WW 2W
R71	249629		RESISTOR, 2.49K OHMS WW 2W
R72	249632		RESISTOR, 1K OHMS POTENTIOMETER
R76	512212		RESISTOR, 1.2K OHMS 1W 10%
R77	512212		RESISTOR, 1.2K OHMS 1W 10%
T1	249630		TRANSFORMER
NO PREFIX			
Electrical/Mechanical			**MODULE EXTENDER MI-560541-B** M/L 3720410 REV 9
J1	420033	3721894 006	CONNECTOR - 7 PIN FEMALE HOUSING
P1	420032	3721894 005	CONNECTOR - 7 PIN MALE HOUSING
11	420035	3721894 010	SOCKET - GUIDE, P1,J1
12	420034	3721894 009	PIN - GUIDE PIN, P1,J1
33	420031	3721894 004	SPRING - RETENTION

TK 869

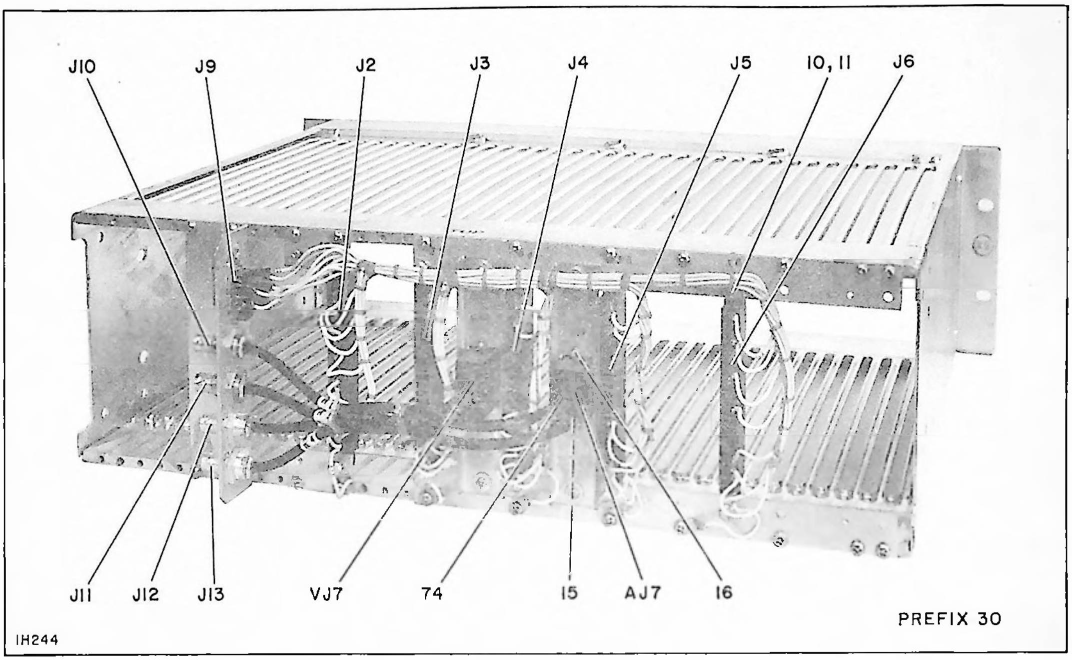


Figure 4-3. Frame Assembly MI-560595, Rear View — Prefix 30

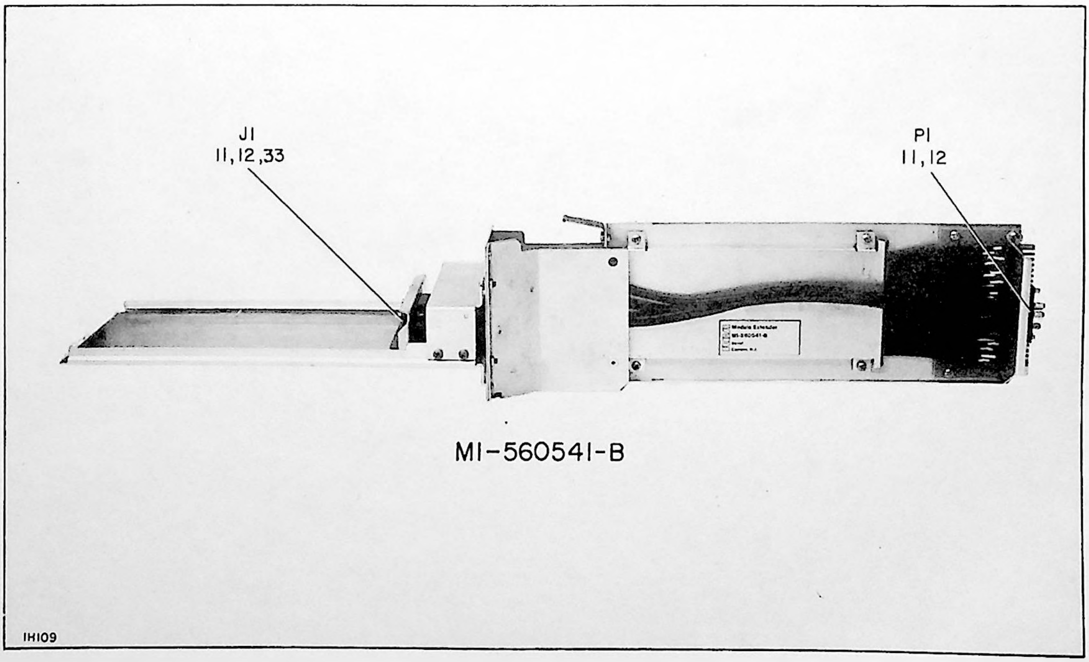


Figure 4-4. Module Extender MI-560541-B

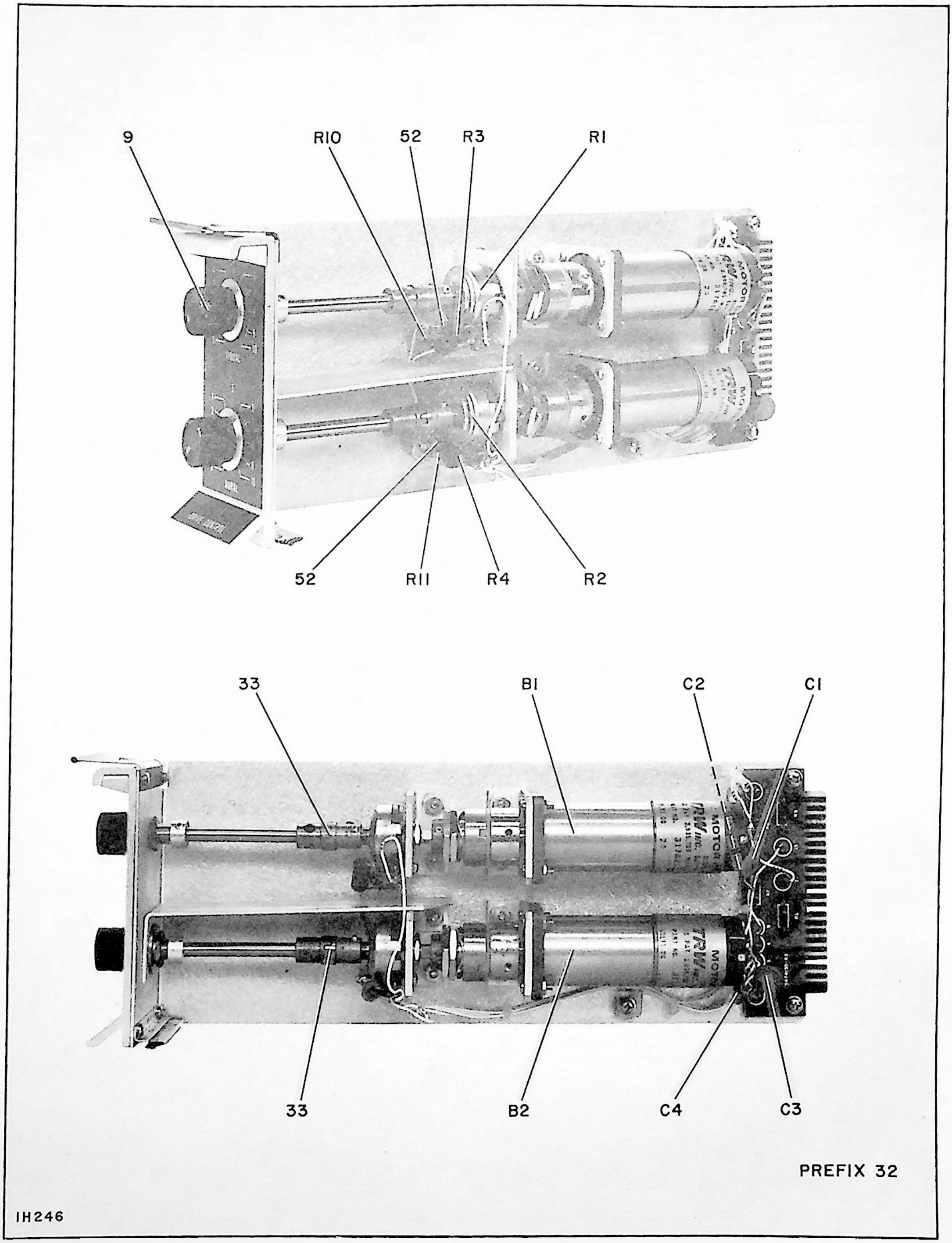
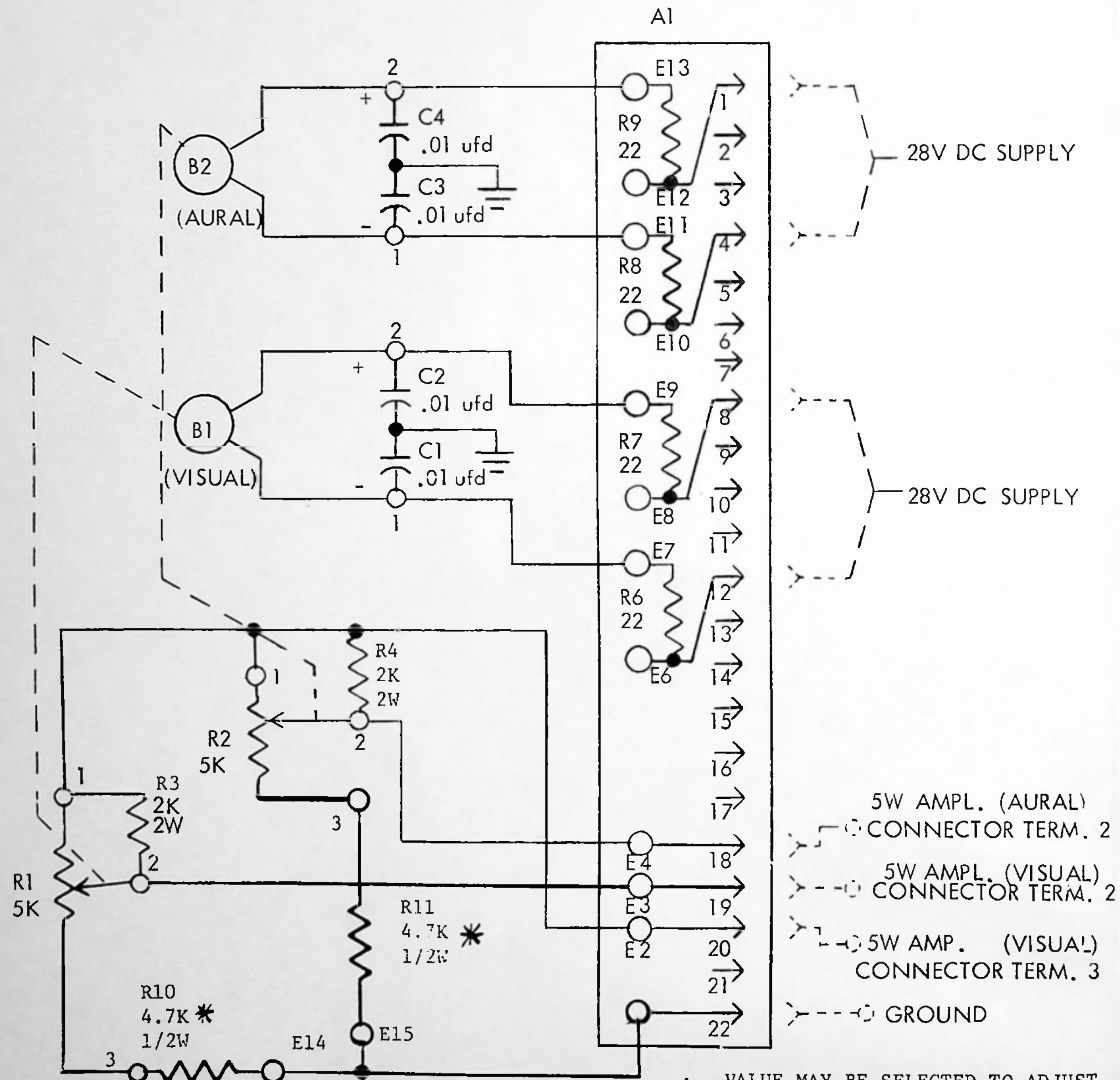
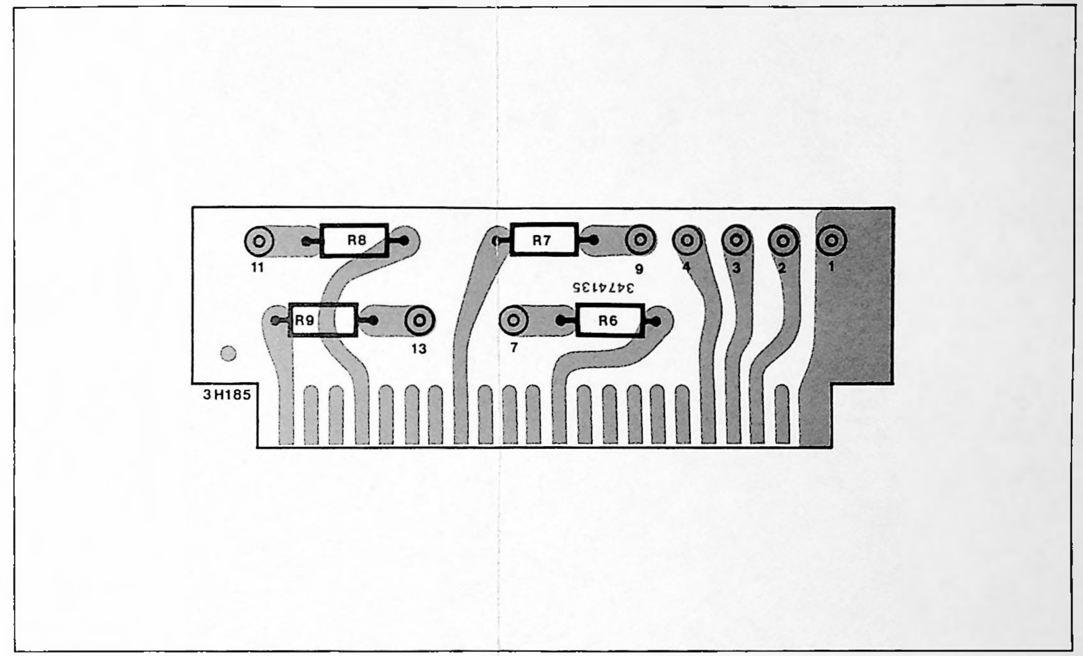


Figure 4-5. Drive Control Module MI-560594 – Prefix 32

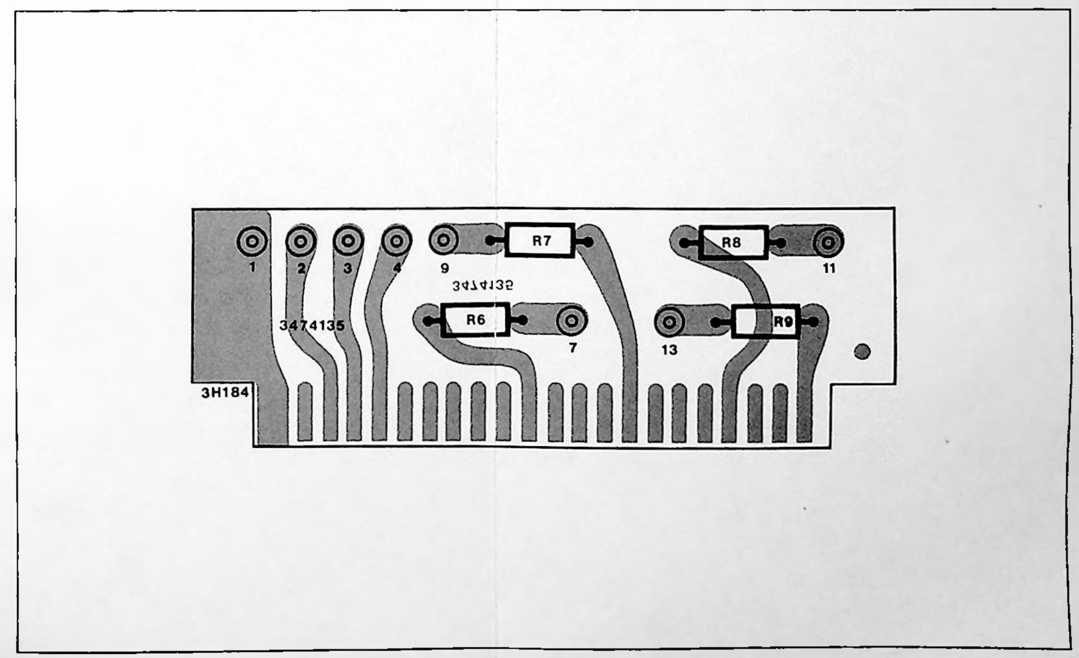


1H240 SYMBOL PREFIX 32 **DERIVED FROM 3459938 REV 3**

* VALUE MAY BE SELECTED TO ADJUST MIN. VOLTAGE TO CUT-OFF POINT OF POWER OUTPUT.



TOP VIEW



BOTTOM VIEW

Figure 4-6. Drive Control Module MI-560594, Schematic Diagram (3459938) and Printed Wiring Board Assembly (A1)

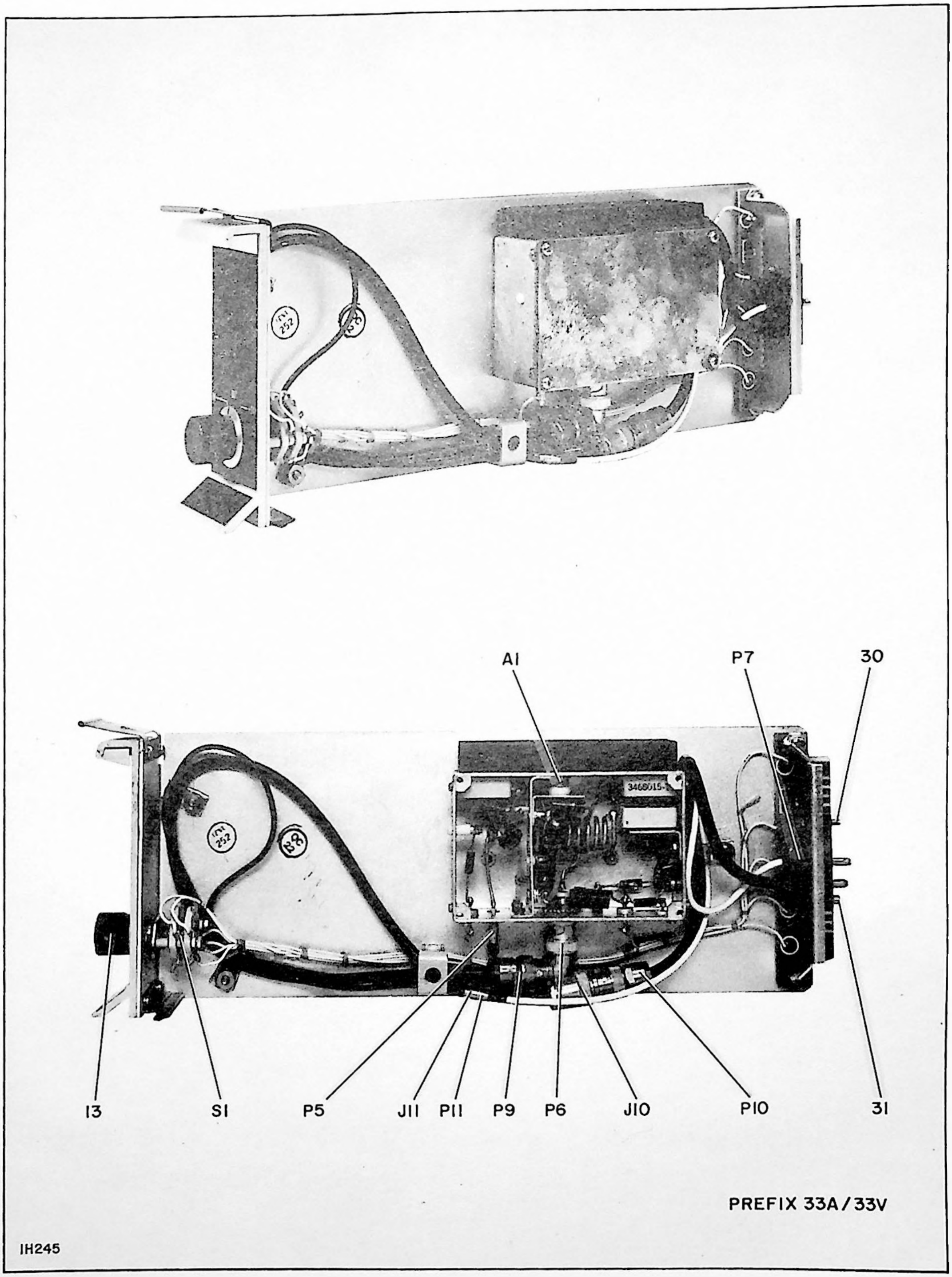
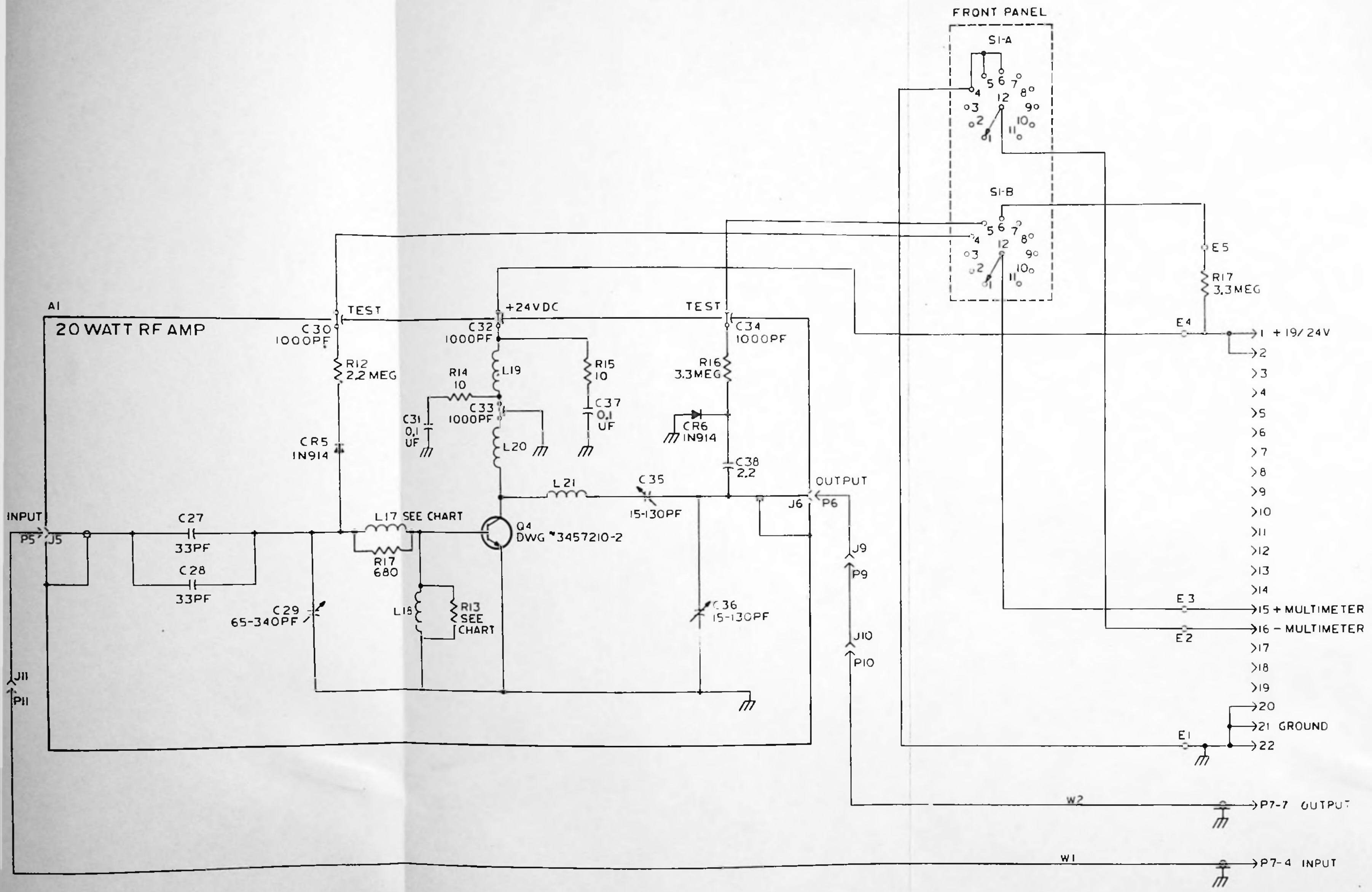


Figure 4-7. 20W Aural/Visual Amplifier Module MI-560590 – Prefix 33A/33V



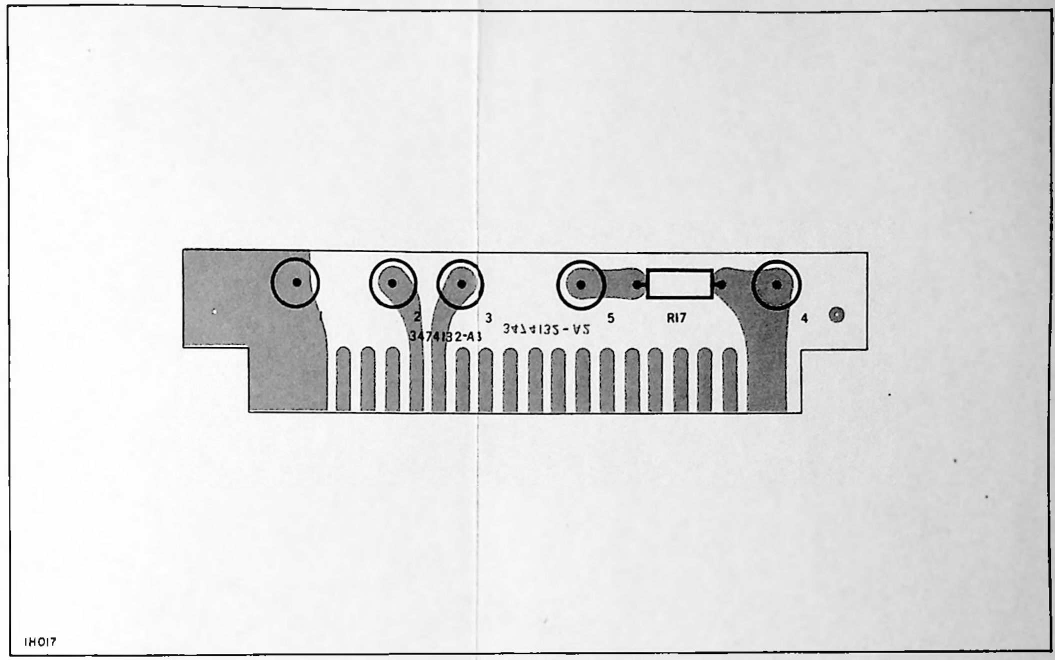
DERIVED FROM
3477314 REV 2

1H238

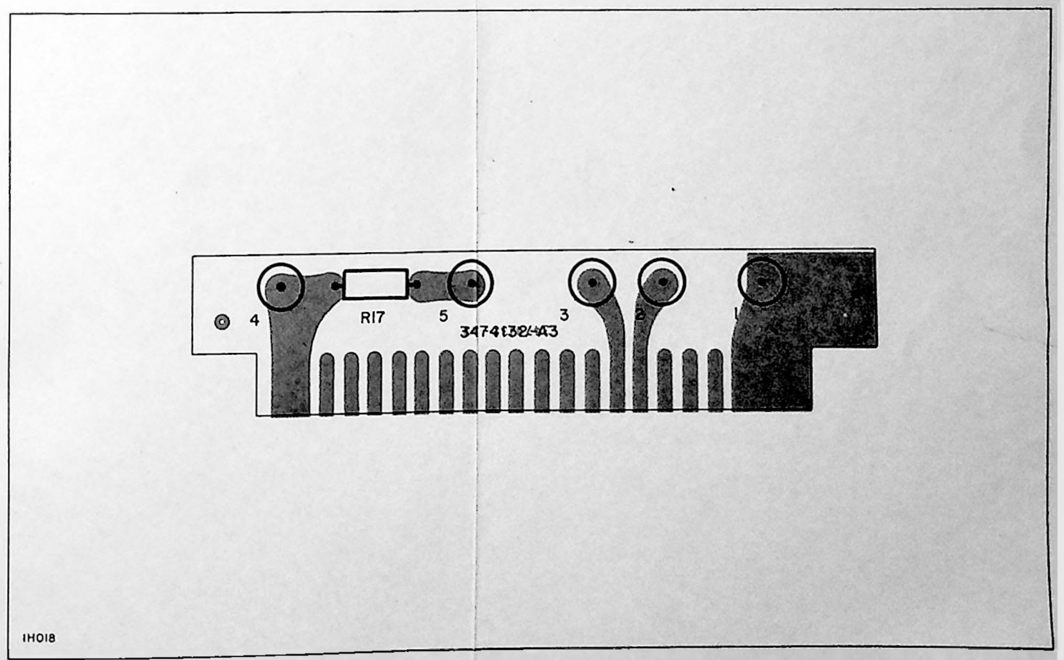
20 WATT AMPL COIL CHART			
COIL	DWG	PT NO	CHANNEL
L17	3469623	17	2 AND 3
L17	3469623	18	4
L17	3469623	8	5
L17	3469623	20	6

20 WATT AMPL RESISTOR CHART			
RESISTOR	DWG	PT NO	CHANNEL
R13	90496	111	2,3 AND 4
R13	90496	119	5 AND 6

NOTES
1. ALL CAPACITOR VALUES ARE IN UF UNLESS OTHERWISE SPECIFIED
2. MODULE PREFIX: 33A FOR AURAL
33V FOR VISUAL



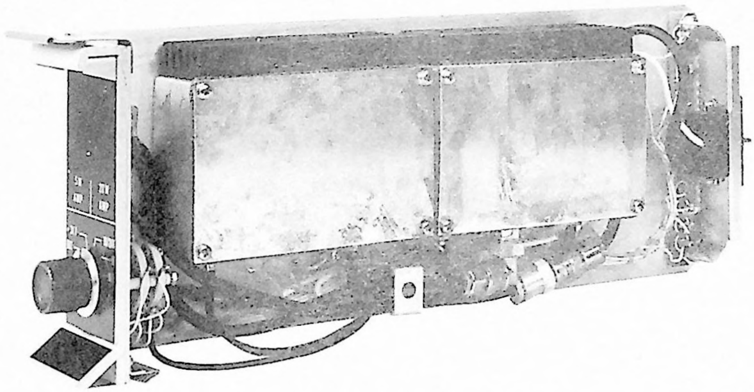
TOP VIEW

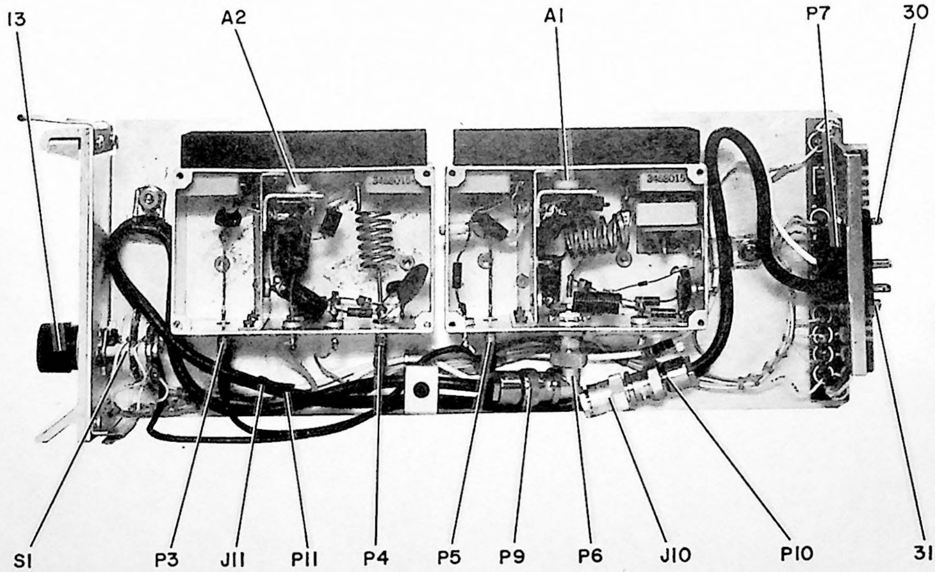


BOTTOM VIEW

Figure 4-8. 20W Aural/Visual Amplifier MI-560590, Schematic Diagram (3477314) and Printed Wiring Board Assembly

Chan. 2 & 3 ours

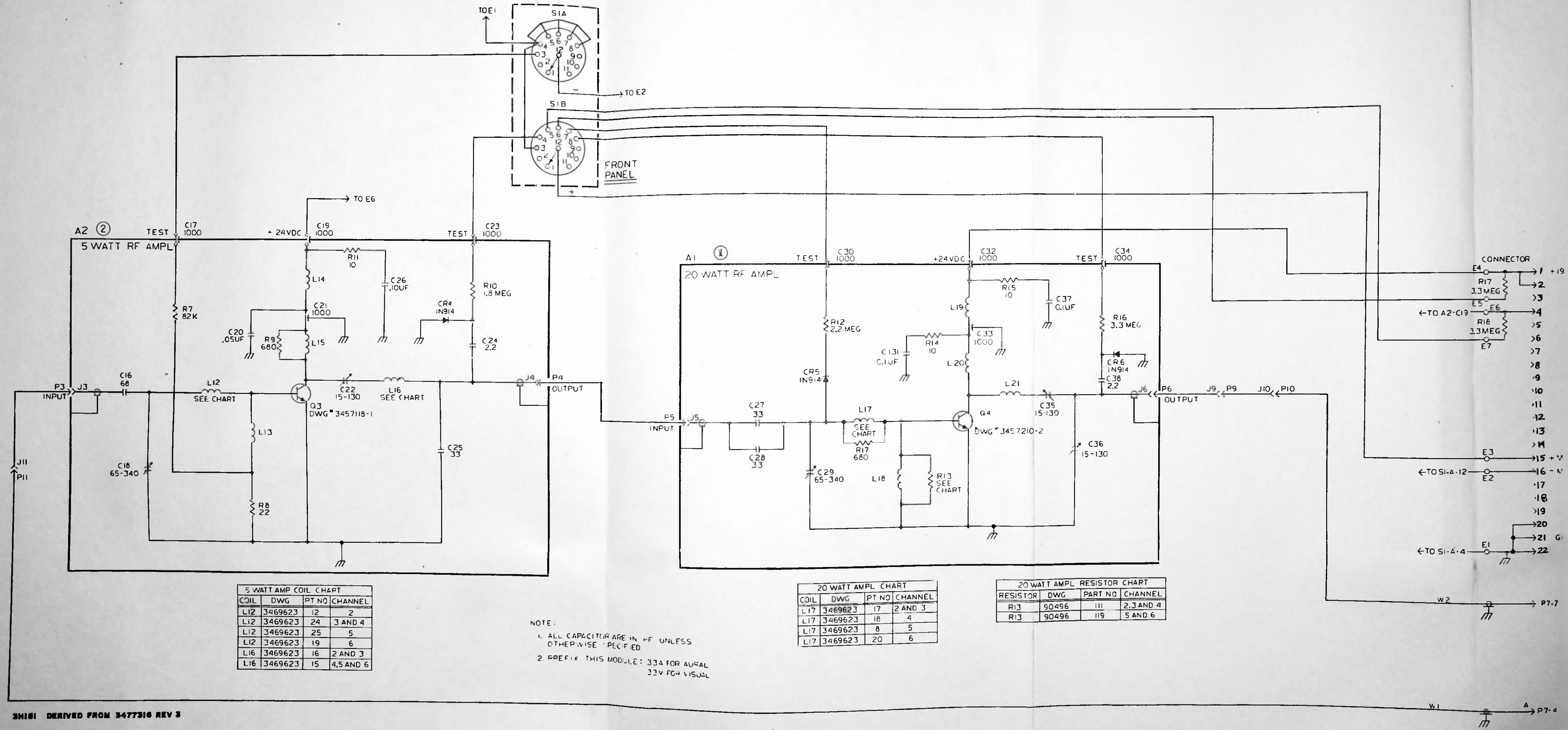




PREFIX 33A/33V

1H247

Figure 4-9. 20W Aural/Visual Amplifier Module MI-560591 – Prefix 33A/33V



5 WATT AMP COIL CHART			
COIL	DWG	PT NO	CHANNEL
L12	3469623	12	2
L12	3469623	24	3 AND 4
L12	3469623	25	5
L12	3469623	19	6
L16	3469623	16	2 AND 3
L16	3469623	15	4,5 AND 6

NOTE:

1. ALL CAPACITOR ARE IN PF UNLESS OTHERWISE SPECIFIED
2. PREFIX THIS MODULE: 33A FOR AURAL
   33V FOR VISUAL

20 WATT AMPL CHART			
COIL	DWG	PT NO	CHANNEL
L17	3469623	17	2 AND 3
L17	3469623	18	4
L17	3469623	8	5
L17	3469623	20	6

20 WATT AMPL RESISTOR CHART			
RESISTOR	DWG	PART NO	CHANNEL
R13	90496	111	2,3 AND 4
R13	90496	119	5 AND 6

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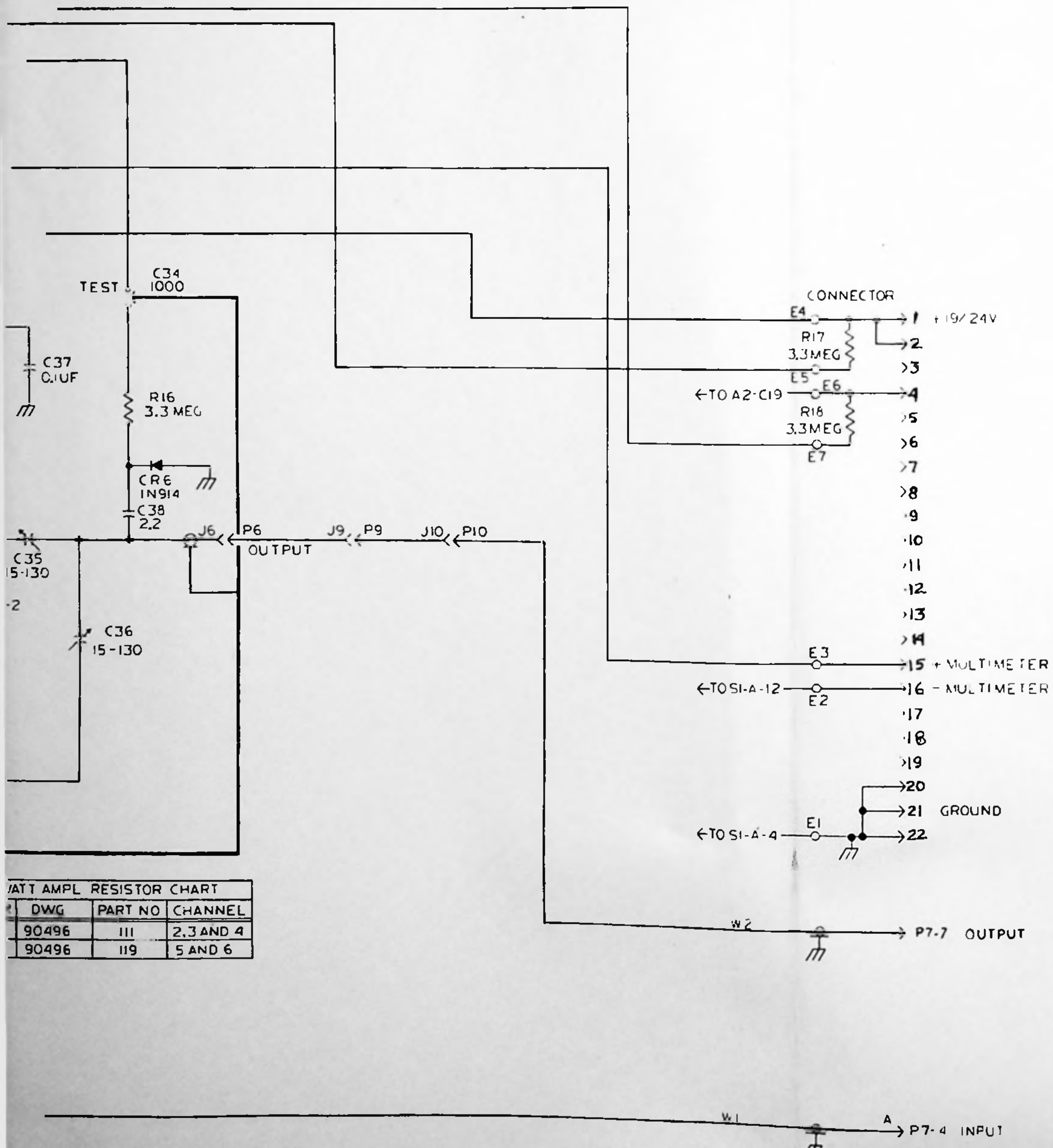
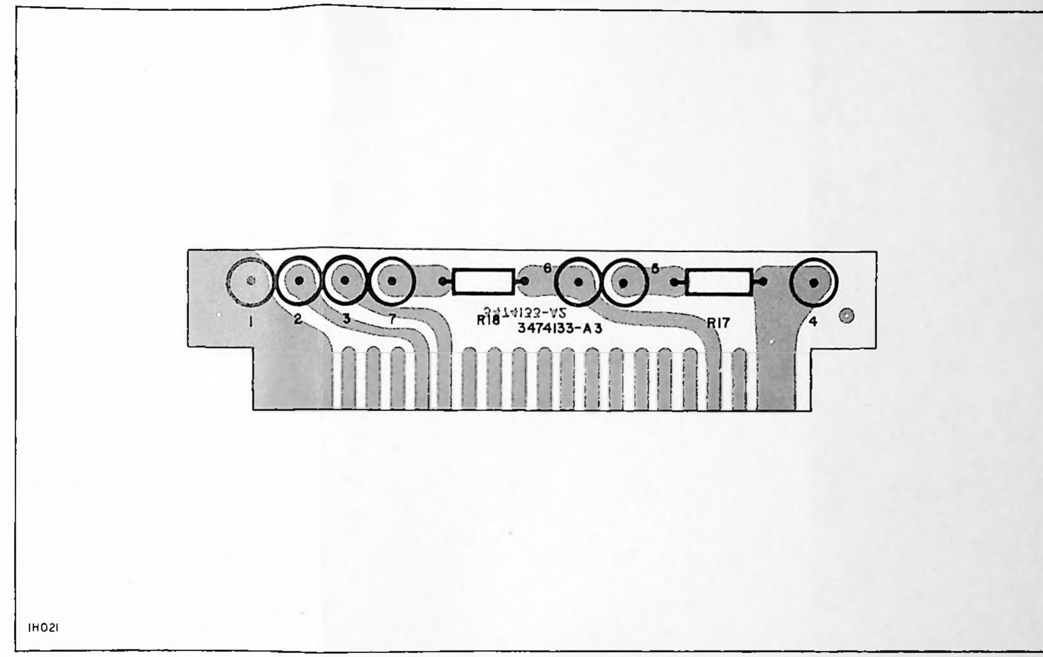
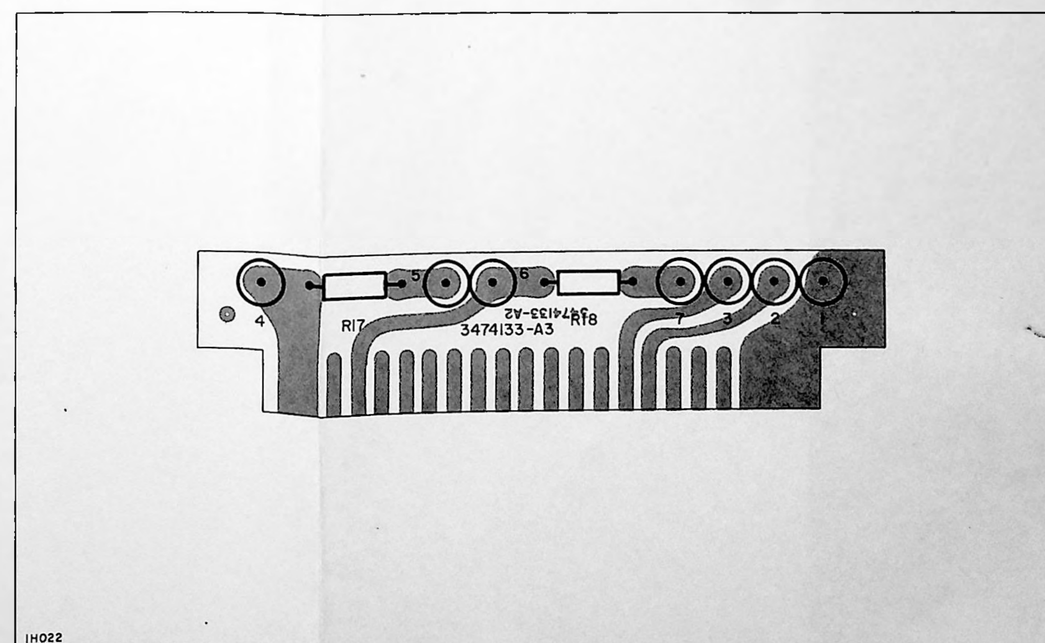


ATT AMPL RESISTOR CHART		
DWG	PART NO	CHANNEL
90496	111	2,3 AND 4
90496	119	5 AND 6



TOP VIEW



BOTTOM VIEW

Figure 4-10. 20W Aural/Visual Amplifier MI-560591, Schematic Diagram (3477316) and Printed Wiring Board Assembly

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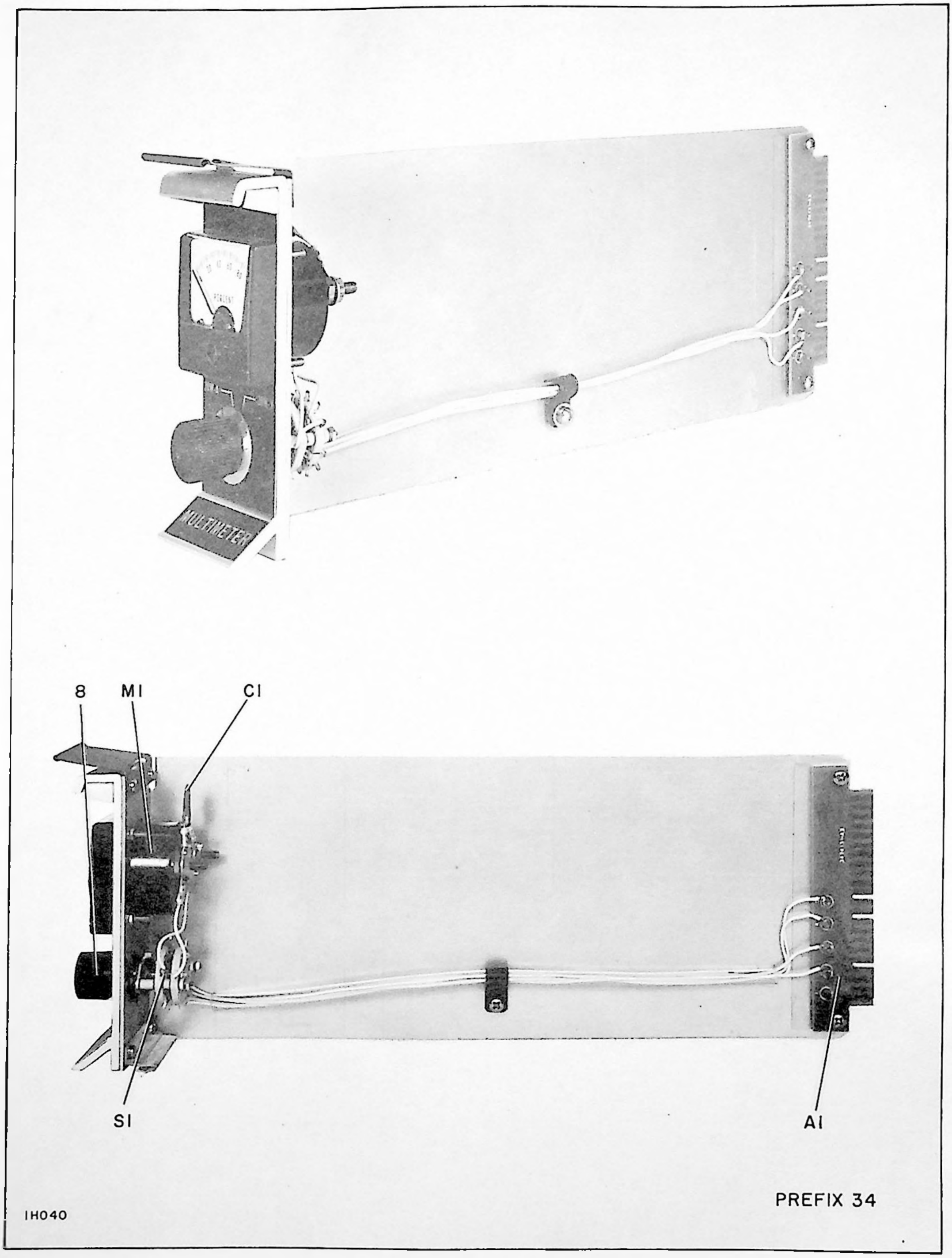
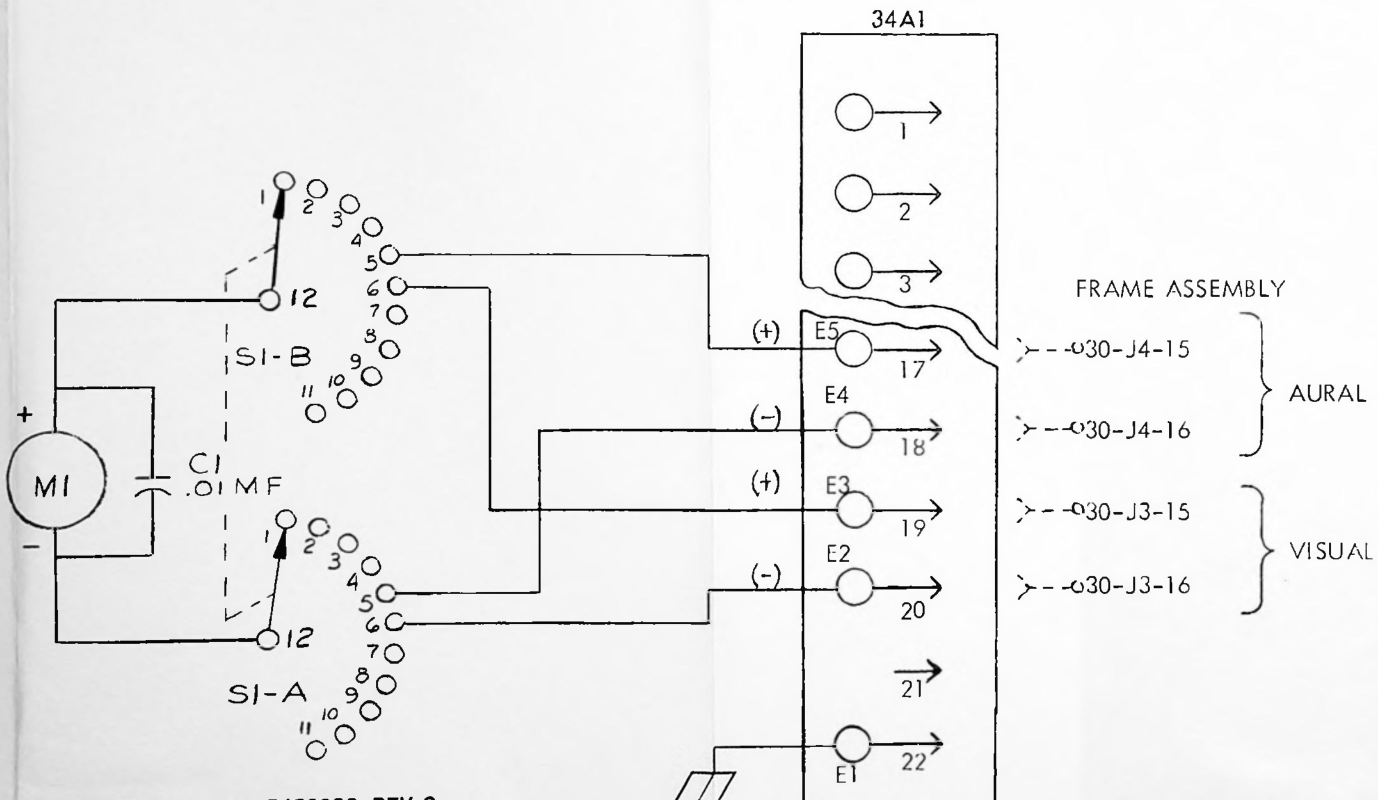


Figure 4-11. Multimeter Module MI-560593 -- Prefix 34



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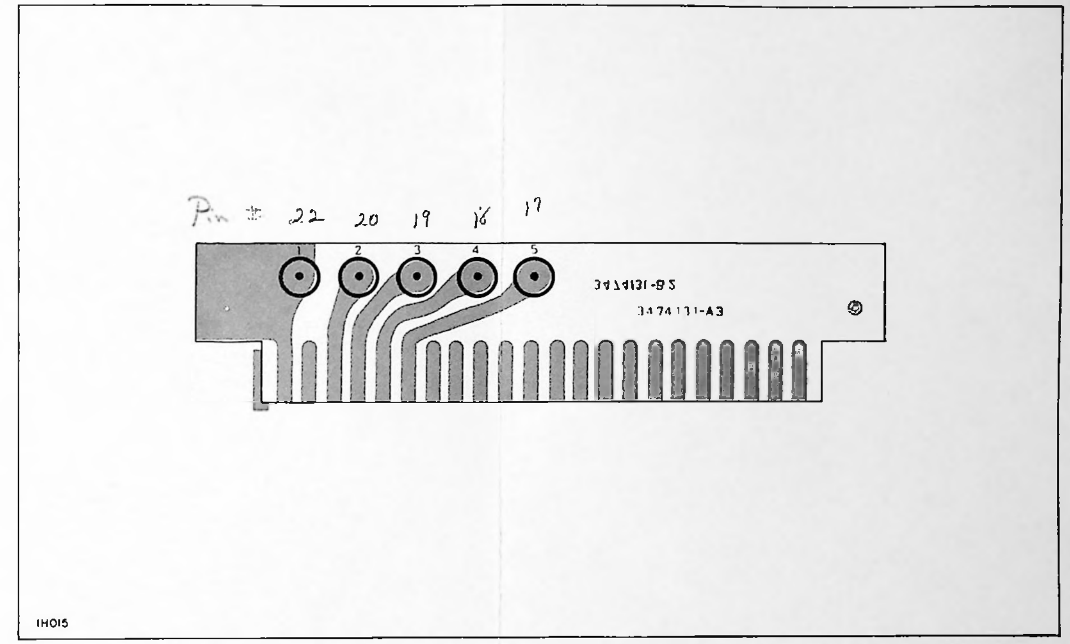
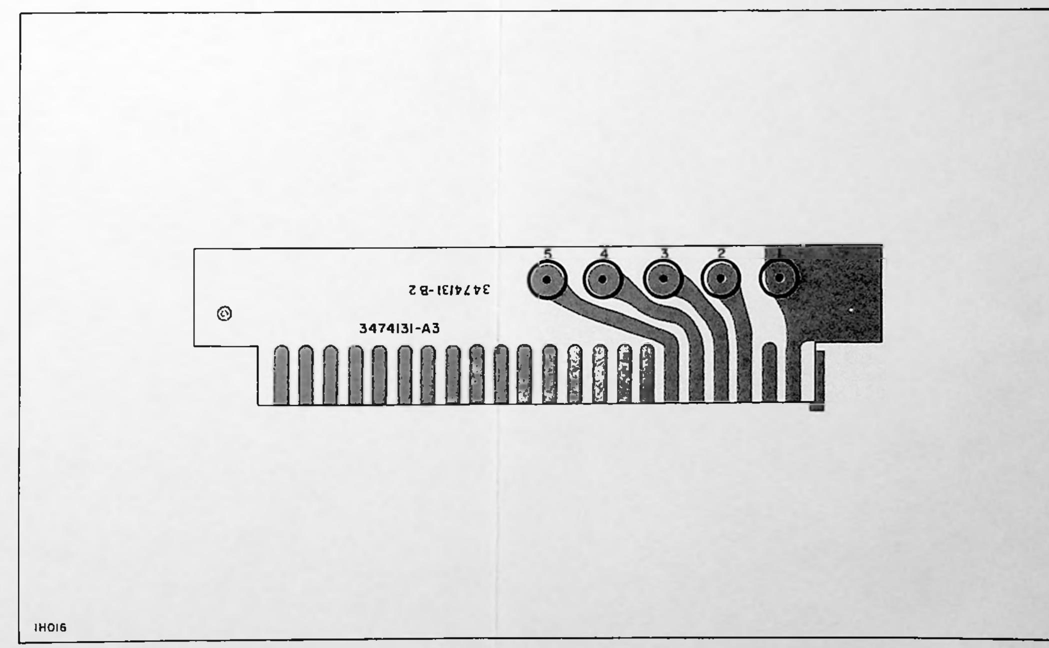
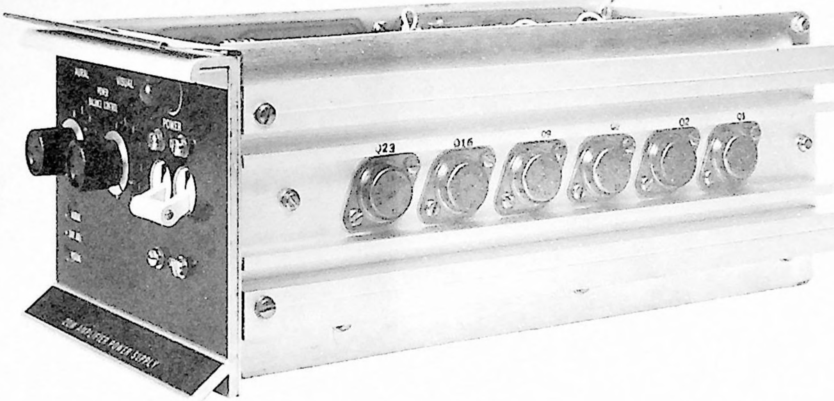


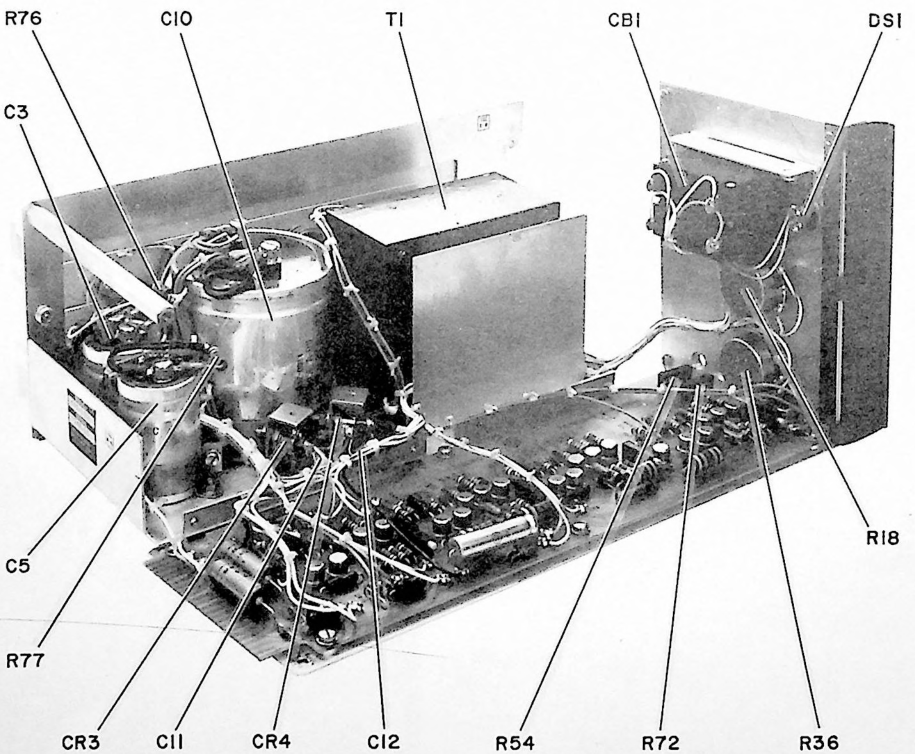
TOP VIEW



BOTTOM VIEW

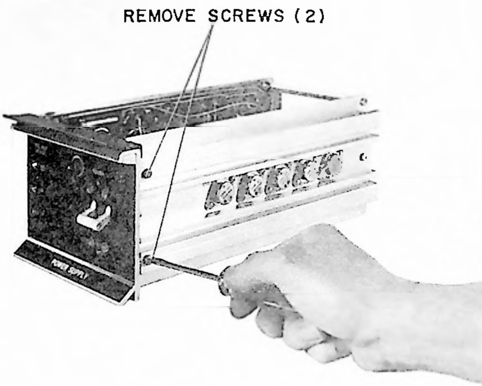
Figure 4-12. Multimeter Module MI-560593, Schematic Diagram (3474303) and Printed Wiring Board Assembly (A1)



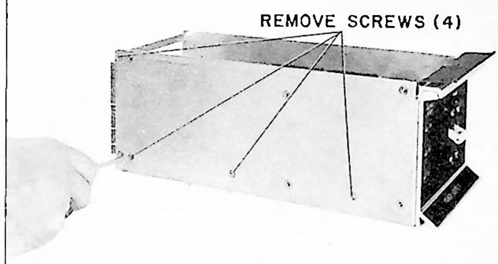


PREFIX 35

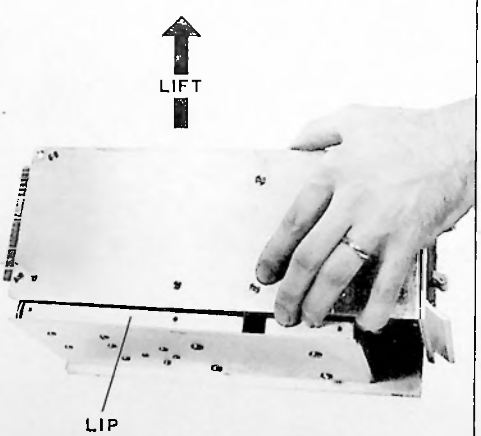
1H248



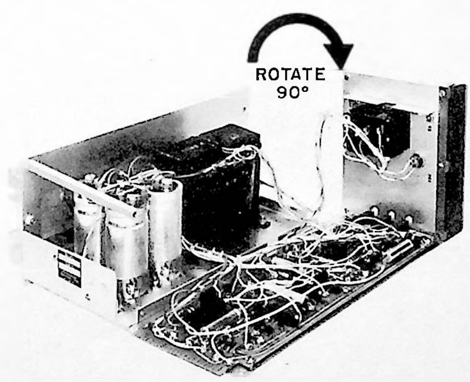
STEP-1



STEP-2

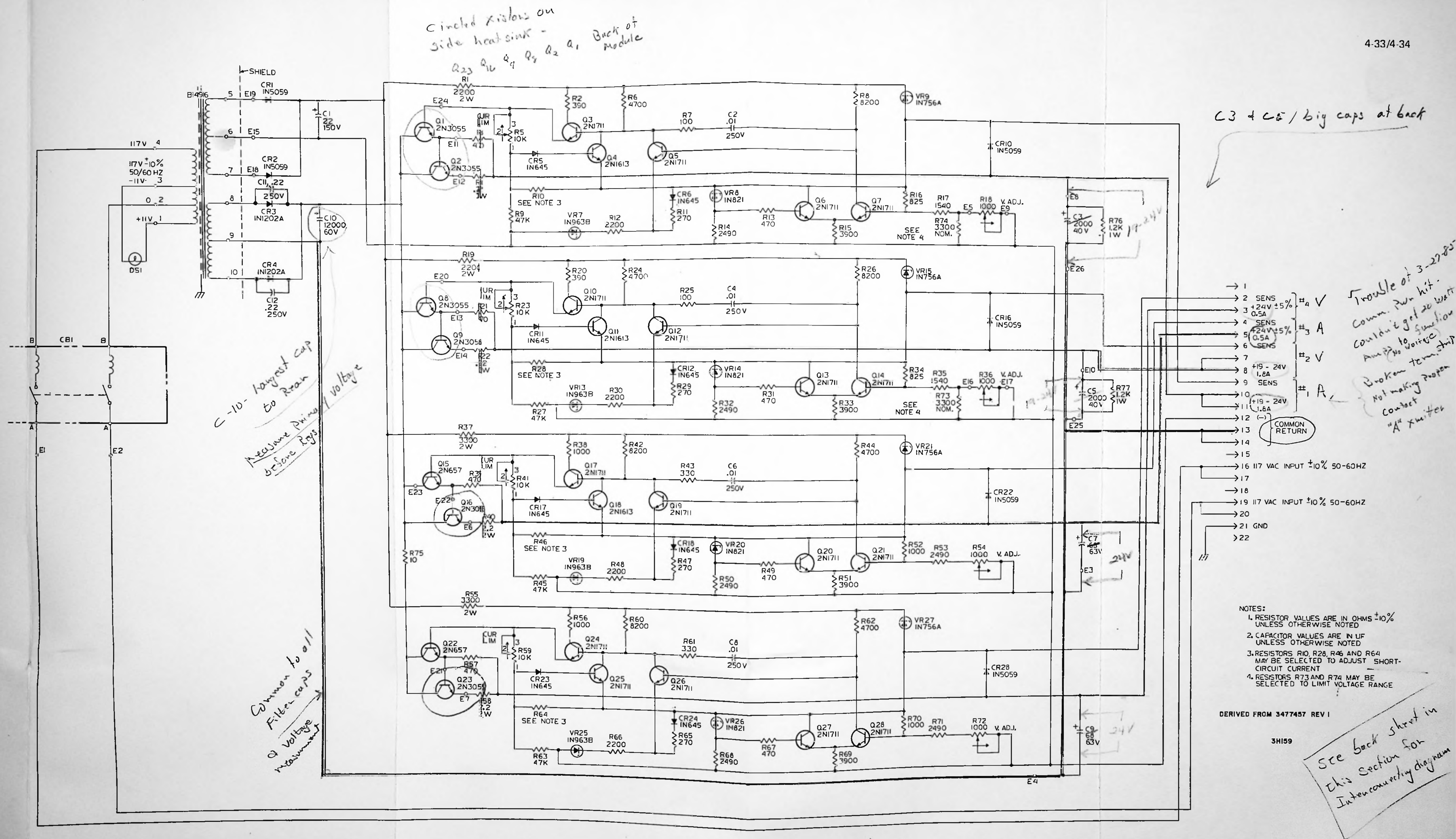


STEP-3



STEP-4

2H016



NOTES:

1. RESISTOR VALUES ARE IN OHMS ±10% UNLESS OTHERWISE NOTED
2. CAPACITOR VALUES ARE IN UF UNLESS OTHERWISE NOTED
3. RESISTORS R10, R28, R46 AND R64 MAY BE SELECTED TO ADJUST SHORT-CIRCUIT CURRENT
4. RESISTORS R73 AND R74 MAY BE SELECTED TO LIMIT VOLTAGE RANGE

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Figure 4-15. 20W Amplifier Power Supply Module MI-560592B Schematic Diagram (3477325)

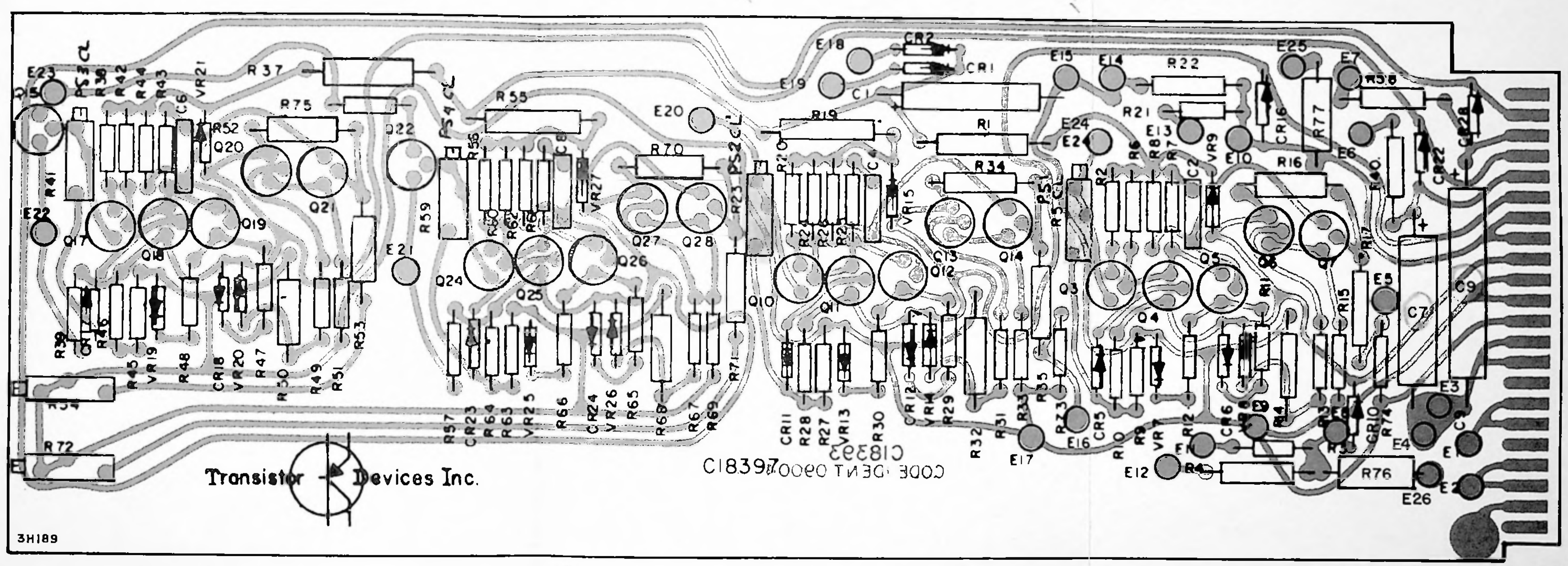
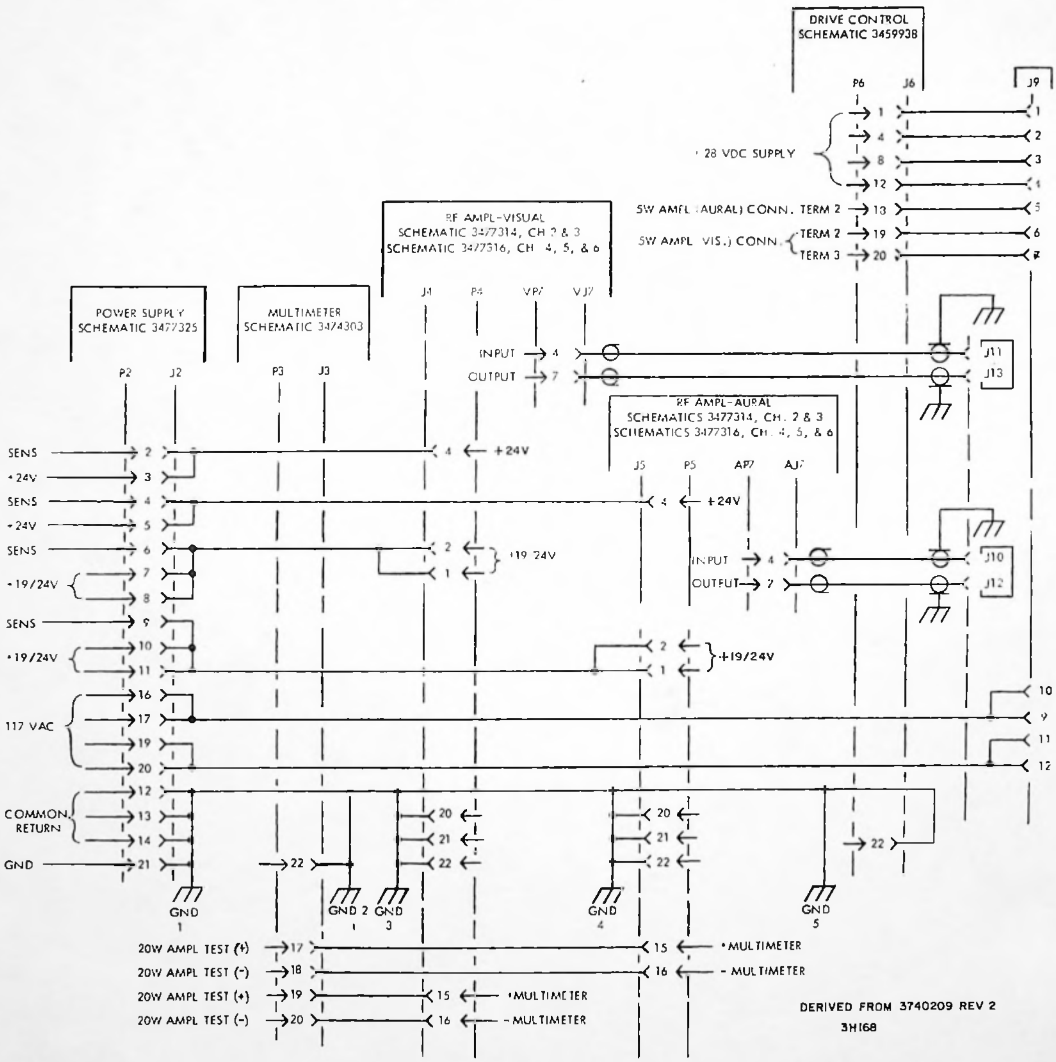


Figure 4-16. 20W Amplifier Power Supply Module MI-560592B
Printed Wiring Board Assembly



20W Aural/Visual Amplifier Module Interconnection Wiring Diagram (3740209)

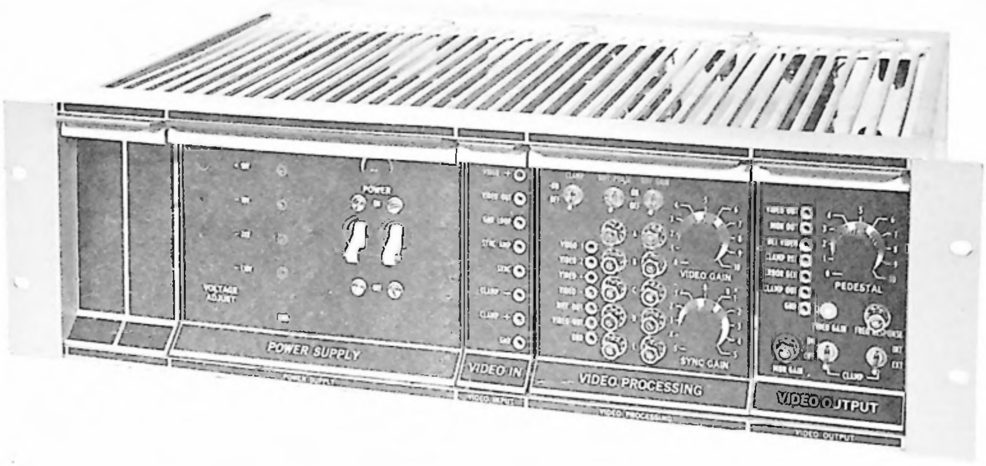


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Figure 5-1. Video Modulator

EQUIPMENT LIST

Quantity	Item	Reference
1	Video Input Module	MI-560455
*	Video Processing Module	MI-560456 or
*	Video Processor Module	MI-560456-A
*	Video Amplifier and Output Module	MI-560457 or MI-560860
*	Video Modulator Power Supply Module	MI-560458-B or MI-560458-C
*	Module Frame Assembly	MI-560459 or MI-560859
1	Module Extender	MI-560541-B
*	Auto Sync Level (ASL) Control Module	MI-561330
*Supplied if or as specified on sales order		

DESCRIPTION

GENERAL

The Video Modulator (see Figure 5-1) is a modularized solid state unit that accepts a nominal video input signal of between 0.5 to 2.0 V peak-to-peak. Linearity correction circuits compensate for the nonlinearity of the visual modulated amplifier and the PA stages. Motor-operated controls are utilized which enable adjustment from a remote control point. The Video Modulator consists of six module assemblies in a standard RCA 5-1/4 x 19 inch Module Frame (see Figure 5-4). The design of the frame permits vertical air flow through the frame for convection cooling. The modules include a Video Input Module MI-560455, a Video Processing Module MI-560456 or ,a Video Processor Module MI-560456-A, a Video Amplifier and Output Module MI-560457 (used with grid modulation) or a Video Amplifier and Output Module MI-560860 (used with diode modulation), an (optional) Automatic Sync Level (ASL) Control Module MI-561330 and a Video Modulator Power Supply MI-560458-B orMI-560458-C used with ASL. Figures 5-2 and 5-3 are the Video

Modulator Functional/Signal Flow Block Diagrams with and without ASL respectively.

MODULE CIRCUIT DESCRIPTION

Video Input Module MI-560455 – Prefix 13

The Video Input Module MI-560455 (see Figures 5-6 thru 5-8) is an all solid state unit utilizing NPN, PNP and MOS FET type transistors. Functionally, the module provides a high input impedance to prevent loading of the loop thru input circuit, a video signal for the Video Processing Module MI-560456/Video Processor Module MI-560456-A, a negative (-) clamp signal for the Video Amplifier and Output Module, and a plus (+) clamp signal for the Video Processing Module MI-560456/Video Processor Module MI-560456-A.

The module operates with a nominal 1.0 V peak-to-peak input signal. A differential input circuit is provided to suppress as much as 8.0 volts peak-to-peak of signal appearing on the common mode or ground of the system (i.e., the difference in potential between power line neutrals at separate locations). The module rejects such signals to ensure minimum distortion of the video signal due to common mode signals.

The circuits in the video input module consist of a differential amplifier (Q1 thru Q3), a sync amplifier (Q4 thru Q6), a sync separator (Q7 and Q8), and a clamp pulse generator (Q9 thru Q12).

The Video input signal is applied to the differential amplifier (Q1 thru Q3) from the phase equalizers and low pass filter circuits. Functionally, whenever identical signals having the same amplitude and phase relationships are applied to the two inputs of a differential amplifier, the output from the circuit is zero. When two different input signals are applied to the differential amplifier, a difference signal appears at the output of the circuit. The center lead of the incoming video line is connected to one input of the differential amplifier which has a high impedance due to the insulated gate of the MOS FET (Q1). The shield of the incoming video line is connected to the other input of the differential amplifier through a voltage divider consisting of resistors R4 and R5. This divider compensates for the signal loss that occurs between the insulated gate (pin 3) and the source (pin 2) leads of the MOS FET (Q1). Since there is a difference between the center lead and shield of the coaxial line, an output signal appears at the drain lead (pin 1) of Q1, but the common mode output signal is suppressed 40 dB from the input signal. Variable capacitor C3 is adjusted to provide optimum frequency response as measured at the output of the Video Processing Module MI-560456/Video Processor Module MI-560456-A.

The emitter follower ground loop circuit (Q2) acts as a buffer amplifier in conjunction with Q1 to remove the common mode signals from the video input signal at the drain lead (pin 1) of Q1. The circuit also provides a low impedance path to ground for Q1 through resistors R9 without affecting the input impedance. The output from the differential amplifier is fed through emitter follower Q3 which provides the video signal to the Processing/Processor Module. An output signal from the collector of Q3 is applied through resistor R13 to the sync separator consisting of feedback pair transistors Q4 and Q5. Capacitors C7 and C17 in the output circuits of Q3 and the feedback pair (Q4 and Q5) roll-off the frequency response of the video signal.

A driven feedback clamp circuit consisting of Q6 and CR1 detects the sync tip amplitude, transforms it into a DC potential, and feeds this potential to the input of the feedback pair (Q4 and Q5). This potential causes the feedback pair (Q4 and Q5) to operate in a non-linear condition, thus allowing only the sync portion of the video signal to be applied to the DC restorer circuit. If any hum is present on the incoming video signal, it will be suppressed by the sync driven feedback clamp circuit. The signal from the sync amplifier is then applied to a DC restorer (CR2) which sets the level of the sync applied to the sync separator (Q7 and Q8). A sample of the feedback signal from Q6 is applied through the network of R21, R23 and C11, to the DC restorer (CR2). This also helps to suppress any hum on the video signal. Part of the sync signal is clipped at the emitter of Q7 by the diode action of the base-emitter junction of Q8.

The output from Q7 is applied to the common-emitter amplifier (Q8) which amplifies part of the remaining sync pulse. Inductor L1 and capacitor C12 make up a delay network which delays the trailing edge of the sync pulse to delay the clamp pulse from the trailing edge of the sync pulse. The output from the common emitter amplifier (Q8) has two signal paths. The first is applied to the Video Processing/Processor Module. When the clamp in the Video Processing/Processor Module is not used, the signal is shorted to ground making the sync amplifier inoperative. The second path is applied to the base of the clamp pulse former (Q9) through the differentiating network consisting of capacitor C13 and resistor R28. The differentiating network determines the width of the clamp pulse. The output from the collector of Q9 is a clamp pulse that has been generated by the trailing edge of sync. Capacitor C16 tends to delay the leading edge of the clamp pulse to ensure that the leading edge of the clamp is delayed from the trailing edge of sync. Diode CR3 in the emitter circuit of Q9 protects the base-emitter junction from reverse voltage breakdown. The output from Q9 is applied to the emitter follower Q10. The output signal from Q10 is a negative clamp pulse applied to the Video Amplifier and Output Module and to the base of the phase inverter Q11. The output from the phase inverter is a positive (+) clamp pulse applied through buffer amplifier Q12 to the Video Processing Module/Processor Module.

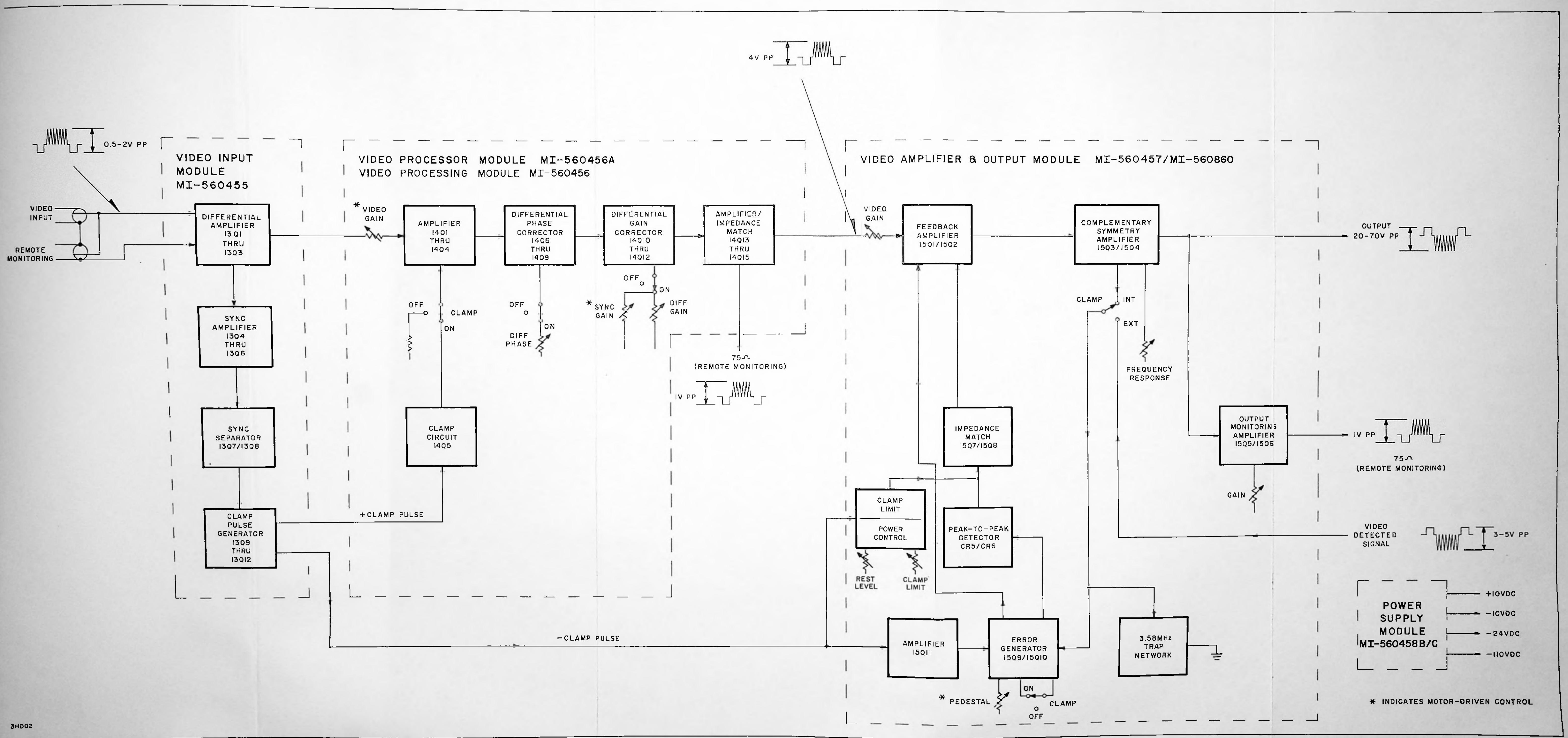


Figure 5-2. Video Modulator Functional/Signal Flow Block Diagram Without ASL

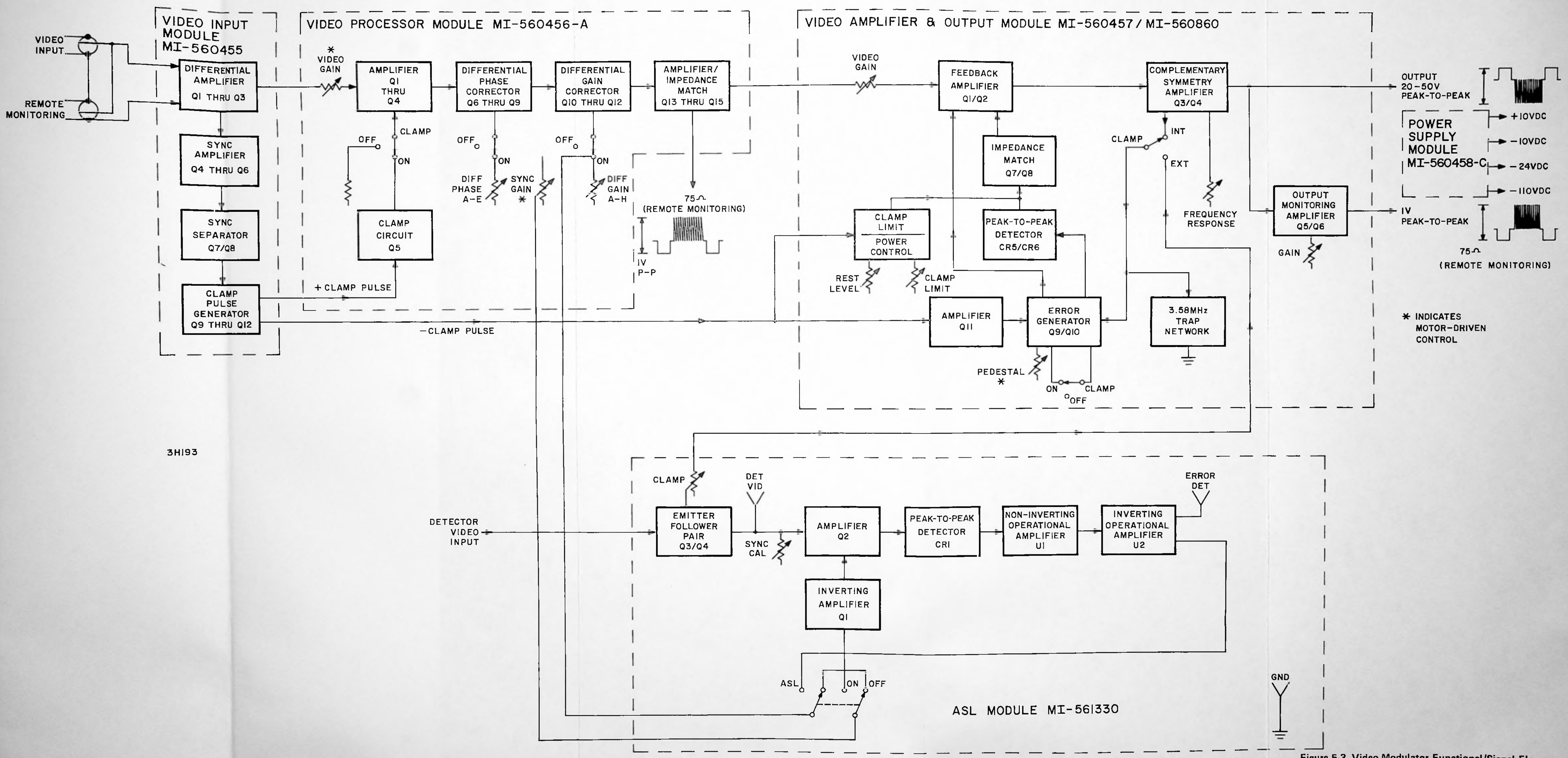


Figure 5-3. Video Modulator Functional/Signal Flow Block Diagram With ASL

Test Points (VIDEO +, VIDEO OUT, GND LOOP, SYNC AMP, SYNC, CLAMP-, CLAMP +, and GND) are provided on the front panel for monitoring the AC and DC potentials of the various stages. The design of the module also ensures that accidental shorting of the test points to ground will not affect the operation of the module.

Video Processing Module MI-560456/Video Processor Module MI-560456A – Prefix 14

The Video Processing Module MI-560456/Video Processor Module MI-560456-A (see Figures 5-9 thru 5-14) is an all solid state unit utilizing NPN and PNP type transistors. The module contains the linearity correction circuits that compensate for the non-linearity of the visual power amplifiers and the RF stages. The circuits in the module consist of an amplifier stage (Q1 thru Q4), a clamp circuit (Q5), phase splitter (Q6 thru Q9), a differential phase circuit, a differential amplifier (Q10 thru Q12), a differential gain circuit, and an amplifier/impedance matching stage (Q13 thru Q15).

The video input signal is applied to the front panel motor-operated VIDEO GAIN control (R101) from the Video Input Module MI-560455. The amplitude of the signal is adjusted for 2.5 V peak-to-peak at the VIDEO 1 test point (for MI-560456) or VIDEO IN test point (for MI-560456-A). This signal is then coupled through capacitor C1 to the first amplifier stage. The amplifier consists of a feedback pair (Q1 and Q2) which has a low impedance output and a gain of approximately 4.5. Variable capacitor C34 adjusts the output of the module for a flat response. The output from the feedback (Q1 and Q2) pair is applied through a high frequency path consisting of C4 and R15 to the base of the emitter follower (Q6). The output from the feedback pair also drives an emitter follower circuit consisting of Q3 and Q4. Capacitor C3 and resistor R8 are part of the feedback network which limits the high frequency response of the video signal. The output from the emitter follower amplifier (Q3 and Q4) is applied through a low frequency path consisting of C5 and R15 to the base of emitter follower (Q6).

NOTE: The VIDEO GAIN control is motor operated for use in remote control operation.

The positive (+) clamp pulse from the Video Input Module MI-560455 is applied to the clamp transistor (Q5). When the CLAMP switch S1 on the front panel is set to the ON position, the positive (+) clamp pulse saturates the clamp transistor (Q5), thus restoring the DC information in the video signal. The 3.58 MHz color burst information is removed causing only low frequency information to be fed through R15 and C4 to the base of the emitter follower circuit (Q6). The feedback pair (Q1 and Q2) supplies the 3.58 MHz color burst information through a network consisting of C4 and R15 to the base of the emitter follower circuit (Q6). This stage provides a high input impedance for the clamp stage.

The output from Q6 is applied to the base of the phase splitter (Q7). The two outputs from the phase splitter are equal in amplitude and opposite in phase, and are fed through the emitter follower stages (Q8 and Q9) to the differential phase circuit. Differential phase correction is accomplished in an RC phase shift network. Four gated capacitors (C9 thru C12) and one varicap diode (CR15) are used. Approximately ±2° of correction is available from each of the gated capacitors and +8° of correction is available from the varicap diode.

CR4 through CR7 are mounted on spring loaded terminals and can be reversed to change the direction of differential phase correction from (+) to (-). The output from the differential phase circuit is fed through the impedance isolation transistor (Q10) to the differential amplifier consisting of an emitter follower (Q11) and a grounded base amplifier (Q12).

NOTE: Refer to one of the two following paragraphs for a circuit description of the differential gain control circuit.

Video Processing Module MI-560456

The gain of the differential amplifier is determined by resistor R40 divided by the emitter-to-emitter resistance of Q11 and Q12 which consists of resistors R41, R42, and R43. Resistors R44 thru R48 are gated across the emitters of Q11 and Q12 by diodes CR9 thru CR13, resulting in an increase in gain of the differential amplifier. The level to which the resistors are gated-in is determined by the front panel differential gain correction potentiometers A thru E (R115 thru R119). Potentiometer A (R115) can be adjusted from the white to the black picture region with little affect on gain correction; but, as each potentiometer (B thru E) is adjusted a larger amount of gain correction is obtained from each control. The total amount of gain correction of the potentiometers is 11 dB.

Video Processor Module MI-560456-A

The gain of the differential amplifier is determined by resistor R40 divided by the emitter-to-emitter resistance of Q11 and Q12 which consists of resistors R41, R42, and R43. Resistors R44 thru R48 and R75 thru R77 are gated across the emitters of Q11 and Q12 by diodes CR9 thru CR13 and CR16 thru CR18, resulting in an increase in gain of the differential amplifier. The level to which the resistors are gated-in is determined by the front panel differential gain correction potentiometers A thru H (R115 thru R119 and R123 thru R125). Potentiometers A thru E are used for gain correction in the white picture region while potentiometers F thru H are used for gain correction in the black picture region. The result is a smooth curve on the step function. The total amount of gain correction in the white region is approximately 11 dB, while in the black region it is approximately 4 dB.

The motor-operated SYNC GAIN potentiometer (R121) is adjustable for approximately 4 dB of sync gain or 3 dB of sync compression. The sync gain resistor (R49) is gated-in by diode CR14 located between the emitters of Q11 and Q12. The compression circuit consisting of diode CR8 and resistors R38 and R39 in the collector circuit of Q12 is controlled by the SYNC GAIN potentiometer (R121) located in the emitter circuit. Varying R121 increases or decreases the current through Q12 causing the collector voltage to vary. This action causes CR8 to conduct which reduces the gain of the video signal at the sync tip region. The DIFFERENTIAL GAIN switch (S3) when in the OFF position, disconnects the gain potentiometers from the circuit. The high impedance output from the grounded-base amplifier (Q12) is fed through an emitter follower circuit (Q13) which drives a feedback type emitter follower circuit (Q14 and Q15). The output is approximately 4 V peak-to-peak with the differential gain circuit adjusted for normal operation. This output voltage is then applied to the Video Amplifier and Output Module. A voltage divider consisting of R65 and R66 in the output circuit of Q15 can be used for remote monitoring or for driving a 75 ohm line.

NOTE: The SYNC GAIN control is motor operated for use in remote control operation.

Test points (VIDEO 1, VIDEO 2, VIDEO +, VIDEO -, DIFF OUT, VIDEO OUT, and GND for MI-560456 – or VIDEO IN, GND, and VIDEO OUT for MI-560456-A) are provided on the front panel for monitoring the DC and/or AC potentials of the various stages within the module.

Video Amplifier and Output Module MI-560457 – Prefix 15 (used with Grid Modulation)

The Video Amplifier and Output Module MI-560457 (see Figures 5-15 thru 5-17) is an all solid state unit utilizing NPN and PNP type transistors. Functionally, the module amplifies the 4 V peak-to-peak video input signal supplied by the Video Processing Module MI-560456/Video Processor Module MI-560456-A to a value of approximately 30 to 50 volts peak-to-peak (depending on power level of the transmitter) for application to the Visual IPA input sub-assembly. The circuits in the module consist of a feedback amplifier (Q1 and Q2), a complementary symmetry amplifier (Q3 and Q4), an inverter amplifier (Q5 and Q6), an impedance matching circuit (Q7 and Q8), an error generator (Q9 and Q10), and a pulse amplifier (Q11).

The 4 V peak-to-peak video input signal from the Video Processing/Processor Module is applied through the VIDEO GAIN potentiometer (R1) to the first amplifier stage consisting of Q1 and Q2. Potentiometer R1 is adjusted such that the output voltage fully modulates the Visual IPA. This voltage may vary from 30 V to 50 V peak-to-peak and is dependent on the power of the transmitter and the age of the visual RF output tubes. The first amplifier is a feedback pair (Q1 and Q2) whose gain is dependent on feedback resistors R4 and R12 thru R15 and the series input resistance consisting of resistors R1 and R2.

When CLAMP switch S1, located on the front panel is in the OFF position, the DC output voltage of the feedback pair amplifier (Q1 and Q2) is determined by the motor-operated PEDESTAL potentiometer (R101). The PEDESTAL potentiometer is connected as a bias control at the input to the feedback pair. The output from the feedback pair is fed to a complementary symmetry emitter follower consisting of Q3 and Q4. These transistors are mounted in a heat sink with temperature compensation diodes CR1 and CR2. Also mounted in the heat sink are two protection diodes CR3 and CR4. Variable capacitor C3 is a frequency response adjustment.

NOTE: The PEDESTAL control is motor driven for use in remote control operation.

The output from Q3 and Q4 is first applied to a voltage divider network consisting of R21 thru R23. Resistor R21, connected between the output of Q3 and Q4 and the -110 V bus line, maintains the current balance between the transistors. The output is also applied through a series peaking coil L1 and resistors R24, R25 and R27 to the input of the Visual Modulated Amplifier. Resistor R107 adjusts the circuit Q of L1 and the input capacitance of the Visual Modulated Amplifier to enable a flat frequency response from the output of the complementary symmetry amplifier. The adjustment of R107 is performed during system adjustment and is dependent upon the input capacitance of the Visual Modulated Amplifier.

The output from the series peaking coil is also applied through a divider network to an inverter amplifier circuit (Q5 and Q6). The amplifier is a feedback pair configuration whose output is used for remote monitoring and whose gain is adjusted by the MON GAIN control (R108) such that a 1.0 V peak-to-peak video signal is presented at the output. Variable capacitor C16 adjusts the frequency response of the inverter amplifier (Q5 and Q6).

When CLAMP switch S1 is set to the ON position and CLAMP switch S2 is set to INT position, the feedback clamp circuit of the module samples video from the voltage divider network consisting of R22 and R23. When S2 is set to the EXT position, the feedback clamp circuit of the module samples video from the video detector circuit. This detector circuit can either be located in the Visual Power Amplifier or on the Visual PA RF output line. The motor-operated PEDESTAL potentiometer (R101) varies the DC level of the sampled video signal. This output is then applied to the base circuit of the error generator (Q10). The trap network (C7and L2), located in the base circuit of Q10, removes the 3.58 MHz color burst information from the sampled video signal to prevent abnormal operation of the error generator (Q10). The negative (-) clamp pulse generated by the Video Input Module MI-560455 is applied to the base of Q11. This pulse causes the collector of Q11 to saturate during the back porch time of the video signal. The output from Q11 is then applied to the emitter of the error generator (Q10).

The output from the error generator is a pulse whose amplitude varies with pedestal level and is applied through emitter follower Q9 to a peak-to-peak detector consisting of CR5 and CR6. The output from the detector is a DC level that varies with pedestal level and is applied through impedance matching emitter followers Q7 and Q8 to a network consisting of resistors R42 and R43 and capacitor C8. Capacitor C8 charges and discharges at a sync repetition rate to remove the sawtooth variations (line-to-line) from the output of the peak-to-peak detector CR5 and CR6. The output is then fed through CLAMP switch S1 to the base of the first amplifier stage (Q1). DC restoration occurs at the base of Q1 by the addition of the DC output from Q7 and video input signal from the Video Processing/Processor Module. If the CLAMP switch S1 is in the ON position and CLAMP switch S2 is set to the EXT position and when voltage is first applied to the transmitter circuits, a time-delay relay located in the control circuits will apply +10 VDC to the feedback clamp circuit during the control turn-on sequence. This signal simulates the detected video signal from the Visual Power Amplifier stage which will set the bias on the Visual IPA to approximately -90 V. When the contacts of the time-delay relay open, the bias voltage will increase in a positive direction until the required output power from the transmitter is obtained. This power is determined by the amount of detected video signal fed to the error generator (Q9 and Q10) from the Feedback Clamp circuit.

The Clamp Limit/Power Control circuit board (A2) located at the rear of the Video Amplifier and Output Module serves two functions. First, a resistor network biases the diode(s) into conduction feeding a voltage to the base of Q8 keeping Q8 biased ON in the event that video input is lost; which keeps the Visual Power Amplifier on-the-air. When video input is present, the clamp pulses are applied to a detector circuit which in turn, allows the clamp circuit to operate normally. Second, a clipper circuit is provided that will limit the input voltage to Q8 which in turn, will limit the maximum output voltage of the video amplifier preventing an overload condition from occurring in the transmitter.

Test points (VIDEO OUT, MON OUT, DET VIDEO, CLAMP REF, ERROR GEN, CLAMP OUT and GND) are provided on the front panel for monitoring the various signal voltages during operation and repair. The only internal adjustments required during system adjustment are of capacitors C3 and C16. These adjustments are made with the module on the Module Extender MI-560541-B.

Video Amplifier and Output Module MI-560860 – Prefix 15 (Used with Diode Modulation)

The Video Amplifier and Output Module MI-560860 (see Figures 5-18 thru 5-20) is an all solid state unit utilizing NPN and PNP type transistors. Functionally, the module amplifies the 4 V peak-to-peak video input signal supplied by the Video Processing Module MI-560456/Video Processor Module MI-560456-A to a value of approximately 30 to 50 volts peak-to-peak (depending on transmitter power level) for application to the Diode Modulator. The circuits in the module consist of a feedback amplifier (Q1 and Q2), a complementary symmetry amplifier (Q3 and Q4), an inverter amplifier (Q5 and Q6), an impedance matching circuit (Q7 and Q8), an error generator (Q9 and Q10), and a pulse amplifier (Q11).

The 4 V peak-to-peak video input signal from the Video Processing Module MI-560456/Video Processor Module MI-560456-A is applied through the VIDEO GAIN potentiometer (R1) to the first amplifier stage consisting of Q1 and Q2. Potentiometer R1 is adjusted such that the output voltage fully modulates the Diode Modulator. This voltage may vary from 30V to 50V peak-to-peak and is dependent on the power of the transmitter, and the age of the visual RF output tubes. The first amplifier is a feedback pair whose gain is dependent on the feedback resistors R4 and R12 thru R15 and the series input resistance consisting of resistors R1 and R2.

When CLAMP switch S1, located on the front panel is in the OFF position, the DC output voltage of the feedback pair amplifier (Q1 and Q2) is determined by the motor-operated PEDESTAL potentiometer (R101). The PEDESTAL potentiometer is connected as a bias control at the input to the feedback pair. The output from the feedback pair is fed to a complementary symmetry emitter follower consisting of Q3 and Q4. These transistors are mounted in a heat sink with temperature compensation diodes CR1 and CR2. Also mounted in the heat sink are two protection diodes CR3 and CR4. Variable capacitor C3 is a frequency response adjustment.

NOTE: The PEDESTAL control is motor driven for remote control operation.

The output from Q3 and Q4 is first applied to a voltage divider network consisting of R21 thru R23. Resistor R21, connected between the output of Q3 and Q4 and the -110 V bus line, maintains the current balance between the transistors. The output is also applied through a series peaking circuit consisting of the coaxial cable center lead inductance (cable between Video Modulator and Diode Modulator) and resistors R25 and R27 to the input of the Diode Modulator. Resistor R107 adjusts the circuit Q and the input capacitance of the Diode Modulator to ensure a flat frequency response from the output of the complementary symmetry amplifier to the input of the Diode Modulator. The adjustment of R107 is performed during system adjustment and is dependent upon the input capacitance of the Diode Modulator.

The output from the series Video Amplifier is also applied through a divider network whose output is used for remote monitoring and whose gain is adjusted by the MON GAIN control (R108) such that a 1.0 V peak-to-peak signal is presented at the output. Variable capacitor C16 adjusts the frequency response of the inverter amplifier (Q5 and Q6).

When CLAMP switch S1 is set to the ON position and CLAMP switch S2 is set INT position, the feedback clamp circuit of the module samples video from the voltage divider network consisting of R22 and R23. When S2 is set to the EXT position, the feedback clamp circuit of the module samples video from the video detector circuit. This detector circuit can either be located in the Visual Power Amplifier or on the Visual PA RF output line. The motor-operated PEDESTAL potentiometer (R101) varies the DC level of the sampled video signal. This output is then applied to the base circuit of the error generator (Q10). The trap network (C7 and L2), located in the base circuit of Q10, removes the 3.58 MHz color burst information from the sampled video signal to prevent abnormal operation of the error generator (Q10). The negative (-) clamp pulse generated by the Video Input Module MI-560455 is applied to the base of Q11. This pulse causes the collector of Q11 to saturate during the back porch time of the video signal. The output from Q11 is then applied to the emitter of the error generator (Q10).

The output of the error generator is a pulse whose amplitude varies with pedestal level and is applied through emitter follower Q9 to a peak-to-peak detector consisting of CR5 and CR6. The output from the detector is a DC level that varies with pedestal level and is applied through impedance matching emitter followers Q7 and Q8 to a network consisting of resistors R42 and R43 and capacitor C8. Capacitor C8 charges and discharges at a sync repetition rate to remove the sawtooth variations (line-to-line) from the output of the peak-to-peak detector CR5 and CR6. The output is then fed through a CLAMP switch S1 to the base of the first amplifier stage (Q1). DC restoration occurs at the base of Q1 by the addition of the DC output from Q7 and the video input signal from the Video Processing/Processor Module. If the CLAMP switch S1 is in the ON position and CLAMP switch S2 is set to the EXT position and when voltage is first applied to the transmitter circuits, a time-delay relay located in the control circuits will apply +10 VDC to the feedback clamp circuit during the control turn-on sequence. This signal simulates the detected video signal from the Visual Power Amplifier stage which will set the bias on the Visual IPA to approximately -90 V. When the contacts of the time-delay relay open, the bias voltage will increase in a positive direction until the required output power from the transmitter is obtained. This power is determined by the amount of detected video signal fed to the error generator (Q9 and Q10) from the Feedback Clamp circuit.

The Clamp Limit/Power Control circuit board (A2) located at the rear of the Video Amplifier and Output Module serves two functions. First, a resistor network biases the diode(s) into conduction feeding a voltage to the base of Q8 keeping Q8 biased ON in the event that video input is lost, which keeps the Visual Power Amplifier on-the-air. When video input is present, the clamp pulses are applied to a detector circuit which in turn, allows the clamp circuit to operate normally. Second, a clipper circuit is provided that will limit the input voltage to Q8 which in turn, will limit the maximum output voltage of the video amplifier preventing an overload condition from occurring in the transmitter.

Test points (VIDEO OUT, MON OUT, DET VIDEO, CLAMP REF, ERROR GEN, CLAMP OUT, and GND) are provided on the front panel for monitoring the various signal voltages during operation and repair. The only internal adjustments required during system adjustment are of capacitors C3 and C16. These adjustments are made with the module in the extended position.

Automatic Sync Level (ASL) Control Module MI-561330

The Automatic Sync Level (ASL) Control Module (see Figures 5-21 thru 5-23) is an optional item available for all RCA FL line transmitters. The ASL module serves to maintain a constant peak sync power through the action of the sync gain circuit in the Video Processor Module MI-560456-A, and in conjunction with the External Feedback Clamp circuit which maintains pedestal level. The result is a very stable transmitter output.

Circuit operation is such that when a detected video signal with sync positive is fed to the emitter follower pair Q3 and Q4, the emitter follower stage furnishes a video signal of approximately 2.5V peak-of-sync which is fed via R31 to the Feedback Clamp circuit and also via R1 to the ASL circuitry.

When the ASL switch (S1) is in the OFF position, the SYNC GAIN potentiometer (R121) is connected back to the sync gain correction circuit in the Video Processor Module MI-560456-A. When the ASL switch

(S1) is in the ON position, the output from the motor-operated SYNC GAIN potentiometer (R121) in the Video Processor Module is now applied through the ASL switch (S1) to the automatic sync level circuit in the ASL Module for automatic control of sync gain (peak power).

With the ASL switch (S1) ON, the base potential of Q1 will be between -10 and -16 volts (supplied by the SYNC GAIN potentiometer in the Processor Module) causing Q1 to act as a current source.

The detected video input signal which is applied to the ASL circuit from the Video Detector located on the Visual PA, is first applied through emitter followers Q3, Q4 and Q2 to a peak detector consisting of CR1. SYNC CAL potentiometer is an adjustment which ensures that the sync level at the transmitter output remains essentially constant whenever the ASL switch (S1) is switched from the ON to OFF position.

The output from the peak detector (CR1) is a DC signal with a value that corresponds to the peak of sync (power at the transmitter output). Therefore, a variation in the peak power causes this DC level to vary at capacitor C2. The output from the peak detector (CR1) is then applied to a pair of series coupled amplifiers (U1 and U2). U1 is a non-inverting amplifier whose output response is shaped by capacitors C3 and C4 and whose gain is fixed by resistors R12 and R13. Amplifier U2 is an inverting type of amplifier whose output response is shaped by capacitor C5 and whose gain is fixed by resistors R14 and R17. The series amplifiers have a cut-off frequency (3 dB point) of approximately 2 Hz. The total amount of amplification from the total sync gain (loop) circuit is approximately 50 dB.

Since the voltage applied to the sync gain circuit in the Video Processor Module MI-560456-A is -10 volts, a voltage divider network consisting of resistors R19 and R20 at the output of amplifier U2 enables the junction of the voltage divider to be at approximately -10 volts. This voltage is then supplied to the sync gain circuit in the Video Processor Module MI-560456-A.

Two test points, located on the front panel, are provided to check the operation of the circuit. DET VID test point (J1) checks the detected video input signal after it has been offset by SYNC CAL potentiometer (R30). ERROR DET test point (J2) checks the output level at amplifier U2 which is a slowly varying DC level (varying with peak power changes) of approximately 0 volts.

Video Modulator Power Supply Module MI-560458-B/MI-560458-C – Prefix 12

The Modulator Power Supply (see Figures 5-24 thru 5-27) provides all operating voltages used in the modulator. These voltages include +10V, -10V, -24V and -110V, and are adjustable ±5% from the front panel. The input voltage is 117V, 50/60 Hz.

The power supply includes short circuit protection in which the circuit breaker will turn off all supplies in the event of a short within the supply itself.

The circuit utilizes a series type regulator with built-in current limiting and over-voltage protection circuits. Briefly explained, emitter-coupled differential amplifiers are used as a comparison element. The purpose of the comparison element is to sample the output voltage, compare it with a reference voltage, and generate an error signal proportional to the output variation. The reference voltage source is a temperature compensated zener diode. Next, a DC amplifier is used to amplify the error signal. This amplified signal, in turn, is fed to a series control transistor which returns the output voltage to its correct value. In the case of an over-voltage condition, over-voltage protection circuits will limit the maximum voltage output to a level determined by potentiometers R71, R80, R81 and R84. If the output voltage rises above the maximum voltage setting, two SCR's will "fire" shorting the outputs of the supplies bringing the output voltage to zero. The power supply will recover when the over-voltage fault is removed. An over-current protection circuit in each supply will automatically fold-back the output current if the current exceeds a value determined by potentiometers R4, R10, R25 and R50. The power supply will automatically recover when the over-current fault is removed.

Refer to Table 5-1 for the adjustments of MI-560458-B or Table 5-2 for the adjustments of MI-560458-C.

TABLE 5-1. POWER SUPPLY ADJUSTMENTS MI-560458-B

Voltage	Current Limiting	Voltage Adj.	Over-voltage Adj.	Current Limit Adj.
+10V	0.40A	R21*	R71	R4
-10V	0.22A	R41*	R80	R10
-24V	0.22A	R45*	R81	R25
-110V	0.20A	R63*	R84	R50
*Front panel adjustments				

TABLE 5-2. POWER SUPPLY ADJUSTMENTS MI-560458-C

Voltage	Current Limiting	Voltage Adj.	Over-voltage Adj.	Current Limit Adj.
+10V	0.70A	R21*	R71	R4
-10V	0.50A	R41*	R80	R10
-24V	0.45A	R45*	R81	R25
-110V	0.20A	R63*	R84	R50
*Front panel adjustments				

Output voltages remain essentially constant over a temperature range of -20°C to +60°C.

Module Extender MI-560541-B

The Module Extender MI-560541-B (see Figure 5-5) is available to permit servicing the modules of the video modulator under operating conditions. The unit to be serviced is removed from the module frame assembly and inserted into the extender which then plugs into the module frame assembly. All components are then conveniently accessible for measurements.

TUNING

GENERAL

Normally, the modules in the Video Modulator are factory tuned and adjusted and should not require any additional adjustment or retuning unless indicated during system test or if a defective component is replaced. To aid in adjusting and tuning, two tuning tools have been provided and are attached to the inside wall of the Multimeter Module in the 5W Exciter frame assembly.

PRELIMINARY

The adjustment and tuning procedures are performed with the Video Modulator installed in the system with all CLAMP, DIFF PHASE, and DIFF GAIN switches in their OFF positions, and the CLAMP INT-EXT switch S2 in the INT (internal) position.

Operate the circuit breaker (CB1) on the Modulator Power Supply to OFF; then operate the AC MAIN LINE circuit breaker (S1) and the DISTRIBUTION switch (S2) located on the Power Supply Cabinet MI-560578-A to their ON positions. Set the CONTROL BREAKER, 115V BUS and the EXCITER switches located on the Control Cabinet to their ON positions. Set EXC TEST pushbutton to TEST position, set the HIGH VOLTAGE DISABLE rocker switch to the DISABLE position and then depress in the following order the TRANSMITTER ON/AIR ON, T.D. BYPASS and PLATE ON indicator pushbuttons.

VIDEO MODULATOR POWER SUPPLY MODULE MI-560458-B/MI-560458-C

1. Remove the Video Input Module MI-560455, Video Processing Module MI-560456/Video Processor Module MI-560456-A, and Video Amplifier and Output Module MI-560457/MI-560860 from the module frame assembly. (Also remove ASL Module MI-561330 if part of system).

2. Turn on the Power Supply. Using a VTVM, check for the correct supply voltages (+10V, -10V, -24V, and -110V) at the front of the module. If necessary, adjust the supply voltages from the front panel VOLTAGE ADJUST potentiometers.

3. Turn off Modulator Power Supply and remove the VTVM from the front of the power supply; then insert all modules into the module frame assembly.

VIDEO INPUT MODULE MI-560455

1. Insert Video Input Module into Module Extender which then plugs into module frame assembly.

2. Disconnect P25 at the rear of the amplifier cabinet; then connect the output of a BW-5C Sideband Response Analyzer to J25.

3. Disconnect P26 at the rear of the amplifier cabinet; then connect from J26 a short length of cable through a UHF tee terminated with a 75 ohm load to input #1 of a dual trace oscilloscope.

4. With an oscilloscope probe attached to input #2 of a dual trace oscilloscope, connect the probe to the emitter of Q3.

5. Turn on the Modulator Power Supply and apply a sweep signal of 1.0 V peak-to-peak from the BW-5C as measured on the oscilloscope — trace #1.

6. Adjust variable capacitor C3 on the Video

Input Module MI-560455 for a flat response (±0.25dB from 200 kHz to 6 MHz) as measured on the oscilloscope — trace #2.

7. Turn off Modulator Power Supply, remove scope probe, and insert module into module frame assembly.

NOTE: When measuring common mode rejection, the Video Input Module should *not* be on the Module Extender.

VIDEO PROCESSING MODULE MI-560456
VIDEO PROCESSOR MODULE MI-560456-A

1. Insert Video Processing/Processor Module into Module Extender which then plugs into module frame assembly.

2. Connect oscilloscope probe to the emitter of Q14.

3. Adjust variable capacitor C34 for a flat response (±0.25dB from 200 kHz to 6 MHz) as measured on the oscilloscope — trace #2.

NOTE: Because of the effect the module extender may have on the Video Input Module circuit, adjustment 13C3 may need to be "touched up" after it has been installed in the module frame assembly to produce a flat response from the output of the Processing/Processor Module.

4. Turn off Modulator Power Supply, remove scope probe, and insert module into module frame assembly.

VIDEO AMPLIFIER AND OUTPUT MODULE MI-50457/MI-560860

1. Insert Video Amplifier and Output Module into Module Extender which then plugs into module frame assembly.

2. Connect a 10 to 1 Low Capacitance Probe to input #2 of a dual trace oscilloscope. Connect the probe to output terminal E16.

3. Ensure that the CLAMP switch S1 is in the OFF position and CLAMP switch S2 is in the INT position; then turn on the Modulator Power Supply. With no video input, adjust the PEDESTAL LEVEL for an approximate -50V as measured on the oscilloscope — trace #2.

4. Apply a 1.0V P-P sweep signal from the BW-5C to the video input connector as measured on the oscilloscope — trace #1. Adjust the VIDEO GAIN control of the Video Amplifier and Output Module for a 10 V peak-to-peak signal as measured on the oscilloscope — trace #2.

5. Adjust variable capacitor C3 for a flat response (±0.25dB from 200 kHz to 6 MHz).

6. Disconnect the probe from terminal E16 and connect it to the emitter of Q6.

7. Adjust MON GAIN control (R108) for approximately 0.25 V peak-to-peak; then adjust C16 for a flat sweep response (+0.25dB to -0.55dB from 200 kHz to 6 MHz) as measured on the oscilloscope — trace #2.

NOTE: If the Video Amplifier and Output Module has a Clamp Limit/Power Control board (A2) (mounted at the rear of the module) with adjustable potentiometers R2 and R5, perform steps 8 through 16 during FINAL TRANSMITTER SET-UP. If there is no A2 board or there are no adjustable potentiometers on the board, proceed to step 16.

8. Depress PLATE OFF pushbutton and insert the Video Amplifier and Output Module on the Extender Module which then plugs into frame assembly.

NOTE: Omit step 9 for Video Amplifier and Output Module MI-560860.

9. Attach a clip lead from video output terminal E16 to the Visual IPA input sub-assembly.

10. Set both the VIDEO REST LEVEL potentiometer (R2) and the CLAMP LIMIT potentiometer (R5) to a fully counterclockwise position.

11. Remove video input to the transmitter by disconnecting the video input cable from the proper jack at the rear of the Visual Amplifier Cabinet.

12. Set HIGH VOLTAGE DISABLE rocker switch to its NORMAL position; then depress PLATE ON pushbutton.

13. Adjust the VIDEO REST LEVEL control (R2) for a power output of approximately 25 percent.

14. Reconnect the video input cable and apply a video stairstep test signal. With a VTVM, measure and record the video DC level present at the VIDEO OUT test point (J1) on the front of the module.

15. Short the DET VIDEO test point (J3) to ground and adjust the CLAMP LIMIT control (R5) so that the video DC level is 4 volts more positive than what was measured in step 14.

16. Depress PLATE OFF pushbutton, turn OFF

the Modulator Power Supply and insert the module into module frame assembly. Reconnect all cables to their correct plug connections and remove all test equipment.

AUTOMATIC SYNC LEVEL (ASL) MODULE MI-561330

1. Set-up the transmitter for full power and full depth of modulation with the ASL switch (S1) set to OFF and the Feedback Clamp switch (S2) on the Video Output Module set to INT position. Depth of modulation and sync amplitude are set using the controls on the Video Processor Module MI-560456-A.

2. Set CLAMP potentiometer (R31) fully counterclockwise and SYNC CAL potentiometer (R30) to mid-position.

3. Modulate the transmitter with 1.0V P-P stair-step test signal. Monitor the detected video at J1 with an oscilloscope. No color subcarrier will be evident due to the limited bandwidth of the video detector.

4. Adjust the signal at the DET VID test point (J1) for approximately 2 V P-P, as measured on the oscilloscope, using the adjustment provided on the video detector head which is adjacent to the video output connector.

5. Switch the FEEDBACK CLAMP switch S2 on the Video Output Module to EXT position. Adjust CLAMP potentiometer (R31) on ASL module to restore normal transmitter power output.

> NOTE: If the transmitter power cannot be adjusted high enough, decrease detector output. If the transmitter power cannot be adjusted low enough, increase detector output.

6. Operate S1 on ASL module to the ON position. Adjust SYNC CAL potentiometer (R30) on ASL module to restore sync to 40 IRE units at the transmitter output.

REPLACEMENT PARTS LIST

GENERAL

The components listed in the replacement parts list are identified by one of the two methods depending on whether the component is a mechanical or electrical part. Electrical parts are assigned a standard electrical symbol and are listed in alphanumerical sequence. Mechanical parts are assigned a numerical symbol (8, 17, 25, etc.) that corresponds to the item number on the mechanical assembly drawing where that particular part is located.

REPLACEMENT PARTS LIST

Symbol	Stock No.	Drawing No.	Description
PREFIX 10			
			MODULE FRAME ASSEMBLY MI-560459/MI-560859 M/L 3459995 503/505 REV 26
Electrical			
CR1	420923	3722719-001	DIODE, FD 600
CR2	420923	3722719-001	DIODE, FD 600
J1 TO J4	229215	8490041-001	CONNECTOR - 22 DUAL AMP. LEAF
J5 TO J9	223652	8532127-001	CONNECTOR - UHF
J10	247838	3720240-002	CONNECTOR - PLUG, 15 CONTACT
J12	420033	3721894-006	CONNECTOR - 7 PIN FEMALE HOUSING (MI-560859 ONLY)
J13	229215	8490041-001	CONNECTOR - 22 DUAL AMP. LEAF (ASL ONLY)
P5 TO P9	93483	1510021-102	PLUG - COAXIAL, UHF
P10	428029	3720240-012	CONNECTOR - RECEPTACLE, 15 CONTACT
R1	502127	82283-145	RESISTOR 270 OHMS 1/2W 5%
Mechanical			
18	231762	8540935-001	KEY
15	420034	3721894-009	PIN - GUIDE PIN (MI-560859 ONLY)
16	420035	3721894-010	SOCKET - GUIDE (MI-560859 ONLY)
11	237823	896536-120	SCREW - SHOULDER
10	237824	1510029-132	SPRING - COMPRESSION
36	232819	8540937-016	SPRING - PRESSURE
9	231766	8540937-013	TERMINAL CONTACT
PREFIX 13			
			VIDEO INPUT MODULE MI-560455 M/L3456902-501 REV. 6
Electrical			
			CAPACITORS
C1	235779	3462014-129	FILM, 0.1 MF 10% 200 V
C2	245975	3410170-409	ELECTROLYTIC, 15 MF 25 V
C3	418020	3456576-002	VARIABLE CERAMIC, 2.5-11 PF
C4	230232	3410170-316	ELECTROLYTIC, 150 MF 15 V
C5	230232	3410170-316	ELECTROLYTIC, 150 MF 15 V
C6	230232	3410170-316	ELECTROLYTIC, 150 MF 15 V
C7	234721	993025-419	MICA, 18 PF 5% 100 V
C8	428026	3462014-117	FILM, .01 MF 10% 200 V
C9	232935	3462014-132	FILM, 0.22 MF 10% 200 V
C10	241534	3462014-126	FILM, .056 MF 10% 200 V
C11	235779	3462014-129	FILM, 0.1 MF 10% 200 V
C12	426228	993025-447	MICA, 270 PF 5% 100 V
C13	225618	993025-454	MICA, 510 PF 5% 100 V
C14	230232	3410170-316	ELECTROLYTIC, 150 MF 15 V
C15	230232	3410170-316	ELECTROLYTIC, 150 MF 15 V
C16	225615	993025-441	MICA, 150 PF 5% 100 V
C17	426866	993025-459	MICA, 820 PF 5% 100 V
C18	138916	993025-443	MICA, 180PF 5% 100W
CR1	236715	3454179-001	DIODE
CR2	236715	3454179-001	DIODE
CR3	236715	3454179-001	DIODE
L1	230341	3456216-002	COIL - 22 UH 20%

Symbol	Stock No.	Drawing No.	Description
L2		3720910-002	BEAD, SHIELDING
Q1	241710	3730409-001	TRANSISTOR
Q2	241012	3730591-001	TRANSISTOR
Q3	231670	3730811-001	TRANSISTOR
Q4	231670	3730811-001	TRANSISTOR
Q5	236268	3730595-001	TRANSISTOR
Q6	236268	3730595-001	TRANSISTOR
Q7	241012	3730591-001	TRANSISTOR
Q8	231670	3730811-001	TRANSISTOR
Q9	246443	3730597-001	TRANSISTOR
Q10	241012	3730591-001	TRANSISTOR - TYPE 2N4037
Q11	231670	3730811-001	TRANSISTOR
Q12	236268	3730595-001	TRANSISTOR
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1	512018	90496-117	18 OHMS 5% 1 W
R2	502410	82283-207	100,000 OHMS 5% 1/2 W
R3	502510	82283-231	1 MEGOHM 5% 1/2 W
R4	502282	82283-181	8200 OHMS 5% 1/2 W
R5	502027	82283-121	27 OHMS 5% 1/2 W
R6	502327	82283-193	27,000 OHMS 5% 1/2 W
R7	502212	82283-161	1200 OHMS 5% 1/2 W
R8	502256	82283-173	5600 OHMS 5% 102 W
R9	502168	82283-155	680 OHMS 5% 1/2 W
R10	502112	82283-137	120 OHMS 5% 1/2 W
R11	502115	82283-139	150 OHMS 5% 1/2 W
R12	502310	82283-183	10,000 OHMS 5% 1/2 W
R13	502127	82283-145	270 OHMS 5% 1/2 W
R14	502327	82283-193	27,000 OHMS 5% 1/2 W
R15	502247	82283-175	4700 OHMS 5% 1/2 W
R16	502310	82283-183	10,000 OHMS 5% 1/2 W
R17	502182	82283-157	820 OHMS 5% 1/2 W
R18	502112	82283-137	120 OHMS 5% 1/2 W
R19	502222	82283-167	2200 OHMS 5% 1/2 W
R20	502222	82283-167	2200 OHMS 5% 1/2 W
R21	502315	82283-187	15,000 OHMS 5% 1/2 W
R22	502339	82283-197	39,000 OHMS 5% 1/2 W
R23	502310	82283-183	10,000 OHMS 5% 1/2 W
R24	502382	82283-205	82,000 OHMS 5% 1/2 W
R25	502310	82283-183	10,000 OHMS 5% 1/2 W
R26	237389	990476-273	FILM, 562 OHMS 1% 1/2 W
R27	236060	990476-289	FILM, 825 OHMS 1% 1/2 W
R28	236089	990476-409	FILM, 12,000 OHMS 1% 1/2 W
R29	236062	990476-301	FILM, 1000 OHMS 1% 1/2 W
R30	502156	82283-153	560 OHMS 5% 1/2 W
R31	502227	82283-169	2700 OHMS 5% 1/2 W
R32	502347	82283-199	47,000 OHMS 5% 1/2 W
R33	502210	82283-159	1000 OHMS 5% 1/2 W
R34	502247	82283-175	4700 OHMS 5% 1/2 W
R35	502315	82283-187	15,000 OHMS 5% 1/2 W
R36	502210	82283-159	1000 OHMS 5% 1/2 W
R37	502168	82283-155	680 OHMS 5% 1/2 W
R38	502227	82280-169	2700 OHMS 5% 1/2 W
R39	502182	82280-157	820 OHMS 5% 1/2 W
R40	502156	82280-153	560 OHMS 5% 1/2 W
R41	502210	82280-159	1000 OHMS 5% 1/2 W
R42	502112	82280-137	120 OHMS 5% 1/2 W
R43	502010	82280-111	10 OHMS 5% 1/2 W
			VIDEO INPUT MODULE ASSEMBLY
Elec/Mech			ML/3459876-501 REV 1
A1		3456902-501	PRINTED CIRCUIT BOARD
J1 TO J8	214603	8941099-004	CONNECTOR - FEMALE
10	418782	3730663-501	CONTACT - BRACKET ASSEMBLY

Symbol	Stock No.	Drawing No.	Description
PREFIX 14			
Electrical			**VIDEO PROCESSING MODULE MI-560456** M/L 3456991-501 REV 14
			CAPACITORS
14C1	246449	3410170-321	ELECTROLYTIC, 260 MF 15 V
14C2	245975	3410170-409	ELECTROLYTIC, 15 MF 25 V
14C3	426711	993025-437	MICA, 100 PF 5% 100 V
14C4	235779	3462014-129	FILM, 0.1 MF 200 V
14C5	246446	8524008-259	TANTALUM, 1.5 MF 20 V
14C6	237357	3410170-301	ELECTROLYTIC, 1MF 15V
14C7	234721	993025-419	MICA, 18 PF 5% 100 V
14C8	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
14C9 TO 14C12	213939	757607-011	MICA, 7 PF 500 V
14C13	230223	3410170-308	ELECTROLYTIC, 10 MF 15 V
14C14	246450	3456887-003	ELECTROLYTIC, 100 MF 20 V
14C15	245975	3410170-409	ELECTROLYTIC, 15 MF 25 V
14C16	420922	3456887-004	ELECTROLYTIC 150UF 20 V
14C17	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
14C18	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
14C19	230232	3410170-316	ELECTROLYTIC, 150 MF 15 V
14C20	230232	3410170-316	ELECTROLYTIC, 150 MF 15 V
14C21	236833	3410170-509	ELECTROLYTIC, 15 MF 50 V
14C22	236833	3410170-509	ELECTROLYTIC, 15 MF 50 V
14C23	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
14C24	230223	3410170-308	ELECTROLYTIC, 10 MF 15 V
14C25	230223	3410170-308	ELECTROLYTIC, 10 MF 15 V
14C26	219436	757607-007	MICA, 5 PF 500 V
14C27	215197	993025-433	MICA, 68 PF 100 V
14C28	427634	993025-430	MICA, 51 PF 100 V
14C29	219668	993025-413	MICA, 10 PF 500 V
14C30	217378	993025-417	MICA, 15 PF 100 V
14C31	218098	993025-423	MICA, 27 PF 100 V
14C32	219744	993025-431	MICA, 56 PF 100 V
14C33	426229	993025-437	MICA, 100 PF 100 V
14C34	430202	3722743-003	TRIMMER, 2.5 - 9 PF
14CR1	225315	3458301-001	DIODE
14CR2	225315	3458301-001	DIODE
14CR3	246447	3720045-001	DIODE
14CR4 TO 14CR14	420923	3722719-001	DIODE FD600
14CR15	234522	3455563-003	DIODE
14Q1	232678	3463780-002	TRANSISTOR
14Q2	232678	3463780-002	TRANSISTOR
14Q3	236268	3730595-001	TRANSISTOR
14Q4	236268	3730595-001	TRANSISTOR
14Q5	231670	3730811-001	TRANSISTOR
14Q6	241012	3730591-001	TRANSISTOR
14Q7	232678	3463780-002	TRANSISTOR
14Q8	232678	3463780-002	TRANSISTOR
14Q9	232678	3463780-002	TRANSISTOR
14Q10	241012	3730591-001	TRANSISTOR
14Q11	232678	3463780-002	TRANSISTOR
14Q12	232678	3463780-002	TRANSISTOR
14Q13	232678	3463780-002	TRANSISTOR
14Q14	232678	3463780-002	TRANSISTOR
14Q15	232678	3463780-002	TRANSISTOR
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
14R1	502133	82283-147	330 OHMS 5% 1/2 W
14R2	502222	82283-167	2200 OHMS 5% 1/2 W
14R3	502227	82283-169	2700 OHMS 5% 1/2 W
14R4	502115	82283-139	150 OHMS 5% 1/2 W

Symbol	Stock No.	Drawing No.	Description
14R5	502215	82283-163	1500 OHMS 5% 1/2 W
14R6	502168	82283-155	680 OHMS 5% 1/2 W
14R7	502147	82283-151	470 OHMS 5% 1/2 W
14R8	502068	82283-131	68 OHMS 5% 1/2 W
14R9	502118	82283-141	180 OHMS 5% 1/2 W
14R10	502212	82283-161	1200 OHMS 5% 1/2 W
14R11	502110	82283-135	100 OHMS 5% 1/2 W
14R12	502147	82283-151	470 OHMS 5% 1/2 W
14R13	502022	82283-119	22 OHMS 5% 1/2W
14R14	502318	82283-189	18,000 OHMS 5% 1/2 W
14R15	502120	82283-142	200 OHMS 5% 1/2 W
14R16	502115	82283-139	150 OHMS 5% 1/2 W
14R17	502247	82283-175	4700 OHMS 5% 1/2 W
14R18	502115	82283-139	150 OHMS 5% 1/2 W
14R19	236062	990476-301	FILM, 1000 OHMS 1% 1/2 W
14R20	236933	990476-266	FILM, 475 OHMS 1% 1/2 W
14R21	502115	82283-139	150 OHMS 5% 1/2 W
14R22	502147	82283-151	470 OHMS 5% 1/2 W
14R23	502115	82283-139	150 OHMS 5% 1/2 W
14R24	236933	990476-266	FILM, 475 OHMS 1% 1/2 W
14R25	236062	990476-301	FILM, 1000 OHMS 1% 1/2 W
14R26	512139	90496-149	390 OHMS 5% 1 W
14R27	502147	82283-151	470 OHMS 5% 1/2 W
14R28	502210	82283-159	1000 OHMS 5% 1/2 W
14R29 TO 14R32	502215	82283-163	1500 OHMS 5% 1/2 W
14R33	502115	82283-139	150 OHMS 5% 1/2 W
14R34	502115	82283-139	150 OHMS 5% 1/2 W
14R35	502310	82283-183	10,000 OHMS 5% 1/2 W
14R36	502227	82283-169	2700 OHMS 5% 1/2 W
14R37	502115	82283-139	150 OHMS 5% 1/2 W
14R38	502122	82283-143	220 OHMS 5% 1/2 W
14R39	502210	82283-159	1000 OHMS 5% 1/2 W
14R40	502168	82283-155	680 OHMS 5% 1/2 W
14R41	502118	82283-141	180 OHMS 5% 1/2 W
14R42	502118	82283-141	180 OHMS 5% 1/2 W
14R43	502133	82283-147	330 OHMS 5% 1/2 W
14R44	502227	82283-169	2700 OHMS 5% 1/2 W
14R45	502215	82283-163	1500 OHMS 5% 1/2 W
14R46	502182	82283-157	820 OHMS 5% 1/2 W
14R47	502156	82283-153	560 OHMS 5% 1/2 W
14R48	502139	82283-149	390 OHMS 5% 1/2 W
14R49	502110	82283-135	100 OHMS 5% 1/2 W
14R50	502156	82283-153	560 OHMS 5% 1/2 W
14R51	502282	82283-181	8200 OHMS 5% 1/2 W
14R52	502282	82283-181	8200 OHMS 5% 1/2 W
14R53	502256	82283-177	5600 OHMS 5% 1/2 W
14R54	502247	82283-175	4700 OHMS 5% 1/2 W
14R55	502239	82283-173	3900 OHMS 5% 1/2 W
14R56	502115	82283-139	150 OHMS 5% 1/2 W
14R57	502227	82283-169	2700 OHMS 5% 1/2 W
14R58	502210	82283-159	1000 OHMS 5% 1/2 W
14R59	502227	82283-169	2700 OHMS 5% 1/2 W
14R60	502115	82283-139	150 OHMS 5% 1/2 W
14R61	502212	82283-161	1200 OHMS 5% 1/2 W
14R62	502110	82283-135	100 OHMS 5% 1/2 W
14R63	502068	82283-131	68 OHMS 5% 1/2 W
14R64	502156	82283-153	560 OHMS 5% 1/2 W
14R65	502118	82283-141	180 OHMS 5% 1/2 W
14R66	502115	82283-139	150 OHMS 5% 1/2 W
14R67 TO 14R70	502022	82283-119	22 OHMS 5% 1/2 W
14R71	502210	82283-159	1000 OHMS 5% 1/2 W
14R72	502010	82283-111	10 OHMS 5% 1/2 W
14R73	502110	82283-135	100 OHMS 5% 1/2 W
14R74	502110	82283-135	100 OHMS 5% 1/2 W
			VIDEO PROCESSING MODULE ASSEMBLY

Symbol	Stock No.	Drawing No.	Description
			M/L 3720001-501 REV 11
14A1		3456991-501	PRINTED CIRCUIT BOARD
14B1	246040	3459943-004	MOTOR - 1 RPM
	246042	3459943-101	SPRING
	246041	3459943-102	BRUSH
14B2	246040	3459943-004	MOTOR - 1 RPM
	246042	3459943-101	SPRING
	246041	3459943-102	BRUSH
14C101 TO 14C104	205656	1510003-037	CERAMIC, 0.01 MF 500 V
14J1 TO 14J7	214603	8941099-004	CONNECTOR - FEMALE
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
14R101	246448	3459994-001	POTENTIOMETER, 250 OHMS 2 W
14R102	502210	82283-159	1000 OHMS 5% 1/2 W
14R103	502215	82283-163	1500 OHMS 5% 1/2 W
14R104 TO 14R107	228997	8868256-044	POTENTIOMETER, 5000 OHMS 1/2 W
14R108	502233	82283-171	3300 OHMS 5% 1/2 W
14R109 TO 14R112	502247	82283-175	4700 OHMS 5% 1/2 W
14R113	228997	8868256-044	POTENTIOMETER, 5000 OHMS 1/2 W
14R114	502322	82283-191	22,000 OHMS 5% 1/2 W
14R115 TO 14R119	228997	8868256-044	POTENTIOMETER, 5000 OHMS 1/2 W
14R120	502156	82283-153	560 OHMS 5% 1/2W
14R121	246448	3459994-001	POTENTIOMETER, 250 OHMS 2 W
14R122	502147	82283-151	COMP, 470 OHMS 5% 1/2W
14S1	230657	8547312-009	SWITCH - TOGGLE
14S2	230662	8547312-004	SWITCH - TOGGLE
14S3	230662	8547312-004	SWITCH - TOGGLE
Mechanical			
14	418785	3730663-504	CONTACT - BRACKET ASSEMBLY
9	229940	1510924-105	KNOB
39	97821	486041-010	TERMINAL - STUD
24	418454	3450427-003	WASHER - SPRING
			VIDEO PROCESSOR MODULE MI-560456-A
Electrical			M/L 3456991-502, 503 REV 14
			CAPACITORS
C1	246449	3410170-321	ELECTROLYTIC, 260 MF 15 V
C2	245975	3410170-409	ELECTROLYTIC, 15 MF 25 V
C3	426711	993025-437	MICA, 100 PF 5% 100 V
C4	235779	3462014-129	FILM, 0.1 MF 200 V
C5	246446	8524008-259	TANTALUM, 1.5 MF 20 V
C6	237357	3410170-301	ELECTROLYTIC, 1MF 15V
C7	234721	993025-419	MICA, 18 PF 5% 100 V
C8	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
C9 TO C12	213939	757607-011	MICA, 7 PF 500 V
C13	230223	3410170-308	ELECTROLYTIC, 10 MF 15 V
C14	246450	3456887-003	ELECTROLYTIC, 100 MF 20 V
C15	245975	3410170-409	ELECTROLYTIC, 15 MF 25 V
C16	420922	3456887-004	ELECTROLYTIC 150UF 20 V
C17	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
C18	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V

Symbol	Stock No.	Drawing No.	Description
C19	230232	3410170-316	ELECTROLYTIC, 150 MF 15 V
C20	230232	3410170-316	ELECTROLYTIC, 150 MF 15 V
C21	236833	3410170-509	ELECTROLYTIC, 15 MF 50 V
C22	236833	3410170-509	ELECTROLYTIC, 15 MF 50 V
C23	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
C24	230223	3410170-308	ELECTROLYTIC, 10 MF 15 V
C25	230223	3410170-308	ELECTROLYTIC, 10 MF 15 V
C26	426230	993025-415	MICA, 12 PF 100 V
C27	215197	993025-433	MICA, 68 PF 100 V
C28	427634	993025-430	MICA, 51 PF 100 V
C29	219668	993025-413	MICA, 10 PF 500 V
C30	217378	993025-417	MICA, 15 PF 100 V
C31	218098	993025-423	MICA, 27 PF 100 V
C32	219744	993025-431	MICA, 56 PF 100 V
C33	426229	993025-437	MICA, 100 PF 100 V
C34	430202	3722743-003	TRIMMER, 2.5-9 PF
C38	426230	993025-415	MICA, 12 PF 100 V
CR1	225315	3458301-001	DIODE
CR2	225315	3458301-001	DIODE
CR3	246447	3720045-001	DIODE
CR8			
TO			
CR14	420923	3722719-001	DIODE FD600
CR15	234522	3455563-003	DIODE
Q1	232678	3463780-002	TRANSISTOR
Q2	232678	3463780-002	TRANSISTOR
Q3	236268	3730595-001	TRANSISTOR
Q4	236268	3730595-001	TRANSISTOR
Q5	231670	3730811-001	TRANSISTOR
Q6	241012	3730591-001	TRANSISTOR
Q7	232678	3463780-002	TRANSISTOR
Q8	232678	3463780-002	TRANSISTOR
Q9	232678	3463780-002	TRANSISTOR
Q10	241012	3730591-001	TRANSISTOR
Q11	232678	3463780-002	TRANSISTOR
Q12	232678	3463780-002	TRANSISTOR
Q13	232678	3463780-002	TRANSISTOR
Q14	232678	3463780-002	TRANSISTOR
Q15	232678	3463780-002	TRANSISTOR
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R1	502133	82283-147	330 OHMS 5% 1/2 W
R2	502222	82283-167	2200 OHMS 5% 1/2 W
R3	502227	82283-169	2700 OHMS 5% 1/2 W
R4	502115	82283-139	150 OHMS 5% 1/2 W
R5	502215	82283-163	1500 OHMS 5% 1/2 W
R6	502168	82283-155	680 OHMS 5% 1/2 W
R7	502147	82283-151	470 OHMS 5% 1/2 W
R8	502068	82283-131	68 OHMS 5% 1/2 W
R9	502118	82283-141	180 OHMS 5% 1/2 W
R10	502212	82283-161	1200 OHMS 5% 1/2 W
R11	502110	82283-135	100 OHMS 5% 1/2 W
R13	502022	82283-119	22 OHMS 5% 1/2W
R14	502318	82283-189	18,000 OHMS 5% 1/2 W
R15	502120	82283-142	200 OHMS 5% 1/2 W
R16	502115	82283-139	150 OHMS 5% 1/2 W
R17	502247	82283-175	4700 OHMS 5% 1/2 W
R18	502115	82283-139	150 OHMS 5% 1/2 W
R19	236062	990476-301	FILM, 1000 OHMS 1% 1/2 W
R20	236933	990476-266	FILM, 475 OHMS 1% 1/2 W
R21	502115	82283-139	150 OHMS 5% 1/2 W
R22	502147	82283-151	470 OHMS 5% 1/2 W
R23	502115	82283-139	150 OHMS 5% 1/2 W
R24	236933	990476-266	FILM, 475 OHMS 1% 1/2 W
R25	236062	990476-301	FILM, 1000 OHMS 1% 1/2 W
R26	512139	90496-149	390 OHMS 5% 1 W
R27	502147	82283-151	470 OHMS 5% 1/2 W
R29			

Symbol	Stock No.	Drawing No.	Description
TO			
R32	502215	82283-163	1500 OHMS 5% 1/2 W
R33	502115	82283-139	150 OHMS 5% 1/2 W
R34	502115	82283-139	150 OHMS 5% 1/2 W
R35	502310	82283-183	10,000 OHMS 5% 1/2 W
R36	502227	82283-169	2700 OHMS 5% 1/2 W
R37	502115	82283-139	150 OHMS 5% 1/2 W
R38	502122	82283-143	220 OHMS 5% 1/2 W
R39	502210	82283-159	1000 OHMS 5% 1/2 W
R40	502168	82283-155	680 OHMS 5% 1/2 W
R41	502118	82283-141	180 OHMS 5% 1/2 W
R42	502118	82283-141	180 OHMS 5% 1/2 W
R43	502133	82283-147	330 OHMS 5% 1/2 W
R44	502227	82283-169	2700 OHMS 5% 1/2 W
R45	502215	82283-163	1500 OHMS 5% 1/2 W
R46	502182	82283-157	820 OHMS 5% 1/2 W
R47	502156	82283-153	560 OHMS 5% 1/2 W
R48	502139	82283-149	390 OHMS 5% 1/2 W
R49	502110	82283-135	100 OHMS 5% 1/2 W
R50	502156	82283-153	560 OHMS 5% 1/2 W
R51	502282	82283-181	8200 OHMS 5% 1/2 W
R52	502282	82283-181	8200 OHMS 5% 1/2 W
R53	502256	82283-177	5600 OHMS 5% 1/2 W
R54	502247	82283-175	4700 OHMS 5% 1/2 W
R55	502239	82283-173	3900 OHMS 5% 1/2 W
R56	502115	82283-139	150 OHMS 5% 1/2 W
R57	502227	82283-169	2700 OHMS 5% 1/2 W
R59	502227	82283-169	2700 OHMS 5% 1/2 W
R60	502115	82283-139	150 OHMS 5% 1/2 W
R61	502212	82283-161	1200 OHMS 5% 1/2 W
R62	502110	82283-135	100 OHMS 5% 1/2 W
R63	502068	82283-131	68 OHMS 5% 1/2 W
R64	502156	82283-153	560 OHMS 5% 1/2 W
R65	502118	82283-141	180 OHMS 5% 1/2 W
R66	502115	82283-139	150 OHMS 5% 1/2 W
R67			
TO			
R70	502022	82283-119	22 OHMS 5% 1/2 W
R71	502210	82283-159	1000 OHMS 5% 1/2 W
R72	502010	82283-111	10 OHMS 5% 1/2 W
R73	502110	82283-135	100 OHMS 5% 1/2 W
R74	502110	82283-135	100 OHMS 5% 1/2 W
15	241636	3450797-007	CONTACT-PIN CONTACT
			VIDEO PROCESSOR MODULE-BABY BD M/L 3456991-503 REV 14
C35	219668	993025-413	CAPACITOR, MICA 10 PF 500 V
C36	217378	993025-417	CAPACITOR, MICA 15 PF 100 V
C37	216971	993025-421	CAPACITOR, MICA 22 PF 100 V
CR16	420923	3722719-001	DIODE - TYPE FD-600
CR17	420923	3722719-001	DIODE - TYPE FD-600
CR18	420923	3722719-001	DIODE - TYPE FD-600
R75	502227	82283-169	RESISTOR, COMP 2.7K OHMS 1/2W 5%
R76	502215	82283-163	RESISTOR, COMP 1.5K OHMS 1/2W 5%
R77	502210	82283-159	RESISTOR, COMP 1K OHMS 5% 1/2W
R78	502322	82283-191	RESISTOR, COMP 22K OHMS 5% 1/2W
R79	502315	82283-187	RESISTOR COMP, 15K OHMS 5% 1/2W
R80	502312	82283-185	RESISTOR, COMP 12K OHMS 5% 1/2W
			VIDEO PROCESSOR MODULE ASSEMBLY M/L 3720001-502 REV 12
A1		3456991-502	PRINTED CIRCUIT BOARD
B1	246040	3459943-004	MOTOR - 1 RPM
	246042	3459943-101	SPRING
	246041	3459943-102	BRUSH
B2	246040	3459943-004	MOTOR - 1 RPM
	246042	3459943-101	SPRING
	246041	3459943-102	BRUSH

Symbol	Stock No.	Drawing No.	Description
C101 TO C104	205656	1510003-037	CERAMIC, 0.01 MF 500 V
CR4 TO CR7	420923	3722719-001	DIODE - TYPE FD-600
J1 TO J3	214603	8941099-004	CONNECTOR - FEMALE
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
R101	246448	3459994-001	POTENTIOMETER, 250 OHMS 2 W
R103	502215	82283-163	1500 OHMS 5% 1/2 W
R104 TO R107	228997	8868256-044	POTENTIOMETER, 5000 OHMS 1/2 W
R108	502233	82283-171	3300 OHMS 5% 1/2 W
R109 TO R112	502247	82283-175	4700 OHMS 5% 1/2 W
R113	228997	8868256-044	POTENTIOMETER, 5000 OHMS 1/2 W
R114	502322	82283-191	22,000 OHMS 5% 1/2 W
R115 TO R119	228997	8868256-044	POTENTIOMETER, 5000 OHMS 1/2 W
R120	502156	82283-153	560 OHMS 5% 1/2W
R121	246448	3459994-001	POTENTIOMETER, 250 OHMS 2 W
R122	502147	82283-151	470 OHMS 5% 1/2W
R123	231914	8868256-045	POTENTIOMETER, 10K OHMS 1/2W
R124	231914	8868256-045	POTENTIOMETER, 10K OHMS 1/2W
R125	231914	8868256-045	POTENTIOMETER, 10K OHMS 1/2W
S1	230657	8547312-009	SWITCH - TOGGLE
S2	230662	8547312-004	SWITCH - TOGGLE
S3	230662	8547312-004	SWITCH - TOGGLE
Mechanical			
14	418785	3730663-504	CONTACT - BRACKET ASSEMBLY
9	229940	1510924-105	KNOB
39	97821	486041-010	TERMINAL - STUD
24	418454	3450427-003	WASHER - SPRING
PREFIX 15			**VIDEO AMPLIFIER and OUTPUT MODULE**
Electrical			**MI-560457/MI-560860** M/L 3720029 501/502 REV 17
			CAPACITORS
15C1	235779	3462014-129	FILM, 0.1 MF 200 V
15C2	239724	3410170-709	ELECTROLYTIC, 15 MF 150 V
15C3	246278	3456576-013	TRIMMER - 15-60 PF
15C4	428026	3462014-117	FILM, .01 MF 200 V
15C5	239724	3410170-709	ELECTROLYTIC, 15 MF 150 V
15C6	230226	3410170-315	ELECTROLYTIC, 100 MF 15 V
15C7	225610	993025-434	MICA, 75 PF 100 V
15C8	232081	3463179-019	FILM, 1 MF 100 V
15C9	232081	3463179-019	FILM, 1 MF 100 V
15C10	232929	3462014-119	FILM, .015 MF 200 V
15C11 TO 15C14	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
15C15	236833	3410170-509	ELECTROLYTIC, 15 MF 50 V
15C16	246278	3456576-013	TRIMMER, 15-60 PF
15C17	099162	993025-420	MICA, 20 PF 100 V (MI-560457 ONLY)
15C18	239821	3462014-119	FILM, 0.015 UF 200 V
15CR1	242039	3460758-002	DIODE - TYPE 1N3754

Symbol	Stock No.	Drawing No.	Description
15CR2	242039	3460758-002	DIODE - TYPE 1N3754
15CR3 TO 15CR7	236715	3454179-001	DIODE - TYPE 1N914
15L1	245960	3456216-006	CHOKE 0.82 UH MOLDED (MI-560457 ONLY)
15L2	246445	3456216-025	CHOKE - 27 UH MOLDED
15L3		3720910-002	BEAD-SHIELDING
15L4		3720910-002	BEAD-SHIELDING
15P12	420032	3721894-005	CONNECTOR - 7 PIN MALE HOUSING (MI-560860 ONLY)
15Q1	241995	3730596-001	TRANSISTOR - TYPE 2N3635
15Q2	241995	3730596-001	TRANSISTOR - TYPE 2N3635
15Q3	241995	3730596-001	TRANSISTOR - TYPE 2N3635
15Q4	233735	3463780-001	TRANSISTOR - TYPE 2N3119
15Q5	231670	3730811-001	TRANSISTOR - TYPE 2N3261
15Q6	232678	3463780-002	TRANSISTOR - TYPE 2N3118
15Q7	241012	3730591-001	TRANSISTOR - TYPE 2N4037
15Q8	236268	3730595-001	TRANSISTOR - TYPE 2N2897
15Q9	236268	3730595-001	TRANSISTOR - TYPE 2N2897
15Q10	241012	3730591-001	TRANSISTOR - TYPE 2N4037
15Q11	246443	3730597-001	TRANSISTOR - TYPE 2N3829
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
15R1	217244	8868256-010	POTENTIOMETER, 500 OHMS 1/2 W
15R2	502075	82283-132	75 OHMS 5% 1/2W (MI-560860 ONLY)
15R2	502082	82283-133	82 OHMS 5% 1/2 W (MI-560457 ONLY)
15R3	502110	82283-135	100 OHMS 5% 1/2 W
15R4	239934	990409-215	390 OHMS 5% 2 W
15R5	502118	82283-141	180 OHMS 5% 1/2 W
15R6	502122	82283-143	220 OHMS 5% 1/2 W
15R7	502056	82283-129	56 OHMS 5% 1/2 W
15R8	243532	990409-247	8200 OHMS 5% 2 W
15R9	243532	990409-247	8200 OHMS 5% 2 W
15R10	243532	990409-247	8200 OHMS 5% 2 W
15R11	502112	82283-137	120 OHMS 5% 1/2 W
15R12 TO 15R15	418021	990409-245	6800 OHMS 5% 2 W
15R16	427742	82283-568	5 OHMS 5% 1/2 W
15R17	502112	82283-137	120 OHMS 5% 1/2 W
15R18	502112	82283-137	120 OHMS 5% 1/2 W
15R19	502010	82283-111	10 OHMS 5% 1/2 W
15R20	502010	82283-111	10 OHMS 5% 1/2 W
15R21	522275	99126-180	7500 OHMS 5% 2 W
15R22	522282	99126-181	8200 OHMS 5% 2 W
15R23	502212	82283-161	1200 OHMS 5% 1/2 W
15R24	502047	82283-127	47 OHMS 5% 1/2 W (MI-560457 ONLY)
15R25	502010	82283-111	10 OHMS 5% 1/2 W
15R26	502110	82283-135	100 OHMS 5% 1/2 W
15R27	502282	82283-181	8200 OHMS 5% 1/2 W
15R28	502127	82283-145	270 OHMS 5% 1/2 W
15R29	502247	82283-175	4700 OHMS 5% 1/2 W
15R30	502127	82283-145	270 OHMS 5% 1/2 W
15R31	502210	82283-159	1000 OHMS 5% 1/2 W
15R32	502227	82283-169	2700 OHMS 5% 1/2 W
15R33	502133	82283-147	330 OHMS 5% 1/2 W
15R34	502075	82283-132	75 OHMS 5% 1/2 W
15R35	502168	82283-155	680 OHMS 5% 1/2 W
15R36	502168	82283-155	680 OHMS 5% 1/2 W
15R37	502168	82283-155	680 OHMS 5% 1/2 W
15R38	502247	82283-175	4700 OHMS 5% 1/2 W
15R39	502210	82283-159	1000 OHMS 5% 1/2 W
15R40	502156	82283-153	560 OHMS 5% 1/2 W
15R41	502156	82283-153	560 OHMS 5% 1/2 W
15R42	502056	82283-129	56 OHMS 5% 1/2 W
15R43	522139	99126-149	390 OHMS 5% 2 W
15R44	502215	82283-163	1500 OHMS 5% 1/2 W
15R45	502339	82283-197	39,000 OHMS 5% 1/2 W
15R46	502227	82283-169	2700 OHMS 5% 1/2 W
15R47	502210	82283-159	1000 OHMS 5% 1/2 W
15R48	502310	82283-183	10,000 OHMS 5% 1/2 W
15R49	502247	82283-175	4700 OHMS 5% 1/2 W

Symbol	Stock No.	Drawing No.	Description
15R50	502247	82283-175	4700 OHMS 5% 1/2 W
15R51	502310	82283-183	10,000 OHMS 5% 1/2 W
15R52	502210	82283-159	1000 OHMS 5% 1/2 W
15R53	502247	82283-175	4700 OHMS 5% 1/2 W
15R54	502022	82283-119	22 OHMS 5% 1/2 W
15R55	502022	82283-119	22 OHMS 5% 1/2 W
15R56	512110	90496-135	100 OHMS 5% 1W
15R57	512110	90496-135	100 OHMS 5% 1W
			VIDEO OUTPUT MODULE ASSEMBLY M/L3720043-501 REV 8
15A1		3720029-502	PRINTED CIRCUIT BOARD (MI-560860 ONLY)
15A1		3720029-501	PRINTED CIRCUIT BOARD (MI-560457 ONLY)
15A2		3724268-502	PRINTED CIRCUIT BOARD ASSEMBLY
15B1	246040	3459943-004	MOTOR - 1 RPM
	246042	3459943-101	SPRING
	246041	3459943-102	BRUSH
15C101	205656	1510003-037	CERAMIC, 0.01 MF 500 V
15C102	205656	1510003-037	CERAMIC, 0.01 MF 500 V
15J1 TO 15J7	214603	8941099-004	CONNECTOR - FEMALE
15P12	420032	3721894-005	CONNECTOR - 7 PIN MALE HOUSING
15R101	246448	3459994-001	POTENTIOMETER - 250 OHMS 2 W
15R102	502027	82283-121	27 OHMS 5% 1/2 W
15R103	502210	82283-159	1000 OHMS 5% 1/2 W
15R105	502212	82283-161	1200 OHMS 5% 1/2 W
15R106	502215	82283-163	1500 OHMS 5% 1/2 W
15R107	222325	8868256-040	POTENTIOMETER - 250 OHMS
15R108	228076	8868256-043	POTENTIOMETER, 2500 OHMS
15S1	230657	8547312-009	SWITCH - TOGGLE
15S2	230657	8547312-009	SWITCH - TOGGLE
Mechanical			
14	418786	3730663-505	CONTACT - BRACKET ASSEMBLY
9	229940	1510924-105	KNOB
25	418454	3450427-003	WASHER - SPRING
50	420034	3721894-009	PIN - GUIDE PIN (MI-560860 ONLY)
51	420035	3721894-010	SOCKET - GUIDE (MI-560860 ONLY)
52	420031	3721894-004	SPRING - RENTENTION (MI-560860 ONLY)
Electrical			A2 BOARD ASSEMBLY (FIXED VALUE TYPE) M/L 3724268-501
C1	249945	3720541-036	CAPACITOR, 0.1UF 10% 50V
C2	249945	3720541-036	CAPACITOR, 0.1UF 10% 50V
CR1 THRU CR8	236715	3454179-001	DIODE - TYPE 1N914
R1	502222	82283-167	RESISTOR, 2.2K OHMS 5% 1/2W
R2	502227	82283-169	RESISTOR, 2.7K OHMS 5% 1/2W
R3	502310	82283-183	RESISTOR, 10K OHMS 5% 1/2W
R4	502310	82283-183	RESISTOR, 10K OHMS 5% 1/2W
R5	502110	82283-135	RESISTOR, 100 OHMS 5% 1/2W
			A2 BOARD ASSEMBLY (VARIABLE VALUE TYPE) M/L 3724268-502
C1	249945	3720532-020	CAPACITOR, 0.1UF 20% 50V
C2	249945	3720532-020	CAPACITOR, 0.1UF 20% 50V
CR1 THRU CR4	236715	3454179-001	DIODE - TYPE 1N914
R1	502222	82283-167	RESISTOR, 2.2K OHMS 5% 1/2W
R2	421224	3330851-009	RESISTOR, VARIABLE 5K 3/4W
R3	502310	82283-183	RESISTOR, 10K OHMS 5% 1/2W
R4	502310	82283-183	RESISTOR, 10K OHMS 5% 1/2W
R5	419989	3330851-006	RESISTOR, VARIABLE 500 OHMS 3/4W
R6	502210	82283-159	RESISTOR, 1K 5% 1/2W

Symbol	Stock No.	Drawing No.	Description
			AUTO SYNC LEVEL (ASL) MODULE MI-561330
			M/L 3724906-501 AND 502 REV 2
Electrical			
			CAPACITORS
C1	239821	3462014-119	.015 MF 200 V
C2 TO			
C5	232935	3462014-132	0.22 MF 200 V
C6	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
C7	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
C8	241058	3410170-511	ELECTROLYTIC, 25 MF 50 V
C9	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
C10	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
CR1	236715	3454179-001	DIODE - TYPE 1N914
J1	214603	8941099-004	JACK - TIP
J2	214603	8941099-004	JACK - TIP
J3	214603	8941099-004	JACK - TIP
Q1	236268	3730595-001	TRANSISTOR - TYPE 2N2897
Q2	246443	3730597-001	TRANSISTOR - TYPE 2N3829
Q3	246443	3730597-001	TRANSISTOR - TYPE 2N3829
Q4	236268	3730595-001	TRANSISTOR - TYPE 2N2897
			RESISTORS
R1	502212	82283-161	1200 OHMS 5% 1/2 W
R2	502210	82283-159	1000 OHMS 5% 1/2 W
R3	502282	82283-181	8200 OHMS 5% 1/2 W
R4	502310	82283-183	10,000 OHMS 5% 1/2 W
R5	502110	82283-135	100 OHMS 5% 1/2 W
R6	502239	82283-173	3900 OHMS 5% 1/2 W
R7	502310	82283-183	10,000 OHMS 5% 1/2 W
R8	502110	82283-135	100 OHMS 5% 1/2 W
R9	502156	82283-153	560 OHMS 5% 1/2 W
R10	502368	82283-203	68,000 OHMS 5% 1/2 W
R11	502247	82283-175	4700 OHMS 5% 1/2 W
R12	502410	82283-207	100,000 OHMS 5% 1/2 W
R13	502247	82283-175	4700 OHMS 5% 1/2 W
R14	502247	82283-175	4700 OHMS 5% 1/2 W
R15	502247	82283-175	4700 OHMS 5% 1/2 W
R16	502210	82283-159	1000 OHMS 5% 1/2 W
R17	502410	82283-207	100,000 OHMS 5% 1/2 W
R18	502210	82283-159	1000 OHMS 5% 1/2 W
R19	502210	82283-159	1000 OHMS 5% 1/2 W
R20	502215	82283-163	1500 OHMS 5% 1/2 W
R21	502110	82283-135	100 OHMS 5% 1/2 W
R22	502210	82283-159	1000 OHMS 5% 1/2 W
R23	502110	82283-135	100 OHMS 5% 1/2 W
R24	502110	82283-135	100 OHMS 5% 1/2 W
R25	502110	82283-135	100 OHMS 5% 1/2 W
R26	502247	82283-175	4700 OHMS 5% 1/2 W
R27	502010	82283-111	10 OHMS 5% 1/2 W
R28	502010	82283-111	10 OHMS 5% 1/2 W
R29	502182	82283-157	820 OHMS 5% 1/2 W
R30	231914	8868256-045	POTENTIOMETER, 10,000 OHMS 1/2 W
R31	223975	8868256-042	POTENTIOMETER, 1000 OHMS 1/2 W
S1	230657	8547312-009	SWITCH - TOGGLE
U1	421670	3721928-001	INTEGRATED CIRCUIT - TYPE UA741
U2	421670	3721928-001	INTEGRATED CIRCUIT - TYPE UA741
Mechanical			
19	418784	3730663-503	BRACKET ASSEMBLY
27	228124	3450797-003	CONTACT - PIN, E1 THRU E12
14	245029	8538278-004	LATCH - SPRING

Symbol	Stock No.	Drawing No.	Description
PREFIX 12			**POWER SUPPLY VIDEO MODULATOR**
			MI-560458B/MI-560458C
Electrical			3721229/3724134
C1	249620		CAPACITOR, 22MFD 50V
C2	428025		CAPACITOR, 2000MFD 40V
C3	421938		CAPACITOR, .01MFD, 200V
C4	242621		CAPACITOR, 150MFD 25V
C5	428025		CAPACITOR, 2000MFD 40V
C6	421938		CAPACITOR, .01MFD 200V
C7	242621		CAPACITOR, 150MFD 25V
C8	426713		CAPACITOR, 950MFD 75V
C9	421938		CAPACITOR, .01MFD 200V
C10	242787		CAPACITOR, 68MFD 50V
C11	421939		CAPACITOR, 110MFD 350V
C12	421938		CAPACITOR, .01MFD 200V
C13	242786		CAPACITOR, 22MFD 150V
C14	221890		CAPACITOR, 1MFD 25V
C15	221890		CAPACITOR, 1MFD 25V
C16	247658		CAPACITOR, .22MFD 200V
C17 TO C20	428655		CAPACITOR, 0.22MFD 250V
CB1	421940		CIRCUIT BREAKER, 3A 250VAC 60HZ
CR1	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR2	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR5	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR6	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR7	217784		SILICON RECTIFIER - TYPE 1N645
CR10	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR11	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR12	217784		SILICON RECTIFIER - TYPE 1N645
CR17	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR18	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR19	217784		SILICON RECTIFIER - TYPE 1N645
CR24	242392		SILICON RECTIFIER - TYPE SCE4/1N5060
CR25	242392		SILICON RECTIFIER - TYPE SCE4/1N5060
CR26	242392		SILICON RECTIFIER - TYPE SCE4/1N5060
CR27	242392		SILICON RECTIFIER - TYPE SCE4/1N5060
CR28	217784		SILICON RECTIFIER - TYPE 1N645
CR29	217784		SILICON RECTIFIER - TYPE 1N645
CR30	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR31	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR32	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR33	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
CR35	217784		SILICON RECTIFIER - TYPE 1N645
DS1	426156		LAMP, #327
XDS1	421941		LAMP HOLDER
Q1	231375		TRANSISTOR - TYPE 2N1613
Q2	420722		TRANSISTOR - TYPE 2N3055
Q3	231375		TRANSISTOR - TYPE 2N1613
Q4	231375		TRANSISTOR - TYPE 2N1613
Q5	231375		TRANSISTOR - TYPE 2N1613
Q6	420722		TRANSISTOR - TYPE 2N3055
Q7	231375		TRANSISTOR - TYPE 2N1613
Q8	231375		TRANSISTOR - TYPE 2N1613
Q9	231375		TRANSISTOR - TYPE 2N1613
Q10	231375		TRANSISTOR - TYPE 2N1613
Q11	231375		TRANSISTOR - TYPE 2N1613
Q12	420722		TRANSISTOR - TYPE 2N3055
Q13	231375		TRANSISTOR - TYPE 2N1613
Q14	231375		TRANSISTOR - TYPE 2N1613
Q15	231375		TRANSISTOR - TYPE 2N1613
Q16	231375		TRANSISTOR - TYPE 2N1613
Q17	241302		TRANSISTOR - TYPE 2N1711
Q18	239991		TRANSISTOR - TYPE DTS 423

Symbol	Stock No.	Drawing No.	Description
Q19	231375		TRANSISTOR - TYPE 2N1613
Q20	241302		TRANSISTOR - TYPE 2N1711
Q21	241302		TRANSISTOR - TYPE 2N1711
Q22	230994		TRANSISTOR - TYPE 2N2907
Q23	230994		TRANSISTOR - TYPE 2N2907
Q24	230994		TRANSISTOR - TYPE 2N2907
Q25	230994		TRANSISTOR - TYPE 2N2907
Q26	231375		TRANSISTOR - TYPE 2N1613
Q27	231375		TRANSISTOR - TYPE 2N1613
R1	502215		RESISTOR, 1.5K OHMS 1/2W 10%
R2	502139		RESISTOR, 390 OHMS 1/2W 10%
R3	502247		RESISTOR, 4.7K OHMS 1/2W 10%
R4	420541		RESISTOR, 5K OHMS VARIABLE
R5	100928		RESISTOR, 3.3 OHMS 1W 10% WW (MI-560458B ONLY)
R5	421564		RESISTOR, 1 OHM 1W 10% WW (MI-560458C ONLY)
R6	502268		RESISTOR, 6.8K OHMS 1/2W 10%
R7	502282		RESISTOR, 8.2K OHMS 1/2W 10%
R8	502115		RESISTOR, 150 OHMS 1/2W 10%
R9	502139		RESISTOR, 390 OHMS 1/2W 10%
R10	420541		RESISTOR, 5K OHMS VARIABLE
R11	100928		RESISTOR, 3.3 OHMS 1W 10% WW (MI-560458B ONLY)
R11	421564		RESISTOR, 1 OHM 1W 10% WW (MI-560458C ONLY)
R12	502247		RESISTOR, 4.7K OHMS 1/2W 10%
R13	502282		RESISTOR, 8.2K OHMS 1/2W 10%
R14	502222		RESISTOR, 2.2K OHMS 1/2W 10%
R15	502127		RESISTOR, 270 OHMS 1/2W 10%
R16	249655		RESISTOR, 511 OHMS 3W 1%
R17	502147		RESISTOR, 470 OHMS 1/2W 10%
R18	502215		RESISTOR, 1.5K OHMS 1/2W 10%
R19	249656		RESISTOR, 2.26K OHMS 3W 1%
R20	249657		RESISTOR, 1K OHMS WW 3W 1%
R21	419477		RESISTOR, 1K OHMS VARIABLE
R22	502139		RESISTOR, 390 OHMS 1/2W 10%
R23	502282		RESISTOR, 8.2K OHMS 1/2W 10%
R24	502282		RESISTOR, 8.2K OHMS 1/2W 10%
R25	420541		RESISTOR, 5K OHMS VARIABLE
R26	100928		RESISTOR, 3.3 OHMS 1W 10% WW
R27	502268		RESISTOR, 6.8K OHMS 1/2W 10%
R28	502310		RESISTOR, 10K OHMS 1/2W 10%
R29	502115		RESISTOR, 150 OHMS 1/2W 10%
R30	502222		RESISTOR, 2.2K OHMS 1/2W 10%
R31	502127		RESISTOR, 270 OHMS 1/2W 10%
R32	249655		RESISTOR, 511 OHMS 3W WW
R33	502147		RESISTOR, 470 OHMS 1/2W 10%
R34	502215		RESISTOR, 1.5K OHMS 1/2W 10%
R35	249656		RESISTOR, 2.26K OHMS 3W 1%
R36	502127		RESISTOR, 270 OHMS 1/2W 10%
R37	249629		RESISTOR, 2.49K OHMS 3W 1%
R38	502147		RESISTOR, 470 OHMS 1/2W 10%
R39	502215		RESISTOR, 1.5K OHMS 1/2W 10%
R40	502115		RESISTOR, 150 OHMS 1/2W 10%
R41	419477		RESISTOR, 1K OHMS VARIABLE
R42	249657		RESISTOR, 1K OHMS 3W 1%
R44	249629		RESISTOR, 2.49K OHMS 3W 1%
R45	419477		RESISTOR, 1K OHMS VARIABLE
R46	249658		RESISTOR, 8.25K OHMS 3W 1%
R47	512010		RESISTOR, 10 OHMS 1W 10%
R48	502133		RESISTOR, 330 OHMS 1/2W 10%
R49	502282		RESISTOR, 8.2K OHMS 1/2W 10%
R50	420541		RESISTOR, 5K OHMS VARIABLE
R51	502212		RESISTOR, 1.2K OHMS 1/2W 10%
R52	502268		RESISTOR, 6.8K OHMS 1/2W 10%
R53	502133		RESISTOR, 330 OHMS 1/2W 10%
R54	512327		RESISTOR, 27K OHMS 1W
R55	502415		RESISTOR, 150K OHMS 1/2W 10%
R56	249659		RESISTOR, 27K OHMS 5W 5%
R60	512010		RESISTOR, 10 OHMS 1W 10%
R61	502147		RESISTOR, 470 OHMS 1/2W 10%
R62	249626		RESISTOR, 1.21K OHMS 3W 1% WW
R63	419477		RESISTOR, 1K OHMS VARIABLE
R64	502327		RESISTOR, 27K OHMS 1/2W 10%

Symbol	Stock No.	Drawing No.	Description
R65	502327		RESISTOR, 27K OHMS 1/2W 10%
R66	502347		RESISTOR, 47K OHMS 2W 10%
R67	502415		RESISTOR, 150K OHMS 1/2W 10%
R70	502210		RESISTOR, 1K OHMS 1/2W 10%
R71	502151		RESISTOR, 500 OHMS 1/2W 10%
R72	502118		RESISTOR, 180 OHMS 1/2W 10%
R73	502210		RESISTOR, 1K OHMS 1/2W 10%
R74	502210		RESISTOR, 1K OHMS 1/2W 10%
R75	502210		RESISTOR, 1K OHMS 1/2W 10%
R76	502118		RESISTOR, 180 OHMS 1/2W 10%
R77	502218		RESISTOR, 1.8K OHMS 1/2W 10%
R78	502310		RESISTOR, 10K OHMS 1/2W 10%
R79	502210		RESISTOR, 1K OHMS 1/2W 10%
R80	422043		RESISTOR, 500 OHMS VAR
R81	419477		RESISTOR, 1K OHMS VAR
R82	502310		RESISTOR, 10K OHMS 1/2W 10%
R83	502312		RESISTOR, 12K OHMS 1/2W 10%
R84	421942		RESISTOR, 10K OHMS VAR
R85	502356		RESISTOR, 56K OHMS 1/2W 10%
R87	502210		RESISTOR, 1K OHMS 1/2W 10%
R88	512256		RESISTOR, 5.6K OHMS 1W 10%
SCR1	420312		SILICON CONT RECTIFIER - TYPE 2N4441
SCR2	421947		SILICON CONT RECTIFIER - TYPE 2N4443
T1	249660		TRANSFORMER
TP1	214783		TEST POINT, RED
TP2	214783		TEST POINT, RED
TP3	214783		TEST POINT, RED
TP4	214783		TEST POINT, RED
TP5	214782		TEST POINT, BLACK
VR1	228458		ZENER DIODE - TYPE 1N756A
VR2	225316		ZENER DIODE - TYPE 1N752A
VR3	225588		ZENER DIODE - TYPE 1N821
VR4	225316		ZENER DIODE - TYPE 1N752A
VR5	225588		ZENER DIODE - TYPE 1N821
VR6	225588		ZENER DIODE - TYPE 1N821
VR7	231343		ZENER DIODE - TYPE 1N963B
VR8	228458		ZENER DIODE - TYPE 1N756A
VR9	228458		ZENER DIODE - TYPE 1N756A
VR10	233951		ZENER DIODE - TYPE 1N978B
VR11	233951		ZENER DIODE - TYPE 1N978B

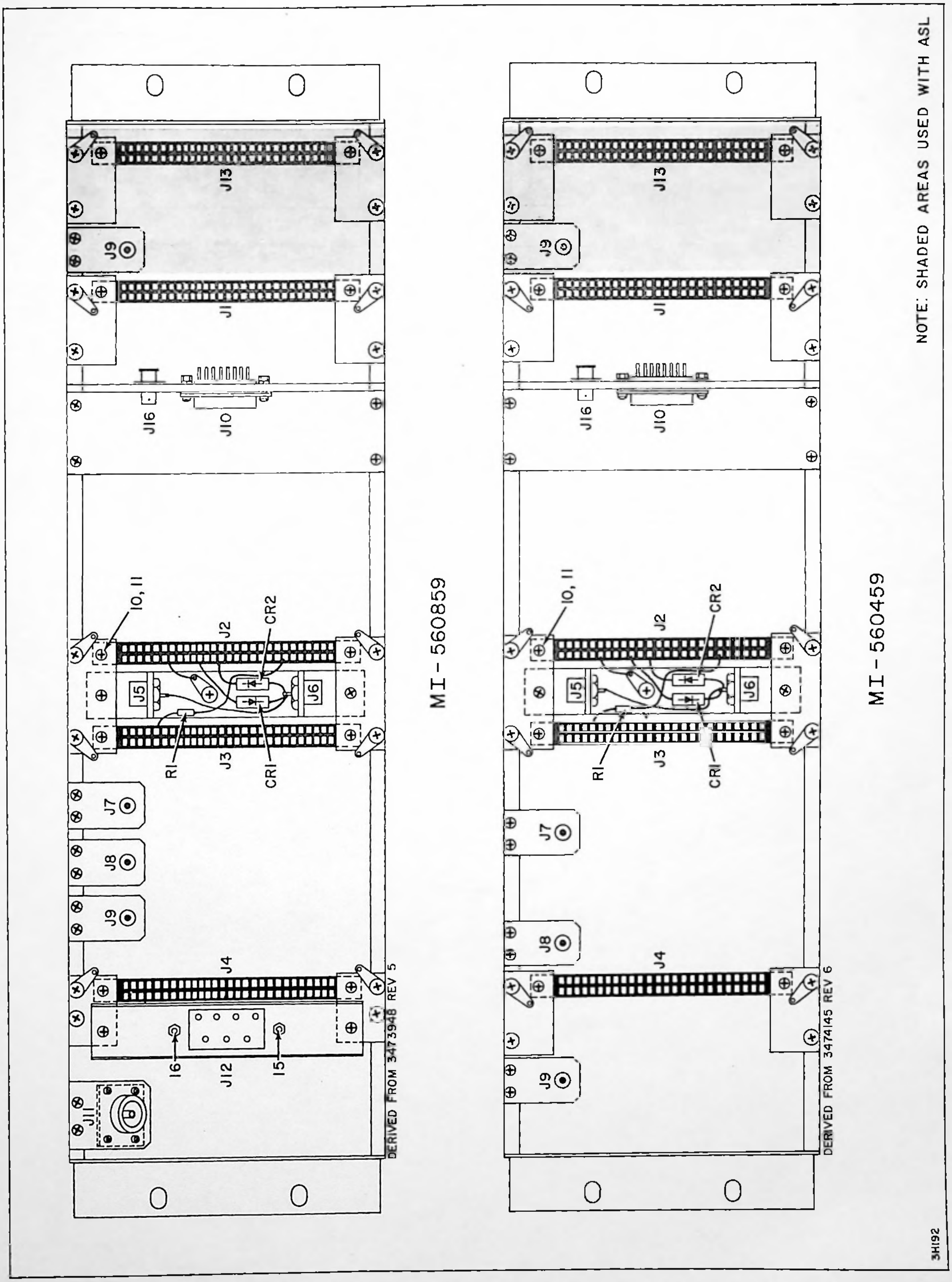


Figure 5-4. Video Modulator Frame Assemblies

Symbol	Stock No.	Drawing No.	Description
NO PREFIX			**MODULE EXTENDER MI-560541-B**
Electrical			M/L 3720410 REV 9
J1	420033	3721894-006	CONNECTOR - 7 PIN FEMALE HOUSING
P1	420032	3721894-005	CONNECTOR - 7 PIN MALE HOUSING
Mechanical			
11	420035	3721894-010	SOCKET - GUIDE, J1, P1
12	420034	3721894-009	PIN - GUIDE, J1, P1
33	420031	3721894-004	SPRING - RENTENTION

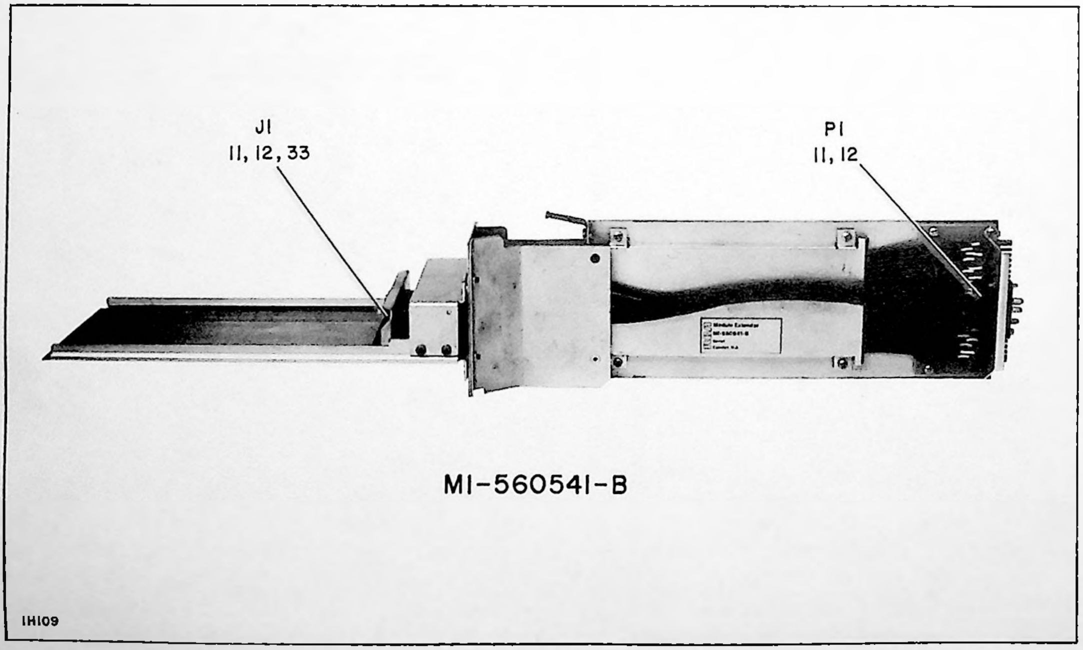


Figure 5-5. Module Extender MI-560541-B

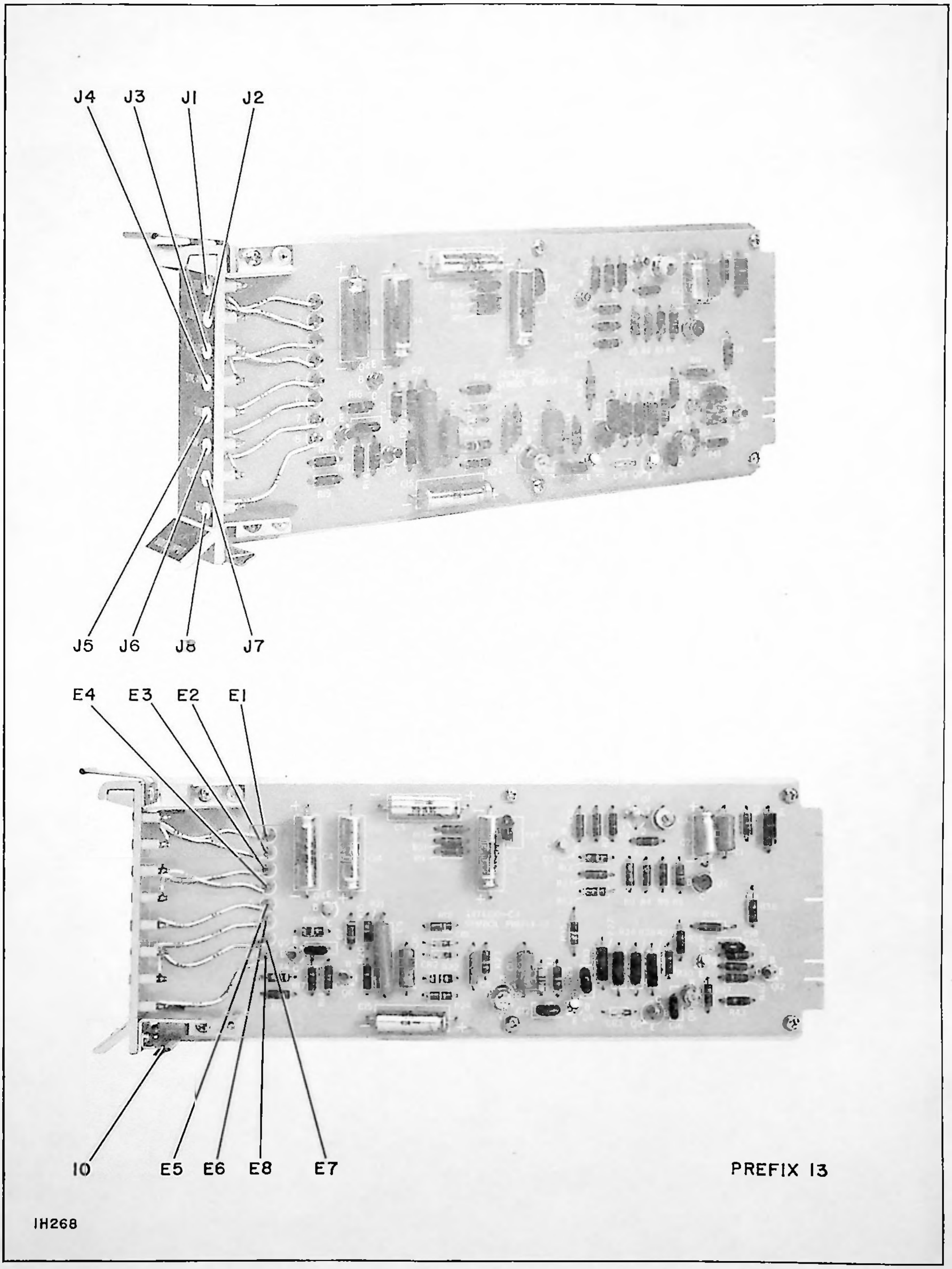
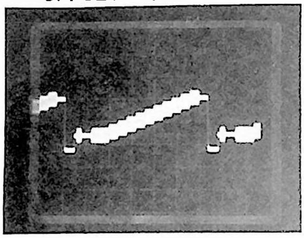
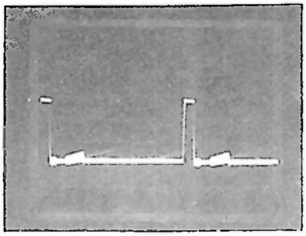


Figure 5-6. Video Input Module MI-560455 – Prefix 13

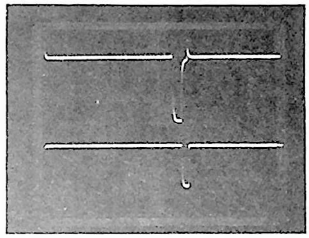
J1--VIDEO
① V-.2V/DIV, H-10µS/DIV
OFFSET 7.5V



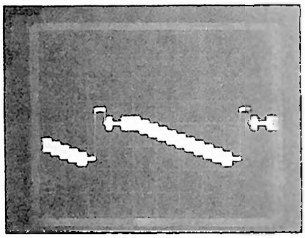
EMITTER OF Q7
④ V-1V/DIV, H-10µS/DIV
OFFSET 0V



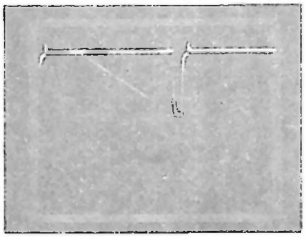
TIMING RELATIONSHIP
BETWEEN ⑤ AND ⑥



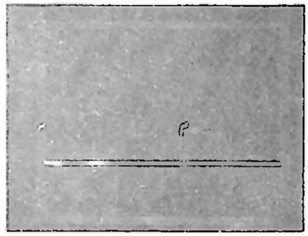
J2--VIDEO OUTPUT
② V-.5V/DIV, H-10µS/DIV
OFFSET 2.7V



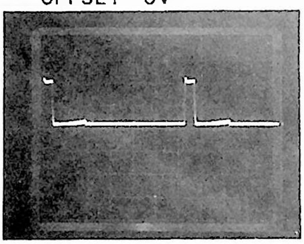
J5--SYNC
⑤ V-2V/DIV, H-10µS/DIV
OFFSET 0V



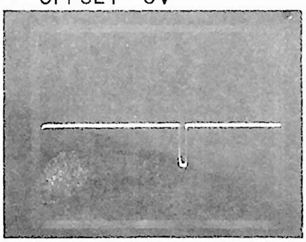
J7--CLAMP +
⑦ V-5V/DIV, H-10µS/DIV
OFFSET 0V



J4--SYNC AMPLIFIER
③ V-2V/DIV, H-10µS/DIV
OFFSET 0V



J6--CLAMP −
⑥ V-5V/DIV, H-10µS/DIV
OFFSET 0V



NOTES:

1. OFFSET VOLTAGE CORRESPONDS TO CENTER LINE ON SCOPE.
2. (#) —SEE SCHEMATIC DIAGRAM FOR THE WAVESHAPE LOCATION.
3. V = VERTICAL H = HORIZONTAL

2H306

Figure 5-7. Video Input Module MI-560455
Typical Waveforms (Sheet 1 of 2)

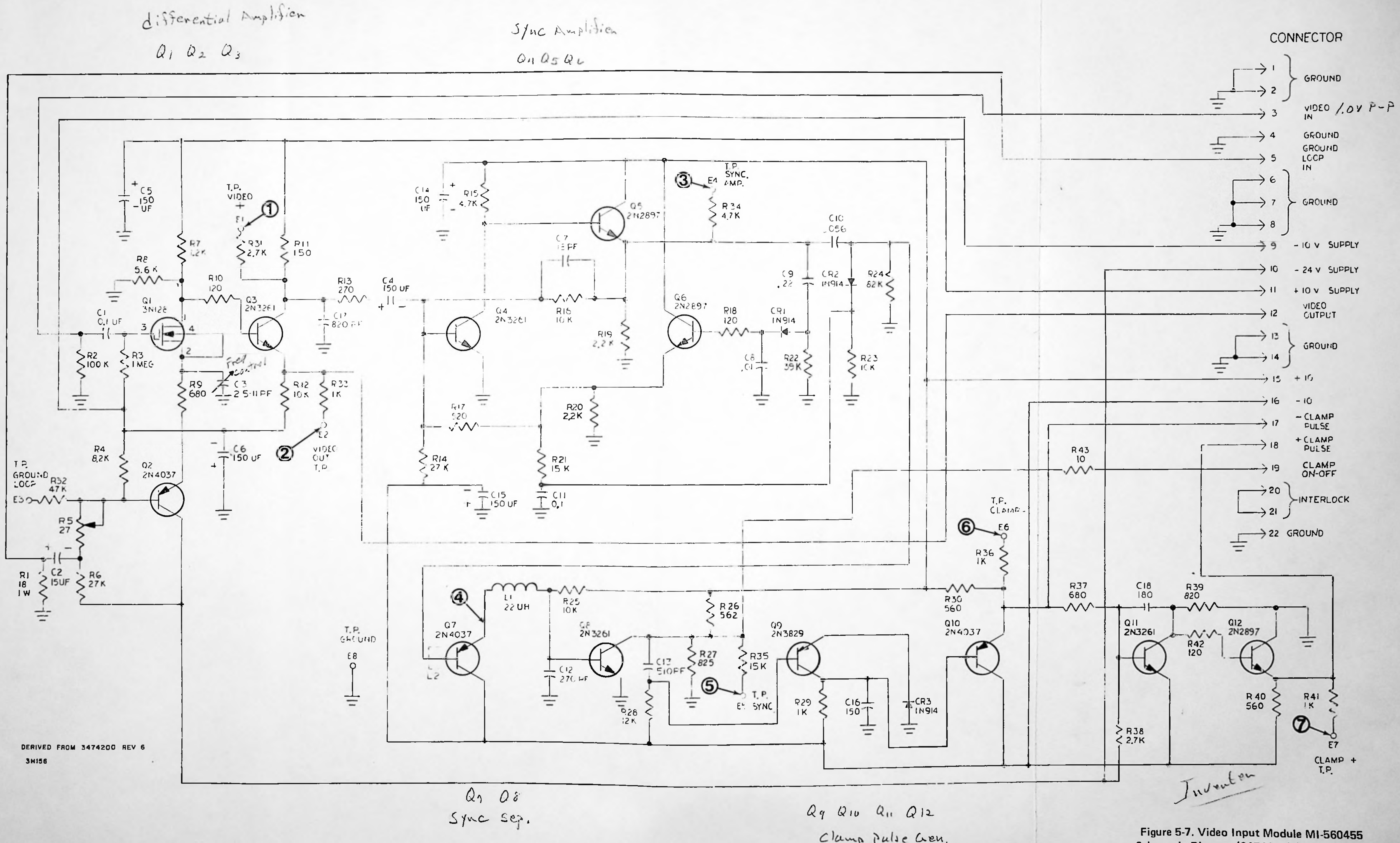
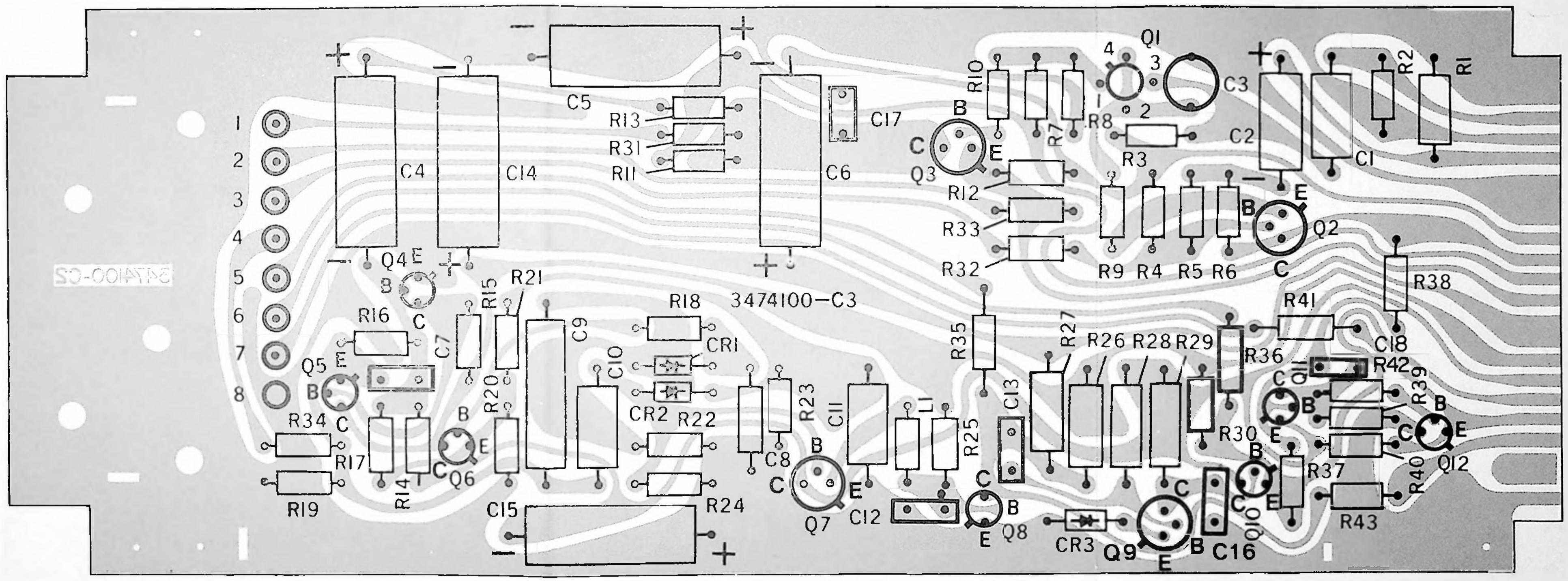


Figure 5-7. Video Input Module MI-560455 Schematic Diagram (3474200) (Sheet 2 of 2)



3H069

TOP VIEW

Figure 5-8. Video Input Module MI-560455
Printed Wiring Board Assembly

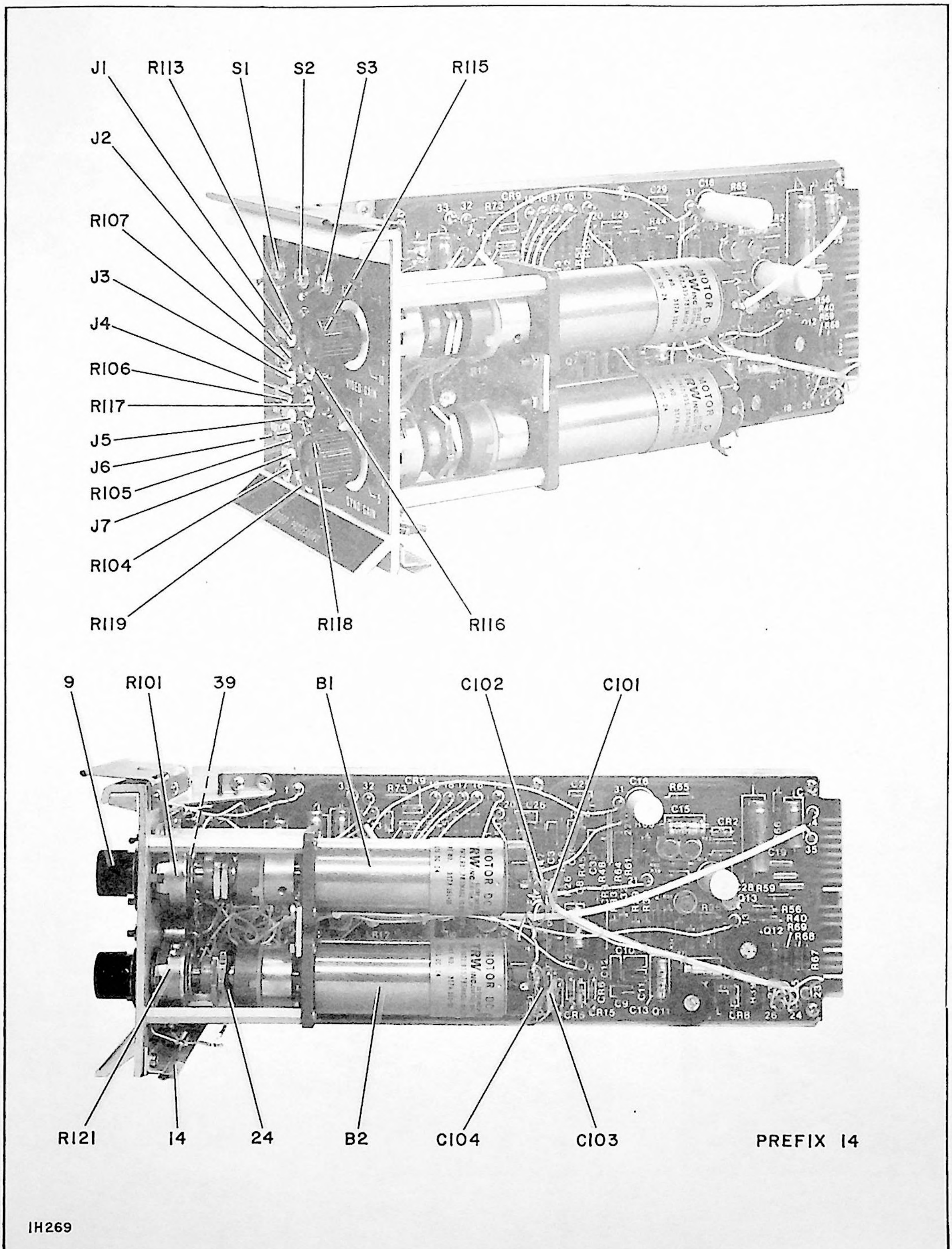
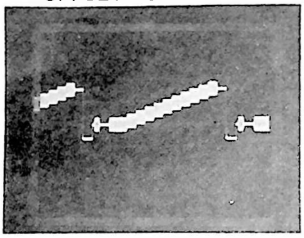
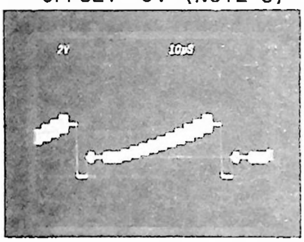


Figure 5-9. Video Processing Module MI-560456 – Prefix 14

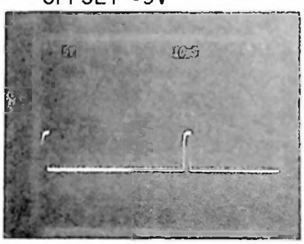
J1--VIDEO INPUT
(1) V-1V/DIV, H-10µS/DIV
OFFSET 0V



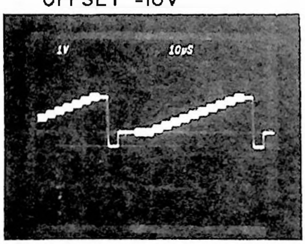
J2/J6--VIDEO OUTPUT
(2) V-2V/DIV, H-10µS/DIV
OFFSET 0V (NOTE 5)



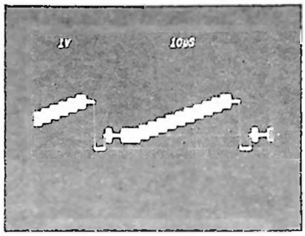
EMITTER OF Q5
(3) V-5V/DIV, H-10µS/DIV
OFFSET -9V



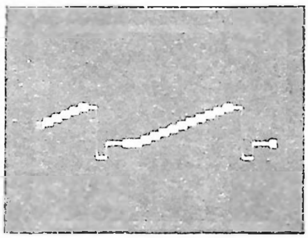
COLLECTOR OF Q5
(4) V-1V/DIV, H-10µS/DIV
OFFSET -10V



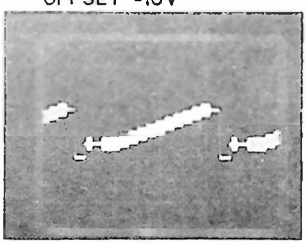
EMITTER OF Q11
(5) V-1V/DIV, H-10µS/DIV
OFFSET -10V



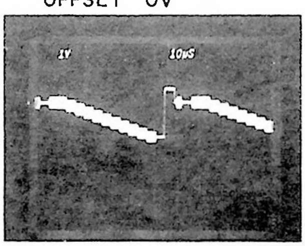
J2--VIDEO 2
(6) V-1V/DIV, H-10µS/DIV
OFFSET 0V



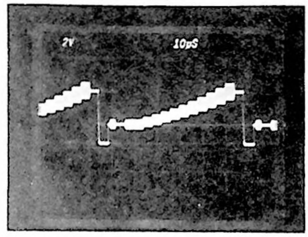
J3--VIDEO +
(7) V-1V/DIV, H-10µS/DIV
OFFSET -10V



J4--VIDEO −
(8) V-1V/DIV, H-10µS/DIV
OFFSET 0V



J5--DIFFERENTIAL OUTPUT
(9) V-2V/DIV, H-10µS/DIV
OFFSET 0V

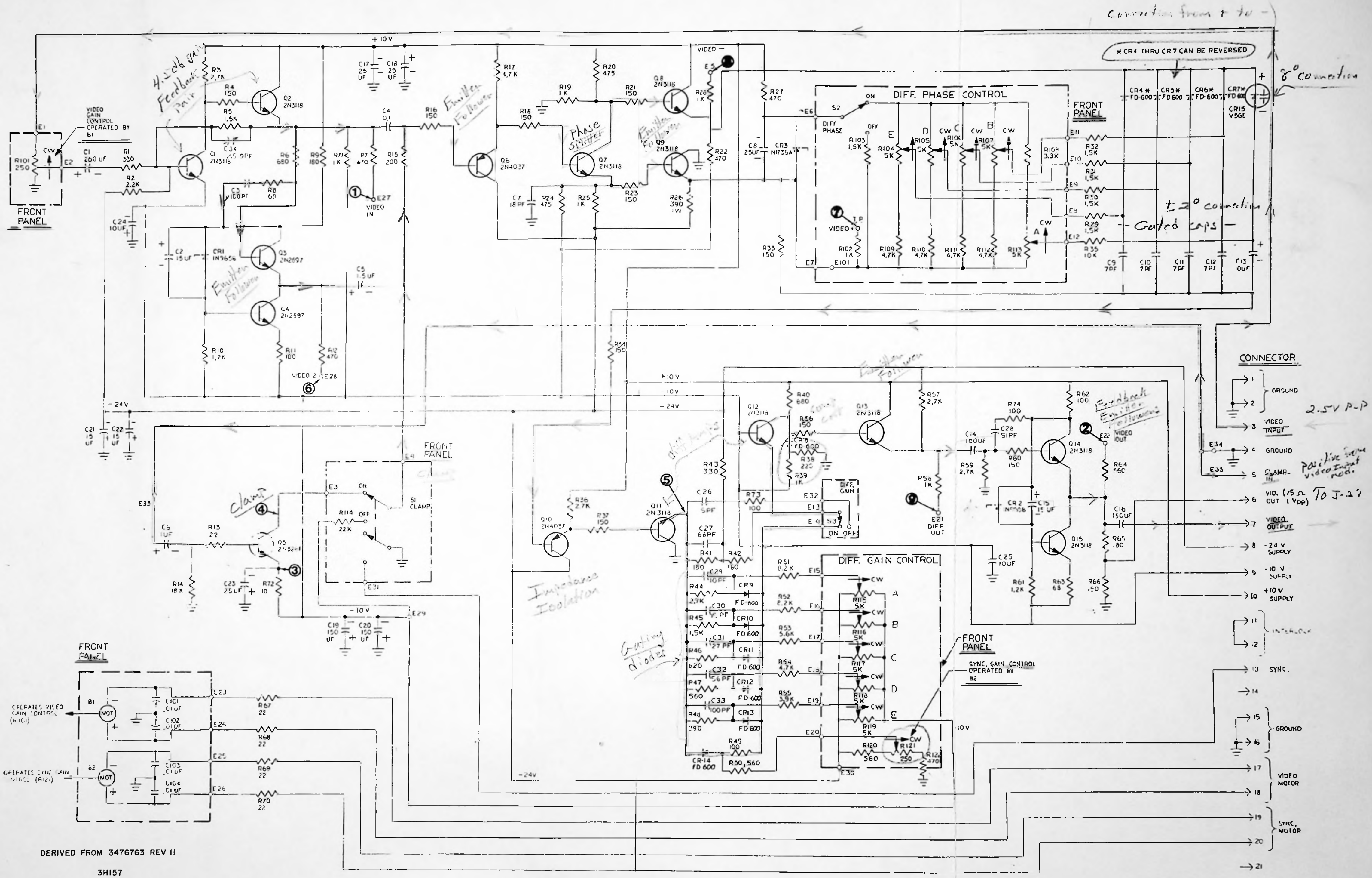


NOTES:

1. OFFSET VOLTAGE CORRESPONDS TO CENTER LINE ON SCOPE.
2. (#) -SEE SCHEMATIC DIAGRAM FOR THE WAVESHAPE LOCATION.
3. (1), (2), (3), (4) & (5) USED ON MI-560456A VIDEO PROCESSOR ONLY.
4. V = VERTICAL
   H = HORIZONTAL
5. J2 USED ON MODULE MI-560456A, J6 USED ON MODULE MI-560456.

2H305

Figure 5-10. Video Processing Module MI-560456 Typical Waveforms (Sheet 1 of 2)

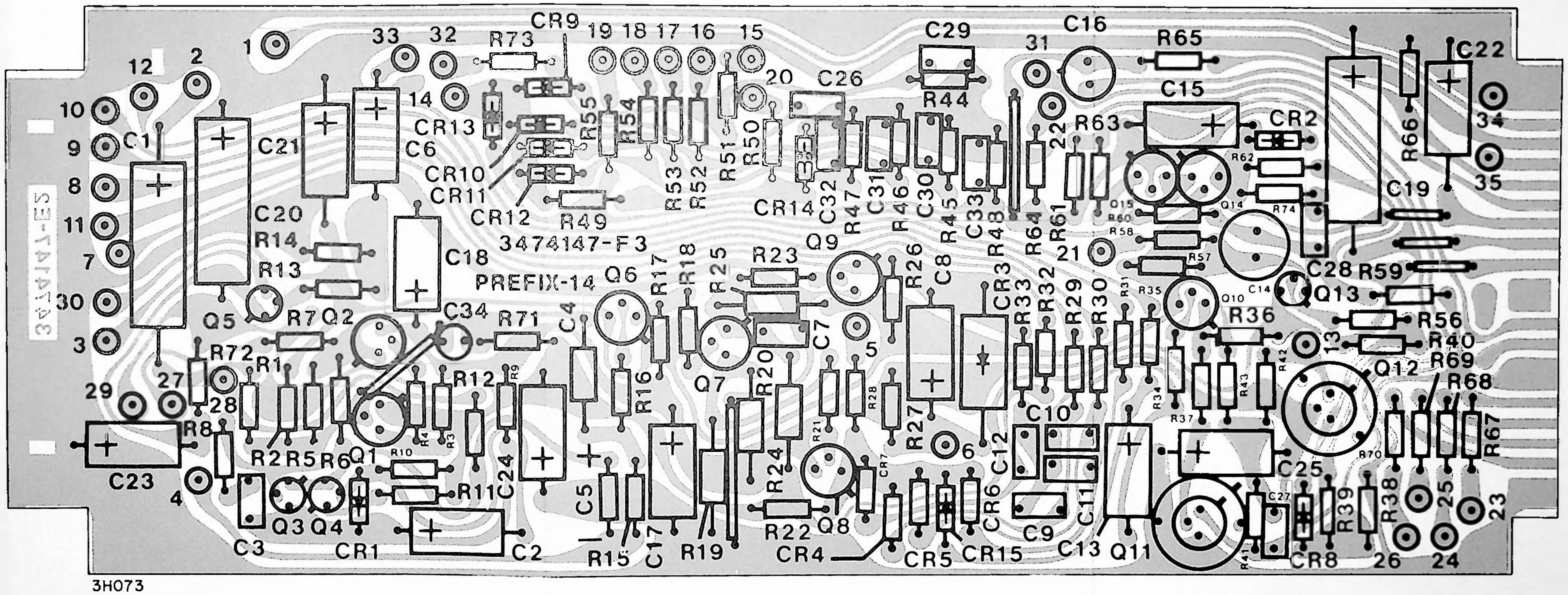


DERIVED FROM 3476763 REV II

3H157

Figure 5-10. Video Processing Module MI-560456 Schematic Diagram (3476763) (Sheet 2 of 2)

420923 FD600



TOP VIEW

Figure 5-11. Video Processing Module MI-560456
Printed Wiring Board Assembly

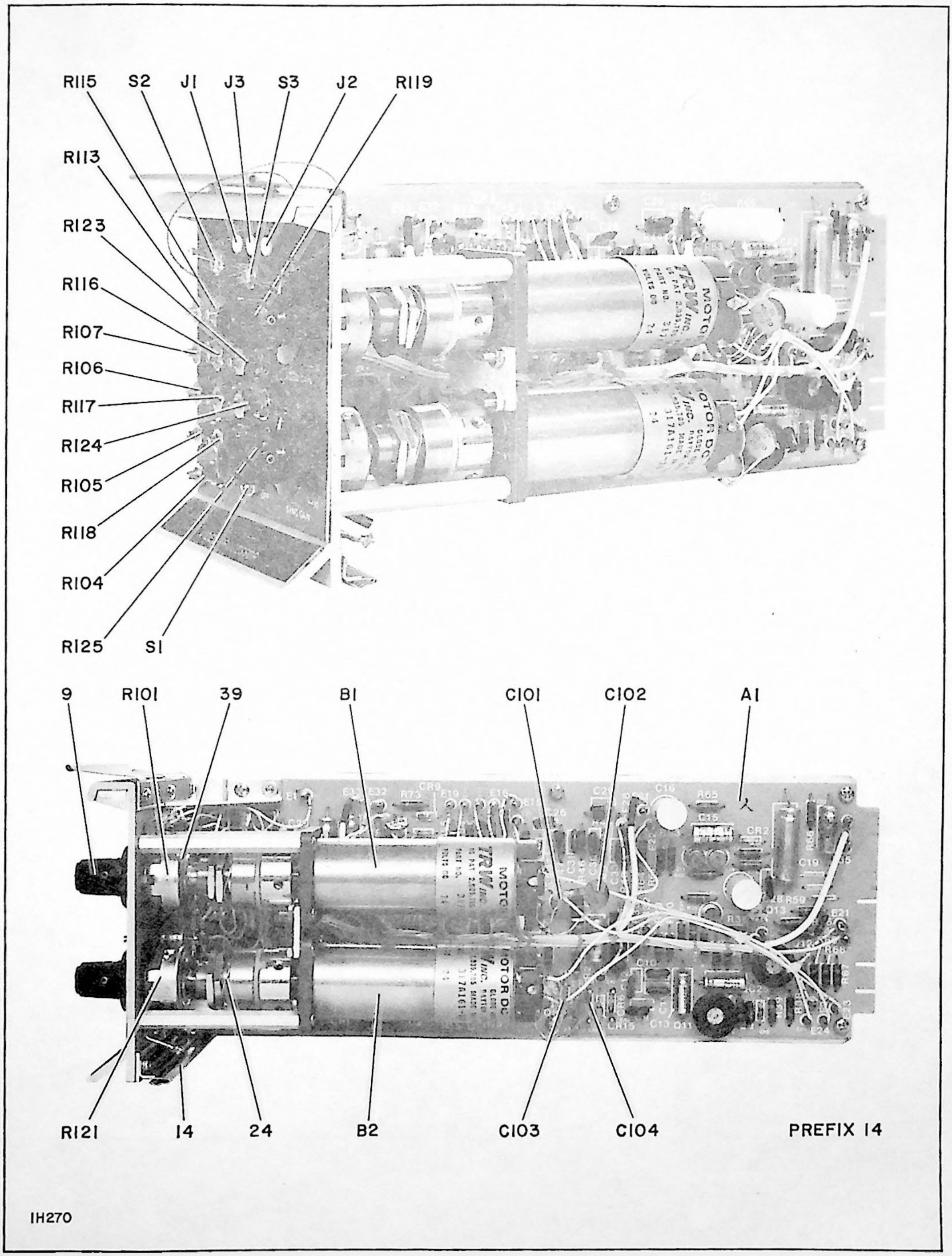
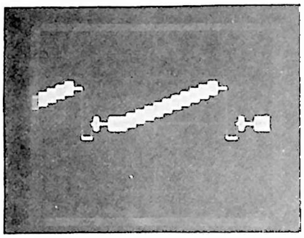


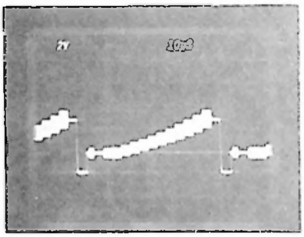
Figure 5-12. Video Processor Module MI-560456A – Prefix 14

Newer Model

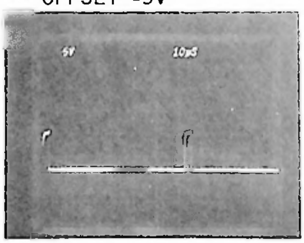
J1--VIDEO INPUT
1 V-1V/DIV, H-10μS/DIV
OFFSET 0V



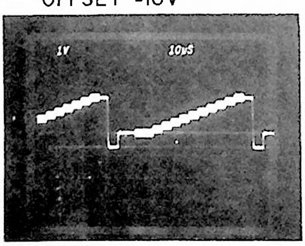
J2/J6--VIDEO OUTPUT
2 V-2V/DIV, H-10μS/DIV
OFFSET 0V (NOTE 5)



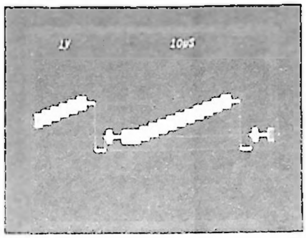
EMITTER OF Q5
3 V-5V/DIV, H-10μS/DIV
OFFSET -9V



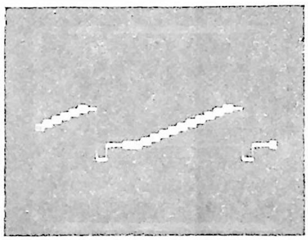
COLLECTOR OF Q5
4 V-1V/DIV, H-10μS/DIV
OFFSET -10V



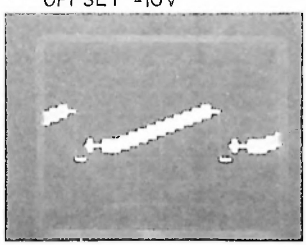
EMITTER OF Q11
5 V-1V/DIV, H-10μS/DIV
OFFSET -10V



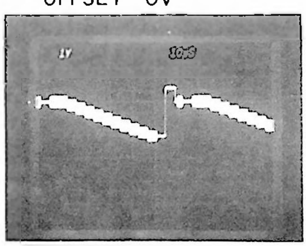
J2--VIDEO 2
6 V-1V/DIV, H-10μS/DIV
OFFSET 0V



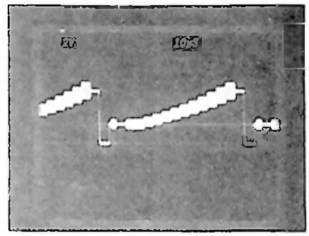
J3--VIDEO +
7 V-1V/DIV, H-10μS/DIV
OFFSET -10V



J4--VIDEO −
8 V-1V/DIV, H-10μS/DIV
OFFSET 0V



J5--DIFFERENTIAL OUTPUT
9 V-2V/DIV, H-10μS/DIV
OFFSET 0V



NOTES:

1. OFFSET VOLTAGE CORRESPONDS TO CENTER LINE ON SCOPE.
2. # -SEE SCHEMATIC DIAGRAM FOR THE WAVESHAPE LOCATION.
3. 1, 2, 3, 4 & 5 USED ON MI-560456A VIDEO PROCESSOR ONLY.
4. V = VERTICAL
   H = HORIZONTAL
5. J2 USED ON MODULE MI-560456A, J6 USED ON MODULE MI-560456.

2H305

Figure 5-13. Video Processor Module MI-560456A
Typical Waveforms (Sheet 1 of 2)

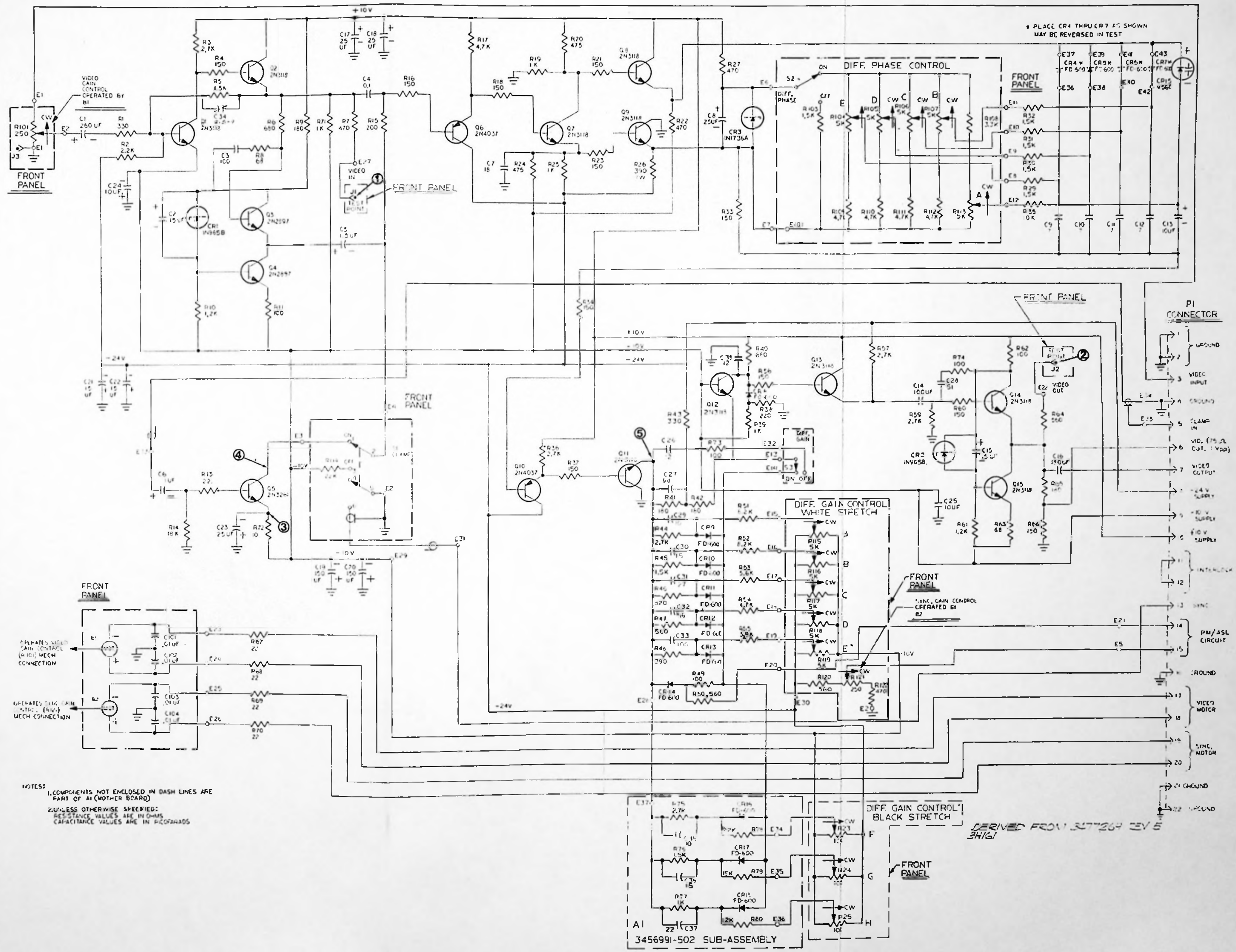
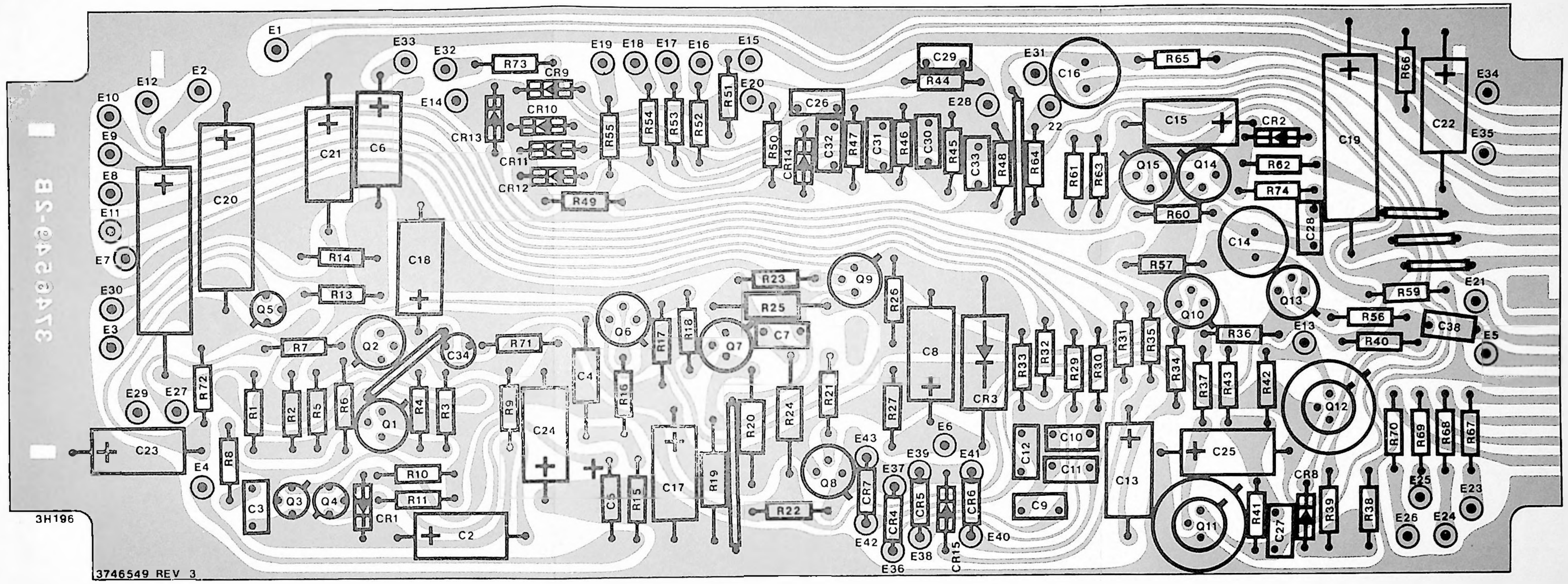
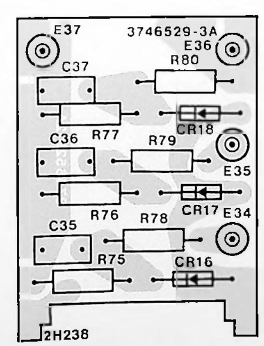


Figure 5-13. Video Processor Module MI-560456A Schematic Diagram (3477269) (Sheet 2 of 2)



TOP VIEW



BABY BOARD – TOP VIEW

Figure 5-14. Video Processor Module MI-560456A Printed Wiring Board Assemblies (A1 and A2)

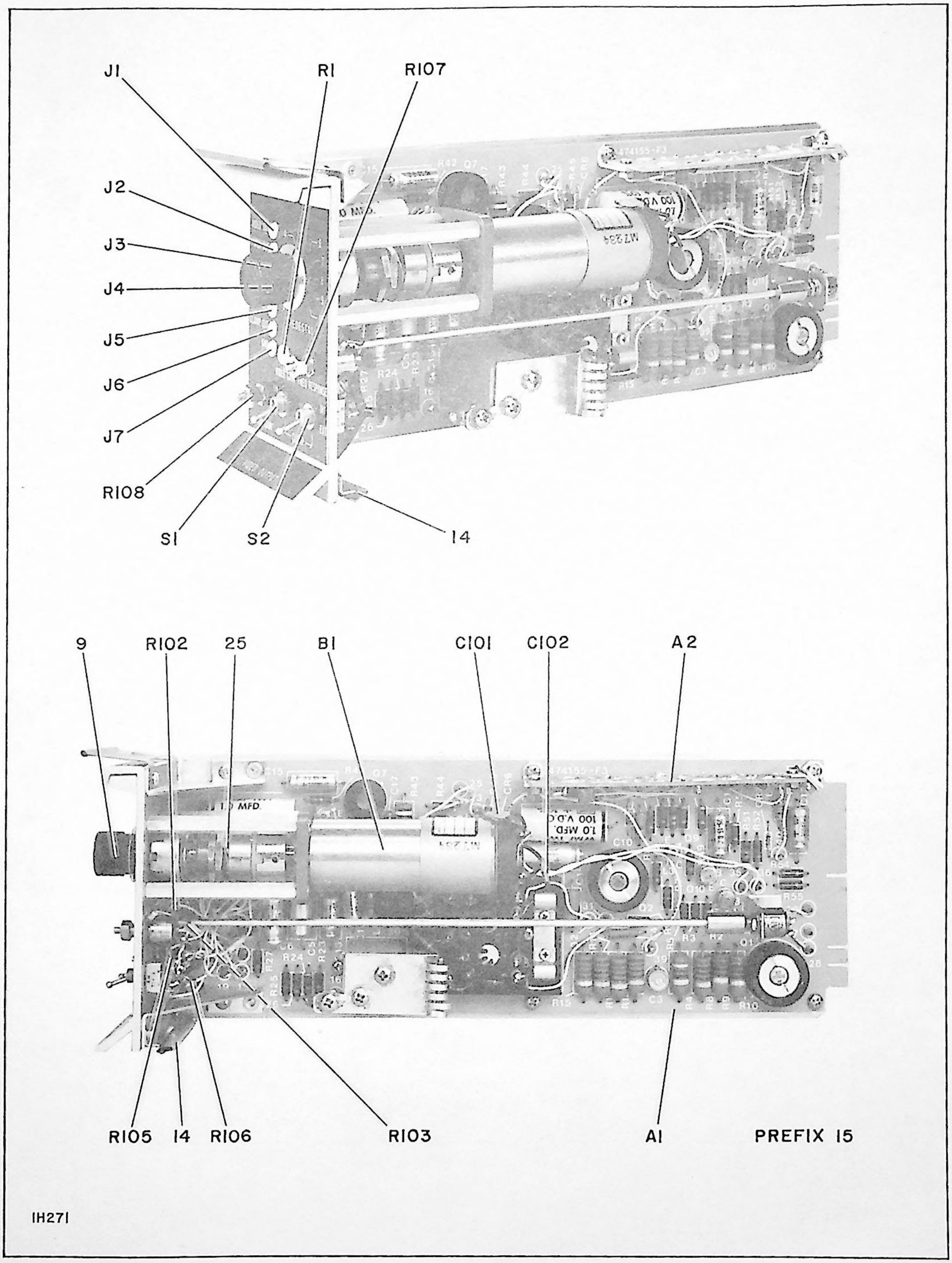
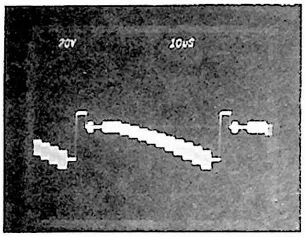
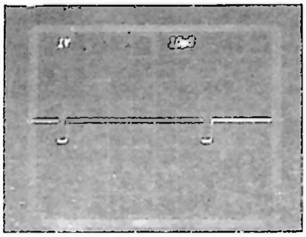


Figure 5-15. Video Amplifier and Output Module MI-560457 – Prefix 15

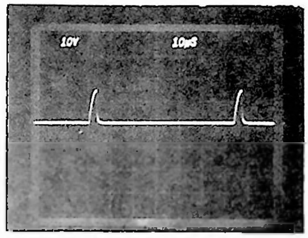
J1--VIDEO OUTPUT (FL)
① V-20V/DIV, H-10µS/DIV
OFFSET -40V



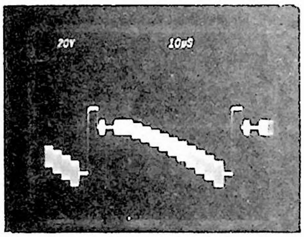
BASE OF Q11
③ V-1V/DIV, H-10µS/DIV
OFFSET 0V



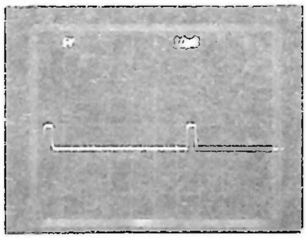
J5--ERROR GENERATOR
⑥ V-10V/DIV, H-10µS/DIV
OFFSET -24V



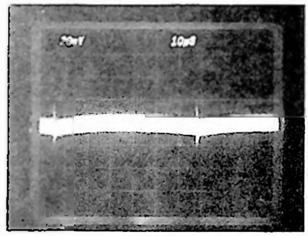
J1--VIDEO OUTPUT (FLD)
① V-20V/DIV, H-10µS/DIV
OFFSET -40V



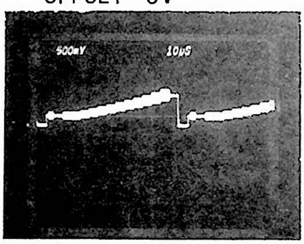
J4--CLAMP REFERENCE
④ V-5V/DIV, H-10µS/DIV
OFFSET 0V



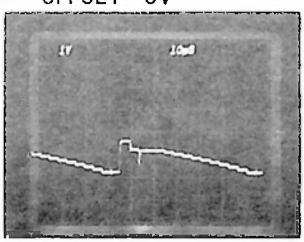
BASE OF Q8
⑦ V-20mV/DIV, H-10µS/DIV
OFFSET -2V



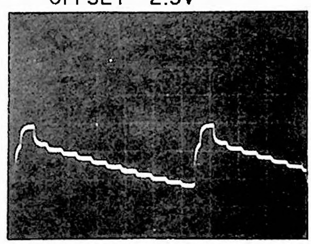
J2--MONITOR OUTPUT
② V-50mV/DIV, H-10µS/DIV
OFFSET 0V



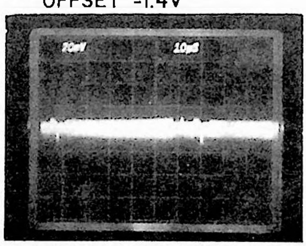
BASE OF Q10
⑤ V-1V/DIV, H-10µS/DIV
OFFSET 0V



J3--DETECTOR VIDEO
⑧ V-1V/DIV, H-10µS/DIV
OFFSET 2.5V



J6--CLAMP OUTPUT
⑨ V-20mV/DIV, H-10µS/DIV
OFFSET -1.4V



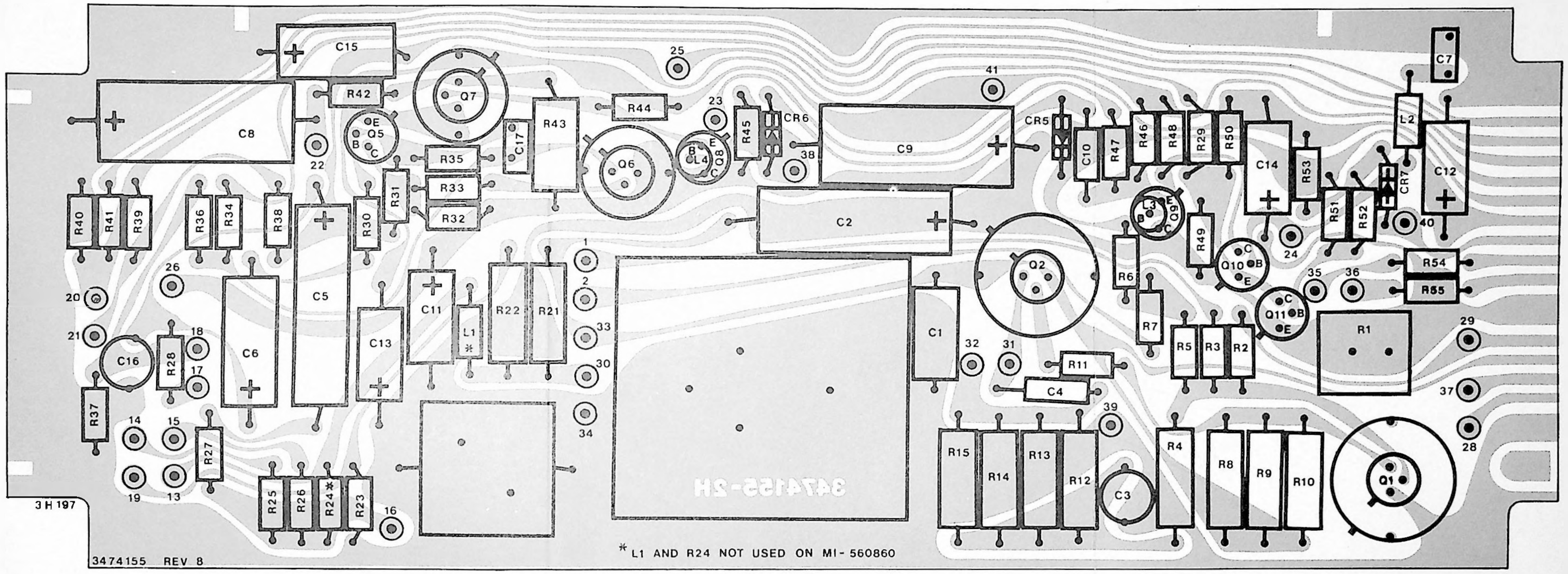
V=VERTICAL
H=HORIZONTAL

NOTES:

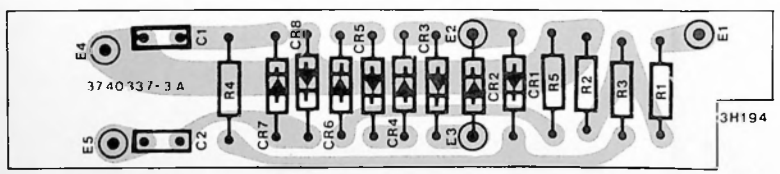
1. OFFSET VOLTAGE CORRESPONDS TO CENTER LINE ON SCOPE.
2. ⊕ -SEE SCHEMATIC DIAGRAM FOR THE WAVESHAPE LOCATION.

2H304

Figure 5-16. Video Amplifier and Output Module MI-560457 Typical Waveforms (Sheet 1 of 2)

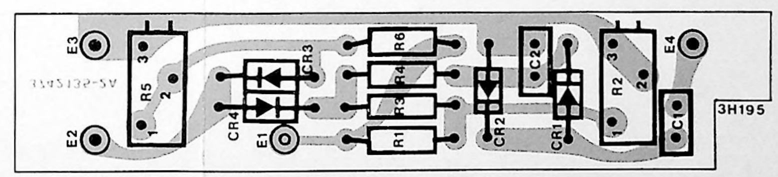


A1 TOP VIEW



FIXED RESISTOR TYPE

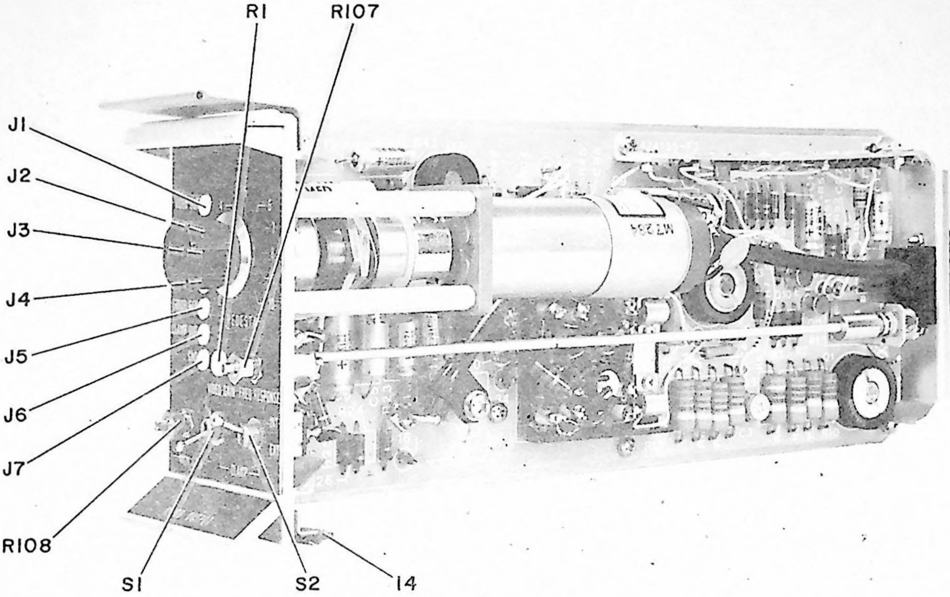
A2 – TOP VIEW

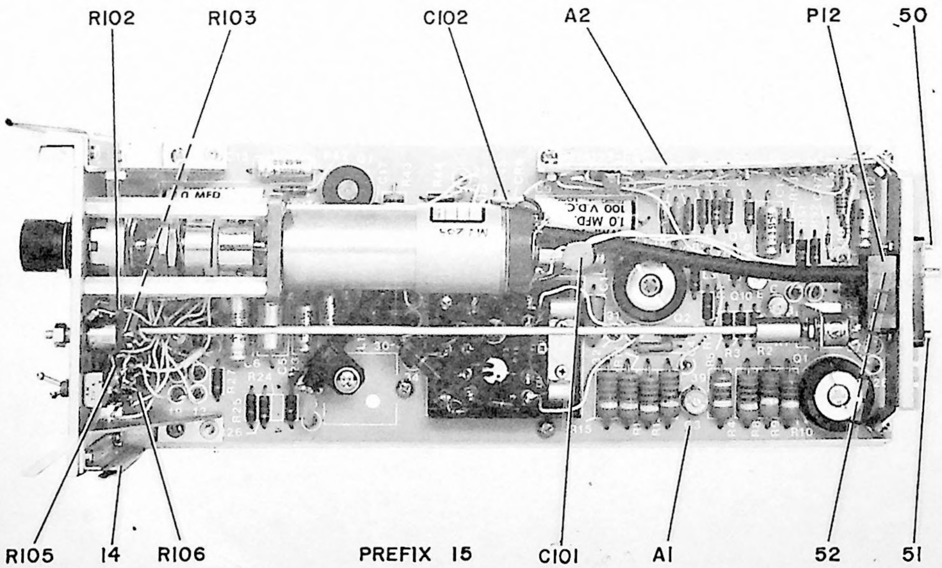


VARIABLE RESISTOR TYPE

A2 – TOP VIEW

Figure 5-17. Video Amplifier and Output Module MI-560457
Printed Wiring Board Assemblies (A1 and A2)

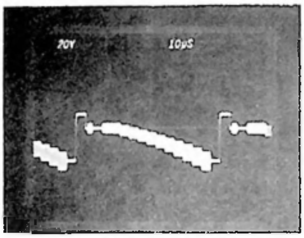




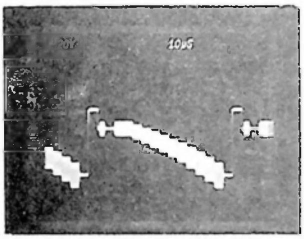
1H272

Figure 5-18. Video Amplifier and Output Module MI-560860 — Prefix 15

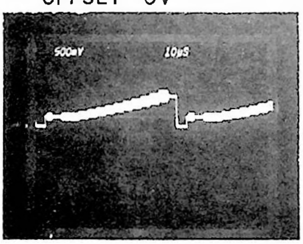
JI--VIDEO OUTPUT (FL)
① V-20V/DIV, H-10µS/DIV
OFFSET -40V



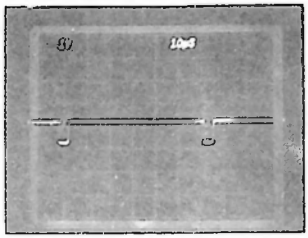
JI--VIDEO OUTPUT (FLD)
① V-20V/DIV, H-10µS/DIV
OFFSET -40V



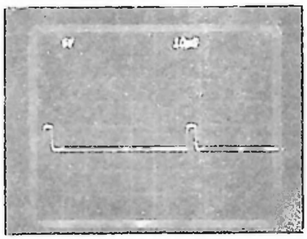
J2--MONITOR OUTPUT
② V-50mV/DIV, H-10µS/DIV
OFFSET 0V



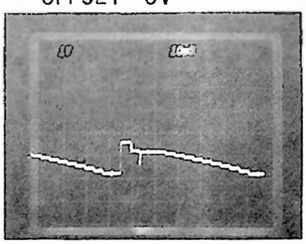
BASE OF Q11
③ V-1V/DIV, H-10µS/DIV
OFFSET 0V



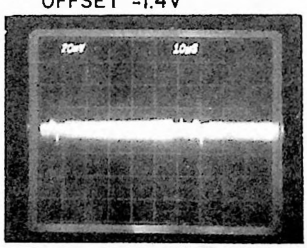
J4--CLAMP REFERENCE
④ V-5V/DIV, H-10µS/DIV
OFFSET 0V



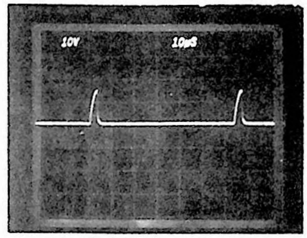
BASE OF Q10
⑤ V-1V/DIV, H-10µS/DIV
OFFSET 0V



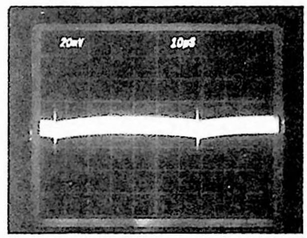
J6--CLAMP OUTPUT
⑨ V-20mV/DIV, H-10µS/DIV
OFFSET -1.4V



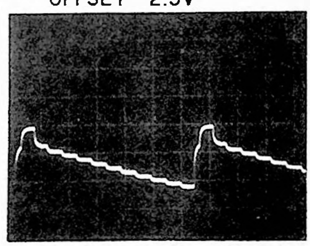
J5--ERROR GENERATOR
⑥ V-10V/DIV, H-10µS/DIV
OFFSET -24V



BASE OF Q8
⑦ V-20mV/DIV, H-10µS/DIV
OFFSET -2V



J3--DETECTOR VIDEO
⑧ V-1V/DIV, H-10µS/DIV
OFFSET 2.5V



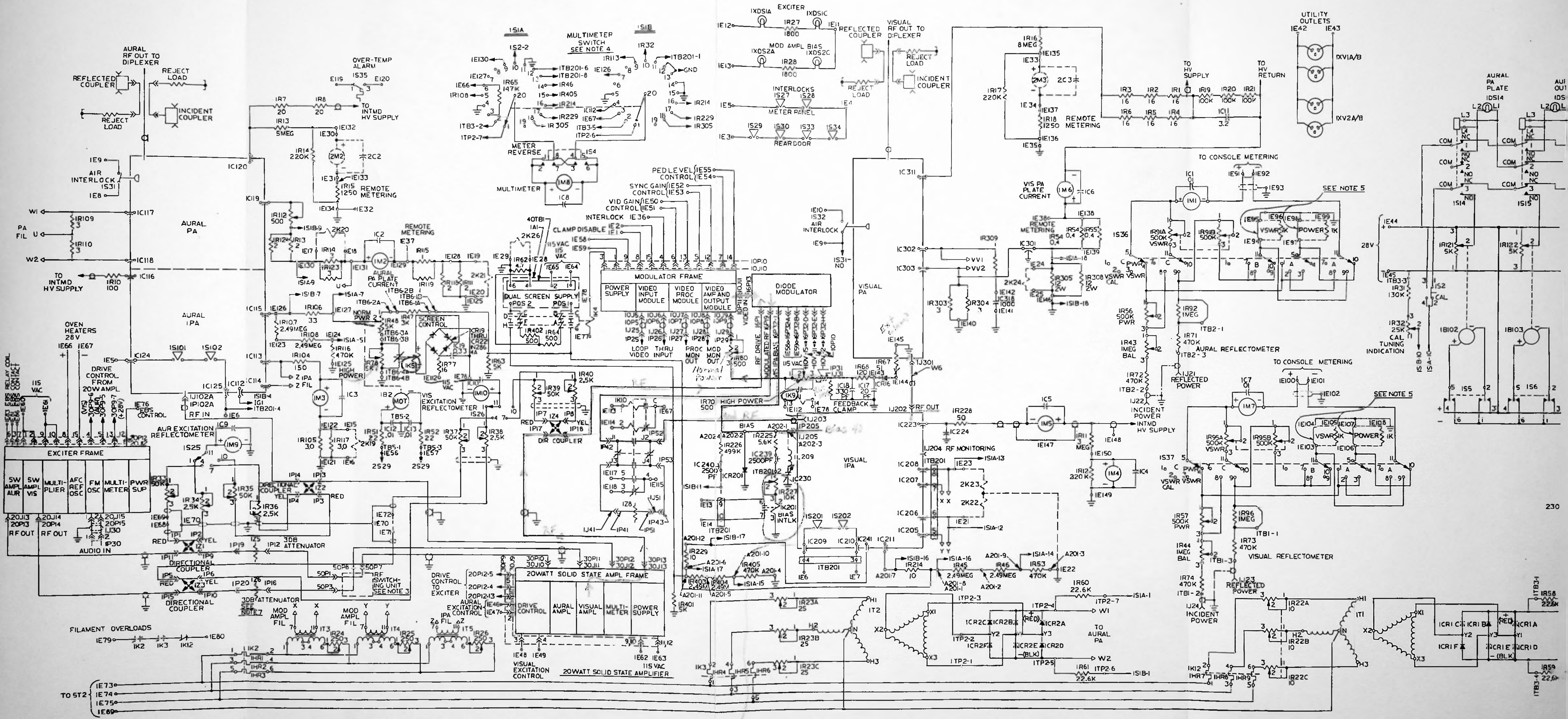
V=VERTICAL
H=HORIZONTAL

NOTES:

1. OFFSET VOLTAGE CORRESPONDS TO CENTER LINE ON SCOPE.
2. (#) -SEE SCHEMATIC DIAGRAM FOR THE WAVESHAPE LOCATION.

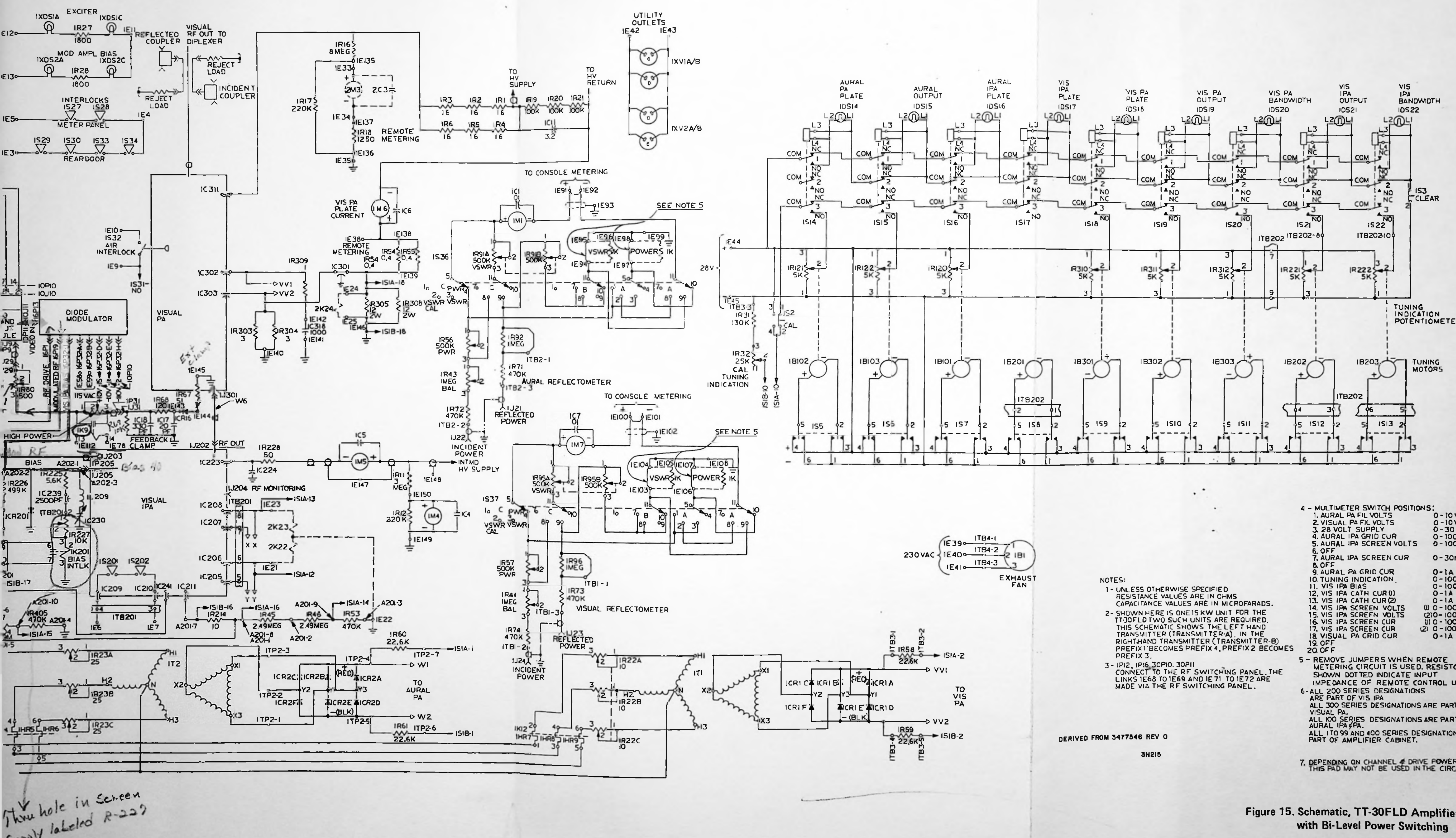
2H304

Figure 5-19. Video Amplifier and Output Module MI-560860 Typical Waveforms (Sheet 1 of 2)



230

Thru hole in Screen supply labeled R-227



NOTES:

1 - UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS CAPACITANCE VALUES ARE IN MICROFARADS.

2 - SHOWN HERE IS ONE 15 KW UNIT FOR THE TT-30FLD TWO SUCH UNITS ARE REQUIRED. THIS SCHEMATIC SHOWS THE LEFT HAND TRANSMITTER (TRANSMITTER-A). IN THE RIGHTHAND TRANSMITTER (TRANSMITTER-B) PREFIX 1 BECOMES PREFIX 4, PREFIX 2 BECOMES PREFIX 3.

3 - 1P12, 1P16, 30P10, 30P11 CONNECT TO THE RF SWITCHING PANEL. THE LINKS 1E68 TO 1E69 AND 1E71 TO 1E72 ARE MADE VIA THE RF SWITCHING PANEL.

4 - MULTIMETER SWITCH POSITIONS:

1. AURAL PA FIL VOLTS		0-10V
2. VISUAL PA FIL VOLTS		0-10V
3. 28 VOLT SUPPLY		0-30V
4. AURAL IPA GRID CUR		0-100mA
5. AURAL IPA SCREEN VOLTS		0-1000V
6. OFF		
7. AURAL IPA SCREEN CUR		0-30mA
8. OFF		
9. AURAL PA GRID CUR		0-1A
10. TUNING INDICATION		0-100
11. VIS IPA BIAS		0-100V
12. VIS IPA CATH CUR (1)		0-1A
13. VIS IPA CATH CUR (2)		0-1A
14. VIS IPA SCREEN VOLTS	(1)	0-1000V
15. VIS IPA SCREEN VOLTS	(2)	0-1000V
16. VIS IPA SCREEN CUR	(1)	0-100mA
17. VIS IPA SCREEN CUR	(2)	0-100mA
18. VISUAL PA GRID CUR		0-1A
19. OFF		
20. OFF		

5 - REMOVE JUMPERS WHEN REMOTE METERING CIRCUIT IS USED. RESISTORS SHOWN DOTTED INDICATE INPUT IMPEDANCE OF REMOTE CONTROL UNIT.

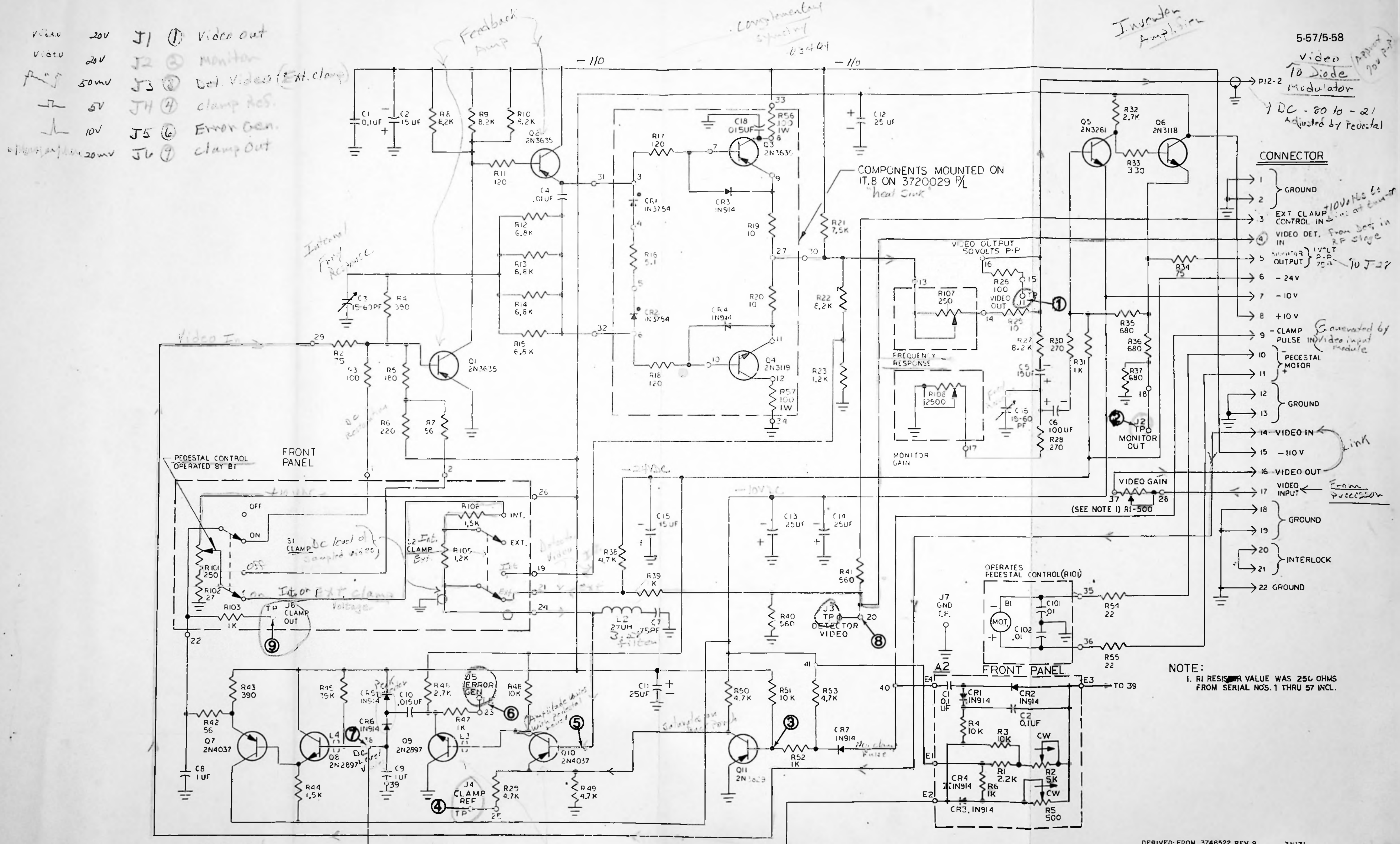
6 - ALL 200 SERIES DESIGNATIONS ARE PART OF VIS IPA
ALL 300 SERIES DESIGNATIONS ARE PART OF VISUAL PA.
ALL 100 SERIES DESIGNATIONS ARE PART OF AURAL IPA & PA.
ALL 1 TO 99 AND 400 SERIES DESIGNATIONS ARE PART OF AMPLIFIER CABINET.

7. DEPENDING ON CHANNEL & DRIVE POWER REQUIRED THIS PAD MAY NOT BE USED IN THE CIRCUIT.

DERIVED FROM 3477546 REV 0

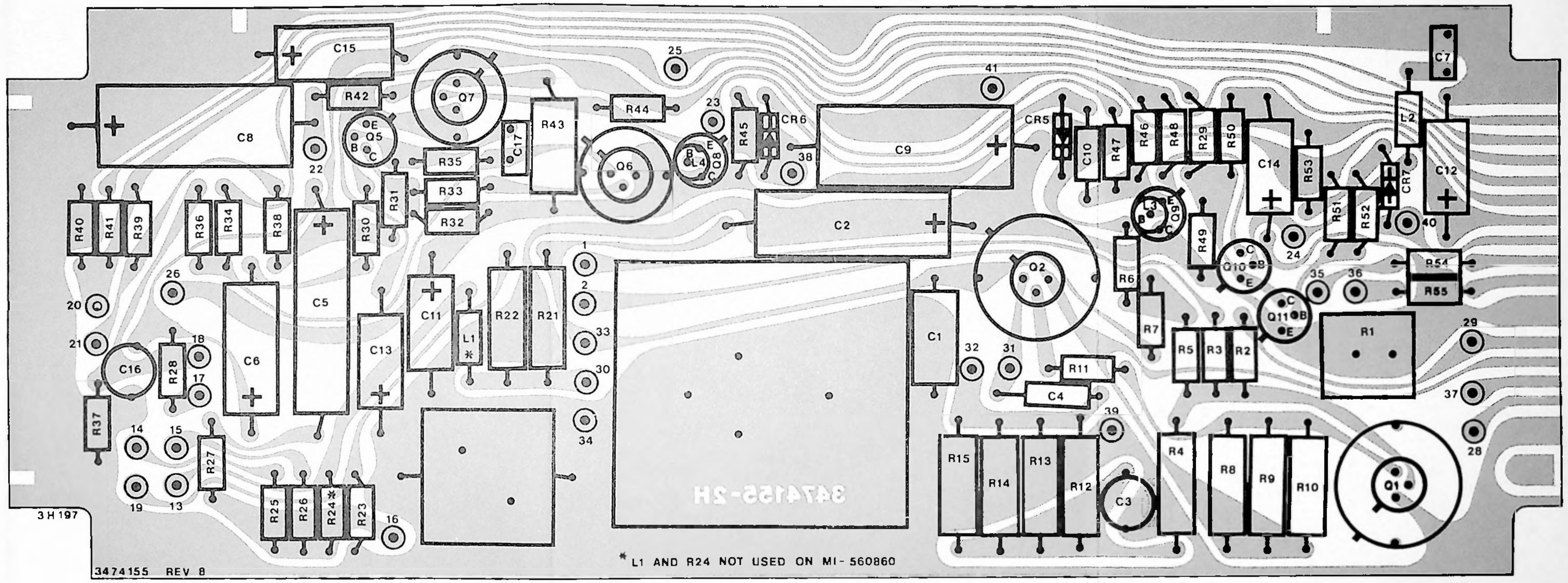
3H215

Figure 15. Schematic, TT-30FLD Amplifier Cabinet with Bi-Level Power Switching

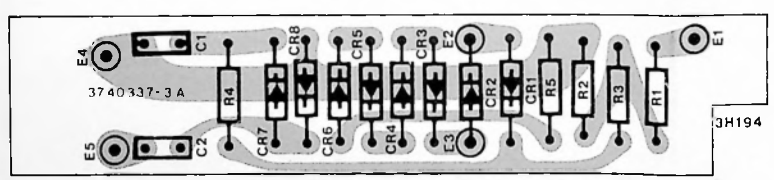


DERIVED FROM 3746522 REV 9 3H171

Figure 5-19. Video Amplifier and Output Module MI-560860 Schematic Diagram (3746522) (Sheet 2 of 2)

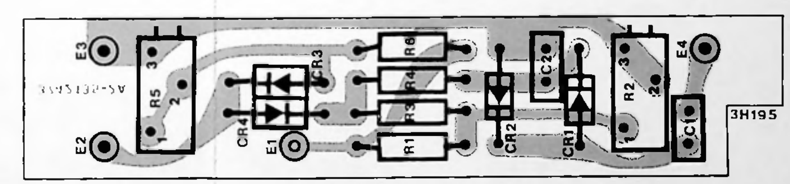


A1 TOP VIEW



FIXED RESISTOR TYPE

A2 – TOP VIEW



VARIABLE RESISTOR TYPE

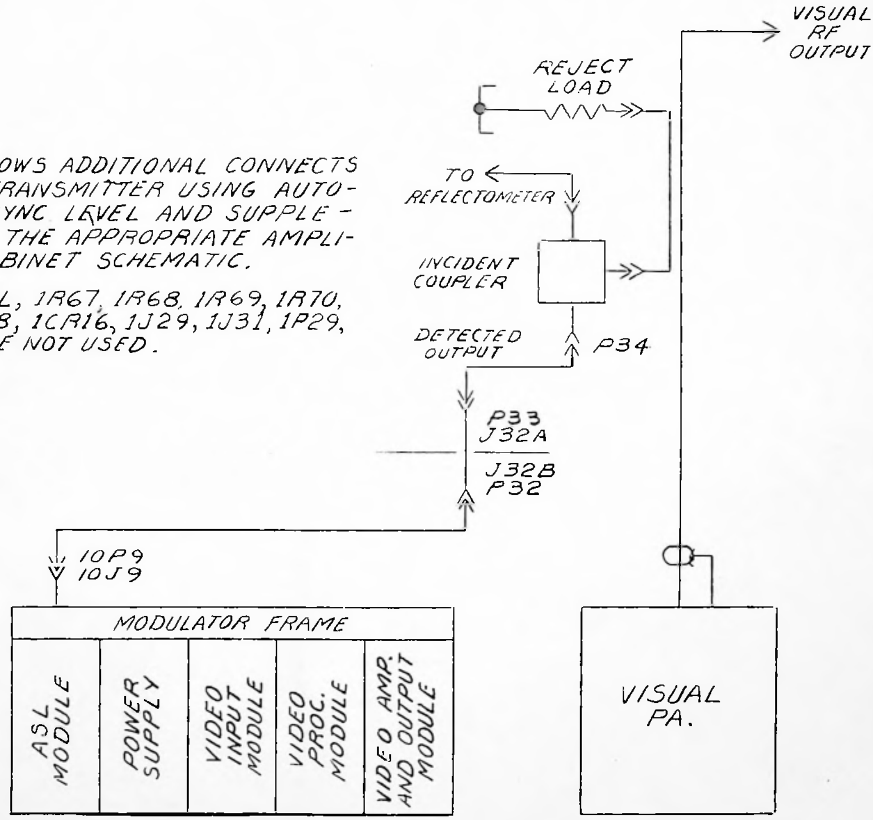
A2 – TOP VIEW

Figure 5-20. Video Amplifier and Output Module MI-560860 Printed Wiring Board Assemblies (A1 and A2)

NOTE:

1. THIS SHOWS ADDITIONAL CONNECTS FOR A TRANSMITTER USING AUTOMATIC SYNC LEVEL AND SUPPLEMENTS THE APPROPRIATE AMPLIFIER CABINET SCHEMATIC.

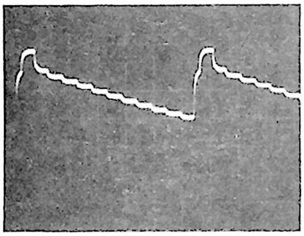
2. WITH ASL, 1R67, 1R68, 1R69, 1R70, 1C17, 1C18, 1CR16, 1J29, 1J31, 1P29, 1P31 ARE NOT USED.



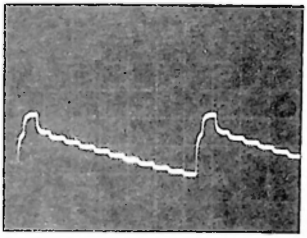
3H177 DERIVED FROM 3734159 REV 0

Figure 5-21. Automatic Sync Level (ASL) Control Module MI-561330, Block Diagram

BASE OF Q3
(1) V–1V/DIV, H–10μS/DIV
OFFSET 0V



J1--DETECTED VIDEO
(2) V–1V/DIV, H–10μS/DIV
OFFSET 0V

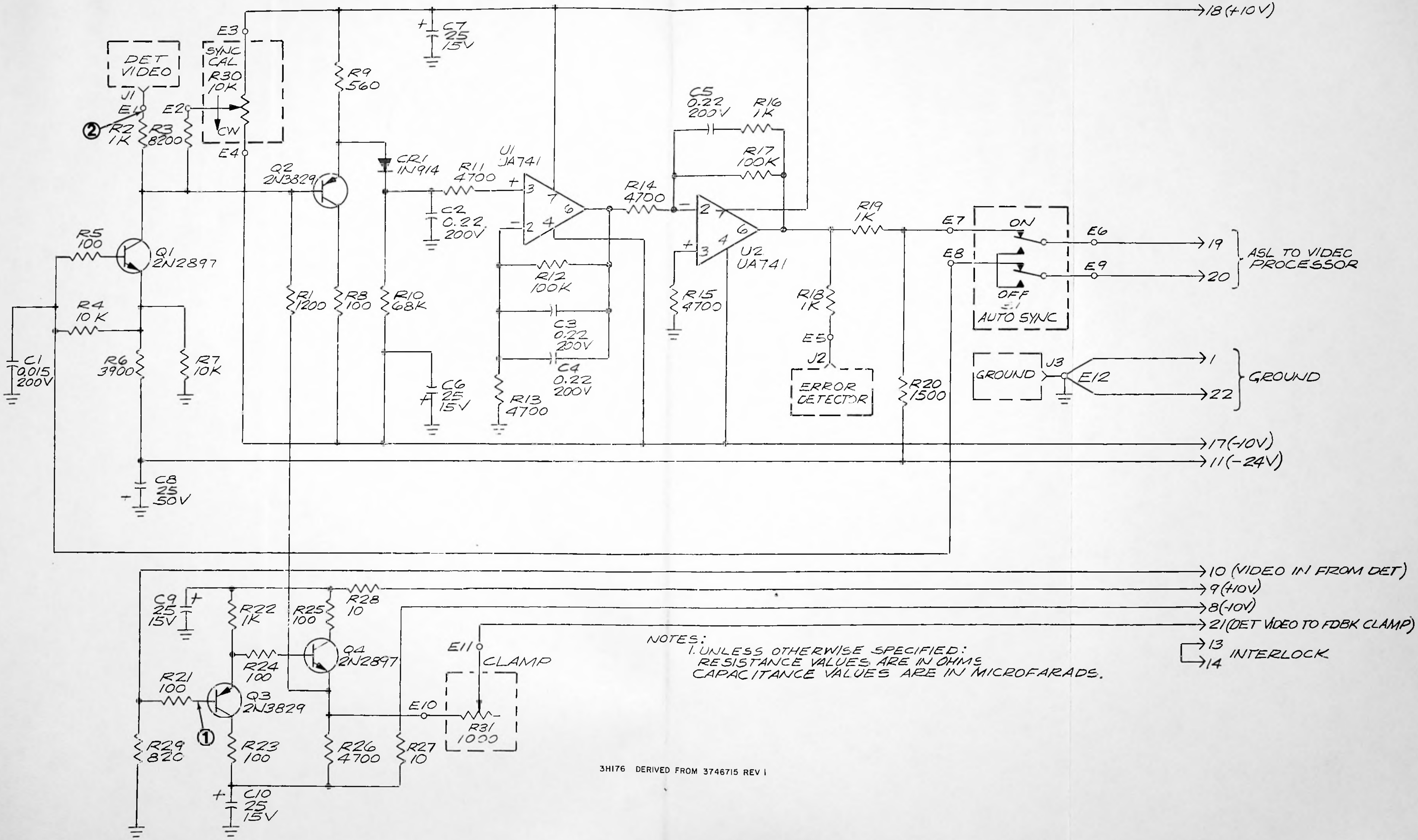


NOTES:

1. OFFSET VOLTAGE CORRESPONDS TO CENTER LINE ON SCOPE.
2. (#) —SEE SCHEMATIC DIAGRAM FOR WAVESHAPE LOCATION.
3. V=VERTICAL H=HORIZONTAL

1H274

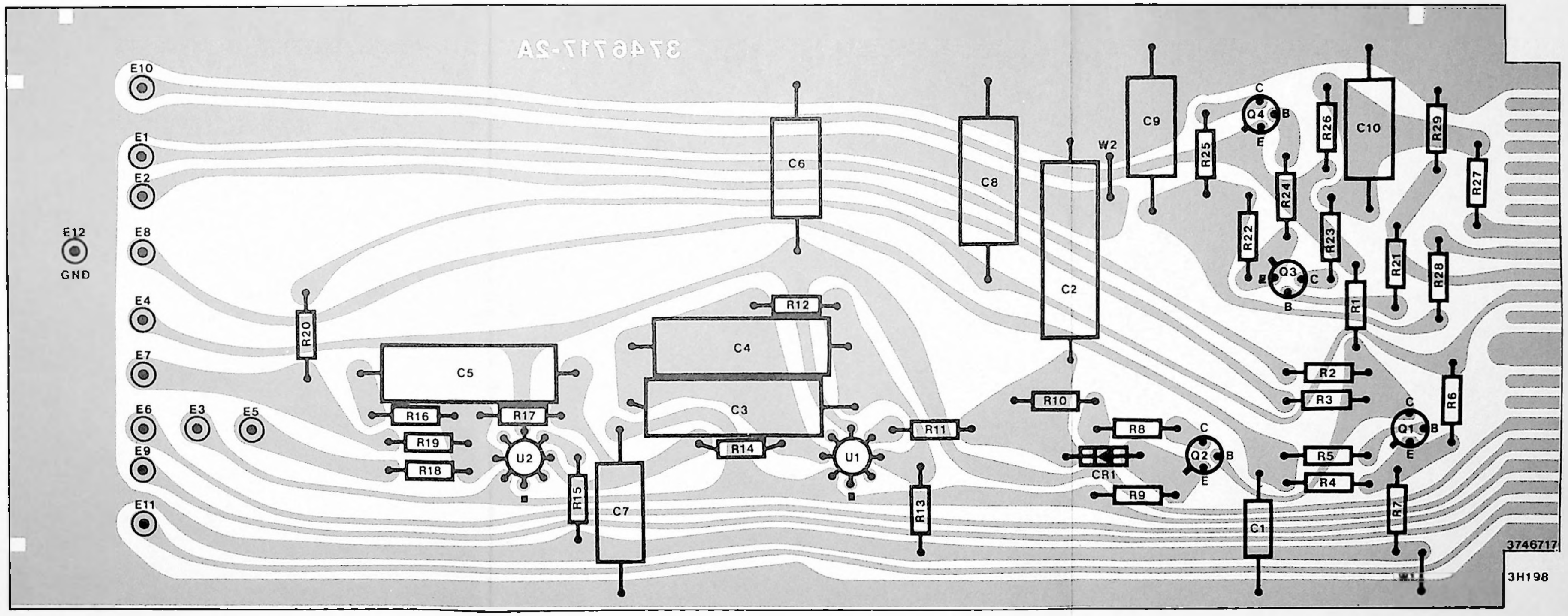
Figure 5-22. ASL Control Module MI-561330
Typical Waveforms (Sheet 1 of 2)



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
RESISTANCE VALUES ARE IN OHMS
CAPACITANCE VALUES ARE IN MICROFARADS.

3H176 DERIVED FROM 3746715 REV 1

Figure 5-22. ASL Control Module MI-561330 Schematic Diagram (3746715) (Sheet 2 of 2)



TOP VIEW

Figure 5-23. ASL Control Module MI-561330
Printed Wiring Board Assembly

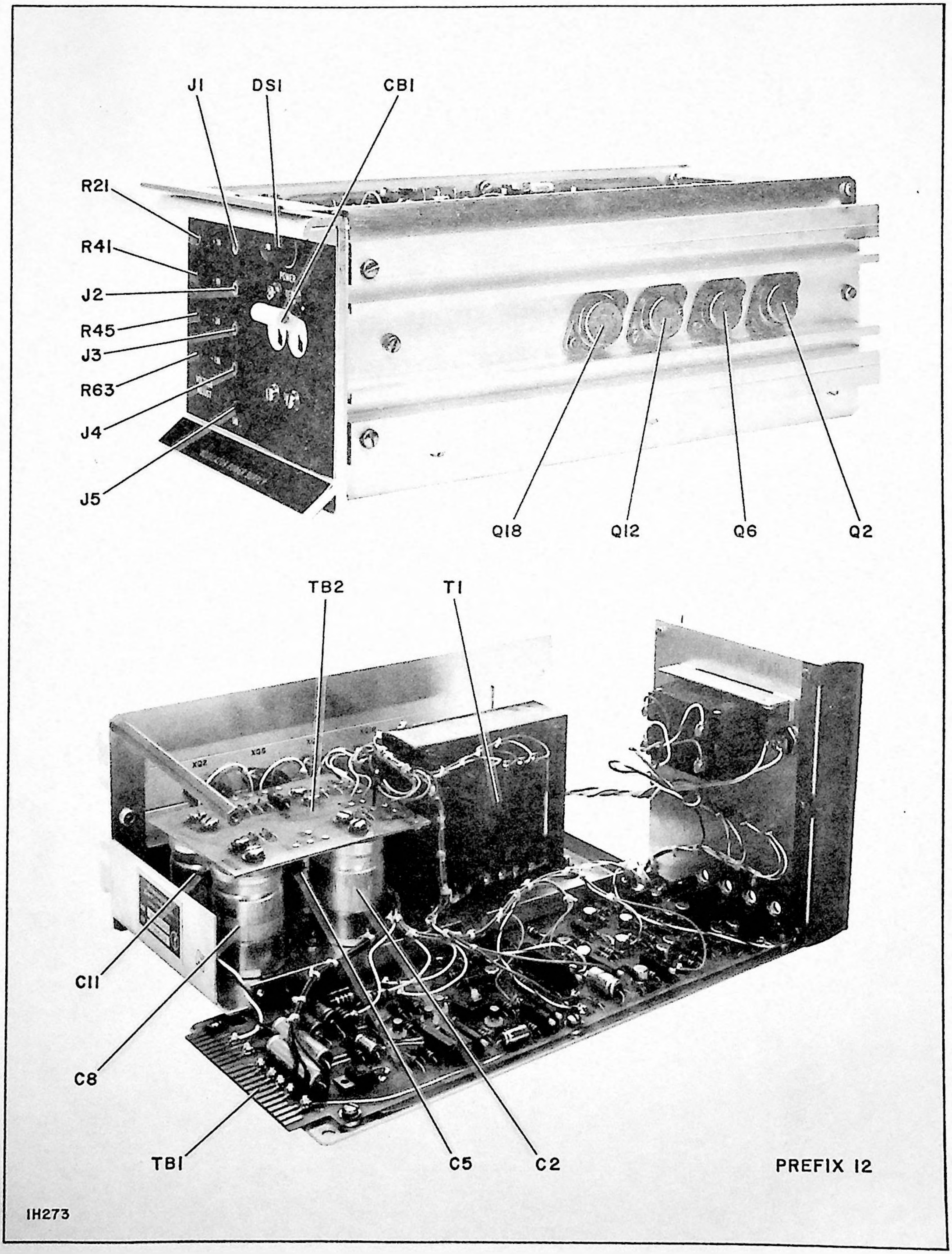


Figure 5-24. Video Modulator Power Supply Module MI-560458B/C – Prefix 12

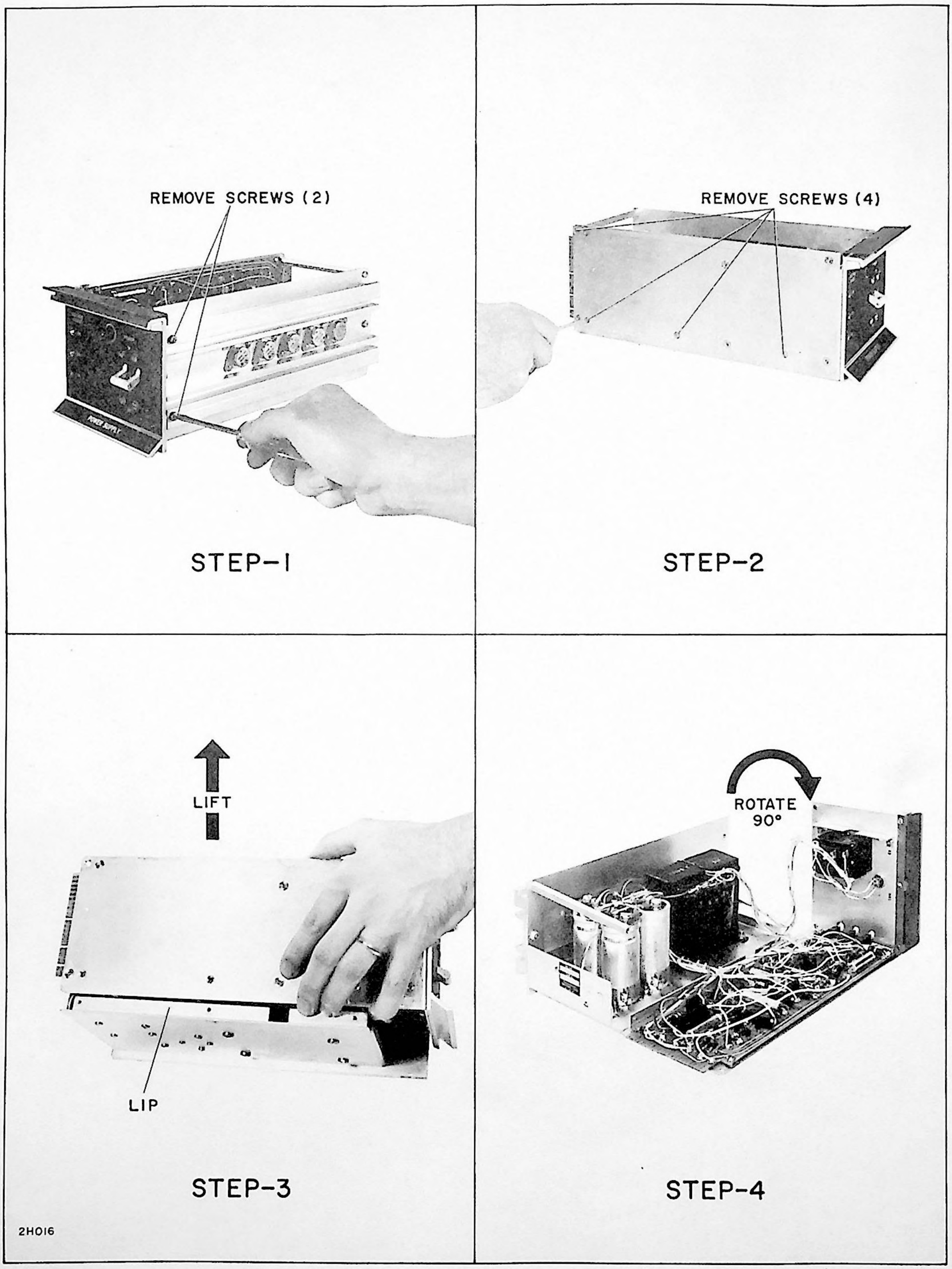
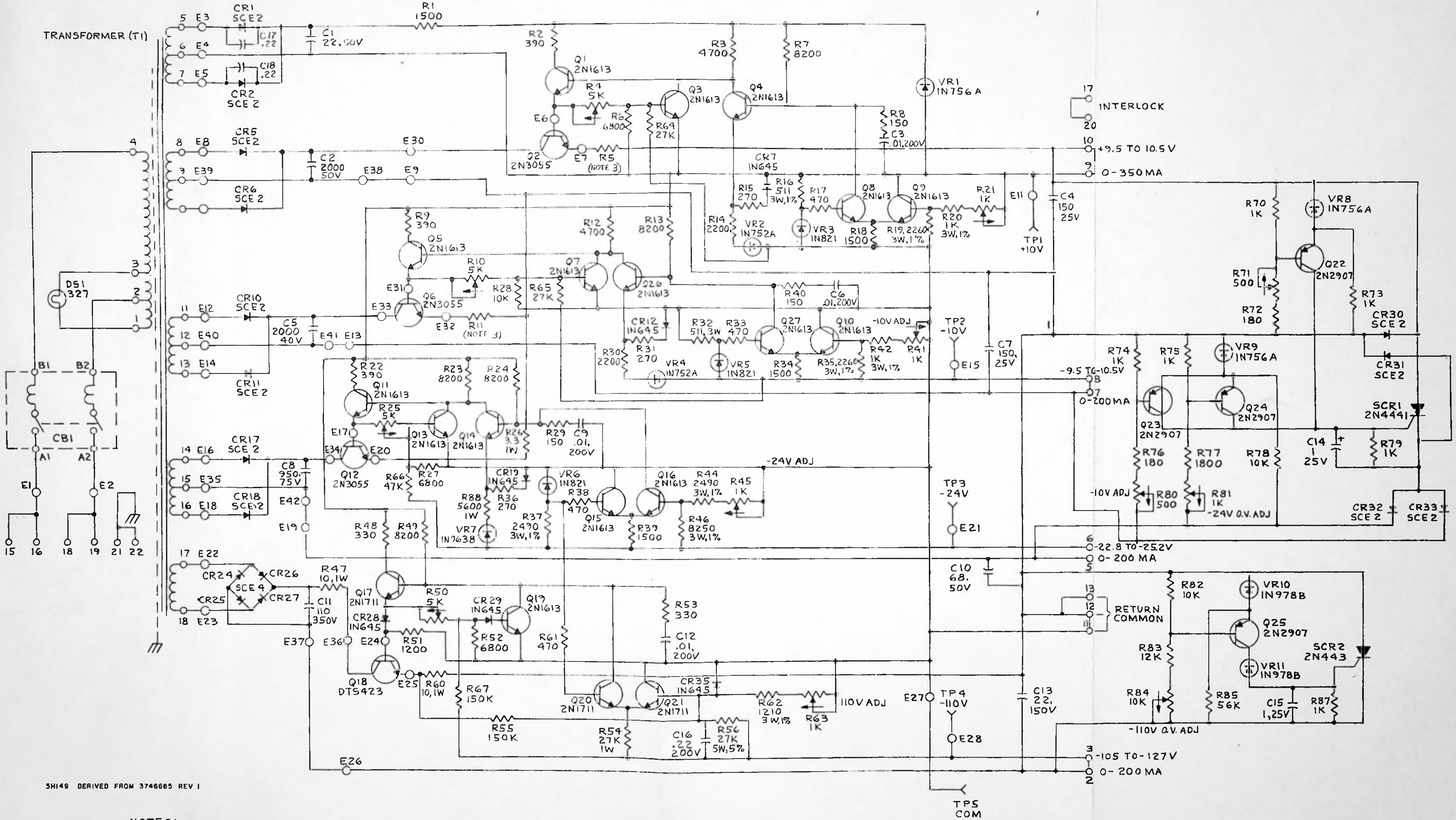


Figure 5-25. Power Supply Disassembly Procedure



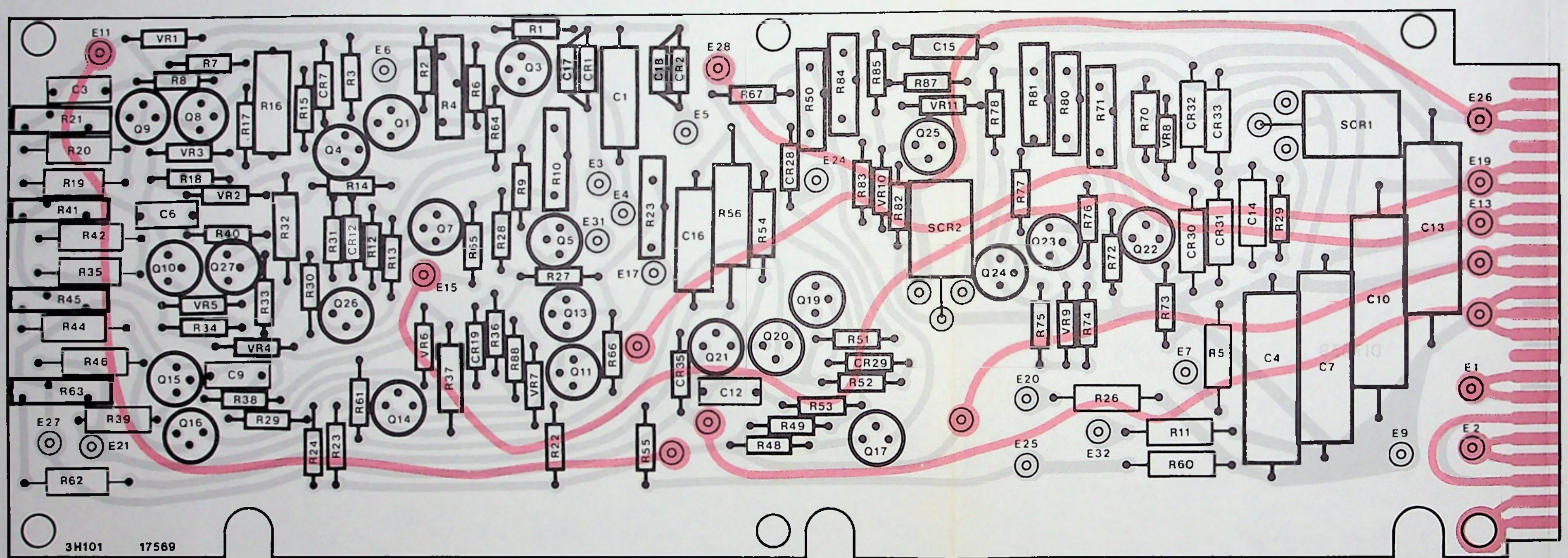
3H149 DERIVED FROM 3746665 REV 1

NOTES:

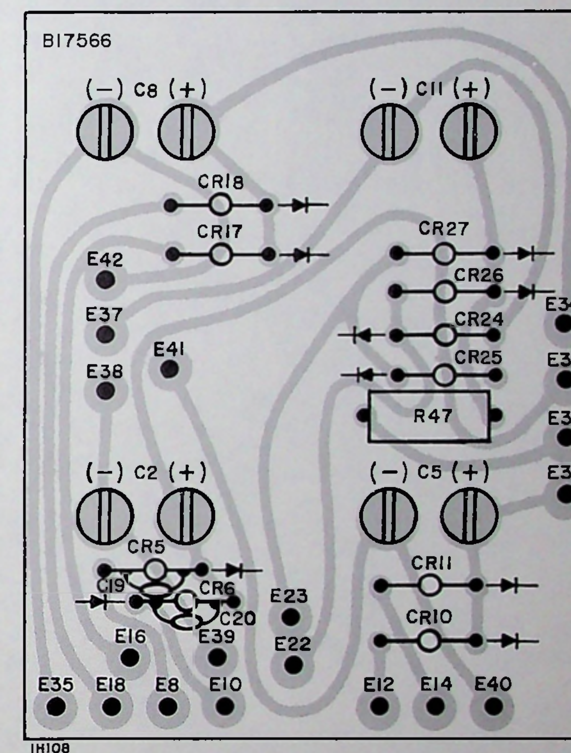
1. RESISTANCE VALUES ARE IN OHMS ±10%, 1/2 W UNLESS OTHERWISE NOTED.
2. CAPACITANCE VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. R5+R11 FOR MI 560458B IS 3.3 OHMS, 1 W AND R5+R11 FOR MI 560458C IS 1 OHM, 1 W

Figure 5-26. Video Modulator Power Supply Module MI-560458B/C, Schematic Diagram (3746665)

TB1 TOP VIEW

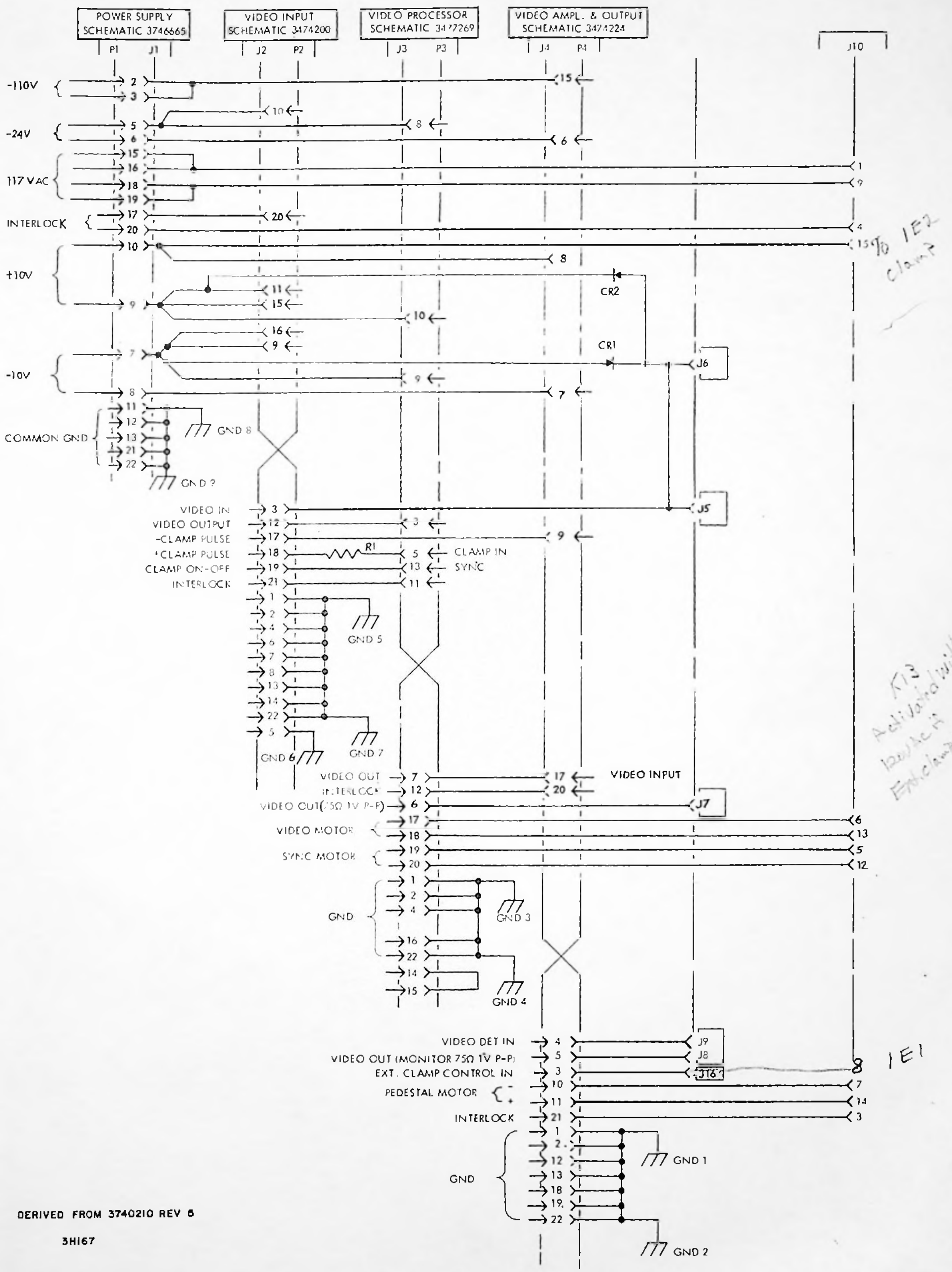


TB2 TOP VIEW



THE TRACK SHOWN IN RED IS ON THE COMPONENT SIDE OF THE BOARD

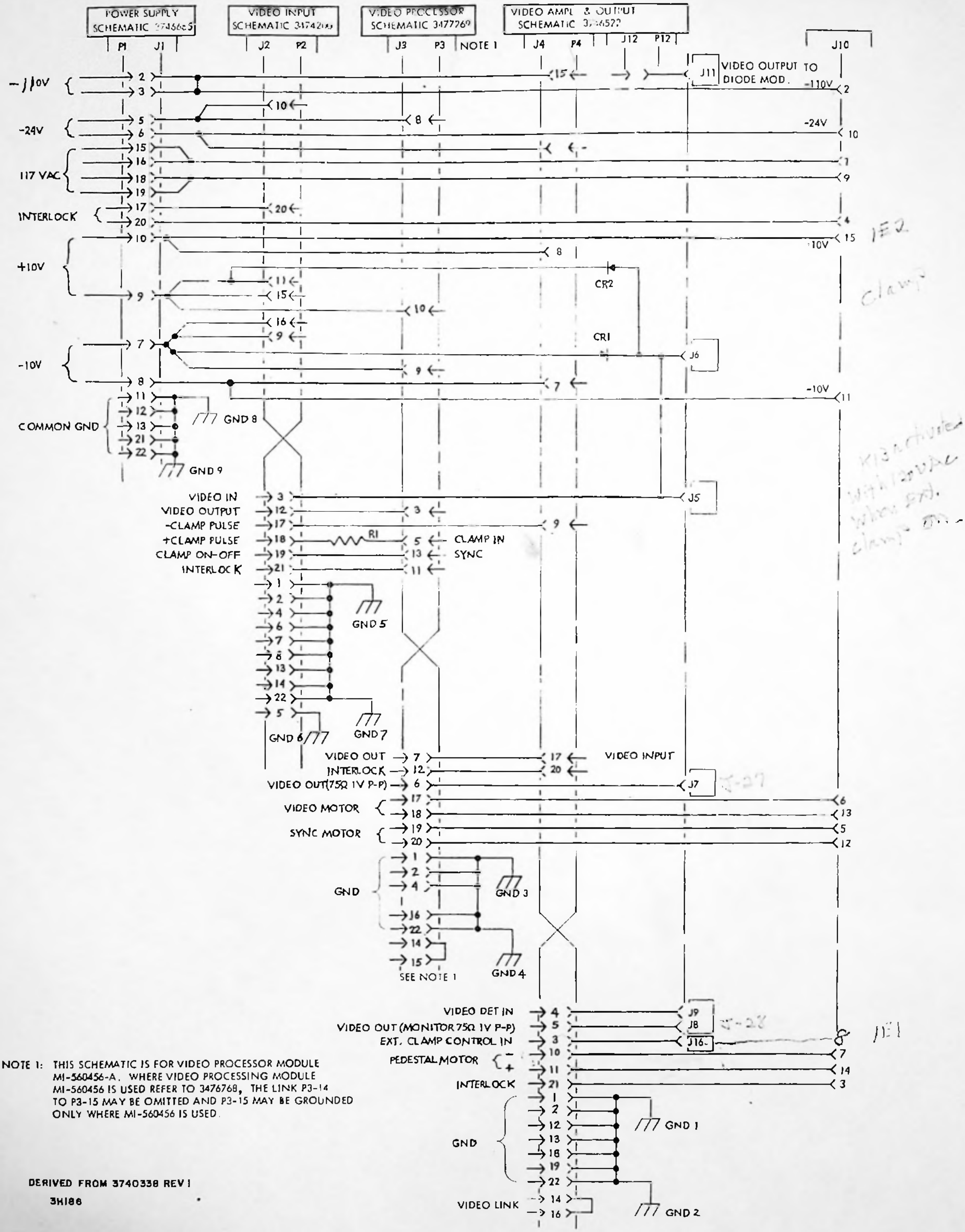
Figure 5-27. Video Modulator Power Supply Module MI-560458B/C, Printed Wiring Board Assemblies (TB1 and TB2)



DERIVED FROM 3740210 REV B

3H167

Figure 5-28. Frame Assembly Interconnection Wiring Diagram (3740210) Without ASL or Diode Modulation

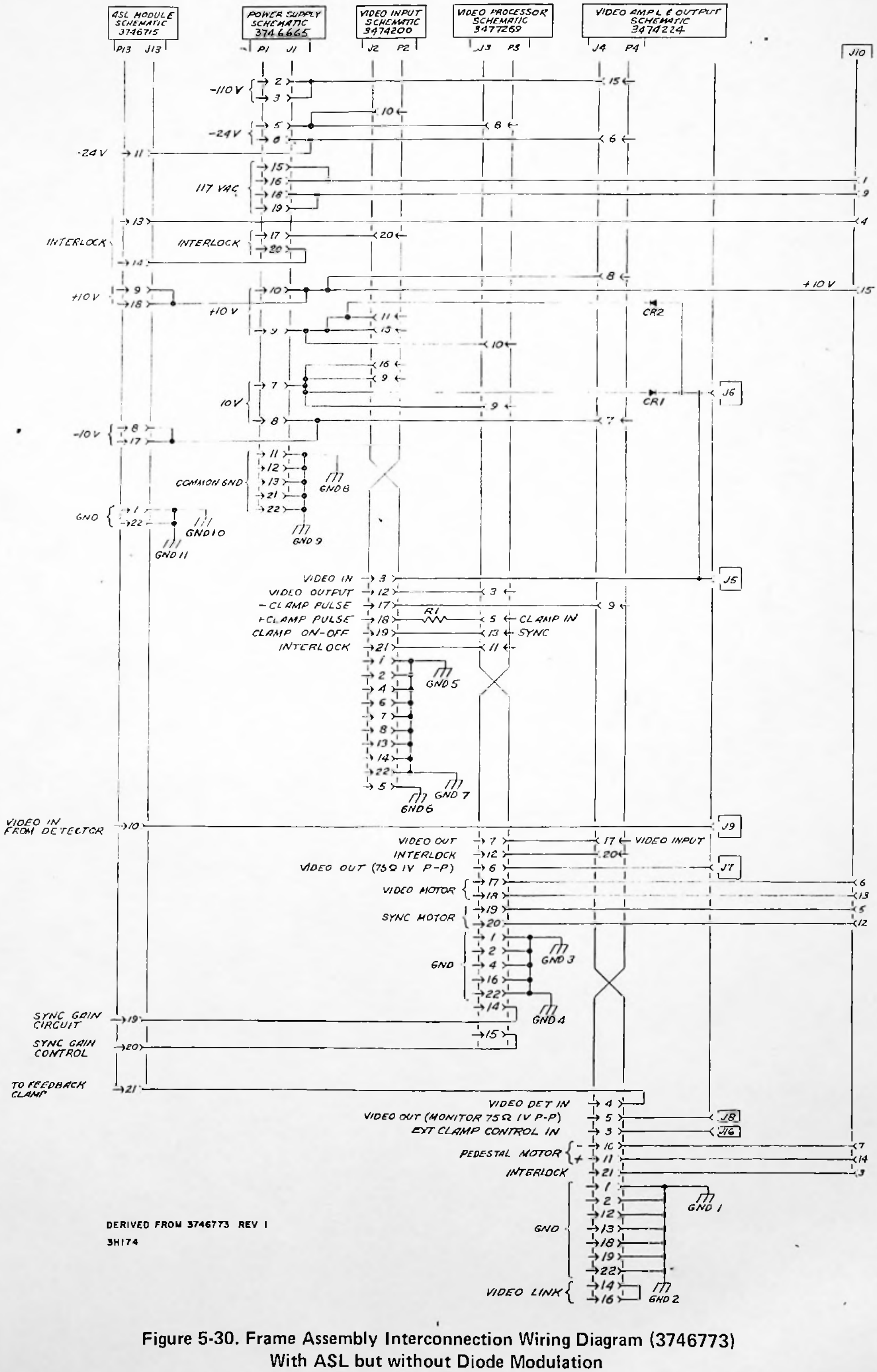


NOTE 1: THIS SCHEMATIC IS FOR VIDEO PROCESSOR MODULE MI-560456-A. WHERE VIDEO PROCESSING MODULE MI-560456 IS USED REFER TO 3476768, THE LINK P3-14 TO P3-15 MAY BE OMITTED AND P3-15 MAY BE GROUNDED ONLY WHERE MI-560456 IS USED.

DERIVED FROM 3740338 REV I

3H186

Figure 5-29. Frame Assembly Interconnection Wiring Diagram (3740338) Without ASL but with Diode Modulation



DERIVED FROM 3746773 REV 1
3H174

Figure 5-30. Frame Assembly Interconnection Wiring Diagram (3746773)
With ASL but without Diode Modulation

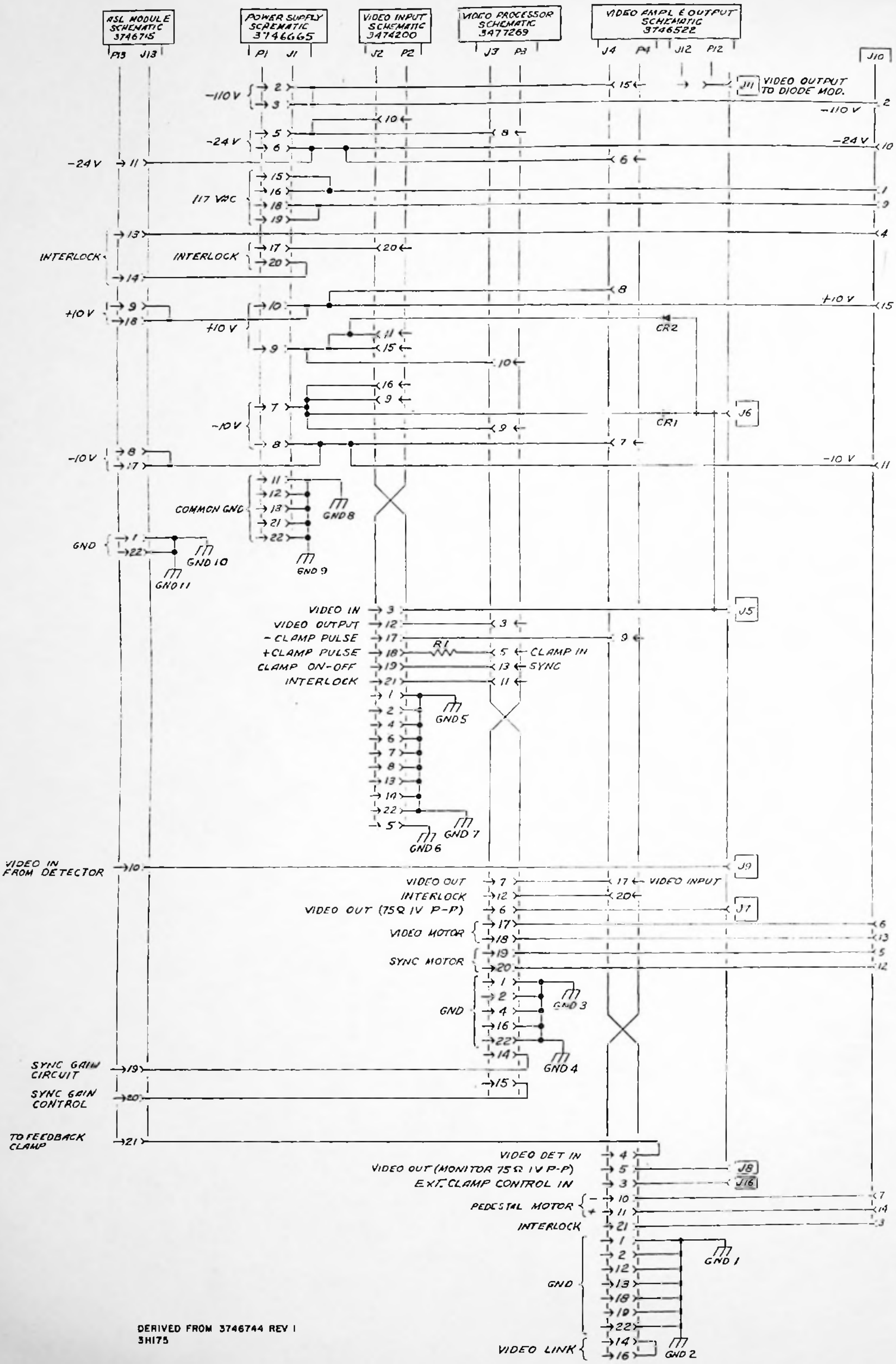
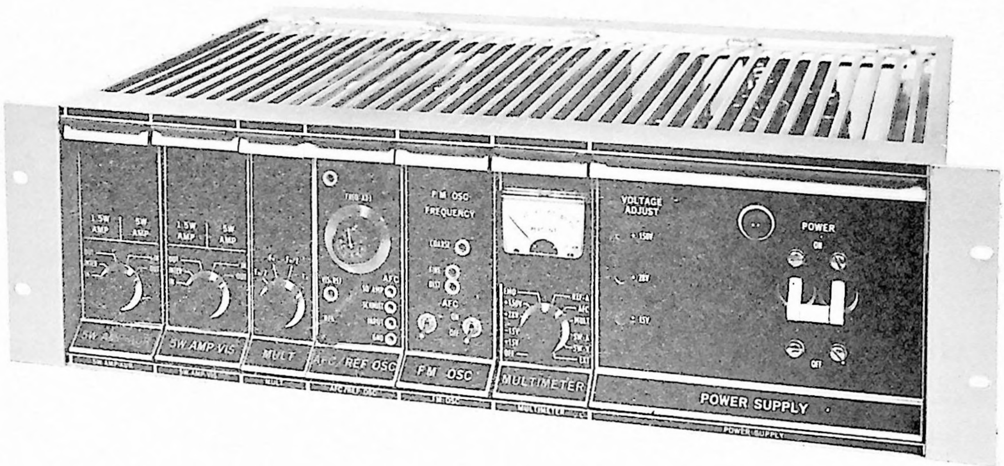


Figure 5-31. Frame Assembly Interconnection Wiring Diagram (3746744) With ASL and Diode Modulation



1H035

Figure 6-1. 5W Exciter

EQUIPMENT LIST

Quantity	Item	Reference
2	5 Watt Amplifier Module – Visual/Aural	MI-560531
1	FM Oscillator Module	MI-560532
1	AFC/Reference Oscillator Module	MI-560533
1	Multiplier Module	MI-560535
1	Multimeter Module	MI-560537
1	Exciter Power Supply Module	MI-560538-B
1	Module Frame Assembly	MI-560525
1	Aural Reference Oscillator and Oven	MI-560539-*
1	Visual Crystal Oscillator and Oven	MI-560540-*
1	Module Extender	MI-560541-B
*Selected according to customer's assigned frequency.		

DESCRIPTION

GENERAL

The VHF 5W Exciter (See Figure 6-1) is a self-powered unit of plug-in modular construction designed for operation on TV channels 2 thru 6. The design employs all solid state circuits. The exciter consists of seven module assemblies contained in a standard RCA 5-1/4" x 19" module frame assembly (see Figure 6-7).

A visual excitation signal and frequency modulated (FM) aural signal are generated and controlled to meet with industry and FCC transmission requirements. An aural carrier frequency stability of ±500 Hz maximum referenced to the visual carrier is maintained by an automatic frequency control (AFC) circuit. The RF Amplifier Modules produce an aural and visual output power of 5 watts. A built-in multimeter is provided for tuning purposes and to enable the function of all modules to be monitored during operation. A module extender, MI-560451B, is provided to permit easy servicing of modules outside the main frame. Figure 6-2 is the 5W Exciter functional/signal flow block diagram.

MODULE CIRCUIT DESCRIPTION

FM Oscillator Module MI-560532 – Prefix 24

The FM oscillator module (see Figures 6-11 thru 6-13) consists of four (4) assemblies. They are:

FM Oscillator – A1
Amplifier – A2
Buffer – A3
FM Oscillator Assembly – A4

The main function of the module is to generate the frequency modulated (FM) aural signal at one-half carrier frequency. Also included in the module is the pre-emphasis network and operational amplifier used in the AFC feedback loop. An audio input signal of +10 dBm is applied to impedance matching transformer A1T1 connected in a balanced configuration. Either a 150 or 600 ohm audio input impedance may be selected by taps on the transformer. The transformer is normally connected for an input of 600 ohms. The signal is then fed through a resistive pad to operational amplifier A1A5. Pre-emphasis is obtained by means of frequency-selective negative feedback and is normally set for a standard 75 microsecond curve. By disconnecting capacitor A1C1, a 50 microsecond pre-emphasis can be obtained. The processed audio signal is then applied to audio level control A1R8 for application to the FM Oscillator Assembly – A4. Operational amplifier A1A6 serves as a high gain DC amplifier connected in a non-inverting configuration. Its function is to amplify the error voltage in the AFC loop. The DC voltage gain is approximately 1000 as determined by the ratio of A1R11 to the sum of A1R9 and A1R10. Bias potentiometer A1R17 adjusts the initial offset voltage of the amplifier to zero.

FM oscillator A4 is a Clapp type oscillator (see Figure 6-3). The free running frequency of oscillation is determined by the settings of A4L4 and A4C5. Varactor A4CR2 is used to control the center frequency when the oscillator is under AFC control, and varactor A4CR1 is used to instantaneously deviate the center frequency in accordance with the audio input. Coarse frequency adjust A4L4, final frequency adjust A4C5 and distortion adjust A4R1 are all accessible from the front panel. The deviation adjust capacitor A4C3 is accessible through the top cover of A4 by extending the module on the module extender. A4R1 and A4C3 are both factory adjusted to provide minimum distortion at full deviation. The oscillator output is coupled to an emitter follower A4Q2 which provides isolation between the oscillator and successive circuitry.

The FMO assembly (A4) employs temperature compensating components. Stability is further enhanced by enclosing the circuit in an RF shielded, shock mounted, proportional control oven. The internal oven temperature is 75°C ±2°C over the operating ambient temperature range with a stability of ±0.5°C at any given ambient temperature within that range. Any drift relative to the reference oscillator is then further corrected by the AFC circuit.

The output signal from FM Oscillator assembly A4 is then applied to FMO amplifier A2. The amplifier is operated Class A in a common emitter configuration. The input tuned circuit consists of A2C100 and A2L100, while the output circuit consists of A2C102, A2L102, and A2C103. Amplifier A2 delivers a 5 mW signal to the Multiplier Module MI-560535 and a 50 mW signal to the AFC/Reference Oscillator Module MI-560533 through Buffer Amplifier A3.

Buffer Amplifier A3 operating in a common collector configuration, serves as an isolation stage from the AFC circuits.

AFC/Reference Oscillator Module MI-560533 – Prefix 23

The AFC/Reference Oscillator Module (see Figures 6-14 thru 6-16) consists of six (6) assemblies. They are:

AFC/Reference Oscillator Main Board – A1
Attenuator – AT1
Mixer – A3
Aural Reference Oscillator – A4
Visual Crystal Oscillator – A5
AFC (Discriminator) – A6

The module is designed to accomplish two things. One function is to provide a signal at one-half the visual carrier frequency. The other function is to provide the AFC DC correction voltage for the frequency modulated oscillator.

Automatic frequency control (AFC) is incorporated to maintain aural center frequency within ±500 Hz of the Visual Carrier. This degree of stability is achieved by a closed loop frequency monitoring system in which the FM Oscillator signal is compared with some absolute reference; in this case, the Aural Reference Oscillator A4. The open loop gain, in this design, determines the ratio of improvement. As an example, if the uncontrolled drift of the FM Oscillator were, for instance ±12.5 kHz, feedback providing an open loop gain of 250 or 48 dB would reduce this drift by a factor of 250 to ±50 Hz.

Refer to Figure 6-4 for assistance in understanding the AFC operation. A reference signal of FA/2 + 150 kHz is derived from the oven-controlled Aural Reference Oscillator A4. The oscillator circuit is of Colpitts design

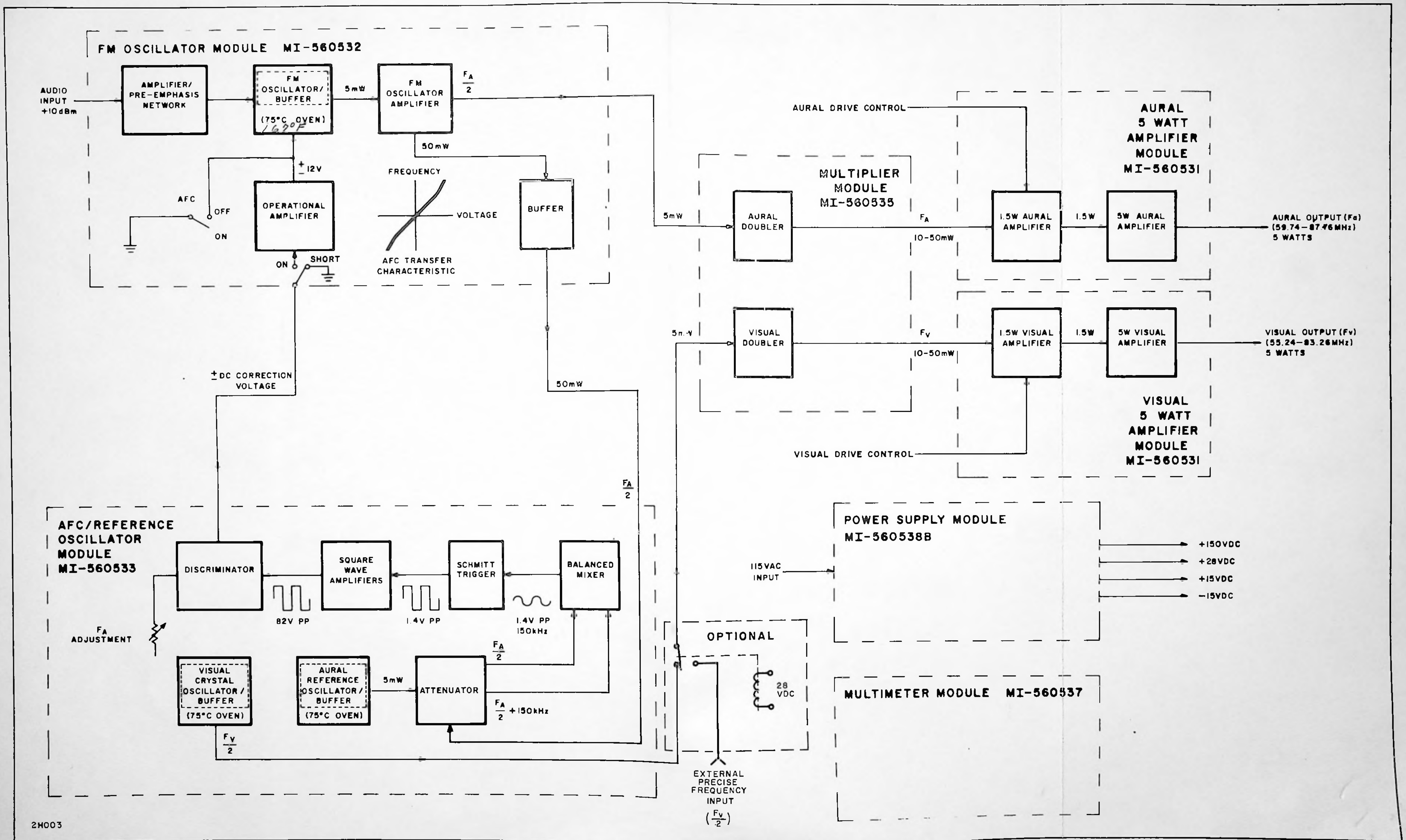


Figure 6-2. 5W Exciter Functional/Signal Flow Block Diagram

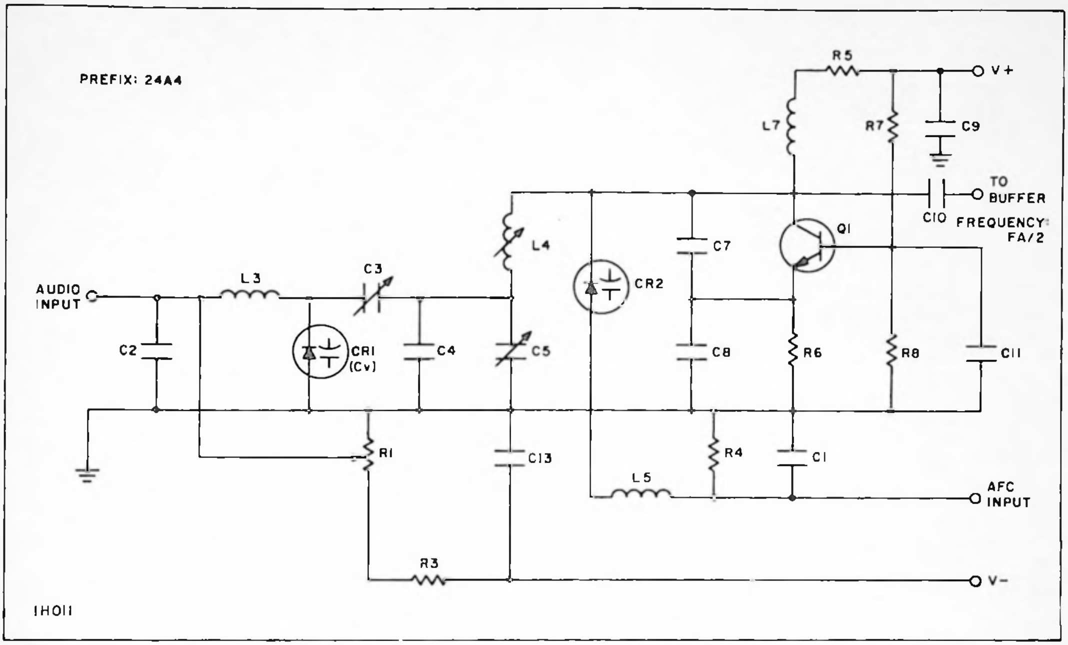


Figure 6-3. FM Oscillator Simplified Schematic

driving an emitter follower isolation stage. The oven used is a DC proportional control type whose cavity temperature is accurately controlled at 75°C ±0.5°C over an ambient temperature range of -20°C to +55°C. A frequency stability of better than ±0.0001% is maintained. This stable reference signal and a sample of FM oscillator frequency FA/2 are applied through an attenuator AT1 to an untuned double-balanced Mixer A3. A beat frequency of 150 kHz with a peak-to-peak amplitude of 0.6 V appears at the mixer output. Any variation of the aural FM oscillator will be reflected by a corresponding variation of this frequency. This signal is applied to a low-pass filter network, and in turn, to the Schmitt Trigger circuit (A1Q1/A1Q2) to transform the sine wave signal into a square wave. Amplitude of the Schmitt Trigger output is approximately 1.4 V peak-to-peak.

This square wave is applied to square wave amplifiers A1Q4 and A1Q7 through emitter follower stages A1Q3, A1Q5, and A1Q6. A peak-to-peak amplitude in excess of 82 V appears at the collector of amplifier A1Q7. This voltage, in turn, is applied to two clamping diodes A6CR1 and A6CR2 which clamp the square wave between ground and an 82 volt reference voltage. The 82 V reference voltage is supplied by the stable reference source, A1DS1. Following the clamping diodes is a counter type detector consisting of capacitor A6C15 and diodes A6CR3 and A6CR4. The output of this highly-linear detector is directly proportional to frequency.

With a 150 kHz input signal applied to the Schmitt Trigger, the discriminator will supply a constant negative voltage. This voltage, however, is balanced by a voltage of opposite polarity derived from the 82 V reference source, so that for a center frequency of 150 kHz, there exsists a zero potential at operational amplifier A1A6 input in the FM Oscillator Module. FREQ ADJUST vernier R25 on the front panel is set for zero error voltage at the correct aural carrier frequency. This zero potential can be made to appear approximately ±5 kHz from the AFC center frequency. In this manner, aural center frequency may be adjusted.

Any error voltage appearing at the operational amplifier A1A6 input will be amplified by approximately 50 dB. Depending on the magnitude and polarity of the error voltage, a voltage of ±12 V maximum is produced at the operational amplifier A1A6 output. Consequently, this DC voltage, which is directly proportional to any frequency drift of the FM oscillator A4, is fed to varactor diode A4CR2. The capacitance of the varactor diode is changed in such a direction as to return the oscillator to the correct frequency. The AFC feedback system causes a drift improvement of approximately 250 with a transfer characteristic sensitivity of 1 volt/100 Hz. Figure 6-5 shows the transfer characteristic of the AFC system. AFC pull-in range is approximately ±250 kHz, which is more than ample for positive frequency control.

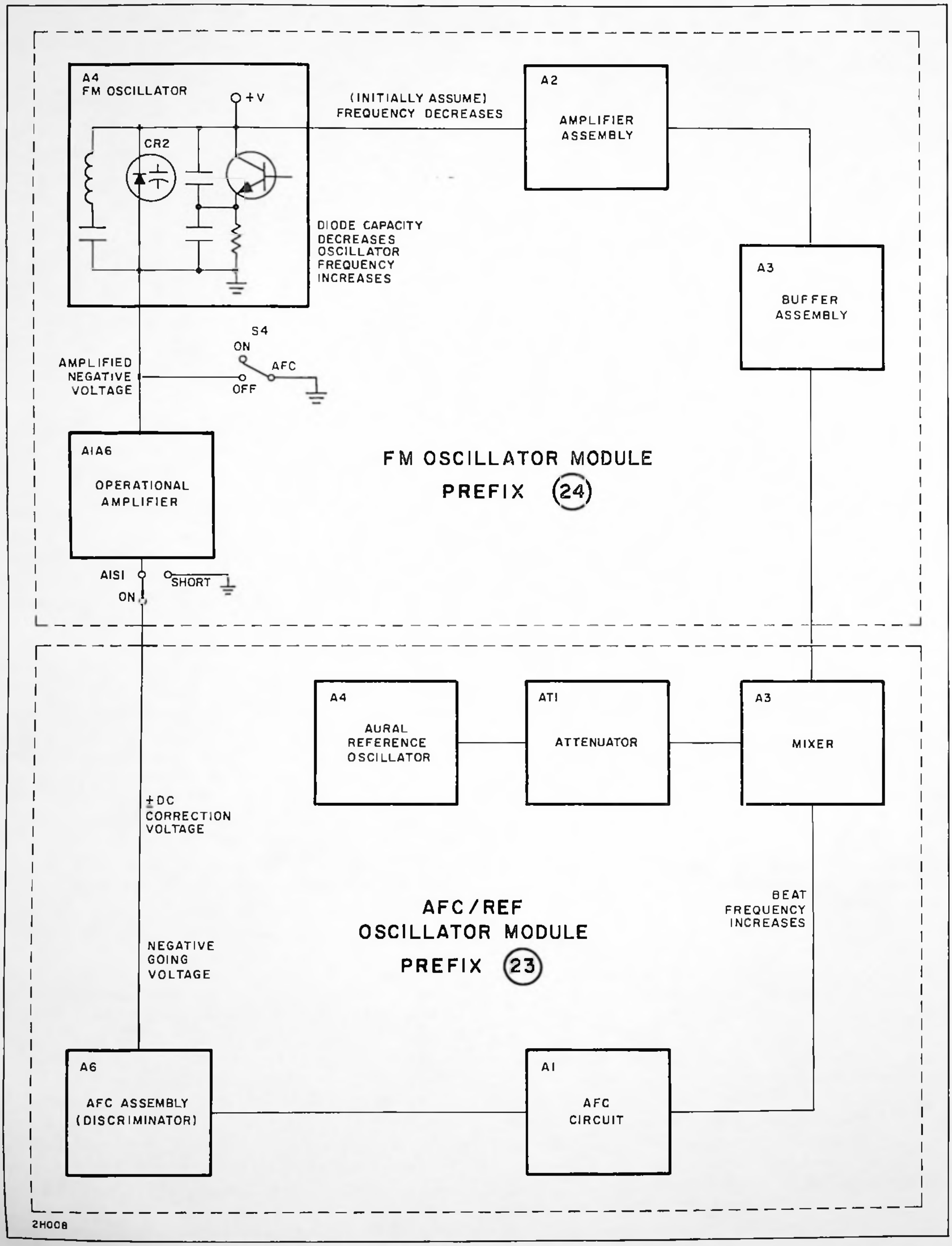


Figure 6-4. AFC Loop Signal Flow Block Diagram

Visual Crystal Oscillator Assembly A5 provides the visual excitation signal at one-half the visual carrier. The visual oscillator and oven are identical to the aural oscillator and oven with the exception of the frequency and the AFC detector which is located in the aural oven.

Precise Frequency Control

When provision is made to supply precise frequency control (PFC) to the 5W Exciter, an external precision oscillator is used in place of the Visual Crystal Oscillator assembly A5. This external oscillator is connected to a coaxial relay which, when energized, from an external power source supplies the FV/2 signal from the external oscillator to the visual doubler module. When this coaxial relay is de-energized, the internal visual oscillator supplies the FV/2 signal to the doubler module.

AFC System Explanation

To easily visualize the operation of the AFC loop, reference should be made to Figure 6-4. Assume the frequency of the FM oscillator 24A4 decreases. The signal output of the oscillator will pass through amplifier 24A2 and buffer 24A3, and then beat against the aural reference oscillator 23A4 in mixer 23A3. A frequency decrease of the FM oscillator results in an increase of the mixer beat frequency. The transfer characteristic of the discriminator circuit is such that an increase in mixer output frequency causes a negative-going voltage at the discriminator output. With the AFC loop closed, this negative voltage is fed through operational amplifier A1A6 to the anode of AFC varactor diode A4CR2. This places a larger reverse bias across the diode and results in a decrease of varactor diode capacitance. The decreased diode capacitance increases the oscillator frequency which counteracts the original frequency decrease. Thus, the FM oscillator is returned toward the correct frequency.

Multiplier Module MI-560535 – Prefix 22

The Multiplier Module (see Figures 6-17 and 6-18) consists of two (2) assemblies. They are:

Frequency Doubler (Aural) – A1
Frequency Doubler (Visual) – A2

The module's function is to double the aural carrier signal (FA/2) from the FM Oscillator Module, MI-560532, and the visual carrier signal (FV/2) from the AFC/Reference Oscillator Module, MI-560533, to obtain the aural and visual exciter output frequencies. The doubler circuits are operated Class C in a common emitter configuration. Top coupled doubled-tuned circuits are employed at the input and output for increased selectivity. Impedance matching is provided by capacitor ratios.

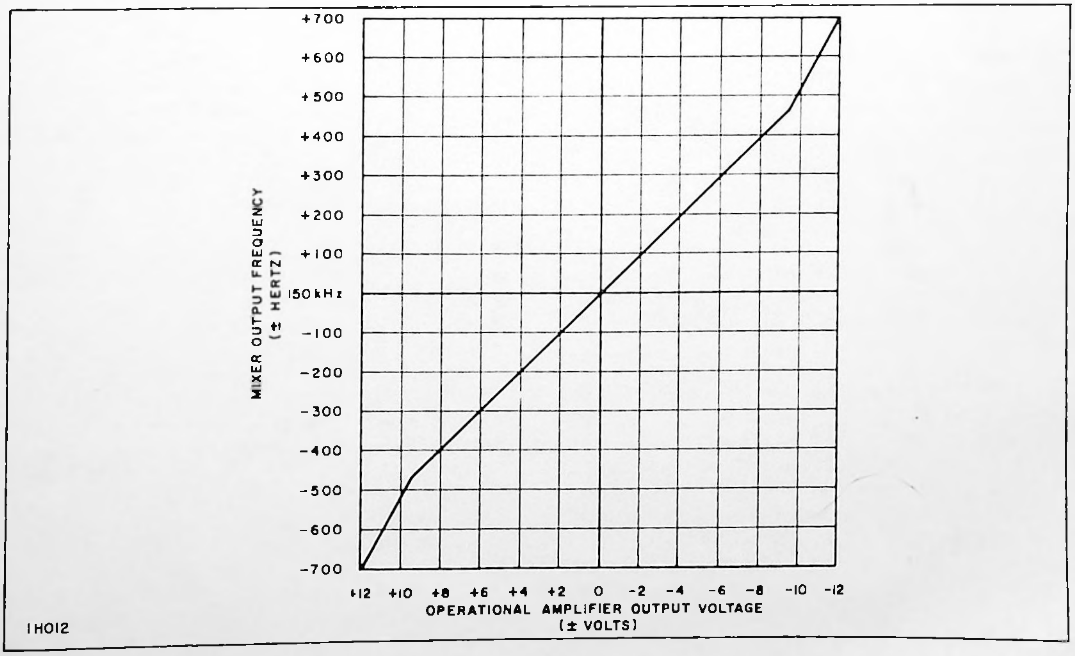


Figure 6-5. AFC Transfer Characteristic Curve

NOTE: For some channels, capacitors C3, C5, C9, and C13 are removed (refer to Table 6-3).

Output frequencies (FA and FV) at power levels of 10 to 50 mW (depending on channel) are then fed to the aural and visual 5 watt Amplifier Modules. Gain adjust potentiometer R2 is provided to set the power level to these amplifiers.

Metering is provided by sampling the RF signal through capacitors C8 and C16 and detecting this signal with diodes CR1 and CR2. Front panel switch S1 is provided to monitor the input and output tuned circuits of each doubler.

5 Watt Amplifier Module – Aural/Visual MI-560531 – Prefix 21A/21V

The aural and visual 5 Watt Amplifier Module (see Figures 6-9 and 6-10) consists of two (2) assemblies. They are:

5 Watt Amplifier – A1
1.5 Watt Amplifier – A2

The aural and visual 5 Watt Amplifier modules are identical except for tuning. The module's function is to amplify a 10 to 50 mW (depending on channel) signal to an output power of 5 watts. The amplifier consists of three Class C stages composed of A2Q1, A2Q2, and A1Q3 used in a common emitter configuration.

Aural or visual carrier frequency (FA or FV) is applied to the 1.5W amplifier A2 from the multiplier module. This signal is then coupled to the base of transistor A2Q1, through the series matching network of A2C1 and A2L1. The collector of A2Q1 is matched to the base of transistor A2Q2 by the tapped parallel-tuned circuit A2C6 and A5L5 and the series capacitor A2C7. Collector voltage to the first stage is adjusted by a potentiometer in the Drive Control Module MI-560594 providing drive control for the exciter. The collector impedance of A2Q2 is matched to its load through network A2C12, A2C13, A2L9, and A2L10 for nominal output power of 1.5W.

The 1.5W signal is then applied to the 5W amplifier A1 and coupled to the base-emitter circuit of transistor A1Q3 by the T-matching network consisting of A1C16, A1C18 and A1L2. The collector impedance of A1Q3 is transformed to 50 ohms by network A1C22, A1C25 and A1L16 for an output power of 5 watts. This final stage will tolerate load mismatches from short circuit to open circuit without damage to the output transistor.

Frequency determining coils for the amplifier module consist of A2L1, A1L12 and A1L16. Capacitors A2C1, A2C6, A1C13, A1C18 and A1C22 provide tuning for maximum output of the fundamental frequency while reducing harmonic frequencies. Filter networks in each collector supply line are incorporated to minimize stray RF fields.

Five metering circuits are provided to monitor operation of the amplifier module. Front panel switch S1 is provided to select the circuit (1.5W AMP-IN, INTER, OUT, 5W AMP-IN, OUT) to be monitored.

Multimeter Module MI-560537 – Prefix 25

The multimeter module (see Figures 6-19 and 6-20) is designed to monitor operation of the exciter circuits including AFC, supply voltages, and RF circuit performance. These circuits can be checked during operation without affecting equipment performance. The module contains a built-in meter M1 with a full-scale sensitivity of 15 microamperes and a 12-position selector switch S1 to measure the following functions:

Switch Position	Function
OFF	
+15V	+15V Supply
-15V	-15V Supply
+28V	+28V Supply
+150V	+150V Supply
FMO	FM Oscillator
Ref-A	Aural Reference Oscillator
AFC	AFC Correction Voltage
MULT	Multimeter Module
5W-A	Aural 5W Amplifier
5W-V	Visual 5W Amplifier
EXT	External Use

Module Extender MI-560541B

The module extender (see Figure 6-8) is available to permit servicing the 5 Watt Exciter under operating conditions. The unit to be serviced is removed from the Module Frame and inserted in the Extender which then plugs into the Module Frame. All components are then conveniently accessible for measurements. When the 5W Amplifier-Aural Module MI-560531 is serviced, the extender must be rotated 90° to allow the module to clear the frame of the Amplifier Cabinet.

5 Watt Exciter Power Supply Module MI-560538B – Prefix 26

The 5 Watt Exciter Power Supply (see figures 6-21 thru 6-23) provides all operating voltages used in the Exciter. These voltages include +15V, -15V, +28V and +150V, and are adjustable from the front panel. The input voltage is 117V, 50/60 Hz.

The power supply includes short circuit protection in which the circuit breaker will turn off all supplies in the event of a short within the supply itself.

The circuit utilizes series type regulators with built-in current limiting and over-voltage protection circuits. Briefly explained, emitter-coupled differential amplifiers are used as a comparison element. The purpose of the comparison element is to sample the output voltage, compare it with a reference voltage, and generate an error signal proportional to the output variation. The reference voltage source is a temperature compensated zener diode. Next, a DC amplifier is used to amplify the error signal. This amplifier signal, in turn, is fed to a series control transistor which returns the output voltage to its correct value. In the case of an over-voltage condition, over-voltage protection circuits will limit the maximum voltage output to a level determined by potentiometers R19, R47, R68 and R72. If the output voltage rises above the maximum voltage setting, SCR1 will "fire" shorting the outputs of the supplies to the -15V line bringing the output voltages to zero. The power supply will recover when the over-voltage fault is removed and circuit breaker (CB1) is switched OFF; then ON again. An over-current protection circuit in each supply will automatically fold-back the output current if the current exceeds a value determined by potentiometers R4, R27, R54 and R80. The power supply will automatically recover when the over-current fault is removed. Refer to Table 6-1 for a listing of potentiometers and their functions.

Output voltages remain essentially constant over a temperature range of -20°C to +60°C.

TABLE 6-1. POWER SUPPLY ADJUSTMENTS

Voltage	Current Limiting	Voltage Adj.	Over-Voltage Adj.	Current Limit Adj.
+150V	0.6A	R14*	R19	R4
+28V	2.5A	R41*	R47	R27
+15V	0.35A	R65*	R68	R54
-15V	0.18A	R91	R72	R80
*Adjusted from front panel				

TUNING

GENERAL

Normally, the modules of the 5 Watt Exciter are factory tuned and adjusted and should not require any additional adjustment or retuning. However, in the event that the exciter has not been factory tuned or a change in operating frequency is desired, the alignment instructions provide the necessary information. To aid in adjusting and tuning, two tuning tools have been provided and are attached to the inside frame of the Multimeter Module MI-560537.

Table 6-2 outlines the frequency determining coils corresponding to channel assignment.

TABLE 6-2. FREQUENCY DETERMINING PARTS

Module	Sub-Assembly	Channel	Coil	Coil Reference
FM Oscillator	Oscillator – A4	2 to 4	L4	3730930-2
FM Oscillator	Oscillator – A4	5 & 6	L4	3730930-1
5 W Amplifier	1.5 W Ampl – A2	2 & 3	L1	3469623-3
5 W Amplifier	1.5 W Ampl – A2	4 & 5	L1	3468623-2
5 W Amplifier	1.5 W Ampl – A2	6	L1	3469623-1
5 W Amplifier	5 W Ampl – A1	2	L12	3469623-12
5 W Amplifier	5 W Ampl – A1	3 & 4	L12	3469623-24
5 W Amplifier	5 W Ampl – A1	5	L12	3468623-25
5 W Amplifier	5 W Ampl – A1	6	L12	3468623-19
5 W Amplifier	5 W Ampl – A1	2 & 3	L16	3469623-16
5 W Amplifier	5 W Ampl – A1	4 to 6	L16	2469623-15

Table 6-3 outlines the frequency determining changes for the Multiplier Module MI-560535 on frequency doubler sub-assemblies A1 (Aural) and A2 (Visual).

TABLE 6-3. MULTIPLIER TUNING TABLE

Channel	Visual Doubler	Aural Doubler
2	—	—
3	—	—
4	—	*
5	*	*
6	*	*
Note: *Clip out C3, C5, C9, and C13.		

ALIGNMENT

Preliminary

Switch circuit breaker on 5W Exciter Power Supply to OFF and then operate the MAIN BREAKER switch S1 and the DISTRIBUTION switch S2 located on the Power Supply Cabinet MI-560578A to the ON position. Set the CONTROL BREAKER, 115V BUS and the EXCITER switches located on the Control Cabinet to their ON positions. Also set EXC TEST to TEST. Finally, depress TRANSMITTER ON/AIR ON push-button indicator.

NOTE: For those transmitters employing Diode Modulation, the PLATE ON push-button must be depressed with HIGH VOLTAGE DISABLE rocker switch in the DISABLE position.

5 Watt Exciter Power Supply MI-560538B

1. Remove all modules except the Power Supply Module and the Multimeter Module

2. Turn on Power Supply. Set multimeter switch to positions +15V, -15V, +28V and +150V to check supply voltages. Meter indication should be approximately 80 for each voltage. For a more accurate check of power supply voltages, place the power supply module on module extender and measure the output voltage from each supply with a voltmeter. Voltages may be adjusted from front panel VOLTAGE ADJUST.

3. Switch Power Supply off and replace all modules.

FM Oscillator Module MI-560532 and AFC/Reference Oscillator Module MI-560533

1. Set front panel AFC switch S4 to OFF.

2. Insert FM Oscillator Module MI-560532 in the extender which then plugs into module frame assembly.

3. Temporarily connect a frequency counter to FM oscillator output A4J1. Switch Power Supply ON and vary COARSE frequency adjust A4L4 to approximately one-half aural carrier frequency or 150 kHz below Aural Reference Oscillator. Vary FINE frequency adjust A4C5 for the exact oscillator frequency. Reconnect A4P1 to A4J1.

4. Set multimeter switch to FMO position and switch A1S2 to AMP position.

5. In amplifier assembly A2, adjust A2C100 and A2C103 for maximum meter deflection.

6. Set switch A1S2 to BUFF position to check buffer assembly A3 output indication. The Multimeter reading should be at least 60.

7. Switch Power Supply OFF; remove module from extender and insert into frame assembly.

8. Set multimeter switch to REF-A position.

9. Remove AFC/Reference Oscillator Module MI-560533 and insert in the extender which then plugs into the module frame assembly.

NOTE: Ensure that the correct Aural Oscillator MI-560539 and Visual Oscillator MI-560540 crystal oscillator assemblies are installed in the module (refer to Tables 6-4 and 6-5, respectively). Check output frequencies and adjust if necessary.

10. Remove the cover of Attenuator AT1.

NOTE: If neither an oscilloscope that has a frequency response to greater than one-half the exciter output frequency nor an RF Voltmeter is available, omit step 11 and perform steps 12 and 13. If an oscilloscope or an RF Voltmeter is available, omit step 12 and perform steps 11 and 13.

11. With power applied to the module, adjust AT1R102 until the output indication measured between ground and AT1E102 is approximately 0.3V RMS. (Make all measurements with an RF Voltmeter or an oscilloscope that has a frequency response greater than one-half the exciter output frequency). Then adjust AT1R104 until the output indication measured between ground and AT1E104 is approximately 0.6V RMS. The 150 kHz sine wave derived from Mixer A3 should now measure 0.6V peak-to-peak (0.2V RMS) between terminals A1E1 and A1E2. If necessary, readjust AT1R102 and AT1R104 until this level is obtained.

12. If a high frequency oscilloscope or RF Voltmeter is not available, place an oscilloscope between terminals A1E1 and A1E2, then adjust AT1R102 and AT1R104 for a maximum 150 kHz indication on the oscilloscope. Next, alternately decrease the settings of AT1R102 and AT1R104 until a sine wave of 0.6V peak-to-peak is observed.

13. Switch Power OFF, remove the test equipment, replace Attenuator AT1 cover and insert the module into the module frame assembly.

14. Remove the FM Oscillator Module MI-560532 and reinsert into extender which is then plugged into module frame assembly.

15. Set multimeter switch to AFC position.

16. Set front panel AFC switch S4 to OFF position and switch A1S1 to SHORT position.

17. Switch Power Supply ON and adjust potentiometer A1R17 for 0 meter indication with front panel AFC switch S3 set to the + or - position.

18. Set switch A1S1 and S4 to ON and insert module into frame.

NOTE: The preceding adjustments will place the FM oscillator in operation at a frequency close to the exact assigned value.

19. With control established, the AFC difference frequency (150 kHz) waveforms should be present at the AFC/Reference Oscillator Module test points shown in Figure 6-6. If necessary, the 150 kHz pulses are to be adjusted for symmetry by varying front panel adjust R26 on the AFC/Rererence Oscillator Module MI-560533.

20. Final Frequency adjustments are to be accomplished by monitoring the exciter or transmitter output, removing the audio input, and adjusting R25 on the AFC/Reference Oscillator Module for the exact carrier frequency with the FM oscillator under AFC control.

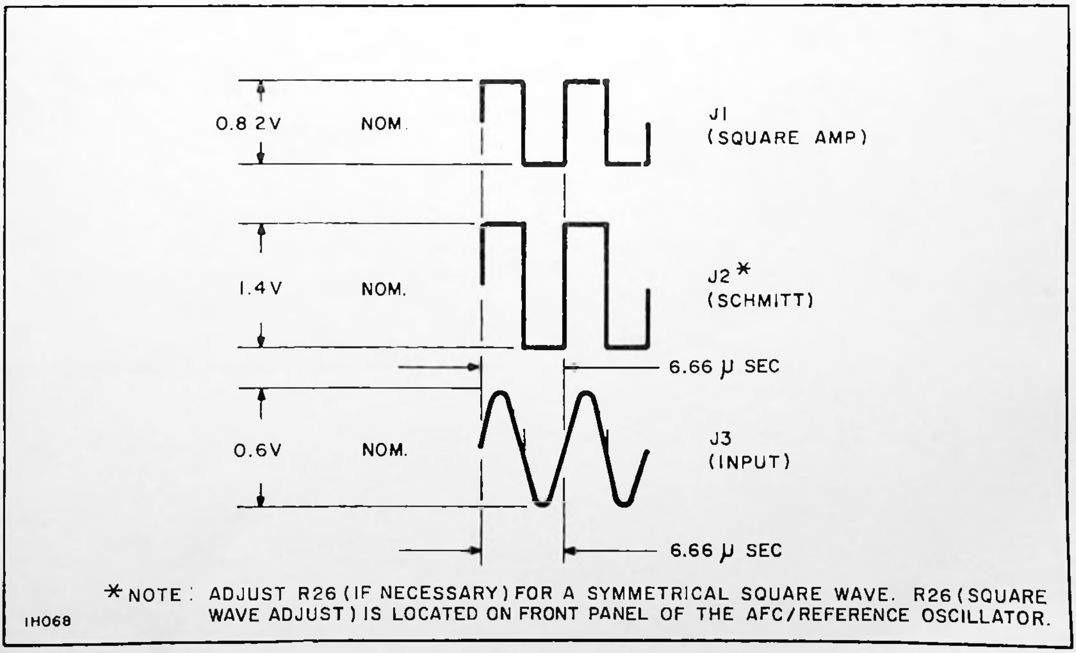


Figure 6-6. AFC Difference Frequency Waveforms

TABLE 6-4. AURAL OSCILLATOR AND AFC ASSEMBLY
CRYSTAL FREQUENCIES MI-560539

MI Number	Carrier Frequency — MHz	Crystal Frequency — MHz
560539-2-L	59.740	30.020
560539-2-O	59.750	30.025
560539-2-H	59.760	30.030
560539-3-L	65.740	33.020
560539-3-O	65.750	33.025
560539-3-H	65.760	33.030
560539-4-L	71.740	36.020
560539-4-O	71.750	36.025
560539-4-H	71.760	36.030
560539-5-L	81.740	41.020
560539-5-O	81.750	41.025
560539-5-H	81.760	41.030
560539-6-L	87.740	44.020
560539-6-O	87.750	44.025
560539-6-H	87.760	44.030
NOTE: $F_{Crystal} = \frac{1}{2}F_{Carrier} + 0.15$ MHz — United States of America Channels: 2 thru 6.		

TABLE 6-5. VISUAL CRYSTAL OSCILLATOR ASSEMBLY
CRYSTAL FREQUENCIES MI-560540

MI Number	Carrier Frequency — MHz	Crystal Frequency — MHz
560540-2-L	55.240	27.620
560540-2-O	55.250	27.625
560540-2-H	55.260	27.630
560540-3-L	61.240	30.620
560540-3-O	61.250	30.625
560540-3-H	61.260	30.630
560540-4-L	67.240	33.620
560540-4-O	67.250	33.625
560540-4-H	67.260	33.630
560540-5-L	77.240	38.620
560540-5-O	77.250	38.625
560540-5-H	77.260	38.630
560540-6-L	83.240	41.620
560540-6-O	83.250	41.625
560540-6-H	83.260	41.630
NOTE: $F_{Crystal} = \frac{1}{2}F_{Carrier}$ — United States of America Channels: 2 thru 6.		

NOTE: Front panel adjustment DIST (A4R1) and capacitor (A4C3) are preset factory adjustments which allow for minimum distortion operation. Audio level adjustment (A1R8) is preset to a value necessary to give 100% modulation with an audio input of +10 dBm. Operational Amplifier offset adjustment (A1R17) is also a factory preset adjustment.

Multiplier Module MI-560535

1. Set multimeter switch to MULT position and multiplier switch to FV/2.

2. Insert module in the extender which then plugs into module frame assembly.

3. Temporarily connect an RF voltmeter with a 50 ohm probe to A2J2. Switch Power Supply ON.

4. In visual doubler assembly A2, set potentiometer R2 to maximum CCW position and adjust L1 and L2 for a maximum multimeter indication.

5. Set multiplier switch to FV and adjust L5 and L6 for a maximum multimeter indication.

NOTE: Adjust gain potentiometer R2 until the output of the doubler assembly is approximately the amount indicated in table 6-6 for your particular channel. This adjustment sets the approximate input power to the RF amplifier for a nominal output power of 5 watts. Carefully repeak the coil for maximum meter indication after adjusting A2R2. This is to ensure low incidental AM readings.

6. Repeat steps 4 and 5 until no further increase is noted.

7. Repeat steps 4, 5 and 6 for aural doubler assembly A1. The 50 ohm RF voltmeter probe is connected to A1J2 with multiplier switch set to FA/2 and FA.

8. Switch Power Supply OFF, then insert module into module frame assembly.

TABLE 6-6. NOMINAL MULTIPLIER OUTPUTS INTO RF VOLTMETER 50 OHM PROBE

Channel	Aural			Visual		
	*Maximum Out	*Reduce To	% Reduction	*Maximum Out	*Reduce To	% Reduction
2	1.29	0.713	44	2.21	0.743	66
3	1.90	1.06	44	2.07	1.08	48
4	1.91	1.28	34	2.70	1.70	46
5	2.21	1.38	38	2.53	1.21	52
6	2.40	1.52	37	2.43	1.48	39
Note: (*) These are average readings measured in Volts RMS						

5 Watt Amplifier – Aural Module MI-560531

1. Set multimeter switch to 5W-A position

2. Insert module in the extender which then plugs into frame assembly.

3. Switch Power Supply ON, then set aural drive control on Drive Control Module MI-560594 fully CW.

4. Set 5W Amplifier switch to 1.5W AMP-IN. Adjust C1 for maximum deflection.

5. Set switch to 1.5W AMP-INTER. Adjust C6 for maximum deflection.

6. Set switch to 1.5W AMP-OUT. Adjust C13 for maximum deflection.

7. Set switch to 5W AMP-IN. Adjust C18 for maximum deflection.

8. Set switch to 5W AMP-OUT. Adjust C22 for maximum deflection.

CAUTION

Do not allow output power to exceed 6 watts.

9. The output power should be set approximately at 5 watts. Temporarily slide out Multiplier Module and slightly adjust R2 in the aural doubler CCW (increased output) or CW (reduced output) and reinsert into frame.

10. With switch in the 5W AMP-OUT position, repeat steps 4 to 8 until no further increase is noted.

11. Switch Power Supply OFF, then insert module into module frame assembly.

5 Watt Amplifier – Visual Module MI-560531

Set multimeter switch to 5W-V position and repeat steps outlined under 5 Watt Amp-Aural tuning procedure.

FINAL FREQUENCY ADJUSTMENTS

The following adjustments should be made after the exciter has been operating for at least thirty (30) minutes.

1. Set multimeter switch to AFC position and AFC switch to OFF position.

2. Readjust the FINE FREQUENCY adjust in the FM Oscillator Module (if necessary) for approximately zero indication, with the AFC polarity switch in the + or - position.

3. Set AFC switch to ON position and meter should indicate zero.

4. Adjust aural carrier to the correct frequency with FREQ ADJ vernier on the AFC/Reference Oscillator Module.

5. Check frequency of visual carrier and adjust Visual Reference Oscillator A5 frequency (if necessary) through front panel adjustment – VIS REF. Oscillator is checked by monitoring frequency of visual carrier.

REPLACEMENT PARTS LIST

GENERAL

The components listed in the replacement parts list are identified by one of two methods depending on whether the component is a mechanical or electrical part. Electrical parts are assigned a standard electrical symbol and are listed in alphanumerical sequence. Mechanical parts are assigned a numerical symbol (8, 17, 25, etc.) that corresponds to the item number on the mechanical assembly drawing where that particular part is located.

REPLACEMENT PARTS LIST

Symbol	Stock No.	Drawing No.	Description
PREFIX 20			
			MODULE FRAME ASSEMBLY MI-560525
Electrical			ML/3459995-501 REV. 26
20C1	420040	8524038-028	FILM, 3.0 MF 10% 200 V
20C2	420040	8524038-028	FILM, 3.0 MF 10% 200 V
20AJ1	420033	3721894-006	CONNECTOR - 7 PIN FEMALE HOUSING
20VJ1	420033	3721894-006	CONNECTOR - 7 PIN FEMALE HOUSING
20J2	420033	3721894-006	CONNECTOR - 7 PIN FEMALE HOUSING
20J3	420033	3721894-006	CONNECTOR - 7 PIN FEMALE HOUSING
20J4	420033	3721894-006	CONNECTOR - 7 PIN FEMALE HOUSING
20J5 TO 20J11	229215	8490041-001	CONNECTOR - 22 DUAL AMP. LEAF
20J12	247838	3720240-002	CONNECTOR - PLUG, 15 CONTACT
20J13	244084	993147-221	CONNECTOR - BNC, PART OF W8
20J14	244084	993147-221	CONNECTOR - BNC, PART OF W7
20J15	211510	481799-002	CONNECTOR - FEMALE, 2 CONDUCTOR
20K1	247841	3720305-003	RELAY - SUBMINIATURE
20P12	428029	3720240-012	CONNECTOR - RECEPTACLE, 15 CONTACT
20P13	242444	3456541-001	CONNECTOR - BNC
20P14	242444	3456541-001	CONNECTOR - BNC
20P15	211509	481799-001	CONNECTOR - MALE, 2 CONDUCTOR
Mechanical			
11	237823	896536-120	SCREW - SHOULDER
18	231762	8540935-001	KEY
10	237824	1510029-132	SPRING - COMPRESSION
15	420034	3721894-009	PIN - GUIDE PIN
16	420035	3721894-010	SOCKET - GUIDE
36	232819	8540937-016	SPRING - PRESSURE
74	420031	3721894-004	SPRING - RETENTION
PREFIX 21			
			5W AURAL/VISUAL AMPLIFIER MODULE MI-560531
			VISUAL/AURAL, CHANNELS 2-6
			MODULE ASSEMBLY R.F. AMP.
Electrical			ML/3459808-501 REV 3
21A1		3456993-501	5 WATT AMPLIFIER
21A2		3456977-501	1.5 WATT AMPLIFIER
21P1	420032	3721894-005	CONNECTOR - 7 PIN MALE HOUSING
21A1P3	245963	3456215-001	CONNECTOR - COAXIAL
21A1P4	245963	3456215-001	CONNECTOR - COAXIAL, PART OF W1
21A2P1	245963	3456215-001	CONNECTOR - COAXIAL, PART OF W2
21A2P2	245963	3456215-001	CONNECTOR - COAXIAL
21S1	245980	3464073-001	SWITCH - ROTARY
Mechanical			
30	418783	3730663-502	CONTACT - BRACKET ASSEMBLY
8	229940	1510924-105	KNOB
25	420034	3721894-009	PIN - GUIDE PIN
26	420035	3721894-010	SOCKET - GUIDE
33	420031	3721894-004	SPRING - RETENTION
10		3456972-501	PRINTED CIRCUIT BOARD ASSEMBLY
			5 WATT AMPLIFIER
Electrical			ML/3456993-501 REV 9
			CAPACITORS

Symbol	Stock No.	Drawing No.	Description
21C16	215197	993025-433	MICA, 68 PF 5% 100 V
21C17	109595	3450097-002	CERAMIC, FEED-THRU, 1000 PF GMV 500 V
21C18	226643	3468015-002	MICA, VARIABLE, 63-340 PF
21C19	109595	3450097-002	CERAMIC, FEED-THRU, 1000 PF GMV 500 V
21C20	235560	3450155-005	CERAMIC, .05 MF 100 V
21C21	113931	3450092-002	CERAMIC, STAND-OFF, 1000 PF GMV 500 V
21C22	921455	3468015-001	MICA, VARIABLE, 15-130 PF
21C23	109595	3450097-002	CERAMIC, FEED-THRU, 1000 PF GMV 500 V
21C24	99681	442905-017	CERAMIC, 2.2 PF 10% 500 V
21C25	224181	993025-425	MICA, 33 PF 5% 100 V
21C26	223142	3456811-007	CERAMIC, 0.1 MF 50 V
21CR4	236715	3454179-001	DIODE
21J3	245964	3456215-010	CONNECTOR - COAXIAL, MALE
21J4	245964	3456215-010	CONNECTOR - COAXIAL, MALE
21L12	246009	3469623-012	COIL - USED FOR CHANNEL 2
21L12	248736	3469623-024	COIL - USED FOR CHANNELS 3 AND 4
21L12	248737	3469623-025	COIL - USED FOR CHANNEL 5
21L12	247465	3469623-019	COIL - USED FOR CHANNEL 6
21L13	232645	3467000-003	CHOKE - R.F.
21L14	246010	3469623-013	COIL
21L15	246011	3469623-014	COIL
21L16	246013	3469623-016	COIL - USED FOR CHANNELS 2 & 3
21L16	246012	3469623-015	COIL - USED FOR CHANNELS 4, 5 & 6
21Q3	236577	3457118-001	TRANSISTOR
21R7	502382	82283-205	82,000 OHMS 5% 1/2 W
21R8	502022	82283-119	22 OHMS 5% 1/2 W
21R9	512168	90496-155	680 OHMS 5% 1 W
21R10	502518	82283-237	1.8 MEGOHM 5% 1/2 W
21R11	502010	82283-111	10 OHMS 5% 1/2 W
	244460	3457758-001	SOCKET - TRANSISTOR
Electrical			1.5 WATT AMPLIFIER ML/3456977-501 REV 4
			CAPACITORS
21C1	921455	3468015-001	MICA, VARIABLE, 15-130 PF
21C2	109595	3450097-002	CERAMIC, FEED-THRU, 1000 PF GMV 500 V
21C3	109595	3450097-002	CERAMIC, FEED-THRU, 1000 PF GMV 500 V
21C4	113931	3450092-002	CERAMIC, STAND-OFF, 1000 PF GMV 500 V
21C5	218469	3720278-001	MICA, 2700 PF 5% 500 V
21C6	921455	3468015-001	MICA, VARIABLE, 15-130 PF
21C7	106940	993025-444	MICA, 200 PF 5% 100 V
21C8	109595	3450097-002	CERAMIC, FEED-THRU, 1000 PF GMV 500 V
21C9	109595	3450097-002	CERAMIC, FEED-THRU, 1000 PF GMV 500 V
21C10	113931	3450092-002	CERAMIC, STAND-OFF, 1000 PF GMV 500 V
21C11	223142	3456811-007	CERAMIC, 0.1 MF 50 V
21C12	218469	3720278-001	MICA, 2700 PF 5% 500 V
21C13	226643	3468015-002	MICA, VARIABLE, 65-340 PF
21C14	109595	3450097-002	CERAMIC, FEED-THRU, 1000 PF GMV 500 V
21CR1	236715	3454179-001	DIODE
21CR2	236715	3454179-001	DIODE
21CR3	236715	3454179-001	DIODE
21J1	245964	3456215-010	CONNECTOR - COAXIAL, MALE
21J2	245964	3456215-010	CONNECTOR - COAXIAL, MALE
21L1	245998	3469623-001	COIL - USED FOR CHANNEL 6
21L1	245999	3469623-002	COIL - USED FOR CHANNELS 4 & 5
21L1	246000	3469623-003	COIL - USED FOR CHANNELS 2 & 3
21L2	232645	3467000-003	CHOKE - R.F.
21L3	246001	3469623-004	COIL
21L4	236348	8886161-003	CHOKE - R.F.
21L5	246002	3469623-005	COIL
21L6	232645	3467000-003	CHOKE - R.F.
21L7	246003	3469623-006	COIL
21L8	246004	3469623-007	COIL
21L9	246006	3469623-009	COIL

Symbol	Stock No.	Drawing No.	Description
21L10	246007	3469623-010	COIL
21Q1	232678	3463780-002	TRANSISTOR
21Q2	245976	3456910-001	TRANSISTOR
21R1	502368	82283-203	68,000 OHMS 5% 1/2 W
21R2	502010	82283-111	10 OHMS 5% 1/2 W
21R3	502382	82283-205	82,000 OHMS 5% 1/2 W
21R4	236525	82283-551	1 OHMS 5% 1/2 W
21R5	502518	82283-237	1.8 MEGOHM 5% 1/2 W
			R.F. AMP. PRINTED CIRCUIT BOARD ML/3456972-501 REV 1
Electrical			
21L1	225277	3456216-019	COIL - 10 UH 10%
21L2	225277	3456216-019	COIL - 10 UH 10%
PREFIX 22			**MULTIPLIER MODULE MI-560535**
			MULTIPLIER MODULE ASSEMBLY ML/3456849-501 REV 5
Electrical			
22A1		3730980-501	FREQUENCY DOUBLER ASSEMBLY - AURAL
22A2		3730980-501	FREQUENCY DOUBLER ASSEMBLY - VISUAL
22A1P1	245963	3456215-001	CONNECTOR - COAXIAL, FEMALE, PART OF W1
22A1P2	245963	3456215-001	CONNECTOR - COAXIAL, FEMALE, PART OF W2
22A2P1	245963	3456215-001	CONNECTOR - COAXIAL, FEMALE, PART OF W3
22A2P2	245963	3456215-001	CONNECTOR - COAXIAL, FEMALE, PART OF W4
22P2	420032	3721894-005	CONNECTOR - 7 PIN MALE HOUSING
22S1	245980	3464073-001	SWITCH - ROTARY
Mechanical			
31	418782	3730663-501	CONTACT - BRACKET ASSEMBLY
8	229940	1510924-105	KNOB
24	420034	3721894-009	PIN - GUIDE PIN
25	420035	3721894-010	SOCKET - GUIDE
34	420031	3721894-004	SPRING - RETENTION
9		3456776-501	PRINTED CIRCUIT BOARD ASSEMBLY
			FREQUENCY DOUBLER ASSEMBLY AURAL-VISUAL ML/3730980-501 REV 3
Electrical			
22C18	244868	3450097-003	FEED-THRU, 1000 PF GMV 500 V
22C19	244868	3450097-003	FEED-THRU, 1000 PF GMV 500 V
22C20	244868	3450097-003	FEED-THRU, 1000 PF GMV 500 V
22J1	245964	3456215-010	CONNECTOR - COAXIAL, MALE
22J2	245964	3456215-010	CONNECTOR - COAXIAL, MALE
4		3456667-501	PRINTED CIRCUIT BOARD ASSEMBLY
			PRINTED CIRCUIT BOARD FREQUENCY DOUBLER ML/3456667-501 REV 3
Electrical			
			CAPACITORS
22C1	218098	993025-423	MICA, 27 PF 5% 100 V
22C2	138916	993025-443	MICA, 180 PF 5% 100 V
22C3	99162	993025-420	MICA, 20 PF 5% 100 V
22C4	97951	442905-013	CERAMIC, 1.0 PF 10% 500 V
22C5	99162	993025-420	MICA, 20 PF 5% 100 V
22C6	225608	993025-424	MICA, 30 PF 5% 100 V
22C7	224549	993025-440	MICA, 130 PF 5% 100 V
22C8	97951	442905-013	CERAMIC, 1.0 PF 10% 500 V
22C9	217378	993025-417	MICA, 15 PF 5% 100 V
22C10	922138	442905-022	CERAMIC, 5.6 PF 10% 500 V
22C11	205656	1510003-037	CERAMIC, .01 MF 200 V
22C12	99680	442905-019	CERAMIC, 3.3 PF 10% 500 V
22C13	217378	993025-417	MICA, 15 PF 5% 100 V
22C14	234721	993025-419	MICA, 18 PF 5% 100 V
22C15	218098	993025-423	MICA, 27 PF 5% 100 V

Symbol	Stock No.	Drawing No.	Description
22C16	99681	442905-017	CERAMIC, 2.2 PF 10% 500 V
22CR1	236715	3454179-001	DIODE
22CR2	236715	3454179-001	DIODE
22L1	245947	3456700-006	COIL - VARIABLE
22L2	245947	3456700-006	COIL - VARIABLE
22L3	245959	3456216-004	COIL - 0.47 UH 20%
22L4	245985	3456216-011	COIL - 2.27 UH 20%
22L5	245946	3456700-005	COIL - VARIABLE
22L6	245946	3456700-005	COIL - VARIABLE
22Q1	232678	3463780-002	TRANSISTOR
22R1	108871	99206-199	47,000 OHMS 5% 1/4 W
22R2	245949	3730645-001	VARIABLE, 50 OHMS 5%
22R3	218500	99206-197	39,000 OHMS 5% 1/4 W
PREFIX 23			**AFC & REFERANCE OSCILLATOR MODULE MI-560533** ML/3456877-501 REV 11
Electrical			
23A1		3456595-501	PRINTED CIRCUIT BOARD ASSEMBLY
23A2			ATTENUATOR 5W EXCITER MOD KIT MI-560851-14
23A3	245955	3730623-001	MIXER
23A4			MI-560539 OSCILLATOR - AURAL REFERENCE
23A5			MI-560540 OSCILLATOR - VISUAL
23A6		3456500-501	AFC ASSEMBLY - PART OF 23A4
23AT1		3732344-501	ATTENUATOR ASSEMBLY PART OF MOD KIT MI-560851-14
23C109	112720	3450097-003	CAPACITOR - 1000 PF 500 V GMV
23J101	245964	3456215-010	CONNECTOR - JACK
23J102	245964	3456215-010	CONNECTOR - JACK
23J103	245964	3456215-010	CONNECTOR - JACK
23J104	245964	3456215-010	CONNECTOR - JACK
3	249940	3720532-022	CAPACITOR, CERAMIC .22PF PART OF MOD. KIT MI-560851-14
			PRINTED CIRCUIT BOARD - ATTENUATOR ASSEMBLY M/L 3721673-501 REV. 1
Electrical			
C101	99681	442905-017	CERAMIC, 2.2 PF 500 V
CR101	230669		DIODE - TYPE 1N38A
R101	241859	990413-245	FILM, 6800 OHMS 5% 1/4 W
R102	420065	3413575-024	VARIABLE, 50 OHMS 5% 1/2 W
R103	418861	990413-194	FILM, 51 OHMS 5% 1/4 W
R104	420065	3413575-024	VARIABLE, 50 OHMS 5% 1/2 W
R105	420066	990413-186	FILM, 24 OHMS 5% 1/4 W
23AT1P 101	245963	3456215-001	CONNECTOR - COAXIAL
23AT1P 102	245963	3456215-001	CONNECTOR - COAXIAL
23AT1P 103	245963	3456215-001	CONNECTOR - COAXIAL, PART OF W1
23AT1P 104	245963	3456215-001	CONNECTOR - COAXIAL
23A3P1	245963	3456215-001	CONNECTOR - COAXIAL, FEMALE
23A3P2	245963	3456215-001	CONNECTOR - COAXIAL, FEMALE, PART OF 23A1
23A3P3	245963	3456215-001	CONNECTOR - COAXIAL, FEMALE
23C13	235486	993025-249	MICA, 330 PF 10% 100 V
23C14	219195	993025-261	MICA, 1000 PF 10% 100 V
23J1 TO 23J4	214603	8941099-004	TIP JACK - YELLOW
23J5	247862	3467968-002	CONNECTOR - RECEPTACLE, 17 PIN
23J6	247862	3467968-002	CONNECTOR - RECEPTACLE, 17 PIN

Symbol	Stock No.	Drawing No.	Description
23P3	420032	3721894-005	CONNECTOR - 7 PIN MALE HOUSING
23R25	245951	8539000-004	WIREWOUND, 10,000 OHMS 5%
23R26	248864	3456888-005	WIREWOUND, 200 OHMS 5%
Mechanical			
36	418783	3730663-502	CONTACT - BRACKET ASSEMBLY
28	247863	3467968-003	CONTACT - PIN, 23J5 AND 23J6
33	228192	3450825-001	RECEPTACLE
16	420034	3721894-009	PIN - GUIDE PIN, P3
17	420035	3721894-010	SOCKET - GUIDE, P3
43	420031	3721894-004	SPRING - RETENTION
Electrical			PRINTED CIRCUIT BOARD AFC AND REFERENCE ML/3456595-501 REV 8
23C1	426228	993025-447	MICA, 270 PF 5% 100 V
23C2	426228	993025-447	MICA, 270 PF 5% 100 V
23C3	226980	990786-013	PLASTIC, .01 MF 20% 50 V
23C4	230221	3410170-311	ELECTROLYTIC, 25 MF 15 V
23C5	216971	993025-421	MICA, 22 PF 5% 100 V
23C6	230227	3410170-411	ELECTROLYTIC, 25 MF 25 V
23C7	230227	3410170-411	ELECTROLYTIC, 25 MF 25 V
23C8	226980	990786-013	PLASTIC, .01 MF 20% 50 V
23C9	237354	3410170-212	ELECTROLYTIC, 35 MF 12 V
23C10	228721	3410170-408	ELECTROLYTIC, 10 MF 25 V
23C11	219118	990786-225	PLASTIC, 0.1 MF 20% 200 V
23C12	226984	990786-325	PLASTIC, 0.1 MF 20% 400 V
23A3P2	245963	3456215-001	CONNECTOR - COAXIAL, FEMALE
23DS1	245954	3456115-001	REGULATOR - GLOW LAMP
23L1	245986	3456216-045	COIL - 180 MICROHENRY 5%
23L2	209846	8926266-001	BEAD - FERRITE
23L3	209846	8926266-001	BEAD - FERRITE
23L4	225277	3456216-019	COIL - 10 MICROHENRY 10%
23Q1 TO 23Q6	231670	3730811-001	TRANSISTOR
23Q7	245962	3456560-001	TRANSISTOR
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
23R1	227741	99206-153	560 OHMS 5% 1/4 W
23R2	227741	99206-153	560 OHMS 5% 1/4 W
23R3	236145	990475-320	FILM, 1580 OHMS 1% 1/4 W
23R4	236130	990475-318	FILM, 1500 OHMS 1% 1/4 W
23R5	224252	990404-219	FILM, 560 OHMS 5% 1/2 W
23R6	228916	990404-239	FILM, 3900 OHMS 5% 1/2 W
23R7	228916	990404-229	FILM, 1500 OHMS 5% 1/2 W
23R8	224249	990404-201	FILM, 100 OHMS 5% 1/2 W
23R9	228712	990404-233	FILM, 2200 OHMS 5% 1/2 W
23R10	229700	990404-222	FILM, 750 OHMS 5% 1/2 W
23R11	502222	82283-167	2200 OHMS 5% 1/2 W
23R12	502310	82283-183	10,000 OHMS 5% 1/2 W
23R13	502218	82283-165	1800 OHMS 5% 1/2 W
23R14	502222	82283-167	2200 OHMS 5% 1/2 W
23R15	502068	82283-131	68 OHMS 5% 1/2 W
23R16	502118	82283-141	180 OHMS 5% 1/2 W
23R17	502147	82283-151	470 OHMS 5% 1/2 W
23R18	502210	82283-159	1000 OHMS 5% 1/2 W
23R19	502110	82283-135	100 OHMS 5% 1/2 W
23R20	502147	82283-151	470 OHMS 5% 1/2 W
23R21	502333	82283-195	33,000 OHMS 5% 1/2 W
23R22	245957	3456235-001	WIREWOUND, 3000 OHMS 1% 10 W
23R23	245956	3456458-001	WIREWOUND, 270 OHMS 1% 1 W
23R24	502347	82283-199	47,000 OHMS 5% 1/2 W
Electrical			PRINTED CIRCUIT BOARD ASSEMBLY ML/3456563-501 REV 3

Symbol	Stock No.	Drawing No.	Description
			CAPACITORS
23C100	245972	3460464-007	CERAMIC, VARIABLE, 10-75 PF
23C101	205656	1510003-037	CERAMIC, .01 MF 10% 500 V
23C102	99162	993025-420	MICA, 20 PF 5% 100 V
23C103	246278	3456576-013	CERAMIC, VARIABLE, 15-60 PF
23C105	99681	442905-017	CERAMIC, 2.2 PF 10% 500 V
23C106	205656	1510003-037	CERAMIC, .01 MF 10% 500 V
23CR1	236715	3454179-001	DIODE - TYPE 1N914
23L100	245960	3456216-006	COIL - 0.82 MICRO HENRYS 10%
23L101	227037	3456216-015	COIL - 4.7 MICRO HENRYS 10%
23L102	245959	3456216-004	COIL - 0.47 MICRO HENRYS 10%
23Q100	232678	3463780-002	TRANSISTOR - TYPE 2N3118
23R100	426234	99206-157	820 OHMS 5% 1/4 W
23R101	113524	99206-169	2700 OHMS 5% 1/4 W
23R102	502212	82283-161	1200 OHMS 5% 1/2 W
23R103	227755	99206-215	220,000 OHMS 5% 1/4 W
			PRINTED CIRCUIT BOARD AFC ASSEMBLY
Electrical			ML/3456500-501 REV 4
23C15	245953	3456455-004	CERAMIC, 47 PF 2% 500 V
23CR1	224109	3731010-001	DIODE - TYPE 1N629
23CR2	224109	3731010-001	DIODE - TYPE 1N629
23CR3	247591	3456225-001	DIODE - TYPE FD100
23CR4	247591	3456225-001	DIODE - TYPE FD100
23R25	238471	990475-458	FILM, 39,200 OHMS 1% 1/4 W
23R26	238471	990475-458	FILM, 39,200 OHMS 1% 1/4 W
23R27	245952	990475-512	FILM, 130,000 OHMS 1% 1/4 W
23R28	235463	990475-401	FILM, 10,000 OHMS 1% 1/4 W
23R29	235463	990475-401	FILM, 10,000 OHMS 1% 1/4 W
PREFIX 24			
			FM OSCILLATOR MODULE MI-560532
			CHANNELS 2-6
Electrical			M/L 3456904-501 REV 9
24A1		3456734-501	PRINTED CIRCUIT BOARD ASSEMBLY
24A2		3730982-502	AMPLIFIER ASSEMBLY
24A3		3730620-501	BUFFER ASSEMBLY
24A4		3730622-501	FM OSCILLATOR ASSEMBLY
24A2P 101	245963	3456215-001	CONNECTOR - COAXIAL
24A2P 102	245963	3456215-001	CONNECTOR - COAXIAL, FEMALE
24A2P 103	245963	3456215-001	CONNECTOR - COAXIAL, PART OF W2
24A3P1	245963	3456215-001	CONNECTOR - COAXIAL
24A3P2	245963	3456215-001	CONNECTOR - COAXIAL, PART OF W3
24A4P1	245963	3456215-001	CONNECTOR - COAXIAL, FEMALE
24P4	420032	3721894-005	CONNECTOR - 7 PIN MALE HOUSING
24S1	230662	8547312-004	SWITCH - TOGGLE
24S2	230662	8547312-004	SWITCH - TOGGLE
24S3	230657	8547312-009	SWITCH - TOGGLE
24S4	230662	8547312-004	SWITCH - TOGGLE
Mechanical			
23	418783	3730663-502	CONTACT - BRACKET ASSEMBLY
16	420034	3721894-009	PIN - GUIDE PIN, P4
17	420035	3721894-010	SOCKET - GUIDE, P4
42	420031	3721894-004	SPRING - RETENTION
41	228192	3450825-001	RECEPTACLE - FOR E14,15,17,18, AND 23
			PRINTED CIRCUIT BOARD
			FREQUENCY MODULATED

Symbol	Stock No.	Drawing No.	Description
			OSCILLATOR MODULE ML/3456734-501 REV 9
Electrical			
24A5	425205	3456639-001	AMPLIFIER - OPERATIONAL
24A6	248888	3456484-001	AMPLIFIER - OPERATIONAL
24C1	420037	3721909-001	PLASTIC, .015 MF 5% 50 V
24C2	420038	3721909-002	PLASTIC, .033 MF 5% 50 V
24C3	219195	993025-261	MICA, 1000 PF 10% 100 V
24C4	230227	3410170-411	ELECTROLYTIC, 25 MF 25 V
24C5	230227	3410170-411	ELECTROLYTIC, 25 MF 25 V
24C6	245975	3410170-409	ELECTROLYTIC, 15 MF 25 V
24C7	245974	3456887-002	ELECTROLYTIC, 5 MF 25 V
24C8	245973	3456887-001	ELECTROLYTIC, 5 MF 10 V
24C9	205656	1510003-037	CERAMIC, .01 MF 500 V
24C10	205656	1510003-037	CERAMIC, .01 MF 500 V
24C11	205656	1510003-037	CERAMIC, .01 MF 500 V
24CR1	245981	3453814-002	DIODE
24CR2	245981	3453814-002	DIODE
24L1	230343	3456216-007	CHOKE - R.F. 1.0 UH 10%
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
24R1	224253	990404-221	FILM, 680 OHMS 5% 1/2 W
24R2	233179	990404-244	FILM, 6200 OHMS 5% 1/2 W
24R3	224253	990404-221	FILM, 680 OHMS 5% 1/2 W
24R4	233202	990404-258	FILM, 24,000 OHMS 5% 1/2 W
24R5	137661	990404-536	FILM, 3000 OHMS 2% 1/2 W
24R6	137661	990404-536	FILM, 3000 OHMS 2% 1/2 W
24R7	228704	990404-209	FILM, 220 OHMS 5% 1/2 W
24R8	428022	8954937-057	VARIABLE, 1000 OHMS 10% 1 W
24R9	239417	990404-177	FILM, 10 OHMS 5% 1/2 W
24R10	228934	990404-200	FILM, 91 OHMS 5% 1/2 W
24R11	224260	990404-273	FILM, 100,000 OHMS 5% 1/2 W
24R12	502315	82283-076	15,000 OHMS 10% 1/2 W
24R13	502510	82283-098	1 MEGOHM 10% 1/2 W
24R14			RESISTOR - PART OF 24A6
24R15	502310	82283-074	10,000 OHMS 10% 1/2 W
24R16	502468	82283-227	680,000 OHMS 5% 1/2 W
24R17	428023	8954937-062	VARIABLE, 50,000 OHMS 10% 1 W
24R18	224260	990404-273	FILM, 100,000 OHMS 5% 1/2 W
24R19	224256	990404-259	FILM, 27,000 OHMS 5% 1/2 W
24S1	230662	8547312-004	SWITCH - TOGGLE
24S2	230662	8547312-004	SWITCH - TOGGLE
24T1	922355	3730879-001	TRANSFORMER - AUDIO
			AMPLIFIER ASSEMBLY ML/3730982-502 REV 5
Electrical			
24C108	244868	3450097-003	FEED-THRU, 1000 PF GMV 500 V
24C109	244868	3450097-003	FEED-THRU, 1000 PF GMV 500 V
24J101	245964	3456215-010	CONNECTOR - COAXIAL, MALE
24J102	245964	3456215-010	CONNECTOR - COAXIAL, MALE
24J103	245964	3456215-010	CONNECTOR - COAXIAL, MALE
		3456563-502	PRINTED CIRCUIT BOARD ASSEMBLY
	228192	3450825-001	RECEPTACLE
			PRINTED CIRCUIT BOARD ASSY ML/3456563-502 REV 2
Electrical			
24C100	245972	3460464-007	CERAMIC, VARIABLE, 10-75 PF
24C101	205656	1510003-037	CERAMIC, .01 MF 10% 500 V
24C102	99162	993025-420	MICA, 20 PF 5% 100 V
24C103	246278	3456576-013	CERAMIC, VARIABLE, 15-60 PF
24C104	219744	993026-431	MICA, 56 PF 5% 500 V
24C105	99681	442905-017	CERAMIC, 2.2 PF 10% 500 V
24C106	205656	1510003-037	CERAMIC, .01 MF 10% 500 V
23CR 100	236715	3454179-001	DIODE
24L100	245960	3456216-006	COIL - 0.82 MICROHENRY 10%

Symbol	Stock No.	Drawing No.	Description
24L101	227037	3456216-015	COIL - 4.7 MICROHENRY 10%
24L102	245960	3456216-006	COIL - 0.82 MICROHENRY 10%
24Q100	232678	3463780-002	TRANSISTOR
24R100	113524	99206-169	2700 OHMS 5% 1/4 W
24R101	113524	99206-169	2700 OHMS 5% 1/4 W
24R102	502212	82283-161	1200 OHMS 5% 1/2 W
24R103	223769	99206-207	100,000 OHMS 5% 1/4 W
24R104	502056	82283-129	56 OHMS 5% 1/2 W
			BUFFER ASSEMBLY
Electrical			ML/3730620-501 REV 9
24C5	244868	3450097-003	FEED-THRU, 1000 PF GMV 500 V
24C6	244868	3450097-003	FEED-THRU, 1000 PF GMV 500 V
24J1	245964	3456215-010	CONNECTOR - COAXIAL, MALE
24J2	245964	3456215-010	CONNECTOR - COAXIAL, MALE
		3456834-501	PRINTED CIRCUIT BOARD ASSEMBLY
	228192	3450825-001	RECEPTACLE
			PRINTED CIRCUIT BOARD ASSEMBLY
Electrical			ML/3456834-501 REV 4
24C1	219195	993025-261	MICA, 1000 PF 10% 100 V
24C2	205656	1510003-037	CERAMIC, .01 MF 500 V
24C3	235486	993025-249	MICA, 330 PF 10% 100 V
24C4	99681	442905-017	CERAMIC, 2.2 PF 10% 500 V
24CR1	236715	3454179-001	DIODE
24L1	225277	3456216-019	COIL - 10 UH 10%
24Q1	231670	3730811-001	TRANSISTOR
24R1	108869	99206-187	15,000 OHMS 5% 1/4 W
24R2	219460	99206-165	1800 OHMS 5% 1/4 W
24R3	512124	90496-144	240 OHMS 5% 1 W
24R4	512124	90496-144	240 OHMS 5% 1 W
24R5	421699	99206-201	56,000 OHMS 5% 1/4 W
24R6	502056	82283-129	56 OHMS 5% 1/2 W
			FM OSCILLATOR ASSEMBLY
Electrical			ML/3730622-501 REV 6
24HR1	245987	3469588-001	OVEN - TEMPERATURE
		3456536-501	PRINTED CIRCUIT BOARD ASSEMBLY
	228192	3450825-001	RECEPTACLE
			PRINTED CIRCUIT BOARD ASSY FM OSCILLATOR
Electrical			ML/3456536-501 REV 6
24C1	112660	1510003-225	CERAMIC, 1000 PF 10% 500 V
24C2	105301	1510003-219	CERAMIC, 330 PF 10% 500 V
24C3	232749	3465708-012	CERAMIC, VARIABLE, 1.5-9.1 PF
24C4	418018	3456485-005	CERAMIC, N470, 27 PF 5% 200 V
24C5	418019	3730789-002	GLASS VARIABLE, 0.6-5.5 PF
24C6	105301	1510003-219	CERAMIC, 330 PF 10% 500 V
24C7	245966	3456527-031	CERAMIC, 82 PF 5% 500 V
24C8	245965	3456527-046	CERAMIC, 360 PF 5% 500 V
24C9	112660	1510003-225	CERAMIC, 1000 PF 10% 500 V
24C10	245967	3456527-002	CERAMIC, 5.1 PF 5% 500 V
24C11	112660	1510003-225	CERAMIC, 1000 PF 10% 500 V
24C12	105301	1510003-219	CERAMIC, 330 PF 10% 500 V
24C13	112660	1510003-225	CERAMIC, 1000 PF 10% 500 V
24C14	112660	1510003-225	CERAMIC, 1000 PF 10% 500 V
24CR1	245968	3456498-001	DIODE - VARIABLE CAPACITANCE, 22.0 PF 100 V
24CR2	245969	3456498-002	DIODE - VARIABLE CAPACITANCE, 33.0 PF 60 V

Symbol	Stock No.	Drawing No.	Description
24L1	209846	8926266-001	BEAD - SHIELDING, FERRITE
24L2	209846	8926266-001	BEAD - SHIELDING, FERRITE
24L3	227037	3456216-015	CHOKE - R.F. 4.7 UH 10%
24L4	245971	3730930-002	COIL - VARIABLE, 0.69 1.16 UH CH 2,3,4
24L4	245970	3730930-001	COIL - VARIABLE, 0.42 TO 0.69 UH CH 5 AND 6
24L5	227037	3456216-015	CHOKE - R.F. 4.7 UH 10%
24L6	209846	8926266-001	BEAD - SHIELDING, FERRITE
24L7	230345	3456216-016	CHOKE - R.F. 5.6 UH 10%
			RESISTORS - FIXED COMPOSITION, UNLESS NOTED
24R1	418017	3456515-010	WIREWOUND, VARIABLE, 10,000 OHMS
24R2	245918	990413-231	FILM, 1800 OHMS 5% 1/4 W
24R3	235604	990475-493	FILM, 90,900 OHMS 1% 1/4 W
24R4	223769	99206-207	100,000 OHMS 5% 1/4 W
24R5	245958	990413-213	FILM, 330 OHMS 5% 1/4 W
24R6	224255	990404-231	FILM, 1800 OHMS 5% 1/2 W
24R7	239461	990413-251	FILM, 12,000 OHMS 5% 1/4 W
24R8	243078	990413-241	FILM, 4700 OHMS 5% 1/4 W
24R9	108868	99206-185	12,000 OHMS 5% 1/4 W
24R10	219464	99206-177	5600 OHMS 5% 1/4 W
24R11	502156	82283-153	560 OHMS 5% 1/2 W
24R12	502147	82283-151	470 OHMS 5% 1/2 W
24Q1	232678	3463780-002	TRANSISTOR
24Q2	232678	3463780-002	TRANSISTOR
PREFIX 25			**MULTIMETER MODULE MI-560537**
			M/L 3456814-501 REV 4
Electrical			
25A1		3456764-501	PRINTED CIRCUIT BOARD ASSEMBLY
25C1	205656	1510003-037	CERAMIC, .01 MF 500 V
25M1	245948	3730625-001	METER - 0-15 UA
25R4	229486	990186-172	FILM, 54.9 OHMS 1% 1/2 W
25S1	245980	3464073-001	SWITCH - ROTARY
8	229940	1510924-105	KNOB
32	422569	3731014-501	TOOL - TUNING
33	070180	86183-502	TOOL - TUNING
			PRINTED CIRCUIT BOARD - MULTI-METER
Electrical			M/L 3456764-501 REV 1
25R1	245945	990186-636	FILM, 2.32 MEGOHM 1% 1/2 W
25R2	236104	990186-510	FILM, 124,000 OHMS 1% 1/2 W
25R3	245944	990186-610	FILM, 1.24 MEGOHM 1% 1/2 W
PREFIX 26			**POWER SUPPLY MODULE MI-560538-B**
			MODEL SPS 1261 T.O.I.
Electrical			M/L 3721228-1 REV 3
26C1	421939		CAPACITOR, 110MFD 350V
26C2	232801		CAPACITOR, 25MFD 50V
26C3	421938		CAPACITOR, .01MFD 200V
26C4	249638		CAPACITOR, .56MFD 200V
26C5	428024		CAPACITOR, 2800MFD 50V
26C6	232801		CAPACITOR, 25MFD 50V
26C7	428024		CAPACITOR, 2800MFD 50V
26C8	421938		CAPACITOR, .01MFD 200V
26C9	421937		CAPACITOR, 12MFD 250V
26C10	428027		CAPACITOR, 4000MFD 40V
26C12	421938		CAPACITOR, .01MFD 200V
26C13	425178		CAPACITOR - 150 MFD 25 V
26C14	425178		CAPACITOR - 150 MFD 25 V

Symbol	Stock No.	Drawing No.	Description
26C15	221890		CAPACITOR, 1MFD 25V
26C16	421938		CAPACITOR, .01MFD 200V
26C17	421936		800MFD 40V
26C18	421935		CAPACITOR, .047 250V
26C19	428655		CAPACITOR, .22MFD 250V
26C20	235504		CAPACITOR, 150MFD 50V
26C21 to 26C24	247658		CAPACITOR, .22MFD 200V
26CB1	421940		CIRCUIT BREAKER, 3 AMP 250VAC 60HZ
26CR1	217784		SILICON RECTIFIER - TYPE 1N645
26CR2	217784		SILICON RECTIFIER - TYPE 1N645
26CR3	242392		SILICON RECTIFIER - TYPE SCE4/1N5060
26CR4	242392		SILICON RECTIFIER - TYPE SCE4/1N5060
26CR5	242392		SILICON RECTIFIER - TYPE SCE4/1N5060
26CR6	242392		SILICON RECTIFIER - TYPE SCE4/1N5060
26CR7	217784		SILICON RECTIFIER - TYPE 1N645
26CR8	217784		SILICON RECTIFIER - TYPE 1N645
26CR9	217784		SILICON RECTIFIER - TYPE 1N645
26CR10	249623		SILICON RECTIFIER - TYPE SCPA1
26CR12	217784		SILICON RECTIFIER - TYPE 1N645
26CR14	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
26CR15	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
26CR17	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
26CR18	217784		SILICON RECTIFIER - TYPE 1N645
26CR19	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
26CR20	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
26CR21	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
26CR22	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
26CR23	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
26CR24	217784		SILICON RECTIFIER - TYPE 1N645
26CR27	246572		SILICON RECTIFIER - TYPE SCE2/1N5059
26DS1	426156		LAMP #327
26XDS1	421941		LAMP HOLDER
26Q1	239991		TRANSISTOR - TYPE DTS 423
26Q2	241302		TRANSISTOR - TYPE 2N1711
26Q3	241302		TRANSISTOR - TYPE 2N1711
26Q4	420722		TRANSISTOR - TYPE 2N3055
26Q5	241302		TRANSISTOR - TYPE 2N1711
26Q6	241302		TRANSISTOR - TYPE 2N1711
26Q7	230994		TRANSISTOR - TYPE 2N2907
26Q8	231375		TRANSISTOR - TYPE 2N1613
26Q9	420722		TRANSISTOR - TYPE 2N3055
26Q10	231375		TRANSISTOR - TYPE 2N1613
26Q11	231375		TRANSISTOR - TYPE 2N1613
26Q12	420722		TRANSISTOR - TYPE 2N3055
26Q13	231375		TRANSISTOR - TYPE 2N1613
26Q14	231375		TRANSISTOR - TYPE 2N1613
26Q15	420722		TRANSISTOR - TYPE 2N3055
26Q16	230994		TRANSISTOR - TYPE 2N2907
26Q17	231375		TRANSISTOR - TYPE 2N1613
26Q18	231375		TRANSISTOR - TYPE 2N1613
26Q19	231375		TRANSISTOR - TYPE 2N1613
26Q20	241302		TRANSISTOR - TYPE 2N1711
26Q21	241302		TRANSISTOR - TYPE 2N1711
26Q22	230994		TRANSISTOR - TYPE 2N2907
26Q23	230994		TRANSISTOR - TYPE 2N2907
26Q24	231375		TRANSISTOR - TYPE 2N1613
26Q25	231375		TRANSISTOR - TYPE 2N1613
26Q26	231375		TRANSISTOR - TYPE 2N1613
26Q27	231375		TRANSISTOR - TYPE 2N1613
26R1	502210		RESISTOR, 1K OHMS 1/2W 10%
26R2	502147		RESISTOR, 470 OHMS 1/2W 10%
26R3	502282		RESISTOR, 8.2K OHMS 1/2W 10%
26R4	421942		RESISTOR, 10K VAR
26R5	502222		RESISTOR, 2.2K OHMS 1/2W 10%
26R6	502010		RESISTOR, 10 OHMS 1/2W 10%
26R7	502027		RESISTOR, 27 OHMS 1/2W 10%
26R8	502156		RESISTOR - 560 OHMS 10% 1/2 W
26R9	249659		RESISTOR, 27K OHMS 5W 5%
26R10	502147		RESISTOR, 470 OHMS 1/2W 10%

Symbol	Stock No.	Drawing No.	Description
26R11	502133		RESISTOR, 330 OHMS 1/2W 10%
26R12	502210		RESISTOR, 1K OHMS 1/2W 10%
26R13	512347		RESISTOR, 47K OHMS 1W 10%
26R14	419477		RESISTOR, 1K OHMS VAR
26R15	249645		RESISTOR, 3.01K OHMS 3W 1%
26R16	249650		RESISTOR, 80K OHMS 5W 5%
26R17	502339		RESISTOR, 39K OHMS 1/2W 10%
26R18	502318		RESISTOR, 18K OHMS 1/2W 10%
26R19	421942		RESISTOR, 10K OHMS VAR.
26R20	502339		RESISTOR, 39K OHMS 1/2W 10%
26R24	502147		RESISTOR, 470 OHMS 1/2W 10%
26R25	502212		RESISTOR, 1.2K OHMS 1/2W 10%
26R26	502210		RESISTOR, 1K OHMS 1/2W 10%
26R27	420541		RESISTOR, 5K OHMS VAR
26R28	502127		RESISTOR, 270 OHMS 1/2W 10%
26R29	425713		RESISTOR, .1 OHMS 5W
26R30	502268		RESISTOR, 6.8K OHMS 1/2W 10%
26R31	502247		RESISTOR, 4.7K OHMS 1/2W 10%
26R32	502147		RESISTOR, 470 OHMS 1/2W 10%
26R33	502282		RESISTOR, 8.2K OHMS 1/2W 10%
26R34	502110		RESISTOR, 100 OHMS 1/2W 10%
26R35	502347		RESISTOR, 47K OHMS 1/2W 10%
26R36	502127		RESISTOR, 270 OHMS 1/2W 10%
26R37	502227		RESISTOR, 2.7K OHMS 1/2W 10%
26R38	249648		RESISTOR, 2.74K OHMS 3W 1%
26R39	502147		RESISTOR, 470 OHMS 1/2W 10%
26R40	502215		RESISTOR, 1.5K OHMS 1/2W 10%
26R41	419477		RESISTOR, 1K OHMS VAR
26R42	249627		RESISTOR, 1.54K OHMS 3W 1%
26R43	421943		RESISTOR, 6.81K OHMS 3W 1%
26R44	502110		RESISTOR, 100 OHMS 1/2W 10%
26R45	502215		RESISTOR, 1.5K OHMS 1/2W 10%
26R46	502156		RESISTOR, 560 OHMS 1/2W 10%
26R47	419477		RESISTOR, 1K OHMS VAR
26R48	502212		RESISTOR, 1.2K OHMS 1/2W 10%
26R50	502127		RESISTOR, 270 OHMS 1/2W 10%
26R51	502247		RESISTOR, 4.7K OHMS 1/2W 10%
26R52	502147		RESISTOR, 470 OHMS 1/2W 10%
26R53	502282		RESISTOR, 8.2K OHMS 1/2W 10%
26R54	420541		RESISTOR, 5K OHMS VAR
26R55	512010		RESISTOR, 10 OHMS 1W
26R56	502268		RESISTOR, 6.8K OHMS 1/2W 10%
26R57	502312		RESISTOR, 12K OHMS 1/2W 10%
26R58	502127		RESISTOR, 270 OHMS 1/2W 10%
26R59	502215		RESISTOR, 1.5K OHMS 1/2W 10%
26R60	249626		RESISTOR, 1.21K OHMS 1% 3W
26R61	502147		RESISTOR, 470 OHMS 1/2W 10%
26R62	502215		RESISTOR, 1.5K OHMS 1/2W 10%
26R63	249629		RESISTOR, 2.49K OHMS 3W 1%
26R64	249626		RESISTOR, 1.21K OHMS 3W 1%
26R65	419477		RESISTOR, 1K OHMS VAR
26R66	502210		RESISTOR, 1K OHMS 1/2W 10%
26R67	502156		RESISTOR, 560 OHMS 1/2W 10%
26R68	419477		RESISTOR, 1K OHMS VAR
26R69	502212		RESISTOR, 1.2K OHMS 1/2W 10%
26R70	502210		RESISTOR, 1K OHMS 1/2W 10%
26R71	502156		RESISTOR, 560 OHMS 1/2W 10%
26R72	419477		RESISTOR, 1K OHMS VAR
26R73	502212		RESISTOR, 1.2K OHMS 1/2W 10%
26R74	502147		RESISTOR, 470 OHMS 1/2W 10%
26R75	502127		RESISTOR, 270 OHMS 1/2W 10%
26R80	420541		RESISTOR, 5K OHMS VAR
26R81	512010		RESISTOR, 10 OHMS 1W
26R82	502282		RESISTOR, 8.2K OHMS 1/2W 10%
26R83	502133		RESISTOR, 330 OHMS 1/2W 10%
26R84	502210		RESISTOR, 1K OHMS 1/2W 10%
26R85	421944		RESISTOR, 4.02 OHMS 3W 1%
26R86	502268		RESISTOR, 6.8K OHMS 1/2W 10%
26R87	502318		RESISTOR, 18K OHMS 1/2W 10%
26R88	502147		RESISTOR, 470 OHMS 1/2W 10%

Symbol	Stock No.	Drawing No.	Description
26R89	502233		RESISTOR, 3.3K OHMS 1/2W 10%
26R90	421945		RESISTOR, 4.62K OHMS 3W 1%
26R91	419477		RESISTOR, 1K OHMS VAR
26R92	522110		RESISTOR, 100 OHMS 2W
26SCR1	421947		SILICON CONT. RECT - TYPE 2N4443
26T1	421946		TRANSFORMER
26VR1	231343		ZENER DIODE - TYPE 1N963B
26VR2	225588		ZENER DIODE - TYPE 1N821
26VR3	233951		ZENER DIODE - TYPE 1N978B
26VR4	233951		ZENER DIODE - TYPE 1N978B
26VR5	233951		ZENER DIODE - TYPE 1N978B
26VR7	228458		ZENER DIODE - TYPE 1N756A
26VR8	225588		ZENER DIODE - TYPE 1N821
26VR9	231343		ZENER DIODE - TYPE 1N963B
26VR10	225590		ZENER DIODE - TYPE 1N968B
26VR11	228458		ZENER DIODE - TYPE 1N756A
26VR12	225588		ZENER DIODE - TYPE 1N821
26VR13	228458		ZENER DIODE - TYPE 1N756A
26VR14	228458		ZENER DIODE - TYPE 1N756A
NO PREFIX			
			MODULE EXTENDER MI-560541-B
			M/L 3720410 REV 9
Electrical/Mechanical			
J1	420033	3721894 006	CONNECTOR - 7 PIN FEMALE HOUSING
P1	420032	3721894 005	CONNECTOR - 7 PIN MALE HOUSING
11	420035	3721894 010	SOCKET - GUIDE, P1,J1
12	420034	3721894 009	PIN - GUIDE PIN, P1,J1
33	420031	3721894 004	SPRING - RETENTION

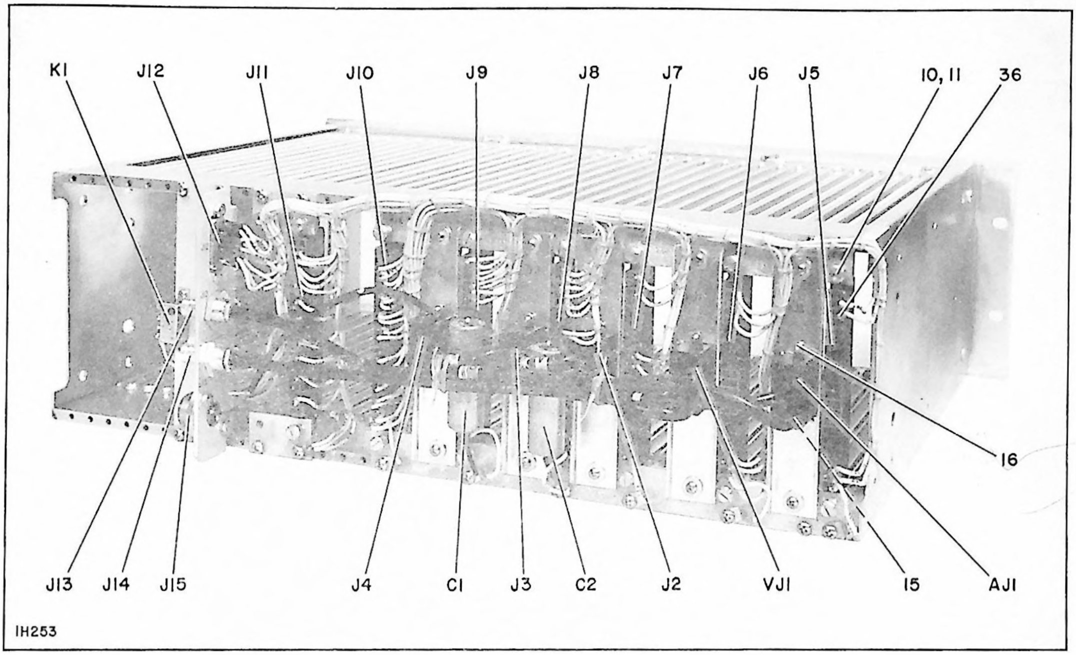


Figure 6-7. 5W Exciter Module Frame Assembly

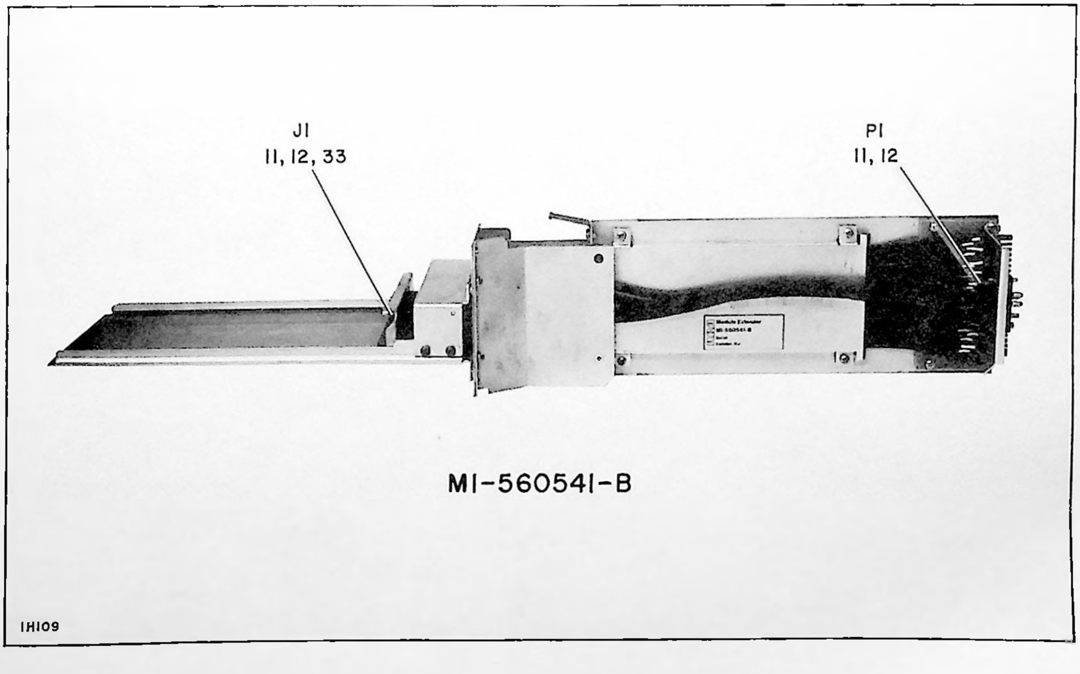
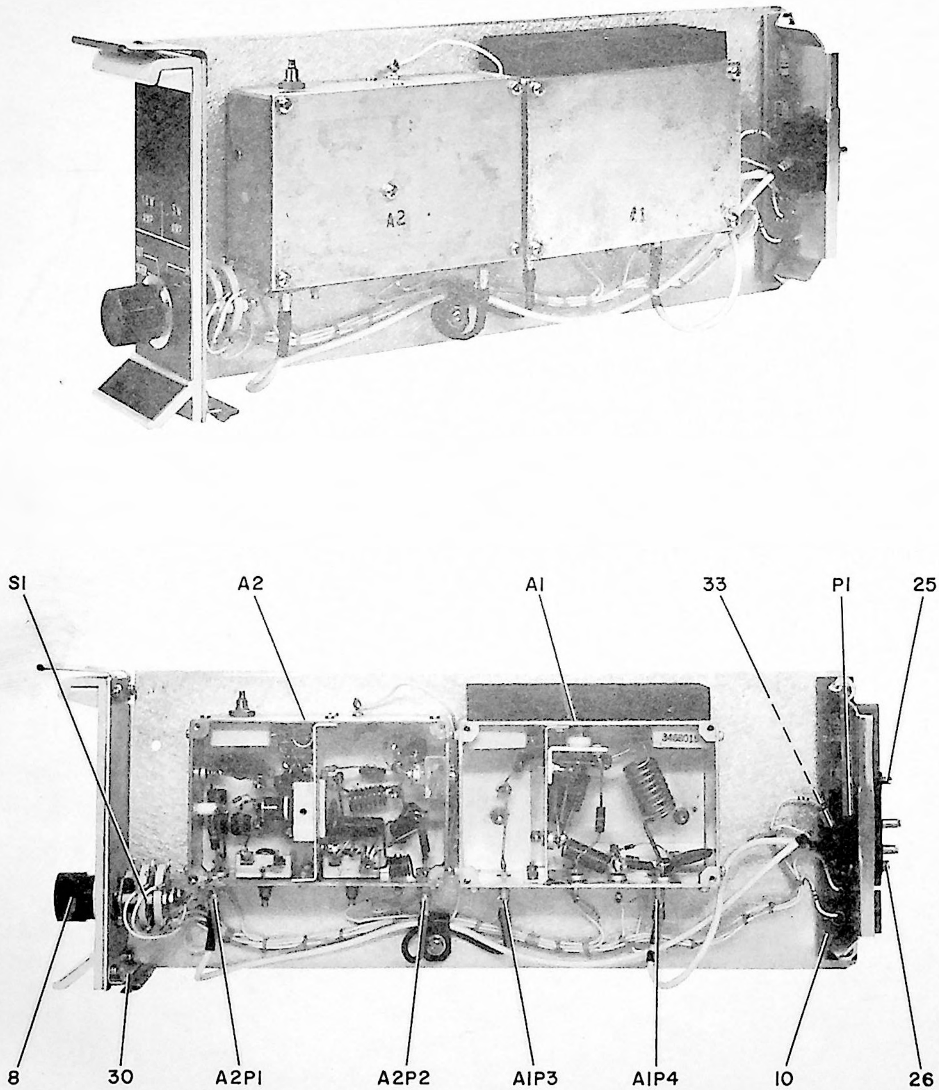


Figure 6-8. Module Extender MI-560541-B

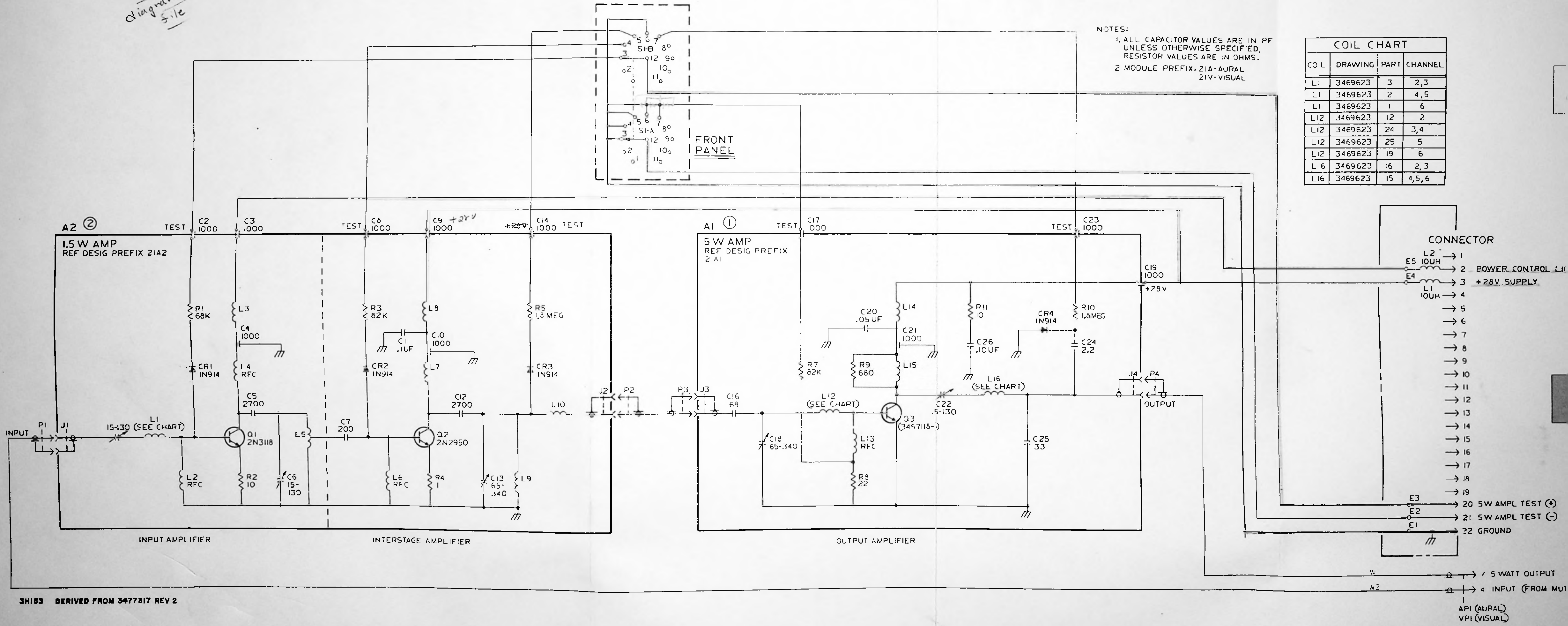


1H252

PREFIX 21A/21V

Figure 6-9. 5W Aural/Visual Amplifier MI-560531 – Prefix 21A/21V

Smaller - individualized diagrams in troubles case history file



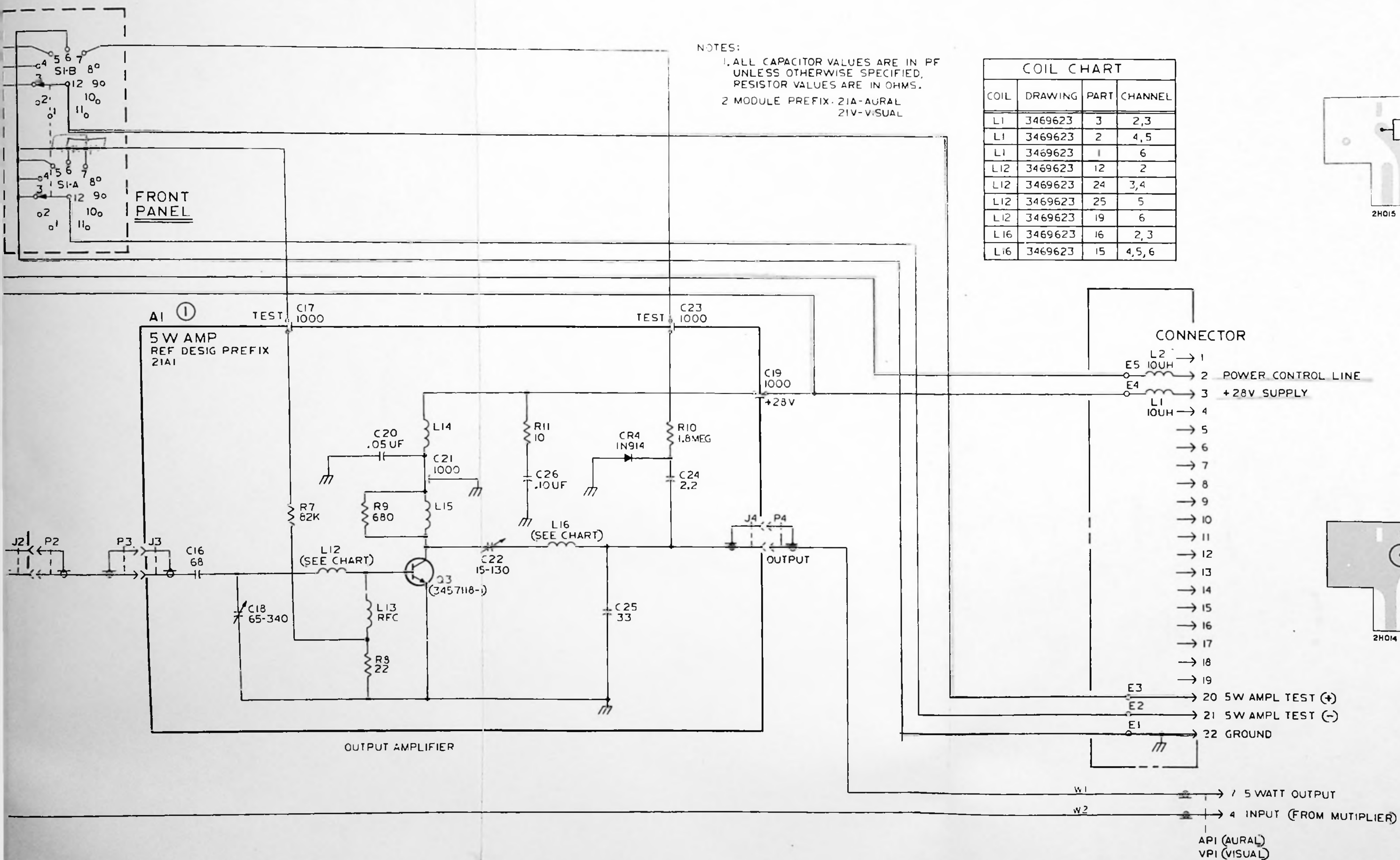
NOTES:
1. ALL CAPACITOR VALUES ARE IN PF UNLESS OTHERWISE SPECIFIED. RESISTOR VALUES ARE IN OHMS.
2 MODULE PREFIX- 21A-AURAL
21V-VISUAL

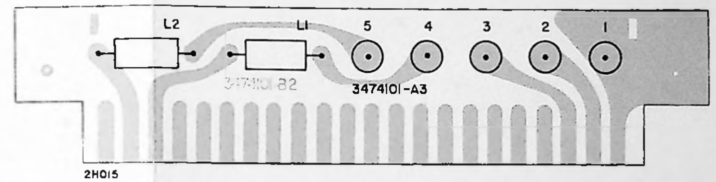
COIL CHART			
COIL	DRAWING	PART	CHANNEL
L1	3469623	3	2,3
L1	3469623	2	4,5
L1	3469623	1	6
L12	3469623	12	2
L12	3469623	24	3,4
L12	3469623	25	5
L12	3469623	19	6
L16	3469623	16	2,3
L16	3469623	15	4,5,6

3H153 DERIVED FROM 3477317 REV 2

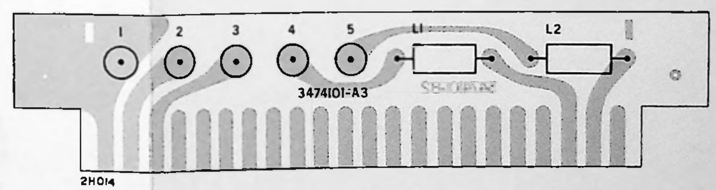
NOTES:
1. ALL CAPACITOR VALUES ARE IN PF UNLESS OTHERWISE SPECIFIED. RESISTOR VALUES ARE IN OHMS.
2. MODULE PREFIX: 21A-AURAL 21V-VISUAL

COIL CHART			
COIL	DRAWING	PART	CHANNEL
L1	3469623	3	2,3
L1	3469623	2	4,5
L1	3469623	1	6
L12	3469623	12	2
L12	3469623	24	3,4
L12	3469623	25	5
L12	3469623	19	6
L16	3469623	16	2,3
L16	3469623	15	4,5,6





TOP VIEW



BOTTOM VIEW

Figure 6-10. 5W Aural/Visual Amplifier Module MI-560531, Schematic Diagram (3477317) and Printed Wiring Board Assembly

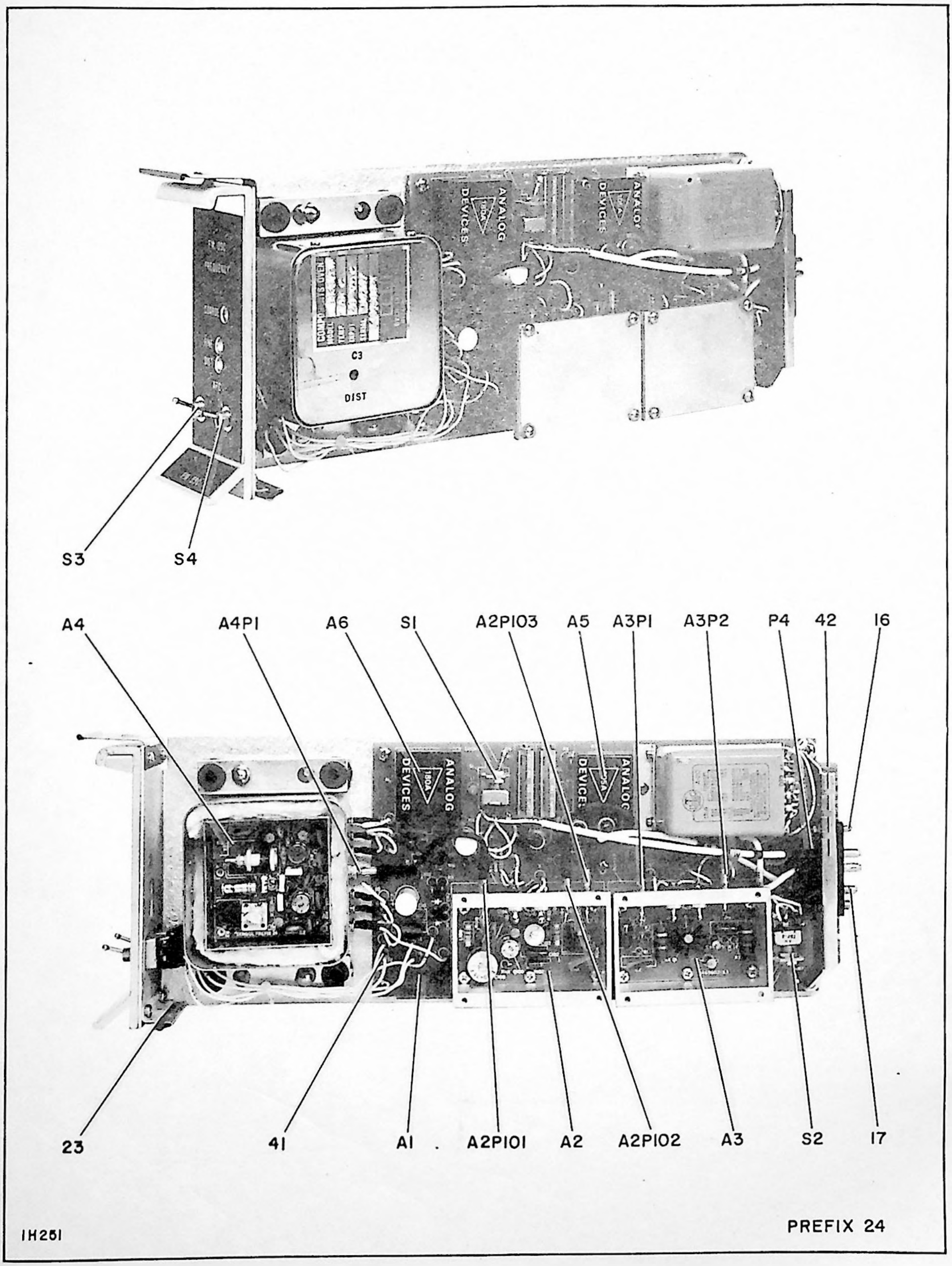
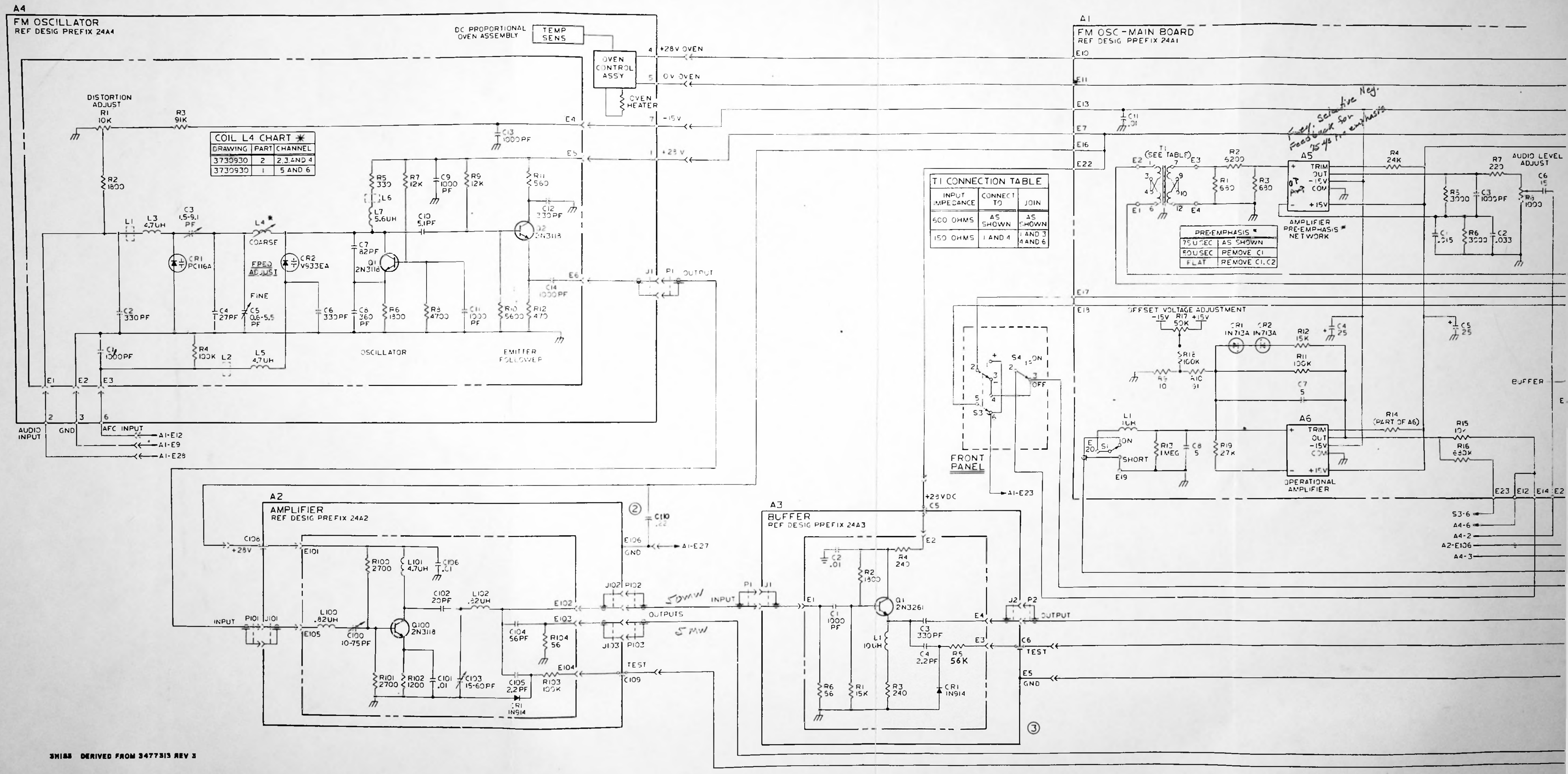


Figure 6-11. FM Oscillator Module MI-560532 – Prefix 24



3H155 DERIVED FROM 3477313 REV 3

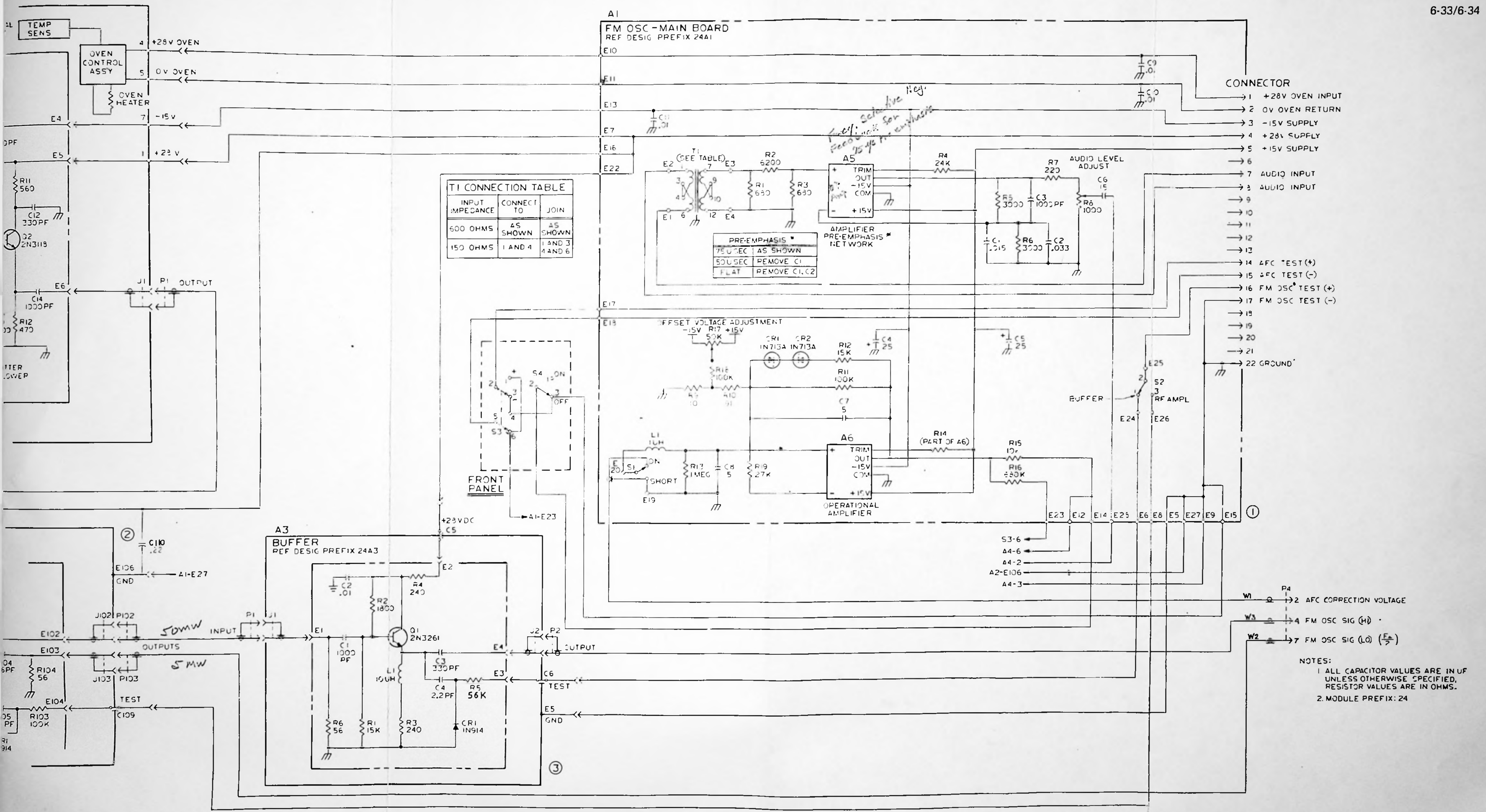
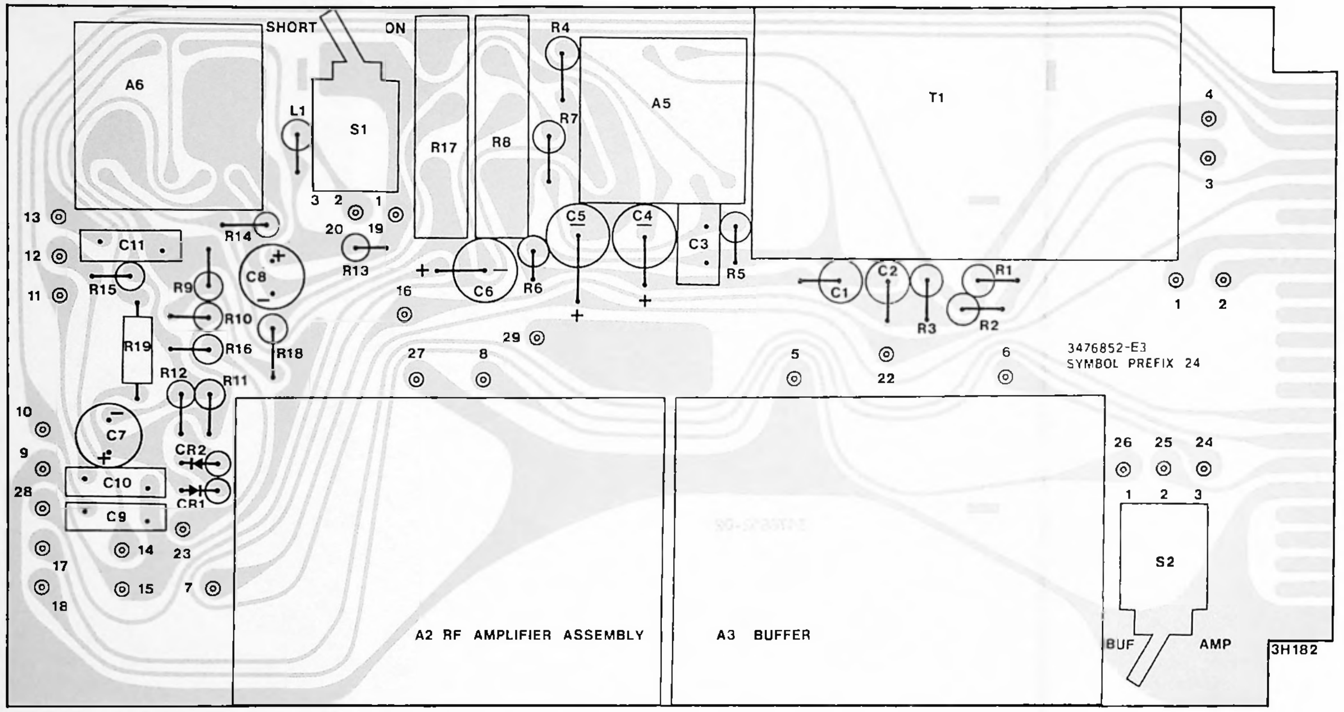
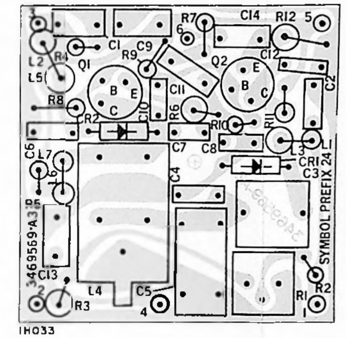


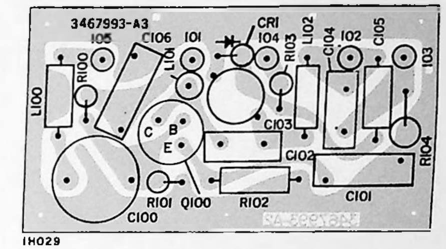
Figure 6-12. FM Oscillator Module MI-560532 Schematic Diagram (3477313)



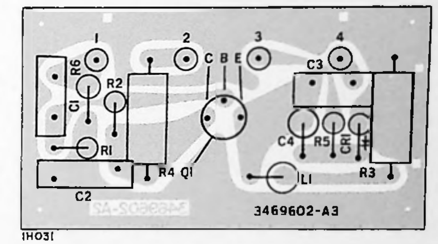
A1 – TOP VIEW



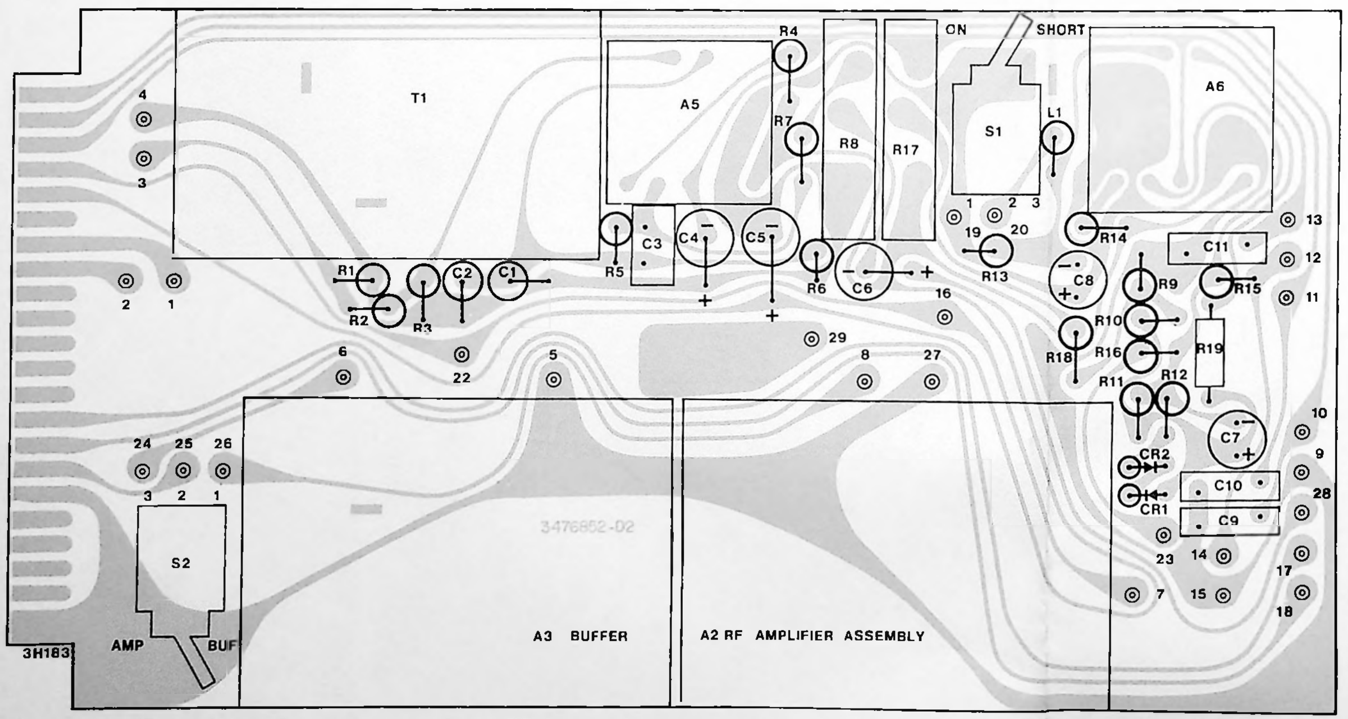
A4 – TOP VIEW



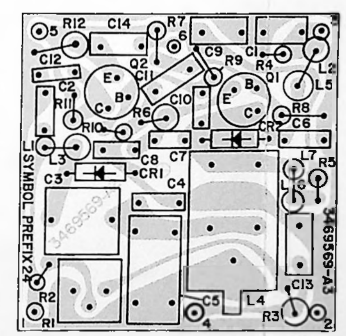
A2 – TOP VIEW



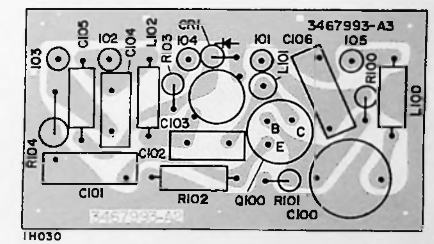
A3 – TOP VIEW



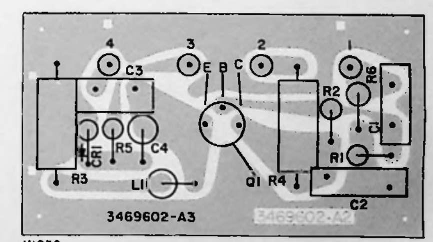
A1 – BOTTOM VIEW



A4 – BOTTOM VIEW



A2 – BOTTOM VIEW



A3 – BOTTOM VIEW

Figure 6-13. FM Oscillator Module MI-560532 Printed Wiring Board Assemblies (A1 thru A4)

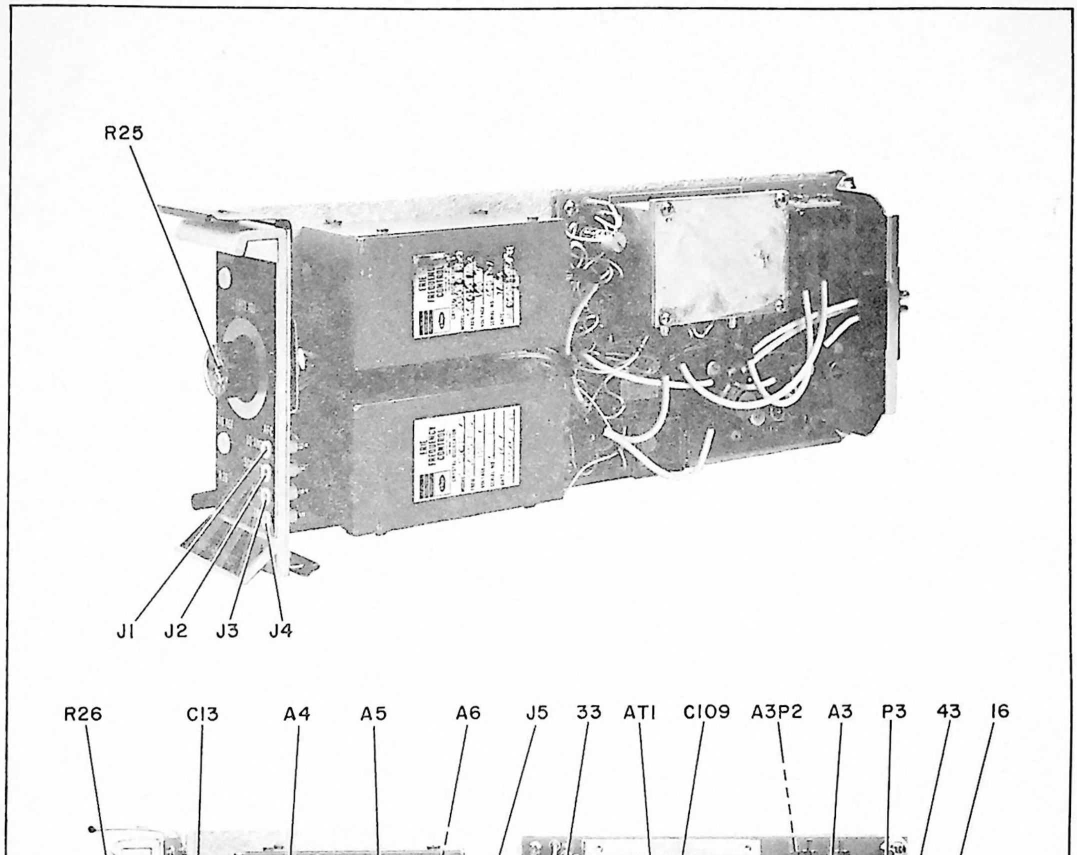
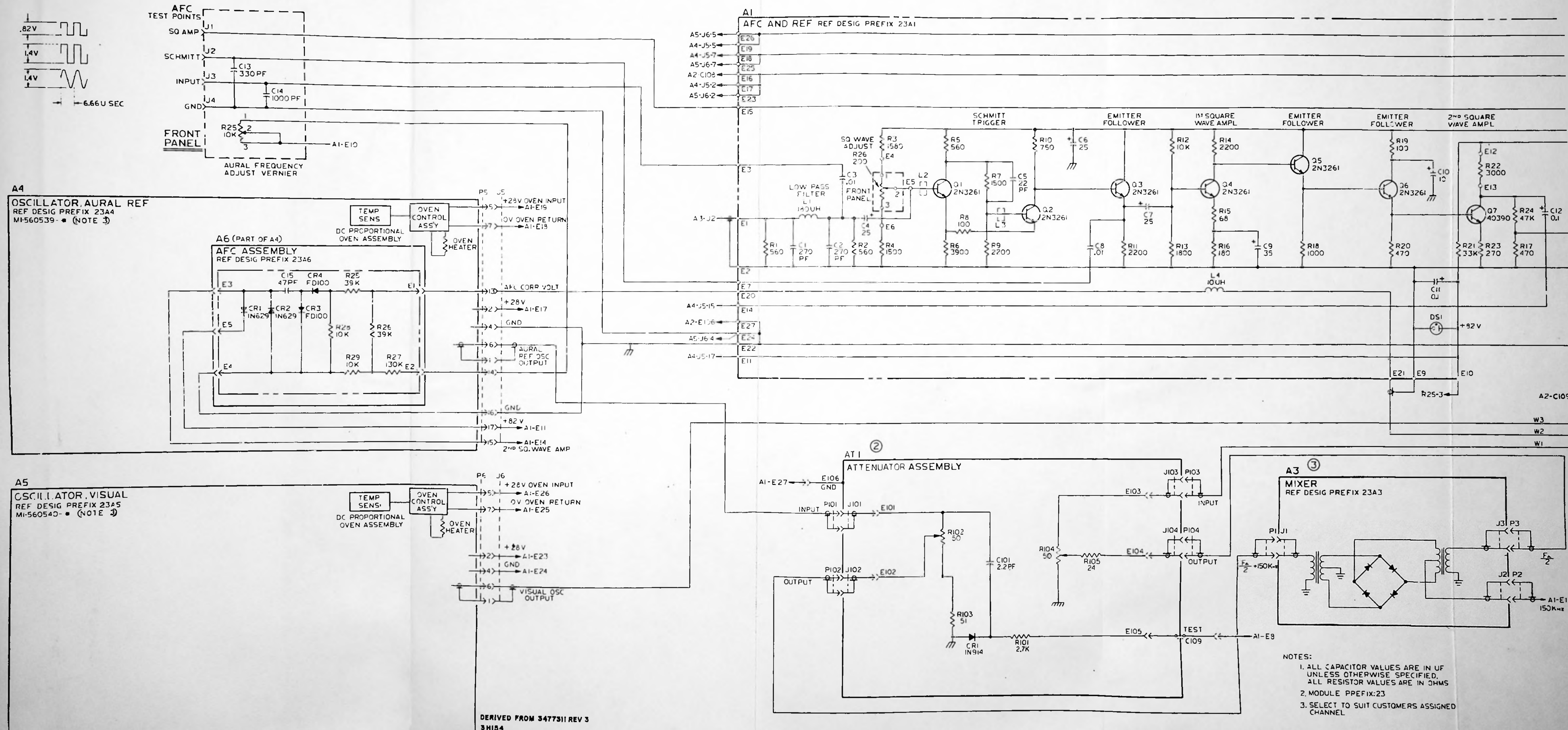


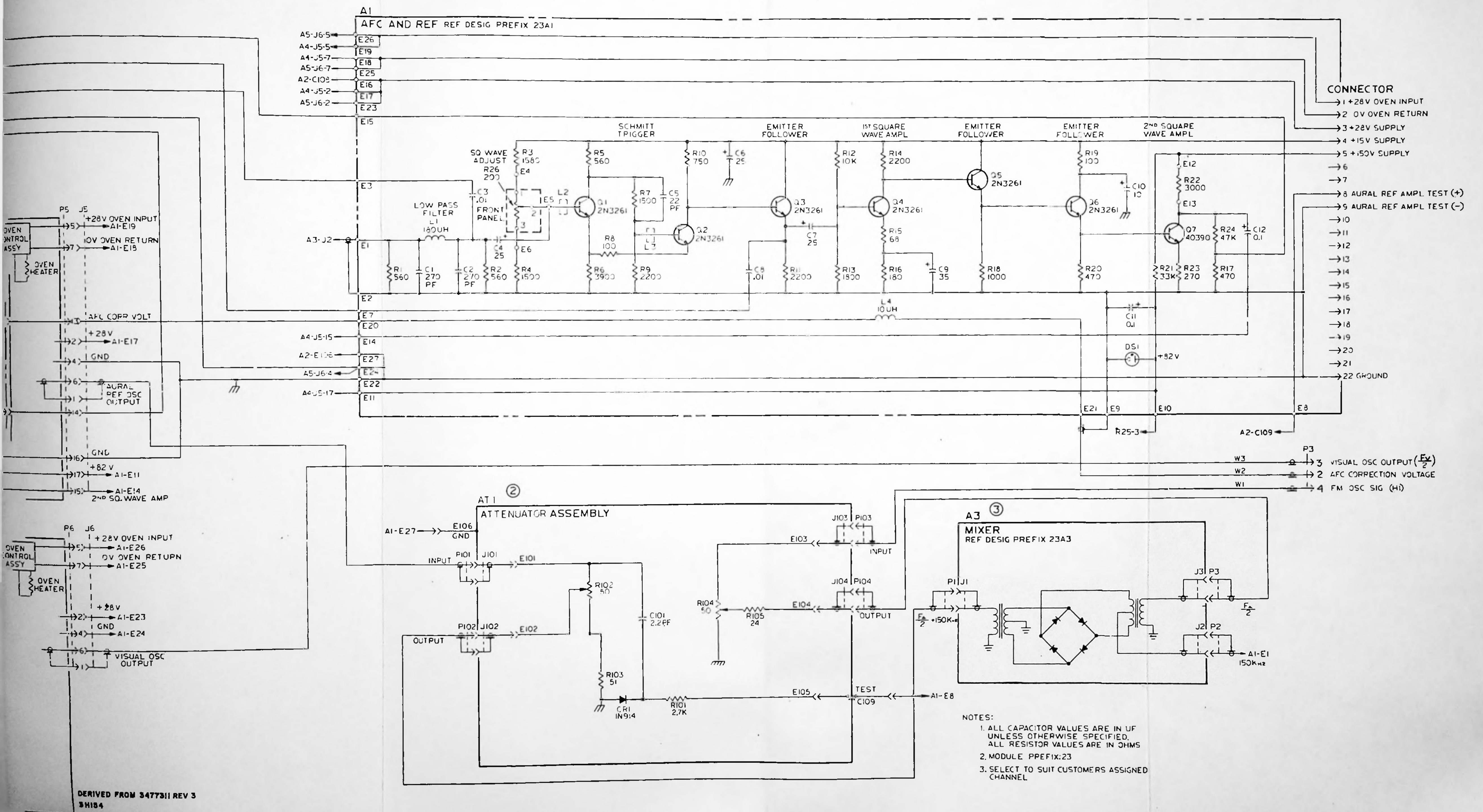
Figure 6-14. AFC/Reference Oscillator Module MI-560533 – Prefix 23



NOTES:

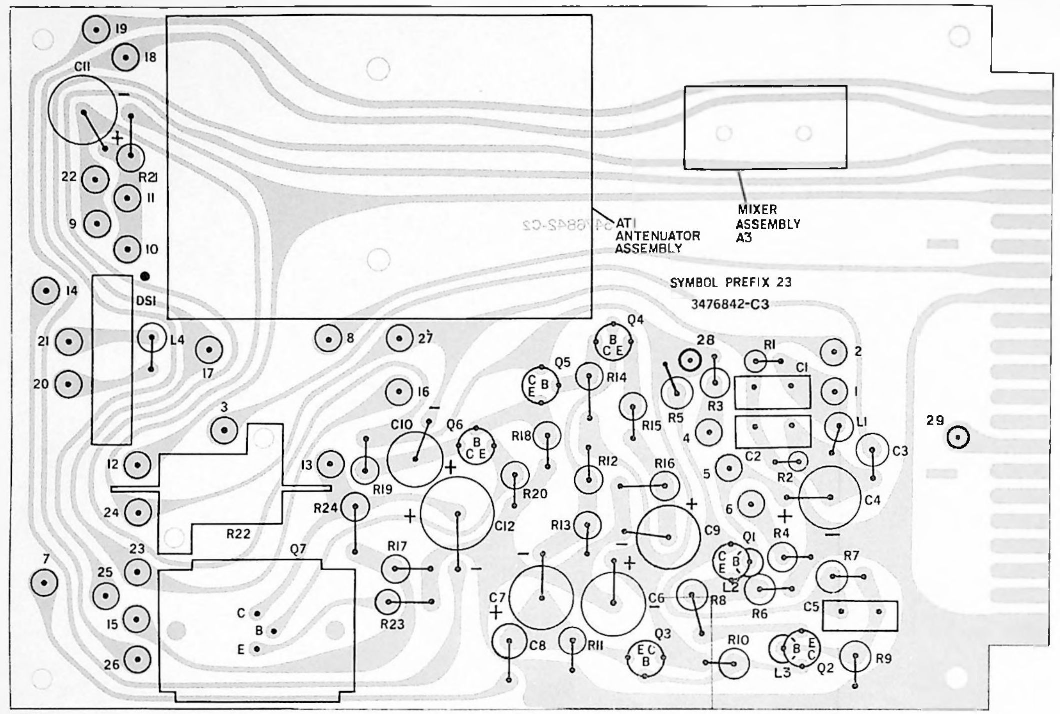
1. ALL CAPACITOR VALUES ARE IN UF UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS
2. MODULE PREFIX:23
3. SELECT TO SUIT CUSTOMERS ASSIGNED CHANNEL

Figure 6-15. AFC/
Sche

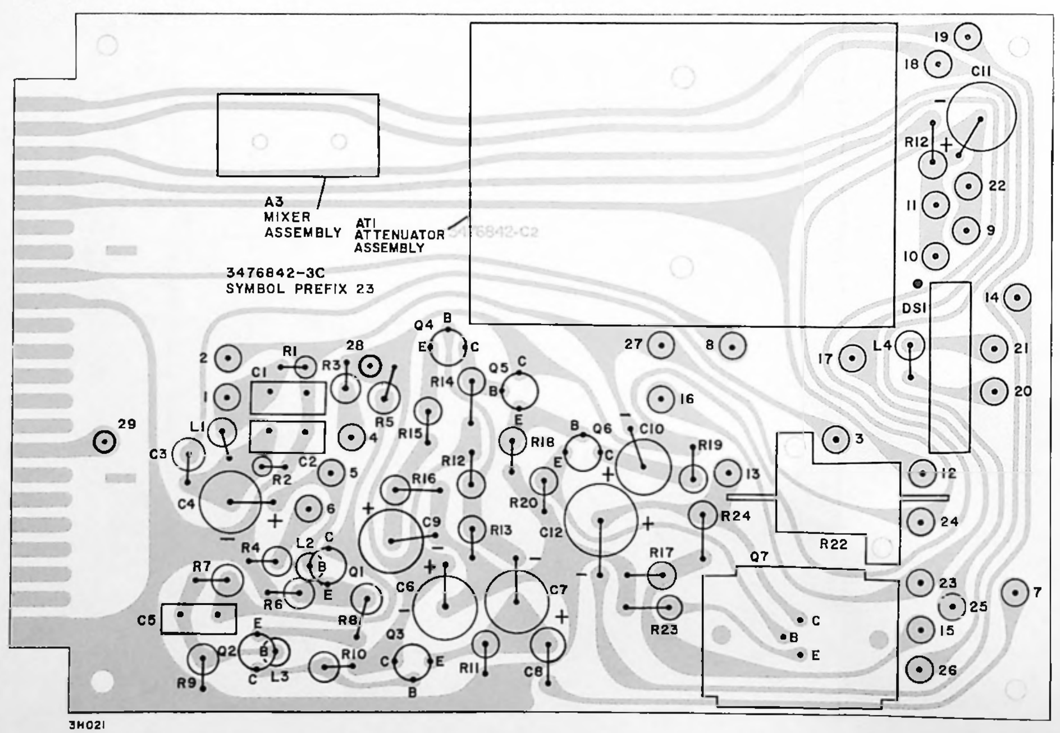


NOTES:
1. ALL CAPACITOR VALUES ARE IN UF UNLESS OTHERWISE SPECIFIED. ALL RESISTOR VALUES ARE IN OHMS
2. MODULE PREFIX:23
3. SELECT TO SUIT CUSTOMERS ASSIGNED CHANNEL

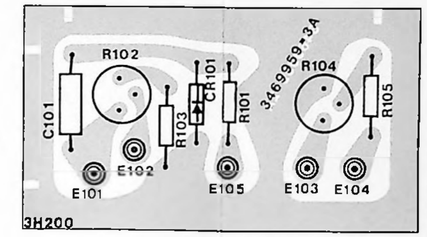
Figure 6-15. AFC/Reference Oscillator Module MI-560533 Schematic Diagram (3477311)



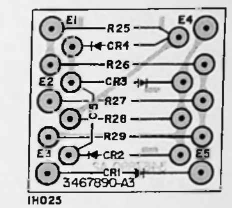
A1 — TOP VIEW



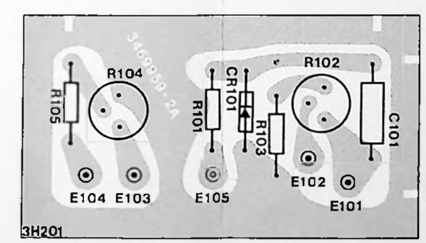
A1 — BOTTOM VIEW



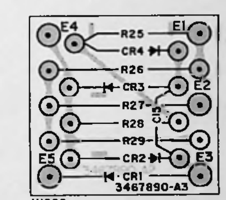
AT1 — TOP VIEW



A6 — TOP VIEW



AT1 — BOTTOM VIEW



A6 — BOTTOM VIEW

Figure 6-16. AFC/Reference Oscillator Module MI-560533 Printed Wiring Board Assemblies (A1, AT1, and A6)

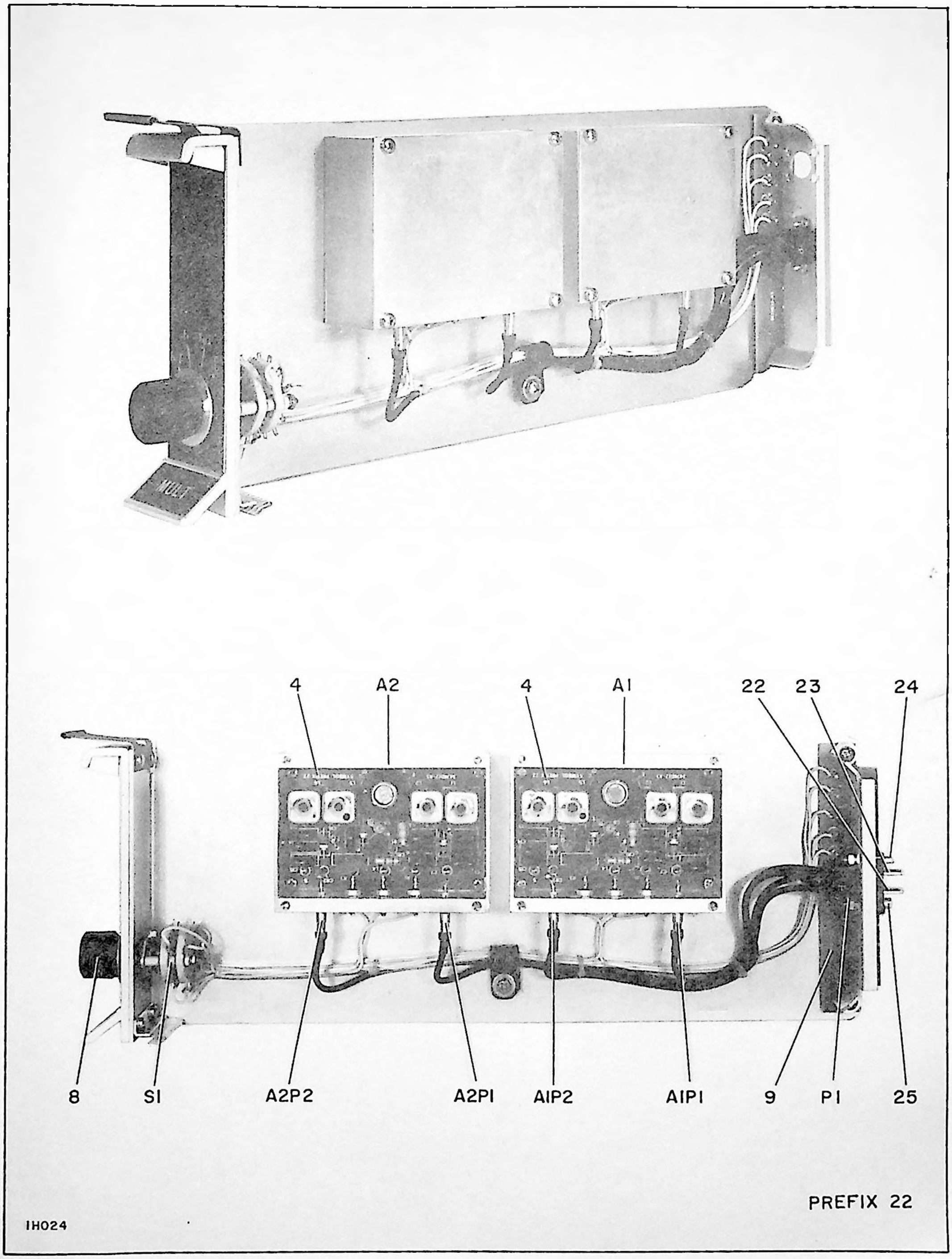
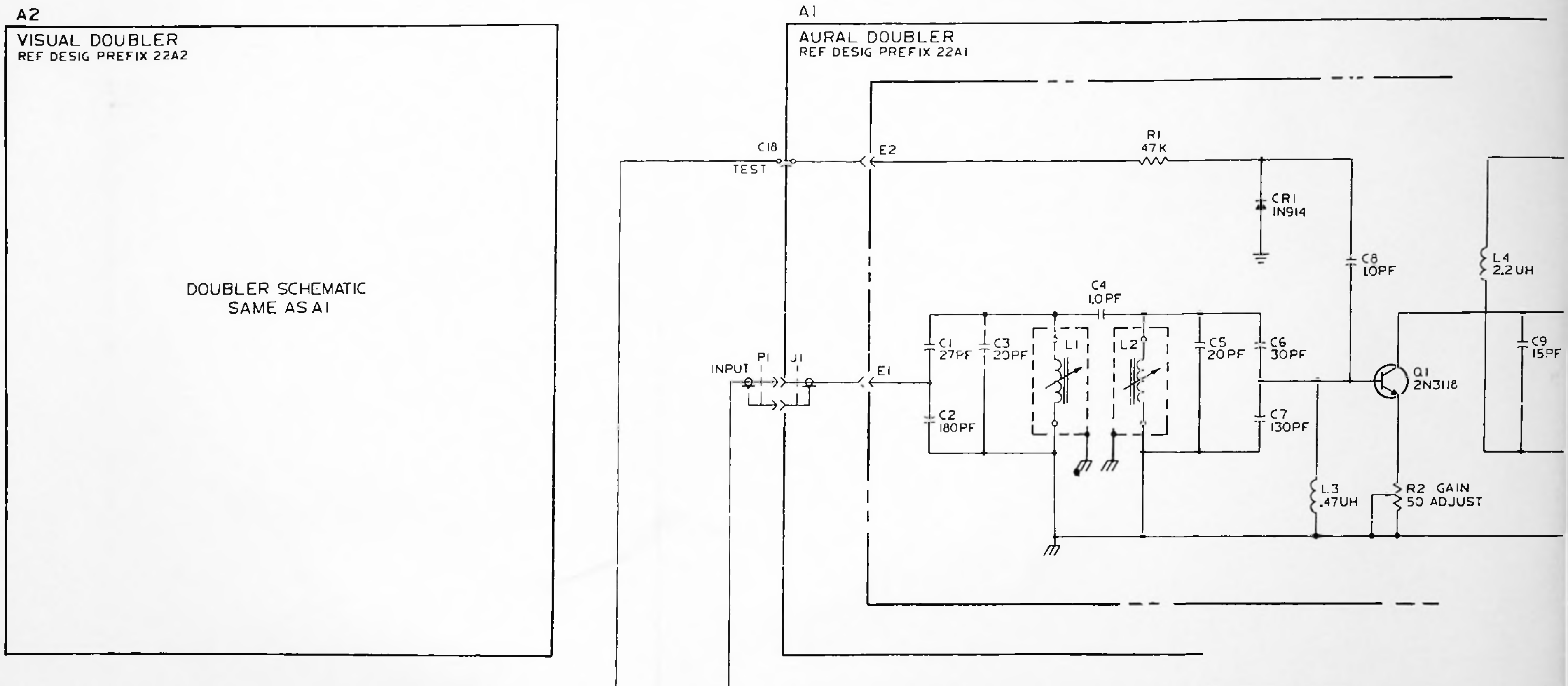


Figure 6-17. Multiplier Module MI-560535 — Prefix 22

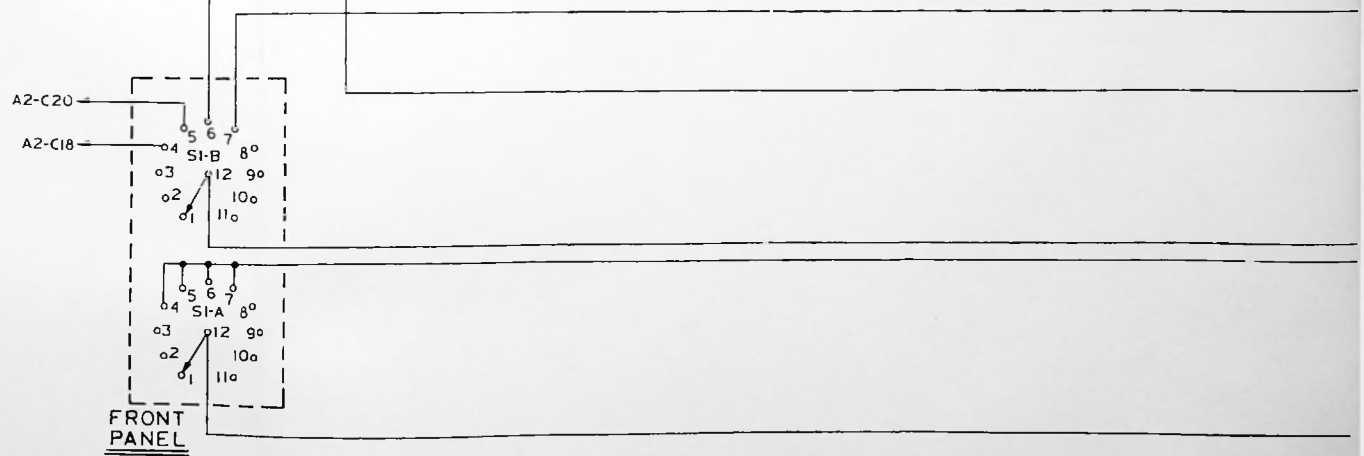


TUNING TABLE		
CHANNEL	VISUAL	AURAL
2	—	—
3	—	—
4	—	*
5	*	*
6	*	*

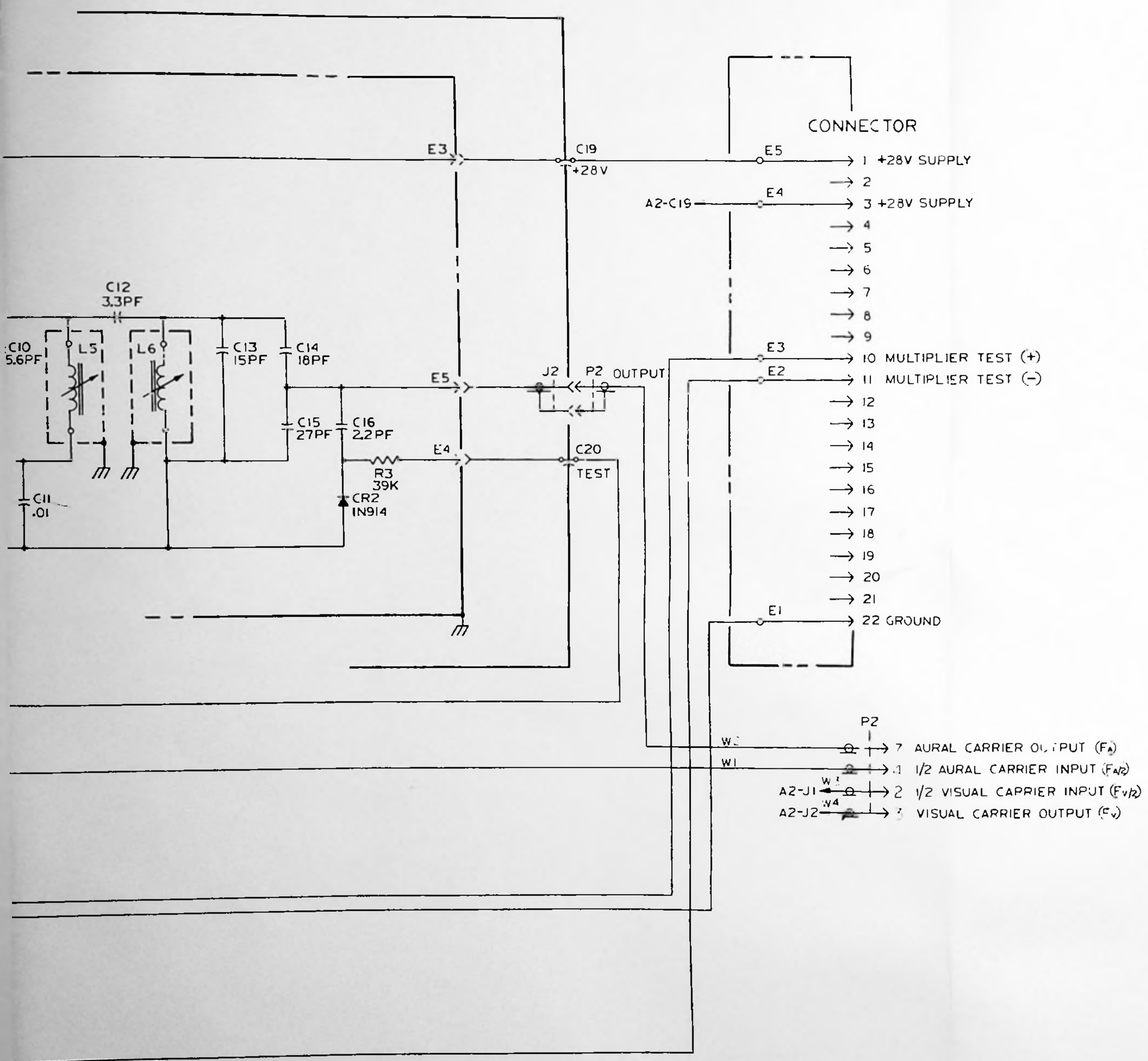
* CLIP CUT C3, C5, C9, AND C13

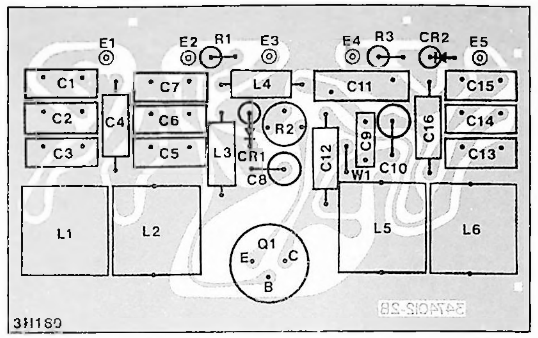
NOTES:

1. ALL CAPACITOR VALUES ARE IN UF UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS
2. MODULE PREFIX: 22

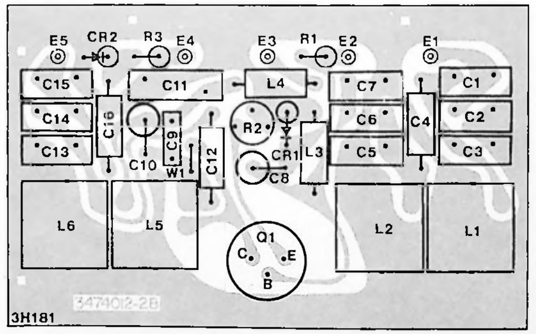


DERIVED FROM 3477318 REV I
3H182

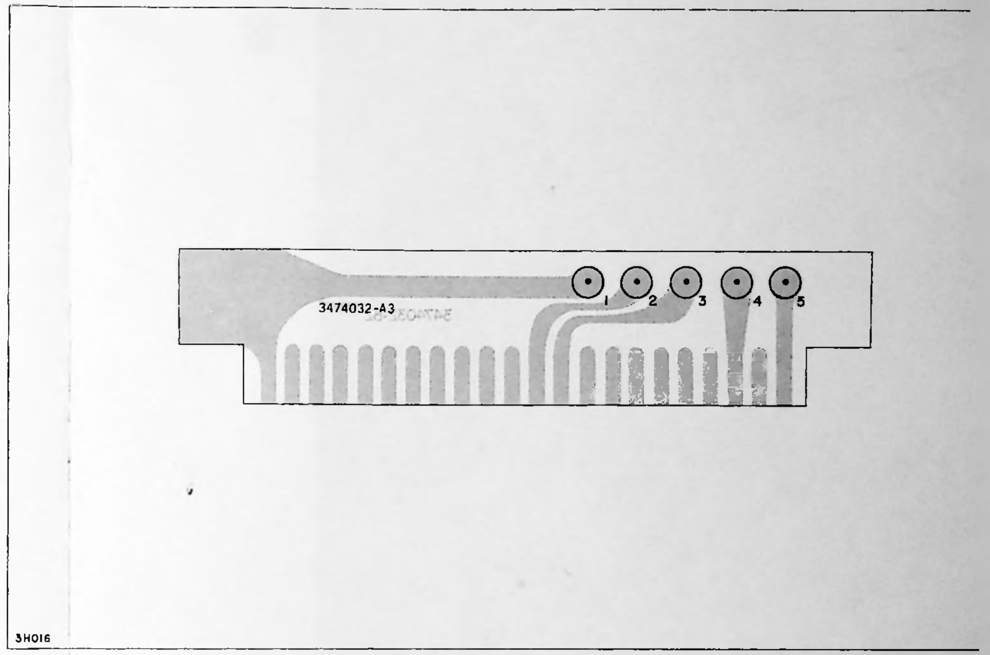




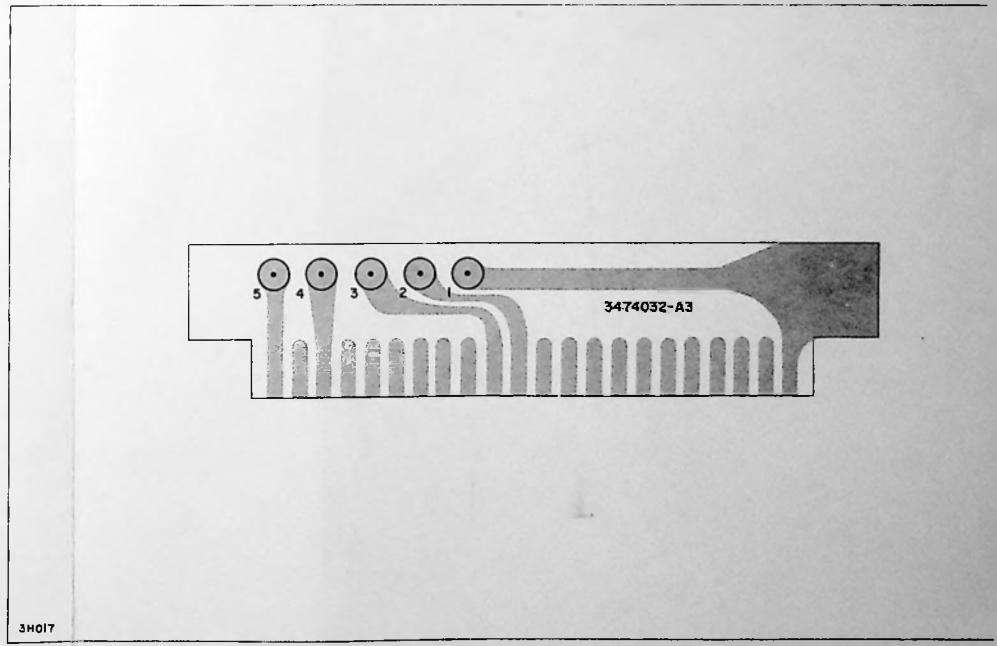
A1/A2 – TOP VIEW



A1/A2 – BOTTOM VIEW



TOP VIEW



BOTTOM VIEW

Figure 6-18. Multiplier Module MI-560535, Schematic
Diagram (3477315) and Printed Wiring Board Assemblies (A1

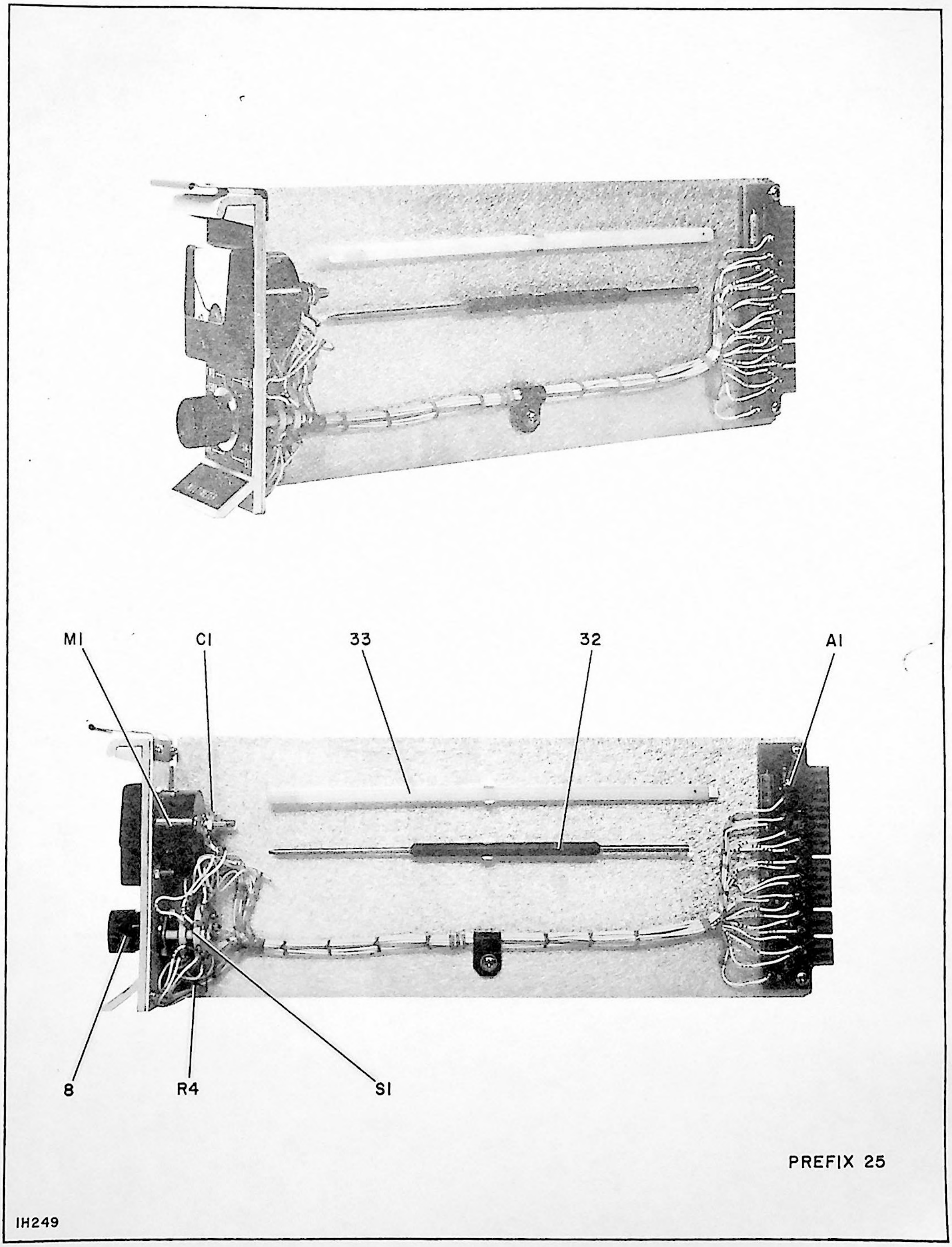
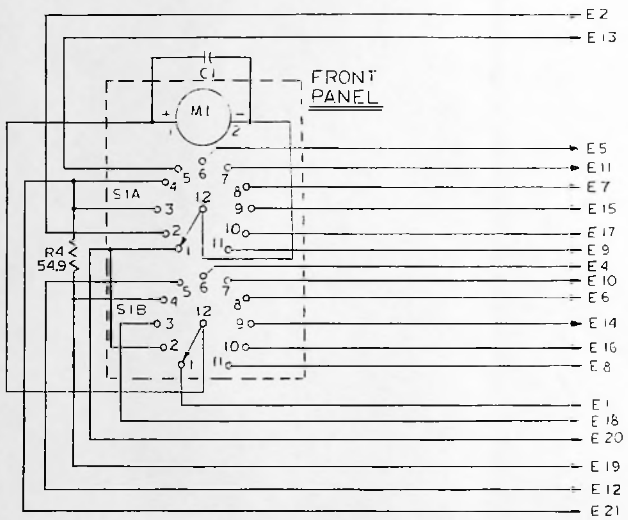
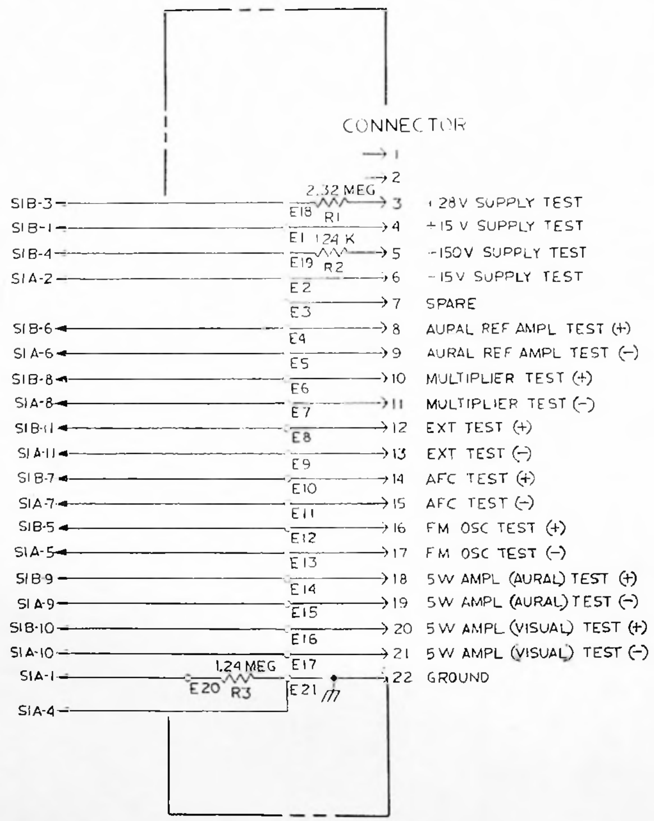


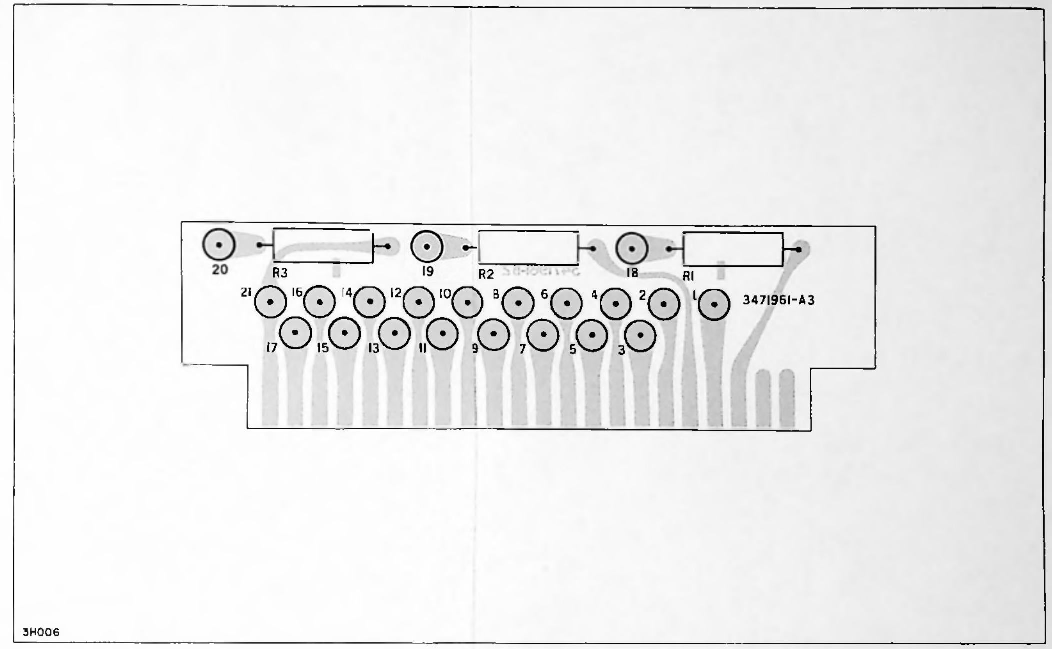
Figure 6-19. Multimeter Module MI-560537 – Prefix 25



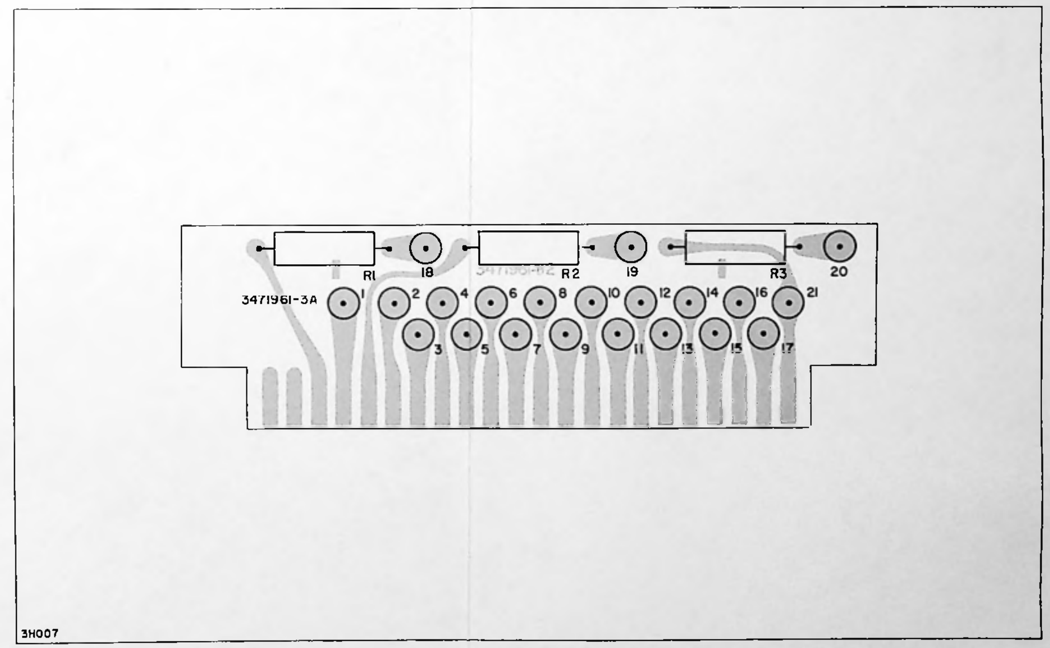
NOTES:
1. ALL RESISTOR VALUES ARE IN OHMS
2. MODULE PREFIX: 25
3. SWITCH VIEWED FROM FRONT-KNOB END

3H158 DERIVED FROM 3477312 REV 0





A1 – TOP VIEW



A1 – BOTTOM VIEW

Figure 6-20. Multimeter Module MI-560537, Schematic Diagram (3477312) and Printed Wiring Board Assembly (A1)

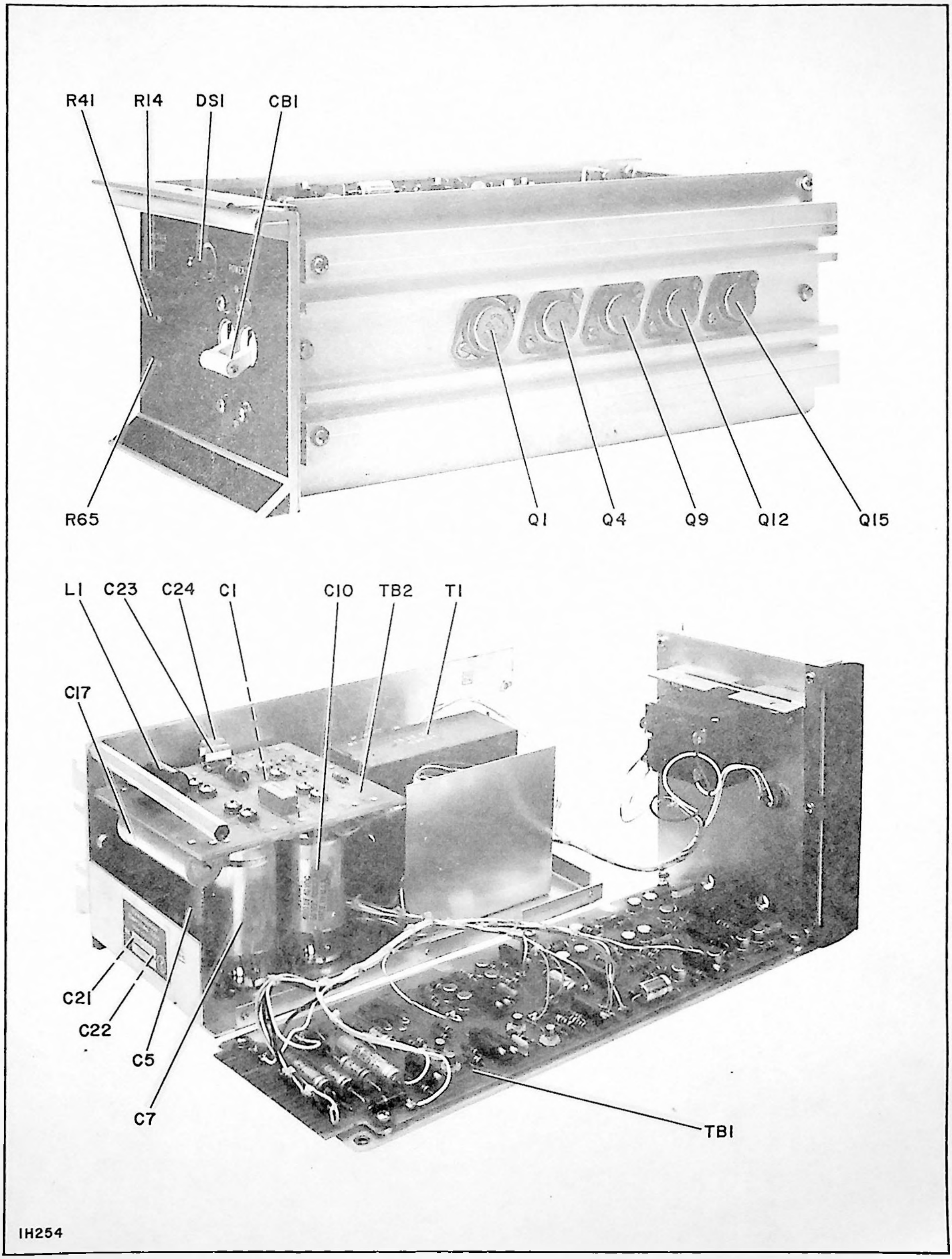


Figure 6-21. 5W Exciter Power Supply Module MI-560538-B — Prefix 26

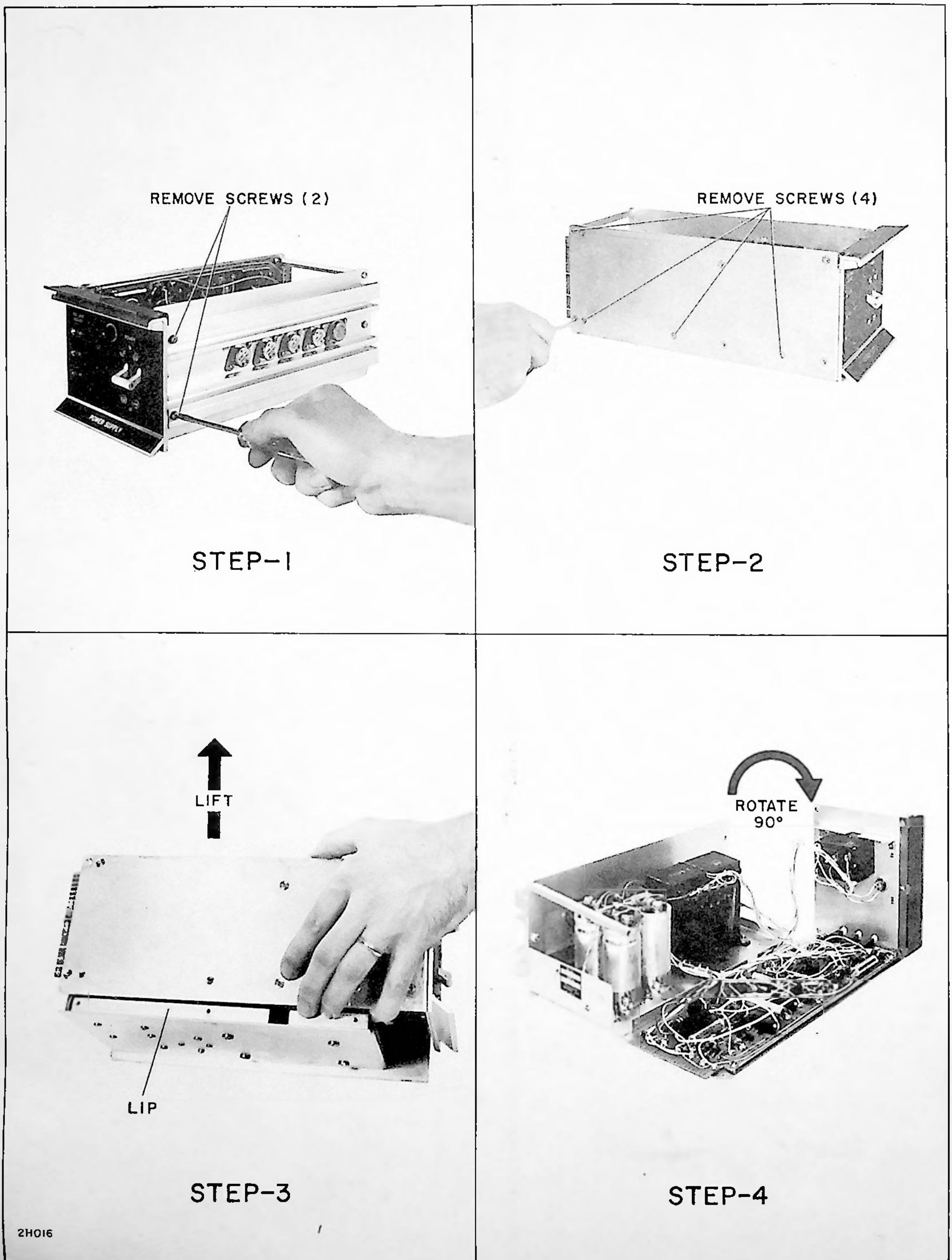


Figure 6-22. Power Supply Disassembly Procedure

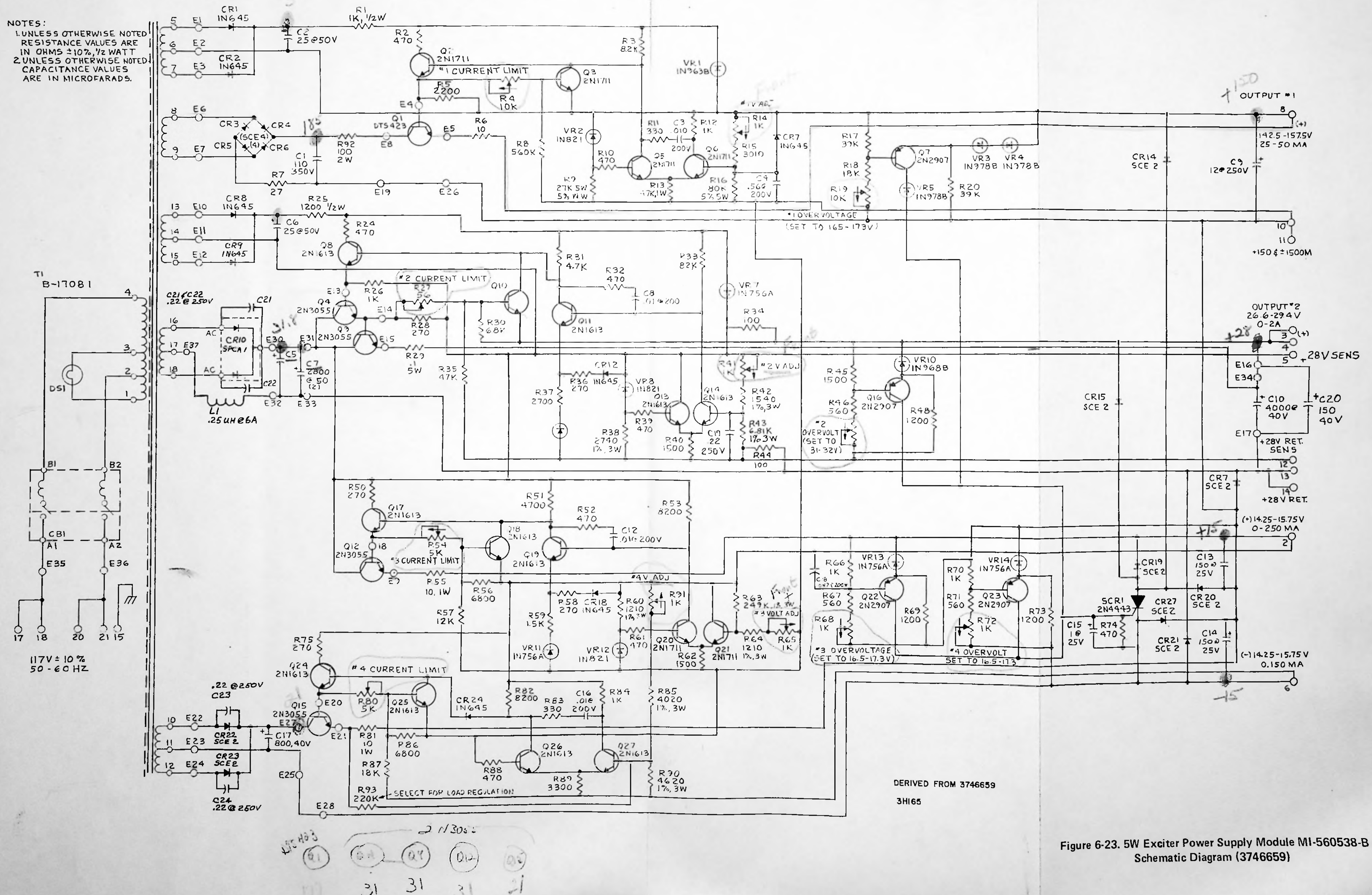


Figure 6-23. 5W Exciter Power Supply Module MI-560538-B Schematic Diagram (3746659)

150 V
28 V
+ 15 V
− 15 V

CW → 90

CW → 90

31 source

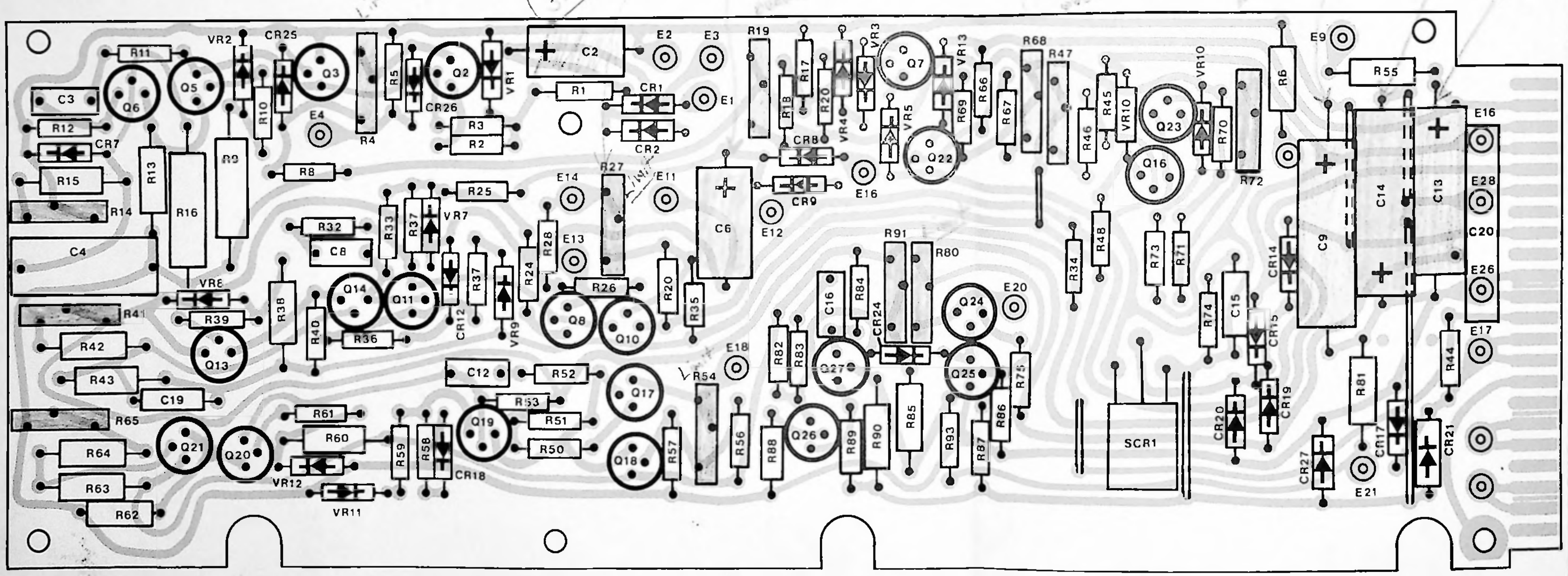
31 source

Test 150

Test −15

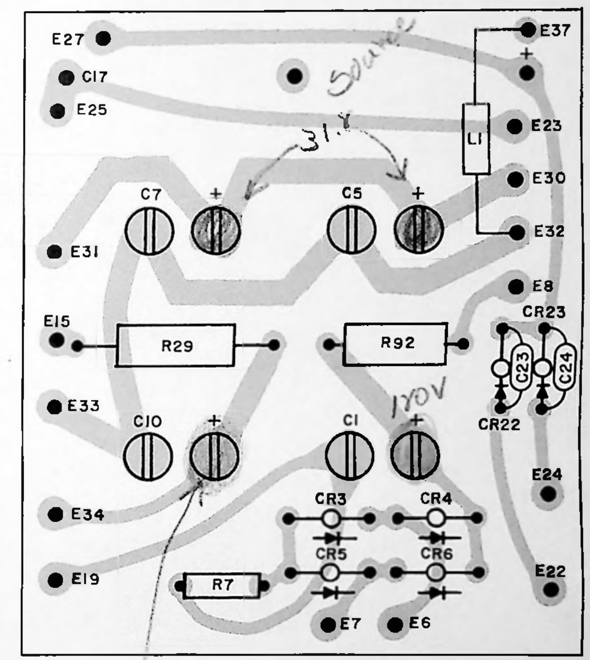
Test +15

TBI–TOP VIEW



3H100
17766

TB2–TOP VIEW



1H107

Test 28

Figure 6-24. 5W Exciter Power Supply Module MI-560538-B Printed Wiring Board Assemblies (TB1 and TB2)

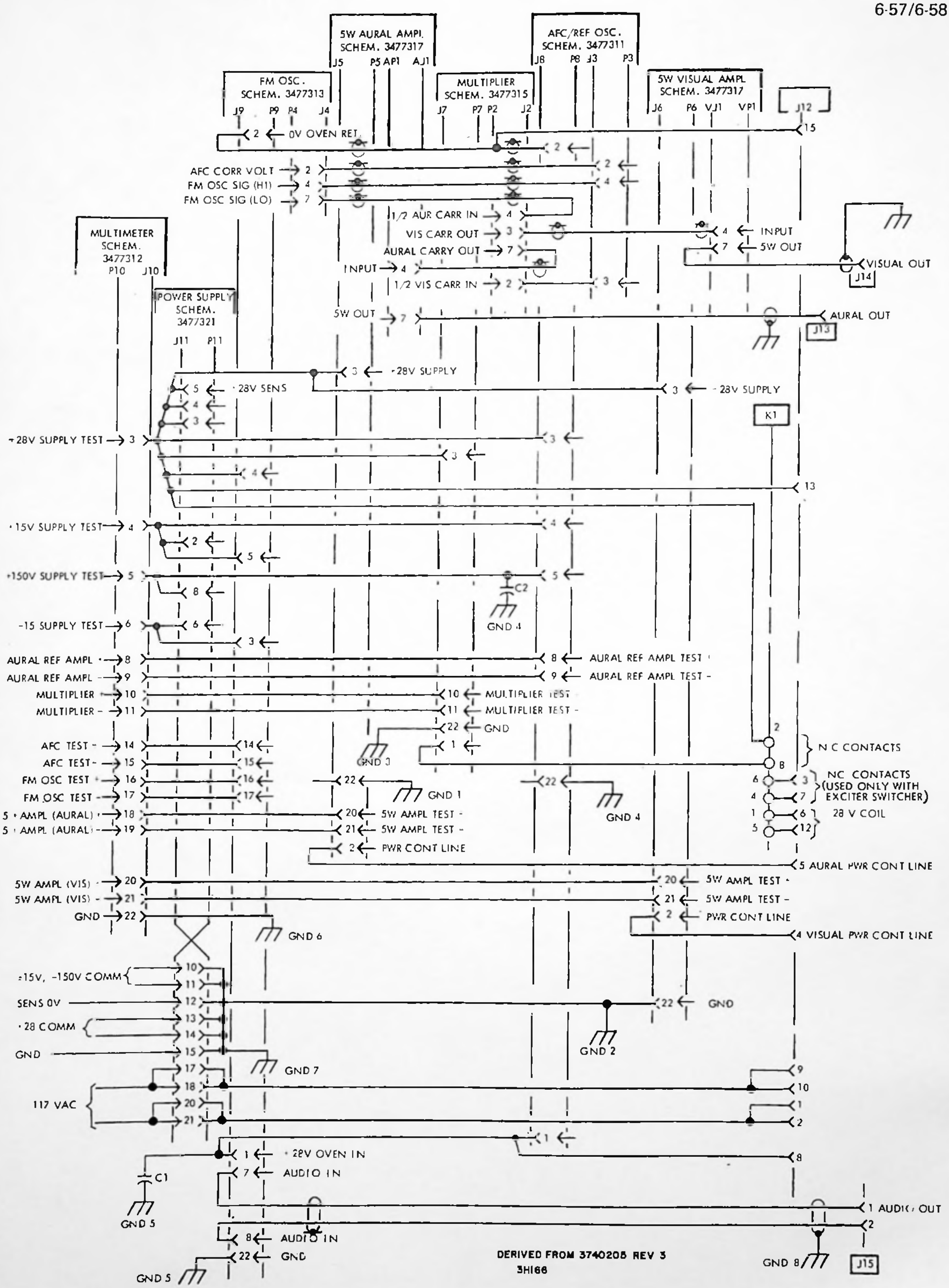


Figure 6-25. 5W Exciter Frame Assembly Wiring Diagram

SECTION VII
MANUFACTURERS' BULLETINS

The following listed bulletins are reprinted in this section with the permission of the respective manufacturers:

1. Type 8791 Linear Beam Power Amplifier Tube - RCA Corp.
2. Type 3CX3000A7 High-Mu Power Triode - Eimac Division of Varian
3. Type 3CX10,000A7 (8160) High-Mu Power Triode - Eimac Division of Varian
4. Type 3CX20,000A7 High-Mu Power Triode - Eimac Division of Varian
5. Application Note AN-4865 - RCA Corp.
6. Application Guide 1CE-300 - RCA Corp.
7. Model 1215B Power Supply Schematic - Acopian Technical Company
8. Model 70 MAGSENSE ® Meter Monitor Instruction Sheet - Control Data Corp.
9. Types SC, SC-1, SV and SV-1 Relays Instructions Sheet - Westinghouse Electric Corp.
10. Types BST-ON and BST-OF Solid State Timer Attachment Instructions Sheet - Westinghouse Electric Corp.
11. Type BF Relay Instructions Sheet - Westinghouse Electric Corp.
12. Adaptor, Solid State Timer - BF Relay Instructions Sheet - Westinghouse Electric Corp.
13. Series A/200 Contactor, NEMA Size 00, 0, 1 Instructions Sheet - Westinghouse Electric Corp.
14. Series A/200 Motor Controller, NEMA Size 0, 1, 1-1/2 Instructions Sheet - Westinghouse Electric Corp.
15. Series A/200 Contactor, NEMA Size 3, 4 Instructions Sheet - Westinghouse Electric Corp.
16. Latch Mechanism for 3 Pole A/200 Contactors, Sizes 00, D, 1, 2, 3, and 4 Instructions Sheet - Westinghouse Electric Corp.
17. Type L-56 Electrical Interlock for A/200 Series Contactors and Starters Instructions Sheet - Westinghouse Electric Corp.
18. Pole Adder for A/200 Series Contactors and Starters Instructions Sheet - Westinghouse Electric Corp.
19. Series A/200 Starters and Contactors, Sizes land 1-1/2, Renewal Parts Data - Westinghouse Electric Corp.
20. Series A/200 Starters and Contactors, Size 2, Renewal Parts Data - Westinghouse Electric Corp.
21. Series A/200 Starters and Contactors, Size 3, Renewal Parts Data - Westinghouse Electric Corp.
22. Series A/200 Starters and Contactors, Size 4, Renewal Parts Data - Westinghouse Electric Corp.
23. Series 1800 Low Differential Pressure Switches Specifications and Instructions - Dwyer Instruments, Inc.
24. Type GEK-28757 High Voltage Relay Instructions - General Electric
25. Series AB DE-ION ® Circuit Breakers Application Data - Westinghouse Electric Corp.
26. AMP-LEAF ® Extraction Tool Instructions Sheet - AMP Inc.
27. N Series Coaxicon ® Connectors Instructions Sheet - AMP Inc.
28. Taper Pin Hand Crimping Tool Instruction Sheet - AMP Inc.
29. Taper Pin Hand Crimping Tool Instruction Sheet - AMP Inc.
30. Certi-Lok ® Taper Pin Insertion Tool Instruction Sheet - AMP Inc.
31. Insulation Piercing Taper Pin Hand Crimping Tool Instruction Sheet - AMP Inc.
32. Certi-Lok ® Taper Pin Insertion Tool Instruction Sheet - AMP Inc.
33. Crimp Tools Specification Sheet - Amphenol

Linear Beam Power Amplifier Tube

- Ruggedized, Reliable
- 80 Watt Average-Noise-Power Output with White Noise Loading
- 200 Watt Power Output in UHF-Linear Telephony Service
- 500 Watts PEP Output in SSB Suppressed-Carrier Service
- CERMOLOX®
- Full Input to 400 MHz

The RCA-8791* is designed specifically to meet the high linearity and low noise requirements of modern data transmission and communication systems. Its ruggedized construction make it ideal for use in portable or mobile equipments.

The design linearity has been evaluated using Method 2206 of MIL-STD-1311. This method employs white noise with a Gaussian amplitude distribution to check the inherent distortion in power amplifiers over a broad operating spectrum. The 8791 tested better than the −40 dB specified for Government high-performance equipments for data transmission. This test checks the linearity for all methods of modulation both continuous (amplitide, frequency and phase) and also pulse (position, amplitude and duration).

The 8791 is also rated for SSB — suppressed carrier service where it can deliver up to 500 watts of peak envelope power at a third order intermodulation of −38 dB when tested with "Two Tone Modulation" (Method 2204 of MIL-STD-1311). It can also supply in excess of 200 watts of useful power output in linear telephony applications.

To assure compliance with environmental design objectives, sample tubes are regularly subjected to 50g-11 millisecond shock; 500g-3/4 millisecond shock and also 20g-2000 hertz vibration testing.

This bulletin gives application information unique to the RCA 8791. General information, covering the installation and operation of this tube type, is given in the "Application Guide for RCA Power Tubes", 1CE-300. Close attention to the instructions contained therein will assure longer tube life, safer operation, less equipment downtime, and fewer tube handling accidents.

*Formerly RCA Dev. No.2912.

General Data

Electrical:

Heater-Cathode:			
Type	Unipotential, Oxide Coated, Matrix Type		
Voltage[a] (ac or dc)	6.3	typ.	V
	6.6	max.	V
Current at 6.3 volts	7.5		A
Minimum Heating Time	120		s
Mu-Factor, (Grid No.2 to Grid No.1)	13		
Direct Interelectrode Capacitances:			
Grid No.1 to plate[b]	0.11	max.	pF
Grid No.1 to cathode & heater	28		pF
Plate to cathode & heater[b]	0.011	max.	pF
Grid No.1 to grid No.2	38		pF
Grid No.2 to plate	5.5		pF
Grid No.2 to cathode & heater[b]	1.1	max.	pF

Mechanical:

Operating Attitude		Any		
Overall Length	(62.0 mm)	2.44	max.	in
Greatest Diameter	(64.8 mm)	2.55	max.	in
Terminal Connections	See Dimensional Outline			
Sockets	See Mounting Arrangement			
Radiator	Integral part of tube			
Weight (Approx.)	(0.3 kg)	3/4 lb		

Thermal:

Seal Temperature[c] (Plate, grid No.2, grid No.1, cathode-heater and heater)	250	max.	°C
Plate-Core Temperature[c]	250	max.	°C

Linear RF Power Amplifier[d]:
Single-Sideband Suppressed-Carrier Service

Maximum CCS Ratings, Absolute-Maximum Values:

	Up to 400 MHz		
DC Plate Voltage[f]	3,000	max.	V
DC Grid-No.2 Voltage[g]	750	max.	V
DC Plate Current at Peak of Envelope[h]	700	max.	mA
Grid-No.2 Input[g]	25	max.	W
Plate Dissipation	1,000	max.	W

Maximum Circuit Values:

Grid-No.1 Circuit Resistance:			
With fixed bias	15,000	max.	Ω
With cathode bias	Not recommended		
Plate Circuit Impedance	See note f		
Grid-No.2 Circuit Impedance	See note g		

Typical Class AB_1 CCS Operation with "Two-Tone Modulation"

			at 30 Mc	
DC Plate Voltage	2000	2000	2500	V
DC Grid-No.2 Voltage	450	450	350	V
DC Grid-No.1 Voltage[j]	–34	–32	–26	V
Zero-Signal DC Plate Current	250	250	200	mA
Effective RF Load Resistance	1850	1850	2750	Ω
DC Plate Current at Peak of Envelope	535	545	430	mA
Average DC Plate Current	400	410	320	mA
DC Grid-No.2 Current at Peak of Envelope	–1.2	+0.2	–4.0	mA
Average DC Grid-No.2 Current	–4.0	–4.0	–3.0	mA
Peak RF Grid-No.1 Voltage	30	40	22	V
Output-Circuit Efficiency (Approx.)	90	90	90	%
Distortion Products Level[k]:				
Third order	38[m]	42	37[m]	dB
Fifth order	48[m]	54	53[m]	dB
Unbypassed Cathode Resistor	0	10	0	Ω
Useful Power Output (Approx.):				
Average	250	250	250	W
Peak envelope	500	500	500	W

Typical Class AB_1 CCS Operation with White Noise Loading as Specified in Method 2206 of MIL-STD-1311

	at 4.0 MHz		
DC Plate Voltage	2000	2000	V
DC Grid-No.2 Voltage	450	450	V
DC Grid No.1 Voltage	–34	–33	V
Zero-Signal DC Plate Current	250	250	mA
RF Load Resistance	1850	1850	Ω
Average DC Plate Current	275	275	mA
Average DC Grid-No.2 Current	–6.0	–6.0	mA
Driver Power Output[n]	1.0	1.0	W
Output Circuit Efficiency	90	90	%
Noise Power Ratio (NPR)	–38	–40	dB
Unbypassed Cathode Resistor	0	5	Ω
Useful Noise Power Output (NP_o)	90	80	W

Linear RF Power Amplifier[d]
Class AB or Class B Telephony

Carrier conditions for use with a maximum modulation factor of 1.0

Maximum CCS Ratings, Absolute-Maximum Values:

DC Plate Voltage[f]	3000	max.	V
DC Grid-No.2 Voltage[g]	750	max.	V
DC Plate Current	500	max.	mA
Grid-No.2 Input	25	max.	W
Plate Dissipation	1000	max.	W

Calculated CCS Operation as a Class AB_1 Amplifier

In a cathode drive circuit, at 400 MHz with an output circuit bandwidth of 10.0 MHz[p]

DC Plate Voltage	2500	V
DC Grid-No.2 Voltage[g]	450	V
DC Grid-No.1 Voltage[r]	–45	V
DC Plate Current	340	mA
DC Grid-No.1 Current	0	A
DC Grid-No.2 Current	–2.0	mA
Drive Power (Approx.)	8.0	W
Output Circuit Efficiency (Approx.)	80	%
Useful Power Output	200	W

RF Power Amplifier & Oscillator — Class C Telegraphy[d] and RF Power Amplifier — Class C FM Telephony[d]

Maximum CCS Ratings, Absolute-Maximum Values:

	up to 400 MHz		
DC Plate Voltage[f]	2500	max.	V
DC Grid-No.2 Voltage[g]	750	max.	V
DC Grid-No.1 Voltage[s]	–250	max.	V
DC Plate Current	500	max.	mA
DC Grid-No.1 Current	100	max.	mA
Grid-No.2 Input[g]	25	max.	W
Plate Dissipation	700	max.	W

Maximum Circuit Values:

Grid-No.1-Circuit Resistance	15,000	max.	Ω
Plate-Circuit Impedance	See note f		
Grid-No.2-Circuit Impedance	See note g		

Typical CCS Operation in a Cathode Drive Circuit

	at 400 MHz		
DC Plate Voltage	2250	2500	V
DC Grid-No.2 Voltage	400	400	V
DC Grid-No.1 Voltage	–45	–35	V
DC Plate Current	450	500	mA
DC Grid-No.2 Current	/	8	mA
DC Grid-No.1 Current	10	12	mA
Drive Power (Approx.)	30	35	W
Output-Circuit Efficiency (Approx.)	80	80	%
Useful Power Output	650	800	W

Characteristics Range Values

	Note	Min.	Max.	Unit
1. Heater Current	t	6.9	8.3	A
2. Direct Interelectrode Capacitances:				
Grid-No.1 to plate	b	–	0.11	pF
Grid No.1 to cathode & heater		26	32	pF
Plate to cathode & heater	b		0.011	pF
Grid No.1 to grid No.2		34	41	pF
Grid No.2 to plate		4.3	6.3	pF
Grid No.2 to cathode & heater	b	–	1.1	pF
3. Reverse Grid-No.1 Current	t,u	–	−50	μA
4. Peak Emission	c,v	80	–	A
5. Interelectrode Leakage Resistance	w	8.0	–	MΩ
6. Cutoff Grid-No.1 Voltage	t,x	–	87	V

Notes

a See Section V.A.3 of 1CE-300.

b With special shield adapter.

c See Dimensional Outline for Temperature Measurement points.

d See Section V.C. of 1CE-300.

f See Sections V.B. and V.B.1 of 1CE-300.

g See Section V.B.2 of 1CE-300.

h During short periods of circuit adjustment, under "Single Tone" conditions, the average plate current may be as high as 750 mA.

j Adjust to specified zero-signal dc plate current.

k Referenced to two equal tones (Method 2204, MIL-STD-1311).

m Measured during open loop operation (no feedback or neutralization employed to enhance performance).

n Measured across a 50 ohm grid-swamping resistor.

p Computed between half power points and based on 1-1/2 times tube output capacity.

r Adjust for zero-signal dc plate current of 200 mA.

s See Section V.B.3 of 1CE-300.

t With 6.3 V ac or dc on heater.

u With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and dc grid-No.1 voltage adjusted to give a plate current of 240 mA.

v For conditions with grid-No.1, grid-No.2, and plate tied together; and pulse voltage source of 850 peak volts, between plate and cathode. Pulse duration is 2 microseconds, pulse repetition frequency is 60 pps, and duty factor is 0.00012. Peak emission current is read after 1 minute.

w Under conditions with tube at 20° to 30° C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two electrodes (except across heater terminals) is measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1.0 megohm.

x With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and dc grid-No.1 voltage adjusted to give a plate current of 5 mA.

Forced-Air Cooling

Air Flow:

Through radiator — Adequate air flow to limit the plate-core temperature 250° C should be delivered by a blower through the radiator before and during the application of heater, plate, grid-No.2, and grid-No.1 voltages. In typical operation at 750 watts plate dissipation and 200° C plate core temperature 12 cfm at 0.36 inch of water at 22° C ambient air temperature should be sufficient as shown on Air Flow Chart.

To Plate, Grid-No.2, Grid-No.1, Heater Cathode, and Heater Terminals — A sufficient quantity of air should be allowed to flow past each of these terminals so that their temperature does not exceed the specified maximum value of 250° C.

During Standby Operation — Cooling air is required when only heater voltage is applied to the tube.

During Shutdown Operation — Air flow should cintinue for a few minutes after all electrode power is removed.

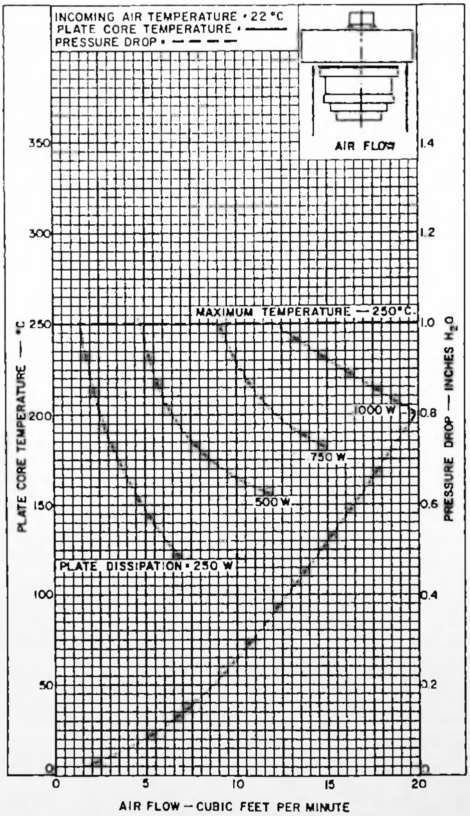


Figure 1 — Typical Cooling Characteristics

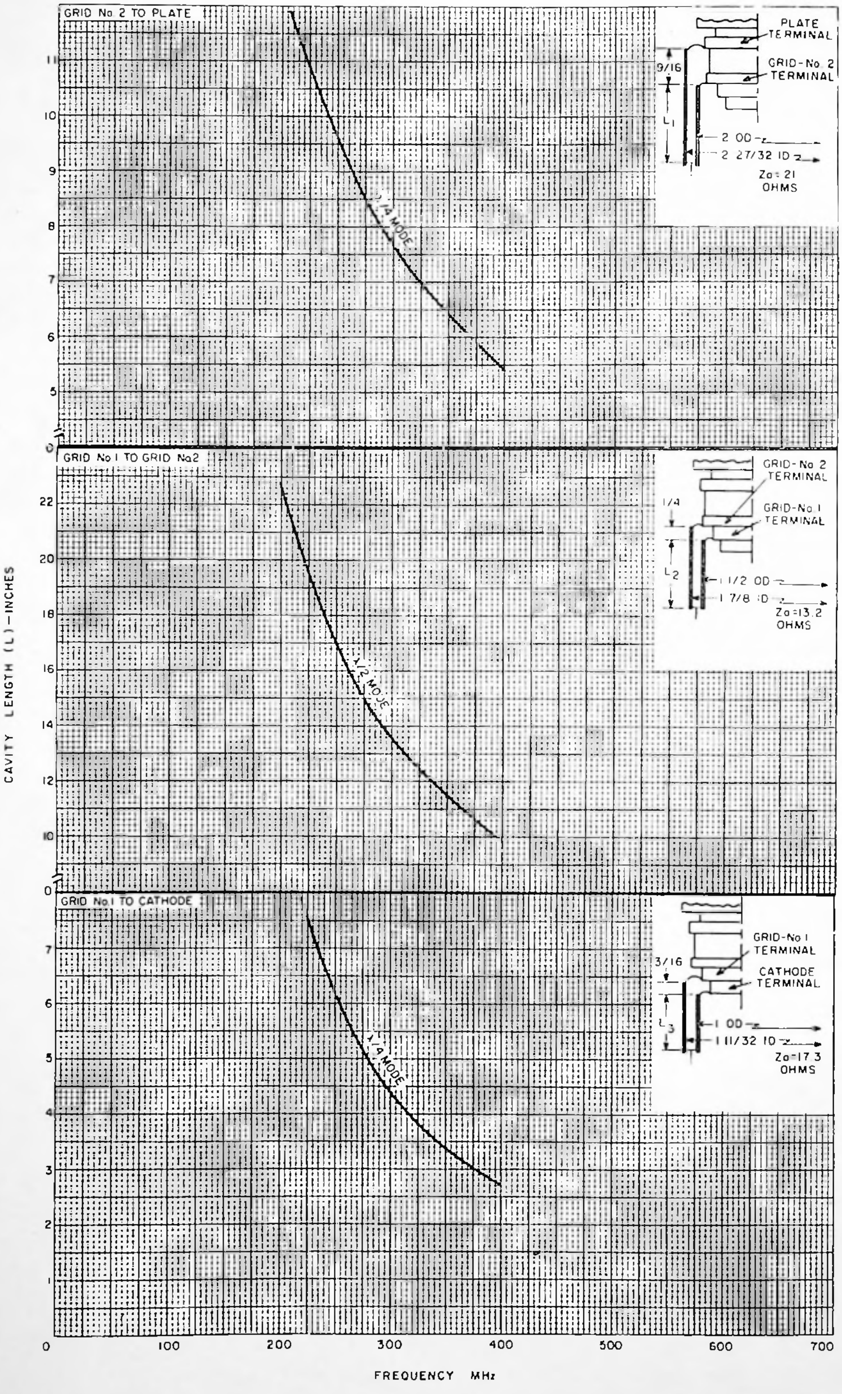


Figure 2 — Electrode Cavity Tuning Characteristics

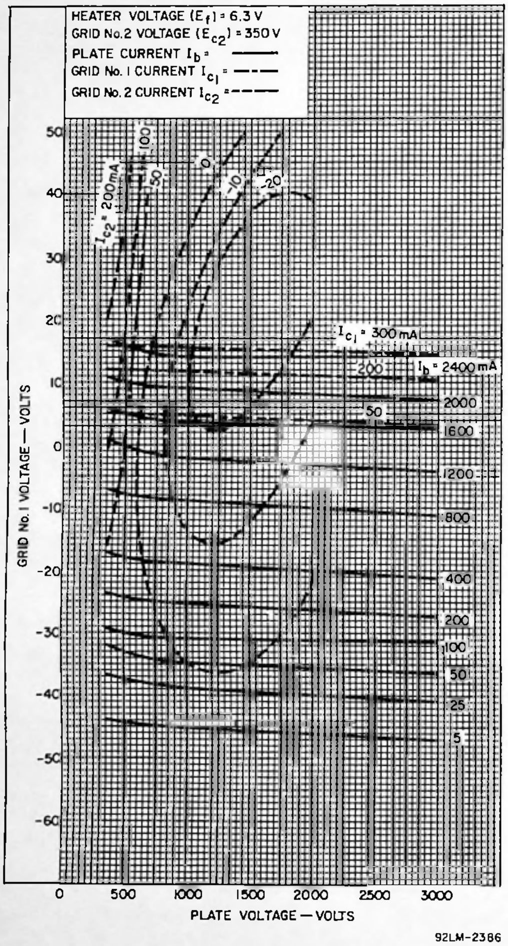


Figure 3 — Typical Constant Current Characteristics (E_{c2} = 350 V)

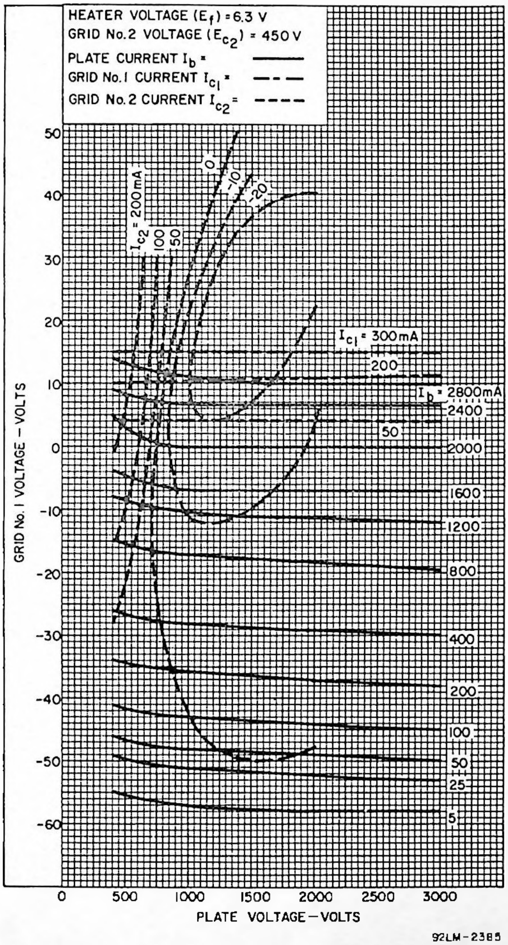


Figure 4 — Typical Constant Current Characteristics (E_{c2} = 450 V)

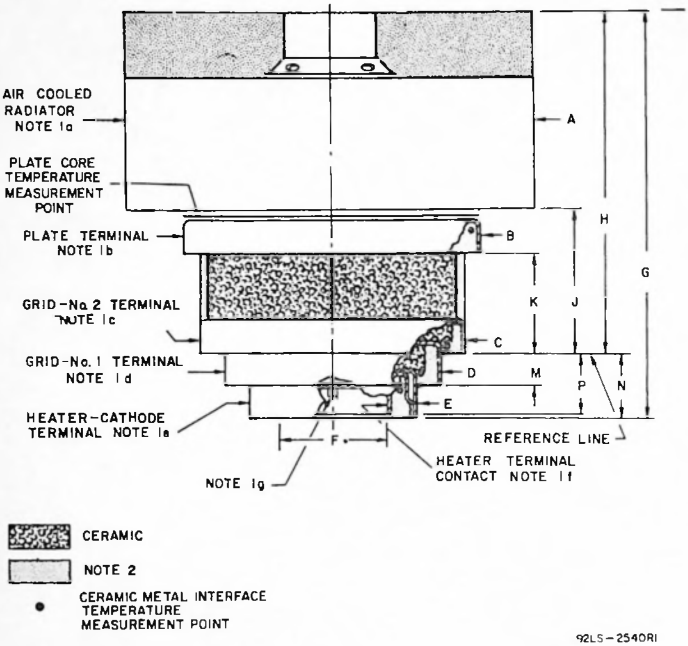


Figure 5 — Dimensional Outline

Tabulated Dimensions*

Dimension	Value			
A	2.52	(64.0)	Max.	Dia.
B	1.745	(44.32)	Min.	Dia.
C	1.590	(40.38)	Min.	Dia.
D	1.290	(32.76)	Min.	Dia.
E	0.99	(25.14)	Min.	Dia.
F	0.67	(17.02)	Max.	Dia.
G	2.44	(62.0)	Max.	
H	1.98 ± .04	(50.29 ± 1.01)		
J	0.830 ± .035	(21.08 ± .88)		
K	0.575 ± .025	(14.61 ± .63)		
M	0.20 ± .02	(5.08 ± .51)		
N	0.40 ± .02	(10.16 ± .51)		
P	0.385 ± .025	(9.78 ± .63)		

*Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimension (1 inch = 25 4 mm)

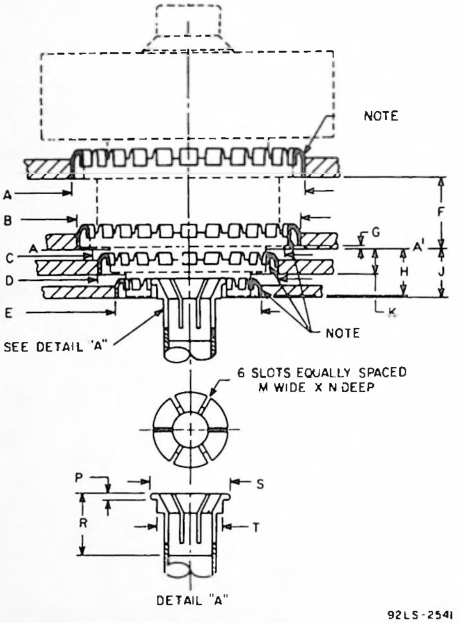
Note 1 — The contact distance* listed is the indicated, uniform length as measured from the edge of the terminal.

Note	Element	Contact Distance
1a.	Radiator	0.730 (18.5) min.
1b.	Plate Terminal	0.145 (3.68) min.
1c.	Grid No.2 Terminal	0.150 (3.81) min.
1d	Grid-No 1 Terminal	0.180 (4.57) min.
1e.	Heater-Cathode Terminal	0.160 (4.06) min.
1f	Heater Terminal	0.115 (2.92) max.
1g.	Pin	

Note 2 — Keep all stippled regions clear. Do not allow contacts or circuit components to protrude into these annular volumes. Diameters of stippled areas above air-cooled radiator, plate terminal contact surface and grid No.2 terminal contact surface shall not be greater than its associated diameter.

Mounting

See the preferred mounting arrangement below. See section III.C.3.a of 1CE-300 for a description of the fixed method of mounting. The adjustable method is not recommended for the 8791. Special sockets are available.



Note — Contact Strip No.97-360A as made by Instrument Specialties Co., Little Falls, N.J. 07424.

Figure 6 — Preferred Mounting Arrangement and Layout of Associated Contacts

Sockets are available in limited quantities from RCA and in production quantities from:

Jettron Products Incorporated
56 Route 10, Hanover, NJ 07936

Erie Technological Products Inc.
644 W. 12th Street, Erie, PA 16512

Supplior	Part Numbers
RCA	J15280, J15284
Jettron	CD-89-078, CD-89-083
Erie	9806-002, 9806-011

Tabulated Dimensions*

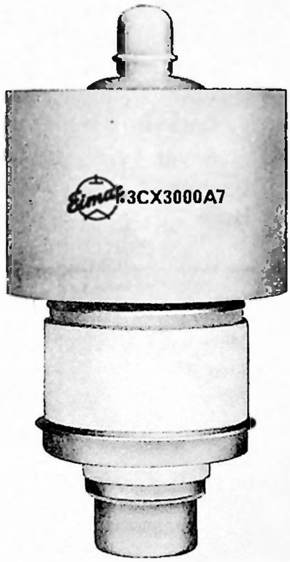
Dimension	Value		
A	1.938 ± .001	(49.225 ± .025)	Dia.
B	1.746 ± .001	(44.348 ± .025)	Dia.
C	1.550 ± .001	(39.370 ± .025)	Dia.
D	1.448 ± .001	(36.779 ± .025)	Dia.
E	1.148 ± .001	(29.159 ± .025)	Dia.
F	0.591 ± .005	(15.01 ± .13)	
G	0.040 ± .005	(1.02 ± .13)	
H	0.385 ± .005	(9.78 ± .13)	
J	0.400 ± .005	(10.16 ± .13)	
K	0.184 ± .005	(4.67 ± .13)	
M	0.020 ± .010	(0.51 ± .25)	
N	0.400 ± .005	(10.16 ± .13)	
P	0.050 ± .005	(1.27 ± .13)	
R	0.500 ± .005	(12.70 ± .13)	
S	0.670 ± .001	(17.018 ± .025)	Dia.
T	0.565 ± .005	(14.35 ± .13)	Dia.

*Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimension (1 inch = 25.4 mm).

TECHNICAL DATA

HIGH-MU
POWER TRIODE

The EIMAC 3CX3000A7 is a ceramic/metal, high-mu, forced-air cooled, external anode transmitting triode with a maximum plate dissipation rating of 3000 watts. Relatively high power output as an amplifier, oscillator, or modulator may be obtained from this tube at low plate voltages. The 3CX-3000A7 is an exact replacement for the EIMAC 3X3000A7. The all ceramic and metal construction insures a margin of safety with respect to tube operating temperatures while permitting higher processing temperatures to insure longer life.



The tube has a rugged, low inductance cylindrical filament-stem structure, which readily becomes part of a linear filament tank circuit for VHF operation. The grid provides thorough shielding between the input and output circuits for grounded-grid applications and is conveniently terminated in a ring between the plate and filament terminals.

The 3CX3000A7 is intended to be used as a zero bias class B amplifier in audio or radio frequency applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive, since a power gain of over twenty times can be obtained.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	7.5 ± 0.37	V
Current, at 7.5 volts	51	A
Amplification Factor (Average)	160	
Direct Interelectrode Capacitance (grounded filament)[2]		
Input	38.0	pF
Output	0.6	pF
Feedback	24.0	pF
Direct Interelectrode Capacitance (grounded grid)[2]		
Input	38.0	pF
Output	24.0	pF
Feedback	0.6	pF
Frequency of Maximum Rating:		
CW	110	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	9.000 in; 228.60 mm
Diameter	4.156 in; 105.56 mm
Net Weight	6.25 lb; 2.84 kg
Operating Position	Vertical, base down or up
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Forced Air
Base	Special Coaxial

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB_2

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	3000	WATTS
GRID DISSIPATION	225	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB2, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	4000	4800	4800	Vdc
Zero-Signal Plate Current[1]	0.25	0.35	0.35	Adc
Single-Tone Plate Current	2.00	1.68	2.00	Adc
Single-Tone Grid Current[1]	0.61	0.46	0.60	Adc
Peak Driving Power	420	293	410	w
Plate Dissipation	2285	2275	2775	W
Single-Tone Plate Output Power	6030	6000	7266	W
Resonant Load Impedance	1210	1720	1425	Ω
Driving Impedance	47.5	50.0	46.3	Ω

1. Approximate value.

RADIO FREQUENCY LINEAR AMPLIFIER, CARRIER CONDITIONS, GRID DRIVEN

Class AB_2

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	3000	WATTS
GRID DISSIPATION	225	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB2, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	4000	Vdc
Zero-Signal Plate Current[1]	0.25	Adc
DC Plate Current	0.74	Adc
DC Grid Current[1]	0.13	Adc
Peak rf Grid Voltage[1]	85.0	v
Peak Driving Power[1]	11.5	w
Plate Dissipation	1830	W
Single-Tone Plate Output Power	1130	W
Resonant Load Impedance	1750	Ω
Peak rf Plate Voltage	2000	v

1. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER

Class C Telegraphy or FM Telephony, Cathode Driven (Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	3000	WATTS
GRID DISSIPATION	225	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	3500	4800	Vdc
Grid Voltage	-50	-60	Vdc
Plate Current	1.30	1.54	Adc
Grid Current[1]	0.42	0.48	Adc
Peak rf Cathode Voltage[1]	220	267	v
Calculated Driving Power[1]	310	435	W
Plate Dissipation	985	1480	W
Useful Output Power[2]	3300	5500	W

1. Approximate value.
2. Output circuit and filter loss of 10% assumed.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB_2, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	3000	WATTS
GRID DISSIPATION	225	WATTS

TYPICAL OPERATION (Two Tubes)

Plate Voltage	4000	Vdc
Zero-Signal Plate Current [1]	0.50	Adc
Max. Signal Plate Current	3.58	Adc
Max. Signal Grid Current [1]	0.58	Adc
Peak af Grid Voltage [2]	190	v
Peak Driving Power [3]	115	w
Max. Signal Plate Dissipation	1850	W
Plate Output Power	10,500	W
Load Resistance (plate to plate)	2720	Ω

1. Approximate value.
2. Per tube.
3. Nominal drive power is one-half peak power.

NOTE: TYPICAL OPERATION data are obtained by measurement or calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 7.5 volts	49.0	54.0	A
Interelectrode Capacitances [1] (grounded filament connection)			
Input	30.0	45.0	pF
Output	---	1.0	pF
Feedback	20.0	28.0	pF
Interelectrode Capacitances [1] (grounded grid connection)			
Input	30.0	45.0	pF
Output	20.0	28.0	pF
Feedback	---	1.0	pF
Zero Bias Plate Current (E_b = 5000 volts)	0.36	0.52	A
Cut-off Bias (E_b = 5000 volts, I_b = 1.0 mAdc)	---	-45.0	V

1. Capacitance values are for a cold tube as measured in a shielded fixture.

APPLICATION

INPUT CIRCUIT - When the 3CX3000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of two or more.

COOLING - The maximum temperature rating for the anode core and seals of the 3CX3000A7 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperatures of the ceramic/metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below the maximum rating. Minimum air flow requirements to maintain anode-core and seal temperatures below 250°C at sea level with an inlet-air temperature of 50°C are tabulated for air-flow in the anode-to-base and base-to-anode directions. At higher ambient temperatures, frequencies above 30 MHz or at higher altitude, a greater quantity of air will be required. It is suggested that temperatures be monitored in any new installation to insure proper cooling.

Base-to-Anode Air Flow				
*	Sea Level		10,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1500	32	0.6	47	0.9
2500	57	1.0	83	1.5
3000	64	1.07	93.4	1.56

Anode-to-Base Air Flow 1				
*	Sea Level		10,000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
1500	33	0.6	48	0.9
2500	66	1.25	96	1.82
3000	72	1.40	105	2.04

*Since the power dissipated by the filament represents about 385 watts and since grid dissipation can, under some conditions represent another 225 watts, allowance has been made in preparing this tabulation for an additional 610 watts.

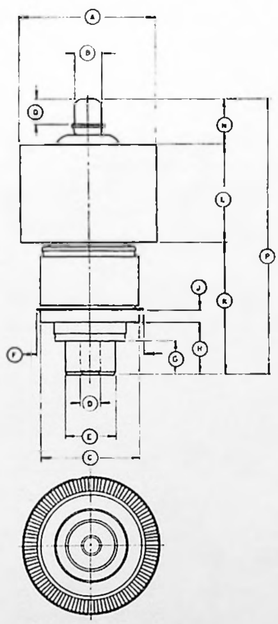
1When air is supplied in the anode-to-base direction, a minimum of 3 cfm must be directed into the filament-stem structure between the inner and outer filament terminals to maintain the base seals below 250° C. No separate air is required with base-to-anode airflow.

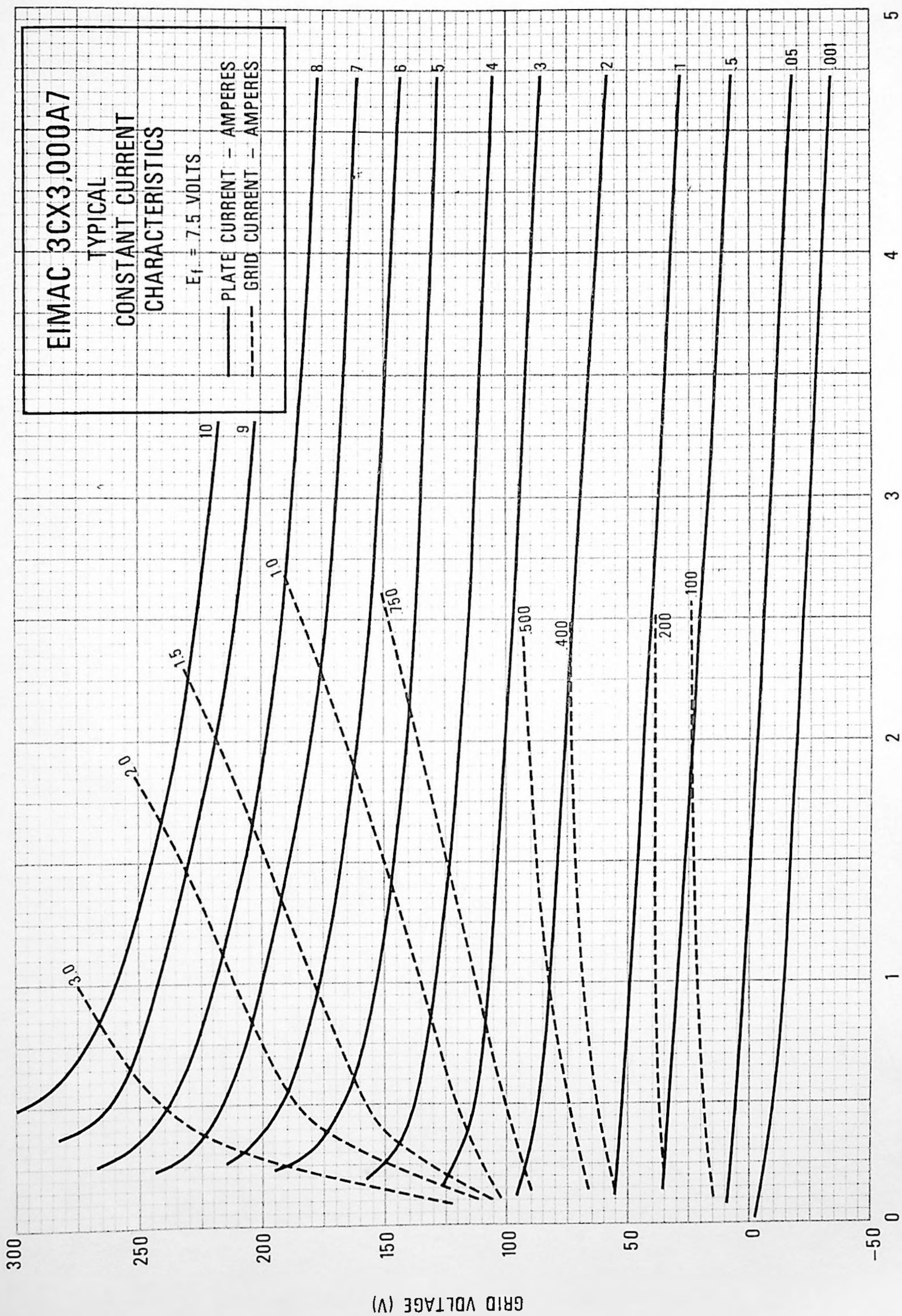
HIGH VOLTAGE - The 3CX3000A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypasses or ''cheated'' to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.

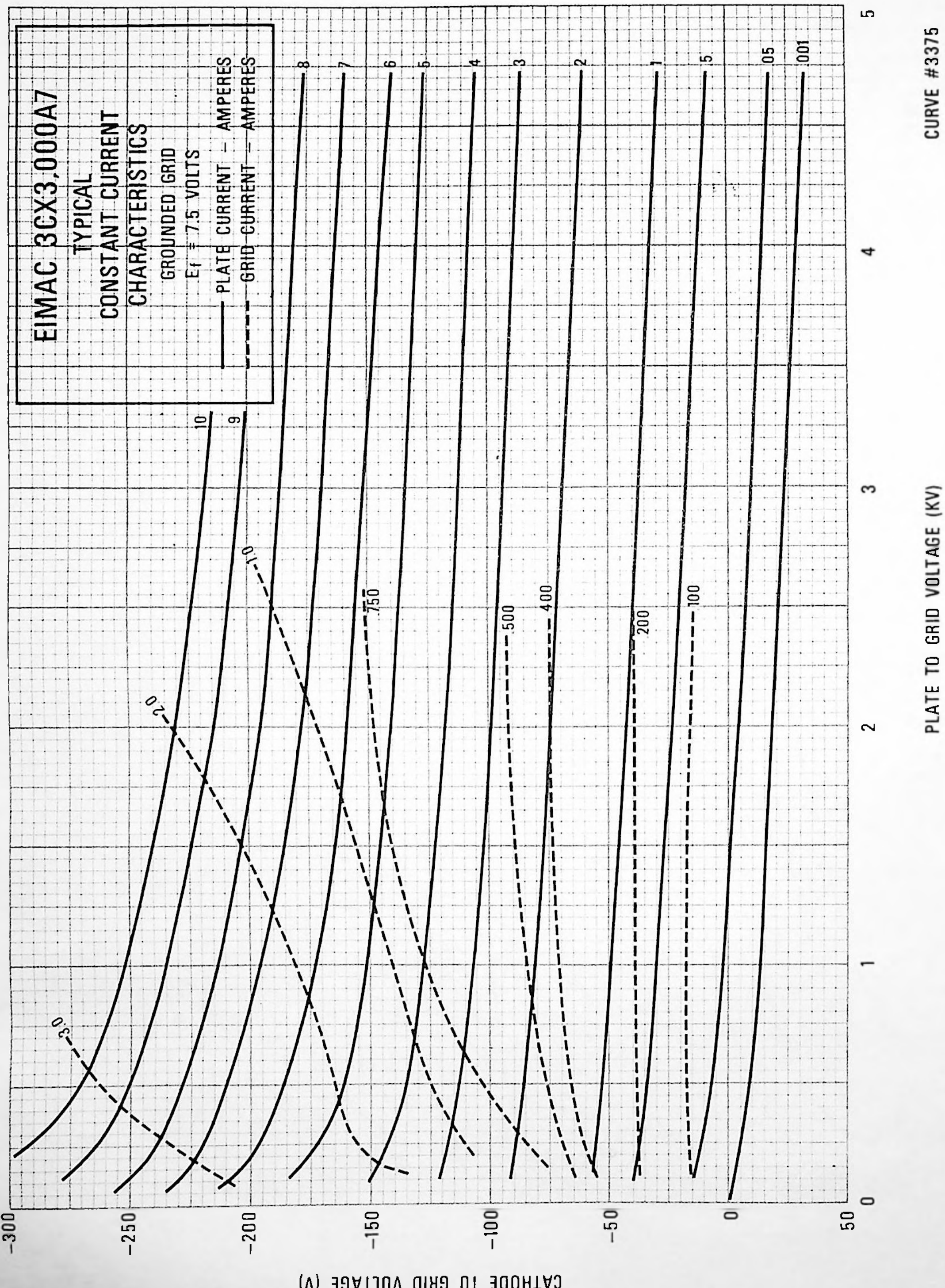
DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.094	4.156	- -	103.99	105.56	- -
B	0.781	0.844	- -	19.83	21.44	- -
C	2.990	3.010	- -	75.95	76.45	- -
D	0.615	0.635	- -	15.62	16.13	- -
E	1.490	1.510	- -	37.85	38.35	- -
F	- -	3.625	- -	- -	92.08	- -
G	0.813	0.937	- -	20.65	23.80	- -
H	1.375	1.625	- -	34.92	41.28	- -
J	0.391	0.422	- -	9.93	10.72	- -
K	3.875	4.250	- -	98.43	107.95	- -
L	2.937	3.063	- -	74.60	77.80	- -
N	1.187	1.687	- -	30.15	42.85	- -
P	8.000	9.000	- -	203.20	228.60	- -
Q	0.687	0.813	- -	17.45	20.65	- -

NOTES
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.




EIMAC 3CX3,000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_f = 7.5 VOLTS
PLATE CURRENT - AMPERES
GRID CURRENT - AMPERES
PLATE VOLTAGE (KV)
GRID VOLTAGE (V)

CURVE #3373


EIMAC 3CX3,000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
E_f = 7.5 VOLTS
PLATE CURRENT - AMPERES
GRID CURRENT - AMPERES
10
9
8
7
6
5
4
3
2
1
.5
.05
.001
3.0
2.0
1.0
.750
.500
.400
.200
.100
CATHODE TO GRID VOLTAGE (V)
-300
-250
-200
-150
-100
-50
0
50
PLATE TO GRID VOLTAGE (KV)
0
1
2
3
4
5
CURVE #3375

TECHNICAL DATA

8160
3CX10,000A7

HIGH-MU
POWER TRIODE

The EIMAC 8160/3CX10,000A7 is a ceramic and metal power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8160/3CX10,000A7.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-Tungsten	
Voltage	7.5 V
Current	100 A
Amplification Factor (Nominal)	200
Direct Interelectrode Capacitances:[2]	
Grid-Filament	59.0 pF
Grid-Plate	36.0 pF
Plate-Filament	0.2 pF
Frequency for Maximum Ratings	160 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Coaxial
Recommended Air-System Socket	EIMAC SK-1300
Recommended Air Chimney	EIMAC SK-1306
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core	250 °C
Ceramic/Metal Seals	250 °C
Maximum Dimensions:	
Height	8.75 in; 222.25 mm
Diameter	7.05 in; 179.07 mm
Net Weight	12 lbs; 5.45 kg

RADIO-FREQUENCY LINEAR AMPLIFIER
Grounded Grid, Class-B

MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	12	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION, Single-Tone Conditions

DC Plate Voltage	7000	7000	V
Zero-Signal DC Plate Current [1]	0.60	0.60	A
Max-Signal DC Plate Current	3.72	5.00	A
Max-Signal DC Grid Current	0.71	1.00	A
Driving Impedance	35	32	Ω
Resonant Load Impedance	1020	745	Ω
Max-Signal Driving Power	885	1540	w
Peak Envelope Plate Output Power	17.7	24.2	kW
Power Gain	13	12	dB

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR
Class B, Grid Driven

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	12	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION, Two Tubes, Sinusoidal Wave

DC Plate Voltage	7000	7000	V
DC Grid Voltage	0	0	V
Zero-Signal DC Plate Current [1]	1.20	1.20	A
Max-Signal DC Plate Current	7.50	10.0	A
Max-Signal DC Grid Current	1.50	2.06	A
Driving Power	315	560	W
Peak AF Driving Voltage (Per Tube)	250	310	v
Load Resistance, Plate-to-Plate	2000	1520	Ω
Max-Signal Plate Output Power	35.6	47.7	kW

RADIO-FREQUENCY LINEAR AMPLIFIER
Carrier Conditions, Grounded-Grid

MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	12	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.
2. Modulation Crest Conditions

TYPICAL OPERATION

DC Plate Voltage	7000	V
DC Grid Voltage	0	V
Zero-Signal DC Plate Current [1]	0.60	A
DC Plate Current	2.40	A
DC Grid Current	0.25	A
Driving Impedance [2]	32	Ω
Peak Driving Voltage [2]	310	v
Driving Power	330	W
Plate Output Power	5650	W

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR
Class-C, Grounded-Grid

MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	10	KILOWATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

DC Plate Voltage	7600	V
DC Plate Current	3.68	A
DC Grid Voltage	-110	V
DC Grid Current	775	mA
Peak RF Cathode Voltage	400	v
Cathode Driving Power [1]	1510	W
Plate Output Power	22.5	kW

1. Approximate value.

PLATE-MODULATED RF POWER AMPLIFIER

MAXIMUM RATINGS

DC PLATE VOLTAGE	6500	VOLTS
DC PLATE CURRENT	3.0	AMPERES
PLATE DISSIPATION	6.5	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION

DC Plate Voltage	5000	V
DC Plate Current	3.0	A
DC Grid Voltage	-200	V
DC Grid Current	775	mA
Peak RF Grid Voltage	490	v
Grid Driving Power [1]	380	W
Plate Output Power	11.9	kW

NOTE: TYPICAL OPERATION data are obtained by measurement or calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

MOUNTING - The 3CX10,000A7 must be operated vertically base up or down. The tube must be protected from severe vibration and shock.

COOLING - The maximum temperature rating for the external surfaces of the 3CX10,000A7 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic/metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated below. The use of these air-flow rates through the recommended socket/chimney and tube combination in the base-to-anode direction provides effective cooling of the tube.

Plate ** Dissipation (Watts)	SEA LEVEL		10,000 FEET	
	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
4000	105	.24	154	.35
6000	178	.50	275	.80
8000	253	.90	370	1.45
10,000	345	1.4	500	2.30
12,000	483	2.25	710	3.40

** Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 500 watts, allowance has been made in preparing this tabulation for an additional 1250 watts dissipation.

INPUT CIRCUIT - When the 3CX10,000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of two of more.

CLASS-C OPERATION - Although specifically designed for class-B service, the 3CX10,000A7 may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier.

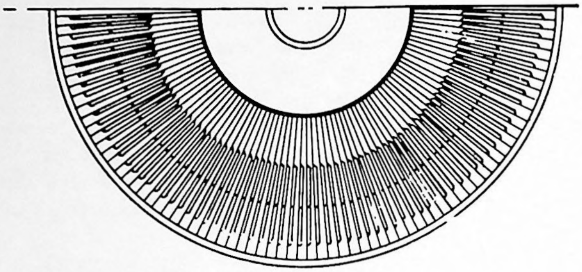
FILAMENT OPERATION - The rated filament voltage for the 3CX10,000A7 is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than plus or minus five percent.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

HIGH VOLTAGE - The 3CX10,000A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

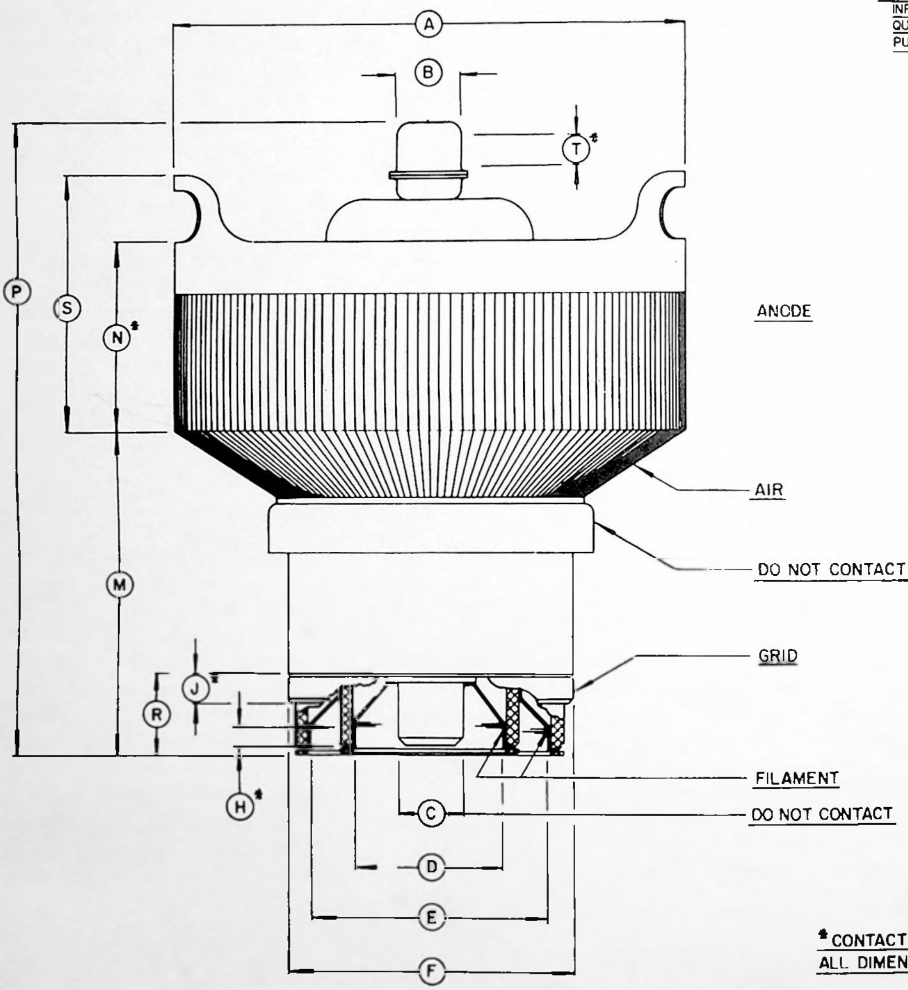
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid **Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, 94070, for information and recommendations.**



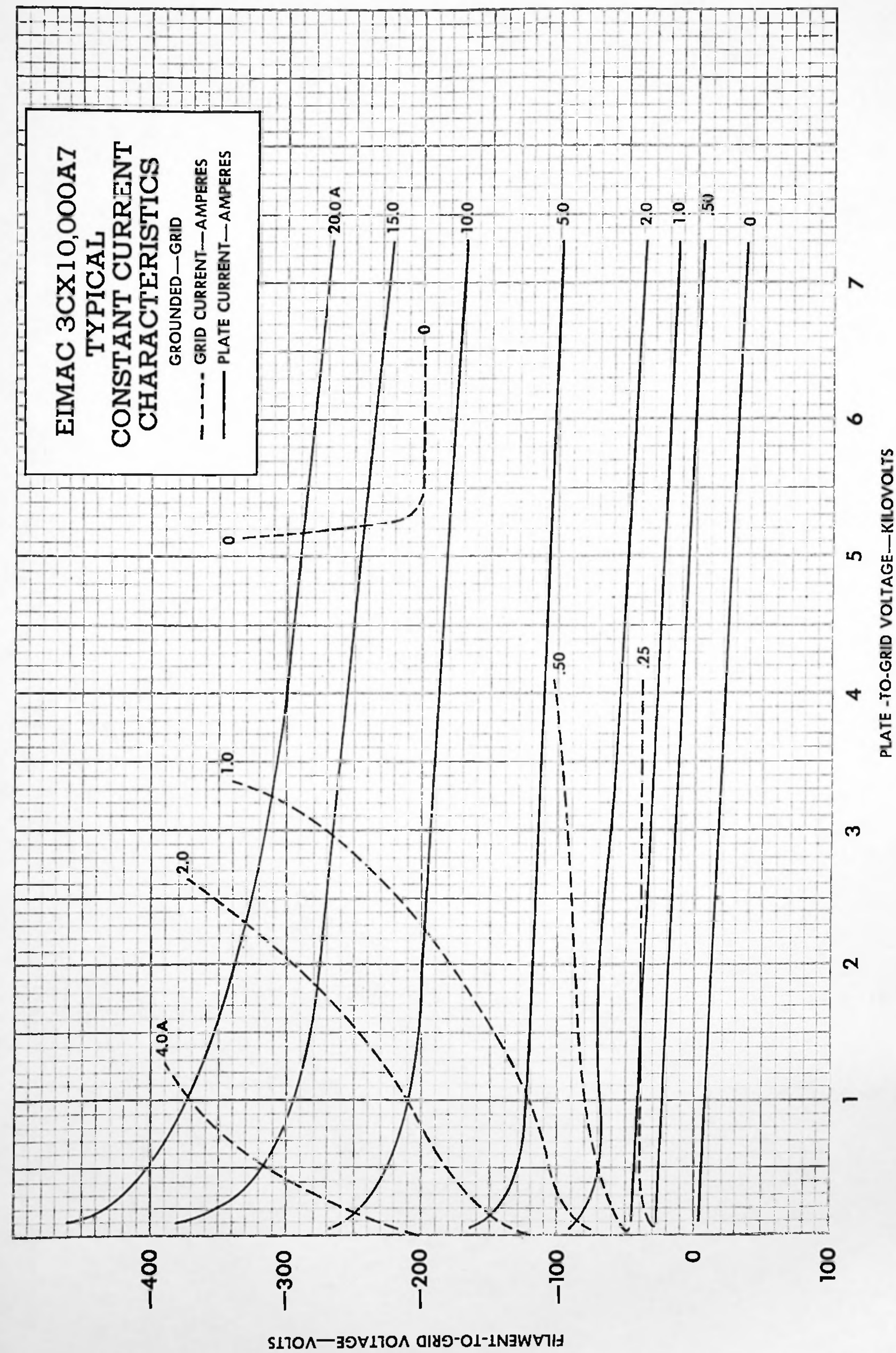
DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	6.928	7050	- -	17597	17907	- -
B	0.855	0.895	- -	21.72	25.49	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
H	0.188	- -	- -	4.77	- -	- -
J	0.188	- -	- -	4.77	- -	- -
M	3.960	4.300	- -	100.33	109.22	- -
N	2.412	2.788	- -	61.26	70.81	- -
P	8.250	8.750	- -	209.55	222.25	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.412	3.788	- -	86.66	96.21	- -
T	0.375	- -	- -	9.52	- -	- -

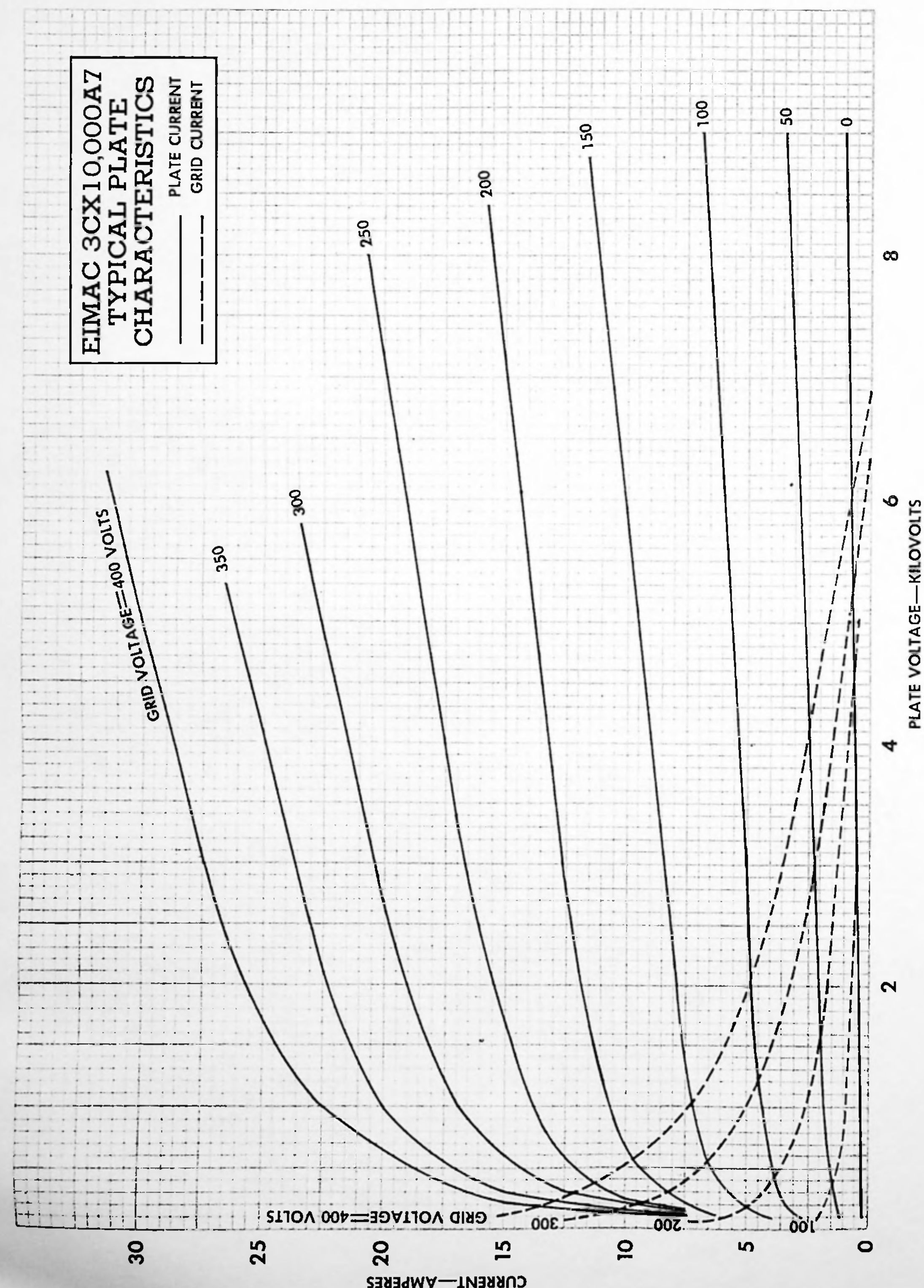
NOTES

1. REF. DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES



*CONTACT SURFACE
ALL DIMENSIONS IN INCHES


EIMAC 3CX10,000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED—GRID
GRID CURRENT—AMPERES
PLATE CURRENT—AMPERES
20.0 A
15.0
10.0
5.0
2.0
1.0
.50
0
4.0 A
2.0
1.0
.50
.25
0
1
2
3
4
5
6
7
PLATE -TO-GRID VOLTAGE—KILOVOLTS
—400
—300
—200
—100
0
100
FILAMENT-TO-GRID VOLTAGE—VOLTS


EIMAC 3CX10,000A7
TYPICAL PLATE
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE=400 VOLTS
350
300
250
200
150
100
50
0
GRID VOLTAGE=400 VOLTS
300
200
100
PLATE VOLTAGE—KILOVOLTS
2
4
6
8
CURRENT—AMPERES
0
5
10
15
20
25
30

TECHNICAL DATA

HIGH-MU
POWER TRIODE

The EIMAC 3CX20,000A7 is a ceramic/metal power triode intended for use as a zero-bias Class B rf amplifier or Class C power amplifier or oscillator. Class B operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 3CX20,000A7.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	160 A
Amplification Factor (Average):	200
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	61.0 pF
Cout	0.2 pF
Cgp	36 pF
Direct Interelectrode Capacitance (grounded grid)[2]	
Cin	61.0 pF
Cout	36 pF
Cpk	0.2 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Overall Dimensions:	
Length	8.50 in; 215.9 mm
Diameter	8.25 in; 209.6 mm
Net Weight	13.5 lb; 6.15 kg
Operating Position	Vertical base up or down
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C

Cooling	Forced air
Base	Coaxial
Recommended Air System Socket	SK-1300 or SK-1320

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	500	WATTS

1. Approximate values.
2. Adjust to obtain specified value.

TYPICAL OPERATION (Frequencies to 110 MHz)
Class AB_2

Plate Voltage	7000	7000	Vdc
Grid Voltage	0	0	Vdc
Zero-Signal Plate Current [1]	.6	.6	Adc
Single-Tone Plate Current [2]	5.92	5.0	Adc
Single-Tone Grid Current [1]	1.22	1.0	Adc
Driving Power [1]	1750	1540	W
Plate Dissipation	13.4	10.8	kW
Single-Tone Plate Output Power	29.6	24.2	kW
Resonant Load Impedance	693	745	Ω
Drive Impedance	27	32	Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM Telephony

Grid Driven

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	7000	Vdc
Grid Voltage	-230	Vdc
Plate Current	4.0	Adc
Grid Current [1]	775	mAdc
Peak rf Grid Voltage [1]	555	v
Calculated Driving Power [1]	430	W
Plate Input Power	28	kW
Plate Dissipation	6.7	kW
Plate Output Power	21.3	kW
Resonant Load Impedance	963	Ω

1. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER

Class B Television Service, Cathode Driven

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 216 MHz)
Class B

Plate Voltage	7200	Vdc
Grid Voltage	0	Vdc
Zero Signal Plate Current	1.2	Adc
Effective rf Load Resistance	605	Ω
Plate Current: Blanking Level	4.8	Adc
Sync. Peak Level	5.8	Adc
Grid Current: Blanking Level	0.47	Adc
Sync. Peak Level	1.14	Adc
rf Cathode Voltage Peak:		
Blanking Level	230	v
Sync. Peak Level	300	v
Driving Power: Blanking Level	690	w
Sync. Peak Level	1700	w
Plate Power Output: Blanking Level	16.5	kw
Sync. Peak Level	27.5	kw

NOTE: TYPICAL OPERATION data are obtained by measurement or calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	152	168	A
Cathode Warmup Time	5.0	---	sec.
Interelectrode Capacitances (grounded grid)[1]			
Cin	55.0	67.0	pF
Cout	32.0	40.0	pF
Cpk	---	0.3	pF
Interelectrode Capacitances (grounded cathode)[1]			
Cin	55.0	67.0	pF
Cout	---	0.3	pF
Cgp	32.0	40.0	pF

1. Capacitance values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MOUNTING & SOCKETING - The 3CX20,000A7 must be operated vertically, base up or down, and should be protected from severe shock and vibration. The use of an EIMAC air-system socket is recommended. For grid-driven applications, the SK-1300 is used; for cathode-driven circuits, the SK-1320 should be used, as the grid is grounded to the socket frame in this unit.

COOLING - The maximum temperature rating for the external surfaces of the 3CX20,000A7 is 250°C. Sufficient forced-air cooling must be provided to maintain the temperature of the anode core and the ceramic/metal seals below the maximum rating. Air flow should be applied before or simultaneously with the application of electrode voltages (including the filament) and should normally be maintained for a short period of time after all voltages are removed to allow for tube cool-down.

FILAMENT OPERATION - The rated filament voltage for the 3CX20,000A7 is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than plus or minus five percent.

INPUT CIRCUIT - When the 3CX20,000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier, it is suggested that the cathode tank circuit operate at a "Q" of two or more.

CLASS-C OPERATION - Although specifically designed for Class-B service, the 3CX20,000A7 may be operated as a Class-C power amplifier or oscillator. The zero-bias characteristic of the 3CX20,000A7 can be used to advantage in Class-C amplifiers by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

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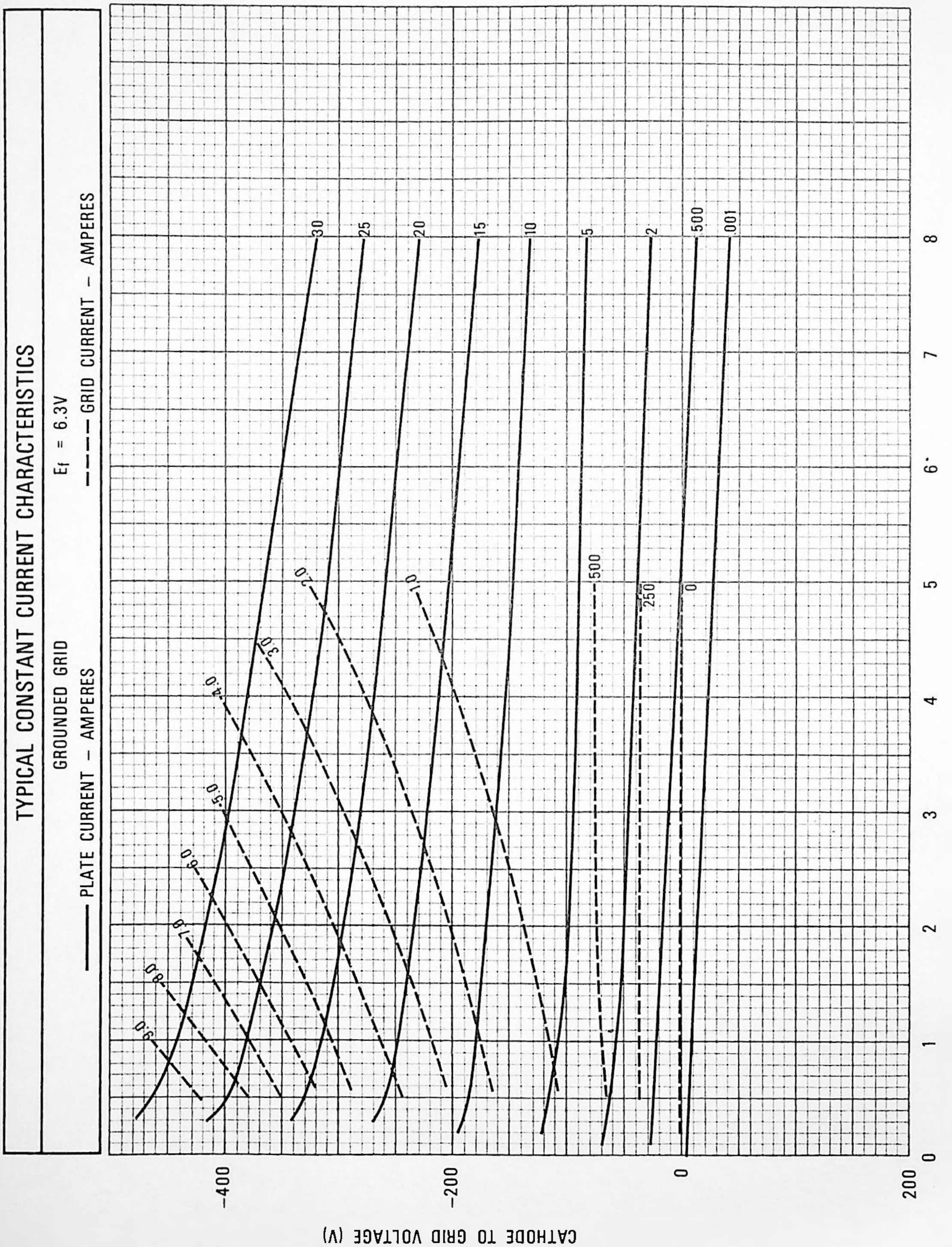
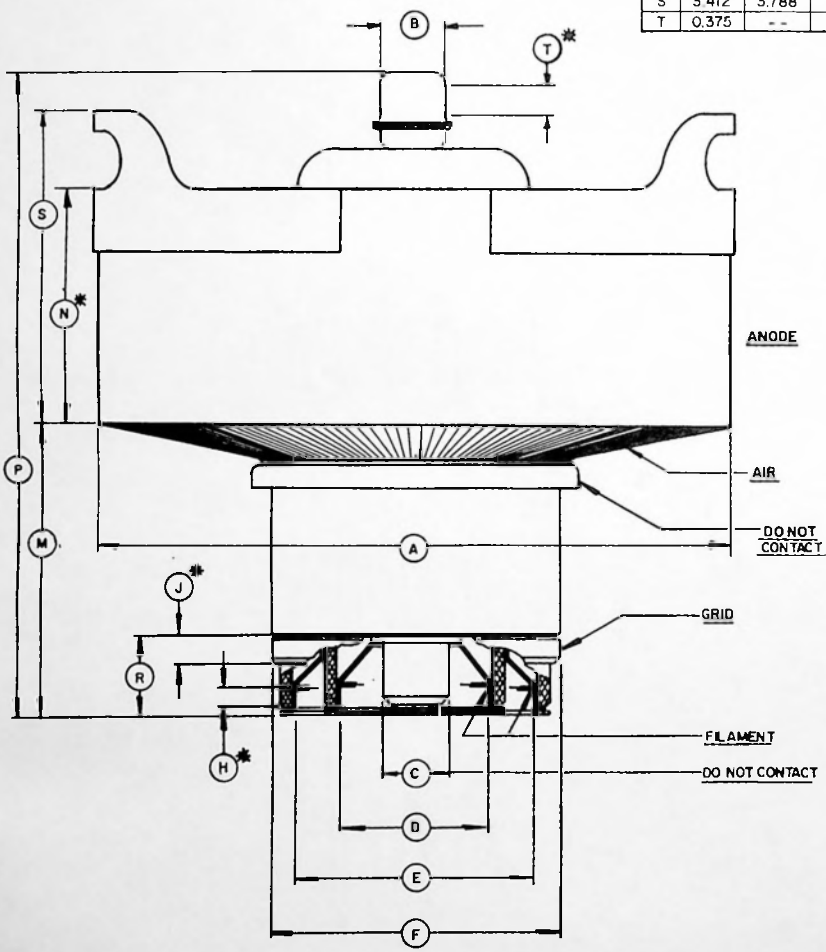


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
E_f = 6.3V
—— PLATE CURRENT – AMPERES
– – – GRID CURRENT – AMPERES
30
25
20
15
10
5
2
.500
.001
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.500
.250
0
PLATE TO GRID VOLTAGE (kV)
0
1
2
3
4
5
6
7
8
CATHODE TO GRID VOLTAGE (V)
-400
-200
0
200

CURVE #4043

DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	- -	8.25	- -	- -	209.6
B	0.855	0.895	- -	21.72	22.73	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	98.86	- -
H	0.188	- -	- -	4.78	- -	- -
J	0.188	- -	- -	4.78	- -	- -
M	3.950	4.300	- -	100.33	109.22	- -
N	2.412	2.788	- -	61.26	70.82	- -
P	8.250	8.750	- -	209.55	222.25	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.412	3.788	- -	86.66	96.22	- -
T	0.375	- -	- -	9.53	- -	- -



NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES

Handling and Operating Considerations When Using RCA Tetrodes

Introduction

RCA power tetrodes are sturdy electronic devices designed for high performance and reliable operation. With care in handling and compliance with recommended limits of operation, long efficient life can be obtained. This note will help operators of RCA power tetrodes to utilize all the features built into these tubes and achieve the longest possible life.

Handling

RCA Power Tubes are packaged in a variety of containers each designed to safeguard its contents against shock, bumps and other mishandling and assure arrival at its destination in good operating condition.

It is important to handle RCA CERMOLOX® tube with care. Do not place the tube directly on a hard surface such as concrete flooring or a wooden bench. The shipping container uses foam polyurethane as a cushion. This makes a good base on which to cradle the tube.

Never tap the tube with a mallet. Even a light plastic mallet can severely damage a filament. If handled gently and correctly RCA CERMOLOX tubes will give long reliable service.

Shipping

RCA Power Tubes are shipped in a variety of packs, each one suited to the tube it contains. Each pack is designed to transport its tube from the manufacturer to the user in safe condition. When a shipping container is received in a damaged condition, the shipper should be notified immediately. If any damage to the ceramic-metal envelope is evident, this should also be reported. The CERMOLOX line of power tetrodes employs ceramic-to-metal construction. This construction permits operation at higher temperatures than glass tubes, along with other advantages. But, it makes visual examination of the internal structure of the tube impossible so that other methods must be used to determine the extent of any shipping damage. Because damage could occur to CERMOLOX tubes which will not be visible and could be subtle enough to escape ohmmeter type evaluation, all new tubes should be unpacked and run in typical operation for some short time — two to three days.

During the run-in, close attention should be paid to meter readings as compared to typical tube readings. Since thoriated tungsten filaments are by their nature brittle, readings of filament voltage and filament current should be carefully checked. It is the filament which usually suffers from shipping or handling damage.

Socketing

RCA CERMOLOX tubes operate in cavities or sockets especially designed for them. Contact fingers engage each element simultaneously. These contact fingers must be clean and unbroken, free from burns or arcing. If more than three fingers are missing from a particular ring, or have lost their temper, the entire ring should be replaced. Oxidized or dirty contacts may be cleaned with crocus cloth or with "Scotch-brite" Type A, a fine abrasive cleaning pad. Contact fingers that appear overheated should be bent inward slightly after cleaning to increase contact pressure.

When socketing a tube, begin the insertion by pressing the tube straight into the socket fingers and then rotate the tube to settle it into the socket contact surfaces. Do not insert or remove the tube by rocking the tube back and forth. This action crushes the contact fingers and can apply undue force to the internal structure of the tube.

Tube Ratings

Each tube type is rated for specific maximum parameters. RCA assures that the tube will perform satisfactorily at these levels within the warranty. Additional life can be gained by operating below these maximum ratings.

CERMOLOX tubes are generally rated at 250° C maximum seal and anode core temperatures. As a general rule, tubes should be operated 25° to 50° below this figure as a safety factor. The air flow needed to cool the tube to this value and below can be found in the particular tube data sheet. Because of the small size of most broadcast CERMOLOX tubes and their higher gain and superior linearity, added consideration must be paid to assure adequate cooling of the tube. Short, straight air paths should be used to maximize the cooling efficiency of the system. Specific airflow calculations are covered in a separate publication, Application Note AN-4869.

Voltage ratings are limiting characteristics within which RCA believes the tube construction can safely operate. Socketry which can enter into the breakdown path from element to element must be avoided. Shielding the contact rings may be necessary to avoid element to ground shorts. For example, screen-grid contact fingers should be so positioned that they do not present a short, sharp path from the anode to ground. It is wise to operate tubes well below their maximum ratings, especially when new equipment is being designed. Numerous changes in specifications during the equipment design cycle often necessitate increased screen and plate potentials. High line and low line conditions should also be considered to assure that operating voltages will stay within rated limits.

Current and dissipation ratings are based on special considerations: warranted tube life, performance stability and also the application that the tube is designed for. The tube must be operated within these ratings to achieve maximum tube life and stable performance. Screen dissipation is generally the most difficult area to control. In the initial equipment tuning, loading must be controlled to prevent screen over-dissipation. Good protection must be supplied to prevent excessive screen current, and in the case of some CERMOLOX matrix oxide tubes, negative screen current must be considered. A resistive bleeder should be used to draw at least the amount of positive screen current from the supply as the expected negative screen current.

(For a more detailed description of screen current loading in tetrodes, see RCA Application Note, AN-4020.) Screen voltage must never be applied before the plate voltage. In addition, the screen voltage must never be permitted to remain after the removal of plate voltage.

Filament

The filament of RCA broadcast type tetrodes of the CERMOLOX family is referred to as a "basket weave", mesh type filament. These filaments are less susceptable to shock and vibration than hair-pin or straight "bar" type filaments. They are also less prone to bow with use and they lend themselves to high Gm, close spaced structures. However, it must be remembered that they are made from carburized, thoriated-tungsten wire and as such are quite brittle, particularly at room temperature where handling is the major cause of broken filaments.

Filament Voltage and Current

Filament voltage should be measured with an accurate rms meter such as an iron-vane or thermocouple type. Common rectifier type meters should not be relied upon, they should be used only as monitors. Filament current can be read accurately with either a calibrated shunt and an oscilloscope or a current transformer and a meter. Clamp-on ammeters are subject to error if not properly used, but can provide good information if employed correctly. Care should be taken to make sure each range is calibrated and that the jaws are firmly together when in place around the conductor.

Filament Warm-up

Most filamentary tubes used in transmitter service are rated for 15 seconds minimum heating time. This warm-up is necessary to allow the grids and the filament to reach an equilibrium temperature and avoid arcing due to momentary shorting between these elements after the application of high voltage. Shortened warm-up time cycles can be used by step starting the filament. If is possible to start tubes with as little as 3 seconds heating time but this procedure can cause subtle internal changes which can result in shortened life times. Such short cycles may be used as emergency starts, but never as normal procedure. In most cases, it is advantageous to use the full 15 seconds minimum heating time, then apply the other voltages before drawing full plate current. This technique results in less thermal stress to all the elements concerned and assists in prolonging tube life. It is good practice to allow filaments to run continuously and minimize start-up stresses. If this method is impractical, the filament should be preheated for 10 to 15 minutes before the application of any other voltages. This procedure can substantially increase tube life expectancy. During starting it is also important to limit initial filament current surges to the value listed in the particular tube bulletin. The ratio of hot to cold resistance of thoriated tungsten wire is about 10:1. If the applied voltagewere supplied by a low impedance filament supply, starting currents could reach as high as 1500 A for the 8807 as an example where the maximum permissible current is 300 A. In a practical application, surge currents of 600 to 700 amperes can be realized and these high surge currents will damage the filament structure.

Methods for holding surge currents below the limiting value include high reactance transformers, a resistive starting network or manual control of filament voltage by a Variac. A combination of the first two can also be used. Many new transmitters employ the "Pulsistor", a type of variable resistor. This device is placed in the filament primary circuit and it limits the surge current by changing resistance, having a high resistance when cold and a low resistance when hot.

Filament Life

The emission of the thoriated tungsten filament in a power tube is dependent on an monolayer of thorium on the surface of the wire. This layer is formed by the reaction of carbon with thoria. The end of tube life occurs when all the carbon is depleted from the filament structure. The physics of the filament are illustrated by the fact that theoretically for every 3% increase in filament voltage there is an increase of 20° Kelvin in the temperature of the filament, a 20% increase in peak emission and a 50% decrease in tube life. It is important then that filament voltage be checked accurately and regularly to assure operation within specified ratings. Good metering has already been mentioned and is important. Lack of such metering can, to some extent, be alleviated by operational testing. Some important criteria, such as sync compression or peak sync slipping, power output or distortion can be used to check tube performance. The tube is set up and the criteria measured or observed. The filament voltage is then reduced until the degradation in the criteria observed is as much as can be tolerated. The filament is then increased to just above the value used to the test. Further checking in 12–24 hours should be done to insure stability at this filament voltage level.

It is recommended that the filament voltage be regulated by a constant voltage transformer such as a "Sola" unit. This regulation will play an important role in assuring extended tube life as shown above.

Voltage Sequence

Following the filament warm-up cycle, and the application of grid-No.1 voltage (bias) to the tube, the high voltage should be applied to the plate at the same time or earlier than to the screen grid to insure against excessive grid-No. 2 dissipation. In addition, at shut down, the grid-No.2 voltage must decrease along with or before the plate voltage. It is important that the grid-No.2 bypass capacitors not hold the screen voltage above that of the plate.

Cleanliness

Tube life can be severely shortened by allowing the tube ceramics to become dirty and precipitating arcs. If the tube ceramics become dirty, they can be cleaned carefully with such a preparation as "Glass-Wax" when the tube is completely cool. Follow this cleaning with a Blacosolv or acetone wipe. Periodically all equipment air filters should be cleaned or replaced if necessary. This period may vary from 1 week in some locations to several weeks in others. The fin louvers will also become dirty and can be cleaned by carefully flushing the radiator with a stream of warm water directed at the louvers followed by air drying. Care must be taken in handling the tubes during all of these cleaning operations. A rubber or foam mat is ideal as a setting for the tube when performing the cleaning operations. Arc marks which have occurred can be removed by the gentle use of very fine emery paper after masking any adjacent ceramic to prevent buffing of the ceramic. All dust from this operation should be removed by a solvent wipe. The cause of the arc marks should be found and corrected before tube reinsertion.

Periodic Maintenance

Continuing attention to these items will improve tube life expectancy and reliability. Every installation will be different so the schedule of maintenance operation must also be developed individually based on environmental and operating considerations. In any event voltages and currents must be monitored, filters cleaned or replaced, surfaces cleaned and connections tightened. All these should be scheduled as frequently as conditions indicate to assure long reliable life.

1CE-300

Application Guide

for

RCA POWER TUBES

Installation

Operation

Maintenance

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES LANCASTER, PA.

FOREWORD

This booklet gives general instructions covering the installation, operation, and maintenance of RCA power tubes. Close attention to these instructions will assure longer tube life, safer operation, less equipment down-time, and fewer tube-handling accidents. For further information on special problems and services, contact your RCA field representative or nearest District Sales Office.

TABLE OF CONTENTS

1CE-300 6-64
Printed in U.S.A.

I - INTRODUCTION

This discussion of general considerations for RCA power tubes is intended for use with the published data given in the technical data sheets on individual tube types to which this booklet is referenced. Application information unique to a particular tube type is not included in this booklet, but is covered in the published data for the given type. If neither source gives the information you require, contact your RCA field representative or the nearest District Sales Office.

II - GENERAL

II.A - Ratings

Ratings are established for electron tube types to guide and assist equipment designers in utilizing to best advantage the performance and service capabilities of each tube type. Rating values are provided for those tube characteristics for which careful study and experience indicate limiting values are required to insure satisfactory performance.

In order that the numerical values of a rating system have significance, the system used must be accurately defined and properly applied.

II.A.1 - Rating System

The maximum ratings given in the published data for RCA power tubes are established in accordance with the following standardized definition of the Absolute-Maximum Rating System for rating electron devices:

"Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

"The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

"The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics."

II.A.2 - Use of Ratings

The user is cautioned against using tubes above maximum ratings or for services other than those for which ratings are given in the published data. Tube warranty is contingent upon operation within these specified ratings.

The tube manufacturer establishes control tests to assure satisfactory tube operation within the published ratings. These test procedures are, in general, available from the following sources: MIL-E-1, government specifications on electron tubes for military use; RCA acceptance specifications for new-equipment manufacturers' use; and Characteristics Range Values in the technical bulletin for general use. Following good manufacturing practice, the average product capability is necessarily better than the minimum capability to accommodate normal product variation. Consequently, limited evaluation may indicate individual tubes of a given type will operate satisfactorily above the maximum ratings or in classes of service other than those for which they are rated. If modified or extended ratings on a given tube type appear economically justified, contact your RCA field representative or the nearest District Sales Office.

II.B - Care

Proper care in the handling, storing, and cleaning of power tubes is as necessary as proper tube and circuit design to insure long tube life. Although it is self-evident that glass types contain many intricate parts, ceramic-metal types contain similar parts whose electrode spacings must be held precisely. All RCA power tubes are sturdily built to withstand the rigorous treatment encountered when they are secured in electronic equipment; however, careless or rough handling of tubes not installed in equipment may subject the tubes to shock or stresses exceeding those for which they were designed to withstand when mounted in sockets.

II.B.1 - Handling

Tubes must be protected during transportation from rough handling that might damage the seal or other parts. Avoid bumping, which could introduce stresses and cause internal damage. For cylindrical-terminal types, remove the tube from its mounting with a slight rocking, upward motion to release the spring-contact fingers. Lift the tube straight out to prevent the terminals from striking the edge of the mounting.

II.B.2 - Storage

During storage, the tube must be protected from moisture and extreme temperature changes. As a safeguard, it is recommended that tubes be stored in the shipping containers in the manner in which they are received. Before a tube is placed in storage, it is recommended that the tube be clean and that it be tested in the equipment in which it is to be used. It is also recommended that tubes in storage and tubes in equipment be exchanged or rotated periodically where practicable. This procedure will minimize the necessity of "break-in" periods as described in section V.D. on page 16.

II.B.3 - Cleaning

Tube cleanliness is an important consideration. As with other high-voltage equipment, it is essential that external parts of power tubes be kept free from accumulated dirt and moisture to minimize surface leakage and the possibility of arc-over.

Some tube configurations contain re-entrant areas at the edge of the insulator seals. Particular care should be taken to prevent foreign matter from coming in contact with these areas. Unless adequately protected by filtered air, these areas collect dirt rapidly as a result of electrostatic forces and the nature of the air circulation around the tube.

The external parts of the tube should periodically be wiped free of dirt. A recommended procedure for cleaning ceramic-metal tubes is as follows:

1. Remove silicone grease or similar material by use of acetone, or equivalent.

   Caution: Do not allow silicone grease or similar materials to remain on any rf contact surfaces. Severe burning of the contact surfaces of cylindrical-terminal types will occur if the contact fingers do not mate firmly with clean metal contact surfaces.

2. Clean rf contact surfaces with Bear-Tex[1], a very fine grade of silicon carbide abrasive pad, or equivalent.

   Caution: Do not permit the cleaning pad to come in contact with the ceramic surfaces. Rub gently to prevent removal of plating.

3. If light dirt conditions exist, clean ceramic with an eraser such as Eberhard Faber[2] #100, or equivalent. If the dirt cannot be removed by an eraser, hand rub with an abrasive such as Norton[3] Crystalon Abrasive No.204-284, grade 3FX, or equivalent.

[1] Manufactured by Behr-Manning Co., Division of Norton Co., Troy, N. Y.

[2] Eberhard Faber, Inc., Crestwood Rd., Wilkes-Barre, Pa.

[3] Norton Abrasive Co., Worcester, Mass.

III - MECHANICAL

III.A - General

Careful attention to mechanical design of equipment to accommodate mechanical tolerances of the tube will not only help insure satisfactory electrical operation, but also will insure mechanical interchangeability. The manufacturer makes every effort to specify the mechanical design of the tube by following EIA Standards, **Recommended Practice For Preparation of Outline Drawings of Electron Tubes and Bases**[4], as a guide.

III.B - Dimensional Outlines

It is the responsibility of the user to assure that the intended equipment is designed to accommodate all tubes meeting the published dimensions. The manufacturer reserves the right to make any outline modifications permissible within the dimension limits.

Dimensioning of a tube outline (see example, Fig.1) begins at a reference plane Ⓐ perpendicular to the major axis Ⓑ and selected for compatibility with both tube design and equipment design. For example, in conventional base-pin-type tubes the reference plane is established at the seat of the base, which is coincident with the bearing surface of the socket. In cylindrical-terminal-type tubes, the reference plane is established at the edge of one of the cylindrical terminals; a plane coincident to this reference should be established in the equipment design for mounting the tube. (Mounting is treated in more detail in section III.C.)

From the reference line, all contact terminals Ⓒ are located by a dimension with tolerances. The surface area to be contacted Ⓓ is specified by a minimum dimension to indicate the maximum area available to the user.

Maximum dimensions are used to control total volume occupied by the device Ⓔ, clearances, and undefined lines. Similarly, minimum dimensions are used to control interior volumes or clearances Ⓕ.

Normally, diameters are specified from a common arbitrary centerline and their tolerances include ellipticity and eccentricity. For some cylindrical-terminal types, however, it becomes desirable to specify diameters with tolerances including only ellipticity Ⓖ; concentricity being specified in the appropriate note Ⓗ. Tolerances including eccentricity may become too large to be handled by the flexibility of spring connectors (finger stock). When concentricity is specified separately, a

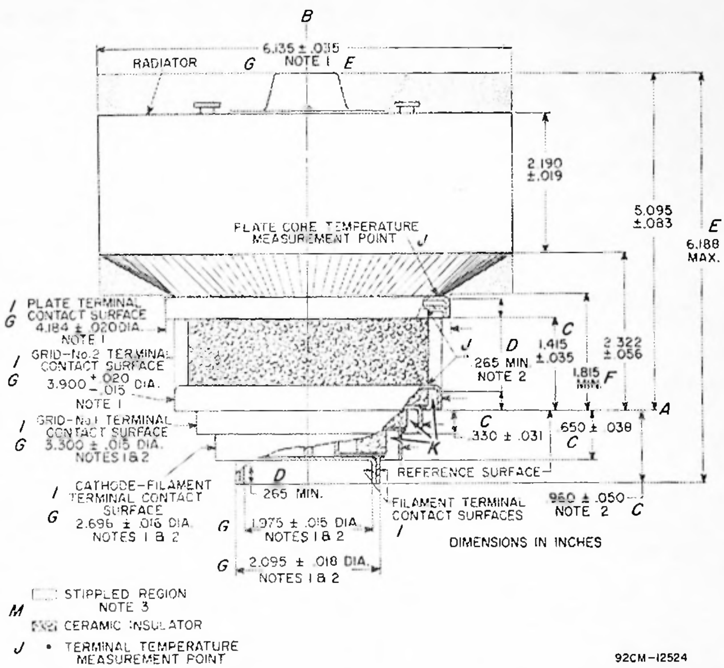
[4] Electronic Industries Association Standard RS-202 Series.

"floating" mount may be used, adjustable to the value of concentricity permitted. (See **Mounting** in section III.C.)

The Dimensional Outline also includes identification of contact surfaces (I), caps, bases, bulb, temperature measurement points (J), cutaways to show interior volumes (K), notes (L), special areas or materials identified by tints (M), or other specifications to simplify and clarify its use.

Standard dimensional characteristics, bases, caps, terminals, and gauges are described in EIA Standards, **Standards for Electron Tubes**[1]. The JEDEC designation is used on Dimensional Outlines to relieve the drawing from the details of these items. When new items are introduced, they are inserted in the published data.

EXAMPLE OF TYPICAL DIMENSIONAL OUTLINE



III.C - Mounting

III.C.1 - General

In any mounting arrangement the electrical, mechanical and thermal aspects of the tube must be considered. Electrical considerations of mounting are discussed under **Connections** in section III.D on page 6. Mechanical considerations must include observance of *Operating Position* given in the published data and should include provisions to protect the tube from appreciable shock or vibration. Thermal considerations require that the mounting arrangement permit the free flow of air unless other arrangements are made to limit the tube-surface temperatures.

III.C.2 - Glass-Bulb Types

For glass pin base and cap types, sockets and cap connectors are generally readily available. When new bases or caps are designed into a new tube type, a suggested socket or cap connector part number and its manufacturer are generally included in the published data.

III.C.3 - Cylindrical-Terminal Types

For cylindrical-terminal types, a suggested socket or a preferred mounting arrangement is generally given in the published data. For the multiple-ring terminal-type tubes, such as Cermolox

(L) (H) Note 1: Concentricity between the various diameters is such that the tube will enter a gauge having suitably spaced concentric apertures and posts of the following diameters:

a. Radiator -- 6.240
b. Plate Terminal -- 4.238
c. Grid-No. 2 Terminal – 3.960
d. Grid-No. 1 Terminal -- 3.335
e. Cathode-Filament Terminal – 2.730
f. Filament Terminal (OD) -- 2.130
g. Filament Terminal (ID) -- 1.935

(L) Note 2: The diameter of the terminal is held to the indicated value only over the contact surface length. The contact surface length of the filament, cathode-filament, and grid-No.1 terminals extends from the edge of its terminal to the plane coincident with the edge of the adjacent larger terminal.

(L) Note 3: Keep all stippled regions clear. Do not allow contacts or circuit components to protrude into these annular regions.

(L) Note 4: The filament terminal is dimensioned for inside diameter and outside diameter to provide a choice of contact mounting; the dimensions shall not be considered concurrently.

Fig.1

[1] Electronic Industries Association, Standard RS-209 Series.

tubes, the mounting may be constructed by using either fixed or adjustable contact rings of finger contact strips in the transverse plane.

III.C.3.a - **Fixed Method**

The fixed method offers simpler design and construction with resulting lower cost. It especially simplifies the associated hollow-cylinder cavity construction, if used. On the other hand, it requires greater finger stock accommodation. As used here, accommodation is defined as the amount of flexing required by the fingers of the finger contact strip to accept tubes at all the extremes of mechanical variation. Accommodation, which must be provided for in the fixed method, is determined from the *Dimensional Outline* and its associated notes. It may be calculated as the difference between the minimum terminal diameter on the *Dimensional Outline* (maximum finger opening) and the associated concentricity gauge aperture opening in the appropriate note (minimum finger opening).

III.C.3.b - **Adjustable Method**

The adjustable method is an alternate method to handle special mounting problems. The advantage of this method is reduced accommodation requirement to permit the use of heavier finger contact strips. In the adjustable method a separate assembly, which is movable in the transverse plane, is supplied for each terminal. In this manner the accommodation is simply the difference between the design center of the terminal diameter (maximum finger opening) and the maximum terminal diameter (minimum finger opening), both indicated on the *Dimensional Outline*. Provision must be made for the finger-contact-strip mounting to "float" within the associated diametrical opening in the appropriate note.

III.C.3.c - **Combination Method**

Combinations of the fixed and adjustable methods described above are also possible, provided that the principles described for each are observed.

III.D - Connections

III.D.1 - General

All electrical connections to the electrode terminals should be considered for the following: size, for current capability; spacing, for voltage holdoff; shielding, for minimum rf leakage; contact, for minimum contact and interface resistance; and lead length, for minimum impedance.

III.D.2 - Glass-Bulb Types

All wires and connections must be so located that during installation and maintenance they will not be close to or touch the bulb. In some of the larger power-tube types this precaution is necessary to avoid almost certain puncture of the glass in the event of corona discharge.

III.D.3 - Cylindrical-Terminal Types

To connect to cylindrical terminals, finger-stock-ring spring connectors are generally used. When such contact fingers are used, each finger should contact the tube terminals, and there should be no broken fingers. Fingers should be checked by actually feeling them for broken or loose fingers rather than relying on visual inspection.

IV - COOLING

IV.A - General

Temperature ratings should be observed in the same manner as other ratings. Envelope temperatures are a primary factor in determining tube life. **Tube life can always be extended by maintaining envelope temperatures substantially below the maximum temperature ratings.**

The user is cautioned that typical cooling characteristics in the published data are offered only as a guide, and that maximum envelope temperatures in the intended operation are the final rating criteria. Adequate safety factors in cooling techniques should be provided to (1) increase life expectancy and (2) insure against other factors, such as rf heating, high ambient temperatures, and high altitudes, which frequently increase envelope temperatures.

Temperature measurements of the tube envelope must be made to insure operation within maximum ratings. For glass-bulb types, the bulb "hot spot" must be located with the tube operating in its intended application. A simple technique for locating the "hot spot" in low-power, receiving-type tubes is to apply a low-temperature-melting paint, such as Tempilaq[1], to the entire bulb surface; the point at which this material first begins to melt is the hottest point on the bulb. For most power tubes, however, this technique is not satisfactory because of radiation effects. Therefore, it is recommended that a thermocouple be moved over the envelope to locate the hottest point on the bulb. (Although the individual thermocouple read-

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[1] Made by the Tempil Corp., 132 W. 22nd Street, New York 1, New York.

ings are not precise, the relative readings are sufficient.) Spots of various higher temperature Tempilaq paints may then be applied only to the hottest area; the lowest Tempilaq paint which will not melt must be at or below the maximum temperature rating. See Ref.1. For ring-terminal, external-plate types, the envelope temperature must be measured at each electrode terminal. In general, the hottest point of a ring terminal is at the seal or junction of the terminal and its adjacent glass or ceramic insulator. For some tube types the temperature measurement points are specified on the *Dimensional Outline* in the published data.

The type of cooling for a given tube type may be dictated by such factors as economy, size of envelope, amount of dissipation, type of tube construction, and the intended environment of the equipment. All types of heat transfer--radiation, convection, conduction, and combinations thereof--are employed in the various cooling techniques: natural, forced-air, liquid, and conduction cooling.

IV.B - Natural Cooling

In general, natural cooling is used for glass-bulb types having plate dissipation ratings up to about 300 watts.

Temperature should be measured at the hottest point on the bulb, using techniques discussed in section IV.A.

Adequate free space around the tube is required for all natural cooled types. Avoid reflective heat surfaces such as tube shields. These and other design considerations affecting natural methods of cooling are described in Ref.2.

IV.C - Forced-Air Cooling

IV.C.1 - Glass-Bulb Types

Forced-air cooling may be applied to glass-bulb types to enhance the convection cooling and reduce bulb temperature. In some glass-bulb types, ratings are given for both natural and forced-air cooling. (The ratings with forced-air cooling reflect the higher permitted value of dissipation.) In general, any natural-cooled type may require some forced-air cooling if operation is near the maximum ratings or if limited space is available around the tube. The final decision can be made only after temperature measurements are made to insure operation below the maximum temperature rating.

IV.C.2 - Radiator Types

The external plate construction lends itself to compactness, higher frequency operation, increased power capability, and intense-cooling techniques. Because the plate is part of the envelope, transfer of heat by radiation from the plate to the envelope is eliminated. The simplest intense-cooling technique is forced-air. All RCA forced-air-cooled, external-plate types contain integral radiators, which are brazed, pressed, or otherwise secured to the plate to insure intimate thermal contact.

Most of the heat within an electron tube is generated at the plate; additional heat generated from the other electrodes migrates to the plate. Precaution, however, must be taken to insure that none of the other terminals exceed their maximum rated temperature value. It may be necessary to direct some forced air across these terminals.

In general, there are two basic types of radiators: the stacked-disc type of finned radiator for transverse forced-air cooling, and the radial-fin type of radiator for axial forced-air cooling. In some of the radial-fin types, louvers are cut in the fins to assure turbulent flow and provide even more efficient cooling.

IV.C.2.a - Transverse Cooling

For transverse cooling, air flow is directed across the radiator from an orifice in a plane normal to the major axis of the tube and at the center of the radiator. More efficient cooling may be accomplished by providing a cowling to direct and confine the air. Pressure drop across the radiator itself is normally insignificant. Typical cooling characteristics for transverse cooling, such as shown in Fig. 2, are given in the published data. The following steps illustrate the use of the chart:

1. Estimate probable *Plate Dissipation* from electrical conditions, locate as point "A" on the abscissa axis (80 watts in example), and erect a perpendicular line "ac".
2. Determine temperature rise by subtracting estimated incoming-air temperature (assume 36° C in example) from estimated tube operating temperature (assume 200° C in example), locate the determined value (200° C - 36° C = 164° C in example) as point "B" on the ordinate axis, and construct horizontal line "bc".
3. Determine air flow by interpolating the air flow curves at the intersection of lines "ac" and "bc", point "C" (16 cfm in example).

IV.C.2.b - Axial Cooling

For axial cooling, air flow is directed through the radiator by suitable ducts. Air flow may be in

EXAMPLE OF
TYPICAL COOLING CHARACTERISTICS

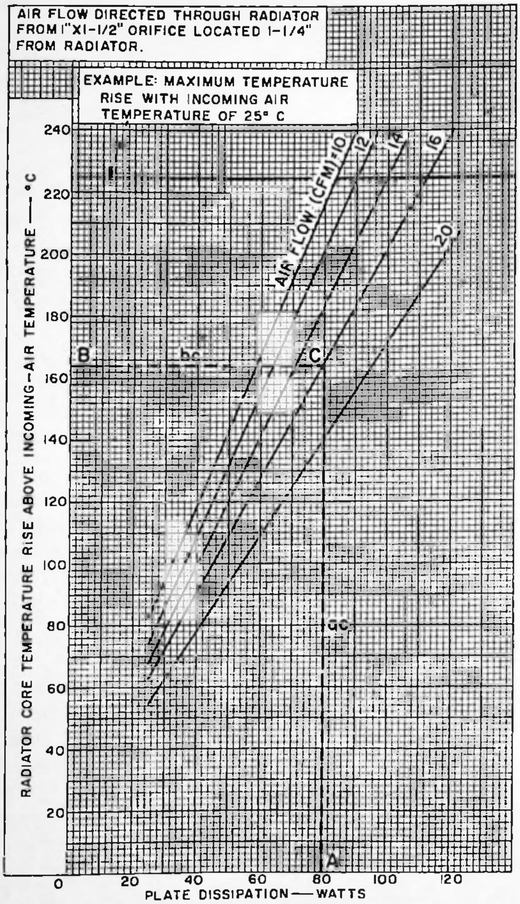

Fig.2

EXAMPLE OF
TYPICAL COOLING CHARACTERISTICS

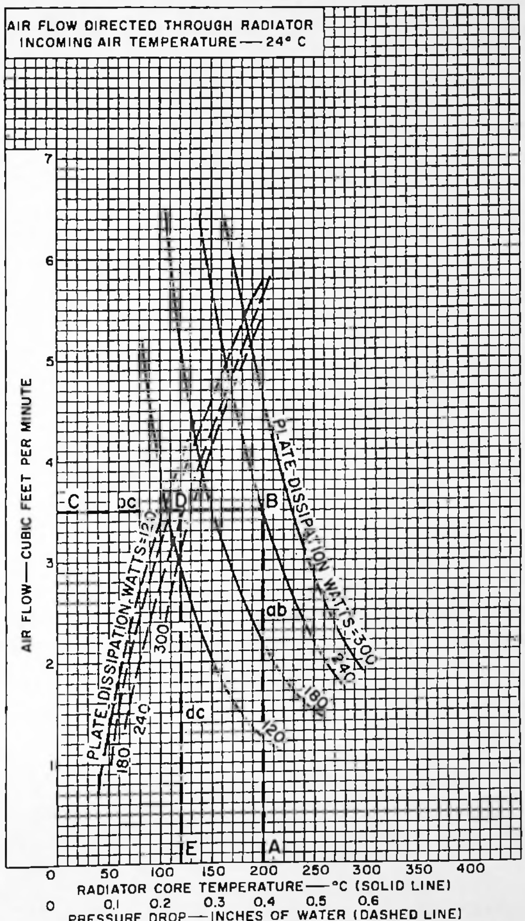

Fig.3

either direction unless otherwise specified. Typical cooling characteristics for axial cooling, such as shown in Fig.3, are given in the published data. The following steps illustrate the use of the chart:

1. Select a tube operating temperature as discussed in section IV.A, locate as point "A" on the abscissa (assume 200° C in example), erect perpendicular line "ab", extend this line until it crosses the estimated plate dissipation curve (240 watts in example) for temperature (solid line), and designate as point "B".
2. Determine air flow by constructing a horizontal line "bc" from point "B" to the ordinate axis and designate point "C" (3.5 cfm in example).
3. Determine the pressure drop across the radiator for the air flow in (2), locate point "D" on line "bc" at the estimated plate dissipation curve (240 watts in example) for pressure drop (dashed line), construct a perpendicular line "de" to the abscissa axis, designate as point "E", and read pressure drop (0.24 inch of water in the example).

IV.C.3 - Blower Requirements

Careful selection of a suitable fan or blower is required to provide the necessary air flow and static pressure. The air flow required depends not only upon the amount of plate dissipation and the maximum ambient temperature expected, but also upon such factors as rf heating, high ambient temperature, and high altitudes in a given application. The static pressure at the blower outlet depends not only upon the pressure drop of the tube itself, but also upon the pressure-versus-air flow characteristics of the system into which the blower must deliver the required volume of air. Some tube types have suggested blowers and their associated motors specified in the published data. See Ref.3 for additional information on the general considerations of blower requirements.

IV.C.4 - Care

A suitable air filter is required in the air supply. Regular care should be given to cleaning or replacing the filter so that accumulated dirt will not obstruct the required flow of air across the socket and radiator.

IV.C.5 - Installation

The forced-air cooling system should be properly installed to insure safe operation of the tube under all conditions. Air-flow interlocks which open the power transformer primaries are required to protect the tube when the air flow is insufficient.

Blowers must normally be interconnected with the primary power supplies. It may also be necessary to continue blower operation for a period subsequent to the removal of primary power.

IV.D - Liquid Cooling

IV.D.1 - System

The liquid-cooling system consists, in general, of a source of cooling liquid, a feed-pipe system which carries the liquid to the water jacket surrounding, and provision for interlocking with the power supplies the liquid flow through the cooling courses. A more sophisticated system would also contain a liquid regeneration loop, flow regulators, and gages; such a system is described in Ref.4.

It is essential that the tubing between the cooling-system piping and each of the cooling connectors have good insulating qualities and be of sufficient length to minimize leakage currents and/or electrolysis effects.

As described in section IV.C.2, some forced-air cooling may also be required to insure that none of the terminals exceed their maximum temperature rating.

For further design information on the methods of liquid cooling electronic equipment, see Ref.5.

IV.D.2 - Precautions

Proper functioning of the coolant system is of the utmost importance. Even a momentary failure of the liquid flow may damage the tube. Without coolant the heat of the filament or heater alone may be sufficient to cause serious harm to some tube types. It is necessary, therefore, to provide a method of preventing tube operation in case the coolant supply should fail. A suitable method is the use of coolant-flow interlocks which open the power supplies when the flow is insufficient or ceases. If there is an interruption of the power supplies, it is then necessary to return the filament or heater voltage to zero and to restart in the normal manner described in the published data. The coolant flow must start before application of any voltage and continue for several seconds after removal of all voltages.

The absolute minimum coolant flow required through the system is given in the published data. Under no circumstances should the temperature of the coolant at any outlet ever exceed the maximum value given in the published data.

When the coolant fluid is water and the tube is used in equipment under conditions such that the ambient temperature is below 0°C, precautions should be taken to prevent the water from freezing in the system.

IV.D.3 - Use of Water as Coolant

For availability and ease in handling, water is recommended as the coolant wherever possible. It is of utmost importance to maintain a high quality of water in the cooling system. Contamination in the water will hasten scale formation, corrosion, and excessive electrolysis; any one of these conditions can greatly reduce tube life. For a more extensive discussion of water purity, see Ref.4.

IV.D.4 - Use of Liquids other than Water as Coolant

When ambient temperatures fall below 0°C, it is possible to use coolants such as ethylene-glycol-water solution and FC75[1]. Neither of these two coolants is as effective a coolant as water, therefore, the plate dissipation and flow data must be modified from that given for water. A more extensive discussion of ethylene-glycol-water solution and FC75 as coolants is given in Ref.4. For information on the use of any coolant for which ratings are not given in the data, contact your RCA field representative or the nearest District Sales Office. A coolant such as oil will require a special plating on the metal of the tube envelope, such as nickel and rhodium to protect the metal surfaces from chemical attack.

[1] Manufactured by the Fluorchemical Division, Minnesota Mining and Manufacturing Co., 900 Bush Avenue, St. Paul 6, Minnesota.

IV.E - Conduction Cooling

IV.E.1 - System

The conduction-cooling system consists, in general, of a constant temperature device (heat sink) and suitable heat-flow path (coupling) between the heat sink and tube. Primary consideration of the system should be given to the design of a heat-flow path (coupling device) with high thermal conductivity. See Ref.6.

IV.E.2 - Heat Sink

The heat sink should be designed to act as a constant-temperature device to prevent any increase in temperature by dissipating the heat beyond the equipment compartment. Heat sinks can take the form of solids or liquids. In most applications such a heat sink is available in the form of equipment chassis, plate line, or output cavity as described in Ref.6.

IV.E.3 - Coupling

There are numerous insulating materials available to serve as the heat-coupling device, such as beryllium oxide (beryllia)[1], high-aluminum oxide (high alumina), mica, and other insulating bodies. Since the thermal conductivity of these insulators varies considerably (as noted in Ref. 6), the choice of insulator will depend primarily on the plate dissipation in the given application.

In hf operation the inductive element of the plate circuit is usually a relatively long coil, which does not provide a good thermal path from plate to chassis. Larger shunt capacity can be tolerated, however, and heat can be conducted through a portion of it to the chassis. In uhf operation the permissible shunt capacity of the plate circuit is limited, but the inductive element is short and can usually be made with sufficient cross-sectional area to form an excellent thermal path. In vhf operation a careful compromise of the above is required to obtain adequate rf performance and reasonable cooling.

V - ELECTRICAL

V.A - Cathode

RCA power tubes use a wide variety of cathodes. All utilize thermionic emission and should be operated at a constant temperature. Cathodes are divided into two basic configurations: the directly heated or filamentary cathode, and the indirectly heated or unipotential cathode. The published data on RCA power tubes identifies the cathode configuration and thermoemissive material.

V.A.1 - Emissive Material

Types and characteristics of thermoemissive material used in RCA power-tube cathodes are described briefly below.

a **Pure tungsten** cathodes withstand momentary tube overloads by resisting high-energy gas ions that can harm oxide-coated and thoriated-tungsten cathodes. Tungsten cathodes have moderate electron emission density for long-pulse operation. They require high input power because of their high-temperature operation and low emission efficiency.

b **Thoriated-tungsten** cathodes have moderate emission efficiency (much higher than pure tungsten types). Thoriated-tungsten cathodes have moderate electron emission density for long-pulse operation, withstand moderate momentary tube overloads, but are more susceptible to damage by high-energy gas ions than pure tungsten types.

c **Oxide-coated** cathodes have high emission efficiency because of their low-temperature operation and high electron emission density. They can deliver extremely high current in short-pulse, low-duty-factor operation. However, this capability decreases with increasing pulse lengths and duty factors. They are less resistant than tungsten counterparts to momentary overloads.

d **Matrix** cathodes are similar in characteristics to oxide-coated types; however, they require somewhat higher input power and are more resistant to momentary overloads.

V.A.2 - Cathode Configurations

V.A.2.a - Filamentary Cathode

The filamentary or directly heated cathode normally consists of a series-parallel arrangement of wire or ribbon conductors supported by tensioning devices and heated by their own resistance. It has the basic advantages of somewhat higher emission efficiency and rapid heating. The rapid heating feature can be further enhanced by the use of a suitably designed filament overvoltage pulse circuit described in section V.A.5 on page 11. They are generally less rugged than the unipotential cathode and may present hum problems when AC excitation voltage is used. The inductance associated with the long wire structures usually causes performance

[1] *Warning: Beryllia dust and fumes are highly toxic to mucous membranes and may cause serious ulcers when imbedded under the skin. See References 7, 8, and 9.*

to degrade faster at higher frequencies than in unipotential cathode types.

A recently developed mesh filament structure, consisting of a self-supporting cylinder of diagonally interconnected wires, provides a much lower inductance structure of greater mechanical strength.

V.A.2.b - Unipotential Cathode

The unipotential cathode is a hollow metal cylinder or sleeve. It is heated by a metal filament, called the heater, mounted inside it. The unipotential cathode has the basic advantages of ruggedness, low inductance, and flexibility of external circuits.

V.A.3 - Filament or Heater

The rated filament or heater voltage should be applied for the heating time specified in the published data to allow the cathode to reach normal operating temperature before voltages are applied to other electrodes.

The life of the cathode can be conserved by adjusting to the lowest filament or heater supply voltage that will give the desired performance. In general, the filament or heater voltage values given in the published data include the maximum value and the typical value. Exceeding the maximum value will damage or severely shorten the life of the cathode. The filament or heater voltage should be adjusted to the typical value initially, then reduced to provide satisfactory tube performance; any further reduction will show some degradation.

Good regulation of the filament or heater voltage about the value found above is, in general, economically advantageous from the view-point of tube life. When the rated value is shown with a percentage value in the published data, the percentage value indicates the tolerable momentary fluctuations from the rated value. For longer life, especially at higher operating frequencies, these fluctuations should be reduced by improved power supply regulation.

The cathode may be subjected to back bombardment as the frequency is increased with resultant increase in temperature. In pulse types back bombardment normally need not be considered when the duty factor is small. However, higher duty factors increase the possibility of this effect. In any event, the filament or heater supply voltage should be reduced as described above.

V.A.4 - Standby Operation

During standby periods, the tube may be operated at decreased filament or heater voltage to conserve life. It is recommended that the filament or heater voltage be reduced to no less than 80 per cent of normal during standby periods of up to 2 hours. For longer periods, the filament or heater voltage should be turned off.

V.A.5 - Filament Overvoltage Pulse Circuits

In certain battery-operated equipment, such as emergency-type, remote-area, or mobile applications, it is of utmost importance to conserve battery power. Quick-heating RCA power tubes provide useful power outputs within about one second from a cold start. This fast "warm-up" feature eliminates the need for standby filament power, resulting in significant conservation of battery power.

In general, "warm-ups" of about one second are adequate in equipment where the microphone switch actuating the transmitter power relay is located in the cradle of the handset, such as a conventional telephone, or similar wall-type installation. However, when the switch is the push-button type located on the handset, faster "warm-ups" are demanded. Extremely fast "warm-ups" of less than 200 milliseconds are possible for such "push-to-talk" microphone switches by the use of a suitably designed filament overvoltage pulse circuit or "hot-shot" circuit.

The diagram shown in Fig.4 depicts the filament-voltage waveform during a transmission using a "hot-shot" circuit. An overvoltage Ef_1 is applied for time t_1. A transfer switch then reduces the filament voltage to the rated value, Ef_2, for the remainder of transmission time t_2. During standby time t_3, the filament voltage is zero.

FILAMENT VOLTAGE WAVE FORM

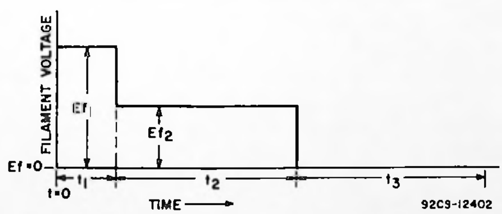

Fig.4

The block diagram shown in Fig.5 depicts the basic requirements of a "hot-shot" circuit in conjunction with the communication equipment. The auxiliary circuit must provide a low-impedance filament overvoltage source, a rated filament voltage source, an accurately timed means of switching these sources, and a protective circuit to prevent possible damage to the tube filament from repeated

BASIC RECEIVER-TRANSMITTER WITH AUXILIARY "HOT-SHOT" CIRCUIT

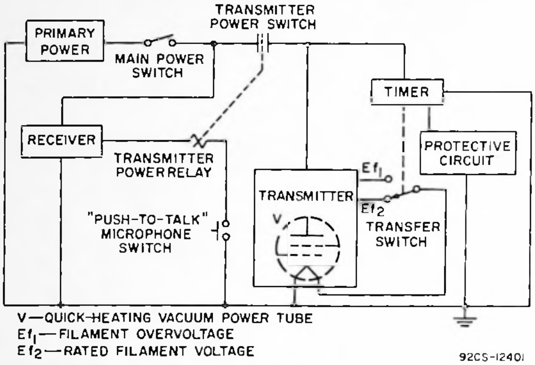

Fig.5

applications of overvoltage with insufficient time for the filament to cool between transmissions. Both filament voltages are obtained from the transmitter power supply. Power is supplied simultaneously to the transmitter and timer by the "**push-to-talk**" **microphone switch**. The **transfer switch**, which is initially connected to the **filament overvoltage** source, is switched by the **timer** to the **rated filament voltage** source in the required time (pulse duration) after application of power to the transmitter.

Before a "hot-shot" circuit can be designed for a quick-heating tube, it is necessary to establish maximum ratings for the peak voltage (on the order of 2 to 3 times the rated filament voltage) and duration of the filament overvoltage pulse for the desired heating time. Filament overvoltage pulse ratings are given in the published data on quick-heating tube types.

Any "hot-shot" circuit design must provide protection against the application of the filament overvoltage pulse to a hot filament.

It is recommended that a dummy filament, simulating the resistance of the specific tube type, be used in the initial testing or checking of a "hot-shot" circuit design. Otherwise, any fault—especially an excessive pulse duration—can cause catastrophic failure of the tube.

V.B - Power Supplies

The voltages at which power tubes are operated are extremely dangerous. Protection circuits must be provided which will protect operation and maintenance personnel, protect the tube in the event of abnormal circuit operation, and protect the tube circuits in the event of abnormal tube operation. Power tubes require mechanical protective devices such as interlocks, relays, and circuit breakers. Circuit breakers alone may not provide adequate protection in certain high-power-tube circuits when the power-supply filter, modulator, or pulse-forming network stores considerable energy. Additional protection may be provided by the use of high-speed electronic circuits or electronic "crow-bars" to bypass the fault current until mechanical circuit breakers are opened. These high-speed circuits and the effectiveness tests of protective devices are described in Ref.4.

Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel cannot possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies and discharge high-voltage capacitors when any gate or door on the protective housing is opened, and should prevent the closing of this primary circuit until the door is again locked.

V.B.1 - Plate Voltage Supply

Power-amplifier tubes usually obtain plate voltage from rectifiers provided with suitable filter circuits, although batteries or local dc generators are sometimes used, especially in portable and mobile equipment.

A time-delay relay should be provided in the plate-supply circuit to delay application of plate voltage until the filament or heater has reached normal operating temperature.

An interlocking relay system should be provided to prevent application of plate voltage prior to the application of sufficient bias voltage and/or rf drive to grid No.1; otherwise, with insufficient bias, the resultant high plate current may cause excessive plate dissipation with consequent damage to the tube. RF-load shorts or other causes of high output VSWR may also cause high dissipations, excessive voltage gradients, or insulator flashovers. The VSWR should be monitored and the detected signal used to actuate the interlock system to remove the plate voltage in less than 10 milliseconds after the fault occurs.

In beam power tubes with closely spaced electrodes, extremely high-voltage gradients occur even with moderate tube operating voltages. Consequently, momentary fault currents may cause catastrophic failure unless protection is provided. A series impedance in the plate lead is recommended. A resultant plate impedance, which will provide a plate-voltage-supply regulation of no better than 10 per cent, is usually sufficient.

V.B.2 - Grid-No.2 Voltage Supply

Grid-No.2 voltage for a beam power tube, pentode, or tetrode may be obtained from a separate dc power supply or from the plate voltage supply for the tube. In the latter case, the required voltage may be obtained either from a voltage divider or through a series resistor. In general, the method recommended for a particular application is given in section V.C below for the class of service in which the power tube is to be used.

The grid No.2 must be protected by a time-delay and interlocking relay similar to the plate-voltage-supply protection described in section V.B.1 on page 12. The plate voltage should be applied simultaneously with or before the grid-No.2 voltage; otherwise, with voltage on grid No.2 only, grid-No.2 current may be large enough to cause excessive grid-No.2 dissipation. If the grid-No.2 voltage is obtained from the plate voltage supply, these precautions will have been accomplished.

Grid-No.2 current is composed of a positive-current component resulting from cathode emission to grid No.2 and a negative-current component resulting from secondary-emission phenomena. Because the net result of these component currents is read on a meter in the grid-No.2 circuit, grid-No.2 dissipation can not be accurately determined. Operation similar to conditions given under *Typical Operation* in the published data will minimize the possibility of exceeding maximum dissipation.

In tubes with precision-aligned grids, such as Cermolox tubes, the grid-No.2 circuit must be capable of maintaining the proper grid-No.2 voltage in the presence of moderate negative dc current as well as normal values of positive current. Complete protection can be achieved by the use of a well-regulated power supply, a grid-No.2-to-ground impedance that is low enough to prevent gradual build-up of grid-No.2 voltage and/or catastrophic build-up (runaway) under negative-current conditions, and a current-overload relay to protect the grid No.2 against positive or negative currents on the order of one-tenth the required plate current.

V.B.3 - Grid-No.1 Voltage Supply

Grid-No.1 voltage or bias for a power tube may be obtained from a separate power supply or a resistor in the grid or cathode circuit. In general, the method recommended for a particular application is given in section V.C below for the class of service in which the power tube is to be used.

The grid-No.1 bias circuit should preferably be adjustable to permit small variations of grid-No.1 voltage. This bias adjustment will permit setting the desired plate current, and it will minimize variations in tube performance. Sufficient fixed bias or cathode resistor bias should be provided to protect the tube in the event that the drive signal is lost.

The design of the bias-voltage supply should include an instantaneous over-current relay. The action of the over-current relay and the inherent regulation of the supply should be such that no damage to the tube or supply will result from an accidental short at the tube connection or from an internal tube fault.

The rf-power-input transmission line should be provided with VSWR protection to remove drive power as well as plate (and grid No.2) voltage within 10 milliseconds in the event of abnormal changes in input VSWR during operation.

V.C - Classes of Service

V.C.1 - AF Power Amplifiers

The current and power values in the Maximum Ratings are averaged over any audio-frequency cycle of sine-wave form. The driver stage should be capable of supplying at low distortion the No.1 grid(s) with the value of peak af voltage given in the *Typical Operation* of the published data. The resistance introduced into the grid-No.1 circuit by the input coupling should be held to a low value. In no case should it exceed the value specified under *Maximum Circuit Values*. Transformer or impedance coupling devices are recommended. Except in the case of class A af power amplifiers, push-pull operation is required to minimize distortion. Hence, *Typical Operation* data are shown for two tubes (two units of a twin-type tube) operating in push-pull. Maximum ratings are given on a per tube (unit) basis; however, individual bias adjustment for each tube (unit) should be used to balance the loading and minimize distortion. The bias of each tube (unit) should be adjusted to divide the value of zero-signal plate current in the published data equally between the two tubes (units).

Also, except for class A amplifiers, the average plate and grid No.2 currents vary with the amplitude of the driving signal. Hence, serious distortion and inadequate power output will result with large input signals unless the plate and grid-No.2 power supplies are well regulated.

V.C.1.a - Class A AF Power Amplifiers

These amplifiers normally do not draw grid-No.1 current or require tube driving power. They draw substantially constant plate and grid-No.2 current and, therefore, can employ simple cathode bias. Where class A_2 (indicating grid-No.1 current flows during part of the cycle) is specified, the grid-No.1 circuit precautions discussed under class AB_2 operation will apply.

V.C.1.b - Class AB_1 AF Power Amplifiers

The subscript 1 in class AB_1 indicates that grid-No.1 current does not flow during any part of the cycle.

V.C.1.c - Class B and Class AB_2 AF Power Amplifiers

These classes of amplifiers normally draw grid-No.1 current (indicated by the subscript 2 in AB_2) with large signals and, therefore, require tube driving power. To minimize distortion, the grid-No.1 bias supply preferably should be regulated or held to a low value of effective resistance. Transformer coupling should be used.

V.C.2 - RF Power Amplifiers or Oscillators

In rf service a maximum frequency limit, for which the full maximum voltage, current, and input ratings apply, is usually given in the published data. On modern ceramic-metal envelope types, this frequency is usually selected as the maximum value at which reasonable gain and efficiency are obtained. Spurious modes may be present above this frequency limit. In glass-envelope types, the maximum frequency is selected as the frequency above which excessive rf envelope losses require voltage deratings and reduced efficiency requires input deratings.

The driver stage must provide the power required by the tube and bias supply plus the rf losses associated with the input circuit. The driver stage should also be designed with sufficient reserve power to accommodate variations in line-voltages, in components, in initial tube characteristics, and in tube characteristics during life.

Driving power values given in the published data include only the power that must be delivered to the tube and bias supply. The term, "driving power", is normally used only at low frequencies where circuit losses are small.

Where *Driver-Power Output* is shown in the published data, the rf losses associated with a typical input circuit are also included.

In cathode-drive circuits, a portion of the driver-power output and the developed rf power output act in series to supply the load circuit. If the driving power is increased, the output will always increase. In a grid-drive circuit, a saturation effect takes place; i.e., above a certain value of driving voltage and current, the output increases very slowly and may even decrease. It is important to recognize this difference and not try to saturate a cathode-drive stage; otherwise, the maximum grid-No.1 and grid-No.2 input may easily be exceeded.

In tuning a cathode-drive rf amplifier, it must be remembered that variations in the output-stage load will produce corresponding variations in the driving-stage load. This effect will be noticed by the simultaneous increase in plate currents of both the output and driver stages.

Parasitic oscillations may be experienced under certain operating conditions. Such oscillations result in erratic performance and may cause damage to the tube and/or associated circuitry. Operating conditions and external circuits should be adjusted for operation without oscillations. References 10 and 11 are suggested for further information on the detection and suppression of parasitic oscillations.

V.C.2.a - Class C Plate-Modulated RF Power Amplifiers

In plate-modulated class C amplifier service, the tube can be modulated 100 per cent. The grid-No.2 voltage must be modulated simultaneously with the plate voltage so that the ratio of grid-No.2 voltage to plate voltage remains constant.

Grid-No.2 voltage should be obtained preferably from a separate source modulated from a separate winding on the modulation transformer. In less critical circuits, grid-No.2 voltage may sometimes be obtained from the modulated plate supply through a series resistor or by connecting grid No.2 through an audio-frequency choke of suitable impedance for low audio frequencies to the fixed grid-No.2 supply voltage. The supply end of the choke should be well bypassed to ground.

Bias voltage may be obtained from a grid-No.1 resistor, but preferably is obtained from a combination of grid-No.1 resistor with either fixed supply or cathode resistor to protect the tube in the event the drive signal is lost.

In cathode-drive, plate-modulated, class C rf power amplifier service, the tube can be modulated 100 per cent if the rf driver stage is simultaneously modulated 100 per cent. Care should be taken to insure that the driver-modulation and amplifier-modulation voltages are exactly in phase.

V.C.2.b - Class C CW Power Amplifiers

In class C rf telegraphy service, the tube may generally be supplied with bias by any convenient method: from fixed supply, by grid-No.1 resistor, by cathode resistor, or by combination methods. However, when the tube is used in the final amplifier or a preceding stage of a transmitter designed for break-in operation and oscillator keying, an amount of fixed bias must be used to limit the plate current and, therefore, the plate dissipation to a safe value. Some fixed bias is preferred in any event to protect the tube in case the drive signal is lost.

Grid-No.2 voltage should be obtained preferably from a separate source. It can also be obtained from the plate-supply voltage with a voltage divider, or through a series resistor. A series grid-No.2 resistor should be used only when the tube is used in a circuit which is not keyed.

V.C.2.c - Linear RF Power Amplifiers

The classes of operation suitable for linear rf power amplifiers include: class A, class AB_1, class AB_2, class B with bias, and class B with zero bias. Class A operation is the more nearly linear, but it is also the least efficient. Application is generally limited to low-power-level amplification. Class AB_1 produces the best compromise for linearity, efficiency, and gain. Class AB_2 or class B operation provides higher output for applications where sufficient driving power is available to permit some "swamping", and where linearity requirements are less stringent. Class B zero-bias operation with suitable high mu triodes may be used when adequate driving power is available.

In general, grid-No.2 voltage should be obtained preferably from a separate, well-regulated source. In circuits where the grid-No.1 current is drawn, a separate, well-regulated source is also required.

V.C.2.c.(1) - Single Sideband, Suppressed Carrier Service

Single sideband suppressed carrier operation is a form of linear amplifier service in which only one sideband is transmitted, and the carrier is suppressed. Maximum ratings on a particular type in this service are given in the published data for peak envelope conditions for a signal having a minimum peak-to-average power ratio of two unless otherwise specified.

The values of *Distortion Products Level* given under *Typical Operation* in the published data are referenced to either of the two tones for "two-tone" modulation and are without the use of feedback to enhance linearity.

V.C.2.c.(2) - Class B and Class C Television Service

Television is a form of linear amplifier service in which the rf carrier is modulated by a video signal. Maximum ratings on a particular type in this service are given in the published data for synchronizing-level conditions per tube unless otherwise specified. Typical operation is given at conditions of a specified bandwidth measured between the half-power points.

The values for the pertinent parameters given under *Typical Operation* in the published data are given at the synchronizing (sync) level and pedestal level (black level or blanking level).

V.C.2.c.(3) - Class B Telephony Service

Class B telephony service is a form of linear amplifier service in which the grid is excited with an rf carrier that is modulated at audio frequencies in one of the preceding stages. Under these conditions, plate dissipation is greatest when the carrier is unmodulated. Grid bias should be obtained from a dc voltage source of good regulation.

V.C.2.d - Pulsed RF Amplifiers and Oscillators

This service consists of the generation and amplification of an rf signal, the envelope of which is a waveform limited to intermittent pulses of defined shape, duration, and repetition frequency. Pulse duration and duty factor are sometimes limited directly by the maximum ratings. More frequently, the maximum ratings define a relationship between these factors as a maximum "ON" time in a given time interval in order to cover pulse-train inputs. Typical operation, in general, is given for conditions with a rectangular waveshape pulse of a given duration and duty factor. For operation at pulse durations or duty factors other than those given in the published data, see Ref. 12.

Rf pulse oscillators may be controlled by the application of pulses of plate voltage, grid-No.2 voltage, grid-No.1 voltage, cathode voltage, or various combinations of these voltages. (For beam power tubes or other tetrode-type tubes, the grid-No. 2 voltage must be pulsed simultaneously with the plate voltage.) Similar pulse voltages may be applied to rf pulse amplifiers to enhance the gain or output capabilities. In the amplifier service, the power supply pulses should preferably start shortly after and end shortly before the rf drive pulse to reduce the possibility of parasitic oscillations. If the rf drive pulses are "gated" within the power-supply pulses (the rf drive pulse starts shortly after and ends shortly before the power-supply pulses), the desired "gate" conditions should be observed carefully when no rf drive pulse is present to be assured that no oscillations are present.

The peak input energy required during the pulse is normally obtained from capacitor banks that must store many times this peak value to prevent excessive voltage droop. Consequently, it is particularly important to observe all the precautions for limiting tube input during faults which are described in section V.B.

V.C.2.e - Pulse-Modulated RF Amplifiers

This service consists of the simultaneous amplification and pulse modulation of a cw rf signal. It differs from the other more conventional modulated rf amplifier services in that the modulating waveform is limited to intermittent pulses of defined shape, duration, and repetition frequency. This type of amplification/modulation is normally done at low power levels; hence, few power tubes are rated specifically for this service. If this service is required, consult your local RCA field representative or the nearest District Sales Office.

V.C.3 - Pulse Modulator Service

In this service the tube supplies a modulation signal consisting of intermittent pulses of defined shape, duration, and repetition frequency. Ratings, waveforms, and precautions are similar to those given for pulsed rf amplifier service (except there is no rf drive signal).

Observation of the exact waveforms must be made with an oscilloscope. In this manner, transient voltage or current spikes caused by unavoidable circuit reactances may be observed. Transient values must be held within the maximum ratings given in the published data.

High-power pulse modulators, when used to "clip" or "flat-top" the output waveform by the overdriving technique, must provide grid-No.1 and grid-No.2 input protection.

Plate current flow during the "OFF" time will contribute to plate dissipation; the bias voltage should be sufficient to hold the plate current below the required levels for any tube. The control limits, such as found in the Characteristics Range Values (see section II.A.2), will provide information in determining the required bias. Current flow during the rise time and the fall time of a "rectangular" pulse can contribute significantly to plate dissipation; this current flow should be considered if the theoretical plate dissipation is close to the rated value.

V.C.4 - Voltage Regulator Service

In this service the tube acts as a "pass tube" having a controllable voltage drop in a series-regulated voltage-supply circuit. The plate voltage rating can be interpreted as applying to the actual plate-to-cathode voltage of the tube rather than the supply voltage. In this case, adequate protective devices must be used to protect the tube in the event of a shorted load. Special precaution should be made to observe the maximum circuit values for grid-No.1 and grid-No.2 impedance. For information on voltage regulator circuits, see Refs. 13, 14, and 15.

It is recommended that only tube types rated for this service be used since the use of a high power vacuum tube in a high-voltage, low-current application will frequently result in the selection of a tube inadequately controlled in the low-current region. To establish ratings and controls for a particular tube type, consult your local RCA field representative or the nearest District Sales Office.

V.D - Break-In Procedure

The following "break-in" treatment is recommended for new or used tubes which have been in storage for an extended period, before placing such tubes in service. This "break-in" treatment preferably should be in equipment in which the tube is to be used when new circuits are tested or when adjustments are made.

Step 1: Make sure that the cooling system and protective devices are functioning properly.

Step 2: With no other voltages on the tube, apply voltage to the filament or heater in the normal manner and operate at the prescribed typical operating voltage for 15 minutes.

Step 3: Apply reduced value of rf drive power and grid-No.1 voltage (approximately three-quarters normal drive power) for 15 minutes.

Step 4: Apply reduced value of plate voltage and grid-No.2 voltage (approximately one-half normal values) until stable performance is obtained.

Step 5: Increase rf drive power and grid-No.1 voltage to normal.

Step 6: Increase plate voltage and grid-No.2

voltage to normal, gradually or in steps. Operate the tube until stable performance is obtained at each voltage level.

After the tube is given the above treatment and is operating normally to give the desired output, it is suggested that the readings of the meters and the control settings be recorded for future reference.

VI - REFERENCES

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3. *Blower Requirements for RCA Forced-Air-Cooled Tubes,* RCA Application Note, AN-161.
4. *Application Guide for RCA Super-Power Tubes,* 1CE-279A.
5. *Design Manual of Methods of Liquid Cooling Electronic Equipment,* Department of the Navy, Bureau of Ships, Navships 900, 195.
6. J.W. Gaylord, *"The Conduction Cooling of Power Tubes in Vehicular Communication Equipment,"* IEEE Transactions on Vehicular Communications, September, 1963.
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8. Donald P. O'Neil, *"Toxic Materials Machined Safely,"* American Machinist, June 4, 1955.
9. Sidney Laskin, Robert A.N. Turner, and Herbert E. Stokinger, *"Analysis of Dust and Fume Hazards in a Beryllium Plant,"* U.S. Atomic Energy Commission, MDDC-1355.
10. F.E. Terman, *"Radio Engineers' Handbook,"* pages 498 to 503 of 1943 edition. Published by McGraw-Hill Pub. Co., Inc.
11. EE Staff of MIT, *"Applied Electronics,"* page 619.
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13. F.V. Hunt, & R.W. Hickman, Review of Scientific Instruments, *"On Electronic Voltage Stabilizers,"* January, 1939.
14. F.E. Terman, *"Radio Engineers' Handbook,"* pages 614 and 615 of 1943 edition. Published by McGraw-Hill Pub. Co., Inc.
15. Cruft Electronics Staff, *"Electronic Circuits and Tubes,"* page 575. Published by McGraw-Hill Pub. Co., Inc.

VII - DEFINITIONS

AB_1 - The subscript 1 indicates that grid-No.1 current does not flow during any part of the input cycle.

AB_2 - The subscript 2 indicates that grid-No.1 current flows during some part of the input cycle.

CCS - Continuous Commercial Service.

Cermolox - A new family of compact RCA beam power tubes featuring the following unique construction: precision-aligned grids, ceramic-metal structure, and unitized cylindrical-electrode-and-terminal design. The precision alignment of the grids minimizes grid and screen currents and permits higher efficiency, i.e., operation with relatively low plate voltage to give large power output with small driving power. The high-alumina ceramic provides a strong, low-loss rf window and permits accurate assembly and high temperature operation. The unitized electrode-and-terminal construction provides high electrical and thermal conductivity between electrode and terminal. The cylindrical terminals lend themselves to either coaxial-cylinder or strip-line circuits.

Duty Factor - Ratio of "ON" time to indicated interval.

ICAS - Intermittent Commercial and Amateur Service.

"ON" Time - The sum of the duration of all individual pulses which occur during an indicated interval.

Peak Value - The maximum value of a smooth curve through the average of fluctuations over the top portions of the pulse.

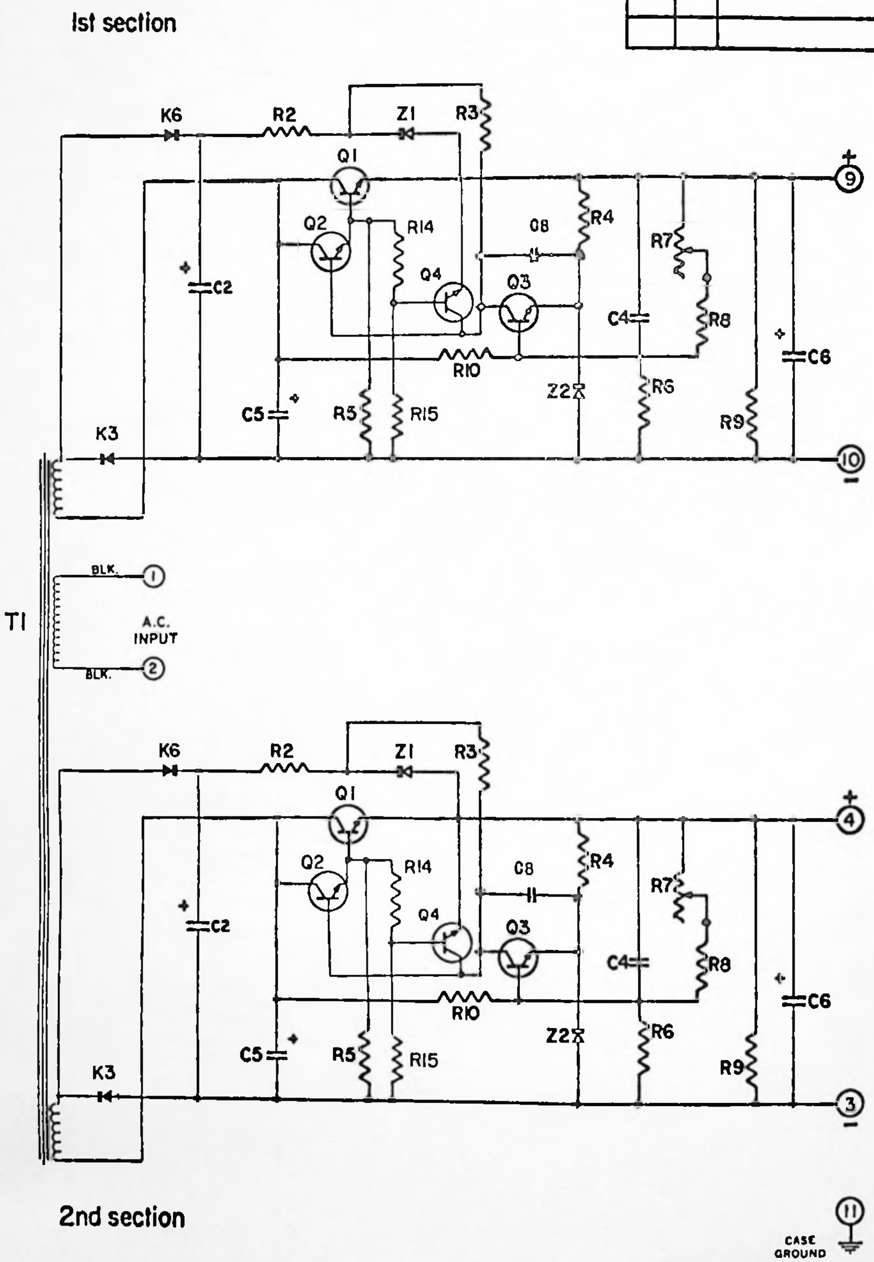
Pulse Duration - The time interval between the two points on the pulse at which the instantaneous value is 70% of the peak voltage value.

"Single-Tone" Modulation - Single-Tone Modulation operation refers to that class of amplifier service in which the input consists of a monofrequency rf signal having constant amplitude. This signal is produced in a single-sideband suppressed-carrier system when a single audio frequency of constant amplitude is applied to the input of the system.

"Two-Tone" Modulation - Two-Tone Modulation operation refers to that class of amplifier service in which the input consists of two monofrequency rf signals having equal peak amplitude.

INDEX

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



SHORT CIRCUIT PROTECTION

This power supply is designed to take short circuit conditions for a short period of time without permanent damage to the unit. If short circuit condition is gone unnoticed for extended period of time, permanent damage may result, therefore a slow-blow fuse of 1/10 amp. is recommended at the A.C. input of power supply.

Acopian Technical Company

EASTON, PENNA.

PROJECT NUMBER	SCALE	DR. ANP
		CK.

TITLE SCHEMATIC FOR POWER SUPPLY MODEL 1215B

DATE	DRAWING NUMBER

MAGSENSE® INSTRUCTION SHEET

MODEL 70
METER MONITOR

NONLATCHING
Part Numbers

100 μa	4-15144-10
1 ma	4-15144-20
10 ma	4-15144-30
100 ma	4-15144-40

CONTROL DATA CORPORATION

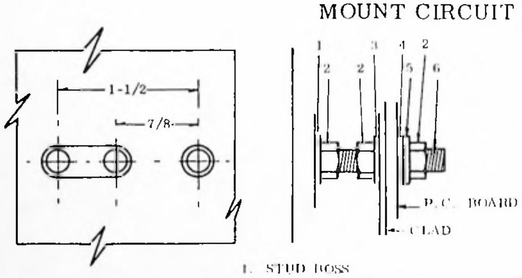
CONTROL SYSTEMS DIVISION
4455 MIRAMAR ROAD, LA JOLLA, CALIFORNIA

METER MONITOR INSTALLATION

CHASSIS MOUNTING. Use insulated, tapped spacers between printed circuit board and chassis. Board mounting holes will accomodate insulated spacer mounting screws within dimensions indicated on the drawing below.

QUICK DISCONNECT MOUNTING. The Meter Monitor can be edge mounted in printed circuit board connectors such as Elco 6007-18, Cinch Jones 250-18, and Precision Connector 60-062-18. The clad runout to the edge of the circuit board from the terminal posts extends the circuitry to the connector.

MOUNT CIRCUIT BOARD ON METER



1. STUD BOSS
2. NUT (NF)
3. EXTERNAL TOOTH LOCK WASHER
4. FLAT WASHER
5. SPRING LOCK WASHER
6. METER STUD 1/4-28 MAX. (NF)

Correct polarity must be observed. Items marked NF (not furnished) are standard items furnished with the meter and used in the installation as shown.

NOTE

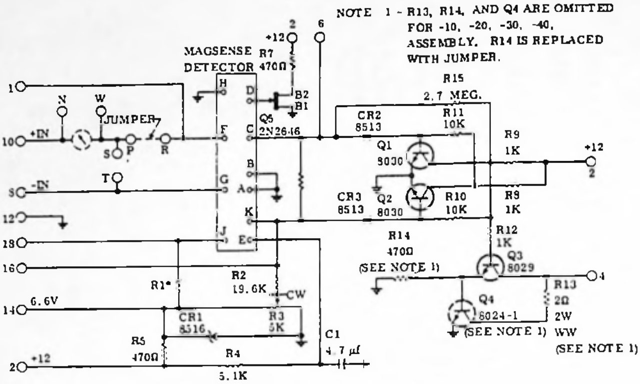
When the Meter Monitor printed circuit board is not mounted on a meter, connect points N and W by a jumper to close the input circuit. (See circuit schematic on reverse side.)

TERMINAL HOOKUP CONNECTIONS

Terminal 2	+12 VDC supply.
Terminal 4	Output terminal. Connect load between terminal 4 and positive voltage per specification.
Terminal 6	External set point current insertion to lower set point.
Terminal 8	Negative input signal.
Terminal 10	Positive input signal.
Terminal 12	Circuit ground. Power return.
Terminal 14	Internal reference voltage, approximately 6.5 VDC. Available current for external use not to exceed 2 ma.
Terminal 16	External set point current insertion to raise set point.

CAUTION

Do not use unassigned connectors for tie points.
Do not apply an output voltage greater than 30 volts.
Do not exceed 50 ma on the output of -10, -20, -30, or -40 units.
Do not exceed 0.5 amp on the output of -11, -21, -31, or -41 units.
Do not reverse printed circuit board in a connector.
The Meter Monitor printed circuit board terminal connections are listed below. Numbers refer to terminal markings on the board.



SCHEMATIC

MAGSENSE Model 70 nonlatching printed circuitboard assembly with all terminals and jumper points identified.

HYSTERESIS ADJUSTMENT: Hysteresis (reset band) is normally factory set at less than 2% of the model range. Hysteresis can be widened by connecting an external resistor from terminal No. 4 to terminal No. 16. Hysteresis can be reduced by an electrical resistor between terminal No. 4 and terminal No. 6 to establish a time-proportioning control band. The resistor value is selected according to:

$$\Delta H = \frac{E}{2R}$$

where: ΔH = change in hysteresis (% of range)
R = Resistor value in megohms
E = Supply voltage to which load is returned.

OUTPUT ACTION: Output terminal No. 4 is energized when the input is more positive than the set point. To energize the output when the input is more negative than the set point:

a. Reverse the input polarities to meter-mounted printed circuit cards by rotating the card 180° on the meter studs.
b. By reversing the input wires, terminal No. 10 goes negative.
c. If only the integral set point pot is used, connect a stable 22K-ohm resistor between terminals No. 14 and No. 6.
d. If an external set point pot is used, connect a 5K-ohm external pot between terminals No. 14 and No. 12 and connect the pot wiper through a stable 20K-ohm resistor to terminal No. 6. Adjust internal set point to zero.

OUTPUT PROTECTION: The Meter Monitor is designed to drive resistive output loads. For inductive loads, such as relay coils, connect a silicon rectifier of suitable voltage rating across the load.

SPECIFICATIONS

Ranges:	100 µa	1 ma	10 ma	100 ma
Input Resistance: (Electrically Isolated)	105 ohms ± 10%	< 2 ohm	< 1 ohm	< 1 ohm
Set Point Range:	0-100 µa	0-1 ma	0-10 ma	0-100 ma
Set Point Resolution:	1 µa	10 µa	0.1 ma	1 ma
Hysteresis:	3 µa max.	30 µa max.	0.3 ma max.	3 ma max.

RESPONSE TIME:

Nominally 50 ms (100 ms maximum) for input current step function traversing set point.

POWER REQUIRED:

10 to 14 VDC at approximately 30 ma.

OUTPUT LOAD:

External load up to 50 ma.

SIZE:

Printed circuit board 3" x 3 3/8" x 1 1/4" maximum component height.

WEIGHT:

Approximately 3 ounces.

DATA SHEETS. Applications and Engineering Data Sheets are available on request. Available sheets present economic use of MAGSENSE instrumentation for solutions to control problems. Request sheets from local authorized MAGSENSE representative or write: MAGSENSE Department.

MODIFICATIONS. The Meter Monitor can be adapted to AC inputs, other DC inputs, suppressed range/applications, differential gap, and time proportional control by means of various modifications. Modifications performed by persons other than authorized company representatives will automatically void the warranty. Such modifications performed by unauthorized personnel are at buyer's risk. Refer to Engineering Data Sheet ED-59M-63 for additional information.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPES SC, SC-1, SV AND SV-1 RELAYS

CAUTION Before putting protective relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

APPLICATION

The types SC and SC-1 current relays and the types SV and SV-1 voltage relays are applicable where an instantaneous plunger relay of high accuracy is required. These relays are suitable for protective service, and for auxiliary service where some of their special features are desired. They are adjustable over a wide range of voltage or current, are provided with mechanical operation indicators, and have a calibrated scale which indicates the pick-up setting. Both contacts can readily be changed from "make" to "break". The volt-ampere burden is low.

The type SC and SV relays have a high ratio of drop-out to pick-up (90 to 98%) and are particularly suitable for fault detector relays. The type SC-1 and SV-1 relays have a lower ratio of drop-out to pick-up. This lower ratio may be desirable in some applications, and it makes possible a plunger pull characteristic which permits the operation of a latching device. The latch is combined with the mechanical operation indicator, and prevents further motion of the moving contacts after the relay has operated.

CONSTRUCTION

The types SC, SC-1, SV and SV-1 relays operate on the solenoid principle. A U-shaped iron frame, mounted on the moulded base, supports the coil and serves as the external magnetic path for the coil. The coil surrounds a core and flux shunt. The upper end of the core is threaded and projects through the upper side of the frame, to which it is fastened by a nut. A tube threaded on the outside at its lower end is assembled in the core, and the threaded end extends below the core. * A graphite bushing, which is the lower bearing for the plunger shaft, is assembled in the lower end of this threaded tube. It is held in place by two split spring sleeves, one above and one below the bearing. The split sleeves must be compressed to insert them in the tube and they will remain at any position in which they are placed. The bearing for the upper end of the plunger shaft is a graphite bushing which is pressed in the upper end of the core. This bearing is visible when the plunger is in the energized position. The plunger itself does not touch the walls of the tube in which it moves.

A flux shunt which surrounds the core is screwed on the tube, and its lower end projects below the relay frame. The position of this shunt determines the pick-up setting of the relay. The lower end of the shunt is beveled and knurled, so that it can be grasped by the fingers and turned to change the setting. A calibrated scale plate is mounted adjacent to the shunt. A groove just above the knurl in the lower end of the shunt serves as an index mark, and the relay pick-up setting is indicated by the calibration scale marking which is adjacent to the groove.

The construction of the plunger, core and flux shunt (which differ in details in the various types of these relays) causes the plunger to float in its energized position,

SUPERSEDES I. L. 41-380K

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*Denotes change from previous issue.

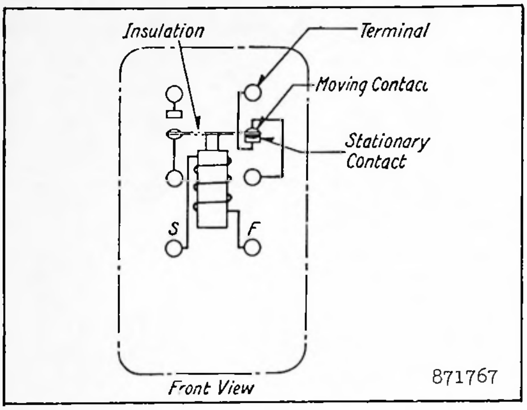


Fig. 1—Internal Wiring of the Relays In The Small Glass Case.

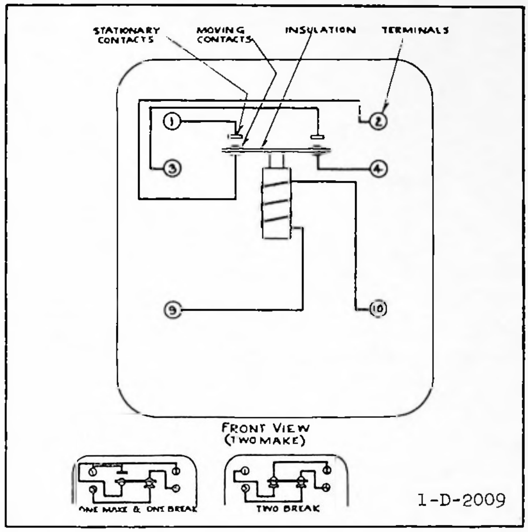


Fig. 2—Internal Wiring of the Relays In The Standard Case.

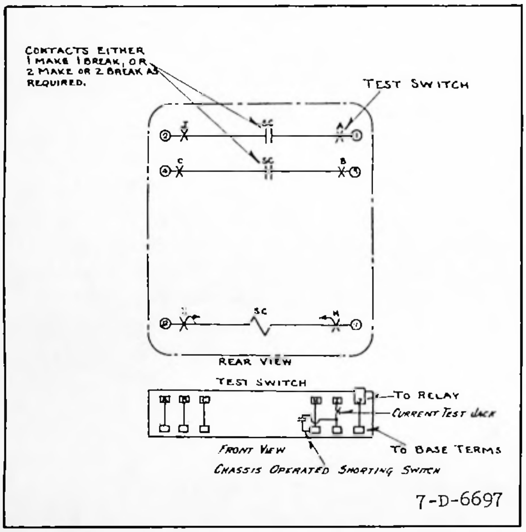


Fig. 3—Internal Schematic of the Single Element Types SC and SC-1 Relays In The Type FT Case.

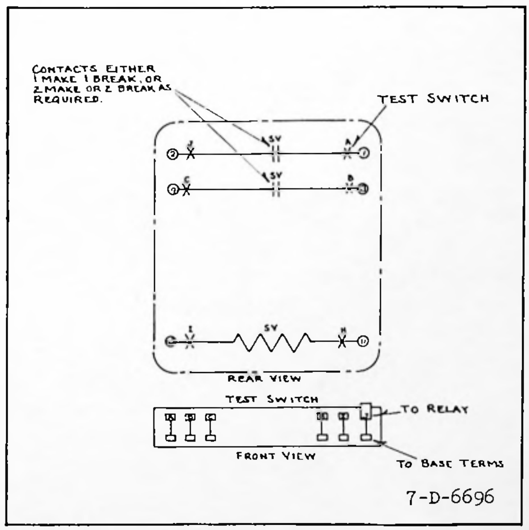
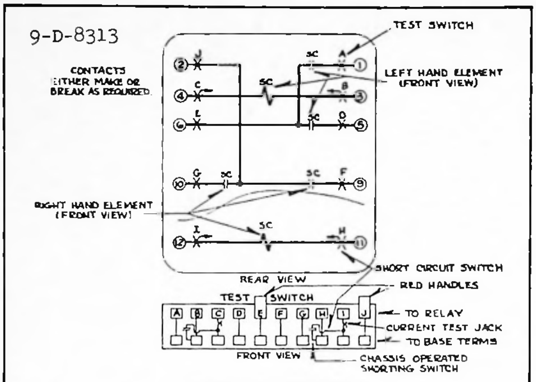


Fig. 4—Internal Schematic of the Single Element Types SV and SV-1 Relays In The Type FT Case.

without being held against a stop, even when energized much above the pick-up value. Consequently, there is negligible noise and the contacts are free from chatter, even on heavy overloads and in 25 cycle applications.

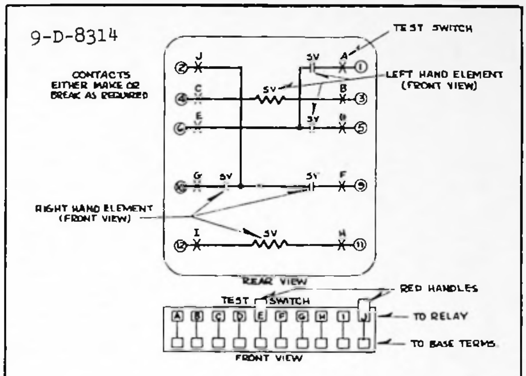
The core, shunt and plunger construction also provides the high ratio of drop-out to pick-up in the SC and SV relays. This ratio is above 90% for any pick-up setting. In the latch type relays it is necessary for the plunger to rise with sufficient force to operate the latch positively and to deflect the stationary contacts sufficiently to prevent their opening, when the relay is de-energized, due to play in the latch. It is necessary to have a lower ratio of drop-out to pick-up in order to obtain this characteristic, and this lower ratio may be desirable



ARRANGEMENT OF ELEMENTS

TYPE OF ELEMENTS	LOCATION OF EACH ELEMENT	
	RIGHT HAND	LEFT HAND
SAME TYPE (SC, SC-1)	LOWER RATING ELEM.	HIGHER RATING ELEM.
SAME TYPE BUT DC & AC	D.C.	A.C.

Fig. 5—Internal Schematic of the Double Element Types SC and SC-1 Relays In The Type FT Case.



ARRANGEMENT OF ELEMENTS

TYPE OF ELEMENTS	LOCATION OF EACH ELEMENT	
	RIGHT HAND	LEFT HAND
SAME TYPE (SV, SV-1)	LOWER RATING ELEM.	HIGHER RATING ELEM.
SAME TYPE BUT DC & AC	D.C.	A.C.

Fig. 6—Internal Schematic of the Double Element Types SV and SV-1 Relays In The Type FT Case.

in some applications where the latch is not required. The plunger floats in its operated position just as in the SC and SV relays. The drop-out ratio varies somewhat for different shunt positions, but is constant for any one setting.

* The shunt is held in any desired position by pressure from a curved arm made of sheet spring steel, which is fastened to the bottom of the coil frame at the rear of the shunt. This spring arm is shaped to extend around the shunt to the front of the relay, and in its normal position it exerts sufficient pressure against the shunt to prevent any creeping of the shunt or undesired change of setting. The front end of the spring arm has a bent-over tab on which thumb-pressure may be applied to move the arm out of contact with the shunt while the position of the latter is being changed.

The stationary contacts are assembled on slotted brackets. These are held in position on the base by filister-head screws which are threaded into the terminal inserts. Lock-washers are assembled inside the moulded terminal bushings between the inserts and the base, as a safeguard against loosening of the screws. By rotating the bracket on its mounting screw and moving it along its slot, the contact assembly can be made either normally open or normally closed. The moving contacts are mounted on a Micarta insulation plate which is secured to the threaded end of the plunger shaft by a nut. The front edge of this insulation plate operates the indicator. The rear portion of the plate is slotted and a post screwed to the frame passes through this slot to prevent the plate from rotating. The moving contacts are double-faced so that they can be "make" or "break" and are connected to the base terminals by flexible leads. All contacts are pure silver. The contacts will carry 5 amperes continuously, and will interrupt 5 amperes at 115 volts A-C, or 1 ampere at 125 volts D-C.

The mechanical operation indicators used on these relays are shockproof, and can be used to indicate on the up stroke or down stroke of the plunger. The indicator is reset by pulling out the knurled stud which projects through the cover nut. The indicator should be reset after each relay operation because
* otherwise there may be a one or two percent decrease in the operating value of the relay. The operation indicator is assembled at the factory to indicate on the up stroke of the

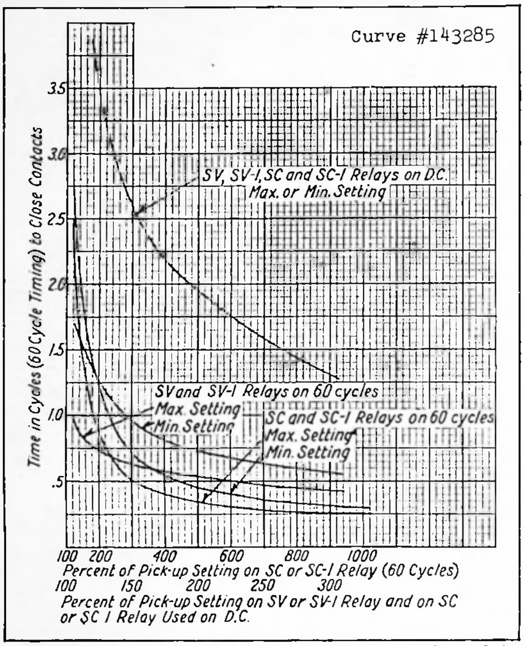


Fig. 7—Typical Time Curves For The Types SC And SV Relays (Using Flux Shunt For Pick-Up Adjustment).

plunger, but by removing the two mounting screws which fasten the indicator to the main frame, turning the indicator bracket around and at the same time swinging the indicator flag 180° about its shaft, the indicator can be set to indicate on the down stroke of the plunger. The rivet weight must be removed from the indicator flag and the latch screen turned around to complete the assembly.

In certain applications, an extremely wide range of current adjustment is desirable, and certain styles of SC and SC-1 relays have been provided with tapped coils to meet this requirement. The coil taps are brought out to a tap block mounted on the lower end of the relay frame or on the relay sub-base, depending on the type of case used. The connector plate on the tap block is marked with the minimum pick-up value of each tap, and the shunt is adjusted in the usual manner to obtain any pick-up setting between taps. The scale plate is not calibrated for the relays with tapped coils, as there is not sufficient space for marking a scale for each tap. However, the scale plate is supplied in order that a customer may mark on it the individual relay setting or settings if desired.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs for the standard cases and the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. Either of the studs or the mounting screws may be utilized for grounding the relay. The electrical connections may be made direct to the terminals by means of screws for steel panel mounting or to terminal studs (furnished on request when ordering the relay) for ebony-asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

* All contacts should be cleaned periodically. A contact burnisher S#182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

Several factors may affect the drop-out ratio of the relay. Whatever affects the ratio does so because either the drop-out or pick-up or both are affected. Obviously, incorrect assembly or interchange of parts, such as the use of the SC plunger with the SV core tube, will alter the electrical characteristics. However, the factor most likely to be

CHARACTERISTICS OF TYPES SC AND SC-1 RELAYS

Type	Frequency	Range of Adjustment Amps.	Max. Amps. Continuous	Watts 5 Amps. 60 Cycles	V.A. at 5 Amps. 60 Cycles	Dropout Ratio-AC	Dropout Ratio-DC
SC	DC, 25 to 60 C.	.5-2	1.5	99	225	90-98%	65-80%
SC	DC, 25 to 60 C.	1-4	3	28	65	90-98%	65-80%
SC	DC, 25 to 60 C.	2-8	6	6.9	19	90-98%	65-80%
SC	DC, 25 to 60 C.	4-16	12	1.5	5	90-98%	65-80%
SC	DC, 25 to 60 C.	10-40	25	.24	.7	90-98%	65-80%
SC	DC, 25 to 60 C.	20-80	40	.07	.16	90-98%	65-80%
SC	DC, 25 to 60 C.	40-160	40	.03	.05	90-98%	65-80%
SC	DC, 25 to 60 C.	4-100*	10-15-20	1.7-0.6-0.18	5-1-0.2	90-98%	65-80%
SC-1	DC, 25 to 60 C.	.5-2	1.5	100	210	35-60%	25-40%
SC-1	DC, 25 to 60 C.	1-4	3	24	60	35-60%	25-40%
SC-1	DC, 25 to 60 C.	2-8	6	6	16	35-60%	25-40%
SC-1	DC, 25 to 60 C.	4-16	12	1.5	5	35-60%	25-40%
SC-1	DC, 25 to 60 C.	10-40	25	.25	.65	35-60%	25-40%
SC-1	DC, 25 to 60 C.	20-80	40	.07	.16	35-60%	25-40%
SC-1	DC, 25 to 60 C.	40-160	40	.03	.05	35-60%	25-40%
SC-1	DC, 25 to 60 C.	4-100*	10-15-20	1.7-0.6-0.18	5-1-0.2	35-60%	25-40%

* Coil has taps on which minimum pickups are 10 and 30 amperes.

CHARACTERISTICS OF SV AND SV-1 RELAYS

Type	Frequency (Cycles	Range of Adjustment Volts	Max. Volts Continuous	Watts at 115 V. AC (125 V. for DC	V.A. at 115 V.	Dropout Ratio
SV	60	70-160	160	3.4	7.3	90-98%
SV	50	70-160	180	2.8	6.1	90-98%
SV	25	70-160	200	1.5	2.5	90-98%
SV	DC	50-150	150	4.8		65-80%
SV-1	60	70-160	160	4.1	8.5	40-80%
SV-1	50	70-160	180	3.5	7.1	40-80%
SV-1	25	70-160	200	1.4	3.2	40-80%
SV-1	DC	50-150	150	4.8		25-40%

NOTES:--Standard current relays are calibrated on 60 cycles. This calibration is approximately correct for 25 cycle and DC applications, but there will be discrepancies of 10% to 15% at some points on the scale.

Values of watts and volt-amperes in the tables are average for various plunger and shunt position.

For the SC relay, volt-amperes for pickup at minimum setting are approximately 3.4 and 1.4 for 60 and 25 cycles. Watts at minimum setting are approximately 1.0, .65 and .57 for 60 cycles, 25 cycles and DC respectively. Multiply values by 16 for approximate burdens at maximum setting.

For the SC-1 relay, volt-amperes for pickup at minimum setting are approximately 3.5 and 1.3 for 60 and 25 cycles. Watts at minimum settings are 1.3, .7 and .57 for 60 cycles, 25 cycles and d-c, respectively. Multiply values by 16 for approximate burdens at maximum setting.

*The V.A. burdens of the SC and SC-1 relays at 3, 10 and 20 times minimum pickup current are approximately 31, 240 and 770 V.A. respectively.

Dropout ratio varies somewhat with pickup adjustment but will be approximately constant for any given pickup setting. Limits in tables include variables such as friction and other individual relay variations.

Maximum continuous volts given for the SV and SV-1 relays for A-C are for the relay set for minimum pickup. With the relay set for maximum pickup the continuous voltage can be increased 10 to 20%.

encountered in service is friction. This may be due to dirt or foreign material between the plunger shaft sand its bearings, to excessive pressure of the indicator screen on the indicator, or to leads so mis-shaped that they tend to rotate or tilt the moving contact insulation plate with appreciable force.

* In order to remove the plunger and shaft assembly, it is necessary to remove the setscrew and nut at the top of the shaft. The spool-shaped bushing assembled on the upper end of the plunger shaft has a portion of its center section machined off so that the shaft is exposed at this point and can be prevented from turning by gripping shaft and bushing with a pair of longnose pliers while removing the set screw and nut. Then by pressing down with the fingers on the upper end of the shaft, the lower split sleeve which retains the lower bearing will be forced out of the threaded tube, the bearing will drop out freely, and the upper split sleeve will be forced out far enough to permit grasping it for removal. The shaft and plunger assembly then can be removed.

The shaft and plunger assembly should be handled carefully to avoid bending the shaft or damaging the bearing surfaces. The shaft should never be gripped on its upper bearing surface, below the spool-shaped bushing, when loosening the nut and set screw, as this would almost certainly damage the bearing surface. The shaft bearing surfaces should not be cleaned or polished with any abrasive material, as the abrasive particles might become imbedded in the shaft and cause difficulty later. The plunger shaft and bearings may be cleaned by wiping them carefully with a clean, lintless cloth. This may be moistened with benzene or some other cleaning solvent if necessary. Use no lubricant on the plunger shaft or bearings when reassembling the relay, since this will eventually become gummy and prevent proper operation. It is recommended that the shaft be cleaned at intervals of approximately * two years. When replacing the lower bearing and the split sleeves, the shorter sleeve (assembled below the bearing) should be pushed in until it is flush with the end of the threaded tube.

The mounting holes in the operation indicator screen are slotted so that its position can be adjusted. For relays in which the moving contacts are not latched in the operated position, the screen should be so located that the indicator positively enters the screen opening when the contacts barely touch. For latch-type relays, the screen should be so located that good contact is still obtained when the relay is de-energized. The pressure of the screen against the indicator may be adjusted by bending the screen between its lower end and the large elongated hole. This pressure should be such that the indicator will be held at any further position to which it is moved after entering the screen opening. However, the minimum amount of pressure necessary to obtain this adjustment should not be exceeded appreciably, since the pick-up value, and consequently the ratio, will be affected. The purpose of this pressure is to eliminate indicator rattle which might otherwise occur under certain energized conditions.

The moving contact leads pass through insulation sleeves assembled on the shanks of the terminal clips which are attached to the base terminals. These sleeves are notched at their upper ends, and the notches are toward the center of the relay. The leads are bent at approximately a right angle where they pass out through the notches, which aids in preventing them from coming into contact with the stationary contact brackets. Figure 11 shows properly coiled and assembled moving contact leads.

Although the moving contact leads are very flexible, if the leads have been pulled out of their original shape by handling they may exert sufficient side pressure on the shaft bearing or twisting force against the guide post to cause appreciable friction and wear. If this condition continues for a long period of time, the resulting wear may affect the relay calibration or the dropout ratio noticeably. In extreme cases the wear may progress to a degree which may occasionally cause failure of the plunger to drop down when the relay is de-energized.

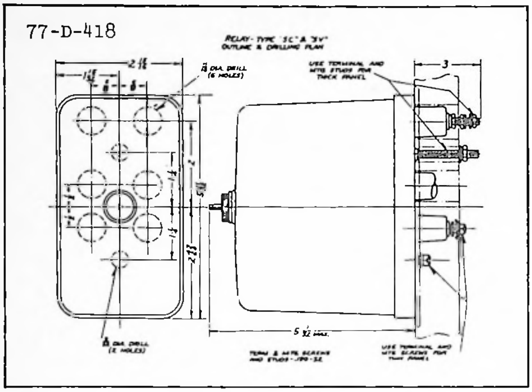


Fig. 8—Outline And Drilling Plan For Relays In The Small Glass Case. For Reference Only.

Correct shaping of the leads is not difficult, and they may be checked readily by removing the guide post and the nut at the top of the shaft. The plunger should be held in the raised position, either by energizing the relay or by pressing lightly against the collar under the insulation plate after raising the plunger manually. With the plunger raised, the insulation plate should be oscillated slightly in a horizontal plane by twisting it horizontally and releasing it. If in several trials the plate comes to rest with the center line of the contacts approximately parallel to the base and with its mounting hole fairly well centered with the end of the shaft, if the plate does not tip appreciably, and if the leads have a safe clearance to the stationary contact brackets, the leads are properly shaped.

If this check shows that re-shaping is necessary, it may be possible to obtain sufficient correction by bending the leads sharply where they emerge from the insulation sleeves. One or two pairs of tweezers are convenient tools for re-shaping the leads. If it is necessary to re-coil the leads, they should be wound around a rod having a diameter of approximately 5/32". The coils then should be stretched out just enough to avoid side pull or twisting force on the plunger assembly.

In all relays except the SV-1 relay for A-C, if the stationary contacts are assembled so that they close when the relay is energized, they should be located so that they barely touch the moving contacts when the latter are 5/32" above the de-energized position. The moving contacts can be held in this position while the adjustment is being made by inserting a 5/32" spacer between the shaft collar

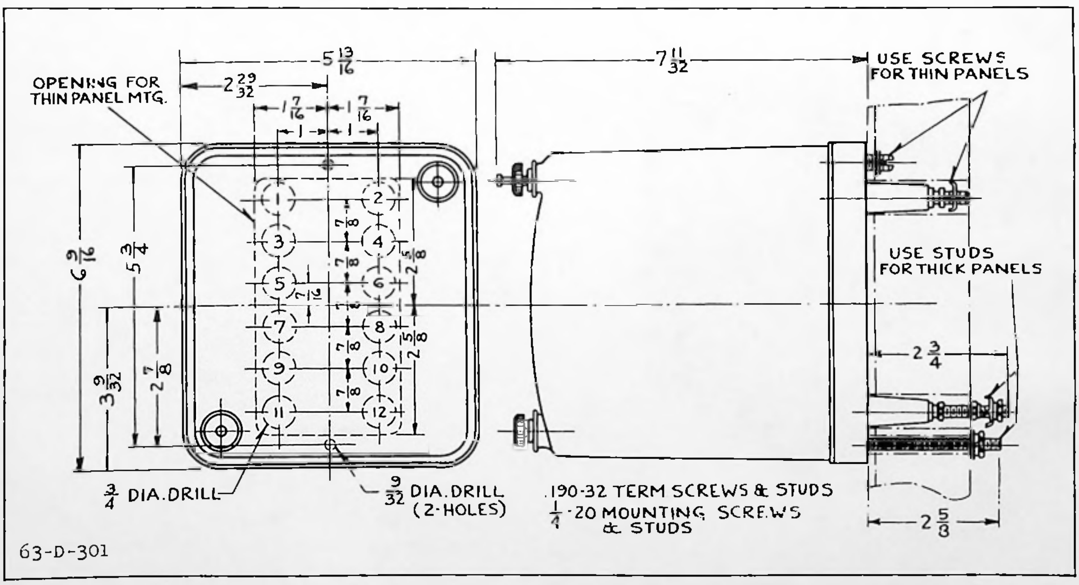


Fig. 9—Outline and Drilling Plan For The Relays In The Standard Case. See The Internal Schematic For The Terminals Supplied. For Reference Only.

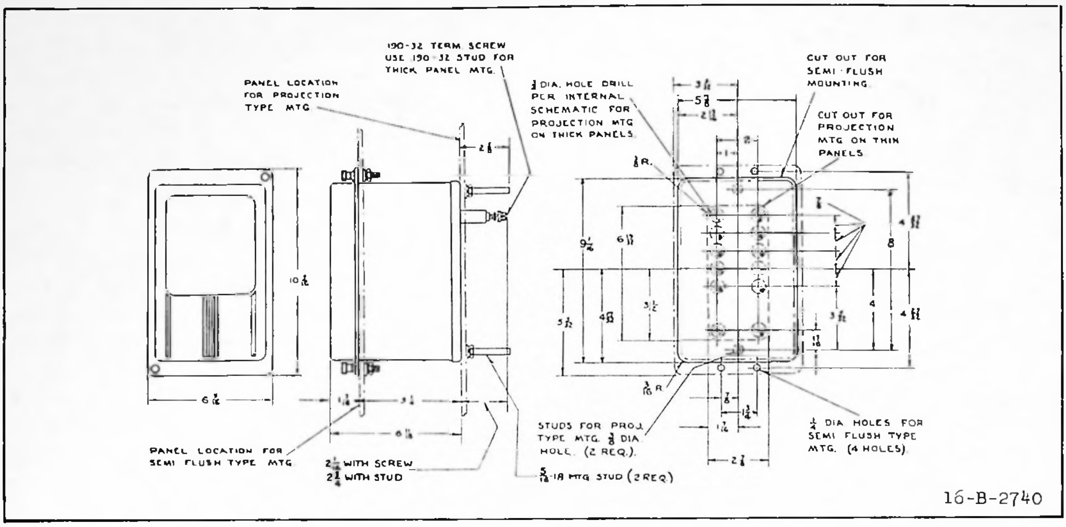


Fig. 10—Outline And Drilling Plan Of The Relays In The S-10 Semi-Flush Or Projection Type FT Flexitest Case. See The Internal Schematic For The Terminals Supplied. For Reference Only.

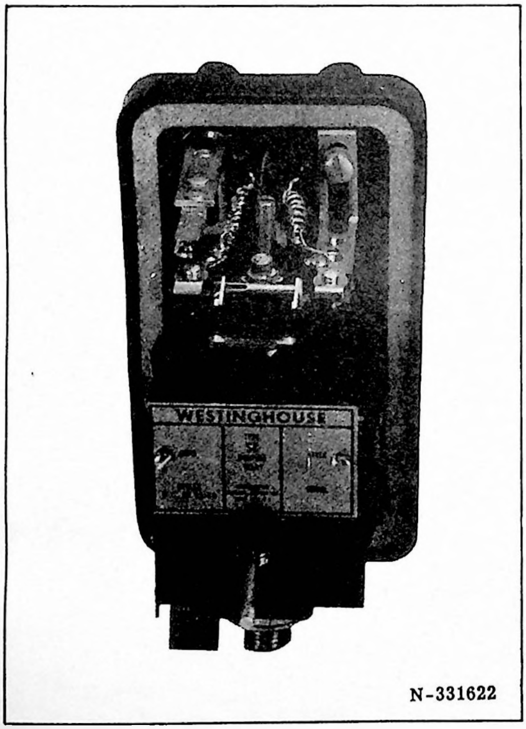


Fig. 11—View Of Type SC Relay Showing Correct Shaping Of Moving Contact Leads.

and the top of the core. This dimension should be 3/16" on the SV-1 relay for A-C. Both contacts should touch at the same time when the plunger is raised. When the plunger is moved upward against its stop, there should be a slight deflection of the stationary contact stop springs, but this should not exceed 1/32". When the stationary contacts are reversed so that they are closed when the relay is de-energized, they should be located so that they just touch the moving contacts when the latter are 1/32" above the de-energized position. On some relays it may be found that when the contacts are used in this position the relay may operate at values a few percent below the scale markings. The adjustments specified for the stationary contacts are important. Failure to observe them may cause improper relay operation, either directly or after a period of service. Contact position should not be used as a means of altering the ratio of dropout to pickup.

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete name-plate data.

Instructions for ON and OFF Delay Solid State Timer Attachment for BF Relay, Style 506C113G05, Cat. BST-OF; and Style 176C332G01, Cat. BST-ON

I.L. 13672A
File 16-300

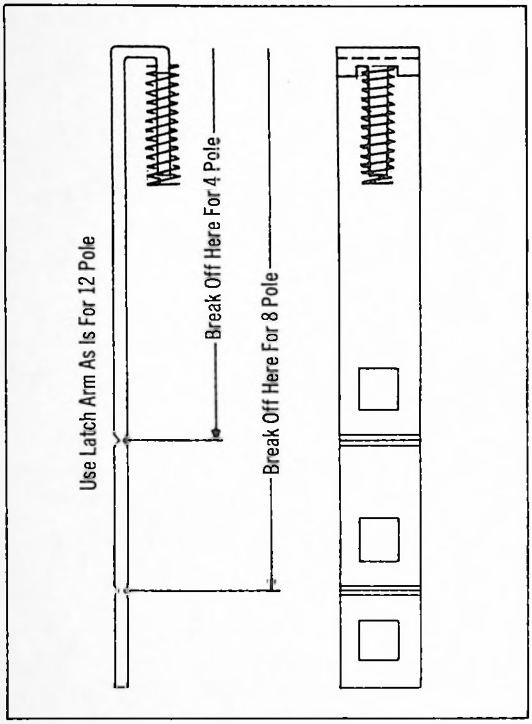


Figure 1 - Mounting Brackets

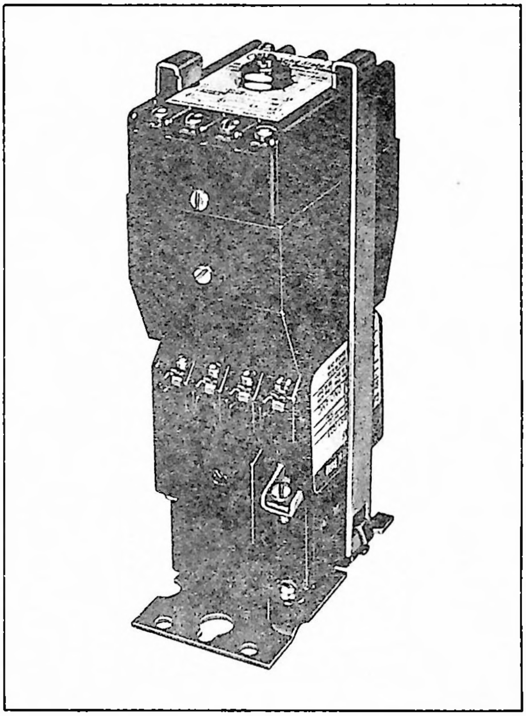


Figure 2 - Timer Attachment

Operation

The Westinghouse ON and OFF Delay all Solid State (no moving parts) timer attachments have 1 NO contact with an adjustable time delay. Designed to be mounted on, and used in conjunction with, Westinghouse type BF relays, they provide accurate reliable timing in a minimum of panel area.

Installation

The Westinghouse timer attachment mounts on the BF relay cover as shown in Figure 2.

Mounting brackets are for the 12-pole relay and can be modified to fit the 4 or 8 pole relay by removing the bottom section as shown in Figure 1. Using the proper size mounting brackets as shown in Figure 1 (when breaking off the end of the arm, we recommend holding the portion to be used with a pair of pliers and bend the parts to be removed), hold the attachment in place and fasten it to the relay with the mounting brackets. Check to determine that the latch mounting brackets are securely fastened to the baseplate mounting hooks. Prior to mounting the attachment, wire the BF relay as desired.

The attachment is then wired in accordance with Figure 3 or 4, depending upon type.

Effective April, 1968 Supersedes I.L. 13672 dated August, 1967

Calibration

Adjust the self-contained adjustment screw with a screwdriver until the required time delay is obtained. Turning the adjustment screw clockwise increases the time delay; turning the screw counterclockwise decreases the time delay. Accuracy of the time setting must be checked by applying power to the attachment. Initiating voltage must be supplied to the input terminals through the user's initiating contact(s). This attachment is designed for billions of operations when operating a BF relay. Applying this relay in excess of its rating can cause failure. If currents in excess of this value could occur in the output circuit, we suggest adding a series fuse having an I^2T rating equal to or less than 0.5 amp^2 sec.

The time sequences of operation are shown in the Figures 5 and 6.

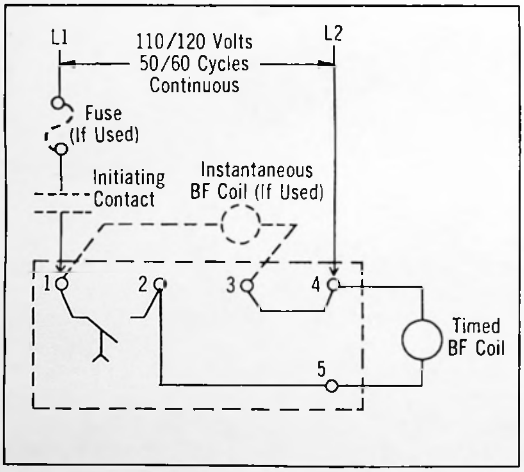


Figure 3 - ON Delay Wiring Diagram

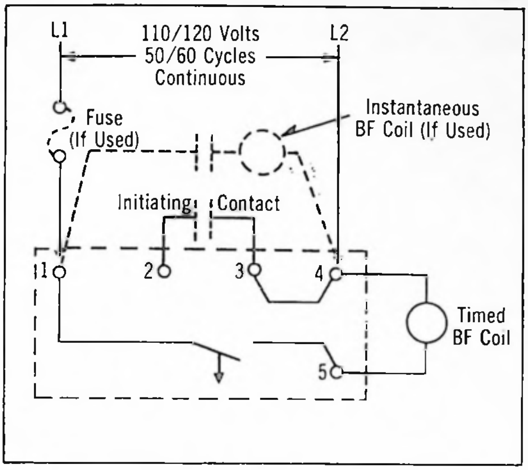


Figure 4 - OFF Delay Wiring Diagram

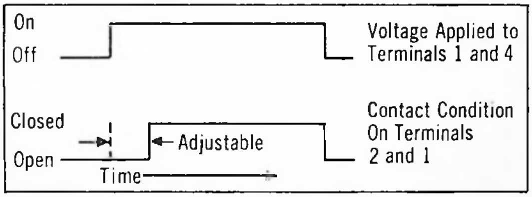


Figure 5 - ON Delay Timing Sequence

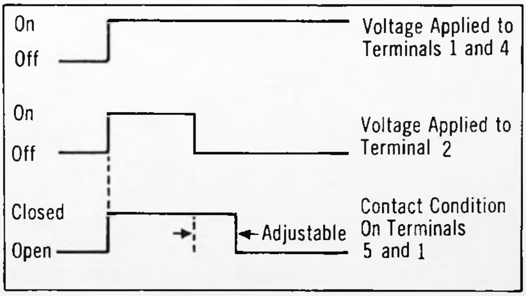


Figure 6 - OFF Delay Timing Sequence

Instructions For Latch Attachment For 4 Pole BF Relay

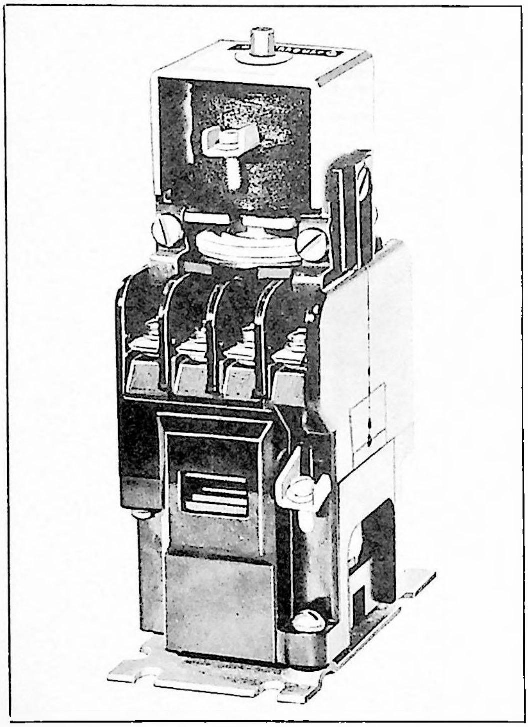


Fig. 1 Latched 4 Pole BF Relay

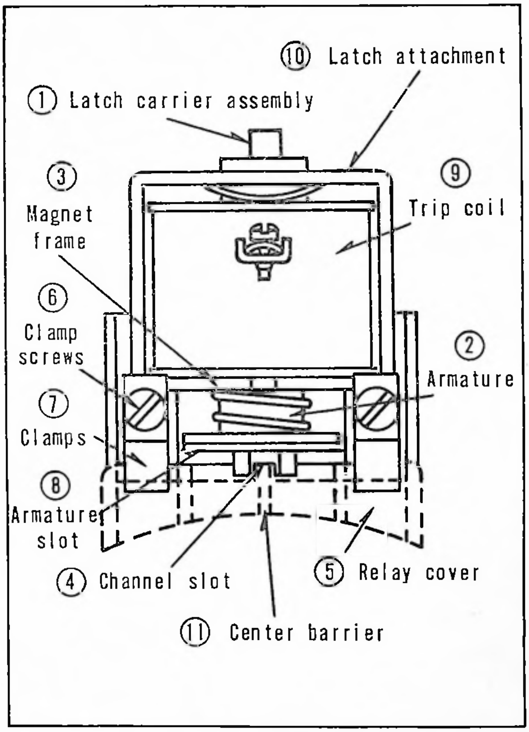


Fig. 2 Parts Identification

The Westinghouse memory latching attachment can be field-mounted on a 4 pole BF Relay at any time, increasing the freedom for both design engineers and panel assemblers. No special provisions need be made as the regular base drillings can be used. The trip coil is equipped with captive clamps and is continuous rated.

Unlatching requires 24 volt amps a-c open gap and closed gap requires 7 volt amps. Burden is four watts.

The latch may be latched or unlatched manually.

Installation

The Westinghouse BF latch attachment mounts on the top of the BF Relay cover as shown in Figures 1 and 2. Prior to mounting, loosen clamp screws (6) two or three turns and remove any thick nameplates or foreign objects from the BF Relay mounting surface.

1. Push the armature (2) up to the magnet frame (3). Holding the latch carrier assembly (1) in its outermost position, place the latch attachment (10) on the relay cover, being careful to set the channel slots (4) over the center barriers (11) of the relay cover (5).

2. Tighten clamp screws (6) so that all four clamps (7) engage the relay cover as shown in Figure 2.

Effective February, 1966. Supersedes I. L. 13015, dated August, 1962

Operation : Testing the Latching MANUALLY

1. Push the latch carrier (1) in to its innermost position. The relay will latch and remain closed. In this closed position the latch carrier will have no more than 1/32" play.

2. To unlatch relay, move the armature (2) to the magnet frame (3) by inserting a screwdriver in the armature slot (8). This movement permits the relay to return to its original position.

Testing the Latching ELECTRICALLY

1. Energize the latched relay. The latch carrier assembly (1) will follow the relay motion and, on removal of voltage, will keep the latched relay closed.

2. Energize the trip coil (9). The latch relay armature (2) will move to the magnet frame, returning the latch carrier assembly (1) to its original position and unlatching the latched relay.

Westinghouse Electric Corporation
Standard Control Division, Beaver, Pa.

Printed in U. S. A.

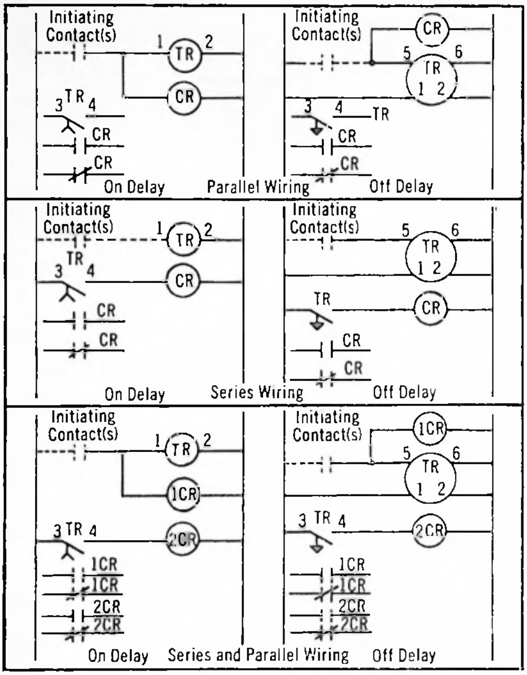


Figure 2 – Wiring Diagrams

2. In series with the relay coil thus providing many timed contacts. (See Figure 2)
3. In series and in parallel with the BF relay coils thus providing many timed and many instantaneous contacts. (See Figure 2)

In all cases operating voltage must be supplied to the initiating terminals (1 and 2 for the ON delay or 5 and 6 for the OFF delay) through the user's initiating contact(s).

Calibration

After the wiring is complete calibrate the unit as follows.

On Delay

Adjustment for time is accomplished in two steps:

1. Select the range (i.e., .1 to 25 sec., etc.) which contains required time setting by placing a jumper on the appropriate terminals.

A jumper wire placed between the terminals listed below provides the following time range:

Jumpered Terminal Numbers	Time Range
5 to 7	.1 to 25 sec.

2. Adjust the potentiometer adjustment screw with a screwdriver until the required time is obtained. Adjustment is logarithmic; turning the adjustment screw clockwise increases the time delay, and turning the screw counterclockwise decreases the time delay. Accuracy of the time setting must be checked by applying power to the timer.

Off Delay

Adjustment for time is accomplished in two steps:

1. Adjust for the desired time delay by turning the adjustment knob. Adjustment is logarithmic; turning the adjustment knob in a clockwise direction increases the time delay, turning the adjustment knob in a counterclockwise direction decreases the time delay.

2. Check the accuracy of the setting by applying power to the timer.

Note: If the timer self-contained adjustment potentiometer *is not being used* be sure that it is locked in the maximum clockwise (remote) position.

Output Rating

BF Relay – a-c Contact Ratings

10 amperes non-inductive, 6 amperes inductive load at 120 volts a-c

60 amperes "make" and 6 amperes "break" inductive load at 120 volts a-c

Solid State Timer – 1 NO timed "solid state contact" rated at 2 amps continuous max. and 132V a-c max. In the event the "solid state contact" is used to energize a device that is physically activating a machine function, i.e. large solenoid, that has an inrush current in excess of 2 amperes, we suggest using a series fuse having an I^2 to rating of 3 amp^2 sec. or less (Bussman Limitation type KAA-2 or type GBB-2 or equivalent).

Westinghouse Electric Corporation
Standard Control Division, Beaver, Pa.

Printed in U.S.A.

Instructions for Solid State Timer-BF Relay Adapter

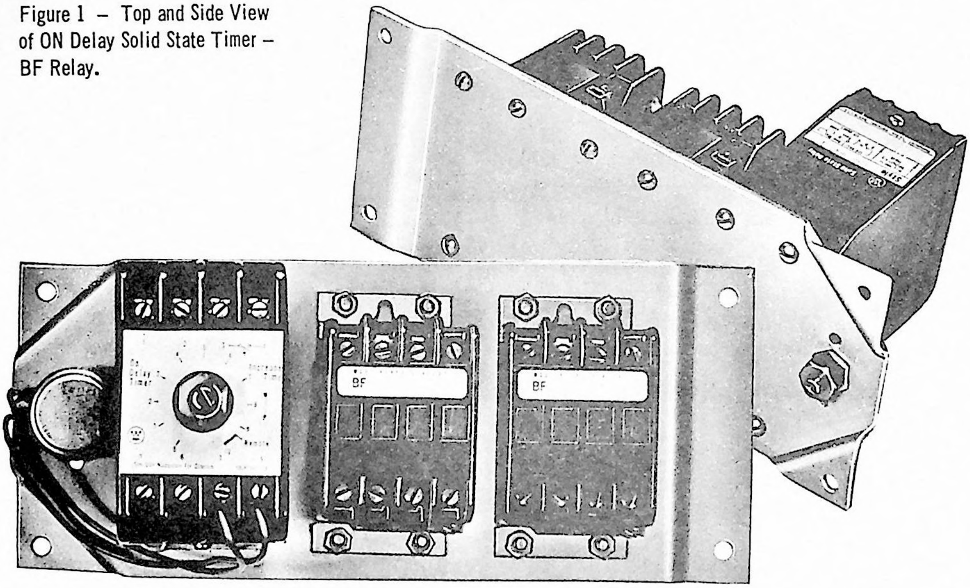


Figure 1 – Top and Side View of ON Delay Solid State Timer – BF Relay.

The Solid State Timer – BF Relay Adapter combines the reliability of solid state timing with the flexibility of multiple relay contact outputs. It is available in six preassembled versions all designed for use in 120 V a-c control circuits.

Style Number	Timer Action	Components
507C247G01	ON Delay	1 - mounting bracket assembly – 1 - S# 505C969G03 ON Delay timer
507C247G02	ON Delay	1 - mounting bracket assembly – 1 - S# 505C969G03 ON Delay timer – 1 - BF 11F Relay
507C247G03	ON Delay	1 - mounting bracket assembly – 1 - S# 505C969G03 ON Delay timer – 2 - BF 11F Relay
507C247G04	OFF Delay	1 - mounting bracket assembly – 1 - S# 506C245G05 OFF Delay timer
507C247G05	OFF Delay	1 - mounting bracket assembly – 1 - S# 506C245G05 OFF Delay timer – 1 - BF 11F Relay
507C247G06	OFF Delay	1 - mounting bracket assembly – 1 - S# 506C245G05 OFF Delay timer – 2 - BF 11F Relay

Installation

This adapter, as furnished, is suitable for flush mounting. If surface mounting is desired merely remove the adjustment potentiometer mounted on the mounting plate and use the self-contained timer potentiometer for time delay adjustment.

Wiring

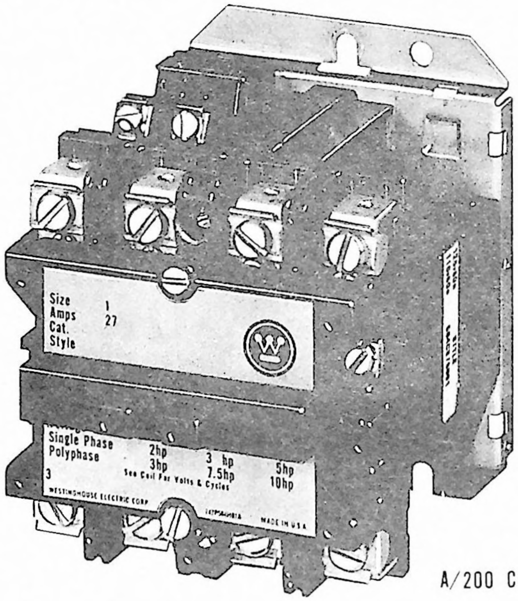
The timer can be wired to the BF relay(s) in three different ways:

1. In parallel with the relay coil thus providing one timed and many instantaneous contacts. (See Figure 2)

Effective February, 1967

Instructions for
A/200 Contactor, NEMA Size 00, 0, 1

I.L. 13144C
File 8200



A/200 Contactor: Size 00, 0, 1

The Westinghouse A/200 Size 00, 0, 1 Contactor has been designed to be applicable as the control for motor load circuits, resistance loads, interconnections of multi-speed motor windings, utilizing main pole combinations of 2, 3, 4 and 5 poles.

Contactor Identification

The A/200 Contactor complete is identified for ordering by Cat. No.

The coil style number, voltage, and frequency rating is marked on the side of the coil.

Coil

The A/200 Contactor is available with single or dual voltage coil. The contactor, when supplied with a dual voltage coil, is normally wired for the high voltage (HV) connection.

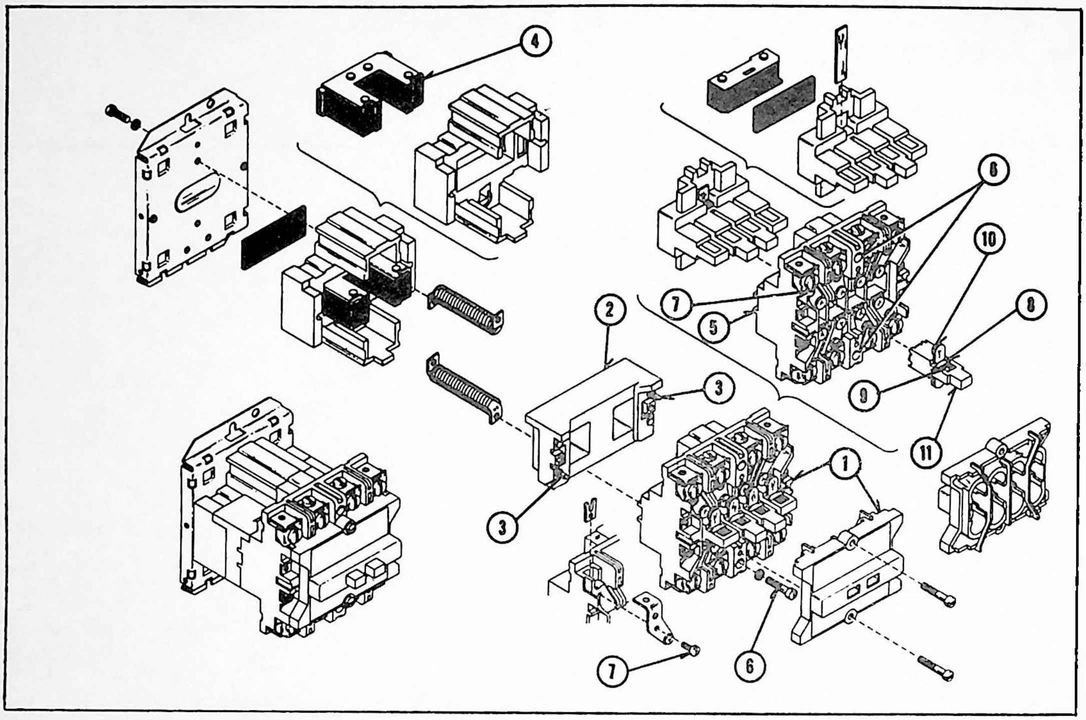
	Coil Volt-Amp Data - 60 cps.			
	2 & 3 Pole		4 & 5 Pole	
Voltage	Open VA	Closed VA	Open VA	Closed VA
110	160	25	200	30
220	160	25	200	30
440/600	160	25	200	30

Maintenance

Magnet and armature mating surfaces are self-aligning; no maintenance is necessary.

To remove contactor coil - loosen the two screws (6) recessed between the two center power poles and lift off the top section (1) of the contactor unit.

Effective April, 1968 Supersedes I.L. 13144B dated March, 1967



Parts Identification

The coil (2) will normally be lifted as a part of this assembly. Pull coil unit loose (disengage coil stabs) (3). If contactor has been installed it will be necessary to remove line leads and tilt the base assembly back over the load leads. A new coil is installed simply by placing it in position on the magnet (4) and replacing the top half of the contactor. Care should be taken to assure proper orientation of coil so keyway (5) will fit the top base section. After new coil has been installed by sure that the two recessed assembly screws (6) are tight.

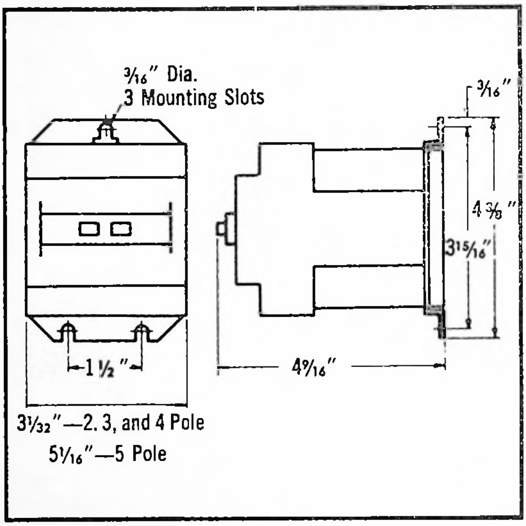
Current Carrying Parts are replaceable. The stationary contact and line or load terminal are parts of one assembly. This assembly may be changed by removing any leads and removing the screw fixing the strap (7) to the molded base. The bridging contact may be changed as follows:

1. Lift the keeper (8) and spring (9) as a group (preferably by using a flat tool such as a screw driver blade).

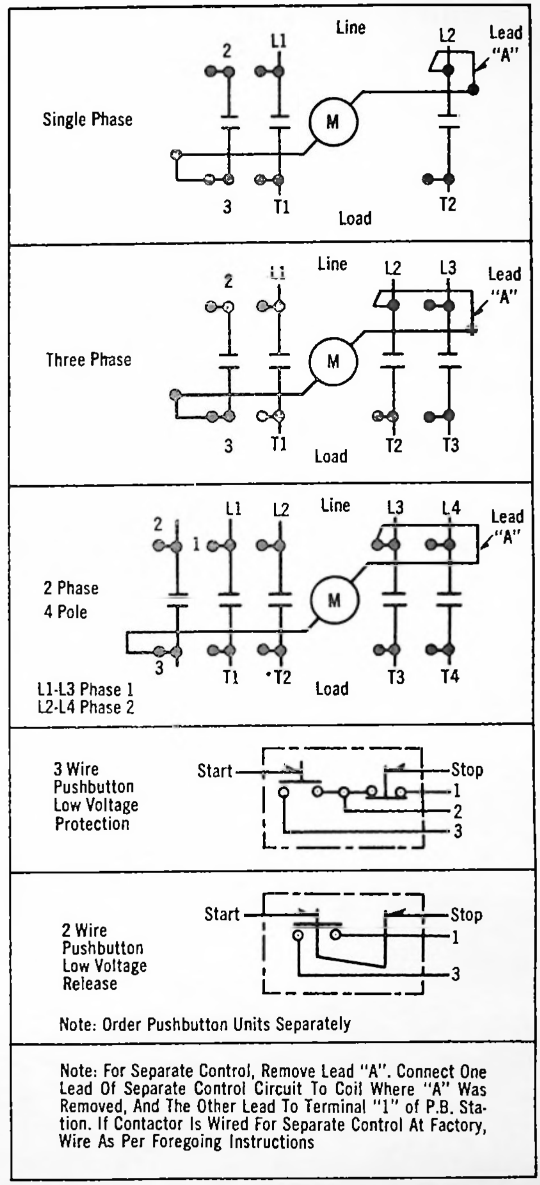
Renewal Part Kits		
Size 00	Two Pole Kit Three & Four Pole Kit	373B331G17 373B331G18
Size 0	Single Pole Kit Two Pole Kit Three & Four Pole Kit Five Pole Kit	373B331G01 373B331G02 373B331G04 373B331G05
Size 1	Single Pole Kit Two Pole Kit Three & Four Pole Kit Five Pole Kit	373B331G06 373B331G07 373B331G09 373B331G10
Kit includes moving and stationary contacts, contact springs.		
L-56 Electrical Interlock One Universal Interlock (NO and NC poles) S#503C782G01.		
Coil Order by style number, voltage and frequency.		

2. Rotate the bridging contact (10) approximately 45°.

3. Withdraw the bridge (10) from the cross-bar (11). New bridging contacts may be added by a similar process. CAUTION. All contacts must be changed as a group to avoid misalignment of contact.



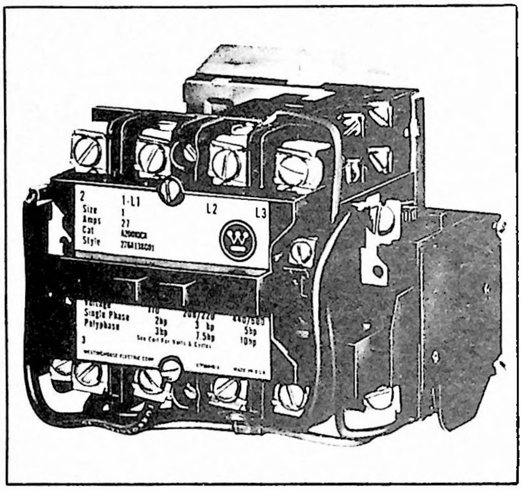
Dimension Drawings



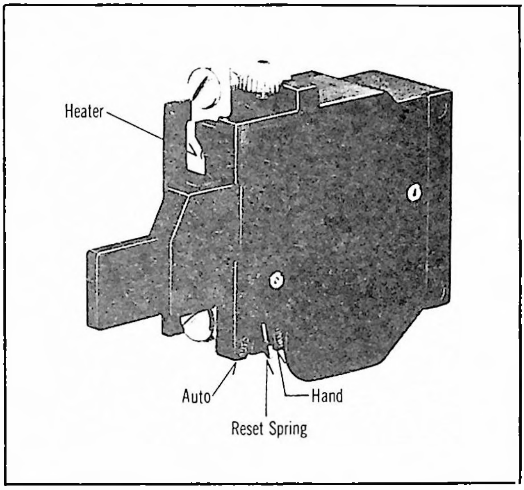
Wiring Diagrams

Instructions for A/200 Series, Sizes 0, 1, 1-1/2, Motor Controller with Single Pole Overload Relays

I.L. 13145-C
File 8200



A/200 Series, Motor Controller



Type AN11A Overload Relay

The A/200 Series Motor Controller, when wired will operate as a full voltage starter and will give protection against overload (but not against short circuit currents) when provided with overload heaters as listed in the Heater Application Tables or when used with any means of inherent protection activated by motor temperature.

The Motor Controller should be protected against short circuits by fuses or by a circuit breaker set at not more than four times the full load motor current.

The A/200 Series Motor Controller complete is identified by CAT. No.

The coil style number is marked on the end of the coil along with the voltage and frequency rating.

Coil

The A/200 Series Motor Controller is available with single or dual voltage coil.

The motor controller, when supplied with a dual voltage coil, is normally wired for the high voltage (HV) connection.

Table I Motor Ratings - Horsepower

NEMA SIZE	Three Phase			Single Phase			Current Rating Amperes	Coil Volt Amp - 60 Cy. 2, 3 & 4 Pole	
	110 Volts	220 Volts	440/600 Volts	115 Volts	230 Volts	440/600 Volts		OPEN VA	CLOSED VA
0	2	3	5	1	2	3	18	160	25
1	3	7-1/2	10	2	3	5	27	160	25
1-1/2	-	-	-	3	5	-	36	160	25

Effective October, 1968 Supersedes I.L. 13145B, dated March 1967

Overload Relays

The A/200 Series Motor Controller is normally supplied with non-compensated single pole overload relays, Type AN11A. This relay has an adjustable range of 85% to 115% of trip rating of respective heater, is equipped with a trip indicator, NC control contacts, and may be operated with either Hand or Automatic reset. A STOP function is not possible with this relay. See I.L. 13063 for more complete information.

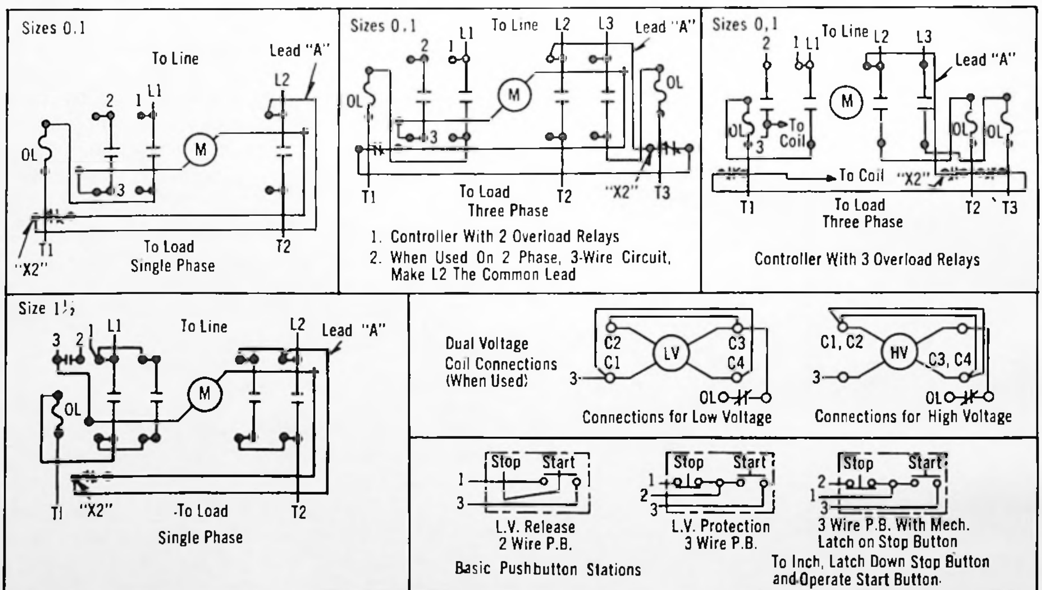
Type of operation is determined by the position of the control spring in, the slots provided in the base. On the "Auto" position the spring is in the front slot in the molded base and in the "Hand" position the spring is in the rear slot. Automatic should not be used with 2-wire master switch.

A temperature compensated relay, Type AA11A, is also available.

Heaters

Heaters are not included with the motor controller and must be ordered separately per the heater application table and the selection information listed below. When installing heaters be sure that connecting surfaces are clean and heaters are attached securely to the relay in the proper location with the screws provided. The trip rating of a heater at 40°C Ambient is 125% of the minimum full load current.

Heaters should be selected on the basis of the motor nameplate rating. The heater application table indicates the range of full load motor current to which a given heater may be applied. When motor and controller are in the same ambient the data listed in the table provide 40°C rated motors or those with a service factor of 1.15 to 1.25 with 115% to 125% protection. For 50°C or 55°C rated motors, those with a 1.00 service factor, or where a maximum of 115% protection is desired, select one size smaller

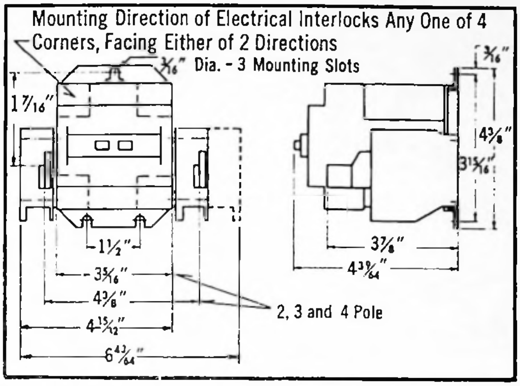


Notes:

1. For Separate Control, Remove Lead "A". Connect One Lead Of Separate Control Circuit To OL Relay Terminal "X2" Where Lead Was Removed And Other Lead To Terminal "1" Of PB Station Or Master SW. (If Starter Is Wired For Separate Control At Factory, Connect Control Supply Leads To Terminal "X2" And Terminal "1" Of PB Station
2. Customer Should Disregard All Schemes Except The One Used In Connecting His Equipment

Wiring Diagrams

Code Marking	Maximum Fuse Protection (Amps)	Full Load Current of Motor (Amperes) 40°C Ambient
HEATER APPLICATION TABLE		
H03	1	.29 - .31
H04	3	.32 - .35
H05	3	.36 - .39
H06	3	.40 - .43
H07	3	.44 - .48
H08	3	.49 - .53
H09	3	.54 - .58
H10	3	.59 - .64
H11	3	.65 - .71
H12	3	.72 - .79
H13	3	.80 - .87
H14	6	.88 - .96
H15	6	.97 - 1.06
H16	6	1.07 - 1.16
H17	6	1.17 - 1.28
H18	6	1.29 - 1.41
H19	6	1.42 - 1.55
H20	6	1.56 - 1.71
H21	6	1.72 - 1.87
H22	8	1.88 - 2.06
H23	8	2.07 - 2.26
H24	8	2.27 - 2.48
H25	9	2.49 - 2.72
H26	9	2.73 - 2.99
H27	12	3.00 - 3.28
H28	12	3.29 - 3.60
H29	15	3.61 - 3.95
H30	15	3.96 - 4.31
H31	15	4.32 - 4.71
H32	20	4.72 - 5.14
H33	20	5.15 - 5.6
H34	20	5.7 - 6.2
H35	25	6.3 - 6.8
H36	30	6.9 - 7.5
H37	30	7.6 - 8.2
H38	35	8.3 - 9.0
H39	35	9.1 - 9.9
H40	40	10.0 - 10.8
H41	45	10.9 - 11.9
H42	50	12.0 - 13.1
H43	50	13.2 - 14.3
H44	60	14.4 - 15.7
H45	60	15.8 - 17.2
H46	70	17.3 - 18.9
Above Heaters for use on Size 0		
H47	80	19.0 - 20.8
H48	90	20.9 - 22.9
H49	100	23.9 - 25.2
H50	100	25.3 - 27.6
Above Heaters for use on Size 1		
H51	110	27.7 - 30.3
H52	125	30.4 - 33.3
H53	125	33.4 - 36.0
Above Heaters for use on Size 1-1/2		



Dimension Drawing

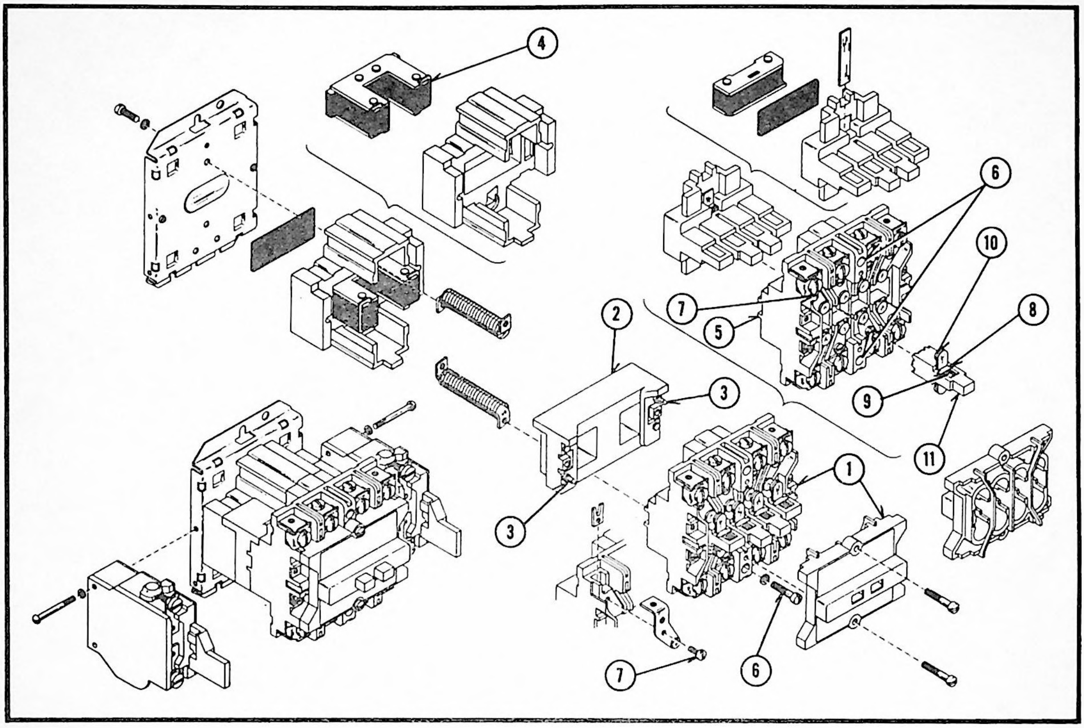
heater than indicated. When motor and controller ambients differ, select heaters from the table using adjusted motor currents as follows: decrease rated motor current 1% for each °C motor ambient exceeds controller ambient; increase rated motor current 1% for each °C controller ambient exceeds motor ambient. For temperature compensated overload relays select heaters according to the table and selection information above regardless of ambient. Protect the heater against short circuits by providing branch circuit protection per National Electric Code but not to exceed the maximum fuse ratings listed in the table.

A maximum of four auxiliary universal contact electrical interlocks, 503C782G01 may be added. I.L. 13134 gives more complete details for the electrical interlock.

Maintenance

Magnet and armature mating surfaces are self-aligning; no maintenance is necessary.

To remove operating coil - Loosen the two screws (6) recessed between the center power poles and lift off the top section (1) of the motor starter unit. The coil (2) will normally be lifted as a part of this assembly. Pull coil unit loose (withdraw coil stabs (3)). If motor starter has been installed and wired it will be necessary to remove line leads and tilt the base assembly back over the load leads. A new coil is



Assembly Parts

installed by positioning it on the magnet (4) and replacing the top section (press firmly in place before restarting screws). After a new coil has been installed be sure that the two recessed assembly screws (6) are tight.

Current carrying parts are replaceable. The stationary contact and line or load terminal are parts of one assembly. This assembly may be changed by removing any leads and by removing the screw (7) holding the strap to the molded base. The bridging contact is changed as shown below.

1. Lift the keeper and overtravel spring (8) and (9) (preferably by using a flat object such as a screw-driver blade).

2. Rotate the bridging contact (10) approximately 45°.

3. Withdraw the bridge from the crossbar (11).

New bridging contacts may be added by a similar process. CAUTION. All contacts must be changed as a group to avoid misalignment.

Renewal Part Kits		
Size 0	Single Pole Kit Two Pole Kit Three & Four Pole Kit	373B331G01 373B331G02 373B331G04
Size 1 and 1-1/2	Single Pole Kit Two Pole Kit Three & Four Pole Kit	373B331G06 373B331G07 373B331G09
Kit includes moving and stationary contacts, contact springs		

Instructions For
A/200 Series Contactor, NEMA Size 3, 4
For 2, 3, 4 and 5 Poles

I.L. 13238-A

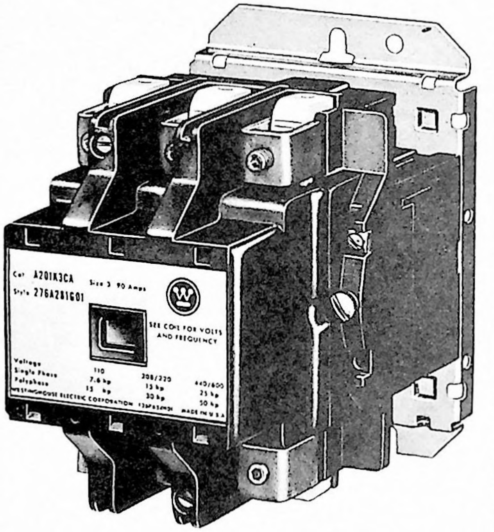


Figure 1 - A/200 Series Contactor, NEMA Size 3

The Westinghouse A/200 Series Contactor has been designed to be applicable as the control for motor load circuits, resistance loads, interconnections of multi-speed motor windings, utilizing main pole combinations of 2, 3, 4 and 5 poles.

TABLE OF RATINGS

Volts	Size	Rating Amps Tungsten Lamp Load	Continuous Current Rating Amps	Horsepower Ratings	
				Single Phase	Poly-Phase
110	3 4	60 120	90 135	7.5 hp -	15 hp 25 hp
220	3 4	60 120	90 135	15 hp -	30 hp 50 hp
440	3 4	60 120	90 135	25 hp -	50 hp 100 hp
600	3 4	60 120	90 135	25 hp -	50 hp 100 hp

COIL VOLT - AMP DATA 60 CYCLE PER SECOND

Volts	Size	2 and 3 Pole		4 and 5 Pole	
		Open VA	Closed VA	Open VA	Closed VA
110	3 4	625 625	50 50	825 825	75 75
220	3 4	625 625	50 50	825 825	75 75
440	3 4	625 625	50 50	825 825	75 75
600	3 4	625 625	50 50	825 825	75 75

The contactor, see Figure 1, has been designed in a layer form to make maximum use of the space it occupies. The main contacts, of copper alloy construction, with silver alloy contact buttons, are located at the front of the unit, for ease of inspection and for front accessibility of the Line and Load terminals. Straight thru wiring is featured for simplicity of design and maintenance. See Figure 2 for Wiring Diagrams.

Pressure-type connectors are provided on main and control terminals to permit use of either solid and stranded wire without soldered joints.

The molded structure supporting the main contacts and terminals is a track resistant material to insure against dielectric breakdown.

The magnet actuator is located behind the contacts, and is supported by damping pads to insure long operating life.

The U-I magnet assembly has a built in permanent air gap which prevents residual magnetic sticking.

Effective June, 1967 Superseded I.L. 13238, dated May, 1965
File 7100

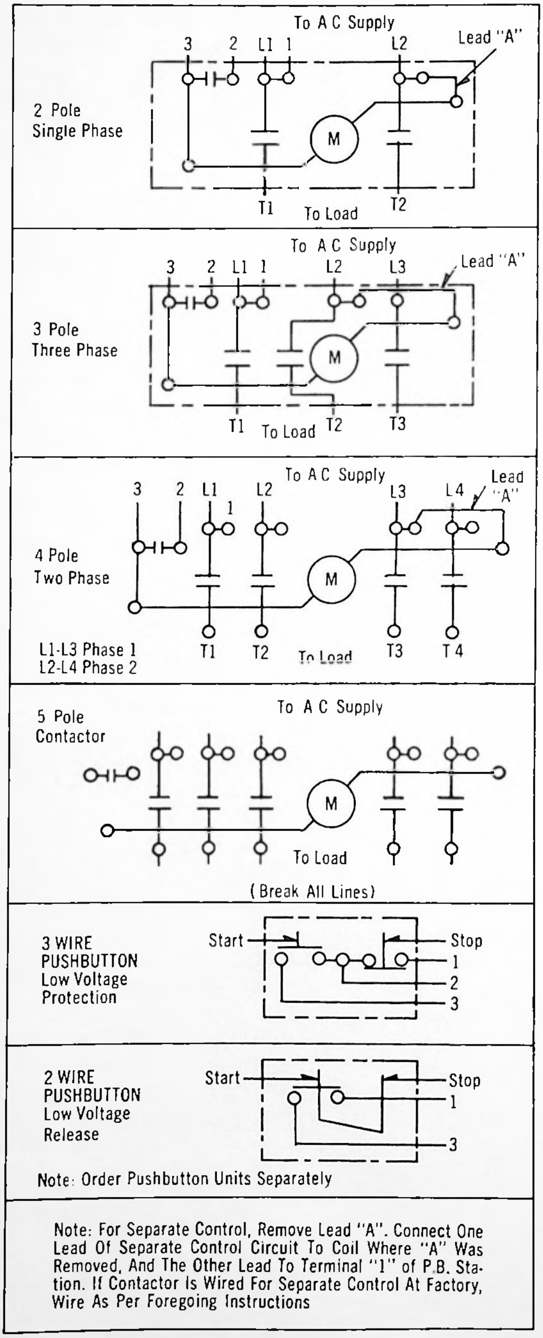


Figure 2 - Wiring Diagrams

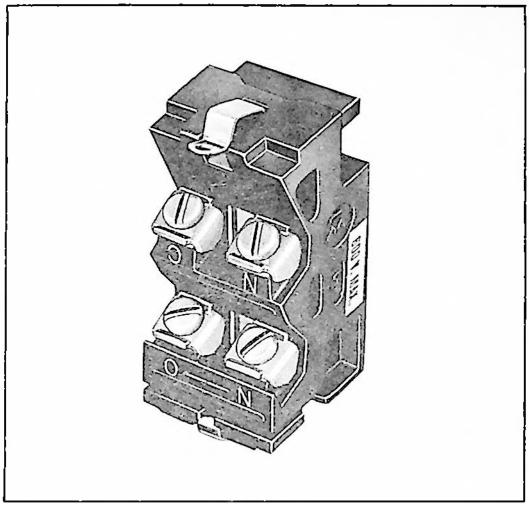


Figure 3 - L-56 Electrical Interlock

L-56 replacement interlocks provide universal poles (Normally Open and Normally Closed) as standard. See Figure 3.

Start and Stop Pushbutton Units

These units are supplied separately.

Maintenance

First Turn Off Power

To inspect contacts-

Loosen the two arc box assembly screws (7) located immediately above and below the nameplate, see Figure 5, and remove arc box (6). Contacts are visible.

To replace contacts-

After removing arc box (6), and having replacement contacts at hand, remove the moving contact carrier (5) by compressing the overtravel spring (10) and displacing carrier from crossbar (11). Stationary contact carriers (4) are removed by only loosening the retaining screw and sliding out the carrier.

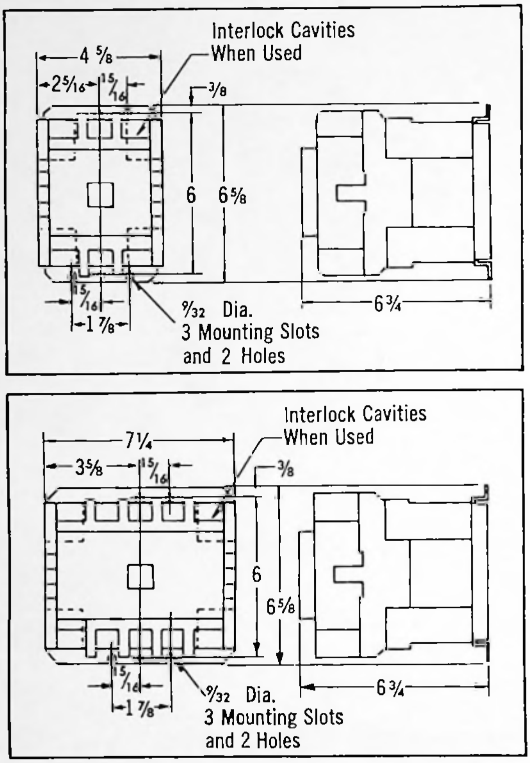


Figure 4 - Dimension Drawings

To replace contact carriers, reverse above procedure, making sure that stationary carriers (4) are secure, moving carriers (5) are free to move, overtravel springs (10) are seated and crossbar (11) moves freely when arc box (6) is in position.

The silver-cadmium oxide contact buttons need no dressing or lubricant throughout their life.

IMPORTANT - Replace all contacts as a group to avoid misalignment.

To replace the coil-

Loosen the assembly screws (8) Figure 5 located to the immediate left and right of the arc box (6).

Pull loosened upper base structure forward. Pull coil (1) from the upper base, plug in new coil, replace upper base structure and check interlocks for secureness when repositioning upper base.

Tighten assembly screws (8).

Magnet - Armature Assembly

Self alignment and permanent air gap features of the magnet-armature make replacement maintenance unnecessary. Mating pole face surfaces should be kept clean.

Contactor Identification

The A/200 Series Contactor complete is identified for ordering by:

Cat. No. (shown on carton and in catalog).

The coil style number, voltage, and frequency rating is marked on the side of the coil.

Renewal Parts		
Contact Carrier Kit		
Pole Combination	Style Number Size 3	Style Number Size 4
2 Pole	373B331G20	373B331G24
3 Pole	373B331G21	373B331G25
4 Pole	373B331G22	373B331G26
5 Pole	373B331G23	373B331G27
L-56 Electrical Interlock		
One Universal Interlock (NO NC poles) S#503C782G01.		
Coil		
Order by style number, voltage and frequency.		

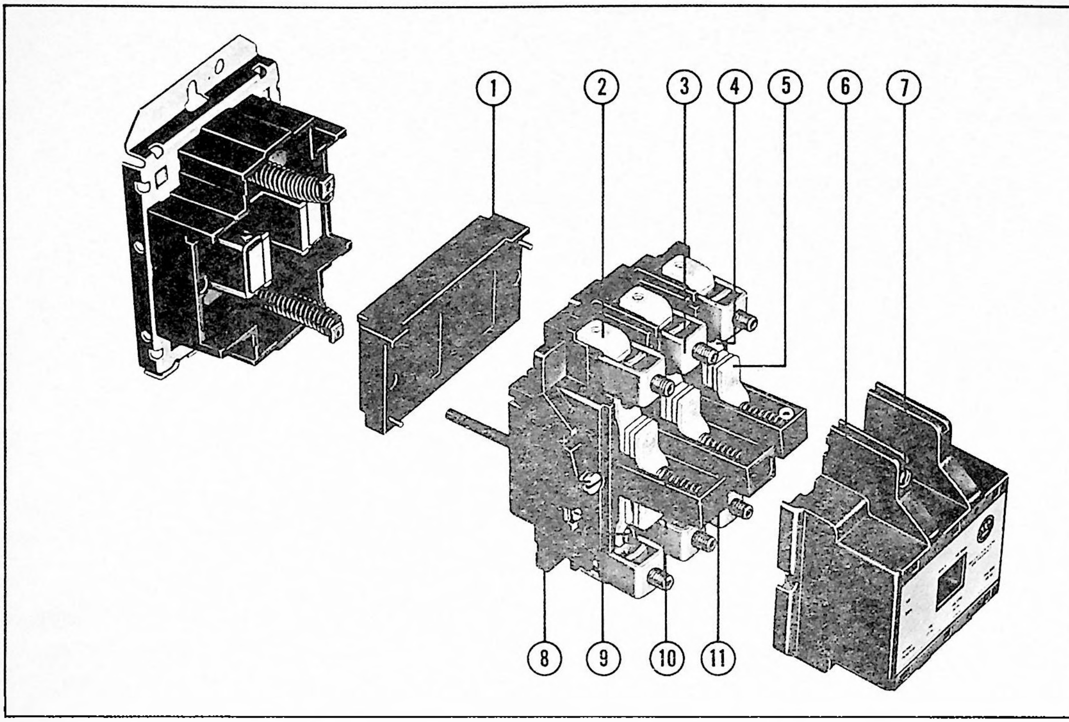


Figure 5 - Contactor Assembly

Instructions for Latch Mechanism for 3 Pole A/200 Contactors, Sizes 00, 0, 1, 2, 3 and 4.

I.L. 13619-A
File 8200

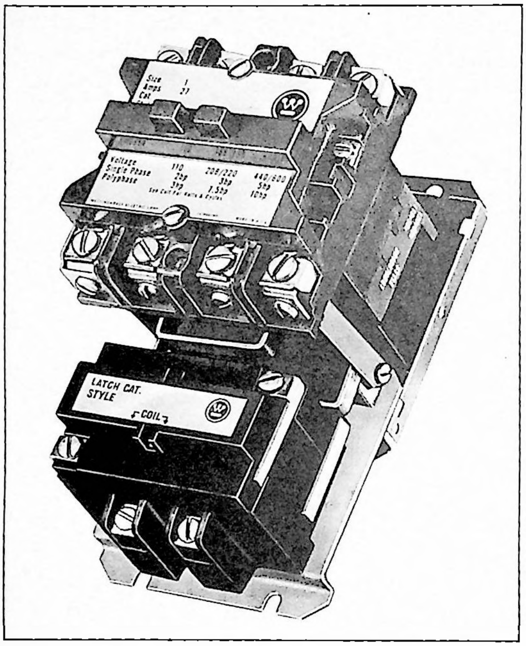


Figure 1 - *Latch Mechanism for A/200 Contactors, Sizes 00, 0, 1, 2, 3 and 4.*

The latch mechanism for A/200 Series contactors is a complete unit, easily attached to the contactor as a factory or field installation. This latch mechanism allows for manual or electrical operation in both latch and unlatch positions. The latch mechanism is identified by the catalog number shown on its nameplate.

Operation

When the contactor crossbar is closed (either manually or by energizing the coil) the biasing spring of the latch mechanism rotates the latch mechanism rocker to engage the contactor crossbar and hold it in the closed position. Unlatching is accomplished either by energizing the latch unit coil or by manually pressing on the center of the latch crossbar. This action causes the latching rocker to rotate and release the contactor crossbar. Outline details and mounting dimensions are shown in Figure 6. (Note that sizes 00, 0, 1 and 2 latched units have the same mounting as the respective vertical starter units.)

Installation

Install the latch mechanism as follows:

1. Refer to Figure 6 for mounting dimensions.

2. Position the contactor and latch units with the lower side of the contactor (side with three slots in the mounting plate) toward the latch unit as shown in Figure 2.

3. Insert the top portion of the latch rocker into the cavities at the lower side of the contactor, as shown in Figure 2.

4. Rotate the latch unit inward, and insert the extension of the latch baseplate into the recess provided in the contactor base.

5. Insert the two screws provided through the panel side of the contactor baseplate and tighten them securely.

6. Wire latch mechanism as required.

Adjustment

Normally it should not be necessary to adjust contactors supplied from the factory complete with latch mech-

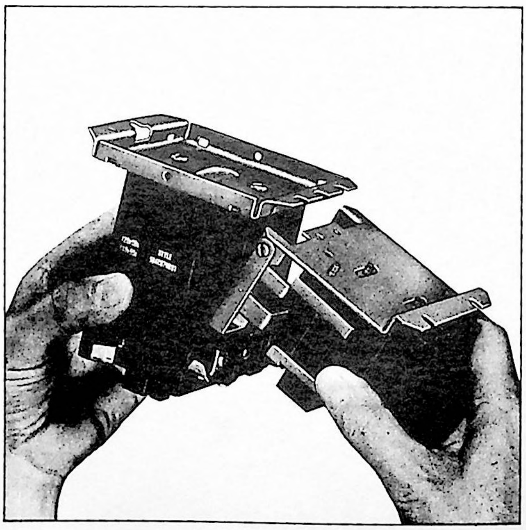


Figure 2 - *Assembly and Installation of Latched A/200 Contactors*

Effective July, 1970 Supersedes I.L. 13619 dated March, 1966

anism. However, when latch mechanisms are supplied separately for installation to the contactor in the field some of the following adjustments may be necessary:

1. Latch Clearance

A. Sizes 0, 1 and 2.

1. With the cross bar fully depressed, the clearance between the molded cross bar and the latching surface of both latch arms should be in accordance with Fig. 3.

2. If adjustment is required to obtain the latch clearance specified in Fig. 3, the latch arms may be slightly bent in the area illustrated in Fig. 3.

B. Sizes 3 and 4

1. With the cross bar fully depressed, the clearance between the molded cross bar and the latching surface of both latch arms should be in accordance with Fig. 4.

2. If the clearance exceeds that specified in Fig. 4, the latch arms may be slightly bent at the upper bend as shown in Fig. 4.

3. If the latch clearance must be increased to permit proper latching, pry up slightly under pivot screws with a large screwdriver per Fig. 4.

2. Latch Engagement

Adjust assembly of latch mechanism to contactor such that both latch arms engage the cross bar equally and as fully as possible in the latched position.

3. Unlatching

The contactor should readily unlatch when the molded trip bar of the latch mechanism is depressed. If this does not occur, adjust the arm extensions by prying up on them with a large screwdriver as illustrated in Fig. 5.

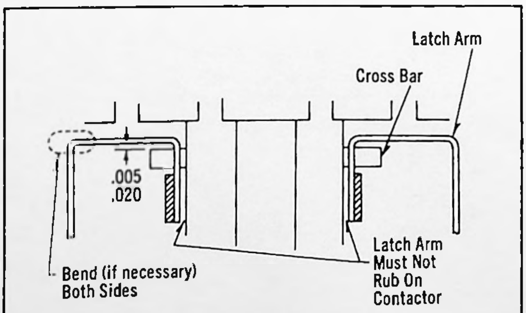


Figure 3 - *Sizes 0, 1 and 2*

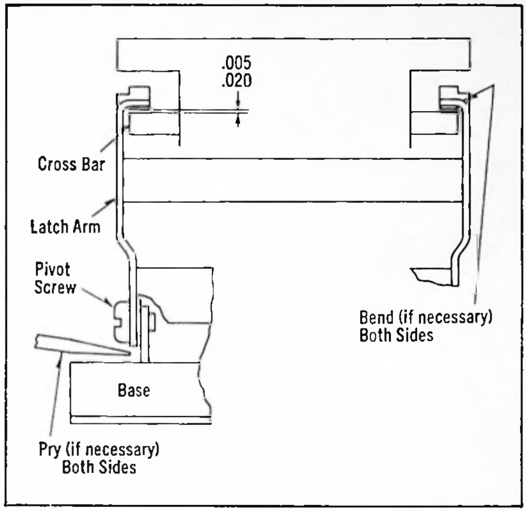


Figure 4 - *Sizes 3 and 4*

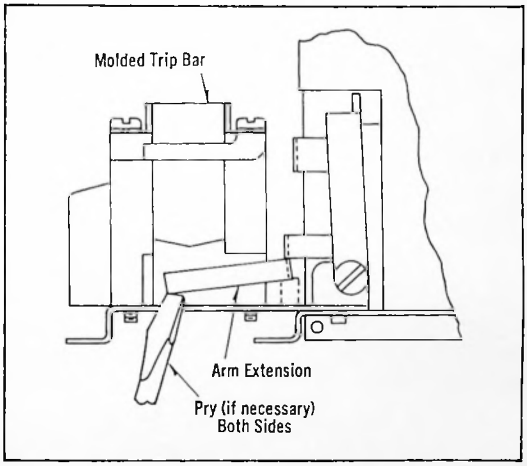


Figure 5 - *Unlatching, All Sizes*

Maintenance

Coil Replacement

Operating coils for the latch unit are continuous duty rated in all standard voltage ratings from 120V to 600V, 60 cycle. Order the correct replacement coil from Table 1. Replace the coil as follows:

1. Loosen the two pan-head screws on the upper right and lower left corners of the latch unit.

2. Remove the two screws holding the crossbar and coil to the base and withdraw the coil and crossbar as an assembly.

3. Remove the coil from the open end of the assembly.

4. Install the replacement coil and reassemble in the reverse order.

Table 1 - Replacement Coils For Latch Unit	
Rating*	Size 00, 0, 1, 2, 3, 4
120V, 60 cps	506C555G01
240V, 60 cps	506C555G03
480V, 60 cps	506C555G04
600V, 60 cps	506C555G05

*Other voltage and frequency ratings are available upon request.

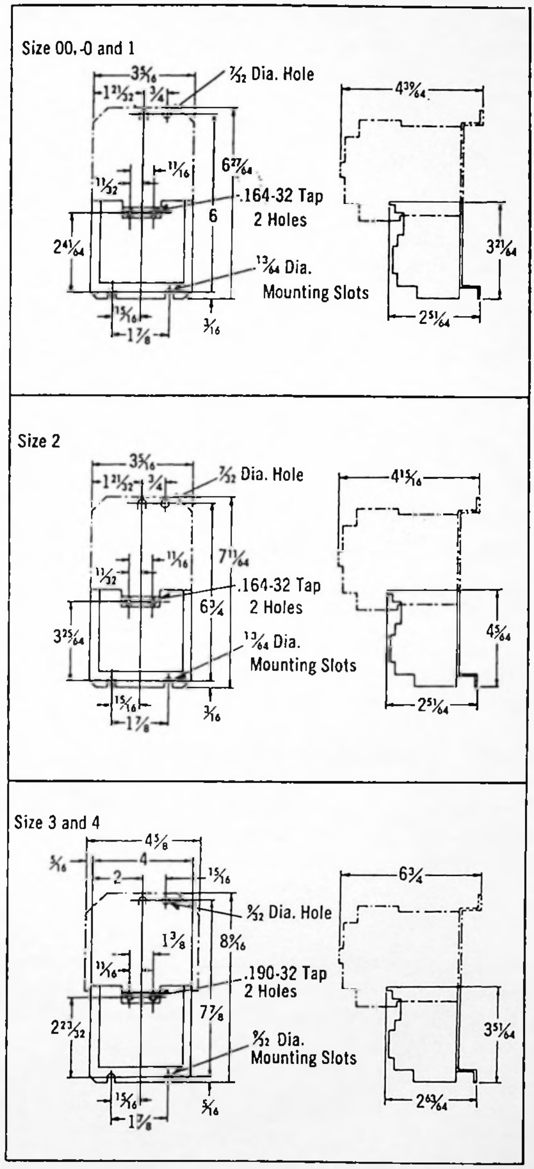


Figure 6 - *Mounting Dimensions for Latched A/200 Contactors*

Instructions For L-56 Electrical Interlock For A/200 Series Contactors and Starters

I.L. 13134A

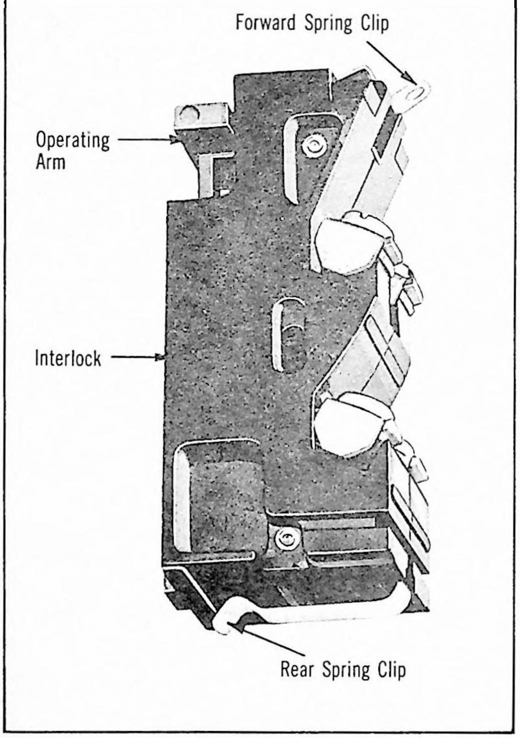


Figure 1 - L-56 Electrical Interlock

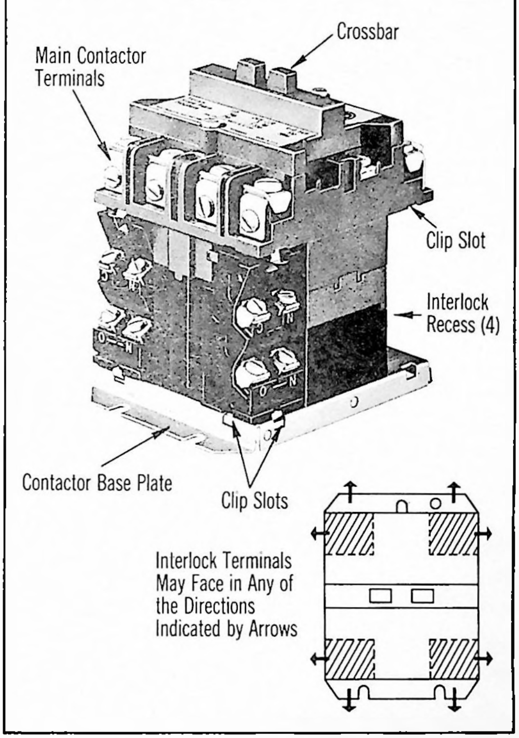


Figure 2 - Interlock Mounting Locations on A/200 Series, NEMA Size 1 Contactor

The L-56 Electrical Interlocks, with NO and NC terminal selection, are designed to be used as auxiliary contact blocks for the Westinghouse A/200 series of contactors are available with Universal Poles as standard replacement interlock units. The L-56 is a riveted unit and no service and replacement parts are required, nor should any oil or lubricants be used on any part of the interlock. The double break silver alloy contacts require no dressing.

The L-56 interlock is held in position by two attached spring clips, so no mounting hardware or tools are required.

Installation

A maximum of four L-56 interlocks can be mounted on each contactor, in recesses below the main contactor terminals at the corners of the base plate, facing any of the directions shown in Figure 2.

1. De-energize contactor and insure that all electrical power is off.

Referring to Figure 2 . . .

2. Select the position desired for mounting the interlock. Prepare to insert

March, 1967 Supersedes I.L. 13134 dated July, 1964
File 7100

the interlock with the wiring terminals facing away from the contactor base plate and the front of the interlock squared-up with the side of the contactor.

3. With the spring clips of the interlock aligned with the clip slots, slide the interlock into the recess allowing both spring clips to lock into their slots. The interlock will then be flush against the rear of the recess.

4. Check engagement of crossbar with operating arm by depressing crossbar manually to insure simultaneous movement of L-56 operating arm.

5. Internal wiring shown in Figure 3.

Removal

The interlock may be removed from the contactor by depressing the forward spring clip approximately 1/16 inch and pulling the interlock from the contactor recess.

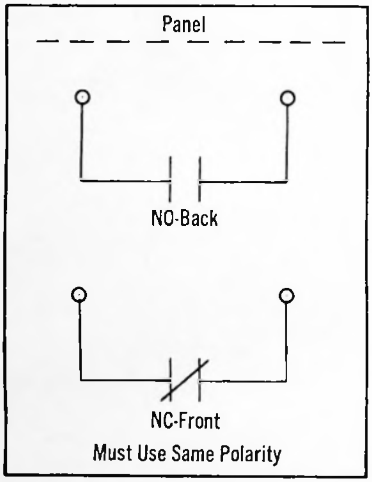


Figure 3 - Internal Wiring Diagrams

TABLE I—RATINGS—L-56 ELECTRICAL INTERLOCK			
SWITCHING RATINGS			
Load	Voltage	Current (Amperes)	
		Inrush	Normal
Inductive, AC	110-125	30	3
	220-250	15	1.5
	440-480	7.5	.75
	550-600	6	.6
DC	115-125		1.1
	230-250		.55
	550-600		.2

Ordering Data

One L-56 Electrical Interlock-Universal Poles-S# 503C782G01
1-NO and 1-NC contact.

Westinghouse Electric Corporation
Standard Control Division, Beaver, Pa.

Printed in U.S.A.

Instructions for Pole Adder, Sizes 0 and 1, Normally Open or Normally Closed, for Use With 3 Pole A/200 Contactor Or Horizontal Starter, Sizes 00 to 2

I.L. 13620-B
File 8200

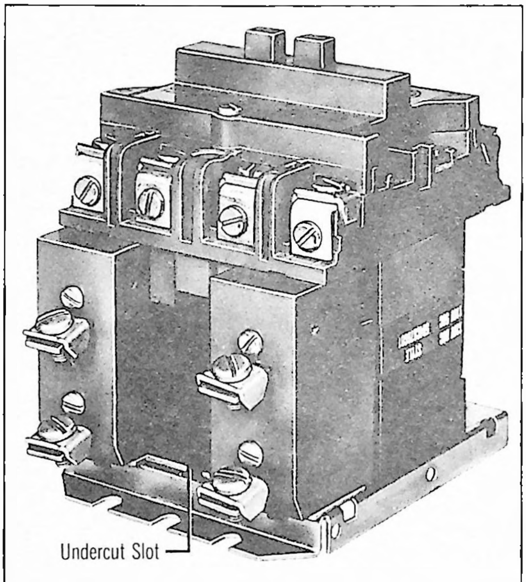


Figure 1 - Pole Adders Mounted on A/200 Contactor

Use of one or two normally open or normally closed pole adder kits greatly increases the application flexibility of the A/200 Sizes 00 to 2 contactors. These pole adder units are rated at 600 Volts a-c maximum with a continuous current rating of 18 amperes for the Size 0 unit and 27 amperes for the Size 1 unit.

As shown in Figure 1, the pole adders mount easily in the recesses provided on the load side of the contactor. All pole adder kits are identified by the catalog number stamped on the molded housing. Additional pole adder kits may be ordered as follows:

Catalog No.	Size	Continuous Current Rating
PNO-0 (Normally Open) PNC-0 (Normally Closed)	0	18 amps
PNO-0 (Normally Open) PNC-1 (Normally Closed)	1	27 amps

All pole adder kits are adaptable for right hand or left hand mounting by merely rotating the pole adder mounting plate.

For specific applications for pole adder kits, contact your nearest Westinghouse office or Standard Control Division, Beaver, Pennsylvania.

Installation

1. Adjust the metal mounting plate of the pole adder unit for left hand or right hand mounting by loosening the base mounting screw, and rotating the pole adder base plate to the desired mounting position. See Figure 2.

2. Slide the pole adder unit into the prepared recess on the load side of the contactor such that the extension of the pole adder base plate slips into the undercut slot of the molded base of the contactor. See Figure 1.

3. Insert the mounting screw through the contactor base plate from the panel side and tighten it securely into the pole adder base extension.

4. Remount the contactor onto its panel.

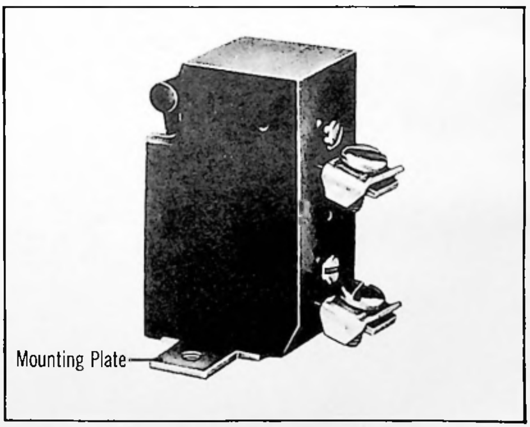


Figure 2 - Pole Adder Detail

Effective April, 1969 Supersedes I.L. 13620-A dated September, 1966

NOTE

When pole adders are used the normal mounting dimensions of the Sizes 0 and 1 contactors remain the same. However, a slight increase in panel area results because of the protruding pole adder terminals. (See Figure 3). It is suggested that the lower center mounting slot be utilized when two pole adders are used.

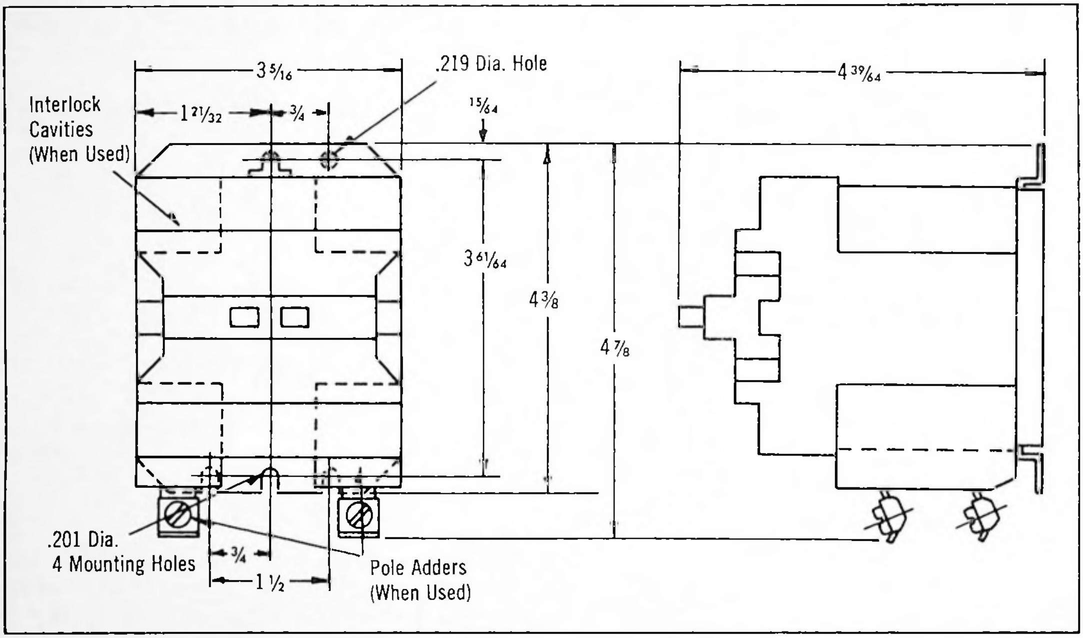


Figure 3 - Dimension Drawing

Westinghouse

A/200 Starters and Contactors, Sizes 1, 1½

General

This data presents the most frequently used renewal parts for sizes 1 and 1½ type A/200 starters and contactors of current design.

information on parts not shown may be obtained at the nearest Westinghouse office. Please advise style number of complete starter when requesting this information.

Style Numbers①

Starters

2-Pole

Non-Reversing	Reversing
276A137G01 to G10	276A653G01 to G10
276A142G01 to G10	764A610G01 to G10
276A609G01 to G10	277A611G01 to G10
276A610G01 to G10	....
276A611G01 to G10	....

3-Pole

Non-Reversing	Reversing
134A489G01 to G08	276A153G01 to G11
276A138G01 to G11	276A154G01 to G11
276A139G01 to G05	276A159G01 to G11
276A140G01 to G11	276A160G01 to G11
276A414G01 to G05	276A201G01 to G05
276A143G01 to G11	276A206G01 to G02
276A145G01 to G11	276A628G01 to G11
276A168G01 to G11	276A629G01 to G05
276A169G01 to G11	276A630G01 to G02
276A170G01 to G11	276A636G01 to G11
276A338G01 to G11	276A637G01 to G11②
276A612G01 to G11	276A638G01 to G11②
276A613G01 to G11	276A671G01 to G11
276A614G01 to G11	276A633G01 to G11
276A615G01 to G05	276A664G01 to G05
276A616G01 to G02	276A665G01 to G02
276A617G01 to G08	277A048G01 to G11
276A656G01 to G11	277A049G01 to G05
276A657G01 to G05	277A422G01 to G11
276A658G01 to G02	277A424G01 to G12
276A931G01 to G11	277A428G01 to G10
277A041G01 to G11	277A429G01 to G09
277A042G01 to G05	277A430G01 to G04
277A054G01 to G11	277A431G01 to G06
277A059G01 to G11	277A441G01 to G12
277A216G01	277A442G01 to G04
277A254G01 to G11	277A445G01 to G10
277A255G01 to G11	277A446G01 to G09
277A256G01 to G11	277A457G01
277A257G01 to G11	277A480G01 to G11②
277A258G01 to G02	277A481G01 to G11②
277A276G01 to G12	277A482G01 to G11②
277A277G01 to G12	277A484G01 to G11②
277A278G01 to G12	277A488G01 to G11②
277A279G01 to G12	277A489G01 to G11②
277A280G01 to G04	764A674G01 to G11
277A281G01 to G04	764A675G01 to G02
277A311G01 to G10	764A734G01
277A312G01 to G10	764A784G01 to G11
277A313G01 to G10	764A785G01 to G05
277A314G01 to G09	764A786G01 to G11
277A315G01 to G10	764A787G01 to G05
277A316G01 to G09	764A788G01 to G11
277A317G01 to G10	764A789G01 to G05
277A318G01 to G09	764A806G01 to G05
277A319G01 to G06	764A809G01 to G05
277A320G01 to G04	765A444G01
277A321G01 to G06	765A533G01 to G05
277A347G01 to G11	765A802G01 to G11
277A348G01 to G02	765A803G01 to G11
277A356G01 to G12	765A841G01 to G05②
277A357G01 to G04	....
277A358G01 to G12	....
277A371G01 to G10	....
277A372G01 to G09	....
277A373G01 to G04	....
277A374G01 to G06	....
277A375G01 to G09	....
277A387G01 to G11	....
277A388G01 to G11	....
277A395G01 to G12	....
277A396G01 to G12	....
277A406G01 to G10	....
277A407G01 to G09	....
277A408G01 to G10	....
277A409G01 to G09	....
277A410G01 to G06	....
277A464G01 to G11	....
277A506G01 to G11	....
277A534G01 to G06	....
764A650G01 to G11	....
764A660G01 to G11	....
764A667G01 to G02	....
764A668G01 to G02	....
764A733G01	....
764A818G01 to G05	....
764A931G01 to G02	....
764A933G01 to G04	....
764A935G01 to G11	....
764A936G01 to G02	....
764A939G01 to G12	....
764A940G01 to G04	....
764A962G01 to G08	....
764A964G01 to G08	....
764A966G01 to G11	....
765A016G01	....
765A440G01	....
765A562G01 to G11	....
765A787G01 to G04	....
765A840G01 to G05	....
765A898G01 to G02	....

4-Pole

Non-Reversing	Reversing
....	276A163G01 to G10
....	276A164G01 to G10

Contactors

1-Pole

Non-Reversing	Reversing
276A132G01 to G11	....

2-Pole

Non-Reversing	Reversing
276A133G01 to G11	....
276A540G01 to G03	....
276A648G01 to G11	....
764A619G01 to G05	....
764A626G01 to G06	....
764A685G01 to G04	....
764A690G01 to G04	....
765A500G01 to G06	....
765A512G01 to G06	....

3-Pole

Non-Reversing	Reversing
276A134G01 to G11	276A147G01 to G11
276A649G01 to G11	276A643G01 to G11
276A668G01 to G11	276A671G01 to G11
277A618G01 to G05	764A783G01 to G11
764A608G01 to G03	764A789G01 to G05
764A620G01 to G05	....
764A627G01 to G06	....
764A686G01 to G04	....
764A691G01 to G04	....
764A727G01 to G03	....
765A283G01 to G11	....
765A501G01 to G06	....
765A513G01 to G04	....
765A609G01 to G03	....

4-Pole

Non-Reversing	Reversing
276A135G01 to G11	....
276A650G01 to G11	....
764A628G01 to G06	....
764A687G01 to G04	....
764A692G01 to G04	....
765A502G01 to G06	....
765A514G01 to G04	....

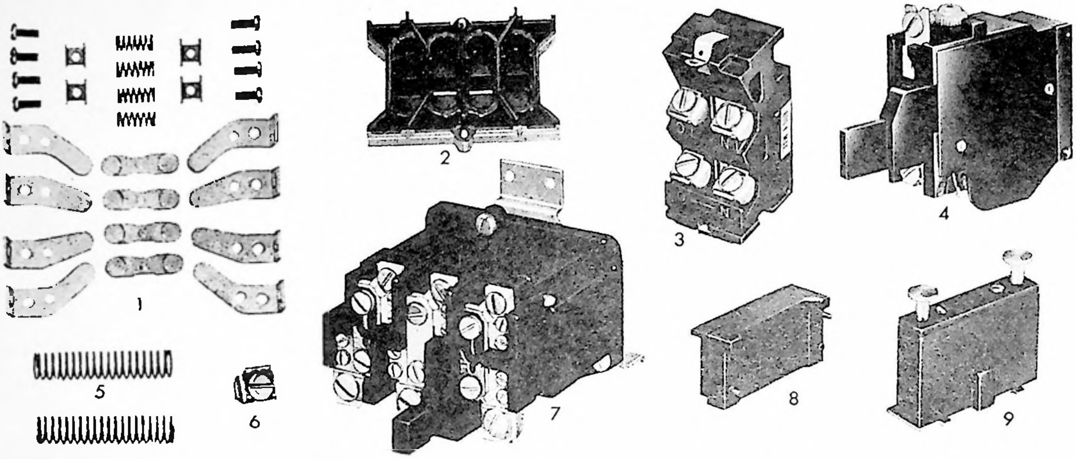
5-Pole

Non-Reversing	Reversing
277A455G01 to G11	....

① Changed since previous issue.
② Uses 1 3-pole and 1 5-pole contactor.

May, 1970
Supersedes Renewal Parts Data 8200A1, pages 1-2, dated January, 1970
E, D, C/2740

A/200 Starters and Contactors, Sizes 1, 1½



Reference No.	Description of Part	Non-Reversing: Style Number of Part 1-Pole	2-Pole	3-Pole	4-Pole	5-Pole	Number Required	Reversing: Style Number of Part 3-Pole x 3-Pole	Number Required
1	Replacement Contact Kit (Complete Set of Moving Contacts, Stationary Contacts, and Springs)	373B331G06	373B331G07	373B331G09	373B331G09	373B331G10	1 Kit	373B331G08	1 Kit
2	Arc Box	504C755H01	504C755H01	504C755H01	504C755H01	504C757H01	1	504C755H01	2
3	NO Holding Interlock	....	....	....	503C782G02	503C782G02	....	....	....
	NO-NC Holding Interlock	....	....	....	....	....	....	503C782G01	2
	Extra NO-NC Interlock	503C782G01	503C782G01	503C782G01	503C782G01	503C782G01	Ref.	503C782G01	Ref.
4	1-Pole Overload Relay for 3-Phase Horizontal and All 1-Phase Starters								
	Non-Compensated	....	371D596G08	371D596G08	....	....	2-3 Phase	371D596G08	2
	Ambient Compensated	....	371D597G07	371D597G07	....	....	1-1 Phase	371D597G07	2
5	Kick Out Springs	503C796H05	503C796H05	503C796H05	503C796H05	503C796H05	2	503C796H05	4
6	Terminal Clamp	764A601G01	764A601G01	764A601G01	764A601G01	764A601G01	2 Per Pole	764A601G01	2 Per Pole
7	Block Type Overload Relay for 3-Phase Starters								
	Non-Compensated	....	5662D74G16③	5662D74G11	....	....	1	5662D74G16	1
	Ambient Compensated	....	5662D74G08③	5662D74G03	....	....	1	5662D74G08	1
8	Operating Coil	See Table Below							
9	Mechanical Interlock								
	3-Phase Horizontal	....	....	....	....	....	....	177C508G01	....
	3-Phase Vertical	....	....	....	....	....	....	177C508G03	....
..	Cross Bar and Armature Assembly	....	373B331G28	373B331G28	373B331G28	373B331G30	1	373B331G28	2
..	Upper Base Assembly	....	373B331G29	373B331G29	373B331G29	373B331G31	1	373B331G32	2

Operating Coils

Number of Poles	Style Number of Operating Coil: 120V/60Cy 110V/50Cy	208V/60Cy 220V/60Cy	240V/60C② 480V/60C	550 Volt 60 Cycle	600V/60C 550V/50C	220 Volt 50 Cycle	440V/60Cy 380V/50Cy
1, 2, 3 and 4	505C806G01	505C806G02	505C806G03	505C806G04	505C806G05	505C806G06	505C806G07
5	505C808G01	505C808G02	505C808G03	505C808G04	505C808G05	505C808G06	505C808G07

Number of Poles	Style Number of Operating Coil: 600 Volt 50 Cycle	120V/60Cy② 240V/60Cy	110 Volt 60 Cycle	240V/60Cy 220V/50Cy	480V/60Cy 440V/50Cy	208V/60Cy② 220V/60Cy 440V/60Cy
1, 2, 3 and 4	505C806G09	505C806G10	505C806G11	505C806G12	505C806G13	505C806G15
5	505C808G09	505C808G10	505C808G11	505C808G12	505C808G13	505C808G14

Replacement Kits

Description	Cat. No.	Style No.
Pushbutton	PBK-1	373D113G01
Selector Switch	SSK-1	373D113G04
Transformer	TXK-1	505C609G01
Third Overload Relay	3OLK-1	625B287G01

Ordering Information

1. Name part and give its style number.
2. State method of shipment desired.
3. Send all orders or correspondence to nearest Westinghouse sales office.

Pricing Information

For prices, refer to PEG 120 or Catalog Section 8220.

② Dual voltage – use only on contactors or starters originally supplied with dual voltage coil.
③ Suitable for two heaters; if three heaters required, third overload kit is required.

Westinghouse Electric Corporation
Control Products Division, Beaver, Pa. 15009
Printed In USA

Westinghouse

A/200 Starters and Contactors, Size 2

General

This data presents the most frequently used renewal parts for size 2 type A/200 starters and contactors of current design.

Information on parts not shown may be obtained at the nearest Westinghouse office. Please advise style number of complete starter when requesting this information.

Style Numbers①

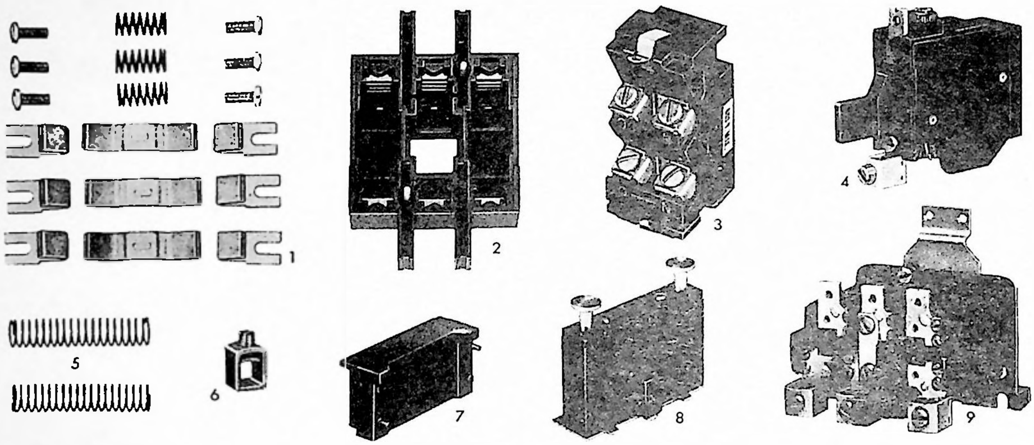
Non-Reversing	Reversing
Starters	
2-Pole	
276A176G01 to G11	....
276A182G01 to G11	....
276A618G01 to G11	....
276A619G01 to G11	....
276A620G01 to G11	....
764A911G01 to G05	....
764A621G01 to G05	....
3-Pole	
276A177G01 to G11	276A186G01 to G11
276A178G01 to G11	276A187G01 to G10
276A179G01 to G11	276A188G01 to G10
276A180G01 to G11	276A189G01 to G10
276A181G01 to G11	276A190G01 to G11
276A183G01 to G11	276A191G01 to G11
276A339G01 to G11	276A196G01 to G11
276A184G01 to G12	276A197G01 to G11
276A621G01 to G11	276A207G01 to G02
276A622G01 to G11	276A631G01 to G11
276A623G01 to G11	276A632G01 to G02
276A624G01 to G02	276A639G01 to G11
276A659G01 to G02	276A640G01 to G11②
276A932G01 to G11	276A641G01 to G11②
277A043G01 to G11	276A666G01 to G11
277A055G01 to G11	277A050G01 to G11
277A060G01 to G11	277A425G01 to G11
277A102G01 to G03	277A432G01 to G04
277A103G01 to G03	277A433G01 to G10
277A104G01 to G03	277A434G01 to G02
277A105G01 to G03	277A443G01 to G11
277A106G01 to G03	277A447G01 to G11
277A107G01 to G03	277A456G01②
277A217G01	277A516G01 to G11②
277A259G01 to G11	277A517G01 to G11②
277A260G01 to G11	277A519G01 to G11②
277A261G01 to G09	277A522G01 to G11②
277A262G01 to G09	277A523G01 to G11②
277A263G01 to G02	764A656G01 to G11
277A282G01 to G05	764A676G01
277A283G01 to G11	764A791G01 to G11
277A284G01 to G06	764A792G01 to G11
277A285G01 to G05	764A793G01 to G11
277A286G01 to G06	764A794G01 to G11
277A287G01 to G05	765A445G01
277A288G01 to G06	765A555G01 to G11
277A289G01 to G02	765A804G01 to G11
277A290G01 to G02	765A805G01 to G11
277A291G01 to G04	765A843G01 to G11②
277A322G01 to G04	....
277A323G01 to G10	....
277A324G01 to G04	....
277A325G01 to G10	....
277A326G01 to G04	....
277A327G01 to G10	....
277A328G01 to G04	....
277A329G01 to G10	....
277A330G01 to G04	....
277A331G01 to G04	....
277A332G01 to G02	....
277A349G01 to G11	....
277A350G01 to G02	....
277A359G01 to G05	....
277A360G01 to G06	....
277A361G01 to G02	....
277A362G01 to G02	....
277A363G01 to G05	....
277A364G01 to G06	....
277A376G01 to G04	....
277A377G01 to G10	....
277A378G01 to G02	....
277A379G01 to G10	....

Non-Reversing	Reversing
3-Pole, Continued	
277A389G01 to G11	....
277A390G01 to G11	....
277A397G01 to G05	....
277A398G01 to G11	....
277A399G01 to G05	....
277A411G01 to G04	....
277A412G01 to G10	....
277A413G01 to G04	....
277A414G01 to G10	....
277A415G01 to G02	....
277A460G01	....
277A461G01	....
277A466G01 to G11	....
277A507G01 to G11	....
277A508G01 to G11	....
764A651G01 to G11	....
764A661G01 to G11	....
764A699G01 to G02	....
764A670G01 to G03	....
764A932G01 to G02	....
764A937G01 to G11	....
764A938G01 to G02	....
764A934G01 to G02	....
764A941G01 to G05	....
764A963G01 to G08	....
764A965G01 to G06	....
764A967G01 to G11	....
765A402G01	....
765A441G01	....
765A554G01 to G11	....
765A563G01 to G11	....
765A622G01	....
765A623G01	....
765A670G01	....
765A788G01 to G02	....
765A818G01 to G02	....
765A823G01 to G02	....
765A842G01 to G11	....
Contactors	
2-Pole	
276A172G01 to G11	....
276A651G01 to G11	....
764A629G01 to G06	....
764A688G01 to G04	....
764A693G01 to G04	....
765A503G01 to G06	....
765A513G01 to G04	....
3-Pole	
276A173G01 to G11	276A672G01 to G11
276A541G01 to G03	276A644G01 to G11
276A652G01 to G11	276A186G01 to G11
276A669G01 to G11	276A185G01 to G10
277A619G01 to G05	277A454G01
764A630G01 to G06	764A790G01 to G11
764A689G01 to G04	....
765A504G01 to G04	....
765A516G01 to G04	....
764A728G01 to G05	....
765A284G01 to G11	....
765A610G01 to G03	....
765A694G01	....
765A984G01, G08, G09	....
4-Pole	
277A494G01 to G11	....
764A631G01 to G06	....
765A505G01 to G06	....
765A611G01 to G03	....
5-Pole	
277A495G01 to G11	....

① Changed or added since previous issue.
② 1-3 Pole and 1-5 Pole contactor.

May, 1970
Supersedes Renewal Parts Data 7000A2, pages 1-2, dated February, 1967
E, D, C/2740

A/200 Starters and Contactors, Size 2



Reference No.	Description of Part	Non-Reversing: Style Number of Part or Parts, 2-Pole	3-Pole	4-Pole	5-Pole	Number Required	Reversing: Style No. of Part, 3-Pole x 3-Pole	Number Required
1	Replacement Contact Kit (Complete Set of Moving Contact, Stationary Contacts and Springs)	373B331G11	373B331G12	373B331G13	373B331G14	1-Kit	373B331G15	1-Kit
2	Arc Box	623B082G01	623B082G01	623B082G02	623B082G02	1	623B082G01	2
3	NO Holding Interlock	503C782G02	503C782G02	503C782G02	503C782G02	1	....	....
	NO-NC Holding Interlock	....	....	....	....	....	503C782G01	2
	Extra NO-NC Interlock	503C782G01	503C782G01	503C782G01	503C782G01	Ref.	503C782G01	Ref.
4	Single Pole Overload Relays for Horizontal 3-Phase and All 1-Phase Starters							
	Non-Compensated	371D598G08	371D598G08	....	....	1-1 Phase	371D598G08	2
	Ambient Compensated	371D599G07	371D599G07	....	....	2-3 Phase	371D599G07	2
5	Kick Out Springs	503C796H20	503C796H20	503C796H20	503C796H20	2	503C796H20	4
6	Terminal Clamp							
	Contactor Line or Load	371B870G01	371B870G01	371B870G01	371B870G01	2 Per Pole	....	....
	Starter Line Only	371B870G01	371B870G01	371B870G01	371B870G01	1 Per Pole	....	....
7	Operating Coil	See Table Below						
8	Mechanical Interlocks							
	3-Phase Horizontal	....	....	....	....	....	372B091G01	1
	3-Phase Vertical	....	....	....	....	....	372B091G02	1
9	Block-Type Overload Relays for 3-Phase Starters							
	Non-Compensated	....	371D595G16	....	....	1	371D595G16	1
	Ambient Compensated	....	371D595G08	....	....	1	371D595G08	1
..	Cross Bar and Armature Assembly	373B331G32	373B331G32	373B331G34	373B331G34	1	373B331G32	2
..	Upper Base Assembly	373B331G33	373B331G33	373B331G35	373B331G35	1	373B331G33	2

Operating Coils

Number of Poles	Style Number of Operating Coil: 120V/60 Cy, 110V/50Cy	208V/60Cy, 220V/60Cy	240V/60Cy②, 480V/60Cy	550 Volt, 60 Cycle	600V/60Cy, 550V/50Cy	440V/60Cy, 380V/50Cy
2 and 3	505C806G01	505C806G02	505C806G03	505C806G04	505C806G05	505C806G07
4 and 5	505C818G01	505C818G02	505C818G03	505C818G04	505C818G05	505C818G07

Number of Poles	Style Number of Operating Coil: 600 Volt, 50 Cycle	120V/60Cy②, 240V/60Cy	110 Volt, 60 Cycle	240V/60Cy, 220V/50Cy	480V/60Cy, 440V/50Cy	208V/60Cy②, 220V/60Cy, 440V/60Cy
2 and 3	505C806G09	505C806G10	505C806G11	505C806G12	505C806G13	505C806G15
4 and 6	605C818G09	605C818G10	505C818G11	505C818G12	505C818G13	505C818G08

Replacement Kits

Description	Cat. No.	Style No.
Pushbutton	PBK-1	373D113G02
Selector Switch	SSK-1	373D113G04
Transformer	TXK-1	505C609G01
Third Overload Relay	3OLK-1	626B287G01

② Dual voltage – use only on contactors or starters originally supplied with dual voltage coil.

Ordering Information

1. Name part and give its style number.
2. State method of shipment desired.
3. Send all orders or correspondence to nearest Westinghouse sales office.

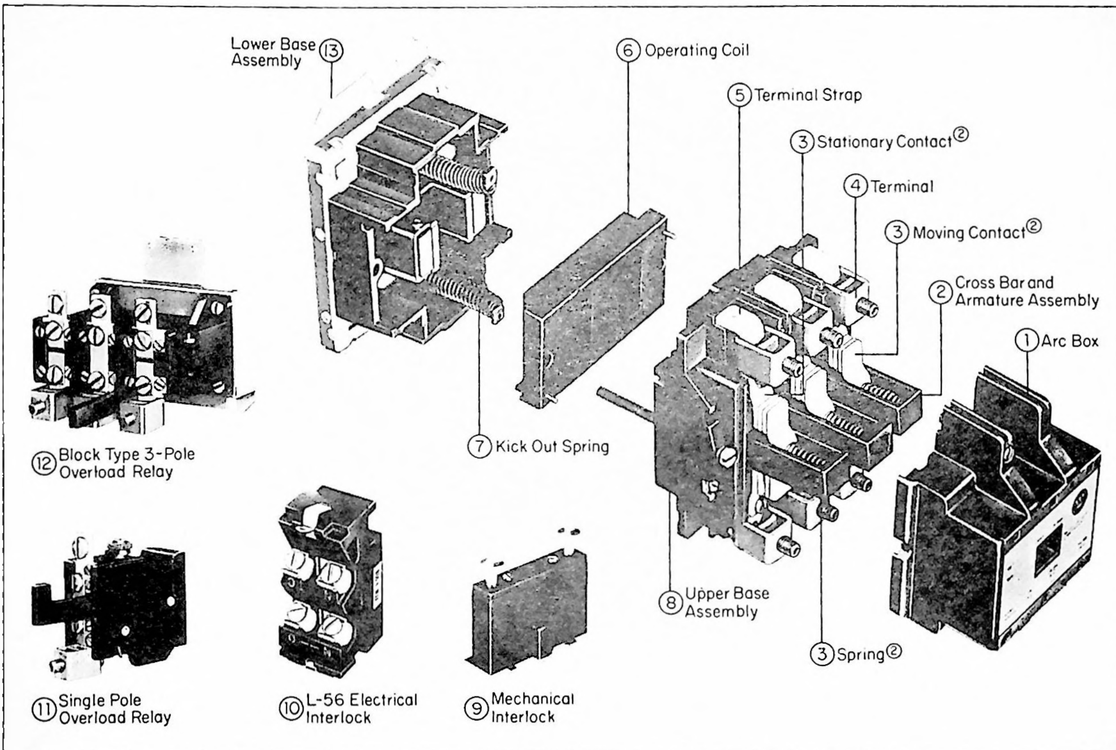
Pricing Information

For prices, refer to PEG 120 or Catalog Section 8220.

Westinghouse Electric Corporation
Control Products Division, Beaver, Pa. 15009
Printed in USA

Westinghouse

A/200 Starters and Contactors, Size 3



Ref. No.	Description of Part	Non-Reversing: Style Number of Part or Parts, 2-Pole	3-Pole	4-Pole	5-Pole	Number Required	Reversing: Style Number of Part, 3-Pole x 3-Pole	No. Req.
1	Arc Box	372D673G01	372D673G01	372D677G01	372D677G01	1 Kit	372D673G01	2
2	Cross Bar and Armature Assembly	373B331G36	373B331G36	373B331G38	373B331G38	1	373B331G36	2
3	Replacement Contact Kit (Consists of Moving Contacts, Stationary Contacts and Springs	626B187G12①	626B187G13①	626B187G14①	626B187G15①	1 Kit	626B187G13①	2 Kits
4	Terminal	372B357G05	372B357G05	372B357G05	372B357G05	2 Per Pole	....	.....
5	Terminal Strap	276A091H01①	276A091H01①	276A091H01①	276A091H01①	2 Per Pole	....	.....
6	Operating Coils	See Table Page 2						
7	Kick-Out Spring	503C796H45①	503C796H45①	503C796H45①	503C796H45①	2	503C796H45	4
8	Upper Base Assembly	373B331G37	373B331G37	373B331G39	373B331G39	1	373B331G37	2
9	Mechanical Interlocks							
	3-Phase Horizontal	....	....	....	....	....	177C508G02	1
	3-Phase Vertical	....	....	....	....	....	179C722G02	1
10	NO Holding Interlock	503C782G02	503C782G02	503C782G02	503C782G02	1	....	.....
	NO-NC Holding Interlock	....	....	....	....	....	503C782G01	2
	Extra NO-NC Interlocks	503C782G01	503C782G01	503C782G01	503C782G01	Ref.	503C782G01	Ref.
11	Single Pole Overload Relay							
	Non-Compensated	....	372D880G09	....	....	2	372D880G09	2
	Ambient Compensated	....	372D850G09	....	....	2	372D860G09	2
12	Block Overload Relay							
	Non-Compensated	....	5667D76G16	....	....	1	372D622G16	1
	Ambient Compensated	....	5667D76G08	....	....	1	372D622G08	1
13	Lower Base Assembly	1250C33G03	1250C33G03	....	....	1	1250C33G03	2

① Changed since previous issue.
② Refer to Item 3.

Additional Data on Page 2 ▶

November, 1971
Supersedes Renewal Parts Data 8200A3, pages 1-2, dated November, 1970
E. D. C/2740

A/200 Starters and Contactors, Size 3

Operating Coils

Volts/Cycles	Style Numbers	
	2, 3, Poles	4, 5 Poles
120/60, 110/50	505C633G01	505C635G01
208/60, 220/60	505C633G02	505C635G02
240/60②, 480/60	505C633G03	505C635G03
550/60	505C633G04	505C635G04
600/60, 550/50	505C633G05	505C635G05
440/60, 380/50	505C633G07	505C635G07
600/50	505C633G09	505C635G09
120/60②, 240/60	505C633G10	505C635G10
110/60	505C633G11	505C635G11
240/60, 220/50	505C633G12	505C635G12
480/60, 440/50	505C633G13	505C635G13
208②/220/240/60	505C633G08	505C635G08

Replacement Kits

Description	Cat. No.	Style No.
Pushbutton	PBK-3	373D113G03
Selector Switch	SSK-1	373D113G04
Transformer	TXK-3	505C609G02
Third Overload Relay	3OLK-3	625B287G03

Ordering Information

1. Name part and give its style number.
2. State method of shipment desired.
3. Send all orders or correspondence to nearest Westinghouse sales office.

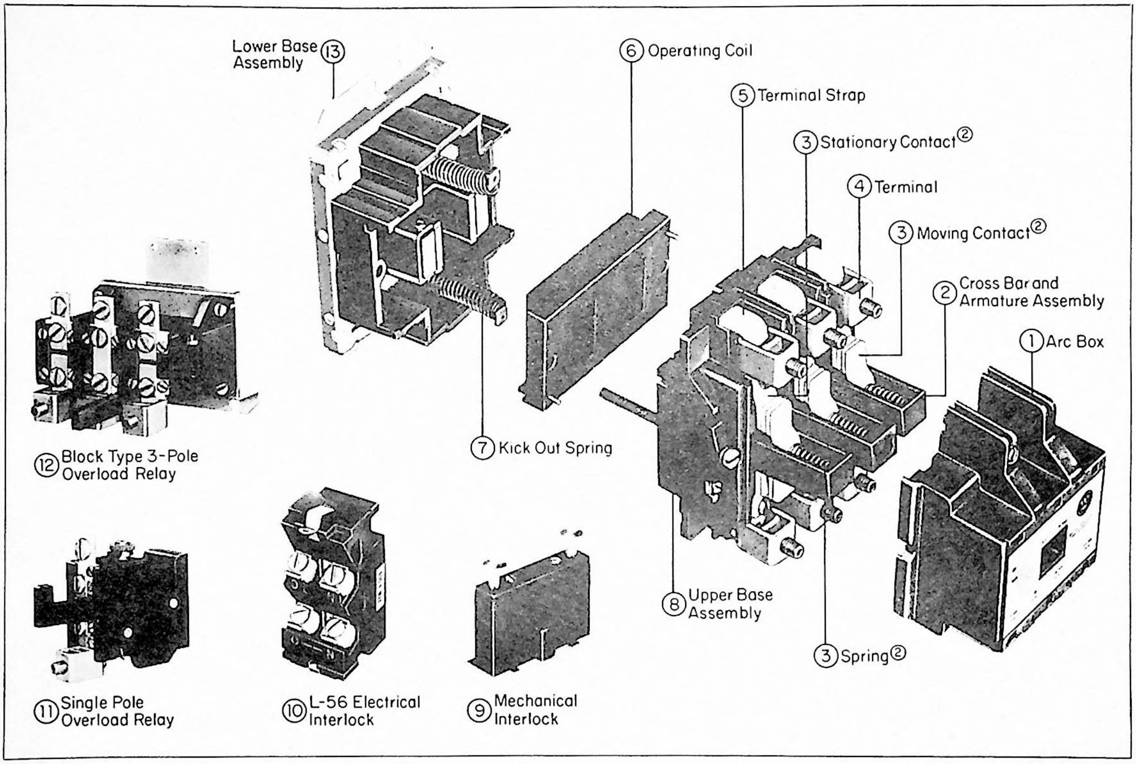
Pricing Information

For prices, refer to PEG 120 or Catalog Section 8220.

Westinghouse Electric Corporation
Control Products Division, Beaver, Pa. 15009
Printed in USA

Westinghouse

A/200 Starters and Contactors, Size 4



Ref. No.	Description of Part	Non-Reversing: Style Number of Part or Parts, 2-Pole	3-Pole	4-Pole	5-Pole	Number Required	Reversing: Style Number of Part, 3-Pole x 3-Pole	No. Req.
1	Arc Box	372D673G01	372D673G01	372D677G01	372D677G01	1 Kit	372D673G01	2
2	Cross Bar and Armature Assembly	373B331G36	373B331G36	373B331G38	373B331G38	1	373B331G36	2
3	Replacement Contact Kit (Consists of Moving Contacts, Stationary Contacts and Springs	626B187G16①	626B187G17①	626B187G18①	626B187G19①	1 Kit	626B187G13①	2 Kits
4	Terminal	372B357G06	372B357G06	372B357G06	372B357G06	2 Per Pole	....	.....
5	Terminal Strap	276A092H01①	276A092H01①	276A092H01①	276A092H01①	2 Per Pole	....	.....
6	Operating Coils	See Table Page 2						
7	Kick-Out Spring	503C796H45①	503C796H45①	503C796H45①	503C796H45①	2	503C796H45	4
8	Upper Base Assembly	373B331G37	373B331G37	373B331G39	373B331G39	1	373B331G37	2
9	Mechanical Interlocks							
	3-Phase Horizontal	....	....	....	....	....	177C508G02	1
	3-Phase Vertical	....	....	....	....	....	179C722G02	1
10	NO Holding Interlock	503C782G02	503C782G02	503C782G02	503C782G02	1	....	.....
	NO-NC Holding Interlock	....	....	....	....	....	503C782G01	2
	Extra NO-NC Interlocks	503C782G01	503C782G01	503C782G01	503C782G01	Ref.	503C782G01	Ref.
11	Single Pole Overload Relay							
	Non-Compensated	....	372D880G09	....	....	2	372D880G09	2
	Ambient Compensated	....	372D850G09	....	....	2	372D850G09	2
12	Block Overload Relay							
	Non-Compensated	....	5667D76G16	....	....	1	372D622G16	1
	Ambient Compensated	....	5667D76G08	....	....	1	372D622G08	1
13	Lower Base Assembly	1250C33G03	1250C33G03	....	....	1	1250C33G03	2

① Changed since previous issue.
② Refer to Item 3.

Additional Data on Page 2 ▶

November, 1971
Supersedes Renewal Parts Data 8200A4, pages 1-2, dated November, 1970
E. D. C/2740

A/200 Starters and Contactors, Size 4

Operating Coils

Volts/Cycles	Style Numbers	
	2, 3, Poles	4, 5 Poles
120/60, 110/50	505C633G01	505C635G01
208/60, 220/60	505C633G02	505C635G02
240/60②, 480/60	505C633G03	505C635G03
550/60	505C633G04	505C635G04
600/60, 550/50	505C633G05	505C635G05
440/60, 380/50	505C633G07	505C635G07
600/50	505C633G09	505C635G09
120/60②, 240/60	505C633G10	505C635G10
110/60	505C633G11	505C635G11
240/60, 220/50	505C633G12	505C635G12
480/60, 440/50	505C633G13	505C635G13
208②/220/240/60	505C633G08	505C635G08

Replacement Kits

Description	Cat. No.	Style No.
Pushbutton	PBK-3	373D113G03
Selector Switch	SSK-1	373D113G04
Transformer	TXK-3	505C609G02
Third Overload Relay	3OLK-3	625B287G03

Ordering Information

1. Name part and give its style number.
2. State method of shipment desired.
3. Send all orders or correspondence to nearest Westinghouse sales office.

Pricing Information

For prices, refer to PEG 120 or Catalog Section 8220.

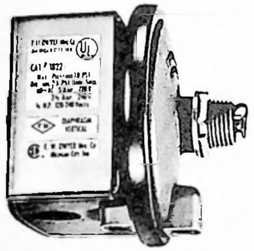
Westinghouse Electric Corporation
Control Products Division, Beaver, Pa. 15009
Printed in USA

Dwyer

SERIES 1800*

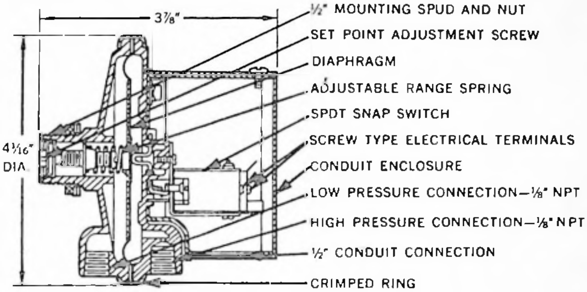
Low Differential Pressure Switches for General Industrial Service

Compact, economically priced switches in 8 standard ranges. Set points from 0.15" to 80" W.C. Repetitive accuracy within 2%. U.L. and C.S.A. listed, F.M. approved.



Model 1823 pressure switch. U.L. and C.S.A. listed, F.M. approved.

Series 1823 pressure switch. Conduit enclosure removed to show electric switch.



Construction and dimensions. Series 1823 pressure switches.

Still our most popular pressure switches. Combine small size and low price with 2% repeatability for enough accuracy for all but the most demanding applications. Set point adjustment inside the mounting spud permits mounting switch on one side of a wall or panel with adjustment easily accessible on the opposite side.

U.L. and C.S.A. listed, F.M. approved.

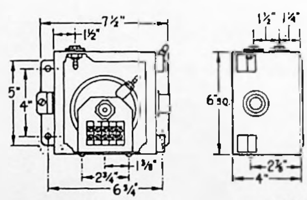
***Model 1823 shown; (1823 replaces 1820, 1821 and 1822 which are similar).**

Environmental (MIL) Switch

Unlisted Model 1820 can be furnished with special snap switch sealed against the environment for temperatures down to −65° F., high humidity and/or for government applications. Similar to standard Model 1823 except dead band is slightly greater. Specify Model 1820 (Range No.) "MIL" in ordering.

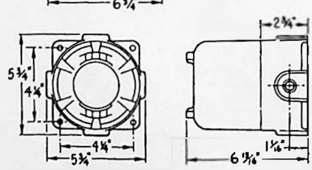
Weatherproof Enclosure

16 ga. steel enclosure for unusually wet or oily conditions. Withstands 200 hour salt spray test. Gasketed cover. Weight 5½ lbs. Switch must be installed at factory. Specify "WP" in addition to switch catalog number.



Explosion-Proof Housing

Cast iron base and aluminum dome cover. Approximate weight 7½ lbs. Specify "EXPL" in addition to switch catalog number.



How to Order: See price list, Bulletin S-26.

PHYSICAL DATA

Temperature limits: 32° F. (−30° for dry air, −65° with "MIL" option) to 110° F. (130° with reduced electrical rating).

Rated pressure: 10 psig one or both sides of diaphragm.

Pressure connections: ⅛" NPT.

Electrical rating: 15 amps, 120-480 volts, 60 Hz. A.C. Resistive ⅛ H.P. @ 125 volts, ¼ H.P. @ 250 volts, 60 Hz. A.C.

Wiring connections: 3 screw type, common, normally open and normally closed.

Set point adjustment: Screw type inside mounting spud.

Housing: Aluminum die casting. Steel fittings zinc plated, dichromate dipped for 200 hour salt spray test.

Diaphragm: Silicone rubber on dacron with aluminum support plate.

Calibration spring: Stainless steel.

Mounting spud: ½" pipe thread.

Weight: 1 lb., 5 oz.

SERIES 1823 SWITCHES: OPERATING RANGES AND DEAD BANDS. U.L. and C.S.A. Listed, F.M. Approved.

Model Number	Operating Range Inches, W.C.	Approximate Dead Band At Min. Set Point	Approximate Dead Band At Max. Set Point
1823-0	0.15 to 0.5	0.06	0.06
1823-1	0.3 to 1.0	0.08	0.08
1823-2	0.5 to 2.0	0.10	0.12
1823-5	1.5 to 5.0	0.14	0.28
1823-10	2.0 to 10	0.18	0.45
1823-20	3 to 22	0.35	0.70
1823-40	5 to 44	0.56	1.1
1823-80	9 to 85	1.3	3.0

Suggested Specification

Differential pressure switches shall be diaphragm operated with 4" diaphragm to actuate a single pole double throw snap switch. Motion of the diaphragm shall be restrained by a calibrated spring that can be adjusted to set the exact pressure differential at which the electrical switch will be actuated. Motion of the diaphragm shall be transmitted to the switch button by means of a direct mechanical linkage. Switches shall be Dwyer Instruments, Inc. Catalog No. 1823-______ for the required operating ranges.

*Patent No. 3,007,017

INSTALLATION AND OPERATION

INSTALLATION

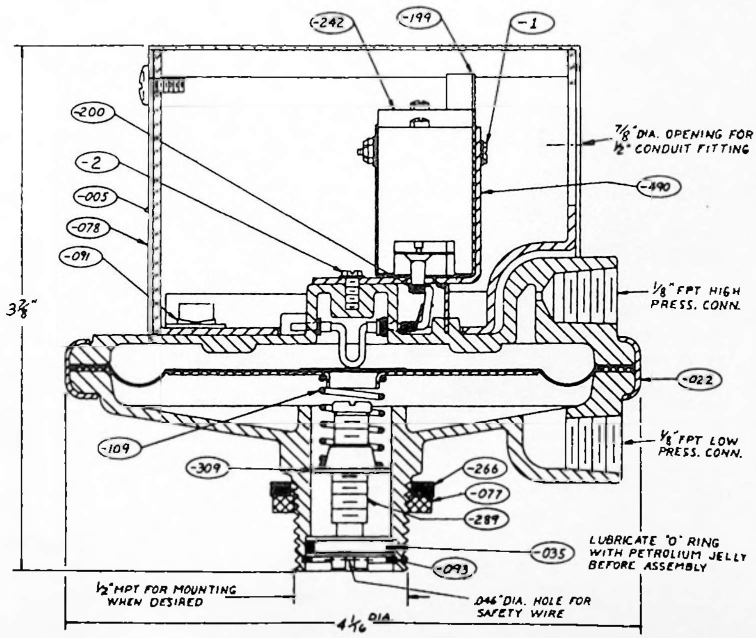
1. Select a location free from excessive vibration where oil or water will not drip upon the switch and where ambient temperature will not exceed 160°F. See special housings for unusual conditions.
2. Mount the switch with the diaphragm in a vertical plane. Must be recalibrated for each change in operating position.
3. Connect switch to source of pressure differential. Metal tubing with 1/4'' O.D. is recommended but any tubing system which will not restrict the air flow unduly is satisfactory. Note that the low pressure connection may be made to the 1/2'' stud at the back of the switch if desired. If so connected, drill 1/16'' diameter holes in the Spring Retainer flange (PN 1823-309) and the head of Adjustment Screw (PN 1823-289) to provide opening to the switch interior and plug the other low pressure connection.
4. Electrical connections for all switches are marked Common, Normally Open and Normally Closed. Be certain connections are properly made and that no mechanical load can be transferred from the wiring to the Micro Switch.

ADJUSTMENT

1. If switch has not been preset or if it is desired to change the set point, observe the following procedure:
   a. To adjust the set point turn the slotted Adjustment Screw (PN 1823-289) clockwise to increase the set point and counter-clockwise to decrease the set point.
   b. Important Note. The following is a recommended procedure for calibrating or checking calibration: Use a "T" assembly with three rubber tubing leads, all as short as possible and the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to a manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point slowly. Note that manometer and pressure switch will have different response characteristics due to different internal volumes, lengths of tubing, oil drainage, etc. Be certain switch is checked in position it will assume in use, i.e., vertical, horizontal, etc.

PARTS LIST

Part No.	Name
1823-005	Conduit Enclosure (1)
1823-022	Switch Body Assembly — Aluminum Die Casting Diaphragm Assembly .008'' Silicone on Nylon and Aluminum Assembly Ring (1)
1823-035	"O" Ring 1/2'' X 5/8'' (1)
1823-077	Mounting Nut — 1/2'' Electrical Nut — Steel (1)
1823-078	Conduit Cover Assembly (1)
1823-091	Conduit Enclosure Fasteners — Tinnerman Speed Nut (4)
1823-093	Retaining Ring (1)
1823-109	Calibration Spring — Stainless Steel (1)
1823-199	Insulation Shield — 1/32'' Thick Hard Fibre (1)
1823-200	Switch Button — Nylon (1)
1823-242	Micro-Switch #BZ-RW84-A2
1823-266	Mounting Washer — 1-5/32'' O.D. X .844'' I.D. — Steel (2)
1823-289	Calibration Adjustment Screw (1)
1823-309	Calibration Spring Retainer — Brass (1)
1823-490	Switch Bracket — Steel (1)
1823-1H	#6-32 X 1 Steel Screw #6L Brass Washer #6-32 Lock Nut
1823-2H	#6-32 X .5/16'' Steel Screw



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F. R. No. 24-440256-00

DWYER INSTRUMENTS, INC.
P. O. BOX 373 MICHIGAN CITY, INDIANA 46360 U.S.A.
Phone: AC 219, 872-9141

INSTRUCTIONS

GEK-28757

HIGH VOLTAGE RELAY

IC 2820K100

GENERAL ELECTRIC
REQUISITION NUMBER

INDUSTRY CONTROL DEPARTMENT
GENERAL ELECTRIC
SALEM, VA.

INSTRUCTION BOOK GEK-28757

FOR IC2820K100 RELAYS

Before any adjustments, servicing, parts replacement or any other act is performed requiring physical contact with the electrical working components or wiring of this equipment, the POWER SUPPLY MUST BE DISCONNECTED.

Introduction

The IC2820K100 relays are high voltages devices. These relays were specifically designed to be used in television transmitters and should not be used in any other application.

The IC2820K100B has four normally closed (N.C.) main poles, and its function is that of a high voltage grounding device. The voltage applied across each tip is 6,500 volts with a maximum make current of 5 amps; break current of 0 amps; carry current of 0 amps; and an inrush current of 5 amps.

The IC2820K100C has four normally open (N.O.) main poles and its function is that of a high voltage surge suppressor. The voltage applied across each tip is 6,500 volts with a maximum make current of 5 amps; break current of 0 amps; carry current of 5 amps; and an inrush current of 5 amps.

Installation

These relays are intended for mounting in an enclosure which has provisions for preventing persons from coming in contact with this device when high voltage power is available within the enclosure. The customer assumes responsibility for mounting this device correctly and wiring it into his circuits to obtain the functions intended by this service.

These relays are not to be applied in any installation which is considered to be in violation of the common industry practices which are used by the television transmitter manufacturers; specifically, creepages and clearances areound the device, when mounted in the enclosure. The ground wire provided should be attached to the mounting bolt, when the device is installed in its enclosure.

Operation

Each device is supplied with a D.C. voltage coil and a rectifier. The control portion, which includes the coil and the rectifier and (resistor when supplied) is available for A.C. voltage input. The terminal board and the coil terminals are available for customer connections of the control voltage (low voltage, less than 600 volts). See wiring diagram 176B9988.

The main poles are the power voltage terminals (high voltage, greater than 600 volts).

These devices have specific timing requirements regarding pick-up times, instantaneous drop-out times, and time delay drop-out. The timing requirements are satisfied by the auxiliary circuitry which is provided by the customer in his overall circuit. As the devices are shipped from the G.E. factory, they are non-functional devices. A control wire harness is provided; however, the operating coil is not wired. This is left to the customer in his application.

Adjustments

1. The mating of the stationary and movable tips are purposely oversized to allow for some misalignment of the tips. However, all the tips (stationary or movable) should align within a 1/16 inch.

   All main tips should touch within a 1/16" of each other when viewing the device per Fig. #1 at "A".

2. The tip gaps as measured at "A" per Fig. 1, are to be 3/4" minimum on all main poles for all forms.

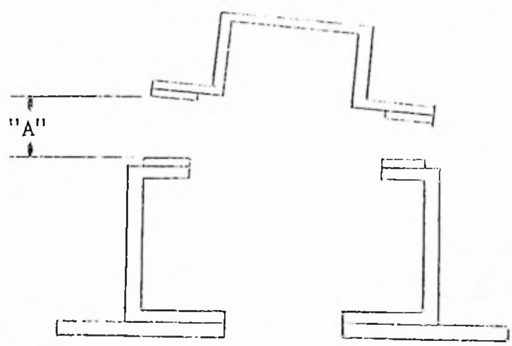


FIG. #1.

   The tip wipes are to be 1/16 inch minimum. This value is obtained by: (1) measuring the free length of the main tip spring; (2) measure the spring length when the armature magnet is fully closed; (3) subtract the value in (2) from the value in (1) and the result will be the tip wipe, and this result must be greater than 1/16 inch. All four main tip wipes are to be checked.

   The maximum wipe should be 7/32 inch at which the springs will be very nearly solid. The springs going solid are not permitted.

3. Insure that grounding wires are properly attached to the switchette support and to the relay frame. Ground the device with ground wire provided.

4. Check the shim:(a) Bimetallic shim to be mounted with steel part forcing the core and bronze part up against the armature; (b) all shims to be fastened to armature with brass screws.

5. It is desirable to have the wipes and gaps on the far right hand main pole the same as that on the far left hand main pole. However, this may not be possible because of the tolerance build-up in the parts. What is essential is that the values for wipe and gap, as given in 2, be maintained.

6. The gap under the armature is not critical. The main pole gaps are critical.

   The gap on the N.O. device and the wipe on the N.C. device may be adjusted by the adjusting screws located above the armature. After adjustments have been made, insure that the lock nut is tight.

7. The armature spring adjustment is not critical and should be set tight. However, when the armature is held against the core of the relay, the spring should not be solid. Some adjustment of this spring may be required to obtain the 85% pick-up. Insure that the cotter pin is inserted properly after adjustments have been made.

8. The switchette supports are provided with four (4) slotted holes which allows for adjustment, up and down. When the armature is seated solidly against the core, the switchette circuits should have been activated. The switchettes will "click" when they have been activated. After the switchettes are activated the switchettes should have some overtravel on the plungers (white bottom). Use a very thin (0.005") feeler gage to check the overtravel. The switchetes have a wide tolerance on their wipes and gaps. So, in the case of the N.C. device, it is not required that all three switchettes activate at the exact same time. All three switchettes must activate.

Description of G.E. Catalog Number:

IC2820K100 B D 3 C

Basic Industry Control Relay Number.

(1) Form Letter

(2) Shim Letter

(3) Coil No.

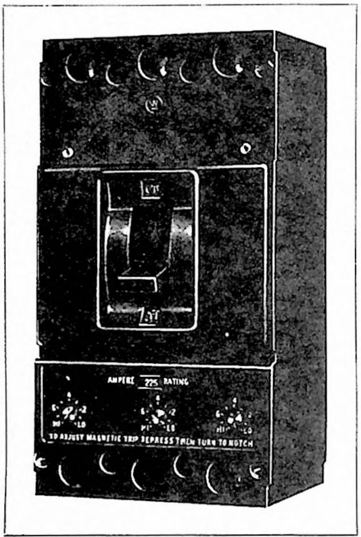
(4) Switchette Letter

(1)	Form Letter:	"B" indicates 4 - N.C. main poles "C" indicates 4 - N.O. main poles "D" indicates 2 - N.C. main poles "E" indicates 2 - N.O. main poles
(2)	Shim Letter:	"B" to be used only on FORMS "C" and "E" "D" to be used only on FORMS "B" and "D"
(3)	Coil No. :	indicates A.C.Control Voltage Input (Customer to specify available A.C. Control Voltage. EX: 120V. A.C.)
(4)	Switchette Letter:	If this letter is left blank, no switchettes will be provided. "A" indicates one switchette, supplied on either forms "B", "C", "D", or "E". "B" indicates two switchettes supplied on either forms "B" or "D". "C" indicates three switchettes supplied on either forms "B" or "D". Each switchette has 1-N.O. & 1-N.C. pole.

(If any other combinations of circuits are required other than those listed, specify by description.
EX: Same as "C" except 6-N.O. auxiliary circuits).

Westinghouse

AB DE-ION® Circuit Breakers Types JA, KA, MARK 75® Type HKA



70-225 Amperes 600 Volts Ac, 250 Volts Dc 2 and 3-Poles

Continuous Ampere Ratings

Underwriters' Laboratories, Inc. Listed
70, 90, 100, 125, 150, 175, 200, 225

Interrupting Ratings, Amperes

Underwriters' Laboratories, Inc. Listed

Types JA and KA
240 Volts Ac: 30,000 Asym., 25,000 Sym.
480 Volts Ac: 25,000 Asym., 22,000 Sym.
600 Volts Ac: 25,000 Asym., 22,000 Sym.
250 Volts Dc: 10,000

Mark 75 Type HKA
240 Volts Ac: 75,000 Asym., 65,000 Sym.
480 Volts Ac: 40,000 Asym., 35,000 Sym.
600 Volts Ac: 30,000 Asym., 25,000 Sym.
250 Volts Dc: 10,000

Application

These breakers are designed for the protection of branch and feeder circuits. Being of compact size, they are ideally suited for use in control panels, panelboards, switchboards or separate enclosures where a 225 ampere frame size breaker is required.

MARK 75 Type HKA Breakers, because of their higher interrupting capacity, are ideally suited for use in network systems where unusually high fault currents are available.

Listed with Underwriters' Laboratories, Inc.

On all three phase Delta, grounded B phase applications, refer to Westinghouse.

Construction

These breakers have all the standard AB breaker features. Two and three pole breakers are supplied in one frame size; the current carrying parts being omitted from the center pole for two pole breakers. In addition, the MARK 75 Type HKA molded case is a higher strength glass polyester material with greater resistance to tracking. Type JA Breakers have non-interchangeable trip units, while Types KA and HKA have interchangeable trips.

Type JA and KA breakers meet the requirements of class 3a and 3b breakers, MARK 75 Type HKA Breakers meet requirements of class 3d as defined in Federal Specification W-C 375a.

Terminals

Two terminals are required per pole.

Terminals are Underwriters' Laboratories, Inc. listed for wire type and range listed below. When used with aluminum conductors, use joint compound.

Terminal arrangement permits ready use of other circuit connecting means, such as rear-connecting studs, panelboard connectors and plug-in adaptor kits.

Max. Breaker Amps.	Catalog Number	Wire Range, Type No. of Cables
Standard Pressure Terminals (Copper Only)		
225	T225LA	1 #6-350 MCM
Optional Al/Cu Pressure Terminals		
225	TA225LA1	1 #6-350 MCM Cu, or 1 #4-350 MCM Al

Operation

When the breaker contacts are open the handle is in either the mid or OFF position. If in the mid-position the breaker has been tripped automatically. The latch must be reset by moving the operating handle to the extreme OFF position before attempting to restore service. Contacts may be closed, after resetting the latch, by moving the handle to the ON position. JA breakers may be mounted in an inverted position and are approved for reverse feed. Types KA and HKA may be mounted in an inverted position, but are not approved for reverse feed. The toggle handle operates with the following forces in pounds from the end of the handle: ON – 24 lbs; OFF – 10 lbs; reset – 15 lbs.

Thermal Magnetic Breakers

These breakers are equipped with thermal, front-adjustable magnetic trip elements. Thermal trip elements are of an indirectly heated bimetallic type having a long time delay well suited for starting motors having high inrush currents of long duration. Instantaneous magnetic trip settings may be adjusted between established limits to take care of circuit surge conditions. Trip units are non-interchangeable on JA breakers, and interchangeable on Type KA and HKA.

Magnetic Trip and Setting Range②

Ampere Rating	70	90	100	125	150	175	200	225
High	700	900	1000	1250	1500	1750	2000	2250
Low	350	450	500	625	750	875	1000	1125

Magnetic Only Circuit Interrupters③

These are breakers with adjustable magnetic trip elements only, for applications where short circuit protection only is required. Magnetic trip ranges are the same as those listed for thermal-magnetic breakers, but the continuous current ratings in all cases are 225 amperes.

Ambient Compensating Breakers③

Have thermal and magnetic trip elements. They are thermal compensating to carry full load at 50°C while also meeting U/L trip requirements at 25°C. Can be applied where a wide range of ambients is experienced.

Saf-T-Vue Breakers (Types JA and KA Only)③

Saf-T-Vue breakers are similar to standard breakers except that they have a transparent window located over the breaker contacts. Saf-T-Vue breakers are commonly used in steel mill applications where sight of contacts is required. Can be supplied in all standard ratings.

Non-Automatic Interrupters (Types JA and KA Only)

Breakers with non-automatic details (latch bracket and bridging strap) can be installed where a heavy-duty, high capacity disconnect switch is required. Accessories, such as shunt trip, undervoltage, etc., cannot be field mounted in non-automatic breakers as a dummy trip is required for mounting. Accessories can be mounted if specified when breaker is ordered.

Circuit Breaker Removal

Before inspecting, installing, or removing from a circuit, the circuit breaker should be in the OFF position, and if practicable the circuit should be de-energized. If the circuit cannot be de-energized insulated tools, rubber gloves and a rubber floor mat should be used.

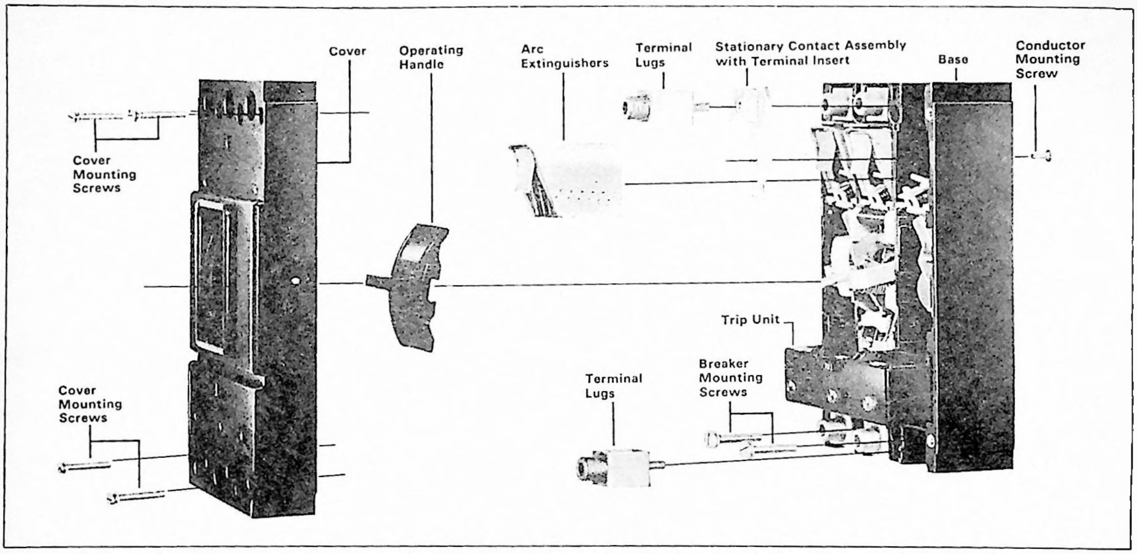
② All adjustable magnetic trips are set in high position at factory; may be adjusted down to required limit in the field.

③ Not Underwriters' Laboratories, Inc. listed.

January, 1971
Supersedes Application Data 29-160, all previous issues.
E, D, C/1901, 1903, 1928/DB

AB DE-ION® Circuit Breakers
Types JA, KA, MARK 75®
Type HKA

Typical Exploded View



To remove a rear-connected circuit breaker from its mounting, remove terminal stud locknuts and pull circuit breaker forward.

To remove a front-connected circuit breaker from its mounting, loosen screws in terminal lugs and remove cables from terminals. Remove circuit breaker mounting screws and pull circuit breaker forward.

To remove a circuit breaker equipped with plug-in mounting blocks from its mounting, remove breaker mounting screws and pull circuit breaker forward.

Inspection and Maintenance

Good maintenance procedure calls for periodic inspection of all electrical apparatus including molded case circuit breakers. Terminal lugs and trip units must be tight to prevent overheating. Due to the inherent wiping action built into the moving contacts of all Westinghouse circuit breakers, operating the breaker several times under load will remove any high resistance film that may have formed. Under normal conditions, additional cleaning of contacts is not required. However, should operating and/or atmospheric conditions make it desirable to clean the contacts further, the following procedure is recommended.

1. Remove cover, arc extinguishers and stationary contact assemblies.
2. Wipe contact surfaces with a clean cloth dipped in a chlorinated solvent. If surfaces are excessively oxidized or corroded, scrape lightly with a fine file before wiping.

It should be noted that removing the sealed cover of the type JA breaker voids the Underwriters' Laboratories, Inc., label.

Replacing Interchangeable Trip Unit, Types KA and HKA

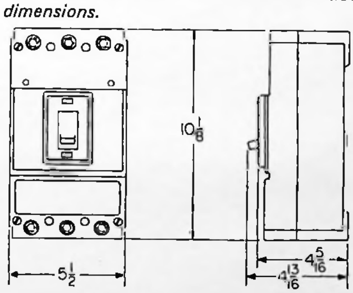
1. Remove circuit breaker from its mounting per instructions under "circuit breaker removal".
2. Remove cover by removing four screws.
3. Remove screws from the outer poles of the line side of the trip unit and loosen the screw in the center pole of the same side of the trip unit.
4. Lift trip unit from frame after removing the operating handle from its mounting.
5. Install new trip unit by reversing above procedure.
6. Before replacing frame cover and mounting circuit breaker, check for proper latching and closing. Perform latching and closing operations per instructions under "operation". Open and close breaker several times to make certain proper latching has been achieved.
7. Replace frame cover and mount circuit breaker.

Accessories and Modifications③

Accessories and modifications available include: alarm switch, auxiliary switch, shunt trip, undervoltage release, line terminal shields, plug-in adaptor kits, rear-connecting studs, center studs, mechanical interlocks, panelboard connectors, paralleling straps, motor operators, handle locking devices, moisture and fungus treatment.

Dimensions, Inches②

Not to be used for construction purposes. See Dimension Sheet 29-170 for detailed dimensions.



② 2-pole breakers supplied in 3-pole frames with center pole parts omitted.
③ Not Underwriters' Laboratories, Inc., listed.

Further Information

Prices: Price List 29-120
Dimensions: Dimension Sheet 29-170
Trip Curves: Application Data 29-160-A

Westinghouse Electric Corporation
Low Voltage Breaker Division, Beaver, Pa. 15009
Printed In USA

AMP INCORPORATED
HARRISBURG, PENNA.

AMP-LEAF ★
EXTRACTION TOOL
Catalog No. 465195-☐

IS	7045
REL.	7-17-62
REV.	

The Tool, see Figure 1, covered by this Instruction Sheet is used to extract AMP-Leaf Contacts from the Housings listed in Figure 2.

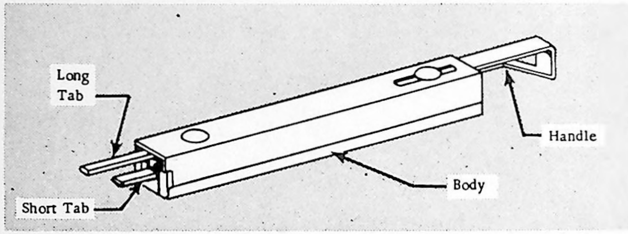


Fig. 1

TOOL NUMBER	USED ON HOUSING NO.	
465195-1	480110-☐	1-582147-☐
	480142-☐	582264-☐
	582140-☐	582358-☐
465195-2	480133-☐	1-582191-☐
	480146-☐	———
465195-3	480111-☐	———

Fig. 2

1. Insert Tabs into Mating Face of Cavity so that Long Tab fits into Offset in Cavity and Short Tab slides into Slot between Cavities. See Figure 3.
2. Make sure Tool is perpendicular to Mating Face of Housing.
3. Hold Tool firmly against Housing and push Handle in to remove Contact. See Figure 4.
4. When Contact is ejected, release Handle and remove Tool.

★ Trademark of AMP INCORPORATED

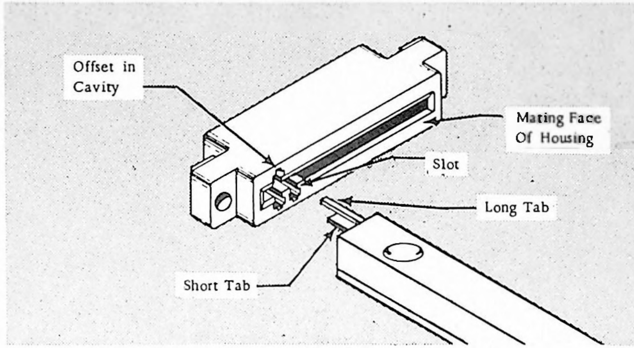


Fig. 3

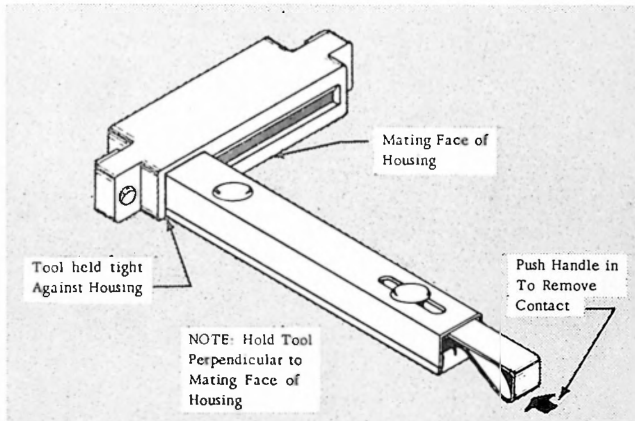


Fig. 4

AMP INCORPORATED
HARRISBURG, PA., U.S.A.

A-MP* N SERIES COAXICON* CONNECTORS

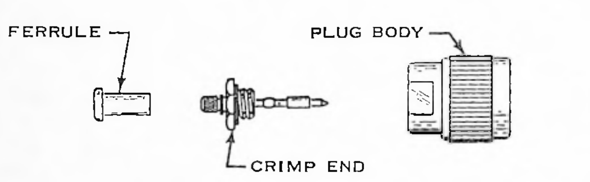
IS 2053
RELEASED 6-21-66
REVISED 9-10-69

SECTION I
SELECTION DATA

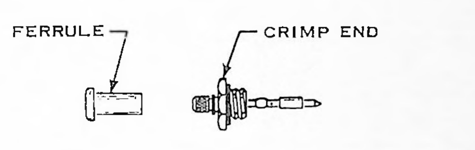
SEE SECTION II FOR WIRE STRIPPING AND CRIMPING PROCEDURE

N SERIES PLUGS

PLUG



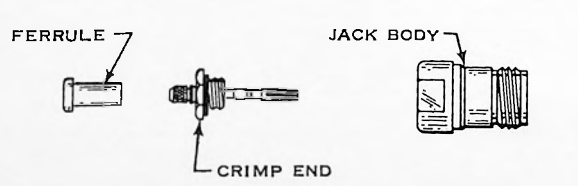
REPLACEMENT CRIMP END



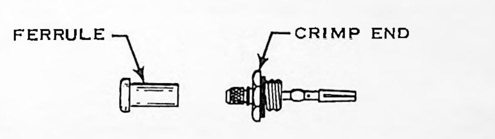
RG/U CABLE	PLUG NO.	DIELECTRIC MATERIAL	REPLACEMENT CRIMP END	FERRULE COLOR †	CRIMPING TOOL NO.	CRIMPING DIE NO.
58, 58B, 58C §	1-332243-5	TEFLON ●	1-332243-6	NATURAL (WHITE) 330927	69376-3	69815
55, 55A, 55B, 223	1-332243-1	TEFLON	1-332243-2	YELLOW 1-330927-0	69376-3	69815
141, 141A	1-332243-3	TEFLON	1-332243-4	NATURAL (WHITE) 330927	69376-1	69493
142, 142A, 142B	332243	TEFLON	1-332243-0	YELLOW 1-330927-0	69376	69493-1

N SERIES JACKS

JACK



REPLACEMENT CRIMP END



RG/U CABLE	JACK NO.	DIELECTRIC MATERIAL	REPLACEMENT CRIMP END	FERRULE COLOR †	CRIMPING TOOL NO.	CRIMPING DIE NO.
58, 58B, 58C §	1-332263-5	TEFLON ●	1-332263-6	NATURAL (WHITE) 330927	69376-3	69815
55, 55A, 55B, 223	1-332263-1	TEFLON	1-332263-2	YELLOW 1-330927-0	69376-3	69815
141, 141A	1-332263-3	TEFLON	1-332263-4	NATURAL (WHITE) 330927	69376-1	69493
142, 142A, 142B	332263	TEFLON	1-332263-0	YELLOW 1-330927-0	69376	69493-1

† NOTE: FERRULE PART NUMBERS ARE SHOWN FOR REFERENCE ONLY SINCE THEY ARE INCLUDED WITH ASSEMBLIES. COLOR OF FERRULE IS USED ONLY FOR FERRULE IDENTIFICATION.

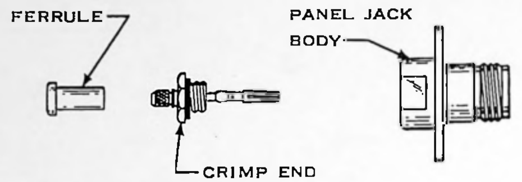
* TRADEMARK OF AMP INCORPORATED

● TRADEMARK OF E. I. DUPONT

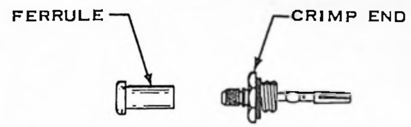
§ WHEN CONNECTORS ARE CRIMPED ON 58C CABLE, TOOL NO. 69376-1 OR INTERCHANGEABLE DIE NO. 69493 CAN ALSO BE USED.

N SERIES PANEL JACKS

PANEL JACK



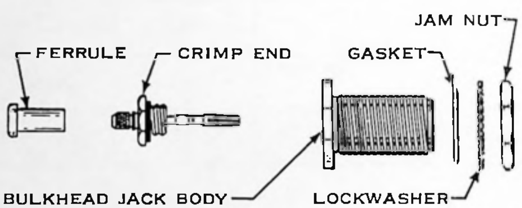
REPLACEMENT CRIMP END



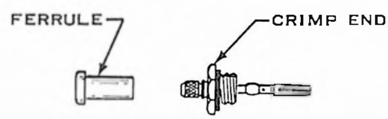
RG/U CABLE	PANEL JACK NO.	DIELECTRIC MATERIAL	REPLACEMENT CRIMP END	FERRULE COLOR†	CRIMPING TOOL NO.	CRIMPING DIE NO.
58, 58B, 58C §	1-332264-5	TEFLON ●	1-332264-6	NATURAL (WHITE) 330927	69376-3	69815
55, 55A, 55B, 223	1-332264-1	TEFLON	1-332264-2	YELLOW 1-330927-0	69376-3	69815
141, 141A	1-332264-3	TEFLON	1-332264-4	NATURAL (WHITE) 330927	69376-1	69493
142, 142A, 142B	332264	TEFLON	1-332264-0	YELLOW 1-330927-0	69376	69493-1

N SERIES BULKHEAD JACKS

BULKHEAD JACK



REPLACEMENT CRIMP END



RG/U CABLE	BULKHEAD JACK NO.	DIELECTRIC MATERIAL	REPLACEMENT CRIMP END	FERRULE COLOR†	CRIMPING TOOL NO.	CRIMPING DIE NO.
58, 58B, 58C §	1-332262-5	TEFLON ●	1-332262-6	NATURAL (WHITE) 330927	69376-3	69815
55, 55A, 55B, 223	1-332262-1	TEFLON	1-332262-2	YELLOW 1-330927-0	69376-3	69815
141, 141A	1-332262-3	TEFLON	1-332262-4	NATURAL (WHITE) 330927	69376-1	69493
142, 142A, 142B	332262	TEFLON	1-332262-0	YELLOW 1-330927-0	69376	69493-1

SECTION II
HAND TOOL CRIMPING PROCEDURE

The following application procedure applies to A-MP N Series Coaxial Cable Connectors. These Connectors include N Series Bodies and Replacement-Type crimp ends. First, the Ferrule is slipped on the Cable and the Cable stripped. The Cable is then inserted into the Crimp End and the Braid Ferrule positioned over the Braid. The Assembly is then placed in the proper A-MP Hand Tool or Pneumatic Tool Die. Both the Braid Ferrule and Center Contact are crimped with a single stroke of the Tool or Die. The Crimp End is then threaded into the Connector Body to complete the assembly. Along with the Plug and Jack, there is also available a Panel Jack and a Bulkhead Jack.

Refer to Section I for the selection of A-MP N Series Connectors and Tooling.

1. CRIMPING TOOLS

The Hand Tools contain a "quick take-up" device, or Handle, on the CERTI-CRIMP* Ratchet Assembly. To close Tool Handles, this small Handle on the Ratchet Assembly is pulled toward Tool Handle. See Figure 1. Both Tool Handles are then closed to complete crimp.

To satisfy preference of individual operators to crimp with either hand, Tool Head can be reversed on Tool Handles.

To reverse Head, first remove Retaining Rings and Pins from ends of Handles. Turn Tool Head 180°, as shown in Figure 2, and re-assemble Pins and Retaining Rings.

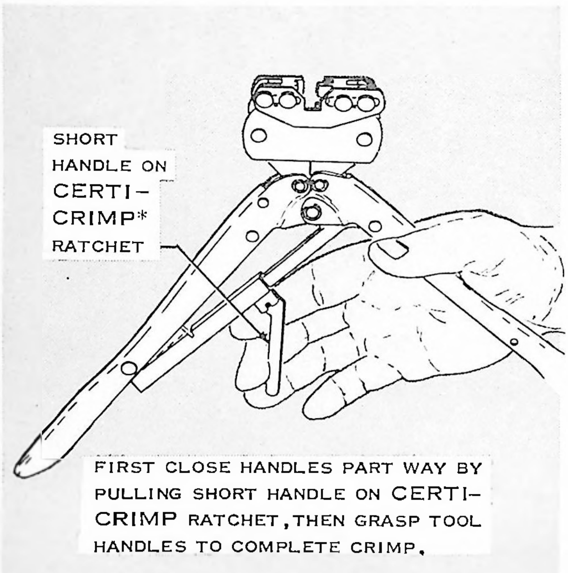


FIG. 1

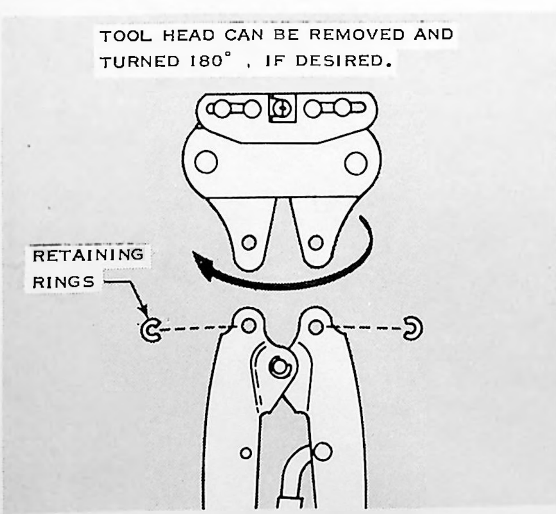


FIG. 2

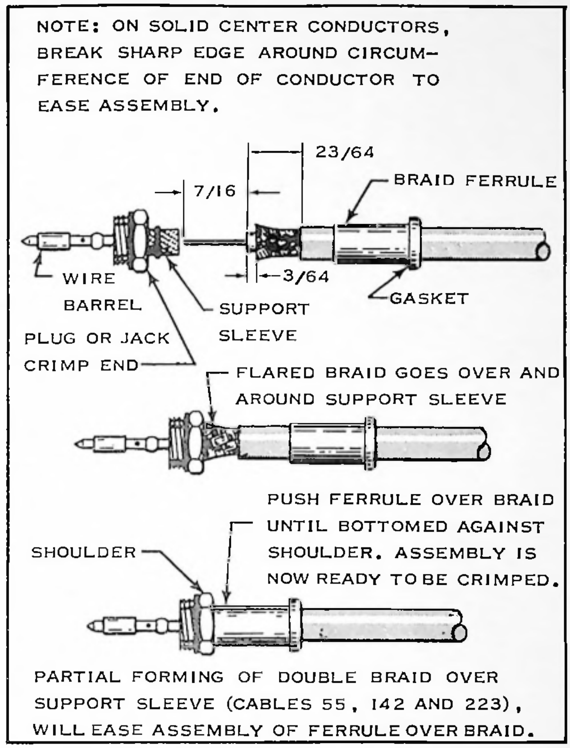


FIG. 3

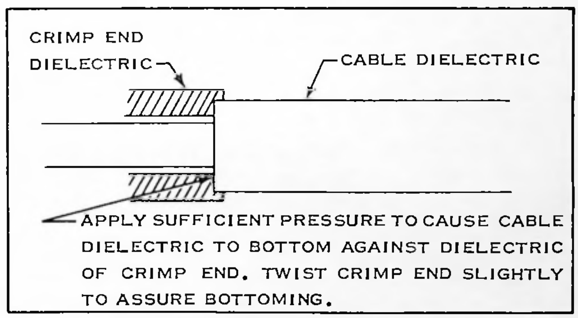


FIG. 4

2. CRIMP END ASSEMBLY

(a) Slide Ferrule, with end containing Rubber Gasket first, on Cable. Strip Cable to dimensions shown in Figure 3.

(b) Flare Braid as shown in Figure 3.

(c) Hold Ferrule in place and insert stripped Conductor into Wire Barrel on Plug or Jack Crimp End. Twist Plug or Jack Crimp End slightly to ease entry of wire. Braid passes over and around Support Sleeve. See Figure 3.

(d) Push Crimp End back under Braid. Apply sufficient pressure to cause Cable Dielectric to bottom against Dielectric of Crimp End, see Figure 4. Twist Crimp End slightly to assure bottoming.

(e) Slide Ferrule forward and over Support Sleeve on Plug or Jack Crimp End as far as it will go. Plug or Jack Crimp End is now ready to be crimped. See Figure 3.

NOTE: The Crimp End Assembly Procedure is the same for all Plugs and the Jacks.

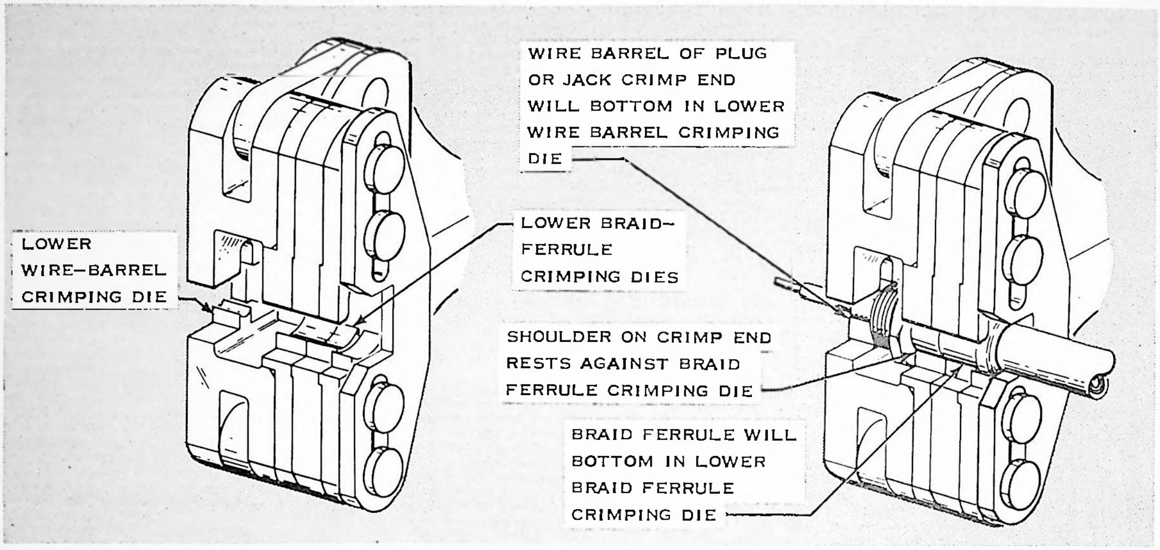


FIG. 5

3. CRIMPING PROCEDURE

(a) To open Tool Handles, close Handles until CERTI-CRIMP Ratchet, see Figure 5, releases. Note that once Ratchet is engaged, the Handles cannot be opened until they are fully closed.

(b) The Crimping Tool has multiple sets of Dies, see Figure 5, to crimp the Braid Ferrule and Wire Barrel of Jack or Plug Crimp End. Ferrule and Wire Barrel are crimped at the same time.

(c) Place the Jack or Plug Crimp End in Crimping Dies as shown in Figure 5.

(d) Make certain that Wire Barrel of Plug or Jack Crimp End is bottomed in Crimping Die.

(e) Braid Ferrule should be bottomed against the Lower Braid Ferrule Crimping Die with Shoulder on Plug or Jack Crimp End resting against Die. See Figure 5.

(f) Hold Assembly in place and complete crimp by closing Handles until CERTI-CRIMP Ratchet releases. Handles will open automatically.

(g) Crimp End can now be threaded into the proper Connector Body. Use a wrench on flats to tighten.

4. PANEL CUT-OUT DIMENSIONS

Use dimensions shown in Figure 6 for cut-out for Panel Jacks. Push crimped Panel Jack through hole and attach with four 4-40 screws. Hardware is not supplied by AMP Incorporated.

For Bulkhead Jacks, use dimensions shown in Figure 7. Insert Jack thru Hole and assemble Lock Washer and Nut.

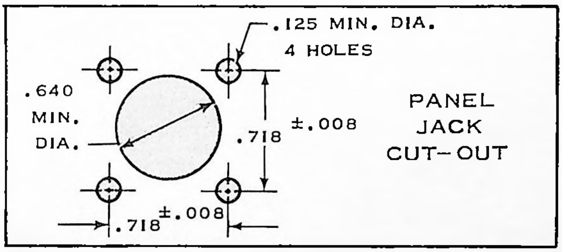


FIG. 6

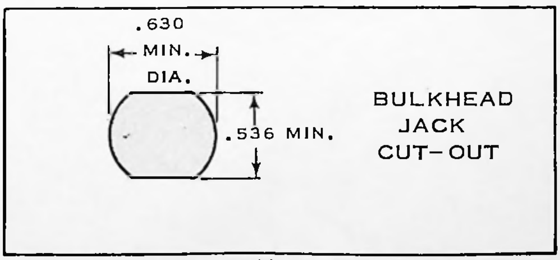


FIG. 7

SECTION III
INTERCHANGEABLE CRIMPING DIES

USE IN PNEUMATIC TOOL NO. 69365 OR HAND TOOL NO. 69710

SEE SECTION I FOR SELECTION DATA
SEE SECTION II FOR WIRE STRIPPING AND ASSEMBLY PROCEDURE

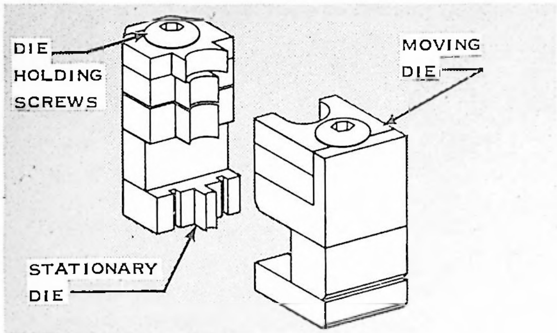


FIG. 1

I. The A-MP Crimping Dies listed in Section I are used in the Tools listed above. First read the instructions shipped with Tool for information concerning Die Insertion, Crimping Procedure and General Tool Performance. Then refer to selection charts in Section I for proper Connectors and Cables to use. Section II contains information concerning Cable Strip Lengths and assembly of Connectors for crimping.

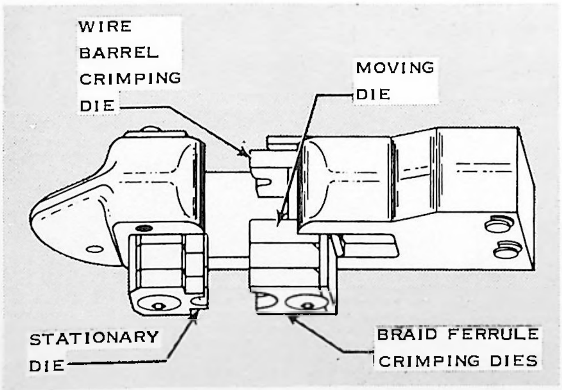


FIG. 2

2. CRIMPING PROCEDURE

(a) Place Crimping Dies in Tool.

(b) The Die Assemblies have multiple sets of Crimping Dies, see Figures 1 and 2, to crimp the Braid Ferrule and Wire Barrel of Jack or Plug Crimp End. Ferrule and Wire Barrel are crimped at the same time.

(c) Place the Jack or Plug Crimp End in Crimping Dies as shown in Figure 3.

(d) Make certain that Wire Barrel of Plug or Jack Crimp End is bottomed in Crimping Die.

(e) Braid Ferrule should now be bottomed against the Lower Braid Ferrule Crimping Die with Shoulder on Plug or Jack Crimp End resting against Die. See Figure 3.

(f) Hold Assembly in place and complete crimp.

(g) Remove crimped Assembly from Crimping Dies.

(h) Refer to Section II for additional information concerning Connectors.

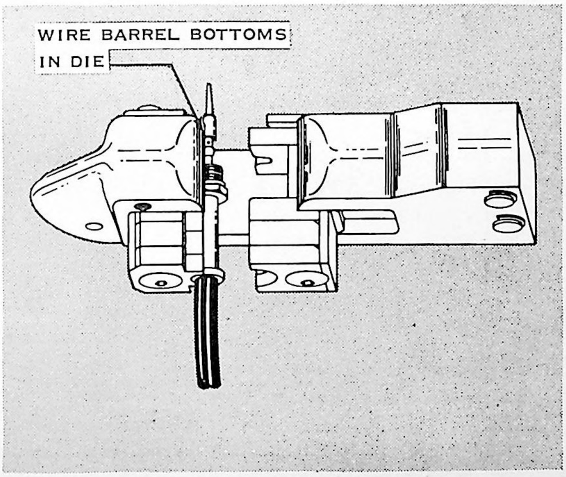


FIG. 3

AMP INCORPORATED
HARRISBURG, PA., U.S.A.

A-MP★ HAND TOOL 90119 FOR CRIMPING TAPER PINS

IS 7156

RELEASED	4·7·64
REVISED	5·8·69

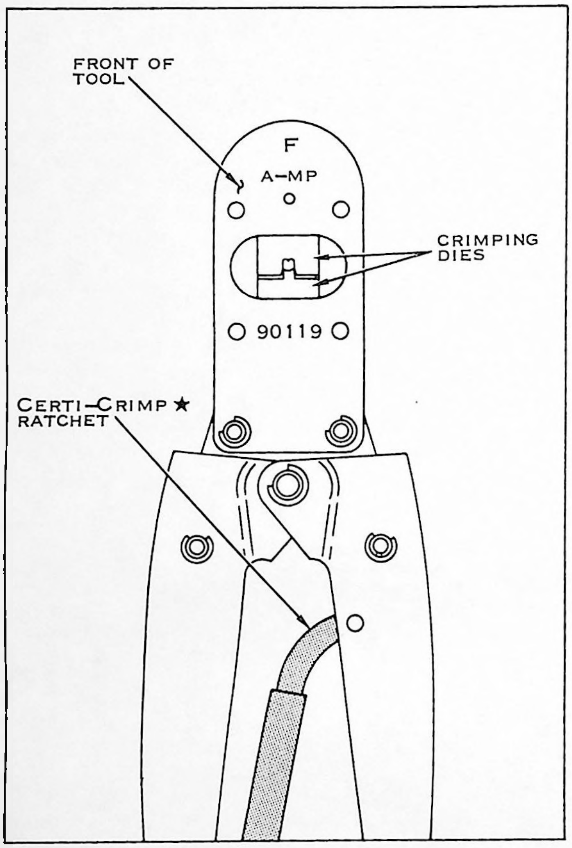


FIGURE 1

1. INTRODUCTION

We recommend this tool for crimping the Taper Pin listed in Figure 2. The tool has a terminal locator and a Certi-Crimp★ ratchet. We will explain more about these features later.

2. IMPORTANT INFORMATION

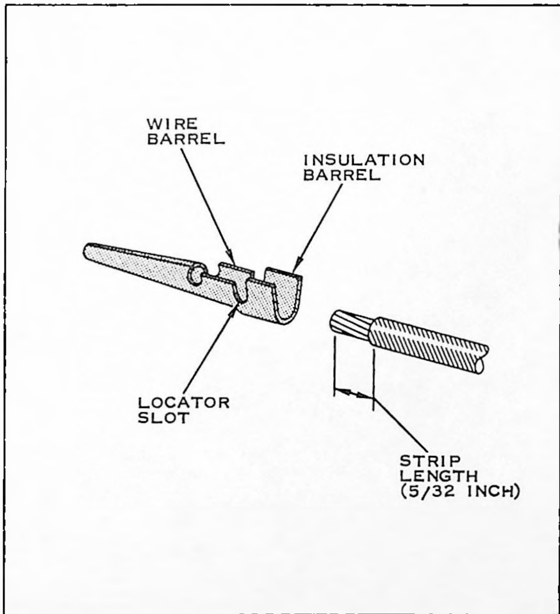
Before you start, check the following in Figure 2:

WIRE SIZE & INSULATION SIZE - Make sure your wire and insulation are within this range.

TERMINAL NUMBER - We recommend loose piece terminals for crimping. Do not cut strip terminals into loose piece form.

WIRE TYPE - Either solid or stranded wire can be crimped.

WIRE STRIP LENGTH - Strip your wire to the length shown. Do not crimp wire that has cut or nicked strands.



WIRE SIZE	TERMINAL NUMBER		INSUL. DIA.	WIRE TYPE
	LP	STRIP		
26–20	66141–☐	66140–☐	.048–.071	SOLID & STRANDED

FIGURE 2

3. CRIMPING PROCEDURE

The Certi-Crimp ratchet ensures a complete crimp of the terminal. When you squeeze the tool handles, the ratchet engages. You can't open the handles now until you close them all the way.

Select a terminal, and crimp it as follows:

1. Open the Tool Handles, and place your terminal in the tool as we've shown in Figure 3. Make sure you've placed the tool's Locator in the slot between the insulation barrel and wire barrel of the terminal.

2. Hold the terminal in place, and squeeze the Tool Handles until the Crimping Dies close on the terminal. You should close them just enough to hold the terminal in place. DO NOT DEFORM THE INSULATION BARREL OR WIRE BARREL.

3. Insert your stripped wire into the terminal. Insert it until the wire's insulation butts against the Locator.

4. While you hold the wire in place, squeeze the Tool Handles until the Ratchet releases. The crimp is finished. Remove the crimped terminal from the tool.

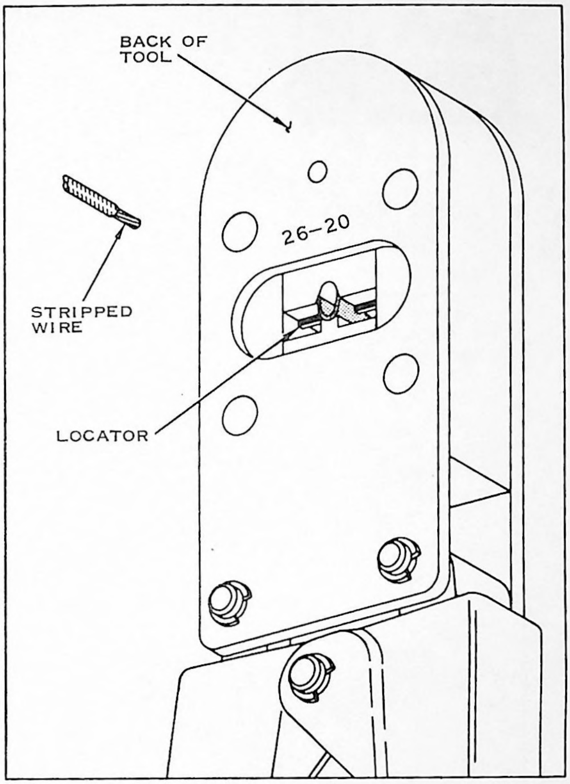


FIGURE 3

4. MAINTENANCE

Oil all Pins, Pivot Points, and Bearing Surfaces of the tool. You may use any good S.A.E. No. 20 Motor Oil. When you are not using the tool, keep the handles closed. This will keep objects from getting stuck in the Crimping Dies.

AMP INCORPORATED
HARRISBURG, PA., U.S.A.

A-MP★ HAND TOOLS FOR CRIMPING A-MP TAPER PINS

IS 7343

RELEASED	10·23·67
REVISED	1·13·69

1. INTRODUCTION

We recommend these tools for crimping the Taper Pins listed in Figure 2.

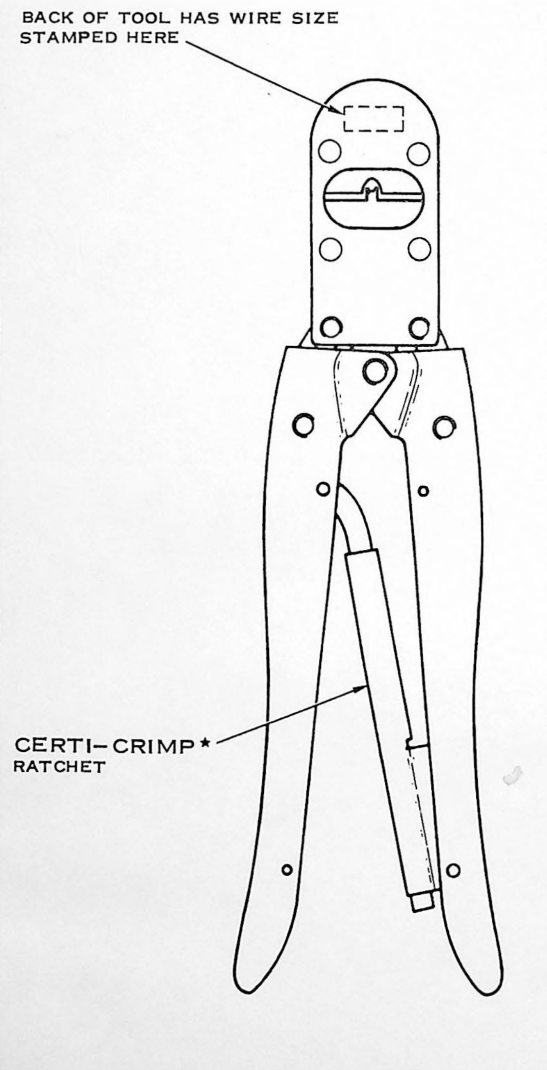


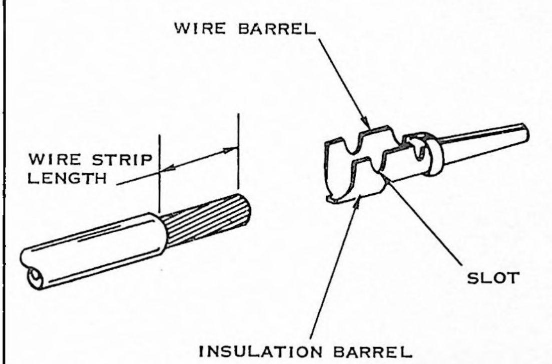
FIGURE 1

2. IMPORTANT DATA

Before crimping Taper Pins check the following information in Figure 2.

WIRE SIZE and INSULATION DIAMETER - Make sure both wire and insulation are within this range.

TAPER PIN NUMBER - Order LOOSE-PIECE Terminals. Do not cut strip-form terminals into loose-piece form.



WIRE SIZE	INSULATION DIAMETER	TAPER PIN NUMBER	HAND TOOL NUMBER	WIRE STRIP LENGTH
20–18	.050–.075	66281 (66267LP)	90214–1	13/64"
30–26	.030–.050	66354	90206–1	11/64"
	.036 MAX.	(66353LP)	90206–2	

FIGURE 2

HAND TOOL NUMBER - This tool is recommended only with the terminal listed.

WIRE STRIP LENGTH - Do not crimp wires that are cut or nicked when the insulation is stripped.

3. CRIMPING PROCEDURE

Each Tool is equipped with a CERTI-CRIMP Ratchet to ensure proper crimping. When the Ratchet is engaged, the Tool Handles cannot be opened until they are fully closed.

★ TRADEMARK OF AMP INCORPORATED

Crimp a Taper Pin as follows:

1. Open the Tool Handles, and place the Taper Pin in the Tool as shown in Figure 3. Make sure the Locator fits into the slot between the Taper Pin's wire barrel and insulation barrel.

2. Squeeze the Handles until the Crimping Inserts close just enough to retain the Taper Pin. DO NOT DEFORM THE INSULATION BARREL OR WIRE BARREL.

3. Insert the stripped wire into the Taper Pin, until the Wire Insulation butts against the Locator.

4. Hold the Wire in place, and squeeze the Handles until the CERTI-CRIMP Ratchet releases. Remove the crimped Taper Pin from the Tool.

4. MAINTENANCE

Lubricate all pins, pivot points, and bearing surfaces of the Tool with any good S.A.E. No. 20 Motor Oil. When the Tool is not in use, keep the Handles closed far enough to prevent objects from becoming lodged in the Crimping Inserts.

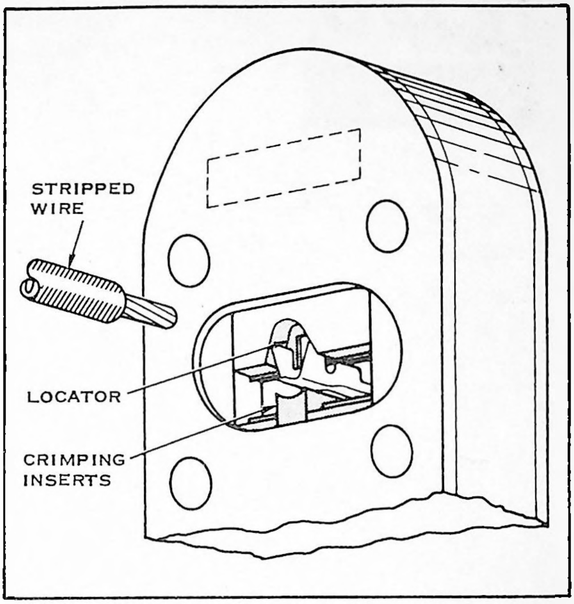


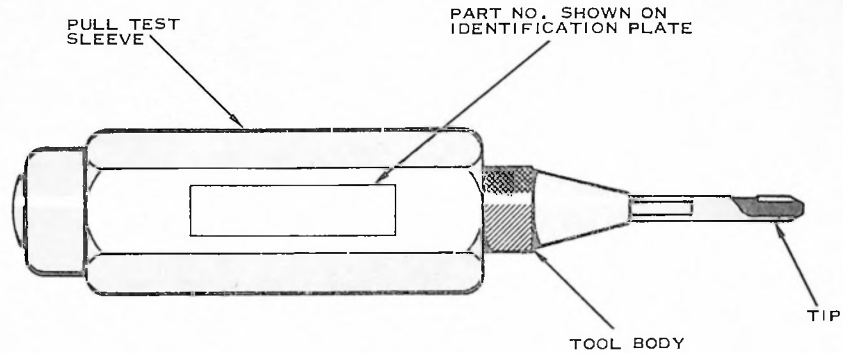
FIGURE 3

AMP INCORPORATED
HARRISBURG, PA., U.S.A.

A-MP★ CERTI-LOK★ TAPER PIN INSERTION TOOL (WITH PULL TEST) (CATALOG NO. 380310-☐)

IS 7076

RELEASED	3·29·63
REVISED	11·5·68



INSERT TERMINAL NUMBER					INTO OR ONTO	WITH TOOL NO.
41278	41640	41862	42600	66113	RECEPTACLES IN RESILIENT MAT'L	380310-1
41496	41646				RECEPTACLES IN RIGID MATERIAL	380310-2
41222	41650	41655	41864	42773	RECEPTACLES IN RIGID MATERIAL	380310-3
41223	41651	41656	41865	60066		
41647	41652	41657	41991			
41648	41653	41658	41992		RECEPTACLES IN RESILIENT MAT'L	380310-4
41649	41654	41863	42229			
42107					RECEPTACLES IN RESILIENT MAT'L	380310-7
					RECEPTACLES IN RIGID MATERIAL	380310-8
66235					RECEPTACLES IN RIGID MATERIAL	380310-9

NOTE RESILIENT MATERIAL IS A MATERIAL SUCH AS SOFT RUBBER, POLYURETHANE, ETC.

FIGURE 1

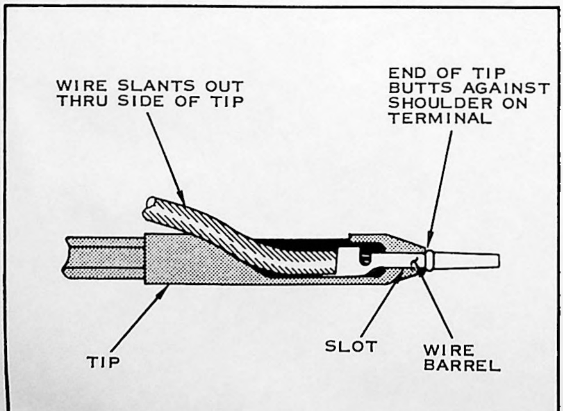


FIGURE 2

1. Select the recommended Insertion Tool from the chart in Figure 1. Insertion Tools listed are used with both A-MP Strip Terminals and Loose Piece equivalents.

2. Place the Wire Barrel of the Terminal into the Slot in the Tip of the Tool. See Figure 2. The end of the Tip must butt against the Shoulder of the Terminal.

3. Let the Wire slant out through the side of the Tip. Use your finger to hold the Terminal in the Tip. See Figure 2.

4. Align the Tool to provide clearance for removing the Tool from the Terminal after insertion.

5. With the Terminal in the Tip, insert the Terminal into the Receptacle. See Figure 3.

★ TRADEMARK OF AMP INCORPORATED

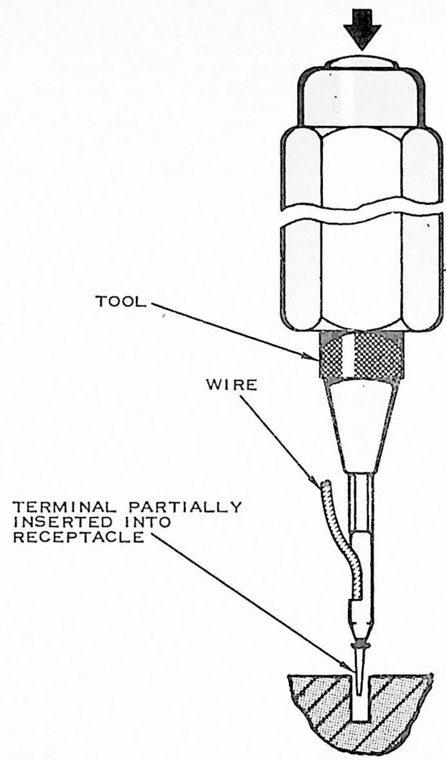


FIGURE 3

NOTE While inserting the Terminal, keep the Tool, Terminal and Receptacle in a straight line.

6. With a straight, steady motion, push the Tool toward the Receptacle until the Tool trips. Use only ONE stroke for each insertion. Extra strokes may damage the Receptacle.

7. To test the connection, slowly pull the Sleeve until it just moves on the Tool.

8. If the Terminal remains in place, the Connection is good. If the Terminal pulls out, repeat Steps 3 thru 8. If the Terminal pulls out again, check the Receptacle.

9. Remove the Tool from the Terminal. Do not bend or twist the Terminal. If the Terminal is bent or twisted during the Tool removal, remove and reinsert the Terminal.

NOTE For Tool Certification, see AMP Customer Drawing No. C-380310.

AMP INCORPORATED
HARRISBURG, PA. U.S.A.

A-MP★ HAND TOOL 47150 FOR CRIMPING INSULATION PIERCING TAPER PINS

IS 1615
RELEASED 5·26·60
REVISED 3·13·69

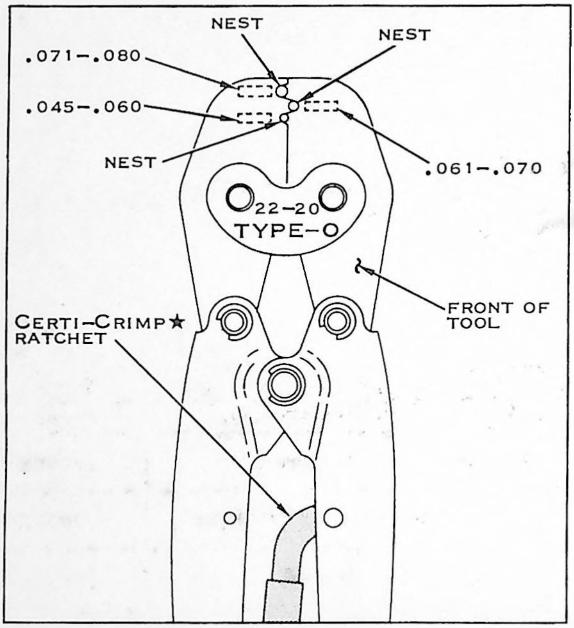


FIGURE 1

INSULATION RANGE	TAPER PIN NO.	CRIMP SECTION MARKING	INSERTION TOOL NO.
.048–.054	40750 41034 41405 42388–1 42391–1	.045–.060	811034–2
.055–.060	41224 41641 41744 41279	.045–.060	811034–3
.065–.071	40628 40669 41686 41752 42386–1 42387–1 42681–1 42681–2 42753–1	.061–.070	811034–2
.070–.076	42004–1 42004–0	.071–.080	811034–2

FIGURE 2

1. INTRODUCTION

We recommend this tool for crimping the Taper Pins listed in Figure 2. The terminals must fall within these insulation ranges:

.045 - .060 inches
.061 - .070 inches
.071 - .080 inches

The three crimping sections of the tool match the insulation ranges.

2. CRIMPING PROCEDURE

The tool's Certi-Crimp★ ratchet ensures a complete crimp of the terminal. When you squeeze the tool handles, the ratchet engages. You can't open the handles now until you close them all the way.

Select a terminal, and crimp it as follows:

1. Open the Tool Handles, and center the terminal's wire barrel in the Crimping Jaws as shown in Figure 3. Make sure the terminal's open barrel is opposite the nest.

2. Hold the terminal in place, and squeeze the Tool Handles until the Crimping Jaws close on the terminal. You should close them just enough to hold the terminal in place. DO NOT DEFORM THE WIRE BARREL.

3. Insert your wire into the terminal.

4. While you hold the wire in place, squeeze the Tool Handles until the Ratchet releases. Your crimp is finished. Remove the crimped terminal from the tool.

3. MAINTENANCE

Oil all Pins, Pivot Points, and Bearing Surfaces of the tool. You may use any good S.A.E. No. 20 Motor Oil. When you are not using the tool, keep the handles closed. This will keep objects from getting stuck in the Crimping Jaws.

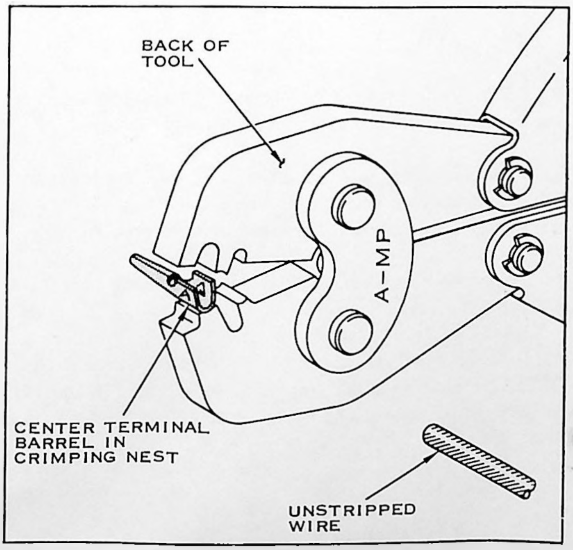


FIGURE 3

★ Trademark of AMP Incorporated

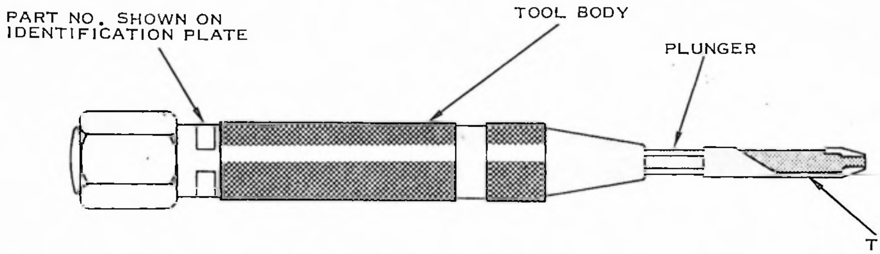
AMP INCORPORATED
HARRISBURG, PA., U.S.A.

A-MP★ CERTI-LOK★ TAPER PIN INSERTION TOOL

(CATALOG NO. 380306-□)

IS 7075

RELEASED	2·20·63
REVISED	4·21·69



INSERT TERMINAL NO.					INTO OR ONTO	WITH TOOL NO.
41278 41496 66266	41640 41646 66346	41862 42600 42762	66113 66353	66091 66186	RECEPTACLES IN RESILIENT MATERIAL	380306-1
					RECEPTACLES IN RIGID MATERIAL	380306-2
41222 41223 41647 41648 41649	41650 41651 41652 41653 41654 66200	41655 41656 41657 41658 41863 60183	41864 41865 41991 41992 42229 66202	42773 60066 66268 42682 66033 66267	RECEPTACLES IN RIGID MATERIAL	380306-3
					RECEPTACLES IN RESILIENT MATERIAL	380306-4
41355 41643	41868 42213	42471 42529	60015 41335	41642 60068 60512	TAPER TABS OR TAPER PINS	380306-5
41756	41757 41758	41913 41914	41915		TAPER TABS	380306-6
42107					RECEPTACLES IN RESILIENT MATERIAL	380306-7
					RECEPTACLES IN RIGID MATERIAL	380306-8
41629 41756 41757	41630 41913 41914	41631 42554 42371	41758 60513	41915 41625	TAPER TABS	1-380306-0

NOTE RESILIENT MATERIAL IS A MATERIAL SUCH AS SOFT RUBBER, POLYURETHANE, ETC.
INSERTION TOOLS LISTED ARE USED WITH BOTH A-MP STRIP TERMINALS AND LOOSE PIECE EQUIVALENTS.

FIGURE 1

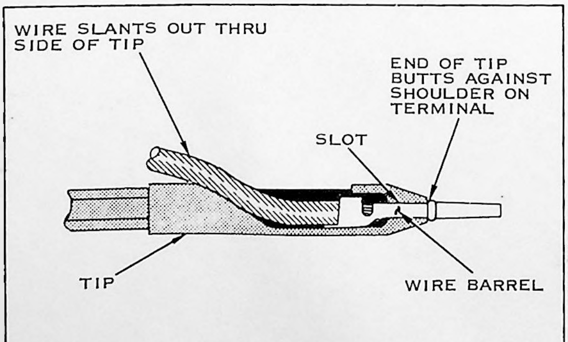


FIGURE 2

1. Select the recommended Insertion Tool from the chart in Figure 1.

2. Place the Wire Barrel of the Terminal into the Slot in the Tip of the Tool. See Figure 2. The end of the Tip must butt against the shoulder.

3. Let the Wire slant out thru the side of the Tip. Use your finger to hold the Terminal in the Tip. See Figure 2.

4. The Back of the Tool Tip must have clearance to move away from each inserted Taper Pin; a Taper Pin next to the Back will not provide proper clearance. Make sure you fill the Receptacle Cavities in a sequence that will allow for Tool removal. See Figure 3.

★TRADEMARK OF AMP INCORPORATED

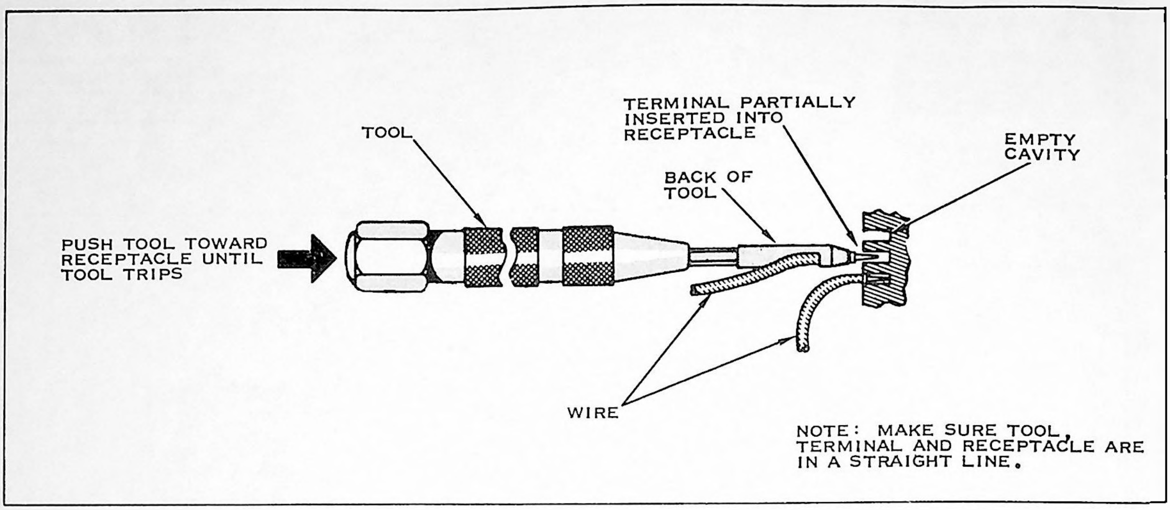


FIGURE 3

5. With the Terminal in the Tip, insert the Terminal into the Receptacle. See Figure 3. While inserting the Terminal keep the Tool, Terminal and Receptacle in a straight line. See Figure 3.

CAUTION Make sure the tip is seated against the tool's plunger. If loose, the tip could break.

6. With a straight, steady motion, push the Tool toward the Receptacle until the Tool trips. Use only ONE stroke for each insertion. Extra strokes may damage the Receptacle.

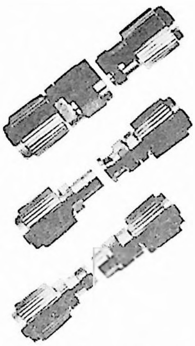
7. Remove the Tool from the Terminal. Do not bend or twist the Terminal. If the Terminal is bent or twisted during removal of the Tool, remove and reinsert the Terminal.

NOTE For Tool Certification, see AMP Customer Drawing No. C-380306.

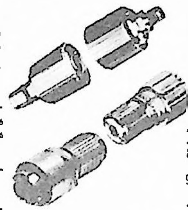
PRECISION ADAPTERS AND RF CRIMPING TOOLS

BUNKER RAMO AMPHENOL

Precision Adapters For APC-7



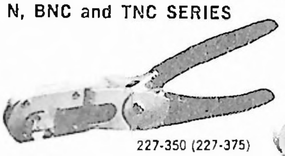
	Part No.	Maximum SWR For a Single Adapter	Dimens., Ins. Length	O.D.
APC-7 TO N				
female male	131-1025 131-1035	1.03 @ 4 GHz 1.04 @ 9 GHz 1.08 @18 GHz	1 43/64 1 13/16	13/16 13/16
APC-7 TO BNC				
female male	131-1027 131-1037	1.035@ 4 GHz 1.045@ 9 GHz 1.08 @12 GHz 1.12 @18 GHz	1 39/64 1 23/32	13/16 13/16
APC-7 TO TNC				
female male	131-1026 131-1036	same as BNC	1 39/64 1 3/4	13/16 13/16



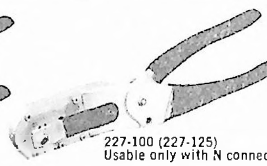
	Part No.	Maximum SWR For a Single Adapter	Dimens., Ins. Length	O.D.
APC-7 TO SMA				
female	131-1028	1.07 @12.4 GHz	1 11/32	13/16
male	131-1038	1.15 @18 GHz	1 3/8	13/16
APC-7 TO GR				
874 900	131-1022 or GR874-QAP7L* 131-1023 or GR900-QAP7*	1.04 @ 4 GHz 1.06 @ 9 GHz 1.011@ 4 GHz 1.021@ 8.5 GHz	2 1/16 2 3/16	1 1 1/16

* Available from General Radio and Amphenol.

N, BNC and TNC SERIES



227-350 (227-375)



227-100 (227-125)
Usable only with N connectors

Braid Crimp Tools
Meet MIL-T-55619 (proposed) for MIL-C-39012 Crimp Connectors.

Crimp Tools

The crimp tools selected for use with Amphenol crimp connectors have been designed for superior performance over a considerable period. The most commonly used crimp tools are shown below. The Amphenol Tool Number is given first and in parenthesis, other tools which are very similar in appearance. Refer to the Tool Summary for detailed application for each tool.

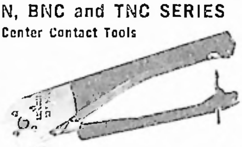
BRAID CRIMP TOOL SUMMARY

Series	type of crimp Description &	Tool No.	Die No.	Die Cavity No.	Die Setting ±.003"	For use with RG-/U Cables
N	MIL-Crimp (Hex)	227-350▲	227-920-1	A	.213	55, 58, 141, 142, 223
		227-375▲	227-920-2	D	.255	59, 62, 140, 210
				C	.268	71
		227-100▲■	227-920-3	E	.415	8, 9, 11, 149, 213, 214
		227-125▲■	227-920-4	G	.324	5, 21, 143, 212, 222
BNC and TNC	MIL-Crimp and Quick-Crimp (Hex)	227-350▲	227-920-1	A	.213	55, 58, 141, 142, 223
				B	.178	122, 174, 179, 180, 187, 189, 195
		227-375▲	227-920-2	D	.255	59, 62, 140, 210
				C	.268	71
	Original Crimp*(Hex)	WT-200(T&B)	—	—	.128	174, 179, 187, 188
SUB-Minax 27	Radial Crimp	227-900	May Require Adapter - see p. 27-9, Cable Ass'y Instr.	—	—	174, 179, 187, 188
		227-901		—	—	180, 195
	Quick-Crimp (Hex)	WT-200(T&B)	—	—	.128	174, 177, 187, 188
		WT-203(T&B)	—	—	.178	180, 195, 21-597
SUB-Minax 5116	Quick-Crimp (Inner Braid)	227-911	—	—	Contact Factory	174, 178, 179, 180, 187, 188, 195, 196
MB, SM	Crimp (Inner Braid)	Standard Pliers	—	M	M	174, 178, 179, 180, 187, 188, 195, 196
MHV	Original Crimp (Hex)	Same as BNC/TNC	—	—	—	55, 58, 141, 142, 223
UHF	Quick-Crimp (Hex)	WT-218(T&B)	—	—	.384	8, 11, 149, 213
		227-350▲	227-920-1	A	.213	55, 58, 141, 142, 223
		227-375▲	227-920-2	D	.255	59, 62, 140, 210

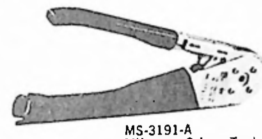
Notes: * Original Crimp, same as MIL- and Quick-Crimp except for the cables shown
(T&B) Manufactured and available from Thomas & Betts Co., Elizabeth, New Jersey
▲ Same tool frame no. 227-921 may be used with any intecrhangeable 227-920- type die
■ Tool and appropriate die have capability as well of hex crimping center contacts for all the cables listed here for the N Series
All Tools are supplied with Dies or Bushings unless noted otherwise

N, BNC and TNC SERIES

Center Contact Tools



227-932-1 (227-932-2, 3)



MS-3191-A
Mil-spec Crimp Tool

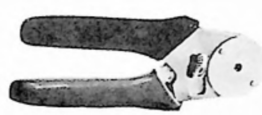
227-927
Usable only with BNC/TNC connectors

SUBMINAX 27 SERIES

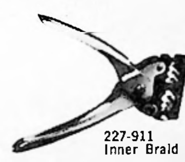
227-900 (227-901)
Radial Crimp Tool

WT-203 (WT-200)
Quick-Crimp Tool

SUBMINAX 5116 SERIES



227-926
Center Contact Tool



227-911
Inner Braid Tool

CENTER CRIMP TOOL SUMMARY

Series	Description & type of crimp	Tool No.	Bushing No.	Die Cavity No.	Die Setting (+.001)	For use with RG-/U Cables
N	MIL-Crimp (4-Indent)	227-932-3△	—	—	.087	5, 8, 9, 11, 21, 55, 58, 59, 62, 71, 140, 141, 142, 143, 149, 210, 212, 213, 214, 222, 223
	MIL-Crimp (Hex)	227-100□	227-920-3	F	(±.002) .100	
		227-125□	227-920-4	H		
BNC and TNC	MIL-Crimp and Quick-Crimp (4-Indent)	227-932-1△	227-1157	—	.058	55, 58, 59, 62, 71, 122, 140, 141, 142, 174, 179, 180, 187, 188, 195, 210, 223
		227-927°	—	—	.058	
		MS-3191A (Mil. Spec. Tool) (not avail. RF)	order separately 227-918 (MIL-Crimp Male) 227-919 (MIL-Crimp Female) 227-1156 (Quick-Crimp M & F)	—	.058	
5116	Quick-Crimp (4-Indent)	227-926	—	—	.034	174, 178, 179, 180, 187, 188, 195, 196

□ Tool and appropriate die have capability as well of braid crimping certain cable sizes — see Braid Crimp Tool Summary

△ Same tool frame no. 227-1189, may be used with either Bushing no. 227-1194, 227-1157 or 227-1199