TECHNICAL MANUAL

HT 35CD - 994 9571 001
HT 30CD - 994 9570 001

988-2385-001

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T.M. No. 888-2385-001

Printed: January 1996
Rev. N1: 01-28-2003

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Returns And Exchanges

Damaged or undamaged equipment should not be returned unless written approval and a Return Authorization is received from HARRIS CORPORATION, Broadcast Systems Division. Special shipping instructions and coding will be provided to assure proper handling. Complete details regarding circumstances and reasons for return are to be included in the request for return. Custom equipment or special order equipment is not returnable. In those instances where return or exchange of equipment is at the request of the customer, or convenience of the customer, a restocking fee will be charged. All returns will be sent freight prepaid and properly insured by the customer. When communicating with HARRIS CORPORATION, Broadcast Systems Division, specify the HARRIS Order Number or Invoice Number.

Unpacking

Carefully unpack the equipment and preform a visual inspection to determine that no apparent damage was incurred during shipment. Retain the shipping materials until it has been determined that all received equipment is not damaged. Locate and retain all PACKING CHECK LISTs. Use the PACKING CHECK LIST to help locate and identify any components or assemblies which are removed for shipping and must be reinstalled. Also remove any shipping supports, straps, and packing materials prior to initial turn on.

Technical Assistance

HARRIS Technical and Troubleshooting assistance is available from HARRIS Field Service during normal business hours (8:00 AM - 5:00 PM Central Time). Emergency service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, HARRIS CORPORATION, Broadcast Systems Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. Technical Support by e-mail: *tsupport@harris.com*. The HARRIS factory may also be contacted through a FAX facility (217/221-7096).

Replaceable Parts Service

Replacement parts are available 24 hours a day, seven days a week from the HARRIS Service Parts Department. Telephone 217/222-8200 to contact the service parts department or address correspondence to Service Parts Department, HARRIS CORPORATION, Broadcast Systems Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a FAX facility (217/221-7096).

NOTE

The # symbol used in the parts list means used with (e.g. #C001 = used with C001).

MANUAL REVISION HISTORY HT 30/35CD 988-2385-001			
REV. #	DATE	ECN	Pages Affected
001-A	02-05-96	41077R	Replaced Title Page and pages 2-35, 2-43, 7-3 to 7-7 & A-2 Added Manual Revision History Page
001-B	02-09-96	41076A	Replaced Title Page, MRH-1/MRH-2, and pages 7-1 to 7-3 and 7-9 to 7-14
001-C	03-05-96	41077R1	Replaced Title Page, MRH-1/MRH-2, and pages 7-3 to 7-6
001-D	07-10-96	41259A	Replaced Title Page, MRH-1/MRH-2, and pages iv, 7-11, & C-1 (remainder of section C removed)
001-E	07-24-96	TPD	Replaced Title Page, MRH-1/MRH-2, and all of Section B
001-E1	06-11-97	41662	Replaced Title Page, MRH-1/MRH-2, and all of Section VII
001-F	11-03-97	41997A	Replaced Title Page, MRH-1/MRH-2, and pages iv thru vi, 3-6, 3-9, 3-17, all of Section V, Q-1, and all of Section W.
001-F1	03-31-98	41969	Replaced Title Page, MRH-1/MRH-2, and all of Section VII
001-G	05-20-99	42921	Replaced Title Page, MRH-1/MRH-2, and pages 2-35, 2-43, and A-2
001-H	08-09-99	45040	Replaced Title Page, MRH-1/MRH-2, and pages 2-21 and 2-22
001-H1	10-22-99	45224	Replaced Title Page, MRH-1/MRH-2, and all of Section VII
001-h2	11-22-99	FS REQUEST	Replaced Title Page, MRH-1/MRH-2, and pages 2-6 and 2-7
001-J	12-8-99	45507	Replaced Title Page, MRH-1/MRH-2, and pages P-15/P-16
001-J1	9-22-00	45651	Replaced Title Page, MRH-1/MRH-2, and all of Section VII
001-K	8-15-01	47587	Replaced Title Page, MRH-1/MRH-2, and page 2-13
001-L	11-02-01	47797	Replaced Title Page, MRH-1/MRH-2, and chapter V
001-M	02-22-02	tdb	Replaced Title Page, MRH-1/MRH-2, and page 2-13
001-M1	09-17-02	48508	Replaced Title Page, MRH-1/MRH-2, and pages 7-17 to 7-19
001-N	10-15-02	tbd	Replaced Title Page, MRH-1/MRH-2, and page 2-25.
001-N1	01-28-03	FS Request	Replaced Title Page, MRH-1/MRH-2, and pages 3-6 & W-9

WARNING: Disconnect primary power prior to servicing.

PS

Drawing 839 6337 264 & 839 6337 297 will need to be pulled as Microfilm or Blueline

Guide to Using Harris Parts List Information

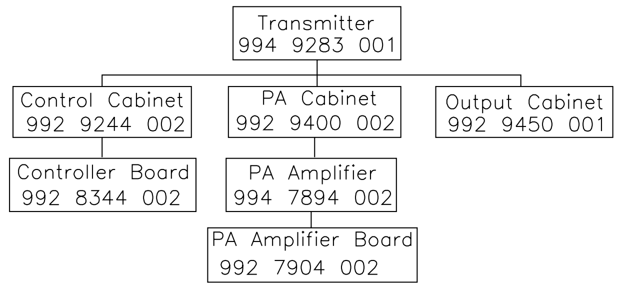
The Harris Replaceable Parts List Index portrays a tree structure with the major items being leftmost in the index. The example below shows the Transmitter as the highest item in the tree structure. If you were to look at the bill of materials table for the Transmitter you would find the Control Cabinet, the PA Cabinet, and the Output Cabinet. In the Replaceable Parts List Index the Control Cabinet, PA Cabinet, and Output Cabinet show up one indentation level below the Transmitter and implies that they are used in the Transmitter. The Controller Board is indented one level below the Control Cabinet so it will show up in the bill of material for the Control Cabinet. The tree structure of this same index is shown to the right of the table and shows indentation level versus tree structure level.

Example of Replaceable Parts List Index and equivalent tree structure:

Replaceable Parts List Index

Table 7−1.	Transmitter	994 9283 001	7−2
Table 7−2.	Control Cabinet	992 9244 002	7−3
Table 7−3.	Controller Board	992 8344 002	7−6
Table 7−4.	PA Cabinet	992 9400 002	7−7
Table 7−5.	PA Amplifier	994 7894 002	7−9
Table 7−6.	PA Amplifier Board	992 7904 002	7−10
Table 7−7.	Output Cabinet	992 9450 001	7−12

⇒



The part number of the item is shown to the right of the description as is the page in the manual where the bill for that part number starts.

Inside the actual tables, four main headings are used:

Table #-#. ITEM NAME - HARRIS PART NUMBER - this line gives the information that corresponds to the Replaceable Parts List Index entry;

HARRIS P/N column gives the ten digit Harris part number (usually in ascending order);

DESCRIPTION column gives a 25 character or less description of the part number;

REF. SYMBOLS/EXPLANATIONS column 1) gives the reference designators for the item (i.e., C001, R102, etc.) that corresponds to the number found in the schematics (C001 in a bill of material is equivalent to C1 on the schematic) or 2) gives added information or further explanation (i.e., “Used for 208V operation only,” or “Used for HT 10LS only,” etc.).

Inside the individual tables some standard conventions are used:

A # symbol in front of a component such as #C001 under the REF. SYMBOLS/EXPLANATIONS column means that this item is used on or with C001 and is not the actual part number for C001.

In the ten digit part numbers, if the last three numbers are 000, the item is a part that Harris has purchased and has not manufactured or modified. If the last three numbers are other than 000, the item is either manufactured by Harris or is purchased from a vendor and modified for use in the Harris product.

The first three digits of the ten digit part number tell which family the part number belongs to - for example, all electrolytic (can) capacitors will be in the same family (524 xxxx 000). If an electrolytic (can) capacitor is found to have a 9xx xxxx xxx part number (a number outside of the normal family of numbers), it has probably been modified in some manner at the Harris factory and will therefore show up farther down into the individual parts list (because each table is normally sorted in ascending order). Most Harris made or modified assemblies will have 9xx xxxx xxx numbers associated with them.

The term “SEE HIGHER LEVEL BILL” in the description column implies that the reference designated part number will show up in a bill that is higher in the tree structure. This is often the case for components that may be frequency determinant or voltage determinant and are called out in a higher level bill structure that is more customer dependent than the bill at a lower level.

HARRIS Broadcast Systems Division
P.O. Box 4290, QUINCY, IL 62305

PARTS ORDER FORM

HARRIS PHONE: 217-222-8200
HARRIS FAX: 217-221-7096

BILLING INFORMATION

CUSTOMER NAME: ____________________

ADDRESS: ____________________

____

____

____

TELEPHONE NUMBER: ____________________

FAX NUMBER: ____________________

PREFERRED PAYMENT METHOD: ____________________

FREQUENCY (If required): ____________________

EQUIPMENT NAME: ____________________

EQUIPMENT PART NUMBER: ____________________

EQUIPMENT SERIAL NUMBER: ____________________

SHIPPING INFORMATION

SHIP TO: (if different from billing information) ____________________

ADDRESS: ____________________

____

____

____

TELEPHONE NUMBER: ____________________

FAX NUMBER: ____________________

SHIPPING METHOD PREFERRED: ____________________

GUIDE FOR ORDERING PARTS

Please use the following parts order form, filling is as much information as possible. The complete informaiton will allow double checking the part number for correctness or locating a substitude if the part is not available.

The equipment name, part number, and serial number will be found on the metal ID plate on the back of the unit. The serial number MUST be included for any parts ordered under warranty.

Describe the part using the description in the parts list if possible. Include the schematic information, schematic number, or number of next higher assembly. The next higher assembly is usually a 992-xxxx-00x type.

ITEM #	QTY ORD	HARRIS PART NUMBER	DESCRIPTION OF PART (PART'S NAME, DESCRIPTION, SPECIFICATION FROM PARTS LIST IF AVAILABLE)	SCHEMATIC REFERENCE REFERENCE NAME (e.g. C001, R100, etc)	ITEM USED ON (NEXT HIGHER ASSEMBLY IF KNOWN) (e.g. C001 used on 992 8025 001, SCHEMATIC 839 8099 991)	COMMENTS

WARNING

THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS. PERSONNEL MUST AT ALL TIMES OBSERVE SAFETY WARNINGS, INSTRUCTIONS AND REGULATIONS.

This manual is intended as a general guide for trained and qualified personnel who are aware of the dangers inherent in handling potentially hazardous electrical/electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

The installation, operation, maintenance and service of this equipment involves risks both to personnel and equipment, and must be performed only by qualified personnel exercising due care. HARRIS CORPORATION shall not be responsible for injury or damage resulting from improper procedures or from the use of improperly trained or inexperienced personnel performing such tasks.

During installation and operation of this equipment, local building codes and fire protection standards must be observed. The following National Fire Protection Association (NFPA) standards are recommended as reference:

- Automatic Fire Detectors, No. 72E
- Installation, Maintenance, and Use of Portable Fire Extinguishers, No. 10
- Halogenated Fire Extinguishing Agent Systems, No. 12A

WARNING

ALWAYS DISCONNECT POWER BEFORE OPENING COVERS, DOORS, ENCLOSURES, GATES, PANELS OR SHIELDS. ALWAYS USE GROUNDING STICKS AND SHORT OUT HIGH VOLTAGE POINTS BEFORE SERVICING. NEVER MAKE INTERNAL ADJUSTMENTS, PERFORM MAINTENANCE OR SERVICE WHEN ALONE OR WHEN FATIGUED.

Do not remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances.

WARNING

IN CASE OF EMERGENCY ENSURE THAT POWER HAS BEEN DISCONNECTED.

WARNING

IF OIL FILLED OR ELECTROLYTIC CAPACITORS ARE UTILIZED IN YOUR EQUIPMENT, AND IF A LEAK OR BULGE IS APPARENT ON THE CAPACITOR CASE WHEN THE UNIT IS OPENED FOR SERVICE OR MAINTENANCE, ALLOW THE UNIT TO COOL DOWN BEFORE ATTEMPTING TO REMOVE THE DEFECTIVE CAPACITOR. DO NOT ATTEMPT TO SERVICE A DEFECTIVE CAPACITOR WHILE IT IS HOT DUE TO THE POSSIBILITY OF A CASE RUPTURE AND SUBSEQUENT INJURY.

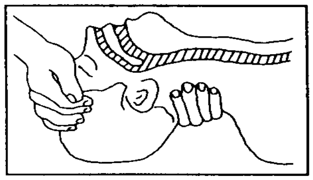
TREATMENT OF ELECTRICAL SHOCK

1. IF VICTIM IS NOT RESPONSIVE FOLLOW THE A-B-CS OF BASIC LIFE SUPPORT.

PLACE VICTIM FLAT ON HIS BACK ON A HARD SURFACE

(A) AIRWAY

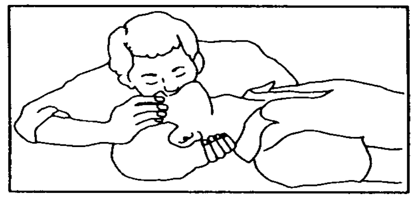
IF UNCONSCIOUS,
OPEN AIRWAY



LIFT UP NECK
PUSH FOREHEAD BACK
CLEAR OUT MOUTH IF NECESSARY
OBSERVE FOR BREATHING

(B) BREATHING

IF NOT BREATHING,
BEGIN ARTIFICIAL BREATHING

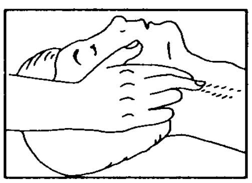


TILT HEAD
PINCH NOSTRILS
MAKE AIRTIGHT SEAL

4 QUICK FULL BREATHS

REMEMBER MOUTH TO MOUTH
RESUSCITATION MUST BE
COMMENCED AS SOON AS POSSIBLE

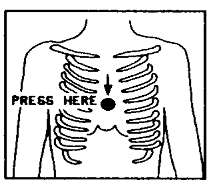
CHECK
CAROTID PULSE



IF PULSE ABSENT,
BEGIN ARTIFICIAL
CIRCULATION

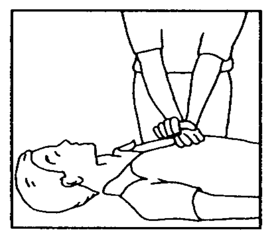
(C) CIRCULATION

DEPRESS STERNUM 1 1/2 TO 2 INCHES



APPROX. RATE OF COMPRESSIONS --80 PER MINUTE: ONE RESCUER — 15 COMPRESSIONS, 2 QUICK BREATHS

APPROX. RATE OF COMPRESSIONS --60 PER MINUTE: TWO RESCUERS — 5 COMPRESSIONS, 1 BREATH



NOTE: DO NOT INTERRUPT RHYTHM OF COMPRESSIONS
WHEN SECOND PERSON IS GIVING BREATH

CALL FOR MEDICAL ASSISTANCE AS SOON AS POSSIBLE.

2. IF VICTIM IS RESPONSIVE.

   A. KEEP THEM WARM
   B. KEEP THEM AS QUIET AS POSSIBLE
   C. LOOSEN THEIR CLOTHING
   D. A RECLINING POSITION IS RECOMMENDED

FIRST-AID

Personnel engaged in the installation, operation, maintenance or servicing of this equipment are urged to become familiar with first-aid theory and practices. The following information is not intended to be complete first-aid procedures, it is a brief and is only to be used as a reference. It is the duty of all personnel using the equipment to be prepared to give adequate Emergency First Aid and thereby prevent avoidable loss of life.

Treatment of Electrical Burns

1. Extensive burned and broken skin

   a. Cover area with clean sheet or cloth. (Cleanest available cloth article.)

   b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply any salve or ointment.

   c. Treat victim for shock as required.

   d. Arrange transportation to a hospital as quickly as possible.

   e. If arms or legs are affected keep them elevated.

NOTE

If medical help will not be available within an hour and the victim is conscious and not vomiting, give him a weak solution of salt and soda: 1 level teaspoonful of salt and 1/2 level teaspoonful of baking soda to each quart of water (neither hot or cold). Allow victim to sip slowly about 4 ounces (a half of glass) over a period of 15 minutes. Discontinue fluid if vomiting occurs. (Do not give alcohol.)

2. Less severe burns - (1st & 2nd degree)

   a. Apply cool (not ice cold) compresses using the cleanest available cloth article.

   b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply salve or ointment.

   c. Apply clean dry dressing if necessary.

   d. Treat victim for shock as required.

   e. Arrange transportation to a hospital as quickly as possible.

   f. If arms or legs are affected keep them elevated.

REFERENCE:

ILLINOIS HEART ASSOCIATION

AMERICAN RED CROSS STANDARD FIRST AID AND PERSONAL SAFETY MANUAL (SECOND EDITION)

Table of Contents

WARNING: Disconnect primary power prior to servicing.

SECTION W
MAIN CONTROLLER SOFTWARE SEQUENCES

SECTION X
VENDOR INFORMATION

1.1 INTRODUCTION

This technical manual contains all the information necessary to install and maintain the HT 30/35CD FM BROADCAST TRANSMITTER. Figure 1-1 depicts the HT 30/35CD.

The various sections of this technical manual provide the following types of information.

a. SECTION I, GENERAL DESCRIPTION, provides a description of the equipment, identifies the major components, and describes other pertinent features of the equipment such as optional capabilities.

b. SECTION II, INSTALLATION, provides information relative to incoming inspection, power requirements, input/output connections, component mounting instructions, and initial setup procedures.

c. SECTION III, OPERATION, provides identification and functions of panel or board mounted controls and indicators, along with information necessary to setup and operate the HT 30/35CD on a daily basis. This section also contains information on the use of the FLEXPatch™ system for emergency operation when a part of the rf system of the HT 30/35CD fails.

d. SECTION IV, PRINCIPLES OF OPERATION, provides theory of operation of the overall the HT 30/35CD System.

e. SECTION V, MAINTENANCE, provides general maintenance procedures as well as a list of fuses used in the HT 30/35CD.

f. SECTION VI, SYSTEM TROUBLESHOOTING, provides troubleshooting procedures and guidelines.

g. SECTION VII, PARTS LIST, provides information on the replaceable parts available for the HT 30/35CD.

h. SECTION VIII, DIAGRAMS, provides overall diagrams for the HT 30/35CD.

i. SECTIONS A through X provide additional information on specific modules as well as information on the Main Controller Software Sequencing.

Section A - High Voltage Power Supply

Section B - RF Preamplifier Module Assembly

Section C - RF Intermediate Power Amplifier Module Assembly

Section D - PA Cavity

Section E - Current Monitor Board

Section F - IPA Low Pass Filter/Directional Coupler

Section G - Controller Assembly

Section H - Controller Motherboard

Section J - Analog Input/Output Board

Section K - Digital Input/Output Board

Section L - Central Processor Unit

Section M - Control Status Board

Section N - Auxiliary Power Supply

Section P - Transmitter Interface/Backup Controller Board

Section Q - Switch Board

Section R - PA Metering Board

Section S - AC Input Phase Monitor Assembly

Section T - Fluorescent Display Board

Section U - Mimic Board

Section V - Spacer Board

Section W - Main Controller Software Sequences

Section X - Vendor Information

1.2 RELATED PUBLICATIONS

For the DIGIT™ FM Exciter installation and operation information, refer to the DIGIT™ FM Exciter Technical Manual.

1.3 EQUIPMENT PURPOSE

The HT 30/35CD is a commercial FM transmitter designed for continuous broadcast operation (Figure 1-1). The transmitter uses a HARRIS DIGIT™ FM Exciter, a solid state driver, and a single tube as a PA stage to provide reliable and efficient operation in the 87.5 to 108 MHz commercial FM Broadcast Band.

1.4 PHYSICAL DESCRIPTION

The unit is contained in a single cabinet, with the exception of the high voltage and screen power supply enclosure. The cabinet size and the internal placement of the second harmonic filter ensures the transmitter will fit in the place of many older 20 to 25 kW FM transmitters.

The high voltage and screen power supplies are located externally in a single enclosure cabinet which provides increased maintenance accessibility and working room. The High Voltage Power Supply may be located next to the transmitter or placed in a remote location.

The main cabinet rear door is hinged and may be removed for maintenance access. Required metering is provided by five meters located on the equipment front panel. An arrangement of light emitting diode (LED) status indicators provides visual indications of transmitter operation and provide a means of making problem isolation very easy. All controls required for normal operation are accessible in full view of all indicators.

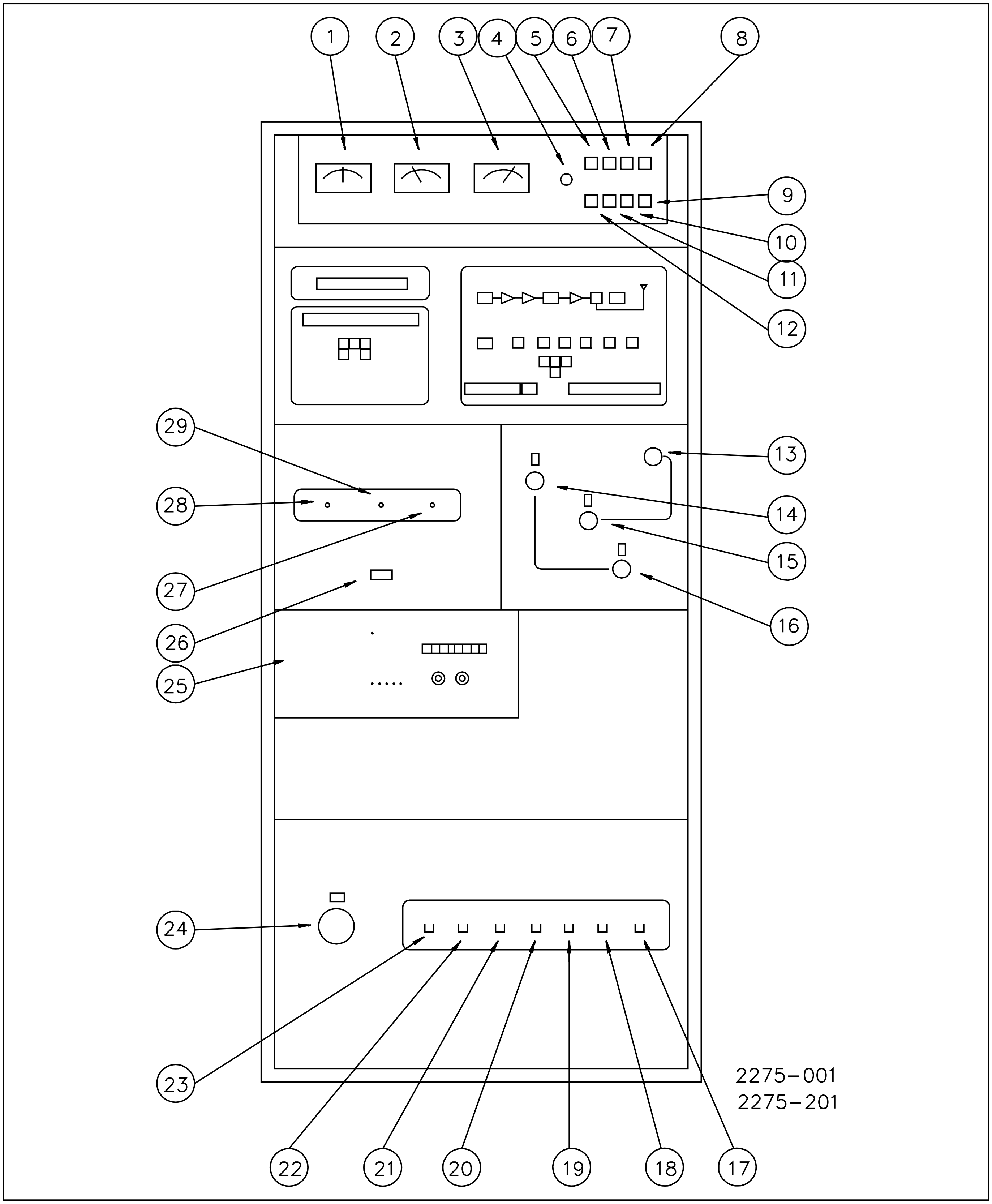


Figure 1-1. HT 30/35CD FM BROADCAST TRANSMITTER

1.5 FUNCTIONAL DESCRIPTION

1.5.1 POWER SUPPLIES

A three-wire source of three phase 208-240 Vac 50/60 Hz wired WYE or closed delta (at 200 amperes per phase for voltages below 230 Vac or 175 amperes per phase for voltages of 230 Vac and above) or a four-wire source of 360-415 Vac 50 Hz (at 115 amperes per phase for voltages below 398 Vac and 100 amperes per phase for voltages of 398 Vac and above) is required to operate the HT 30/35CD High Voltage Power Supply.

NOTE

The line current capabilities listed above are those recommended for an HT 30/35CD operating at 35 kW output. For specific fusing recommendations, particularly for transmitters operating at output power levels below 35 kW, see the installation section of this technical manual.

Additionally, a separate three phase input (at 30 amperes per phase for line voltages 208-240 Vac 50/60 Hz or 20 amperes per phase for line voltages 360-415 Vac 50 Hz) is required to operate the HT 30/35CD cabinet power supplies.

All power supplies are overload protected and are full wave rectified using solid state devices.

The following power supplies are contained within the transmitter cabinet (Figure 1-2):

a. PREAMPLIFIER and IPA: +49 Vdc at 36 amperes.
b. CONTROL LOGIC: 5 Vdc at 15 amperes, +12 Vdc at 4A, -12 Vdc at 3A, +10 Vdc @ 1.5A.
c. CONTROL GRID BIAS: -500 Vdc at 0.1 amperes.
d. PA FILAMENT: 7.5 Vac at 150 amperes.
e. RELAY AND SOLENOID SWITCHING: 24 Vac.

The following power supplies are contained within the High Voltage Power Supply cabinet (see Figure 1-2).

HT 35CD PLATE: +12000 Vdc or +6700 Vdc at 4.5 amperes.

HT 30CD PLATE: +10400 Vdc or +5800 Vdc at 3.6 amperes.

SCREEN GRID: +1500 Vdc at 0.4 amperes.

1.5.2 DIGIT™ FM EXCITER

The standard FM Exciter for all HARRIS FM transmitters is the DIGIT™. The DIGIT™ FM Exciter produces a frequency modulated output continuously variable up to 55 watts into a 50-ohm load for any channel assignment within the 87 to 108 MHz Commercial FM Broadcast Band. Servicing is simplified as the DIGIT™ FM Exciter is modular in concept, with a 3 year warrantee exchange on the individual boards. The front panel metering includes a bargraph modulation meter and LCD display for Forward Power, Reflected Power, PA Volts and PA Amps.

The DIGIT™ exciter requires an input module of which there are two to choose from, the Digital Stereo Generator Module or the Analog I/O Module.

The Digital Stereo Generator Module is the standard input module and has the following inputs:

1 AES/EBU compatible digital audio input

2 SCA inputs

1 RBDS input

The Analog I/O Module is optional and has the following inputs:

1 Balanced Composite input

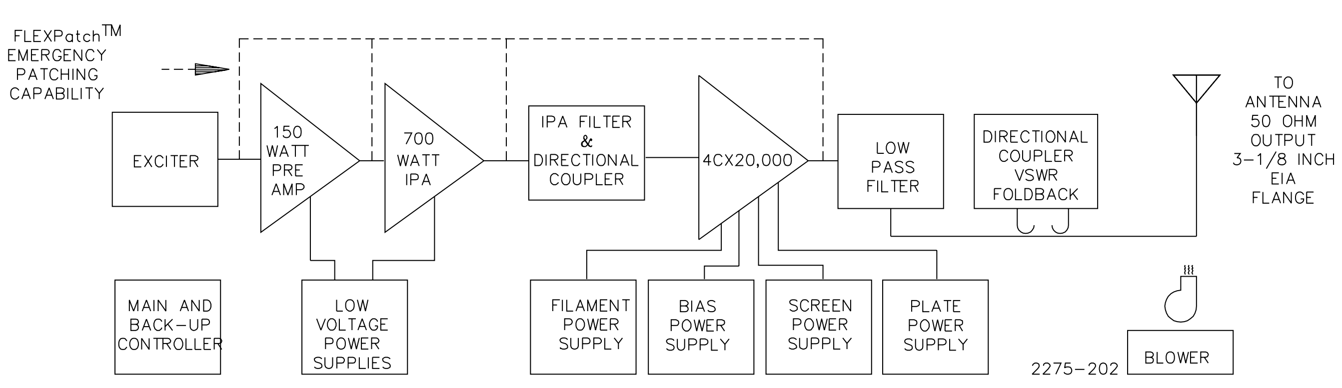


Figure 1-2. HT 30/35CD Simplified Block Diagram

1 Unbalanced Composite input

1 Mono input

3 SCA inputs

For more information on the input modules and the DIGIT™ exciter refer to the DIGIT™ FM Exciter Technical Manual, 988-2356-001.

1.5.3 PREAMPLIFIER

The 150 watt solid state RF Preamplifier is a unitized, modular RF Preamplifier conservatively rated for 150 watts of output power. In the HT 30/35CD, only 80 watts is normally needed so the amplifier operates at 54% of its rating. The module uses two advanced high efficiency VHF MOSFET power transistors in parallel. The 50 ohm input/output impedance permits easy emergency connection through FLEXPatch™. The module is completely broadband from 88 to 108 MHz and has no tuning adjustments. RF drive to the HT 30/35CD's IPA Amplifier is controlled by varying the supply voltage to the Preamplifier. The Preamplifier has a quick connect/disconnect umbilical cord.

1.5.4 IPA

The 700 watt solid state IPA is a unitized, modular RF IPA which essentially combines two 350 watt sections together with each side independently fuse protected. Eight load balanced VHF MOSFET transistors are used to produce the 700 watts. The 50 ohm input/output impedance permits easy emergency connection through FLEXPatch™. The module is completely broadband from 88 to 108 MHz and has no tuning components. The module has a quick connect/disconnect umbilical cord.

1.5.5 PA STAGE

A quarterwave cavity design is utilized in order to maximize signal bandwidth. The nominal bandwidth of the HT 30/35CD is 2.2 MHz. Wide bandwidth minimizes degradation of the signal delivered from the DIGIT™ exciter. Forced-air cooling ensures cool operation and long tube life. The input impedance of the PA stage is 50 ohms. In the event of a total PA stage failure, the output of the exciter, IPA Preamplifier, or IPA can be routed through the FLEXPatch™ system to the 50-ohm transmitter antenna load as an emergency back-up. With an optional Low Pass Filter, the DIGIT™ can also be placed directly on to the antenna.

The quarterwave mechanical implementation used in the HT 30/35CD allows the quarterwave "shorted" point to appear "below" the cavity tube deck. This technique allows easy tube removal/insertion since there is no chimney to move. No sliding finger stock is used at any high current points inside the cavity.

Screen neutralization is used with the 4CX20,000D which helps achieve the excellent bandwidth exhibited. Neutralization is achieved when feedthrough voltage, measured with a scope or RF voltmeter at the output of the cavity, is minimized while driving the PA (filaments ON and HV OFF) with a low level signal from an FM band exciter or RF generator test source.

The HT 35CD maintains 80% PA efficiency across a power output range of 14 kW through 35 kW (10 kW through 30 kW for the HT 30CD). This is accomplished through multiple plate voltage supply taps.

Front panel tuning controls consist of the following:

Input Match (Grid Circuit)
Input Tuning (Grid Circuit)
PA Tuning (Fine PA Tuning Control "flapper")
PA Loading (PA Loading using variable vacuum capacitor)

1.5.5.1 OUTPUT CIRCUIT

The rf output to the antenna is coupled through a 2nd Harmonic Stub Filter, a coaxial low pass filter, and a Directional Coupler. The 2nd Harmonic Filter operates at dc ground potential for safety and further immunity from lightning damage. Special provisions allow connection of monitors directly to the transmission line at the rf transmitter output.

1.5.6 CONTROL CIRCUITS

1.5.6.1 COLORSTAT™ SIGNAL FLOW DIAGRAM

The front panel display will show RF signal flow (RF path) and associated subsection interconnect (power supplies, etc.). Each of the major signal flow and subsection blocks will contain an LED capable of three status displays:

- Red: State inoperative
- Yellow: Warning of abnormal operation
- Green: Stage operational

During transmitter start-up, operation or shutdown, the mimic panel will display the status of the stage only if an activate command has been given to the stage.

1.5.6.2 STATUSPLUS™ ALPHANUMERIC

The StatusPlus™ alphanumeric display serves as the main multimeter of the HT 30/35CD. The multimeter parameters and associated overload readout(s) will be displayed in the correct units (mA, kW, etc.).

The following alphanumeric readouts are available on the StatusPlus™ display:

PLATE E
(Plate voltage)
PLATE I
(Plate current)
PLATE OVR
(Plate current overload set point)
PA FWD
(Output forward power)
APC PWR
(Automatic power control set point)
PA REFD

(Output reflected power)
PA OVR
(Output reflected power overload set point)
SCREEN E
(Screen voltage)
SCREEN I
(Screen current)
SCN OVR
(Screen current overload set point)
GRID E
(Grid voltage)
GRID I
(Grid current)
FILAMENT
(Filament voltage - True RMS)
INLET T
(Inlet air temperature)
STACK T
(PA cavity air outlet temperature)
IPA FWD
(IPA forward output power)
IPA REF
(IPA reflected output power)
IPA REF
(IPA reflected output power overload set point)
IPA E
(IPA supply voltage)
IPA I
(IPA supply current)
IPA T
(IPA heat sink temperature)
PREA PWR
(Preamplifier output power)
PREAMP E
(Preamplifier regulator output voltage)
PREAMP I
(Preamplifier regulator output current)
PREAMP DRV
(Preamplifier input drive power)
PHASE A
(AC line Phase A voltage)
PHASE B
(AC line Phase B voltage)
PHASE C
(AC line Phase C voltage)
+5 SUPPLY
(Controller internal +5V supply voltage)
+12 SUPPLY
(Controller internal +12V supply voltage)
-12 SUPPLY
(Controller internal -12V supply voltage)
+10 REF
(Controller A/D converter +10V reference voltage)
-10 REF
(Controller A/D converter -10V reference voltage)
TEMP
(Controller internal temperature)
PA VSWR OVR
(Time/Date record of last 8 PA VSWR overloads)
PLATE I OVR
(Time/Date record of last 8 Plate current overloads)
SCREEN I OVR
(Time/Date record of last 8 Screen current overloads)
IPA VSWR OVR
(Time/Date record of last 8 IPA VSWR overloads)
EXCITER OVR
(Time/Date record of last 8 Exciter AFC overloads)
EXTERNAL OVR
(Time/Date record of last 8 External overloads)
FILAMENT OVR
(Time/Date record of last 8 Filament voltage overloads)
CLOCK
(Displays current Date/Time of internal clock)
HOURS
(Allows setting of the Hours of internal clock)
MINUTES
(Allows setting of the Minutes of internal clock)
SECONDS
(Allows setting of the Seconds of internal clock)
MONTH
(Allows setting of the Month of internal clock)
DAY
(Allows setting of the Day of internal clock)
YEAR
(Allows setting of the Year of internal clock)
FAULT CAUSE
Displays a 2 digit code to indicate condition leading to cessation of operation

The following parameters are displayed on dedicated analog front panel meters:

PLATE VOLTAGE
(0-15 KVDC)
PLATE CURRENT
(0-5 ADC)
OUTPUT POWER/VSWR
(0-120% forward, 1:1-3:1 VSWR)
FILAMENT HOURS
(0-99, 999.9 Hours)
IPA FWD/REF POWER
(Dual 100 segment bar graph display simultaneously reads IPA forward output power on a 0-700 watt linear scale and IPA reflected output power on a 0-70 watt logarithmic scale. In addition, the IPA reflected output power overload set point is displayed as a single illuminated bar on the reflected power scale.)

1.5.7 CONTROLS

The following front panel controls are provided:

FILAMENT ON pushbutton
FILAMENT OFF pushbutton
PLATE ON pushbutton
PLATE OFF pushbutton
AUTOMATIC POWER CONTROL SELECT pushbutton
MANUAL POWER CONTROL SELECT pushbutton
OUTPUT POWER FORWARD/REFLECTED SELECT switch
LOCAL CONTROL SELECT pushbutton
REMOTE CONTROL SELECT pushbutton
EXTENDED CONTROL SELECT pushbutton
OVERLOAD/INTERLOCK INDICATOR RESET pushbutton

NEXT, PREVIOUS, SELECT, RETURN
Selection pushbuttons associated with the Status-Plus™ Alphanumeric display.

REMOTE AND EXTENDED CONTROL CONNECTIONS

ANALOG OUTPUTS:
REMOTE PLATE VOLTAGE SAMPLE
REMOTE PLATE CURRENT SAMPLE
REMOTE OUTPUT FORWARD POWER SAMPLE
REMOTE OUTPUT REFLECTED POWER SAMPLE
REMOTE SCREEN CURRENT SAMPLE
EXTENDED PLATE VOLTAGE SAMPLE
EXTENDED PLATE CURRENT SAMPLE
EXTENDED OUTPUT FORWARD POWER SAMPLE
EXTENDED OUTPUT REFLECTED POWER SAMPLE
SPARE ANALOG VOLTAGE OUTPUT*

* Not active under backup controller operation.

CONTROL INPUTS:
REMOTE FILAMENT ON
REMOTE FILAMENT OFF
REMOTE PLATE ON
REMOTE PLATE OFF
REMOTE POWER RAISE
REMOTE POWER LOWER
REMOTE AUTO POWER CONTROL*
REMOTE MANUAL POWER CONTROL*
REMOTE BACKUP MODE ON
EXTENDED FILAMENT ON
EXTENDED FILAMENT OFF
EXTENDED PLATE ON
EXTENDED PLATE OFF
EXTENDED POWER RAISE
EXTENDED POWER LOWER
EXTENDED AUTO POWER CONTROL*
EXTENDED MANUAL POWER CONTROL*
EXTENDED BACKUP MODE ON
EXTENDED BACKUP MODE OFF
FAILSAFE
EXTERNAL INTERLOCK
EXTERNAL OVERLOAD
OVERLOAD INDICATOR RESET
SPARE 1*
SPARE 2*
SPARE 3*
SPARE 4*
SPARE 5*
SPARE 6*

STATUS OUTPUTS:
REMOTE BACKUP
REMOTE FAULT
REMOTE FILAMENT ON
REMOTE PLATE ON
REMOTE POWER RAISE
REMOTE POWER LOWER
REMOTE AUTO POWER CONTROL*
REMOTE MANUAL POWER CONTROL*
EXTENDED BACKUP
EXTENDED FAULT
EXTENDED FILAMENT
* Not active under backup controller operation.
EXTENDED PLATE
EXTENDED POWER RAISE
EXTENDED POWER LOWER
EXTENDED AUTO POWER CONTROL*
EXTENDED MANUAL POWER CONTROL*
REMOTE EXCITER AFC OVERLOAD*
REMOTE FILAMENT OVERLOAD*
REMOTE PLATE OVERLOAD*
REMOTE PA VSWR OVERLOAD*
REMOTE IPA VSWR OVERLOAD*
REMOTE PHASE LOSS INTERLOCK*
REMOTE VSWR FOLDBACK*
REMOTE AIR INTERLOCK*
REMOTE EXTERNAL OVERLOAD
REMOTE AUXILIARY 1*
REMOTE AUXILIARY 2*
REMOTE AUXILIARY 3*
REMOTE AUXILIARY 4*

ANALOG INPUTS:
SPARE 1 ANALOG INPUT* **
SPARE 2 ANALOG INPUT* **
SPARE 3 ANALOG INPUT* **
SPARE 4 ANALOG INPUT* **
SPARE 5 ANALOG INPUT* **
SPARE 6 ANALOG INPUT* **
SPARE 7 ANALOG INPUT* **

SPARE 8 ANALOG INPUT* **

* Not active under backup controller operation.

** No present use or function. Available for future expansion.

1.5.8 AUTOMATIC POWER CONTROL

Automatic power control (APC) will maintain output power within -5% to +3% of the desired value. APC is activated with the front panel “AUTO ON” switch. Remote and extended capability to raise and lower power remotely as well as to enable/disable “AUTO ON” mode is also provided.

1.5.9 AUTOMATIC VSWR FOLDBACK

An automatic VSWR foldback circuit will reduce the output power according to the amount of reflected power detected. The foldback circuit is capable of reducing output power (via screen voltage variac) to typically 2 kW.

When the detected reflected power is reduced, power increases will be made to a safe operating level. Full power operation will be automatically restored when the reflected power is below a set threshold. An amber colored mimic display LED will illuminate during a VSWR foldback condition and in addition a remote control status indication is provided . VSWR foldback is active (along with APC) only in the “AUTO ON” mode. VSWR foldback and APC are not active under Backup Controller mode.

1.5.10 FAULT TIME AND DATE RECORDER

The fault time and date recorder provides logging of the following overloads:

a. Exciter AFC Overload
b. PA VSWR Overload
c. PA Plate Current Overload
d. PA Screen Current Overload
e. IPA VSWR Overload
f. Filament Overload
g. External Overload

The fault time and date recorder displays the information in the alphanumeric “cluster” readout. Overload events are protected with battery backup.

However, under loss of power condition, the internal clock resumes time at the point at which power was removed.

1.5.11 CONTROLLER DESIGN

The controller consists of two parallel systems:

a. Microprocessor software/firmware running all command monitoring display and interface chores.
b. Backup discrete logic running basic command and overload commands.

Switching to the backup controller is automatic. However, the automatic command can be overridden by a local or remote command.

1.5.12 MAIN CONTROLLER SERVICE

All major PC boards of the main controller are removable from the transmitter for servicing, while the transmitter continues to operate in the Backup Controller mode, if continued operation is desired.

1.5.13 FUTURE EXPANSION/INTERFACE

There are two serial interfaces which adhere to the EIA RS-232-C specification for electrical performance. One of these interfaces is used to communicate with the fluorescent display and mimic panel. The other interface has no defined function at this time.

1.5.14 SAFETY

The transmitter design provides safety features which ensure that no voltage potentials are accessible to operational personnel from the front panel. Additionally, no high voltage points are readily accessible to maintenance personnel unless a cabinet door or panel is opened. If a door or a power supply panel is opened when power is energized, interlocks will remove high voltage from both cabinets and operation will have to be manually restored.

1.6 EQUIPMENT CHARACTERISTICS

NOTE

Specifications in Table 1-1 are subject to change without notice.

Table 1-1. Electrical & Physical Characteristics

FUNCTION/CHARACTERISTIC
GENERAL

Power Output
- HT 35CD 10kW - 35kW (FCC type notified range)
- HT 30CD 10kW - 30kW (FCC type notified range)

PA Efficiency
- 80% typical (14kW to 35kW)

Frequency Range
- 88 MHz - 108 MHz (Tuned to single frequency)

RF Load Impedance
- 50 ohm

RF Output Termination
- 3-1/8" EIA female flanged

PA Matching Range
- 1.7:1 VSWR

RF Output Spurious and Harmonic
- Meets or exceeds FCC requirements

AC Line Voltage
- 208/240 VAC, 50/60 Hz, 3-phase, WYE or closed delta or 360/415 VAC, 50/60 Hz, 3-phase 4-wire WYE; line variation (voltage magnitude) +/-5% slow. 3-phase AC line voltage must be balanced within 3% for transmitter to meet all audio specifications.

Transformer Taps
- 208V, 240V, (VERNIER: -10V, 0V, +10V)

Primary Power Consumption
- HT 35CD typically 52 kW (.95 PF) @ 35 kW TPO
- HT 30CD typically 46 kW (.95 PF) @ 30 kW TPO

Inlet Air
- MAIN CABINET: 985 CFM (total inlet), HVPS: 250 CFM

Size and Weight

Main Transmitter Cabinet
- Height 72 in., Width 33.5 in., Depth 33.5 in., Weight 650 lbs.

High Voltage Power Supply
- Height 60.2 in., Width 52 in., Depth 26 in., Weight 1900 lbs.

Ambient Temperature
- 0°C - 50°C

Altitude
- 10,000 ft. AMSL maximum, maximum temperature decreases 2°C per 1,000 ft. to 30°C at 10,000 ft. AMSL.

Humidity
- 0-95% non-condensing

Table 1-1. Electrical & Physical Characteristics (Continued)

WIDEBAND COMPOSITE OPERATION

Composite Inputs
One balanced floating input, one unbalanced input
Composite Input Impedance
2000 ohms resistive
Composite Input Connectors
Female BNC
Composite Input Level
1.0 volt RMS nominal for +/-75 kHz deviation
External SCA Generator Inputs
Two unbalanced inputs
Composite FM Signal to Noise
80 dB below 100% modulation (reference 400 Hz @ +/-75 kHz deviation with 75 microsecond deemphasis, 20 Hz to 200 kHz bandwidth)
Composite Harmonic Distortion
.08%

2.1 INTRODUCTION

This section of the manual describes the incoming inspection and unpacking procedures that should be followed when the HT 30/35CD FM BROADCAST TRANSMITTER is received. Installation instructions and initial turn on procedures are also provided in this section of the technical manual.

2.2 INCOMING INSPECTION AND UNPACKING

The HT 30/35CD is usually shipped via private carrier. Upon delivery, the shipping container should be examined for indications of possible mishandling. If damage has occurred, immediately notify the carrier and HARRIS CORPORATION, Broadcast Division (refer to paragraph 2.3, Returns and Exchanges).

When unpacking the shipping container, care should be exercised to prevent equipment damage. The control numbers on the Packing List should be checked to verify completeness of the shipment. Any discrepancy is to be reported immediately to HARRIS CORPORATION, Broadcast Division.

2.3 RETURNS AND EXCHANGES

Damaged or undamaged equipment should not be returned unless written approval and a Return Authorization is received from HARRIS CORPORATION, Broadcast Division. Special shipping instructions and coding will be provided to assure proper handling. Complete details regarding circumstances and reasons for return are to be included in the request for return.

Custom equipment or special order equipment is not returnable. In those instances where return or exchange of equipment is at the request of the customer, or convenience of the customer, a restocking fee will be charged. All returns will be sent freight prepaid and properly insured by the customer. When communicating with HARRIS CORPORATION, Broadcast Division, specify the HARRIS Order Number or Invoice Number.

2.4 INSTALLATION

Prior to installation, this Technical Manual and the DIGIT™ FM Exciter Technical Manual should be carefully studied to obtain a thorough understanding of the principles of operation, circuitry and nomenclature. This will facilitate proper installation and initial checkout. Installation is accomplished in four steps: (1) transmitter placement, (2) component installation, (3) transmitter wiring, and (4) initial checkout.

2.4.1 COOLING AIR REQUIREMENTS

Harris transmitters are always designed to operate in a free, unobstructed environment with a maximum inlet air temperature of 50°C. This means that the transmitter air system is designed to supply sufficient air at the required static pressure to cool the transmitter only. Any additional pressure loses introduced by air exhaust systems & air supply systems must be satisfied by means other than the transmitter blower. These inlet & exhaust systems generally need to be fan driven.

When installing an exhaust system which removes the warm air from the transmitter room or building, a replacement air system which delivers at least the same volume of air removed is mandatory.

It is considered to be good Engineering practice to allow a relief gap (6 to 10 inches of space) above the exhaust plane at the top of the transmitter in order to minimize the likelihood of introducing undesired restrictions to air flow.

For specific transmitter air requirements refer to the Figure 2-1, Transmitter Outline drawing.

2.4.2 TRANSMITTER PLACEMENT

SPECIAL NOTE

BEFORE PLACING THE TRANSMITTER IN A PERMANENT POSITION, BE SURE ALL SHIPPING BLOCKS AND HARDWARE ARE REMOVED. IT IS RECOMMENDED THAT THE PROTECTIVE PLASTIC COVER OVER THE TOP OF THE TRANSMITTER AND THE PROTECTIVE PLASTIC TAPE ON INSIDE OF THE REAR DOOR BE LEFT IN PLACE UNTIL ALL INSTALLATION WORK IS COMPLETE. THIS WILL PREVENT DEBRIS AND SMALL PARTS FROM FALLING INTO THE TRANSMITTER THROUGH THE AIR GRILL IN THE TOP OF THE CABINET.

Set the transmitter and High Voltage Power Supply in place on a smooth and level location near power and signal cables (see Figure 2-1). The High Voltage Power Supply must be placed within reach of the 40 foot (12.2 meter) interconnecting cables. Ensure adequate cable length is allowed for any vertical rises. The floor must be capable of supporting the 650 pounds (294.8 kg) weight of the transmitter and the 1900 pound (861.8 kg) weight of the High Voltage Power Supply. The standard interconnect cable supplied with the HT 30/35CD is 40 ft. (12.2m) in length. Optional interconnect cables of longer lengths are available by contacting the HARRIS factory.

The interconnecting cables may be trimmed to length if desired, using the additional hardware supplied with the cables. Splicing of the high voltage and screen voltage cables, however, is not recommended.

2.4.3 COMPONENT INSTALLATION

Some components may be removed from the transmitter after final test for shipment. The removal of components varies due to the method and requirements of shipment. Capacitors, connectors, cables, etc., are shipped in separate cartons. All removed items will be tagged to aid reinstallation in the transmitter. The transmitter rear door should be removed and left off until the installation is complete.

Items such as interconnecting wires and cables, shock mounted devices and miscellaneous small parts may be taped or tied in for shipment. Remove all tape, string and packing material that has been used for this purpose. Symbol numbers and descriptions are provided on each removed component corresponding to the schematic diagram, parts list and packing list. Symbol numbers are also stenciled near the cabinet location of each removed item. Terminals and wires carry tags with information telling how to reconnect each item. Mounting hardware will be found either in small bags attached to each removed component or inserted in the tapped holes where each component mounts. Arrange the removed components in separate groups according to where each was removed. Reinstall all components in their proper locations. Parts in the interior should be installed first.

Do not install the Power Amplifier tube until the installation and wiring are complete. Tube installation procedures are given in paragraph 2.4.3.12.

Before starting transmitter wiring, it is recommended that local electrical codes be reviewed and that the installation be done according to those codes. A local electrical contractor can be a good source of information on local codes and practices. The following installation information should be viewed as the minimum requirements for safe transmitter operation.

Control, audio, high voltage, and power wire entrances are provided on the top, sides and floor of the HT 30/35CD main cabinet and high voltage power supply cabinet (see Figure 2-1). The top and side entrances of the main cabinet will accommodate 1-1/2" conduit nipples. Those in the top and sides of the high voltage power supply cabinet will accommodate 2" conduit nipples for power cables and 1-1/2" conduit nipples for control and 1" conduit nipples for high voltage cables.

NOTE

If any of these entrances are used without a conduit nipple installed, a rubber grommet must be installed in the sheet metal cutout before any wires are routed though. This will prevent accidental damage to the wire insulation and a potentially dangerous or damaging situation from occurring.

Entrances in the floor of both the main cabinet and the high voltage power supply cabinet provide access from in-floor trenches.

If the top entrances are used in the main cabinet, cable channels are provided in the side walls at the rear of the cabinet. Incoming wires and cables may be routed into the channel at the top entrance and out through the lower entrance. This will allow for a neat and safe installation and will protect the incoming wires from accidental damage.

Figure 2-2, Interconnecting Wiring, and Figures 2-3 and 2-4, Primary AC Wiring, show the electrical connections to the HT 30/35CD. Figures 2-5 and 2-6, Transmitter Cabinet External Connection Points, and Figures 2-7 through 2-9, Power Supply External Connection Points, identify the physical location of the external connections.

NOTE

The HT 30/35CD is designed to operate from a closed-delta type power source. If the service entrance to the transmitter building is an open-delta or “V-V” configuration, the local power company should be contacted and the service changed to a closed-delta configuration for proper transmitter operation. Refer to “Engineering Report, Susceptibility of the Open-Delta Connection to Third Harmonic and Transient Disturbances” in the Vendor Data Section (X) of this manual for a complete discussion.

Special consideration must also be given to operation of the HT 30/35CD from single phase power systems using a rotary phase converter. For further information related to the problems that will be encountered when operating equipment on these power sources, contact HARRIS factory.

Connect a two inch wide, 0.020 inch thick (minimum) copper ground strap (not supplied) between the grounding block in the transmitter cabinet and the ground block in the lower front of the high voltage power supply cabinet. Refer to Figures 2-1, 2-5, and 2-9 to make these connections. At a central point, bond the ground strap directly to the station earth ground connection point. It is also recommended that the customer furnished power disconnects also be bonded at some central point to the station ground.

CAUTION

BECAUSE LOW RESISTANCE IN THE GROUND SYSTEM IS ESSENTIAL TO PROVIDE MAXIMUM PROTECTION FOR THE EQUIPMENT, IT IS RECOMMENDED THAT ALL CONNECTIONS BETWEEN COPPER STRAPS BE BOLTED TOGETHER AND THEN EITHER BE SOLDERED OR BRAZED. THIS WILL INSURE LONG TERM LOW RESISTANCE CONNECTIONS.

FIGURE 2-1

SEE TRANSMITTER OUTLINE DRAWING

839 6337 289

IN DRAWING PACKAGE

Figure 2-1

WARNING: Disconnect primary power prior to servicing.

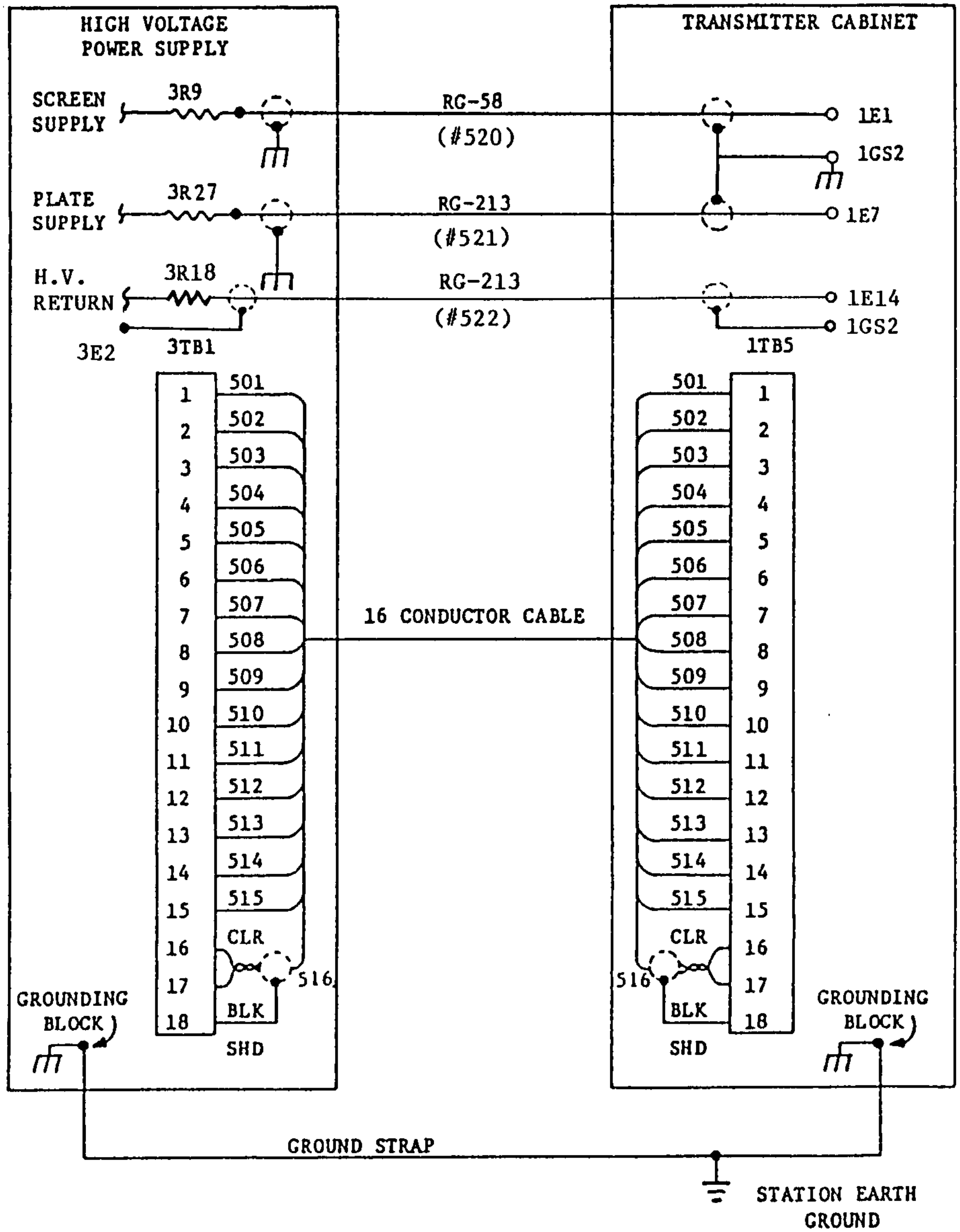
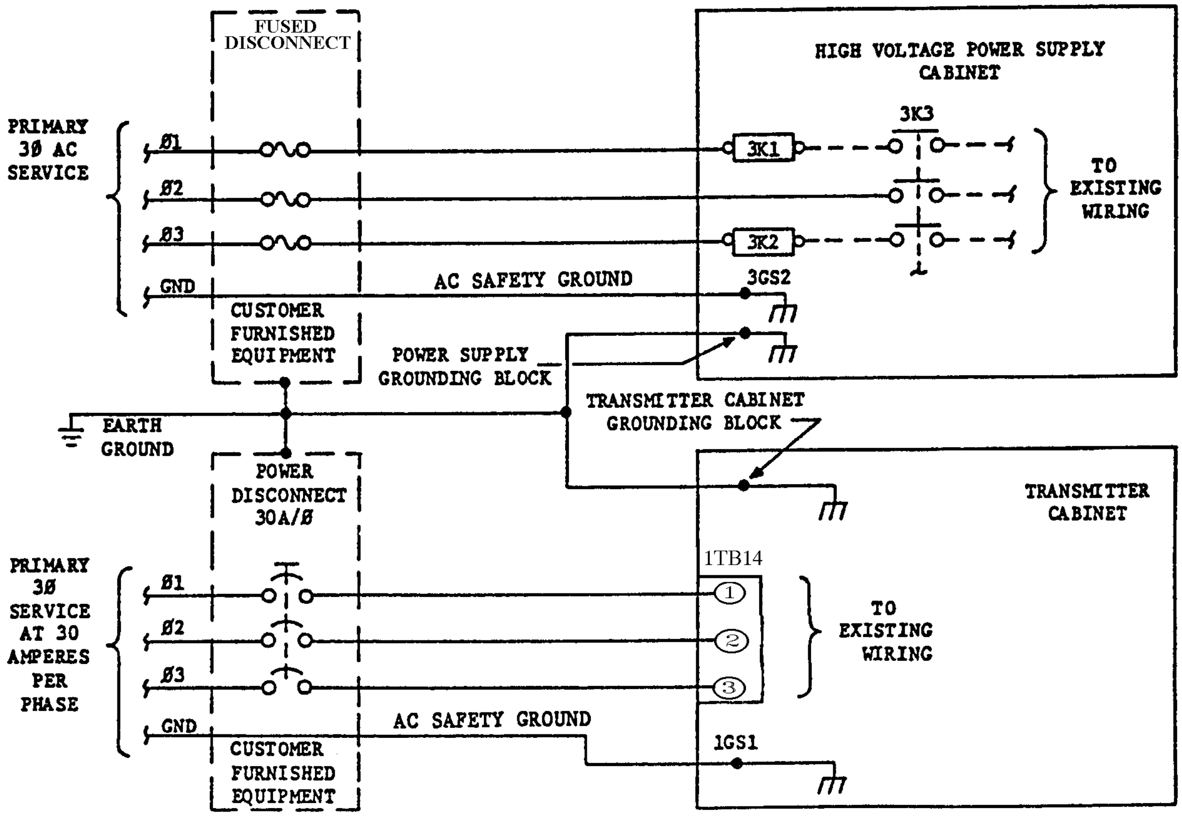


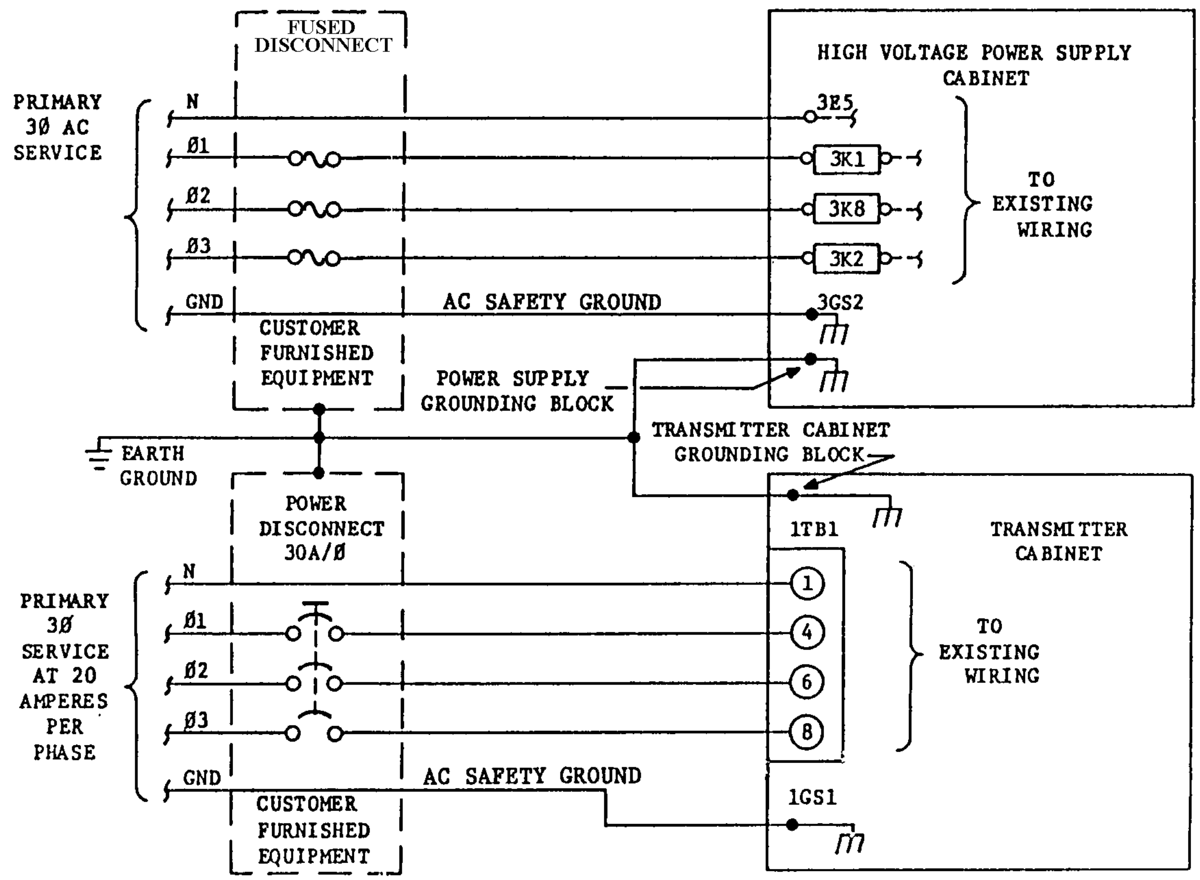
Figure 2-2. Interconnecting Wiring



NOTES: 1. WIRE TRANSMITTER CABINET WITH NO. 10 THHN WIRE. *
2. WIRE HIGH VOLTAGE POWER SUPPLY CABINET WITH NO. 3/0 THHN WIRE. *

* REFER TO LOCAL ELECTRICAL CODES FOR CONDUCTOR SIZING.

Figure 2-3. Primary AC Wiring,
3 Phase, 208/240 Vac, 50/60 Hz



NOTES: 1. WIRE TRANSMITTER CABINET WITH NO. 10 THHN WIRE. *
2. WIRE HIGH VOLTAGE POWER SUPPLY CABINET WITH NO. #2 THHN WIRE. *

* REFER TO LOCAL ELECTRICAL CODES FOR CONDUCTOR SIZING.

Figure 2-4. Primary AC Wiring,
3 Phase, 4-Wire, 380/415 Vac, 50 Hz

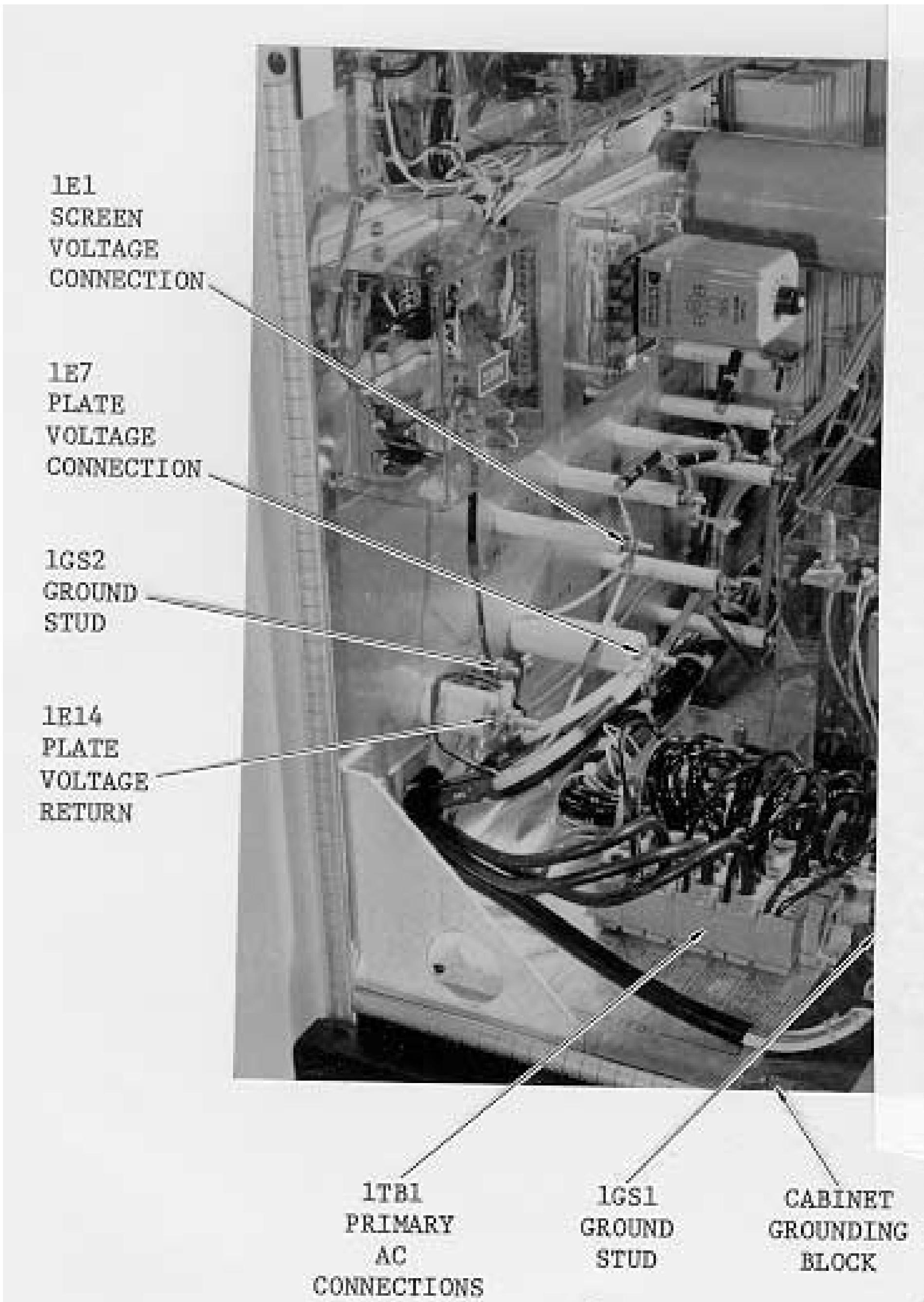


Figure 2-5. Transmitter Cabinet External Connection Points

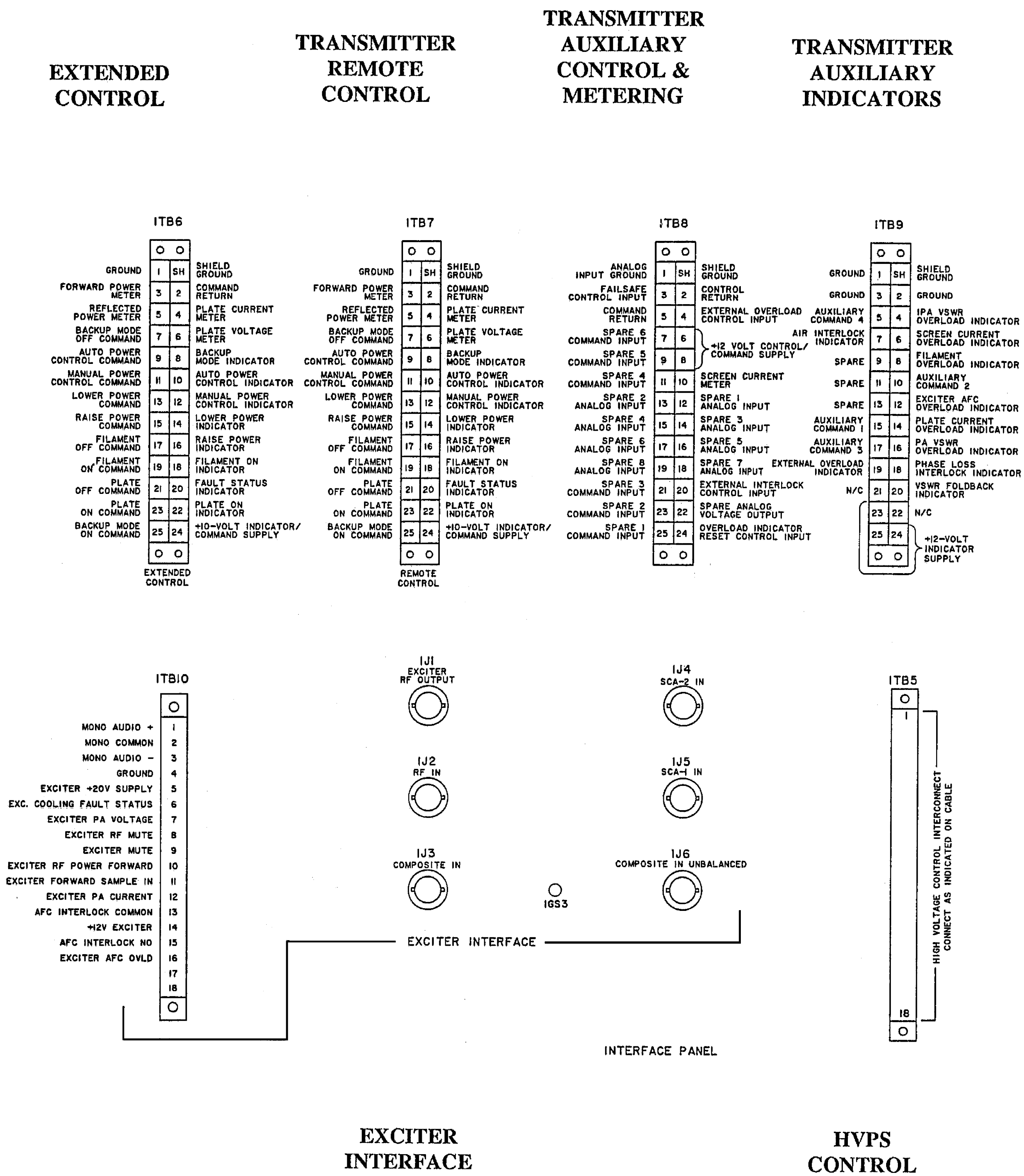


Figure 2-6. Transmitter Cabinet Interface Panel External Connection Points

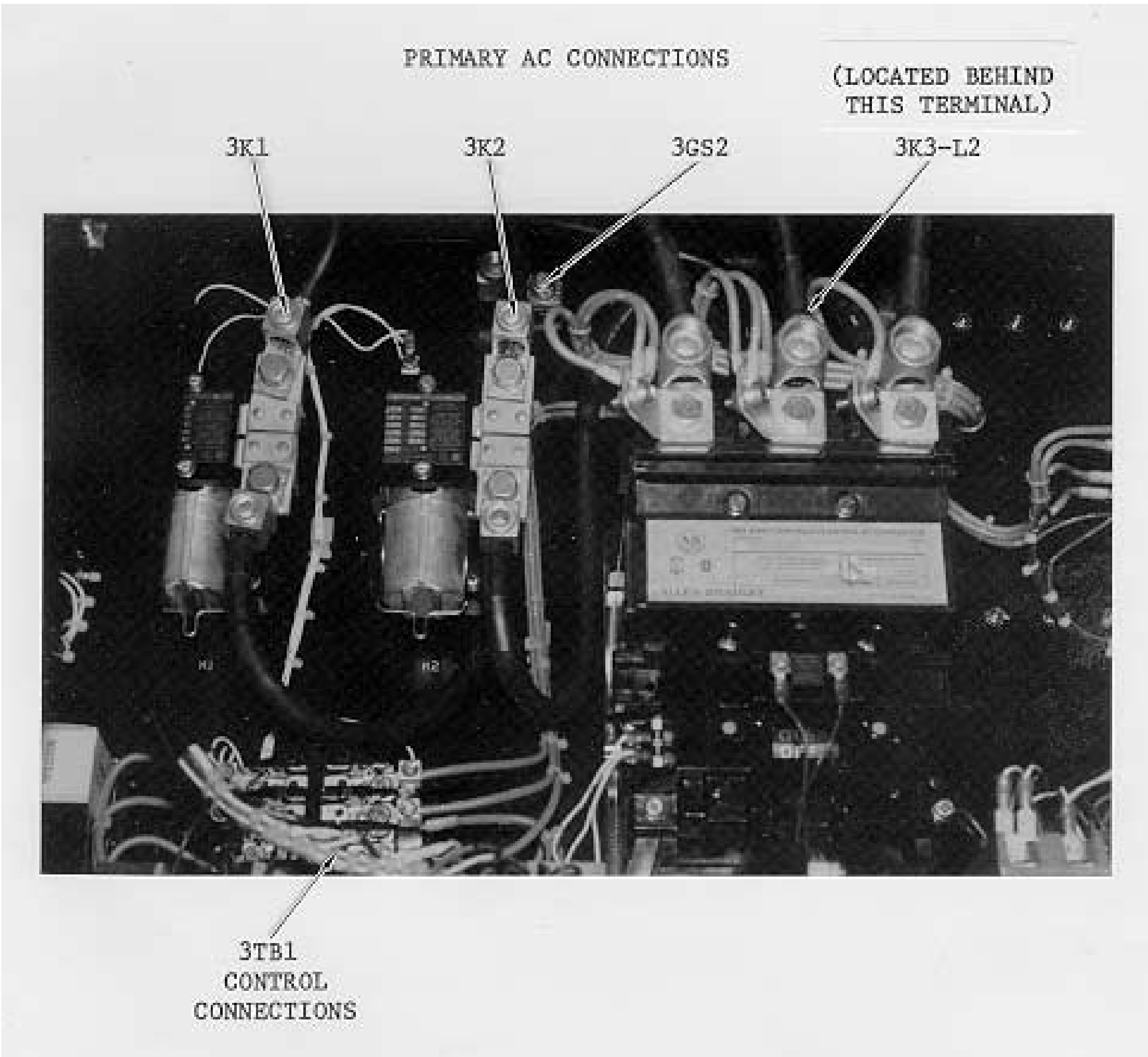


Figure 2-7. High Voltage Power Supply Cabinet
External Connection Points
3 wire 208-240 VAC

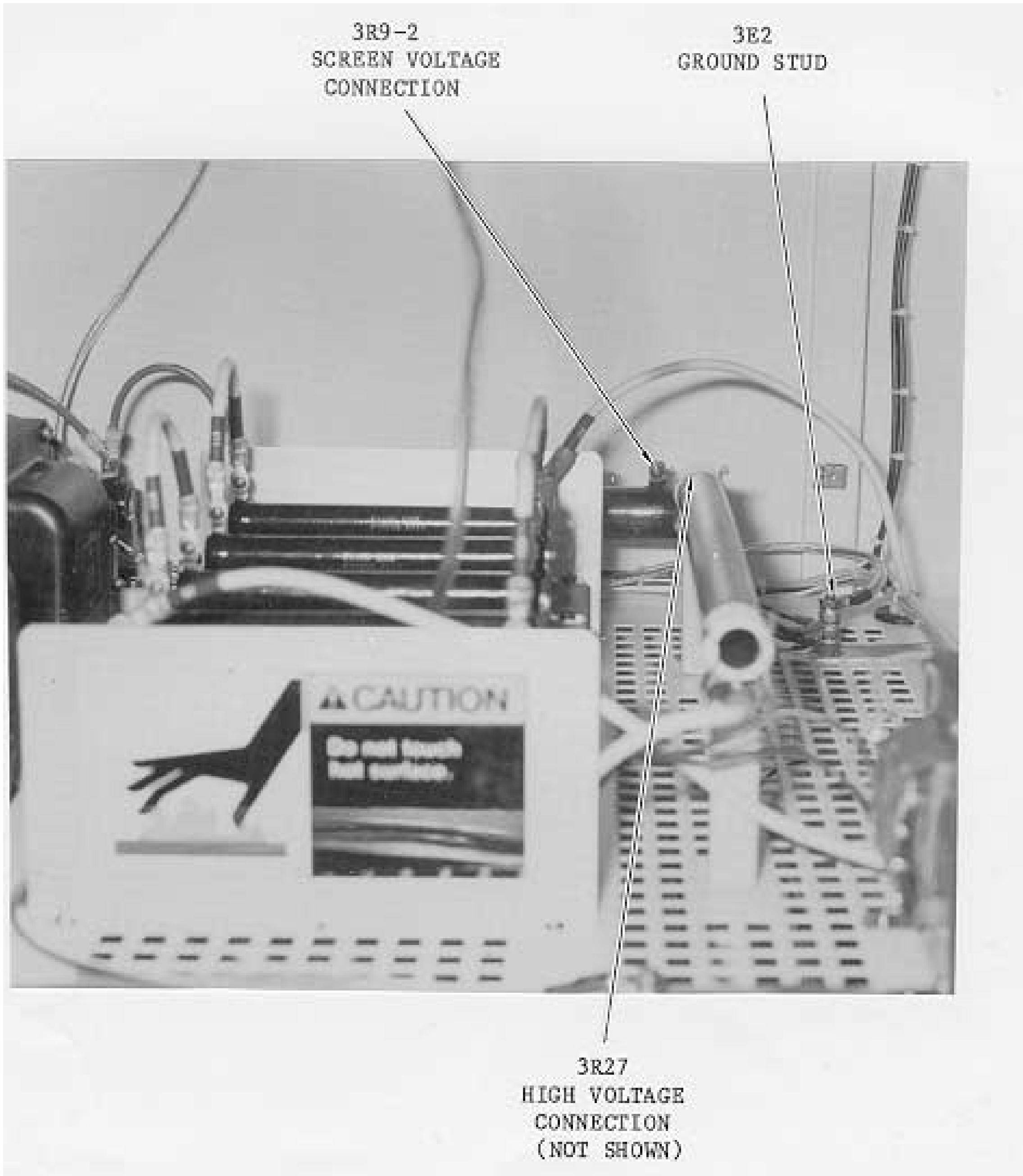


Figure 2-8. High Voltage Power Supply Cabinet
External Connection Points

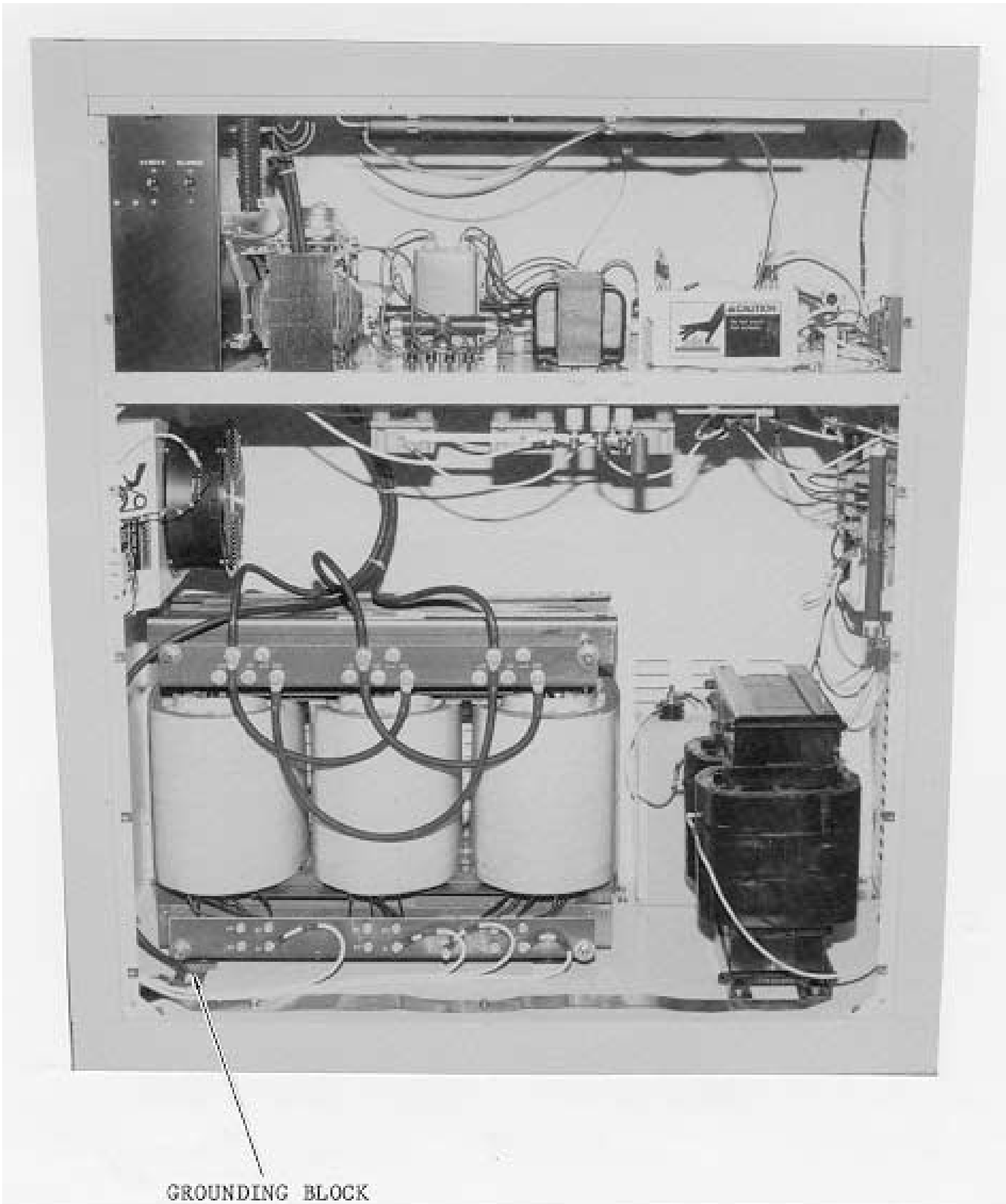


Figure 2-9. High Voltage Power Supply Cabinet External Connection Points

2.4.3.1 TRANSMITTER CABINET TO HIGH VOLTAGE POWER SUPPLY WIRING

The location of the control cable and high voltage cable connection points are shown in Figures 2-2, 2-5, 2-7, 2-8, 2-9, and 2-10. If it is desired to use cables of shorter length, the cables may be cut to length and terminated. Connect the control and high voltage wiring as follows:

a. Connect the control cable (HARRIS part number 917 1335 121) from 1TB5 in the transmitter cabinet to 3TB1 in the high voltage power supply cabinet observing the correct wire number to terminal number as shown in Figure 2-2. See Figure 2-13 for instructions in making connection to these terminal blocks. They are of a new quick, lugless type.

b. Connect the center conductor of the RG-58 (#520) portion of the high voltage cable (HARRIS part number 929 7924 001) to terminal 1E1 in the transmitter cabinet.

c. Connect the center conductor of the RG-213 (#521) portion of the high voltage cable to terminal 1E7 in the transmitter cabinet.

d. Connect the center conductor of the RG-213 (#522) high voltage cable to terminal 1E14 in the transmitter cabinet.

e. Connect the shield from the RG-58 (#520) cable to the ground stud 1GS2 in the transmitter cabinet. Connect the shield from the RG-213 (#512) cable to 1GS2 in the transmitter cabinet. Connect the shield from the RG-213 (#522) cable to 1GS2 in the transmitter cabinet.

f. In the high voltage power supply cabinet, connect the shield of the RG-58 (#520) cable to terminal 3E2.

g. Connect the center conductor of the RG-58 (#520) cable to the open end of 3R9 in the high voltage power supply cabinet.

h. Connect the shield of the RG-213 (#521) cable to ground stud 3E2 in the high voltage power supply cabinet.

i. Connect the center conductor of the RG-213 (#521) cable to the open end of resistor 3R27 in the high voltage power supply cabinet.

j. Connect the shield from the RG-213 (#522) cable to 3E2 in the high voltage power supply cabinet.

k. Connect the center conductor of the RG-213 (#522) cable to the bottom end of 3R18 (with wires #93 and #109).

CAUTION

BE SURE AND CONNECT THE CABLES AS SHOWN IN FIGURE 2-2 AND DRESS THE WIRES AWAY FROM HIGH VOLTAGE TERMINALS.

2.4.3.2 EXCITER AUDIO WIRING

The DIGIT™ Exciter requires the use of an input module, the standard Digital Stereo Generator Module or the optional Analog I/O Module. If your DIGIT™ exciter is using the optional Analog I/O Module, then all exciter connections will be made at the transmitter interface panel at the rear of the transmitter. If your DIGIT™ uses the Digital Stereo Generator Module, then all of the connections will be made at the transmitter interface panel with the exception of the following which will have to be made directly to the Digital Stereo Generator Module:

a. The AES/EBU Digital Audio Input will have to be connected directly to J9 on the Digital Stereo Generator Module with a male XLR connector.

b. The RBDS input and 19kHz output will have to be connected directly to J4 and J8 (BNC connectors) respectively.

c. Remote Control and I/O connections to the Digital Stereo Generator Module will also have to be connected directly to J7 (a 9 pin D connector) on the Digital Stereo Generator Module. For more information on these connections refer to the DIGIT™ FM Exciter Technical Manual, Section II, Installation.

Refer to Figure 2-6, Transmitter Cabinet External Connection Points, and Figure 2-11.

Note

A Transmitter Mounting Kit is available to adapt the DIGIT™ exciter into any HT 30/35FM transmitter. The HARRIS part# for the Transmitter Mounting Kit is 992-8993-001. There is also a Rack Mounting Kit available for mounting the DIGIT™ exciter in a rack near the transmitter. The HARRIS part# is 992-8998-001. A listing of all available DIGIT™ mounting kits is listed in the DIGIT™ Exciter parts list, in the DIGIT™ Exciter Technical Manual.

2.4.3.2.1 Analog Inputs

The following is based on the use of the optional Analog I/O Module on the DIGIT™ exciter. The 600 ohm balanced analog audio input for the DIGIT™ monaural mode is located on terminal board 1TB10. (See Figure 2-13 for information on making connections to 1TB10.) Connections to this input should be made using shielded, twisted pair audio cable. Connections should be made according to phasing polarity and ground connection information contained in Figure 2-10. This information is also located on the inside of the rear door of the transmitter cabinet.

When wideband, analog composite operation is desired, jacks 1J3 and 1J6 on the Interface Panel provides the input connections to the composite inputs of the DIGIT™ Exciter Analog I/O Module. 1J3 and 1J6 are isolated BNC connectors and it is recommended that a triaxial type of cable be used to connect between 1J3 or 1J6 and the composite source. The center conductor of the triaxial cable and the inner most shield should be terminated in a standard BNC male cable connector. This connector will then mate with 1J3 or 1J6. The outer most shield should be lugged and connected to the ground stud 1GS3. The source end of this cable should be terminated in a similar manner using a connector compatible with the source equipment. This will provide a most effective barrier against unwanted noise or hum effecting the composite audio signal.

Triaxial cables of specific lengths already terminated with a BNC connector and ground lug on each end are available by contacting the HARRIS factory.

Length	HARRIS Part No.
3 ft.	922 0014 001
5 ft.	922 0014 002
10 ft.	922 0014 003
15 ft.	922 0014 004
25 ft.	922 0014 005
40 ft.	922 0014 006

NOTE

The triaxial cable used to make this composite input connection is of the type with two individual shields that are insulated from one another. Double shielded cables without an insulating material between the two shields will not work properly in this application.

NOTE

For specific information on proper audio levels and audio input impedances, refer to the DIGIT™ FM Exciter Technical Manual.

2.4.3.3 EXCITER REMOTE CONTROL AND METERING CONNECTIONS

Remote mode control and metering connections for the DIGIT™ Exciter are available on terminal board 1TB10, located on the Interface Panel on the rear of the transmitter cabinet. Consult the DIGIT™ FM Exciter Technical Manual and or the instructions included with the exciter mounting kit for detailed information on interfacing to these control inputs and metering outputs. Figure 2-11 gives pin assignment information for 1TB10.

2.4.3.4 EXCITER WIRING WITH THE EXCITER LOCATED IN AN EXTERNAL RACK

Refer to Figure 2-12, Wiring diagram for operation with externally mounted Exciter. In some cases it may be desirable to locate the exciter externally to the transmitter. It is recommended that the Rack Mounting Kit, part #992-8998-001 be used for this type of installation. To relocate the exciter from the transmitter cabinet to an external rack, follow the steps below.

a. Slide the exciter out on its extender rails.

b. Reach in over the top of the exciter and disconnect all of the connectors that are plugged into the rear of the exciter.

c. Using cable ty-raps, attach the loose cables that used to go to the exciter to the vertical main cable run on the left side wall of the transmitter. These cables must be securely held in place to avoid accidental contact with transmitter components during transmitter operation. Secure the access door with the hardware provided.

d. To fill the front panel void left with the removal of the exciter, install a blank 19" rack panel in its place on the front of the transmitter. A blank panel of the appropriate size and painted to match the transmitter cabinet is available from the HARRIS factory. Order HARRIS part number 843 4827 004.

e. Install the Exciter in the desired location in the external rack.

f. In order to maintain correct transmitter operation, the following wiring changes on the transmitter Interface panel (accessible through the rear door) must be made:

g. Remove the following wire jumpers.

   1. #287 from between terminals 13 and 14 of 1TB10.
   2. #83 from between terminals 8 and 9 of 1TB10.
   3. #288 from between terminals 16 and 15 of 1TB10.
   4. #289 from between terminals 10 and 11 of 1TB10.

h. Remove the coaxial cable jumper (#210) that is connected between 1J1 and 1J2.

i. Also, the following interconnections between the transmitter Interface panel and the exciter must be made:

   1. From 1TB10 terminal 14 on the interface panel to J2-10 on the rear of the DIGIT™ Exciter. (Use #22 AWG or larger stranded insulated wire.)
   2. From 1TB10 terminal 9 on the interface panel to J2-9 on the rear of DIGIT™ Exciter. (Use #22 AWG or larger stranded insulated wire.)
   3. From 1TB10 terminal 16 on the interface panel to J2-12 on the rear of DIGIT™ Exciter. (Use #22 AWG or larger stranded insulated wire.)
   4. From 1TB10 terminal 11 on the interface panel to J2-2 on the rear of DIGIT™ Exciter. (Use #22 AWG or larger stranded insulated wire.)
   5. From 1GS3 on the interface panel to the ground lug on the rear of DIGIT™ Exciter. (Use #22 AWG or larger stranded insulated wire.)
   6. Install a coaxial cable with a BNC male connector on each end between 1J2 on the interface panel and J1 (RF OUT) on the rear of the DIGIT™ Exciter. (Use RG-58U for runs of less than 25 feet and RG-213U for runs of more than 25 feet.)

j. In cases where the coaxial cable that is installed between DIGIT™ Exciter and the transmitter interface panel is long, higher than normal RF losses may result. This may be compensated for by raising the RF output level of DIGIT™ Exciter, using the factory test data as a guide in re-establishing normal Preamplifier and IPA output power levels. In no case, however, should DIGIT™ be operated at an output level in excess of 15 watts. This may be done at the end of the initial checkout procedure.

k. Remote Control and Metering connections to the exciter, J2, and the Digital Stereo Generator Module J7, can now

FIGURE 2-10

SEE INTERCONNECTION DIAGRAM

839 6337 265

IN DRAWING PACKAGE

Figure 2-10

FIGURE 2-11
INTERFACE PANEL

2-17/2-18

Figure 2-11. Interface Panel (See Figure 2-6)

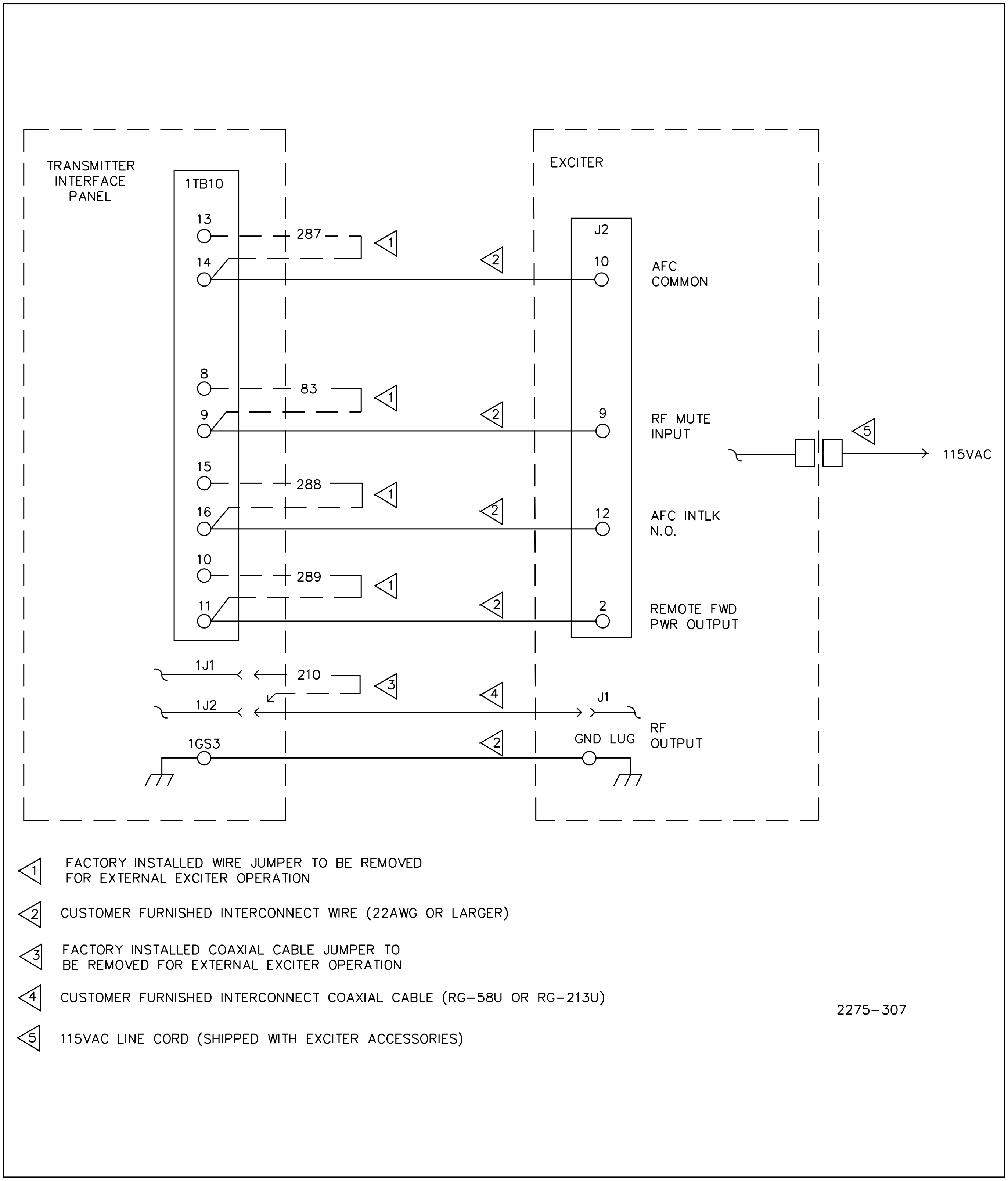


Figure 2-12. Wiring Diagram for Operation with Externally Mounted Digit™ FM Exciter

To prepare wire, strip insulation back approximately 1/2" and twist strands back into their natural position.

A small size flat blade screwdriver is an appropriate tool to use to make the connection. To make connection, align wire in side opening and depress clamp down from the opening with tool. Insert wire or component and release by withdrawing tool.

Two conductor block which is simply a single internal current bar block creating a straight thru connection (GREY BLOCKS)

Four conductor block which is a single internal current bar with 4 input ports all inter-connected. (BLUE BLOCKS)

Assembly of terminal block strips from modular terminals

Mounting of end plate

Figure 2-13. Operating Instructions For Terminal Boards 1TB2, 1TB3, 1TB5, 1TB10, 1TB11, 3TB1 & 3TB2

be made directly to the exciter and the input module. For information on these connections refer to the exciter manual.

l. The AES/EBU Digital audio input, SCA's and RBDS inputs will also be routed directly to the appropriate input on the exciter input module.

2.4.3.5 SELECTION OF PRIMARY AC CURRENT LIMITING DEVICES

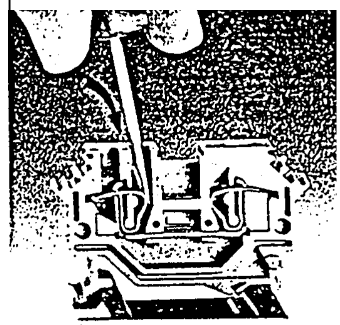
Every ac line current limiting device, be it a fuse or a circuit breaker, has a characteristic clearing (opening) time that is dependant upon the magnitude of the current that is passing through it. Some types are very fast and can clear in a matter of a few milliseconds when the current rating of the device is greatly exceeded. This type of fuse or circuit breaker may be used to protect sensitive solid state devices. In this case, current overloads can be harmful, even if the overload condition lasts for only a very short period of time.

Other types of current protection devices are designed so that a current overload condition is allowed to exist for a well defined period of time before the device will open. This type of device is used when overcurrent conditions are expected and must be allowed to exist for a short period of time before operation is determined to be outside normal limits and the protection device is required to interrupt the current. A fuse or circuit breaker of this type is used, for example, to protect large electric motors. When first started, the motor will draw a heavier than normal line current. This over-current condition will usually exist until the motor comes up to normal operating speed. This may be referred to as an inrush current or starting current. To interrupt the ac current due to this expected momentary over-current condition would be to interfere with the normal operation of the motor and would not be at all desirable.

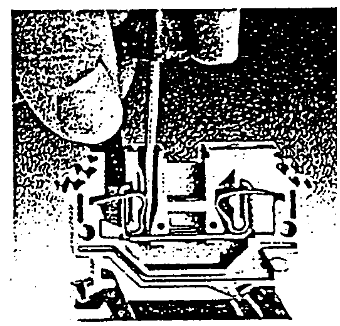
Not entirely unlike the electric motor, the transmitter may, under fault or overload conditions, momentarily draw heavier than normal line currents. This current overload condition will exist until the transmitter control circuits react and turn the transmitter off. At this time, if the fault condition is cleared, the control circuits will proceed to re-establish normal on-air transmitter operation (recycle).

If the line current limiting devices should open too quickly, normal transmitter operation will be prevented from taking place, and the transmitter will be needlessly off the air. For this reason, the line current protection devices used to protect the transmitter should not be the quick acting type. It is recommended that the devices used with the HT 30/35CD have a clearing time versus current characteristic curve of RK5, for example Buss FRN-R or Littlefuse FLNR_ID in 250 VAC applications or FRS-R/FLSR_ID in 600 VAC applications. Use of a current protection device of this type will ensure proper transmitter operation during these possible over-current conditions.

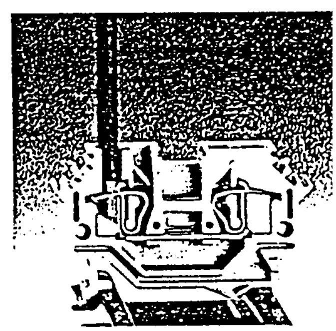
Prepare wire by stripping insulation back approximately 3/4". Slightly twist the wire strands so that they lay in their natural position.
A medium size flat blade screwdriver is an appropriate tool to use to make the connection.



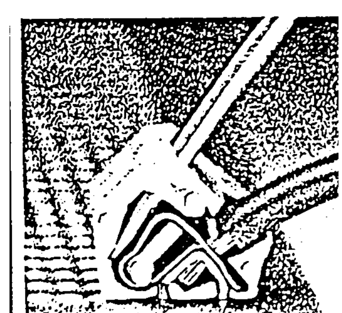
Front entry:
Depression of the cage-clamp spring and wire entry from the front, both under visual control of the operator.
1. The screwdriver is introduced in the operating slot up to the stop.



2. The screwdriver blade holds the clamping spring open automatically so that the conductor can be introduced into the clamping unit.



3. The screwdriver is withdrawn - the conductor is automatically clamped.



The contact quality of the cage-clamp connection is almost independent of the operator's skill.

Figure 2-14. Operating Instructions for Terminal Board 1TB1

2.4.3.6 INPUT POWER CONNECTIONS

Refer to Figures 2-3, 2-4, and 2-10 and complete the input power connections as follows:

WARNING

ENSURE THAT STATION PRIMARY POWER TO THE TRANSMITTER IS DISCONNECTED AND LOCKED OUT WHILE COMPLETING THE FOLLOWING CONNECTIONS.

CAUTION

A SMALL AMOUNT OF SILICON FLUID WAS INSTALLED IN THE DASHPOT CUPS OF MAGNETIC OVERLOAD RELAYS 3K1 and 3K2 (ALSO 3K8 IN THE 4-WIRE CONFIGURATION). THIS AMOUNT OF FLUID PREVENTS NUISANCE TRIPPING OF THE RELAYS ON SHORT DURATION CURRENT SPIKES. IF REPLACEMENT OF ONE OF THE RELAYS IS REQUIRED, A BOTTLE OF FLUID WILL BE SUPPLIED WITH THE NEW PART. FLUID SHOULD BE ADDED TO THE CUP UP TO BUT NOT OVER THE LEVEL OF THE MOLDED GROOVES IN THE BOTTOM OF THE CUP. DO NOT USE MORE FLUID THAN REQUIRED TO FILL THESE GROOVES AS THIS WILL CHANGE THE REACTION TIME OF THE RELAY.

a. Connect the three number 10 THHN wires from the 30A power disconnect to 1TB14-1, -2, -3 in the transmitter cabinet. (Use a 20A power disconnect for 360/415 vac 50 Hz 4-wire systems.)

b. Connect a fourth number 10 THHN wire from the power system ground to terminal GS2 in the transmitter cabinet.

c. Prepare wire by stripping insulation back approximately 3/4". Slightly twist the wire strands so that they lay in their natural position. A medium size flat blade screwdriver is an appropriate tool to use to make the connection.

d. For 35 kW transmitter power output, use 200 ampere service for voltages up to 230 volts and 175 ampere service for voltages above 230 volts. On 4-wire power systems, use 125 ampere service for voltages up to 400 volts and 100 ampere service for voltages over 400 volts.

e. For power outputs significantly less than 35 kW, size the power service according to the power consumption of the transmitter during final test. Multiply the final test line voltage by the highest three-phase line current reading on the test data sheet multiplied by 1.732. This will determine kVA consumption. To obtain the line current for the voltage, divide the kVA consumption by the line voltage times 1.732. Add 30 percent to this value for a safety margin.

f. 208/240 vac 3-wire installations. Connect the 3 phase power disconnect (sized in step d. or e. above) to the high voltage power supply cabinet with three #000 (3/0) THHN wires. Connect one wire to the open terminal of 3K1. Connect one wire to the open terminal of 3K2. Connect the third wire to 3K3 terminal L2.

g. Connect a fourth #000 (3/0) wire from the power system ground to ground lug 3GS2.

h. 380/415 vac 4-wire installations. Connect the 3 phase power disconnect (sized in step d. or e. above) to the high voltage power supply cabinet with four #2 THHN wires. Connect the three phase wires to the open terminals of 3K1, 3K2, and 3K8. Connect the NEUTRAL wire to terminal 3E5. Connect a fifth #2 wire from the power system ground to ground lug 3GS2.

WARNING

REMOVE THE PROTECTIVE PLASTIC COVER OVER THE TOP OF THE TRANSMITTER AND THE PLASTIC TAPE ON THE INSIDE OF THE REAR DOOR OF THE MAIN TRANSMITTER CABINET AT THIS TIME. ALL PLASTIC TAPE MUST BE REMOVED FROM THE REAR DOOR BEFORE PUTTING TRANSMITTER INTO OPERATION.

2.4.3.7 OUTPUT COAXIAL LINE INSTALLATION

Using Figure 2-1 as a guide, proceed as follows:

a. Connect the end of the low pass filter/directional coupler assembly (943 4114 139) with the elbow to the output port of the transmitter. Secure using the compression band supplied.

b. Terminate the directional coupler end of the filter assembly with the station load or the station antenna.

CAUTION

FAILURE TO INSTALL THE DIRECTIONAL COUPLER AND LOW-PASS FILTER IN THIS EXACT CONFIGURATION MAY RESULT IN ABNORMAL TRANSMITTER OPERATION AND LOSS OF CALIBRATION OF THE OUTPUT POWER AND VSWR METERING.

c. Connect the directional coupler to the Transmitter cabinet using the supplied interconnecting cable containing wires 601 and 602. Connect the BNC connector on wire 601 to 1J11 on the Transmitter cabinet top. Connect the BNC connector on wire 602 to 1J12 on the Transmitter cabinet top. Connect the other end of wire 601 to the jack on the directional coupler with the yellow band. Connect the other end of wire 602 to the jack on the directional coupler with the red band. Refer to Figure 2-10 for further information on installing this cable.

2.4.3.8 INTERFACE INFORMATION FOR THE HT 30/35CD

Interface connections for Remote and Extended control of the HT 30/35CD are made through a set of barrier strip adapters on the Interface Panel on the right rear panel at the rear of the Main Cabinet of the transmitter. These barrier strips are connected through dedicated cables to the Transmitter Interface/Backup Controller board on the Controller Assembly.

The configuration of the Control Input circuitry is designed to provide maximum flexibility in connecting Remote Control equipment of all kinds. All connections to and from remote control equipment are provided with rf bypass components at the Controller end of the cabling to minimize the possibility of introducing unwanted signal elements into the transmitter control circuits.

In the paragraphs below, those circuits designated PRIMARY operate at all times, whether the transmitter is operating in the MAIN Mode or the BACKUP Mode. The circuits listed in the SECONDARY categories are associated with the Main (Micro-processor) Controller only, and should not be assumed to be operable when the transmitter is operating in the BACKUP Mode. There is an exception to these statements in that the AUTO Power Control and MANUAL Power Control inputs are not operable, and the AUTO Power Control status output is not meaningful when the transmitter is operating in the BACKUP Mode.

2.4.3.8.1 *Primary Control Inputs*

This category includes the FILAMENT ON, FILAMENT OFF and PLATE ON, PLATE OFF circuits, the RAISE POWER and LOWER POWER circuits, the AUTO POWER and MANUAL POWER Control circuits (see comment above) and the BACKUP Mode ON and OFF circuits. All of these inputs are optically isolated and may be connected to remote control systems which provide positive voltages in the range of eight to fifteen. The transmitter supplies a voltage source that may be used in the event that the Remote Control equipment provides contact closures instead of voltages. The "return" side of these circuits may be connected to either the Remote Control ground or to the transmitter ground.

The circuitry in this category is duplicated for the Extended Control group, so that a separate source of power and ground may be used for each.

There is another circuit group, isolated from the two discussed above which includes the FAILSAFE, EXTERNAL INTERLOCK, and OVERLOAD INDICATOR RESET inputs. The EXTERNAL INTERLOCK (used for rf switching interlock, water load interlock, etc.) is operative at all times and will not allow starting the Plate power supply or the application of rf. The FAILSAFE circuit operates similarly, but is active only when Remote control and/or Extended control operation is enabled.

2.4.3.8.2 *Secondary Control Inputs*

This fourth group of control inputs is reserved for future use and is recognized only by the Main Controller.

2.4.3.8.3 *Analog Inputs*

The last group of external inputs is connected through the Transmitter Interface/Backup Controller board to the Analog section of the Main Controller. There are eight of these inputs, presently designated Spare 1 Analog Input through Spare 8 Analog Input (on 1TB8). Future software releases may use these inputs singly or in balanced pairs.

2.4.3.8.4 *Primary Control Outputs*

This category includes the status indicators for the main functions of the HT 30/35CD. They may be used to operate lamps or Remote Control equipment inputs. Included here are the following: FILAMENT ON, PLATE ON, POWER RAISE,

Table 2-1. 1TB7 Connections

Ground	
FORWARD POWER Meter *	2, 3
REFLECTED POWER Meter *	4, 5
MAIN (Not Used)	7
AUTO Pwr. Cntrl. Command	8, 9
MANUAL Pwr. Cntrl. Command	10, 11
LOWER POWER Command	12, 13
RAISE POWER Command	14, 15
FILAMENT OFF Command	16, 17
FILAMENT ON Command	18, 19
PLATE OFF Command	21
PLATE ON Command	23
GO TO BACKUP MODE	24, 25
(Constant Closure)	

POWER LOWER, AUTO POWER CONTROL ON, AUTO POWER CONTROL OFF, active FAULT condition, and BACKUP Mode active. These circuits are “ground switching" (current sink) by solid state devices and the transmitter provides a +10-volt supply for the external return of these circuits. These outputs are available for both the Remote Control and Extended Control applications.

CAUTION

THE MAXIMUM SAFE CURRENT SINK CAPABILITY OF EACH OF THESE OUTPUTS IS 50 MA. THIS LEVEL MUST NOT BE EXCEEDED UNDER ANY CIRCUMSTANCE.

2.4.3.8.5 Secondary Control Outputs

This larger group contains the auxiliary status indicator circuits required for the more complete Remote Control installation. Included are: EXCITER AFC Overload, FILAMENT Overload, PLATE Current Overload, SCREEN Current Overload, PA VSWR Overload, IPA VSWR Overload, PHASE LOSS Interlock, VSWR FOLDBACK Active, AIR Interlock, and four circuits reserved for future use. Presently, these four circuits are designated Auxiliary Command 1 through Auxiliary Command 4.

CAUTION

THE MAXIMUM SAFE CURRENT SINK CAPABILITY OF EACH OF THESE OUTPUTS IS 50 MA. THIS LEVEL MUST NOT BE EXCEEDED UNDER ANY CIRCUMSTANCE.

2.4.3.8.6 Analog Outputs

The first group of analog outputs is independent of the choice of controller (Main or Backup). Included in this group are the PLATE VOLTAGE Sample, PLATE CURRENT Sample, PA FORWARD POWER Sample, PA REFLECTED POWER Sample, and SCREEN CURRENT Sample. These outputs are +10 volts maximum through a 2 k ohm resistor, allowing for external calibration controls (such as a 10 k ohm variable resistor in series with an external meter having 1 mA full-scale sensitivity). These outputs are suitable for all remote control applications which do not require more than 2.5 mA at 5 volts for full-scale indication. On 1TB7, these four meter circuits are further enhanced by the presence of “padding" resistors to permit direct connection to Remote Control equipment requiring only 1 Volt or 4 Volts for the equivalent of full-scale deflection.

There is another similar analog output which is reserved for future use and is under control of the Main Controller only.

2.4.3.8.7 1TB7 - Remote Control and 1TB6 - Extended Control

See Table 2-1. Terminal 2 is the common Command Return. To use the internal HT 30/35CD Indicator/Command power supply, connect Command Return (terminal 2 of 1TB7 or 1TB6) to Ground (terminal 1 of 1TB7 or 1TB6) and connect the +10-volt Indicator/Command Supply (terminal 24 of 1TB7 or 1TB6) through the external switches to the applicable Command terminals of 1TB7 or 1TB6. See Figure 2-15. The Command Return must be connected to ground to enable the Remote/ Extended control inputs when using the internal +10 VOLT indicator/command supply.

If an external 8-volt to 15-volt power supply is to be used for the Command Circuits, connect the negative terminal of the external power supply to Command Return (terminal 2 of 1TB7 or 1TB6). Connect the positive terminal of the external power supply through the external switches to the applicable Command terminals of 1TB7 or 1TB6. See Figure 2-16. The external supply negative terminal must be connected to the Command Return terminal to enable Remote/Extended control switching when using an external power supply.

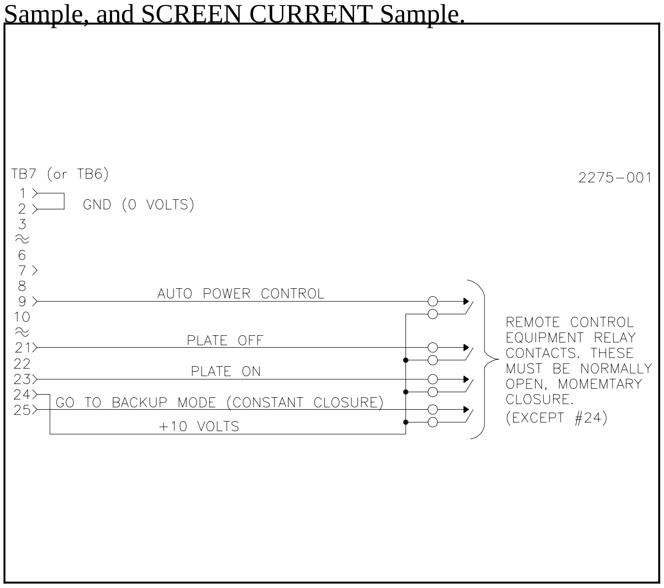


Figure 2-15. Typical Wiring for Command Inputs Using HT 30/35FM Internal Power Supply

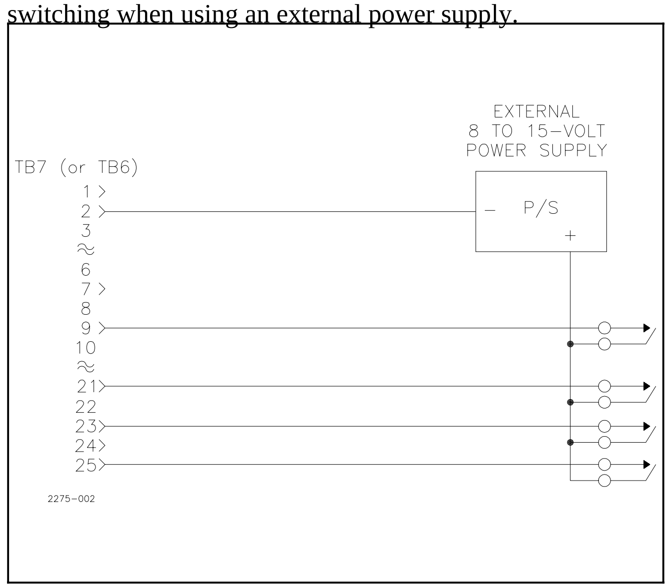


Figure 2-16. Typical Wiring for Command Inputs Using External Power Supply

WARNING: Disconnect primary power prior to servicing.

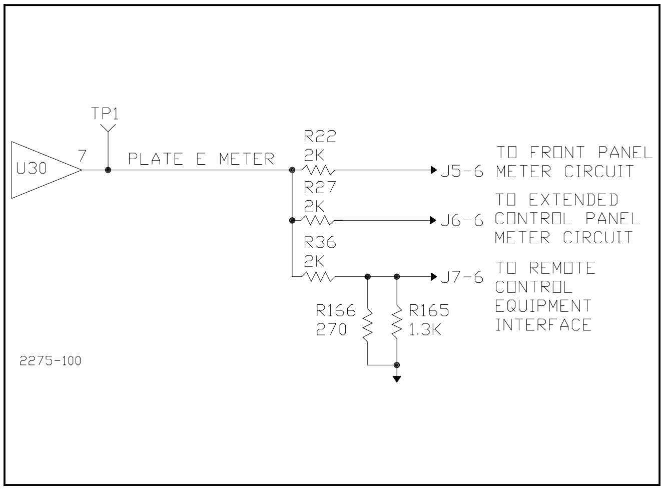


Figure 2-17. Typical Meter Circuit

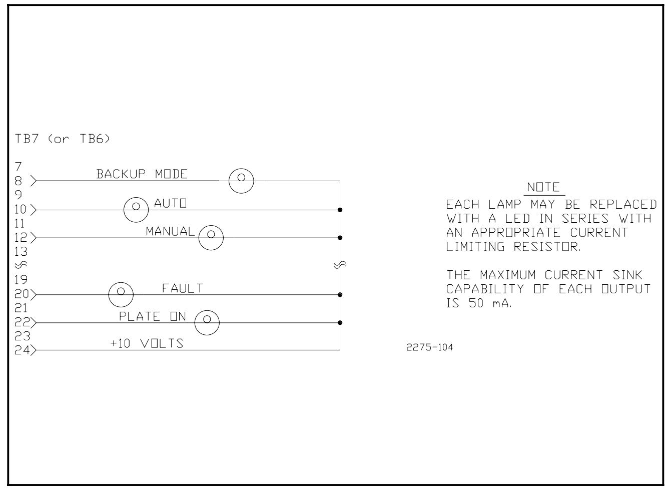


Figure 2-18. Typical Indicator Circuit Using HT 30/35CD Internal Power Supply

NOTE

The +10 VOLT Indicator/Command supply is designed to drive the optically coupled Remote/Extended control inputs and low current (50 mA maximum each) external status indicators or remote control telemetry device inputs. Do not use this +10 volt supply for additional external control circuit loads such as mode switching relay, etc. Excessive current drain from this supply could cause transmitter control circuit malfunction. The use of an external power source to power such external loads is required. The Meter terminals of Terminal Strips 1TB7 or 1TB6 are intended to be connected to Remote Control Equipment or to external meters, and they are referenced to Ground (terminal 1 of 1TB7 or 1TB6). The external meters should have movements rated at 1 mA full scale and should have 10 k ohm variable resistors in series with each meter for calibration.

NOTE

The Meter outputs on 1TB7 (not 1TB6) are equipped with “padding" resistors which permit these outputs to be connected to Remote Control system telemetry inputs with various maximum limits. Each of these pads consists of a 1.3 k ohm resistor and a 270 ohm resistor connected in parallel from the meter output to ground. With both of these resistors in place, the meter voltage is divided by 10 so that the maximum reading that may be delivered to the Remote Control equipment input is 1 volt. If the 270 ohm resistor is removed, the meter voltage is divided by 2.5 so that the maximum reading that may be delivered to the Remote Control equipment input is 4 volts. With both the 270 ohm and 1.3k ohm resistors removed, the maximum reading that may be delivered to the Remote Control equipment input is 10 volts. All of the meter circuits provided on 1TB7 are equipped with the padding resistors. Therefore, four or eight resistors must be removed if the Remote Control equipment requires other than a 1-volt limit for sample inputs. The location of these resistors (R159-R166) is the Transmitter Interface/Backup Control board, located on the top of the controller

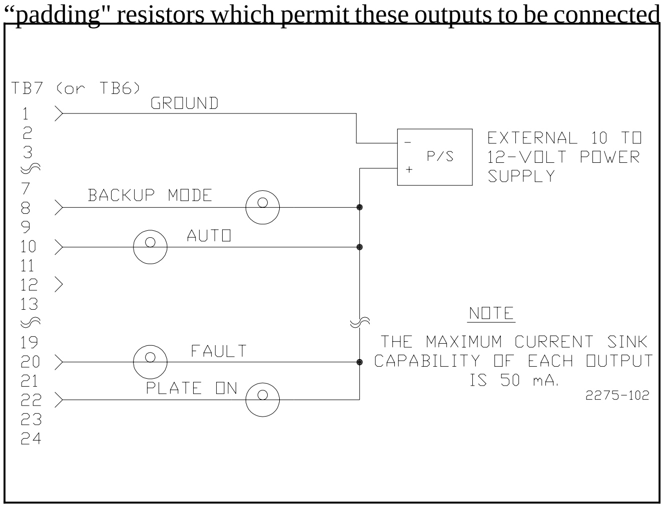


Figure 2-19. Typical Indicator Circuit Using External Power Supply

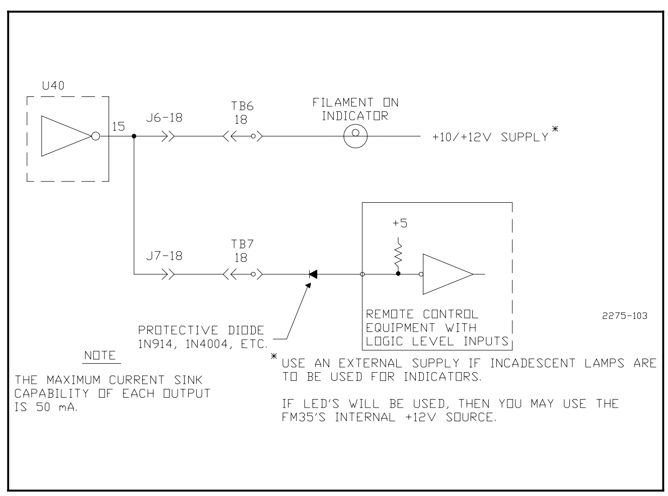


Figure 2-20. Typical Dual Use of TB6 and TB7 With Protective Diode Added

section. Refer to Section G for a procedure for removing the controller section from the transmitter.

If the Command or Indicator circuits are to use an external power supply for any reason, MAKE SURE that the wire connecting the negative terminal of the external power supply to terminal 1 of 1TB7 or 1TB6 does not share any of the meter circuit wiring. In other words, make no connections to this wire at the power supply end or anywhere else except at 1TB7 or 1TB6.

The Indicator circuits on terminal strips 1TB6 and 1TB7 are “Ground Switching" (current sink) and are intended to be returned to the transmitter +10-volt Indicator/Command power supply (terminal 24 of 1TB7 or 1TB6). See Figure 2-18.

NOTE

The maximum safe current sink capability of each of these outputs is 50 mA. This level must not be exceeded under any circumstance.

If an external 10-volt or 12-volt power supply is to be used for this purpose, connect the negative terminal of the external power supply to Ground (terminal 1 of 1TB7 or 1TB6) and return the indicators (or Remote Control Equipment inputs) to the positive terminal (+10 or +12 volts) of the external power supply. See Figure 2-19.

Some Remote Control equipment requires a “Logic Level" input for indicator (status) circuits. Usually, these inputs are returned to the High (+5-Volt) state by resistors internal to the Remote Control equipment. This High state represents an OFF condition. The transmitter indicator circuits are “Open Collector". That is, they are pulled to the Low state when ON, but are allowed to “float" when OFF. These outputs (all of the Indicator circuits on 1TB6 and 1TB7 except the BACKUP MODE indicator, J6-8 and J7-8) may be connected to Logic Level inputs, as long as J6 and J7 do not both have connections to these circuits with these connections going to different types of equipment. For example, if 1TB6 has connections to indicator circuits that are returned to the +10-Volt Indicator/Command Supply (J6-24), J7 may not have Indicator circuit connections directly to Remote Control equipment requiring Logic Level inputs (which are returned in the Remote Control equipment to its +5-Volt Supply).

Figure 2-20 shows a generally satisfactory solution to this problem, with the diode (one per circuit) providing the isolation required to prevent the OFF-state application of the +10-Volt supply (thru its indicator) to the Logic Level input. Without the diode, one or two things will happen: if the Logic Level circuit has an internal protective diode, its input will be limited to +5 Volts and the indicator connected to J6 will have about 5 Volts applied to it in the OFF state. If the Logic Level input circuit is not protected internally, it will probably be damaged by the application (through the indicator connected to J6) of an input voltage greater than +5 volts. In either case the indicator may illuminate falsely due to current flow from the +10 volt supply to the +5 volt control equipment supply.

PLEASE NOTE that the transmitter has an internal indicator connected to the BACKUP MODE circuit. It is necessary to use the diode protecting circuit for this indicator circuit when J7-8 is connected to a Logic Level Remote Control equipment input. It may also be necessary to use a diode for isolation on J6-8 if the indicator circuit connected there is not returned to the transmitter +10-Volt Indicator/Command Supply (J6-24).

In general, anytime the indicator circuits are returned to multiple devices with different return voltages, diode isolation is required for the circuits having the lower voltage. In the case

Table 2-2. 1TB8 Connections

Analog Input Ground	1	SH	Shield Ground
FAILSAFE Control Input	3	2	Control Return
Command Return	5	4	EXTERNAL Overload Control Input
Spare 6 Command Input	7	6	+12-Volt Control/Command Supply
Spare 5 Command Input	9	8	+12-Volt Control/Command Supply
Spare 4 Command Input	11	10	SCREEN Current Meter
Spare 2 Analog Input	13	12	Spare 1 Analog Input
Spare 4 Analog Input	15	14	Spare 3 Analog Input
Spare 6 Analog Input	17	16	Spare 5 Analog Input
Spare 8 Analog Input	19	18	Spare 7 Analog Input
Spare 3 Command Input	21	20	EXTERNAL Interlock Control Input
Spare 2 Command Input	23	22	Spare Analog Voltage Output
Spare 1 Command Input	25	24	OVERLOAD Indicator Reset Control Input

WARNING: Disconnect primary power prior to servicing.

of the BACKUP MODE indicator, the transmitter is always connected and is returned to the internal transmitter supply.

2.4.3.8.8 1TB8 - Auxiliary Control and Metering

See Table 2-2.

Command Inputs are common to Command Return (terminal 5 of 1TB8). See notes on 1TB6 and 1TB7 about the use of external power supplies.

Control Inputs are common to Control Return (terminal 2 of 1TB8). See notes on 1TB6 and 1TB7 about the use of external power supplies.

To use FAILSAFE and other Control Inputs with the internal HT 30/35CD +12-Volt power supply, verify that a jumper exists between the Control Return (terminal 2 of 1TB8 and common to all Control Inputs) and Ground (terminal 1 of 1TB8). Then:

a. Connect the Failsafe circuit between FAILSAFE Control Input (terminal 3 of 1TB8) and +12-Volt Control/Command Supply (terminal 6 of 1TB8). A contact closure between the two terminals will allow transmitter operation in the REMOTE Mode. If the contact is open, plate voltage and RF drive will be removed and the FAILSAFE indicator will illuminate.

b. Connect the External Overload circuit between EXTERNAL Overload Control Input (terminal 4 of 1TB8) and +12-Volt Control/Command Supply (terminal 8 of 1TB8). A contact closure between these two terminals signifies that an external overload condition exists. Plate voltage and RF drive will be removed as long as these contacts remain closed. The EXTERNAL OVERLOAD indicator will be illuminated.

NOTE

The External Overload input is active ONLY in the MAIN control mode. For this reason dummy load and RF switch interlocking should be accomplished by use of the EXTERNAL INTERLOCK input on 1TB8. (See paragraph 2.4.3.8.8.c.)

c. Remove the factory installed jumper from between the External Interlock Control Input (terminal 20 on 1TB8) and the +12V control/command supply (terminal 6 or 8 of 1TB8). Connect the External Interlock circuit between the External Interlock control input (terminal 20 of 1TB8) and the +12 volt control/command supply (terminal 6 or 8 of 1TB8). A contact closure between these two terminals will allow normal transmitter operation. If these contacts open, plate voltage and RF drive will be removed and the EXTERNAL INTERLOCK indicator will be illuminated. A manual restart will be required to re-establish transmitter operation once the interlock condition has been cleared and the contacts close.

To use FAILSAFE and other Control Inputs with an external +8-volt to +15-Volt power supply, remove the jumper that is connected between terminals 1 and 2 of 1TB8 and connect the negative terminal of the external power supply to Control Return (terminal 2 of 1TB8). Then:

a. Connect the Failsafe circuit between FAILSAFE Control Input (terminal 3 of 1TB8) and the positive terminal of the external power supply. A contact closure between these two terminals will allow transmitter operation in the REMOTE Mode. If the contact is open, plate voltage and RF drive will be removed and the FAILSAFE indicator will illuminate.

Table 2-3. 1TB9 Connections

Ground	
Ground	
Auxiliary Command 4	5
AIR Interlock Indicator	7
Spare	
Spare	
Spare	
Auxiliary Command 1	15
Auxiliary Command 3	17
Spare	
	(n. c.)
+12-Volt Indicator Supply	23
+12-Volt Indicator Supply	24

b. Connect the External Overload circuit between the EXTERNAL OVERLOAD Control Input (terminal 4 of 1TB8) and the positive terminal of the external power supply. A contact closure between these two terminals signifies that an external overload condition exists. Plate voltage and RF drive will be removed as long as these contacts remain closed. The EXTERNAL OVERLOAD indicator will be illuminated.

c. Connect the External Interlock circuit between EXTERNAL Interlock Control Input (terminal 20 of 1TB8) and the positive terminal of the external power supply. A contact closure between these two terminals will allow normal transmitter operation. If these contacts open, plate voltage and RF drive will be removed and the External Interlock indicator will be illuminated. A manual restart will be required to re-establish transmitter operation once the interlock condition has been cleared and the contacts close.

NOTE

The +12 volt Control/Command supply is designed to drive the Auxiliary Control/Command inputs. DO NOT use this +12 volt supply for additional external control loads such as mode switching relays. Excessive current drain from this supply could cause transmitter control circuit malfunction. The use of an external power source to power such external loads is required.

The Screen Current Sample and the Spare Analog Output are referenced to Ground (terminal 1 of 1TB8). These outputs may go to +10 Volts as a limit. If a lower limit is required, connect external resistors to “pad" the output as follows: for a 4-Volt limit, connect a 1.3k ohm resistor from the output to ground (terminal 1 of 1TB8); for a 1-Volt limit, connect a 270 ohm resistor and a 1.3k ohm resistor in parallel from the output to ground (terminal 1 of 1TB8).

Analog Inputs are referenced to Ground (terminal 1 of 1TB8).

2.4.3.8.9 1TB9 - Auxiliary Indicator

See Table 2-3.

Terminals marked “(n. c.)" are not usable.

Terminals carrying Indicator circuits are “Ground Switching" (current sink) and are intended to be returned to the internal HT 30/35CD +12-volt Indicator Supply (terminals 23, 24 or 25 of 1TB9). If an external 10-volt to 12-volt power supply is to be used for this purpose, connect the negative terminal of the external power supply to Ground (terminals 1, 2 or 3 of 1TB9) and return the indicators to the positive terminal of the external power supply.

NOTE

The maximum current sink capability of each output is 50 mA. This level must not be exceeded under any circumstance.

Terminals carrying Auxiliary Command circuits (output) are “Ground Switching" (current sink) and are referenced (switched) to the internal HT 30/35CD Ground (terminals 1, 2 or 3 of 1TB9) The external controlled circuit may be returned to the internal HT 30/35CD +12-volt Indicator Supply (terminals 23, 24 or 25 of 1TB9) or to the positive terminal of an external 10-volt to 12-volt power supply.

NOTE

The +12 volt indicator supply is designed to provide power to low current (50 mA maximum each) external status indicators or remote control telemetry device inputs. DO NOT use this +12 volt supply for additional external control circuit loads such as mode switching relay, etc. Excessive current drain from this supply could cause transmitter control circuit malfunction. The use of an external power source to power such external loads is required.

2.4.3.9 MONITOR CONNECTIONS

Two BNC monitor jacks for station monitoring equipment are provided on the elbow assembly installed in paragraph 2.4.3.7.a. The rf output level of these monitor jacks may be varied by adjusting the depth of penetration of the coupling loop. An adjustment screw on each side of the elbow near the BNC connectors provides this adjustment.

2.4.3.10 FAILSAFE CONNECTIONS

The failsafe input to the control system is provided on terminal board 1TB8. (See Figure 2-6 for the location of this terminal board and Figure 2-10 for wiring information.) To use FAILSAFE and other Control Inputs with an external +8-volt to +15-Volt power supply, remove the jumper that is connected between terminals 1 and 2 of 1TB8 and connect the negative terminal of the external power supply to Control Return (terminal 2 of 1TB8). Then connect the Failsafe circuit between FAILSAFE Control Input (terminal 3 of 1TB8) and the positive terminal of the external power supply. A contact closure between these two terminals will allow transmitter operation in the REMOTE Mode. If the contact is open, plate voltage and RF drive will be removed and the FAILSAFE indicator will illuminate.

2.4.3.11 EXTERNAL OVERLOAD AND EXTERNAL INTERLOCK CONNECTIONS

a. External overload connections are provided on 1TB8 of the transmitter cabinet, (refer to Figure 2-6 for the location of 1TB8). These input connections allow auxiliary station equipment to cause a momentary interruption of transmitter operation. The External Overload Input is active ONLY under MAIN control mode. Therefore, this input should be used only for non-essential functions. The External overload input accepts a normally open set of contacts that close when normal transmitter operation is to be inhibited for as long as the contacts remain closed.

b. The External Interlock Input connections are also located on 1TB8 and are to be used for essential interlock functions such as dummy load and RF switch interlocking. The External Interlock input accepts a normally closed set of contacts that open when normal transmitter opera-

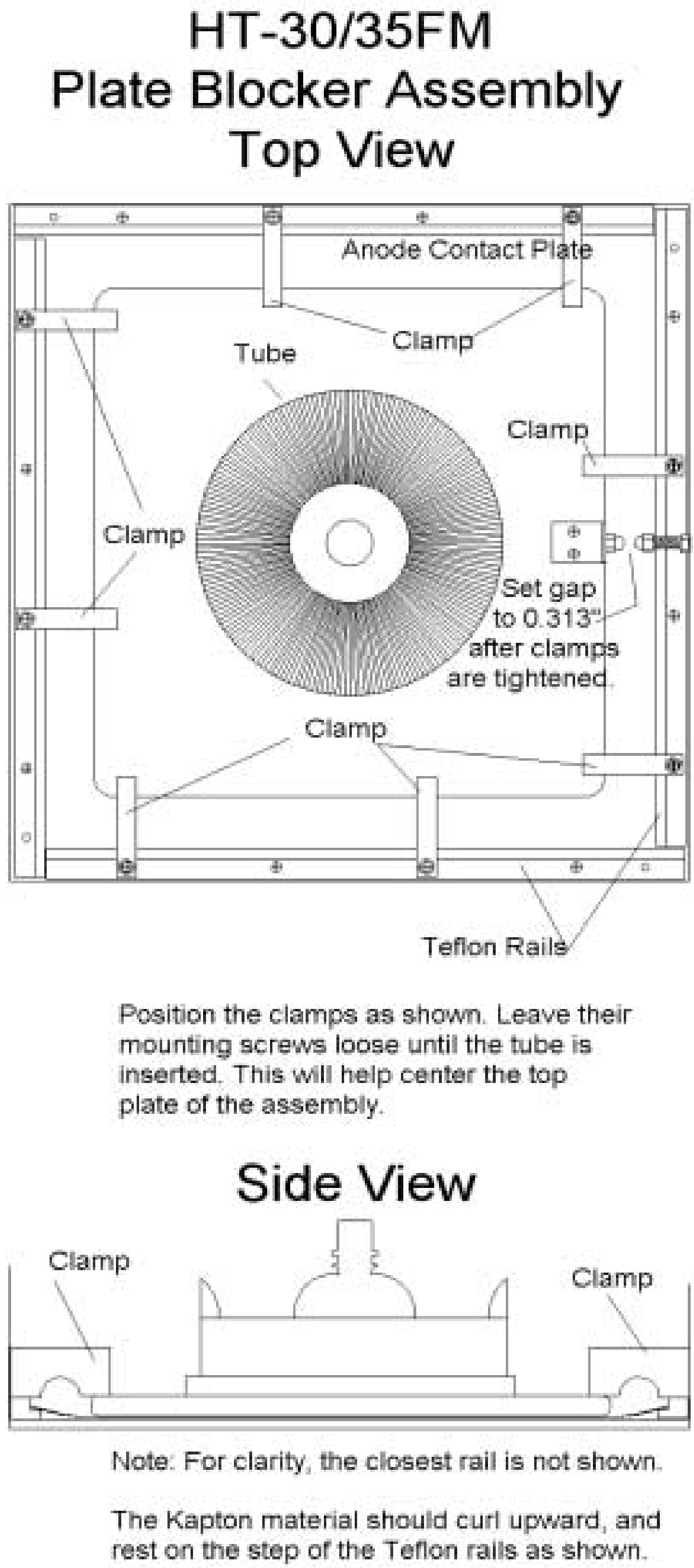


Figure 2-21. PA Tube Socket (Shown With Tube Installed)

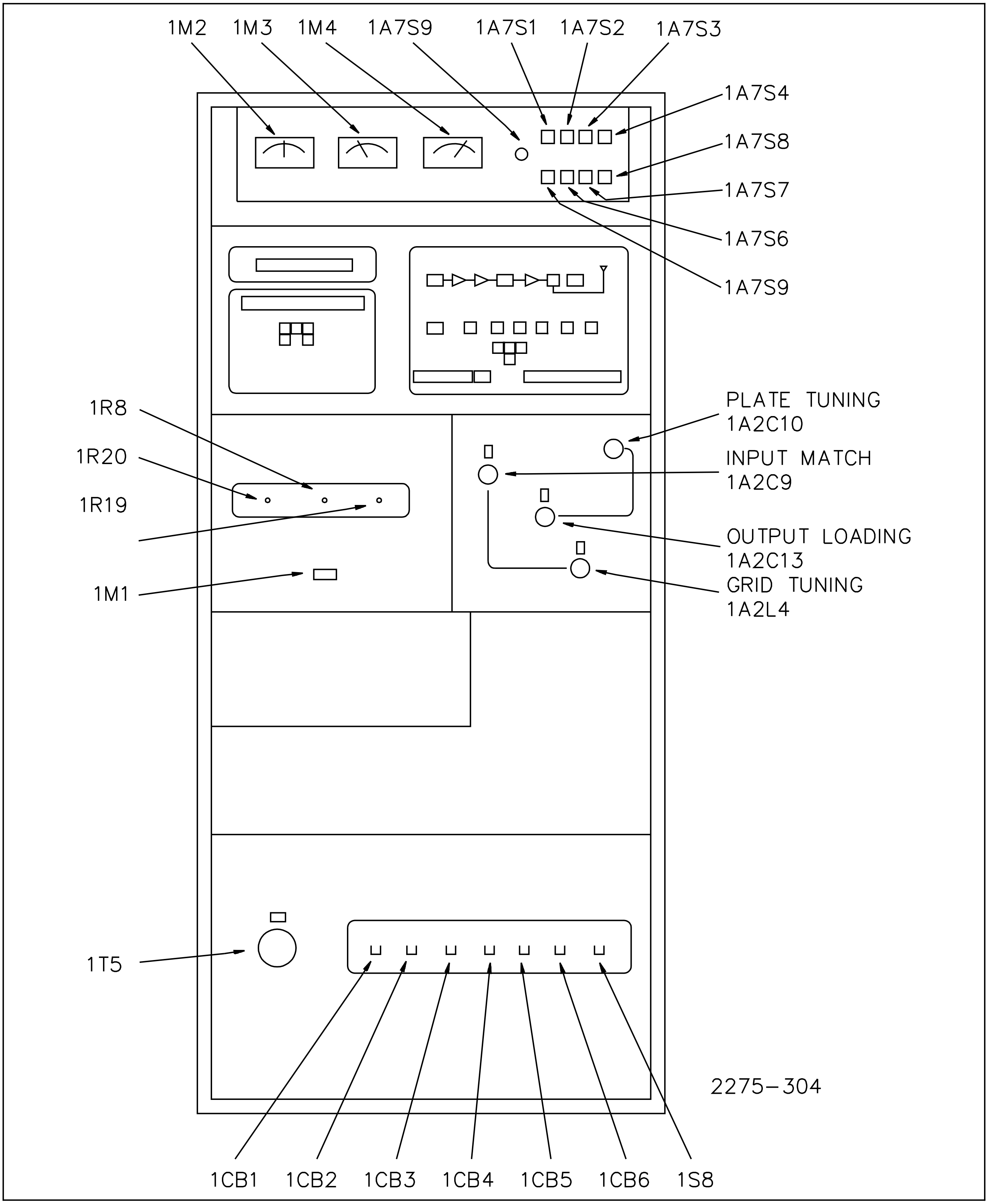


Figure 2-22. Transmitter Cabinet Controls & Indicators

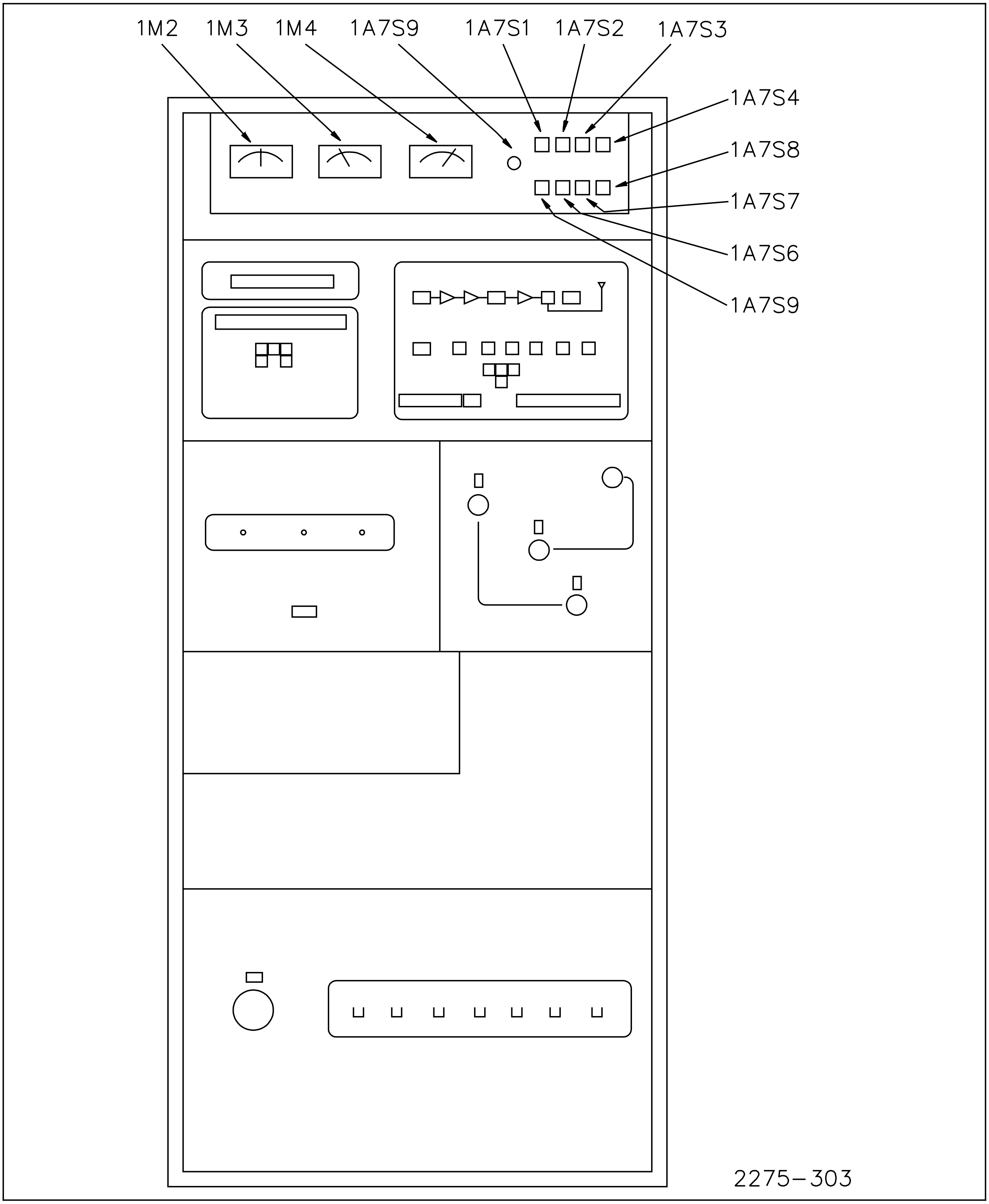


Figure 2-23. Meter Panel and Switch Board 1A7
Controls and Indicators

Figure 2-24. Fluorescent Display Board 1A8 and Mimic Panel Board 1A9 Controls and Indicators

Figure 2-25. Control Status Panel 1A6A13
Controls and Indicators

Figure 2-26. HT 30/35CD Lower Front Panel tion is to be terminated. Once the interlock condition is cleared and normal transmitter operation is to be re-established, a manual restart will be required.

2.4.3.12 INITIAL PA TUBE INSTALLATION

Refer to Figure 2-21 for the location of the PA tube socket in the transmitter cabinet.

CAUTION

IT CANNOT BE OVER EMPHASIZED THAT IMPROPER TUBE INSTALLATION CAN RESULT IN DAMAGE TO THE TUBE SOCKET FINGERSTOCK. ALSO, IF THE TUBE IS NOT FULLY SEATED, IMPROPER OPERATION OF THE PA CAVITY MAY RESULT AS WELL AS DAMAGE TO THE FINGERSTOCK DUE TO OVERHEATING.

Remove the upper PA cavity access panel. The tube socket will be visible by looking down through the opening in the anode blocker plate. Unpack the PA tube (HARRIS part number 374 0168 000) and inspect it for any packing materials that might be lodged in the anode cooling fins. Using the tube handles, center the tube (with the ceramic stem down) over the opening in the blocker plate. Carefully lower the tube into the socket while keeping it well centered. When contact is made between the tube and the socket, stop and allow the tube to rest in this position.

Remove the lower PA cavity access panel and inspect the alignment of the tube in the socket. Correct any misalignment before proceeding.

Once alignment is determined to be correct, reapply the downward force until the tube seats on the four posts in the sockets. These posts are visible through the lower access panel. DC connection to the anode is by way of the anode blocker plate. Also no clamps, brackets or bands are required.

Replace the upper and lower PA cavity access panels.

NOTE

Do not over-tighten the access panel fasteners as permanent damage to the RF seals may result. Tighten all fasteners no more than one-half turn beyond finger tight.

2.5 INITIAL TURN-ON AND CHECK-OUT

2.5.1 INITIAL CHECKOUT

a. Set the following circuit breakers and switches to the OFF position:
   1. Station power distribution breaker to the High Voltage Power Supply.
   2. Station power distribution breaker to the Transmitter cabinet.
   3. Both circuit breakers on the High Voltage Power Supply cabinet (3CB1,3CB2).
   4. The six circuit breakers and the one switch on the Transmitter cabinet lower front panel (1CB1 thru 1CB6 and 1S8).
   5. The two rocker arm circuit breakers behind the Controller access door (1CB7 and 1CB8).
   6. On the Control Status panel; 1) set the PA bypass switch (1A6A13S4) to the OPERATE position, 2) set the Controller switch (1A6A13S1) to the BACKUP position, 3) set the meter cal switch (1A6A13S3) to the VSWR position. (See Figure 2-25).

b. Set the following controls to their minimum (fully CCW) position.
   1. The IPA power adjust potentiometer (1R20) on the Transmitter cabinet front panel.
   2. The filament voltage adjust variac (1T5) on the Transmitter cabinet lower front panel.

c. In the High Voltage Power Supply cabinet set the high/low plate voltage switch (3S8) to the LOW position. Also disconnect 3RV7 by unplugging the short jumper wire from J1 (adjacent to E1 on the fiberglass board near 3S8).

d. Ensure that the three coaxial cable jumpers on the FLEX-Patch™ panel are in their normal positions as indicated by the silkscreen on that panel.

e. Thoroughly clean the interior of the Transmitter cabinet and the High Voltage Power Supply cabinet with a vacuum cleaner. Ensure that all packing materials have been removed and that all components that were removed for shipment have been re-installed. Check for any loose connection hardware and if needed, tighten.

f. Set the Transmitter cabinet front panel output POWER meter FWD/REF select switch (1A7S9) to the FWD position.

g. Verify all wiring connections to the Transmitter cabinet and the High Voltage Power Supply cabinet using the wiring diagrams.

h. Verify that both grounding hooks in the High Voltage Power Supply cabinet are in their holders. Verify that the grounding hook in the Transmitter cabinet is in its holder.

i. Place all remote and/or extended control equipment in a standby mode or otherwise inhibit the equipment to prevent accidental override of the local control.

j. Verify that the transmitter RF output is terminated into the station antenna or a load with a known good VSWR.

k. Connect the leads of a volt/ohm meter to terminals 1TB1-4 and 1TB1-6.

l. Use probe type leads and insert the tips into the top entry point on the appropriate terminals.

m. Route the leads out through the rear door of the cabinet and close the door.

n. Set the voltmeter to the appropriate scale for the phase to phase voltage.

o. Apply the station primary power to the Transmitter cabinet only. Verify the correct line voltage.

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

p. Open the Transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARD TERMINALS BEFORE TOUCHING THEM.

q. Move the meter lead connected to 1TB1-6 to 1TB1-8.

r. Close the rear door and apply station power to the Transmitter cabinet ONLY.

s. Verify the correct voltage.

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

t. Open the Transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARD TERMINALS BEFORE TOUCHING THEM.

u. Move the meter lead connected to 1TB1-4 to 1TB1-8.

v. Close the rear door and apply station power to the Transmitter cabinet only.

w. Verify the correct line voltage.

Figure 2-27. Loss-of-Phase Detector (1K5) Location

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

x. Open the Transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARD TERMINALS BEFORE TOUCHING THEM.

y. Disconnect and remove the voltmeter test leads and close the rear door.

NOTE

Once the AC line voltage has been measured, verify that all power supply transformers are tapped correctly for that line voltage. Those transformers are: 1T1, 1T2, 1T3, and 1T6 in the main transmitter cabinet and 3T1, and 3T3 in the power supply cabinet. It is important that these transformers be tapped properly for the line voltage in use or improper transmitter operation may result. Additionally verify that the voltage select control on the loss-of-phase detector (1K5) is set for the correct line voltage. (See Figure 2-27 for the location of 1K5.)

z. Apply station power to the Transmitter cabinet only. Turn on the CONTROLLER switch (1S8) located on the lower front panel of the Transmitter cabinet. (See Figure 2-26.)

aa. Turn on the Controller auxiliary power supply circuit breaker (1CB7) located behind the Controller access door. The red FILAMENT OFF pushbutton (1A7S2) on the Transmitter cabinet front panel should illuminate. Also on the Mimic panel, the Controller BACKUP light (1A9DS32) should illuminate amber.

ab. On the Mimic panel, the LOCAL control button indicator (1A9DS13, Part of 1A9S4) should be illuminated red. If it is not illuminated, depress the LOCAL pushbutton (1A9S4) and it should then illuminate. At this time the indicators in the REMOTE pushbutton (1A9DS12, part of 1A9S2) and the EXTEND pushbutton (1A9DS11, part of 1A9S3) should be extinguished.

ac. Exercising the LOCAL, REMOTE, and EXTENDED pushbuttons (1A9S4, 1A9S2, and 1A9S3) should produce the following results. Depressing either the REMOTE or the EXTEND pushbutton should cause both the REMOTE and EXTEND indicators (1A9DS12 and 1A9DS11) to illuminate green and the LOCAL indicator (1A9DS13) to extinguish; depressing the LOCAL pushbutton should cause the LOCAL indicator to illuminate red, and the REMOTE and EXTEND indicators to extinguish.

ad. Leave the transmitter with the local control mode selected (1A9DS13 illuminated).

ae. Depress the front panel power control AUTO and MANUAL pushbuttons (1A7S5, 1A7S6). The pushbuttons should not illuminate.

af. Alternately depress the front panel power control RAISE and LOWER pushbuttons (1A7S7, 1A7S8). The pushbuttons should illuminate while depressed. On the Control Status panel (1A6A13) the corresponding backup RAISE or LOWER indicator should also illuminate. While observing the motorized variac (3T2) in the High Voltage Power Supply cabinet, alternately depress the RAISE and LOWER pushbuttons. The variac should not change position.

ag. Turn on the CABINET CONTROL circuit breaker (1CB6). Again while observing the motorized variac, depress the RAISE pushbutton. The variac arm should move counterclockwise as viewed from above, and continue to move as long as the RAISE pushbutton is depressed or until the upper limit of the travel is reached.

NOTE

The variac will not move if the upper limit has already been reached.

ah. Again while observing the motorized variac, depress the LOWER pushbutton. The variac should rotate clockwise as viewed from above until the pushbutton is released or the lower end limit of travel is reached. Position the variac at or near the lower limit of travel (fully clockwise).

ai. Install all access panels on the High Voltage Power Supply cabinet. Observe the Control Status panel (1A6A13). All indicators should be extinguished.

aj. Depress the Transmitter cabinet front panel FILAMENT ON pushbutton. It should not illuminate. On the Control Status panel the backup BLOWER ON indicator should illuminate while the FILAMENT ON pushbutton is depressed. No other indicator on this panel should illuminate at this time. The main blower should not start. The sound of the blower contactor (1K1) closing should be heard in the Transmitter cabinet. If the foregoing results are observed, proceed to step al. If however, the BLOWER ON indicator does not illuminate and contactor 1K1 is not heard actuating, then proceed as follows:

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

1. Open the Transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARD TERMINALS BEFORE TOUCHING THEM.

2. At 1TB1, exchange any two of the three station power wires that supply ac voltage to the Transmitter cabinet. Close the rear door.

NOTE

The transmitter is equipped with an AC loss-of-phase detector (1K5). This detector monitors the three phase incoming line for proper phase sequencing and amplitude as well as phase voltage balance. Exchanging any two input line wires should satisfy the correct sequencing requirement. If this fails to enable transmitter blower operation, confirm the proper adjustment of the line voltage selector control on the top of 1K5. (See Figure 2-27.)

3. Reapply station power to the Transmitter cabinet. Return to step ak. and proceed to repeat the procedures in that paragraph.

NOTE

The drop solenoids in the High Voltage Power Supply cabinet will not operate with the Transmitter cabinet rear door open.

ak. Turn on the CABINET FAN circuit breaker (1CB5) located on the lower front panel of the Transmitter cabinet. Open the rear door of the Transmitter cabinet. While depressing the FILAMENT ON pushbutton, observe the cabinet flushing fan (1B2) mounted in the rear door air shroud. The fan should operate as long as the FILAMENT ON pushbutton is depressed and turn off when it is released. Close the rear door on the Transmitter cabinet.

al. Turn on the MAIN BLOWER circuit breaker (1CB4) located on the lower front panel of the Transmitter cabinet. Locate the Transmitter cabinet PA cavity air exhaust. While observing the airflow from this opening, depress the FILAMENT ON pushbutton. The pushbutton should illuminate and remain on. The main blower should start and a sizeable airflow should be present at the air exhaust. The Control Status panel BACKUP FIL/IPA ON and BACKUP BLOWER ON indicators should be illuminated. If the main blower fails to remain on after the FILAMENT ON pushbutton is released, the air switch may require adjustment. The air interlock switch has been adjusted during final test at the HARRIS factory to hold the transmitter on at the test lab elevation. At altitudes above 1,000 feet AMSL, the air switch tripout point may have to be lowered because of the air density change with altitude. The air switch adjustment screw is located at the center of the base of the switch. Access to the switch is through the small access panel behind the controller door. The switch is mounted on the side of the PA cavity near the top of the cabinet. Turn the adjustment screw counterclockwise in 1-turn increments, repeating the first part of this step in between until the blower remains on and the FILAMENT ON pushbutton lamp illuminates when released.

am. Depress the FILAMENT OFF pushbutton. The main blower should stop running and the FILAMENT ON pushbutton should be extinguished. All indicators on the Control Status panel should be extinguished.

an. Depress the FILAMENT ON pushbutton. Verify that all indications are as they were in step am.

ao. Depress the PLATE ON pushbutton (1A7S3). No transmitter response should be observed.

ap. Verify that the filament voltage variac (1T5) on the Transmitter cabinet lower front panel is set for minimum filament voltage (fully counterclockwise). Also verify that the vacuum tube (1V1) has been installed in the PA cavity socket. Turn on the filament circuit breaker (1CB1) located on the lower front panel.

aq. Depress the PLATE ON pushbutton. Observe that on the Control Status panel the backup BIAS ON indicator (1A6A13DS18) will illuminate as long as the pushbutton is depressed. The pushbutton itself should not illuminate.

ar. Before proceeding, ensure that any auxiliary equipment that is connected to the transmitter EXTERNAL INTERLOCK input is in the mode that will satisfy the interlock normal requirement.

as. Turn on the IPA circuit breaker (1CB3) located on the lower front panel of the Transmitter cabinet. Again depress the PLATE ON pushbutton. As before, the control status backup BIAS ON indicator should illuminate as long as the pushbutton is depressed.

at. Turn on the BIAS circuit breaker (1CB2) on the lower front panel of the Transmitter cabinet. All circuit breakers on that panel should now be in the ON position. Depress the PLATE ON pushbutton. The Control Status panel BACKUP BIAS ON and STEP/START indicators should illuminate in rapid sequence and remain illuminated as long as the pushbutton is depressed. The PLATE ON pushbutton should not illuminate. Release the pushbutton.

au. Turn off the filament circuit breaker (1CB1). The main blower will continue to run until the FILAMENT OFF pushbutton is depressed. (This is a convenient method of providing a manually timed filament cool down period when operating the transmitter in the backup control mode.)

av. Momentarily depress the FILAMENT OFF pushbutton. The main blower should stop running immediately. On the Control Status panel, select the MAIN control mode with the CONTROLLER select toggle switch (1A6A13S1). The FILAMENT OFF pushbutton should remain illuminated, indicating the control remained in the BACKUP mode due to the lack of ac power to the Main Controller. Return the MODE switch to the BACKUP position.

aw. Turn on the Controller main power supply circuit breaker (1CB8) located behind the Controller access door. The indicators located on the Schmidt Trigger (1A6A9), DIGITAL I/O (1A6A6), and the ANALOG I/O (1A6A8) PC assemblies in the main Controller card cage should illuminate. On the Mimic panel, the CONTROLLER MAIN indicator should be illuminated green, the CONTROLLER BACKUP indicator should be illuminated amber, and one or more of the interlock and overload indicators may be illuminated. Momentarily depress the indicator reset pushbutton (1A9S1) on the Mimic panel. All interlock and overload indicators should now be extinguished. If any interlock indicators remain illuminated, this would indicate a valid interlock condition that should be cleared before proceeding.

ax. On the Controller access door, depress the RETURN pushbutton twice and the digital multimeter display (1A8VF2) should display the words BASIC READINGS. (The display may briefly display the words HARRIS CORP at turn on before changing to the last selected display.)

ay. Advance the multimeter by momentarily depressing the NEXT pushbutton (1A8A1S1) several times until the display contains the words CLOCK SET. Momentarily depress the SELECT pushbutton once. The display will now display the hour of day currently in the clock (24 hr format). Use the NEXT and PREVIOUS pushbuttons to set the clock to the correct hour. When it is set, depress the SELECT pushbutton once and the clock will now display the minutes. Again use the NEXT and PREVIOUS pushbuttons to set the clock to the current time.

az. Depress the SELECT pushbutton again and the display will indicate the seconds. Use the NEXT and PREVIOUS pushbuttons to correct, if desired. Again depress the SELECT pushbutton and the display will indicate the month of the year (1 to 12).

ba. Use the NEXT and PREVIOUS pushbuttons to set to the current month.

bb. Again depress the select pushbutton and the display will indicate the day of the month. Using the NEXT and PREVIOUS pushbuttons, correct the day to the current date. Depressing the SELECT pushbutton will display the year.

bc. Again use the NEXT and PREVIOUS pushbuttons to set the current year.

bd. Now momentarily depress the return key twice and the display will return the words BASIC READINGS.

2.5.1.1 BASIC READINGS

a. On the Control Status panel, use the CONTROLLER toggle switch to select the MAIN control mode. On the Mimic panel, verify that the BACKUP Controller indicator is not illuminated. Also verify that the FILAMENT OFF pushbutton is not illuminated, and that either the AUTO or the MANUAL power control pushbutton is now illuminated.

b. Alternately depress the AUTO and MANUAL pushbuttons. The illumination should follow to the pushbutton that was depressed most recently. Select the MANUAL power control mode as indicated by the illumination of the MANUAL power control pushbutton.

c. Turn on the FILAMENT circuit breaker (1CB1). Verify that the digital multimeter now displays the words BASIC READINGS.

d. Momentarily depress the SELECT pushbutton once and then the PREVIOUS pushbutton until the display indicates FILAMENT and a value which should be near 0 V. Verify that the Exciter is on.

e. Momentarily depress the FILAMENT ON pushbutton. The pushbutton should illuminate. The main blower should start and continue to run. Verify that on the Control Status panel the following MAIN status indicators should be illuminated; BLOWER ON and FIL/IPA ON. On the Mimic panel the AIR indicator should be illuminated green, the FILAMENT indicator should be flashing green and the IPA PS indicator should also be illuminated green. Verify that the digital multimeter indicates a filament voltage of about 6.3V or higher.

f. At the expiration of the filament warm up period (approximately 20 sec.) the Mimic panel FILAMENT indicator should change to illuminating a steady green.

NOTE

If the filament voltage is below the predetermined normal working voltage threshold, this indicator will be illuminated yellow.

g. Whenever it becomes necessary to turn the filament supply off, momentarily depress the FILAMENT OFF pushbutton. The Mimic panel FILAMENT and IPA indicators will extinguish. The AIR indicator will begin flashing green and the FILAMENT ON pushbutton will extinguish. Filament voltage as indicated on the multimeter will again indicate about 0V. On the Control Status panel, the FIL and IPA ON indicators will extinguish. If the plate voltage had been ON when the FILAMENT OFF pushbutton was depressed, the RUN and EXCITER ENABLE indicators will also extinguish. After the filament cool down period has expired, (approximately 3 minutes) the main blower will stop running. The Mimic panel AIR indicator will extinguish and the Control

Status panel main BLOWER ON indicator will extinguish.

h. If the filament voltage, as indicated on the multimeter, is between 6.5V and 7.3V, proceed to step k. If the voltage is not within these limits, it may be that the filament transformer is incorrectly tapped for the line voltage in use. Proceed to terminate transmitter operation by depressing the FILAMENT OFF pushbutton. After the main blower has stopped running disconnect and lock out station primary power to the Transmitter and the High Voltage Power Supply cabinets.

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

i. Open the Transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARD TERMINALS BEFORE TOUCHING THEM.

j. Locate the filament transformer (1T3) and verify that it is correctly tapped for the line voltage in use. If not, change the primary taps to match the line voltage. If it appears that the taps are correct for the line voltage in use, try retapping the transformer for the next higher voltage if the filament voltage was above the limits in step h. Retap for the next lower primary voltage if the filament voltage was below the limits. Close the Transmitter cabinet rear door and reapply station power. Depress the FILAMENT ON pushbutton and after the filament warm up period has passed, proceed to and repeat step h.

k. Advance the filament voltage control clockwise until the filament voltage indicated is 7.5V.

NOTE

If the filament indicator was yellow, it should now change to green as the filament voltage is increased.

l. Verify that the front panel IPA POWER control (1R20) is fully counterclockwise. Verify that all INTERLOCK and OVERLOAD indicators on the Mimic panel are extinguished. If any are illuminated, terminate transmitter operation and investigate before proceeding.

WARNING

VERIFY THAT STATION POWER TO THE HIGH VOLTAGE POWER SUPPLY IS DISCONNECTED AND LOCKED OUT.

m. Momentarily depress the PLATE ON pushbutton. The following sequence should be observed on the Mimic panel: The BIAS indicator will be illuminated green, the PLATE indicator will be illuminated red and then the BIAS indicator will be extinguished. The sequence as observed on the Control Status panel MAIN indicators: BIAS ON indicator on, STEP/START indicator on, and then quickly, STEP/START indicator off, and finally BIAS ON indicator off. The Mimic panel PLATE indicator will remain illuminated. The PLATE I OVERLOAD indicator should illuminate. This indicator remaining on indicates that transmitter operation was terminated because of plate and screen power supply problems. In this case, the problem was lack of output voltage from the power supply. The cause, of course, is the lack of station power to the High Voltage Power Supply cabinet. Depress the Mimic panel RESET pushbutton to extinguish the plate and screen current overload indicators.

NOTE

At any time transmitter operation is terminated with a Mimic panel indicator illuminated red (due to a fault condition in one of the transmitter functional areas), that indicator will remain illuminated red until such time as normal transmitter operation is restored. This allows quick visual identification of the problem area, even if the transmitter is no longer in operation (as long as power is ON to the MAIN controller).

n. Connect the station power to the High Voltage Power Supply cabinet.

o. Momentarily depress the PLATE ON pushbutton. The following sequence will be observed: The Control Status panel MAIN BIAS ON indicator will illuminate, the control status MAIN STEP/START indicator will illuminate, the plate voltage meter will read up scale, the control status MAIN control RUN and EXCITER ENABLE indicators will illuminate, the PLATE ON pushbutton will illuminate, the Mimic panel SCREEN indicator will illuminate amber and the PLATE indicator will illuminate green, followed by the control status MAIN control STEP/START indicator being extinguished. At this time the front panel analog plate voltmeter should read between 4500 Vdc to 7400 Vdc. The plate current meter should read 0 amperes and the output power meter should also read 0 (with the FWD/REF switch 1A7S9 in the FWD position). Momentarily depress the PLATE OFF pushbutton.

p. Preset the following PA cavity front panel controls to the dial readings indicated on the factory test data sheets: PLATE TUNING (1A2C10), OUTPUT LOADING (1A2C13), INPUT MATCH (1A2C9), and GRID TUNING (1A2L4).

q. On the digital multimeter, depress the RETURN pushbutton several times until the words BASIC READINGS are displayed. Then depress the SELECT pushbutton once. The display should now read PLATE I 0.0A. Momentarily depress the NEXT pushbutton 3 times. The display should now read SCREEN E 0V.

WARNING

BEFORE PROCEEDING, ENSURE THAT THE HT 30/35CD IS TERMINATED IN A 50 OHM LOAD CAPABLE OF DISSIPATING 35 KW OF RF POWER. IF A NON-RADIATING LOAD IS USED AND IT IS EITHER WATER COOLED OR FORCED AIR COOLED, VERIFY THAT THE LOAD IS INTERLOCKED TO THE EXTERNAL INTERLOCK INPUT OF THE HT 30/35CD. (SEE PARAGRAPH 2.4.3.11 FOR DETAILS ON THE USE OF THE EXTERNAL INTERLOCK INPUT.)

r. Place the FWD/REF select switch (1A7S9) in the FWD position. The RF output meter 1M4 will now be preset to indicate forward output power.

s. Momentarily depress the PLATE ON pushbutton. The PLATE VOLT meter should again read 4500 Vdc to 7400 Vdc. The multimeter should indicate a screen voltage of 0 Vdc.

t. Turn on the SCREEN circuit breaker (3CB1) and the BLOWER circuit breaker (3CB2) located on the front of the High Voltage Power Supply cabinet.

u. The digital multimeter should now indicate a voltage between 0 and 1550V.

v. Depress and hold the POWER CONTROL RAISE pushbutton, it will illuminate. The control MAIN SCREEN RAISE indicator will illuminate also. At this time the multimeter reading should increase from near 0 V. Continue to depress the POWER CONTROL RAISE pushbutton until it is extinguished. At this time the control status MAIN SCREEN RAISE indicator should also extinguish. Both indicators should remain extinguished even if the pushbutton is depressed again. The multimeter should now indicate a screen voltage of approximately 1500V. Now depress and hold the POWER CONTROL LOWER pushbutton. When depressed it should illuminate as well as the control status MAIN SCREEN LOWER indicator. The multimeter should indicate a decreasing screen voltage. The voltage should continue to decrease until it reaches nearly 0V. At this time the pushbutton should be extinguished as well as the MAIN SCREEN LOWER indicator on the Control Status panel. Now depress and hold the POWER CONTROL RAISE pushbutton and hold it in until the multimeter indicates a screen voltage of 500V.

w. On the DIGIT™ Exciter, readjust the power output to the level called for on the Factory Test Data Sheets or 10 watts whichever is lower.

x. Verify that the POWER CONTROL MANUAL pushbutton is illuminated. Select the FWD PWR position on the exciter multimeter. The meter should indicate 10 watts or the value indicated on the test data sheets, whichever is lower. Select the REF PWR position on the exciter multimeter. Verify that the reflected power reading is the same as recorded on the test data sheets. This reading should always be 2 watts or less. Using a small blade screwdriver, turn the IPA POWER control potentiometer (1R20) slightly clockwise until the IPA FORWARD POWER bar graph indicates a forward power of 100 watts.

y. The voltage indicated on the front panel PLATE VOLTAGE meter should drop slightly. The PLATE CURRENT meter should indicate a current of 0.3 to 1.0 amperes. The OUTPUT POWER meter should now indicate a forward power of between 2 and 15% of normal output. The IPA REFLECTED POWER bar graph should now show a reading of 0 to 25 watts. On the Mimic panel the PRE AMP indicator should be illuminated either yellow or green. Allow a few moments of running time for the system to temperature stabilize. (The SCREEN indicator may alternate between red, yellow, and green).

z. Advance the IPA POWER control until the IPA FORWARD POWER bar display indicates a forward power of 200 watts. The PLATE CURRENT meter should now indicate a value of 0.5 to 1.5 amperes. The OUTPUT POWER meter should now indicate a forward power of 5% to 20%.

aa. Carefully adjust the PLATE TUNING and OUTPUT LOADING controls for a maximum reading on the output POWER meter. Best PA efficiency as indicated by the PLATE CURRENT meter should occur at or near the output power peak. The Mimic panel PREAMP indicator may now be illuminated green or yellow indicating an output level near or above minimum for normal operation.

ab. While observing the IPA REFLECTED POWER bar display, carefully adjust the GRID TUNING and INPUT MATCH controls for a minimum indication.

ac. Advance (CW) the IPA POWER control until a forward power of 300 watts is indicated on the IPA FORWARD POWER bar display.

ad. Carefully adjust the GRID TUNING control and INPUT MATCH control for a minimum indication on the IPA REFLECTED POWER bar display. Due to the sampling rate of the IPA POWER bar graph display, there is a slight delay in updating this meter. It is advisable to make small adjustments in the position of the GRID TUNING and INPUT MATCH controls, waiting after each adjustment for the display to indicate the resulting change in readings.

ae. Carefully adjust the PLATE TUNING control and the OUTPUT LOADING control for maximum output power and best power amplifier efficiency as indicated on the output POWER meter and the PLATE CURRENT meter. The output power meter should now read 15% to 25%.

af. Advance the screen voltage as indicated on the multimeter to 750V by depressing the POWER CONTROL RAISE pushbutton. Carefully adjust the PLATE TUNING and OUTPUT LOADING controls for best PA efficiency and highest RF output. Again adjust the GRID TUNING and INPUT MATCH controls for a minimum indication of the IPA REFLECTED POWER bar display.

ag. Switch to the REFL position on the FWD/REFL switch (1A7S9). The OUTPUT POWER meter will now indicate reflected power.

ah. To calibrate for VSWR readings, move the CAL/VSWR switch (1A6A13S3) on the Control Status panel to the CAL position. Adjust the CAL control to set the needle on the OUTPUT POWER meter to the CAL mark on the scale. Return the CAL/VSWR switch to the VSWR position. Now read the load VSWR on the lower scale of the OUTPUT POWER meter. It should read 1.2:1 or lower. Move the FWD/REFL switch to the FWD position.

ai. Raise the screen voltage by depressing the POWER CONTROL RAISE pushbutton until the multimeter indicates a screen voltage of 1000V. (If a screen current overload occurs, retune and reload the PA output for lower screen current before proceeding.) Advance the IPA PWR control clockwise until the IPA FORWARD POWER bar display indicates 400 watts. Readjust the INPUT MATCH and GRID TUNING controls for a minimum reading on the IPA REFLECTED POWER bar display. Readjust the OUTPUT TUNING and OUTPUT LOADING controls for maximum output power and best PA efficiency as indicated on the OUTPUT POWER and PLATE CURRENT meters.

aj. Momentarily depress the RETURN pushbutton once and then the SELECT pushbutton once. The multimeter should display the words PLATE E and a reading in kilovolts. The reading should agree with that on the PLATE VOLTAGE meter.

ak. Momentarily depress the NEXT pushbutton. The multimeter should now display the words PLATE I and the reading should agree with that on the PLATE CURRENT meter. Again, momentarily depress the NEXT pushbutton.

al. The display will now read PLATE OVR and the overload current setting should agree with the value on the factory test data sheet. Momentarily depress the next pushbutton again and the display will read PA FWD with a value that should correspond to the percentage of normal transmitter power output indicated on the OUTPUT POWER meter.

am Again, momentarily depress the next pushbutton. The display should now display the words APC PWR. Momentarily depress the POWER CONTROL AUTO pushbutton. It should illuminate and the multimeter display will now indicate the power level that the automatic power control is set to maintain. This power should be approximately the present output power. Momentarily depress the POWER CONTROL MANUAL pushbutton to transfer back to manual power control.

an. Momentarily depress the NEXT pushbutton. The PA REF displayed is the power reflected back to the transmitter from the output load. The reading should be near 0 kW. Again depress the NEXT pushbutton and the display will read PA OVR with a value that is the same as recorded on the factory test data sheets. Depress the NEXT pushbutton and the display will read SCREEN E. The value should be about 1000V. Again depressing the NEXT pushbutton will bring the words SCREEN I to the display with a value that should be between 50 and 200 mA. Again, momentarily depress the NEXT pushbutton and the multimeter should display the words SCREEN OVR and a value that should be the same as that recorded on the test data sheets. Depressing NEXT again will display GRID E with a value that should be between -250 and -450 Vdc. Depressing the NEXT pushbutton again will bring the words GRID I to the multimeter display. The reading should be between -50 and -150 mA. Momentarily depress the NEXT pushbutton and the multimeter will display FILAMENT. The filament voltage should be 7.5V +/-0.1V. Depress the NEXT pushbutton again and the multimeter will display INLET T. The inlet temperature should be at or just above the ambient room temperature. Momentarily depressing the NEXT pushbutton again will display the STACK T or PA exhaust outlet temperature. The reading should be between a few degrees F and 90°F above room ambient.

ao. Once more depressing the NEXT pushbutton will cause the display to once again display PLATE E, the first reading of the PA READINGS group.

ap. Momentarily depress the RETURN and NEXT pushbuttons. The multimeter should now display the words IPA READINGS. Momentarily depress the SELECT pushbutton and the display will move to the first reading in this group IPA FWD. This reading should be about 400 watts. This should agree closely with the IPA FORWARD POWER bar display reading. Depress the NEXT pushbutton and the multimeter will display IPA REF with a value that corresponds to the reading on the IPA REFLECTED POWER bar display. Depress NEXT again and IPA OVR will be displayed with the test data value. Again momentarily depress the NEXT pushbutton and

WARNING: Disconnect primary power prior to servicing.

the multimeter will display IPA E. This voltage should be between 46 and 51 volts. Depress the NEXT pushbutton again and the multimeter will display IPA I with a value that should be between 15 and 25 amperes.

aq. Again depressing NEXT will change the multimeter. It should now display the words IPA T. This heatsink temperature should be between the ambient room temperature and 176°F. Depress the NEXT pushbutton once more and the multimeter will again display IPA FWD, the first parameter in the IPA READINGS group.

ar. Momentarily depress the RETURN and then the NEXT pushbuttons. The multimeter should now display the words PREAMP READINGS. Momentarily depress the SELECT pushbutton and the first parameter displayed will be PREA PWR. The value should be between 30 and 90 watts. Depress the NEXT pushbutton and the multimeter will display PREAMP E. The voltage will be between 14 and 25 volts. Depress NEXT again and PREAMP I will be displayed with a value that should be between 2 and 6 amperes. Depress the NEXT pushbutton again and the word PREA DRV will appear on the multimeter. The value of the drive to the Preamplifier should be between 9.5 and 10.5 watts. Again, momentarily depress the NEXT pushbutton and PREA PWR will appear indicating the multimeter is back to the first reading in this group.

as. Momentarily depress the RETURN and then the NEXT pushbuttons. The multimeter should now display the words CONTROL STATUS. Momentarily depress the SELECT pushbutton and the multimeter will display PHASE A, the first parameter in this group. The Phase A line voltage should be between 197 and 250 volts.

at. This should closely agree with the line voltage in use with the transmitter. Depress the NEXT pushbutton again to display PHASE B and again to display PHASE C. Each of these should be within a few volts of the PHASE A reading. Once again depress the NEXT pushbutton and the multimeter will display +5 SUPPLY. The value should be 5.0 +/-0.1 volts. Again depress the NEXT pushbutton and the multimeter will display +12. This supply should measure 12.0 +/-0.1 volts. Depress NEXT again and the multimeter will read -12. The -12 volt supply should measure -12.5 +/-0.1 volts. Depress the NEXT pushbutton again and the display will read +10 REF. This analog to digital converter reference voltage should measure +10 +/-0.1 volts. Depress the NEXT pushbutton again and the -10 REF will be displayed. The -10 volt reference should measure -10 +/-0.1 volts. Depress the NEXT pushbutton again and the multimeter will display TEMP. This internal Controller temperature should measure between ambient and 130°F. Again depressing the NEXT pushbutton will bring the multimeter back to PHASE A, the first parameter in this group.

au. Momentarily depress the RETURN and then the NEXT pushbuttons. The multimeter should now display the words OVERLOADS. Depress NEXT again and the multimeter will display CLOCK SET. Depress NEXT again and the current date and time will be displayed. Depress it once more and it will display the words BASIC READINGS. The multimeter is now back at the beginning of the group sequence.

av. Momentarily depress the NEXT and then the SELECT pushbuttons. The multimeter should now display the words PLATE E. Momentarily depress the NEXT pushbutton four times. The display should now read APC PWR. Momentarily depress the POWER CONTROL AUTO pushbutton which should illuminate as a result. The reading for APC PWR in the multimeter should now be the value in kilowatts presently indicated by the OUTPUT POWER meter. Automatic power control is now active and it is controlling the RF output to the APC PWR value as displayed by the multimeter. The POWER CONTROL RAISE and POWER CONTROL LOWER pushbuttons may illuminate briefly at various times. This indicates corrective action is being taken to maintain the output power at the APC PWR level. Now depress and hold the POWER CONTROL LOWER pushbutton. It should illuminate for a second or two and the output power should decrease. Hold the pushbutton in until it is extinguished and then release it. As soon as the POWER CONTROL LOWER pushbutton is extinguished, the POWER CONTROL RAISE pushbutton should start flashing on and off indicating automatic power control has inhibited any further lowering of the output power and is raising it back to agree with the APC PWR figure. When the POWER CONTROL RAISE pushbutton stops flashing (indicating the output power now is at the APC PWR level), depress and hold the POWER CONTROL RAISE pushbutton. Hold it in until it is extinguished. The POWER CONTROL LOWER pushbutton should begin flashing and will continue to do so until the output power is again the same as the APC PWR.

aw Momentarily depress the POWER CONTROL AUTO pushbutton several times while observing the multimeter reading. Notice that each time the pushbutton is depressed a new APC PWR level is set. This is signified by the slight changes observed on the multimeter. Depress the POWER CONTROL MANUAL pushbutton. It should illuminate.

ax. Depress the PLATE OFF pushbutton. The following will be observed: The PLATE VOLTAGE, PLATE CURRENT, and output POWER meter will fall to 0 indication. On the Mimic panel the PLATE, SCREEN, and BIAS indicators should extinguish as well as the PREAMP, IPA, PA, and VSWR FOLDBACK if they were green at the time the pushbutton was depressed. If any of these were yellow or red at that time, it will remain illuminated. The PLATE ON pushbutton will extinguish as the plate voltage falls to zero. On the Control Status panel, all MAIN CONTROLLER indicators should be extinguished except BLOWER ON, FIL/IPA ON, and EXCITER ENABLE.

ay. Momentarily depress the FILAMENT OFF pushbutton. The FILAMENT ON pushbutton will be extinguished as well as the Mimic panel FILAMENT and IPA PS indicators. The Mimic panel AIR indicator will begin flashing green signifying the three minute filament cool down period is in progress. Depress the NEXT pushbutton several times until FILAMENT is displayed on the multimeter. The reading should be 0 volts. After 3 minutes the blower will stop running and the Mimic panel AIR indicator will be extinguished as well.

az. On the Control Status panel all indicators, except the CONTROLLER indicators, should be extinguished. (Unless they were red or yellow at the time the PLATE OFF pushbutton was depressed.)

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

ba. Open the front access panel on the High Voltage Power Supply cabinet.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARD TERMINALS BEFORE TOUCHING THEM.

bb. Move the high/low plate voltage switch (3S8) to the high position, and reconnect 3RV7. Replace the access panel.

bc. Reapply station supply voltage to both cabinets. Turn the IPA POWER control (1R20) fully counterclockwise. Confirm that the FILAMENT OFF pushbutton is not illuminated and that the CONTROLLER BACKUP indicator on the Mimic panel is also not illuminated. If they are illuminated, move the Control Status panel CONTROLLER switch to the BACKUP position. After 5 seconds, move the switch back to the MAIN position. Both the FILAMENT OFF pushbutton and the CONTROLLER BACKUP indicator should be extinguished; indicating the main Controller is operational.

bd. Depress the FILAMENT ON pushbutton and after the filament warmup period, depress the PLATE ON pushbutton. The PLATE VOLTAGE meter should indicate 8 to 12.6 kilovolts. Depress the PREVIOUS pushbutton several times until the multimeter displays PLATE E. The reading should agree with the PLATE VOLTAGE meter reading. All indicators on the Mimic panel should be green except PREAMP, IPA, and PA. The PRE AMP should be illuminated red. The PA and IPA indicators should be extinguished. Depress the NEXT pushbutton several times until the multimeter displays ‘SCREEN E’. Depress the POWER CONTROL LOWER pushbutton until the multimeter reads 500 volts.

be. Advance the IPA POWER control clockwise until the IPA FORWARD POWER bar display indicates 300 watts. Carefully readjust the PLATE TUNING and OUTPUT LOADING controls for maximum output power and best PA efficiency. Readjust the INPUT MATCH and GRID TUNING controls for a minimum indication on the IPA REFLECTED POWER bar display.

bf. Advance the IPA POWER control clockwise until the IPA FORWARD POWER bar display indicates 400 watts. Readjust the OUTPUT LOADING and PLATE TUNING controls for maximum output power and best PA efficiency. Readjust the INPUT MATCH and GRID TUNING controls for a minimum indication on the IPA REFLECTED POWER bar display.

bg. Depress the POWER CONTROL RAISE pushbutton until the multimeter indicates a screen voltage of 750 volts. Readjust the OUTPUT LOADING and PLATE TUNING controls for maximum forward output power. (If a screen current overload occurs, retune and reload the PA output for a lower screen current reading.)

bh. Advance the IPA POWER control clockwise until the IPA FORWARD POWER bar display indicates 500 watts. Readjust the INPUT MATCH and GRID TUNING controls for a minimum indication on the IPA REFLECTED POWER bar display.

bi. Depress the POWER CONTROL RAISE pushbutton until the multimeter indicates a screen voltage of 1000 volts OR the value indicated on the factory final test data sheets, whichever is LOWER. Readjust the PLATE TUNING and OUTPUT LOADING controls for maximum forward output power and best PA efficiency.

bj. Advance the IPA POWER control clockwise until the IPA FORWARD POWER bar display indicates the value recorded on the factory final test data sheets.

bk. Readjust the INPUT MATCH and GRID TUNING controls for a minimum indication on the IPA REFLECTED POWER bar display.

bl. If the screen voltage reading on the multimeter is below that recorded on the factory final test data sheets, depress the POWER CONTROL RAISE pushbutton. Hold and pushbutton in until the screen voltage indicated is the same as that recorded on the factory test data sheets OR until the forward output power reaches 100% as read on the output POWER meter, whichever is LOWER. Readjust the OUTPUT LOADING and PLATE TUNING controls for best PA efficiency and maximum forward output power. Readjust the screen voltage if necessary to maintain a 100% indication on the output POWER meter. Readjust the INPUT MATCH and GRID TUNING controls for a minimum indication on the IPA REFLECTED POWER bar display. Readjust the screen voltage if necessary to maintain 100% output power.

bm. Depress the NEXT pushbutton several times until the multimeter displays APC PWR. Next depress the POWER CONTROL AUTO pushbutton. The multimeter should now display an APC Power reading that corresponds to the 100% output POWER value. The POWER CONTROL RAISE and POWER CONTROL LOWER pushbuttons may now flash on and off randomly indicating that automatic power control (APC) is functioning.

bn. On the Control Status panel move the VSWR/CAL switch to the CAL position. On the front panel move the output POWER meter select switch to the REFL position. Adjust the CAL control on the Control Status panel to set the needle on the output POWER meter to the CAL mark. Return the VSWR/CAL switch to the normal (VSWR) position. Read the output VSWR condition on the output POWER meter. It should be less than 1.2:1.

bo. Momentarily depress the RETURN switch on the multimeter twice. Depress the NEXT switch once. The display should now read PA READINGS. Depress the SELECT switch. Beginning with the PA readings, compare the multimeter readings with those recorded on the factory test data sheets.

bp. Depress the FILAMENT OFF pushbutton. Following the filament cool down period and the shutdown of the main blower, remove all station supply voltage from both the Transmitter cabinet and from the High Voltage Power Supply cabinet.

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

NOTE

TO OPTIMIZE TUBE PERFORMANCE AND LIFE EXPECTANCY, REFER TO THE EIMAC BULLETIN ENTITLED EXTENDING TRANSMITTER TUBE LIFE" IN VENDOR SECTION OF MANUAL BEFORE BEGINNING NORMAL OPERATION OF THE TRANSMITTER.

bq. This completes the initial turn on and checkout procedure.

WARNING: Disconnect primary power prior to servicing.

SECTION III
OPERATION

3.1. INTRODUCTION

This section of the Technical Manual provides an introduction to the controls and indicators on the HT 30/35CD FM BROADCAST TRANSMITTER as well as operating procedures to follow in using the HT 30/35CD.

3.2. CONTROLS AND INDICATORS

Figures 3-1 thru 3-5 show the location of all HT 30/35CD controls and indicators.Tables 3-1 thru 3-5 list all controls and indicators with the function of each item listed.

Controls and indicators for the DIGIT™ FM Exciter are described in the DIGIT™ FM Exciter Technical Manual.

WARNING: Disconnect primary power prior to servicing.

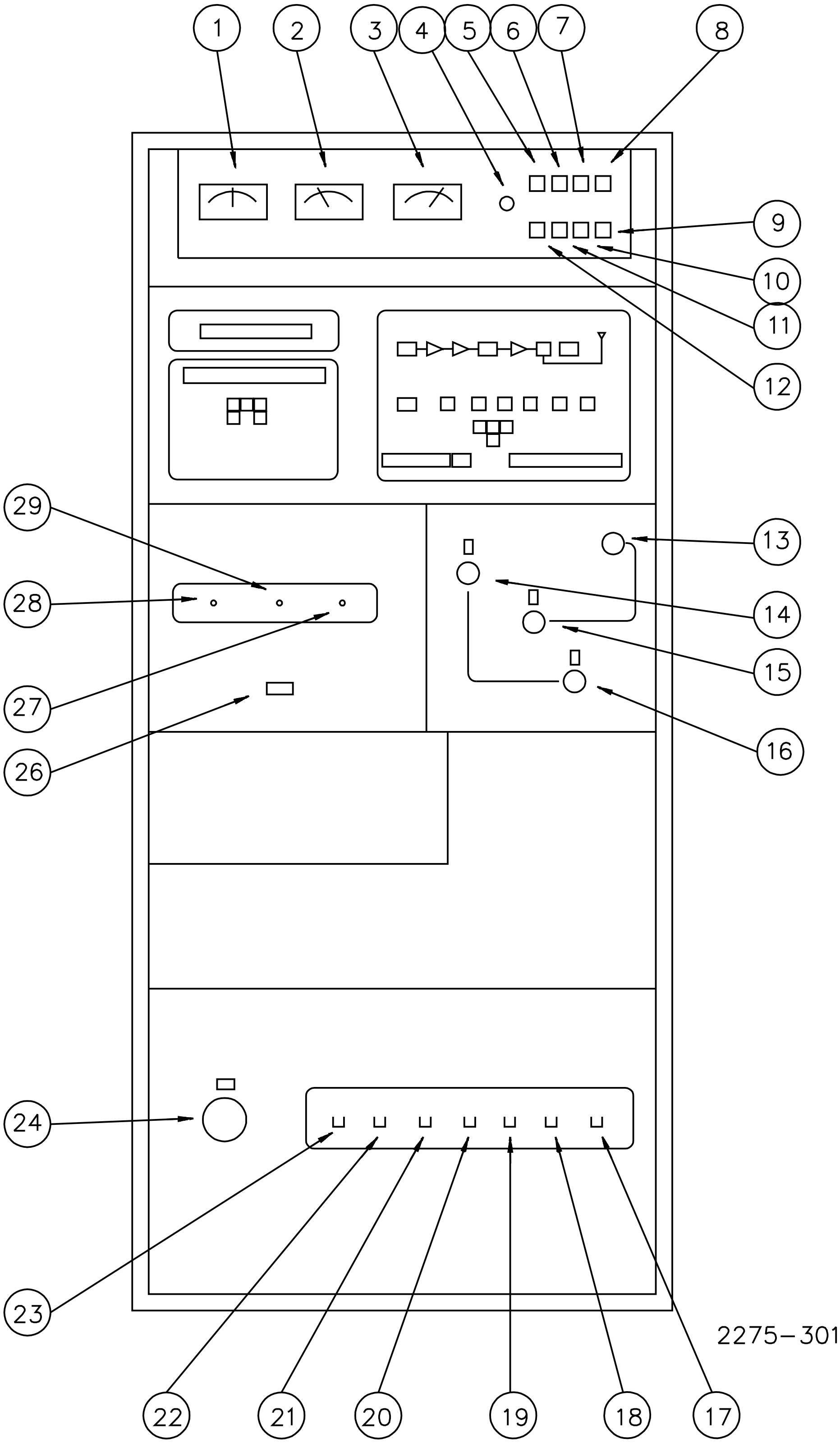


Figure 3-1. HT-35CD Transmitter Cabinet Controls and Indicators

Table 3-1. HT 30/35CD Transmitter Cabinet Controls and Indicators

REF. Figure 3-1	CONTROL/INDICATOR	FUNCTION
1	PLATE VOLTAGE meter 1M2	Displays PA plate voltage.
2	PLATE CURRENT meter 1M3	Displays PA plate current.
3	POWER meter 1M4	Displays VSWR or transmitter rf output power as selected by the POWER FWD/REFL switch 1A7S9.
4	POWER FWD/REFL switch 1A7S9	Selects between a POWER meter (1M4) display of transmitter output power or VSWR.
5	FILAMENT ON pushbutton 1A7S1	Initiates the filament turn on sequence and illuminates to indicate that filament voltage is present at the tube socket.
6	FILAMENT OFF pushbutton 1A7S2	Initiates the filament turn off sequence. Initiates the filament cool down timer when the transmitter is in MAIN control mode. Illuminates when transmitter is operated in BACKUP control mode.
7	PLATE ON pushbutton 1A7S3	Initiates the plate on sequence and illuminates when that sequence has been successfully completed.
8	PLATE OFF pushbutton 1A7S4	Initiates the plate off sequence and illuminates to indicate transmitter shutdown due to a fault condition when the transmitter is being operated in the BACKUP control mode.
9	POWER CONTROL LOWER pushbutton 1A7S8	Lowers the screen voltage to the PA stage. When transmitter is operated in the MAIN control mode, this pushbutton illuminates to indicate the screen voltage is being lowered either as a result of a manual lower command or as a result of automatic power control action.
10	POWER CONTROL RAISE push-button 1A7S7	Raises the screen voltage to the PA stage. When the transmitter is operated in the MAIN control mode, this pushbutton illuminates to indicate the screen voltage is being raised either as a result of a manual raise command or as a result of automatic power control action.
11	POWER CONTROL MANUAL pushbutton 1A7S6	Selects the MANUAL power control mode when the transmitter is operated in the MAIN control mode. Illuminates to confirm this mode of operation has been selected.
12	POWER CONTROL AUTO push-button 1A7S5	Selects the AUTO power control mode when the transmitter is operated in the MAIN control mode. Illuminates to confirm this mode of operation has been selected.
13	PLATE TUNING control 1A2C10	Adjusts the resonant frequency of the PA cavity output circuit.
14	INPUT MATCH control 1A2C9	Adjusts the input circuit of the PA cavity to match the 50 ohm output impedance of the IPA stage.
15	OUTPUT LOADING control 1A2C13	Adjusts the coupling of the PA cavity output circuit to the antenna.
16	GRID TUNING control 1A2L4	Adjusts the resonant frequency of the PA cavity input circuit.
17	CONTROLLER switch 1S8	Provides control of ac power to the MAIN and BACKUP control circuits.
18	CABINET CONTROL circuit breaker 1CB6	Provides control and overload protection for the 24 Vac power supply that provides operating voltage to all contactors and to the high voltage shorting solenoids.
19	CABINET FAN circuit breaker 1CB5	Provides control and overload protection for the transmitter cabinet flushing fan.
20	MAIN BLOWER circuit breaker 1CB4	Provides control and overload protection for the transmitter cabinet main blower.
21	IPA circuit breaker 1CB3	Provides control and overload protection for the IPA and PREAMP power supply.
22	BIAS circuit breaker 1CB2	Provides control and overload protection for the bias power supply for the PA stage.

Table 3-1. HT 30/35CD Transmitter Cabinet Controls and Indicators (Continued)

Figure 3-2. Fluorescent Display Board 1A8 & Mimic Panel Board 1A9 Controls and Indicators

Table 3-2. Fluorescent Display Board 1A8 and Mimic Panel Board 1A9 Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
Figure 3-2		Note: See Table W-1, Front Panel Lamp Cross Reference.
1	CONTROLLER MAIN indicator 1A9DS2	Illuminates green to indicate that main controller is operational. It will be illuminated even when BACKUP control mode is selected as long as the main controller is functional.
2	CONTROLLER BACKUP indicator 1A9DS32	Illuminates yellow when BACKUP control mode is selected or if the main controller is not functional.
3	EXCITER indicator 1A9DS1	Illuminates green to indicate normal exciter operation. Illuminates yellow to indicate an abnormal exciter condition and red to indicate an exciter fault condition.
4	PREAMP indicator 1A9DS29	Illuminates green to indicate normal PREAMP operation. Illuminates yellow to indicate an abnormal PREAMP condition and red to indicate a PREAMP fault condition.
5	IPA PS indicator 1A9DS3	Illuminates green to indicate normal operation of the IPA power supply. Illuminates red to indicate a fault condition.
6	IPA indicator 1A9DS28	Illuminates green to indicate normal operation of the IPA stage. Illuminates yellow to indicate an abnormal operating condition and red to indicate an IPA fault.
7	FILAMENT indicator 1A9DS4	Illuminates steady green to indicate normal filament voltage. Illuminates yellow to indicate filament voltage is outside (high or low) normal operating limits. Illuminates red to indicate extremely low filament voltage or a shorted filament condition. Flashes green to indicate filament warm-up cycle in progress.
8	REMOTE pushbutton 1A9S2	Enables the remote control inputs available on terminal board 1TB7.
8	REMOTE indicator 1A9DS12 (part of 1A9S2)	Illuminates when the remote control mode has been selected and indicates that the command inputs on 1TB7 are active.
9	BIAS indicator 1A9DS5	Illuminates green to indicate normal operation of the BIAS power supply. Illuminates red to indicate a BIAS supply fault condition.
10	PA indicator 1A9DS33	Illuminates green to indicate normal operation of the PA stage. Illuminates yellow to indicate abnormal operation of the PA stage and red to indicate a fault condition in the PA stage.
11	SCREEN indicator 1A9DS6	Illuminates green to indicate normal operation of the screen power supply. Illuminates yellow to indicate abnormal operation of the screen supply or operation at an output voltage below normal. Illuminates red to indicate a fault condition in the screen supply.
12	PLATE indicator 1A9DS7	Illuminates green to indicate normal operation of the plate power supply. Illuminates red to indicate a fault condition in the plate supply.
13	VSWR FOLDBACK indicator 1A9DS15	Illuminates green to indicate a normal VSWR condition at the output of the transmitter. Illuminates yellow to indicate an output VSWR level high enough to cause the VSWR foldback circuit to turn on. NOTE: VSWR foldback operates as part of automatic power control.
14	AIR indicator 1A9DS8	Illuminates green to indicate proper operation of the main blower and sufficient cavity air pressure to ensure proper cooling of the PA, IPA and PREAMP stages. Illuminates red to indicate a fault condition in the main blower or insufficient air pressure in the PA cavity. Flashes green to indicate that the blower run-down cycle is in progress.
15	EXTEND control pushbutton 1A9S3	Enables the extended control inputs available on the optional terminal board 1TB6.
15	EXTEND indicator 1A9DS11 (part of 1A9S3)	Illuminates when the extended control mode has been selected and indicates that the command inputs on 1TB6 (optional) are active.
16	EXTERNAL OVERLOAD indicator 1A9DS20	Not used at present.

Table 3-2. Fluorescent Display Board 1A8 and Mimic Panel Board 1A9 Controls and Indicators (Continued)

REF. Figure 3-2	CONTROL/INDICATOR	FUNCTION
17	PA VSWR OVERLOAD indicator 1A9DS25	Illuminates to indicate that a high PA VSWR condition has triggered the PA VSWR circuit.
18	PLATE I OVERLOAD indicator 1A9DS24	Illuminates to indicate that excessive PA tube plate current has triggered the PA plate current overload circuit.
19	SCREEN I OVERLOAD indicator 1A9DS23	Illuminates to indicate that excessive PA screen current has triggered the PA screen current overload circuit.
20	IPA VSWR OVERLOAD indicator 1A9DS22	Illuminates to indicate that excessive PA grid circuit VSWR has triggered the IPA VSWR overload circuit.
21	FILAMENT OVERLOAD indicator 1A9DS26	Illuminates to indicate excessively low filament voltage has triggered the filament overload circuit.
22	EXCITER AFC OVERLOAD indicator 1A9DS21	Illuminates to indicate that the exciter AFC loop has unlocked, triggering the exciter AFC overload circuit.
23	RESET pushbutton 1A9S1	When depressed, resets the overload and interlock indicators.
24	LOCAL pushbutton 1A9S4	Selects the local control mode of operation disabling the remote and extended control inputs on 1TB7 and 1TB6.
24	LOCAL indicator 1A9DS13 (part of 1A9S4)	Illuminates to indicate the local control mode has been selected and that the remote and extended control inputs on 1TB7 and 1TB6 are not active.
25	FAILSAFE indicator 1A9DS14	Illuminates to indicate that the external remote control system’s failsafe contacts were open while the remote control mode was selected.
26	FAULT indicator 1A9DS9	Illuminates to indicate transmitter operation was halted by the main controller due to three overload conditions occurring in a short period of time.
27	HV CAB INTERLOCK indicator 1A9DS27	Illuminates to indicate that an access panel is not installed on the high voltage power supply cabinet or that one of the grounding sticks is not in its holder.
28	MAIN CAB INTERLOCK indicator 1A9DS19	Illuminates to indicate that a door is open on the transmitter cabinet.
29	PHASE LOSS INTERLOCK indicator 1A9DS18	Illuminates to indicate a single phase loss or phase reversal condition on the station power input to the transmitter cabinet or to indicate that a short ac mains interruption has occured.
30	AIR INTERLOCK indicator 1A9DS17	Illuminates to indicate that there is a low pressure condition in the PA cavity.
31	EXTERNAL INTERLOCK indicator 1A9DS16	Illuminates to indicate that the external interlock is open.
32	RETURN pushbutton 1A8A1S8	When depressed, will cause the multimeter to return to a pre-determined position in the multimeter readings sequence.
33	SELECT pushbutton 1A8A1S4	When depressed, will select for display the parameters in the group whose name appears on the multimeter display.
34	PREVIOUS pushbutton 1A8A1S5	When depressed, will cause the multimeter to display the previous parameter or group name in the sequence.
35	NEXT pushbutton 1A8A1S1	When depressed, will cause the multimeter to display the next parameter or group name in the sequence.
36	MULTIMETER display 1A8VF2	The 16 character alpha-numeric display where the selected multimeter information or reading is displayed.
37	IPA FORWARD/REFLECTED POWER bar display 1A9VF1	A dual 100 segment bar display that simultaneously indicates the forward and reflected power conditions at the output of the IPA.
38 & 39	1A8A1S2 & S3	Presently no user defined function (for future use)

WARNING: Disconnect primary power prior to servicing.

Figure 3-3. Control Status Panel 1A6A13
Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 3-3. Controls Status Panel 1A6A13
Controls and Indicators

REF. Figure 3-3	CONTROL/INDICATOR	FUNCTION
1	PA OPERATE/BYPASS switch 1A6A13S4	Selects the operating mode of the PA cavity and related power supplies. In the bypass position, allows the IPA to be operated with the plate, screen, bias and filament power supplies off. Used in conjunction with the FLEXPatch™ emergency bypass system.
2	CONTROLLER MAIN/BACKUP switch 1A6A13S1	Selects the transmitter control mode. Allows operation using either the main or the backup controller.
3	CONTROLLER MAIN SCREEN RAISE indicator 1A6A13DS5	Illuminates to indicate that the main controller screen raise output line is true.
4	CONTROLLER BACKUP SCREEN RAISE indicator 1A6A13DS14	Illuminates to indicate that the backup controller screen raise output line is true.
5	CONTROLLER MAIN SCREEN LOWER indicator 1A6A13DS6	Illuminates to indicate that the main controller screen lower output line is true.
6	CONTROLLER BACKUP SCREEN LOWER indicator 1A6A13DS15	Illuminates to indicate that the backup controller screen lower output line is true.
7	CONTROLLER MAIN BLOWER ON indicator 1A6A13DS7	Illuminates to indicate that the main controller blower on output line is true.
8	CONTROLLER BACKUP BLOWER ON indicator 1A6A13DS16	Illuminates to indicate that the backup controller blower on output line is true.
9	CONTROLLER MAIN FIL/IPA ON indicator 1A6A13DS8	Illuminates to indicate that the main controller filament on and IPA power supply on output line is true.
10	CONTROLLER BACKUP FIL/IPA ON indicator 1A6A13DS17	Illuminates to indicate that the backup controller filament on and IPA power supply on output line is true.
11	CONTROLLER MAIN BIAS ON indicator 1A6A13DS9	Illuminates to indicate that the main controller bias on output line is true.
12	CONTROLLER BACKUP BIAS ON indicator 1A6A13DS18	Illuminates to indicate that the backup controller bias on output line is true.
13	CONTROLLER MAIN STEP/START indicator 1A6A13DS10	Illuminates to indicate that the main controller step/start output line is true.
14	CONTROLLER BACKUP STEP/START indicator 1A6A13DS19	Illuminates to indicate that the backup controller step/start output line is true.
15	CONTROLLER MAIN RUN indicator 1A6A13DS11	Illuminates to indicate that the main controller run output line is true.
16	CONTROLLER BACKUP RUN indicator 1A6A13DS20	Illuminates to indicate that the backup controller run output line is true.
17	IPA LEVEL Control 1A6A13R13	Adjusts the maximum RF output allowed under backup control mode.
18	CONTROLLER MAIN EXCITER ENABLE indicator 1A6A13DS12	Illuminates to indicate that the main controller exciter enable output line is true.
19	CONTROLLER MAIN IPA ENABLE indicator 1A6A13DS13	Illuminates to indicate that the main controller IPA enable output line is true.
20	R104 adjustment 1A6A13R104	Allows calibration of the IPA REFLECTED POWER bar display. NOTE: This is a factory adjustment.

Table 3-3. Controls Status Panel 1A6A13
Controls and Indicators (Continued)

REF. Figure 3-3	CONTROL/INDICATOR	FUNCTION
21	R103 adjustment 1A6A13R103	Allows calibration of the IPA FORWARD POWER bar display. NOTE: This is a factory adjustment.
22	R102 adjustment 1A6A13R102	Allows calibration of the PA REF reading on the multimeter display. NOTE: This is a factory adjustment.
23	R101 adjustment 1A6A13R101	Allows calibration of the PA FWD reading on the multimeter display. NOTE: This is a factory adjustment.
24	deleted	deleted
25	CAL/VSWR switch 1A6A13S3	Allows selection of a normal (VSWR) or calibrate (CAL) function in the REF mode of the OUTPUT power meter. Used in conjunction with 1A6A13R105 to calibrate the REF mode on that meter for true VSWR readings.
26	CAL control 1A6A13R105	Allows calibration of the REF mode of the OUTPUT power meter for true VSWR readings. Used in conjunction with and 1A6A13S3.
27	IPA VSWR OVERLOAD control 1A6A13R100	Allows adjustment of the IPA VSWR overload setting. This overload setting is read out on the multimeter under IPA READINGS.
28	IPA VSWR OVERLOAD indicator 1A6A13DS4	Illuminates to indicate that an excessive PA tube control grid VSWR has triggered the IPA VSWR circuit while the transmitter was in the backup control mode.
29	PA VSWR OVERLOAD control 1A6A13R99	Allows adjustment of the PA VSWR overload setting. This overload setting is readout on the multimeter under PA readings.
30	PA VSWR OVERLOAD indicator 1A6A13DS3	Illuminates to indicate that excessive PA output VSWR has triggered the PA VSWR overload circuit while the transmitter was in the backup control mode.
31	SCREEN OVERLOAD control 1A6A13R98	Allows adjustment of the screen current overload setting. This overload setting is readout on the multimeter under PA READINGS.
32	SCREEN OVERLOAD indicator 1A6A13DS2	Illuminates to indicate that excessive PA tube screen current has triggered the screen current overload circuit while the transmitter was in the backup control mode.
33	PLATE OVERLOAD control 1A6A13R97	Allows adjustment of the plate current overload setting. This overload setting is readout on the multimeter under PA READINGS.
34	PLATE OVERLOAD indicator 1A6A13DS1	Illuminates to indicate that PA tube plate current has triggered the plate overload circuit while the transmitter was in the backup control mode.

WARNING: Disconnect primary power prior to servicing.

Figure 3-4. Controller Panel, Controls and Indicators

Table 3-4. Controlller Panel, Controls and Indicators

REF. Figure 3-4	CONTROL/INDICATOR	FUNCTION
1	RESET switch 1A8S1	Provides a manual reset signal for the multimeter and Mimic panel circuits.
2	AUX PS circuit breaker 1CB7	Provides control and overload protection for the Controller Aux Power Supply (1A6A15).
3	MAIN PS circuit breaker 1CB8	Provides control and overload protecfor the Controller Main Power Supply (1A6A14).
4	DIGITAL I/O ACTIVITY indicator 1A6A6DS1	Provides a visual indication of the circuit activity of the Digital I/O card assembly.
5	ANALOG I/O ACTIVITY indicator 1A6A8DS1	Provides a visual indication of the circuit activity of the Analog I/O card assembly.

WARNING: Disconnect primary power prior to servicing.

Figure 3-5. High Voltage Power Supply Cabinet Controls and Indicators

Table 3-5. High Voltage Power Supply Cabinet Controls and Indicators

REF. Figure 3-5	CONTROL/INDICATOR	FUNCTION
1	SCREEN circuit breaker 3CB1	Provides control and overload protection for the PA screen power supply.
2	BLOWER circuit breaker 3CB2	Provides control and overload protection for the High Voltage Power Supply cabinet flushing fan 3B1.
3	3S1 interlock switch	Provides interlock protection to ensure the ground stick is in its holder.
4	3S2 interlock switch	Provides interlock protection to ensure the ground stick is in its holder.

3.3. OPERATION

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER CABINET AND HIGH VOLTAGE POWER SUPPLY CABINET BEFORE PERFORMING THE FOLLOWING STEP. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

The following operational procedure is presented for the HT 30/35CD Transmitter under the assumption that the transmitter has been thoroughly and properly tested using the ‘Initial Turn-On Procedure’ of Section II of this Technical Manual and is free of any discrepancies. Also, that the Transmitter cabinet and High Voltage Power Supply cabinet have been inspected to ensure that no foreign objects are inside, all parts and components are properly installed, all connections are secure, and all interlocks are closed.

3.3.1. TRANSMITTER TURN ON

Activate station power to the Transmitter cabinet and to the high voltage power supply cabinet.

Select the MAIN controller mode by moving the CONTROLLER mode switch S1 on the Control Status panel first to the BACKUP position and then to the MAIN position. After 15 seconds, verify that the FILAMENT OFF pushbutton is not illuminated and that the BACKUP CONTROLLER indicator on the Mimic panel is extinguished.

Set the POWER FWD/REFL output POWER meter select switch to the FWD position.

Depress the PLATE ON pushbutton. The pushbutton will illuminate. On the Mimic panel, the IPA PS and AIR indicators will illuminate green. In addition, the FILAMENT indicator will begin flashing green.

After a delay of approximately twenty seconds, the FILAMENT indicator will illuminate steady green on the Mimic panel.

The PLATE ON pushbutton will immediately illuminate and the PLATE VOLTAGE meter will read upscale. The PLATE CURRENT meter and the output POWER meter will slowly move upscale as the rf drive level is increased by the Controller. The Mimic panel EXCITER, BIAS, SCREEN and PLATE indicators will illuminate green. As the rf drive increases, the PREAMP, IPA, and PA indicators will first illuminate yellow and then green. Finally the VSWR indicator will illuminate green.

Note the reading of the PA CURRENT meter to ensure that the PA plate circuit is correctly resonated. If adjustment is required or if the output POWER meter indication is not at 100%, proceed as follows:

a. Depress the POWER CONTROL MANUAL pushbutton. It will illuminate indicating the transmitter is in manual power control.
b. Carefully adjust the PLATE TUNING and OUTPUT loading controls for maximum output power and best PA efficiency.
c. Refer to the factory final test data sheets. Set the IPA FORWARD POWER bar display to the value indicated using the IPA POWER control.
d. Carefully adjust the GRID TUNING and INPUT MATCH controls for a minimum indication on the IPA REFLECTED POWER bar display.
e. If the indicated forward output power is not at 100% indication on the output POWER meter, adjust the screen voltage to the PA tube using the POWER CONTROL RAISE or POWER CONTROL LOWER pushbutton controls. Repeat steps b. and d. Repeat this step if necessary.
f. When final tuning is achieved (at 100% output power), return to automatic power control may be achieved (if desired) by momentarily depressing the POWER CONTROL AUTO pushbutton. The POWER CONTROL AUTO pushbutton should illuminate (and the POWER CONTROL MANUAL pushbutton should be extinguished), signifying return to automatic power control mode.
g. In situations where severe line voltage variations are encountered, it may be desirable to pretune the output of the PA cavity in such a manner as to minimize the screen voltage changes that would be required to compensate for the resulting changes in output power. This would be particularly true where the line voltage frequently sags and then suddenly recovers. In this situation, a screen current

overload may occur. To prevent this from happening, pretune the transmitter (in manual power control, and under normal line voltage conditions) to about 103 to 104% normal output. Then reduce output power using the MANUAL POWER LOWER pushbutton to 100%. Then switch to AUTO power control. Now, when line voltage sags occur, a greater increase in output power will be achieved with a smaller increase in screen voltage. This will minimize the chances of a screen current overload occurring if the line voltage should suddenly return to normal.

Set the POWER FWD/REFL switch to the REFL position. Set the CAL/VSWR switch to the CAL position on the Control Status panel. Set the CAL control so that the output POWER meter pointer is on the CAL mark.

Return the CAL/VSWR switch to the non-CAL position. Now read antenna VSWR on the output POWER meter.

3.3.2. TRANSMITTER TURN OFF

Depress the PLATE OFF pushbutton. On the Mimic panel, the VSWR, PA, IPA, PREAMP, PLATE, SCREEN, and BIAS indicators will extinguish if they were previously illuminated green. Also the PLATE ON pushbutton will be extinguished. After an appropriate cool-down period, depress the FILAMENT OFF pushbutton. The FILAMENT ON pushbutton will extinguish as will the Mimic panel FILAMENT and IPA PS indicators if they were previously illuminated green. The Mimic panel AIR indicator will flash on and off green and the main blower will continue to run for three minutes to ensure proper cooling of the PA tube.

At the end of the three minute cool-down period, the main blower will cease to run and the Mimic panel AIR indicator will be extinguished.

3.3.3. OPERATION IN BACKUP CONTROL MODE

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER CABINET AND HIGH VOLTAGE POWER SUPPLY CABINET BEFORE PERFORMING THE FOLLOWING STEP. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

The following operational procedure is presented for the HT 30/35CD TRANSMITTER under the assumption that the transmitter has been thoroughly and properly aligned and is free of any discrepancies except that the MAIN CONTROL MODE is either inoperative or that operation in the BACKUP CONTROL MODE is specifically desired. Also, ensure that the Transmitter cabinet and the High Voltage Power Supply cabinet have been inspected to ensure that no foreign objects are inside, all parts and components are properly installed, all connections are secure, and all interlocks are closed.

The following procedure also assumes that the Mimic panel, MULTIMETER, IPA FORWARD POWER and IPA REFLECTED POWER displays are not functional. This would be the case when the MAIN Controller system is inoperative or removed for service.

Activate station power to the Transmitter cabinet and to the high voltage power supply cabinet.

3.3.3.1. *TRANSMITTER TURN ON*

Select the BACKUP control mode with the CONTROLLER switch S1 on the Control Status panel by switching S1 to BACKUP. Verify that the FILAMENT OFF pushbutton is illuminated and neither the POWER CONTROL AUTO nor the POWER CONTROL MANUAL pushbutton is illuminated.

NOTE

In the BACKUP control mode, none of the higher level control functions (i.e. automatic power control, VSWR foldback, ac restart, automatic filament warm-up and cool-down, overload recycle) are operative. The BACKUP control system provides basic transmitter on and off functions and overload shutdown protection.

Set the POWER FWD/REFL selector switch to the FWD position.

Depress and briefly hold the FILAMENT ON pushbutton. Verify that the main blower continues to run and that the FILAMENT ON pushbutton remains illuminated after the pushbutton is released.

Wait a minimum of twenty seconds and then depress the PLATE ON pushbutton.

Verify that the PLATE ON pushbutton remains illuminated after it is released.

The PLATE VOLTAGE meter will read upscale and, as the rf drive level increases, so will the PLATE CURRENT and output POWER meters.

Note the reading on the PLATE CURRENT meter to ensure that the PA plate circuit is correctly resonated. If adjustment is required or if the output POWER meter indication is not at 100%, proceed as follows:

a. Carefully adjust the PLATE TUNING and OUTPUT LOADING controls for maximum output power and best PA efficiency.
b. Record the cyclometer readings on the INPUT MATCH and GRID TUNING controls. Now carefully vary each control one or two turns (maximum) in each direction (CW and CCW) while observing the output POWER meter. If an increase is output power can be seen with in this range of control variation, tune that control for a maximum reading. If no variation can be discerned, return these controls to their original positions. If a change in control position(s) takes place, repeat step a.
c. If the output power indication on the output POWER meter is not at 100%, use the POWER CONTROL RAISE or POWER CONTROL LOWER pushbuttons to raise or lower the output power to 100% and then repeat steps a. and b.

Set the POWER FWD/REFL switch to the REFL position. Set the CAL/VSWR switch to the CAL position on the Control Status panel. Set the CAL control so that the output POWER meter pointer is on the CAL mark.

Return the CAL/VSWR switch to the non-CAL positions. Now read antenna VSWR on the output POWER meter.

3.3.3.2. *TRANSMITTER TURN OFF*

Depress the PLATE OFF pushbutton. The pushbutton will extinguish. Verify that the PLATE VOLTAGE, PLATE CURRENT, and output POWER meters drop to zero.

Set the FILAMENT circuit breaker to the OFF position.

After an appropriate cool-down period has passed (3 minutes minimum) depress the FILAMENT OFF pushbutton. The main blower should stop immediately and the FILAMENT ON pushbutton should extinguish. Set the FILAMENT circuit breaker back to the ON position.

3.3.4. TRANSMITTER CONTROLLER SELECTION

3.3.4.1. *POWER UP*

At power up cycle, the MAIN/BACKUP switch is placed in the MAIN position. The Main controller should always be operational as long as power is on. DO NOT power up with the switch set in BACKUP, unless there is a known Main controller problem.

3.3.4.2. *AUTOMATIC SWITCH FROM MAIN TO BACKUP*

Although unlikely, there is a possibility that the Main controller could stop functioning (computer glitch, hardware failure, etc.). If this occurs, the Backup controller automatically starts functioning. The HT 30/35CD displays this fact by illuminating the FILAMENT OFF lamp. When this occurs, the Main controller tries to recycle up to the current operating state. The Backup controller retains the operating control.

3.3.4.3. *RETURNING TO MAIN CONTROLLER (WHEN BACKUP IS OPERATIONAL)*

When the Main controller and Backup controller are in sync (inside panel lights similar), toggle the MAIN/BACKUP switch to BACKUP position, wait 45 seconds, then toggle back to MAIN position. The FILAMENT OFF lamp should extinguish and the Main controller should take over the operating state.

If the Main and Backup controllers are not in sync, turn off the plate and filament. At the conclusion of the shutdown sequence, all inside panel lights should be extinguished. The controllers are now in sync and the MAIN/BACKUP switch may be toggled. The filament and plate may now be restarted.

If the MAIN/BACKUP switch is toggled from BACKUP to MAIN and the two controllers are not in sync, transmitter operation may be abruptly halted and a manual restart of the transmitter may be required.

NOTE

'SYNC' is defined in the following way. On the Control Status Panel, the status shown by the MAIN indicators must exactly duplicate the status shown by the BACKUP indicators.

3.3.4.4. *MANUAL SWITCH FROM MAIN TO BACKUP*

During Main controller operation, the MAIN/BACKUP switch should NEVER be toggled. This process causes a power on reset to the Main controller. The current operating state is lost and the main/backup sync process may not occur. If you must toggle this switch, no guarantee of correct operation should be expected.

3.4. MULTIMETER INFORMATION

The following information is provided to aid the user in the operation of the multimeter used in the HT 30/35CD. Included are a Multimeter Flow Diagram (Figure 3-6) and a simplified overview of the transmitter metering functions (Table 3-6).

3.5. TRANSMITTER METERING FUNCTIONS

3.5.1. MULTIMETER SWITCHES

(See NOTE that follows)

Operation of the multimeter is accomplished with the push-button switches described in the paragraphs below. After using the multimeter a few times, you will quickly learn to use it without the aid the Technical Manual.

After power has been applied to the main transmitter cabinet, the multimeter display should read “BASIC READINGS.”

If you wish to use the multimeter at this time, you may choose to depress “SELECT,” “NEXT,” or “PREVIOUS.”

If you depress “SELECT,” the multimeter will display the first parameter (plate current) under the heading of “BASIC READINGS.” You may then advance through the other readings in the “BASIC READINGS” listing. See Table 3-6.

Depressing the “RETURN” switch will return the display to the heading of “BASIC READINGS.”

You may advance through the headings of “PA READINGS,” “IPA READINGS,” PREAMP READINGS," “CONTROL STATUS,” “OVERLOADS,” and “CLOCK STATUS” by depressing the “NEXT” pushbutton.

By depressing the “SELECT” switch, you can look at the parameters under the displayed heading.

3.5.1.1. *RETURN*

When the display is in a subscript (a-o) (see Table 3-6), depressing the RETURN key once will move it back to its heading (1-5) (see Table 3-6).

When the display is in a heading (1-5), depressing the RETURN key once will move it back to Basic Reading (1).

3.5.1.2. *SELECT*

When the display is in a heading (1-5), depressing the SELECT key once will move it to the first subscript (a-o).

3.5.1.3. *NEXT*

When the display is in a heading (1-5), each time the NEXT key is depressed, the display will move to the next heading (1-5).

When the display is in a subscript (a-o), each time the NEXT key is depressed, the display will move to the next subscript (a-o).

3.5.1.4. *PREVIOUS*

When the display is in a heading (1-5), each time the PREVIOUS key is depressed, the display will move to the previous heading (1-5).

When the display is in a subscript (a-o), each time the PREVIOUS key is depressed, the display will move to the previous subscript (a-o).

NOTE

See Overload and Clock Set Multimeter Flow Diagrams. These functions use the various keys in different manners than those described on this page.

To clear the overload memory, first advance to the “OVERLOADS” heading. When you depress “SELECT,” the display will show one of the overload headings, such as “PA VSWR.”

Table 3-6. Transmitter Multimeter Functions

1. BASIC READINGS
   a - PLATE I
   b - PLATE E
   c - SCREEN I
   d - SCREEN E
   e - FILAMENT
   f - IPA FWD
   g - IPA REF
2. PA READINGS

   a - PLATE E
   b - PLATE I
   c - PLATE OVR
   d - PA FWD
   e - APC PWR
   f - PA REFD
   g - PA OVR
   h - SCREEN E
   i - SCREEN I
   j - SCN OVR
   k - GRID E
   l - GRID I
   m - FILAMENT
   n - INLET T
   o - STACK T
3. IPA READINGS

   a - IPA FWD
   b - IPA REF
   c - IPA OVR
   d - IPA E
   e - IPA I
   f - IPA T
4. PREAMP READINGS
   a - PREA PWR
   b - PREAMP E
   c - PREAMP I
   d - PREA DRV
5. CONTROL STATUS
   a - PHASE A
   b - PHASE B
   c - PHASE C
   d - +5 SUPPLY
   e - +12
   f - -12
   g - +10 REF
   h - -10 REF
   i - TEMP
6. OVERLOADS

   PA VSWR OVR
   PLATE I OVR
   SCREEN I OVR
   IPA VWSR OVR
   EXCITER OVR
   FILAMENT OVR
   FAULT CAUSE
7. CLOCK SET

   HOURS
   MINUTES
   SECONDS
   MONTH
   DAY
   YEAR

If you want to clear the overload memory under the selected overload heading, you must depress the UN-MARKED switch to the left of the "SELECT" switch two times.

To change to a different overload heading, use the "NEXT" or "PREVIOUS" pushbuttons to obtain the desired heading.

To clear, depress the unmarked pushbutton beside the "SELECT" switch two times.

To view the overload history for the heading which is displayed, depress the "SELECT" switch. The display will then show the most recent overload event. To view prior overloads, depress the "PREVIOUS" switch.

Use the "RETURN" switch as needed to return to the desired heading.

Fault Cause Table

Code	Reason
1	AFC did not lock
2	Calculated VSWR was greater than 2:1 while in Auto power control
4	There were too many recycles within the specified period
Filament On Sequence	
10	A filament OFF button was pressed (such as a stuck FIL OFF switch)
11	The phase monitor was open indicating a phase loss/reversal
12	The air switch did not close within 3 seconds after turning on the blower
13	The filament voltage did not go above 5 volts within 2 seconds after turning on the filament primary voltage
14	The IPA power supply voltage was less than 28 volts
Plate On Sequence	
20	A filament or plate OFF button was pressed (such as a stuck PLATE OFF switch)
21	The magnetic overload contacts were open (3K1 and 3K2 in the HV Power Supply)
22	The bias voltage did not reach a value more negative than -150 volts within 2 seconds after being turned on
23	The plate current was greater than 3 amps with only the step contactor energized
24	The plate voltage remained below 6kV for 300 ms during step sequence
Continuous Operation	
30	The bias voltage was more positive than -150 volts for 2 seconds when the plate supply was on

The FAULT CAUSE table can be accessed just like any of the overload types under the OVERLOADS heading. If you select the OVERLOADS heading, you can advance through the overload types. FAULT CAUSE will follow FILAMENT in the overload stack. If you select FAULT CAUSE, the display will show the most recent type of fault in the 1 to 2 digit code.

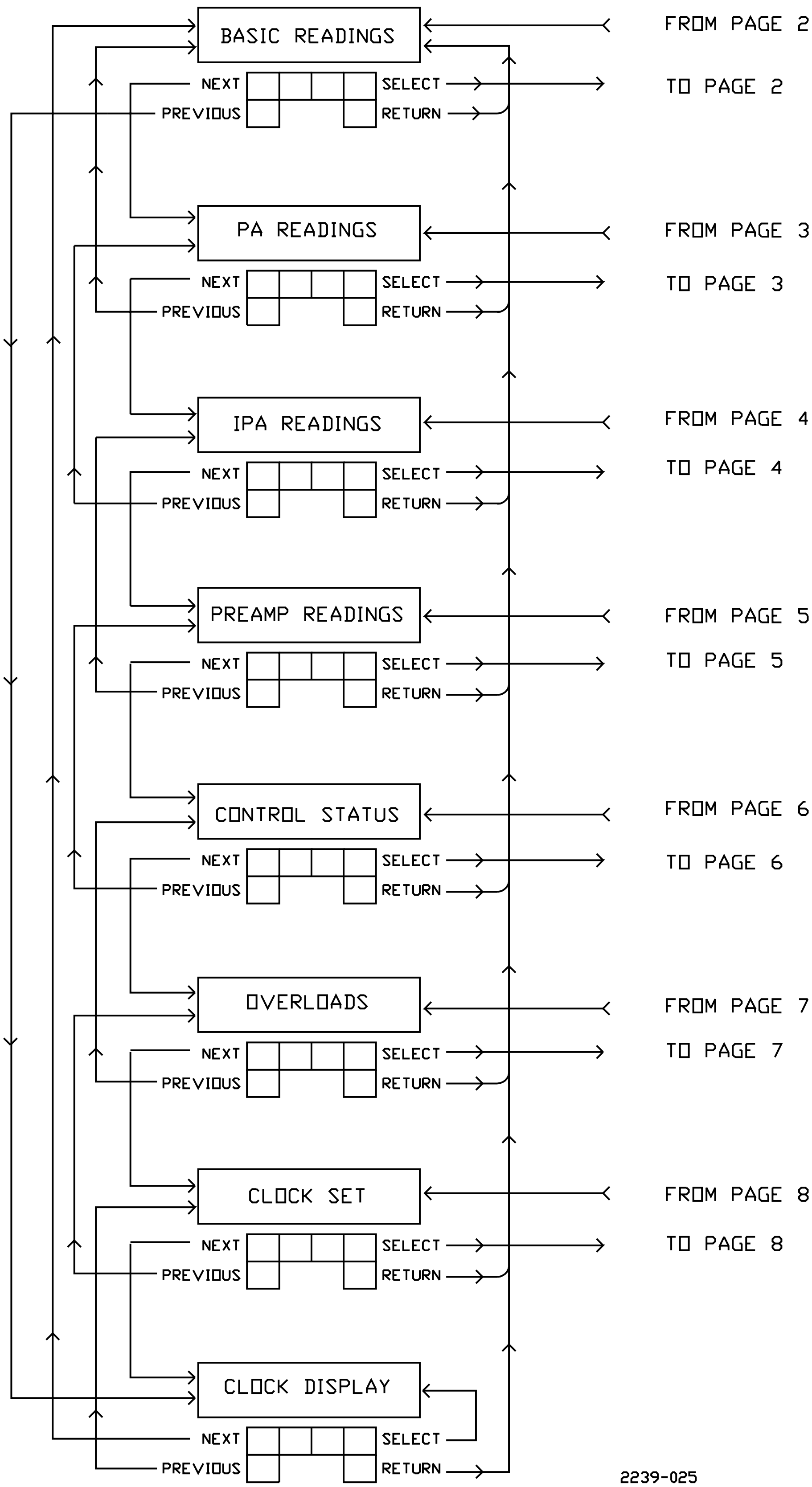


Figure 3-6. Multimeter Flow Diagram (Page 1 of 8)

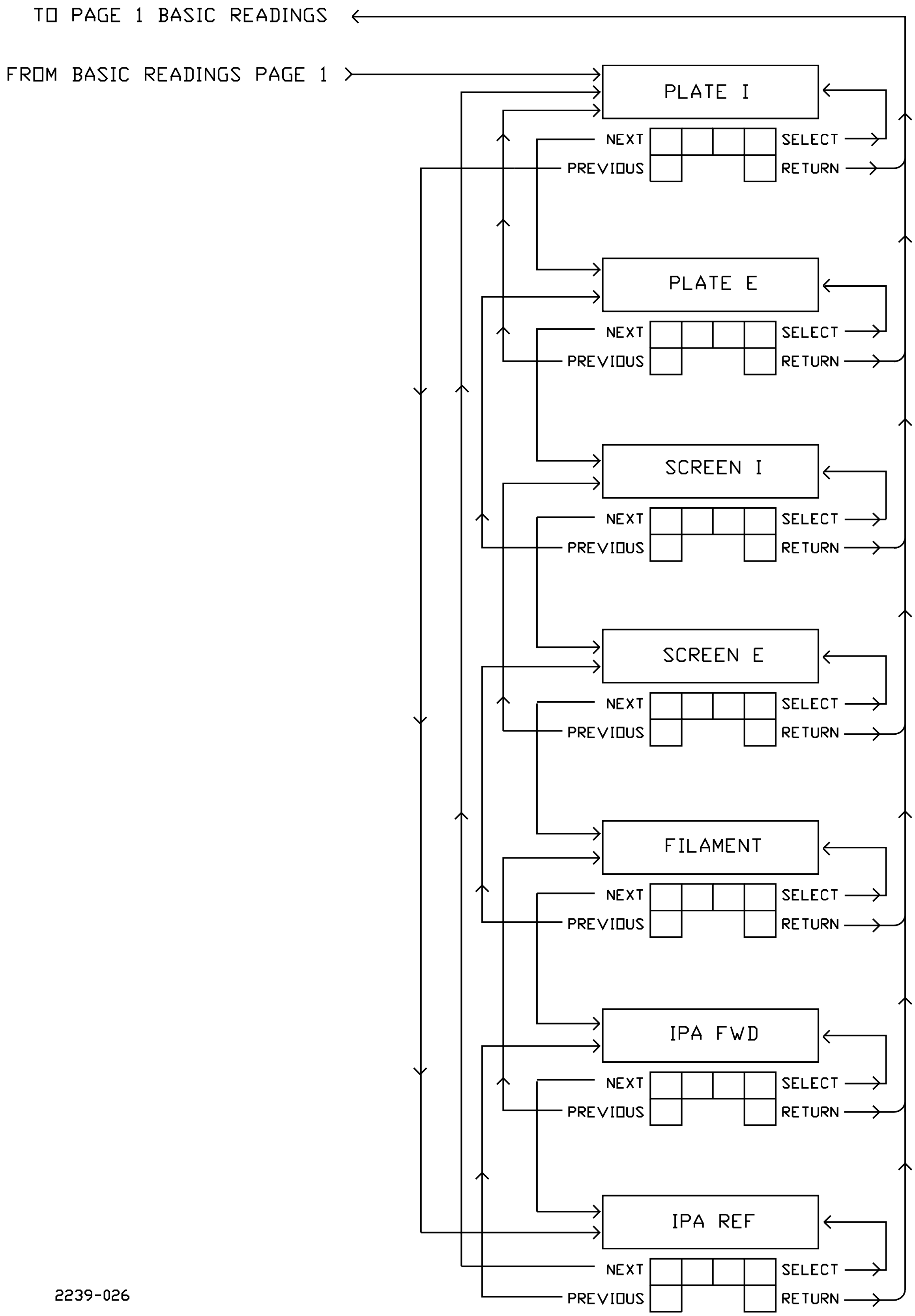


Figure 3-6. Multimeter Flow Diagram
(Page 2 of 8) Basic Readings

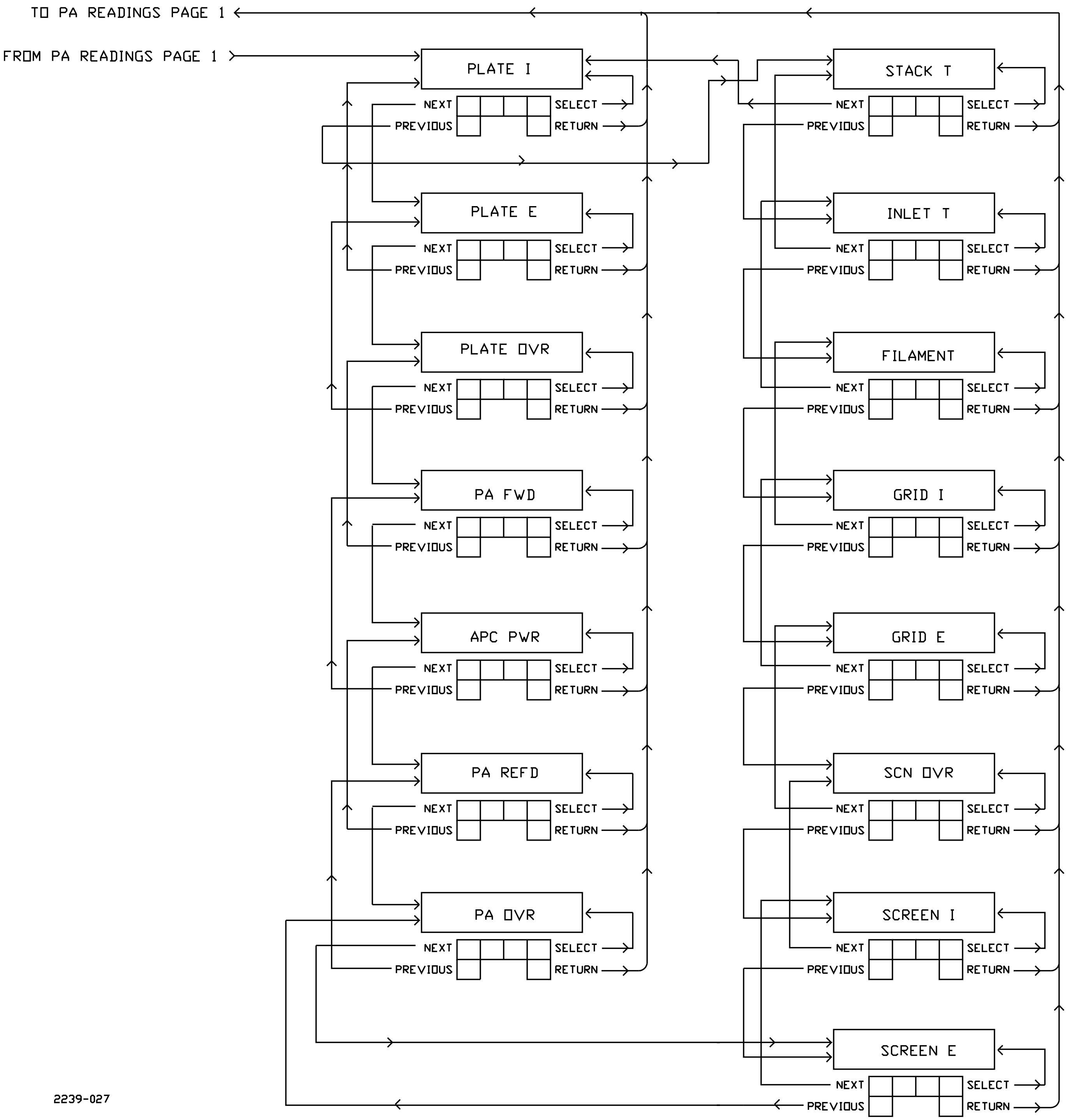


Figure 3-6. Multimeter Flow Diagram
(Page 3 of 8) PA Readings

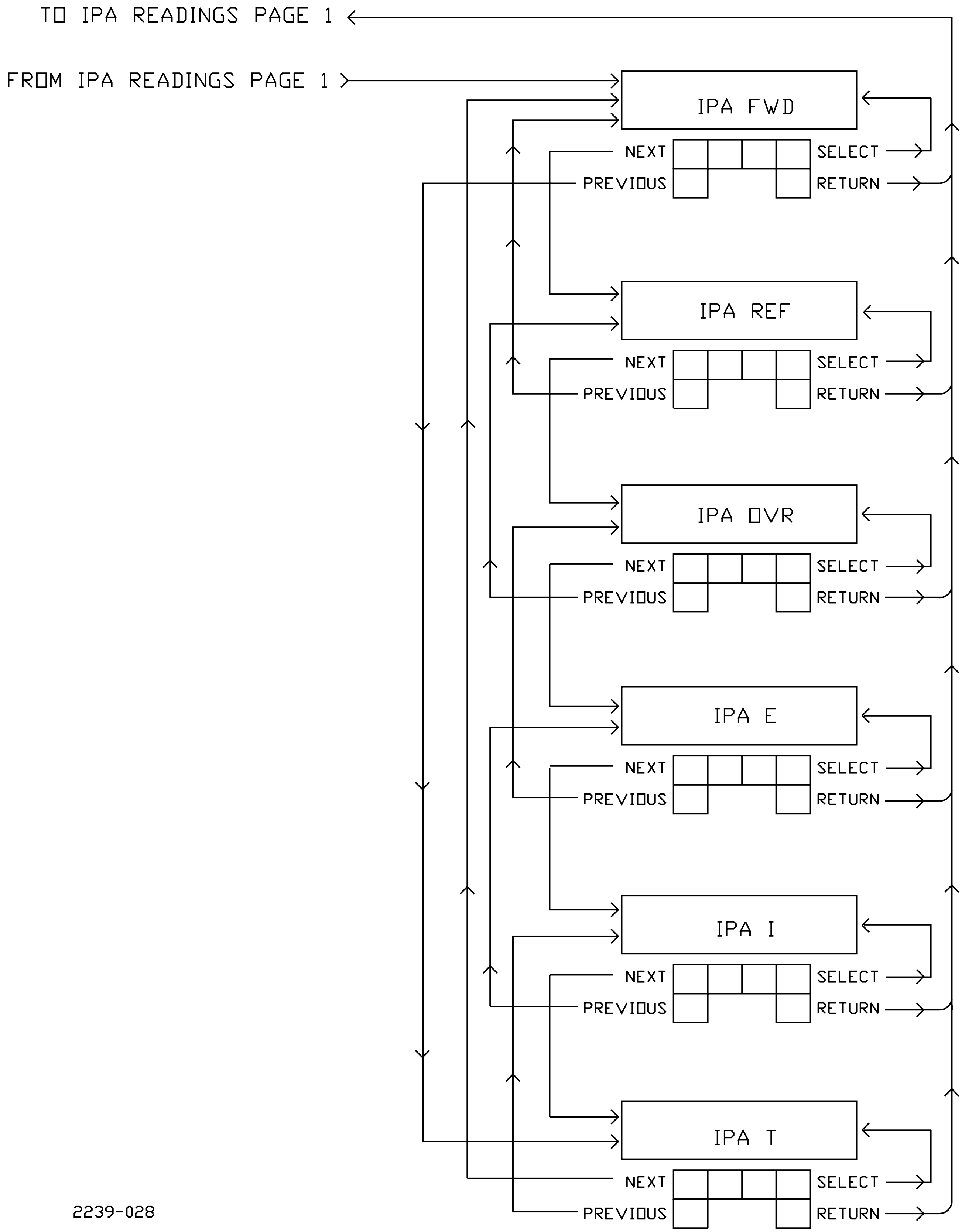


Figure 3-6. Multimeter Flow Diagram
(Page 4 of 8) IPA Readings

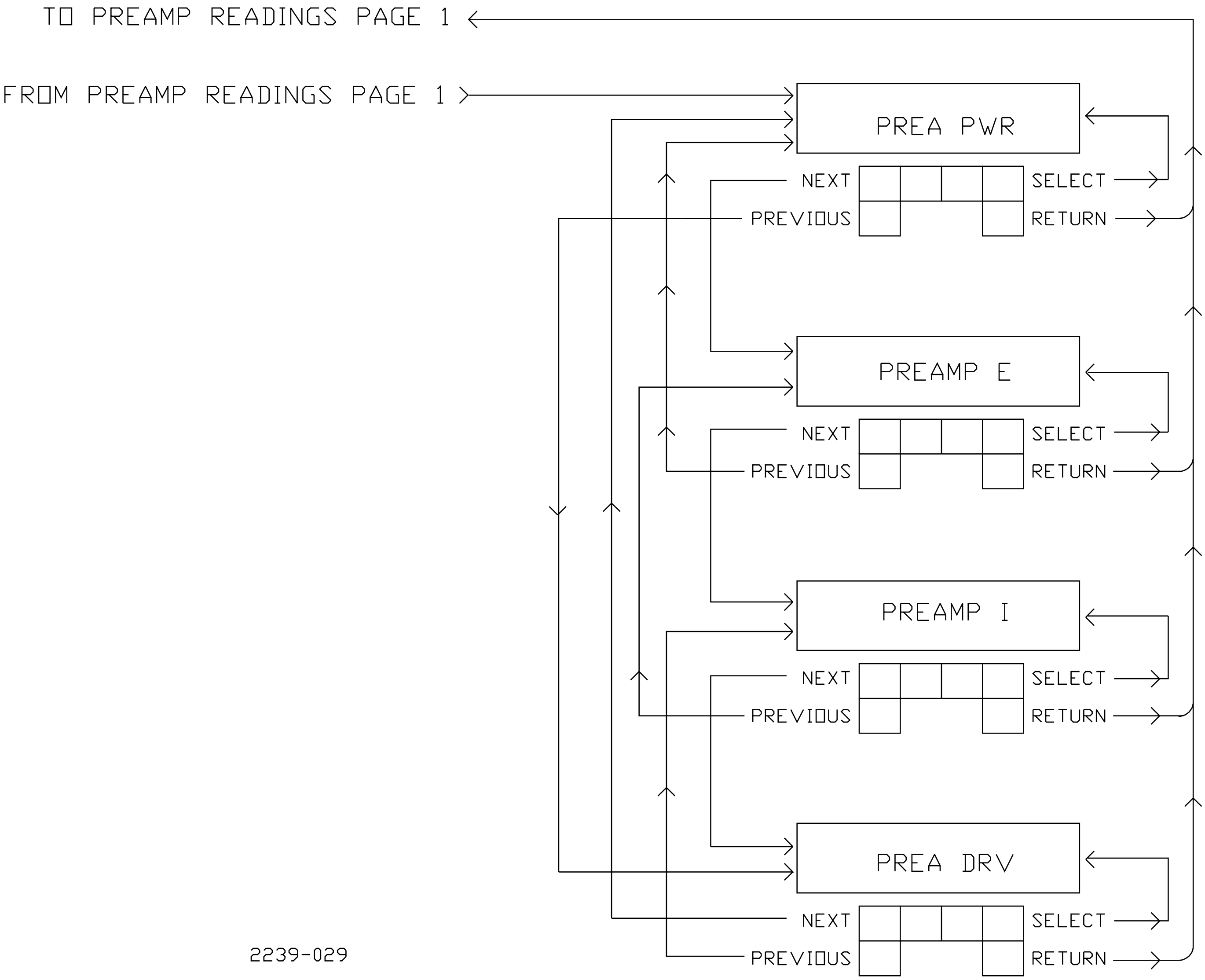


Figure 3-6. Multimeter Flow Diagram
(Page 5 of 8) Preamp Readings

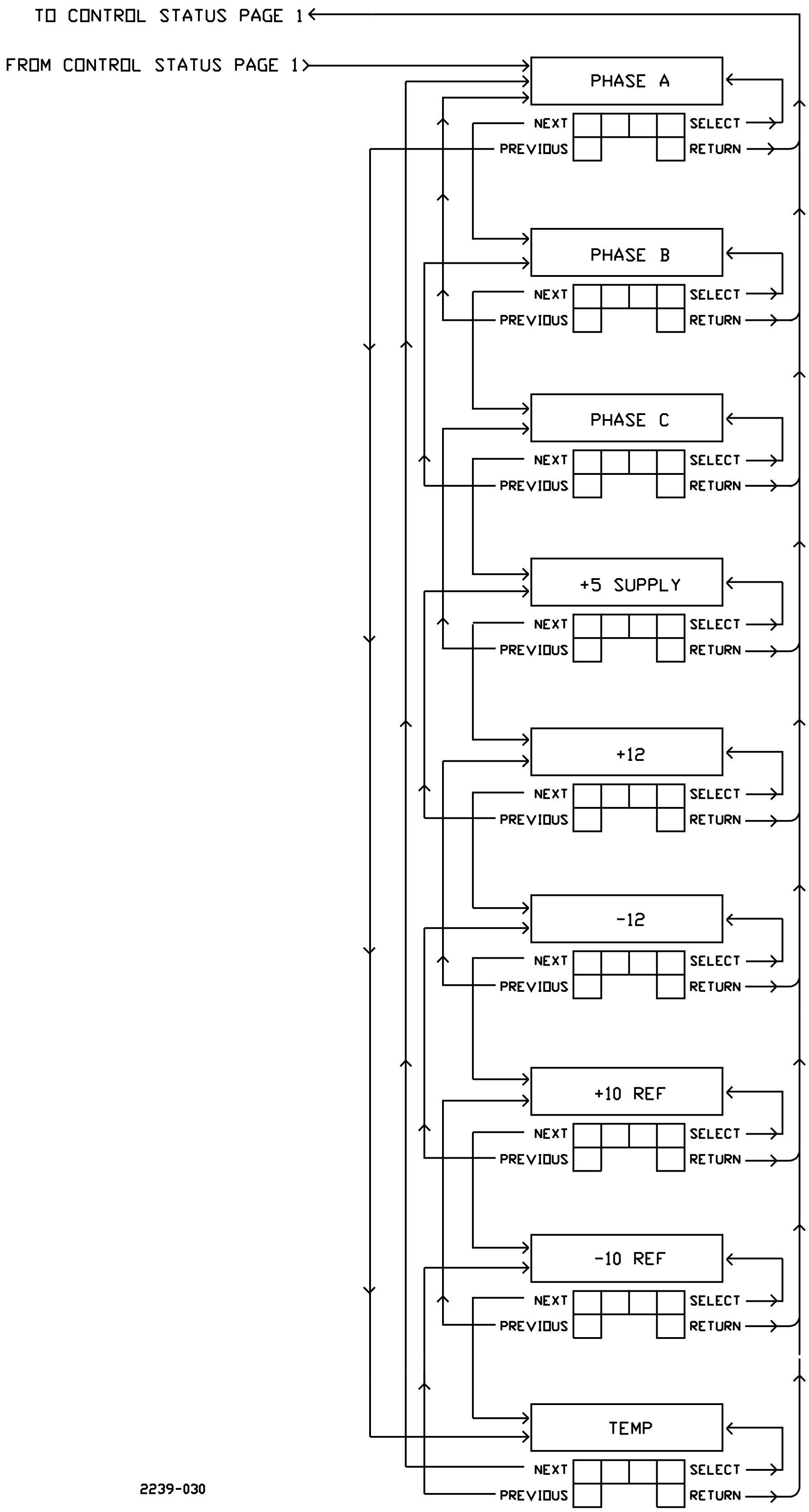


Figure 3-6. Multimeter Flow Diagram
(Page 6 of 8) Control Status

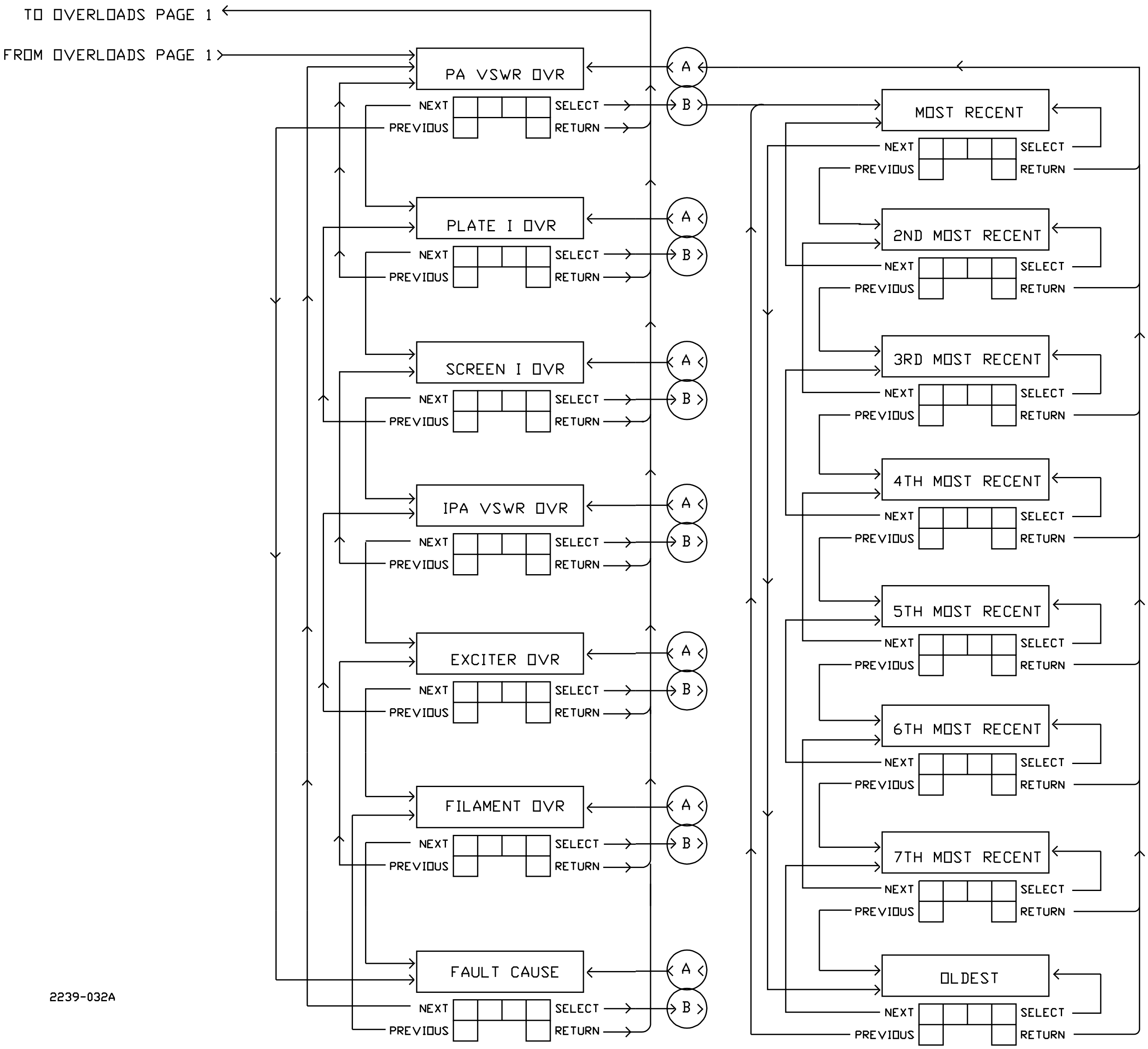


Figure 3-6. Multimeter Flow Diagram
(Page 7 of 8) Overloads

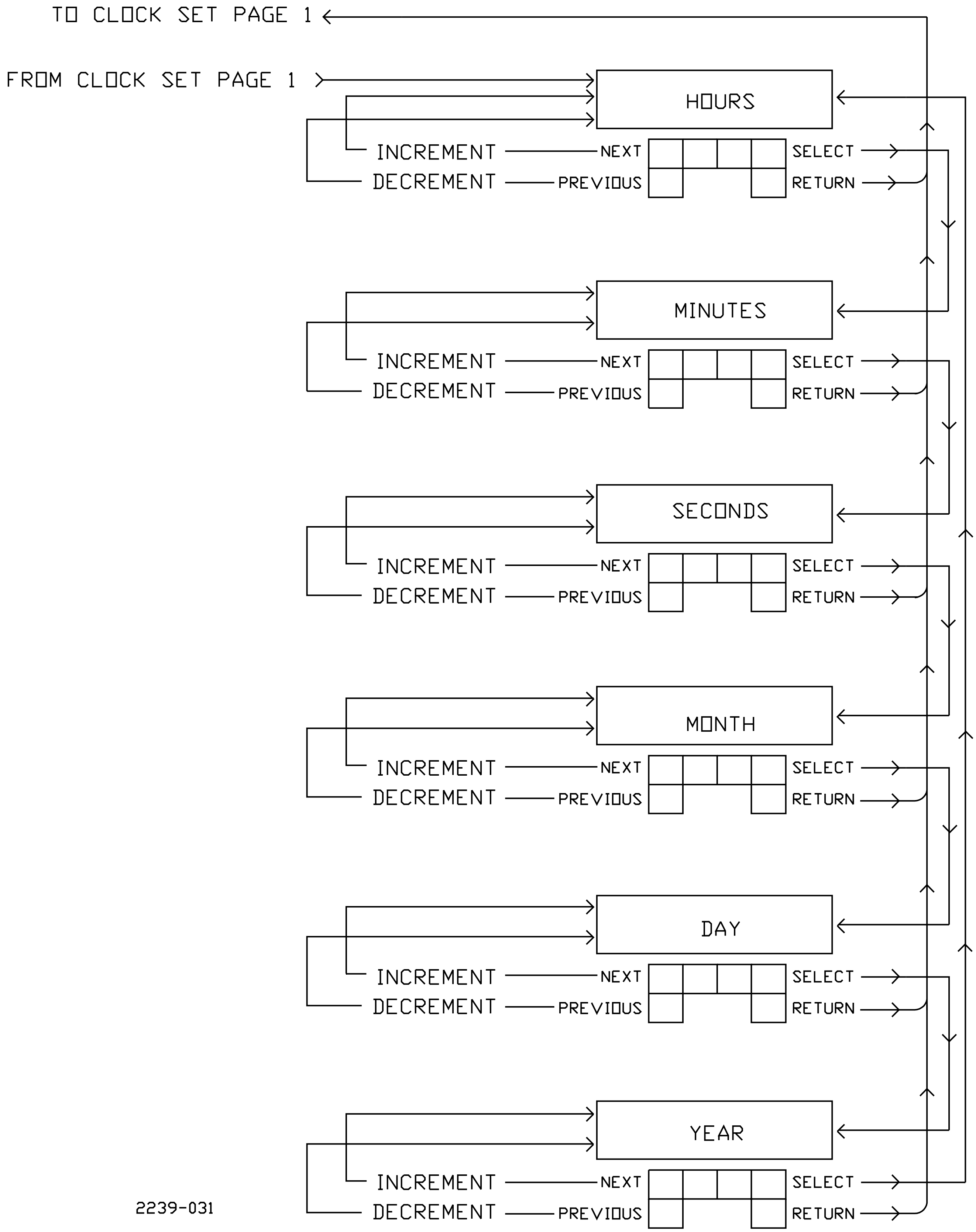


Figure 3-6. Multimeter Flow Diagram
(Page 8 of 8) Clock Set

WARNING: Disconnect primary power prior to servicing.

3.6. OPERATION IN NON-STANDARD CONFIGURATIONS USING FLEXPatch™

FLEXPatch™ allows transmitter operation in any of several configurations that permit an inoperative rf stage to be easily bypassed. Transmitter operation in any of these bypass modes will be at a reduced output power level.

At any time that a FLEXPatch™ bypass mode is in use, the transmitter must be operated in the BACKUP control mode.

Even though FLEXPatch™ requires operation in the BACKUP control mode, the MAIN controller will continue to operate. The multimeter information as well as that provided by the IPA FORWARD/REFLECTED bar display will be available and of great use in these modes. However, the indicators associated with the Mimic panel will not necessarily indicate the true operating status of the system. As a result they should be ignored when operating in a FLEXPatch™ mode.

Figure 3-7 shows the STANDARD jumper configuration of the FLEXPatch™ panel.

All of the bypass modes may be configured by simply reconnecting these coaxial jumpers. If an inoperative PA cavity is to be bypassed, an additional change must be made inside the cavity assembly to effect a connection to the output transmission line center conductor. Also a jumper will be installed between the FLEXPatch™ and the IPA directional coupler (1A3).

After determining which rf stage is inoperative, terminate transmitter operation by depressing the FILAMENT OFF pushbutton. Following completion of the filament cool down period, the main cabinet blower will cease running. At this time, disconnect station power to the transmitter.

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

Open the transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARDS BEFORE TOUCHING THEM.

Having determined which stage(s) needs to be bypassed, find the appropriate FLEXPatch™ bypass mode from the Table 3-7. Proceed to the paragraph indicated in Table 3-7. Figures 3-8 through 3-14 show the FLEXPatch™ jumper configurations to accomplish the various bypass configurations.

Table 3-7. FLEXPatch™ Bypass Configurations

Figures 3-8 through 3-14 show the FLEXPatch™ jumper configurations to accomplish the various bypass configurations as follows:
Fig. 3-8 Configuration to bypass an inoperative PREAMP stage. See paragraph 3.6.1.
Fig. 3-9 Configuration to bypass an inoperative IPA stage. See paragraph 3.6.2.
Fig. 3-10 Configuration to bypass inoperative PREAMP and IPA stages. See paragraph 3.6.3.
Fig. 3-11* Configuration to bypass an inoperative PA stage. See paragraph 3.6.4.
Fig. 3-12* Configuration to bypass inoperative PREAMP, IPA and PA stages. See paragraph 3.6.5.
Fig. 3-13* Configuration to bypass inoperative PREAMP and PA stage. See paragraph 3.6.6.
Fig. 3-14* Configuration to bypass inoperative IPA and PA stages. See paragraph 3.6.7.
* Note: An additional change must be made within the PA cavity to facilitate these modes.

Figure 3-7. FLEXPatch™ - Normal Configuration
(No Bypass)

3.6.1. FLEXPatch™ OPERATION TO BYPASS AN INOPERATIVE PREAMP STAGE

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

Locate the front access panel upon which the FILAMENT HOURS meter 1M1 is mounted. Remove and retain the hardware that secures this access panel. Open the panel and locate the FLEXPatch™ panel to the right through the opening.

Remove and reconnect the three coaxial jumpers (#269, #271, #273) as appropriate to reconfigure the panel to match Figure 3-8. Close the access panel and replace the hardware that secures the access panel.

Figure 3-8.FLEXPatch™ - Preamp Bypassed (Exciter - IPA - PA - Antenna)

Open the Controller access panel and move the CONTROLLER switch on the Control Status panel to the BACKUP position. Ensure that the PA switch is in the OPERATE position. Close the panel.

Pull the exciter out on its extender rails and unplug the ac power cord from the back. Open the exciter top cover and find JP6 on the Regulator Board which is located right behind the front panel. Place JP6 in the 60W position which is pins 1-2. This allows the exciter to go to full power output. Close the exciter, plug the ac cord back into the exciter, slide it back into the transmitter and reapply power.

Close the rear door on the Transmitter cabinet. Reapply station power to the Transmitter cabinet and to the High Voltage Power Supply cabinet.

Depress and momentarily hold the FILAMENT ON pushbutton. Release and confirm that the FILAMENT ON pushbutton remains illuminated and that the blower is running.

After allowing at least a twenty second warm up period, depress and momentarily hold the PLATE ON pushbutton. The PLATE VOLTAGE meter should read upscale to the normal voltage. The PLATE CURRENT and output POWER meters should remain at a 0 reading. Release the PLATE ON pushbutton.

Select the FWD PWR on the DIGIT™ front panel multimeter. Increase the exciter power output until the DIGIT™ multimeter indicates 55 watts or the IPA FWD POWER bar graph reads normal IPA Forward power for the normal transmitter TPO.

NOTE

With the PREAMP bypassed, the front panel IPA POWER control has no effect on IPA RF output power.

The IPA FORWARD POWER bar display should read between 400 and 600 watts.

Carefully adjust the INPUT MATCH and GRID TUNING controls for a minimum reading on the IPA REFLECTED POWER bar display.

Select the SCREEN E position on the multimeter. Using the POWER CONTROL RAISE and POWER CONTROL LOWER pushbuttons, set the screen voltage to 1300V.

Using the OUTPUT TUNING and OUTPUT LOADING controls, tune for maximum rf output on the POWER meter and best PA efficiency.

NOTE

Because the operating point of the cavity has been radically altered by the lower drive level, the OUTPUT TUNING control may run at or near one or the other tuning limit. This is acceptable as long as the PA anode dissipation is not greater than 12 kilowatts.

The output POWER meter should read a percentage of output power that is equivalent to 18000 to 35000 watts.

NOTE

If normal transmitter output power is below that obtained in this FLEXPatch™ mode, reduce screen voltage until the output POWER meter indicates 100%.

When it is desired to return to the normal transmitter configuration, first reduce the power output of the Exciter to 12 watts or the value recorded on the factory final test data sheet, whichever is lower.

Reduce the PA screen voltage to that value recorded in the factory final test data sheets.

Terminate transmitter operation by depressing the PLATE OFF pushbutton. Set the FILAMENT circuit breaker to the OFF position.

After approximately three minutes, depress the FILAMENT OFF pushbutton. After the blower ceases to run and the FILAMENT ON pushbutton is extinguished, set the FILAMENT circuit breaker to the ON position.

Disconnect station power to the Transmitter cabinet and to the High Voltage Power Supply cabinet.

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

Open the Transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARDS BEFORE TOUCHING THEM.

Move the CONTROLLER switch to the MAIN position on the Control Status panel.

Replace and/or repair the failed unit(s).

Return the FLEXPatch™ jumpers to their normal configuration as shown in Figure 3-7. Set JP6 on the exciter Regulator Board to the 20W position pins 2-3 to limit the exciter output to 20W.

Close the Transmitter cabinet rear door and secure all access panels.

Return the HT 30/35CD Transmitter to normal operation by following the turn on procedure as described beginning in paragraph 3.3.1.

3.6.2. FLEXPatch™ OPERATION TO BYPASS AN INOPERATIVE IPA STAGE

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

Locate the front access panel upon which the FILAMENT HOURS meter 1M1 is mounted. Remove and retain the hardware that secures this access panel. Open the panel and locate the FLEXPatch™ panel to the right through the opening.

Remove and reconnect the three coaxial jumpers (#269, #271, #273) as appropriate to reconfigure the panel to match Figure 3-9. Close the access panel and replace the hardware that secures the access panel.

Figure 3-9.FLEXPatch™ - IPA Bypassed
(Exciter - Preamp - PA - Antenna)

Open the Controller access panel and move the CONTROLLER switch on the Control Status panel to the BACKUP position. Ensure that the PA switch is in the OPERATE position. Close the panel.

Close the rear door on the Transmitter cabinet. Reapply station power to the Transmitter cabinet and to the High Voltage Power Supply cabinet.

Depress and momentarily hold the FILAMENT ON pushbutton. Release and confirm that the FILAMENT ON pushbutton remains illuminated and that the blower is running.

After allowing at least a twenty second warmup period, depress and momentarily hold the PLATE ON pushbutton. The PLATE VOLTAGE meter should read upscale to the normal voltage. The PLATE CURRENT and output POWER meters should read upscale to values much lower than normal.

Select FWD PWR on the DIGIT™ front panel multimeter. Using the front panel exciter controls, increase exciter power output until the DIGIT™ multimeter indicates 15 watts. DO NOT EXCEED 15 WATTS AT ANY TIME.

Advance the IPA POWER control fully clockwise.

The IPA FORWARD POWER bar display should read between 50 and 100 watts.

Carefully adjust the INPUT MATCH and GRID TUNING controls for a minimum reading on the IPA REFLECTED POWER bar display.

Select the SCREEN E position on the multimeter. Using the POWER CONTROL RAISE and POWER CONTROL LOWER pushbuttons, set the screen voltage to 1450V.

Using the OUTPUT TUNING and OUTPUT LOADING controls, tune for maximum rf output on the POWER meter and best PA efficiency.

NOTE

Because the operating point of the cavity has been radically altered by the lower drive level, the OUTPUT TUNING control may run at or near one or the other tuning limit. This is acceptable as long as the PA anode dissipation is not greater than 12 kilowatts.

The output POWER meter should read a percentage of output power that is equivalent to 8000 to 10000 watts.

NOTE

If normal transmitter output power is below that obtained in this FLEXPatch™ mode, reduce screen voltage until the output POWER meter indicates 100%.

When it is desired to return to the normal transmitter configuration, first reduce the power output of the Exciter to 10 watts or the value recorded on the factory final test data sheet, whichever is lower.

Reduce the PA screen voltage to that value recorded in the factory final test data sheets.

Terminate transmitter operation by depressing the PLATE OFF pushbutton. Set the FILAMENT circuit breaker to the OFF position.

After approximately three minutes, depress the FILAMENT OFF pushbutton. After the blower ceases to run and the FILAMENT ON pushbutton is extinguished, set the FILAMENT circuit breaker to the ON position.

Disconnect station power to the Transmitter cabinet and to the High Voltage Power Supply cabinet.

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

Open the Transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARDS BEFORE TOUCHING THEM.

Move the CONTROLLER switch to the MAIN position on the Control Status panel.

Replace and/or repair the failed unit(s).

Return the FLEXPatch™ jumpers to their normal configuration as shown in Figure 3-7.

Close the Transmitter cabinet rear door and secure all access panels.

Return the HT 30/35CD Transmitter to normal operation by following the turn on procedure as described beginning in paragraph 3.3.1.

3.6.3. FLEXPatch™ OPERATION TO BYPASS INOPERATIVE PREAMP AND IPA STAGES

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

Locate the front access panel upon which the FILAMENT HOURS meter 1M1 is mounted. Remove and retain the hardware that secures this access panel. Open the panel and locate the FLEXPatch™ panel to the right through the opening.

Remove and reconnect the three coaxial jumpers (#269, #271, #273) as appropriate to reconfigure the panel to match Figure 3-10. Close the access panel and replace the hardware that secures the access panel.

Open the Controller access panel and move the CONTROLLER switch on the Control Status panel to the BACKUP position. Ensure that the PA switch is in the OPERATE position. Close the panel.

Pull the DIGIT™ exciter out on its extender rails and unplug the ac power cord. Open the exciter top cover and find JP6 on the Regulator Board which is located right behind the front panel. Place JP6 in the 60W position which is pins 1-2. This allows the exciter to go to full power output. Close the exciter, plug in the ac cord, slide it back into the transmitter and reapply power.

Close the rear door on the Transmitter cabinet. Reapply station power to the Transmitter cabinet and to the High Voltage Power Supply cabinet.

Depress and momentarily hold the FILAMENT ON pushbutton. Release and confirm that the FILAMENT ON pushbutton remains illuminated and that the blower is running.

After allowing at least a twenty second warm up period, depress and momentarily hold the PLATE ON pushbutton. The PLATE VOLTAGE meter should read upscale to the normal voltage. The PLATE CURRENT and output POWER meters should remain at a 0 reading. Release the PLATE ON pushbutton.

Select FWD PWR on the DIGIT™ front panel multimeter. Increase the exciter power output until the DIGIT™ multimeter indicates 55 watts.

Figure 3-10.FLEXPatch™ - Preamp & IPA Bypassed (Exciter - PA - Antenna)

NOTE

With the PREAMP bypassed, the front panel IPA POWER control has no effect on IPA RF output power.

The IPA FORWARD POWER bar display should read at or near 0 watts. Select REF PWR on the DIGIT™ front panel multimeter. Carefully adjust the INPUT MATCH and GRID TUNING controls for a minimum reading on DIGIT™ multimeter.

Select the SCREEN E position on the multimeter. Using the POWER CONTROL RAISE and POWER CONTROL LOWER pushbuttons, set the screen voltage to 1450V.

Observe the PLATE CURRENT meter reads slightly upscale (about 0.5 Amperes).

However the output POWER meter may not indicate a forward power reading. Move the OUTPUT TUNE control fully clockwise. Power output from the PA cavity is now in the range of 500-2000 watts. Continue to operate in this mode as long as necessary.

When it is desired to return to the normal transmitter configuration, first reduce the power output of the Exciter to 12 watts or the value recorded on the factory final test data sheet, whichever is lower.

Reduce the PA screen voltage to that value recorded in the factory final test data sheets.

Terminate transmitter operation by depressing the PLATE OFF pushbutton. Set the FILAMENT circuit breaker to the OFF position.

After approximately three minutes, depress the FILAMENT OFF pushbutton. After the blower ceases to run and the FILAMENT ON pushbutton is extinguished, set the FILAMENT circuit breaker to the ON position.

Disconnect station power to the Transmitter cabinet and to the High Voltage Power Supply cabinet.

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

Open the Transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARDS BEFORE TOUCHING THEM.

Move the CONTROLLER switch to the MAIN position on the Control Status panel.

Replace and/or repair the failed unit(s).

Return the FLEXPatch™ jumpers to their normal configuration as shown in Figure 3-7.

Set JP6 on the exciter Regulator Board to the 20W position pins 2-3 to limit the exciter output to 20W.

Close the Transmitter cabinet rear door and secure all access panels. Return the HT 30/35CD Transmitter to normal operation by following the turn on procedure as described beginning in paragraph 3.3.1.

3.6.4. FLEXPatch™ OPERATION TO BYPASS AN INOPERATIVE PA STAGE

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

Locate the front panel access panel upon which the FILAMENT HOURS meter 1M1 is mounted. Remove and retain the hardware that secures this panel. Open the panel and locate the FLEXPatch™ panel to the right through this opening.

Remove and reconnect the three coaxial jumpers (#269, #271, #273) as appropriate to reconfigure the panel to match Figure 3-11. Disconnect cable #233 from J1 on the IPA LPF/Directional Coupler 1A3. Secure this end of cable #233 with masking tape so that it does not fall down into the transmitter base area where it would create a hazard during operation. Locate the FLEXPatch™ JUMPER cable that is packed with the transmitter accessories. Install as per Figure 3-11 between 1A3-J1 and 1J19 on the FLEXPatch™ panel. Close the access panel and secure with the hardware remove previously.

Open the Controller access panel and move the CONTROLLER switch to the BACKUP position. Move the PA switch to the BYPASS position. Close the panel.

WARNING

ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT WHEN PERFORMING THE FOLLOWING STEP.

Remove the lower PA Cavity access panel. Locate the inductive output loop (1A2L6) connected between the OUTPUT LOAD capacitor (1A2C13) and the center conductor of the output transmission line.

Locate the PA Cavity Emergency bypass input connector (1A2J2). Locate the PA Emergency bypass cable (P/N 922 1065 001) that was packed with the transmitter accessories. Install the cable in the cavity by first connecting the type N connector to the bypass input connector. Attach the lugged end of the center conductor to the long 6/32 screw that connects the output loading strap to the output loading capacitor.

Figure 3-11.FLEXPatch™ - PA Bypassed (Exciter - Preamp - IPA - Antenna)

Connect the outer conductor (shield) of the bypass cable to the 8/32 press-in nut mounted in the cavity wall. Tighten gently but firmly. Check to make sure all connections are tight. Replace the cavity access panel.

NOTE

This panel must be in place to provide adequate cooling to the PREAMP and IPA.

Turn the IPA POWER control fully counterclockwise.

Close the rear door of the Transmitter cabinet. Apply station power to the Transmitter cabinet ONLY.

WARNING

DO NOT APPLY STATION POWER TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

Depress and momentarily hold the FILAMENT ON pushbutton. Release and confirm that the FILAMENT ON pushbutton remains illuminated and that the blower is running.

Advance the multimeter to the IPA E position in the IPA Readings group. The IPA E reading should be approximately 43V.

Advance the IPA POWER control until the IPA FORWARD POWER bar display indicates some forward output power. Note that the IPA REFLECTED POWER bar display may indicate some value of reflected power depending on the antenna VSWR. This is normal. As the IPA power is advanced, tune the PA output loading and PA plate tuning for minimum reflected IPA power. THE PA tube must remain in place for this PA bypass to operate properly. The output POWER meter may indicate upscale slightly due to the 500 watts of output power. Continue to operate in this mode as necessary.

Note that in this PA BYPASS mode no station power is reconnected to the High Voltage Power Supply. Also none of the contactors in that cabinet are energized at any time. In addition, the filament and PA bias supplies are not energized in the Transmitter cabinet. Only the blower and IPA power supply are active in the PA BYPASS mode.

When it is desired to return to the normal transmitter configuration, first readjust the IPA POWER control so that the IPA FWD power reading on the multimeter reads the same as that on the factory final test data sheet. Set the IPA circuit breaker to the OFF position.

Wait three minutes and then depress the FILAMENT OFF pushbutton. After the main blower stops, set the IPA circuit breaker to the ON position.

Disconnect station power to the Transmitter cabinet and to the High Voltage Power Supply cabinet.

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

Open the Transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARDS BEFORE TOUCHING THEM.

Move the CONTROLLER switch to the MAIN position on the Control Status panel and the PA switch to the OPERATE position.

Replace and/or repair the failed unit(s).

Access the FLEXPatch™ panel through the front access panel. Remove the FLEXPatch™ JUMPER that is connected between 1A3-J1 and 1J19 on the FLEXPatch™ panel. Retain it for future use. Reconnect coaxial cable #233 to 1A3-J1.

Return the FLEXPatch™ jumpers to their normal configuration as shown in Figure 3-7.

WARNING

ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT WHEN PERFORMING THE FOLLOWING STEP.

Remove the lower access panel on the PA cavity. Remove the emergency PA bypass cable and store it for future use. Reinstall the output inductive loop using the original hardware. Be sure it is in the same orientation as it originally was before it was removed. Firmly tighten all hardware. Replace the PA cavity access panel and tighten the hardware that secures it.

Close the Transmitter cabinet rear door and secure all access panels.

Return the HT 30/35CD Transmitter to normal operation by following the turn on procedure as described beginning in paragraph 3.3.1.

3.6.5. FLEXPatch™ OPERATION TO BYPASS INOPERATIVE PREAMP, IPA, AND PA STAGES

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

Locate the front access panel upon which the FILAMENT HOURS meter 1M1 is mounted. Remove and retain the hardware that secures this access panel. Open the panel and locate the FLEXPatch™ panel to the right through the opening.

Figure 3-12.FLEXPatch™ - Preamp, IPA, & PA Bypassed (Exciter - Antenna)

Remove and reconnect the three coaxial jumpers (#269, #271, #273) as appropriate to reconfigure the panel to match Figure 3-12.

WARNING

ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT WHEN PERFORMING THE FOLLOWING STEP.

Remove the lower PA Cavity access panel. Locate the inductive output loop (1A2L6) connected between the OUTPUT LOAD capacitor (1A2C13) and the center conductor of the output transmission line. Note the loop orientation for future reference. Unbolt and remove the loop and retain for future use.

Locate the PA Cavity Emergency bypass input connector (1A2J2). Locate the PA Emergency bypass cable (P/N 929 9135 397) that was packed with the transmitter accessories. Install the cable in the cavity by first connecting the type N connector to the bypass input connector. Attach the lugged end of the center conductor to the center conductor of the output transmission line. Do so by placing the lug under the bolt that goes into the center conductor and tightening gently but firmly. Notice now that the lug attached to the outside shield of the cable falls directly over one of the bolts that holds the outer conductor of the transmission line to the cavity wall. Remove that bolt. Run it through the lug and reinstall it. Tighten gently but firmly. Check to make sure all connections are tight. Replace the cavity access panel.

NOTE

This panel must be in place to provide adequate cooling to the PREAMP and IPA.

Locate the ac power connector on the rear of the DIGIT™ Exciter. This may be done by pulling the exciter out on its extender rails and reaching over the top of the exciter. Unplug the ac power cord from the transmitter wiring and control circuits. Locate the standard ac line cord that is placed with the transmitter accessories. Plug this line cord into the ac connector on the rear of the DIGIT™ Exciter. Route the line cord out of the cabinet through the front access panel but do not plug it in yet.

NOTE

If maximum power (55 watts) is desired out of the exciter, open the top cover and set JP6 on the Regulator Board to the 2-3 position and close the exciter top cover. This selects the 60W max output range.

Plug the line cord into a source of 120 Vac.

WARNING

DO NOT APPLY STATION POWER TO EITHER THE HIGH VOLTAGE POWER SUPPLY CABINET OR TO THE TRANSMITTER CABINET.

Select FWD PWR on the DIGIT™ front panel multimeter. Increase the exciter power output until the DIGIT™ multimeter indicates 15 watts (or 55 watts if the PWR RANGE SELECT jumper, JP6 was positioned in the 60W max position).

Operate in this mode as necessary.

When it is desired to return to the normal transmitter configuration, first readjust the exciter power output so that DIGIT™ multimeter indicates the FWD PWR reading recorded on the factory final test data sheet.

NOTE

If the PWR RANGE SELECT jumper, JP6 was moved to the 2-3 position for 60W max output, you will have to remove all power from the exciter, open the top cover of exciter, and reposition the PWR RANGE SELECT jumper to the 1-2 position (20W max) before proceeding.

To terminate the DIGIT™ Exciter operation it will have to be unplugged.

Move the CONTROLLER switch to the MAIN position on the Control Status panel and the PA switch to the OPERATE position.

Replace and/or repair the failed unit(s).

Return the FLEXPatch™ jumpers to their normal configuration as shown in Figure 3-7.

Unplug the DIGIT™ line cord from the 120 Vac source. Disconnect the temporary ac line cord from the ac power connector on the rear of the DIGIT™ Exciter.

Reconnect the normal cable in the Transmitter cabinet to the ac input on the rear of the DIGIT™ Exciter.

Return the FLEXPatch™ jumpers to their normal configuration as shown in Figure 3-7.

WARNING

ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT WHEN PERFORMING THE FOLLOWING STEP.

Remove the lower access panel on the PA cavity. Remove the emergency PA bypass cable and store it for future use. Reinstall the output inductive loop using the original hardware. Be sure it is in the same orientation as it originally was before it was removed. Firmly tighten all hardware. Replace the PA cavity access panel and tighten the hardware that secures it.

Close the Transmitter cabinet rear door and secure all access panels.

Return the HT 30/35CD Transmitter to normal operation by following the turn on procedure as described beginning in paragraph 3.3.1.

3.6.6. FLEXPatch™ OPERATION TO BYPASS INOPERATIVE PREAMP AND PA STAGES

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

Locate the front panel access panel upon which the FILAMENT HOURS meter 1M1 is mounted. Remove and retain the hardware that secures this panel. Open the panel and locate the FLEXPatch™ panel to the right through this opening.

Remove and reconnect the three coaxial jumpers (#269, #271, #273) as appropriate to reconfigure the panel to match Figure 3-13. Disconnect cable #233 from J1 on the IPA LPF/Directional Coupler 1A3. Secure this end of cable #233 with masking tape so that it does not fall down into the transmitter base area where it would create a hazard during operation. Locate the FLEXPatch™ JUMPER cable that is packed with the transmitter accessories. Install as per Figure 3-13 between 1A3-J1 and 1J19 on the FLEXPatch™ panel. Close the access panel and secure with the hardware remove previously.

Open the Controller access panel and move the CONTROLLER switch to the BACKUP position. Move the PA switch to the BYPASS position. Close the panel.

Figure 3-13.FLEXPatch™ - Preamp & PA Bypassed (Exciter - IPA - Antenna)

WARNING

ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT WHEN PERFORMING THE FOLLOWING STEP.

Remove the lower PA Cavity access panel. Locate the inductive output loop (1A2L6) connected between the OUTPUT LOAD capacitor (1A2C13) and the center conductor of the output transmission line. Note the loop orientation for future reference. Unbolt and remove the loop and retain for future use.

Locate the PA Cavity Emergency bypass input connector (1A2J2). Locate the PA Emergency bypass cable (P/N 929 9135 397) that was packed with the transmitter accessories. Install the cable in the cavity by first connecting the type N connector to the bypass input connector. Attach the lugged end of the center conductor to the center conductor of the output transmission line. Do so by placing the lug under the bolt that goes into the center conductor and tightening gently but firmly. Notice now that the lug attached to the outside shield of the cable falls directly over one of the bolts that holds the outer conductor of the transmission line to the cavity wall. Remove that bolt.

Run it through the lug and reinstall it. Tighten gently but firmly. Check to make sure all connections are tight. Replace the cavity access panel.

NOTE

This panel must be in place to provide adequate cooling to the PREAMP and IPA.

Close the rear door of the Transmitter cabinet. Apply station power to the Transmitter cabinet ONLY.

WARNING

DO NOT APPLY STATION POWER TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

Depress and momentarily hold the FILAMENT ON pushbutton. Release and confirm that the FILAMENT ON pushbutton remains illuminated and that the blower is running.

Advance the multimeter to the IPA E position in the IPA Readings group. The IPA E reading should be approximately 43V.

Select FWD PWR on the DIGIT™ front panel multimeter. Increase the exciter power output until the DIGIT™ multimeter indicates 15 watts.

NOTE

With the PREAMP bypassed, the front panel IPA POWER control has no effect on IPA RF output power.

The IPA FORWARD POWER bar display should read between 100 and 200 watts.

Notice that the IPA REFLECTED POWER bar display may indicate some value of reflected power depending on the antenna VSWR. This is normal. As the IPA is driving the antenna directly, there are no controls to match the IPA to this load. The output POWER meter may indicate upscale very slightly due to the power output from the IPA. Continue to operate in this mode as necessary.

Note that in this PA BYPASS mode no station power is reconnected to the High Voltage Power Supply. Also none of the contactors in that cabinet are energized at any time. In addition, the filament and PA bias supplies are not energized in the Transmitter cabinet. Only the blower and IPA power supply are active in the PA BYPASS mode.

When it is desired to return to the normal transmitter configuration, first lower the DIGIT™ power output for a FWD PWR reading of 10 watts or the value recorded on the factory final test data sheet, whichever is lower. Set the IPA circuit breaker to the OFF position.

Wait three minutes and then depress the FILAMENT OFF pushbutton. After the main blower stops, set the IPA circuit breaker to the ON position.

Disconnect station power to the Transmitter cabinet and to the High Voltage Power Supply cabinet.

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

Open the Transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARDS BEFORE TOUCHING THEM.

Move the CONTROLLER switch to the MAIN position on the Control Status panel and the PA switch to the OPERATE position.

Replace and/or repair the failed unit(s).

Access the FLEXPatch™ panel through the front access panel. Remove the FLEXPatch™ JUMPER that is connected between 1A3-J1 and 1J19 on the FLEXPatch™ panel. Retain it for future use. Reconnect coaxial cable #233 to 1A3-J1.

Return the FLEXPatch™ jumpers to their normal configuration as shown in Figure 3-7.

Remove the lower access panel on the PA cavity. Remove the emergency PA bypass cable and store it for future use. Reinstall the output inductive loop using the original hardware. Be sure it is in the same orientation as it originally was before it was removed. Firmly tighten all hardware. Replace the PA cavity access panel and tighten the hardware that secures it.

Close the Transmitter cabinet rear door and secure all access panels.

Return the HT 30/35CD Transmitter to normal operation by following the turn on procedure as described beginning in paragraph 3.3.1.

3.6.7. FLEXPatch™ OPERATION TO BYPASS INOPERATIVE IPA AND PA STAGE

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

Locate the front panel access panel upon which the FILAMENT HOURS meter 1M1 is mounted. Remove and retain the hardware that secures this panel. Open the panel and locate the FLEXPatch™ panel to the right through this opening.

Remove and reconnect the three coaxial jumpers (#269, #271, #273) as appropriate to reconfigure the panel to match Figure 3-14. Disconnect cable #233 from J1 on the IPA LPF/Directional Coupler 1A3. Secure this end of cable #233 with masking tape so that it does not fall down into the transmitter base area where it would create a hazard during operation. Locate the FLEXPatch™ JUMPER cable that is packed with the transmitter accessories. Install as per Figure 3-14 between 1A3-J1 and 1J19 on the FLEXPatch™ panel. Close the access panel and secure with the hardware remove previously.

Open the Controller access panel and move the CONTROLLER switch to the BACKUP position. Move the PA switch to the BYPASS position. Close the panel.

Figure 3-14.FLEXPatch™ - IPA & PA Bypassed (Exciter - Preamp - Antenna)

WARNING

ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT WHEN PERFORMING THE FOLLOWING STEP.

Remove the lower PA Cavity access panel. Locate the inductive output loop (1A2L6) connected between the OUTPUT LOAD capacitor (1A2C13) and the center conductor of the output transmission line. Note the loop orientation for future reference. Unbolt and remove the loop and retain for future use.

Locate the PA Cavity Emergency bypass input connector (1A2J2). Locate the PA Emergency bypass cable (P/N 929 9135 397) that was packed with the transmitter accessories. Install the cable in the cavity by first connecting the type N connector to the bypass input connector. Attach the lugged end of the center conductor to the center conductor of the output transmission line. Do so by placing the lug under the bolt that goes into the center conductor and tightening gently but firmly. Notice now that the lug attached to the outside shield of the cable falls directly over one of the bolts that holds the outer conductor of the transmission line to the cavity wall. Remove that bolt. Run it through the lug and reinstall it. Tighten gently but firmly.

Check to make sure all connections are tight. Replace the cavity access panel.

NOTE

This panel must be in place to provide adequate cooling to the PREAMP and IPA.

Turn the IPA POWER control fully counterclockwise.

Close the rear door of the Transmitter cabinet. Apply station power to the Transmitter cabinet ONLY.

WARNING

DO NOT APPLY STATION POWER TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

Depress and momentarily hold the FILAMENT ON pushbutton. Release and confirm that the FILAMENT ON pushbutton remains illuminated and that the blower is running.

Advance the multimeter to the IPA E position in the IPA Readings group. The IPA E reading should be approximately 43V.

Select FWD PWR on the DIGIT™ front panel multimeter. Increase the exciter power output until the DIGIT™ multimeter indicates 15 watts.

Advance the IPA POWER control fully clockwise. The IPA FORWARD POWER bar display should read 70 to 100 watts. Notice that the IPA REFLECTED POWER bar display may indicate some value of reflected power depending upon antenna VSWR. This is normal as the Preamp is driving the antenna directly and there are no controls to match the Preamp to this load. The output POWER meter will not indicate upscale in this mode due to the low power level. Continue to operate in this mode as long as necessary.

Note that in this PA BYPASS mode no station power is reconnected to the High Voltage Power Supply. Also none of the contactors in that cabinet are energized at any time. In addition, the filament and PA bias supplies are not energized in the Transmitter cabinet. Only the blower and IPA power supply are active in the PA BYPASS mode.

When it is desired to return to the normal transmitter configuration, first lower the exciter power output for a FWD PWR reading of 10 watts or the value recorded on the factory final test data sheet, whichever is lower. Set the IPA circuit breaker to the OFF position.

Wait three minutes and then depress the FILAMENT OFF pushbutton. After the main blower stops, set the IPA circuit breaker to the ON position.

Disconnect station power to the Transmitter cabinet and to the High Voltage Power Supply cabinet.

WARNING

DISCONNECT AND LOCK OUT STATION PRIMARY POWER TO THE TRANSMITTER CABINET AND TO THE HIGH VOLTAGE POWER SUPPLY CABINET.

Open the Transmitter cabinet rear door.

WARNING

USE THE GROUNDING STICK TO DISSIPATE ALL RESIDUAL POTENTIALS FROM ALL COMPONENTS AND TERMINAL BOARDS BEFORE TOUCHING THEM.

Move the CONTROLLER switch to the MAIN position on the Control Status panel and the PA switch to the OPERATE position.

Replace and/or repair the failed unit(s).

Access the FLEXPatch™ panel through the front access panel. Remove the FLEXPatch™ JUMPER that is connected between 1A3-J1 and 1J19 on the FLEXPatch™ panel. Retain it for future use. Reconnect coaxial cable #233 to 1A3-J1.

Return the FLEXPatch™ jumpers to their normal configuration as shown in Figure 3-7.

Remove the lower access panel on the PA cavity. Remove the emergency PA bypass cable and store it for future use. Reinstall the output inductive loop using the original hardware. Be sure it is in the same orientation as it originally was before it was removed. Firmly tighten all hardware. Replace the PA cavity access panel and tighten the hardware that secures it.

Close the Transmitter cabinet rear door and secure all access panels.

Return the HT 30/35CD Transmitter to normal operation by following the turn on procedure as described beginning in paragraph 3.3.1.

SECTION IV
PRINCIPLES OF OPERATION

4.1. INTRODUCTION

This section of the Technical Manual will present the principles of operation of the HT 30/35CD FM BROADCAST TRANSMITTER. Overall system theory will be presented.

4.2. THEORY OF OPERATION

4.2.1. SYSTEM CONTROL FUNCTIONS

The basic function of any radio transmitter is to produce a modulated radio frequency output when provided with power source and modulating signal inputs. The HT 30/35CD employs a straight-forward rf signal generation and amplification system supported by reliable power control and protective circuit systems.

The rf generating and amplifying sections of the HT 30/35CD are, the DIGIT™ Exciter, a ramp-controlled RF Preamplifier with a 150 Watt capability, an IPA with a 700 Watt capability, and a single tube PA with a 36,750 Watt capability. The PA tube is the only vacuum tube in the RF system.

Among the circuit features which enhance the overall performance of the HT 30/35CD are: a three-phase power line sensor which will not allow the transmitter to operate if the power line is unsuitable for the blower motor; low-voltage control and interlock circuitry operating "above ground" so that open circuits or short circuits to ground in the interlock circuitry will prevent operation rather than permit unsafe operation; a BACKUP Controller which will permit non-automatic operation of the transmitter in the unlikely event of a computer failure; automatic changeover to the BACKUP Controller if needed; an auxiliary power supply for the BACKUP Controller, etc.

The HT 30/35CD includes FLEXPatch™, an easily used method of temporarily bypassing an inoperative Preamplifier or IPA, or both. Use of FLEXPatch™ offers the maximum probability of keeping a signal on-the-air.

In addition, there are numerous protective features inherent in the design of the primary power control circuits, all of which are intended to maximize the reliability and safety of the HT 30/35CD.

4.2.2. POWER CONTROL SEQUENCE - ON

Whether the HT 30/35CD is operated by the MAIN Controller or the BACKUP Controller, the application of primary power to the various parts of the transmitter is much the same.

In the idle condition, with power applied, the MAIN and AUXILIARY Controller power supplies are energized, as are the 24-Volt Cabinet Control transformer and the IPA Current Monitor circuits. Operation of the POWER RAISE and POWER LOWER buttons will cause the Screen Power Supply control motor to move the variable auto-transformer. The control range is from zero to the maximum recommended screen voltage.

A request for FILAMENT ON produces the following events: if the Three-phase Line Monitor is satisfied with the condition of the power delivered to the Main Cabinet, the DIGIT™ Exciter is turned on and the Blower is started; when the Air Switch closes, the Filament solid state relay (SSR) is energized and voltage is applied to the PA Filament; if the Main Cabinet doors are all closed, power is applied to the IPA Power Supply. Finally, if the High Voltage Power Supply cabinet doors and grounding-sticks are all in place and the three phase power is applied to the High Voltage Power Supply, the "Drop Solenoids" operate, removing the short circuits that protect against accidental application of high voltage.

Each step in the above sequence is checked by the computer. If an error occurs, such as Filament voltage too soon (indicating an open filament) or no Filament voltage (indicating a shorted filament or Filament Circuit Breaker open), the sequence is reversed and the transmitter is shut down, with appropriate indicators illuminated on the front panel of the HT 30/35CD.

A request for PLATE ON results in a similar but longer sequence: if Filament voltage is present, the Bias Power Supply is turned on; if Bias voltage develops, the STEP/START contactor in the High Voltage Power Supply is energized and Plate voltage begins to appear; if Plate voltage rises properly, the RUN contactor in the High Voltage Power Supply is energized; the IPA is now unmuted and "ramped up". The computer makes adjustments to the Screen Voltage Power Supply and the IPA RAMP to achieve the desired power level with the best efficiency. In the process, the PA Screen Current, PA Forward Power and PA Reflected Power are checked. If a VSWR problem is encountered (such as may result from antenna icing or a transmission line defect), the VSWR FOLDBACK mode is entered. In this situation, the computer holds the transmitter power below the danger level and constantly monitors the situation. If it improves, the power is raised as much as improved conditions will allow.

During the normal operation of the HT 30/35CD, the Preamplifier, IPA and PA are all monitored for signs of abnormal operation. Should such operation be identified, the computer will take action to correct it. This action may be only the illumination or change in color of a front-panel indicator. Or, it may be the reduction of transmitter output power. If the improper operation is such that more drastic action be taken, the computer will shut down the transmitter. In any case, the display on the front panel will contain indication of the cause of the problem, and the data available to the Digital Multimeter will assist if defining the exact nature of the abnormal operation.

Under normal MAIN Controller operation, One-Button Start is permitted.

Pressing the PLATE ON button will "save" the PLATE ON command, request a FILAMENT ON sequence, wait for the proper filament warm-up time, and then begin the PLATE ON sequence.

4.2.3. POWER CONTROL SEQUENCE - OFF

The PLATE OFF sequence is initiated by pressing the PLATE OFF button and is monitored by the computer. First, the IPA is muted (terminating rf output).

Then the RUN contactor in the High Voltage Power Supply is released. If the Plate Voltage does not drop at a satisfactory rate, the computer again closes the RUN contactor. The assumption is that either the STEP/START or RUN contactor is remaining closed. If the shut down procedure were allowed to continue, the Drop Solenoids would short out the High Voltage Power Supply and if the STEP/START contactor had been the one that was stuck, the Step/Start resistors would be destroyed. Appropriate front-panel warnings assist in diagnosing the problem.

If the high voltage decays properly, the Bias Power Supply is turned off. If the bias voltage decays properly and if then the FILAMENT OFF pushbutton is depressed, then the Filament and IPA Power Supply are turned off, and with loss of filament voltage, the computer starts the “blower run-down” cycle.

After that interval, the blower is turned off and the Drop Solenoids are released.

Under normal MAIN Controller operation, One-Button Stop is permitted.

Pressing the FILAMENT OFF button will “save” the FILAMENT OFF command, request a PLATE OFF sequence, wait for the proper High Voltage shut down, and then begin the FILAMENT OFF sequence.

4.2.4. AUTO POWER CONTROL

When enabled by pressing the AUTO button, Auto Power Control works to maintain the output power of the HT 30/35CD at the level existing when the button was pressed. Auto Power Control overrides any attempt to adjust the output power by use of the POWER RAISE and POWER LOWER buttons. These buttons are allowed to work, but only until the power reaches the limits of the “window” around the desired power.

To change the output power of the transmitter, it is necessary to press the MANUAL button, ending Auto Power Control. The output power level may then be adjusted and AUTO pressed again to restore Auto Power Control at the new power level.

FIGURE 4-1. BLOCK DIAGRAM
2275-005

888-2275-001
4-3/4-4

Figure 4-1. Block Diagram

FIGURE 4-2

SEE SIMPLIFIED WIRING DIAGRAM

POWER DISTRIBUTION AND CONTROL

839 6337 261

IN DRAWING PACKAGE

SECTION V
MAINTENANCE

5.1. INTRODUCTION

This section provides preventive maintenance information and corrective maintenance procedures for the HT 30/35FMFM BROADCAST TRANSMITTER. The information contained in this section is to provide guidance for establishing a comprehensive maintenance program to promote operational readiness and eliminate downtime. Particular emphasis is placed on preventive maintenance and record-keeping functions.

5.2. STATION RECORDS

The importance of keeping station performance records cannot be overemphasized. Separate logbooks should be maintained by operation and maintenance activities. These records can provide data for predicting potential problem areas and analyzing equipment malfunctions.

5.2.1. MAINTENANCE LOGBOOK

The maintenance logbook should contain a complete description of all maintenance activities required to keep the equipment in operational status.

A listing of maintenance information to be recorded and analyzed to provide a data base for a failure reporting system is as follows:

DISCREPANCY

Describe the nature of the malfunction including all observable symptoms and performance characteristics.

CORRECTIVE ACTION

Describe the repair procedure used to correct the malfunction.

DEFECTIVE PART(S)

List all parts and components replaced or repaired and include the following details:

a. TIME IN USE

b. PART NUMBER

c. SCHEMATIC NUMBER

d. ASSEMBLY NUMBER

e. REFERENCE DESIGNATOR

SYSTEM ELAPSED TIME

Total time on equipment

NAME OF REPAIRMAN

Person who actually made the repair

STATION ENGINEER

Indicates Chief Engineer noted and approved the repair of the equipment

5.3. PREVENTIVE MAINTENANCE

Preventive maintenance is a systematic series of operations performed periodically on equipment. Because these procedures cannot be applied indiscriminately, specific instructions are necessary. Preventive maintenance consists of six operations: inspecting, feeling, tightening, cleaning, adjusting, and painting.

a. INSPECT. Inspection is the most important preventive maintenance operation because it determines the necessity for the others. Become thoroughly acquainted with normal operating conditions in order to recognize and identify abnormal conditions readily. Inspect for the following:
   1. Overheating, which is indicated by discoloration, buldging of parts, and peculiar odors.
   2. Oxidation.
   3. Dirt, corrosion, rust, mildew, and fungus growth.

b. FEEL. Use this operation to check parts for overheating, especially rotating parts such as blower motors. By this means, the need for lubrication, the lack of proper ventilation, or the existence of some defect can be detected and corrected before serious trouble occurs. Become familiar with operating temperatures in order to recognize deviations from the normal range.

c. TIGHTEN. Tighten loose screws, bolts, and nuts. Do not tighten indiscriminately as fittings that are tightened beyond the pressure for which they are designed may be damaged or broken.

d. CLEAN. Clean parts only when inspection shows that cleaning is required and only use approved cleaning solvent.

e. ADJUST. Make adjustments only when inspection shows that they are necessary to maintain normal operation.

f. PAINT. Paint surfaces with the original type of paint (using prime coat if necessary) whenever inspection shows rust, or worn or broken paint film.

5.3.1. MAINTENANCE OF COMPONENTS

The following paragraphs provide information necessary for the maintenance of components.

5.3.1.1. *TRANSISTORS*

Preventive maintenance of transistors is accomplished by performing the following steps:

a. Inspect the transistors and surrounding area for dirt as accumulations of dirt or dust could form leakage paths.

b. Use compressed dry air to remove dust from the area.

WARNING

ALWAYS WEAR SAFETY GOGGLES WHEN USING COMPRESSED AIR.

c. Examine all transistors for loose connections or corrosion.

5.3.1.2. *INTEGRATED CIRCUITS*

Preventive maintenance of integrated circuits is accomplished by performing the following steps:

CAUTION

USE CARE TO AVOID THE BUILDUP OF STATIC ELECTRICITY WHEN WORKING AROUND INTEGRATED CIRCUITS.

a. Inspect the integrated circuits and surrounding area for dirt as accumulations of dirt or dust could form leakage paths.

b. Use compressed dry air to remove dust from the area.

WARNING

ALWAYS WEAR SAFETY GOGGLES WHEN USING COMPRESSED AIR.

5.3.1.3. *CAPACITORS*

Preventive maintenance of capacitors is accomplished by performing the following steps:

a. Examine all capacitor terminals for loose connections or corrosion.
b. Ensure that component mountings are tight.
c. Examine the body of each capacitor for swelling, discoloration, or other evidence of breakdown.
d. Use standard practices to repair poor solder connections with a low-wattage soldering iron.
e. Clean cases and bodies of all capacitors.

5.3.1.4. *FIXED RESISTORS*

Preventive maintenance of fixed resistors is accomplished by performing the following steps:

a. When inspecting a chassis, printed-circuit board, or discrete component assembly, examine resistors for dirt or signs of overheating. Discolored, cracked, or chipped components indicate a possible overload.
b. When replacing a resistor, ensure that the replacement value corresponds to the component designated by the schematic diagram and parts list.
c. Clean dirty resistors with a small brush.

5.3.1.5. *VARIABLE RESISTORS*

Preventive maintenance of variable resistors is accomplished by performing the following steps:

a. Inspect the variable resistors and tighten all loose mountings, connections, and control knob setscrews (do not disturb knob alignment).
b. If necessary, clean component with a dry brush or a lint-free cloth.
c. When dirt is difficult to remove, clean component with a lint-free cloth moistened with an approved cleaning solvent.

5.3.1.6. *FUSES*

Preventive maintenance is accomplished by performing the following steps:

WARNING

ALWAYS REMOVE ALL POWER AND USE GROUNDING STICK BEFORE TOUCHING ANY OF THE COMPONENTS IN THE FOLLOWING STEPS.

a. When a fuse blows, determine the cause before installing a replacement.
b. Inspect fuse caps and mounts for charring and corrosion.
c. Examine clips for dirt, improper tension, and loose connections.
d. If necessary, tighten fuse clips and connections to the clips. The tension of the fuse clips may be increased by pressing the clip sides closer together.
e. Clean fuses and clips with a small brush.
f. Remove corrosion with crocus cloth.

5.3.1.7. *SWITCHES*

Preventive maintenance of switches is accomplished by performing the following steps:

a. Inspect switch for defective mechanical action or looseness of mounting and connections.
b. Examine cases for chips or cracks. Do not disassemble switches.
c. Inspect accessible contact switches for dirt, corrosion, or looseness of mountings or connections.
d. Check contacts for pitting, corrosion, or wear.
e. Operate the switches to determine if they move freely and are positive in action. In gang and wafer switches, the movable blade should make good contact with the stationary member.
f. Tighten all loose connections and mountings.

5.3.1.8. *INDICATORS AND INDICATOR SWITCHES*

Preventive maintenance of indicator lamps and indicator switches is accomplished by performing the following steps:

a. Examine indicator sockets for corrosion, loose nuts, and condition of rubber grommets.
b. Remove indicator switch by pulling the plastic cover, indicator assembly, from the case and rotating the assembly 90 degrees.
c. Inspect indicator assemblies for broken or cracked covers, loose envelopes, loose mounting screws, and loose or dirty connections.
d. Tighten loose mounting screws. Solder loose connections. If connections are dirty or corroded, clean with crocus cloth before soldering.
e. Clean indicator covers, bases, and glass bulbs with a dry cloth.
f. Clean corroded socket contacts and connections with crocus cloth. Low operating voltages require clean contact and connections.

5.3.1.9. *PRINTED-CIRCUIT BOARDS*

Preventive maintenance of printed-circuit boards is accomplished by performing the following steps:

a. Inspect the printed-circuit boards for cracks or breaks.
b. Inspect the wiring for open circuits or raised foil.
c. Check components for breakage or discoloration due to overheating.
d. Clean off dust and dirt with a clean, dry lint-free cloth.
e. Use standard practices to repair poor solder connections with a low-wattage soldering iron.

5.3.1.10. *PA TUBE FILAMENT VOLTAGE*

To optimize tube performance and life expeciency, refer to the Eimac bulletin entitled “Extending Transmitter Tube Life” in Vendor Section of this manual before beginning normal operation of the transmitter.

5.4. TRANSMITTER FORWARD AND REFLECTED POWER CALIBRATION

Forward power calibration is done on the Digital Multimeter (Control Status Board 1A6A13) and secondly on the Analog Multimeter (Switch Board 1A7).

The Forward Power analog voltage from the directional coupler first goes through the Control Status Board calibration potentiometer, R101, before going to the Switch Board, R3, and the Analog Power Meter.

Once the Analog meter reads the same as the Digital Meter, the Control Status adjustment is the only one necessary to calibrate the two meter simultaneously.

See the Adjustmens section in the Control Status and Switch Board sections for further calibration details for the Digital and Analog Power Meters.

5.5. IPA FORWARD AND REFLECTED POWER METER CALIBRATION

See the Adjustments section in the Control Status section for further calibration details.

Table 5-1
HT 30/35 FM Fuse Table

REF. SYMBOL	HARRIS P/N	DESCRIPTION	PURPOSE	LOCATION
1F1	398 0141 000	20A 250V	24VAC distribution from 1T6	Main Cabinet floor near 1TB2
1F2, 1F3, 1F4	398 0368 000	2A 600V	AC Phase monitor	Main Cabinet floor near 1TB1
1F5	398 0138 000	10A 250V	Pre-Amp unregulated supply	Main Cabinet sidewall near 1R3
1A10A2F1	398 0138 000	10A 250V	Pre-Amp unregulated supply	Main Cabinet, inside 1A10 Pre-Amp module
1A6A12F1	398 0022 000	5A 250V	24 VAC, screen raise/lower, blower contactor.	Main Cabinet, top of removable 1A6 controller chassis
1A6A12F2	398 0021 000	4A 250 V	24 VAC, IPA power supply contactor	Main Cabinet, top of removable 1A6 controller chassis
1A6A12F3	398 0015 000	0.5A 250V	+12 VDC, Interlocks Exciter AFC Overload	Main Cabinet, top of removable 1A6 controller chassis
1A6A12F4	398 0015 000	0.5A 250V	+12 VDC, Indicator supply	Main Cabinet, top of removable 1A6 controller chassis
1A14F1	398-0478-000	30A 125V	unregulated IPA supply	Main Cabinet, 1A14 IPA module
3F1, 3F2	398 0454 000	5A 250V	240 VAC, 3K3, 3K5, 3K6, 3K7, 3K10, 3T4, 3A1L1, 3A1L2	HVPS Cabinet near 3K3

Operating Log Sheet

Call Letters____________________ Frequency____________________
Transmitter S/N________________ PA tube S/N__________________

Output Power Analog Meters

Plate Voltage________________KV.
Plate Current________________Amps.
Forward Power________________W.

VSWR__________________________
Efficiency (PA Fwd power/PA V * PA I)_____

Control Settings

Output Loading__________________
Plate Tuning____________________

Grid Tuning_____________________
Input Match_____________________

Multimeter Readings:

Basic Readings;

Plate I____________________Amps
Plate E____________________KVDC
Screen I___________________mA
Screen E___________________VDC

Filament___________________VAC
IPA FWD____________________W
IPA REF____________________W

PA Readings;

Plate E____________________KVDC
Plate I____________________Amps
Plate OVR__________________Amps
PA FWD_____________________KW
APC Pwr____________________KW
PA Ref_____________________KW
PA OVR_____________________KW
Screen E___________________VDC

Screen I___________________mA
Screen OVLD________________mA
Grid E_____________________VDC
Grid I_____________________mA
Filament___________________VAC
Inlet I____________________F
Stack______________________F

IPA Readings;

IPA FWD____________________W
IPA Ref____________________W
IPA OVR____________________W

IPA E______________________VDC
IPA I______________________Amps
IPA T______________________F

Preamp Readings;

Pre Amp PWR________________W
Pre Amp E__________________VDC

Pre Amp I__________________Amps
Pre Amp DRV________________W

Control Status;

Phase A____________________VAC
Phase B____________________VAC
Phase C____________________VAC
+5 Supply__________________VDC
+12 Supply_________________VDC

-12 Supply_________________VDC
+10 Ref____________________VDC
-10 Ref____________________VDC
Temp_______________________F

Exciter Multimeter;

Fwd PWR____________________W

Ref PWR____________________W

WARNING: Disconnect primary power prior to servicing.

SECTION VI
SYSTEM TROUBLESHOOTING

6.1. INTRODUCTION

This section of the technical manual will contain troubleshooting aids to facilitate maintenance of the HT 30/35FM FM BROADCAST TRANSMITTER.

6.1.1. SYSTEM TROUBLESHOOTING GUIDE

The HT 30/35FM provides several diagnostic tools which will aid in locating the problem area when operational difficulties are encountered. These tools include the digital multimeter, the overload and interlock status indicators as well as the mimic panel tri-color indicators and the front panel analog meters.

Operational problems generally can be grouped into three types. The first type is the least serious type, usually characterized by a visual indication that some part or subsystem of the transmitter is operating outside of its normal operating range, however not outside of its safe operating limits.

The visual indication might take the form of an abnormally high or low meter reading or an amber indicator on the mimic panel. The transmitter continues to operate. The second type of operational problem usually manifests itself as an overload condition that resulted in a successful transmitter recycle.

The visual indication here would be one or more overload indicators illuminated as well as those event records being displayed under the OVERLOADS section of the digital multimeter. Following the successful recycle, the transmitter continues to operate, however, further recycles may continue to occur infrequently. The third general type of problem is the most serious.

This is where transmitter operation has been automatically terminated for an out of safe operating limits condition. Visual indications here would be one or more overload indicators illuminated, the fault indicator illuminated and one or more mimic panel indicators illuminated red. This would be the typical result of a situation where repeated overloads occurred, which caused the controller to terminal operation. Also falling into this same category are situations where a transmitter turn-on sequence was terminated before it was completed. In this case, an overload may not have occurred, however, an out of limit operating condition was detected by the controller during the turn-on sequence. As a result, one or more indicators on the mimic panel will be illuminated red indicating the subsystem of the transmitter where the out of limits condition was detected.

In the first case, where an out of normal range condition exists, troubleshooting would be centered around the section or subsystem of the transmitter with which the abnormal reading is associated. Careful observation of all metering readings as well as the tracking of the problem over a several day period may reveal the source. It may be outside of the transmitter. This would be the case, for instance, where an amber indication in the IPA SUPPLY block on the mimic panel was observed and careful tracking of the 3 phase line voltages indicated that when the light was amber the line voltage had sagged. Or perhaps the transformer in the supply was not tapped correctly for the line voltage in the use at the station site. If, however, no correlation is found to an outside stimulus, then further investigation would be necessary using the schematics, troubleshooting guide and theory of operation sections relating to the subsystems.

In the case of infrequent overloads that result in a transmitter recycle, careful observation and tracking of these events will aid in determining the problem source. The cause could be either internal or external. The use of the time and date recording feature that is part of the StatusPlus™ multimeter can be very helpful in this situation. If these records indicate the overload repeats periodically or at specific times of the day, an external source may be involved. This might include other power line loads turning on and off, events related to the remote control system or daily variations in ambient conditions in the transmitter building. If no correlation is found to an external event, further tracking might reveal that the overload event does correlate to an internal transmitter condition that is observable on the visual indicators and metering. It might be for instance that normal line voltage variations result in the plate or screen currents exceeding their preset overload limits. It may be in this case that retuning and reloading of the PA Cavity is required to minimize the variations in current that result from the line voltage variations. If it appears that the problem is purely random in nature and does not track with any other observable parameter, then the use of the theory of operation, troubleshooting guide and schematics relating to the problem section would be in order to troubleshoot the transmitter hardware.

In the case of a transmitter shutdown due to repeated overloads, the overload indicator will be the main visual clue to the problem. If for instance, transmitter operation is automatically terminated for repeated PLATE I overloads, the first step in isolating the problem would be to determine if the overload results from a dc voltage breakdown problem or if it is a function of RF drive. If the overload occurs even with drive removed, then the course of action would include a visual and ohmmeter check of all components and conductors related to the high voltage supply. If it were a case where the overload only occurs if drive is applied, then the area of investigation would need to be expanded to include the PA tube, the RF output components and transmission line, the cavity RF tuning and loading hardware, as well as the power supply. Again the individual theory of operation sections, troubleshooting guides and schematics would be used. When the problem occurs during a turn-on sequence, other things need to be considered.

For instance, if a PLATE ON sequence is terminated with a red indicator in the BIAS SUPPLY block, several areas would need to be checked. First, is the bias circuit breaker turned ON? If it is ON, is the BIAS ON LED on the Control Status panel (either MAIN or BACKUP as determined by the control mode) illuminating during the PLATE ON sequence? If it is, then it might be appropriate to observe the BIAS E reading on the multimeter during the ON sequence to see if any bias voltage is present at turn-on. If some voltage is present, it may be that the problem is only that the voltage is insufficient to meet the ON criteria and adjustment of the front panel BIAS control is

WARNING: Disconnect primary power prior to servicing.

necessary. If no voltage is present, then further investigation of the bias supply is the next step.

If, however, the BIAS ON LED does not illuminate, then there could exist a control problem. At any time a control problem is suspected, the first isolation step is to repeat the turn-on sequence under BACKUP control.

If both sequences fail to complete, then the problem is probably not a control problem. REMEMBER, however, in the BACKUP control mode the front panel mimic panel indicators may not give valid indications. Again, once the problem is isolated to an area, the schematic, theory of operation and troubleshooting guides are the tools to use.

The user is encouraged to read and study the section of this Technical Manual that describes the software sequences that are part of the HT 30/35FM controller.

Also, contained in that section is a table that details the criteria used by the controller to illuminate each mimic panel indicator either red, amber or green. A thorough and complete understanding of the software sequences and the LED illumination criteria is essential to the correct interpretation of the information conveyed to the observer by these indicators. Also essential to the most efficient use of time in diagnosing an operational problem is a thorough understanding of the transmitter hardware, i.e., function, location, system interrelatedness, individual characteristics, etc. Without this familiarity, much time could be used to locate and correct a problem.

Table 6-1 is provided as an aid to problem tracing. Many schematic diagrams include typical voltages at key points in the circuitry and may be used as a further aid to problem tracing. When using these as a guide, please be aware of the conditions under which the measurement was made. These conditions are noted on each drawing (when applicable).

Prior to starting a troubleshooting procedure check all switches, power cord connections, connecting cables, and power fuses.

6.2. TECHNICAL ASSISTANCE

HARRIS Technical and Troubleshooting assistance is available from HARRIS Field Service during normal business hours (8:00 AM to 5:00 PM Central Time). Emergency service is available 24 hours a day. Telephone 800-422-2218 to contact the Field Service Department or address correspondence to Field Service Department, HARRIS CORPORATION, Broadcast Products Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a FAX facility (217-222-7041) or a TELEX service (247319).

Table 6-1. Symptom Index

SYMPTOM	PAGE
No RF Output Power	6-3
RF Power Output Low	6-4
No or Low RF Output from IPA Module	6-5
Low or No Regulated Voltage	6-6
or	
Low or No RF Output from Preamp Module	

Figure 6-1. No RF Output Power (2239-040)

Figure 6-2. RF Power Output Low (2239-041)

Figure 6-3. No or Low RF Output from IPA Module
(2275-009)

Figure 6-4. Low or No Regulated Voltage or
Low or No RF Output from Preamp Module
(2275-010)

8.1. INTRODUCTION

This section of the technical manual for HT 30/35FM FM BROADCAST TRANSMITTER contains schematics pertaining to the overall HT 30/35FM.

SECTION VIII
DIAGRAMS

* NOTE: See drawing package supplied under separate cover.

WARNING: Disconnect primary power prior to servicing.

N O T E S

WARNING: Disconnect primary power prior to servicing.

FIGURE 8-3. SCHEMATIC
TEMPERATURE SENSOR
839 6337 291
888-2275-001
8-7/8-8

SECTION A
HIGH VOLTAGE POWER SUPPLY CABINET

A.1. INTRODUCTION

This section of the HT 30/35FM Transmitter manual contains information on the High Voltage Power Supply.

A.2. DESCRIPTION

Refer to Figures A-2 & A-3 (839 6232 013 and 839 6332 247). The HARRIS HT 30/35FM high voltage power supply produces the proper plate and screen voltages for operation of the HT 30/35FM Transmitter over its entire rated RF output range.

The primary of the supply is designed to operate from a 208/240 Vac 50/60 Hz, 3-phase, three-wire source or a 360/415 Vac, 50 Hz, 3-phase, four-wire source.

Positive cabinet air pressure is provided by a flushing fan 3B1. Circuit breaker 3CB2 provides control and overload protection for the fan.

Three access panels and two grounding sticks are provided. All are interlocked to inhibit power supply operation if the panels or ground sticks are not in place. The interlock system is comprised of DPST switches 3S1 through 3S5. One pole of each switch is in a control circuit that provides a +12 Vdc level (H.V. CAB INTERLOCK) to the HT 30/35FM Controller when all interlocks are in their normal (closed) position. The other pole of each switch interlocks a 24 Vac control voltage that is used to energize several of the electromechanical components in the high voltage power supply cabinet.

The automatic shorting switch assembly, 3A1, provides for the immediate discharge of the high voltage (plate) filter capacitor, 3C4. The two automatic shorting solenoids 3A1L1, 3A1L2 are energized during transmitter operation by the interlocked 24 Vac control voltage. The 24 Vac control voltage operates relay 3K10 which switches the primary voltage (230 Vac) to 3T4. Transformer 3T4 steps the voltage down to 115 Vac, which is then applied to the shorting solenoids. If the 24 Vac control voltage is interrupted, 3A1L1 and 3A1L2 will be released. As 3A1L2 has a shorter stroke (drop) solenoid, it will close the connection between 3A1E2 and 3A1E1 quickly. This will place resistor 3R17 across the filter capacitor 3C4, and begin to discharge it. Shortly thereafter, the longer stroke (drop) solenoid 3A1L1 will close the connection between 3A1E1 and 3A1E2. This will place a short across 3C4 and fully discharge it.

Magnetic overload relays 3K1 and 3K2 (and 3K8 in the 360/415 Vac, 50 Hz, 3-phase, four-wire version) provide primary overload protection for the ac power mains to the cabinet. The primary current of phase 1 passes through the coil of 3K1 and the primary current of phase 3 passes through the coil of 3K2. (In the four-wire configuration the current in phase 2 passes through the coil of 3K8.) During normal operation, the contacts of 3K1 and 3K2 are closed and a +12 Vdc level (MAG OVLD) is provided via 3K9 to the Controller to indicate the line currents are below the overload levels determined by 3K1 and 3K2 (as well as 3K8 in the four-wire configuration). If a line current exceeds the overload level in any one of the magnetic overload relays, the relay will actuate, opening its control contacts. This will result in the closure of relay 3K9 and interrupt the +12 Vdc source of MAG OVLD to the Controller. The Controller will then take a pre-determined course of action to terminate and then possibly restore transmitter operation.

Three phase transient protection is provided by three Metal Oxide Varistors (MOV's) located in the power supply cabinet. One is connected from each phase to the power line ground. (3RV003, 3RV004 and 3RV005). Although small in physical size, each one has substantial transient absorption capability.

The primary control circuit of the HT 30/35FM includes contactors 3K3 and 3K4, solid state relays 3K5 and 3K6, relay 3K7, and resistors 3R1, 3R2, and 3R3.

The normal sequence as a result of a PLATE ON command will begin with the Controller output line STEP/START SSR changing from 0 Vdc to +12 Vdc. This level is applied to the control input of 3K6. As a result, the output section of 3K6 will conduct current and apply 24 Vac to the coil of 3K4. The closing of 3K4 will then apply the three phase line voltage (through step-start resistors 3R1, 3R2, and 3R3) to the plate transformer (3T1) as well as single phase line voltage to the screen transformer (3T3) and screen variac (3T2) and the flushing fan (3B1). In addition, the closing of the auxiliary contacts of 3K4 will provide a level change to +12 Vdc on the STEP/START AUX line back to the Controller. As a result, the Controller output line RUN SSR will immediately change from 0 Vdc to +12 Vdc. This voltage is applied to the control input of 3K5. The output section of 3K5 will then conduct current applying 230 Vac to the coil of 3K4, through the contacts of 3K7 (3K7 is already energized as a result of all interlocks being closed and 24 Vac being present). When 3K3 closes, a short is placed across resistors 3R1, 3R2 and 3R3 and full line voltage is applied to all loads. Also when 3K3 closes, its auxiliary contacts will raise the RUN AUX line to +12 Vdc, signaling successful closure of 3K3. The Controller will then return the STEP/START SSR line back to 0 Vdc. This will de-energize 3K6 and 3K4, removing step-start resistors 3R1, 3R2 and 3R3 from the circuit. This is then, the normal steady-state on condition.

Turn-off, normally initiated by a PLATE OFF command, results in the control line RUN SSR returning to 0 Vdc. This will de-energize 3K5 and 3K6, removing line voltage from all loads in the cabinet.

If a cabinet interlock is opened, power supply operation is terminated as a result of interruption of the 24 Vac current to relay 3K7. When 3K7 opens, the 230 Vac line current to the coil of 3K3 is interrupted.

When 3K3 opens, all line voltage is removed from the loads in the power supply cabinet. In addition, the absence of 24 Vac will prevent the energizing of contactor 3K4. At the same time as relay 3K3 opens, drop solenoids 3A1L1 and 3A1L2 will de-energize and discharge the high voltage filter capacitor 3C4.

Opening an interlock switch also returns the H.V. CAB INTERLOCK line to 0 Vdc, thus supplying the open interlock status to the Controller. Normal transmitter operation cannot be reinstated until the interlock is closed.

The high voltage or plate power supply is a full wave rectified three phase supply. Filtering is provided by a single section LC filter. The major components are transformer 3T1, rectifier assemblies 3CR1, 3CR2 and 3CR3, filter reactor 3L1, and filter capacitor 3C4. Arc gap E1 and MOV 3RV7 serve to limit the flyback voltage from 3L1 so as to minimize overvoltage transients that can occur in the Plate circuit due to sudden changes in the Plate current, or as a result of power line transient activity.

A half wave mode switch 3S8 provides a means of quickly switching to half voltage for test purposes.

CAUTION

NOTE THAT WHEN USING THE HALF VOLTAGE POSITION, 3RV7 MUST BE DISCONNECTED, OTHERWISE IT WILL BE DAMAGED.

Resistor 3R5 and capacitor 3C6 provide a transient suppression feature and resistors 3R12 through 3R16 form the bleeder resistance. (See Figure A-1 for simplified power supply diagrams.)

The primary of 3T1 is connected in a DELTA configuration for 208/240 Vac, 3-wire operation and in a WYE for 360/415 Vac 4-wire operation. In the WYE configuration capacitors 3C7, 3C8, and 3C9 are added, one each across the three primary winding of 3T1.

In addition to primary winding taps to allow proper input voltage selection, transformer 3T1 has tapped secondary windings. This allows selection of a plate voltage to match transmitter output power reduction requirements. If permanent operation well below 35 kW is desired, lowering the plate voltage results in lower PA cavity stress levels, retention of the wide RF bandwidth exhibited at 35 kW and maintenance of 80% PA plate efficiency at lower power levels. Table A-1 shows the plate voltage steps available and the corresponding output power level ranges.

The screen supply is also housed in the high voltage power supply cabinet. It is a single phase full wave rectified supply with a two section L-C filter.

Primary taps on the transformer allow operation over the range of 208 to 240 Vac. Also a variable auto transformer connected in the primary circuit allows the output voltage of the supply to vary from very near 0 Vdc to the full output voltage of 1500 Vdc.

The main components of the screen supply are transformer 3T3, rectifiers 3CR4-3CR7, and filter components 3L2, 3L3, 3C2, and 3C3. Resistors 3R19, 3R10, and 3R8 form the bleeder. Resistors 3R6 and 3R7 in parallel form a 12.5 ohm current sample resistance in the negative lead of the supply. This sample voltage is fed back to the Controller for metering. Resistor 3R4 and capacitor 3C1 form a transient suppression network. Motor assembly 3B2 and auto transformer 3T2 provide for a variable line voltage to the input of 3T3.

Limit switches 3S6 and 3S7 inhibit rotation into the mechanical stops of 3T2 and also provide signals (RAISE LIMIT and LOWER LIMIT) to the Controller that the end of range has been reached. The primary circuit to the screen supply is protected by circuit breaker 3CB1.

Table A-1. Plate Transformer Secondary Taps vs Output Power

SECONDARY TAPS	PLATE E	OUTPUT POWER RANGE
A1, B1, C1	12.1 kV	28 - 35 kW
A2, B2, C2	10.6 kV	22 - 27 kW
A3, B3, C3	9.3 kV	16 - 21 kW
A4, B4, C4	8.2 kV	10 - 15 kW

Figure A-1. Simplified HV Power Supply Diagrams

Figure A-2

See Schematic HVPS 208-240VAC 3-Wire

839 6232 013

in Separate Drawing Package

Figure A-3

See Schematic HVPS 380-415VAC 4-Wire (50Hz)

839 6232 018

in Separate Drawing Package

SECTION B
PREAMPLIFIER MODULE ASSEMBLY (1A10)

B.1. REMOVAL AND REPLACEMENT

WARNING

BEFORE BEGINNING ANY WORK IN THE MAIN CABINET, REMOVE ALL POWER FROM THE TRANSMITTER MAIN CABINET AND HIGH VOLTAGE POWER SUPPLY. ALWAYS USE A GROUNDING STICK (INSIDE THE REAR DOOR OF THE MAIN CABINET) TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

Disconnect the RF input cable (#270) from the Preamplifier input connector (1A10A1J1). In the same manner, disconnect the RF output BNC TEE from the Preamplifier RF output connector (1A10A1J2). Next, disconnect the multipin power plug from the power and input connector in the Preamplifier module (1A10A2J1).

Using a phillips screwdriver, remove the four screws and clamps that secure the module in place. (One is located on each of the four corners of the module heatsink.) Remove the module from the air duct.

Replacement is a simple reversal of the removal procedure. Care must be taken, however, to ensure correct mating of the multipin power and control plug to the connector on the module (1A10A2J1).

B.2. PURPOSE

The purpose of the Preamplifier module is to amplify the RF output of the FM Exciter to a level sufficient to drive the 700W IPA module to the required output level. In addition, the RF gain of the Preamplifier is controllable by means of an externally provided DC voltage. This DC voltage controlled input allows the transmitter control system to electrically set the gain of the Preamplifier. This gain control is the means by which the transmitter control system 'ramps-up' the RF output of the Preamplifier and hence the output of the IPA and PA stages.

B.3. PHYSICAL DESCRIPTION

The Preamplifier module consists of two electrical assemblies mounted on a common heatsink. These two assemblies are an RF amplifier assembly and a voltage regulator PC assembly (including separately mounted pass transistors). A common sheet metal cover provides electrical shielding and dust protection for both assemblies.

B.4. CIRCUIT DESCRIPTION

Refer to Figure B-3 for information about the internal wiring of the Preamplifier module. Refer to Figures 8-1 or 8-2 in Section VIII for connection information between the Preamplifier module and other components of the main cabinet.

Figure B-1 is a simplified diagram of the control, power, and metering connections to the Preamplifier module. The IPA RAMP input to the module is provided by either a digital generator (MAIN control mode) or an analog generator (BACK-UP control mode) as selected by 1A6A12K1. With a ramp voltage of 0 Vdc the regulator output will be at or near 0 Vdc and the gain of the RF amplifier will be very low. At full ramp voltage (about 8 Vdc), the output of the regulator will be maximum (as set by 1R20), and the gain of the RF amplifier will be at a value that is a function of the regulator voltage.

Irregardless of the ramp voltage, the output of the regulator may be inhibited by the IPA SHUTDOWN control line. Transistor 1A6A12Q18 is turned on (to ground) to inhibit the regulator and hence the amplifier. If the transistor is turned off, normal Preamplifier module operation is allowed. Scaled voltage sample outputs, (V REG TEST and V UNREG TEST) are provided to the controller for readout through the digital multimeter. The output current sample (PRE-AMP I- and PRE-AMP I+) is a differential voltage sample that is proportional to the regulator output current. This sample is conditioned by the current monitor board (1A4) for readout through the Controller digital multimeter. The IPA POWER adjustment potentiometer (1R20) sets the maximum output voltage of the regulator at full ramp voltage and hence the gain of the RF amplifier. Power to the module is provided by the common IPA power supply.

Refer to Figure B-4 for the schematic of the Preamplifier regulator board, including pass transistors 1A10Q3 and 1A10Q4. The regulator consists of two stages of regulation, a fixed regulator and this is followed by a variable regulator. The input voltage at about 46 to 51 Vdc is applied to the collector of 1A10Q3 through fuse F1. Fuse F1 protects the external wiring from accidental short circuits on the PC cord. Resistors R18 and R22 form a voltage divider that generates the V UNREG TEST voltage sample. The output of Q31 (at its emitter) is set by the zener diode CR1. The voltage at the emitter of 1A10Q3 is about 33 Vdc. This fixed stage provides proper operating voltage for the variable regulator IC U1 and sets the maximum voltage that can be applied to the RF amplifier.

The 34V output of 1A10Q3 is applied to regulator U1 and the collector of the output pass transistor 1A10Q4. The output of regulator U1 is proportional to the voltage at the NI input. This voltage is determined by the IPA RAMP input voltage and the position of the IPA PWR potentiometer 1R20. (J2 is normally connected from 1 to 2.) U2A is a buffer amplifier with unity gain that isolates the ramp generator in the controller from the regulator circuitry.

The output of U1, (Vout) provides the base drive to the output pass transistor 1A10Q4. The output of 1A10Q4 is the voltage that is applied to the output terminal (E7) of the regulator PC assembly, through the current metering resistors R12 and R13. The V REG TEST voltage sample is derived from the voltage divider formed by R12 and R21. This sample is read out through the digital multimeter portion of the controller.

The current sample voltage developed across resistors R12 and R13 is also scaled and applied to the CS and CL inputs of U1. This provides the information necessary to allow the current foldback feature of U1 to function properly. If output current exceeds the normal maximum, then the voltage at Vout of U1 will decrease. This will result in a lower output voltage at the emitter of 1A10Q4 and hence a lower load current. This process will continue until the load current comes back into normal range.

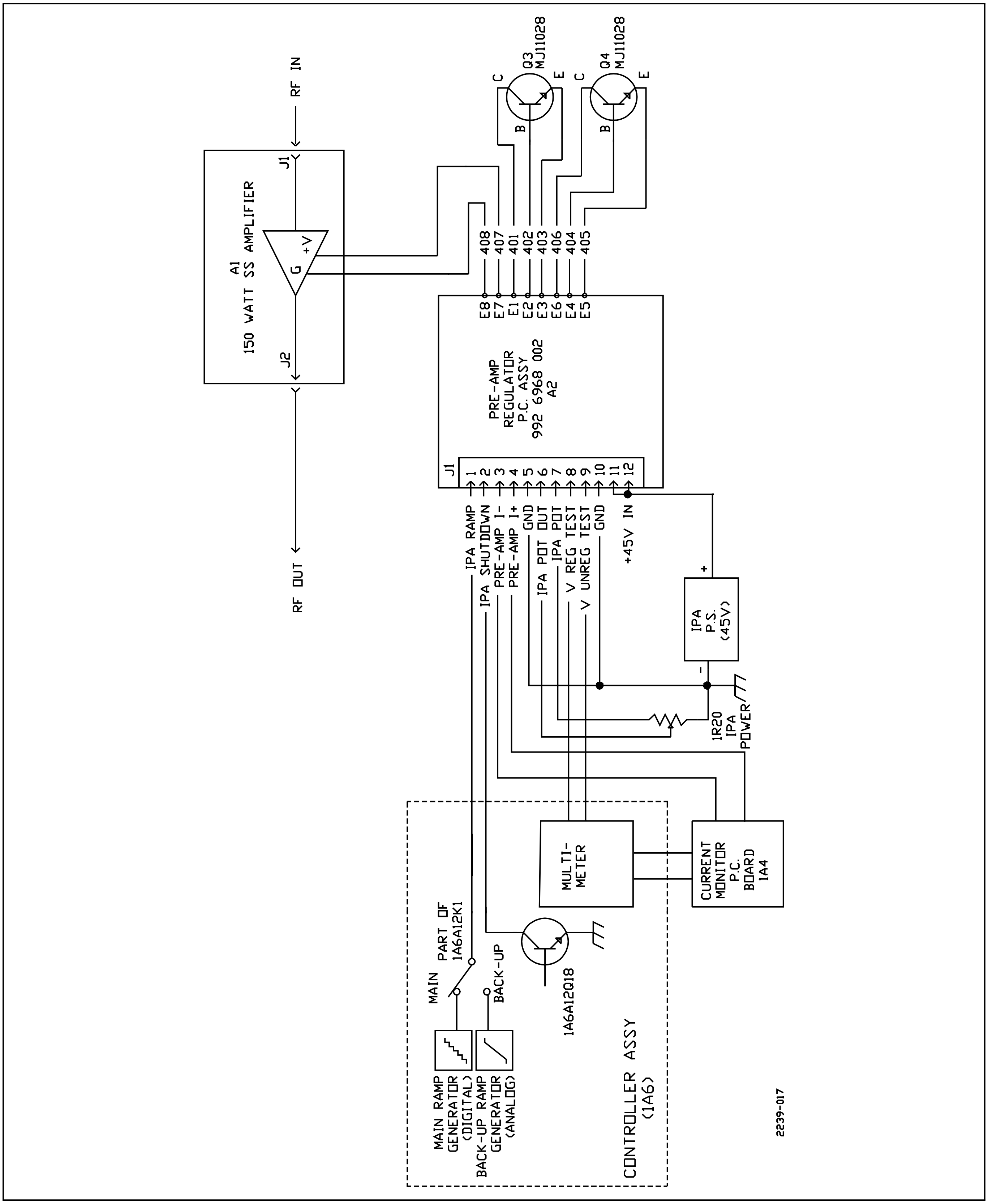


Figure B-1. Simplified Diagram, Preamplifier Module 1A10

Transistors Q1 and Q2 and their associated parts form an interface network between the IPA MUTE (RF DISABLE) control line and the COMP input to U1. Under normal operation the control line IPA MUTE will be high (+12V) and Q2 will be turned off. This will allow normal operation of U1. Under a plate off condition, the controller will ground IPA MUTE. Q1 will be turned ON, grounding the COMP input to U1. This will inhibit the output (Vout) even if full ramp voltage is present at NI.

The RF amplifier assembly is capable of 150 Watts output at a minimum gain of 11 dB when operated from a 50 Vdc supply. In the HT 30/35FM, the maximum required drive is well below 100 watts. Therefore the maximum supply voltage supplied to the RF amplifier is about 30 Vdc. Input and output impedances are 50 ohm.

Jumpers J3-J6 allow the module to be configured specifically for operation in the HT 30/35FM transmitter and should be jumpered as shown in the table on the Regulator schematic 839 7729 002.

The RF transistor devices in the Preamplifier module are field replaceable by a qualified technician with experience in replacement of transmission line type RF transistor devices. These RF devices must mate up correctly to pads on the pc board and be properly soldered and heat sunk to operate properly and to retain the normal life expectancy of the devices. A high level of skill is also required to change this type of device so as to not damage the pc board through overheating or damage due to lifted pads and traces on the board.

Repair or exchange service is also available from HARRIS CORPORATION. Refer to the section on returns and exchanges.

Determining if either of the devices is actually defective may prove to be very difficult. After it is determined which device is defective the units must be replaced as a pair.

PROCEDURE FOR REMOVING AN RF POWER TRANSISTOR (530021) FROM PREAMPLIFIER MODULE

CAUTION

BEFORE THE FOLLOWING PROCEDURE IS INITIATED, THE PREAMP MODULE MUST BE REMOVED FROM THE TRANSMITTER AND PLACED IN A SUITABLE WORKPLACE. NONE OF THE TRANSISTOR REPLACEMENT PROCEDURES SHOULD BE PERFORMED WHILE THE MODULE IS CONNECTED TO THE TRANSMITTER.

NOTE

If a failure has occurred in an Preamp module, the transistors must be replaced as a pair (Q1 and Q2). The RF devices used in this module are sold as Matched Pairs*.*

NOTE

Note the placement of the wide inductors located close to the matched pair of RF transistors. One end of inductors L3 and L4 can be lifted to gain easier access.

a. Before removing transistor, note orientation of leads and body to ensure you can install the new transistor properly.
b. With a modified cutting tool (Harris P/N 929 9326 001) cut the leads of the transistor adjacent to the ceramic cap of the transistor.
c. Remove the screws holding the transistor to the heat sink and remove the transistor.
d. Hold the transistor leads remaining on the pc board with needle nose pliers and remove the leads with a soldering iron.

NOTE

Use a soldering iron of sufficient wattage to remove the leads, but do not overheat *or damage to the pc board will result.*

PROCEDURE TO MOUNT NEW TRANSISTORS TO PREAMP MODULE

a. Clean and inspect transistor position on the heat sink to ensure heat sink area where transistor mounts is flat and even.
b. Brush on a thin, even film of heat sink compound (Harris P/N 555 0100 005) where the transistor is to be placed on the heat sink. Do not put compound on the screw holes in heat sink.
c. Wipe on a thin, even layer of heat sink compound on the bottom of the transistor flange that mounts to the heat sink.
d. Place the transistor on the heat sink. Ensure that body and leads are orientated properly as noted previously in transistor removal procedure.
e. Insert two screws into transistor mounting holes and into heat sink. Alternately turn the two screws in the transistor flange clockwise; using only minimal pressure until both screws are snug. Final torque for the two screws should be 6-inch-lbs. Use a torque screwdriver for this operation to ensure proper transistor to heat sink heat transfer.
f. Using a constant temperature 65-watt soldering iron, solder the tabs of the transistor to the proper positions on the pc board. Use only enough heat to flow the solder over the transistor leads.
g. Resolder the ends of the inductors that were removed.
h. Remove excess solder flux from the transistors and resistors by brushing with a suitable flux remover available in electronic supply houses.
i. Reinstall module in transmitter. Bring up drive level slowly and check for proper operation of the Preamp.

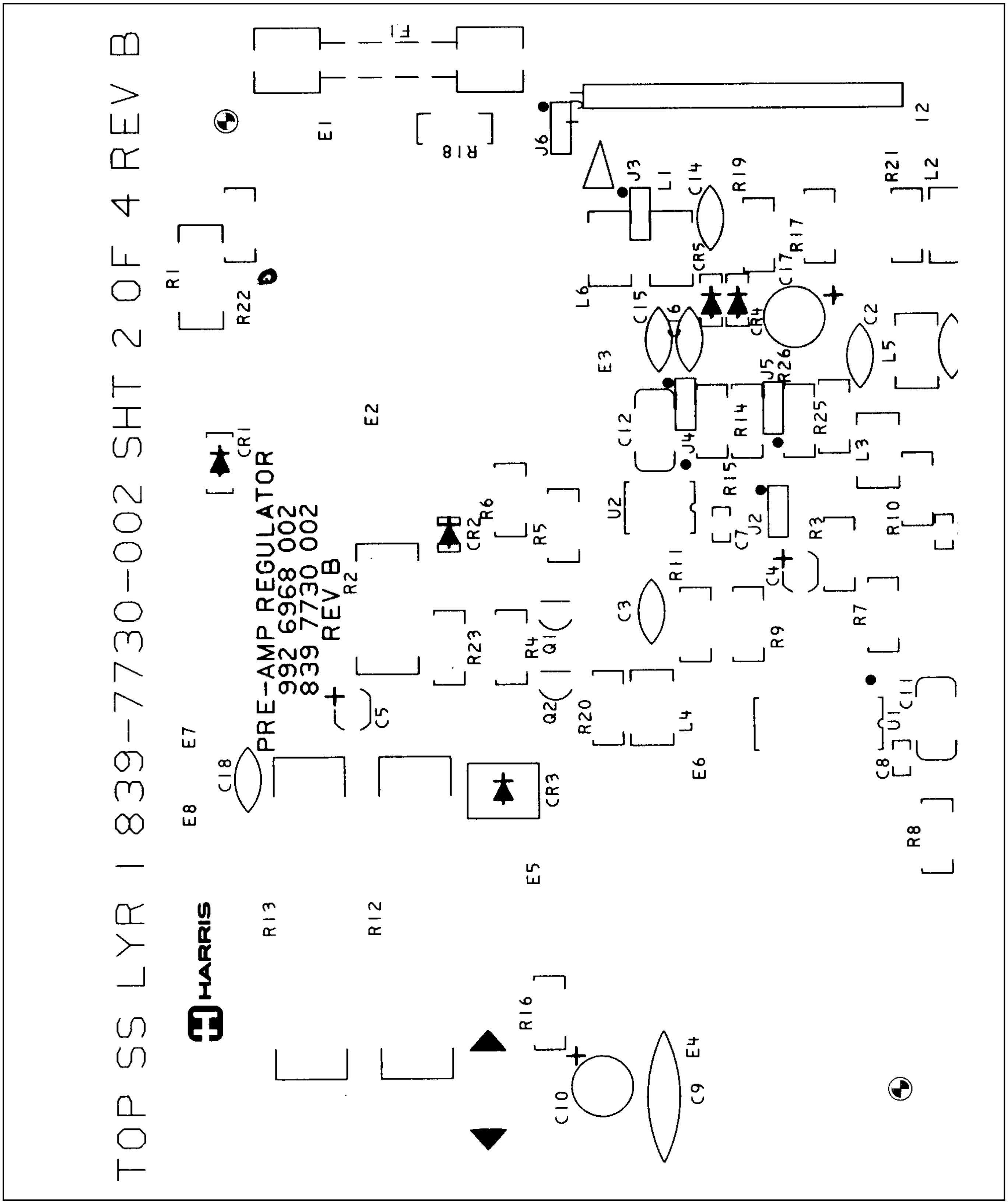


Figure B-2. Preamplifier Regulator Board

FIGURE B-3

SEE SCHEMATIC PREAMP MODULE 1A10

839 7765 001

IN DRAWING PACKAGE

FIGURE B-4

SEE PREAMP REGULATOR BOARD

839 7729 002

IN DRAWING PACKAGE

FIGURE B-5

SEE SCHEMATIC PREAMP POWER MONITOR

839 6337 217

IN DRAWING PACKAGE

FIGURE B-6

SEE SCHEMATIC 150W MODULE

822 0960 001

IN DRAWING PACKAGE

END OF SECTION B

SECTION C
RF INTERMEDIATE POWER AMPLIFIER DRIVER MODULE ASSEMBLY

C.1. PURPOSE

The purpose of the IPA module is to amplify the output of the Preamplifier module to the level required to drive the PA amplifier stage to the desired level. A temperature sensor (1TC3) provides a means by which the temperature of the heatsink may be read out through the digital multimeter.

C.2. CIRCUIT DESCRIPTION

The 700 watt output IPA unit consists of two 350 watt assemblies. An input power splitter provides equal drive levels to each amplifier section from the common input. An output power combiner sums the outputs of the two sections to the common output.

SECTION D
POWER AMPLIFIER CAVITY ASSEMBLY (1A2)

D.1. REMOVAL AND REPLACEMENT

The PA Cavity assembly is an integral part of the main cabinet structure. For this reason it is impractical to remove the complete cavity unit. Adequate access has been provided to ensure all components within the PA Cavity may be reached for inspection and servicing.

The tube socket deck (at the top of the center column) is the only part of the cavity that is removed as a subassembly. It may then be serviced and/or repaired and then re-installed. Instructions for removal and reinstallation are found in the last paragraph under D.3.

D.2. PURPOSE

The purpose of the PA Cavity is to amplify the RF output of the IPA module to the required level for delivery to the RF load. In addition, the PA cavity must provide output tuning capability to match the 50 ohm output of the transmitter into loads exhibiting a VSWR of up to 1.7:1.

D.3. CIRCUIT DESCRIPTION

Refer to Figure D-5. The Power Amplifier Cavity assembly employs a single high gain, high efficiency tetrode, the 9015/4CX20,000D. The stage is operated Class C in a quarter wave cavity configuration. The combination of the high efficiency tetrode and the quarter wave design ensure optimum efficiency in converting DC anode input power into RF output power. In addition, the quarter wave design ensures a wide bandwidth is maintained from the exciter VCO output right through to the transmitter output. Figure D-1 indicates the typical overall RF bandwidth of the HT 30/35FM. Figure D-2 illustrates the typical PA cavity anode efficiency.

The RF input from the IPA module is connected to J1. The RF energy passes through strip line filter A2 and is applied to the PA input circuit (C9, L4, L5, and L8) which is tuned for optimum input match.

The control grid bias (negative) is applied to E12 through a hum null circuit. The resulting DC bias with an AC component is applied to the grid collet of the PA tube socket through RF filter components L2, C2, C4, C8, C17, R2, R3 and R6. The ac component of the grid bias voltage helps to cancel the amplitude modulating effects of AC filament voltage. C12, C22 and C24 are grid bias blocking capacitors and employ a thin sheet of copper plated Kapton film as a dielectric.

Screen voltage from the High Voltage power supply cabinet is connected to E11. The screen voltage is then routed to the screen contact ring through the RF filter network formed by C1, C3, C7, C16, L1 and R1. C11 is the screen blocking capacitor. It is a mechanical assembly and uses a sheet of film mylar as a dielectric. Arc gap E2 protects the dielectric material from damage due to excessive voltage. The recommended gap setting for E2 is .022 inches. See Figure D-3 for location of E2.

The AC filament voltage is connected to the cavity assembly at E10 and GS10 and then from there to the tube socket by way of wires 708 and 709. Filament metering components R7 and C19 provide a current limited sample of the AC filament voltage at TB1-1 and TB1-2 for metering and display by the transmitter controller.

Inductor L6 is a mechanical part formed by the several spacers that are installed between the screen blocker plate and the screen contact ring. L6 is factory adjusted for optimum neutralization and should not require adjustment in the field. C26 is the variable neutralization capacitor.

Coarse tuning plate L7 and coarse tuning capacitor C25 set the cavity to the approximate operating frequency. Air variable capacitor C10 allows for fine tuning from the front panel control. Variable output loading is provided by vacuum variable capacitor C13 operating in conjunction with inductive loop L10.

The network formed by capacitors C14 and C15, along with inductor L3 prevent RF energy from leaving the cavity by way of the high voltage cable. R5 and C20 provide transient protection for the DC plate supply line.

Plate blocking (bypass) capacitor C23 is formed by placing a dielectric sheet (kapton) between the anode plate and the top of the RF cavity. This structure is located in the air chamber above the RF cavity. This capacitor allows the anode of the PA tube to be bypassed to ground for RF currents while being operated at a high positive DC potential. This is a requirement as a result of operating the cavity and PA tube in a “grounded anode” configuration. This allows for a simpler, more reliable anode blocking capacitor structure than if operation were in the more traditional “grounded cathode” configuration. Arc gap E1 protects this capacitor for transient overvoltage conditions. The recommended gap setting is .313 inches. See Figure D-4 for location of E1.

D.4. TUBE SOCKET REMOVAL (FILAMENT AND CATHODE ASSEMBLY)

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

To remove the tube socket, use the following procedures:

a. Remove power from the Main Cabinet and High Voltage Power Supply by setting the power distribution breaker to off. Open the transmitter cabinet rear door. Locate standoff insulators 1E1 and 1E7, and short these terminals with the ground hook mounted on the rear door.
b. Remove the access covers (two outside, one inside) from the PA cavity.
c. Short tube anode/bypass plate and screen bypass plate with ground hook.
d. Remove tube and place in shipping carton.
e. Remove screen bypass plate and arc gap held in place by four nonmetallic spacers via 1 nut and 3 screws.
f. Remove screen blocker material from top of tube socket support plate.

g. Through inner access area, locate and remove filament and cathode leads from tube socket lugs.

h. Remove filament metering board from tube socket lugs.

i. Unscrew hose clamp on filament air tube elbow and remove elbow from the vertical copper tube.

j. Locate the four flat head screws on top of the tube socket support plate that secure the four pillars to the plate.

k. After the screws are removed, the socket (with pillars attached) can be lowered, rotated counterclockwise, and pulled out through the access opening. Note that the grid contact ring will remain attached to the bottom of the socket support plate.

Replacement is the reversal of the removal procedure.

The screen ring and blocker assembly screws are left loose on assembly, allowing it to self center when the tube is inserted into the socket at which time the holddown screws can be secured.

Adjust spark gap to recommended setting using feeler gauge. The recommended gap setting for E2 is .022 inches.

D.5. TUBE REPLACEMENT AND C10 TUNING RANGE

The front panel tuning control (C10) has been designed to have sufficient range for the tuning the cavity to resonance under a wide set of conditions.

This includes the normal variance encountered in the value of the output capacitance of replacement tubes (V1). If however a circumstance occurs that results in the plate tuning control falling against a travel limit, the coarse tuning plate C25 may be adjusted to set the normal tuning point back to the center of the range of C10. This may be done by observing where C10 tunes.

If C10 is against the stop where the plate is closest to the center column, move C25 closer to the center column. If C10 tunes to the other limit (furthest from the center column), move C25 away from the center column. When a final position of C25 is found, tighten all hardware securely.

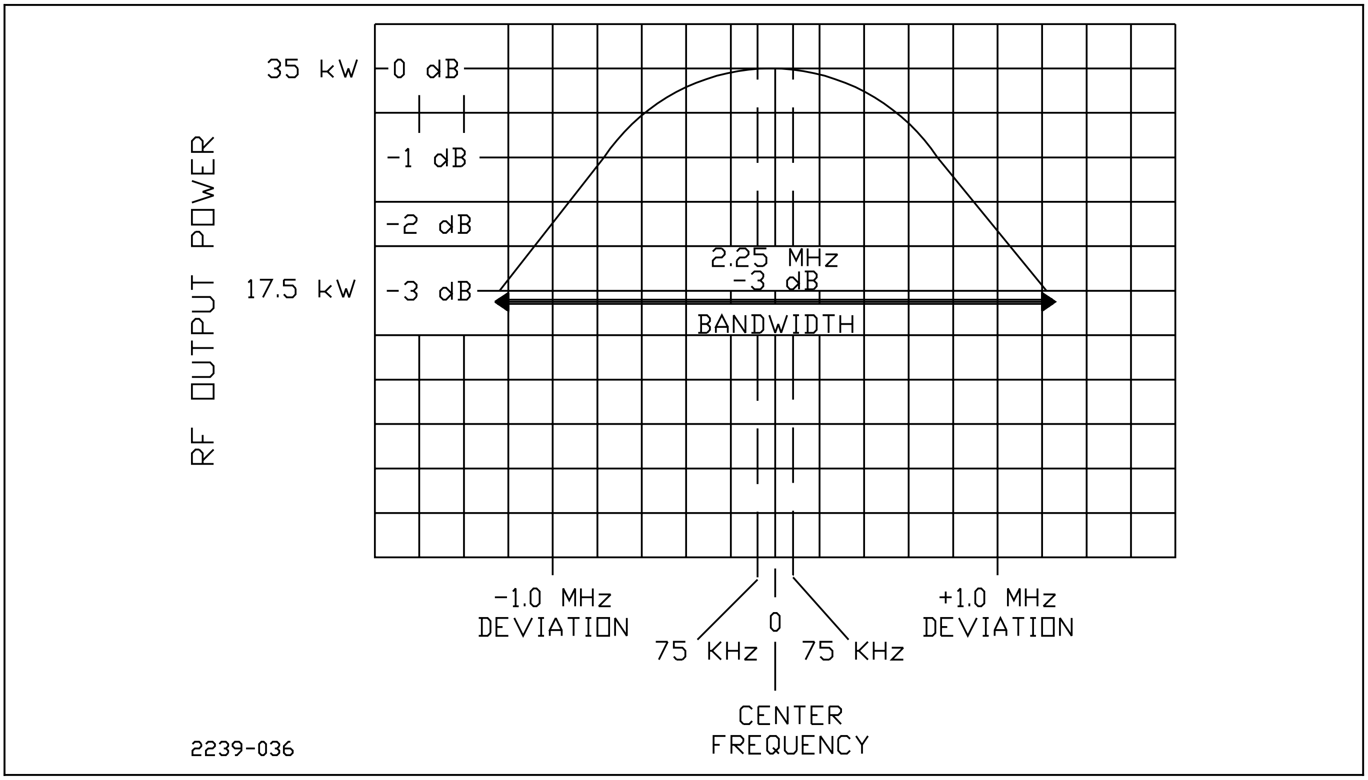


Figure D-1. RF Bandwidth of HT 35FM

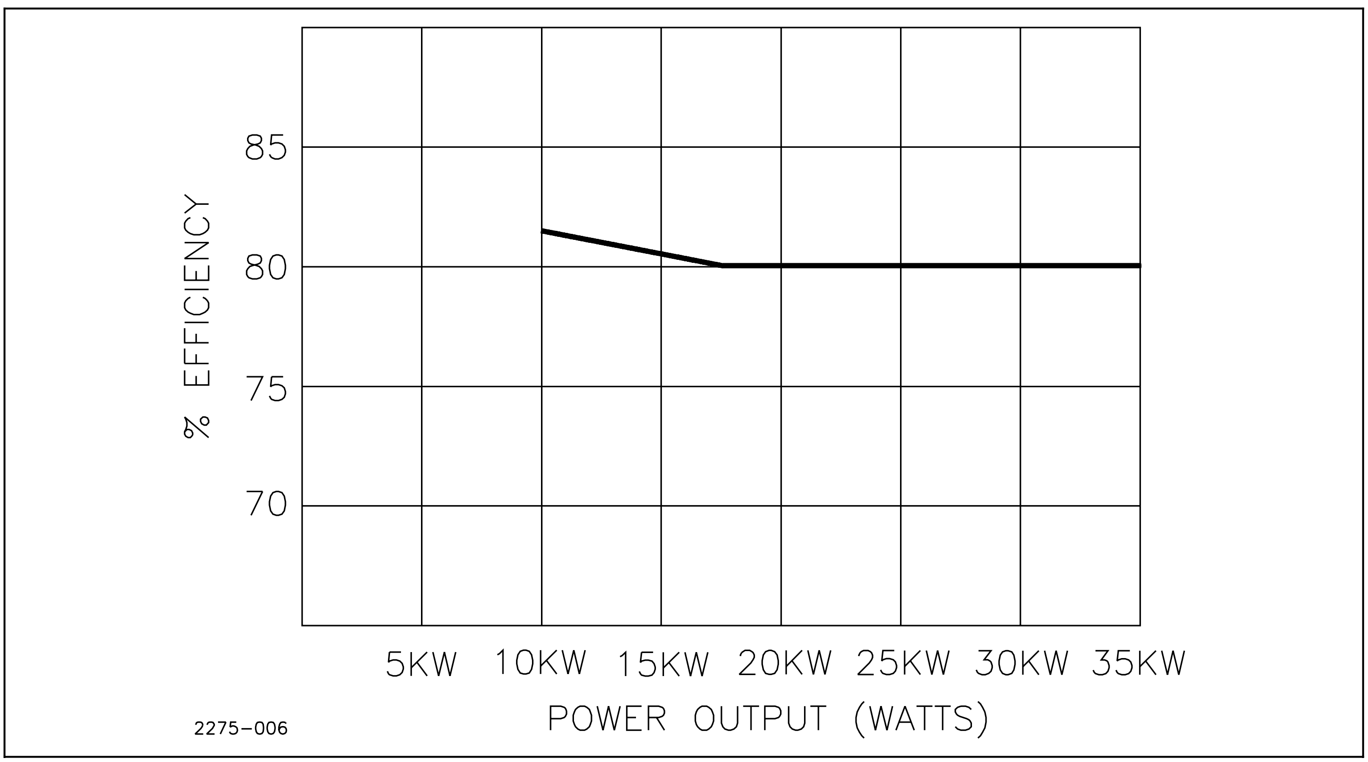


Figure D-2. Typical PA Anode Efficiency

WARNING: Disconnect primary power prior to servicing.

Figure D-3. Location of Screen Arc Gap E2

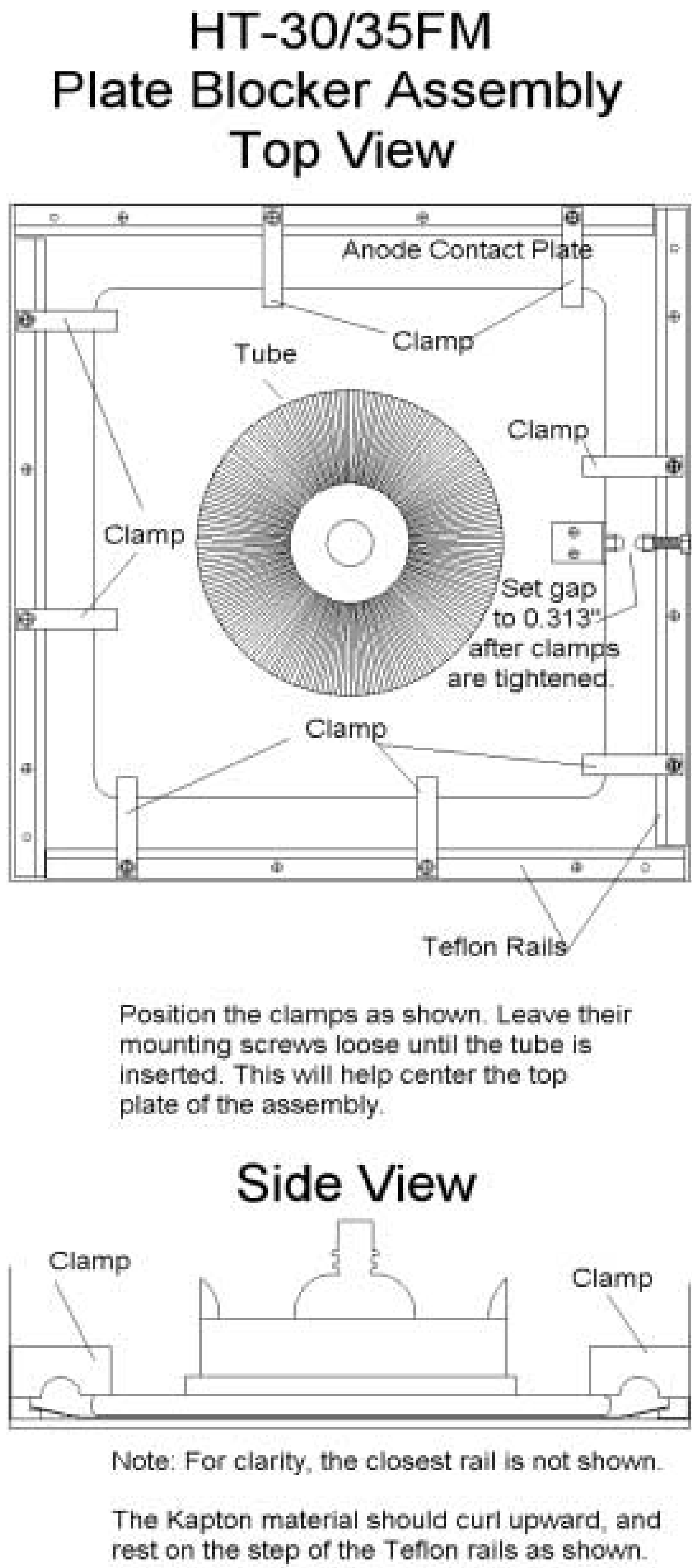


Figure D-4. Location of Plate Arc Gap E1

FIGURE D-5

SEE SCHEMATIC HT 30/35FM CAVITY

839 6337 259

IN DRAWING PACKAGE

WARNING: Disconnect primary power prior to servicing.

SECTION E
CURRENT MONITOR BOARD

E.1. PURPOSE

The purpose of the Current Monitor Board is to generate two current sink pulse train outputs at frequencies proportional to Preamplifier and IPA currents. The current samples are supplied as voltages developed across current sampling resistors located in the respective power supply or regulator.

E.2. OVERALL DESCRIPTION

The Current Monitor Board employs two precision voltage-to-frequency converters to transform the current sample inputs to fixed amplitude variable frequency outputs. The current sample inputs are voltages developed across small sampling resistors located in the high side of the Preamplifier regulator output and the IPA power supply. The voltage-to-frequency converters have to operate with an input having a common mode offset up to approximately 45 Vdc. Therefore the power supplies on the monitor board are not referenced to ground.

The outputs are in the form of a current sink at a frequency in the range of 0 to 10 kHz, and proportional to the actual current. These outputs are sent to the LED portion of two opto-isolators. The transistor output sections operate as switches and supply two fixed amplitude (4.7V across a zener diode) variable frequency pulse trains.

E.3. DETAILED CIRCUIT DESCRIPTION

The Current Monitor Schematic is Figure E-2. It will be helpful to refer also to the overall schematic, Figure 8-1 or 8-2 and Transmitter Interface/Backup Controller schematic, Figure P-10. Since the current monitor circuits for both the Preamplifier and IPA are identical, the section used for Preamplifier current monitoring will be described more fully.

Transformer T1 on the monitor board receives 230 Vac from switch 1S8 and circuit breaker 1CB8 via 1TB4. Two bridge rectifiers receive AC voltage from separate T1 secondary windings. Three terminal 12V regulators, U1 and U2, provide operating voltage to the voltage-to-frequency converters U3 and U4.

Capacitors C1 and C2 filter the regulator input voltages. Diodes CR3 and CR4 protect the regulators against an input short to the regulator. It is important to note that since the current samples are developed in the high side of the respective power supplies, the current monitor board is not referenced to ground, other than filtering provided by C5 and C6.

The Preamplifier current sample of approximately 1 Vdc, is developed across R12 and R13 located in the Preamplifier Regulator board (see Figure B-4) and is brought into the current monitor board on J1-7 and J1-8. Calibration is accomplished by R1 using an external ammeter. Diode CR7 provides protection against excessive input voltage. Resistors R19 and R20 on the Preamplifier Regulator board protect against a short in the voltage-to-frequency converter U3.

The IPA current sample of approximately 1 Vdc, is developed across 1R4 shown on the overall schematic. The 3.9K resistors 1R9 and 1R10 protect against a short in the voltage-to-frequency converter U4 on the current monitor board.

The output of the voltage-to-frequency converter U3 is provided as a current sink at pin 9. An unregulated voltage of approximately 15 volts is available through R7 at J1-4, thence via ribbon cable to J4-41 on the Transmitter Interface/Backup Controller board. (See Sheet 3 of Figure P-10, 6-D). From J4-41, the input goes to LED section of opto-isolator U17 and returns to J4-15, back to Current Monitor J1-6 to U3-9.

Voltage-to-frequency converter U3 provides continuity to the -VS input, pin 5, in the frequency range 0 to 10 kHz, depending upon the input voltage which is the current sample. Because the input to opto-isolator U17 is in the form of a current pulse train, U17 in the Transmitter Interface/ Backup Controller board provides a voltage pulse train to the CPU at a frequency proportional to Preamplifier current. The pulse train amplitude is 4.7V as determined by CR75.

E.4. MAINTENANCE PROCEDURES

If the current monitor fails to operate normally as indicated by no readings or incorrect reading of Preamplifier and/or IPA currents, and with normal IPA output power, proceed as follows.

E.4.1. VISUAL INSPECTION

Visually check to make sure that connectors J1 on the module and J4 on the Transmitter Interface/Backup Controller board are properly installed. If connectors J1 and J4 are properly installed, proceed to next paragraph.

E.4.2. MEASUREMENT OF POWER SUPPLY VOLTAGES

Using a suitable voltmeter (isolated from ground) measure the regulator output at U1-2 if there is no Preamplifier current reading, or U2-2 if there is no IPA current reading. If the regulator output is normal, measure the current sample input to the V to F converter U3 or U4. If there is a DC input, then U3 or U4 is probably defective and should be replaced.

If either regulator has no output, check the unregulated input at U1-1 and/or U2-1. If the input voltage(s) is/are normal, the regulator(s) is/are probably defective and should be replaced.

If the unregulated inputs are low or absent, measure the secondary voltage supplied to the bridge rectifier. If the secondary voltage is normal (10-12 VRMS) then the bridge rectifier is defective and needs to be replaced. Before replacing it, check C1 and/or C2 for a short. If defective, replace it.

E.4.3. OPTO-ISOLATORS

The opto-isolators may be checked by substitution of a known good unit. If a good unit is not available, and one current reading is normal, the two opto-isolators (U3 and U4) could be switched. If both opto-isolators are suspected of being defective, an ohmmeter could be used to check the LED section, as well as a collector-emitter short in the transistor section.

E.5. CALIBRATION

There are two calibration adjustments on the Current Monitor board. These are the Preamplifier and the IPA current adjustments. Both calibration adjustments were done at the factory and normally do not have to be recalibrated unless repairs have been made on the Monitor board. If recalibration is necessary, proceed as follows.

E.5.1. PREAMPLIFIER CURRENT CALIBRATION

Connect an accurate clamp-on ammeter capable of handling up to 10 Adc onto wires 99 and 299, accessible behind the access door in front of the Preamplifier module. If the ammeter appears to be sensitive to RF pickup, go to the fuse input end of these two wires.

Adjust the IPA for 400W to 500W output (or normal power output) and adjust 1A4R1 until the transmitter multimeter, set to PREAMP I position, reads the same as the clamp-on ammeter.

E.5.2. IPA CURRENT CALIBRATION

Connect an accurate clamp-on ammeter capable of reading up to 30 Adc to wires 701 and 702 which are accessible behind the access door in front of the IPA module.

Adjust the IPA for 400W to 500W output (or normal power output) and adjust 1A4R2 until the Transmitter multimeter set to IPA I reads the same as the clamp-on ammeter.

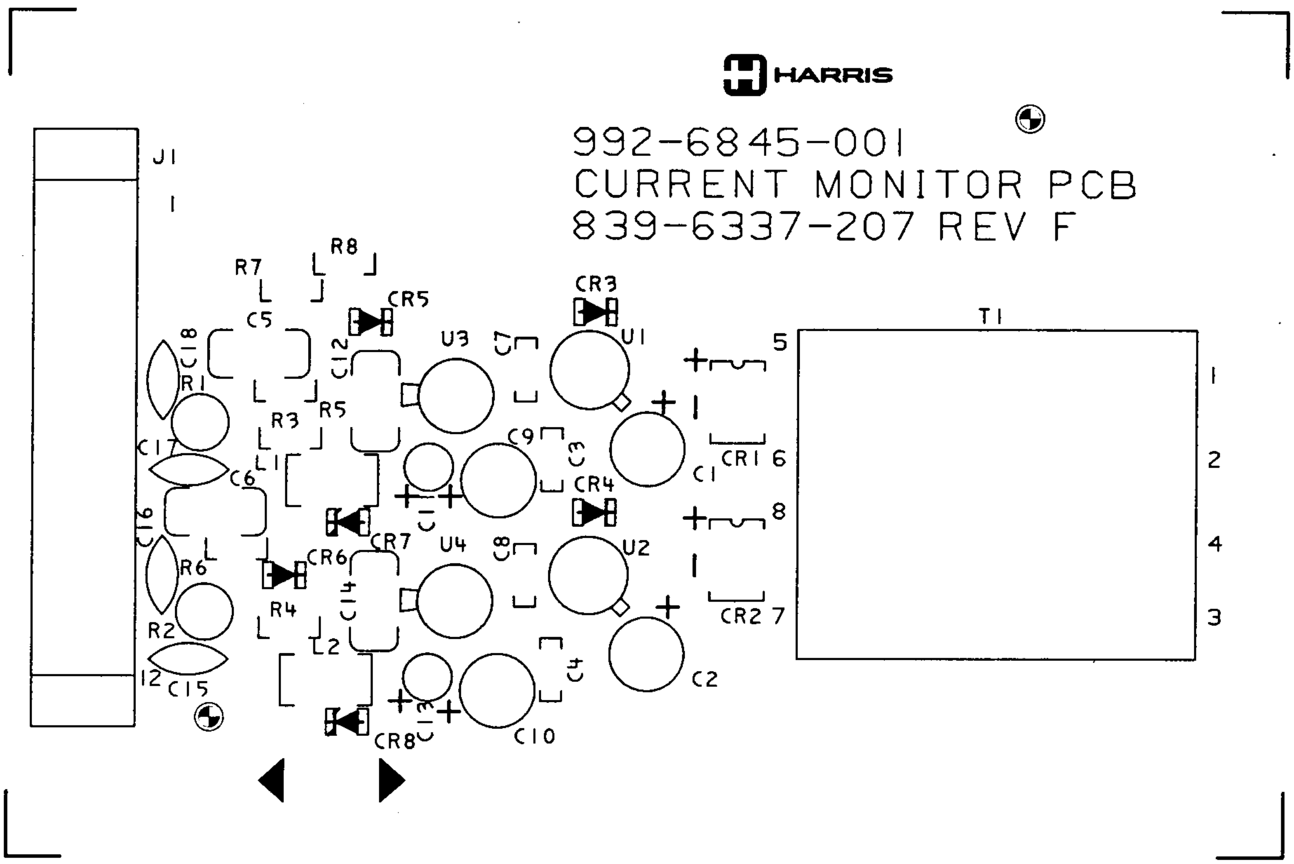


Figure E-1. Current Monitor Board
(839 6337 207)

WARNING: Disconnect primary power prior to servicing.

FIGURE E-2

SEE SCHEMATIC CURRENT MONITOR BOARD

839 6337 208

IN DRAWING PACKAGE

WARNING: Disconnect primary power prior to servicing.

SECTION F
LOW PASS FILTER/DIRECTIONAL COUPLER

F.1. PURPOSE

The purpose of the Low Pass Filter and Directional Coupler is to provide tuning, low pass filtering, and loading for the IPA Amplifier. A second harmonic notch is incorporated in the low pass filter. The directional coupler provides DC outputs proportional to forward and reflected power which are used for metering. This permits optimal matching between the IPA output and the PA input. The reflected power output also permits VSWR protection.

F.2. DETAILED CIRCUIT DESCRIPTION

The low pass filter may be viewed as a PI LC filter followed by a T LC filter. Refer to Figure F-1. The second harmonic trap is composed of L3, CB, and C2. This network is series tuned for resonance at the transmitter second harmonic. At the transmitter carrier frequency the network appears capacitive. Therefore, when combined with L4, C3, and C4, it forms the PI LC filter section. The T filter is composed of L1, L2, C1, and C11.

In addition to low pass filtering, the multiple filter sections permit optimal tuning and loading of the IPA and impedance matching between the IPA and the PA. Capacitor C3 serves as a tuning adjustment, and C1 is the IPA loading adjustment. Capacitor CB is formed on the printed circuit board.

The directional coupler uses microstrip techniques to form the sensing lines. The principle of operation is that the two outside line sections are coupled to the center conductor, both inductively and capacitively. Thus RF voltages generated on the outside lines are proportional to both voltage and current, permitting power monitoring. Coupling to opposite ends of the sense lines provides directivity.

Diode CR2 rectifies the forward power sample. Filtering is provided by C6, L6, and C7. Capacitors C5 and C6 form a capacitive voltage divider which tends to broaden out the frequency response across the entire FM band. Resistor R3 provides proper termination of the sense line.

The Reflected Port of the Directional Coupler is terminated by the resistance of R1 and R2 and nulled by the combination of capacitor C12, inductor L7, and variable resistor R2. The rf sample developed by the Reflected Coupler is then filtered to remove harmonic components. The single section pi filter consists of capacitors C8, C9, and inductor L5. The filtered rf sample then appears across resistor R4. The filtered sample is then rectified by diode CR1, developing a negative voltage across a resistive voltage divider formed by R5 and R6. Capacitor C10 removes any remaining rf energy from the sample voltage. Reflected power indication is also sent to the VSWR protection circuitry in the Transmitter Interface/Backup Controller board.

F.3. ADJUSTMENTS

Tuning adjustments are done at the factory and do not require further adjustment unless repair is made on the filter section. If repair is required or misadjustment is suspected, proceed as follows:

a. Connect a Bird 43 (or equivalent) wattmeter directly to the directional coupler output.
b. Connect an FM band directional coupler to the Bird Wattmeter.
c. Connect the output of the directional coupler to the PA input.
d. Connect a spectrum analyzer to the forward port of the directional coupler.

NOTE

Protect the spectrum analyzer input with suitable attenuators.

e. Connect a Simpson 260 to monitor voltage at C13.
f. Bring the transmitter to Plate ON status and 100W forward IPA power on the Bird wattmeter by adjusting IPA Power Control, 1R20.
g. Carefully adjust C1 and C3 for maximum power on the Bird.
h. Adjust C12 and R2 for minimum reading on the Simpson (reflected power).
i. Adjust C2 for minimum 2nd harmonic on the spectrum analyzer.

NOTE

Fine tune C1 and C3 to one side of IPA forward power peak which minimizes IPA amplifier current and maximizes IPA forward power.

F.4. CALIBRATION PROCEDURES

Module repair may be indicated if there is malfunction in the basic functions, unexplained change in IPA forward or reflected power readings from normal, or change in IPA current. Visual inspection of circuit board may reveal area of component or circuit board failure.

If visual examination fails to show circuit failure, use an ohmmeter to provide more in-depth investigation. If this fails, proceed as follows:

a. Repeat the basic touch-up tuning procedure given in paragraph entitled ADJUSTMENTS. It may be necessary to compress or expand the coils on the board. If the circuit board has been functioning properly, it should not be necessary to readjust the coils. Some other component failure may be masking the true problem.
b. If readjustment effort fails, it will be necessary to remove the module from the transmitter. Place the module on a bench, and remove the cover to expose the board. Connect a directional coupler between the input (J2) and an RF signal generator. Connect the module output (J1) to a 50 ohm load. Connect a Simpson 260 meter to E1 (reflected power meter output).
c. Use the signal generator, oscilloscope, and ohmmeter to locate and replace the defective component or components. After repair, readjust per paragraph entitled ADJUSTMENTS.

FIGURE F-1

SEE LOW PASS FILTER & DIRECTIONAL COUPLER

839 5303 001

IN DRAWING PACKAGE

SECTION G
CONTROLLER ASSEMBLY 1A6

G.1. INSTALLATION

The Controller Assembly is a component of the Main Cabinet and requires no separate installation procedure.

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

G.2. REMOVAL AND REPLACEMENT

The Controller Assembly is located behind the Mimic Panel display panel (which includes the Digital Multimeter). To access the Controller, open the Mimic Panel (by releasing the two captive thumbscrews). To remove the Controller, remove the four screws from the edges of the Controller front panel.

The Controller is mounted on a slide-out assembly. As soon as the four screws are removed from the edges of the panel and the ribbon cable is disconnected from the front of the CPU module (at location A10), the Controller may be withdrawn from the transmitter several inches. There is a cable assembly alongside the Controller on the left side and it may tend to catch behind the main panel. If this happens, simply reach through the opening with one finger and press the cable toward the Controller side panel. The Controller may now be withdrawn to the limit of the slides (about 10"). In this position, access is permitted to most of the Transmitter Interface/Backup Controller board (which is mounted flat on top of the Controller Assembly).

If complete removal is required, disconnect the ribbon cables from the connectors along the rear of the Transmitter Interface/Backup Controller board and the Temperature sensor cable from the right front area of the board.

Check each one to be sure that it is marked with the number of the connector (to facilitate replacement). Next, remove the cable clamp screw from the left side panel of the Controller Assembly. Carefully unplug this cable from the front bottom-mounted connector (J4) on the Transmitter Interface/Backup Controller board.

At this point, the remaining connections to the Controller are the two cables at the rear of the Controller Assembly (J1, J2), the cable to the rear bottom-mounted connector (J3) on the Transmitter Interface/Backup Controller board and the ground strap mounted with a push-on connector at the bottom left rear of the Controller Assembly. It may be easier to remove these connections from the rear (through the rear door) by pushing the Controller Assembly part way into the cabinet. The two connectors on the rear panel (J1 and J2) have retaining latches which may be released by squeezing on the latch ribs close to the rear panel and pulling the connector away from the panel.

After all of the wiring to the Assembly has been disconnected, slide the Assembly to the front. Lift the Assembly and push it to the rear about an inch, “feeling” for the release openings in the slide assembly. When found, the Controller Assembly will move up about 1/4th inch and may now be removed from the cabinet by pulling forward.

The rear panel may be opened to gain access to the interior of the Controller Assembly, including the Main and Auxiliary Power Supplies and the rear of the Motherboard. Place the Controller on a convenient work surface and remove the screws holding the rear panel in place. PLEASE BE CAREFUL] The rear panel supports the Main Controller Power Supply and is heavier than might be expected. Take care to retain all of the locking hardware and screws for replacement later. The cabling to the rear panel will allow the panel to lie flat on the work surface. Provide a support, such as a book, for the panel so that no pressure is applied to the connectors that are mounted on the rear panel.

Replacement is achieved through the reversal of the steps described above.

Push the lower portion of the slide feet (on the bottom of the Controller Assembly) into the slide assembly channels and allow them to drop down through the release openings. The assembly may now by pulled forward or pushed back as required. Be careful when re-connecting the cables to J1, J2, J3, and J4 to dress the cable harness so as to permit easy withdrawal of the Controller Assembly.

Re-connect the ground cable and all of the ribbon connectors and the Temperature sensor cable to the proper connectors on the Transmitter Interface/Backup Controller board. Push the Controller Assembly carefully into place, taking care not to damage the ribbon cable that connects to the front of the CPU module (A10). When in place, and after all of the cables have been checked for proper location (when viewed from the rear) replace the four screws along the edges of the Controller front panel. Close the rear door, apply power to the cabinet and make a preliminary check of the operation of the Controller. If satisfactory, close the Mimic Panel and retain it with the captive hardware.

G.3. PURPOSE

The Controller is the logical heart of the HT 30/35FM. The Transmitter Interface/Backup Controller board (on the top of the Controller) contains all of the interface and rf suppression circuitry for the circuits connecting the Microprocessor Controller with the ac and rf control circuits in the transmitter Main Cabinet and the High Voltage Power Supply. In addition, the Transmitter Interface/Backup Controller board contains the BACKUP Controller circuitry and the circuitry for the front-panel meters.

Included in the Controller card cage are the components of the Microprocessor Controller, which normally operate the transmitter. To support both the Microprocessor and Backup Controllers, the Controller Assembly contains the Main and Auxiliary Controller power supplies. These power supplies also provide power for the Mimic Panel and the Digital Multimeter. Refer to Figure G-1, Controller System Simplified Diagram.

Also included in the Controller Assembly is the Control Status module. It is mounted on the front of the Controller to the left of the card cage. It is functionally the Transmitter Interface/Backup Controller board and is described more fully with that equipment.

G.4. CIRCUIT DESCRIPTION

Refer to Figure G-2 (Schematic Diagram 839 6337 222). There are two ac inputs to the Controller so that the two power supplies may be operated independently (J1). The Controller Main power supply (A14) provides +5 Volts for the Mimic Panel (and Digital Multimeter) from 1TB1-11 via J2 and for the Microprocessor from TB1-12. A -5 Volt supply for the Microprocessor is derived from TB1-5.

Plus 12 and -12 Volt supplies from 1TB1-8 and 1TB1-7 are connected to the Microprocessor, the Mimic Panel (via J2) and the Transmitter Interface (via the Auxiliary Power Supply).

The Auxiliary Power Supply (A15) contains a diode switch to permit the Transmitter Interface +12 and -12 Volt supplies to be derived from either the Main supply or the Auxiliary supply. In addition, the Auxiliary Power Supply contains a +10 Volt source (derived from either power supply) and a 24 Volt ac time standard for the Microprocessor (via the Transmitter Interface/Backup Controller board and Digital I/O module, A6). The remaining wiring between J2 and the Transmitter Interface/Backup Controller board is for the circuits controlled by the four pushbuttons in the center of the Mimic Panel.

All wiring to the Microprocessor boards (CPU, Analog I/O and Digital I/O modules) is contained either in the wiring harness within the Controller Assembly (which connects to the Motherboard, A11) or in the three ribbon cables which connect between the modules and the Transmitter Interface/Backup Controller board.

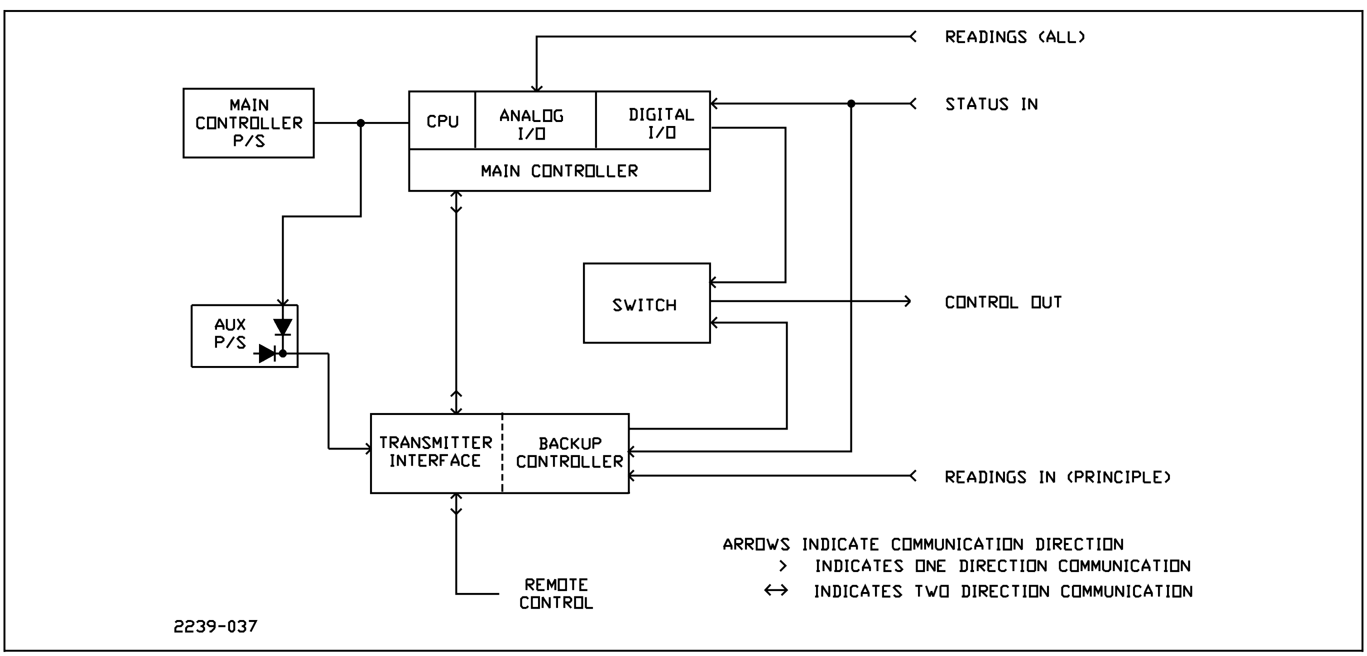


Figure G-1. Controller System Simplified Diagram

FIGURE G-2

SEE SCHEMATIC TRANSMITTER CONTROL UNIT 1A6

839 6337 222

IN DRAWING PACKAGE

FIGURE G-3

SEE SCHEMATIC SCHMITT TRIGGER

839 8023 002

IN DRAWING PACKAGE

SECTION H
MOTHERBOARD 1A6A11

H.1. INSTALLATION

The Motherboard is a component of the Controller and requires no separate installation procedure.

H.2. REMOVAL AND REPLACEMENT

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

To access the Motherboard for service, first follow the appropriate instructions for removal of the Controller. Place the Controller on a convenient work surface and remove the screws holding the rear panel in place. PLEASE BE CAREFUL] The rear panel supports the Main Controller Power Supply and is heavier than might be expected. Take care to retain all of the locking hardware and screws for replacement later. The cabling to the rear panel will allow the panel to lie flat on the work surface. Provide a support, such as a book, for the panel so that no pressure is applied to the connectors that are mounted on the rear panel.

As viewed from the rear of the Controller, the Motherboard is the large pc board directly in front of the space occupied by the Main Controller Power Supply (when the rear panel is in place).

Removal of the Motherboard (if required) is accomplished as follows: first, unplug and set aside the CPU, Analog I/O, Digital I/O pc boards. Release the ribbon cable clamps on the Spacer pc boards, feed the ribbon cables out through the slotted openings in the boards and remove them from the assembly.

Next, unsolder the seven wires in the harness connecting to the Motherboard, being careful to note which wire connects to which terminal. Make sure that the wire numbers agree with those on Transmitter Control Unit wiring diagram, 839 6337 222 (Figure G-2). The identity of each circuit is etched on the board.

Next, remove the twenty (20) screws which enter the edge connector mounting lugs from the front side. The Motherboard (with the pc board sockets attached to it) may now be removed from the assembly.

Re-assembly is accomplished by reversing the preceding process. Be sure to install the Motherboard with the proper orientation: printed circuit socket terminals 1 and 2 go toward the top, terminals 55 and 56 go toward the bottom.

After installing the three Spacer pc boards, install the Digital I/O, Analog I/O and CPU boards. The easiest way to install these boards is as follows: hold the pc board in the right hand, connect the ribbon cable, press the cable flat along the component side of the board with the left hand and start the board into the guides with both hands making a “sandwich” of the board. After the board is started into the guides, remove the left hand and the cable will follow the board as it is pushed in with the right hand.

H.3. PURPOSE

The purpose of the Motherboard is to provide all of the computerrelated connections required by the Digital I/O, Analog I/O and CPU pc boards. These connections consist of the power supply circuits, power fail sense and pushbutton reset circuits as well as the address and data bus groups used by the CPU and the I/O boards.

H.4. CIRCUIT DESCRIPTION

Refer to Figure H-1 (Schematic Diagram 839 6337 177). The circuit is nearly self-explanatory. All of the circuits on the Motherboard are bussed (paralleled) to all ten (10) sockets, J1 through J10, except the Priority Control circuit, which passes through each module in series on its way to the CPU (which must be located in the last connector). To complete this circuit, each of the Spacer printed circuit boards has a jumper from terminal 51 to terminal 52. If the Spacer Board in J7 or J9 (location A7 or A9) is unplugged, the system will cease to function properly. The schematic diagram contains a sketch of a portion of two typical sockets (as view from the front of the assembly) indicating the actual arrangement of the terminals.

This will assist a technician in locating circuits with a ‘scope probe’.

FIGURE H-1

SEE SCHEMATIC, MOTHERBOARD

839 6337 177

IN DRAWING PACKAGE

SECTION J
ANALOG INPUT/OUTPUT BOARD

J.1. INSTALLATION

The Analog Input/Output board is a component of the Controller and requires no separate installation procedure.

J.2. REMOVAL AND REPLACEMENT

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

Use the cam lever mounted on the upper corner of the module to extract the Analog I/O board from the socket. Disconnect ribbon cable connector from the board.

J.3. PURPOSE

The purpose of the Analog I/O board is to serve as an interface between analog sampler of voltage, current, power and other inputs, and the various digital displays of these parameters.

J.4. CIRCUIT DESCRIPTION

Refer to Figure J-2 for the following discussion.

The Analog I/O board is under the control of the Central Processor Unit (CPU) and receives control inputs on P1. Some of these inputs (A2-A7) are directed to U1 which is a programmable read only memory (PROM). When all outputs ($\overline{\text{I/O-0}}$ through $\overline{\text{I/O-7}}$) are low, the output of U5 permits digital data outputs to exit the module via U2. Read, write and I/O Request (all active low) inputs are also used to generate control signals for the module.

Digital data in and out is handled by U2, a bi-directional bus transceiver. Data is transferred into the Analog I/O board when enable input pin 19 is low ($\overline{\text{E}}$) and pin 1 is high (DR). Data is transferred out of the module when DR input is low. When enable input pin 19 is high, no data may be transferred either direction.

Data enters the Analog I/O board via U2 and is directed to U14 which is a CMOS multiplying digital to analog converter (MDAC). The output of U14 is thus a function of the data inputs (BDO through BD7) and the reference (multiplying) input coming in on pin 15. The reference input comes from a Sample and Hold circuit, U9. The input to the Sample and Hold is the output of the multiplying DAC (MDAC). Thus the function of the Sample and Hold is similar to an AGC control on the MDAC.

The output of the Sample and Hold is proportional to the digital data to the MDAC. This analog output is also sent to buffer amplifier U12, and the output of U12 goes to U11, which is an analog to digital converter (ADC). Digital data is then taken from U11 and directed to U2, the bi-directional bus transceiver and is available as data at P1, pins 7 through 14.

Analog data proportional to transmitter current, voltage, power and other monitored parameters enters on J3 and goes to U16 and U19 through U21, which are analog multiplexers designed to connect one of eight inputs to a common output line (pin 9) according to a three bit address input (BD0-BD2). These multiplexers have an asynchronous reset (pin 18) and a write input ($\overline{\text{WR}}$) at pin 1. The enable input on pin 3 must be high to enable the address latches.

The analog outputs from U16 and U18 through U21 are directed to U17. Component U17 is a one of eight lines multiplexer. The output of U17 is a multiplexed stream of analog outputs which are sent to buffer amplifier U15, through a calibration control R14, then to U14. The digital data inputs (BD0-BD7) set latches during the write cycle ($\overline{\text{WR}}$). A binary R-2R network, which has its input at pin 15 (reference input from the Sample and Hold circuit, U9), thus supplies an analog output to pin 1. This output is modified by the feedback input to pin 16, which is determined by the multiplexed outputs representing monitored transmitter parameters. The adjustment R14 permits calibrating the meter function.

Retriggerable one-shot U6 is used to monitor continued operation of the board. Normal trigger inputs to U6 will prevent the one shot from timing out, which would permit DS1 to extinguish. The timing period is determined by R3 and C2. Slight blinking indicates normal module activity.

Power Supply samples (+ and -12 Vdc) and temperature are available at pins 12, 13, and 8, respectively, of U16.

The digital to analog converter U22 receives digital inputs from the CPU, and in turn generates a ramp which is used by the Preamplifier regulator to increase the RF output power from zero to the normal output level. When the transmitter is under control of the Backup Controller, the ramp is generated by a ramp generator on the Transmitter Interface/Backup Controller board.

J.5. MAINTENANCE

J.5.1. PREVENTIVE MAINTENANCE

Preventive maintenance consists in keeping the circuit board clean and free of dust, and the connectors properly installed.

WARNING

THE ANALOG I/O BOARD SHOULD NEVER BE REMOVED OR INSTALLED UNDER POWER. ALWAYS TURN THE TRANSMITTER OFF, AND DISCONNECT ALL PRIMARY POWER FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY. USE GROUNDING STICK TO DISCHARGE ALL CAPACITORS.

J.5.2. CORRECTIVE MAINTENANCE

J.5.2.1. *ADJUSTMENTS*

There is only one adjustment on the board, which is R14. This adjustment was done at the factory and should not require readjustment.

J.5.3. TROUBLESHOOTING AND REPAIR

The Analog I/O board is difficult to troubleshoot without specialized test equipment. It is also very difficult to repair because of the multilayer board construction. Attempts to repair may damage the board beyond repair. The board should be returned to HARRIS CORPORATION, Broadcast Products Division for repair. Refer to paragraph on Returns and Exchanges.

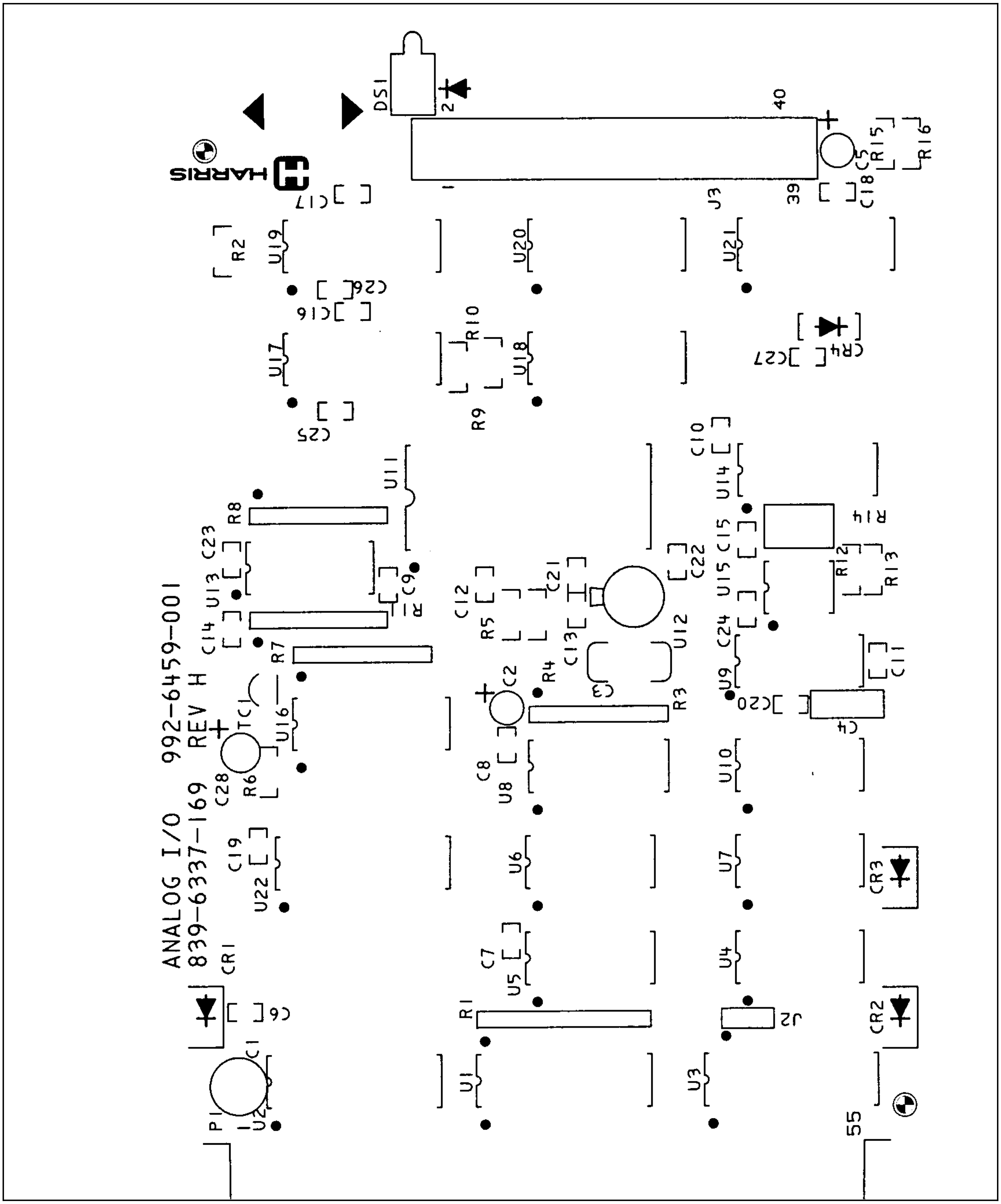


Figure J-1. Analog Input/Output Board

FIGURE J-2

SEE SCHEMATIC, ANALOG I/O

839 6337 153

IN DRAWING PACKAGE

WARNING: Disconnect primary power prior to servicing.

SECTION K
DIGITAL INPUT/OUTPUT BOARD

K.1. INSTALLATION

The Digital Input/Output Board (Digital I/O) is a component of the Main Controller and requires no separate installation procedure.

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

K.2. REMOVAL AND REPLACEMENT

The Digital I/O Board is located in the controller card cage. Use the cam lever mounted on the upper corner of the module to extract the Digital I/O board from the socket. Disconnect ribbon cable connectors from the board.

K.3. PURPOSE

The purpose of the Digital I/O board is to serve as an interface between the CPU and transmitter control circuits and status indication circuits.

K.4. CIRCUIT DESCRIPTION

Refer to Figure K-2 for the following discussion.

Digital data from the CPU enters on P1 and is received by U1 which is a bi-directional bus transceiver. The Directional (DIR) input and Enable input ($\overline{ENA}$) determine the direction of transfer. When the DR input is High, data enters the module and exits the module when DR is Low. If ENA input is high, the transceiver is disabled (high impedance output).

Digital data output from U1 goes to U11 and U14. Device U11 is a universal interrupt controller and U14 is a programmable keyboard/display interface.

Both of these devices have a bi-directional data bus, and the direction of data is determined by the $\overline{IACK}$, $\overline{WR}$, and $\overline{RD}$ inputs (all active low).

The universal interrupt controller receives interrupt requests (IREQ0-IREQ7) from the transmitter overload comparators located on the Transmitter Interface/Backup Controller board (Refer to Figure P-10 sheet 2) and informs the CPU that its services are required. These inputs are held high by pullup resistors to +5Vdc. An overload condition will pull the respective input low through the diode and U11 thus receives an interrupt request.

The response to the interrupt (all of which are asynchronous) is that up to four programmable response bytes are output on the data bus and out of the board via U1. The transmitter response to the overload is thus controlled by means of this output by the CPU. The direction of data is determined by the $\overline{IACK}$, $\overline{WR}$, and $\overline{RD}$ inputs (all active low).

Device U14 serves as the interface between the Transmitter Interface/Backup Controller Read Line and Select Lines (RL0-RL7 and SL0-SL7, respectively) and the CPU. Refer to the Figure P-10. There Read and Select Line inputs serve as transmitter status inputs to the CPU via U14, and are used in transmitter control. (Refer to the description of the Transmitter Interface/Backup Controller.)

The Select Line outputs SL0-SL3 from U14 provide a continuous binary count from zero to fifteen. Three of these outputs, SL0-SL2, are directed to U13 which is a one of eight decoder/multiplexer. These three outputs count continuously in binary from zero to seven. The outputs SL0-SL7 are normally high, and with a binary weighted three bit input, when enabled via a high input on pin 6, will produce eight mutually exclusive active low outputs.

These outputs are used to scan the matrix in the Transmitter Interface/Backup Controller.

The Read Lines RL0-RL7 are the return lines for the Scan Lines through the matrix in the Transmitter Interface/Backup Controller (Figure P-10, Sheet 1).

Thus as the Scan lines (U13) are cycled low, one at a time, if the corresponding matrix point located on the Transmitter Interface/ Backup Controller board is closed, a low input is thereby supplied to the corresponding Read Line input of U14. The outputs A0-A3 and B0-B3 then respond appropriately to the matrix inputs to give the transmitter status via U15 through U19, which are octal latched peripheral drivers. The matrix provides information as to transmitter status. Refer to Figure P-10.

The outputs A0-A3 and B0-B3 are synchronized to the Scan Lines SL0-SL3 and are used by the multiplexed display of the transmitter.

The octal latched peripheral drivers U15-U19 receive eight data bits from the programmable keyboard/display interface and when properly enabled provide latched outputs with open collector outputs. Positive input edge latching is used. If the $\overline{CLR}$ input is high, when $\overline{STR}$ input goes low, the data inputs will be latched. When the data input is high, the output will be low (driver transistor turned on).

The active low strobe input ($\overline{STR}$) is developed by U12 in response to the Select Line outputs of U14.

The digital data stream entering via U1 is thus processed so as to provide complete transmitter status indication and transmitter control and overload protection and involves the CPU and Transmitter Interface/Backup Controller board.

Status of the Digital I/O Board may be determined by observing the red LED, DS1 on the card edge. This LED is driven by the output of U9 which is a retriggerable one-shot. As long as a continuous stream of inputs is received on the B input, and A is low, the LED will be on. Normally a slight flicker is expected.

Address input data is received via U2 which is a receiver/transmitter. Both enable inputs (G1 and G2) are low, thus enabling all driver units. The address input (A0-A3) is compared with the address input determined by J2 (B0-B3). When both addresses are equal, U5, which is a four bit comparator, supplies an A=B output (high) which enables U1-19 via U4-6 and U20-8.

K.5. MAINTENANCE

K.5.1. PREVENTIVE MAINTENANCE

Preventive maintenance consists is keeping the board clean and free of dust, and the connectors properly installed.

WARNING

THE DIGITAL I/O BOARD SHOULD NEVER BE REMOVED OR INSTALLED UNDER POWER. ALWAYS TURN THE TRANSMITTER OFF, AND DISCONNECT ALL PRIMARY POWER FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY. USE GROUNDING STICK TO DISCHARGE ALL CAPACITORS.

K.5.2. CORRECTIVE MAINTENANCE

K.5.2.1. *ADJUSTMENTS*

There are no adjustments or calibrators on the Digital I/O Module.

K.5.3. TROUBLESHOOTING AND REPAIR

The Digital I/O board is difficult to troubleshoot without specialized test equipment. It is also very difficult to repair because of the multilayer board construction. Attempts to repair may damage the board beyond repair.

The board should be returned to HARRIS CORPORATION, Broadcast Products Division for repair. Refer to paragraph on Returns and Exchanges.

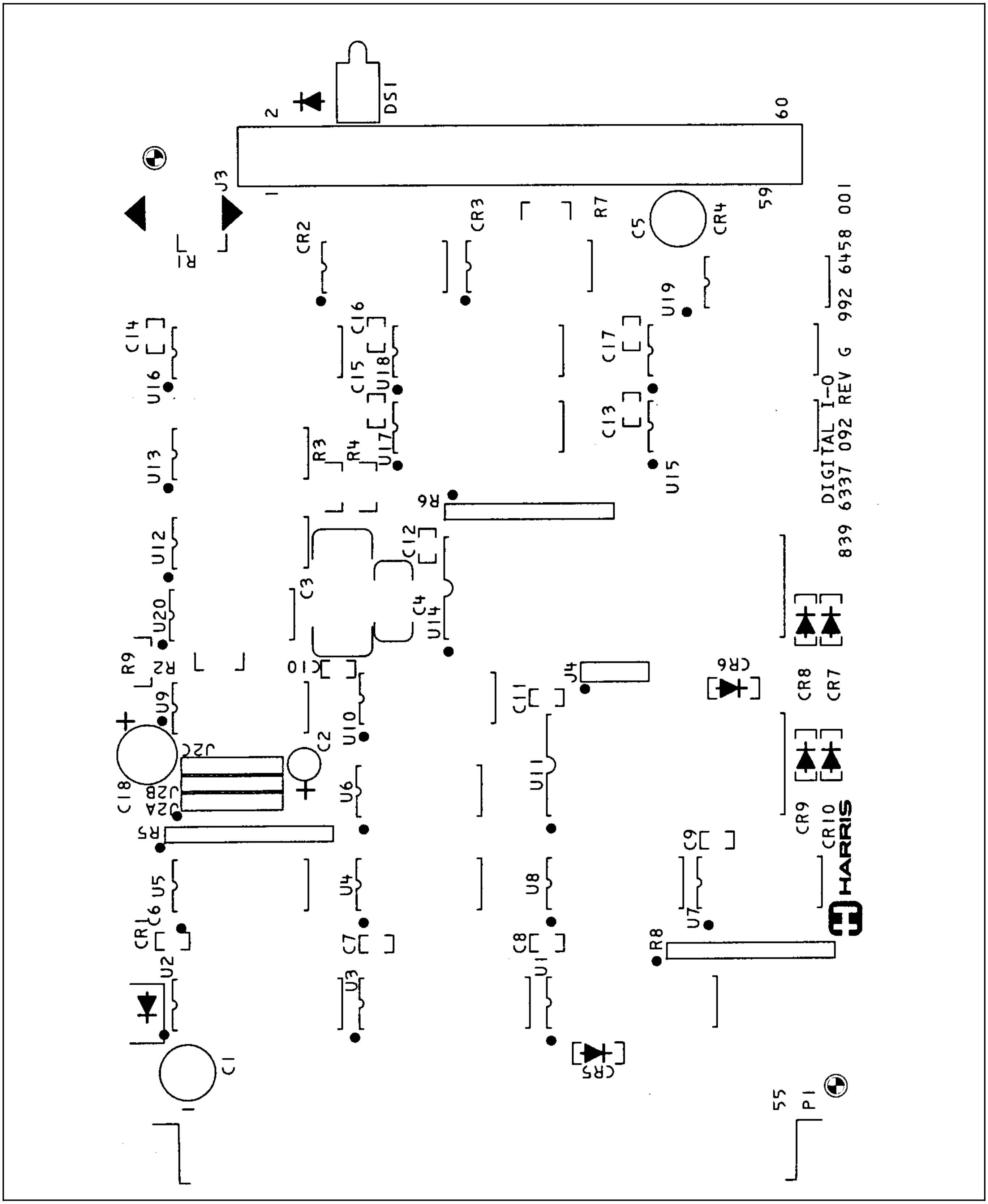


Figure K-1. Digital Input/Output Board

FIGURE K-2

SEE SCHEMATIC, DIGITAL I/O

839 6337 171

IN DRAWING PACKAGE

WARNING: Disconnect primary power prior to servicing.

SECTION L
CENTRAL PROCESSOR UNIT (CPU)

L.1. INSTALLATION

The Central Processor Unit (CPU) is a component of the Main Controller and requires no separate installation procedure.

WARNING

BEFORE BEGINNING ANY WORK IN THE MAIN CABINET, REMOVE ALL POWER FROM THE TRANSMITTER MAIN CABINET AND HIGH VOLTAGE POWER SUPPLY. ALWAYS USE A GROUNDING STICK (INSIDE THE REAR DOOR OF THE MAIN CABINET) TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

L.2. REMOVAL AND REPLACEMENT

The CPU board is located in the card cage of the Controller card cage. Use the cam lever mounted on the upper edge of the card to extract the card from the socket. Disconnect the ribbon cable connectors from the board.

L.3. PURPOSE

The purpose of the CPU is to provide the major portion of the microprocessor control of the transmitter operating system. It is the brain which controls the entire transmitter. In the unlikely event that it should malfunction, the transmitter will automatically switch to the Backup Controller.

L.4. CIRCUIT DESCRIPTION

The CPU is designed around the Z-80 microprocessor. Supporting the microprocessor is a 2K non-volatile Random Access Memory (NOV RAM), 8K of Random Access Memory (RAM) and two 32K Erasable Programmable Read Only Memories (EPROM).

The CPU board is a purchased module and the software details are proprietary.

Various jumpers on the board permit configuring the module properly. This is done at the factory and is not intended to be user adjustable.

L.5. MAINTENANCE

L.5.1. PREVENTIVE MAINTENANCE

Preventive maintenance consists in keeping the module clean and free of dust and the connectors properly installed.

WARNING

THE CPU BOARD SHOULD NEVER UNDER ANY CIRCUMSTANCES BE REMOVED OR INSTALLED UNDER POWER. ALWAYS TURN THE TRANSMITTER OFF, AND DISCONNECT THE PRIMARY POWER FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY. USE THE GROUNDING STICK TO DISCHARGE ALL CAPACITORS IN THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY CABINET.

L.5.2. CORRECTIVE MAINTENANCE

L.5.2.1. *ADJUSTMENTS*

There are no user adjustments on the CPU board.

L.6. TROUBLESHOOTING AND REPAIR

It is not possible to troubleshoot the CPU board without specialized test equipment. It is very difficult to repair the module because of the multilayer printed circuit board construction. Attempts to repair may damage the module beyond repair. If the module should be suspected of malfunctioning, please return the module to HARRIS CORPORATION, Broadcast Products Division. Refer to paragraph on Returns and Exchanges.

SECTION M
CONTROL STATUS BOARD

M.1. INSTALLATION

The Control Status Board is a component of the Controller and requires no separate installation procedure.

M.1.1. REMOVAL AND REPLACEMENT

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STOPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

To remove the Control Status board for service, remove the screws holding the board to the front panel of the Controller. Pull the board away from the Controller and disconnect the connector from the board.

M.2. PURPOSE

The Control Status Board has several unrelated functions. The main purpose is to provide visual indication (LED's) of transmitter overload status, and transmitter control circuitry status - both Main and Backup Controllers.

Other features include overload adjustment potentiometers, power (PA and IPA) calibration amplifiers, Backup Controller IPA power level potentiometer, PA bypass switch and Main/Backup Controller select switch. Refer to Figure M-2.

It may also be helpful to refer to the Transmitter Interface/Backup Controller schematic, Figure P-10.

M.3. CIRCUIT DESCRIPTION

The overload LED inputs, and transmitter (main) control circuit status inputs are active low. Both sets of inputs operate on the Transmitter

Interface/Backup Controller board. A low input on any line completes the circuit for the respective LED, current limiting resistor and +12 Vdc source.

The inputs to the LED's used to indicate transmitter status when operating off the Backup Controller are active high. The LED's are returned through current limiting resistors to J1-49 and 50. These connector pins are connected via ribbon cable to the Transmitter Interface/Backup Controller board at J11-49 and 50 (Figure P-10, Sheet 2, B9). These pins are connected to ground by the Main/Backup control relay K1 when in the Backup Controller mode. In the Main Controller mode, K1 provides +12 Vdc to the backup status LED's, making them inoperative.

The transmitter overload adjustment pots, R97 through R100, provide overload limit inputs to the respective overload comparators. These limit inputs may be read directly in correct electrical units on the transmitter multimeter by calling up the respective overload readings.

The IPA and PA power calibration amplifiers (U1 & U2) receive their respective inputs from the Directional Coupler buffer amplifiers located on the Transmitter Interface/Backup Controller board (Figure P-10, Sheet 3, 8B).

These buffer amplifiers are unity gain, non inverting buffers. Their outputs are directly proportional to the outputs of the respective directional couplers.

The potentiometers on the calibrating amplifiers permit the transmitter multimeter to be calibrated for IPA and PA forward and reflected power, using an external standard.

Since the directional couplers' outputs are negative, and the buffer amplifiers on the Transmitter Interface/Backup Controller board are noninverting, the inputs to the calibrating amplifiers will be negative. The inverting inputs are used by the calibrating amplifier; therefore, the outputs are positive.

The PA forward and reflected power calibration amplifiers have a CAL/VSWR switch which diverts the PA forward power sample voltage from U1-1 into the front panel power meter switched to the reflected power position. This permits the VSWR meter to be calibrated to the transmitter normal output power by adjusting R105 to "CAL" mark on the power meter.

The backup IPA level potentiometer R13 receives a ramp input from the Transmitter Interface/Backup Controller board at J1-1. The potentiometer is adjusted to set the ramp voltage level to the Preamplifier regulator so that the power output of the transmitter with the Backup Controller will be the same as with the Main Controller.

Switch S1 controls the latching relay K1 on the Transmitter Interface/Backup Controller board to select Main or Backup Controller mode. Switch S4 disables the PA circuits in the event of a PA failure so that the transmitter may be operated in the PA bypass mode.

M.4. MAINTENANCE

M.4.1. ADJUSTMENTS

M.4.1.1. *OVERLOAD ADJUSTMENTS*

These adjustments are made at the factory, but may be easily changed if conditions change.

Use the transmitter multimeter to read the PA OVLD. Adjust R97 for desired PA current limit value.

Repeat the procedure of the previous step for the screen current limit, using R98. For PA VSWR and IPA VSWR, use R99 and R100 respectively.

M.4.2. POWER AMPLIFIER CALIBRATION ADJUSTMENTS

The following calibration adjustments should only be made if an accurate power meter is available.

M.4.2.1. *IPA POWER CALIBRATION*

Connect a Bird 43 power meter (or equivalent) directly to the output of the IPA Low Pass Filter unit. Connect an FM band directional coupler to the Bird power meter. Connect the output of the directional coupler to the PA input.

Turn the transmitter ON and set the IPA Power Control adjustment to 400W to 500W (or normal IPA output power) as indicated on the Bird power meter.

Set the transmitter multimeter to IPA FWD. Adjust R103 on the Control Status board to make the multimeter reading agree with the Bird power meter.

M.4.2.2. *IPA REFLECTED POWER*

Reduce the IPA forward power to minimum using the IPA Power Adjust control.

Insert a 25 watt element in the Bird power meter. Set the element to read reflected power.

Increase the IPA Power Adjust for normal power output as read on the IPA FWD multimeter reading. Be sure to monitor the IPA reflected power reading on the Bird power meter. Readjust the GRID TUNE and/or MATCH as required to limit the reflected power to less than 25 watts.

Detune the GRID TUNE and/or MATCH to increase the IPA reflected power to 25 watts as read on the Bird power meter. Set the transmitter multimeter to IPA REF.

Adjust R104 on the Control Status board to make the multimeter reading agree with the Bird power meter.

Remove the directional coupler and Bird power meter. Renull the IPA reflected power meter reading.

Set the multimeter to IPA OVR. Adjust R100 on the Control Status for a reading of 25 watts (or the desired reading) on the multimeter.

M.4.2.3. *PA FORWARD POWER CALIBRATION*

Operate the transmitter into a calorimetric load or insert an accurate power meter so that power output may be accurately measured. Set the transmitter to normal output power.

Set the Transmitter Multimeter to PA FWD. Adjust R101 to make the multimeter agree with the external power meter.

Check the front panel power meter. Adjust R3 on the switch board (behind the dress panel) if necessary to make the meter agree with the multimeter reading.

M.4.2.4. *PA REFLECTED POWER CALIBRATE*

The following procedure should be performed with AC powr applied to the main cabinet only and with plate and filament circuits de-energized (OFF).

Locate connect pair 1P11/1J11 on the top of the transmitter cabient. Desengage 1P11 from 1J11.

Using a stable, variable source of DC voltage, apply -0.900 Vdc to the center pin of 1J11 referenced to the shell of 1J11 (GND). Use a digital voltmeter to measure the voltage while applied to 1J11. (NOTE: The PA VSWR LED on the transmitter front panel may illluminate at this time.)

Select the PA REF position on the digital multimeter. Adjust R102 on the Control Status board to set the PA REF reading on the digital multimeter to 2.2 kW.

Disconnect the voltage source from 1J11 and reconnect 1P11. Depress the front panel RESET switch to clear any overload indications.

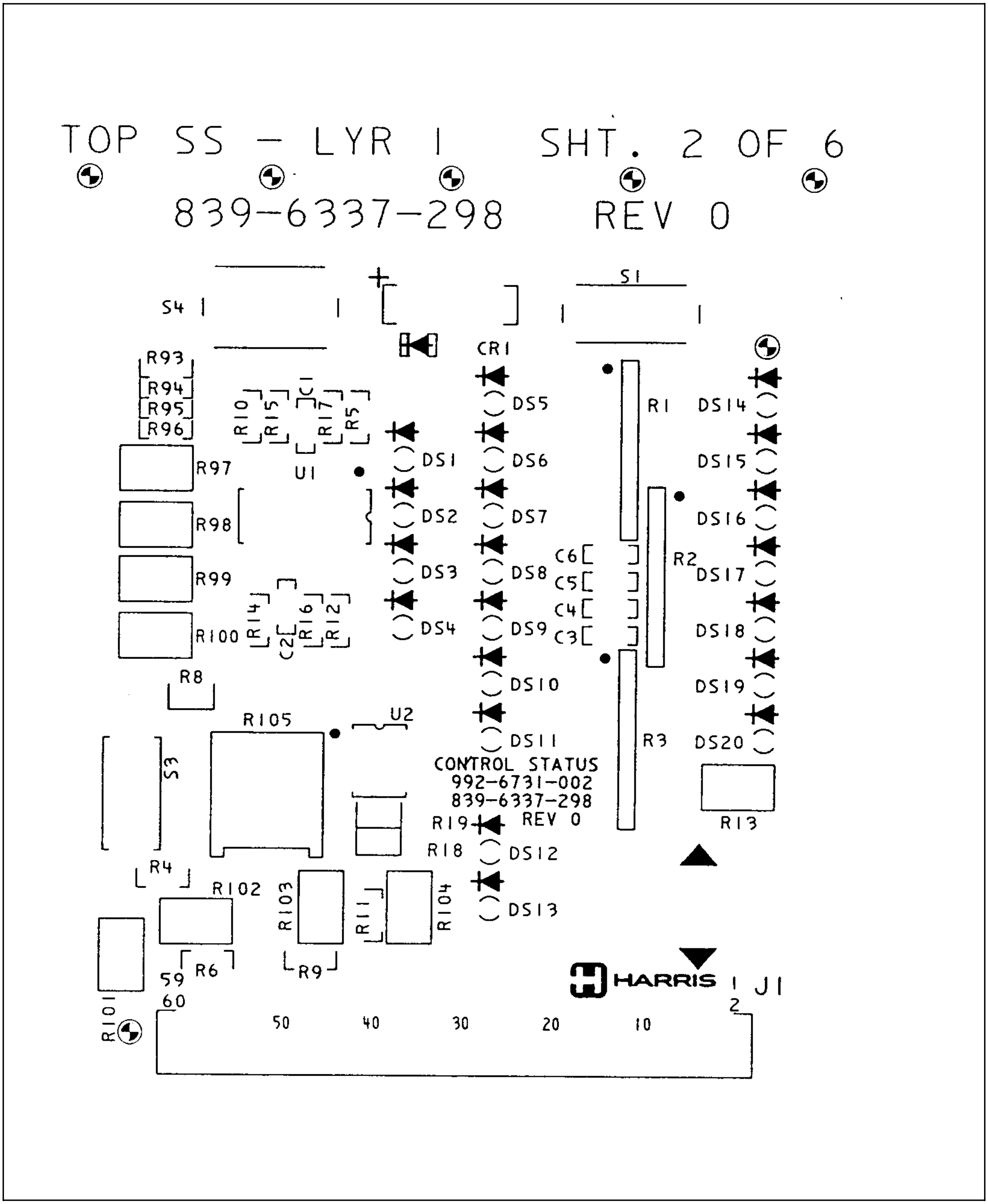


Figure M-1. Control Status Board
(839 6337 298)

FIGURE M-2

SEE SCHEMATIC, CONTROL STATUS

839 6337 297

IN DRAWING PACKAGE

SECTION N
AUXILIARY POWER SUPPLY

N.1. INSTALLATION

The Auxiliary Power Supply is a component of the Controller and requires no separate installation procedure.

N.2. REMOVAL AND REPLACEMENT

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

To remove the Auxiliary Power Supply for service, first follow the appropriate instructions for removal of the Controller. Place the Controller on a convenient work surface and remove the screws holding the rear panel in place. PLEASE BE CAREFUL] The rear panel supports the Main Controller Power Supply and is heavier than might be expected. Take care to retain all of the locking hardware and screws for replacement later. The cabling to the rear panel will allow the panel to lie flat on the work surface. Provide a support, such as a book, for the panel so that no pressure is applied to the connectors that are mounted on the rear panel.

As viewed from the rear of the Controller, the Auxiliary Power Supply is inside and to the right side of the Controller. It is mounted with four captive screws and has one multi-conductor cable connected to it with a plug and socket (P1/J1). The cable is disconnected by pulling the connector body away from the Auxiliary Power Supply.

Use a conventional flat-blade screwdriver with a 1/4-inch blade to loosen and release the captive screws which hold the Auxiliary Power Supply in place.

Remove the unit from the Controller.

Replacement of the Auxiliary Power Supply is accomplished by reversing the above process. Hold the unit in place (with the cable connector toward the bottom) and start the captive screws by hand. When all four screw are started, use the screwdriver to tighten the screws firmly but not excessively. Replace the rear panel and install all of its retaining screws with their hardware. Replace the Controller in the HT-35FM Main Cabinet in accordance with the instructions for the Controller.

N.3. PURPOSE

The Auxiliary Power Supply is intended to be a backup supply for the Transmitter Interface/Backup Controller board. In this way, the HT-35FM may be kept On-the-Air with the Backup Controller during time that the Main Power Supply in the Controller is out of service (which leaves the computer without power).

IMPORTANT!!

Because the Main Controller Power Supply +12-Volt and -12-Volt outputs for the Transmitter Interface/Backup Controller board are routed through the Auxiliary Power Supply, the Controller cannot be operated without the Auxiliary Power Supply in place and the diodes operating correctly.

In addition to the necessary positive and negative 12-Volt supplies, the Auxiliary Power Supply contains the diode networks which permit either power supply to provide power for the Transmitter Interface/Backup Controller board.

The low-voltage transformer on the Auxiliary Power Supply is also the source of the pulses that the computer uses for keeping real time and date.

Finally, there is a +10-Volt source for the Control and Indicator circuits used by Remote Control and Extended Control systems. This isolates a possible short-circuit-to-ground in such wiring from the local Control and Indicator circuits, thus permitting the HT 30/35FM to be operated locally while efforts are made to locate the short circuit.

N.4. CIRCUIT DESCRIPTION

Refer to Figure N-2 (Schematic Diagram 839 6337 185). The Auxiliary Power Supply is powered from the 220/240-Volt line through circuitry in the Main Cabinet, connector J1 on the rear panel of the Controller and the wiring harness inside the Controller enclosure to Auxiliary Power Supply connector J1 terminals 1 and 2. Transformer T1 has two 120-Volt primary windings connected in series. The secondary windings are nominally 24 volts each.

One of the secondary windings is connected to J1 terminal 9 which makes a power-line sample available for the computer (via the Transmitter Interface/Backup Controller board) for time-keeping purposes. Both secondary windings are connected to bridge-rectifier assembly CR1 which provides positive and negative voltages for regulators U2 and U3 respectively. Filter capacitors C1 and C2 provide initial filtering of these voltages.

The output of the -12-Volt regulator, U3, passes through CR5 on its way to J1-11, the circuit which goes to the Transmitter Interface/Backup Controller board. Connector J1-10 is the -12-Volt input from the Main Controller Power Supply. This circuit passes through CR4 and is connected to the same output terminal as CR5. In this way, either -12-Volt power supply can provide the required -12 Volts for the Transmitter Interface/Backup Controller board.

Similarly, the +12-Volt input from the Main Controller Power Supply at J1-8 is “mixed” with the output of the +12-Volt regulator, U2, through diodes CR3 and CR2 and applied to J1-6 (for the Transmitter Interface/Backup Controller board) and J1-7 (for the Remote/Local switches on the Mimic Panel).

The +12-Volt “mixed” supply is also applied to +10-volt regulator U1. Its output is connected to the Transmitter Interface/Backup Controller board through J1-5.

The common electrical ground is connected through J1-12.

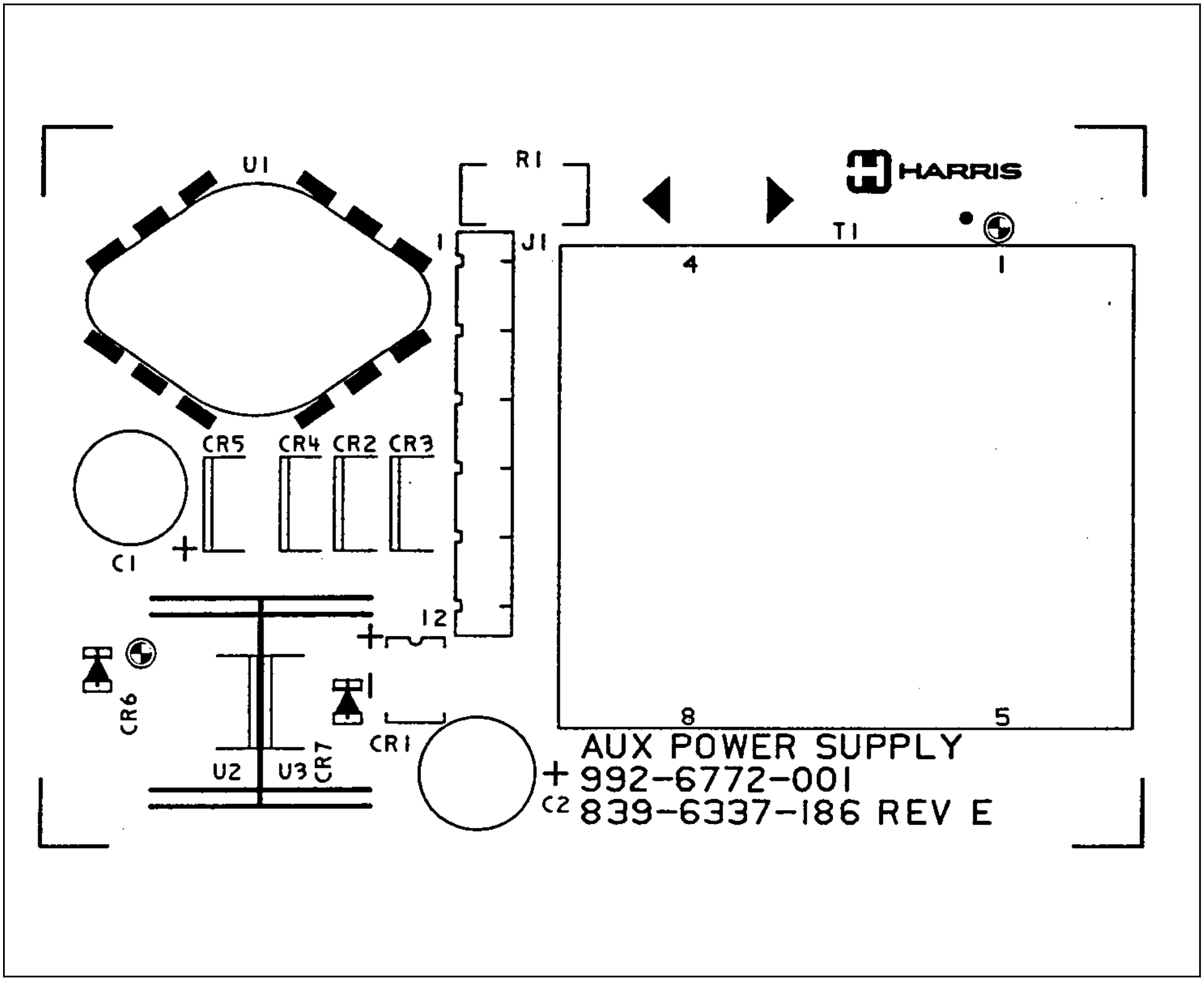


Figure N-1. Aux Power Supply Board

FIGURE N-2

SEE SCHEMATIC AUX POWER SUPPLY BOARD

839 6337 185

IN DRAWING PACKAGE

SECTION P
TRANSMITTER INTERFACE/BACKUP CONTROLLER BOARD

P.1. INSTALLATION

The Transmitter Interface/Backup Controller board is a component of the Controller and requires no separate installation procedure.

P.2. REMOVAL AND REPLACEMENT

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

In some cases, sufficient access to the Transmitter Interface/Backup Controller board may be achieved without removing the Controller from the Main Cabinet, since the Board is mounted on the top of the Controller. Simply remove the Controller retaining screws from each end of the Controller panel and pull the Controller forward.

If it is necessary to remove the Transmitter Interface/Backup Controller board for service, first follow the appropriate instructions for removal of the Controller in Section G-3. Place the Controller on a convenient work surface. Remove the Control Status Panel from the front of the Controller by removing the four screws and unplugging the ribbon cable. Disconnect the ribbon cables from the front edge of the Transmitter Interface/Backup Controller board. Remove the mounting screws which hold the Transmitter Interface/Backup Controller board to the top of the Controller. Carefully lift the rear edge of the board and disconnect the cable which comes up from the power supplies. Lift the board gently and pass the Control Status Panel cable through the opening in the top of the Controller.

Re-assembly of the equipment is accomplished by reversing the sequence described above. Be careful to observe the proper polarity when re-connecting the power supply cable to the bottom of the Transmitter Interface/Backup Controller board.

Please note that there are no adjustments on the Transmitter Interface/Backup Controller board. If it is necessary to replace the board, it should be unnecessary to re-calibrate the Overload Limit and RF Sample adjustments on the Control Status Panel.

P.3. PURPOSE

The Transmitter Interface/Backup Controller board has two major functions.

The first is to serve the purpose implied by the name: it is the point of interconnection between the hardware of the HT 30/35FM Main Cabinet and the hardware of the computer based Controller. The second function is to serve as a Backup Controller, permitting operation of the transmitter in a non-automatic mode. Provision is made for automatically switching to the Backup Controller in the event of a computer failure.

Circuitry also exists for remote control of the transfer between the Main Controller and the Backup Controller should the transmitter operator determine that this is necessary. The Control Status Panel functions as an integral part of transmitter interface and will be included in the explanations and circuit descriptions of the Transmitter Interface/Backup Controller board.

The circuitry of the Transmitter Interface/Backup Controller is arranged to permit both local and remote readings of Plate Voltage, Plate Current and Forward and Reflected Power that are independent of the computer and are always available when operating in the Backup Mode, even with the computer-based (Main) Controller out of service. Principal electronic overload protection circuitry (including Plate Current, Screen Current, Reflected Power and IPA Reflected Power) is also retained in the Backup Mode.

Switches are provided on the Control Status Panel for selection of controller (MAIN/BACKUP) and Power Amplifier mode (OPERATE/BYPASS). In the Bypass Mode, the Exciter and IPA may be operated without the PA, after the RF Bypass connection is made in the PA Cavity. In this way, it is possible to remain on the air (at reduced power) without using the PA or the High Voltage Power Supply.

P.3.1. INPUT CIRCUITS

Refer to Figures P-10 and M-2. Figure P-10, Sheet 1, contains (at the top of the page) the +12 and -12 volt distribution circuitry for the integrated circuits. It also includes the Local, Extended and Remote "Command Input" circuitry. This circuitry represents virtually all of inputs which convey operator commands to the HT 30/35FM. Receptacle J7 is connected (by way of a ribbon cable) to TB7 on the Customer Interface Panel in the bottom rear of the Main Cabinet. Receptacle J5 is similarly connected to the Switch Panel (at the top front of the Main Cabinet). On Sheet 3 (location E-1), a connection is shown from the +12 supply to J5-24. When any pushbutton switch on the Switch Panel is pressed, this +12 source is returned to one of the Local "Command" circuits shown on Sheet 1 (location C-9).

Current flows from the switch through the ribbon cable and connectors and then through an Isocoupler and a resistor to ground. Each Isocoupler is a combination of LED (Light-Emitting Diode) and Photo Transistor (Light Sensitive Transistor) in a set. (The Isocouplers used in the HT 30/35FM are packaged with four sets in a 16-pin DIP, or Dual In-line Package.) While the pushbutton is pressed and current is flowing, the LED portion of the Isocoupler is active and the photo-transistor is conductive. In other words, this circuit acts as a relay: it provides dc isolation between input (pushbutton) and output (Transmitter Interface control) circuits.

In the case of the front-panel MANUAL and AUTO circuits, the Isocoupler is the only functional element in the circuit (see Figure P-1). For example, the Local front-panel AUTO circuit is complete after passing through R1, U9 (pins 7 & 8) and R11 to ground. (R1 and C1, and other similar circuits, reduce the amount of rf which might enter the Controller from the Main Cabinet.) In the case of the other front-panel controls (PLATE ON, PLATE OFF, FILAMENT ON, FILAMENT OFF, Power RAISE and Power LOWER), there is a second functional circuit which is "tapped off" between the cathode of the Isocoupler and the resistor. This second circuit passes through a resistor to circuitry on Sheet 2 of Figure P-10. As an example, the Local front-panel PLATE OFF circuit is complete through R1, U10 (pins 5 & 6) and R78 (to ground), with the "tap" mentioned above (R79) connected at the cathode of the U10 LED (pin 6), above R78.

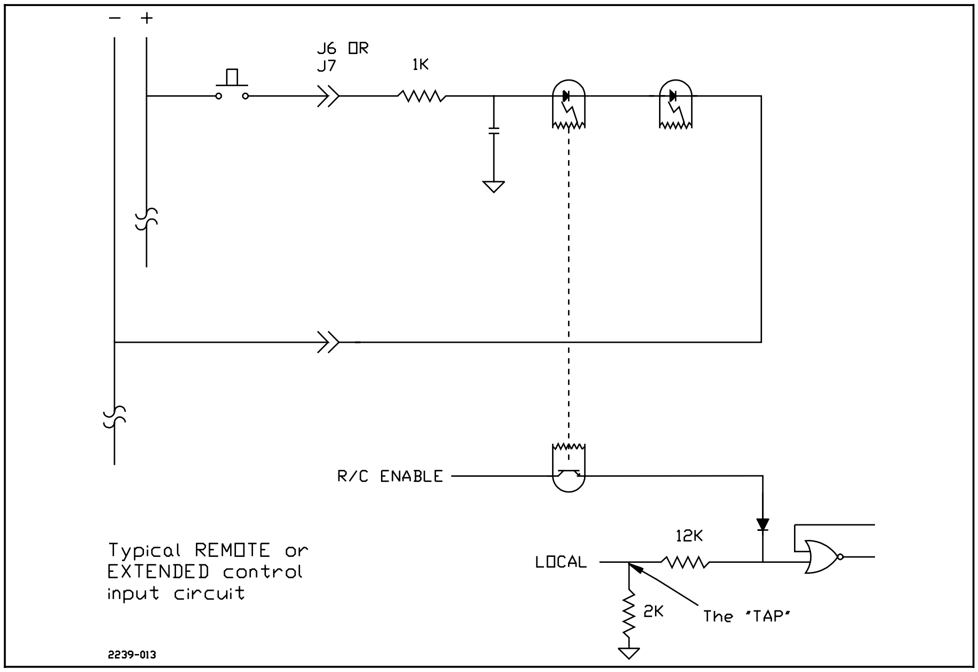


Figure P-2. Remote/Extended Pushbutton Inputs

There is a second input to the "tap" which comes from the Remote and Extended Plate Off Command inputs. When either the Local front-panel PLATE OFF pushbutton or the Remote Control PLATE OFF circuit or the Extended Control PLATE OFF circuit is operated (these inputs are functional only when Remote Control is Enabled), the voltage at the "tap" is raised. In the case of the Remote (or Extended) circuits, this is accomplished by the appropriate Isocoupler photo-transistor section turning on. The circuit is completed from the Remote Control Enable circuit (at about +12 volts), through the active photo-transistor, the diode (CR16 in this case), R79 and R78 to ground (see Figure P-2). The current flow through R78 raises the voltage at the cathode of the diode to about +10 volts.

In the case of the Local circuit, the voltage is derived at the "upper" end of R78 (as described above), and is about +10 volts. In either case, the voltage passed from the "tap" to the circuitry on Sheet 2 is about +10 volts while the circuit is active. It is at zero volts at other times.

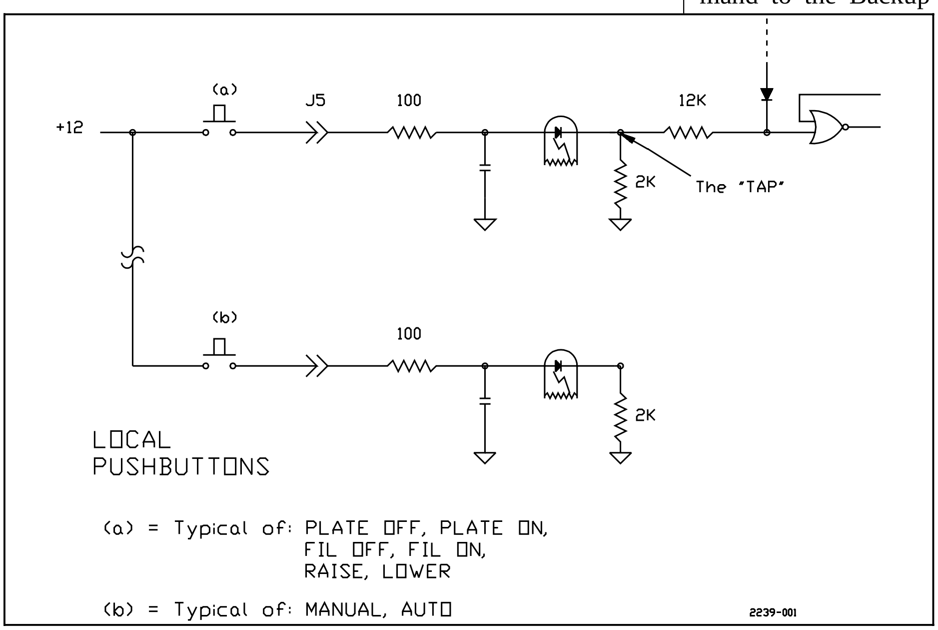


Figure P-1. Local Pushbutton Inputs

Figure P-2 shows how the Local (front panel) and Remote commands for a function are combined for input to the Backup controller. For the Remote input, the transistor portion of Isocoupler U4 supplies a voltage to CR16 (if Remote Control is enabled). For the Local input, the voltage developed across R78 is passed through R79. In either case, the voltage at the junction of the cathode of CR16 and R79 becomes the Plate Off command to the Backup Controller. Each of the other Backup controller input commands (Filament On, Filament Off, Plate On, power Raise, power Lower) is generated in the same way. It is through this circuitry that the Backup Controller and the computer-based controller receive the same command at the same time from a single input circuit. This permits the Backup Controller to be in the same operating state as the Main Controller at all times so that switching from Main to Backup mode will not take the transmitter off-the-air.

P.3.2. THE MATRIX

Each of the Local, Remote and Extended circuits described thus far has an Isocoupler whose photo-transistor circuits are shown (in Figures P-1 and P-2) without connections. These circuits are part of a matrix. The matrix is connected to the Digital I/O printed circuit board in the computer portion of

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Table P-1. The Matrix

	SL0	SL1	SL2	SL3	SL4	SL5	SL6	SL7	
RL7	REMOTE PLATE OFF	EXTENDED PLATE OFF	LOCAL PLATE OFF		FAILSAFE CLOSED	PHASE LOSS CLOSED			RL7
RL6	REMOTE PLATE ON	EXTENDED PLATE ON	LOCAL PLATE ON		EXTERNAL OVERLOAD	REMOTE IND. RESET			RL6
RL5	REMOTE FILAMENT OFF	EXTENDED FILAMENT OFF	LOCAL FILAMENT OFF	SPARE 6 COMMAND IN	H/V PWR SPLY INTERLOCK	EXTERNAL INTERLOCK			RL5
RL4	REMOTE FILAMENT ON	EXTENDED FILAMENT ON	LOCAL FILAMENT ON	SPARE 5 COMMAND IN	MAGNETIC OVERLOAD	EXCITER AFC INTERLOCK			RL4
RL3	REMOTE RAISE POWER	EXTENDED RAISE POWER	LOCAL RAISE POWER	SPARE 4 COMMAND IN	RAISE LIMIT REACHED	MAIN CABINET INTERLOCK			RL3
RL2	REMOTE LOWER POWER	EXTENDED LOWER POWER	LOCAL LOWER POWER	SPARE 3 COMMAND IN	STEP CONT. CLOSED	LOWER LIMIT REACHED			RL2
RL1	REMOTE APC OFF	EXTENDED APC OFF	LOCAL APC OFF	SPARE 2 COMMAND IN	AIR SWITCH CLOSED	START CONT. CLOSED			RL1
RL0	REMOTE APC ON	EXTENDED APC ON	LOCAL APC ON	SPARE 1 COMMAND IN	LOCAL MOTE ACTIVE	BACKUP MODE ACTIVE			RL0
	SL0	SL1	SL2	SL3	SL4	SL5	SL6	SL7	

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the Controller through a ribbon cable connection made to J10 on the Transmitter Interface/Backup Controller board. It is through this matrix that the computer learns of changes in digital (On-Off) inputs. These digital inputs include the control push-buttons.

Table P-1 shows the complete matrix. Note that the front-panel (Local) PLATE OFF command appears at the intersection of row RL6 and column SL2, while the Remote PLATE OFF appears independently at the intersection of RL6 and SL0.

The computer "scans" the matrix continuously and takes action appropriate to a change of state at any intersection. The computer accepts or ignores inputs as required, permitting an Extended PLATE ON command to be ignored if the Extended control capability has not been enabled, even though the Remote control capability may have been enabled. The computer use of the inputs in the matrix will be described in more detail elsewhere.

P.3.3. THE SWITCH

The circuits described below are called the "Switch" because they act as a multiple pole, two position selector. This selector chooses which Controller (Main or Backup) will operate the transmitter.

Figures P-3A, B and C show the development of the "Switch" circuit. In Figure P-3A, the Isocoupler which drives the "Controlled Circuit" (the Output) is affected by the input to the transistor base. The input is referred to as "Battery Switching" because it is in the logical "High" state when on. In other words, the input is connected to a source of "battery" (the +12-Volt power supply) when it is active. The current required by the Isocoupler is determined by the series resistor.

Figure P-3B shows the equivalent circuit when the input is "Ground Switching" (active in the logical "Low" state). In this case, the controlling input is connected to Ground when the output circuit is to be active.

These two circuits can be combined in such a way as to permit a single circuit to choose which input controls the output. Figure P-3C shows how this may be done. The Single-Pole-Double-Throw relay contact determines the way in which the circuit operates. When it is switched to Ground, the circuit acts like the "Battery Switching" circuit in Figure P-3A. Diode CR-A is reverse-biased and does not conduct. However, diode CR-B conducts and the "Ground-Switching" input is unimportant because diode CR-B is providing the required ground connection. The Isocoupler is controlled entirely by the "Battery Switching" transistor.

If the relay contact is moved to the position shown (to +12 Volts, or "Battery"), the circuit acts like the "Ground Switching" circuit in Figure P-3B. Diode CR-B is reverse-biased and does not conduct. However, diode CR-A conducts and the "Battery Switching" input is unimportant because diode CR-A is providing the required "Battery" connection. The Isocoupler is controlled entirely by the "Ground Switching" transistor, which is part of the Digital I/O board circuitry in the computer.

As noted in Figure P-3C, the output of the relay contact may be connected to other similar switching networks so that a single contact may control as many networks as required. This is the method employed on the Transmitter Interface/Backup Controller board to choose between the Main and Backup Controllers, using four-pole latching relay K1. Two paralleled sets of contacts on the relay act to control the "Switch". They provide the choice of Ground or +12 Volts for the diode networks (described above) for all control functions of the Controller.

The other two sets of contacts on Relay K1 are used to select the source of the IPA Ramp voltage. In the Main position, the IPA Ramp is generated by the Analog I/O Board in the computer. In the Backup position, the IPA Ramp originates on the Transmitter Interface/Backup Controller board in a ramp generator described in more detail later.

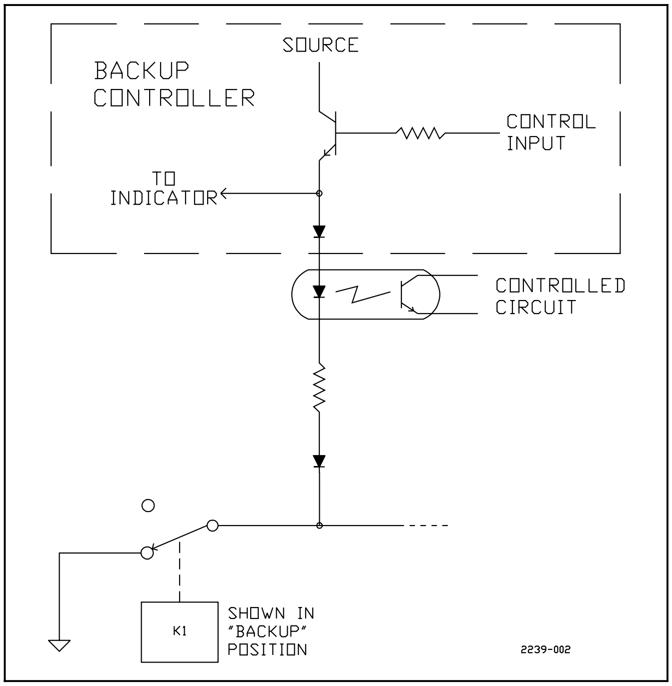

Figure P-3A. "Battery" Switching

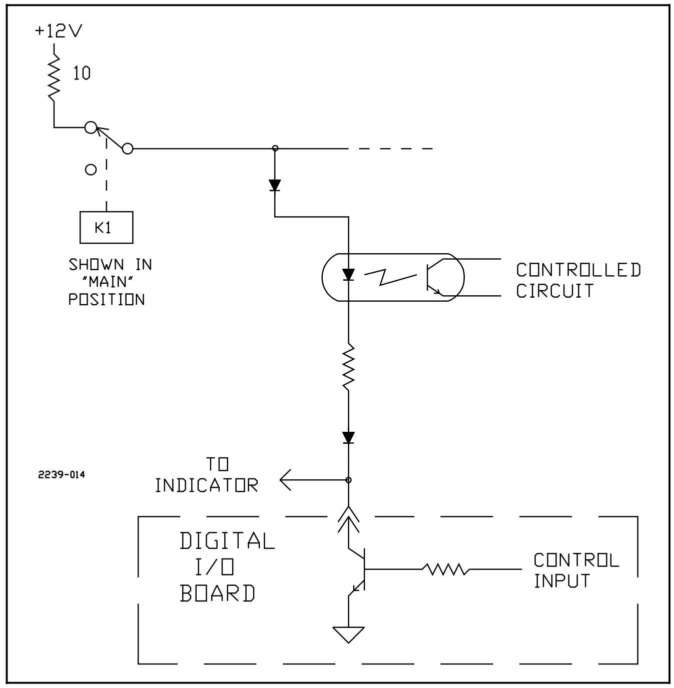

Figure P-3B. "Ground" Switching

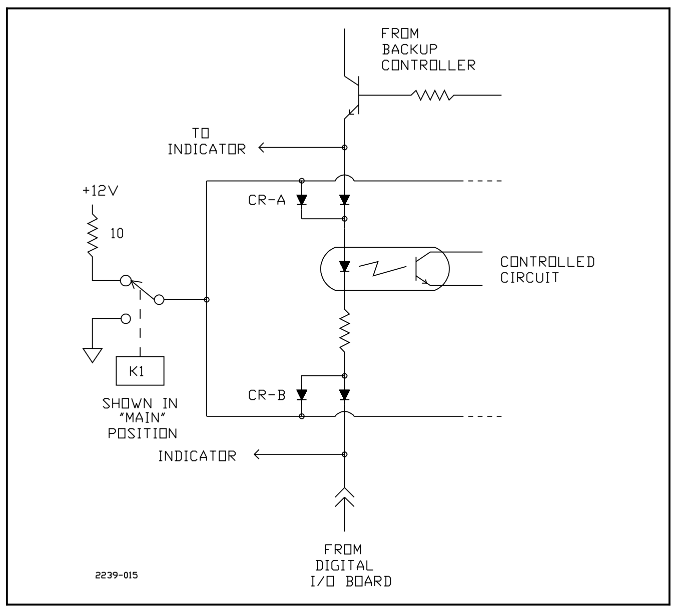

Figure P-3C. The "Switch"

Relay K1 may be controlled by any of three methods. The most direct is the MAIN/BACKUP switch (S1) on the CONTROL STATUS panel of the Controller. If switch S1 is in the Backup position, transistor Q6 is kept active and the SET coil of K1 is continuously energized. The relay will stay in the Backup position regardless of the operation of transistor Q5 and the RESET coil of K1.

When switch S1 is in the Backup position, or if the computer has failed (which keeps U26-13 low), Remote control of the MAIN/BACKUP selection is inhibited so that there will be no activation of Q5 and the RESET coil. This is accomplished through the RMT BACKUP INHIBIT circuit and transistor Q2 (see Figure P-10, Sheet 1). When this transistor is active, transistor Q1 is turned off, preventing remote or extended control of these two functions, even if Remote or Extended Control is enabled. RMT BACKUP INHIBIT is generated by a section of U26 (which acts as an inverter). When U26-13 is being held low (indicating a computer failure) or when S1 is in the BACKUP position, the input to the inverter section of U26 (pin 6) is held low and its output (U26-5) is high, inhibiting Remote or Extended Control of the choice of Main or Backup Controller.

When switch S1 (MAIN/BACKUP) is moved to the MAIN position, transistor Q6 is turned off, (unless the computer is inoperative). Switch S1, through capacitor C19, provides a momentary source of current for transistor Q5 (through CR9). If the computer is operating (and transistor Q6 is turned off), relay K1 moves to the RESET position. Its contacts reverse and the "Switch" is now set for the Main (computer) Controller. However, if the computer is not in operation, the output of U26 (pin 13) is low, keeping Q6 turned on and the relay will not change positions. If this condition exists, the Remote and Extended control of the MAIN/BACKUP choice remain inhibited. If the computer is operating, U26 will have no effect on relay K1, and after S1 is moved to the MAIN position, Remote or Extended control of the MAIN/BACKUP choice is permitted (if Remote and/or Extended Control are enabled).

If the computer fails while in normal operation (and switch S1 is in the MAIN position), U26-13 will go to the "Low" state and relay K1 will move to the SET position, switching the Controller to the Backup Mode. Remote and/or Extended Control of the MAIN/BACKUP function are inhibited as long as the computer is inoperative. Once the computer is operational, control may be returned to MAIN by either of two methods; by moving S1 to

BACKUP and back to MAIN, or by Remote or Extended Control selection of MAIN (if Remote and/or Extended Control are enabled).

In summary, the "Switch" is functionally a multi-pole, two position set of circuits which select either the Main (computer) or Backup controller to operate the transmitter. Should the computer fail or should the MAIN/BACKUP switch (S1) on the CONTROL STATUS Panel be set to BACKUP, the "Switch" will select the Backup Controller and Remote or Extended control of this selection is inhibited. If the computer is operative, the choice of Main or Backup may also be made from properly enabled Remote or Extended inputs.

U26 (pins 8, 10, 11, 12 and 13) is the computer failure protection circuit. It is commonly referred to as a "deadman" timer. When power is first applied to the equipment, C47 holds U26-10 (the Reset input for U26) low for a relatively long period of time. U26-13 is an open circuit under this condition and has no effect on the position of relay K1. After the computer begins to operate (delayed by its initialization sequences), it begins to provide a series of pulses at the output of the Digital I/O board to J10-25.

These pulses are coupled through C45 and CR37 to C43, keeping it discharged.

CR40 acts as a dc restorer for C45. Under normal conditions, these pulses will begin before C47 charges and releases the Reset input to U26-10. As long as C43 remains discharged, the voltage at U26-8 and U26-12 remains low and U26-13 remains an open circuit. If the computer fails (and the pulses stop), R107 will charge C43 (and C45 if J10-25 is low when the computer fails). When the voltage on C43 reaches about 8 Volts, U26-13 will switch on at the low state, forcing the controller selection to Backup mode. U26-13 will remain low until the computer again produces a series of pulses.

P.3.4. BACKUP CONTROLLER

The Backup Controller consists principally of the circuits associated with IC's U20, U21, U22, U23 and U24 (see Figure P-10, Sheet 2). Transistors Q7 through Q16 represent the "Battery Switching" outputs from the Backup Controller. These outputs are connected to the "Switch", which chooses either the Backup Controller or the Main Controller for the operation of the control circuitry in the Main Cabinet and High Voltage Power Supply. The "Switch" is described in detail in the preceding paragraphs.

Refer to Figure P-10, Sheet 2. The Lower command (from the input circuitry described earlier) is connected to U20-8,9. This IC section serves as an inverter and its output is connected to U20-5. The other input to this IC section is the "Switch" control line, and is "low" (zero volts) when the Backup Controller is active. If the Local (front panel) LOWER button is pressed, the Lower Command (from the input circuitry) is inverted by the first section of U20 (pins 8, 9, 10), enabled and inverted by the second section of U20 (pins 5, 6, 4) and applied (through R93) to the base of emitter-follower transistor Q7. If the Main Controller is enabled instead of the Backup Controller, U20-6 (the "Switch" control line) will be in the "high" state and Q7 will not be turned on.

The RAISE circuit operates in the same manner.

The Filament portion of the Backup Controller is somewhat more complicated.

In the Backup mode, the anode of CR17 is low and it does not conduct. A FILAMENT ON command is presented to U21-6 as a high. The resulting low from the output is passed through the second section of U21 (pins 12, 13, 11), if there is no active Overload (which would present a high at U21-13). The high at U21-11 is connected to U22-8 and U21-2. The output at U21-3 is inverted by U22 (pins 1, 2, 3) and passed through resistor R93 to the base of transistor Q9. Under normal conditions this will start the Blower. However, if the Phase Detector Control Input (J4-36) is open, indicating that the Three-Phase Detector does not consider the Power Line input to be correct for Blower use, there will be no Collector connection for transistor Q9 and there will be no control for the Blower contactor. If the Blower runs properly, the Air switch closes and the other input to U22 (pin 9) is raised to the high state by the voltage returned from the Air switch. U22-10 now goes low and is presented to U21-8.

If the FILAMENT OFF command is not present (it would be if the FILAMENT OFF button were being held pressed), U21-10 goes high. This high goes three places; first to U21-5. The "loop" is now complete and it is no longer necessary to hold the FILAMENT ON button pressed. Note that the loop was not complete until the Air Switch closed. In the Backup mode, it is necessary to hold the FILAMENT ON button pressed until the Air Switch closes in order for the Filament circuit to "lock up". Ordinarily, this delay is less than one second.

The second output from U21-10 is presented through R93 to the base of Q10.

This results in the operation of both the Filament supply for the PA tube and the Power Supply for the Preamplifier and IPA. The third use of the output from U21-10 is an input to U24-9. This will permit the Plate circuit to be turned On. Note that the collector of transistor Q10 and the upper side of Isocoupler U18 (pin 15) are connected to the return from the Air Switch. This is additional insurance that the Filament circuit cannot be energized without an air supply.

Filament voltage is sampled at the PA tube socket and connected to inputs of U27 (see Figure P-10, Sheet 3) by way of Main Cabinet wiring and terminals 18 and 44 of connector J4 on the Transmitter Interface/Backup Controller board.

The first two sections of U27 (pins 8, 9 and 10 and pins 5, 6 and 7) are simply voltage followers (current amplifiers). The third section (pins 1, 2 and 3) is a differential amplifier with the purpose of removing any common-mode voltage which may be present at the input of the two followers.

The output at U27-1 is presented to U29, an RMS converter. The output of U29 is a dc voltage representative of the true rms input to U29.

This voltage is divided in half (by resistors R128 and R135) for input to the Analog I/O portion of the computer-based controller, and is applied directly to U30 (pins 8, 9 and 10) which has a six-volt reference applied to its inverting input. The output of this section of U30 is positive (and is passed through diode CR66 as a logic "high") whenever the Filament voltage is more than six volts.

When Filament voltage is actually present (as indicated by this "high"), the input to U21-1 and U22-6 goes to the high state. The action at U21 is to prevent the Blower from being turned Off if the Filament voltage remains On when the FILAMENT OFF button is pressed. The intention is to reduce the possibility of damaging a tube or tube socket if the Filament relay fails in the closed position. The use of a Filament-On logic signal at U22-6 enables the operation of the Bias supply (when the Plate On sequence starts). If there is no Filament voltage, the Bias supply cannot be turned on and the Plate On logic is interlocked so that Plate and Screen power supplies cannot be turned on.

A FILAMENT OFF command introduces a logic "high" at U21-9. This turns off the output of this section (U21-10) which "unlatches" the Filament control circuit and removes the drive for Q10, turning off the Filament transformer. The output at U21-4 goes high, U21-11 goes low, U21-3 goes high, U22-3 goes low, and the Blower turns off (if the Filament Voltage has gone away). If Filament voltage remains, U21-3 remains low, U22-3 stays high, keeping Q9 turned on and the Blower continues to run to protect the tube and tube socket.

The Plate On sequence starts with a PLATE ON command from the Input Circuits.

(CR19 is reverse-biased when the "Switch" is set for the Backup controller.) This input is applied to U23-1 and U24-6. U24-5 is low at this time so that no further action takes place on this branch of the circuit. However, U23 (pins 1, 2 and 3) inverts the command and applies it to U23-12.

If the Filament system is operating, U24-9 is high. U24-8 is high if the transmitter is in LOCAL or if the Failsafe Control Input is present. U24-10 then applies a low to U23-13. The resulting high at U23-11 is applied to U24-2, U24-5 and U22-5. Since U22-6 is high (if there is more than six volts on the Filament), U22-4 goes low and U22-11 goes high, turning on Q11, if the Main Cabinet Interlock circuit is closed. Current flows in the Isocoupler (U18) which controls the BIAS solid-state relay (SSR). If the Bias Power Supply operates correctly, Bias voltage will be applied to the PA tube.

A portion of the Bias voltage, known as GRID E SAMPLE, is connected through Main Cabinet wiring to terminal 43 of J4 (Figure P-10, Sheet 3, location C-7). This sample, through protective resistor R168, is applied to U30-12.

The inverting input has a reference voltage of about -1.2 volts applied to it. The non-inverting input will have about this voltage when the Bias voltage reaches -180. Therefore, if the Bias voltage reaches or exceeds -180 volts, U30-14 will go negative. Diode CR65 "converts" this to a logic low.

The low is applied to U23-5. U23-6 is already low because both inputs 5 and 6 of U24 are high. The high produced at U23-4 is applied through R93 to the base of Q12. Note the conditions which must hold true for all of this to happen: (a) The Filament circuit must be on with more than six volts present; (b) The Bias Power Supply must come on with at least 180 volts present; (c) the PLATE ON Command Input must still be present. At this time, current is applied by Q12 to the Isocoupler which controls the STEP/START SSR. However, there are some other circuit conditions which must be met before the STEP/START SSR can operate.

Terminals 10 and 14 of U18 are connected to terminal 9 of Isocoupler U15.

This circuit can be ON only if the External Interlock Control Input is active. (This circuit might be used with an rf switching system so that the transmitter Plate cannot be turned on if the transmitter is connected to a water-cooled dummy load while the water is off.) Terminal 10 of Isocoupler U15 is connected to terminal 33 of J4. If the High Voltage Power Supply interlocks (doors switches or grounding-stick switches) are open (indicating something out of place), this circuit will be open and the High Voltage Power Supply cannot be turned on.

If all of the Interlock circuits are closed, the Isocoupler controlled by Q12 will operate the STEP/START SSR circuit. In the High Voltage Power Supply (HVPS), the STEP/START SSR (3K6) completes the circuit for 3K4, the STEP/START contactor. When the contactor closes, its Auxiliary Contacts complete a circuit from +12 volts through the wiring in the HVPS, the interconnecting cable, and the Main Cabinet to terminal 29 of J4 (Figure P-10, Sheet 2, location E-9). This voltage is applied through CR28 to the Isocoupler which controls the RUN SSR.

This signal energizes 3K5 in the HVPS, which completes a path through 3K7 for the operation of 3K3, the RUN contactor. (Relay 3K7 is operated as long as the 24 volt ac Interlock circuit is closed through all doors and grounding-stick switches in the Main Cabinet and the HVPS.) When the RUN contactor closes, its Auxiliary contacts complete a circuit from +12 volts through the wiring in the HVPS, the interconnecting cable, and the Main Cabinet to terminal 3 of J4 (Figure P-10, Sheet 2, location E-9). This voltage is applied through R89 to U24-1. U24-2 is already high and the low output is applied to U24-12 (U24-13 is low if the bias supply is lower than -180 Vdc) and to the PA OPERATE/BYPASS switch on the CONTROL/STATUS Panel. In the normal OPERATE position, the switch completes the circuit to U23-9. If the Plate Off circuit is not active, U23-10 goes high. This is applied to U23-2 and R125. U23-2 is now "latched" and the PLATE ON command circuit (front-panel pushbutton or Remote Control input) may be released. When this command is released, the STEP/ START SSR and STEP/START contactor in the HVPS are released. The high from U24-11 has turned on Q13 to maintain drive for the RUN Isocoupler (which will hold the RUN contactor closed after the STEP/START contactor is released).

The high applied to R125 provides drive for the base of Q15. The collector of Q15 is connected to supply voltage if the External Interlock Control Input and the Exciter AFC Interlock Control Input are both active. In other words, even though we have turned on the High Voltage Power Supply, there will not be any further activation of the rf control circuits if the Exciter AFC circuit is open.

If Q15 collector has the required collector voltage present, the emitter of Q15 provides drive for the base of Q14. This transistor turns on the lamp circuit for the PLATE ON button and starts the rf path control. Diode CR64 completes a path to two sections of Isocoupler U19. One section acts to turn off Q18, which unmutes the IPA Preamplifier. The other section turns off Q17, which unmutes the Exciter. The voltage from CR64 is divided

WARNING: Disconnect primary power prior to servicing.

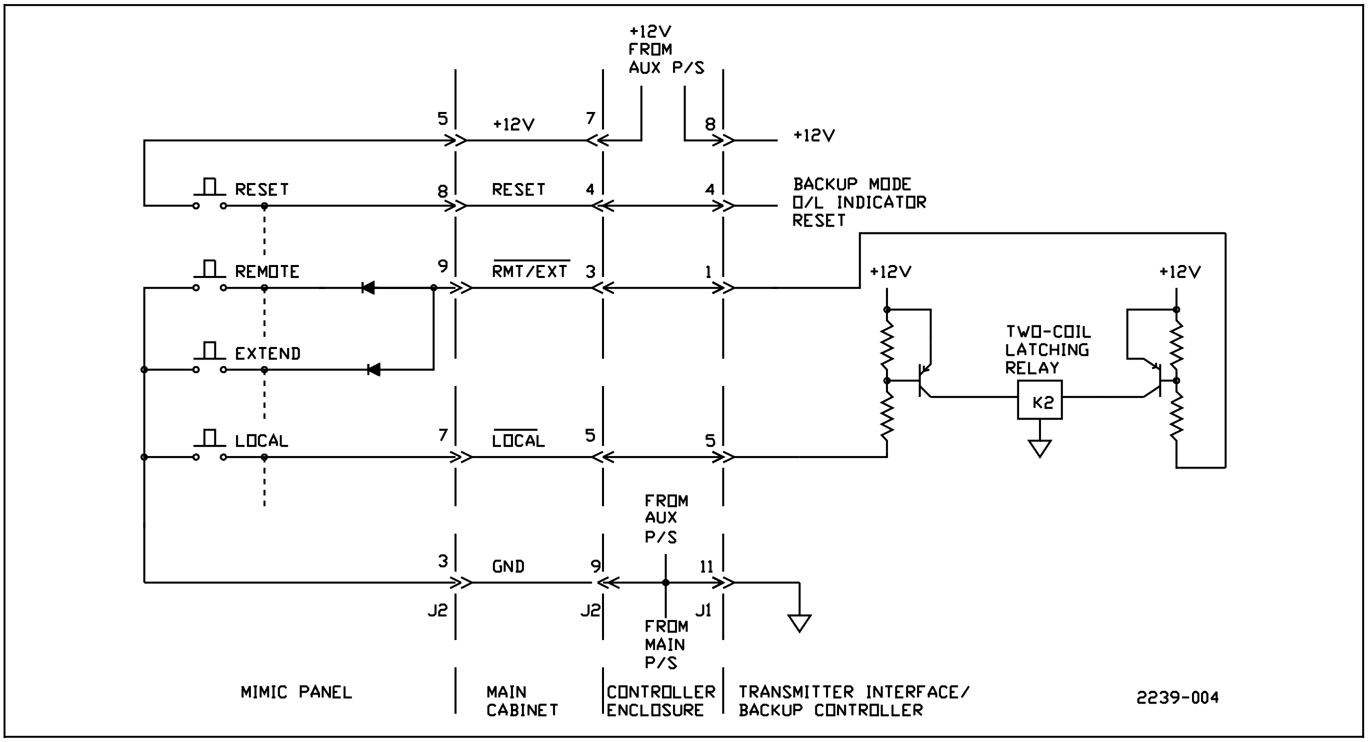

Figure P-4. Local/Remote Switching

by R121 and R122 and applied to the base of PNP transistor Q22. Transistors Q20 and Q21 make up a "current mirror" linear slope generator. The theory is that if Q20 and Q21 are perfectly matched, the current in the collector circuit of Q20 will be the same as the current in the collector circuit of Q21, which is determined by R120. This current will be available for charging C79, the ramp slope capacitor.

When a voltage is established at the base of emitter-follower Q22, this "releases" a clamp which has held C79 at about the 1.6 volt level. C79 now begins to charge from the current available at the collector of Q20. The voltage on C79 is coupled through diode CR58 to the base of Q19, which is an emitter-follower to provide drive for the IPA Preamplifier. CR58 is not necessary for the operation of the circuit, however the drop across the diode equals the drop across CR57 which means that the voltage at the base of Q19 will equal the voltage at the emitter of Q22. Further, the voltage drop across the base-emitter junction of Q19 equals that of Q22. The result of this is that the final ramp voltage at Q19 emitter will equal the voltage established at the base of Q22 when the circuit was enabled.

When the PLATE OFF circuit is operated, all of the related Isocoupler circuits are de-energized at once. The IPA Mute is reestablished immediately, and the ramp is reset quickly by discharging C79 through CR57 and Q22. The Exciter is muted by Q17 after the delay of charging C96 through R118 to the voltage required to turn on Zener diode CR73.

If the Main Controller is enabled, all of the control functions of the Filament and Plate sections of the Backup Controller are inhibited at the "Switch" circuits. However, in order for the Backup Controller to keep up with the computer-based Main Controller, it is necessary to "precondition" the Backup Controller. This is done through diodes CR17 and CR19, which provide the equivalent of FILAMENT ON and PLATE ON commands to the Backup Controller inputs. When the Main Controller responds to a FILAMENT ON command, it will start the Blower. Once the Blower is running, the Air Switch closes and the Backup Controller will "latch" and will be ready to take over if the change is made to the Backup Controller. Similarly, when the Main Controller enters the FILAMENT OFF routine, it turns off the Filament circuit but keeps the Blower running for a Filament cool-down period. During this time, the Backup Controller remains in the Filament On mode. If there is a switch to the Backup Controller before the Blower is turned off, the Filament will again be turned On and a new FILAMENT OFF command will be required.

P.3.5. REMOTE CONTROL ENABLING

Figures P-4 and P-5 are simplifications of the circuitry for selecting Local or Remote/Extended control of the transmitter. The circuits not shown completely are a part of the Mimic Panel circuitry and are used to send information to the computer when buttons are pressed.

Figure P-4, Local/Remote Switching shows the connection of the frontpanel switches (on the Mimic Panel) to relay K2 on the Transmitter Interface/Backup Controller board. The RESET button returns +12 Volts when pressed and is used to reset the Overload Indicator latches which are used in the Backup mode of operation. The REMOTE and EXTEND switches are connected to a single circuit.

There is no difference between the Remote and Extended control inputs when operating in the Backup mode.

WARNING: Disconnect primary power prior to servicing.

Each of the control lines (RMT/EXT or LOCAL) simply turns on a transistor, which in turn supplies current for one coil of relay K2. The nature of this circuit is that the relay always follows the pushbutton selection, whether the controller is set for Main or Backup mode.

Figure P-5, Local/Remote Indicator Control, shows how the Mimic Panel indicators (associated with the Remote/Local functions) are connected. When relay K1 (on the Transmitter Interface/Backup Controller board) is set for Main (as shown), the Controller BACKUP LED is dark and the diodes in series with the EXTEND and REMOTE switch LED's will be reverse biased and will not conduct. This Controller BACKUP LED is located in the Mimic Panel display area box called CONTROLLER.

When operating in the Main controller mode, these two indicators are entirely under control of the Mimic Panel circuitry, which is, in turn, under control of the computer. If Local is selected, there is no +12 Volt reference for the EXTEND and REMOTE indicators and they will not light. The LOCAL indicator will be lighted directly from the ground on the R/C ENABLE circuit.

When operating in the Backup controller mode, relay K1 on the Transmitter Interface/Backup Controller board will be in the opposite position from that shown. A ground is provided which will illuminate the BACKUP indicator in the CONTROLLER box on the Mimic Panel display, and will force the lighting of both the EXTEND and REMOTE button indicators whenever relay K2 is in the RMT/EXT position. As before, when K2 is in the Local position, the LOCAL LED is lighted and the EXTEND and REMOTE indicators are dark.

P.3.6. INTERLOCK CIRCUITS

Figures P-6 and P-7 are simplifications of circuitry which is discussed in part in the description of "the Switch". Figure P-6 shows three Interlock inputs, the HVPS Cabinet Interlock, the External Interlock and the Exciter AFC Interlock. Each of these includes a section of an Isocoupler which is a part of "the Matrix". In addition, there is some logical "ANDing" of inputs to develop some additional combinations of these interlock inputs.

The HVPS Cabinet Interlock and External Interlock inputs are combined to generate the STEP/START and RUN Source. This is the voltage which is used for the circuits in the Switch which originate the commands for these functions.

If either the HVPS Cabinet Interlock circuit or the External Interlock circuit is open, the STEP/START and RUN command circuits will not operate.

The Exciter AFC Interlock and External Interlock circuits are combined so that if either one is open there will be no Exciter unmute, IPA unmute or IPA Ramp generation. Please note: this circuit is bypassed when operating in the Main controller mode]

The External Interlock circuit returns to a circuit labeled CONTROL RETURN.

This circuit is shared with the interlock inputs show in Figure P-7. Since all of these circuits originate outside the transmitter, they are provided with a separate control return to permit the use of an external power supply if desired. (See Section II, INSTAL-

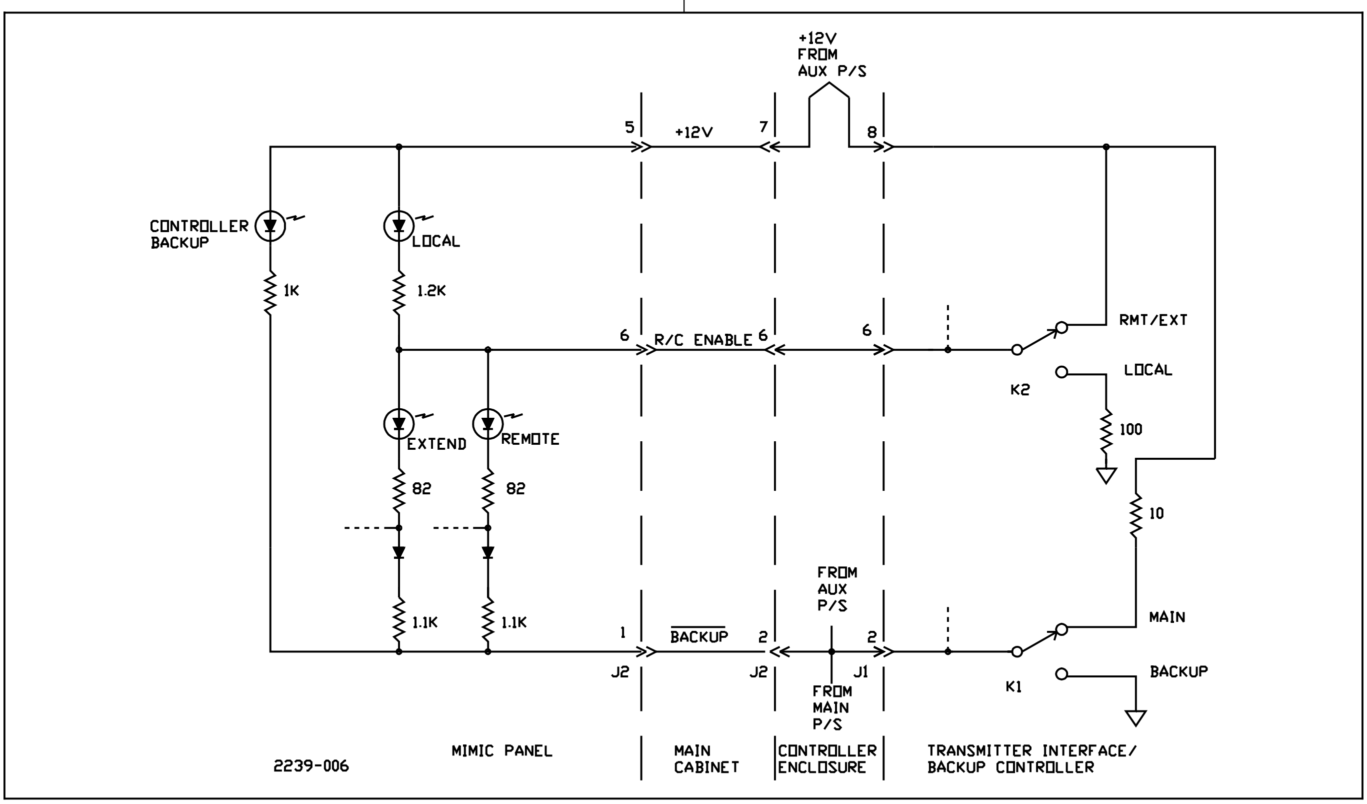

Figure P-5. Local/Remote Indicator Control

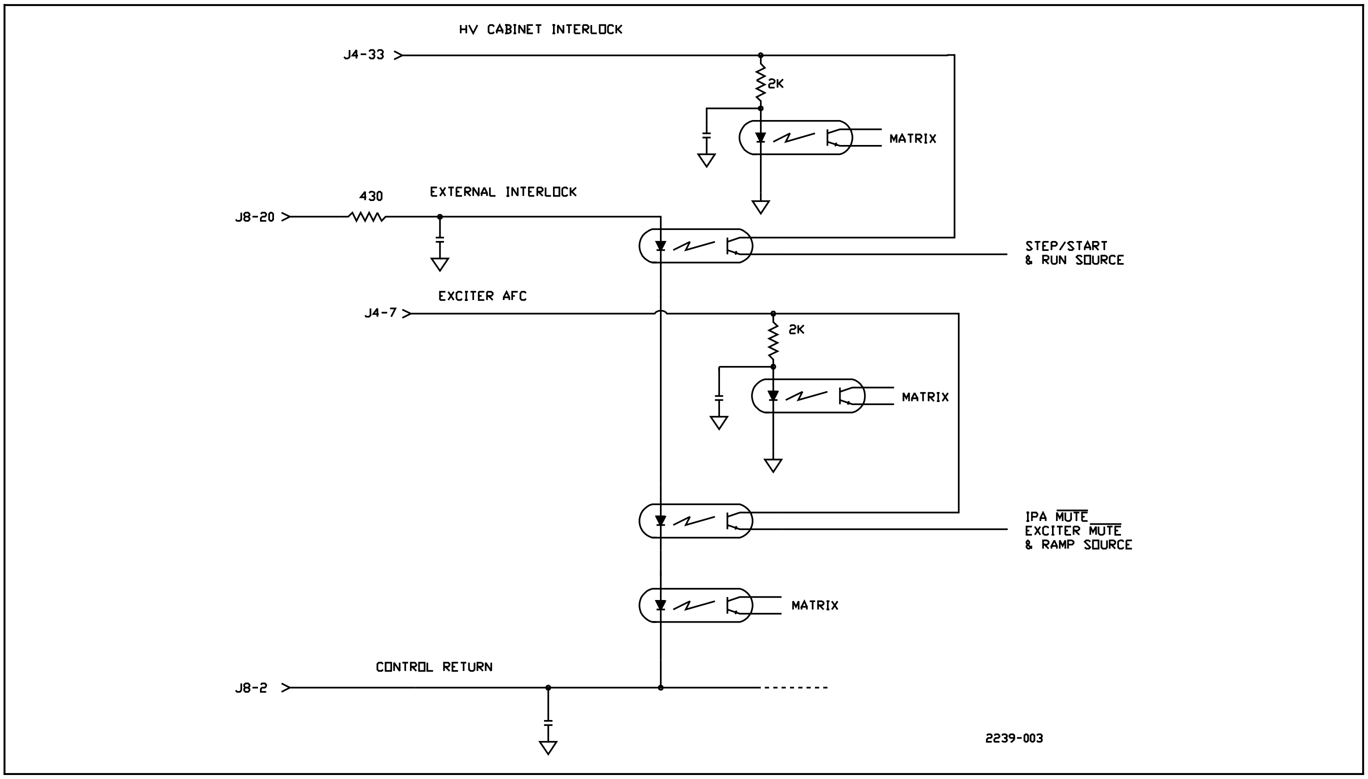

Figure P-6. Interlock Circuits - 1

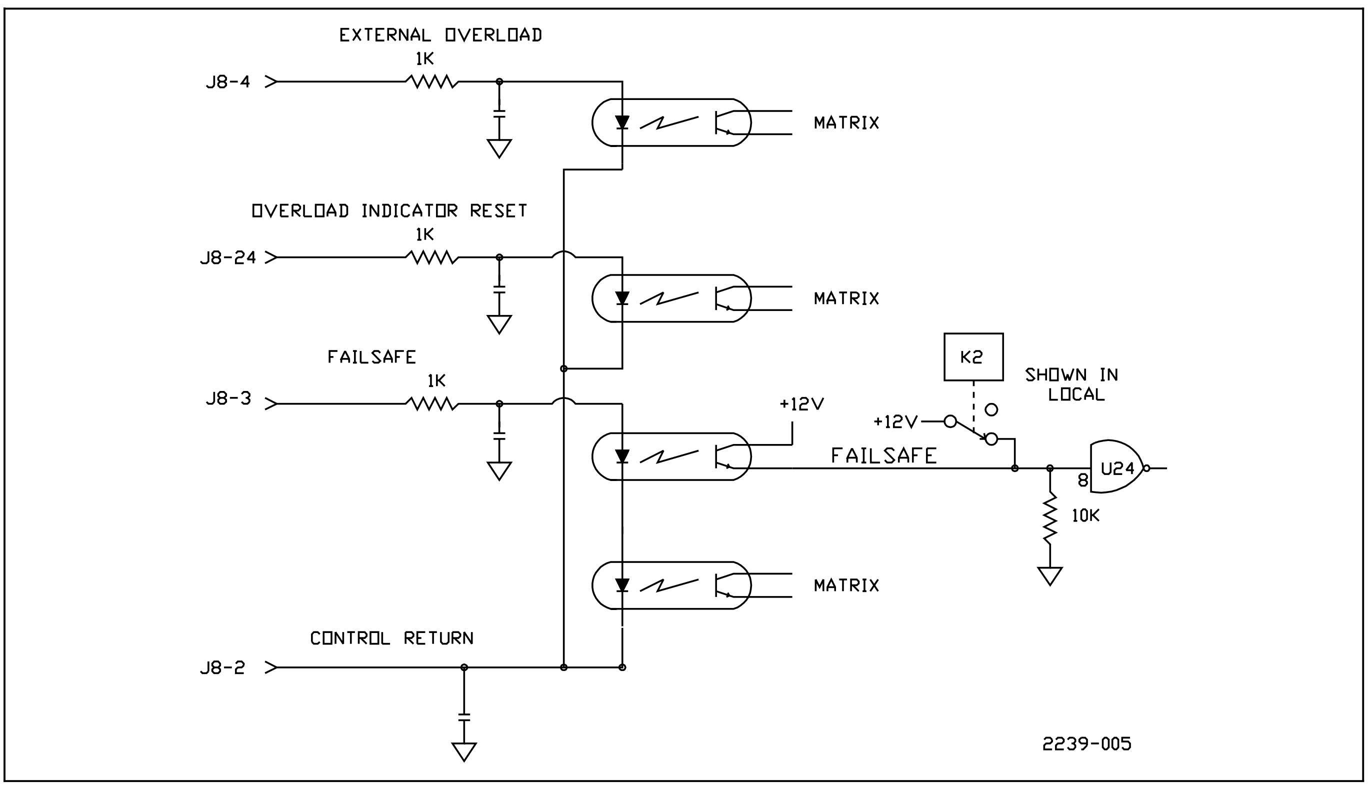

Figure P-7. Interlock Circuits - 2

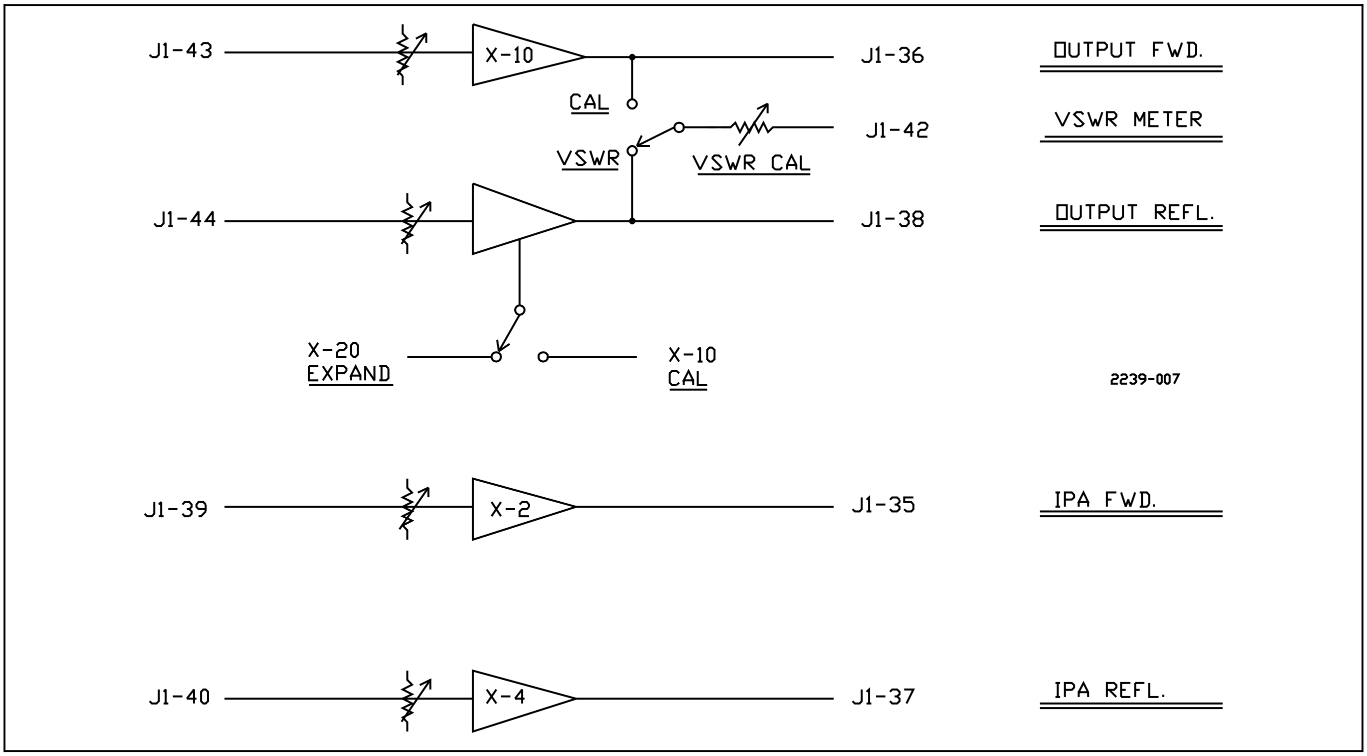

Figure P-8. Calibration Amps, Control Status Panel

LATION.)

The inputs shown in Figure P-7 include EXTERNAL OVERLOAD, OVERLOAD INDICATOR RESET and FAILSAFE. As before, each is connected to the Matrix. However, for two of these inputs, the Matrix connection is the only one. This means that they are not recognized when operating on the Backup mode.

The FAILSAFE input is connected to the Backup Controller, and, as shown, is bypassed when the control is selected to Local.

The remaining overload input is from the MAGNETIC OVERLOAD circuit in the HVPS. This circuit will be discussed with the Transmitter Interface/ Backup Controller board overload circuits. There are two other interlock circuit inputs to the Matrix that have already been mentioned. These are the PHASE DETECTOR CONTROL input and the MAIN CABINET INTERLOCK circuit.

P.3.7. OTHER MATRIX INPUTS

The computer is given information about several other circuits through the Matrix. These include LOCAL MODE (derived from relay K2), BACKUP MODE (derived from relay K1), AIR SWITCH closed, STEP/START contactor closed, RUN contactor closed, and UPPER LIMIT and LOWER LIMIT switches operated.

P.3.8. TIME REFERENCE SIGNAL

At the lower left corner of Sheet 2 of Figure P-10 there is an integration network terminating at the base of transistor Q25. The input to this circuit is 24 Volts ac from the transformer in the Auxiliary Power Supply. The integration removes noise that may be on the power line input to the transmitter and the transistor serves as a rectifier and pulse amplifier. The output from Q25 is connected to the Digital I/O board in the computer and is used as the 60Hz input for the real-time clock/calendar.

P.3.9. METERING CIRCUITS

Figure P-10, Sheet 3, shows the metering circuits on the Transmitter Interface/Backup Controller board. The first of these circuits is for Filament Voltage monitoring and is described briefly in the section about the Backup Controller. It consists of three sections of U27 arranged to provide a well isolated differential input to the RMS converter, U29. The output is divided in half by resistors R135 and R128 so that the sample voltage will not overload the input to the Analog I/O board of the computer under any circumstances. Without this division, it is possible that the output of the RMS converter could approach the Analog input limit if the filament was open (or the tube not connected). The entire output of the RMS converter is used by the logic comparator for the Backup Controller.

The resistors that divide the converter output also serve another purpose. If the computer is turned off, or for any other reason the Controller Main Power Supply is inoperative, the inputs to the Analog I/O board are “clamped” at a low level because of the protective diodes that are present on the Analog I/O board input circuits. The sampling circuits that are present on the Transmitter Interface/Backup Controller board and which are used by circuits on the Transmitter Interface/Backup Controller board as well as by the Analog I/O board, must have isolation so that the “power-off” loading will not affect the

Backup mode use of these circuits. These isolation resistors will be identified as they are encountered in the description of the metering circuits. The second metering circuit shown on Figure P-10, Sheet 3 is the Plate I or Plate Current circuit. In addition to the current limiting resistors in the input to U28 there are also diode clamping components in the form of bridge rectifier CR69. The first two sections of U28 are connected as a differential amplifier with a voltage gain of two (2). This is followed by a section of U27 connected to remove the common mode component of the input signal. It has a voltage gain of one. Therefore, the entire circuit has a differential input and a voltage gain of two. The output is connected to the Analog I/O circuit (PLATE I METER) through an isolation resistor (R175), to the overload comparator (U32-9) and to the isolation resistors for J5 (R24), J6 (R25) and J7 (R36). These connectors are for the local front-panel meter (J5), the Extended Control circuit (J6, which goes to TB6 on the Customer Interface Panel) and the Remote Control circuit (J7, which goes to TB7 on the Customer Interface Panel).

Two sections of U28 and one section of U30 provide the same sort of circuit for the Screen I or Screen Current sample input. The output of the circuit in this case goes to the Analog I/O board (SCREEN I METER) through the isolation resistor (R174), to the overload comparator (U32-11) and to a presently unused output at J5-25 and an output at J8-10.

At the lower left corner of Sheet 3 of Figure P-10, is the Plate E or Plate Voltage Sample. This circuit consists of protective components and a section of U30 connected as a follower. The output of this circuit is connected to the Analog I/O board through an isolation resistor (R169) and to the output connectors J5, J6 and J7 through isolation resistors. The voltage gain of U30 is one.

The remaining four metering input circuits shown on Sheet 3 of Figure P-10 are identical. They are for the output of the directional couplers that are in the transmission line and in the filter between the IPA and the PA. Each of these amplifiers has a voltage gain of one and is used as a current amplifier. The outputs of all four of these circuits are carried to the Control Status board (Figure M-2).

In each circuit there is a calibration control and an amplifier. The design of the directional couplers is such that the input voltage to these amplifiers is not more than five (5) Volts at full operating levels. The amplifiers are designed so that they will have the intended gain when the calibration controls are adjusted to about 700 to 800 ohms. At this value, the total input resistance for each of the amplifiers is about 5k Ohms. (It should be noted that in actual practice, the ideal setting will rarely be used: sample signal voltages are never what the designer wanted them to be. This is why adjustable controls are provided.)

The design goal for the amplifier in the OUTPUT RF FORWARD SAMPLE circuit is about -10 (the sample signal from the directional coupler is negative and a positive indication is needed). This gain is determined by the ratio of R5 (51k Ohms) to the input circuit (5100 Ohms, the result of R4, 4300 Ohms, in series with R101, set to 800 Ohms). The output of this amplifier is returned to the Transmitter Interface/Backup Controller board sent to the Analog I/O board (through an isolation resistor) and to the connectors J5, J6 and J7, through isolation resistors. The output of this amplifier is also connected to the VSWR CALibration Switch, S3, on the Control Status panel.

The design goal for the amplifier in the OUTPUT RF REFLECTED SAMPLE circuit is about -20 (when the CAL switch, S2, is in the EXPAND position) or -10 (when switch S2 is in the CAL position). When in the CAL position, the amplifier can be made to match the Forward amplifier. In the EXPAND position, the gain of the amplifier is doubled to provide an expanded VSWR scale for easier reading. Once the input controls of these two amplifiers are adjusted (see the proper procedure in the section M of this Manual), switch S2 can be left in the EXPAND position. Routine operation of the equipment will make use of switch S3 (CAL/VSWR) and R105 (VSWR CAL) to adjust the front panel meter to display VSWR properly for the current operating power.

The output of the amplifier, U1-8, is returned to the Transmitter Interface/Backup Controller board (REFLECTED POWER METER) and sent to the Analog I/O board (through an isolation resistor), to a comparator (U32-5) and to connectors J6 and J7, through isolation resistors. The output of R105, VSWR METER, is returned to the Transmitter Interface/Backup Controller board and sent to J5, for use by the front panel meter.

The two remaining amplifiers, for IPA RF FORWARD SAMPLE and IPA RF REFLECTED SAMPLE, have design gains of -2 and -4 respectively. Their outputs are returned to the Transmitter Interface/Backup Controller board. The IPA FORWARD METER is sent only to the Analog I/O board through an isolation resistor. The IPA REFLECTED METER is sent to the Analog I/O board through an isolation resistor and to a comparator (U32-7).

P.3.10. METER PADDING CIRCUITS

The four meter circuits connected to J7 (Remote Control) have padding resistors connected to them. These resistors, a 270 Ohm and a 1.3k Ohm in parallel on each of the four circuits, provide open circuit limitation on the voltage which might be applied to Remote Control analog sample input circuits. With both resistors in place, the open circuit limit is one (1) Volt. If the 270 Ohm resistor is cut out (leaving the 1.3k Ohm resistor), the open circuit maximum is four Volts. With both resistors cut out, the open circuit maximum is 10 volts. The 10 Volt limit is also the value for the Extended Control connector, J6.

P.3.11. AUXILIARY ANALOG CIRCUITS

There are several other voltage and current samples that enter the Transmitter Interface/Backup Controller board for the one purpose of being passed along to the Analog I/O board in the computer. These circuits are shown near the center of Sheet 2 of Figure P-10, and include:

GRID E SAMPLE
GRID I SAMPLE
SCREEN E SAMPLE
UNREG E SAMPLE
REG E SAMPLE
PRE-AMP FWD SAMPLE
PHASE “A” SAMPLE

PHASE “B” SAMPLE

PHASE “C” SAMPLE

EXEC FWD SAMPLE

IPA TEMP SAMPLE

INLET TEMP SAMPLE

STACK TEMP SAMPLE

There are also some auxiliary outputs from the Analog I/O board. These have no anticipated use with one exception: the signal at J12-38, is amplified by U41 and sent to J8-22 and J5-7. In a future release of HT 30/35FM software, it is anticipated that this output may have an analog equivalent of the front-panel digital multi-meter display.

P.3.12. OVERLOAD CIRCUITS

The HT 30/35FM Overload Circuits are intended to protect the transmitter in the event of a failure of the computer-based Main Controller. There are five of them, four on the Transmitter Interface/Backup Controller board and one in the HVPS. The four on the Transmitter Interface/Backup Controller board are originated by comparators. Each of the four comparators (U32) has a sample input, obtained from one of the amplifiers on the Control Status panel, and a reference voltage, obtained from a LIMIT control on the Control Status panel.

The Limit voltages are also connected to the Analog I/O board, through isolation resistors, so the computer has the same Overload Limit setting as the hardware comparator. This makes it possible to set the LIMIT controls by reading the digital multimeter display. The outputs of the four comparators are normally at a logic low level. Each is connected to the Digital I/O board and to an OR gate, U33. The output of U33-10 is inverted by U33 (pins 11, 12, 13) and delivered to AND gate U34-8. If the PLATE REQUEST circuit is at a logic high (indicating that a Plate On should exist), a Plate Current or Screen Current overload will cause a low at U34-10. (If a Plate On condition does not exist, PLATE REQUEST is low and U34-9 is low, blocking the output from either the PLATE I or SCREEN I comparators.)

An OUTPUT REFLECTED OVERLOAD or an IPA REFLECTED OVERLOAD will similarly be sent to the Digital I/O board and to U33 (pins 5 or 6). U33-4 is connected to U34-6 and will go low with an overload on either of these two circuits. U34-4 is connected to the Clock (“Latch”) input of U35 (pin 9 serves all four sections of U35). When any of the four overloads occur, the Clock is taken to the high level and latches any of the inputs which may have been high at the time of the Clock input. In this way, U35 stores the identity of the overload which caused the Clock action.

The Clock signal, identified as HDWR OVLD, goes to U25-9 and is OR’ed with the MAGNETIC OVERLOAD input from the HVPS cabinet. (The active state of this overload is provided by R101 if the PLATE REQUEST circuit is high and if there is a momentary open at either of the Magnetic Overload Sensors in the three-phase input to the HVPS.

The output of the OR gate (U25-10) goes two places. First, to U25-5, and U25-6 where it is inverted and sent to the base of Q16, and to U21-3 where it inhibits the output of this circuit and therefore turns off the transmitter, Plate and Filament. The purpose of Q16 is to mute the IPA as quickly as possible, stopping the rf output of the transmitter more quickly than would normally occur with the unlatching of the Plate and Filament circuits.

The second output of U25-10 goes to U34-13. This section of U34 (pins 11, 12 and 13) and another (pins 1, 2 and 3) are connected as an R-S latch, and the low at pin 13 will cause this latch to go to the “set” state (U34-11 high, U34-3 low) if Backup Mode is active. (If Backup Mode is active and there is no INDICATOR RESET function active, U33-1 and U33-2 are both low and U33-3 is high. Under this condition, U34-13 can “set” the R-S latch.) When set, the high at U34-11 will turn on the FAULT STATUS LAMP (the lamp in the PLATE OFF pushbutton). U33-3 is also connected to U35-1, the common RESET input to this circuit, and is inactive when in the idle high state.

When the transmitter is operating in the Backup mode, U35 will light one or more of the four Overload indicators on the CONTROL STATUS panel. If the transmitter is in the Main Controller mode, the Backup circuit is high. This high at U33-1 causes U33-3 to be low, which prevents the U34 R-S latch or U35 (the quad latch) from storing any input data.

P.3.13. CONTROL SWITCH INDICATORS

The Digital I/O board controls the indicator lamps in the front-panel Control pushbutton switches when operating in Main Controller mode. These circuits begin on the Digital I/O board, continue through the ribbon cable to J10 on the Transmitter Interface/Backup Controller board and are OR’ed with the corresponding circuits from the Backup Controller. The Fault Status Lamp circuit from J10-18 is inverted by U36 (pins 11 & 9) and OR’ed with the Backup Controller circuit by diodes CR35 and CR30. The indicator signal is then amplified by U39 and U40 and sent to J7, J6 and J5.

Similarly, the Raise and Lower circuits enter the Transmitter Interface/Backup Controller board at J10-21 and J10-22, are inverted by two sections of U36, are then OR’ed with the Backup Controller inputs and amplified by U39 and U40.

The Plate On and Filament On indicators are processed differently. The portion of the circuit which carries the Main Controller output is the same, but the input from the Backup Controller is gated by transistors Q23 and Q24.

If the controller selector (“Switch”) circuit is low (Backup mode), these transistors couple the Backup Controller outputs to the indicator drive circuits through diodes CR6 and CR7. If the selector line is high (Main mode), the transistors are biased off and will not conduct.

Two of the indicator circuits, Manual Power Control and Auto Power Control, are activated only by outputs from the Digital I/O board.

P.3.14. AUXILIARY DIGITAL CIRCUITS

At the lower center part of Sheet 3 of Figure P-10, there is a group of digital circuits shown which have no application on the Transmitter Interface/Backup Controller board. These are status indicator circuits for use by Remote Control equipment and are connected to J9 (which terminates at TB9 on the Customer Interface panel). These include:

EXCITER AFC OVERLOAD INDICATOR

FILAMENT OVERLOAD INDICATOR

PLATE I OVERLOAD INDICATOR

SCREEN I OVERLOAD INDICATOR

PA VSWR OVERLOAD INDICATOR

IPA REFLECTED OVERLOAD INDICATOR

PHASE LOSS INTERLOCK INDICATOR

VSWR FOLDBACK INDICATOR

AIR INTERLOCK INDICATOR

AUX COMMAND #1*

AUX COMMAND #2*

AUX COMMAND #3*

AUX COMMAND #4*

EXTERNAL OVERLOAD INDICATOR

* No present use or function. Available for future expansion.

P.3.15. CURRENT SAMPLE INPUT CIRCUITS

On Sheet 3 of Figure P-10 are the Preamplifier and IPA current sample circuits. These circuits are referenced to the IPA power supply voltage and are pulses at a frequency which represents the current present in the circuit being metered. These two circuits are connected to the LED portion of two Isocouplers. The transistor portion of these devices are connected to the CPU board in the computer. The resistors provide the active high and the Zener diodes limit the logic high voltage in the CPU side of the circuit.

The currents to be sampled are measured at the IPA supply voltage (see the description on the IPA Power Supply) because the Power Supply is common to both parts of the IPA. The sample voltages, one representing each current, are connected to two voltage-to-frequency converters. The outputs from these converters are pulses of a constant amplitude but varying frequency, with the frequency dependant on the sample voltage connected to the converter input. The Isocouplers permit dc isolation of the pulses (which are about 35 volts above ground) from the computer input (which must be at ground).

P.3.16. 24 VAC POWER DISTRIBUTION FUSE PROTECTION

Two fast blow fuses are mounted on the Transmitter Interface/Backup Controller board. These fuses are in the two 24 Vac input lines to solid state control relays K3, K4, K5 and K6. The fuses protect the circuit board traces from damage due to accidental shorting of the output lines from these relays.

Replacement should normally not be required.

	DESCRIPTION	HARRIS PART NO.
F1	5A 250V Fast Cart.	398 0022 000
F2	4A 250V Fast Cart.	398 0021 000
F3	.5A 250V Fast Cart.	398 0015 000
F4	.5A 250V Fast Cart.	398 0015 000

NOTES

WARNING: Disconnect primary power prior to servicing.

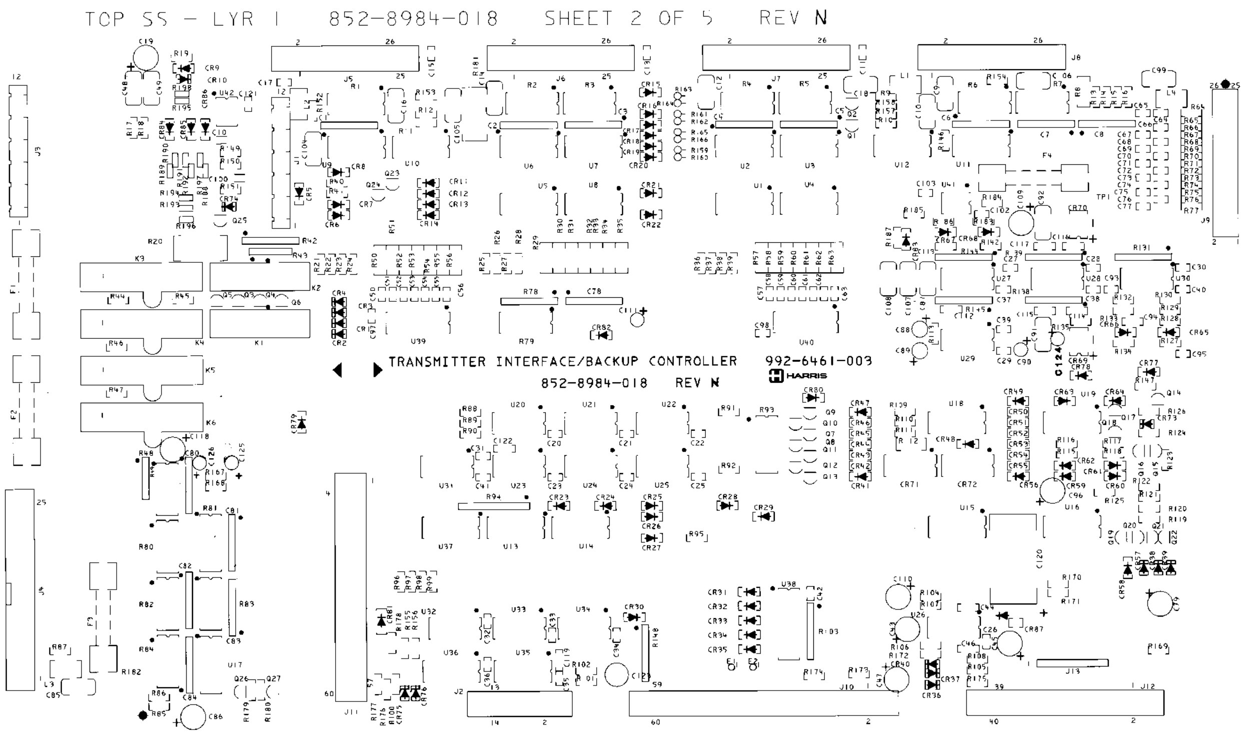

Figure P-9
Transmitter Interface/Back-Up Controller
P-15/P-16

WARNING: Disconnect primary power prior to servicing.

FIGURE P-10

SEE SCHEMATIC TRANSMITTER INTERFACE/BACKUP CONTROLLER

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WARNING: Disconnect primary power prior to servicing.

SECTION Q
SWITCH BOARD 1A7

Q.1. REMOVAL AND REPLACEMENT PROCEDURE

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND THE HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

To remove the Switch Board for service, first remove the Trim Panel at the top front of the transmitter Main Cabinet. Set the Trim Panel aside in a safe place. Remove the six screws (with hardware) that mount the Meter/Switch panel. Disconnect the ribbon cable connected to the Switch Board and take the panel to a convenient work location.

Remove the red and green caps from the pushbutton switches by pulling them away from the panel. Be careful not to drop the caps as they contain the indicator lamps. Note the position of the indicator marker on the Meter Switch knob and use the proper sized Allen wrench to remove the knob. Unplug the meter wiring harness connector at J2. Dismount the Switch Board from the meter panel by removing the eight large hex shaped nuts from the switches.

Replacement of the Switch Board is accomplished by reversing the above process. After mounting the board and replacing the nuts on the switches, re-connect the meter wiring harness, being careful to align the connectors correctly. Replace the knob, taking care to align the marker correctly. Then install the switch caps. Note that there is an alignment tab on each cap. Be sure that this tab is properly aligned with the slot in the switch shaft. The green caps are used on the first and third switches (counting from the left) in the top row.

Re-connect the ribbon cable at J1 on the Switch Board and re-mount the Meter/Switch panel. Be sure to use all of the locking hardware on the screws and tighten securely. Replace the Trim Panel.

Q.2. PURPOSE

The primary purpose of the Switch Board is to make electrical connections to the eight front-panel pushbutton switches S1 through S8 and the meter selector switch S9 (FWD - VSWR). It also serves as a convenient location for the meter calibration controls R1 through R4.

Q.3. CIRCUIT DESCRIPTION

Refer to Figure Q-2. The Switch Board pushbutton switches, S1 through S8, have one switch terminal and one indicator lamp terminal connected to a common bus. This bus is provided with +10 Volts from the Transmitter Interface/ Backup Controller board. Each of the switches returns this voltage when pressed. Each of the indicator lamps is illuminated by a circuit on the Transmitter Interface/Backup Controller board as required.

The PLATE E METER, PLATE I METER, FWD PWR METER and VSWR METER circuits from the Transmitter Interface/Backup Controller board are connected to calibration controls R1 through R4, respectively. The outputs from R1 and R2 are connected through J2 and the meter wiring harness to the Plate Voltage and Plate Current meters (M2 and M3). The outputs from R3 and R4 are connected to switch S9, which selects (for meter M4, the Output meter) either the display of output power (FWD) or reflected power, calibrated to read as VSWR (Voltage Standing Wave Ratio).

Forward Power Meter Calibration is accomplished by adjusting R3 until Analog Forward power reads the proper percentage power level with relation to the TPO of the transmitter.

NOTE

Prior to adjusting the Analog Power Meter, make sure the Digital Meter has been calibrated as the metering sample to the Analog Meter changes when the Digital Multimeter Probe is change.

See the Control Status section for calibration of the Digital Power Meter.

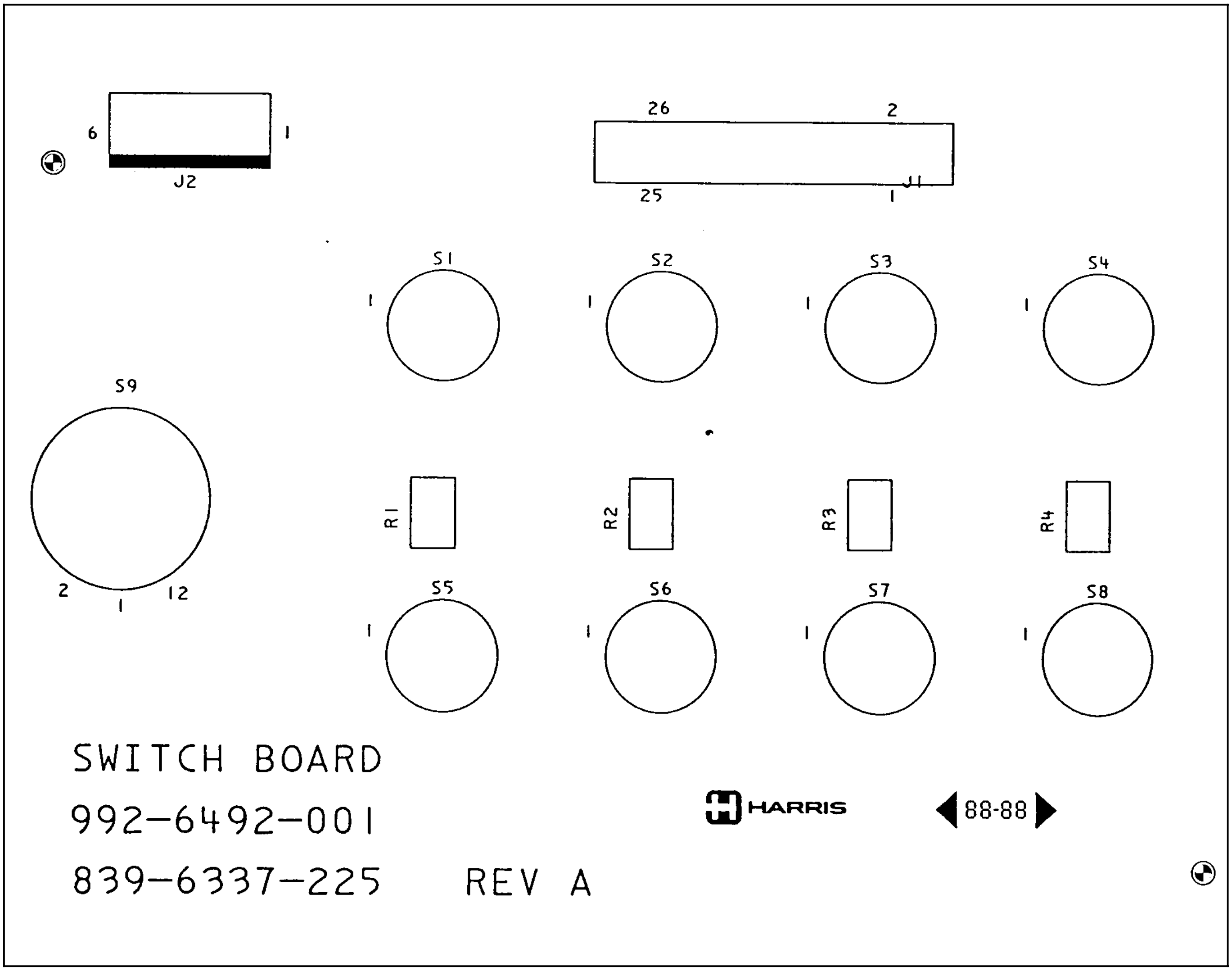

Figure Q-1. Switch Board

FIGURE Q-2

SEE SCHEMATIC SWITCH BOARD

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SECTION R
PA METERING BOARD

R.1. REMOVAL AND REPLACEMENT PROCEDURE

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

The PA Metering Board is located on the left inside wall of the Main Cabinet near the bottom toward the front.

Component CR1 on the PA Metering Board may be replaced without removing the board from the transmitter. Use a medium sized soldering iron (35 to 100 Watt) to remove and replace CR1 if necessary.

To remove the PA Metering Board for service, first REMOVE ALL POWER from the Main cabinet and the High Voltage Power Supply. Open the Circuit Breaker Panel and swing it out of the way. Locate the PA Metering Board and note the way in which connections are made to it. Disconnect all wiring from the board. Remove the hardware at the four corners of the board and take the board to a convenient working location. Leave the Circuit Breaker Panel open as insurance that the transmitter cannot be turned on while the PA Metering Board is out for service.

When replacing the board, be absolutely sure that the ground strap is captive between the PA Metering Board and the side wall of the transmitter.

Re-connect the wiring and check it to be sure that it has been connected correctly. Errors here can cause significant damage to components elsewhere in the transmitter.

R.2. PURPOSE

The purpose of the PA Metering Board is to derive sample voltages representative of several of the voltages and currents associated with the PA (Power Amplifier).

R.3. CIRCUIT DESCRIPTION

Refer to Figure R-2 (Schematic Diagram 839\6337\189). All of the current flowing in the PA Grid circuit passes through resistors R11, R12 and R13. These resistors (in parallel) represent 33-1/3 Ohms and will develop one volt across the circuit for each 30 mA flowing through the circuit. Capacitor C1 removes small transient voltages which might make the meter reading unstable. The voltage appearing between terminals 2 and 1 on the board is connected to the Controller through the Transmitter Interface/Backup Controller board on the Controller assembly.

The PA Grid voltage is connected to terminal 7 of the board. Resistors R7, R8, R9 and R10 are a voltage divider which derives a sample (at terminal 6) which is about 2/3rds of 1% of the voltage at terminal 7. The sample, then, is about 1 volt for every 151 volts on the Grid. This voltage is connected to the Controller through the Transmitter Interface/ Backup Controller board on the Controller assembly.

The negative terminal of the Plate Supply (in the High Voltage Power Supply) is connected to terminal 4 of the PA Metering Board and completes its path to ground through the parallel resistor network consisting of R1, R2, R3, R4, and R5. The voltage developed across these resistors (with a combined value of one Ohm) is 1 Volt for each 1 Amp of Plate current.

Under normal conditions, the voltage across the network is well below the value required to cause CR1 to conduct. Since the metering circuit on the Transmitter Interface/Backup Controller board is very high impedance, there is no significant voltage drop across R6 and the sample applied to terminals 3 and 5 is the same as the voltage developed across terminals 4 and 8. However, on the occasion of a cavity or tube arc, the Plate current rises sharply and the sample voltage rises with it to the point at which CR1 begins to conduct.

At this point, the sample voltage does not rise any further and the metering circuits are protected.

Should CR1 be damaged while performing this protection function, the Plate current meter reading will be below the actual value of the current. If there is any reason to believe that the reading is inaccurate for this reason, follow the procedures described in paragraph R-3 to replace diode CR1.

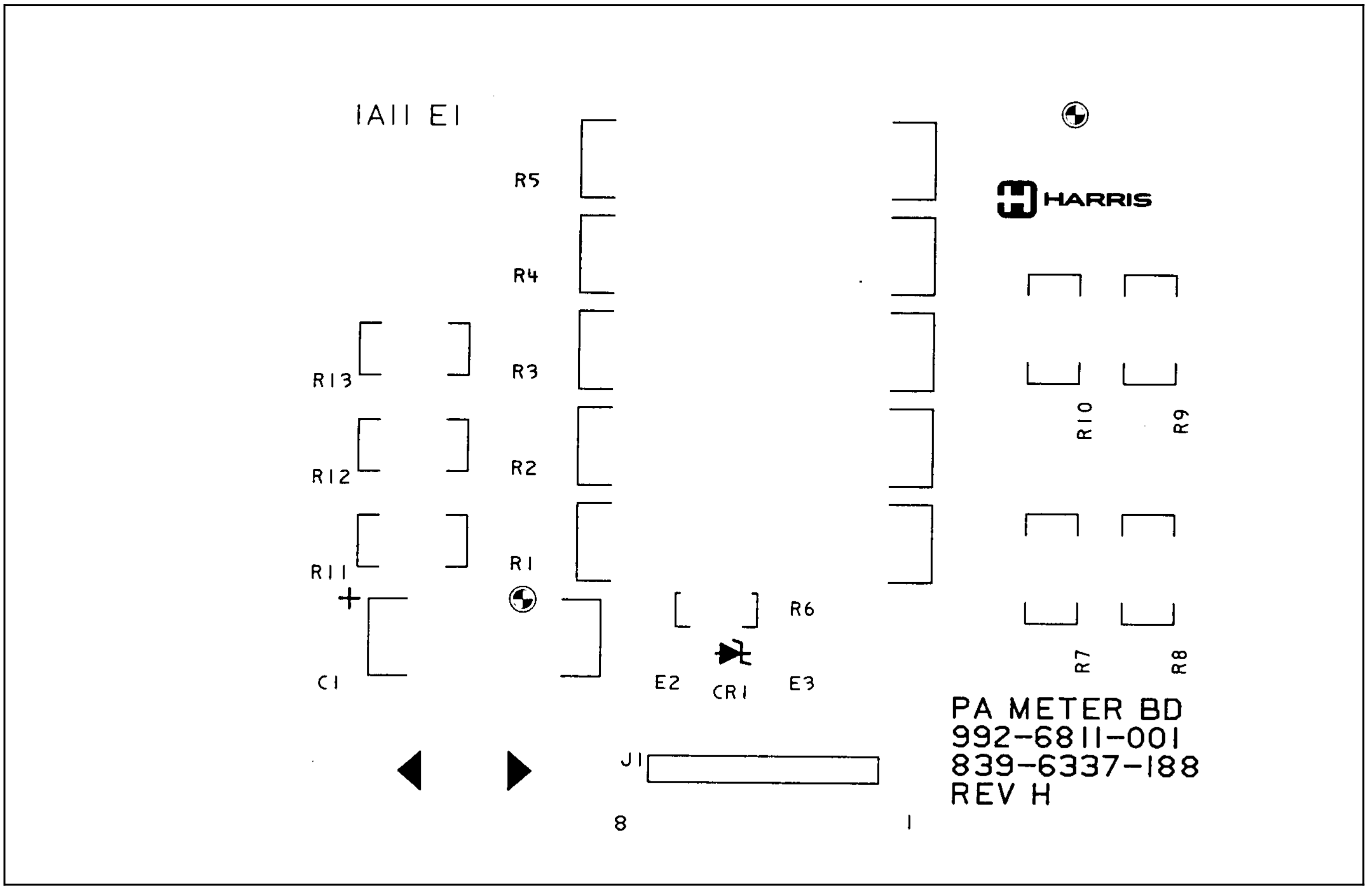

Figure R-1. PA Meter Board

FIGURE R-2

SEE SCHEMATIC, PA METERING BOARD

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SECTION S
AC INPUT PHASE MONITOR ASSEMBLY
(AND AC INPUT PHASE LOSS DETECTOR UNIT)

S.1. PURPOSE

The AC Input Phase Monitor in conjunction with the Phase Loss Detector Unit 1K5, continuously monitors the three phase AC input to the transmitter and either prevents transmitter turn-on or turns the transmitter off if the phase rotation changes, one phase drops out, or the input voltage drops below a safe input level. In addition, samples of the three phase voltages are developed for metering through the digital multimeter.

S.2. CIRCUIT DESCRIPTION

Three phase AC voltage is brought into the AC Input Phase Monitor board from 1TB1 through fuses 1F2, 1F3 and 1F4 to J1-1, J1-3, J1-7 to T1, T2 and T3. For a four wire wye input, the neutral is brought in on J1-5. Jumpers J2 through J4 must be placed properly to permit 200-250 Vac (Δ) or 380-435 Vac (Y) operation. Please refer to the overall schematic (Figure 8-1 or 8-2) and Figure S-2. The three phase input voltage is also routed by means of the board to the Phase Loss Detector Unit, 1K5, through J2-1, J2-3, and J2-7. See Figure S-2.

Transformers T1, T2, and T3 secondaries each provide approximately 12 VRMS to a rectifier, filter capacitor and voltage divider network. The output of each circuit is about +12 Vdc which is sent to unity gain buffer amplifiers (U3).

The outputs of U3 are sent to the Transmitter Interface/ Backup Controller board. A fourth section of U3 is unused. The buffer amplifiers (U3) are supplied +12 Vdc through J1-11. This same +12 Vdc is used as a local interlock voltage and comes from J4-2 on the Transmitter Interface/ Backup Controller board. A +12 Vdc output is routed through the AC Phase Monitor and AC Phase Loss Detector modules and is available at J1-10 to illuminate the LED indicator DS1 and as an input to ac phase loss interlock circuitry at J4-36 on the Transmitter Interface/Backup Controller board. In the 3 wire (208-240 Vac) configured transmitter, the ground return for the energizing coil of blower contactor 1K1 is supplied through terminals 3 and 1 of the Phase Loss Detector, 1K5, via J2-9 and J1-9 of the AC Phase Monitor board. In the 4 wire (360-415 Vac) configured transmitter, the ground return for the energizing coil of 1K1 is supplied through terminals 9 and 8 of 1K5 via J2-9 and J1-9 of the AC Phase Monitor board.

S.3. CORRECTIVE MAINTENANCE

S.3.1. ADJUSTMENTS

There are no adjustments on the AC Input Phase Monitor board. Jumpers J2 through J4 are positioned according to the input ac line voltage. Position the jumpers in the 'Δ' position for 208-240 Vac or in the 'Y' position for 360-415 Vac input.

There is one adjustment for minimum line voltage on the Phase Loss Detector Unit, 1K5. This should be set for the minimum normal line voltage expected.

S.3.2. TROUBLESHOOTING AC PHASE LOSS DETECTOR 1K5

S.3.2.1. *CIRCUIT BOARD LED DS1 EXTINGUISHED*

If a phase reversal occurs or an input voltage phase is dropped or the line voltage is low, the AC Phase Loss Detector will respond by turning the transmitter off and the indicator LED DS1 on the AC Input Phase Monitor circuit board (1A12) will be extinguished. In this case, proceed as follows.

S.3.2.2. *MEASUREMENT OF AC INPUT LINE VOLTAGE*

Use the transmitter multimeter to read the input line voltages. If they are all normal, then phase rotation has changed or the Phase Detector Unit, 1K5, requires checking. If one or more phase voltage is abnormal, then either a phase has been dropped or one or more of the three phase protection fuses 1F2, 1F3 or 1F4 has opened.

If one or more of the three phase voltages reads low, remove power from the cabinet.

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY AND IS LOCKED OUT BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

Open the rear door of the transmitter and discharge all storage devices.

Using a VOM on an ohmmeter scale, verify that all three fuses (1F2, 1F3, 1F4) are good. If all three are found to be good, proceed to paragraph S-17. If any of the three are open, inspect the Phase Loss Detector (1K5) and the interconnecting wiring between it and 1TB1 and the plugin socket for 1K5 for possible shorts. If the wiring appears normal, replace the open fuse(s) and reapply power to the transmitter cabinet.

If the problem persists, remove station power from the transmitter cabinet.

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY AND IS LOCKED OUT BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGE. PRESENT.

Again verify if another fuse has opened. If this has happened, either the Phase Loss Detector 1K5 or the AC Input Phase Monitor assembly is defective.

If all three fuses are good, then verify the low line voltage using the procedure in Section 2 under INITIAL CHECKOUT. If indeed a phase is low, first check the wall disconnect for proper operation. If all is in good working order, then an incoming phase is low and the utility company should be notified.

S.3.2.3. *TROUBLESHOOTING THE AC INPUT PHASE MONITOR ASSEMBLY 1A12*

Loss of metering of the input line voltage may be due to a malfunction of part of the AC Input Phase Monitor Assembly or an open fuse among the line fuses 1F2, 1F3, or 1F4. Verify the integrity of the fuses using the procedure outlined in paragraphs S-13 and S-14. If the fuses are found to be good then the problem lies in the Phase Monitor printed circuit board assembly. Correct outputs from the AC Input Phase Monitor assembly to the Transmitter Interface/Backup Controller board may be verified by measurement at 1A6A12J4 in the Controller assembly. Following the instruction beginning in paragraph P-4 for access to the Transmitter Interface/Backup Controller board, measure the dc voltages present on pins 12, 36, and 37 of 1A6A12J4. These are the dc sample voltages which correspond to the rms value of the three phase ac input line voltages. Each should measure approximately 10.3 Vdc depending upon the actual ac line voltage. If any one of the three values measured is far different from the other two, or all three vary widely from the typical 10.3 Vdc value, then the problem lies within the AC Input Phase Monitor assembly.

Remove and lock out the three phase station power to the transmitter cabinet and the power supply cabinet.

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY AND IS LOCKED OUT BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGE PRESENT.

Open the rear transmitter cabinet door and using the grounding stick, discharge all storage devices. Unmount the AC Input Phase Monitor assembly from the lower left hand side panel. Inspect the board for any sign of damage to the assembly or signs of component failure. Using an ohmmeter, verify the conditions of diodes CR1, CR2, and CR3 as well as choke L1. Also verify that L1, C2, and C3 are not shorted. If these components check out to be in good condition, then the problem is probably U3. Replace U3 and reinstall the assembly along with its safety covers and 1K5.

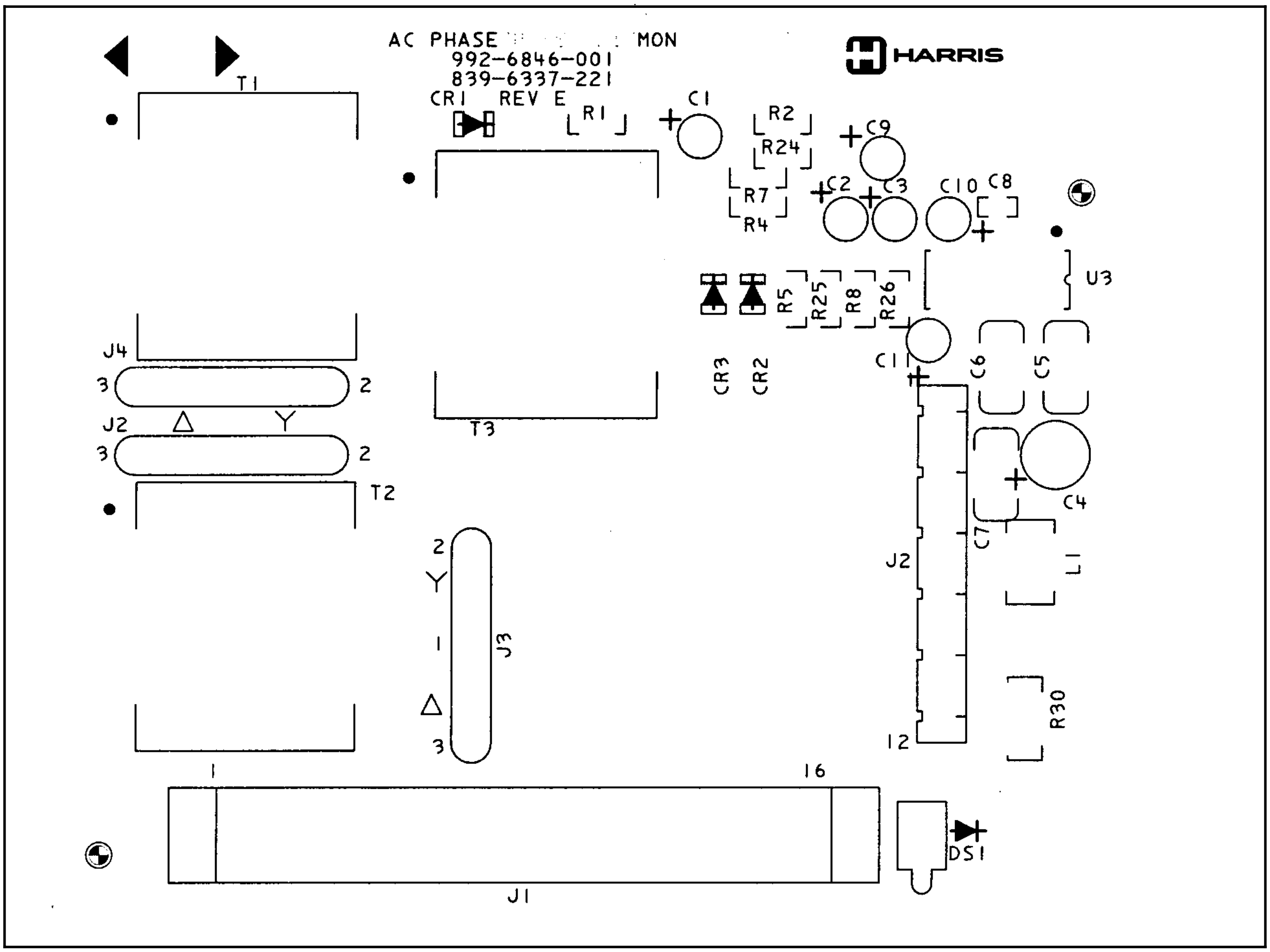

Figure S-1. AC Input Phase Monitor Board

FIGURE S-2

SEE AC INPUT PHASE MONITOR

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IN DRAWING PACKAGE

SECTION T
FLUORESCENT DISPLAY

T.1. INSTALLATION

The Fluorescent Display is a component of the Controller Assembly and requires no separate installation procedure.

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

T.1.1. REMOVAL AND REPLACEMENT

Remove the connector plugs from the Fluorescent Display board.

Remove the mounting screws, being careful to support the assembly while doing so.

Reinstallation is essentially the reverse procedure.

Set the Fluorescent Display board in place and reinstall the mounting screws.

Reinstall the connector plugs.

T.1.2. PURPOSE

The purpose of the Fluorescent Display is to provide alphanumeric display of all transmitter monitored variables, including currents, voltages, and power on the Digital Multimeter (DMM), and bargraph presentation of IPA forward and reflected power. Also, the mimic board LED displays is under control of the microprocessor on the Fluorescent Display.

Refer to the schematic diagram, Figure T-2. The Fluorescent Display is designed around an 8085 microprocessor which controls the dual bargraphs for IPA forward and reflected power, the digital multimeter display and most of the mimic board displays. The displays are all scanned to give the appearance of steady readings or indications.

Power is brought in on J2 as +5 Vdc, and + and -12 Vdc. A dc to dc connector, T1, is used to connect +5 Vdc to +39 Vdc for the plates of the displays (both bargraph and digital multimeter) and to 5.4 Vac for the filaments of both displays.

Operating commands are received from the Main Controller on J5-5, 9, and 11, and are RS-232C compatible. The commands are received by U6 which is a universal asynchronous receiver transmitter (UART).

The UART is clocked by a signal developed by U5, the baud rate generator. The crystal Y2 sets the basic oscillator frequency and the switch sections of J2 determine the divider ratio, thus producing various frequencies. The table on the Figure T-2, Sheet 1 gives the settings versus baud rates.

The initialization for the microprocessor is provided by U28A power monitor, and U28B, R13, C17 reset delay logic. A reset input is provided by closure of S1.

The lower eight bits of output from the microprocessor U1 are directed to U2 which is an octal D flip-flop used as address storage during the first part of the bus cycle. Thus these outputs of U2 are address bits.

The lower bits AD0 to AD7 are treated as data during the second half of the bus cycle. The upper two bits (A14 and A15) from the microprocessor are used to generate chip select inputs to the rest of the circuits.

The program for the system is contained in the ROM U8, and U9 is used for temporary data storage.

The displays VF1 and VF2 are vacuum fluorescent displays. The plate inputs which determine the length of the bars are input by latches U16, U17, and U18 in response to the data inputs (AD0 to AD7). The data is updated by the strobe inputs.

The grid information is latched into the bargraph display VF1 by U19 and U20.

The data inputs (AD0 to AD7) are updated by the strobe inputs.

Data for multimeter display, VF2, is latched into the display by U23, U24, and U25, and is updated with the strobe input. The data is entered via U25, which is a 4 line to 16 line decoder. The outputs of U25 determine the outputs of U23 and U24, both of which provide the grid inputs to VF2.

Inputs from the Key pad is sensed on RETURN LINE 0 or 1. If SIG 1 is a 0, the 0 return line is selected. If SIG1 is high, the 1 return line is selected.

The key selected is determined by U27.

The mimic board matrix inputs are provided by U27 and U3, with the column enabled being determined by U26, and the bit pattern for the rows of mimic board LED matrix determined by U3.

T.2. MAINTENANCE

T.2.1. ADJUSTMENTS

There are no adjustments. Switch S2 is set per the Table on Sheet 1 of Figure T-2, according to the desired baud rate.

T.2.2. PREVENTIVE MAINTENANCE

Preventive maintenance consists of keeping the circuit boards free of dirt, mounting hardware tight and the connector plugs properly seated.

T.2.3. CORRECTIVE MAINTENANCE

The Fluorescent Display board is not field repairable. The board should be returned to HARRIS CORPORATION, Broadcast Division for repair. Refer to paragraph on Returns and Exchanges on back of Title Page.

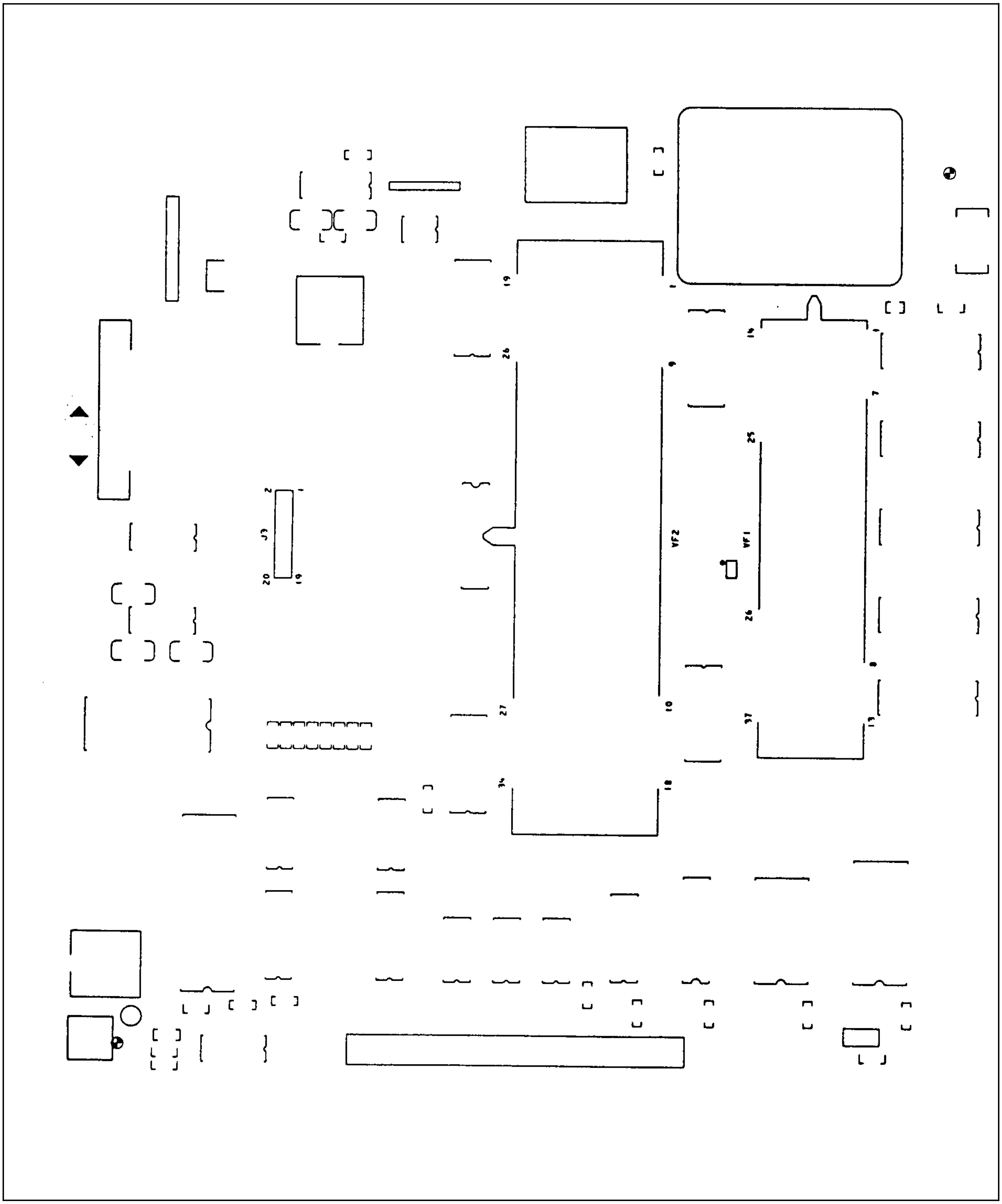

Figure T-1. Fluorescent Display Board

FIGURE T-2

SEE SCHEMATIC, FLUORESCENT DISPLAY

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SECTION U
MIMIC BOARD

U.1. INSTALLATION

The Mimic board is a component of the Controller and requires no separate installation procedure.

U.2. REMOVAL AND REPLACEMENT

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

Remove the two plugs from the Mimic board.

Remove the mounting screws from the board. Support the board as the screws are removed so that the alignment of the LED indicators is not changed. This will facilitate reinstallation of the Mimic board.

Reinstallation of the Mimic board is essentially the reverse process. Carefully set the board in place, giving attention to the alignment of the LED indicators as they are inserted through the holes in the door panel.

Install and tighten the mounting screws. Tighten firmly but do not over tighten.

Reinstall the connector plugs.

U.3. PURPOSE

The purpose of the Mimic board is to provide transmitter status, overload, and interlock status indications. Also, the board contains the Local/Remote/Extend and Reset switches.

U.4. CIRCUIT DESCRIPTION

A multiplex scheme is used to illuminate the various LED's. A matrix is thus established between the inputs on J1 to transistors Q1 through Q8 and the inputs also on J1 to transistors Q9 through Q16. See Table U-1.

The inputs to J1 controlling the matrix come from the Fluorescent Display board. The inputs are under control of the Fluorescent Display board microprocessor.

Some LED's are bi-color devices. In each bi-color device there are two LED's, one red and one green. Thus the LED may appear red or green, depending upon which one diode is being driven, or orange if both are being driven.

The matrix or multiplex system enables many LED's to be illuminated as appropriate using less than one transistor per LED. The inputs to the drive transistors Q1-Q16 are scanned so as to make the LED's illumination appear continuous.

The cathodes of several LED's (e.g. DS3, DS6, DS29) are tied together. If a logic 1 input is supplied at Q7 at J1-54, transistor Q7 will be turned on, pulling the cathodes of LED's DS3, DS6, and DS29 to ground through R3. Thus one or more of these LED's could be turned on. Logic inputs to Q1 through Q8 each enable a group of LED's to be driven.

Anode drive for one or more LED's is provided by transistor Q9 through Q16. Transistors Q15 and Q16 provide drive to only the green and red section of DS15 respectively. If both Q15 and Q16 are driven then an orange color will appear in DS15. Transistor Q3 must also be turned on to permit DS15 to be illuminated.

The inputs to transistors Q9 through Q16 are active low. Thus if the input at J1-30 is brought to ground, Q13 will be turned on, supplying approximately +5 Vdc to DS20R, DS33R, DS2G, DS3R, and DS8G.

All the LED's connected to the collector of Q13 would be on when Q13 is on, if the cathode of these LED's were held at

Table U-1. Mimic Board Indicator Matrix

TRANSISTOR	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
Q1	FAULT	X	X	X	X	X	X	X
Q2	X	FAILSAFE	X	X	X	X	X	X
Q3	EXTEND	OVLD PA VSWR	REMOTE	OVLD FIL	OVLD EXT AFL	INTLK HV CAB	VSWR FB G	VSWR FB R
Q4	OVLD EXC AFC	OVLD PLT I	OVLD IPA VSWR	OVLD SCRN I	PA R	PA G	X	X
Q5	INTLK EXT R	AIR R	FIL R	FIL G	INTLK PA LOSS	INTLK MAIN CAB	X	X
Q6	IPA R	IPA G	BIAS R	BIAS G	CTRL MAIN G	CTRL MAIN R	X	X
Q7	SCREEN R	SCREEN G	PREAMP G	PREAMP R	IPA-PS R	IPA-PS R	X	X
Q8	SCREEN G	PLATE R	PLATE G	PLATE R	AIR G	AIR R	X	X

NOTE: PA R and PA G mean PA Red and PA Green LED's, respectively.

ground potential by Q3 through Q8 being on. Thus, clearly, if an LED is to be turned off, during the time that Q13 is on, the respective transistor (Q3, Q4, Q5, Q6, Q7, or Q8) will have to be off when Q13 is on. This is all handled by the microprocessor on the Fluorescent Display.

Switches S1 through S4 permit Reset, Remote, Extended and Local control inputs. The Reset input is active high from +12V. The other inputs are active low inputs. Status inputs are provided through opto-isolator U1 and are available at J1, pins 16, 6, 4 and 2. The spare switches, S5 through S8, are not used.

Opto-isolators U3 and U4, also in the matrix, control DS11 and DS12, the Extended and Remote indicators. The LED portion of U3 and U4 is pin 1 and pin 2, with pin 2 being the cathode. Thus when Transistor Q3 is turned on, the LED cathodes of U3 and U4 are taken to ground through R4. Extend and Remote indicators may then be illuminated by turning on Q9 and/or Q11. Note also that the Remote Control Enable input at J2-6 must be high before DS11 and/or DS12 can be illuminated. This enable input originates in the Transmitter Interface/Backup Controller board, and is approximately +12V. When the Remote Control Enable input is low, the local LED DS13 will be illuminated.

When the transmitter is operating on the Main Controller, the Controller main LED DS2 is illuminated under control of the microprocessor on the Fluorescent board. When the transmitter goes to the Backup Controller, J2-1 input (BACKUP)* goes low and Controller Backup indicator DS32 is illuminated.

When the Remote Control Enable input is high, and the transmitter is on the Backup Controller, both Extended and Remote indicators DS11 and DS12 will be illuminated through CR5 and CR6.

U.5. MAINTENANCE

U.5.1. ADJUSTMENTS

There are no adjustments on the Mimic board.

U.5.2. PREVENTIVE MAINTENANCE

Preventive maintenance consists in keeping the board clean, keeping mounting hardware tight and convertors properly connected.

U.5.3. CORRECTIVE MAINTENANCE

WARNING

ALWAYS TURN TRANSMITTER COMPLETELY OFF BEFORE USING OHMMETER TO TROUBLESHOOT ANY CIRCUIT.

U.5.3.1. *ONE OR MORE INDICATORS NOT ILLUMINATING*

If one or more LED's do not illuminate, it may be due to failure of one or more of transistors Q1 through Q16. If none of the LED's whose cathodes are tied together fail to illuminate, it may be due to the respective transistor (Q1 through Q8) failing to turn on.

U.5.3.2. *GROUP OF INDICATORS ILLUMINATED*

If all the indicators driven by one transistor (Q1 through Q8) are illuminated, it may be due to the respective transistor having a collector-to-emitter short. In either case, the transistor should be checked with an ohmmeter or replaced. If all components check good, a scope may be used to check inputs to the specific transistors.

U.5.3.3. *ONE INDICATOR NOT ILLUMINATING*

If one of the indicators in one or more blocks (cathodes tied together) cannot be illuminated, it is most likely due to that indicator transistor (one of Q9 through Q16) failing to turn on. An ohmmeter may be used to check the transistor.

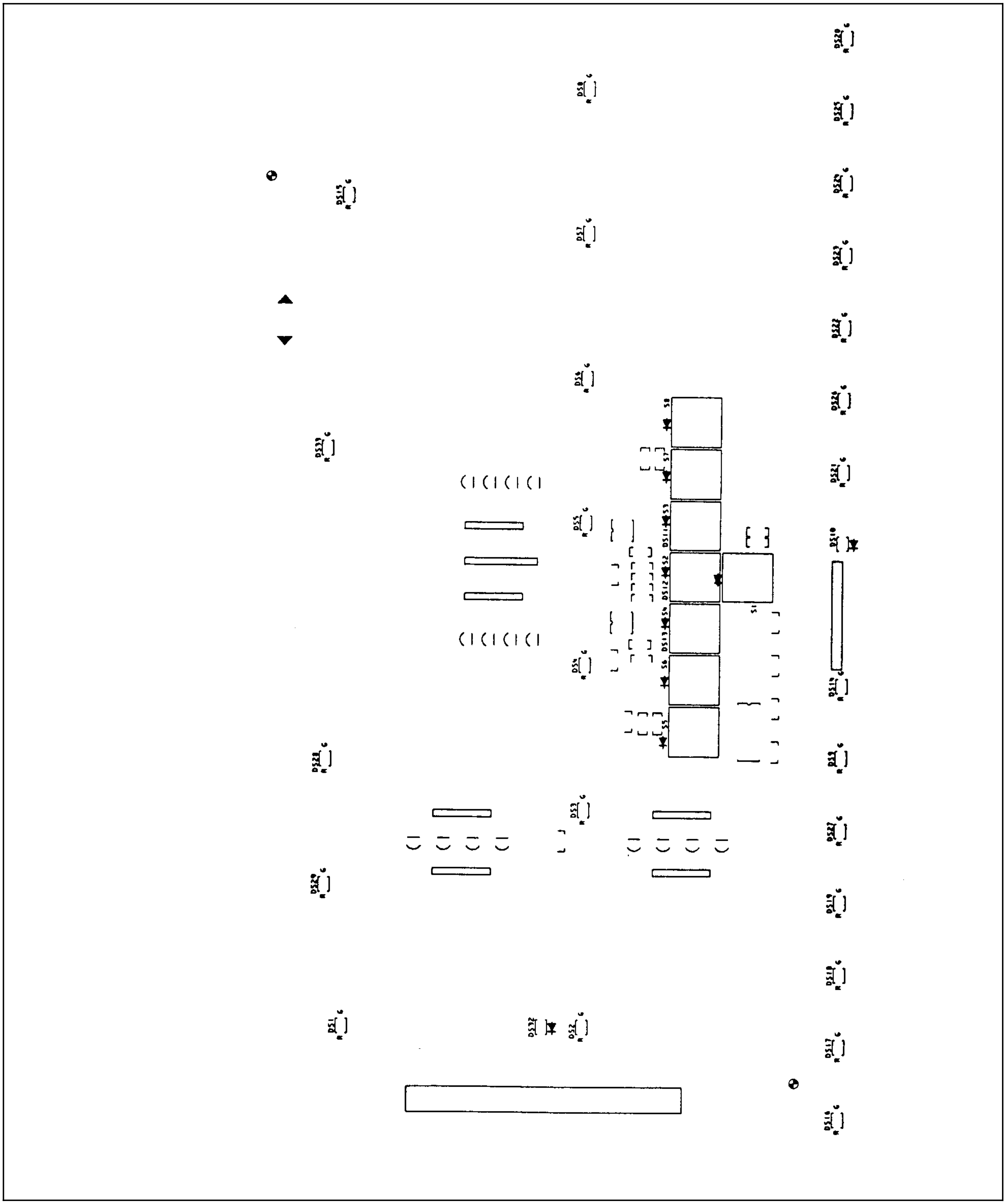

Figure U-1. Mimic Panel Board

FIGURE U-2

SEE SCHEMATIC, MIMIC BOARD

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SECTION V
SPACER BOARDS

V.1. INSTALLATION

The Spacer boards are part of the Main Controller Assembly and require no separate installation procedure.

WARNING

BEFORE BEGINNING ANY WORK IN THE MAIN CABINET, REMOVE ALL POWER FROM THE TRANSMITTER MAIN CABINET AND HIGH VOLTAGE POWER SUPPLY. ALWAYS USE A GROUNDING STICK (INSIDE THE REAR DOOR OF THE MAIN CABINET) TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

V.2. REMOVAL AND REPLACEMENT

The Spacer boards (three required) are located in the Controller card cage.

Each one may be removed by carefully disconnecting the ribbon cable plug from the respective circuit board, unplugging the Spacer board from the socket in the rear of the card cage and threading the ribbon cable through the guide slot in the front edge of the board.

CAUTION

THE CONTROLLER WILL NOT WORK WITHOUT ALL SPACER BOARDS PROPERLY INSTALLED.

V.3. PURPOSE

The purpose of the Spacer board is to provide mechanical support and strain relief for the ribbon cables connected to the Digital and Analog I/O boards, and the CPU board.

V.4. CIRCUIT DESCRIPTION

The Spacer boards serve primarily for mechanical purposes in supporting the ribbon cables. To ensure that they are properly installed, continuity jumpers are connected between pins 51 and 52. Please refer to Figure H-1 for the Mother board schematic.

V.5. MAINTENANCE

No maintenance, adjustments or troubleshooting is required. The Spacer board will rarely be required to be removed but should be kept properly installed in its connector.

SECTION W
MAIN CONTROLLER SOFTWARE SEQUENCES

W.1. INTRODUCTION

The following information is a summarized description of the microprocessor based main controller sequence of events that actually occur during different phases of transmitter operation. The following is not intended to be a detailed description of all the software activities. Our intention is to provide sufficient information to aid the user develop an overall understanding of transmitter events sequencing.

W.1.1. FILAMENT ON SEQUENCE

a. Abort filament-off sequence
b. Set filament rundown status OFF
c. Check Filament-On sequence status.
   1. If already running or completed, turn filament mimic lamp green and discontinue or exit filament-on sequence.
   2. If not already running or completed, continue filament-on sequence.
d. Check "Mains" phase loss detector status.
   1. If OK, continue filament-on sequence.
   2. If not OK, discontinue or exit filament-on sequence.
e. Turn on blower.
f. Check air switch status.
   1. If air switch does not close after 4 seconds:
      a) Turn air mimic lamp red.
      b) Turn air interlock LED on.
      c) Turn blower off.
      d) Discontinue/exit filament-on sequence.
   2. If air switch closes within 4 seconds, continue filament-on sequence.
g. Turn air mimic lamp green.
h. Turn air interlock LED off.
i. Turn filament on (start filaments and IPA power supply).
j. Check filament voltage status.
   1. If less than 5 volts after 2 seconds:
      a) Turn filament off
      b) Turn filament mimic lamp red
      c) Turn filament overload LED on
      d) Log filament overload
      e) Discontinue/exit sequence
   2. If greater than or equal to 5 volts within 2 seconds, continue filament on sequence.
k. Turn filament lamp on.
l. Blink filament mimic lamp green to indicate filament warm-up.
m. Check IPA power supply status.
   1. If less than 28 volts, turn IPA PS mimic lamp red and continue sequence.
   2. If less than 35 volts, blink IPA PS mimic lamp amber and continue sequence.
   3. If greater than or equal to 35 volts, turn IPA PS mimic lamp green and continue sequence.

NOTE

Wait for filament warm-up timer to expire. (For initial filament-on sequence timer duration is 20 seconds.) For filament-on sequence during AC restart, the warm-up timer is bypassed.

n. Repeat IPA power supply status check.
   1. If less than 28 volts:
      a) Turn IPA PS mimic lamp red.
      b) Turn filament LED off.
      c) Discontinue/exit filament-on sequence.
   2. If less than 35 volts, blink IPA PS mimic lamp amber and continue sequence.
   3. If greater than or equal to 28 volts, turn IPA PS mimic lamp green and continue sequence.
o. Turn filament mimic lamp green.
p. Filament-on sequence completed successfully.

W.1.2. PLATE-ON SEQUENCE

a. Turn off fault LED.
b. Check filament-on sequence status.
   1. If already running or completed, bypass filament-on sequence.
   2. If not already running or completed, continue filament-on sequence.
   3. If filament-on sequence runs successfully, continue plate-on sequence.
   4. If filament-on sequence does not complete, turn on fault light and discontinue/exit plate-on sequence.
c. Wait for exciter to lock.
   1. If exciter AFC locks within 10 seconds, continue sequence.
   2. If exciter does not lock within 10 seconds:
      a) Turn on exciter AFC overload lamp.
      b) Turn on fault light and discontinue/exit plate-on sequence.
d. External or Magnetic overload presence effects:
   1. If Magnetic overload active:
      a) Turn on plate current overload LED.
      b) Turn plate mimic LED red.
      c) Turn on fault light and discontinue/exit plate-on sequence.
   2. If External overload active:
      a) Turn on external overload LED.
      b) Turn on fault light and discontinue/exit plate-on sequence.
e. Energize bias supply.
f. Check bias voltage status.

1. If less than -200 volts after 500 ms:
    a) Turn bias mimic lamp red.
    b) Turn off bias supply.
    c) Turn on fault light and discontinue/exit plate-on sequence.
2. If greater than or equal to -200 volts within 500 ms:
    a) Turn bias mimic lamp green.
    b) Continue plate-on sequence.

g. Check plate current status.
1. If plate current exists:
    a) Assume backup controller is running.
    b) Go to step m. of this description and continue plate-on sequence from that point.
2. If plate current does not exist, continue plate-on sequence.

h. Energize step/start contactor.

i. Wait 50 milliseconds

j. Check plate current status.
1. If greater than or equal to 3 amps:
    a) Deenergize step/start contactor.
    b) Turn plate mimic lamp red.
    c) Turn on plate current overload LED.
    d) Turn on fault light and discontinue/exit plate-on sequence.
2. If less than 3 amps, continue plate-on sequence.

k. Wait 50 milliseconds.

l. Check plate voltage status.
1. If less than 2,000 volts; wait 50 ms, if plate voltage still less than 2000 volts:
    a) Deenergize step/start contactor.
    b) Turn plate mimic lamp red.
    c) Turn on plate current overload LED.
    d) Turn on fault light and discontinue/exit plate-on sequence.
2. If greater than or equal to 2,000 volts, continue plate-on sequence.

m. Check screen voltage status.
1. If less than 300 volts:
    a) Turn screen mimic lamp amber.
    b) Continue plate-on sequence.
2. If greater than or equal to 300 volts:
    a) Turn screen mimic lamp green.
    b) Continue plate-on sequence.

n. Energize main contactor.

o. Wait up to 100 milliseconds for the run contactor aux. contacts to close.

p. Deenergize step-start contactor.

q. Check run contactor auxiliary contacts status.
1. If open:
    a) Turn plate mimic lamp red.
    b) Turn on fault light and discontinue/exit plate-on sequence.
2. If closed:
    a) Turn plate mimic lamp green.
    b) Continue plate-on sequence.

r. Check AFC (Exciter) contact status.
1. If not closed:
    a) Turn exciter mimic lamp red.
    b) Turn on AFC overload LED.
    c) Turn on fault LED and discontinue/exit plate-on sequence.
2. If closed:
    a) Turn exciter mimic lamp green.
    b) Continue plate-on sequence.

s. Activate plate-on lamp.

t. Start APC sequence.

W.1.3. PLATE-OFF SEQUENCE

a. Set failsafe restart status off.

b. Abort plate-on sequence.

c. Abort APC task.

d. Set RF ramp to zero.

e. Deenergize main contactor.

f. Mute exciter and IPA. Stop Raise & Lower commands. Turn off green LED's on RF chain on mimic panel.

g. Check step-start contactor status.
1. If closed:
    a) Deenergize step/start contactor.
    b) Wait 250 milliseconds.
    c) Recheck step/start contactor status and if still closed:
        1) Blink plate mimic lamp red.
        2) Blink screen mimic lamp red.
        3) Exit.
2. If open, continue plate-off sequence.

h. Read plate voltage and save for later.

i. Check plate voltage status.
1. If less than 6 kV, go to step l. of the plate-off sequence and continue.
2. If greater than or equal to 6 kV:
    a) Recheck plate voltage status.
        1) If less than 90% of first reading within 2 seconds go to step l.:
        2) If greater than or equal to 90% of previous reading after 2 seconds, proceed with step K-3.
3. Energize step/start contactor.
4. After 50 ms delay, turn on main contactor.

5. Turn off step/start contactor.
6. Blink plate mimic lamp red.
7. Blink screen mimic lamp red.
8. Exit routine - rf drive is off but HVPS remains on, however.

j. If plate mimic lamp is green, turn plate mimic lamp off.
k. If screen mimic lamp is green, turn screen mimic lamp off.
l. If this sequence was not caused by a short ac power fail:
   1. Deenergize bias supply.
   2. Check bias supply voltage status.
      a) If greater than or equal to -200 volts, blink bias mimic lamp red.
      b) If less than -200 volts, turn off bias mimic lamp.
m. Turn plate lamp off, sequence completed successfully.

W.1.4. FILAMENT-OFF SEQUENCE

a. Abort filament-on sequence.
b. Set filament-on task off.
c. Set failsafe restart status off.
d. Run plate-off task.
   1. If successful, proceed with step.
   2. If not successful, exit routine.
e. Check filament rundown status.
   1. If on:
      a) Blink air mimic lamp green.
      b) Turn blower on.
      c) Continue filament-off sequence.
   2. If off, continue filament off sequence.
f. Turn filament lamp off.
g. Set filament status off.
h. Set filament warm-up status off.
i. Deenergize filament (filament/IPA power supply).
j. set blower status off.
k. Wait 250 ms.
l. Turn IPA power supply mimic lamp off.
m. Check filament voltage.
   1. If filament voltage is greater than 5.0 volts and phase loss detector contacts are closed:
      a) Blink red filament mimic lamp red.
      b) Energize and maintain blower operation.
      c) Discontinue/exit filament-off sequence.
   2. If filament voltage is less or equal to than 5.0 volts:
      a) Blink air mimic lamp green.
      b) Turn filament mimic lamp off.
n. If phase loss detector contacts closed and blower is on wait 180 seconds, deenergize blower.
o. After 5 second delay, check air switch status.
   1. If closed:
      a) Blink air mimic lamp red.
      b) Discontinue/exit filament-off sequence.
   2. If open:
      a) Turn air mimic lamp off.
      b) Exit, filament-off sequence completed.

W.1.5. LOG (TYPE,DELAY) SEQUENCE

a. Light appropriate (TYPE) overload light(s) on mimic panel.
   1. Plate current overload:
      a) Turn PA lamp red.
      b) Turn off VSWR foldback lamp.
      c) Turn on plate current overload LED.
   2. Magnetic overload:
      a) Turn plate block red.
      b) Turn off VSWR foldback.
      c) Turn on plate current overload.
   3. PA VSWR overload:
      a) Turn on PA VSWR overload LED.
      b) Blink IPA block red.
   4. IPA VSWR overload - Turn on IPA VSWR overload LED.
   5. Screen overload:
      a) Turn off VSWR foldback lamp.
      b) Turn PA lamp red.
      c) Turn on SCREEN overload LED.
   6. Exciter (AFC) overload - Turn on exciter overload LED.
   7. External overload - Turn on external overload LED.
   8. Filament overload - Turn on filament overload LED.
   9. Phase loss overload - Turn on phase loss interlock LED.
b. Record overload TYPE and time/date unless this is a phase loss overload.
c. Restart recovery-timer with delay.

W.2. OVERLOAD INTERRUPT SERVICE ROUTINES

W.2.1. PLATE CURRENT OVERLOAD

a. Check interlock status.
   1. If open:
      a) Disable recycle function.
      b) Continue plate current overload sequence.
   2. If closed, continue plate current overload sequence.
b. Run plate-off sequence.
c. Run Log routine including transmission of recycle initiate time delay value.
d. Clear interrupt.

W.2.2. PA VSWR OVERLOAD

a. Set ramp-up type to a slow ramp-up.
b. Check interlock status.
   1. If open:
      a) Disable recycle function.
      b) Continue PA VSWR overload sequence.

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2. If closed, continue PA VSWR overload sequence.

c. Run plate-off sequence.

d. Run log routine including transmission of recycle initiate time delay value.

e. Clear interrupt.

W.2.3. IPA VSWR OVERLOAD

a. Check status of AFC and blower status.

1. If AFC is open and blower is on.

a) Shut off APC task:

1) If third strike condition exists, run plate-off sequence.

2) If other than third strike condition exists, run ramp-down portion of APC sequence and start 10 second AFC timer.

b) Set ramp-up speed to slow.

b. Run Log routine including transmission of recycle initiate time delay value.

W.2.4. SCREEN CURRENT OVERLOAD

a. Check interlock status.

1. If open:

a) Disable recycle function.

b) Continue screen current overload sequence.

2. If closed, continue screen current overload sequence.

3. Check for short ac loss.

b. Run plate-off sequence.

c. Run Log routine including transmission of recycle initiate time delay value.

d. Clear interrupt.

W.2.5. EXCITER AFC OVERLOAD

a. Check status of AFC and blower status.

1. If AFC is open and blower is on.

a) Abort APC task.

b) Set RF ramp to zero.

c) Deenergize main contactor.

d) Mute exciter and IPA. Stop Raise & Lower commands. Turn off green LED's on RF chain on mimic panel.

e) Set ramp-up speed to fast.

1) Run Log routine including transmission of recycle initiate time delay value.

W.2.6. EXTERNAL OVERLOAD

a. If external interlock is open:

1. Disable recycle function.

2. Continue screen current overload sequence.

3. If closed, continue screen current overload sequence.

4. Check for short ac loss.

5. Run plate off sequence.

6. Set ramp-up speed to slow.

7. Run Log routine including transmission of recycle initiate time delay value.

W.2.7. MAG OVERLOAD

a. If magnetic overload status is open.

1. Check interlock status.

a) If open:

1) Disable recycle function.

2) Continue magnetic overload overload sequence.

b) If closed, continue magnetic current overload sequence.

2. Run plate-off sequence.

3. Set ramp speed to slow.

4. Log plate current value and transmit recycle initiate time delay value.

5. Clear interrupt.

W.3. INTERLOCK INTERRUPT SERVICE ROUTINES

W.3.1. MAIN CABINET INTERLOCK

a. If interlock is open:

1. Disable recycle function.

2. Run plate-off sequence.

3. Turn-on main cabinet interlock LED.

W.3.2. HIGH VOLTAGE INTERLOCK

a. If interlock open:

1. Disable recycle function.

2. Run plate-off sequence.

3. Turn on high voltage interlock LED.

W.3.3. PHASE LOSS INTERLOCK

a. If phase loss detector interlock contact(s) open:

1. Run filament off sequence.

2. Turn on phase loss interlock LED.

W.3.4. AIR INTERLOCK

a. If air switch is open and blower status is on:

1. Run plate-off sequence.

2. Turn on air interlock LED.

W.3.5. EXTERNAL INTERLOCK

a. If interlock is open:

1. Disable recycle function.

2. Run filament-off sequence.

3. Turn on external interlock LED.

b. If external interlock is closed, turn off external interlock LED.

W.4. MISCELLANEOUS INTERRUPT SERVICE ROUTINES

W.4.1. FAILSAFE INTERRUPT

a. If remote or extended status active:

1. If failsafe off:

a) Turn on failsafe LED.

b) If plate status on:

1) Run plate-off sequence.

2) Set failsafe restart status on.

2. If failsafe on:

a) Turn off failsafe LED.

b) If failsafe restart status on:

1) Set failsafe restart status off.

2) Run plate-on sequence.

W.4.2. RAISE LIMIT INTERRUPT

a. Turn off screen raise control.

b. Turn off raise lamp.

W.4.3. LOWER LIMIT INTERRUPT

a. Turn off screen lower control.

b. Turn off lower lamp.

W.4.4. APC AND VSWR FOLDBACK TASK (RAMP-UP/SHUTDOWN)

a. Take Exciter output power reading.

b. If fast start status is on and ramp is not all the way up:

1. Execute ramp-up process.
2. Restart the APC task.

c. Take Reflected power reading.

d. Take Forward power reading.

e. Take IPA Forward power reading.

f. Set Screen Supply lamp priority to green.

g. Set VSWR lamp priority to green.

h. If APC status is active and reflected power is greater than zero and forward power is greater than or equal to 1:

1. If PA VSWR is greater than or equal to 2.0 : 1:

a) Turn VSWR foldback LED red.

b) Disable recycle function.

c) Log VSWR overload.

d) Run fault-off sequence.

2. If PA reflected power is greater than or equal to .422 of overload set point:

a) Set VSWR foldback lamp priority to amber.

b) Execute Lower Screen voltage.

3. If Screen I is greater than .80 of overload set point:

a) Set PA lamp priority to amber.

b) Set Screen Supply lamp priority to amber.

c) Execute Lower Screen voltage.

4. If PA forward is greater than 1.03 of APC value set point:

a) Execute Lower Screen voltage.

5. If IPA ramp is not all the way up and other screen parameters are OK:

a) Execute ramp-up process.

6. If PA forward is less than .95 of APC value, and all screen parameters are OK, and IPA forward power is greater than 10:

a) Execute Raise Screen voltage.

i. If ramp is not all the way up:

1. Execute ramp-up process.

j. If ramp is all the way up:

1. Check exciter output power:

a) If equal to or greater than 3 watts set exciter lamp priority to green.

b) If less than 1.0 watts set exciter lamp priority to red.

c) Otherwise set exciter lamp priority to amber.

2. Take Preamp power reading.
3. Quotient = Preamp power / exciter power.
4. Check quotient.

a) If quotient is equal to or greater than 2.75 set Preamp lamp priority to green.

b) If quotient is less than 1.0 , set Preamp lamp priority to red.

c) Otherwise, set Preamp lamp priority to amber.

5. Quotient = IPA Forward power / Preamp power.
6. Check quotient.

a) If quotient is equal to or greather than 2.75 set IPA lamp priority to green.

b) If quotient is less than 1.05 , set IPA lamp priority to red.

c) Otherwise, set IPA lamp priority to amber.

7. Quotient = forward power / IPA forward power.
8. Check quotient.

a) If quotient is equal to or greater than 0.0275, set PA lamp priority to green.

b) If quotient is less than .0105, set PA lamp priority to red.

c) Otherwise, set PA lamp priority to amber.

9. If PA lamp priority is off, set VSWR foldback lamp priority to off.
10. Check one of these next three values per pass. Check next value on next pass. Continuous loop to check values.

a) If on pass one, check:

1) If IPA PS is less than 28, turn IPA PS lamp red.

2) If IPA PS is less than 35, blink IPA PS lamp amber.

3) Turn IPA PS lamp green.

b) If on pass two, check:

1) If filament voltage is greater than 7.9 or less than 5.0, turn filament lamp amber.

2) If otherwise, turn filament lamp green.

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c) If on pass three, check:

1) If bias is less than -200, turn bias lamp red.

2) If otherwise, turn bias lamp green.

11. Set all lamps according to their highest priority. The priority is as follows:

a) Dark lowest

1) Green value next

2) Amber value next

3) Red value highest

k. If fast start status is on and ramp is not all the way up:

1. Execute ramp-up process.

l. Restart APC task.

W.4.5. RAMP-UP PROCESS

a. If exciter off or IPA muted:

1. Unmute exciter.
2. Unmute IPA.

b. If Exciter power is greater than 2.0 watts:

1. If ramp-up value is zero, set ramp-up value to 100.
2. If ramp-up value is less than 245, increase ramp-up value by 10.
3. If otherwise, increase ramp value by 1.
4. Set Screen flag false.

W.4.6. LOWER SCREEN PROCESS

a. Inhibit raise screen command.
b. Turn raise lamp off.
c. Start lower screen command
d. Turn lower lamp on.
e. Delay .25 seconds.
f. Stop lower screen command.
g. Turn lower lamp off.

W.4.7. RAISE SCREEN PROCESS

a. Inhibit lower screen command.
b. Turn lower lamp off.
c. Start raise screen command.
d. Turn raise lamp on.
e. Delay .25 seconds.
f. Stop raise screen command.
g. Turn raise lamp off.

W.4.8. TIMER INTERRUPTS

W.4.8.1. *WALL CLOCK TIMER*

a. For each front panel lamp:

1. If lamp defined to blink:

a) If lamp is off, turn lamp on.

b) If lamp is on, turn lamp off.

W.4.8.2. *RECOVERY-TIMER TIMEOUT ROUTINE (OVERLOAD RESTART)*

a. Reset strike-timer to 20 seconds.
b. Increment 3-strike.
c. If 3-strike is greater than 2:

1. Disable recycle function.
2. Run fault-off sequence.
3. Exit.

d. Otherwise:

1. Increment 3-strike counter.
2. If failsafe is off and remote or extended mode is selected:

a) Exit.

3. Otherwise, if plates are supposed to be on:

a) Run plate-on sequence.

W.4.9. FILAMENT-OVERLOAD TIMER ROUTINE

a. If filament status is on or filament warmup status is on:

1. Read filament voltage.
2. If voltage is less than 2.0 volts:

a) Run filament-off sequence.

b) Log (filament) in 0.5 seconds.

3. If voltage is greater than or equal to 2.0 volts, restart filament-overload timer at 200 milliseconds.

W.4.10. STRIKE-TIMER TIMEOUT PROCEDURE

a. If 3-strike is greater than or equal to 1, decrement 3-strike.
b. If 3-strike is greater than zero, restart strike-timer at 20 seconds.

W.4.11. DEADMAN TIMER TIMEOUT PROCEDURE

a. Set deadman timer to opposite last value.
b. Set deadman timer value to 50ms.

Table W-1 gives information on the front panel status display lamps. It gives information concerning what status or event will turn a particular lamp either on or off, blink it on and off, or turn a particular color on or off if that lamp can be more than one color.

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Table W-1. Front Panel Lamp Cross Reference Chart

LAMP	COLOR	EVENT	REASON
Backup	Red	Backup Controller Active	The main controller malfunctioned causing the backup controller to be active, or the main/backup switch is in backup.
Main	Green	Main Controller	The main controller is active with all subsystems initialized during power on start/restart.
Backup	Off	Backup Controller Inactive	The backup controller is inactive.
Main	Off	Main Controller Inactive	The main controller has not initialized during the power on start/restart and is inactive.
IPA-PS	Green	Filament On	IPA-PS voltage is greater than or equal to 35 volts.
IPA-PS	Amber Blink	Filament On	IPA-PS voltage is less than 35 volts or greater than or equal to 28 volts.
IPA-PS	Red	Filament On	IPA-PS voltage is less than 28 volts.
IPA-PS	Off	Filament Off	The filament is turned off at the start of the filament rundown.
Filament	Green Blink	Filament On	During initial filament warmup with voltage greater than or equal to 5 volts.
Filament	Red Blink	Filament Off	During filament off cycle when voltage is greater than or equal to 5 volts and all 3 phase monitor contacts are closed.
Filament	Green	Filament On	The filament voltage is greater than or equal to 5 volts and is less than 7.9 volts after warmup.
Filament	Amber	Filament On Ramp Up	The filament voltage is greater than 7.9 volts or less than 5 volts after warmup.
Filament	Red	Filament On	During initial filament on process, if after 2 seconds the voltage is less than 5 volts.
Filament	Off	Filament Overload	When filament is on and the voltage is less than 2 volts.
Filament	Off	Filament Off	The filaments are turned off.
BIAS	Green	Plate On	Bias supply voltage is greater than or equal to -200 volts after .5 seconds from bias start.
BIAS	Red	Plate On	Bias supply voltage is less than -200 volts after initial bias start.
LAMP	COLOR	EVENT	REASON

WARNING: Disconnect primary power prior to servicing.

Table W-1. Front Panel Lamp Cross Reference Chart (Continued)

BIAS	Red Blink	Plate Off	Bias voltage is greater than or equal to -200 volts after .25 seconds from bias off process.
BIAS	Off	Plate Off	Bias voltage is less than -200 volts after bias off process.
SCREEN	Green	Plate On	Screen voltage is greater than or equal to 300 volts.
SCREEN	Amber	Plate On	Screen voltage is less than 300 volts.
SCREEN	Amber	APC Active	When screen current is greater than or equal to .8 times overload.
SCREEN	Red Blink	Plate Off	After main contactor turn off and step contactor closed.
SCREEN	Red Blink	Plate Off	During plate off cycle, if plate voltage is greater than or equal to 6,000 volts and after 2 seconds is greater than 90% less than first reading.
SCREEN	Off	Plate Off	During plate off cycle, if last screen status was green and plate voltage was less than 6000 volts.
PLATE	Green	Plate On	Plate on sequence completed with no abnormal conditions.
PLATE	Red	Plate On	During plate on sequence the plate voltage was less than 2000 volts.
PLATE	Red	Plate On	After step contactor is turned on and a 50 millisecond delay the plate current is greater than or equal to 3 amps.
PLATE	Red Blink	Plate Off	During plate off sequence the step contactor remains closed .25 seconds after the main contactor is turned off.
PLATE	Red	Plate On	After .1 seconds of main contactor on, the main-auxiliary response is open.
PLATE	Red Blink	Plate Off	During plate off cycle the plate voltage is greater than or equal to 6,000 volts and after 2 seconds the plate voltage is greater than 90% less than the first reading.
PLATE	Off	Plate Off	Successful plate off sequence.
AIR	Green	Filament On	Air switch closed within 3 seconds of blower on sequence.
AIR	Green Blink	Filament Off	Filament rundown cycle.
LAMP	COLOR	EVENT	REASON

WARNING: Disconnect primary power prior to servicing.

Table W-1. Front Panel Lamp Cross Reference Chart (Continued)

AIR	Red	Filament On	Air switch open after 3 seconds of blower on sequence.
AIR	Red Blink	Filament Off	Air switch closed 5 seconds after blower off sequence.
AIR	Off	Filament Off	During filament off, blower off sequence, the air switch closed within 5 seconds.
EXCITER	Green	Plate On	During plate on sequence, after plate lamp goes green and AFC is closed.
EXCITER	Red	Plate On	During plate on sequence if AFC is open. Exciter output less than 1.0 watt.
EXCITER	Off	RF Shutdown	During ramp of zero if exciter lamp was green.
EXCITER	Off	Plate On	Exciter either has no RF (Exciter RF less than 4 Watts) or Exciter FWD metering is not connected (e.g. externally mounted exciter).
EXCITER	Green	Exciter Overload	At executes overload and AFC open with filament on.
EXCITER	Green	IPA-VSWR Overload Recycle	IPA-VSWR overload restart process.
PREAMP	Green	Plate On Ramp-up	Preamp power/exciter power is greater than or equal to 4 (exciter power is displayed as PREA DRV in the multimeter).
PREAMP	Amber	Plate On Ramp-up	Preamp power/exciter power is greater than or equal to 1.05 and less than 4.
PREAMP	Red	Plate On Ramp-up	Preamp power exciter power is less than 1.05.
PREAMP	Off	RF Shutdown	Ramp of zero if lamp was green.
PREAMP	Off	Plate On	Prior stage has no RF (Exciter output).
IPA	Green	Plate On Ramp-up	IPA forward power/preamp power is greater than or equal to 2.75.
IPA	Amber	Plate On Ramp-up	IPA forward power/preamp power is greater than or equal to 1.05 and less than 2.75.
IPA	Red	Plate On Ramp-up	IPA forward power/preamp power is less than 1.05.
IPA	Off	RF Shutdown	Ramp of zero if lamp was green.
IPA	Off	Plate On	Prior stage has no RF (Pre-amp output)

Table W-1. Front Panel Lamp Cross Reference Chart (Continued)

PA	Green	Plate On Ramp-up	Forward power/IPA forward power is greater than or equal to .0275.
PA	Amber	Plate On Ramp-up	Forward power/IPA forward power is greater than or equal to .0105 and less than .0275.
PA	Red	Plate On Ramp-up	Forward power/IPA forward power is less than .0105.
PA	Red	Plate or Screen Overloads	Plate or screen overload caused a plate off sequence.
PA	Off	RF Shutdown	Ramp or zero if lamp was green.
VSWR FOLDBACK	Green	Plate On Ramp-upAPC inactive or when APC active,	1) forward power greater than reflected power. 2) forward power greater than 1. 3) see Note 1 on next page.
VSWR FOLDBACK	Amber	Plate On Ramp-up	When APC active and the reflected power greater than (.422) times reflected overload.
VSWR FOLDBACK	Red	Plate On Ramp-up	If forward power is greater than or equal to 1 or forward power is less than or equal to reflected power or (see Note 2 on next page).

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Table W-1. Front Panel Lamp Cross Reference Chart (Continued)

$$\frac{1 + \sqrt{\frac{\text{Reflected Power}}{\text{Forward Power}}}}{1 - \sqrt{\frac{\text{Reflected Power}}{\text{Forward Power}}}} \text{ less than or equal to } 2$$

NOTE 1

$$\frac{1 + \sqrt{\frac{\text{Reflected Power}}{\text{Forward Power}}}}{1 - \sqrt{\frac{\text{Reflected Power}}{\text{Forward Power}}}} \text{ greater than } 2$$

NOTE 2

Table W-2. Fault Cause Table

Code	Reason
1	AFC did not lock
2	Calculated VSWR was greater than 2:1 while in Auto power control
4	There were too many recycles within the specified period
Filament On Sequence	
10	A filament OFF button was pressed (such as a stuck FIL OFF switch)
11	The phase monitor was open indicating a phase loss/reversal
12	The air switch did not close within 3 seconds after turning on the blower
13	The filament voltage did not go above 5 volts within 2 seconds after turning on the filament primary voltage
14	The IPA power supply voltage was less than 28 volts
Plate On Sequence	
20	A filament or plate OFF button was pressed (such as a stuck PLATE OFF switch)
21	The magnetic overload contacts were open (3K1 and 3K2 in the HV Power Supply)
22	The bias voltage did not reach a value more negative than -150 volts within 2 seconds after being turned on
23	The plate current was greater than 3 amps with only the step contactor energized
24	The plate voltage remained below 6kV for 300 ms during step sequence
Continuous Operation	
30	The bias voltage was more positive than -150 volts for 2 seconds when the plate supply was on

The FAULT CAUSE table can be accessed just like any of the overload types under the OVERLOADS heading. If you select the OVERLOADS heading, you can advance through the overload types. FAULT CAUSE will follow FILAMENT in the overload stack. If you select FAULT CAUSE, the display will show the most recent type of fault in the 1 to 2 digit code.

SECTION X
VENDOR INFORMATION

X.1. INTRODUCTION

This section of the HT 30/35FM Technical Manual contains selected vendor data. Table X-1 lists the vendor data included.

Table X-1. Vendor Data Index

N O T E S

WARNING: Disconnect primary power prior to servicing.

TECHNICAL DATA

9015 4CX20,000D VHF RADIAL BEAM POWER TETRODE

The EIMAC 9015/4CX20,000D is a ceramic/metal VHF power tetrode intended for use as an rf amplifier up to 110 MHz. It is particularly recommended for use in the 88-108 MHz FM band. It features an electro-mechanical structure which provides high rf operating efficiency and low rf losses.

The 9015/4CX20,000D has a gain of up to 20 dB in FM broadcast service. The anode is rated for 20 kilowatts of dissipation with forced-air cooling and incorporates a highly efficient cooler of new design.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten Mesh	
Voltage	7.5 ± 0.4 V
Current, at 7.5 volts	145 A
Amplification Factor, Average, Grid to Screen	9.5
Direct Interelectrode Capacitances (cathode grounded)[2]	
Cin	181 pF
Cout	18.7 pF
Cgp	0.5 pF
Direct Interelectrode Capacitances (grids grounded)[2]	
Cin	76 pF
Cout	19.2 pF
Cpk	0.05 pF
Maximum Frequency for Full Ratings (CW)	110 MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. Varian EIMAC 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

Maximum Overall Dimensions:	
Length	9.51 In; 24.17 cm
Diameter	7.85 In; 19.95 cm
Net Weight (approximate)	14.8 Lbs; 6.7 kg
Operating Position	Axis Vertical, Base Up or Down
Cooling	Forced Air
Operating Temperature, Absolute Maximum, Ceramic/Metal Seals and Anode Core	250°C
Base	Special, Coaxial
Recommended Air-System Socket (for Frequencies to 30 MHz)	EIMAC SK-320
Recommended Air-System Socket (for VHF Applications)	EIMAC SK-360
Recommended Air Chimney (for use with SK-360 only)	EIMAC SK-336
Available Anode Contact Connector Clip	EIMAC ACC-3

RADIO FREQUENCY POWER AMPLIFIER

Class C FM (key-down conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	12.5 KILOVOLTS
DC SCREEN VOLTAGE	2.0 KILOVOLTS
DC GRID VOLTAGE	-1.5 KILOVOLTS
DC PLATE CURRENT	5.0 AMPERES
PLATE DISSIPATION	20 KILOWATTS
SCREEN DISSIPATION	300 WATTS
GRID DISSIPATION	200 WATTS

TYPICAL CAVITY OPERATION (Measured data at frequency shown with low-pass filter in output line)

Frequency	107.9	107.9	MHz
Plate Voltage	12.0	11.6	kVdc
Screen Voltage	1050	1360	Vdc
Grid Voltage	-300	-400	Vdc
Plate Current	3.4	3.72	Adc
Screen Current *	130	138	mAdc
Grid Current *	132	125	mAdc
Driving Power *	400	500	W
Useful Power Output #	33.3	35.0	kW
Plate Efficiency	80	81.1	%
Gain *	19.2	18.5	dB

* Approximate; will vary with circuit & tube.
# Delivered to the load.

VA4973(Effective February 1987 - Replaces March 1986) Printed in U.S.A.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 7.5 volts	140	150	A
Interelectrode Capacitance (grounded filament connection)[1]			
Cin	176	186	pF
Cout	18.2	19.2	pF
Cgp	---	0.8	pF
Interelectrode Capacitance (grounded grid connection)[1]			
Cin	73	82	pF
Cout	18.7	20.3	pF
Cpk	---	0.10	pF

1 Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Standard RS-191.

TYPICAL OPERATION values shown were obtained by measurement. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations.

APPLICATION

MECHANICAL

STORAGE - If a tube is to be stored as a spare it should be kept in its original shipping carton, with the original packing material, to minimize the possibility of handling damage.

Before storage a new tube should be operated in the equipment for 100 to 200 hours to establish it has not been damaged and operates properly (See FILAMENT OPERATION for recommendations on initial value of filament voltage during this operation period). If the tube is still in storage 6 months later it again should be operated in the equipment for 100 to 200 hours to make sure there has been no degradation. If operation is satisfactory the tube can again be stored with great assurance of being a known-good spare.

MOUNTING - The 4CX20,000D must be operated with its axis vertical. The base of the tube may be up or down at the convenience of the designer.

SOCKET & CHIMNEY - The EIMAC air-system socket SK-320 is designed for use with the 4CX20,000D in dc or LF/HF applications. For VHF applications the SK-360 air-system socket is recommended and the matching air-system chimney SK-336 is available. The use of the recommended air flow through an air-system socket will provide effective cooling of the base, with air then guided to the anode cooling fins by the chimney.

COOLING - The maximum temperature for the external surfaces of the tube is 250°C and forced-air cooling must be used in all applications to keep the temperature of the anode (at the base of the cooling fins) and the temperature of the ceramic/metal seals comfortably below this rated maximum.

It is considered good engineering practice to design for a maximum anode core temperature of 225°C and temperature-sensitive paints are available for checking base and seal temperatures before any design is finalized. EIMAC Application Bulletin #20 titled "TEMPERATURE MEASUREMENTS WITH EIMAC TUBES" is available on request.

It is also good practice to allow for variables such as dirty air filters, rf seal heating, and the fact that the anode cooling fins may not be clean if the tube has been in service for some length of time. Special attention is required in cooling the center of the stem (base), by means of special directors or some other provision. An air interlock system should be incorporated in the design to automatically remove all voltages from the tube in case of even partial failure of the tube cooling air.

Minimum air flow requirements for a maximum anode temperature of 225°C (or a maximum outlet air temperature of 160°C, whichever is reached first, which occurs only at the 5 kW dissipation level) for various altitudes and dissipation levels are listed. Pressure drop values shown are approximate and are for the tube anode cooler only. Pressure drop in a typical installation will be higher because of system loss.

Inlet Air Temperature = 25°C

Sea Level	Plate Diss. kW	Flow Rate CFM	Press. Drop In.Water
	5.0	80	0.2
	10.0	230	0.9
	15.0	580	3.3
	20.0	1130	9.6

5000 Feet	Plate Diss. kW	Flow Rate CFM	Press. Drop In.Water
	5.0	100	0.2
	10.0	280	0.9
	15.0	700	3.6
	20.0	1370	10.8

10,000 Feet	Plate Diss. kW	Flow Rate CFM	Press. Drop In.Water
	5.0	120	0.3
	10.0	340	1.0
	15.0	850	4.0
	20.0	1660	12.3

Inlet Air Temperature = 35°C

Sea Level	Plate Diss. kW	Flow Rate CFM	Press. Drop In.Water
	5.0	90	0.3
	10.0	270	1.0
	15.0	670	4.0
	20.0	1310	11.8

5000 Feet	Plate Diss. kW	Flow Rate CFM	Press. Drop In.Water
	5.0	110	0.3
	10.0	330	1.1
	15.0	820	4.4
	20.0	1590	13.4

10,000 Feet	Plate Diss. kW	Flow Rate CFM	Press. Drop In.Water
	5.0	140	0.3
	10.0	400	1.2
	15.0	990	4.9
	20.0	1920	15.3

Inlet Air Temperature = 50°C

Sea Level	Plate Diss. kW	Flow Rate CFM	Press. Drop In.Water
	5.0	110	0.3
	10.0	340	1.3
	15.0	850	5.4
	20.0	1660	16.6

5000 Feet	Plate Diss. kW	Flow Rate CFM	Press. Drop In.Water
	5.0	140	0.3
	10.0	410	1.5
	15.0	1030	6.0
	20.0	2000	19.0

10,000 Feet	Plate Diss. kW	Flow Rate CFM	Press. Drop In.Water
	5.0	170	0.3
	10.0	500	1.6
	15.0	1250	6.8
	20.0	2430	22.0

When long life and consistent performance are factors cooling in excess of minimum requirements is normally beneficial. It should be noted the contact fingers used in the contact collet assemblies (inner and outer filament, control grid and screen grid) are made of beryllium copper. If operated above 150°C for any appreciable length of time this material will lose its temper (springy characteristic) and then will no longer make good contact to the base contact areas of the tube. This can lead to arcing which can melt metal in a contact area (primarily the inner or outer filament contacts) and the tube's vacuum integrity may be destroyed.

Movement of cooling air around the base accomplishes a double purpose in keeping the tube base and the socket contact fingers at a safe operating temperature.

Air flow must be applied before or simultaneously with the application of power, including the tube filament, and should normally be maintained for a short period of time after all power is removed to allow for tube cooldown.

ELECTRICAL

ABSOLUTE MAXIMUM RATINGS - Values shown for each type of service are based on the "absolute system" and are not to be exceeded under any service conditions. These ratings are limiting values outside which the serviceability of the tube may be impaired. In order not to exceed absolute ratings the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by a safety factor so the absolute values will never be exceeded under any usual conditions of supply voltage variation, load variation, or manufacturing variation in the equipment itself. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

FILAMENT WARMUP - Filament voltage should be measured at the tube base or socket, using an accurate rms-responding meter. During turn-on the inrush current should be limited to 300 amperes.

FILAMENT OPERATION - At the rated (nominal) filament voltage the peak emission capability of the tube is many times that needed for communication service. A reduction in filament voltage will lower the filament temperature, which will substantially increase life expectancy. The correct value of filament voltage should be determined for the particular application. It is recommended the tube be operated at full nominal voltage for an initial stabilization period of 100 to 200 hours before any action is taken to operate at reduced voltage. The voltage should gradually be reduced until there is a slight degradation in performance (such as power output or distortion). The filament voltage should then be increased a few tenths of a volt above the value where performance degradation was noted for operation. The operating point should be rechecked after 24 hours.

Filament voltage should be closely regulated when voltage is to be reduced below nominal in this manner, to avoid any adverse influence by normal line voltage variations. For further information read EIMAC Application Bulleti #18 regarding this subject.

Filament voltage should be measured at the tube base or socket, using an accurate rms-responding meter. Periodically throughout the life of the tube the procedure outlined above for reduction of voltage should be repeated, with voltage reset as required, to assure best tube life.

ELECTRODE DISSIPATION RATINGS - The maximum dissipation ratings for the 4CX20,000D must be respected to avoid damage to the tube. An exception is the plate dissipation which may be permitted to rise above the rated maximum during brief periods (10 seconds maximum) such as may occur in tuning.

GRID OPERATION - The maximum control grid dissipation is 200 watts, determined approximately by the product of the dc grid current and the peak positive grid voltage. A protective spark-gap device should be connected between the control grid and the cathode to guard against excessive voltage.

SCREEN OPERATION - The maximum screen grid dissipation is 300 watts. With no ac applied to the screen grid, dissipation is simply the product of dc screen voltage and the dc screen current. Plate voltage, plate loading, or bias voltage must never be removed while filament and screen voltages are present, since screen dissipation ratings will be exceeded. Energy limiting circuitry (which will activate if there is a fault condition) and spark gap over-voltage protection are recommended as good engineering practice.

The tube may exhibit reversed (negative) screen current under some operating conditions. The screen supply voltage must be maintained constant for any values of negative and positive screen current which may be encountered. Dangerously high plate current may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished with a bleeder resistor connected from screen to cathode, to assure that net screen supply current is always positive. This is absolutely essential if a series electronic regulator is employed.

FAULT PROTECTION - In addition to the normal plate over-current interlock, screen current interlock, and coolant interlock, the tube must be protected from internal damage caused by an internal plate arc which may occur at high plate voltage. A protective resistance (10 ohm, 500 W) should always be connected in series with each tube anode, to help absorb power supply stored energy if an internal arc should occur. If power supply stored energy is high an electronic crowbar, which will discharge power supply capacitors in a few microseconds after the start of an arc, is recommended. The protection criteria for each electrode supply is to short each electrode to ground, one at a time, through a vacuum relay switch and a 6-inch length of #30 AWG copper wire. The wire will remain intact if protection is adequate.

EIMAC's Application Bulletin #17 titled FAULT PROTECTION contains considerable detail, and is available on request.

HIGH VOLTAGE - Normal operating voltages used with this tube are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment 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 primary circuits of the power supply and to discharge high-voltage capacitors 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.

RADIO-FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 300 MHz most of the energy will pass completely through the human body with little attenuation or heating affect. Public health agencies are concerned with the hazard, and the published OSHA (Occupational Safety and Health Administration) recommendation is to limit prolonged exposure of rf radiation to 10 milliwatts per square centimeter.

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 Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of a specially constructed test fixture which effectively shields 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. The capacitance values shown in the technical data 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.

SPECIAL APPLICATIONS - When it is desired to operate this tube under conditions widely different from those listed here, write to Varian EIMAC; Attn: Applications Engineering; 301 Industrial Way; San Carlos, CA 94070 U.S.A.

OPERATING HAZARDS

PROPER USE AND SAFE OPERATING PRACTICES WITH RESPECT TO POWER TUBES ARE THE RESPONSIBILITY OF EQUIPMENT MANUFACTURERS AND USERS OF SUCH TUBES. ALL PERSONS WHO WORK WITH OR ARE EXPOSED TO POWER TUBES OR EQUIPMENT WHICH UTILIZES SUCH TUBES MUST TAKE PRECAUTIONS TO PROTECT THEMSELVES AGAINST POSSIBLE SERIOUS BODILY INJURY. DO NOT BE CARELESS AROUND SUCH PRODUCTS.

The operation of this tube may involve the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel:

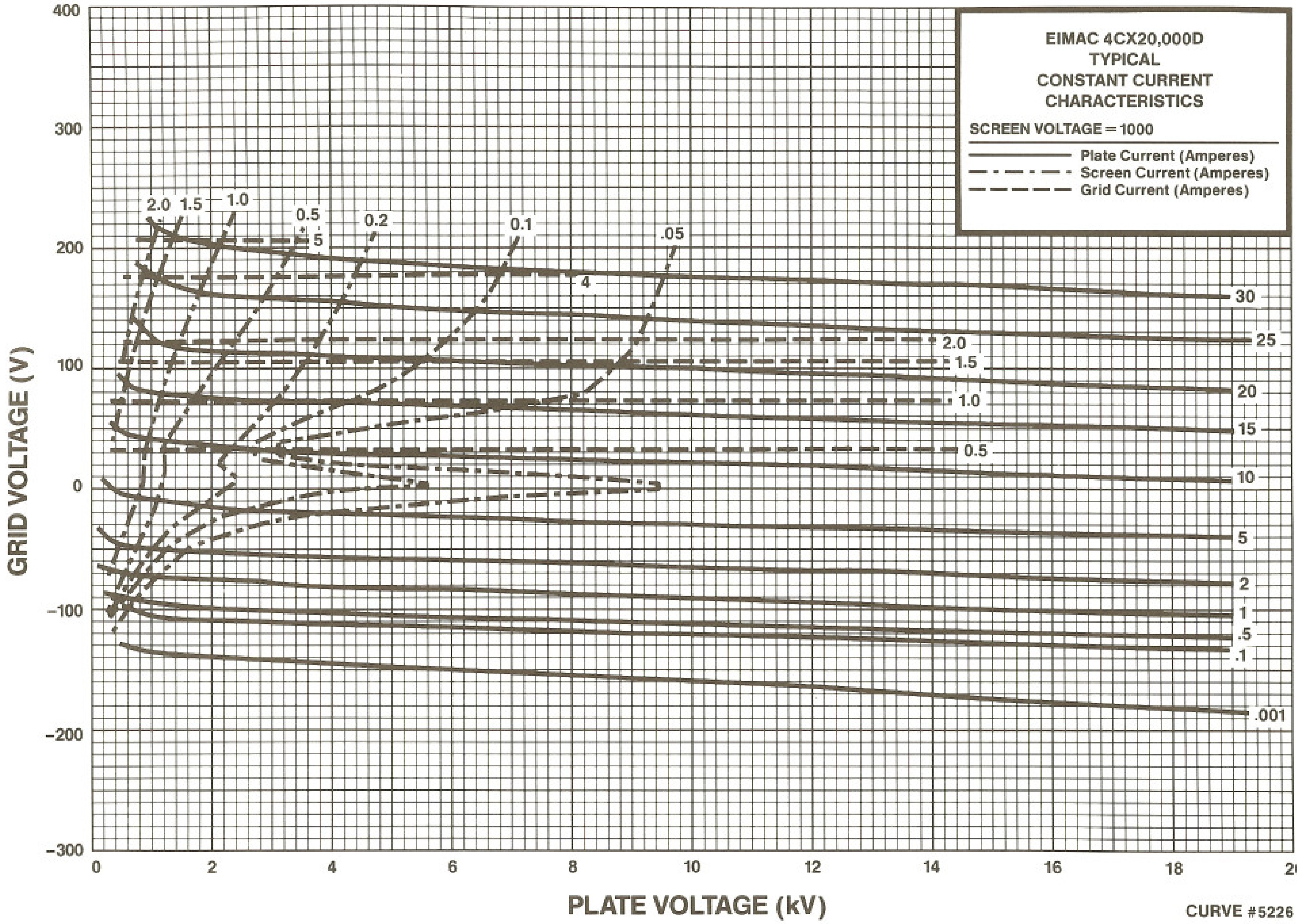
a. HIGH VOLTAGE - Normal operating voltages can be deadly. Remember that HIGH VOLTAGE CAN KILL.

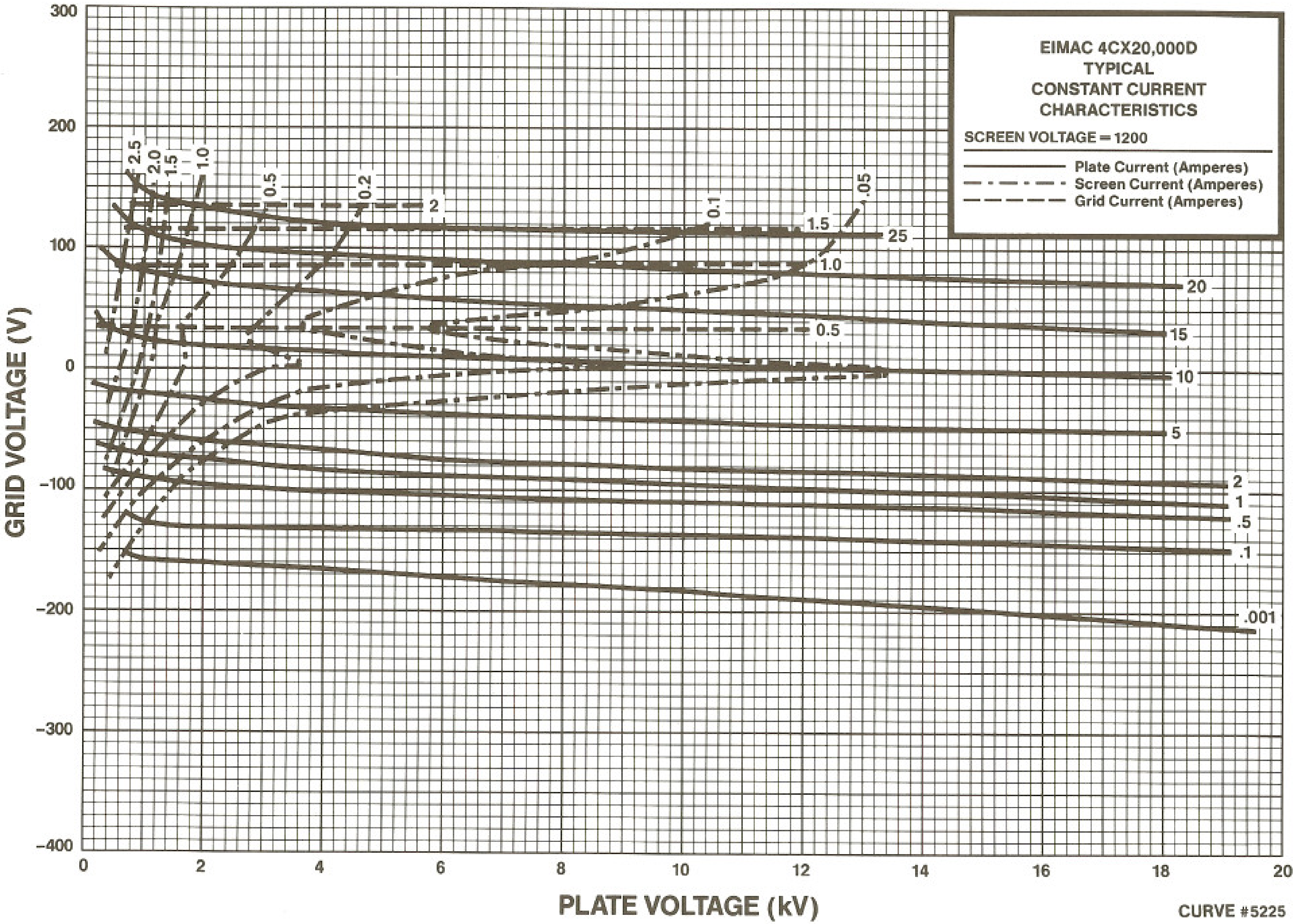
b. LOW-VOLTAGE HIGH-CURRENT CIRCUITS - Personal jewelry, such as rings, should not be worn when working with filament contacts or connectors as a short circuit can produce very high current and melting, resulting in severe burns.

c. RF RADIATION - Exposure to strong rf fields should be avoided, even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. CARDIAC PACEMAKERS MAY BE EFFECTED.

d. HOT SURFACES - Surfaces of tubes can reach temperatures of several hundred °C and cause serious burns if touched for several minutes after all power is removed.

Please review the detailed operating hazards sheet enclosed with each tube, or request a copy from: Varian EIMAC, Power Grid Application Engineering, 301 Industrial Way, San Carlos CA 94070.


EIMAC 4CX20,000D
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1000
Plate Current (Amperes)
Screen Current (Amperes)
Grid Current (Amperes)
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
400
300
200
100
0
−100
−200
−300
0
2
4
6
8
10
12
14
16
18
20
2.0
1.5
1.0
0.5
0.2
0.1
.05
5
4
2.0
1.5
1.0
0.5
30
25
20
15
10
5
2
1
.5
.1
.001
CURVE #5226



9015/4CX20,000D

	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	7.725	7.855		196.22	199.52	
B	.855	.895		21.72	22.73	
C	4.406	4.468		111.91	113.49	
D	.600	.760		15.24	19.30	
E	1.896	1.936		48.16	49.17	
F	3.133	3.173		79.58	80.59	
G	3.792	3.832		96.32	97.33	
H	3.980	4.020		101.09	102.11	
J	.188			4.78		
K	.188			4.78		
L	.188			4.78		
M	3.968	4.031		100.78	102.39	
N	.219			5.56		
P	4.757	4.820		120.83	122.43	
R	1.355	1.475		34.42	37.47	
S	9.140	9.515		232.16	241.68	
T	.500			12.70		
U	1.780	1.842		45.21	46.79	

NOTES

1. REF DIMENSIONS FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES
2. * CONTACT SURFACE.
3. OPTIMUM FILAMENT 8 GRID CONNECTOR HEIGHTS FOR SOCKET DESIGN PURPOSES