

TECHNICAL

MANUAL

TV 60UM TELEVISION TRANSMITTER

994 9171 002



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NOTE

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

MANUAL REVISION HISTORY

TV-60UM

888-2326-XXX

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002-B	Oct. 1991	37504	Replaced Title Page, MRH-1/MRH-2, and 7-5, 7-6, 7-25, & 7-26
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002-P	08-19-96	40042	Replaced Title Page, MRH-1/MRH-2, and pages 7-3 & 7-4

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.

SAFETY PRECAUTIONS TO OBSERVE WHILE TROUBLESHOOTING

- 1) Read safety warning and first aid information before proceeding.

- 2) **WARNING:** Use breakers or disconnect switches to remove all primary power to transmitter and peripheral equipment before opening enclosures, or removing any panel or shield.

Do not rely on internal contactors, relays, interlocks, or switching devices to remove all dangerous voltages.

- 3) Use grounding stick to discharge high voltage points before touching any points within the enclosure.

- 4) If a voltage reading or waveform analysis is required, route test leads through an opening in the cabinet to the desired measurement point. Secure leads away from any circuit with voltages beyond the break down point of their insulation or the isolation rating of the measuring device. Do not hold any measuring device in your hand while the equipment is energized. Securely ground the chassis of any scope, analyzer, or other test equipment.

- 5) Close cabinet doors and replace all panels before applying power and taking readings.

Do not attempt measurement of any circuits of transmitter sub-assembly with chassis floating at high voltage (i.e. DC filament assembly, rectifiers, Ion-Pump power supply, or Pulser) while the beam supply is energized.

- 6) After taking reading, use breakers or disconnect switches to again remove all primary power to transmitter and peripheral equipment before opening enclosure where test leads were routed or connected. Use grounding stick to discharge all high voltage points and points where test leads are attached before touching any points or removing test leads.

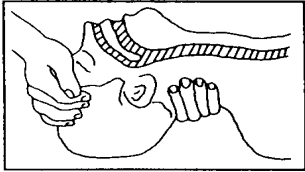
TREATMENT OF ELECTRICAL SHOCK

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

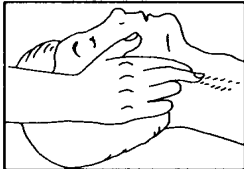
(A) AIRWAY

IF UNCONSCIOUS.
OPEN AIRWAY



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

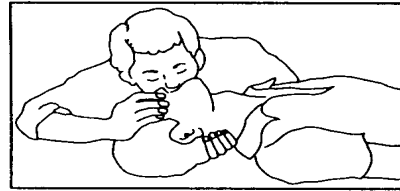
CHECK
CAROTID PULSE



IF PULSE ABSENT.
BEGIN ARTIFICIAL
CIRCULATION

(B) BREATHING

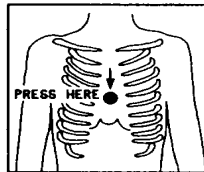
IF NOT BREATHING.
BEGIN ARTIFICIAL BREATHING



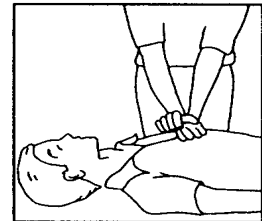
TILT HEAD
PINCH NOSTRILS
MAKE AIRTIGHT SEAL
4 QUICK FULL BREATHS
REMEMBER MOUTH TO MOUTH
RESUSCITATION MUST BE
COMMENCED AS SOON AS POSSIBLE

(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)

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SECTION I GENERAL DESCRIPTION

1.1. PURPOSE OF EQUIPMENT

The TV 60UM UHF TELEVISION TRANSMITTER (TV 60UM) is designed to operate on any of the UHF channels, 470-806 MHz, and provide 60 kW peak power visual output with up to 12 kW average power aural output. Utilizing intermediate frequency low-level modulation, the transmitter maintains a high degree of stability and linearity. Through the use of self monitoring and remote control circuits, the equipment provides reliable attended or unattended continuous operation.

The TV 60UM may be ordered with an RF system for combining visual and aural power. A typical RF system contains a waveguide notch diplexer equipped with aural notch detuners for emergency multiplex operation, a coaxial 7-port patch panel that provides test mode versatility, and a water-glycol test load.

1.2. DOCUMENTATION PROVIDED

The following subassembly technical manuals are provided with the TV 60UM TELEVISION TRANSMITTER:

<u>Subassembly</u>	<u>Manual Number</u>
IPA Cabinet	988 2264 001
Visual Exciter	988 2265 001
Aural Exciter	988 1903 001
Notch Diplexer Equalizer	988 1150 001
Heat Exchanger	988 2324 001
24/26V Ferro-Resonant PS	988 2261 001

1.3. TRANSMITTER DESCRIPTION

1.3.1. GENERAL

The TV 60UM is housed in four metal cabinets (Figure 1-1). The IPA CABINET (left cabinet) contains both visual and aural exciters and the IPA. The VISUAL AMPLIFIER CABINET (second from the left) contains the visual klystron and its support circuitry. Third from the left is the CONTROL CABINET that contains klystron collector voltage and current metering circuits, the circuitry to facilitate remote control, low voltage power supplies, and the beam power supply control circuits. Each klystron's cathode and collector potentials are supplied by separate high voltage DC BEAM POWER SUPPLIES. Klystron collector cooling is provided by a two stage liquid cooling system. Klystron body and magnet are cooled by a blower in each amplifier cabinet. Primary ac power for the transmitter and beam power supplies is controlled by each LINE CONTROL CABINET.

1.3.2. FUNCTIONAL DESCRIPTION

Figure 1-2 is a Simplified Block Diagram of the transmitter system.

A video signal applied to the transmitter input is first passed through the Notch Diplexer Equalizer where group delay error caused by the Notch Diplexer is pre-corrected. Following the equalizer, the video signal is pre-corrected by a Luminance Linearity Corrector before being sent to the visual exciter. The luminance corrector compensates for low frequency non-linearity in the system.

In the Visual Exciter, the video input signal is clamped to the back porch and corrected for differential phase. Also, circuits in the video portion of the visual exciter derive information from the video signal that lead to operation and timing of the Annular Ring Pulser and the circuit that corrects for incidental phase modulation distortion that occurs during pulsing. The video signal then amplitude modulates a 37 MHz IF carrier in a double balanced mixer. The modulated IF signal is group delay corrected (caused by the visual klystron), vestigial side-band filtered with a SAW filter, and linearity corrected. The modulated IF signal is converted to final frequency by mixing it in another double balanced mixer with a highly stable frequency developed from a crystal oscillator. The result is a fully processed on-channel signal that is linearly amplified to a 500 mw level before leaving the exciter. An AGC loop within the exciter maintains power level stability.

Modulation of the Aural Exciter can originate from two different sources. The first is a 600 ohm balanced monaural audio signal that is pre-emphasized in the exciter before being applied to the FM modulator. The second modulation source is in the form of a wideband unbalanced input that accepts a stereo composite signal. The audio signal frequency modulates a 32.5 MHz oscillator (4.5 MHz from the visual IF frequency). In order to maintain frequency stability, the modulated oscillator is phase locked to a crystal controlled reference oscillator. The output of the modulated oscillator is converted to final frequency by mixing its output with a sample of the crystal sourced reference frequency developed in the Visual Exciter. The resulting on-channel modulated signal is amplified to the 500 mw level before leaving the Aural Exciter.

Following the exciters is the Emergency Multiplex circuit that can be invoked if the aural amplification chain fails. This circuit combines the aural and visual exciter outputs and directs them to the visual amplification chain. This circuit is used in conjunction with notch diplexer cavity detuning mechanisms, diplexer bypass switching systems, or manual diplexer bypass patching systems to avoid filtration of the aural signal in the diplexer during multiplex operation.

The visual linear high power amplification chain begins with the visual IPA. Because the Annular Ring Pulser reduces klystron beam current during the video portion of the picture, klystron power gain is reduced. Up to 80 watts of blanking level drive power may be required to drive the klystron to full power. Drive power is provided by the solid state IPA amplifier assembly. The IPA is configured in several different ways, depending upon operating channel. An independent AGC system around the IPA maintains its amplitude stability over a wide range of ambient temperatures.

The aural klystron requires up to 10 watts of power to fully saturate the klystron. Normal operation requires approximately 6 watts. The aural exciter output is amplified to this level by the aural IPA.

Identical four cavity depressed collector klystrons are used for both visual and aural service. High power amplification of the

visual signal is accomplished by using multiple resonant cavities to velocity modulate the klystron beam at an RF rate. Maximum klystron efficiency is realized by limiting the klystron DC input power to the power required at any given moment dictated by the RF signal amplitude. This is done by utilizing the depressed collector techniques along with increasing klystron beam current only during sync pulses with the Annular Ring Pulser.

An extensive control system provides monitoring and protection for the klystrons. Klystron support equipment such as filament power supplies, ion pump power supplies, Annular Ring Pulser (visual only), magnet and refocus coil power supplies, beam supply and cooling system make up the majority of the transmitter hardware.

Two multiphase high voltage power supplies, one for each klystron, provide cathode and collector potentials.

Klystron liquid cooling is provided by a two stage heat exchanger system. A closed high purity water system cools the klystron collectors. The water system is equipped with its own continuous cleaning system that maintains or even improves water purity during transmitter operation. Heat from the pure water system is transferred to the second stage of the heat exchanger system which uses a water-glycol mixture as a liquid medium. The second stage transfers heat to an outside liquid to air heat exchanger that dissipates the heat directly into the atmosphere. The secondary loop can also be used to cool the station test load.

Low pass filters at the klystrons output attenuate any harmonic content in the signals before the aural and visual signals are combined in the notch diplexer. As shown in Figure 1-2, a 7-port patch panel is often used as a convenient way of connecting either klystron or the output of the diplexer to a test load.

1.4. SPECIFICATIONS

Refer to Table 1-1 for transmitter performance specifications, AC power requirements, environmental requirements, and physical characteristics.

NOTE

Specifications subject to change without notice.

1.5. COOLING & VENTILATING EQUIPMENT

1.5.1. GENERAL INFORMATION

It is necessary that the building be air conditioned or fan ventilated to maintain the room temperature below 50°C (122°F). The total heat dissipated by the transmitter and water lines is approximately 30,000 BTU per hour. Heat given off by additional electronic equipment located in the transmitter room will increase the total room heat load and must be considered in the room cooling design. Transmitter room cooling or ventilating equipment is not supplied with the transmitter.

1.6. EQUIPMENT SUPPLIED

Refer to Table 1-2 for a listing of the basic transmitter major equipment supplied.

Table 1-2. Listing of Major Equipment Supplied

DESCRIPTION	QUANTITY	COMMENTS
VISUAL AMPLIFIER CABINET	1	
AURAL AMPLIFIER CABINET	1	
CONTROL CABINET	1	
IPA CABINET	1	
VISUAL EXCITER	1	
AURAL EXCITER	1	
BEAM POWER SUPPLY	2	
LINE CONTROL CABINET	2	
PUMP MODULE	1	
ELECTRICAL INSTALLATION MATERIALS KIT	1	SEE SECTION VII FOR CONTENTS
PLUMBING KIT	1	SEE SECTION VII & DWG 843-5123-097 FOR CONTENTS

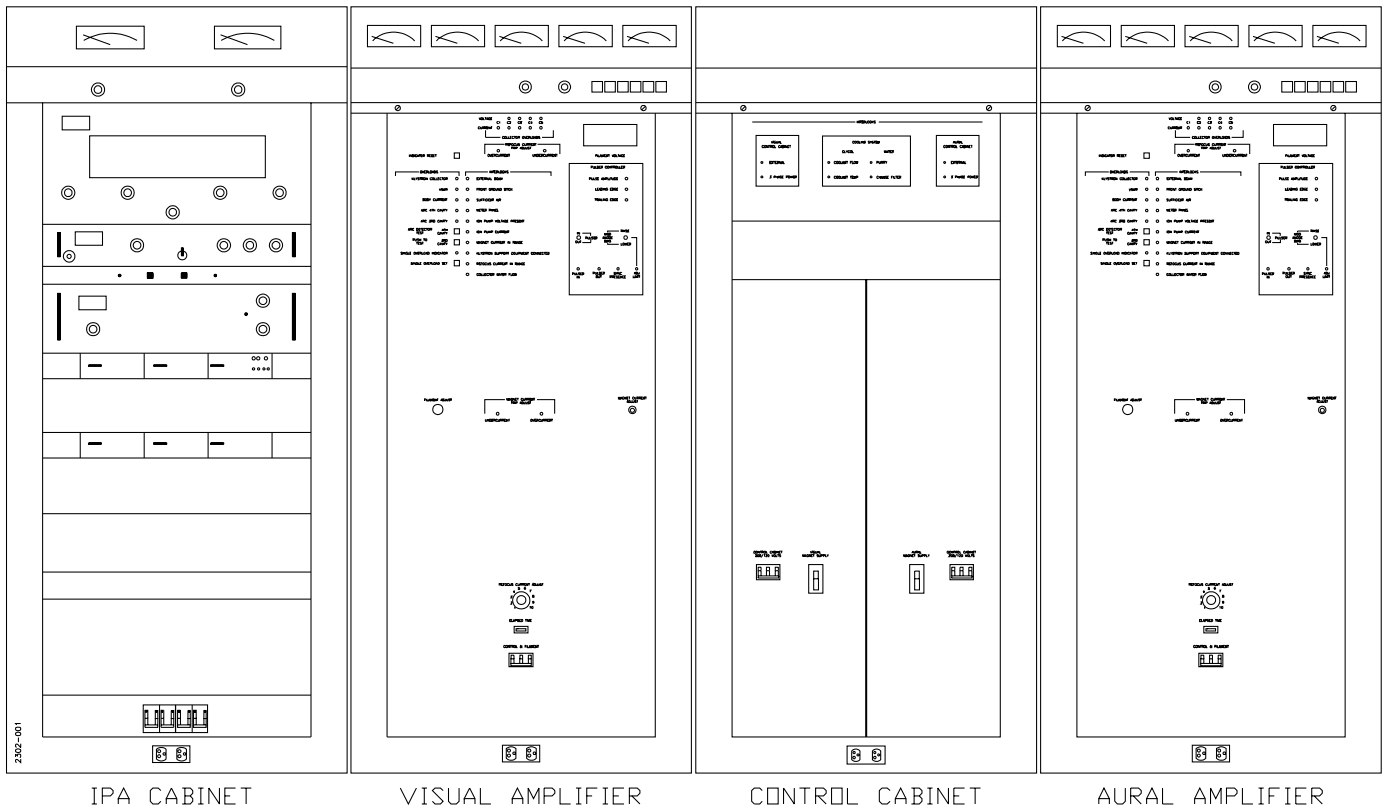


Figure 1-1. TV 60UM UHF Television Transmitter

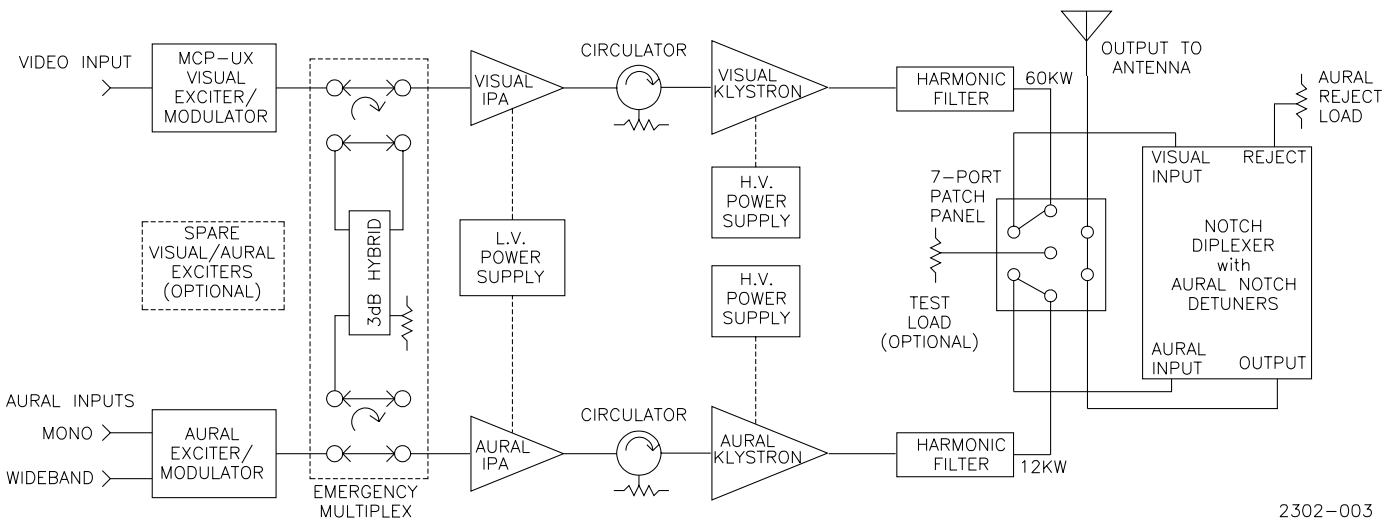


Figure 1-2. Block Diagram TV 60UM

Table 1-1. Specifications

	SYSTEM M/NTSC	SYSTEMS B/PAL, B/SECAM
VISUAL PERFORMANCE		
VISUAL POWER OUTPUT	60kW Peak. (At diplexer output)	60kW Peak (At diplexer output)
RF LOAD IMPEDANCE	50 ohms, Cabinet connector 3-1/8" EIA. Diplexer output connector 6-1/8" EIA.	50 ohms, Cabinet connector 3-1/8" EIA. Diplexer output connector 6-1/8" EIA
FREQUENCY RANGE	470-806MHz (Channels 14-69).	470-854MHz (Channels E21-E68)
CARRIER FREQUENCY STABILITY (1)	+/-500Hz (Maximum variation over 30 days).	+/-500Hz (Maximum variation over 30 days).
REGULATION OF OUTPUT POWER	3% or less relative to peak sync.	3% or less relative to peak sync.
VARIATION OF OUTPUT	3% or less.	3% or less.
VISUAL SIDEBAND RESPONSE (2)	-3.58MHz -42dB or better	-4.43MHz -30dB or better
(At output of optional Harris supplied notch diplexer)	-1.25MHz to -4.25MHz -20dB or better -0.75MHz to +3.58MHz +/-0.5dB +4.18MHz 0 to -2.5dB +4.50MHz to 7.75MHz -40db or better	-1.25MHz and lower -20dB or better -0.75MHz to +4.43MHz +/-0.5dB +5.0MHz 0 to -2.5dB +5.5MHz -30dB or better
FREQUENCY RESPONSE vs BRIGHTNESS (3)	+/-0.75dB.	+/-0.75dB.
MODULATION CAPABILITY	0%.	0%.
DIFFERENTIAL GAIN (4)	0.5dB or better.	0.5dB or better.
DIFFERENTIAL PHASE (4)	3° or better.	3° or better.
INCIDENTAL CARRIER PHASE MODULATION (4)	+/-2.0° or better relative to blanking.	+/-2.0° or better relative to blanking.
LUMINANCE NON-LINEARITY (5)	1.0dB or better.	1.0dB or better.
SIGNAL TO NOISE		
Total random and periodic noise un-weighted	-55dB RMS or better relative to sync peak.	-55dB RMS or better relative to sync peak.
2t K-FACTOR	2% Maximum.	2% Maximum.
20t GAIN AND DELAY RESPONSE	3% or less total baseline distortion.	3% or less total baseline distortion.
SYNC OVERSHOOT	5% or less within +/-300nS of leading/trailing edge.	5% or less within +/-300nS of leading/trailing edge.
EQUIVALENT ENVELOPE DELAY	0.2 to 2.1MHz +/-40nS	Transmitter supplied with receiver equalizer compliant with CCIR Report 624, Figure 3, curve A or B.
(Referenced to FCC standard curve)	at 3.58MHz +/-30nS at 4.18MHz +/-60nS	
VIDEO INPUT LEVEL	0.7 to 2.0 volts, 75 ohm, -36dB return loss.	0.7 to 2.0 volts, 75 ohm, -36dB return loss.
HARMONIC RADIATION & SPURIOUS EMISSION (Beyond +/-3MHz of channel edge)	-60dB relative to peak of sync.	-60dB relative to peak of sync.
AURAL PERFORMANCE		

Table 1-1. Specifications (Continued)

	SYSTEM M/NTSC	SYSTEMS B/PAL, B/SECAM
AURAL POWER OUTPUT	12kW. (At diplexer output)	12kW. (At diplexer output)
RF LOAD IMPEDANCE	50 ohms, Cabinet output connector 3-1/8" EIA.	50 ohms, Cabinet output connector 3-1/8" EIA.
FREQUENCY STABILITY	+/-20Hz. (Relative to 4.5MHz visual frequency offset.	+/-20Hz. (Relative to 5.5MHz visual frequency offset)
MODULATION CAPABILITY	+/-120kHz peak deviation.	+/-120kHz peak deviation.
STEREO PERFORMANCE (At +/-75kHz deviation)		
INPUT LEVEL	1 volt RMS, nominal.	1 volt RMS, nominal.
INPUT IMPEDANCE	75 ohms unbalanced.	75 ohms unbalanced.
FREQUENCY RESPONSE	+/-0.15dB, 50Hz to 50kHz. +/-0.5dB, 50kHz to 110kHz.	+/-0.15dB, 50Hz to 50kHz. +/-0.5dB, 50kHz to 110kHz.
FM NOISE	-70dB or beter after de-emphasis.	-70dB or better after de-emphasis.
DISTORTION (THD)	1% or less 50Hz to 15kHz. 2% or less 15kHz to 50kHz.	1% or less 50Hz to 15kHz. 2% or less 15kHz to 50kHz.
DISTORTION (IMD)	2% or less (SMPTE 4:1)	2% or less (SMPTE 4:1)
STEREO SEPARATION (Equivalent mode)	40dB or better, 50Hz to 15kHz.	40dB or better, 50 Hz to 15kHz.
CROSSTALK (Stereo or Main to SAP)	45dB or better, 50Hz to 15kHz.	45dB or better, 50 Hz to 15kHz.
MONAURAL PERFORMANCE	(At +/-25kHz deviation)	(At +/-50kHz deviation)
INPUT LEVEL	+10dBm nominal (adjustable).	+10dBm nominal (adjustable).
INPUT IMPEDANCE	600 ohms, balanced.	600 ohms, balanced.
PRE-EMPHASIS	75uS, or flat; selectable.	50uS, or flat; selectable.
FREQUENCY RESPONSE	+/-0.5dB, 30Hz to 15kHz.	+/-0.5dB, 30Hz to 15kHz.
DISTORTION (THD)	0.5% or less, 30Hz to 15kHz, after de-emphasis.	0.5% or less, 30Hz to 15kHz, after de-emphasis.
FM NOISE	-60dB or better, after de-emphasis.	-60dB or better, afte de-emphasis.
AM NOISE	-55dB relative to 100% modulation.	-55dB relative to 100% modulation.
AM SYNCHRONOUS NOISE	-40dB or better, relative to 100% amplitude mod.	-40dB or better, relative to 100% amplitude mod.
SCA (2 INPUT), INPUT LEVEL	1 volt RMS, nominal (adjustable)	1 volt RMS, nominal (adjustable)
IMPEDANCE	75 ohms, unbalanced.	75 ohms, unbalanced.
FREQUENCY RESPONSE	+/-1dB 20kHz to 110kHz.	+/-1dB 20kHz to 110kHz.
SERVICE CONDITIONS		

Table 1-1. Specifications (Continued)

	SYSTEM M/NTSC	SYSTEMS B/PAL, B/SECAM
AMBIENT TEMPERATURE RANGE (6)	+2° to 50°C (+36° to +122°F).	+2° to 50°C.
AMBIENT HUMIDITY RANGE	0% to 95% relative humidity, non-condensing.	0% to 95% relative humidity, non-condensing.
ALTITUDE	Sea level to 7,500ft.	Sea level to 2,286m.
PHYSICAL AND MECHANICAL DIMENSIONS	TRANSMITTER: 126"W x 74"D x 73.5"H.	TRANSMITTER: 320cm W x 188cm D x 187cm H.
	Weight: 5000 lbs.	Weight: 2,268kg.
	(2) POWER SUPPLY: 52"W x 68"D x 67.5"H.	POWER SUPPLY: 132cm W x 178cm D x 171cm H.
	Weight: 7,100lbs. each.	Weight: 3,220kg.
	PUMP MODULE: 36"W x 61"D x 63"H.	PUMP MODULE: 91cm W x 155cm D x 160cm H.
	Weight: 1040lbs. (Without coolant).	Weight: 472kg. (Without coolant).
	FAN/COIL MODULE: 54"W x 106"D x 45"H.	FAN/COIL MODULE: 137cm W x 270cm D x 114cm H.
	Weight: 800lbs. (Without coolant).	Weight: 363kg. (Without coolant).
(2) LINE CONTROL: 24"W x 24"D x 48"H.	LINE CONTROL: 61cm W x 61cm D x 122cm H.	
Weight: 300lbs each.	Weight: 136kg.	
ELECTRICAL REQUIREMENTS	460/480/500 volts, +/-5%, 3 phase, 60Hz.	380/400/415 volts, +/-5%, 3 phase, 50Hz.
POWER CONSUMPTION (Estimated)	90kW (10% Aural), 110kW (20% Aural)	90kW (10% Aural), 110kW (20% Aural).
NOTES:		
(1) After initial aging of 60 days.		
(2) Response specified for transmitter operating into a resistive load of 1.05 VSWR or better.		
(3) Measured using 20% p.p amplitude swept video modulation with pedestal set at black 10%, white 90% with reference grey level 50%. All percentages relative to a blanking to white excursion.		
(4) Measured with 5-step riser signal from 75% to 12.5% of peak sync level. Sub-carrier modulation level 12.5% peak-to-peak.		
(5) Measured with 5-step riser signal. Test signal No. 3 CCIR REC 421-3.		
(6) Derate 2°C per 1,000 feet (305 meters) altitude above sea level.		

SECTION II INSTALLATION

2.1. GENERAL

This section provides information and instructions necessary for the installation of the HARRIS TV 60UM TELEVISION TRANSMITTER. Guidelines in the form of installation instructions are given to minimize the installation time required. Care and precautionary measures are given to prevent problems or injury from occurring during installation.

Probably the most important factors in a successful, efficient, and safe installation phase of a new transmitter is PLANNING AND PREPARATION. Study equipment manuals beforehand and become thoroughly familiar with the installation requirements for each piece of equipment.

When considering the sequence of events during an installation, it is important to approach the transmitter, its peripherals, and the building as a system. "Typical" drawings will be used as a references, but it must be assumed special requirements will cause deviations from the published installation drawings in order to accommodate a particular configuration or building requirement.

Plan the AUDIO AND VIDEO DISTRIBUTION SYSTEMS ahead of time and draw schematics and/or wiring diagrams for them. If possible, install them. Plan and, if possible, install the MICROWAVE SYSTEM (if used). Plan the REMOTE CONTROL SYSTEM, if the plant will be so equipped. Know where the remote equipment will mount and what parameters it should monitor and what functions it should control.

The TRANSMITTER EQUIPMENT installation phases should be planned before the equipment arrives and a detailed plan worked out and written down. Assure that it is known what installation equipment and materials HARRIS is supplying with the transmitter and what equipment and materials the station must supply. In general, a transmitter installation requires that the following areas be addressed:

- a. In a new installation, WILL THE BUILDING/TRANSMITTER ROOM BE COMPLETED? Transmitting equipment and any electronic equipment can be damaged or made inoperable by dust and dirt entering the equipment. Even a plastic covering placed over the transmitter rarely keeps out concrete dust and plaster dust created from drywall installation. Interior walls should be in place, ceiling work should be complete, concrete floors should be aged and well sealed.
- b. In a new installation, WILL ELECTRICAL POWER BE AVAILABLE WHEN NEEDED? Often transmitter installation and checkout is held up because primary power is not available for the transmitter.
- c. In an existing facility, MUST AN EXISTING TRANSMITTER REMAIN ON THE AIR during installation of the new equipment? Plan how this is to be done to minimize off-air time.
- d. STAGING AREA. An area should be chosen and set aside to place all the boxes and crates that contain all the smaller parts and assemblies not shipped attached to the transmitter proper. A separate area should be used to

stage all installation materials (plumbing materials, wire, conduit and accessories, loose hardware, etc.). Each piece of equipment should be inspected for shipping damage. Inventory all equipment and the contents of each box and compare to the packing check list that comes with the equipment.

- e. UNLOADING. Will the proper lifting and moving equipment be there when the truck containing the transmitter arrives? Will there be enough workers there to help?
- f. EQUIPMENT PLACEMENT. Using a station layout drawing, determine equipment placement AND IN WHAT ORDER EQUIPMENT SHOULD BE SET IN PLACE. If possible, lay out equipment location with lines marked on the floor.
- g. HANGING HARDWARE. Ensure that all pipe hangers, conduit hangers, threaded rod, beam clamps, Unistrut and unistrut hardware is on site.
- h. TOOLS. Ensure that all necessary tools will be on site when needed. Make sure all tools are in good shape. Check transmitter and other equipment technical manuals to see if any specialized tools are required. Make arrangements to obtain them if necessary.

2.2. DELIVERY AND STORAGE

The TV 60UM is normally delivered with the larger units mounted on shipping skids. Smaller components are shipped in cardboard cartons. Any obvious damage should be noted at the time of receipt and claims filed with the carrier.

In unloading the equipment, the receiver will require suitable equipment capable of handling a 8,000 pound load (3629 kg). Extreme care should be taken during the unloading operation to prevent injury to personnel or damage to the equipment.

If storage of the equipment is to be made, all units except the high voltage power supply require inside storage. Except for the small cardboard cartons, stacking of items should not be done. The storage area should be dry and clean.

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. UNPACKING

The following guidelines are provided for ease of unpacking the equipment.

2.4.1. HIGH VOLTAGE POWER SUPPLIES

Each high voltage power supply weighs approximately 7,100 pounds necessitating the use of suitable mechanical equipment. Use lifting hooks provided on the power supply tank or fork lift under unit.

2.4.2. HEAT EXCHANGER COMPONENTS

Using the fork lift or other suitable equipment and extreme care remove the pump module, and fan unit from their skids.

2.4.3. TRANSMITTER CABINETS

Carefully remove cabinets from skids.

CAUTION

UNIT MUST NOT BE DROPPED. MAKE A RAMP TO ROLL UNIT FROM SKID TO FLOOR.

Side panels and doors, if not already mounted on cabinet, are wrapped in protective material. Do not use a knife or other sharp object to remove wrapping, as these tools may damage the finish.

Cardboard cartons should be opened with the carton in the proper position (note "UP" arrows on carton). Parts inside are wrapped and extreme care must be taken when unwrapping these parts so as not to drop or discard parts as waste.

2.4.4. PACKING CHECK LIST

A list of the items to be unpacked is given in the Packing Check List provided with the transmitter. See Section VII for a list of the installation material normally supplied with the transmitter.

2.5. EQUIPMENT PLACEMENT

2.5.1. TYPICAL STATION LAYOUTS

The recommended equipment placement depends somewhat on the operating channel, especially if operation is to be at channel 52 or higher. Refer to the typical station layout and plumbing drawings. These drawings provide useful information regarding floor plan, RF transmission line layout, and plumbing for the cooling system.

2.5.2. BEAM SUPPLIES AND HEAT EXCHANGER FAN MODULE

It is recommended that the beam power supplies and the heat exchanger fan module be mounted on a concrete pad in a secure area outside the building.

2.5.3. PUMP MODULE AND LINE CONTROL CABINETS

Place the Heat Exchanger Pump Module and Line Control Cabinets according to the floor plan.

2.5.4. TRANSMITTER CABINETS

Refer to the typical station layout and proceed as follows:

- Move the diplexer into the area in which it will be installed.
- Snap a chalk line on the floor where the front of the transmitter cabinets will rest. Also snap a chalk line on the floor where one end of the transmitter cabinets will rest.

- Begin moving each cabinet into place lining it up with the chalk lines. It is a good idea to level each cabinet as it is moved into its final position. Use small pieces of sheet metal at each cabinet corner as leveling adjustments.
- Connect ground straps between each cabinet and install the ground strap system in the transmitter room.

WARNING

ENSURE GROUND STRAPS ARE CONNECTED BETWEEN CABINETS, HIGH VOLTAGE POWER SUPPLIES, LINE CONTROL CABINETS, AND OTHER TRANSMITTING EQUIPMENT AND THAT AT A CENTRAL POINT THE GROUND STRAPS ARE BONDED TO STATION GROUND. AT A MINIMUM THE STRAPS SHOULD BE BOLTED TOGETHER USING SEVERAL BOLTS AND LARGE WASHERS AT EACH CONNECTION TO MAXIMIZE THE SURFACE AREA OF THE STRAPS UNDER COMPRESSION. IT IS RECOMMENDED THAT THE CONNECTIONS ALSO BE SOLDERED.

2.5.5. KLYSTRON UNCRATING AND ASSEMBLY

A chain hoist assembly is supplied to facilitate the installation of the klystron into the magnet/carriage assembly. Refer to the station layout drawings for proper hoist installation height.

It may be desirable to check the quality of the vacuum inside the klystron while it is still in the crate. This is done by applying voltage to the klystron's Vac-ion pump and measuring the current being drawn by the pump. Refer to procedures provided by the klystron manufacturer in Section IX.

CAUTION

THE KLYSTRON WEIGHS APPROXIMATELY 190 LBS BY ITSELF; 400 LBS WHEN THE WEIGHT OF THE SHIPPING FRAME IS INCLUDED. THE LIFTING SUPPORT STRUCTURE MUST BE CAPABLE OF SUPPORTING THIS LOAD. THE SUPPORTING STRUCTURE MUST BE STRONG ENOUGH TO SUPPORT A LOAD AT LEAST EQUAL TO RATING OF THE HOIST (1 TON).

Follow closely the klystron manufacturer's instructions in Section IX to unload the klystron from the shipping crate.

See Figure 2-1. Ensure that the orientation of the klystron into the magnet structure is correct; otherwise the klystron magnet

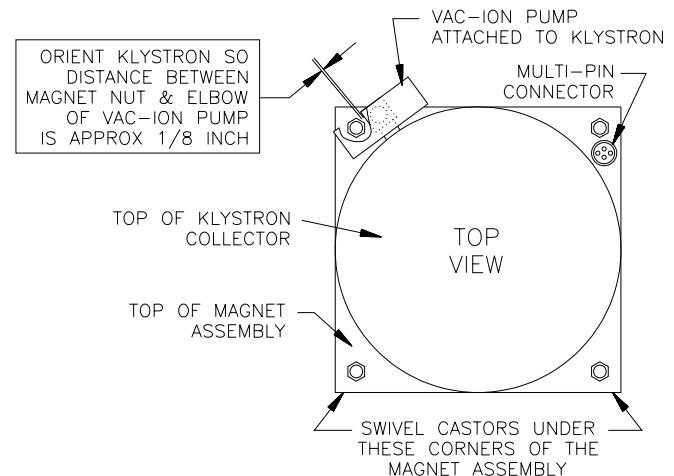


Figure 2-1. Klystron Orientation In Magnet Assembly

assembly will not fit into the transmitter cabinet. As the klystron is being lowered into the magnet assembly, just before the klystron seats into the magnet and the weight of the klystron is still being supported by the hoist, rotate the klystron so the tubing at the bottom of the Vac-ion pump is close to the magnet post assembly nut (on the top of the magnet) as possible.

When the klystron is seated and oriented properly into the magnet assembly, installation of the cavities may begin. Metric tools and metric hardware for cavity installation are provided by the klystron supplier. Refer to the tube manufacturer's assembly manual for specific procedures to use in unpacking and assembling the klystron cavity circuits.

NOTE

It is desirable to pre-tune the 4th cavity before fitting the breakaway. Refer to tuning procedures in Maintenance Section.

CAUTION

THE ASSEMBLED KLYSTRON/MAGNET IS TOP HEAVY AND CAUTION SHOULD BE OBSERVED WHEN ROLLING IT ACROSS THE FLOOR. THE AREA SHOULD BE SMOOTH AND FREE OF ANY DEBRIS WHICH MIGHT INTERFERE WITH THE WHEELS AND CAUSE THE KLYSTRON AND MAGNET TO TIP OVER.

The klystron/magnet assembly should be kept in a safe and secure area until it is needed for final transmitter installation. It should be kept covered to prevent dust and dirt contamination.

It will be necessary to temporarily install the klystron/magnet assembly into the Amplifier Cabinet to determine the height and centering of the RF transmission line breakaway.

2.5.6. TRANSMITTER TRANSMISSION LINE HEIGHT ADJUSTMENT

- a. Install the top half of the rf breakaway in the cabinet. Threaded rod supports it from three bolt holes in the cabinet top mounting plate. See Figures 2-2 through 2-5.
- b. For those amplifiers that will be connected to 6-1/8" transmission line, install a 3-1/8" to 6-1/8" adaptor on the top half of the breakaway.
- c. Roll the klystron/magnet assembly temporarily into the cabinet. Adjust the centering of the upper breakaway by moving the support plate. Adjust the height of the breakaway so it mates with the lower section of the breakaway (mounted on the klystron/magnet assembly) by adjusting the nuts on the threaded rod supports. When properly adjusted, tighten the hardware on the support plate and threaded rods.
- d. Disengage the breakaway at its break-point by unbolting the center conductor and remove the klystron/magnet Assembly (with lower portion of breakaway) to a safe area until construction is completed.

2.5.7. RF SYSTEM

Study the typical station layout drawings or custom layout drawings before beginning installation of the RF system. The horizontal and vertical placement of the RF system in relation to the transmitter is crucial to the successful installation of the interconnecting and antenna transmission lines.

If a patch panel (optional) is to be installed, consider that for most RF system designs, the minimum mounting height of the diplexer is dictated by the mounting height of a horizontally mounted patch

panel. The patch panel should be installed so it can be operated from the floor, yet it should not be low enough to cause a hazard in a high traffic area. If the quantity of coaxial elbows that connect the panel to the diplexer is to be minimized, the diplexer must be elevated to exactly the distance equivalent to two leg lengths of a 6-1/8" elbow. If the diplexer is to be mounted higher, than it must be at least 6" higher than two elbow leg lengths to accommodate the shortest length of 6-1/8" transmission line possible. See Figure 2-9 to determine elbow leg lengths.

Leg lengths of 3-1/8" elbows, minimum length of straight pieces, and the length of 6-1/8" to 3-1/8" adapters all usually used in the aural signal path also can influence diplexer height and therefore should be taken into consideration.

Finally check to make sure that the patch panel mounting location will not interfere with the clearance of the klystron cabinets rear doors.

2.5.7.1. Diplexer Placement

Identify the diplexer visual input port on the layout drawing and determine its location with respect to the transmitter. Locate the same point on the floor of the room and mark it.

Place the center sections of the diplexer on saw horses as shown in Figure 2-6. Orient the section so the visual input of the diplexer, when attached, will be close to being directly over the mark on the floor made previously. Install the proper 3dB hybrid combiners to both ends of the center sections using marking or labeling on the pieces as a guide. Alignment pins are provided and should be used in diagonal corners to assure proper seating of flanges. Tighten the bolts in the sequence shown in Figure 2-7; then torque each to 15 Ft. Lbs. Position the visual input port of the assembled diplexer directly over the mark on floor using a plumb bob. Also using the plumb bob, locate the proper placement and install the all-thread rods from the overhead support system. Locate the rods so they are directly over the hanging brackets on the RF system. Raise the diplexer using suitable hoists and pulleys. Level the diplexer when its proper height is reached and it has been attached to the all-thread rods.

NOTE

The length of the threaded rods hanging the diplexer should be as short as possible to minimize objectionable lateral movement. If the RF system equipment is to be supported from a high ceiling, an intermediate metal frame grid should be constructed that hangs from the ceiling and in turn provides the structure from which the RF system is suspended.

2.5.7.2. Installation of Optional Patch Panel

Set the patch panel and mounting frame on the floor under the desired mounting position. Mount and position all-thread rods directly overhead using the plumb bob. Raise the patch panel and frame into position, level, and secure.

CAUTION

LEAVE PATCHES IN PLACE DURING INSTALLATION TO STIFFEN AND SUPPORT THE PANEL.

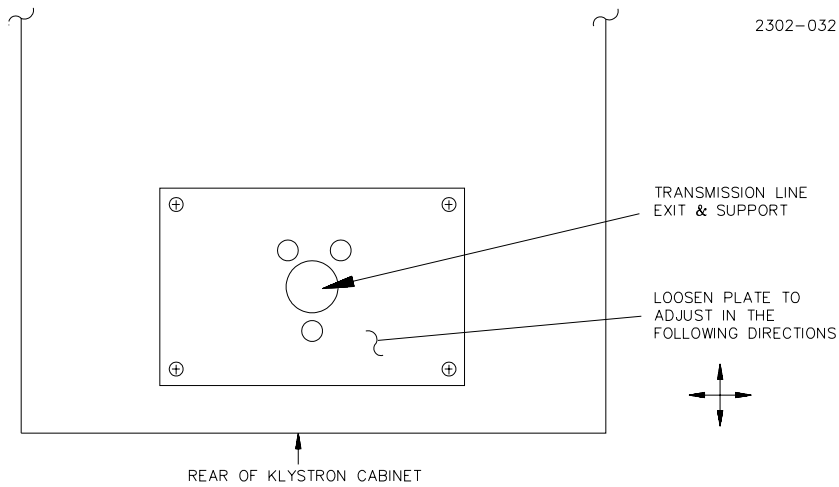


Figure 2-2. Transmission Line Lateral Adjustment

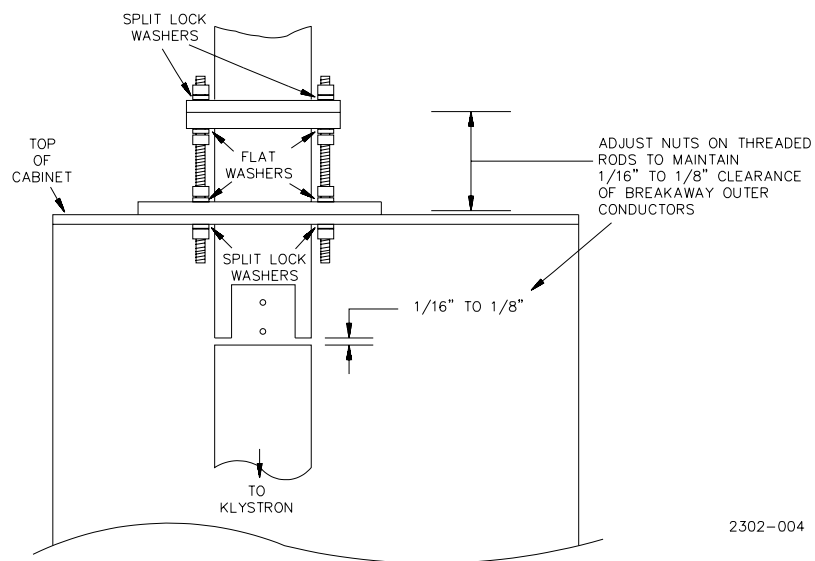


Figure 2-3. Transmission Vertical Support Adjustment

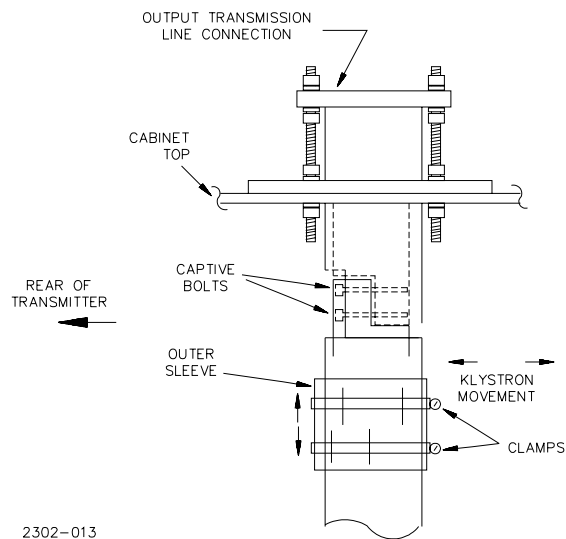


Figure 2-4. RF Breakaway Section Operation

Figure 2-5. RF Transmission Line Breakaway Operation

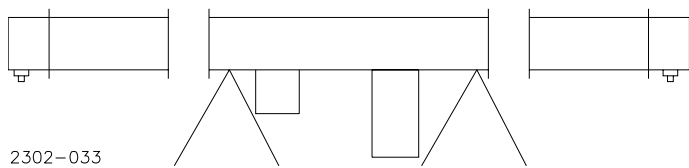
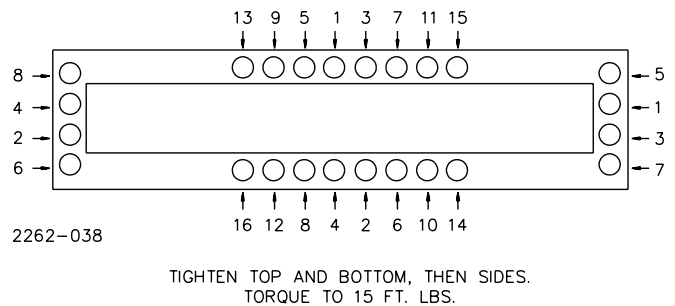


Figure 2-6. Dual Square Tee Section on Saw Horses

2.6. EQUIPMENT INTERCONNECTIONS

2.6.1. INTERCONNECTING TRANSMISSION LINE AND WAVEGUIDE

Because of the relative routing inflexibility of transmission line and waveguide connections and components, it is recommended that transmitter to RF system transmission line be installed before the plumbing and conduit are installed. This will allow some movement of the RF system or the transmitter cabinets for needed alignment, if necessary, without having to disconnect plumbing or conduit lines. The typical station layout drawing shows one method of proper installation of the transmission line.



TIGHTEN TOP AND BOTTOM, THEN SIDES.
TORQUE TO 15 FT. LBS.

Figure 2-7. Tightening Sequence

2.6.2. PREPARATION FOR INSTALLING INTERCONNECTING TRANSMISSION LINE

Before cutting any transmission line, verify that the transmitter and RF system components are correctly positioned and are level. See the applicable typical layout drawings.

Before cutting transmission line for the connection between the Amplifier Cabinets and the RF system, the correct transmission line vertical height at the top of each transmitter Amplifier Cabinet must be established. If it has not already been done, temporarily install each klystron/magnet assembly in its cabinet. Adjust the height and centering of each breakaway to properly connect to the other half of the breakaway mounted to the klystron. This procedure will help compensate for slight variances in the floor level.

2.6.3. SUGGESTED PROCEDURE FOR CUTTING AND SOLDERING TRANSMISSION LINE

The purpose of this procedure is to provide guidelines for field cutting and soldering of RF transmission line used inside the building to interconnect the transmitter to the RF system.

Try to cut and flange the longest pieces first. Complete one run at a time in order to avoid accumulated errors. (i.e.: Cut, solder, and hang line from antenna port of diplexer to patch panel. Then cut, solder, and hang line from the aural input port of diplexer to patch panel.)

Listed in Table 2-1 are some tools and materials that have proven effective.

2.6.3.1. Transmission Line Cutting and Flange Soldering Procedure

- a. Determine the flange-face to flange-face length of the transmission line run needed. (If the run includes an elbow, see Figure 2-9 to determine the elbow length.)
- b. Subtract twice the cutback dimension of the flange. This dimension varies with flange manufacturer. See Figure 2-8. Using the suggested methods for cutting the line given in paragraph 2.6.4, cut the outer conductor to the length just calculated.
- c. If holes in the outer conductor are needed for directional couplers, tuning paddles, etc. they should be added now and the holes properly deburred.
- d. Using the suggested techniques for installing the flanges given in paragraph 2.6.5, solder a flange to each end of the outer conductor.
- e. Measure the flange-face to flange-face dimension after soldering to confirm the proper length and to determine the initial length of the inner conductor.
- f. Determine the length of the inner conductor by using the flange-face to flange-face dimension of the outer conductor and subtracting the dimension of the anchor connector (bullet) shown in Figure 2-10. This dimension determines the proper cutback of the inner conductor for **BOTH ENDS OF THE LINE AT THE SAME TIME. DO NOT DOUBLE THIS DIMENSION WHEN SUBTRACTING FROM THE OUTER CONDUCTOR LENGTH.**
- g. Cut the inner conductor and deburr the cut edges.
- h. Ensure the inside of the outer conductor is clean; then insert the inner conductor. The line is ready to install.

2.6.4. CUTTING THE TRANSMISSION LINE

A square smooth cut is required. Several methods may be used with the choice depending on tools available and labor available to be expended.

- a. **METHOD #1.** A hand hack saw and cast iron cutting guide is a good combination for making a cut with a minimum of tools for one or two pieces, but can be very labor intensive for putting up an entire system. See Figure 2-11.
- b. **METHOD #2.** Hand Band Saw. Most popular saws can be rented or purchased. See Figure 2-12.
- c. **METHOD #3.** Swing Arm Band Saw. This is a good way to go if one can be rented or borrowed. Many pipe fitters and electrical contractors own them. If the saw has an automatic feed, cut slowly. It is critical that the support

Table 2-1. Installation Tools and Materials

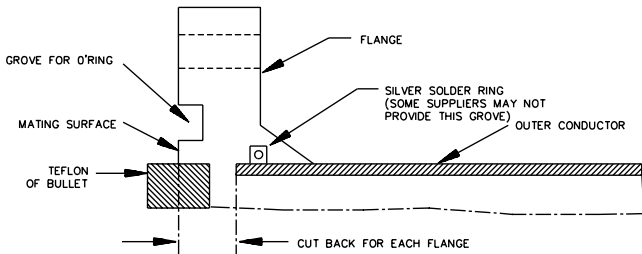
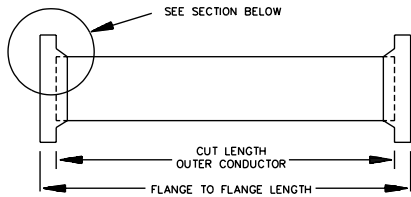
Welding Torch Set
Oxygen and Acetylene Tanks
Welder's Mask or Goggles
Power Band Saw (can be rented) and Extra Blades
Silver Solder 1/16 inch diameter, 30%-45%, Hard Stay-Silv #45, Aladdin #45, HARRIS part number 099 0002 238
Paste flux (Engelhard Ultra-Flux 1 lb jar) HARRIS part number 099 0002 241
(HARRIS part number 086 0004 040, 16 oz bottle)
Muriatic Acid (quart)
Baking Soda (two 1-pound boxes)
Three plastic 5-gallon buckets or containers with open tops
Scotch Brite
Steel Wool
Emery Cloth (roll type like plumber uses)
Carpenters Square
Level
Plumb Bob
Chalk Line
Hacksaw and Extra Blades
Wrenches
Crowbar
Rope
Saw Horses or Cutting Table
Come-along or Chain-Fall Hoist
Ladders
Files
Garden Hose
25-Ft Tape Measure
Hole Saw, 1-7/8 inches, for installing directional couplers
Rubber Hammer
Claw Hammer
Gloves
Safety Glasses
NOTE: All-thread rod, hangers, angle iron or channel will be needed to support the transmission line, dummy load, etc.

saw horses be made level with the saw. Test cuts should first be made using scrap pipe or a wood 4x4 to verify that the blade is not creeping and the saw is in alignment. See Figure 2-13.

CAUTION

DO NOT OVER TIGHTEN THE VISE USED WITH THESE SAWS. IT WILL BE DIFFICULT TO PUT THE FLANGE ON AN OUT OF ROUND PIPE.

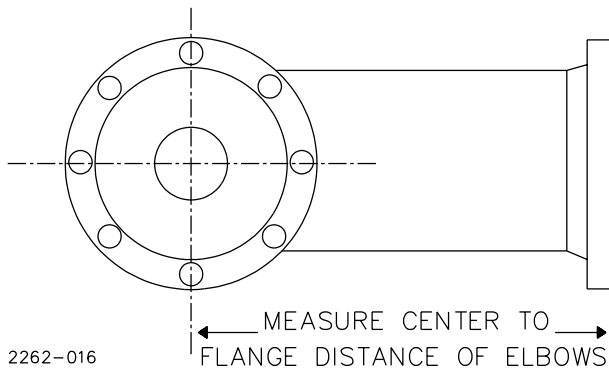
- d. **METHOD #4.** Tubing Cutter. This is generally not recommended. Many cuts end up with crimped ends due to dull cutters or trying to cut too fast. Use with caution. Avoid if possible unless someone is available that has had a lot of experience using a tubing cutter on this type of installation. See Figure 2-14.
- e. **METHOD #5.** Cut Off Saw. These saws are similar to radial arm saws. It is rare to find one big enough to cut



2262-015

NOTE: THIS WILL VARY FOR DIFFERENT TRANSMISSION LINE MANUFACTURERS

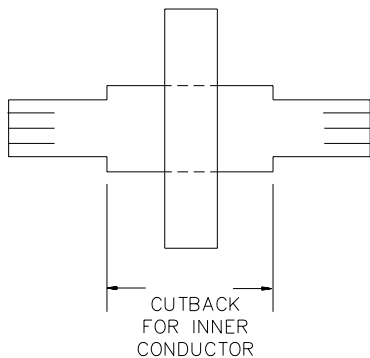
Figure 2-8. Outer Conductor Measurements



2262-016

Figure 2-9. Measurements When Elbows Are Used

2262-017



THIS WILL VARY FOR DIFFERENT TRANSMISSION LINE MANUFACTURERS

Figure 2-10. Measurements for Cutback of Inner Conductor

2262-018

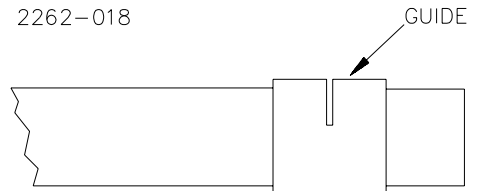
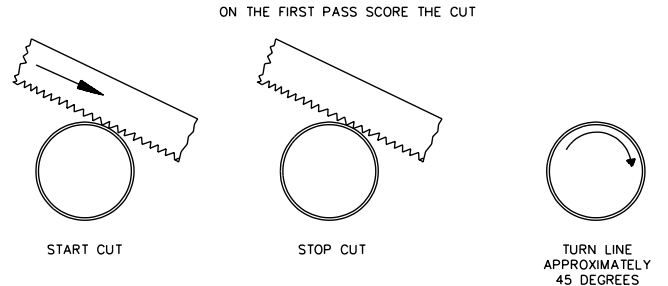
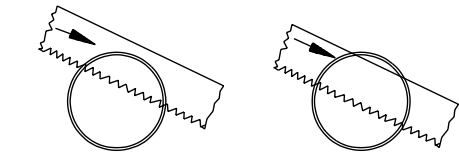


Figure 2-11. Guide For Use With Hand Hack Saw



FINISH CUT ON SECOND PASS. KEEPING THE BLADE FROM FALLING BELOW THE SURFACE KEEPS THE CUT SMOOTH.



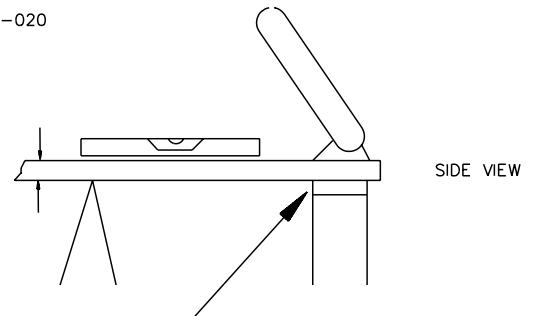
CORRECT DEPTH

CUT TOO DEEP

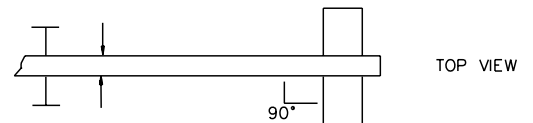
2262-019

Figure 2-12. Cutting With Hand Band Saw

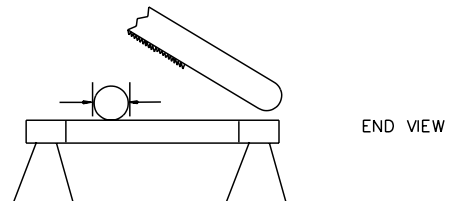
2262-020



LEVEL SAW TABLE FIRST AND THEN ADJUST THE SAWHORSE TO LEVEL THE PIPE BEING CUT



MAKE SURE LINE IS SQUARE WITH SAW



DON'T OVERTIGHTEN VISE. IF LINE IS BENT OUT OF ROUND, FLANGES WILL BE DIFFICULT TO ASSEMBLE

Figure 2-13. Swing Arm Band Saw Cutting Tips

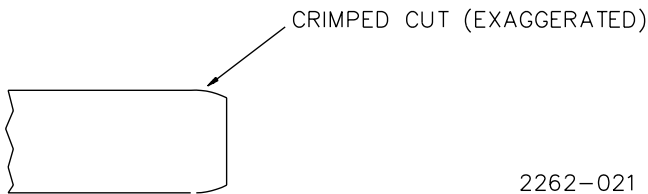


Figure 2-14.
Crimped Cut (Exaggerated)

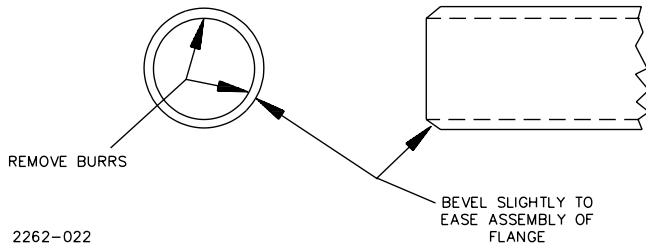


Figure 2-15.
Bevel and Remove Burrs

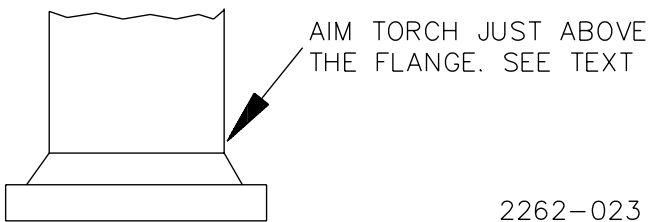


Figure 2-16.
Torch Aiming Location

6-1/8" line. The set up is similar to the swing arm band saw. See Figure 2-13.

2.6.5. SOLDERING TRANSMISSION LINE FLANGES

Transmission line flanges that are supplied with the optional transmission line kit are the silver solder type. Although the attachment of this type of flange may require more care and skill than the soft solder type, it has been found that the silver soldered flange provides much greater reliability. The services of a steam fitter or plumber may be helpful if personnel are not available that are experienced with silver soldering.

2.6.5.1. Soldering Procedure

- The line should be free of burrs. The outer corner may be beveled slightly to make assembly of flange easier. See Figure 2-15.
- Emery cloth should be used to clean the outside of the line where it will meet the flange. Also clean the inner surface of the flange with emery cloth.
- Insert the solder ring into the groove on the flange. If solder rings are not included with the flange, they can be made from .062-inch diameter silver solder wire (30-45% silver).

- Apply a thin coat of flux to the line and to the flange.
- Slide the flange onto the end of the outer conductor.

WARNING

SKIN BURN HAZARD. TEMPERATURE OF THE HEATED LINE IN THE FOLLOWING STEPS IS QUITE HIGH AND PRECAUTIONS MUST BE TAKEN TO AVOID CONTACT WITH EXPOSED SKIN.

- Stand the line on end (vertical) for soldering (flange to be soldered pointing down). Ensure that the flange remains square with the outer conductor.
- Using a #3 or #4 torch tip, heat the entire circumference of the line and flange. Keep the torch moving and heat 2 or 3 inches of the line/flange at a time. Aim the torch at the copper just above the crack between the flange and the line. This will minimize the need for fill solder. If the brass flange is heated more than the copper line, the flange will expand and create an unnecessary gap to fill with solder. Use caution. There is a fine line between melting the solder and melting the brass flange or burning a hole in the copper. The solder will pull up into the joint from the solder ring by capillary action. Once it starts to flow, do not stop until the entire circumference of the joint has solder appearing in it. If the solder from the internal solder ring does not "wick up" and become visible at the joint after a few minutes, a small amount of solder can be applied to the joint to enhance the heat transfer. See Figure 2-16.

2.6.6. CLEANING THE SOLDERED JOINT

Vigorous scrubbing with a wire brush and steel wool will remove torch black with good results. In addition, cleaning with an acid solution can make this job easier. The procedure is as follows:

WARNING

MURIATIC ACID USED IN THE FOLLOWING PROCEDURE IS HAZARDOUS. USE EYE AND SKIN PROTECTION WHEN HANDLING OR MIXING. KEEP AN EXTRA BOX OF BAKING SODA HANDY FOR FIRST AID OR TO NEUTRALIZE SPILLS. PERFORM THE PROCEDURES OUTDOORS IF POSSIBLE. IF THE WORK MUST BE DONE INDOORS, WORK ONLY IN WELL VENTILATED AREA.

WARNING

IN THE FOLLOWING MIXING PROCEDURE, ALWAYS PUT WATER IN THE CONTAINER FIRST AND THEN ADD ACID TO THE WATER. ADDING WATER TO A CONTAINER OF ACID MAY RESULT IN A VIOLENT & DANGEROUS REACTION.

- Prepare three plastic 5 gallon buckets as follows:
 - Bucket #1 - Water
 - Bucket #2 - One quart muriatic acid in four gallons of water (SEE WARNINGS ABOVE)
 - Bucket #3 - One pound baking soda in five gallons of water
- After soldering is finished, dip the end of the line in the water to cool.

- c. Set the cooled end of the line into the acid-water mixture for 5-10 minutes. This will loosen the film and brighten the silver.
- d. Immerse the end of the line into the soda solution. This will stop the action of the acid.
- e. Use a Scotch Bright pad or steel wool to scrub off the remaining torch black.
- f. If the flux scale is particularly stubborn repeat the process.
- g. Rinse thoroughly when done with water and dry line before assembling.

2.6.7. ALTERNATE CLEANING METHOD

The following is an alternate procedure to clean the soldered transmission line. The following materials are needed.

- Water and Hose
- Small Paint Brush
- Rubber Gloves
- Scotch Brite Pad or BBQ Grill Cleaning Pad With Handle
- Naval Jelly (or equivalent rust remover)

WARNING

NAVAL JELLY CONTAINS PHOSPHORIC ACID AND CAN BE DANGEROUS IF IT COMES IN CONTACT WITH SKIN OR EYES OR IF IT IS SWALLOWED. READ AND FOLLOW THE PRECAUTIONS AND EMERGENCY PROCEDURES ON THE NAVAL JELLY CONTAINER BEFORE USING.

- a. After soldering the flange, dip the end of the line into water or spray it with a hose until it is cool.
- b. Using a small paint brush, apply a coating of Naval Jelly to the torch black and flux scale on the outside and inside of the line. Let the Naval Jelly set from 10 to 20 minutes.
- c. Scrub the line with Scotch Brite or the BBQ Grill pad to loosen the torch black and flux scale.
- d. Flush with water until the Naval Jelly residue is gone.
- e. Repeat the process until all the torch black and flux scale is removed.

The first application of the Naval Jelly will remove the torch black and some of the flux scale. Normally, if vigorous scrubbing is done, repeating the process a second time will completely clean the line.

2.6.8. PLUMBING SYSTEM INSTALLATION

The plumbing system consists of two separate loops. One loop carries pure water between klystrons and the pump module. A second loop carries a water/glycol mixture between the pump module and the outside fan unit.

Use the following information for assistance during installation:

- Drawing 843 5123 097, Typical Plumbing Layout in conjunction with the list of plumbing kit parts in Section VII
- or
- A Custom Plumbing Layout Drawing
- Heat Exchanger Technical Manual

CAUTION

DO NOT ATTEMPT TO SOLDER PIPES WHILE A RUBBER HOSE IS CONNECTED TO THE PIPE BEING SOLDERED. THE HEAT REQUIRED FOR SOLDERING MAY DAMAGE THE RUBBER HOSE.

Install the plumbing system per the drawings. Take extra care with each solder joint to make sure it is well sealed. Extra time spent making sure each solder joints are leak-free will save hours of time later.

2.6.9. GUIDELINES FOR INSTALLING COPPER PLUMBING

The following tools and materials are needed:

- Welding Torch Set
- Oxygen & Acetylene Tanks
- Welders Mask or Goggles
- Tubing Cutter for 2 inch tubing or Hacksaw
- Flux (Sil-Flux) or Equivalent (HARRIS part number 086 0004 040; one 16 oz bottle provided with plumbing kit)
- Soft silver solder (96.5% tin; 3.5% silver) such as Aladdin #450 (HARRIS part number 086 0004 038; three 1 lb rolls supplied with plumbing kit)
- Wire Brush and Rags
- Water Hose

In addition, all thread rod, angle iron or channel, and hangers will be needed to support the plumbing.

The copper plumbing lines can be cut with a tubing cutter or a hack saw. Be sure and deburr the line after cutting.

WARNING

TEMPERATURE OF THE HEATED LINE IN THE FOLLOWING STEPS IS QUITE HIGH AND PRECAUTIONS MUST BE TAKEN TO AVOID CONTACT WITH EXPOSED SKIN.

- a. It is recommended that Aladdin 450 soft silver solder (HARRIS part number 086 0004 038) be used to assemble all plumbing joints. The line, elbows and tees should be cleaned with emery cloth or Scotch Bright before flux is applied for soldering. Since considerable heat is necessary to make the solder flow, some torch black and flaking may develop inside the pipe. Before hanging the line, it is recommended that a hose and wire brush or rag be used to clean and flush the inside of the line. This will avoid future problems with plugged strainer baskets and fittings due to dirty internal line.

2.6.10. CONDUIT INSTALLATION

Although it is not supplied with the TV 60UM transmitter, metal conduit must be used to support and enclose wires connecting each piece of equipment. **PLASTIC CONDUIT IS NOT AN ACCEPTABLE SUBSTITUTION FOR METALLIC CONDUIT.**

Drawing 843 5123 049, Peripheral Equipment Installation provides information on conduit installation for the HV Beam Supplies and Line Control Cabinets.

Drawing 839 7891 172, AC Power Flow Diagram and 839 7891 169, Power and Control Wiring should be used to help determine conduit sizes and runs.

2.6.11. TRANSMITTER CABINETS PREPARATION

Remove all packing material and supports.

There are four connector jacks labeled J1, J10, J11, J12 at the lower rear of the Amplifier Cabinets. Connect these jacks to plugs from the Control Cabinet as follows:

- a. Control Cabinet to Visual Amplifier Cabinet (J1, J10, J11, J12)

- b. Control Cabinet to Aural Amplifier Cabinet (J10, J11, J12). J1 is for pulser circuits and is not used on aural.
- c. Refer to drawings 839 7891 038 & 839 7891 040 to confirm connections.

Locate the two multi-wire cables that originate in the Control Cabinet and extend to either side of the Control Cabinet towards the Amplifier Cabinets. Each of these cables will connect to TB1 in both of the amplifier cabinets (inside cabinet, on the floor, towards front of cabinet). Route each cable into the Amplifier Cabinets from the side of the cabinet at the floor. Lay in place so the terminals are near TB1. (They need not be connected at this time).

Remove shorts from all meters.

Insert the Notch Diplexer Equalizer (994 6915 001) into the right hand hole in the upper accessory tray assembly of the IPA Cabinet.

Insert Luminance Linearity Corrector into the right hand holes in the lower accessory tray assembly of the IPA Cabinet.

Install the IPA modules in their proper positions in the IPA Cabinet. The preamp goes in the center hole. If the transmitter is to operate on channels 31-69 only one PA module is supplied and it mounts in the left hole.

Install the Exciter Switcher module (if two sets of exciters are used) in the IPA Cabinet.

2.6.12. CABLE AND WIRE CONNECTIONS

Make the following interconnecting cable connections as shown in the applicable drawings.

2.6.12.1. Control Cabinet To Each Amplifier Cabinet.

- a. Connect the multi-wire cable to TB1 in the Visual Amplifier Cabinet (see drawing 839 7891 038, Amplifier Cabinet, and 839 7891 040, Control Cabinet) as follows:

TB1	Wire No.
1	11
2	12
3	13
4	5
5	7
6	9
7	10
8	8
9	6
10	1
11	2

- b. Connect the cable to TB1 in the Aural Amplifier Cabinet (See drawing 839 7891 038, Amplifier Cabinet, and 839 7891 040, Control Cabinet) as follows:

TB1	Wire No.
1	20
2	21
3	22
4	14
5	16
6	18
7	19
8	17
9	15
10	3
11	4

- c. Connect wires to TB34 in the Visual Amplifier Cabinet and Aural Amplifier Cabinet as follows:

See drawing 839 7891 040, Control Cabinet		
Visual Amplifier	1	225 HOT
	2	226 NEUTRAL
Aural Amplifier	1	228 NEUTRAL
	2	230 HOT

- d. Blower motor wiring

1. Connect wires 407, 408, and 409 from K2 of the Control Cabinet to TB6 in the Visual Amplifier Cabinet.
2. Connect wires 410, 411, and 412 from K3 in the Control Cabinet to TB6 in the Aural Amplifier Cabinet.

2.6.12.2. IPA Cabinet to Control Cabinet

See drawing 839 7740 072, TV 60UM Interconnect. Connect interconnecting cable (W-7) between TB3, TB4, TB5 and TB6 of the IPA Cabinet to TB16, TB17, TB20, TB25 and TB26 of the Control Cabinet.

2.6.12.3. IPA Cabinet to Amplifier Cabinets

See drawing 839 7740 072. Install coax cables 752, 753, and 757. The RF cables connecting to the RF input (1st cavity) of the klystrons may be connected to the klystrons after the klystrons are installed.

2.6.12.4. IPA Cabinet to RF System

See drawing 839 7740 072. Terminate one end of the 12 conductor sheathed cable (supplied) with the 15 pin D-connector (supplied) and attach to J2 of the Multiplex Control Panel in the IPA Cabinet. The other end connects to the terminal board on the Detuner Assembly on the Diplexer.

2.6.12.5. Control Cabinet to Heat Exchanger Pump Module

- a. Connect four #20 AWG wires from either Visual or Aural power supply deck TB15 in the Control Cabinet to TB2 of the pump module as shown in drawing 839 7891 169.
- b. Connect two #20 AWG wires from the water/glycol flow interlock switch mounted near the pump module to TB2-3,-6 in the pump module.
- c. Connect 4 wires from TB26 in the Control Cabinet to terminal board TB2 in the Water Pump Module as shown in drawing 839 7891 169.

2.6.12.6. VISUAL Line Control Cabinet to Transmitter Cabinets

See drawings 839 7891 038, 839 7891 040, 839 7891 042, 839 7891 169, and 839 7891 136.

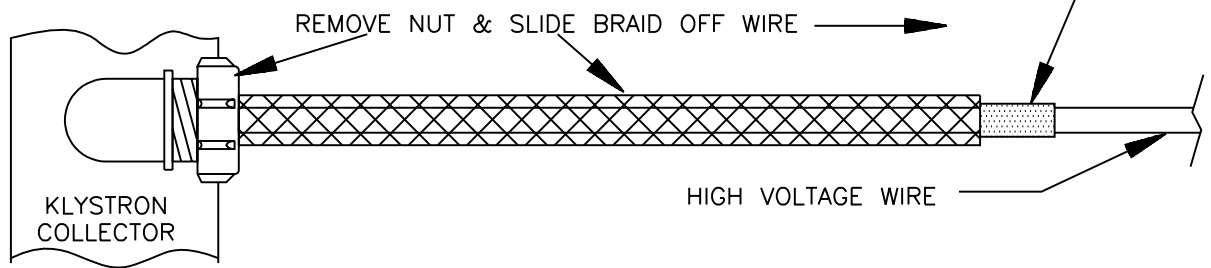
IMPORTANT

TWO IDENTICAL POWER SUPPLY DECKS WITH THE SAME TERMINAL BOARD DESIGNATOR "TB15" EXIST IN THE TOP OF THE CONTROL CABINET. THE DECK AT THE FRONT OF THE CABINET IS ASSOCIATED WITH VISUAL AMPLIFIER FUNCTIONS. THE DECK AT THE REAR OF THE CABINET IS ASSOCIATED WITH AURAL AMPLIFIER FUNCTIONS. IN THE FOLLOWING STEPS, ENSURE THAT EXTERNAL WIRING ASSOCIATED WITH VISUAL OR AURAL FUNCTIONS ARE CONNECTED TO THE PROPER "TB15".

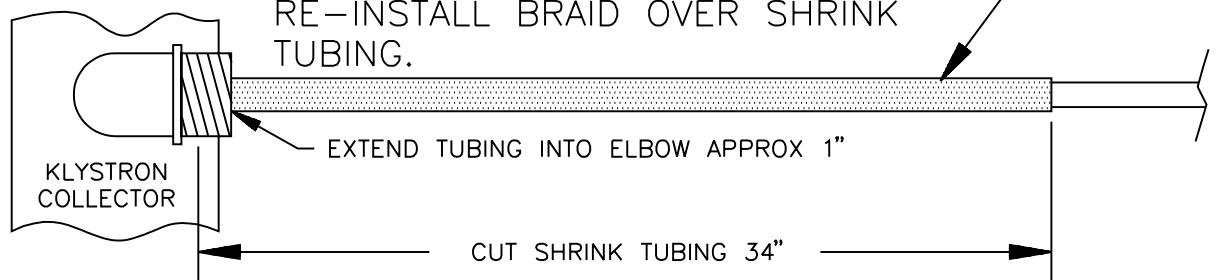
- a. Using three No. 10 wires, connect the 460 volt, 3 phase wiring from TB25 in the VISUAL Line Control Cabinet

STEP 1. CHECK TO SEE IF SHRINK TUBING HAS BEEN INSTALLED ON HV WIRE. IF IT IS IN PLACE, SKIP TO STEP 4.

STEP 2. TEMPORARILY REMOVE BRAID.



STEP 3. INSTALL HEAT SHRINK TUBING OVER HV WIRE RE-INSTALL BRAID OVER SHRINK TUBING.



STEP 4. INSTALL PRE-CUT LENGTH OF FLEXIBLE CONDUIT OVER WIRE/SHIELD. DRESS SHIELD AS SHOWN (BOTH ENDS).

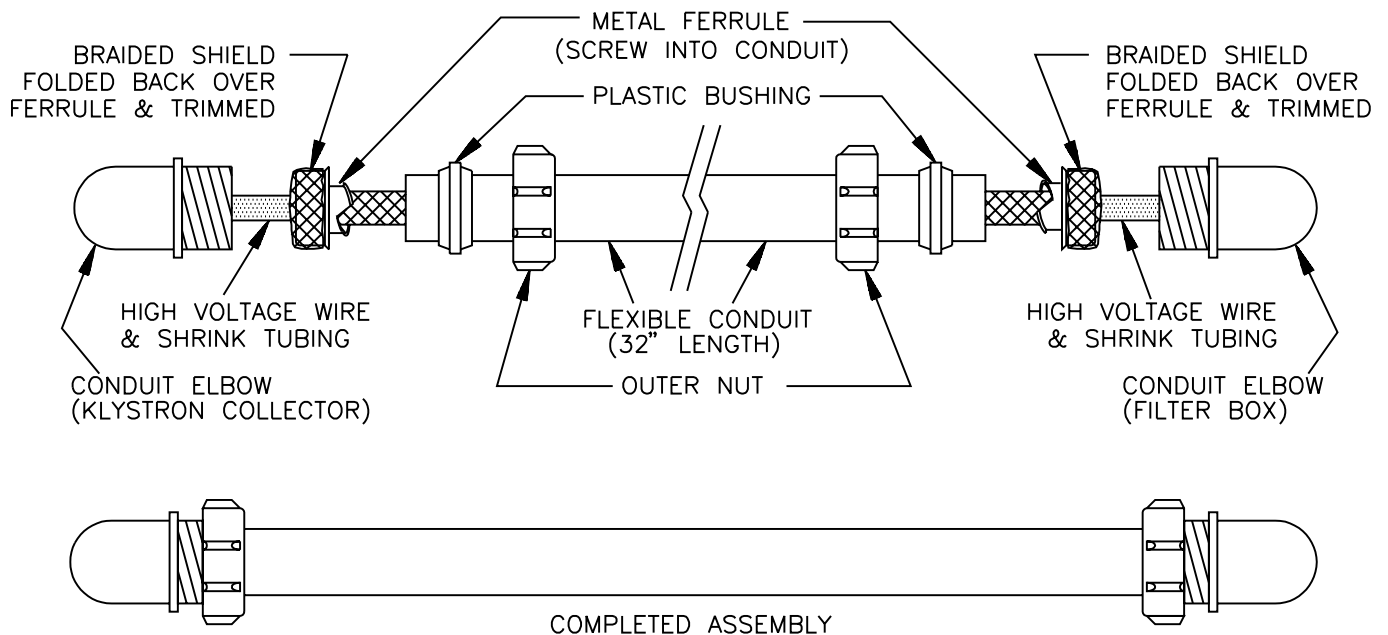
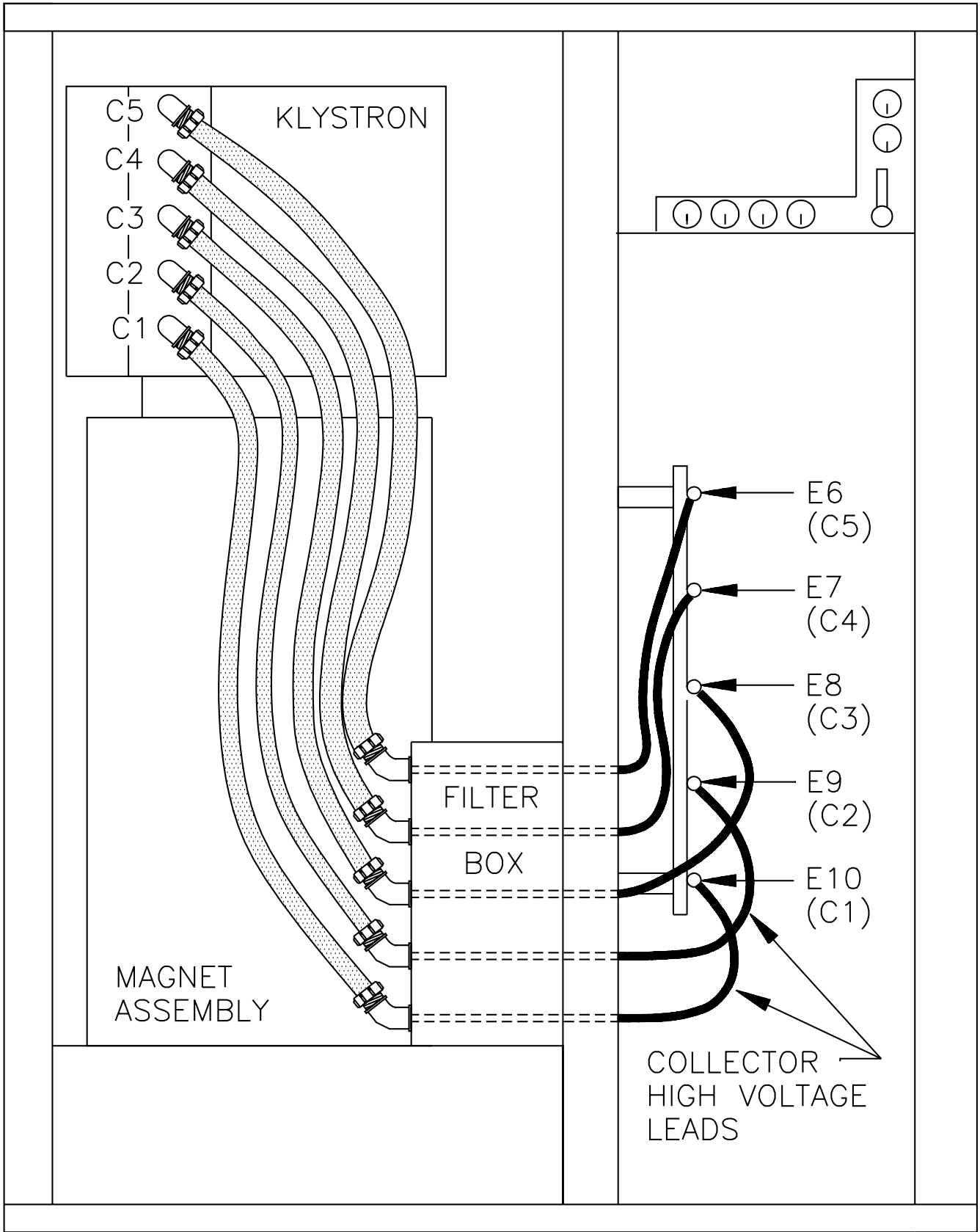


Figure 2-17. Collector High Voltage Wire Preparation



AMPLIFIER CABINET SIDE

Figure 2-18. Collector Lead Routing

to S11, the high voltage grounding bar, in the VISUAL Amplifier Cabinet.

- b. Using #16 wire, make the following connections between TB24 in the VISUAL Line Control Cabinet and TB15 of the front power supply deck in the Control Cabinet:

Visual Line Control Cabinet	Control Cabinet
<u>TB24</u>	<u>TB15</u>
1	1
2	2
3	7

- c. Using four #14 AWG wires connect TB23 in the VISUAL Line Control Cabinet to TB22 in the Control Cabinet.

2.6.12.7. VISUAL Amplifier Cabinet to VISUAL Beam Supply

See drawings 839 7891 169 and 839 7891 136 and the Beam Supply Schematic in the NWL supplied Technical Manual.

WARNING

USE SHORTING STICK TO REMOVE ANY RESIDUAL VOLTAGE IN THE POWER SUPPLY.

IMPORTANT

IT IS EXTREMELY IMPORTANT THAT THE FOLLOWING HIGH VOLTAGE CONNECTIONS BE WIRED CORRECTLY. CHECK AND DOUBLE CHECK TO ASSURE THAT THE EACH POWER SUPPLY TERMINAL HAS NOT BEEN WIRED TO THE WRONG TRANSMITTER CABINET TERMINAL.

CAUTION

Extreme care should be used in pulling and handling the high voltage wire. Talcum powder, NOT wire pulling lubricant, should be used. The wire must not be stepped on or pulled tight; damage to the insulation may result. Keep the wire clean and off the floor. Ensure that no sharp edges or metal filings come in contact with the wire.

- a. Connect four high voltage wires from the VISUAL Amplifier cabinet high voltage terminal lugs on shorting switch S11-A,B,C,and D to the four terminals marked (-) in the VISUAL Beam Supply as follows:

IMPORTANT

Terminal "A" on S11 is the terminal furthest from the key lock assembly. This terminal should have the highest voltage connected to it.

Visual Amplifier Cabinet	Visual Beam Supply
<u>S11</u>	<u>Terminals</u>
A	X4 -24kv
B	X3 -18kv
C	X2 -12kv
D	X1 -6kv

- b. Connect a #10 AWG wire from TP1 in the VISUAL Amplifier Cabinet to the terminal marked (+ RET), in the VISUAL Beam Supply. TP1 is located below and to the right of the Hall Sensors. Dress the #10 wire so it is well

away from any high voltage terminal both in the cabinet and in the power supply.

2.6.12.8. Control Cabinet to VISUAL Beam Supply

WARNING

USE THE SHORTING STICK TO REMOVE ANY RESIDUAL VOLTAGE IN THE POWER SUPPLY.

- a. Connect two #16 AWG wires from TB15 on the VISUAL Power Supply Deck in the Control Cabinet to the VISUAL Beam Supply as follows:

Control Cabinet	Visual Beam Supply
<u>TB15</u>	
7	S1
6	S2

2.6.12.9. VISUAL Line Control Cabinet to VISUAL Beam Supply

See drawings 839 7891 169 and 839 7891 042 and the Beam Supply Schematic in the NWL supplied Technical Manual.

Using No. 1/0 wire make the connections from the VISUAL Line Control cabinet to the VISUAL Beam Supply PS1 (6 wires).

2.6.12.10. AURAL Line Control Cabinet to Transmitter Cabinets

See drawings 839 7891 038, 839 7891 040, 839 7891 042, 839 7891 169, and 839 7891 136.

IMPORTANT

TWO IDENTICAL POWER SUPPLY DECKS WITH THE SAME TERMINAL BOARD DESIGNATOR "TB15" EXIST IN THE TOP OF THE CONTROL CABINET. THE DECK AT THE FRONT OF THE CABINET IS ASSOCIATED WITH VISUAL AMPLIFIER FUNCTIONS. THE DECK AT THE REAR OF THE CABINET IS ASSOCIATED WITH AURAL AMPLIFIER FUNCTIONS. IN THE FOLLOWING STEPS, ENSURE THAT EXTERNAL WIRING ASSOCIATED WITH VISUAL OR AURAL FUNCTIONS ARE CONNECTED TO THE PROPER "TB15".

- a. Using three No. 10 wires, connect the 460 volt, 3 phase wiring from TB25 in the AURAL Line Control Cabinet to S11, the high voltage grounding bar, in the AURAL Amplifier Cabinet.
- b. Using #16 wire, make the following connections between TB24 in the AURAL Line Control Cabinet and TB15 of the rear power supply deck in the Control Cabinet:

Aural Line Control Cabinet	Control Cabinet
<u>TB24</u>	<u>TB15</u>
1	1
2	2
3	7

- a. Using four #14 AWG wires connect TB23 in the AURAL Line Control Cabinet to TB23 in the Control Cabinet.

2.6.12.11. AURAL Amplifier Cabinet to AURAL Beam Supply
See drawings 839 7891 169 and 839 7891 136 and the Beam Supply Schematic in the NWL supplied Technical Manual.

WARNING

USE SHORTING STICK TO REMOVE ANY RESIDUAL VOLTAGE IN THE POWER SUPPLY.

IMPORTANT

IT IS EXTREMELY IMPORTANT THAT THE FOLLOWING HIGH VOLTAGE CONNECTIONS BE WIRED CORRECTLY. CHECK AND DOUBLE CHECK TO ASSURE THAT THE EACH POWER SUPPLY TERMINAL HAS NOT BEEN WIRED TO THE WRONG TRANSMITTER CABINET TERMINAL.

CAUTION

Extreme care should be used in pulling and handling the high voltage wire. Talcum powder, NOT wire pulling lubricant, should be used. The wire must not be stepped on or pulled tight; damage to the insulation may result. Keep the wire clean and off the floor. Ensure that no sharp edges or metal filings come in contact with the wire.

- a. Connect four high voltage wires from the AURAL Amplifier cabinet high voltage terminal lugs on shorting switch S11-A,B,C,and D to the four terminals marked (-) in the AURAL Beam Supply as follows:

IMPORTANT

Terminal "A" on S11 is the terminal furthest from the key lock assembly. This terminal should have the highest voltage connected to it.

Aural Amplifier Cabinet	Aural Beam Supply
<u>S11</u>	<u>"-"</u> Terminals
A	X4 -24kv
B	X3 -18kv
C	X2 -12kv
D	X1 -6kv

- a. Connect a #10 AWG wire from TP1 in the AURAL Amplifier Cabinet to the terminal marked (+ RET), in the AURAL Beam Supply. TP1 is located below and to the right of the Hall Sensors. Dress the #10 wire so it is well away from any high voltage terminal both in the cabinet and in the power supply.

2.6.12.12. Control Cabinet to AURAL Beam Supply

WARNING

USE SHORTING STICK TO REMOVE ANY RESIDUAL VOLTAGE IN THE POWER SUPPLY.

- a. Connect two #16 AWG wires from TB15 on the AURAL Power Supply Deck in the Control Cabinet to the AURAL Beam Supply as follows:

Control Cabinet	Aural Beam Supply
<u>TB15</u>	
7	S1
6	S2

2.6.12.13. AURAL Line Control Cabinet to AURAL Beam Supply

See drawings 839 7891 169 and 839 7891 042 and the Beam Supply Schematic in the NWL supplied Technical Manual.

Using No. 4 AWG wire make the connections from the AURAL Line Control cabinet to the AURAL Beam Supply PS2 (6 wires).

2.6.12.14. RF System Interlock Wiring

Drawing 839 7891 169, sheet 2 shows an interlock scheme that can be used with the RF system often installed with the TV-60UM. To utilize this scheme, wire the circuit as shown. All voltages used in the circuit shown are low (+12vdc) and the circuit may be successfully wired using #20 AWG wire.

2.6.13. AC POWER FOR THE TRANSMITTER AND BEAM SUPPLIES

Refer to drawings 839 7891 172, 839 7891 169, and 839 7891 042.

2.6.13.1. Line Control Cabinets

Connect the transmitter main power three phase 460 volt wiring from the station power distribution panel to each Line Control Cabinet. Use the wire sizes and insulation type indicated on drawing 839 7891 172 unless the local electrical code requires larger wire. Do not use wire smaller nor insulation inferior to that recommended.

2.6.13.2. IPA Cabinet and Exciter

Refer additionally to the IPA Cabinet wiring diagram located in the separate IPA Technical Manual.

Connect single phase 120 volt to the IPA cabinet from the station power distribution. The power must be connected to TB1-1,-2 in order to power the cabinet. However, AC power to the exciters mounted within the cabinet may be wired several different ways at the option of the station.

- a. The exciters (both main and standby, if so equipped) may be powered from the same AC feed as the rest of the IPA cabinet by connecting jumpers from IPA Cabinet TB1-1,-2 to TB1-5,-6 to power exciter pair A and to TB1-7,-8 to power exciter pair B (if installed).
- b. The exciters may be operated from a separate AC feed from the distribution panel by removing all jumpers between terminals on TB1 and connecting the separate feed to TB1-5,-6 for a single exciter set (pair A) or additionally to TB1-7,-8 to power a second set (pair B).
- c. Finally, two separate exciter power feeds may be run to power each exciter pair (if so equipped) independently. In this case no jumpers between terminals on TB1 need be installed. Each feed should be connected to the appropriate pair of terminals.

2.6.13.3. Transmitter Cabinet AC Power Service Receptacles

A separate 120vac distribution circuit should be used to power the ac service receptacles on the front of the transmitter. By doing so, transmitter operation will not be affected if the service receptacle circuit becomes overloaded and trips a circuit breaker. Connect the service receptacle power as follows:

- a. IPA Cabinet: Connect to TB1, terminals 9 and 10 (11, Grd) in the IPA Cabinet.

- b. Control Cabinet: Connect to TB33, terminals 1 and 2 (3, Grd) in the Control Cabinet.

2.6.13.4. AC Power For the Heat Exchanger

See drawings 839 7891 172 and 839 7891 169. Connect three phase 460 volt wiring from the station power distribution panel to the following:

- a. TB1 in the Pump Module; see drawing 843 5123 072 in the Heat Exchanger Technical Manual.
- b. TB1 in the Fan Cooler Coil assembly; see sheet 3 of drawing 839 7891 150 in the Heat Exchanger Technical Manual.

2.6.14. KLYSTRON/MAGNET ASSEMBLY MECHANICAL INSTALLATION INTO TRANSMITTER

- a. Pre-Tune the klystron cavities before installing the klystron/magnet assembly. See Section V.
- b. Carefully roll the klystron/magnet assembly into the Amplifier Cabinet. Position the klystron/magnet so the lower half of the breakaway inner conductor mates with the upper half of the inner conductor. The breakaway height and centering should have been previously adjusted. See Figure 2-2 through 2-4.
- c. Rotate and lock the swivel casters at the rear of the cabinet. A 90° opposing configuration of the casters provide the most stable configuration.
- d. When the breakaway center conductor is properly aligned, screw-in and tighten the inner conductor Allen head screws.
- e. Slide the outer sleeve in place and tighten the clamps.
- f. DO NOT connect the water hoses to the klystron until the cooling system has been checked out and cleaned. Procedures in the Heat Exchanger Technical Manual describe those processes.

2.6.15. KLYSTRON & MAGNET ELECTRICAL CONNECTIONS

2.6.15.1. Gun Region (Lower Klystron Area)

See drawing 839 7891 059.

- a. Connect wire J12 to the mod anode ring.
- b. Connect wire J16 to the cathode.
- c. Connect wire J20 to the filament.
- d. VISUAL KLYSTRON: Connect wire J22 to the annular ring (ACE) and remove jumper wire that may be connected from the annular ring to the cathode.
- e. AURAL KLYSTRON: Ensure that a jumper wire **IS** connected between the annular ring and cathode.

CAUTION

VERIFY CORRECT HEATER/CATHODE WIRING. THE FILAMENT CAN BURN OUT IF INCORRECTLY WIRED.

2.6.15.2. Collector Region (Upper Klystron Area)

See drawings 839 7891 059, 839 7891 136, Figure 2-17, and Figure 2-18.

- a. Connect the ion pump to the klystron by plugging the large right-angle plug to the top of the Vac-Ion pump.

CAUTION

It is very important that the insulation of the high voltage collector leads not be damaged. Do not let any tool or anything else puncture, slice, abrade, or cut the insulation even in the slightest amount. Failure to heed this warning will very likely result in a high voltage arc when the transmitter is turned on.

- b. Dress each high voltage collector wire through a supplied pre-cut piece of flexible conduit. Follow the instructions of Figure 2-17 closely.
- c. Feed each wire through the filter box and secure the flexible conduit at the filter box. See figure 2-18.

IMPORTANT

In the following step, it is important that the proper wire lug be used. The wire lug, once it is crimped on the high voltage wire, must be able to pass through the filter box. Otherwise, if the klystron must be removed for service, the lugs on the high voltage wire will have to be cut off and the wires re-terminated when the klystron is re-installed.

Blue #8 ring lugs are supplied for collector lead termination. Double check to make sure the proper lug is being used.

- a. Before cutting and terminating the high voltage leads, double check for correct connections. Do not permit an excessive service loop between the filter box exit and the termination point. Allow only enough to easily connect the wire without stress on the wire and a small amount of additional length that will allow re-terminating the wire, should it become necessary.
- b. Cut, terminate, and connect each collector wire.
- c. Connect magnet plug P5 into the multi-pin receptacle on top of the magnet. See Figure 2-18.
- d. Connect refocus coil plug P4 into the receptacle on the klystron located at the base of the collector between the water connections to the refocus coil.
- e. Connect the ground strap to the ground lug on top of the magnet.
- f. Screw "N" connector low pass filters FL1 and FL2 on the breakaway line directional couplers.
- g. Attach coax cable 162 to the forward sample coupler and cable 163 to the reflected sample coupler.
- h. Connect the opposite end of cable #162 through a 6dB pad to J1 of the Peak Power Detector. The pad ensures automatic calibration of the power meter expanded VSWR scale.
- i. Connect the opposite end of cable #163 to J2 of the Peak Power Detector.

2.6.15.3. Cavity Region

- a. Refer to drawing 839 7891 038, Amplifier Cabinet.

Wire arc sensor cables that come from cavities 3 and 4 to plugs P16 and P17 in preparation for connection to the arc detector box.

- a. Connect the arc sensor cables to the arc detector box. Plug P16 from the 4th cavity arc sensor connects to J2, the upper jack on the arc detector box. Plug P17, from the third cavity arc sensor connects to the lower jack.
- b. Connect the RF input coax cable to cavity 1 (bottom) coupling loop:

Visual	V1	#753
Aural	V2	#786

- c. Connect heliax cable J32 from 2nd cavity coupling loop to load RL1.
- d. Connect heliax cable J33 from 3rd cavity coupling to load RL2.
- e. In the VISUAL Amplifier Cabinet, remove the shipping plug from RL1 & RL2 (2nd and 3rd cavity 1 kW reject loads) and reinstall the attached vented plugs.

2.6.16. FINAL INSTALLATION PROCEDURES

Before beginning transmitter checkout, the following should be reviewed.

- a. Check cooling system to see that the cleaning & initial checkout procedures have been performed per the instructions in the Heat Exchanger Technical Manual. If

- these procedures are complete, the cooling system may be connected to the klystrons and the cooling system filled with distilled water.
- b. Check the RF system for tight connections, interlock wiring complete, and coolant flow through the test load.
- c. Check the power distribution system to ensure that the correct voltages will be supplied to the transmitter. WITH ALL POWER REMOVED, check all primary voltage high current connections for tightness. Double check all excess current protective devices.



FUNCTION ACTIVE AFTER MOMENTARY CONNECTION FOR FOLLOWING:
 TRANSMITTER FILAMENT ON/OFF
 TRANSMITTER BEAM ON/OFF
 OVERLOAD RESET
 EXCITER PAIR SELECT (DUAL EXCITERS)
 EXCITER SWITCHER AUTO/MAN SELECT
 RF SYSTEM MODE COMMANDS

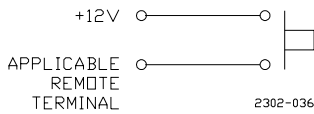


Figure 2-19. Basic Remote Control Circuit 1

FUNCTION ACTIVE AS LONG AS CONNECTION MADE FOR FOLLOWING:
 VISUAL EXCITER VIDEO GAIN RAISE/LOWER
 VISUAL EXCITER OUTPUT POWER RAISE/LOWER
 AURAL EXCITER OUTPUT POWER RAISE/LOWER
 AURAL EXCITER MONAURAL/SCA INPUTS ACTIVE; STEREO INACTIVE
 AMPLIFIER BEAM INTERLOCK
 AMPLIFIER FILAMENT INTERLOCK
 MOD ANODE BIAS RAISE/LOWER

FUNCTION ACTIVE AFTER MOMENTARY CONNECTION FOR FOLLOWING:
 MULTIPLEX ON/OFF
 PULSER IN/OUT

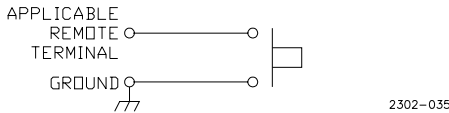


Figure 2-20. Basic Remote Control Circuit 2

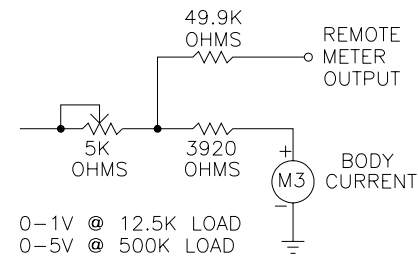


Figure 2-23. Basic Body Current Remote Metering Circuit

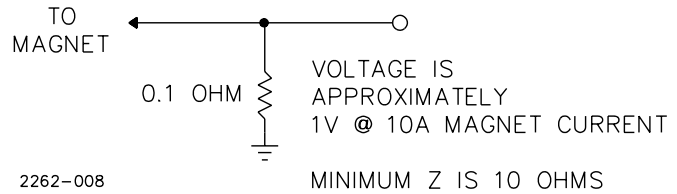


Figure 2-24. Basic Magnet Current Remote Metering Circuit

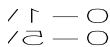
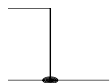


Figure 2-21. Basic Beam Voltage Remote Metering Circuit

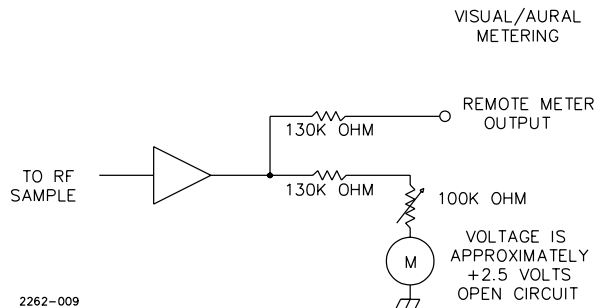


Figure 2-25. Basic RF Power Remote Metering Circuit

- d. It is recommended that a remote control system NOT be connected to the transmitter until transmitter checkout is complete.

2.6.17. REMOTE CONTROL EQUIPMENT CONNECTIONS

THIS SECTION IS INTENDED TO ASSIST IN THE CONNECTION OF A REMOTE CONTROL SYSTEM. DIAGRAMS 2-19 THROUGH 2-29 IN THIS SECTION PROVIDE BASIC FUNCTIONAL INFORMATION ABOUT

THE REMOTE CONTROL AND METERING CIRCUITS WITHIN THE TRANSMITTER.

2.6.17.1. Remote Terminal Location and Identification

Except for heat exchanger pump module status, which are located in the pump module cabinet, all remote equipment terminal connections are located in the rear of the Control and IPA cabinets. All connections are provided on barrier type terminal strips.

Table 2-2 identifies the remote control connection points by function, cabinet, terminal board, and terminal number.

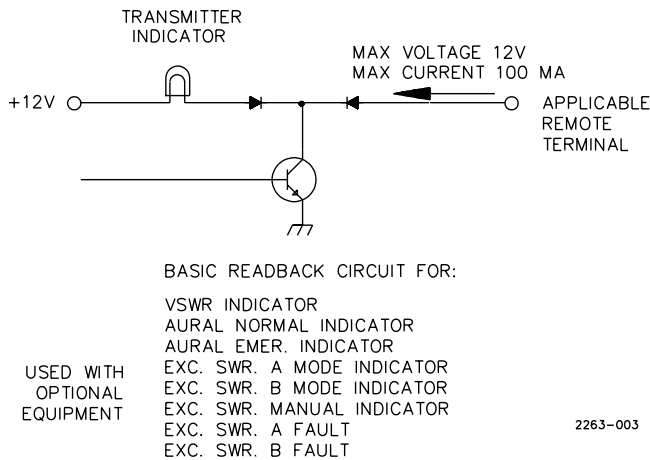


Figure 2-26. Basic Readback Circuit 1

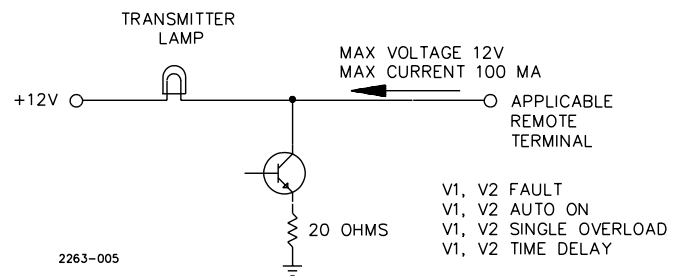


Figure 2-27. Basic Readback Circuit 2

Figure 2-28. Basic Readback Circuit 3

- V1, V2 FAULT
- V1, V2 AUTO ON
- V1, V2 SINGLE OVERLOAD
- V1, V2 TIME DELAY

2263-005

Figure 2-29. Basic Readback Circuit 4

Table 2-2. Remote Control Connections

CONTROL FUNCTIONS	
CONTROL CABINET	
V1 FIL ON	TB16-1
V1 FIL OFF	TB16-2
V1 BEAM ON	TB16-4
V1 BEAM OFF	TB16-5
V1 PULSER IN	TB25-7
V1 PULSER OUT	TB25-9
V1 BIAS RAISE	TB25-11
V1 BIAS LOWER	TB25-12
V1 FAULT RESET	TB16-3
+12V CONTROL VOLTAGE	TB16-18
GROUND	TB16-19
V2 FIL ON	TB17-1
V2 FIL OFF	TB17-2
V2 BEAM ON	TB17-4
V2 BEAM OFF	TB17-5
V2 FAULT RESET	TB17-3
GROUND	TB17-18
IPA CABINET	
VISUAL POWER RAISE	TB4-7
VISUAL POWER LOWER	TB4-6
VIDEO GAIN RAISE	TB4-4
VIDEO GAIN LOWER	TB4-3
AURAL POWER RAISE	TB4-8
AURAL POWER LOWER	TB4-9
EXCITER "A" SELECT	TB5-3
EXCITER "B" SELECT	TB5-4
EXCITER "AUTO" SELECT	TB5-5
EXCITER "MANUAL" SELECT	TB5-6
MULTIPLEX "ON" COMMAND	TB5-14
MULTIPLEX NORMAL SELECT	TB5-15
MONO/STEREO SELECT	TB4-14
+12V CONTROL VOLTAGE	TB4-15
CONTROL GROUND	TB5-13
PUMP MODULE	
ALT GLYCOL PUMP SELECT	TB2-17
(Requires contact closure)	TB2-18
ALT WATER PUMP SELECT	TB2-4
(Requires contact closure)	TB2-5
STATUS FUNCTIONS	
CONTROL CABINET	
V1 FIL ON IND.	TB25-1
V1 BEAM ON IND.	TB25-4
V1 PULSER IN IND.	TB25-13
V1 BIAS LINIT IND.	TB25-14
SINGLE OVLD IND.	TB25-6
V1 AUTO ON IND.	TB25-5
V1 TIME DELAY IND.	TB25-2
V1 FAULT LIGHT IND.	TB25-3
V2 FIL ON IND.	TB26-1
V2 BEAM ON IND.	TB26-4
V2 FAULT OVERLOAD IND.	TB26-3
V2 AUTO ON IND.	TB26-5
V2 TIME DELAY IND.	TB26-2
V2 SINGLE OVLD IND.	TB26-6
WATER PURITY INTLK IND.	TB26-16
CHANGE FILTER IND.	TB26-17
(IPA CABINET)	
* EXCITER "A" IND.	TB5-7
* EXCITER "B" IND.	TB5-8

* EXCITER MANUAL MODE IND.	TB5-9
* EXCITER "A" FAULT IND.	TB5-11
* EXCITER "B" FAULT IND.	TB4-12
* Used with Optional Spare Exciter/Exciter Switcher	
MULTIPLEX ON IND.	TB5-16
MULTIPLEX NORM. IND	TB5-17
PUMP MODULE	
GLYCOL PUMP A IND.	TB2-21
GLYCOL PUMP B IND.	TB2-20
WATER PUMP A IND	TB2-9
WATER PUMP B IND	TB2-8
FAN 1 IND.	TB2-22
FAN 2 IND.	TB2-23
GLYCOL LOW IND.	TB2-16
WATER LOW IND	TB2-1
COOLANT TEMP. IND.	TB2-11
ALT GLYCOL PUMP SELECT IND.	TB2-19
ALT WATER PUMP SELECT IND	TB2-7
PUMP MODULE +12V STATUS	TB2-4
PUMP MODULE GROUND	TB2-6
ANALOG FUNCTIONS	
CONTROL CABINET	
V1 BEAM VOLTAGE C1	TB18-1
C2	TB18-2
C3	TB18-3
C4	TB18-4
V1 BEAM CURRENT C1	TB18-5
C2	TB18-6
C3	TB18-7
C4	TB18-8
C5	TB18-9
V1 BODY CURRENT	TB16-14
V1 MAGNET CURRENT	TB16-15
V1 FORWARD POWER	TB16-8
V1 REFLECTED POWER	TB16-9
GROUND	TB18-10
V2 BEAM VOLTAGE C1	TB19-1
C2	TB19-2
C3	TB19-3
C4	TB19-4
V2 BEAM CURRENT C1	TB19-5
C2	TB19-6
C3	TB19-7
C4	TB19-8
C5	TB19-9
V2 BODY CURRENT	TB17-10
V2 MAGNET CURRENT	TB17-11
V2 FORWARD POWER	TB17-19
V2 REFLECTED POWER	TB17-20
GROUND	TB19-10

SECTION III CHECKOUT AND OPERATION

3.1. GENERAL

It is recommended that thorough familiarization be accomplished utilizing the control and indicator information prior to performing the checkout procedures. Once checkout has been accomplished, proceed with the operating procedures.

3.2. TEST EQUIPMENT

The basic equipment needed to accomplish this checkout procedure is as follows:

- a. One 0-6A current adjustable DC power supply.
- b. Two 0-5 Vdc power supplies capable of producing 200mA.
- c. One digital multimeter.

- d. One 0-6A DC meter. This item not needed if the multimeter has this capability.
- e. One 30 ohm, 2W resistor. (Tolerance not critical.) The above equipment may also be needed during re-calibration procedures during the life of the transmitter, especially after certain components replacement. Those procedures are described in the Maintenance Section (Section V) of this manual.

3.3. CONTROLS AND INDICATORS

Figures 3-1 through 3-7 and Tables 3-1 through 3-7 list the controls and indicators, describes their function and references illustrations showing their location. Table 3-8 presents the typical operating meter readings.

Table 3-8. Typical Operating Meter Readings

	VISUAL			AURAL			AURAL		
	60KW SYNC PEAK:			6KW OUTPUT			12KW OUTPUT		
UNPULSED	BEAM VOLTAGE:	C1	26KV	BEAM VOLTAGE:	C1	26KV	BEAM VOLTAGE:	C1	26KV
		C2	20KV		C2	20KV		C2	20KV
		C3	13KV		C3	13KV		C3	13KV
		C4	6.2KV		C4	6.2KV		C4	6.2KV
		C5	0		C5	0		C5	0
	BEAM CURRENT:	C1	.35A	BEAM CURRENT:	C1	0	BEAM CURRENT:	C1	.10A
		C2	.9A		C2	.35A		C2	.80A
		C3	1.3A		C3	.80A		C3	.85A
		C4	2.0A		C4	.50A		C4	.55A
		C5	.26A		C5	.18A		C5	.3A
	BODY CURRENT:		20ma	BODY CURRENT:		20mA	BODY CURRENT:		20mA
PULSED	BEAM VOLTAGE:	C1	26KV						
		C2	20KV						
		C3	13KV						
		C4	6.2KV						
		C5	0						
	BEAM CURRENT:	C1	.32A						
		C2	.89A						
		C3	.90A						
		C4	1.64A						
		C5	.3A						
	BODY CURRENT:		20mA						

3.4. PRELIMINARY CHECKOUT PROCEDURES

In performing the transmitter checkout procedure the process will be broken up into seven steps:

- a. Cooling System Checkout
- b. Visual transmitter cabinets checkout
- c. Aural transmitter cabinets checkout
- d. RF system/transmitter interface checkout
- e. RF Drive system checkout
- f. Visual amplifier HV application and final tests
- g. Aural amplifier HV application and final tests Perform the following checkout procedures prior to placing the equipment in operation.

3.4.1. SAFETY GROUNDING DEVICES CHECKOUT

Perform the following steps:

- a. Turn OFF all circuit breakers on the control and amplifier cabinets.
- b. Check the ground cables on each of the shorting sticks to ensure proper grounds in:
 - 1. Each high voltage power supply
 - 2. The front of each amplifier cabinet
- c. Check the wiring, contacts, and operation of each of the shorting switch assemblies.

3.4.2. POWER LINE CHECK

WARNING

PROPER PROCEDURE FOR MEASURING VOLTAGES IN THE FOLLOWING STEP REQUIRES PRIOR REMOVAL OF ALL POWER AND SUBSEQUENT GROUNDING OF ALL LOCATIONS WHERE TEST LEADS ARE TO BE ATTACHED OR REMOVED. THE TEST METER IS TO BE LOCATED OUTSIDE THE TRANSMITTER CABINET AND ALL DOORS ARE TO BE CLOSED AND LOCKED PRIOR TO APPLYING ANY POWER.

With all circuit breakers of the Line Control cabinet OFF, check the three phase power line. Voltages from leg to leg should be within 2% of one another.

NOTE

The primary input wires to the high voltage power supplies should initially be connected to the highest voltage labeled tap terminal. This will produce a lower output voltage at first turn on. Later in the checkout, it is probable the output voltage will be raised by changing the taps.

The primary wires to T1 in each line control cabinet should be connected to the taps labeled nearest the line voltages measured.

3.5. COOLING SYSTEM CHECKOUT

If it has not already been done, follow the initial checkout and cleaning procedures given in the Heat Exchanger System Technical Manual 988-2324-001.

3.6. VISUAL TRANSMITTER CABINETS CHECKOUT

3.6.1. KEYLOCK SYSTEM CHECKOUT

The keylock system has been designed to deny entry to potentially dangerous parts of the transmitter unless certain specific steps have been taken to remove harmful voltages.

Figure 3-8 shows the steps that must be taken to gain access to the interior of the transmitter. Checkout procedure is as follows:

- a. Remove all power to the line control cabinet at the station power distribution panel.
- b. Perform Steps 1,2, & 3. Make sure that the slide bolt cannot be moved to the left until all 3 circuit breakers are OFF and the key cannot be removed until the bar is slid to the left.
- c. Perform Step 4. Make sure the shorting bar cannot be rotated to the shorted position until the master key is inserted and rotated. Make sure the lower key cannot be removed until the master key is inserted and rotated.
- d. Perform Step 5. Make sure the 4 cabinet keys cannot be removed until the submaster key is inserted and rotated in the cabinet key bank. Once the submaster key is inserted and rotated in the cabinet key bank, make sure the shorting bar cannot be rotated from the shorted position.
- e. Perform Step 6 removing one key. Make sure with the one key removed the submaster key cannot be removed from the cabinet key bank.
- f. Remove all four door keys and try each of them to assure they all will operate the amplifier front door, the amplifier rear side panels, and the proper rear panel in the control cabinet. Check to see that, once the panel or door is opened, the key cannot be removed from the lock until the door or panel is re-closed and locked.

3.6.2. CONTROL VOLTAGE CHECK

- a. At the VISUAL Line Control Cabinet, turn ON TRANSMITTER CABINET MAIN breaker (CB7) and TRANSMITTER CABINET CONTROL breaker (CB9).

CAUTION

DO NOT TURN ON THE BEAM SUPPLY BREAKERS.

- b. At the Control Cabinet, turn ON the VISUAL CONTROL CABINET breaker. The cabinet 120/208V systems now have voltage.

WARNING

PROPER PROCEDURE FOR MEASURING VOLTAGES IN THE FOLLOWING STEP REQUIRES PRIOR REMOVAL OF ALL POWER AND SUBSEQUENT GROUNDING OF ALL LOCATIONS WHERE TEST LEADS ARE TO BE ATTACHED OR REMOVED. THE TEST METER IS TO BE LOCATED OUTSIDE THE TRANSMITTER CABINET AND ALL DOORS ARE TO BE CLOSED AND LOCKED PRIOR TO APPLYING ANY POWER.

NOTE

Steps c. and d. should be performed in the VISUAL Line Control Cabinet.

- c. Check the voltage at TB23 (inside Line Control Cabinet), terminals 1, 2, 3 with respect to transmitter ground. 114-126 Vac should be present.

- d. Check the voltage at TB23-1 to -2, -2 to -3, and -1 to -3. Each voltage should be 197-218 Vac.

NOTE

The remaining steps should be performed at the Control Cabinet.

- e. Check for +14.75vdc at the V+ terminal of PS3 on the power supply deck at the top of the control cabinet. The deck at the front of the cabinet behind the blank meter panel supplies the visual part of the transmitter; the deck at the rear of the cabinet supplies the aural part of the transmitter.
- f. Check for approximately +24vdc at the junction of R2-R3 on PC12 (mounted on the power supply deck).
- g. Check for approximately +100vdc at the junction of CR12-CR13 on PC12.

3.6.3. AMPLIFIER CABINET CHECK

CAUTION

MAKE SURE THE BEAM SUPPLY BREAKERS ON BOTH LINE CONTROL CABINETS ARE OFF.

- a. Rotate FILAMENT VOLTAGE control to minimum (CCW).
- b. Rotate MAGNET CURRENT control to minimum (CCW).
- c. At the Amplifier cabinet, set the CONTROL & FILAMENT breaker (CB1) ON.
- d. Measure voltage on the overload LED common bus (rear of door). The voltage should be +12.5-13.5 volts with respect to ground. If adjustment is necessary see Section V.

NOTE

If a temporary jumper was used in the pump module to operate the pumps without the transmitter being energized, that jumper should be removed at this time.

- e. Apply ac power to the heat exchanger and press FIL ON. The transmitter blowers and the pumps should energize. After a short period of time (approximately 2 seconds) the filament contactor will operate and the FIL ON button will light. The SUFFICIENT AIR LED and the COLLECTOR WATER FLOW LED on the amplifier cabinet should be illuminated. The COOLANT FLOW LED on the Control cabinet should also be illuminated.

3.6.4. BLOWER ROTATION

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE CHANGING WIRE CONNECTIONS IN THE FOLLOWING STEPS.

Check for air pressure at the air hose connecting to the RF line breakaway section. If no air pressure is present, the blower is rotating backwards. Restore proper rotation by removing power and reversing any two of the three 208V wires connected to the motor. This can be done at TB6.

3.6.5. SUFFICIENT AIR INTERLOCK

- a. Remove the small tubing from the input of the air pressure switch S14.

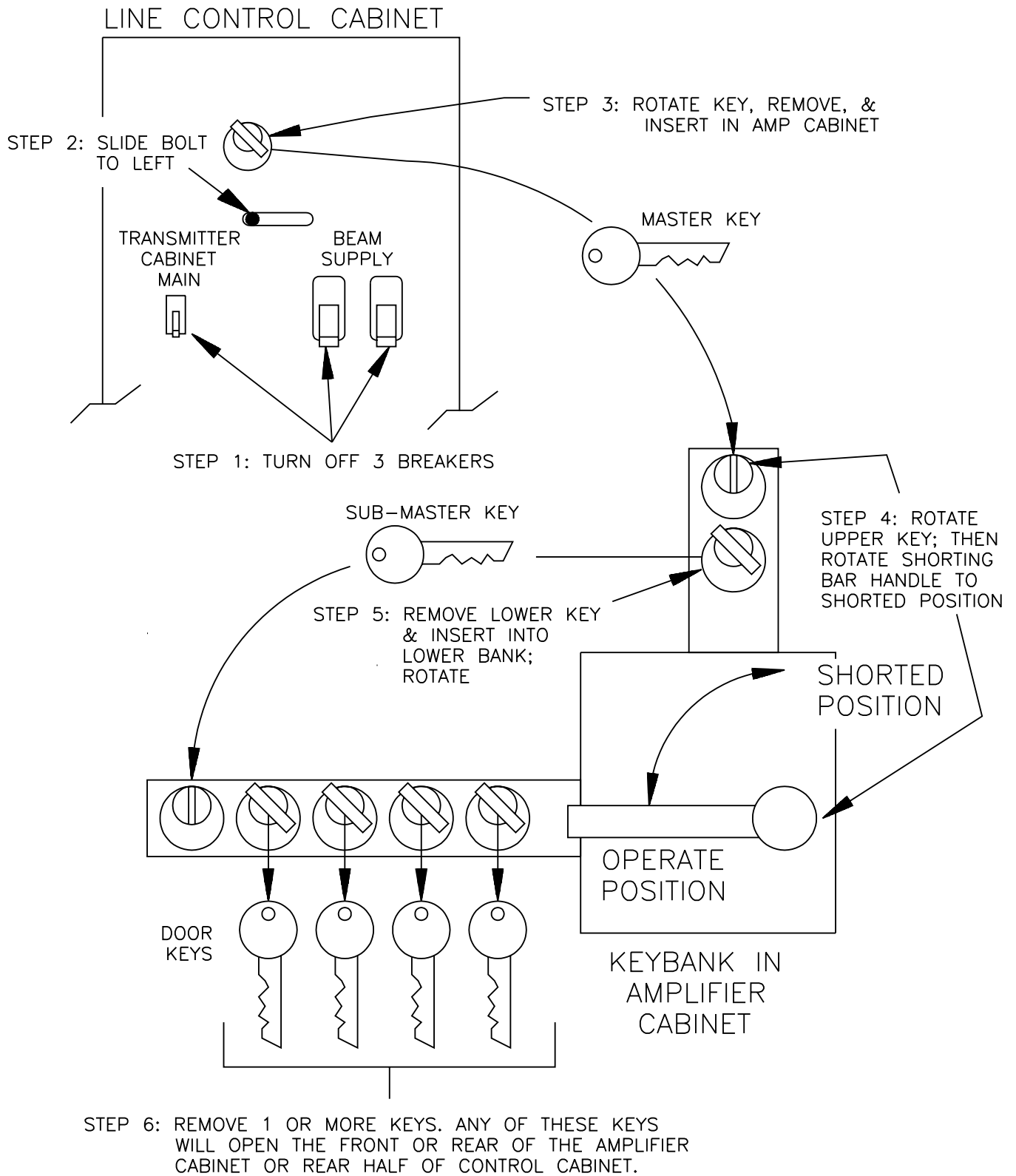


Figure 3-8. Key Lock System Operation

- b. Push the FIL ON button. The SUFFICIENT AIR LED and the FIL ON lamp should remain dark as the fan comes up to speed.
- c. Restore the air switch tubing and press the FIL ON button again the SUFFICIENT AIR LED and the FIL ON indicator should illuminate.

3.6.6. POWER LINE PHASE MONITOR

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER BEFORE CHANGING WIRE CONNECTIONS IN FOLLOWING STEPS.

- a. Remove wires 116, 117, and 118 one at a time from K1 (the visual phase monitor) in the Control cabinet (wires 417, 418, 419, and K4 when checking the aural cabinet). The 3 PHASE POWER LED should extinguish and the klystron blower in the amplifier cabinet should not operate when FIL ON is depressed.
- b. Reverse any two of the above 3 phase inputs to the Phase Monitor. Again, the blower should not operate when FIL ON is depressed. The 3 PHASE POWER LED should be OFF.
- c. Restore normal wiring.

3.6.7. MAGNET CURRENT POWER SUPPLY & INTER-LOCK

- a. Power up the cabinet to the FIL ON state.
- b. With the MAGNET CURRENT control set for minimum (CCW) turn ON the MAGNET SUPPLY breaker on the control cabinet. A few amperes should be flowing through the magnet and should deflect the magnet current meter slightly.
- c. Increase the magnet current to 10 amperes with the MAGNET CURRENT control. The control should be 1/2 to 3/4 turns open (CW). The MAG CURRENT IN RANGE LED should be ON.
- d. Reduce the magnet current while watching the MAGNET CURRENT IN RANGE LED on the Amplifier cabinet. The LED should go out at 9A. If adjustment of the trip point is necessary, see Section V.

NOTE

Be sure to test the dropout point by reducing current, to see where the LED extinguishes, not by increasing current to see where the LED lights.

- e. Increase the magnet current while watching the MAGNET CURRENT IN RANGE LED and the magnet current meter. The MAGNET CURRENT LED should extinguish at approximately 12A. If the trip point needs adjustment see Section V.
- f. Reduce magnet current to value given on klystron data sheet.

3.6.8. RUN DOWN TIME CHECK

- a. Check the time and turn off the filament by depressing FIL OFF.
- b. The cabinet fans should run for approximately 5 minutes (+ 1 minute). If no other amplifier cabinets are running, the pumps should also shut off at this time.

3.6.9. REFOCUS CURRENT CHECK

- a. Power up the cabinet to the FIL ON state.
- b. With the REFOCUS CURRENT control set for mid-range the REFOCUS CURRENT IN RANGE LED should be illuminated.
- c. Rotate the REFOCUS CURRENT control fully counter-clockwise. The REFOCUS CURRENT IN RANGE LED should extinguish.
 - a. Rotate the REFOCUS CURRENT control fully clockwise. The REFOCUS CURRENT IN RANGE LED should illuminate as the control is moved approximately 1/3 of its travel and then extinguish again as the control is rotated into the last third of its rotation. If adjustment of the lower or upper trip point is necessary, see Section V.
- b. Reset the REFOCUS CURRENT control to mid-range. Final adjustment will be made later when the klystron is operating.

3.6.10. ARC OVERLOAD TEST

To test the Arc Overload proceed as follows:

- a. Depress the CAVITY 4 ARC TEST button for one second. The CAVITY 4 ARC OVERLOAD LED should light and the FAULT light should flash.
- b. Reset the overload indicator and FAULT light.
- c. Repeat using the CAVITY 3 ARC TEST button.

NOTE

A bright light such as the strobe light from a camera or even bright direct sunlight directed at the rear of the klystron cabinet when the rear doors are open may cause the transmitter to overload and indicate an arc failure. This condition results from the sensitive arc detectors in the cavities sensing the bright external light.

3.6.11. BODY CURRENT OVERLOAD CHECK

- a. USE AN EXTERNAL VARIABLE CURRENT SOURCE CAPABLE OF PRODUCING 200MA AT APPROXIMATELY 1VDC. A STANDARD SIZE BATTERY AND A 20 OHM POT WIRED AS SHOWN IN FIGURE 3-9 WILL SUFFICE. USING ALLIGATOR CLIPS OR OTHER SUCH TEMPORARY ATTACHMENTS, CONNECT THE POSITIVE LEAD TO TP1 AND THE NEGATIVE LEAD TO GROUND. TP1 IS LOCATED JUST BELOW THE HALL EFFECT SENSORS IN THE COMPARTMENT IN FRONT OF THE KLYSTRON AND IS THE TERMINAL THAT THE RETURN LEAD FROM THE BEAM SUPPLY IS CONNECTED. MAKE THE TEMPORARY LEADS LONG ENOUGH SO THAT THE POTENTIOMETER CAN BE ADJUSTED WHILE OBSERVING THE BODY CURRENT METER ON THE FRONT OF THE TRANSMITTER.
- b. Apply control circuit power to the transmitter cabinets. A deflection of the BODY CURRENT meter should be seen.
- c. Using the test fixture potentiometer, slowly raise the body current. Near 100mA, the BODY CURRENT OVERLOAD LED should illuminate along with the flashing of the cabinet FAULT indicator. If the trip point needs adjustment, follow the procedure in Section V.

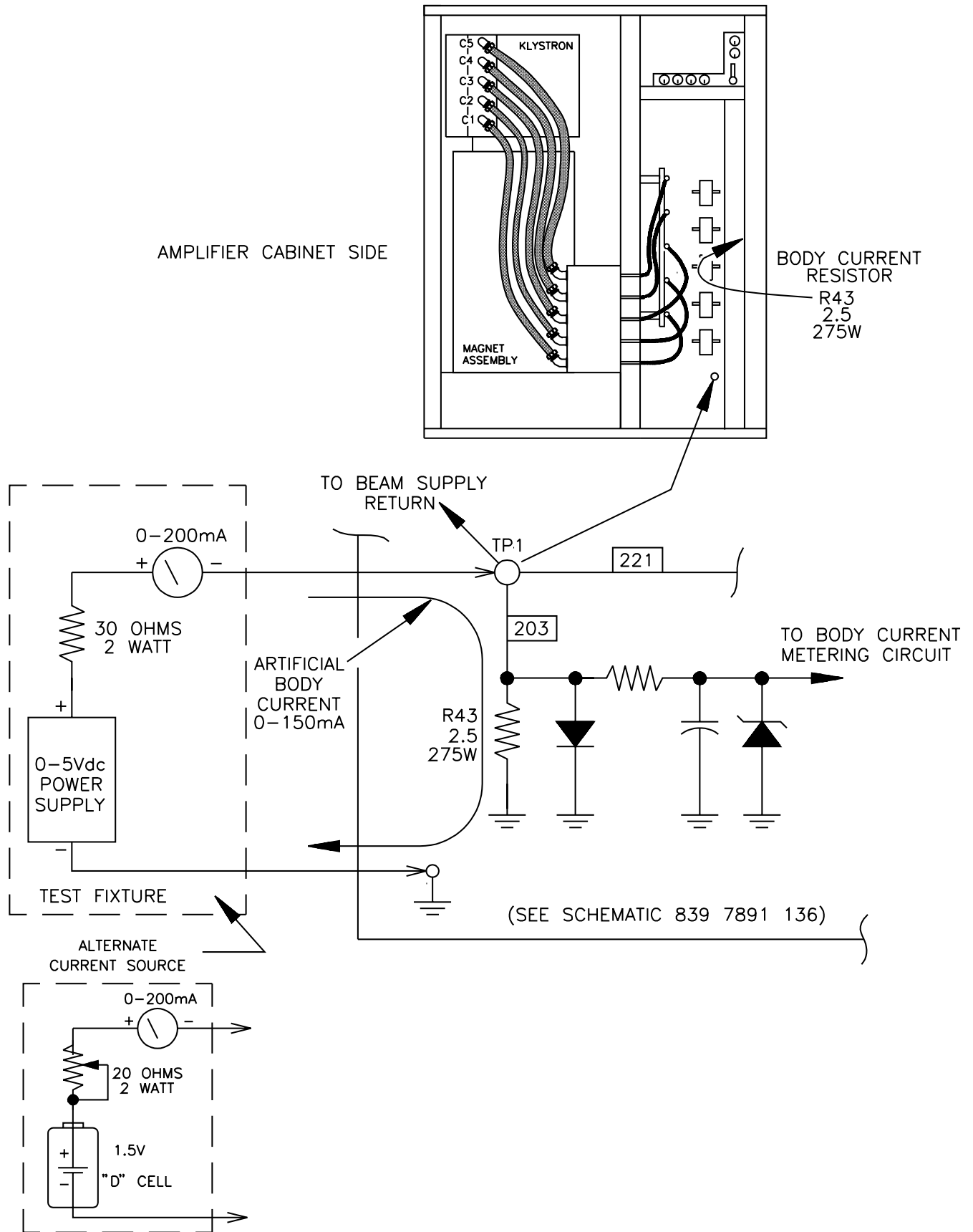


Fig. 3-9. Technique for Checking Body Current Circuit

Table 3-9. Collector Currents & Overload Settings

COLLECTOR CURRENT METER CALIBRATION LEVELS		OVERLOAD SETTING
C1	1.0 A	2.5 A
C2	1.0 A	2.5 A
C3	1.5 A	2.5 A
C4	5.0 A (3.0A AURAL)	6.0 A (4.0A AURAL)
C5	1.0 A	2.0 A

- d. Reduce the body current below the trip point, reset the overload and fault indicators, and remove the temporary current source and potentiometer.

3.6.12. KLYSTRON COLLECTOR CURRENT METERING & OVERLOAD CHECK

Checkout of the five collector current metering and overload circuits involves feeding an externally produced and metered current through each Hall effect sensor. The transmitter meter reading and overload trip setting is then checked against this current.

In addition to the high voltage wire and the multi-turn degaussing coil running through the sensor, each Hall effect sensor assembly contains an additional loop of wire. This wire has been installed for the express purpose of facilitating applying a test current through the sensor. The ends of this test loop are accessible on the printed circuit board at the brass threaded terminals E6 and E7. See Figure 3-10.

The checkout procedure is as follows:

- a. Connect the power supply to the C1 (lower) Hall sensor test loop.
- b. Set the test power supply to minimum current.
- c. Power up the transmitter to the FIL ON level.
- d. Switch the front panel COLLECTOR VOLTAGE/CURRENT meter switch to the C1 position. Slowly increase the test current and compare the test current to the panel meter reading at the calibration level operating current shown in Table 3-9. Reverse polarity of the test power supply if the meter deflects below zero. Calibration procedures, if needed, are given in Section V.
- e. Slowly increase the test current until the C1 COLLECTOR CURRENT OVERLOAD LED illuminates. The trip point should occur at approximately the overload setting shown in Table 3-9. Trip point adjustment procedure, if needed, is given in Section V.
- f. Remove the test current and press the BEAM OFF button. This activates the de-gaussing circuit; evident by an approximate 3 second negative deflection of the collector current meter.
- g. Depress FIL OFF and repeat the procedure for each of the remaining collectors.

3.6.13. COLLECTOR VOLTAGE METERING & OVERLOAD CHECK

Use two 5Vdc power supplies connected to the meter multiplier board as shown in Figure 3-11. Note that the positive lead of each supply is connected to ground terminals E11 & E13.

- a. Set both test power supplies to 5.00V using a digital voltmeter.

- b. Apply control voltage to the transmitter and rotate the front panel COLLECTOR VOLTAGE/CURRENT meter switch to the C1 position. The COLLECTOR VOLTAGE meter should read 30kV +/-1kV.
- c. Rotate the meter switch to each of the other collector voltage positions. Each reading should be very near zero.
- d. Using the digital voltmeter, set test power supply #2 to 2.5V. Some of the COLLECTOR VOLTAGE OVERLOAD indicators will probably illuminate, but ignore them for now.
- e. Rotate the meter switch to the C2, C3, and C4 positions. Each should read approximately 15kV on the COLLECTOR VOLTAGE meter. (The C5 switch position yields a meter reading of zero.) Since there are no adjustments in the collector metering circuit, a failure of the above test probably indicates a bad component or a non-linear collector voltage meter.
- f. Set test power supply #2 for 5V again and reset any overload indicator lights. Assure that test power supply #1 is still producing 5.00V.
- g. Slowly reduce the output voltage of test power supply #2 while monitoring it with the digital voltmeter. As the voltage is reduced, the collector voltage overload indicators should illuminate at approximately the following test voltages:

TEST POWER SUPPLY #2 VOLTAGE	COLLECTOR LED THAT ILLUMINATES
4.7V	C5
3.2V	C4
1.7V	C3
0.8V	C2

There are no collector voltage overload adjustments. If the above test fails, it is probably due to a failed component.

- h. This completes the collector voltage metering check. Remove the test power supplies and temporary jumpers.

CAUTION

MAKE SURE THE TEMPORARY JUMPERS BETWEEN E7, E8, E9, & E10 ARE REMOVED.

3.6.14. PRELIMINARY VISUAL EXCITER CHECK

The visual exciter will be used in the next procedure as a RF source. The purpose of this procedure is only to power up the exciter enough to obtain some RF energy.

Perform the preliminary exciter check as follows:

- a. Turn EXCITER PAIR A circuit breaker (located at bottom of IPA cabinet) ON.
- b. Turn the Visual Exciter circuit breaker inside exciter to ON. The POWER indicator on the front panel of the exciter should illuminate.
- c. Apply any standard video test signal to the exciter.
- d. Rotate the exciter front panel multi-meter switch to the VIS PWR position.
- e. Rotate the exciter front panel VISUAL POWER control clockwise. A deflection of the multi-meter should be seen indicating the presence of exciter output power.

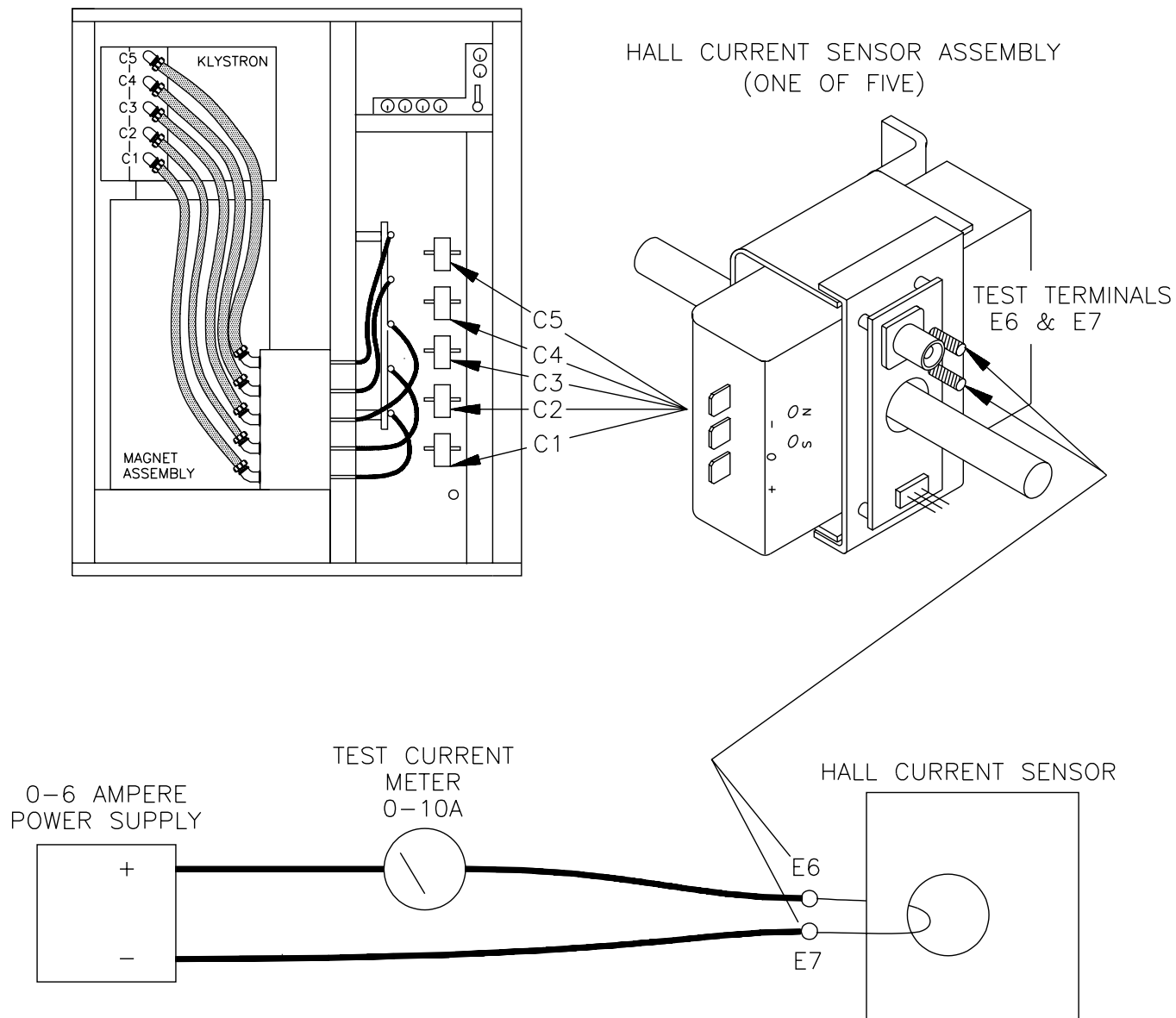


Figure 3-10. Checking Collector Current Metering

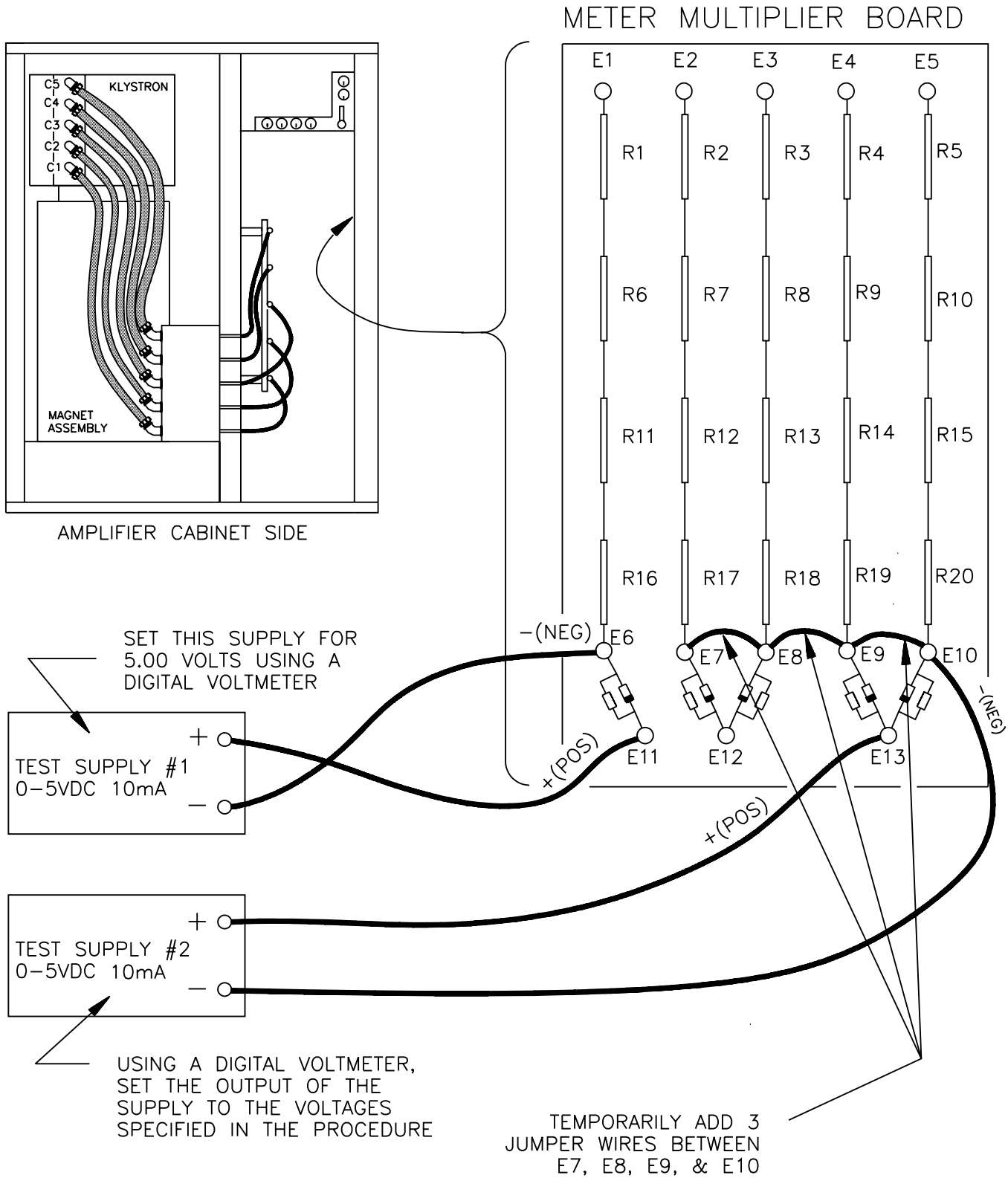


Figure 3-11. Test Set-Up for Checking Collector Voltage Metering and Overload Circuits

- f. Rotate the VISUAL POWER control fully counter-clockwise. Leave the exciter turned on.

3.6.15. POWER METERING AND VSWR OVERLOAD CHECK

Perform the following steps:

- a. Using a BNC 50 ohm cable, temporarily connect the RF output (J4) of the Visual Exciter to J1 of the Peak Power Detector (PD-1). The detector assembly is mounted at the lower portion of the klystron cabinet and is accessible by opening the rear door.
- b. Rotate the FORWARD/REFLECTED power meter switch on the meter panel to the FORWARD position.
- c. Increase the exciter visual power slowly while watching for deflection of the power meter.
- d. Rotate the exciter power control fully counter-clockwise.
- e. Re-connect the temporary coaxial cable from J1 to J2 of the Peak Power Detector.
- f. Rotate the FORWARD/REFLECTED power meter switch on the meter panel to the REFLECTED position.
- g. Increase the exciter visual power slowly while watching the deflection of the power meter. The VSWR overload LED should light and the FAULT light should start flashing when a VSWR of 1.4 is reached. If trip point adjustment is necessary, see Section V.
- h. Remove temporary cable and reset the overload indicators.
- i. Reconnect the proper cables to the exciter and peak detector.

3.6.16. HIGH VOLTAGE INTERLOCKS

CAUTION

MAKE SURE THE BEAM SUPPLY BREAKERS ON LINE CONTROL CABINET ARE OFF.

- a. The status of the INTERLOCK INDICATORS on the amplifier cabinet and the appropriate display on the control cabinet should be as follows:

ILLUMINATED INDICATORS	EXTINGUISHED INDICATORS
AMPLIFIER CABINET	
FRONT GROUND STICK	MAGNET CURRENT IN RANGE
METER PANEL	SUFFICIENT AIR
KLYSTRON SUPPORT EQUIPMENT	
EXTERNAL BEAM	
REFOCUS CURRENT IN RANGE	REFOCUS CURRENT IN RANGE
COLLECTOR WATER FLOW	COLLECTOR WATER FLOW
CONTROL CABINET	
VISUAL (AURAL)	EXTERNAL GLYCOL FLOW
VISUAL (AURAL)	
3 PHASE PWR	3 PHASE PWR
COOLANT TEMP	
WATER PURITY	
CHANGE FILTER	

- b. Depress FIL ON on the amplifier cabinet. The Heat Exchanger pump module should energize.
- c. Adjust the magnet current to 11 amps and set the refocus current adjustment to mid-range.
- d. All the interlock lights on the amplifier cabinet should now be illuminated. On the control cabinet, the GLYCOL FLOW indicator should be illuminated and the orange CHANGE FILTER indicator should have extinguished.

CAUTION

MAKE SURE THE BEAM SUPPLY BREAKERS ON LINE CONTROL CABINET ARE OFF.

- e. Depress BEAM ON on the amplifier cabinet under test and wait until the filament time delay has elapsed (approximately 5 minutes after the FIL ON button was depressed). When the time delay has finished (indicated by the illumination of the green TIME DELAY light) the Line Control Cabinet contactors may be heard activating and the BEAM ON indicator will light.
- f. Depress BEAM OFF. The line control cabinet primary ac contactors to the beam supply should open immediately.
- g. Press BEAM ON. The sequence should be as follows:
 1. BEAM ON is depressed.
 2. 1 second later the primary ac contactors close.
- h. Open the meter panel by unfastening the two screws at the bottom of the panel. The BEAM ON indicator and METER PANEL LED indicator should extinguish. It should not be possible to turn BEAM ON with the interlock open. Close and re-fasten the meter panel.
- i. Using the front panel adjustment, reduce the magnet current below the minimum current trip point. The BEAM ON indicator along with the MAGNET CURRENT IN RANGE should extinguish.
- j. Rotate the magnet current adjustment clockwise to increase magnet current. The BEAM ON indicator should illuminate again until the magnet current reaches its upper set point, where a further increase of magnet current will also extinguish the BEAM ON and MAGNET CURRENT IN RANGE indicators. Reset the magnet current to the klystron test data current.
- k. Using the front panel adjustment, reduce the refocus coil current below the minimum current trip point. The BEAM ON indicator along with the REFOCUS CURRENT IN RANGE should extinguish.
 1. Rotate the refocus current adjustment clockwise to increase refocus current. The BEAM ON indicator should illuminate again until the refocus current reaches its upper set point, where a further increase of refocus current will also extinguish the BEAM ON and REFOCUS CURRENT IN RANGE indicators. Reset the refocus current adjustment knob to mid-range.
- m. Using the valve in the plumbing line supplying pure water to the klystron, reduce the water flow rate. As the flow falls to below 5 GPM, the BEAM ON indicator and COLLECTOR WATER FLOW LED should extinguish. Re-establish the proper flow rate.

Table 3-10. Optional Patch Panel Interlock System Checkout (Refer to drawing 839-7891-086, sheet 2)

INTERLOCK SWITCH(ES) <u>DEPRESSED</u>	VISUAL BEAM ON <u>INDICATOR</u>	AURAL BEAM ON <u>INDICATOR</u>
S3	ON	OFF
S4 & S2	ON	OFF
S10 & TEST LOAD WATER ON	ON	OFF
S10 & TEST LOAD WATER OFF	OFF	OFF
S4 & S8 & TEST LOAD WATER ON	ON	OFF
S4 & S8 & TEST LOAD WATER OFF	OFF	OFF
S6 & S2	OFF	ON
S12 & TEST LOAD WATER ON	OFF	ON
S12 & TEST LOAD WATER OFF	OFF	OFF
S6 & S8 & TEST WATER ON	OFF	ON
S6 & S8 & TEST LOAD WATER OFF	OFF	OFF
S4 & S6	OFF	OFF
S4 & S6 & S2	ON	ON
S4 & S6 & S8 & TEST LOAD WATER ON	ON	ON
S4 & S6 & S8 & TEST LOAD WATER OFF	OFF	OFF

- n. One at a time, disconnect the arc detector sensor input plugs where they connect to the arc detector box. In each case, the BEAM ON indicator along with the KLYSTRON SUPPORT EQUIPMENT LED should extinguish.
- o. On the Control Cabinet, turn OFF the MAGNET SUPPLY circuit breaker. On the Amplifier Cabinet, rotate the refocus current adjustment fully counter clockwise.
- p. One at a time, remove and then replace the magnet plug (on top of the magnet) and the refocus coil plug (at the base of the klystron collector). The removal of each plug should cause the KLYSTRON SUPPORT EQUIPMENT interlock LED to extinguish.
- q. Assure both plugs are firmly reattached. Re-establish magnet current by turning ON the control cabinet MAGNET SUPPLY circuit breaker, and the refocus current by re-setting its control to the mid-range position.
- r. On the front of the control cabinet just below the interlock display panel, remove the blank panel cover over the collector voltage and current monitoring PC boards. (The left cover contains the PC boards dedicated to the visual amplifier; the PC boards under the right cover monitor the aural klystron.) Unplug each board, one at a time, and check to see that the BEAM ON indicator extinguishes. There is no interlock indicator associated with this function.
- s. Remove all power to the transmitter and open the front door. Remove the shorting stick from its holder and stand it in the front right corner in the cabinet.

CAUTION

MAKE SURE THE BEAM SUPPLY BREAKERS ON LINE CONTROL CABINET ARE OFF.

- t. Re-power the transmitter and attempt to illuminate the BEAM ON indicator again. It should not be possible to do so. Also the GROUND STICK LED indicator should be extinguished.
- u. Remove power and replace the ground stick in its holder. Re-power the transmitter to the BEAM ON indicator illuminated condition as before.

CAUTION

MAKE SURE THE BEAM SUPPLY BREAKERS ON LINE CONTROL CABINET ARE OFF.

- v. Temporarily ground TB-15 terminal 5, on either power supply deck in the Control Cabinet. This simulates a high coolant (either water or glycol) temperature interlock. The primary ac contactor in the Line Control Cabinet should open and the COOLANT TEMP interlock LED should extinguish.
- w. Shut off the glycol flow by setting the glycol pump switch on the pump module to the OFF (center) position. The primary ac contactor in the Line Control Cabinet should open and the GLYCOL FLOW interlock LED should extinguish. Reset the glycol pump switch to start the pump.
- x. Temporarily loosen the beam supply terminal access cover enough to release the interlock switch. The primary ac contactor in the Line Control Cabinet should open and

the VISUAL (or AURAL, as appropriate) EXTERNAL interlock LED on the Control Cabinet should extinguish. Re-fasten the power supply cover.

3.6.17. AMPLIFIER CABINET THREE OCCURRENCE OVERLOAD TEST

CAUTION

MAKE SURE THE BEAM SUPPLY BREAKERS ON LINE CONTROL CABINET ARE OFF.

Power up the transmitter to the BEAM ON indicator illuminated condition (without high voltage present) and perform the following steps:

- a. Operate the one of the ARC (PUSH TO TEST) overloads momentarily. The overload LED should illuminate and the Line Control Cabinet power supply contactors should be heard de-actuating. If the overload test button was pushed just long enough to cause the ARC OVERLOAD indicator to illuminate (without causing the yellow FAULT indicator to start flashing) the beam supply contactors should be heard re-actuating after 1.5 seconds.

NOTE

If the ARC overload test button was pushed for too long the FAULT indicator will start flashing. If this happens reset the FAULT and ARC OVERLOAD indicators and repeat the test.

- b. Operate the ARC (PUSH TO TEST) overload again momentarily. The action should be the same as the previous step except that the SINGLE OVERLOAD SET LED should illuminate. This indicates two of the three overloads that will shut down the transmitter have occurred.
- c. Operate the ARC (PUSH TO TEST) overload again momentarily. The Line Control Cabinet contactors should release and remain de-actuated. The SINGLE OVERLOAD SET LED should have extinguished and the FAULT indicator should start flashing.
- d. Reset the FAULT and the OVERLOAD indicators.
- e. Depress the SINGLE OVERLOAD SET button. The LED should illuminate.
- f. Enter one overload with one of the ARC (PUSH TO TEST) overloads. The BEAM ON light should extinguish and the FAULT indicator should start flashing.
- g. Enter two faults with the ARC (PUSH TO TEST) overload to illuminate the SINGLE OVERLOAD SET indicator. Measure the time from the application of the first overload to when the SINGLE OVERLOAD SET LED extinguishes. This time interval should be approximately one minute.
- h. Operate the ARC (PUSH TO TEST) overload and hold it depressed for at least one second. The Line Control Cabinet ac contactors should open, the ARC OVERLOAD indicator should be illuminated, and the yellow FAULT light should be flashing.

3.6.18. AC FAIL TEST

Perform the following steps:

- a. Set the AC FAIL toggle switches on the power supply decks in the control cabinet to IN.

NOTE

It is possible that the battery has insufficient charge to perform the following test. See step f.

CAUTION

MAKE SURE THE BEAM SUPPLY BREAKERS ON LINE CONTROL CABINET ARE OFF.

- b. Power up the amplifier cabinet to the BEAM ON indicator illuminated level (without high voltage present).
- c. Shut off all power to the transmitter for 10 seconds. The amplifier cabinet should return to the BEAM ON state when power is re-applied.
- d. Shut off all power to the transmitter for 30 seconds. The FIL ON lamp and AUTO ON lamp should light when power is re-applied. The BEAM ON lamp should illuminate after approximately 30 seconds.
- e. Shut off all power to the transmitter for 5 minutes. The FIL ON lamp and AUTO ON lamp should light when power is re-applied. The BEAM ON lamp should illuminate after approximately 5 minutes.
- f. If steps c., d., and e. do not work, it is probable that the battery is not fully charged. Allow the battery to charge for at least 10 hours by having power applied to the control circuitry and repeat the tests. (The AC FAIL switch must be set to IN.)

3.6.19. FILAMENT VOLTAGE METERING CALIBRATION

CAUTION

MAKE SURE THE BEAM SUPPLY BREAKERS ON LINE CONTROL CABINET ARE OFF.

- a. Connect a digital multimeter directly to the filament and cathode terminals AT THE BOTTOM OF THE KLYSTRON. Set the meter to measure DC volts in the 7 vdc range.
- b. Power up the amplifier cabinet to the FIL ON level.
- c. Slowly rotate the FILAMENT ADJUST knob clockwise while observing the FILAMENT VOLTAGE meter through the window of the front door. Set the filament voltage for about 7 volts.
- d. Check the digital voltmeter reading and, if necessary, reset the filament voltage to 7.0 volts as read on the digital voltmeter.
- e. Compare the digital voltmeter reading to the cabinet filament voltmeter reading. If a difference in readings is observed, record the difference as the calibration error of the internal meter. This information should be noted whenever filament voltage is read.

3.7. AURAL TRANSMITTER CABINETS CHECKOUT

Checkout of the Aural Amplifier Cabinet and the aural portion of the Control Cabinet is identical to the checkout of the visual portion of the transmitter. Therefore the previous procedure should be repeated using the aural amplifier cabinet and aural portion of the Control Cabinet.

3.8. RF SYSTEM MULTIPLEX CONTROL CHECKOUT

Perform the following procedure:

- a. Apply 110 Vac power to the diplexer AURAL DETUNERS.

The detuner mechanism may change position when power is first applied aligning itself with the logic command being sent from the transmitter.

- b. Observe the MULTIPLEX status indicators. One should be illuminated. Momentarily depress the switch under the one that is NOT illuminated.

The diplexer cavity detuner mechanism should begin to move. The indicator above the switch depressed should illuminate when the detuner mechanism reaches its new position.

- c. Check the diplexer cavity detuners to assure that the position of the detuners agrees with the mode status indicator.

Locate the aural notch cavities on the diplexers. On the wall of each cavity is a plunger entering the cavity that is driven by a common bar that drives both cavity plungers at the same time. The plunger changes the RF coupling in the cavity causing the resonating frequency to move higher. When the plungers are inserted into the cavities, the common drive bar is positioned close to the aural cavity flange (about an inch from it). In this mode, the cavities are detuned. This corresponds to the MULTIPLEX mode. The NORMAL mode corresponds to the plungers retracted out from the cavities. The common drive bar will be several inches from the cavity flange when the detuners are positioned in the NORMAL mode.

- d. While the detuners are in the MULTIPLEX mode, check the EXTERNAL interlock LED on the AURAL amplifier cabinet. It should be extinguished indicating the aural cabinet is interlocked off during multiplex operation.
- e. Depress the NORMAL switch on Emergency Multiplex control panel.

3.9. RF SYSTEM INTERLOCK CHECKOUT

WARNING

IN THE FOLLOWING STEPS, MAKE SURE BOTH BEAM POWER SUPPLY BREAKERS ON BOTH LINE CONTROL CABINETS ARE SET TO OFF.

This procedure assumes the optional patch panel and interlock circuit shown on sheet 2 of drawing 839 7891 169 (Power & Control Wiring diagram) are installed and wired per the drawing.

NOTE

If the optional patch panel is not used, the Aural Reject Load Thermal Interlock should be wired directly to TB17-14 and TB17-18 in the Control Cabinet.

3.9.0.1. Procedure

Perform the following steps:

- a. Apply sufficient water flow to the station test load to release the low water flow interlock switch.
- b. Assure that the BEAM POWER SUPPLY BREAKERS on the Line Control cabinets are both set to OFF. Depress the FIL ON and BEAM ON pushbuttons on both visual

and aural amplifier cabinets so after the time delay expires, both BEAM ON indicators illuminate. Assure that the multiplex mode is set to NORMAL.

- c. Remove all three patch links from the 7-port patch panel. Both visual and aural BEAM ON indicators should extinguish.
- d. Using masking tape, label each interlock switch actuator rod hole with the switch number so it corresponds to the schematic.
- e. Using a screwdriver or other tool, depress the patch panel interlock switches per Table 3-10. Follow the table and check the appropriate visual or aural BEAM ON indicator for proper responses.
- f. Replace the patch links so the visual and aural amplifiers are routed to the diplexer and the diplexer output is routed to the test load. (Switches S4, S6, & S8 depressed.) Both visual and aural BEAM ON indicators should illuminate.
- g. Temporarily remove the thermal interlock plug from the diplexer aural reject load. Short the two pins in the plug with a piece of wire to simulate an overheated load condition. The aural amplifier BEAM ON indicator should extinguish. Reinstall the thermal interlock plug onto the load.

3.10. NOTCH DIPLEXER EQUALIZER CHECK

Refer to the Notch Diplexer Equalizer technical manual (988-1150-001) for proper checkout procedures.

3.11. EXCITER SWITCHER CHECK (OPTIONAL EQUIPMENT)

Refer to the Exciter Switcher Technical Manual (988-2232-001) for proper checkout procedures.

3.12. EXCITER CHECKOUT

Refer to the Exciter Technical Manual (988-2265-001) for proper checkout procedures.

3.13. IPA CABINET CHECKOUT

Refer to the IPA Cabinet Technical Manual (988-2264-001) for proper checkout procedures.

3.14. KLYSTRON CAVITY PRETUNING

Before applying high voltage and rf to the klystron, the cavity tuning should be preset to the channel of operation. Perform the procedures listed in Section V before continuing.

3.15. APPLICATION OF HIGH VOLTAGE: VISUAL AMPLIFIER CABINET

CAUTION

SUCCESSFUL COMPLETION OF THE RF SYSTEM INTERLOCK CHECKOUT MUST BE COMPLETED BEFORE PROCEEDING.

Read paragraphs in this section entitled TRANSMITTER TURN-ON before proceeding.

Perform the following steps:

- a. Assure that the klystron cavities have been pretuned.

WARNING

REMOVE ALL INPUT POWER FROM TRANSMITTER AND BEAM SUPPLIES BEFORE PERFORMING THE FOLLOWING STEPS. USE SHORTING STICK ON ALL TERMINALS BEFORE TOUCHING THEM.

- b. Assure the BEAM SUPPLY BREAKERS on the Line Control Cabinets are OFF.
- c. In the High Voltage Power Supplies connect the ac primary wires to the 500V and +20V taps. This will initially produce a lower beam voltage.
- d. Consult drawing 839 7891 059, HV Wiring Diagram, for initial mod anode bias tap positions. Be sure that the Zener board is installed in the recommended resistor position.
- e. In the Visual Amplifier Cabinet, move HV wire J14 from the zener diode board to the junction of R25 and R26. This will produce a low beam current. (In the Aural Amplifier Cabinet, the HV wire J14 should remain connected to E6 of the auxiliary zener board which should be installed in place of R25).
- f. Check that the input and output of the klystron is terminated into 50 ohms, with adequate termination dissipation.
- g. Apply ac power to the appropriate Line Control cabinet.
- h. Set both the BEAM SUPPLY breakers on the appropriate Line Control Cabinet to ON.

CAUTION

Never throw the Line Control Cabinet BEAM SUPPLY breakers ON if the Amplifier Cabinet BEAM ON indicator is illuminated. Doing so will bypass the beam supply step-start circuits and may damage the beam power supply.

- i. Make sure the pump module switches are ON and power is applied to the outside fan unit.
- j. Depress FIL ON.
- k. Check for proper meter readings of filament voltage, magnet current, and ion pump current.

NOTE

See tube data sheet supplied with klystron for magnet current and filament voltage.

CAUTION

DO NOT APPLY BEAM VOLTAGE IF THE ION CURRENT IS ABOVE 10uA. IF THE ION CURRENT IS EXCESSIVE, LET THE KLYSTRON RUN WITH FILAMENT VOLTAGE ONLY (AND ION PUMP VOLTAGE) APPLIED TO THE TUBE. THIS SHOULD REDUCE ION PUMP CURRENT.

- l. Set the Visual and Aural Exciter POWER controls to minimum (fully counterclockwise).
- m. Set the pulser to OUT. (Visual only).
- n. Depress BEAM ON (after time delay runs out).

WARNING

HIGH VOLTAGE IS NOW PRESENT IN THE AMPLIFIER CABINET.

- o. Check the body current, collector voltage, and collector current readings as follows:
 - 1. Body Current: less than 20mA.

- 2. C1- Collector Voltage: approx. 24kV;
Collector Current: 0 A
- 3. C2- Collector Voltage: approx. 18kV;
Collector Current: 0 A
- 4. C3- Collector Voltage: approx. 12kV;
Collector Current: <1A
- 5. C4- Collector Voltage: approx. 6kV;
Collector Current: <3A
- 6. C5- Collector Voltage: 0kV;
Collector Current: 0A
- p. Check to see that ion current does not exceed 10uA.
- q. Allow the transmitter to warm up for a minimum of 30 minutes at this reduced beam voltage & beam current level before proceeding. Check meter readings periodically for possible problem areas.
- r. If no problems have developed depress BEAM OFF and FIL OFF and proceed to full beam voltage and beam current. During the RF testing portion of the checkout, beam voltage (beam supply primary taps) and total beam current (mod anode resistor tap settings) may have to be changed to obtain optimum performance.

WARNING

REMOVE ALL POWER BEFORE PERFORMING THE FOLLOWING STEPS. USE SHORTING STICK ON ALL TERMINALS BEFORE TOUCHING THEM.

- s. Set BEAM SUPPLY breakers on Line Control cabinet to OFF.
- t. In the High Voltage Power Supply, return the primary ac wires to the taps that match the line voltage measured. In the Visual amplifier cabinet, move HV wire J14 back to E3 on the auxiliary zener diode board.
- u. Reapply power to the Line Control cabinet and set the BEAM SUPPLY breakers to ON.
- v. Depress FIL ON.
- w. Depress BEAM ON after the time delay runs out.
- x. Check the body current, collector voltage, and collector current readings as follows:
 - 1. VISUAL AMPLIFIER
 - a) Body Current: less than 30mA.
 - b) C1- Collector Voltage: approx. 26.0kV;
Collector Current: 0A
 - c) C2- Collector Voltage: approx. 19.5kV;
Collector Current: <.5A
 - d) C3- Collector Voltage: approx. 13.0kV;
Collector Current: <.5A
 - e) C4- Collector Voltage: approx. 6.5kV;
Collector Current: <5.5A
 - f) C5- Collector Voltage: 0kV;
Collector Current: 0A
 - g) Ion pump current less than 10uA.
 - 2. AURAL AMPLIFIER
 - a) Body Current: less than 30mA.
 - b) C1- Collector Voltage: approx. 26.0kV;
Collector Current: 0A
 - c) C2- Collector Voltage: approx. 19.5kV;
Collector Current: 0A

- d) C3- Collector Voltage: approx. 13.0kV;
Collector Current: 0A
- e) C4- Collector Voltage: approx. 6.5kV;
Collector Current: 2.5A
- f) C5- Collector Voltage: 0kV;
Collector Current: 0A
- g) Ion pump current less than 10uA.

- y. Allow the amplifier to operate in this mode about 15 minutes before proceeding. During this time double check performance of the cooling system, and especially look for cooling system leaks as the coolant warms.
- z. If the amplifier under test is to be used in visual service, tune the klystron initially for the unpulsed mode per the procedure in Section V. Refer to Table 3-8 for typical meter readings under drive conditions.
The procedure for aural service tuning is also contained in Section V.
- aa. For visual amplifiers, follow the procedure in Section V to set tuning of the amplifier for pulsed conditions after having tuned the klystron for unpulsed service.
- ab. Allow the amplifier to operate at full power while checking the temperature of all elbows and transmission lines for heating.

3.16. APPLICATION OF HIGH VOLTAGE: AURAL AMPLIFIER CABINET

The procedures for applying high voltage to the Aural Amplifier Cabinet are identical to the checkout of the visual portion of the transmitter. Therefore the previous procedure should be repeated using the aural amplifier cabinet and those notes and meter readings in the procedure that apply to the aural amplifier.

3.17. DIPLEXED AMPLIFIER CHECKOUT

- a. Connect each amplifier output to the notch diplexer and the output of the diplexer to a dummy load with adequate dissipation for both visual and aural signals.
- b. Turn ON the BEAM SUPPLY BREAKERS on the Line Control Cabinets. Depress FIL ON on both visual and aural amplifiers
- c. After the time delays expire depress BEAM ON on both amplifiers. Increase AURAL RF drive slowly while watching the AURAL VSWR, power output and diplexer reject load power. The aural VSWR should be less than 1.2:1 and reject load power less than 1500 watts at 100% aural power.
- d. Slowly, increase the VISUAL power while watching VISUAL VSWR, power output, and diplexer reject load power. The VISUAL VSWR should be less than 1.2:1 and the diplexer reject load power should not increase significantly. Reject load power should not be allowed to increase beyond 1500 watts.
- e. Allow the transmitter to operate several hours at full power periodically checking the temperature of all elbows and transmission lines for heating.
- f. Check diplexer reject load power. It should decrease as the diplexer warms up.

- g. Check both the pure water and glycol temperatures at the heat exchanger modules. Both should be less than 120F. (If outside ambient air temperature is less than 100F.)

3.18. MULTIPLEX SYSTEM CHECKOUT UNDER POWER

Perform the following steps. It is assumed that both visual and aural amplifiers are energized (BEAM ON) and that both are capable of producing licensed power.

- a. Rotate both (with spare exciters) Visual Exciter POWER controls fully counterclockwise. Rotate both (with spare exciters) Aural Exciter POWER controls fully counterclockwise.
- b. Depress the MULTIPLEX switch. The aural amplifier should shut off along with the visual amplifier pulser.
- c. Rotate the on-air Visual Exciter POWER control clockwise while monitoring the VISUAL POWER meter to confirm that visual power can be applied to the system output through the visual amplification chain. Rotate the POWER control fully counterclockwise after confirmation.
- d. Rotate the on-air Aural Exciter POWER control clockwise while monitoring the VISUAL POWER meter to confirm that aural power can also be applied to the system output through the visual amplification chain. Rotate the POWER control fully counterclockwise after confirmation.
- e. Depress the multiplex NORMAL switch.
- f. Slowly increase aural power using the on-air Aural Exciter POWER control while monitoring the diplexer reject load power and VSWR on the aural amplifier cabinet power meter.
- g. When full power is attained, note the exact position of the POWER control knob on the Aural Exciter and record this position on a piece of paper.
- h. Reduce aural power by rotating the Aural Exciter POWER control fully counterclockwise.
- i. Operate the visual amplifier at full visual power.
- j. Without changing the Visual Exciter POWER control, depress the MULTIPLEX pushbutton.
The VISUAL POWER meter should read approximately 25%.
- k. Slowly increase the Aural Exciter POWER control to the knob position recorded in step g. The VISUAL POWER meter reading should increase to approximately 32%.

The transmitter is now operating in its multiplex mode.

NOTE

The amount of visual power that can be produced in the emergency multiplex mode of operation is dependent upon several factors:

1. *If out of band intermodulation products can be allowed to exceed the legal limit of -60dB without causing adjacent channel interference, transmitter power can be increased.*
2. *If the percentage of aural power reference to visual power can be decreased during the emergency mode, visual power may be increased.*

3. If 1. above is not a factor and existing klystron tuning and precorrection settings will permit higher output powers without causing excessive in-band intermodulation products, higher transmitter output powers are possible. In-band intermodulation products, if they are strong enough, will be visible in the transmitted picture as diagonal hash lines.

Visual and aural preset power levels are set by fixed pads attached to the multiplex hybrid HYB-4 in the IPA cabinet. Different pad values may be substituted for those installed in the transmitter if a change in preset multiplex power levels is desired. Also, instead of changing pad values, the individual exciter power levels may be changed using the exciter POWER controls. In any case, a spectrum analyzer and demodulated picture examination should be used to determine maximum emergency multiplex power levels.

1. Depress the multiplex NORMAL pushbutton. The transmitter will return to its normal duplexed operating mode.

3.19. FINAL CHECK

If the station is equipped with an output dummy load (optional equipment), operate the full transmitter into the dummy load for several hours. Check all VSWRs and for heating of RF components. Monitor all transmitter parameters.

Check response, differential gain, differential phase, sync levels, modulation depth and subcarrier notch depth after the diplexer. Check and adjust, if necessary, group delay caused by the notch diplexer. Refer to Notch Diplexer Equalizer technical manual.

3.20. DAY TO DAY OPERATION

Before operating the transmitter each day, the following checks should be made.

- a. Assure all transmitter doors are closed and that all external interlocked devices are in place.
- b. Assure the transmitter RF output is properly terminated into the dummy load or antenna.
- c. Apply power to the equipment by closing all circuit breakers on the Line Control Cabinets.

3.20.1. TRANSMITTER TURN-ON

NOTE

The following steps are applicable to either the visual or aural amplifier cabinet.

- a. Depress the FIL ON pushbutton. The FIL ON lamp will illuminate when the filaments energize.
- b. The Control Cabinet GLYCOL FLOW indicator should illuminate and the amber CHANGE FILTER indicator should extinguish.
- c. The following amplifier cabinet indicators should illuminate and indicate normal up-sequencing: SUFFICIENT AIR, COLLECTOR WATER FLOW, MAGNET CURRENT IN RANGE, REFOCUS CURRENT IN RANGE and SUFFICIENT AIR.
- d. After the 5 minute delay period, the TIME DELAY lamp will come on.
- e. After the TIME DELAY lamp illuminates, depress the BEAM ON pushbutton. The BEAM ON lamp will illu-

minate and audible evidence of the Line Control Cabinet contactor closures may be heard. The transmitter is now ON.

- f. VISUAL POWER. Observe the indication given on the visual POWER OUTPUT meter (FORWARD POWER). If necessary, use the MOD ANODE bias switch on the visual amplifier cabinet to set peak sync output power at 100%. Observe the demodulated television signal and adjust the visual exciter POWER control to produce the proper blanking to sync ratio.
- g. AURAL POWER. Observe the aural POWER OUTPUT meter (FORWARD POWER). Use the power control on the aural exciter, to set the meter to 100%.
- h. Check transmitter meter parameters and compare with previously recorded data and/or with data shown in Table 3-10.

3.20.1.1. Turn-on Using The Auto On Mode

Whenever the BEAM ON function is energized on the amplifier cabinet before the FIL TIME DELAY has elapsed, the AUTO ON light on the amplifier cabinet will illuminate indicating that beam voltage will automatically be applied to the tube when the FIL TIME DELAY elapses.

Also, whenever each amplifier cabinet is turned off by depressing FIL OFF at the amplifier cabinet without depressing BEAM OFF, the control logic will have been left in the AUTO ON mode and will apply beam voltage to the klystron the next time the filaments are turned on and the TIME DELAY elapses.

3.20.2. TRANSMITTER TURN-OFF

Two methods are provided:

- a. Manual. Depressing the BEAM OFF and FIL OFF pushbuttons in that order. The transmitter fans and the pump module will continue to operate for 5 minutes. The transmitter is off and the filament circuits are de-energized. To return the transmitter to the air, depress the FIL ON and the BEAM ON in that order. After the warm-up time delay, the transmitter will return to operation.
- b. Semiautomatic. With the transmitter in operation, depress the FIL OFF pushbutton. The high voltage circuitry is automatically de-energized along with the filament circuitry. The fans and pump module will continue to operate for 5 minutes. To return the transmitter to the air depress the FIL ON pushbutton. The transmitter will automatically return to operation when the TIME DELAY elapses.

3.20.3. EXCITER TURN-ON AND TURN-OFF

- a. Aural Exciter. The toggle switch inside the chassis should be left in the ON position for normal operation. It can be moved to the OFF position when it is desired that the exciter output be turned off during test functions.
- b. Visual Exciter. The circuit breaker inside the chassis should be left in the ON position. It can be moved to the OFF position when it is desired that the exciter output be turned off during test functions.

3.20.4. FAULT RESET

If an amplifier cabinet experiences three overloads within one minute, the amplifier will remove beam voltage from its

klystron and illuminate the flashing FAULT indicator. The indicator may be reset and high voltage reapplied to the klystron by depressing the FAULT PUSH TO RESET switch on the amplifier cabinet that has shut off.

CAUTION

DO NOT REPEATEDLY RESET THE OVERLOAD CAUSING BEAM VOLTAGE TO BE REAPPLIED TO THE KLYSTRON IF THE OVERLOAD CONTINUES TO PERSIST. RATHER SWITCH TO ONE OF THE EMERGENCY MODES AND DETERMINE THE REASON FOR THE OVERLOAD.

3.20.5. POWER LINE INTERRUPTION

During operation, if a power line interruption of less than 30-seconds occurs, the transmitter will automatically return to the air without the 5-minute warmup period. If the power interruption exceeds the 30-second period, the transmitter will automatically return to the air but with a proportional warm-up delay. Power interruption of up to approximately 1 hour is

provided for. If the outage exceeds this period, the transmitter must be returned to operation manually.

3.20.6. EMERGENCY MULTIPLEX OPERATION

Emergency multiplex is a transmitter mode designed to overcome an aural amplifier chain failure. It allows signals from both the visual and aural exciters to be amplified by the visual klystron and fed to the antenna at reduced power. This is an emergency only procedure.

3.20.6.1. Procedure

- a. Depress the MULTIPLEX pushbutton on the IPA cabinet. Both Visual and Aural Exciter outputs will mix and be amplified by the visual amplifier. The sum of the visual and aural powers will be indicated on the VISUAL POWER meter. The meter reading will be about 30%. The aural amplifier cabinet will be interlocked off (BEAM OFF).

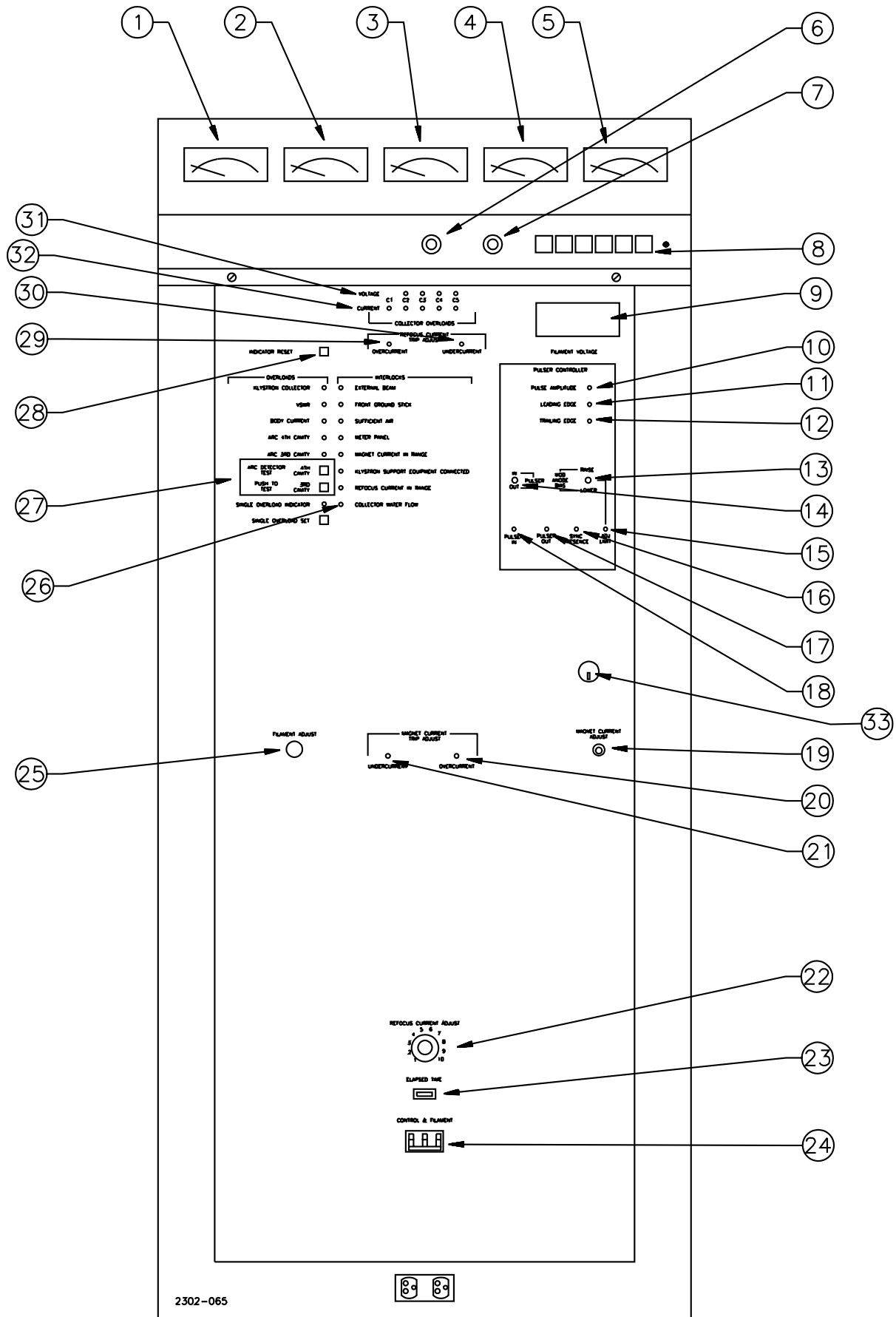


Figure 3-1. Amplifier Cabinet Controls and Indicators

Table 3-1. Amplifier Cabinet Controls & Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	MAGNET CURRENT meter, M1, 0-15Adc	Indicates klystron magnet current.
2	BEAM VOLTAGE meter, M2, 0-30kVdc	Indicates klystron beam voltage.
3	BODY CURRENT meter, M3, 0-200mA	Indicates klystron body current.
4	POWER OUTPUT meter, M5, 0-130%, 1.0-3.0 VSWR	Indicates forward or reflected klystron rf power.
5	BEAM CURRENT meter, M5, 0-6Adc Visual, 0-4Adc, Aural	Indicates klystron beam current.
6	BEAM VOLTAGE/CURRENT switch S12	Selects input to beam voltage meter M2 and beam current meter M5.
7	POWER OUTPUT FORWARD/REFLECTED VSWR switch, S16	Switches POWER OUTPUT meter circuit.
8	FIL ON switch, S1	Applies control logic input to energize klystron filaments, blowers, heat exchanger, and high voltage power supply.
	TIME DELAY indicator, A10	Indicates the 5 minute turn-on delay has been completed.
	FIL OFF switch, S2	Applies control logic input to deenergize klystron filaments, blower, heat exchanger, and high voltage power supply.
	FAULT PUSH TO RESET switch,/indicator, S3/A11	When illuminated an error condition has occurred. Depressing the switch resets the fault shift register. (If AUTO ON lamp is illuminated, the beam will re-cycle when FAULT RESET is depressed.)
	BEAM ON switch, S4	Applies control logic input to apply klystron beam voltage and +24V to IPA.
	BEAM OFF switch, S5	Applies control logic input to remove klystron beam voltage and +24V from IPA.
	AUTO ON indicator	When illuminated, indicates control logic has klystron in AUTO ON mode and beam voltage will be applied to the klystron whenever the 5 minute filament time delay has been completed.
9	Filament meter, M6 (located behind door)	Indicates filament voltage level applied to klystron.
10*	PULSE AMPLITUDE control, R51	Controls amplitude of sync pulse applied to klystron annular ring.
11*	LEADING EDGE control, R3	Adjusts timing of sync pulse applied to klystron annular ring. Used mainly to adjust pulser output coincident with 2nd pulser output.
12*	TRAILING EDGE control, R4	Same as above.
13*	MOD ANODE BIAS RAISE/LOWER switch, S2	Accuates motor driven potentiometer in Mod Anode resistor divider string to raise/lower klystron output capability. (NOT USED ON AURAL.)
14*	PULSER IN/OUT switch, S1	Selects use of Annular Ring Pulser or fixed beam current operation for Visual Amplifier.
15*	ADJ LIMIT, indicator, CR27	Illuminates while RAISE/LOWER switch is accuated if motorized potentiometer reaches end of travel in either direction
16*	SYNC PRESENCE indicator CR7	Indicates sync is being received from the Visual Exciter by the Pulser Controller. Note: Due to switching of IPA power supply with BEAM ON/OFF, the sync presence LED display is only valid when beams are on and the sync output cable from the exciter is properly connected to the IPA AGC detector. Operators should disregard the LED when beams are off or if the IPA AGC sync cable is disconnected.
17*	PULSER OUT indicator CR3	Indicates Annular Ring Pulser has been switched out and klystron is being operated with fixed beam current.
18*	PULSER IN indicator CR34	Indicates Annular Ring Pulser has been switched into circuit.

Table 3-1. Amplifier Cabinet Controls & Indicators (Cont.)

REF.	CONTROL/INDICATOR	FUNCTION
	* VISUAL AMPLIFIER CABINET ONLY	
19	MAGNET CURRENT ADJ	Adjusts klystron magnet current by controlling magnet power supply regulator.
20	MAGNET UNDERCURRENT TRIP ADJUST control	Sets minimum operating magnet current (typical = 9A).
21	MAGNET OVERCURRENT TRIP ADJUST control	Sets maximum operating magnet current (typical = 12A).
22	REFOCUS CURRENT ADJUST	Adjusts klystron refocus current by controlling refocus power supply.
23	ELAPSED TIME meter, M7	Indicates operating hours on filament.
24	CONTROL AND FILAMENT circuit breaker, CB1	Controls +12 Vdc applied to the logic and relay control circuitry and the 208Vac voltage applied to the filament transformer.
25	FILAMENT ADJUST transformer, T3	Variable transformer used to vary the ac input to the klystron dc filament voltage supply.
26	INTERLOCKS	
	FRONT GROUND STICK	Indicates front ground stick has been returned to its holder.
	METER PANEL	Indicates hinged upper panel on front of cabinet is closed
	MAGNET CURRENT IN RANGE	Indicates magnet current above undercurrent trip point and below overcurrent trip point.
	KLYSTRON SUPPORT EQUIPMENT CONNECTED	Indicates loop-thru circuit complete to arc detector, collector temperature and magnet wiring.
	SUFFICIENT AIR	Actuated by an air pressure switch monitoring the klystron cavity main blower.
	EXTERNAL BEAM	Indicates satisfactory condition of external interlock.
	REFOCUS CURRENT IN RANGE	Indicates refocus current above undercurrent trip point and below overcurrent trip point.
	COLLECTOR WATER FLOW	Indicates sufficient water flow to klystron.
27	OVERLOADS	
	KLYSTRON COLLECTOR	Indicates klystron beam current or voltage limit has been exceeded.
	VSWR	Indicates VSWR limit has been exceeded.
	BODY CURRENT	Indicates klystron body current has exceeded limit.
	ARC 4TH CAVITY	Indicates rf arc has occurred in 4th cavity
	ARC 3RD CAVITY	Indicates rf arc has occurred in 3rd cavity.
	ARC DETECTOR OVLD PUSH TO TEST 4TH CAVITY & 3RD CAVITY	Depress indicated pushbutton to test arc overload logic. CAUTION: PERFORMING THE TEST FUNCTION WILL CAUSE THE TRANSMITTER TO TURN OFF.
	SINGLE OVERLOAD INDICATOR	When illuminated, indicates single overload will shut klystron beam voltage off and not automatically return it.
	SINGLE OVERLOAD SET	Depress to enable single overload logic in preference to 3-time overload logic.
28	INDICATOR RESET	When depressed, extinguishes overload lamps that are illuminated. If lamp remains illuminated it indicates that overload is still present.
29	REFOCUS UNDERCURRENT TRIP ADJUST control	Set minimum operating refocus current.
30	REFOCUS OVERCURRENT TRIP ADJUST control	Sets maximum operating refocus current.

Table 3-1. Amplifier Cabinet Controls & Indicators (Cont.)

REF.	CONTROL/INDICATOR	FUNCTION
31	COLLECTOR VOLTAGE OVERLOAD	Indicates klystron voltage has exceeded limit on one of the collectors.
32	COLLECTOR CURRENT OVERLOAD	Indicates klystron current has exceeded limit on one of the collectors.
33	KEY LOCK	Controls access to the cabinet interior.

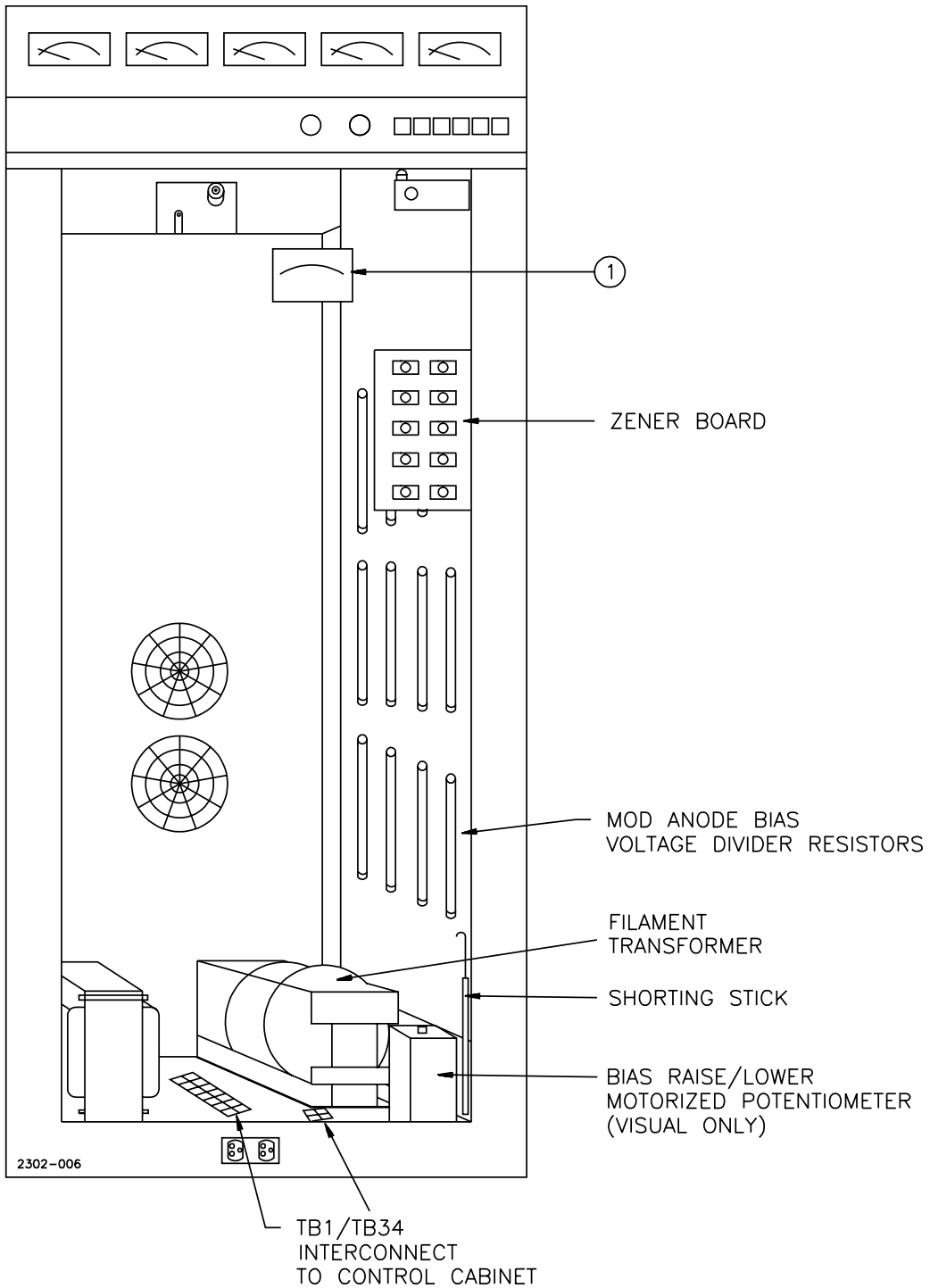
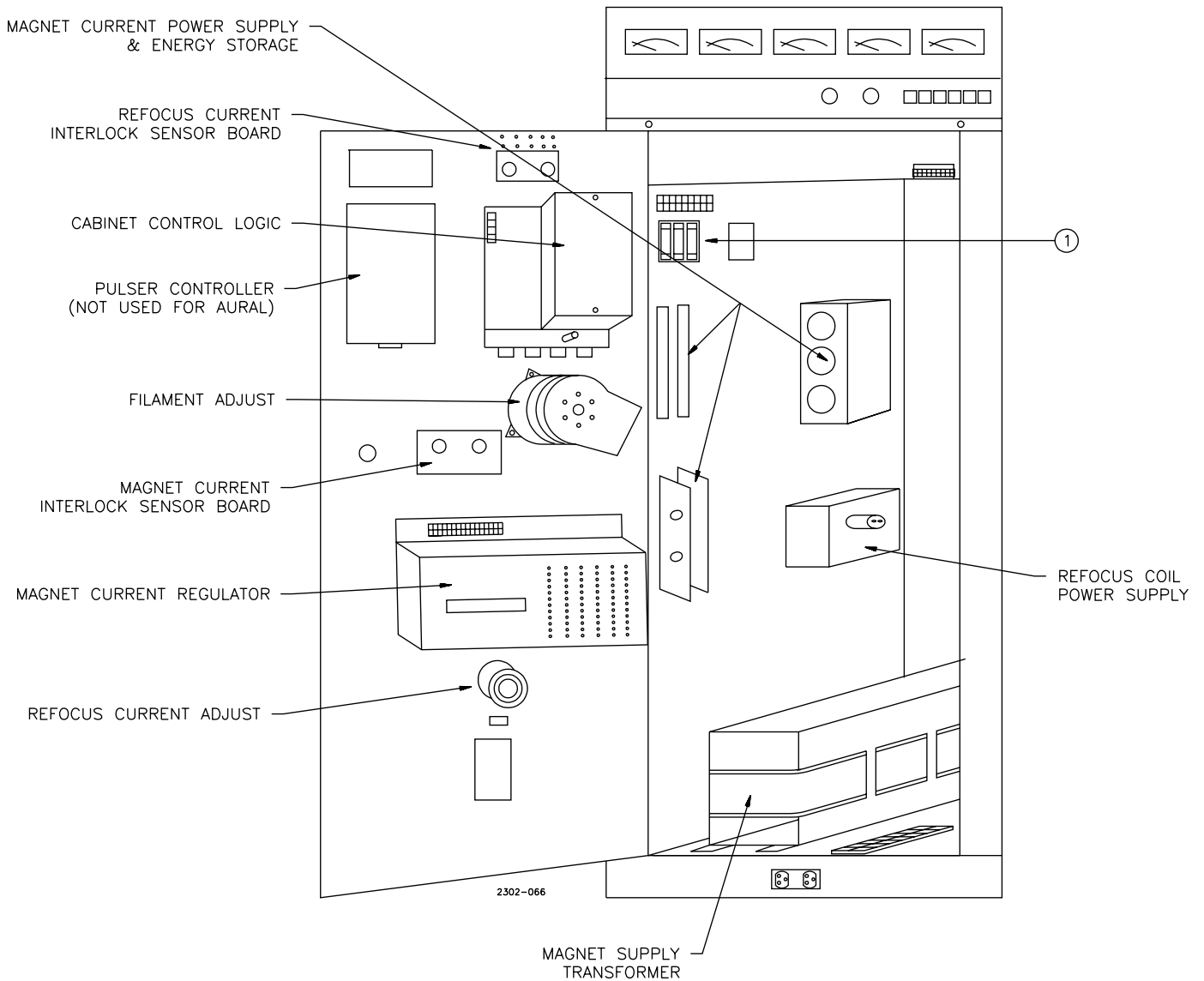


Figure 3-2. Amplifier Cabinet Interior View Right Side Controls & Indicators

Table 3-2. Amplifier Cabinet Interior View Right Side Controls & Indicators

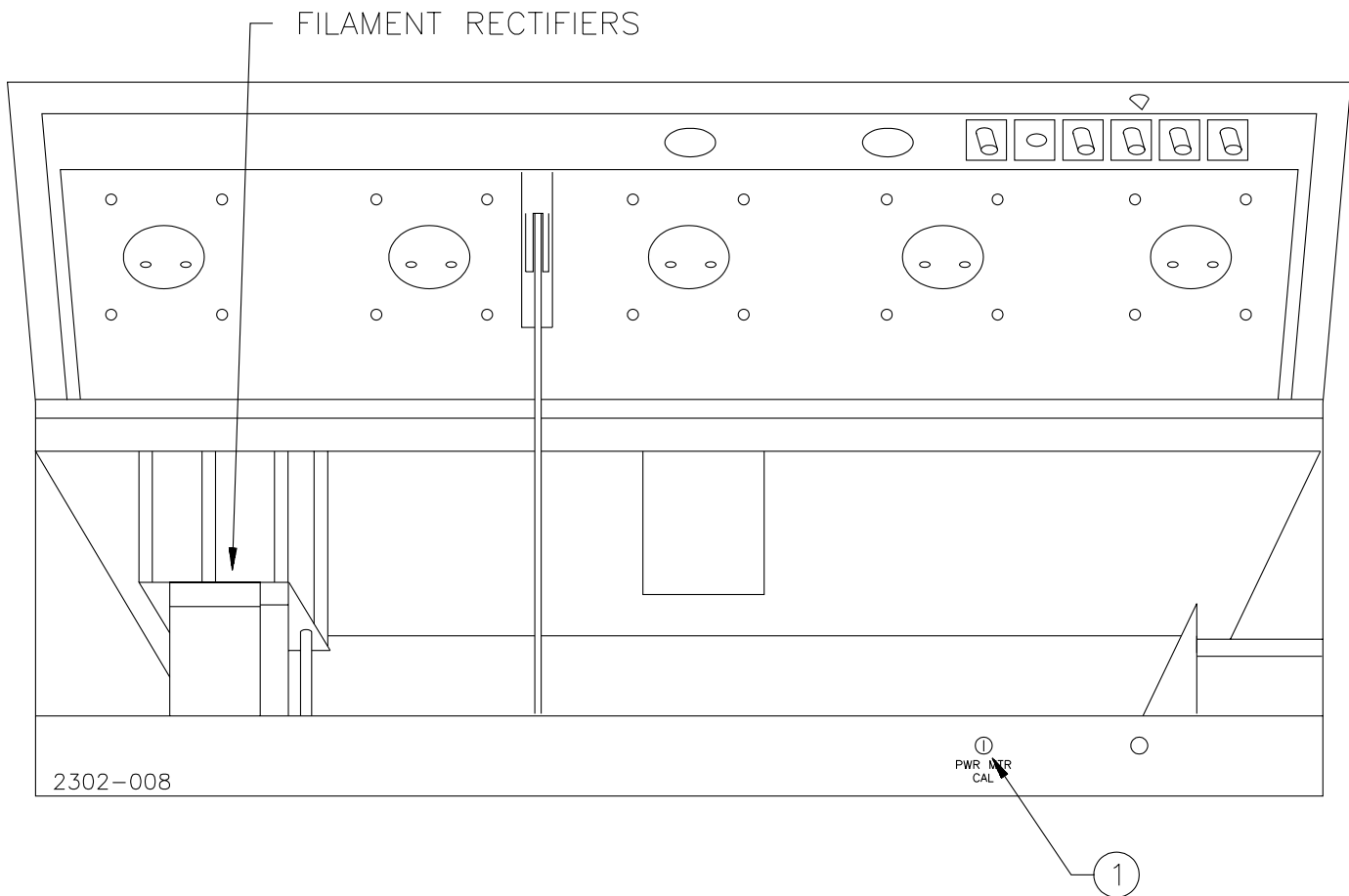
REF.	CONTROL/INDICATOR	FUNCTION
1	Filament Meter	Indicates filament voltage level applied to klystron.



**Figure 3-3. Amplifier Cabinet Interior View Left Side
Controls & Indicators**

**Table 3-3. Amplifier Cabinet Interior View Left Side
Controls & Indicators**

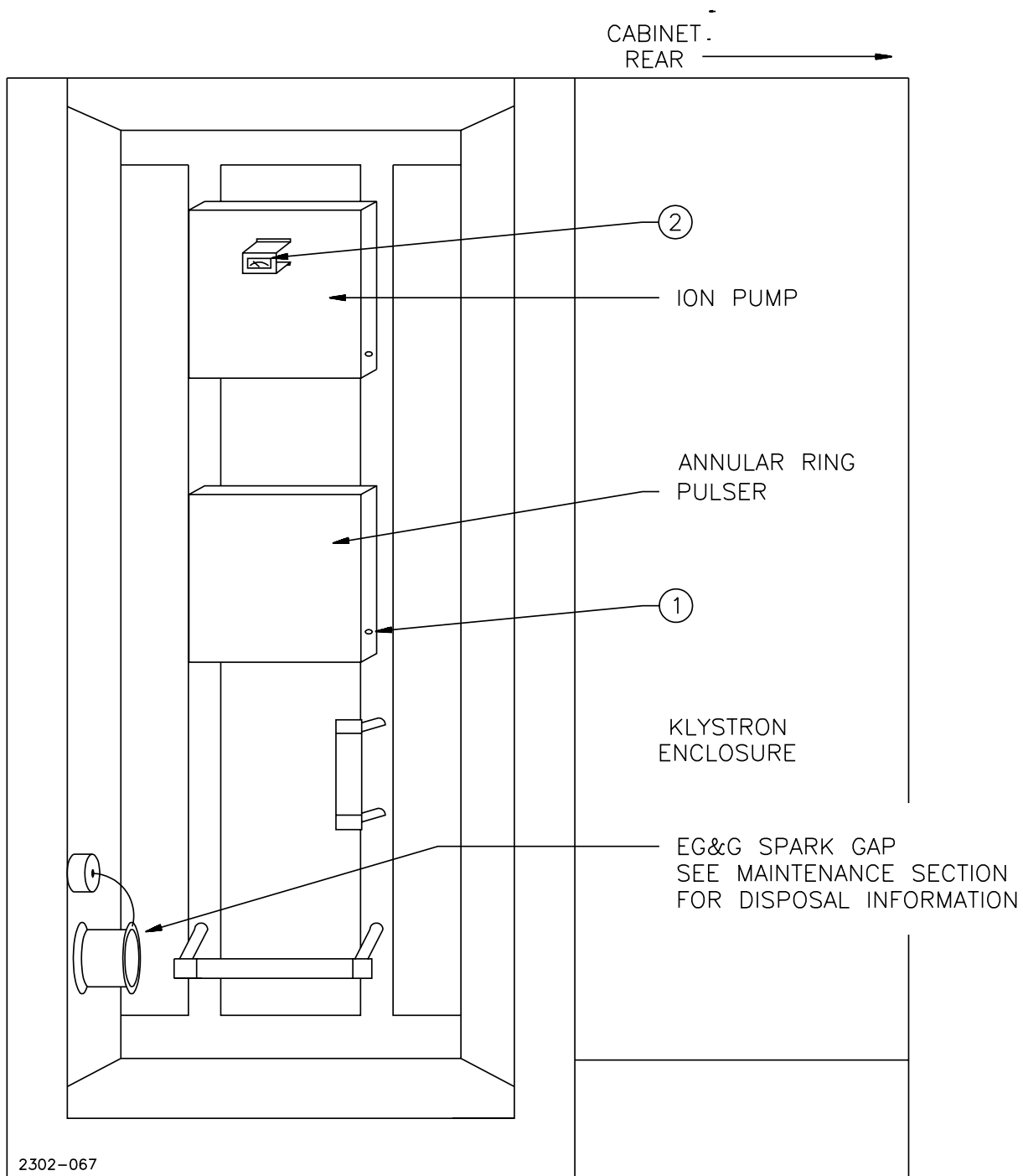
REF.	CONTROL/INDICATOR	FUNCTION
1	Magnet Supply fuses F1, F2, & F3	Protect Magnet Supply from overcurrent condition.



**Figure 3-4. Amplifier Cabinet with Meter Panel Open
Controls & Indicators**

**Table 3-4. Amplifier Cabinet with Meter Panel Open
Controls & Indicators**

REF.	CONTROL/INDICATOR	FUNCTION
1	PWR MTR CAL	Calibration potentiometer for Power Output meter M4.



**Figure 3-5. Visual Amplifier Cabinet Right Side View
Panel Removed, Controls & Indicators**

**Table 3-5. Visual Amplifier Cabinet Right Side View
Panel Removed, Controls & Indicators**

REF.	CONTROL/INDICATOR	FUNCTION
1	Pulser circuit breaker CB1	Protects Pulser from overcurrent condition.
2	Ion Pump Current Meter	Indicates quality of the klystron's vacuum by monitoring the amount of ions being drawn out of the vacuum.

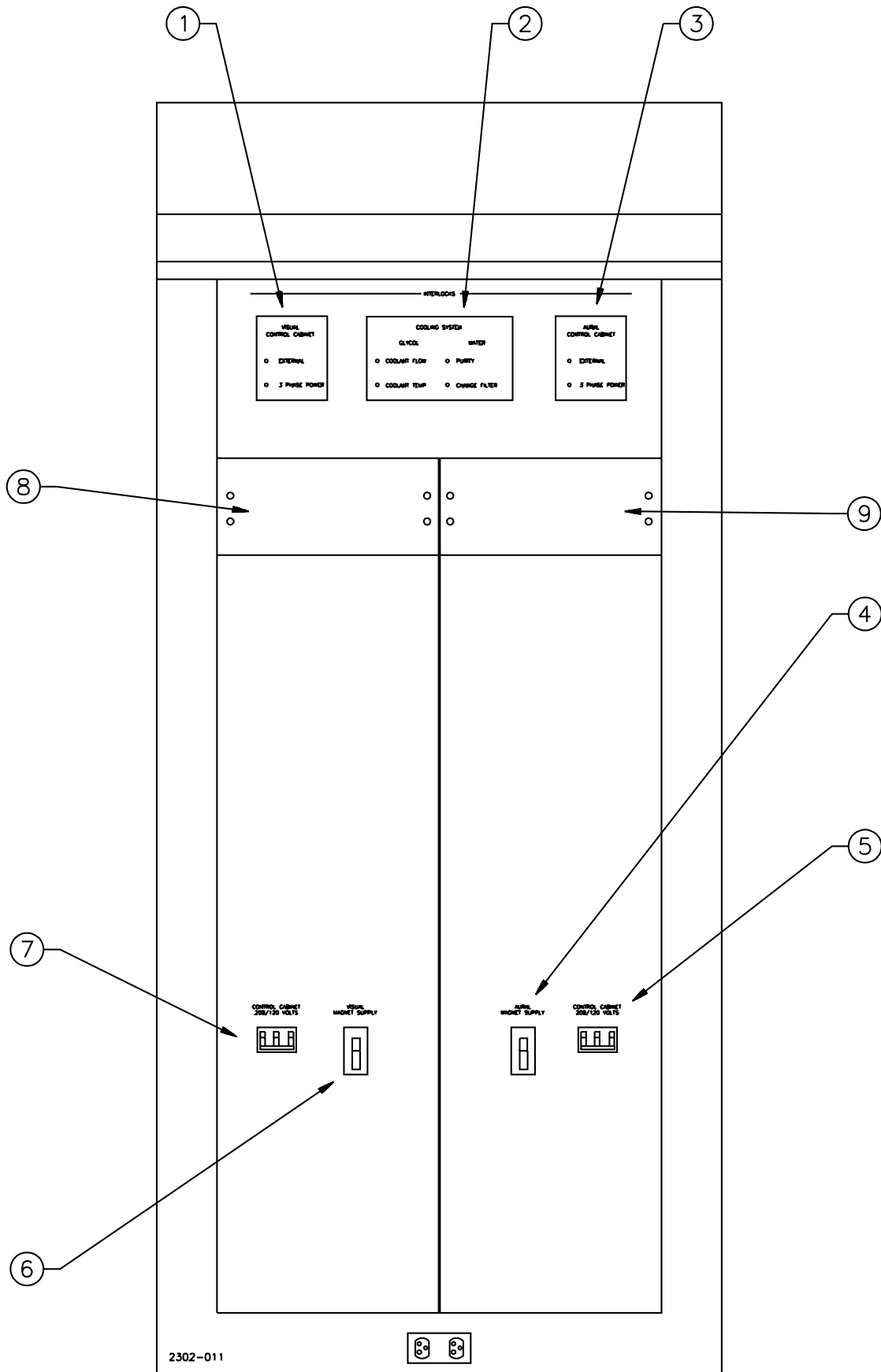


Figure 3-6. Control Cabinet Controls & Indicators

Table 3-6. Control Cabinet Controls & Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	VISUAL EXTERNAL	Indicates any external series connected interlock connected between VTB15-6 and VTB15-7 are all closed allowing normal operation.
	VISUAL 3 PHASE POWER	Indicates phase monitor senses all three 208 Vac incoming power line phases are above threshold and are in the proper phase relationship. Circuit interrupts visual amplifier cabinet blower with loss of a phase or sequence reversal.
2	GLYCOL FLOW	Indicates sufficient flow of glycol from pump module to heat exchanger.
	COOLANT TEMP	Indicates coolant temperature within desired range.
	WATER PURITY indicator	Indicates water resistivity above 200k ohms.
	INDICATOR	
3	CHANGE FILTER	Indicates water resistivity has dropped below 1 megohms.
	INTERLOCKS	
	AURAL EXTERNAL	Indicates any external series connected interlock connected between ATB15-6 and ATB15-7 are all closed allowing normal operation.
	AURAL 3 PHASE POWER	Indicates phase monitor senses all three 208 Vac incoming power line phases are above threshold and are in the proper phase relationship. Circuit interrupts aural amplifier cabinet blower with loss of a phase or sequence reversal.
4	CONTROLS	
	AURAL MAGNET SUPPLY circuit breaker CB3	Controls the ac input to the aural magnet supply.
5	CONTROL CABINET 208/120 VOLT circuit breaker CB5	Controls ac input to all 208/120 Vac circuits within aural side of this cabinet.
6	VISUAL MAGNET SUPPLY circuit breaker CB4	Controls the ac input to the visual magnet supply.
7	CONTROL CABINET 208/120 VOLT circuit breaker CB2	Controls ac input to all 208/120 Vac circuits within visual side of this cabinet.
8	VISUAL COLLECTOR CURRENT & VOLTAGE METERING/OVERLOAD PC BOARDS	PC1 (Upper Board) monitors output of visual Hall effect sensors and drives visual metering & collector current overloads. PC2 (Lower Board) monitors visual collector voltages and drives visual metering & collector voltage overloads.
9	AURAL COLLECTOR CURRENT & VOLTAGE METERING/OVERLOAD PC BOARDS	PC1 (Upper Board) monitors output of aural Hall effect sensors and drives aural metering & collector current overloads. PC2 (Lower Board) monitors aural collector voltages and drives aural metering & collector voltage overloads.

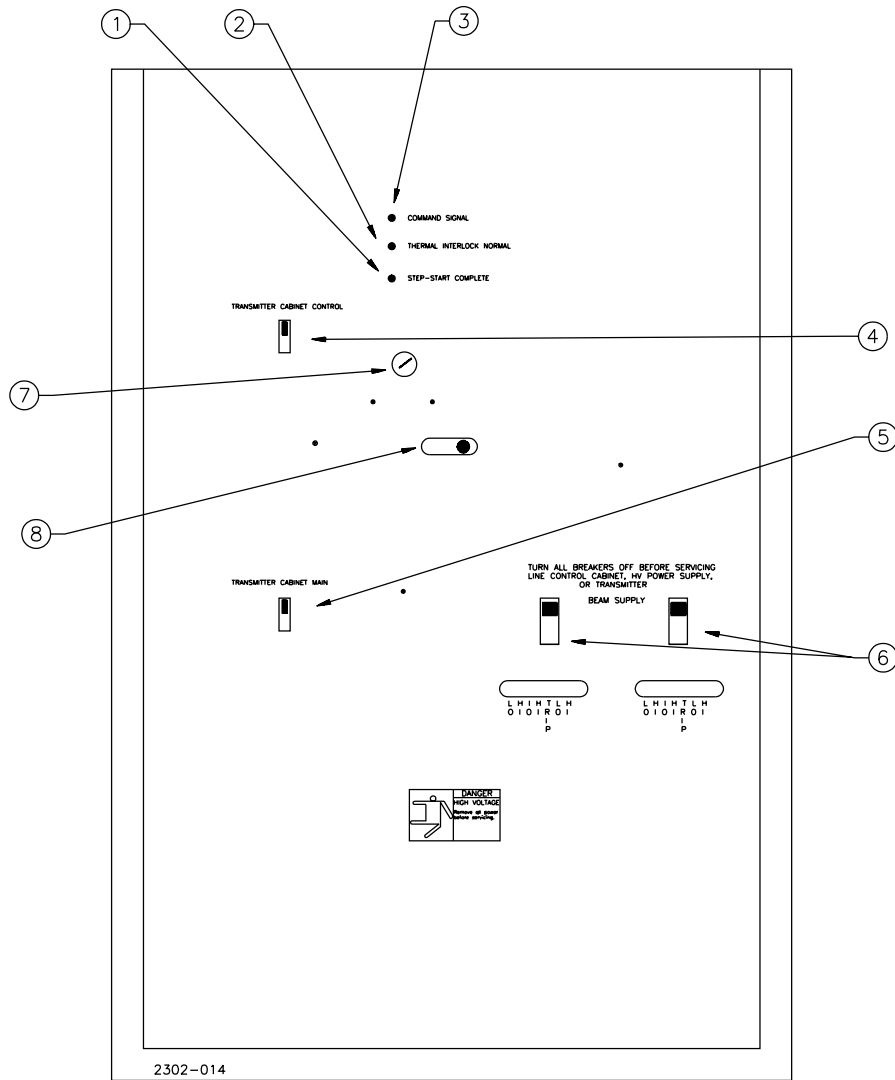


Figure 3-7. Line Control Cabinet Controls & Indicators

Table 3-7. Line Control Cabinet Controls & Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	STEP-START COMPLETE indicator DS3	When illuminated, indicates step start sequence has been completed.
2	THERMAL INTERLOCK NORMAL indicator DS2	When illuminated, indicates S1, S2, and S3 (thermal interlocks in Line Control Cabinet) are in normally closed (cool) position.
3	COMMAND SIGNAL indicator DS1	When illuminated, indicates 100 Vdc is being supplied from Control cabinet.
4	TRANSMITTER CABINET CONTROL circuit breaker CB9	Protects 3 phase 480Vac input to step down transformer.
5	TRANSMITTER CABINET MAIN circuit breaker CB7	Protects all ac inputs to transmitter cabinets except utility outlets & IPA.
6	BEAM SUPPLY circuit breakers CB6 & CB8	Protects 480Vac input to the high voltage dc power supply.
7	MASTER KEY and LOCK	Must be removed to open transmitter doors.
8	SLIDE BOLT	Must be operated to remove master key; cannot be operated until CB6, CB7, CB8 are OFF

SECTION IV CIRCUIT DESCRIPTION

4.1. SAFETY KEYLOCK SYSTEM

Reference Figure 4-1. Each amplifier and its associated high voltages is protected from access by a system of keylocks and shorting bars. This system prevents access to lethal voltages and forces the operator to turn off the high voltage power supply and short the high voltage feed lines to ground at the entrance point to each amplifier cabinet.

The transmitter is equipped with a separate, independent key system for each amplifier so that one amplifier may be serviced while the other amplifiers are operating. Each lock system installed in the transmitter has its own unique set of keys. Each system consists of the components shown in Table 4-1.

Opening of both lock sets indicated by an asterisk in Table 4-1 allows access to the high voltage connections at the filament and cathode terminals of the klystron.

4.2. MANAGEMENT AND CONTROL OF THE KEYLOCK SYSTEM

The Harris TV-UM series of television transmitters has been designed to provide user safety through the use of a system of interlocked keys and locks. The safety of this system must be maintained by utilizing only one set of keys per amplifier cabinet.

Each transmitter is shipped with only one set of unique keys for that transmitter. Even though all keys must be in place in a specific lock in order to operate the transmitter, it is recognized that the possibility of key loss or damage exists during maintenance functions. For this reason, Harris maintains a second set of keys for every transmitter shipped and can provide, on short notice, a duplicate set of keys at no charge for the first duplicate set.

TO PRESERVE THE USER SAFETY DESIGNED INTO THE TRANSMITTER, A DUPLICATE KEY MUST ONLY BE USED IF THE ORIGINAL CANNOT BE USED. DO NOT USE A SECOND SET OF KEYS SIMPLY FOR THE CONVENIENCE OF MAINTENANCE.

The station may also request this second set of keys to keep on their premises; but it must be recognized that whenever a duplicate set of keys are requested by the station then the station accepts the responsibility for the safe use of the transmitter.

Table 4-1. Keylock System Components

ITEM DESCRIPTION	LOCATION	FUNCTION
RETRACTABLE BOLT LOCK SET, 1 CYLINDER	LINE CONTROL CABINET	LOCKS MAINS CIRCUIT BREAKERS IN OFF POSITION AND RELEASES MASTER KEY FOR THE SET.
RETRACTABLE BOLT LOCK SET, 2 CYLINDERS	AMPLIFIER CABINET SHORTING SWITCH	UNLOCKS SHORTING SWITCH. RETAINS MASTER KEY AND RELEASES SUBMASTER KEY.
RETRACTABLE BOLT LOCK SET, 5 CYLINDERS	AMPLIFIER CABINET SHORTING SWITCH	LOCKS SHORTING SWITCH IN SHORTED POSITION, RETAINS SUBMASTER KEY AND RELEASES 4 DOOR ACCESS KEYS.
DOOR LOCK WITH STRIKER	FRONT OF AMPLIFIER CABINET	UNLOCKS FRONT OF AMPLIFIER AND CAPTURES KEY.
DOOR LOCK WITH STRIKER	* RIGHT SIDE OF KLYSTRON ENCLOSURE	UNLOCKS RIGHT SIDE OF KLYSTRON ENCLOSURE AND CAPTURES KEY.
DOOR LOCK WITH STRIKER	* LEFT SIDE OF KLYSTRON ENCLOSURE	UNLOCKS LEFT SIDE OF KLYSTRON ENCLOSURE AND CAPTURES KEY.

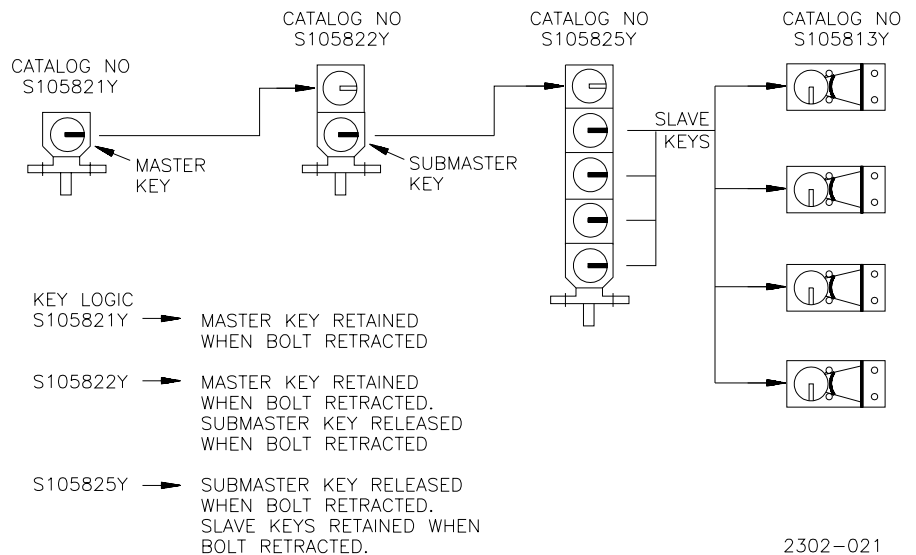


Figure 4-1. Keylock System

In addition, specific individual replacement keys may be ordered from Harris. The serial number of the specific lock requiring a replacement key must be provided at the time of order.

Harris requires a written authorization from a designated station authority before either the Harris retained duplicate keys or ordered new replacement keys are shipped. See the form for this purpose at the beginning of this Technical Manual.

4.3. FUNCTIONAL DESCRIPTION: TRANSMITTER CIRCUITS

The following functional description is applicable to each combination of Amplifier Cabinet, supporting Control Cabinet, Beam Power Supply and Line Control Cabinet.

4.3.1. AC POWER VOLTAGES UTILIZED

480 Vac power applied to each Line Control Cabinet's circuit breakers operates the High Voltage Beam Power Supply and transmitter cabinets associated with that Line Control Cabinet. The Control Cabinet is electrically divided, with power for each half originating from the Amplifier Cabinet immediately next to it or from the Line Control Cabinet associated with that Amplifier Cabinet. A transformer in each line control cabinet converts the 480 Vac 3 phase power to 208 Vac 3 phase. The transmitter cabinet circuits use 3 phase 480 Vac along with 3 phase and single phase 208 Vac developed from the Line Control Cabinet transformer. 120 Vac developed from the 208 Vac powers a number of transmitter circuits.

The IPA Cabinet and the utility outlets on the front of the transmitter are powered directly from the station's 120 Vac distribution.

4.3.2. MODULATION AND RF AMPLIFICATION SYSTEM

See paragraph 1.3.2 in Section I

4.3.3. CONTROL SYSTEM

Refer to drawing 839 7891 087. Depressing the filament ON pushbutton activates the blower and filament binaries on PC4. The output of the blower binary activates relay K1 which energizes the blower and heat exchanger contactor (K5/K9). The contactor operates the heat exchanger pump module and the fans within the transmitter cabinets including the IPA blower. When air pressure from the klystron cavity fan (B1) exceeds the set point of the air switch (monitored by the SUFFICIENT AIR LED), the AND gate on logic card PC4 clears and activates filament driver relay K2. K2 in turn activates filament contactor K5 and relay K6, energizing the magnet power supply.

The ion pump circuit is energized from the filament contactor and the annular ring pulser (visual cabinet) is powered from the filament transformer secondary winding, therefore when the filament circuit is activated the ion pump power supply and the pulser are also activated.

When control circuit relay K1 closes at the FIL ON command, a 5 minute filament warm-up time delay is activated on PC5. At the end of the warm-up period the TIME DELAY lamp illuminates. Depressing the BEAM ON pushbutton activates the beam binary on PC5 which activates the driver of the AUTO-ON LED and clears the beam on NAND gate.

A pulse from a monostable circuit on PC5 activates the overload monostable on PC11, inhibiting the beam supply turn-on for 1.5 seconds. Meanwhile, the signal that will eventually activate K4 and send beam voltage to the klystron has been delayed 0.5 seconds on PC5. At the end of the 1.5 second period primary voltage is applied to the beam supply. Note that the 1.5 second and .5 delays just described are not required operation for the TV-UM series of transmitters; however the logic system used is the same used with other Harris UHF TV products that do require the delays described.

When relay K4 is activated, another contactor in the IPA cabinet closes that powers-up the IPA amplifiers by activating their +24Vdc power supply.

The transmitter is now operating. Front panel lights indicating the presence of filament and beam voltage are illuminated by contacts on the beam and filament relays.

Depressing the BEAM OFF pushbutton resets the beam binary on PC5 thus inhibiting the beam on NAND gate.

Depressing the FIL OFF pushbutton shuts down the filament circuits. The FIL OFF command also activates a 5 minute timer on PC4 that allows the heat exchanger pump and transmitter fans and blowers to continue to run in a cool down cycle before shutting off.

4.3.4. INTERLOCK SYSTEM

Each amplifier/control cabinet combination contains three interlock systems: the filament interlock system, the beam interlock system, and the beam supply interlock system.

4.3.4.1. Filament Interlock System

See drawing 839 7891 087. This system consists of the amplifier cabinet air switch and a normally unused, but available external interlock. When either of them grounds the input of the filament AND gate on PC4, the filament power supply and all devices that depend on the filament being operational are shut down (ion pump, pulser, magnet supply, and beam supply).

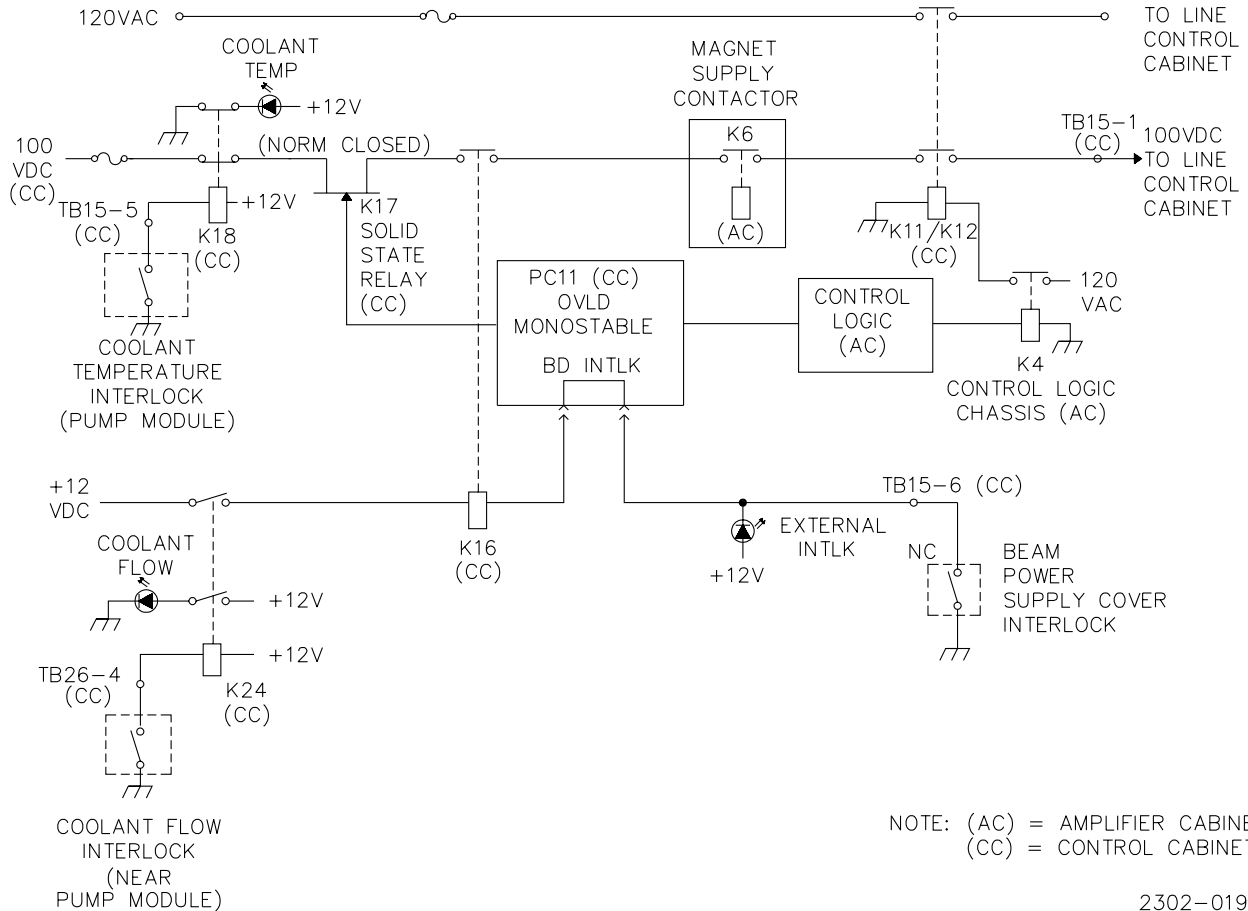
4.3.4.2. Beam Interlock System

See drawing 839 7891 087. This system consists of interlock switches connected to the meter panel, front shorting stick holder, and circuits associated with the magnet current sensor, refocus current sensor, collector water flow, glycol flow or any interlock external to the transmitter cabinets such as the dummy load coolant flow switches or device protection interlocks in the RF system. All these interlocks are also connected in parallel and also operate by connecting to ground. However, in this case the BEAM ON NAND gate on PC5 is inhibited and the high voltage control relay is opened removing beam voltage from the klystron. The filament circuit and its associated devices remain activated.

4.3.4.3. Beam Supply Interlock System

See Figure 4-2. This system consists of interlock switches mounted in and near the heat exchanger pump module that monitor both glycol temperature as it leaves the pump module and glycol flow rate as it returns to the pump module. In addition, a loop-thru circuit on PC11 in the top of the control cabinet insures that PC11 is plugged in. External interlocks connected to TB15 on the control cabinet include interlocks

**Figure 4-2. Simplified Schematic
Beam Supply Control and Interlock System**



within the beam supplies. Each of these interlocks will interrupt the +100Vdc that operates the Line Control cabinet and thus inhibit the beam supply.

4.3.5. OVERLOAD SYSTEM

The overload system monitors various parameters within the transmitter and causes the transmitter to shut off if any of these parameters exceed a set point. Each overload sensing device is designed to apply a constant +12Vdc signal to the logic overload input as long as the parameter exceeds the set point. However most of the parameters being monitored will fall below the exceeded set point as soon as beam voltage is removed.

The parameters being monitored are as follows:

- **Klystron Collector.** This overload senses excessive collector current and collector voltage deviation from normal. In the control cabinet logic box, PC1 monitors the collector currents and PC2 monitors the collector voltages. If any one of these voltages or currents rise above a predetermined limit, an overload signal is sent to the logic.
- **VSWR.** This overload samples the reflected power at the output of the klystron using a directional coupler. The rf sample is detected in the Peak Detector producing a dc voltage proportional to the rf voltage. The detected dc voltage is compared against a preset dc voltage and causes an overload input to the logic if the detected dc voltage exceeds the comparison voltage.

- **Body Current.** PC1 in the control cabinet logic box senses the voltage developed across R43 (in the amplifier cabinet) as body current flows from the positive return in the HV power supply through R43 to ground and then to the body of the klystron. If the voltage exceeds a predetermined limit, PC1 sends an overload signal to the logic.
- **Arc Overloads.** The 3rd and 4th cavities of the klystron are equipped with photocells that sense light in the cavity. An rf arc within the cavity causes the photocell to change resistance. The arc detector circuit monitors this change in resistance and reports it to the logic as an overload. An incandescent bulb near the photo cell allows testing the overload.

CAUTION

A BRIGHT LIGHT SUCH AS THE STROBE LIGHT FROM A CAMERA OR EVEN BRIGHT DIRECT SUNLIGHT DIRECTED AT THE REAR OF THE KLYSTRON CABINET WHEN THE REAR DOORS ARE OPEN MAY CAUSE THE TRANSMITTER TO OVERLOAD AND INDICATE AN ARC FAILURE. THIS CONDITION RESULTS FROM THE SENSITIVE ARC DETECTORS IN THE CAVITIES SENSING THE BRIGHT EXTERNAL LIGHT.

The overload logic allows an overload to occur once or twice within approximately one minute with only a momentary shut-down of the transmitter. (The primary of the beam supply is opened for 1.5 seconds and then re-closed). However if a 3rd overload occurs within the time period, the beam supply will

shut-down and will stay that way until the overload circuit is manually reset. This is accomplished by depressing the FAULT PUSH TO RESET pushbutton on the meter panel. The yellow FAULT PUSH TO RESET pushbutton flashes when a 3 time overload has shut down the transmitter. An overload condition that does not disappear immediately when the beam voltage is removed bypasses the 3 time overload and shuts down the transmitter. A manual reset using the flashing FAULT PUSH TO RESET button will clear the overload logic, but will not clear the overload input, if it is still present. A SINGLE OVERLOAD SET pushbutton on the front of the transmitter also defeats the 3 time overload causing the transmitter to shut down the first time an overload occurs. A LED indicator shows when 2 overloads have already occurred or when the SINGLE OVERLOAD SET mode has been activated.

4.3.6. AC FAIL SYSTEM

In the event of a power line failure, a nicad battery mounted in the top of the control cabinet will preserve the important logic functions of the transmitter so that, when ac power returns, the transmitter will automatically reactivate itself and return to the air. The battery output, controlled by the AC FAIL circuit, will keep portions of the logic control circuits energized for 10 seconds and return the amplifier to operation automatically when power returns. If the power line failure is longer than 10 seconds, the transmitter will automatically return to operation after a proportional filament warm-up period once ac power has returned. The battery has a continuous operation period of approximately one hour and is trickle charged during normal operation. If a power failure lasts long enough to discharge the battery, the amplifier must be re-started manually when power returns. A switch labeled AC FAIL, is provided to disconnect the battery when power is purposely turned off for maintenance. The switch MUST be in the IN position to charge.

4.3.7. ANNULAR RING PULSER SYSTEM (VISUAL ONLY)

The Pulser Controller, mounted on the front of the visual amplifier cabinet controls the H.V. Pulser via two fiber optic links. The controller receives sync timing information from the Visual Exciter and sends that information to the H.V. Pulser on one fiber link. The other fiber link carries pulse amplitude information from the adjustment on the front of the controller to the power supply mounted on the H.V. Pulser. The pulser controller also interfaces with the system control logic; shutting off the pulser when the system configuration warrants, and modifying the gain of the IPA as a function of the pulser being IN or OUT. Status LED's are front panel mounted along with amplitude and coarse pulse timing controls. A momentary contact switch on the front panel sets the pulser IN (operating) or OUT (off). Although not directly related to the operation of the pulser, a second momentary switch is mounted on the Pulser Controller front panel that raises or lowers the mod anode bias. A LED indicator shows when the mod anode adjustment limits are reached.

The H.V. Pulser, mounted in the high voltage area of the rear amplifier cabinet, generates a high voltage pulse (negative with respect to the cathode) coordinated by the video sync pulse. When connected between the cathode and annular ring of the klystron, the high voltage pulser controls klystron beam cur-

rent; keeping the current low during the video portion of the television signal and increasing beam current only during sync pulses when more output power is needed. Since klystron current is kept low most of the time, the effect is increased efficiency by the reduction of the input power needed.

4.3.8. ION PUMP POWER SUPPLY AND MONITOR

The Ion Pump circuit provides approximately 4 kV to the getter of the klystron. This attracts unwanted gas particles (ions) and helps maintain the vacuum necessary for proper klystron operation. The ion pump circuit is equipped with a meter that monitors the amount of ion pump current.

4.4. DETAILED DESCRIPTION: SUBASSEMBLIES

Certain subassemblies and systems are not covered in this portion of the manual but are described in the Vendor Equipment Section or are described in their own separate Technical Manual. Those items are as follows:

- Visual Exciter. See Technical Manual 988-2265-001.
- Aural Exciter. See Technical Manual 988-1903-001.
- IPA Cabinet. See Technical Manual 988-2264-001.
- Notch Diplexer Equalizer. See Technical Manual 988-1150-001.
- IPA 24 Volt Ferro-Resonant Power Supply. See Technical Manual 988-2261-001.
- Heat Exchanger System. See Technical Manual 988-2324-001.
- Low Frequency Linearity Corrector. See vendor supplied Technical Manual.
- Visual/Aural Klystron. See vendor information, Section IX.
- Control system 15 Volt Power Supply. See vendor information, Section IX.
- High Voltage Beam Power Supply. See vendor supplied Technical Manual.

4.4.1. TRANSMITTER CONTROL LOGIC SYSTEM

Refer to drawing 839 7891 087. The logic diagram shows the control circuitry that is involved for each amplifier cabinet.

Depressing the FIL ON pushbutton (PC4) sets the filament and blower binaries, sets the beam-on time delay latch, and enables one input to the AND gate. Through the relay driver, the blower and heat exchanger control relays are energized. As soon as air flow is normal, the remaining input to the AND gate is enabled, the SUFFICIENT AIR lamp is illuminated and through the relay driver, the filament contactor and magnet supply relays are energized.

Depressing the FIL OFF pushbutton resets the filament binary. The filament contactor, and magnet supply relays are immediately de-energized. The blower and heat exchanger control relays remain energized for the 5 minute time delay. Note that the 12-volt supply to PC4 is provided via a loop-through circuit on the other logic boards. This prevents the transmitter from being turned on if any board is not in place. Depressing the BEAM ON pushbutton (PC5) sets the beam binary, illuminates the AUTO ON lamp and enables one input to the NAND gate. At the completion of a 5-minute time delay, starting with the depression of the FIL ON pushbutton, the second input to the NAND gate is enabled and the TIME DELAY lamp is illuminated. The remainder of the NAND

inputs are satisfied by interlock circuitry, the shift register output (PC3), the filament contactor auxiliary contacts, and sufficient magnet current indicated by the closure of relay K3. With all inputs enabled the PC5 NAND gate output is low. Through an inverter, and a NAND gate on PC5, a high is produced triggering the overload monostable on PC11 via an emitter follower circuit on PC1. This prevents the primary beam supply contactors from closing for 1.5 seconds.

During transmitter operation, an overload condition of the CAVITY 4 ARC OVERLOAD will appear as positive going signal at the input integrator circuit at PC1. Overloads sensed for klystron collector, body current, VSWR, or CAVITY 3 ARC will appear as a positive going input to the integrators on PC2. All of the overload input signals act on logic in the same way: the signals set the respective overload memory latch on the board that it enters, illuminates the associated overload LED, applies an input pulse to the shift register on PC3, and through an emitter follower circuit, applies an input pulse to the overload monostable circuit on PC11 within the control cabinet. The monostable circuit causes the beam supply primary power to be interrupted for 1.5 seconds. The amplifier will return to the air automatically, however the shift register on PC3 will be set to a count of 1. If three overloads occur within 1 minute the amplifier will not be returned to the air automatically. If less than three overloads occur within the 1 minute period, the shift register clears itself and normal monitoring continues.

The amplifier may be conditioned to automatically shut off (requiring manual reset) after one error occurrence. To accomplish this the SINGLE OVERLOAD SET pushbutton is depressed. This action sets the shift register to a count of 2 so that only one error occurrence is required to shut off the transmitter with no automatic return to the air. This feature is useful in transmitter testing.

If, for some reason, an overload input remains high for longer than 0.5 second the third stage of the shift register will trigger, opening the high voltage control relay and shutting off the beam supply. The FAULT PUSH TO RESET lamp will flash, indicating an error has occurred. Depressing the FAULT PUSH TO RESET will return the amplifier to the air (assuming the overload has been cleared) and reset the shift register on PC3. Depressing the OVERLOAD RESET will reset the overload memories on PC1 & PC2 and extinguish the overload indicators.

4.4.1.1. PC1: Overload Input Board #1

Refer to drawing 838 4926 001. Transistors Q1, Q2, and Q3 form a latch circuit and lamp driver for Overload Memory 1. Transistors Q4, Q5, Q6 and Q7, Q8, Q9 form the same circuit for Overload Memories 2 & 3. A positive going pulse at J1-5 will cause Overload Memory 1 latch circuit to assume a state of Q1 conducting, Q2 nonconducting. Transistor Q3 conducts and the overload lamp illuminates.

Overload memory 2 and 3 circuits function in the same manner with their respective inputs and indicators. Through CR3, CR6, and CR9, any positive going input signal that sets the latches will be OR gated to the shift register on PC3 to increase the count of error occurrences. An isolated OR output of the input signals (through CR10) is applied to J1-7 as the overload OR gate output. Transistor Q10 functions as an OR

gated emitter follower with inputs from J1-7 or CR10. Output of the emitter follower is a positive going pulse applied to J1-8 as the overload trigger output.

4.4.1.2. PC2: Overload Input Board #2

Refer to drawing 838 4929 001. The overload memory latches and lamp drivers on PC2 function identically to those on PC1. Through diodes CR3, CR6, CR9, and CR10, the input positive overload signals are OR gated and applied to J2-4 as the OR gate output. Through CR13 an isolated OR gate output is applied to J2-5 as the summed overload output to the emitter follower circuit on PC1 that ultimately drives the overload monostable on PC11.

4.4.1.3. PC3: Shift Register Board

Refer to drawing 842 6300 001. Transistors Q1 through Q6 form a shift register in that the output of an initiating stage is used to control succeeding stages. Initially, a positive input pulse as FAULT RESET, J3-2, will reset the shift register and auto reset latch circuits causing transistors Q2, Q4, Q6, and Q9 to conduct. Within the shift register, this holds the bases of transistors Q1, Q3, and Q5 at zero volts. An error input in the form of a positive pulse at J3-13, FAULT INPUT, will cause through Q12, a positive going input to the monostable circuit (1/2 of U1). The monostable output is a positive pulse, which, through Q13, provides a negative going square wave pulse input to the shift register stages and the auto reset latch circuit. The first register stage and the auto reset latch will change state. The negative going pulse coupled to the second and third register stages will not cause these stages to change state. With the shift register effectively holding a count of 1, Q2 will now be applying a positive voltage to the cathode of CR6 and Q4 will be holding zero volts applied to CR10. When the second error pulse is received, the negative going pulse produced by Q13 will cause the second register stage to change state and thereby prepare the third stage. Since the first stage is already in the set state, the second impulse has no effect. When the third error pulse is received the third stage will change state and register has shifted all stages to represent a count of 3.

The auto reset latch circuit changes state upon the first error input pulse and remains in the set state until reset manually or by the time delay circuit. Setting the auto reset latch circuit produces a positive voltage input to the RC circuit R55/C14 whose time delay along with Q8 is 1 minute. If no further error pulses are received during this time, Q8 causes a positive going pulse to reset the latch circuit and the shift register stages. During this single error time, a low was maintained at the input of the base of transistor Q11 holding it off and keeping the SINGLE OVERLOAD SET lamp extinguished. Since only one error impulse was received, the astable multivibrator circuit (1/2 of U1) and Q7 remain unaffected and the FAULT indicator remains extinguished.

In the event the second error impulse is received within the 1 minute time delay, the second shift register stage will be set. As result, a high is now present as input to Q11 and the SINGLE OVERLOAD SET lamp will illuminate, indicating that on receipt of one more error pulse the transmitter will be removed from the air but will not automatically be returned to operation. This condition may be simulated by manually depressing the

SINGLE OVERLOAD SET pushbutton. This directly sets the second shift register stage and illuminates the SINGLE OVERLOAD SET lamp.

If the third error pulse is received within the 1 minute time delay, the third shift register stage will be set. This applies a low level to Q11 that extinguishes the SINGLE OVERLOAD SET indicator and applies a BEAM CUTOFF signal which holds the beam voltage NAND gate on PC5 disabled. A high level is applied to R29 within the astable multivibrator circuit and to the reset side of the auto reset latch. The high level to R29 allows the multivibrator to operate and through Q7, the FAULT lamp flashes. Transistor Q9 in the auto reset latch conducts and disables the time delay. The transmitter has now been down cycled and must be manually reset to return it to operation. In the event that the fault input remains high longer than 0.5 seconds (as in the case of collector temperature and magnet current) flip-flop 3 of the shift register will be set causing the transmitter to be shut down as before.

4.4.1.4. PC4: Filament/Blower Control Board

Refer to drawing 838 4928 001. The blower and filament binary latches function in the same manner as those used on the overload boards. As with all the flip-flop circuits used, to ensure the latches operate to the reset state when first energized, a larger base return resistor, is used for the reset transistor (R4) than is used for "set" transistor (R3).

Depressing the FIL ON switch applies a positive pulse to J4-18 and will cause both Q1 and Q4 to conduct. Setting both latches causes Q3 to energize the blower and heat exchanger control relay and places a high on one input (CR14) to transistor Q9. The input to Q9 through CR12 will go high as the klystron air flow switch closes. This causes Q9 to conduct and energize the filament and beam contactor driver relay through J4-4.

Depressing the FIL OFF pushbutton resets the filament binary and causes the voltage to pin 6 of U1 to go high. U1 is a programmable timer IC composed of a counter and an internal oscillator. The oscillator frequency is set by external components R24 and C7. The counter is programmed by the connection of pins 12 and 13 to count a predetermined number of cycles then output a logic high at pin 8 which resets the blower binary latch via R9 and CR2. In this manner the blower and heat exchanger are kept operating 5 minutes after the FIL OFF switch has been depressed.

4.4.1.5. PC5: Proportional Timer and Beam Control Board

The signal that activates logic relay K2, the filament contactor driver, also applies a logic low on pin 9 of PC5. The collector of Q1 goes high starting the timing circuit composed of R4, R5, and C3. CR3 regulates pin 2 of comparator U1 at 5.1 volts. C3 will charge to approximately 5.5 volts which causes the output of U1 to go high. R8 and R10 determine the gain of U1. The high at the output of U1 appears on the base of Q2 which activates the time delay lamp. The output of U1 is also applied to AND gate U3A. When the FIL OFF pushbutton is depressed, C3 discharges through R3 paralleled with R4 and R5 causing the voltage on C3 to drop below the reference voltage of 5.1 volts, and produces a low at the output of U1. Approximately 20 seconds is needed to discharge C3 to the reference level of 5.1 volts. During this time the TIME DELAY light will remain

illuminated and the transmitter may be turned back on without delay. Time in excess of 20 seconds requires approximately equal warmup time before beam voltage can be re-applied. The maximum time delay is 5 minutes. Since the circuit is powered from the battery back-up +12v "C" bus, the same circuit performance will occur during an AC power failure.

When all the inputs to beam gate U3A are high, the output goes low beginning the beam supply turn-on process. Conversely, if any input of U3A goes low, beam voltage will be interrupted.

When the beam gate (U3A) changes state (either high or low), two things occur. First, a pulse is generated by monostable U4A or U4B (depending on the state of beam gate U3A). Gate U3B acts as a NOR gate accepting a logic low pulse from either monostable and causing a logic high pulse to appear at J5-6 via Q8 and Q9. This pulse triggers the overload monostable circuit on PC11 which inhibits the beam power supply primary contactors for 1.5 seconds. Secondly, the signal from U3A is delayed by 0.5 second by R26/C16/Q5/Q6 before being applied to Q7 which switches the high voltage relay driver K4. Q5 and Q6 are biased such that they turn on when the charge on C16 exceeds 6 volts.

4.4.2. PC11: OVERLOAD MONOSTABLE BOARD

Refer to drawing 827 9945 001. The Overload Monostable Board monitors all amplifier overloads, beam interlocks, and beam on/off commands. Activation of any of the aforementioned functions will cause the Overload Monostable board to cause the immediate removal of beam supply primary voltage for 1.5 seconds. During the 1.5 second interval, other slower circuits in the transmitter may act to keep the beam supply primary voltage off once the 1.5 second interval has elapsed, but the activation of the Overload Monostable Board driving solid state relay K17 on the power supply deck, provides the fastest beam removal path.

The board two inputs, however only one is utilized in the TV-UM transmitter. A positive going signal to inputs J23-3 or J23-4 causes the output of the monostable IC (U1) to change state. A trigger signal at pin 1 activates a positive going pulse at output pin 2 and a negative going pulse at output pin 6. A trigger signal at pin 13 activates a positive going pulse at output pin 12 and a negative going pulse at output pin 8. Since the IC outputs are gated together, a trigger signal at either input will produce a 1.5 second long output pulse that activates Q1. Q1's drive signal leaves the board to activate normally closed solid state relay K17. K17 interrupts the Line Control Cabinet +100Vdc voltage, which opens the contactors supplying beam supply primary voltage. Unless other transmitter circuits interrupt the +100Vdc path, at the completion of the 1.5 second pulse, the beam supply primary contactors will close re-activating the beam supply.

Two outputs of the board labeled "RF Drive Cutoff" and "Beam Supply Lamp" are not used in the TV-UM transmitter.

The Overload Monostable Board is equipped with a loop-thru interlock at J23-8, J23-9 that prevents beam supply activation if the board is removed.

4.4.3. SOLID STATE OVERLOAD RELAY, K17

Refer to drawing 839 7891 132. Solid State Relay K17 is constructed in a rectangular metal box that plugs into an octal socket on the power supply decks in the control cabinet.

The output of the Overload Monostable Board acts directly on Solid State Relay K17 in order to remove beam voltage as quickly as possible. The +100Vdc circuit that energizes the Line Control Cabinet passes through normally conducting FET Q2. Q2 is maintained in conduction by the conduction of driver transistor Q1. Pull-up resistor R2 maintains Q1 in conduction. A logic low signal from the Overload Monostable Board at P1-7 turns off Q1. Pull up resistor R4 assures that Q2 turns off quickly by pulling the gate of the FET to +100Vdc.

A release of the logic low command at P1-7 returns both Q1 and Q2 to conduction, permitting the Line Control Cabinet to re-activate.

4.4.4. LINE CONTROL CABINET

Refer to Figure 4-3 and drawing 839 7891 042. Each Line Control cabinet controls the 3 phase power input to an Amplifier Cabinet, half of the Control Cabinet and the respective high voltage power supply. Circuit breakers CB6 & CB8 control ac power to the high voltage power supply while circuit breaker CB7 controls the ac input to the magnet power supply in the transmitter cabinets. Circuit breaker CB9 controls the input to step down transformer T1 which supplies 208/120Vac to the transmitter.

Control lines from the transmitter that energize the contactors connect to TB24. Step-start turn-on sequence of the Line Control cabinet is initiated by 100 Vdc sent by the transmitter cabinet to TB24 terminal 1. This voltage energizes K22 and K23 via thermal interlock switches S1, S2, and S3. Once K23 is energized, its auxiliary contacts energize K20 which places the step start resistors in the circuit and relay K21, a 1 second time delay relay. After 1 second has elapsed, K21 pulls-in, energizing K19 which shorts out the step-start resistors and provides full voltage to the power supply primary windings. When 3 seconds from the initial application of the 100 Vdc signal have elapsed, relay K22 pulls-in, releasing contactor K20. This action would also de-energize contactor K21 and K19 except that K21, and thus K19, are held in via the auxiliary contacts on K19. The effect of this action is that, unless K19 pulls-in within 3 seconds of the initial application of 100 Vdc, power to the beam supply primary will be shut off when contactor K20 opens. This protects the step-start resistors from overheating if K21 or K19 fail.

A back up protective circuit is provided in the form of thermal switches S1, S2, and S3 which monitor the temperature of the step-start resistors and remove the 100 Vdc signal if excessive heating is detected. The indicators on the cabinet front give an indication of the status of the step-start circuit.

The step-start routine is repeated every time PC11 (the overload monostable circuit in the Control Cabinet) activates. (i.e., overload, beam turn-on, beam turn-off).

WARNING

CIRCUIT BREAKERS CB6 & CB8 SHOULD NEVER BE RESET OR TURNED ON IF THE STEP-START ROUTINE HAS ALREADY TAKEN PLACE. DO NOT RESET THESE BREAKERS UNTIL THE LINE CONTROL CABINET INDICATORS ARE EXTINGUISHED BY DEPRESSING 'BEAM OFF' ON THE TRANSMITTER.

4.4.5. MAGNET CURRENT SENSE BOARD (PC6)

Refer to drawing 839 7740 006. Magnet undercurrent and overcurrent are sensed by PC6 by monitoring the voltage across R3, a 0.1 ohm resistor mounted in the amplifier cabinet. Voltage produced by R3 enters the board at E2 and is compared against two pre-set voltages at U1 and U2. The pre-set threshold voltages are established by R1 for magnet under current conditions and by R2 for magnet over current. If magnet under current is sensed, relay K2 will de-energize, opening the circuit to the magnet underload relay (K3) on the transmitter logic assembly and cause removal of beam voltage. If an over current condition is sensed, relay K1 will energize and act directly on the cabinet beam interlock bus. Magnet current in the proper range for operation cause relays K1 and K2 on the board to illuminate the MAGNET CURRENT IN RANGE LED on the cabinet front.

4.4.6. REFOCUS CURRENT SENSE BOARD (PC8)

Refer to drawing 839 7891 061. The Refocus Current Sense Board is the same circuit as the Magnet Current Sense board described previously; however the function of adjustments R1 and R2 are reversed. R1 is used to set the trip threshold for excess refocus current leaving R2 to set the undercurrent trip threshold.

The Refocus Current Sense Board monitors voltage developed across resistor R1, a 0.15 ohm, resistor mounted on the refocus power supply assembly.

Relays K1 and K2 both act directly on the cabinet interlock bus, rather than the undercurrent function operating an intermediate relay, as is the case with the magnet current sense circuit.

4.4.7. ARC OVERLOAD SENSORS AND DETECTOR ASSEMBLY

Refer to drawing 839 7740 001. A photocell is mounted in a small enclosure within the klystron 3rd and 4th cavities to detect arcs that may be generated by the RF voltage present within the cavity. Reacting to the light generated by an arc, the resistance of the photocell drops from megohms of resistance to a few thousand ohms.

The photocells are connected to the input of the arc detector assembly which detects this change of resistance and sends an overload signal to the transmitter control logic. The assembly contains two identical printed boards; each board monitoring one of the photocells.

The overload trip adjustment (5M ohm pot) is connected from the base of Q1 to +12V. The photo cell is connected from Q1's base to ground. Because the dark resistance of the photocell is much larger than the resistance of the 5M ohm pot, Q1 is biased off. However, when light strikes the photocell, its resistance drops enough to cause sufficient base current conduction of Q1 to turn on Q1, Q2 and Q3. As a result, relay K1 energizes sending a +12V overload signal to the transmitter control logic.

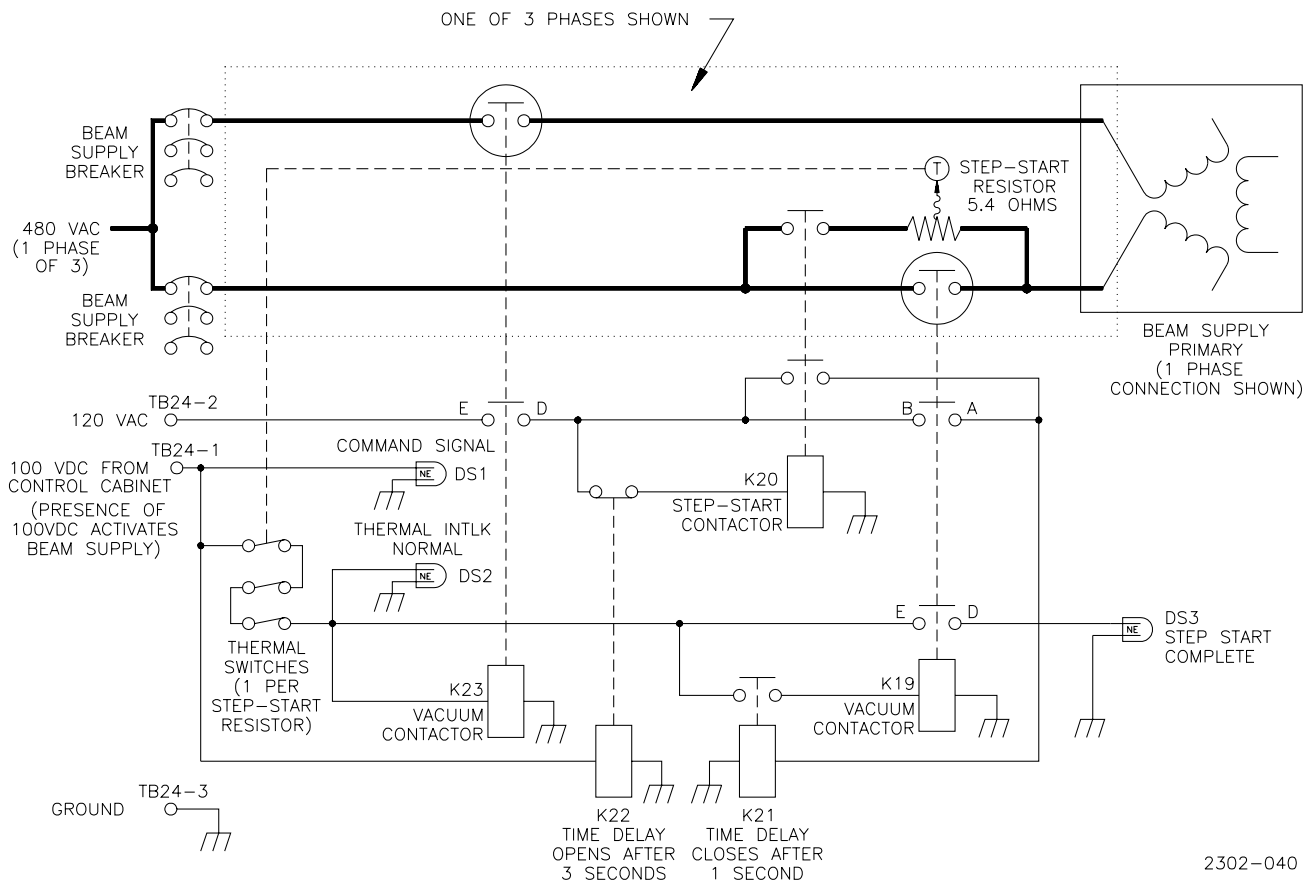


Figure 4-3. Simplified Schematic, Line Control Cabinet

The 5M ohm pot varies the resistance ratio between itself and the photocell and is therefore a trip sensitivity adjustment.

CAUTION

A BRIGHT LIGHT SUCH AS THE STROBE LIGHT FROM A CAMERA OR EVEN BRIGHT DIRECT SUNLIGHT DIRECTED AT THE REAR OF THE KLYSTRON CABINET WHEN THE REAR DOORS ARE OPEN MAY CAUSE THE TRANSMITTER TO OVERLOAD AND INDICATE AN ARC FAILURE. THIS CONDITION RESULTS FROM THE SENSITIVE ARC DETECTORS IN THE CAVITIES SENSING THE BRIGHT EXTERNAL LIGHT.

4.4.8. PEAK POWER DETECTOR AND VSWR OVERLOAD

Refer to drawing 839 6816 130. The peak detector converts low power rf sample voltages to a dc voltage proportional to the peak of the rf sample voltage. Samples from both forward conducted power and reflected power at the klystron output are monitored. The samples are used to generate front panel power metering and as an indicator of high VSWR which initiates a transmitter overload and shutdown.

The forward power sample voltage is applied to J1 where it is terminated by R11. C9 provides dc blocking for the detector. The rf sample is detected by CR4 and is filtered by C10, C19, C11 and R26. R13 and R14 form a resistive divider that develops bias voltage for CR4. L2 prevents rf currents from entering the dc circuit. Potentiometer R13 adjusts CR4's bias point. CR5 compensates for temperature changes that might affect CR4. U1C is a voltage buffer. It provides the detector

with a high impedance load and supplies the current required for both front panel meters and remote control analog monitoring inputs.

Reflected power rf voltage samples are applied to J2. The detection circuits function identically to those in the forward sample detection circuit. The only difference between the two circuits occurs after the reflected power voltage buffer, U1A. Connected to the output of U1A is comparator U1B. U1B compares the detected sample with a reference voltage regulated by U2, a +5V regulator, and made variable by potentiometer R9. Should a high VSWR condition occur, the detected sample voltage will become greater than the reference voltage. U1B's output goes low driving Q1 into conduction. The voltage developed across R27 is sent to the transmitter control logic as a VSWR overload input.

4.4.9. PC12: POWER SUPPLY AND AC FAIL BOARD

Refer to drawing 827 8143 001. PC12 contains the rectifiers for the +100Vdc and +24Vdc power supplies along with the ac fail circuit used during ac power interruptions. A transformer (T8) on the power supply deck supplies 18 volts and 70 volts ac to the bridge rectifiers CR1 through CR4 and CR10 through CR13 respectively. Output voltages of 24 and 100 volts dc are developed after connection to large filter capacitors on the power supply deck.

The +100 Vdc is used to drive the main contactors in the Line Control Cabinet that supply voltage to the beam power supply.

The 24 volts dc is used to provide voltage for the klystron cavity arc test lamps. Also, through resistor R4, 14 volts dc is developed to trickle charge battery BA1.

4.4.10. AC FAIL: BATTERY CONNECTION CIRCUITS

Refer to the PC12 schematic (827 8143 001) and the Power Supply Deck drawing 839 7740 099.

Three 12Vdc control voltage busses exist in the transmitter:

- The 12VA bus is connected only to the +15Vdc power supply and is present only when ac voltage is present.
- The 12VB bus is connected to the +15Vdc power supply when ac is present and the battery for 10 seconds after ac fails.
- The 12VC bus is connected to the +15Vdc power supply when ac is present and to the battery indefinitely after ac fails.

The 12VA bus is normally supplied from PS3 through CR13 and K15 pins 9 and 5. When ac fails, K15 releases, breaking the 12VA line.

The 12VB bus is normally supplied from PS3 through CR13 and K15 pins 8 and 12. When ac fails, K15 releases connecting BA1 to the 12VB bus through K1 on PC12 and K15 pins 4 and 12. K1 of PC12 is held closed when ac is present because PC12 pin 1 is held at ground through K15 pins 11 and 7. This allows Q2 on PC12 to conduct closing K1. When ac fails, K15 releases placing pin 1 of PC12 on the battery 12VB bus through K15 pins 11 and 3. R-C time constant formed by R6 and C1 delays conduction of Q1 for 10 seconds. As Q1 conducts, Q2 is turned off releasing K1 removing the 12VB bus from the battery.

The 12VC bus is normally supplied from PS3 through CR13 and K15 pins 10 and 6. When ac fails, K15 releases connecting the 12VC bus to BA1 through pins 2 and 10.

4.4.11. KLYSTRON CURRENT MONITORING & OVERLOAD BOARD

(PC1; Mounted in logic box in transmitter control cabinet)
Refer to drawing 839-7891-024.

4.4.11.1. Collector Current Metering and Overload

Each klystron collector high voltage lead passes through a sensor that monitors DC current flow through the wire by means of a Hall effect device. The output of the Hall effect sensor is set to a nominal 1Vdc (0.8-1.2v) output at zero collector current through the sensor. The output of each current sensor is connected to the appropriate collector input on PC1, the klystron current monitoring board. Here the signal's offset voltage is set to zero by one section of op-amp U1, U2, or U3 and the METER ZERO pots.

The output of the Hall effect sensor produces approximately 50mv/ampere of DC current flowing through the collector leads. This voltage is sent to the current monitoring board, amplified, and applied to the collector current meter via a rotary switch. The METER CALIBRATE adjustments set each signal's amplification factor.

Excessive klystron collector current is sensed by monitoring excessive voltage at the output of the zero offset op-amps (meter zeroing circuits). If collector current goes high enough to produce a Hall effect sensor output voltage that exceeds the voltage set by the OVERLOAD SET adjustments, the normally low outputs of comparator circuits U4 and U5 will go high. A

Schmitt trigger inverter (U6) following the comparator assures a sharp voltage transition as the comparator output voltage changes. The overload signal is OR gated with the other collector current overloads (CR104, CR204, CR304, CR404, and CR504) and buffered by a high current driver circuit (U10, Q1, and Q2). It is then sent to the collector overload input of the amplifier cabinet's control logic where the beam voltage control circuits remove beam voltage from the klystron.

Individual history of a collector overload occurrence is provided by latching circuits comprised of U7, U8, and U9. A current overload causing a LOW on the output of one or more of the Schmitt trigger invertors (U6) will latch the associated flip-flop and light the appropriate front panel LED. The OVERLOAD INDICATOR RESET button on the amplifier cabinet that resets the amplifier cabinet overload indicators also resets the collector current overload indicators via inverter U9.

4.4.11.2. Body Current Metering and Overload

Body current produced in the klystron circuit flows through R43, a 2.5 ohm 275 watt resistor mounted in the same high voltage area of the cabinet where the Hall effect sensors are mounted. The resulting voltage developed across this resistor by the body current is sent to PC1, the current monitoring board in the control cabinet. The voltage applied to the body current input pin (P1-6) of the board is approximately 250mv for 100ma of body current. One section of op-amp U3 amplifies the voltage 10 times to drive the BODY CURRENT meter mounted in the amplifier cabinet through the BODY CURRENT METER CALIBRATE adjustment pot (R605) and series resistor R606.

Body current overload protection is provided by a section of U5 used as a comparator. A sample of the incoming voltage is taken at the input of U3 before it is amplified, and is compared with a voltage set by the BODY CURRENT OVERLOAD SET pot at U5. If the incoming voltage sample exceeds the overload set voltage, the output of U5 will change state sending an overload signal, via high current buffer Q600, Q601, to the body current overload input of the amplifier cabinet control logic where beam control and overload indicator circuits react to the overload input.

Body current overloads may occur with some klystrons as the beam voltage is removed due to the klystron beam spreading as the voltage decays. This is a condition which is not detrimental to the klystron but will cause nuisance overload trips. A circuit on PC1, the current monitoring board, inhibits the body current overload whenever beam voltage is removed from the klystron. A signal from the output from PC11 (mounted in the power supply deck at the top of the control cabinet) that ultimately controls the removal of beam voltage, is also connected to the body overload inhibit input (P1-15) of PC1. This signal which is normally HIGH and goes LOW when the beam voltage is commanded off, is buffered and inverted by a section of U6 and applied to U5 to inhibit the overload. R616 and C603 delays the inhibit function approximately 15ms to allow time for the power supply capacitors to discharge after the beam voltage off command has been issued.

4.4.11.3. Degauss Control Circuit

The Hall effect current sensors used to monitor klystron collector current are susceptible to retaining a magnetic charge, especially as a result of a sudden heavy current flowing in the collector wire being monitored. This magnetic charge will cause metering inaccuracies and must be neutralized periodically.

Built into the transmitter is a degaussing circuit that performs this task every time the BEAM OFF push button is depressed. A high current 60hz AC signal that gradually reduces to zero current is impressed upon a 10 turn coil of wire installed on each Hall effect sensor. This technique effectively neutralizes any residual magnetic field.

The degaussing circuit control circuit is located on the current monitoring board, PC1. When the BEAM OFF command is issued, either locally or by remote control, a HIGH is applied to the DEGAUSS COMMAND INPUT pin (P1-9) of PC1 and the first section of buffer U11. As the output of U11 goes HIGH, capacitors C702 and C703 are charged very quickly causing the output of the other two sections of U11 to go HIGH. The signal from U11-4, via CR701 acts to inhibit each of the collector current metering and overload circuits while degaussing is in progress. The signal from U11-6 turns on Q700 that drives the relay thus starting the degaussing. A RC time constant formed by C703 and R706 maintains the degaussing circuit on for approximately 2 seconds while a RC time constant formed by C702 and R702 maintains the inhibit signal slightly longer (2.5 seconds). The longer delay insures that any degaussing current is gone before metering and overloads are re-established therefore preventing a false overload from occurring. The negative deflection of the beam current meter seen during the degaussing period is the result of the inhibit signal rather than from the degaussing current being applied to the Hall effect sensors.

4.4.12. KLYSTRON VOLTAGE METERING & OVERLOAD BOARD

(PC2; Mounted in logic box in transmitter control cabinet)
Refer to drawings 839-7891-028 and 839-7981-175.

4.4.12.1. Collector Voltage Metering

Each klystron collector except collector 1 is equipped with a high voltage resistive divider that provides a low voltage proportional to the voltage being applied to the collector. In addition, a fifth high voltage divider is connected to the C5 beam power supply lead on the supply side of the C5 current limiting resistors. The beam voltage at this point is the same voltage applied to the klystron cathode. It becomes the reference voltage for measuring the rest of the collector voltages.

The low voltage samples from each high voltage divider are sent to PC2 in the control cabinet. Each voltage sample is negative in polarity with respect to ground. On PC2, the polarity of the voltage samples are inverted by IC's U1 & U2 as the samples first enter the board.

Since the cathode voltage is the reference voltage against which all other collector voltages are to be measured, the cathode sample voltage becomes the reference voltage on PC2. The collector sample voltages from C2, C3, and C4 are compared to the cathode sample voltage in the three sections of U3.

A voltage representing the difference between the reference and the sampled voltage is produced by each section of U3 that drives the collector voltage meter via the collector voltage selection switch.

Collector C1's voltage potential is virtual ground (2.5 ohms between C1 and ground) and is therefore at the highest potential with respect to the cathode. The cathode's voltage potential, with respect to ground, equals the potential of collector C1 with respect to the cathode. The metered voltage for collector C1 is then simply the voltage sample of the cathode. This sampled voltage is applied directly to the C1 meter-switch position.

Collector C5's voltage potential is almost always equal to that of the cathode; normally only a very small amount of current flows in the current limiting resistors inserted in the circuit between the cathode and C5 voltage monitoring points. During normal operation, the voltage on C5 is always zero with respect to the cathode and is represented on the beam voltage meter by simply grounding the C5 metering position. An overload condition can create a difference in voltage between the cathode and C5, and protection circuits are present that sense and act on the voltage difference, however metering the voltage difference during the milli-second duration of the overload is not useful.

4.4.12.2. Collector Voltage Overloads

The voltage potential between collectors within the klystron must not be allowed to exceed the value specified by the klystron manufacturer. Arcing between collectors could occur possibly damaging the klystron. Inter-collector voltage potential limits can occur if any of the collector beam supplies fails or arcs to ground.

The overload circuits on PC2 protect against inter-collector arcing by comparing the collector monitored voltage on a given collector and comparing it against a fixed voltage developed from the reference (cathode) voltage. By using the reference voltage to develop the fixed voltages, overload sensitivity does not change as the beam voltage changes with primary voltage variations or re-tapping.

Resistors R207, R307, R407, and R507 on PC2 divide the cathode reference voltage sample to the same voltage produced by each of the collector voltage samples. IC U4 is a high impedance, non-inverting, unity gain buffer. It prevents the voltages on the preceding resistor divider from changing with various loadings of the circuit following the buffer. The buffer's output voltage is resistor divided to a voltage that sets the overload trip level at the "+" input to U5. The variation in collector voltage that will trip the overload can be determined by multiplying the collector voltage by the ratio of the resistors at the "-" input of U5.

Example: C4 is operating at 18kV;

The resistor ratio (R409/R410) at C4's overload circuit is
 $10k/57.6k = 0.1736$;
 $0.1736 \times 18kV = 3.125kV$.

If the collector voltage at C4 changes by 3.125kV during a fault condition, the transmitter will overload.

At U5, the collector voltage sample is compared to the resistor divided voltage. A fault on a collector will cause the collector

voltage to become more positive (with respect to ground) and, due to inverter U2 on PC2, cause its sampled voltage to go less positive at the input of U5. As soon as the voltage drops below that set by the resistive divider, the normally low output of comparator U5 goes HIGH. A Schmitt trigger (U6) assures a sharp voltage transition as U5's output voltage changes. The overload signal is OR gated with the other collector voltage overloads (CR201, CR301, CR401, and CR501) and buffered by a high current driver circuit (U9, Q1, and Q2). It is then sent to the collector overload input of the amplifier cabinet's control logic where the beam voltage control circuits remove beam voltage from the klystron.

Individual history of a collector voltage overload occurrence is provided by latching circuits comprised of U7, and U8. A voltage overload causing a LOW on the output of one or more of the Schmitt trigger gates (U6) will latch the associated flip-flop and light the appropriate front panel LED. The OVERLOAD INDICATOR RESET button on the amplifier cabinet that resets the amplifier cabinet overload indicators is also connected to the collector voltage overload indicator reset terminals via inverter U9.

Due to different loads on each output of the beam supply, a slight variation in time that is required for each power supply section to reach full voltage can cause nuisance voltage overload trips. A circuit on PC2 inhibits the voltage overloads until the reference voltage reaches approximately -15kV. The third section of U1 compares the reference voltage sample to a fixed voltage developed from a regulated +8v. If the reference voltage is low, the output of U1, via zener CR101 holds one input of each Schmitt trigger gate of U6 LOW. This prevents any overload signals from any section of U5 from satisfying the U6 gate. As the reference voltage exceeds -15kV and approaches its more normal -24.5kV level, the overload inhibit is released. Zener CR101 and pull-up resistor R115 help assure that voltage variations at the output of U1 cannot inhibit the overloads.

4.4.13. MAGNET CURRENT POWER SUPPLY AND REGULATOR

Refer to drawing 839 7740 117. The magnet current power supply is designed for constant current regulation. T1 drops the ac input voltage to about 145V rms. CR1 through CR6 provide full wave rectification. T5/T6 are saturable reactors used to control the input current flow. The output current is directly proportional to the control current. With 10 amperes magnet current flowing, the reactor control current is about 1.3A. C6 through C8 maintain the magnetic field until the klystron beam dissolves following an ac power failure.

T2 is used to generate the proper control voltages for the feedback circuits and the saturable reactors.

Refer to Figure 4-4. VR1 and VR2 provide the correct power supply voltages for the operational amplifier uA741C. VR3 is a temperature compensated zener diode from which the front panel controls derives its voltage.

The feedback circuits around the operational amplifier provide a very high dc gain for tight regulation. Other feedback paths are provided to achieve stability.

Figure 4-4. Magnet Current Power Supply Regulator Simplified Schematic

Transistors Q1 through Q4 are used to amplify the error signal from the operational amplifier to a level suitable for the saturable reactors.

4.4.14. ZENER BOARD

See drawing 839 7891 059. This board and its ten 200V zeners provide a stable low impedance voltage source for the mod anode. This 2000V range is shifted toward the cathode potential or away from it by selecting the appropriate tie points into the resistor string on the Resistor Board assembly. This board will replace one resistor in the resistor board assembly so klystron efficiency can be optimized.

4.4.15. ANNULAR RING PULSER: CONTROLLER

See Figure 4-5 and drawing 839 7740 036.

Inputs to the Pulser Controller are sync pulses from the Visual Exciter, +12-16 Vdc from the amplifier cabinet, Aural Emergency (TV-120UM) and MUX, logic data from a remote control interface, FOP status (From Other Pulser)(TV-120UM), and an End of Travel switch closure from the Motorized Pot Assembly. All inputs except for sync are diode and resistor protected.

Outputs from the Pulser Controller are sync pulses, fiber optic sources for sync and amplitude information to the Pulser HV Assembly. The Phase Mod and Sync Reduction logic outputs go to the exciter while normally closed, normally open, and the common relay ports are sent to the IPA. TOP status (To Other Pulser)(TV-120UM) and Remote Out logic to remote control equipment are available. All logic outputs are diode and resistor protected.

4.4.15.1. Pulse Amplitude Control

Front panel potentiometer R51 is used to set the amplitude of the high voltage pulse applied to the annular ring. Device U8, a CMOS oscillator/divider, operates at a frequency of 3.68 MHz by virtue of Y1 and associated components. At pin 14, an output square wave of 14.375 kHz triggers U9, a monostable multivibrator at regular intervals. The output of U9 at pin 6 is a square wave whose pulse width is determined by R51, R55,

and C25. The output of U9 controls switch Q9 and in turn fiber optic transmitter CR37. The resultant signal whose pulse width determines high voltage pulse amplitude is averaged in the Pulser HV Assembly to create a control voltage for an internal high voltage power supply.

4.4.15.2. Pulser Sync

The pulser sync signal sent from the Visual Exciter is “daisy chained” via high impedance ports J3/J4 through the Pulser Controller. Sync information is picked off to drive several CMOS stages. A sync presence detector is made from U4C, U4D, and associated components. The 15.734 kHz sync pulses are detected by CR5, R25, C12, and R27 providing dc input to U4C, pin 8. If noise is present, it is highpass coupled by C10 and detected by CR6, C11, and R26. The resultant dc plus a dc bias created by R23, R24, C9, and CR4 is applied to pin 9 & 12 of U4. The resultant logic level at U4D pin 13 is as follows for various signal inputs:

only sync = 1
no sync = 0
noise or noise + sync = 0

Sync presence is used to light a front panel LED, CR7, and to provide internal input to determine pulser on/off status. R28 and R29 protect the CMOS inputs in the event of power failure.

Front panel control of high voltage pulse leading and trailing edges is made via R3 and R4 respectively. Sync input leading edge triggers monostable U1A, whose leading edge delay is determined by R9, R3, and C1. The falling edge at pin 13 of U1A triggers U1B, whose short pulse leading edge triggers flip-flop U3A/U3B.

Sync input trailing edge triggers monostable U2A, whose trailing edge delay is determined by R10, R4, and C2. The falling edge at pin 13 of U2A triggers U2B, whose short pulse leading edge triggers flip-flop U3A/U3B. The output of U3A pin 3 leading and trailing edge can be manipulated by R3 and R4. This delayed sync pulse is input to inverter/gates U4A and U3C.

During normal Pulser In operation, U4A and U3C pass and invert the delayed sync pulse. When the pulser is disabled, U4A output pin 1 stays low, causing CR2 to remain on and causing continuous high beam current in the klystron. During pulser disabling, U3C output pin 8 stays high, resulting in continuous low beam current in the klystron. Choice of either continuous high or low beam current operation during pulser disabling can be made by the appropriate placement of P1 (P1: 1,2 = high; P1: 2,3 = low). Emissions or pulses of light from fiber optic transmitter CR2 correspond directly plus delay to exciter sync input.

4.4.15.3. Pulser IN/OUT Control

Internally, numerous inputs are used to determine pulser on/off status. Sync presence, Aural Emergency (TV-120UM), multiplex operation (MUX), Remote Pulser IN/ OUT, and the front panel momentary contact switch are OR'd together in U5C, U5D, and U6A and form the TOP (To Other Pulser) output. This output is needed only when more than one pulsed visual klystron is used. Also the TOP signal controls PULSER IN LED CR34 through Q7 and PULSER OUT LED CR3 through U3D and Q2. Both are front panel mounted. The TOP

output is high when the pulser is enabled. Aural Emergency (TV-120UM) and MUX inputs are normally high (>+5Vdc) and only low when active (<+1.5Vdc). Remote Pulser In and Remote Pulser Out are active when momentarily brought to ground. Simultaneous activation is a disallowed state. Remote inputs can be relay closures or logic with high = +12Vdc. Front panel switch S1 operates in parallel to the Remote inputs. Pulser In/Out status is stored in the event of power failure by latching relay K2.

The TOP output is also used, via Q7, to control Q8 which will allow 20 ma to flow into a remote control equipment interface to report that the pulser is on. No current flows when the pulser is off.

4.4.15.4. IPA Gain Control

K1 relay contacts normally open, normally closed, and common are available to control the IPA gain by activating a preset gain change circuit in the IPA Preamp. Pulser enabling energizes K1 through Q3. IPA gain normally should reduce if the pulser is disabled, however if the Aural Emergency mode is selected (TV-120UM optional equipment) additional IPA gain may be needed. The choice of whether IPA is reduced or not when the pulser is out can be selected by the appropriate placement of jumper plug P2 (P2: 1,2 = high gain; P2: 2,3 = low gain).

4.4.15.5. Mod Anode Motorized Pot Control

A motorized pot assembly mounted in the amplifier cabinet and connected to the mod anode resistors is controlled by momentary contact switch S2 on the Pulser Controller to provide limited mod anode bias voltage adjustment. S2 grounds the appropriate motor winding drive relay. The pot assembly has limit switches to indicate end of travel of the motorized pot so the command may be discontinued. The limit switches are OR'd together and illuminate the front panel mounted LED CR27 when end of travel is reached for either direction.

4.4.16. ANNULAR RING PULSER: HIGH VOLTAGE ASSEMBLY

See drawings 839 7740 050 and 839 7891 059.

WARNING

THE PULSER HIGH VOLTAGE ASSEMBLY PRODUCES UP TO 1400V WHEN ENERGIZED. ALSO, WHEN THE KLYSTRON IS ENERGIZED, THE PULSER HIGH VOLTAGE CHASSIS HAS - 24,000V APPLIED TO IT. WHEN TROUBLESHOOTING, DO NOT CONNECT ANY TEST EQUIPMENT THAT WILL NOT WITHSTAND THE VOLTAGE PRESENT.

Inputs to the Pulser HV Assembly are 27-48 Vrms from a dedicated secondary winding of the klystron filament transformer and fiber optic data from the Pulser Controller. Sync information and high voltage pulse amplitude information is sent via fiber optics. See Figure 4-5.

4.4.16.1. High Voltage Pulses

Outputs from the Pulser HV Assembly are connected to the klystron cathode and annular ring terminals. A high voltage power supply along with a FET switching network applies pulses synchronously with video sync so that annular ring to cathode potential is zero during the sync pulse (high beam

current). During video interval, the annular ring to cathode potential is negative (typical 1000Vdc, low beam current). The annular ring to cathode potential or pulse amplitude is adjustable from the front panel of the Pulser Controller.

High voltage pulsing is accomplished by the near complementary switching of Q4/Q5 and Q6/Q7 and the internal supply PS1.

During pulsing, Q4/Q5 is turned on (a low impedance, 20 ohms) causing the annular ring to cathode potential at the junction of R16 and R17 to be the potential of the output of PS1.

The magnitude of PS1 is controlled or set at pin 3 of PS1. The output wave shape and harmonic content is affected by a low pass filter comprised of R19, R20, C18, L1, and L2.

Annular ring arcs or shorts to tube ground are dealt with by CR31 and R39. CR31 is normally reverse biased and transparent to pulsing. If the Mod Anode arcs over to the annular ring or a short occurs (both situations create 24 kV cathode to annular ring potential), CR31 becomes forward biased (3 Vdc) and GloBar R39 absorbs the beam supply power as shutdown occurs.

CR3-CR10 and CR22-CR29 serve to equalize voltages around turned off FET's and to insure that the maximum voltage rating, drain to source, is not exceeded. CR2, CR14, CR19, and CR30 serve to protect the gates from damaging input transients.

4.4.16.2. Input Sync (Fiber Optic Link)

Sync pulses are sent from the Pulser Controller via a fiber optic interface. The sync pulses arrive as pulses of light which are received and inverted by U1. U3A, U3B, and U3C are used to provide pulse delay and positioning for the upper switch path. U3C drives Q1 which in turn drives the transmitter of opto-isolator U4. This high speed device inverts the pulses and

provides isolation from the high voltage present in the upper switch and drive circuits during the pulse interval. MOSFET driver U5 is a high speed device designed to drive high capacitance loads such as power MOSFET's.

Path delay in the lower path is provided by U3F, U3E, and U3D in a pulse stretching circuit. Because the signal paths for upper and lower are different, this arrangement allows proper timing for the switching of Q4/Q5 and Q6/Q7. U3D drives U10, the exact counterpart of U5. Actual signal drives into Q5 and Q7 are 180 degrees out of phase with each other. FET combination Q4/Q5 and Q6/Q7 act in master/slave configurations. For example when Q5 is turned on, Q4 is allowed to be forward biased as Q5 drain to source resistance drops to approximately 10 ohms. Speedup capacitor C8 allows for fast turn on and R1, C5, CR1 allow for steady state dc bias. Q6/Q7 and associated components act in the same manner.

Pulse amplitude control information is received and inverted via fiber optic receiver U2. The resulting square wave is buffered and averaged by Q2, R25, C16, R26, C17, CR15, and Q3. The average voltage is applied to pin 3 of PS1. Pulse Amplitude adjustment of the Pulser Controller varies the pulse width of the square wave so that wider pulses at the collector of Q2 increases the average voltage which in turn increases the output voltage of PS1.

4.4.17. ION PUMP

WARNING

WHEN ENERGIZED, THE ION PUMP CIRCUIT (MOUNTED IN THE HIGH VOLTAGE AREA) WILL PRODUCE UP TO 4000V. WHEN TROUBLESHOOTING, DO NOT ATTACH ANY TEST EQUIPMENT NOT CAPABLE OF WITHSTANDING THE VOLTAGE PRESENT.

4

Figure 4-5. Block Diagram Pulser

Refer to drawing 839 8052 002 for the following discussion. Power for the Ion Pump is derived from the filament contactor K5 which supplies 120vac to PS-1.

PS1 is a 4kV DC power supply that provides the voltage needed by the ion pump. Current is limited by 7.5 megohm resistor R1 inserted in the positive lead feeding the ion pump. A 20uA meter in the return lead monitors the current being drawn out of the vacuum by the pump. The value of resistor R2 is chosen to start biasing ON diode CR1 at currents exceeding 15uA. This action protects the meter from damage due to currents higher than 20uA. However this protection scheme also causes an increasing inaccurate meter reading above approximately 15uA. Since beam voltage should not be applied to the klystron if ion current is in excess of 10uA, metering inaccuracies in excess of 10uA are not as important.

4.4.18. AURAL IPA AMPLIFIER

Refer to drawing 839 5436 002. Each of the amplifiers used provides approximately 8dB of gain to provide power for the aural klystron. Each are tuned to channel and are capable of operating over the whole UHF band.

C2 and C3, along with the input transmission lines printed on the printed circuit board, provide input tune and match controls

for Q2. C4 and C5, along with their transmission lines, provide output tune and match controls for the collector of Q2.

C7 and its transmission line, along with L2, provide rf bypassing. R9 reduces the Q of L2. C10 and C11 provide video bypassing.

L3, C6 and L1 provide rf bypassing and R7 reduces the Q of L1. C8 provides video bypassing. R8 provides current limiting for Q1.

Q2 is biased class A by Q1. R1 samples Q2's collector current and the voltage across R1 is presented to Q1's base emitter junction through resistive divider R2, R3 and R4. An increase in Q2 collector current increases the voltage drop across R1. This increase appears as a decrease in Q1 base emitter voltage which reduces its conduction and hence reduces Q2's base current.

C1 and C12 provide rf bypassing on the dc supply. CR3-CR6 form a full wave bridge and prevent any negative voltages generated by Q2 (when drive is present but dc power is off) from appearing on E1 or E2 which might affect power supply operation.

□

SECTION V MAINTENANCE

NOTE

Paragraphs 5.1 and 5.1.1 only applicable if spark gaps are marked with radioactivity label.

5.1. SAFETY STATEMENT: OVERVOLTAGE GAPS CONTAINING KRYPTON 85

The following paragraphs refer to the overvoltage gaps (spark gaps) mounted in the base of the Visual and Aural Amplifier cabinets. The radioactive material used in these devices is Krypton 85, a pure beta radiator with a half life of eleven years.

The by-product is in a gaseous form that is added to the gas used to backfill the devices.

The total content of radioactive by-product is in all cases less than 30 microcuries per device as determined by device volume, fill pressure and activity level of the backfill gas.

The maximum allowable level of radioactivity for devices shipped to non-licensed users is 30 microcuries per device.

There is no measurable level of radiation from the devices with the glass or ceramic envelope intact. The radioactive source can only be released from the device by fracturing the envelope. Envelope breakage does not occur under the most severe operational or destructive testing likely to be encountered in the normal use of the device.

The hazard associated with the normal use of these devices is at an absolute minimum.

5.1.1. DISPOSAL OF OVERVOLTAGE GAPS

EG&G, a manufacturer of radioactive spark gaps, recommends disposal of spent devices by consignment to a low level radioactive disposal center or returning to EG&G for disposal at no cost to the customer.

DANGER

DISPOSE OF SPENT SPARK GAP BY CONSIGNMENT TO A LOW LEVEL RADIOACTIVE DISPOSAL CENTER OR BY RETURNING TO SPARK GAP MANUFACTURER - EG&G ELECTRO-OPTICS DIVISION, 35 CONGRESS STREET, SALEM, MASSACHUSETTS, 01970, TEL (617) 745-3200, TWX 710-347-6741.

5.2. GENERAL TRANSMITTER MAINTENANCE INFORMATION

This section provides the maintenance instructions for the TV 60UM UHF Television Transmitter. Routine maintenance and the recommended maintenance schedule is given. Test equipment needed for the effective accomplishment of maintenance is listed and test/adjustment procedures are given. It should be kept in mind that the equipment type involved and its use, brings about a maintenance function that closely allies operation, testing, and troubleshooting. In many instances, one cannot be accomplished without the other. In view of this, the procedures contained in this section should be looked upon as the basic guidelines for continued reliable operation but do not in all cases constitute the sole manner of proper maintenance.

5.3. EQUIPMENT CLEANING

Cleaning the external surfaces of the transmitter can be done at any time without contacting dangerous voltages. A soft cloth

and household type spray detergent should be used to remove fingerprints and dirt smudges from the painted surfaces. Do not spray cleanser into cracks, drawers or other crevices on the exterior of the transmitter or saturate hinges or latch assemblies. It is recommended that the cleaning cloth be sprayed and the equipment carefully wiped clean. For transparent meter faces a static free glass cleaner should be used to prevent changing meter calibration due to generated static potential.

5.4. SCHEDULED MAINTENANCE

The maintenance schedule was established based on 18 operating hours per day. The schedule should vary proportionally, especially on mechanical equipment, if the daily use is other than 18 hours. Inspection of the equipment should be performed at an interval no greater than that indicated in the schedule.

5.4.1. WEEKLY MAINTENANCE

5.4.1.1. Cooling System

- Water System Leaks. Check the water system for leaks especially around the water connections to the klystron. Also check closely any water pipe joints and connections that may be located above the transmitter cabinets. All valves should be checked for leakage.
- Glycol System Leaks. By its nature, glycol has the ability to leak through a hole that water may not. Closely inspect the glycol cooling system for leaks including the piping to the outside cooling fans. With the pumps shut off, remove the side of the pump module and look for evidence of leaks on the floor of the module.
- Check the water flow rates to each klystron. Flow rate should be 6 GPM.
- Check the coolant flow rates to reject loads in the RF system (if so equipped).
- Check the water and glycol temperatures and compare with previously recorded data.
- Check the CHANGE FILTER LED on the Control Cabinet. If the water pump is running and the CHANGE FILTER LED is illuminated, the pure water filters should be changed. (If the pump is not operating, the still water in the purity sensor usually will drop below the water resistance trip point and illuminate the CHANGE FILTER LED. Therefore, the warning given by the LED is only valid if the water is flowing).

5.4.1.2. Electrical Performance

It is recommended that the following be checked and adjusted only if out of specification. See System Test/Adjustment for details.

- Filament voltage
- Meter readings on amplifier cabinets, IPA, Aural Exciter, and Visual Exciter
- Amplitude response (use a multi-burst signal for a quick indication)
- Differential gain
- Incidental phase
- Differential phase

- g. Low frequency linearity
- h. Envelope delay (pulse method)
- i. Sync shape (pulsar and correction timing during horizontal sync)
- j. Overload system. If not on the air, check by pushing one of the ARC PUSH TO TEST buttons to see that beam voltage is removed. Do NOT perform this test during the broadcast day as the transmitter will be removed from operation.
- k. Ion pump current. A log should be kept of this parameter for each klystron. A slow trend towards higher ion pump current on an older tube will often give warning of end of service life in time to obtain a replacement klystron.

5.4.2. MONTHLY MAINTENANCE

5.4.2.1. Cooling System

Refer to the Heat Exchanger Technical Manual 988-2324-001 for maintenance instructions.

- a. Check the pumps for excessive or unusual noises. Check for leaks around the pump seals.
- b. Check pump pressures and compare with previously recorded data.
- c. Clean the glycol system filter screen.
- d. Check the outside fan unit for loose or rattling parts. Make sure power is disconnected from the fan unit before accessing the motors or fans.
- e. Check the outside fan unit to make sure bearings are free and the motor is secure within its mount. Make sure power is disconnected from the fan unit before accessing the motors or fans.

5.4.2.2. Transmitter Cabinet Air Filters

Remove the air filters and clean with soapy water. Rinse and dry thoroughly before re-installing.

5.4.2.3. Electrical Performance

- a. Check the visual and aural carrier frequencies and adjust if necessary.
- b. Check the performance of the coolant flow interlocks. (Operation of these interlocks will remove the transmitter from the air).

5.4.2.4. Transmitter Room

- a. Check the transmitter room cooling/heating system. Room temperatures between 70 and 80F (21.1 and 26.7°C) assure the maximum stability and fewest failures of the equipment.
- b. Clean any filtration equipment associated with maintaining the transmitter room temperature and cleanliness.

5.4.3. BIANNUAL MAINTENANCE

5.4.3.1. Heat Exchanger

- a. Inspect and clean the fins of the outside fan unit. Clean the cooling fins of all debris that may inhibit air flow. This can be done with compressed air or a commercial coil cleaner. Check for bent or damaged coil fins and repair as necessary.
- b. All fan motors in the outside fan units are equipped with sealed bearings that do not require periodic lubrication, however some fan unit models have bearing equipped pillow blocks that support the fan shaft. Check for the

presence of the pillow blocks on your unit and see if a lubrication fitting is installed. If so, these bearings require lubrication on a biannual basis.

5.4.3.2. Interior Transmitter Cleaning

Clean the inside of the transmitter should be done using a vacuum cleaner and a soft paint brush. Ensure that all power to the transmitter is off and all high voltage circuits have been discharged. Be careful to not dislodge or damage wiring, components, or terminals. The soft bristle paint brush is recommended for dislodging dust.

5.4.3.3. Electrical Performance

- a. Check power meter calibration.
- b. Check each interlock and overload for proper operation. See Section III.
- c. Check collector current metering calibration. See Section III.
- d. Check body current metering calibration. See section III.

5.4.3.4. Klystron Inspection

Assure that the set screw that holds each coupler in the proper rotational position is tight. Mark the orientation of the coupler mounting plate in relation to the cavity and, one at a time remove the couplers on cavities one, two and three. Use a flashlight to inspect the klystron ceramic. Look for dirt on the ceramic, especially on the ceramic surface that faces the cooling air discharge duct. The amount of dirt on the ceramic and the frequency that the ceramic should be cleaned depends on the cleanliness of the air in the transmitter room. Excessively dirty air will probably mean the ceramics will have to be cleaned more often. See Annual Maintenance for the procedure.

Inspect and clean the honeycomb on the cavity air inlet ports. Also clean screens on the RF output line.

5.4.3.5. Beam Power Supply

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.

- a. Check for tightness of all wire connections.
- b. Check the lead dress of the beam supply wiring. Wires should not touch any sharp edges nor should any wire with low voltage insulation be allowed any closer to any high voltage terminal than 6 inches.
- c. Check the feed through bushings for oil leaks.
- d. Visually inspect the bleeder resistors and check with an ohmmeter.
- e. Wipe off the high voltage insulators on the beam supply and filter capacitors with a clean dry cloth.

5.4.4. ANNUAL MAINTENANCE

5.4.4.1. Klystron Ceramic Cleaning

Cleaning of tube ceramics is only necessary if they are dirty. Dirt and foreign matter on the surface of the ceramic may cause local overheating or arcing and can lead to klystron failure.

- a. Near the tuning knob, mark each cavity so it can be replaced in the same position (Cavity 1, Cavity 2, etc.).
- b. Unbolt the cavity halves and remove the left half (the half with the tuning knob) to gain access to the klystron ceramics.
- c. Dust may be removed from the ceramic parts with a soft cloth or brush. More persistent spots may be removed with rubbing alcohol applied to a clean cloth and then cleaning the ceramic. If arc marks or other contamination remain on the ceramic that rubbing alcohol will not remove, refer to the klystron manufacturer's application data sheet that covers this subject.
- d. The cavities should be checked and cleaned whenever they are removed from the tube. The inside of the cavity should be cleaned with a clean, dry cloth. A dry, soft brush is recommended to clean the contact fingers. More persistent dust may be removed with rubbing alcohol. Do not use contact sprays.
- e. The contact areas of the spring contacts inside and outside the cavity should be inspected for burn marks. If small burn marks are noticed they should be carefully sanded off with crocus cloth or #600 or finer sandpaper.
- f. Damaged contact springs, particularly those that have been deformed, must be renewed. If the deformation is small, they may be straightened.

5.4.4.2. Beam Power Supply

- a. Visually inspect the oil in the power supply and look for cloudy and/or contaminated oil.
- b. Remove a small sample of oil from the bottom of the power supply at the valve on the oil tank and have it checked for water contamination.

5.5. KLYSTRON REMOVAL/REPLACEMENT

It is recommended that only maintenance personnel who are thoroughly familiar with the transmitter be involved with klystron 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.

The following procedure describes the steps necessary to remove a failed klystron:

5.5.1. REMOVAL OF CABINET PANELS & COVERS

- a. Remove both rear cabinet side panels.
- b. Remove the lower rear cover to gain access to the bottom of the klystron.

5.5.2. DETACHMENT OF WIRES & CABLES

- a. Disconnect the coaxial cables from the coupling loops of cavities 1, 2, and 3.
- b. Disconnect the coaxial cables with the tubular filters attached, from the directional couplers on the output transmission line.
- c. Disconnect the two arc detector cables.

- d. Disconnect the refocus coil connector at the base of the collector.
- e. Disconnect the magnet plug.
- f. Remove the ground strap fastened to the top of the magnet frame.
- g. At the high power resistor assembly, disconnect the five white high voltage wires that go to the klystron collector.
- h. At the klystron side of the filter assembly, unscrew each of the five flexible conduit nuts. Pull each conduit back from the filter box assembly pulling the white high voltage wire back through the filter box assembly until it is free.
- i. On the opposite side of the cabinet, unplug the right angle ion pump plug.
- j. At the bottom of the klystron, detach the cathode, filament, mod anode and (visual only) annular ring wires and arrange them on the floor so the magnet castors will not run over them when the magnet is removed.
- k. Detach the two water lines at the water quick-disconnects and move the water hoses out of the way.
- l. On the output transmission line, remove the air hose.

5.5.3. TRANSMISSION LINE BREAKAWAY

5.5.3.1. Disassembly/Assembly

When Other Klystrons Operating When klystron is being replaced while another klystron in the transmitter continues to operate, a possibility of significant levels of RF energy may exist on the transmission line inner conductor of the breakaway being disassembled. Therefore, if other portions of the transmitter continue to operate, disassemble the breakaway transmission line on the failed klystron using the following procedure:

WARNING

THE FOLLOWING PROCEDURE EXPOSES A CONDUCTOR THAT MAY CONTAIN RF VOLTAGE THAT COULD CAUSE RF BURNS TO THE SKIN. WEAR ELECTRICALLY INSULATING RUBBER GLOVES WHEN USING TOOLS THAT WILL TOUCH THE CENTER CONDUCTOR.

- a. Loosen the outer sleeve over the transmission line breakaway and slide it down clear of the outer conductor separation point.
- b. Using a metallic tool with an insulated handle, short the inner conductor of the breakaway to the outer conductor.
- c. Continue to short the inner conductor to the outer conductor. Wear electrically insulating rubber gloves. On the center conductor, unfasten the two captive screws to free the lower half of the center conductor from the upper half.
- d. To re-assemble the breakaway assembly, perform the previous procedure in reverse order using the same precautions.

5.5.3.2. Disassembly/Assembly When Other Klystrons NOT Operating

- a. Loosen the outer sleeve over the transmission line breakaway and slide it down clear of the outer conductor separation point.

Table 5-1. Recommended Test Equipment

Vestigial Sideband Demodulator	Tektronix 1450-1 37MHz IF (NTSC CCIR-M) or Tektronix 1450-2 38.9MHz (PAL CCIR-B) or Phillips PM 5560
Tektronix Sideband Analyzer	Tektronix 1405 Sideband Adapter and Tektronix Spectrum Analyzer Model 2710, 490, 2750
Video Signal Generator	Tektronix 1910, 1410, or Phillips PM 5646
Video Waveform Monitor	Tektronix 1480, 1780, or VM-700A
Vectorscope	Tektronix 1780, VM-700A
Aural Stereo Test Generator	RE Instruments, RE-540
Aural Stereo Monitor	Tektronix 751 or TFT-850
Aural Mono Demodulator/Monitor	TFT-701, 702 or Tektronix 751
Frequency Measuring Equipment	HP-5315A, 5342 or Tektronix DC 508A
Audio Measuring Equipment	Sound Technology 1710A or Potomac AA-51 and AG-51
Envelope Delay Measuring Equipment	Tektronix VM-700A or Asaca 201-1 or Rhode&Schartz SKOF
Miscellaneous Test Equipment	Boonton RF Voltmeter with 50 Ohm adapter Polaroid Oscilloscope Camera Bird Model 43 Wattmeter with 1W to 1kW ele- ments Fluke Multimeter Model 77, 87, 23 with style C current probe RF Bridge, Eagle RLB-150, or precision directional coupler RF Notch Filter, Eagle Model TNF-1 0-6A Current Variable Power Supply Quantity 2 or Dual Output Voltage Variable 0-5V Power Supply. Maximum current needed is 150uA
Adapters and Connectors	3-1/8 inch to type "N" adapter Type N to BNC male to female Type N to BNC female to male Type N barrel Type BNC barrel Type BNC to SMB (push-on) Type BNC to SMC (screw-on)

- b. On the center conductor, unfasten the two captive screws to free the lower half of the center conductor from the upper half.

5.5.4. KLYSTRON REMOVAL

- a. Unlock the magnet swivel castors.
- b. Carefully roll klystron/magnet assembly out of the transmitter.
- c. Unscrew each flexible conduit nut at the klystron and slide the flexible conduit off each collector lead.
- d. Remove the output transmission line elbow from cavity 4.
- e. Label each cavity (e.g. cavity 1, cavity 2, etc.) to ensure the cavities will be re-installed in the same position.
- f. Remove all four cavities.
- g. Inspect each klystron ceramic for cracks. If a crack is evident, devise a method of re-enforcement to prevent the klystron from breaking apart at the crack as it is lifted from the magnet.
- h. Install all four square posts of the lifting harness into the receptacles at the base of the klystron collector and carefully begin lifting the klystron.
- i. When the klystron has been lifted a few inches, remove the split magnet flux ring that sets on the bottom plate of the magnet and supports the klystron.
- j. Lift the klystron out of the magnet.
- k. Lower and secure the failed klystron into an empty shipping crate.

5.5.5. KLYSTRON INSTALLATION

Install the new klystron by performing the previous steps in reverse order. Also consult paragraphs 2.6.14 and 2.6.15 in Section II for additional installation and connection information. Because of the considerable number of connections that must be made when re-installing a klystron/magnet assembly, a connection checklist is included in Tables 5-2 and 5-3.

5.6. TEST EQUIPMENT

The basic test equipment recommended for transmitter maintenance is given in Table 5-1. Equivalent test equipment may be substituted; however, the electrical specifications must be comparable to the equipment listed.

5.7. TRANSMITTER SETUP REMOTE CONTROL UNIT

This device provides a means of controlling an individual amplifier from the back of the transmitter during maintenance. A receptacle is provided on the transmitter for each amplifier. The remote control unit is then plugged into the proper receptacle to control a single amplifier cabinet. The functions controlled from the unit are as follows:

- a. Power Raise
- b. Power Lower
- c. Beam On
- d. Beam Off
- e. Klystron Output Power Metering

5.8. CONTROL AND SUPPORT SYSTEMS: TESTING/ADJUSTMENTS

This procedure is closely aligned with the Checkout Procedures given in Section III in that it provides further detailed instructions in support of the Checkout Procedure.

Table 5-2. Visual Klystron/Magnet Connection Checklist

VISUAL KLYSTRON

- Magnet Wheels Locked
- Cathode Connection
- Mod Anode Connection
- Filament Connection
- Annular Ring Connection to Pulser
- Ion Pump Plug
- Collector Connections
- Water Inlet Hose, Outlet Hose
- Magnet Frame Ground Strap
- Breakaway Inner Conductor Tightened
- Breakaway Outer Sleeve In Place & Tightened
- Air Supply Hose To Breakaway
- Magnet Plug
- Arc Detector Cables
- Coax Cables To 1st, 2nd, 3rd Cavities
- Directional Coupler Coax Cables
- Body Water Jumper Hose
- Refocus Current Plug

5.8.1. AC CONTROL VOLTAGE

This procedure checks and sets the proper amplitude of the 3 phase 208/120 vac that powers the transmitter control and most of the support systems.

WARNING

PROPER PROCEDURE FOR MEASURING VOLTAGES IN THE FOLLOWING STEPS REQUIRES PRIOR REMOVAL OF ALL POWER AND GROUNDING OF ALL LOCATIONS WHERE TEST LEADS ARE TO BE CONNECTED TO OR DISCONNECTED FROM. THE TEST METER IS TO BE LOCATED OUTSIDE THE ENCLOSURE AND ALL DOORS OR PANELS ARE TO BE CLOSED PRIOR TO APPLYING ANY POWER.

- a. Measure the open circuit voltage of the 3 phase power line supplying power to the line control cabinet. Measure phase to phase.
- b. Set the taps on transformer T1 in each Line Control Cabinet to the corresponding line voltage.
- c. Apply power to transformer T1 by setting the TRANSMITTER CABINET MAIN breaker (CB7) and TRANSMITTER CABINET CONTROL breaker (CB9) on the Line Control Cabinet to ON.

WARNING

THE BEAM SUPPLY BREAKERS (CB6 & CB8) SHOULD BE OFF.

- d. Measure the voltage at terminals 1, 2, and 3 of TB23 in the Line Control cabinet with respect to transmitter ground. 114-126 Vac should be present. Reconnect the taps on T1 if necessary.
- e. Measure the voltage from terminals 1 to 2, 2 to 3, and 1 to 3 on TB23. Each voltage should be 197-218 Vac.

Table 5-3. Aural Klystron/Magnet Connection Checklist

AURAL KLYSTRON

- Magnet Wheels Locked
- Cathode Connection
- Mod Anode Connection
- Filament Connection
- Annular Ring Jumper to Cathode
- Ion Pump Plug
- Collector Connections
- Water Inlet Hose, Outlet Hose
- Magnet Frame Ground Strap
- Breakaway Inner Conductor Tightened
- Breakaway Outer Sleeve In Place & Tightened
- Air Supply Hose To Breakaway
- Magnet Plug
- Arc Detector Cables
- Coax Cables To 1st, 2nd, 3rd Cavities
- Directional Coupler Coax Cables
- Body Water Jumper Hose
- Refocus Current Plug

5.8.2. BEAM VOLTAGE: BEAM POWER SUPPLY

WARNING

PROPER PROCEDURE FOR MEASURING VOLTAGES IN THE FOLLOWING STEPS REQUIRES PRIOR REMOVAL OF ALL POWER AND GROUNDING OF ALL LOCATIONS WHERE TEST LEADS ARE TO BE CONNECTED TO OR DISCONNECTED FROM. METER IS TO BE LOCATED OUTSIDE THE ENCLOSURE AND ALL DOORS AND PANELS ARE TO BE CLOSED PRIOR TO APPLYING ANY POWER.

- a. Measure the open circuit voltage of the 3 phase power line, phase to phase, that powers the line control cabinet.
- b. See Table 5-4. Connect the primary beam supply terminals to produce the desired cathode voltage. Note that Table 5-4 is intended to be a connection guide. Voltages derived in the table are calculated voltages and the actual voltages obtained for a particular supply may be different.

NOTE

The first time beam voltage is to be applied to a new tube or during initial transmitter checkout, the beam voltage should be adjusted to produce the lowest beam voltage possible, then increased in steps to that voltage that yields proper performance.

5.8.3. CIRCUIT BREAKER MAGNETIC TRIP SETTINGS

BEAM SUPPLY breakers (CB6 & CB8) in the Line Control Cabinet are equipped with a magnetic trip feature that trips the circuit breaker on fast surge currents. The trip points are adjustable and should normally be set to the LO setting (minimum sensitivity: fully CCW. If increased sensitivity is desired the adjustment may be changed. See the breaker trip curves in Section IX of this manual.

**Table 5-4. Calculated Cathode Voltage
(and C1 collector metered voltage)
for Various Line Voltages and Beam Supply Connections**

LINE VOLTAGE	BEAM SUPPLY CONNECTIONS					
	500/+20	500/0	500/-20	440/+20	440/0	440/-20
440V	20.7kV	21.6kV	22.5kV	23.4kV	24.5kV	25.7kV
450V	21.2kV	22.1kV	23.0kV	24.0kV	25.0kV	26.2kV
460V	21.7kV	22.5kV	23.5kV	24.5kV	25.6kV	26.8kV
470V	22.2kV	23.0kV	24.0kV	25.0kV	26.2kV	27.4kV
480V	22.6kV	23.5kV	24.5kV	25.6kV	26.7kV	28.0kV
490V	23.1kV	24.0kV	25.0kV	26.0kV	27.3kV	28.6kV
500V	23.6kV	24.5kV	25.5kV	26.6kV	27.8kV	29.2kV

NOTE: Shaded areas indicate voltages out of normal klystron operating range.

If the magnetic trip point is set too sensitive, the circuit breakers will trip before the automatic overload circuitry in the transmitter can respond and remove the overload.

The trip adjustments can be changed using a flat blade screwdriver. They are accessible through the front panel of the Line Control Cabinet, just below the breaker handle.

5.8.4. CONTROL VOLTAGE AND CURRENT FOLD-BACK ADJUSTMENT

+12V control voltage referred to elsewhere in this manual is derived from a +15V power supply. The +15V power supply is located in the upper portion of the Control cabinet on each power supply deck. The deck at the front of the cabinet behind the blank meter panel supplies the visual part of the transmitter; the deck at the rear of the cabinet supplies the aural part of the transmitter. Panels that yield access to the decks are not interlocked. The voltage adjustment is located on the back wall of the power supply. See Vendor information in Section IX for location.

- a. Adjust the power supply (PS3) for +14.75Vdc at the V+ terminal of the supply.
- b. The power supply is equipped with foldback current limiting. Ordinarily no adjustment is necessary. However if the power supply output folds back, first determine whether a malfunction in the transmitter is causing current draw from the supply in excess of 8 amperes. If the current draw is not excessive, and the supply still folds back, it may be necessary to adjust the foldback threshold point. Refer to the manufacturer's instructions in the Vendor Information Section IX.

5.8.5. FILAMENT VOLTAGE ADJUSTMENT

The filament voltage adjustment is located on the front panel of the amplifier cabinet. A meter is provided inside the amplifier cabinet which can be read through the window of the panel. Set the voltage to the filament voltage indicated on the klystron data sheet (usually 7.0 volts). When setting the filament voltage, be sure to consider any meter calibration correction. The procedure for checking filament meter accuracy and determining a calibration correction is given in the checkout procedures, Section III.

5.8.6. MAGNET CURRENT ADJUSTMENT

The magnet current adjustment is located on the Amplifier Cabinet front door. Metering is provided on the meter panel at the top of the cabinet. Initially adjust the magnet current to the value specified on the tube data sheet (approximately 10A). During final transmitter adjustments it may be necessary to adjust the magnet current slightly. Changing the magnet current can have the following effects on the klystron:

- a. Body current. Body current is especially sensitive to the magnet current setting since the magnetic field will change the shape of the klystron electron beam. Ideally the magnet current should be set for minimum body current. In actual practice, the magnet current setting is usually a compromise between minimum body current and the other effects listed below. Often several body current nulls (minimum body current readings) will be found in the range of magnet current adjustment. Excessive body current, causing an amplifier cabinet overload, can also be produced by incorrect magnet current.
 - b. Sync Peak Power. During final adjustments of the transmitter, especially adjustments for maximum efficiency, the maximum sync peak power sometimes can be increased a few percent by slightly modifying the magnet current setting. This usually means an increase in body current. Body currents at 100mA or less under worst case condition (full power; black picture) are acceptable.
 - c. Signal Stability. Improper magnet current setting can sometimes cause what appears to be a small amount of high frequency oscillation on a portion of the tip of horizontal sync. A small adjustment of magnet current will usually correct the problem.
- Whenever magnet current is adjusted with the klystron operating, the magnet current should be adjusted very slowly in small amounts while observing:
- d. The magnet current meter to keep the current within its operating range (keep from interlocking OFF).
 - e. The body current meter to maintain body current below 100mA.
 - f. The demodulated signal waveform monitor to see the effect on the signal.

5.8.7. REFOCUS CURRENT ADJUSTMENT

The Refocus Coil is an electro-magnetic coil installed in the klystron at the base of the collector assembly during manufacture of the klystron. Like the body magnet, only on a lesser scale, it is used to modify the shape of the electron beam as it enters the collector region. It does not, however, have as much affect on the electron beam as the body magnet.

The Refocus Current adjustment is located on the Amplifier Cabinet front door. Initial adjustment, until a new klystron is set to final beam voltage and cathode current, is the center of the adjustment range. During klystron operation, set the refocus current in the following manner:

- a. Remove RF drive to the klystron.
- b. Rotate the COLLECTOR VOLTAGE/CURRENT meter switch to the C3 position.
- c. Rotate the REFOCUS CURRENT adjustment control to minimize C3 collector current.
- d. Like the body magnet, the refocus coil can affect body current and the performance of the RF output signal. Therefore, under klystron RF drive, the refocus current may have to be adjusted to enhance RF signal performance and/or reduce body current.

Whenever refocus coil current is adjusted with the klystron operating, the refocus current should be adjusted very slowly in small amounts while observing:

- e. The position of the refocus current knob to keep the current within its operating range (keep from interlocking OFF).
- f. The body current meter to maintain body current below 100mA.
- g. The demodulated signal waveform monitor to see the effect on the signal.

5.8.8. FILAMENT TIME DELAY ADJUSTMENT

The pre-heating time during which the klystron filament heats to the proper temperature for electron emission is adjusted by a pot located on PC5 in the cabinet control logic assembly.

- a. Set the BEAM SUPPLY breakers on the Line Control Cabinet to OFF.
- b. If klystron filaments have/had been operating, press the FIL OFF pushbutton and wait 5 minutes.
- c. Depress the FIL ON pushbutton and begin timing the warm up as soon as the FIL ON indicator illuminates. If the time until the TIME DELAY illuminates is less than 4 minutes 30 seconds or more than 6 minutes the time delay should be adjusted.
- d. Depress FIL OFF. Remove power and open the front door of the amplifier cabinet. Remove the control logic assembly cover.
- e. Adjust the time delay by turning R5 on PC5 counter-clockwise to increase the time or clockwise to reduce the time delay.
- f. Repeat steps c. through e. until the proper time delay is achieved.

5.8.9. COLLECTOR CURRENT METERING CALIBRATION

Calibration of the collector current metering system involves first checking the performance of the Hall effect sensors, then feeding an externally produced and metered current through

each of five Hall effect sensors. The transmitter meter reading is then adjusted to match this current.

In addition to the high voltage wire and a multi-turn degaussing coil running through the sensor, each Hall effect sensor assembly contains an additional loop of wire. This wire has been installed for the express purpose of facilitating the application of a test current through the sensor. The ends of this test loop are accessible on the printed circuit board at the brass threaded terminals E6 and E7. See Figure 3-10 in Section III. The checkout procedure is as follows:

- a. Assure that the BEAM SUPPLY breakers on the Line Control Cabinet are OFF.
- b. On the Control Cabinet, remove the front panel covering the current and voltage metering boards. The visual boards are in the compartment on the left; the aural on the right.
- c. Remove the current board (top board) and re-install it on the extender board.
- d. Power up the transmitter to the FIL ON level.
- e. Press the BEAM OFF button to operate the Hall sensor degaussing circuit.
- f. Refer to schematic 839 7891 024. Locate test points TP1 through TP5 on the board and one of the ground plane terminals TP10 through TP15. TP1 through TP5 are connected to the respective outputs of the current sensors for klystron collectors C1 through C5.
- g. Using a digital voltmeter with the negative lead connected to one of the ground plane terminals, measure the voltage at each of the terminals TP1 through TP5. The voltage at each terminal should be within the range 0.8-1.2 volts. Any terminal measuring a voltage out of this range indicates a Hall sensor that needs adjustment. Collector Current Sensor Adjustment should be accomplished on the sensor before proceeding.
- h. Rotate the COLLECTOR VOLTAGE/CURRENT meter selection switch on the Amplifier Cabinet to each collector and zero the COLLECTOR CURRENT meter at each switch position using the METER ZERO pots on the board.
- i. Connect the external power supply to the test loop of the Hall sensor for the collector under calibration. See Figure 3-10 in Section III.
- j. Set the test power supply to minimum current.
- k. Switch the front panel COLLECTOR VOLTAGE/CURRENT meter switch to the appropriate position. Monitoring the test meter, slowly increase the test current to the calibration current shown in Table 5-5.

NOTE

If a sudden, heavy current was inadvertently passed through the sensor in the previous step, the sensor should be de-gaussed by pressing the BEAM OFF button before proceeding to the next step.

- l. Reverse polarity of the test power supply if the transmitter meter deflects below zero. If the polarity was reversed, press the BEAM OFF button to activate the degaussing circuit before proceeding.

Table 5-5. Collector Currents & Overload Settings

COLLECTOR CURRENT METER CALIBRATION LEVELS		OVERLOAD SETTING
C1	1.0 A	2.5 A
C2	1.0 A	2.5 A
C3	1.5 A	2.5 A
C4	5.0 A (3.0A AURAL)	6.0 A (4.0A AURAL)
C5	1.0 A	2.0 A

- m. Using the appropriate METER CALIBRATE pot on the PC board, adjust the meter reading to match that of the test meter.
- n. Repeat the above procedure for each of the five collector circuits.

5.8.10. COLLECTOR CURRENT SENSOR ADJUSTMENT (HALL EFFECT SENSOR)

Adjustments to the Hall sensor need only be done if:

- a. Under zero feed-through current conditions, the terminated output voltage of the sensor is outside the range .8-1.2 Vdc. See the previous procedure Collector Current Metering Calibration.
- b. A replacement sensor is to be installed in the transmitter. The procedure involves removing the sensor from the cabinet, connecting it to its internal cabinet connections with extension cables, and making adjustments to the sensor using an externally produced DC current flowing through the sensor hole.
- c. If the sensor needing adjustment is mounted in the transmitter, detach the high voltage wire and pull it out of the sensor, unplug the BNC and 3-pin plug from the sensor PC board, and unbolt the whole sensor assembly (2 bolts) and remove it from the cabinet. If the sensor is new, make sure that it has been assembled into its copper mounting and is completely wired to the PC board.
- d. In order to adjust the sensor outside the cabinet (so power can be applied to the cabinet), connect the BNC and 3-pin extension cables from the cables inside the cabinet to the sensor to be adjusted. **BE ABSOLUTELY SURE THAT THE 3-PIN PLUGS & JACKS ARE CONNECTED PROPERLY. DAMAGE TO THE SENSORS CAN RESULT FROM AN INCORRECT CONNECTION.**

WARNING

THE BEAM SUPPLY BREAKERS (CB6 & CB8) ON THE LINE CONTROL CABINET MUST BE OFF.

- e. Connect the positive lead of a digital voltmeter to sensor PC board terminal E2 or the O (OUT) terminal of the sensor, whichever is more convenient. Connect the negative meter lead to PC board terminal E3 or sensor terminal -.
- f. Connect an external 0-6 ampere power supply and test current meter to terminals E6 and E7 as shown in Figure 3-10, Section III. Do not energize the power supply yet.

- g. Power up the cabinet to the FIL ON condition.
- h. The sensor is sensitive to the earth's magnetic field; therefore during adjustments, it should be oriented in the same manner as it is when mounted in the cabinet.
- i. Press the BEAM OFF button on the cabinet to active the de-gaussing circuit.
- j. With zero current flowing through the sensor hole (from the test power supply), rotate the adjustment control labelled N (Null) until the digital voltmeter measuring the sensor output reads 1.00 volts.
- k. Slowly increase current from the 0-6A power supply until the supply is producing exactly 6.00 amperes. If the test current surges when the supply is turned on or when current begins to increase, the sensor should be de-gaussed again (BEAM OFF button) before the following adjustment is made.
- l. With the test power supply producing exactly 6.00 amperes, rotate the S (Sensitivity) adjustment until the output voltage is exactly 1.24 volts. (0.040 volts increase per ampere of test current).
- m. Remove the test current, de-gauss the sensor, and recheck and re-adjust the NULL adjustment for 1.00 volts.
- n. The two controls interact with each other. Therefore repeat applying test current, adjusting the SENSITIVITY control, degaussing, and re-setting the NULL at zero current until both 1.00 volts and 1.24 volts outputs are obtained under the respective test current conditions.
- o. Check linearity of the sensor by seeing that the output voltage changes at a linear rate with the test current. The output voltage should be 1.24V at 6.0A test current, 1.18V at 4.5A test current, 1.12V at 3A test current, and 1.06V at 1.5A test current.
- p. When adjustment is complete, remove all voltages and re-install the sensor into the cabinet.

CAUTION

Be sure to re-install the high voltage wire through the center hole of the sensor and re-connect it to its terminal on the resistor assembly. Also, be sure the 3-pin plug is properly attached to the sensor PC board. Incorrect installation can damage one or more Hall effect sensors and the Collector Current Metering and Overload PC board in the Control Cabinet.

- q. Perform the Collector Current Metering Calibration procedure on the circuit associated with the sensor just re-installed.

5.8.11. OVERLOAD/INTERNAL INTERLOCK ADJUSTMENTS

WARNING

ALL OVERLOAD/INTERLOCK ADJUSTMENTS SHOULD BE MADE WITH THE LINE CONTROL CABINET BEAM SUPPLY CIRCUIT BREAKERS SET TO OFF.

5.8.11.1. Body Current

The Body Current overload is the most important overload in the transmitter. Use special care to assure that it is properly operating.

- a. See Figure 3-9 in Section III. Use an external variable current source capable of producing 200mA at approximately 1Vdc. A standard D size battery and a 20 ohm pot wired as shown in Figure 3-9 will suffice. Using alligator clips or other such temporary attachments, connect the positive lead to TP1 and the negative lead to ground as shown. TP1 is located just below the Hall effect sensors in the compartment in front of the klystron and is the terminal that the return lead from the beam supply is connected. Make the temporary leads long enough so that the potentiometer can be adjusted while observing the body current meter on the front of the transmitter.
- b. On the Control Cabinet, remove the front panel covering the current and voltage metering boards. The visual boards are in the compartment on the left; the aural on the right.
- c. Remove the current board (top board) and re-install it on the extender board. Locate the BODY CURRENT OVERLOAD SET pot (R610) on the board. See also schematic 839 7891 024.
- d. Apply control circuit power to the transmitter cabinets.
- e. Using the test fixture potentiometer, set the body current to 100mA.
- f. If the BODY CURRENT OVERLOAD LED is not illuminated, rotate the BODY CURRENT OVERLOAD SET pot counter-clockwise until the BODY CURRENT OVERLOAD LED just illuminates. If the LED is illuminated when current is applied, first rotate the pot clockwise until the LED can be reset (OVERLOAD INDICATOR RESET) button, then rotate the overload set pot counter-clockwise until the overload LED just illuminates.
- g. Test the overload trip point by first reducing the test current, resetting the overload, then slowly raising the test current to check the trip point.

5.8.11.2. Collector Current

This procedure uses the collector meter zeroing pots to create a voltage on the overload circuits equivalent to that produced by excessive current through the Hall effect sensors.

- a. On the Control Cabinet, remove the front panel covering the current and voltage metering boards. The visual boards are in the compartment on the left; the aural on the right.
- b. Remove the current board (top board) and re-install it on the extender board. Locate the five collector current OVERLOAD SET pots on the board. See also schematic 839 7891 024.
- c. Apply control circuit power to the transmitter cabinets.
- d. Select the collector whose overload is to be set and locate the METER ZERO pot for that collector. Set the COLLECTOR VOLTAGE/CURRENT meter switch to the collector overload being adjusted.
- e. Rotate the METER ZERO adjustment pot until the current meter deflects to the overload set value given in Table 5-5.
- f. If the applicable collector current overload LED is not illuminated, rotate the applicable collector overload set

pot counter-clockwise until the overload LED just illuminates. If the LED is illuminated when the meter is first deflected to the overload point, first rotate the pot clockwise until the LED can be reset (OVERLOAD INDICATOR RESET) button, then rotate the overload set pot counter-clockwise until the overload LED just illuminates.

- g. Test the overload trip point by first reducing the meter deflection, resetting the overload, then slowly raising the meter deflection to check the trip point.
- h. Using the METER ZERO pots, reset each collector current meter reading to zero.

5.8.11.3. VSWR Overload

The procedure consists of using RF power from the visual exciter connected to the peak detector VSWR input to drive VSWR metering and the overload circuit. The peak detector is accessible from the rear of the amplifier cabinet.

- a. Use a 50 ohm BNC equipped jumper cable to temporarily connect the output of the Visual Exciter to J2 of the peak detector.
- b. Set the Amplifier Cabinet POWER OUTPUT metering switch to VSWR.
- c. Turn Visual Exciter ON.
- d. Raise the visual power control until the VSWR meter reads 1.4.
- e. At the rear of the amplifier cabinet, adjust the VSWR overload trip point potentiometer (R9) located near the peak detector BNC input connectors.

NOTE

When the overload point is reached the overload indicator will illuminate.

- f. Remove the temporary cable and re-connect the original cables.

5.8.11.4. Arc Overload

The procedure consists of temporarily substituting the cavity arc sensors with a known fixed resistance. The overload sensitivity is then adjusted based on the fixed resistance. The arc detector assembly is accessible at the rear of the amplifier cabinet.

- a. Turn the arc overload adjustments fully CCW.
- b. Disconnect the cavity arc sensor cable from the arc detector.
- c. Temporarily connect a 1 Meg ohm resistor from pin 1 to pin 2 of J2 or J3. (J2 for fourth cavity overload; J3 for the third cavity).
- d. Slowly rotate the appropriate arc overload adjustment clockwise until the cavity ARC OVERLOAD LED on the front of the cabinet illuminates.
- e. Remove the 1 Meg ohm resistor and reset the overload and fault indicators.
- f. Reconnect the arc sensor cable.
- g. Depress the appropriate front panel ARC OVERLOAD TEST pushbutton to assure that the overload is operating properly. (The overload indicator should light.)
- h. Repeat steps a. through g. for the other cavity detector.

5.8.11.5. Magnet Current Out of Range Interlock

The procedure consists of adjusting magnet current to its lower and upper operating limits, then adjusting the interlock trip point so the interlock occurs at these current levels.

- a. Power up the cabinet to the FIL ON level.
- b. If the magnet current has been previously set for operation, note and record the operational magnet current.
- c. Reduce the magnet current to 9A.
- d. Through the adjustment hole on the front door of the amplifier cabinet, adjust the MAGNET UNDERCURRENT TRIP ADJUST control to the point where the MAGNET CURRENT IN RANGE indicator just extinguishes.
- e. Raise the magnet current slightly. The MAGNET CURRENT IN RANGE INDICATOR should light.
- f. Increase the magnet current to 12A.
- g. Through the adjustment hole on the front door of the amplifier cabinet, adjust the MAGNET OVERCURRENT TRIP ADJUST control to the point where the MAGNET CURRENT IN RANGE indicator just extinguishes.
- h. Lower the magnet current slightly. The MAGNET CURRENT IN RANGE INDICATOR should light.
- i. Re-adjust the magnet current to 10A or to the operational current level recorded in Step a.

5.8.11.6. Refocus Current Out of Range Interlock

The procedure consists of adjusting refocus current to its lower and upper operating limits, then adjusting the interlock trip point so the interlock occurs at these current levels.

- a. Power up the cabinet to the FIL ON level.
- b. If the refocus current has been previously set for operation, note and record the operational knob setting.
- c. Adjust the refocus knob setting to number 7.
- d. Through the adjustment hole on the front door of the amplifier cabinet, adjust the REFOCUS UNDERCURRENT TRIP ADJUST control to the point where the REFOCUS CURRENT IN RANGE indicator just extinguishes.
- e. Raise the refocus current slightly by rotating the knob clockwise. The REFOCUS CURRENT IN RANGE INDICATOR should light.
- f. Adjust the refocus knob setting to number 12.
- g. Through the adjustment hole on the front door of the amplifier cabinet, adjust the REFOCUS OVERCURRENT TRIP ADJUST control to the point where the REFOCUS CURRENT IN RANGE indicator just extinguishes.
- h. Lower the refocus current slightly by rotating the knob counter-clockwise. The REFOCUS CURRENT IN RANGE INDICATOR should light.
- i. Re-adjust the refocus knob to the center of the range or to the operational current level recorded in Step a.

5.9. RF AMPLIFICATION SYSTEM: TEST/ADJUSTMENT

5.9.1. KLYSTRON PRE-TUNING

Pre-tuning the klystron cavities is necessary only under the following circumstances:

- a. Initial installation of the cavity
- b. A previously tuned cavity has been disassembled for repair
- c. The cavities are not re-installed in the same position as they were before removal (i.e. Cavity 1 at bottom, cavity 2 next, etc.)
- d. The klystron is to be used on a different operating channel.

Pre-tuning the cavities is not necessary when replacing the klystron, provided the cavities are re-installed in the same positions.

Pre-tuning is accomplished by setting the cavity doors (movable walls in the cavity) to the point where the volume between the cavity walls is resonant at a frequency in the operating channel bandwidth.

Perform the following procedure:

- a. Connect a UHF sweep generator, or the Visual Exciter to one of the klystron cavities using a directional coupler or impedance bridge as shown in Figure 5-1. Note that the directional coupler is oriented to monitor the reflected signal from the cavity.
- b. Adjust the sweep generator to sweep frequencies approximately one full channel on either side of the channel of interest.
- c. Consult the klystron manufacturer's Technical Data for the chart of cavity adjustments versus channel. (Assure that the channel designation is for CCIR-M channels (United States) and not CCIR-G system channels (European)).
- d. Set the tuning knob and both front and back cavity doors to the distances indicated by the klystron manufacturer.
- e. Observe the signal from the directional coupler and look for a notch in the response that indicates resonant frequency.
- f. Adjust the cavity coupling loop to the horizontal position (perpendicular to the length of the klystron) in order to increase the Q of the notch in the response and make it easier to see.
- g. Adjust both cavity doors until the notch is somewhere within the passband, then use the tuning knob to set the notch on the proper frequency as follows:

VISUAL CAVITY	SERVICE FREQUENCY
1	VISUAL CARRIER -1 MHz
2	VISUAL CARRIER +2 MHz
3	VISUAL CARRIER +10 MHz
4	VISUAL CARRIER

AURAL CAVITY	SERVICE FREQUENCY
1	AURAL CARRIER - 1/2 MHz
2	AURAL CARRIER + 1/2 MHz
3	AURAL CARRIER + 10 MHz
4	AURAL CARRIER

- h. Repeat the procedure for each of the cavities. The fourth cavity should have a 3-1/8 to N reducer attached to the output elbow in order to attach the directional coupler. The Q of cavity 4 is less than the other cavities; therefore the notch will be quite broad and may be difficult to see.

- i. See Figure 5-2. Initially set each cavity coupler as follows:
 - 1st cavity: approximately 45
 - 2nd cavity: approximately 45
 - 3rd cavity: fully uncoupled: 0
 - 4th cavity: fully coupled

WARNING

IT IS IMPERATIVE THAT THE 4TH CAVITY COUPLING LOOP IS INITIALLY FULLY COUPLED. ASSURE THAT THE INTERNAL LOOP IS PARALLEL TO THE KLYSTRON BODY. SEE FIGURE 5-2.

5.9.2. CONDITIONING PROCEDURE FOR A NEW KLYSTRON (OR SPARE KLYSTRON IN EXTENDED STORAGE)

- a. Pre-tune the cavities if not previously done.
- b. If the klystron will be used in visual service, re-tap the mod anode voltage divider to produce approximately 1/2 the beam current expected to be needed for normal operation. For aural service, the mod anode tap can be set to produce expected operational beam current. See drawing 839 7891 059.
- c. Assure the klystron is terminated in 50 ohms.
- d. Set the Line Control Cabinet circuit breakers to ON.
- e. Set the pulser to OUT.
- f. Depress the FIL ON pushbutton. Set filament voltage and magnet current to the values specified on the klystron test data sheet (filament = 7.0V typically, magnet current = 10-11A typically).
- g. Check the ion pump current meter for ion current in excess of 10uA. A new tube or a tube that has been stored may draw ion current when filaments are energized. The current should become less as the tube vacuum improves.
- h. After 10 minutes of filament operation, depress the BEAM ON pushbutton. Operate the klystron for 30 minutes at reduced beam current.
- i. Turn off beam and filament voltage and set the BEAM SUPPLY circuit breakers on the Line Control Cabinet to OFF.
- j. In several steps, increase beam current until it equals the value given in the klystron test data sheet. Assure the pulser is set to OUT (off). Check the collector currents at each step; with no drive all collector currents except C4 should be zero or very low.
- k. Refer to the tuning procedures and gradually bring up RF drive, tune klystron, and operate at full beam current for 2 hours.

5.9.3. PULSER COARSE TIMING: KLYSTRON OFF

This procedure assures that a reasonable sync shape is present before the klystron first turned on. Subsequent coarse timing adjustments may be accomplished after the klystron is producing power by using the PULSER COARSE TIMING: KLYSTRON ON procedure. Accomplish the current procedure by comparing the timing of the demodulated exciter RF sync pulse with the annular ring pulse. Adjustments are made for leading and trailing edge timing.

WARNING

DISCONNECT ALL POWER BEFORE PERFORMING THE FOLLOWING STEP.

- a. Connect a dual channel oscilloscope as shown in Figure 5-3. Operate the Visual Exciter to assure that a demodulated waveform with sync appears on the scope.
- b. Assure that the VSB filter switch and the DELAY LINE switch in the Visual Exciter are set to IN.
- c. Rotate the PULSE AMPLITUDE control on the front of the Visual Amplifier cabinet fully counterclockwise.

WARNING

A HIGH VOLTAGE (2000 VOLTS) SCOPE PROBE MUST BE UTILIZED FOR THE FOLLOWING STEPS. EVEN THOUGH THE PROCEDURE CALLS FOR PULSE AMPLITUDE ADJUSTMENTS OF ONLY 100 VOLTS, A MIS-ADJUSTMENT COULD CAUSE THE PULSER TO PRODUCE PULSES UP TO 1300VDC. THIS IS USUALLY MORE VOLTAGE THAN AN OSCILLOSCOPE CAN WITHSTAND. CARE MUST BE TAKEN TO NOT EXCEED THE OSCILLOSCOPE VOLTAGE RATING.

WARNING

MAKE SURE THAT THE BEAM SUPPLY CIRCUIT BREAKERS ON THE LINE CONTROL CABINET ARE OFF.

- d. Set the pulser status to PULSER IN.
- e. Depress the Visual FIL ON push button.
- f. Slowly increase the pulse voltage using the PULSE AMPLITUDE control until a 100 volt pulse is produced.
- g. Compare the leading and trailing edge timing of the pulser pulse with the exciter sync pulse. Use the pulser LEADING EDGE and TRAILING EDGE timing adjustments on the front of the amplifier to make them coincident.
- h. Depress the FIL OFF switch.

WARNING

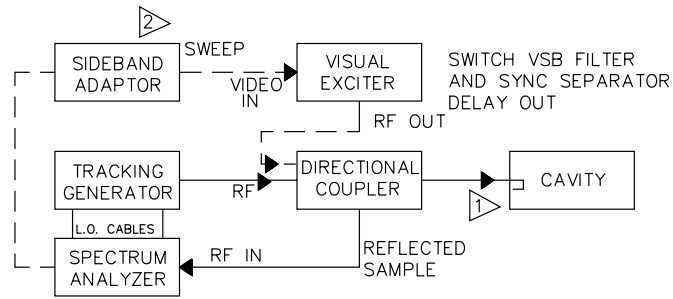
REMOVE ALL POWER BEFORE PERFORMING THE FOLLOWING STEP.

- i. Remove the oscilloscope probe from the base of the klystron.

5.9.4. VISUAL SERVICE: KLYSTRON TUNING AND ADJUSTMENTS

The general procedure for tuning and adjusting the visual klystron consists of:

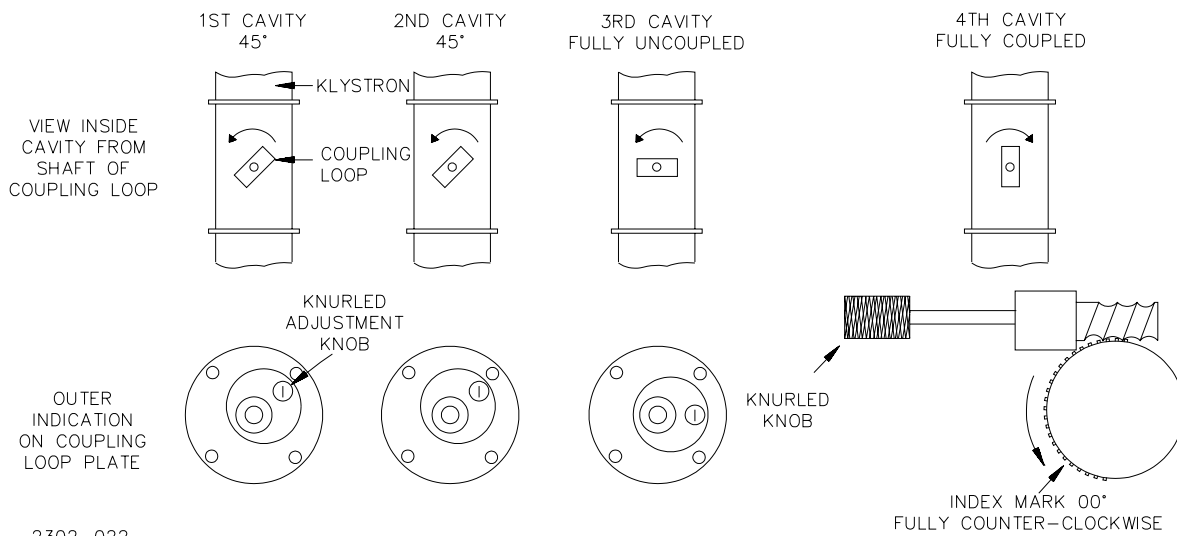
1. With pulser off, coarsely adjust klystron frequency response.
2. With pulser off, adjust beam current and klystron output cavity coupling loop so klystron saturation occurs just at the needed peak power (sync tip).
3. With pulser operating, adjust pulser amplitude so that, during the video portion of the picture, klystron saturation occurs just above the power needed at video blanking amplitude.
4. With the pulser operating, perform coarse linearity adjustments and re-adjust and finalize klystron frequency response.
5. With the pulser operating, perform video performance adjustments and balance that performance against klystron efficiency.



2262-027

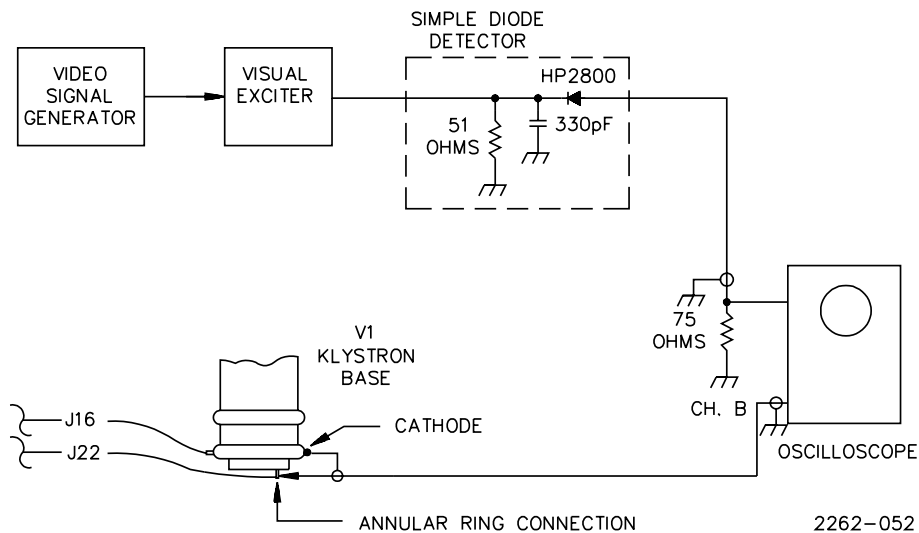
- 1 A 3-1/8" TO N REDUCER IS REQUIRED TO TUNE CAVITY 4
- 2 VISUAL EXCITER MAY BE USED AS RF SOURCE IF TRACKING GENERATOR IS NOT AVAILABLE

Figure 5-1. Test Equipment Set Up for Klystron Pre-Tuning



2302-022

Figure 5-2. Initial Coupling Loop Settings



2262-052

Figure 5-3. V1 Pulsar Coarse Timing Set Up

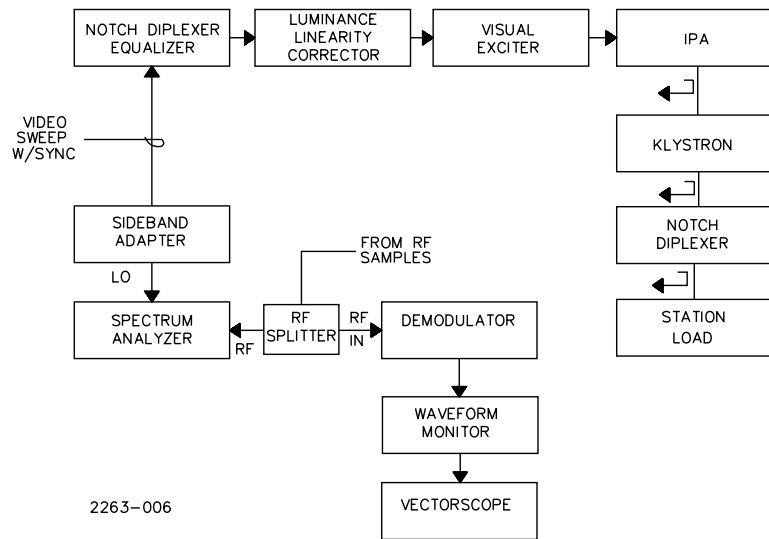


Figure 5-4. Visual Tuning Test Equipment Set Up

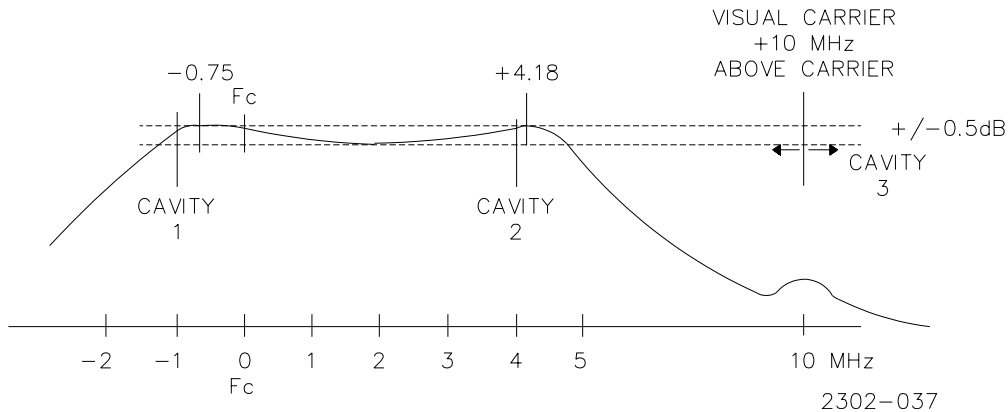


Figure 5-5. Visual Tuning Waveform

5.9.4.1. TUNING AND ADJUSTMENTS TO OBTAIN RATED POWER (PEAK POWER)

- a. Assure that the klystron cavities have either been previously tuned and have been re-installed in the same position or have been pre-tuned.
- b. Connect the klystron output to a 50 ohm 50 kW (minimum) load.
- c. Set up the test equipment per Figure 5-4.
- d. Set MOD ANODE BIAS RAISE/LOWER motor pot to mid range. The easiest way to do this is to measure the time it takes for the motor to travel its full range. Using the front panel raise/lower switch and monitor the end of travel with the ADJ LIMIT LED. Once full travel time is established, operate the motor the opposite direction for 1/2 the time measured.
- e. Switch OUT (bypass) the following:
 - Notch Diplexer Equalizer (IPA cabinet)
 - Luminance Linearity Corrector (IPA cabinet)
 - VSB Filter (visual exciter; See Figure 5-7)
 - Delay Line (visual exciter; See Figure 5-7)
 - IF Linearity Corrector (visual exciter; See Figure 5-7)
 - ICPM Corrector (visual exciter; See Figure 5-7)

- Differential Phase Corrector (visual exciter; See Figure 5-7)
- Delay Compensation (both sections) (visual exciter; See Figure 5-7)
- Pulsar OUT (amplifier cabinet)

NOTE

See Figure 5-7. In the following procedures, whenever the exciter VSB Filter bypass switch is operated, the Delay Line Bypass switch, also in the exciter, must be operated at the same time. Both switches should be thrown in the same direction: either towards the front of the exciter or away from the front. Failure to do this affects the AGC circuits of the exciter and IPA and can result in apparently unexplained changes in klystron output power.

- f. Apply video sweep with sync to transmitter video input. Check Visual Exciter and IPA RF output for flat response and proper depth of modulation - refer to Visual Exciter or IPA Technical Manual if adjustment is needed.
- g. Set Visual Exciter POWER to minimum.
- h. Energize the filament and beam.
- i. Slowly increase drive until a usable display appears on the spectrum analyzer. Keep the klystron output power low.

- j. Readjust tuning and coupling of cavities 1 and 2 for a swept response similar to Figure 5-5. At this time the frequency response adjustment need only be a coarse adjustment; adjusting only to assure that a rough band-pass shape can be produced.
- k. Check to make sure the 3rd cavity is tuned to a frequency high above the passband. This can be checked by rocking the cavity tuning back and forth while looking carefully for a slight bump on the upper slope of the passband. The bump should be seen changing frequency as the cavity is rocked. The third cavity should be set approximately 10MHz higher than the visual carrier frequency and in no case should be closer to the visual carrier than +6MHz.

WARNING

SETTING THE 3RD CAVITY CLOSER IN FREQUENCY TO VISUAL CARRIER THAN +6MHZ WILL VERY LIKELY CAUSE KLYSTRON DAMAGE OR DESTRUCTION AS OPERATING POWER LEVELS ARE REACHED.

- l. Set the demodulator to the MANUAL GAIN mode and set the waveform monitor to DC COUPLING, and DC RESTORE OFF.
- m. Increase Visual Exciter POWER while observing the demodulated video signal and adjusting the demodulator manual gain until sync is heavily saturated.
- n. Adjust cavity 4 tuning for maximum sync power output as read on the remote tuning meter.

CAUTION

IN THE FOLLOWING STEP, ADJUSTING THE 4TH CAVITY COUPLING LOOP FURTHER TOWARDS THE UNCOUPLED POSITION THAN WHAT IS REQUIRED FOR MAXIMUM SYNC POWER WILL RESULT IN RF CAVITY ARCING AND POSSIBLE DAMAGE TO THE KLYSTRON. ASSURE THAT THE ARC DETECTOR PROTECTION CIRCUITS ARE WORKING PROPERLY.

- o. See Figure 5-2. Carefully adjust the 4th cavity coupling loop toward the uncoupled region. Adjust the loop position for maximum power at sync tip while sync is driven into saturation. When maximum saturated power is found, then back the coupling adjustment off 1 or 2 degrees toward the fully coupled or safe region.
- p. Re-check the cavity 4 tuning for maximum sync power output as read on the remote tuning meter. If beam current is changed later, the 4th cavity tuning and coupling may have to be readjusted.
- q. Switch in VSB FILTER and DELAY LINE switch (Figure 5-7) in the Visual Exciter.
- r. Apply a blanking level video signal with sync.
- s. Reduce the exciter power and switch in the IF linearity corrector board.
- t. Calculate the needed average power with a blanking level signal (sync power/1.68 = average power). Monitor the in-line wattmeter for the needed average power while adjusting the exciter power and THRESHOLD 4 and SLOPE 4 controls of the IF Linearity Corrector (See Figure 5-7) for proper sync ratio as seen on the waveform monitor.

- u. If the proper sync to video ratio cannot be obtained at the needed average power, and the accuracy of the in-line wattmeter is not known, set the exciter power and linearity adjustments to the highest power that does yield the proper ratio and perform a calorimetric power measurement. If the transmitter peak power meter has not been calibrated, it can be done at this time by setting it to a percentage reading other than 100%. The setting is calculated by:

$$\frac{((\text{CALORIMETRIC AVG PWR} \times 1.68) / \text{DESIRED SYNC PEAK PWR}) \times 100}{\text{PERCENT OF DESIRED SYNC PEAK POWER}}$$

- v. When the actual output power is known, and the power being produced is too high, the klystron beam current should be reduced until klystron saturation occurs at the desired peak sync power.
- w. When the actual output power is known, and the power being produced is too low, the beam current may have to be increased. However before increasing beam current, try the following:
 - 1. Check C1 collector voltage (same as the cathode voltage) and compare with the klystron data sheet.
 - 2. Assure that sufficient drive signal is present by checking the demodulated output of the IPA to assure the signal is not saturated. (Maximum collector current into the IPA final transistors should not exceed 2.5A with a blanking level picture).
 - 3. Very slowly change magnet current and see if an increase in peak power can be obtained while maintaining a low (below 50mA with blanking level picture) body current and a stable sync pulse.
 - 4. Try moving the klystron 3rd cavity tuning slightly. Change the transmitter input back to the swept frequency signal to be able to monitor the frequency setting of the cavity as it is changed. Be sure to switch OUT the VSB Filter and Sync Separator DELAY LINE switches in the Visual Exciter so the third cavity bump can be seen. If the cavity is initially set around +10Mhz above visual carrier, try re-setting it to +9MHz or +8MHz. It is recommended that it NOT be tuned lower than +8MHz. If it is tuned around +8MHz, try moving the cavity higher in frequency. The setting of the cavity is similar to the setting of the 4th cavity coupling loop in that there is a frequency setting which will allow the klystron to produce maximum saturated power.
- x. If the above fail to produce the power needed, increase beam current. If the mod anode taps have to be changed to obtain the current needed, the 4th cavity coupling loop should be set more heavily coupled (change the setting more towards the safe setting) before the beam current is increased. A new maximum saturated power setting of the coupling loop should then be established after the current is increased. Changing beam current with the front panel MOD ANODE BIAS SWITCH will not require re-setting the 4th cavity coupling.

- y. Complete visual klystron tuning and adjustments by performing the efficiency enhancement procedures that follow.

5.9.4.2. TUNING AND ADJUSTMENTS TO OBTAIN BEST EFFICIENCY: PULSER AND KLYSTRON ADJUSTMENTS

- a. For a new transmitter installation, or after replacement of the Pulser Controller Assembly, assure that the PULSER COARSE TIMING: KLYSTRON OFF procedure has been completed.
- b. Assure the klystron, operating with fixed beam current (pulser off), has been adjusted to produce the needed peak sync power output.
- c. Feed a blanking plus sync signal into the transmitter video input.
- d. Set Visual Exciter POWER to minimum. If not already on, energize the klystron beam.
- e. Set the pulser to IN (turn on pulser).
- f. Monitor C4 current and adjust pulser SYNC AMPLITUDE control on the Pulser Controller to reduce C4 current. A good starting value is 4A.
- g. Set the demodulator to AGC on sync tip instead of blanking and set the waveform monitor to DC RESTORE on sync rather than on blanking.
- h. Slowly increase the exciter power until the amplifier power output meter reads 100%.
- i. Note that at this point the waveform monitor shows that the blanking to sync ratio is not correct. The signal apparently contains far too much sync signal.
- j. Slowly increase the Visual Exciter POWER and note that on the video monitor, the blanking level power is increasing. Note also that the peak power as read on the amplifier cabinet is lower than it was, indicating that the sync pulse is being pushed hard into saturation. The output power is actually going down as exciter power is increased. Also, body current will climb sharply.
- k. Adjust the SYNC REDUCTION A potentiometer on the Phase Modulator board in the Visual Exciter (see Figure 5-7) to reduce the amount of sync applied to the klystron. Peak sync output power should climb to a peak and then start back down in power. Body current should decrease as output sync power increases.
- l. Continue increasing exciter power and readjust the sync reduction control until the proper sync to video ratio is reached, the in-line wattmeter is reading the correct average power, and the cabinet output peak power meter reading is 100%.
- m. If the proper ratio cannot be obtained, fine adjustments to beam current may be made as follows:
The Pulser PULSE AMPLITUDE control will increase or decrease blanking mode current. Use this to adjust the current needed to obtain enough power at blanking.
The MOD ANODE BIAS adjust switch increases or decreases both sync level and blanking level current. Use this control primarily to adjust for adequate peak sync power, then readjust the pulse amplitude control for proper blanking power.
- n. Re-tune cavities 1 and 2 for changes in response due to the reduced beam current.

- o. Apply a staircase or ramp video test signal. Set the demodulator to SYNC AGC and use SYNC DC RESTORE on the waveform monitor.

CAUTION

IN THE FOLLOWING STEP, MONITOR THE CURRENT OF THE IPA FINAL TRANSISTORS USING THE METERING ON THE FRONT OF THE IPA CABINET. DO NOT PERMIT THE CURRENTS TO EXCEED 2.5 AMPERES.

- p. Increase the Visual Exciter power until the average power at blanking saturates as seen by the average power meter starting to fold back, then reduce power somewhat (do not operate more than a few minutes at saturation). The klystron should saturate approximately 3kw higher than normal blanking power. The PULSE AMPLITUDE control adjusts this saturation point. The closer the saturated power is to the blanking power needed, the better the efficiency. However, as saturation approaches blanking level power, signal pre-correction becomes more difficult.
- q. Reset the exciter to produce normal blanking power.
- r. Check the IPA agc setup at this time. Refer to the IPA Technical Manual 988 2264 001 for the procedure.
- s. Using the appropriate test signals, attempt to optimize differential gain, ICPM, differential phase, and low frequency linearity. See the Visual Exciter Technical Manual and the vender's Luminance Linearity Corrector (low frequency linearity) Manual for instructions concerning optimizing these parameters.
- t. If the signal is distorted beyond correction, increase blanking saturation with the PULSE AMPLITUDE control. If excess blanking power is available and efficiency is too low, decrease blanking saturation. Set to a level that offers the best compromise of efficiency and performance.
- u. Re-check frequency response and proceed to optimize the signal parameters. See Signal Pre-Correction Adjustments.

5.9.5. EFFICIENCY MEASUREMENT AND CALCULATION

Klystron efficiency is calculated by the following:

$$(\text{POWER OUT}/\text{POWER INPUT}) \times 100 = \% \text{ EFFICIENCY}$$

Because the visual klystron output is rated by the peak sync power, the term Figure of Merit is often used instead of efficiency when the peak output power is used for the POWER OUT term in the formula.

To calculate Figure of Merit for the MSDC klystron, use the following in the above formula:

POWER OUT = Peak power output of the klystron.

POWER IN = Sum of the powers of each collector with the klystron being driven by a composite picture with a flat field set to gray picture level. Thus:

$$\begin{aligned} E_{c1} \times I_{c1} &= P_{c1} \\ E_{c2} \times I_{c2} &= P_{c2} \\ E_{c3} \times I_{c3} &= P_{c3} \\ E_{c4} \times I_{c4} &= P_{c4} \\ E_{c5} \times I_{c5} &= P_{c5} \end{aligned}$$

TOTAL = POWER INPUT

Where E_c , I_c , and P_c are the collector voltage, collector current, and collector power respectively.

5.9.6. KLYSTRON BEAM CURRENT ADJUSTMENT

The beam current in each klystron is determined by the beam voltage applied to the cathode and the voltage applied to the mod anode. The mod anode voltage source is a voltage dividing resistor bank located on the right hand side inside each amplifier cabinet. The mod anode connects to a tap point on the resistor string. As the mod anode is made more negative with respect to ground (closer to the cathode potential), klystron beam current is reduced. This reduces the saturated power capability of the klystron.

The visual klystron is equipped with a motorized rheostat in series with the voltage divider. It can vary the voltage of the entire divider and thus also the mod anode.

Ordinarily, total beam current is a summation of all the collector currents plus body current. C4 collector current, when the klystron has no drive, is a close approximation of total beam current.

5.9.6.1. CHANGING VISUAL BEAM CURRENT USING THE MOTORIZED RHEOSTAT

- a. Use the MOD ANODE BIAS RAISE/LOWER switch on the front of the amplifier cabinet. The current can be changed while the klystron is operating. Pushing up on the switch will raise current, pushing down will lower current. Total beam current variation is about 400mA over the range of the control.
- b. When the rheostat reaches the end of its range, the ADJ LIMIT LED will illuminate.

5.9.6.2. CHANGING AURAL BEAM CURRENT; OR VISUAL BEAM CURRENT BEYOND THE RANGE OF THE MOTORIZED RHEOSTAT

WARNING

REMOVE ALL POWER AND USE SHORTING STICK.

- a. Shut off the amplifier cabinet and open the front door.
- b. Remove the tap wire attached to the Aux Zener Diode board (on the right hand side of the cabinet) and re-attach in the desired location. Moving the tap one zener will change beam current approximately 0.05 amperes. The lower resistor nearest the front door is connected nearest to ground. Moving the tap electrically closer to this resistor will increase current. Moving the opposite way will reduce current.
- c. Replace the shorting stick, close the front door, and turn on the transmitter.

5.9.6.3. CHANGING VISUAL OR AURAL BEAM CURRENT BEYOND THE RANGE OF THE AUX ZENER BOARD

WARNING

REMOVE ALL POWER AND USE SHORTING STICK.

- a. Shut off the amplifier cabinet and open the front door.
- b. Remove the Aux Zener board and exchange mounting positions and wiring with the resistor next to it; if more current is needed, exchange positions with the resistor electrically closer to the ground end of the voltage divider. If less current is needed, exchange positions with the resistor electrically closer to the high voltage end of

the divider. Changing the Aux Zener Board location up or down the voltage divider will move the beam current adjustment window approximately 0.5A per resistor.

CAUTION

THE AUX ZENER DIODE BOARD IS POLARIZED. NO MATTER WHICH RESISTOR THE BOARD REPLACES, TERMINAL E11 MUST BE ORIENTATED ELECTRICALLY TOWARD THE GROUND END OF THE RESISTOR DIVIDER STRING.

OBSERVE PROPER POLARITY OF THE AUX ZENER DIODE BOARD WHEN REINSTALLING IN THE CABINET. IF PROPERLY INSTALLED, THE ZENER BOARD COMPONENTS WILL FACE THE FRONT OF THE CABINET WHEN INSTALLED IN THE 1ST (NEAREST THE FRONT DOOR), 3RD, AND 5TH RESISTOR VERTICAL COLUMNS; THE BOARD COMPONENTS SHOULD FACE THE CABINET REAR IF THE BOARD IS INSTALLED IN THE OTHER COLUMNS.

- c. Assure all wires are re-connected. Re-attach the mod anode high voltage wire to the desired zener board tap.

NOTE

If beam current is being changed only temporarily, such as reduced beam current for conditioning a new tube or for test purposes, the Aux Zener Board does not have to be moved. Simply remove the Mod Anode high voltage wire jumper from the board and attach it directly to the resistor terminal on the voltage divider that will produce the desired beam current.

5.9.7. SIGNAL PRE-CORRECTION ADJUSTMENTS

When rated power and efficiency are achieved for the visual klystron through the VISUAL AMPLIFIER: TUNING AND ADJUSTMENT procedures, final optimization of the transmitted signal can be adjusted.

5.9.7.1. PULSER COARSE TIMING: KLYSTRON ON

Once the klystron has been turned on, this procedure describes a method to further adjust the pulser controller coarse timing controls to assure they are set properly. Perform the following procedure :

- a. Set the pulser to IN (turn pulser on).
- b. Use a diode detector and oscilloscope and set-up as shown in Figure 5-6.

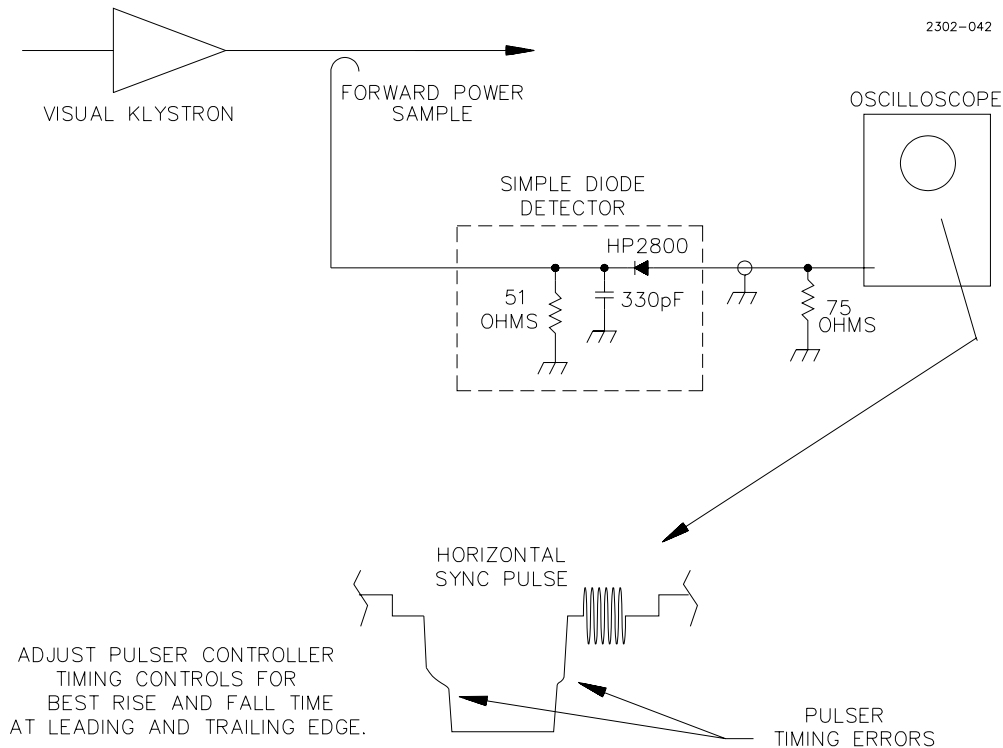
NOTE

Use of a synchronous demodulator instead of the simple diode detector will show the result of phase distortions mixed with the pulser timing errors. This will make timing errors caused by the pulser more difficult to discern.

- c. Use the pulser leading and trailing edge timing adjustments on the amplifier cabinet front panel to optimize the horizontal sync pulse rise and fall times. Since this adjustment is only a coarse adjustment, precise setting is not required; final timing adjustments will be made later with timing adjustments in the visual exciter.

5.9.7.2. COARSE TIMING ADJUSTMENTS: PHASE MODULATOR AND SYNC REDUCTION CIRCUITS

- a. Set the BEAM SUPPLY breakers OFF on both Line Control Cabinets.
- b. Connect the test equipment to the IPA RF sample jack as shown in Figure 5-8(A). Use external sync to trigger the waveform monitor and set the demodulator to the manual gain mode.



**Figure 5-6. Pulser Coarse Timing
With Klystron Operating**

- c. Activate the visual amplifier to the BEAM ON mode (without high voltage).
- d. Set the pulser to IN (ON).
- e. In the Visual Exciter, rotate the PHASE MOD Level, and SYNC REDUCE A potentiometers fully counterclockwise (see Figure 5-7).
- f. Apply a standard stairstep video signal to the transmitter input.
- g. Increase the exciter output power until the IPA output power is approximately 60%.
- h. Expand the waveform monitor presentation to observe horizontal sink pulse. At this point it should resemble a normal sync pulse as shown in Figure 5-8(B).
- i. Rotate the exciter PHASE MOD level pot clockwise to about half its range. Spiking should be seen on or around the leading and trailing edges of the sync pulse. Ideally, the spiking should occur ON the leading and trailing edges as shown in Figure 5-8(C).
- j. If the spiking does not occur on the sync edges, as represented by Figure 5-8(C) and (D), adjust the exciter PHASE MOD LEADING and TRAILING edge timing adjustments until the spiking resembles Figure 5-8(E). The REFERENCE PULSE WIDTH control may have to be rotated a slight amount to adjust the overall width of the pulse that triggers the leading and trailing edge timing adjustments. The desired settings are those that produce the fastest sync rise and fall times and produce the greatest spike amplitude.
- k. Rotate the PHASE MOD level control (Figure 5-7) fully counterclockwise.
- l. Using the SYNC REDUCE A control in the visual exciter, reduce the sync tip amplitude to the blanking level amplitude. See Figure 5-8(F).
- m. Use the exciter SYNC REDUCE LEADING and TRAILING edge timing controls to MINIMIZE the spiking seen on the waveform in the area where sync edges would ordinarily be located. See Figure 5-8(G).
- n. When finished, rotate the SYNC REDUCE A control fully counter clockwise.
- o. Depress BEAM OFF on both visual amplifier cabinets and set the Beam Supply Breakers to ON.

5.9.7.3. SIGNAL OPTIMIZATION

Pre-correction optimization of the visual amplifier should be performed in the following order. Assure that the COARSE TIMING ADJUSTMENTS: PHASE MODULATOR AND SYNC REDUCTION CIRCUITS procedure has been performed. Except where noted, all of the adjustments are in the Visual Exciter. Refer to Figure 5-7 for location and the Visual Exciter Technical Manual (988-2265-001) for information concerning the adjustments.

1. IPA AUTOMATIC GAIN CONTROL (AGC). The action of the rest of the pre-correction adjustments can be affected by the IPA AGC setup. Therefore check and adjust, if necessary, the IPA AGC setup before proceeding. Use the adjustments on the IPA Preamp board and the RF coupler within the IPA Cabinet. Refer to the IPA Technical Manual (988-2264-001) for setup instructions.
2. DIFFERENTIAL GAIN. Use the IF Linearity Corrector. Visual exciter power output settings and sync

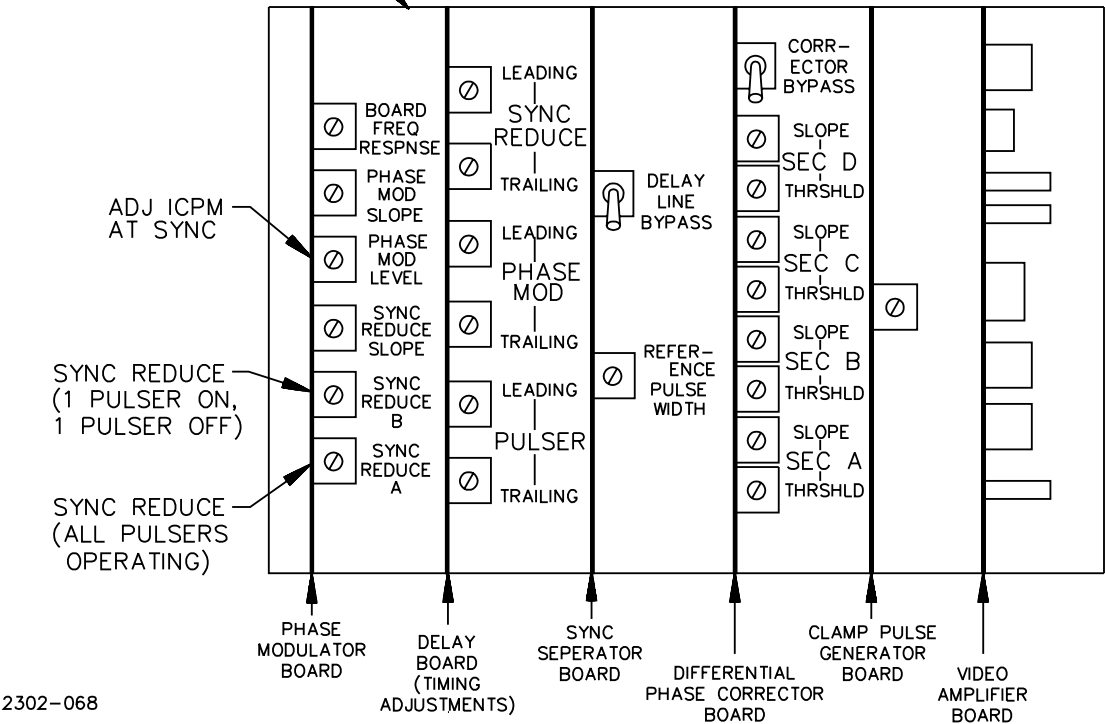
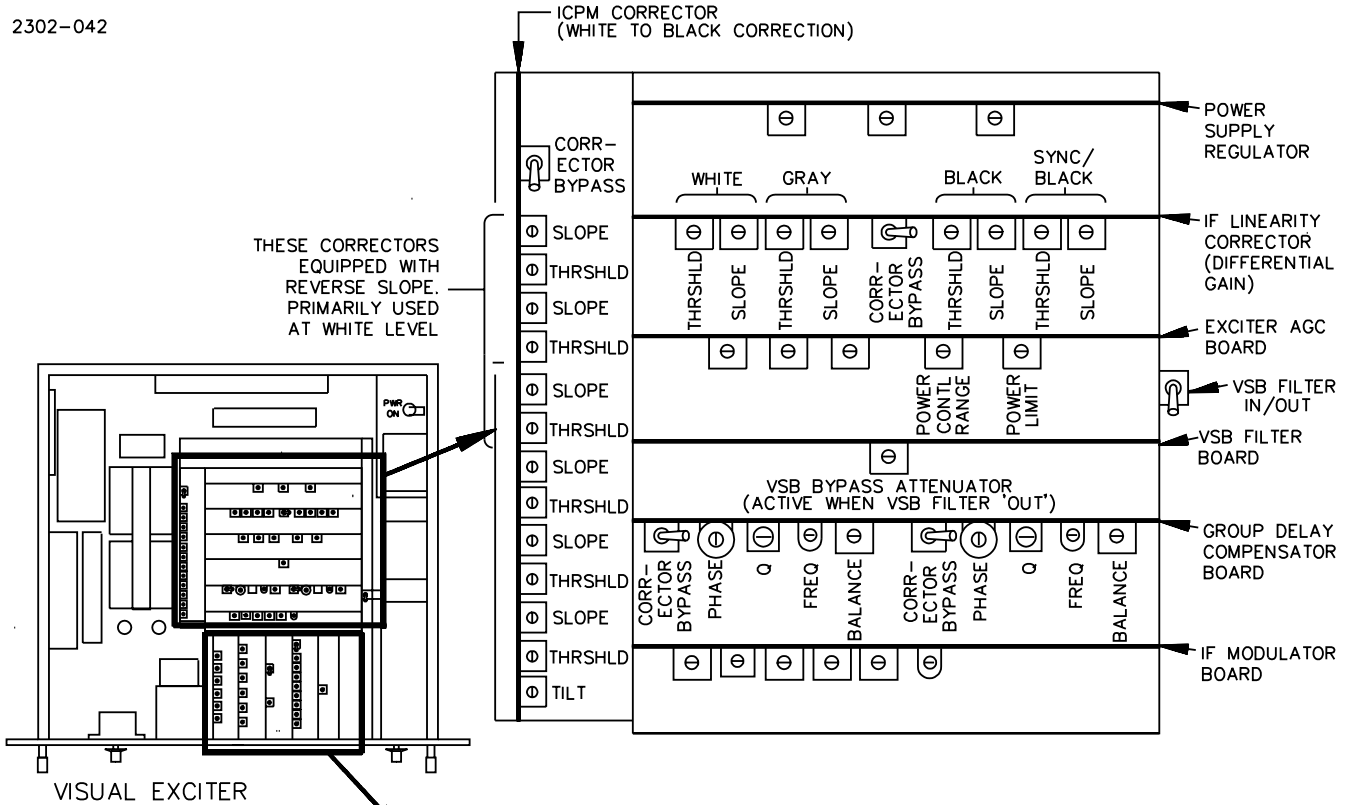


Figure 5-7. Location: Pre-Correction Adjustments

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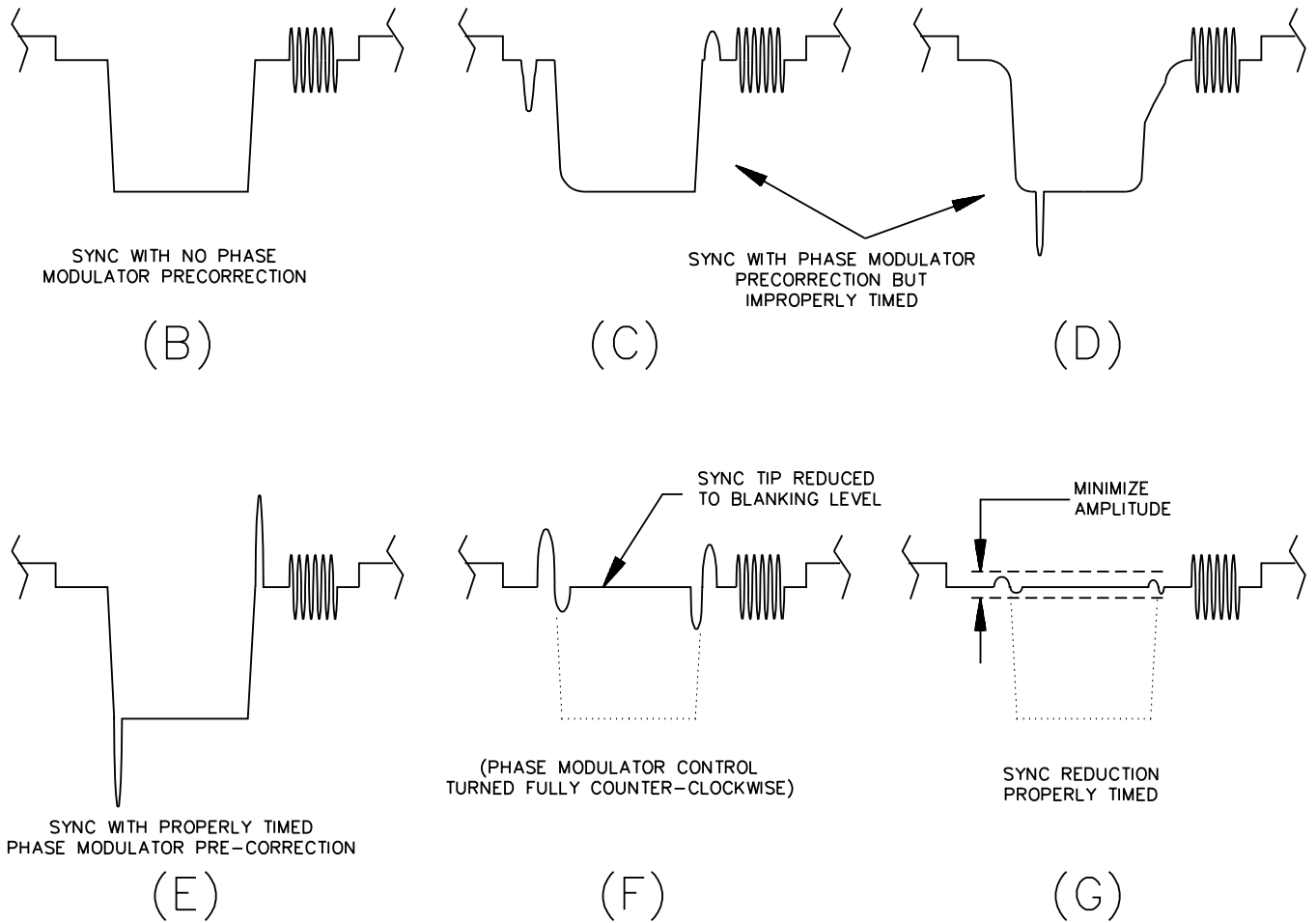
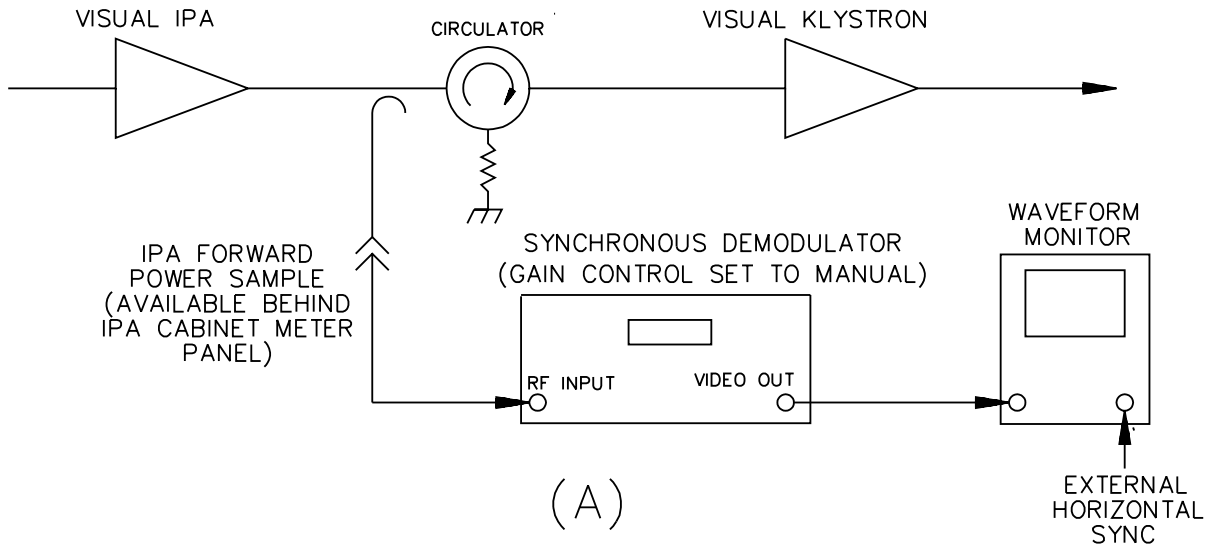


Figure 5-8. Coarse Timing: Phase Modulator & Sync Reduction

reduction control will probably have to be re-adjusted as differential gain is being optimized.

3. ICPM (INCIDENTAL PHASE MODULATION) DURING VIDEO. Use the IF ICPM Corrector for minimum ICPM in the white to black excursion.
4. ICPM (INCIDENTAL PHASE MODULATION) DURING SYNC. Use the IF Phase Modulator board. This corrector is active only when pulser is operating and adjusts ICPM only between the blanking to sync tip excursion.
5. DIFFERENTIAL PHASE. Use the video Differential Phase Corrector.
6. LOW FREQUENCY LINEARITY. Use the video Luminance Linearity corrector mounted in one of the equipment slots on the IPA cabinet. Visual exciter power output settings, exciter video gain adjustment and sync reduction control will probably have to be re-adjusted as low frequency linearity is being optimized. Refer to the separate Luminance Linearity Corrector Technical Manual for adjustment instructions.
7. Repeat steps 2. through 6.
8. TRANSMITTER GROUP DELAY (2T/12.5T PULSE & BAR). Use the IF Delay Compensator board. Note that this corrector is not to be used to correct for group delay caused by the notch diplexer. Sample the visual output before the Notch Diplexer. The separate Notch Diplexer Equalizer should be bypassed and the RF sample used should be taken before the notch diplexer.
9. FREQUENCY RESPONSE: FINE ADJUSTMENT. Use the IF Delay Compensator board and adjust in conjunction with transmitter group delay.
10. NOTCH DIPLEXER GROUP DELAY (2T/12.5T PULSE & BAR). Use the video Notch Diplexer Equalizer mounted in one of the equipment trays in the IPA Cabinet. Use a RF sample taken after the Notch Diplexer. Refer to the Notch Diplexer Equalizer Technical Manual (988-1150-001) for adjustment instructions.
11. Re-check pulser timing at the output of the visual klystron and re-adjust the pulser controller leading and trailing edge coarse timing adjustments as necessary. Use the PULSER COARSE TIMING: KLYSTRON ON procedure.
12. Repeat steps 2. through 11.
13. EXCITER AUTOMATIC POWER CONTROL RANGE AND POWER LIMIT (AGC). Use the AGC board to adjust these settings based on the drive power needed.
14. SYNC PULSE SHAPING. This correction capability active only when pulser is operating. Use the leading and trailing edge timing adjustments on the Pulse Delay board to align each of the following keyed correctors: Phase Modulator, Sync Reduction, and Pulser Sync. Adjust for an optimally shaped demodulated sync pulse.

5.9.8. IPA REDUCED DRIVE LEVEL ADJUSTMENT

The klystron drive power at blanking level is considerable higher for a klystron being pulsed than for an unpulsed klystron. If one were to stop pulsing (or greatly reduce the pulse amplitude) without reducing the drive power, the klystron would become over driven and shut off due to a body current overload. The IPA Preamp assemblies are equipped with circuitry to reduce gain when a signal from the pulser controller indicates the pulser is OUT. This potentiometer adjustment is inside the Preamp assembly and is factory set for a 9dB gain reduction. However, the adjustment may be changed by the user in order to obtain best performance of the klystron in the unpulsed mode. Refer to the IPA Technical Manual for identification and operation of this pre-set control.

5.9.9. AURAL SERVICE: KLYSTRON TUNING AND ADJUSTMENTS

- a. Assure that the klystron cavities have either been previously tuned and have been re-installed in the same position or have been pre-tuned.
- b. Connect the klystron output to a 50 ohm load capable of dissipating the power from the aural klystron.
- c. Assure that the third cavity is tuned +10MHz above aural carrier. It is difficult to check the tuning location of the third cavity when the klystron is operating. Therefore it is a good idea to repeat the KLYSTRON PRE-TUNING procedure for the third cavity at this time.

WARNING

SETTING THE 3RD CAVITY CLOSER IN FREQUENCY TO VISUAL CARRIER THAN +6MHZ WILL VERY LIKELY CAUSE KLYSTRON DAMAGE OR DESTRUCTION WHEN OPERATING POWER LEVELS ARE REACHED.

- d. In order to measure the aural bandpass, the aural klystron must be frequency swept. Two methods are suggested. The preferred method is shown in Figure 5-9. It requires the use of a tracking generator. If a tracking generator is not available, the second method, shown in Figure 5-10, may be used. There is a possibility that this method does not produce results as accurate as the first method.

Set up the test equipment per Figure 5-9 or 5-10.

WARNING

REMOVE ALL POWER AND USE SHORTING STICK BEFORE TOUCHING ANY TERMINALS IN THE FOLLOWING STEP.

- e. See drawing 839 7891 059 and set the mod anode tap initially as shown for either 6kW or 12kW operation.
- f. Energize the filament and beam.
- g. Slowly increase drive until a usable display appears on the spectrum analyzer. Keep the klystron output power low.
- h. Readjust tuning and coupling of cavities 1 and 2 for a swept response similar to the lower curve of Figure 5-11. Adjust the tuning of cavity 4 for maximum power as seen on the Remote Tuning Meter box. At this time the frequency response adjustment need only be a coarse adjustment; adjusting only to assure that a rough bandpass shape can be produced.

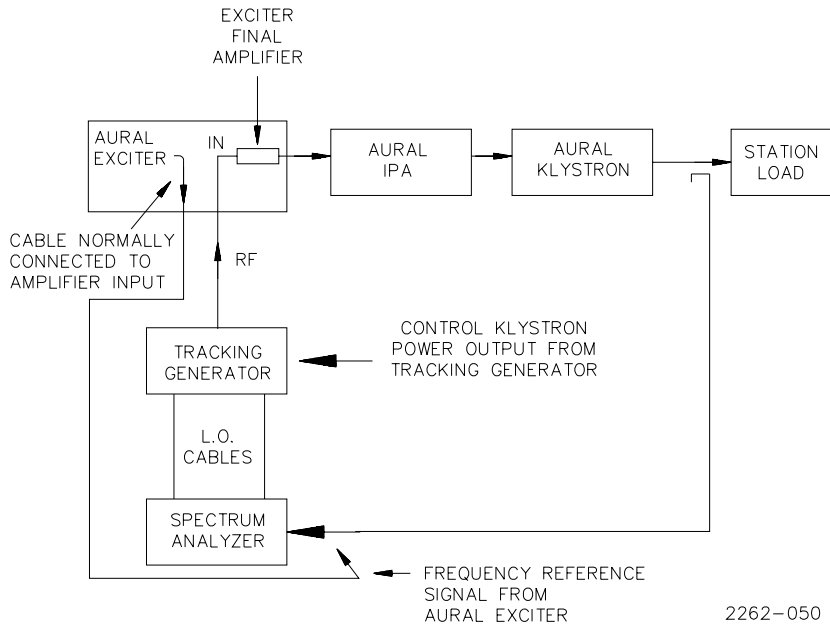


Figure 5-9. Frequency Sweeping the Aural Klystron Method #1

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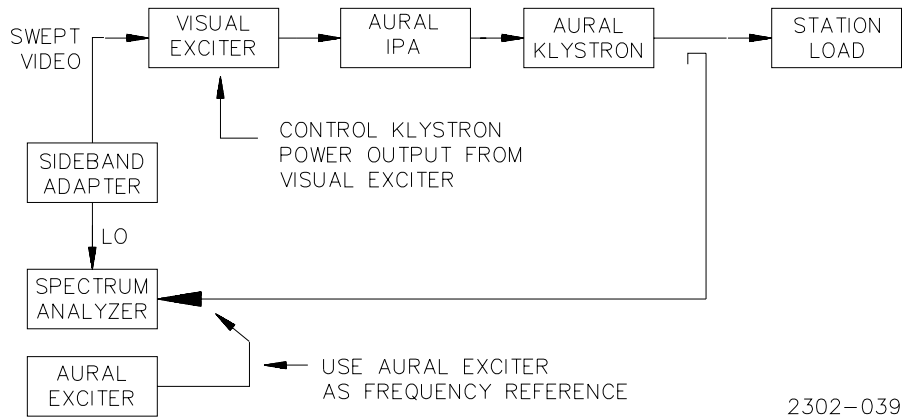


Figure 5-10. Frequency Sweeping the Aural Klystron Method #2

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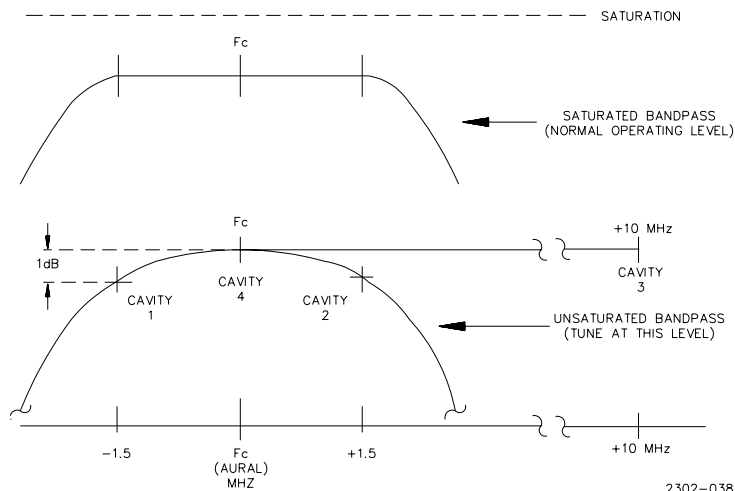


Figure 5-11. Aural Cavity Bandpass and Tuning

2302-038

- i. Increase power as much as possible without going into saturation. If the swept signal begins to flatten as power is increased, the tube is being driven to saturation. See Figure 5-11.
- j. Re-adjust the response so it looks like the lower curve of Figure 5-11.
- k. Depress BEAM OFF and re-connect the normal aural drive connections.
- l. Re-energize the beam.
- m. Using the Aural Exciter, increase aural power to the point where the aural klystron is saturated.
- n. Very carefully move the 4th cavity coupler from the fully coupled position towards the uncoupled position while monitoring the output power. The output power should increase as the coupling control is moved but will reach a point of maximum power. At this point move the 4th cavity coupler back towards the fully coupled direction a few degrees.
- o. Using the Aural Exciter power control, determine the saturated power point. Then reduce power about 10%.
- p. Perform a calorimetric power calibration and if necessary, calibrate the directional couplers and the front panel power meter. Remember that the aural power is the average power measured. Do NOT multiply the average power by 1.68 as was done during the visual calibration.
- q. If the power measured is different than needed, raise or lower the beam current until the proper power can be obtained. If current is increased, the 4th cavity coupling loop should be adjusted toward the coupled (safe) direction 10 or 20 before producing RF power. The coupler must then be re-optimized as previously described.

5.9.10. AURAL POWER METERING AND VSWR CALIBRATION

- a. Operate the aural amplifier into a 50 ohm load.
- b. Using the calorimetric equipment check the amplifier's power output level and adjust the aural exciter power control and recheck power until the desired power is attained.

CAUTION

A GLYCOL SOLUTION IS USED TO COOL THE RF LOAD. REFER TO THE HEAT EXCHANGER TECHNICAL MANUAL (988-2324-001) FOR THE PROPER PROCEDURE TO USE IN MAKING CALORIMETRIC MEASUREMENTS WITH GLYCOL SOLUTIONS.

NOTE

Since the aural signal is a FM signal, peak power has no meaning. Unlike the visual procedure, do NOT multiply the calorimetric power measurement by 1.68 in determining aural power. The AVERAGE power measurement is the aural power.

NOTE

The directional couplers on the output of the klystron are not factory set and will need to be set initially. Once adjusted they

rarely need adjustment. For field adjustment the reflected power coupler should be at the same depth as forward power coupler. Connect an RF voltmeter to the reflected coupler. The reflected coupler should be rotated for minimum reading on the RF voltmeter (choose the deepest of the two nulls). The forward coupler should be set 180 opposite the reflected coupler and at the same depth. A 6dB pad must be installed on the forward input of the peak detector for correct calibration.

- c. Calibrate the FORWARD POWER OUTPUT meter to 100% using the adjustment R14 located just below the power meter in back of the Aural Amplifier cabinet front cross-brace. R14 can be adjusted through the hole provided in the cross-brace.
Assuming the reflected power sample port is set at the same coupling value as the forward port, and the forward sample line has a 6dB pad installed, calibration of VSWR is automatic when the forward power is calibrated.
- d. If the 100% reading cannot be attained within the range of the calibration pot (make sure the meter switch is set to FORWARD), the depth of both directional couplers should be changed; deeper penetration for more sampled voltage or slightly less penetration for less sampled voltage. If the depth is changed, the directional couplers must be re-calibrated per the NOTE above. Both directional couplers must penetrate the transmission line to the same depth.

5.9.11. AURAL IPA AMPLIFIER ADJUSTMENT

Routine adjustment of the amplifier is not required. In the event that transistor Q2 is replaced, adjustment of the tuning and matching controls may be required. See drawing 839 5436 002. A directional coupler with a directivity of at least 30 dB needed to perform the procedure.

- a. Insert the directional coupler between the Aural Exciter output and the input of the amplifier. Connect the coupler so the return loss from the amplifier can be measured. Terminate the output of the amplifier in 50 ohms.
- b. Monitor the return loss with a RF meter or spectrum analyzer.
- c. Adjust capacitors C2 and C3 to minimize the return loss.
- d. Re-connect the directional coupler between the amplifier output and the termination. Orient the coupler to monitor forward power from the amplifier.
- e. Adjust capacitors C4 and C5 to maximize the amplifier output power.
- f. Since some interaction between the input and output may exist, repeat steps a. through e. until interaction of the adjustments is no longer seen.

5.9.12. HEAT EXCHANGER ADJUSTMENTS

Refer to the Heat Exchanger Technical Manual (988-2324-001) for adjustment procedures that apply to unit.

SECTION VI TROUBLESHOOTING

6.1. INTRODUCTION

In the event of a problem, the trouble area must first be isolated to a particular area such as an exciter, IPA input, IPA, power supply, module or RF component. Most troubleshooting consists of visual checks. The meters and indicator lamps will give immediate indication of many of the failures that will occur.

Once the trouble is isolated to a specific area, refer to the theory section of the appropriate technical manual for circuit discussion to aid in problem resolution. If parts are required, refer to Parts List in appropriate technical manual.

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 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, HARRIS CORPORATION, Broadcast Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA.

NOTE

When troubleshooting the TV 60UM, wire numbers that may be when viewed from wrong direction are marked either with an underline or with a - sign following the number (i.e. 68- or 68, 9- or 9, etc).

6.3. SAFETY PRECAUTIONS TO OBSERVE WHILE TROUBLESHOOTING

1. Read safety warning and first aid information before proceeding.
2. WARNING: Use breakers or disconnect switches to remove all primary power to transmitter and peripheral

equipment before opening enclosures, or removing any panel or shield.

Do not rely on internal contactors, relays, interlocks, or switching devices to remove all dangerous voltages.

3. Use grounding stick to discharge high voltage points before touching any points within the enclosure.

4. If a voltage reading or waveform analysis is required, route test leads through an opening in the cabinet to the desired measurement point. Secure leads away from any circuit with voltages beyond the break down point of their insulation or the isolation rating of the measuring device. Do not hold any measuring device in your hand while the equipment is energized. Securely ground the chassis of any scope, analyzer, or other test equipment.

5. Close cabinet doors and replace all panels before applying power and taking readings.

Do not attempt measurement of any circuits of transmitter sub-assembly with chassis floating at high voltage (i.e. DC filament assembly, rectifiers, Ion-Pump power supply, or Pulser) while the beam supply is energized.

6. After taking reading, use breakers or disconnect switches to again remove all primary power to transmitter and peripheral equipment before opening enclosure where test leads were routed or connected. Use grounding stick to discharge all high voltage points and points where test leads are attached before touching any points or removing test leads.

**Table 6-1. General Troubleshooting
General Troubleshooting**

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Transmitter has no indicators illuminated	No primary power.	Check building breaker/fuses.
	Open Breaker.	Check 30A breakers on line control cabinets.
	+12V Supply lost.	Refer to paragraph 6.3 before proceeding. Measure voltage at PS-1 in control cabinet power supply deck.
No +12V in control cabinet	Supply in current limit.	Lift wires, check for excessive load
	Supply in crowbar.	Adjust supply voltage or crowbar circuit. Turn off line breaker and re-start.
	Defect in PS1.	Replace.
Filament will not operate. (Blowers and pumps running.)	Open interlock.	Check LED status. Secure doors and panels. Check air switch.
	K2, PC4 on control circuit, K5 filament contactor.	Refer to paragraph 6.3 before proceeding. Measure voltages. Substitute parts from another cabinet.
Blower will not start when filament is depressed.	Look at K1, PC4 on control circuit, K2/K9 or K3/K5 in control cabinet.	Substitute parts.
	3-Phase power sequencing has reversed.	Refer to paragraph 6.3 before proceeding. Measure primary power voltages. Check phase monitor operation.
Filament voltage low despite adjustment.	Tube has gone to air.	Gas check tube, replace klystron.
Amplifier cabinet beam or filament comes on when the appropriate button is depressed, but goes off when button released.	Remote off/command latch.	Check remote control.
	Defect in PC4 (FIL) or PC5 (BEAM)	Exchange cards with another amplifier to see if problem follows logic card.
	Beam off interlock command from rf system.	Check motor, coax, or waveguide switches, reject load water flow or temperature interlocks, aural cavity air switch, steam valve interlocks.
Amplifier filament on but beam will not come on.	Interlocks.	Check interlocks status panel, time delay, etc.

Table 6-1. Continued

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
No visible indicator on interlock status panel. Filament on but beam will not come on.	Defect on PC3 (Fault), PC4 (FIL), PC5 (Beam NAND gate). Defect in interlock circuit.	Check PC5 NAND gate inputs; trace back any low inputs.
Beam status lamp is on. No beam voltage on meter.	K4, K3.	Substitute parts.
Line control cabinet does not complete step start.	No command signal to line control, open breaker on line control.	Refer to paragraph 6.3 before proceeding. Check line control status lamps and breakers, check high voltage switching cabinet 100V path.
Line control breaker trips.	Open thermal switch, time delay relay bad, defective auxiliary switch contacts on vacuum contactors.	Refer to paragraph 6.3 before proceeding. Check 100V path on power supply deck in control cabinet.
	Open coil on contactor.	Check coil resistance.
	High voltage filter cap break down.	Temporarily disconnect cap.
	Rectifier stack short.	Ohmmeter will show only grossly shorted diodes. Reverse bias break down and leakage may occur with HV ON. Substitute new rectifier.
	Water in oil, water in conduit.	Inspect supply tank and wiring.
	Defective breaker.	Measure line with clamp-on meter, replace breaker.
	Magnetic trip point set too sensitive.	Adjust.
	Short/breakdown of transformer/choke.	Hi-Pot test transformer/choke.
Body current trip.	Cathode or Collector arc to ground.	Check condition of high voltage wires. High voltage wiring clearances.
	Improper Magnet current, defective coil.	Adjust Magnet current, measure coils.
	Klystron overdriven.	Adjust exciter power. Adjust sync reduction.
	Open Mod Anode resistor.	Check 100K resistors and zener board.
	Defective klystron.	Change klystron.

Table 6-1. Continued

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
<p>Klystron Cathode current trip.</p> <p>Cathode to cathode arc.</p>	<p>Overload setting not correct.</p>	<p>Check & if necessary adjust overload setting.</p>
<p>Defective klystron.</p>	<p>Check water purity. Disassemble klystron collector housing & look for water leak or other reason for arc.</p>	<p>Change klystron.</p>
<p>VSWR trip.</p>	<p>Forward/Reflected cables interchanged at Peak Detector.</p> <p>Crosstalk from diplexer or combiner.</p> <p>Defective outside transmission line—antenna or dummy load.</p> <p>Transmission line faulty inside RF system.</p> <p>Faulty directional coupler.</p> <p>Improperly set VSWR overload.</p>	<p>Reconnect properly.</p> <p>Check all reject loads. Measure VSWR while other amplifiers are turned OFF/ON.</p> <p>Operate transmitter into dummy load to confirm inside/outside.</p> <p>Try different modes, check for hot spots, measure return loss, disassemble RF system.</p> <p>Check load resistance on coupling loop. Check coupler alignment.</p> <p>Reset overload.</p>
<p>Cavity arc—third or fourth.</p>	<p>Bad contact on fingerstock.</p> <p>Improper tuning.</p> <p>False trips.</p> <p>External bright light shining in cavities.</p>	<p>Disassemble and inspect cavity. Replace fingerstock if required.</p> <p>Adjust output loop, adjust third or fourth cavity tuning.</p> <p>Adjust arc detector sensitivity, replace photo resistor.</p> <p>Remove light or close rear klystron cabinet doors.</p>
<p>Excessive Ion Pump current.</p>	<p>Gassy tube (new or spare which has been idle).</p> <p>Tube gone to air.</p>	<p>Operate pump and filament to improve vacuum.</p> <p>Gas check tube, observe filament voltage, replace tube.</p>
<p>No Mag Current (filament is on).</p>	<p>Magnet not connected.</p> <p>Open breaker.</p> <p>Shorted capacitor.</p>	<p>Allow supply to discharge before connecting Magnet.</p> <p>Check Magnet supply breaker.</p> <p>Temporarily disconnect capacitors, try to operate Magnet.</p>

Table 6-1. Continued

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
	<p>Open fuses at TB11.</p> <p>Open meter.</p> <p>Control cabinet contactor K8 or K10.</p> <p>Open magnet coil.</p> <p>Defective regulator PC board.</p>	<p>Check fuses - replace.</p> <p>Replace meter.</p> <p>Refer to paragraph 6.3 before proceeding. Measure voltages.</p> <p>Determine continuity.</p> <p>Swap with PC regulator from another cabinet to verify problem. Check zener diodes and u741 op amp.</p>

Table 6-3. Pulser Troubleshooting Chart

PULSER CONTROLLER LOGIC STATES

INPUTS										OUTPUTS					
SYNC	FDP	REMOTE PULSER IN	REMOTE PULSER OUT	IN/OUT SWITCH IN	IN/OUT SWITCH OUT	MUX	AURAL EMERG	IPA GAIN DEFAULT	BEAM CURRENT DEFAULT	PHASE MOD	SYNC REDUC	IPA	TDP	REMOTE	BEAM CURRENT
S	H	H,∩	H	H,∩	H	H	H	X	X	H	H	H	H	H	P
S	L	H,∩	H	H,∩	H	H	H	X	X	H	L	H	H	H	P
NS	H	H,∩	H	H,∩	H	H	H	X	HB	H	L	L	L	L	↑
NS	H	H,∩	H	H,∩	H	H	H	X	LB	H	L	L	L	L	↓
NS	L	H,∩	H	H,∩	H	H	H	X	HB	L	L	L	L	L	↑
NS	L	H,∩	H	H,∩	H	H	H	X	LB	L	L	L	L	L	↓
X	H	H	H,∩	H	H,∩	H	H	X	HB	H	L	L	L	L	↑
X	H	H	H,∩	H	H,∩	H	H	X	LB	H	L	L	L	L	↓
X	L	H	H,∩	H	H,∩	H	H	X	HB	L	L	L	L	L	↑
X	L	H	H,∩	H	H,∩	H	H	X	LB	L	L	L	L	L	↓
X	H	X	X	X	X	X	L	HG	HB	H	H	H	L	L	↑
X	H	X	X	X	X	X	L	HG	LB	H	H	H	L	L	↓
X	H	X	X	X	X	X	L	LG	HB	H	H	L	L	L	↑
X	H	X	X	X	X	X	L	LG	LB	H	H	L	L	L	↓
X	L	X	X	X	X	X	L	HG	HB	L	L	H	L	L	↑
X	L	X	X	X	X	X	L	HG	LB	L	L	H	L	L	↓
X	L	X	X	X	X	X	L	LG	HB	L	L	L	L	L	↑
X	L	X	X	X	X	X	L	LG	LB	L	L	L	L	L	↓
X	L	X	X	X	X	L	H	X	HB	L	L	L	L	L	↑
X	L	X	X	X	X	L	H	X	LB	L	L	L	L	L	↓

P = PULSED
 NS = NO SYNC
 X = DON'T CARE
 S = SYNC

LG = LOW GAIN
 HG = HIGH GAIN
 LB = LOW BEAM
 HB = HIGH BEAM

∩ = SHORT FALLING PULSE
 ↑ = CONTINUOUS HIGH BEAM
 ↓ = CONTINUOUS LOW BEAM

REFERENCE DRAWING
 839 7740 036

2262-040

SECTION VII REPLACEMENT PARTS

INTRODUCTION

This section contains a list of replaceable parts for the TV 60UM UHF TELEVISION TRANSMITTER.

REPLACEABLE PARTS SERVICE

Replacement parts are available 24 hours a day, seven days a week from the HARRIS Service Parts Department. Telephone 800/422-2218 to contact the service parts department or address correspondence to Service Parts Department, HARRIS CORPORATION, Broadcast Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA.

NOTE

symbol used in parts list means "used with" (e.g. #C001 means used with C001).

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Table 7-1. XMTR, TV-60UM/TV-70UM - 994 9171 002

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
000 0000 003.	FREQUENCY DETERMINED PART	0.0 EA	XSTAL #VISUALEXCITER QTY 1 SEE 838-4575-001
378 0162 000.	KLYSTRON, EXT CAVITY MSDC .	0.0 EA	QTY 2 REQ
404 0809 000.	*MAGNET, EXT CAVITY MSDC . .	0.0 EA	QTY 2 REQ
432 0366 000.	HEAT EXCH COOLING COIL	1.0 EA	DROP SHIP ITEM
448 0950 000.	*LOCK SYSTEM,843-5123-024 . . .	2.0 EA	
484 0138 000.	FILTER HARMONIC CH14-43	0.0 EA	CH14-43 QTY 1
484 0139 000.	FILTER HARMONIC CH44-51	0.0 EA	CH44-51 QTY 1 IND CHAN# IN PN
484 0161 000.	FILTER 3DB LOW PASS	0.0 EA	CH14-35 QTY 4
484 0162 000.	FILTER 3 DB LOW PASS	0.0 EA	CH36-67 QTY 4
484 0163 000.	FILTER 3DB LOW PASS	0.0 EA	CH68-69 QTY 4
484 0179 000.	FILTER HARMONIC CH52-69	0.0 EA	CH52-69 QTY 1 IND CHAN# IN PN
484 0236 000.	FILTER HARMONIC CH14-69	0.0 EA	CH14-69 QTY 1 IND CHAN# IN PN
618 0222 000.	ISOLATOR 470-600MHZ 10W	0.0 EA	CH14-35 QTY 1
618 0223 000.	ISOLATOR 600-890 MHZ	0.0 EA	CH36-69 QTY 1
620 2163 000.	CIRCULATOR 650-810 MHZ	0.0 EA	CH52-69 QTY 1 HY1
620 2295 000.	CIRCULATOR 470-580MHZ	0.0 EA	CH14-29 QTY 1 HY1
620 2296 000.	CIRCULATOR 550-670MHZ	0.0 EA	CH30-51 QTY 1 HY1
620 2472 000.	DIPLXR, 60KW CHAN 14-19	0.0 EA	SPEC 817-1593-009
620 2473 000.	DIPLXR, 60KW CHAN 20-47	0.0 EA	SPEC 817-1593-009
620 2474 000.	DIPLXR, 60KW CHAN 48-69	0.0 EA	SPEC 817-1593-009
622 0010 000.	WAVEGUIDE TRANS CH52-69 . . .	0.0 EA	WAVEGUIDE TRANS CH52-69 FOR REF ONLY CH52-69 QTY 1 IND CHAN# IN P/N
622 0193 000.	WAVEGUIDE TRANS CH 52-69 . .	0.0 EA	WAVEGUIDE TRANS CH52-69 FOR REF ONLY CH52-69 QTY 1 REQD
646 1084 000.	NAMEPLATE HARRIS	1.0 EA	
646 1093 000.	FRAME, NAMEPLATE	1.0 EA	
646 1353 000.	NAMEPLATE, XMTR EQUIPMENT	1.0 EA	
646 1465 000.	INSERT TV60UM	1.0 EA	
700 0202 000.	ELEMENT 50KE6	1.0 EA	
700 0204 000.	WATTMETER 4902A	1.0 EA	
736 0222 000.	POWER SUPPLY, UM XMTR	2.0 EA	PS001 PS002
813 5007 026.	STDOFF 6-32X1/2 1/4 DIA	4.0 EA	#END BELL MTG.
817 2029 073.	SPEC, EQUIP-TV60UX	0.0 EA	
822 0965 056.	DOOR LOCK MOUNT	4.0 EA	#USED WITH PNL LOCK'S
822 0965 079.	STUD, LOCK MTG.	8.0 EA	
827 4230 001.	ANGLE	2.0 EA	#END BELL MTG.
839 7740 066.	DIAG, SYSTEM, TV-60	0.0 EA	
839 7740 067.	DIAG, SYSTEM, TV-60	0.0 EA	
839 7740 072.	INTERCONNECT DIAG, TV-60 . . .	0.0 EA	
839 7891 059.	WIRING DIAG, HIGH VOLTAGE . .	0.0 EA	
839 7891 109.	LAYOUT, TYPICAL RF LINE	0.0 EA	
839 7891 168.	EQUIPMENT LAYOUT - TV60UM .	0.0 EA	
839 7891 169.	WIRING DIAGRAM, POWER AND	0.0 EA	
839 7891 172.	DIAG,AC POWER FLOW-TV60UM	0.0 EA	
839 7891 174.	FAMILY TREE - TV60UM	0.0 EA	
839 7891 175.	SCHEM, MSDC KYLSTRON SYS .	0.0 EA	
843 4803 002.	PERIPHERIAL EQUIPMENT	0.0 EA	
917 2029 030.	CABLE, RF 22" LG #12 IPA	0.0 EA	QTY 1 REQ CH31-69 IPA CABLE #12
922 0741 033.	AIR DAM ASSY ECK	0.0 EA	CH31-69 QTY 1 REQ #IPA PWR AMP
922 0965 066.	SHIM, LOCK	3.0 EA	

929 9440 054.	PANEL, DRESS	2.0 EA	
943 5123 097.	PLUMBING KIT - TV60UM	1.0 EA	
943 5123 099.	BREAKAWAY LINE SECTION . . .	0.0 EA	5 CAVITY ONLY CH.14-41 QTY 2
943 5123 100.	BREAKAWAY LINE SECTION . . .	0.0 EA	5 CAVITY ONLY CH.42-69 QTY 2
943 5123 124.	ASSY, BREAKAWAY LINE	0.0 EA	4 CAVITY ONLY CH 14-41;QTY 2
943 5123 125.	ASSY, BREAKAWAY LINE, 4	0.0 EA	4 CAVITY ONLY CH 42-69;QTY 2
988 2326 002.	DP, TV 60UM	2.0 EA	
989 0082 002.	PACKING CHECKLIST TV-60UM . .	0.0 EA	
990 1105 001.	R-SK TV-60UM REC S/C KIT	0.0 EA	
992 5647 001.	UHF BOOST AMP ASSY	2.0 EA	TUNED ASSY A011 A012 # 60 CONT
992 6499 004.	IPA/EXCITER CABINET ASSY . . .	1.0 EA	
992 6652 003.	ELECT INSTL MATL TV-60UM . . .	1.0 EA	4 CAVITY ONLY
992 6742 003.	WATER/GLYCOL PUMP MODULE . . .	1.0 EA	
992 6994 002.	IPA PWR AMP-TUNED CH14-30 . .	0.0 EA	QTY 2 REQ CH14-30
992 6994 003.	IPA PWR AMP-TUNED CH31-69 . .	0.0 EA	QTY 1 REQ CH31-69
992 7012 001.	KIT, IPA PWR AMP CH14-30	0.0 EA	QTY 1 REQ CH14-30
992 8095 003.	CONTROL CABINET 60KW MSDC . . .	1.0 EA	
992 8095 005.	VISUAL AMP CAB UM	1.0 EA	
992 8095 006.	AURAL AMP CAB UM	1.0 EA	
992 8110 002.	VISUAL LINE CONTROL CAB	1.0 EA	
992 8110 003.	AURAL LINE CONTROL CAB	1.0 EA	
992 8462 001.	KIT, 5-CAVITY CONVERSION	0.0 EA	5 CAVITY ONLY; QTY 2
992 8462 002.	KIT, 4-CAVITY CONVERSION	0.0 EA	4 CAVITY ONLY; QTY 2
992 8550 001.	KIT, FILLER PNL	3.0 EA	
994 8012 014.	EXC, AURAL UHF TV, STEREO . . .	1.0 EA	
994 8442 001.	KIT, PROBE (1.50)	5.0 EA	
994 8714 013.	BASIC UHF VIS EXC MCP-UX	1.0 EA	
994 8917 004.	KIT SPARE UHF EXCITER ECK	0.0 EA	
994 9059 001.	KIT, FRONT DOOR	0.0 EA	4 REQ'D
994 9114 003.	SC48 RCS OPTION TV-60UM	0.0 EA	
994 9119 002.	R-BK-TV60UM REC BD KIT	0.0 EA	
994 9120 002.	R-PK-TV60UM REC PTS KIT	0.0 EA	

Table 7-2. PLUMBING KIT - TV60UM - 943 5123 097

FIND#	HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
000 . . .	086 0004 038 . .	SOLDER, SILVER SIZE 0.062 . .	3. LB	
000 . . .	086 0004 040 . .	STAY CLEAN FLUX	1. . .	
000 . . .	299 0018 000 . .	THRED-TAPE, TEFLON	2. RL	
000 . . .	358 2765 000 . .	HYDROMETER	1. . .	
000 . . .	358 2766 000 . .	HYDROMETER	1. . .	
000 . . .	358 2767 000 . .	CYLINDER, HYDROMETER	1 PG	
000 . . .	432 0357 000 . .	PUMP, SS 1 X 1-1/4 X 6	0. . .	#WATER MODULE
000 . . .	629 0052 000 . .	METER, DIGITAL WATER	0. . .	#WATER MODULE
000 . . .	690 0017 000 . .	PIPE JOINT COMPOUND	1. . .	
000 . . .	843 5123 097 . .	PLUMBING LAYOUT - TV60UM	0. . .	
000 . . .	992 8183 001 . .	KIT, WATER MODULE CART.	0. . .	#WATER MODULE
002 . . .	003 8020 050 . .	CU, TBG 1.5 NOM DIA	100. FT	
003 . . .	003 8020 040 . .	CU, TBG 1.0 NOM DIA	40. FT	
004 . . .	003 8020 030 . .	CU, TBG .75 NOM DIA	4. FT	
008 . . .	359 0246 000 . .	ELBOW, 90 DEG 1-1/2 CXC	17. . .	
009 . . .	359 0890 000 . .	ELBOW 90 DEG 1-1/2 X 1	4. . .	

010... 359 0192 000 .. ELBOW, 90 DEG 1" CXC 7...
 011... 359 0596 000 .. ELBOW ELL CXC 2...
 012... 359 0610 000 .. ELBOW 3/4 IN X 45 DEG 4...
 013... 359 0477 000 .. UNION, 2" CXC 2...
 014... 359 0274 000 .. TEE 1-1/2 IN 1...
 015... 359 0230 000 .. TEE 1.5"C X 1.5"C X 1.0"C 3...
 016... 359 1010 000 .. TEE, 1-1/2 X 1-1/2 X 3/4 1...
 017... 359 0193 000 .. TEE 1 IN 1...
 019... 359 0893 000 .. TEE, 3/4 X 1/8 X 1 2...
 020... 359 0959 000 .. COUPLING W/STOP 1 X 3/4 ... 6...
 021... 359 0269 000 .. ADAPTER, MALE 2...
 022... 359 0151 000 .. REDUCING CPLG .75-.5 2...
 023... 359 0253 000 .. COUPLING 1-1/2" CXC 3...
 024... 359 0403 000 .. COUPLING 1" CXC 6...
 026... 359 0435 000 .. UNION C X M 1-1/2 IN 11...
 028... 359 0594 000 .. UNION, 3/4 CXM CAST 4...
 029... 359 0225 000 .. ADAPTER 1" C X 1" M 1...
 030... 359 0250 000 .. ADAPTER, FEMALE 2...
 031... 359 0197 000 .. ADAPTER FEMALE FITTING . 13...
 032... 359 0268 000 .. ADAPTER, MALE 4...
 033... 359 0876 000 .. UNION, 1/2" CXM 2...
 036... 358 3038 000 .. HOSE BARB 1" H X 1" MPT 4...
 038... 424 0469 000 .. HOSE SIL RUB 1" X 12' LG 4...
 039... 358 1722 000 .. CLAMP, ADJ, SIZE 20 32...
 040... 359 0324 000 .. VALVE GLOBE 1" CXC BRONZE 3...
 041... 359 0251 000 .. VALVE, GATE 1"CXC BRONZE 5...
 044... 448 0873 000 .. FILTER HOUSING 3/4" NPTF .. 1...
 045... 448 0874 000 .. * FILTER CARTRIDGE 1. CT
 046... 442 0092 000 .. PROBE, TEMP 300 DEG F MAX 2...
 047... 442 0109 000 .. THERM DGTL -40 DEG F TO .. 1...
 048... 442 0093 000 .. THERMISTOR CABLE EXT 50' . 2...
 049... 629 0036 000 .. ROTAMETER 1...
 050... 604 0210 000 .. SW, FLOW 1"F X 1"F 1...
 051... 358 2718 000 .. SOCKET, FEMALE 6-HK 4...
 052... 629 0055 000 .. MTR, 8 GPM 3/4 IN BRONZE .. 2...
 053... 604 1045 000 .. SW, FLOW SPDT 1...
 057... 359 1014 000 .. STRAINER 1.5 IN "Y" 2...
 063... 359 0960 000 .. TEE 1-1/2" CX1-1/2" CX1"F 1...
 064... 359 0686 000 .. TEE 1-1/2 X 1-1/2 X 1/2 1...
 065... 359 0085 000 .. PLUG, PIPE BRASS 1...
 066... 359 0418 000 .. ELBOW 90 DEG STREET 1...
 067... 359 0829 000 .. UNION 1" CXM 1...
 069... 359 0999 000 .. BOILER DRAIN VALVE 1...
 070... 358 3348 000 .. HOSE CAP, 3/4 HOSE THD. ... 1...
 071... 646 1488 000 .. LABEL, WARNING 2...
 072... 358 3351 000 .. HOSE BARB, SS FITTING 12...
 073... 359 0252 000 .. VALVE, GATE 1-1/2 CXC 2...

Table 7-3. KIT, WATER MODULE CART. - 992 8183 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
358 3284 000.	CARTRIDGE OXY REM	1 ..	
358 3285 000.	CARTRIDGE,HIGH TEMP MIXED .	1 ..	
358 3292 000.	FILTER CARTRIDGE.2 MICRON..	1 ..	
358 3294 000.	SEAL, O-RING	2 ..	
358 3299 000.	SEAL, O-RING FOR SINGLE	1 ..	

Table 7-4. BREAKAWAY LINE SECTION - 943 5123 099

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
843 5123 099.	ASSY INSTR, BREAKAWAY LN . .	0 ..	
939 7891 006.	OUTER COND.,UPPER BRKAWAY	1 ..	
939 7891 008.	OUTER COND., LOWER BRKAWY	1 ..	
922 0965 136.	INNER CONDUCTOR-UPPER . . .	1 ..	
922 0965 135.	INNER CONDUCTOR-BREAKAWAY . . .	1 ..	
922 0965 009.	INSULATOR, INNER COND.	2 ..	
620 0499 000.	COUPLING, STRAIGHT 3-1/8	1 ..	
620 0500 000.	SAMPLING ASSY W/CLMP	2 ..	
922 0965 012.	SCREW, MODIFIED	2 ..	
314 0009 000.	WASHER, SPLIT-LOCK 1/4	2 ..	
620 0543 000.	CONN, ANCHOR 3-1/8	2 ..	

Table 7-5. BREAKAWAY LINE SECTION - 943 5123 100

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
843 5123 100.	ASSY INSTR, BREAKAWAY LN . .	0 ..	
939 7891 006.	OUTER COND.,UPPER BRKAWAY	1 ..	
939 7891 008.	OUTER COND., LOWER BRKAWY	1 ..	
922 0965 136.	INNER CONDUCTOR-UPPER . . .	1 ..	
922 0965 134.	INNER COND.-BREAKAWAY . . .	1 ..	
922 0965 009.	INSULATOR, INNER COND.	2 ..	
620 0499 000.	COUPLING, STRAIGHT 3-1/8	1 ..	
620 0500 000.	SAMPLING ASSY W/CLMP	2 ..	
922 0965 012.	SCREW, MODIFIED	2 ..	
314 0009 000.	WASHER, SPLIT-LOCK 1/4	2 ..	
620 0543 000.	CONN, ANCHOR 3-1/8	2 ..	

Table 7-6. ASSY, BREAKAWAY LINE - 943 5123 124

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
843 5123 124.	ASSY INSTR,BREAKAWAY LINE .	0 ..	
939 7891 006.	OUTER COND.,UPPER BRKAWAY	1 ..	
939 7891 207.	ASSY, OUTER COND.	1 ..	
922 0965 136.	INNER CONDUCTOR-UPPER . . .	1 ..	
922 0965 205.	INNER COND.LOWER CH 14-41..	1 ..	
922 0965 009.	INSULATOR, INNER COND.	2 ..	
620 0499 000.	COUPLING, STRAIGHT 3-1/8	1 ..	
620 0500 000.	SAMPLING ASSY W/CLMP	2 ..	
922 0965 012.	SCREW, MODIFIED	2 ..	
314 0009 000.	WASHER, SPLIT-LOCK 1/4	2 ..	
620 0543 000.	CONN, ANCHOR 3-1/8	2 ..	

Table 7-7. ASSY, BREAKAWAY LINE, 4 - 943 5123 125

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
843 5123 125.	ASSY INSTR,BREAKAWAY LINE .	0 ..	
939 7891 006.	OUTER COND.,UPPER BRKAWAY	1 ..	
939 7891 207.	ASSY, OUTER COND.	1 ..	
922 0965 136.	INNER CONDUCTOR-UPPER ...	1 ..	
922 0965 204.	INNER COND,LOWER 4 CAVITY .	1 ..	
922 0965 009.	INSULATOR, INNER COND.	2 ..	
620 0499 000.	COUPLING, STRAIGHT 3-1/8	1 ..	
620 0500 000.	SAMPLING ASSY W/CLMP	2 ..	
922 0965 012.	SCREW, MODIFIED	2 ..	
314 0009 000.	WASHER, SPLIT-LOCK 1/4	2 ..	
620 0543 000.	CONN, ANCHOR 3-1/8	2 ..	

Table 7-8. PACKING CHECKLIST TV-60UM - 989 0082 002

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
378 0162 000.	KLYSTRON, EXT CAVITY MSDC .	0 ..	QTY 2 REQ
404 0809 000.	MAGNET, EXT CAVITY MSDC ...	0 ..	QTY 2 REQ
484 0138 000.	FILTER HARMONIC CH14-43	0 ..	CH14-43 QTY 1
484 0139 000.	FILTER HARMONIC CH44-51	0 ..	CH44-51 QTY 1 IND CHAN# IN PN
484 0161 000.	FILTER 3DB LOW PASS	0 ..	CH14-35 QTY 4
484 0162 000.	FILTER 3 DB LOW PASS	0 ..	CH36-67 QTY 4
484 0163 000.	FILTER 3DB LOW PASS	0 ..	CH68-69 QTY 4
484 0179 000.	FILTER HARMONIC CH52-69	0 ..	CH52-69 QTY 1 IND CHAN# IN PN
484 0236 000.	FILTER HARMONIC CH14-69	0 ..	CH14-69 QTY 1 IND CHAN# IN PN
618 0222 000.	ISOLATOR 470-600MHZ 10W	0 ..	CH14-35 QTY 1
618 0223 000.	ISOLATOR 600-890 MHZ	0 ..	CH36-69 QTY 1
620 2163 000.	CIRCULATOR 650-810 MHZ	0 ..	CH52-69 QTY 1 HY1
620 2295 000.	CIRCULATOR 470-580MHZ	0 ..	CH14-29 QTY 1 HY1
620 2296 000.	CIRCULATOR 550-670MHZ	0 ..	CH30-51 QTY 1 HY1
622 0009 000.	BEND, MITRE CH52-69	0 ..	CH52-69 QTY 1 IND CHAN# IN PN
622 0010 000.	WAVEGUIDE TRANS CH52-69 ...	0 ..	CH52-69 QTY 1 IND CHAN# IN PN
622 0193 000.	WAVEGUIDE TRANS CH 52-69 ..	0 ..	CH 52-69 QTY 2 REQ
736 0222 000.	POWER SUPPLY, UM XMTR	2 ..	
929 9440 054.	PANEL, DRESS	2 ..	
992 8550 001.	KIT, FILLER PNL	3 ..	
943 5123 097.	PLUMBING KIT - TV60UM	1 ..	
992 8110 003.	AURAL LINE CONTROL CAB	1 ..	
992 5647 001.	UHF BOOST AMP ASSY	2 ..	TUNED ASSY, A011, A012, # 60 CONT
992 6499 004.	IPA/EXCITER CABINET ASSY ...	1 ..	
992 8095 003.	CONTROL CABINET 60KW MSDC	1 ..	
992 6652 003.	ELECT INSTL MATL TV-60UM ...	1 ..	
992 6742 003.	WATER/GLYCOL PUMP MODULE	1 ..	
992 8095 005.	VISUAL AMP CAB UM	1 ..	
992 8095 006.	AURAL AMP CAB UM	1 ..	
994 8917 004.	KIT SPARE UHF EXCITER ECK ..	0 ..	
994 9059 001.	KIT, FRONT DOOR	0 ..	4 REQ'D
992 6994 002.	IPA PWR AMP-TUNED CH14-30..	0 ..	CH 14-27 QTY 2 REQ REMOVED FROM IPA CAB FOR SHIPMENT
992 6996 002.	PREAMP MODULE, ECK	2 ..	REMOVED FROM IPA CAB FORSHIPMENT

994 6976 001.	BLANK PANEL	4 ..	REMOVED FROM TV ACCESSORY TRAY FOR SHIPMENT
992 6994 003.	IPA PWR AMP-TUNED CH31-69..	0 ..	CH 28-29 QTY 1 REQ REMOVED FROM IPA CAB FOR SHIPMENT
994 6915 001.	NOTCH DIPLEXER EQLR	1 ..	REMOVED FROM TV ACCESSORY TRAY FOR SHIPMENT
992 7008 001.	LUMINANCE LIN CORR ASSY . . .	2 ..	
817 1593 048.	SPACER, CAB TIE	4 ..	
302 0654 000.	SCR, 10-32 X 3	4 ..	
992 8110 002.	VISUAL LINE CONTROL CAB . . .	1 ..	
927 4935 004.	AC CORD ASSY	2 ..	
988 2326 002.	DP, TV 60UM	2 ..	
700 0202 000.	ELEMENT 50KE6	1 ..	
700 0204 000.	WATTMETER 4902A	1 ..	
943 5123 099.	BREAKAWAY LINE SECTION . . .	0 ..	CH14-41, QTY 2 REMOVED FROM REAR AMP CAB FOR SHIPMENT
943 5123 100.	BREAKAWAY LINE SECTION . . .	0 ..	CH42-70, QTY 2 REMOVED FROM REAR AMP CAB FOR SHIPMENT

Table 7-9. AURAL LINE CONTROL CAB - 992 8110 003

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
606 0819 000.	CKT BREAKER 70A	2 ..	CB006 CB008
816 2727 003.	TRIM STRIP	1 ..	
992 8110 001.	BASIC LINE CONTROL CAB	1 ..	

Table 7-10. BASIC LINE CONTROL CAB - 992 8110 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
055 0120 482.	BLANK, CONDUIT SNAP-IN 2" . . .	4 ..	
302 0675 000.	SCR, 1/4-20 X 4-1/2	8 ..	
312 0069 000.	WASHER, INT-EXT LOCK 5/16 . . .	1 ..	
354 0207 000.	TERMINAL LUG	6 ..	
358 3184 000.	PLUG, WHT .875" HOLE	1 ..	
404 0018 000.	SOCKET TUBE 11 PIN	1 ..	XK021
406 0488 000.	LIGHT, INDICATOR NEON RED . .	3 ..	DS001 DS002 DS003
410 0001 000.	INSULATOR ROUND NS5W 0104 . .	2 ..	#FOR MOV BRD
410 0014 000.	INSULATOR ROUND NS5W 0220 . .	4 ..	#TB026
410 0017 000.	INSULATOR ROUND NS5W 0310 . .	6 ..	#S001 #S002 #S003
442 0123 000.	THERMOSTAT 155 DEG F N.C. . .	3 ..	S001 S002 S003
472 1147 000.	XFMR, STPDN 60HZ, P12513 . . .	1 ..	T001
540 0094 000.	RES 75.0K OHM 1/2W 5%	1 ..	R056
542 1006 000.	RES 5.4 OHM 766W 10%	3 ..	R053 R054 R055
560 0059 000.	VARISTOR V511DB40	6 ..	RV001 RV002 RV003 RV004 RV005 RV006
570 0160 000.	CONTACTOR, VAC 3PH	2 ..	K019 K023
570 0303 000.	CONTACTOR 150A 550V 3P	1 ..	K020
576 0136 000.	RELAY, TIMING 115VDC SPDT... .	1 ..	K022
576 0141 000.	TD RELAY	1 ..	K021
606 0170 000.	CKT BREAKER 600V 30A	1 ..	CB007
606 0174 000.	CKT BREAKER 600V 10A	1 ..	CB009
614 0003 000.	TERM BD 3 TERM	1 ..	TB024
614 0094 000.	TERM BD 4 TERM	1 ..	TB023
614 0224 000.	TERM BD 3 TERM	1 ..	TB025

614 0784 000.	TERM BD 3 TERM	1 ..	TB026
813 5007 026.	STDOFF 6-32X1/2 1/4 DIA	8 ..	
813 5606 033.	STUD, BRS 10-32 X 1 1/4	1 ..	GS001
815 1674 001.	ANGLE, SUPPORT	3 ..	
817 1593 056.	RUNNING SHEETS	0 ..	
827 6384 001.	ANGLE TOP	4 ..	
829 9726 175.	STRAP, GND	1 ..	
838 4522 001.	STIFFENER, CAB.	4 ..	
839 7372 001.	PLATE, RELAY MTG	1 ..	#K022
839 7891 042.	WIRING DIAG, LINE CTL CAB	0 ..	
915 1641 001.	STIFFENER	1 ..	
915 1641 002.	STIFFENER	1 ..	
917 2116 004.	ROD, KEY LOCK, LINE CONT	1 ..	
917 2116 005.	BUSHING, KEY LOCK	3 ..	
917 2116 062.	BRACKET, THERMAL SWITCH	3 ..	#S001 #S002 #S003
922 0965 038.	BRACKET, KEY LOCK MTG	1 ..	
938 4523 002.	PNL, SIDE	3 ..	
939 5617 002.	BRKT, THERMAL SW	1 ..	
939 7891 020.	PANEL, FRONT LINE CON CAB	1 ..	
939 7891 021.	BRACKET, CIRCUIT BREAKER	1 ..	#CB007 #TB024
939 7891 022.	BRACKET, RESISTOR MTG	1 ..	
939 7891 023.	BRACKET, CIRCUIT BREAKER	1 ..	
939 7891 047.	SUPPORT, CB	1 ..	
939 7891 128.	PLATE, VARISTOR MTG.	1 ..	#RV001-RV006
943 4357 062.	COVER, SAFETY	1 ..	#TB026
943 5123 013.	PANEL, CIRCUIT BREAKER	1 ..	#CB006 #CB008 #K020
943 5123 031.	CAB ASSY, LINE CONTROL	1 ..	
952 9126 002.	CABLE ASSY, LINE CTL CAB	1 ..	
992 8391 004.	MOV-AC PROT ASSY	1 ..	
999 2649 001.	WIRE/TUBING LIST	1 ..	
999 2650 001.	HARDWARE LIST	1 ..	

Table 7-11. CONTROL CABINET 60KW MSDC - 992 8095 003

<i>HARRIS P/N</i>	<i>DESCRIPTION</i>	<i>QTY/UM</i>	<i>REF. SYMBOLS/EXPLANATIONS</i>
053 0100 056.	METAL SWITCH BOX	1 ..	
055 0120 476.	CONNECTOR, 1-1/2	1 ..	
358 0437 000.	BUSHING PANEL .252 ID	2 ..	
358 2105 000.	CARD GUIDE	8 ..	
358 2426 000.	PLUG, WHITE 2" HOLE	4 ..	#CAB TOP CORNERS
358 3135 000.	STUD, BRS 1/4-20 X 2	2 ..	
384 0695 000.	LED GREEN CART 12V	5 ..	DS001 DS003 DS004 DS005 DS007
384 0842 000.	LED AMBER CART 12V	1 ..	DS006
384 1129 000.	LED, GREEN CART 2.4V	2 ..	DS002 DS008
424 0018 000.	GROMMET 1-1/2 MTG DI	1 ..	
424 0048 000.	BUMPER PLUG TYPE	2 ..	
430 0024 000.	FAN 115V 50/60HZ	2 ..	B001 B002
430 0084 000.	FINGER GUARD 476646	2 ..	#B001 #B002
448 0955 000.	LATCH, VISE ACTION	1 ..	
476 0300 000.	REACTOR, SATURABLE	2 ..	T005 T006
560 0035 000.	MOV 4500A 35J 130 VAC	3 ..	RV001 RV002 RV010
570 0267 000.	CONTACTOR 3 POLE 30A	2 ..	K008 K010
570 0310 000.	CONTACTOR 18A 3 POLE	2 ..	K002 K003

574 0157 000.	RLY AC CTL 4 POLE	2 ..	K005 K009
574 0198 000.	RELAY 120VAC	2 ..	K011 K012
606 0175 000.	CKT BREAKER 600V 20A	2 ..	CB3 CB4
606 0176 000.	CIRCUIT BREAKER 7A	2 ..	CB002 CB005
612 0412 000.	RECP DUPLEX OUTLET	1 ..	
614 0224 000.	TERM BD 3 TERM	1 ..	TB033
620 0122 000.	ADPTR ANGLE N UG27CU	1 ..	
646 1253 000.	LABEL H-139	1 ..	BETWEEN #B001 & #B002
736 0150 000.	PWR SUPPLY, REGULATED	2 ..	PS001 PS002
736 0153 000.	PWR SUPPLY 12VDC 1.8A	2 ..	PS005 PS006
740 1139 000.	PHASE MONITOR 208V-240V	2 ..	K001 K004
813 5001 069.	STDOFF 10-32X1-1/4 3/8 H	4 ..	
813 5010 007.	STDOFF 6-32X1/2 1/2 RD	6 ..	B001 B002
813 5606 026.	STUD BRS 10-32 X 2-3/4	1 ..	
815 0996 001.	STRAP	1 ..	
815 1720 001.	SPACER	4 ..	#TB016 #TB017
815 5522 001.	BRACKET HINGE, TOP	1 ..	
817 1460 024.	PIN, INTLK ACTUATOR	1 ..	
822 0922 075.	DOOR HINGE PIN	4 ..	
827 4247 001.	BRACKET	10 .	
827 5999 001.	ANGLE, XFMR MTG	4 ..	
827 6068 001.	STRAP	1 ..	
827 6893 001.	PLATE	2 ..	
829 8255 001.	AIR FILTER	2 ..	
829 9440 074.	PLATE, LATCH FILLER	2 ..	
829 9440 075.	PLATE, LT FILLER	1 ..	
829 9440 076.	PLATE, RT FILLER	1 ..	
829 9726 173.	SHLD, SAFETY	1 ..	
829 9726 178.	HINGE BRKT, BOTT	1 ..	
839 6816 200.	SHLD, SAFETY	1 ..	
839 7891 040.	WIRING DIAG, 60KW CONTROL.	0 ..	
914 9322 001.	RECPT COVER MOD	1 ..	
917 1956 001.	COVER TERM BD	1 ..	#TB033
917 2116 030.	CABLE, LOGIC BOX	2 ..	
917 2116 034.	CABLE ASSY,60KW VISUAL PR.	1 ..	
917 2116 035.	CABLE ASSY,60KW AURAL PWR.	1 ..	
917 2116 065.	CABLE, 60 KW CTRL CAB	1 ..	
917 2116 070.	ANGLE, DOOR LATCH	1 ..	
922 0965 040.	PANEL, FILLER	2 ..	
922 0965 041.	ANGLE, FRONT MTG.	2 ..	
922 0965 042.	ANGLE, BASE MTG.	2 ..	
922 0965 051.	BRACKET, SHIELD MTG.	4 ..	
922 0965 075.	NUT PLATE	2 ..	
922 0965 097.	PLATE, PHASE MONITOR	1 ..	
922 0965 209.	GROUND STRAP	1 ..	
939 7343 002.	BRACKET ASSY, BOOST AMP	1 ..	
939 7891 025.	ANGLE, FRONT PNL MTG.	1 ..	
939 7891 026.	ANGLE, REAR PANEL MTG	1 ..	
939 7891 030.	PLATE, CONNECTOR MTG.	2 ..	
939 7891 031.	SHIELD, POWER SUPPLY	2 ..	
939 7891 034.	PANEL, STATUS	1 ..	
939 7891 072.	PLATE, POWER SUPPLY MTG.	1 ..	#PS005
939 7891 073.	PLATE, POWER SUPPLY MTG.	1 ..	#PS006
939 7891 216.	GROUND STRAP	1 ..	

942 5783 003.	BRKT & PNL ASSY TV-60UX	....	1	..	
943 3620 003.	DOOR, REAR	.....	1	..	
943 5123 015.	CARD CAGE	.....	2	..	
943 5123 016.	DIVIDER	.....	1	..	
943 5123 017.	DECK	.....	1	..	
943 5123 025.	PANEL, BREAKER MTG	.....	1	..	
943 5123 026.	PANEL, BREAKER MTG	.....	1	..	
943 5123 033.	PANEL, REAR COVER	.....	2	..	
952 6512 001.	CABINET ASSY UHF TV	.....	1	..	
992 2819 003.	POWER SUPPLY DECK	.....	2	..	PS003 PS004
992 8111 001.	PC BOARD VOLTAGE METERING		2	..	PC002
992 8112 001.	PC BOARD CURRENT METERING		2	..	PC001
992 8464 001.	PANEL ASSY	.....	1	..	
999 2645 001.	HARDWARE LIST FOR CONTROL		1	..	
999 2646 001.	WIRE/TUBING LIST FOR CTRL...		1	..	

Table 7-12. CABLE, LOGIC BOX - 917 2116 030

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
817 2116 030.	CADS	0	..
839 7891 052.	CABLE LAYOUT, LOGIC BOX	0	..
252 0002 000.	WIRE, STRD 22AWG GRN	86	.. FT
612 0571 000.	CONN	2	.. J007 J008
612 1240 000.	HOUSING, CAP 15 CKT	5	.. J001 J002 J003 J004 J005
614 0163 000.	TERM STRIP 7 TERM	1	.. TP001
354 0147 000.	LUG SHAKE .150 MTG	1	..
354 0756 000.	CONTACT, SOCKET GOLD PLATE	30	..
354 0755 000.	CONTACT, PIN GOLD PLATE	42	..
358 0907 000.	POLARIZATION KEY	2	..
296 0261 000.	TUBING, SHRINK 1/8 WHITE	2.4	.. FT
384 0597 000.	RECT 1N4002	2	..
540 0049 000.	RES 1K OHM 1/2W 5%	2	..
414 0220 000.	TOROID F626-12-H	6	..
618 0705 000.	COAX CABLE, RG316/U 50 OHM.	12.5	.. FT
354 0001 000.	LUG #6 RING RED 22-18 AWG	6	..
296 0259 000.	TUBING TEFLON 18 AWG	.5	.. FT

Table 7-13. CABLE ASSY, 60KW VISUAL PR - 917 2116 034

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
252 0006 000.	WIRE, STRD 14AWG BLU	118	.. FT
252 0008 000.	WIRE, STRD 10AWG GRY	122	.. FT
354 0010 000.	LUG #10 RING BLU 16-14AWG	16	..
354 0011 000.	LUG BLUE RING .25	1	..
354 0015 000.	LUG BLUE SPADE 6	5	..
354 0016 000.	LUG BLUE SPADE 8	10	..
354 0017 000.	LUG BLUE SPADE 10	14	..
354 0026 000.	LUG YEL SPADE 10	15	..
354 0325 000.	LUG, .25 RING YEL 12-10AWG	9	..
424 0617 000.	GROMMET 7/16 MTG DIA	1	..
817 2116 034.	CADS, 60KW VISUAL PWR	0	..
852 9175 007.	CABLE LAYOUT, 60KW VISUAL	0	..

Table 7-14. CABLE ASSY,60KW AURAL PWR - 917 2116 035

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
252 0006 000.	WIRE, STRD 14AWG BLU	75 . FT	
252 0008 000.	WIRE, STRD 10AWG GRY	117.4FT	
354 0010 000.	LUG #10 RING BLU 16-14AWG	9 . .	
354 0011 000.	LUG BLUE RING .25	1 . .	
354 0015 000.	LUG BLUE SPADE 6	5 . .	
354 0016 000.	LUG BLUE SPADE 8	3 . .	
354 0017 000.	LUG BLUE SPADE 10	14 .	
354 0026 000.	LUG YEL SPADE 10	15 .	
354 0325 000.	LUG,.25 RING YEL 12-10AWG	9 . .	
817 2116 035.	CADS, 60KW AURAL PWR	0 . .	
852 9175 008.	CABLE LAYOUT, 60KW AURAL	0 . .	

Table 7-15. CABLE, 60 KW CTRL CAB - 917 2116 065

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
252 0003 000.	WIRE, STRD 20AWG WHT	1422.5.	FT
252 0006 000.	WIRE, STRD 14AWG BLU . . . . .	.3. .	FT
253 0059 000.	CABLE, 2C 22AWG AUDIO	14 .	FT
254 0002 000.	WIRE, BUS CU 20AWG . . . . .	.2. .	FT
296 0253 000.	TUBING, SHRINK 3/16 WHITE.	1.3.	FT
296 0259 000.	TUBING TEFLON 18 AWG . . . . .	.6. .	FT
296 0260 000.	TUBING, SHRINK 3.32 WHITE.	1.7.	FT
296 0261 000.	TUBING, SHRINK 1/8 WHITE	3.1.	FT
296 0262 000.	TUBING, SHRINK 1/4 WHITE . . . . .	.2. .	FT
296 0263 000.	TUBING, SHRINK 3/8 WHITE . . . . .	.9. .	FT
296 0264 000.	TUBING, SHRINK 1/2 WHITE	1.3.	FT
296 0267 000.	TUBING TEFLON 14 AWG . . . . .	.3. .	FT
354 0001 000.	LUG #6 RING RED 22-18 AWG	41 .	
354 0002 000.	LUG, #8 RING RED 22-18AWG	1 . .	
354 0004 000.	LUG .25 RING RED 22-18AWG	19 .	
354 0005 000.	TERM LUG RED SPADE 6	145	
354 0006 000.	TERM LUG RED SPADE 8	9 . .	
354 0008 000.	LUG #6 RING BLUE 16-14AWG.	4 . .	
354 0010 000.	LUG #10 RING BLU 16-14AWG.	2 . .	
354 0303 000.	FLAG CONTACT	1 . .	
354 0755 000.	CONTACT, PIN GOLD PLATE	79 .	
354 0756 000.	CONTACT, SOCKET GOLD PLATE	115	
354 0775 000.	TERM FOR .020 X .110 TAB	4 . .	
384 0165 000.	RECTIFIER 1N4720	2 . .	CR001 CR002
384 0597 000.	RECT 1N4002	2 . .	CR004 CR005
404 0774 000.	SOCKET RELAY 11 PIN OCTAL	2 . .	XK011 XK012
406 0491 000.	PLUG WIRING FOR LED CART	8 . .	
540 0042 000.	RES 510.0 OHM 1/2W 5%	2 . .	R001 R005
610 1019 000.	HOUSING, PLUG 15 CKT	15 .	
612 0462 000.	RECEPTACLE S-3308-AB	2 . .	
614 0046 000.	TERM BD 2 TERM	1 . .	TB035
614 0048 000.	TERM BD 4 TERM	2 . .	TB022 TB023
614 0050 000.	TERM BD 6 TERM	2 . .	TB020 TB021
614 0149 000.	TERM STRIP 5 TERM 1 GND	2 . .	TS001 TS002
614 0692 000.	TERM BD 20 TERM	6 . .	TB016 TB017 TB018 TB019 TB025 TB026
618 0210 000.	COAX CABLE RG142B, 50 OHM.	1.8.	FT

618 0705 000.	COAX CABLE, RG316/U 50 OHM..	22.8 FT	
620 2174 000.	"N" PLUG CRIMP ST	4 ..	
817 2116 065.	CADS, 60 KW CTRL CAB	0 ..	
852 9175 022.	CABLE LAYOUT - PWR SUPPLY .	0 ..	
915 1842 002.	STUD TERMINAL	7 ..	#TB016 #TB017 #K012
938 5170 001.	BRKT, TERM BD	1 ..	
939 7740 047.	BRKT, TERM BD	1 ..	
939 7891 069.	BRKT, TERM BD	1 ..	#TB018 #TB022 #XK012
939 7891 084.	BRACKET, TERM BD MTG	1 ..	#TB019 #TB023 #XK011
999 2702 001.	HARDWARE LIST	1 ..	

Table 7-16. POWER SUPPLY DECK - 992 2819 003

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
358 0908 000.	POLARIZATION KEY	2 ..	
358 0950 000.	GUIDE. CARD 4.5 IN L	2 ..	
358 1024 000.	CABLE STRIP MOUNT	2 ..	
358 2772 000.	STANDOFF 6-32 X 3/4	2 ..	#TB015
384 0018 000.	RECT 1N2069/1N4003	6 ..	CR012 CR014 CR015 CR016 CR017 CR018
384 0289 000.	RECTIFIER 1N1199	1 ..	CR013
398 0330 000.	FUSE, 2A	1 ..	F001
398 0336 000.	FUSE, 5A	1 ..	F002
402 0001 000.	CLIP, FUSE 1.062 60A 600V	2 ..	
402 0103 000.	FUSE HOLDER, HLD	2 ..	XF001 XF002
404 0016 000.	SOCKET TUBE 8 PIN OCTAL	1 ..	XK017
404 0018 000.	SOCKET TUBE 11 PIN	1 ..	XK016
404 0160 000.	SOCKET RELAY 27E006	3 ..	XK015 XK018 XK024
424 0005 000.	GROMMET 3/4 MTG DIA	4 ..	
472 0686 000.	XFMR, PLT, 815-1348-001	1 ..	T008
516 0081 000.	CAP, DISC .01UF 1KV 20%	1 ..	C036
524 0164 000.	CAP 2500UF 35V	1 ..	C034
524 0165 000.	CAP 1550UF 150V	1 ..	C033
524 0167 000.	CAP 9200UF 15V	1 ..	C035
530 0088 000.	BRACKET, CAP, 2" ID	1 ..	
530 0094 000.	BRACKET, CAP, 1.375"ID	2 ..	
540 0635 000.	RES 10.0K OHM 2W 5%	1 ..	R050
574 0156 000.	RELAY 12VDC 4PDT	2 ..	K018 K024
574 0179 000.	RLY 120VAC 4PDT	1 ..	K015
574 0460 000.	RELAY 3PDT 12VDC	1 ..	K016
604 0398 000.	SW, TGL SPDT	1 ..	S023
612 0432 000.	CONN HOUSING 14 POS	2 ..	J023 J024
614 0030 000.	TERM BD 8 TERM	1 ..	TB015
614 0132 000.	TERM STRIP 2 TERM	1 ..	TB023
614 0159 000.	TERM STRIP 3 TERM	1 ..	TB021
646 0569 000.	LABEL 814-2939-001	1 ..	#TB015
660 0023 000.	* BATT NICKEL CADMIUM 12V...	1 ..	BA001
736 0160 000.	PWR SUPPLY 15V 8A	1 ..	PS003
839 7740 099.	WIRING DIAG, PWR SUPPLY	0 ..	
839 7799 002.	COVER, SAFETY	1 ..	#TB015
922 0741 032.	CABLE, POWER SUPPLY	1 ..	
928 9005 001.	CABLE, PWR SUP.	1 ..	
943 4917 016.	DECK, POWER SUPPLY	1 ..	
992 2821 001.	PC-12 BOARD BT55U	1 ..	

992 3513 001. PC11 BOARD ASSY 1 ..
 992 8241 001. SOLID STATE RELAY ASSY 1 ..

Table 7-17. PC-12 BOARD BT55U - 992 2821 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
380 0125 000.	XSTR, NPN 2N4401	1.0.	Q1
380 0126 000.	XSTR, PNP 2N4403	1.0.	Q2
384 0018 000.	RECT 1N2069/1N4003	5.0.	CR1 CR2 CR3 CR4 CR5
384 0205 000.	DIODE SILICON 1N914/4148	2 ..	CR7 CR9
384 0290 000.	RECTIFIER, SILICON	4.0.	CR10 CR11 CR12 CR13
386 0082 000.	ZENER, 1N4744A 15V 1W 5% ...	1.0.	CR6
386 0183 000.	ZENER, 1N4099 6.8V	1 ..	CR008
448 0290 000.	HANDLE PC CARD	1.0.	
522 0213 000.	CAP 250 UF 16V	1.0.	C1
540 0032 000.	RES 200 OHM 1/2W 5%	1.0.	R9
540 0049 000.	RES 1K OHM 1/2W 5%	1.0.	R5
540 0073 000.	RES 10.0K OHM 1/2W 5%	1.0.	R7
540 0090 000.	RES 51.0K OHM 1/2W 5%	1.0.	R6
540 0318 000.	RES 270.0 OHM 1W 5%	2.0.	R2 R3
540 0607 000.	RES 680.0 OHM 2W 5%	1.0.	R4
542 0001 000.	RES 1 OHM 5% 8W	1.0.	R8
542 0003 000.	RES 3 OHM 5% 8W	1.0.	R1
574 0194 000.	RELAY, REED SPST 12VDC	1.0.	K1
827 5940 001.	SCHEMATIC	0 ..	
827 6189 001.	PRINTED BOARD	1.0.	

Table 7-18. PC11 BOARD ASSY - 992 3513 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
354 0309 000.	TERM SOLDER	2 ..	
380 0125 000.	XSTR, NPN 2N4401	4.0.	Q1 Q4 Q5 Q6
380 0126 000.	XSTR, PNP 2N4403	2.0.	Q2 Q3
382 0055 000.	* IC MC667 ESD	1.0.	U1
384 0205 000.	DIODE SILICON 1N914/4148	10 .	CR1 CR10 CR12 CR2 CR3 CR4 CR5 CR7 CR8 CR9
386 0183 000.	ZENER, 1N4099 6.8V	2 ..	CR006 CR011
448 0290 000.	HANDLE PC CARD	1.0.	
516 0429 000.	CAP .03UF 100V 20%	4.0.	C11 C3 C7 C8
522 0505 000.	CAP 220UF 25V -10/+50%	2 ..	C4 C6
522 0550 000.	CAP 100U 25V ELECTROLYTIC ..	1 ..	C5
526 0004 000.	CAP 1 UF 35V 10% TANT	3.0.	C1 C2 C9
526 0041 000.	CAP 18 UF 25V 10%	1.0.	C10
540 0001 000.	RES 10 OHM 1/2W 5%	2.0.	R13 R7
540 0010 000.	RES 24.0 OHM 1/2W 5%	1.0.	R9
540 0037 000.	RES 330.0 OHM 1/2W 5%	1.0.	R10
540 0043 000.	RES 560 OHM 1/2W 5%	2.0.	R1 R2
540 0049 000.	RES 1K OHM 1/2W 5%	2.0.	R3 R4
540 0059 000.	RES 2.7K OHM 1/2W 5%	2 ..	R008 R011
540 0060 000.	RES 3K OHM 1/2W 5%	1.0.	R14
540 0063 000.	RES 3.9K OHM 1/2W 5%	1.0.	R12
540 0067 000.	RES 5.6K OHM 1/2W 5%	2.0.	R16 R17
540 0077 000.	RES 15K OHM 1/2W 5%	1.0.	R15

540 0083 000. RES 27K OHM 1/2W 5% 2.0. R5 R6
 827 9945 001. SCHEMATIC 0 ..
 843 5157 001. PWB, PC 11 CENTER CONTROL . 1 ..

Table 7-19. SOLID STATE RELAY ASSY - 992 8241 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
336 1198 000.	SCREW 6-32 X 1/4	4 ..	
380 0518 000.	XSTR, TIP47	1 ..	
380 0721 000.	XSTR MOSFET IRF9640	1 ..	
410 0335 000.	INSULATOR SCREW	2 ..	
410 0405 000.	INSULATOR XSTR TO220	2 ..	
610 1103 000.	HEADER FOR OCTAL SOCKET ..	1 ..	P001
839 7891 132.	SCHEM, SOLID STATE RELAY ..	0 ..	
922 0965 116.	HEATSINK, SS RELAY	1 ..	
922 0965 117.	COVER, SS RELAY	1 ..	
939 7891 144.	CHASSIS, SS RELAY	1 ..	
992 8242 001.	PC BOARD ASSY SS RELAY	1 ..	
999 2627 001.	HARDWARE LIST	1 ..	
999 2628 001.	WIRE/TUBING LIST	1 ..	

Table 7-20. PC BOARD ASSY SS RELAY - 992 8242 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
354 0309 000.	TERM SOLDER	5 ..	
354 0320 000.	TERM, SOLDER, SLOTTED	6 ..	
358 2523 000.	STANDOFF 1/4 DIA 3/16 LG	2 ..	
384 0431 000.	RECT. 1N4001	1 ..	CR001
386 0082 000.	ZENER, 1N4744A 15V 1W 5% ...	1 ..	CR004
386 0186 000.	ZENER, 1N4737A 7.5V	1 ..	CR002
386 0437 000.	ZENER 1N5383B 150V 5W 5% ...	1 ..	CR003
516 0084 000.	CAP DISC .02UF 600V	1 ..	C001
540 0049 000.	RES 1K OHM 1/2W 5%	1 ..	R004
540 0635 000.	RES 10.0K OHM 2W 5%	1 ..	R003
540 0932 000.	RES 6.8K OHM 1/4W 5%	1 ..	R002
540 0936 000.	RES 10.0K OHM 1/4W 5%	1 ..	R001
839 7891 132.	SCHEM, SOLID STATE RELAY ..	0 ..	
839 7891 149.	PWB, SOLID STATE RELAY	1 ..	

Table 7-21. PC BOARD VOLTAGE METERING - 992 8111 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
380 0125 000.	XSTR, NPN 2N4401	5 ..	Q001 Q200 Q300 Q400 Q500
380 0126 000.	XSTR, PNP 2N4403	1 ..	Q002
382 0273 000.	IC, LM 7808C ESD	1 ..	U010
382 0367 000.	IC, 4049/14049 ESD	1 ..	U009
382 0385 000.	IC, 7908	1 ..	U011
382 0587 000.	IC, CD4011/MC14011 ESD	2 ..	U007 U008
382 0626 000.	IC, 4093B/14093B ESD	1 ..	U006
382 0719 000.	IC LM324AN ESD	5 ..	U001 U002 U003 U004 U005
384 0431 000.	RECT. 1N4001	8 ..	CR004 CR005 CR006 CR007 CR201 CR301 CR401 CR501
384 0720 000.	TRANSZORB 1N6377 15V 5W ...	7 ..	CR001 CR002 CR100 CR200 CR300 CR400

386 0091 000.	ZENER, 1N4738 8.2V	1 ..	CR500
404 0674 000.	SOCKET 14 PIN DIP (D-L)	8 ..	CR101
			XU001 XU002 XU003 XU004 XU005 XU006
			XU007 XU008
404 0675 000.	SOCKET IC 16 CONT	1 ..	XU009
448 0462 000.	HANDLE 21-0240L	2 ..	
494 0219 000.	CHOKE WIDE BAND	5 ..	L100 L200 L300 L400 L500
516 0453 000.	CAP .1UF 100V 20% X7R	11 .	C002 C004 C007 C008 C022 C023
			C024 C200 C300 C400 C500
516 0516 000.	CAP 1UF 100V 20%	3 ..	C001 C003 C020
516 0530 000.	CAP .01UF 10% 100V X7R	11 .	C009 C010 C011 C012 C013 C014
			C015 C016 C017 C018 C019
522 0550 000.	CAP 100U 25V ELECTROLYTIC	3 ..	C005 C006 C021
540 0001 000.	RES 10 OHM 1/2W 5%	2 ..	R003 R004
540 0292 000.	RES 22.0 OHM 1W 5%	2 ..	R001 R002
540 0912 000.	RES 1.0K OHM 1/4W 5%	1 ..	R005
540 0918 000.	RES 1.8K OHM 1/4W 5%	1 ..	R009
540 0927 000.	RES 4.3K OHM 1/4W 5%	9 ..	R008 R215 R216 R315 R316 R415
			R416 R515 R516
540 0936 000.	RES 10.0K OHM 1/4W 5%	3 ..	R006 R011 R115
540 0949 000.	RES 36.0K OHM 1/4W 5%	1 ..	R007
540 1008 000.	RES 10.0M OHM 1/4W 5%	5 ..	R106 R211 R311 R411 R511
548 0815 000.	RES 1M OHM 1/2W 1%	10 .	R100 R102 R200 R202 R300 R302
			R400 R402 R500 R502
548 0863 000.	RES 536 OHM 1/2W 1%	4 ..	R114 R214 R314 R414
548 1097 000.	RES 4.42K OHM 1/4W 1%	4 ..	R113 R213 R313 R413
548 1121 000.	RES 10K OHM 1/4W 1%	13 .	R103 R207 R208 R209 R307 R308
			R309 R407 R408 R409 R507 R508
			R509
548 1139 000.	RES 20K OHM 1/4W 1%	13 .	R203 R204 R205 R206 R303 R304
			R305 R306 R403 R404 R405 R406
			R210
548 1149 000.	RES 150K OHM 1/4W 1%	1 ..	R510
548 1500 000.	RES 499K OHM 1/2W 1%	5 ..	R101 R201 R301 R401 R501
548 1520 000.	RES 6.65K OHM 1/4W 1%	1 ..	R105
548 1525 000.	RES 23.2K OHM 1/4W 1%	1 ..	R310
548 2069 000.	RES 49.9K OHM 1/4W 1%	4 ..	R112 R212 R312 R412
548 2087 000.	RES 14.7K OHM 1/4W 1%	1 ..	R104
548 2119 000.	RES 57.6K OHM 1/4W 1%	1 ..	R410
610 0933 000.	JUMPER, PWB TEST POINT	11 .	TP001 TP002 TP003 TP004 TP005 TP006
			TP007 TP008 TP009 TP010 TP011
839 7891 028.	SCHEM, VOLTAGE METER BD	0 ..	
843 5123 020.	PWB, VOLTAGE, METERING &	1 ..	

Table 7-22. PC BOARD CURRENT METERING - 992 8112 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
380 0125 000.	XSTR, NPN 2N4401	8 ..	Q001 Q100 Q200 Q300 Q400 Q500
			Q600 Q700
380 0126 000.	XSTR, PNP 2N4403	2 ..	Q002 Q601
382 0273 000.	IC, LM 7808C ESD	1 ..	U012
382 0288 000.	IC, 4011/14011 ESD	3 ..	U007 U008 U009
382 0367 000.	IC, 4049/14049 ESD	1 ..	U010

382 0415 000.	IC, 324 ESD	5 ..	U001 U002 U003 U004 U005
382 0605 000.	IC 7905C ESD	1 ..	U013
382 0619 000.	IC, CD4050/MC14050 ESD	1 ..	U011
382 1192 000.	IC, MC14584BCP	1 ..	U006
384 0431 000.	RECT. 1N4001	30 .	CR003 CR004 CR005 CR006 CR101 CR102 CR103 CR104 CR201 CR202 CR203 CR204 CR301 CR302 CR303 CR304 CR401 CR402 CR403 CR404 CR501 CR502 CR503 CR504 CR601 CR603 CR604 CR700 CR702 CR703 CR100 CR200 CR300 CR400 CR500 CR600
384 0719 000.	TRANSZORB 1N6373 5V 5W	6 ..	CR001 CR002
384 0720 000.	TRANSZORB 1N6377 15V 5W	2 ..	CR701
386 0078 000.	ZENER, 1N4734A 5.6V	1 ..	XU001 XU002 XU003 XU004 XU005 XU006 XU007 XU008 XU009
404 0674 000.	SOCKET 14 PIN DIP (D-L)	9 ..	XU010 XU011
404 0675 000.	SOCKET IC 16 CONT	2 ..	
448 0462 000.	HANDLE 21-0240L	2 ..	
494 0219 000.	CHOKE WIDE BAND	8 ..	L100 L200 L300 L400 L500 L600 L601 L700
516 0453 000.	CAP .1UF 100V 20% X7R	8 ..	C002 C004 C102 C202 C302 C402 C502 C701
516 0516 000.	CAP 1UF 100V 20%	3 ..	C001 C003 C023
516 0530 000.	CAP .01UF 10% 100V X7R	17 .	C005 C006 C007 C008 C009 C010 C011 C012 C013 C014 C017 C018 C019 C020 C021 C022 C603
516 0736 000.	CAP .001UF 10% 100V X7R	9 ..	C100 C200 C300 C400 C500 C600 C601 C700 C704
516 0771 000.	CAP 33PF 5% 100V C0G	2 ..	C602 C705
522 0550 000.	CAP 100U 25V ELECTROLYTIC	3 ..	C015 C016 C024
526 0358 000.	CAP 22UF 35V 10%	2 ..	C702 C703
540 0001 000.	RES 10 OHM 1/2W 5%	2 ..	R003 R004
540 0025 000.	RES 100 OHM 1/2W 5%	1 ..	R600
540 0049 000.	RES 1K OHM 1/2W 5%	2 ..	R601 R700
540 0292 000.	RES 22.0 OHM 1W 5%	2 ..	R001 R002
540 0912 000.	RES 1.0K OHM 1/4W 5%	3 ..	R005 R701 R705
540 0918 000.	RES 1.8K OHM 1/4W 5%	2 ..	R009 R613
540 0927 000.	RES 4.3K OHM 1/4W 5%	13 .	R008 R118 R119 R218 R219 R318 R319 R418 R419 R518 R519 R612 R707
540 0949 000.	RES 36.0K OHM 1/4W 5%	1 ..	R011
540 0963 000.	RES 130.0K OHM 1/4W 5%	1 ..	R706
540 0965 000.	RES 160.0K OHM 1/4W 5%	1 ..	R702
540 0988 000.	RES 1.5M OHM 1/4W 5%	1 ..	R616
540 1008 000.	RES 10.0M OHM 1/4W 5%	7 ..	R116 R216 R316 R416 R516 R608 R611
548 0281 000.	RES 6.19K OHM 1/2W 1%	5 ..	R108 R208 R308 R408 R508
548 0366 000.	RES 22.1K OHM 1/2W 1%	1 ..	R609
548 1115 000.	RES 332 OHM 1/4W 1%	5 ..	R100 R200 R300 R400 R500
548 1120 000.	RES 2K OHM 1/4W 1%	2 ..	R615 R703
548 1121 000.	RES 10K OHM 1/4W 1%	5 ..	R006 R007 R602 R603 R617
548 1139 000.	RES 20K OHM 1/4W 1%	5 ..	R117 R217 R317 R417 R517
548 1147 000.	RES 4.75K OHM 1/4W 1%	5 ..	R112 R212 R312 R412 R512
548 1148 000.	RES 100K OHM 1/4W 1%	1 ..	R604
548 1149 000.	RES 150K OHM 1/4W 1%	20 .	R101 R102 R106 R107 R201 R202 R206 R207 R301 R302 R306 R307

			R401 R402 R406 R407 R501 R502 R506 R507
548 1158 000.	RES 3.92K OHM 1/4W 1%	1 ..	R606
548 1170 000.	RES 200K OHM 1/4W 1%	5 ..	R110 R210 R310 R410 R510
548 1244 000.	RES 619 OHM 1/4W 1%	5 ..	R105 R205 R305 R405 R505
548 1279 000.	RES 301 OHM 1/4W 1%	1 ..	R618
548 2054 000.	RES 232 OHM 1/2W 1%	5 ..	R111 R211 R311 R411 R511
548 2068 000.	RES 24.9K OHM 1/4W 1%	5 ..	R114 R214 R314 R414 R514
548 2069 000.	RES 49.9K OHM 1/4W 1%	6 ..	R113 R213 R313 R413 R513 R607
548 2086 000.	RES 7.32K OHM 1/4W 1%	5 ..	R103 R203 R303 R403 R503
548 2132 000.	RES 14.7 OHM 1/4W 1%	1 ..	R704
550 0858 000.	POT 5K OHM .5W 10%	1 ..	R605
550 0947 000.	POT 1K OHM 1/2W 10%	10 .	R104 R115 R204 R215 R304 R315 R404 R415 R504 R515
550 0956 000.	POT 2000 OHM 1/2W 10%	1 ..	R610
550 0958 000.	POT 10K OHM 1/2 W 10%	5 ..	R109 R209 R309 R409 R509
610 0933 000.	JUMPER, PWB TEST POINT	15 .	TP001 TP002 TP003 TP004 TP005 TP006 TP007 TP008 TP009 TP010 TP011 TP012 TP013 TP014 TP015
839 7891 024.	SCHEM, COLLECTOR CURRENT	0 ..	
843 5123 019.	PWB, CURRENT METERING AND	1 ..	
999 2615 001.	HARDWARE LIST	1 ..	

Table 7-23. ELECT INSTL MATL TV-60UM - 992 6652 003

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
003 4010 050.	CU, STRAP .020 X 4"	100 FT	
080 0201 032.	PAINT KIT TOUCH-UP	1 ..	
250 0108 000.	CABLE, 12C 22AWG	50 . FT	
250 0387 000.	CABLE, 6C 20AWG	30 . FT	
252 0003 000.	WIRE, STRD 20AWG WHT	900 FT	
252 0005 000.	WIRE, STRD 16AWG BRN	500 FT	
252 0006 000.	WIRE, STRD 14AWG BLU	400 FT	
252 0008 000.	WIRE, STRD 10AWG GRY	400 FT	
255 0006 000.	WIRE HV 8AWG 100KVDC	200 FT	
255 0024 000.	WIRE, HIGH VOLTAGE 12 AWG	200 FT	
296 0383 000.	TUBING, ZIPPER 1-1/2 IN	100 FT	
302 0389 000.	SCR, 10-32 X 1/2	32 .	
302 0654 000.	SCR, 10-32 X 3	6 ..	
303 0041 000.	SCREW, MACH M6-1.0 X 12	32 .	
306 0018 000.	NUT, HEX KEP 10-32	6 ..	
314 0019 000.	WASHER, INT-EXT LOCK 10	6 ..	
354 0005 000.	TERM LUG RED SPADE 6	25 .	
354 0006 000.	TERM LUG RED SPADE 8	50 .	
354 0015 000.	LUG BLUE SPADE 6	50 .	
354 0016 000.	LUG BLUE SPADE 8	50 .	
354 0027 000.	TERM LUG YEL SPADE 8	20 .	
354 0245 000.	TERM LUG YEL RING 10	10 .	
354 0325 000.	LUG,.25 RING YEL 12-10AWG	20 .	
354 0325 000.	LUG,.25 RING YEL 12-10AWG	10 .	
354 0338 000.	LUG 4 RING RED	40 .	
354 0385 000.	CONTACT, SOCKET	15 .	
354 0567 000.	TERMINAL 3/8 RING	10 .	

384 0371 000.	RECTIFIER IN4003	2	..	CR100 CR101
408 0223 000.	SHIELD 15 POSITION	1	..	
432 0357 001.	RFRB KIT FOR 432-0357-000	0	..	#WATER MODULE
448 0835 000.	LATCH, ASSY END DISC	1	..	PG#MUX LOGIC PLUG
464 0242 000.	CHAIN HOIST 10 FT, 1 TON	1	..	# KLYSTRON
464 0243 000.	TOOL, CONT EXTRACTION	1	..	
464 0253 000.	PLIERS, ZIPPER TUBING	1	..	
612 0543 000.	RECEPTACLE 205205-1	1	..	
620 0495 000.	TERM BNC 75 OHM	1	..	J23-VISUAL #FOR PULSER SYNC SIGNAL TERMINATION
629 0052 000.	METER, DIGITAL WATER	0	..	
690 0016 000.	DUCT SEALANT, PUTTY	2	..	BX
817 1593 048.	SPACER, CAB TIE	6	..	
822 0965 119.	SHIELD, COLLECTOR LEAD	10	..	
839 7891 086.	WIRING DIAG, TV-60UM PWR	0	..	
917 2029 051.	CABLE, RF #752	1	..	
917 2029 052.	CABLE, RF #753	1	..	
917 2029 056.	CABLE, RF #757	1	..	
917 2029 058.	CABLE, RF #786	1	..	
917 2116 046.	CABLE, RF SAMPLE #162 FWD	2	..	
917 2116 047.	CABLE,RF SAMPLE #163 REFL	2	..	
917 2248 001.	CABLE, HALL SENSOR TEST	1	..	
922 0965 091.	RETAINER, RFI SHIELD	8	..	
922 0965 092.	SHIELD, RFI	8	..	
922 1144 001.	HALL EXTENSION CABLE	1	..	
927 4935 003.	AC CORD ASSY	1	..	#VIS EX
927 7135 001.	BOARD, EXTENDER	1	..	#PWR SUPPLY DECK
929 9726 134.	CABLE, INTERCONNECT	1	..	W007
943 5123 066.	LIFT, KLYSTRON	1	..	
992 3136 001.	RMT PWR METER	1	..	
992 3660 001.	KIT, HARDWARE	1	..	MISC HDWR
992 4021 001.	TOOL KIT, INSTL	1	..	
992 4831 001.	EXTENDER CARD	1	..	#VIS EX
992 8167 001.	PWB, EXTENDER BD	1	..	#LOGIC BOX
992 8183 001.	KIT, WATER MODULE CART.	0	..	#WATER MODULE
992 8396 001.	ASSY, EXTENDER BOARD	1	..	#ACC TRAY
992 8456 001.	KIT,TUBE INSTL 4-CAV MSDC	0	..	

Table 7-24. CABLE, RF #752 - 917 2029 051

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
296 0263 000.	TUBING, SHRINK 3/8 WHITE	.2	.. FT CUT .6 2PL MARK 752 2PL
618 0211 000.	COAX CABLE RG59B, 75 OHM	12.1	.. FT #CUT TO 144" +/- .1
620 1952 000.	STRAIGHT PLUG BNC CRIMP	2	.. J016 J022

Table 7-25. CABLE, RF #753 - 917 2029 052

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
296 0271 000.	TUBING, SHRINK 3/4 WHITE	.2	.. FT CUT .6 2PL MARK 753 2PL
618 0221 000.	1/2" COAX CABLE, FSJ450B	22.4	.. FT #CUT TO 268" +/- .1
620 0574 000.	PLUG, MALE TYPE N, 44ASW	2	.. J017

Table 7-26. CABLE, RF #757 - 917 2029 056

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
296 0263 000.	TUBING, SHRINK 3/8 WHITE . . . .	.2..	FT CUT .6 2PL MARK 757 2PL
618 0230 000.	CABLE, COAX, 50 OHM	19.4	FT CUT TO 232" +/- .1
620 0676 000.	PLUG, TYPE N MALE	2 ..	J001 J021

Table 7-27. CABLE, RF #786 - 917 2029 058

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
296 0263 000.	TUBING, SHRINK 3/8 WHITE . . . .	.5..	FT CUT TO .6 2 PL MARK HY1J2 (ONE END) MARK V3RFIN (ONE END)
618 0230 000.	CABLE, COAX, 50 OHM	10.1	FT CUT TO 120"+/- .1
620 0676 000.	PLUG, TYPE N MALE	2 ..	

Table 7-28. CABLE, RF SAMPLE #162 FWD - 917 2116 046

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
296 0262 000.	TUBING, SHRINK 1/4 WHITE . . . .	.4..	FT #CUT TO 1 1/2", 2 PIECESREQD. MARK ONE PIECE "FWD" MARK THE OTHER PIECE PD-1/AT1. INSTALL "FWD" AT RT ANGLE END.
618 0051 000.	COAX CABLE RG58C, 50 OHM . .	6 ..	FT #CUT TO 72" +/- .1"
620 0502 000.	PLUG BNC UG-88/U	1 ..	
620 0585 000.	PLUG ANGLE TYPE N	1 ..	

Table 7-29. CABLE, RF SAMPLE #163 REFL - 917 2116 047

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
296 0262 000.	TUBING, SHRINK 1/4 WHITE . . . .	.4..	FT #CUT TO 1 1/2", 2 PIECESREQD MARK ONE PIECE "REFL", THE OTHER "PD-1/J2" INSTALL "REFL" AT RT ANGLE END.
618 0051 000.	COAX CABLE RG58C, 50 OHM . .	6 ..	FT #CUT TO 72" +/- .1"
620 0502 000.	PLUG BNC UG-88/U	1 ..	
620 0585 000.	PLUG ANGLE TYPE N	1 ..	

Table 7-30. RMT PWR METER - 992 3136 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
358 0317 000.	PLUG BUTTON .375 HOLE	1.0.	
424 0073 000.	BUMPER RUBBER 1561	4.0.	
822 0240 001.	WIRING DIAG	0 ..	
827 7622 001.	ENCL., BOTTOM	1.0.	
927 7628 001.	CABLE RMT CTL BT55U	1.0.	
992 3866 001.	BASIC CTL ASSY	1.0.	

Table 7-31. CABLE RMT CTL BT55U - 927 7628 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
827 7628 001.	FAB/ASSY INSTR, CABLE	0 ..	
354 0003 000.	LUG #10 RING RED 22-18AWG . .	1 ..	
296 0264 000.	TUBING, SHRINK 1/2 WHITE . . . .	.2..	FT
610 0473 000.	PLUG P-3308-CCT	1.0.	

250 0222 000. CABLE, 14C 22AWG 18 . FT
 296 0260 000. TUBING, SHRINK 3.32 WHITE.4. . FT

Table 7-32. BASIC CTL ASSY - 992 3866 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
302 0104 000.	SCR, 6-32 X 1/4	5.0.	
312 0005 000.	WASHER, INT LOCK 6	5.0.	
424 0003 000.	GROMMET 1/2 MTG DIA	1.0.	
550 0010 000.	POT 100K OHM .5W	1.0.	R1
598 0169 000.	SWITCH CAP, PB, RED	2.0.	
598 0188 000.	SW BASE 513-0410-001	4.0.	#S1 #S2 #S3 #S4
598 0195 000.	SWITCH CAP, PB, YELL	2.0.	
632 0641 000.	* METER, PK PWR/VSWR,	1.0.	M1
646 1078 001.	PLT, LOGO 2.0LG PLSTC	1 ..	
813 5606 020.	STUD BRS 10-32 X 1-5/8	2.0.	
814 9584 001.	SPACER	2.0.	
814 9585 001.	HANDLE	1.0.	
815 2462 001.	PLATE, MTR MTG	1.0.	
815 3414 001.	SPACER, POT	1.0.	
928 5981 001.	ENC. REMOTE CONTROL	1.0.	
999 2671 001.	HARDWARE LIST	1 ..	

Table 7-33. VISUAL AMP CAB UM - 992 8095 005

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
358 0062 000.	STUD 85 OVAL HEAD	8 ..	
358 0410 000.	RETAINER 85 ALL HDS	8 ..	
358 0721 000.	RECEPTACLE 85 CLIP	8 ..	
358 1974 000.	SPEED NUT 10-32	8 ..	
402 0020 000.	CLIP, FUSE	2 ..	#EG002
410 0028 000.	INSULATOR ROUND NS5W 0432.	6 ..	#R039 #R044 #R045
510 0758 000.	CAP, .25UF/25KV .5UF/35KV.	1 ..	C006
540 1451 000.	RES 220.0 OHM 50W 10%	1 ..	R039
540 1522 000.	RES 16.6 OHM 75W 20%	2 ..	R044 R045
560 0086 000.	SPARK GAP 5KV +/- 10%	1 ..	EG002, # MOTOR POT
632 1088 000.	MTR PK PWR/VSWR, 4-1/2",S.	1 ..	M004
632 1159 000.	MTR 0-6ADC SC 4-1/2" S	1 ..	M005
646 0665 000.	INSPECTION LABEL	1 ..	
700 0484 000.	LOAD, COAXIAL 1000W	2 ..	RL001 RL002
810 4036 004.	CONN PLATE	3 ..	
815 0996 001.	STRAP	1 ..	#GS2
816 2727 002.	TRIM STRIP, VISUAL	1 ..	
829 9548 006.	ANGLE	6 ..	#R039 #R044 #R045
917 2116 019.	CABLE,FIBER OPTICS PULSER.	1 ..	#F001 #F002
917 2116 020.	CABLE,HV VISUAL CABINET	1 ..	
922 0965 036.	PLATE, LOAD MTG.	4 ..	
929 9539 001.	RESISTOR CAP ASSY	6 ..	#R039 #R044 #R045
939 5212 003.	MOTORIZED POT ASSY.	1 ..	A107
992 6998 001.	PULSER ASSY	1 ..	
992 6999 001.	PULSER CONTROLLER ASSY ...	1 ..	
992 8403 001.	BASIC AMP CABINET	1 ..	

Table 7-34. CABLE,FIBER OPTICS PULSER - 917 2116 019

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
817 2116 019.	CADS, FIBER OPT PULSER	0 ..	
618 0690 000.	CABLE, FIBER OPTIC	9 ..	MR
612 1275 000.	CONN, FIBER OPTIC, BLUE	4 ..	

Table 7-35. CABLE,HV VISUAL CABINET - 917 2116 020

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
817 2116 020.	ASSY INSTR, CADS	0 ..	
255 0021 000.	WIRE HV #20AWG 40KVDC	28.5	FT
354 0669 000.	TERM 250 FEM RED 22-18	4 ..	
354 0004 000.	LUG .25 RING RED 22-18AWG	4 ..	
354 0003 000.	LUG #10 RING RED 22-18AWG	2 ..	
354 0002 000.	LUG, #8 RING RED 22-18AWG	6 ..	
354 0001 000.	LUG #6 RING RED 22-18 AWG	2 ..	
296 0262 000.	TUBING, SHRINK 1/4 WHITE . . . . .	.7..	FT
255 0024 000.	WIRE, HIGH VOLTAGE 12 AWG	5.33	FT
354 0325 000.	LUG,.25 RING YEL 12-10AWG	7 ..	
354 0324 000.	LUG #10 RING YEL 12-10AWG	3 ..	
296 0263 000.	TUBING, SHRINK 3/8 WHITE	1.6.	FT

Table 7-36. MOTORIZED POT ASSY. - 939 5212 003

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
614 0127 000.	TERM STRIP 1 TERM	2 ..	
817 2029 087.	RUN LIST, MOTORIZED POT	0 ..	
839 5212 003.	ASSY INSTR, MOTORIZED POT	0 ..	
839 7891 038.	WIRING DIAG, AMP CABINET	0 ..	
839 5158 003.	MOTOR MTG BASE, ECK	1 ..	
839 5159 001.	PLATE MOUNTING	1 ..	
436 0061 000.	MOTOR, SYNCH 1 RPM	1 ..	B001
939 5895 001.	BASE, MOTORIZED POT	1 ..	
813 9339 001.	CPLG MOTOR POWERSTAT	1 ..	B002
604 0624 000.	SW, SPDT	2 ..	S001 S002
574 0156 000.	RELAY 12VDC 4PDT	2 ..	K001 K002
404 0578 000.	SOCKET RELAY, 4PDT	2 ..	XK001 XK002
354 0755 000.	CONTACT, PIN GOLD PLATE	9 ..	#J001
612 1240 000.	HOUSING, CAP 15 CKT	1 ..	J001
384 0357 000.	RECTIFIER 1N4004	2 ..	CR001 CR002
302 0133 000.	SCR, 8-32 X 3/4	1 ..	B001
813 4999 003.	STDOFF 4-40X1/4 1/4 HEX	4 ..	
552 0988 000.	RHEOSTAT, TANDEM 50K OHM	1 ..	
424 0001 000.	GROMMET 3/8 MTG DIA	2 ..	
344 0009 000.	SCREW, SET 8-32 X 3/16	5 ..	
999 2555 001.	WIRE/TUBING LIST	1 ..	

Table 7-37. PULSER ASSY - 992 6998 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
310 0001 000.	WASHER, FLAT #2	4 ..	# SPRING CLIP
335 0017 000.	WASHER NYLON .261 ID	4 ..	

350 0048 000.	RIVET POP .093X.337	4	..
358 2401 000.	STANDOFF, HINGED 1/4 OD	3	..
410 0028 000.	INSULATOR ROUND NS5W 0432.	4	..
813 4999 030.	STDOFF 6-32X1 1/4 HEX	4	..
839 7740 063.	BASE, H.V. PULSER	1	..
992 7003 001.	H.V. PULSER PC ASSY, ECK	1	..

Table 7-38. H.V. PULSER PC ASSY, ECK - 992 7003 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
252 0003 000.	WIRE, STRD 20AWG WHT	1.7.	FT
302 0062 000.	SCR, 4-40 X 1.25	4	..
302 0383 000.	SCR, 4-40 X 1-1/2	2	..
358 0419 000.	SPACER, ROLLED 15/16	4	..
380 0189 000.	XSTR, NPN 2N3904	3	.. Q001 Q002 Q003
380 0527 000.	XSTR, TIP120	1	.. Q008
380 0682 000.	XSTR, POWER MOSFET	4	.. Q004 Q005 Q006 Q007
382 0184 000.	IC, 340T-5/7805 +5V REG	2	.. U007 U009
382 0406 000.	IC, MC7812CT	2	.. U006 U008
382 0774 000.	IC 74HC14 ESD	1	.. U003
382 1131 000.	RECEIVER FIBER OPTIC	2	.. U001 U002
382 1133 000.	IC, TSC-429CPA ESD.	2	.. U005 U010
382 1134 000.	IC, HCPL-2601	1	.. U004
384 0205 000.	DIODE SILICON 1N914/4148	2	.. CR011 CR012
384 0665 000.	RECT, FW BRIDGE 2A 600V	2	.. CR016 CR017
384 0748 000.	TRANSZORB, BIPOLAR 90V	4	.. CR006 CR010 CR025 CR029
384 0749 000.	TRANZORB, BIPOLAR 220V	12	.. CR003 CR004 CR005 CR007 CR008 CR009 CR022 CR023 CR024 CR026 CR027 CR028
384 0799 000.	DIODE, BIPOLAR	4	.. CR002 CR014 CR019 CR030
384 0811 000.	DIODE, 3W2 2KV PIV	1	.. CR031
386 0078 000.	ZENER, 1N4734A 5.6V	1	.. CR015
386 0137 000.	ZENER, 1N4746A 18V	2	.. CR001 CR018
386 0138 000.	ZENER, 1N4750A 27V	1	.. CR020
404 0673 000.	SOCKET 8 PIN DIP (DL)	3	.. #U004 #U005 #U010
404 0674 000.	SOCKET 14 PIN DIP (D-L)	1	.. #U003
404 0713 000.	HEAT SINK TO-220 CASE	2	.. #U006 #U008
404 0758 000.	HEAT SINK FOR TO-220	1	.. #Q008
472 1641 000.	XFMR, ISO 120V 100MA	1	.. T001
494 0238 000.	CHOKE RF 39UH	1	.. L002
494 0401 000.	CHOKE RF 18.0UH	1	.. L001
500 0759 000.	CAP 100PF 500V 5%	3	.. C011 C012 C033
504 0501 000.	CAP .22UFD, 2000VVDC, 10%...	1	.. C009
506 0246 000.	CAP .47UF 63V 5%	2	.. C006 C034
516 0453 000.	CAP .1UF 100V 20% X7R	17	.. C001 C002 C003 C004 C005 C007 C010 C014 C019 C021 C023 C024 C025 C026 C027 C028 C035
516 0854 000.	CAP 47PF 20% 3KV	3	.. C008 C018 C029
522 0565 000.	CAP 2200UF 63V 20%	1	.. C020
522 0566 000.	CAP 100UF 63V 20%	3	.. C015 C022 C032
526 0050 000.	CAP 1UF 35V 20%	2	.. C016 C017
540 0298 000.	RES 39.0 OHM 1W 5%	1	.. R028
540 0327 000.	RES 620.0 OHM 1W 5%	3	.. R001 R029 R041
540 0588 000.	RES 110.0 OHM 2W 5%	2	.. R019 R020

540 0597 000.	RES 270.0 OHM 2W 5%	4 ..	R015 R016 R017 R018
540 0598 000.	RES 300.0 OHM 2W 5%	1 ..	R034
540 0673 000.	RES 390.0K OHM 2W 5%	4 ..	R002 R003 R030 R031
540 0676 000.	RES 510.0K OHM 2W 5%	4 ..	R004 R005 R032 R033
540 0864 000.	RES 10.0 OHM 1/4W 5%	5 ..	R011 R012 R023 R037 R038
540 0895 000.	RES 200.0 OHM 1/4W 5%	1 ..	R009
540 0902 000.	RES 390.0 OHM 1/4W 5%	3 ..	R010 R013 R047
540 0912 000.	RES 1.0K OHM 1/4W 5%	2 ..	R008 R024
540 0920 000.	RES 2.2K OHM 1/4W 5%	4 ..	R006 R007 R025 R026
540 0923 000.	RES 3.0K OHM 1/4W 5%	1 ..	R036
540 0936 000.	RES 10.0K OHM 1/4W 5%	7 ..	R022 R027 R042 R043 R044 R045 R046
548 2180 000.	RES 7.5 MEGOHM 5W 5%	1 ..	R048
606 0781 000.	CB, MAGNETIC 2A	1 ..	CB001
610 0933 000.	JUMPER, PWB TEST POINT	8 ..	TP001 TP002 TP003F TP004F TP005F TP013 TP014 TP015
610 1066 000.	CONN, .25 FASTON PC MOUNT	4 ..	J001 J002 J003 J004
736 0210 000.	POWER SUPPLY 1300V 10MA	1 ..	PS001
822 0741 051.	BRACKET, CIRCUIT BREAKER	1 ..	
839 7740 050.	SCHEM, H.V. PULSER	0 ..	
843 4917 022.	PWB, H.V. PULSER	1 ..	PWB001
922 0995 001.	HEATSINK	1 ..	
999 2502 001.	HARDWARE LIST	1 ..	

Table 7-39. PULSER CONTROL - 992 6991 001

<i>HARRIS P/N</i>	<i>DESCRIPTION</i>	<i>QTY/UM</i>	<i>REF. SYMBOLS/EXPLANATIONS</i>
358 1214 000.	SCREWLOCK, FEMALE	1 ..	#J005
358 2827 000.	SPACER, LED MOUNT .25 LG	8 ..	#CR003 #CR007 #CR027 #CR034
380 0189 000.	XSTR, NPN 2N3904	6 ..	Q001 Q002 Q003 Q004 Q007 Q009
380 0190 000.	XSTR, PNP 2N3906	3 ..	Q005 Q006 Q008
382 0088 000.	IC, 74121	1 ..	U009
382 0184 000.	IC, 340T-5/7805 +5V REG	1 ..	U007
382 0581 000.	IC, 74LS123	2 ..	U001 U002
382 0769 000.	IC 74HC02 ESD	2 ..	U004 U006
382 0789 000.	IC 74HC132 ESD	2 ..	U003 U005
382 1033 000.	IC, 4060B	1 ..	U008
382 1132 000.	TRANSMITTER FIBER OPTIC	2 ..	CR002 CR037
384 0205 000.	DIODE SILICON 1N914/4148	9 ..	CR001 CR004 CR005 CR006 CR011 CR025 CR026 CR032 CR033
384 0253 000.	RECTIFIER 1N4007	18 ..	CR009 CR010 CR013 CR014 CR015 CR016 CR017 CR018 CR019 CR020 CR021 CR022 CR023 CR024 CR028 CR029 CR035 CR036
384 0610 000.	LED, GREEN	2 ..	CR007 CR034
384 0611 000.	LED, RED	2 ..	CR003 CR027
386 0078 000.	ZENER, 1N4734A 5.6V	1 ..	CR008
404 0674 000.	SOCKET 14 PIN DIP (D-L)	5 ..	#U003 #U004 #U005 #U006 #U009
404 0675 000.	SOCKET IC 16 CONT	5 ..	#U001 #U002 #U008 #K001 #K002
444 2774 000.	XTAL 3.6864 MHZ	1 ..	Y001
500 0804 000.	CAP 10PF 500V +/-5PF	1 ..	C010
500 0806 000.	CAP 15PF 500V 5%	1 ..	C022
500 0812 000.	CAP 30PF 500V 5%	1 ..	C023
500 0817 000.	CAP 47PF 500V 5%	4 ..	C001 C002 C003 C004

500 0903 000.	CAP 2700PF 500V 5%	1 ..	C025
506 0245 000.	CAP .33UF 63V 5%	1 ..	C012
516 0453 000.	CAP .1UF 100V 20% X7R	10 .	C005 C006 C007 C008 C011 C015 C016 C019 C024 C026
522 0524 000.	CAP 10 UF 25V 30%	1 ..	C018
522 0550 000.	CAP 100U 25V ELECTROLYTIC ..	2 ..	C017 C027
526 0050 000.	CAP 1UF 35V 20%	1 ..	C009
540 0041 000.	RES 470 OHM 1/2W 5%	2 ..	R030 R047
540 0042 000.	RES 510.0 OHM 1/2W 5%	1 ..	R049
540 0317 000.	RES 240.0 OHM 1W 5%	1 ..	R013
540 0319 000.	RES 300.0 OHM 1W 5%	1 ..	R053
540 0888 000.	RES 100 OHM 1/4W 5%	3 ..	R020 R038 R039
540 0900 000.	RES 330.0 OHM 1/4W 5%	7 ..	R001 R002 R016 R028 R029 R035 R037
540 0912 000.	RES 1.0K OHM 1/4W 5%	4 ..	R007 R008 R014 R044
540 0916 000.	RES 1.5K OHM 1/4W 5%	3 ..	R009 R010 R055
540 0928 000.	RES 4.7K OHM 1/4W 5%	2 ..	R011 R025
540 0936 000.	RES 10.0K OHM 1/4W 5%	3 ..	R005 R006 R052
540 0940 000.	RES 15K OHM 1/4W 5%	1 ..	R024
540 0944 000.	RES 22.0K OHM 1/4W 5%	12 .	R015 R017 R018 R019 R031 R034 R036 R042 R043 R045 R046 R048
540 0949 000.	RES 36.0K OHM 1/4W 5%	1 ..	R023
540 0953 000.	RES 51.0K OHM 1/4W 5%	2 ..	R040 R041
540 0976 000.	RES 470.0K OHM 1/4W 5%	1 ..	R027
540 0990 000.	RES 1.8M OHM 1/4W 5%	1 ..	R026
540 1008 000.	RES 10.0M OHM 1/4W 5%	1 ..	R050
550 0959 000.	POT 20K OHM 1/2 W 10%	3 ..	R003 R004 R051
560 0078 000.	RES, SAFETY 3.3 OHM	1 ..	R054
578 0022 000.	RLY 12V DPDT LATCHING	1 ..	K002
578 0023 000.	RLY, 12V DPDT	1 ..	K001
604 0903 000.	SWITCH, TGL SPDT MOM OFF ..	2 ..	S001 S002
610 0899 000.	HEADER 3 PIN RT ANGLE	2 ..	J001 J002
610 0948 000.	PLUG 25 CONT D RT ANG PC ...	1 ..	J005
612 1184 000.	JUMPER .1" CENTERS	2 ..	P001 P002
612 1268 000.	RECEPTACLE RT ANG BNC	2 ..	J003 J004
839 7740 036.	SCHEM, PULSER CONTROL	0 ..	
843 4917 014.	PWB, PULSER CONTROL	1 ..	PWB1

Table 7-40. BASIC AMP CABINET - 992 8403 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
051 0001 017.	* ADHESIVE, LIQUID NAILS	0 ..	
053 0100 056.	METAL SWITCH BOX	1 ..	
300 1571 000.	SCR, 8-32 X 1-1/4	3 ..	
357 0071 000.	SCREW 10-32 X 1/2	2 ..	
358 0002 000.	BRACKET RESISTOR MTG	6 ..	#PS2R1 #PS2R2 #PS2R3
358 0004 000.	BRACKET RESISTOR MTG	30 .	2#R023 2#R024 2#R025 2#R026 2#R027 2#R028 2#R029 2#R030 2#R031 2#R032 2#R033 2#R034 2#R001 2#R002 2#R003
358 0499 000.	CLAMP, HOSE	2 ..	#BREAKAWAY
358 2375 000.	BUSHING, TEFLON	6 ..	
358 2426 000.	PLUG, WHITE 2" HOLE	2 ..	
358 2772 000.	STANDOFF 6-32 X 3/4	2 ..	#TB002

358 3109 000.	STUD, BRS 8-32 X 1	1 ..	
358 3109 000.	STUD, BRS 8-32 X 1	2 ..	#TB034
358 3111 000.	STUD, BRS 8-32 X 1-1/2	1 ..	#C005
358 3133 000.	STUD, BRS 1/4-20 X 1-1/2	2 ..	
358 3188 000.	SPACER,RD .50D X.75LG, #6.	6 ..	#B004 #B005
359 0179 000.	CONNECTOR MALE 268-N	1 ..	#S014
380 0125 000.	XSTR, NPN 2N4401	1 ..	Q001 #FRONT DOOR
384 0284 000.	DIODE 10D4/1N2070	1 ..	CR103
384 0340 000.	RECT, 1N1188RA	3 ..	PS1CR004, PS1CR005 PS1CR006
384 0431 000.	RECT. 1N4001	5 ..	CR100 CR101 CR102 CR104 CR107
384 0466 000.	RECT., 1N1188A	4 ..	PS1CR001 PS1CR002 PS1CR003 CR005
384 0628 000.	RECT 1N3289/1N3289A	2 ..	CR003 CR004
384 0667 000.	RECTIFIER 1N3289R	2 ..	CR001 CR002
384 0694 000.	LED RED CART 12V	15 ..	DS014 DS015 DS016 DS017 DS018 DS019 DS022 DS023 DS024 DS025 DS026 DS027 DS028 DS029 DS030
384 0695 000.	LED GREEN CART 12V	9 ..	DS001 DS002 DS003 DS004 DS007 DS008 DS009 DS011 DS020
384 0702 000.	RECT FW BRIDGE 600V 35A	1 ..	PS2CR1
384 0719 000.	TRANSZORB 1N6373 5V 5W	1 ..	CR006
386 0106 000.	ZENER, 1N4737 7.5V	1 ..	CR106
396 0012 000.	LAMP, 6W 115-125V	1 ..	A013
396 0183 000.	LAMP, 14V .08A 382	4 ..	A009 A010 A011 A012
398 0183 000.	FUSE,1 TIME CART 15A 250V	1 ..	PS1F4
398 0368 000.	FUSE, CART 2A 600V	3 ..	PS1F1, PS1F2, PS1F3
402 0001 000.	CLIP, FUSE 1.062 60A 600V	48 ..	
402 0107 000.	CLIP, FUSE 9/16	2 ..	#GND HOOKS
402 0130 000.	FUSE HOLDER, 3 POLE	1 ..	#PS1F1, PS1F2, PS1F3
402 0179 000.	FUSE BLOCK 1P 30A - 250V	1 ..	PS1XF4
404 0016 000.	SOCKET TUBE 8 PIN OCTAL	1 ..	XK007
404 0018 000.	SOCKET TUBE 11 PIN	1 ..	XK006
404 0578 000.	SOCKET RELAY, 4PDT	2 ..	XK004 XK008
406 0411 000.	LIGHT, INDICATOR	1 ..	XA013
406 0441 000.	LIGHT, INDICATOR BASE	1 ..	
410 0016 000.	INSULATOR ROUND NS5W 0308.	2 ..	
410 0027 000.	INSULATOR ROUND NS5W 0424.	12 ..	
410 0028 000.	INSULATOR ROUND NS5W 0432.	21 ..	
424 0007 000.	GROMMET 13/16 MTG DI	5 ..	
424 0009 000.	GROMMET 1-3/8 MTG DI	6 ..	
424 0015 000.	GROMMET 1/2 MTG DIA	1 ..	
424 0018 000.	GROMMET 1-1/2 MTG DI	1 ..	
424 0025 000.	GROMMET 1/2 MTG DIA	4 ..	
424 0586 000.	HOSE BLACK 2" ID	3.5 FT	
430 0024 000.	FAN 115V 50/60HZ	2 ..	B002 B003
430 0084 000.	FINGER GUARD 476646	2 ..	#B002 #B003
432 0362 000.	WHEEL, BLOWER FWD CURVE	1 ..	
436 0294 000.	MOTOR 1/2 HP 50/60 HZ 3PH.	1 ..	#B001
448 0224 000.	HANDLE ALUM	4 ..	
448 0495 000.	LATCH, SPRING	19 ..	
448 0869 000.	AIR FILTER 20 X 25 X .88	2 ..	
448 0906 000.	HINGE DOOR POSITIONING	2 ..	#REAR DOOR
448 0955 000.	LATCH, VISE ACTION	1 ..	#REAR DOOR
472 0092 000.	TRANSFORMER FIL	1 ..	T006

472 0680 000.	XFMR, PLT, 815-0558-001	1 ..	T002
472 0681 000.	XFMR, PLT, 815-0559-001	1 ..	T001
472 1620 000.	XFMR, FIL 11.1V 30.5 A	1 ..	T004
472 1687 000.	XFMR, PWR, 817-2151-001	1 ..	T007
472 1696 000.	XFMR, PWR 16V CT @ 25A	1 ..	PS2T1
474 0125 000.	VARIABLE XFMR 1.2KVA 5A	1 ..	T003
474 0129 000.	XFMR, VARIABLE	1 ..	T005
516 0081 000.	CAP, DISC .01UF 1KV 20%	5 ..	C001 C002 C003 C004 C007
516 0439 000.	CAP 2700PF 40KV	1 ..	C005
516 0516 000.	CAP 1UF 100V 20%	1 ..	C008
524 0352 000.	CAP 3700UF 75WVDC	2 ..	PS2C1 PS2C2
524 0360 000.	CAP 18000 UF 200VDC	6 ..	PS1C6 - PS1011
524 0361 000.	CAP 76,000UF 40WVDC	1 ..	C001 #DC FIL.
530 0092 000.	BRACKET, CAP, 3" ID	3 ..	#PS2C001 #PS2C002 #DCFILC001
540 0611 000.	RES 1.0K OHM 2W 5%	1 ..	R040
540 0936 000.	RES 10.0K OHM 1/4W 5%	1 ..	R050
540 1199 000.	RES 3.3K OHM 75W 10%	4 ..	R035 R036 R037 R038
540 1226 000.	RES 2.5 OHM 275W 10%	1 ..	R043
540 1388 000.	RES 30.0 OHM 100W 20%	3 ..	R001 R002 R003
540 1439 000.	RES 50.0 OHM 75W 20%	17 .	
542 0054 000.	RES 10 OHM 5% 12W	1 ..	R041
542 0060 000.	RES 100 OHM 5% 12W	1 ..	R042
542 0455 000.	RES 150 OHM 5% 225W	2 ..	PS1R1 PS1R2
542 1165 000.	RES .1 OHM 300W	1 ..	R003
542 1582 000.	* RES 100K OHM 100W 5%	11 .	R023 R024 R025 R026 R027 R028
			R029 R030 R031 R032 R034
542 1599 000.	RESISTOR 0.15 OHM 35W	3 ..	PS2R1 PS2R2 PS2R3
550 0073 000.	POT, 100K OHM 2W	1 ..	R014 #PWR MTR ADJ
552 0820 000.	POT, W.W. 1000 OHM	1 ..	R017 # MAG ADJ
556 0049 000.	PAD, FXD 50 OHM 6DB	1 ..	AT001
560 0035 000.	MOV 4500A 35J 130 VAC	4 ..	RV001 RV002 RV003 RV004
560 0084 000.	POSISTOR, 8OHM, 140V	1 ..	R004
560 0087 000.	SPARK GAP 34KV W/O KR GAS.	1 ..	EG001
574 0156 000.	RELAY 12VDC 4PDT	2 ..	K004 K008
574 0157 000.	RLY AC CTL 4 POLE	1 ..	K005 #FIL CONTACTOR
574 0198 000.	RELAY 120VAC	1 ..	K006 #MAG SUPPLY
574 0199 000.	RELAY 12VDC 2VA/1.2W	1 ..	K007
598 0169 000.	SWITCH CAP, PB, RED	2 ..	
598 0170 000.	SWITCH CAP, PB, GR	3 ..	
598 0188 000.	SW BASE 513-0410-001	5 ..	S001 S002 S003 S004 S005
598 0195 000.	SWITCH CAP, PB, YELL	1 ..	
604 0450 000.	SW, PRECISION DPDT	1 ..	S018
604 0990 000.	SW, PB SPDT	1 ..	S008
604 0991 000.	SW, PB, MOM, SPDT	3 ..	S009 S006 S007
604 1005 000.	SW, AIR PRESSURE	1 ..	S014
604 1026 000.	SW DPDT 15A 125/250 VAC	1 ..	S010
606 0176 000.	CIRCUIT BREAKER 7A	1 ..	CB001
612 0311 000.	JACK TEST POINT, BLK	1 ..	TP002
612 0312 000.	JACK TEST POINT,WH	1 ..	TP001
612 0412 000.	RECP DUPLEX OUTLET	1 ..	
614 0012 000.	TERM BD 12 TERM	1 ..	TB002
614 0047 000.	TERM BD 3 TERM	1 ..	
614 0048 000.	TERM BD 4 TERM	1 ..	TB007

614 0049 000.	TERM BD 5 TERM	1 ..	PS2TB1
614 0092 000.	TERM BD 2 TERM	1 ..	TB034
614 0093 000.	TERM BD 3 TERM	2 ..	PS1TB012, TB006
614 0100 000.	TERM BD 10 TERM	1 ..	TB011
614 0128 000.	TERM STRIP 1 LT TERM	1 ..	TS001 #R040
614 0154 000.	TERM STRIP 6 TERM	1 ..	TS003 #FRONT DR
614 0162 000.	TERM STRIP 6 TERM	1 ..	
614 0233 000.	TERM BD 12 TERM	1 ..	TB001
614 0525 000.	JUMPER TYPE 600-J	5 ..	
614 0691 000.	TERM BD 15 TERM	2 ..	TB003 TB004
614 0693 000.	TERM BD 4 TERM	1 ..	TB005
620 0305 000.	ADAPTOR,RT ANGLE UG-27B/U	4 ..	
632 1086 000.	MTR 0-30KV, 4-1/2", S	1 ..	M002
632 1092 000.	MTR 0-10VDC, 4-1/2", S	1 ..	M006
632 1132 000.	MTR 0-15 ADC, 4-1/2", S	1 ..	M001
632 1143 000.	MTR 0-200MA, 4-1/2", S	1 ..	M003
636 0036 000.	METER, ELAPSED TIME 60HZ	1 ..	M007
638 0021 000.	SH, 30A 100MV	1 ..	PS1R003
646 0569 000.	LABEL 814-2939-001	3 ..	
646 1253 000.	LABEL H-139	1 ..	#B002 #B003
646 1254 000.	LABEL H-140	3 ..	#REAR CAB SIDE PANELS, KLYSTRON CART SHIELD
646 1290 000.	LABEL VSWR DISCONNECT WAR	1 ..	
650 0028 000.	KNOB RD SKIRT 1.135" DIA	3 ..	
736 0012 000.	BRD SMALL CIRCUITRY	1 ..	
810 2264 001.	LOCKING PLATE	1 ..	
813 4999 027.	STDOFF 6-32X5/8 1/4 HEX	8 ..	
813 5000 026.	STDOFF 8-32X1/2 5/16 HEX	2 ..	#TB034
813 5000 030.	STDOFF 8-32X1 5/16 HEX	1 ..	
813 5011 049.	STDOFF 1" LG #10-32	1 ..	#R040
813 5019 051.	STDOFF 10-32X1-1/2 1/2 H	1 ..	
813 5019 057.	STDOFF 10-32X3 1/2 HEX	1 ..	
813 5078 018.	SPACER	4 ..	
813 5606 015.	STUD BRS 10-32 X 1-1/4	5 ..	
813 5613 003.	STUD, 8-32 X 1/2	1 ..	#USE WITH SHORTING SW.
815 0936 001.	BAR, TAPPING	8 ..	
815 1834 001.	STRAP, GND	1 ..	
815 2015 001.	STRAP, CONNECTING (LONG)	1 ..	
815 2016 001.	STRAP, CONNECTING	2 ..	
815 2017 001.	STRAP, CONNECTING (SHORT)	2 ..	
815 3001 001.	STRIP, TRIM SIDE	2 ..	
815 5342 001.	BLOCK, HINGE	2 ..	
815 5343 001.	BLOCK, PIVOT	1 ..	
815 5713 001.	STRAP	1 ..	
815 5714 001.	STRAP	1 ..	
816 7304 001.	DIODE MTG. BRKT.	1 ..	#CR005
817 1460 033.	ROD, LATCHING	1 ..	
817 1460 034.	BRKT, LOWER CTL ARM	1 ..	
817 2116 017.	RUNNING LIST, AMPL CAB	0 ..	
822 0001 001.	BRKT, DIODE	2 ..	
822 0741 016.	METER WINDOW	1 ..	
822 0965 047.	BLOCK LOCK MOUNT	1 ..	
822 0965 053.	SWITCH HANDLE	1 ..	
822 0965 054.	SWITCH WINDOW	1 ..	

822 0965 055.	SWITCH WINDOW	1	..	
822 0965 064.	SWITCH STOP	1	..	
822 0965 065.	STDOFF .5 X .56 X .281	8	..	
822 0965 073.	RETAINER, HONEYCOMB	6	..	
827 4247 001.	BRACKET	11	..	
827 5744 001.	BRACKET, RELAY	1	..	
827 5749 001.	BRACKET, METER	1	..	
827 5754 001.	BLOCK	1	..	
827 6064 001.	STRAP, GND	1	..	
827 6226 001.	BRACKET, GND SW	1	..	#S0018
827 6893 001.	PLATE	2	..	
827 8069 001.	TRIM, STRIP	2	..	
827 9898 001.	HINGE, METER PANEL	1	..	
827 9903 001.	LINK, METER PANEL	1	..	
827 9904 001.	LINK, METER PANEL	1	..	
829 9135 173.	BRACKET, AIR SWITCH MTG.	1	..	
829 9434 006.	BRACKET, SPARK GAP	1	..	#EG001 #R022 #C005
829 9440 023.	BRACKET, POT R14 & R16	1	..	#R014
829 9440 036.	HINGE, INNER DOOR	1	..	
829 9440 070.	GLASS, METER PNL	1	..	
829 9440 074.	PLATE, LATCH FILLER	2	..	
829 9440 075.	PLATE, LT FILLER	1	..	
829 9440 076.	PLATE, RT FILLER	1	..	
829 9548 006.	ANGLE	2	..	#R022
829 9946 001.	HEATSINK, DC FIL PWR SUPP.	2	..	
839 6816 134.	PLATE MTR MTG	1	..	
839 6816 135.	TRIM MTR PANEL	1	..	
839 6816 158.	ARC SHIELD	1	..	
839 7070 001.	PLATE, HEATSINK MOUNT	1	..	
839 7740 117.	SCHEM, MAGNET CURRENT	0	..	
839 7799 001.	COVER, SAFETY	1	..	#TB002
839 7891 035.	SWITCH MTG ANGLE	1	..	#S-11
839 7891 038.	WIRING DIAG, AMP CABINET	0	..	
839 7891 041.	REAR ACCESS PNL	1	..	
839 7891 058.	WIRING DIAGRAM, 120KW	0	..	
839 7891 087.	FUNCTION DIAG, CONT LOGIC	0	..	
839 7891 136.	WIRING DIAG, HV MOUNTING	0	..	
839 7891 142.	GND STRAP	1	..	
839 7891 143.	GND STRAP	1	..	
843 5123 021.	SWITCH PLATE	1	..	
914 9322 001.	RECPT COVER MOD	1	..	
915 0943 001.	SWITCH, MODIFIED	1	..	S016
915 0943 003.	ROTARY SWITCH	1	..	S012
915 1842 003.	STUD TERMINAL	1	..	
917 2029 008.	KNOB MODIFICATION	1	..	#T003
917 2029 086.	STUD 3/8-16X5" #BREAKAWAY	3	..	
917 2116 021.	CABLES, HV-JUMPERS AMP	1	..	
917 2116 022.	BASIC AMP CABLE	1	..	
917 2116 031.	CABLE, CAP RACK	1	..	
922 0965 003.	INLET VENTURI	1	..	
922 0965 017.	BRACKET, RESISTOR MTG.	6	..	
922 0965 023.	PLATE, RESISTOR MTG.	2	..	
922 0965 024.	PLATE, RESISTOR MTG.	2	..	
922 0965 025.	PLATE, RESISTOR MTG.	2	..	

922 0965 030.	STIFFNER, MOTOR FRAME	1 ..	
922 0965 037.	ASSY., HOSE MTG. PLATE	1 ..	
922 0965 045.	END BLOCK	1 ..	
922 0965 066.	SHIM, LOCK	1 ..	
922 0965 068.	BRKT, LAMP	1 ..	
922 0965 075.	NUT PLATE	2 ..	
922 0965 096.	PLATE, RESISTOR MTG	2 ..	
922 0965 130.	PLATE, LOCK MTG	1 ..	
922 0965 131.	SHIM, LOCK	1 ..	
922 0965 140.	HINGE	1 ..	
922 0965 142.	HONEYCOMB, AIR DUCT	1 ..	
922 0965 148.	INSULATION, REAR DOOR	1 ..	
922 0965 151.	WINDOW, SIDE PANEL ECK	1 ..	
922 0965 158.	GND STRAP	1 ..	
922 0965 159.	GND STRAP	1 ..	
922 0965 160.	GROUND STRAP	1 ..	
922 0965 166.	PLATE, LINE SUPPORT	1 ..	BREAKAWAY LINE
922 0965 167.	RING, MTG.	1 ..	BREAKAWAY LINE
922 0965 168.	RING, RETAINER	1 ..	BREAKAWAY LINE
922 0965 172.	TUBE, AIR SWITCH	1 ..	
922 0965 206.	STRAP, CAPACITOR	2 ..	#C006 - C011
922 0965 216.	CONTACT ASSEMBLY	8 ..	
922 1180 001.	SAFETY COVER	1 ..	#TB034
928 5360 001.	CABLE ASSEMBLY	1 ..	
929 9440 020.	PLATE, BACK MTR PNL	1 ..	
929 9440 059.	CABLE	1 ..	#CAPACITOR BANK
929 9539 001.	RESISTOR CAP ASSY	2 ..	#R022
929 9935 001.	WIRE ASSY, DC FIL PWR SUP	1 ..	
929 9935 002.	WIRE ASSY, DC FIL PWR SUP	1 ..	
938 4203 001.	GROUND HOOKS ASSY	1 ..	
938 4313 002.	PANEL, RELAY	1 ..	
939 7891 011.	BOARD, RESISTOR MTG.	1 ..	
939 7891 019.	FRAME, MOTOR MTG.	1 ..	
939 7891 029.	LOCK BRACKET	1 ..	
939 7891 033.	SWITCH	1 ..	
939 7891 130.	PLATE, DEGAUSSING CIRCUIT	1 ..	
939 7891 152.	GROUND STRAP	1 ..	
939 7891 182.	BACKING PLATE	1 ..	
939 7891 183.	DOOR, TUNING ACCESS	1 ..	
939 7891 185.	ANGLE, SWITCH MTG.	1 ..	
939 7891 192.	BRACKET, DETECTOR MTG.	1 ..	#S-11
939 7891 193.	GROUND STRAP	1 ..	
939 7891 200.	CHASSIS, REFOCUS PS	1 ..	#PS002
939 7891 208.	SHIELD, RIGHT SIDE	1 ..	
939 7891 209.	SHIELD, LEFT SIDE	1 ..	
939 7891 210.	SHIELD, REAR	1 ..	
939 7891 211.	ANGLE, SHIELD MTG	2 ..	
939 7891 212.	PLATE, REAR ACCESS PANEL	1 ..	
939 7891 213.	BRACKET, CAPACITOR MTG.	1 ..	#C006 - C011
943 4524 002.	CAP RACK ASSY	1 ..	
943 5123 001.	PANEL, METER	1 ..	
943 5123 002.	DOOR, FRONT AMP CABINET	1 ..	
943 5123 108.	ASSY, SIDE ACCESS PANEL	1 ..	
943 5123 110.	ASSY, SIDE ACCESS PANEL	1 ..	

943 5123 111.	SWITCH COVER	2	..	
943 5123 112.	REAR DOOR	1	..	
943 5123 113.	PLATE, REAR DOOR	1	..	
943 5123 114.	SCROLL, BLOWER	1	..	
943 5123 115.	PLATE, AIR DUCT	1	..	
943 5123 120.	BOARD, RESISTOR MTG.	1	..	
952 6464 002.	CABINET ASSY	1	..	
952 9155 002.	PANEL DIVIDER	1	..	
952 9175 018.	CABINET, EXT KLYSTRON	1	..	
952 9175 019.	REAR PLATE, AIR DUCT	1	..	
952 9175 020.	FRONT PLATE, AIR DUCT	1	..	
992 2830 002.	ARC DETECTOR ASSY	1	..	
992 2846 002.	CONTROL CIRCUIT ASSY	1	..	
992 5641 003.	MAGNETIC OVLD ASSY	2	..	PC006 PC008
992 6108 001.	AUX DIODE ASSY	1	..	
992 6521 004.	PEAK DETECTOR-UHF TV	1	..	PD001
992 6997 002.	ION PUMP ASSY	1	..	
992 8226 002.	ASSEMBLY, HALL SENSOR	5	..	MT001-MT005
992 8402 001.	FILTER, COLLECTOR LEAD	1	..	
992 8504 001.	ASSY, METER MULTIPLIER BD	1	..	
999 2635 002.	WIRE/TUBING LIST	1	..	
999 2636 002.	HARDWARE LIST	1	..	

Table 7-41. CABLES, HV-JUMPERS AMP - 917 2116 021

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
817 2116 021.	ASSY INSTR, CADS	0	..
255 0006 000.	WIRE HV 8AWG 100KVDC	42.3	FT
296 0271 000.	TUBING, SHRINK 3/4 WHITE	2.3125	..... FT
354 0292 000.	LUG #10 RING U/INS 6-5AWG	7	..
255 0021 000.	WIRE HV #20AWG 40KVDC	25	. FT
354 0578 000.	TERMINAL 1/4 RING	5	..
618 0221 000.	1/2" COAX CABLE, FSJ450B	9	.. FT
255 0024 000.	WIRE, HIGH VOLTAGE 12 AWG	39.4	FT
620 0574 000.	PLUG, MALE TYPE N, 44ASW	4	..
354 0004 000.	LUG .25 RING RED 22-18AWG	1	..
354 0002 000.	LUG, #8 RING RED 22-18AWG	6	..
354 0003 000.	LUG #10 RING RED 22-18AWG	5	..
296 0262 000.	TUBING, SHRINK 1/4 WHITE	.83	FT
354 0324 000.	LUG #10 RING YEL 12-10AWG	12	.
354 0325 000.	LUG,.25 RING YEL 12-10AWG	6	..
296 0263 000.	TUBING, SHRINK 3/8 WHITE	1.92	FT

Table 7-42. BASIC AMP CABLE - 917 2116 022

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
252 0003 000.	WIRE, STRD 20AWG WHT	1667 FT	
252 0007 000.	WIRE, STRD 12AWG BLK	69 . FT	
817 2116 022.	CADS, BASIC AMP CAB	0 ..	
852 9175 005.	CABLE LAYOUT, AMPL CAB	0 ..	
252 0002 000.	WIRE, STRD 22AWG GRN	207 FT	
252 0006 000.	WIRE, STRD 14AWG BLU	135 FT	
252 0008 000.	WIRE, STRD 10AWG GRY	72 . FT	
618 0705 000.	COAX CABLE, RG316/U 50 OHM. .	153 FT	
610 1019 000.	HOUSING, PLUG 15 CKT	9 ..	P001 P002 P005 P006 P007 P008 P009 P014 P021
354 0001 000.	LUG #6 RING RED 22-18 AWG . . .	6 ..	
354 0002 000.	LUG, #8 RING RED 22-18AWG . . .	8 ..	
354 0003 000.	LUG #10 RING RED 22-18AWG . .	30 .	
250 0471 000.	CABLE 10 COND 22AWG	23 . FT	
354 0325 000.	LUG, .25 RING YEL 12-10AWG . . .	7 ..	
253 0059 000.	CABLE, 2C 22AWG AUDIO	9.1. FT	
354 0323 000.	LUG #8 RING YEL 12-10AWG . . .	1 ..	
354 0010 000.	LUG #10 RING BLU 16-14AWG . . .	2 ..	
252 0374 000.	CABLE, WELDING 6AWG 600V . .	3 .. FT	
354 0005 000.	TERM LUG RED SPADE 6	90 .	
354 0026 000.	LUG YEL SPADE 10	20 .	
354 0015 000.	LUG BLUE SPADE 6	14 .	
354 0027 000.	TERM LUG YEL SPADE 8	4 ..	
354 0756 000.	CONTACT, SOCKET GOLD PLATE	106	
354 0755 000.	CONTACT, PIN GOLD PLATE . . .	74 .	
612 1240 000.	HOUSING, CAP 15 CKT	4 ..	J001 J010 J011 J012
354 0292 000.	LUG #10 RING U/INS 6-5AWG. . . .	2 ..	
296 0265 000.	TUBING, SHRINK 1/16 WHITE. . . .	.7.. FT	
296 0253 000.	TUBING, SHRINK 3/16 WHITE. . . .	1 .. FT	
612 1336 000.	CONN, STRAIGHT 4 PIN FEM. . . .	1 ..	J005
356 0238 000.	CABLE CLAMP, SIZE 16 SHELL. . .	1 ..	#J005
354 0252 000.	TERM 250 FEM BLU 16-14	1 ..	
354 0669 000.	TERM 250 FEM RED 22-18	7 ..	
296 0261 000.	TUBING, SHRINK 1/8 WHITE . . . .	.5.. FT	
354 0007 000.	LUG RED SPADE 10	6 ..	
354 0017 000.	LUG BLUE SPADE 10	6 ..	
610 1018 000.	HOUSING, PLUG 9 CKT	2 ..	P015 P024
296 0262 000.	TUBING, SHRINK 1/4 WHITE . . . .	.2.. FT	
252 0057 000.	WIRE, NYLON 24AWG WHT	1 .. FT	
299 0010 000.	SPIRAL PLASTIC WRAP	10 . FT	
612 0536 000.	RECP 09-50-3031	5 ..	
354 0689 000.	TERM, 18-24 AWG CRIMP	15 .	
620 1913 000.	PLUG, STRAIGHT BNC	5 ..	
296 0263 000.	TUBING, SHRINK 3/8 WHITE . . . .	.5.. FT	
406 0491 000.	PLUG WIRING FOR LED CART . .	24 .	XDS001 XDS002 XDS003 XDS004 XDS007 XDS008 XDS009 XDS011 XDS014 XDS015 XDS016 XDS017 XDS018 XDS019 XDS020 XDS022 XDS023 XDS024 XDS025 XDS026 XDS027 XDS028 XDS029 XDS030
612 0544 000.	RECEPTACLE 205207-1	1 ..	P019
354 0385 000.	CONTACT, SOCKET	18 .	#P019
618 0211 000.	COAX CABLE RG59B, 75 OHM . .	27 . FT	

620 1958 000.	PLUG, BNC RIGHT ANGLE	2 ..	P024 P025
620 1963 000.	JACK, BNC BULKHEAD	2 ..	J022 J023
612 1325 000.	CONNECTOR, 7 PIN FEMALE . . .	1 ..	J004
354 0016 000.	LUG BLUE SPADE 8	5 ..	
354 0324 000.	LUG #10 RING YEL 12-10AWG . . .	5 ..	
354 0004 000.	LUG .25 RING RED 22-18AWG . . .	8 ..	
354 0011 000.	LUG BLUE RING .25	1 ..	
296 0020 000.	PLASTIC TUBE 3AWG CLEAR . . .	2 ..	FT
354 0008 000.	LUG #6 RING BLUE 16-14AWG . . .	5 ..	
354 0764 000.	TERM, 110 FEM 16-14	2 ..	
354 0006 000.	TERM LUG RED SPADE 8	9 ..	
354 0265 000.	SPLICE WIRE 22 TO 18	2 ..	
358 3267 000.	BUSHING, RUBBER	2 ..	#J004 #J005
356 0042 000.	CBL CLAMP AN 3057 10	1 ..	#J004
358 1213 000.	RETAINER KIT, MALE SCREW . .	2 ..	#E8

Table 7-43. CABLE, CAP RACK - 917 2116 031

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
817 2116 031.	CADS, CAP RACK	0 ..	
843 5123 046.	CABLE LAYOUT	0 ..	
252 0003 000.	WIRE, STRD 20AWG WHT	10.6	FT
252 0008 000.	WIRE, STRD 10AWG GRY	9.4.	FT
354 0006 000.	TERM LUG RED SPADE 8	10 .	
354 0007 000.	LUG RED SPADE 10	6 ..	
354 0027 000.	TERM LUG YEL SPADE 8	2 ..	
354 0325 000.	LUG,.25 RING YEL 12-10AWG . . .	12 .	
354 0004 000.	LUG .25 RING RED 22-18AWG . . .	2 ..	
354 0324 000.	LUG #10 RING YEL 12-10AWG . . .	4 ..	
354 0002 000.	LUG, #8 RING RED 22-18AWG . . .	4 ..	
354 0026 000.	LUG YEL SPADE 10	2 ..	

Table 7-44. GROUND HOOKS ASSY - 938 4203 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
838 4203 001.	ASSY INSTR, GROUND HOOK . .	0 ..	
814 7796 002.	HANDLE	1 ..	
814 7917 001.	HOOK, 1/2IN RADIUS	1 ..	
354 0287 000.	LUG #10 RING N/INS 7-9AWG. . . .	2.0.	
296 0019 000.	PLASTIC TUBE 4AWG CLEAR . . .	4.1.	FT
254 0017 000.	WIRE, ROPE 10AWG	4.2.	FT
306 0006 000.	NUT, HEX 10-32	2 ..	
312 0007 000.	WASHER, INT LOCK 10	1 ..	
308 0007 000.	10 FLAT WASHER BRASS	1 ..	
312 0049 000.	WASHER, SPLIT-LOCK 10	1 ..	

Table 7-45. ARC DETECTOR ASSY - 992 2830 002

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
354 0755 000.	CONTACT, PIN GOLD PLATE . . .	12 .	#P016 #P017 BAG WITH UNIT FOR CUSTOMER INSTALLATION
550 0015 000.	POT 5.0 MEGOHM .5W	2 ..	R001 R002
610 1018 000.	HOUSING, PLUG 9 CKT	2 ..	P016 P017 #BAG WITH UNIT FOR CUSTOMER INSTALLATION
612 1239 000.	HOUSING, CAP 9 CKT	3 ..	J001 J002 J003
814 8852 001.	PLATE	1 ..	
817 2029 002.	WIRE LIST, ARC DETECTOR	0 ..	
822 0741 005.	ENCLOSURE ARC DETECTOR	1 ..	
839 7740 001.	SCHEM, ARC DETECTOR	0 ..	
922 0741 001.	FRONT PLATE ASSY	1 ..	
992 2831 001.	PC BOARD	2 ..	PC001 PC002
999 2499 001.	HARDWARE LIST	1 ..	
999 2500 001.	W/TUBING LIST	1 ..	

Table 7-46. PC BOARD - 992 2831 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
380 0126 000.	XSTR, PNP 2N4403	3.0.	Q1 Q2 Q3
384 0205 000.	DIODE SILICON 1N914/4148	1 ..	CR2
386 0183 000.	ZENER, 1N4099 6.8V	1 ..	CR001
516 0054 000.	CAP, DISC .001UF 1KV 10%	1.0.	C2
526 0057 000.	CAP 100UF 20V 20%	1.0.	C1
540 0018 000.	RES 51.0 OHM 1/2W 5%	1.0.	R4
540 0049 000.	RES 1K OHM 1/2W 5%	1.0.	R2
540 0097 000.	RES 100.0K OHM 1/2W 5%	1.0.	R1
578 0021 000.	RELAY DPDT 12V	1 ..	K001
815 1051 001.	SCHEMATIC	0 ..	
939 7263 001.	ASSY, ACE OVERLOAD SENSOR	1 ..	

Table 7-47. CONTROL CIRCUIT ASSY - 992 2846 002

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
358 0171 000.	STUD 82 WING HEAD	2 ..	
358 0184 000.	RETAINER 82 ALL HDS	2 ..	
358 0765 000.	WASHER WEAR 82 NYLON	2 ..	
358 0796 000.	RECEPTACLE 82 CLIP	2 ..	
358 0907 000.	POLARIZATION KEY	5 ..	
358 0950 000.	GUIDE. CARD 4.5 IN L	10 .	
358 1726 000.	SPRING, HOLD DOWN	4 ..	#K001 #K002 #K003 #K004
384 0020 000.	RECTIFIER IN4005	4 ..	CR001 CR002 CR003 CR004
404 0160 000.	SOCKET RELAY 27E006	4 ..	XK001 XK002 XK003 XK004
524 0163 000.	CAP 13,000 UF 15V	1 ..	C005
530 0094 000.	BRACKET, CAP, 1.375"ID	1 ..	
540 0012 000.	RES 30.0 OHM 1/2W 5%	2 ..	R001 R002
574 0156 000.	RELAY 12VDC 4PDT	4 ..	K001 K002 K003 K004
612 0449 000.	CONN	5 ..	
827 5222 001.	COVER, CTL CKT	1 ..	
842 6315 001.	DIAGRAM, WIRING	0 ..	
927 5224 001.	CARD RACK	1 ..	
927 5870 001.	PRINTED BD. ASSY	1 ..	

929 9726 186.	CABLE ASSY CTL CKT	1 ..
943 4774 001.	CHASSIS CTL CKT	1 ..
992 2847 001.	PC 1 BOARD BT55U	1 ..
992 2848 001.	PC 2 BOARD BT55U	1 ..
992 2849 001.	PC 3 BOARD BT55U	1 ..
992 2850 001.	PC 4 BOARD BT55U	1 ..
992 3572 001.	PC-5 BOARD ASSY	1 ..
999 1166 001.	HARDWARE LIST	1 ..
999 1167 002.	WIRE TUBING LIST	1 ..

Table 7-48. PC 1 BOARD BT55U - 992 2847 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
380 0125 000.	XSTR, NPN 2N4401	10.0	Q1 Q10 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9
384 0205 000.	DIODE SILICON 1N914/4148	7 ..	CR1 CR2 CR4 CR5 CR7 CR8 C10
384 0284 000.	DIODE 10D4/1N2070	3.0.	CR3 CR6 CR9
386 0092 000.	ZENER, 1N4744 15V	3.0.	CR11 CR12 CR13
448 0290 000.	HANDLE PC CARD	1.0.	
516 0429 000.	CAP .03UF 100V 20%	6.0.	C1 C2 C5 C6 C8 C9
522 0247 000.	CAP 1 UF 50V	3 ..	C012 C013 C014
522 0550 000.	CAP 100U 25V ELECTROLYTIC	1 ..	C11
526 0004 000.	CAP 1 UF 35V 10% TANT	4 ..	C003 C004 C007 C010
540 0001 000.	RES 10 OHM 1/2W 5%	3.0.	R38 R39 R40
540 0007 000.	RES 18.0 OHM 1/2W 5%	1.0.	R31
540 0036 000.	RES 300.0 OHM 1/2W 5%	3.0.	R11 R32 R35
540 0043 000.	RES 560 OHM 1/2W 5%	1.0.	R12
540 0049 000.	RES 1K OHM 1/2W 5%	7.0.	R1 R10 R13 R22 R33 R36 R37
540 0051 000.	RES 1.2K OHM 1/2W 5%	3.0.	R18 R28 R6
540 0060 000.	RES 3K OHM 1/2W 5%	1.0.	R34
540 0071 000.	RES 8.2K OHM 1/2W 5%	3.0.	R21 R29 R7
540 0076 000.	RES 13.0K OHM 1/2W 5%	3.0.	R15 R24 R3
540 0077 000.	RES 15K OHM 1/2W 5%	3.0.	R17 R27 R5
540 0087 000.	RES 39.0K OHM 1/2W 5%	6.0.	R19 R20 R25 R30 R8 R9
540 0089 000.	RES 47.0K OHM 1/2W 5%	6.0.	R14 R16 R2 R23 R26 R4
540 0936 000.	RES 10.0K OHM 1/4W 5%	1 ..	R041
838 4926 001.	SCHEMATIC	0 ..	
843 5156 001.	PWB, PC1 UHF CNTRL LOGIC	1 ..	

Table 7-49. PC 2 BOARD BT55U - 992 2848 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
380 0125 000.	XSTR, NPN 2N4401	12.0	Q1 Q10 Q11 Q12 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9
384 0205 000.	DIODE SILICON 1N914/4148	9 ..	CR1 CR11 CR12 CR13 CR2 CR4 CR5 CR7 CR8
384 0284 000.	DIODE 10D4/1N2070	4.0.	CR10 CR3 CR6 CR9
386 0092 000.	ZENER, 1N4744 15V	4.0.	CR014 CR015 CR016 CR017
448 0290 000.	HANDLE PC CARD	1.0.	
516 0429 000.	CAP .03UF 100V 20%	8.0.	C1 C12 C13 C2 C4 C5 C7 C8

522 0247 000.	CAP 1 UF 50V	4 ..	C014 C015 C016 C017
522 0550 000.	CAP 100U 25V ELECTROLYTIC ..	1 ..	C10
526 0004 000.	CAP 1 UF 35V 10% TANT	4 ..	C003 C006 C009 C011
540 0001 000.	RES 10 OHM 1/2W 5%	4.0.	R46 R47 R48 R49
540 0007 000.	RES 18.0 OHM 1/2W 5%	1.0.	R34
540 0036 000.	RES 300.0 OHM 1/2W 5%	4.0.	R11 R22 R33 R36
540 0049 000.	RES 1K OHM 1/2W 5%	8.0.	R1 R10 R12 R21 R23 R32 R35 R41
540 0051 000.	RES 1.2K OHM 1/2W 5%	4.0.	R15 R26 R4 R42
540 0071 000.	RES 8.2K OHM 1/2W 5%	4.0.	R18 R29 R43 R7
540 0076 000.	RES 13.0K OHM 1/2W 5%	4.0.	R14 R25 R3 R38
540 0077 000.	RES 15K OHM 1/2W 5%	4.0.	R17 R28 R44 R6
540 0087 000.	RES 39.0K OHM 1/2W 5%	8.0.	R19 R20 R30 R31 R37 R45 R8 R9
540 0089 000.	RES 47.0K OHM 1/2W 5%	8.0.	R13 R16 R2 R24 R27 R39 R40 R5
838 4456 001.	PC BOARD	1.0.	
838 4929 001.	SCHEMATIC	0 ..	

Table 7-50. PC 3 BOARD BT55U - 992 2849 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
380 0122 000.	XSTR, 2N4853	1.0.	Q8
380 0125 000.	XSTR, NPN 2N4401	12.0	Q1 Q10 Q11 Q12 Q13 Q2 Q3 Q4 Q5 Q6 Q7 Q9
382 0055 000.	* IC MC667 ESD	1.0.	Z1
384 0205 000.	DIODE SILICON 1N914/4148	21 .	CR1 CR10 CR11 CR13 CR14 CR15 CR16 CR17 CR18 CR19 CR2 CR20 CR22 CR23 CR3 CR4 CR5 CR6 CR7 CR8 CR9 CR012 CR021
386 0183 000.	ZENER, 1N4099 6.8V	2 ..	
448 0290 000.	HANDLE PC CARD	1.0.	
516 0429 000.	CAP .03UF 100V 20%	10.0	C10 C15 C16 C2 C24 C25 C3 C5 C6 C9
522 0224 000.	OBS USE NFFF 522-0594-000. ...	1.0.	C12
522 0531 000.	CAP 1UF 50V 20%	2 ..	C26 C27
522 0550 000.	CAP 100U 25V ELECTROLYTIC ..	1 ..	C21
526 0004 000.	CAP 1 UF 35V 10% TANT	4.0.	C19 C20 C22 C23
526 0014 000.	CAP 22UF 15V 10%	1.0.	C14
526 0018 000.	CAP .33UF 35V 10%	4.0.	C1 C17 C4 C8
526 0048 000.	CAP 10UF 20V 20%	1.0.	C13
526 0063 000.	CAP 3.3UF 15V 10%	2.0.	C11 C7
526 0068 000.	CAP 100UF 25V 10%	1.0.	C18
540 0007 000.	RES 18.0 OHM 1/2W 5%	1.0.	R50
540 0042 000.	RES 510.0 OHM 1/2W 5%	1.0.	R52
540 0866 000.	RES 12.0 OHM 1/4W 5%	1.0.	R26
540 0874 000.	RES 27 OHM 1/4W 5%	1.0.	R31
540 0888 000.	RES 100 OHM 1/4W 5%	1.0.	R34
540 0906 000.	RES 560.0 OHM 1/4W 5%	1.0.	R32
540 0912 000.	RES 1.0K OHM 1/4W 5%	10.0	R10 R2 R20 R30 R40 R47 R48 R49 R51 R54
540 0914 000.	RES 1.2K OHM 1/4W 5%	4.0.	R15 R25 R35 R7
540 0915 000.	RES 1.3K OHM 1/4W 5%	1.0.	R53

540 0919 000.	RES 2.0K OHM 1/4W 5%	1.0.	R33
540 0924 000.	RES 3.3K OHM 1/4W 5%	1.0.	R46
540 0931 000.	RES 6.2K OHM 1/4W 5%	1.0.	R45
540 0939 000.	RES 13.0K OHM 1/4W 5%	4.0.	R13 R23 R38 R4
540 0940 000.	RES 15K OHM 1/4W 5%	5.0.	R14 R24 R29 R37 R5
540 0944 000.	RES 22.0K OHM 1/4W 5%	4.0.	R18 R27 R43 R8
540 0946 000.	RES 27K OHM 1/4W 5%	1.0.	R44
540 0950 000.	RES 39.0K OHM 1/4W 5%	2.0.	R17 R42
540 0952 000.	RES 47.0K OHM 1/4W 5%	8.0.	R11 R12 R21 R22 R3 R36 R39 R6
540 0960 000.	RES 100.0K OHM 1/4W 5%	2.0.	R16 R28
540 0968 000.	RES 220.0K OHM 1/4W 5%	4.0.	R1 R19 R41 R9
540 0992 000.	RES 2.2M OHM 1/4W 5%	1.0.	R55
838 4457 001.	PRINTED BOARD	1.0.	
842 6300 001.	SCHEMATIC	0 ..	

Table 7-51. PC 4 BOARD BT55U - 992 2850 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
380 0125 000.	XSTR, NPN 2N4401	6.0.	Q1 Q2 Q3 Q4 Q5 Q9
382 1011 000.	IC, 14541/4541	1 ..	U001
384 0205 000.	DIODE SILICON 1N914/4148	8 ..	CR001 CR002 CR003 CR004 CR005 CR011 CR014 CR018
384 0284 000.	DIODE 10D4/1N2070	2.0.	CR12 CR13
386 0092 000.	ZENER, 1N4744 15V	3.0.	CR15 CR16 CR17
386 0183 000.	ZENER, 1N4099 6.8V	1 ..	CR010
448 0290 000.	HANDLE PC CARD	1.0.	
516 0429 000.	CAP .03UF 100V 20%	5.0.	C1 C12 C2 C3 C4
516 0453 000.	CAP .1UF 100V 20% X7R	1 ..	C007
522 0550 000.	CAP 100U 25V ELECTROLYTIC	1 ..	C008
526 0050 000.	CAP 1UF 35V 20%	3 ..	C10 C14 C9
526 0057 000.	CAP 100UF 20V 20%	1 ..	C013
526 0063 000.	CAP 3.3UF 15V 10%	1.0.	C11
540 0001 000.	RES 10 OHM 1/2W 5%	1.0.	R19
540 0007 000.	RES 18.0 OHM 1/2W 5%	1.0.	R33
540 0018 000.	RES 51.0 OHM 1/2W 5%	1.0.	R39
540 0025 000.	RES 100 OHM 1/2W 5%	2 ..	R040 R041
540 0049 000.	RES 1K OHM 1/2W 5%	6 ..	R001 R010 R026 R034 R036 R037
540 0051 000.	RES 1.2K OHM 1/2W 5%	2.0.	R15 R6
540 0058 000.	RES 2.4K OHM 1/2W 5%	1 ..	R042
540 0060 000.	RES 3K OHM 1/2W 5%	1.0.	R32
540 0061 000.	RES 3.3K OHM 1/2W 5%	1.0.	R35
540 0071 000.	RES 8.2K OHM 1/2W 5%	1.0.	R7
540 0075 000.	RES 12.0K OHM 1/2W 5%	1.0.	R9
540 0076 000.	RES 13.0K OHM 1/2W 5%	2.0.	R12 R3
540 0077 000.	RES 15K OHM 1/2W 5%	6.0.	R11 R13 R14 R2 R4 R5
540 0080 000.	RES 20.0K OHM 1/2W 5%	3.0.	R16 R17 R8
540 0089 000.	RES 47.0K OHM 1/2W 5%	1 ..	R024
540 0090 000.	RES 51.0K OHM 1/2W 5%	1.0.	R38
540 0097 000.	RES 100.0K OHM 1/2W 5%	1 ..	R027
838 4928 001.	SCHEMATIC	0 ..	
843 5145 001.	PC BOARD CONTROL LOGIC	1 ..	

Table 7-52. PC-5 BOARD ASSY - 992 3572 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
380 0125 000.	XSTR, NPN 2N4401	7.0.	Q1 Q2 Q3 Q4 Q5 Q6 Q8
380 0126 000.	XSTR, PNP 2N4403	2.0.	Q7 Q9
382 0055 000.	* IC MC667 ESD	1.0.	U4
382 0056 000.	IC, 301A	1.0.	U1
382 0106 000.	* IC MC672P	1 ..	U002
382 0163 000.	IC, MC660P	1.0.	U3
384 0205 000.	DIODE SILICON 1N914/4148	5 ..	CR1 CR10 CR13 CR14 CR2
384 0357 000.	RECTIFIER 1N4004	3.0.	CR4 CR8 CR9
384 0431 000.	RECT. 1N4001	2 ..	CR015 CR016
386 0092 000.	ZENER, 1N4744 15V	2.0.	CR6 CR7
386 0183 000.	ZENER, 1N4099 6.8V	3 ..	CR005 CR011 CR012
386 0394 000.	ZENER, 1N5231A 5.1V .5W	1 ..	CR003
404 0674 000.	SOCKET 14 PIN DIP (D-L)	3 ..	XU2 XU3 XU4
448 0290 000.	HANDLE PC CARD	1.0.	
516 0375 000.	CAP .01UF 50V	2.0.	C4 C5
516 0393 000.	CAP DISC .025UF 500V	3.0.	C18 C19 C21
522 0247 000.	CAP 1 UF 50V	3 ..	C007 C009 C022
522 0550 000.	CAP 100U 25V ELECTROLYTIC ..	2 ..	C1 C6
526 0004 000.	CAP 1 UF 35V 10% TANT	7 ..	C002 C012 C013 C014 C015 C017 C020
526 0014 000.	CAP 22UF 15V 10%	2.0.	C10 C8
526 0047 000.	CAP 220UF 10V 20%	1 ..	C003
526 0067 000.	CAP 68UF 15V 20%	1.0.	C16
526 0358 000.	CAP 22UF 35V 10%	1 ..	C011
540 0001 000.	RES 10 OHM 1/2W 5%	1.0.	R29
540 0007 000.	RES 18.0 OHM 1/2W 5%	1.0.	R19
540 0008 000.	RES 20.0 OHM 1/2W 5%	2.0.	R12 R18
540 0010 000.	RES 24.0 OHM 1/2W 5%	1.0.	R9
540 0025 000.	RES 100 OHM 1/2W 5%	1.0.	R8
540 0042 000.	RES 510.0 OHM 1/2W 5%	4.0.	R13 R14 R15 R16
540 0044 000.	RES 620 OHM 1/2W 5%	1.0.	R7
540 0049 000.	RES 1K OHM 1/2W 5%	8.0.	R1 R20 R21 R22 R23 R25 R31 R34
540 0053 000.	RES 1.5K OHM 1/2W 5%	1.0.	R28
540 0058 000.	RES 2.4K OHM 1/2W 5%	1.0.	R27
540 0066 000.	RES 5.1K OHM 1/2W 5%	2.0.	R24 R30
540 0071 000.	RES 8.2K OHM 1/2W 5%	1.0.	R26
540 0073 000.	RES 10.0K OHM 1/2W 5%	5.0.	R10 R11 R17 R2 R32
540 0080 000.	RES 20.0K OHM 1/2W 5%	3.0.	R33 R35 R36
540 0101 000.	RES 150.0K OHM 1/2W 5%	1.0.	R6
540 0121 000.	RES 1.0M OHM 1/2W 5%	2 ..	R3 R4
540 0936 000.	RES 10.0K OHM 1/4W 5%	3 ..	R037 R038 R039
550 0421 000.	POT 2 MEGOHM 3/4W 20%	1.0.	R5
838 6474 001.	SCHEMATIC	0 ..	
843 5154 001.	PWB,PC5 UHF CONTROL LOGIC.	1 ..	

Table 7-53. MAGNETIC OVLD ASSY - 992 5641 003

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
354 0309 000.	TERM SOLDER	21 .	E001 E002 E003 E004 E005 E006 E007 E008 E009 E010 E011 E012 E013 E014 E015 E016 E017 E018 E019 E020 E021
382 0452 000.	IC, LM311/CA311 ESD	2 ..	U001 U002
384 0205 000.	DIODE SILICON 1N914/4148	2 ..	CR006 CR007
386 0092 000.	ZENER, 1N4744 15V	1 ..	CR001
386 0112 000.	ZENER, 1N4733 5.1V	2 ..	CR002 CR003
386 0181 000.	ZENER, 1N4739A 9.1V	2 ..	CR004 CR005
404 0673 000.	SOCKET 8 PIN DIP (DL)	2 ..	XU001 XU002
516 0375 000.	CAP .01UF 50V	6 ..	C001 C002 C003 C004 C005 C006
522 0578 000.	CAP 1UF 20% 50 VDC	2 ..	C007 C008
540 0017 000.	RES 47.0 OHM 1/2W 5%	1 ..	
540 0356 000.	RES 10.0K OHM 1W 5%	2 ..	R004 R005
540 0908 000.	RES 680.0 OHM 1/4W 5%	2 ..	R003 R007
540 0977 000.	RES 510K OHM 1/4W 5%	2 ..	R008 R009
550 0067 000.	POT 10K OHM 2W 10%	2 ..	R001 R002
578 0021 000.	RELAY DPDT 12V	2 ..	K001 K002
839 7740 005.	PWB MAGNET OVERLOAD	1 ..	
839 7740 006.	SCHEM, MAGNET OVERLOAD ..	0 ..	
839 7891 061.	SCHEM, REFOCUS OVLD	0 ..	

Table 7-54. AUX DIODE ASSY - 992 6108 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
300 1578 000.	SCR, 10-32 X 5/8	11 .	
304 0098 000.	NUT, HEX 10-32	22 .	
308 0007 000.	10 FLAT WASHER BRASS	11 .	
312 0049 000.	WASHER, SPLIT-LOCK 10	22 .	
357 0019 000.	NUT HEX 10-32 NYLON	2 ..	
357 0021 000.	SCREW 10-32 X .75 BHMS	2 ..	
386 0155 000.	ZNR 1N3015A 200V 10W 10% ...	10 .	CR001 CR002 CR003 CR004 CR005 CR006 CR007 CR008 CR009 CR010
516 0081 000.	CAP, DISC .01UF 1KV 20%	10 .	C001 C002 C003 C004 C005 C006 C007 C008 C009 C010
540 0659 000.	RES 100.0K OHM 2W 5%	10 .	R001 R002 R003 R004 R005 R006 R007 R008 R009 R010
829 9094 001.	MTG BRKT	1 ..	
839 6319 001.	PC BD, ZENER DIODE	1 ..	
839 6390 001.	SCHEM-ZENER DIODE ASSY ...	0 ..	
929 7568 002.	HEATSINK	10 .	#CR001 #CR002 #CR003 #CR004 #CR005 #CR006 #CR007 #CR008 #CR009 #CR010
999 2187 001.	WIRE & TUBG LIST	1 ..	

Table 7-55. PEAK DETECTOR-UHF TV - 992 6521 004

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
414 0087 000.	BEAD FERRITE SHIELD	14 .	
500 0803 000.	CAP 5PF 500V +/-5PF	2 ..	C001 C009
612 0317 000.	RECEPTACLE BNC UG-1094/U ..	4 ..	J001 J002 J004 J005
612 1240 000.	HOUSING, CAP 15 CKT	1 ..	J003

814 8852 001.	PLATE	1 ..
822 0252 001.	BRACKET, SOCKET	1 ..
829 9726 042.	PLATE, RECEPTACLE	1 ..
829 9726 043.	STRAP, PC GND PEAK DET	1 ..
829 9726 052.	LUG, SOLDER	1 ..
839 6816 130.	SCHEM, PEAK DETECTOR	0 ..
929 9726 041.	ENCL. PEAL PWR DETECTOR	1 ..
992 6550 001.	PWB, PEAK PWR DETECTOR	1 ..
999 2382 001.	HARDWARE LIST	1 ..
999 2383 002.	WIRE/TUBING LIST	1 ..

Table 7-56. PWB, PEAK PWR DETECTOR - 992 6550 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
540 0018 000.	RES 51.0 OHM 1/2W 5%	3 ..	R001 R011 R018
540 0922 000.	RES 2.7K OHM 1/4W 5%	2 ..	R006 R014
540 0963 000.	RES 130.0K OHM 1/4W 5%	6 ..	R003 R004 R015 R016 R024 R025
540 0905 000.	RES 510.0 OHM 1/4W 5%	1 ..	R008
540 0936 000.	RES 10.0K OHM 1/4W 5%	1 ..	R020
540 1015 000.	RES 20.0M OHM 1/4W 5%	1 ..	R019
540 0912 000.	RES 1.0K OHM 1/4W 5%	3 ..	R021 R022 R027
540 0976 000.	RES 470.0K OHM 1/4W 5%	2 ..	R010 R017
540 0960 000.	RES 100.0K OHM 1/4W 5%	2 ..	R007 R026
550 0320 000.	POT 1K OHM 1/2W 30%	2 ..	R005 R013
550 0964 000.	POT. 20K OHM .5W 10%	1 ..	R009
516 0054 000.	CAP, DISC .001UF 1KV 10%	4 ..	C002 C006 C010 C014
526 0108 000.	CAP 4.7UF 35V 20%	2 ..	C003 C011
384 0678 000.	DIODE DSR-3200	1 ..	CR009
526 0051 000.	CAP 5.6 UF 35V 10%	1 ..	C008
526 0050 000.	CAP 1UF 35V 20%	1 ..	C015
494 0166 000.	CHOKE RF 2.7UH	2 ..	L001 L002
384 0252 000.	DIODE HP5082-2900/AHR2900	4 ..	CR001 CR002 CR004 CR005
384 0357 000.	RECTIFIER 1N4004	1 ..	CR006
384 0205 000.	DIODE SILICON 1N914/4148	1 ..	CR003
522 0573 000.	CAP 47UF 50V 20%	1 ..	C022
382 0719 000.	IC LM324AN ESD	1 ..	U1A U1B U1C
382 0882 000.	IC, 78L05A	1 ..	U002
380 0126 000.	XSTR, PNP 2N4403	1 ..	Q001
516 0084 000.	CAP DISC .02UF 600V	2 ..	C018 C019
516 0375 000.	CAP .01UF 50V	7 ..	C004 C005 C012 C013 C016 C017 C023
939 6903 001.	PWB ASSY, PEAK-DET	1 ..	
540 0864 000.	RES 10.0 OHM 1/4W 5%	1 ..	R028

Table 7-57. ION PUMP ASSY - 992 6997 002

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
310 0001 000.	WASHER, FLAT #2	4 ..	# SPRING CLIP
335 0017 000.	WASHER NYLON .261 ID	4 ..	
350 0048 000.	RIVET POP .093X.337	4 ..	
354 0760 000.	TAB ADAPTOR 250 SERIES	1 ..	#E8
410 0028 000.	INSULATOR ROUND NS5W 0432.	4 ..	
632 1142 000.	MTR 0-20 UADC, 2-1/2", B	1 ..	M001

736 0212 000.	5KV PWR PACK, HV50-152M	1 ..	PS001
813 4999 030.	STDOFF 6-32X1 1/4 HEX	4 ..	
822 0741 044.	BRACKET, PWR PACK	1 ..	#PS002
839 7891 198.	WIRING DIAG, ION PUMP MON ..	0 ..	
839 8052 002.	SCHEMATIC	0 ..	
922 0965 150.	BRACKET, METER MTG.	1 ..	
939 7891 056.	BASE, ION PS	1 ..	
992 8455 002.	PCB ASSY, ION PUMP MON. . . .	1 ..	

Table 7-58. PCB ASSY, ION PUMP MON. - 992 8455 002

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
384 0597 000.	RECT 1N4002	2 ..	CR001 CR002
508 0268 000.	CAP, .1 UF 100V 10%	1 ..	C001
548 1095 000.	RES 12.1K OHM 1/4W 1%	1 ..	R002
548 2180 000.	RES 7.5 MEGOHM 5W 5%	1 ..	R001
610 1066 000.	CONN, .25 FASTON PC MOUNT. . .	12 .	E001 E002 E003 E004 E005 E006 E007 E008 E009 E010 E011 E012
839 7891 198.	WIRING DIAG, ION PUMP MON ..	0 ..	
839 8052 001.	SCHEM,ION PUMP MONITOR BD	0 ..	
839 8052 002.	SCHEMATIC	0 ..	
843 5123 117.	PWB, ION PUMP MONITOR	1 ..	

Table 7-59. ASSEMBLY, HALL SENSOR - 992 8226 002

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
252 0240 000.	WIRE, STRD 20AWG WHT	5.5.	FT
300 1537 000.	SCR, 6-32 X 5/16	6 ..	
300 1567 000.	SCR, 8-32 X 3/4	2 ..	
302 0106 000.	SCR, 6-32 X 3/8	4 ..	
304 0090 000.	NUT, HEX 8-32	4 ..	
308 0005 000.	NO 6 FLAT WASHER BRS	6 ..	
308 0006 000.	NO 8 FLAT WASHER BRS	6 ..	
310 0012 000.	WASHER FLAT 6	4 ..	
312 0047 000.	WASHER, SPLIT-LOCK 6	6 ..	
312 0048 000.	WASHER, SPLIT-LOCK 8	4 ..	
314 0005 000.	WASHER, SPLIT-LOCK 6	4 ..	
354 0001 000.	LUG #6 RING RED 22-18 AWG . . .	2 ..	
354 0669 000.	TERM 250 FEM RED 22-18	3 ..	
358 3088 000.	RING, RETAINING .438 NOM	1 ..	
740 1151 000.	SENSOR DC CURRENT	1 ..	
839 7891 135.	SCHEM, HALL SENSOR PWB . . .	0 ..	
939 7891 126.	PLATE, SENSOR MTG.	1 ..	
939 7891 127.	COVER, SENSOR	1 ..	
992 8226 001.	PWB ASSY, HALL SENSOR	1 ..	
999 2686 001.	WIRE/TUBING LIST	1 ..	
999 2687 001.	HARDWARE LIST	1 ..	

Table 7-60. PWB ASSY, HALL SENSOR - 992 8226 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
354 0309 000.	TERM SOLDER	5 ..	
384 0357 000.	RECTIFIER 1N4004	1 ..	CR001
384 0719 000.	TRANSZORB 1N6373 5V 5W	1 ..	CR003
384 0720 000.	TRANSZORB 1N6377 15V 5W ...	1 ..	CR002
522 0550 000.	CAP 100U 25V ELECTROLYTIC ..	1 ..	C001
610 0777 000.	HDR 3C 1ROW STRAIGHT	1 ..	P001
620 1677 000.	RECEPTACLE, PC MT, BNC	1 ..	P002
839 7891 135.	SCHEM, HALL SENSOR PWB ...	0 ..	
843 5123 065.	PWB, HALL SENSOR	1 ..	

Table 7-61. ASSY, METER MULTIPLIER BD - 992 8504 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
358 3109 000.	STUD, BRS 8-32 X 1	25 ..	
384 0720 000.	TRANSZORB 1N6377 15V 5W ...	5 ..	
410 0010 000.	INSULATOR ROUND NS5W 0208.	25 ..	
548 2066 000.	RES 4.99K OHM 1/4W 1%	5 ..	
548 2179 000.	RES 7.5 MEGOHM 5W 1%	20 ..	
813 5000 026.	STDOFF 8-32X1/2 5/16 HEX	3 ..	
839 7891 145.	GND STRAP	1 ..	
939 7891 003.	PANEL, METER MULTIPLIER	1 ..	

Table 7-62. AURAL AMP CAB UM - 992 8095 006

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
302 0137 000.	SCR, 8-32 X 1-1/4	12 ..	#MTG RF LOADS
304 0039 000.	NUT CAP .312-18 BRS	2 ..	#HEATSINK
620 0305 000.	ADAPTOR, RT ANGLE UG-27B/U .	2 ..	#RL001 #RL002
632 0974 000.	MTR 0-4ADC, 4-1/2", S	1 ..	M005
632 1107 000.	MTR PWR, 4-1/2", S	1 ..	M004
646 0665 000.	INSPECTION LABEL	1 ..	
700 0621 000.	LOAD, RF 300W	2 ..	RL001 RL002
816 2727 001.	TRIM STRIP AURAL	1 ..	
822 0741 021.	PANEL, PULSER BLANK	1 ..	
922 0965 173.	STUD, LOAD MTG	2 ..	#HEATSINK
929 9926 001.	HEAT SINK, 300W RF LOAD	1 ..	
992 8403 001.	BASIC AMP CABINET	1 ..	

Table 7-63. KIT SPARE UHF EXCITER ECK - 994 8917 004

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
000 0000 003.	FREQUENCY DETERMINED PART	0 ..	QTY 1 SEE 838-4575-001
358 1022 000.	SLIDE, DRAWER	4 ..	
358 1955 000.	CABLE CARRIER STEEL	2 ..	
358 2040 000.	S HOOK	2 ..	
583 0097 000.	RELAY, COAXIAL 12VDC COIL...	1 ..	K009
620 0455 000.	ADPT BNC UG492A/U	6 ..	J002 J004 J006 J010 J012 J014
822 0900 109.	SPACER, CABLE RETRACT MTG.	2 ..	
915 1915 006.	STOP CORD AURAL EXC.	1 ..	
915 1915 007.	STOP CORD VIS. EXC.	1 ..	

992 0741 049.	CABLE RF DUAL EXC W6	.....	1 ..	W006
992 6814 003.	HARDWARE KIT	.....	1 ..	
992 7008 001.	LUMINANCE LIN CORR ASSY	...	1 ..	
994 6915 001.	NOTCH DIPLEXER EQLR	.....	1 ..	
994 7076 003.	UHF EXCITER/MOD SWITCH	....	1 ..	
994 8012 014.	EXC, AURAL UHF TV, STEREO	..	1 ..	
994 8714 013.	BASIC UHF VIS EXC MCP-UX	...	1 ..	

Table 7-64. CABLE RF DUAL EXC W6 - 922 0741 049

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
817 2208 001.	CADS, RF DUAL EXC W6	.....	0 ..
852 9155 010.	CABLE LAY RF DUAL EXC W6	..	0 ..
618 0211 000.	COAX CABLE RG59B, 75 OHM	..	73.2 FT
620 1952 000.	STRAIGHT PLUG BNC CRIMP	...	20 .
296 0263 000.	TUBING, SHRINK 3/8 WHITE	....	1.9. FT
618 0210 000.	COAX CABLE RG142B, 50 OHM	..	21.5 FT
620 2175 000.	"N" PLUG CRIMP RT ANGLE	....	2 .. A13D2-INA13D4-IN
620 0818 000.	PLUG, STRAIGHT BNC	.....	2 .. A6J4 A7J4
618 0051 000.	COAX CABLE RG58C, 50 OHM	..	14.2 FT
620 1951 000.	STRAIGHT PLUG BNC CRIMP	...	2 .. A6J3 A7J3

Table 7-65. VISUAL LINE CONTROL CAB - 992 8110 002

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
606 0821 000.	CKT BREAKER 150A	.....	2 .. CB006 CB008
816 2727 004.	TRIM STRIP	.....	1 ..
992 8110 001.	BASIC LINE CONTROL CAB	.....	1 ..

Table 7-66. KIT, 5-CAVITY CONVERSION - 992 8462 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
055 0120 373.	CONN 1/2 IN. 90 DEG	.....	1 ..
302 0137 000.	SCR, 8-32 X 1-1/4	.....	6 .. #MTG RF LOAD RL003
304 0039 000.	NUT CAP .312-18 BRS	.....	2 .. #HEATSINK
354 0760 000.	TAB ADAPTOR 250 SERIES	.....	2 ..
358 3088 000.	RING, RETAINING .438 NOM	....	2 ..
358 3133 000.	STUD, BRS 1/4-20 X 1-1/2	.....	2 .. #E010
384 0694 000.	LED RED CART 12V	.....	1 .. DS012
406 0491 000.	PLUG WIRING FOR LED CART	..	1 .. XDS012
410 0028 000.	INSULATOR ROUND NS5W 0432	..	6 .. #E010
424 0009 000.	GROMMET 1-3/8 MTG DI	.....	1 ..
472 1275 000.	XFMR, PWR, DP241-6-16	.....	1 .. T001
604 0991 000.	SW, PB, MOM, SPDT	.....	1 .. S011
620 0305 000.	ADAPTOR,RT ANGLE UG-27B/U	..	2 ..
700 0621 000.	LOAD, RF 300W	.....	1 .. RL003
822 0965 104.	TUBE, EXTENSION	.....	2 ..
839 7891 198.	WIRING DIAG, ION PUMP MON	..	0 ..
917 2116 061.	CABLE,HV JUMPERS 5 CAVITY	..	1 ..
917 2116 064.	CABLE, 5-CAVITY	.....	1 ..
922 0965 025.	PLATE, RESISTOR MTG.	.....	1 .. #E010
922 0965 102.	END PLATE, FILTER HOUSING	..	1 ..
922 0965 103.	PLATE, SHORTING	.....	2 ..

922 0965 111.	ASSY, AIR INPUT TUBE	5	..	
922 0965 164.	DRESS PLATE, 2ND CAVITY	1	..	
922 0965 173.	STUD, LOAD MTG	2	..	#HEATSINK
929 9926 001.	HEAT SINK, 300W RF LOAD	1	..	
943 5123 068.	HOUSING, FILTER	1	..	
943 5123 118.	PLATE, AIR INPUT	1	..	
992 2830 002.	ARC DETECTOR ASSY	1	..	
992 8461 001.	SPARK GAP BOARD	1	..	

Table 7-67. SPARK GAP BOARD - 992 8461 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
402 0020 000.	CLIP, FUSE	6	..
548 2180 000.	RES 7.5 MEGOHM 5W 5%	1	..
560 0086 000.	SPARK GAP 5KV +/- 10%	3	..
610 1066 000.	CONN, .25 FASTON PC MOUNT.	6	..
843 5123 123.	PWB, SPARK GAP	1	..

Table 7-68. KIT, 4-CAVITY CONVERSION - 992 8462 002

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
250 0475 000.	CONNECTOR, ION PUMP, HV	1	.. #ION PUMP
917 2116 060.	COVER PLATE	1	.. FRONT DOOR
922 0965 100.	HOSE, TUBE CONNECTING	1	..
922 0965 111.	ASSY, AIR INPUT TUBE	3	..
922 0965 154.	ASSY, AIR INPUT TUBE	1	..
943 5123 119.	PLATE, AIR INPUT	1	..

Table 7-69. HOSE, TUBE CONNECTING - 922 0965 100

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
822 0965 100.	ASSY INSTR, HOSE,TUBE CON.	0	..
358 2718 000.	SOCKET, FEMALE 6-HK	2	..
359 0874 000.	ELBOW, 90 DEG STREET 3/4"	1	..
424 0506 000.	HOSE .500 ID, .875 OD	1.5	.. FT
358 3349 000.	HOSE BARB, SS FITTING	2	..
358 0935 000.	CLAMP, HOSE	2	..
359 0980 000.	BUSHING, HEXAGON	2	..

*** END OF REPORT ***

SECTION VIII DIAGRAMS

8.1. INTRODUCTION

This section of the technical manual contains a list of the drawings provided in a separate package that can be used as

aids in the installation and maintenance of the TV 60UM transmitter.

DESCRIPTION	DRAWING #
REMOTE TUNING CONTROL, WIRING DIAGRAM	822 0240 001
POWER SUPPLY AND AC FAIL, PC12	827 8143 001
OVERLOAD MONOSTABLE, PC11	827 9945 001
UHF CONTROL LOGIC, PC1	838 4926 001
UHF CONTROL LOGIC, PC4	838 4928 001
UHF CONTROL LOGIC, PC2	838 4929 001
UHF CONTROL LOGIC, PC5	838 6474 001
SCHEMATIC, AURAL IPA AMPLIFIER	839 5436 002
PEAK POWER DETECTOR	839 6816 130
ARC OVERLOAD SENSOR, PC9	839 7740 001
MAGNET CURRENT SENSOR, PC6	839 7740 006
PULSER CONTROLLER	839 7740 036
PULSER HV ASSEMBLY	839 7740 050
TV 60UM INTERCONNECT DIAGRAM	839 7740 072
CONTROL CABINET, POWER SUPPLY DECK	839 7740 099
MAGNET CURRENT POWER SUPPLY & REGULATOR	839 7740 117
CURRENT LOGIC PC BD	839 7891 024
VOLTAGE LOGIC PC BD	839 7891 028
WIRING DIAGRAM, CABINETS #2 & #4	839 7891 038
WIRING DIAGRAM, LOGIC BOX	839 7891 039
WIRING DIAGRAM, CABINET #3 (60 CONTROL)	839 7891 040
WIRING DIAGRAM, LINE CONTROL CABINET	839 7891 042
WIRING DIAGRAM, HIGH VOLTAGE	839 7891 059
REFOCUS CURRENT SENSOR, PC8	839 7891 061
POWER AND CONTROL WIRING	839 7891 169
FUNCTION DIAGRAM, UHF CONTROL LOGIC	839 7891 087
AC POWER FLOW DIAGRAM	839 7891 172
TYPICAL STATION LAYOUT	839 7891 168
TYPICAL RF TRANSMISSION LINE LAYOUT	839 7891 109
SYSTEM DIAGRAM CH 52-69	839 7891 133
SYSTEM DIAGRAM CH 14-51	839 7891 134
HALL SENSOR PC BD	839 7891 135
WIRING DIAGRAM HIGH VOLTAGE MONITORING AMPLIFIER CABINET	839 7891 136

DESCRIPTION	DRAWING #
ION PUMP POWER SUPPLY AND MONITORING SYSTEM	839 8052 002
UHF CONTROL LOGIC, PC3	842 6300 001
VISUAL/AURAL AMPLIFIER CONTROL LOGIC CHASSIS, WIRING DIAGRAM	842 6315 001
PERIPHERAL EQUIPMENT INSTALLATION (3 SHEETS)	843 4123 049
PLUMBING LAYOUT (2 SHEETS)	843 5123 097

SECTION IX VENDOR INFORMATION

9.1. INTRODUCTION

This section of the TV 60UM TELEVISION TRANSMITTER Technical Manual contains selected information on vendor products used in the transmitter.

VENDOR DATA
NWL Power Supply Spare Parts List
Diversified Electronics,, Inc. SLA Series Phase Monitors
General Electric Circuit Breaker Curve; Line Control Cabinet Beam Supply Breakers
Electro-Therm SH66A Hand Held Temperature Tester
Standard Power Inc. SPS/CPS Series Power Supply
Superior Interlock Corporation Locksets
Varian UHF Klystron Amplifier and Circuit Assemblies

QTY.	DESCRIPTION	NWL#	HARRIS #
3	Capacitor, 30 microfarad, 660 VAC	H16055	510 0748 000
1	Trans-Pak, Full wave bridge, rectifier, 10.5 ADC, 70 KPIV w/RC network	G33011	384 0851 000
1	Pressure Relief Valve	H12099	___ ___
1	Liquid Level Gauge	H12105	359 0979 000
1	Temperature Gauge	H12104	442 0104 000
1	Gate Valve	H17121	___ ___
3	Surge Arrestor	H15106	560 0085 000
36	Cover Clamps	H17001	358 2870 000
3	Metal Oxide Varistor, 575 VRMS	H16224	560 0081 000
2	Capacitor, 2 Microfarad, 40kVdc	H16058	510 0749 000
1	Capacitor, 4 Microfarad, 40kVdc	H16070	510 0755 000