The Eimac 3K50,000LA, 3K50,000LF and 3K50,000LK klystrons are three cavity, magnetically focused power amplifiers intended primarily for UHF television broadcast service. Each klystron type, operating as a television visual r-f amplifier, will deliver 12 kW of peak synchronizing power output with a power gain of approximately 20 db. The cavities of the Eimac UHF television klystrons have ceramic windows and are completed by tuning boxes external to the tubes.

**Nominal Tuning Range**
The UHF television band (470-890 Mc) is covered by the three tube types as follows:

<table>
<thead>
<tr>
<th>Tube Type Number</th>
<th>MC</th>
<th>Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>3K50,000LA</td>
<td>470-580</td>
<td>14-32</td>
</tr>
<tr>
<td>3K50,000LF</td>
<td>580-720</td>
<td>33-55</td>
</tr>
<tr>
<td>3K50,000LK</td>
<td>720-890</td>
<td>56-83</td>
</tr>
</tbody>
</table>

**Mechanical**
- Mounting (See Outline Drawing): Support from Mounting Flange
- Mounting Position: Axis Vertical
- Cooling: Water & Forced Air

**Electrical**
- Filament: Pure Tungsten
- Voltage: 9.0 volts
- Current (with cathode cold): 42 amperes
- Current (with cathode at operating temperature): 39 amperes
- Maximum Allowable Short Circuit Current: 84 amperes
- Cathode: Unipotential; heated by electron bombardment
- Maximum Cathode Ratings:
  - DC Voltage: 2300 MAX. VOLTS
  - DC Current: .75 MAX. AMPERES
  - DC Power: 1600 MAX. WATTS
- Focus Electrode
- Voltage (with respect to cathode): 0 to 500 volts
- Magnetic Field: Axial (See Magnetic Circuit Schematic)
- Field Strength (approximately): 120 gauss

**General Characteristics**
- Filament: "A", "F", "K"
- Maximum Overall Dimensions:
  - Length: 54 inches
  - Diameter: 5\(\frac{1}{2}\) inches
  - Net Weight: 53 pounds
  - Shipping Weight: 185 pounds

**Ultra High Frequency Power Amplifier**

**Maximum Ratings**
- DC Beam Voltage: 19.5 MAX. KILOWOLTS
- DC Beam Current: 2.56 MAX. AMPERES
- Collector Dissipation: 50.0 MAX. KILOWATTS

**TYPICAL OPERATION**

**RF Amplifier—Television Visual Service**
- DC Cathode Bombarding Power: 1400 watts
- DC Cathode Bombarding Voltage: 2100 volts
- DC Cathode Bombarding Current (approximately): .66 amperes
- DC Focus Electrode Voltage: 0 volts
- DC Beam Voltage: 17.2 kilovolts
- DC Beam Current: 2.15 amperes
- DC Collector Current (approximately): 1.72 amperes
- Peak Synchronizing Level (80% of saturation power):
  - Driving Power (approximately): 55 watts
  - Power Output: 12.0 kilowatts
  - Efficiency: 41 percent
- Black Level:
  - Collector Dissipation (approximately): 30 kilowatts
  - Driving Power (approximately): 33 watts
  - Power Output: 7.2 kilowatts
  - Efficiency: 19 percent

**RF Amplifier—Television Aural Service**
- DC Cathode Bombarding Power: 1400 watts
- DC Cathode Bombarding Voltage: 2100 volts
- DC Cathode Bombarding Current: .66 amperes
- DC Focus Electrode Voltage: 0 volts
- DC Beam Voltage: 12.3 kilovolts
- DC Beam Current: 1.33 amperes
- DC Collector Current: 1.06 amperes
- Driving Power: 20 watts
- Collector Dissipation (approximately): 10 kilowatts
- Power Output: 6 kilowatts
- Efficiency: 36 percent

*Minor tube-to-tube variations may be expected.

*Total driving power includes losses inserted for broadband operation. The output power is useful power measured in a load circuit.

*The driving power is the total power required by the tube and a resonant circuit.

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APPLICATION

Mounting—The klystrons are provided with a mounting flange (See Outline Drawing) which may be used to support the tubes with either end up.

Filament Operation—For maximum tube life, the pure tungsten filament should be operated just above the emission limiting temperature. This temperature will be obtained with a filament voltage, as measured directly at the terminals, of approximately 9 volts.

Cathode Heating Power—The cathode is unpotentential and heated by electron bombardment. A dc potential of approximately 2100 volts is applied between the filament and the cathode; and the recommended cathode heating power of 1400 watts is obtained with approximately .66 amperes. The filament is designed to operate under space-charge limited conditions. Cathode temperature is varied by changing the bombarding potential between the filament and the cathode.

Cooling—Forced air is used to cool the Electron Gun Structure and the Middle and Output Cavieties. Only clean, well filtered air should be blown on the tube to avoid voltage breakdown due to dust accumulation. The temperature of the metal in the region of the metal-to-glass seals should not exceed 150°C. Tubing temperatures may be measured with a temperature-sensitive paint, such as “Templiq”, manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N. Y.

Water is used to cool the Drift Tubes and the Collector Assembly. The cooling water should be of sufficient purity to prevent liming of the water system, and the use of a heat exchanger is recommended. The inlet water pressure of the Drift Tubes and the Collector Assembly should not exceed 50 pounds per square inch. The outlet water temperature must not exceed a maximum of 70°C. under any condition.

Air and water flow should be started before the filament and cathode power are applied and maintained for at least two minutes after the filament and cathode power have been removed.

Klystron Cooling Requirements for Typical Operating Conditions and Correct Magnetic Field Adjustment:

<table>
<thead>
<tr>
<th>Input Drift Tube</th>
<th>Water</th>
<th>1 gpm</th>
<th>1 psi</th>
<th>*Water</th>
<th>1 gpm</th>
<th>1 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Drift Tube Jacket</td>
<td>Water</td>
<td>1 gpm</td>
<td>1 psi</td>
<td>Water</td>
<td>1 gpm</td>
<td>1 psi</td>
</tr>
<tr>
<td>Long Drift Tube Jacket</td>
<td>Water</td>
<td>1 gpm</td>
<td>1 psi</td>
<td>Water</td>
<td>1 gpm</td>
<td>1 psi</td>
</tr>
<tr>
<td>Collector Assembly</td>
<td>Water</td>
<td>15 gpm</td>
<td>3 psi</td>
<td>Water</td>
<td>15 gpm</td>
<td>3 psi</td>
</tr>
</tbody>
</table>

**Cooling Medium**

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Volume</th>
<th>Pressure Drop</th>
<th>Total Pressure Drop</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>gpm</td>
<td>psi</td>
<td></td>
</tr>
<tr>
<td>Input Drift Tube</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Short Drift Tube Jacket</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Long Drift Tube Jacket</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Collector Assembly</td>
<td>15</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks**

- *Water: 1 gpm* and *1 psi*
- Total pressure drop if series connected with 5/16" tubing = 4 psi.

Magnetic Field—An adjustable magnetic field is necessary to control and direct the beam throughout the length of the drift tube. The magnetic field should be capable of variation around the recommended field strength of 120 gauss. Typical magnetic circuit requirements for a 3K500,000LK are shown in the Magnetic Circuit Schematic. The current and adjustment of the pre-focusing coil are optimized under low beam voltage conditions and will require minor readjustment with changes in beam voltage. The current and location of the focusing coils should be capable of independent adjustment. Readjustment of the current of the focusing coils is necessary with changes in beam voltage. Beam transmission (collector current divided by the beam current as measured in the cathode return to beam power supply) will vary from 75% to 95%. Improper adjustment or misalignment of the magnetic field, as indicated by too low a value of beam transmission, may cause the beam to strike and overheat the drift tube walls.

**MAGNETIC FIELD COIL REQUIREMENTS**

<table>
<thead>
<tr>
<th>Number of Coils Required for Field Strength of Approximately 120 Gauss.</th>
<th>Pre-focusing Coils</th>
<th>Focusing Coils</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>375-750 amperes-turns per coil</em></td>
<td><em>1600-4800 amperes-turns per coil</em></td>
<td><em>0-1600 amperes-turns per coil</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tube Type</th>
<th>3K500,000LA</th>
<th>3K500,000LF</th>
<th>3K500,000LK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

CAUTION—It is convenient to operate the r-f and collector portions of the tube at ground potential. Since the cathode and filament are operated at high negative potentials with respect to ground, filament and cathode power supplies and voltmeters must be adequately insulated for these high voltages. Protection must also be afforded to operating personnel.

Protection—It is recommended that the following protective devices be used:

1. Interlocks in air and water supplies.
2. Interlocks in magnetic field supply circuits.
3. Current overload in cathode bombardment supply circuit.
6. Current limiting resistor of approximately 100 ohms in series with beam power supply to isolate tube from final capacitor of supply.

The filament and cathode bombardment voltages will normally be applied before the beam voltage. Cavity tuning or magnetic field adjustment should be made with reduced beam voltage (1/2 to 2/3 normal). Slight retuning and readjustment will be necessary when beam voltage is raised to full value.
"IMPERIAL FLEX FITTINGS" FOR 3/8 OD TUBING.
ALL OTHERS ARE "IMPERIAL FLEX FITTINGS" FOR 5/8 OD TUBING.

OUTPUT END VIEW

DIMENSIONS IN INCHES

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>3K50,000 LA</td>
<td>53</td>
<td>31</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>3K50,000 LF</td>
<td>46</td>
<td>25</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3K50,000 LK</td>
<td>44</td>
<td>22</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
COOLING DIAGRAM

*WATER CONNECTIONS ARE MADE AS SHOWN WHEN TUBE IS MOUNTED WITH COLLECTOR UP. WHEN TUBE IS MOUNTED WITH ANODE UP THE WATER CONNECTIONS MUST BE REVERSED.

* THIS COOLING MAY BE SUPPLIED BY A SINGLE BLOWER THROUGH SUITABLE MANIFOLD & BAFFLES.

INPUT CAVITY
AIR COOLING NOT REQUIRED

OUTPUT CAVITY
AIR COOLING

MIDDLE CAVITY
AIR COOLING

GASS ENVELOPE AND SEAL
AIR COOLING

CATHODE TERMINAL
AIR COOLING

FILAMENT STEM
AIR COOLING

WATER OUT*
WATER IN*

WATER OUT*
WATER IN*

WATER OUT*
WATER IN*

WATER OUT*
WATER IN*

WATER OUT*
WATER IN*

COLLECTOR
COOLING

OUTPUT DRIFT TUBE COOLING

DRIFT TUBE COOLING

INPUT DRIFT TUBE COOLING
TYPICAL PERFORMANCE
3K50,000L \( A \) F KLYSTRON

\( \eta \) vs. \( E_b \)
\( I_b \) vs. \( E_b \)
\( P_0 \) vs. \( E_b \)

BEAM CURRENT, POWER OUTPUT AND EFFICIENCY VS. BEAM VOLTAGE