The Eimac 4CX250B/M is a ceramic/metal, forced-air cooled external-anode tetrode with a maximum anode dissipation rating of 250 Watts. The 4CX250B/M is intended for use in applications where tight control of electrical specifications is required and replaces the 4CX250B in all applications. This tube utilizes a ruggedized internal structure and utilizes a welded anode cap for improved reliability.

**CHARACTERISTICS**

**ELECTRICAL**
- Cathode: Oxide coated, Unipotential
- Filament Voltage: 6.0± 0.3 V
- Current at 6.0 Volts: 2.6 A
- Direct Interelectrode Capacitances (grounded cathode)\(^2\)
  - Cin: 15.7 pF
  - Cout: 4.5 pF
  - Cgp: 0.04 pF
- Amplification Factor, Average (screen-grid): 5
- Frequency of Maximum Ratings (CW): 500 MHz

**MECHANICAL:**
- Overall Dimensions:
  - Length: 2.46 in; 62.5 mm
  - Diameter: 1.64 in; 41.7 mm
- Weight (approx.): 4 oz; 113 gm
- Operating Postion: Any
- Maximum Operating Temperature:
  - Ceramic/Metal Seals & Envelope: 250°C
  - Anode Core: 250°C
- Cooling: Forced Air
- Base: Special, 9-pin Jede-B8-236
- Recommended Air System Socket: SK-600 Series
- Recommended Air Chimney: SK-606

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**RANGE VALUES FOR EQUIPMENT DESIGN**

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Nom.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament Current @ 6.0 Volts</td>
<td>2.3</td>
<td>--</td>
<td>2.9</td>
</tr>
<tr>
<td>Cathode Warm-up Time</td>
<td>30</td>
<td>60</td>
<td>--</td>
</tr>
</tbody>
</table>
| Interelectrode Capacitance \(^1\) (grounded cathode circuit)
  - Cin    | 14.2 | --   | 17.2 |
  - Cout   | 4.0  | --   | 5.0  |
  - Cgp    | --   | --   | 0.04 |
| Interelectrode Capacitance \(^1\) (grounded grid circuit)
  - Cin    | --   | 13.0 | --   |
  - Cout   | 4.0  | --   | 5.0  |
  - Cpk    | --   | 0.01 | --   |

\(^1\) Capacitance values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

\(^2\) Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

The values listed above represent specified limits for the product and are subject to change. The data should be used for basic information only. Formal, controlled specifications may be obtained from CPI for use in equipment design.

For information on this and other CPI products, visit our website at: [www.cpii.com](http://www.cpii.com).

or contact: CPI MPP, Eimac Operation, 607 Hansen Way, Palo Alto, CA 94303

**TELEPHONE:** 1(800) 414-8823  |  **FAX:** (650) 592-9988  |  **EMAIL:** powergrid@cpii.com

July 2011
RADIO FREQUENCY AMPLIFIER
Class C, CW Operation

ABSOLUTE MAXIMUM RATINGS:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode Voltage</td>
<td>2000 Vdc</td>
</tr>
<tr>
<td>Screen Voltage</td>
<td>300 Vdc</td>
</tr>
<tr>
<td>Anode Current</td>
<td>0.250 Adc</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>250 Watts</td>
</tr>
<tr>
<td>Screen Dissipation</td>
<td>12 Watts</td>
</tr>
<tr>
<td>Grid Dissipation</td>
<td>2 Watts</td>
</tr>
<tr>
<td>Heater-to-Grid Voltage</td>
<td>150 Volts</td>
</tr>
</tbody>
</table>

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage (feedback) to obtain the specified anode current at the specified bias and anode voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed.

APPLICATION

MECHANICAL

MOUNTING - The 4CX250B/M may be mounted in any position.

SOCKETING - The Eimac SK-600 series air system sockets or a socket having equivalent characteristics is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

COOLING – Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the Eimac SK-600 series and an Eimac SK-606 chimney are used with an air flow in the base-to-anode direction. Tube life is prolonged if the anode temperature is maintained at values lower than the maximum rating.

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown in the chart plus any drop encountered in ducts and filters. The blower must be designed to deliver necessary airflow at the desired altitude.

<table>
<thead>
<tr>
<th>Anode Dissipation (Watts)</th>
<th>SEA LEVEL</th>
<th>10,000 FEET</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Air Flow</td>
<td>Pressure Drop</td>
</tr>
<tr>
<td></td>
<td>(CFM)</td>
<td>(In. of Water)</td>
</tr>
<tr>
<td>200</td>
<td>5.0</td>
<td>0.52</td>
</tr>
<tr>
<td>250</td>
<td>6.4</td>
<td>0.82</td>
</tr>
</tbody>
</table>

At 500 MHz or below base cooling air requirements are satisfied automatically when the tube is used in an EIMAC Air-System socket and the recommended air flow rates are used. Experience has shown that if reliable long life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

VIBRATION – The 4CX250B/M is capable of withstanding shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in environments where shock and vibration are anticipated.
RADIAL BEAM POWER TETRODE
4CX250B/M
7203A

ELECTRICAL

HEATER OPERATION - The rated heater voltage for the 4CX250B/M, 6.0 volts as measured at the socket, should be maintained at this value to obtain optimum performance and maximum tube life. In no case should the voltage be allowed to deviate from 6.0 volts by more than plus or minus five percent (5%). Short-time changes of +/- 10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within +/- 5% to minimize these variations and to obtain maximum tube life.

At frequencies above approx. 300 MHz transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, anode current, and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the table below:

<table>
<thead>
<tr>
<th>Frequency MHz</th>
<th>Heater Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 and lower</td>
<td>6.00 Volts</td>
</tr>
<tr>
<td>301 to 400</td>
<td>5.76 Volts</td>
</tr>
<tr>
<td>401 to 500</td>
<td>5.50 Volts</td>
</tr>
</tbody>
</table>

CATHODE OPERATION - The oxide coated unipotential cathode must be protected against excessive high emission currents. The maximum rated dc input current is 200 mA for plate modulated operation and 250 mA for all other types of operation with the exception of pulsed applications.

The cathode is connected internally to four pins and all four should be used to make connection to external circuits to lower inductance. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that the rated nominal heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage of 150 volts should be observed, regardless of polarity.

GRID OPERATION - The maximum rated dc grid bias voltage is -250 volts and the maximum grid dissipation rating is 2.0 Watts. In ordinary audio and rf amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100 MHz region, driving power requirements for amplifiers increase noticeably. At 500 MHz as much as 20 Watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is only increased slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid-current values below approx. 15 mA. The maximum permissible grid-circuit resistance per tube is 100K Ohms.

SCREEN OPERATION - The maximum rated dissipation for the screen grid is 12 Watts and the screen input power must be kept below that level. The product of peak screen current and peak screen voltage approximates the screen input power when amplitude modulation is used. In some cases screen current may tend to be negative. The 4CX250B/M shows reduced screen current, compared to the 4CX250B, and is therefore preferred for use in amplifiers where screen supply voltage regulation is poor or where an increase in screen current above the normal value will cause a significant reduction in voltage. At UHF increased output (cavity) loading is recommended to reduce screen current even if the overall tube efficiency is reduced somewhat.

FAULT PROTECTION - All power tubes operate at voltages which can cause severe damage in the event of an internal arc, especially in those cases where large amounts of stored energy or follow-on current are involved. Some means of protection is advised in all cases, and it is recommended that a series resistor be used in the anode circuit (20 to 50 ohms) to limit peak current and provide a means of dissipating the energy in the event of a tube or circuit arc. For an oxide-cathode tube such as the 4CX250B/M a maximum of 4 joules total energy may be permitted to be dumped into an internal arc. Amounts in excess of this may permanently damage the cathode or the tube grids. Additional information is found in Eimac’s Application Bulletin #17 titled “FAULT PROTECTION,” available on request.

RF RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 300 MHz most of the energy will pass completely through the human body with little attenuation or heating affect. Public health agencies are concerned with hazard even at these frequencies. OSHA (Occupational Safety and Health Administration) recommends that prolonged exposure to rf radiation should be limited to 10 milliwatts per square centimeter.

INTERELECTRODE CAPACITANCE - The actual internal inter-electrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to “ground”. The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a
period of time, even when the tube may be made by different manu-facturers. The capacitance values shown in the manu-
facturer’s technical data, or test specifications, normally are
taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allow-
ance for the actual capacitance values which will exist in any
normal application. Measurements should be taken with the
socket and mounting which represent approximate final layout
if capacitance values are highly significant in the design.

HOT SURFACES - Air-cooled surfaces and other parts of tubes
can reach temperatures of several hundred degrees C and
cause serious burns if touched for several minutes after all
power is removed.

HIGH VOLTAGE - The 4CX250B/M operates at voltages which
can be deadly, and the equipment must be designed properly
and operating precautions must be followed. Equipment must
be designed so that no one can come in contact with high volt-
ages. All equipment must include safety enclosures for high-
vote circuits and terminals, with interlock switches to open
the primary circuits of the power supplies and to discharge
high-voltage condensers whenever access doors are opened.
Interlock switches must not be bypassed or “cheated” to allow
operation with access doors open. Always remember that HIGH
VOLTAGE CAN KILL.

SPECIAL APPLICATIONS - If it is desired to operate this tube
under conditions widely different from those given here, contact
the Application Engineering Dept., CPI MPP Eimac Opera-
tion, Palo Alto, Calif. 94304 for information and recommendations.

OPERATING HAZARDS

Proper use and safe operating practices with respect to power tubes are the responsibility of equipment manufacturers and users
of such tubes. All persons who work with and are exposed to power tubes, or equipment that utilizes such tubes, must take precau-
tions to protect themselves against possible serious bodily injury. DO NOT BE CARELESS AROUND SUCH PRODUCTS.

The operation of this tube may involve the following hazards, any one of which, in the absence of safe operating practices and pre-
cautions, could result in serious harm to personnel.

HIGH VOLTAGE – Normal operating voltages can be deadly.
Remember the HIGH VOLTAGE CAN KILL.

LOW-VOLTAGE HIGH-CURRENT CIRCUITS - Personal jewelry,
such as rings, should not be worn when working with filament
contacts or connectors as a short circuit can produce very high
current and melting, resulting in severe burns.

RF RADIATION – Exposure to strong rf fields should be avoided,
even at relatively low frequencies. CARDIAC PACEMAKERS
MAY BE AFFECTED.

HOT SURFACES – Surfaces of tubes can reach temperatures
of several hundred °C and cause serious burns if touched for
several minutes after all power is removed.

MATERIAL COMPLIANCE - This product and package conforms
to the conditions and limitations specified in 49CFR 173.424 for
radioactive material, excepted package-instruments or articles,
UN2910. In addition, this product and package contains no
beryllium oxide (BeO).

Please review the detailed Operating Hazards sheet enclosed
with each tube, or request a copy from CPI MPP, Eimac Opera-
tion Application Engineering at 1-650-592-1221.
TYPICAL CONSTANT CURRENT CHARACTERISTICS

SCREEN VOLTAGE = 350V

- - - - PLATE CURRENT - AMPERES
- - - - SCREEN CURRENT - AMPERES
- - - - GRID CURRENT - AMPERES

GRID VOLTAGE (V)

0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000

PLATE VOLTAGE (V)
INDEX (ALIGNED WITH CONTROL GRID GUIDE LUG)

NOTES:
1. REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY, AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. * CONTACT SURFACE.

ANODE RADIATOR

SCREEN GRID
(CONTACT OUTER CYLINDRICAL SURFACE ONLY)

PIN CONNECTION
PIN NO. 1 - SCREEN GRID
PIN NO. 2 - CATHODE
PIN NO. 3 - HEATER
PIN NO. 4 - CATHODE
PIN NO. 5 - I.C.
(DO NOT USE FOR EXTERNAL CONNECTION.)
PIN NO. 6 - CATHODE
PIN NO. 7 - HEATER
PIN NO. 8 - CATHODE
CENTER PIN = CONTROL GRID

DIMENSIONAL DATA

<table>
<thead>
<tr>
<th>DIMENSIONS</th>
<th>INCHES</th>
<th>MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.324</td>
<td>.5903</td>
</tr>
<tr>
<td>B</td>
<td>1.610</td>
<td>40.96</td>
</tr>
<tr>
<td>C</td>
<td>1.810</td>
<td>45.97</td>
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<tr>
<td>D</td>
<td>.750</td>
<td>19.05</td>
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<tr>
<td>E</td>
<td>.710</td>
<td>18.03</td>
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<td>F</td>
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<td>35.71</td>
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<td>G</td>
<td>.187</td>
<td>4.75</td>
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<tr>
<td>H</td>
<td>BASE .28236</td>
<td>.0705</td>
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<tr>
<td>J</td>
<td>.659</td>
<td>16.76</td>
</tr>
<tr>
<td>K</td>
<td>.240</td>
<td>6.10</td>
</tr>
</tbody>
</table>