VKE2401P Series

CW EXTENDED INTERACTION OSCILLATOR

INSTALLATION & OPERATING INSTRUCTIONS MANUAL

PREPARED BY:

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CW EXTENDED INTERACTION OSCILLATOR

INSTALLATION AND OPERATING INSTRUCTIONS

SECTION 1 - INTRODUCTION

This manual contains the instructions required to install and operate a CW Extended Interaction Oscillator (EIO).

Specific information is contained on the Test Data Sheet for the particular EIO shipped (Appendix). For further information regarding this product or for additional copies of this manual or the Test Data sheet please contact your CPI representative:

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SECTION 2 - PROTECTIVE MEASURES

2.0 GENERAL

Equipment, in which the EIOs are used, should provide protection to personnel as described below. In addition, to protect the EIO, installation and operating precautions must be observed, and absolute ratings must not be exceeded.

2.1 PERSONNEL

2.1.1 High Voltage

WARNING: ***VOLTAGES REQUIRED FOR THE OPERATION OF EIKS CAN BE DANGEROUS AND POTENTIALLY FATAL TO PERSONNEL. EQUIPMENT MUST BE DESIGNED WITH PROTECTIVE DEVICES SUCH AS PHYSICAL SHIELDS AND FAILSAFE INTERLOCK CIRCUITS ON ACCESS PANELS TO PREVENT ACCIDENTAL CONTACT WITH HIGH VOLTAGE. SOME COLLECTOR DESIGNS OPERATE AT DEPRESSED VOLTAGE POTENTIAL. THUS THE COLLECTOR BECOMES AN EXPOSED HIGH VOLTAGE SURFACE AND IS EXTREMELY DANGEROUS TO LIFE. COOLING SYSTEMS MUST BE DESIGNED TO PREVENT ACCIDENTAL CONTACT WITH THE HIGH VOLTAGE ON THE COLLECTOR. LIQUID COOLED AND AIR COOLED DEPRESSED COLLECTORS HAVE UNIQUE REQUIREMENTS TO ENSURE SAFE OPERATION OF THE EIK.***

2.1.2 Air Cooled Collector Hazard

Installers and operators need to be aware of a potential ***high voltage hazard*** when operating air-cooled EIKs with depressed voltage collectors and the need to ensure that the installation presents no risk of electrical shock.

If the EIK collector is not directly grounded, and is to be operated either above or below ground potential, then the collector becomes an exposed high voltage surface. **Contact with this surface can be fatal.** The shaded area in Figure 1 indicates the high voltage surfaces on the collector.

The EIK must be installed inside a grounded enclosure. This enclosure must have provision to allow cooling air to flow past the EIK and prevent contact with high voltage surfaces of the collector by an operator/installer directly or with any type of tool.

Protective devices such as physical shields and failsafe interlock switch circuits, etc., must be installed and functioning to prevent physical contact with the collector.

Do not attempt to operate the EIK until it has been determined that all precautions have been taken to protect personnel from all hazards.

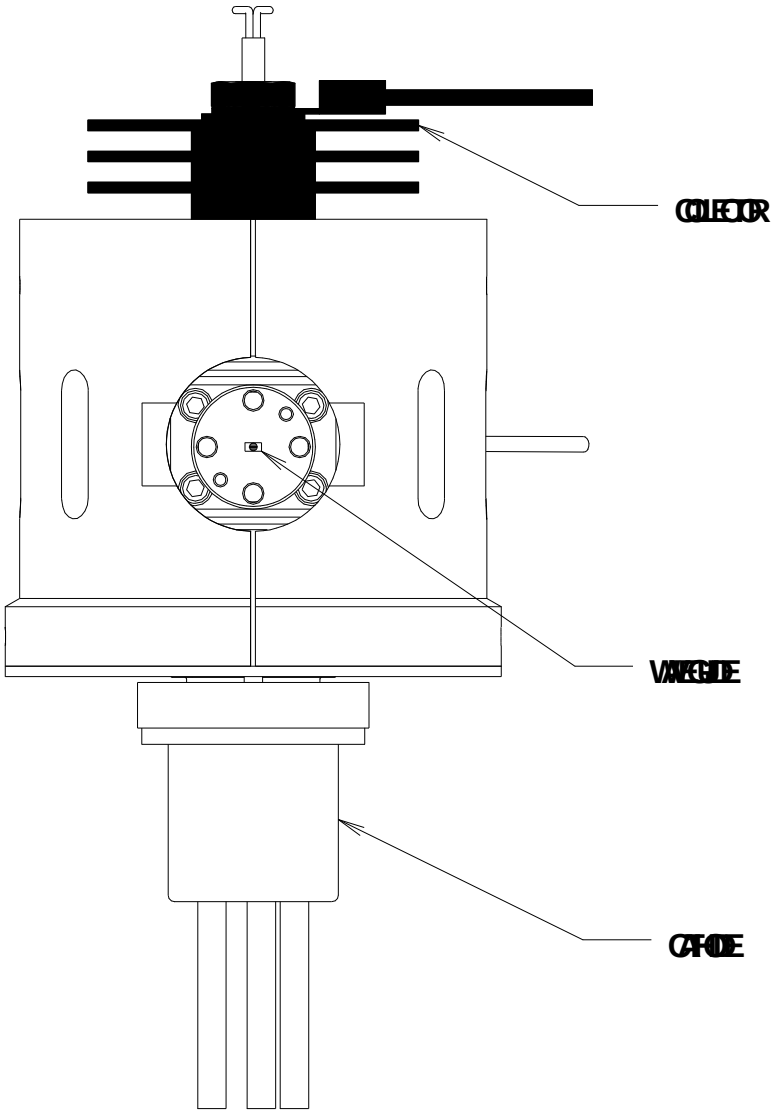


Figure 1
HIGH VOLTAGE SURFACES ON THE COLLECTOR
(Protective Cage not Shown for Clarity)

2.1.3 Liquid Cooled Collector Hazard

Installers and operators need to be aware of a potential ***high voltage hazard*** when operating liquid cooled EIKs with depressed voltage collectors and the need to ensure that the installation presents no risk of electrical shock. All coolants must be regarded as partial conductors of electricity. The following discussion assumes that the coolant lines are made of insulating material.

If the EIK collector is not directly grounded, and is to be operated either above or below ground potential, the coolant (in both flow and return lines) will equivalent to a resistor chain. A voltage distribution will exist along the lines, zero being located at the first grounded point encountered. Any part of the coolant line which is electrically conducting and not directly grounded may develop a hazardous voltage.

To prevent the above scenario, **directly ground all** metal plumbing components in **both** flow and return coolant lines attached to the EIK, see Figure 2. Steps must be taken to prevent contact with all electrically conducting materials. For further information please contact your CPI representative.

Do not attempt to operate the EIK until it has been determined that all precautions have been taken to protect personnel from all hazards.

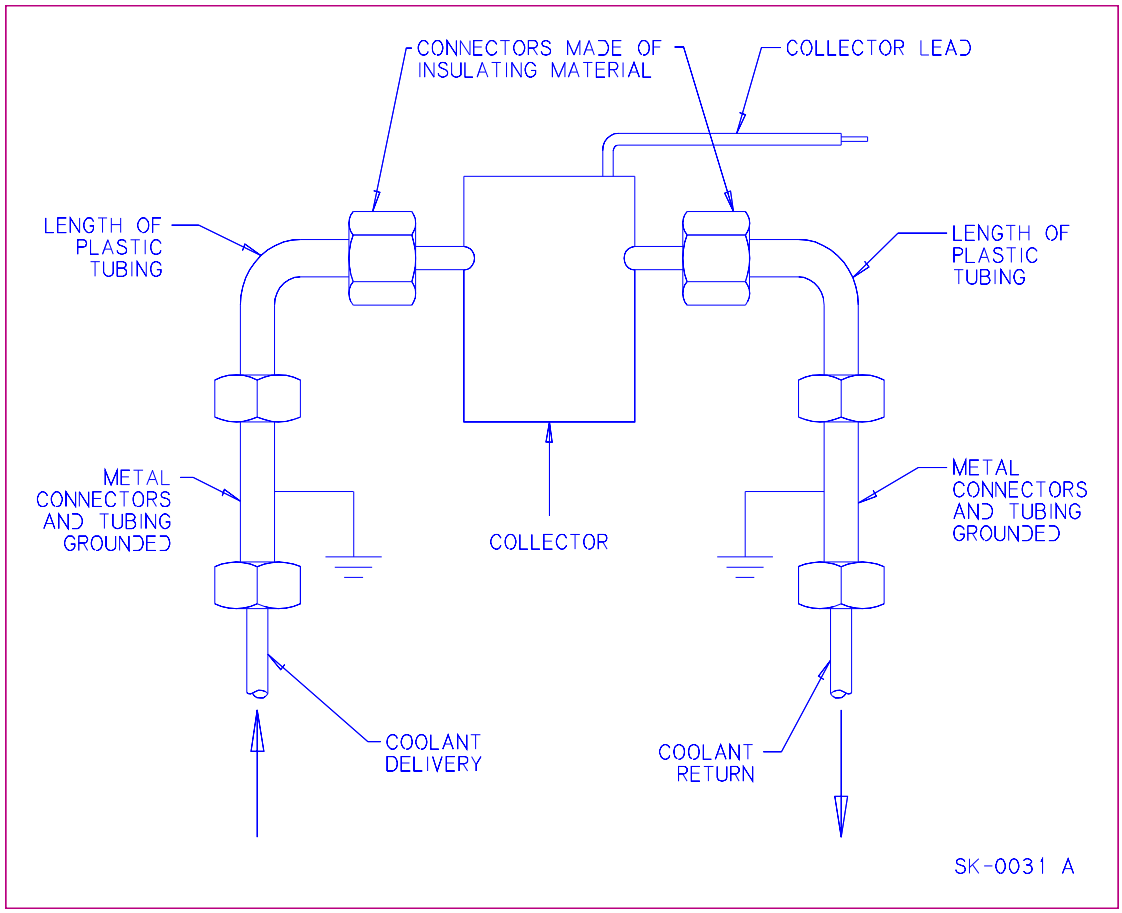


Figure 2
TYPICAL CONFIGURATION TO PREVENT ELECTRICAL HAZARD

2.1.4 Microwave Radiation

WARNING: ***PRECAUTIONS SHOULD BE TAKEN TO PREVENT EXPOSURE OF PERSONNEL TO THE MICROWAVE FIELDS PRODUCED BY THE EIK. EIK MILLIMETRE WAVE WAVEGUIDE CIRCUITS EMPLOY HIGH POWER DENSITY RF WHICH MAY RADIATE FROM ANY WAVEGUIDE FLANGE GAPS.***

Refer to: “American National Standard Safe Levels of Microwave Radiation” (ANSI C95.1 published by the I.E.E.E., 345 East 47th Street, New York, NY., 10017) for safe radiation levels.

2.2 EQUIPMENT

2.2.1 Current Limiting

Every effort has been made to ensure that all electrode spacings within the EIO are sufficient to withstand the applied voltages; however, an occasional breakdown is possible. Many power supplies use large capacitors for filtering purposes which provide sufficient current, when a breakdown occurs, to damage the EIO beyond repair. It is strongly recommended that the EIO current be limited by inserting a resistor (typically, 1000 Ohms) in series with the high voltage power supplies unless peak current from the power supplies is limited in some other way.

NOTE: **The 1kΩ resistor in the collector leads shown in Figures 1 & 2 is not primarily for arc protection, but is to ensure that the collector is always somewhat negative with respect to the EIO body.**

2.2.2 Heater Voltage

The heater voltage must be supplied from an isolated transformer or DC power supply which has adequate insulation. One terminal of the heater power supply (the positive if a direct current power supply is used) must be connected to the heater cathode lead (white).

2.2.3 Anode

The anode provides a means of controlling the output power by controlling the cathode current of the EIO; whilst the cathode voltage remains constant. The anode voltage is applied between the anode and cathode.

NOTE: **Anode current may flow in the reverse direction through the anode power supply. The design of the anode power supply must take this factor into consideration.**

2.2.4 Collector

The collector is insulated from the EIO body to allow for body current monitoring and for the collector potential to be depressed with respect to the body potential. It should be biased negatively with respect to the body by about a minimum of 100 volts, the actual value is not critical but prolonged operation at zero bias could reduce EIO life.

2.2.5 Interlock System

Interlocks should be built into the system to remove or prevent the application of cathode and anode voltage if any of the absolute ratings of the EIO are exceeded. Install coolant flow interlocks on the coolant exhaust side of the EIO.

SECTION 3 - INSTALLATION INSTRUCTIONS

3.0 HANDLING

Remove the inner shipping box from the outer shipping box. The EIO should be handled by its yoke, painted red or its base plate.

CAUTION: ***NEVER HANDLE THE EIO BY THE COOLANT LINES, ELECTRICAL LEADS, TUNER OR COLLECTOR***

Remove the EIO from the inner shipping box, observing the precautions listed above.

3.1 MOUNTING

CAUTION: ***KEEP MAGNETIC MATERIALS AT LEAST FIVE CENTIMETRES AWAY FROM THE EIO***

The EIO may be mounted using holes provided with .250" hardware. Clearance is required for the electrical leads and the collector cooling assembly. (See outline drawing in the EIO specifications section in the appendix)

3.2 COOLING

3.2.1 General

This EIK must be water-cooled.

For proper operation and long life, liquid-cooled EIKs require careful attention to the maintenance of adequate water flow and purity.

The minimum flow as specified on the Test Data Sheet must be maintained at all times when the EIK is in operation. Inadequate flow of water at high temperature will cause formation of steam bubbles at the collector surface where the water is in direct contact with it. This overheating will result in permanent damage to the EIK.

Water with contaminant levels that exceed the purity requirements will cause corrosion and scaling, this includes ordinary tap water. Unchecked corrosion of the metals in the EIK coolant passages reduces operating life. Scaling obstructs cooling passages preventing efficient heat transfer resulting in overheating

and permanent damage. Continuous filtering, deionizing and oxygen removal is necessary for maintaining high water purity.

For water purity requirements and further information, please refer to the application note "**EIK Water Cooling Requirements**" in the appendix.

3.2.2 Coolant

Deionized water is the recommended coolant for EIK's.

For protection against low temperatures, the use of water heaters or draining the system during non-operating periods is advised.

If a freezing point depressant is necessary, an *uninhibited* solution of ethylene glycol and water is the recommended coolant. Inhibited ethylene glycol cannot be used with coolant purification systems, because the inhibitors will saturate the ion-exchange resin and render it useless.

In cases where ethylene glycol is required, the coolant flow must be increased to allow for the poorer heat capacity and higher viscosity of the ethylene glycol solution. Before ethylene glycol is used in CPI EIK's, the CPI Marketing Department must be consulted for specific recommendations.

WARNING: ***FOR LIQUID COOLED COLLECTORS, ALL METAL COMPNENTS OF THE LIQUID –COOLING SYSTEM (EXCEPT THE EIK COLLECTOR) MUST BE GROUNDED TO PREVENT CHARGE ACCUMULATION (POTENTIALLY COLLECTOR TO BODY VOLTAGE) THROUGH THE COOLANT POSING AN OPERATOR HAZARD. REFER TO SECTION 2.1.3.***

3.2.3 Coolant Connections

Coolant lines are attached using swagelock nuts and nylon ferrules. Excessive force must not be used when attaching the coolant hose. Adequate torque can be obtained using fingers only.

CAUTION: ***IF MORE FORCE SEEMS TO BE REQUIRED DISMANTLE AND EXAMINE THE CONNECTION***

Cooling fluid must enter at the collector and exit at the body connector of the EIK.

A coolant flow interlock should be used to ensure proper coolant flow exiting the EIK.

A singing or hissing noise emanating from the EIK may indicate inadequate coolant flow.

CAUTION: ***CORRECT ANY COOLANT PROBLEMS IMMEDIATELY***

3.3 CONNECTIONS

3.3.1 Electrical Connections

CAUTION: ***ALTHOUGH THE HIGH VOLTAGE LEADS ARE ADEQUATELY INSULATED; THEY SHOULD BE SHIELDED FROM ACCIDENTAL CONTACT WITH PERSONNEL BY A SUITABLE GROUND SHIELD OR GROUNDED ENCLOSURE. TO PREVENT OR REDUCE CORONA, THEY MAY REQUIRE AN INCREASED AIR GAP OR INCREASED INSULATION.***

The electrical connections to the EIO are colour-coded as follows:

YELLOW	-	HEATER
WHITE	-	CATHODE & HEATER
BLUE	-	COLLECTOR
BROWN	-	BODY
RED	-	ANODE
PURPLE	-	BODY GROUND INTERLOCK

3.3.2 RF Connections

RF connections to the EIO are made through a waveguide flange. Refer to the specification section (in appendix) for the applicable waveguide size and mating flange types.

The waveguide flange connection must be made with care in order to avoid gaps between the mating surfaces. Avoid overtightening the flange screws.

CAUTION: ***IT IS ESSENTIAL THAT THE MATING FLANGE BE FLAT***

The EIO window is .002" thick.

CAUTION: ***UNDER NO CIRCUMSTANCES ALLOW SOLID OBJECTS TO ENTER THE OUTPUT WAVEGUIDE***

SECTION 4 - OPERATING PROCEDURES

4.0 GENERAL

Ensure that all power supplies are OFF, and that all controls are set at zero before proceeding.

The Test Data sheet lists the cathode voltage required for maximum power at discrete frequencies. The cathode voltage required for other frequencies may be obtained by interpolation.

Refer to the absolute ratings listed in the SPECIFICATIONS (in appendix) and the test data supplied with each EIO.

Set the maximum cathode current trip to the value posted on the EIO. The maximum body current trip may be set to the value specified in the absolute ratings; however, the body current is generally set a few milliamperes above the value listed on the Test Data sheet.

4.1 INITIALIZATION CHECKLIST

It is recommended that the following checklist be covered before applying any voltages:

1. Connect the collector to the power supply positive.

2. Connect the body (normally ground) to the power supply positive.

3. Ensure the heater, cathode and anode leads are adequately insulated; connect the leads to their respective power supplies.

4. Ensure coolant flow is adequate.

5. Ensure, by the use of trips, adjustment stops, etc. that the absolute ratings will not be exceeded. (Refer to Maximum Ratings in appendix.)

6. Connect the O/P flange and the I/P flange (where applicable) to suitable RF loads.

7. Ensure personnel will not be subject to exposure from the microwave fields.

9. Ensure personnel cannot come into contact with any high voltage.

4.2 CONFIGURATION 1 - Refer to Figure 3

Connect the EIO to the power supplies as shown in Figure 3. Configuration 1 is similar to the circuit used with the CPI EIK Power Supply, Model VPW2827. Protect the EIO as discussed in Section 4.0 and 4.1.

Switch the heater supply ON. When the minimum specified heater delay has elapsed, the beam power supply may be turned ON. Set the beam voltage to the value specified for the desired frequency of operation on the Test Data Sheet, an exact setting is not required.

NOTE: **The anode voltage is referenced to the cathode. When the anode voltage is switched OFF, the anode-to-body (ground) voltage equals the beam voltage. As the anode voltage is increased, the anode-to-body voltage decreases.**

Switch the anode power supply ON and increase the anode voltage until the beam current specified on the Test Data Sheet is obtained.

CAUTION: ***DO NOT ALLOW THE ANODE TO BECOME POSITIVE WITH RESPECT TO THE BODY. THE ANODE VOLTAGE SHOULD EXCEED –50 VOLTS WITH RESPECT TO BODY WHEN THE EIO IS OPERATING.***

Adjust the tuner until the EIO oscillates at the desired frequency. With the beam voltage set correctly, the EIO should be operating at the peak power for the mode; i.e., at the maximum power consistent with the beam current specified on the Test Data Sheet for the operating frequency.

The beam voltage may be optimized to obtain the maximum possible RF power output. Varying the beam voltage produces a corresponding change in frequency due to electronic tuning.

Adjust the beam voltage to obtain the maximum possible power.

Retune the EIO to obtain maximum possible power at the required frequency.

The power output may be reduced by lowering the anode voltage.

CAUTION: ***DO NOT, UNDER ANY CIRCUMSTANCES, EXCEED THE MAXIMUM BEAM CURRENT OR BODY CURRENT SPECIFIED IN THE OPERATING INSTRUCTIONS FOR THE INDIVIDUAL EIO***

THE ABSOLUTE RATINGS MUST BE ADHERED TO

Special attention should be paid to maximum current, and to the polarity and value of the anode potential.

4.2.1 Turn-Off Procedure

- Switch the anode power supply OFF.
- Switch the beam power supply OFF.
-Switch the heater power supply OFF.
-Switch the mains power supply OFF.

NOTE: **The EIO power supply, VPW2827, may be shut-down fast by switching the beam power supply OFF; the anode power supply will automatically switch OFF.**

NOTE: **Opening an interlock will have the same result.**

4.3 CONFIGURATION 2 - Refer to Figure 4

Connect the EIO to the power supplies as shown in Figure 4. Protect the EIO as discussed in Section 4.0 and 4.1.

Set the anode potentiometer to approximately centre position.

Switch the beam power supply ON and set the voltage to the value specified on the Test Data sheet for the desired frequency of operation; an exact setting is not required.

Set the anode voltage to provide the beam current specified on the Test Data sheet.

Adjust the tuner until the EIO oscillates at the desired frequency. With the beam voltage set correctly, the EIO should be operating at peak power for the mode; ie:, at the maximum power consistent with the beam current specified in the Test Data for the operating frequency.

The beam voltage may be optimized to obtain the maximum possible RF power output. Varying the beam voltage produces a corresponding change in frequency due to electronic tuning.

Adjust the beam voltage to obtain the maximum possible power.

Retune the EIO to obtain maximum possible power at the required frequency.

Repeat the beam voltage and the tuner adjustments until maximum power has been obtained at the operating frequency.

The power output may be reduced by lowering the anode voltage with respect to the beam voltage.

NOTE: **With this configuration, the beam current will change when the beam voltage is changed.**

CAUTION: ***DO NOT, UNDER ANY CIRCUMSTANCES, EXCEED THE MAXIMUM BEAM CURRENT SPECIFIED IN THE OPERATING INSTRUCTIONS FOR THE INDIVIDUAL EIO***

THE ABSOLUTE RATINGS MUST BE ADHERED TO

4.3 CONFIGURATION 2 ... cont'd

Special attention should be paid to maximum cathode current, and to the polarity and value of the anode potential.

4.3.1 Turn-Off Procedure

Switch the beam power supply OFF.
Switch the heater power supply OFF.
Switch the mains power supply OFF.

SECTION 5 - TUNING PROCEDURE

5.1 General

The tuner is located on the face of the EIO opposite to the waveguide output flange.

Tuning is achieved by the rotation of the tuning knob or operation of the tuning motor.

Clockwise rotation of the tuner INCREASES the frequency.

CAUTION: ***DO NOT ATTEMPT TO DISMANTLE THE TUNING MECHANISM CONTACT COMMUNICATIONS & POWER INDUSTRIES CANADA INC., FOR ADVICE IN THE EVENT OF TUNER MALFUNCTION***

The tuning range of the tuner is limited by mechanical stops. Damage may result if an attempt is made to tune beyond the range established by the stops. The stops normally allow the EIO to be tuned over a range greater than the frequency range specified for the EIO.

CAUTION: ***UNNECESSARY TUNING SHOULD BE AVOIDED***

5.2 Motor Tuned EIO (If Applicable)

The EIO tuner is driven by a 12V d.c. motor assembly. Mechanical stops and clutch mechanism are provided: but, the motor must not be left running unnecessarily against stops or in a jammed position. The tuning direction (an increase or decrease in rf frequency) is changed by reversing the drive voltage polarity to the motor. The motor tuning may be overridden by manually turning the knurled knob.

A 10 kΩ potentiometer is provided at terminals 1, 2 & 3 to indicate relative tuner position.

Terminal #1 (left hand)	-	position potentiometer (wiper)
Terminal #2	-	position potentiometer (CCW)
Terminal #3	-	position potentiometer (CW)
Terminal #4	-	motor
Terminal #5	-	motor

SECTION 6 - STORAGE OF EIKs

6.0 GENERAL

Stored EIKs should be inspected and tested at regular intervals, normally once a month.

Preferred storage conditions are a vibration free and stable, clean, dry atmosphere at room temperature. It is recommended that whenever the EIK is not in use, the waveguide flanges are covered, the high voltage lead wires are dressed to avoid strain, and the cooling tubes are dried.

Visual inspection should include looking for corrosion; shrinking, swelling or cracking of the silicone rubber; ferrous material build-up around the magnet poles; blistering or flaking paint.

The following electrical test can be used to indicate the condition of the vacuum and of the cathode in an EIK.

6.1 HEATER CURRENT

An EIK with an extremely poor vacuum will exhibit significantly increased heater current at the operating heater voltage after a warm up period. To test for this fault condition, apply 6.3 volts to the heater and limit the current to 2.0 amps. Within two minutes the current should have fallen to the value stated on the final test performance sheet supplied with each EIK. If the current remains high, the EIK is probably faulty.

6.2 CATHODE EMISSION

An EIK with poor cathode emission may be damaged by full power operation. A low voltage test can reveal emission problems and condition the EIK back to an acceptable performance. To establish normal cathode emission characteristics, perform the following test soon after receipt of an EIK. Connect a 300 volt, 15 mA beam supply (VDC) and a "floating" heater supply according to Figure 7. Anode should be connected to the body. After heater warm up, increase the beam power supply to 300 volts note the beam current and compare to the value indicated on the Test Data Sheet. Future measurements should indicate the same value of beam current. Operation for 30 minutes under these conditions is recommended. If the beam current is low, operation under these conditions for 2 - 4 hours may be necessary to recondition the cathode.

A fault in any test suggests a possible vacuum failure. CMP, or its representatives, should be consulted for further action.

SECTION 7 - SHIPPING INSTRUCTIONS

7.0 GENERAL

In the event of the EIO being returned to the manufacturer or shipped to any other point by conventional carrier:

1. Remove the EIO from the installation.

2. Blow all coolant water from the coolant tubes with clean dry air.

3. Cover the waveguide output and coolant lines.

4. Tie down the electrical leads and any other free-moving parts of the EIO.

5. Attach the EIO to the shipping feet and install the EIO into the inner shipping box.

6. Protect the collector and tuner from supporting any of the EIO's weight.

7. Place the inner shipping container into the foam lined outer shipping container. (Close and seal the container.)

8. Identify the container as called for by your carrier.

7.1 SPECIAL INSTRUCTIONS

If the original containers are not available, please contact Communications & Power Industries Canada Inc. before shipping the EIO. EIOs shipped not following these instructions will likely be damaged and could void the warranty.

SECTION 8 - ILLUSTRATIONS

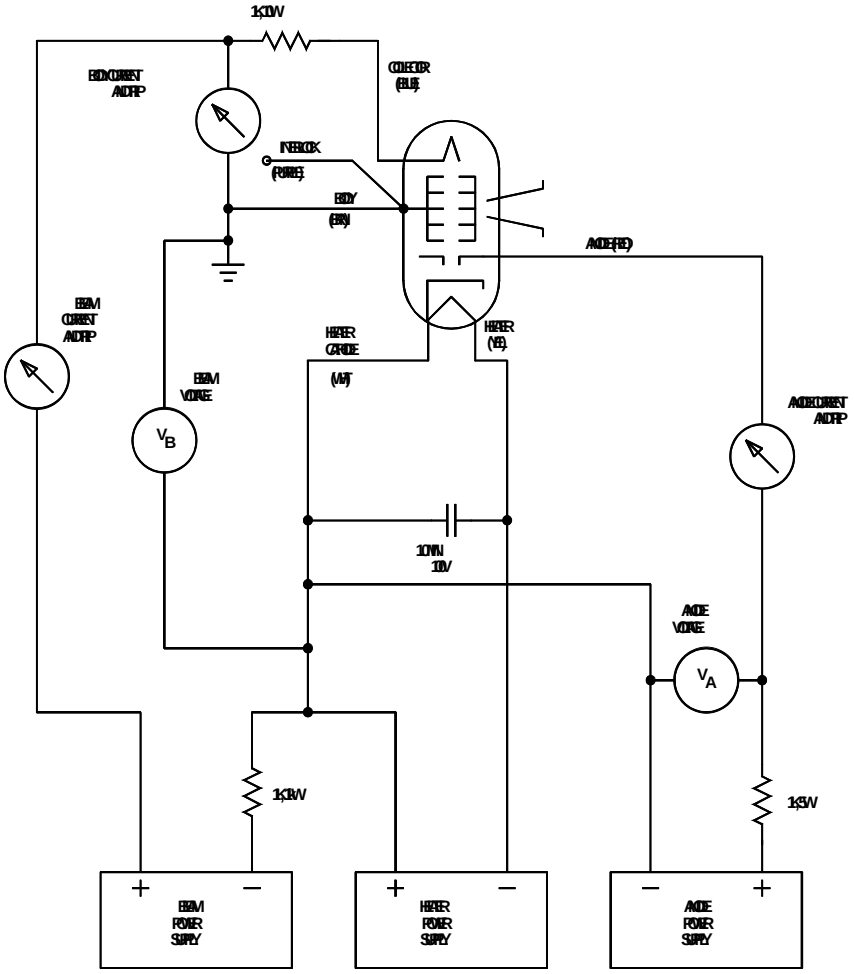


Figure 3
POWER SUPPLY CONFIGURATION 1

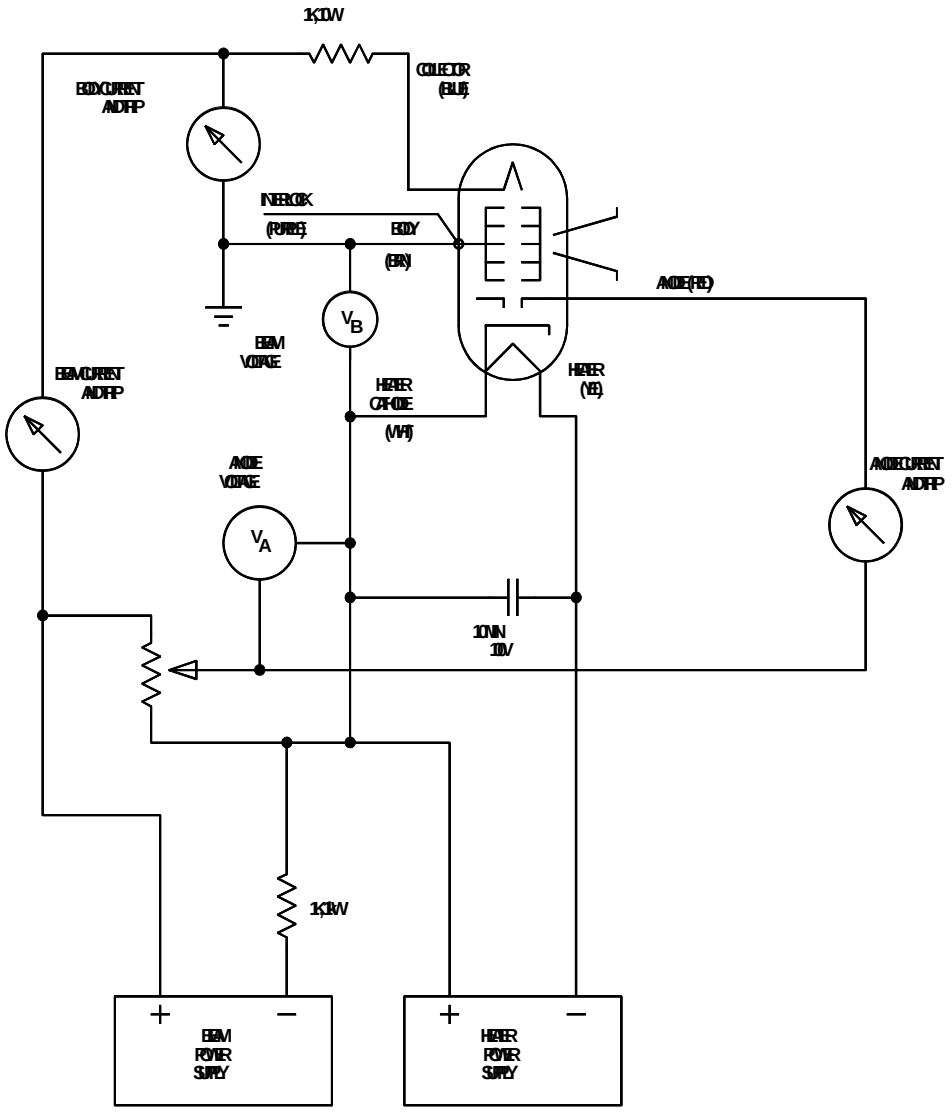
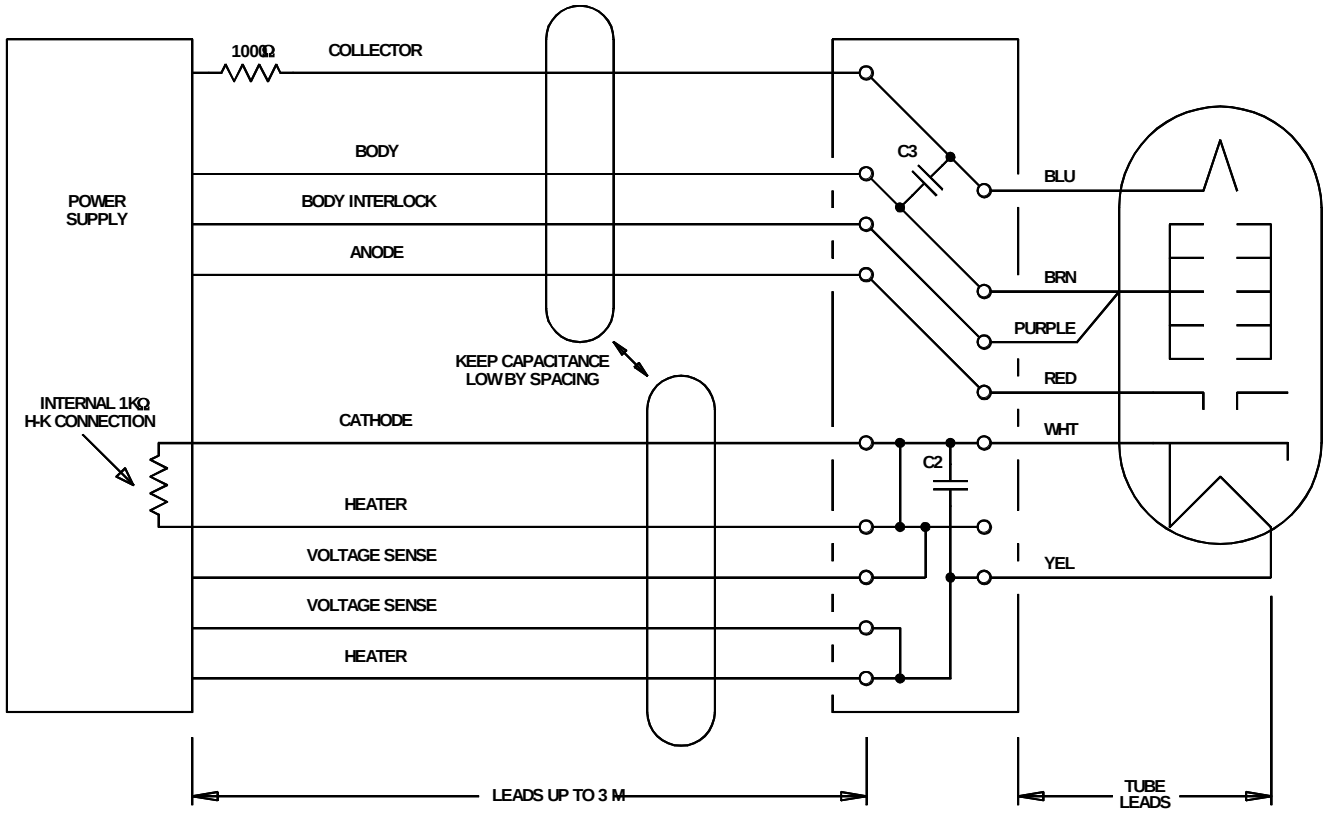


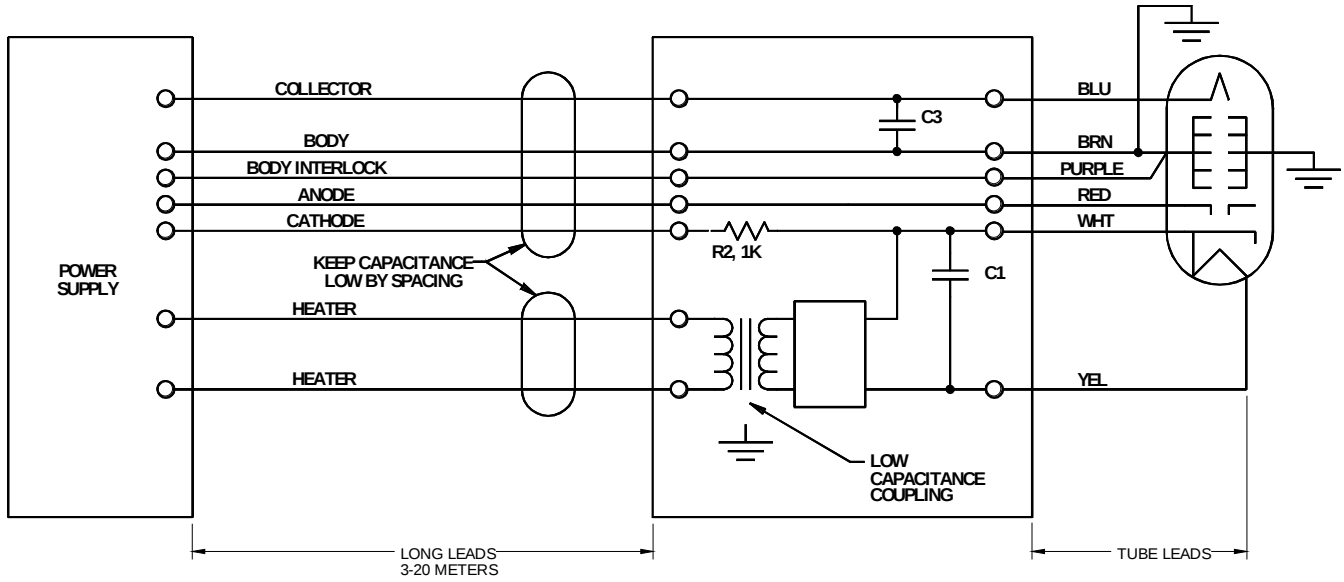
Figure 4
POWER SUPPLY CONFIGURATION 2



1. CAPACITORS - 1 MICROFARAD 500V

MD-0571A

Figure 5
POWER SUPPLY REMOTE CONNECTION (UP TO 3 METERS)



1. CAPACITORS - 1 MICROFARAD 500V.
2. CHECK HEATER VOLTAGE AT TUBE.
3. REMOVE:

   - 1K HEATER TO CATHODE CONNECTION
   - 1K CATHODE SERIES CONNECTION FROM INSIDE POWER SUPPL

MD-0572

Figure 6
POWER SUPPLY REMOTE CONNECTION (3-20 METERS)

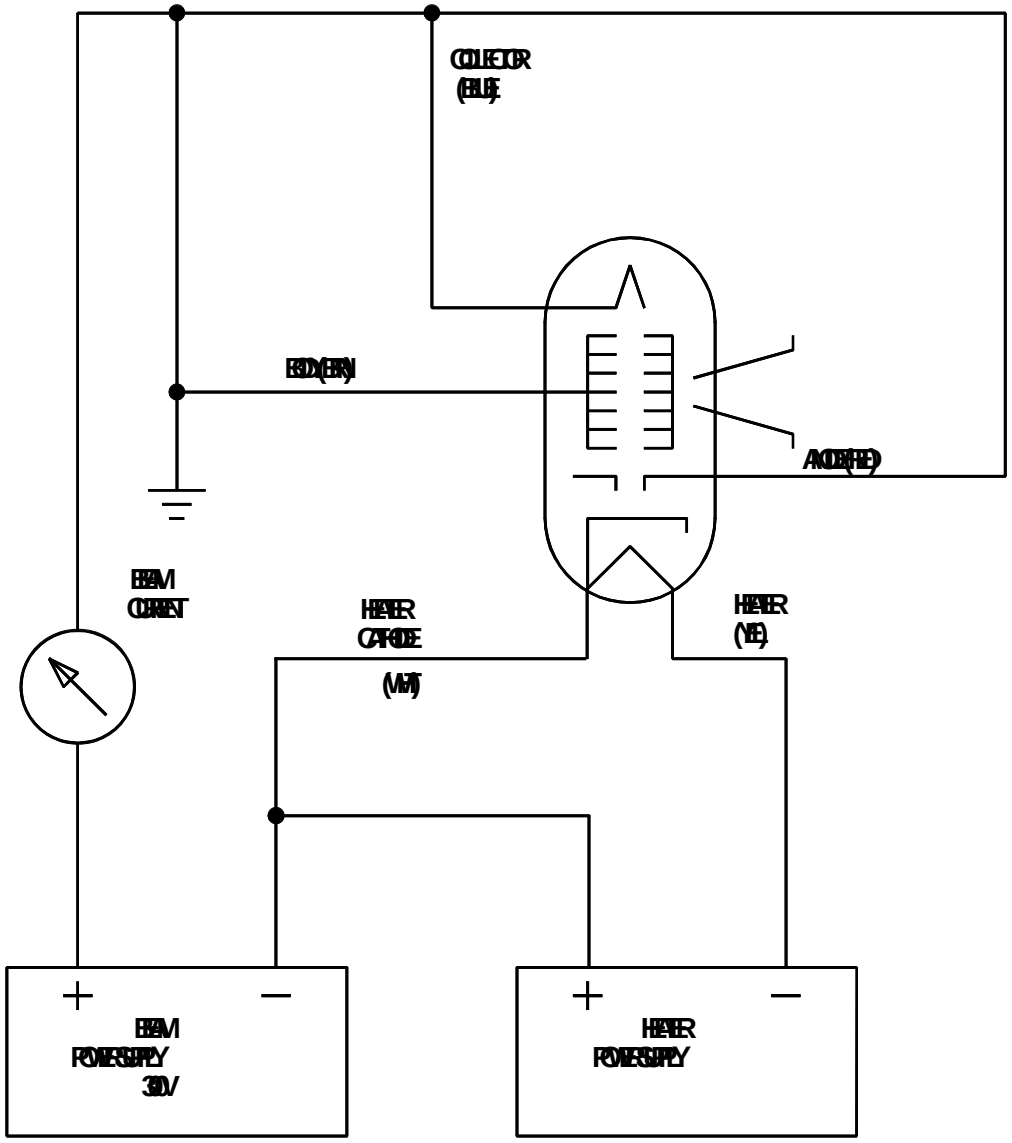


Figure 7
EMISSION TEST

APPENDIX