

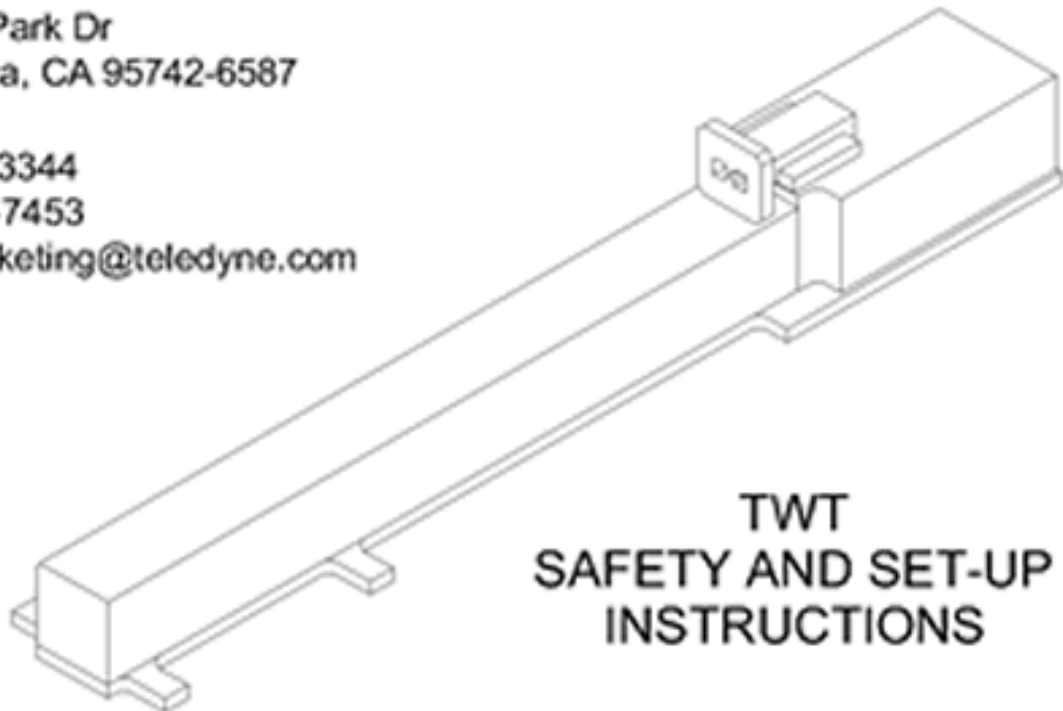
TELEDYNE
ELECTRONIC TECHNOLOGIES
MICROWAVE ELECTRONIC COMPONENTS

11361 Sunrise Park Dr
Rancho Cordova, CA 95742-6587
U.S.A.

TEL: (916) 638-3344

FAX: (916) 636-7453

E-mail: tw_t_marketing@teledyne.com



TWT
SAFETY AND SET-UP
INSTRUCTIONS

TABLE OF CONTENTS

- ~ SAFETY WARNINGS
- ~ SAFETY INSTRUCTIONS
- ~ SET-UP INSTRUCTIONS (MECHANICAL)
- ~ SET-UP INSTRUCTIONS (ELECTRICAL)
- ~ PRODUCT INFORMATION/EXPORT REGULATIONS
- ~ SCHEMATICS
 - FIGURE 1 CW
 - NO CONTROL ELECTRODE
 - SINGLE COLLECTOR
 - ANODE SUPPLY
 - FIGURE 2 CW/PULSED
 - CONTROL ELECTRODE (GRID)
 - SINGLE OR MULTIPLE COLLECTOR(S)
 - FIGURE 3 CW/PULSED
 - CONTROL ELECTRODE (FOCUS ELECTRODE)
 - SINGLE OR MULTIPLE COLLECTOR(S)
 - FIGURE 4 CW
 - NO CONTROL ELECTRODE
 - MULTIPLE COLLECTOR(S)
 - ANODE SUPPLY WITH SOLENOID SUPPLY FOR BEAM FOCUSING

~ **SAFETY WARNINGS**

For your protection and the safety of others, please read and understand the following warnings before operating this product. Special precautions must be taken for safe and proper operation.

➤ **HIGH VOLTAGE**

Exposure to lethal voltages is possible. Extreme caution is advised.

➤ **RF RADIATION**

Exposure to high and low levels of microwave radiation is possible. Extreme caution is advised.

➤ **HIGH TEMPERATURES**

Exposure to temperatures exceeding 120°C (248°F) is possible. Caution is advised.

➤ **TOXIC MATERIAL**

This product contains beryllium oxide (BeO). Do not disassemble, crush or dispose of this product with normal waste. Breathing beryllium oxide (BeO) dust can cause berylliosis (lung disease). Caution is advised.

➤ **X-RAY RADIATION**

Operating conditions not in accordance with the data sheets or labels can cause levels of x-rays above those permissible. Caution is advised.

~

SAFETY INSTRUCTIONS

For your protection and the safety of others, please read, understand and follow the safety instructions, including correcting any deficiencies, before operating this product.

➤ **HIGH VOLTAGE EXPOSURE**

- Grounding
 - Do not operate this product without a proper ground return to the high voltage power supply. High voltage leads and/or connectors do not include a ground return.
 - Inspect for:
 - Proper grounding from the TWT baseplate to the high voltage power supply chassis ground.
- High Voltage Connectors
 - Carefully examine the high voltage connectors for any damage due to improper handling, shipping and/or long term usage or exposure.
 - Inspect for:
 - Cracked, split or missing connector housing parts.
 - Any visible damage; bent, brittle, torn, crushed, melted, etc...
 - Any missing seals, o-rings, potting (insulation) and/or gaskets.
- High Voltage Leads
 - Carefully examine the high voltage leads for damage due to improper handling, shipping and/or long term usage or exposure.
 - Inspect for:
 - Insulation damage; splits, cracks, cuts, pinched, pin holes, abrasions, etc...
 - Any visible imperfections; defects, flaws or blemishes, etc...

➤ RF RADIATION EXPOSURE

- High Level Microwave Energy
 - Do not operate this product without the output port (waveguide or coaxial) connector terminated properly by a high power microwave output termination.
 - High levels of microwave energy can cause permanent damage to human tissue or organs due to internal heating.
 - Eyes are most susceptible to damage. Never look into the unterminated output port of any microwave device when energized.
 - A microwave radiation monitor or warning device is recommended for personal safety.
Example: Nardalert Personal Monitors
Model 8840D-1
Threshold = $1\text{mW}/\text{cm}^2$
1 to 100 GHz
- Low Level Microwave Energy
 - Carefully examine waveguides or coaxial connectors for damage due to improper shipping, handling or long term usage.
 - Inspect for:
 - Scratched, warped, corroded, twisted or pitted waveguide flange surfaces.
 - Damaged threads, dielectric, outer conductor (shielding), and center pins on coaxial connectors.
- RF Leakage should not exceed $5\text{mW}/\text{cm}^2$
 - A microwave radiation monitor or warning device is recommended for personal safety.
Example: Nardalert Personal Monitors
Model 8841D-5
Threshold = $5\text{mW}/\text{cm}^2$
1 to 50 GHz

➤ HIGH TEMPERATURES

- During operation of this product, even with proper cooling, temperatures as high as 120°C (248°F) may be common.
 - Avoid any contact with the operating TWT.
 - Do not mount the TWT on or near materials with flash point temperatures below 150°C (302°F).

➤ TOXIC MATERIAL

- This product contains beryllium oxide (BeO) ceramics.
 - Beryllium oxide (BeO) dust is toxic.
- Do not crush or disassemble this product.
- Do not dispose of this product with normal waste.
- For disposal or disposal information contact:

Teledyne Electronic Technologies
Microwave Electronic Components
11361 Sunrise Park Drive
Rancho Cordova, CA 95742-6587
U.S.A.

TEL: (916) 638-3344

FAX: (916) 636-7453

E-Mail: TWT_Marketing@teledyne.com

➤ X-RAY RADIATION

- This product could produce unallowable x-rays with applied voltage(s) above the label values.
 - Do not apply voltages greater than specified on the label or data sheet.

SET-UP INSTRUCTIONS (MECHANICAL)

- To avoid damage to high voltage leads and connections (RF and dc), proper care must be taken during inspection and installation.
 - Read all parameter/warning labels, data sheets, and instructions provided.
 - Check connectors for any foreign material that may cause improper mating.
 - Inspect leads for nicks, cracks, cuts or abrasions.
 - Check that the threads on connectors have not been damaged.

➤ INSTALLATION

- Prior to use, the TWT should be given a thorough inspection of high/low voltage leads and RF connectors. Cleanliness of the connectors and baseplate should be checked together with cleanliness and flatness of mating surfaces.
- Check and verify high voltage power supply voltages, voltage sequence and lead connections as per data sheets, labels and figures:
 - Figure 1 - CW: No control electrode; single collector with anode supply.
 - Figure 2 - CW/Pulsed: Control electrode - (grid); single or multiple collector(s).
 - Figure 3 - CW/Pulsed: Control electrode - (focus electrode); single or multiple collector(s).
 - Figure 4 - CW: No control electrode; multiple collector(s) anode supply with solenoid supply for beam focusing.

- Cooling - Check and verify the flatness of the TWT baseplate and the system heatsink. A very thin coating of thermal grease should be used to enhance heat transfer.
 - Recommended thermal grease: Mfg: Dow Corning heatsink compound #340 or equivalent.
 - Verify air flow or coolant flow for typical operational temperature range of -40°C (-40°F) to 85°C (185°F).
- Check and verify that excessive stresses are not applied to RF lines and high voltage leads.
- Check and verify the torque on the input (SMA) connector:
 - 10 inch-lb. max recommended.
- Check and verify the torque on the output (TNC; N; S/C) connectors:
 - 25 inch-lb. max recommended.
- Check and verify the torque on the waveguide flange screws:

<u>Screw Size</u>	<u>Threads per Inch</u>	<u>Recommended Torque (inch-lb.)</u>
No. 4	40	4.5 max
	80	5.5 max
No. 6	32	8.5 max
	40	10 max
No. 8	32	18 max
	36	20 max
No. 10	24	23 max
	32	32 max

SET-UP INSTRUCTIONS (ELECTRICAL)

WARNING

- Minimum and maximum voltages, currents and temperatures are defined as values beyond which serviceability of this product may be permanently damaged. The “minimum” and “maximum” limits (values) should not be exceeded singly or in combination.
- Refreshing Traveling Wave Tubes (TWTs)

TWT LIFE

Current process and fabrication technologies have eliminated the need to periodically “refresh” TWT vacuum during prolonged storage. If there is concern about turning-on a TWT after storage, an extended heater warm-up of from 8 to 24 hours prior to the application of cathode voltage should be adequate. The primary enemies of TWTs are foreign material in high voltage and RF connectors and corrosion-causing moisture. Keeping stored TWTs clean and dry is the best means of insuring high vacuum integrity and long life.

- Initial set-up prior to energizing the TWT:
 - Check and verify the following:
 - Proper connections of dc leads, particularly ground, per appropriate Figure 1, 2, 3 or 4.
 - Air or liquid cooling is operating satisfactorily.
 - Appropriate load or source terminations are connected to the TWT.
 - RF Input Power (signal) off.

“TWT LIFE-COMMENTARY”

If a TWT is operated within its ratings, the end of life will be reached when the cathode emission falls below some minimum level. Most modern TWTs use M-Type (osmium coated) dispenser cathodes with potted heaters. The total length of time such a cathode will supply the necessary emission is essentially dependent on its temperature. The rates of the mechanisms that are responsible for emission decay (including the evaporation of barium and the interdiffusion of osmium and tungsten) vary exponentially with cathode temperature. It makes very little difference if the current is drawn from the cathode or not.

Therefore, if a TWT is to be operated intermittently, it makes good sense to turn off the heater voltage as well as the high voltage during off periods. This will result in a delay because of heater warm-up time (typically three minutes) whenever the TWT is turned on. In some circumstances, the delay may be unacceptable. In this case it makes good sense to operate the heater at a reduced voltage; i.e., 5.7 volts for a 6.3-volt heater, during standby times. For typical Teledyne MEC TWTs, this will lower the cathode temperature by about 60 °C. Because of the exponential dependence of the decay mechanisms on temperature, this will reduce their rate substantially.

The warm-up time on re-application of 6.3 volts will be much less than three minutes, perhaps as short as ten seconds. In some instances, it may be practical to apply high voltage simultaneously as the heater voltage increases conditions may vary from TWT type to TWT type. It is critical in all cases, however, to ensure that the helix current turn-on does not exceed the value obtained with a three minute warm-up.

There is an erroneous belief perpetuated in the industry that it is disadvantageous to turn the heater off and on frequently because it may lead to heater failure. This belief arises from experience with incandescent lamps and vacuum tubes with directly heated filament / cathodes. It does not apply to Teledyne's potted heaters.

➤ VOLTAGE TURN-ON SEQUENCE

- The TWT voltage turn-on must follow this sequence. The following values of regulation and ripple are guidelines only.
 - Heater warm-up, three (3) minutes minimum; label value: $\pm 2\%$. Ripple $< \pm 50$ millivolts P-P. Maximum surge current: (3X) label value.
 - Control electrode (OFF) voltage; label value $\pm 2\%$. Ripple < 3 volts P-P. (Optional)
 - Collector voltage(s); label value(s) $\pm 2\%$. Ripple: < 100 volts P-P.
 - Cathode (beam) voltage; label value $\pm 0.25\%$. Ripple: $< \pm 50$ millivolts P-P.
 - Control electrode (ON) voltage; label value $\pm 2\%$. Ripple: $< \pm 1$ volt P-P. Transition time from control electrode (OFF) to control electrode (ON) voltage: 50 microseconds maximum. (Optional)
- * Note:
 - Collector and cathode (beam) voltage may also be applied simultaneously.
 - The regulation and ripple (guideline) values will meet most TWT noise specifications.
 - Shutdown shall be the reverse of the above sequence.

➤ ARC PROTECTION (HIGH VOLTAGE)

- To avoid damage to the TWT grid structure.
 - Limit the amount of energy stored in the power supply.
 - In the event of an arc, the maximum energy that can be delivered to the TWT shall be <7 Joulés.

➤ ARC PROTECTION (WAVEGUIDE)

- To avoid damage to the TWT.
 - Inspect output waveguide (w/g) for cleanliness before installation and operation.
 - Use of dry air or dry nitrogen in waveguides is preferred.
 - Protection considerations.
 - Mating w/g and flanges; foreign material (cleanliness); VSWR (output) antenna or load; humidity; purging; condensation; pressurization.
 - Waveguide Pressurization.
 - Ensure proper pressurization of TWT waveguide before operation above 10,000 feet.

*WARNING:

- If Freon or Sulphur Hexafluoride is used to pressurize waveguides, toxic byproducts can be produced as a result of RF arcing.

➤ PERFORMANCE ADJUSTMENTS

- The RF and dc parameters supplied on the final test data sheet reflect performance over a given frequency range and in accordance with customer requirements. If improved performance is needed at a special frequency, contact Teledyne Electronic Technologies for further instruction or information.

➤ IF SOMETHING SHOULD GO WRONG

- Unless special provisions have been arranged, this TWT is warranted for one year from date of delivery, as determined by the date code on the TWT label (Example: 3201 = 32nd week of 2001). Contact:

Teledyne Electronic Technologies
Microwave Electronic Components
11361 Sunrise Park Drive
Rancho Cordova, CA 95742-6587
U.S.A.

TEL: (916) 638-3344

FAX: (916) 636-7453

E-Mail: TWT_Marketing@teledyne.com

for warranty instructions. If the TWT is beyond its warranty period, contact the above for evaluation, repair or proper disposal information.

➤ PRODUCT INFORMATION (CATALOG)

- Visit our website via www.teledyne-mec.com
 - TWT Performance Fundamentals
 - General Purpose TWTs (continuous wave)
 - General Purpose TWTs (pulse)
 - Communication TWTs

➤ EXPORT REGULATIONS

- This item is subject to the U.S. Government Export Control laws and regulations; diversion is contrary to these U.S. laws and regulations. Prior authorization from the U.S. Government is required before this item can be transferred, transshipped on a non-continuous voyage or otherwise be disposed of in any other country, either in its original form or after being incorporated into another end-item.

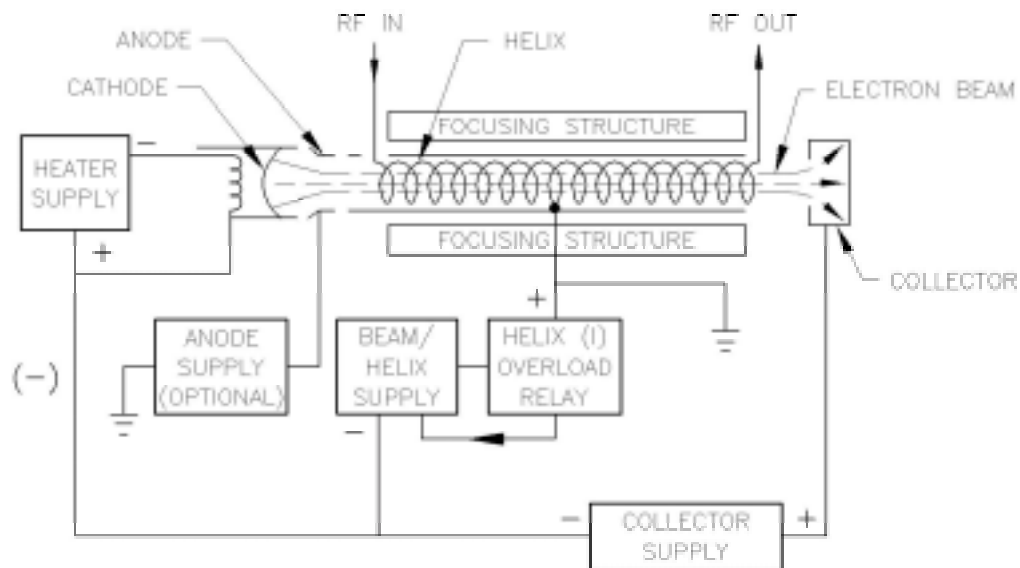


FIGURE 1

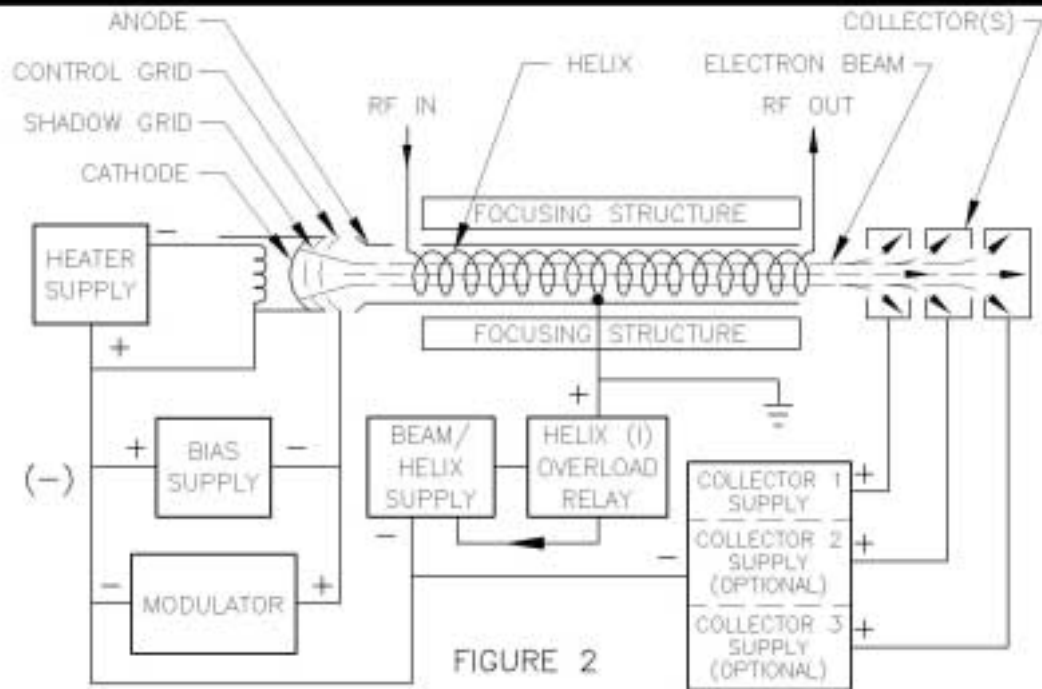


FIGURE 2

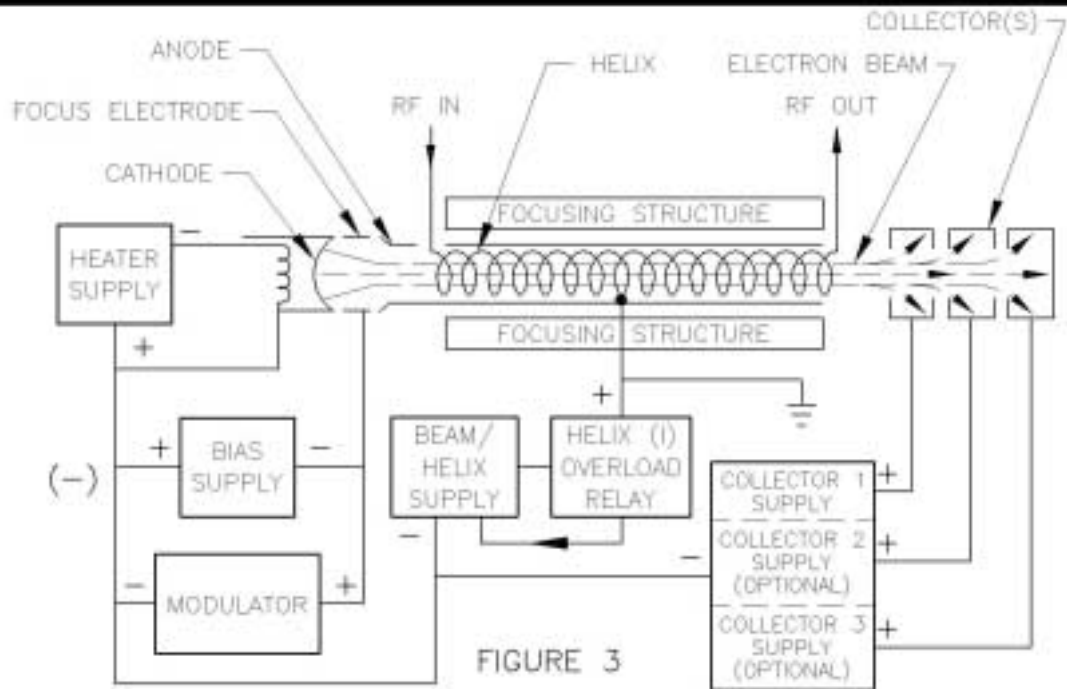


FIGURE 3

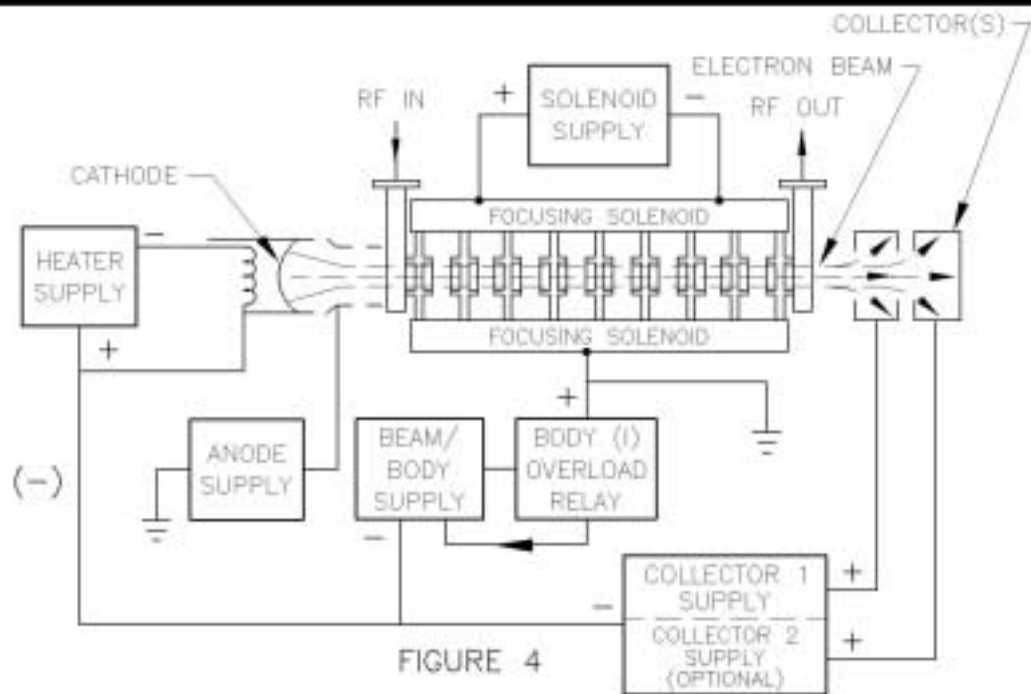


FIGURE 4