



ELECTRON TUBE DEPARTMENT ■ **COMPONENTS DIVISION**
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION, CLIFTON, NEW JERSEY

F-6868
TRAVELING
WAVE TUBE

TENTATIVE

DESCRIPTION:

The F-6868 is a 10 watt CW traveling wave amplifier tube having 30 db gain and 1700 to 4000 mc frequency range. It is constructed in a rugged metal envelope with a helix-type slow wave structure. The integral matching circuit is in 50 ohm coaxial line and is provided with type "N" connectors. The tube is self-aligning in the external solenoid which is required to provide a uniform magnetic field. A convergent beam gun and oxide impregnated cathode are used. A control electrode suitable for use as a gain control is provided. The tube is suitable for either CW or pulse service utilizing the full bandwidth or portions of it. It is also suitable for frequency shifting, such as serrodyne operation.

ELECTRICAL RATINGS, ABSOLUTE VALUES:

Heater Voltage	6.3 ($\pm 10\%$)	volts
Heater Current	2.5	amperes
Maximum Anode Voltage (Note 1)	1500	volts
Maximum Shell Current (Note 2)	5	ma
Maximum Collector Voltage (Note 3)	1750	volts
Maximum Collector Dissipation (Note 4)	150	watts
Maximum Control Electrode Voltage (Note 5)	-250	watts

ELECTRICAL INFORMATION:

Maximum Frequency	4000	mc
Minimum Frequency	1700	mc
Minimum Cold Transmission Loss	50	db
Capacitance		
Control Electrode to all other elements	12	μpfd
All Gun elements to Shell	4.5	μpfd

MECHANICAL INFORMATION:

Type of Cathode	Oxide Impregnated Unipotential
Base, Small Shell Duodecal, 5 Pin	JEDEC Designation B5-57
Type of Envelope	Metal
Magnetic Field Strength (nominal)	1000 gauss
Length of Magnetic Field	6.75 inches uniform
Mounting Position	Any
Weight (not including magnet)	1 lb. 7 ozs.
R-F Connections	50 ohm coax with Type "N" Jack UG-23B/U
Type of Cooling	Forced Air
Glass Temperature	160°C max.
Cooling Air Required (Note 4)	30 cfm

TYPICAL OPERATION AS POWER AMPLIFIER:

Anode Voltage	1200 volts
Shell Current	3 ma
Collector Voltage	1400 volts
Collector Current	70 ma
Control Electrode Voltage	0 volts
Power Output (see Curves)	10 watts nominal
Gain (see Curves)	30 db nominal
Duty Cycle	
R-F	Variable to 1.0
Beam	1.0

TYPICAL OPERATION AS LINEAR AMPLIFIER:
(Input powers less than -10 dbm)

Anode Voltage	1150 volts
Shell Current	2.5 ma
Collector Voltage	1400 volts
Collector Current	67 ma
Control Electrode Voltage	0 volts
Gain (see Curves)	35 db nominal
Noise Figure	30 db
Duty Cycle	
R-F	Variable to 1.0
Beam	1.0

- Note 1: All voltages shown are with respect to cathode. Anode and helix are connected internally to the shell. The shell is normally operated at approximate ground potential and the d-c connection is made to the shell of the solenoid.
- Note 2: The shell current is the difference between the cathode current and collector current. Since this current, in general, should be minimized, it is desirable to measure the current from shell to ground. It is recommended that overload protection be provided to remove high voltage if the shell current exceeds 5 ma.
- Note 3: It is generally desirable to operate the collector at 100 to 200 volts positive with respect to shell, and potential difference between collector and shell should be limited to 300 volts maximum.
- Note 4: Forced air cooling of collector is required for average collector power in excess of 10 watts. As the collector power is increased, the air flow required increases. At the maximum collector power of 150 watts, a minimum air flow of 30 cfm through the cooling fins is required.
- Note 5: This electrode is a remote cutoff grid, suitable for use as a gain control providing approximately 30 db control range but is not suitable for low level pulsing of the beam. It is recommended that, where feasible, provision should be made to operate the tube with small negative voltage on this electrode (-5 to -10 volts) as this permits operation of the tube at approximately optimum conditions with very low interception (shell current). It may also be operated fixed at cathode potential, if desired.

OPERATING PROCEDURE:

- (1) Insert tube in solenoid, secure in place with stops provided, make connections.
- (2) Turn on cooling air, solenoid voltage (adjust to approximately 1000 gauss), heater voltage, collector voltage (if used), control electrode voltage (if used).
- (3) Raise high voltage to desired value, readjusting magnetic field if necessary to obtain minimum shell current. At no time should shell current exceed 5 ma.



- (4) After initial set up as above, tube voltages may be applied simultaneously; however, it is recommended that heater voltage, solenoid voltage, and cooling air be applied at least two minutes before applying high voltage. Observance of the 5 ma maximum limit for shell current is essential to prevent tube damage.

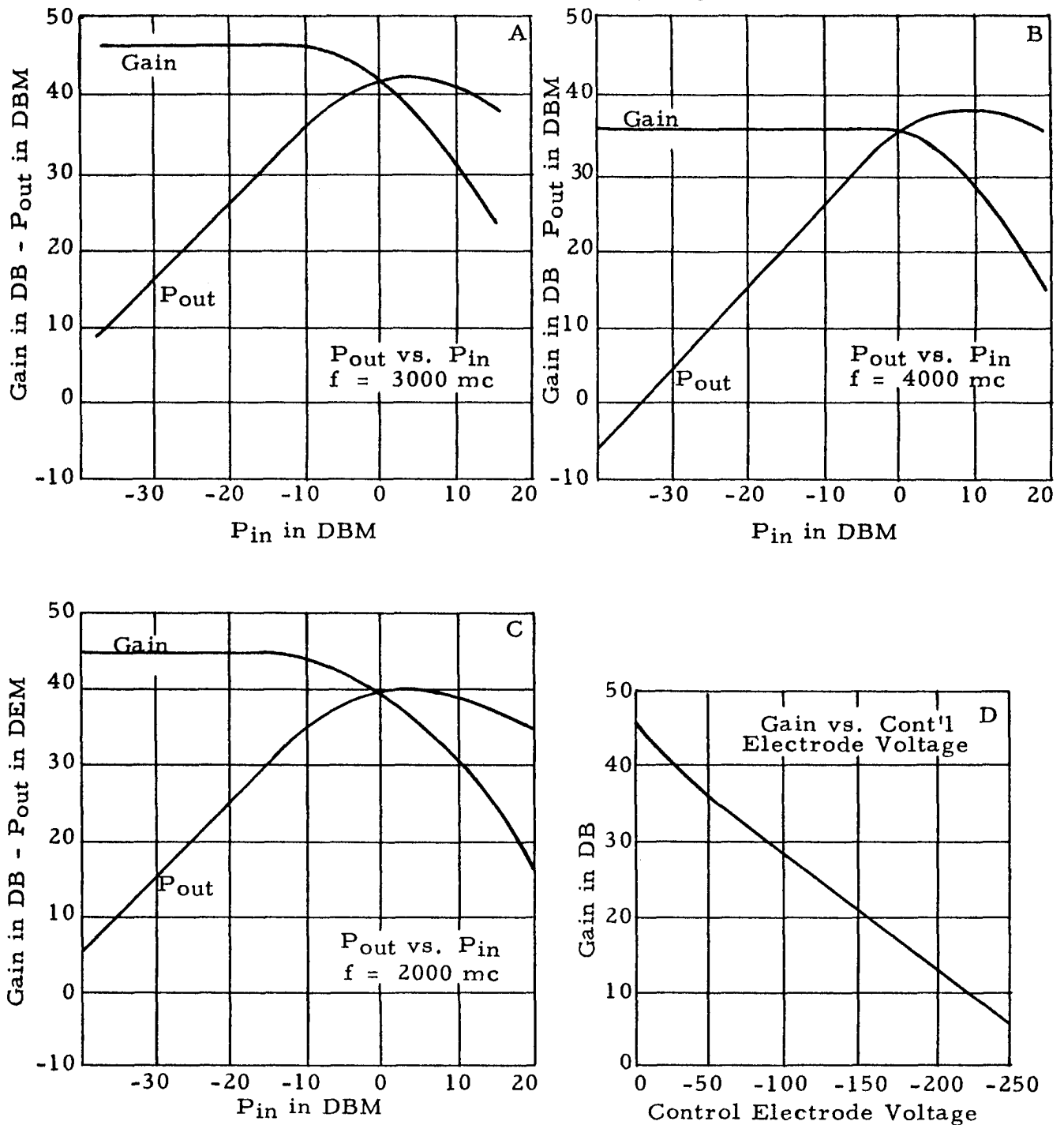
The data presented here is representative of operation of this type as an amplifier with maximum bandwidth and does not indicate the maximum performance obtainable under specific conditions, particularly narrower bandwidths.

Standard solenoids to operate this tube are available, and solenoids designed for particular applications can be supplied.

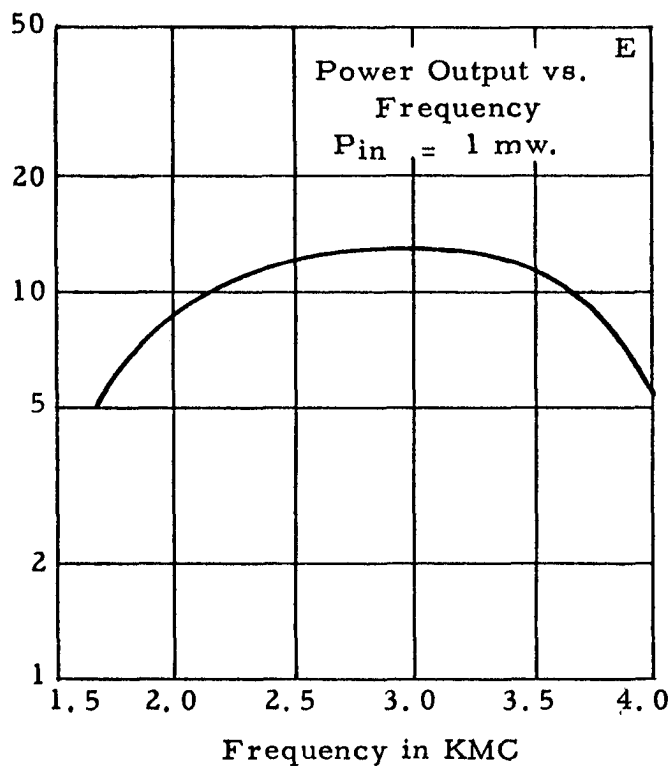
Additional information for specific applications can be obtained from the

Electron Tube Applications Section
ITT Components Division
Box 412
Clifton, New Jersey

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

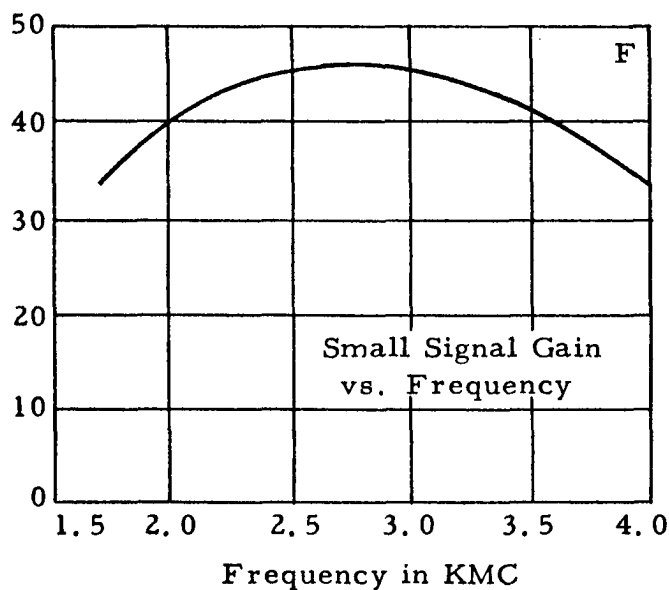


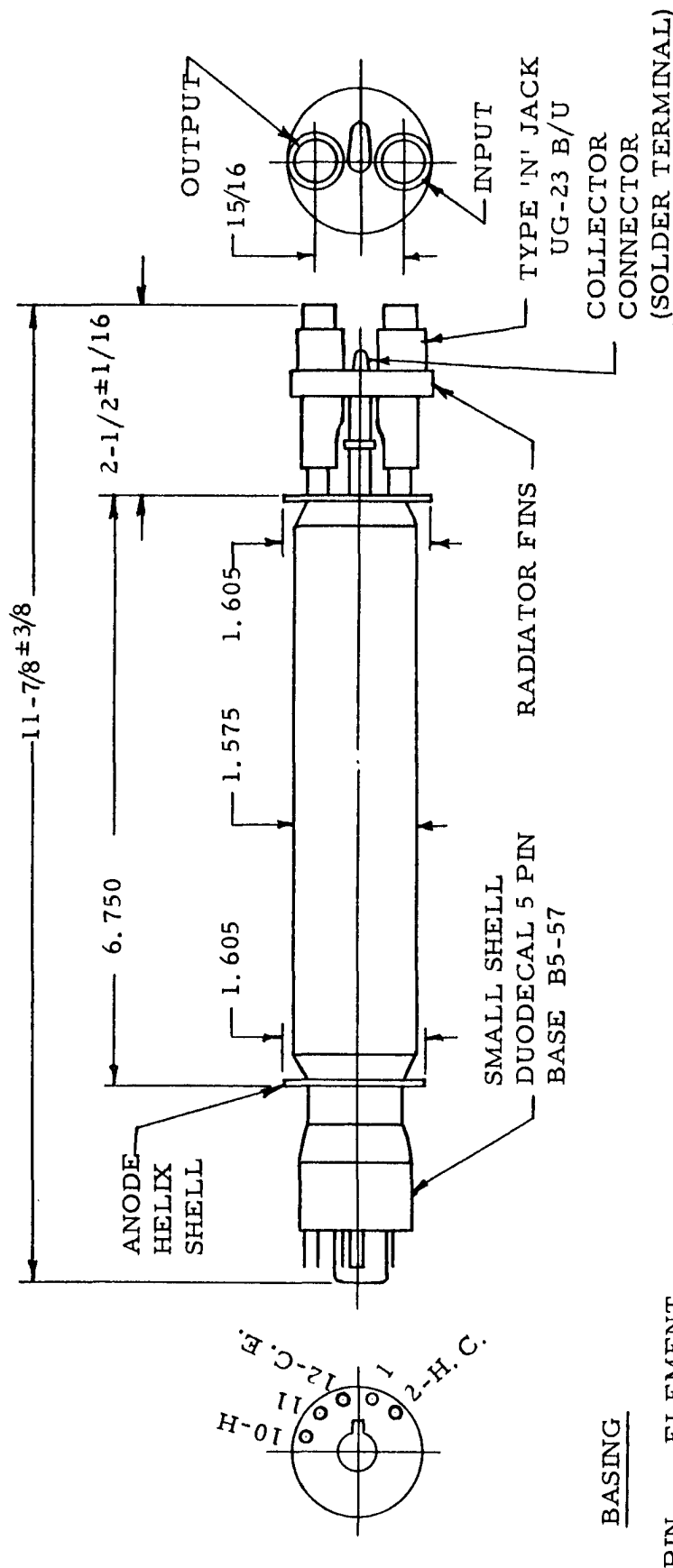
All curves shown with magnetic field set for minimum shell current in range of 750 to 1000 gauss.

For curves A, B, C, and E, voltage is set for maximum P_{out} at $f = 4.0 \text{ kmc}$ with $P_{in} = 1 \text{ mw}$ approx. 1200 v.).

For curve F, voltage is set for maximum gain at $f = 4.0 \text{ kmc}$ with $P_{in} = -20 \text{ dbm.}$ (approx. 1150 v.).

Curve D shows typical shape and range of control electrode characteristic.





TRAVELING WAVE TUBE TYPE F-6868



OPERATING INSTRUCTIONS FOR THE F-6868 TRAVELING WAVE TUBE

WHEN PLACING THE F-6868 TRAVELING WAVE TUBE IN OPERATION FOR THE FIRST TIME, THE FOLLOWING PROCEDURE SHOULD BE FOLLOWED:

1. MAKE A VISUAL INSPECTION OF THE TUBE TO CHECK FOR LOOSE CONNECTIONS OR GLASS CRACKS.
2. PLACE THE TUBE IN THE PROPER SOLENOID AND MAKE CONNECTIONS TO THE TUBE AND SOLENOID.
 - A) HEATER, HEATER/CATHODE, AND CONTROL ELECTRODE CONNECTIONS ARE MADE TO THE BASE OF THE TUBE. THE COLLECTOR CONNECTION IS MADE TO A SOLDER LUG ON THE RADIATOR. THE SHELL/HELIX CONNECTION IS MADE TO THE SHELL OF THE TUBE AND/OR THE CASE OF THE SOLENOID WHICH IS GROUNDED.
3. APPLY COOLING TO THE SOLENOID AND TO THE RADIATOR OF THE TUBE.
4. VOLTAGES ARE APPLIED IN THE FOLLOWING ORDER:
 - A) HEATER VOLTAGE (6.3 VOLTS).
 - B) SOLENOID VOLTAGE (ADJUST SOLENOID CURRENT FOR PROPER MAGNETIC FIELD 1000 GAUSS).
 - C) CONTROL ELECTRODE VOLTAGE. (USUALLY ZERO VOLTS WITH RESPECT TO CATHODE, BUT MAY BE USED TO CONTROL OUTPUT OF TUBE BY APPLYING NEGATIVE VOLTAGE WITH RESPECT TO CATHODE. THIS ELECTRODE SHOULD NEVER GO POSITIVE WITH RESPECT TO CATHODE.)
 - D) COLLECTOR VOLTAGE ($\neq$ 150 VOLTS WITH RESPECT TO SHELL).
 - E) CATHODE VOLTAGE. ADJUST SLOWLY TO THE VALUE INDICATED ON THE DATA SHEET; USUALLY ABOUT MINUS 1250 VOLTS WITH RESPECT TO THE SHELL. AT ALL TIMES OBSERVE HELIX CURRENT AND DO NOT PERMIT TO RISE ABOVE 3.0 MA. IT IS POSSIBLE FOR HELIX CURRENT TO READ NEGATIVE WITHOUT DAMAGE TO THE TUBE, BUT BEFORE OPERATION UNDER THIS CONDITION IS PERMITTED, POLARITY OF THE HELIX CURRENT METER SHOULD BE CHECKED TO BE SURE IT IS CORRECT.

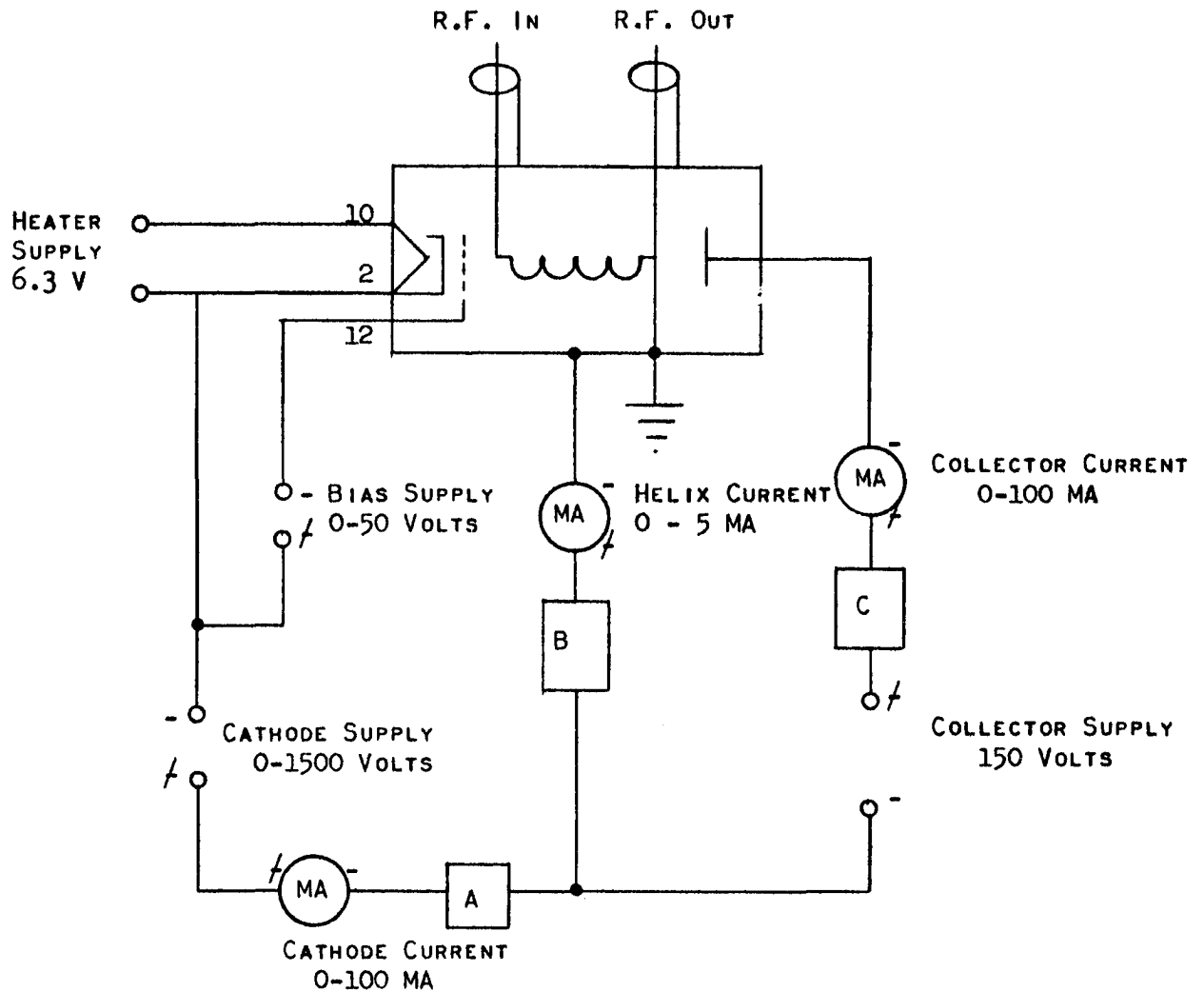
OPERATING INSTRUCTIONS FOR THE F-6868 TRAVELING WAVE TUBE (CONTINUED)

5. R.F. INPUT TO THE TUBE SHOULD BE LIMITED TO 1.0 WATT AND R.F. OUTPUT SHOULD BE LIMITED TO 20 WATTS.
6. THE CATHODE VOLTAGE MAY BE ADJUSTED FOR OPTIMUM POWER OUTPUT AT THE DESIRED FREQUENCIES.

THE FOLLOWING PRECAUTIONS SHOULD BE TAKEN WHEN OPERATING THE TRAVELING WAVE TUBE:

1. NEVER OPERATE THE F-6868 WITHOUT PROPER COOLING OF THE COLLECTOR. 50 CFM DIRECTED ACROSS THE RADIATOR FINS SHOULD BE SUFFICIENT. IN ANY CASE, THE TEMPERATURE OF THE GLASS TO METAL SEALS SHOULD NOT BE PERMITTED TO EXCEED 160°C.
2. NEVER OPERATE THE F-6868 WITHOUT THE PROPER MAGNETIC FIELD. BE SURE SUFFICIENT COOLING IS SUPPLIED TO TUBE AND SOLENOID.
3. NEVER OPERATE THE F-6868 WITH HELIX CURRENT IN EXCESS OF 3.0 MA. UNDER MOST CONDITIONS HELIX CURRENT WILL BE 1.0 MA OR LESS. IT IS IMPORTANT THAT HELIX OVERLOAD PROTECTION BE PROVIDED.
4. BE SURE COAXIAL CABLES TO BE CONNECTED TO THE TUBE INPUT AND OUTPUT CONNECTORS ARE ASSEMBLED CORRECTLY. IF THE INNER CONDUCTOR OF THE CABLE CONNECTION IS TOO LONG, PRESSURE WILL BE APPLIED TO A GLASS BEAD INSIDE THE TUBE, CAUSING PERMANENT DAMAGE TO THE TUBE. IF THE INNER CONDUCTOR OF THE CABLE CONNECTOR IS TOO SHORT, A POOR CONNECTION WILL RESULT IN POOR R.F. PERFORMANCE.

THE ATTACHED SCHEMATIC IS A SUGGESTED METHOD OF CONNECTING THE F-6868 SHOWING LOCATION OF PROTECTION CIRCUITS AND METER POLARITY.



BASE CONNECTIONS

PIN 2 - HEATER CATHODE
 PIN 10 - HEATER
 PIN 12 - CONTROL ELECTRODE

- A. CATHODE CURRENT OVERLOAD PROTECTION SET AT 90 MA.
- B. HELIX CURRENT OVERLOAD PROTECTION SET AT 3.0 MA.
- C. COLLECTOR CURRENT OVERLOAD PROTECTION SET AT 90 MA.

NOTE: ALL OVERLOADS SHOULD OPERATE TO DISCONNECT HIGH VOLTAGE.

CONNECTION DIAGRAM FOR F-6868 TWT TUBE

