



# TECHNICAL DATA

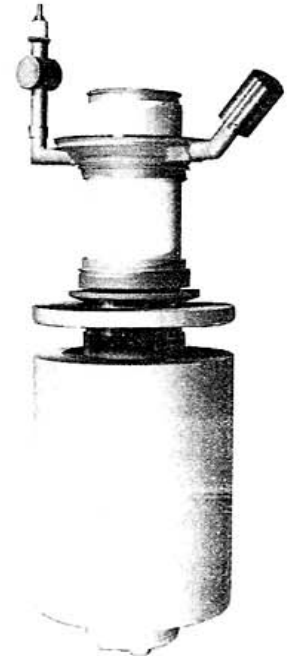
**2KDX40LA  
2KDX40LF  
40 KW VISION  
30 KW VISION/SOUND  
UHF-TV KLYSTRODE®  
AMPLIFIERS**

The EIMAC air-cooled 2KDX40LA Klystrode® and 2KDX40LF Klystrode tubes provide exceptionally high average energy efficiency in UHF Television service. The Klystrode combines the features of a klystron and a tetrode, having a magnetically focused electron beam, an output cavity and a collector. The electron beam is bunched by an rf cavity-driven grid. The Klystrode can therefore be operated as a Class B linear amplifier.

The Klystrode beam power varies with modulation depth. Because power from the beam supply follows the modulation waveform, the Klystrode operates in TV visual service with low average beam current, saving energy which otherwise would be wasted as collector heat. Collector dissipation is small and therefore the tube can be air cooled. Because the collector is separate from the rf circuitry and because of a highly efficient patented cooling fin design, air pressure and flow requirements are low, minimizing acoustical noise.

The Klystrode also operates as an FM aural power amplifier. It may be operated in the FM mode at 10% to 20% of the peak sync power of a companion visual Klystrode with a common beam power supply.

These new Klystrodes may be operated efficiently at from 20 to 40 kw peak sync power output in visual service. They may also be operated efficiently in combined sound and vision service from 15 to 30 kw peak sync with pre-correction. This mode of operation results in an extremely simple, compact/energy efficient and economical transmitter design.



<u>Klystrode</u>	<u>Circuit Assembly</u>	<u>Frequency Range</u>
2KDX40LA	CV5100	470-600 MHz
2KDX40LF	CV5101	600-860 MHz

## GENERAL CHARACTERISTICS <sup>1</sup>

### ELECTRICAL

Cathode: Dispenser Type		
Heater Current (nominal)	.....	10 to 11 Adc
Heater Voltage	.....	0 to 9 Vdc
Maximum Cold Start Heater Current	.....	15 Adc
Heater Warmup Time (minimum)	.....	300 Sec
Magnet - Part of Circuit Assembly:		
Voltage (range)	.....	0 to 10 Vdc
Current (range)	.....	0 to 25 Adc

### MECHANICAL

Cooling	.....	Forced Air
Input rf Connector	.....	Type N
Output rf Connector	.....	3-1/8 In. EIA Standard
Dimensions (2KDX40LA in CV5100 Hardware):		
Length	.....	72 In; 182.9 cm
Width	.....	27 In; 68.6 cm
Depth	.....	27 In; 68.6 cm
Dimensions (2KDX40LF in CV5101 Hardware):		
Length	.....	70 In; 177.8 cm
Width	.....	27 In; 68.6 cm
Depth	.....	27 In; 68.6 cm
Weight (Tube Only)	.....	75 lb; 34.1 kg
Weight (CV5100 or CV5101 circuit assembly without tube installed)	.....	110 lb; 50.0 kg

1. These figures may change without notice as the result of additional information. Varian should be consulted before using this information for final equipment design. Klystrode is a registered trademark of Varian Associates.



**2KDX40LA, 2KDX40LF**

40 KW MEASURED DATA, VISION SERVICE, TYPICAL, 2KDX40LF

Vision Power Output (peak sync)	40	kw
Beam Voltage	27.5	kVdc
Beam Current (peak sync)	2.5	a
Beam Current (black level), average	1.8	a
Beam Current (average picture), average	1.12	a
Beam Current (white level), average	0.76	a
RF Drive Power (peak sync)	170	w
Bias Voltage	52	Vdc
Magnet Voltage	2.4	Vdc
Magnet Current	7.0	Adc
Heater Voltage	8.4	Vdc
Heater Current	10.8	Adc
Zero Signal Beam Current	200	mAdc
Bandwidth, 0.5 dB	7	MHz

30 KW MEASURED DATA, COMBINED SOUND/VISION & VISUAL SERVICE, TYPICAL, 2KDX40LF

	Combined Sound/Vision	Vision Only	
Vision Power Output, Sync	30	30	kw
Sound Power Output, CW	3	-	kW
Beam Voltage	27.5	26.0	kVdc
Beam Current (peak sync), peak	-	1.85	a
Beam Current (black level), average	1.56	1.3	Adc
Beam Current (average picture) average	1.18	0.96	Adc
Beam Current (white level), average	0.82	0.60	Adc
RF Drive Level (peak sync, vision only)	65	65	w
Bias Voltage	52	50	Vdc
Bias Current (average picture)	35	20	mAdc
Magnet Voltage	2.4	2.4	Vdc
Magnet Current	7.0	7.0	Adc
Heater Voltage	8.4	8.4	Vdc
Heater Current	10.8	10.8	Adc
Zero Signal Beam Current	200	200	mAdc
Bandwidth, 0.5 dB	7	7	MHz

20 KW MEASURED DATA, COMBINED SOUND/VISION & VISION SERVICE, TYPICAL, 2KDX40LF

	Combined Sound/Vision	Vision Only	
Vision Power Output (peak sync)	20	20	kw
Sound Power Output, CW	2	-	kW
Beam Voltage	24.0	24.0	kVdc
Beam Current (peak sync)	-	1.9	a
Beam Current (black level), average	1.38	1.31	Adc
Beam Current (average picture), average	1.1	0.94	Adc
Beam Current (white level), average	0.78	0.59	Adc
RF Drive Power (peak sync, vision only)	56	56	w
Bias Voltage	44	44	Vdc
Bias Current (average picture)	40	19	mAdc
Magnet Voltage	2.4	2.4	Vdc
Magnet Current	7.0	7.0	Adc
Heater Voltage	2.4	2.4	Vdc
Heater Current	10.8	10.8	Adc
Zero Signal Beam Current	200	200	mAdc
Bandwidth, 0.5 dB	7	7	MHz

- 1 All above data taken at American Channel 41, 633.25 MHz.
- 2 All average beam current data includes sync pulses.
- 3 All average picture data taken with linear ramp.
- 4 Under the above conditions in-band intermodulation products can be precorrected to better than 60 dB below peak sync level for both sound/vision service; 60 dB data has also been taken at a sound power level of 8 dB sound/vision ratio.

**SOUND, TYPICAL**

FM CW RF Power Output . . . . .	4.0	8.0	kW
Beam Voltage . . . . .	27	27	kVdc
Beam Current . . . . .	0.5	0.85	Adc
RF Drive Power . . . . .	20	20	W
RF Power Gain . . . . .	23	23	dB

Note: Beam current is set by the RF drive level which is adjusted for the required power output. The beam voltage may be the same as that used on the associated visual klystron. Efficiency, power gain, power level and beam voltage are interrelated.

**APPLICATION****MECHANICAL**

**CIRCUIT ASSEMBLIES** - Included are a magnetic frame, magnet coil, input cavity, double-tuned output cavity and input and output rf couplers.

Circuit assembly type numbers are as follows:

CV5100 for 2KDX40LA 470-600 MHz  
CV5101 for 2KDX40LF 600-860 MHz

**VACUUM PUMP** - The tube is supplied with a two-liter ion pump and its associated permanent magnet. The primary function of this device is to allow monitoring of the condition of tube vacuum, as shown by an ion current meter. A power supply and a cable assembly are required for operation. Typical voltage is 3.3 kVdc and maximum current is 5 mAdc. An overload circuit should be arranged to cut off beam voltage and rf drive at 20 microamperes and to cut off the heater voltage above 200 microamperes. The Vacuum pump power supply can be any of a variety of types. A satisfactory unit is Varian type number 921-2001 and the cable assembly is Varian type number 924-0741.

**INPUT CAVITY COOLING** - Forced-air cooling is required, with a minimum flow of 30 cfm (0.86 cubic meters per minutes) at sea level at a pressure drop of approximately 5.0 inches of water (1.2 kPa). Maximum air inlet temperature is 35°C.

**OUTPUT CAVITY COOLING** - For power outputs over about 6 kw air must be blown through the output cavity and load coupler. Approximately 70 cfm (2.0 cubic meters per minute) at 5.0 inches of water pressure (1.2 kPa) is required. Maximum air inlet temperature is 35°C.

**COLLECTOR COOLING** - Forced-air cooling is required with a minimum flow of 750 cfm (21.5 cubic meters per minutes) at sea level at a pressure drop of approximately 8.5 inches of water (2.1 kPa). The maximum air inlet temperature is 35°C.

**ELECTRICAL**

**HIGH VOLTAGE** - Normal operating voltages used with this tube are deadly. Equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. Interlock switches must not be bypassed or "cheated". Always remember that HIGH VOLTAGE CAN KILL.

**RADIO-FREQUENCY RADIATION** - Exposure to strong rf fields should be avoided, especially at frequencies above 300 MHz, where energy absorption by the

human body is significant. The human eye is particularly sensitive. Prolonged exposure to rf radiation should be limited to 10 milliwatts per square centimeter (Occupational Safety & Health Administration (OSHA) standard). **CARDIAC PACE-MAKERS MAY BE AFFECTED.**

**X-RADIATION HAZARD** - High-vacuum tubes operating at voltages higher than 15 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. This tube, operating at its rated voltages and currents, is a potential X-ray source. Only limited shielding is afforded by the tube envelope. X-ray shielding may be required on all sides of tubes operating at these voltages. If there is any question as to the need for or the adequacy of shielding, an expert in this field should be consulted.

**HEATER VOLTAGE** - Voltage should be adjustable over the range from 0 to 9.0 volts dc and measured with an accurate meter. Ripple should not exceed plus/minus five percent. During turn-on, current should be limited to 15 amperes. A step-start system may be used. The heater connection must be negative, with the cathode positive.

**CATHODE/GRID BIAS** - A regulated power supply should be used to provide grid bias. The supply should be adjustable over a range of 0 to 60 volts. The supply should be swamped with a 100 ohm bleeder resistor.

**MAGNET POWER SUPPLY REGULATION** - Performance of the Klystron is quite insensitive to magnet current, and thus magnet power supply regulation need be no better than plus and minus ten percent. Ripple may be plus or minus ten percent. Magnet power consumption is less than 200 watts.

**RF ARC DETECTOR** - An rf arc detector is provided as part of the CV5200 and CV5201 circuit assemblies for protection of the output cavity. The arc detector is built into the output cavity. The sensor is a cadmium sulfide photo resistor which changes resistance with light level. With no light resistance is greater than 50K ohms. With an arc or when the test lamp is energized resistance drops to less than 5K ohms. When this happens rf drive power and beam voltage must be removed, but the crowbar need not fire. A test lamp is located near the arc detector to simulate an arc for test purposes. The test lamp is also built into the output cavity. It is sealed into the assembly housing with the photo detector. The lamp may be energized at 28 volts and 1.5 milliamperes.



## 2KDX40LA, 2KDX40LF

**BEAM POWER SUPPLY** - For FM sound the Klystrode may be operated from the same power supply as the visual klystron. Beam current may be adjusted to the value necessary for the required power output by changing the rf drive power.

**TUBE PROTECTION** - In the event of an internal tube arc, or an arc in the input cavity, a "crowbar" device must be used to instantly remove high voltage from the Klystrode. Application Bulletin #17 titled **FAULT PROTECTION** (available on request) contains considerable detail on the subject. A crowbar assembly, the EIMAC CB-40, is available.

**BERYLLIUM OXIDE CERAMICS (BeO)** - The output cavity insulator of this tube is fabricated from beryl-

lium oxide ceramic. Normal use of BeO ceramics has never been considered hazardous, but the user should avoid any operation which would create BeO dust particles in the air, or fumes, which could be breathed, as these are considered dangerous. Do not alter, grind, lap, fire, or chemically clean, or perform any other operation on any section of beryllium oxide ceramic material. It should be noted that this tube does not contain any BeO internally. Only the output cavity insulator is made of BeO, because of its insulating qualities combined with its high thermal conductivity.

**FOR MORE INFORMATION** - Write to: Varian, Attn: Klystrode Marketing Manager, 301 Industrial Way, San Carlos CA 94070, USA.

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### OPERATING HAZARDS

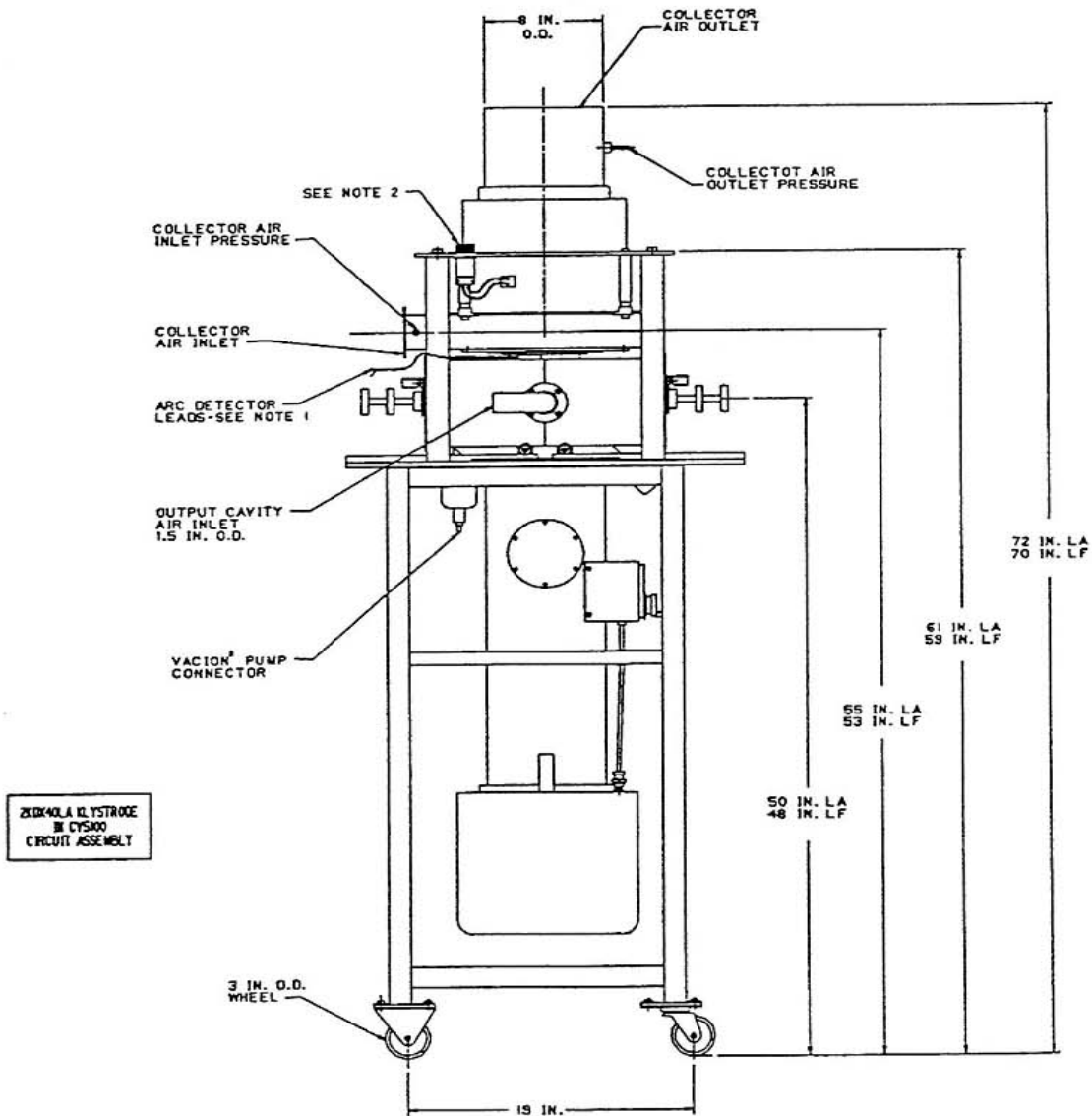
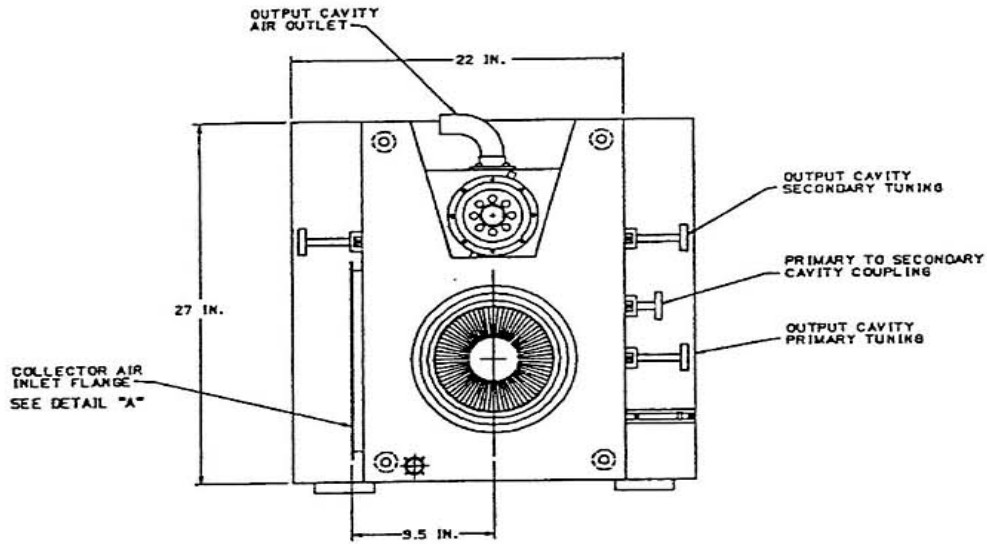
PROPER USE AND SAFE OPERATING PRACTICES WITH RESPECT TO POWER TUBES ARE THE RESPONSIBILITY OF EQUIPMENT MANUFACTURERS AND USERS OF SUCH TUBES. ALL PERSONS WHO WORK WITH OR ARE EXPOSED TO POWER TUBES OR EQUIPMENT WHICH UTILIZES SUCH TUBES MUST TAKE PRECAUTIONS TO PROTECT THEMSELVES AGAINST POSSIBLE SERIOUS 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 precautions, could result in serious harm to personnel:

- a. **HIGH VOLTAGE** - Normal operating voltages can be deadly. Remember that **HIGH VOLTAGE CAN KILL**.
- b. **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.
- c. **X-RAY RADIATION** - High-voltage tubes are a potential source of dangerous X-Ray radiation and shielding may be required on all sides of the tube. An X-Ray survey by an expert in this field may be required.
- d. **RF RADIATION** - Exposure to strong rf fields should be avoided, even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. **CARDIAC PACEMAKERS MAY BE AFFECTED**.
- e. **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.
- f. Dust or fumes from BeO ceramics are toxic and can cause serious injury. **SEE COMMENT ABOVE**.

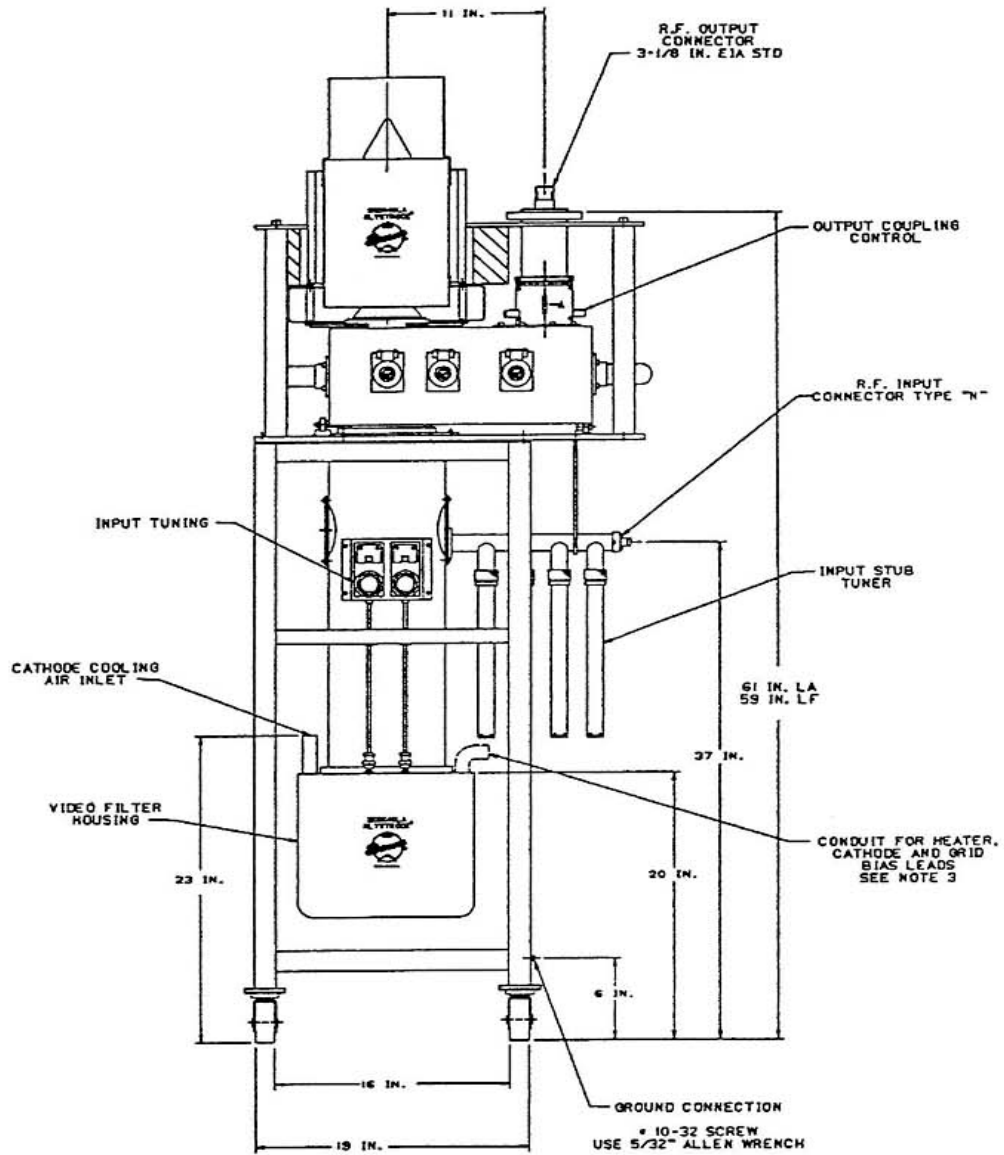
Please review the detailed operating hazards sheet enclosed with each tube, or request a copy from: Varian EIMAC, Power Grid Application Engineering, 301 Industrial Way, San Carlos CA 94070.

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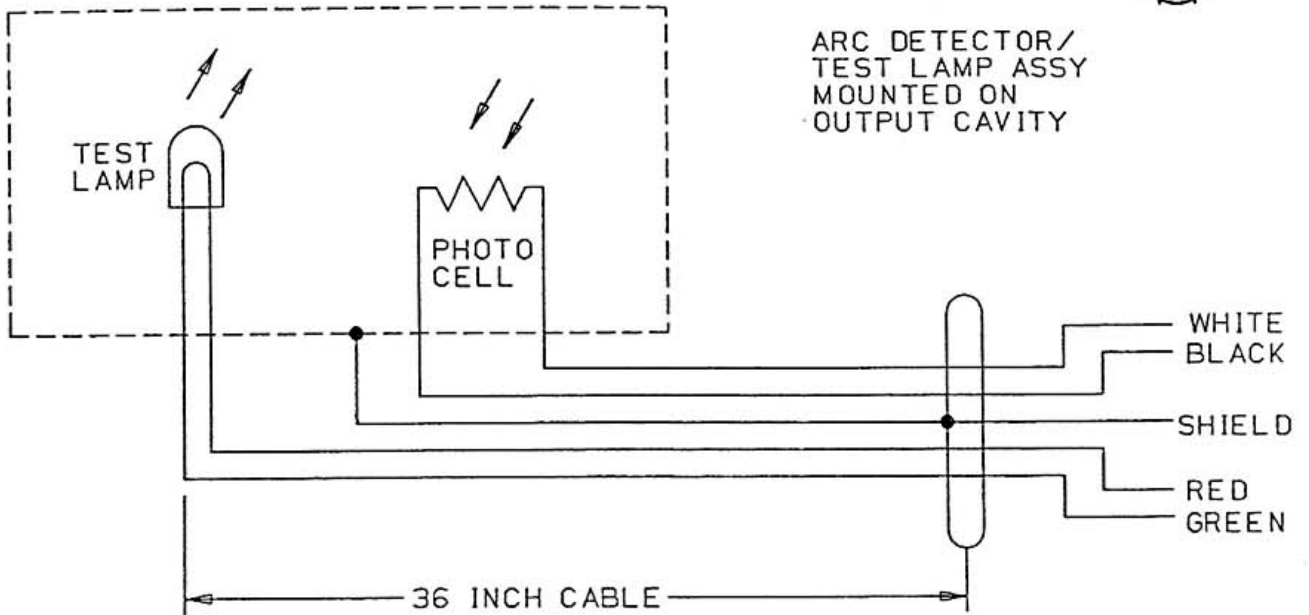
2KDX40LA, 2KDX40LF



2KDX40LA KLYSTRODE  
IN CV5400  
CIRCUIT ASSEMBLY

NOTE 1:

2KDX40LA, 2KDX40LF

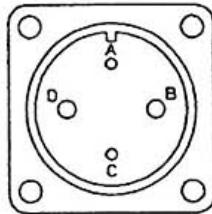


NOTE 2:

FOCUS COIL CONNECTOR,  
TOP VIEW

CONNECTIONS:

- A) INTERLOCK
- B) FOCUS COIL POSITIVE
- C) INTERLOCK
- D) FOCUS COIL NEGATIVE

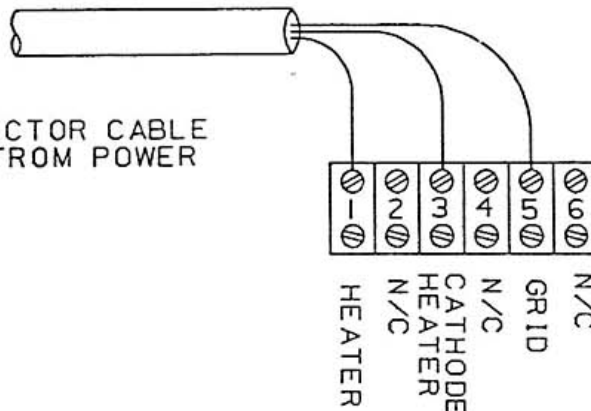


AMPHENOL RECEPTACLE P/N  
97-3100A-2024P. MATES  
WITH AMPHENOL PLUG P/N  
97-3106A-2024P, NOT  
SUPPLIED

PINS A & C ARE CONNECTED  
INTERNALLY FOR USE AS AN  
INTERLOCK CIRCUIT.

NOTE 3:

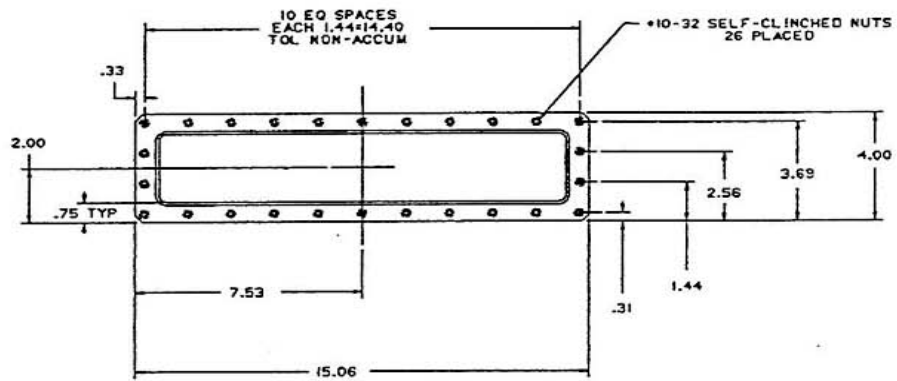
THREE CONDUCTOR CABLE  
IN CONDUIT FROM POWER  
SUPPLY



SIX CONTACT BARRIER  
STRIP IN VIDEO  
FILTER HOUSING

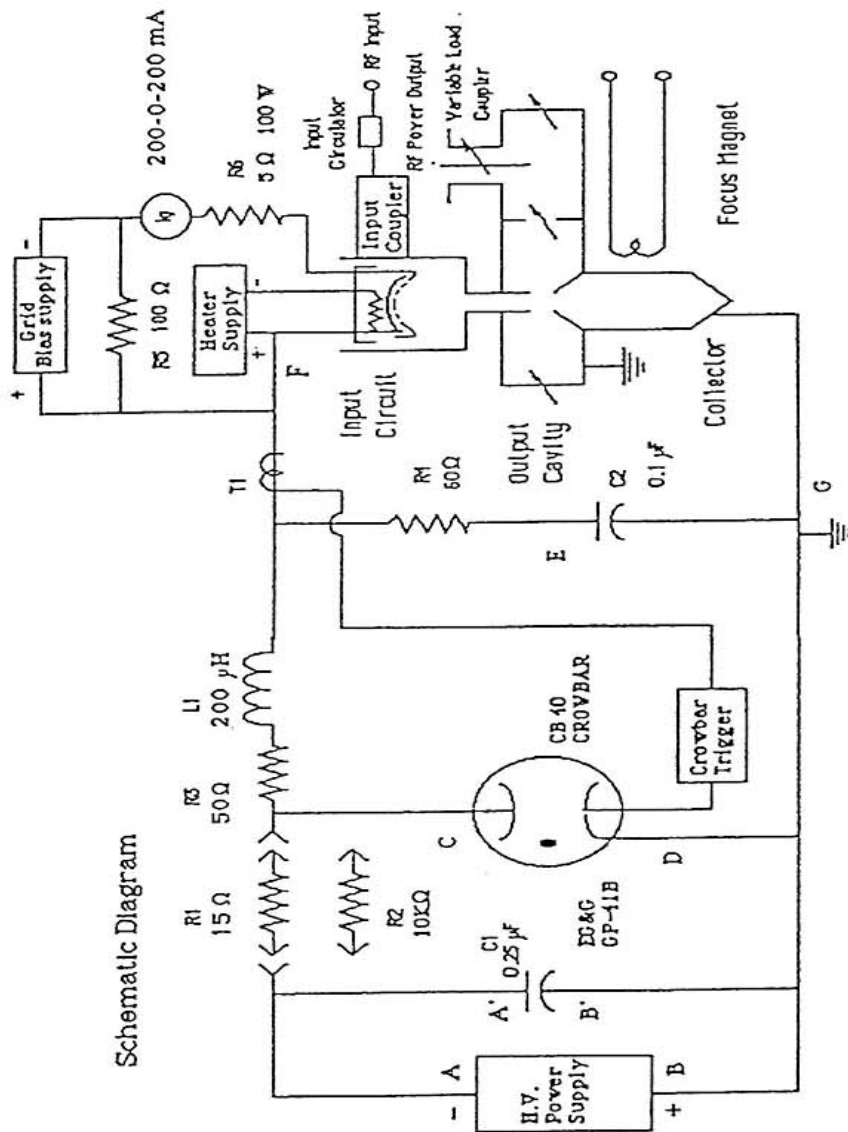


2KDX40LA, 2KDX40LF



COLLECTOR AIR INLET FLANGE

DETAIL "A"



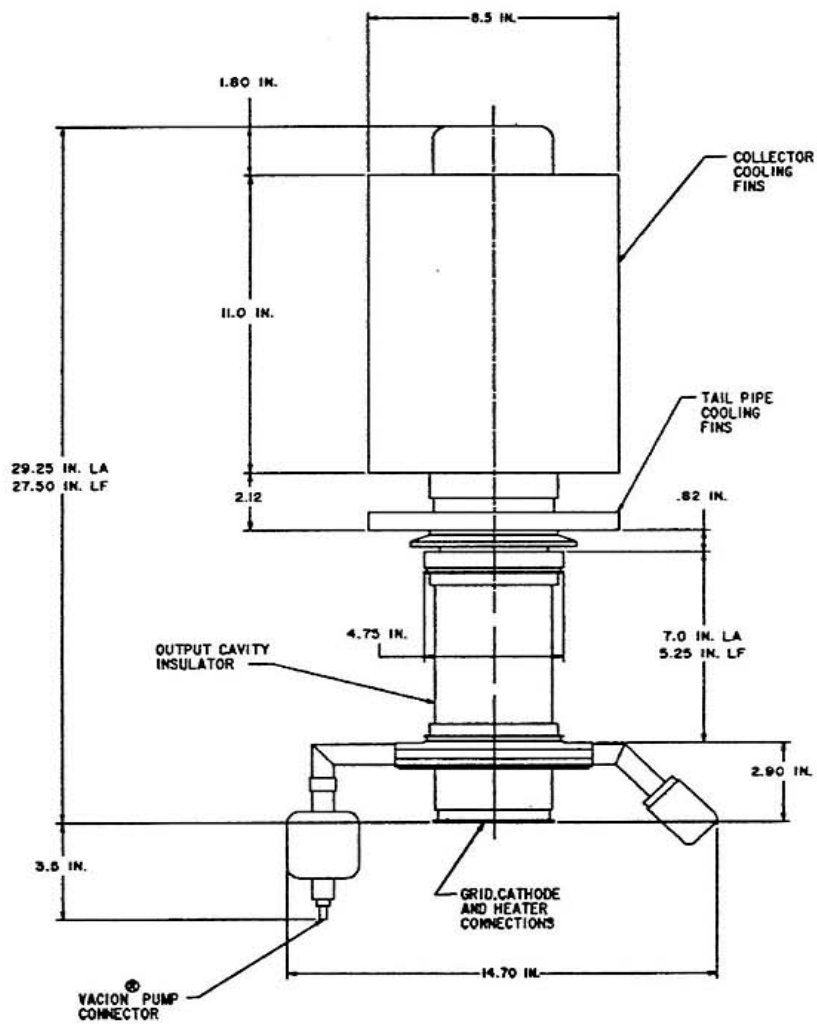
Schematic Diagram

NOTES:

- a) Lead Length FEG should not exceed 5 feet.
- b) If sum of lead lengths AC+BD is more than 5 feet, Add C2 so that the sum of A'C+B'D is less than 5 feet.
- c) EIMAC crowbar CB40 consists of crowbar trigger unit with EG&G GP-41B spark gap and overload sensor T1.
- d) R1 through R4 are 300W non-Inductive High Voltage Resistors capable of holding off transient voltages in excess of the beam voltage.
- e) Circulator not included with circuit assembly.
- f) Crowbar discharge currents can be close to a kiloamp. Care must be taken to avoid unwanted coupling of this transient into other circuits.
- g) R2 processing resistor should be used in place of or in addition to R1 on installation of a new tube.
- h) L1 is a high voltage inductor capable of withstanding transients in excess of the beam voltage without breakdown.



2KDX40LA, 2KDX40LF



2KDX40LA/LF  
OUTLINE DRAWING