TECHNICAL DATA

2KDX15LA
2KDX15LF
AIR COOLED
15KW VISION
10KW VISION/SOUND
UHF-TV KLYSTRODE
AMPLIFIERS

The EIMAC air-cooled 2KDX15LA Klystrode®and 2KDX15LF Klystrode tubes are a new development providing exceptionally high average conversion 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 input beam power varies with modulation depth. Because input power follows the modulation waveform precisely, the Klystrode operates in TV visual service with low average beam current, saving beam power which would otherwise 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 pressure and flow requirements are low, minimizing acoustical noise.

These new Klystrodes may be operated efficiently at 15 kw peak sync power output in visual service. At this power level the ratio of peak sync power output to average beam power input (figure of merit) exceeds 100 percent.

Two tubes and circuit assemblies cover the UHF-TV band:
2KDX15LA w/CV5200 470-600 MHz
2KDX15LF w/CV5201 600-860 MHz.

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 klystrode tubes may also be operated in combined sound and vision service at 10 kw peak sync with pre-correction. This internal diplexing mode of operation results in an extremely simple, compact and economical tranmitter design.

A new feature of these tubes is a great reduction in magnet focusing power requirements to less than 25 watts.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Dispenser Type	
Heater Voltage	7.5 to 8.0 Vdc
Heater Current (nominal)	10.5 to 11.1 Adc
Maximum Cold Start Heater Current	20 Adc
Heater Warmup Time (minimum)	300 Sec
Magnet - Part of Circuit Assembly:	
Voltage (typical)	2.5 Vdc
Current (typical)	6 Adc

MECHANICAL

Cooling	Forced Air
Input rf Connector	Type N
Output rf Connector	3-1/8 In. EIA Standard
Dimensions (2KDX15LA in Hardware):	
Length	76 In; 193 cm
Width	28.0 In; 71.1 cm
Depth	27.0 In; 68.6 cm
Dimensions (2KDX15LF in Hardware):	
Length	74 In; 188 cm
Width	28.0 In; 71.1 cm
Depth	27.0 In; 68.6 cm
Weight (Tube Only)	50 lb; 22.7 kg
Weight (CV5200 or CV5201 circuit assembly with tube installed)	100 lb; 45.5 kg

1. Characteristics and typical operating conditions are tentative. These figures may change without notice as the result of additional information. Varian EIMAC should be consulted before using this information for final equipment design. Klystrode®is a registered trademark of Varian Associates.

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VISUAL SERVICE - 2KDX15LF Klystrode Measured Performance at 783 MHz, -0.5 dB bandwidth 8 MHz

Beam Voltage	18.2	kVdc
Beam Current (P.S. - Peak of Sync)	1.6	a
Beam Current (B.L. - Black Level))	1.1	a
Beam Current (A.P. - Average Picture Level)	0.82	a
rf Power Output (P.S.)	15.5	kw
rf Power Output (B.L.)	8.7	kw
rf Power Output (A.P.)	3.1	kw
Conversion Efficiency (P.S.)	53	%
rf Drive Power (P.S.)	86	w
rf Drive Power (B.L.)	50	w

$$\text{Figure of Merit} = \frac{\text{Peak Sync Power Out}}{\text{Average Picture Power Input including sync \& blanking pulses}} = 100\%$$

The currents shown above are instantaneous values measured in repetitive pulse operation with constant pulse width, amplitude and pulse repetition rate, and with zero current between pulses. Currents are not the same as those measured in TV service when sync and blanking pulses are present; these would be different for different TV systems (NTSC, PAL, etc.).

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:

CV5200	for 2KDX15LA	470-600 MHz
CV5201	for 2KDX15LF	600-860 MHz

VACION® 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 Vacion 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 7 cfm (0.2 cubic meters per minute) at sea level at a pressure drop of approximately 1.5 inch of water (0.37 kPa). Maximum air inlet temperature is 35°C.

OUTPUT CAVITY COOLING - For power outputs over 3 kw A.P. air must be blown through the output cav ity and load coupler.

COLLECTOR AIR COOLING - Approximately 300 cfm (10 cubic meters per minute) at 4 inches of water pressure (1 kPa) of air flow is required for a continuous black level output (8.6 kw). Collector air flow must be interlocked with the power supply or the rf drive. The air-cooling manifolds are provided as part of the circuit assembly.

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 PACEMAKERS 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 jncreased. 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 8.0 volts dc and measured with an accurate meter. Ripple should not exceed plus/minus five percent. During turn-on current should be limited to 20 amperes. Alternately, 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 10 to 40

volts. The supply should be swamped with a 100 ohm bleeder resistor. Alternately, regulated cathode bias may be applied. A conveniently packaged device to provide adjustable and regulated cathode bias is available from EIMAC.

MAGNET POWER SUPPLY REGULATION - Performance of the Klystrode 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 typically is only 15 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.

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. EIMAC Application Bulletin #17 titled FAULT PROTECTION (available on request) contains considerable detail on the subject. A crowbar assembly is available from EIMAC.

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

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. Always remember that HIGH VOLTAGE CAN KILL.

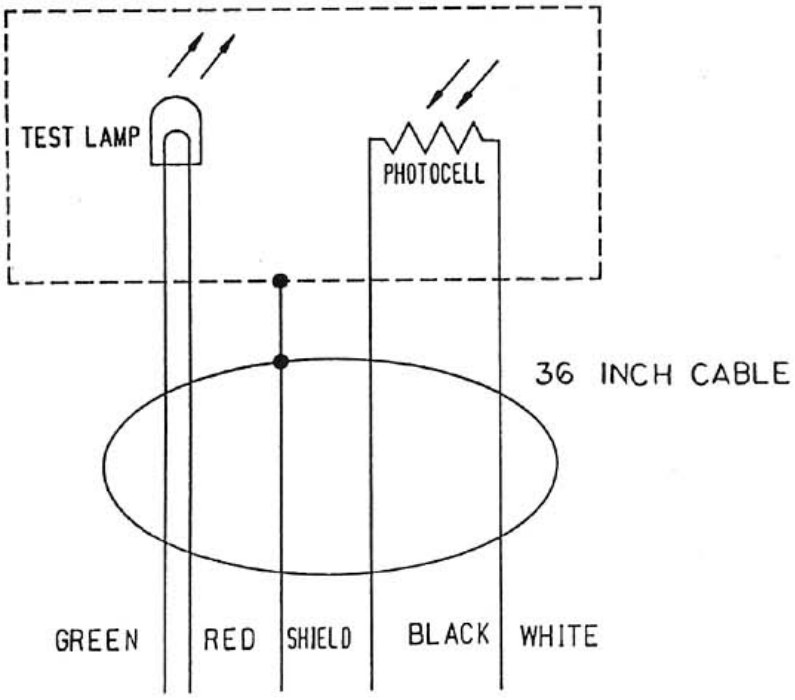
b. LOW-VOLTAGE HIGH-CURRENT CIRCUITS - Personal jewelry, such as rings, should not be worn when working with filament contacts or connectors as a short circuit can produce very high current and melting, resulting in severe burns.

c. X-RAY RADIATION - High-voltage pulse modulator 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.

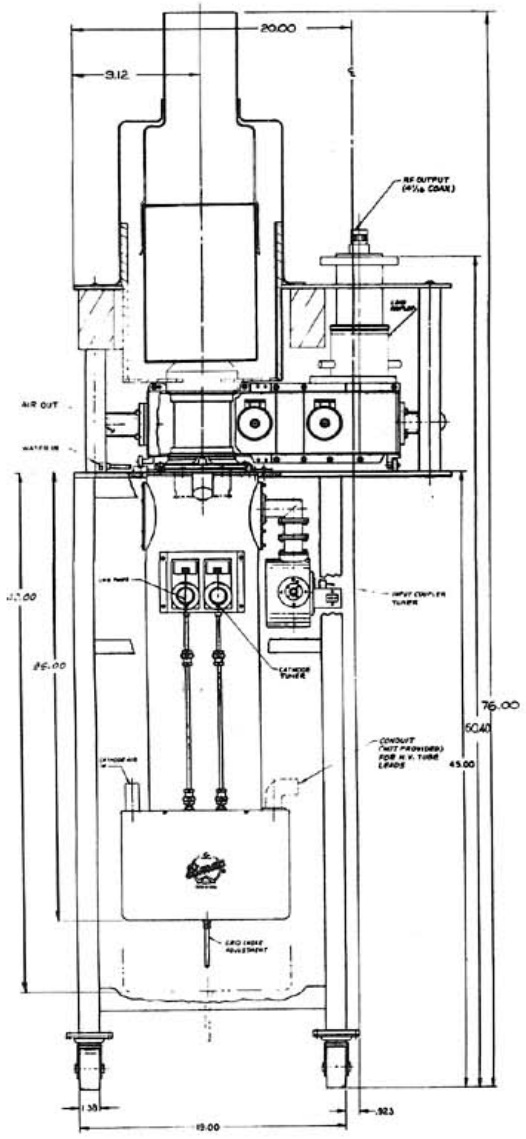
d. RF RADIATION - Exposure to strong rf fields should be avoided, even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. CARDIAC PACEMAKERS MAY BE AFFECTED.

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.

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.



ARC DETECTOR SCHEMATIC



2KDX15LA
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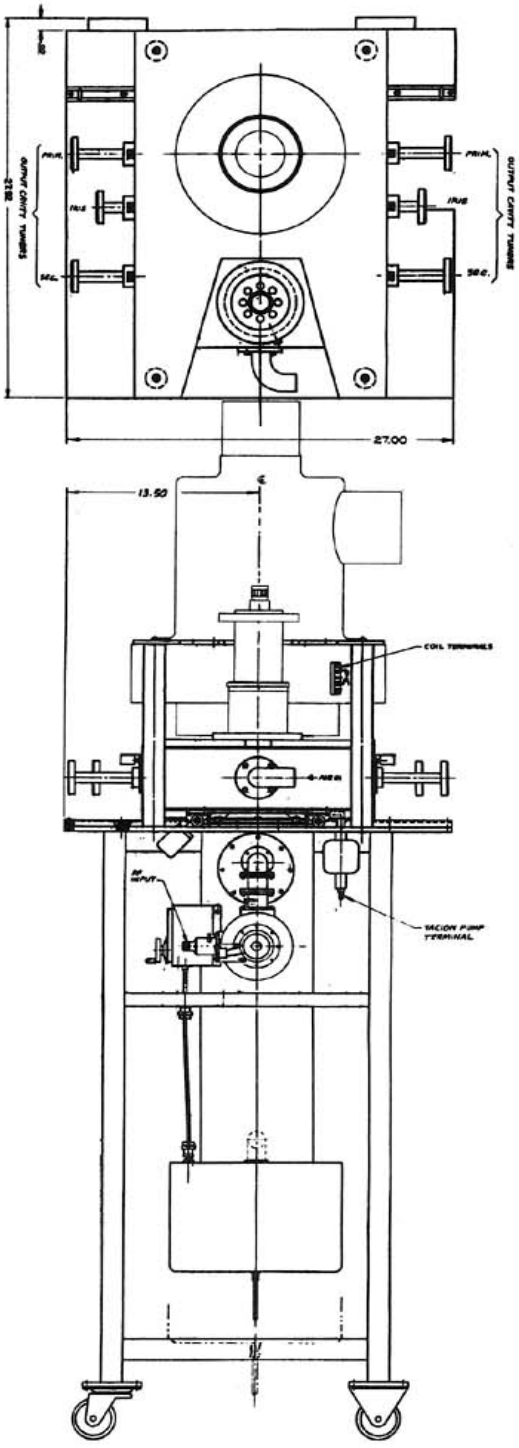
15 KW KLYSTRODE
IN CV5200
CIRCUIT ASSEMBLY



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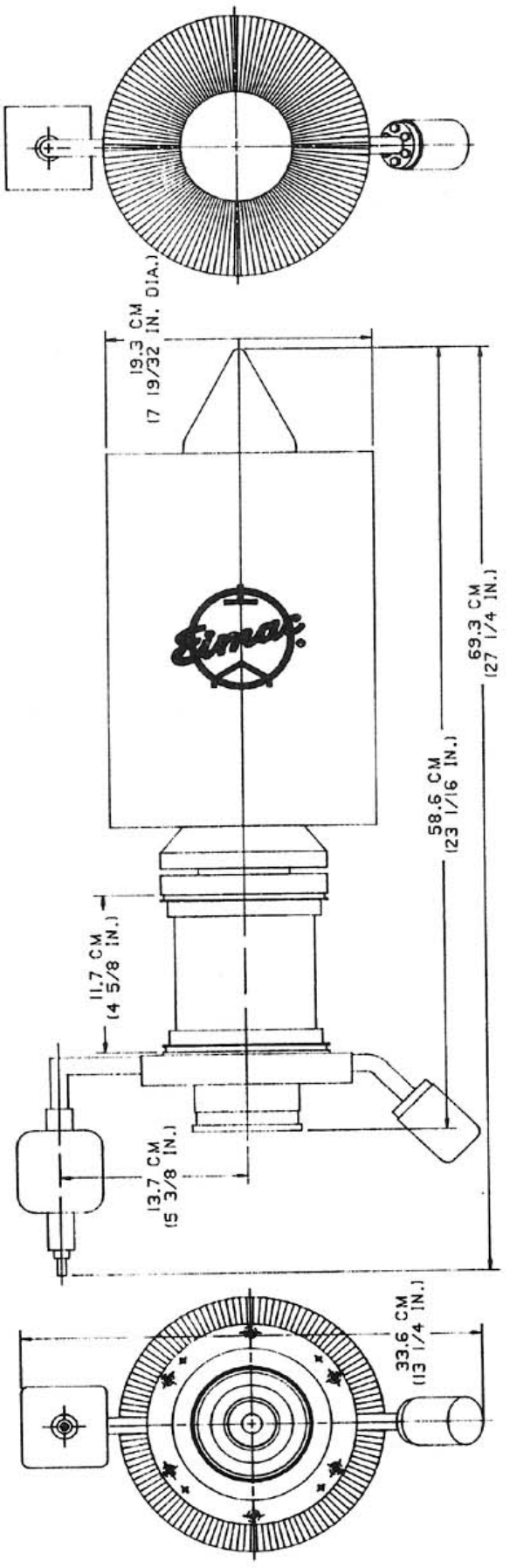
19.3 CM
(7 19/32 IN. DIA.)
69.3 CM
(27 1/4 IN.)
58.6 CM
(23 1/16 IN.)
11.7 CM
(4 5/8 IN.)
13.7 CM
(5 3/8 IN.)
33.6 CM
(13 1/4 IN.)

2KDX15LA