

OPERATING HAZARDS

Read the following and take all necessary precautions to protect personnel. Safe operating conditions are the responsibility of the equipment designer and the user.

High Voltage. This tube operates at voltages which can be deadly. Equipment must be designed so personnel cannot come in contact with operating voltages. Enclose high-voltage circuits and terminals and provide fail-safe interlocking switch circuits to open the primary circuits of the power supply and to discharge high-voltage capacitors whenever access is required.

Microwave Radiation. Exposure of the human body to microwave radiation in excess of 1 milliwatt per square centimeter is unsafe and can result in blindness or other injury. Personnel must be fully protected from the microwave energy which radiates from this device. All input and output r-f connections, waveguide flanges, and gaskets must be r-f leakproof and

properly engaged. Never operate this device without a microwave-energy-absorbing load attached. Personnel must be prevented from looking into open waveguides or antennas while such a device is energized. (Ref. Proc. IRE, Vol. 49, No. 2, pp. 427-447, Feb. 1961).

X Rays. This device may produce X-ray radiation when energized. Operating personnel must be protected by appropriate shielding. Provide adequate X-ray shielding on all sides of this device, as well as the modulator and pulse transformer tanks. X-ray caution signs or labels must be permanently attached to equipment directing operating personnel never to operate this device without X-ray shielding in place.

Equipment must be designed to fully safeguard all personnel from these hazards. Labels and caution notices must be provided on equipment and in manuals clearly warning of those hazards which cannot be avoided.



varian

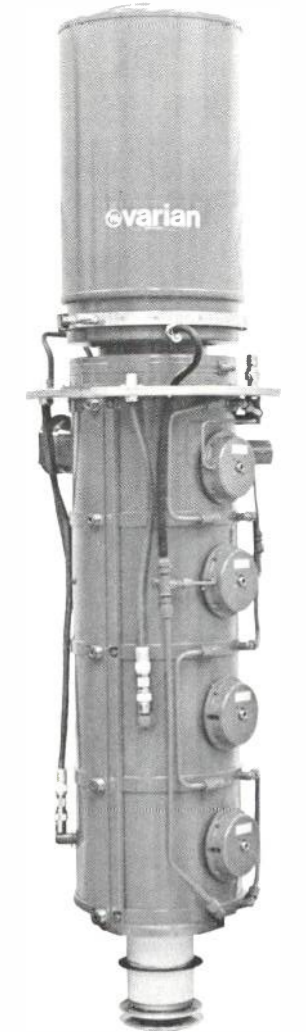
TECHNICAL DATA

VA-890H
VA-891H

CW KLYSTRON AMPLIFIER

DESCRIPTION

VA-890H and VA-891H are four-cavity, vapor-cooled klystrons for use as final amplifier tubes in both visual and aural sections of UHF-TV transmitters. These klystrons cover the frequency range of 470 to 698 megahertz in two consecutive segments. They are directly interchangeable with the earlier VA-890A and VA-891A versions, respectively. They offer the user a choice of improved linearity or higher operating efficiency either by providing higher transmitter output power or lower d-c input power for the same transmitter power rating. The special design of these tubes permits multiplexing both visual and aural signals at 50 to 75 percent of the visual-only rating, depending upon the means of signal generation and linearity correction employed.

**FEATURES**

High Gain -- Gain of at least 35 dB produces a 32 kW peak-of-sync output with less than 10 W of rf drive.

High Efficiency -- Up to 40% efficiency at peak-of-sync output (older tubes operate at 29-35%) for reliable, long-life performance.

Ample Bandwidth — One-dB bandwidth is at least 7 MHz over the tuning range. Output power will not vary more than ± 1.0 dB over the range of -1.5 MHz to +5.5 MHz from the visual carrier frequency and over the power levels from white to black.

Vapor Cooling — Reduces equipment size, noise, and cost: only 2 gal/min water flow required.

Modulating Anode — Provides means for aural power control using the visual beam power supply.

Multiplex Operation — Operation at 15 kW or more in full multiplex.

Simple Installation and Operation — Each tube is factory tuned to a specified frequency but is tunable over its entire frequency range. The electromagnet operates from a single power supply. Installing the tube is made easy by rollers on the tube which mate with channels in the electromagnet.

GENERAL CHARACTERISTICS¹

ELECTRICAL

Frequency Range 470 to 698 MHz
 VA-890H, Channels 14-29 ... 470 to 566 MHz
 VA-891H, Channels 30-51 ... 566 to 698 MHz
 Heater Voltage 6.3 ± 0.5 Vac
 Heater Current, at 6.0 V typ 16.4 Aac
 Heater Surge Current, max 30 Aac
 Heater Warm-up Time, min 5 min
 Focusing Electromagnet
 Electromagnet Voltage, max 145 Vdc
 Electromagnet Current, max 30 Adc

PHYSICAL

Dimensions, tube and magnet See Outline Drawings
 Weight, approx
 VA-890H 270 lb
 VA-1590B Electromagnet 350 lb
 VA-891H 240 lb
 VA-1591B Electromagnet 315 lb
 Mounting Position Cathode Down
 Cooling²
 Tube Water Vapor and Forced Air
 Electromagnet Water
 Water Inlet Temperature, max 60 °C

OPERATING CONDITIONS AND RATINGS¹

	Typical Operation ³	Maximum Ratings ⁵
Frequency, visual, VA-890H	519	--- MHz
Output, saturated	35.5	--- kW
Output, peak-of-sync	32	--- kW
Drive Power, peak-of-sync	10	--- W
Gain, peak-of-sync	35	--- dB
Efficiency, saturated	43	--- %
Bandwidth, 1-dB	7.5	--- MHz
Beam Voltage	18.5	20.0 kVdc
Beam Current	4.51	6.1 Adc
Body Current	15	100 mAdc
Modulating Anode Voltage	16.2	20.0 kVdc
Modulating Anode Current	0.5	5 mAdc
Focusing Current	28	30 Adc
Load VSWR	< 1.1:1	1.5:1
Collector Temperature ⁴	105	245 °C

COOLING

Distilled water is the preferred coolant. Water purity should be maintained in accordance with the information contained in the Varian Application Engineering Bulletin AEB-31. In addition,

at least 200 lb/h of clean dry air should be directed at the cathode. For additional information, contact the nearest Varian Sales Office, or the Palo Alto Microwave Tube Division, Palo Alto, California.

Water Flow, minimum
 Tube, body and collector in series 2 gal/min
 Electromagnet 2 gal/min

Pressure Drop, at minimum flow, maximum
 Tube 50 lbf/in²
 Electromagnet 35 lbf/in²

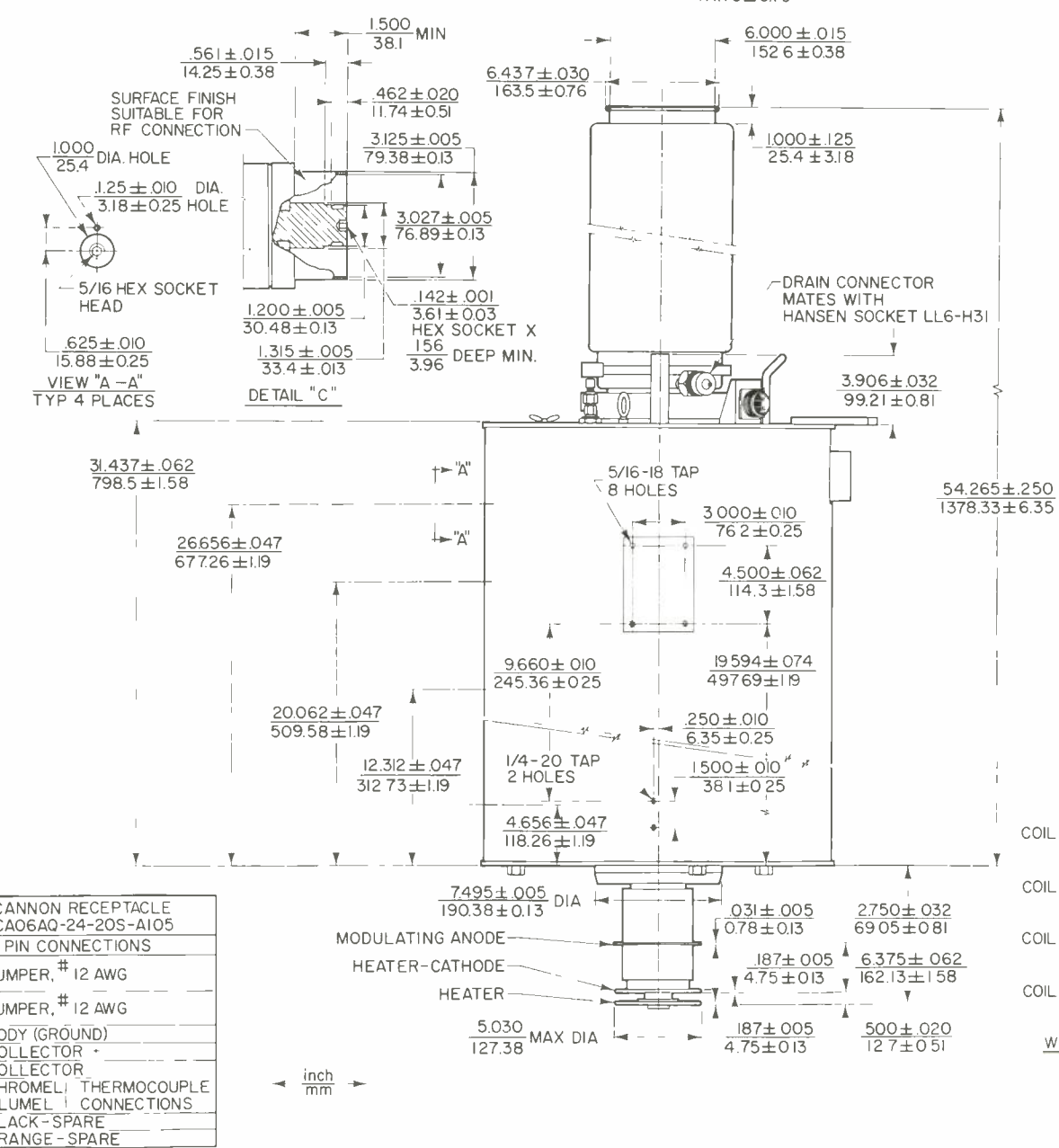
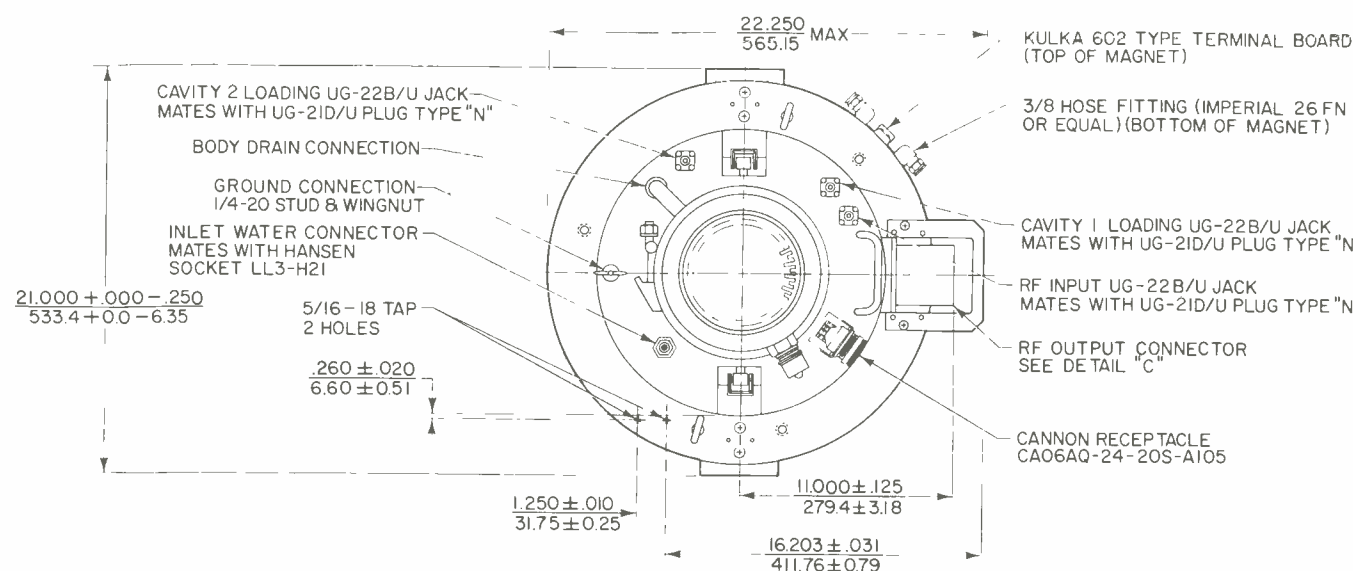
NOTES:

- Characteristic and operating values are based on performance tests. These figures may be changed without notice as a result of additional data or product refinement. Consult Varian before using this information for final equipment design.
- For optimum performance, the water inlet temperature should be kept within 5°C of the coolest practical value.
- Typical operation assumes a 91% peak-of-sync power

- ratio. Other ratios can be used depending upon the degree of linearity required.
- The collector temperature is monitored by a chromel-alumel thermocouple attached to each tube.
- Ratings should not be exceeded under continuous or transient conditions. A single rating may be the limitation and simultaneous operation at more than one rating may not be possible. Equipment design should limit voltage and environmental variations so that the ratings will never be exceeded.

OUTLINE DRAWING

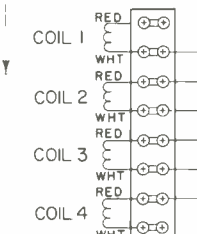
VA-890H Tube in VA-1590B Electromagnet



CANNON RECEPTACLE CA06AQ-24-20S-A105	
PIN CONNECTIONS	
A	JUMPER, # 12 AWG
B	JUMPER, # 12 AWG
C	JUMPER, # 12 AWG
D	JUMPER, # 12 AWG
E	BODY (GROUND)
F	COLLECTOR *
G	COLLECTOR
H	CHROMEL THERMOCOUPLE
J	ALUMEL CONNECTIONS
K	BLACK-SPARE
L	ORANGE-SPARE

* ALWAYS USE PINS F AND G IN PARALLEL

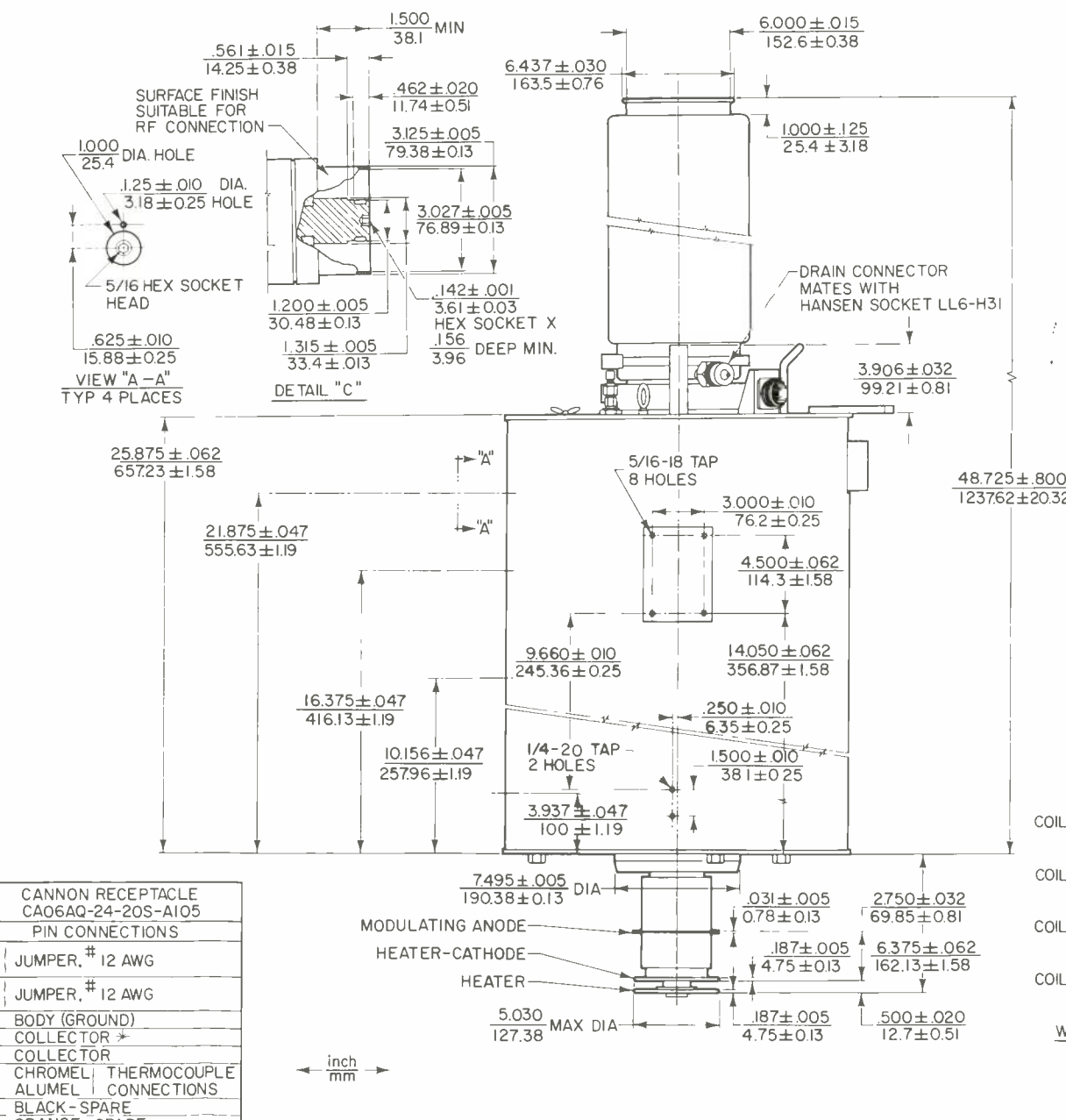
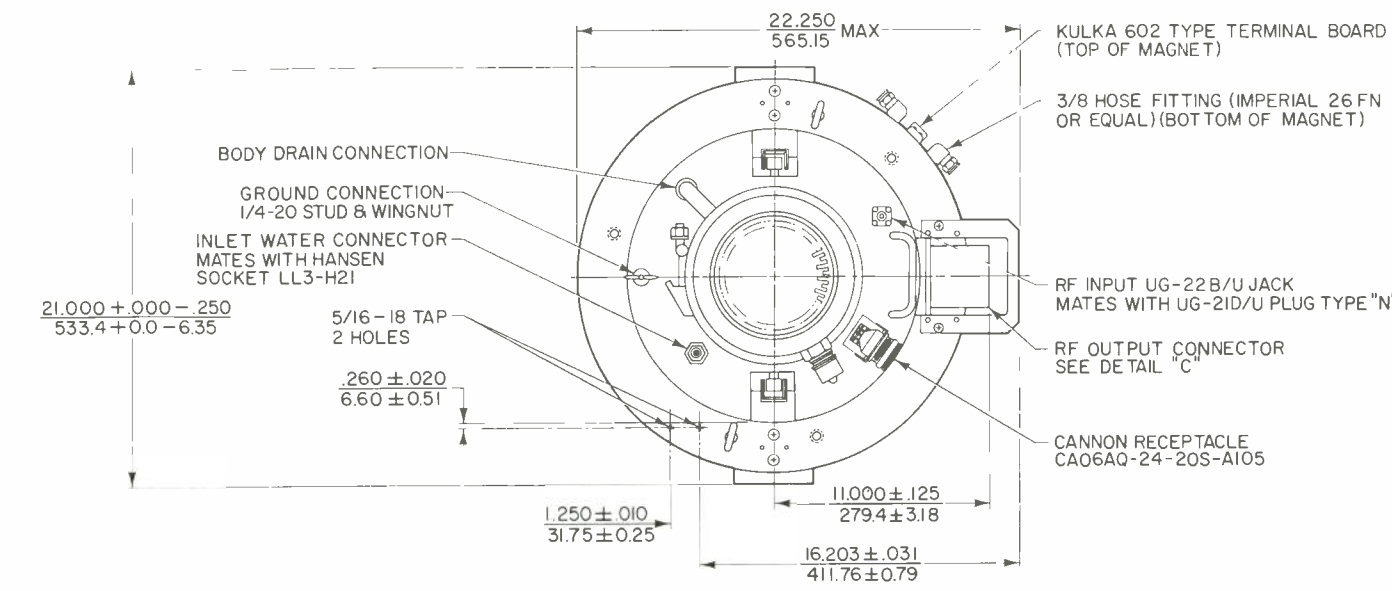
JUMPERS



WIRING DIAGRAM

OUTLINE DRAWING

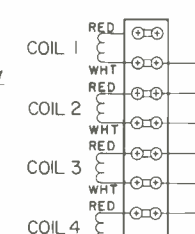
VA-891H Tube in VA-1591B Electromagnet



CANNON RECEPTACLE CA06AQ-24-20S-A105	
PIN CONNECTIONS	
A	JUMPER, # 12 AWG
B	JUMPER, # 12 AWG
C	JUMPER, # 12 AWG
D	JUMPER, # 12 AWG
E	BODY (GROUND)
F	COLLECTOR *
G	COLLECTOR
H	CHROMEL THERMOCOUPLE
J	ALUMEL CONNECTIONS
K	BLACK-SPARE
L	ORANGE-SPARE

* ALWAYS USE PINS F AND G IN PARALLEL

JUMPERS



WIRING DIAGRAM

OPERATING HAZARDS

Proper use and safe operating practices with respect to microwave tubes are the responsibility of equipment manufacturers and users of such tubes. Varian provides information on its products and associated hazards, but it assumes no responsibility for after-sale operating and safety practices. Limited life and random failures are inherent characteristics of electron tubes. Take appropriate action through redundancy or safeguards to protect personnel and property from tube failure.

All persons who work with or are exposed to microwave 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.

WARNING — SERIOUS HAZARDS EXIST IN THE OPERATION OF MICROWAVE TUBES

The operation of microwave tubes involves one or more of 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.
- b. RF RADIATION — Exposure to rf radiation may cause serious bodily injury possibly resulting in blindness or death. *Cardiac pacemakers may be affected.*

c. X-RAY RADIATION — High voltage tubes produce dangerous, possibly fatal, x-rays.

d. BERYLLIUM OXIDE POISONING — The dust or fumes from beryllium oxide (BeO₂) ceramics used in microwave tubes are highly toxic and can cause serious injury or death.

e. CORROSIVE AND POISONOUS COMPOUNDS — Upon microwave or high voltage breakdown in the external waveguide portion of microwave tubes, a dielectric gas which is sometimes used may combine with impurities to form highly toxic and corrosive compounds.

f. IMPLOSION HAZARD — Ceramic windows in microwave tubes can shatter on impact or crack in use, possibly resulting in injury from flying particles or from beryllium oxide (BeO₂) dust or fumes.

g. HOT WATER — The electron collector and water used to cool it reach scalding temperatures. Touching or rupture of the cooling system can cause serious burns.

h. HOT SURFACES — Surfaces of air-cooled collectors and other parts of tubes can reach temperatures of several hundred degrees centigrade and cause serious burns if touched.

Please see the Palo Alto Microwave Tube Division Operating Hazard sheet (Publication No. 3386) for more details on operating hazards.



TECHNICAL DATA

VA-953H
VA-954H
CW KLYSTRON AMPLIFIER
470-698 MHz
57 kW

DESCRIPTION

VA-953H and VA-954H are five-cavity, vapor-cooled klystrons for use as final amplifier tubes in both visual and aural sections of UHF-TV transmitters. These klystrons cover the frequency range of 470 to 698 megahertz. They offer the user improved linearity and higher operating efficiency by providing either lower d-c input power or higher transmitter output power for the same transmitter power rating. The special design of these tubes permits multiplexing both visual and aural signals at 50 to 75 percent of the visual-only rating, depending upon the means of signal generation and linearity correction employed.

FEATURES

High Gain — Gain of at least 47 dB produces a 55 kW peak-of-sync output with less than 0.7 W of r-f drive.

High Efficiency — Up to 42% efficiency at peak-of-sync output for reliable, long-life performance (standard tubes operate at 29-32%).

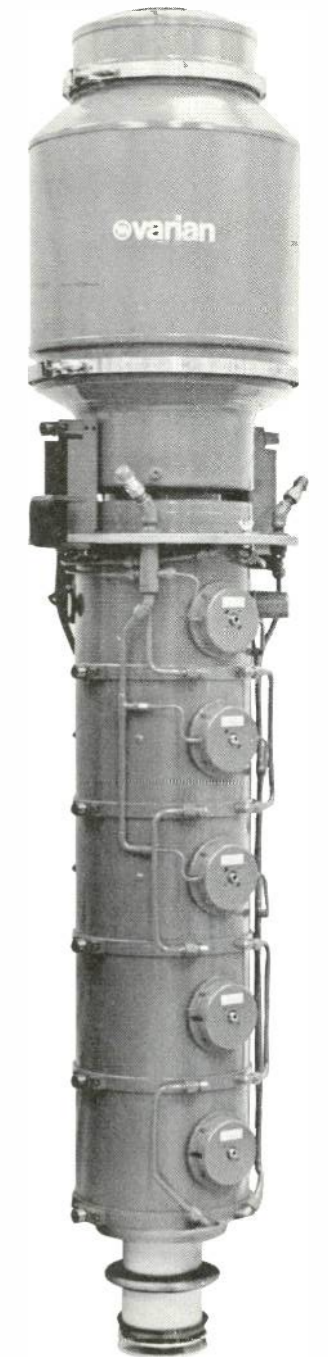
Ample Bandwidth — One-dB is at least 7 MHz over the tuning range. Output power will not vary more than ±1.0 dB over the range of -1.5 MHz to +5.5 MHz from the visual carrier frequency and over the power levels from white to black.

Vapor Cooling — Reduces equipment size, noise, and cost: only 2 gal/min (0.12 l/s) water flow required.

Modulating Anode — Provides means for aural power control using the visual beam power supply.

Multiplex Operation — Operation at 25 kW or more in full multiplex.

Simple Installation and Operation — Each tube is factory tuned to a specified frequency but is tunable over its entire frequency range. The electromagnet operates from a single power supply. Installing the tube is made easy by rollers on the tube which mate with channels in the electromagnet.



GENERAL CHARACTERISTICS¹

ELECTRICAL

Frequency Range	470 to 698 MHz
VA-953H	470 to 566 MHz
VA-954H	566 to 698 MHz
Heater Voltage	7.0 to 7.7 Vac
Heater Current, typ	17 Aac
Heater Surge Current, max	30 Aac
Heater Warm-up Time, max	5 min
Focusing	Electromagnet
Electromagnet Voltage, max	145 Vdc
Electromagnet Current, max	30 Adc

PHYSICAL

Dimensions	See Outline Drawing
Weight, approx	
VA-953H	430 lb/195.2 kg
VA-1950 & VA-1953 Series	
Electromagnets	650 lb/295 kg
VA-954H	390 lb/177 kg
VA-1951 & VA-1954 Series	
Electromagnets	600 lb/272.4 kg
Mounting Position	Cathode down
Cooling	
Tube	Water Vapor and Forced Air
Electromagnet	Water
Water Inlet Temperature, ² max	60 °C

OPERATING CONDITIONS AND RATINGS¹

Frequency, visual, VA-953H	519	---	MHz
Output, saturated	65	---	kW
Output, peak-of-sync	57	---	kW
Drive Power, peak-of-sync	0.7	---	W
Gain, peak-of-sync	49	---	dB
Efficiency, saturated	42	---	%
Bandwidth, 1-dB	8	---	MHz
Beam Voltage	24	---	kVdc
Beam Current	6.8	---	8 Adc
Body Current	15	---	100 mAcd
Modulating Anode Voltage	24	---	kVdc
Modulating Anode Current	0.5	---	5 mAcd
Focusing Current	30	---	32 Adc
Load VSWR	< 1.1:1	---	1.5:1
Collector Temperature ⁴	130	---	145 °C

COOLING

Distilled water is the preferred coolant. Water purity should be maintained in accordance with the information contained in the Varian Application Engineering Bulletin AEB-31. In addition, at least 200 lb/h (90.8 kg/h) of clean dry air

should be directed at the cathode. For additional information, contact the nearest Varian Sales Office, or the Palo Alto Microwave Tube Division, Palo Alto, California.

Water Flow, minimum

Tube Body	2.5 gal/min(0.15 l/s)
Tube Collector	2.0 gal/min(0.12 l/s)
Electromagnet	2 gal/min(0.12 l/s)

NOTES:

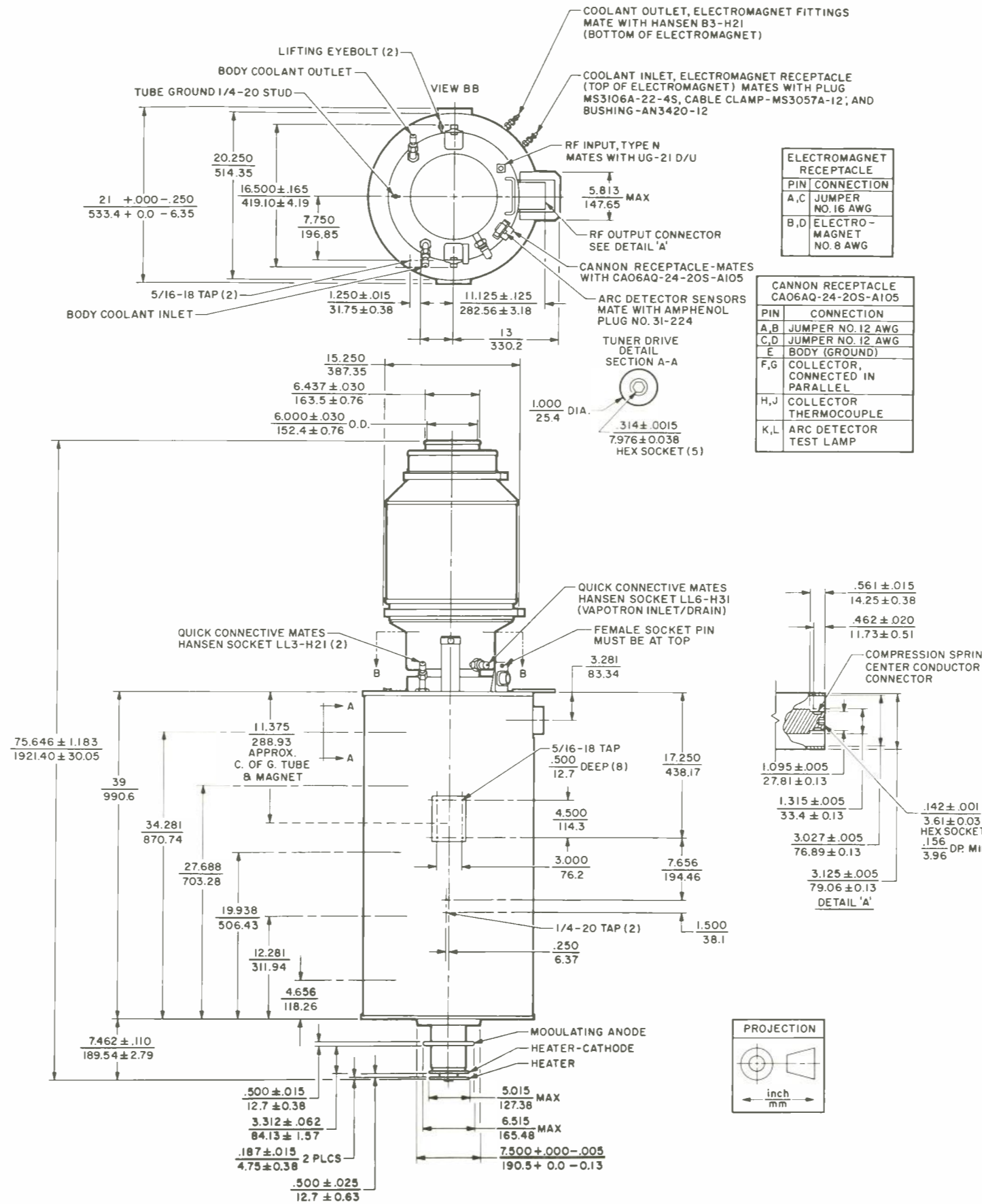
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- For optimum performance, the water inlet temperature should be kept within 5°C of the coolest practical value.
- Typical operation assumes a 91% peak-of-sync power to

saturated power ratio. Other ratios can be used depending upon the degree of linearity required.

- The collector temperature should be monitored using the thermocouple attached to each tube.
- Ratings should not be exceeded under continuous or transient conditions. A single rating may be the limitation and simultaneous operation at more than one rating may not be possible. Equipment design should limit voltage and environmental variations so that the ratings will never be exceeded.

OUTLINE DRAWING

VA-953H Tube in VA-1950 or VA-1953 Electromagnet



OUTLINE DRAWING

VA-954H Tube in VA-1951 or VA-1954 Electromagnet

