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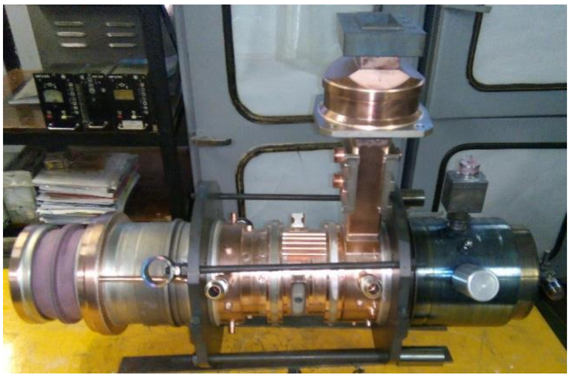
TECHNICAL SPECIFICATION
Multi-beam S-band Klystron type BT267



VDBT

The company was created for the development and manufacture of precision microwave vacuum-electron-tube devices (VETD).
The main product areas being manufactured are:
- Linear electron accelerators.
- Vacuum-tube radar devices.
- Multi-beam high power klystrons (MBK).

Advantages of BT267

- Low Working voltage (less than half) when compared to similar RF power single beam klystrons.
- Reduction of harmful X-rays during operation.
- High efficiency performance due to the state-of-art Bunching Alignment Collecting (BAC) beam technology.
- Ability to work in air, without an oil tank, which reduces the installation weight.
- It can operate in spatial position and on mobile installations.
- Total cost of ownership (TCO) is much better since you need less power and the overall systems becomes smaller.
- Permanent magnet focusing that significantly reduces the MBK weight and additionally increases overall system efficiency due to absence of solenoid power losses.
- Application for the BT267 is Medical, Industry, Science and Defence.

GENERAL DATA CHARACTERISTICS (1)

Electrical(2)	Min.		Max.	Units
Frequency		2856		MHz
Peak RF Output Power (1)		15.0	16.0	MW
Heater Voltage (3)			24	V
Heater Current (3)			28	A
Heater Current (Surge) (3)			30	A
Heater Warm-up Time	12			min
Peak Beam Voltage (4)	72		78	kV
Peak Cathode Current	380		420	A
Peak RF Drive Power (5)			250	W
Collector Dissipation			35	kW
Efficiency (1)	50			%
Gain	45			dB
Average RF Output Power		19.5	20	kW
Pulse Width (Beam Voltage) (4)		4.5	16.5	µs
Pulse Width (RF Output Power) (6)		5.0	15.5	µs
Pulse Repetition Rate(6)			200	pps
Load VSWR			1.2	
Ground		Tube Body		
Irradiation with X-ray shield at 5 meter distance			3	mR/hour

Physical	Min	Max	Units
Mechanical			
Dimensions	See outline drawing		mm
Height		Approx. 800	
Net Weight		Aprox. 90	kg
Mounting Position	Vertical, Cathode down, horizontal position is also permitted, in the case of necessity		
Cathode	Impregnated Cathode		
Ion Pump (2) (7) (8)	1.5		L/s
Focusing Electromagnet	Permanent, it is mounted on the klystron		
X-ray Shields (9)	VDBT X-ray Shielding KIT VD-112		
Connection			
Heater/Cathode	External screw M8		
Heater	External screw M8		
RF Input	Coaxial, Type N receptacle		
RF Output	WR-284 (10), LIL-284 flange		
Ground	External screw M8		
Ion Pump	Coaxial, see outline drawing		
Cooling			
Collector	Water (11) (12)		
Flow Rate	70		L/min
Pressure Drop	0.15		MPa
Coolant Pressure		0.7	MPa
Inlet Coolant Temperature	4	40	^{0}C
Inlet/Outlet Connector	M24x1.5 tubing		
Body	Water (11) (12)		
Flow Rate	20		L/min
Pressure Drop	0.15		MPa
Coolant Pressure		0.7	MPa
Inlet Coolant Temperature	4	40	^{0}C
Inlet/Outlet Connector	M24x1.5 tubing		
Environmental			
Temperature	5	45	^{0}C
Humidity	30	65	%

ABSOLUTE RATINGS (1)(13)

	Min.	Max.	Units
Frequency	2853	2859	MHz
Heater Voltage (3) (14)		24	V
Heater Current (3) (14)		28	A
Heater Current (Surge) (3)		30	A
Heater Warm-up Time	12		min.
Peak Beam Voltage (4) (15)		78	kV
Peak Beam Inverse Voltage (16)		20	kV
Peak Cathode Current (17) (18)		420	A
Peak RF Drive Power (5) (19)		250	W
Peak RF Output Power		16	MW
Average RF Output Power		20	kW
Collector Dissipation		35	kW
Pulse Width (Beam Voltage)(4)		17.0	μs
Pulse Width (RF Output Power)(6)(7)		16.0	μs
Pulse Repetition Rate		200	pps
Load VSWR (20)		1.3	
Coolant Flow (Collector) (12)	70		L/min.
Coolant Flow (Body) (12)	20		L/min.
Inlet Coolant Temperature	4	40	°C
Coolant Pressure (Collector) (11)		0.7	MPa
Coolant Pressure (Body) (11)		0.7	MPa
Ion Pump Voltage	3.5	4.5	KV
Waveguide Pressure, absolute (10)	10^{-6}	0.3	MPa
Environmental Temperature	5	45	°C
Environmental Humidity	30	65	%

FACTORY TEST (typical)

		Units
Frequency	2856	MHz
Heater Voltage	21	V
Heater Current	25	A
Peak Beam Voltage	76	kV
Peak Cathode Current	420	A
Peak RF Drive Power	200	W
Peak RF Output Power	16	MW
Efficiency	50	%
Gain	46	dB
Pulse Width (Beam Voltage)	12	μs
Pulse Width (RF Output Power)	10	μs
Pulse Repetition Rate	10	pps

KLYSTRON AND EQUIPMENT PROTECTION

The protective devices mentioned below must be provided. They must be connected that a defect in any one of them will prevent operation of the tube. Whenever possible, an indicating light should show the reason for protective action.

Characteristics	Type	Point of action	Action speed
Ion pump current	max. A	Klystron high voltage	Fast
Tube water flow	min. F	Heater supply	Medium
Tube water temperature	max. F	Heater supply	Medium
Heater voltage	min. max. A	Klystron high voltage	Medium
Heater current	min. max. A	Klystron high voltage	Medium
Beam voltage	max. A	Klystron high voltage	Medium and Pulse-to-pulse
Beam current	max. A	Klystron high voltage	Medium and Pulse-to-pulse
Klystron inverse voltage	max. F	RF drive or klystron high voltage	Pulse-to-pulse
Waveguide pressure(Vacuum)	max. F	RF drive or klystron high voltage	Fast
Waveguide SWR	max. F	Klystron high voltage	Pulse-to-pulse

--- "F" indicates a device designed for operation at a rated value.
--- "A" indicates a device which operating point is adjustable according to the individual characteristics of each tube.
--- "S" indicates a device which operating point is specified by the equipment manufacturer.
--- The "medium" action speed indicates the monitoring system can be based on average value measurements.
--- The "fast" action speed indicates the klystron high voltage must be cut off as soon as possible. Usually this can be done by cutting off the thyratron triggering signal.
--- The "pulse-to-pulse" action speed indicates that the monitoring device must detect the first single irregular
Pulse and interlock system must cut off the next pulse to the irregular pulse detected. For this purpose, peak measuring devices and comparators with references, which can be adjustable, are necessary.

Notes

(1) All voltages except heater voltage and ion pump voltage are referenced to the cathode. The ion pump voltage is referenced to the tube body. The tube body must be firmly connected to the ground.
(2) An ion pump shall be an integral part of each tube. This ion pump shall operate at +4000Vdc +/- 300Vdc from a high impedance power supply capable of delivering 10mA. For normal tube operation, the ion pump current shall be less than 12μAdc. Because of the size of this tube, it is not abnormal to observe changes in the internal vacuum during storage. To be able to put the stored klystron into operation quickly, the klystron ion pump be operated all the time.
(3) When the heater power is applied to a cold tube, the heater voltage shall be adjusted from zero to prescribed values so that the heater current should not exceed 30 A. This value of heater voltage shall be maintained for at least 12 minutes prior to the application of beam voltage. The liquid coolant flow must be operating whenever the heater power is applied.
(4) The beam pulse width (duration) shall be measured between the 75% point of the beam voltage pulse. It can be increased to 17 µs, in that case pulse repetition rate is no more than 80 pps.
(5) Drive power is defined as the power incident to the klystron.
(6) The RF pulse width shall be measured between the 3 dB points of the output pulse. It can be increased to 16 µs, in that case pulse repetition rate is no more than 80 pps. The average power consumption must be no more than 40 kW at any case, pulse repetition rate should be chosen based on this condition. 200 pps can be used only for pulses of beam voltage less than 5,5 µs.
(7) Interlock should be provided to prevent application of beam voltage, unless the ion pump current is less than the normal operating value.
(8) To operate the ion pump, a specific magnet is required. Unless specified in contract, the magnet for the ion pump will be provided with the klystron.
(9) X-ray shields are required to operate the klystron. The VDBT X-ray shielding kit is available.
(10) The output waveguide shall be operated in SF_6 or in vacuum, output flange can be made CRP-284F(EIA) compatible.
(11) By de-ionized low conductivity water.
(12) Interlocks in the liquid cooling system should prevent the application of heater voltage and beam voltage, unless the liquid coolant flow is at, or above the specified minimum flow rate.
(13) Those values are based on the “absolute system” and should not be exceeded under continuous or transit conditions. A single rate may be the limitation and simultaneous operation at another rating may not be possible. Design values for systems should include a safety factor to maintain operation within ratings under voltage and ion pump voltage and environmental variation.
(14) Interlock should be provided to prevent application of a beam voltage unless the heater voltage and the heater current are within ± 5% of prescribed value, and have been applied for the period of time specified in Note(3).
(15) Interlocks should be provided to prevent application of beam voltage greater than 5% above normal operating value, as well as preventing exceeding the Absolute Ratings.
(16) Interlocks should be provided to prevent application of beam voltage, unless inverse beam voltage is less than the Absolute Ratings value.
(17) Interlocks should be provided to prevent the cathode (beam) current from exceeding values greater than 10% above normal operating values, as well as preventing exceeding the Absolute Ratings.
(18) Interlocks should be provided to prevent the application of beam voltage, unless inverse cathode (beam) current is less than the specified value.
(19) The tube shall not be damaged when operated at maximum rated RF drive power when the beam voltage removed.
(20) Output power is measured under a load VSWR 1.2 maximum.

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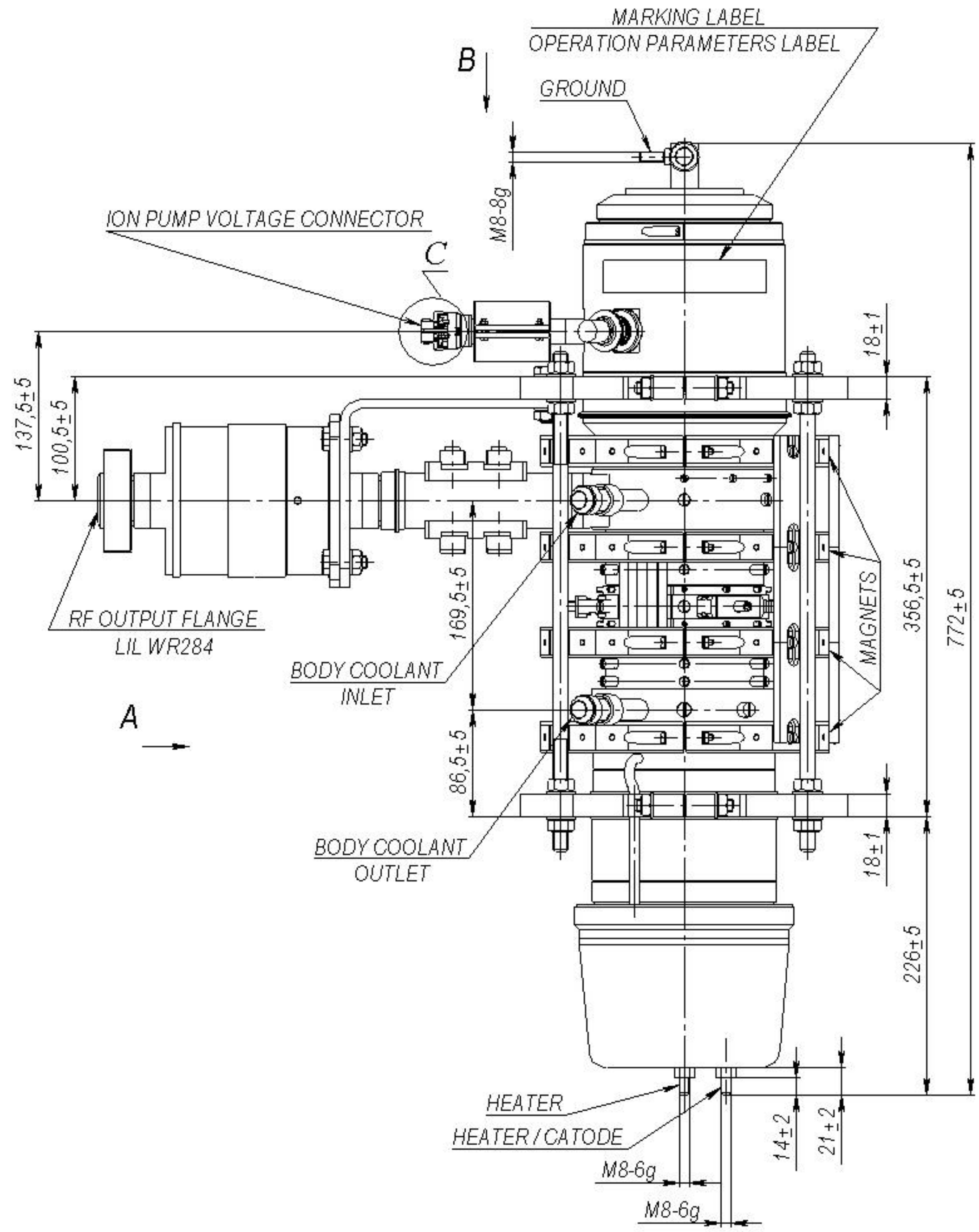
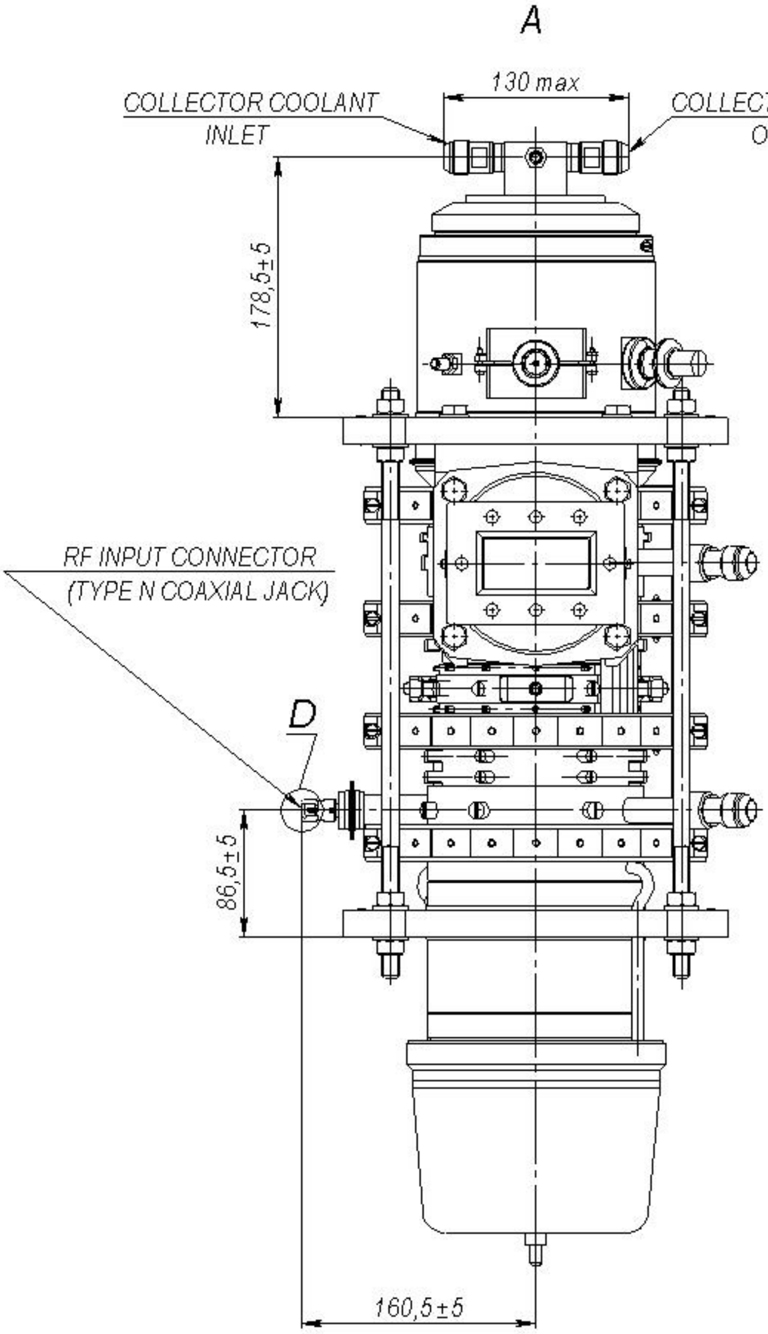
DIMENSIONAL OUTLINE OF THE BT276 KLYSTRON (Reference)

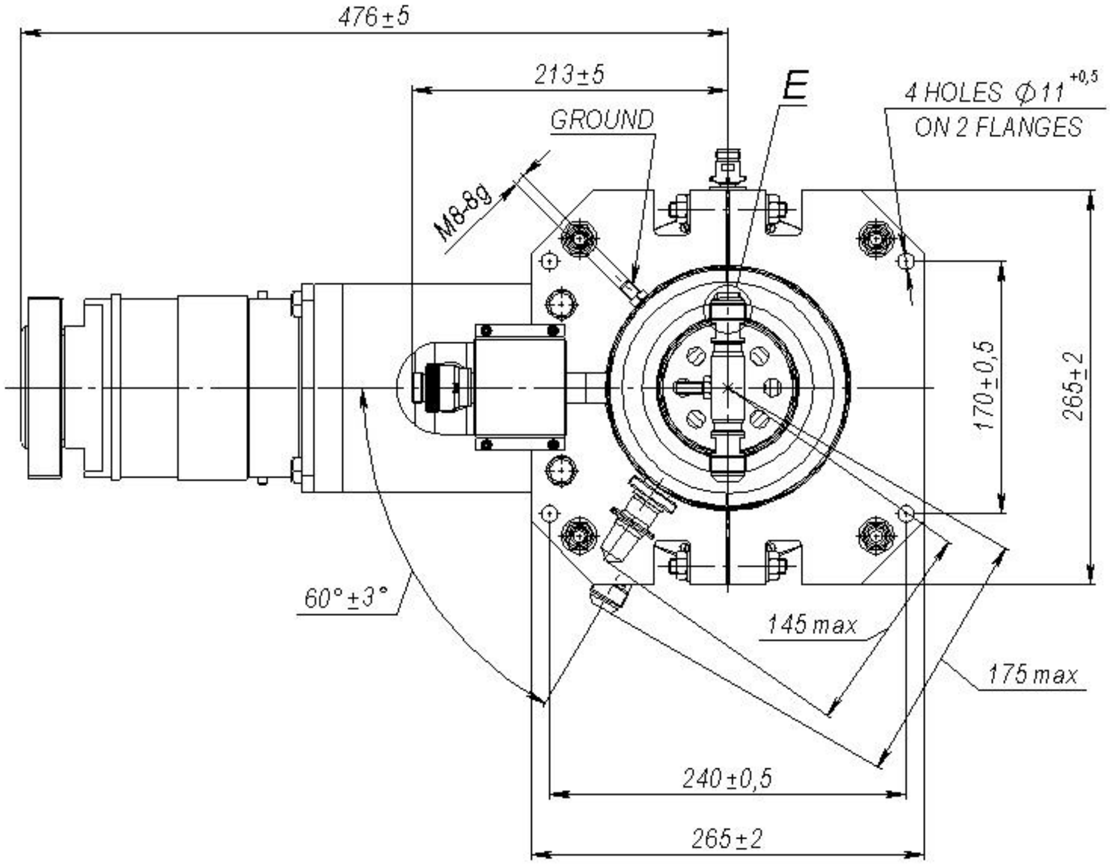
Unit:mm



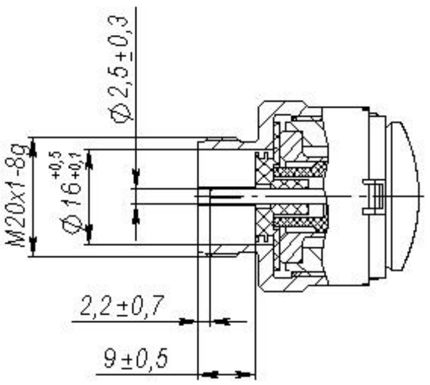
Dimensional outline will be submitted within Three (3) months after P/O


A
130 max
COLLECTOR COOLANT INLET
COLLECTOR COOLANT OUTLET
178,5±5
RF INPUT CONNECTOR (TYPE N COAXIAL JACK)
D
86,5±5
160,5±5

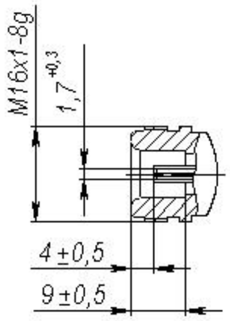
B



C



D



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4 PIECES