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GD000017 Specification

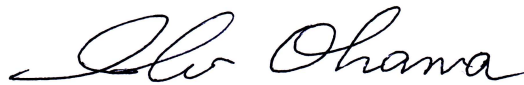
To : Lyncean Technologies, Inc.

Receipt Signature and Date

Please return one of specification after your receipt signature.

This specification will be applied to the serial delivery or lot delivery until obtaining your signed specification or your counter proposal to be agreed.

SPECIFICATION
FOR
E3730A KLYSTRON SET



Shinji Ohama

General Manager
Sales Department

Specification Number: T200061-L973

Rev. 0

Issued : 2020-08-17

Revised :

To : Lyncean Technologies, Inc.

SPECIFICATIONS
FOR
E3730A KLYSTRON SET

CETD Pulse Klystron Amplifier

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Limitation of Product Liability

In case you receive a claim from a third party that any loss or damage to property, bodily injury or death of a person was caused by a defect of the Component, you shall immediately notify Canon Electron Tubes & Devices Co., Ltd. (CETD) of such claim and consult with CETD for any actions to be taken. In any event, liability of CETD shall be confined to the extent reasonably foreseeable and proximately caused by the defect of Component with a limitation of aggregated amount paid by you for the Components.

Provided, however, CETD shall not be liable in the cases, where,

- (1) it was impossible for CETD to discover the defect based upon the state of scientific or technical knowledge at the time of delivery to you,
- (2) the defect is due to the compliance with your instruction regarding the specification or design,
- (3) you failed to incorporate fail-safe design to your products in consideration of the reasonably expected failure ratio/pattern of the Components incorporated therein,
- (4) the defect is due to the compliance with mandatory regulations/standards issued by the public authorities; or
- (5) the defect did not exist at the time of delivery.

About the sales of this product and combination devices

Export Control

1. US Export Administration Regulations: This product contains U.S.-origin component and technologies. It may not be transferred, or otherwise disposed of, to any country or to any person restricted under U.S. laws and regulations, without first obtaining approval from the U.S. government or as otherwise authorized by U.S. law and regulations.
2. Others: Distribution of the products and/or devices which incorporate the products may require prior approval of or notification to the regulatory authorities and/or the relevant government authorities. When distributing the product, all the laws and/or regulations applicable in the country and/or the region must be observed.

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SPECIFICATION
E3730A KLYSTRON SET

Configuration table

Configuration table of E3730A KLYSTRON SET

Description	Product name	Quantity	Remarks
Klystron	E3730A	1	
Electromagnet	VT-68922	0	
Ion pump magnet	VT-69062	(1)	Integrated with tube
X-ray shield for collector	VT-69063	(1)	Integrated with tube
X-ray shield for output	VT-69064	1	
Lifting attachment	VT-69065	1	
Sealing gasket (Option)	VT-69045	-	Excluded

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PRODUCT SPECIFICATION FOR E3730A

Description: Pulse klystron amplifier, 50 MW peak, 2856 MHz, Electromagnetically focused, Five-cavity klystron. TiN-coated output window both inside and outside of the tube to suppress multipactoring, Coaxial input, Liquid cooled.

ABSOLUTE RATINGS: (Note 1, 2)

Parameters	Symbol	Units	Max.	Min.	Notes
Frequency	f	MHz	2857	2855	
Heater Voltage	Ef	V	20	---	3,4
Heater Current	If	A	20	---	3
Heater Current (surge)	If(surge)	A	40	---	3
Heater Warm-up Time	tk	minutes	---	60	3
Peak Forward Beam Voltage	epy	kV	325	---	5,6
Peak Inverse Beam Voltage	epx	kV	100	---	7
Peak Cathode Current	ik	A	400	-55	8,8A
Peak Drive Power	pd	W	1000	---	9
Peak RF Output Power	po	MW	52	---	
Average RF Output Power	Po	kW	10.5	---	
Collector Dissipation	Pcol	kW	35	---	
Pulse Width(duration) (epy)	t(epy)	μs	6.7	---	10
Pulse Width(duration) (rf)	t(rf)	μs	4.0	---	11
Pulse Repetition Rate	pr	pps	50	---	
Ion Pump Voltage	Vip	kV	3.9	3.1	15
Load VSWR	σL	VSWR	1.4	---	11A
Coolant Flow	Qw	L/min.	---	30	12,14
Inlet Coolant Temperature	Tw,i	°C	35	5	12,12A
Outlet Coolant Temperature	Tw,o	°C	70	---	12
Coolant Pressure	Pw	MPa	0.98	---	12
		(kgf/cm ²	10.0	---	
Waveguide Pressure (Vacuum)	PW/G	Pa	6.7x10 ⁻⁵	---	13
		(Torr	5 x 10 ⁻⁷	---	
Environmental temperature					
(Operating)	Te	°C	40	0	12B
(Storage, Transport)	Ts	°C	50	-40	12A,12B,12C
Environmental humidity					
(Operating)	He	%	80	0	12B
(Storage, Transport)	Hs	%	90	0	12A,12B,12C

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PHYSICAL SPECIFICATIONS:

Mounting Position	Vertical, Cathode down
Cooling	Liquid, (Note 12, 14)
RF Input Connector	Type "N" 50 ohm coaxial; UG-22D/U Compatible
RF Output Connector	SLAC type flange "Female". See Outline Drawing Output waveguide WR-284
Ion Pump	HN-R type connector (Note 15,16,17) CETD Ion pump power supply "VT-69240-H2O"
Filament/Cathode Connector	Spring Contact Rods. See Outline Drawing (Note 17A)
Cooling Water Connector (for both Collector and Body)	NITTO KOHKI "SP- type COUPLER" "4P" for the inlet, "4S" for the outlet (Note 18)
Output Waveguide Cooling	Swagelok-1/4" (Note 18A)
Cathode	Dispenser cathode
Ground	Tube body
Focusing	CETD electromagnet "VT-68922" (Note 17,19)
X-ray Shieldings	CETD shield kit "VT-69063" (Factory furnished) CETD shield kit "VT-69064" (Note 20)
Dimensions	See Outline Drawing
Weight	Approx. 140 kg, max. without the shield kit VT-69063 Approx. 280 kg with factory furnished X-ray shield VT-69063
Marking	See "Marking E3730A"
Packing	CETD standard commercial transport (Note 24)

TUBE ACCESSORIES:

INTEGRATED WITH THE TUBE

O-ring for Gun Oil Seal "JIS G 200" (Viton)	1P
Ion Pump Magnet "VT-69062"	1P
X-ray Shield for Collector "VT-69063"	1P
Inlet/Outlet Connector (mated Connector)	
NITTO KOHKI "SP-type COUPLER" "4S"	1P
NITTO KOHKI "SP-type COUPLER" "4P"	1P

NOT INCLUDED AS OPTION

Output Flange Gasket "VT-69045"

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QUALITY CONFORMANCE INSPECTION (1): (Note 25)

1 : Factory Test

Test	Condition	Symbol	Min.	Max.	Unit
Dimensions	Per outline drawing				
Vacuum Check	No operating voltage Ion pump readings	I ion	---	4.0	μA
Hydrostatic Pressure body and collector	No operating voltage P=0.98 MPa (10 kgf/cm ²) water, t = 15 min	No visible leaks and no damage			
Heater Current	Ef= Prescribed value (Note 3)	If	---	20	A
Solenoid Current		Isol1:	---	25	Adc
		Isol2:	---	38	Adc
		Isol3:	---	18.5	Adc
		Isol4:	---	24	Adc
		Isol5:	---	16.5	Adc
		Isol6:	---	10	Adc
Cathode Current	epy = 310 kV ik		345	380	A
Power Output (Note 22)	Test Condition (1)	po	50	---	MW
Efficiency	Test Condition (1)	η	42	---	%
Gain (Saturation)	Test Condition (1)	Gp	50	---	dB
Perveance	Test Condition (1)	G	1.95	2.2	μA/V ^{3/2}
X-ray Leakage (Note 21)	30 cm distance from the surface of klystron or the electromagnet		---	10	μSv/h
Test Condition (1)	epy = 325 kV, max. Ef = Prescribed value Isol = Prescribed value F0 = 2856 MHz tp(epy) ≐ 6.7 μs (Note 10) tp(rf) = 4.0 μs (Note 11) prr = 50 pps pd = 500 W, max. (Note 23) Load VSWR = Matched Load Coolant Flow = 30 L/min. Output waveguide Pressure = 1.3x10 ⁻⁵ Pa, max. (1 x 10 ⁻⁷ Torr, max.)				

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QUALITY CONFORMANCE INSPECTION (2)

2 : Acceptance Test

Test	Condition	Symbol	Min.	Max.	Unit
Heater Check	Not open				
Dimensions	Per outline drawing				
Vacuum Check	No operating voltage Ion pump readings	I ion	---	4.0	μA
Cathode Current	epy = 300 kV	ik	328	362	A
Power Output (Note 22)	Test Condition (1)	po	45	---	MW
Efficiency	Test Condition (1)	η	41	---	%
Gain (Saturation)	Test Condition (1)	Gp	50	---	dB
Perveance	Test Condition (1)	G	1.95	2.2	μA/V ^{3/2}
Test Condition (1)	epy = 305 kV, max. Ef = Prescribed value Isol = Prescribed value+ F0 = 2856 MHz tp(epy) = 6.7 μs, max. (Note 10) tp(rf) = 4.0 μs (Note 11) prr = 50 pps pd = 500 W, max. (Note 23) Load VSWR = Matched Load Coolant Flow = 30 L/min Output waveguide Pressure = 1.3x10 ⁻⁵ Pa, max. (1 x 10 ⁻⁷ Torr, max.)				

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WARRANTY:

Test	Condition	Symbol	Min.	Max.	Unit
Service life warranty	A. 12 months from the date of the original B/L or B. 2000 hours (filament): 100%				
	The warranty period will be terminated by condition A or condition B, whichever occurs first				
Life end point	Power output	po	40	---	MW
	Perveance	G	1.8	---	$\mu\text{A}/\text{V}^{3/2}$
	Gain	Gp	48	---	dB
Shelf time	One year unless the output window packing is opened. (The windows are packed with nitrogen gas in shipping.)				

1. CETD warrants the klystrons to be free of manufacturing defects which will impair their normal operational life during the warranty period, provided that the klystrons are used within the ratings and in accordance with CETD's instructions and specifications.
2. The warranty period extends for twelve (12) months from the date of the original Bill of Lading. If the klystron shall prove to be defective during the warranty period, CETD shall refund the original amount.
3. Notification of the claim shall be received by CETD within the three (3) months after discovery of failure, filling in CETD's report form. When the return of the defective klystron is required by CETD, each return shall be made without delay, and accordance with CETD instruction.
4. The warranty shall not apply to defect resulting from accidents, alterations, abuse or misuse, or improper installation.

Be sure to refer to "E3730A Operating Instructions", before installing or operating the klystron. Interlocks and the necessary action speed are described in "E3730A Operating Instructions".

NOTES:

- Note 1: Referring to paragraph 6.5 of MIL-E-1G, those values are based on the "absolute system" and should not be exceeded under continuous or transient conditions. A single rating 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 environmental variation.
- Note 2: All voltages except heater voltage and ion pump voltage are referenced to the cathode.
- Note 3: When the heater power is applied to a cold tube, the heater voltage shall be adjusted from zero to prescribed value so that the heater current should not exceed 40 A. This value of heater voltage shall be maintained for at least 60 minutes prior to the application of beam voltage. The liquid coolant flow must be operating whenever the heater power is applied.
- Note 4: Interlocks should be provided to prevent application of a beam voltage unless the heater voltage is within +/- 5% of prescribed value and has been applied for the period specified in Note 3.
- Note 5: The electron gun insulator shall be operated in certified insulation oil. The electric strength of the oil must be more than 50 kV/2.5 mm.
- Note 6: 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.
- Note 7: Interlocks should be provided to prevent application of beam voltage, unless inverse beam voltage is less than the Absolute Rating value.
- Note 8: 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.
- Note 8A: Interlocks should be provided to prevent the application of beam voltage, unless inverse cathode (beam) current is less than the Absolute Rating value.
- Note 9: The tube shall not be damaged when operated at maximum rated rf drive when the beam voltage removed.

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Note 10: The beam pulse width (duration) shall be measured between the 75% point of the beam voltage pulse.

Note 11: The rf pulse width shall be measured between the -3 dB point of the rf output pulse.

Note 11A: Load voltage standing wave ratio (VSWR) must be less than 1.4:1 at any phase. Any reflected power must not exceed the VSWR of 1.4:1 even in transient condition.

Interlock system that detects the reflection and cuts off drive power or HV in pulse-to-pulse basis must be provided.

Note 12: By de-ionized low conductivity water. The maximum inlet water pressure must not exceed 0.98 MPa (10 kgf/cm²). The maximum input coolant temperature must not exceed 35 °C. The maximum output coolant temperature must not exceed 70 °C. Interlocks should be provided to prevent application of heater voltage, unless the temperatures are less than the above values.

Note 12A: Do not allow coolant to freeze in the klystron. Remove all coolant before shipping or storing or when coolant freezing is anticipated. Below freezing temperature, the unit should be fully drained and dried of coolant. And inlet coolant temperature has to be maintained above the local ambient dew point temperature.

Note 12B: Non-condensing.

Note 12C: For storage of the klystron tube, store the tube in the transport case or put it in a stand for storage. Operate an ion pump power supply at all the time except for an unavoidable case. When putting the tube to the stand for storage, support the tube at the pole piece flange on the collector. Cover the output flange of the klystron tube. Be careful contamination and oxidization at the electron gun and the electrode by dust and humidity.

Note 13: Interlocks should be provided to prevent application of rf drive, unless waveguide vacuum pressure is less than the specified value.

Note 14: Interlocks in the liquid cooling system should prevent the application of heater voltage and electromagnet (solenoid) supplies, unless the liquid coolant flow is at or above the specified minimum flow rate.

Note 15: An ion pump shall be an integral part of each tube. This ion pump shall operate at +3500 Vdc +/- 400 Vdc from a high impedance power supply capable of delivering 5 mA max. For normal tube operation, the ion pump current shall be less than 10 μ Adc.

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- Note 16: Interlocks should be provided to prevent application of beam voltage, unless the ion pump current is less than the normal operating value.
- Note 17: An ion pump cover box delivered with the tube is equipped with "HN-R" connector. The ion pump cover box is factory integrated.
- Note 17A: Socket shall be prepared by equipment manufacturer. Spring contact rods for HV connection are available as optional accessory.
- Note 18: Connectors mated with NITTO KOHKI COUPLER "SP-Coupler series" are available from NITTO KOHKI U.S.A INC. [46 Chancellor Drive, Roselle, Illinois 60172, U.S.A. TEL +1-630-924-5959, FAX +1-630-924-1174].
- Note.18A: Output waveguide cooling is not necessary if the average rf output power is less than 6.3 kW; 60% of the absolute rating.
- Note 19: Interlocks should be provided to prevent application of beam voltage unless solenoid coil current is within +/-5% of the specified value.
- Note 20: X-ray shielding for collector "VT-69063" is furnished as an integral part of the klystron if optioned. However, it is the responsibility of the equipment manufacturer to furnish any additional protection necessary to meet all required safety standards when the tube is operated in the equipment.
- Note 21: Measured the tube with the X-ray shields; "VT-69063" for the collector and "VT-69064" for the gap between the electromagnet and the klystron.
- Note 22: Output power is measured by calorimetric means.
- Note 23: Drive power is defined as the power incident to the klystron.
- Note 24: The packed tube shall not be damaged by a shock of 6 G maximum.

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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 protection activation.

Characteristics	Type	Point of action	Action speed
Oil level	min. F	Klystron high voltage	Medium or Manual
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
Klystron temperature	max. F	Klystron high voltage	Medium
Heater voltage	min. max. A	Klystron high voltage	Medium
Heater current	min. max. A	Klystron high voltage	Medium
Beam voltage	max. F	Klystron high voltage	Medium and pulse-to-pulse
Beam current	max. F	Klystron high voltage	Medium and pulse-to-pulse
Klystron inverse voltage	max. F	Klystron high voltage	Pulse-to-pulse
Klystron inverse current	max. F	Klystron high voltage	Pulse-to-pulse
Waveguide pressure	max. F	Klystron high voltage	Fast
Waveguide SWR	max. F	RF drive or klystron high voltage	Pulse-to-pulse
Electromagnet current	min. max. A	Klystron high voltage	Medium
Electromagnet voltage	min. max. A	Klystron high voltage	Medium
Electromagnet water flow	min. F	Electromagnet supply	Medium
Electromagnet water temperature	max. F	Electromagnet supply	Medium
Electromagnet temperature	max. F	Electromagnet supply	Medium

"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.

The "medium" action speed indicates the monitoring system can be based on average value measurements. It should be around 100 ms.

The "fast" action speed indicates the klystron high voltage must be cut off as soon as possible within 30 ms. Usually this can be done by cutting off the thyatron 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.

In order to protect the ceramic windows, an ion pump should be equipped within 1 m from the windows. Monitor waveguide pressure with a cold cathode gauge and interlock at fast speed.

DEVICES NECESSARY FOR INSTALLATION:

- a. Carrying device such as a hoist etc.

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Lifting height of the crane should be 3 meters or more from the flange plane of the oil tank to install the klystron tube.

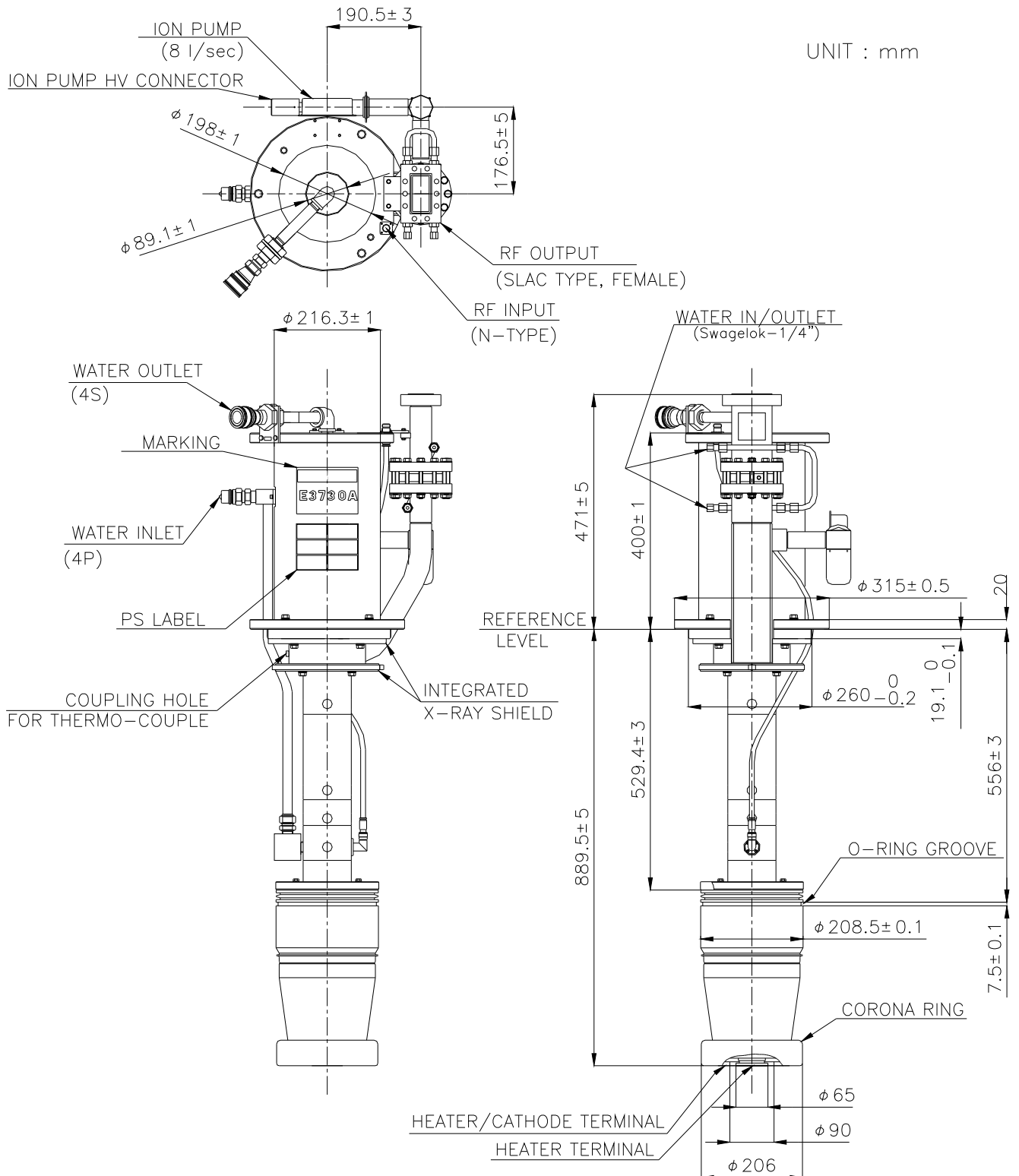
b. Stand for the klystron tube.

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OUTLINE DRAWING E3730A

UNIT : mm

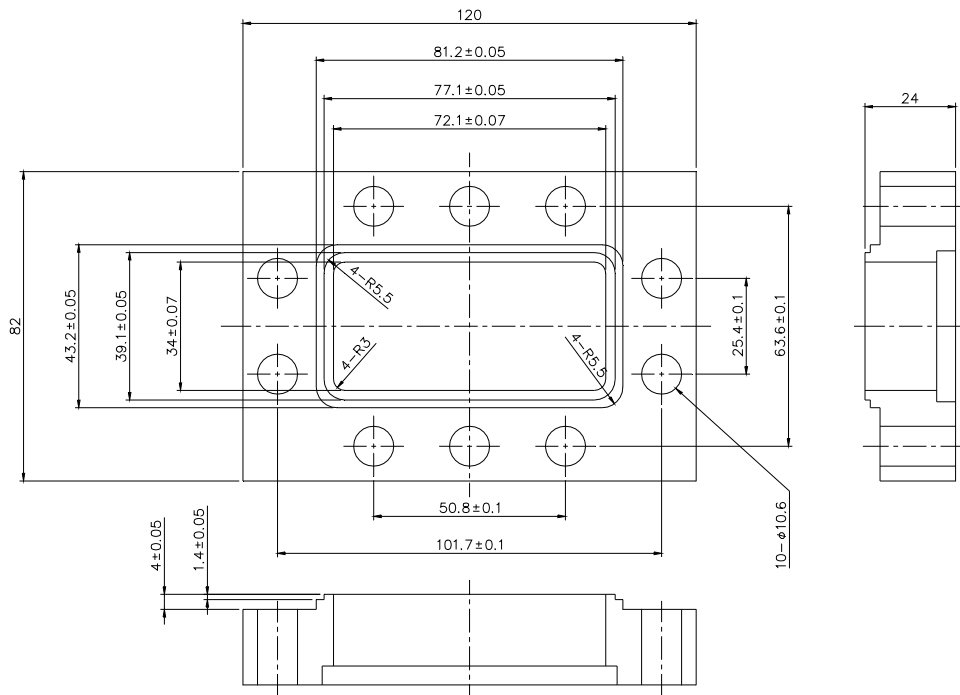


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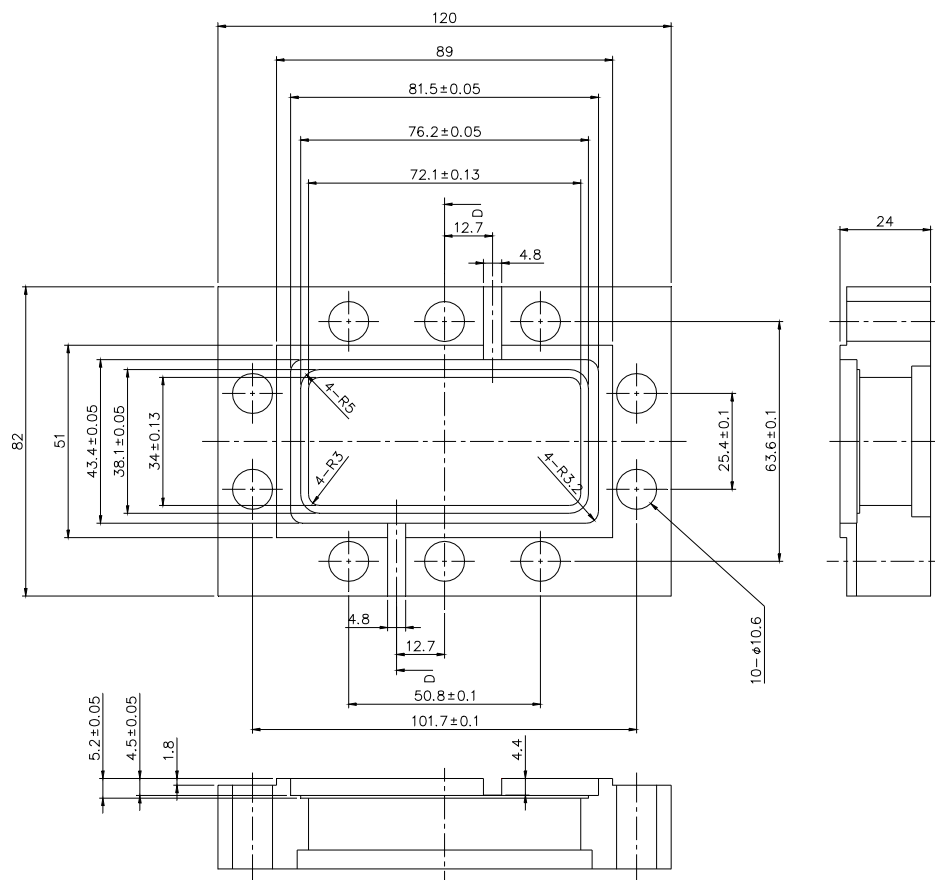
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SLAC-TYPE FLANGE(MALE)



SLAC-TYPE FLANGE(FEMALE)



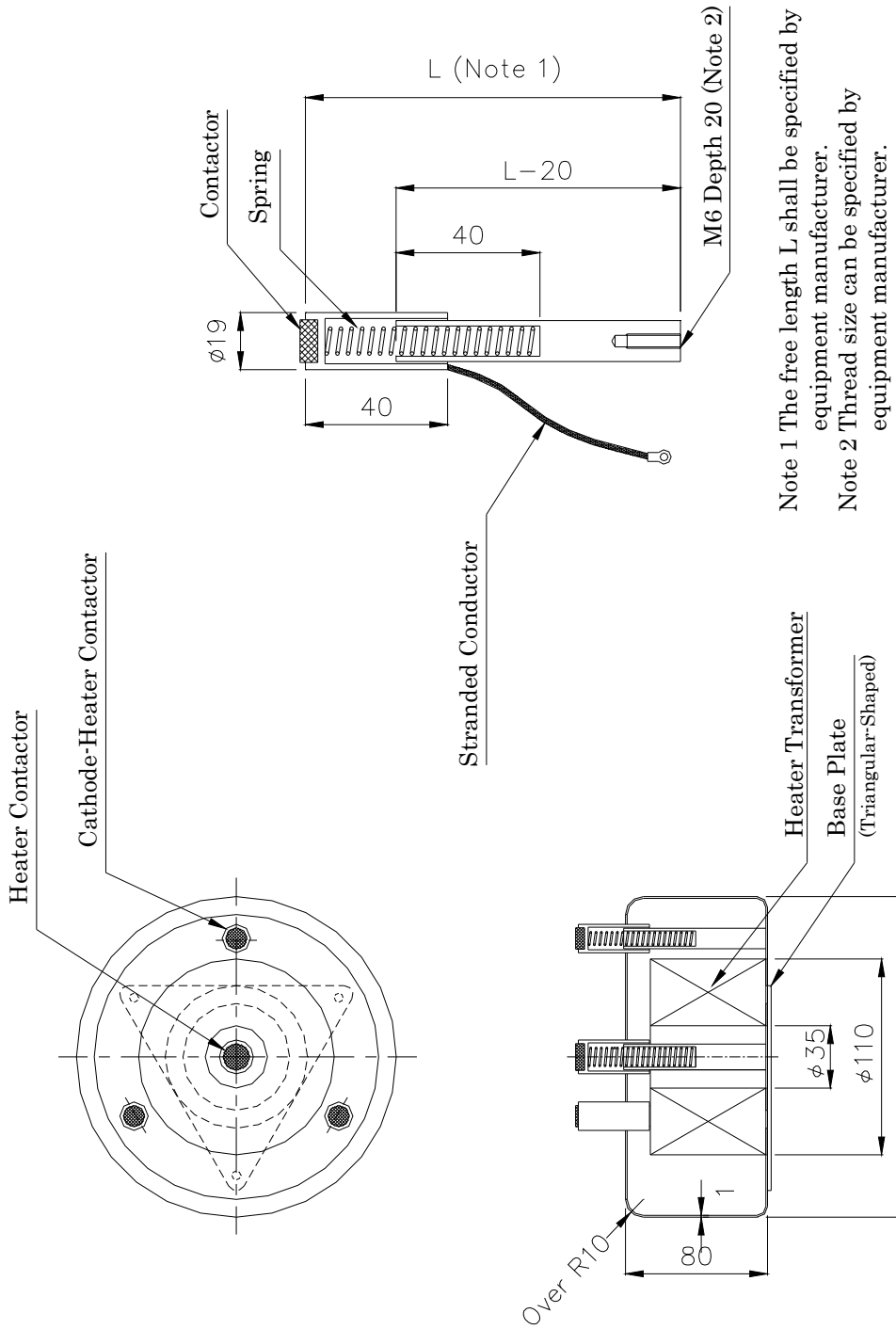
D-D Cross Section View

DIMENSIONAL DRAWING SLAC Type Flange

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Unit : mm



Example of socket using the spring contactors

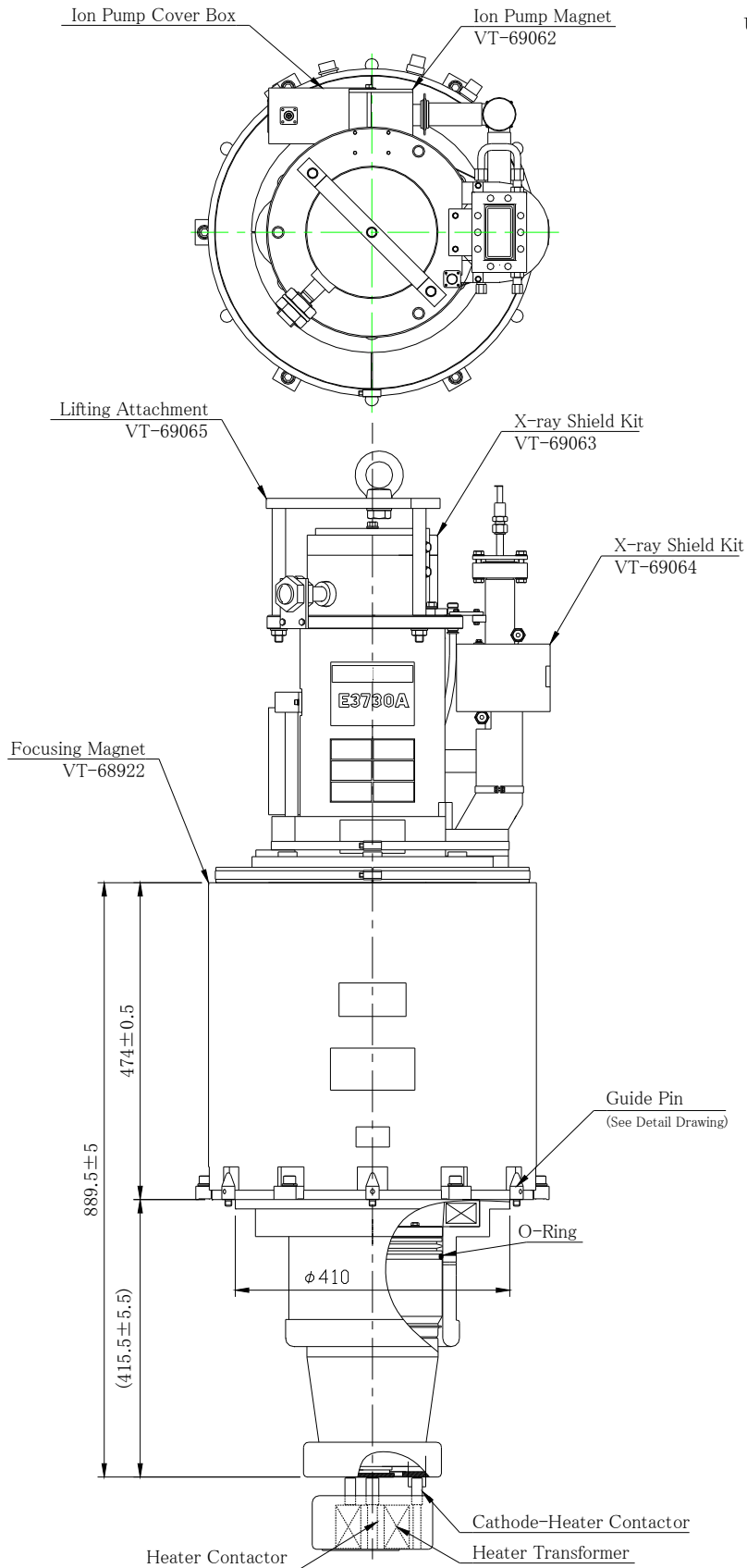
Spring Contact Rods

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SPECIFICATION E3730A

Unit : mm



Configuration of Klystron Units

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Marking Label E3730A

PRODUCT SPECIFICATION FOR VT-68922

Description: Liquid Cooled Focusing Electromagnet for use with CETD E3730A High Power Pulse Klystron. The electromagnet consists of five (5) main coils and one (1) supplementary coil which are connected to each connector. When energized with the proper current specified by the tube manufacturer, the electromagnet provides the shaped field required to properly operate the klystron.

ABSOLUTE RATINGS: (Note 1)

Parameters	Symbol	Units	Max.	Min.	Notes
Solenoid Current	Isol(1-5)	Adc	40	---	2
	Isol(6)	Adc	10	---	2
Coil voltage to case	Vsol,case	Vdc	1000	-1000	
Coolant flow	Qw	L/min.	---	10	3
Coolant pressure	Pw	MPa	0.98	---	
		(kgf/cm ²)	10.0	---	
Coolant pressure drop	ΔPw	MPa	0.19	---	
		(kgf/cm ²)	2.0	---	
Inlet Coolant temperature	Tw	°C	40	5	4, 5
Environmental temperature	Te	°C	40	0	5
Environmental humidity	H	%	90	0	4, 6

PHYSICAL RATINGS:

Dimensions	See VT-68922 OUTLINE DRAWING
Marking	See VT-68922 MARKING
Electrical Connections	MS3102A-24-10S for coil current lead (No.1-No.3) (Note 7)
	MS3102A-24-10P for coil current lead (No.4-No.6) (Note 7)
	MS3102A-16S-1S for Thermo Sensor (Note 7A)
Mounting Position	Vertical, collector end up
Coolant	Water (Note 3, 4, 5, 8)
Coolant Connector	NITTO KOHKI COUPLER, "SP-Coupler series":
	Equipped with "4P" for the inlet and "4S" for the outlet
Interlock Signal Output	High temperature interlock.
Finish	Painted side-surface of the shell with black: Munsell N-1.0
	Yoke iron plate on both top and bottom are chromate treated or bright
	Ni-plated
Weight	Approx. 520 kg
Shipping	CETD standard package
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ELECTRICAL RATINGS:

Item	Condition	Symbol	Min.	Max.	Unit
Operating Voltage	Isol1 = 25.0 Adc,	Esol1	---	15.0	Vdc
	Isol2 = 38.0 Adc,	Esol2	---	30.0	Vdc
	Isol3 = 18.5 Adc,	Esol3	---	25.0	Vdc
	Isol4 = 24.0 Adc,	Esol4	---	39.0	Vdc
	Isol5 = 16.5 Adc,	Esol5	---	22.5	Vdc
	Isol6 = 10.0 Adc,	Esol6	---	10.0	Vdc
Field Polarity	Main coils (No.1-No.5) aiding				
	Auxiliary coil (No.6) aiding				
Insulation Resistance	1000 MΩ, minimum at +/-1000 Vdc in 30 seconds (Note 9)				

ATTACHED ACCESORIES:

INTEGRATED WITH THE ELECTROMAGNET

Inlet/Outlet Connector	NITTO KOHKI "SP-type COUPLER" "4S"	1P
(mated Connector)	NITTO KOHKI "SP-type COUPLER" "4P"	1P
Coil Current Lead	MS3106B-24-10P (No.1-No.3)	1S
(mated Connector)	MS3106B-24-10S (No.4-No.6)	1S
Thermo Sensor	MS3106BA-16S-1P	1S
(mated Connector)		
Cable Cramp	MS3057-16A (for MS3106B-24-10P,10S)	2S
	MS3057-8A (for MS3106B16S-1P)	1S

ATTACHED WITH THE ELECTROMAGNET

Guiding Rods	Per Outline Drawing	6P
Clamps	Per Outline Drawing	6P

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QUALITY CONFORMANCE INSPECTION (1):

Test	Condition	Symbol	Min.	Max.	Unit
Dimensions	Per Outline Drawing (Note 12)	---	---	---	---
Insulation resistance	DC1000 V for 30 seconds between Coil terminal and Magnet shell	(Note 9)	1000	---	MΩ
Hydrostatic pressure	P=0.98 MPa (10 kgf/cm ²) water for 15 minutes		No visible leak nor damage		
Coolant pressure drop (Note 6)	Qw=10 L/min.	ΔPw	---	0.2	MPa
			(---	2.0	kgf/cm ²)
Operating Voltage	Isol1 = 25 Adc,	Esol1	---	12.5	Vdc
	Isol2 = 35 Adc,	Esol2	---	24.0	Vdc
	Isol3 = 20 Adc,	Esol3	---	25.5	Vdc
	Isol4 = 30 Adc,	Esol4	---	39.0	Vdc
	Isol5 = 20 Adc,	Esol5	---	22.5	Vdc
	Isol6 = 10 Adc,	Esol6	---	10.0	Vdc
	after 3 hours				
	Te=room temp.				
	Tw=25 °C				

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WARRANTY:

1. CETD warrants the products to be free of manufacturing defects which will impair their normal operational life during the warranty period, provided that the klystrons are used within the ratings and in accordance with CETD's instructions and specifications.
2. The warranty period extends for twelve (12) months from the date of the original Bill of Lading. If the product shall prove to be defective during the warranty period, CETD shall refund the original amount.
3. Notification of the claim shall be received by CETD within the three (3) months after discovery of failure, filling in CETD's report form. When the return of the defective product is required by CETD, each return shall be made without delay, and accordance with CETD instruction.
4. The warranty shall not apply to defect resulting from accidents, alterations, abuse or misuse, or improper installation.

NOTES:

- Note 1: Referring to paragraph 6.5 of MIL-E-1G, those values are based on the "absolute system" and should not be exceeded under continuous or transient conditions. A single rating 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 environmental variation.
- Note 2: The unit is capable of operating continuously at 40 Adc in No1-No.5 coils and 10 Adc in No.6 coil under the minimum coolant flow and maximum inlet coolant temperature without damage. Be sure that a supplemental coil (No.6) for Electron Gun region is immersed in oil up to O-ring level of the tube and coolant flow is above the minimum flow rate, when energize the electromagnet VT-68922.
- Note 3: Interlocks in the liquid cooling system should prevent the application of electromagnet (solenoid) supplies, unless the liquid coolant flow is at, or above the specified minimum flow rate. It is recommended that the maximum coolant flow rate be limited to less than 14 l/min. to prevent cavitation and resultant corrosion acceleration due to high coolant velocity.
- Note 4: Inlet coolant temperature has to be maintained above the local ambient dew point temperature.
- Note 5: Do not allow coolant to freeze in the magnet. Remove all coolant before shipping or storing or when coolant freezing is anticipated. Below freezing temperature, the unit should be fully drained and dried of coolant.

Note 6: Non-condensing

Issued : 2020-08-17

Revised :

SPECIFICATION

VT-68922

Note 7: Focusing Electromagnet is basically wired with any polarity. Each Coil (No.1-No.6) is connected with the following polarity:

MS3102A-24-10S Connector

A(+), B(-) for No.1, C(+), D(-) for No.2, E(+), F(-) for No.3, G : Not Connected

MS3102A-24-10P Connector

A(+), B(-) for No.4, C(+), D(-) for No.5, E(+), F(-) for No.6, G : Not Connected

Note 7A: Equipped with Thermo couples (CA-type) as thermal sensor of coils.

MS3102A-16-1S Connector

A(+), B(-) for Ch1, C(+), D(-) for Ch2, E,F,G : Not Connected.

Note 8: Small traces of high purity water left in a stored unit will cause accelerated corrosion in copper. Dry the unit thoroughly before storage, especially if high purity water was used in testing or operation.

Note 9: The insulation resistance measurement shall be done after the hydrostatic pressure test. The magnet shell and cooling system constitute ground for insulation resistance measurements. The test voltage shall be brought up to the maximum specified in the time given.

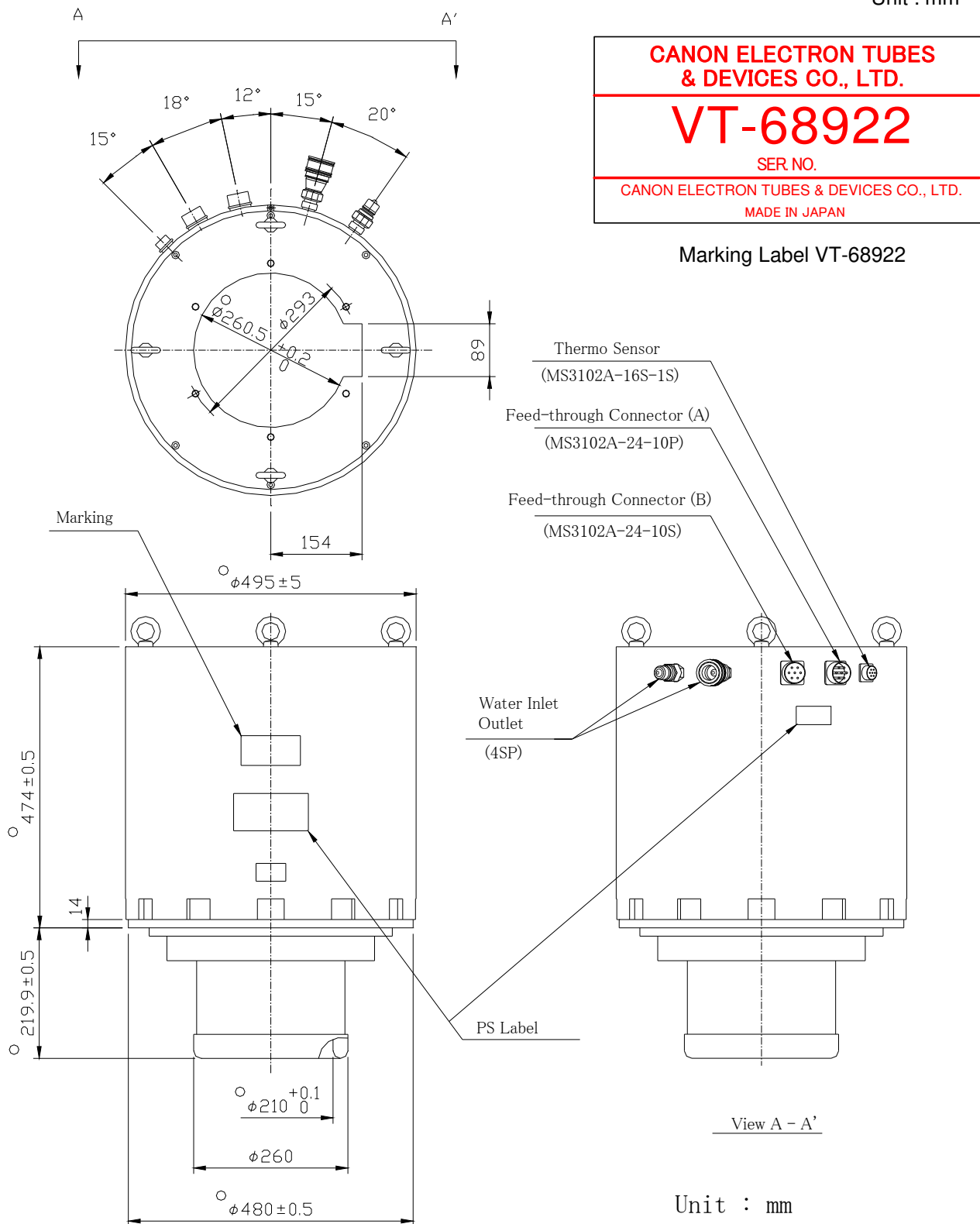
Note 10: CETD E3730A klystron is mounted into the magnet for conforming dimensional validity.

Issued : 2020-08-17

Revised :

VT-68922

Unit : mm

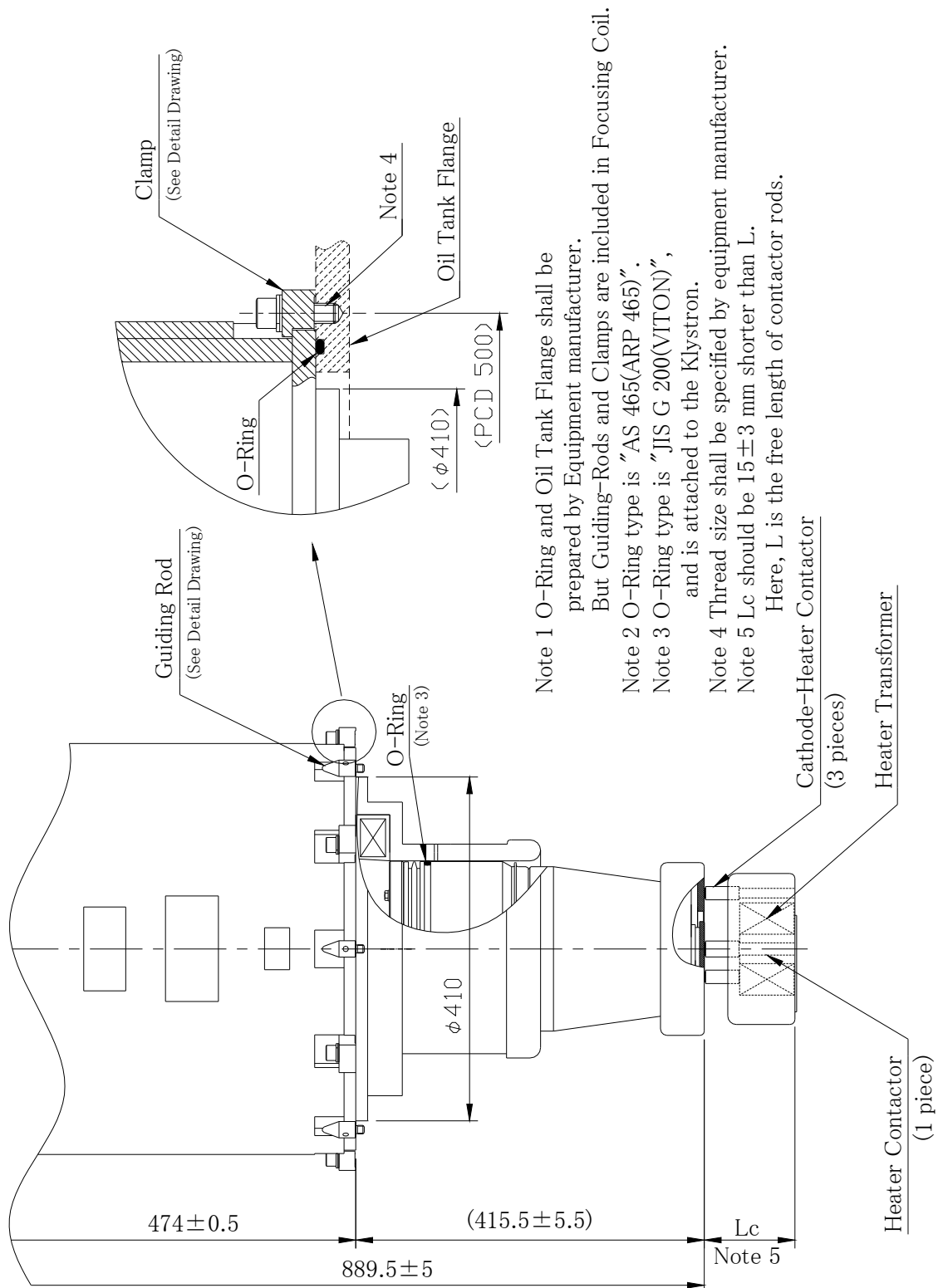


OUTLINE DRAWING VT-68922

Issued : 2020-08-17

Revised :

Unit : mm

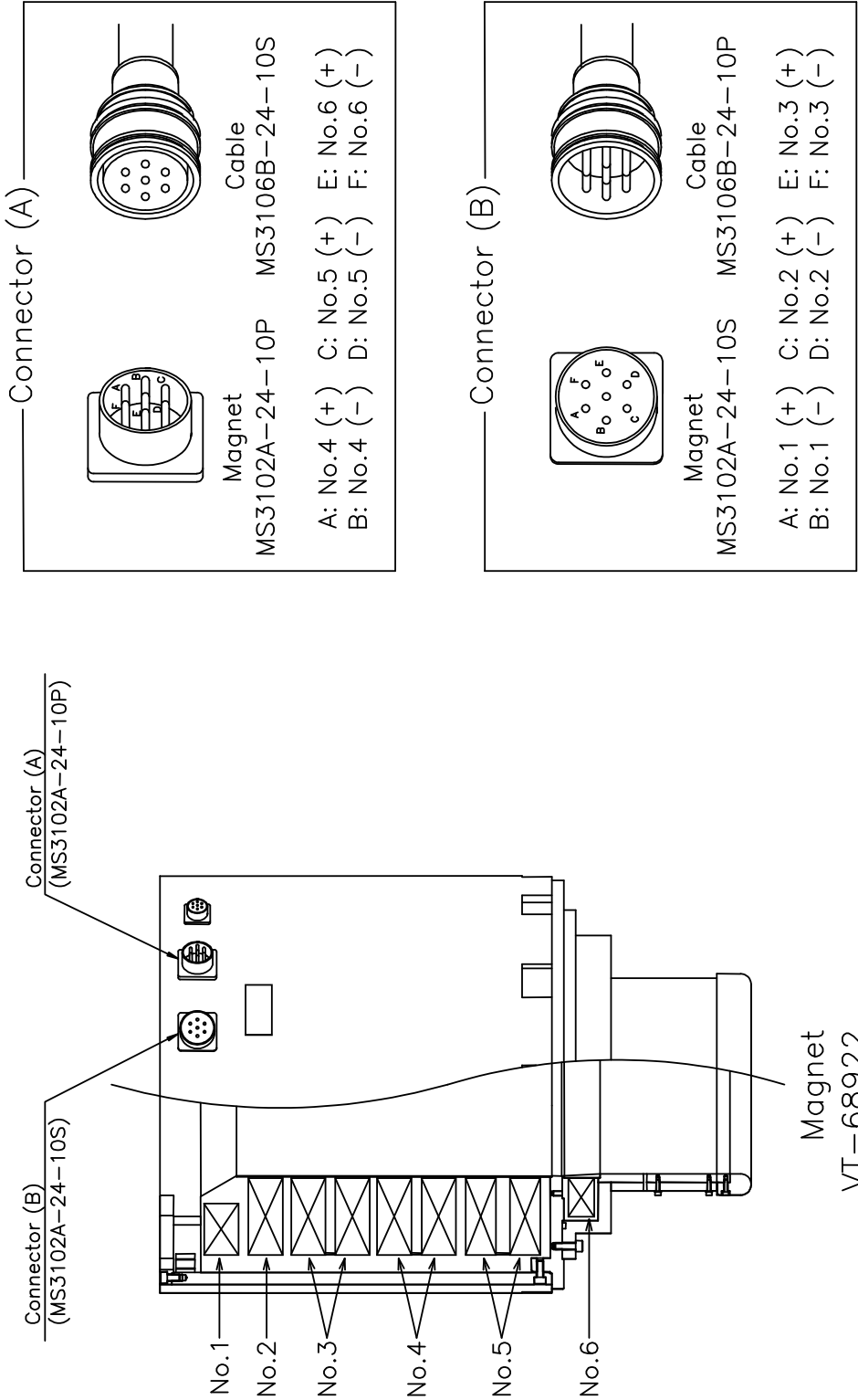


Interface with Oil Tank Flange

Issued : 2020-08-17

Revised :

Detail Description for Magnet Connector

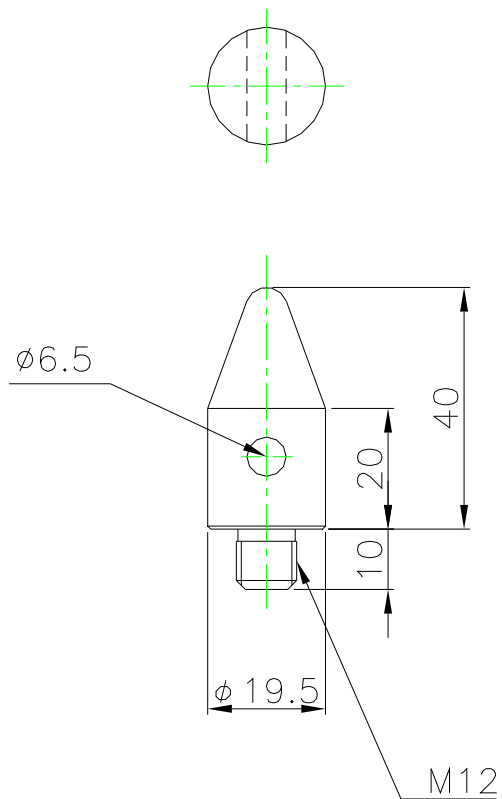


Detail Description for Magnet Connector

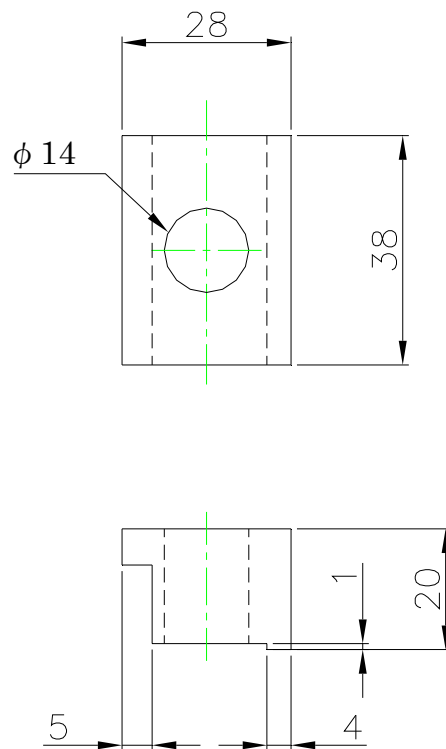
Issued : 2020-08-17
Revised :

Unit : mm

Guiding Rod



Clamp



OUTLINE DRAWING: Guiding- Rod and Clamp

Issued : 2020-08-17

Revised :

PRODUCT SPECIFICATION FOR VT-69045

Description: Sealing gasket for vacuum waveguide flange. Made of oxygen free copper. (OFC).
Designed for the output waveguide flanges of CETD E3730A pulsed klystron.

PHYSICAL RATINGS:

Dimensions	See VT-69045 OUTLINE DRAWING
Weight	Approx. 0.015 kg
Material	OFC (Annealed)
Packing	CETD standard package

QUALITY CONFORMANCE INSPECTION:

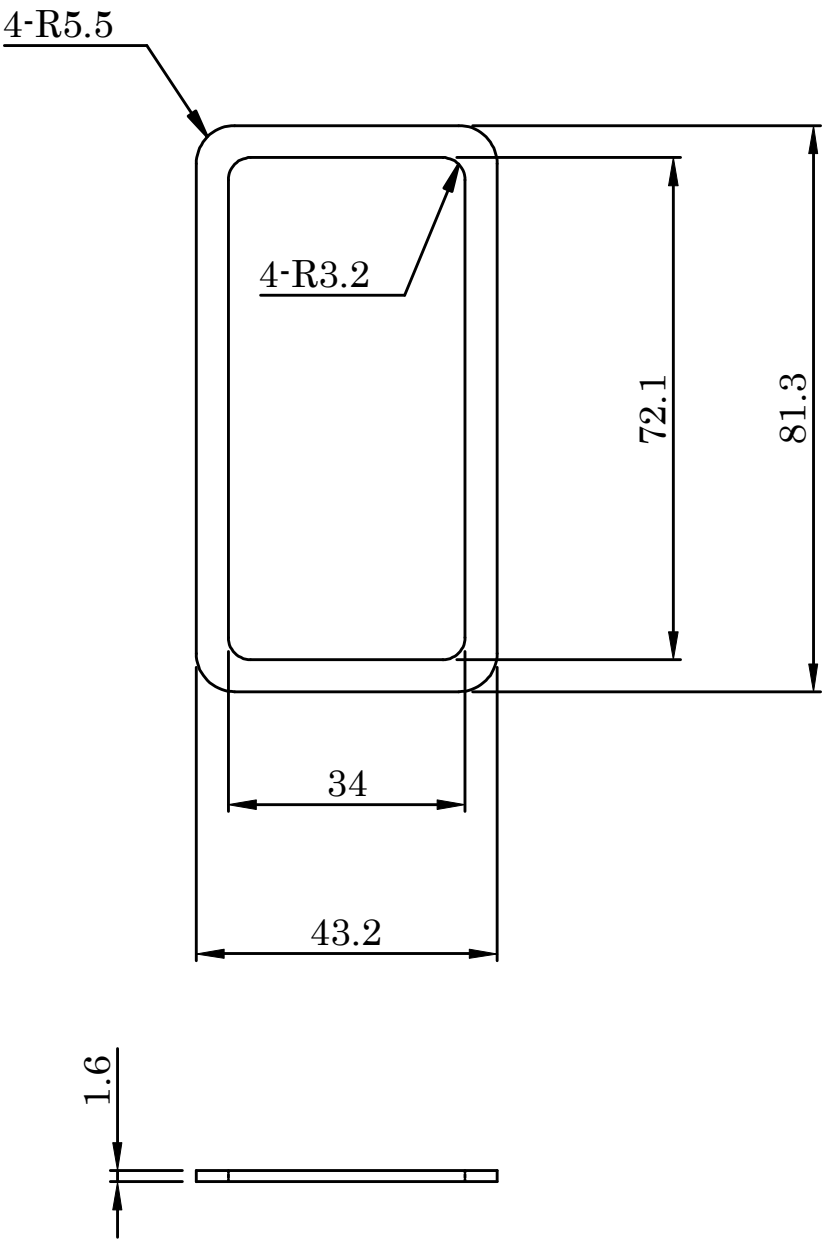
Test	Condition	Symbol	Min.	Max.	Unit
Dimensions	Per outline drawing	---	No flaw on sealing faces		

WARRANTY:

1. CETD warrants the products to be free of manufacturing defects which will impair their normal operational life during the warranty period, provided that the klystrons are used within the ratings and in accordance with CETD's instructions and specifications.
2. The warranty period extends for twelve (12) months from the date of the original Bill of Lading. If the products shall prove to be defective during the warranty period, CETD shall refund the original amount.
3. Notification of the claim shall be received by CETD within the three (3) months after discovery of failure, filling in CETD' s report form. When the return of the defective product is required by CETD, each return shall be made without delay, and accordance with CETD instruction.
4. The warranty shall not apply to defect resulting from accidents, alterations, abuse or misuse, or improper installation.

Issued : 2020-08-17
Revised :

Unit : mm
Material : OFC



OUTLINE DRAWING VT-69045

Issued : 2020-08-17
Revised :

PRODUCT SPECIFICATION FOR VT-69062

Description: Ion pump magnet unit with magnetic shield case for an 8 L/s ion pump integrated with E3730A (Note 1)

PHYSICAL RATINGS:

Dimensions	See VT-69062 OUTLINE DRAWING
Weight	Approx. 4 kg
Material	Ferrite Magnet and Iron Shield
Packing	Integrated with E3730A klystron (Note 2)

QUALITY CONFORMANCE INSPECTION:

Test	Condition	Symbol	Min.	Max.	Unit
Dimensions	Per outline drawing	-	-	-	-

WARRANTY:

1. CETD warrants the products to be free of manufacturing defects which will impair their normal operational life during the warranty period, provided that the klystrons are used within the ratings and in accordance with CETD's instructions and specifications.
2. The warranty period extends for twelve (12) months from the date of the original Bill of Lading. If the klystron shall prove to be defective during the warranty period, CETD shall refund the original amount.
3. Notification of the claim shall be received by CETD within the three (3) months after discovery of failure, filling in CETD's report form. When the return of the defective klystron is required by CETD, each return shall be made without delay, and accordance with CETD instruction.
4. The warranty shall not apply to defect resulting from accidents, alterations, abuse or misuse, or improper installation.

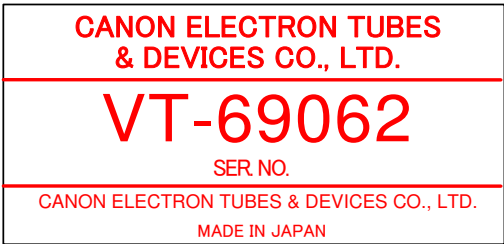
NOTES:

Note 1: Stray magnetic field is less than 0.0001 T (1 Gauss) at a distance of 6 cm away from the magnet case.

Note 2: Factory furnished when Ion Pump Magnet VT-69062 is optioned as an accessory.

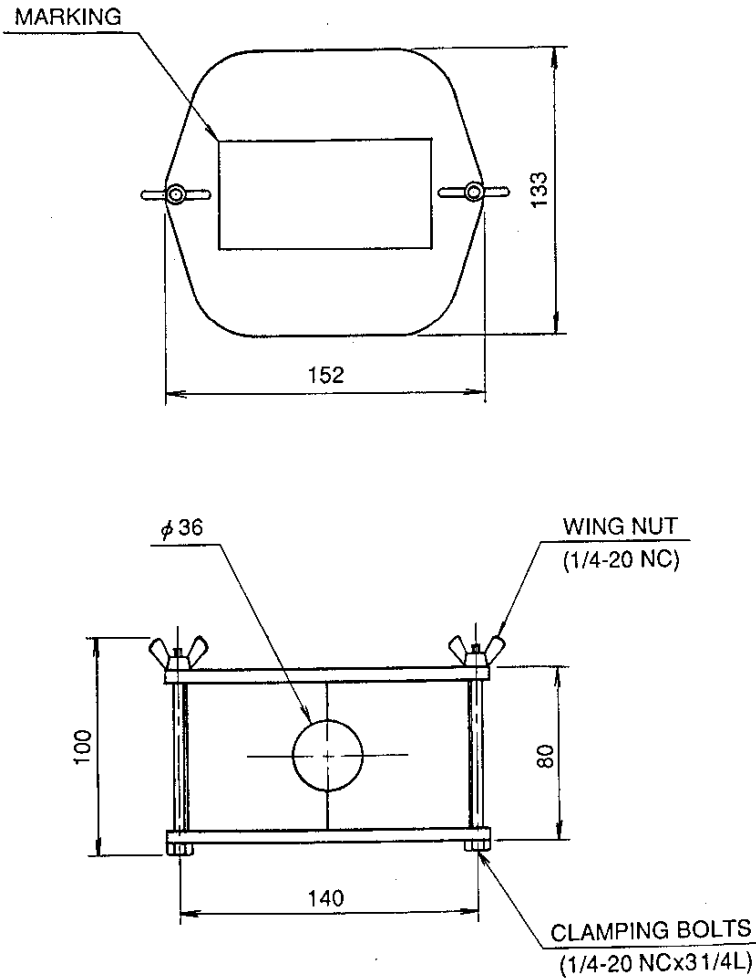
Issued : 2020-08-17

Revised :



Marking Label VT-69062

Unit : mm (inch)



OUTLINE DRAWING VT-69062

Issued : 2020-08-17
Revised :

PRODUCT SPECIFICATION FOR VT-69063

Description: X-Ray shield specific for the collector of CETD E3730A pulsed klystron. (Note 1)

PHYSICAL RATINGS:

Dimensions	See VT-69063 OUTLINE DRAWING
Total length	520 mm
Material	Lead (Note 3)
Number of piece parts	4
Weight	Approx. 140 kg
Packing	Integrated with E3730A klystron (Note 2)

QUALITY CONFORMANCE INSPECTION:

Test	Condition	Symbol	Min.	Max.	Unit
Dimensions	Per outline drawing	-	-	-	-

WARRANTY:

1. CETD warrants the products to be free of manufacturing defects which will impair their normal operational life during the warranty period, provided that the klystrons are used within the ratings and in accordance with CETD's instructions and specifications.
2. The warranty period extends for twelve (12) months from the date of the original Bill of Lading. If the product shall prove to be defective during the warranty period, CETD shall refund the original amount.
3. Notification of the claim shall be received by CETD within the three (3) months after discovery of failure, filling in CETD's report form. When the return of the defective product is required by CETD, each return shall be made without delay, and accordance with CETD instruction.
4. The warranty shall not apply to defect resulting from accidents, alterations, abuse or misuse, or improper installation.

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Revised :

CAUTION

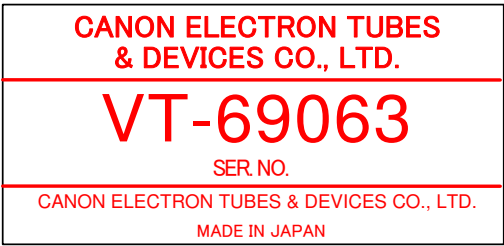
Lead is used for X-ray shield, do not abrade because lead powder is harmful if it comes into contact with skin or is ingested. Wear protective gloves when handling it, and be sure to wash the hands after handling.

NOTES:

- Note 1: When used with specific electromagnet VT-68922, it is possible to suppress X-ray leakage into the level lower than 10 $\mu\text{Sv/h}$ from the surface of the collector at the output level of 46 MW with the pulse repetition rate of 50 pps.
However, X-ray leakage can exceed the above level from the cooling water outlet on the top of the collector. Additional X-ray shield (lead thicker than 10 mm) should be prepared by the equipment manufacturer.
- Note 2: Factory integrated when X-ray shield VT-69063 is optioned as an accessory.
When installing VT-69063 into the collector of E3730A, it is recommended to use with a specific lifting fixture VT-69067 (Option). When installing or uninstalling the X-ray shield, the fitting of the outlet for cooling water should be detached.
- Note 3: Be careful to handle the shield kit, because it is easily deformed by stressing or shock. This shield kit consists of four parts; a lid, a cylindrical body, a pipe shield for water outlet and a shield fastener. Each part is not fixed together. Handle individual part one after another so as not to drop a lid.

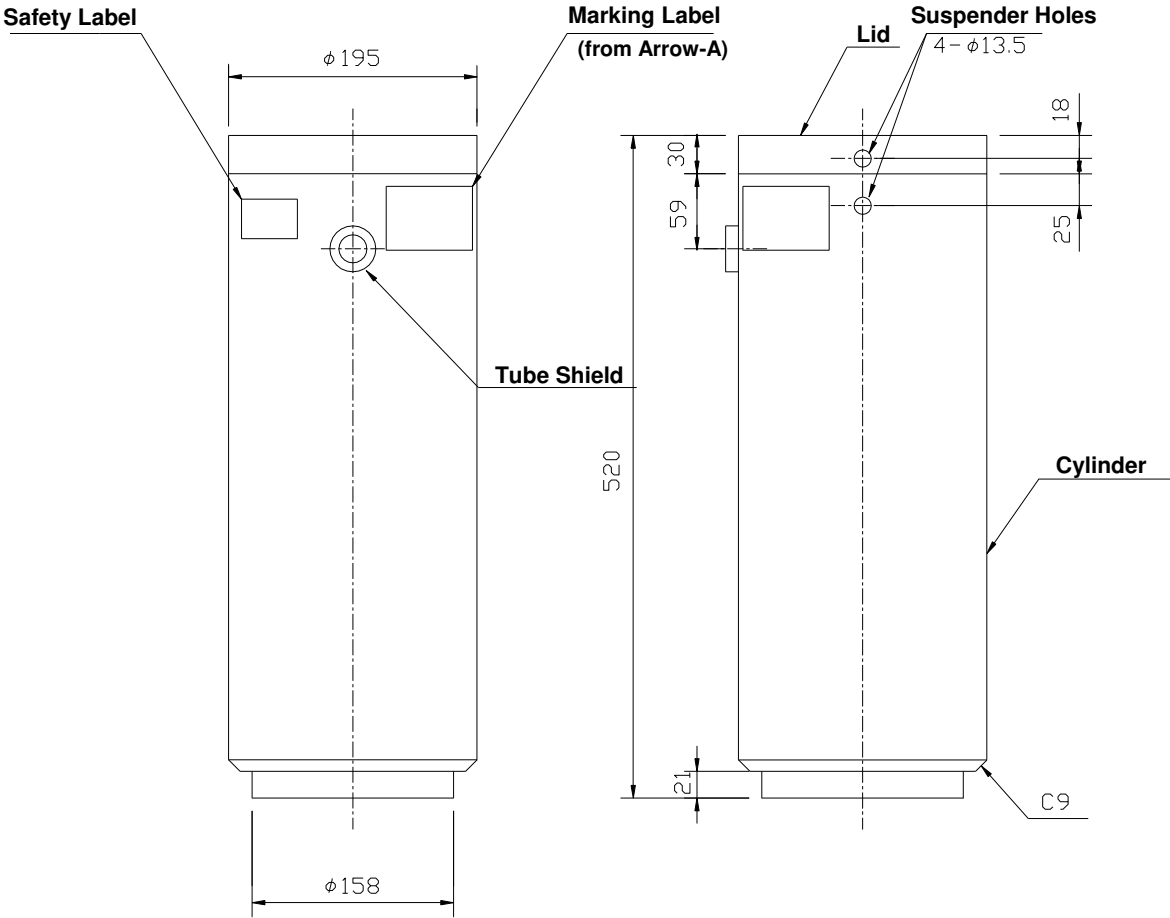
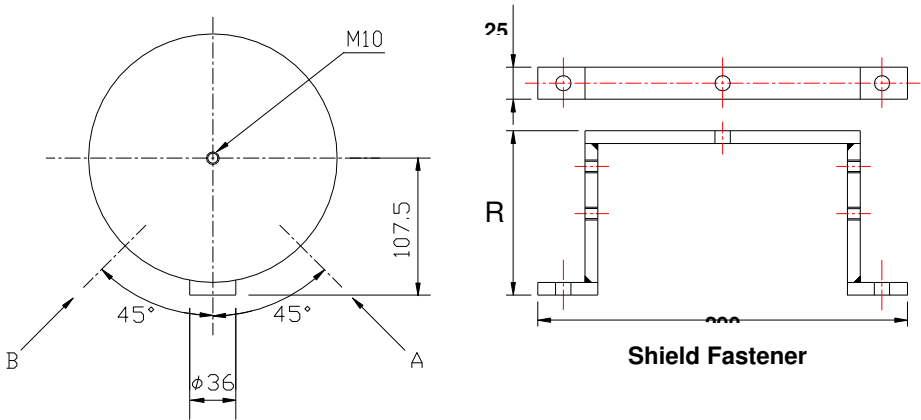
Issued : 2020-08-17

Revised :



Marking Label VT-69063

UNIT : mm



OUTLINE DRAWING VT-69063

PRODUCT SPECIFICATION FOR VT-69064

Description: X-Ray shield kit to prevent x-ray from leaking from the output cavity section and output waveguide section of CETD E3730A when installed in the electromagnet VT-68922 (Note 1)

PHYSICAL RATINGS:

Dimensions	See VT-69064 OUTLINE DRAWING
Material	Lead (Note 2)
Number of piece parts	8 (Note 3)
Weight	Approx. 40 kg
Packing	CETD standard package
Finish	--- (Option: Painted surface-side with black: Munsell N1.0)

QUALITY CONFORMANCE INSPECTION:

Test	Condition	Symbol	Min.	Max.	Unit
Dimensions	Per outline drawing	---	---	---	---

WARRANTY:

1. CETD warrants the products to be free of manufacturing defects which will impair their normal operational life during the warranty period, provided that the klystrons are used within the ratings and in accordance with CETD's instructions and specifications.
2. The warranty period extends for twelve (12) months from the date of the original Bill of Lading. If the klystron shall prove to be defective during the warranty period, CETD shall refund the original amount.
3. Notification of the claim shall be received by CETD within the three (3) months after discovery of failure, filling in CETD's report form. When the return of the defective klystron is required by CETD, each return shall be made without delay, and accordance with CETD instruction.
4. The warranty shall not apply to defect resulting from accidents, alterations, abuse or misuse, or improper installation.

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Revised :

CAUTION

Lead is used for the X-ray shield, do not abrade because lead powder is harmful if it comes into contact with skin or is ingested. Wear protective gloves when handling it, and be sure to wash the hands after handling.

NOTES:

- Note 1: When used with specific electromagnet VT-68922, it is possible to suppress X-ray leakage into the level lower than 10 $\mu\text{Sv/h}$ from the surface of klystron unit in condition that the output level is below 46 MW with the pulse repetition rate of 50 pps.
However, X-ray leakage can exceed the above level from some points of the electromagnet shell: The inlet and outlet of cooling water: Current lead connector: Thermo sensor connector.
Additional X-ray shields (lead thicker than 10 mm) should be prepared by the equipment manufacturer.
- Note 2: Be careful to handle the shield kit, because it is easily deformed by stressing or dropped shock.
Note that lead is harmful material to human body.
- Note 3: As the "VT-69064" is not firmly fixed to the klystron unit due to the structure, it should be removed when the klystron unit is moved.

SPECIFICATION

VT-69064

**CANON ELECTRON TUBES
& DEVICES CO., LTD.**

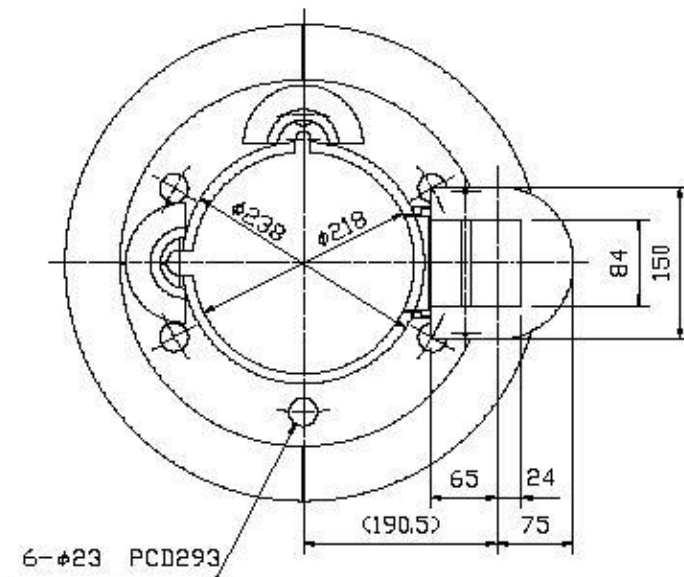
VT-69064

SER. NO.

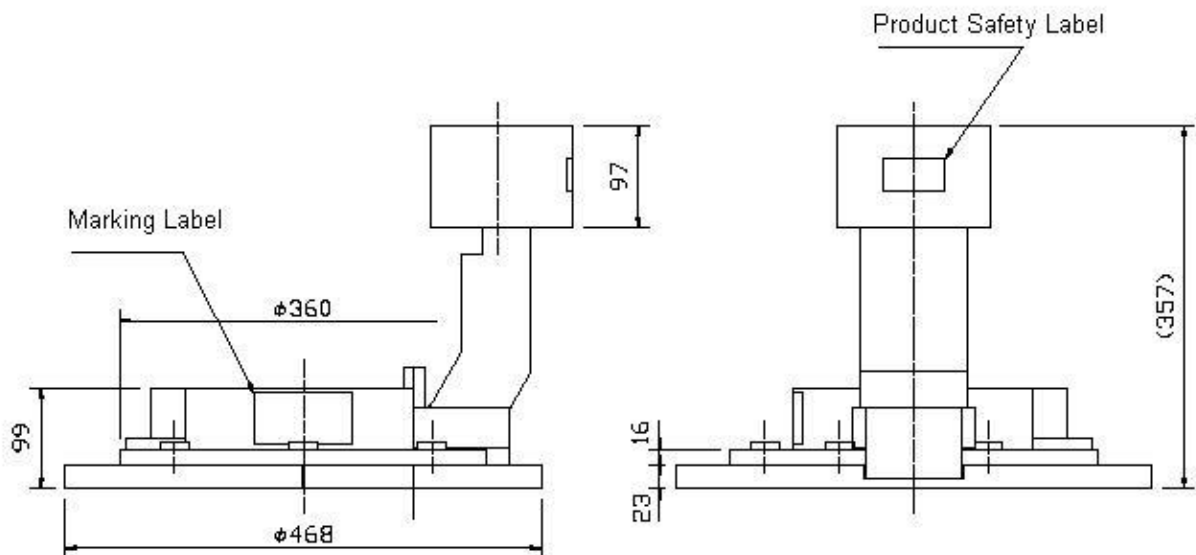
CANON ELECTRON TUBES & DEVICES CO., LTD.

MADE IN JAPAN

Marking Label VT-69064



UNIT: mm



OUTLINE DRAWING VT-69064

Issued : 2020-08-17

Revised :

PRODUCT SPECIFICATION FOR VT-69065

Description: Lifting attachment for suspending CETD E3730A klystron right vertically (Note 1)

PHYSICAL RATINGS:

Dimensions	See VT-69065 OUTLINE DRAWING
Marking	See VT-69065 Marking
Material	Stainless Steel
Weight	Approx. 10 kg
Packing	Integrated with E3730A klystron (Option)
Load Weight	630 kg

QUALITY CONFORMANCE INSPECTION:

Test	Condition	Symbol	Min.	Max.	Unit
Dimensions	Per outline drawing	---	---	---	---

WARRANTY:

1. CETD warrants the products to be free of manufacturing defects which will impair their normal operational life during the warranty period, provided that the klystrons are used within the ratings and in accordance with CETD's instructions and specifications.
2. The warranty period extends for twelve (12) months from the date of the original Bill of Lading. If the product shall prove to be defective during the warranty period, CETD shall refund the original amount.
3. Notification of the claim shall be received by CETD within the three (3) months after discovery of failure, filling in CETD's report form. When the return of the defective product is required by CETD, each return shall be made without delay, and accordance with CETD instruction.
4. The warranty shall not apply to defect resulting from accidents, alterations, abuse or misuse, or improper installation.

Issued : 2020-08-17

Revised :

NOTES:

- Note 1: This device shall work correctly when it is used for lifting CETD E3730A pulsed klystron with CETD VT-69063 collector shield kit. When anything else is attached to the klystron, the klystron may not be suspended right vertically and may not be easily installed into electromagnet or klystron socket.
- Note 2: This device must not be used for lifting anything other than CETD E3730A klystron. When this device is used for anything else, the manufacturer's guarantee becomes null and void.
- Note.3: This device must be hooked up at the eyebolt fastened on the triangular plate. The klystron must be fastened with three threads and nuts firmly at the collector bracket.

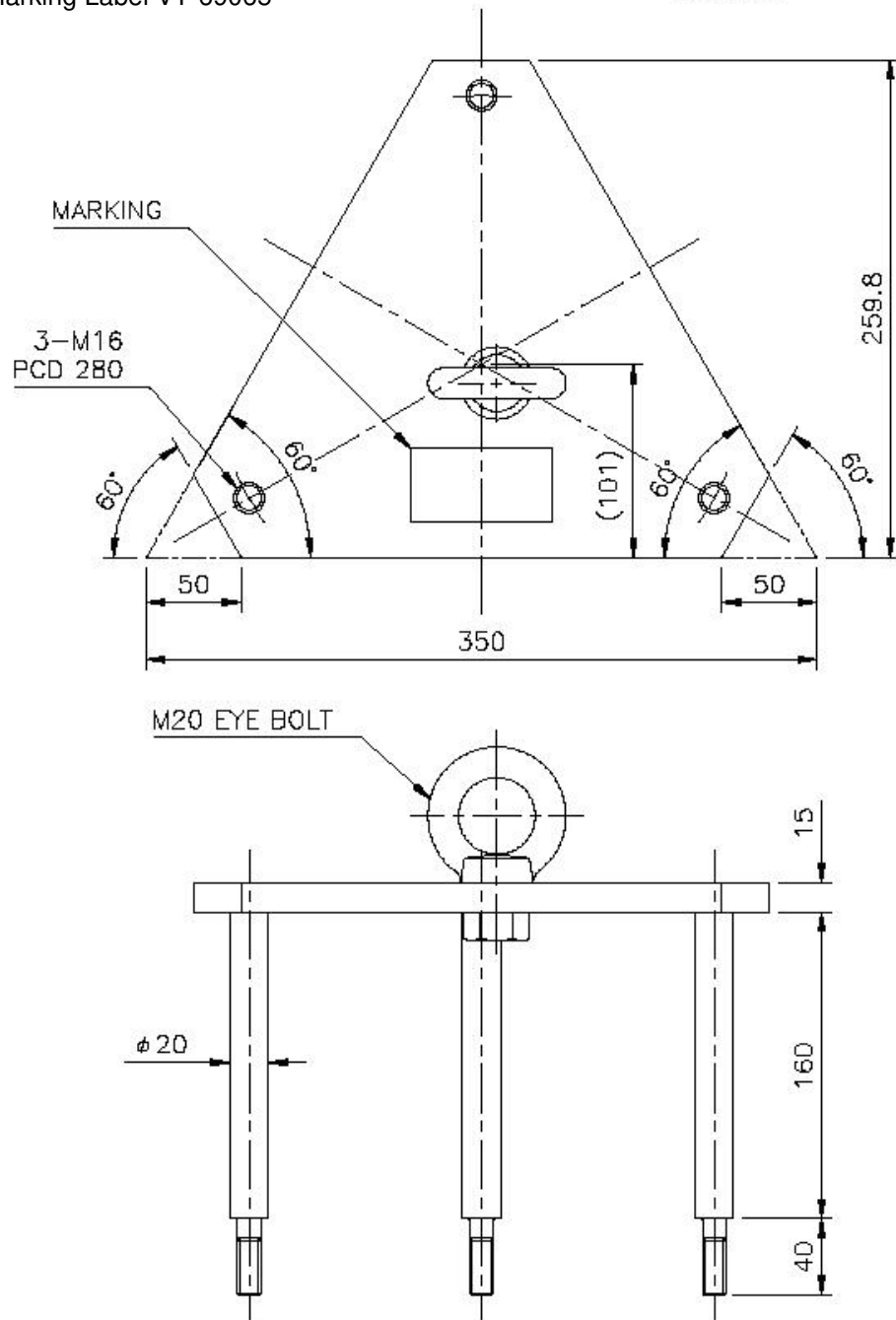
Issued : 2020-08-17

Revised :



Marking Label VT-69065

UNIT : mm



Three M12 Nuts of stainless steel are attached.

OUTLINE DRAWING VT-69065




Issued : 2020-08-17

Revised :

SAFETY PRECAUTIONS AND WARNINGS

This specification describes important information for preventing injury to users, personnel at manufactures employing this electron tube, and other personnel, as well as for preventing property loss and ensuring safe operation. Fully understand the meanings of the following indications and symbols before reading this manual and observe all precautions to ensure safe operation.

[Description of indications]

Indication	Meaning
 DANGER:	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
 WARNING:	Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.
 CAUTION:	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury or extensive property damage (e.g. damage to machinery, units, and accessories or occurrence of a fire).

This electron tube is intended and designed for use in combination with amplifier for industrial devices and scientific equipment.

If this electron tube is to be used with equipment other than the above, contact CETD in advance. CETD will not be held responsible for malfunction or damage caused by the use of this electron tube in applications other than those specified without prior approval.

When designing or operating equipment employing the electron tube, do not attempt to modify the electron tube and do not allow the electron tube to be operated beyond its ratings. CETD will not be held liable if these precautions are not observed.

[Warning Labels]




1. Warning labels as described in the operation manual are attached to this electron tube. Confirm that they are attached correctly before operating the electron tube. If incorrectly attached or missing labels are found, contact CETD.
2. Read all the labels and fully understand their meanings to ensure safe operation of the electron tube.
3. Maintain the labels so that they can be seen easily. Do not remove any labels or allow them to become dirty, covered, or otherwise obscured.

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[Manufacturing equipment, warning indications for equipment, use of the electron tube]








- (1) All equipment incorporating this electron tube must be equipped with safety mechanisms as described below.
- (2) All equipment incorporating this electron tube and their operations manual must include the warning indications described below to ensure safe operation of the electron tube.
- (3) To ensure safe operation of this electron tube, observe the precautions described below.
- (4) For any questionable points, consult with CETD before operating this electron tube.

<div style="text-align: center;">  Danger </div>	
 (High Voltage)	<p>High voltage is supplied to the electron gun section and the ion pump section of this electron tube.</p> <ol style="list-style-type: none"> (1) The main body (body terminal) of this electron tube is used as the return circuit (ground). Securely connect it with the circuit return wire (ground) of the equipment together with the electromagnet to ensure proper grounding. (2) Place a cover or cage around the high-voltage section to prevent it from being touched. The circuit must be designed so that a switch on the door cuts off high voltage and discharges the capacitor of the high-voltage section when the cover or cage is opened. (3) Before replacing or performing maintenance work on the electron tube, be sure to turn OFF the power switch and discharge all residual charge by touching each electrode of the electron tube with a ground rod. Pay particular attention to the charge in the capacitor of the high-voltage section. Never disable the door switch when the cage is open. At least two workers are required for replacement or maintenance work to ensure safety. (A person who has received training in cardiopulmonary resuscitation should be present.) (4) When connecting / disconnecting the ion pump, be sure to turn OFF the ion pump power supply and confirm safety.
 (Electromagnetic Radiation)	<p>Observe the following precautions to prevent exposure to harmful high-frequency electromagnetic radiation (in particular, to avoid the risk of eyedamage) and to prevent telecommunication devices from being adversely affected:</p> <ol style="list-style-type: none"> (1) Never supply high voltage when the high-frequency load (output waveguide) is not connected to the high-frequency output section. (2) To prevent high-frequency leakage due to connection failure in the high-frequency output section and the high-frequency load, securely connect the coaxial tube, the waveguide, and the shield cover. (3) Do not modify or remove the high-frequency contact elements such as the gasket of the cavity/output section, the finger, etc. of the electron tube. If an electromagnetic shield is mounted, do not remove or modify it. (4) Evaluation of electromagnetic radiation leakage must be performed with the electron tube and the high-frequency load mounted in the equipment.

Issued : 2020-08-17



Revised :

	<h2 style="text-align: center;">Warning</h2>
 (X-ray Radiation)	<p>An electron tube with a tube voltage of more than 10 kV will generate X-rays. X-ray generation increases as the voltage and current are increased.</p> <ol style="list-style-type: none"> (1) Perform thorough evaluation for X-ray leakage for the equipment used in combination with this electron tube. Add shielding appropriate for the installation and operating conditions as required. Checks for X-ray generation must be performed both when high-frequency output operation is performed and when it is not performed. (2) If an X-ray shield is already mounted, do not remove or modify it. <p>Since the amount of X-ray generation may change over time, perform X-ray checks periodically.</p>
 (Magnetic Field)	<p>About 0.30-tesla intense magnetic field should be used for this electron tube.</p> <ol style="list-style-type: none"> (1) Persons with cardiac pacemakers must not engage in the handling, operation, or maintenance of this electron tube. (2) The magnetic field of the electromagnet has been precisely adjusted. Do not allow any permanent magnets or magnetic objects to come near the electron tube or electromagnet. They will be attracted by the magnetic field, possibly resulting in personal injury or damage to the electron tube. <p>Do not place magnetic cards, floppy disks, etc. near the electron tube.</p>

	<h2 style="text-align: center;">CAUTION</h2>						
 (Handling)	<p>Only qualified engineers or persons who have received the specialized training listed below are permitted to handle this electron tube. The types of specialized training required are as follows:</p> <table border="0" style="width: 100%;"> <tr> <td>(1) High-voltage work</td><td>(4) Slings work</td></tr> <tr> <td>(2) X-ray work</td><td>(5) Crane operation</td></tr> <tr> <td>(3) High-frequency work</td><td>(6) Electrical device work</td></tr> </table> <p>Read the operation manual carefully and fully understand the contents before handling the electron tube.</p>	(1) High-voltage work	(4) Slings work	(2) X-ray work	(5) Crane operation	(3) High-frequency work	(6) Electrical device work
(1) High-voltage work	(4) Slings work						
(2) X-ray work	(5) Crane operation						
(3) High-frequency work	(6) Electrical device work						
 (Temperature, Heat)	<p>The following sections of the electron tube become very hot during operation: Collector enclosure, Electron gun section, Focusing coil</p> <p>(1) Do not touch any of the sections listed above during operation or immediately after operation. (After operation is stopped, the above parts will remain hot for a while.) The high temperature of these sections may cause a burn.</p> <p>(2) In tubes with forced-air cooling, the exhaust air is very hot. Do not place your hand, face, or any other part of your body directly into the exhaust air.</p> <p>(3) In tubes with evaporative cooling, the cooling water in the cooling-water tank is very hot, reaching temperatures near 100 °C. Be extremely careful when handling it. Before disconnecting tubing, confirm that the cooling water has cooled sufficiently.</p>						
 (Weight)	<p>Be careful when handling this electron tube because it is heavy (Approx. 300kg).</p> <p>(1) Be extremely careful to ensure safety when lifting, moving, or installing this electron tube.</p> <p>(2) Be careful not to subject this electron tube to excessive vibration or shock because it is a precision device.</p> <p>(3) Use the standard packing box to carry or store the electron tube.</p>						
 (Caution)	<p>Use the frequency specified by laws, regulations, or standards.</p>						
 (Caution)	<p>Note the following when handling damaged or used electron tubes:</p> <p>(1) When handling a tube that has fractured, wear protective gloves, protective glasses, etc. because the ceramic or metal fragments are sharp and very dangerous.</p> <p>(2) Dispose the scrapped products according to the requirement of local regulation. If you have any questions, please contact to our local sales representatives for further information.</p> <p>(3) The main materials used in this electron tube are as follows: Copper, stainless steel, iron, nickel/iron alloy, tungsten, molybdenum, ceramics. Note that no radioisotopes or beryllia porcelain are used.</p>						
 (Caution)	<p>Before operating this electron tube, confirm that the cooling unit operates properly.</p> <p>(1) Excessive temperatures due to interruption of cooling air or water may result in damage to the tube, smoking, or a fire.</p> <p>(2) It is recommended that various sensors such as an airflow sensor, a water flow sensor, a pressure sensor, a thermometer, and/or a smoke sensor be provided to protect the tube.</p>						

Issued : 2020-08-17

Revised :

 CAUTION	
 (Caution)	<p>Perform periodic inspection.</p> <ul style="list-style-type: none">(1) Dust from the air may build up on the electron gun section or collector section over time, leading to deterioration of withstand-voltage characteristics and interfering with cooling.(2) For devices in which insulation oil is used, dirty oil may lead to deterioration of the withstand-voltage characteristics. Ensure that the insulation oil is always clean.

Issued : 2020-08-17

Revised :

History of Revision

Date	Page	Revised Contents	Revised Reason
2020-08-07	All	-	Issued

Issued : 2020-08-17

Revised :