

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

E3772A,A



Shinji Ohama

General Manager

Sales Department

Specification Number : T180156-L973

Rev.0

Issued : 2018-10-23

Revised :

To : Lyncean Technologies, Inc.

SPECIFICATION
FOR
E3772A,A

Toshiba High Power 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 Toshiba Electron Tubes & Devices Co., Ltd. (TETD) of such claim and consult with TETD for any actions to be taken. In any event, liability of TETD 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, TETD shall not be liable in the cases, where,

- (1) it was impossible for TETD 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.

PRODUCT SPECIFICATION FOR E3772A,A

Description: Pulse klystron amplifier: 7.5MW peak power, 10kW average power, 2856MHz frequency, Electromagnetically focused, Five-cavity klystron, Waveguide Output, Coaxial Input, Water-cooled.

ABSOLUTE RATINGS Note 1 and 2

Parameters	Symbol	Unit	Min.	Max.	Note(s)
Frequency	f	MHz	2854	2858	
Heater Voltage	Ef	V	---	20	3&4
Heater Current	If	A	---	18	3
Heater Current (surge)	If (surge)	A	---	20	
Cathode Warm-up Time	tk	minutes	30	---	3
Peak Forward Beam Voltage	epy	kV	---	165	5&6
Peak Inverse Beam Voltage	epx	kV	---	20	7
Peak Cathode Current	ik	A	---	120	8
Peak Inverse Beam Current	ikx	A	---	10	8A
Peak Drive Power	pd	W	---	120	9
Peak RF Output Power	po	MW	---	8.5	
Average RF Output Power	Po	kW	---	10	
Collector Dissipation	Pcol	kW	---	20	
Pulse Width (duration) (epy)	tp(epy)	μs	---	8.5	10
Pulse Width (duration) (rf)	tp(rf)	μs	---	6.0	11
Pulse Repetition Rate	prr	pps	---	250	
Ion Pump Voltage	Vip	kV	3.2	3.8	15
Load VSWR	σL	VSWR	---	1.4	11A
Coolant Flow					
Collector	Qw,c	L/min	25	---	14&14A
Body	Qw,b	L/min	10	---	14
Inlet Coolant Temperature	Tw,i	centigrade	5	40	12
Coolant Pressure	Pw	MPa	---	0.8	12
		(kgf/cm ²	---	8.0)	
Waveguide Pressure					
Gauge Pressure	PW/G	MPa	0.1	0.3	13&13A
		(kgf/cm ²	1.0	3.0)	

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PHYSICAL

Mounting Position:	Vertical, Cathode down
Cooling:	Liquid Notes 12 and 14
RF Input Connector:	Type "N" 50 ohm coaxial; UG-22D/U Compatible
RF Output Connector:	CPR-284F Compatible, See Outline Drawing Output waveguide, WR-284
Ion Pump:	HN-R coaxial type connector, UG-560/U Compatible Notes 15 and 16
Filament/Cathode Connector:	
Heater/Cathode	Mate with Socket, See Outline Drawing
Heater	Mate with Socket, See Outline Drawing
Cooling Water Connector:	
Collector	1/2 inch tubing
Body	1/2 inch tubing
Cathode:	Dispenser cathode (Ir-coated M-type cathode)
Ground:	Tube body
Focusing Magnet (not included):	Toshiba solenoid magnet VT-68934,E Note 17
X-ray Shielding (not included):	Toshiba X-ray shielding kit VT-69133 Note 22
Dimensions:	See Outline Drawing
Weight:	35 kg (Approx.), 40 kg (Max.) without the X-ray shielding kit
Marking:	See "Marking E3772A,A"
Packing:	Standard commercial transport of TETD Note 21

QUALITY CONFORMANCE INSPECTION

Production units shall be tested in accordance with TETD's internal testing procedures. The test items are listed below. TETD provides a copy of the test data with each unit delivered.

Test	Condition	Symbol	Min.	Max.	Unit	Note(s)
Dimensions	Per outline drawing					
Vacuum Check	No operating voltage Ion pump readings	I _{ion}	---	5.0	μA	
Output Window Pressure	SF ₆ gas pressure of 0.3 MPa for 5 minutes through de-pressurizing valve	No detectable change in Ion pump current indicator				
Hydrostatic Pressure Collector and Body	No operating voltage P _w =0.8 MPa (8 kgf/cm ²) water , t = 15 min	No visible leaks and no damage				
Heater Voltage	I _f = label value	E _f	---	20	V	3
Cathode Current	e _{py} = 155 kV	i _k	103.7	115.9	A	
Power Output 1	Test Condition (1)	p _o	7.5	8.5	MW	18
		e _{py}	---	160	kV	
		i _k	---	115	A	
		p _d	---	120	W	
		η	40	---	%	
		G _p	48	---	dB	
		I _{ion}	---	10	μA	

Test Condition (1) :
 Note 19
 e_{py} = 160 kV, max
 i_k = 115 A, max
 I_f = label value
 I_{sol} = label value
 f₀ = 2856MHz
 t_p(e_{py}) ≈ 6.5 μs (Note 10)
 t_p(r_f) ≥ 4.0 μs (Note 11)
 p_{rr} ≥ 150 pps
 p_d = 120 W, max (Note 20)
 Load VSWR = Matched Load
 Collector Coolant Flow ≈ 25 L/min
 Body Coolant Flow ≈ 10 L/min
 Output waveguide Pressure ≈ 0.2 MPa
 (2kgf/cm²)

END OF LIFE CONDITION

Item	Condition	Symbol	Min.	Max.	Unit	Note(s)
Life End Point	Reduction in po	Δp_o	---	0.5	dB	
	Change of Perveance	ΔK	-0.21	---	$\mu A/V^{3/2}$	

WARRANTY

Item	Condition
Warranty	A. 12 months from the date of departure at the factory B. 1500 hours (filament): 100%

The warranty period will be terminated by condition A or condition B, whichever occurs first.

1. TETD warrants the klystrons to be free of manufacturing defects which will impair their normal operation life during the warranty period, provided that the klystrons are used within the ratings and in accordance with instructions and specifications issued by TETD.
2. The warranty period extends for twelve (12) months from the date of departure at the factory or 1500 hours of applying the voltage to the filament, whichever occurs first. If the klystron shall be proved to be defective during the warranty period, TETD shall repair or replace the product.
3. Notification of the claim shall be received by TETD within three (3) months after discovery of failure. If TETD requires return of the defective klystron, each return shall be made without delay, and in accordance with the instruction of TETD.
4. The warranty shall not apply to defects resulting from accidents, alterations, abuse or misuse, or improper installation.

Be sure to refer to "E3772A,A Operating Instructions", before installing or operating the klystron. Interlocks and the necessary action speed are described in this specification and "E3772A,A Operating Instructions".

ENVIRONMENTAL REQUIREMENTS Note 23

Item	Condition	Symbol	Min.	Max.	Unit	Note(s)
Temperature	Operating	To	5	45	centigrade	
	Storage (without water)	Ts	0	85	centigrade	
Humidity	Operating	Ho	30	65	%	
	Storage	Hs	10	90	%	

SERVICEABILITY DESIGN (REFURBISHMENT)

The klystron tube is designed for refurbishment. In case of the refurbishment, the electron gun, the output window, the ion pump can be replaced. In any case, TETD will examine the prospective tube whether the tube can be refurbished or not, at first.

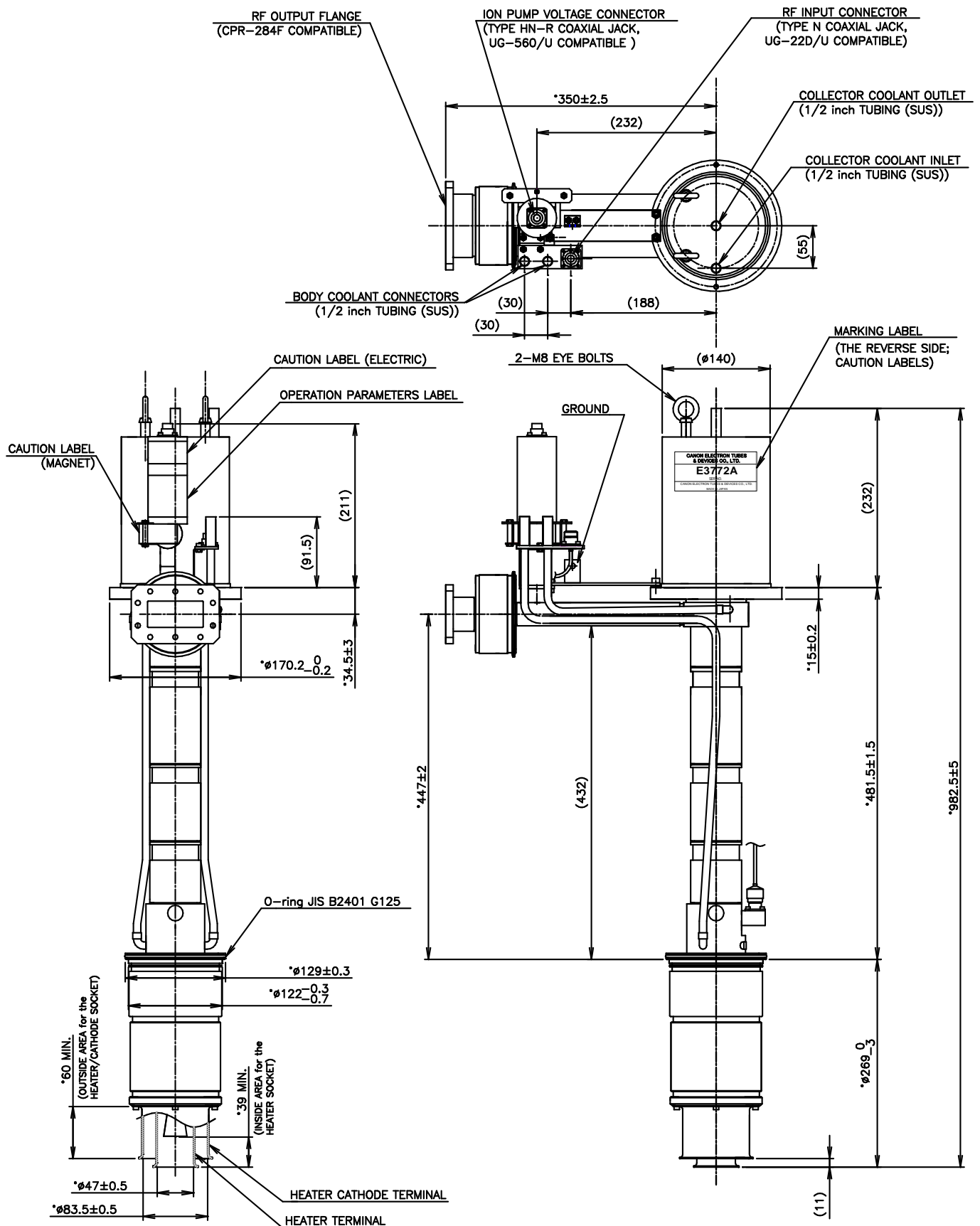
SHIPMENT CONTENTS

Each shipment contains the following, as a minimum:

1. Klystron tube ----- One (1) unit
2. Submission documents
 - Inspection Data Sheet ----- Three (3) copies

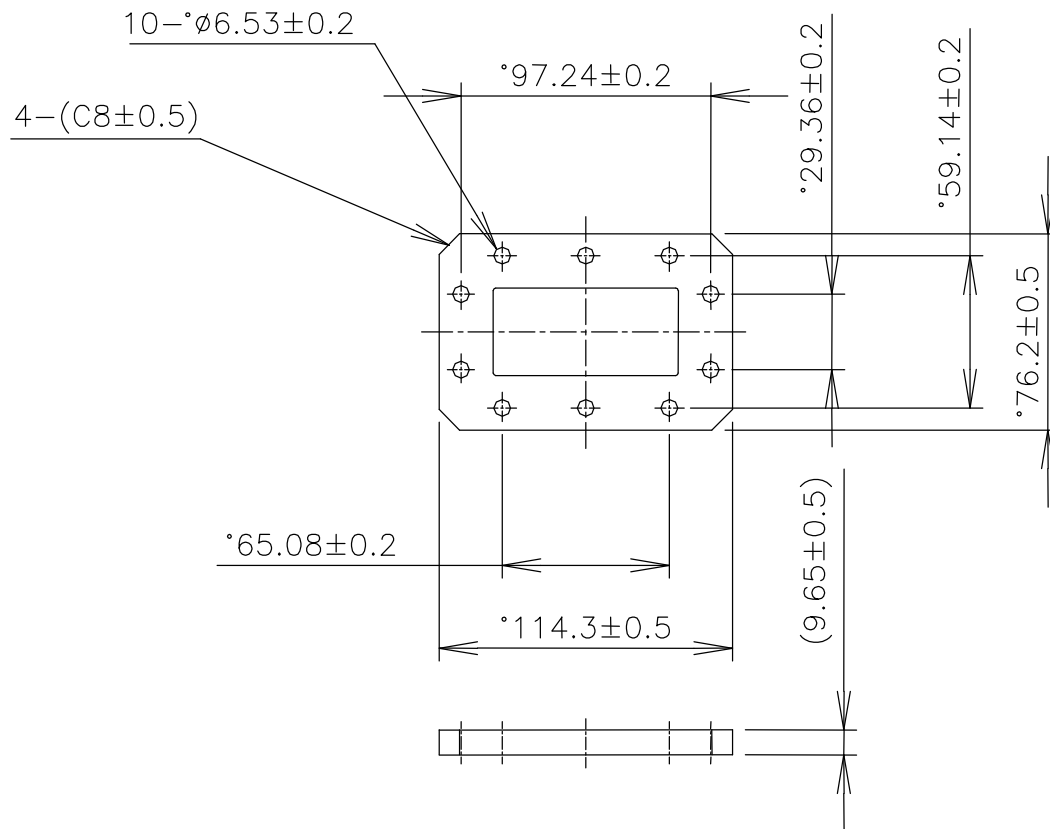
OUTLINE DRAWING of E3772A,A

Unit: mm



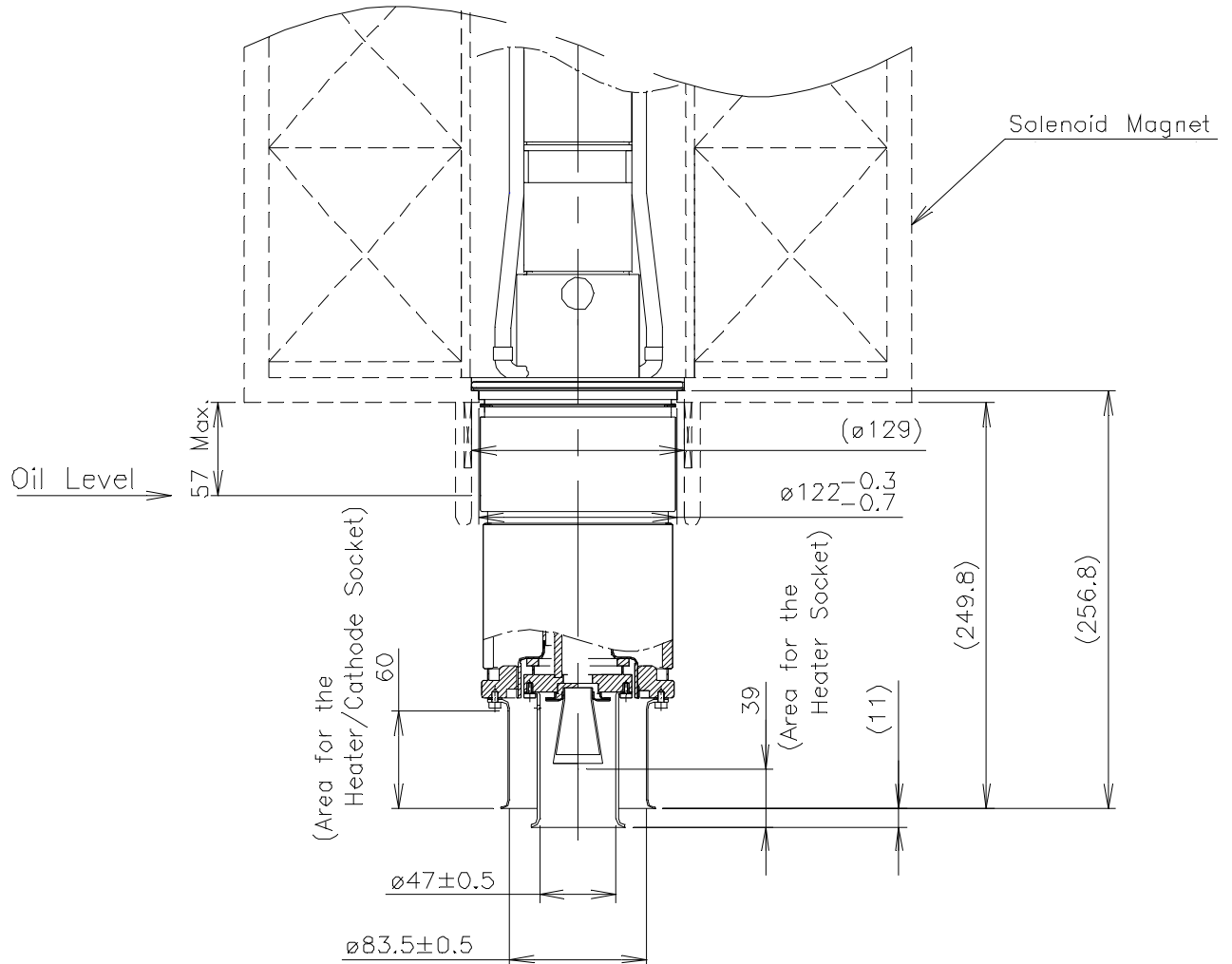
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UNIT: mm



**Dimensional Drawing of Output Flange
(CPR284F Compatible)**

Unit: mm



Detail Drawing of Heater/Cathode Terminal

CANON ELECTRON TUBES & DEVICES CO., LTD.
E3772A
SER. NO.
CANON ELECTRON TUBES & DEVICES CO., LTD. MADE IN JAPAN

Marking Label E3772A,A

BEAM VOLTAGE	<input type="text"/>	kV
RF DRIVE	<input type="text"/>	W
HEATER VOLTAGE	<input type="text"/>	V
HEATER CURRENT	<input type="text"/>	A
FOCUS COIL CURRENT	<input type="text"/>	A
SERIAL NO.	<input type="text"/>	

Operating Parameters Label



Caution Label (Collector side)



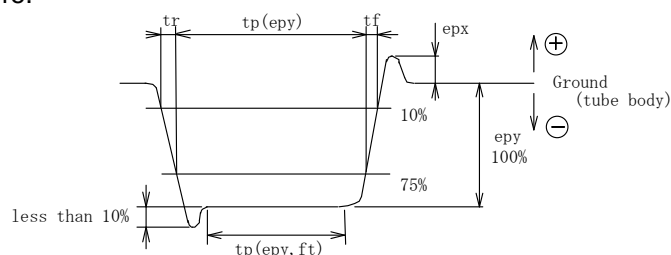
Caution Label (Electric)



Caution Label (Magnet)

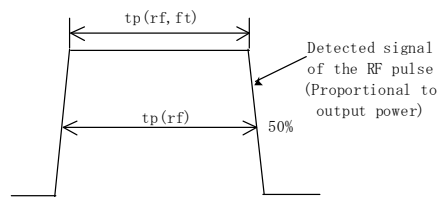
NOTES:

- 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 20A. This value of heater voltage shall be maintained for at least 30 minutes prior to the application of beam voltage. The liquid coolant flow must be operated whenever the heater power is applied.
- Note 4: Interlocks should be provided to prevent application of a beam voltage unless the heater voltage or the heater current is within $\pm 5\%$ of prescribed value, and has been applied for the period of time specified in Note 3.
- Note 5: The electron gun insulator shall be operated in certified insulation oil. The electrical insulation strength of the oil must be more than 30kV/2.5mm.
- 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: Interlock 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.
- Note 10: The beam pulse width (duration) shall be measured between the 75% point of the beam voltage pulse. The voltage waveform of the beam pulse is based on the following figure.



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Note 11: The RF pulse width shall be measured between the -3 dB points of the RF output pulse. The peak output power is measured equal or over than 2 micro seconds. Stability of RF waveform is checked in 4.0 micro sec. RF pulse width operation. The RF pulse width is defined as the following figure.



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.

Note 12: Coolant shall be LCW (Low Conductivity Water).
LCW (Low Conductivity Water) quality requirements:

pH factor	7 - 8
Dissolved oxygen	1 - 6 ppm
Resistivity	min. 10 kΩ-cm
Particle-matter size	max. 50 μm (325 mesh)

The maximum inlet water pressure must not exceed 0.8MPa (8 kgf/cm²). The maximum input coolant temperature must not exceed 40 degree Centigrade. Interlocks should be provided to prevent application of heater voltage, unless the temperatures are less than the values described as above.

Note 13: The output waveguide line shall be pressurized with SF₆ gas.

Note.13A: Interlocks should be provided to prevent application of RF drive, unless the gas pressure of output waveguide is at and above the value specified by the equipment manufacturer. Also the gas pressure should not exceed the Absolute Rating.

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 14A: When coolant water delivery is the following rate, the collector dissipation should be the following power.

Coolant delivery	Collector dissipation
25 L/min	Less than 20 kW
18 L/min	Less than 16 kW
12 L/min	Less than 11 kW

Note 15: An ion pump shall be an integral part of each tube. This ion pump shall operate at between +3200 Vdc and +3800 Vdc from a high impedance power supply capable of delivering 2 mA Max. For normal tube operation, the ion pump current shall be less than 10 μAdc.

Note 16: Interlock should be provided to prevent application of beam voltage, unless the ion pump current is less than the normal operating value.

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Note 17: Interlocks should be provided to prevent application of beam voltage unless solenoid coil current is within $\pm 5\%$ of the specified value.

Note 18: Output power is measured by calorimetric means.

Note 19: The values of I_f and I_{ol} for the power output test condition will be marked on the label of the tube.

Note 20: Drive power is defined as the power incident to the klystron.

Note 21: The packed tube shall not be damaged by a shock of 6 G maximum.

Note 22: It is possible that leakage of the X-ray radiation at the point 1 meter from the center of the tube is decreased to be less than $20\mu\text{sv/h}$ by using the focusing magnet (VT-68934,E) and the X-ray shields kit for E3772A,A (VT-69133) under the condition of $p_o=7.5\text{MW}$, $t_p(\text{rf})=4.5\mu\text{s}$, $p_{rr}=200\text{pps}$. However, this value does not mean the X-ray intensity which is harmless for the human body. Also, this value does not mean the assured intensity of X-ray leakage for the device. Considerable amount of leaking X-ray radiation is possibly leaked from the opening parts at the X-ray shield for laying the coolant pipes at the collector and the output port for the output waveguide at the focusing magnet. Read "SAFETY PRECAUTIONS AND WARNINGS" in this specification carefully.

Note 23: The klystron tube should be operated and stored in an air-conditioned room in which there is no dust and no vibration and no oil dispersion. Do not operate or store the klystron tube in the following environment:

1. Environment with a lot of caustic gases such as sea breeze, Cl_2 , HCl , H_2S , NH_3 , SO_2 , and No_x
2. Environment with dispersion of water, oil, chemicals, and organic solvent, etc.
3. Environment with strong static electricity
4. Direct sunshine and outdoor exposure environment

Notes of System Structure

For a system to operate a klystron, please pay attention to the following points. In case the abnormal condition occurs, protection interlocks are required for high voltage power supply to protect the klystron. A table below shows protection setting value, action speed, and shield mode. However, these values are variable by type of the high voltage power supply, so please contact us for the further details, as well as voltage application in normal condition and shield sequence.

Item	Protection action value	Point of action	Action Speed
Heater warm-up time	Within specified time	No application of high voltage	-
Oil level	Oil surface is under the specified surface level	Pause of beam high voltage application	Medium
Ion pump current	More than a specified value (Regular operation value plus 2 μ A)	Pause of beam high voltage application	High
Water-coolant Flow (Collector and body)	Less than minimum ratings	Pause of heater high voltage application Pause of beam high voltage application	Medium
Inlet coolant Temperature	Maximum rate more than (40 degrees centigrade)	Pause of heater high voltage application Pause of beam high voltage application	Medium
Heater Voltage	Out of the specified rate +/-5% for each Klystron	Pause of beam high voltage application	Medium
Heater Current	Out of the specified rate +/-5% for each Klystron	Pause of beam high voltage application	Medium
Beam Voltage	Exceed the normal value plus 5% or the maximum rating	Pause of beam high voltage application	High
Beam Current	Exceed the normal value plus 10% or the maximum rating.	Pause of beam high voltage application	High
Beam Inverse Voltage	Exceed the rated value (20kV)	Pause of beam high voltage application	High
Load Waveguide Arc	Discharge in waveguide	Pause of RF application	High
Focusing magnet current	Out of the specified rate +/-5% for each klystron	Pause of beam high voltage application	High
Focusing magnet voltage	Out of the normal value +/-10%	Pause of beam high voltage application	High
Water-coolant Flow for focusing magnet	Less than the specified value	Pause of power supply for magnet and beam high voltage application	Medium
Inlet coolant Temperature for focusing magnet	Less than the specified value	Pause of power supply for magnet and beam high voltage application	Medium
Load waveguide vacuum	Out of the specified rating	Pause of RF application	High

(Attention) The definition of action speed indicated in the table is as following.




Medium Speed – It should be around 100ms

High Speed - Activate as fast within 10ms (possibly next pulse will not be applied)

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 TETD in advance. TETD 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. TETD 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 TETD.
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.

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

<p>(1) All equipment incorporating this electron tube must be equipped with safety mechanisms as described below.</p> <p>(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.</p> <p>(3) To ensure safe operation of this electron tube, observe the precautions described below.</p> <p>(4) For any questionable points, consult with TETD before operating this electron tube.</p>	
<div style="text-align: center;">  Danger </div>	
<div style="text-align: center;">  (High Voltage) </div>	<p>High voltage is supplied to the electron gun section and the ion pump section of this electron tube.</p> <p>(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.</p> <p>(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.</p> <p>(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.)</p> <p>(4) When connecting / disconnecting the ion pump, be sure to turn OFF the ion pump power supply and confirm safety.</p>
<div style="text-align: center;">  (Electromagnetic Radiation) </div>	<p>Observe the following precautions to prevent exposure to harmful high-frequency electromagnetic radiation (in particular, to avoid the risk of eye-damage) and to prevent telecommunication devices from being adversely affected:</p> <p>(1) Never supply high voltage when the high-frequency load (output waveguide) is not connected to the high-frequency output section.</p> <p>(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.</p> <p>(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.</p> <p>(4) Evaluation of electromagnetic radiation leakage must be performed with the electron tube and the high-frequency load mounted in the equipment.</p>

 Warning	
 (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. Since the amount of X-ray generation may change over time, perform X-ray checks periodically.
 (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. Do not place magnetic cards, floppy disks, etc. near the electron tube.

	<h2>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"> <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						
 (Weight)	<p>Be careful when handling this electron tube because it is heavy (Approx. 40kg).</p> <ol style="list-style-type: none"> (1) Be extremely careful to ensure safety when lifting, moving, or installing this electron tube. (2) Be careful not to subject this electron tube to excessive vibration or shock because it is a precision device. (3) Use the standard packing box to carry or store the electron tube. 						
 (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> <ol style="list-style-type: none"> (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. (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. (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. 						
 (Caution)	<p>Before operating this electron tube, confirm that the cooling unit operates properly.</p> <ol style="list-style-type: none"> (1) Excessive temperatures due to interruption of cooling air or water may result in damage to the tube, smoking, or a fire. (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. 						
 (Caution)	<p>Perform periodic inspection.</p> <ol 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. 						

OPERATING HAZARDS

Read the following instruction and take necessary precautions to prevent personnel from hazards. Safe operating conditions are the responsibility of the equipment designers and the users of such tubes.

(1) High voltage

This tube operates at high voltage. So that, equipments, electromagnet and klystron must be designed so that personnel cannot come in contact with operation voltages.

(2) X-ray radiation

Operation personnel must be protected by appropriate X-ray radiation shielding. Adequate X-ray shielding should be provided for this tube. X-ray signs or labels must be permanently attached on the equipment to notify operating personnel never to operate this device without X-ray shielding in place.

(3) Microwave radiation

Exposure of the human body to microwave radiation in excess of 1mW 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 RF connections, waveguide flanges, and gaskets must be RF leakproof and properly engaged. Never operate this device without a microwave-energy-absorbing load. Personnel must be prevented from looking into open waveguide or antennas while this device is energized. Equipment must be designed to protect all the personnel from the hazards. The label and caution notices must be provided on the equipment and in the manuals warning clearly of these hazards.

(4) Maintenance and Storage

Maintenance

In case of shutting down operating the device for a comparably long period, prevent the coolant from freezing. If there is fear of the coolant freezing, remove the coolant from the klystron. Please operate an ion pump power supply at all the time except for an unavoidable case. Cover the output flange to avoid soiling the ceramic window by dust.

Storage

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. Remove the coolant in the klystron tube completely. Cover the output flange of the klystron tube. Be careful contamination and oxidization at the electron gun and the electrode by dust and humidity.

Transportation

Use the formal package and cushion for transportation of the klystron tube.

History of Revision

Date	Page	Revised Contents	Revised Reason