Canon

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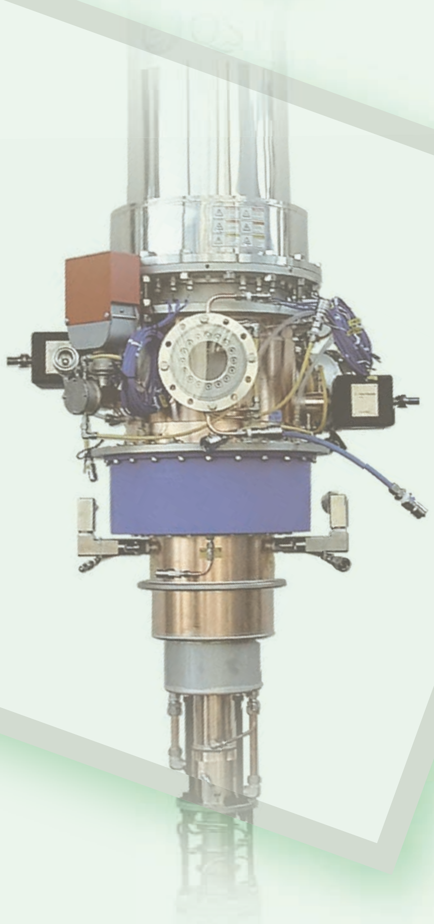
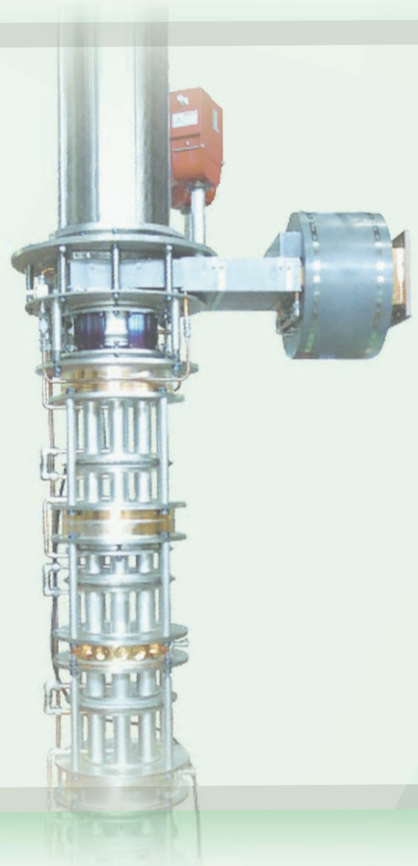
2020-03

MICROWAVE TUBES

PRODUCT CATALOG

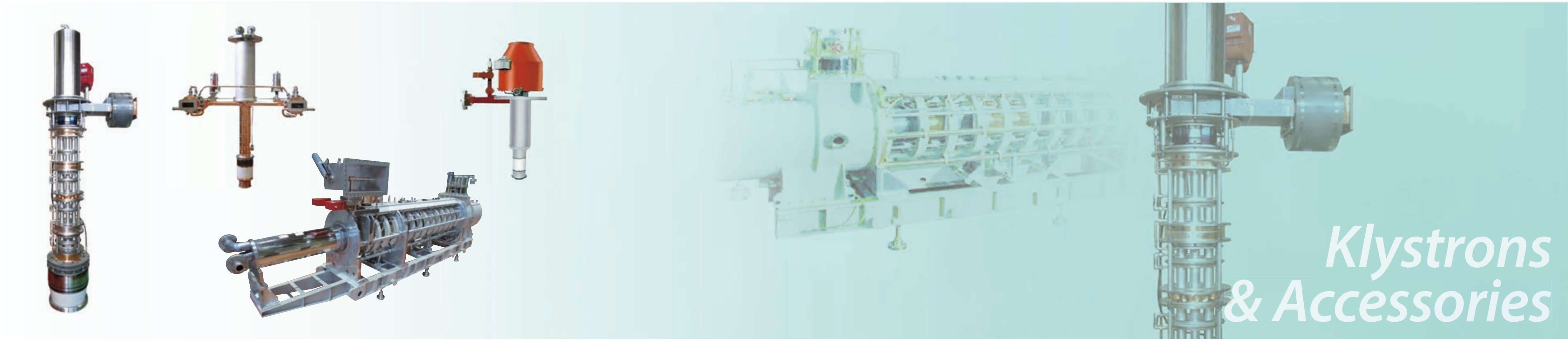




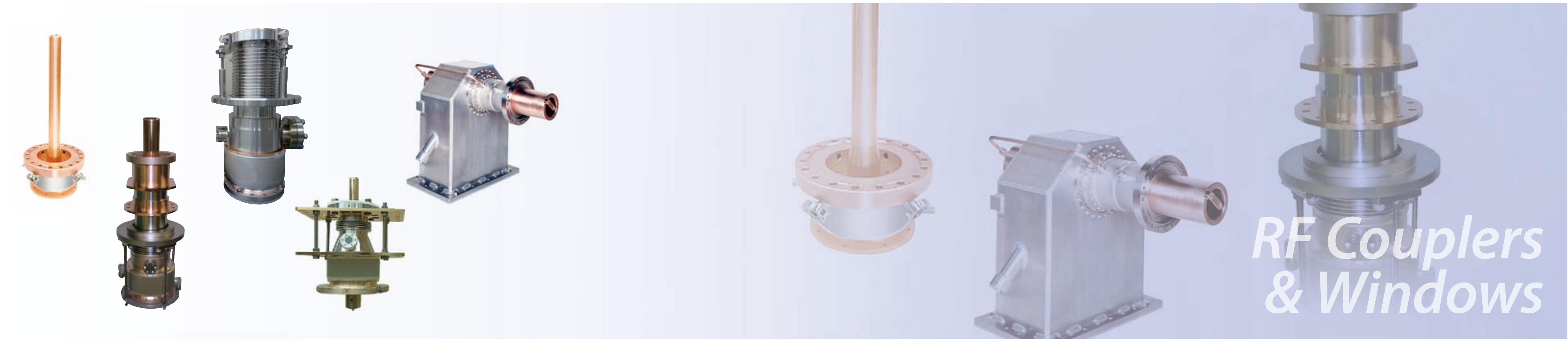
CANON ELECTRON TUBES & DEVICES CO., LTD.

Product lineup

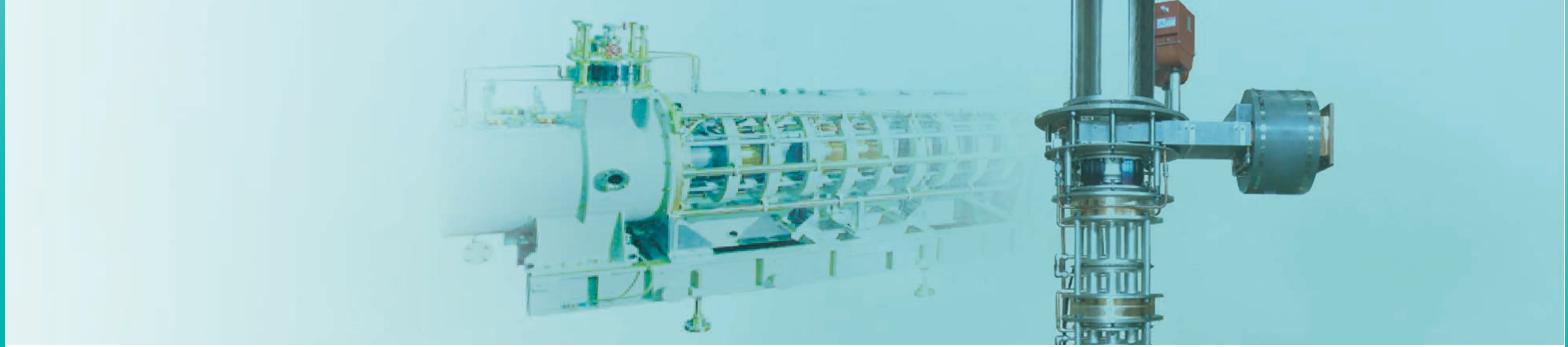
Klystrons & Accessories



RF Couplers & Windows



Gyrotrons



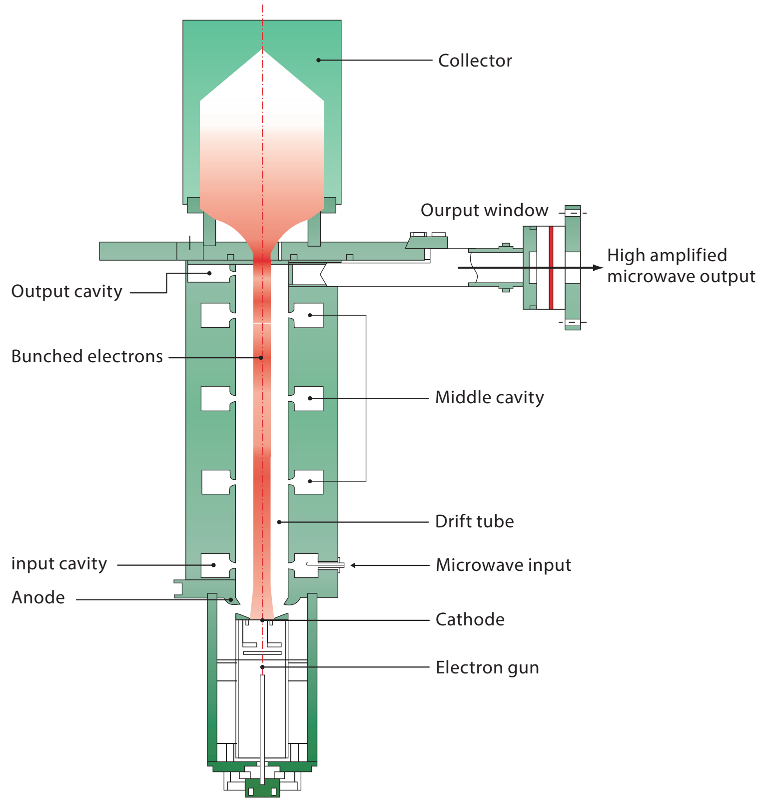
Klystrons

We are one of the world's leading manufactures, and has been manufacturing and developing various klystrons for more than 60 years since the company began the first production in 1955. All the electron guns, cavities, output windows and collectors required for klystrons are all those optimally designed by Canon Electron Tubes & Devices.

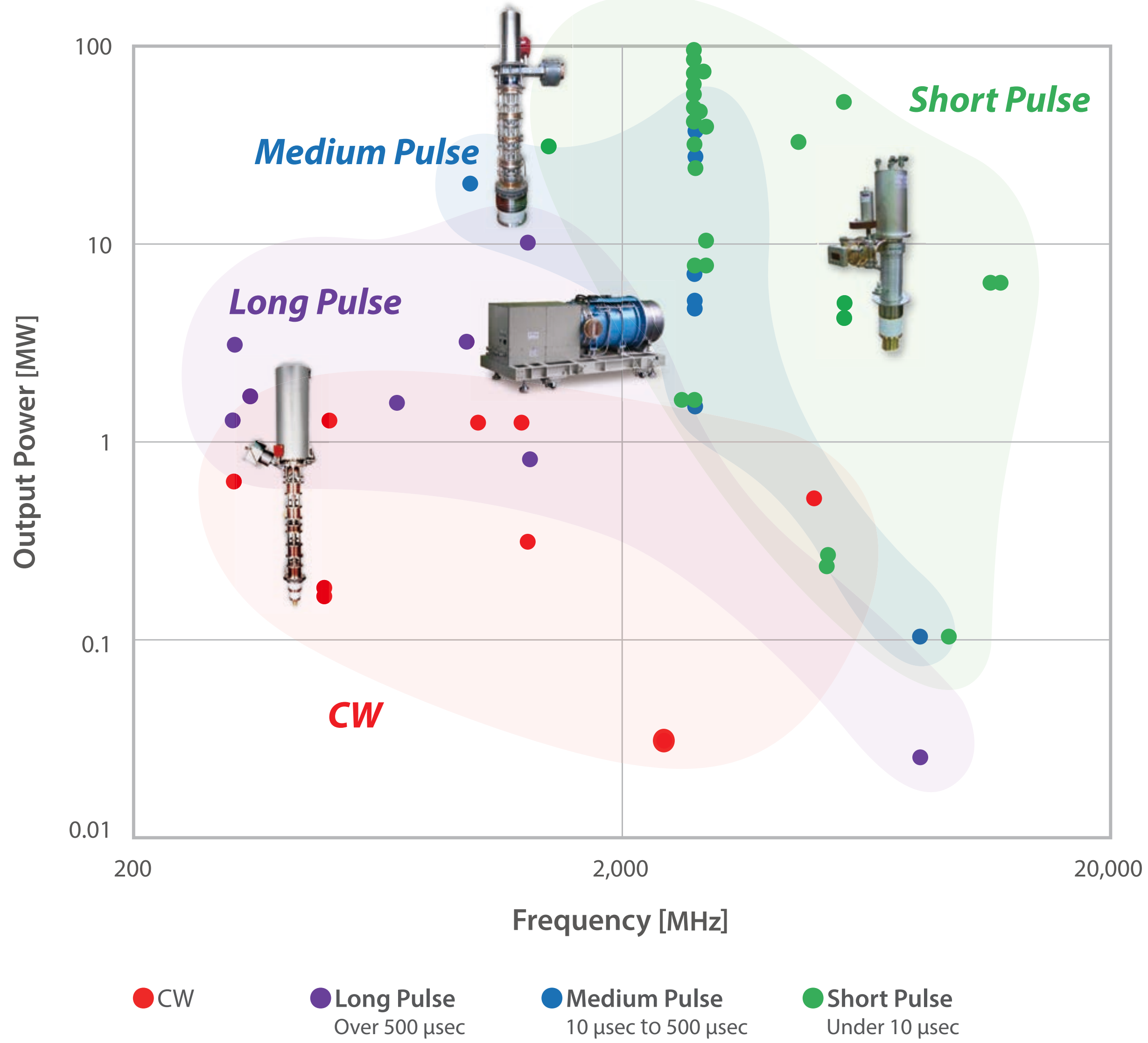
Principle of Operation

Electrons emitted from the cathode are accelerated by the electric field between the cathode and anode, and enter the cavity. At this time, depending upon phase of microwave field inputted from a drive circuit, some electrons are accelerated and some are deaccelerated (velocity modulation). While running the interaction section with uniform electric field, the faster electrons are reached the slower ones and bunched (density modulation).

The electron bunch is gradually emphasized by the self-induced microwave field in middle cavities located at appropriate positions. Finally the electron bunch enters into the output cavity and excites large microwave field to it. The amplified microwave is outputted through the output window.



Selection Guide Klystrons



Product lineup

Klystron for Science and Technology

CW Klystrons

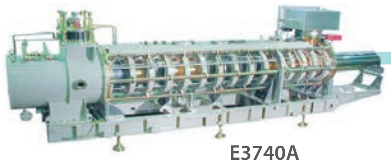
E3732

Type	Frequency (MHz)	Average Power (kW)	Efficiency (%)	Gain (dB)	Beam Volt. (kV)	Beam Curr. (A)	Weight (kg)	Length (m)
E37705	325	600	60	41	71	14.3	1,100	4.5
E3774	499.7/500.1	180	53	42	42	8.1	340	2.6
E3774,U	499.7	165	65	42	40	6.3	400	2.6
E3732	508.6/508.9	1,200	63	56	93	20.5	1,250	4.4
E37701*	1,017.8	1,200	63	60	93	20.5	1,100	3.3
E3718	1,250	1,200	63	48	85	22.4	1,250	3.5
E37750	1,300	300	63	40	49	9.7	180	1.8
E3762*	5,000	500	50	48	68	15	970	2.6

*Under development

Long Pulse Klystrons

Over 500 μsec



E3740A

E3736H

Type	Frequency (MHz)	Peak Power (MW)	Average Power (kW)	Efficiency (%)	Gain (dB)	Pulse Length (μs)	Pulse-Rate (pps)	Beam Volt. (kV)	Beam Curr. (A)	Weight (kg)	Length (m)
E3740A	324/325	3	93	55	50	620	50	110	50	730	4.5
E37621	350	1.6	144	58	45	1,500	60	106	26	770	4.8
E37504	704.4	1.5	73.5	66	47	3,500	14	108	21	600	3
E3766A	972	3	93	55	50	620	50	110	50	500	3
E37501	1,300	0.8	6	57	46	1,500	5	64	22	70	1.2
E3736/E3736H	1,300	10	150	66	49	1,500	10	115	132	340	2.3
E3794*	8,200	25kW	0.25	15	41	1sec	0.01	31	5.1	150	1.1

*Under development

Medium Pulse Klystrons

10 μsec to 500 μsec

E37503

Type	Frequency (MHz)	Peak Power (MW)	Average Power (kW)	Efficiency (%)	Gain (dB)	Pulse Length (μs)	Pulse-Rate (pps)	Beam Volt. (kV)	Beam Curr. (A)	Weight (kg)	Length (m)
E37503	999.5	20	150	70	54	150	50	159	180	630	3.1
E3729	2,856	24	4.3	31	50	18	10	284	280	380	1.9
		34	12.8	34	52	12.5	30	312	328		
E3794*	8,200	100kW	0.1	35	47	20	500	39	7.2	150	1.1

*Under development

Short Pulse Klystrons

Under 10 μsec

E37202

E37310

E373212

Type	Frequency (MHz)	Peak Power (MW)	Average Power (kW)	Efficiency (%)	Gain (dB)	Pulse Length (μs)	Pulse-Rate (pps)	Beam Volt. (kV)	Beam Curr. (A)	Weight (kg)	Length (m)
E37612	1,428	30	10.8	40	48	6	60	295	260	450	2
E3772A	2,856	7.5	6	45	51	4	200	150	110	40	1
E37300	2,856	20	4	41	52	4	50	222	222	160	1.5
E37308	2,856	25	20	40	50	4	200	246	256	160	1.5
E37311	2,856	30	56.3	40	48	3	625	266	284	160	1.6
E3754	2,856	40	8	43	51	4	50	285	326	140	1.4
E3730A	2,856	50	10	45	51	4	50	312	362	140	1.4
E37306	2,856	50	7.5	40	52	2.5	60	368	335	350	1.7
E37340	2,856	50	26.3	42	50	3.5	150	320	370	350	1.6
E37314	2,856	60	24	41	53	4	100	360	412	600	2
E3729	2,856	70	14	42	55	4	50	378	451	380	1.9
E3712	2,856	80	16	42	53	4	50	400	480	380	1.9
E37320	2,856	80	19.2	42	53	4	60	400	480	380	1.9
E3712	2,856	100	5	46	56	1	50	422	522	380	1.9
E37334	2,860	25	5	39	50	4	50	251	251	140	1.4
E37326	2,998	7.5	7.5	43	48	5	200	158	111	42	1
E37325	2,998	10	10	45	48	4	250	175	130	50	1
E37310	2,998	37	16.7	40	48	4.5	100	295	320	300	1.5
E37302A	2,998	45	2.7	40	52	3	20	315	356	160	1.5
E37333	2,998	70	21	40	53	3	100	387	452	600	2
E37202	5,712	50	7.5	43	52	2.5	60	360	323	300	1.4
E37212	5,712	50	15	43	52	3	100	360	323	600	1.5
E37214	5,712	50	15	41	52	2.5	120	370	330	350	1.4
E37115,B	11,424	6	12	40	49	5	400	160	96	150	1
E37116*	11,424	20	12	47	52	1.5	400	260	164	300	1.3
E37113	11,994	6	12	39	48	5	400	155	98	150	1

*Under development

Product lineup

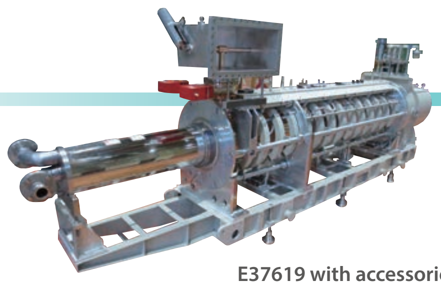
Klystron for Industry

CW Klystrons

Type	Frequency (MHz)	Average Power (kW)	Efficiency (%)	Gain (dB)	Beam Volt. (kV)	Beam Curr. (A)	Weight (kg)	Length (m)
E3739B	2,450	30	58	47	25.5	2.0	30	0.9

Long Pulse Klystrons

Over 500 μsec



E37619 with accessories

Type	Frequency (MHz)	Peak Power (MW)	Average Power (kW)	Efficiency (%)	Gain (dB)	Pulse Length (μs)	Pulse-Rate (pps)	Beam Volt. (kV)	Beam Curr. (A)	Weight (kg)	Length (m)
E37619	324	1.2	240	53	47	1,000	200	87	26	750	4.6

Medium Pulse Klystrons

10 μsec to 500 μsec

E3765

E37307

Type	Frequency (MHz)	Peak Power (MW)	Average Power (kW)	Efficiency (%)	Gain (dB)	Pulse Length (μs)	Pulse-Rate (pps)	Beam Volt. (kV)	Beam Curr. (A)	Weight (kg)	Length (m)
E3783	2,856	1.5	9	31	40	20	300	94	52	60	1.2
		4.5	22.5	43	48		250	128	82		
E3765,A	2,856	5	31.6	42	48	11.5	550	135	89	80	1.3
E3735A	2,856	5	45	44	48	15	600	132	86	80	1.3
E37307	2,856	5	60	39	46	18	667	135	95	110	1.5
E37338	2,856	7	14	44	50	10	200	150	104	80	1.3
E37341	2,856	5	48.9	43	43	16.3	600	125	92	100	1.2

Short Pulse Klystrons

Under 10 μsec

E3773

Type	Frequency (MHz)	Peak Power (MW)	Average Power (kW)	Efficiency (%)	Gain (dB)	Pulse Length (μs)	Pulse-Rate (pps)	Beam Volt. (kV)	Beam Curr. (A)	Weight (kg)	Length (m)
E3772A	2,856	7.5	6	45	51	4	200	150	110	450	2
E37308	2,856	25	20	40	50	4	200	246	256	160	1.5
E3779, B	2,998	7.5	10	43	49	5	200	158	111	42	1
E3773, A	5,712	4	4	38	46	4	250	135	81	80	0.9
E3773, D	5,712	5	2.9	46	45	4	145	94	93	60	0.9
E37115, B	11,424	6	12	40	49	5	400	160	96	150	1
E37116	11,424	20	12	47	52	1.5	400	260	164	300	1.3
E37113	11,994	6	12	39	48	5	400	155	98	150	1

Klystron for Radar

Short Pulse Klystrons

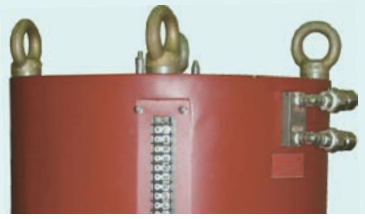
Under 10 μsec

E3734

Type	Frequency (MHz)	Peak Power (kW)	Average Power (kW)	Efficiency (%)	Gain (dB)	Pulse Length (μs)	Pulse-Rate (pps)	Beam Volt. (kV)	Beam Curr. (A)	Weight (kg)	Length (m)
E3734	5,250 to 5,350	230	0.5	43	48	2	1,000	48	11	35	0.6
E37201	5,330 to 5,370	270	0.5	48	47	2	1,000	50	12	35	0.6
E37150	9,000 to 9,200	50	-	-	-	6	3,100	7	2.6	16	0.3
E37100	9,500	100	0.4	28	53	4	1,000	44	8.2	16	0.3
E37102	9,700 to 9,800	2,300	-	-	-	4	3,100	7	2.6	16	0.3

Product lineup

Accessories for Klystrons



Ion-pump Power Supplies

VT-69240

Type	Sensitivity (μA)	Output (DC kV)	Output Terminal	Meter Relay	Weight (kg)	Dimension W × D × H (mm)	Power Inlet
VT-69239-H	5	3.5	HN-R	2 channels	6.5	230 × 180 × 200	100V(Type-A)
VT-69240-H	5	3.5	HN-R	1 channel	6.5	230 × 180 × 200	100V/120V (Type-A) 220V (Type-O/Type-SE)
VT-69240-S	5	3.5	SHV-R	1 channel	6.5	230 × 180 × 200	100V/120V (Type-A) 230V (Type-SE)

Cables

Type	Length (m)	Terminal
VT-69035	4, 10, 15, 20	HN-HN
VT-69094	4, 10, 15, 20	SHV-SHV

Please indicate the service voltage, plug shape and cable length.

Oil Tanks

VT-61174

Type	Klystron	Oil	Cooling	Weight (kg)	Dimension (mm)
VT-61169, STD	E3730A / E3754 / E37302	50kV / 2.5mm	L	400	ϕ850 × 1,250
VT-61174	E3712	50kV / 2.5mm	L	550	ϕ1,100 × 1,000
VT-61181	E37202	50kV / 2.5mm	L	600	ϕ1,000 × 1,000
VT-61183	E37308	50kV / 2.5mm	L	500	ϕ850 × 1,200
VT-61186,A	E3729	50kV / 2.5mm	L	1,270	ϕ1,200 × 1,200

C: Conducting Cooling/ L: Liquid Cooling/ FA: Forced Air Cooling

Focusing Electromagnets

VT-68915

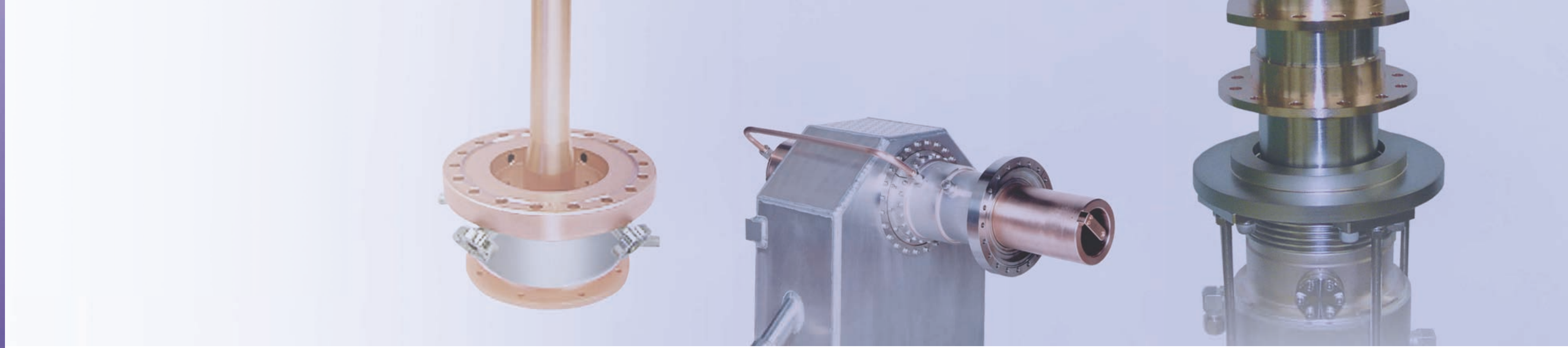
VT-68922

VT-68926

Type	Klystron	Coil Current (A)	Coil Voltage (V)	Cooling	Coil Weight (kg)	Coil L × Φ (mm)	Oil Tank (kg)	Oil Tank W × D × H (m)
For CW/Long Pulse Klystron								
VT-68960B	E37504	15/15/15	300/300/300	L	450	1.6 × 0.6	-	-
E3766A_ACC	E3766A	20/20	20/470	L	1,100	1.4 × 0.9	550	1.5 × 1.5 × 1.0
VT-68933B	E3766A	20/20	20/470	L	1,100	1.4 × 0.9	-	-
VT-68958	E37503	50/50/50	10/150/25	L	3,100	2.1 × 0.9	-	-
VT-68945	E37701	8.2	450	L	900	1.1 × 0.9	-	-
VT-68950	E37501	24	100	L	280	0.6 × 0.5	-	-
VT-68948	E37750	25	100	L	520	0.6 × 0.6	-	-
E37750_ACC	E37750	25	100	L	520	0.6 × 0.6	430	1.0 × 1.3 × 1.3
VT-68927B	E3739B	33	30	L	120	0.4 × 0.3	-	-
For Pulse Klystron								
VT-68946	E37612	18	250	L	835	1.2 × 0.5	-	-
VT-68934,E/ (VT-68934,G)	E3772/E3779,B/E3783 E3765,A/E3735A/E37325/ E37326	42/32	160/5	L	400	0.6 × 0.5	-	-
VT-68934,F	E37307	42/32	160/5	L	400	0.6 × 0.5	-	-
VT-68931A	E3730A/E3754/E37300/ E37302/E37308/E37310	20	250	L	520	0.7 × 0.5	-	-
VT-68922	E3730A/E3754/E37300/ E37302/E37308/E37310	25/38/19 24/17/10	15/30/25 40/23/10	L	520	0.7 × 0.5	-	-
VT-68915	E3712/E3729/E37320	24	250	L	1,000	1.1 × 0.6	-	-
VT-68953	E37314,A/E37333	24	250	L	1,400	1.1 × 0.6	-	-
VT-68924A	E3734/E37201	22	100	FA	135	0.3 × 0.5	-	-
VT-68926B	E37202	30	250	L	850	0.7 × 0.6	-	-
VT-68954	E37210/E37212	30	260/280	L	1,000/1,460	0.7 × 0.7	-	-
VT-68956	E37113/E37115	34/30	200/20	L	420	0.3 × 0.7	-	-
VT-68970	E37116	27	233	L	800	0.4 × 0.8	-	-

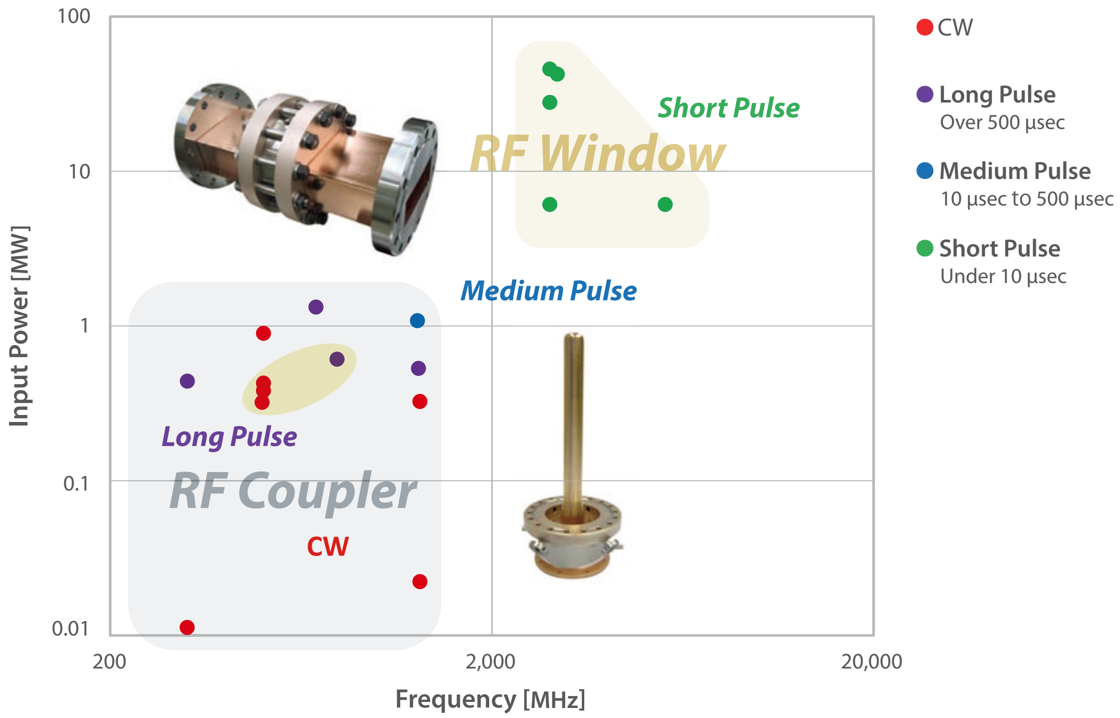
C: Conducting Cooling/ L: Liquid Cooling/ FA: Forced Air Cooling

RF Couplers & Windows



We have a lot of experiences in designing and manufacturing of high power input couplers and RF windows that meet your requirements. In a joint effort with High Energy Accelerator Research Organization(KEK), We have developed a wide variety of input couplers and RF windows that can transmit high amount of power.
We will propose a coupler structure by designating the shape and cooling structure.

Selection Guide RF Couplers & Windows



E4278

cold part warm part

E42101

E4262

cold part

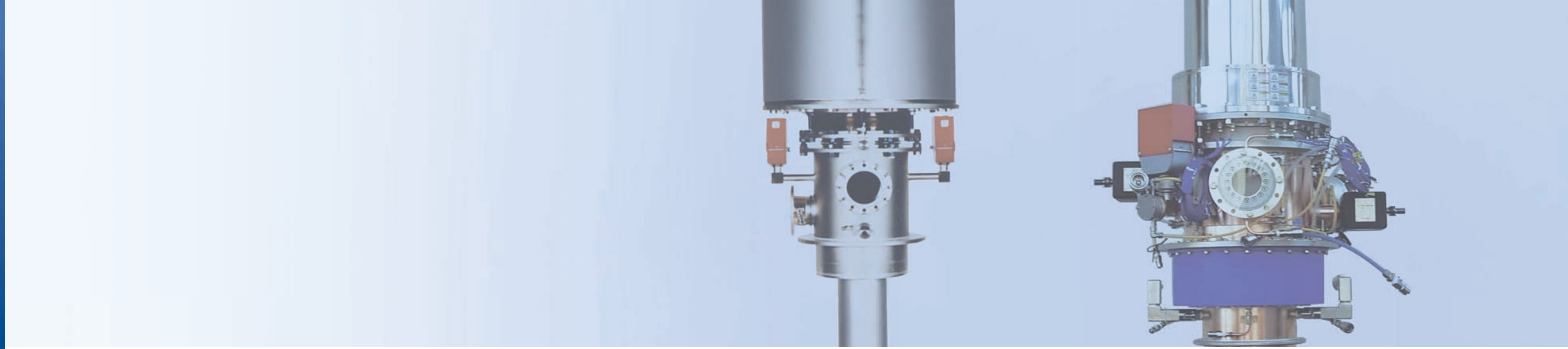
E42109

Couplers Lineup

Type	Frequency (MHz)	Input Power	CW/Pulse	Flange Input	Flange Output	Cooling	Weight (kg)	Length (mm)
Couplers								
E42135	322	10kW	CW	coaxial	coaxial	FA	10	532
E4277	324	400kW	620μs	WX-152D	ICF203	L	60	1,230
E4294	324	400kW	620μs	WX-152D	WX-77D	L	70	819
E4262	500.1	300kW	CW	WR1500	ICF203	L, FA	50	708
E4263	508.6	300kW	CW	WR1500	ICF203	L, FA	50	990
E4268	508.9	800kW	CW	WR1500	ICF203	L, FA	50	703
E42107	508.9	800kW	CW	WR1500	ICF203	L, FA	55	765
E4274	508.9	40kW	CW	ICF203	WX-120D	L	30	820
E42128	704	1.2MW	3.6msec	coaxial	coaxial	L	10	312
E42109	1,300	20kW	CW	coaxial	coaxial	-	25	750
E42111	1,300	300kW	CW	coaxial	coaxial	L, FA	13	603
E42100	1,300	1MW/ 500kW	400μs/ 1.3msec	WR650	coaxial	C	25	730
E42101	1,300	1MW	1.5msec	coaxial	coaxial	C	25	607
E42130*	1,300	1MW	1.5msec	coaxial	coaxial	C	25	607
Windows								
E4271/E42110	508.6	350kW	CW	152D / coaxial	152D / coaxial	L	15	377
E4278	805	550kW	1.3 msec	coaxial	coaxial	FA	10	408
E42103	2,856	42MW/ 10kW	4 μs	SLAC type round flange "Male"	SLAC type round flange "Female"	A	10	260
E42113	2,856	25MW/ 20kW	5 μs	SLAC type round flange "Male"	SLAC type round flange "Female"	L	15	275
E42131	2,856	5.5MW/ 47.5kW	15μs	CPR-284F Compatible	CPI Type Flange	L	10	297
E42120	2,998	38MW/ 20kW	4.5 μs	WR-284 LIL type flange	WR-284 LIL type flange	L	15	285
E42137	5,712	5.5MW/ 5kW	4 μs	WR-187 RIKEN DESY type flanges	WR-187 RIKEN DESY type flanges	L	9	307

*Under development
C: Conducting Cooling/ L: Liquid Cooling/ FA: Forced Air Cooling

Gyrotrons



We have developed various gyrotrons for fusion plasma heating and measurements, in collaboration with some research institutes, especially QST. We developed internal mode converter technology, which transform the cavity oscillation mode to a wave beam, and separate the output microwave beam from the spent electron beam. By taking advantage of the internal mode converter, we developed the first CPD(Collector Potential Depression) gyrotrons in the world(1994). This improvement dramatically increased the efficiency to approx. 50% from the previous level of about 30%, by recovering the spent electron beam energy.

QST: National Institutes for Quantum and Radiological Science and Technology

Gyrotrons

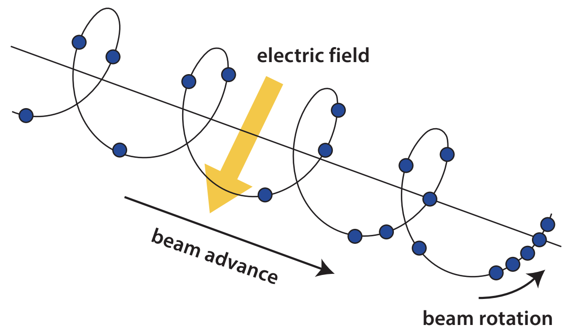
E39104

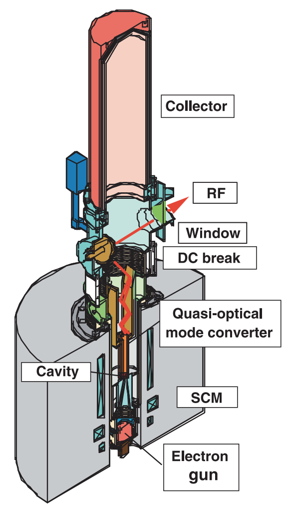
Type	Frequency (GHz)	Output Power (kW)	Output Aperture (kW)	Output Mode	Weight (kg)	Length (m)
E39200	28	1,000	11.2	TEM 00	750	2.6
E3988	77	1,000	8	TEM 00	820	3.1
E39101	110/138	1,000	8	TEM 00	820	3.1
E39210	154	1,000	8	TEM 00	820	3.1
E3998	170/137	1,000	8	TEM 00	820	3.1
E39104	170	1,000	8	TEM 00	820	3.1
E39103	170/137	1,000	8	TEM 00	820	3.1
E39203	303	300	8	TEM 00	120	1.7

"technology" for the "development" or "production" of the 'Vacuum electronic devices' operating at frequencies of 31.8 GHz or higher is controlled by the export control law based on "Wassenaar Arrangement 3.E.3.g".

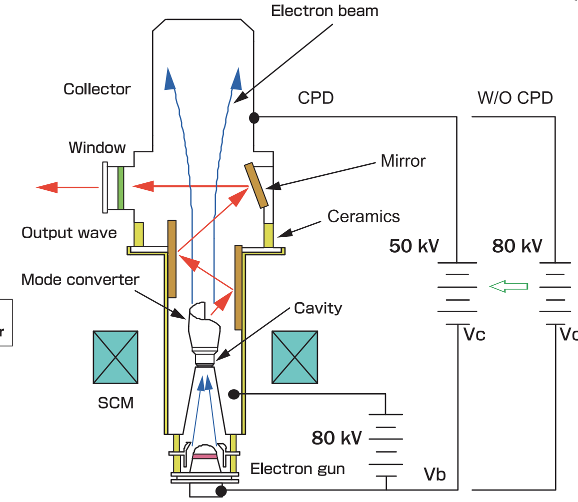
Principle of Operation

Gyrotrons consists of an electron gun, a cavity resonator, a mode converter, an output window and a collector, which require a solenoid magnet to give gyrating motion to electron beam. Electrons are emitted from a cathode under the action of the electric field, and move in gradually increasing magnetic field towards the cavity. In this motion, part of energy of the electron motion along the lines of magnetic field is transformed into the energy of gyration. Electrons that have a cyclotron frequency slightly below a resonant frequency of the microwave excited in the cavity are bunched and decelerated by its transverse electric field. As a result, the microwave is given the gyration energy by the bunched electrons and start oscillation.
The microwave generated with a cavity mode is converted to wave beam by the mode converter, and shaped by some mirrors, and outputted through the output window.





Gyrotron 3D illustration



Gyrotron diagrammatic illustration

(by courtesy of QST)

Technologies for Products

Core Technologies

Klystron electron beam
(Electron interaction + Electromagnetic wave + Microwave)

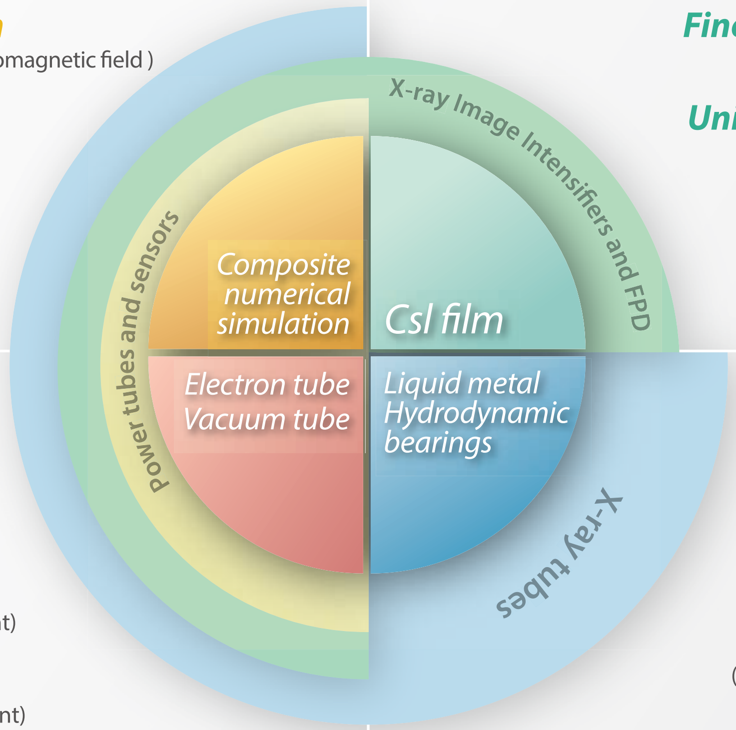
X-ray electron gun
(Electron interaction + Electromagnetic field)

X-ray bearing
(Fluid + heat + structure)

High transparent crystal
(High-efficiency X-ray optical conversion)

Fine columnar crystal
(High resolution)

Uniform pillar crystal
(Uniform resolution)



Vacuum sealing
(Bonding, material treatment)

Vacuum keeping
(Degassing, surface treatment)

Voltage endurance
(Material, geometric design, surface treatment)

Bearings for CT equipment
(High load, heat conduction)

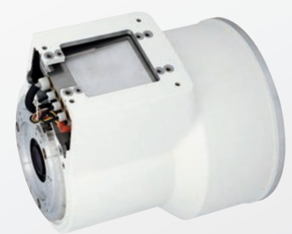
Bearings for angiography equipment
(High speed rotation, lubricant sealing)

World's Largest Shipment Volume Products (An internal investigation)

World's largest shipment volume share based on long life, high reliability, superior cost performance

3-inch X-ray Tube Assemblies

9-inch X-ray Image Intensifiers



Stationary Anode X-ray Tubes

Environmental Consideration

Aiming at a Society to Hand on the Rich Earth to Future Generations

We are promoting the creation of environmentally friendly products.
These products contribute to the realization of a low-carbon, resource circulation society, avoid chemical hazardous material rejection and prevent pollution.
While being committed to reducing environmental burdens, we offer medical system components and other products that contribute to society in the fields of industrial and scientific technologies.
Our focus is on creating products that contribute to society and enhance the total value of our customers' medical systems and others.

Environmentally Conscious Products Spawned from Core Technologies

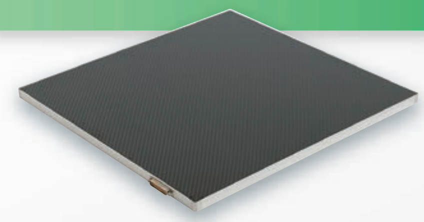
Products Certified In-House for Outstanding Environmental Performance

2MHU-CT X-ray Tube Assemblies

Realization of Resource Circulation Society
Reduction in weight by downsizing from previous higher-end models
Development of technology to improve reliability of anode target
Development of technology to improve maintainability of cooler

Chemical Hazardous Material Rejection & Pollution Prevention
Conforms to the revised European RoHS2 Directive (2011/65/EU)

X-ray Flat Panel Detectors

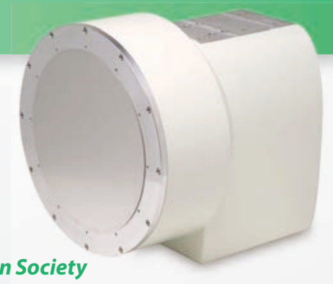


Realization of Low-Carbon Society
Low-dose imaging using Quadcel, our developed
core technologycore technology Reduces exposure of patients to radiation
and saves energy through the use of a low-power technology

Realization of Resource Circulation Society
Compact sizing and product-life extending can be achieved with Quadcel technology

Chemical Hazardous Material Rejection & Pollution
Conforms to the revised European RoHS2 Directive (2011/65/EU)

X-ray Image Intensifiers



Realization of Low-Carbon Society
High sensitivity through technical improvements in
the input fluorescent surface and photoelectric surface

Realization of Resource Circulation Society
Extended life through technical improvements in the output fluorescent

Chemical Hazardous Material Rejection & Pollution
Conforms to the revised European RoHS2 Directive (2011/65/EU)
First in the world to be free of Cd and Cr (VI)Cd-free output fluorescent surface
Photoelectric surface manufacturing process that does not leave behind any Cr (VI)

Multi-beam Klystrons

Realization of Low-Carbon Society
Large power efficiency achieved with a low operating voltage

Realization of Resource Circulation Society
Extended life through optimization of the cathode loading

Chemical Hazardous Material Rejection & Pollution
Conformance with European RoHS2 Directive (2011/65/EU) from the prior period of application onwards

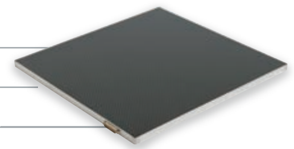
Company Profile

History

Our products, such as Japan's first commercially available X-ray tube in 1915, X-ray Image Intensifiers, Flat Panel Detectors, and electron tubes, have served as components in a wide range of equipment. Building on the reliability and business performance achieved so far, we will continue to pursue stable and continuous growth for the next 100 years.

GIBA X-ray Tube

1915	:Developed X-ray tube.
1954	:Developed X-ray Image Intensifiers (I.I.).
1977	:Succeeded in growing CsI crystals with a pillar structure and using them in the input phosphor.
1986	:Developed high DQE Super Metal X-ray image intensifier.
1990	:Developed high-Gx and high-contrast advanced super-metal I.I. (H-series).
1991	:Completely discontinued use of Freon and trichloroethane. :Achieved production of a total of 200,000 rotating anode X-ray tubes.
1992	:Developed 4 inch I.I. for industrial-use soft X-ray (initial full-scale entry into industrial-use equipment market).
1994	:Developed 4 MHU CT tube with hydrodynamic pressure bearing (CSRX-7713D-H).
1995	:Developed high-DQE and high-contrast I.I. (J-series).
1996	:Obtained CE mark certification, BS 7750 certification, and ISO 14001 certification. :Achieved compliance with the European Medical Devices Directive.
1998	:Developed SD series I.I. with high MTF and high image uniformity.
2001	:Developed LM cardiac tube.
2008	:Developed digital X-ray sensor with CsI and CMOS technology. :Developed the world's first nano focus soft X-ray tube with a closed structure and thermal field emitter.
2009	:Commenced commercial production of 43 cm × 43 cm Flat Panel Detector for radiography (FDX4343R).
2012	:Commenced commercial production of 35 cm × 43 cm portable Flat Panel Detector for radiography (FDX3543RP).
2013	:Commenced commercial production of 35 cm × 43 cm portable Wireless Flat Panel Detector for radiography (FDX3543RPW).
2015	:100th anniversary
2016	:Developed 5.7 MHU CT tube with hydrodynamic pressure bearing.
2017	:Commenced commercial production of 43 cm × 43 cm Flat Panel Detector for radiography(FDXA4343R)
2018	:Renamed "Canon Electron Tubes & Devices Co.,Ltd."



Fixed Panel

CSRX-7713D-H 4MHU

SD Series

Wireless Panel

Essential Historical Materials for Science and Technology (Mirai Technology Heritage) in Japan

1. GIBA X-ray Tube (Registered in 2010)
2. Collector Potential Depression (CPD) type gyrotron (Registered in 2009)
3. Klystron E3732 (Registered in 2014)
4. Traveling Wave Tube 1W50 (Registered in 2014)
5. Coolidge U-Type X-ray Tube (Registered in 2018)

Company information

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