

# X band Magnetron

*Draft*

## ■ GENERAL DESCRIPTION

MX7621 is a tunable X-band pulsed type magnetron intended primarily for linear accelerator. It is cooled with water and has a UG51/U (WR112) output coupling.

It is designed to operate in the frequency range of 9275 to 9325 MHz with a peak output power of 2MW and the duty cycle of 0.001.



## ■ GENERAL CHARACTERISTICS

### ELECTRICAL

PARAMETERS		
Heater voltage	(note 1)	10.0V
Heater current	(note 2 and 3)	12.5A
Minimum pre-heat time		600sec

### MECHANICAL

PARAMETERS		
Overall Dimensions		See outline
Net weight		12 kg approximately
Tuner revolutions to cover frequency range	(note 4)	10
Mounting position		Any
Cooling	(note 5)	Water: Anode cavity Forced-air: Input ceramics and terminals
Output coupling	(note 6)	UG51/U
Magnet	(note 7)	Integral, Permanent

## ■ ABSOLUTE MAXIMUM RATINGS

These ratings cannot necessarily be used simultaneously and no individual ratings should be exceeded.

PARAMETERS	Minimum	Maximum	Units	
Heater voltage	(note 1)	-	15	V
Anode voltage (peak)		-	40	kV
Anode current (peak)		50	105	A
Input power (mean)		-	4.2	kW
Duty cycle	(note 8)	-	0.0011	-
Pulse duration		-	4.5	μs
Frequency stability in pulse	(note 9)	-	0.2	MHz
Rate of rise of voltage pulse	(note 10)	80	120	kV/μs
Outlet water temperature		-	50	°C

PARAMETERS	Minimum	Maximum	Units
VSWR at the output coupler	-	1.3 : 1	-
Pressurizing of waveguide (note 11 and 12)	-	0.3	MPa

**■ TEST CONDITIONS AND LIMITS**

The magnetron is tested to comply with the following electrical specification.

Test conditions		Units
Heater voltage (operating)	0	V
Anode current (peak)	100	A
Duty cycle (note 8)	0.001	-
Pulse duration	4.0	μs
VSWR at the output coupler	1.05:1	-
Minimum rate of rise of voltage pulse (note 10)	120	kV/μs

Limits	Minimum	Maximum	Units
Anode voltage (peak)	36	40	kV
Output power (peak) (note 13)	2.0	-	MW
Frequency (note 14)			
Lower end of tuning range †	-	9275	MHz
Upper end of tuning range †	9325	-	MHz
RF bandwidth	-	2.5/t <sub>p</sub>	MHz
Frequency pulling (VSWR not less than 1.3 : 1)	-	5.0	MHz
Stability (note 15)	-	0.02	%
Heater current (note 2 and 3)	8	15	A

† : Inlet water at 35 degrees centigrade, t<sub>p</sub>: Pulse duration

**■ LIFE TEST**

The test is performed under test conditions.

The magnetron is deemed to have reached the end of life when it fails to satisfy the following:

PARAMETERS	
Anode voltage (peak)	36 kV min.
Output power (peak)	1.6 MW min.
Frequency (note 14)	
Lower end of tuning range †	9275 MHz max.
Upper end of tuning range †	9325 MHz min.
RF bandwidth	3.0/t <sub>p</sub> MHz max.
Stability (note 15)	1% max.

† : Inlet water at 35 degrees centigrade, t<sub>p</sub>: Pulse duration

Notes

1. Heater voltage must be reduced within 5 seconds after the application of high voltage according to the schedule shown on page 5.  
The magnetron heater must be protected against arcing by the use of a capacitance at least 4000pF shunted across the heater terminal directly.
2. Measured with heater voltage of 10.0 V and no anode input power, the heater current limits are 8.0A minimum, 15.0A maximum.
3. Maximum heater surge current must not exceed 40amperes.
4. The tuner mechanism is driven by the tuner shaft (see outline drawing). The torque required is 0.05 Nm minimum; the torque applied must not exceed 0.3Nm.
5. The recommended water quality is pure grade.  
The recommended water flow is minimum 2.5 l/ minutes; a pressure of approximately 0.06 MPa will be necessary to give this rate of flow. The outlet water temperature must not exceed 50 degrees centigrade.  
The input ceramics and input terminals must be cooled by forced-air at air flow rate of minimum 1000 l/minutes. Interlock of the fan operating should be provided and heater input should be turned off in case of stopping fan operation for avoiding the damage to the magnetron.
6. The magnetron must be coupled directly to a UG-52/BU choke flange modified with the 4 clearance holes of 0.166" diameter.
7. In handling and mounting the magnetron, care must be exercised to prevent demagnetization. Magnetic materials must not be permitted at any time closer than 200 millimeters from the tube. Any energized magnets must not be permitted at any time closer than 300mm from the tube.
8. The various parameters are related by the following formula:

$$P_i = i_b \times e_{py} \times D_u$$

	Pi: mean input power in W
where	i <sub>b</sub> : peak anode current in A
	e <sub>py</sub> : peak anode voltage in V
	D <sub>u</sub> : duty cycle

9. The frequency stability is defined as a jitter of the anode current when a mode-jump occurs in oscillation.
10. The rate of rise of voltage (rrv) is defined as steepest tangent to the leading edge of the voltage pulse above 80 percent amplitude. Any capacitance in viewing system must not exceed 6.0pF.
11. At the maximum pressure of 0.3Mpa the maximum leakage will be such that the pressure will not drop by more than 70 kPa in 7 days with an enclosed volume of 1 liter.
12. The pressurized gas in the waveguide need provide insulating properties consistent with power levels developed.  
It is recommended that sulfur Hexafluoride (SF<sub>6</sub>) should be used as the pressurized insulating gas. A minimum pressure of SF<sub>6</sub> of 0.2MPa is considered adequate.
13. The maximum variation of mean output power when the magnetron is rotated through 360° around any axis of the magnetron will not be greater than 4 %.
14. The maximum variation of frequency when the magnetron is rotated through 360° around any axis of the magnetron will not be greater than 0.7 MHz.
15. With the tube operating into a VSWR of 1.15:1 and various phases to give maximum instability.  
Pulses are defined as missing when the RF energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes.

## HEALTH AND SAFETY HAZARDS

Magnetrons are safe to handle and operate.

The relevant precautions stated herein must be treated appropriately.

Equipment manufacturers and users must ensure that adequate precautions are taken. Appropriate warning labels and notices must be provided on equipment and in operating manuals.



### High Voltage

Equipment must be designed so that personnel cannot come into contact with high voltage circuits. All high voltage circuits and terminals must be enclosed. Fail-safe interlock switches must be fitted to disconnect the primary power supply and discharge all high voltage capacitors and other stored charges before allowing access. Interlock switches must not be bypassed to allow operation with access doors open.



### RF Radiation

Personnel must not be exposed to excessive RF radiation.

High voltage magnetrons not only emit RF energy from the RF output but also leak one from the input insulator.

All RF connectors must be correctly fitted before operation so that no leakage of RF energy can occur and the RF output must be coupled efficiently to the load.

Personnel must maintain sufficient clearance away from the magnetron while the device is energized.

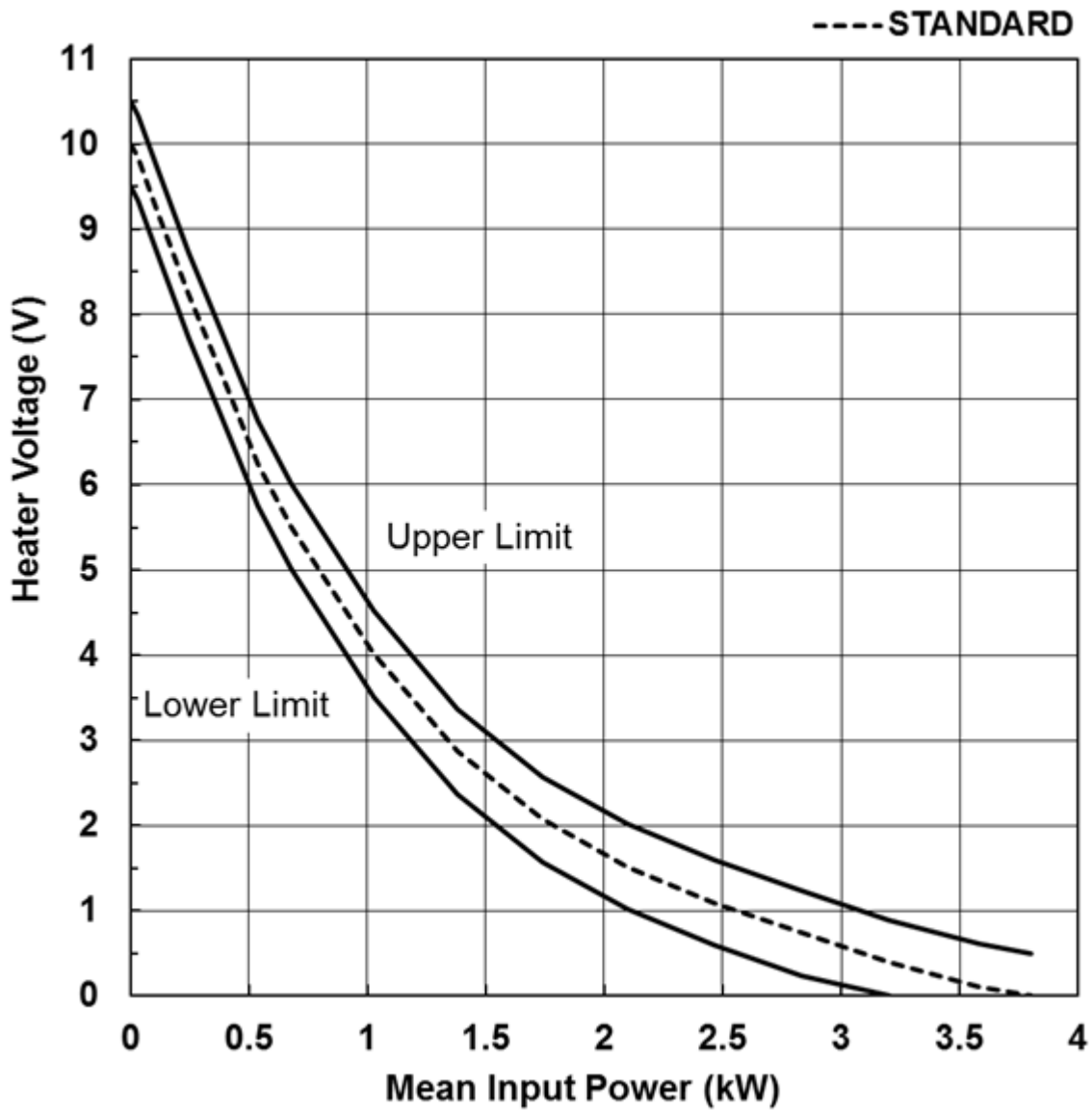
It is particularly dangerous to look into open waveguide while the magnetron is energized.



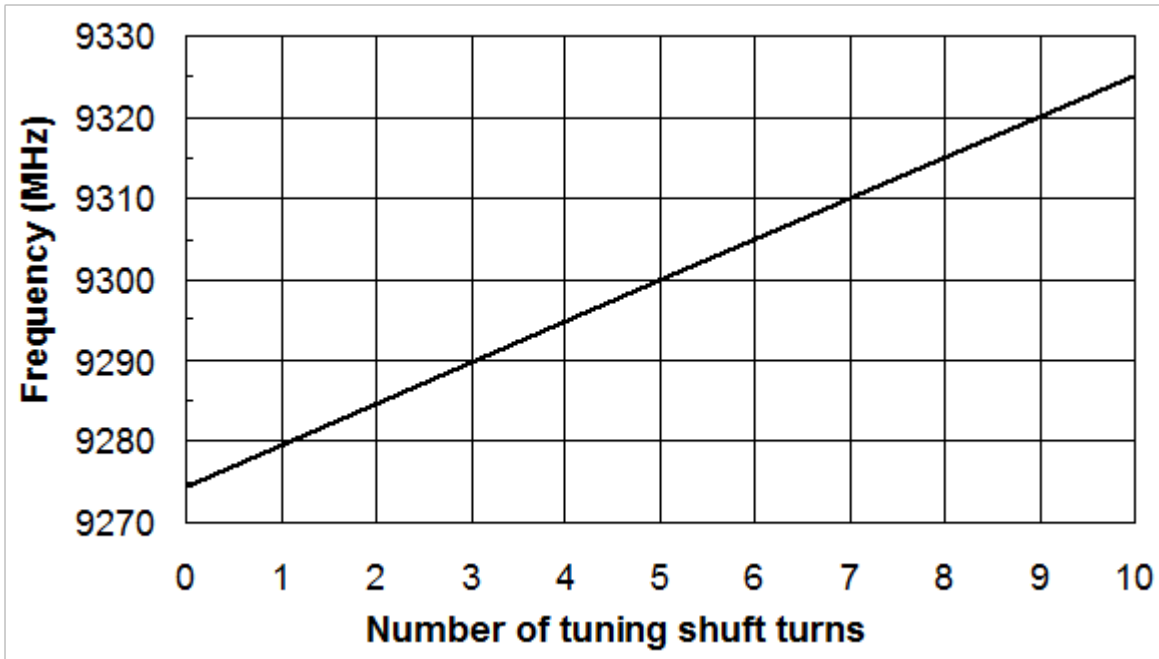
### X-Ray Radiation

High voltage magnetrons emit a significant intensity of X-rays not only from the input insulator but also from cathodes sidearm and the others. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. The intensity of X-rays depends on the anode voltage.

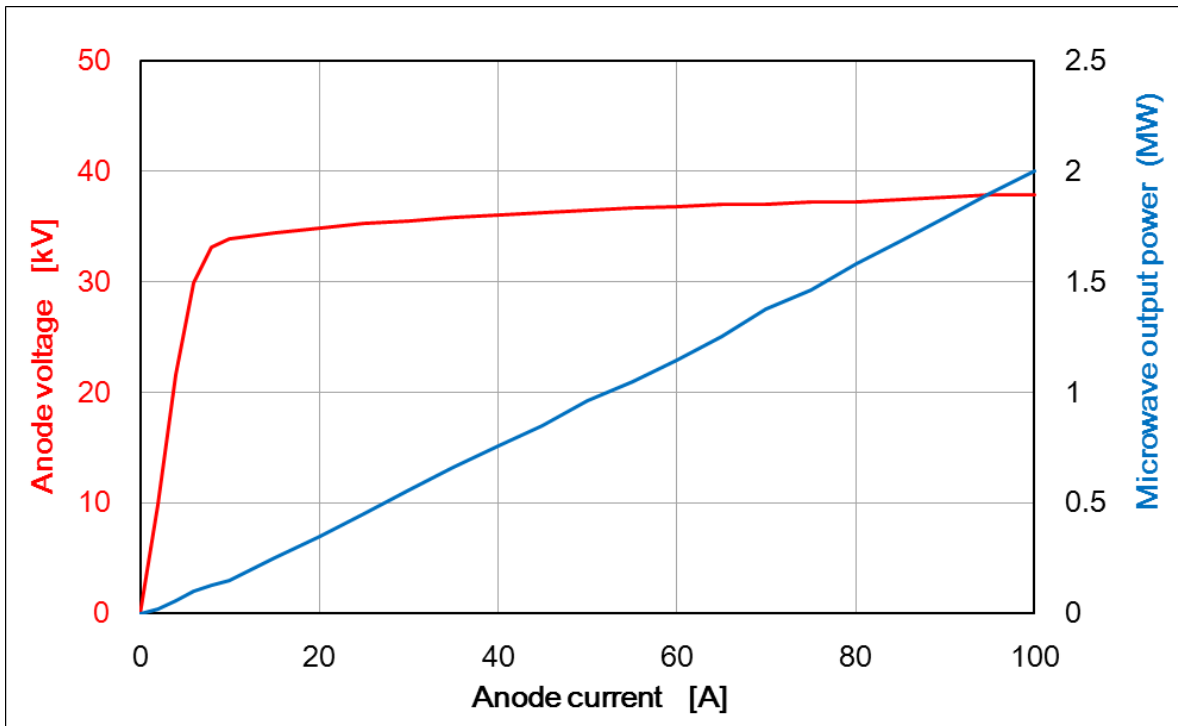
■ HEATER VOLTAGE REDUCTION SCHEDULE



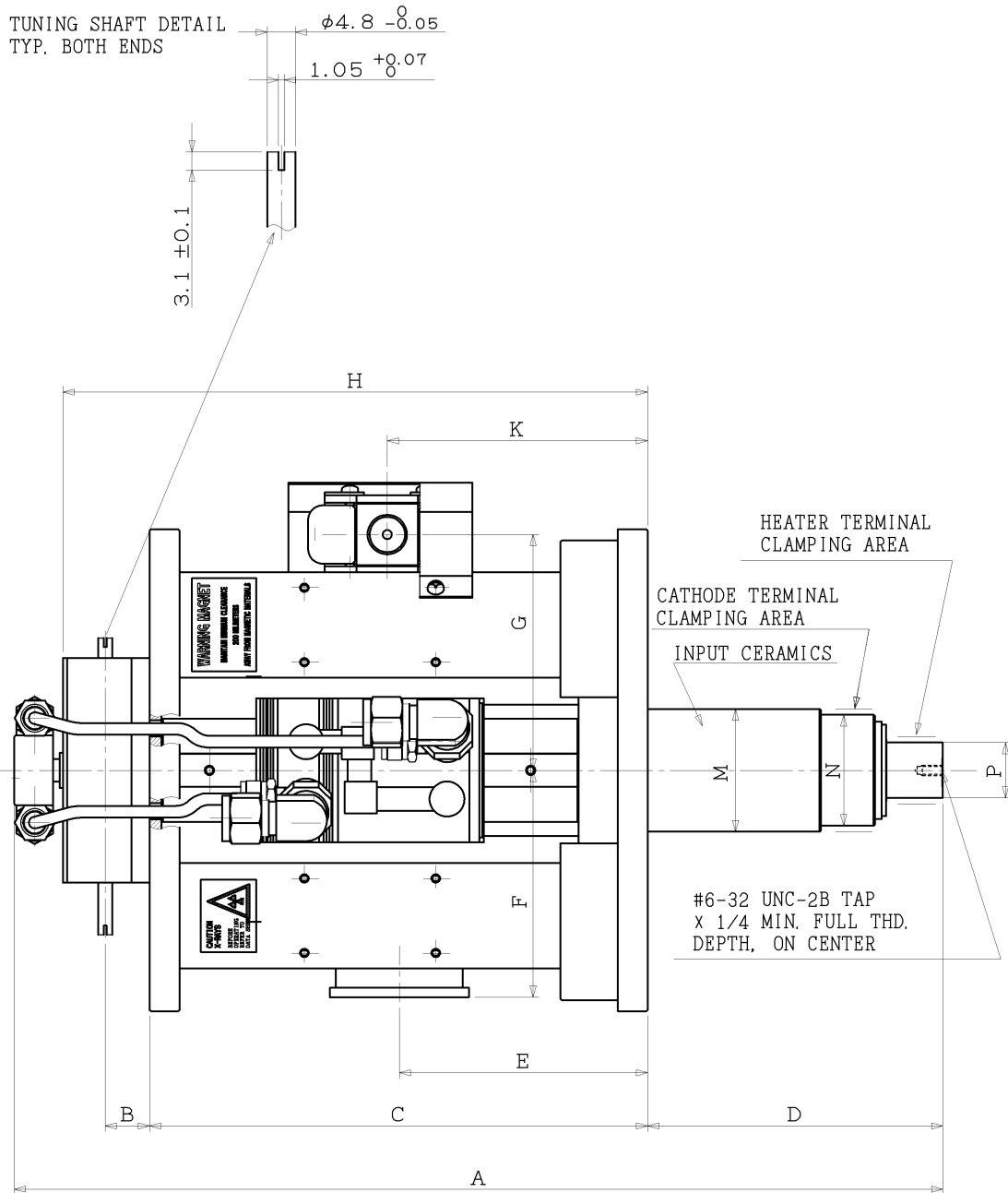
■ FREQUENCY ADJUSTMENT

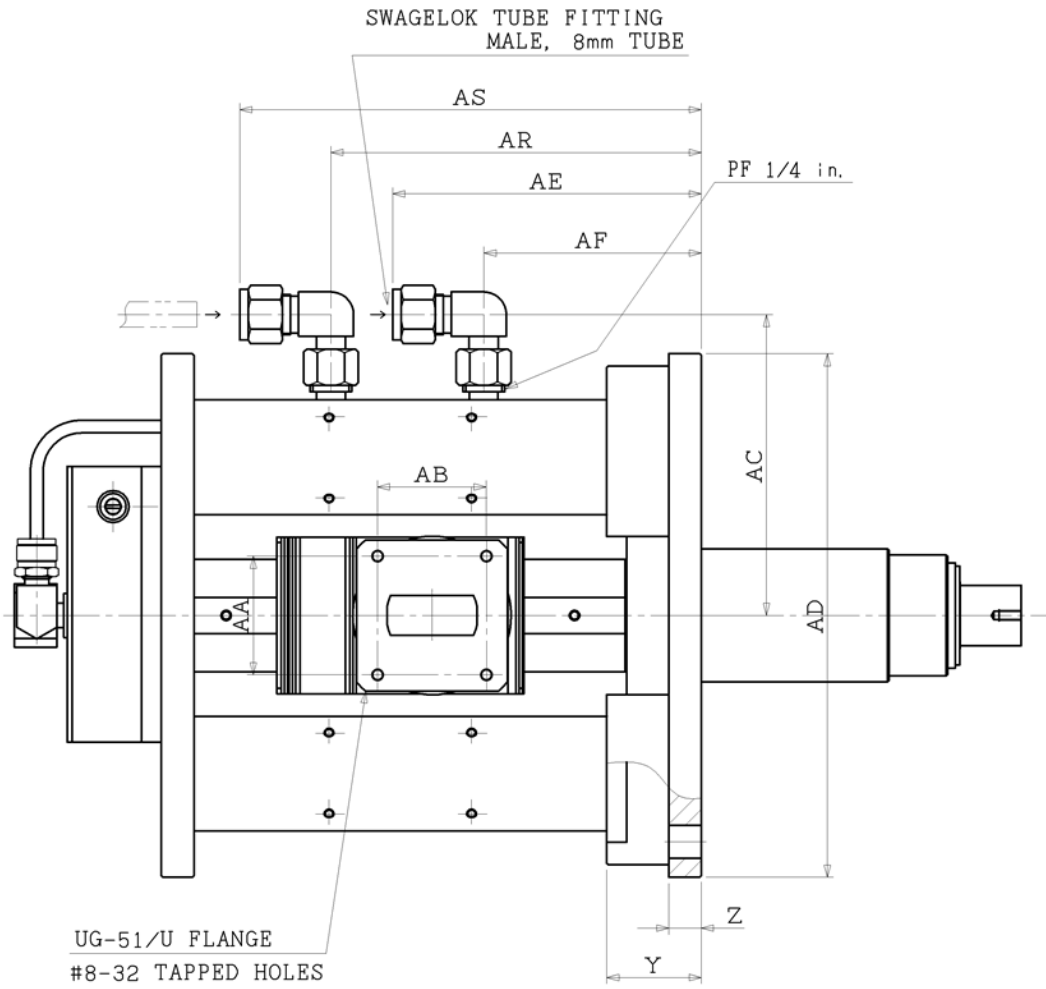


■ PERFORMANCE CHART

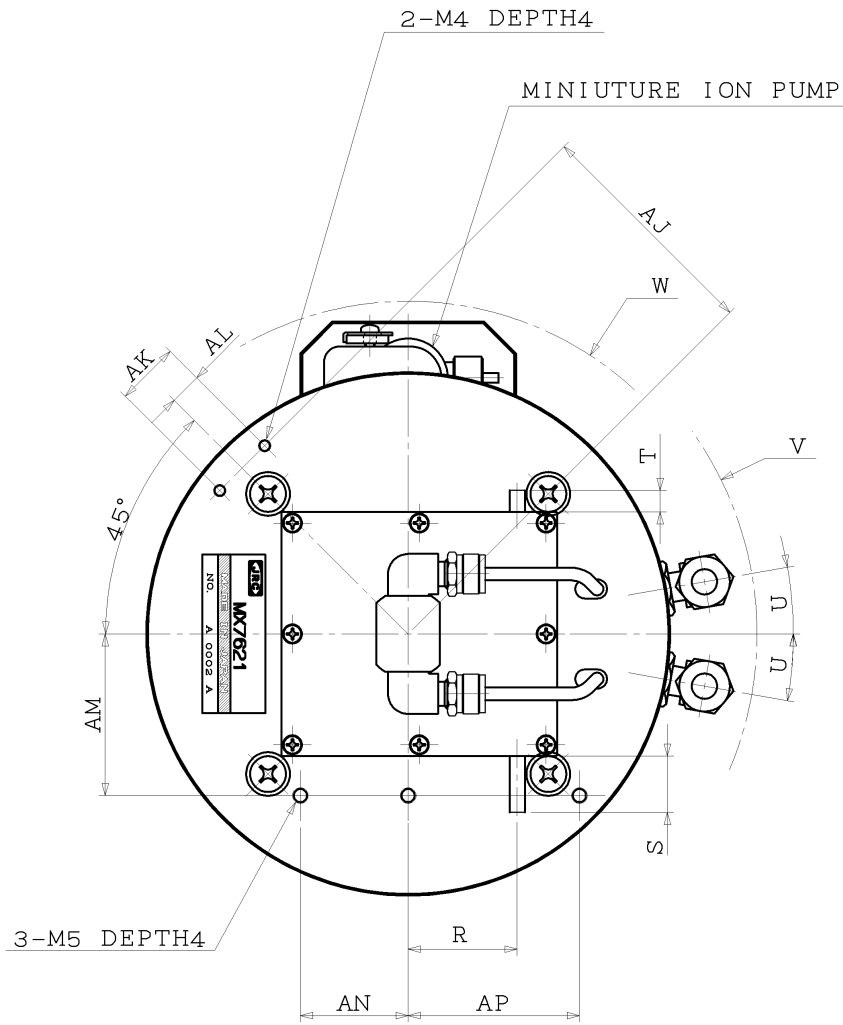


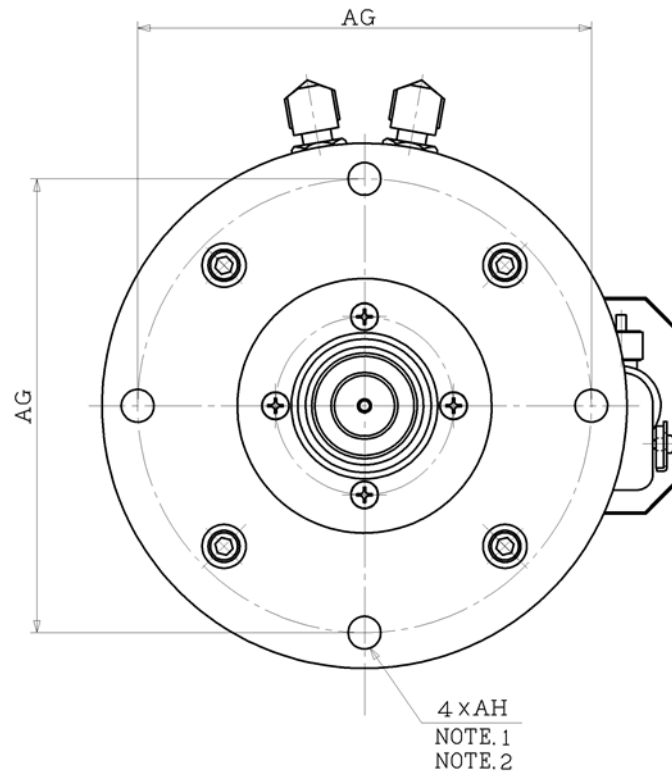
OUTLINE











Ref.	Millimeters	
	MAX	MIN
A	321.0	—
B	15.4	15.0
C	171.0	—
D	101.5	100.5
E	85.3	84.8
F	78.1	77.3
G	83	78
H	200.8	199.8
K	89.7	88.7
M	φ42.8	φ41.2
N	φ38.4	φ37.9
P	φ19.3	φ18.8
R	35	—
S	18.3	17.3
T	7.3	6.3
U	10.25°	9.75°
V	φ220	
W	φ210	
Y	30.0	29.8
Z	10.4	10.0

Ref.	Millimeters	
	MAX	MIN
AA	37.6	37.3
AB	34.5	34.2
AC	95.3	94.3
AD	φ165.2	φ165.0
AE	98.8	—
AF	69.3	68.3
AG	143.0	142.5
AH	φ10.26	
AJ	74.2	73.8
AK	20.2	19.8
AL	10.2	9.8
AM	51.2	50.8
AN	34.2	33.8
AP	54.2	53.8
AR	117.5	116.5
AS	147.0	—

**Notes**

1. Directly connect to the ground (low voltage side from pulse transformer) terminal of modulator with the shortest length and 8 mm<sup>2</sup> cross section area of lead wire.
2. Positional tolerance of holes 0.1 mm diameter.
3. All dimensions without limits are nominal.

\*Note: The contents of this sheet are subject to change without notice.

