

X-band 20-MW klystron ready for prototyping

Canon Electron Tubes & Devises Co., Ltd. has designed an X-band 20-MW klystron E37116 for industrial and scientific applications. The peak output power of the klystron is more than three times higher than our conventional X-band 6-MW klystrons and the average output power is up to 12.4 kW. The klystron will be prototyped in 2020 and will be a suitable klystron for uses requiring the high peak and average RF power in the X-band.

Background

The X-band accelerators are compact and sometime the total cost of a machine can be saved. For this reason, the market of the X-band klystron is expanding in these days. We already have X-band 6-MW klystrons in the product lineup and some 50-MW klystrons exist in the market, whereas klystrons which have a moderate output power between them are not available. Therefore, we designed an X-band (11.424 GHz) 20-MW klystron.

Design

The klystron was designed based on our experience of the existing X-band 6-MW klystron. The new electron gun which makes the beam current of 170.3 A at the beam voltage of 265 kV was designed.

The cavity shapes and positions were scaled from the existing klystron and the RF amplification was simulated. Totally five cavities were used and the 3-cell $\pi/2$ mode travelling wave cavity was used as the output cavity to reduce the electric field strength of the output section to achieve the target RF pulse length of 1.5 μs . The design target and result are summarized in the table 1. All design targets were achieved in the simulation.

After finishing the electrical design works, the overall structure of the klystron was considered and the mechanical design has been done. The appearance of the klystron is shown in the figure 1. The output windows and output waveguides are water-cooled for the operation at the average power up to 12.4 kW. The height and the weight of the klystron will be about 1.3 meters and 300 kg, respectively.

Conclusion

The 11.424-GHz 20-MW klystron has been designed. The klystron will be prototyped in 2020. The X-band klystrons will be key components for the future compact accelerator systems.

Table 1. Design target and design result.

Parameter	Unit	Design target	Result
Frequency	GHz	11.424	11.424
Beam voltage	kV	265	265
Beam current	A	170.3	170.3
Output power*	MW	> 23	24.3
Efficiency*	%	> 51	53.8
Drive power	W	~120	120
Max. electric field strength in cavity	kV/mm	< 64.5 (for 1.5 μ s RF)	60.4

* The target output power and the target efficiency were set considering the difference between the simulation and the estimated actual value.

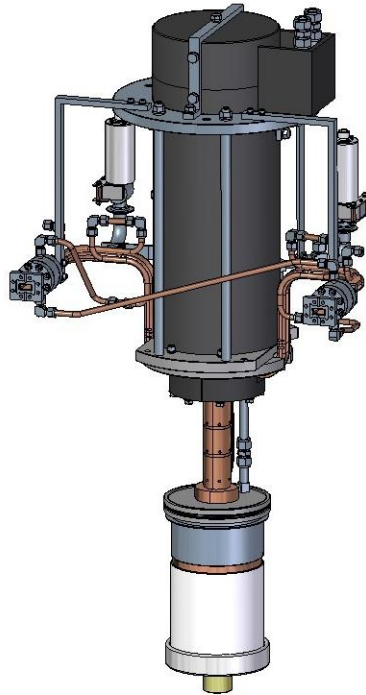


Figure 1. Appearance of klystron.

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