Development of HPRF dummy load for PEFP

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1. Introduction

The 100MeV, 20mA proton linear accelerator for PEFP (Proton Engineering Frontier project) is being developed [1][2]. As a low energy accelerator, 3MeV RFQ was built and 20MeV DTL consists of 4 tanks is being constructed [3]. Two sets of 1MW, 350MHz RF system are required for each accelerating structure. RF power from 1MW klystron is split into two legs and four legs by magic tee to drive RFQ, DTL tanks respectively. 100kW magic tee dummy load is required to absorb asymmetry RF power reflected from each accelerating structure. The RF dummy load can be matched with matching posts and input coolant temperature.

2. Manufacture and Matching

In this section manufacture and matching results of the RF dummy load are described.

2.1 Design and Manufacture

100kW magic tee RF dummy load for absorption of asymmetry RF power reflected from accelerating structure was designed and manufactured as shown in figure 1. The length and gradient of waveguide were determined due to the constant dissipation per unit length of 100kW RF power. It uses mixture of water and MEG with additives-DOWTHERM SR-1 (volume ratio 50:50) as a coolant.

Figure 1. external and internal shapes of manufactured 100kW magic tee dummy load.

2.2 Matching

The RF dummy load can be matched with two matching posts and given input coolant temperature. The equivalent circuit of the RF dummy load is shown in figure 2.
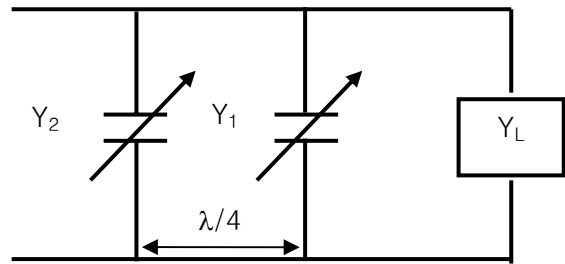

Figure 2. equivalent circuit for the dummy load.

$$Y_L = g_L + jb_L$$
$$Y_1 = jb_1$$
$$Y_2 = jb_2$$
$$b_1 = g_L \sqrt{\frac{1}{g_L} - 1} - b_L$$
$$b_2 = \sqrt{\frac{1}{g_L} - 1}$$

Matching condition (b1, b2) can be obtained at given input coolant temperature. Height and position of two matching posts was determined to match the RF dummy load. The required VSWR value is 1.05 below and the measured VSWR value is 1.0105 at 45 degree coolant temperature. Figure 3, 4 show the measured VSWR and smith chart using Agilent 8753ES network analyzer.
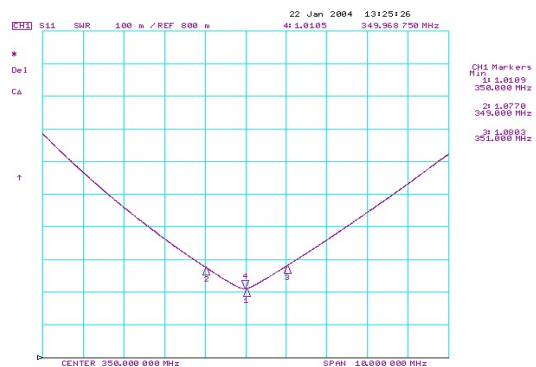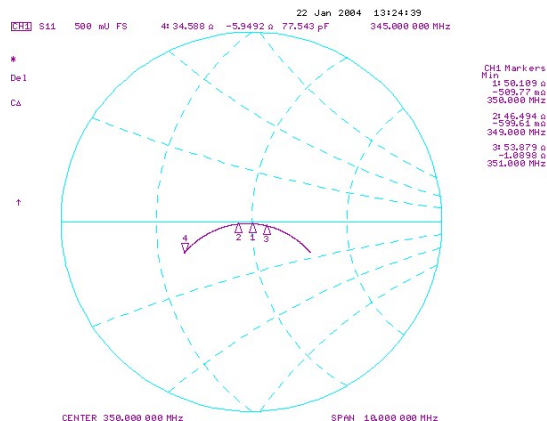

Figure 3. The measured VSWR at 45 degree coolant

Figure 3. The measured smith chart at 45 degree coolant

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3. Conclusion

100kW magic tee dummy load has been designed and manufactured. It could be matched by adjusting height and position of two matching posts at 45 degree coolant temperature. The measured VSWR value is 1.02 at 45 degree. The developed RF dummy load will be used for absorbing the reflected RF power from accelerating structure.

4. Acknowledgements

REFERENCES

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[3] H, J, Kwon, et al, "The RF power delivery system design and its component characterization for PEFP DTL", Proc. of Particle Accelerator Conference, Portland, Oregon USA, 2003