500 MHz 200 kW CW KLYSTRON FOR PHOTON FACTORY STORAGE RING

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Introduction

A CW klystron E3774(500 MHz, 200 kW) for photon factory storage ring in KEK is presented.

In the design of high power klystron, it is very important to utilize the harmonic component contribution to electron beam[1].
There are two approaches for this purpose:

(1) To use the second harmonic cavities,---E.L.Lien[1]
(2) To use the abnormally long drift spaces,---E.L.Lien[1], T.G.Mihran[2]

Design and Performance

In the klystron E3774 to be designed in our purpose, it is required to get the producibility and the easy handling and maintenance as well as the high efficiency. In order to attain the klystron with the efficiency more than 62.5 % and particularly the reduced length, we analyzed and obtained the optimum values by the new computer simulation method, which includes the effect of the high efficiency by the second harmonic contribution.

As a result of this analysis, we found the high efficiency, high gain, and comparatively short klystron with the different cavity location from the above mentioned klystrons[1,2]. The interval of the input and output gap in our klystron is about a half in the 2nd approach.

The electrical and mechanical characteristics designed for the klystron E3774 are shown in Table 1, and its photograph is shown in Fig. 1.

The calculated and measured effect of the debunching frequency which affects the beam in the drift space are shown in Fig.3, where Merit Figure[3] is used as the calculated efficiency.

The measured efficiency is slightly different from the calculated one, however the tendency resembles well each other. This discrepancy seems to be due to the fact that the one-dimensional analysis was used, or the parameters of E3774, particularly output Q, are not optimized yet.

Fig.2 shows electron phase angle, normalized RF beam currents, and Merit Figure vs normalized distance.

Conclusion

We developed the 200 kW comparatively short klystron in this frequency range with the high efficiency of 53 % and the high gain of 60 dB at 46 kV 8.2 A.

Although the difference between the calculated and measured efficiency is about 10 %, it can be reduced and the higher efficiency klystron will be obtained by more optimization of designed parameters.

Acknowledgement

We wish to thank Proffessor Fuke of KEK for his many helpful suggestions and useful advices.

References

(1) E.L.Lien, 8th Int. Conf. on MOGA, Amsterdam (1970) 11.
(2) T.G.Mihran, G.M.Branch, JR, and G.J.Griffin, JR, TEEE Trans. on ED, ED-18 (1971) 124.
(3) T.G.Mihran, IEEE Trans. on ED, ED-14 (1967) 201.

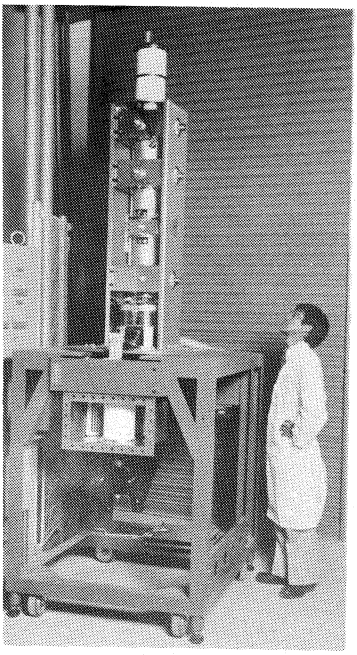

Fig. 1 Klystron E3774

Table] Designed Parameters of E3774

Frequency	500.08 MHz
Instantaneous Bandwidth(0.5 dB Points)	0.5 MHz
Beam Voltage	40 kV
Beam Current	8 A
RF Power Output(saturation)	200 kW
Efficiency	62.5 %
Gain(saturation)	40 dB
Gain(Po=1d0 kW)	42 dB
Load VSWR	1.3
Overall Length	2.5 m
RF Input	Coaxial Type N Connector
RF Output	WR 1500 Wave Guide
Magnetic Focusing Field	250 Gauss
Collector and Body	Water-cooled 425 ℓ/min
Focusing Coil and Cathode	Air-Cooled

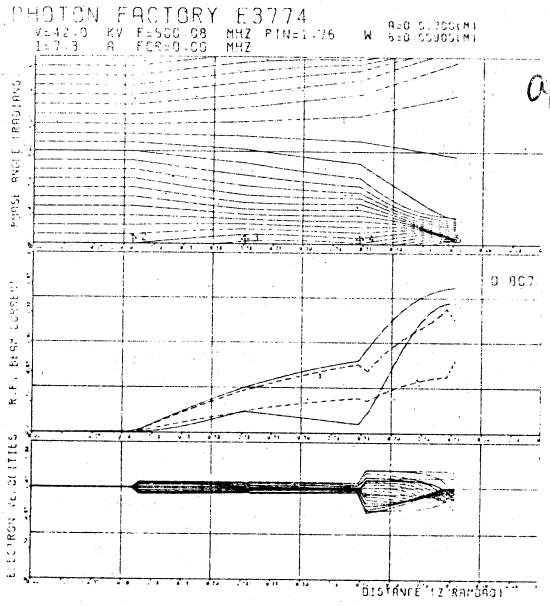

Fig.2 Electron phase angle, Normalized RF beam current, and Merit figure vs Normalized distance.

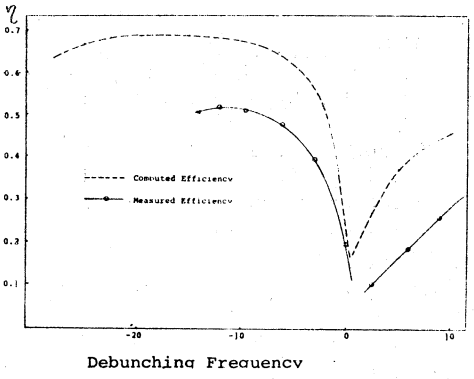

Fig.3 Efficiency vs Debunching frequency.