Toshiba/KEK MBK for TESLA: Design, Status and Schedule

Yong Ho Chin TESLA Collaboration Meeting DESY, Berlin January 21-23, 2004

2004/1/26

Reminders from Previous Talk

Toshiba was inquired by DESY about its interest in production of a MBK for TESLA in summer 2002.

- KEK/BINP team provided a basic design of TESLA MBK to Toshiba, based on our experience of designing a X-band PPM MBK for JLC (Japan Linear Collider).
 Toshiba improved the design for better performance and for meeting the specifications of TESLA.
- The design was approved and the order was placed to Toshiba in early summer 2003.
- The production is under way for the final delivery in October 2004.

Design Parameters

Toshiba E-3736 (design)

Operating Frequency 1300 MHz Peak Output Power 10 MW Average Output Power 150 kW Beam Voltage 115 kV Beam Current 132 A 70-75 % Efficiency **RF** Pulse Duration 1.5-2.0 ms **Repetition Rate** 10 pps Saturation Gain 47 dB 6 Number of Beams Number of Cavities 6 Cathode Loading <2.1 A/cm² Solenoid Power kW **<4**

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Thales TH1801 (measured)

1300 MHz 10 MW 75 kW 117 kV 131 A 65 % 1.5 ms 5 pps 48.2 dB 7 6 5.5 A/cm^2 6 kW



Mile Stones, Multi beam Kkystron E3736 for DESY

TOSHIBA Corporation

Display Devices & Components Control S Electron Tubes & Devices Division

Sep. 03, 2003

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Acceptance Test at DESY												En						

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Design Updates

3MHz bandwidth requirement at 8.7MW

- Adding one more bunching cavity was proposed at the last design review.
- However, it turned out that <u>lowering Q-value of</u> <u>the second gain cavity only can produce enough</u> <u>bandwidth (3.7MHz).</u>
- The <u>hot dimension of the gun (the actual dimension</u> when the cathode on) was calculated using ANSIS thermal code.
 - The mechanical design of the gun was revised accordingly.

The distance between the input cavity and the output cavity was increased slightly by 4cm.

Bandwidth Requirement

The second gain cavity



Instantaneous Bandwidth



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Simulations results by FCI





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Simulations results 2 by FCI



TOSE	IIBA M	ÍBK						Page 3
fo = Eb = Ik = 1 Pd =	1300.0 (M 115.00 (kV 22.00 (A) 14.00 (W	Hz) dr) dz rm) zm	= 0.750 = 2.500 ax= 11.25 ax= 900.0	RF-E Kinet 5 Beam 1 Loss	ficiency Po ic Loss on O Loss on O Power on D	/Eb/Ik= Output Cavi ntput Cavity ntt-Tube=	74.61 ity= 74.76 y= 0.00 5.75	1 (%) 4 (%) 0 (%) 7 (%) 6 (%)
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3 4 5	370.00 530.00 710.00	2571.50 1357.50 1347.50	104.00 99.80 108.50	5000.00 8450.00 7960.00	0.000 0.000 0.000	21.10 20.50 44.00	4.30 16.50 26.70	2 1 1
6	840.00	1298 50	107.66	42.00	0.000	131.00	29.00	1



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Thermal Calculation of Gun



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Cold and Hot Dimensions



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Distribution of Power Loss in the Collector For DC beam by Arsenal



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DC sheet beam by MAGIC



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Puls collector loading 2D beam model with artificial bunching RF modulation with bunch lenght of 120 degree Output cavity efficiency is 50% V_beam=115 kV, I_beam=132 A P_average = P_puls*0.015 P_max_average = 135 W/cm2





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Toshiba/KEK, DESY, Y.H.Chin

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MBK Outline



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Status and Schedule

About 60% of brazing was already finished.

- The baking of the tube will start in early February.
- So, by the end of February, the Prototype-O will be ready for testing at Toshiba, as scheduled.
- The delivery of waveguide components has been a bit slow.
- If the delivery of the waveguide system can meet the schedule, the testing of Prototype-O will start in March.