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Performance of Transmission Line System at 42±0.2GHz for an Indigenous Gyrotron System

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In high microwave power applications like gyrotron, transmission line system, calorimetric dummy load, etc, requires design, modeling, simulation and evaluation of transmission line system before fabrication of the same is undertaken. Under the aegis of Department of Science and Technology (DST), a multi-institutional program for the development of a gyrotron operating at 42±0.2GHz/200kW/3secs in TE03 mode has been undertaken. It is currently in an advance stage of test and commissioning at IPR (Institute for Plasma Research). It is desired for plasma applications that the output mode of gyrotron in TE03 mode is to be converted to HE11 mode for efficient coupling to plasma. The HE11 mode (TEM00 mode), has an electric field distribution very close to that of an ideal Gaussian mode. This gaussian like mode is preferred for high-power transmission through overmoded corrugated waveguides, which gives insertion loss lower than that of any other modes. The proposed design of transmission line system converts unpolarized TE03 mode into polarized HE11 mode. The ripples walled mode converters are designed for converting TE03 to TE01 in two steps. TE01 mode is converted to TM11 by bending a smooth waveguide at an angle of 34.94°. Finally TM11 mode is converted to HE11 mode. Miter bend for TE01 mode and HE11 mode are also designed. The designed corrugated waveguide operates at 42±0.2GHz. The Final design of all the components are verified using simulation studies carried out in CST-MWS. Performance optimization has been carried out prior to fabrication process. At this point in time, fabrication of many of the mode converters has been completed and miter bends are under mechanical fabrication process. As a part of a design, transmission line system is mechanically compatible to high vacuum and 1bar pressurization.

The system includes two design approaches whose performances are compared in terms of insertion loss, bandwidth and cost effective manufacturing. Both the proposed design approaches of transmission line system have total insertion loss of 1.3 to 1.5dB. The bandwidth of first design approach is wider as compared to second. Flexibility of manufacturing process of transmission line system is an advantage of second approach. The Salient point of design and simulation studies of transmission line system are discussed and highlighted in the manuscript.

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