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P2.018 Wideband polarizers switches and waveguide for Electron Cyclotron transmission lines

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Overmoded corrugated waveguide is used in high power microwave applications such as Electron Cyclotron Heating systems, where it is necessary to transmit high power at very low loss. In the primary propagating HE₁₁ mode, corrugated waveguide is effective over a large frequency bandwidth. This operational flexibility becomes important in multi-frequency systems. For 50-mm diameter aluminium corrugated waveguide nominally designed for the ITER 170 GHz ECH system, the theoretical ohmic loss of the HE₁₁ mode is around 0.3e-3 dB/m. In a possible dual-frequency system at ITER, the theoretical loss in the same waveguide only increases to a manageable 0.8e-3 dB/m at 104 GHz.

For ECH, it is also necessary to change the polarization state of the propagating wave. A pair of miter bends with different mirror groove depths is useful for this purpose. By rotating both mirrors, the pair can be used to generate any desired polarization state. The design is frequency sensitive, so it can be difficult to achieve polarizers that function properly over a wide bandwidth. General Atomics has built a pair of 63.5-mm waveguide polarizers for the TCV tokamak's ECH transmission line that are designed to operate at frequencies ranging from 82.6 to 118 GHz. In addition, polarizers have been designed for ITER's 50-mm diameter transmission line. A computer code that calculates both the required mirror rotation angles and the ohmic losses in the grooves predicts that these polarizers will function properly at both 170 GHz and 104 GHz.

General Atomics has recently fabricated a new class of waveguide switches with rotary actuators that have up to four waveguide outputs (or inputs). Such switches with three outputs have been supplied for 82.6-126 GHz transmission lines at TCV. These switches are inherently wideband.

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