TM_{01} to TE_{11} Mode Converter at 2.65 GHz

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The Virtual Cathode Oscillator, commonly referred to as the Vircator, produces high power microwaves in one or more TM_{0n} transverse magnetic modes. Even if such a mode is good for power transmission in long runs of straight circular waveguides, the almost linearly polarized TE_{11} mode is better suited for the requirements of microwave applications. The TM_{0n} to TE_{11} mode converter can be designed as a smooth circular waveguide with a curvature and a constant cross section avoiding high power flux densities and breakdown in waveguide (G. S. Ling and J. J. Zhou, Chinese Physics Letters, Vol 18, 9, Sep 2001, p 1285-1287). It is then named as Denisov mode converter.

Calculations based on coupled mode equations permitted to optimise the Denisov mode converter design at frequency of interest. It is composed of two back-to-back 40.03° bends with 730 mm curvature in the circular waveguide of 152 mm internal diameter. The calculated efficiency of conversion from TM_{0n} to TE_{11} at 2.65 GHz exceeds 98.3 % and outmatches 90 % in the calculated range from 2.38 GHz to 2.92 GHz.
Simulations performed with MAGIC code allow to following the wave propagation though the mode converter and are in good agreement to calculations. The mode converter was tested in an anechoic chamber. Two radiating systems were required. The first one generated E-plane radiation pattern of TM_{01}. As no Vircator was available, the TM_{01} mode was generated by the mean of a TEM to TM_{0n} mode converter. The free space adaptation was realised thanks to a 1 meter, 300 mm diameter circular horn. The second one radiated E-plane of TE_{11}. It is composed of the same TEM to TM_{01} mode converter and circular horn to which the Denisov TM_{0n} to TE_{11} mode converter previously designed has been added.

Comparisons of the two measurements give the performances of the Denisov mode converter. Radiated patterns show that the mode conversion efficiency exceeds 80 % at 2.65 GHz. The differences between simulations and measurements mainly come from the horn gain which depends on the mode radiated.