§12. Development of Miter Bend with Movable Corrugated Waveguides

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The outdoors transmission system should absorb expansion and constriction of the waveguide due to the change in atmospheric temperature. From an economical viewpoint, we develop a 90-degree miter bend with movable circular corrugated (CC) waveguide slided into arm with the circular smooth (CS) waveguide instead of the corrugated bellows which is flexible. A schematic view of miter bend for 53.2 GHz developed is shown in Fig. 1. The end A-A'(or C-C'') of CC-waveguide with 88.9 mm in diameter has the interface at the CS-waveguide (A-A' to B-B' or C-C'' to E-E').

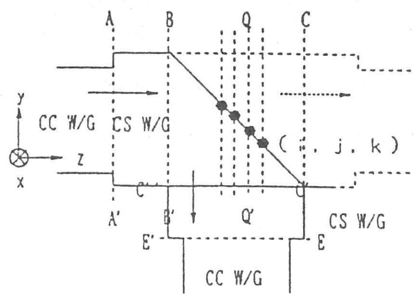

Figure 1. Schematic view of the miter bend with movable corrugated waveguide arms.

The length of the CS-waveguide l_s is varied by sliding the CC-waveguide. The standard l_s is 3 cm for both arms. When the pure hybrid mode HE_{11} is injected into the interface at A-A' plane, HE_{11} mode is decomposed into TE_{1n} and TM_{1n} in the CS-waveguide with different diameter of 110 mm.

At first, we compute the mode purity at the A-A' by using the mode matching technique. Amplitude patterns of E_y and E_x at the interface A-A' between the CC- and CS-waveguides are shown in Fig. 2. Each TE- and TM-mode in the CS-waveguide propagates with different propagation constant and the field pattern at B-B' is obtained by superposing all the modes. The radiation patterns at the various positions $z = p\Delta z$ from the waveguide aperture at B-B' are calculated by using FFT-superposition of plane wave (SPW). Here, Δz is the distance between samplings and p the integer. We choose sampling points of m_s in x-direction and n_s in y-direction for a waveguide mouth so as to satisfy $m_s^2 + n_s^2 \leq (L/\lambda)/\{1+(2z/L)^2\}$, where, L is the sampling size $(L \times L)$ of B-B'' plane.

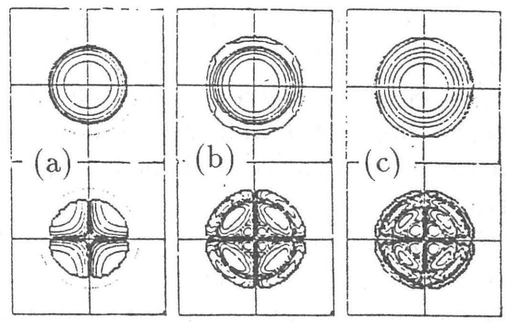

Figure 2. E_y (upper) and E_x (lower figure) at the various planes. (a) A-A' in the CC-waveguide. (b) B-B', (c) E-E' in the CS-waveguide. Each contour is plotted by 5 db.

The phase correction Φ is obtained by compensating the sum of wave phase at the flat mirror injected from each inlet of the bend; $\Phi(x,y,z) = -arg[E_y(x,y,R-y)] - arg[E_y(x,y,R+y)]$ where, R is the radius of the CS-waveguide. From the calculated Φ, we can easily determine shape of the surface on reflector. The field component, for example E_y at the reflector is multiplied by $\exp(i\Phi)$. The corrected field represents the source field at the reflector with phase correction. Because the reflector plane is non-parallel with the bend output in the configuration, we adopt the new method to calculate the radiation pattern at the bend output by SPW. Radiation patterns at position of the bend output from the source plane (Q-Q' plane) being made up of sampling points with the same z on the reflector are calculated. All the radiation patterns are linear-superposed and we obtain field patterns at the outlet of bend.

It is shown trhat 98.8% of the HE_{11}-mode injected is transmitted to the final output. The ramain part is the higher modes including the HE_{12}-mode.