Technology from Kyoto University

Waveguide-Type Phase Shifter with Simple Structure and Variable Phase Shift

We are looking to out-license the technology for its commercialization.

Waveguide phase shifter featuring movable metal plate enables simplified structure and arbitrary phase adjustment

◆Background

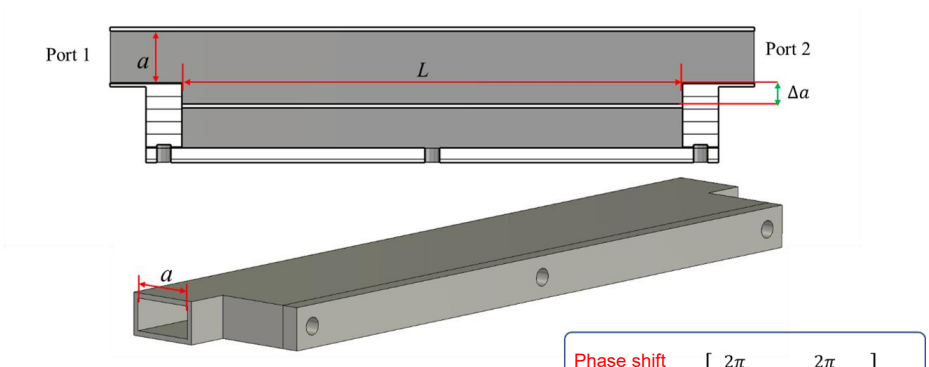
Conventional waveguide phase shifters using constricted sections, such as those disclosed in the Japanese Utility Model Appl. Publication no. 1992-123602, have simple structures but provide a fixed phase shift. As a result, they cannot be externally controlled to vary the phase shift, presenting a limitation in tunability.

◆Description

To address this challenge, researchers at Kyoto University developed a variable phase shifter by introducing a movable metal plate into the waveguide, as illustrated below. The plate moves only along the direction parallel to the narrow side of the waveguide and can be positioned externally. When the plate covers a length *L*, it effectively increases the broad side dimension of the waveguide to a + Δa in that region, thereby altering the guided wavelength λg. This change enables adjustable phase control of the signal between Port 1 and Port 2.

This invention provides three main advantages:

- **Simple Structure**
  In this phase shifter, the phase difference can be easily and quickly adjusted by moving the movable plate relative to the main body.
- **360-Degree Phase Range**
  A single unit of this phase shifter can provide any desired phase difference.
- **Low Insertion Loss**
  While conventional waveguide phase shifters have an insertion loss of approximately 0.3 dB, this phase shifter maintains an insertion loss of less than 0.2 dB.



TE mode cutoff wavelength:

$$\lambda_c = \frac{2\pi}{\sqrt{\left(\frac{m\pi}{a}\right)^2 + \left(\frac{n\pi}{b}\right)^2}}$$

TE10 cutoff wavelength:

$$\lambda_c(1,0) = 2a$$

Phase shift range

$$\Delta\varphi = \left[\frac{2\pi}{\lambda_g(a)} - \frac{2\pi}{\lambda_g(a+\Delta a)}\right] \cdot L$$

Guided wavelength

$$\lambda_g(a) = \frac{\lambda}{\sqrt{1-(\lambda/2a)^2}}$$

Figure: Structure and principle of the newly developed phase shifter

◆Development Status

- Theoretically Proven and Experimentally Verified

◆Applications

- Microwave and millimeter-wave components
- Automatic impedance matchers
- Microwave heating devices
- Phased arrays

◆Offers

- Patent* License
- Option for Patent* License

* PCT patent application pending

◆Contact

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IAC Institutional Advancement and Communications

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