§10. Development of 1-Dimensional Antenna Array for Microwave Imaging Interferometer in GAMMA 10 Diverter Simulation Experiments

Kuwahara, D. (TUAT),
Nagayama, Y., Tsuchiya, H.,
Yoshikawa, M., Kohagura, J., Morikawa, Y., Hasegawa, Y. (Univ. Tsukuba),
Mase, A. (Kyushu Univ.),
Ito, N. (UNCT),
Kogi, Y. (FIT)

Microwave imaging diagnostics can be potentially used to observe functions in the electron density and electron temperature profiles in magnetically confined high temperature plasma[1]. In LHD, a horn antenna mixer array (HMA) has been developed as a receiver of a microwave imaging reflectometry[2]. However, the HMA has a problem that it is necessary to use an external LO optics. In order to obtain electron density profiles for GAMMA 10 diverter simulation experiments, and to eliminate the local oscillation (LO) optics, a new 1-D antenna array for a microwave imaging interferometer is designed.

Figure 1 shows schematic diagram of the new HMA. The new HMA consists of 6 important elements: horn antennas, waveguide-to-microstrip line transitions, mixers, IF circuits, LO quadruplers and LO power dividers. The quadrupler converts an LO wave to a pre-LO signal having 1/4 of the frequency. By using the quadrupler, the mixer can receive the LO wave on the same PCB. When the frequencies of the RF and LO waves are 60.150 GHz and 60 GHz, respectively, 1/4 of the frequency of the LO wave is 15 GHz. The signal at the frequency of 15 GHz is easily divided, transmitted, and amplified on the PCB. In addition, signals in this frequency band can be transmitted with low loss by a coaxial connector. Therefore, the new HMA can provide LO waves to each mixer inside the antenna housing, without the LO optics.

The former HMA uses a converter that combines a single-probe-type waveguide-to-microstrip line transition and a single diode mixer. In contrast, the new HMA has to use a discrete waveguide-to-microstrip line transition. Figure 2 shows details of the test modules of finline waveguide-to-microstrip line transition. The size of the waveguide is 1.9 × 3.8 mm, which is equivalent to a V-band (50 – 75 GHz) waveguide. Figure 3 shows the transmission characteristic of a test module, where the transmission loss is -1.7 dB at a frequency of 60 GHz.

For the next year, we will fabricate a two-channel test module to demonstrate the new HMA.

1) Nagayama, Y. et al.: Rev. Sci. Instrum., 83, 10E305 (2012).
2) Kuwahara, D. et al.: Rev. Sci. Instrum, **81**, 10D919 (2010).

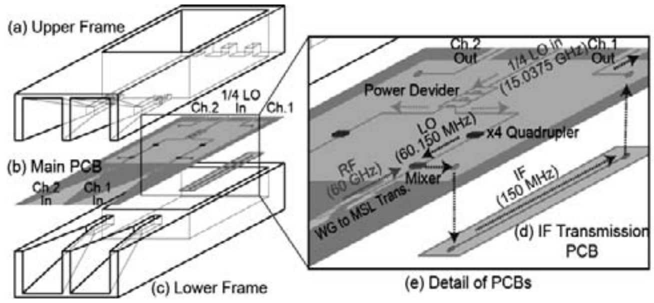

Fig. 1. Schematic of the new HMA

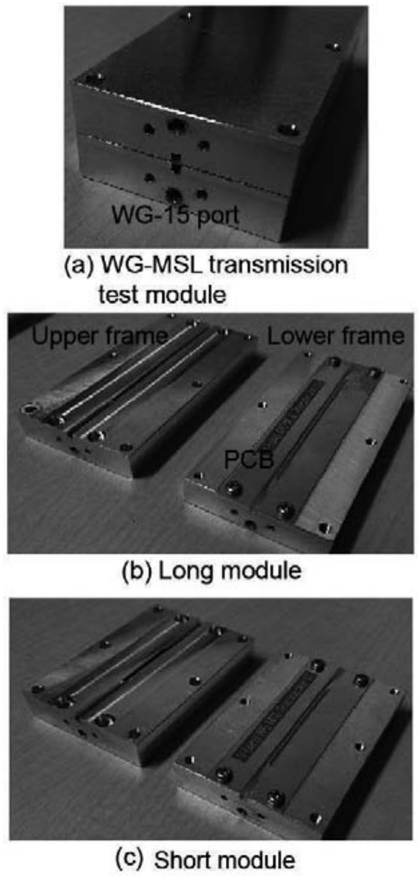

Fig. 2. Test modules of the waveguide-to-microstrip line transmission.

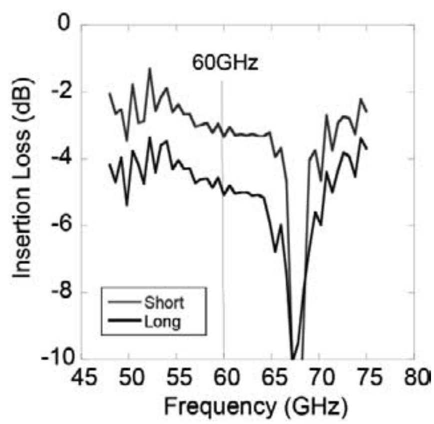

Fig. 3. Transmission losses of long and short waveguide-to-microstrip line transmissions..