Reflection Type of Injection Locked Gunn Oscillator and Its Applications at 60 GHz.

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The NRD guide, consisting of dielectric strips inserted in a below cutoff parallel metal plate waveguide, has low transmission loss nature inherent in dielectric waveguides as well as no undesired radiation at curved sections and discontinuities (T. Yoneyama and S. Nishida, IEEE Trans., Microwave Theory and Tech. , Vol. MTT-29, No. 11, pp.1188-1192, 1981). Actually high performance millimeter-wave components have been developed by unique circuitry integration. In particular, the self-injection locked NRD guide Gunn oscillator has great advantages such as a low phase noise and a medium output power, where the oscillation frequency was stabilized by a band-stop type self-injection locking technique using a low-loss ceramic resonator (F. Kuroki, M. Sugioka, and et al, IEEE Trans. Microwave Theory Tech., Vol. 46, No.6, pp.806-811, 1998). Another candidate as an oscillation frequency stabilization technique is a reflection type of self-injection locking.

Having this fact in mind, we investigated a performance of a frequency stabilized NRD guide Gunn oscillator based on the reflection type of self-injection locking methods. From experimental results, it was obvious that effectiveness of phase noise reduction in the reflection type was the same as that in the band-stop type, and that the injection locked range in the reflection type was more attractive than that in the band-stop type.

Figure 1 shows a structure of NRD guide Gunn oscillator with two output ports, which consists of the reflection type oscillator described above. A Gunn diode was transversely inserted in an H-shaped metal block, where a λ / 4 choke circuit was installed in the metal block. An oscillation power is introduced to a dielectric strip of the port 1 via a metal strip resonator. To stabilize an oscillation frequency, a low-loss ceramic resonator is installed behind the metal strip resonator by spacing: g, and moreover, another dielectric strip is located behind the ceramic resonator by the same spacing: g to introduce a part of the oscillation power into port 2. The measured output power at each port is shown in Fig. 2. By selecting the spacing to be around 1.5 mm, a medium power of 10 dBm was obtained. A small phase noise of less than 95 dBc/Hz for 100 kHz offset was successfully obtained.

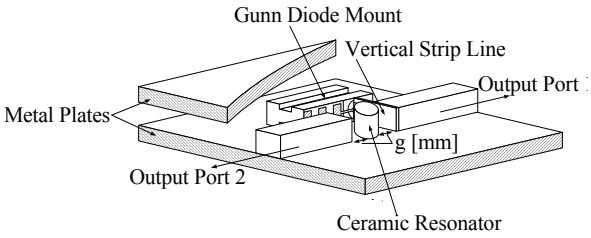

Fig. 1. Structure of NRD guide Gunn oscillator with two output ports.

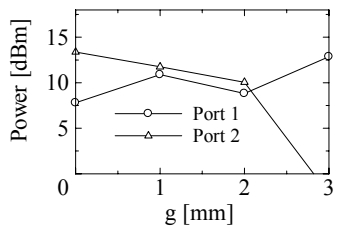

Fig. 2. Measured oscillation power of NRD guide Gunn oscillator with 2 output ports.