Basic Evaluation of a Slot-Ring Gunn Oscillator for Active Antennas

Hiroki Ushiroda* Eisuke Nishiyama Ichihiko Toyoda
(Dept. of Electrical and Electronic Engineering, Saga University)
*ushiroda@ceng.ec.saga-u.ac.jp

1 Introduction

We have proposed a spatial modulation scheme using polarizations [1-2]. In this paper, a Gunn oscillator to be integrated in active antennas is proposed for the spatial modulation and its characteristics are experimentally evaluated.

2 Structure of Gunn Oscillator

Fig. 1 shows the structure of the proposed Gunn oscillator. It consists of Gunn diodes, elliptical slot-ring resonator, open-ends microstrip lines and microstrip lines for output. The length of the slot-ring resonator is two wavelengths at the design frequency. As the length of the open-ends microstrip lines just above the Gunn diodes is designed half-wavelength, the slot ring is short-circuited at the Gunn diodes. Therefore, the electric field intensity becomes zero there.

Fig. 2 shows a sketch of the electric field standing wave in the resonator. As the length from A to E is one wavelength and there are nodes of the standing wave at A and E, the electric field becomes maximum at B, B', D and D'. Then the output ports P1 to P4 are attached at these points using microstrip lines loosely coupled to the resonator.

3 Experimental result

Fig. 3 shows the output power spectrum measured at the output port P1. The output frequency and output power were 10.27 GHz and 9.768 dBm, respectively. Better than 9.5-dBm output power and less than 20-dB spurious were obtained around the design frequency. The bias voltage and total current of the Gunn diode were 8.0 V and 240 mA, respectively.

Table 1 shows the measured output power of the prototype Gunn oscillator. Almost the same output power of about 10 dBm is obtained from each port.

4 Conclusion

In this paper, a Gunn oscillator suitable for active antennas has been proposed and experimentally examined. The oscillator has four output ports with a simple structure, and each port provides better than 9.3 dBm.

References

[1] S. Matsuyuki, et al., "Advanced planar antenna with polarization switching and detection functions for space modulation," IECE Technical Report, SRW2013-4, pp. 37-41, Apr. 2013.

[2] S. Matsuyuki, E. Nishiyama, and I. Toyoda, "Prototype Evaluation of a PSK Modulator/Demodulator," Rec. 66th Joint Conference of Electrical and Electronics Engineers in Kyushu, 03-1P-08, Sept. 2013.

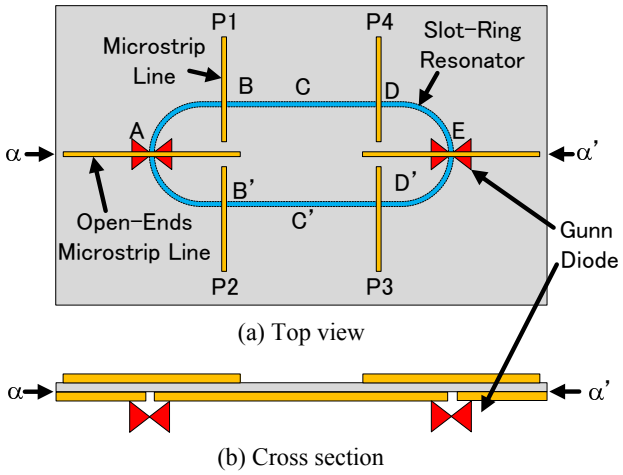

Fig. 1 Structure of the proposed Gunn oscillator.

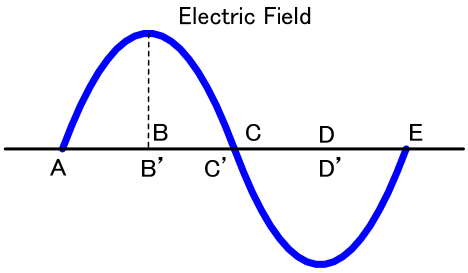

Fig. 2 Electric field standing wave in the slot ring.

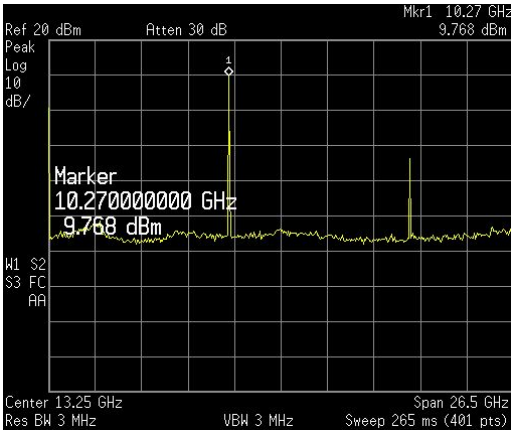

Fig. 3 Output power spectrum measured at P1.

Table 1 Measured output power of the prototype Gunn oscillator.

Port	P1	P2	P3	P4
Output (dBm)	9.768	9.958	10.2	9.33