Ka-BAND SOLID-STATE PULSED GUNN OSCILLATOR AND POWER COMBINER

Y. M. Tao, 1 J. Nin, 2 and G. Y. Delisle 1

1Department of Electrical Engineering, Laval University
Quebec (Quebec), G1K7P4, Canada
2MMW and Light Wave Research Institute
Nanjing University of Science and Technology
Nanjing, 210094, People's Republic of China

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ABSTRACT

GaAs Gunn diodes were fabricated for pulse source application at 8 mm wave band and operated with pulsewidths of 0.05 to 2.0 microseconds and duty cycles of 0.001 to 0.01. Peak pulse output power levels of 0.8–1.2W are achieved and the maximum available power is 1.6W with the highest efficiency of 6.5 percent. A simple and compact pulsed power combiner is also given in this paper.

INTRODUCTION

Recently, there has been considerable interest in using solid-state millimeter-wave pulsed sources as transmitters in active seekers for missile applications and in airborne altimeters. Millimeter wave pulsed Gunn diode oscillator is preferred because of its long working life, high reliability, small size and light weight, especially simple requirement for power source compared with IMPATT source, which are important considerations for seeker applications. In addition, the high output power, excellent frequency and power stability of these pulsed Gunn diode oscillators make them ideally suited for radar transmitters, pulsed target signal simulator, point to point digital communication links, industrial control systems as well as laboratory applications.

This paper describes the development of pulsed Gunn oscillator at Ka-band, which will cover Pulsed Gunn diode design consideration and fabrication, simple discussion of circuit and pulse modulator. Besides, an efficient and compact pulsed power combiner using single waveguide cavity is developed with 3 W peak power output.

GUNN DIODE

Pulsed operation of Gunn diodes has been reported in the S, C, X and Ku
bands (1)-(2), but only 0.5W peak power has been realized at Ka-band (3). For certain active seeker application, pulsed sources are designed for maximum peak power with a substantial change in output frequency or chirp as determined by the IF bandwidth. Based on this requirement, it was necessary to optimize the Gunn diode design at each frequency to achieve high peak power output and low chirp. From theoretical analysis and experiment, the best power performance is obtained from diodes which have active-layer carrier densities of 4–8 × 10^{13} cm^{-3} and gold plated layer thickness of 65 μm, and the structure of diode is shown in Fig. 1.

![Fig. 1 The structure of diode](image)

**RF CIRCUIT AND MODULATOR**

The oscillator circuit consists of a reduced height waveguide cavity with a movable tuning short. A schematic drawing of it is shown in Fig. 2. To match the load, a quarter wavelength step transformer is used. The diode is mounted on a diode-seating and connected directly with bias pin. The Q of this circuit is low, which causes the oscillator characteristic to be very sensitive to external load changes. Therefore, it is necessary for an isolator to be attached to the output of the cavity. By changing the position of the diode and tuning short, the optimum impedance match can be realized not only between the diode and circuit, but also between the circuit and load, so that the required operating frequency and the best power output are obtained.

![Fig.2 A schematic drawing of oscillator circuit.](image)