

High Power Pulsed 263 GHz Extended Interaction Amplifier

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Abstract: This paper presents test results on a new model of pulsed EIK amplifier operating at 263 GHz targeting applications in advanced weather radar, DNP enhancement of NMR systems and visual imaging for homeland security. This EIK delivered an output power greater than 70 watts, gain of over 30dB and a -3dB bandwidth greater than 1000 MHz.

Keywords: millimeter waves; THz, Extended Interaction Klystrons; cloud radar; DNP; NMR; security screening

Introduction

CPI Canada is a world leader in the design and fabrication of the Extended Interaction Klystron Amplifiers and Oscillators [1]. CPI EIK technology preserves the ruggedness and high power capability of the conventional klystron, while achieving enhanced power, bandwidth and efficiency at GHz and THz frequencies with moderate electron beam voltages [2].



8 cm

Figure 1. 263 GHz Pulsed EIK

EIK Design and Performance

In 2014 CPI Canada developed a 15W pulsed amplifier at 264 GHz [3]. The market for DNP-NMR and radar requires, however, at least 50W of pulsed power with a minimum gain of 30 dB. The path to improved EIK performance at G-Band is new electron beam optics. The beam diameter was reduced by 13% while maintaining beam power and low RF circuit interception. Successful

beam-stick results were previously reported [5]. The present work describes the addition of an RF circuit to the established beam optics to form a complete G-band amplifier.

The baseline 15W RF circuit was revised through the reduction of the beam tunnel, geometry improvements for increased cavity R/Q, and improved power coupling to the waveguide interfaces. Diamond windows with low return loss and structural design suitable for high temperature processing were also developed [4].

The performance of the EIK is shown in Figure 2. The main operating parameters are listed in Table 1.

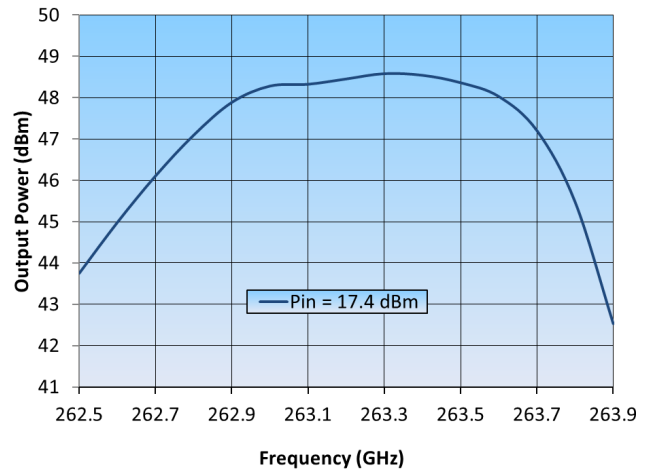


Figure 2. 263 GHz Pulsed EIK Performance

Table 1

| Parameter | EIK Performance |
|-----------------------|------------------------------|
| Centre Frequency | 263.25 GHz |
| Output RF Pulse Power | 72 W |
| Input RF Power | 55 mW |
| Gain | 31 dB |
| Bandwidth | 1000 MHz |
| Beam Voltage | 18.5 kV |
| Beam Current | 188 mA |
| Duty Cycle | 1% (tested) up to 5% capable |

This EIK uses an M-type dispenser coated cathode with average current density of 11 A/cm² with expected lifetime of over 20,000 hours.

Conclusions

A novel model of the compact high power 263 GHz CW Extended Interaction Amplifier has been developed by CPI Canada for use in cloud profiling radars (CPR) and Dynamic Nuclear Polarization – enhanced Nuclear Magnetic Resonance (DNP-NMR) and security screening applications.

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