THz Impulse and Frequency Comb Generation Using Reverse Recovery of PIN Diode

Tech ID: 31686 / UC Case 2019-897-0

SUMMARY

UCLA researchers in the Department of Electrical and Computer Engineering have developed an antenna design procedure that can realize devices with beam scanning at a fixed frequency on a single element antenna.

BACKGROUND

Broadband pulse generation has a wide range of applications such as high-speed communication, high-resolution radars, spectroscopy, and remote sensing. Techniques to increase bandwidth and radiation power have generated great interest in terahertz (THz) and mm-wave research but are hindered by the limitations of silicon-based technologies. Methods to overcome these limitations have included the use of dynamic pulse generation but programming the phase and amplitude of tones at mm-wave/THz frequencies requires complex circuit blocks. Step-Recovery-Diodes (SRD) are popular for harmonic generation and frequency multipliers due to their ultra-sharp reverse recovery, yet SRDs are not available in silicon processes typically used in THz frequency generation devices. There is a need for SRD available in silicon processes for THz and mm-wave generation.

INNOVATION

UCLA researchers have demonstrated a PIN diode-based THz pulse radiator implemented in a silicon-based process for broadband pulse generation. In this inventionthe reverse-recovery of a PIN diode is used to generate THz-pulses (wideband frequency comb), which are radiated through a wideband on-chip antenna. When used in an on-chip slot bow-tie antenna the THz pulse radiator demonstrated an efficiency above 60% over the band of radiation. The disclosed invention demonstrates higher radiation power at frequencies above 300 GHz, a flatter average ERIP spectrum, and lower power consumption (<50x) compared to the current state of the art THz broadband pulse generation.

APPLICATIONS

- High-speed communication
- High-resolution radars
- Spectroscopy
- Remote sensing

ADVANTAGES

- Higher radiation power at frequencies above 300 GHz
- Flatter average ERIP spectrum
- Lower power consumption

PATENT STATUS

Country	Type	Number	Dated	Case
Germany	Issued Patent	60 2020 059 077.3	09/17/2025	2019-897
France	Issued Patent	3 991 247	09/17/2025	2019-897
United Kingdom	Issued Patent	3 991 247	09/17/2025	2019-897
United States Of America	Issued Patent	12,250,014	03/11/2025	2019-897

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OTHER INFORMATION

KEYWORDS

wireless communications, THZ pulse radiator, high-speed wireless communication, bandwith, broadband pulse generation, wideband frequency comb, step-recovery-diodes (SRD)

CATEGORIZED AS

- **Communications**
  - Wireless
- **Sensors & Instrumentation**
  - Position sensors

RELATED CASES

2019-897-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Vibration Sensing and Long-Distance Sounding with THz Waves
- Broadband Comb-Based Spectrum Sensing

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