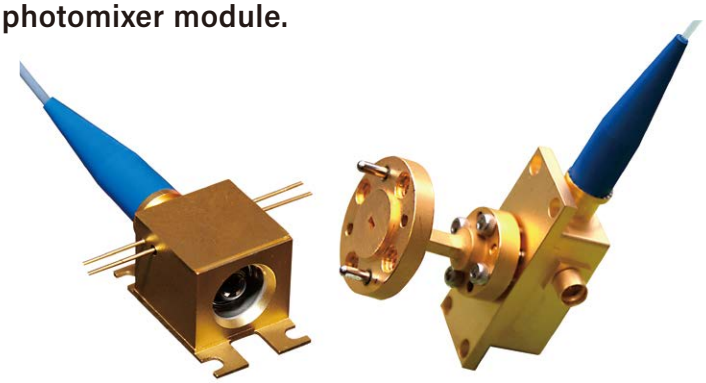
UTC Photomixer

Photonic generation of THz signals is promising for various applications. Especially important is that this technique can provide very wide bandwidths and low-loss transmission of very-high-frequency signals, which cannot be attained by current electronics-based techniques. For the development of a photonic THz generator system, 1550-nm photodiode having high output powers as well as superior high-frequency characteristics is a key component.
The uni-travelling-carrier photodiode (UTC-PD) is one of the best solutions, because it provides a high 3 dB down bandwidth and high-saturation-output power simultaneously.
NTT Innovative Devices have developed two types of UTC-PD photomixer modules.
One is a compact rectangular-waveguide-coupled photomixer, and another is an antenna-integrated (quasi-optical module) photomixer module.

FEATURES

- Efficient THz generation
- Wide frequency-range operation
- High stability
- Room-temperature operation

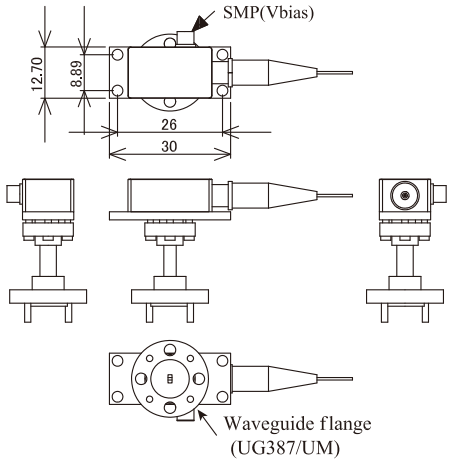


SPECIFICATIONS

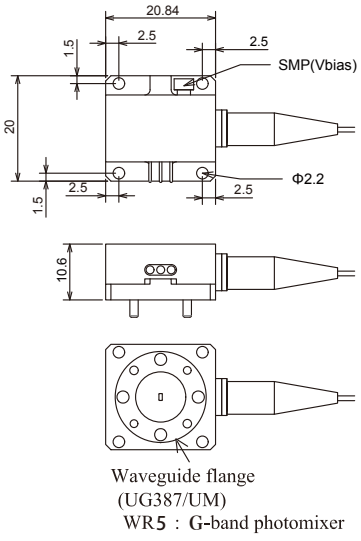
Type	Model	Frequency (GHz)			Output power (dBm)		
		Min.	Typ.	Max.	Min.	Max.	
W	IOD-PMW-13001	75	90	110	-8.0	-5.0	@90GHz
	IOD-PMF-13001	90	115	140	-8.0	-5.0	@140GHz
	IOD-PMD-14001	110	140	170	-9.0	-6.0	@140GHz
	IOD-PMG-20001	140	180	220	-18.0	-11.0	@180GHz
	IOD-PMJ-13001	280	330	380	-18.0	-11.0	@330GHz
A	IOD-PMAN-13001	300		(3000)	-34.0	-28.0	@1000GHz

OUTSIDE DIMENSIONS

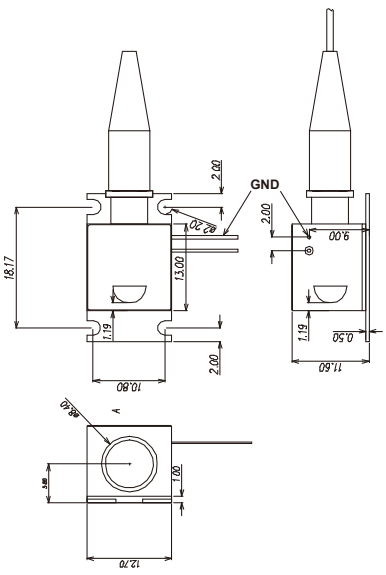
Rectangular-waveguide-coupled photomixer



G-band photomixer

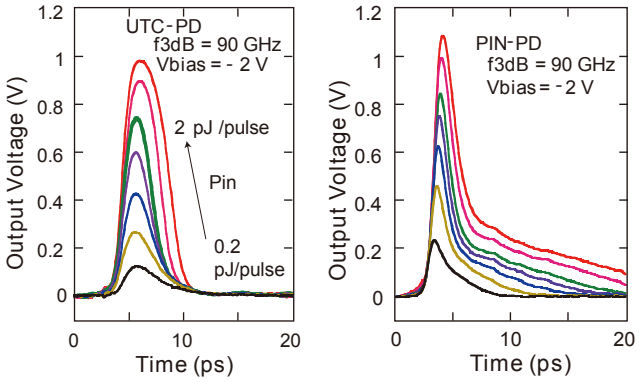


Antenna-integrated photomixer



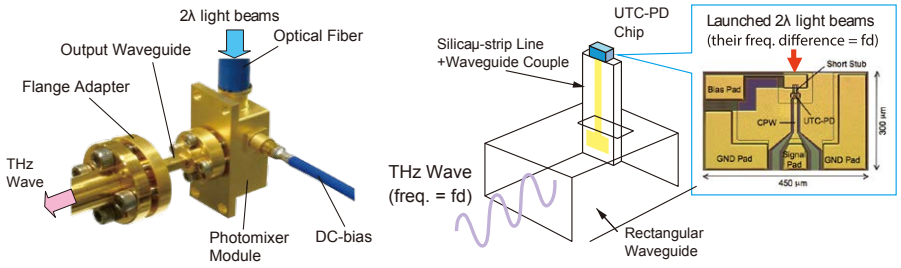
KEY CONCEPTS OF UTC

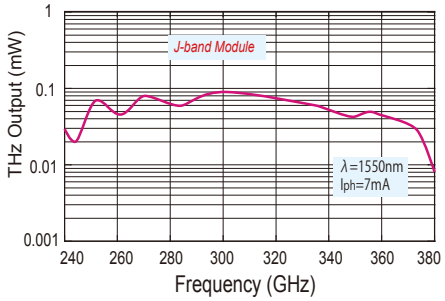
UTC-PD was developed by NTT in Japan. A UTC diode features a moderately p-doped InGaAs absorption layer and a depleted, undoped or lightly n-doped InP carrier collection layer. Photocarriers are generated in the absorption layer. The electrons diffuse/drift into the (higher-bandgap) collection layer but, due to an additional diffusion block, not to the p-contact layer. The holes, by contrast, travel to the p-contact but do not enter the collection layer. Thus, only the electrons cross the collection layer. This type of carrier transport is substantially different from conventional p-i-n diodes, where both electrons and holes contribute to the high-frequency photocurrent.

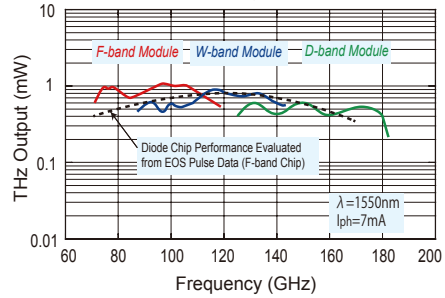


RECTANGULAR-WAVEGUIDE-COUPLED PHOTOMIXER

The photomixer module has a PD-waveguide mode-conversion coupler and output rectangularwaveguide.
The coupler is fabricated on quartz substrate and acts as a circuit to match impedance between PD chip and the waveguide.
NTT Innovative Devices manufactures rectangularwaveguide coupled photomixer with sub-THz frequency region below about 300GHz.

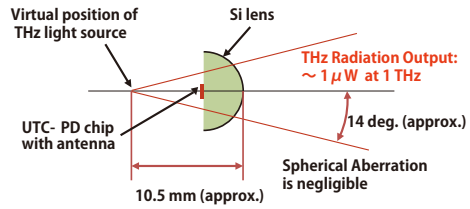


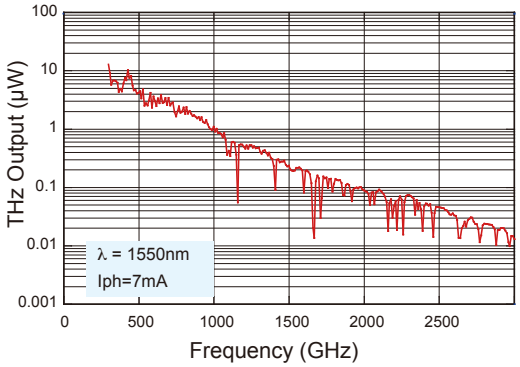




ANTENNA-INTEGRATED PHOTOMIXER

A UTC-PD chip is monolithically integrated with a broad-band antenna (self-complementary bow-tie antenna). The chip was placed on a hyper-hemispherical Si lens and electrically connected to the dc bias leads. The THz wave was emitted through Si lens. The output power decreased gradually with increasing frequency, and we could detect submillimeter waves at frequencies of up to 3 THz. The output power increased linearly in proportion to the square of the photocurrent. The typical output power was -30 dBm at 1 THz for a photocurrent of about 7 mA.





NTT Innovative Devices

NTT Innovative Devices Corporation
Aquaria Tower Yokohama, 1-1-32 Shin-urashimacho,
Kanagawa-ku, Yokohama-shi, Kanagawa, 221-0031, Japan
E-mail: opt-tec@ntt-el.com https://www.ntt-innovative-devices.com/en/

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