

// NEW DEVELOPMENTS IN THE TERAHERTZ FREQUENCY RANGE

Ref-Nr: TA-IN0057

HINTERGRUND

The terahertz (THz) frequency range is one of the last underexplored ranges of the electromagnetic spectrum. Nowadays the THz range is becoming more and more accessible due to the recent development of efficient detectors and mixers. Interestingly, the THz frequency range has multiple advantages compared to other frequency ranges of the electromagnetic spectrum. For example, THz radiation can penetrate many optical non-transparent materials. This property is very intriguing in terms of applications for medical, safety or food technology. Thus, the further development of THz technologies is very promising and can lead to a vast amount of future mass market devices.

LÖSUNG

Antenna I

A newly developed detector is based on an antenna structure which is arranged together with at least one field effect transistor on a single substrate. The detector serves in particular to capture the power and phase of THz waves. The antenna structure and the field effect transistor are connected in such a way that an antenna-received signal in the range of THz frequency is fed into the field effect transistor via the gate-source contact. Here, the integration of the antenna structure and of the field effect transistor provides a high integration density. Moreover the corresponding short or non-existent distance between the field effect transistor and the antenna structure avoids transport losses during the transmission of signals.

Antenna II

This new improved detector serves for the detection of electromagnetic radiation in THz frequency range. Thereby, the invention provides both increased detection efficiency and more flexibility in the circuit design. Moreover it provides an improved robustness.

Due to the novel arrangement of antenna and transistor additional components, like protection diodes are no longer necessary. Protection diodes are usually needed to prevent the generation of charge during the manufacturing process of similar circuits. Therefore, modulation and operating frequency are not limited.



INNOVECTIS Gesellschaft für
Innovations-Dienstleistungen
mbH

Kirstin Schilling
06925616320
info@innovectis.de
www.innovectis.de

ENTWICKLUNGSSTAND

Prototyp

PATENTSITUATION

DE 10 2007 062 562 erteilt
US 8,330,111 erteilt
CA 2,710,450 erteilt
JP 5401469 erteilt
EP 08865626 anhängig
DE 10 2011 076 840 erteilt
US 9,508,764 erteilt
JP 5930494 erteilt
EP 12726084 anhängig
US 9,190,956 erteilt
JP 6084921 erteilt
EP 11721283 anhängig

CATEGORIES

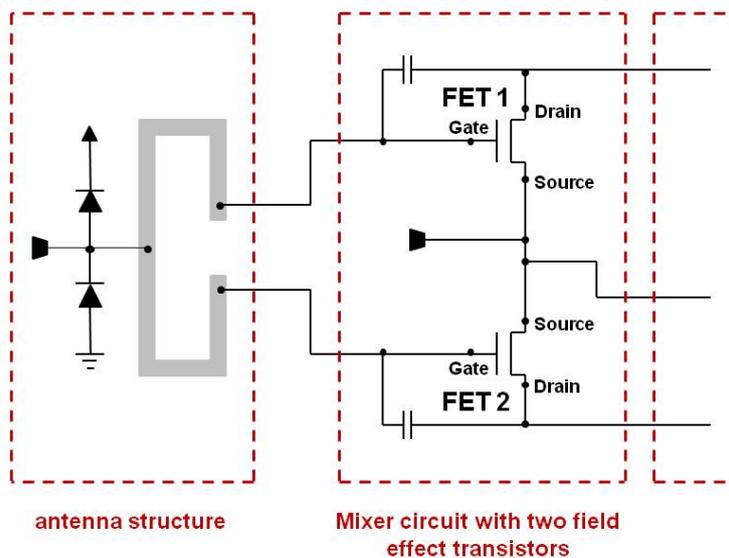
// Nachrichtentechnik // Bildgebende
Verfahren // Maschinenbau // Sensorik
und Messgeräte // Elektrische
Schaltungen // Halbleiter

Additionally, the arrangement leads to the possibility to utilize the antenna as a low pass filter. This makes additional transmission elements redundant and further reduces transmission loss.

Subharmonic mixer

The new subharmonic frequency mixer is based on standard semiconductor technology. It is used to generate a mixed signal from frequencies in the submillimeter and the THz range.

This new cost-effective mixing concept allows for an increased sensitivity compared with direct detection of high-frequency signals. Therefore, it is suitable for power measurements, distance sensors, cameras, tomography devices as well as in the high-frequency communication technology.



Antenna I

ANWENDUNGSBEREICHE

The newly developed detectors and mixer are intriguing for a vast amount of

applications.

Medical engineering

THz technology is opposed to x-ray technology non-hazardous for human tissue. With the aid of THz devices the water content of a human body can be measured. This is very useful for example to distinguish between a tumor and healthy tissue.

Non-destructive material testing

Spatial THz spectroscopy can be utilized to check a material for internal defects. Materials such as pottery and synthetics are penetrated by THz radiation. On the contrary THz radiation cannot penetrate water and metals. This property can be used to locate inclusions of water or paint within a material without destroying it.

Security technology

The same principles which are used for non-destructive material testing can be applied to security technology as well. THz technology is already deployed in body scanners in airports or the examination of mail.

Spectroscopy

THz radiation is an excellent tool to analyze materials and molecules. In many cases the THz spectrum yields in characteristic absorption bands. Additionally, it is possible to capture 2D and 3D images.

SERVICE

The technologies can be licensed or assigned. Moreover, collaborations regarding further development are welcome.

PUBLIKATIONEN & VERWEISE

[1] Lisauskas, Alvydas, et al. "Rational design of high-responsivity detectors of terahertz radiation based on distributed self-mixing in silicon field-effect transistors." *Journal of Applied Physics* 105.11 (2009): 114511

[2] Boppel, S., et al. "Performance and performance variations of sub-1 THz detectors fabricated with 0.15 μm CMOS foundry process." *Electronics Letters* 47.11 (2011): 661-662

[3] Lisauskas, Alvydas, et al. "Subharmonic mixing with field-effect transistors: Theory and experiment at 639 GHz high above f_{T} ." *IEEE Sensors Journal* 13.1 (2013): 124-132.

