Instruction manual and data sheet cPCA-1000-05-05-800-x

Photoconductive THz antenna for laser excitation wavelength λ ~ 800 nm

cPCA – **c**ross dipole **P**hoto **C**onductive **A**ntenna

For polarization sensitive THz measurements

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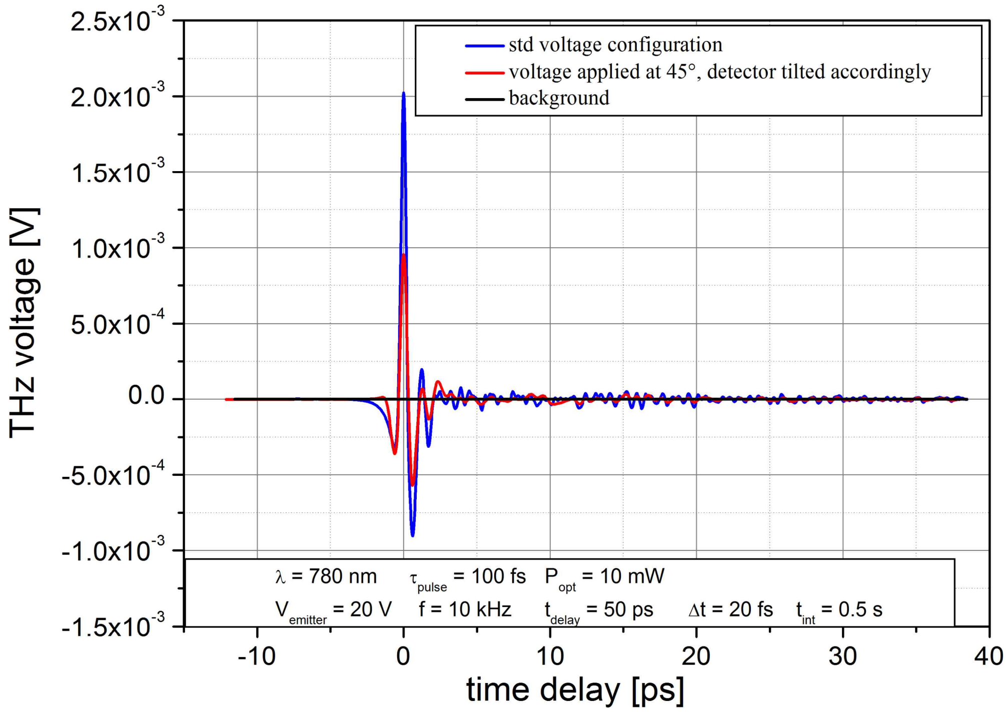
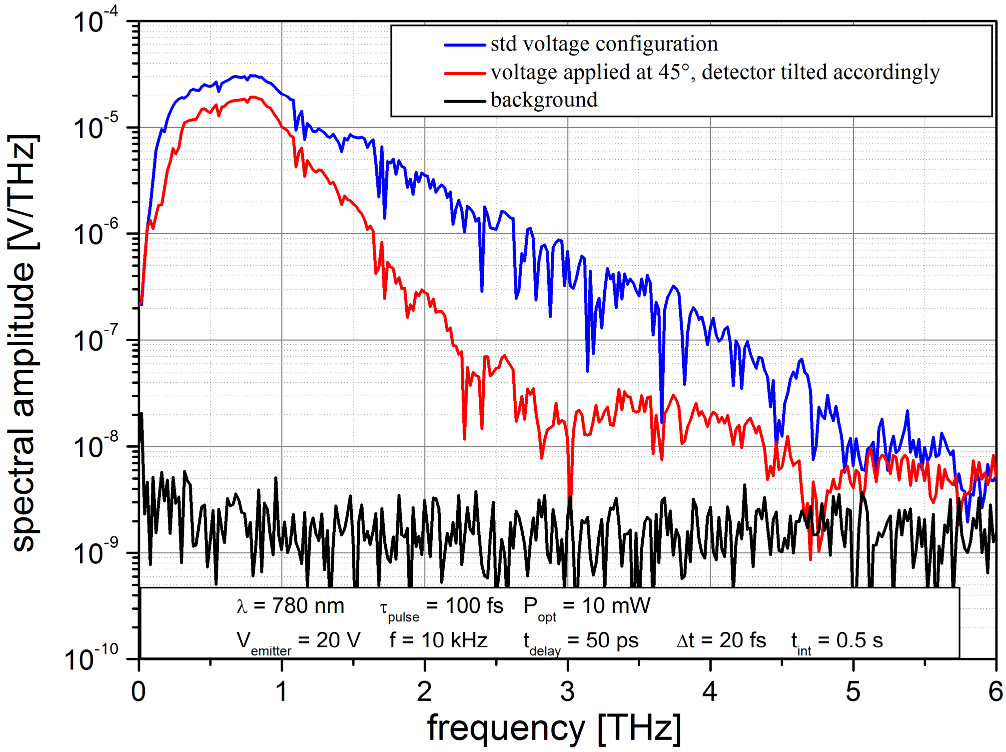
1. Antenna performance

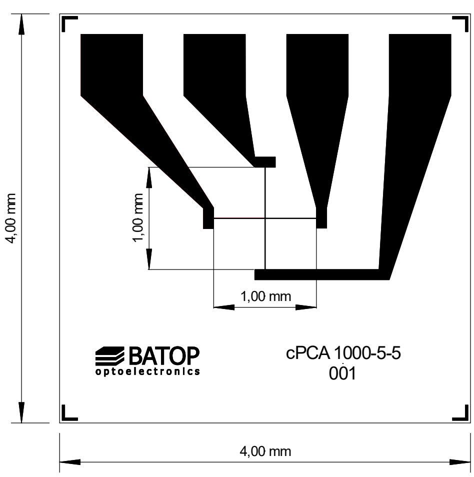
Emitter: cPCA-1000-05-05-800-h Detector: PCA-100-05-10-800-h



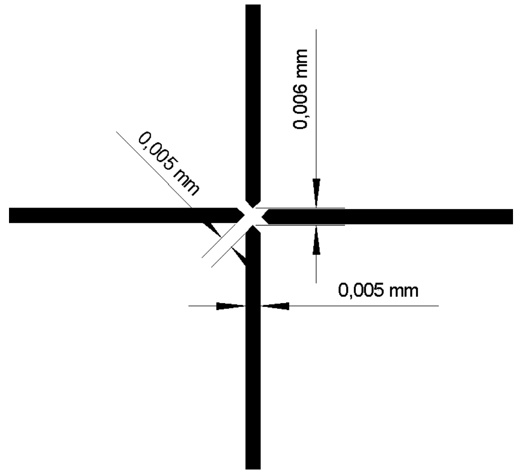


Wafer 928

2. Antenna design



Antenna chip dimensions



Central part with antenna gap

3. Antenna parameters

Parameter	minimum ratings	standard	maximum ratings
Dark resistance	1.5 MΩ	2.5 MΩ	3.5 MΩ
Voltage ($2xV_X$, $2xV_Y$), symmetrically		20 V	25 V
Optical mean power @ 50 – 100 MHz repetition rate		10 mW	15 mW
Optical pulse fluence		250 µJ/cm^2	500 µJ/cm^2

Attention: The F-number of the optical lens focusing the laser beam onto the antenna gap must be larger then a certain value to avoid too high pulse fluency. This means, that the minimum diameter of the focused beam waist must be about 120 % of the gap distance g. For a Gaussian beam the minimum focus length f_{min} of the optical lens can be estimated as

$$f_{\min} = \frac{0.3 \cdot \pi \cdot g \cdot D}{\lambda}$$

with g – gap distance of the antenna

λ - laser wavelength

D – diameter of the laser beam hitting the focusing lens.

For λ = 0.8 µm and g = 5 µm the minimum possible F-number of the lens is $f_{min}/D = 1.9\pi \approx 6$.

4. Antenna applications

Possible applications of crossed dipole antennas are:

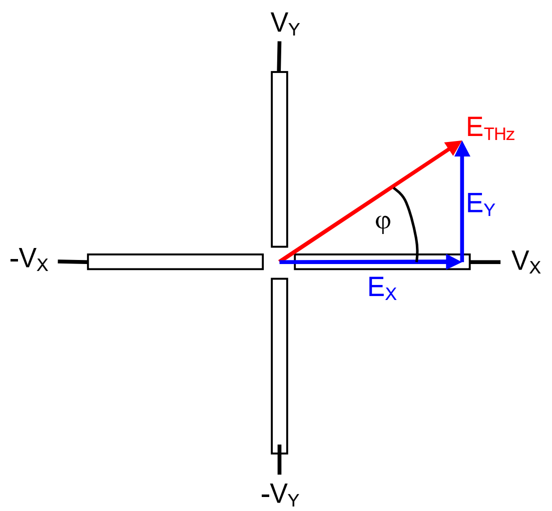
- ***Emission of THz waves with electronically controlled polarization direction***
  By using the crossed dipole antenna as emitter the polarization of the emitted THz waves is determined by the bias voltage ratio on the crossed dipoles. This allows polarization dependent reflection or transmission measurements on a sample without mechanical rotation of the antennas or the sample.

- ***Detection of the polarization direction of incoming THz waves***
  The induced signal voltage ratio on both arms of the crossed dipole receiver antenna can be used to determine the polarization direction of incoming THz waves.

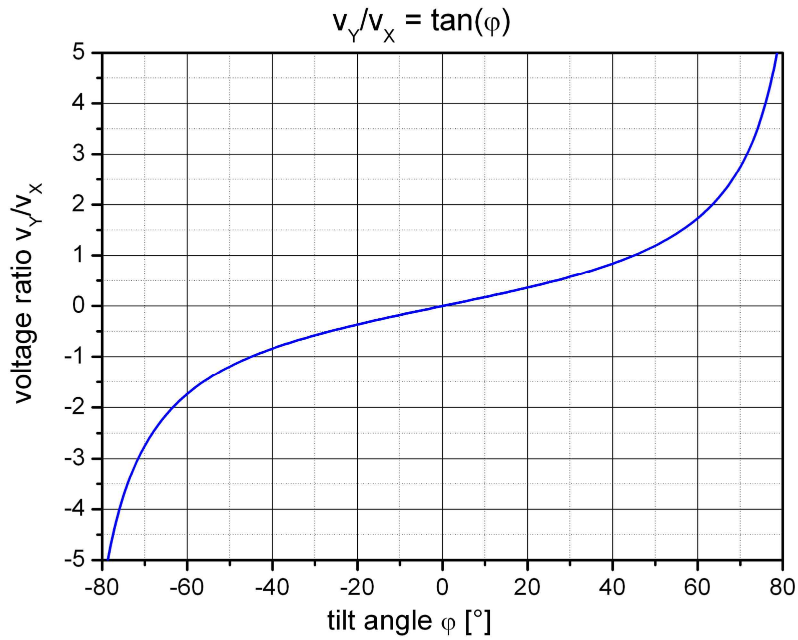
- ***Functional principle of the crossed dipole antenna***

By using the antenna as emitter the two dipoles x and y are driven by separate supply voltages V_X and V_Y. The emitted electric field amplitudes E_X and E_Y add up to the resulting THz electric field amplitude E_{THz} according to the superposition principle. The tilt angle φ between the THz field direction and the x-dipole is determined by the supply voltage ratio V_Y/V_X according to

$$\varphi = \arctan\left(\frac{V_Y}{V_X}\right) \qquad (1)$$

Crossed dipole antenna with separate supply voltages V_X and V_Y on the single dipoles x and y. The resulting THz electric field E_{THz} is the superposition of the filed components E_X and E_Y from both dipoles. The tilt angle φ between the THz field and the x-dipole direction is determined by the voltage ratio V_Y/V_X according to equation (1). **Important:** The supply voltages are symmetrical with respect to the ground potential located at the illuminated crossed dipole center.	

The graph below shows the connection between the voltage ratio V_Y/V_X and the tilt angle φ according to equation (1). If the same voltage is applied on both dipoles then the tilt angle is φ = 45 °.



- ***Receiver antenna***

If the antenna is used as polarization sensitive detector the incoming THz field E_{THz} induces the detector voltages V_Y and V_X in the two dipoles. These voltages are also symmetrically with respect to the illuminated antenna gap ground point. Therefore two amplifier circuits with a symmetric input must be used for signal voltage detection.

The tilt angle φ of the THz field against the x-dipole direction can be calculated also with equation (1).

5. Order information

cPCA-1000-5-15-800-**x** Photoconductive antenna

length l = 1000 µm

gap g = 5 µm

width w = 5 µm

laser wavelength λ = 800 nm

x denotes the type of mounting as follows:

x = 0	unmounted chip 4 mm x 4 mm with 4 bond contact pads
x = h	mounted on an Al disc with 25.4 mm ∅ and hyperhemispherical silicon substrate lens, 1m four wire cable
x = a	mounted on an Al disc with 25.4 mm ∅ and aspheric focusing silicon substrate lens, 1m four wire cable
x = c	mounted on an Al disc with 25.4 mm ∅ and aspheric collimating silicon substrate lens CL-20 for 20 mm THz beam diameter, 1m four wire cable
x = c-f	fiber coupled antenna with collimating silicon substrate lens
x = l	with aspheric focusing optical lens for free space laser excitation