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Single channel 100 Gbit/s link in the 300 GHz band

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***Abstract*— We report on the achievement of single channel 100 Gbit/s transmission, using linear resonant cavity enhanced unitravelling carrier photodiodes and QAM-16 modulation format. The indoor wireless link has been validated for up to 100 Gbit/s and 280 GHz carrier frequency.**

I. Introduction And Background

Since 10 years, significant efforts enable to reach technological breakthrough towards > 40 Gbit/s wireless communications in the THz bands [1], and a new standard has been established by the IEEE [2]. Photonics-based solutions, are intrinsic wideband and linear due to the photomixing process, with output powers up to the mW range [3]. We demonstrate in this paper the use of these photodiodes for 100 Gbit/s data-rates at 280 GHz.

II. UTC-PD Performance

The structure and topology of the UTC-PD used in this experiment has been reported recently [3]. This photodiode is using a semitransparent top contact with subwavelength apertures for enhanced optical transmission, front-side illumination of the photodiode (1.55 µm wavelength), featuring a good trade-off between optical responsivity and RF electrical losses (the metallic layer of the top contact is not covering the full UTC-PD mesa). The responsivity of the device is further increased by using a metallic mirror below the diode mesa through wafer bonding. The DC response of the UTC-PD (4 µm diameter) used here is 0.1 A/W. The available power at UTC-PD output is given by the figure 1.

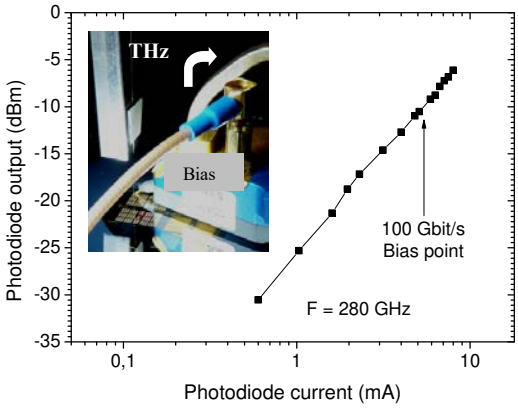


Fig. 1 Output power of the RCE UTC-PD at carrier frequency (280 GHz). Inset: view of the probed device. Left: fibre holder to illuminate the device, and right: coplanar probe in 220-325 GHz range.

III. Datacom Results

The figure 2 is presenting the experimental setup used to establish the 300 GHz datalink. The system is composed of optical modulation in QAM-16 (Quadrature Amplitude Modulation) obtained by driving optical modulator with two PAM (Pulsed Amplitude Modulation) with 4 levels and 25 GBaud. This signal is converted into the THz range using a UTC-PD photomixer, and further detected by a sub-harmonic mixer (SHM), followed by a wideband oscilloscope for detection and constellation analysis.

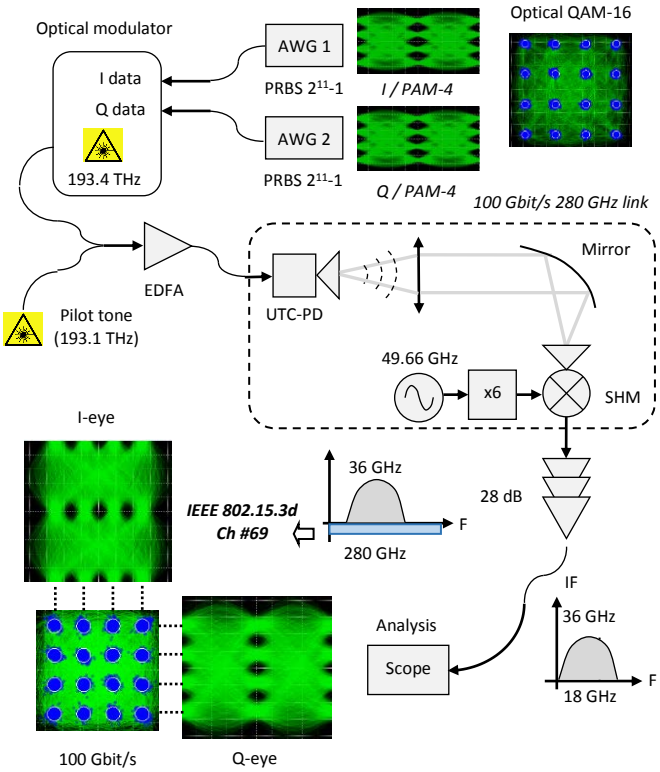
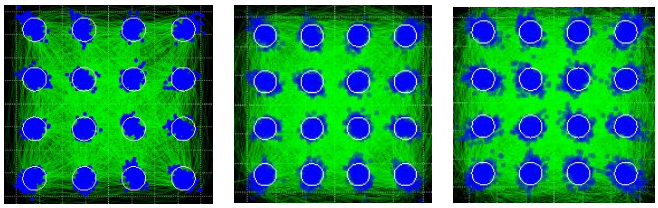


Fig. 2. Experimental setup. RCE-UTC-PD: Resonant Cavity Enhanced Photodiode. EDFA = Erbium Doped Fiber Amplifier.

The constellations of THz transmission at 56, 80 and 100 Gbit/s data rate are shown in the figure 3. A very linear QAM-16 is detected, up to 100 Gbit/s data rates. The blue points correspond to the decision instants, and the green curves behind are the signal path between two decision instants. It can be seen that in any case, the QAM-16 constellation is clearly shown, with an increase of the noise level due to the decrease of the signal to noise ratio at highest data-rates.



56 Gbit/s 14 GBaud BER = 5.10^{-7}	80 Gbit/s 20 GBaud BER = 10^{-5}	100 Gbit/s 25 GBaud BER = 10^{-4}

Fig. 3 Constellations examples obtained at the end of the THz link. Photodiode (-1 V bias) current level was 4.9 mA for 56 Gbit/s, 5.1 mA for 80 Gbit/s and 5.3 mA for 100 Gbit/s, using 23 taps for digital equalization.

The figure 4 shows the results of the highest data-rate tested, precisely 100 Gbit/s. The digitally processed Bit Error Rate (BER) evolution is given with current inside the photodiode. At 100 Gbit/s, BER down to $1E^{-6}$ have been reached with this photodiodes, over a half-meter link distance (limited by the lab configuration).

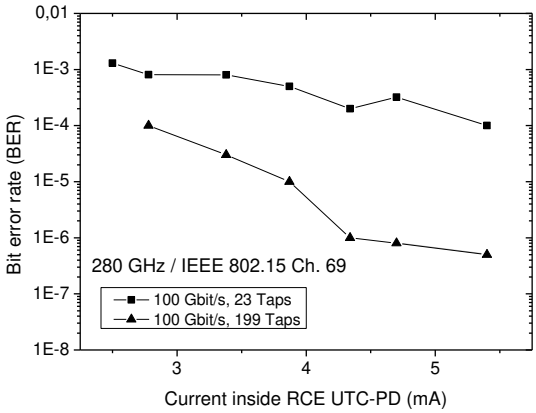


Fig. 4. BER performances achieved for up to 100 Gbit/s with tap number used at the receiver.

CONCLUSION

Using linear UTC-PD, we have reported the demonstration of a single 100 Gbit/s THz channel using QAM-16 signaling, compliant to the new IEEE standard for 100 Gbit/s wireless communications in the 300 GHz bands [2].

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