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Photonic Detection of On-Off-Keying Terahertz Wave Based on Terahertz-to-Optical Carrier Conversion

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The use of THz waves as a wireless carrier is being considered for next-generation mobile communications (6G). If carrier conversion from THz waves to optical carriers at telecommunication wavelengths can be realized, existing optical communication platforms could be utilized without modification. To achieve this "all-photonic THz detection," we are exploring the use of an optical frequency comb (OFC) as an optical carrier and an electro-optic polymer (EOP) modulator as a THz-to-optical carrier converter. The EOP modulator achieves a carrier-to-sideband ratio (CSR) of 42.3 dB [1]. The signal-to-noise ratio (SNR) of the OFC modes was enhanced by injection-locking to a pair of continuous-wave (CW) lasers [2]. By combining these two techniques, photonic detection of an unmodulated THz carrier has been demonstrated [3]. However, photonic detection of a modulated THz signal has not yet been reported.

In this paper, we demonstrate image signal transmission using the 270-Mbps On-Off-Keying (OOK) modulation format by using EOP modulator and dual-wavelength CW laser optical-injection-locked to the electro-optic-modulator OFC. Figure 1 shows the RF spectrum of the optical beat signal between the modulated THz sideband and the unmodulated THz carrier. We confirmed an RF beat signal with a center frequency of 1 GHz, a modulation bandwidth of 270 MHz, and an SNR of 20 dB. Figure 2 shows the corresponding eye diagram of the OOK signal. The eye is fully open, indicating successful transmission. From this eye pattern, the Q-factor was calculated to be 6.14, which satisfies the forward error correction (FEC) limit.

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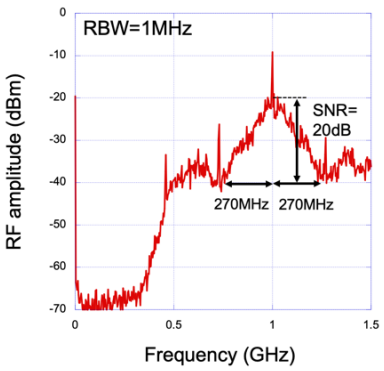

Fig. 1. Optical beat signal.

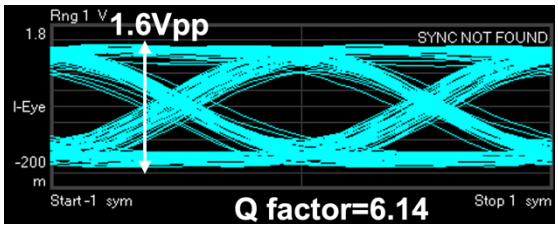

Fig. 2. Eye pattern

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