Supplemental Document

Ultra-wideband MHz to THz plasmonic EO modulator: supplement

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Supplementary Information for:

Ultra-Wideband MHz to THz Plasmonic EO Modulator

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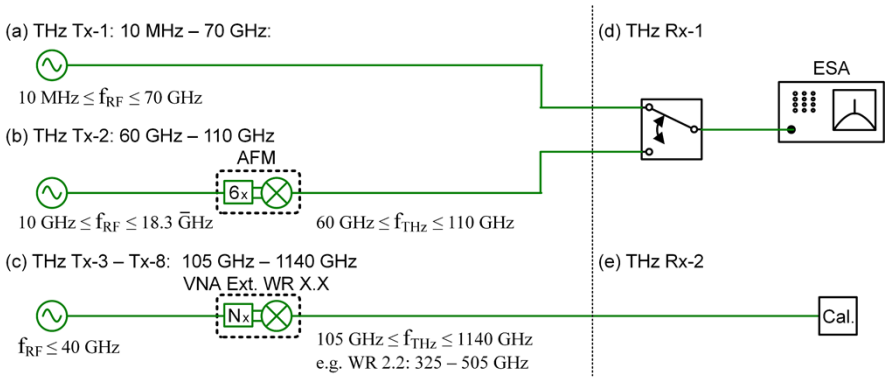

Fig. S1. Experimental setup of the eight different THz sources and their calibration process. AFM, active frequency multiplier; Cal., calorimeter; ESA., electrical spectrum analyzer; VNA Ext., vector network analyzer extender.

Eight different sources were utilized to generate sinusoidal THz signals across the investigated frequency range from 10 MHz to 1.165 THz. The corresponding setups are illustrated in Fig. S1(a), (b) and (c). THz Tx-1: For 10 MHz to 70 GHz, an analog signal generator (Agilent E8257D) was used, see Fig. S1(a). This signal source was further used as a local oscillator for nth order multipliers for higher frequencies. Therefore, in THz Tx-2 the 70 to 110 GHz signals were generated by a frequency multiplier (Radiometer Physics AFM6), see Fig. S1(b). THz Tx-3 – THz Tx-8: The 105 to 1140 GHz frequencies were generated by VNA extenders (VDI WR 6.5, WR 5.1, WR 4.3, WR 3.4, WR 2.2, WR 1.5 and WR 1.0). For the calibration process, the generated THz output powers of the THz sources Tx-1 and Tx-2 were measured as a function of frequency by a high-speed 110 GHz electrical spectrum analyzer. Further, the THz sources Tx-3 to Tx-8 were measured in a waveguide-coupled calorimeter (VDI, Erickson PM4), see (e) THz Rx-2, and compared to the enclosed calibration files of the manufacturer. The S21-parameters of the RF probes used to connect the THz sources to the devices under test were obtained by the enclosed calibration files of their manufacturers. These frequency-dependent values were incorporated in the power calibration.