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Harmonic 4-PAM modulator for wireless harmonic transponders

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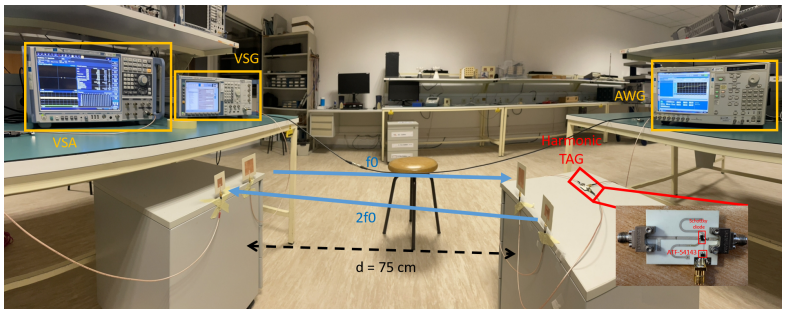
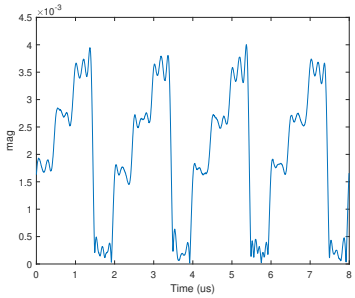
Nowadays, the search for solutions on communications with low energy and low monetary cost has become more and more intense. In this sense, some approaches have emerged that may revolutionize the global paradigm [1]. Among them harmonic transponders can play a key role since they can operate without any dc power supply, which means that they do not require any periodic battery replacement. Moreover, thanks to their capability to use different frequencies for the uplink and downlink frequencies harmonic systems are insensitive to strong signal reflections and to the transmitter phase noise. In work [2], the authors demonstrate that it is possible to create a completely passive tag that works with a frequency doubler combining it with an On-Off keying modulator. Through a monostatic approach, it was possible to demonstrate the feasibility of the system for short measurement distances. In the work [3], it is shown that it is possible to increase the order of the modulation of traditional backscatter radios to obtain a higher bit rate and communication speed. In this work both approaches are combined and a harmonic transponder based on a Schottky-diode capable of modulating the second harmonic with a 4-(Pulsed Amplitude Modulation)PAM modulation is presented. Figure 1 shows the setup used in the measurements and the demodulation results of the received signal. The transmitted signal is a continuous wave (CW) at 1.5 GHz with a power of 0 dBm, while the backscattered second harmonic is acquired by a VSA. The transponder has a conversion loss of 15 dB at -10 dBm. An E-pHEMPT transistor is used to control the self-bias point of the Schottky diode, thereby modulating the amplitude of the backscattered second harmonic generated by the transponder and a 4-PAM modulation with a bit rate of 1Mb/s on the second harmonic is demonstrated. The result in Fig. 1b proves that it is possible to demodulate the received signal at a distance of 75 cm.



(a) Practical setup



(b) Bit demodulation

Figure 1. Measurement setup and results

References

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