Testing Wireless Devices

TECHNICAL BRIEF

Characterizing Remote Keyless Entry Systems

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Summary

Teledyne LeCroy oscilloscopes are ideal for acquiring and analyzing signals from wireless devices due to their long acquisition memory and extensive math processing.

Waveform Math and Long Memory for Testing Transmitters

Teledyne LeCroy oscilloscopes are ideal tools for testing wireless devices. The combination of a 1GHz bandwidth, up to 25 Mpoints of acquisition memory, and advanced waveform processing are particularly useful features for analyzing wireless "keyless entry" transmitters.

Keyless remote entry systems operate in the region of 300 - 400 MHz. Testing requirements include the need to measure the keying characteristics. Simple on/off continuous-wave keying is used to form data packets that identify the transmitter and the desired function (e.g. unlock the doors). It is important to be able to measure the transition times of the modulation envelope.

Additionally, long acquisition memory allows the entire transmitted packet to be acquired and converted into NRZ data streams for additional analysis.

Figure 1 shows the use of the LeCroy HDO 6000 series oscilloscope to capture, peak detect, filter, and measure the transition times of a typical transmission.

Figure 1: Acquiring and detecting a remote keyless entry packet and measuring the transition times of the packet envelope

The top trace in Figure 1 shows the acquired waveform. The next lower trace, Trace F1, shows the detected envelope of the RF pulse. Detection is accomplished by applying the absolute math function (equivalent to full wave detection) followed by enhanced resolution (ERES) low-pass filtering. Parameter P1 reads the frequency of the carrier, while parameter P4 measures pulse width and P5 measures the pulse repetition period between the first two packets.

Zoom trace Z1 is an expanded view of the leading edge of the RF burst, while Z2 shows the trailing edge. Overlaid on these expanded views is the envelope-detected version, traces F2 and F3 respectively. Parameter P2 is measuring the rise time of the envelope; P3 is the measured fall time. So with these measurements we have characterized the timing of the detected RF envelope.

The entire data packet as shown in Figure 2.

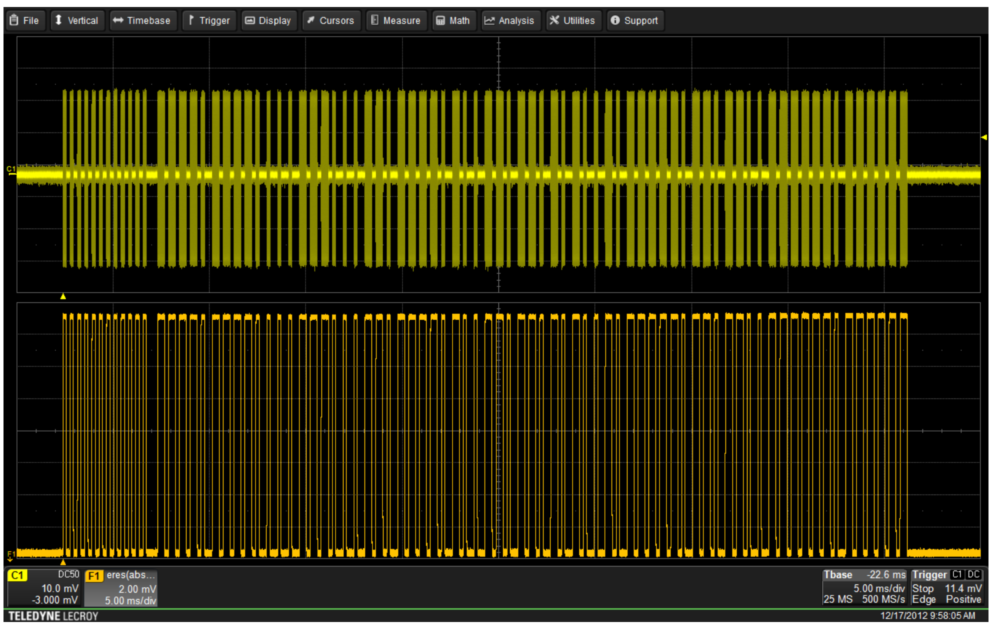

Figure 2: Detecting and viewing the acquired packets as NRZ data

Using the same detection technique, the ‘bursted’ RF packet is converted into NRZ data. This allows evaluation of the data content and of the transmitter’s physical characteristics.

Note that the RF carrier frequency in this measurement is actually down-converted to about 185 MHz (the lower sideband of the mixing of 315 MHz and 500 MHz). This is a result of aliasing (undersampling) the carrier. Under sampling does not affect measurements on the envelope, but only measurements of the carrier frequency. The upper sideband and carrier are filtered out by the ERES low-pass filter. This is a benign effect of aliasing because the signal being aliased has a very narrow bandwidth. With this little trick, we can acquire this 45 ms-long packet without distorting the envelope.