Testing Wireless Devices

Waveform Math Used To Test Keyless Entry Transmitters

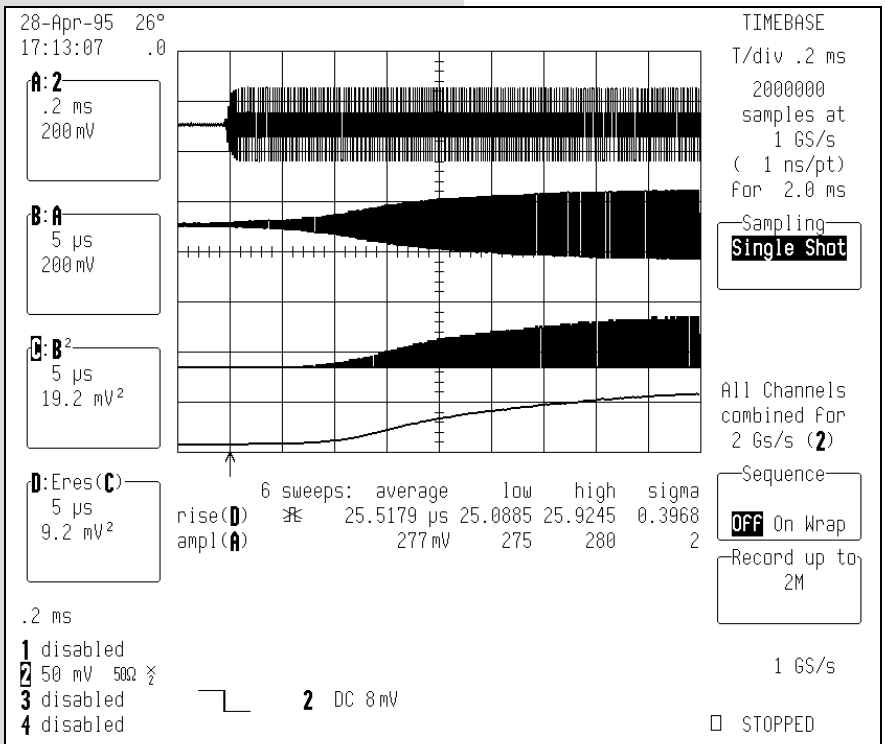

Figure 1 - Detection and measurement of the risetime of the modulation envelope using waveform math

The LeCroy 9374L oscilloscope is an ideal tool for testing wireless devices. 1 GHz bandwidth combined with up to 8 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 risetime of the modulation envelope.

Figure 1 shows the use of the LeCroy 9374L oscilloscope to capture, square law detect, filter, and measure the rise time of a typical transmission. The top trace in figure 1 shows the acquired waveform. The next lower trace, Trace B, is expanded horizontally to show the rising edge of the rf pulse. In Trace C the waveform has been squared as the first step in the detection process. The squared waveform is low pass filtered using the enhanced resolution capability of the DSO. This completes the detection process and extracts the envelope of the rf pulse as shown in Trace D at the bottom of the waveform display. The ability to display the source trace and the processed traces simultaneously allows evaluation of the detection process. The extracted envelope can be compared directly to the source rf pulse to assure that there has been no distortion of the pulse envelope.

The risetime of the pulse envelope is measured automatically using one of the standard measurement parameters. Note that parameter statistics have been used to average several acquisitions and readout the average value of the risetime along with the low/high range and the standard deviation of the measurement. At the same time the amplitude of the original pulse has been measured. Up to 5

parameters, selected from 36 standard parameters or up to 70 optional parameters, can be displayed along with the source traces.

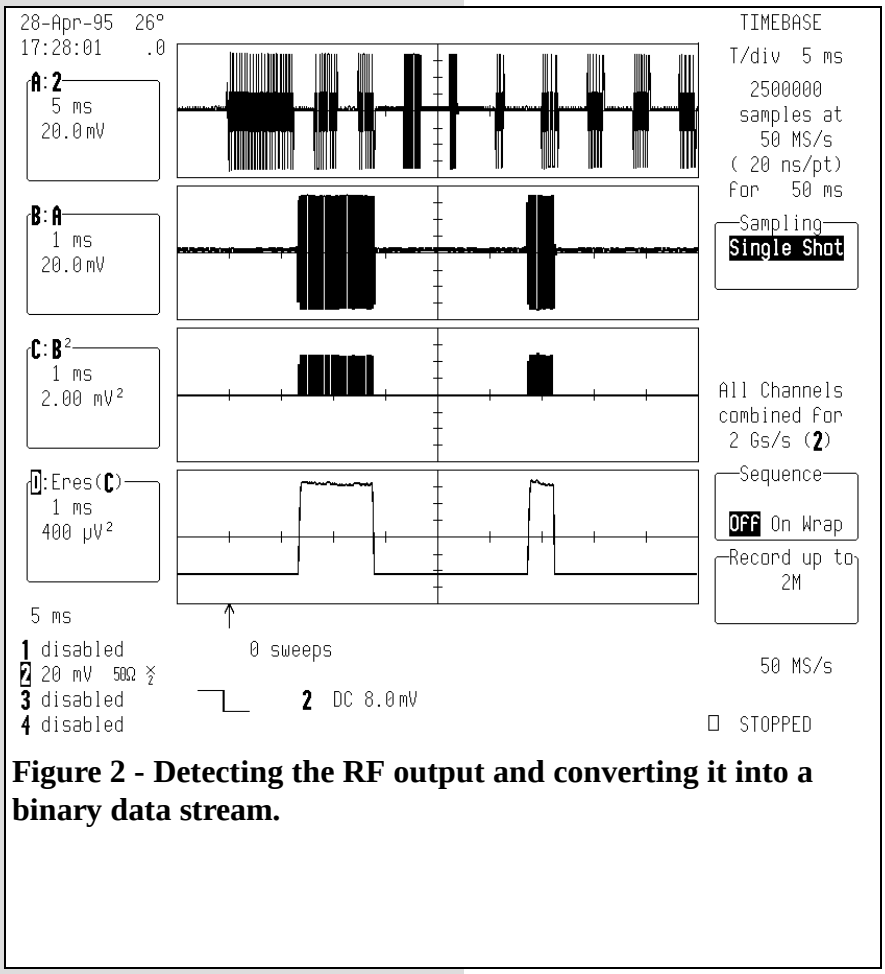

Figure 2 - Detecting the RF output and converting it into a binary data stream.

The detection scheme used in the measurement of the rf pulse risetime can be used to detect the entire data packet. Figure 2 shows how this can be done.

In this application the entire 500 ms transmission can be acquired using the long memory of the 9374L. In this example only a few characters are being used for clarity.

The narrow bandwidth rf carrier, sampled at 50 MS/s is effectively down converted to a lower frequency. This is a beneficial use of aliasing. The modulation envelope is preserved in this process an is easily detected using the squaring/filtering steps outlined previously. Trace C shows the result of the squaring operation and Trace D contains the encoded information in the form of a binary data stream.

This is a typical example of how the LeCroy 9300 series oscilloscopes combine advanced acquisition features, like high bandwidth, high sampling rate, and long memory with powerful waveform processing. Processing is supported by up to 64 Mbytes of processing memory allowing multiple math operations on Mbyte records to be performed simultaneously.