EMI receiver plus digitizer RF Transient measurements

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Summary

Nowadays it is not difficult to find electromagnetic environments where coexist machinery switching power loads and asynchronous communication systems. This sort of EMC scenario is specially challenging, because it involves the measurement of high frequency, short duration and very low level amplitude interferences. The available measurement equipment typically used in EMC is in general not able to perform this kind of measurements, either because the operating frequency range is too low, because the sensitivity is not sufficient, or because the sample memory is too small.

Transient measurements can be performed either in the frequency or time domains. The first approach implies the use of a spectrum analyzer or an EMI receiver while for the second option a digital storage oscilloscope is needed. Both frequency and time domain methods have several limitations when measuring low power, high frequency, short duration transients. On the one hand, although spectrum analyzers and EMI receivers have a frequency bandwidth that overlaps the frequency range of most commonly used communication systems, and its sensitivity and dynamic range allows displaying high sampling frequency and specialized trigger functions, but its resolution in amplitude is too low, and the high sampling frequency quickly fill the sample memory.

There is also some specialized equipment, like Real Time Spectrum Analyzers [1] that presents at frequency domain the time domain acquired data. Their specifications fulfil the requirements for high frequency measurements, but as they are oriented to other uses than EMI measurements, they are not flexible enough for measuring RF transients.

In this work we propose a system that takes benefit of the advantages of both methods. It is based on an EMI receiver with an available intermediate-frequency (IF) output and a fast digitizer system. The signal is measured with the spectrum analyzer in zero span mode, setting the central frequency and the bandwidth for measuring the communication system of interest. In these conditions the IF output corresponds to the input signal amplified by the RF amplifier and modulated in amplitude by an IF carrier, that is, a signal with higher amplitude and lower frequency than the input signal. This allows using a less restrictive specifications digitizer. The signal samples are stored in the digitizer memory and then they are sent to a PC for definitive measurement result storing and displaying. The use of a relatively low sampling frequency allows to have an acceptable dynamic range in the digitizing system (>12 bits) with a moderate cost.

The proposed system (Figure 1) is based on a Rohde & Schwarz ESPI TEST receiver and a National Instruments PXI-5620 14 bits digitizer. It allows measuring 10 MHz frequency bandwidth transients along the EMI receiver frequency range (9 kHz to 3 GHz). The dynamic range is 84 dB (14 bits) over the EMI receiver sensitivity. The digitizer has 32 Mbytes of sampling memory and allows a maximum acquisition length of 250 ms. A time trigger stage has been developed to trigger the digitizer when an IF signal transient is detected.

In order to check the system performance we have measured the transients generated by the commutations of a 12 V relay. The electromagnetic transient generated by the sparks was measured using a biconical antenna. The measurement system was set at 50 MHz with a 10 MHz bandwidth, digitizing the signal during 125 µs when a trigger condition is achieved (1 mV amplitude level at the FI output). The system performance was satisfactory recording the complete transient wave with a 1 µs time resolution (see Figure 2).

The final paper will include some measurements from an industrial environment at a communication system frequency bandwidth.

References:

[1] RSA2203A, RSA2208A, RSA3303A and RSA3308A Real-Time Spectrum Analyzers. Tektronix. www.tek.com.

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[3] Jakel, B.W.; Muller, A.B. ***Switching transient levels relevant to medium voltage switchgear and associated instrumentation*** Electromagnetic Compatibility, 1999. EMC York 99. International Conference and Exhibition on (Conf. Publ. No. 464) , 12-13 July 1999 Pages:35 - 40

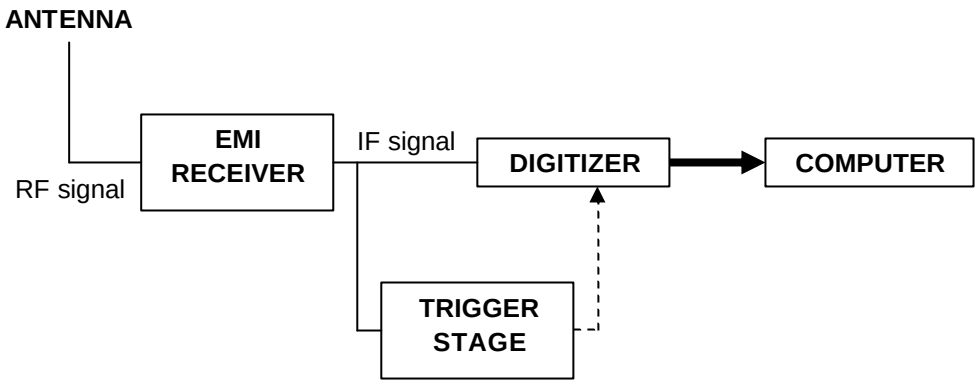

Figure 1. Measurement system

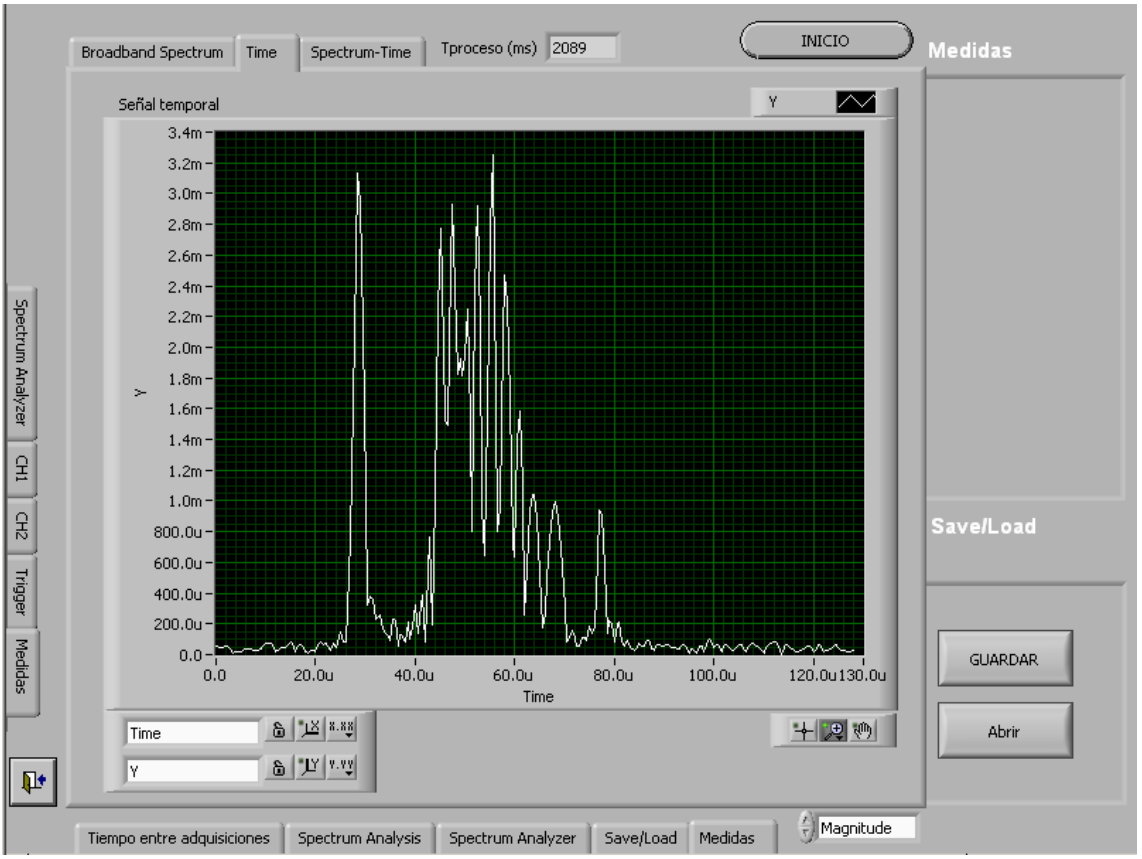

Figure 2. RF transient measured