Application Note #65
Proper use of Field Analyzers at Lower Frequencies

Introduction

Most RF field probes are designed to measure only the root mean square (RMS) of a continuous wave (CW) electric field over a broad range of frequencies and amplitudes. This is not the case for the AR Field Analyzer. The AR Field Analyzer contains an embedded web-page that has the ability to measure CW and Modulated electric field or power density in the time domain using an oscilloscope-type display. Please see AR Application Note #63 for background information on the development of Field Analyzers and how they meet a growing need in system test.

Background on theory

Field Analyzers typically measure a wide bandwidth, have a very fast sample rate and fast analog response time. This allows them to be used for fast pulsed field measurements. Their ability to reproduce the envelope of a pulsed electric field in an oscilloscope-like display sets them apart from conventional field probes.

The fast analog response time of the detector diode (short time constant) provides the responsiveness needed to react to short RF pulses and modulated fields. At low frequencies, however, with this short time constant, the detector diode circuit begins to respond to the carrier cycles, resulting in the detector voltage 'drooping' between carrier cycles. Lengthening the time constant would eliminate this effect, however, a long time constant results in an unacceptably slow rise and fall times for the pulse edges. This situation creates a conflict in trying to meet both criteria: 1) a flat-topped pulse and 2) a pulse with fast edges at the low end of the specified bandwidth for these devices. This drooping effect is not only present with pulse measurements, but CW measurements as well.

Field Analyzers are intentionally designed to allow maximum measurement capability, and so consequently the cutoff frequency prior to the Analog-to-Digital converter is set artificially higher than the Nyquist frequency. The secondary challenge causes the potential for aliasing if frequencies higher than the Nyquist frequency make their way into the system. This is what is occurring in the frequency range where drooping of the carrier occurs, which is inherent to this design. So how do you accommodate for this scenario?

AR has found the simplest solution to these issues is to provide a software algorithm to perform a maximum holding (Max Hold) function on all samples. This works because, over time, samples will occur at all points on the drooping cycles including the tops of the cycles. Eventually, the tops of many cycles will be sampled by nature of the sample frequency being different than the carrier frequency.

160 School House Road Souderton, PA 18964-9990 • 215-723-8181 • www.arworld.us

Measurement Technique

How do you determine which signal needs to use the Max Hold function? The Rule of Thumb is that signals at the lower end of the band (<20 MHz) will benefit from the use of the maximum hold function. This method works for both CW fields and for modulated signals that can be triggered. By using this method an accurate representation of the modulation envelope can be resolved. Note that this method does not work for single pulse events because of insufficient signal data.

In Figure 1 below, the orange trace is a live pulse signal at 100 MHz, with pulse width of 20 usec and period of 1 msec (2% duty cycle). The Max Hold function is not required because there is no drooping, and the measured signal is not at the low end of the frequency band. Please note that in the following figures the reported period and duty cycle are not correct because two pulses are required on the display to calculate these values.

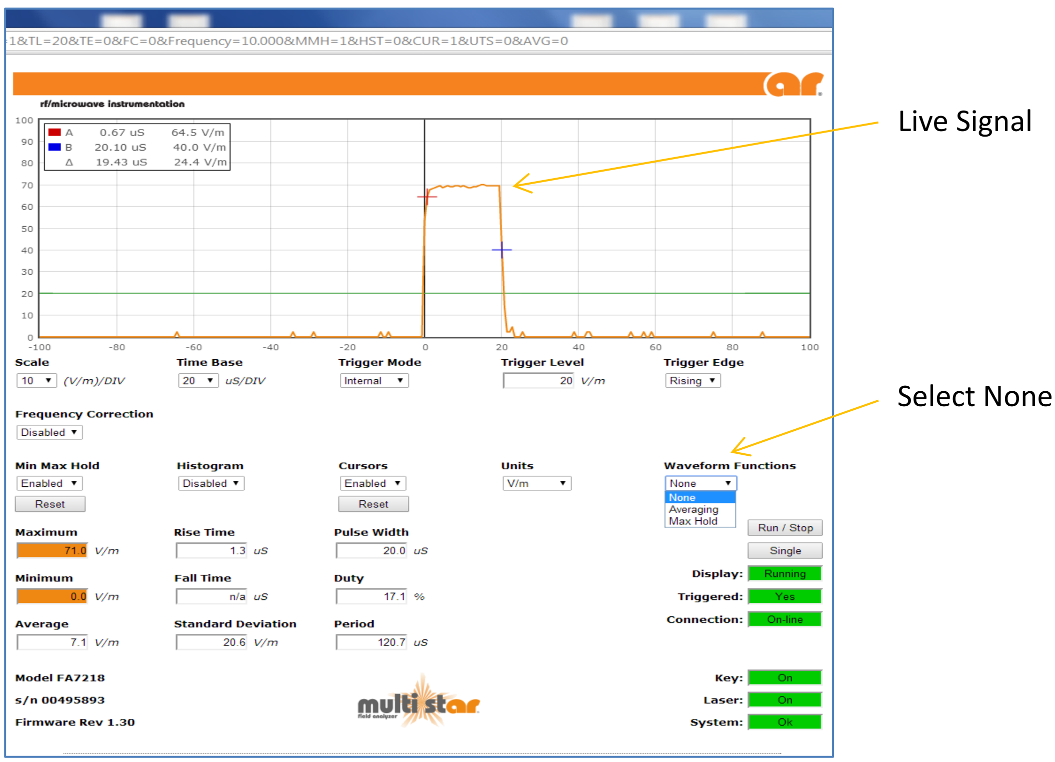

Figure 1. Display with 100 MHz signal

In Figure 2 below, a 10MHz pulse signal, with pulse width of 20uS and period of 1msec (2% duty cycle) is shown; this signal is at the lower end of the frequency band. The Live signal (orange trace) exhibits drooping between carrier cycles during the pulse. This is the perfect scenario for the operator to select 'Max Hold'.

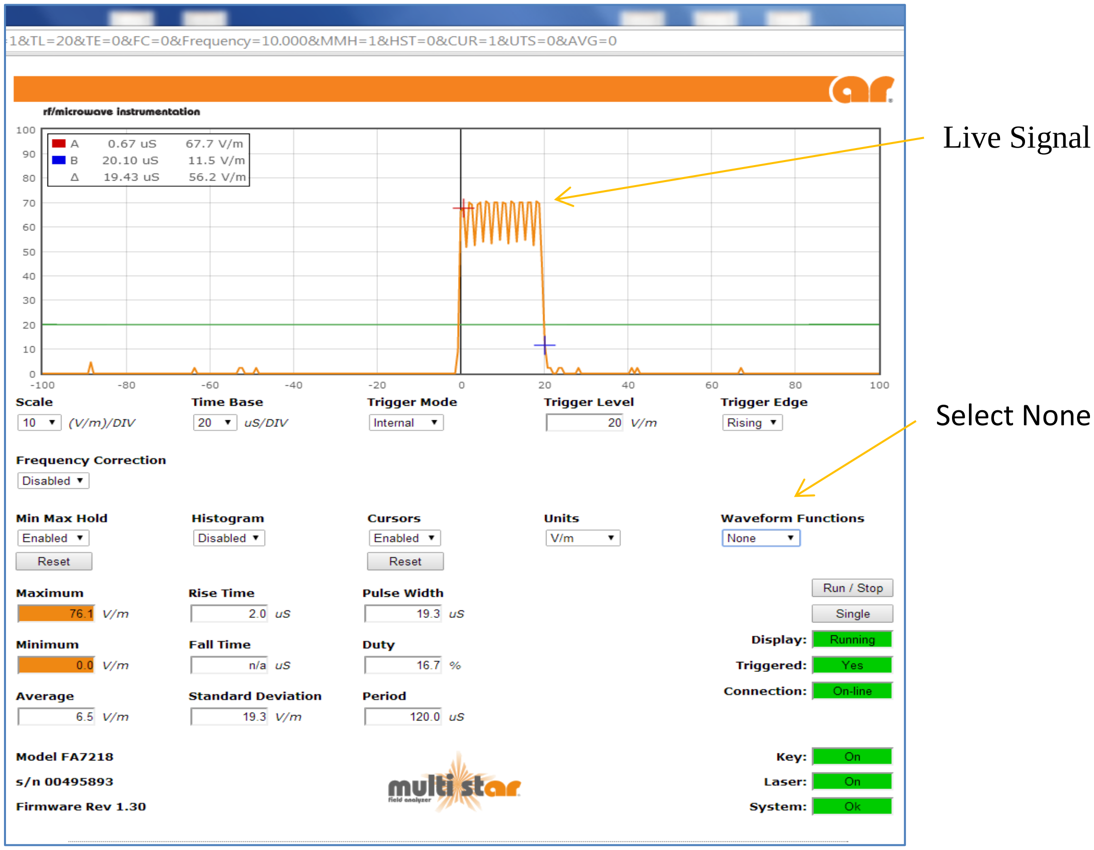

Figure 2. Display with 10 MHz signal without max hold

In Figure 3, the Max Hold is selected and the orange trace displays the accumulated max peak from multiple sweeps, and the grey trace is the live signal. The live signal will be displayed as long as the signal is present. If the signal is not present, the grey trace will disappear from the screen and the orange trace (Max Hold) will remain unless a reset is performed. With the Max Hold enabled the true pulse envelope is displayed.

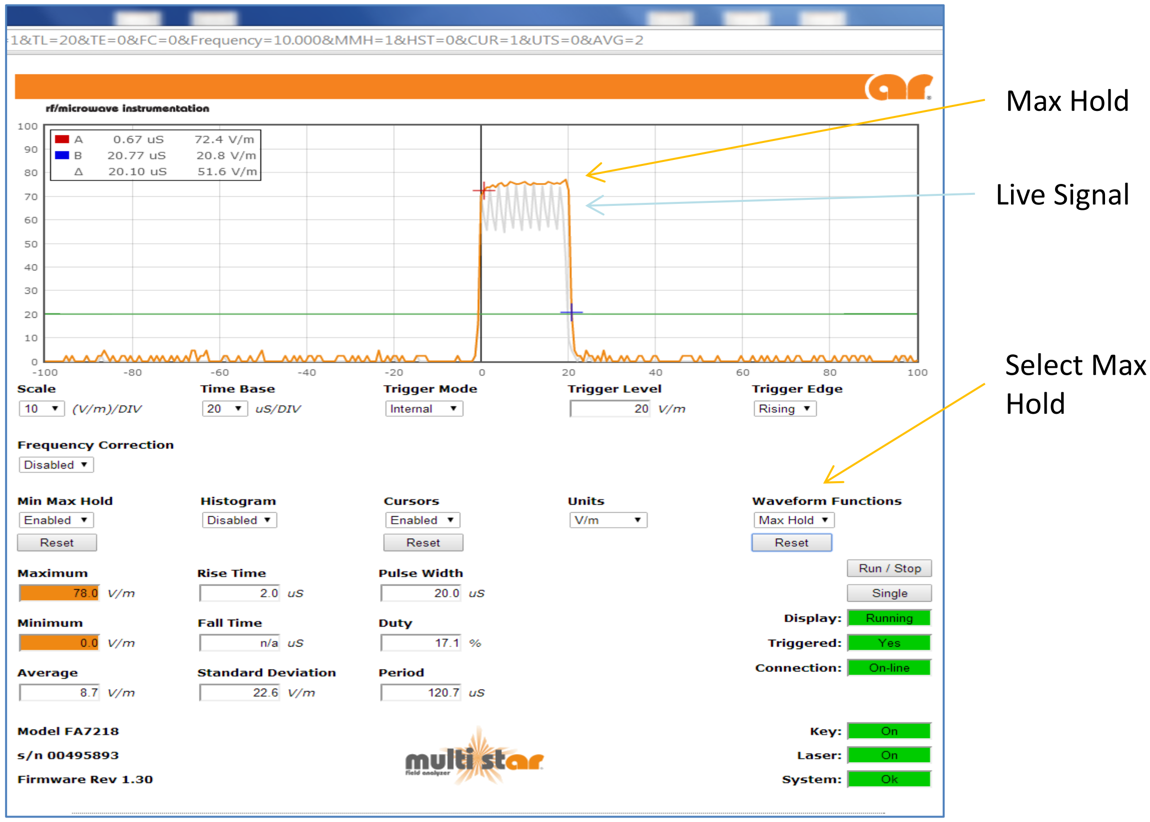

Figure 3. Display with 10 MHz signal and with max hold

Field Analyzers can also be used where automated software such as the AR emcware® controls all of the test equipment in an RF radiated immunity test setup. When querying for Maximum Field Level, the returned value will be the maximum value of the envelope that was measured over the time interval sampled. For best accuracy, when using remote commands, the timebase should be set for the maximum. A trigger event updates this value and no further trigger events are captured until the value is read from the buffer.

Summary

Signals at the lower end of the frequency band should use the Max Hold function to get an accurate representation of the modulation envelope on the display. When the field analyzer is remotely controlled the command returns the maximum modulation envelope composite field level as required by the standards.