Active Technologies

Low Amplitude Pulse Signals Generation

Introduction

Real-world **millivolt signals** produced by microchannel plate detectors, microchannel plate photomultiplier tubes, fast photodiodes, discrete-dynode photomultiplier tubes, but also cardiac signals require **very low amplitude pulses** to test electronic devices like low signal amplifiers or any other R&D or medical equipment.

The Active Technologies AWG-4000 Arbitrary Waveform Generator has 16 Bits of vertical resolution and a full scale range of 12Vpp 50 Ohms into 50 Ohms: the resolution (DAC step size) is 12Vpp / 2^16 = 0.1831 mV.
It means that with 3 mVpp waveform amplitude the DAC uses 4 bits only.

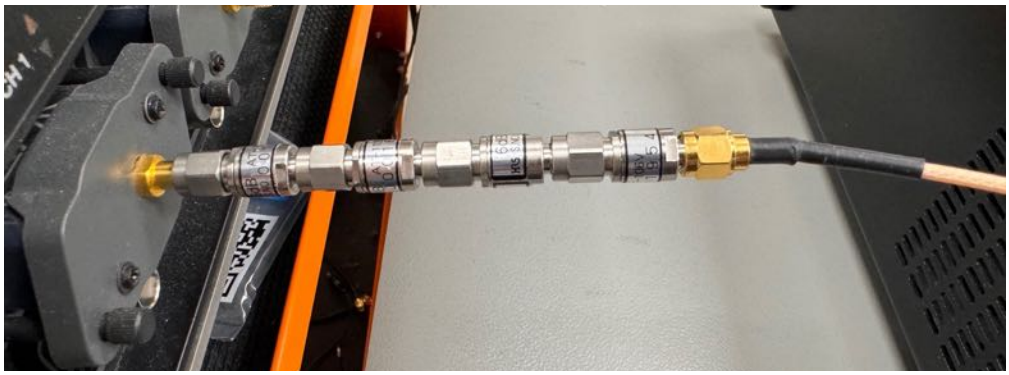
The AWG-5000 and AWG-7000 have a full scale range of 5Vpp into 50 Ohms.
The resolution is 5Vpp/2^16 = 0.07629 mV for AWG-5000 and 5Vpp/2^14 = 0.305175 mV for AWG-7000; it means that if you want to generate 6 mVpp waveform amplitude using the AWG-5000 model, the DAC uses 6 bits only.

The PG-1000 Pulse Generator has a full scale of 5Vpp and for this reason when you try to generate a very low amplitude pulse signal, its full range is not optimized.

It is highly suggested to use an **external attenuator** in combination with the Rider Series Waveform and Pulse Generator to reach the best performances in term of very low amplitude pulses, fast rise/fall time, minimum pulse width and high signal fidelity.

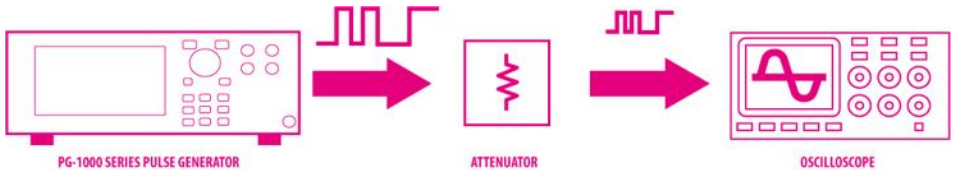
Very-Low-Amplitude Pulse Generation with PG-1000

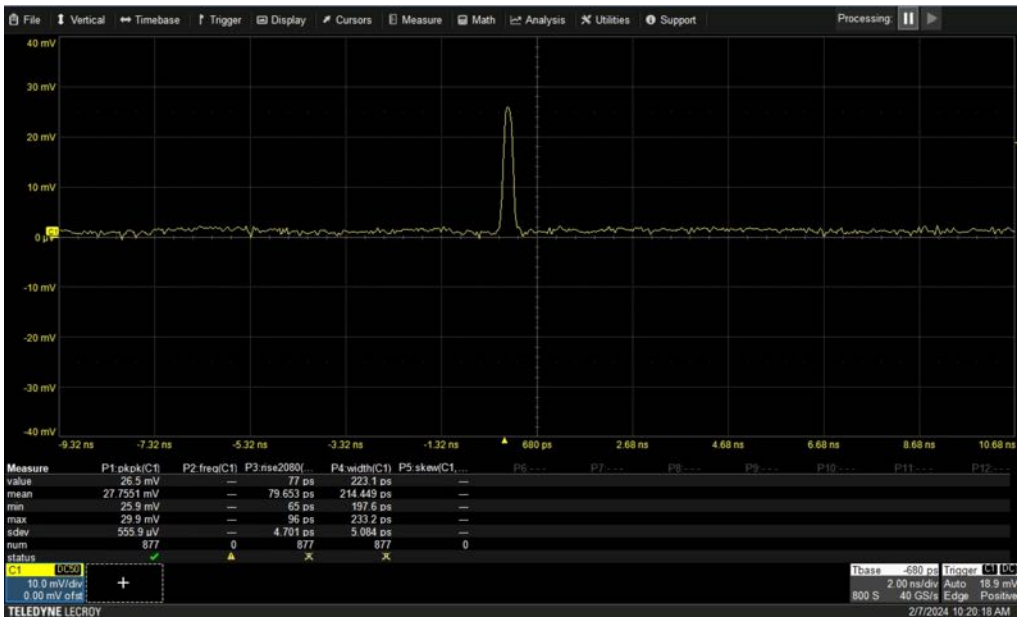
The generation of low-level pulses needs an external attenuator to optimize the signal-to-noise ration and to obtain the best overall results.
In the following tests, we used an external 30 dB Attenuator like the one of the following picture.



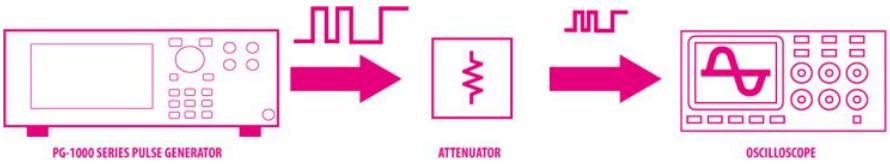
In this paper we've performed several measurements on very low amplitude pulses using an oscilloscope; you can see the different tests and results in the pictures below.

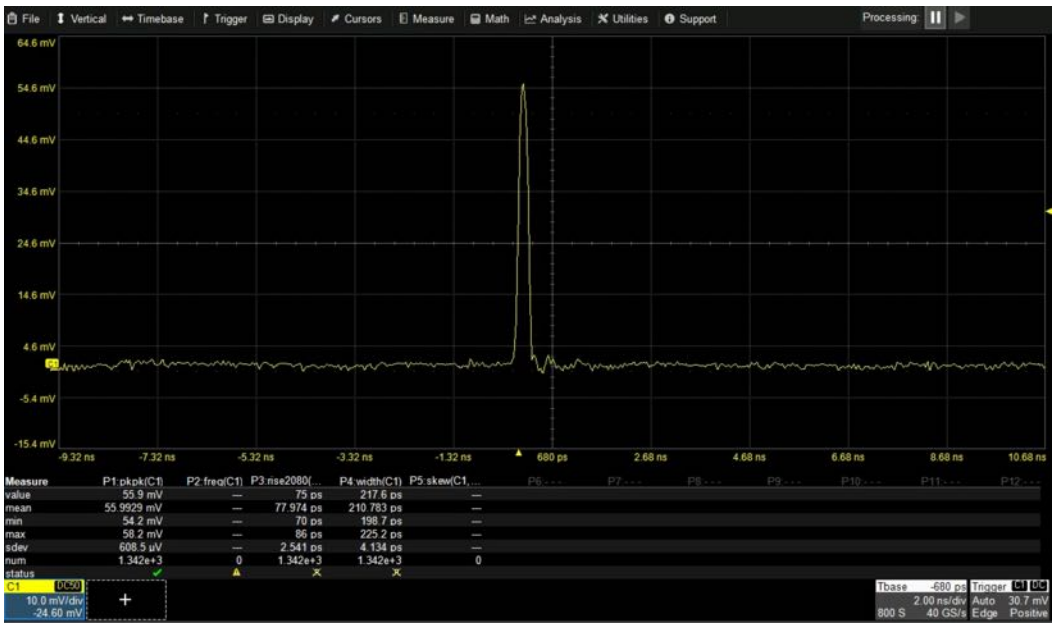
1. PG-1000 | Pulse wave | 27 mVpp Amplitude | Attenuator 30 dB | Oscilloscope





2. PG-1000 | Pulse wave | 56 mVpp Amplitude | Attenuator 30 dB | Oscilloscope





3. PG-1000 | Pulse wave | 140 mVpp Amplitude | Attenuator 30 dB | Oscilloscope

Very-Low-Amplitude Pulse Generation with AWG-4010

The AWG-4010 Arbitrary Waveform Generator Series has a full scale of 12Vpp into 50 Ohm, so also in this case an external 30 dB Attenuator is needed for optimal results.

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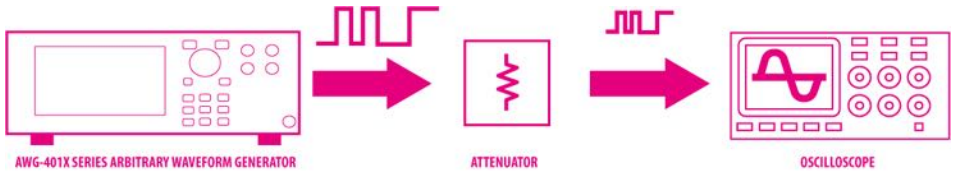
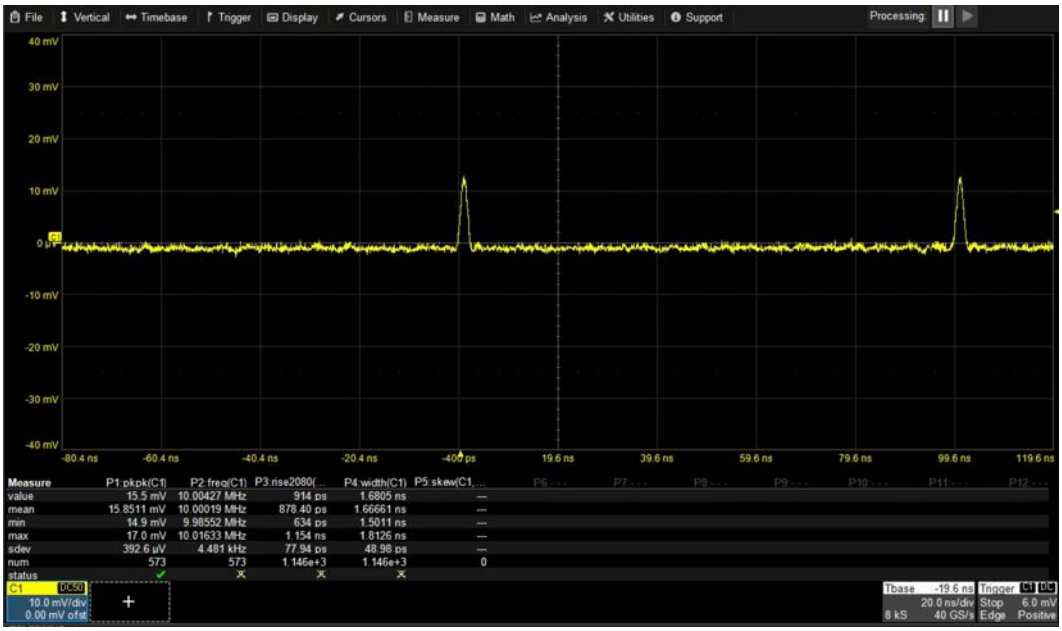
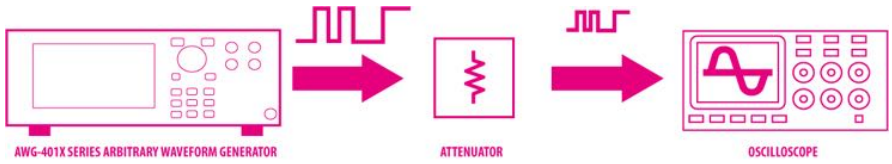
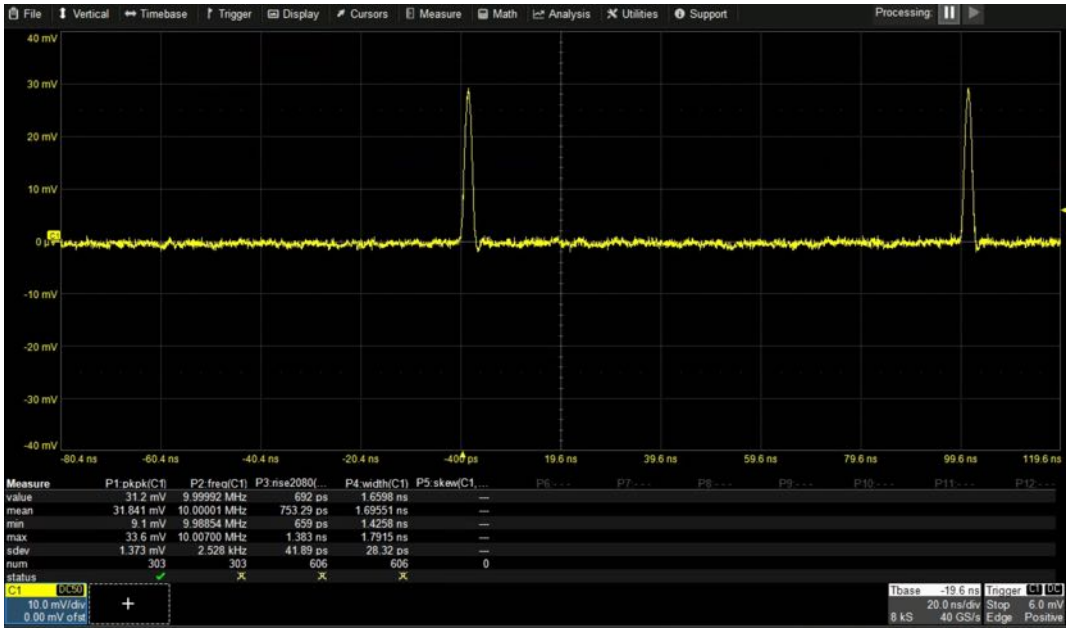
1. AWG-4010 | Pulse wave | 15 mVpp Amplitude | Attenuator 30 dB | Oscilloscope



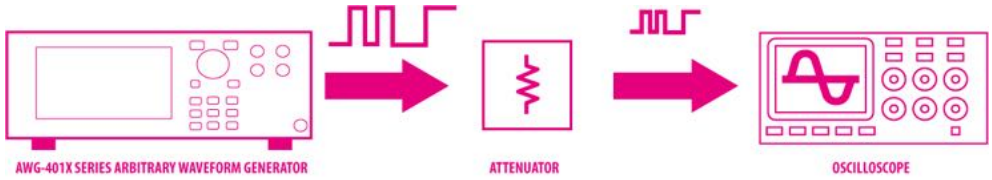


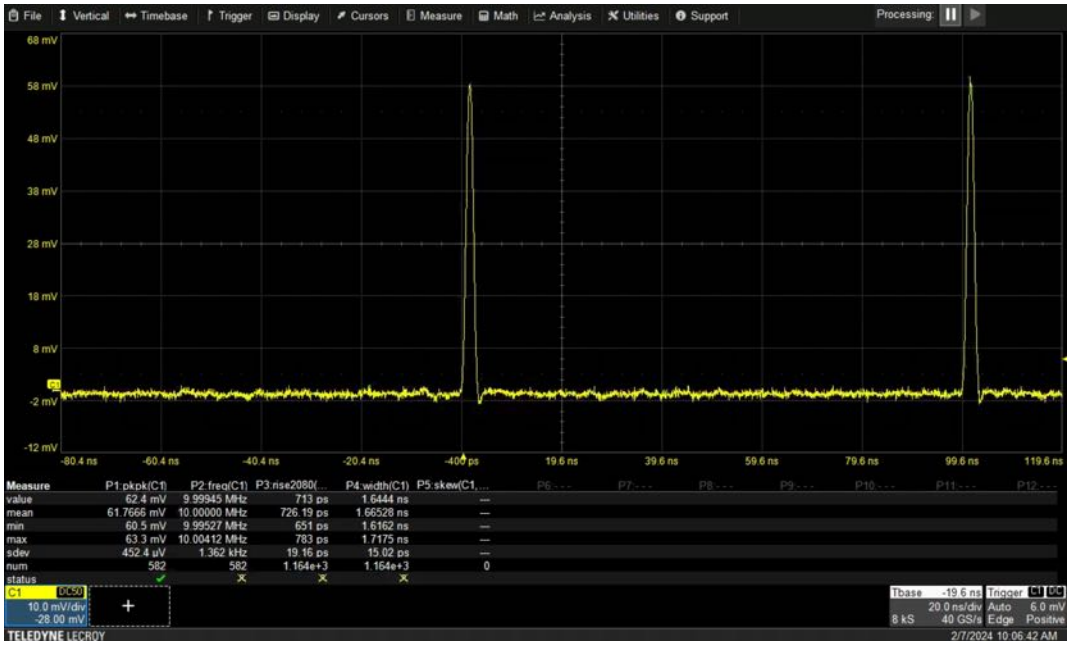
2. AWG-4010 | Pulse wave | 31 mVpp Amplitude | Attenuator 30 dB | Oscilloscope



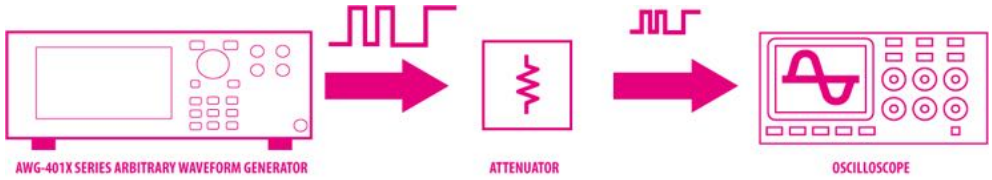


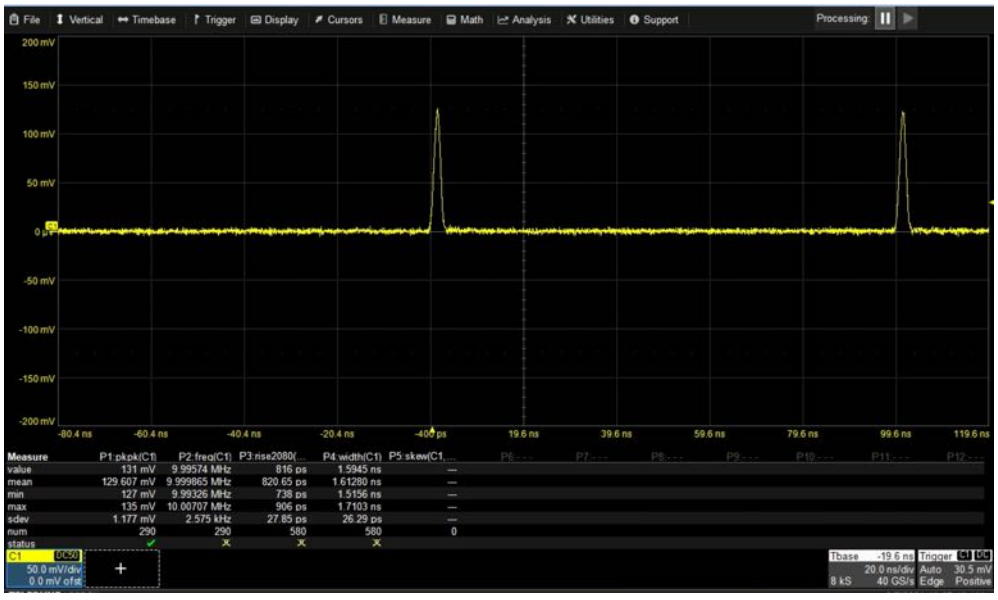
3. AWG-4010 | Pulse wave | 61mVpp Amplitude | Attenuator 30 dB | Oscilloscope



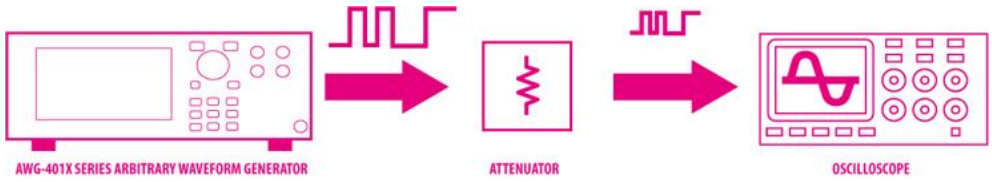


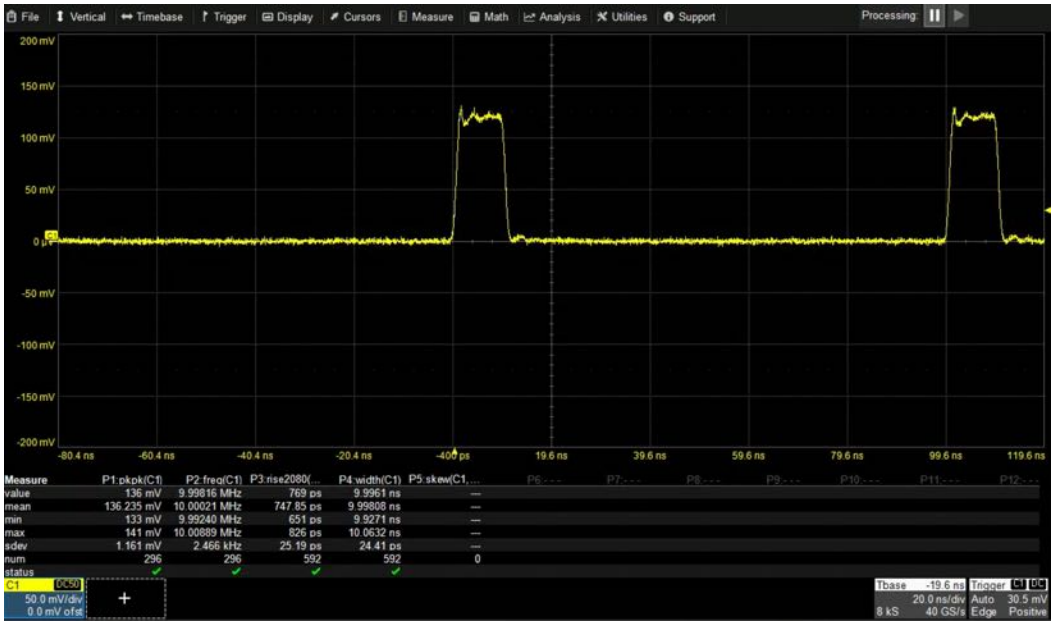
4. AWG-4010 | Pulse wave | 130 mVpp Amplitude | Attenuator 30 dB | Oscilloscope





5. AWG-4010 | Pulse wave | 130 mVpp Amplitude | 10 ms Width | Attenuator 30 dB | Oscilloscope





Very-Low-Amplitude Pulse Generation with AWG-5000

The AWG-5000 Arbitrary Waveform Generator Series has a full scale of 5Vpp into 50 Ohm and an analog bandwidth greater than 2 GHz, so also in this case an external 30 dB Attenuator is needed for the optimization of the signal to noise ratio.

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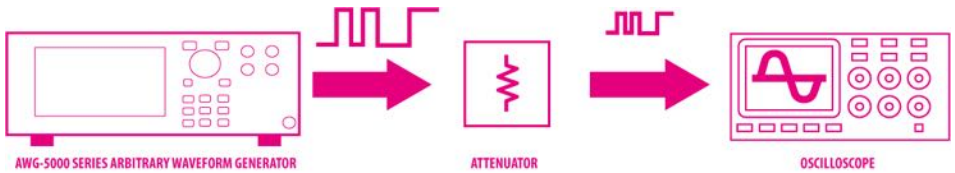
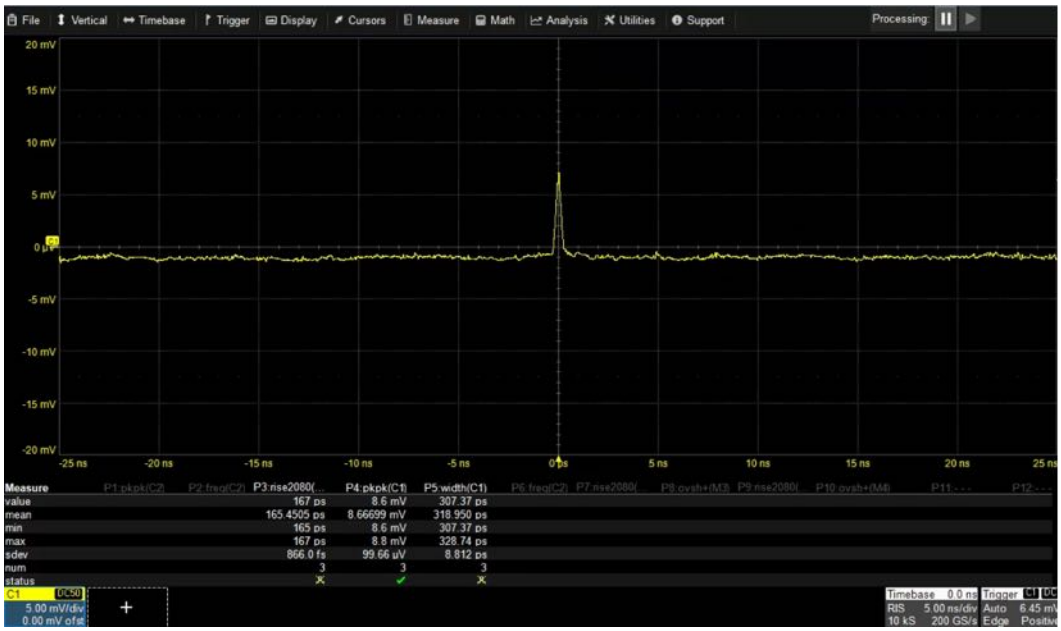
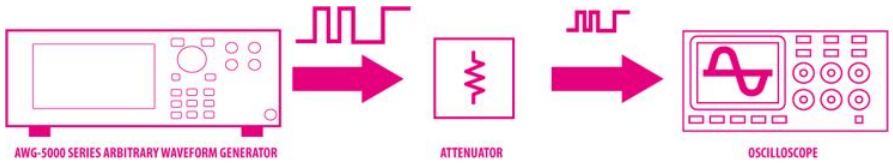
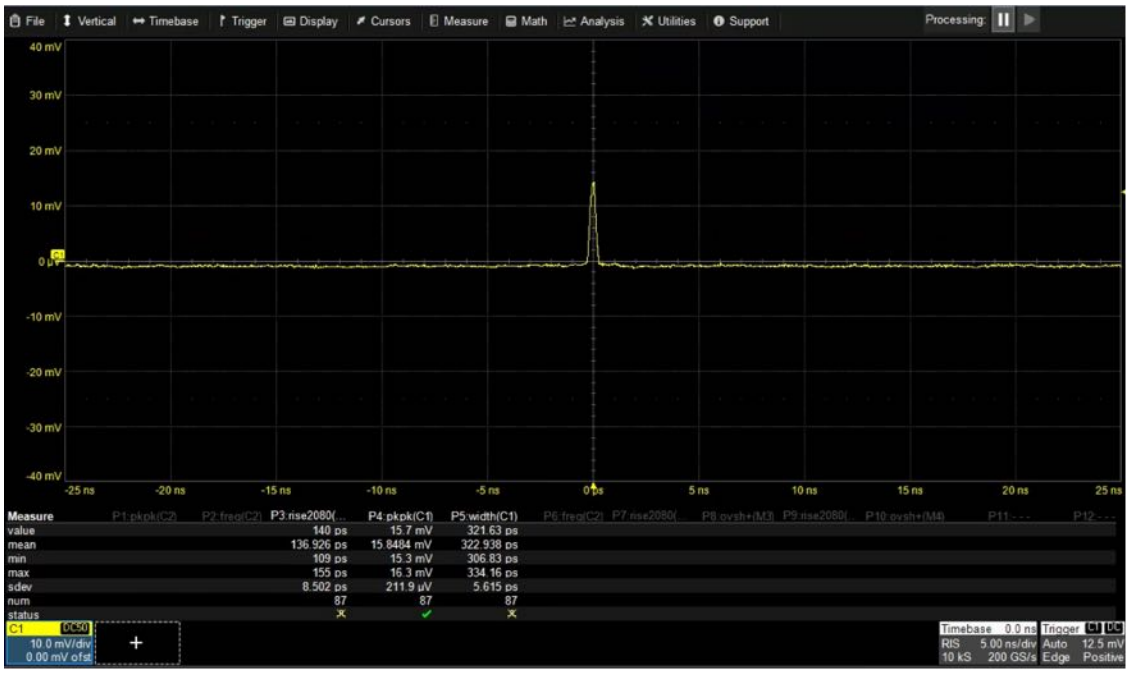
1. AWG-5000 | Pulse wave | 8 mVpp Amplitude | Attenuator 30 dB | Oscilloscope



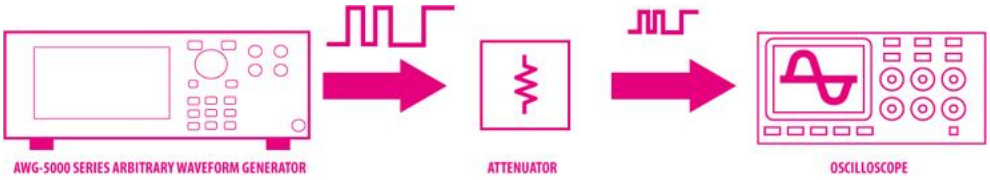


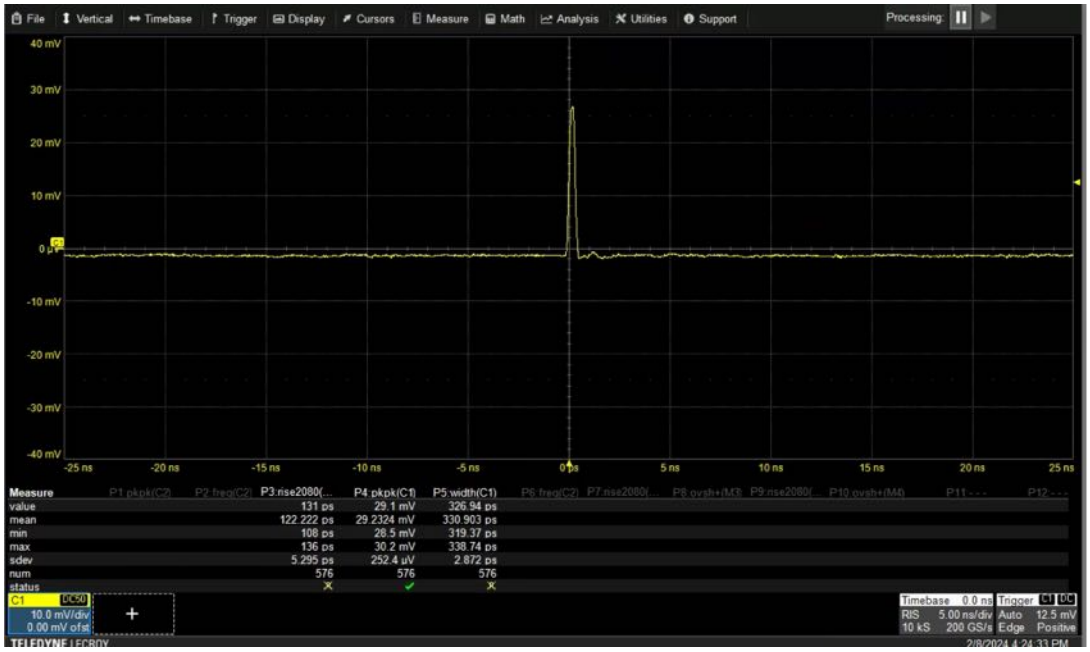
2. AWG-5000 | Pulse wave | 15 mVpp Amplitude | Attenuator 30 dB | Oscilloscope



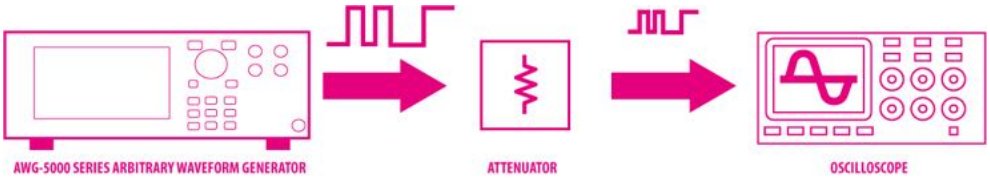


3. AWG-5000 | Pulse wave | 30 mVpp Amplitude | Attenuator 30 dB | Oscilloscope

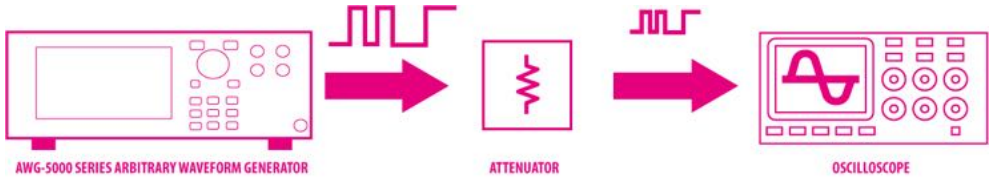


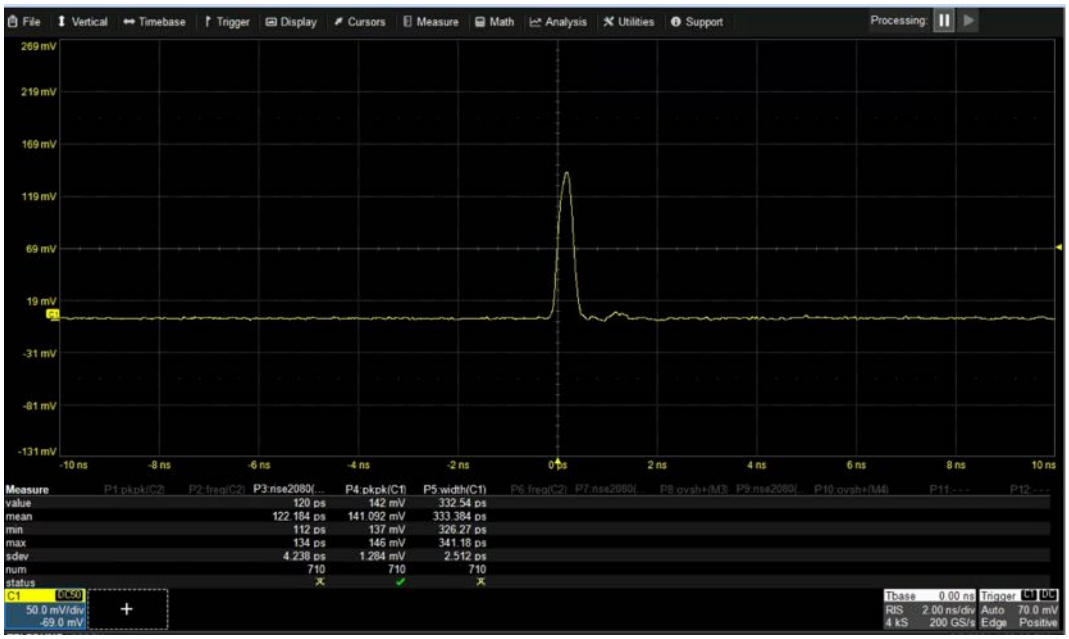


4. AWG-5000 | Pulse wave | 60 mVpp Amplitude | Attenuator 30 dB | Oscilloscope



5. AWG-5000 | Pulse wave | 140 mVpp Amplitude | Attenuator 30 dB | Oscilloscope





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Very-Low-Amplitude Pulse Generation with AWG-7000

The AWG-7000 Arbitrary Waveform Generator Series has a full scale of 5Vpp into 50 Ohm and an analog bandwidth greater than 8 GHz, so also in this case an external 30 dB Attenuator is needed to obtain the optimal results.

Using the AWG-7000, you can obtain very small amplitude pulses with 50 ps of rise and fall time and about 100 ps of minimum pulse width.

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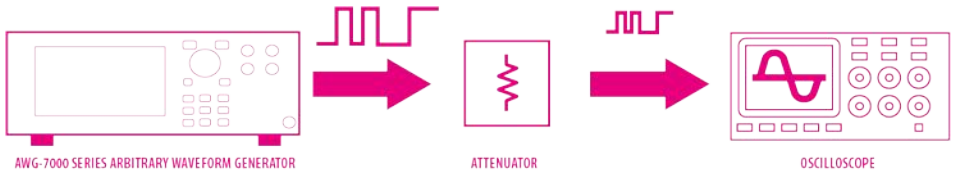
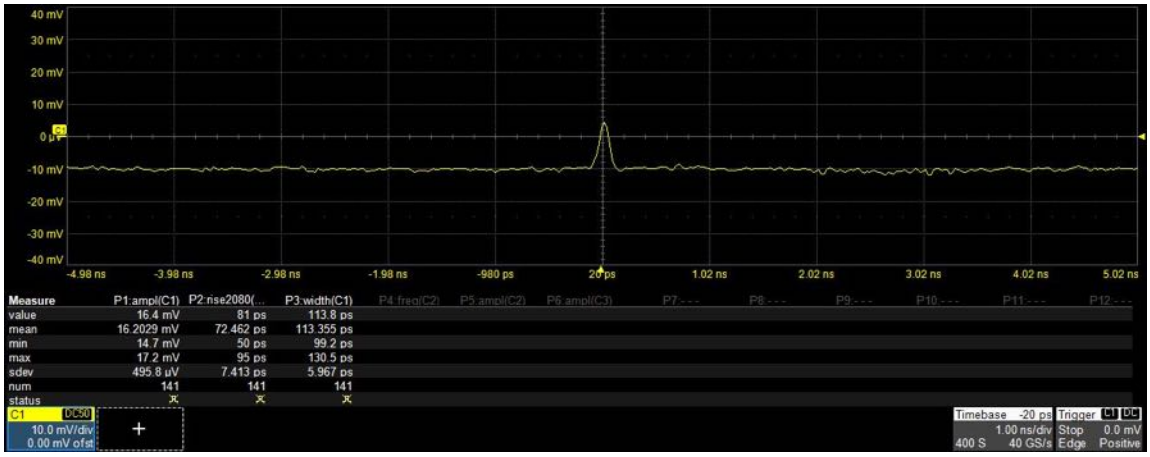
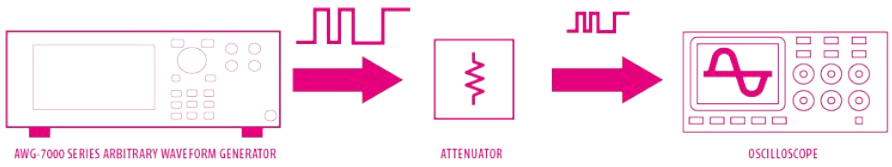
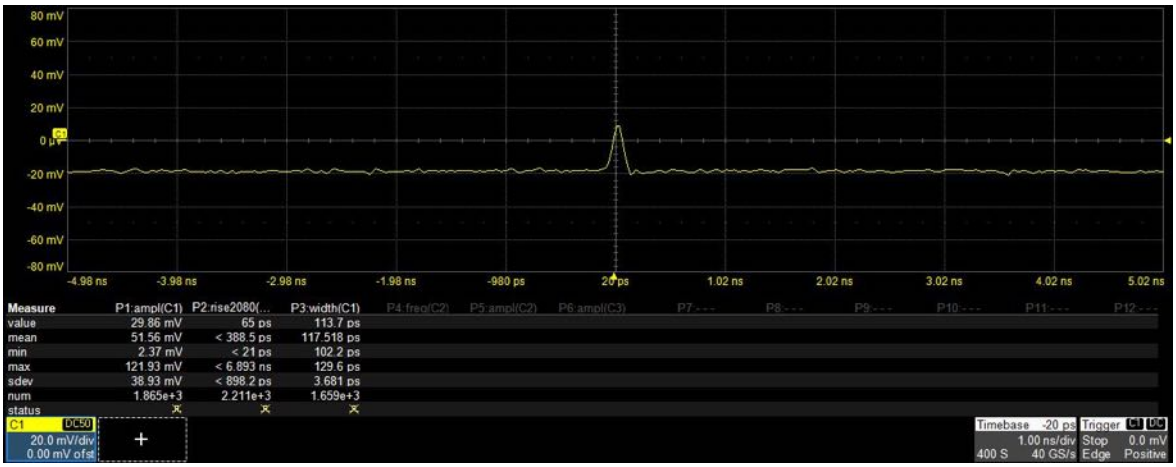
1. AWG-7000 | Pulse wave | 16 mVpp Amplitude | Attenuator 30 dB | Oscilloscope



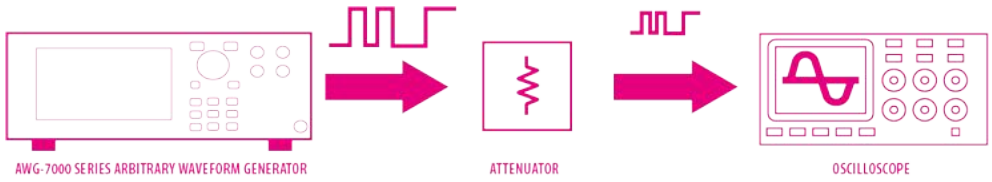


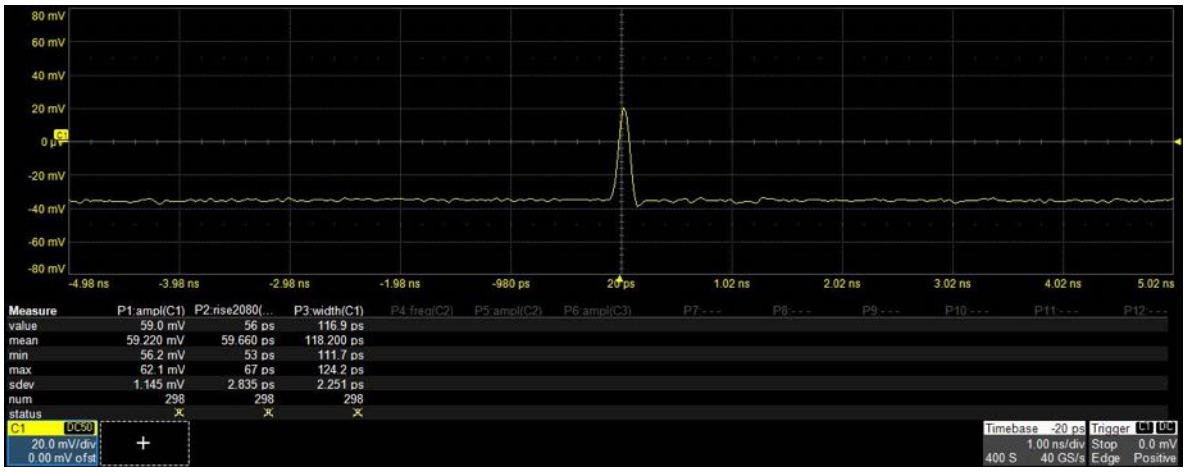
2. AWG-7000 | Pulse wave | 30 mVpp Amplitude | Attenuator 30 dB | Oscilloscope



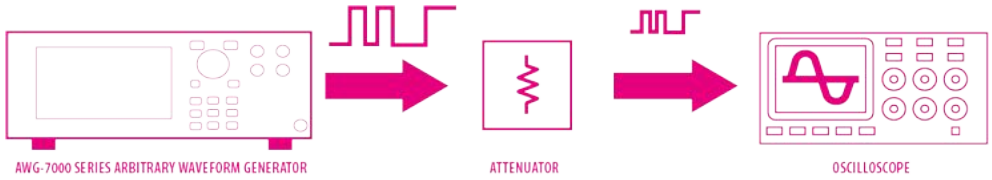


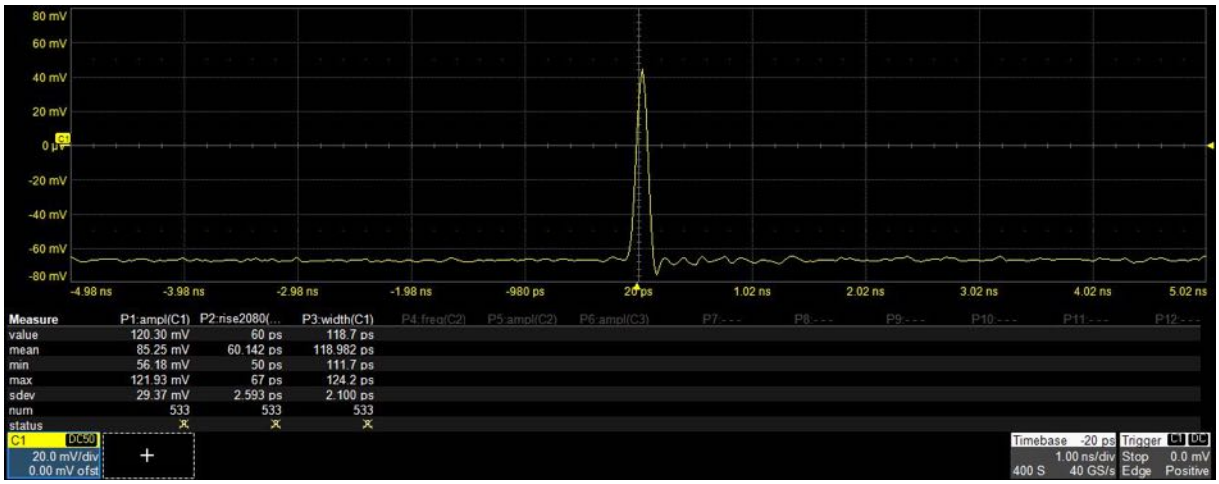
3. AWG-7000 | Pulse wave | 60 mVpp Amplitude | Attenuator 30 dB | Oscilloscope





4. AWG-7000 | Pulse wave | 120 mVpp Amplitude | Attenuator 30 dB | Oscilloscope





Conclusion

The Active Technologies ARB Rider and Pulse Rider Series first-class hardware architecture coupled with an external attenuator offers the ability to generate unmatched performance and high signal fidelity when you need to generate very low amplitude, fast rise/fall time and very small width pulses , that are needed in the latest advanced R&D challenges.