

**10 Tips for Electronic
Warfare and Radar
Signal Simulation
Using COTS Transceivers**

Enabling the Breakthroughs of Tomorrow

10 Tips for Electronic Warfare and Radar Signal Simulation using COTS Transceivers

It is now possible to adapt a test and evaluation strategy to encompass new threats by using commercial off-the-shelf (COTS) transceiver subsystems. The Proteus Arbitrary Waveform Transceiver (AWT) is an advanced FPGA based RF transmitter and receiver hardware platform that provides a key building block for closed-loop or hardware-in-the-loop test systems. With three modes of operation, it changes the way you approach emulate threats.

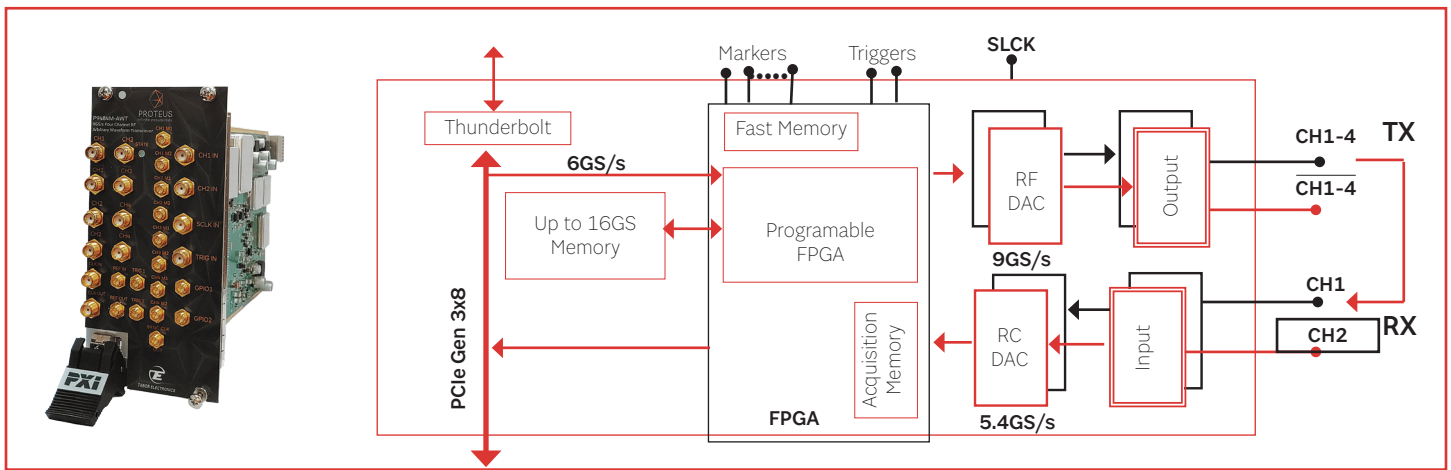
As an RF Arbitrary Waveform Generator with 4.5GHz of instantaneous transmission bandwidth, deep memory, and dynamic upload capability, you'll never run out of waveform memory while recreating the details of threat characteristics. The transceiver has 2.7GHz of instantaneous receiver bandwidth and a programmable FPGA, allowing you to adapt to the threat behavior in real-time. It delivers wideband streaming capability enabled by PCIe Gen 3, x8 backplane technology, providing the ability to playback RF events from a hard disk array.

The Proteus Series is fully scalable to many channels and can be packaged as a benchtop, desktop instrument, or as a PXIe module to best suit your test and evaluation needs. It offers full-phase coherent operation across all channels.

In this solution note we cover the following 10 use scenarios of the Proteus AWT.

1. Using direct digital architecture for Signal Simulation
2. Generating Wide and Ultrawide Bandwidth (UWB) Signals
3. Determining Agility and Frequency Switching Speed
4. Understanding Coherence
5. Creating directional signals (Angle of Arrival)
6. Developing complex multi-emitter scenarios
7. Real Time Scenario Generation
8. Closed Loop, Hardware in the Loop (HiL) for Radar Target and Altimeter evaluation.
9. Adding realism with Background Electromagnetic Emissions (EME)
10. Understanding the Benefits of Commercial-of-the-shelf

1. Using Direct Digital Architecture for Signal Simulation



Proteus is a Modular, Scalable Transceiver system for Radar and Electronic warfare applications. It uses Wide bandwidth RF DACs and ADC, allowing for multiple Nyquist zone use for direct signal simulation applications to 10GHz. At the heart of the unit is a state-of-the-art FPGA, that can schedule waveform playout deterministically. Each module connects via a PCIe high speed backplane ensuring multiple complex operation can be carried out.

2. Generating Wide and Ultrawide Bandwidth (UWB) Signals

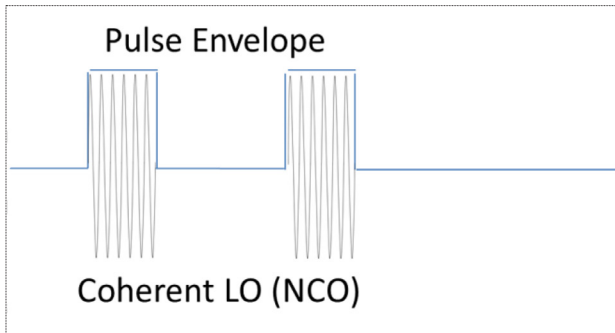


Tabor Proteus is ideal for generating wide bandwidth signals such as short duration fast rise pulses, or wide frequency sweep FMCW signals for high range resolution radar modes. Tabor's DAC and ADC technology can generate and receive signals with more than 2.7GHz of bandwidth.

3. Determining Agility and Frequency Switching Speed

The ability to quickly switch from one frequency to another is key in many radar or threat scenario applications. The Tabor Proteus DAC and ADC have built-in wide bandwidth IQ modulators utilizing a numerically controlled oscillator (NCO) as a local oscillator. With over two GHz of bandwidth, the instrument can be tuned to a specific band using the NCO and a sequence of frequency agile pulses programmed to quickly switch frequency across the band.

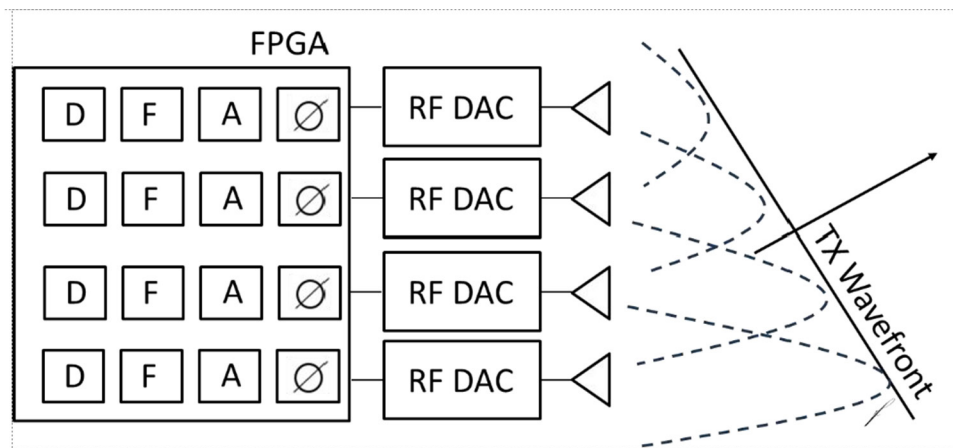
4. Understanding Coherence



Single channel coherence: The Tabor Proteus numerically controlled oscillator (NCO) when set to a specific frequency is always running, specific pulses of various shapes with added second/third order characteristics can be created in the arbitrary waveform memory. Creating a coherent sequence of pulses.

Multi-channel coherence: The ability to have multiple phase/time aligned transmit and receive channels has many advantages. The Tabor Proteus is scalable from just a couple of channels to many 100's of channels with each channel.

5. Creating directional signals (Angle of Arrival)



Each Proteus Module has four RF DAC outputs. Adjusting or weighting the phase and amplitude (A) of each coherent channel allows for wavefront creation. This can be useful for phase array radar emulation or simulating specific angles of arrival when testing radar warning receivers. The Dealt (D) and Frequency (F) of each channel can also be independently set.

6. Developing complex multi-emitter scenarios

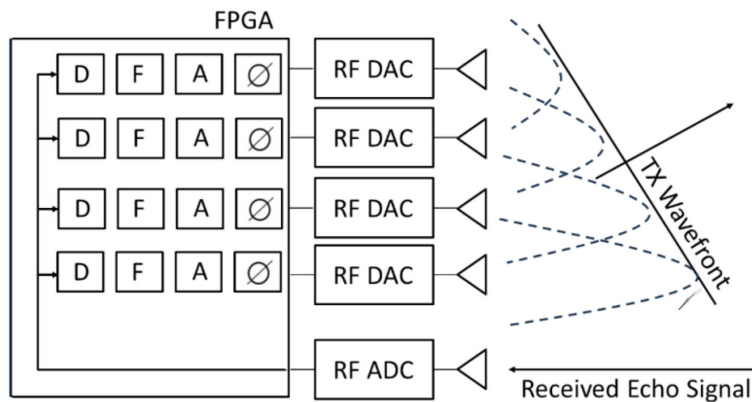


As the Proteus system is built on a coherent modular architecture hundreds of radar signals can be generated creating complex scenarios accurately emulate an electronic order of battle.

7. Real Time Scenario Generation

Real Time Scenario generation can be achieved in multi ways. The instruments large memory can store millions of pulses, that can be configured into specific radar modes using its pulse scheduler, modes or individual pulses can be accessed using a real time scheduler that could be driven directly from an FPGA subsystem. Or alternatively the instruments fast PCIe backplane technology can stream multiple channels of waveforms directly form a large disk array system.

8. Closed Loop, Hardware in the Loop (HiL) for Radar Target and Altimeter evaluation.



Four Channel Proteus Arbitrary Waveform Transceiver

As the Tabor Proteus has both RF DAC and ADC capability a real time loop back can be realized. This is an extremely powerful capability that enables the unit to receive a radar signal and retransmit it with added delay (D), amplitude (A), doppler frequency (F) shifts and phase changes between multiple channels simplify multiple channel radar target generation or altimeter test.

9. Adding realism with Background Electromagnetic Emissions (EME)

Utilizing the Proteus wideband with mode up to 4GHz of background EME created, adding realism to your scenario, emulating anything from TV and Radio Transmitters to Cellular network transmitters.

10. Understanding the Benefits of Commercial-off-the-shelf

The Tabor Proteus is a compact, modular commercial-off-the-shelf (COTS), cost-effective, direct to digital transceiver that has been designed for radar signal and threat simulation, quantum physics and commercial communications. It simplifies test and evaluation of new systems both from a hardware perspective – eliminating hardware such as up-converters, delay lines and phase shifters, and from a software perspective being easy to program with MATLAB and Python.



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