



# PROTEUS

Infinite possibilities

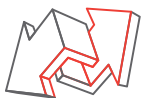
## RF AWG Module Platform

Introducing Tabor's new addition to its industry leading Proteus, Arbitrary Waveform generators/Transceivers series. The new RF AWG/AWT offers a built in IQ modulator with advanced capabilities for multi-channel RF signal generation. Based on a PXIe platform, the system integrates the ability to transmit, receive and perform digital signal processing all in a single instrument. The modular, compact and cost effective system offers industry leading performance, high channel density and user customizable FPGA. For synchronized, phase coherent, multi-channel applications such as quantum physics and radar applications the Proteus RF AWG is an ideal, space efficient and cost effective solution.

### Leading Features:



Four channels 9GS/s 16 bit, AWG & AWT configurations



Real time data streaming directly to the FPGA for continuous and infinite waveform generation

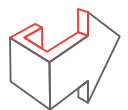


Integrated digital up-converter to RF frequencies for coherent multi-channel RF applications across multiple modules

8GHz Bandwidth, 5.4GS/s 12 bit digitizer option for feedback control system and conditional waveform generation

Innovative task oriented sequence programming for maximum flexibility to generate any imaginable scenario

Up to 8GS waveform memory with the ability to simultaneously generate and download waveforms.



Excellent phase noise and spurious performance

Customizable FPGA for use embedded IP and application specific requirements

High speed PCIe GEN3x8 lanes communication interface

Modular and space efficient PXI Express platform, easily scalable to hundreds of channels.

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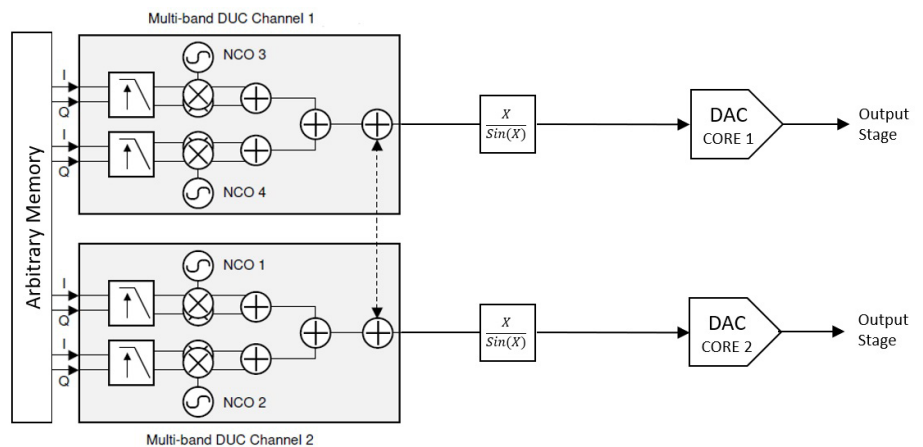
## MODULAR, SCALABLE AND COMPACT

Based on PXI Express industry standard the modular architecture can easily scale up to hundreds of channels, while keeping the required space to a minimum. The compact form size enables up to 4 generator output channels and 2 digitizer input channels to occupy only 3 PXI slots.

## DIRECT GENERATION OF COMPLEX RF SIGNALS

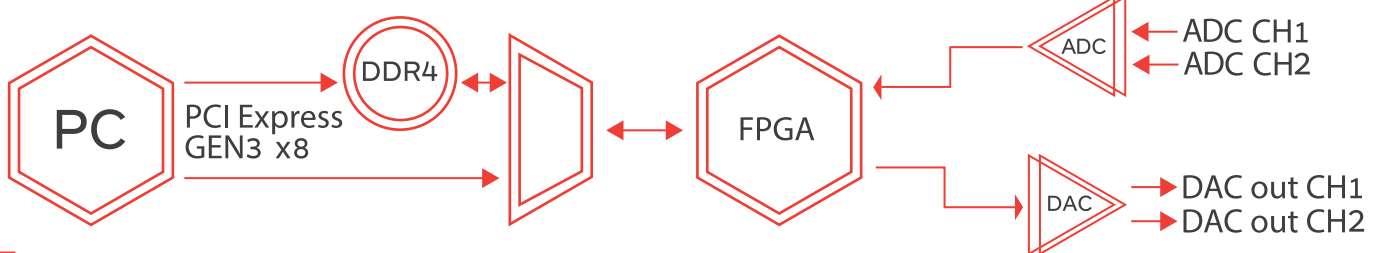
The new addition to the Proteus series offers an integrated Numerically Controlled Oscillator (NCO), digital interpolator and IQ modulator for generation of complex RF signals directly from the Proteus instrument. The internal digital-up-converter enables direct generation of IQ modulation signals eliminating

limitations such as IQ mismatch, and in-band carrier feed-through that are present with external IQ modulators and mixers. Also, by reducing the waveform size with up to x8 interpolation factor it saves on critical processing and compilation times present in many test and simulation systems. Coherent multiple-channel RF signal generation across multiple modules for applications such as Phase-Array Radar, Massive MIMO and Beamforming, or Quantum Computing can be easily implemented.



## ULTRA-FAST COMMUNICATION INTERFACE

The Proteus PXIe platform utilizes PCI express Gen 3x8 lanes connection that enables up to 64Gb/s of data transfer speed. This enable the Proteus AWT to offer the fastest waveform download available on the market today, saving you valuable time.



## FEEDBACK CONTROL SYSTEM

The Proteus AWT integrates both DAC and ADC in one system, controlled by a single FPGA for optimal synchronization and minimum latency. This high speed control system provides a feedback loop for fast decision making.

## GENERATE ANY IMAGINABLE SCENARIO

Innovative task oriented sequence programming where you can change the full instrument setup at every line of the task table. Not only can you generate and download waveforms simultaneously, you can stream data directly to the FPGA without the need to use the built in memory. This enables generating random, complex, unique and infinitely long scenarios directly from the controlling PC at DAC speeds of up to 6GS/s.

GENERAL CHARACTERISTICS		P9482/4M
<b>NUMBER OF CHANNELS</b>		
Standard		2/4
x1 Mode		1/2
<b>MAX. SAMPLE RATE</b>		9GS/s
<b>MAX. INPUT DATA RATE</b>		
Standard		2.5GS/s
x1 Mode		9GS/s
<b>RESOLUTION</b>		16-bit
<b>ANALOG BANDWIDTH</b>		8GHz
<b>MAX. MEMORY SIZE</b>		Up to 8GS
<b>INTERFACE</b>		PXI Express Gen3 x8 lanes

INTER-CHANNEL SKEW CONTROL	
<b>INITIAL SKEW</b>	<20ps
<b>FINE DELAY</b>	
RANGE	0 to 5 ns
<b>RESOLUTION</b>	5ps
<b>ACCURACY</b>	±5ps
<b>COARSE DELAY</b>	
RANGE	0 to wavelength

ARBITRARY MODE		
<b>NUMBER OF SEGMENTS</b>	64k	
<b>MINIMUM SEGMENT LENGTH</b>		
NORMAL	<u>x1 Mode</u> 2048 points	<u>Standard</u> 1024 points
FAST SEGMENT	224 points	64 points
<b>WAVEFORM GRANULARITY</b>		
STANDARD	<u>x1 Mode</u> 64 points	<u>Standard</u> 32 points
OPTIONAL	32 points	16 points

TASK MODE	
<b>TASK TABLE LENGTH</b>	64K tasks per channel
<b>TASK LOOPS</b>	1M
<b>SEQUENCE (1)</b>	
<b>MAX. NUMBER OF SEQUENCES</b>	32K sequences
<b>SEQUENCE LOOPS</b>	1M
<b>SCENARIO (2)</b>	
<b>MAX. NUMBER OF SCENARIOS</b>	1K scenarios

STREAMING (STM OPTION)	
<b>MAX. STREAM RATE</b>	Up to 6GS/s
<b>MINIMUM PC REQUIREMENTS</b>	
CPU	i7
MEMORY	32GB
OPERATING SYSTEM	WINDOWS 10
<b>SOURCE</b>	PXI Express Bus

SIGNAL PURITY	
<b>HARMONIC DISTORTION (3)</b>	
f <sub>out</sub> = 10 MHz - 200 MHz, Measured @ DC to 2 GHz	< -70 dBc (typ.)
f <sub>out</sub> = 200 MHz ... 1.5 GHz, Measured @ DC to 4.5 GHz	< -60 dBc (typ.)
f <sub>out</sub> = 1.5 GHz ... 4.5 GHz, Measured @ DC to 4.5 GHz	< -50 dBc (typ.)
<b>SFDR (4)</b>	
f <sub>out</sub> = 10 MHz...500 MHz, Measured @ DC to 1.5 GHz	< -85 dBc (typ)
f <sub>out</sub> = 500 MHz...4.5 GHz , Measured @ DC to 4.5 GHz	< -75 dBc (typ)
<b>PHASE NOISE (@10kHz offset)</b>	
f <sub>out</sub> = 140.625MHz	-134 dBc/Hz
f <sub>out</sub> = 280.25MHz	-128 dBc/Hz
f <sub>out</sub> = 562.5MHz	-122 dBc/Hz
f <sub>out</sub> = 1.125GHz	-116 dBc/Hz
f <sub>out</sub> = 2.25GHz	-110 dBc/Hz
f <sub>out</sub> = 4.5GHz	-104 dBc/Hz

DIRECT OUTPUT	
<b>OUTPUT TYPE</b>	AC coupled
<b>IMPEDANCE</b>	50Ω (nom)
<b>AMPLITUDE (5)</b>	
Single-ended	1mV to 550mVpp
Differential	1mV to 1.1Vpp
<b>AMPLITUDE RESOLUTION</b>	1mV
<b>AMPLITUDE ACCURACY</b>	±(3% of amplitude ±2 mV)
<b>RISE/FALL TIME (20% TO 80%)</b>	< 60 ps (typ)
<b>INSTANTANEOUS BANDWIDTH</b>	
Standard	1.25GHz
x1 Mode	4.5GHz
<b>MAX. USABLE FREQUENCY</b>	2nd Nyquist, 8GHz
<b>SKEW BETWEEN NORMAL AND COMPLEMENT OUTPUTS</b>	0ps
<b>JITTER (PEAK-PEAK)</b>	< 15 ps (typ)
<b>CONNECTOR TYPE</b>	SMA

SAMPLE CLOCK OUTPUT	
<b>SOURCE</b>	Selectable, internal synthesizer or sample clock input
<b>FREQUENCY RANGE</b>	SCLK Range
<b>OUTPUT AMPLITUDE</b>	0.5V to 1V depending on SCLK
<b>IMPEDANCE</b>	50Ω (nom), AC coupled
<b>CONNECTOR</b>	SMA

(1) A sequence is defined as a continuous and looped series of tasks

(2) A scenario is defined as a continuous series of tasks/sequences

(3) SCLK=Max sample rate, amplitude = 400mVpp, Direct mode, measured using balun

(4) SCLK=Max sample rate, amplitude = 400mVpp, excluding SCLK/2-fout, measured using balun

(5) Double into open impedance

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SYNC CLOCK OUTPUT	
AMPLITUDE	500mVpp, typ.
FREQUENCY Standard x1 Mode	SCLK/8 SCLK/32
WAVEFORM	Square
RISE/FALL TIME (20% TO 80%)	<150ps
IMPEDANCE	LVC MOS
CONNECTOR	SMP

REFERENCE CLOCK OUTPUT	
SOURCE	Internal TCXO
WAVEFORM	Square
FREQUENCY	100MHz or REF IN
STABILITY	+/- 2.5 PPM
AGING	+/- 1 PPM @ +25°C (per year)
CONNECTOR	SMP

MARKER OUTPUTS	
NUMBER OF MARKERS	8
OUTPUT TYPE	Single Ended
OUTPUT IMPEDANCE	50Ω (nom)
AMPLITUDE	
VOLTAGE WINDOW	±1.15V
RESOLUTION	10mVpp
ACCURACY	±7%
OFFSET	
RANGE	±0.5V
RESOLUTION	10mV
ACCURACY	±(3% of setting+1% of amp ±15 mV)
RISE/FALL TIME (20% TO 80%)	<200ps
MARKER LENGHT	0 - waveform length
RESOLUTION Standard x1 Mode	2 pts 8 pts
MARKER DELAY	
COARSE DELAY	
RANGE	0 to 2048 points
RESOLUTION Standard x1 Mode	8 points 32 points
FINE DELAY	
RANGE	0 to 1.2ns
RESOLUTION	1ps
ACCURACY	15ps
CONNECTOR TYPE	SMP

DIGITIZER CHARACTERISTICS (AWT OPTION)	
NUMBER OF CHANNELS	1 or 2
INPUT VOLTAGE RANGE	500 mVpp (full scale)
INPUT VOLTAGE OFFSET	-2V to +2V
INPUT FREQUENCY RANGE	9GHz
RESOLUTION	12 bits
ACQUISITION MEMORY	Up to max. arbitrary memory
SAMPLE CLOCK SOURCES	Internal or external
INTERNAL CLOCK SOURCE	Internal, external reference
MAX SAMPLING RATE	5.4GS/s in Single channel mode 2.7Gs/s in Dual channel mode
MIN SAMPLING RATE	800MS/s
CLOCK ACCURACY	<2 ppm
IMPEDANCE	50Ω
COUPLING	DC or AC (factory configured)
CONNECTOR	SMA
TRIGGER SYSTEM	
TRIGGER MODES	Positive, negative edge
TRIGGER SOURCES	External, Software, Channel
COUPLING	DC
IMPEDANCE	50Ω (nominal)
LEVEL RANGE	>± 2.5 V (nominal)
FREQUENCY RANGE	DC to 65MHz
CONNECTOR	SMA

TRIGGER INPUTS	
RANGE	-5 V to +5 V
THRESHOLD	±5 V
RESOLUTION	100 mV
SENSITIVITY	200 mV
JITTER Standard x1 Mode Low Trigger Jitter Opt.	8 SCLK periods 32 SCLK periods SQRT(SCLK period <sup>2</sup> + 150e-12 <sup>2</sup> )
LATENCY / SYSTEM DELAY Standard x1 Mode	<900SCLK periods <2700 SCLK Periods
POLARITY	Pos or Neg
SOURCE	Selectable between channels
INPUT IMPEDANCE	10 kΩ or 50Ω (nom), DC coupled, factory configured
MAX TOGGLE FREQUENCY	10MHz (50MHz optional)
MINIMUM PULSE WIDTH	50ns (5ns optional)
CONNECTOR TYPE	SMP

REFERENCE CLOCK INPUT	
INPUT FREQUENCIES	10MHz / 100MHz selectable
LOCK RANGE	± 1MHz
INPUT LEVEL	0.6 Vp-p to 1.7 Vp-p
IMPEDANCE	50Ω, AC coupled (nom)
CONNECTOR TYPE	SMP

SAMPLE CLOCK INPUT	
FREQUENCY RANGE	SCLK Range
INPUT LEVEL RANGE	0.4Vpp to 1.2Vpp
DAMAGE LEVEL	<-0.5V or >1.5V
INPUT IMPEDANCE	50Ω nom, AC coupled
CONNECTOR TYPE	SMA

FAST SEGMENT DYNAMIC CONTROL INPUT (OPTIONAL)	
INPUT SIGNALS	Data 6 bit, Channel select 2 bit, Valid 1 bit
SEGMENTS / SEQUENCES	64 fast
DATA RATE	35MHz
MINIMUM LATENCY (Dynamic control input to direct out)	
FAST SEGMENT	<250ns
NORMAL SEGMENT	<1μ
INPUT LEVEL	LVTTTL
CONNECTOR	D-SUB 9-Pin

DIGITAL UPCONVERTER	
MODES	NCO / Interpolation / IQ Modulation
SAMPLING RATE	1GS/s to Max sample rate
CARRIER FREQUENCY	
RANGE	0 to 40% of Sampling rate
RESOLUTION	48 bit
PHASE RANGE	0 to 360°
PHASE RESOLUTION	16 bit
INTERPOLATION FACTORS	x2, x4, x8
IQ FORMAT	<u>x2 Mode</u> <u>x4 Mode</u> <u>x8 Mode</u>
IQ PAIR PER CHANNEL	1   1   1 or 2
MAX INPUT RATE	2,500MS/s   2,250MS/s   1,125MS/s
NUMBER OF CHANNEL	2   2   4
SFDR AND HARMONICS	Same as Arbitrary
MEMORY	Same as Arbitrary

FPGA PROGRAMMING	
FPGA TYPE	Xilinx Kintex UltraScale XCKU060 upgradeable to XCKU115
MODES	
STANDARD	Tabor standard built-In functionality
SHELL	Open core providing all interfaces and configuration path to the user

GENERAL	
INPUT VOLTAGE RANGE	100 VAC to 264 VAC
INPUT FREQUENCY RANGE	47Hz to 63Hz
Interface:	PXle Gen3 x8 Lanes
Power Consumption:	50W max per slot
Current Consumption:	+3.3V 4A max. +12V 4A max.
Dimensions:	Base – 8HP PXle (2 Slots) AWT/MRK Opt. add 4HP ea.
Weight: Without Package Shipping Weight Approx.	Approx. 1 kg 1.5 kg
Temperature: Operating Storage	0°C to +40°C -40°C to +70°C
Warm up time:	15 minutes
Humidity:	85% RH, non-condensing
Safety:	CE Marked, EC61010-1:2010
EMC:	IEC 61326-1:2013
Calibration:	2 years
Warranty*:	3 year standard * 1 year standard in India

ORDERING INFORMATION	
MODEL	DESCRIPTION
P9482M	9GS/s 16Bit 8GS Mem 2CH 8 Markers RF AWG Module
P9484M	9GS/s 16Bit 8GS Mem 4CH 8 Markers RF AWG Module

OPTIONS	
DC1	DC output for IQ baseband applications for model P9482M
DC2	DC output for IQ baseband applications for model P9484M
DJ1	Dynamic Jump Input option for model P9482M
DJ2	Dynamic Jump Input option for model P9484M
MRK1	x8 Extra Markers option for model P9482M
MRK2	x8 Extra Markers option for model P9484M
LTJ1	Ultra Low Trigger Jitter (200ps typ.) option for model P9482M
LTJ2	Ultra Low Trigger Jitter (200ps typ.) option for model P9484M
G1	Low Waveform Granularity option for models P9482M
G2	Low Waveform Granularity option for model P9484M
TRG	Faster trigger input (50MHz instead of 10MHz)
AWT	5.4GS/s Single, 2.7GS/s Dual Channel 12 Bit Digitizer option for models P9482M and P9484M
STM	Streaming option
FPGA PROG	High level FPGA programming capability through desicion blocks of built-in Demodulation & digital Filters
Shell Core	Programmable FPGA with open core for user embedded IP

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