# PROTEUS

Infinite possibilities

## Benchtop Platform

Introducing Tabor's all new Proteus series, the world's first Arbitrary Waveform Transceiver. In its benchtop platform, with a 9" touch display and on-board PC the system integrates the ability to transmit, receive and perform digital signal processing all in a single instrument. The fully standalone operated system, offers industry leading performance, various configuration options, an innovative task oriented programming, and user programmable FPGA. So whether it is for high-en aerospace and defense, telecommunications, automotive, medical or d physics applications Proteus opens the door to a world of infinite possibilities.

## Leading Features:

Dual, four, eight or twelve channel 1.25GS/s & 2.5 GS/s 16 bit, or dual, four or six channel 9GS/s 8 bit, AWG & AWT configurations

Integrated NCO for digital up-converting to microwave frequencies

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

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

Excellent phase noise and spurious performance

User Customizable DSP block for real time processing and application specific functionality

Standalone 4U, 19" wide benchtop platform, with 9" touch display, USB 3.0, 10G Ethernet and Thunderbolt high speed interfaces

Up to 16GS waveform memory with the ability to simultaneously generate and download waveforms.

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## Standalone and easy to use

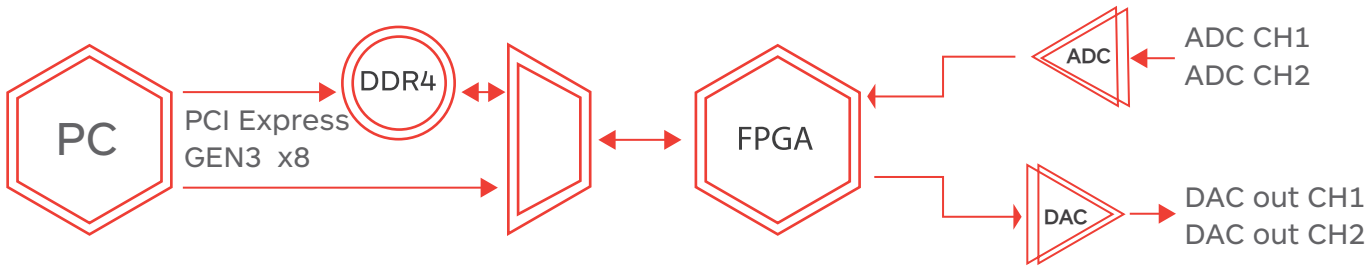
The benchtop version of the Proteus series offers up to 12 channels in a 4U, 19" benchtop box. With a 9" touch display and on-board PC the benchtop platform enables users to program the instrument without the need of an external PC. Users can program the instrument from the on-board PC using various programming environments such as MATLAB, LabView, Python and more. So for synchronized, phase coherent, multi-channel applications such as quantum physics and radar applications the Proteus arbitrary waveform transceiver is an ideal, high performance and cost effective solution.

## Ultra-fast data transfer rates

Spending more time setting up your generated scenario than actually running it? The Proteus Benchtop platform utilizes PCI express Gen 3 x4 lanes connection that enables up to 32Gb/s of data transfer speed. This enable the Proteus arbitrary waveform transceiver to offer the fastest waveform download available on the market today, saving you one of your most valuable resources, time.

## Feedback control system

Many of today's applications, require conditional waveform generation depending on input signals from the environment. The Proteus arbitrary waveform transceiver flawlessly 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 on the fly with minimum latency.




## Generate any imaginable scenario

The new series offers an innovative task oriented sequence programming where user can change the full instrument set up at every line of the task table. In addition, not only can users of the Proteus series instruments generate and download waveforms simultaneously, they can stream data directly to the FPGA without the need to use the built in memory. This enables generating random, unique and infinitely long scenarios directly from the controlling PC at DAC speeds of up to 3GS/s. So no matter whether your scenario is extremely complex, infinite or even dynamic you can generate it with the Proteus series model.

| CHANNELS CHARACTERISTICS | P9082/4/6B | P2582/4/8/12B | P1282/4/8/12B |
|---|---|---|---|
| **NUMBER OF CHANNELS** | 2/4/6 | 2/4/8/12 | 2/4/8/12 |
| **INITIAL SKEW** | <20ps | | |
| **FINE DELAY** | | | |
| RANGE | 0 to 5 ns | | |
| RESOLUTION | 5ps | | |
| ACCURACY | ±5ps | | |
| **COARSE DELAY** | | | |
| RANGE | 0 to wavelength | | |
| RESOLUTION | 1 sample point | | |

| ARBITRARY MODE | P9082/4/6B | P2582/4/8/12B | P1282/4/8/12B |
|---|---|---|---|
| **MAX. SAMPLE RATE** | 9GS/s | 2.5GS/s | 1.25GS/s |
| **RESOLUTION** | 8-bit | 16-bit | |
| **MAX. MEMORY SIZE** | Up to 16GS | Up to 8GS | |
| **NUMBER OF SEGMENTS** | 64k | | |
| **MINIMUM SEGMENT LENGTH**<br>NORMAL<br>FAST SEGMENT | 2048 points<br>224 points | 1024 points<br>64 points | |
| **WAVEFORM GRANULARITY**<br>STANDARD<br>OPTIONAL | 64 points<br>32 points | 32 points<br>16 points | 32 points<br>16 points |

| TASK MODE | |
|---|---|
| **TASK TABLE LENGTH** | 64K tasks per channel |
| **TASK LOOPS** | 1M |
| **SEQUENCE** | A sequence is defined as a continuous and looped series of tasks |
| **MAX. NUMBER OF SEQUENCES** | 32K sequences |
| **SEQUENCE LOOPS** | 1M |
| **SCENARIO** | A scenario is defined as a continuous series of tasks/sequences |
| **MAX. NUMBER OF SCENARIOS** | 1K scenarios |

| STREAMING (STM OPTION) | |
|---|---|
| **MAX. STREAM RATE** | 3GS/s |
| **MINIMUM PC REQUIREMENTS** | |
| CPU | i7 |
| MEMORY | 32GB |
| OPERATING SYSTEM | WINDOWS 10 IoT |
| **SOURCE** | Internal / Rear panel interfaces |

| SIGNAL PURITY | DC OUTPUT | DIRECT OUTPUT |
|---|---|---|
| **HARMONIC DISTORTION** [2] | | |
| fout = 10 MHz - 200 MHz, Measured @ DC to 2 GHz | <-70 dBc (typ.) | <-70 dBc (typ.) |
| fout = 200 MHz ... 1.5 GHz, Measured @ DC to 4.5 GHz | <-60 dBc (typ.) | <-60 dBc (typ.) |
| fout = 1.5 GHz ... 4.5 GHz, Measured @ DC to 4.5 GHz | <-50 dBc (typ.) | <-50 dBc (typ.) |
| **SFDR** [3] | | |
| fout = 10 MHz...500 MHz, Measured @ DC to 1.5 GHz | -80 dBc (typ) | <-85 dBc (typ) |
| fout = 500 MHz...4.5 GHz , Measured @ DC to 4.5 GHz | -70 dBc (typ) | <-75 dBc (typ) |
| **PHASE NOISE (@10kHz offset)** | | |
| fout = 140.625MHz | -134 dBc/Hz | |
| fout = 280.25MHz | -128 dBc/Hz | |
| fout = 562.5MHz | -122 dBc/Hz | |
| fout = 1.125GHz | -116 dBc/Hz | |
| fout = 2.25GHz | -110 dBc/Hz | |
| fout = 4.5GHz | -104 dBc/Hz | |

[1] Max input data rate is 2.5GS/s. Max. interpolating sample rate is 9GS/s
[2] SCLK=Max sample rate, amplitude = 400mVpp, Direct mode, measured using balun
[3] SCLK=Max sample rate, amplitude = 400mVpp, excluding SCLK/2-fout, measured using balun

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| DC OUTPUT | |
|---|---|
| OUTPUT TYPE | Single-ended or differential, DC-coupled |
| IMPEDANCE | 50Ω (nom) |
| AMPLITUDE | 50 mVp-p to 1.3 Vp-p |
| AMPLITUDE RESOLUTION | 1mV |
| DC AMPLITUDE ACCURACY | ±(3% of amplitude ±2 mV) |
| VOLTAGE WINDOW | ±1.15V |
| DC OFFSET | ±0.5V |
| OFFSET RESOLUTION | 10mV |
| DC OFFSET ACCURACY | ±(3% of setting ±15 mV) |
| SKEW BETWEEN NORMAL AND COMPLEMENT OUTPUTS | 0ps |
| RISE/FALL TIME (20% TO 80%) | < 130 ps (typ) |
| INSTANTANEOUS BANDWIDTH<br>P128xB \| P258xB \| P908xB | <br>625MHz \| 1.25GHz \| 4.5GHz |
| MAX. USABLE FREQUENCY<br>P128xB \| P258xB \| P908xB | 2nd Nyquist<br>1.25GHz \| 2.5GHz \| 4.5GHz |
| JITTER (PEAK-PEAK) | <15 ps (typ) |
| OVERSHOOT | <5% (typ) |
| CONNECTOR TYPE | SMA |

| DIRECT OUTPUT (OPTIONAL) | |
|---|---|
| OUTPUT TYPE | Single-ended or differential, AC coupled |
| IMPEDANCE | 50Ω (nom) |
| AMPLITUDE | 1mVpp to 550mVpp |
| AMPLITUDE RESOLUTION | 1mV |
| AMPLITUDE ACCURACY | ±(3% of amplitude ±2 mV) |
| RISE/FALL TIME (20% TO 80%) | < 60 ps (typ) |
| INSTANTANEOUS BANDWIDTH<br>P128xB \| P258xB \| P908xB | <br>625MHz \| 1.25GHz \| 4.5GHz |
| MAX. USABLE FREQUENCY<br>P128xB \| P258xB \| P908xB | 2nd Nyquist<br>1.25GHz \| 2.5GHz \| 8GHz |
| CONNECTOR TYPE | SMA |

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

| SYNC CLOCK OUTPUT | |
|---|---|
| AMPLITUDE | 500mVpp, typ. |
| FREQUENCY<br>P908xB<br>P128xB, P258xB | <br>SCLK/32<br>SCLK/8 |

| SYNC CLOCK OUTPUT (Continued) | |
|---|---|
| WAVEFORM | Square |
| RISE/FALL TIME (20% TO 80%) | <150ps |
| IMPEDANCE | LVCMOS |
| CONNECTOR | SMP |

| MARKER OUTPUTS | |
|---|---|
| NUMBER OF MARKERS<br>P1282B, P1284B<br>P1288,P2582,P2584, P9082B<br>P12812B<br>P2588B, P9084B<br>P25812B, P9086B | <br>4<br>8<br>12<br>16<br>24 |
| OUTPUT TYPE | Single Ended |
| OUTPUT IMPEDANCE | 50Ω (nom) |
| AMPLITUDE | |
| VOLTAGE WINDOW | ±1.15V |
| LEVEL | 32mVpp to 1.2Vpp (32 discrete levels) |
| RESOLUTION | 10mVpp |
| ACCURACY | ±7% |
| OFFSET | |
| RANGE | ±0.5V |
| RESOLUTION | 10mV |
| ACCURACY | ±(3% of setting ±15 mV) |
| RISE/FALL TIME (20% TO 80%) | <200ps |
| RANGE | 0 - waveform length |
| RESOLUTION<br>P128xB, P258xB<br>P908xB | <br>2 pts<br>8 pts |
| MARKER DELAY | |
| COARSE DELAY | |
| RANGE | 0 to 2048 points |
| RESOLUTION<br>P128xB, P258xB<br>P908xB | <br>8 points<br>32 points |
| FINE DELAY | |
| RANGE | 0 to 1.2ns |
| RESOLUTION | 1ps |
| ACCURACY | 15ps |
| CONNECTOR TYPE | 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 |

| 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 POEVEL RANGE** | 0.4Vpp to 1.2Vpp |
| **DAMAGE LEVEL** | <-0.5V or >1.5V |
| **INPUT IMPEDANCE** | 50Ω nom, AC coupled |
| **CONNECTOR TYPE** | SMA |

| TRIGGER INPUTS | |
|---|---|
| **RANGE** | –5 V to +5 V |
| **THRESHOLD** | ±5 V |
| **RESOLUTION** | 100 mV |
| **SENSITIVITY** | 200 mV |
| **JITTER**<br>Standard<br>P128xB, P258xB<br>P908xB<br>Low Trigger Jitter Opt. | <br><br>8 SCLK periods<br>32 SCLK periods<br>SQRT(SCLK period^2 + 150e-12^2) |
| **LATENCY / SYSTEM DELAY**<br>P128xB, P258xB<br>P908xB | <br><900SCLK periods<br><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 |

| FAST SEGMENT DYNAMIC CONTROL INPUT (OPTIONAL) | |
|---|---|
| **INPUT SIGNALS** | Data 6bit, 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** | LVTTL |
| **CONNECTOR** | D-SUB, 9 pin |

| 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 8GS |
| **SAMPLE CLOCK SOURCES** | Internal or external |
| **INTERNAL CLOCK SOURCE** | Internal, external reference |
| **MAX SAMPLING RATE** | 5.4GS/s in Single channel mode<br>2.7Gs/s in Dual channel mode |
| **MIN SAMPLING RATE** | 1GS/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 |

| FPGA PROGRAMMING | |
|---|---|
| **FPGA TYPE** | Xilinx Kintex UltraScale XCKU060 upgradeable to XCKU115 |
| **MODES** | |
| STANDARD | Tabor standard built-In functionality |
| DECISION BLOCKS | Built-in library of mathematical functions, modulation & digital Filters |
| SHELL | Open core providing all interfaces and configuration path to the user |

| DIGITAL UPCONVERTER | |
|---|---|
| **MODES**<br>P258X<br>ALL OTHERS MODELS | <br>NCO / Interpolation / IQModulation<br>NCO only |
| **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**<br>IQ PAIR PER CHANNEL<br>MAX INPUT RATE<br>NUMBER OF CHANNEL | x2 Mode<br>1<br>1,250MS/s<br>2 |
| **SFDR AND HARMONICS** | Same as Arbitrary |
| **MEMORY** | Same as Arbitrary |

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| GENERAL | |
|---|---|
| **VOLTAGE RANGE:** | 100 VAC to 264 VAC |
| **FREQUENCY RANGE:** | 47Hz to 63Hz |
| **POWER CONSUMPTION:** | 550W max. |
| **INTERFACE:**<br>USB<br><br><br>Thunderbolt (Optional)<br>LAN (BASE-T)<br>SFP+ (Optional, Replaces RJ45)<br>GPIB (Optional) | <br>1 x front panel USB host (type A)<br>2 x rear panel USB host, (type A)<br>1 x rear panel USB Device (type C)<br>1 x rear panel Thunderbolt3<br>1 x rear panel RJ45 1000/100/10<br>1 x rear panel SFP+ 10G Optical<br>IEEE 488.2 – GPIB |
| **STORAGE** | 120GB removable |
| **WEIGHT**<br>Without Package<br>Shipping Weight | <br>7.5 kg<br>9 kg |
| **DIMENSIONS:**<br>With feet<br>Without feet | <br>440 X 175 x 330 mm (W x H x D)<br>440 X 190 x 330 mm (W x H x D) |
| **TEMPERATURE:**<br>Operating<br>Storage<br>Warm up time | <br>0°C to +40°C<br>-40°C to +70°C<br>15 minutes |
| **HUMIDITY:** | 85% RH, non-condensing |
| **SAFETY:** | CE Marked, EC61010-1:2010 |
| **EMC:** | IEC 61326-1:2013 |
| **CALIBRATION:** | 2 years |
| **WARRANTY:** | 1 or 3 year warranty plan |

| ORDERING INFORMATION | |
|---|---|
| **MODEL** | **DESCRIPTION** |
| P1282B | 1.25GS/s, 16Bit, AWG, 1GS Memory, 2CH, 4 Markers |
| P1284B | 1.25GS/s, 16Bit, AWG, 1GS Memory, 4CH, 4 Markers |
| P1288B | 1.25GS/s, 16Bit, 2GS Memory, 8CH 8 Markers |
| P12812B | 1.25GS/s, 16Bit, 2GS Memory, 12CH 12 Markers |
| P2582B | 2.5GS/s, 16Bit, 2GS Memory 2CH, 8 Markers |
| P2584B | 2.5GS/s, 16Bit, 2GS Memory, 4CH, 8 Markers |
| P2588B | 2.5GS/s, 16Bit, 2GS Memory, 8CH 16 Markers |
| P25812B | 2.5GS/s, 16Bit, 2GS Memory, 12CH, 24 Markers |
| P9082B | 9GS/s, 16Bit, 4GS Memory 2CH, 8 Markers |
| P9084B | 9GS/s, 16Bit, 4GS Memory 4CH, 16 Markers |
| P9086B | 9GS/s, 16Bit, 4GS Memory 6CH, 24 Markers |

| OPTIONS | |
|---|---|
| 4M1 | 4GS Memory option for models P1282B & P2582B |
| 4M2 | 4GS Memory option for models P1284B & P2584B |
| 4M3 | 4GS Memory option for models P1288B, P2588B & P9084B |
| 4M4 | 4GS Memory option for models P12812B, P25812B & P9086B |
| 8M1 | 8GS Memory option for models P1282B & P2582B |
| 8M2 | 8GS Memory option for models P1284B, P2584B & P9082B |
| 8M3 | 8GS Memory option for models P1288B, P2588B & P9084B |
| 8M4 | 8GS Memory option for models P12812B, P25812B & P9086B |

| OPTIONS (Continued) | |
|---|---|
| 16M1 | 16GS Memory option for models P9082B |
| 16M2 | 16GS Memory option for models P9084B |
| 16M3 | 16GS Memory option for models P9086B |
| DO1 | 9GHz BW Direct Output option for models P1282B & P2582B |
| DO2 | 9GHz BW Direct Output option for models Pxx84B & P9082B |
| DO3 | 9GHz BW Direct Output option for models Pxx88B & P9084B |
| DO4 | 9GHz BW Direct Output option for models Pxx812B & P9086B |
| DJ1 | Dynamic Jump Input option for models P1282B & P2582B |
| DJ2 | Dynamic Jump Input option for P1284B, P2584B & P9082B |
| DJ3 | Dynamic Jump Input option for P1288B, P2588B & P9084B |
| IM1 | Interpolation Mode option for P258B (x2 and x4) |
| IM2 | Interpolation Mode option for P908B (x2, x4 and x8) |
| MRK1 | x8 Extra Markers option for models P1282B & P2582B |
| MRK2 | x8 Extra Markers option for models P1284B, P2584B & P9082B |
| MRK3 | x16 Extra Markers option for models P1288B, P2588B & P9084B |
| LTJ1 | Ultra Low Trigger Jitter (200ps typ.) option for models P1282B & P2582B |
| LTJ2 | Ultra Low Trigger Jitter (200ps typ.) option for models P1284B, P2584B & P9082B |
| LTJ3 | Ultra Low Trigger Jitter (200ps typ.) option for models P1288B, P2588B & P9084B |
| LTJ4 | Ultra Low Trigger Jitter (200ps typ.) option for models P12812B, P25812B & P9086B |
| G1 | Low Waveform Granularity option for models P1282B & P2582B |
| G2 | Low Waveform Granularity option for P1284B, P2584B & P9082B |
| G3 | Low Waveform Granularity option for P1288B, P2588B & P9084B |
| G4 | Low Waveform Granularity option for P12812B, P25812B & P9086B |
| AWT | 5.4GS/s Single, 2.7GS/s Dual Channel 12 Bit Digitizer option for models P1284B, P1288B, P2584B, P2588B, P9082B & P9084B |
| STM | 3GS/s Streaming option |
| DUC | Digital UpConverter for models P2582B, P2584B, P2588B & P25812B |
| SEC | Removable SSD option for security needs for all models |
| SSD | Extra Factory Duplicated Solid State Drive (SSD) for option SEC |
| TRG | Faster trigger input (50MHz instead of 10MHz) |
| PROG | High level FPGA programming capability through decision blocks of built-in Demodulation & digital Filters |
| Shell | Programmable FPGA with open core for user embedded IP |
| TBolt | Rear panel Thunderbolt3 USB (type C) |
| SFP+ | Rear panel 10G optical SFP+ connectivity (replace the LAN) |