Note: No guarantee is made that information relating to non-Narwhal Devices instruments in this document is accurate. Please refer to the manufacturer to confirm any specifications.

	PB24-100-4k-PCI	PB24-100-4k-USB-RM	PBESR-PRO-500	PBESR-PRO-250-USB-RM	Narwhal Devices *Pulse Generator*
Price	$1525	$3495	$3985	$4485	$500
Interface	PCI	USB	PCI	USB	USB
Channels	24	24	21	21	24
Channels with BNC connectors	0	24	4	21	24
Clock frequency (Cycle period)	100MHz (10ns)	100MHz (10ns)	500MHz (2ns)	250MHz (4ns)	100MHz (10ns)
Minimum pulse length (cycles)	50ns (5 cycles)	50ns (5 cycles)	2ns (1 cycle)[note1]	4ns (1 cycle)[note1]	10ns (1 cycle)
Pulse length resolution (cycles)	10ns (1 cycle)	10ns (1 cycle)	2ns (1 cycle)	4ns (1 cycle)	10ns (1 cycle)
Minimum time between instructions (cycles)	50ns (5 cycles)	50ns (5 cycles)	10-14ns (5-7 cycles) [note2]	20ns (5 cycles)	10ns (1 cycle)
Total instruction capacity	4096 [note3]	4096	4096	4096	8192

	PB24-100-4k-PCI	PB24-100-4k-USB-RM	PBESR-PRO-500	PBESR-PRO-250-USB-RM	Narwhal Devices *Pulse Generator*
Delay counter (bits/ max. val/max. time)	32bits/~4billion/**42 seconds** [note4] 52bits/ ~4quadrillion/ 521days	32bits/~4billion/**42 seconds** [note4] 52bits/ ~4quadrillion/ 521days	32bits/~4billion/**8.5 seconds** [note4] 52bits/ ~4quadrillion/ 104days	32bits/~4billion/**17 seconds** [note4] 52bits/ ~4quadrillion/ 208days	48bits/~280trillion/ **32days**
Max. loops in an instruction (bits/ number)	20bits/~1million	20bits/~1million	20bits/~1million	20bits/~1million	32bits/~4billion
Max. number of nested loops	8	8	8	8	8192
Max triggering frequency	5MHz	5MHz	15MHz	10MHz	33MHz (every 3cycles)
Trigger latency	80ns (8 cycles)	80ns (8 cycles)	16ns (8 cycles)	32ns (8 cycles)	20ns (2 cycles)
"Stop and wait for trigger" tag on instructions?	Yes	Yes	Yes	Yes	Yes
Can sync to external reference clock?	Yes, 50MHz. [note5,6]	Yes, 50MHz. [note5] Custom frequencies may be available on request.	Yes, 50MHz. [note5,6]	Yes, 50MHz. [note5]	Yes. 10MHz. No conditioning required. Custom frequencies available on request.
Can sync to AC mains power?	No	No	No	No	Yes. Both for main trigger, and individual instructions.
Output termination	Unterminated	"impedance matched to 50 ohm" [note7]	Unterminated	"impedance matched to 50 ohm" [note7]	Series terminated at source.
Output Low voltage	0V	0V	0V	0V	0V

	PB24-100-4k-PCI	PB24-100-4k-USB-RM	PBESR-PRO-500	PBESR-PRO-250-USB-RM	Narwhal Devices *Pulse Generator*
Output High voltage into high impedance load	3.3V[note8]	3.3V[note7]	3.3V[note8]	3.3V[note7]	3.3V Clean signal - minimal reflections.
Output High voltage into 50Ω load	2.5V	2.5V	2.5V	2.5V	1.5V
Prebuilt interface options	• C/C++ library • Callable DLL • Labview • Basic GUI	• C/C++ library • Callable DLL • Labview • Basic GUI	• C/C++ library • Callable DLL • Labview • Basic GUI	• C/C++ library • Callable DLL • Labview • Basic GUI	• Python library

[note1]: Requires use of "Short Pulse Feature". All active channels must share this pulse profile. A new instruction can only be executed every 5 cycles, but within one instruction pulses can be generated down to 1 cycle in length.

[note2] A new instruction can only be executed every 7 cycles for most PBESR-PRO-500 instructions.

[note3] Up to 64,000 available. Other performance is reduced.

[note4] Requires use of "Long delay" feature. This may double the minimum pulse length (eg. 50ns→ 100ns) and pulse resolution (eg. 10ns→ 20ns). But this is not totally clear.

[note5] Requires signal conditioning. ie, must be square, positive only 3.3V @ 50MHz.

[note6] Requires removal of internal crystal oscillator.

[note7] Termination type is not clear, but source termination seems unlikely. May result in reflections if not 50Ω terminated at end of line (which drags down voltage), possibly leading to very unclean signals when switching.

[note8] Will result in reflections, possibly leading to very unclean signals when switching.

Narwhal Devices - *Pulse Generator* other features

- Single run, continuous re-run, and static modes.
- Device can signal host computer when a run is completed, and on any instruction as desired.
- Software triggering, hardware triggering, or both.
- Both input and output reference clock ports for easy synchronisation of lab devices.
- Output trigger delay and duration configurable.
- Hardware and software "enable" can pause and resume run at any time.
- Communication by USB is treated as a Virtual Com Port (looks like a serial port form the users point of view). Easy communication using Windows, Linux and MacOS. (Using MacOS requires reduced data rate due to current driver issues. Pulse generator firmware must be swapped to achieve this.)
- Fully load all 8192 instructions in only 125ms.

Note that the mains power IEC connector is for synchronisation to mains AC line only. Power is provided by the USB type-C port at the front of device.