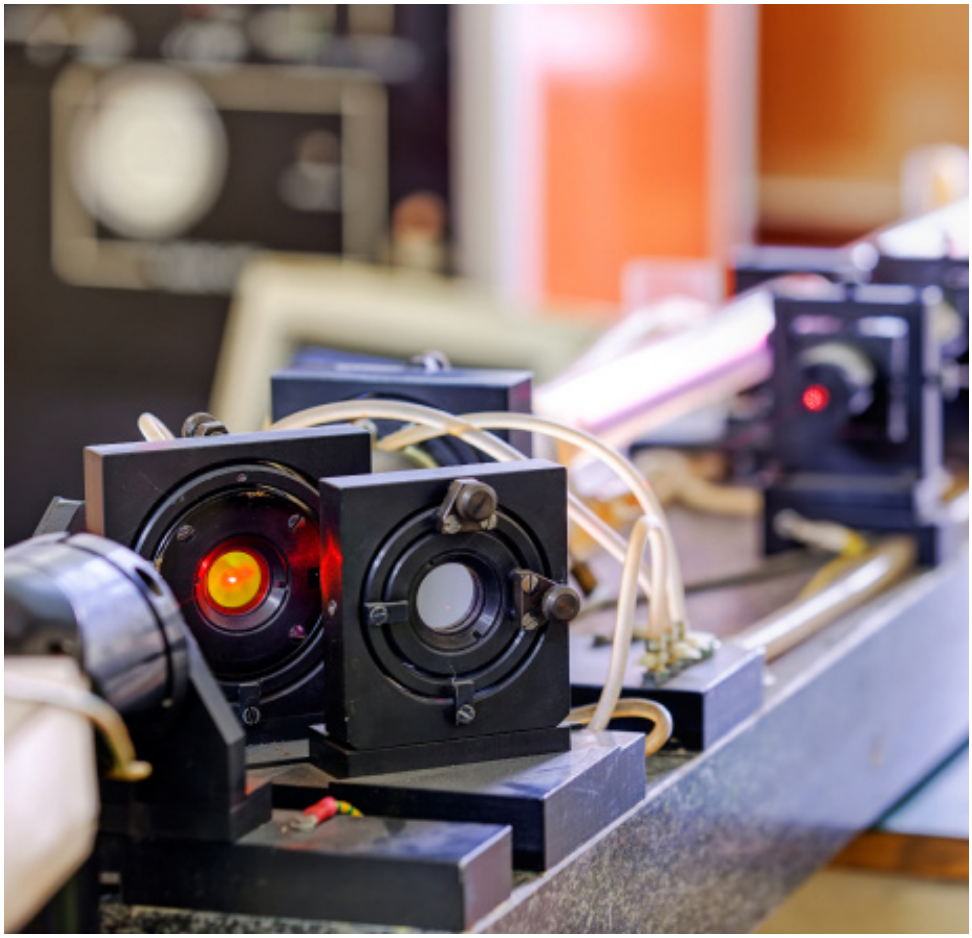
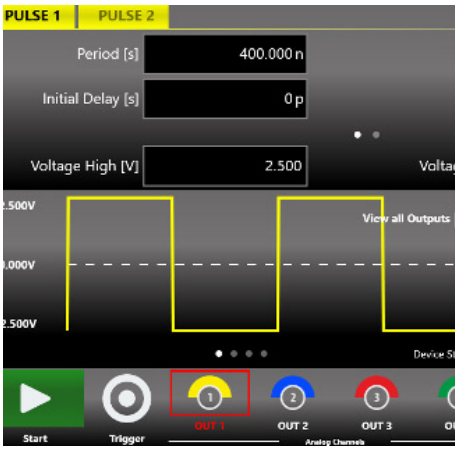
Model 765 Fast Rise Time Pulse Generator





Features of the 765:

- 70 ps Rise (Tr) and Fall (Tf) Times
- +/- 5.0 Volts pk-pk
- Delay and Width Resolution of 10 ps
- Narrow Widths (300ns)
- Jitter < 25 ps
- Complete Channel Multiplex
- Get Started in 5 Minutes with Easy GUI and Gestures

Applications of the 765:

- Big physics applications
- Experiments colliders
- Lasers modulation
- Radar and sonar systems
- Semiconductors tests

Model 765

Fast Rise Time Pulse Generator

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Model 765

Description

The Model 765 Pulse Generator is feature-rich pulse and delay generator with 2 or 4 channels of completely programmable pulse and delay generation. The instrument offers many improvements over our previous design – faster transition times, narrow pulses, broader and more accurate amplitude control and a redesigned user interface. Take control of your time and amplitude domain!

Intuitive User Interface

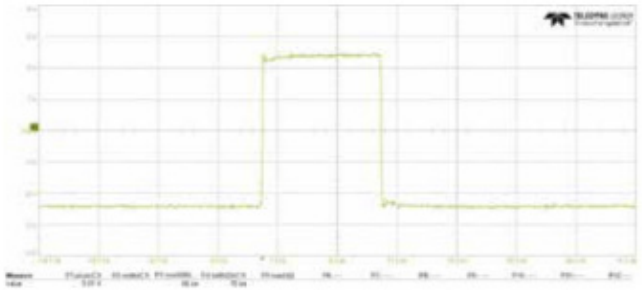
The front panel controls for the Model 765 Pulse Generator include a 7” touchscreen and tactile controls for most operations. The touchscreen was designed to drive simplicity in operating and programming by giving users smartphone-like architecture complete with gesture control. The primary channel controls and programming options are easy to navigate, with a swipe gesture to move from channel to channel. Handy features like combining multiple pulses on one output can be graphically controlled and are easily identified on the screen. In addition, a rotary encoder and backlit pushbuttons provide an alternative yet familiar experience to users needing front panel controls.

Rotary Encoder: The Model 765 front panel encoder is ideal for fine tuning pulse parameters on the fly. Dialing the encoder will change the value in continuous, analog fashion. Pushing the encoder in will move the value adjustment from fine to coarse adjust, further simplifying setup and ‘on-the-fly’ adjustments.

Fast Rise Times and Plenty of Range

The Model 765 offers 70ps Rise and Fall times (@ 5.0V pk-pk) over a large time domain. Our front end electronics circuit and new analog edge convertor have been integrated into the pulse generator using a proprietary technology that virtually eliminates overshoot (<5.0% typical) and ringing. The new design allows for pulse widths as low as 300

Shown right: 70ps Tr @ 5.0V



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Programming

The Model 765 offers several useful remote programming options. In addition, the networking feature allows users to use a VXI-11 LAN protocol to network the instrument for printing, file sharing, internet access and remote login. The remote programming uses common SCPI commands, ensuring compatibility with a wide range of development environments. Visual Studio, .NET, LabView, LabWindows/CVI, Microsoft Visual Studio and MatLab are all supported. Berkeley Nucleonics provides a comprehensive Software Development Kit (SDK) at no additional charge.

Inputs and Outputs

Pulse Out: The Model 765 offers inputs and outputs on the front and rear panel to accommodate users with rackmount or benchtop applications. The Pulse Out connectors are DC Coupled SMA connectors with 50 Ohm impedance and with strain-relief panel mounts. The pulse out settings can be independently positive or negative (0V to +/-5V, adjustable). The following table shows the parameter limits for pulse outputs:

Parameter	Min	Max
Voltage High	-5.0V	+5.0V
Voltage Low	-5.0V	+5.0V
Amplitude	-2.5V	+2.5V
Offest	-2.5V	+2.5V
Width	300 ps	8 sec
Duty Cycle	1%	99%
Period	8 ns	8 sec
Frequency	1.0 Hz	125.0 MHz
Delay	0 sec	8 sec
Burst N	1	4,294,967,295

Table 1: Pulse Out Limits

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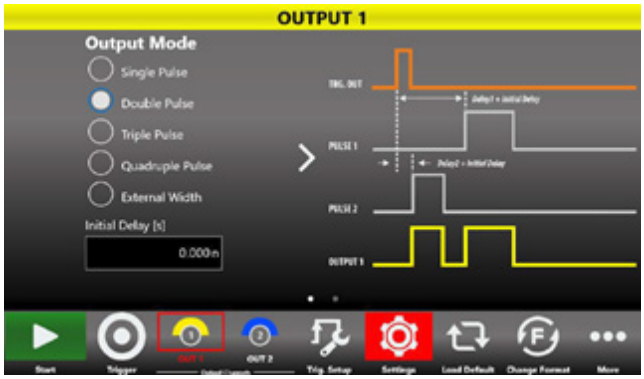
Trigger In / Out: The Model 765 Trigger Input is a SMA connector with a programmable impedance and threshold (50 Ohm / 1k Ohm, -10.0V to +10.0V). The programmable trigger threshold has a resolution of 4mV, ensuring precise triggering. The Model 765 can trigger on signals down to 20 mV and as narrow as 1ns, and a convenient 'Autosense' function will measure the current trigger input level. The Model 765 also measures the Trigger In frequency and displays the result in the Trigger Setup Window. The Trigger Out is a SMA connector with 50 Ohm impedance and an output voltage range of 1.8 V to 3.3 V (open load).

USB: There are 2 handy USB 3.0 Ports on the front panel for auxiliary equipment such as a keyboard, additional storage or other system requirements.

Rear Panel: Additional input and output connectors on the rear panel include PS/2 Mouse and Keyboard connectors, video output connectors (HDMI, DVI, VGA), LAN and Audio.

Pulse Out Multiplex: The Model 765 allows users to combine four digitally programmed pulses on each output. They are logically combined with an "OR" operation to allow complex timing sequences, repetition rates to 500 MHz and double/quad pulse operation. The graphical user interface allows users an easy representation of the outputs on a given channel. Mulitplex up to 4 pulses on a single output channel. A simple example showing different delay and width settings from a common trigger follows:



Shown Above: Output 1 (PULSE1 + PULSE2

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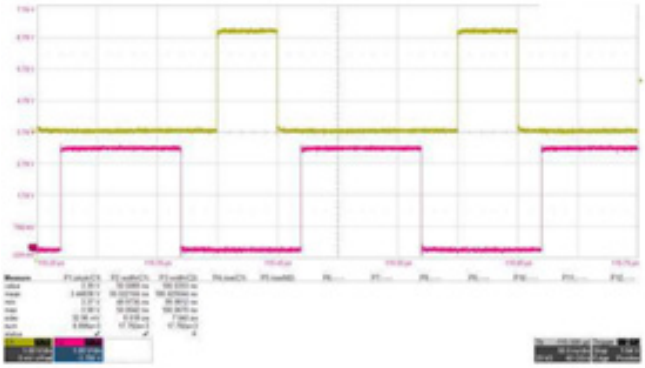
Application Idea – Semiconductor Test

Characterization of Non-Volitile Memory Cells requires very precise pulse control, both in amplitude and time domains. The Model 765, with 10 ps time resolution and 10mV amplitude resolution allows just that. R&D in memory devices is leading to cell types which have the speed of RAM and the data retention of mass memory. Emerging R&D exits in FeRAM (Ferroelectric RAM), ReRAM (Resistive RAM), MRAM (Magnetoresistive RAM), STT-MRAM (Spin-Transfer Torque Magnetoresistive RAM) and PCM (Phase Change Memory). This R&D is based on changing the conductivity of a material using different stimuli principles. Examples include formation and destruction of a thin w ire into a material stack, changing the material structure from amorphous to polycrystalline, alignment of magnetic fields, etc. Accurate front end control in all these processes is critical for successful results. Let's look at testing STT-MRAM.

MRAM memory cells use Magnetic Tunnel Junctions (MTJ) that consist of two ferromagnets separated by a thin insulator. If the magnetic fields of the two ferromagnets are oriented in the same direction, electronics can tunnel from one ferromagnet to the other through the insulator. The first ferromagnet has a fixed magnetic field and the second can be changed by applying a current pulse. Inverting the magnetic field orientation changes the conductivity of the stack. To program or erase a bit, a current pulse is applied through the stack. The efficiency of the program/erase process depends on the duration and amplitude of the pulse, so R&D engineers are testing different combinations of pulse widths and amplitudes (and repetition rates). In the scope trace below, the 50 ns pulse @3.3 V is used to erase a single cell and the 100 ns pulse @3.3V is used to erase an array of cells.



Shown Above: 50ns @ 3.3V, 100ns @ 3.3V

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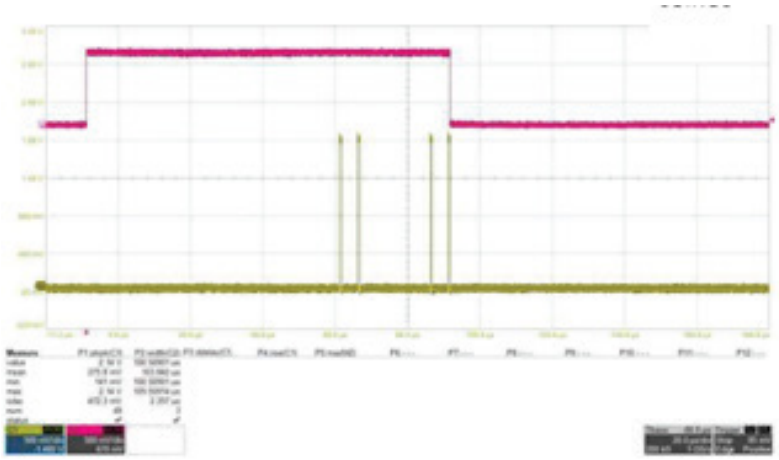
Model 765

Application Idea – Radar

In radar testing, many situations mak e actual target measurements impractical. Simulating moving targets is a solution for expediting the R&D, Calibration and Test of Radar systems. The typical radar system measures the time of flight of the signal and calculates the distance from the target using the following equation:

Distance (km) = (DelayTime (sec) / 2) * 3x105 km/s, where 3x105 km/s is an approximation of the speed of light.

The delay between transmitted and received signals is dependent on distance. In complex systems, multiple targets are detected and the radar system is required to distinguish between various targets. A multi-channel pulse generator is used to test the detection ability of the radar without requiring actual field measurements of moving targets. The Model 765 offers multiplexing, allowing up to 4 pulses with different widths and delays to be generated on a single output. A repetition rate of 125 MHz allows testing the real time frequency capabilities of the radar system. With resolution of 10ps and jitter <25 ps RMS, the pulse generator can verify and calibrate a radar system with resolution under 1 centimeter. Shown below is an example of Quad-Multiplexing, 4 different narrow pulses with unique delays from the Trigger in, simulating the detection of multiple targets.



Shown Above – Quad-Multiplex

Ordering Information

Model 765-2C	2 Channel Pulse Generator
Model 765-4C	4 Channel Pulse Generator
P/N 765-RMKit	19: Rack Mount Kit for the 765-X
P/N 765 SSKit	Solid State Storage Drive Kit for 765-X
P/N 765-X-WAR	3 Year Warrenty Extension for 765-X

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Model 765 Specifications

Specifications	Model 765-2 Channel	Model 765-4 Channel
Number of Analog Channels	2	4
Timing specifications		
Pulse Period Range (spec.) Resolution (spec.) RMS jitter [1] (Integration Range 100 Hz to 10 MHz, Fout = 200 MHz)	5 ns to 8 sec. 10 ps 4 ps	
Pulse Frequency Range (spec.) Accuracy	0.125 Hz to 200 MHz (Single pulse mode) 0.25 Hz to 400 MHz (Double pulse mode) 0.375 Hz to 600 MHz (Triple pulse mode) 0.5 Hz to 800 MHz (Quadruple pulse mode) ± 2 ppm max	
Pulse Width Range (spec.) Resolution (spec.) Accuracy RMS jitter [1]	300 ps to (period – 300 ps) 10 ps ± (0.1 % + 30 ps) < 10 ps	
Pulse Delay (single/double/triple/quadruple) Range (spec.) Resolution (spec.) Accuracy	0 ps to period 10 ps ± (0.1 % + 30 ps)	
Output specifications (50 Ohm load)		
Impedance	50 Ohm nominal	
Amplitude Range pk-pk (spec.) Absolute accuracy (spec.) Resolution (spec.)	10 mVpp to 5 Vpp ± (1% of amplitude pk-pk + 1% o f |DC Offset| + 10 mV) 4 mV (amplitude 250 mVpp to 5Vpp), 1 mV (amplitude 10 mVpp to 250mVpp)	
Baseline DC Offset Range (spec.) Resolution (spec.)	± 2.5V adjustable 2 mV	
Rise/Fall Time (20% to 80%)	< 70 ps	
Rise/Fall Time (10% to 90%)	< 95 ps (1Vpp amplitude), < 105 ps (5Vpp amplitude)	
Overshoot	< 5%	
Channel to Channel RMS Jitter [1]	< 10 ps	
Trigger input specifications		
Impedance	50 Ohm or 1K Ohm programmable	
Range (spec.)	± 3.5 V (50 Ohm input impedance) ± 10 V (1K Ohm input impedance)	
Minimum detectable amplitude (spec.)	< 50 mVpp	

Specifications	Model 765-2 Channel	Model 765-4 Channel
Threshold Range (spec.) Resolution (spec.) Accuracy	± 8V 10 mV ± 100 mV	
Max. input frequency (spec.)	40 MHz	
Min. pulse width (spec.)	1 ns	
Max. external width mode input frequency (spec.)	1 GHz	
Edge selection	Positive, negative, both	
Trigger output specifications		
Impedance	50 Ohm nominal	
Amplitude (open load) Range (spec.) Resolution (spec.) Accuracy	1.8V to 3.3V adjustable 1 mV ± 1%	
Delay (trigger in to trigger out)	< 100 ns	
RMS jitter (trigger in to trigger out)	< 30 ps (Trigger IN Frequency ≤ 15 MHz)	
Width	10 ns (single,burst mode) Period/2 (continuous mode)	
Internal timer		
Time range (Frequency range)	25ns to 42.9 sec (40Mhz to 23.3 mHz)	
Time resolution	1 ps	
Frequency accuracy	± 2ppm max	
External Clock IN		
Connector type	SMA on rear panel	
Input Impedance	50 Ω,AC Coupled	
Input voltage range	-5 dBm to 4 dBm sine or square wave (rise time T10-90 <1 ns and duty cycle from 40% to 60%)	
Damage level	+8 dBm or ±15 VDC Max	
Frequency range	10 MHz to 100 MHz	
External Clock OUT		
Connector type	SMA on rear panel	
Output Impedance	50 Ω,DC Coupled	
Frequency	10 MHz or External Clock IN Frequency	
Accuracy	± 2ppm max	
Aging	± 1.0 ppm/year max	
Amplitude	Square wave: 0V to 1.25 V into 50 Ω, 0V to 2.5 V into High Z	
Programmability		
Trigger modes	Single, continuous, burst, gated	
Multiple pulse modes	Single, double, triple, quadruple, external width	

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Specifications	Model 765-2 Channel	Model 765-4 Channel
Power		
Voltage range	100-240 VAC ±10%	
Frequency range	47-63 Hz	
Max. power consumption	120 W	
Environmental characteristics		
Temperature (operating)	+5 °C to +40 °C (+41°F to 104 °F)	
Temperature (non-operating)	-20 °C to +60 °C (-4 °F to 140 °F)	
Humidity (operating)	5 % to 80 % relative humidity with a maximum wet bulb temperature of 29 °C at or below +40 °C, (upper limit de-rates to 20.6 % relative humidity at +40 °C . Non-condensing.	
Humidity (non-operating)	5 % to 95 % relative humidity with a maximum wet bulb temperature of 40 °C at or below +60 °C, (upper limit de-rates to 29.8 % relative humidity at +60 °C. Non-condensing.	
Altitude (operating)	3,000 meters (9,842 feet) maximum at or below 25°	
Altitude (non-operating)	12,000 meters (39,370 feet) maximum	
EMC and safety		
Safety	EN61010-1	
Main Standards	EN 61326-1:2013 – Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements	
Immunity	EN 61326-1:2013	
General characteristics		
Display	7 inch, 1024x600, capacitive touch LCD	
Operative System	Windows 10	
External Dimensions	W 445 mm – H 135 mm – D 320 mm (3U 19” rackmount)	
Weight	21.4 lbs (9.7 Kg)	
Front panel connectors	OUTPUT1 (SMA) OUTPUT2 (SMA) TRG.IN (SMA) TRG.OUT (SMA) 2 USB 3.0 ports	OUTPUT1 (SMA) OUTPUT2 (SMA) OUTPUT3 (SMA) OUTPUT4 (SMA) TRG.IN (SMA) TRG.OUT (SMA) 2 USB 3.0 ports

Specifications	Model 765-2 Channel	Model 765-4 Channel
Rear panel connectors	External Monitor ports (HDMI, VGA) 2 USB 2.0 ports 2 USB 3.0 ports 3 COM ports 2 Ethernet ports (10/100/1000BaseT Ethernet, RJ45 port) Audio In/Out ports 2 PS/2 keyboard and mouse ports External Clock IN (SMA) External Clock OUT (SMA)	
Hard Disk	128 GB SSD	
Processor	Intel® Celeron J1900, 2 GHz (or better)	
Processor Memory	8 GB	

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