Model 765
Fast Rise Time Pulse Generator

Features

- Up to 4 Independent Channels
- < 70 ps rise/fall time
- Adjustable Output Level from 10 mVpp to 5 Vpp
- Adjustable Baseline Offset ± 2.5 V
- Maximum Repetition Rate 500 MHz
- < 27 ps RMS Jitter
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 300ns and as wide as 8 seconds. This wide range coupled with fast transition times and fast programming speeds allow a broad range of component and system tests previously requiring multiple instruments. The Model 765 Delay and Pulse Width resolution is 10ps and trigger jitter is <25 ps RMS, giving the user fine controls over output sequences.

Shown above: 70ps $T_r$ @ 5.0V
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:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage High</td>
<td>-5.0V</td>
<td>+5.0V</td>
</tr>
<tr>
<td>Voltage Low</td>
<td>-5.0V</td>
<td>+5.0V</td>
</tr>
<tr>
<td>Amplitude</td>
<td>-2.5V</td>
<td>+2.5V</td>
</tr>
<tr>
<td>Offset</td>
<td>-2.5V</td>
<td>+2.5V</td>
</tr>
<tr>
<td>Width</td>
<td>300ps</td>
<td>8 sec</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td>1%</td>
<td>99%</td>
</tr>
<tr>
<td>Period</td>
<td>8ns</td>
<td>8 sec</td>
</tr>
<tr>
<td>Frequency</td>
<td>1.0 Hz</td>
<td>125.0 MHz</td>
</tr>
<tr>
<td>Delay</td>
<td>0 sec</td>
<td>8 sec</td>
</tr>
<tr>
<td>Burst N</td>
<td>1</td>
<td>4,294,967,295</td>
</tr>
</tbody>
</table>

*Table 1: Pulse Out Limits*

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. Multiplex up to 4 pulses on a single output channel. A simple example showing different delay and width settings from a common delay follows:

![Pulse Out Multiplex Example]

Shown above: Output 1 (PULSE1 + PULSE2)

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 20mV 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 1.8V to 3.3V (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.

Application Idea – Semiconductor Test

Characterization of Non-Volatile Memory Cells requires very precise pulse control, both in amplitude and time domains. The Model 765, with 10ps 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 wire 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 50ns 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

Application Idea – Radar

In radar testing, many situations make 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:

\[ \text{Distance (km)} = \frac{(\text{DelayTime (sec)})}{2} \times 3 \times 10^5 \text{ km/s, where } 3 \times 10^5 \text{ km/s is an approximation of the speed of light.} \]
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 <25ps 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 765-X
- P/N 765-SSKit  Solid State Storage Drive Kit for 765-X
- P/N 765-X-WAR  3 Year Warranty Extension for 765-X