The Model 765 Pulse Generator

Application Note: Big Physics

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In big physics experiments, the use of photomultipliers is fundamental and common. The Photomultiplier is used to convert an electrical charge to be received by an acquisition system which allows photons to be detected. The emission of photons can be correlated to a specific phenomenon studied by physicians such as the "Cherenkov Effect".

During the design and production of a photomultiplier, it is necessary to characterize and calibrate them using a laser or a LED diode. The light source must be driven by a preassigned signal with a fixed width and sequence.

Using the Model 765 pulse generator, by Berkeley Nucleonics, it is now easier than ever to generate a pulse with various widths, periods and amplitudes. Setup is intuitive and easy, setting a single pulse puts the instrument waiting for external trigger-in or generate pulses in continuous way.

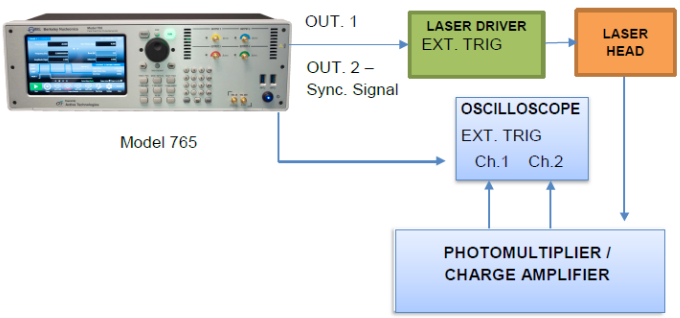
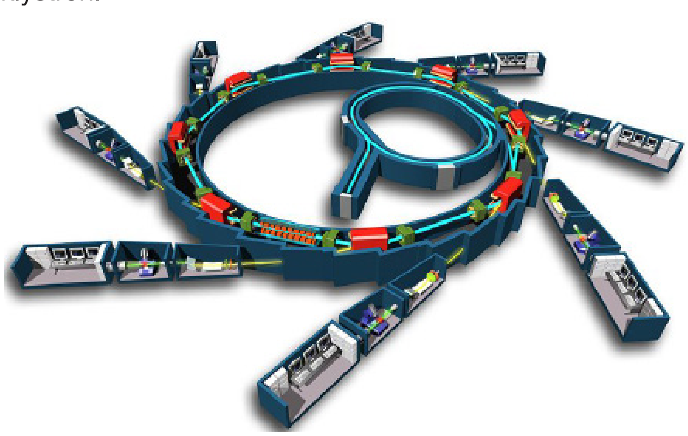


Figure 1: Principle scheme of set-up for the photomultiplier / charge amplifier test and characterization.

Klystron Control and Synchronization

A klystron is a specialized linear-beam vacuum tube that can be used in multiple applications. For example, in the colliders used for big physics experiments, it is used to generate the particles that will collide. Much like using a light source to characterize and calibrate a photomultiplier, it is necessary to generate and enable a signal to drive the klystron.



The signal needed can be generated by a complex system based on logical port or on FPGA however, the design and developing of such systems are lengthy and restrictive. If there is sudden need to change the timing, the user must change the schematic or the FPGA code, taking up additional time and resources that could be directed elsewhere.

The Model 765 offers an off-the-shelf solution to control and modify klystrons. The touch screen display allows for users to simply enable signal parameters

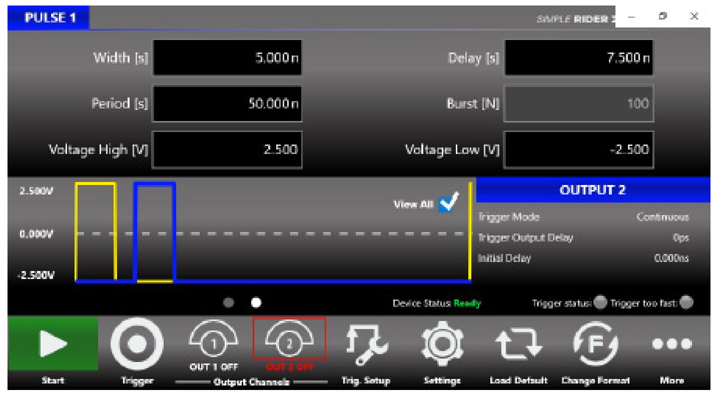


Figure 2: Simple Rider UI, generation of two narrow pulses (5 ns) with 7.5 ns of Delay(s) one from the other.

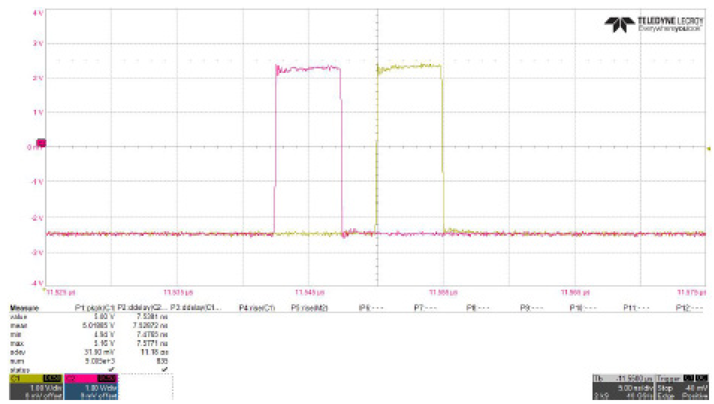


Figure 3: Oscilloscope screen capture, generation of two narrow pulses (5 ns) with 7.5 ns of Delay(s) one from the other.

In addition, when driving a klystron, the user can synchronize multiple units to the Model 765. With up to 4 independent channels, the user can set independent synchronization signals with specific delays from the trigger signal. This feature allows multiple klystrons to be synchronized while taking in account and compensating the delay between the different driving chains.

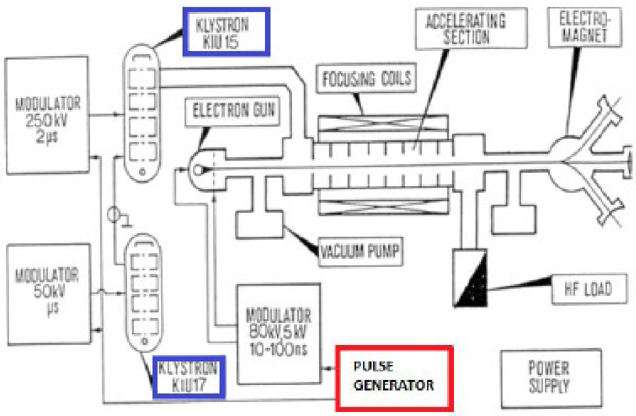


Figure 4 Example of complex system, where a Model 765 pulse generator can synchronize two klystrons

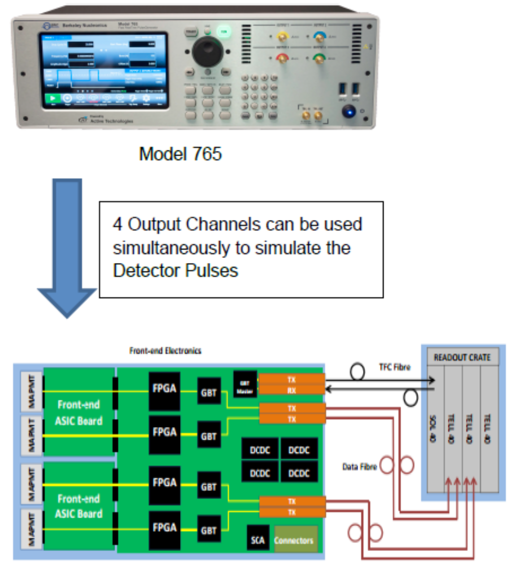


Figure 5: Principle scheme of read out chain: the Model 765 pulse generator substitute the the photomultiplier and the charge amplifier during the preliminary test.

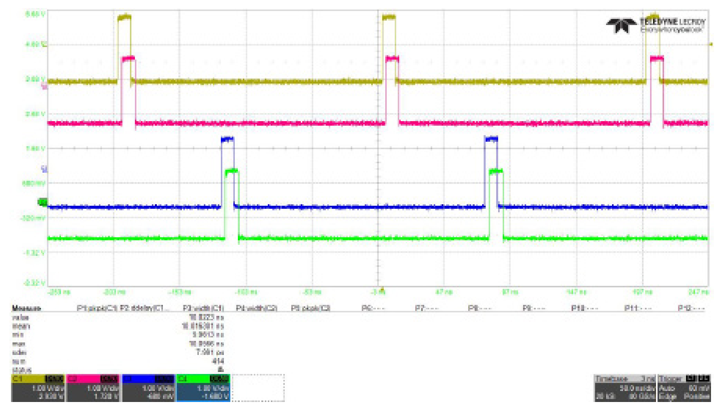


Figure 6: Model 765-4: four channel synchronized with delay between 100ps and 1 ns

Read Out System Testing

In big physics experiments, the main role is played by detectors that allow for the observation of different physical phenomena. Often over looked, however, is the acquisition chain, which is equally important as it permits the collection and storage of real time data.

The read-out chain is based on a hierarchic tree structure where the lowest level is near the detectors. It converts the digital pulses using a communication protocol to deliver information to the next level.

Usually, the lowest level is composed by an FPGA system which collects the digital pulses of multiple detectors, creating a data packet to deliver to the next level via an optical link. During the development of such a system, engineers usually do not have access to detectors or the entire colliders, making it imperative to find a easier and more convenient ways to simulate pulses generated by the detectors.

Using the BNC Model 765 pulse generator, it is possible to test the response of a FPGA system, ensuring that the timings and synchronization settings. For an example, a user can inspect what will happen if the channels would have skew and test the receiving of multiple pulses for glitches.

The Model 765 pulse generators offers up to 4 channels, each channel can deliver single, double, triple or quadruple pulses. Each pulse independent with its period, width and delay in respect to the trigger-in signal.

About Berkeley Nucleonics Corporation

Berkeley Nucleonics Corporation (BNC) is a leading manufacturer of precision electronic instrumentation for test, measurement, and nuclear research. Our corporate headquarters are in San Rafael, California, with additional manufacturing facilities and sales offices located throughout the United States.

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