The Model 765 Pulse Generator

Application Note: Radar Application

Berkeley Nucleonics Corporation
info@berkeleynucleonics.com | www.berkeleynucleonics.com
2955 Kerner Blvd, San Rafael, CA 94901 | 800-234-7858

Primary Pulse Radar

A primary radar generates a signal that illuminates the target and receives its echo. It is possible to distinguish between different types of radars depending on the modulation (analog or digital) and

On the discontinuities of the generated signal.

The simplest radar is the pulse radar, which doesn't use any type of modulation, but rather operates by generating a signal for a short time and receives the echo response produced by the signal reflecting target.

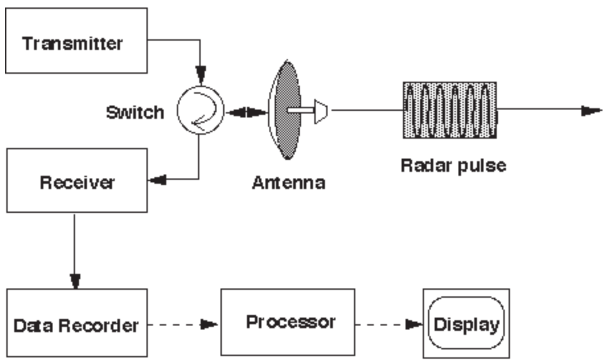

Figure 1: Primary Pulse Radar basic diagram

In this way, it determines the distance from the object by calculating the time of flight between the sent signal and the received echo. This architecture is limited by the trade-off between the maximum range and the resolution. A larger pulse increases the average transmitted power and, consequently, the maximum range, but it reduces the resolution.

For this reason, this type of radar finds application in long-range control, principally in air traffic control and weather observation (especially precipitation).

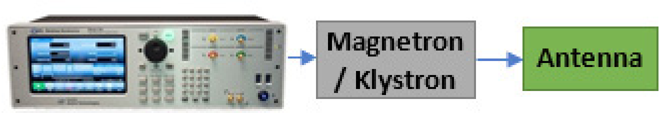

Figure 2: Example of magnetron / klystron driving using Model 765

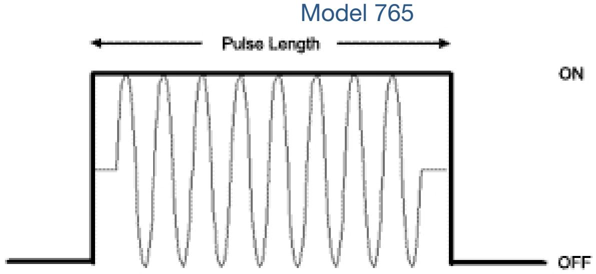

Figure 3: Radar pulse

During the development of a system that uses a RF modulating chain, it is helpful to use a pulse generator to test the receiver behavior by varying the pulse duration to the modulating chain.

Model 765 from Berkeley Nucleonics allows the user to easily create pulses with different pulse width, repetition rate, and amplitude by using the graphical interface and the touch screen display. Following this solution, the user can save time developing the pulse system and concentrate his or her efforts on the radar design and test goals.

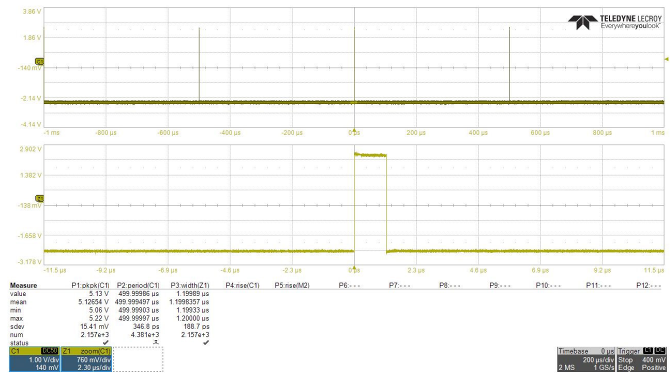

Figure 4: Radar pulse: Pulse Repetition Interval (PRI) = 500 µs, width 1.2 µs

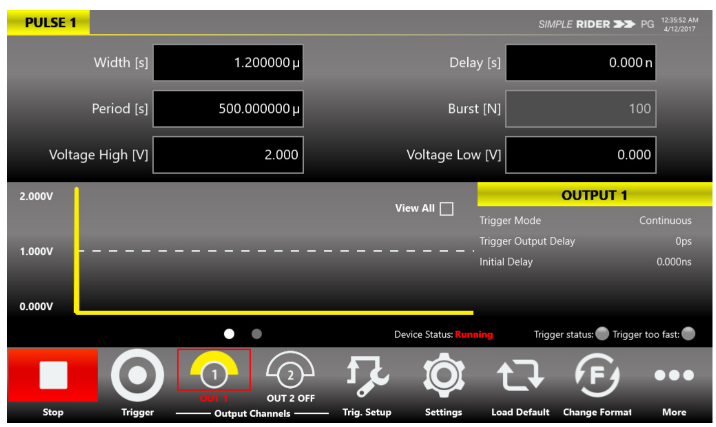

Figure 5: Model 765 interface in continuous generation

Secondary Radar

A secondary radar is used for air traffic control that works in conjunction with the aircraft transponder. It interrogates the transponder using a pulse code and waits for the response. Depending on the transmitted code, it can request the identification number, the altitude, etc.

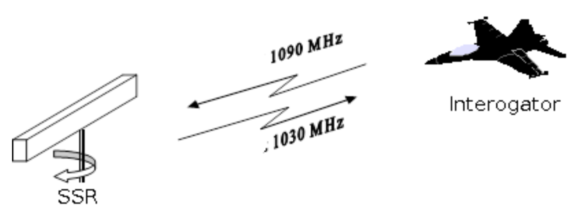

Figure 6: Secondary Radar basic diagram

The interrogation base band code is very simple. It is composed of 3 pulses called P1, P2 and P3 with a fixed duration of 800 ns.

The first pulse (P1) and the last one (P3) are transmitted by a directive antenna defining the code through the distance between them.

The second pulse (P2) is transmitted in an omnidirectional way with a delay of 2 µs from the first one. This pulse is necessary because the secondary lobes emitted by the directive antenna could hit other transponders, causing an incorrect response and interference. The transponder measures the received power during the pulses P1 and P2 and it distinguishes whether it is reached by the main antenna lobe or by a secondary one. In the first case it sends the response.

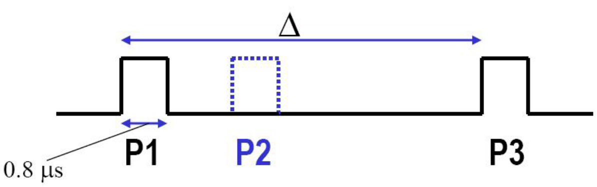

Figure 7: Example of a secondary radar interrogation code

Model 765 allows the user to produce the double pulses P1 and P3 with a defined distance and duration (it offers excellent time resolution of 10 ps). The availability of multiple channels is perfect for supplying the second pulse (P2) with a delay of 2 µs from the first one. A jitter under 25 ps ensures optimum synchronization between channels.

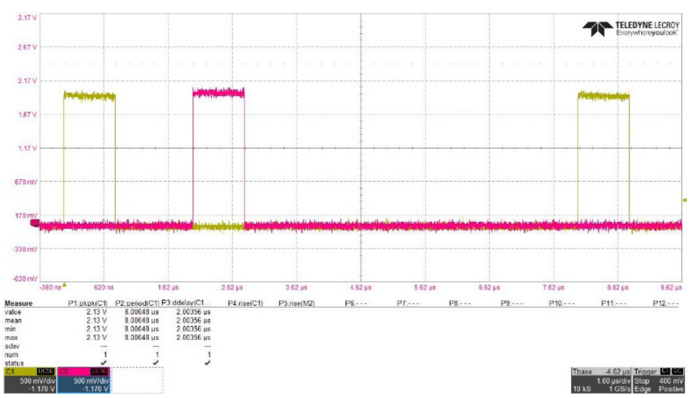

Figure 8: Secondary radar example of interrogation code (delay P1-P3=8us)

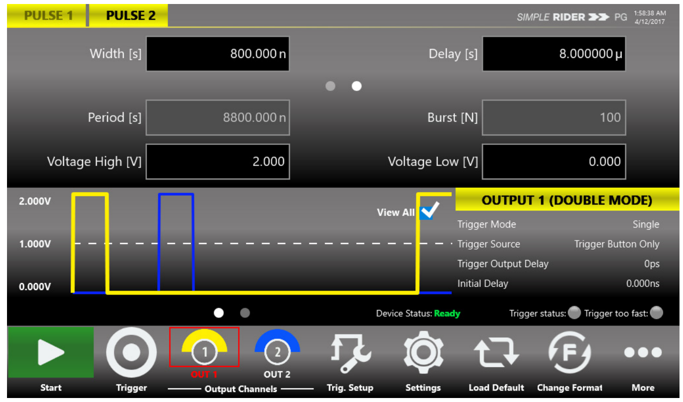

Figure 9: Model 765 interface waiting for trigger-in signal

Multiple Target Simulation using a Pulse/Delay Generator

In a primary radar system, the elaboration system measures the time of flight of the signal to calculate the distance from target. It extracts the distance using the following equation: , where is an approssimation of the light speed. It means that the delay between the transmitted and the received signal depends on distance.

In case of multiple targets, multiple signals are received, and the detection system must be able to distinguish between them.

Model 765 is the perfect choice to test the detection chain by shortening the development time without having the complete radar system and targets at which to aim.

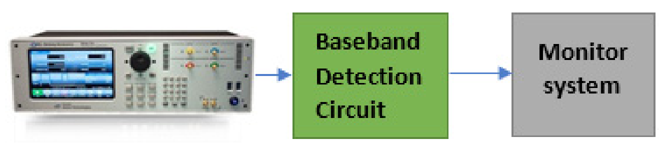

Figure 10: Example of detection circuit testing using Model 765

The multiple pulse mode offers double, triple, and quadruple pulses with different duration and delay from a trigger-in signal that can be repeated up to 125 MHz for testing the real-time frequency operation of the detection system.

The resolution of 10 ps and the jitter below 25 ps RMS give the necessary accuracy to take count of the expected RF chain delay and to simulate the detection of the target with a resolution under one centimeter.

(Figures on next page)

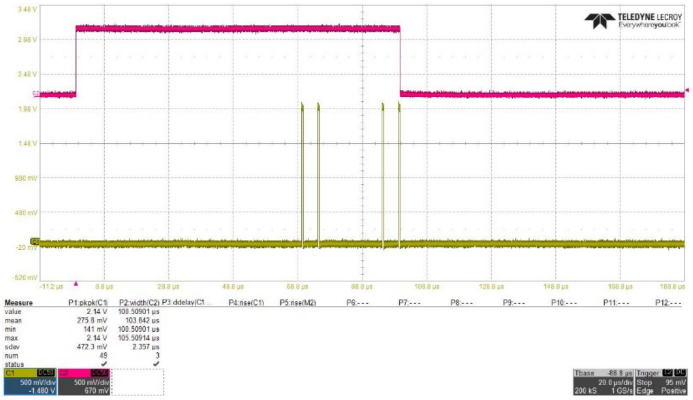

Figure 11: Example of quadruple pulses with a fixed delay from trigger-in signal to simulate the detection of multiple targets

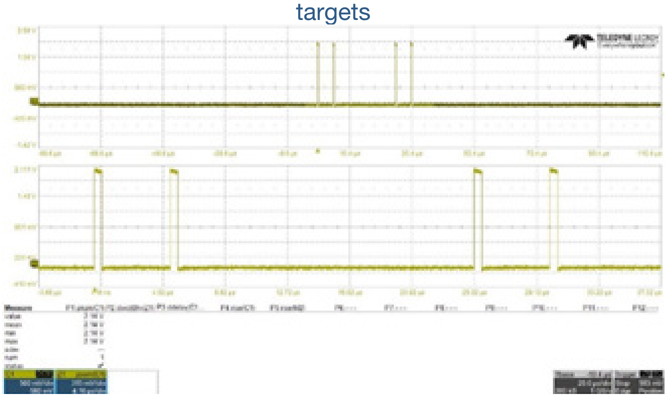

Figure 12: Zoom on quadruple pulse

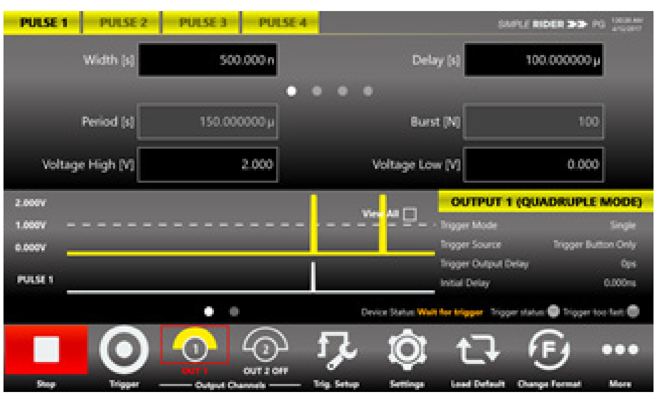

Figure 13: Model 765 interface waiting with quadruple pulse setting

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.

Learn more about us:

Berkeley Nucleonics Corporation
2955 Kerner Boulevard
San Rafael, CA 94901
Phone: 805-527-5939
Website: www.berkeleynucleonics.com