Keysight Technologies
81100 Family of Pulse Pattern/Generators Radar Distance Test to Airborne Planes

Technical Overview

KEYSIGHT TECHNOLOGIES

Introduction

Keysight Technologies, Inc. pulse generators are used for testing radar communication systems in the military industry, and as demonstrated in this technical overview, the aviation industry.

A trigger pulse train of double pulses is sent from the control tower's radar system to an airborne plane. The plane responds with a standard signature signal which is sent back to the control tower. This occurs up to 450 times per second. The control tower receives the signal, recognizes its signature, and then analyzes the delay to determine the distance between the tower and the airborne plane.

To test a radar system on a regular basis, an 81150A is used to simulate the signature signal. Varying the delay from the external trigger to the start of the output signal, various distances from the control tower can be simulated. This delay can be up to 2 ms. Therefore, it has to be created by leading zeroes added to the signature signal.

Due to the legal safety requirements, it is critical to have very accurate edge placement of the pulses. The 81150A has a frequency accuracy of ± 50 ppm.

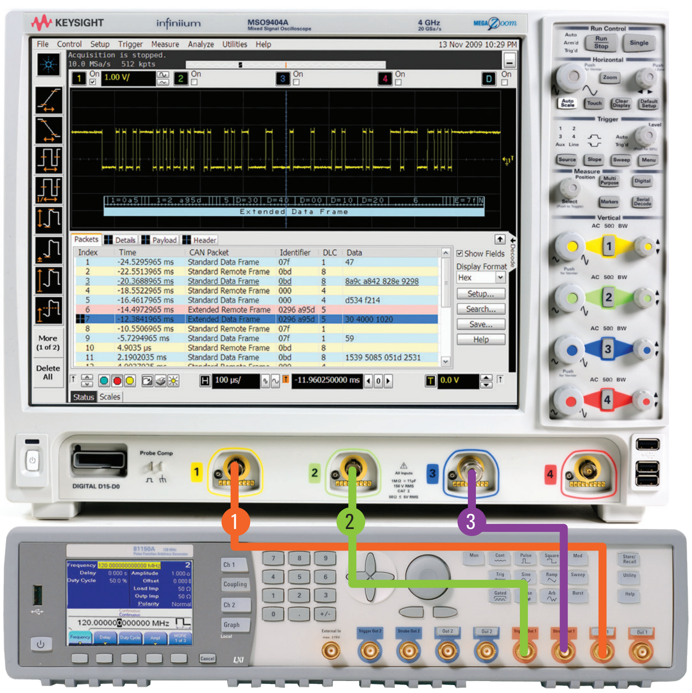

Figure 1. Setup of a Keysight pulse generator and a Keysight Infiniium oscilloscope.

Required equipment for lab 1:

- 1 x 81150A pulse pattern generator (or 81160A)
- 1 x Infiniium oscilloscope
- 2 x BNC cables

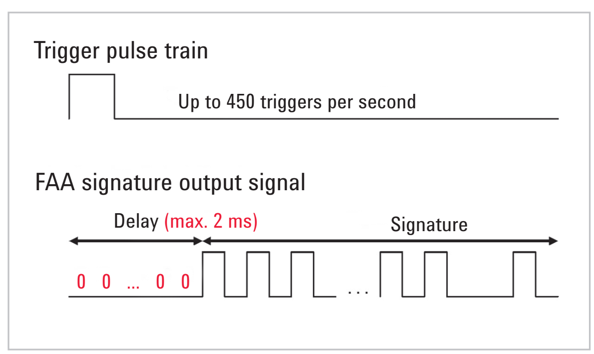

Figure 2. Simulated signature signal.

What do we need to simulate the response signal of an airborne plane?

We need:

– Externally triggered pulses
– At 0.6 MHz frequency (Figure 3)

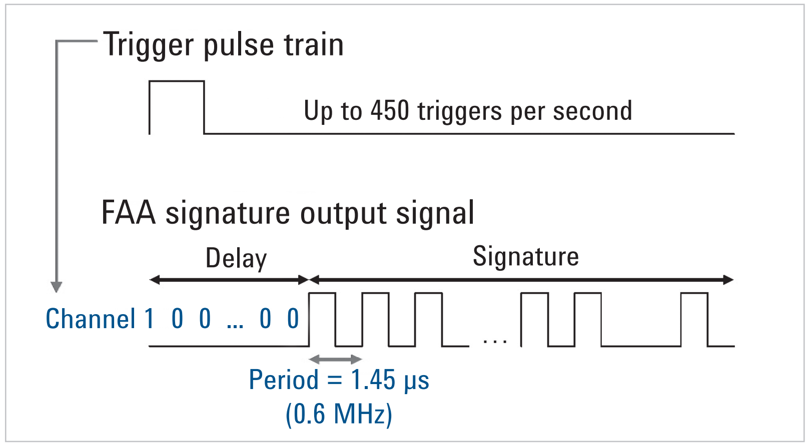

Figure 3

– A programmable bit pattern
– And highest possible frequency accuracy (Figure 4)

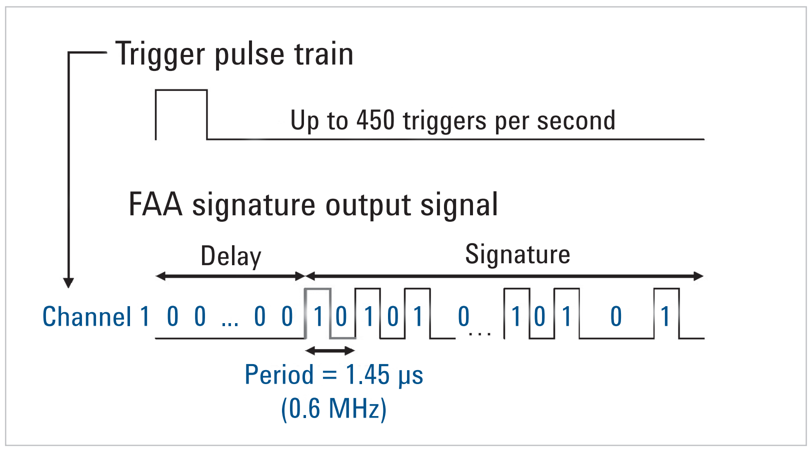

Figure 4

Now let's set up the instruments as shown in the screen shots.

First, reset the instrument by selecting "store/recall" and by selecting "set to defaults."

Second, select "cont" and select "pulse".

Go to the TIMING menu and set the pulse period and width, in accordance with what is specified in the timing diagram. Switch on output 1.

Note: If you need faster rise times, please refer to the Pulse Pattern Generators Selection Guide www.keysight.com/find/ppg-selection-guide.

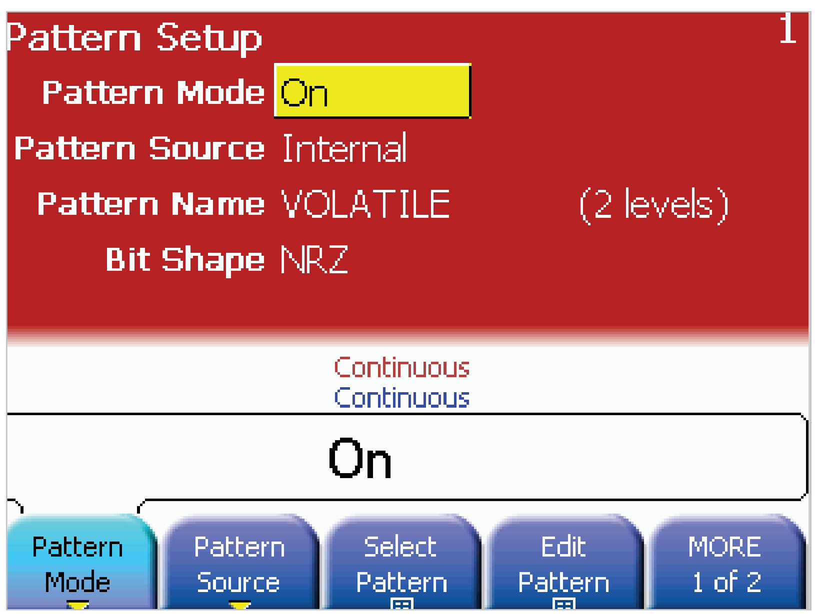

Figure 5

In order to get the 2.0 ms delay, add leading zeros to the 36 bit pattern (the 81150A will not allow a delay of more than 750 ns). Because we have NRZ pulses, use two bits per period, set at a rate of 1.45 μs. 1,379 leading zeros are needed to create an 1,999.55 μs delay.

To get these leading zeros, go to the pattern setup, choose Edit Pattern and create a new one (Figure 6).

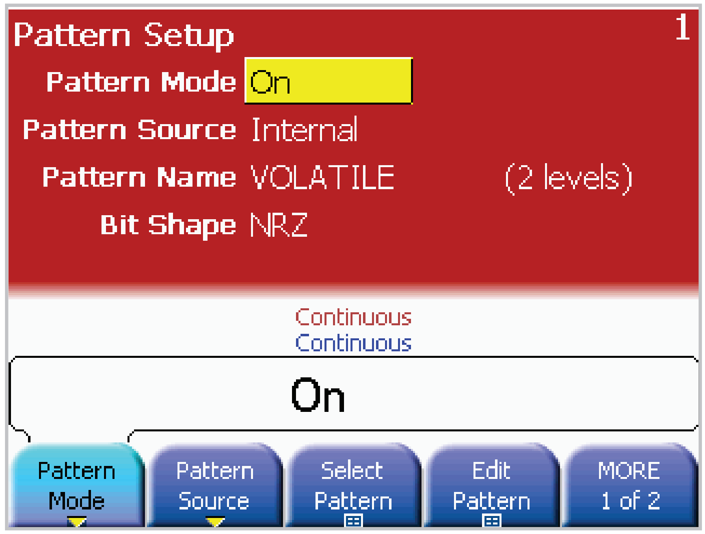

Figure 6. Edit user pattern.

The number of bits is 1,415 (1,379 + 36). Starting at the reference point of 1380, set the bit pattern of the radar signal to 36 (Figures 7 and 8).

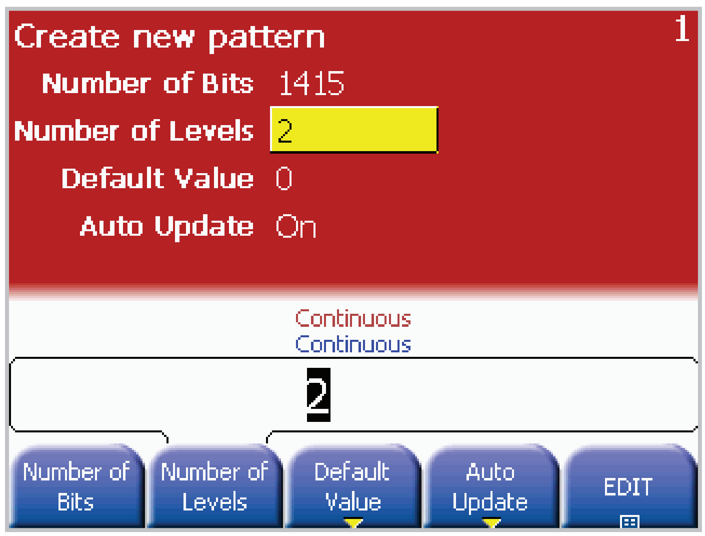

Figure 7. Create new pattern.

Note: The pattern from reference point 1380 to 1415 is 010101010101010101010101010101010 1000010.

Start with setting the last bit to 1415.

Switch on output 1 by pressing "Out1."

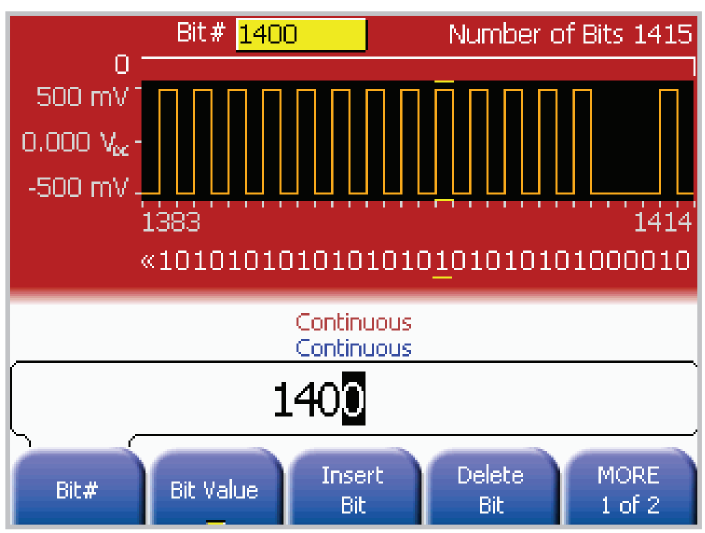

Figure 8. Set bits.

Finally, view the last 36 bits of the pattern on an MSO9404 Infiniium oscilloscope.

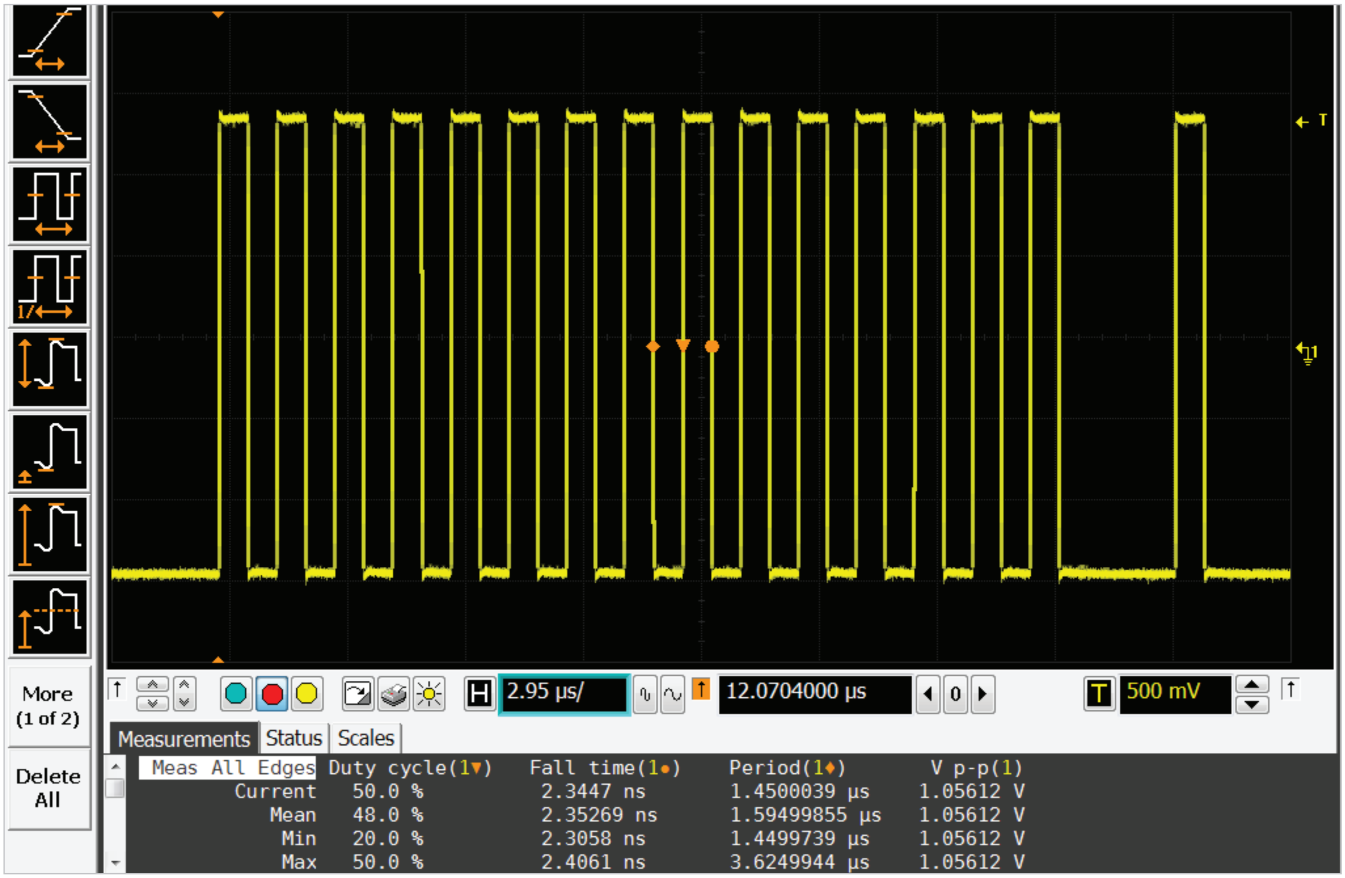

Figure 9. Keysight MSO9404 Infiniium oscilloscope showing the last 36 bits.

Related Literature

Keysight 81100 Family of Pulse/Pattern Generators – Brochure	5890-0489E
Keysight 81130A Pulse-/Pattern Generator – Data Sheet	5967-6237E
Keysight 81150A and 81160A – Data Sheet	5967-5984E
Radar Distance Test to Airborne Planes – Application Note	5968-5843E
The Dual Clock Gbit Chip Test – Application Note	5968-5844E
Magneto-Optical Disk Drive Research – Application Note	5968-5845E
Simulation of Jittering Synchronization Signals for Video Interfaces – Application Note	5968-5846E

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