Agilent N1918A
Radar Pulse Measurement

Application Note

Introduction

Radar pulse measurements are a critical part of radar in the electronic warfare and electromagnetic intelligence systems. Radar pulse measurements have historically presented many challenges for the design engineer, production test manager, and field technician. The transient nature of the radar pulse combined with modern pulse-compression schemes often demand elaborate test setup.

In Figure 2 on page 2, one of the key measurement parameters is the pulse characterization and analysis. Measurement and analysis parameters typically include peak power, rise/fall time, pulse width, pulse repetitive frequency (PRF), pulse-to-pulse delay. Typical test instruments involved in such application are high-sampling oscilloscopes, RF peak power meters (or analyzers), signal generators, and pulse or function generators.

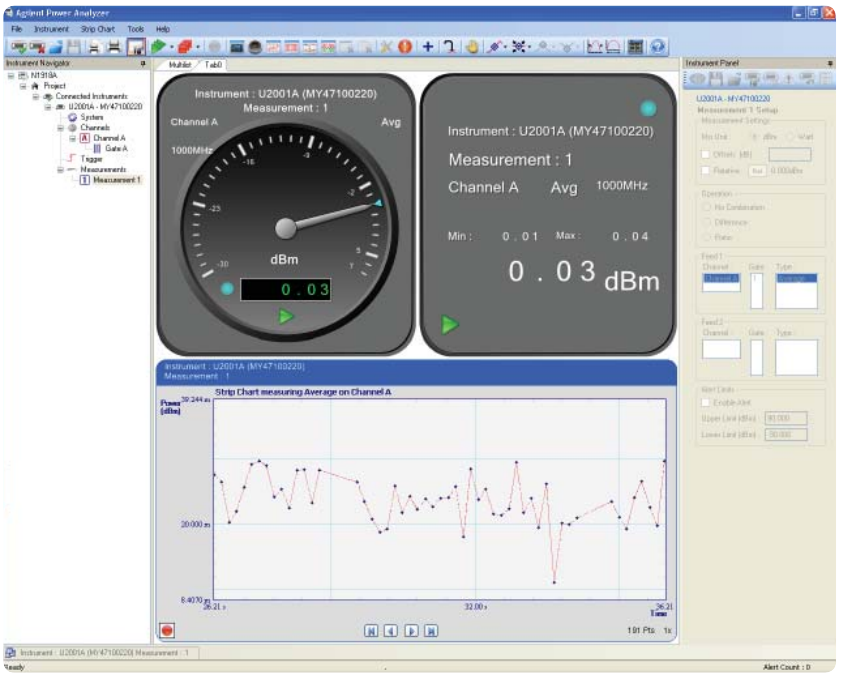

Figure 1. Agilent N1918A Power Analysis Manager

Previously, the discontinued 8990A or 8991A peak-power analyzer was used extensively in radar pulse measurement. Now, Agilent's P-Series power meter/sensor combined with the new N1918A PC software provide features similar to those of the legacy 8990/1A peak-power analyzer. This application note explains how this combination will help radar technicians and engineers perform their radar module maintenance tests. Two new features of the N1918A will be showcased: the 12-point pulse analysis and the overlay measurement.

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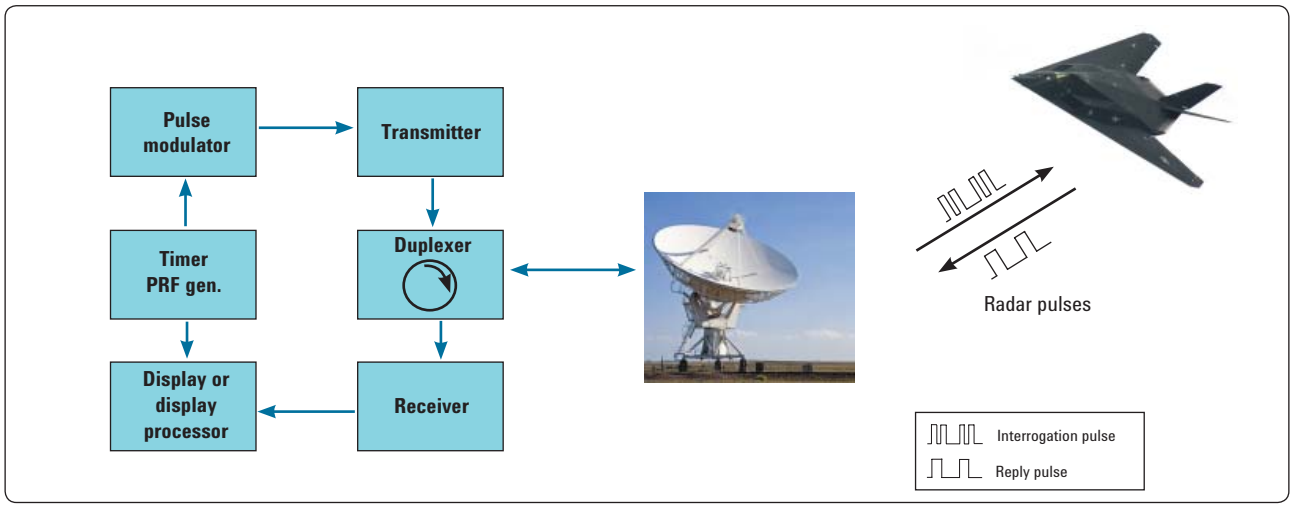

Figure 2. Simple radar system block diagram

12-Point Pulse Analysis Measurements

In radar transmitter design and manufacturing testing, accurately evaluating pulsed RF radar requires measurement of different signal-pulse characteristics, both of output power and of timing. A typical radar pulse characteristic measurement requirement is shown in Figure 3. A poorly shaped pulse with too much rise/fall time can lead to position and distance inaccuracies, which ultimately lead to false target readings.

When measuring a typical radar pulse, the P-Series N1911/12A can display rise/fall time, pulse width, pulse period, duty cycle and PRF. The P-Series pulse measurements display screen is shown in Figure 4 on page 3.

However, with the new PC software N1918A, the P-Series can perform seven automatic timing measurements—rise time, fall time, pulse width, off time, duty cycle, primary rate interface (PRI), and PRF. It can also perform five automatic power measurements —average power, minimum power, peak power, pulse top, and base amplitude via a graphical user interface that is easy to set up.

This feature allows the you to see all the pulse characteristics in one large display. Being able to see all the pulse parameters affected helps you to tune and tweak the radar system.

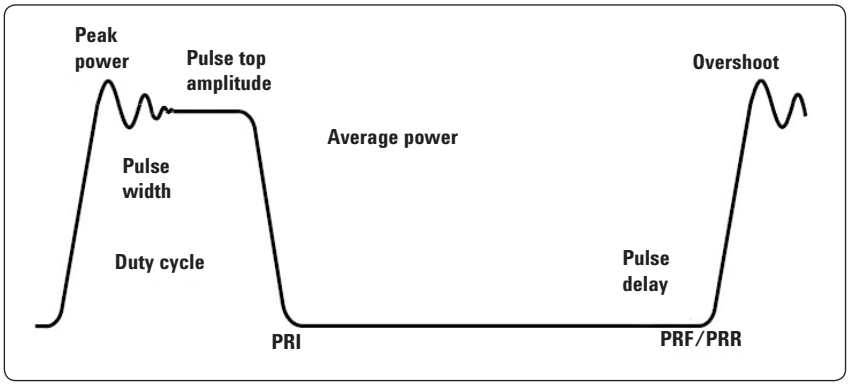

Figure 3. Typical radar pulse analysis parameters

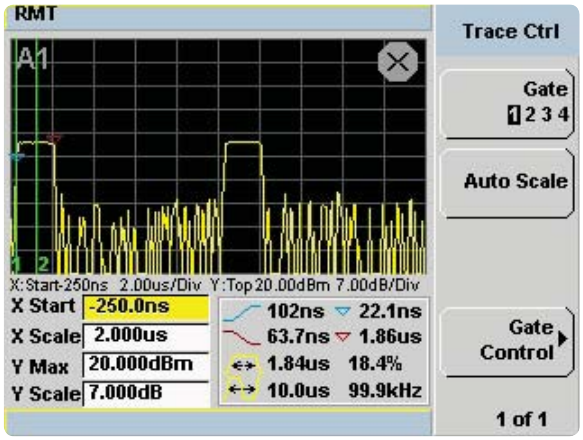

Figure 4. P-Series pulse characteristic measurement

How to Turn on 12 point-Pulse Measurement in N1918A

After the required pulse is triggered and displayed on the N1918A, click on the **Pulse Analysis** tab on the bottom left. Then click the **Measurement Selector**, you can choose and select any of the pulse analysis measurement parameters. After selecting the parameters, measurement results will pop up as shown in Figure 5.

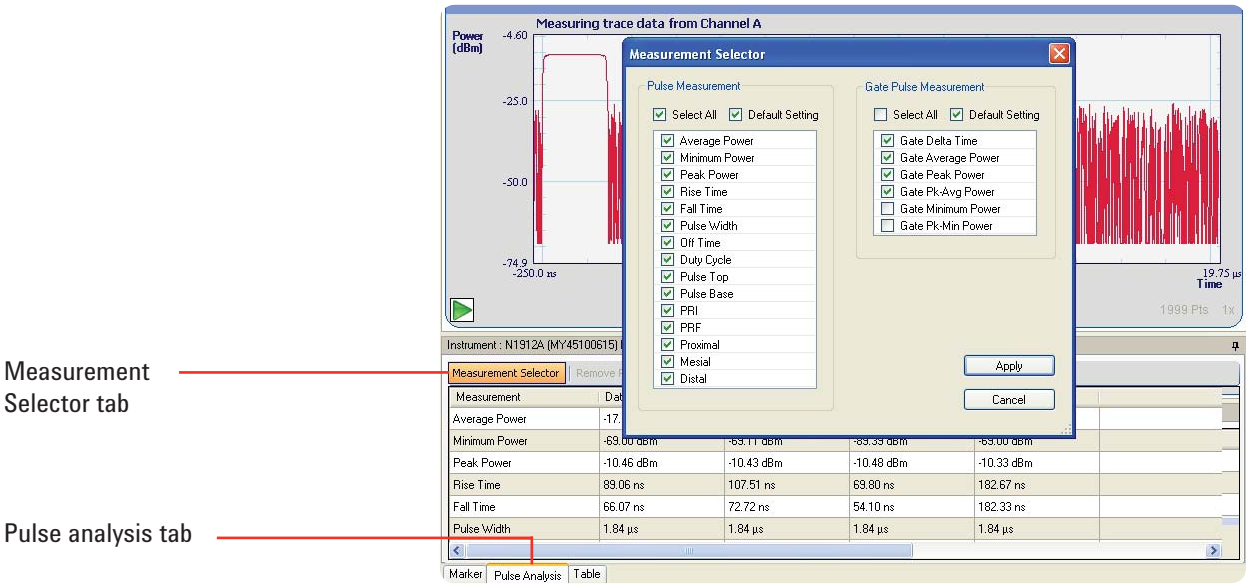

Figure 5. 12-point pulse measurement in N1918A

Pulse-to-pulse Analysis Measurement

In a typical Air Traffic Control Radar Beacon System (ATCRBS) transponder maintenance test as shown on Figure 6, radar pulse analysis involve two channel measurements: interrogation pulse and reply pulse. For such applications, the ability to view both interrogation and reply pulse signals is important as you are able to analyze two pulses at the same time on the display.

The maintenance task typically starts by validating each of the interrogation and reply pulse characteristics and making sure the pulses meet the system specifications accordingly. The test set is then checked to validate whether it is functioning properly according to the sent-receive-reply specification. For example, in Mode S standard transponder operation, the transponder should provide three pulse replies once it receives the valid interrogation pulse from the other transponder.

In order to execute dual-channel power measurements (during radar module maintenance), the P-Series meter/sensor with the N1918A Power Analyzer software will be the perfect solution. The N1918A software will enable you to analyze pulse-to-pulse signals on a same time domain display.

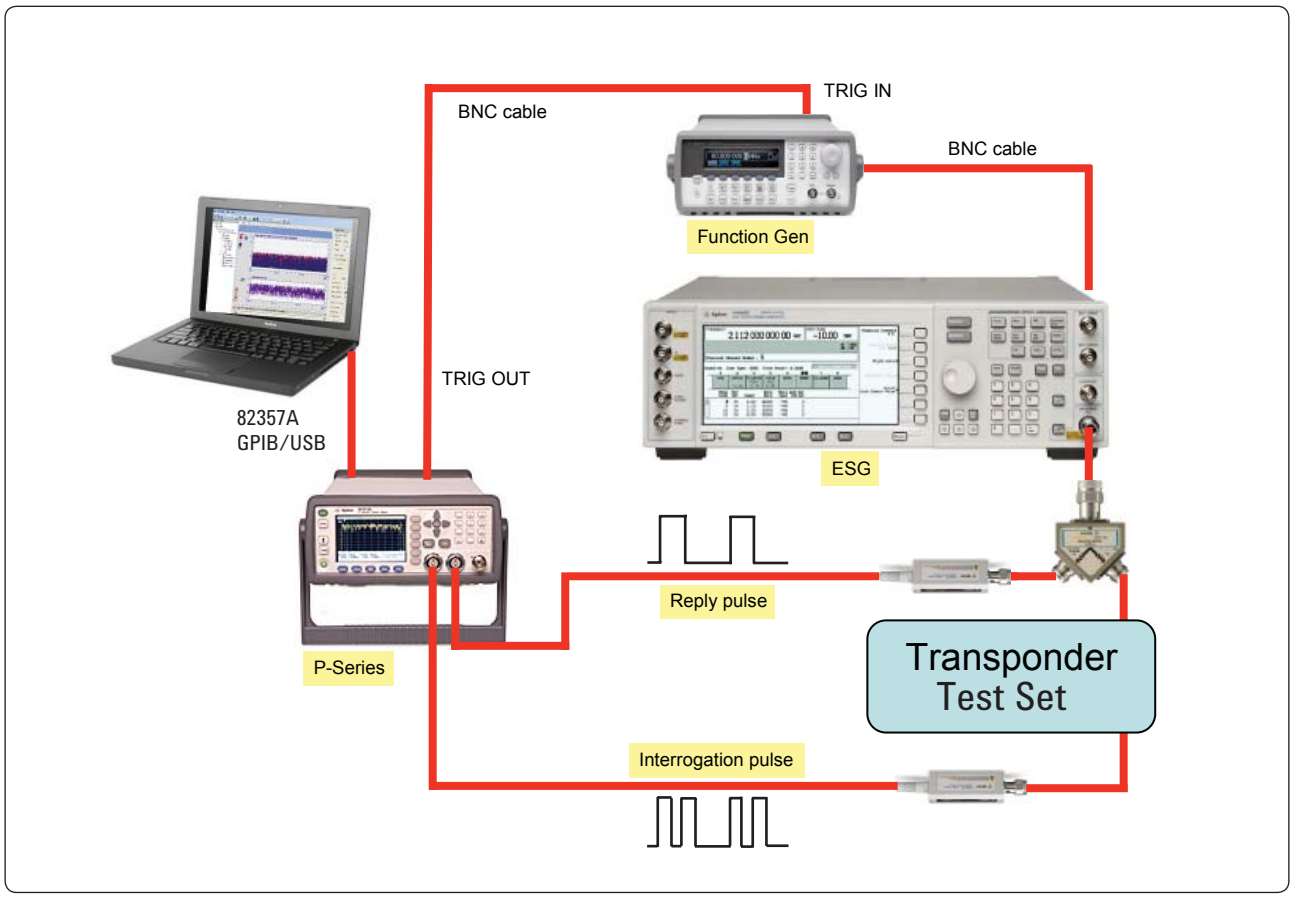

Figure 6. Radar transponder test set up with P-Series dual channel

When using the current P-Series meter N1912A (two channels) alone without the N1918A software, these two pulses will be displayed in the main screen as shown in Figure 7. This limitation makes it difficult to execute the pulse analysis and time measurement accurately.

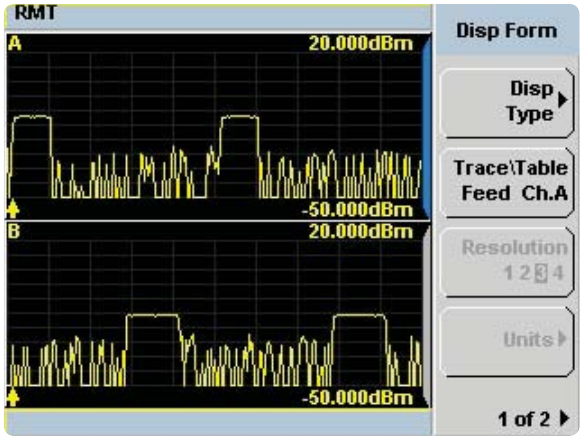

Figure 7. P-Series displaying two channel pulse measurements

With the overlay feature in the N1918A PC software, you can now combine these two pulses into a common time domain axis. Consequently, pulse-to-pulse analysis can be done easily by using the markers, as shown in Figure 8. From the overlay display, you can easily determine the parameters such as the power level between the pulses (delay between the interrogation pulses and reply pulses) which are required during maintenance and calibration.

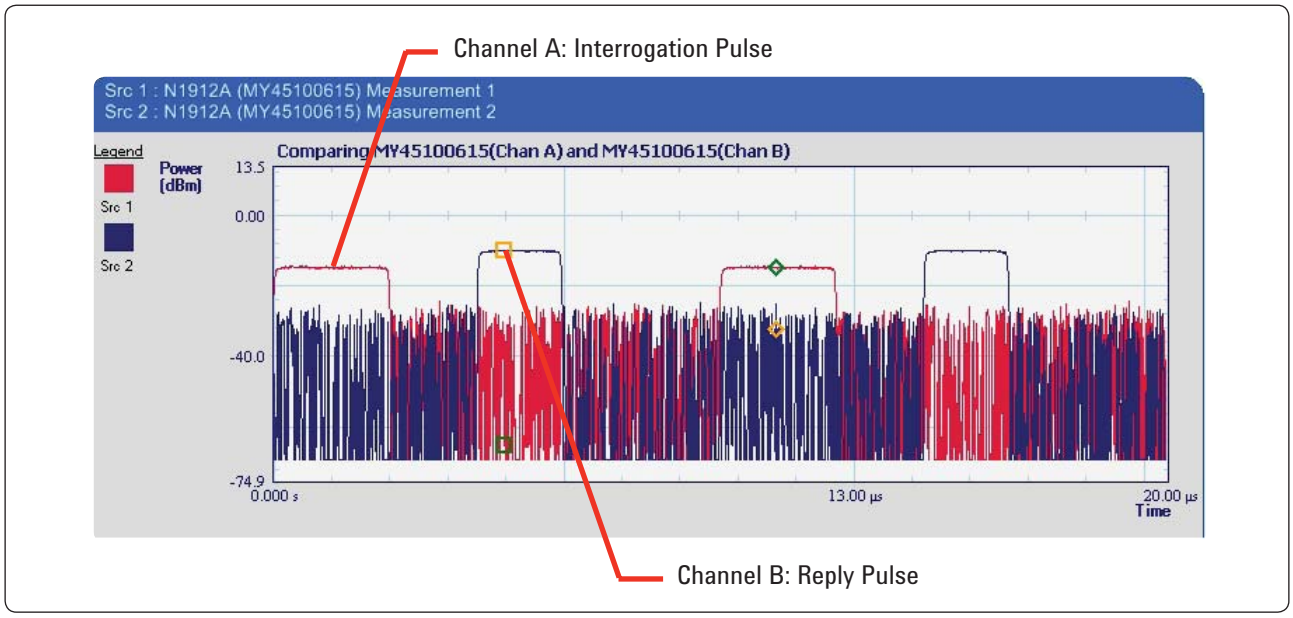

Figure 8. N1918A Overlay feature displaying both interrogation and reply pulse

How to Use the Overlay Measurement in N1918A

After seeing the pulse signals on the N1912A meter display shown in Figure 7, you can enable the N1918A software. Set up the required channel setting and triggering, and make sure both channels have the trace feature enabled. Click on the **Create Overlay** function button on the top menu (as shown in Figure 9), and assign both channels' measurement to source 1 and 2 accordingly. Both pulses shown on Figure 9 display the amplitude difference and time delay.

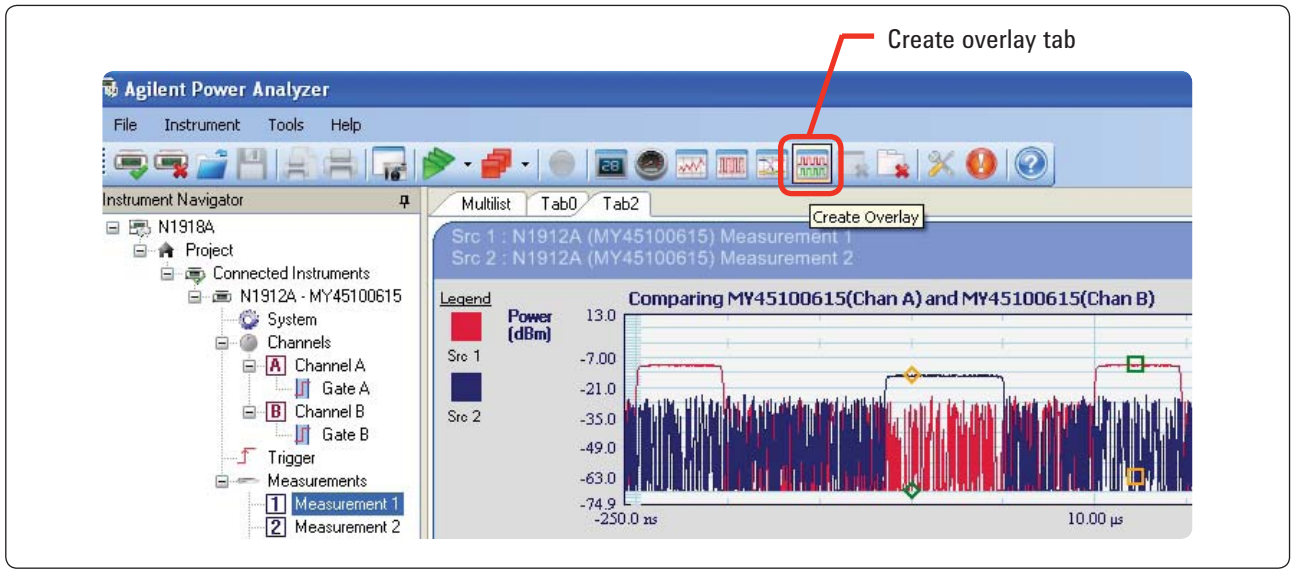

Figure 9. Create overlay in N1918A

In order to obtain the amplitude (peak power) difference and the time delay between the two pulse, you can use the markers function shown in Figure 10. Move the mouse pointer to the overlay trace, right click the mouse, and the markers function will be shown. Select two sets of markers and move them to the required pulses trace.

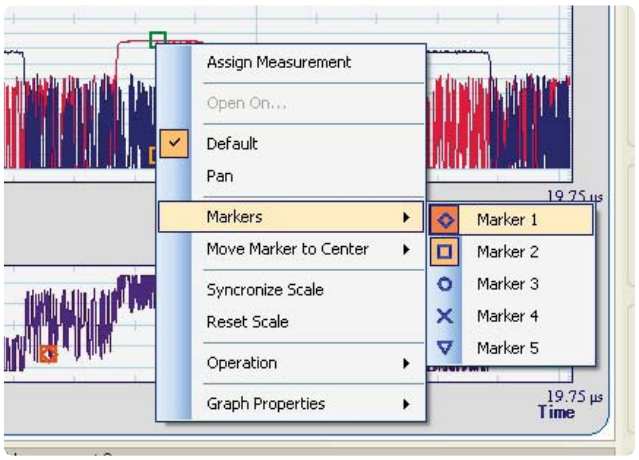

Figure 10. Markers in N1918A

Figure 10 displays the related X (time) and Y (power amplitude) of each marker. In order to obtain the amplitude difference between pulse 1 and pulse 2, calculate the difference between the power measured at Y or marker 1 and the Y of marker 2. In this example, the difference between pulse 1 and 2 is about 5 dB (Trace2 Marker 2 – Trace1 Marker 1). Use the same method to obtain the time delay between the two pulses.

Src 1 : N1912A (MY45100615) Measurement 1 \ Src 2 : N1912A (MY45100615) Measurement 2

Marker	X	Y
Trace1 Marker 1	11.25 µs	-14.97 dBm
Trace2 Marker 1	11.25 µs	-32.14 dBm
DeltaTrace Marker 1	10.00 µs	-3.84 dBm
Trace1 Marker 2	5.17 µs	-65.34 dBm
Trace2 Marker 2	5.17 µs	-10.20 dBm
DeltaTrace Marker 2	10.00 µs	-3.84 dBm

Figure 10. Table showing the markers' measurement results in N1918A

Conclusion

The N1918A Power Analysis Manager is a PC software application that is easy to set up and use. It provides the features you need for radar module testing and measurements. The P-Series meter and sensors' video bandwidth enable you to measure down to 13 ns rise time with minimum 50 ns pulse width radar pulse signals. This combination of power meter/sensors with the N1918A makes it an ideal and cost effective solution for radar module design, manufacturing, or even maintenance and calibration.

Related Agilent Literature

Please refer to the following publications for further information.

Publication title	Pub number
Agilent N1918A Power Analysis Manager, Data Sheet	5989-6612EN
Agilent N1911A/N1912A P-Series Power Meters and N1921A/N1922A Wideband Power Sensors, Data Sheet	5989-2471EN
P-Series Power Meters and P-Series Wideband Power Sensors, Configuration Guide	5989-1252EN
P-Series Power Meters and P-Series Wideband Power Sensors, Technical Overview	5989-1049EN
Agilent Radar Measurement, Application Note	5989-7575EN
Perfecting Pulsed RF Radar Measurements, White Paper	5989-7323EN

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