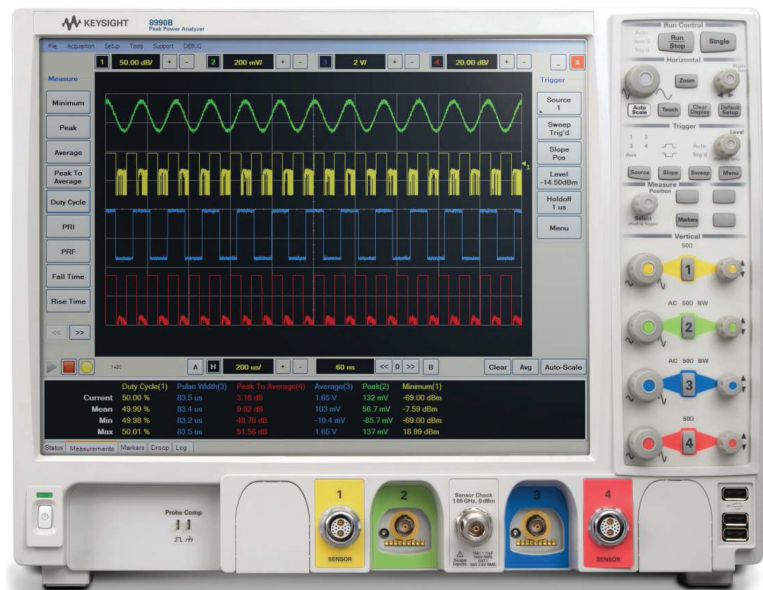


Keysight Technologies

Making 14-Points Pulse Characterization Measurements Using the 8990B Peak Power Analyzer



Application Brief

Introduction

This application note applies to the following products from Keysight:

- Keysight 8990B peak power analyzer (PPA)
- Keysight N1923/24A wideband power sensor

Radar pulse measurement can be separated into two types. One is for individual pulse characterization, sometimes called the pulse shaping measurement. The other is the multi-pulse timing measurement. Radar pulse characterization and analysis measurement examples are rise/fall time, pulse droop, pulse width, peak power, and average power. Timing measurement examples are PRI, delay measurement, limiter recovery time, and multi-pulse spacing. To obtain all these measurements traditionally requires a combination of an oscilloscope, peak power meter and sensor, and sometimes a spectrum analyzer.

This application note demonstrates how the Keysight Technologies, Inc. 8990B peak power analyzer (PPA) is used to obtain 14-point pulse parameter values from the trace graph, where the parameters values are automatically calculated by the 8990B application whenever a trace pattern appears on the graph.

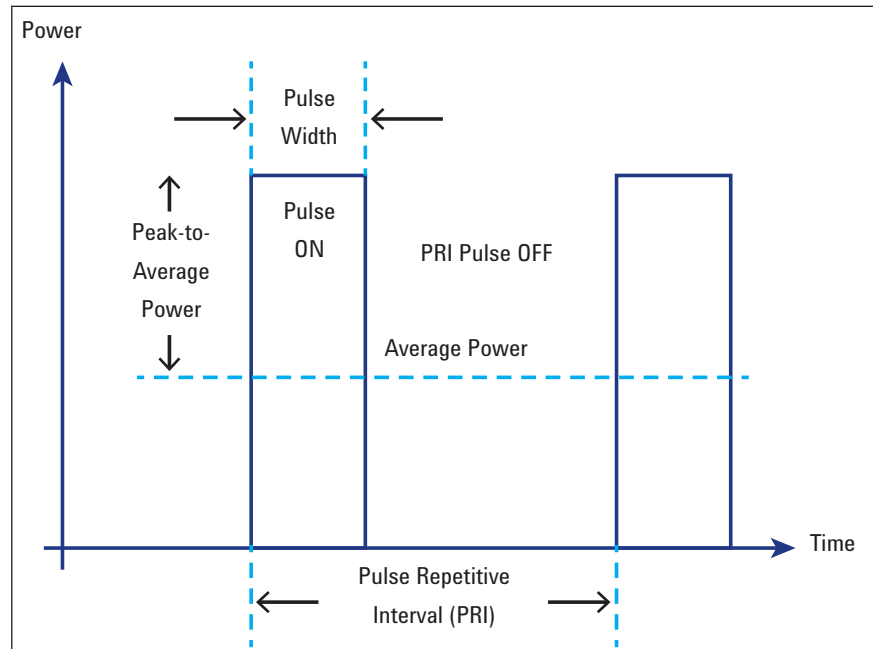


Figure 1. Pulse power measurement

Making 14-Point Pulse Characterization Measurements

The 8990B peak power analyzer is designed to provide both aspects of the radar pulse analysis measurement and perform the 14-point pulse characteristic measurements noted in Table 1. Figures 1 and 2 provide a reference to waveform attributes being measured.

Pulse parameters	Description
Minimum	The minimum value of a waveform
Peak	The maximum instantaneous power
Average	The power integrated over a complete time waveform (on time and off time) Average power = $10 \log(\text{pulse width}/\text{PRI})$
Peak-to-average	The ratio between the peak power level and average power level
Duty cycle	The ratio between the pulse duration (pulse width) and pulse period (pulse repetitive interval) of a rectangular waveform Duty cycle = pulse width x pulse repetitive interval
Pulse repetitive interval (PRI)	The interval between the pulse start time of the first pulse and the immediately-following pulse in a periodic pulse train
Pulse repetitive frequency (PRF)	The reciprocal of the PRI $\text{PRF} = 1/\text{PRI}$
Rise time	The time interval for a pulse to increase from 10% to 90% of its peak value
Fall time	The time interval for a pulse to decrease from 90% to 10% of its peak value
Off time	The duration of pulse off
Pulse base	Refers to the statistically most prevalent amplitude level (straight line) when the pulse is set to OFF
Pulse top	Refers to the statistically most prevalent amplitude level (straight line) when the pulse are set to ON
Pulse width	The duration of pulse on
Overshoot	The amount the first maximum spark occurs exceeds the straight line segment of the pulse top. Overshoot is expressed in percentage (%)

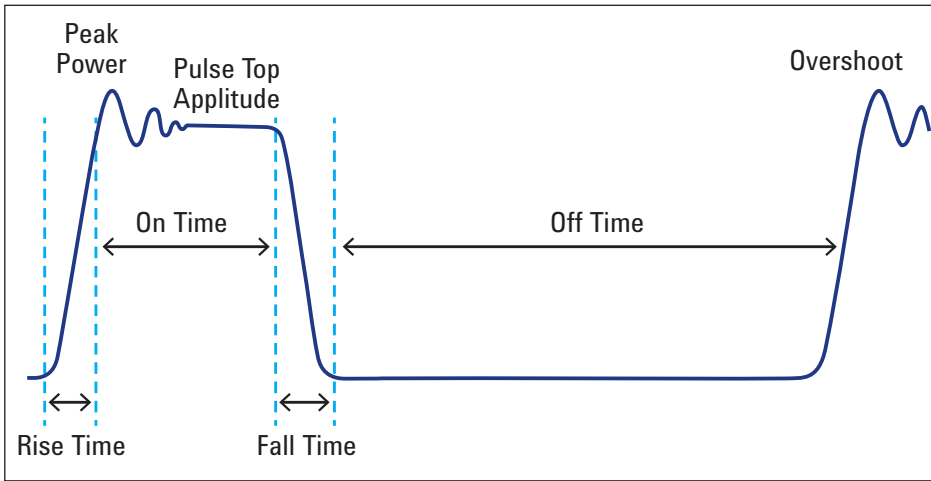


Figure 2. Typical radar pulse analysis parameters

Test Configuration and SCPI Commands

Figure 3 illustrates the equipment configuration for obtaining 14-point pulse parameter values.

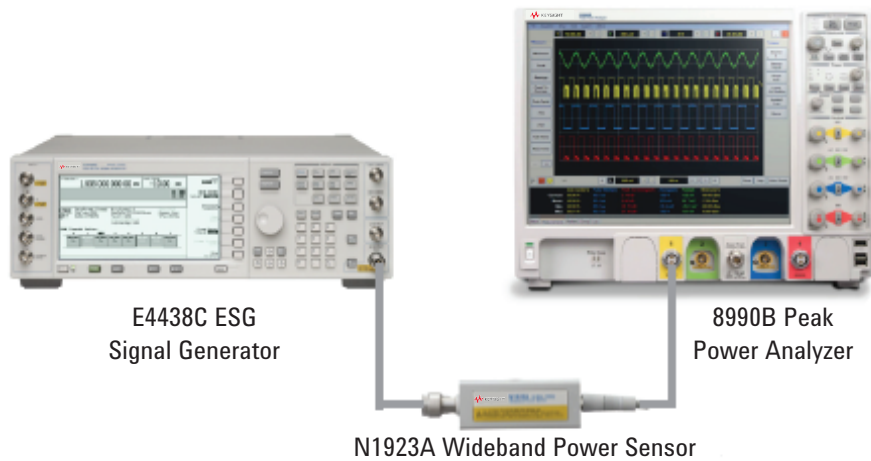


Figure 3. Test setup for obtaining 14-point pulse parameter values

Measurement data is acquired using the following SCPI commands.

SCPI	Description
Keysight ESG/MXG/EXG/PSG signal generator	
SYST:PRES	Preset the instrument to its default settings
FREQ 1GHz	Set frequency to 1 GHz (example)
POW:LEVEL 0DBM	Set output power to 0 dBm (example)
SOUR:PULM:INIT1:PERIOD 1mS	Set pulse period to 1 ms (example)
SOUR:PULM:INIT1:PWIDTH 200uS	Set pulse width to 200 μ s (example)
SOUR:PULM:STAT ON	Turn on pulse signal
OUTP:MOD:STAT ON	Turn on modulation signal
OUTP:STAT ON	Turn on RF output
Keysight 8990B PPA - initialization	
SYST:PRES	Query minimum power for Channel 1
*OPC?	Wait for operation to complete; Return 1 means operation completed
CHAN1:FREQ 1G	Set Channel 1 frequency to 1 GHz
AUT	Autoscale the waveform display
*OPC?	
TRIG:SOUR CHAN1	Set trigger source to Channel 1
TIME:SCALE 200u	Set timebase to 200 μ s/div
*OPC?	
Querying measurement	
MEAS:MIN? CHAN1	Query minimum power for Channel 1
MEAS:PEAK? CHAN1	Query peak power for Channel 1
MEAS:AVERAGE? CHAN1	Query average power for Channel 1
MEAS:PAVERAGE CHAN1	Query peak-to-average power for Channel 1
MEAS:DUTY? CHAN1	Query duty cycle (%) for Channel 1
MEAS:PRI? CHAN1	Query pulse repetitive interval for Channel 1
MEAS:PRF? CHAN1	Query pulse repetitive frequency for Channel 1
MEAS:OFFTIME? CHAN1	Query off-time duration for Channel 1
MEAS:PBASE? CHAN1	Query pulse-base power for Channel 1
MEAS:PTOP? CHAN1	Query pulse-top power for Channel 1
MEAS:PWIDTH? CHAN1	Query pulse width duration for Channel 1
MEAS: OVERSHOOT? CHAN1	Query overshoot measurement for Channel 1
Querying rise time measurement	
TIME:SCALE 50u	Set the timebase to 50 μ s/div
MEAS:RISE? CHAN1	Query rise time measurement for Channel 1
Querying fall time measurement	
TRIG:EDGE:SLOP NEG	Set the trigger edge slope to negative
MEAS:FALL? CHAN1	Query fall time measurement for Channel 1

Conclusion

The 8990B offers most of the basic pulse parameters and timing measurements required for radar pulse analysis. Test setup simplicity and Windows-based software make it easy to obtain radar pulse analysis and wireless pulse measurement results, which are provided on the screen of the 8990B.

References

Keysight 8990B Peak Power Analyzer (PPA) Pulse Radar Power Measurement, demonstration guide, literature number 5990-8708EN

Keysight Best Practices for Making the Most Accurate Radar Pulse Measurements, application note, literature number 5991-0434EN

How to Measure 5ns Rise/Fall Time on an RF Pulsed Power Amplifier using the 8990B Peak Power Analyzer, application note, literature number 5990-9661EN

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