Peak Power Analyzer (8990B) Introduction and Applications

A more powerful solution for radar pulse analysis

Agilent Technologies

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History of Peak Power Analyzer (8990A/91A)

• Introduced in 1993, discontinued in 1998 due to system/parts obsolete
• Heavily leverage from old HP oscilloscope design platform
• Main installed base are from A&D (>50%)
• Typically application is for Radar Pulse analysis (Power vs. Time)
• Key specs:
  - 150MHz Video Bandwidth (repetitive sampling)
  - Frequency up to 40GHz
  - Dynamic Range: -32 dBM to +20 dBM
  - Minimum Pulse Width: 10 ns
  - Rise Time: 5 ns
  - 2 RF Sensor and 2 (Scope) Video Inputs
  - Supports 8481XA sensors only
The new Agilent 8990B Peak Power Analyzer
Agilent Power Meter Series
Agilent Power Meters and Sensor for RF and microwave measurements

**Performance**

- **Peak Power Analyzer**
  - Peak, Average, CCDF (<30MHz VBW)
  - Pulse Measurement
  - Radar Pulse Tr < 5ns

- **NEW June '11**

- **USB Sensors**
  - Average Power
  - Low Cost Solution
  - SIM market, R&D & Mfg

- **EPM**
  - Average Power
  - Wireless Com (GSM, EDGE, WCDMA, Bluetooth, etc)
  - Radar Pulse Tr > 200ns

- **EPM-P**
  - Peak & Average (<5MHz VBW)
  - Wireless Networking (WLAN, WiMAX, MIMO)
  - Radar Pulse Tr > 13ns

- **P-Series**
  - Peak, Average, CCDF (<30MHz VBW)
  - Wireless Networking (WLAN, WiMAX, MIMO)
  - Radar Pulse Tr > 13ns

- **P-Series LXI**
  - Peak, Average, CCDF (<30MHz VBW)
  - Compact, modular, faceless
  - For A&D ATE/ CASS

- **Handheld Power Meter**
  - Average Power
  - Handheld solutions

- **Price**

- **Agilent Technologies**
8990B Peak Power Analyzer Overview

Key Specifications

- Frequency Range: 50MHz to 40GHz (sensor dependent)
- System Rise / Fall Time: 5nsec (-20 dBm to +20 dBm)
- Video BW: 30MHz (single shot) 150MHz (repetitive)
- Dynamic Range: -35 dBm to +20 dBm (CW) -25 dBm to +20 dBm (Pulse)
- Sampling Rate: 100 MSa/sec
- Overall Accuracy: ± 0.2 dB or ±4.5%

Key Features

- 15” XGA Color Display + Touch Screen
- 4 channels (Two RF and two Analog)
- Internal Zero and Calibration
- Dual Screen Zoom Window
- 15 Pulse Characterization Measurements
- Automatic pulse delay measurement between channels
8990B Peak Power Analyzer Overview

- Interactive controls with color coded knobs for each channel.
- Standard Agilent Oscilloscope knobs layout – easy to get familiarized with.
- Easy waveform storage.
- 15 inch XGA color display + Touch Screen.
- Soft key menu.
- 15 automatic pulse characteristics measurements.

- 50MHz / 1.05GHz absolute accurate source for sensor check.
- Two RF channels and two Analog channels (standard scope probe input) with color coded.
8990B Peak Power Analyzer Overview

USB TMC-488 / LAN / LXI-C Instrument Control Ports

N4865A GPIB to LAN adapter

Removable Hard Disk (option)
Pouch bag for sensors and cable storage
8990B Peak Power Analyzer GUI Overview

Measurement Screen

Delay Measurement

Threshold Settings

Spacing Measurement

Zoom Screen
What’s the value of the new 8990B going to offer?

Fast rise/fall time measurement
- 3 nanosecond on sensor, 4 nanosecond on meter, effective system rise time -> 5 nanosecond
- Able to measure short radar pulse rise/fall time accurately

Power vs. Time measurement accuracy & traceability
- $\leq 0.2$ dB or $\pm 4.5\%$ average power measurement accuracy*
- Delta time accuracy equal or better than the old box

Utilizing standard Agilent scope user interface
- Knobs and 15” touch screen
- Minimize the effort to familiarize the user interface

Compatible with USB Sensors
- Connect to USB sensors for average power measurement

Internal Zero and Calibration
- Hassle free with auto zeroing and calibration when sensor is connected to the analyzer

* Specification is valid over a range of -15 to +20 dBm, and a frequency range of 0.5 to 10 GHz, DUT Max. SWR<1.27 for the N1923A, and a frequency range of 0.5 to 40GHz, DUT Max. SWR<1.2 for the N1924A. Averaging is set to 32.
Other exciting features

• 4 channels simultaneous trace & measurements

• Automatic pulse characteristic measurements

<table>
<thead>
<tr>
<th></th>
<th>PRI(2)</th>
<th>Average(2)</th>
<th>PRI(1)</th>
<th>Pulse Top(1)</th>
<th>Peak(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>80 us</td>
<td>-479 mV</td>
<td>50.3 us</td>
<td>-0.10 dBm</td>
<td>0.29 dBm</td>
</tr>
<tr>
<td>Mean</td>
<td>80 us</td>
<td>-404 mV</td>
<td>50.3 us</td>
<td>-0.08 dBm</td>
<td>0.30 dBm</td>
</tr>
<tr>
<td>Min</td>
<td>80 us</td>
<td>-488 mV</td>
<td>50.3 us</td>
<td>-0.10 dBm</td>
<td>0.29 dBm</td>
</tr>
<tr>
<td>Max</td>
<td>80 us</td>
<td>-478 mV</td>
<td>50.3 us</td>
<td>-0.05 dBm</td>
<td>0.32 dBm</td>
</tr>
</tbody>
</table>

• USB & LAN (LXI-C) connectivity
• Auto scale → automatically configure the traces
• Markers
• Statistical measurements → CCDF
• Easy waveform storage
• Zoom function – dual window
• Removable hard disk
New Peak Power Analyzer Wide Band Sensors

Frequency:
50MHz – 18GHz (N1923A)
50MHz – 40GHz (N1924A)

Power Range:
-35dBm to +20dBm

Rise /Fall Time: 3ns

Linearity: < 0.3%

Overshoot: < 5%

SWR: < 1.2
New Peak Power Analyzer Wide Band Sensors

<table>
<thead>
<tr>
<th>Old Sensors</th>
<th>Frequency Range</th>
<th>Rise time***</th>
<th>Power Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 84812A*</td>
<td>500MHz to 18GHz</td>
<td>5nsec - 250us</td>
<td>-32 to +20dBm</td>
</tr>
<tr>
<td>HP 84813A*</td>
<td>500MHz to 26.5GHz</td>
<td>5nsec - 250us</td>
<td>-32 to +20dBm</td>
</tr>
<tr>
<td>HP 84814A*</td>
<td>500MHz to 40GHz</td>
<td>5nsec - 250us</td>
<td>-32 to +20dBm</td>
</tr>
<tr>
<td>HP 84815A**</td>
<td>50 MHz to 18 GHz</td>
<td>45nsec -</td>
<td>-32 to +20dBm</td>
</tr>
</tbody>
</table>

* 84812A, 84813A & 84814A can be replaced by N1923A & N1924A
** 84815A rise time <45nsec can be replaced by N1921A
*** Power range dependent

<table>
<thead>
<tr>
<th>New Sensor</th>
<th>Frequency Range</th>
<th>System Rise time</th>
<th>Connector Type</th>
<th>Power Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>New (N1923A)</td>
<td>50MHz to 18GHz</td>
<td>5nsec</td>
<td>Type N (m)</td>
<td>-35 to +20dBm</td>
</tr>
<tr>
<td>New (N1924A)</td>
<td>50MHz to 40GHz</td>
<td>5nsec</td>
<td>2.4 mm (m)</td>
<td>-35 to +20dBm</td>
</tr>
<tr>
<td>N1921A</td>
<td>50MHz to 18GHz</td>
<td>13nsec</td>
<td>Type N (m)</td>
<td>-35 to +20dBm</td>
</tr>
<tr>
<td>N1922A</td>
<td>50MHz to 40GHz</td>
<td>13nsec</td>
<td>2.4 mm (m)</td>
<td>-35 to +20dBm</td>
</tr>
</tbody>
</table>

**Highlights**

Equipped with Internal zeroing & calibration for easy/convenient setup
# New and Old Peak Power Analyzer Comparison

<table>
<thead>
<tr>
<th>Features</th>
<th>HP 8990A/ 8991A</th>
<th>Agilent 8990B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>9” Mono</td>
<td>15” XGA (color display)</td>
</tr>
<tr>
<td>Video Bandwidth</td>
<td>1MHz (single shot) 150MHz (repetitive)</td>
<td>30MHz (single shot) 150MHz (repetitive)</td>
</tr>
<tr>
<td>Rise/ Fall Time</td>
<td>5nsec (0 to +20dBm)</td>
<td>5nsec (-20 to +20dBm)</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>-32 to +20dBm (CW) -30 to +20dBm (Pulse)</td>
<td>-35 to +20dBm (CW) -25 to +20dBm (Pulse)</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>50MHz to 40GHz</td>
<td>50MHz to 40GHz</td>
</tr>
<tr>
<td>User Interface</td>
<td>Push buttons and knobs</td>
<td>Touch Screen and knobs</td>
</tr>
<tr>
<td>Power Sensors</td>
<td>8481xA</td>
<td>N192xA (Internal zero &amp; cal)</td>
</tr>
<tr>
<td>Number of channels</td>
<td>2 + 2</td>
<td>2 + 2 + 1 (USB sensor)</td>
</tr>
</tbody>
</table>
Peak Power Analyzer Application in Transponder Test Set Validation
Transponder Test Set Validation

Test set up

1 GHz DSO Scope

Signal Generator

8472B Crystal Detector

8472B Crystal Detector

Interrogation pulse

Reply Pulse delay measurement

Interrogation pulse

Reply pulse

Reply pulse delay

RF channel 1

RF channel 4

Limitation:
This setup only measure the reply pulse delay measurement. You still need power meter for other power measurement!
Transponder Test Set Validation

Advantage:
Besides measuring the reply pulse delay time, Peak Power Analyzer can measure other power measurements.
Peak Power Analyzer Application in Power Amplifier / TWT Design Testing
Power Amplifier/ TWT Design Testing

**Test set up**

- Input RF pulse trace
- Output pulse

**Gain Measurements**

- N1912A P-series

**Current Solution**

- Limitation: User’s need to ratio the amplitude from Input vs. output manually.
Power Amplifier/ TWT Design Testing

Test set up

Gain Measurements

8990B PPA

Advantage:
1. Two traces in same screen
2. Observe the gain visually

New Solution

Input RF pulse trace

Output pulse

Advantage:
1. Two traces in same screen
2. Observe the gain visually
Peak Power Analyzer Application in Pulse Droop Measurement
Pulse Droop Measurement

Pulse droop

- To check the stability of the power amplifier’s output power.

\[ X2 - X1 = b - a \]

\[ Y2 - Y1 = d - c \]

Markers measurement

Time difference

Droop measurement
Pulse Droop Measurement

Test set up

1 GHz DSO Scope

8472B Crystal Detector

Power Amplifier

Input RF pulse trace

Voltage

Output pulse

Pulse Droop Measurements

Limitation: User’s need to convert the information from Volt to dBm.
Pulse Droop Measurement

Test set up

Automatic Pulse Droop Measurements

8990B PPA

Input RF pulse trace

Output pulse

New Solution
Radar Pulse Parameters Measurement in Transmitter

- **Pulse droop AUTOMATIC** measurement

![Pulse droop trace](image)

Pulse droop automatic measurement, Results shows in %
QUESTIONS & ANSWER?