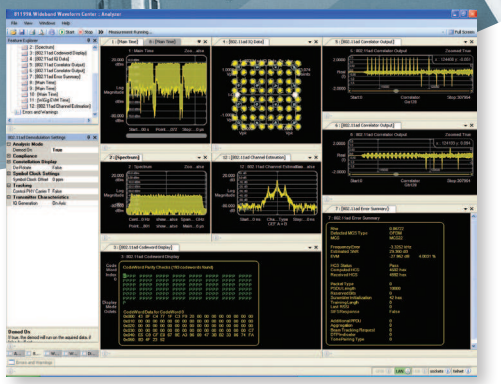
Agilent 81199A Wideband Waveform Center

Data Sheet 1.0

Overview

The trend continues: Increasingly convenient wireless access is driving demand for more data in less time. As transmission rates climb, it puts additional strain on components, infrastructure, frequency spectrum and developers. The demand for wideband data is also inspiring the creation of new standards that utilize increasingly complex modulation schemes to transmit more data through the available spectrum.

To help you keep pace with higher frequencies, wider bandwidths and new standards, Agilent has created the 81199A Wireless Waveform Center software. Key elements include the Wideband Waveform Creator signal-generation application and the Wideband Waveform Analyzer application. Both support emerging wideband modulation formats such as Wireless HD, WiGig and IEEE 802.11ad.



Simplify the testing of 60 GHz wireless devices

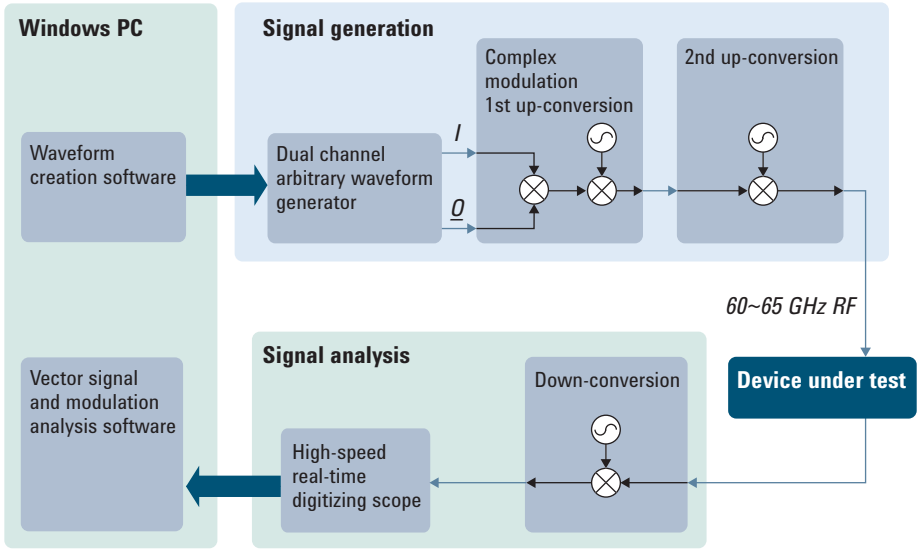
Agilent Technologies

Assemble a flexible and realistic solution

For every new device, product development includes testing and debugging of both the transmitter and receiver sections. Independent of the standard, a flexible and realistic test solution includes four key elements:

- Waveform creation
- Arbitrary waveform generation
- Frequency upconversion and downconversion
- Spectrum and signal analysis

Agilent offers all of these elements, and each is addressed in the pages of this overview. With this combination of advanced tools, you'll be well equipped to keep meeting the needs of data-hungry end users.



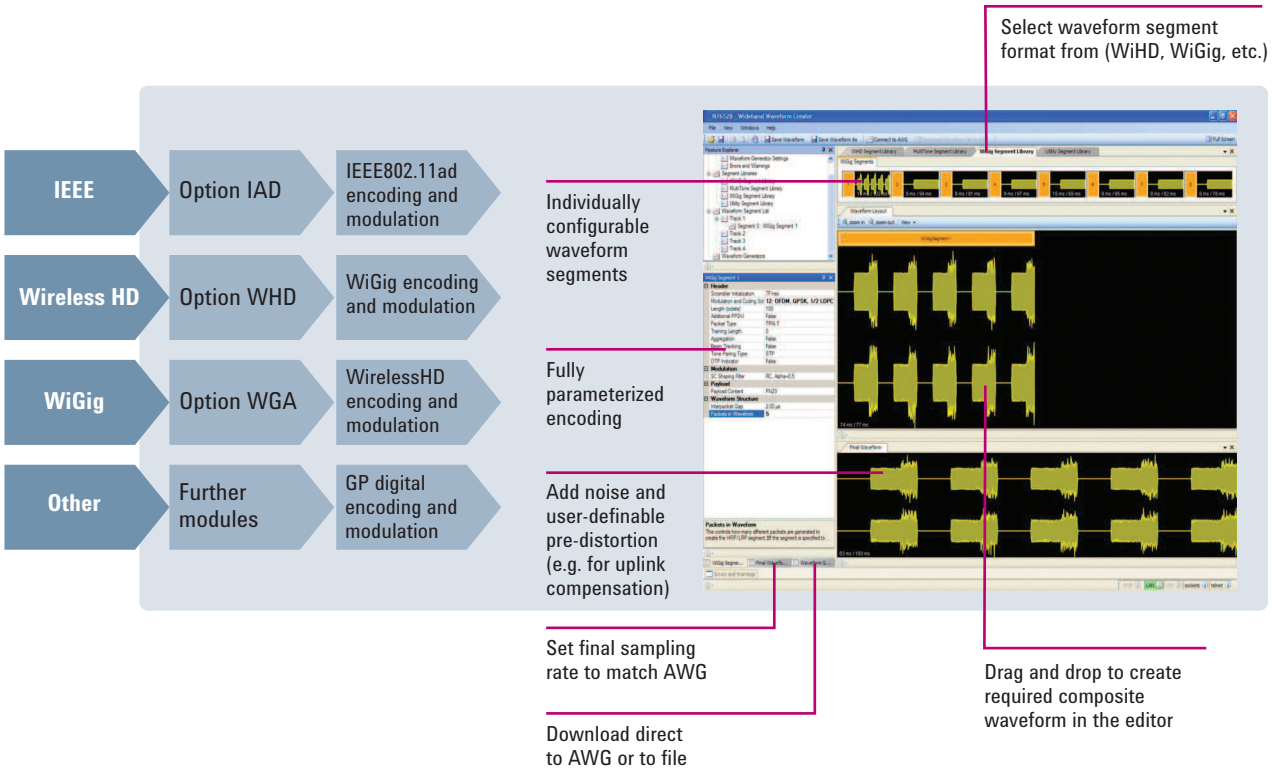
Block diagram of the complete test setup

Keep it simple with drag-and-drop waveform creation

A variety of powerful software tools are available for waveform creation at baseband frequencies. For those who work with an Agilent arbitrary waveform generator (AWG), the most popular choices have been SystemVue from Agilent and MATLAB from The MathWorks. The newest member of the list is Agilent's Wideband Waveform Creator.

As part of the Wideband Waveform Center, the Wideband Waveform Creator makes it easy to test emerging modulation formats such as Wireless HD, WiGig and IEEE 802.11ad. The major capabilities and functions are shown in the figure.

For each standard, Wideband Waveform Creator includes a library of individually configurable waveform segments. Assembling a signal is a matter of dragging and dropping waveform segments and then assigning essential attributes related to encoding and modulation. You can also add noise, IQ impairments and user-defined pre-distortion for uplink compensation and other such functions. The final steps are selecting a sample rate that matches the AWG and then downloading the signal to an AWG or a file.



Enhance your reality with arbitrary waveform generation

When testing 60 GHz wireless signals, one of the biggest challenges is creating test signals with 2 GHz modulation bandwidth, which is up to 100 times wider than that of the IEEE 802.11ac standard. Our latest generation of arbitrary waveform generators can meet the challenge: the standalone Agilent 81180A 4.2 GSa/s AWG instrument and the AXIe-based Agilent M8190A 12 GSa/s AWG module.

Key features of the 81180A include 12-bit resolution, up to 64 MSa memory, and advanced sequencing capabilities. The standard 81180A includes one output channel, and it can be configured with a second output channel to support generation of complex I/Q modulation. A single channel can also be configured to directly generate IF signal with up to 2 GHz modulation bandwidth on a carrier frequency of up to 1.5 GHz.

The M8190A can operate in two different modes: 12-bit resolution at up to 12 GSa/s, or 14-bit resolution at up to 8 GSa/s. The 14-bit mode provides the highest possible spurious-free dynamic range (SFDR) at wide bandwidth, and the 12 GSa/s mode enables generation of direct IF signals up to 5 GHz. To maximize flexibility, switching between the two modes can be done on the fly via software control. In either the 12- or 14-bit mode, the availability of up to 2 GSa of memory combined with advanced sequencing capabilities ensures long playback times when you're creating complex signal scenarios.

With Agilent, you can take reality to the extreme. The 81180A and M8190A AWGs are the sources of greater fidelity, delivering high resolution and wide bandwidth—simultaneously. This unique combination lets you create signal scenarios that push your designs to the limit and bring new insight to your analysis.

Enable high precision on the transmitter and receiver sides

Accurate testing requires precise frequency conversion. On the transmitter side, upconversion translates simulated signals up to the frequency range of the device under test (DUT). On the receiver side, precise downconversion brings the signal into the range of the DUT's internal circuitry into the range of powerful tools for spectrum, signal and modulation analysis.

Upconversion: Signal simulation on the transmitter side

IF-band frequency upconversion can be accomplished with a vector signal generator that includes wideband external I/Q inputs. One excellent example is the Agilent E8267D PSG vector signal generator, which provides IF frequency coverage up to 44 GHz and can be configured with an optional pair of wideband external I/Q inputs (Option 016).

A custom-designed upconverter such as the Agilent N5152A provides frequency conversion into the RF range, spanning 57 to 66 GHz. A high precision microwave analog signal generator such as the Agilent N5183A MXG can be used to provide a stable local oscillator (LO) signal for the upconverter.

Downconversion: Signal analysis on the receiver side

A custom-designed downconverter such as the N1999A provides frequency translation to the IF band. For excellent signal analysis and modulation analysis, consider an Agilent Infiniium 90000 X Series oscilloscope—with up to 32 GHz analog bandwidth—and the Agilent N9030A PXA signal analyzer with frequency coverage that reaches up to 50 GHz and can be extended to 325 GHz and beyond using external mixing.

These instruments are compatible with the industry-leading Agilent 89600 vector signal analysis (VSA) software. The 89600 VSA supports more than 30 hardware platforms and can run on a PC or inside newer Agilent instruments based on Windows®. The VSA software supports more than 70 signal formats, provides advanced demodulation capabilities, and performs measurements of EVM and other important signal characteristics.

Within the Wideband Waveform Center, the Wideband Waveform Analyzer is another important part of the receiver-side solution. This functionality provides a software environment for modulation analysis of fully coded signals, and the graphical presentation of results enables at-a-glance detection of problems. The figure describes additional capabilities that are part of the Wideband Waveform Analyzer.

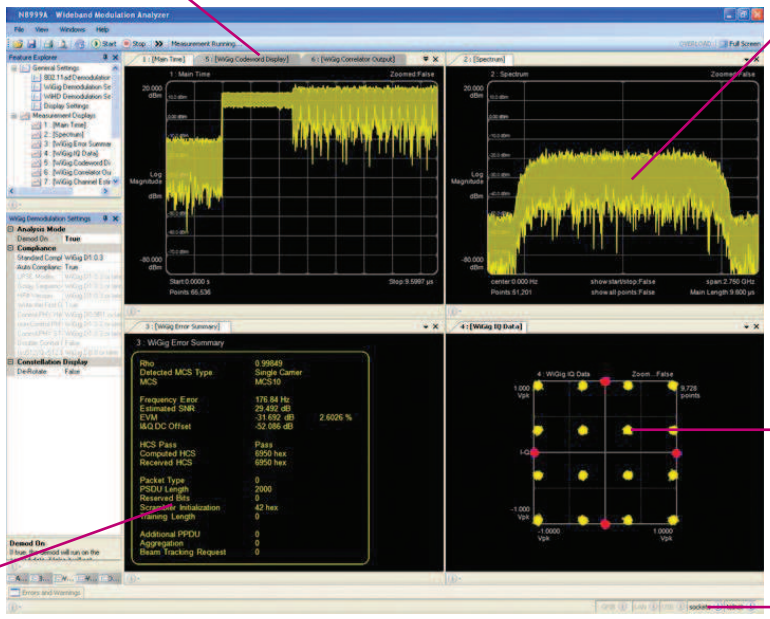
Characterizing devices with network analysis

For additional RF characterization from 10 MHz to 67 GHz, a microwave network analyzer provides single-connection measurements of active devices such as amplifiers, mixers and frequency converters. To simplify test configuration, built-in elements include a second signal source, a combiner and internal signal-routing switches. Example measurements include S-parameters, gain compression, two-tone measurements, and noise-figure measurements on converters and two-port devices.

Multiple dockable windows, each independently configurable to display any mix of:

- Spectrum
- Main time
- Error summary
- Decoded payload data
- LDPC codeword display
- Correlator output
- Channel estimation
- Channel frequency response
- IQ data
- EVM spectrum
- EVM time
- OFDM EVM vs. symbol
- OFDM EVM vs. subcarrier
- Carrier tracking
- Phase error
- Power vs. time

Detailed tabulation of numerical results



Flexible graphing including image cut/paste for easy documentation

Full demodulation and analysis of all 32 MCS; CPHY; SCPHY; OFDMPHY and LPSCPHY

Full remote control using SCPI over LAN/telnet/sockets

Solution details for the 81199A Wideband Waveform Center

Option 001: Wideband waveform creator

General features:

- IQ impairments and Gaussian noise addition
- Pre-distortion: complex and sin(x)/x
- Output direct to Agilent arbitrary waveform generators
- Unencrypted output to file (Option DFP)
  - I/Q data in CSV, BIN, or MAT format

General-purpose digital modulation:

- Single-tone , two-tone and multi-tone
- QPSK, 8-PSK, 16-QAM, GMSK, Pi/2-BPSK
- Configurable baseband filtering

Option WHD: Wireless HD

- Available only to members of the Wireless HD Consortium
- V1.0A and V1.1 compliant waveform (including errata)
- Supports HRP and PRP
- Supports all transmit modes

Option WGA: WiGig

- Available only to members of the Wireless Gigabit Alliance
- Fully compliant waveforms
- Supports control, SC and OFDM PHYs
- Supports all 32 MCS

Option IAD: IEEE 802.11ad

- Equivalent to WiGig specifications (see Option RFP, above)

Option 002: Wideband waveform analyzer

- Color-coded composite constellation display
- Multiple dockable windows, each independently configurable to display one of 13 measurement results:
  - Spectrum
  - Main time
  - Constellation
  - Error vector spectrum
  - EVM vs. subcarrier
  - EVM vs. symbol
  - Equalized frequency response magnitude
  - Equalized frequency response phase
  - Tracking error
  - Cross correlation
  - Error summary
  - Header summary
  - Payload analysis

Detailed measurements for option WHD

Full list of HRP measurements

- EVM (dB and % rms)
- Peak EVM (dB and % rms) and symbol/subcarrier location of peak
- Data EVM (dB and % rms)
- Pilot EVM (dB and % rms)
- QPSK EVM (dB and % rms)
- 16-QAM EVM (dB and % rms)
- Frequency error
- Sync correlation
- Symbol clock error
- I/Q timing skew
- I/Q quadrature error
- I/Q DC offset
- I/Q gain imbalance
- Common tracking error
- Time-domain preamble power (dBm)
- Frequency-domain preamble power (dBm)
- TD/FD preamble relative power (dB)
- Pilots relative power (dB)
- TD preamble correlation
- FD preamble correlation
- Header checksum (HCS) pass/fail
- Header beam-tracking bit
- Header UEP mapping-mode bit
- Header S0, S1, S2, S3 bits
- Subpacket 1 – 7 transmit-mode index
- Subpacket 1 – 7 subpacket length (in octets)
- Subpacket 1 – 7 payload checksum (PCS) pass/fail
- Payload 1 – 7 data octet decode

Full list of LRP measurements

- EVM (dB and % rms)
- Peak EVM (dB and % rms) and symbol/subcarrier location of peak
- Data EVM (dB and % rms)
- Pilot EVM (dB and % rms)
- QPSK EVM (dB and % rms)
- 16-QAM EVM (dB and % rms)
- Frequency error
- Sync correlation
- Symbol clock error
- I/Q timing skew
- I/Q quadrature error
- I/Q DC offset
- I/Q gain imbalance
- Common tracking error
- Time-domain preamble power (dBm)
- Frequency-domain preamble power (dBm)
- TD/FD preamble relative power (dB)
- Time-domain preamble field cross correlations
- Header checksum (HCS) pass/fail
- Payload checksum (PCS) pass/fail
- Mode index
- Payload length
- Scrambler initialization
- Payload decode

Full List of mixed HRP/LRP measurements

- HRP/LRP relative frequency error
- HRP/LRP relative symbol clock error

Detailed measurements for options WGA/IAD, WGA and IAD

Measurement	CPHY	SCPHY	OFDMPHY	LPSCPHY
Spectrum	●	●	●	●
Time	●	●	●	●
Preamble rho	●	●	●	●
Detected MCS type	●	●	●	●
Frequency error	●	●	●	●
Estimated SNR	●	●	●	●
EVM	●	●	●	●
EVM (DC compensated)		●		●
I & Q DC offset		●		●
IQ amplitude imbalance		●		●
LO Quadrature error		●		●
Header information	●	●	●	●
◦ MCS		●	●	●
◦ HCS status	●	●	●	●
◦ Computed HCS	●	●	●	●
◦ Received HCS	●	●	●	●
◦ Packet type	●	●	●	●
◦ PSDU length	●	●	●	●
◦ Scrambler initialization	●	●	●	●
◦ Training length	●	●	●	●
◦ Last RSSI		●	●	●
◦ SIFS response	●	●	●	●
◦ Additional PPDU		●	●	●
◦ Aggregation		●	●	●
◦ Beam tracking request		●	●	●
◦ DTP indicator			●	
◦ Tone pairing type			●	
Decoded payload data (octets or bits)	●	●	●	●
LDPC codeword display (octets or bits)	●	●	●	
RS codeword display (octets or bits)				●
Correlator outputs (Ga32, Gb32)	●			
Correlator outputs (Ga64, Gb64)		●	●	●
Correlator outputs (Ga128, Gb128)	●	●	●	●
Channel estimation CEF A, CEF B or CEF A+B)	●	●	●	●
Channel frequency response	●	●	●	●
IQ Data (color coded header, data and pilots)	●	●	●	●
EVM spectrum		●	●	●
EVM time	●	●	●	●
OFDM EVM vs. symbol (color coded)			●	
OFDM EVM vs. subcarrier (color coded)			●	
Carrier tracking		●	●	●
Phase error	●	●	●	●
Power vs. time	●	●	●	●

Tasks and relevant Agilent products

Task	Relevant Agilent Products
Signal creation	81199A Wideband Waveform Creator in Wideband Waveform Center
Signal generation	81180A wideband arbitrary waveform generator; two channels, 64 MSa, 10-bit resolution, 4.2 GSa/s M8190A wideband arbitrary waveform generator; two channels, 2 GSa, 14-bit resolution, 12 GSa/s E8267D PSG vector signal generator; up to 44 GHz + Opt 016 wideband external I/Q inputs E8257D-567 frequency range from 250 kHz to 67 GHz (CW) N5152A 5 GHz/57-66 GHz upconverter N5183A-520 MXG microwave signal generator (serves as upconverter local oscillator)
Network analysis	E8361C PNA Series microwave network analyzer, 10 MHz to 67 GHz V11644A mechanical calibration kit, 40 to 75 GHz, waveguide, WR-15
Spectrum analysis	E4448A PSA Series spectrum analyzer, 3 Hz to 50 GHz + Option AYZ (external mixing) 11974V preselected millimeter mixer, 50 GHz to 75 GHz + Option 001 (calibration accessory) N9030A PXA Series spectrum analyzer, 3 Hz to 50 GHz M1970V, 50 to 75 GHz waveguide harmonic mixer
RF power measurements	N1913/14A, EPM Series power meters V8486A V-band power sensor, –30 dBm to +20 dBm Option H02 V-band power sensor, –60 dBm to +20 dBm N8488A, 10 MHz to 67 GHz power sensor, –35 dBm to +20 dBm
Signal acquisition	N1999A 57-66 GHz downconverter N5183A-520 MXG microwave signal generator (serves as downconverter local oscillator) Infiniium 90000 Series high-performance oscilloscope, up to 13 GHz 1169A 12 GHz InfiniiMax II series probe amplifier + N5380A InfiniiMax II 12 GHz differential SMA adapter Infiniium 90000 X-Series high-performance oscilloscope, up to 32 GHz
Vector signal analysis	89600 vector signal analysis software 81199A Wireless HD/WiGig/IEEE 802.11ad wideband waveform analysis software
Device testing	66300 mobile-communications DC sources
Protocol analysis	N5998A HDMI protocol/audio/video analyzer and generator

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