



IEEE 802.11a/b/g/n Manufacturing Test with the Agilent N8300A

Part 4: How to migrate from the N4010A to N8300A for WLAN testing
Application Note



Introduction

This application note is one of a four part series of documents on IEEE 802.11a/b/g/n WLAN testing using the Agilent N8300A wireless networking test set.



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Introduction

This application note is one of a four part series of documents on IEEE 802.11a/b/g/n WLAN testing using the Agilent N8300A wireless networking test set. The literature has been segmented into four technical areas as the following abstracts explain.

1. *IEEE 802.11a/b/g/n Manufacturing Test with the N8300A*

Part 1: Introduction to a WLAN manufacturing test plan and theory of implementation

Part 1 introduces a typical WLAN manufacturing test plan for testing IEEE 802.11a/b/g/n format devices. The document provides background and theory on the test phases using an example test plan. This is useful for development and production engineers wishing to understand the key tests in manufacturing. The N8300A measurements are introduced at each test phase with pseudo code used to demonstrate how a test may be implemented with the device under test (DUT.) As a result, the engineer should be ready to progress to the implementation of a test plan and N8300A test code.

2. *IEEE 802.11a/b/g/n Manufacturing Test with the Agilent N8300A*

Part 2: Implementation of a WLAN test plan using SCPI programming

This application note builds upon the pseudo code examples and test phases presented in Part 1 of the series by providing standard commands for programmable instruments (SCPI) scripts. This document is particularly useful for test and production engineers who wish to programmatically implement tests with a DUT. These examples are easily leveraged into any programming environment.

3. *IEEE 802.11a/b/g/n Manufacturing Test with the Agilent N8300A*

Part 3: Techniques for optimizing WLAN device testing

Test speed is influenced by a range of variables including the DUT, test methodology, and the test instrumentation. Part 3 of the series presents test techniques, test methods, and programming recommendations that are aimed at optimizing speed. This document is aimed at engineers who want to optimize existing tests, or, aiming to obtain best practices for maximizing speed and efficiency of a new test plan.

4. *IEEE 802.11a/b/g/n Manufacturing Test with the Agilent N8300A*

Part 4: How to migrate from the N4010A to N8300A for WLAN testing

This document presents two different options for backwards compatibility with the existing Agilent N4010A wireless connectivity test set WLAN measurements. Engineers may choose to use the Agilent N8300A wireless networking test set hardware as a drop-in replacement instead of the N4010A, thereby re-using existing test software. In contrast, engineers who wish to migrate away from the N4010A driver application programmable interface (API) to SCPI may do so with the guidance contained within this application note.

The Agilent N4010A is recognized as being an optimized one box tester (OBT) that delivers fast test speed for IEEE 802.11a/b/g/n WLAN formats and Bluetooth®. The Agilent N8300A is an evolution of the N4010A, offering WiMAX™ testing as part of its technology coverage. If a test engineer is to transition successfully from one instrument to another, it is important to first understand the differences. To then successfully migrate test code controlling the hardware, it is important to understand the options available and the impact on test code and specific measurements (if any). The assumptions below are based on N4010A WLAN driver v6.38 with N8300A firmware A.06.46.

Hardware Overview and Features Comparison

Similarities

In terms of WLAN DUT testing the existing test approaches used in N4010A remain the same as the N8300A. As outlined in the previous application notes, it is assumed that device test modes exist to facilitate transmitter and receiver testing via chipset control code, and that use of protocol is not intended or required.

The measurements in N4010A are leveraged in N8300A providing tight correlation of results. The N8300A uses the sequential capture technique [4] for 802.11n multi-channel testing. The WLAN Virtual Front Panel is also common to both instruments as a benchtop test tool.

Differences

The main difference between the two test instruments is in their hardware and so the datasheet is an important resource. In addition, the N8300A can be configured with a single RF I/O or multiple RF I/O. The N4010A has only one RF I/O but can be used alongside the Agilent N4011A MIMO multi-port adaptor. The capability of the N4011A is integral to a MIMO optioned N8300A and no additional hardware is required. Comparing a MIMO N8300A again to the N4011A, there is no support for N4011A reference ports in the N8300A. These ports on the N4011A are typically used for connecting to golden radios. The N8300A does not support loss compensation and this must be handled inside test code.

With a MIMO N8300A, broadcast mode can be enabled. This allows for simultaneous transmission out from the RF I/O ports (see Multiple Port Control in [2] for further details.) This may help reduce test time with appropriate device control.

Another difference between the two test sets is that the N8300A can be programmed and controlled using standard commands for programmable instruments (SCPI) for WLAN test. The following sections now cover this in more detail.

N8300A Code Migration Options

The following two options exist to port existing N4010A test code to work with the N8300A:

1. **Use the N8300A as a drop-in replacement with existing N4010A driver application programmable interface (API) test code.** This approach has the benefit of fast migration and backwards compatibility with the minimum of changes to test code. The N8300A can then be used with the existing N4010A driver API. For further information on how to migrate existing N4010A code to N8300A SCPI, refer to Section 3.1 below.
2. **Migrate the N4010A driver API test code to N8300A SCPI.** This approach allows engineers to make use of the benefits of SCPI control of the N8300A, removing API calls to the N4010A driver. This requires test code changes. For further information on how to migrate existing N4010A code to N8300A SCPI, refer to Section 3.2 below.

Using N8300A as a drop-in replacement

By using the N8300A as a drop-in replacement for the N4010A, existing test code can be easily leveraged. In addition, the N4010A WLAN Virtual Front Panel (used for benchtop testing) is also the same. However, some differences do exist in the N8300A hardware and as such has some impact on N4010A test code. The following key differences will be evident:

1. Loss compensation – The N8300A controls loss compensation differently
2. RF performance – The N8300A has improved specifications
3. Associated software – Additional software such as Signal Studio® will be different for the N8300A

Migrating the N4010A driver API to N8300A SCPI

If Option 2 in Section 3.1 is chosen as the transition of switching N4010A test code to N8300A SCPI commands, the test engineer needs to understand differences in the N4010A driver (API) and the N8300A SCPI interface.

Migrating instrument features

The following table compares key N4010A WLAN instrument methods and properties with N8300A WLAN SCPI functionality. Here the instrument class is within the Agilent.N4010.WLanTest namespace with *method()* representing a method, everything else assumed to a property. Methods and properties are listed in alphabetical order.

Table 1: N4010A instrument class migration to N8300A

Agilent.N4010.WLanTest instrument class methods and properties	N8300A	Remark
AutoRangeRunning	No equivalent command	
Calibrate()	No equivalent command	IQ calibration can be carried out on the source
CalibrationNeeded	No equivalent command	
CalibrationRunning	No equivalent command	
Dispose()	N/A	To end WLAN testing, either finish the VISA session to instrument or switch to non-WLAN modes as required
DriverVersion	N/A	No driver is required for SCPI control
DUTChanged()	No equivalent command	Use :READ? To initiate another measurement after a change of device. Use :FETCH? to return cached results

FramesUsed	<measurement>:AVERage:COUNT <average>	See "Averaging" section in [2]
Frequency	:SENSe:FREQuency:CENTer <frequency>	
InstrumentCapability40MHz	N/A	N8300A is 40 MHz compatible
InstrumentFirmwareRevision	*IDN?	
InstrumentManufacturer	*IDN?	
InstrumentModel	*IDN?	
InstrumentOption2GHz	*OPT?	Options are different from N4010A
InstrumentOption5GHz	*OPT?	Options are different from N4010A
InstrumentOption80211n	*OPT?	Options are different from N4010A
InstrumentOptionBluetooth	N/A	No Bluetooth test mode link hardware capability in N8300A
InstrumentOptionFlexibleWaveformGenerator	N/A	Licensing in N8300A uses five-pack licences, allowing for individual waveform licensing
InstrumentSerialNumber	*IDN?	
InstrumentVisaResourceName	N/A	
IsN8300	*IDN?	
LossCompensation	No equivalent command	The N8300A does not have a mechanism for handling loss compensation internally
MaxPacketLength	:SENSe:RADio:MPACKetlen <packet length>	See "Basic Settings" section in [2]
MaxSymbolsUsed	:SENSe:RADio:MSYMBOLs <number_symbols>	See "Basic Settings" section in [2]
MeasurementRunning	No equivalent command	
MeasurementTimeout	N/A	This is configured in a VISA session within test code that supports SCPI
MirrorFrequency	:SENSe:RADio:STANdard:MIRRorspec?	
MmpaConnected	N/A	Use *OPT? to check for equivalent N4011A options in N8300A
MPA	N/A	Use *OPT? to check for equivalent N4011A options in N8300A
N8300Control	N/A	For Agilent use only
PowerRange	:SENSe:POWer:RANGe <range>	See "Basic Settings" section in [2]
Preset()	*RST	
PrimaryRFPort	:SOURce:PORT:PRIMary RFIO1	
QuickCal()	No equivalent command	
ReferenceLocked	No equivalent command	
RFPort1	N/A	See section "Multiple port control" in [2] for range of options in using RFIO ports
RFPort2	N/A	
RFPort3	N/A	
RFPort4	N/A	
SelfTest()	No equivalent command	
SelfTestRunning	No equivalent command	
SetBluetoothMode()	N/A	No Bluetooth test mode link hardware capability in N8300A
SetChannel()	:SENSe:FREQuency:CENTer <frequency> :SENSe:RADio:STANdard:SElect:WLAN <format>	Set frequency and format to replicate
SetDemoMode()	N/A	
SetWlanMode()	:INSTrument:SElect WLAN	See "Basic Settings" section in [2]
Suspend()	N/A	

SuspendWithAWGRunning()	:SOURce:SUSpend	A VISA lock can be broken and the source will continue to transmit. :SOURce:RESume to resume the lock
TriggerDelay	:TRIGger:SEquence:RFBurst:DELay <delay> :TRIGger:SEquence:RFBurst:DELay:STATe ON	See "Triggering" section in [2]
TriggerHoldoff	:TRIGger:SEquence:HOLDoff <holdoff> :TRIGger:SEquence:HOLDoff:STATe ON	See "Triggering" section in [2]
TriggerLevel	:TRIGger:SEquence:RFBurst:LEVel:ABSolut e <level>	See "Triggering" section in [2]. Note that trigger level default unit is now dBm (previously only voltage)
TriggerStyle	<measurement>:TRIGger:SOURce <style>	See "Triggering" section in [2]
TTLOutput	N/A	
TTLOutput0	N/A	
TTLOutput1	N/A	
TTLOutput2	N/A	
TTLOutput3	N/A	
UsealternateSyncSequence	:CALCulate:EVM:CESTimation ON	
WindowType	:CALC:<measurement>:WTYPE <type>	

Migrating measurements

The following table compares the N4010A WLAN transmit testing measurements with the N8300A WLAN measurements (Note: Receiver testing is under arbitrary waveform generator (AWG) migration Section 3.2.5). For the N4010A, the class within the driver is shown in brackets. Such classes are found in Agilent.N4010.WLANTest.Measurements namespace. An "*" indicates that a migration to a different N8300A measurement is required or recommended in order to return the result(s) for the measurement.

Table 2: N4010A measurement class migration to N8300A

Agilent.N4010.WLANTest.Measurements namespace classes	N8300A	Remark
Average Power (MeasurementAveragePower)	Power (:READ:TXPower?)	
Carrier Suppression (MeasurementCarrierSuppression11b)	Carrier Suppression (:READ:CSUPpression?)	
Center Frequency Leakage (MeasurementCFL11ag)	Center Frequency Leakage (:READ:CFLeakage?)	
CW Frequency Offset (MeasurementCWFrequencyOffset)	CW Frequency Offset (:READ:CWFoffset?)	
11a Demod (MeasurementDemod11a)	11a Demod (:READ:EVM?)	
11b Demod (MeasurementDemod11b)	11b Demod (:READ:EVM?)	
11n Demod (MeasurementDemod11n)	11n Demod (:READ:EVM?)	
11b Power Ramp (MeasurementDsssPowerRamp)	11b Power Ramp (:READ:PRAMP?)	
11a EVM (MeasurementEVM11ag)	11a Demod (:READ:EVM?) *	The N4010A EVM result is returned as a percentage. Demod returns dB
11b EVM (MeasurementEVM11b)	11b Demod (:READ:EVM?) *	Peak EVM and RMS EVM returned as a percentage (previously RMS) as part of Demod measurement
11a Frequency Error (MeasurementFrequencyError11a)	11a Demod (:READ:EVM?) *	Error returned in Hz (previously ppm) as part of Demod measurement
11b Frequency Error (MeasurementFrequencyError11b)	11b Demod (:READ:EVM?) *	Error returned in Hz (previously ppm) as part of Demod measurement

Gated Spectrum (MeasurementGatedSpectrum)	Spectral Mask (:READ:SMASK?) *	Superseded by Spectral Mask measurement. :READ:GSP0? and :READ:GSP1? provide backwards compatibility for power and frequency arrays
IQ Capture (MeasurementIQSamples)	IQ Capture (:READ:IQCapture?)	
Multi-Step Power (MeasurementMultiStepPower)	Multi-Step Power (:READ:MSPower?)	
Power versus Time (MeasurementPvT)	Power versus Time (:READ:PVTime?)	
11ag Spectral Flatness (MeasurementSpectralFlatness11ag)	Spectral Flatness (:READ:SPFlatness?)	
11a Spectral Mask (MeasurementSpectralMask11a)	Spectral Mask (:READ:SMASK?)	FastMask property is on by default
11b Spectral Mask (MeasurementSpectralMask11b)	Spectral Mask (:READ:SMASK?)	FastMask property is on by default
11n Spectral Mask (MeasurementSpectralMask11n)	Spectral Mask (:READ:SMASK?)	FastMask property is on by default

Migrating utility features

There is no backwards compatibility in the N8300A for N4010A loss compensation. The Autorange method in N8300A will produce slightly different setup parameters than the N4010A. This is due to the different, and better-specified, hardware being used in the N8300A.

The following table compares the N4010A WLAN utility classes with N8300A WLAN functionality. For the N4010A the class within the driver is referenced. Such classes are found under the Agilent.N4010.WLanTest.Utility namespace.

Table 3: N4010A utilities class migration to N8300A

Agilent.N4010.WLanTest.Utility namespace classes	N8300A	Remark
11a Autorange (WtaAutoRange11a)	:READ:ARANge?	
11b Autorange (WtaAutoRange11b)	:READ:ARANge?	
11n Autorange (WtaAutoRange11n)	:READ:ARANge?	
Analyzer Loss Compensation (AnalyzerLossCompensation)	No equivalent command	
Loss Compensation (LossCompensation)	No equivalent command	
Multi Port Adaptor (MPA)	N/A	Use *OPT? to check for relevant options
RF Port (RFPort)	N/A	No reference ports (as per N4011A) are provided on the N8300A
Source Loss Compensation (SourceLossCompensation)	N/A	

Migrating exception handling

The N4010A Agilent.N4010.WLanTest.Exceptions namespace contains definitions of all the public exceptions used in the Agilent N4010 WLanTest programming interface. In the N8300A these classes are replaced with the system error queue (:SYST:ERR?). This is covered in more detail in [2].

Migrating AWG functions

The N8300A flexible port control is virtually identical to the N4010A functionality. As with the N4010A, the N8300A can output continuously with port switching enabled, and supports dynamic frequency and power adjustment within each WLAN band (2.4 and 5 GHz.) However, the N8300A offers additional flexibility with broadcast mode and increased power output. Incorporating this new functionality may reduce test times and improve test coverage. Please consult the relevant datasheets for specifications.

The N8300A comes complete with the same pre-developed receiver testing files provided with the N4010A. This should ensure consistency in receiver testing.

The following table compares key N4010A WLAN AWG methods and properties with N8300A WLAN SCPI functionality. Here the methods and properties are within the Agilent.N4010.WLanTest.AWG namespace with *method()* representing a method, everything else assumed to a property.

Table 4: N4010A WLAN AWG methods and properties compared to N8300A WLAN SCPI functionality

Agilent.N4010.WLanTest.AWG class methods and properties	N8300A	Remark
AddSegment()	:SOURce:RADio:ARB:SEQuence <parameters>	AddSegment is within ComplexSequenceFile class
AddSegment()	:SOURce:RADio:ARB:SEQuence <parameters>	AddSegment is within the SequenceFile class
AdjustOutput()	:SOURce:ADJust <power level>,<offset frequency>	
CopyMarker()	:SOURce:COPY:MARKer <parameters>	
CopySegment()	:SOURce:COPY:SEGMENT <parameters>	
CwTone()	SOURce:CWTone <power level>,<frequency offset>	
DeleteMarker()	:SOURce:DELeTe:MARKer <marker>	
DeleteMarkerNV()	:SOURce:DELeTe:NVMarker <marker>	
DeleteSegment()	:SOURce:DELeTe:SEGMENT <segment>	
DeleteSegmentNV()	:SOURce:DELeTe:NVSegment <segment>	
DeleteSequence()	:SOURce:DELeTe:SEQuence <sequence>	
FreeMarkerSpace	:SOURce:FSPace?	Returns free space in segment, NVsegment, marker, NVmarker, and sequence
FreeMarkerSpaceNV	:SOURce:FSPace?	
FreeSegmentSpace	:SOURce:FSPace?	
FreeSegmentSpaceNV	:SOURce:FSPace?	
FreeSequenceSpace	:SOURce:FSPace?	
HighPowerMode	N/A	N8300A has higher output power than N4010A
LoadCSV()	N/A	
LoadCSVNV()	N/A	
LoadedMarkers	:SOURce:LOAded:MARKers?	
LoadedMarkersNV	:SOURce:LOAded:NVMarkers?	
LoadedSegments	:SOURce:LOAded:SEGMENTS?	
LoadedSegmentsNV	:SOURce:LOAded:NVSegments?	
LoadedSequences	:SOURce:LOAded:SEQuences?	
LoadMarker()	:SOURce:DATA:MARKer <parameters>	
LoadMarkerNV()	:SOURce:DATA:NVMarker <parameters>	
LoadSegment()	:SOURce:DATA:SEGMENT <parameters>	Note that :SOURce:DATA:STANDARD can be used to load the AWG segment files supplied with N8300A

LoadSegmentNV()	:SOURce:DATA:NVSegment <parameters>	
LoadSequence()	:SOURce:DATA:SEQuence <parameters>	Note that :SOURce:DATA:STANdard can be used to load the AWG sequence files supplied with N8300A
PlayA()	:SOURce:SEGMent:PLAY <parameters>	
PlayB()	:SOURce:SEGMent:PLAY <parameters>	
PlayCustom()	:SOURce:SEGMent:PLAY <parameters>	
PortSelection	No equivalent command	Port selection is not available
Save()	:SOURce:RADio:ARB:SEQuence? <parameters>	Save is within the SequenceFile class
SaveMarker()	:SOURce:DATA:MARKer?	
SaveMarkerNV()	:SOURce:DATA:NVMarker?	
SaveSegment()	:SOURce:DATA:SEGMent?	
SaveSegmentNV()	:SOURce:DATA:NVSegment?	
SaveSequence()	:SOURce:RADio:ARB:SEQuence? <parameters>	SaveSequence is within ComplexSequenceFile class
SegmentLoadFileNames	:SOURce:RADio:ARB:SEQuence? <parameters>	SegmentLoadFileNames is within ComplexSequenceFile class
SegmentWindowsFileNames	:SOURce:RADio:ARB:SEQuence? <parameters>	SegmentWindowsFileNames is within ComplexSequenceFile class
SelectSequenceA()	:SOURce:SEQuence:SElect <parameters>	
SelectSequenceB()	:SOURce:SEQuence:SElect <parameters>	
SelectSequenceCustom()	:SOURce:SEQuence:SElect <parameters>	
SequencePlaying	:SOURce:SEQuence:PLAYing?	
SourceActive	:SOURce:ACTive?	
Stop()	:SOURce:STOP	
TriggerSequence()	:SOURce:TRIGger	

References

[1] *IEEE 802.11a/b/g/n Manufacturing Test with the N8300A, Part 1: Introduction to a WLAN manufacturing test plan and theory of implementation*, application note, literature number 5989-9958EN

[2] *IEEE 802.11a/b/g/n Manufacturing Test with the N8300A, Part 3: The first steps towards test automation*, application note, literature number 5989-9960EN

[3] *IEEE 802.11a/b/g/n Manufacturing Test with the N8300A, Part 4: How to migrate from the N4010A to N8300A for WLAN testing*, application note, literature number 5989-9961EN

[4] *Agilent MIMO Manufacturing Solution*, application note, literature number 5989-7037EN

More Information

Agilent N8300A Wireless Networking Test Set Help

N4010A WLAN IEEE 802.11a/b/g/n Video Series, section "N4010A/N4011A 802.11n Test", http://www.agilent.com/find/N4010A_videos

Glossary of Terms

API	Application programmable interface
AWG	Arbitrary waveform generator
DUT	Device under test (the device being tested)
EVM	Error vector magnitude
OBT	One box tester, or one box test set
SCPI	Standard commands for programmable instruments
Segment file	A file containing a representation of a waveform, which can be played by the N8300A source
Sequence file	A file containing one or more pairs of (segment file name, count) which is used to cause the segment file to be generated a specific number of times



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