

Keysight Technologies

DSOXT3NFC/DSOX4NFC

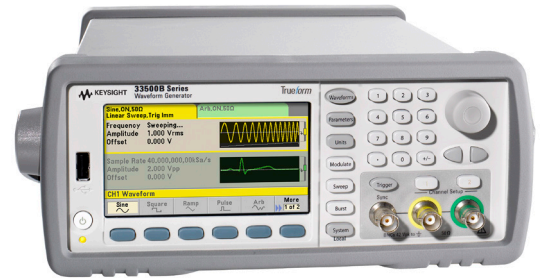
Automated NFC Test Software

N2116A/N2134A/N2135A

Programmable NFC 3-in-1 Antenna

For Keysight InfiniiVision 3000T and 4000 X-Series Oscilloscopes

Data Sheet



Unlocking Measurement Insights

# Introduction

Testing NFC-enabled devices is essential during the design validation phase, as well as during manufacturing test to ensure quality and reliability of data transmission. This is especially important when you consider that the data being transferred/exchanged between NFC-enabled devices is often secured financial transactions.

The Keysight Technologies, Inc.'s DSOXT3NFC/DSOX4NFC automated NFC test software provides thorough physical layer testing with fast throughput. Although the DSOXT3NFC/DSOX4NFC software does not provide complete NFC conformance testing, this software package is based on Keysight's award-winning Infiniium oscilloscope conformance test software to provide a low-cost test solution that includes a broad range of the most critical tests to ensure quality and reliability.

The PC-based software controls a Keysight Technologies, Inc. Trueform waveform generator to produce a variety of test signals based on various NFC standards, and then measures the response captured by a Keysight Technologies, Inc. InfiniVision X-Series oscilloscope with real-time sampling up to 5 GSa/s. Measurement results are then compared against published NFC specifications for pass/fail conditions. The DSOXT3NFC/DSOX4NFC software also provides complete report generation with statistical and margin analysis capabilities as shown in Figure 1.

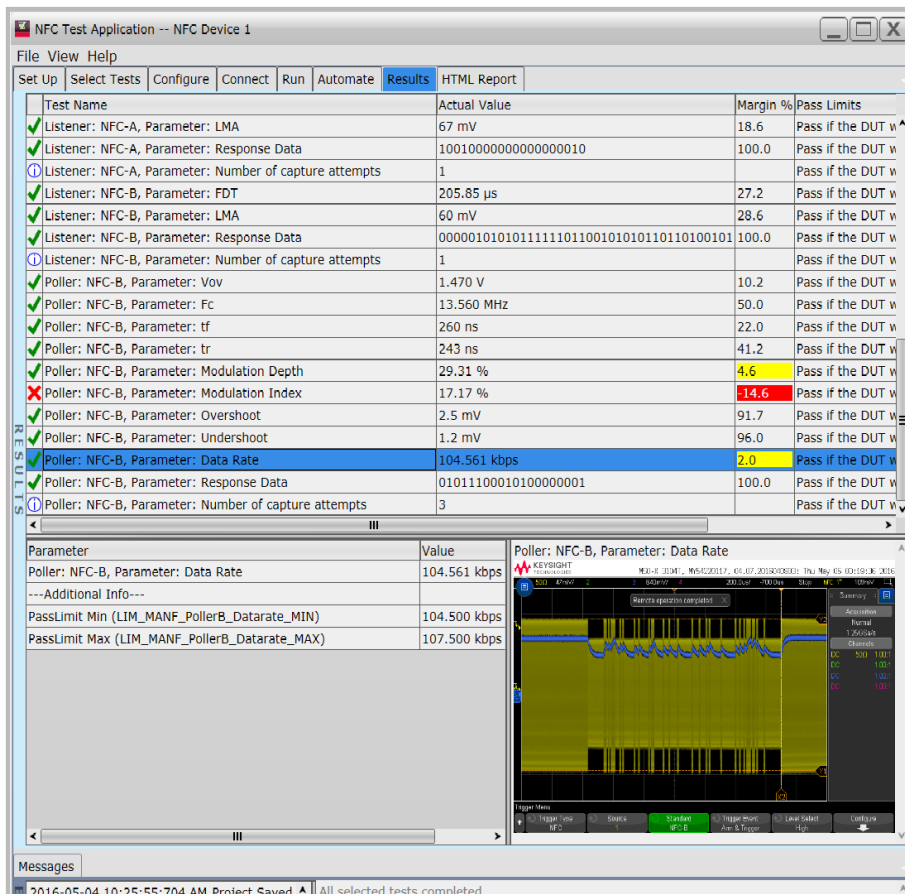


Figure 1. NFC test results shows Poller parameters that fail to meet specifications highlighted in red, as well as marginal test results highlighted in yellow.

Keysight's DSOXT3NFC/DSOX4NFC automated NFC test software guides you through the process of selecting and configuring tests, making oscilloscope connections, running tests, and evaluating the test results. This software:

- Allows you to select individual or multiple tests to run.
- Shows you how to make connections to the test equipment and device under test (DUT) based on a selected connection type.
- Automatically checks for proper test equipment configuration.
- Automatically sets up the equipment for each test.
- Provides detailed information for each test that has been run and lets you specify the thresholds at which marginal or critical warnings appear.
- Creates a printable HTML report of the tests that have been run.

The complete Keysight automated NFC test system for manufacturing test and design validation (Figure 2) consists of the following four components:

1. Keysight DSOXT3NFC or DSOX4NFC PC-based software
2. Keysight 3000T or 4000 X-Series InfiniiVision oscilloscope
3. Keysight 33500 or 33600 Series Trueform waveform generator
4. Keysight N2116A/N2134A/N2135A 3-in-1 programmable NFC antenna (Poller, Listener, and Resonant Frequency test coils)

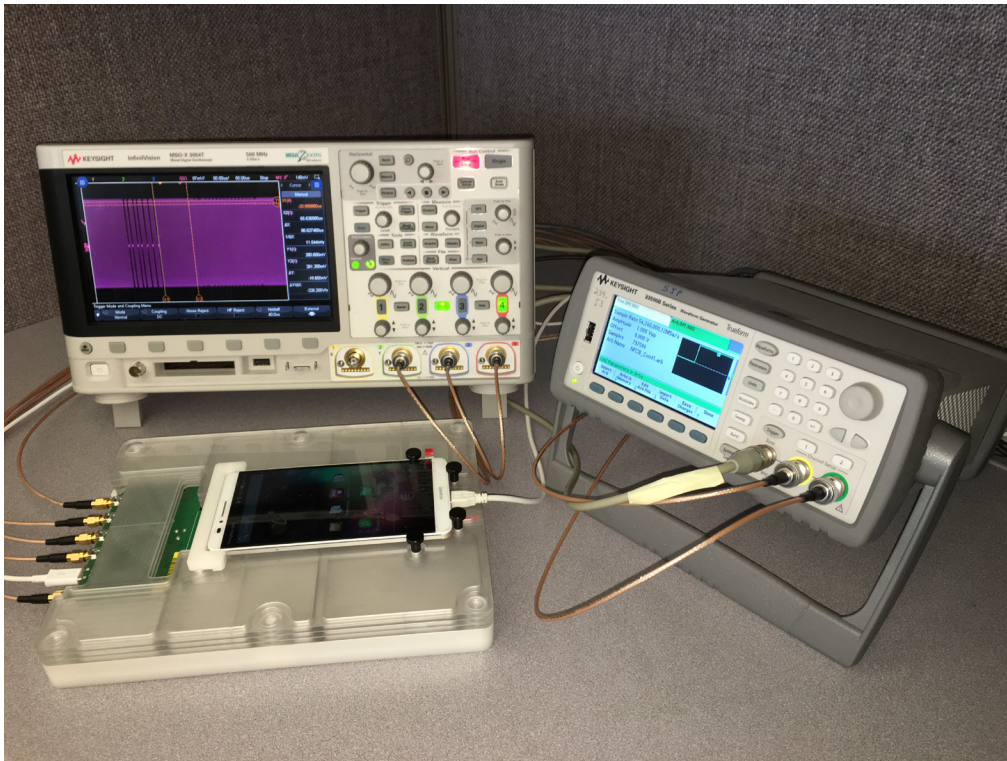


Figure 2. Keysight's oscilloscope-based NFC test system (holding fixture for 3-in-1 antenna/DUT not included).

## NFC Test Coverage

Keysight's automated NFC test software provides higher-level functional pass/fail testing, as well as lower-level physical layer parametric testing. You have the ability to customize your specific test needs by selecting just the measurements required for your particular test environment. Table 1 shows the range of measurements that can be selected.

Table 1. Keysight NFC test coverage

Test	NFC-A	NFC-B	NFC-F (212 kbps)	NFC-F (424 kbps)
<b>Listener mode tests</b>				
Pass/Fail	√	√	√	√
Frame delay time (FTD)	√	√	√	√
Load modulation amplitude (LMA)	√	√	√	√
Response data	√	√	√	√
<b>Poller mode tests</b>				
Pass/Fail	√	√	√	√
t1	√			
t2	√			
t3	√			
t4	√			
t5	√			
Data rate	√	√	√	√
Field strength (Vov)	√	√	√	√
Carrier frequency (Fc)	√	√	√	√
Modulation depth	√	√	√	√
Modulation index	√	√	√	√
Response data	√	√	√	√
Overshoot	√	√	√	√
Undershoot		√	√	√
Rise time (tr)		√	√	√
Fall time (tf)		√	√	√
<b>Resonant frequency test</b>				
	√	√	√	√

## Design Validation and Debug

Keysight's InfiniiVision oscilloscope-based NFC test solution has several advantages over traditional NFC one-box testers. During the design phase of NFC-based products, an oscilloscope is a core test and debug instrument used by nearly all R&D hardware engineers. Although the DSOXT3NFC/DSOX4NFC software runs on an external PC, the software license resides in the scope. This is important because the license also enables special NFC hardware trigger modes in the scope. This means that you can use the scope in a standalone troubleshooting use-model without running the automated test software. The ability to trigger on NFC communication can be an invaluable R&D debug tool.

Before moving an NFC-based device into production, design verification based on published standards is important. Having an NFC test solution that can be quickly set up and provide automated test results in the R&D environment, and then transfer the same test methodology into the manufacturing test environment ensures consistency between all product development and manufacturing test phases.

And finally, when things go wrong on the production floor, Keysight's DSOXT3NFC/DSOX4NFC software can be used on the repair line as well. If a specific test fails on the production line, such as Poller NFC-B modulation depth, just that test can be selected to run on the repair line. When the test is complete, the scope is configured for that particular debugging condition. This enables the repair technician to quickly begin manual troubleshooting with the scope without having to manually set up the scope for complex test conditions as shown in Figure 3.



Figure 3. Using the scope's NFC trigger mode to manually characterize the Poller NFC-B modulation depth after automated test failure on the production line.

## Keysight 3-in-1 Programmable NFC Antenna

Another key element of Keysight's test system is the 3-in-1 programmable NFC antenna. This multi-coil antenna is available in three different fixed spacings:

- 5 mm (N2116A)
- 10 mm (N2134A)
- 15 mm (N2135A)

With this programmable antenna, testing can quickly progress from Listener mode to Poller mode to Resonant Frequency test mode without having to manually or robotically move the DUT from one antenna type to the next.

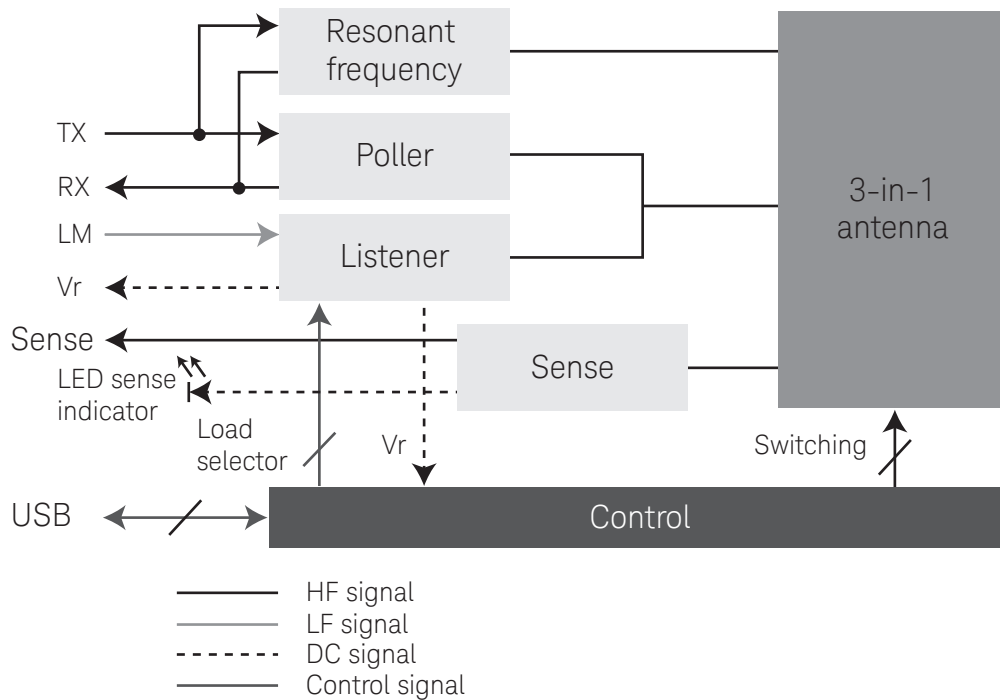


Figure 4. Block diagram of Keysight's 3-in-1 programmable NFC antenna.



Figure 5. The N2116A 3-in-1 NFC antenna.

## Technical Performance Characteristics

Table 2. DSOX3014T oscilloscope (receiver)

Parameter	Measurement input channel <sup>1</sup>	Value
Input impedance	Resonant frequency (channel-1)	50-Ω
	Listener sense (channel-2)	50-Ω
	Poller receive (channel-4)	50-Ω
	Poller Vov (channel-3)	1-MΩ, 14 pF
Max input voltage	Listener sense, Poller receive	8 Vpp
	Poller Vov	40 V
Δ voltage accuracy	Listener sense, Poller receive	± 3% of full-scale at 13.56 MHz
Absolute voltage accuracy	Poller Vov	± 2% of full-scale ± 0.1 div ± 2 mV ± 1% of offset setting
Vertical resolution	All channels	8 bits (0.4%)
Frequency range	All channels	DC to 100 MHz <sup>2</sup>
Max sample rate	All channels	5 GSa/s
Timebase accuracy	All channels	± 1.6 ppm + aging factor <sup>3</sup> (< ± 45 Hz at 13.56 MHz after 5 years)
Spurious (non-harmonic)	Listener sense, Poller receive	< -60 dBc typical (10 to 20 MHz)
Input return loss	Listener sense, Poller receive	> 35 dB

1. Default settings. Channel assignments can be user-modified.
2. -3 dB bandwidth specification for the 100-MHz bandwidth DSOX3014T model. Maximum frequency higher for higher bandwidth models.
3. Aging factor - 1st year: ± 0.5 ppm, 2nd year: ± 0.7 ppm, 5 years: ± 1.5 ppm, 10 years: ± 2.0 ppm.

Table 3. DSOX3014T oscilloscope (NFC triggering <sup>1</sup>)

NFC-A	Trigger on: <ul style="list-style-type: none"> <li>- SENS_REQ</li> <li>- ALL_REQ</li> <li>- Either (SENS_REQ or ALL_REQ)</li> <li>- SDD_REQ</li> <li>- Arm &amp; Trigger...</li> </ul>	<b>...Arm &amp; Trigger</b> Arm on: <ul style="list-style-type: none"> <li>- SENS_REQ</li> <li>- ALL_REQ</li> <li>- Either (SENS_REQ or ALL_REQ)</li> </ul> Trigger on: <ul style="list-style-type: none"> <li>- SDD_REQ or Time-out <sup>2</sup></li> </ul>
NFC-B	Trigger on: <ul style="list-style-type: none"> <li>- SENSB_REQ</li> <li>- ALLB_REQ</li> <li>- Either (SENSB_REQ or ALLB_REQ)</li> <li>- ATTRIB</li> <li>- Arm &amp; Trigger...</li> </ul>	<b>...Arm &amp; Trigger</b> Arm on: <ul style="list-style-type: none"> <li>- SENSB_REQ</li> <li>- ALLB_REQ</li> <li>- Either (SENB_REQ or ALLB_REQ)</li> </ul> Trigger on: <ul style="list-style-type: none"> <li>- ATTRIB or Time-out <sup>2</sup></li> </ul>
NFC-F <sup>3</sup>	Trigger on: <ul style="list-style-type: none"> <li>- SENSE_REQ</li> <li>- ATR_REQ</li> <li>- Preamble</li> <li>- Arm &amp; Trigger...</li> </ul>	<b>...Arm &amp; Trigger</b> Arm on: <ul style="list-style-type: none"> <li>- SENSE_REQ</li> </ul> Trigger on: <ul style="list-style-type: none"> <li>- ATR_REQ or Time-out <sup>2</sup></li> </ul>

1. The following NFC triggering capabilities are available in the oscilloscope when licensed with the DSOXT3NFC/DSOX4NFC option. Running the automated NFC PC-based test software is not required to support these triggering conditions.
2. When using the "Arm & Trigger" selection, after qualifying on the "arm" condition, the scope will trigger on the specified "trigger on" condition or the user-entered time-out setting, whichever occurs first.
3. Both NFC-F (212 kbps) and NFC-F (424 kbps) supported.

## Technical Performance Characteristics (Continued)

Table 4. 33512B waveform generator (transmitter)

Parameter	Output channel	Value
Output impedance	Load modulation (channel-1)	50-Ω
	RF carrier (channel-2)	50-Ω
Output voltage range	RF carrier, Load modulation	1 mVpp to 10 Vpp (re: 50-Ω)
Output power	RF carrier	> 23.9 dBm
Output voltage accuracy	RF carrier, Load modulation	± 3.5% of setting ± 1 mVpp at 13.56 MHz
Output voltage resolution	Load modulation	16 bits (160 μV at 10 Vpp)
	RF carrier	4 digits (1 mV or 0.01 dBm at 10 Vpp)
Frequency range	RF carrier (channel-2)	1 μHz to 20 MHz <sup>1</sup>
Frequency accuracy	RF carrier, Load modulation	± 2 ppm of setting ± 15 pHz (< 27 Hz at 13.56 MHz)
Frequency resolution	RF carrier	1 μHz
Spurious	RF carrier	Standard: < -75 dBc, increasing +20 dBc/decade above 2 MHz
		Option OCX: < -75 dBc, increasing +20 dBc/decade above 10 MHz

1. Maximum frequency based on the 20 MHz 33512B. Higher frequency ranges available on higher frequency 33500 and 33600 models.

Table 5. N2116A/N2134A/N2135A 3-in-1 antenna

Resonant frequency	13.56 MHz
Poller coil size	Poller 3 equivalent
Listener coil size	Listener 3 equivalent
Listener loads (configurable)	82, 330, 820, 5000-Ω
Standards supported	NFC Forum Types A, B, F
Poller/Listener test spacing	
– N2116A	5 mm
– N2134A	10 mm
– N2135A	15 mm
I/O ports	
Tx – RF input port for Poll mode and Resonant Frequency	Connector type: SMA
– Impedance	50-Ω
– Input power range	-1.85 to +24.25 dBm
– Frequency range	10 to 20 MHz
Rx – RF output port for Poll mode and Resonant Frequency	Connector type: SMA
– Impedance	50-Ω
– Output voltage range	10 mV to 1 V
LM (load modulation) for Listen mode	Connector type: SMA
– Impedance	> 10 MΩ
– Input voltage range	0 to 5 V
Sense – RF output for Listen mode	Connector type: SMA
VR – VDC output for Listen mode	Connector type: SMA
– Range	0 to 10 VDC
Communication and power	Connector type: MicroUSB



## Technical Performance Characteristics (Continued)

Table 6. N2116a/N2134A/N2135A 3-in-1 antenna general characteristics

<b>Dimensions<sup>1</sup></b>	<b>(W x H x D)</b>
– N2116A (5 mm fixed spacing)	116 mm x 18 mm x 162 mm
– N2134A (10 mm fixed spacing)	116 mm x 23 mm x 162 mm
– N2135A (15 mm fixed spacing)	116 mm x 28 mm x 162 mm
Supply voltage range	5 V (microUSB loaded)
Supply frequency range	DC
Operating temperature	10 to 45 °C
Storage temperature	-20 to +60 °C
Humidity	20 to 80%
EMC	IEC 61326-1:2012 EN 61326-1:2013

1. Refer to the DSOXT2NFC/DSOX4NFC User's Guide for mechanical drawings with exact dimensions.

## Recommended Configuration

### Step 1. Select oscilloscope

All 4-channel InfiniiVision 3000T and 4000 X-Series oscilloscopes (DSO or MSO) are compatible with performing automated NFC testing. The minimum recommended and lowest-priced model that meets specifications is the 100-MHz bandwidth DSOX3014T oscilloscope.

Automated NFC testing can be performed via LAN (Ethernet) or USB. All Keysight InfiniiVision X-Series oscilloscopes come standard with USB interfaces. The LAN interface is standard on the 4000 X-Series oscilloscopes. However, if using a 3000T X-Series oscilloscope in your NFC test system, you also will need to order the optional LAN interface module for this scope (DSOXLAN).

In addition to the above listed minimum system requirements, it is recommended that your 3000T or 4000 X-Series oscilloscope be running on firmware version 4.08 or greater.

### Step 2. Select software

If your automated NFC test system includes one of Keysight's InfiniiVision 3000T X-Series oscilloscopes, then order the DSOXT3NFC software license. If your automated NFC test system includes one of Keysight's InfiniiVision 4000 X-Series oscilloscopes, then order the DSOX4NFC software license.

The NFC automated software can be downloaded from Keysight's DSOXT3NFC or DSOX4NFC product website at no charge. However, running the software requires that the license be installed on the oscilloscope.

### Step 3. Select waveform generator

All 2-channel Trueform 33500 and 33600 waveform generators are compatible with performing automated NFC testing. The minimum recommended and lowest-priced model that meets specifications is the 20-MHz 33512B with Option MEM. If ordering one of the 2-channel 33600 models, Option MEM is not required.

### Step 4. Select antenna

For fastest throughput, Keysight recommends ordering the N2116A 3-in-1 programmable NFC antenna. This antenna provides a fixed 5 mm spacing between the device-under-test and the Poller/Listener coils. Also available is the N2134A with 10 mm spacing, and the N2135A with 15 mm spacing. All of Keysight's 3-in-1 programmable NFC antennas (N2116A, N2134A, and N2135A) come standard with all required BNC/SMA cabling for interconnections between scope/generator/antenna.

Keysight's automated NFC test solution is also compatible with NFC Forum individual antennas. However, testing must be paused between Poller, Listener, and Resonant Frequency testing for DUT placement.

## Ordering Information

Product number	Description
DSOX3014T <sup>1</sup>	100-MHz bandwidth, 4-channel InfiniiVision 3000T X-Series oscilloscope
DSOXLAN	LAN module for 3000T X-Series oscilloscope. Standard on 4000 X-Series
DSOXT3NFC	NFC automated test software and NFC triggers for 3000T X-Series oscilloscope
DSOX4024A <sup>1</sup>	200-MHz bandwidth, 4-channel InfiniiVision 4000 X-Series oscilloscope
DSOX4NFC	NFC automated test software and NFC triggers for 4000 X-Series oscilloscope
33512B <sup>1</sup>	20-MHz, 2-channel Trueform waveform generator
33512B-MEM	16 M memory option for 33500
N2116A <sup>2</sup>	3-in-1 programmable NFC antenna with 5 mm fixed spacing
N2116A-001	3-in-1 programmable NFC antenna kit that supports 5-, 10-, and 15-mm spacing. Must also order N2116A
N2134A <sup>2</sup>	3-in-1 programmable NFC antenna with 10 mm fixed spacing
N2135A <sup>2</sup>	3-in-1 programmable NFC antenna with 15 mm fixed spacing

1. Only the lowest priced 4-channel oscilloscopes and 2-channel waveform generator models are listed in this table. All other higher bandwidth InfiniiVision 3000T and 4000A X-Series oscilloscope models, as well as higher frequency Trueform waveform generators (33500 and 33600 Series), are also compatible. For ordering information for higher performance oscilloscope and waveform generator models, refer to the appropriate data sheets listed in the Related Literature section of this document.
2. All of Keysight 3-in-1 programmable NFC antennas come standard with all required SMA and BNC cabling.

## Related Literature

Publication title	Publication number
InfiniiVision 3000T X-Series Oscilloscopes - Data Sheet	5992-0140EN
InfiniiVision 4000 X-Series Oscilloscopes - Data Sheet	5991-1103EN
InfiniiVision 6000 X-Series Oscilloscopes - Data Sheet	5991-4087EN
33500B Series Waveform Generators - Data Sheet	5991-0692EN
33600A Series Trueform Waveform Generators - Data Sheet	5991-3272EN
T3100S Series NFC Test Systems - Technical Overview	5992-0188EN

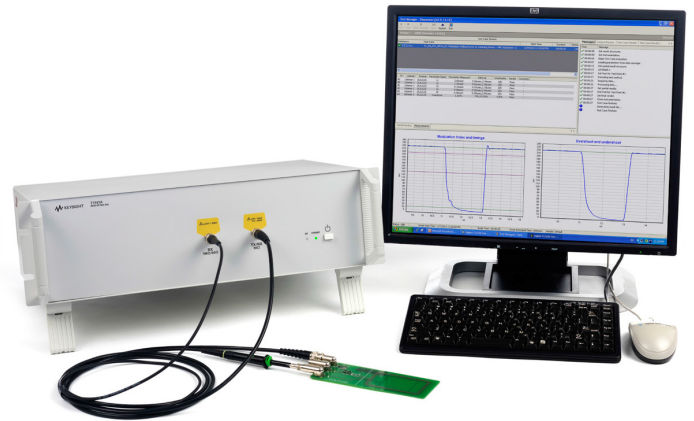
To download these documents, insert the publication number in the URL:

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## Related Products

For full/complete NFC conformance testing, Keysight recommends the T3111S.

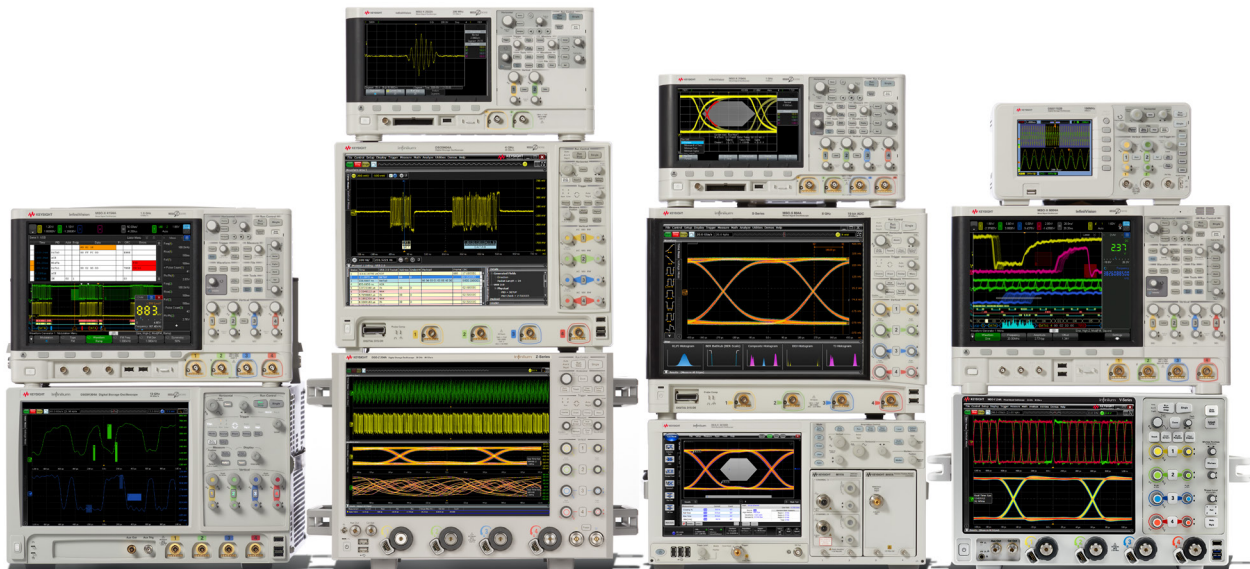
- Supports analog RF and digital protocol parts of NFC, EMV™ and ISO test specifications
- Platform supports R&D, pre-conformance, and conformance testing
- Fully-qualified by NFC Forum certification program
- Qualified for EMV Level 1 test including PICC/Mobile and PCD
- Software-upgradeable, integrated, automated, extensible test platform
- Available with automatic positions robots for accurate antenna location
- Easy-to-use test manager for execution and results analysis



## Product web sites

For the most up-to-date and complete application and product information, please visit our product Web sites at:

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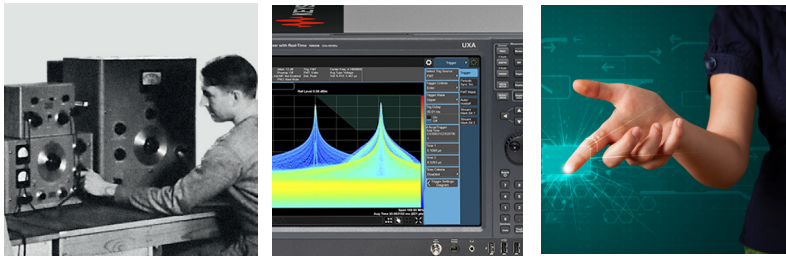
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