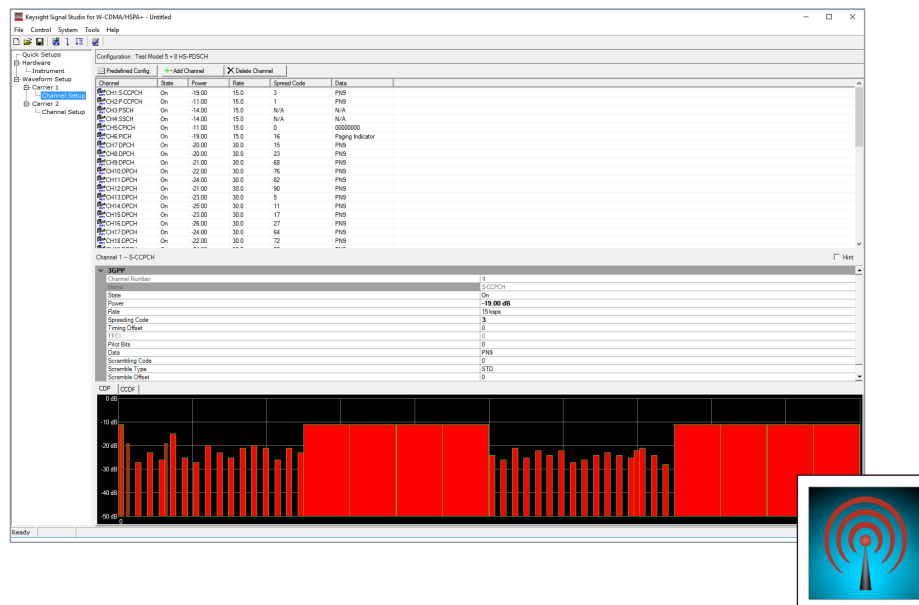# Keysight Technologies
Signal Studio for W-CDMA/HSPA+
N7600C

Technical Overview

– Create Keysight Technologies, Inc. validated and performance optimized reference signals compliant to W-CDMA, HSPA and HSPA+ 3GPP Release 11
– Perform UE and BTS component testing with a broad collection of predefined 3GPP physical layer DL test models and UL sub-tests
– Use predefined reference measurement channels (RMC) and fixed reference channels (FRC) to perform UE and BTS receiver conformance testing
– Enable conformance testing with closed-loop HARQ feedback and verification of compressed mode, CELL_FACH, PRACH, and more in UL real-time mode
– Create DL DC+MIMO signals for UE receiver test and UL HS-DPCCH with 4C+MIMO feedback for BTS receiver test
– Accelerate the signal creation process with a user interface based on parameterized and graphical signal configuration and tree-style navigation

KEYSIGHT
TECHNOLOGIES

Keysight Signal Studio software is a flexible suite of signal-creation tools that will reduce the time you spend on signal simulation. For W-CDMA, HSPA and HSPA+, Signal Studio's performance-optimized reference signals—validated by Keysight—enhance the characterization and verification of your devices. Through its application-specific user-interface you'll create standards-based and custom test signals for component, transmitter, and receiver test.

Component and transmitter test

Signal Studio's basic capabilities use waveform playback mode to create and customize waveform files needed to test components and transmitters. Its user friendly interface lets you configure signal parameters, calculate the resulting waveforms and download files for playback. The applications for these partially coded, statistically correct signals include:

– Parametric test of components, such as amplifiers and filters
– Performance characterization and verification of RF sub-systems

Receiver test

Signal Studio's advanced capabilities enable you to create fully channel-coded signals for receiver bit-error-rate (BER), or block-error-rate (BLER) analysis.
Applications include:

– Performance verification and functional test of receivers, during RF/baseband integration and system verification
– Coding verification of baseband subsystems, including FPGAs, ASICs, and DSPs

More advanced capabilities operate in real-time mode, which is used to define the parameters of nonrepeating and dynamically changing signals needed for receiver testing. Its graphical interface provides a direct instrument connection for parameter transfer and closed-loop or interactive control during signal generation.

Apply your signals in real-world testing

Once you have setup your signals in Signal Studio, you can download them to a variety of Keysight instruments and software platforms. Signal Studio software complements these platforms by providing a cost-effective way to tailor them to your test needs in design, development and production test.

– Vector signal generators
   – X-Series: MXG and EXG
   – PSG
   – ESG
   – First-generation MXG
   – M9381A PXIe VSG
– M9420/21A PXIe VXT vector transceiver
– E6640A EXM wireless test set
– M8190/95A AXIe arbitrary waveform generator

Typical Measurements

Test components with basic capabilities:

– IMD / NPR
– ACLR
– CCDF
– EVM
– Modulation accuracy
– Code domain power
– Channel power
– Occupied bandwidth

Verify receivers with advanced capabilities:

– Sensitivity
– Maximum input level
– Selectivity
– Blocking
– Intermodulation
– Power control

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Component and Transmitter Test

Figure 1. Typical component test configuration using Signal Studio's basic capabilities with a Keysight X-Series signal generator and an X-Series signal analyzer

Basic N7600C Signal Studio functionality enables you to characterize device performance under a wide variety of test conditions. Create physical layer W-CDMA/HSPA and HSPA+ signals, so you can work on BTS and UE components to investigate the power and modulation qualities of your device under test. You can also simplify and accelerate testing of standards-based test scenarios with included downlink test models and reference measurement channels, the physical layer definitions of H-Sets 1-11, and uplink Release 6–8 subtests.

– Create spectrally-correct signals for ACLR, channel power, spectral mask, and spurious testing
– Set parameters such as channel power and data channel modulation type (BPSK, QPSK, 4PAM, 16QAM, 64QAM), including HS-DPDCH, S-CCPCH, and E-DPDCH channels, for modulation verification and analysis such as code-domain or EVM testing
– Generate multicarrier signals for up to 128 carriers, each with adjustable timing, phase offsets, and clipping, as well as scramble code, TFCI field, and transmitter diversity
– Automatically calculate cubic metric and set k-value
– View CCDF graphs for insight into the waveform power statistics as system parameters such as modulation, power, OVSF codes and clipping are varied
– Generate slot-length based waveforms to help make fast PA tests with a waveform sequence
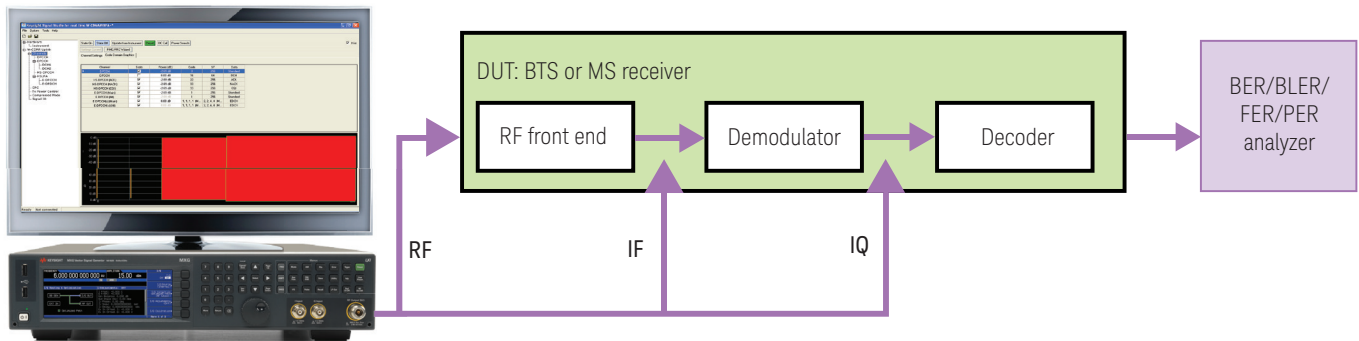
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Receiver Test

Figure 2. Generate fully channel-coded signals to evaluate the BER, BLER, PER, or FER of your receiver with Keysight X-Series signal generators and Signal Studio's advanced capabilities

Advanced N7600C Signal Studio functionality enables you to characterize receiver performance under a wide variety of test conditions. Create transport layer coded W-CDMA, HSPA and HSPA+ signals, to validate receiver characteristics and performance. Using advanced waveform playback mode enables you to generate long uplink and downlink waveforms, with over 1000 frames for continuous PN9 sequence generation, to validate both BTS and UE receiver characteristics and performance. The real-time mode enables you to define the parameters of non-repeating uplink signals for BTS receiver testing and provides a direct instrument connection to dynamically change signal parameters and respond to closed-loop feedback.

BTS receiver testing

- Save time with pre-defined uplink configurations for conformance testing including:
  - UL RMC 12.2 kbps[1] to 384 kbps and FRC 1-8 for BLER and BER testing
  - PRACH with single or multiple preambles for BLER testing
- Flexible channel configuration enables BTS CELL_FACH state verification
- Customizable HSPA+ configurations including DTX patterns for CPC simulation and appropriate feedback on HS-DPCCH for multi-cell[2], MIMO, and multi-cell[2] with MIMO configurations
- Closed-loop conformance testing with real-time BTS feedback including HARQ ACK/NACK, transmit power control and E-TFCI switching
- Test BER/BLER using a compressed frame signal
- Multiple PRACH for BER testing
- Flexible control of transport channel parameters enable testing beyond 3GPP requirements
- Up to 128 carriers to simulate multi-user with unique scramble code, timing offset, power offset, and slot format for BTS capacity test

UE receiver testing using waveform playback mode

- Pre-defined RMC 12.2 kbps[1] to 384 kbps and H-Set 1-12, including requirements for 64QAM and MIMO
- Complete receiver evaluation with DC, MIMO, DC+MIMO, CPC, compressed mode and more
- Simplify synchronization with automatic calculation of BCH payload including SFN, MCC, MNC and LAC
- Automatically configure HS-SCCH and HS-PDSCH to handle modulation, coding, HARQ, and other parameters
- Verify transport channel decoding with up to 8 DCH and 8 FACH/PCH for HS-PDSCH and S-CCPCH
- Advanced functional testing with E-AGCH, E-RGCH, and E-HICH with transport layer coding

Conformance test made easy with N7649B Test Case Manager

Test Case Manager (TCM) provides a simplified user interface for quick and easy set-up of standard-compliant conformance test configurations for eNB receiver tests. With TCM, simply choose one of the test cases from TS36.141 clause 7 and clause 8 from the tree menu and specify a few parameters such as eNB type, carrier frequency, etc. TCM then automatically generates standard-compliant wanted and interference waveforms and sets up the signal generators according to the standard requirement.

For more information, please visit **www.keysight.com/find/N7649b**
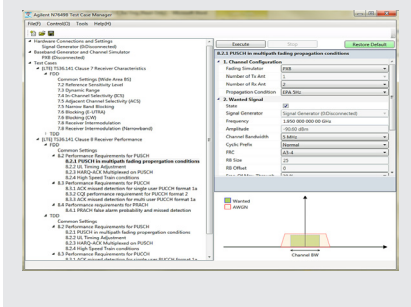
1. More than one signal generator is needed to generate both the wanted signal and the interference signal.
2. Multi-cell includes dual-cell, 3-cell and 4-cell.

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Features Summary

W-CDMA / HSPA+	Component & transmitter testing		Receiver testing	
Signal Studio	**Basic waveform playback mode**		**Advanced waveform playback mode**	**Advanced real-time mode[1]**
	(3GPP Rel 7)	**(3GPP Rel 8)**		
W-CDMA/HSPA support	●	●	●	●
HSPA+ support		●	●	●
Calibrated AWGN (requires instrument option)	●	●	●	●
Extended waveform/signal length			●	●
CCDF, spectrum, and time domain graphics	●	●	●	
Code domain graph	●	●	●	●
Multi-carrier timing, phase offsets, and clipping	●	●	●	
128-carrier support	●	●	●	
Short length waveform	●	●		
Downlink				
Preconfigured channel setups (including test models 1–5)	●			
Preconfigured channel setups (including test models 1–6, and Home Node B, RMC[2], and RMC+HSET 1-11 [2])		●		
S-CCPCH selectable modulation: QPSK, 16QAM		●	●	
HS-PDSCH selectable modulation: QPSK, 16QAM, 64QAM		●	●	
Preconfigured channel setups for RMC and RMC+HSET 1-12 (including transport channel coding)			●	
Control channel message support (BCCH–BCH message)			●	
Flexible DCH, FACH, PCH configuration			●	
HS-SCCH HARQ process configuration and management			●	
DC order support in HS-SCCH			●	
Closed-loop transport diversity coded signal			●	
Transport layer channel coding for E-AGCH, E-RGCH and E-HICH			●	
CPC			●	
Flexible transport position on DPCH and S-CCPCH			●	
E-RGCH and E-HICH share channelization code			●	
Compressed Mode (with DCH transport channel coding[3])			●	
MIMO and dual cell			●	

1. Advanced real-time mode applicable for UL signal generation only.
2. Without transport layer coding.
3. DCH transport channel coding is only available for SF/2 compressed mode method.

Features Summary (continued)

W-CDMA / HSPA+	Component & transmitter testing		Receiver testing	
Signal Studio	**Basic waveform playback mode**		**Advanced waveform playback mode**	**Advanced real-time mode[1]**
	(3GPP Rel 7)	**(3GPP Rel 8)**		
Uplink				
Preconfigured sub-tests	●	●		
Preconfigured sub-tests supporting E-DCH with 16QAM		●		
Cubic metric settings	●	●		
E-DPDCH selectable modulation: BPSK, 4PAM		●		●
Base-station conformance test configurations (RMC/FRC) with transport channel coding for BER/BLER testing			●	●
Configurable transport coding parameters for DPDCH			●	●
User-definable DPCCH and HS-DPCCH transmission patterns			●	●
Alternate settings for E-DPCCH and E-DPDCH			●	●
Feedback on HS-DPCCH for up to 8C-HSDPA with MIMO			●	●[2]
UL-DTX mode for CPC			●	●
Flexible DCH/E-DCH configurations				●

Closed loop testing
  HARQ
  Transmit power control
  E-TFCI switching
				●

PRACH with transport channel coding for BLER testing			●	●
Multiple PRACH with transport channel coding for BER testing				●
Compressed mode				●
CELL_FACH			●	●

1. Advanced real-time mode applicable for UL signal generation only.
2. Real-time supports up to dual cell.

Supported Standards and Test Configurations

3GPP technical specification	Version	Date
25.211	11.5.0	2014-06
25.212	11.7.0	2014-03
25.213	11.4.0	2012-12
25.214	11.11.0	2014-12
25.215	11.0.0	2011-12
25.101	11.11.0	2014-12
25.141	11.10.0	2014-12
25.306	11.10.0	2014-12
25.321	11.5.0	2013-12
34.108	11.12.0	2014-12
34.121	11.6.0	2014-12

BTS conformance tests (3GPP TS 25.141)

BTS transmitter characteristics

Transmitter characteristics (Section 6)		Keysight solution	
Test models type	Test model use case	Signal Studio mode	Recommended hardware
Test model 1	Occupied bandwidth Spectrum emission mask ACLR Spurious emissions Transmit intermodulation Base station maximum output power Total power dynamic range (at Pmax) Home base station output power for adjacent channel protection Frequency error (at Pmax) IPDL time mask	Waveform playback	X-Series EXG/MXG, M9381A PXIe VSG, or M9420A PXIe VXT
Test model 2	Output power dynamics CPICH power accuracy		
Test model 3	Peak code domain error		
Test model 4	EVM measurement Total power dynamic range Frequency error		

Test model 5	EVM for base stations supporting
	   HS-PDSCH transmission using
	   16QAM modulation (at Pmax)		

Test model 6	Relative CDE for base stations
	   supporting HS-PDSCH transmission
	   using 64QAM modulation		

BTS receiver characteristics

Receiver characteristics (Section 7)	Keysight solution		
	Wanted signal Signal Studio mode[1,2]	Interfering signal Signal Studio mode[3]	Recommended hardware
7.2 Reference sensitivity level	Waveform playback or real-time	N/A	X-Series MXG, M9381A PXIe VSG, or M9420A PXIe VXT
7.3 Dynamic range	Waveform playback with AWGN or real-time with AWGN		
7.4 Adjacent channel selectivity	Waveform playback or real-time	Waveform playback	2 X-Series MXG, 2 M9381A PXIe VSGs, or 2 M9420A PXIe VXTs
7.5 Blocking (in-band)			
7.5 Blocking (out-of-band)		CW	
7.5 Blocking (Co-location with other base stations)			
7.5 Narrowband blocking		Waveform playback	
7.6 Intermodulation		CW and waveform playback	3 X-Series MXGs, 3 M9381A PXIe VSGs, or 3 M9420A PXIe VXTs
7.6 Intermodulation (Narrow band intermodulation)			
7.7 Spurious emissions	This requires a signal analyzer such as the Keysight X-Series		
7.8 Verification of the internal BER calculation	Real-time	N/A	X-Series MXG

1. Predefined setups for all Reference Measurement Channel (RMC) are available.
2. Waveform playback requires basic and advanced arbitrary options.
3. Only basic option of Waveform playback required.

BTS performance requirements

Performance requirements (Section 8)	Keysight solution	
	Wanted signal Signal Studio mode[1]	Recommended hardware[2, 3]
8.2 Demodulation in static propagation condition	Waveform playback or real-time	X-Series MXG, PXB, M9381A PXIe VSG, or M9420A PXIe VXT
8.3 Demodulation of DCH in multipath fading conditions		
8.4 Demodulation of DCH in moving propagation conditions		
8.5 Demodulation of DCH in birth/death propagation conditions		
8.5A Demodulation of DCH in high speed train conditions		
8.8.1 RACH preamble detection in static propagation conditions		
8.8.2 RACH preamble detection in multipath fading case 3		
8.8.2A RACH preamble detection in high speed train conditions		
8.8.3 Demodulation of RACH message in static propagation conditions		
8.8.4 Demodulation of RACH message in multipath fading case 3		
8.8.5 Demodulation of RACH message in high speed train conditions		
8.11.1 ACK false alarm in static propagation conditions		
8.11.2 ACK false alarm in multipath fading conditions		
8.11.3 ACK mis-detection in static propagation conditions		
8.11.4 ACK mis-detection in multipath fading conditions		
8.12 Demodulation of E-DPDCH in multipath fading conditions	Real-time (with HARQ feedback)	X-Series MXG
8.13 Performance of signaling detection for E-DPCCH in multipath fading conditions		

1. Waveform playback requires basic and advanced arbitrary options.
2. Hardware recommendation is assuming single antenna testing.
3. A separate MXG is required for each antenna port on the base station receiver.

Performance Characteristics

Definitions

Specification (spec):

Represents warranted performance of a calibrated instrument that has been stored for a minimum of 2 hours within the operating temperature range of 0 to 55 °C, unless otherwise stated, and after a 45 minute warm-up period. The specifications include measurement uncertainty. Data represented in this document are specifications unless otherwise noted.

Typical (typ):

Represents characteristic performance, which 80% of the instruments manufactured will meet. This data is not warranted, does not include measurement uncertainty, and is valid only at room temperature (approximately 25 °C).

Measured (meas):

An attribute measured during the design phase for purposes of communicating expected performance, such as amplitude drift vs. time. This data is not warranted and is measured at room temperature (approximately 25 °C).

The following performance characteristics apply to the instruments indicated in the respective tables. For performance characteristics of other instruments, refer to the respective product data sheet.

Distortion performance at 1800 to 2200 MHz frequency (Playback mode)

| Configuration | Offset | N5172B EXG/N5182B MXG X-Series vector signal generators | | | | | | M9381A PXIe VSG | |
| | | Standard (≤ 2 dBm) | | Option UNV (≤ 2 dBm) | | Option UNV with Option 1EA (≤ 5 dBm) | | Standard (≤ 4 dBm) | Option 1EA (≤ 12 dBm) |
		Specification (dBc)	Typical (dBc)	Specification (dBc)	Typical (dBc)	Specification (dBc)	Typical (dBc)	Typical (dBc)	Typical (dBc)
1 DPCH 1 carrier	Adjacent (5 MHz)	– 69	–73	–71	–75	–71	–75	–69	–63
	Alternate (10 MHz)	–70	–75	–72	–77	–71	–77	–75	–77
TM1+64 DPCH 1 carrier	Adjacent (5 MHz)	–68	–70	–71	–73	–71	–72	–71	–54
	Alternate (10 MHz)	–69	–73	–72	–76	–71	–76	–73	–73
TM1+64 DPCH 4 carrier	Adjacent (5 MHz)	–63	–65	–65	–67	–64	–66	–71	–54
	Alternate (10 MHz)	–64	–66	–66	–68	–66	–68	–73	–73

Distortion performance at 1800 to 2200 MHz frequency (real-time mode)

Note: This table applies to the N5172B EXG and N5182B MXG X-Series vector signal generators

Configuration	Offset	Standard (≤ –7 dBm) Measured (dBc)	Option UNV with Option 1EA (≤ 5 dBm) Measured (dBc)
UL RMC12.2k	Adjacent (5 MHz)	–72	–73
	Alternate (10 MHz)	–74	–76

EVM performance at 1800 to 2200 MHz frequency

Configuration	Channel configuration	N5182B EXG/N5182B MXG X-Series vector signal generators		M9381A PXIe EVM
		EVM Note: EVM power level ≤ 7 dBm. With Option 1EA, EVM power level is ≤ 13 dBm.		EVM Note: EVM power level ≤ 10 dBm. With Option 1EA, EVM power level is ≤ 12 dBm.
Playback mode W-CDMA	1 DPCH	1.2% (spec)	0.8% (typ)	0.56% (typ)
Real-time mode W-CDMA	UL RMC12.2k	0.53% (meas)		N/A

Ordering Information

Software licensing and configuration

Signal Studio offers flexible licensing options, including:

– **Node-locked:** Allows you to use the license on one specified instrument/computer.
– **Transportable:** Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
– **Floating:** Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
– **Time-based:** License is time limited to a defined period, such as 12-months.

N7600C Signal Studio for W-CDMA/HSPA+

Waveform playback licenses (N7600EMBC)

Software	Support Contract	Description
N7600EMBC-1FP	R-Y5B-001-A[2]	Node-locked perpetual license
N7600EMBC-1FL	R-Y4B-001-L[1]	Node-locked 12-month license
N7600EMBC-1TP	R-Y5B-004-D[2]	Transportable perpetual license
N7600EMBC-1TL	R-Y4B-004-L[1]	Transportable 12-month license

Software support subscription for perpetual licenses [3]

Support Contract	Description
R-Y6B-001-L	12-months of support for node-locked licenses
R-Y6B-004-L	12-months of support for transportable licenses
R-Y6B-501	1-month of support for node-locked licenses (extension after 1st year)
R-Y6B-504	1-month of support for transportable licenses (extension after 1st year)

1. All time-based software licenses include a 12-month support contract.
2. Support contracts must be purchased for all perpetual licenses in the first year. All software upgrades and KeysightCare support are provided for software licenses with valid support contracts.
3. After the first year, support contracts for all perpetual licenses may be extended with annual and monthly support extensions.

Try Before You Buy!

Free 30-day trials of Signal Studio software provide unrestricted use of the features and functions, including signal generation, with your compatible platform. Redeem a trial license online at

www.keysight.com/find/SignalStudio_trial

Hardware configurations

To learn more about compatible hardware and required configurations, please visit: www.keysight.com/find/SignalStudio_platforms

PC requirements

A PC is required to run Signal Studio. www.keysight.com/find/SignalStudio_pc

Model numbers & options

To learn more about Signal Studio licensing, model numbers and options, please visit: www.keysight.com/find/signalstudio_model

Websites

www.keysight.com/find/SignalStudio

Comprehensive Online Documentation
www.keysight.com/find/signalstudio_support

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Signal Studio and Signal Creation Software
www.keysight.com/find/signalstudio_software

Digital video industry webpage
www.keysight.com/find/W-CDMA

Literature

Keysight W-CDMA Bit Error Test on picoChip Femtocell Reference Design Using the Keysight N5182A MXG Vector Signal Generator, Application Note, literature number 5990-4642EN

Signal Studio Software, Brochure, literature number 5989-6448EN

Transition from 2G/3G to 3.9G/4G Base Station Receiver Conformance Test, Application Note, literature number 5991-0280EN

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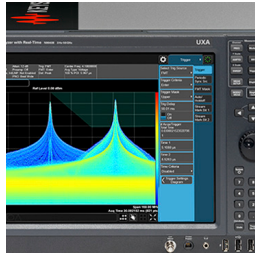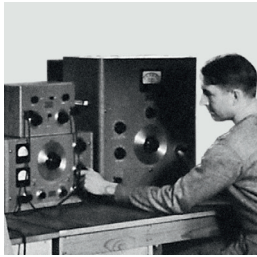
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Up to ten years of protection and no budgetary surprises to ensure your instruments are operating to specification, so you can rely on accurate measurements.

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