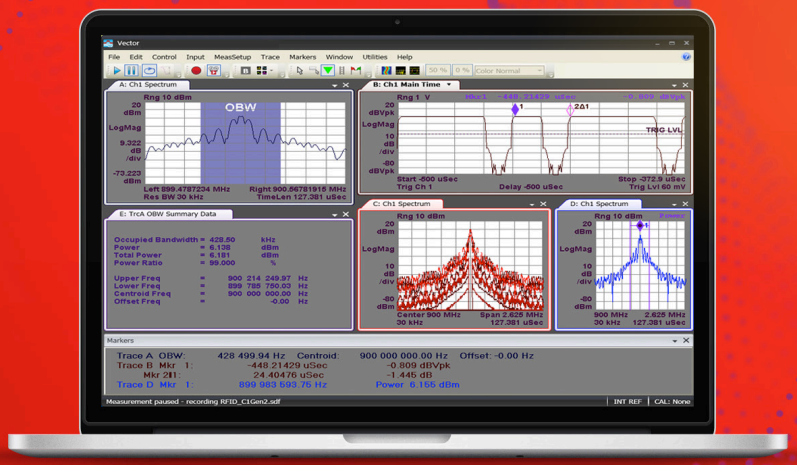


TECHNICAL OVERVIEW

RFID Modulation Analysis (IoT Modulation Analysis) 89600 VSA Software

Option 89601BHTC (replacing 89601B/BN/BK-BHC and BHT)

Key features

- Compatible with RFID standards, including EPCglobal Class 1 Generation 2, and many NFC standards
- Analyze forward (interrogator) and return (tag) bursts
- Make important time-domain measurements
- Decode and analyze burst frame structure elements
- Advanced troubleshooting tools offer detailed look at signal behavior

RFID Modulation Analysis

Option 89601BHTC provides powerful measurements and displays designed to help you thoroughly understand your RFID signal. With detailed format-specific summary results, demodulation down to the bit level, versatile time and frequency analysis tools, and easy measurement setup tools, Option 89601BHTC offers insight into a wide range of RFID formats.

The RFID modulation formats covered by Option 89601BHTC are just some of over 70 signal standards and modulation types for which the 89600B vector signal analysis (VSA) software creates a window into what's happening inside your complex wireless devices. The 89600B tools provide views of virtually every facet of a problem, helping you see the "why?" behind signal problems. Whether you're working with emerging or established standards, Keysight's industry-leading 89600B VSA software helps you see through the complexity.

KEYSIGHT TECHNOLOGIES

RFID overview

Radio Frequency Identification (RFID) is a wireless technology used for tracking placement or movement of objects as in, for example, inventory tracking. Applications vary from security access to buildings to tracking animals, automation of toll collections, and tracking goods in supply chain management.

Typically, inventory is tracked by attaching a passive “tag” device. In the EPCglobal Class 1 Generation 2 standard, for example, the tag must be extremely small and cheap, and typically cannot require any power source other than what can be received from RF transmissions. The “interrogator” or “reader” that talks to the RFID device typically alternates between a modulated signal (to communicate with the RFID device) and an unmodulated CW signal (to provide power so that the RFID device can respond).

There are multiple incompatible standards for RFID, but over time they appear to be slowly converging. The EPCglobal Class 1 Generation 2 standard is an example of this. Near Field Communication (NFC), uses RFID technology as defined in ISO 18092, including some compatibility with ISO 14443 standards. NFC is expected to be implemented in mobile phones for bill payment, security ID card, or coupon ticket services.

Try before you buy!

Download the 89600B software and use it free for 14 days to make measurements with your analysis hardware, or use our recorded demo signals by selecting

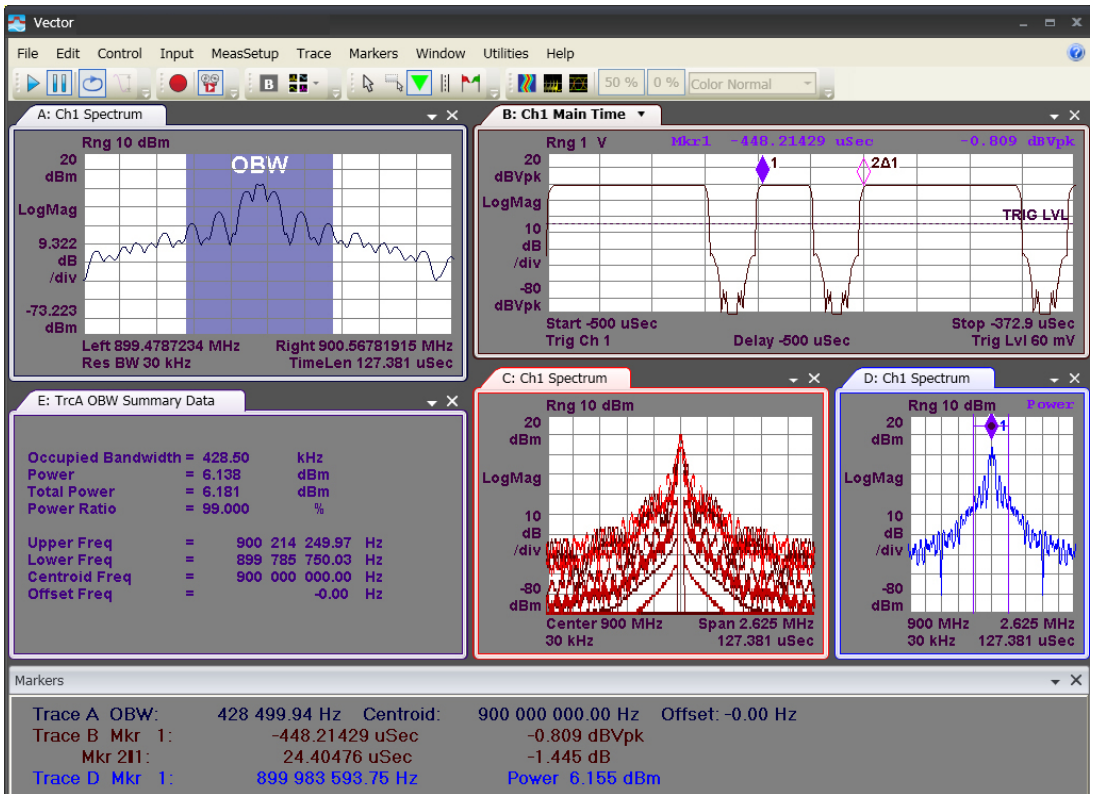
File > Recall > Recall Demo > RFID > on the software toolbar. Request your free trial license today:

www.keysight.com/find/89600_trial

Analysis and Troubleshooting

Verify your signal performance using versatile time and frequency domain measurements

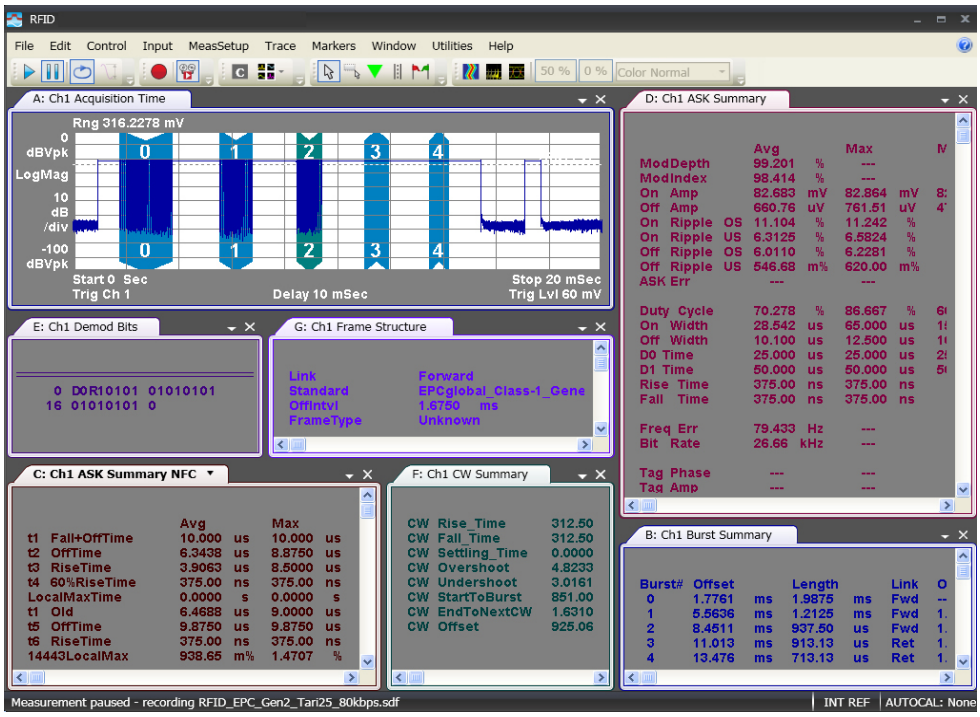
Start your characterization with a detailed understanding of your signal’s time and frequency behavior. Option 89601BHTC offers simultaneous time, spectrum, occupied bandwidth, and statistical measurements, such as CCDF, plus innovative displays such as spectrogram, digital persistence, and cumulative history.



Examine your signal's time and frequency behavior. Up to 20 traces can be displayed, each with up to 20 markers. Size each display or undock the trace window to best fit your available workspace.

Examine your entire RFID signal with simultaneous burst and CW analysis

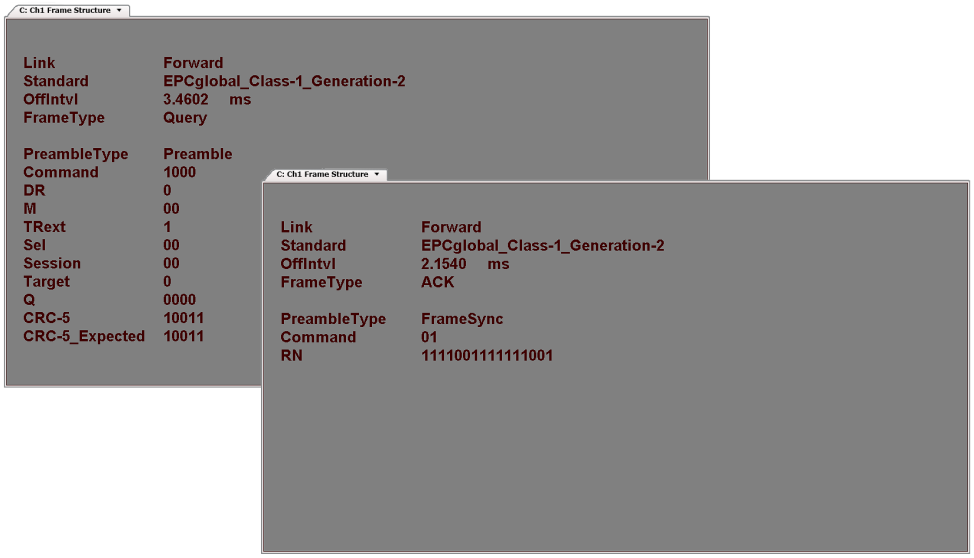
The 89600B software automatically identifies burst locations and displays them to you using "arrows" pointing downward for forward (interrogator) bursts and upward for return (tag) bursts. As you move from one burst to another, the analyzer determines the direction of the burst and automatically applies the modulation format and encoding parameters defined. Detailed CW and burst time, modulation, power and error parameters are available in multiple tables.



Option BHC provides a wide range of information, from burst structures and time parameters, to actual decoded bits. Additional features designed to make analyzing your signal easier include arrows on bursts to indicate direction (forward/reverse) and highlighting the current burst under analysis.

Use sophisticated advanced troubleshooting tools to uncover structure and coding errors

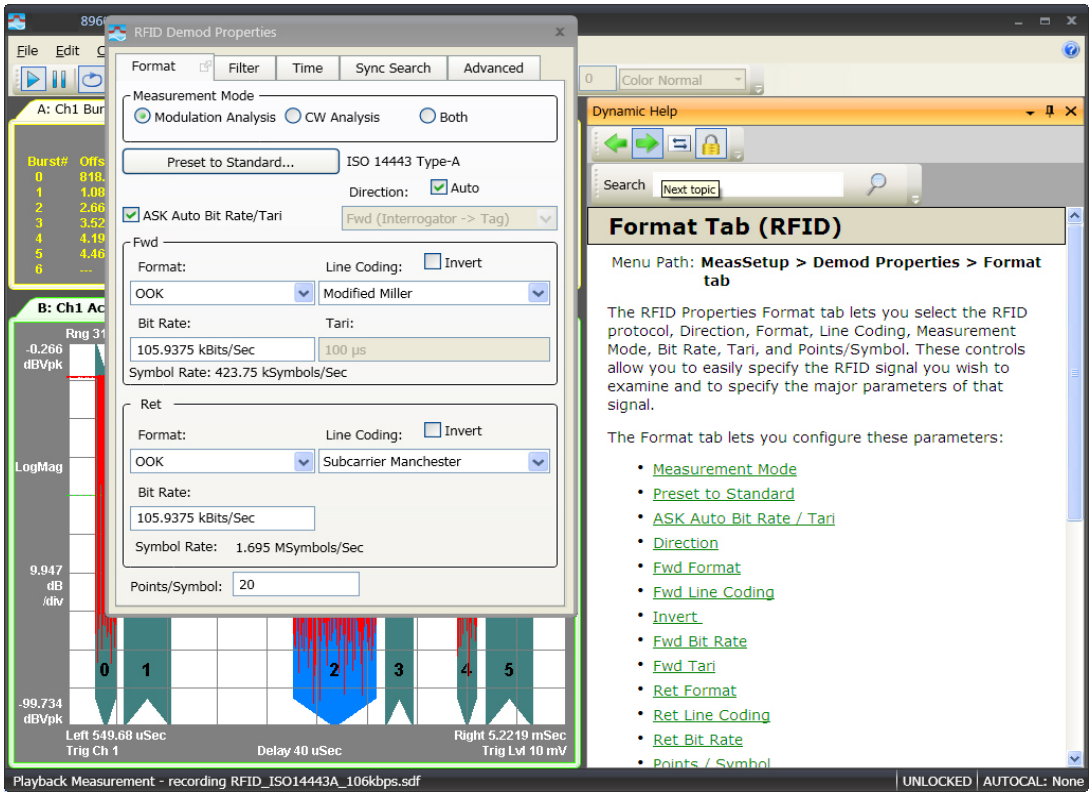
Both demodulated and raw demodulated bits detected prior to applying coding are available. Option 89601BHTC can synchronize on standard search words, such as a preamble, frame sync, or other. For greater flexibility, you can also search on a manually entered sync word.



The Frame Structure table decodes the burst header data. Depending on the burst, Option BHC can decode information useful for verifying that the setup matches the demodulation parameter setup. Different standards and formats dictate which parameters are available for decoding.

Analyze a wide range of standards, modulation formats, and line coding

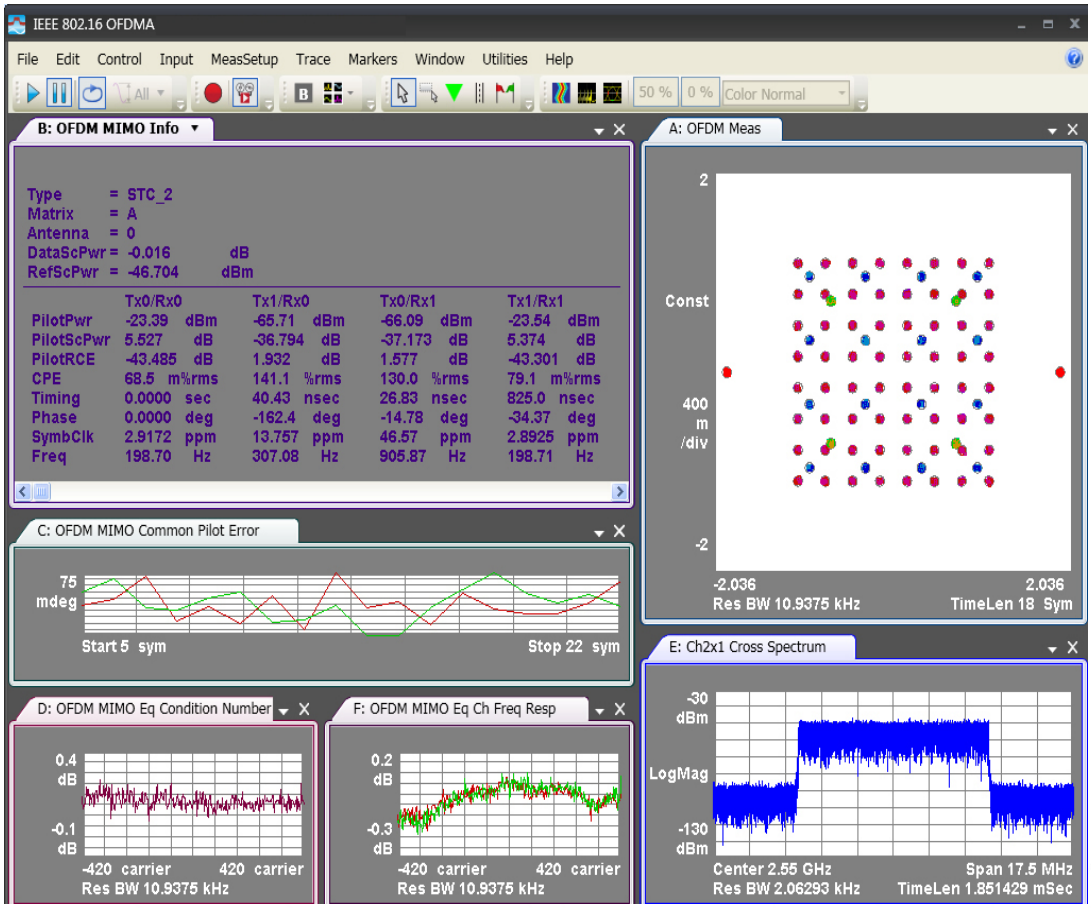
RFID standards vary widely and use many modulation formats and line coding. Option 89601BHTC is flexible enough to handle multiple standards, including EPCGen2, NFC formats 14443 Type A or B, and ISO 15693. Choose setup presets and adjust required parameters.



Click on a menu or trace and use Dynamic Help to access information. Here you can learn more about the Format tab, where you can set many important parameters.

Save and recall signals for more effective troubleshooting

The 89600B VSA includes signal capture and playback capabilities. Use it to capture burst and transient signals for analysis. Use tools like overlap processing for detailed “slow motion” analysis and the spectrogram and cumulative history traces for evaluating your signal’s dynamic frequency and amplitude behavior over time. A player window provides detailed access to the recording, or you can use the stop/play buttons on the main toolbar.



Save a signal and analyze it later with all the Option 89601BHTC tools. The cumulative history display format (Trace C), highlights signal performance over long periods. Place a marker on any point, particularly a transient outlying point, to determine its density of occurrence.

Software Features

Adjustable setup parameters	
Format parameters	
Standards supported (with presets)	EPCglobal Class-1 Generation-2 (ISO 18000-6 Type C); ISO 18000-4 Mode-1 [1]; ISO 18000-6 Type-A [1]; ISO 18000-6 Type-B [1]; ISO 18092 (106, 212, and 424 kbps, for passive and active targets); ISO 14443 Type A (106, 212, 424, 848 kbps); ISO 14443 Type B (106, 212, 424, 848 kbps); ISO 15693 (Low/High Rate)
Auto-direction	Automatically determine link direction; on/off
Direction	For both the forward link (interrogator -> tag) and return link (tag -> interrogator), independently set:
Modulation format	
Forward direction	DSB-ASK, SSB-ASK, PR-ASK, FSK-2, OOK
Return direction	DSB-ASK, FSK-2, OOK
Line coding	
Forward direction	None (NRZ), Manchester, FM0, PIE (ISO 18000-6 Type-A), PIE (EPC C1Gen2), Modified Miller, ISO 15693 1-out-of-4; ISO 15693 1-out-of-256
Return direction	None (NRZ), Manchester, FM0, Miller, Miller-2, Miller-4, Miller-8, Modified Miller, Subcarrier Manchester, Subcarrier BPSK1, Subcarrier BPSK2, Subcarrier BPSK4, Subcarrier BPSK8; for ISO 15693: Single Subcarrier LR, Single Subcarrier HR, Dual Subcarrier LR, Dual Subcarrier HR
Invert	On/off; inverts the raw demod bits going into the line decoding
Bit rate	Manually set, or auto-detected; bps
Tari	Manually set, or auto-detected; used only for PIE line coding; forward direction only
Symbol rate	Rate (frequency) at which symbols occur; symbols/sec
ASK Auto Bit Rate/ Tari	Adjusts the expected bit rate by analyzing input data; on/off
Points/symbol	Number of points to be used for MeasTime and RefTime traces; 10, 20
Measurement modes	Modulation analysis (burst), CW analysis, or both
Filter parameters	
Measurement filters	None, root raised cosine
Reference filters	None, raised cosine, Gaussian
Alpha/BT	Alpha of root raised cosine, or raised cosine filter; or BT of Gaussian filter
Time parameters	
Acquisition length	Length over which demodulation will occur; secs
Burst search	On/off
• Burst index	Specifies which burst is selected for demodulation when burst search on
• Result length	Measurement interval; secs
• Sync search length	Specifies the length of time over which to search for the sync pattern

1. Beta implementation only.

Time parameters (Continued)	
• Sync search offset	Specifies where to start the search for the sync pattern
• Sync offset	Used to determine the start of the demodulated data, as an offset from the location of the sync pattern; only used when Sync search is on, and burst search is off
• Result offset	Offset for measurement start point, secs
Synchronization search parameters	
Synch search	Used to measure a signal that has a certain symbol pattern; on/off
Type	Per standard preamble and/or delimiter values; or user-defined bit pattern encoded per specified line coding
Advanced parameters	
IQ normalize	Valid only for non-ASK formats; on/off
Mirror frequency spectrum	Determines whether to do a frequency inversion before synchronizing and demodulating a signal
Clock adjust	Allows user-adjustment of symbol timing used when demodulating; symbols
Thresholds	Used for setting levels used when calculating CW or ASK errors; CW lower/upper/settling; ASK lower/upper, if applicable
Measurement results	
Channel 1 trace results	
Raw main time	Time data acquired by the hardware, including any extra acquisition to allow for filter settling
Acquisition time	Block of data acquired and searched for bursts
Spectrum	Averaged frequency spectrum of time trace
Instantaneous spectrum	Frequency spectrum of time trace
Time	Time record block of data
Correction	Frequency domain correction applied to raw measured time data
Raw demod bits	Raw demod bit stream obtained
Burst summary table	Table of values for all detected bursts in the acquisition time, including burst index, offset length link direction, off interval
CW summary table	Summary of time-domain characteristics of the interrogator CW power-up and power-down
• CW rise time	Time for the CW to transition between CW lower and upper threshold values during power up; secs
• CW overshoot	Overshoot of CW signal during power-up; % of steady-state CW level
• CW undershoot	Undershoot of CW signal during power-up; % of steady-state CW level
• CW settling time	Time from the end of the CW rise time until the CW has settled to within the CW settling threshold of the steady state CW level; secs
• CW fall time	Time it takes the CW to transition between the CW upper threshold and the CW lower threshold during power-down; secs
• CW start to burst	Time between the end of the CW burst and the start of the next CW burst
• End to next CW	Time between the start of CW and the start of the first burst

Channel 1 demod trace results	Trace results available for ASK, OOK, FSK; dependent on burst selected for analysis
Demod bits	Decoded raw demod bit stream using selected line-coding method
Hex bits	Hexadecimal display of demodulated bits; follows Symbol Table Bit Order for MSB- or LSB-first
Meas time with CW	Signal trace that is filtered, resampled, and frequency-, phase-compensated
Meas time	Same as Meas Time with interrogator CW power removed
Magnitude error	Amplitude difference between the I/Q reference signal and the I/Q measured signal measured at the symbol times
Ref time	Reference of signal which is shaped using the reference filter
Error time	Error trace calculated as [Meas Time] – [Ref Time]
Summary table	For non-FSK formats
Modulation depth	Calculated from Meas time with CW
Modulation index	Calculated from Meas time with CW
On amplitude	Calculated from Meas time with CW; average, max, min calculated for a single scan
Off amplitude	Calculated from Meas time with CW; average, max, min calculated for a single scan
On ripple overshoot	Calculated from Meas time; avg, max calculated for a single scan
On ripple undershoot	Calculated from Meas time; avg, max calculated for a single scan
Off ripple overshoot	Calculated from Meas time; avg, max calculated for a single scan
Off ripple undershoot	Calculated from Meas time; avg, max calculated for a single scan
ASK error	Calculated from Error time; rms avg, max calculated for a single scan
Duty cycle	Calculated from Meas time; avg, max, min calculated for a single scan
On width	Calculated from Meas time; avg, max, min calculated for a single scan
Off width	Calculated from Meas time; avg, max, min calculated for a single scan
D0 time	Calculated from Meas time when PIE encoding selected
D1 time	Calculated from Meas time when PIE encoding selected
Rise time	Calculated from Meas time; avg, max calculated for a single scan
Fall time	Calculated from Meas time; avg, max calculated for a single scan
Frequency error	Avg frequency offset between the center of the signal and the center frequency of the front end instrument
Bit rate	Calculated from Meas time, when auto bit rate enabled or PIE line coding selected
Tag phase	Phase of tag relative to CW; avg, max, min values
Tag amplitude	Amplitude of tag relative to CW; avg, max, min values
FSK summary table	For FSK formats only
• FSK error	Calculated from FSK error time; rms avg, max calculated for a single scan
• Magnitude error	Carrier magnitude drift from a constant reference line; rms avg, max
• Deviation	Frequency deviation of the FSK signal
• Frequency error	Average carrier offset of FSK signal

Channel 1 demod trace results (Continued)	Trace results available for ASK, OOK, FSK; dependent on burst selected for analysis (Continued)
NFC summary	Summary table specific to NFC formats
• t1 Fall Time + Off Time	Avg, max, min values
• t2 Off Time	Avg, max, min values
• t3 Rise Time	5 to 90 % rise time; avg, max, min values
• t4 60 % Rise Time	5 to 60 % rise time; avg, max, min values
• t1 Old	Avg, max, min fall off time using a previous definition
• t5 Off Time	Avg, max, min values for t5 (ISO 14443 Type A standard)
• t6 Rise Time	Avg, max, min values for t6 (ISO 14443 Type A standard)
• 14443B EGT	Extra guard time separation between transmitted characters (ISO 14443 Type B standard); etu
• 14443B SOF On Width	Length of the logic “1” start of frame field (ISO 14443 Type B standard)
• 14443B SOF Off Width	Length of logic “0” part of start of frame field (ISO 14443 Type B standard)
• 14443B EOF Off Width	Length of logic “0” part of the end of frame field (ISO 14443 Type standard)
• 14443 Local Max	Avg, max, min values of the local peaks during the Local Maximum search period (ISO 14443 signals using ASK only)
• 14443B TR0	Time between PCD end of EOF and PICC start of subcarrier (ISO 14443B signals only)
• 14443B TR1	Time between PICC start of subcarrier and start of SOF (ISO 14443B signals only)
• 14443B TR2	Time between PICC start of EOF and PCD start of SOF (ISO 14443B signals only)
• 14443B FsToOff	Time between PICC end of EOF and end of subcarrier (ISO 14443B signals only)
Frame structure table	EPC Class 1 Gen 2 signals only. Additional table entries may also be present depending on frame type.
• Link	Defines the direction of the burst: forward or reverse
• Standard	Displays the standard being used for the measurement
• Off interval	Interval between bursts preceding the numbered burst
• Frame type	Type of frame. Additional information specific to the frame type is also displayed
• Preamble type	Shows the preamble type: Preamble or FrameSync
• Command	Multi-bit command code corresponding to frame type

Ordering Information

Software licensing and configuration

Flexible licensing and configuration

- **Perpetual:** License can be used in perpetuity.
- **Time-based:** License is time limited to a defined period, such as 12-months.
- **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.
- **USB portable:** Allows you to move the license from one instrument/computer to another by end-user only with certified USB dongle, purchased separately.
- **Software support subscription:** Allows the license holder access to Keysight technical support and all software upgrades

Basic vector signal analysis and hardware connectivity (89601200C) (required)

IoT Modulation Analysis (89601BHTC)

Software license type	Software license	Support subscription
Node-locked perpetual	R-Y5A-001-A	R-Y6A-001-z [2]
Node-locked time-based	R-Y4A-001-z [1]	Included
Transportable perpetual	R-Y5A-004-D	R-Y6A-004-z [2]
Transportable time-based	R-Y4A-004-z [1]	Included
Floating perpetual (single site)	R-Y5A-002-B	R-Y6A-002-z [2]
Floating time-based (single site)	R-Y4A-002-z [1]	Included
Floating perpetual (regional)	R-Y5A-006-F	R-Y6A-006-z [2]
Floating time-based (regional)	R-Y4A-006-z [1]	Included
Floating perpetual (worldwide)	R-Y5A-010-J	R-Y6A-010-z [2]
Floating time-based (worldwide)	R-Y4A-010-z [1]	Included
USB portable perpetual	R-Y5A-005-E	R-Y6A-005-z [2]
USB portable time-based	R-Y4A-005-z [1]	Included

1. z means different time-based license duration. F for six months, L for 12 months, X for 24 months, and Y for 36 months. All time-based licenses have included the support subscription same as the time-base duration.
2. z means different support subscription duration. L for 12 months (as default), X for 24 months, Y for 36 months, and Z for 60-months. Support subscription must be purchased for all perpetual licenses with 12-months as the default. All software upgrades and KeysightCare support are provided for software licenses with valid support subscription.

Hardware configuration

The 89600B software supports over 30 instrument platforms, including spectrum analyzers, oscilloscopes, logic analyzers, and modular instrument systems. For a complete list, visit www.keysight.com/find/89600_hardware

Keep your 89600B VSA up-to-date

With rapidly evolving standards and continuous advancements in signal analysis, the VSA 89601C software with valid 89601200C, and 89601BHTC KeysightCare support subscription can offers you the advantage of immediate access to the latest features and enhancements available for the 89600B VSA software. www.keysight.com/find/89600B

You can upgrade!

All VSA 89600 options can be added after your initial purchase and are license-key enabled. For more information please refer to www.keysight.com/find/89600B_upgrades

Additional Resources

Literature

- 89600 VSA Software, Brochure, literature number 5990-6553EN
- 89600 VSA Software, Configuration Guide, literature number 5990-6386EN
- Option 89601200C Basic Vector and Hardware Connectivity, Technical Overview, literature number 5992-4210EN
- Option 89601BHTC NB-IoT Modulation Analysis as part of IoT Modulation Analysis, Technical Overview, literature number 5992-4207EN

Web

- www.keysight.com/find/89600vsa

Learn more at: www.keysight.com

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