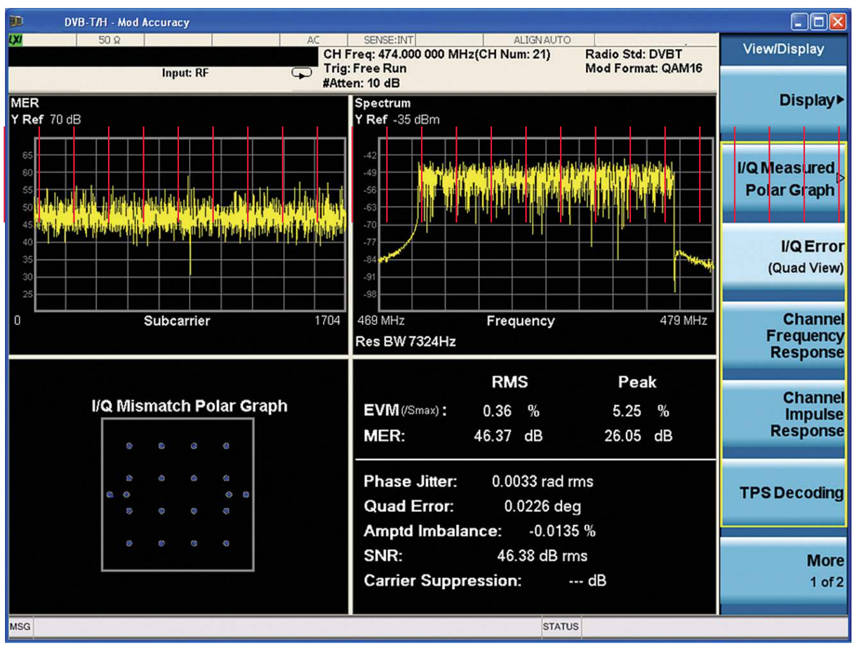
Keysight Technologies
N6153A & W6153A DVB-T/H with T2

X-Series Measurement Application

Demo Guide



KEYSIGHT TECHNOLOGIES

Introduction

This demonstration guide follows the list on page 2 which shows the functions of the N6153A & W6153A measurement applications. Each demonstration is given a brief description of its function and the corresponding measurement steps on the signal generator and/or signal analyzer.

Measurement Details

All of the RF transmitter measurements as defined by the DVB-T/H/T2 standard, as well as a wide range of additional measurements and analysis tools, are available with a press of a button (Table 3). These measurements are fully remote controllable via the IEC/IEEE bus or LAN, using SCPI commands.

Analog baseband measurements are available on the MXA signal analyzer equipped with BBIQ hardware. Supported baseband measurements include all of the modulation quality, power stat CCDF, and IQ waveform measurements.

Table 1. One-button measurements provided by the N/W6153A measurement application

Technology	DVB-T/H	DVB-T2
Measurement application	N6153A-2FP, W6153A-2FP	N6153A-3FP, W6153A-3FP
X-Series analyzer	PXA, MXA, EXA, CXA	PXA, MXA, EXA, CXA
Measurements		
Channel power	●	●
Shoulder attenuation	●	●
Spectrum mask with analog TV in adjacent channel	●	●
Adjacent channel power	●	●
Spectrum emission mask	●	●
Power statistic CCDF	●	●
Spurious emission	●	●
Modulation accuracy		
RMS EVM (%)	●	●
Peak EVM (%)	●	●
Position of peak EVM	●	●
RMS MER (dB)	●	●
Peak MER (dB)	●	●
Position of peak MER	●	●
RMS mag error (%)	●	●
Peak mag error (%)	●	●
Position of peak Mag error	●	●
RMS phase error (deg)	●	●
Peak phase error (deg)	●	●
Position of peak phase error	●	●
Frequency error (Hz)	●	●
Tx power (dBm)	●	●
Amplitude Imbalance	●	●
Quadrature error (deg)	●	●
Phase jitter (rad)	●	
Carrier suppression (dB)	●	
SNR (dB)	●	
TPS power ratio (dB)	●	
Data power ratio (dB)	●	
MER/EVM vs. subcarriers/frequency	●	●
MER of data (dB)	●	●
MER of pilot/TPS (dB)	●	
MER of P2 Pilot/L1-Pre/L1-Post/Cont Pilot/Scat Pilot/FC Pilot		●
Amplitude vs. subcarriers (dB)	●	●
Phase vs. subcarriers (deg)	●	●
Group delay vs. subcarriers (ns)	●	●
Channel impulse response (dB)	●	●
BER results	●	
TPS decoding	●	
L1 signalling		●
MER monitor	●	●

Demonstration Preparation

Minimum equipment configuration requirements

The demonstrations below use an X-Series signal analyzer and the N5182A MXG vector signal generator. Keystrokes surrounded by [ ] indicate front-panel keys; keystrokes surrounded by { } indicate softkeys located on the display.

Product type	Model number	Required options
MXG vector signal generator	N5182A (Firmware revision A.01.20 or later)	– 651, 652 or 654 – internal baseband generator (30 M/60 M/125 MSa/s, 8 MSa) – 019 – Upgrade baseband generator memory to 64 MSa (recommended)
Signal Studio for digital video	N7623B QFP or QTP Advanced DVB-T/H/C/J.83 A/C N7623B ZFP or ZTP Advanced DVB-T2 (software version: 2.2.7.0 or later)	Please check N7623B signal studio Web page for the latest version www.keysight.com/find/signalstudio
X-Series signal analyzer	N9000A1, N9010A, N9020A, or N9030A firmware revision A.07.xx or later	Recommended: – EA3 – Electric attenuator, 3.6 GHz – P0x – Preamplifier – P0x (P03, P08 (P07 for CXA)) – B25 – Analysis bandwidth, 25 MHz (for analysis over 10 MHz up to 25 MHz) – BBA – Analog baseband IQ inputs (for analog baseband IQ analysis) Required: – 503, 508, 507 (EXA and CXA), 513 or 526–513 and 526 not available on CXA
X-Series DVB-T/H Digital Video	N6153A – N9010A, N9020A, N9030A W6153A – N9000A only	Required: – 2FP: DVB-T/H measurement application, fixed perpetual license – 3 FP DVB-T2 measurement application, fixed perpetual license OR – 2TP: DVB-T/H measurement application, transportable license – 3 TP DVB-T2 measurement application, trans-portable license
Controller PC for Signal Studio for digital video[1]		Install N7623B to generate and download the signal waveform into the Keysight MXG via GPIB or LAN (TCP/IP)—please refer to the online documentation for installation and setup

1. *Keysight X-Series PXA/MXA/EXA/CXA signal analyzers can be used as the controller PC to install the N7623B Signal Studio software and download waveforms into the MXG via LAN or GPIB.*

Helpful tip:

Update your instrument firmware and software to the latest version, at

www.keysight.com/find/xseries_software
www.keysight.com/find/signalstudio

Demonstration Setup

Connect the PC, X-Series, and MXG

Connect a PC (loaded with Keysight N7623B Signal Studio for Digital Video software and Keysight I/O libraries) to the N5182A MXG via GPIB or LAN. Follow the Signal Studio instructions to complete the connection, and then perform the following steps to interconnect the X-Series analyzer (see Figure 1 for a graphical overview):

A. Connect the MXG RF output port to the X-Series signal analyzer RF input port
B. Connect the MXG 10 MHz Out to the X-Series signal analyzer Ext Ref In port (rear panel)

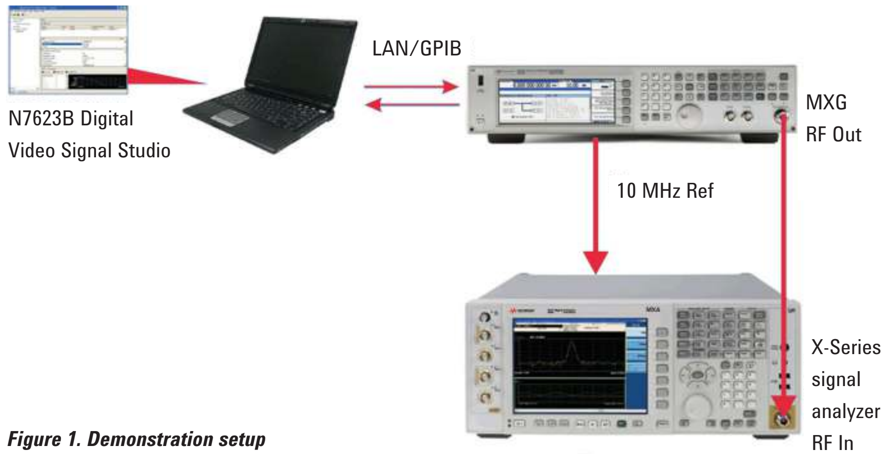


Figure 1. Demonstration setup

Demonstrations

Demonstration 1:

Set up Signal Studio for Digital Video to generate DVB-T/H/T2 signals

The Keysight Technologies, Inc. N7623B Signal Studio for Digital Video is a Windows-based utility that simplifies the creation of standards-based or customized DVB-T/H and DVB-T2 signals. The waveform is downloaded into the MXG vector signal generator, which generates RF or IQ signals.

The settings of DVB-T/H and DVB-T2 signals under test are as follows:

DVB-T/H settings

Standard:	DVB-T
Frequency:	474 MHz
Channel bandwidth:	8 MHz
FFT size:	2 K
Modulation type:	16QAM
Alpha:	1
GI (guard interval):	¼
Transmission modes:	Hierarchical
HP/LP code rate:	½

DVB-T2 settings (Signal PLP)

P1 type:	SISO
Frequency:	474 MHz
Channel bandwidth:	8 MHz
PAPR type:	No PAPR
GI (guard interval):	1/128
FFT size:	32 K
Pilot pattern:	PP7
Carrier mode:	Extended
Data symbol number:	7
L1 modulation type:	64QAM
Number of frames per superframe:	2

PLP settings

Modulation format:	256QAM
Constellation rotation:	On
FEC type:	Normal (64 K)
LDPC code rate:	3/5
Number of TI (time interleaving) blocks per interleaving frame:	3
FEC block number:	26

Instructions	Keystrokes
On the MXG:	
Preset the MXG Check the IP address	**[Preset]** **[Utility] {I/O Config} {LAN Setup}**
On the Signal Studio software:	
Run the Keysight Signal Studio for digital video	Double-click on the Digital Video shortcut on the desktop or access the program via the Windows start menu
Verify the software is communicating with the instrument via the GPIB or LAN (TCP/IP) link	To establish a new connection, click on the {**System**} pull-down menu at the top of the Signal Studio program window. Next, select {**Run System Configuration Wizard**}
To generate DVB-T/H signals:	
Select the DVB-T/H format	Click on the **{Format}** pull-down menu at the top of the Signal Studio program window. Next, select **{DVB-T/H}**
Set the parameters of the signal generator with center frequency 474 MHz, amplitude –20 dBm, RF Output turned on, and ALC On	Click **Signal Generator** at the left on the Explorer menu. Instrument Model Number: N5162A/N5182A Press **[Preset]** green button at the top. Frequency = 474 MHz, Amplitude = –20 dBm, RF Output = On, ALC = On
Confirm the waveform setup from upper level	Click **Waveform Setup** to see the fundamental waveform signal setups, set DVB-T/H common parameters as follows: Oversampling Ratio = 1, Mirror Spectrum = Off, Quadrature Angle Adjustment = 0 deg, I/Q Gain Balance = 0 dB
Set a test signal for demonstrations	Click **Carrier0** under **Waveform Setup** on the left of the explorer menu. Set the parameters of the signal to be transmitted on right side of the menu. Figure 2 shows the Signal Studio settings after the setup done
To generate DVB-T2 signals:	
Select the DVB-T2 format	Click on the **{Format}** pull-down menu at the top of the Signal Studio program window. Next, select **{DVB-T2}**
Set the parameters of the signal generator with center frequency 474 MHz, amplitude –20 dBm, RF Output turned on, and ALC On	Click **Signal Generator** at the left on the Explorer menu. Instrument Model Number: N5162A/N5182A Press **[Preset]** green button at the top. Frequency = 474 MHz, Amplitude = –20 dBm, RF Output = On, ALC = On
Confirm the waveform setup from upper level	Click **Waveform Setup** to see the fundamental waveform signal setups, set DVB-T2 common parameters as follows: Oversampling Ratio = 1, Mirror Spectrum = Off, Quadrature Angle Adjustment = 0 deg, I/Q Gain Balance = 0 dB
Set the general DVB-T2 parameters for carrier 0	Click **Carrier0** under **Waveform Setup** on the left of the explorer menu. Set the parameters of the signal to be transmitted on the right side of the menu. The Carrier0 settings should look like Figure 3
Set the PLP0 parameter	Click **PLP 0** under **Carrier0** on the left of the explore menu. Set the parameters according to the settings of the signal under test on the right side of the menu. The PLP 0 settings should look like Figure 4
Download and save settings:	
Download the signal to the MXG	Click on the top tool bar. If you encounter any errors, please refer to the online help of Signal Studio software
Save the signal file for future use	**File > Save Setting File > DVB.scp** (create filename)
Export the waveform file for future use	**File > Export Waveform Data > DVB.wfm** (create filename)

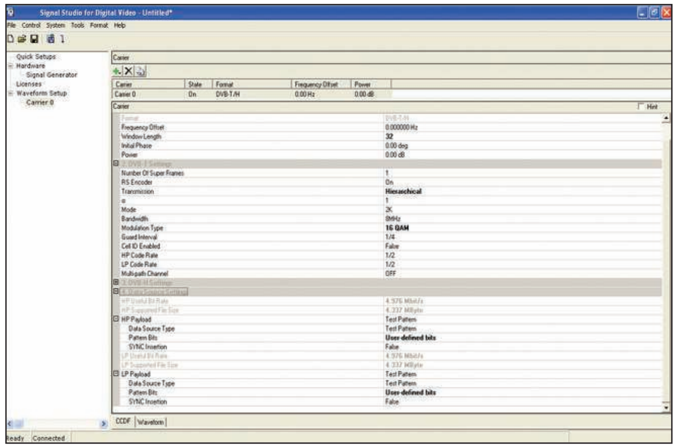


Figure 2. DVB-T/H signals setup in the Keysight Signal Studio software

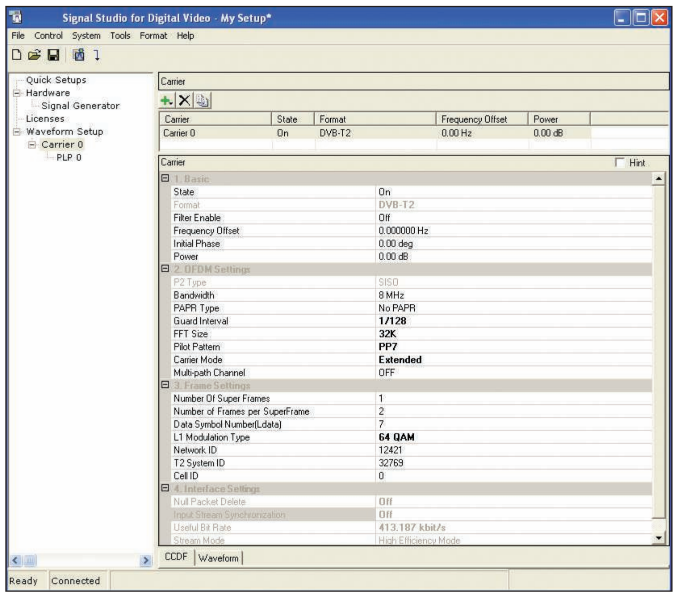


Figure 3 Carrier 0 settings for DVB-T2 signal

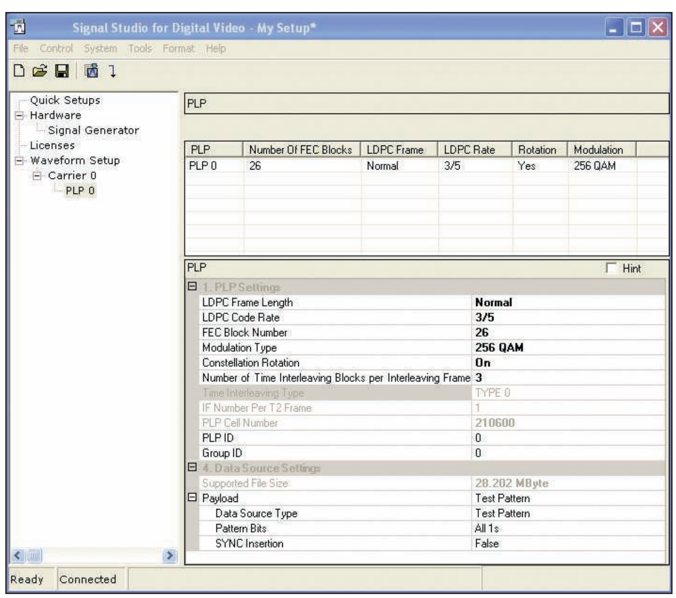


Figure 4. PLP 0 settings for DVB-T2 signal

Demonstration 2:

Channel power

The channel power measurement has three views: RF spectrum, shoulder attenuation, and spectrum mask.

The RF spectrum view measures and reports the integrated power in a DVB-T/H/T2 defined bandwidth and power spectral density (PSD) displayed in dBm/Hz or dBm/MHz.

Shoulder attenuation is used to characterize the linearity of the OFDM signal without reference to the spectrum mask.

The spectrum mask view compares the input signal against the spectrum mask defined in ETSI EN 300 744 for the condition of analog TV signal in adjacent channel.

Instructions	Keystrokes
On the X-Series:	
Select DVB-T/H with T2 mode	**[Mode] {DVB-T/H with T2}**
Set the center frequency	**[FREQ Channel] {Center Freq} {474} {MHz}**
Choose DVB-T mode and set channel bandwidth	**[Mode Setup] {Radio Std} {DVB-T}** **[Mode Setup] {Channel BW} {8 MHz}**
Select channel power measurement (RF spectrum default)	**[Meas] {Channel Power}**
Switch to shoulder attenuation view	**[View/Display] {Shoulder Attenuation}**

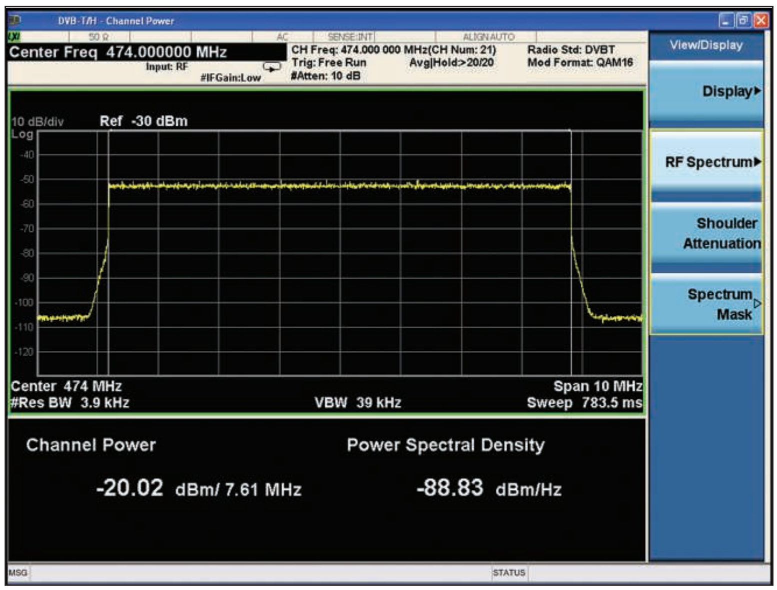


Figure 5. Channel power measurement with RF spectrum view

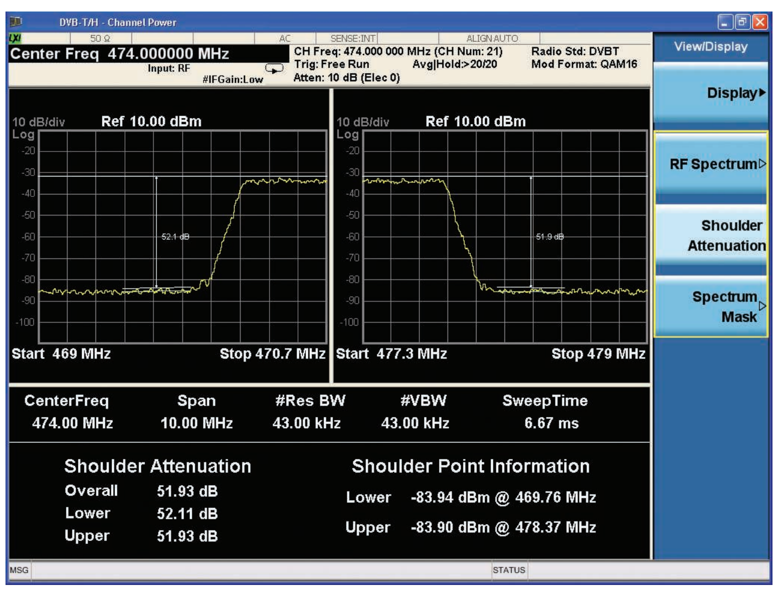


Figure 6. Channel power measurement with shoulder attenuation view

Spectrum mask view

The dynamic range of the RF output of a real DVB-T/H with T2 transmitter typically exceeds the dynamic range of the analyzer. Therefore, the direct measurement result is always "FAIL" and cannot reflect the real RF output.

To measure the spectrum mask of the transmitter's RF output, there are two methods.

Method 1: When the DVB-T/H/T2 transmitter has an output filter, the diagram for spectrum mask measurement is shown in Figure 7.

Three steps for measuring the spectrum mask are as follows:

A. Measure the frequency response of the output filter using a network analyzer or a combination of signal source and signal analyzer.

B. Measure the signal transmitted at point A as shown in Figure 7.

C. Apply amplitude correction on spectrum value measured in Step B using the filter's response from Step A.

The correction data is typically a table of the filter's frequency response in dB, at a number of frequency points across the band.

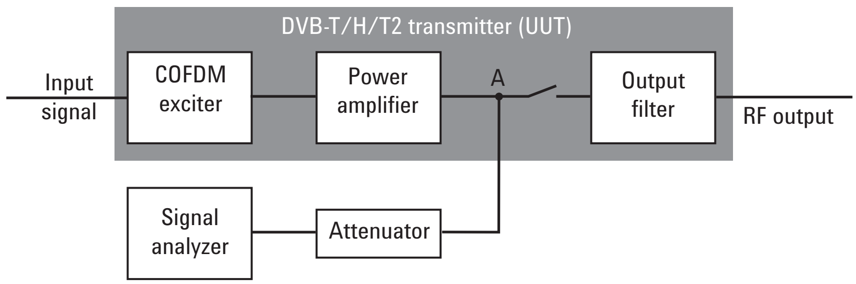


Figure 7. Diagram for spectrum mask measurement on DVB-T/H/T2 transmitter without output filter

---

Method 2: When the transmitter does not have an output filter, an external filter with a band-block filter frequency response should be added after the transmitter for measurement arrangement as shown in Figure 8.

The steps for measuring the spectrum mask are as follows:

A. Measure the frequency response of the output filter using a network analyzer or a combination of signal source and signal analyzer.

B. Measure the signal transmitted at point B as shown in Figure 8.

C. Apply amplitude correction on spectrum value measured in Step B using the filter's response from Step A.

The correction data is typically a table of the negative values of this band-block filter's frequency response in dB, at a number of frequency points across the band.

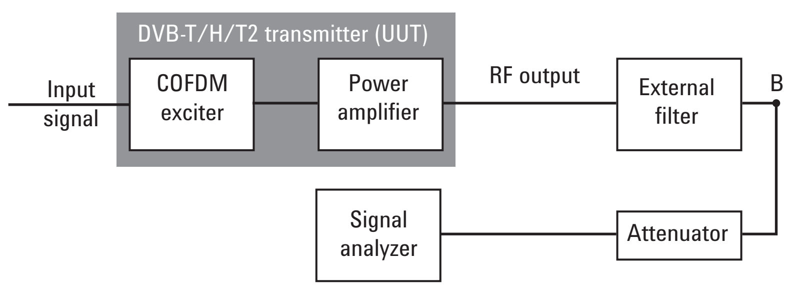


Figure 8. Diagram for spectrum mask measurement on a DVB-T/H/T2 transmitter without an external filter

Note: In spectrum mask view, if the bandwidth is not 8 MHz, the mask trace will not be displayed and a "No Result" message will be displayed, because the spectrum mask for those cases is not currently defined in the specs.

Instructions	Keystrokes
On the X-Series:	
Select the spectrum mask view	**[View/Display] {Spectrum Mask}**
Input the value of the attenuator (for real DVB-T transmitter)	**[Input/Output] {External Gain} {Ext Preamp}**
Recall or edit the correction table	**[Input/Output] {More 1 of 2} {Corrections} {Edit}** or **[Recall] {Data}**
Turn the correction on	**[Input/Output] {More 1 of 2} {Corrections} {On}**

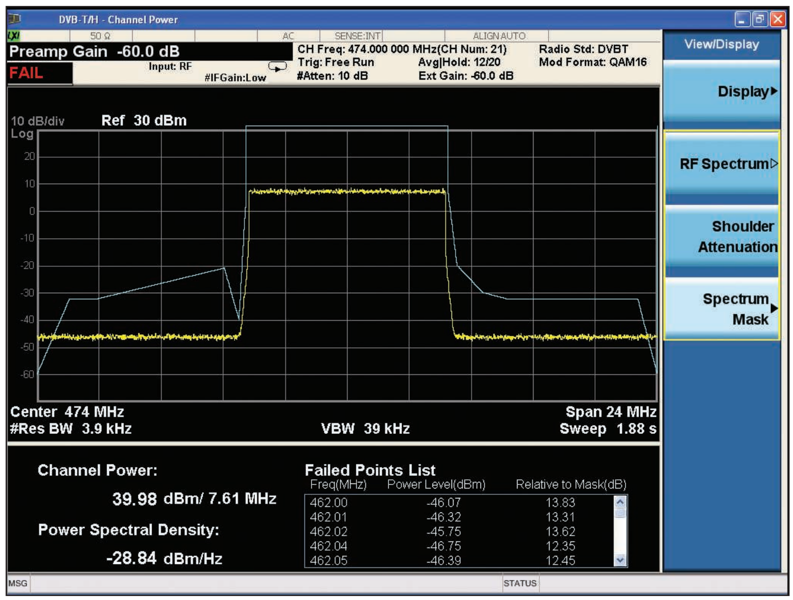


Figure 9. Channel power measurement with spectrum mask view before applying amplitude corrections

Figure 10. Channel power measurement with spectrum mask view after amplitude corrections

Demonstration 3:

Adjacent channel power (ACP)

Adjacent channel power can measure and report the power in one or more transmit channels. The text window shows the total power within defined carrier bandwidth and at given frequency offsets on both sides of the carrier frequency. The ACP measurement results should look like Figure 11.

Instructions	Keystrokes
On the X-Series in DVB-T/H with T2 mode:	
Set the center frequency	**[FREQ Channel] {Center Freq} {474} {MHz}**
Select the radio standard under test and channel bandwidth	**[Mode Setup] {Radio Std} {DVB-T}** **[Mode Setup] {Channel BW} {8 MHz}**
Activate adjacent channel power measurement	**[Meas] {ACP}**
Compare the measurement result with noise correction turned on (default is off). A better ACP result is achieved with noise correction on (Figure 11)	**[Meas Setup] {More 1 of 2}** **{Noise Correction On}**

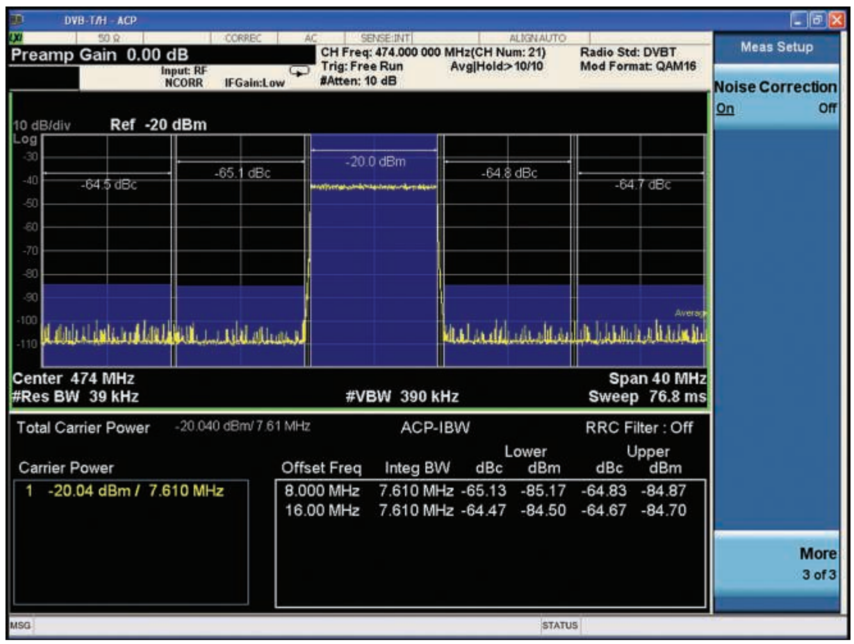


Figure 11. ACP measurement with noise correction on

Demonstration 4:

Power stat CCDF)

The power stat complementary cumulative distribution function (CCDF) is a statistical method used to interpret the peak-to-average ratio of digitally modulated noise-like signals. It is a key tool for power amplifier design for DVB-T/H/T2 transmitters, which is particularly challenging because the amplifier must be capable of handling the high peak-to-average ratio while maintaining good adjacent channel leakage performance.

Instructions	Keystrokes
On the X-Series in DVB-T/H with T2 mode:	
Set the center frequency	**[FREQ Channel] {Center Freq} {474} {MHz}**
Select the radio standard under test and channel bandwidth	**[Mode Setup] {Radio Std} {DVB-T}** **[Mode Setup] {Channel BW} {8 MHz}**
Activate the power stat CCDF measurement	**[Meas] {Power Stat CCDF}**
Store a reference trace	**[Trace/Detector] {Store Ref Trace}**
Turn on reference trace	**[Trace/Detector] {Ref Trace On}**

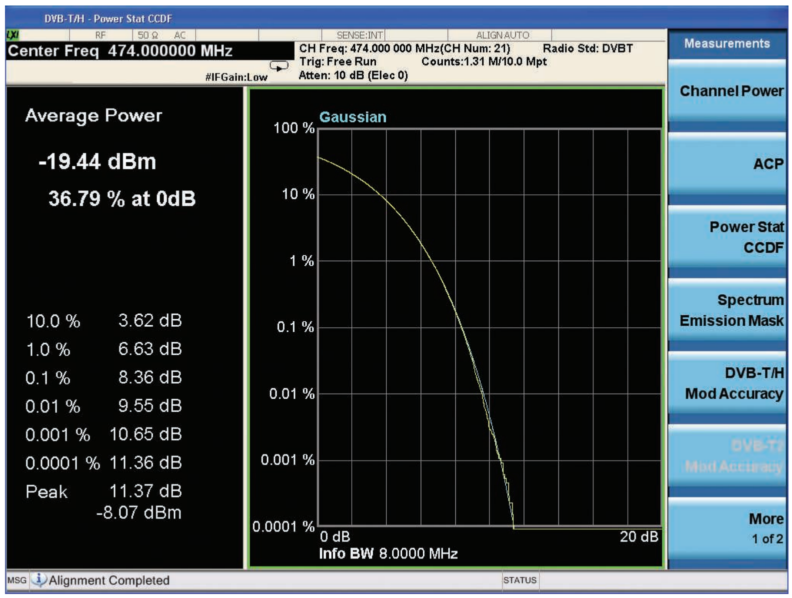


Figure 12. Power stat CCDF measurement

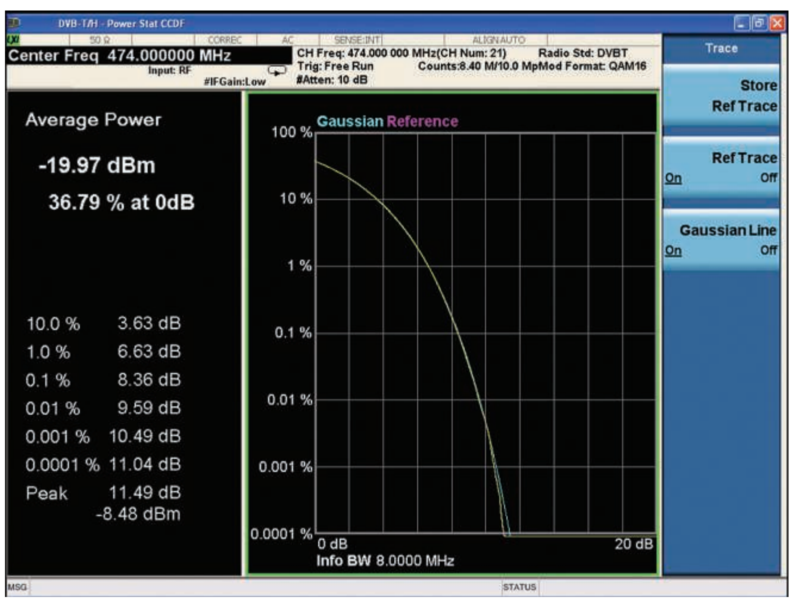


Figure 13. Power stat CCDF measurement with reference trace

Demonstration 5:

Spectrum emission mask

The spectrum emission mask (SEM) measurement can compare the total power level within the defined carrier bandwidth and the given offset channel on both sides of the carrier frequency to levels allowed by the standard when there is a digital TV signal in an adjacent channel. This measurement refers to the design of the power amplifier in the DVB-T/H/T2 transmitter, and it is a key measurement linking amplifier linearity and other performance characteristics to the stringent system specifications.

For a detailed explanation of how to make spectrum emission mask measurements, please refer to the descriptions in the channel power measurement and spectrum mask view sections.

Note: In the spectrum emission mask measurement, if the bandwidth is not 7 MHz or 8 MHz, the mask trace will be displayed as a horizontal line on the top of the screen. You can then set the mask trace manually through **[Meas Setup] {Offset/Limit}**.

Note: Unless otherwise declared by the manufacturer, you should use the noncritical case to measure a transmitting signal; use the critical case when the television channels are adjacent to other services (low power or receive only).

Instructions	Keystrokes
On the X-Series in DVB-T/H with T2 mode:	
Set the center frequency	**[FREQ Channel] {Center Freq} {474} {MHz}**
Select the radio standard under test and channel bandwidth	**[Mode Setup] {Radio Std} {DVB-T}** **[Mode Setup] {Channel BW} {8 MHz}**
Activate spectrum emission mask (non-critical case default)	**[Meas] {Spectrum Emission Mask}**
Input the value of the attenuator (for real DVB-T transmitter)	**[Input/Output] {External Gain} {Ext Preamp}**
Recall or edit the correction table	**[Input/Output] {More 1 of 2} {Corrections} {Edit} or [Recall] {Data}**
Turn correction on	**[Input/Output] {More 1 of 2} {Corrections} {On}**
Measure spectrum emission mask in critical case	**[Meas Setup] {Limit Type} {Critical}**

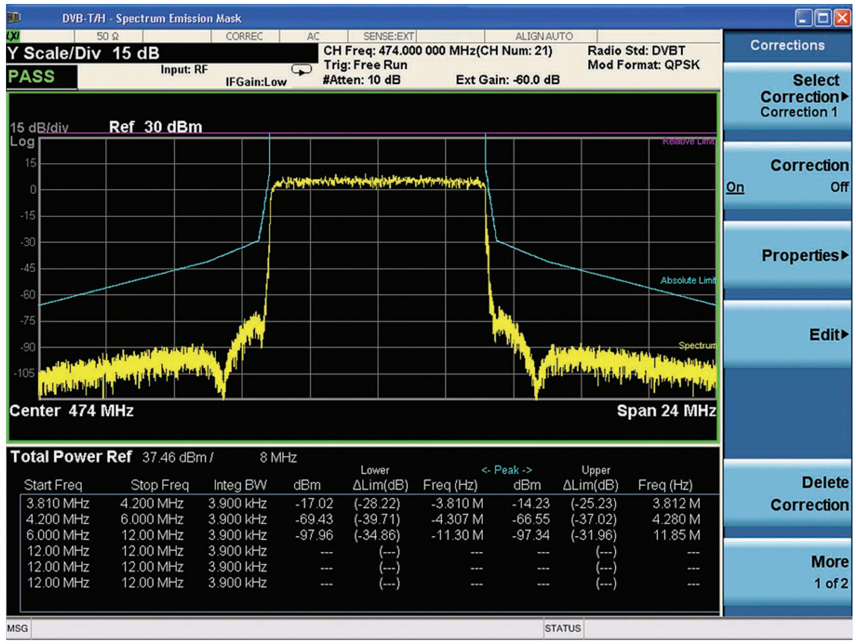


Figure 14. Spectrum emission mask measurement in a non-critical case after amplitude correction

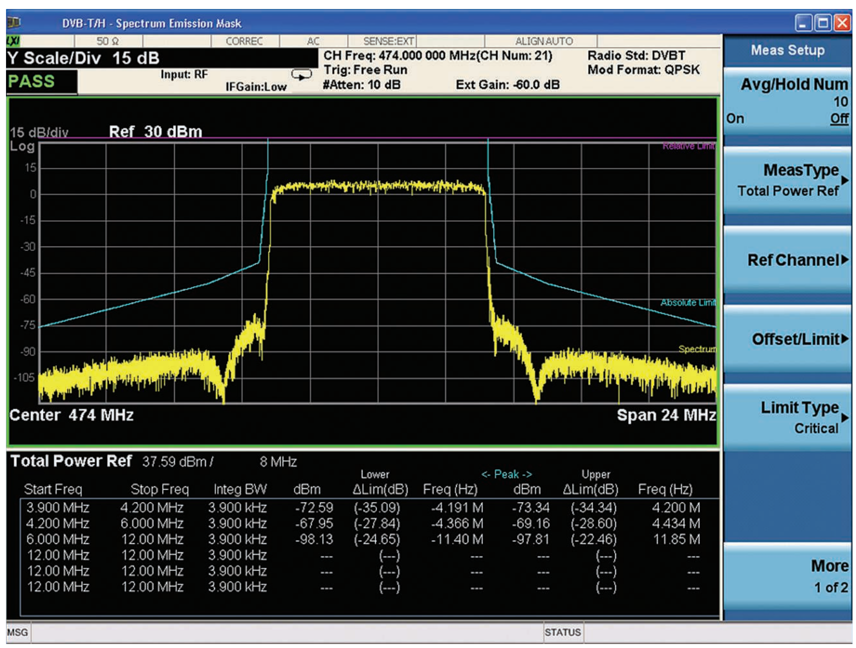


Figure 15. Spectrum emission mask measurement in a critical case after amplitude correction

Demonstration 6:

DVB-T/H modulation accuracy

Measurement of modulation accuracy and quality are necessary to meet DVB-T/H defined tests and ensure proper operations of the transmitters. Error vector magnitude (EVM) and modulation error ratio (MER) are defined in DVB-T/H to present the total signal degradation including noise, interferences, or distortions at the input of a commercial receiver's decision circuits to give an indication of that receiver's ability to correctly decode the signal. EVM is a measurement parameter for evaluating the quality of a modulation, and it is widely used in digital communications. MER is a representation of the distance between measured and theoretical constellation points, which is an indicator of noise, interferences, or distortions on a signal. MER is usually used in broadcasting applications. MER and EVM can convert each other.

The Keysight X-Series DVB-T/H modulation accuracy measurement provides many methods for measuring the errors in a DVB-T/H transmitter. In the measurements, you can measure the EVM, MER, magnitude error, phase error, and more.

Available views and traces in modulation accuracy:

- **I/Q measured polar graph** view (Figure 16): A view of I/Q measured data of the selected sub-carriers
  - Results metrics (left)
  - I/Q measured polar graph (right)
- **I/Q error** view (Figure 17): A view of computed error vector between corresponding symbol points in the I/Q measured and I/Q reference signals
  - MER/EVM vs. sub-carrier/ frequency view (top left)
  - Spectrum (top right)
  - I/Q measured polar graph (bottom left)
  - Results metrics (bottom right)
- **Channel frequency response** view (Figure 18):
  - Amplitude vs. sub-carrier (top)
  - Phase vs. sub-carrier (middle)
  - Group delay vs. sub-carrier (bottom)
- **Channel impulse response** view (Figure 19): A view of the state of the channel including two windows:
  - Peak table (left)
  - Amplitude vs. time (right)
- **TPS decoding** view (Figure 20): TPS decoding graph shows original bits of TPS and the information decoded from TPS
- **BER results** view (Figure 21): Summary of non real-time BER results
- **MER monitor** view (Figure 22): Monitor of the MER results over time while detailed information and raw data for the failed MER are recorded.
- **Result metrics** view (Figure 23): Summary of all the result metrics

Note 1: If the current measurement is DVB-T2 Mod Accuracy, the DVB-T and DVB-H keys are grayed out. In this case you need to switch to other measurements before changing the radio standard.

Note 2: In the I/Q error view, to display the value of carrier suppressions, set the I/Q Mismatch mode to be **{Std}** using keystrokes **[Meas Setup] {Advanced} {I/Q Mismatch} {Std}**.

Note 3: The peak table window in channel impulse response view is very helpful in identifying the multipaths existing in the channel. Figure 24 is an example of a four-path channel with 0, 10, 20, and 30 μs delay respectively.

Note 4: In the MER monitor view, if the limit line **(Meas Setup, More 1 of 2, MER Monitor)** is turned on and the current MER result is lower than the limit, the corresponding failure raw IQ data for the specific measurement will be saved to the directory "D:\userdata\DVB-TH\rawdata," which can be used by the capture buffer of the X-Series signal analyzer for future research. During the monitor process, a log file, including all the MER results, time information, and failure data path, is also saved to the directory "D:\userdata\DVB-TH."

Instructions	Keystrokes
On the X-Series in DVB-T/H with T2 mode:	
Set the center frequency	**[FREQ Channel] {Center Freq} {474} {M Hz}**
Select the radio standard under test and channel bandwidth	**[Mode Setup] {Radio Std} {DVB-T}** **[Mode Setup] {Channel BW} {8 MHz}**
Activate modulation accuracy measurement	**[Meas] {DVB-T/H Mod Accuracy}**
Select demodulation options	**[Mode Setup] {Auto Detect}**
Observe the I/Q measured polar vector display and quantitative data (Figure 16)	**[View/Display] {IQ Measured Polar Graph}**
Switch to the IQ error view (Figure 17)	**[View/Display] {I/Q Error (Quad View)}**
View the channel frequency response (Figure 18)	**[View/Display] {Channel Frequency Response} [Meas Setup] {Advanced} {Equalization On}**
View the channel impulse response and turn on the equalization (Figure 19)	**[View/Display] {Channel Impulse Response} [Meas Setup] {Advanced} {Equalization On}**
View the TPS decoding (Figure 20)	**[View/Display] {TPS Decoding}**
View BER results (Figure 21)	**[View/Display] {More 1 of 2} {BER Results}**
View the MER monitor results (Figure 22)	**[View/Display] {More 1 of 2} {MER Monitor}**
View result metrics (Figure 23)	**[View/Display] {More 1 of 2} {Result Metrics}**

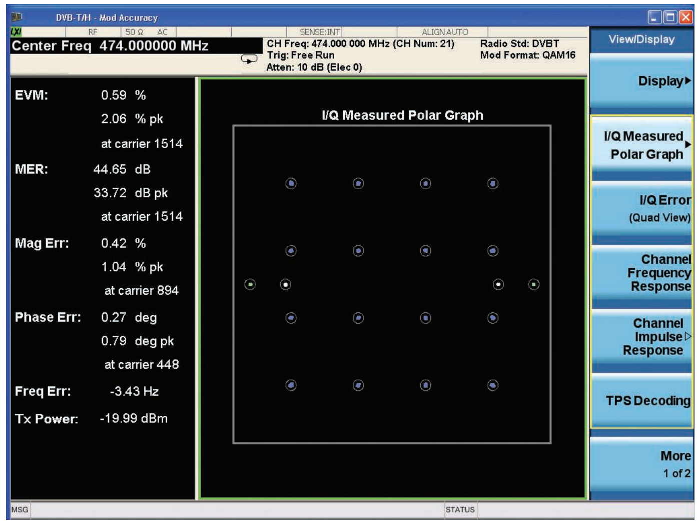


Figure 16. Modulation accuracy measurement with I/Q measured polar graph view

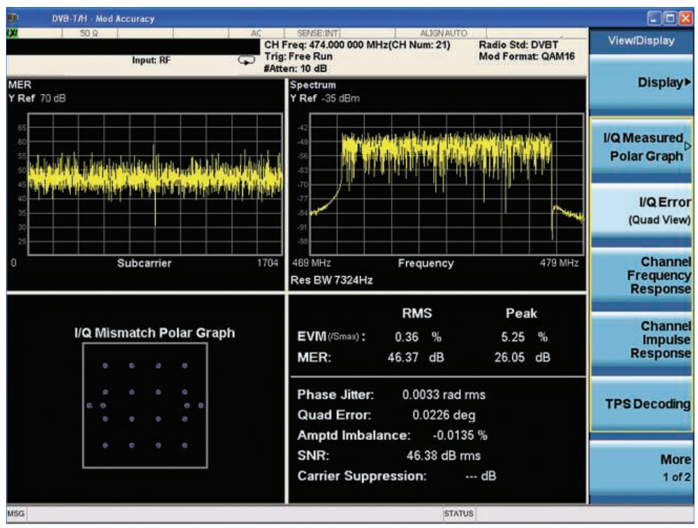


Figure 17. Modulation accuracy measurement with I/Q error view

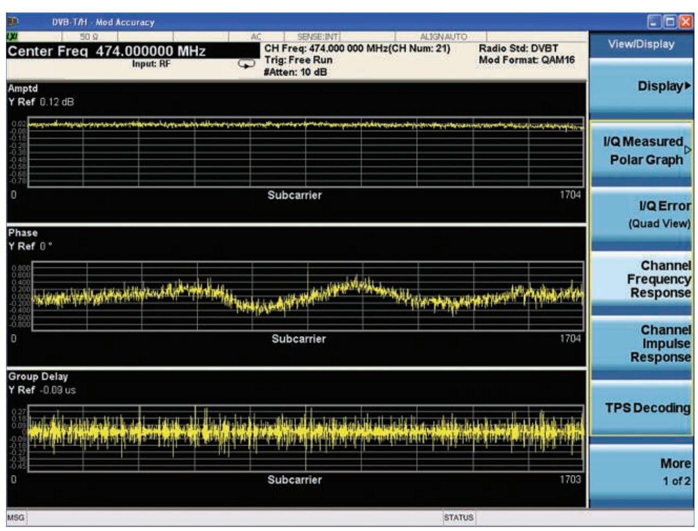


Figure 18. Modulation accuracy measurement with channel frequency response view

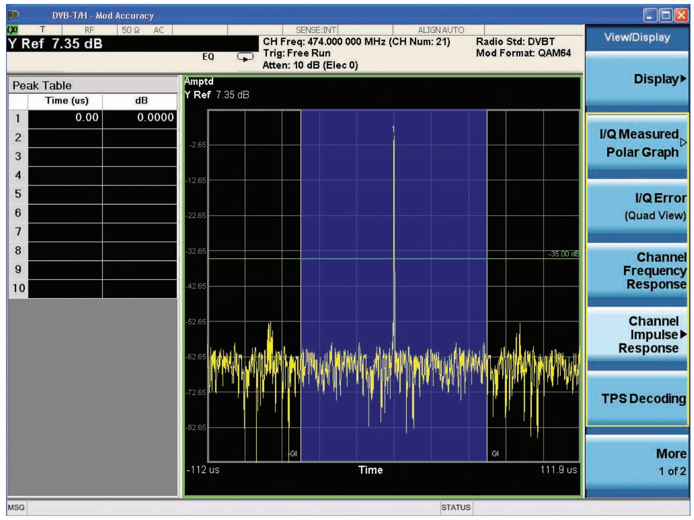


Figure 19. Modulation accuracy measurement with channel impulse response view

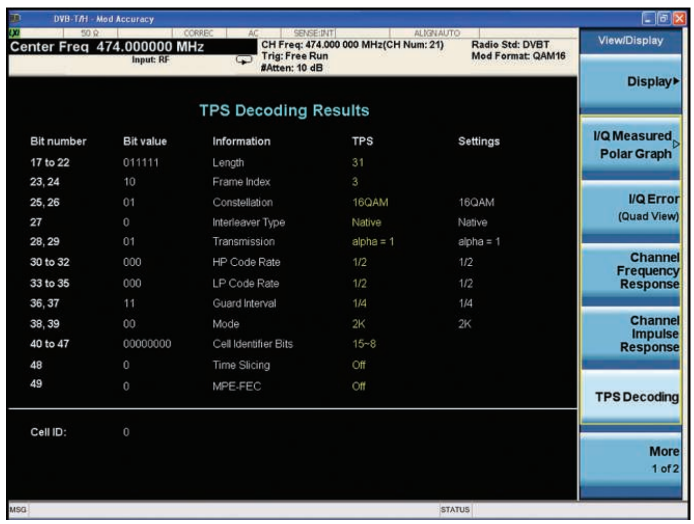


Figure 20. Modulation accuracy measurement with TPS decoding view

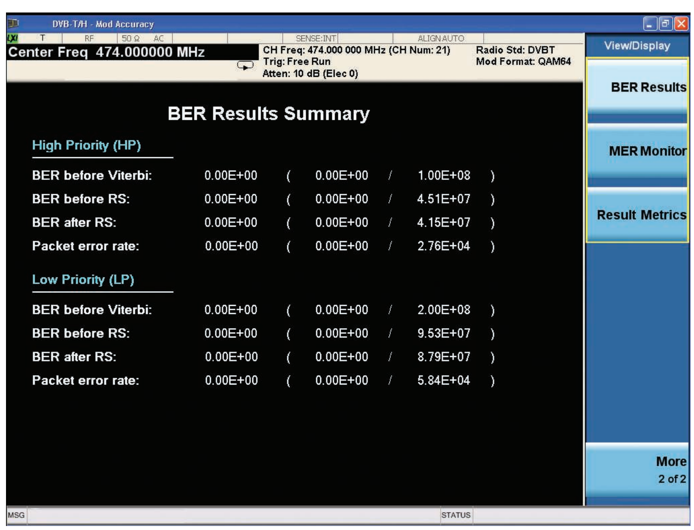


Figure 21. Modulation accuracy measurement with BER results view

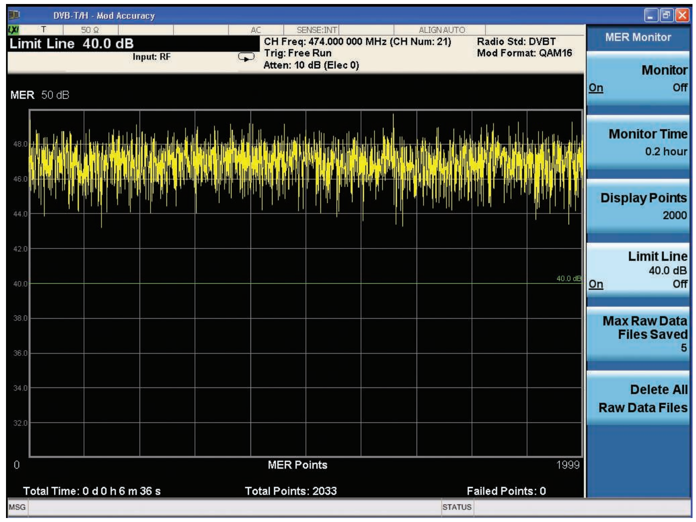


Figure 22. MER monitor view

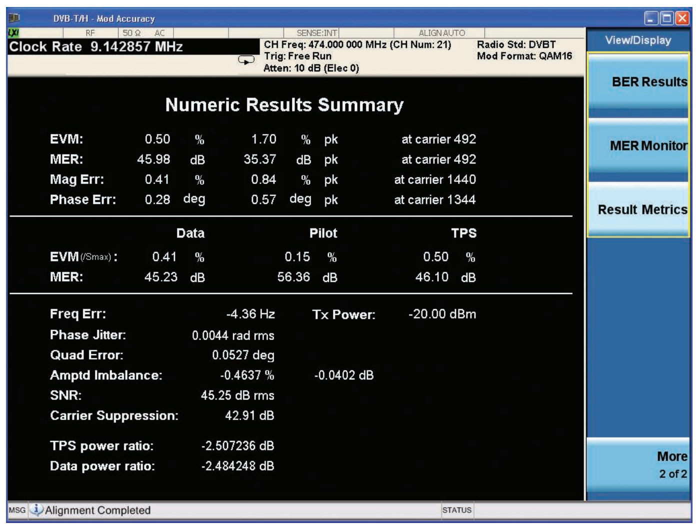


Figure 23. Modulation accuracy measurement with results metrics view

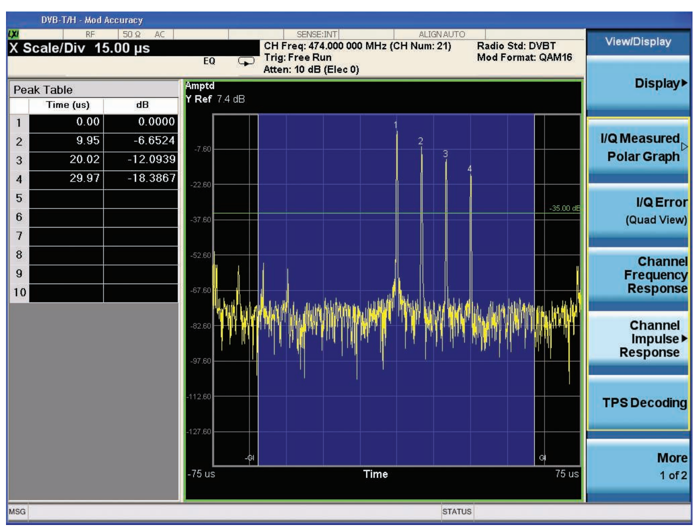


Figure 24. Four-path channel

Demonstration 7:

DVB–T2 modulation accuracy

The DVB-T2 modulation accuracy measurement enables you to demodulate the DVB-T2 signals, providing results like MER, EVM, magnitude error, phase error, L1 signaling information, and so on. The demodulation parameters of the input DVB-T2 signal can be either auto-detected by the instrument using the L1 signaling data or set up manually.

During the demodulation process, an internal periodic trigger, with the period of a DVB-T2 frame, is used as a reference to synchronize and demodulate the DVB-T2 signals.

Available views and traces in DVB-T2 modulation accuracy measurement:

- **I/Q measured polar graph** view (Figure 25): A view of I/Q measured data of the specified sub-carriers and PLP index.
  - Results metrics (left): Calculated using the overall data
  - I/Q measured polar graph (right): Constellation graph for the specified sub-carrier range and PLP ID
- **I/Q error view** (Figure 26): A view of computed error vector between corresponding symbol points in the I/Q measured and I/Q reference signals
  - MER/EVM vs. Sub-carrier/ Frequency view (top left): Calculated using the overall data
  - L1 signaling decoding results (top right)
  - I/Q measured polar graph (bottom left): Constellation graph for the specified PLP index
  - Results metrics (bottom right): A summary of results calculated using the specified PLP index
- **Channel frequency response** view (Figure 27):
  - Amplitude vs. sub-carrier (top)
  - Phase vs. sub-carrier (middle)
  - Group delay vs. sub-carrier (bottom)
- **Channel impulse response** view (Figure 28): A view of the state of the channel
  - Peak table (left)
  - Channel impulse response trace (right)
- **L1 signaling view** (Figure 29)
- **MER monitor view** (Figure 30): Monitor of the MER results over time while detailed information and raw data for the failed MER are recorded
- **Result metrics** view (Figure 31): Summary of all the result metrics

Note 1: If the current measurement is DVB-T/H mod accuracy, the DVB-T2 key is grayed out, you need to switch to other measurements before changing the radio standard.

Note 2: In the right bottom window of IQ error view, the peak values for EVM, MER, Mag Err, and phase error are all displayed as "---" because constellation rotation are used in the current PLP.

Note 3: In the MER monitor view, if the limit line **(Meas Setup, More 1 of 2, MER Monitor**) is turned on and the current MER results is lower than the limit, the corresponding failure raw IQ data for the specific measurement will be saved to the directory "D:\userdata\DVB-T2\rawdata," which can be used by the capture buffer of the X-Series signal analyzer for future research. During the monitor process, a log file, including all the MER results, time information, and failure data path, is also saved to the directory "D:\userdata\DVB-T2."

Instructions	Keystrokes
On the X-Series in DVB-T/H with T2 mode:	
Set the center frequency	**[FREQ Channel] {Center Freq} {474} {MHz}**
Select the radio standard under test and channel bandwidth	**[Mode Setup] {Radio Std} {DVB-T2} [Mode Setup] {Channel BW} {8 MHz}**
Activate the DVB-T2 modulation accuracy measurement	**[Meas] {DVB-T2 Mod Accuracy}**
Set the instrument to auto-detect the demodulation parameters	**[Meas Setup] {Auto Detect} {On}**
Synchronize the start of the T2 frame of the input DVB-T2 signal with the signal analyzer's internal periodic trigger	**[Meas Setup] {Sync Frame Now}**
View the I/Q measured polar graph results (Figure 25)	**[View/Display] {IQ Measured Polar Graph}**
View the I/Q error results and specify the PLP index to view (Figure 26)	**[View/Display] {I/Q Error (Quad View)}**
View the channel frequency response (Figure 27)	**[View/Display] {Channel Frequency Response}**
View the channel impulse response and turn on the equalization (Figure 28)	**[View/Display] {Channel Impulse Response} [Meas Setup] {Advanced} {Equalization} {On}**
View the L1 signaling information (Figure 29)	**[View/Display] {L1 Signalling}**
View the MER monitor results (Figure 30)	**[View/Display] {More 1 of 2} {MER Monitor}**
View the result metrics (Figure 31)	**[View/Display] {More 1 of 2} {Result Metrics}**

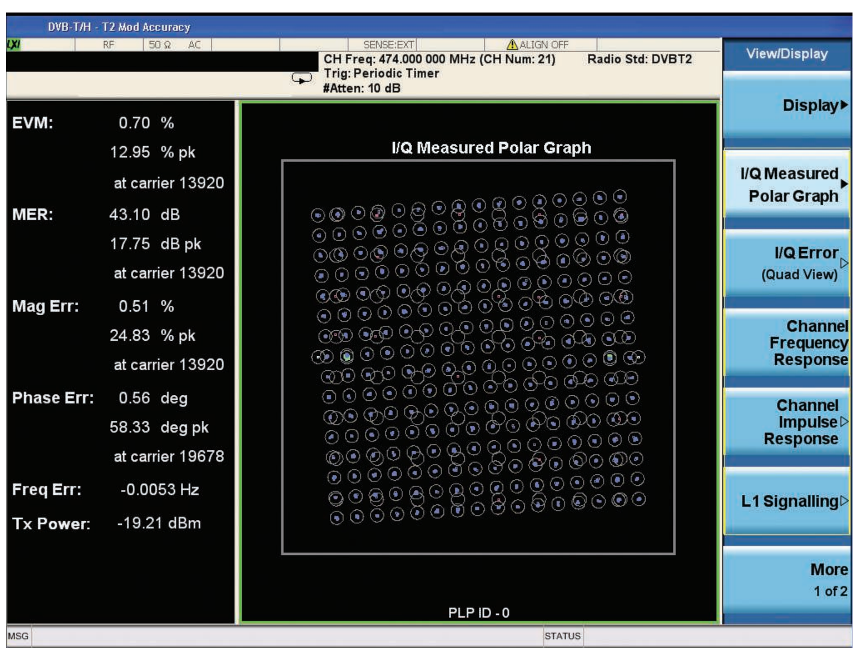


Figure 25. I/Q measured polar graph view

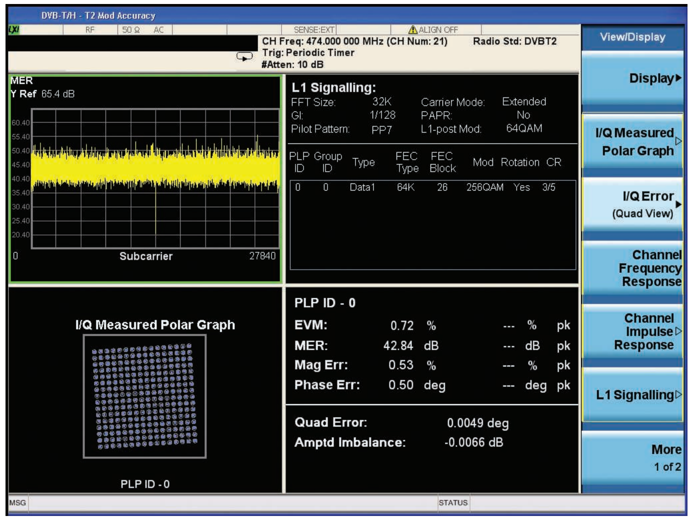


Figure 26. I/Q error view

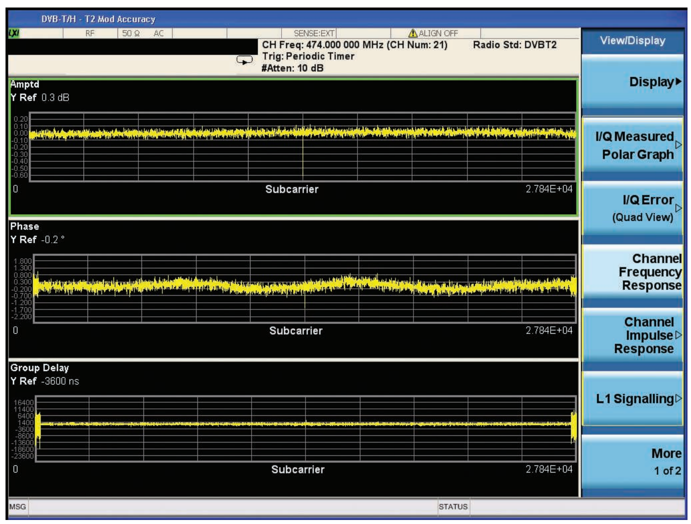


Figure 27. Channel frequency response view

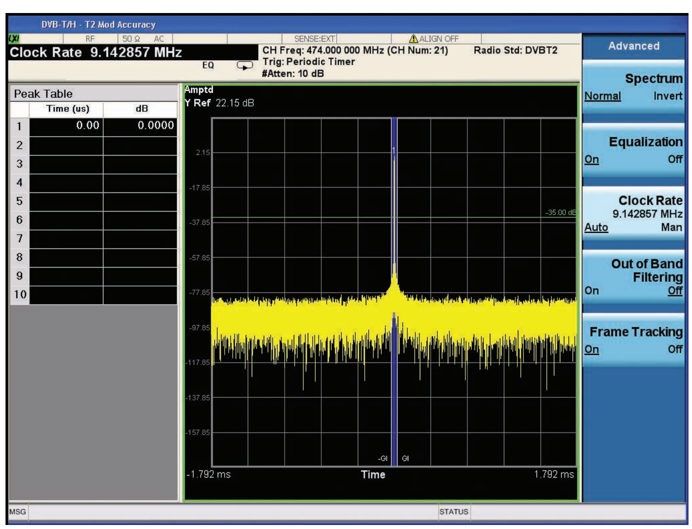


Figure 28. Channel impulse response view

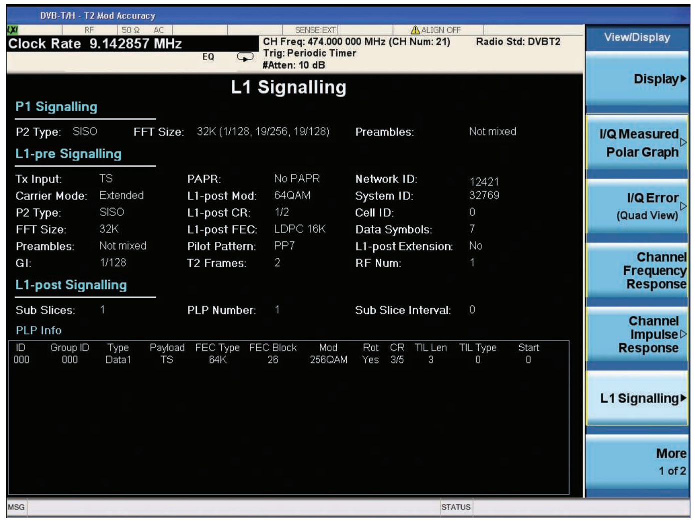


Figure 29. L1 signaling view

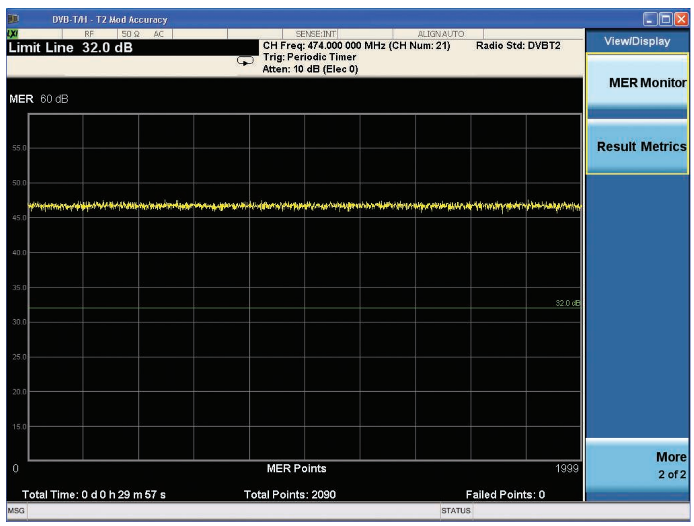


Figure 30. MER monitor view

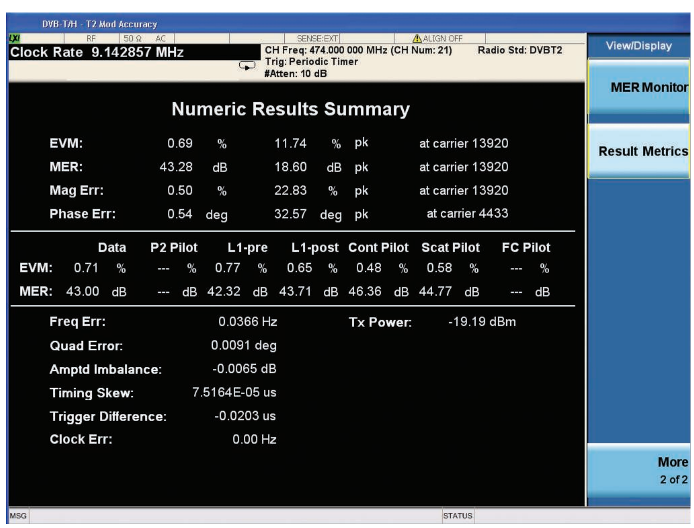


Figure 31. Result metrics view

Demonstration 8:

Spurious emissions

The spurious emissions measurement identifies and determines the power level of spurious emissions in frequency bands defined in ETSI EN 302 296. This measurement can verify the ability of the transmitter to limit the interference caused by unwanted transmitter effects to other systems operating at frequencies away from the carrier frequency.

In the Keysight PXA/MXA/EXA/CXA, the range of frequencies to search for spurs is user-adjustable, up to 200 spurs can be reported in a result table.

Note: The failed point in Figure 32 is the actual transmitted signal with the center frequency of 474 MHz. To avoid seeing this, you can either set the range table not to cover the frequency band containing the transmitted signal or connect a filter between the transmitter and the instruments to remove the undesired signal.

Note: The limit parameter is different depending on the mean power of the transmitter. Thus before measuring spurious emissions, you should set the mean power of the transmitter using **[Meas Setup] {CH Mean Power}.**

Instructions	Keystrokes
On the X-Series in DVB-T/H with T2 mode:	
Set the center frequency	**[FREQ Channel] {Center Freq} {474} {MHz}**
Select the radio standard under test and channel bandwidth	**[Mode Setup] {Radio Std} {DVB-T}** **[Mode Setup] {Channel BW} {8 MHz}**
Activate spectrum emission mask	**[Meas] {Spectrum Emissions}**
Set mean power of the transmitter	**[Meas Setup] {CH Mean Power}**
Edit the range table as needed	**[Meas Setup] {Range Table}**

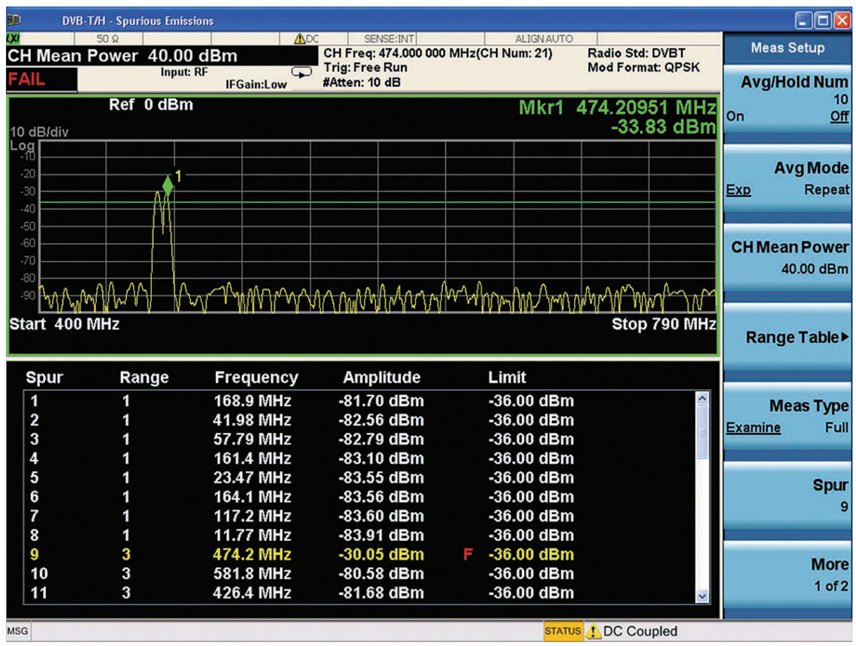


Figure 32. Spectrum emissions measurement

Demonstration 9:

Monitor spectrum

The monitor spectrum measurement is used as a quick, convenient means of looking at the entire spectrum. While the look and feel is similar to the spectrum analyzer mode, the functionality is greatly reduced for easy operation. The main purpose of the measurement is to show the spectrum.

Instructions	Keystrokes
On the X-Series in DVB-T/H with T2 mode:	
Set the center frequency	**[FREQ Channel] {Center Freq} {474} {MHz}**
Select the radio standard under test and channel bandwidth	**[Mode Setup] {Radio Std} {DVB-T}** **[Mode Setup] {Channel BW} {8 MHz}**
Activate monitor waveform measurement	**[Meas] {Monitor Spectrum}**

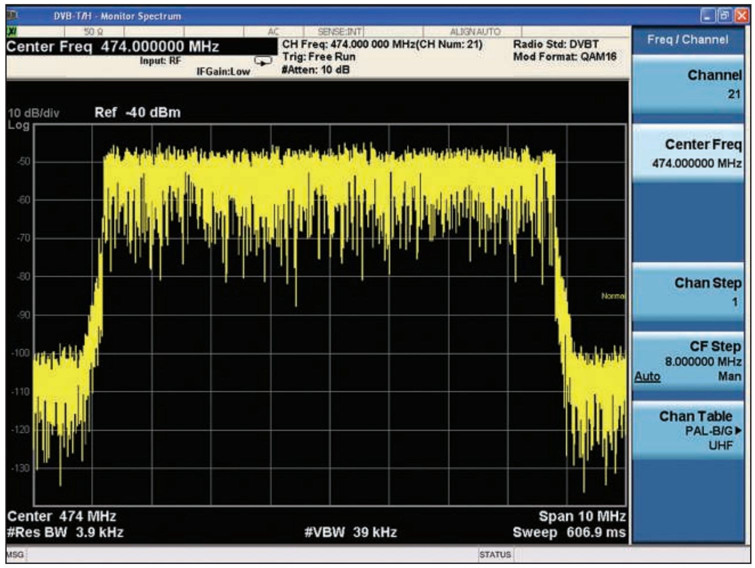


Figure 33. Waveform measurement with RF envelope view

Demonstration 10:

IQ waveform

Waveform measurement is a generic measurement for viewing the input signal waveforms in the time domain. Under this measurement there is also an I/Q waveform window, which shows I and Q signal waveforms in parameters of voltage versus time to disclose the voltages, which comprise the complex modulated waveform of a digital signal. The waveform measurement can also be used to perform general-purpose power measurements with a high degree of accuracy.

Instructions	Keystrokes
On the X-Series in DVB-T/H with T2 mode:	
Set the center frequency	**[FREQ Channel] {Center Freq} {474} {MHz}**
Select the radio standard under test and channel bandwidth	**[Mode Setup] {Radio Std} {DVB-T}** **[Mode Setup] {Channel BW} {8 MHz}**
Activate IQ waveform measurement (RF envelope default)	**[Meas] {IQ Waveform}**
View the I/Q waveform	**[View/Display] {I/Q Waveform}**

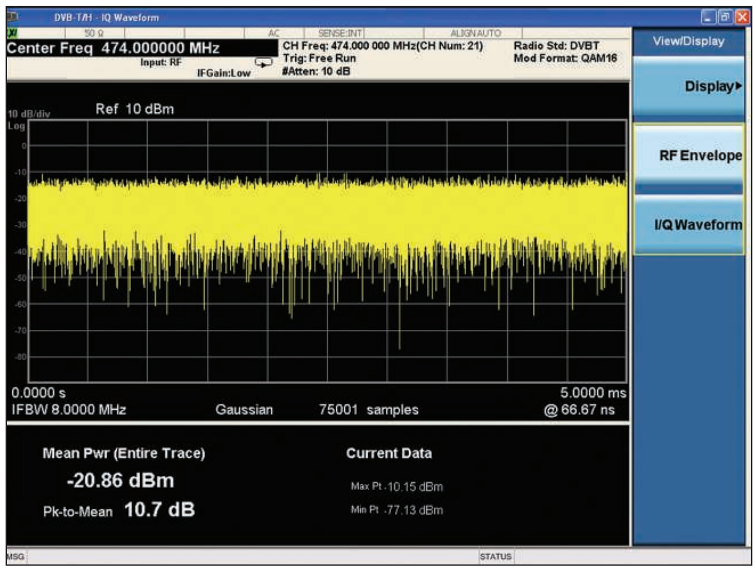


Figure 34. Waveform measurement with RF envelope view

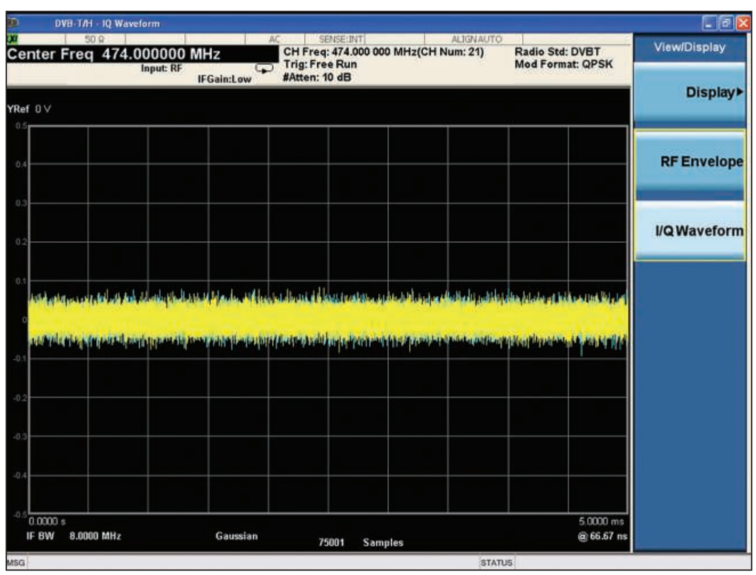


Figure 35. Waveform measurement with I/Q waveform view

myKeysight

www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

www.lxistandard.org
LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. Keysight is a founding member of the LXI consortium.

www.keysight.com/find/ThreeYearWarranty
Keysight's commitment to superior product quality and lower total cost of ownership. The only test and measurement company with three-year warranty standard on all instruments, worldwide.

Keysight Assurance Plans
www.keysight.com/find/AssurancePlans
Up to five years of protection and no budgetary surprises to ensure your instruments are operating to specification so you can rely on accurate measurements.

www.keysight.com/quality
Keysight Electronic Measurement Group
DEKRA Certified ISO 9001:2008
Quality Management System

Keysight Channel Partners
www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

www.keysight.com/find/n6153a

Web Resources

Product page:
www.keysight.com/find/n6153a and
www.keysight.com/find/w6153a

X-Series signal analyzers:
www.keysight.com/find/X-Series

X-Series advanced measurement applications:
www.keysight.com/find/X-Series_Apps

Signal Studio software:
www.keysight.com/find/digitalvideo

Signal Studio software:
www.keysight.com/find/SignalStudio

Signal generators:
www.keysight.com/find/sg

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

Americas	
Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	(800) 829 4444
Asia Pacific	
Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100
Europe & Middle East	
Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	0800 000154
Sweden	0200 882255
Switzerland	0800 805353
	Opt. 1 (DE)
	Opt. 2 (FR)
	Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-05-19-14)

Published in USA, July 31, 2014
5990-5931EN
www.keysight.com