



# Agilent X-Series Signal Analyzer

**This manual provides documentation for the  
following X-Series Analyzers:**

**PXA Signal Analyzer N9030A  
MXA Signal Analyzer N9020A  
EXA Signal Analyzer N9010A  
CXA Signal Analyzer N9000A**

## **N6153A & W6153A DVB-T/H Measurement Application Measurement Guide**



**Agilent Technologies**

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# 1

## About the DVB-T/H Measurement Application

This chapter provides the overall information on the N6153A DVB-T/H measurement application, and describes DVB-T/H measurements made by the analyzer.

DVB-T/H (Digital Video Broadcasting-Terrestrial/Handheld) is the European-based consortium standard for broadcast transmission of digital terrestrial/handheld television.

## What Does the DVB-T/H Application Do?

The DVB-T/H application allows the analyzer to be used for testing a DVB-T/H transmitter. This application is manufactured according to the following standard documents:

- ETSI EN 300 744 Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television
- ETSI EN 302 304 Digital Video Broadcasting (DVB); Transmission System for Handheld Terminals (DVB-H)
- ETSI EN 302 296 Electromagnetic compatibility and Radio spectrum Matters (ERM); Transmitting equipment for the digital television broadcast service, Terrestrial (DVB-T); Harmonized EN under article 3.2 of the R&TTE Directive
- ETSI TR 101 290 Digital Video Broadcasting (DVB); Measurement guidelines for DVB systems

These documents define complex, multi-part measurements used to create and maintain an interference-free environment. For example, the documents include standardized test methods for the measurement of power, spectrum emission mask, and other critical measurements.

The instrument automatically makes these measurements using the measurement methods and limits defined in the documents. The detailed results displayed by the measurements enable you to analyze DVB-T/H transmitter's performance. You may alter the measurement parameters for specialized analysis. For infrastructure test, the analyzer will test transmitters in a non-interfering manner using a coupler or power splitter.

This analyzer makes the following measurements of DVB-T/H signals:

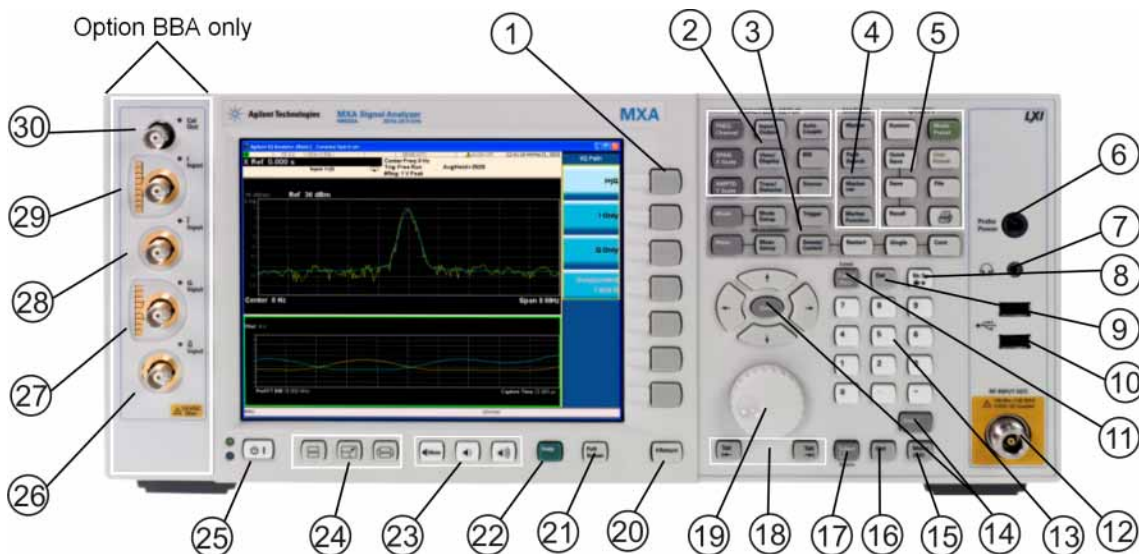
- Channel Power
- Adjacent Channel Power (ACP)
- Power Stat CCDF
- Spurious Emissions
- Spectrum Emission Mask
- Modulation Accuracy
- Monitor Spectrum
- IQ Waveform (Time Domain)

If the option BBA is installed, the ability to analyze baseband I/Q signal characteristics of mobile and base station transmitters is provided. The Baseband I/Q Input is available in the following measurements:

- Modulation Accuracy
- Power Stat CCDF
- IQ Waveform (Time Domain)

- “Front-Panel Features” on page 12
- “Display Annotations” on page 19
- “Rear-Panel Features” on page 21
- “Front and Rear Panel Symbols” on page 24

## Front-Panel Features



Item		Description
#	Name	
1	Menu Keys	Key labels appear to the left of the menu keys to identify the current function of each key. The displayed functions are dependent on the currently selected Mode and Measurement, and are directly related to the most recent key press.
2	Analyzer Setup Keys	These keys set the parameters used for making measurements in the current Mode and Measurement.
3	Measurement Keys	These keys select the Mode, and the Measurement within the mode. They also control the initiation and rate of recurrence of measurements.
4	Marker Keys	Markers are often available for a measurement, to measure a very specific point/segment of data within the range of the current measurement data.
5	Utility Keys	These keys control system-wide functionality such as: <ul style="list-style-type: none"> <li>• instrument configuration information and I/O setup,</li> <li>• printer setup and printing,</li> <li>• file management, save and recall,</li> <li>• instrument presets.</li> </ul>
6	Probe Power	Supplies power for external high frequency probes and accessories.
7	Headphones Output	Headphones can be used to hear any available audio output.
8	Back Space Key	Press this key to delete the previous character when entering alphanumeric information. It also works as the Back key in Help and Explorer windows.

Item		Description
#	Name	
9	Delete Key	Press this key to delete files, or to perform other deletion tasks.
10	USB Connectors	Standard USB 2.0 ports, Type A. Connect to external peripherals such as a mouse, keyboard, DVD drive, or hard drive.
11	Local/Cancel/(Esc) Key	<p>If you are in remote operation, Local:</p> <ul style="list-style-type: none"> <li>returns instrument control from remote back to local (the front panel).</li> <li>turns the display on (if it was turned off for remote operation).</li> <li>can be used to clear errors. (Press the key once to return to local control, and a second time to clear error message line.)</li> </ul> <p>If you have not already pressed the units or Enter key, Cancel exits the currently selected function without changing its value.</p> <p>Esc works the same as it does on a PC keyboard. It:</p> <ul style="list-style-type: none"> <li>exits Windows dialogs</li> <li>clears errors</li> <li>aborts printing</li> <li>cancels operations.</li> </ul>
12	RF Input	Connector for inputting an external signal. Make sure that the total power of all signals at the analyzer input does <i>not</i> exceed +30 dBm (1 watt).
13	Numeric Keypad	Enters a specific numeric value for the current function. Entries appear on the upper left of the display, in the measurement information area.
14	Enter and Arrow Keys	<p>The Enter key terminates data entry when either no unit of measure is needed, or you want to use the default unit.</p> <p>The arrow keys:</p> <ul style="list-style-type: none"> <li>Increment and decrement the value of the current measurement selection.</li> <li>Navigate help topics.</li> <li>Navigate, or make selections, within Windows dialogs.</li> <li>Navigate within forms used for setting up measurements.</li> <li>Navigate within tables.</li> </ul> <p><b>NOTE</b> The arrow keys cannot be used to move a mouse pointer around on the display.</p>
15	Menu/ (Alt) Key	Alt works the same as a PC keyboard. Use it to change control focus in Windows pull-down menus.
16	Ctrl Key	Ctrl works the same as a PC keyboard. Use it to navigate in Windows applications, or to select multiple items in lists.
17	Select / Space Key	Select is also the Space key and it has typical PC functionality. For example, in Windows dialogs, it selects files, checks and unchecks check boxes, and picks radio button choices. It opens a highlighted Help topic.
18	Tab Keys	Use these keys to move between fields in Windows dialogs.
19	Knob	Increments and decrements the value of the current active function.
20	Return Key	Exits the current menu and returns to the previous menu. Has typical PC functionality.

Front and Rear Panel Features  
**Front-Panel Features**

Item		Description
#	Name	
21	Full Screen Key	Pressing this key turns off the softkeys to maximize the graticule display area. Press the key again to restore the normal display.
22	Help Key	Initiates a context-sensitive Help display for the current Mode. Once Help is accessed, pressing a front panel key brings up the help topic for that key function.
23	Speaker Control Keys	Enables you to increase or decrease the speaker volume, or mute it.
24	Window Control Keys	These keys select between single or multiple window displays. They zoom the current window to fill the data display, or change the currently selected window. They can be used to switch between the Help window navigation pane and the topic pane.
25	Power Standby/ On	Turns the analyzer on. A green light indicates power on. A yellow light indicates standby mode.  <div style="border: 1px solid gray; padding: 2px; display: inline-block; margin-bottom: 5px;"><b>NOTE</b></div> The front-panel switch is a standby switch, <i>not</i> a LINE switch (disconnecting device). The analyzer continues to draw power even when the line switch is in standby.  The main power cord can be used as the system disconnecting device. It disconnects the mains circuits from the mains supply.
26	Q Input	Input port for the Q channel when in differential mode. <sup>a</sup>
27	Q Input	Input port for the Q channel for either single or differential mode. <sup>a</sup>
28	I Input	Input port for the I channel when in differential mode. <sup>a</sup>
29	I Input	Input port for the I channel for either single or differential mode. <sup>a</sup>
30	Cal Out	Output port for calibrating the I, I, Q and Q inputs and probes used with these inputs. <sup>a</sup>

- a. Status of the LED indicates whether the current state of the port is active (green) or is not in use (dark).

### Overview of key types

The keys labeled **FREQ Channel**, **System**, and **Marker Functions** are all examples of front-panel keys.

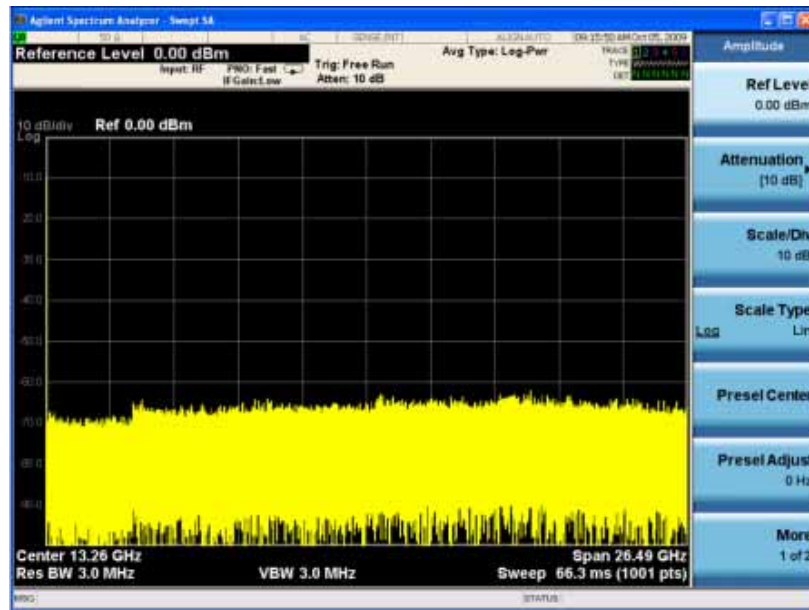


Most of the dark or light gray keys access menus of functions that are displayed along the right side of the display. These displayed key labels are next to a column of keys called menu keys.

Menu keys list functions based on which front-panel key was pressed last. These

functions are also dependant on the current selection of measurement application (**Mode**) and measurement (**Meas**).

If the numeric value of a menu key function can be changed, it is called an active function. The function label of the active function is highlighted after that key has been selected. For example, press **AMPTD Y Scale**. This calls up the menu of related amplitude functions. The function labeled **Ref Level** (the default selected key in the Amplitude menu) is highlighted. **Ref Level** also appears in the upper left of the display in the measurement information area. The displayed value indicates that the function is selected and its value can now be changed using any of the data entry controls.

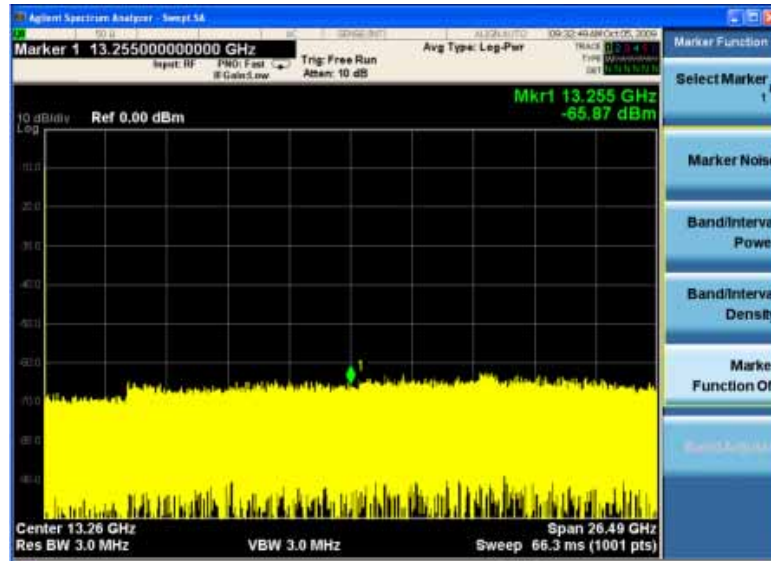


Some menu keys have multiple choices on their label, such as **On/Off**, **Auto/Man**, or **Log/Lin** (as shown above). The different choices are selected by pressing the key multiple times. For example, the Auto/Man type of key. To select the function, press the menu key and notice that Auto is underlined and the key becomes highlighted. To change the function to manual, press the key again so that Man is underlined. If there are more than two settings on the key, keep pressing it until the desired selection is underlined.

## Front and Rear Panel Features

### Front-Panel Features

When a menu first appears, one key label is highlighted to show which key is the default selection. If you press **Marker Function**, the **Marker Function Off** key is the menu default key, and is highlighted.

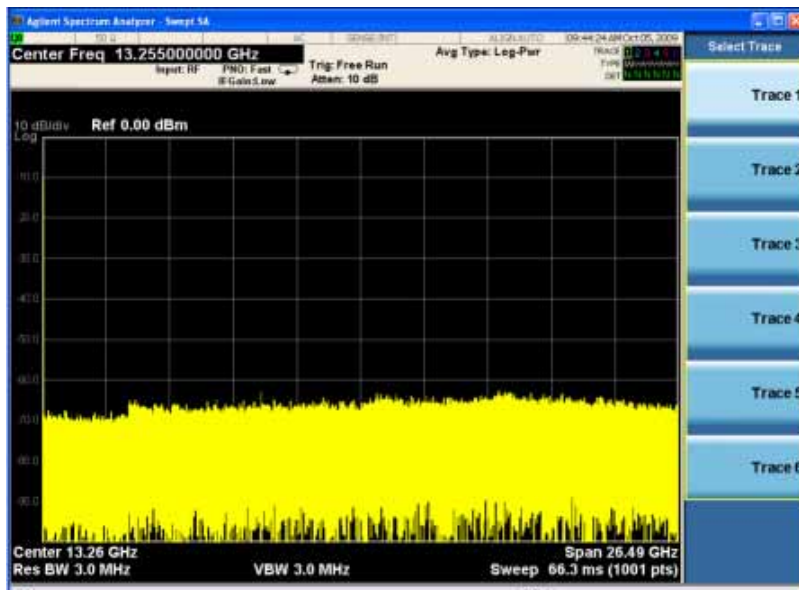


Some of the menu keys are grouped together by a yellow bar running behind the keys near the left side or by a yellow border around the group of keys. When you press a key within the yellow region, such as **Marker Noise**, the highlight moves to that key to show it has been selected. The keys that are linked are related functions, and only one of them can be selected at any one time. For example, a marker can only have one marker function active on it. So if you select a different function it turns off the previous selection. If the current menu is two pages long, the yellow bar or border could include keys on the second page of keys.

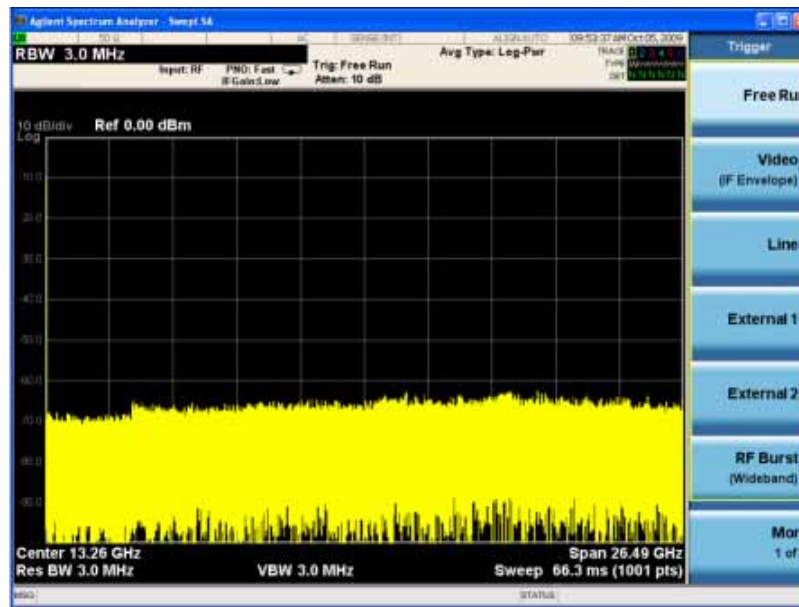
In some key menus, a key label is highlighted to show which key has been selected from multiple available choices. And the menu is immediately exited when you press one of the other keys. For example, when you press the **Select Trace** key (in the **Trace/Detector** menu), it brings up its own menu of keys. The **Trace 1** key is highlighted. When you press the **Trace 2** key, the highlight moves to that key and



the screen returns to the **Trace/Detector** menu.

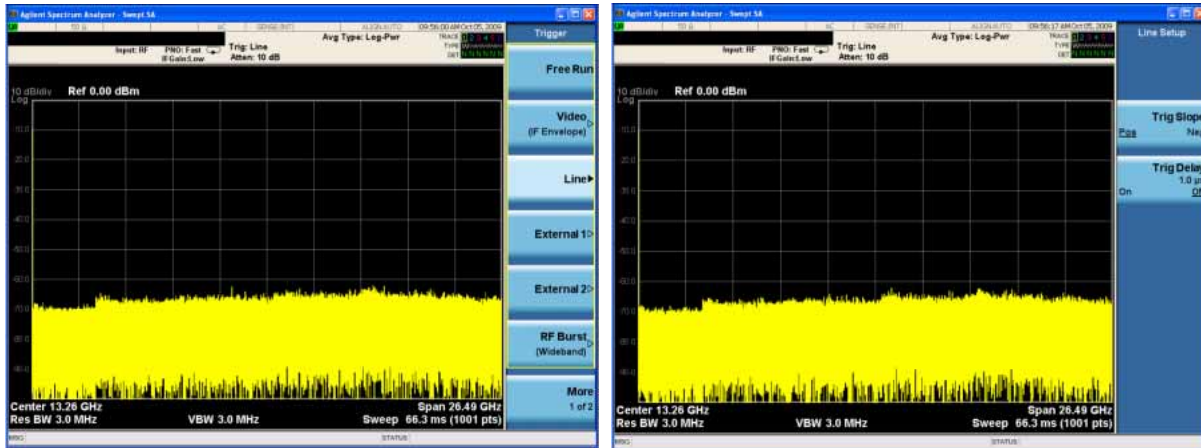


If a displayed key label shows a small solid-black arrow tip pointing to the right, it indicates that additional key menus are available. If the arrow tip is not filled in solid then pressing the key the first time selects that function. Now the arrow is solid and pressing it again brings up an additional menu of settings.



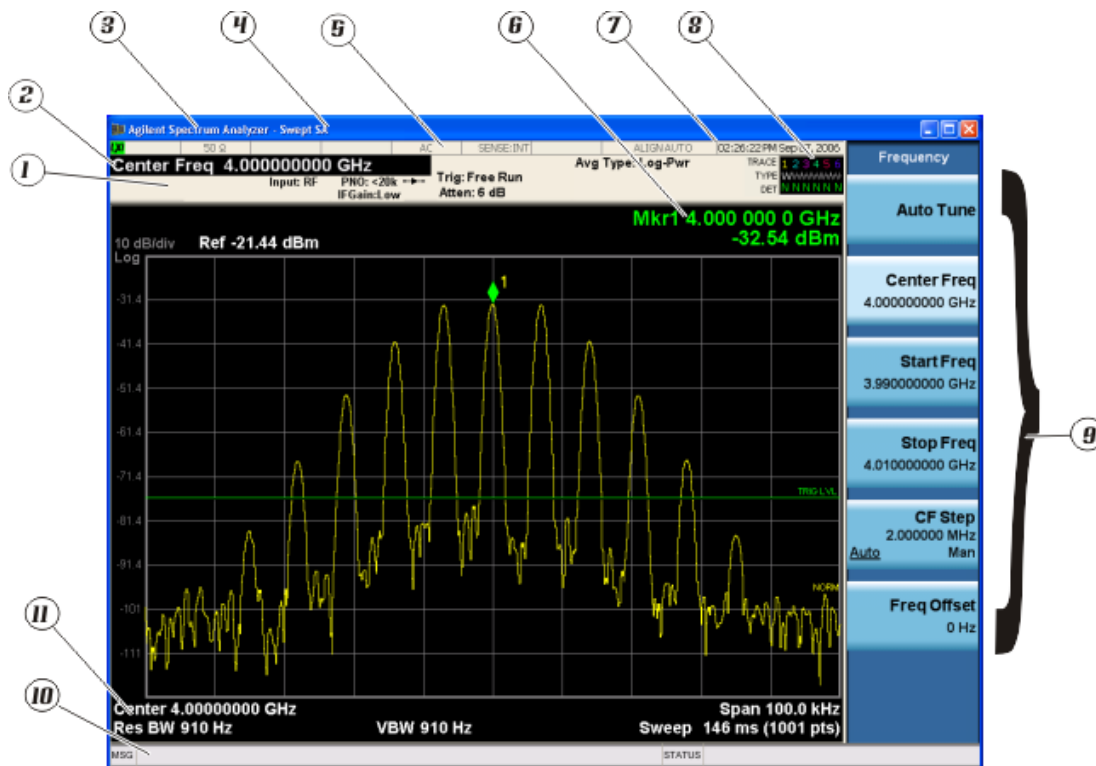
## Front and Rear Panel Features



### Front-Panel Features



## Display Annotations

This section describes the display annotation as it is on the Spectrum Analyzer Measurement Application display. Other measurement application modes will have some annotation differences.



Item	Description	Function Keys
1	Measurement bar - Shows general measurement settings and information.   Indicates single/continuous measurement. Some measurements include limits that the data is tested against. A Pass/Fail indication may be shown in the lower left of the measurement bar.	All the keys in the Analyzer Setup part of the front panel.
2	Active Function (measurement bar) - when the current active function has a settable numeric value, it is shown here.	Currently selected front panel key.
3	Banner - shows the name of the selected measurement application and the measurement that is currently running.	<b>Mode, Meas</b>

## Front and Rear Panel Features Display Annotations

Item	Description	Function Keys
4	Measurement title (banner) - shows title information for the current Measurement, or a title that you created for the measurement.	<b>Meas</b> <b>View/Display, Display, Title</b>
5	Settings panel - displays system information that is not specific to any one application. <ul style="list-style-type: none"> <li>• Input/Output status - green LXI indicates the LAN is connected. RLTS indicate Remote, Listen, Talk, SRQ</li> <li>• Input impedance and coupling</li> <li>• Selection of external frequency reference</li> <li>• Setting of automatic internal alignment routine</li> </ul>	<b>Local</b> and <b>System, I/O Config</b> <b>Input/Output, Amplitude, System</b> and others.
6	Active marker frequency, amplitude or function value.	<b>Marker</b>
7	Settings panel - time and date display.	<b>System, Control Panel</b>
8	Trace and detector information.	<b>Trace/Detector, Clear Write (W) Trace Average (A) Max Hold (M) Min Hold (m)</b> <b>Trace/Detector, More, Detector, Average (A) Normal (N) Peak (P) Sample (S) Negative Peak (p)</b>
9	Key labels that change based on the most recent key press.	Softkeys
10	Displays information, warning and error messages. Message area - single events, Status area - conditions.	
11	Measurement settings for the data currently being displayed in the graticule area. In the example above: center frequency, resolution bandwidth, video bandwidth, frequency span, sweep time and number of sweep points.	Keys in the Analyzer Setup part of the front panel.

## Rear-Panel Features

PXA, MXA and EXA with Option PC2

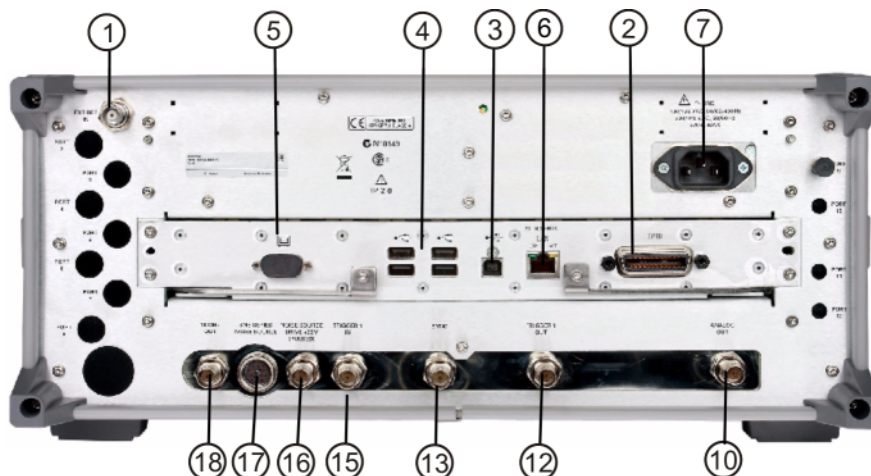


EXA



Front and Rear Panel Features  
**Rear-Panel Features**

**CXA**



Item		Description
#	Name	
1	EXT REF IN	Input for an external frequency reference signal:  For PXA – 1 to 50 MHz For MXA – 1 to 50 MHz For EXA – 10 MHz. For CXA – 10 MHz.
2	GPIB	A General Purpose Interface Bus (GPIB, IEEE 488.1) connection that can be used for remote analyzer operation.
3	USB Connector	USB 2.0 port, Type B. USB TMC (test and measurement class) connects to an external pc controller to control the instrument and for data transfers over a 480 Mbps link.
4	USB Connectors	Standard USB 2.0 ports, Type A. Connect to external peripherals such as a mouse, keyboard, printer, DVD drive, or hard drive.
5	MONITOR	Allows connection of an external VGA monitor.
6	LAN	A TCP/IP Interface that is used for remote analyzer operation.
7	Line power input	The AC power connection. See the product specifications for more details.
8	Removable Disk Drive	Standard on PXA and MXA. Optional on EXA.
9	Digital Bus	Reserved for future use.

Item		Description
#	Name	
10	Analog Out	For PXA option YAV:  Screen Video Log Video Linear Video  For PXA option EMC:  Demod Audio
11	TRIGGER 2 OUT	A trigger output used to synchronize other test equipment with the analyzer. Configurable from the Input/Output keys.
12	TRIGGER 1 OUT	A trigger output used to synchronize other test equipment with the analyzer. Configurable from the Input/Output keys.
13	Sync	Reserved for future use.
14	TRIGGER 2 IN	Allows external triggering of measurements.
15	TRIGGER 1 IN	Allows external triggering of measurements.
16	Noise Source Drive +28 V (Pulsed)	For use with Agilent 346A, 346B, and 346C Noise Sources.
17	SNS Series Noise Source	For use with Agilent N4000A, N4001A, N4002A Smart Noise Sources (SNS).
18	10 MHz OUT	An output of the analyzer internal 10 MHz frequency reference signal. It is used to lock the frequency reference of other test equipment to the analyzer.
19	Preselector Tune Out	Reserved for future use.
20	Aux IF Out	For PXA options:  CR3 Second IF Out CRP Arbitrary IF Out ALV Log Video

## Front and Rear Panel Symbols



This symbol is used to indicate power ON (green LED).



This symbol is used to indicate power STANDBY mode (yellow LED).



This symbol indicates the input power required is AC.



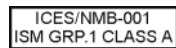
The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to instructions in the documentation.



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This chapter first introduces the instructions common to all measurements, and then, discusses the instructions specific to individual measurements, as follows.

- “Channel Power Measurements” on page 29
- “ACP Measurements” on page 35
- “Power Statistics CCDF Measurements” on page 37
- “Spurious Emissions Measurements” on page 41
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- “IQ Waveform (Time Domain) Measurements” on page 65

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## Setting Up and Making a Measurement

### Making the Initial Signal Connection and Configuring the Measurement System

- Step 1.** Set the DVB-T/H transmitter under test to transmit RF power. This transmitting signal is connected to the RF input port of the instrument. Connect the equipment as shown below.

---

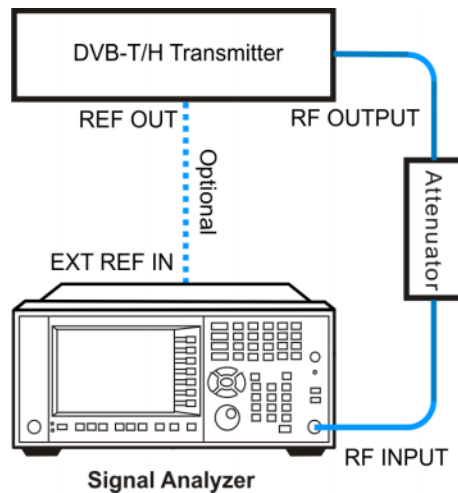
**CAUTION**

Before connecting a signal to the analyzer, make sure the analyzer can safely accept the signal level provided. The maximum signal level limits are marked next to the RF Input connectors on the front panel.

---

**Figure 3-1**

#### Channel Power Measurement System



1. Connect the output signal from the DVB-T/H transmitter to the RF input port of the analyzer using appropriate cables, attenuators, and adapters.
2. Optional: If there is a frequency reference port on the DVB-T/H transmitter, connect it to the EXT REF IN port of the analyzer with a cable for frequency synchronization.

- Step 2.** Select the input port settings using keys under **Input/Output** menu.

### Setting the DVB-T/H Transmitter (Example)

Set up the DVB-T/H transmitter to transmit the RF power as follows:

Standard: DVB-T

Frequency: 474 MHz (Channel Num: 21, Channel Table: PAL-B/G UHF)

Channel Bandwidth: 8 MHz

FFT Size: 2 K  
Modulation Type: 16 QAM  
Alpha: 1  
Guard Interval: 1/4  
Transmission modes: Hierarchical  
HP code rate: 1/2  
LP code rate: 1/2  
Attenuator: 60 dB  
Transmitted Power: 40 dBm (at RF output); -20 dBm (at the analyzer input)

## Using Analyzer Mode and Measurement Presets

To set your current measurement mode to a known factory default state, press **Mode Preset**. This initializes the analyzer mode by returning the mode setup and all of the measurement setups in that mode to the factory default parameters.

To preset the parameters that are specific to an active, selected measurement, press **Meas Setup, Meas Preset**. This returns all the measurement setup parameters to the factory defaults, but only for the currently selected measurement.



## The 3 Steps to Set Up and Make Measurements

Generally speaking, all measurements can be set up using the following three steps in [Table 3-1](#). [Table 3-2](#) shows the main keys and functions that may be used while following the steps. For the detailed procedures for a specific measurement, refer to:

- [“Channel Power Measurements” on page 29](#)
- [“ACP Measurements” on page 35](#)
- [“Power Statistics CCDF Measurements” on page 37](#)
- [“Spurious Emissions Measurements” on page 41](#)
- [“Spectrum Emission Mask Measurements” on page 45](#)
- [“Modulation Accuracy Measurements” on page 51](#)
- [“Monitor Spectrum Measurements” on page 63](#)
- [“IQ Waveform \(Time Domain\) Measurements” on page 65](#)

---

### NOTE

Press the  key on the front panel to enter the help system and see the detailed descriptions for the keys you are not familiar with. Press the  key on the front panel to exit the help system.

---

**Table 3-1 The 3 Steps to Set Up and Make a Measurement**

Step	Action	Notes
<b>1. Select and Set Up the Mode</b>	<ul style="list-style-type: none"> <li>a. Press <b>Mode</b>.</li> <li>b. Press a mode key, like <b>Spectrum Analyzer, IQ Analyzer (Basic), or DVB-T/H</b>.</li> <li>c. Press <b>Mode Preset</b>.</li> <li>d. Press <b>Mode Setup</b>.</li> </ul>	<p>All licensed, installed modes available are shown under the <b>Mode</b> key.</p> <p>Using <b>Mode Setup</b>, make any required adjustments to the mode settings. These settings apply to all measurements in the mode.</p>
<b>2. Select and Set Up the Measurement</b>	<ul style="list-style-type: none"> <li>a. Press <b>Meas</b>.</li> <li>b. Select the specific measurement to be performed.</li> <li>c. Press <b>Meas Setup</b>.</li> </ul>	<p>The result data is shown on the display or is available for export.</p> <p>Use <b>Meas Setup</b> to make any required adjustment to the selected measurement settings. The settings only apply to this measurement.</p>
<b>3. Select and Set Up a View of the Results</b>	<p>Press <b>View/Display</b>. Set display format and select a view for the current measurement data.</p>	<p>Depending on the mode and measurement selected, the graphical and tabular data presentations are available.</p> <p>Use <b>Span X Scale</b> and <b>AMPTD Y Scale</b> to adjust the display of the measurement graphics.</p>

---

**NOTE** You can change settings as needed, and the changes will be in effect on the next measurement cycle or view.

---

**Table 3-2 Main Keys and Functions for Making Measurements**

Step	Primary Key	Setup Keys	Related Keys
1. Select and set up a mode.	<b>Mode</b>	<b>Mode Setup, FREQ Channel</b>	<b>System, Input/Output</b>
2. Select and set up a measurement.	<b>Meas</b>	<b>Meas Setup</b>	<b>BW, Sweep/Control, Restart, Single, Cont</b>
3. Select and set up a view of the results.	<b>View/Display</b>	<b>SPAN X Scale, AMPTD Y Scale</b>	<b>Peak Search, Quick Save, Save, Recall, File, Print</b>

---

**NOTE** If you encounter a problem, or get an error message, see the guide “*Instrument Messages*”, which is provided on the Documentation CD ROM, and in the instrument here:

C:\Program Files\Agilent\SignalAnalysis\Infrastructure\Help\bookfiles.

---

## Channel Power Measurements

This section explains how to make a Channel Power measurement on a DVB-T/H transmitter. This test measures the total RF power and shoulder attenuation present in the channel, and provides a view that compares the input signal against the DVB-T/H defined spectrum mask under the condition of an analog TV signal in an adjacent channel.

The Channel Power measurement procedure includes four parts:

- a. “[Selecting and Setting up the DVB-T/H Mode](#)” on page 29
- b. “[Setting up the Input/Output Ports](#)” on page 30
- c. “[Selecting and Setting up Channel Power Measurement](#)” on page 30
- d. “[Selecting and Viewing the Measurement Results](#)” on page 30

### Selecting and Setting up the DVB-T/H Mode

**Step 1.** Select DVB-T/H mode.

Press **Mode, DVB-T/H**.

**Step 2.** Preset the analyzer.

Press **Mode Preset**.

**Step 3.** Set the center frequency. There are two methods:

- Enter the center frequency directly.

Press **FREQ Channel, Center Freq, 474, MHz**.

- Select the channel number under a specific channel table.

- a. Specify a channel table by selecting a video standard.

Press **FREQ Channel, Chan Table, PAL-B/G, PAL-B/G UHF**.

- b. Set the channel number.

Press **FREQ Channel, Channel, 21**.

**Step 4.** Set the channel bandwidth.

Press **Mode Setup, Channel BW, 8 MHz**.

**Step 5.** Select DVB-T standard.

Press **Mode Setup, Radio Std, DVB-T**.

## Setting up the Input/Output Ports

---

**NOTE** If you are going to view the Spectrum Mask view result in Channel Power measurement, set up the Input/Output ports as follows. If not, you can skip this part.

---

**Step 1.** Input the value of the external attenuator.

Press **Input/Output, External Gain, Ext Preamp, -60, dB**.

**Step 2.** Use amplitude corrections.

Press **Input/Output, More 1 of 2, Corrections**. Then,

a. Specify the correction data using:

- Onscreen editor. Press **Edit**.
- SCPI, or
- A file. Press **Recall, Data (Import) Amptd Cor1, Open**.

---

**TIP** To get the format of the file to be recalled, first edit several points using onscreen editor, then press **Save, Data (Export) Correction 1, Save As...** to save the correction data to a file. Open the file, and view the format.

It is recommended to edit and save the correction data using a file when the correction data has a lot of points.

b. Toggle the **Correction** key to **On** to apply the corrections.

---

**NOTE** For the reasons of using amplitude correction and the definition of correction data, refer to [“Amplitude Correction in Spectrum Emission Mask Measurement”](#) on page 87.

---

## Selecting and Setting up Channel Power Measurement

**Step 1.** Initiate the Channel Power measurement.

Press **Meas, Channel Power**.

**Step 2.** Set up the Channel Power measurement and see the parameters available to change. The default settings are compliant with the specification in DVB-T/H standards, so you can use the default settings for most cases.

Press **Meas Setup**.

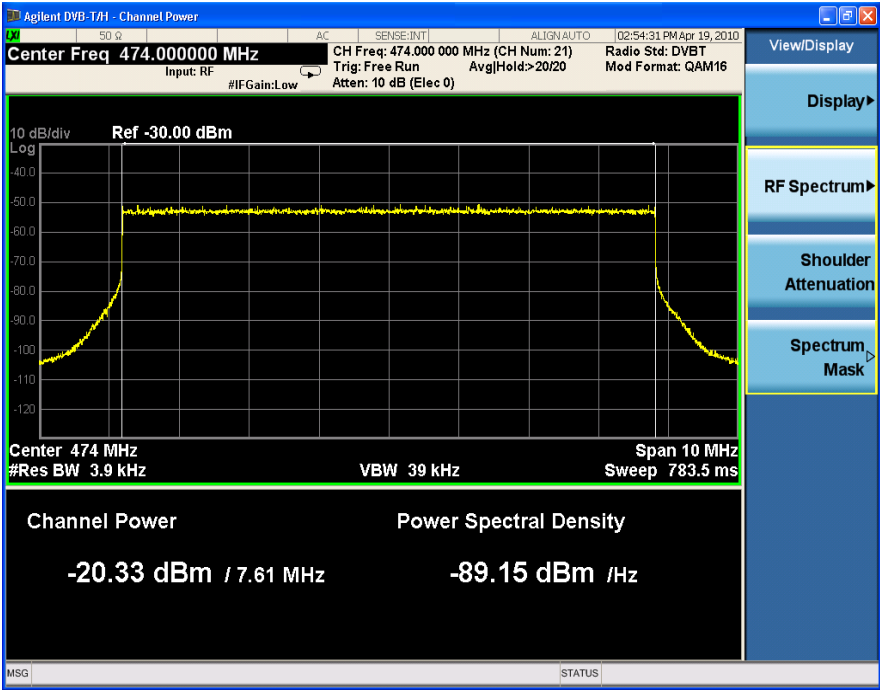
## Selecting and Viewing the Measurement Results

Three views are available in the Channel Power measurement. Press **View/Display, the name of the view** to display them.

- **RF Spectrum** displays the RF spectrum and power in the channel. The spectrum graph measurement results should look like [Figure 3-2](#). The text window shows the total channel power and its mean power spectral density values over 7.61 MHz.

**NOTE** To change the measurement bandwidth, press **Meas Setup, Integ BW**.

**Figure 3-2** Channel Power Measurement Result (Default)

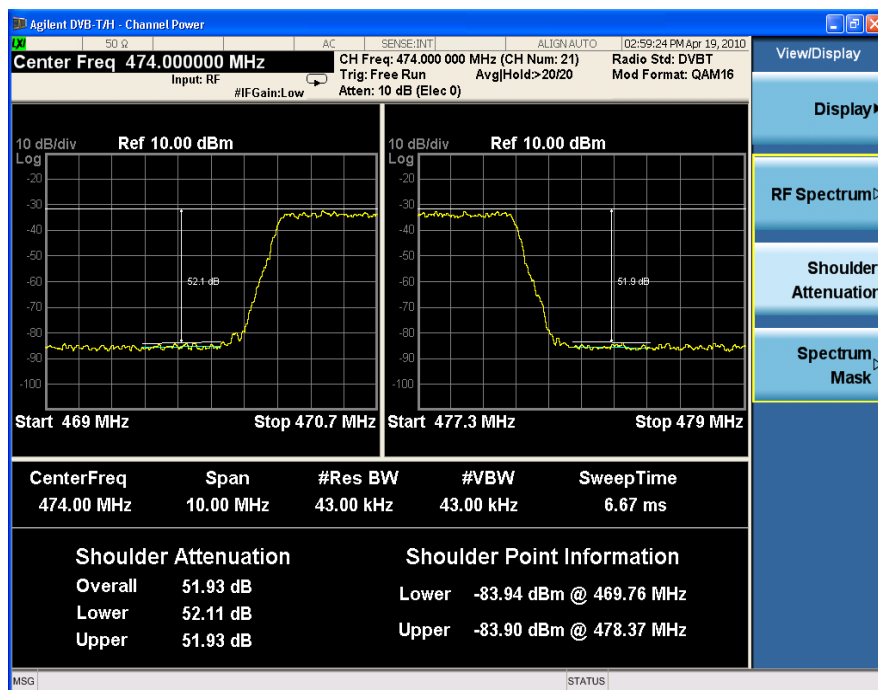


- **Shoulder Attenuation** displays the DVB-T/H standard defined shoulder attenuation. The shoulder attenuation measurement result should look like [Figure 3-3](#). The text window shows the value of shoulder attenuation and shoulder point information.

To learn more about the measurement method of shoulder attenuation, refer to “Shoulder Attenuation” on page 79.

Figure 3-3

Channel Power Measurement Result - Shoulder Attenuation View



**NOTE**

To make the measurement on a specified frequency range, press **Meas Setup** and set the value for **Shoulder Offset Start** and **Shoulder Offset Stop** correspondingly.

- **Spectrum Mask** displays the channel power spectrum with the DVB-T defined analog TV spectrum mask overlay. When analog TV signal is used in an adjacent channel, use this view to see whether the transmitting signal complies with the spectrum mask specified by the DVB-T standard.

The spectrum mask measurement results should look like [Figure 3-4](#). The text window shows total power, power spectral density and the failed points list.

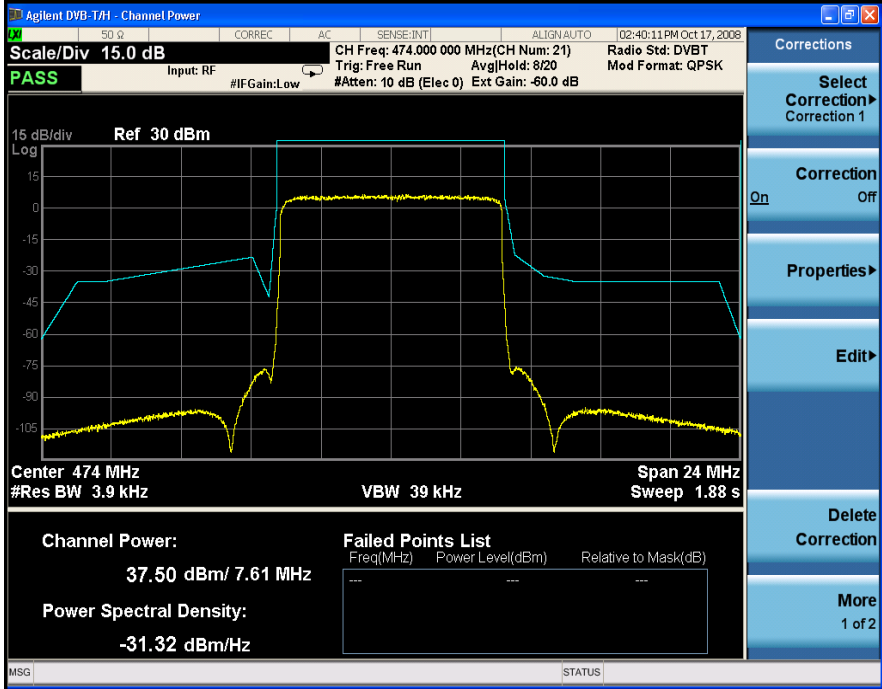
— Press **Spectrum Mask** to select the analog TV system in the adjacent channel.

**NOTE**

Use the keys under **Spectrum Mask, Scroll** to see the total information of the Failed Point List at the right bottom of the screen.



Figure 3-4 Channel Power Measurement Result - Spectrum Mask View after Amplitude Correction



**NOTE** In the spectrum mask view, if the value of channel bandwidth (under **Mode Setup, Channel BW**) is 5, 6, or 7 MHz, the mask trace will not be displayed and a “No Result” message will be displayed on the screen, because the spectrum masks for these bandwidths are not defined in DVB-T/H specs.



## ACP Measurements

This section describes the Adjacent Channel Leakage Power Ratio (ACLR or ACPR) measurements on a DVB-T/H transmitter. ACPR is the measurement of the amount of interference, or power, in adjacent frequency channels. The results are displayed as a bar graph or as spectrum data, with measurement data at specified offsets.

The ACP measurement procedure includes three parts:

- a. “[Selecting and Setting up the DVB-T/H Mode](#)” on page 35
- b. “[Selecting and Setting up ACP Measurement](#)” on page 35
- c. “[Viewing ACP Measurement Results](#)” on page 36

### Selecting and Setting up the DVB-T/H Mode

**Step 1.** Select DVB-T/H mode.

Press **Mode, DVB-T/H**.

**Step 2.** Preset the analyzer.

Press **Mode Preset**.

**Step 3.** Set the center frequency. There are two methods:

- Enter the center frequency directly.  
Press **FREQ Channel, Center Freq, 474, MHz**.
- Select the channel number under a specific channel table.
  - a. Specify a channel table by selecting a video standard.  
Press **FREQ Channel, Chan Table, PAL-B/G, PAL-B/G UHF**.
  - b. Set the channel number.  
Press **FREQ Channel, Channel, 21**.

**Step 4.** Set the channel bandwidth.

Press **Mode Setup, Channel BW, 8 MHz**.

**Step 5.** Select DVB-T standard.

Press **Mode Setup, Radio Std, DVB-T**.

### Selecting and Setting up ACP Measurement

**Step 1.** Initiate the Adjacent Channel Power measurement.

Press **Meas, ACP**.

## Making DVB-T/H Measurements

### ACP Measurements

**Step 2.** Set up the ACP measurement and see the parameters available to change. The default settings are compliant with the specification in DVB-T/H standards, so you can use the default settings for most cases.

Press **Meas Setup**.

#### TIP


To get better ACP results, press **Meas Setup, More 1 of 2**, and toggle the **Noise Correction** key to **On**.

## Viewing ACP Measurement Results

The ACP measurement results should look like [Figure 3-5](#). The graph window shows the bar graph with the spectrum trace overlay. The text window shows the total power in reference channel, absolute and relative power in offset channels.

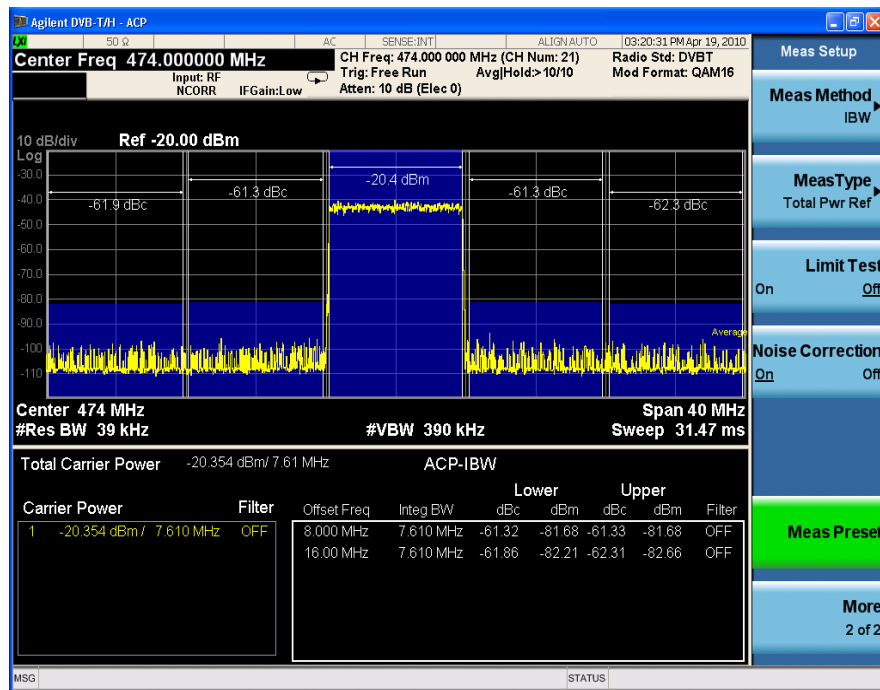
- Toggle **View/Display, Bar Graph** to **Off** to turn off the bar graph.

#### NOTE

You can zoom on either the graphic window or the text window by pressing the Window Control keys  at the left bottom of the front panel.

**Figure 3-5**

### ACP Measurement Result - Noise Correction



## Power Statistics CCDF Measurements

This section outlines how to make the Power Statistics Complementary Cumulative Distribution Function (Power Stat CCDF) measurements on a DVB-T/H transmitter. Power Stat CCDF measurements characterize the higher level power statistics of a digitally modulated signal.

The Power Stat CCDF measurement procedure includes three parts:

- a. [“Selecting and Setting up the DVB-T/H Mode” on page 37](#)
- b. [“Selecting and Setting up Power Stat CCDF Measurement” on page 38](#)
- c. [“Viewing the Measurement Results” on page 38](#)

### Selecting and Setting up the DVB-T/H Mode

**Step 1.** Select DVB-T/H mode.

Press **Mode, DVB-T/H**.

**Step 2.** Preset the analyzer.

Press **Mode Preset**.

**Step 3.** Set the center frequency. There are two methods:

- Enter the center frequency directly.  
Press **FREQ Channel, Center Freq, 474, MHz**.
- Select the channel number under a specific channel table.
  - a. Specify a channel table by selecting a video standard.  
Press **FREQ Channel, Chan Table, PAL-B/G, PAL-B/G UHF**.
  - b. Set the channel number.  
Press **FREQ Channel, Channel, 21**.

**Step 4.** Set the channel bandwidth.

Press **Mode Setup, Channel BW, 8 MHz**.

**Step 5.** Select DVB-T standard.

Press **Mode Setup, Radio Std, DVB-T**.

---

#### NOTE

Power Stat CCDF measurements can be used to measure the BBIQ (Baseband I/Q) signals. For the detailed measurement procedure, refer to [“Using Option BBA Baseband I/Q Inputs” on page 69](#).

---

## Selecting and Setting up Power Stat CCDF Measurement

**Step 1.** Initiate the power statistics CCDF measurement.

Press **Meas, Power Stat CCDF**.

**Step 2.** Set up the Power Stat CCDF measurement and see the parameters available to change. You can use the default settings for most cases.

Press **Meas Setup**.

### TIP

Three key parameters under **Meas Setup** menu are available to set up the Power Stat CCDF measurements.

- **Counts** sets the accumulated number of sampling points for data acquisition.
- **Meas Cycles** sets the number of measurement cycles.
- **Meas Interval** sets the measurement time for one cycle.

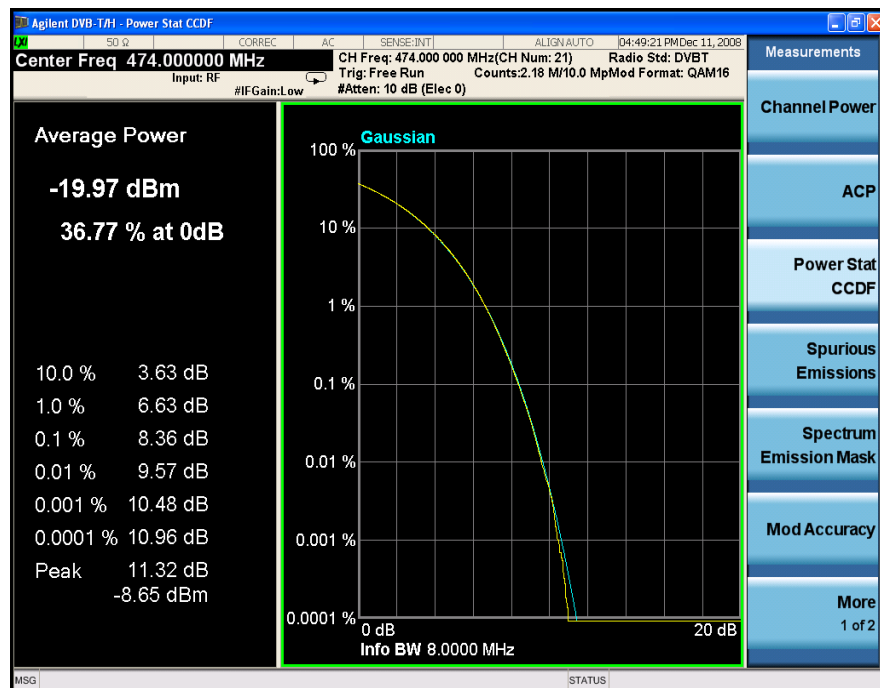
## Viewing the Measurement Results

The Power Stat CCDF measurement result should look like [Figure 3-6](#).

- Press **Trace/Detector, Ref Trace (On)** to display the user-definable reference trace (violet line). The Power Stat CCDF measurement with the reference trace should look like [Figure 3-7](#).

**Figure 3-6**

### Measurement Results-Power Statistics CCDF Result

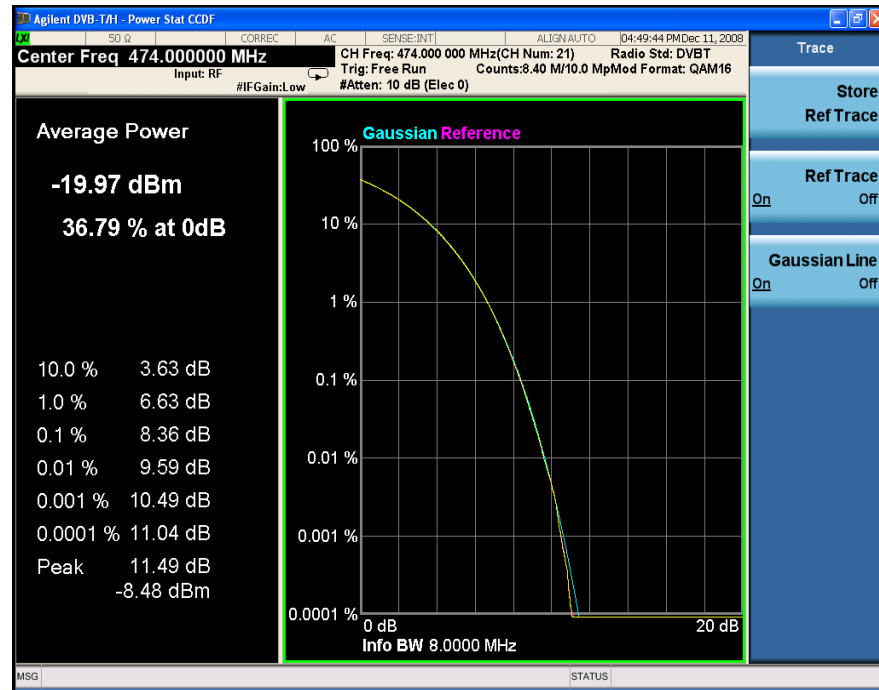


The blue line is the Gaussian trace and the yellow line is the measurement result. The Info BW is the channel bandwidth that will be used for data acquisition. The

default value is 8 MHz. You can manually change the Info BW by pressing **BW**,  
**Info BW**.

Figure 3-7

Power Statistics CCDF Result



The reference trace is a measurement trace stored as a reference trace to be compared to a later measurement. You can use the **Store Ref Trace** key to save the currently measured trace as the reference trace. This reference trace will be lost if you switch between modes or measurements.

## Troubleshooting Hints

The Power Statistics CCDF measurements are useful in defining the signal power specifications for design criteria for systems, amplifiers, and other components. When the signal power is larger than the limit of the mixer or ADC, the CCDF result trace will deviate from the Gaussian trace.



## Spurious Emissions Measurements

This section describes how to make a Spurious Emissions Measurement on a DVB-T/H transmitter. This measurement identifies and determines the power level of spurious emissions in certain frequency bands.

The Spurious Emissions measurement procedure includes four parts:

- a. “Selecting and Setting up the DVB-T/H Mode” on page 41
- b. “Setting up the Input Ports” on page 42
- c. “Selecting and Setting up Spurious Emissions Measurement” on page 42
- d. “Viewing Spurious Emissions Measurement Results” on page 43

### Selecting and Setting up the DVB-T/H Mode

**Step 1.** Select DVB-T/H mode.

Press **Mode, DVB-T/H**.

**Step 2.** Preset the analyzer.

Press **Mode Preset**.

**Step 3.** Set the center frequency. There are two methods:

- Enter the center frequency directly.  
Press **FREQ Channel, Center Freq, 474, MHz**.
- Select the channel number under a specific channel table.
  - a. Specify a channel table by selecting a video standard.  
Press **FREQ Channel, Chan Table, PAL-B/G, PAL-B/G UHF**.
  - b. Set the channel number.  
Press **FREQ Channel, Channel, 21**.

**Step 4.** Set the channel bandwidth.

Press **Mode Setup, Channel BW, 8 MHz**.

**Step 5.** Select DVB-T standard.

Press **Mode Setup, Radio Std, DVB-T**.

## Setting up the Input Ports

Set the RF coupling to DC.

Press **Input/Output, RF Input, RF Coupling** to toggle the RF Coupling to **DC**.

### NOTE

In AC coupling mode, you can view signals less than 10 MHz but the amplitude accuracy is not specified. To accurately see a signal of less than 10 MHz, you must switch to DC coupling.

When operating in DC coupled mode, ensure the protection of the external mixer by limiting the DC part of the input level to within 200 mV of 0 Vdc.

## Selecting and Setting up Spurious Emissions Measurement

**Step 1.** Initiate the Spurious Emissions measurement.

Press **Meas, Spurious Emissions**.

**Step 2.** Set up the Spurious Emissions measurement and see the parameters available to change.

Press **Meas Setup** and set up the key parameters as shown in [Table 3-3](#).

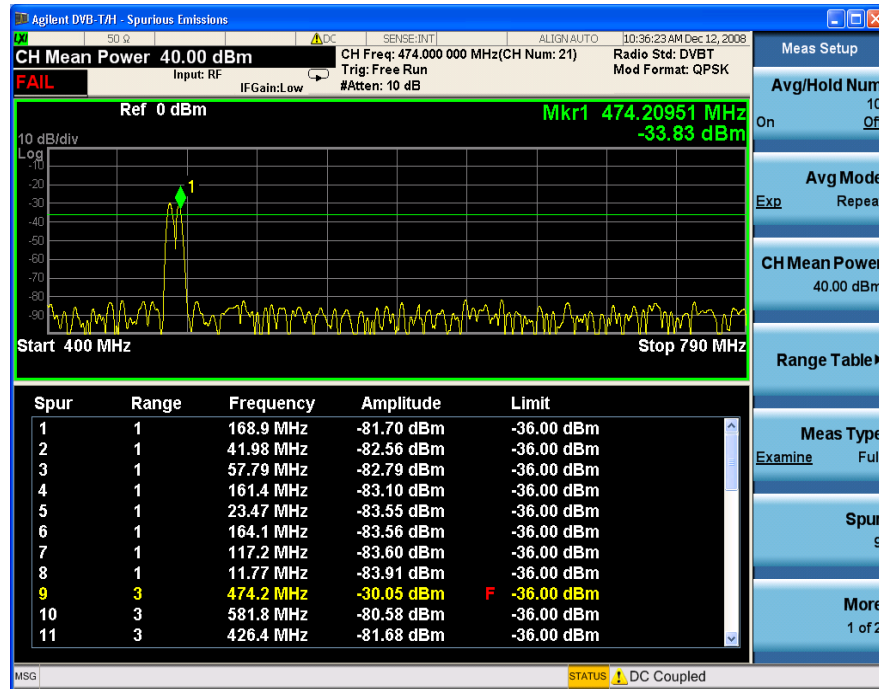
**Table 3-3** Key Parameters in Spurious Emissions Measurement

Parameters	Actions	Notes
CH Mean Power	Set the mean power of the transmitter. Press <b>Meas Setup, CH Mean Power</b> .	Set the mean power before measuring spurious emissions, since the limit parameters are different for different transmit power.
Range Table	Set the limit line of the Spurious Emissions measurement. Press <b>Meas Setup, Range Table</b> and set the parameters as you need.	You can set up to 20 ranges in a limit line. The default settings for range table are compliant to the limits defined in ETSI EN 302 296. To see the measurement result for different ranges, press <b>Meas Setup, Range Table, Range</b> , then enter the range number that you wish to see.
Meas Type	Set the Meas Type to Examine. Press <b>Meas Setup</b> , and toggle the <b>Meas Type</b> to <b>Examine</b> .	<ul style="list-style-type: none"> <li>• <b>Examine:</b> The average mode is set to exponential and the trace is continuously updating to show the latest spectrum in the range that has the worst spurious. A marker is placed on the frequency of the worst spur.</li> <li>• <b>Full:</b> The average mode is set to repeat and the measurement result of the select spur and range is shown.</li> </ul>

## Viewing Spurious Emissions Measurement Results

The Spurious Emissions measurement results should look like [Figure 3-8](#). The spectrum window and the text window show the spurs that are within the current value of the Marker Peak Excursion setting and the absolute limit.

**Figure 3-8** Spurious Emissions Measurement



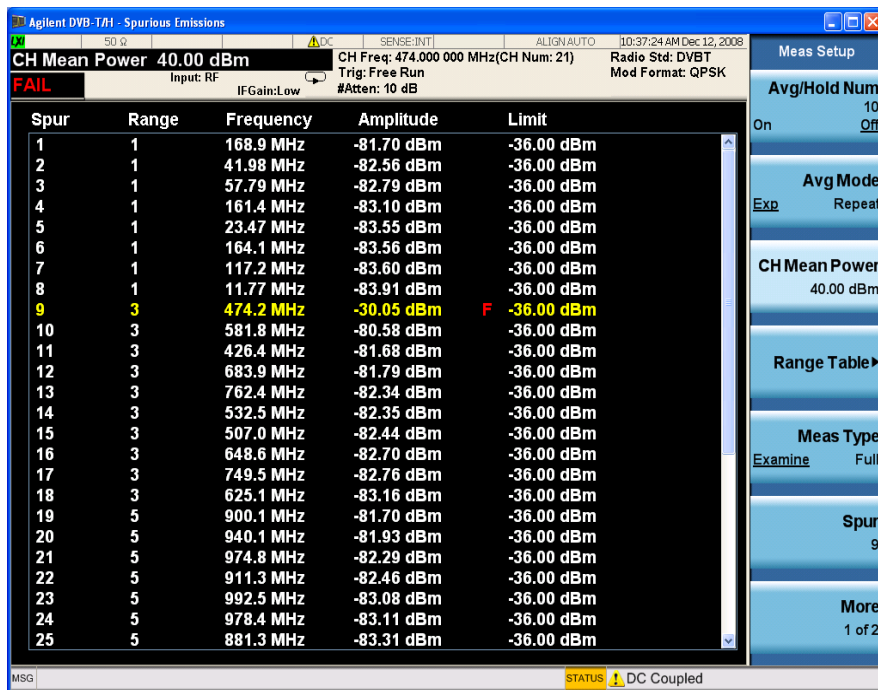
### NOTE

The failed point in [Figure 3-8](#) above is the transmitted signal at the center frequency of 474 MHz. To avoid this, you can either set the range table not to cover the carrier frequency band or connect a band rejection filter between the transmitter and the instruments to remove the undesired signal.

You can use the Window Control keys  below the screen to zoom the result screen. See [Figure 3-9](#).

Figure 3-9

Spurious Emissions Measurement - Numeric Result Screen



## Spectrum Emission Mask Measurements

This section describes how to make a Spectrum Emission Mask (SEM) measurement on a DVB-T/H transmitter. SEM measurements compare the power levels within given offset channels on both sides of the carrier frequency, to the power levels allowed by the standard when there are digital TV signals or other services in adjacent channel. Results of each offset segment measurement can be viewed separately.

The SEM measurement procedure includes four parts:

- a. “[Selecting and Setting up the DVB-T/H Mode](#)” on page 45
- b. “[Setting up the Input Ports](#)” on page 46
- c. “[Setting up Spectrum Emission Mask Measurement](#)” on page 46
- d. “[Viewing the Measurement Results](#)” on page 47

### Selecting and Setting up the DVB-T/H Mode

**Step 1.** Select DVB-T/H mode.

Press **Mode, DVB-T/H**.

**Step 2.** Preset the analyzer.

Press **Mode Preset**.

**Step 3.** Set the center frequency. There are two methods:

- Enter the center frequency directly.  
Press **FREQ Channel, Center Freq, 474, MHz**.
- Select the channel number under a specific channel table.
  - a. Specify a channel table by selecting a video standard.  
Press **FREQ Channel, Chan Table, PAL-B/G, PAL-B/G UHF**.
  - b. Set the channel number.  
Press **FREQ Channel, Channel, 21**.

**Step 4.** Set the channel bandwidth.

Press **Mode Setup, Channel BW, 8 MHz**.

**Step 5.** Select DVB-T standard.

Press **Mode Setup, Radio Std, DVB-T**.

## Setting up the Input Ports

**Step 1.** Input the value of the external attenuator.

Press **Input/Output, External Gain, Ext Preamp, -60, dB**.

---

**NOTE**

The spectrum mask varies with the change of the transmit power as shown in [Table 4-2 on page 86](#) and [Table 4-3 on page 86](#).

**Step 2.** Use amplitude corrections.

Press **Input/Output, More 1 of 2, Corrections**. Then,

a. Specify the correction data using:

- Onscreen editor. Press **Edit**.
- SCPI, or
- A file. Press **Recall, Data (Import) Amptd Cor1, Open**.

---

**TIP**

To get the format of the file to be recalled, first edit several points using onscreen editor, then press **Save, Data (Export) Correction 1, Save As...** to save the correction data to a file. Open the file, and view the format.

It is recommended to edit and save the correction data using a file when the correction data has a lot of points.

b. Toggle the **Correction** key to **On** to apply the corrections.

---

**NOTE**

For the reasons of using amplitude correction and the definition of correction data, refer to [“Amplitude Correction in Spectrum Emission Mask Measurement” on page 87](#).

## Setting up Spectrum Emission Mask Measurement

**Step 1.** Initiate the Spectrum Emission Mask measurement.

Press **Meas, Spectrum Emission Mask**.

**Step 2.** Set up the Spectrum Emission Mask measurement and see the parameters available to change.

Press **Meas Setup**.

- Select the limit type as Non-Critical.

Press **Limit Type, Non-Critical**.

---

**NOTE**

---

Unless otherwise declared by the manufacturer, use the non-critical limit to measure a transmitting signal; Use the critical limit when the television channels are adjacent to other services (low power or receive only).

The **Limit Type** key appears different for the different radio bandwidths.

- When the radio bandwidth is 5MHz or 6 MHz, the **Limit Type** key has only one option: Manual. The **Non-Critical** and **Critical** keys will be grayed out. You should set the limit line manually through **Meas Setup, Offset/Limit**.
- When the radio bandwidth is 7 MHz or 8 MHz, the **Limit Type** key has three options: Manual, Non-critical and Critical. The default value is Non-Critical after **Meas Preset**. When the value of the **Limit Type** is set (Critical/Non-critical), the parameters displayed on the offset/Limits panel will be modified automatically according to [Table 4-2 on page 86](#) and [Table 4-3 on page 86](#).


## Viewing the Measurement Results

Three views are available in the Spectrum Emission Mask measurement. Press **View/Display, the name of the view** to display them. In Spectrum Emission Mask measurement of DVB-T/H signal, use the first two views: Abs Pwr Freq view and Rel Pwr Freq view.

---

**NOTE**

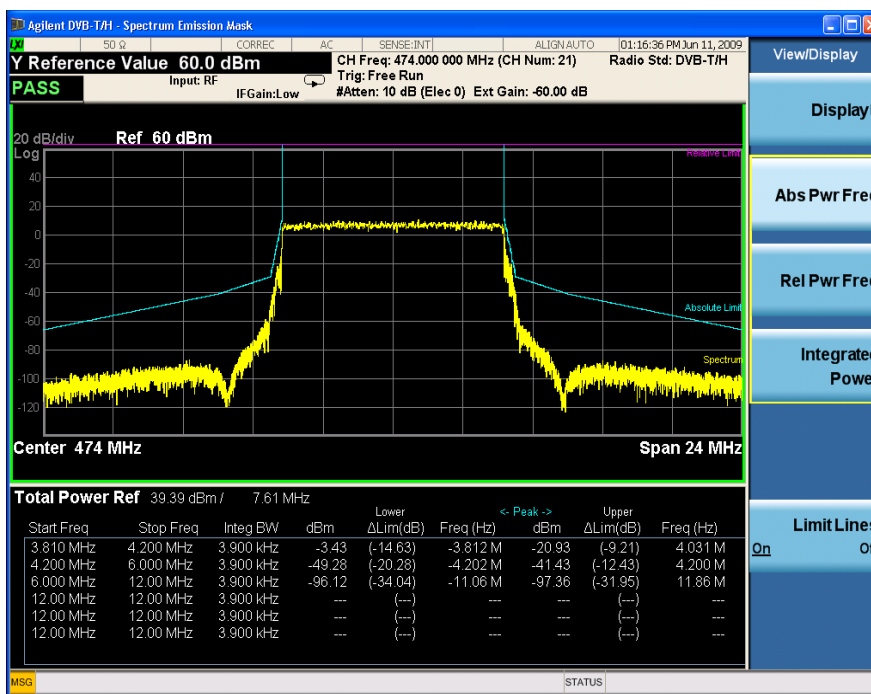
---

You can zoom on either the graphic window or the text window by pressing the Window Control keys  at the left bottom of the frontpanel.

- **Abs Pwr Freq** displays the absolute power levels in dBm and the corresponding frequencies in the text window, as shown in [Figure 3-10](#).

Figure 3-10

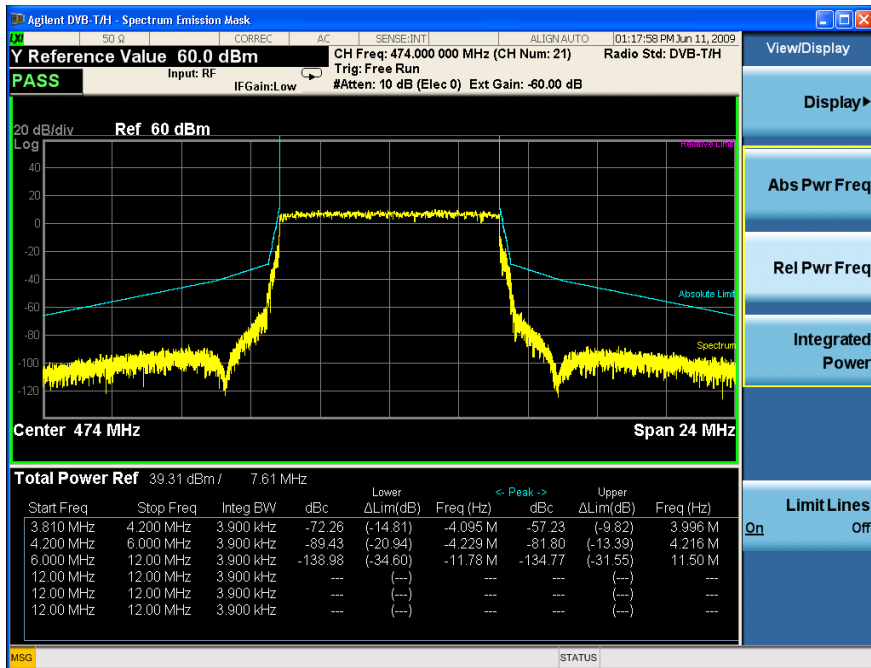
Spectrum Emission Mask Measurement Result - Abs Pwr Freq (Default)View



- **Rel Pwr Freq** displays the relative power levels in dBc and the corresponding frequencies in the text window, as shown in Figure 3-11.

Figure 3-11

Spectrum Emission Mask Measurement Result - Rel Pwr Freq View

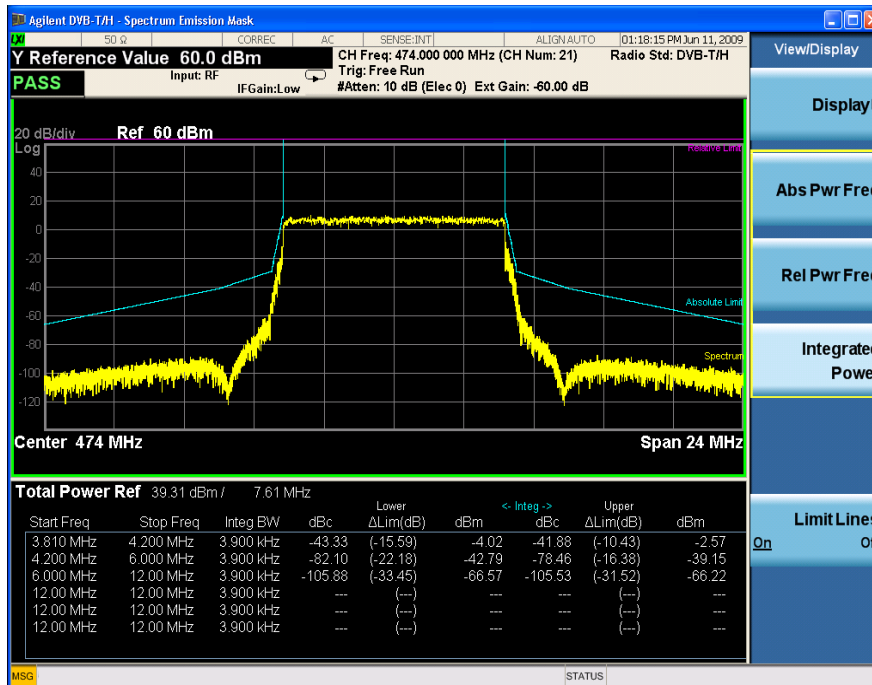


- **Integrated Power** displays the absolute and relative power levels integrated



throughout the bandwidths between the start and stop frequencies in the text window, as shown in Figure 3-12.

**Figure 3-12** Spectrum Emission Mask Measurement Result - Integrated Power View



## Troubleshooting Hints

This Spectrum Emission Mask measurement can reveal degraded or defective parts in the transmitter section of the unit under test (UUT). The following are examples of typical causes for poor performance:

- Faulty DC power supply control of the transmitter power amplifier.
- RF power controller of the pre-power amplifier stage.
- I/Q control of the baseband stage.
- Degradation in the gain and output power level of the amplifier may be due to degraded gain control or increased distortion, or both.
- Degradation of the amplifier linearity or other performance characteristics.

Power amplifiers are one of the final stage elements of a DVB-T/H transmitter and are a critical part of meeting the important power and spectral efficiency specifications. Since spectrum emission mask measures the spectral response of the amplifier to a complex wideband signal, SEM is a key measurement linking amplifier linearity and other performance characteristics to the stringent system specifications.

## Modulation Accuracy Measurements

This section describes how to make a Modulation Accuracy measurement on a DVB-T/H transmitter. Modulation Accuracy measurements provide methods for measuring the I/Q errors in DVB-T/H transmitter. The results comprise EVM, MER, magnitude error, phase error, frequency error, phase jitter, quad error, amplitude imbalance, SNR, carrier suppression, etc.

The Mod Accuracy measurement procedure includes three parts:

- a. “Selecting and Setting up the DVB-T/H Mode” on page 51
- b. “Selecting and Setting up Mod Accuracy Measurement” on page 53
- c. “Selecting and Viewing the Measurement Results” on page 53

### Selecting and Setting up the DVB-T/H Mode

**Step 1.** Select DVB-T/H mode.

Press **Mode, DVB-T/H**.

**Step 2.** Preset the analyzer.

Press **Mode Preset**.

**Step 3.** Set the center frequency. There are two methods:

- Enter the center frequency directly.  
Press **FREQ Channel, Center Freq, 474, MHz**.
- Select the channel number under a specific channel table.
  - a. Specify a channel table by selecting a video standard.  
Press **FREQ Channel, Chan Table, PAL-B/G, PAL-B/G UHF**.
  - b. Set the channel number.  
Press **FREQ Channel, Channel, 21**.

**Step 4.** Set the channel bandwidth.

Press **Mode Setup, Channel BW, 8 MHz**.

**Step 5.** Select DVB-T standard.

Press **Mode Setup, Radio Std, DVB-T**.

**Step 6.** Set the demodulation options for the transmitter under test. There are two methods:

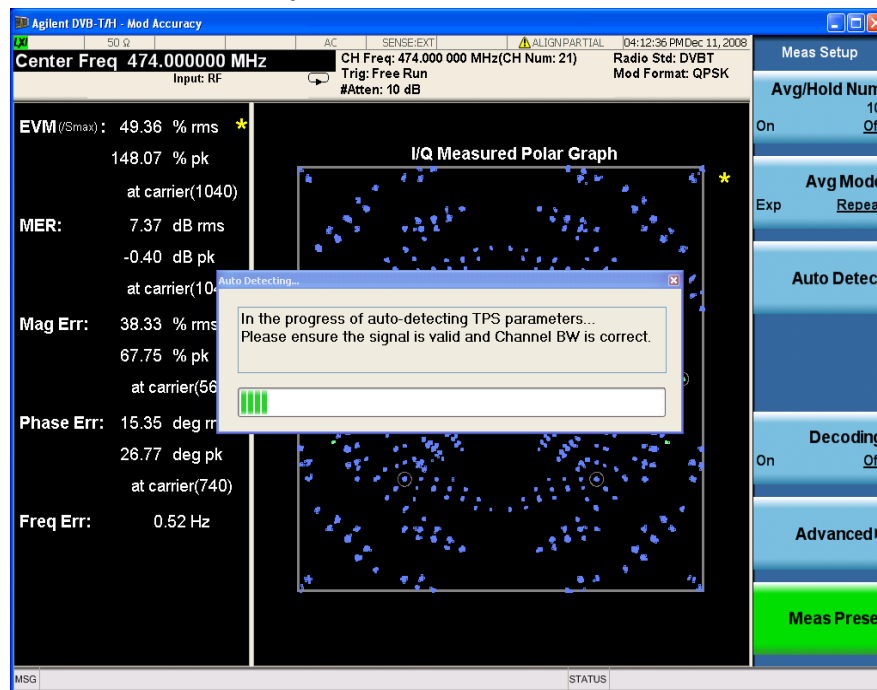
- Auto Detect the modulation parameters from the input signal, see [Figure 3-13](#).  
Press **Meas Setup, Auto Detect**.

## Making DVB-T/H Measurements Modulation Accuracy Measurements

**NOTE** Before auto-detect, ensure the signal is valid and the channel bandwidth is correct.

- Set up the modulation parameters manually. Press **Mode Setup, Demod**, then,
  - Press **FFT Size, 2K**.
  - Press **Modulation Format, 16QAM**.
  - Press **Alpha, Alpha = 1**.
  - Press **Guard Interval, 1/4**.
  - Toggle the **Hierarchical** key to **On**.
  - Press **More 1 of 2, HP Code Rate, 1/2**.
  - Press **LP Code Rate, 1/2**.

**Figure 3-13** Modulation Accuracy Measurement - Auto Detect



**NOTE** Mod Accuracy measurements can also be used to measure the BBIQ (Baseband I/Q) signals. For the detailed measurement procedure, refer to “Using Option BBA Baseband I/Q Inputs” on page 69.

## Selecting and Setting up Mod Accuracy Measurement

**Step 1.** Initiate the Modulation Accuracy measurement.

Press **Meas, Mod Accuracy**.

**Step 2.** Set up the Mod Accuracy measurement and see the parameters available to change. Several functions can be set under this menu, as described below.

Press **Meas Setup**.

- a. **MER Monitor.** Using the settings under this key, you can monitor the MER results. If **Monitor** is toggled to **On**, MER Monitor process will start. During this process, any other operations, which cause the measurement to restart, will restart the MER Monitor process. For the details of actions during MER Monitor process, refer to “[MER Monitor Process](#)” on page 92.
- b. **Decoding.** Toggling the state of **Decoding** key from **Off** to **On** will start the calculation of BER results in the background. Afterwards, you can view the BER results in **BER Results** view. During the BER calculation process, any other operations, which cause the measurement to restart, will restart the BER calculation.

---

**NOTE**

If the **Decoding** key is toggled to **On**, the measurement speed will slow down.

More parameters, such as EVM reference, I/Q Mismatch, spectrum, Payload type, clock rate, demod symbols, and so on, can be set under **Meas Setup, Advanced**.

## Selecting and Viewing the Measurement Results

Eight views are available in the Mod Accuracy measurement. Press **View/Display**, **the name of the view** to display them.

- **I/Q Measured Polar Graph** displays a combination view of I/Q measured polar graph and metric windows as shown in [Figure 3-14](#). The modulation constellation is shown, along with EVM, MER, magnitude and phase errors, and frequency error.

---

**NOTE**

View the modulation constellation for specified carriers by setting the **Start Carrier** value and **Stop Carrier** value under the **I/Q Measured Polar Graph** key.

Figure 3-14 Modulation Accuracy Measurement Result - I/Q Measured Polar Graph (Default) View



- **I/Q Error (Quad View)** displays a combination view of the MER/EVM, spectrum, I/Q mismatch Polar graph and result summary.

**NOTE**

Note that, you can set the scale type of the vertical axis to MER or EVM and horizontal axis to **Carrier** or **Freq** in the top left window of I/Q Error view. To view the MER vs. Subcarrier results,

- Press **AMPTD Y Scale, More 1 of 2** and toggle the **Scale Type** key to **MER**.
- Press **Span X Scale** and toggle the **Scale Type** key to **Carrier**.

The measurement result of this view should look like [Figure 3-15](#), in which Carrier Suppression has no valid value.

Press **Meas Setup, Advanced, I/Q Mismatch, Std** to obtain the carrier suppression result, see [Figure 3-16](#).

In the I/Q Mismatch estimation method, “Std” means using the formula in the standard to calculate Amptd Imbalance, Quad Error and Carrier Suppression, providing results only in 2k mode; “Fast” means using Agilent internal algorithm to calculate Amptd Imbalance and Quad Error, providing results in 2k, 4k and 8k mode.

Figure 3-15

Modulation Accuracy Measurement Result - I/Q Error View

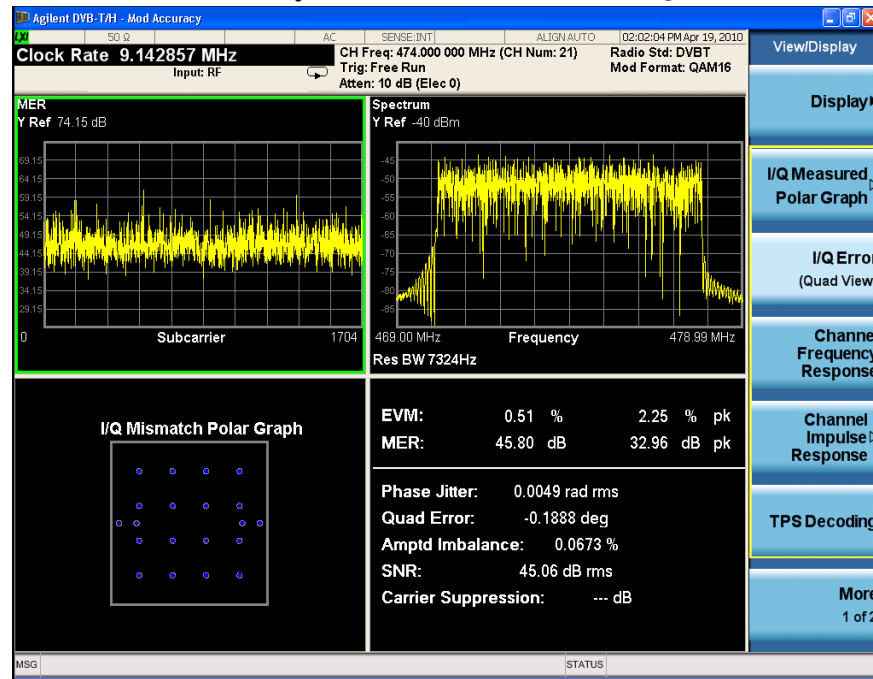
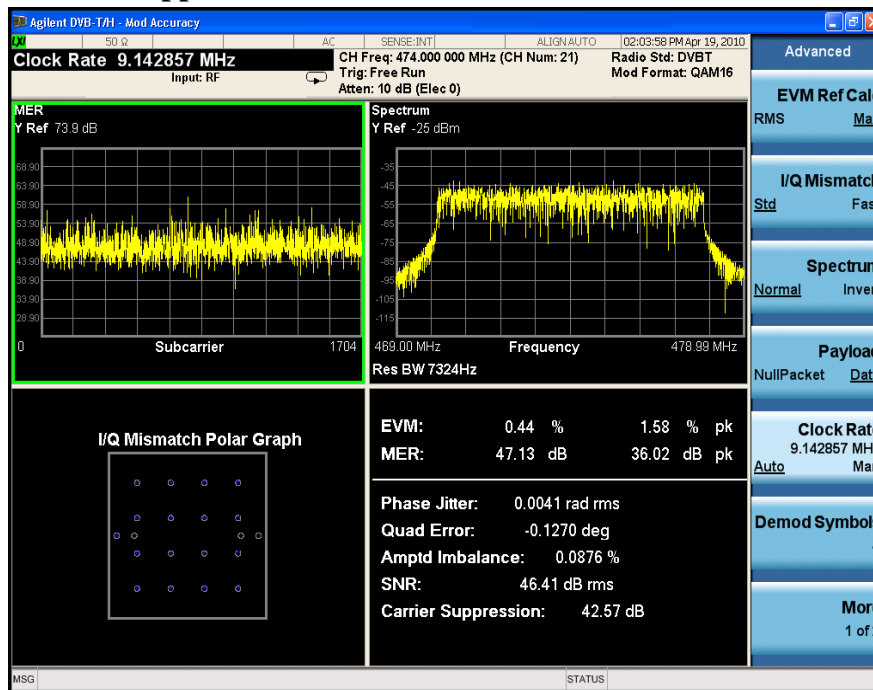


Figure 3-16

Modulation Accuracy Measurement Result - I/Q Error View with Carrier Suppression



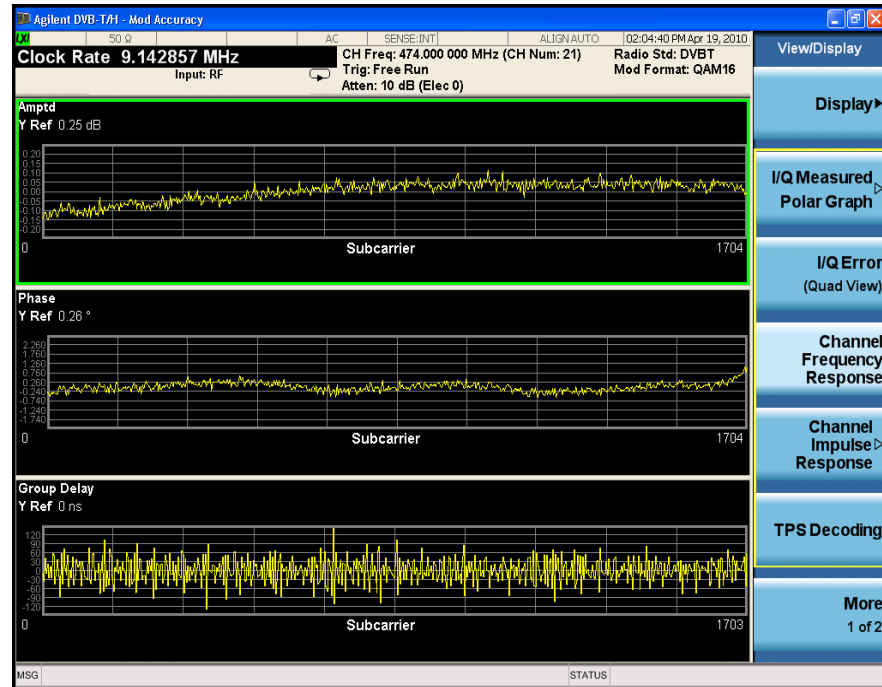
**NOTE**

The I/Q Mismatch Polar Graph in Figure 3-16 only displays the constellations for central carrier if the “Std” method is selected, and displays the constellations for all carriers if the “Fast” method is selected.

- **Channel Frequency Response** displays the amplitude, phase and group delay of the channel frequency response on every subcarrier as shown in [Figure 3-17](#).

Figure 3-17

### Modulation Accuracy Measurement Result-Channel Frequency Response



- **Channel Impulse Response** displays the state and the delay profile of the channel. There are two windows in this view, the graphic window showing the channel impulse response trace and the peak table window showing the delay and amplitude of the top 10 peaks on the trace.

In this view, equalization need to be turned on to get better result. Press **Meas Setup, Advanced, Equalization**, and toggle Equalization to **On**. The measurement results should look like [Figure 3-18](#). The green line with -35.00 dB above its right side is the peak limit line, which means only peaks above this line can be displayed in the peak table. To adjust the peak limit line, press **Peak Search, More 1 of 2, Peak table**, and enter your desired peak limit value.

Peak table window is very helpful when there are more than one path in the channel. Here is an example of the channel impulse response of a two-path channel. The delay for each path are 0, 20 us respectively. You can customize the peak table measurement as following:

- Press **Peak Search, More 1 of 2, Peak Criteria, Pk Excursion, 10, dB, Pk Threshold, -60, dB** and then toggle **PK Threshold Line** to **On** to set the criteria for peak. To see how the Pk Excursion and Pk Threshold affect the peak criteria, refer to [“Peak Criteria” on page 93](#).

The measurement result should look like [Figure 3-19](#), including peak threshold line, peak excursion, and peak limit line.



Figure 3-18 Modulation Accuracy Measurement - Channel Impulse Response

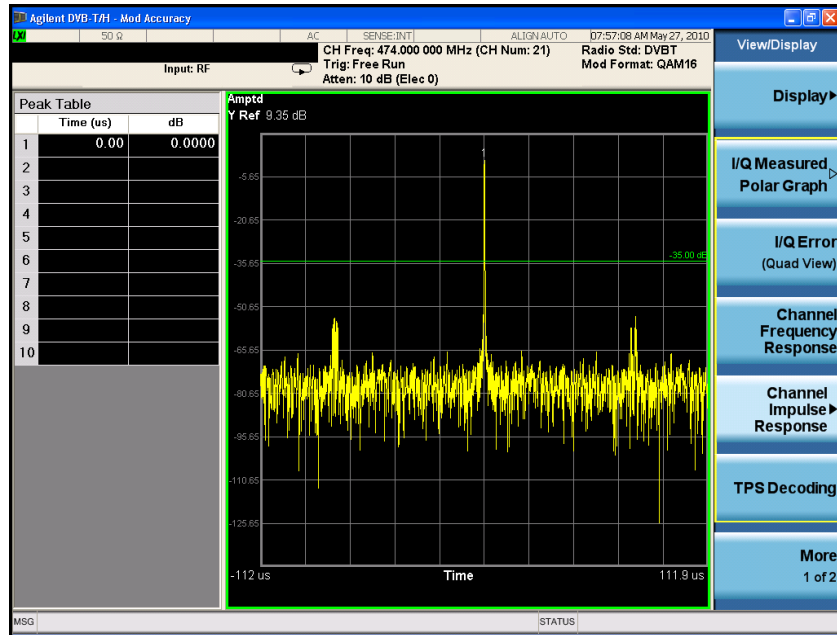
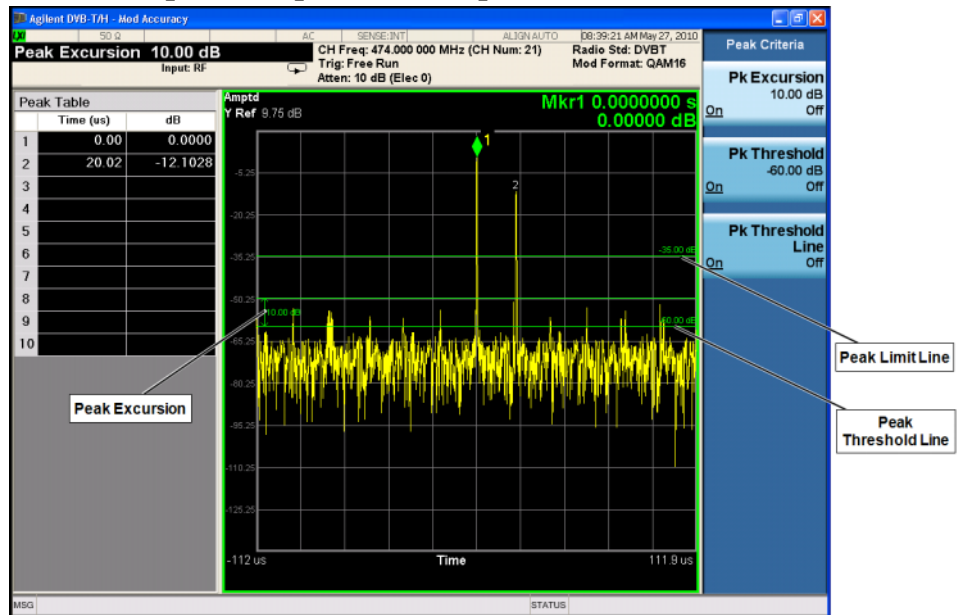


Figure 3-19 Channel Impulse Response (Multi-path)



**NOTE** To display a bar indicating the -GI to GI range on the channel impulse response trace, press **Channel Impulse Response** again, and toggle **GI Range Bar** to **On**.

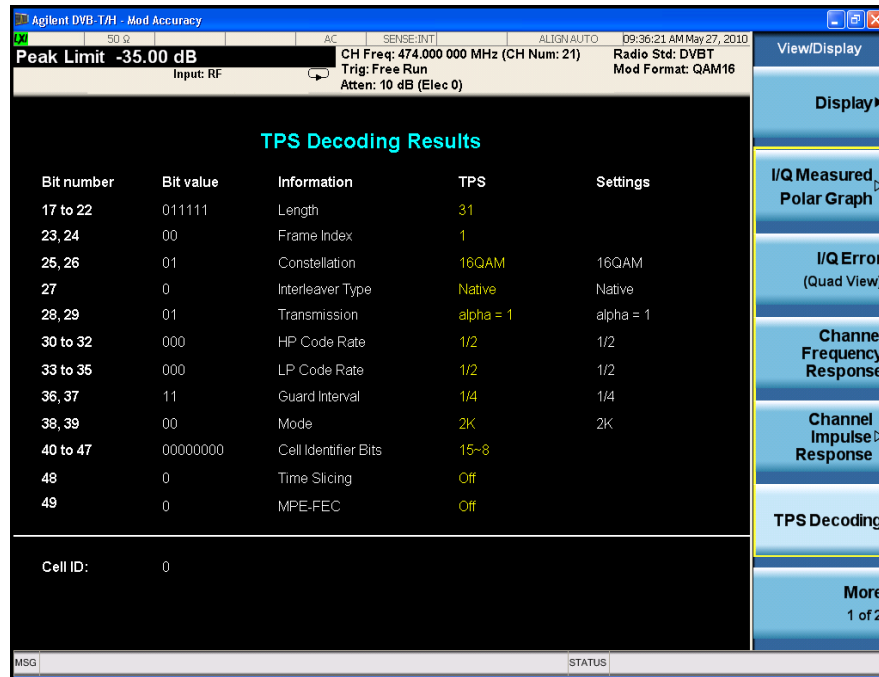
Making DVB-T/H Measurements  
**Modulation Accuracy Measurements**

- **TPS Decoding** displays the original bits of TPS and information decoded from TPS. The TPS decoding measurement results should look like [Figure 3-20](#).

In the graphic, the results in yellow show the TPS measurement results, and the results in white in the rightmost row indicate the current setting under **Mode Setup, Demod**.

**Figure 3-20**

**Modulation Accuracy Measurement Result -TPS Decoding**



- **More 1 of 2, BER Results** shows the BER results. The BER measurement results should look like [Figure 3-21](#).

If the transmitting signal is TS null, set the Payload type to **NullPacket** to measure the error count after RS decoding.

— Press **Meas Setup, Advanced, Payload, NullPacket**. The BER measurement results with error count after RS should look like [Figure 3-22](#).

**TIP**

Control the BER calculation stop time by setting the **BER Bit Count** and **BER Count Type** keys under **Meas Setup, Advanced**. When the total bit count of the specified type exceeds the value of BER bit Count for the first time, the calculation of BER stops.

Figure 3-21

Modulation Accuracy Measurement Result -BER Results

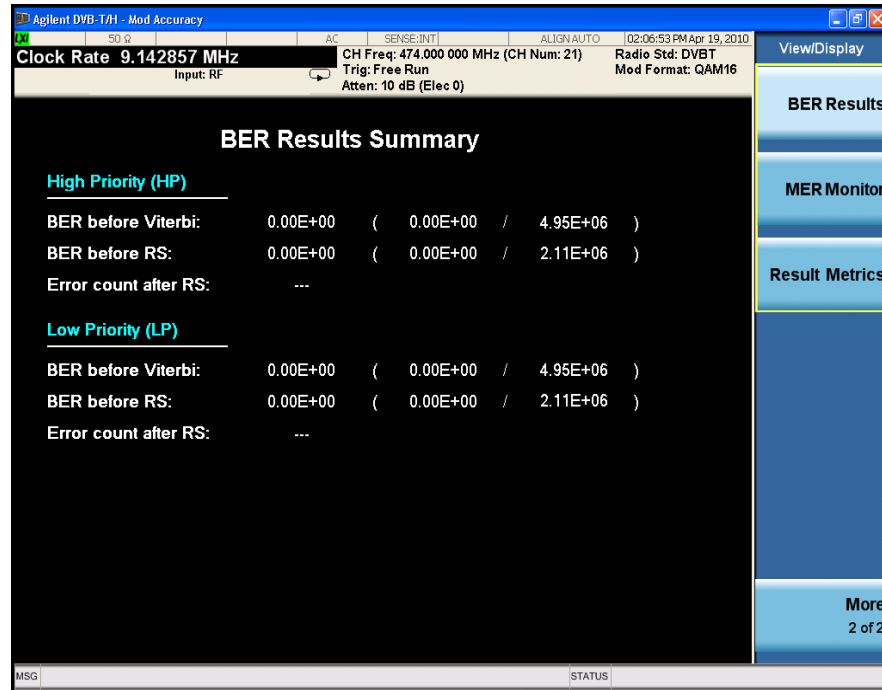
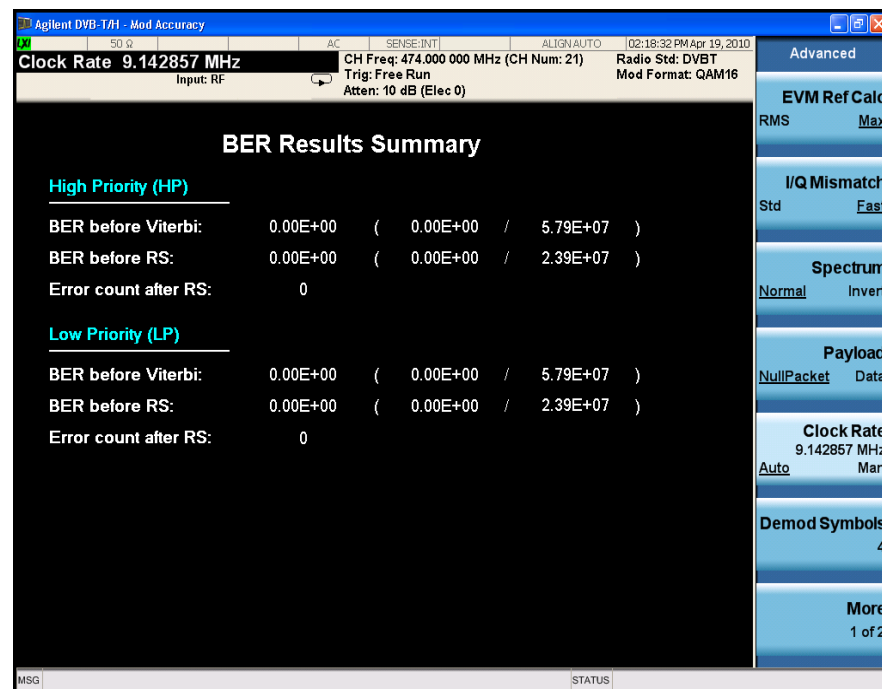


Figure 3-22

Modulation Accuracy Measurement Result -BER Results with Error Count after RS



In the BER Results view, the results for High Priority (HP) data stream and Low Priority (LP) data stream are listed. If Hierarchical (Mode Setup, Demod) is set to off, the results for LP stream will not be shown. Refer to “BER” on page 92 for details of the concepts and measurement methods for BER.

## Making DVB-T/H Measurements Modulation Accuracy Measurements

- **More 1 of 2, MER Monitor** displays the MER results sequentially during the MER monitor process as shown in [Figure 3-23](#), and at the same time, Log files and raw data are recorded. For the details, refer to “[MER Monitor Process](#)” on [page 92](#).

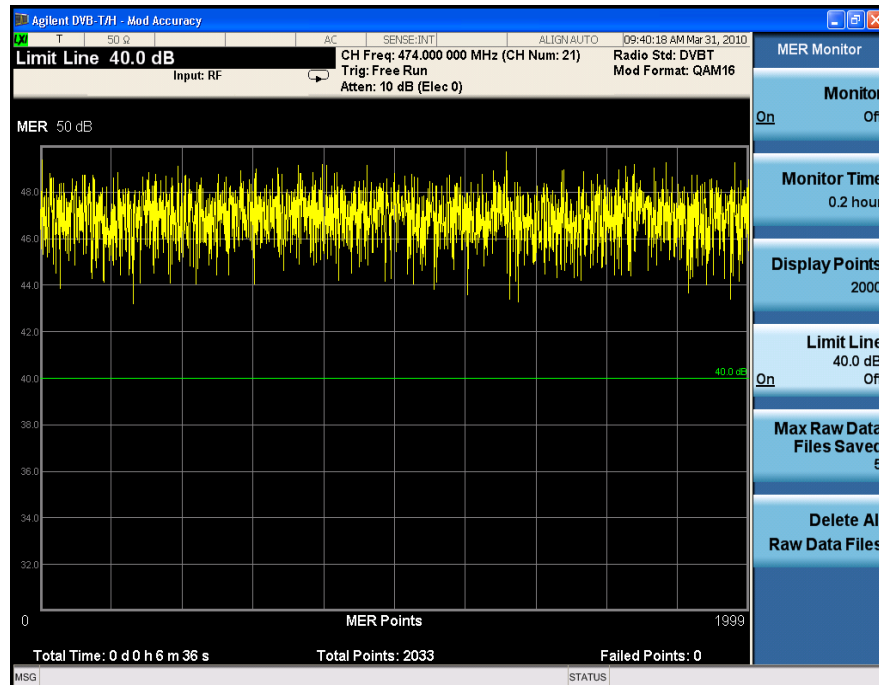
You can customize the MER Monitor measurement as follows:

Press **Meas Setup, MER Monitor**,

- **Monitor Time, 0.2, hour** to set the time for MER monitor.
- **Display Points, 2000** to set the maximum number of points displayed on the graph. If the actual points exceed this number, only the most recent 2000 points are displayed on the graph.
- **Limit Line, 40, dB** and toggle the Limit Line to **On** to turn on the limit line and set the limit line to 40 dB. The green line on [Figure 3-23](#) is the limit line. If the measured MER is below this line, the raw data will be saved to `D:\userdata\DVB-T\rawdata` for further research.
- **Max Raw Data Files Saved, 5** to set the maximum number of raw data files that can be saved if the measured MER is lower than the limit line.

**Figure 3-23**

### Modulation Accuracy Measurement Result - MER Monitor

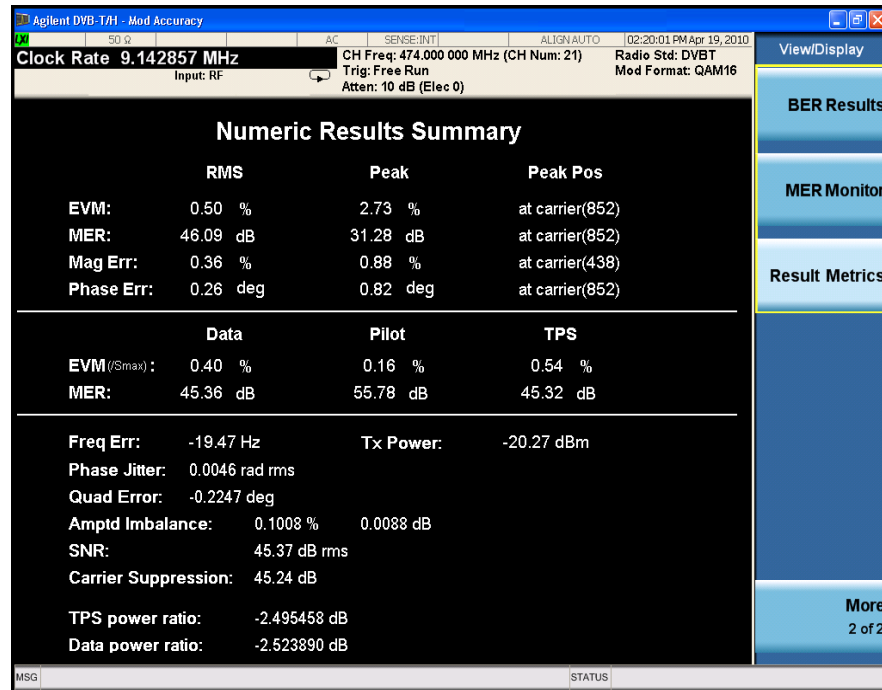


- **More 1 of 2, Result Metrics** displays a summary of the measurement results as shown in [Figure 3-24](#).

You can check the MER results of all the data, data block, pilot, or TPS information in the Result Metrics view.

Figure 3-24

Modulation Accuracy Measurement Result - Result Metrics



**NOTE**

To place a Marker on the different traces of the various views, press **Marker, Properties, Marker Trace**, then select the trace you want to put the marker on. There are eight traces to select from: Polar Trace, MER/EVM vs.Carr/Freq, Spectrum, Amptd vs.Carr, Phase vs.Carr, GD vs.Carr, Amptd vs.Time, and MER vs. Time.

Making DVB-T/H Measurements  
**Modulation Accuracy Measurements**

## Monitor Spectrum Measurements

This section describes how to make a Monitor Spectrum measurement on a DVB-T/H transmitter. Monitor Spectrum measurements show a spectrum domain display of the DVB-T/H signal.

The Monitor Spectrum measurement procedure includes three parts:

- a. “Selecting and Setting up the DVB-T/H Mode” on page 63
- b. “Selecting and Setting up Monitor Spectrum Measurement” on page 64
- c. “Viewing the Measurement Results” on page 64

### Selecting and Setting up the DVB-T/H Mode

**Step 1.** Select DVB-T/H mode.

Press **Mode, DVB-T/H**.

**Step 2.** Preset the analyzer.

Press **Mode Preset**.

**Step 3.** Set the center frequency. There are two methods:

- Enter the center frequency directly.  
Press **FREQ Channel, Center Freq, 474, MHz**.
- Select the channel number under a specific channel table.
  - a. Specify a channel table by selecting a video standard.  
Press **FREQ Channel, Chan Table, PAL-B/G, PAL-B/G UHF**.
  - b. Set the channel number.  
Press **FREQ Channel, Channel, 21**.

**Step 4.** Set the channel bandwidth.

Press **Mode Setup, Channel BW, 8 MHz**.

**Step 5.** Select DVB-T standard.

Press **Mode Setup, Radio Std, DVB-T**.

## Selecting and Setting up Monitor Spectrum Measurement

**Step 1.** Initiate the Monitor Spectrum measurement.

Press **Meas, Monitor Spectrum**.

**Step 2.** Set up the Monitor Spectrum measurement and see the parameters available to change. You can use the default settings for most cases.

Press **Meas Setup**.

## Viewing the Measurement Results

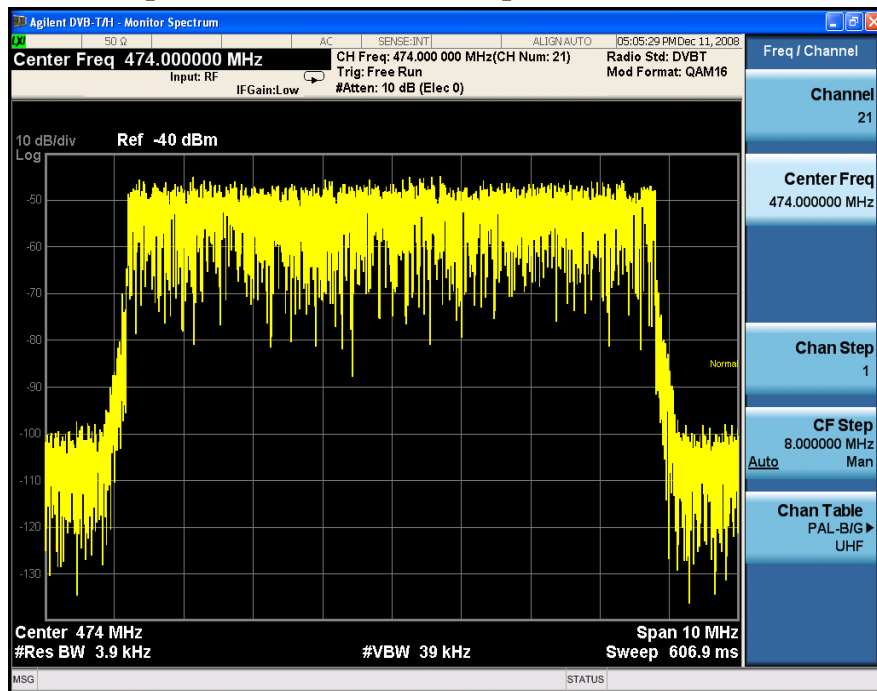
The Monitor Spectrum measurement result should look like [Figure 3-25](#).

The default display shows the **Current** (yellow trace) data. To make viewing the display easier, you can view either the **Current** trace or **Average** separately.

- Press **Trace/Detector, Select Trace** and select the trace(s) desired for display, then toggle **Display** to **Show**. Then press Update to **On** to see the updated trace.

Figure 3-25

Monitor Spectrum Measurement - Spectrum View





## **IQ Waveform (Time Domain) Measurements**

This section explains how to make a Waveform (time domain) measurement on a DVB-T/H transmitter. The measurement of I and Q modulated waveforms in the time domain discloses the voltages which comprise the complex modulated waveform of a digital signal.

The IQ Waveform measurement procedure includes three parts:

- a. [“Selecting and Setting up the DVB-T/H Mode” on page 65](#)
- b. [“Selecting and Setting up IQ Waveform Measurements” on page 66](#)
- c. [“Selecting and Viewing the Measurement Results” on page 66](#)

### **Selecting and Setting up the DVB-T/H Mode**

**Step 1.** Select DVB-T/H mode.

Press **Mode, DVB-T/H**.

**Step 2.** Preset the analyzer.

Press **Mode Preset**.

**Step 3.** Set the center frequency. There are two methods:

- Enter the center frequency directly.  
Press **FREQ Channel, Center Freq, 474, MHz**.
- Select the channel number under a specific channel table.
  - a. Specify a channel table by selecting a video standard.  
Press **FREQ Channel, Chan Table, PAL-B/G, PAL-B/G UHF**.
  - b. Set the channel number.  
Press **FREQ Channel, Channel, 21**.

**Step 4.** Set the channel bandwidth.

Press **Mode Setup, Channel BW, 8 MHz**.

**Step 5.** Select DVB-T standard.

Press **Mode Setup, Radio Std, DVB-T**.

---

**NOTE**

IQ Waveform measurements can be used to measure the BBIQ (Baseband I/Q) signals. For the detailed measurement procedure, refer to [“Using Option BBA Baseband I/Q Inputs” on page 69](#).

---

## Selecting and Setting up IQ Waveform Measurements

**Step 1.** Initiate the IQ Waveform measurement.

Press **Meas, IQ Waveform**.

**Step 2.** Set up the IQ Waveform measurement and see the parameters available to change. You can use the default settings for most cases.

Press **Meas Setup**.

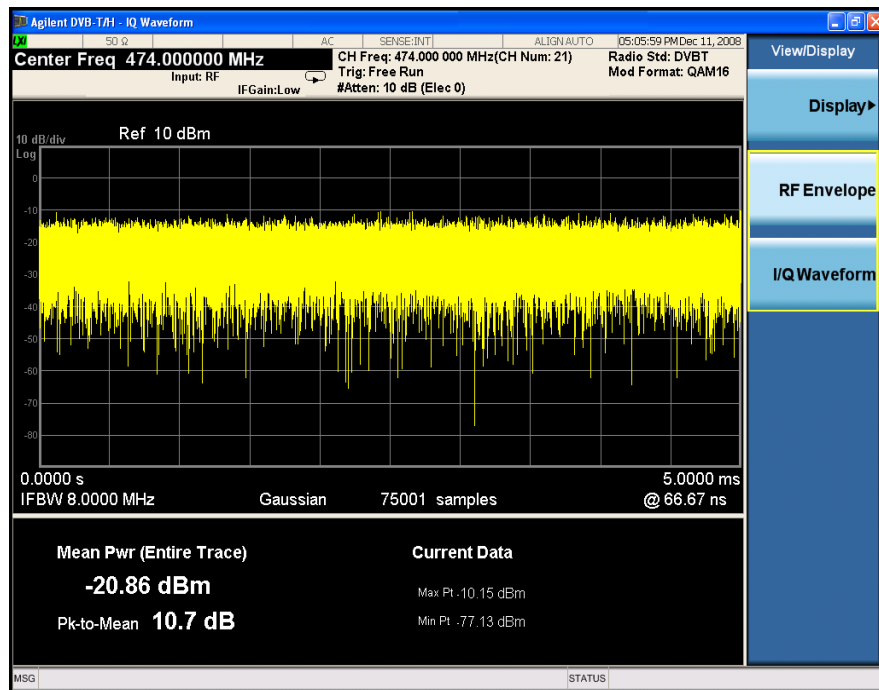
## Selecting and Viewing the Measurement Results

Two views are available in the IQ Waveform measurement. Press **View/Display**, the name of the view to display them.

- **RF Envelope** displays the RF envelope with the current data as shown in [Figure 3-26](#). The measured values for the mean power and peak-to-mean power are shown in the text window.

**Figure 3-26**

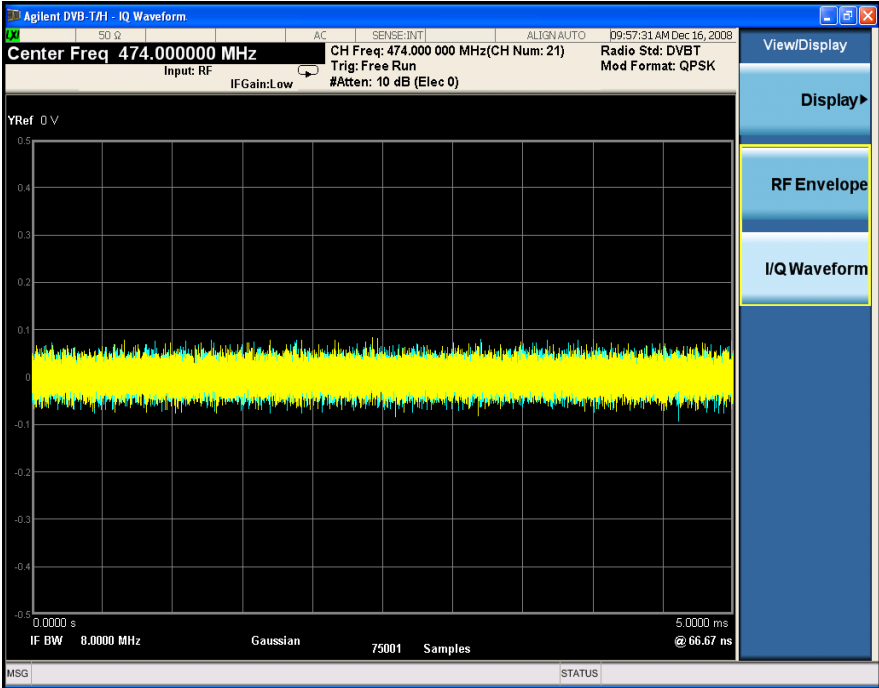
### Waveform Measurement - RF Envelope (Default View)



- **IQ Waveform** displays a view of the I (yellow trace) and Q (blue trace) waveforms on the same graph in terms of voltage versus time in linear scale as shown in [Figure 3-27](#).

Figure 3-27

Waveform Measurement - I/Q Waveform View



Making DVB-T/H Measurements  
**IQ Waveform (Time Domain) Measurements**

## Using Option BBA Baseband I/Q Inputs

### Baseband I/Q Measurements Available for X-Series Signal Analyzers

The following table shows the measurements that can be made using Baseband I/Q inputs:

**Table 3-4 BBIQ Supported Measurements vs. Mode**

Mode	Measurements
GSM	IQ Waveform GMSK Phase & Freq EDGE EVM
802.16 OFDMA	IQ Waveform Power Stat CCDF Modulation Analysis
TD-SCDMA	IQ Waveform Power Stat CCDF Code Domain Mod Accuracy
cdma2000	IQ Waveform Power Stat CCDF Code Domain Mod Accuracy QPSK EVM
DTMB (CTTB)	IQ Waveform Power Stat CCDF Mod Accuracy
DVB-T/H	IQ Waveform Power Stat CCDF Mod Accuracy
CMMB	IQ Waveform Power Stat CCDF Mod Accuracy
ISDB-T	IQ Waveform Power Stat CCDF Mod Accuracy
IQ Analyzer (Basic)	IQ Waveform Complex Spectrum

## Baseband I/Q Measurement Overview

The Baseband I/Q functionality is a hardware option, Option BBA. If the option is not installed in the instrument, the I/Q functionality cannot be enabled.

The Baseband I/Q option provides four input ports and one Calibration Output port. The input ports are I, I-bar, Q, and Q-bar. The I and I-bar together compose the I channel and the Q and Q-bar together compose the Q channel. Each channel has two modes of operation:

Single Ended  
(unbalanced)

In this mode, only the main port (I or Q) is used and the complementary ports (I-bar or Q-bar) are ignored. The I and Q ports are in single-ended mode when Differential “Off” is selected.

Differential  
(balanced)

In this mode, both main and complementary ports are used. To activate this mode, select Differential “On” from the I and Q Setup softkey menus.

The system supports a variety of input passive probes as well as the Agilent 1153A active differential probe using the Infinimax probe interface.

---

### NOTE

To avoid duplication, this section describes only the details unique to using the baseband I/Q inputs. For generic measurement details, refer to the previous [“Making DVB-T/H Measurements” on page 25](#) sections.

To make measurements using baseband I/Q Inputs, make the following selections:

- Step 1.** Select a measurement that supports baseband I/Q inputs.
- Step 2.** Select the I/Q Path.  
Press **Input/Output, I/Q, I/Q Path**. Select from the choices present on the screen. The path selected is shown at the top of the measurement screen.
- Step 3.** Select the appropriate circuit location and probe(s) for measurements. For details see [“Selecting Input Probes for Baseband Measurements” on page 99](#) in the Concepts chapter.
- Step 4.** Select baseband I/Q input connectors.
- Step 5.** If you have set the I/Q Path to **I+jQ** or to **I Only**, press **I Setup**.
  - A. Select whether **Differential (Balanced)** input is **On** or **Off**.
  - B. Select the input impedance, **Input Z**.
  - C. Input a **Skew** value in seconds.
  - D. Set up the I Probe by pressing **I Probe**.
    - a. Select probe **Attenuation**.
    - b. Calibrate the probe. Press **Calibrate...** to start the calibration procedure.

Follow the calibration procedure, clicking **Next** at the end of each step.

- Step 6.** If you have set the I/Q Path to **I+jQ** or to **Q Only**, press **Q Setup**.
- A. Select whether **Differential (Balanced)** input is **On** or **Off**.
  - B. Select the input impedance, **Input Z**.
  - C. Input a **Skew** value in seconds.
  - D. Set up the I Probe by pressing **I Probe**.
    - a. Select probe **Attenuation**.
    - b. Calibrate the probe. Press **Calibrate...** to start the calibration procedure. Follow the calibration procedure, clicking **Next** at the end of each step.
- Step 7.** Select the reference impedance by pressing **Reference Z**, and inputting a value from one ohm to one megohm. The impedance selected is shown at the top of the measurement screen.
- Step 8.** If you using cables that were not calibrated in the probe calibration step, press **I/Q Cable Calibrate...** Follow the calibration procedure, clicking **Next** at the end of each step.
- Step 9.** After completing the baseband IQ setup procedures, make your desired measurement.

Making DVB-T/H Measurements  
Using Option BBA Baseband I/Q Inputs



This chapter provides details about the DVB-T/H broadcast systems, and explains how the various measurements are performed by the instrument. Suggestions for optimizing and troubleshooting your setup are provided, along with a list of related documents that are referenced for further information.

## Introduction

DVB-T/H concept information is split between these sections as follows:

1. A general introduction for DVB-T/H Broadcast system, see [“What Is the DVB-T/H Broadcast System?”](#) on page 75.
2. Key technologies used in DVB-T/H system, see [“Key Technologies”](#) on page 77.
3. Concepts and measurement methods for each measurement.
  - [“Channel Power Measurement Concepts”](#) on page 79.
  - [“Adjacent Channel Power \(ACP\) Measurement Concepts”](#) on page 80.
  - [“Power Statistics CCDF Measurement Concepts”](#) on page 81.
  - [“Spurious Emissions Measurement Concepts”](#) on page 83.
  - [“Spectrum Emission Mask Measurement Concepts”](#) on page 85.
  - [“Modulation Accuracy Measurement Concepts”](#) on page 89.
  - [“Monitor Spectrum Measurement Concepts”](#) on page 95.
  - [“IQ Waveform Measurement Concepts”](#) on page 96.
4. Concepts and measurement methods for baseband I/Q input, see [“Baseband I/Q Inputs \(Option BBA\) Measurement Concepts”](#) on page 97.
5. Other sources of measurement information is also given, see [“Other Sources of Measurement Information”](#) on page 102.
6. See [“References”](#) on page 103 for references used in this chapter.

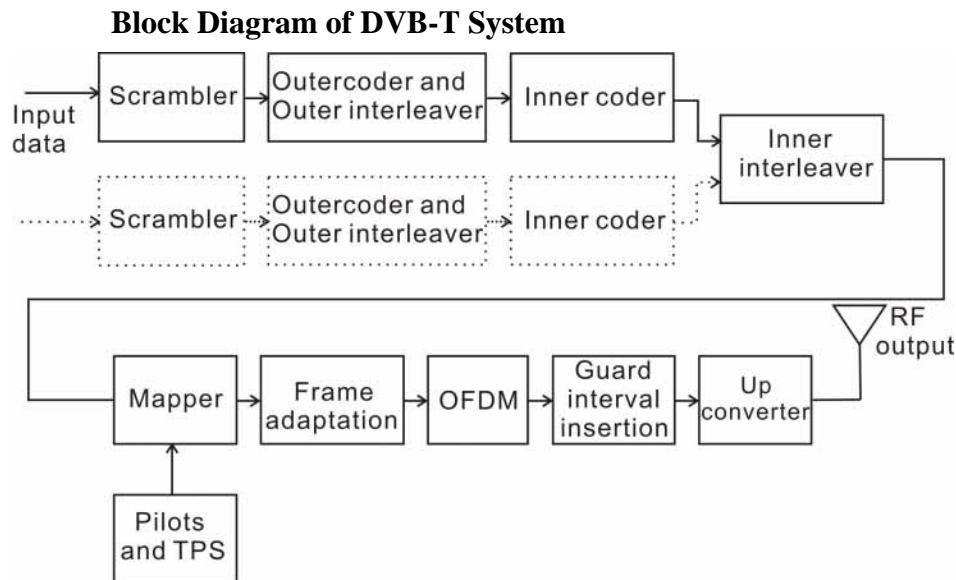
## What Is the DVB-T/H Broadcast System?

Digital Video Broadcasting-Terrestrial/Handheld (DVB-T/H) is the European consortium standard for broadcast transmission of digital terrestrial/ handheld television.

### DVB-T

DVB-T, compliant with the ETSI EN 300 744 standard, is the most popular digital terrestrial transmission system in the world. It performs the adaptation of the TV transmitted signals from the output of the MPEG-2 multiplexer. A block diagram of typical DVB-T system is shown in [Figure 4-1](#).

**Figure 4-1**



In DVB-T, the capacity for hierarchical modulation can enable two completely separate data stream to transmit in a single signal which can be used to trade bit rate versus ruggedness. The use of OFDM modulation with appropriate guard interval allows optimal trade-off between network topology and frequency efficiency. DVB-T has the following technical characteristics that make it a very flexible system.

3 modulation options: QPSK/ 16QAM/ 64QAM

5 different FEC rates: 1/2, 2/3, 3/4, 5/6, 7/8

4 Guard interval options: 1/4, 1/8, 1/16, 1/32

2 transmission modes: 2 k/ 8 k

3 channel bandwidth: 6/7/8 MHz

## DVB-H

DVB-H is an extension of the DVB-T, which is suitable for handheld portable devices and mobile reception. It has been commercially launched on some European, Asian and African countries, and is being adopted more and more widely in the world.

DVB-H takes into account the properties of the handheld receivers such as small, light weight, portable and battery powered. DVB-H has the following specifications:

- **Time-slicing:** Rather than continuous data transmission as in DVB-T, DVB-H employs a mechanism where bursts of data is received at a time-an IP datacast carousel. This means that the receiver is inactive for much of the time, and can thus, by means of clever control signaling, be “switched off”. The result is a power saving of approximately 90 percent and more in some cases.
- **4 K mode:** With 4 K mode, DVB-H benefits from the compromise between the high-speed small-area SFN capability of 2 K DVB-T and the lower speed but larger area SFN of 8 K DVB-T. In addition, with the aid of enhanced in-depth interleaver in 2 K and 4 K modes, DVB-H has better immunity to ignition interference.
- **MPE-FEC:** The addition of an optional, multiplexer level, forward error correction scheme means that DVB-H transmissions can be even more robust.

Refer to [1] and [2] for more details of the DVB-T/H broadcast system.

---

## Key Technologies

### Hierarchical Transmission

DVB-T/H system supports hierarchical transmission, in which there are two transport stream inputs and two FEC blocks.

The stream with a low data rate is fed into the High priority (HP) path and provided with a large amount of error protection. The stream with higher data rate is fed in parallel into the Low priority (LP) path with less error protection.

On the HP path, the modulation type is equal to QPSK, which is a particularly robust type of modulation, while on the LP path, a higher level of modulation is needed due to the higher data rate. In DVB-T/H, the two paths are not modulated with different types of modulation. Instead, each carrier transmits both of LP data and HP data in 16QAM or 64QAM.

### Frame Structure

DVB-T/H transmitted signal is organized in frames. Four consecutive frames form one super-frame. One frame contains 68 OFDM symbols, and one symbol has 6817 carriers in 8K mode and has 1705 carriers in 2K mode.

Besides the transmitted data, a Frame also contains scattered pilot cells, continual pilot carriers, and TPS (Transmission Parameter Signalling) carriers. The pilots is useful for frame synchronization, frequency synchronization, time synchronization, channel estimation, transmission mode identification and for following the phase noise. The TPS is used to inform the receiver the current transmission parameters.

### OFDM

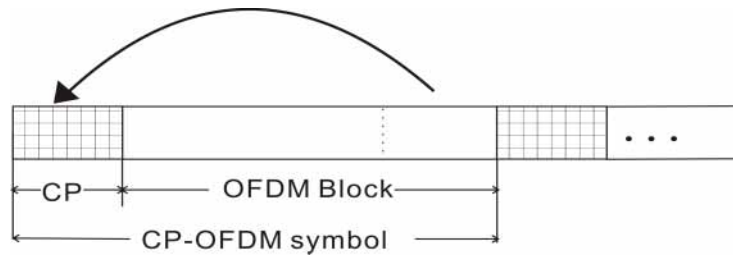
DVB-T/H uses Cyclic Prefix Orthogonal Frequency Division Multiplexing (CP-OFDM) for modulation.

In CP-OFDM, a cyclic prefix (CP) is inserted between two consecutive OFDM symbols as guard interval. The guard interval is designed to be longer than the maximum value of the channel's delay spread.

The cyclic prefix consists a cyclic continuation of the useful OFDM symbol time domain samples. By discarding the CP directly at the receiver, the inter symbol interference (ISI) is then removed.

By introducing CP, the convolution between the transmitting signal and the channel impulse response turns to a circular one, hence, the equalization can be performed with much low complexity. The signal frame structure of CP-OFDM is shown in [Figure 4-2](#).

**Figure 4-2** Signal Frame Structure for CP-OFDM Symbols



Four GI (guard interval) values are used in DVB-T/H standard, which are  $1/4$ ,  $1/8$ ,  $1/16$ ,  $1/32$  of the duration of the OFDM block.

## Channel Power Measurement Concepts

### Purpose

Channel Power measurement is an important test in the digital video industry to measure the power characteristics of the DVB-T/H radio signal. First of all, it measures the integrated power and power spectral density (PSD) in DVB-T/H defined bandwidth. Secondly, it measures and reports the shoulder attenuation. Thirdly, it provides a view comparing the input signal against the DVB-T/H defined spectrum mask for the case of analog TV signal in adjacent channel.

### Measurement Method

Channel Power measurement has three views. The measurement methods for each view are described as follows:

#### RF Spectrum

The RF Spectrum measurement reports the total transmitted power within the channel bandwidth (5/6/7/8 MHz for the DVB-T/H mode). The integration bandwidth (IBW) method is used to determine channel power.

Channel Power is a swept-frequency measurement allowing you to change the RBW and VBW settings manually. To improve repeatability, you can increase the number of averages. The channel power graph is shown in the graph window, while the absolute channel power in dBm and the mean power spectral density in dBm/Hz are shown in the text window.

#### Shoulder Attenuation

For shoulder attenuation view, the measurement includes the following steps [3]:

- a. Find the maximum value of the spectrum by using resolution bandwidth at approximately 10 times the carrier spacing.
- b. Place declined, straight lines connecting the measurement points at 300 kHz and 700 kHz from each of the upper and lower edges of the spectrum. Draw additional parallel to these, so that the highest spectrum value within the respective range lies on the line.
- c. Subtract the power value of the center of the line (500 kHz away from the upper and lower edge) from the maximum spectrum value of step a and note the difference as the “shoulder attenuation” at the upper and lower edge.
- d. Take the worst case value of the upper and lower results from step c as the overall “shoulder attenuation”.

#### Spectrum Mask

For the spectrum mask which is used to compare with the input signal in the third view, refer to [2].

## Adjacent Channel Power (ACP) Measurement Concepts

### Purpose

Adjacent Channel Power (ACP), as it applies to DVB-T/H, is the power contained in a specified frequency channel bandwidth relative to the total carrier power. It may also be expressed as a ratio of power spectral densities between the carrier and the specified offset frequency band.

As a measurement of out-of-channel emissions, ACP combines both in-band and out-of-band specifications to provide useful figures-of-merit for spectral regrowth and emissions produced by components and circuit blocks without the rigor of performing a full spectrum emissions mask measurement.

### Measurement Method

This ACP measurement analyzes the total power levels within the defined carrier bandwidth and at given frequency offsets on both sides of the carrier frequency. This measurement allows the user to specify measurement bandwidths of the carrier channel and each of the offset frequency pairs up to 6. Each pair may be defined with unique measurement bandwidths.

In this measurement, three methods can be used to calculate power.

- **IBW (Integration BW):** The channel integration bandwidth is analyzed using the user defined resolution bandwidth (RBW), which is much narrower than the channel bandwidth.
- **Filter IBW:** This method is useful for improving dynamic range on the signal because a sharp cutoff band pass filter is used.
- **RBW:** This method uses zero-span and an appropriate RBW setting to capture the power level in the carrier channel and the offsets.

If **Total Pwr Ref** is selected as the measurement type, the reference is the total power in carrier channel, and the results are displayed as relative power in dBc and as absolute power in dBm. If **PSD Ref** (Power Spectral Density Reference) is selected, the reference is the PSD in carrier channel, the results are displayed as relative power in dB, and as absolute power in dBm/Hz.



## Power Statistics CCDF Measurement Concepts

### Purpose

Many digitally modulated signals appear noise-like in the time and frequency domain. This means that statistical measurements of the signals can be a useful characterization. Power Complementary Cumulative Distribution Function (CCDF) curves characterize the higher-level power statistics of a digitally-modulated signal. The curves can be useful in determining design parameters for digital Broadcast systems.

Peak-to-average power ratio is the ratio of the peak envelope power to the average envelope power of a signal. If the peak-to-average power ratio is small, the headroom required in the amplifier to prevent compression of the signal and interference with the adjacent frequency channels is small. Thus, the amplifier can operate more efficiently.

The amplifier must be capable of handling the different peak-to-average power ratios the signal exhibits for the different channel configurations, while maintaining good adjacent channel power (ACP) performance. From the measurement perspective, the statistics of the signal may impact the result of the measurement. Therefore, it is important to choose the signal's channel configuration carefully. You need to cover the real-life worst cases, such as those with the most stressful signal configurations or highest peak-to-average power ratios.

The power statistics CCDF measurement can be affected by many factors. For example, modulation filtering, modulation format, combining the multiple signals at different frequencies, number of active codes and correlation between symbols on different codes with spread spectrum systems. These factors are all related to modulation and signal parameters. External factors such as signal compression and expansion by non-linear components, group delay distortion from filtering, and power control within the observation interval also affect the measurement.

CCDF curves can help you in several situations:

- To determine the headroom required when designing a component.
- To confirm the power statistics of a given signal or stimulus. CCDF curves allow you to verify if the stimulus signal provided by another design team is adequate. For example, RF designers can use CCDF curves to verify that the signal provided by the digital signal processing (DSP) section is realistic.
- To confirm that a component design is adequate or to troubleshoot your subsystem or system design, you can make CCDF measurements at several points of a system.

### Measurement Method

The power measured in power statistics CCDF curves is actually instantaneous

envelope power defined by the equation:

$$P = (I^2 + Q^2)/Z_0$$

(where I and Q are the quadrature voltage components of the waveform and  $Z_0$  is the characteristic impedance).

Then, to obtain the distribution, make a frequency distribution table in the power calculated above. In this measurement, there are 30001 points range from -200 dBm to 100 dBm by 0.01dB. For example: sampled power = 10 dBm, this means the 21000th index point of this table, so increase the variable that is index by this power.

After that, the CCDF trace vector can be made. The CCDF means a probability distribution more than any power and the trace starts from average power. The trace is obtained by converting the frequency distribution table of more than average power.

To make the power statistics CCDF measurement, the instrument uses digital signal processing (DSP) to sample the input signal in the channel bandwidth.

The Gaussian distribution line as the band-limited gaussian noise CCDF reference line, the user-definable reference trace, and the currently measured trace can be displayed on a semi-log graph. If the currently measured trace is above the user reference trace, it means that the higher peak power levels against the average power are included in the input signal.

## Spurious Emissions Measurement Concepts

### Purpose

Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions. Spurious emissions from the transmitter should be minimized to guarantee minimum interference with other frequency channels in the system.

This measurements verifies the frequency ranges of interest are free of interference by measuring the spurious signals specified by the user defined range table.

### Measurement method

The table-driven measurement has flexibility to set up custom parameters such as frequency, span, resolution bandwidth, and video bandwidth.

For each range that you specify and activate, the analyzer scans the band using the specified Range Table settings. Then, using the Peak Excursion and Peak Threshold values, determine which spurs to report.

As each band is swept, any signal which is above the Peak Threshold value and has a peak excursion of greater than the Peak Excursion value will be added to a list of spurs displayed in the lower results window. A total of 200 spurs can be recorded for one measurement, with a limit of 10 spurs per frequency range. To improve repeatability, you can increase the number of averages.

From the spurs in the list, those with peak amplitude greater than the Absolute Limit for that range will be logged as a measurement failure. If no spurs are reported, but the measured trace exceeds the limit line for any range, the fail flag is set to FAIL.

This measurement has the ability to display two traces using different detectors on the display simultaneously. All spur detection and limit line testing are only applied to the trace associated with Detector 1, which will be colored yellow. The trace associated with Detector 2 will be colored cyan.

If the sweep time for the selected range exceeds 2 seconds, a flashing message "Sweeping...Please wait" appears in the annunciator area. This message advises you that the time to complete the sweep is between 2 and 2000 seconds, and is used to prevent the display from appearing frozen, and to alert the user that the measurement is still ongoing.

### Spurious emission limits for DVB-T transmitter defined by Standard

Spurious emissions shall not exceed the values set out in [Table 4-1](#) for the frequency range 9 kHz to 4.5 GHz. [4]

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**Spurious Emissions Measurement Concepts**

**Table 4-1 Spurious emission limits for DVB-T transmitters**

Frequency range	Limits	Reference bandwidth
9 kHz to 174 MHz	-36 dBm (250 nW)	100 kHz
> 174 MHz to 400 MHz	-82 dBm, for $P \leq 25$ W -126 dBc, for $25$ W < $P \leq 1000$ W -66 dBm, for $1000$ W < $P$	4 kHz
> 400 MHz to 790 MHz	-36 dBm (250 nW)	100 kHz
> 790 MHz to 862 MHz	-76 dBm, for $P \leq 25$ W -120 dBc, for $25$ W < $P \leq 1000$ W -60 dBm, for $1000$ W < $P$	4 kHz
> 862 MHz to 1000 MHz	-36 dBm (250 nW)	100 kHz
> 1000 MHz	-30 dBm (1 $\mu$ W)	100 kHz
Note: P is the mean power of the transmitter		

## Spectrum Emission Mask Measurement Concepts

### Purpose

Spectrum Emission Mask measurements include the in-band and out-of-band spurious emissions. As it applies to DVB-T/H, it is the power contained in a specified frequency bandwidth at certain offsets relative to the total carrier power. It may also be expressed as a ratio of power spectral densities between the carrier and the specified offset frequency band.

As a measurement of out-of-channel emissions, the spectrum emission mask measurement combines both in-band and out-of-band specifications to provide useful figures-of-merit for spectral regrowth and emissions produced by components and circuit blocks without the rigor of performing a full spectrum emissions mask measurement.

### Measurement Method

The spectrum emission mask measurement measures spurious signal levels in up to six pairs of offset/region frequencies and relates them to the carrier power. The reference channel integration bandwidth method is used to measure the carrier channel power.

The channel integration bandwidth is analyzed using the user defined resolution bandwidth (RBW), which is much narrower than the channel bandwidth. The measurement computes an average power of the channel or offset/region over a specified number of data acquisitions, automatically compensating for resolution bandwidth and noise bandwidth.

This measurement requires the user to specify measurement bandwidths of the carrier channel and each of the offset/region frequency pairs up to 6. Each pair may be defined with unique measurement bandwidths. The results are displayed both as relative power in dBc, and as absolute power in dBm.

### Spectrum Emission limits defined by Standard

The spectrum emissions shall not exceed the limits specified in [Table 4-2](#) and [Table 4-3](#). [4]

Spectrum emission limits are given as mean power level measured in a 4 kHz bandwidth, where 0 dB corresponds to the mean output power.

For critical cases such as television channels adjacent to other services (low power or receive only), a spectrum mask with higher out-of-channel attenuation may be needed.

Unless otherwise declared by the manufacture, it shall be assumed that the UUT

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conforms to the non-critical case.

**Table 4-2 Spectrum emission limits for transmitter with output power  $\geq 25$  W**

Classification accordingly the frequency assignment	7 MHz Channel, frequency difference from the center frequency (MHz)	8 MHz Channel, frequency difference from the center frequency (MHz)	Relative level (dBc)
Non-critical cases	$\pm 3.4$	$\pm 3.81$	-32.2/-32.8
	$\pm 3.7$	$\pm 4.2$	-73
	$\pm 5.25$	$\pm 6$	-85
	$\pm 10.5$	$\pm 12$	-110
	$\pm 13.85$	-	-126
Critical cases	$\pm 3.4$	$\pm 3.81$	-32.2/-32.8
	$\pm 3.7$	$\pm 4.2$	-83
	$\pm 5.25$	$\pm 6$	-95
	$\pm 10.5$	$\pm 12$	-120
	$\pm 11.75$	-	-126

**Table 4-3 Spectrum emission limits for transmitter with output power  $< 25$  W**

Classification accordingly the frequency assignment	7 MHz Channel, frequency difference from the center frequency (MHz)	8 MHz Channel, frequency difference from the center frequency (MHz)	Absolute level (dBm)
Non-critical cases	$\pm 3.4$	$\pm 3.81$	11.8/11.2
	$\pm 3.7$	$\pm 4.2$	-29
	$\pm 5.25$	$\pm 6$	-41
	$\pm 10.5$	$\pm 12$	-66
	$\pm 13.85$	-	-82
Critical cases	$\pm 3.4$	$\pm 3.9$	11.8/11.2
	$\pm 3.7$	$\pm 4.2$	-39
	$\pm 5.25$	$\pm 6$	-51
	$\pm 10.5$	$\pm 12$	-76
	$\pm 11.75$	-	-82

## Amplitude Correction in Spectrum Emission Mask Measurement

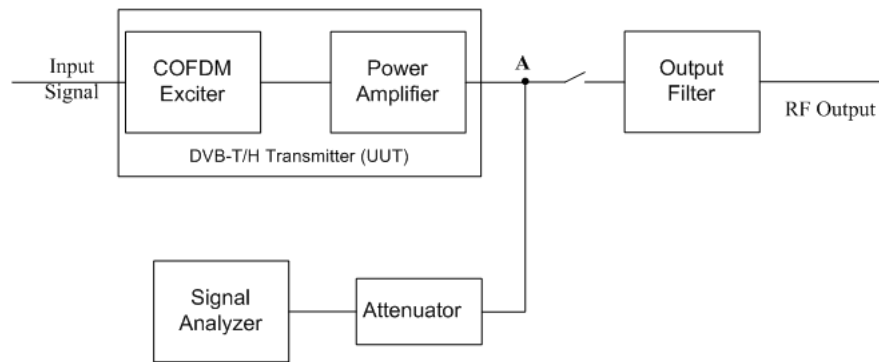
The dynamic range of the RF output of a real DVB-T/H transmitter typically exceeds that of the analyzer, therefore, the direct measurement result is always “FAIL”, which does not reflect the real RF output.

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

- When the DVB-T/H transmitter has an mask filter, the diagram for spectrum emission mask measurement is shown in [Figure 4-3](#).

Figure 4-3

### Diagram for the Spectrum Emission Mask Measurement on a DVB-T/H Transmitter



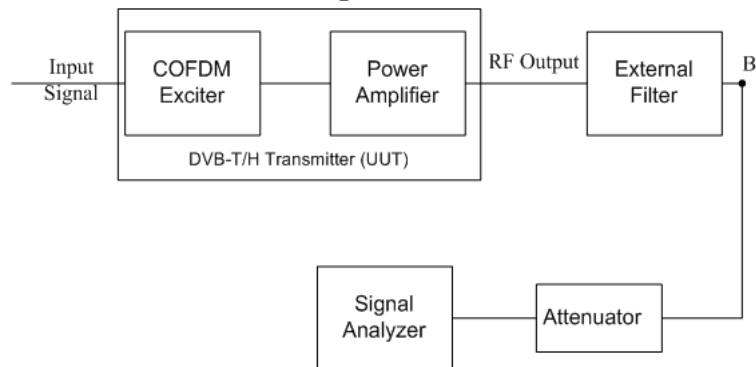
The steps for measuring the spectrum emission mask are as follows:

- 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 4-3](#).
- 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.

- When the transmitter doesn’t have the 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 4-4](#).

Figure 4-4

**Diagram for Spectrum Emission Mask Measurement on a DVB-T/H Transmitter without Output Filter**

The steps for measuring the spectrum emission mask is as follows:

- Measure the frequency response of the external filter using a network analyzer or a combination of signal source and signal analyzer.
- Measure the signal transmitted at point B as shown in [Figure 4-4](#).
- 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 of filter's frequency response value, in dB, at a number of frequency points across the band.



## Modulation Accuracy Measurement Concepts

### Purpose

Measurement of modulation accuracy and quality are necessary to meet DVB-T/H defined tests and ensure proper operation of the transmitters. This measurement takes into account all possible error mechanisms in the entire transmission chain including baseband filtering, I/Q modulation anomalies, filter amplitude and phase non-linearities, and power amplifier distortion. This measurement provides an overall indication of the performance level of the transmitter of the UUT.

### Measurement Method

Modulation Accuracy measurement measures the performance of the transmitter's modulation circuitry.

In a digitally modulated signal, it is possible to predict what the ideal magnitude and phase of the carrier should be at any time, based on the transmitted data sequence. The transmitter's modulated signal is compared to an ideal signal vector. The difference between these two vectors is sampled and processed using DSP.

In the Modulation Accuracy measurement, the following results are provided:

- EVM - peak and rms error vector magnitude
- MER - distance between measured and theoretical constellation points
- Magnitude Error - rms magnitude error
- Phase Error - rms phase error
- Freq Error - the frequency difference between the transmitter's actual center frequency and the frequency (or channel) that you entered
- Quad Error - the orthogonal error between I and Q signals
- Amplitude Imbalance - a form of IQ gain imbalance
- TPS Decoding results-Original bits of TPS and information decoded from TPS
- BER results

The detailed description of the parameters above is as follows:

### EVM

EVM (Error Vector Magnitude) is a modulation quality metric widely used in digital Broadcast systems. It is defined as:

$$EVM = \sqrt{\frac{\frac{1}{N} \sum_{j=1}^N (\delta I_j^2 + \delta Q_j^2)}{S_{max}^2}} \times 100\%$$

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**Modulation Accuracy Measurement Concepts**

Where N is the number of data points in the measurement samples.  $s_{max}$  is the magnitude of the vector to the outermost state of the constellation.

**NOTE**

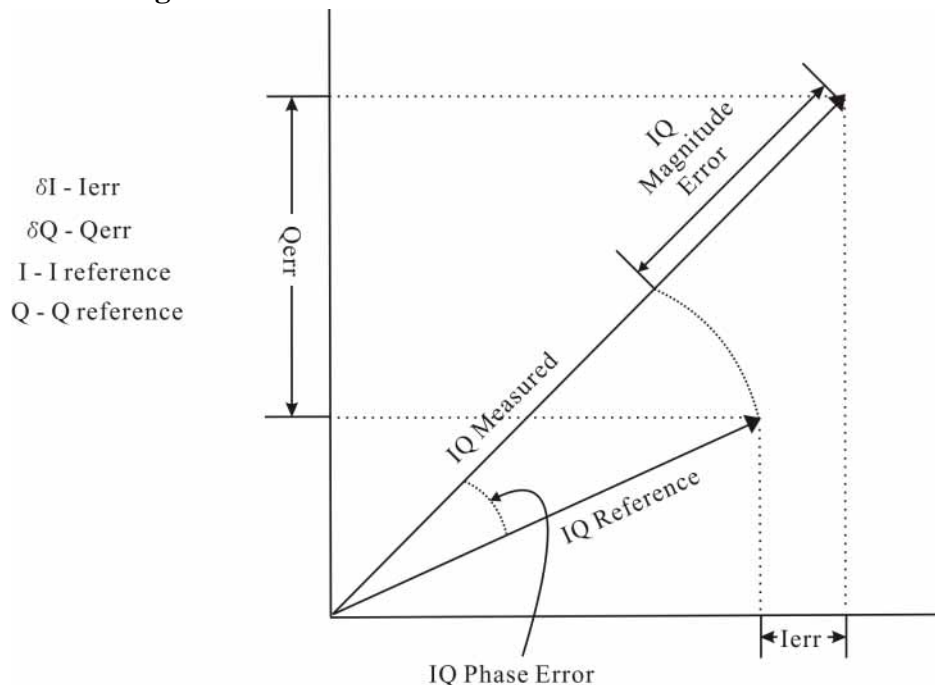
This definition is only used in broadcast industry, and in wireless industry EVM is defined as the ratio of error vector vs. RMS reference vector.

$$EVM = \frac{\sqrt{\frac{1}{N} \sum_{j=1}^N (\delta I_j^2 + \delta Q_j^2)}}{S_{rms}} \times 100\%$$

$s_{rms}$  is calculated in the following way:  $s_{rms} = \sqrt{\frac{1}{N} \sum_{j=1}^N (I_j^2 + Q_j^2)}$

The representation of other definitions are expressed in [Figure 4-5](#).

**Figure 4-5** Digital Demodulation Error



**MER**

MER (Modulation Error Ratio) is a power ratio expressed in dB of the sum of squares of the magnitude of the ideal symbol vectors to the sum of the squares of the magnitudes of the symbol error vectors.

MER results reflect the quality of digital video signals directly. It indicates the signal deterioration even before the BER result turns bad.

The MER is calculated as below:

$$MER = 10 \log_{10} \left[ \frac{\sum_{j=1}^N (I_j^2 + Q_j^2)}{\sum_{j=1}^N (\delta I_j^2 + \delta Q_j^2)} \right] dB$$

N is the number of data points in the measurement samples.

The representations of other definitions are expressed in [Figure 4-5](#).

### Magnitude Error

Magnitude Error is the difference in amplitude between the I/Q measured signal and the I/Q reference signal which is shown in [Figure 4-5](#).

### Phase Error

Phase error is the difference in phase between the I/Q reference signal and the I/Q measured signal for composite signal. Phase Error is shown in [Figure 4-5](#).

### Frequency Error

Frequency Error shows the signal carrier frequency-error relative to analyzer's center frequency. This parameter is displayed in Hz and is the amount of frequency shift, from the analyzer's center frequency, that the analyzer must perform to achieve carrier lock.

Errors in RF frequency, LO frequency, or digitizer clock rate could all appear as carrier frequency error.

### Quad Error

Quad Error (Quadrature Skew Error) indicates the orthogonal error between the I and Q signals.

Ideally, I and Q should be orthogonal (90 degrees apart). A quadrature skew error of 3 degrees means I and Q are 93 degrees apart. A quadrature skew error of -3 degrees means I and Q are 87 degrees apart.

### Amplitude Imbalance

Amplitude Imbalance is another form of IQ Gain imbalance. It is calculated from the formula below:

$$AI = \begin{cases} \left( \frac{v_I}{v_Q} - 1 \right) \times 100\% & \text{if } v_I > v_Q \\ \left( 1 - \frac{v_Q}{v_I} \right) \times 100\% & \text{if } v_Q > v_I \end{cases}$$

Where  $v_I$  and  $v_Q$  represent I and Q gain respectively.

In order to exclude the interference between sub-carriers, AI is calculated by central carrier only. In 4k or 8k mode, central carrier is pilot (BPSK), then AI is not provided.

## SNR

SNR stands for Signal-to-Noise Ratio. It is the power ratio of the measured signal data to the error data between the measured signal data and the reference signal data in dB.

## Carrier Suppression

Carrier suppression searches for systematic deviations of all constellation points of the central carrier and isolate the residual carrier. It is calculated as below:

$$CS = 10\log_{10}\left(\frac{P_{sig}}{P_{RC}}\right) dB$$

Where  $P_{RC}$  is the power of the residual carrier and  $P_{sig}$  is the power of the central carrier of the OFDM signal (without residual carrier).

## TPS power ratio & Data power ratio

TPS power ratio is the power ratio of TPS carriers to the pilots.

Data power ratio is the power ratio of the measured signal data to the pilots.

The pilots are always at amplitude 4/3 (power = 16/9). The TPS carriers are supposed to be at a power of 1 and the expected power for the data is also supposed to be 1.

## BER

BER performance of the signal transmitted is measured in the following three aspects.

1. BER before Viterbi (inner) decoder.
2. BER before RS (Outer) decoder.
3. BER after RS (outer) decoder (Bit error count).

Refer to [3] for more detail about measurement principle and method of BER measurement.

## MER Monitor Process

In Modulation Accuracy measurement, the MER results can be monitored while detailed information and raw data are recorded onto the local hard disk. The actions performed during the MER monitor process are as follows:

- Recording the raw data

If the **Limit Line (Meas Setup, MER Monitor)** is turned on and the current MER result is smaller than the limit, the raw data for current measurement will

be saved to D:\userdata\DVB-TH\rawdata, which can be used by the capture buffer of the X-Series signal analyzers for further research directly.

The recording file name is “dataIndex\_HourMinuteSecond.bin” (Index is the sequence number of the files saved in one monitoring process), such as “data2\_155636.bin”.

The maximum number of files saved is controlled by **Max Raw Data Files Saved (Meas Setup, MER Monitor)**. If the failed measurements exceed this number, raw data will not be saved anymore. A message (File Number exceeds MaxRawDataFileSaved. Raw Data are not saved) will appear after the MER result in the Log file.

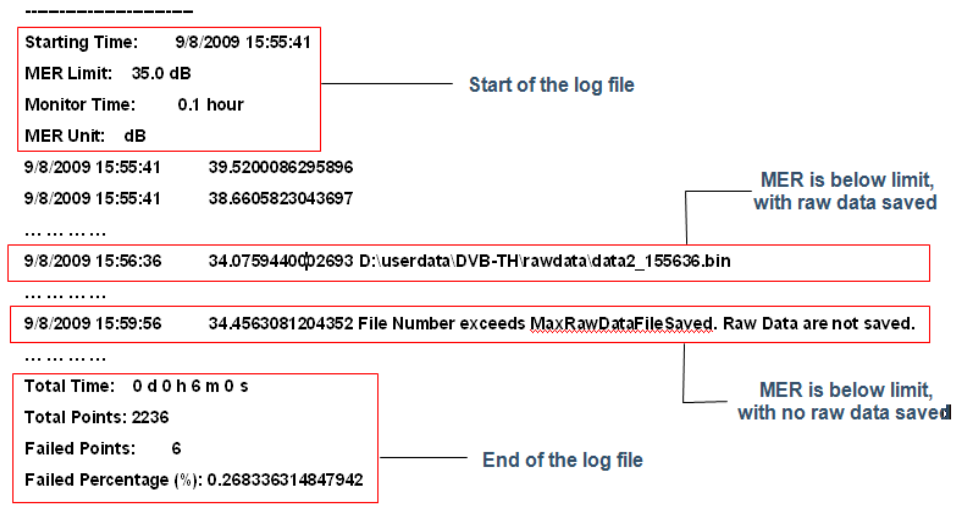
- Log file

Date, time, MER results, and raw data file path (if MER is below the limit) will be saved as a log file named MER\_log\_DVB\_TH.txt in D:\userdata\DVB-TH.

The format of this file is shown below.

Figure 4-6

**Format of the Log File**



**Peak Criteria**

How can a signal be considered as a peak? This section describes the criteria for peak, which involves mainly two parameters: Peak Excursion and Peak Threshold.

Peak (Pk) Excursion: This value determines the minimum amplitude variation (rise and fall) required for a signal to be identified as a peak.

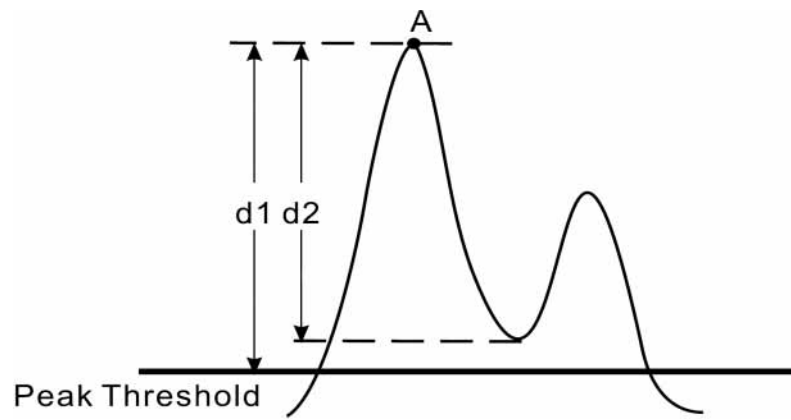
Peak (Pk) Threshold: This value defines the minimum signal level that the peak identification algorithm uses to recognize a peak.

If both Pk excursion and Pk Threshold are on, a signal must rise above the Pk threshold value by at least the Peak Excursion value and then fall back from its local maximum by at least Peak Excursion value to be considered as a peak. As shown in Figure 4-7, only when both d1 and d2 are more than or equal to the value

of peak excursion, point A can be identified as a peak.

Figure 4-7

Peak Criteria



## Monitor Spectrum Measurement Concepts

### Purpose

The monitor spectrum measurement provides spectrum analysis capability for the instrument. It is used as a quick, convenient means of looking at the entire spectrum. While the look and feel are 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. The default span should cover an appropriate frequency range of the application.

### Measurement Method

The measurement takes the sweep and acquires the data between the start frequency and stop frequency, then trace is displayed in the measurement window.

### Troubleshooting Hints

Changes made by the user to advanced spectrum settings, particularly to ADC range settings, can inadvertently result in spectrum measurements that are invalid and cause error messages to appear. Care needs to be taken when using advanced features.

## **IQ Waveform Measurement Concepts**

### **Purpose**

The waveform measurement is a generic measurement for viewing the input signal waveforms in the time domain. This measurement is how the instrument performs the zero span functionality found in traditional spectrum analyzers.

Basic mode waveform measurement data may be displayed using either a Signal Envelope window, or an I/Q window which shows the I and Q signal waveforms in parameters of voltage versus time. The advantage of having an I/Q view available while making a waveform measurement is that it allows you to view complex components of the same signal without changing settings or measurements.

The waveform measurement can be used to perform general purpose power measurements in the time domain with excellent accuracy.

### **Measurement Method**

The instrument makes repeated power measurements at a set frequency, similar to the way a swept-tuned spectrum analyzer makes zero span measurements. The input analog signal is converted to a digital signal, which then is processed into a representation of a waveform measurement. The measurement relies on a high rate of sampling to create an accurate representation of a time domain signal.



## Baseband I/Q Inputs (Option BBA) Measurement Concepts

The N9020A Option BBA Baseband I/Q Inputs provides the ability to analyze baseband I/Q signal characteristics of mobile and base station transmitters. This option may be used only in conjunction with the following modes:

- IQ Analyzer (Basic)
- 802.16 OFDMA (WiMAX/WiBro)
- cdma2000
- GSM/EDGE
- TD-SCDMA
- DTMB (CTTB)
- DVB-T/H
- CMMB
- ISDB-T

### What are Baseband I/Q Inputs?

Option BBA consists of a Baseband Input module, four input connectors, and a calibration output connector. The connectors are at the left side of the front panel. The two ports labeled “I” and “Q” are the “unbalanced” inputs.

An unbalanced or “single-ended” baseband measurement of an I or Q signal is made using a probe connected to the I or Q connector. A simultaneous I/Q unbalanced single-ended measurement may be made using two probes connected to the I and Q input connectors.

If “balanced” signals are available, they may be used to make a more accurate measurement. Balanced signals are signals present in two separate conductors, are symmetrical about ground, and are opposite in polarity, or out of phase by 180 degrees.

Measurements using balanced signals can have a higher signal to noise ratio resulting in improved accuracy. Noise coupled into each conductor equally in a “common mode” to both signals may be separated from the signal. The measure of this separation is “common-mode rejection”.

To make a balanced measurement, the two connectors labeled “I” and “Q” are used in conjunction with the I and Q inputs. The terms “I-bar” and “Q-bar” may be applied to the signals, as well as the inputs themselves. Probes (customer provided) must be used to input balanced baseband I/Q signals. This may be referred to as a balanced measurement.

Balanced baseband measurements are made using the I and connectors for I only

signal measurements, while the Q and connectors are used for a Q only signal measurement. Balanced measurements of I/Q require differential probe connections to all four input connectors. For details of probe selection and use, refer to “[Selecting Input Probes for Baseband Measurements](#)” on page 99.

## What are Baseband I/Q Signals?

In transmitters, the term baseband I/Q refers to signals that are the fundamental products of individual I/Q modulators, before the I and Q component signals are combined, and before upconversion to IF or RF frequencies.

In receivers, baseband I/Q analysis may be used to test the I and Q products of I/Q demodulators, after a RF signal has been downconverted and demodulated.

## Why Make Measurements at Baseband?

Baseband I/Q measurements are a valuable means of making qualitative analyses of the following operating characteristics:

- I/Q signal layer access for performing format-specific demodulation measurements (for example, DTMB (CTTB), DVB-T/H, W-CDMA).
- Modulation accuracy – that is, I/Q plane metrics:
  - error vector magnitude; rms, peak
  - frequency error
  - magnitude and phase errors
- CCDF of  $I^2 + Q^2$
- Basic analysis of I and Q signals in isolation including: DC content, rms and peak to peak levels, CCDF of each channel

Comparisons of measurements made at baseband and RF frequencies produced by the same device are especially revealing. Once signal integrity is verified at baseband, impairments can be traced to specific stages of upconversion, amplification, or filtering by RF analysis. In addition, impairments to signal quality that are apparent at RF frequencies may be traceable to baseband using baseband analysis.

## Selecting Input Probes for Baseband Measurements

The selection of baseband measurement probe(s) and measurement method is primarily dependent on the location of the measurement point in the circuit. The probe must sample voltages without imposing an inappropriate load on the circuit.

The system supports a variety of 1 M $\Omega$  impedance input passive probes as well as the Agilent 1153A active differential probe using the InfiniMax probe interface.

The Agilent 1153A active probe can be used for both single-ended and differential measurements. In either case a single connection is made for each channel (on either the I or Q input). The input is automatically configured to 50  $\Omega$  single-ended type measurement and the probe power is supplied through the InfiniMax interface. The probe can be configured for a variety of input coupling and low frequency rejection modes. In addition, a wide range of offset voltages and probe attenuation accessories are supported at the probe interface. The active probe has the advantage that it does not significantly load the circuit under test, even with unity gain probing.

With passive 1 M $\Omega$  probes, the probe will introduce a capacitive load on the circuit, unless a higher attenuation is used at the probe interface. Higher attenuation helps isolate the probe, however, it reduces the signal level and degrades the signal-to-noise-ratio of the measurement. Passive probes are available with a variety of attenuation values for a moderate cost. Many Agilent passive probes can be automatically identified by the system, setting the input impedance required as well as the nominal attenuation. For single-ended measurements a single probe is used for each channel. Other passive probes can be used, after manually setting the attenuation and probe impedance configurations.

For full differential measurements, the system supports probes on each of the four inputs. The attenuation for each of the probes should be the same for good common mode rejection and channel match.

### Supported Probes

The following table lists the probes currently supported by Option BBA:

Probe Type	Model Number	Description
Active	1130A	1.5 GHz differential probe amp (No probe head)
	1131A <sup>a</sup>	InfiniMax 3.5 GHz probe
	1132A <sup>a</sup>	InfiniMax 5 GHz probe
	1133A <sup>a</sup>	InfiniMax 7 GHz probe
Passive	1161A	Miniature passive probe, 10:1, 10 M $\Omega$ , 1.5 m

- a. Probe heads are necessary to attach to your device properly. Probe connectivity kits such as the E2668A, E2669A or E2675A are needed. For more details, refer to the Agilent probe configuration guide, 5968-7141EN and 5989-6162EN.

### Probes without Stored Calibration

The following 115xA active probes may be used with the MXA's baseband IQ inputs and may use the same probe calibration utility software. However, the probe calibration data is not stored in the MXA and will be lost if power is cycled. Use of the E2655B de-skew and calibration kit, including the calibration fixture, is required because of the different physical configuration of the probes. (The physical connections are different mechanically, not electrically.)

Probe Type	Model Number	Description
Active	1153A	200MHz differential probe
	1156A	Active probe, 1.5 GHz
	1157A	Active probe, 2.5 GHz
	1158A	Active probe, 4 GHz

Refer to the current Agilent probe data sheet for specific information regarding frequency of operation and power supply requirements.

### Baseband I/Q Measurement Views

Measurement result views made in the IQ Analyzer (Basic) mode are available for baseband signals if they relate to the nature of the signal itself. Many measurements which relate to the characteristics that baseband I and Q signals have when mixed and upconverted to signals in the RF spectrum can be made as well. However, measurements which relate to the characteristics of an upconverted signal that lie beyond the bandwidth available to the Baseband I/Q Input circuits can not be measured (the limits are dependent on the installed options: Standard – 10 Hz to 20 MHz, Option B25 – 10 Hz to 50 MHz, and Option S40 – 10 Hz to 80 MHz).

At RF frequencies, power measurements are conventionally displayed on a logarithmic vertical scale in dBm units, whereas measurements of baseband signals using Baseband I/Q inputs may be conveniently displayed as voltage using a linear vertical scale as well as a log scale.

### Spectrum Views and 0 Hz Center Frequency

To view the Spectrum display of I only or Q only signals, use the Complex Spectrum measurement capability in IQ Analyzer (Basic) Mode.

I only and Q only Spectrum views are conventional, displayed with 0 Hz at the left side of the horizontal axis. When upconverted or multiplied, an I only or Q only signal could ultimately lie above or below the carrier center frequency, but in

either case it will only occupy half the bandwidth.

### **Waveform Signal Envelope Views of I only or Q only**

To view the Signal Envelope display of I only or Q only signals, use the Waveform measurement capability in IQ Analyzer (Basic) Mode.

The I and Q Waveform of an I/Q signal is very different from the complex signal displayed in the RF Envelope view. That is because the RF Envelope is a product of both the I and Q modulation waveforms.

However, an I and Q Waveform measurement of an I only or Q only signal is exactly the same signal displayed in the RF Envelope view. That is because an I only or Q only waveform determines the I only or Q only signal envelope. Thus, the RF Envelope view can be used to measure an I only or Q only waveform directly.

## Other Sources of Measurement Information

Additional measurement application information is available through your local Agilent Technologies sales and service office. The following application notes treat digital communications measurements in much greater detail than discussed in this measurement guide.

- Application Note 1298  
Digital Modulation in Communications Systems - An Introduction  
Agilent part number 5965-7160E
- Application Note  
Characterizing Digitally Modulated Signals with CCDF Curves  
Agilent part number 5968-5858E
- Application Note  
BER and Subjective Evaluation for DVB-T/H Receiver Test  
Agilent part number 5989-8446E

Go to [http://www.agilent.com/find/digital\\_video](http://www.agilent.com/find/digital_video) to find more products and literatures on digital video transmitter and receiver measurements.

## Instrument Updates at [www.agilent.com](http://www.agilent.com)

These web locations can be used to access the latest information about the instrument, including the latest firmware version.

<http://www.agilent.com/find/cxa>

<http://www.agilent.com/find/exa>

<http://www.agilent.com/find/mxa>

<http://www.agilent.com/find/pxa>

## References

- [1] ETSI EN 302 304: Digital Video Broadcasting (DVB); Transmission System for Handheld Terminals (DVB-H)
- [2] ETSI EN 300 744: Digital Video Broadcasting (DVB); Frame structure, channel coding and modulation for digital terrestrial television
- [3] ETSI TR 101 290: Digital Video Broadcasting (DVB); Measurement guidelines for DVB systems
- [4] ETSI EN 302 296: Electromagnetic compatibility and Radio spectrum Matters (ERM); Transmitting equipment for the digital television broadcast service, Terrestrial (DVB-T); Harmonized EN under article 3.2 of the R&TTE Directive

Concepts  
References