

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

**N6156A & W6156A
DTMB (CTTB)**

**Measurement Application
Measurement Guide**



Agilent Technologies

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About the DTMB (CTTB) Measurement Application

This chapter provides the overall information on the N6156A DTMB (CTTB) measurement application, and describes DTMB (CTTB) measurements made by the analyzer.

DTMB (Digital terrestrial/television multimedia broadcasting), also known as CTTB (China Terrestrial Television Broadcasting), is the Chinese National Terrestrial Digital TV Broadcasting Standard which is announced on August 18,2006 and implemented from August 1,2007.

What Does the DTMB (CTTB) Application Do?

The DTMB (CTTB) application allows the analyzer to be used for testing a DTMB (CTTB) transmitter/exciter. This application is manufactured according to the following standard documents:

- GB 20600-2006 Framing Structure, Channel Coding and Modulation for Digital Television Terrestrial Broadcasting System
- GY/T 229.4-2008 Technical specifications and methods of measurement for digital terrestrial television broadcasting transmitters
- GY/T 229.2-2008 Technical Specifications and methods of measurement for digital terrestrial television broadcasting exciter

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 DTMB (CTTB) transmitter/exciter's performance. You may alter the measurement parameters for specialized analysis. For infrastructure test, the analyzer will test transmitters/exciter in a non-interfering manner using a coupler or power splitter.

This analyzer makes the following measurements of DTMB (CTTB) signals:

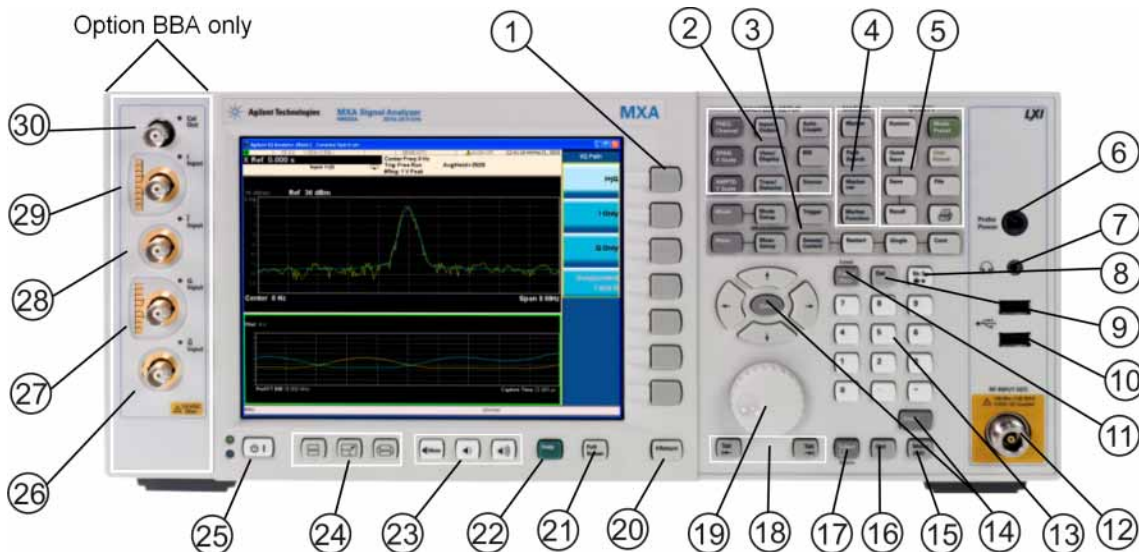
- Channel Power
- Adjacent Channel Power (ACP)
- Power Stat CCDF
- Spectrum Emission Mask
- Modulation Accuracy
- Monitor Spectrum
- IQ Waveform (Time Domain)

If the option BBA is installed, the ability to analyzer 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 10
- “Display Annotations” on page 17
- “Rear-Panel Features” on page 19
- “Front and Rear Panel Symbols” on page 22

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"> • instrument configuration information and I/O setup, • printer setup and printing, • file management, save and recall, • instrument presets.
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"> returns instrument control from remote back to local (the front panel). turns the display on (if it was turned off for remote operation). can be used to clear errors. (Press the key once to return to local control, and a second time to clear error message line.) <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"> exits Windows dialogs clears errors aborts printing cancels operations.
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"> Increment and decrement the value of the current measurement selection. Navigate help topics. Navigate, or make selections, within Windows dialogs. Navigate within forms used for setting up measurements. Navigate within tables. <p>NOTE 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;">NOTE</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. ^a
27	Q Input	Input port for the Q channel for either single or differential mode. ^a
28	I Input	Input port for the I channel when in differential mode. ^a
29	I Input	Input port for the I channel for either single or differential mode. ^a
30	Cal Out	Output port for calibrating the I, I, Q and Q inputs and probes used with these inputs. ^a

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.

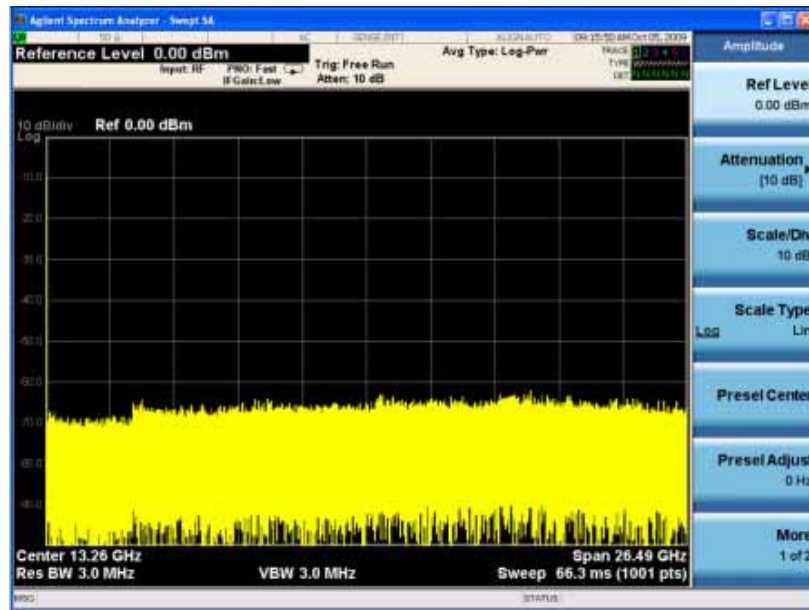


Most of the dark or light gray keys access menus of functions that are displayed along the right side of the display. These displayed key labels are next to a column of keys called menu keys.

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.

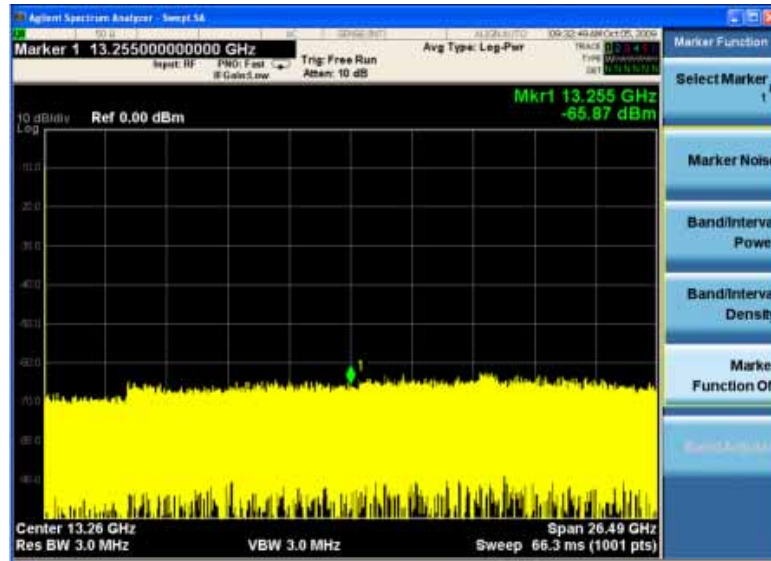


Some menu keys have multiple choices on their label, such as **On/Off**, **Auto/Man**, or **Log/Lin** (as shown above). The different choices are selected by pressing the key multiple times. For example, the Auto/Man type of key. To select the function, press the menu key and notice that Auto is underlined 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

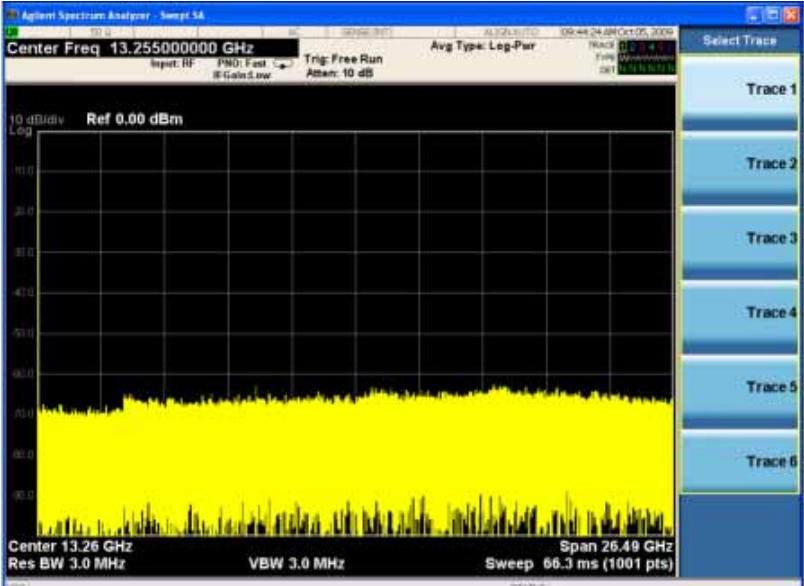
When a menu first appears, one key label is highlighted to show which key is the default selection. If you press **Marker Function**, the **Marker Function Off** key is the menu default key, and is highlighted.



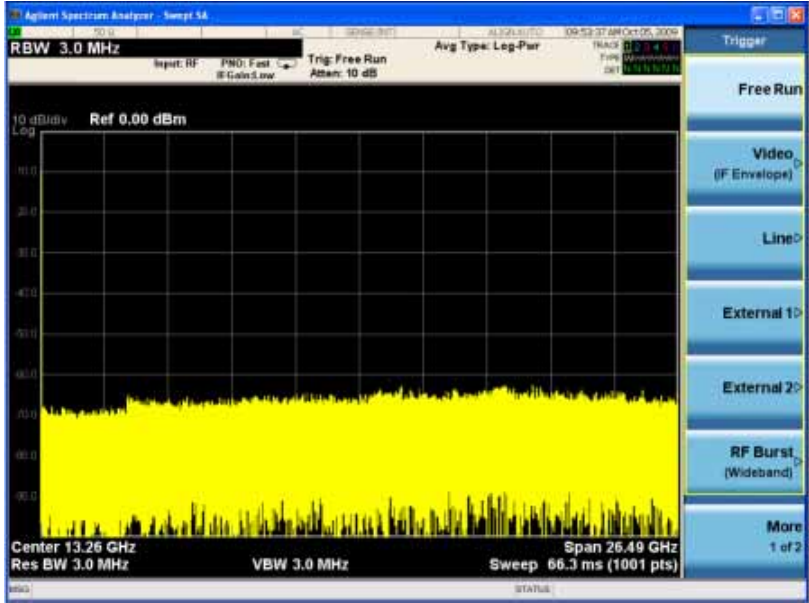
Some of the menu keys are grouped together by a yellow bar running behind the keys near the left side or by a yellow border around the group of keys. When you press a key within the yellow region, such as **Marker Noise**, the highlight moves to that key to show it has been selected. The keys that are 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.

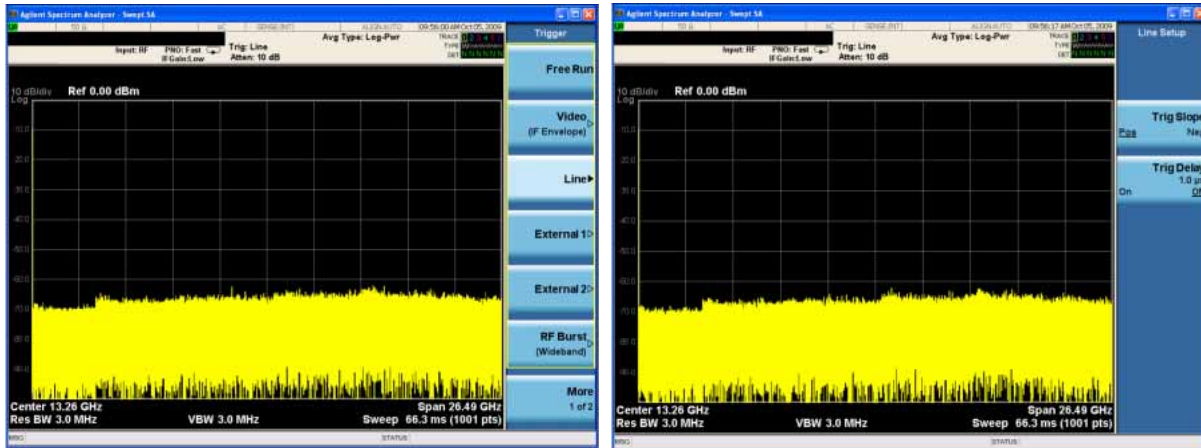


If a displayed key label shows a small solid-black arrow tip pointing to the right, it indicates that additional key menus are available. If the arrow tip is not filled in solid then pressing the key the first time selects that function. Now the arrow is solid and pressing it again brings up an additional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



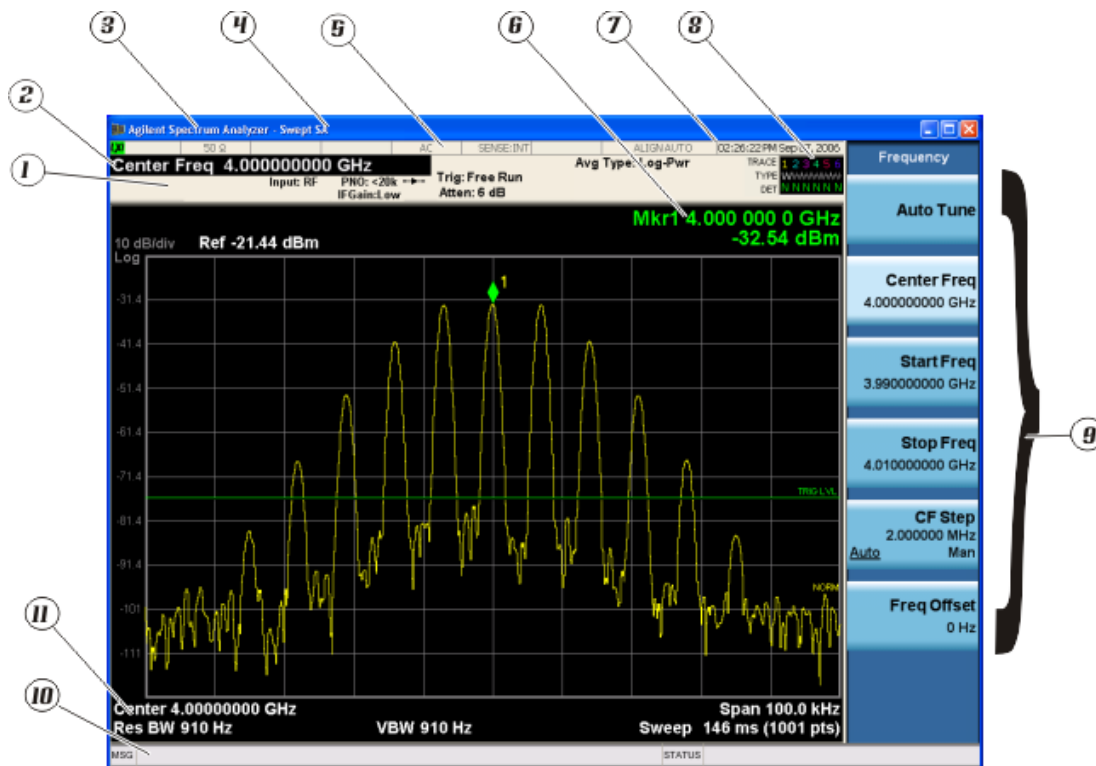
Front and Rear Panel Features



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	<p>Measurement bar - Shows general measurement settings and information.</p> <p>  Indicates single/continuous measurement.</p> <p>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.</p>	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.	Mode, Meas

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.	Meas View/Display, Display, Title
5	Settings panel - displays system information that is not specific to any one application. <ul style="list-style-type: none"> • Input/Output status - green LXI indicates the LAN is connected. RLTS indicate Remote, Listen, Talk, SRQ • Input impedance and coupling • Selection of external frequency reference • Setting of automatic internal alignment routine 	Local and System, I/O Config Input/Output, Amplitude, System and others.
6	Active marker frequency, amplitude or function value.	Marker
7	Settings panel - time and date display.	System, Control Panel
8	Trace and detector information.	Trace/Detector, Clear Write (W) Trace Average (A) Max Hold (M) Min Hold (m) Trace/Detector, More, Detector, Average (A) Normal (N) Peak (P) Sample (S) Negative Peak (p)
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

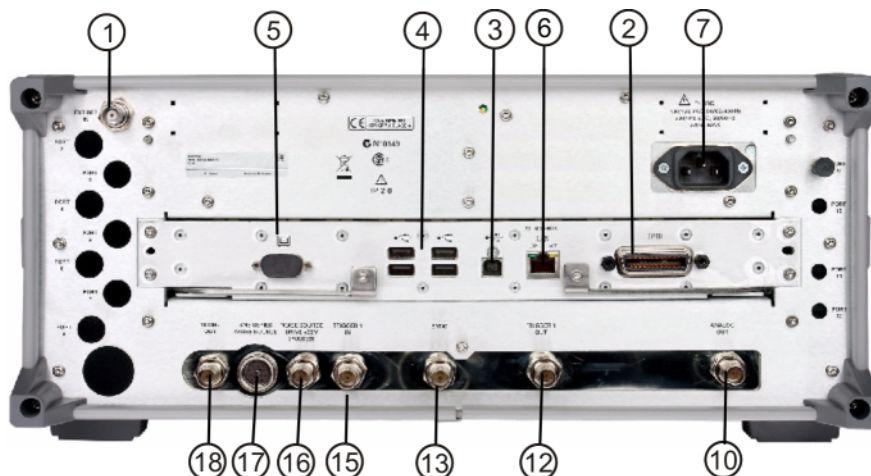


EXA



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.



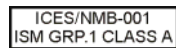
The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to instructions in the documentation.



The CE mark is a registered trademark of the European Community.



The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.



This is a marking of a product in compliance with the Canadian Interference-Causing Equipment Standard (ICES-001).

This is also a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 4).



The CSA mark is a registered trademark of the CSA International.



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

- “Channel Power Measurements” on page 27
- “ACP Measurements” on page 33
- “Power Statistics CCDF Measurements” on page 37
- “Spectrum Emission Mask Measurements” on page 41
- “Modulation Accuracy Measurements” on page 47
- “Monitor Spectrum Measurements” on page 54
- “IQ Waveform (Time Domain) Measurements” on page 56

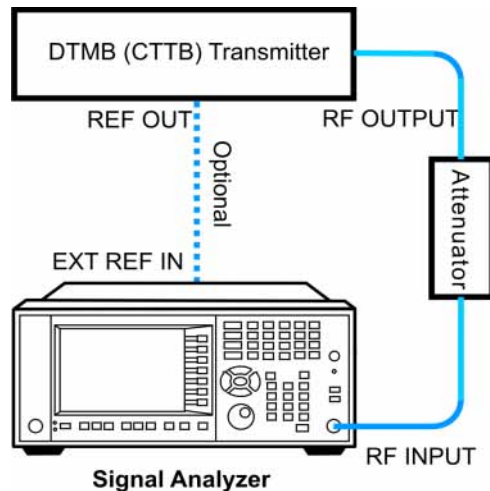
Setting Up and Making a Measurement

Making the Initial Signal Connection and Configuring the Measurement System

- Step 1.** Set the DTMB (CTTB) transmitter under test to transmit the RF power. This transmitting signal is connected to the RF input port of the instrument. Connect the equipment as shown.

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

Figure 3-1 DTMB (CTTB) Measurement System



1. Connect the output signal from the DTMB (CTTB) 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 DTMB (CTTB) transmitter, connect it to the EXT REF IN port of the analyzer with a cable for frequency synchronization.

- Step 2.** Set up the input port using keys under **Input/Output** menu. You can use the default settings for most cases.

NOTE The parameters under **Input/Output** menu can't be reset by pressing **Mode Preset**. Then if you've made any changes to the Input/output parameters which aren't required in another measurement, remember to restore those settings manually.

Setting up the DTMB (CTTB) Transmitter (Example)

Set up the DTMB (CTTB) transmitter to transmit the RF power as follows:

Frequency: 666 MHz (Channel Num: 32, Channel Table: PAL-D/K DS)
Bandwidth: 8 MHz
Frame Header Type: PN420
Modulation Type: 4 QAM
Subcarrier number: 3780
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 by returning the mode setup and all of the measurement setups in the 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 27](#)
- [“ACP Measurements” on page 33](#)
- [“Power Statistics CCDF Measurements” on page 37](#)
- [“Spectrum Emission Mask Measurements” on page 41](#)
- [“Modulation Accuracy Measurements” on page 47](#)
- [“Monitor Spectrum Measurements” on page 54](#)
- [“IQ Waveform \(Time Domain\) Measurements” on page 56](#)

NOTE



Press the  key on the front panel to enter the help system and see 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
1. Select and Set Up the Mode	a. Press Mode . b. Press a mode key, like Spectrum Analyzer , or DTMB (CTTB) . c. Press Mode Preset . d. Press Mode Setup .	All licensed, installed modes are shown under the Mode key. Using Mode Setup , make any required adjustments to the mode settings. These settings apply to all measurements in the mode.
2. Select and Set Up the Measurement	a. Press Meas . b. Select the specific measurement to be performed. c. Press Meas Setup .	The resulting data is shown on the display or is available for export. Use Meas Setup to make any required adjustment to the selected measurement settings. The settings only apply to this measurement.
3. Select and Set Up a View of the Results	Press View/Display . Set display format and select a view for the current measurement data.	Depending on the mode and measurement selected, the graphical and tabular data presentations are available. Use Span X Scale and AMPTD Y Scale to adjust the display of the measurement graphics.

NOTE You can change the 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.	Mode	Mode Setup, FREQ Channel	System
2. Select and set up a measurement.	Meas	Meas Setup	BW, Sweep/Control, Input/Output, Restart, Single, Cont
3. Select and set up a view of the results.	View/Display	SPAN X Scale, AMPTD Y Scale	Peak Search, Quick Save, Save, Recall, File, Print

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 DTMB (CTTB) transmitter. Channel Power measurement measures the total RF power, shoulder attenuation present in the channel, and provides a view that compares the input signal against the DTMB (CTTB) defined spectrum mask when there is an analog TV signal in an adjacent channel.

The Channel Power measurement procedure includes four parts:

- a. “[Selecting and Setting up the DTMB \(CTTB\) Mode](#)” on page 27
- b. “[Setting up the Input Ports](#)” on page 28
- c. “[Selecting and Setting up Channel Power Measurement](#)” on page 28
- d. “[Selecting and Viewing the Measurement Results](#)” on page 28

Selecting and Setting up the DTMB (CTTB) Mode

Step 1. Select DTMB (CTTB) mode.

Press **Mode, DTMB (CTTB)**.

Step 2. Preset the analyzer.

Press **Mode Preset**.

Step 3. Set the Device Type to Transmitter.

Press **Mode Setup, Device Type, Transmitter**.

Step 4. Set the center frequency. There are two methods:

- Enter the center frequency directly.
Press **FREQ Channel, Center Freq, 666, 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-D/K, PAL-D/K DS**.
 - b. Set the channel number.
Press **FREQ Channel, Channel, 32**.

Step 5. Set the channel bandwidth.

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

Setting up the Input Ports

NOTE If you are going to see the Spectrum Mask view result in Channel Power measurement, set up the Input 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 one of the following methods.

- Onscreen editor. Press **Edit**.
- SCPI
- 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 saved 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.

For the reasons of using amplitude correction and the definition of correction data, refer to [“Using Amplitude Correction in Spectrum Emission Mask Measurement” on page 75](#).

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 DTMB (CTTB) standards, so you can use the default settings for most cases.

Press **Meas Setup**.

Selecting and Viewing the Measurement Results

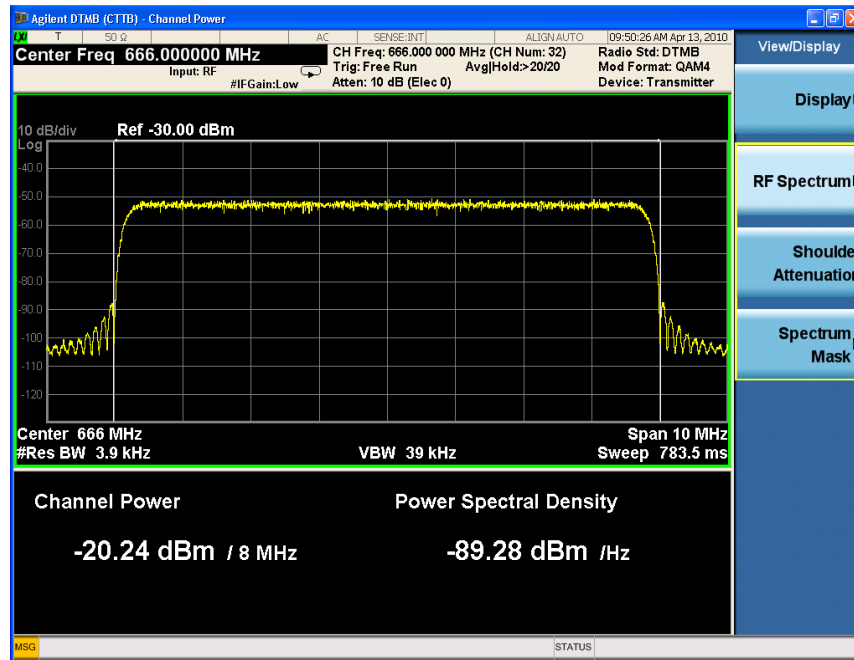
Three views are available in the Channel Power measurement. Press **View/Display, the name of the view** to display them.

- **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 8 MHz.

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

Figure 3-2 Channel Power Measurement Result - RF Spectrum View



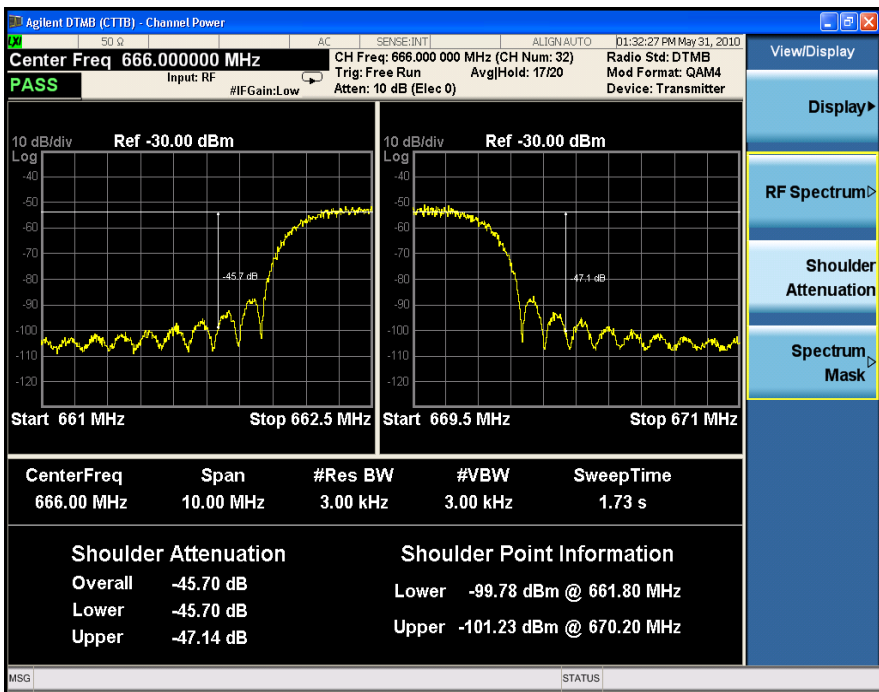
- **Shoulder Attenuation** displays the shoulder attenuation defined in the specs. The shoulder attenuation measurement should look like [Figure 3-3](#). The text window shows the value of shoulder attenuation and shoulder point information.

For the measurement method of shoulder attenuation, refer to “[Shoulder Attenuation](#)” on page 68.

NOTE To make the measurement on a specified shoulder offset, press **Meas Setup** and set the value for **Shoulder Offset**.

Figure 3-3

Channel Power Measurement Result - Shoulder Attenuation View



- **Spectrum Mask** displays the channel power spectrum with the DTMB (CTTB) defined spectrum mask overlay. This view is used to see whether the transmitting signal complies with the spectrum mask specified in the specs when there is an analog TV signal in an adjacent channel. For the spectrum mask used in this view, refer to “[Spectrum Mask](#)” on page 68.

NOTE

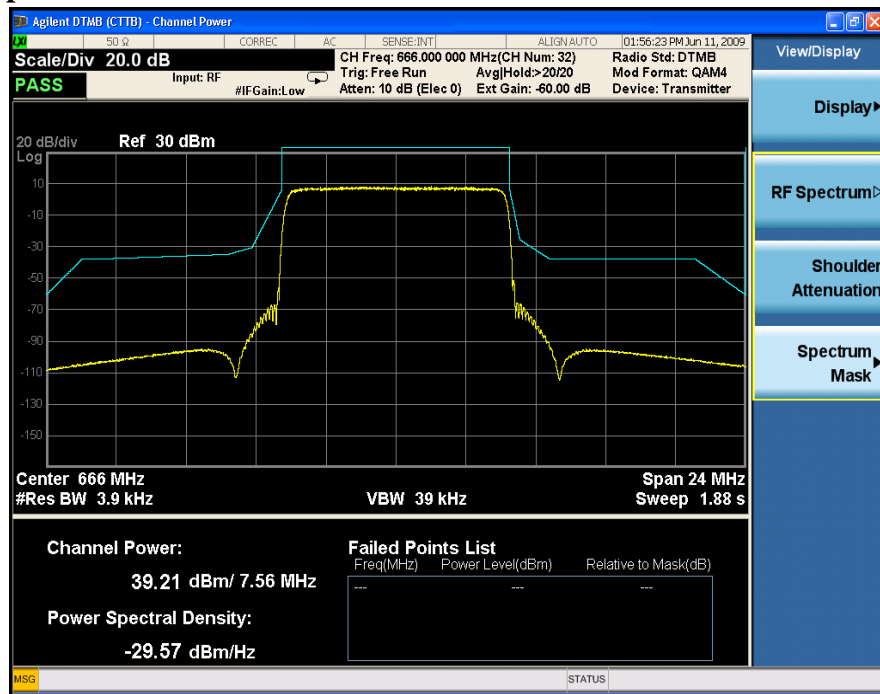
You should perform the steps in “[Setting up the Input Ports](#)” on page 28 before viewing the Spectrum Mask results. If you don’t set up the input ports, the spectrum mask measurement will fail and can’t reflect your real input signal.

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.

If the device type is Exciter or the bandwidth is 6 MHz, the mask trace will not be displayed and a “No Result” message will be displayed.

Figure 3-4

Channel Power Measurement Result - Spectrum Mask View after Amplitude Correction



Making DTMB (CTTB) Measurements
Channel Power Measurements

ACP Measurements

This section explains how to make Adjacent Channel Leakage Power Ratio (ACLR or ACPR) measurements on a DTMB (CTTB) transmitter. ACPR is a measurement of the amount of interference, or power, in an adjacent frequency channel. 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 DTMB \(CTTB\) Mode](#)” on page 33
- b. “[Selecting and Setting up ACP Measurement](#)” on page 33
- c. “[Viewing ACP Measurement Results](#)” on page 34

Selecting and Setting up the DTMB (CTTB) Mode

Step 1. Select DTMB (CTTB) mode.

Press **Mode, DTMB (CTTB)**.

Step 2. Preset the analyzer.

Press **Mode Preset**.

Step 3. Set the Device Type to Transmitter.

Press **Mode Setup, Device Type, Transmitter**.

Step 4. Set the center frequency. There are two methods:

- Enter the center frequency directly.
Press **FREQ Channel, Center Freq, 666, 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-D/K, PAL-D/K DS**.
 - b. Set the channel number.
Press **FREQ Channel, Channel, 32**.

Step 5. Set the channel bandwidth.

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

Selecting and Setting up ACP Measurement

Step 1. Initiate the adjacent channel power measurement.

Press **Meas, ACP**.

Making DTMB (CTTB) 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 DTMB (CTTB) standards, so you can use the default settings for most cases.

Press **Meas Setup**.

TIP To achieve 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 graphic window shows the bar graph with the spectrum trace overlay. The text window shows the absolute total power reference, while the power inside the adjacent channel and outside the adjacent channel are displayed in both absolute and relative readings.

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


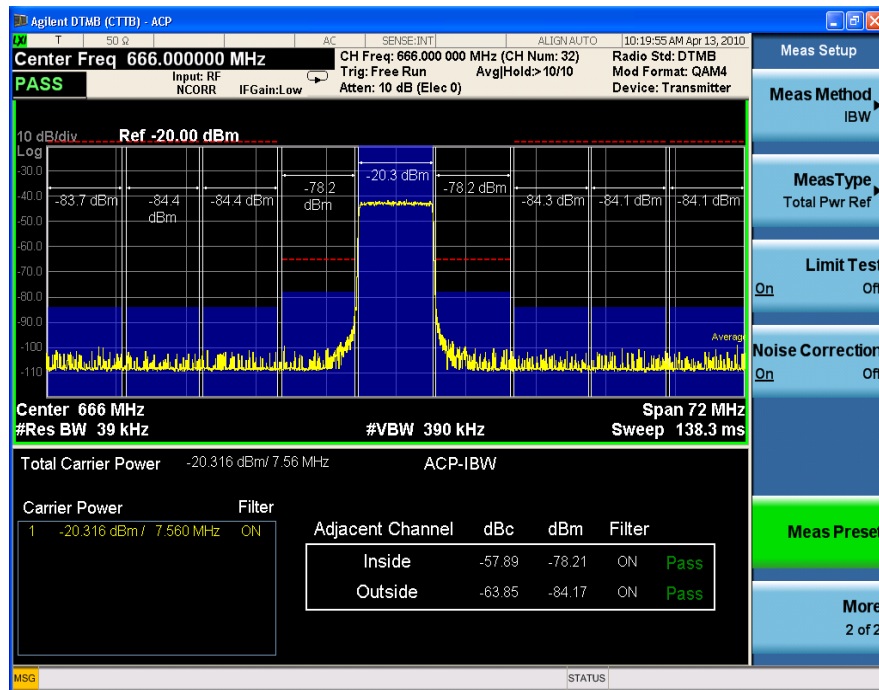
NOTE You can zoom on either the graphic window or the text window by pressing the Window Control keys  at the left bottom of the frontpanel.

Figure 3-5

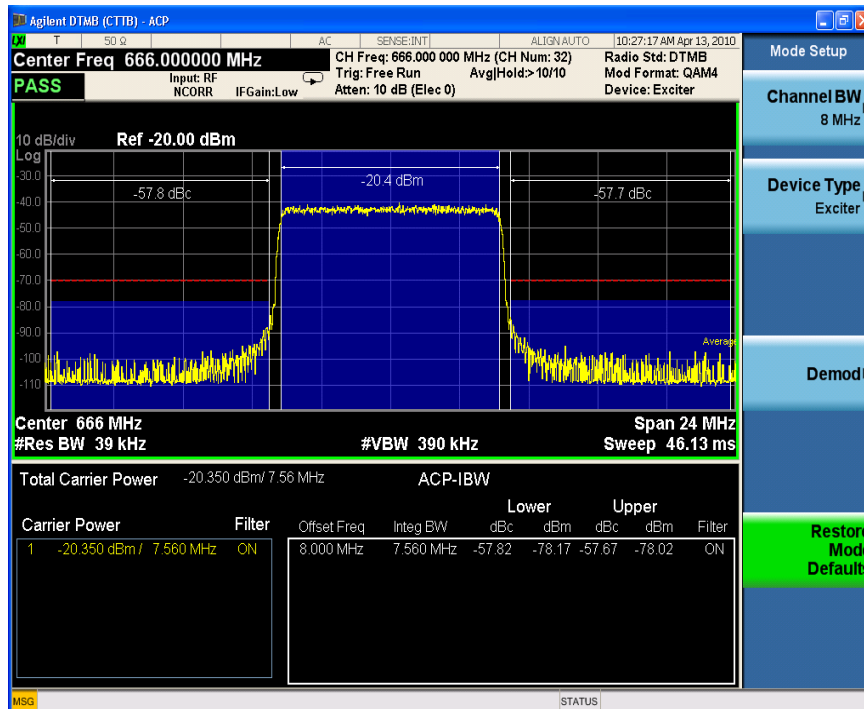
ACP Measurement Result - Noise Correction On



If the device under test is Exciter, the display of the ACP measurement results is different, as shown in [Figure 3-6](#). 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.

Figure 3-6

ACP Measurement Result for Exciter



NOTE

The measurement method and PASS/FAIL limit is described in Table 4-3. If the measurement bandwidth is 6 MHz, there is no default measurement method and PASS/FAIL limit. You can define it manually through **Meas Setup, Offset/Limits**.

Making DTMB (CTTB) Measurements
ACP Measurements

Power Statistics CCDF Measurements

This section explains how to make Power Statistics Complementary Cumulative Distribution Function (Power Stat CCDF) measurements on a DTMB (CTTB) transmitter. Power Stat CCDF curves 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 DTMB \(CTTB\) 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 DTMB (CTTB) Mode

Step 1. Select DTMB (CTTB) mode.

Press **Mode, DTMB (CTTB)**.

Step 2. Preset the analyzer.

Press **Mode Preset**.

Step 3. Set the Device Type to Transmitter.

Press **Mode Setup, Device Type, Transmitter**.

Step 4. Set the center frequency. There are two methods:

- Enter the center frequency directly.
Press **FREQ Channel, Center Freq, 666, 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-D/K, PAL-D/K DS**.
 - b. Set the channel number.
Press **FREQ Channel, Channel, 32**.

Step 5. Set the channel bandwidth.

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

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 57](#).

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.
-

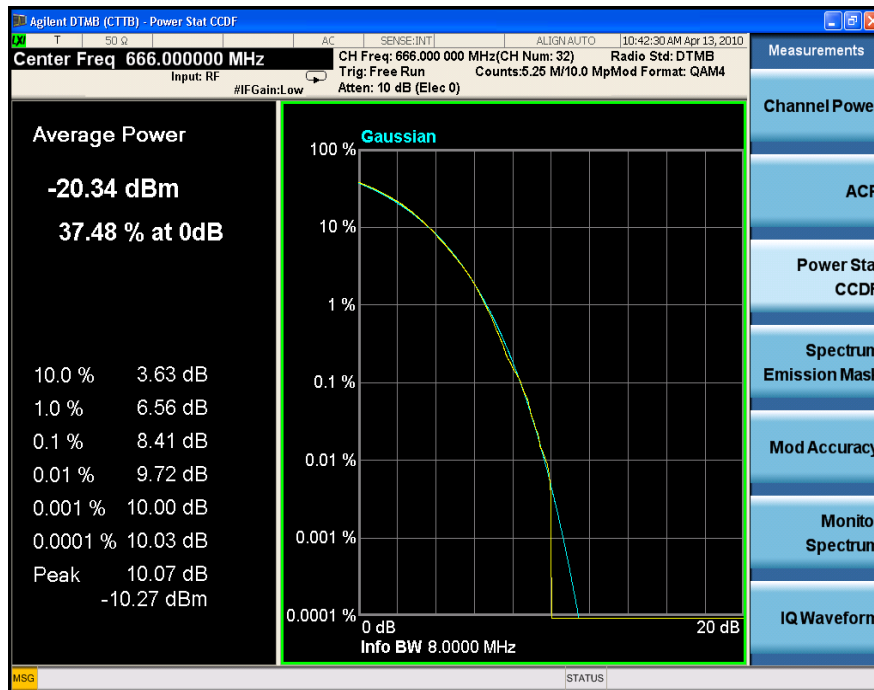
Viewing the Measurement Results

The Power Stat CCDF measurement result should look like [Figure 3-7](#).

- 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 3-8](#).

Figure 3-7

Power Statistics CCDF Measurement Result

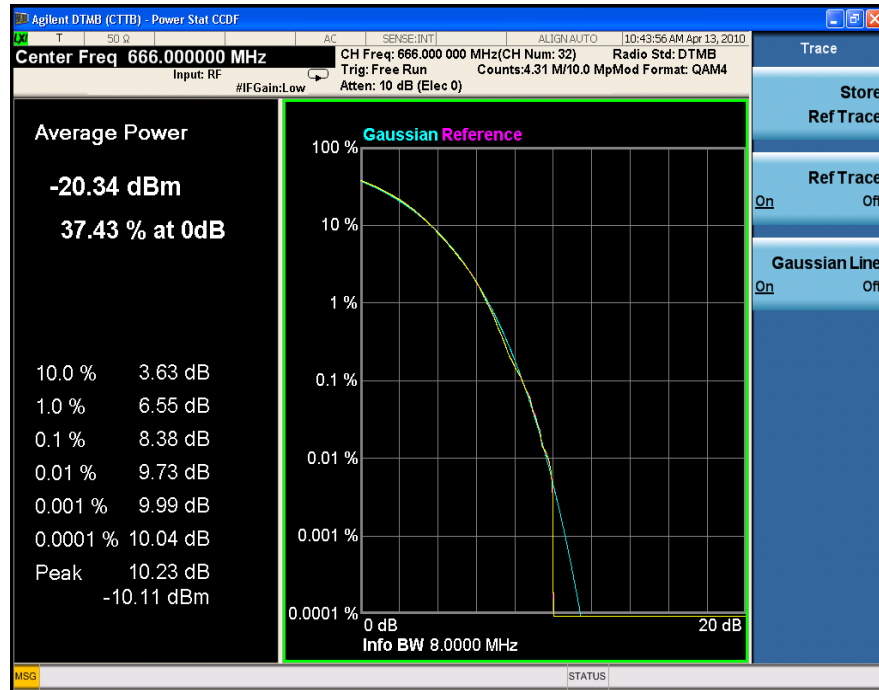


The blue line is the Gaussian trace and the yellow line is the measurement result. The Info BW is the channel bandwidth that will be used for data acquisition. The

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

Figure 3-8

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 measurement can contribute in setting 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.

Spectrum Emission Mask Measurements

This section describes how to make Spectrum Emission Mask (SEM) measurements on a DTMB (CTTB) transmitter. SEM measurements compare the power level within the given offset channels on both sides of the carrier frequency, to the spectrum mask of critical cases defined by the DTMB (CTTB) standard. Results of the measurement on each offset segment can be viewed separately.

The SEM measurement procedure includes four parts:

- a. “[Selecting and Setting up the DTMB \(CTTB\) Mode](#)” on page 41
- b. “[Setting up the Input Ports](#)” on page 42
- c. “[Selecting and Setting up Spectrum Emission Mask Measurement](#)” on page 42
- d. “[Viewing the Measurement Results](#)” on page 42

Selecting and Setting up the DTMB (CTTB) Mode

Step 1. Select DTMB (CTTB) mode.

Press **Mode, DTMB (CTTB)**.

Step 2. Preset the analyzer.

Press **Mode Preset**.

Step 3. Set the Device Type to Transmitter.

Press **Mode Setup, Device Type, Transmitter**.

Step 4. Set the center frequency. There are two methods:

- Enter the center frequency directly.
Press **FREQ Channel, Center Freq, 666, 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-D/K, PAL-D/K DS**.
 - b. Set the channel number.
Press **FREQ Channel, Channel, 32**.

Step 5. Set the channel bandwidth.

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

Setting up the Input Ports

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 one of the following methods.

- Onscreen editor. Press **Edit**.
- SCPI
- 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 [“Using Amplitude Correction in Spectrum Emission Mask Measurement” on page 75](#).

Selecting and 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. The default settings are compliant with the specifications in DTMB (CTTB) standards, so you can use the default settings for most cases.

Press **Meas Setup**.

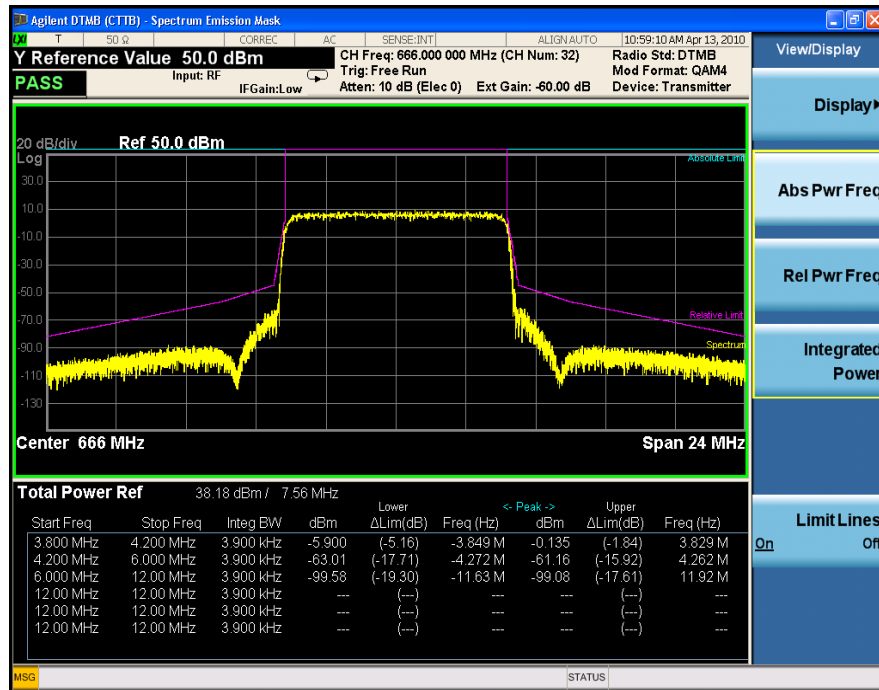
Viewing the Measurement Results

Three views are available in the Spectrum Emission Mask measurement. Press **View/Display, the name of the view** to display them. In the Spectrum Emission Mask measurement of DTMB (CTTB) 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 3-9](#).

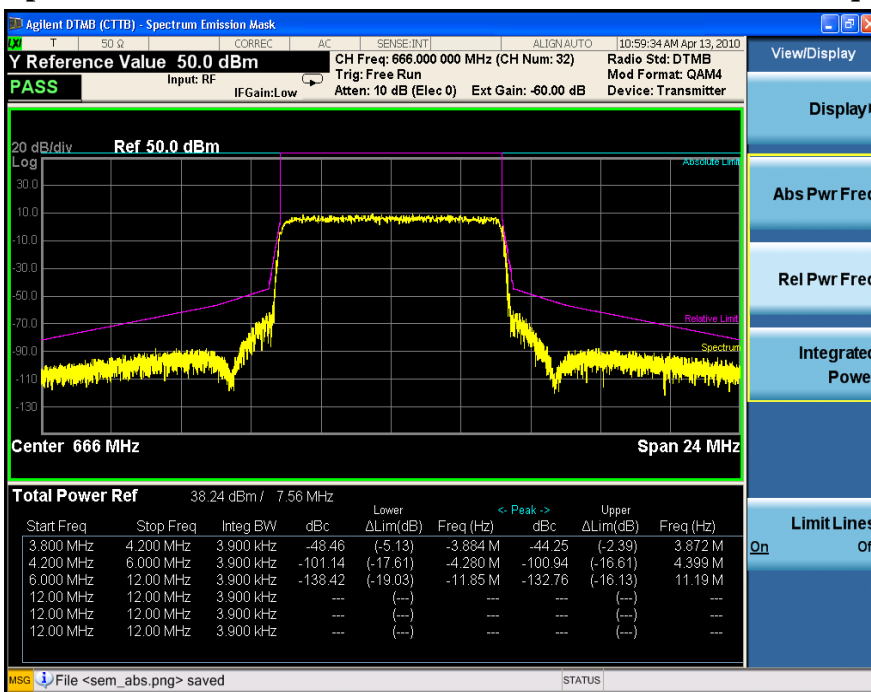
Figure 3-9 Spectrum Emission Mask Measurement Result - Abs Pwr Freq (Default)View



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

Figure 3-10

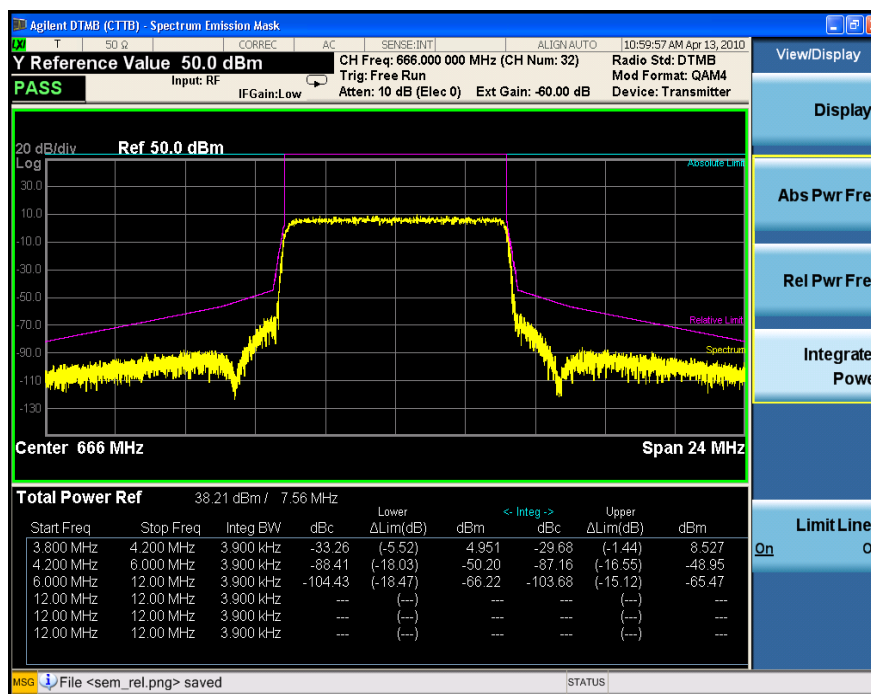
Spectrum Emission Mask Measurement Result - Rel Pwr Freq View



- **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 3-11.

Figure 3-11

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 examples are those areas to be checked further.

- 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 due to the 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 base or mobile 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, it is a key measurement linking amplifier linearity and other performance characteristics to the stringent system specifications.

Making DTMB (CTTB) Measurements
Spectrum Emission Mask Measurements

Modulation Accuracy Measurements

This section explains how to make a Modulation Accuracy measurement on a DTMB (CTTB) transmitter. Modulation Accuracy measurements provide methods for measuring the I/Q errors on DTMB (CTTB) transmitter. The results comprise EVM, MER, magnitude error, phase error, frequency error, clock error, quad error, amplitude imbalance, etc.

The Mod Accuracy measurement procedure includes three parts:

- a. “[Selecting and Setting up the DTMB \(CTTB\) Mode](#)” on page 47
- b. “[Selecting and Setting up Mod Accuracy Measurement](#)” on page 48
- c. “[Selecting and Viewing the Measurement Results](#)” on page 48

Selecting and Setting up the DTMB (CTTB) Mode

Step 1. Select DTMB (CTTB) mode.

Press **Mode, DTMB (CTTB)**.

Step 2. Preset the analyzer.

Press **Mode Preset**.

Step 3. Set the Device Type to Transmitter.

Press **Mode Setup, Device Type, Transmitter**.

Step 4. Set the center frequency. There are two methods:

- Enter the center frequency directly.
Press **FREQ Channel, Center Freq, 666, 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-D/K, PAL-D/K DS**.
 - b. Set the channel number.
Press **FREQ Channel, Channel, 32**.

Step 5. Set the channel bandwidth.

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

Step 6. Set demodulation options according to the transmitter.

Press **Mode Setup, Demod**.

- Set the frame header type.

Making DTMB (CTTB) Measurements Modulation Accuracy Measurements

Press **Frame Header, PN420**.

- Set the carrier format.

Press **Carrier Format, OFDM**.

- Set the modulation format.

Press **Modulation Format, 4QAM**.

NOTE

Modulation Accuracy 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 57.

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 as needed. In this test case, the default settings are used.

Press **Meas Setup**.

Selecting and Viewing the Measurement Results

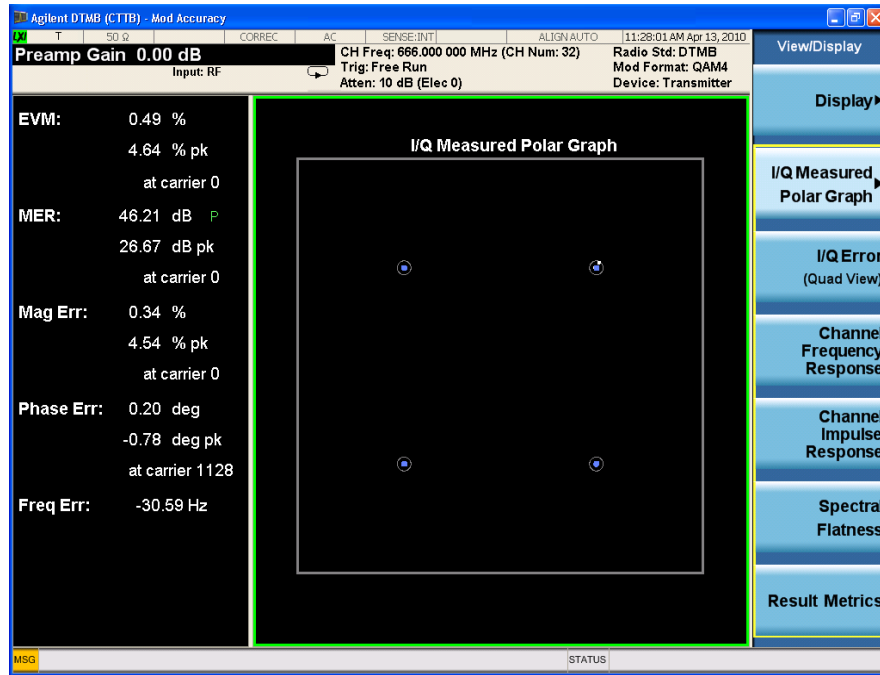
Six views are available in the Mod Accuracy measurement. Press **View/Display, the name of the view** to display them.

- **I/Q Measured Polar Graph** displays a combination view of I/Q measured polar graph and metric windows as shown in [Figure 3-12](#). 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 3-12 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 Measured Polar graph and a result summary.

NOTE

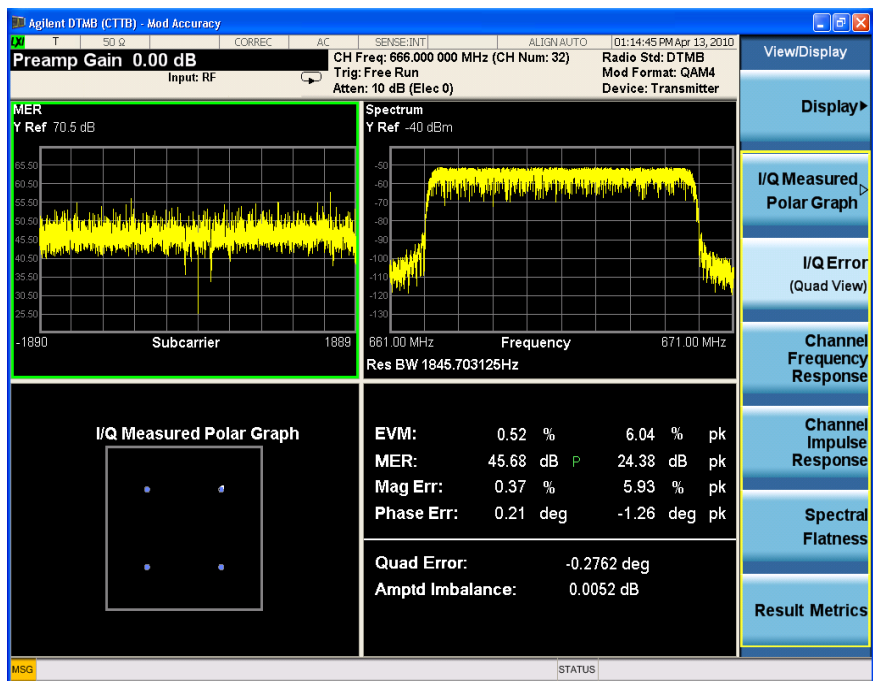
Note that, you can set the scale type for the vertical axis as MER or EVM and horizontal axis as **Carrier** or **Freq** in the top left window of I/Q Error view. To view the MER vs. Subcarrier results,

- 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 3-13](#).

Figure 3-13

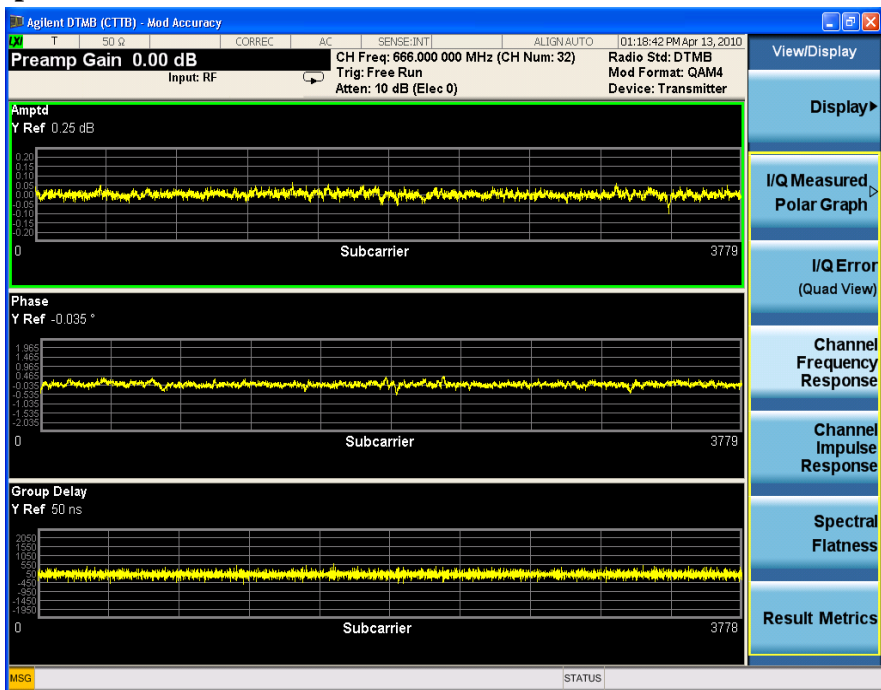
Modulation Accuracy Measurement Result - I/Q Error View



- **Channel Frequency Response** displays the amplitude, phase and group delay of the channel frequency response on every subcarrier as shown in Figure 3-14.

Figure 3-14

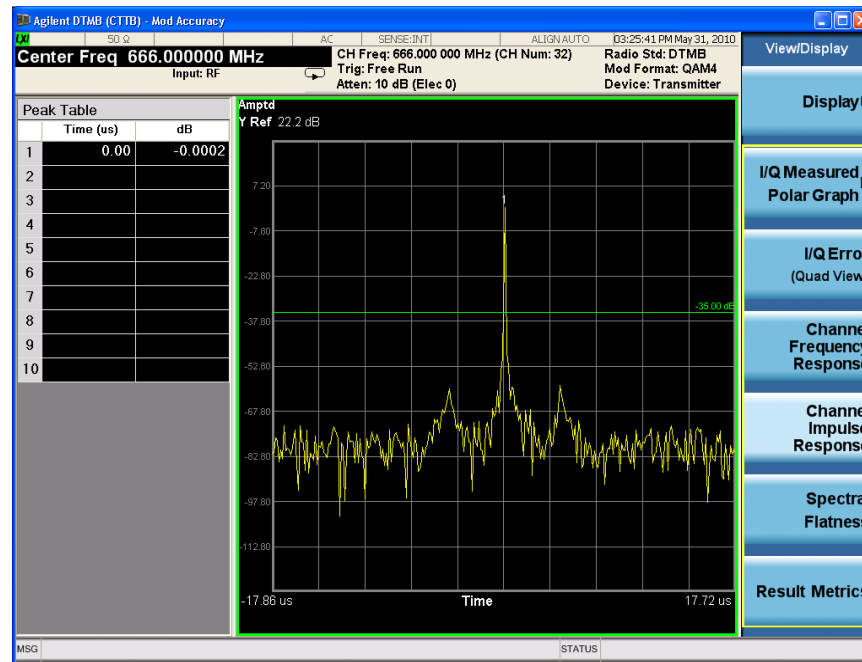
Modulation Accuracy Measurement Result-Channel Frequency Response



- **Channel Impulse Response** displays the state and the delay profile of the channel. This view has two windows, 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.

The measurement results should look like [Figure 3-15](#). 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.

Figure 3-15 Modulation Accuracy Measurement Result-Channel Impulse Response

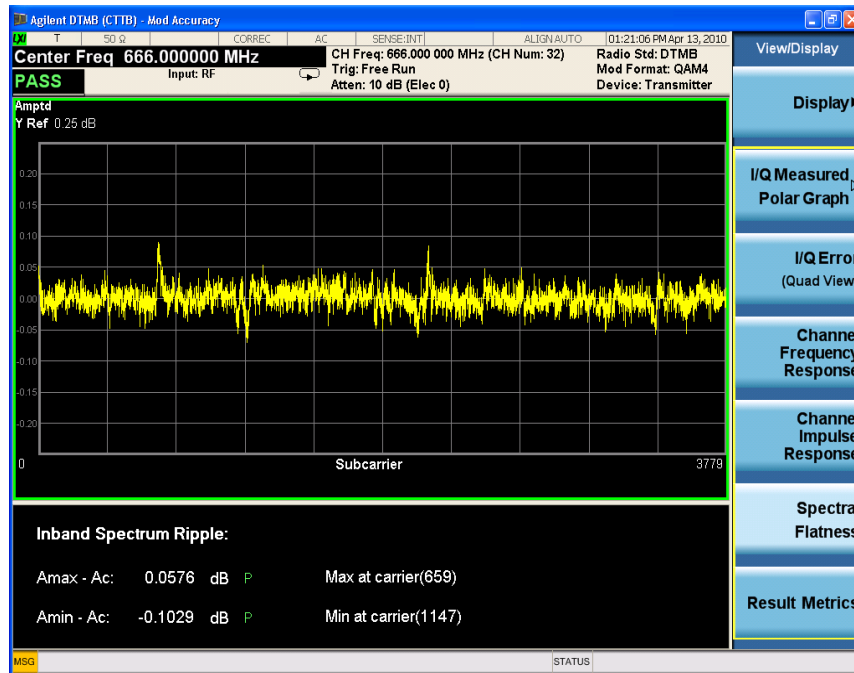


Making DTMB (CTTB) Measurements Modulation Accuracy Measurements

- **Spectral Flatness** displays the inband spectrum ripple as shown in [Figure 3-16](#).

Figure 3-16

Modulation Accuracy Measurement Results-Spectrum Flatness

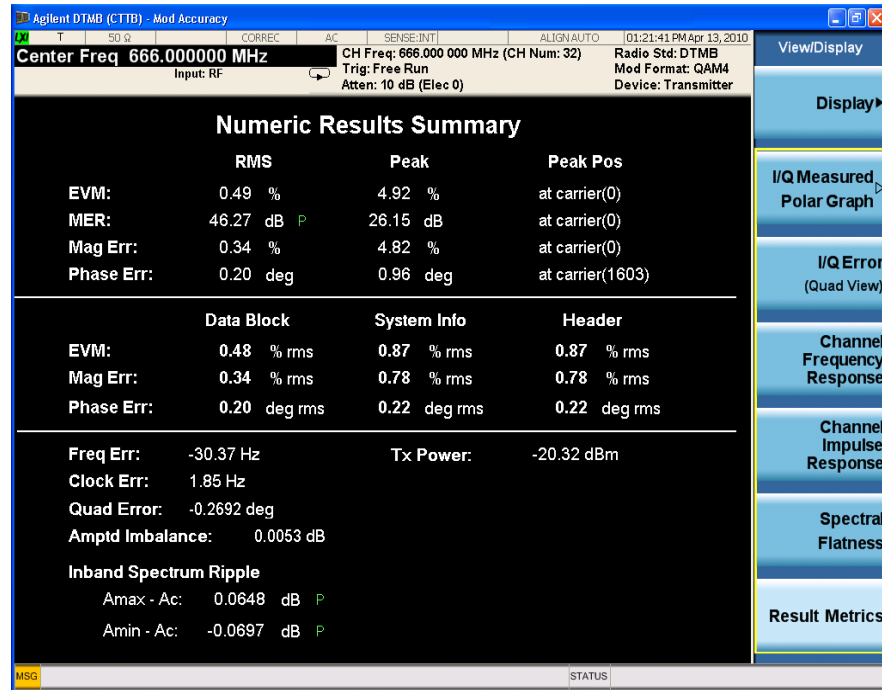


According to the standard, the spectrum flatness should be less than $\pm 0.5\text{dB}$. The PASS/FAIL in the top left corner indicates the test result.

- **Result Metrics** displays a summary of the measurement results as shown in [Figure 3-17](#). You can see the MER results of all the data, data block, system information, or header in this view.

Figure 3-17

Modulation Accuracy Measurement Results-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 7 traces to select from: Polar Trace, MER/EVM vs.Carr/Freq, Spectrum, Amptd vs.Carr, Phase vs.Carr, GD vs.Carr, and Amptd vs.Time.

Monitor Spectrum Measurements

This section explains how to make a Monitor Spectrum measurement on a DTMB (CTTB) transmitter. Monitor Spectrum measurements show a spectrum domain display of the DTMB (CTTB) signal.

The Monitor Spectrum measurement procedure includes three parts:

- a. “Selecting and Setting up the DTMB (CTTB) Mode” on page 54
- b. “Selecting and Setting up Monitor Spectrum Measurement” on page 54
- c. “Viewing the Measurement Results” on page 55

Selecting and Setting up the DTMB (CTTB) Mode

Step 1. Select DTMB (CTTB) mode.

Press **Mode, DTMB (CTTB)**.

Step 2. Preset the analyzer.

Press **Mode Preset**.

Step 3. Set the Device Type to Transmitter.

Press **Mode Setup, Device Type, Transmitter**.

Step 4. Set the center frequency. There are two methods:

- Enter the center frequency directly.
Press **FREQ Channel, Center Freq, 666, 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-D/K, PAL-D/K DS**.
 - b. Set the channel number.
Press **FREQ Channel, Channel, 32**.

Step 5. Set the channel bandwidth.

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

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

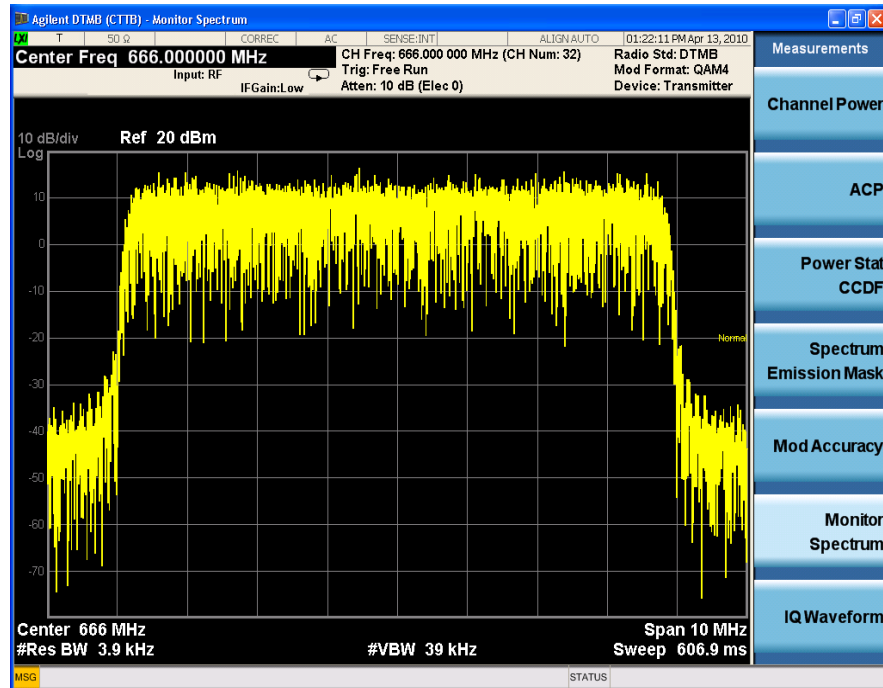
The Monitor Spectrum measurement result should look like [Figure 3-18](#).

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 3-18

Monitor Spectrum Measurement - Spectrum View



IQ Waveform (Time Domain) Measurements

This section explains how to make a Waveform (time domain) measurement on a DTMB (CTTB) transmitter. The measurement of I and Q modulated waveforms in the time domain disclose 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 DTMB \(CTTB\) Mode” on page 56](#)
- b. [“Selecting and Setting up IQ Waveform Measurements” on page 57](#)
- c. [“Selecting and Viewing the Measurement Results” on page 57](#)

Selecting and Setting up the DTMB (CTTB) Mode

Step 1. Select DTMB (CTTB) mode.

Press **Mode, DTMB (CTTB)**.

Step 2. Preset the analyzer.

Press **Mode Preset**.

Step 3. Set the Device Type as Transmitter.

Press **Mode Setup, Device Type, Transmitter**.

Step 4. Set the center frequency. There are two methods:

- Enter the center frequency directly.
Press **FREQ Channel, Center Freq, 666, 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-D/K, PAL-D/K DS**.
 - b. Set the channel number.
Press **FREQ Channel, Channel, 32**.

Step 5. Set the channel bandwidth.

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

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 57](#).

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**.

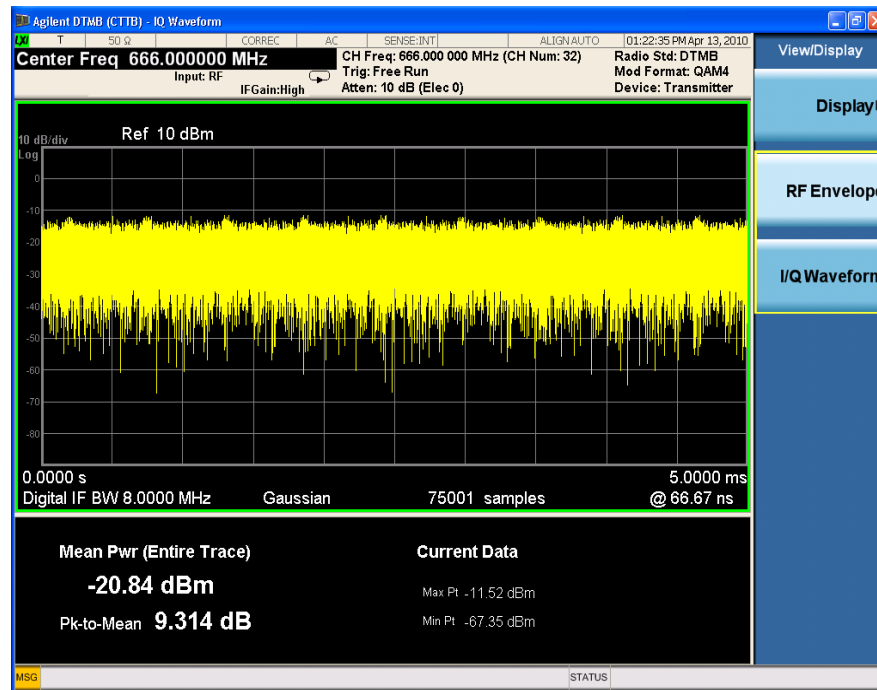
Selecting and Viewing the Measurement Results

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 3-19](#). The measured values for the mean power and peak-to-mean power are shown in the text window.

Figure 3-19

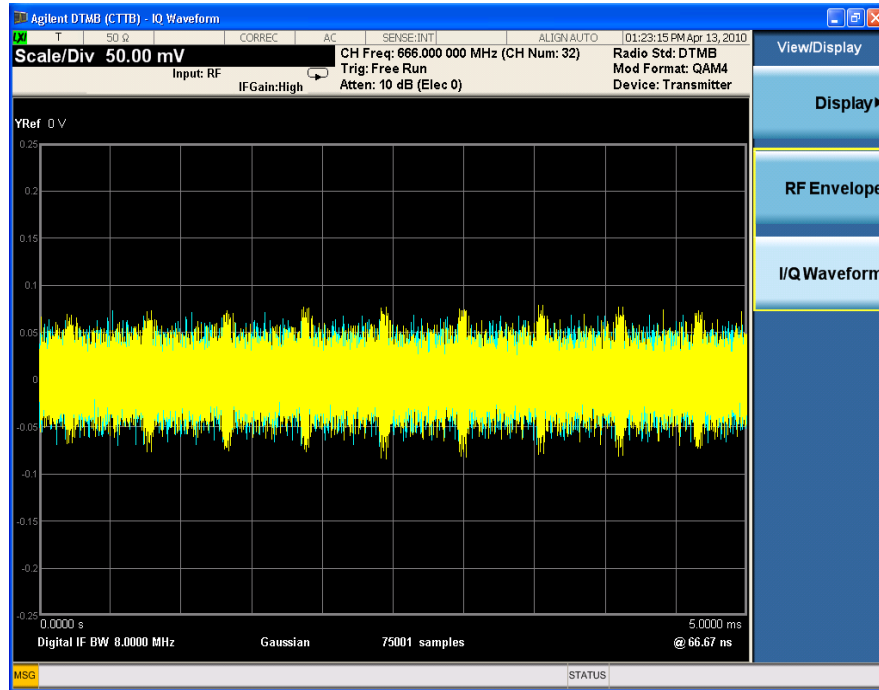
Waveform Measurement - RF Envelope (Default View)



- **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 3-20](#).

Figure 3-20

Waveform Measurement - I/Q Waveform View



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 3-3 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 DTMB \(CTTB\) Measurements” on page 23](#) 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 84](#) 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.

Making DTMB (CTTB) Measurements Using Option BBA Baseband I/Q Inputs

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.

This chapter provides details about the DTMB (CTTB) 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

DTMB (CTTB) concept information is split between these sections as follows:

1. A general introduction for DTMB (CTTB) Broadcast system, see [“What Is the DTMB \(CTTB\) Broadcast System?”](#) on page 65.
2. Key technologies used in DTMB (CTTB) system, such as FEC, Framing, TDS-OFDM, see [“Key Technologies”](#) on page 66.
3. Concepts and measurement methods for each measurement.
 - [“Channel Power Measurement Concepts”](#) on page 68.
 - [“Adjacent Channel Power \(ACP\) Measurement Concepts”](#) on page 70.
 - [“Power Statistics CCDF Measurement Concepts”](#) on page 72.
 - [“Spectrum Emission Mask Measurement Concepts”](#) on page 74.
 - [“Modulation Accuracy Measurement Concepts”](#) on page 77.
 - [“Monitor Spectrum Measurement Concepts”](#) on page 80.
 - [“IQ Waveform Measurement Concepts”](#) on page 81.
4. Concepts and measurement methods for baseband I/Q input, see [“Baseband I/Q Inputs \(Option BBA\) Measurement Concepts”](#) on page 82.
5. Other sources of measurement information is also given, see [“Other Sources of Measurement Information”](#) on page 87.
6. See [“References”](#) on page 88 for references used in this chapter.

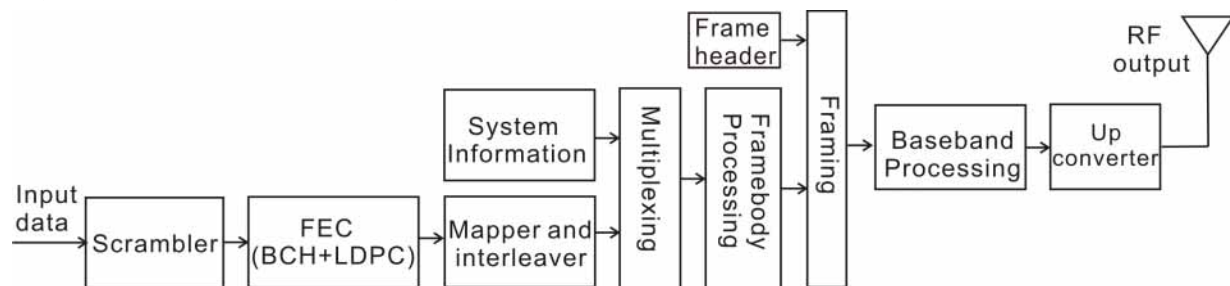
What Is the DTMB (CTTB) Broadcast System?

Digital terrestrial multimedia broadcasting (DTMB), also known as CTTB (China Terrestrial Television Broadcasting), is the Chinese National Terrestrial Digital TV broadcasting Standard which was announced on August 18th, 2006 and implemented beginning August 1st, 2007. The full name of this national standard (GB20600-2006) is “Frame structure, channel coding and modulation for digital television terrestrial broadcasting system“.

The DTMB (CTTB) system performs the adaptation of the Digital Video signals from the output of the MPEG-2 multiplexer. A block diagram for typical DTMB (CTTB) system is shown in [Figure 4-1](#).

Figure 4-1

Block Diagram for DTMB (CTTB) System



The input data first goes through a scrambler, Forward Error Correction (FEC) coding, bit-to-symbol mapping, and interleaving to form the basic data block. After that, the basic data block is multiplexed with system information and the data is processed to form the Frame Body (FB). Then, the signal frame, which is the combination of the FB and corresponding Frame Header (FH), is converted to baseband output signal through baseband processing (with in 8 MHz bandwidth). Finally, the RF output (within the VHF and UHF bands) is obtained after upconverting the baseband signal.

Briefly, the following processes are applied to the input data stream:

- Scrambler: randomization for energy dispersal
- FEC: concatenation of BCH and LDPC
- Mapping: 64QAM, 32QAM, 16QAM, 4QAM, 4QAM-NR
- Interleaving: time interleaving and frequency interleaving (only for C=3780)
- Framing and framebody data processing
- Baseband processing and Upconverter

The DTMB (CTTB) system has two transmission modes. One is C=1, in which mode, two pilots can be optionally inserted at ± 0.5 symbol rate into the framebody data after the signal frame is formed. The other one is C=3780 mode, in which mode, the carrier spacing is 2 kHz.

Refer to [\[1\]](#) for more details about DTMB (CTTB) broadcast system.

Key Technologies

FEC

DTMB (CTTB) system uses a concatenation of outer BCH and inner LDPC as the Forward Error Correction (FEC) code.

The BCH code is derived from BCH(1023, 1013). 261 zeros are added in front of the 752 information bits before BCH encoding, and then removed from the output of BCH encoder.

The LDPC has 3 inner code rate as shown in [Figure 4-1](#).

Table 4-1 LDPC code rates

Code Rate	Block Length (Bits)	Information Bit Length
0.4	7488	3008
0.6	7488	4512
0.8	7488	6016

Frame Structure

DTMB (CTTB) system takes a hierarchical frame structure, which includes:

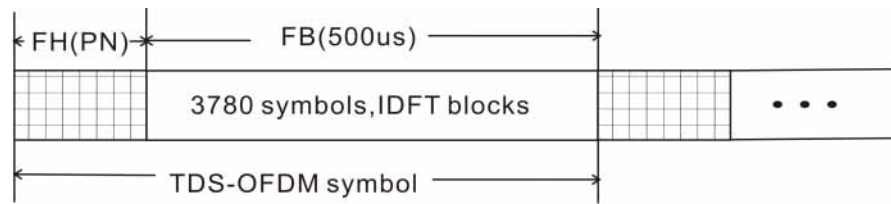
- Calendar Day Frame (starting from 00:00:00 a.m. each day)
- Minute Frame: Lasts exactly 1 minute.
- Super Frame: Lasts 125 ms.
- Signal Frame: Consists of Frame Header (FH) and Frame Body (FB).

The frame structure is exactly synchronized with real-time, so it is easily to realize time synchronizations between different transmitters.

TDS-OFDM

Time-Domain Synchronous Orthogonal Frequency Division Multiplexing (TDS-OFDM) is a key technology in DTMB (CTTB). TDS-OFDM utilizes the known pseudorandom noise (PN) sequences as guard intervals (frame header). The PN sequences can serve as training symbols for synchronization and channel estimation purpose, so no additional pilot is needed. And high spectrum efficiency is also achieved. The signal frame structure using TDS-OFDM is shown in [Figure 4-2](#).

Figure 4-2 Signal Frame Structure for TDS-OFDM Symbols

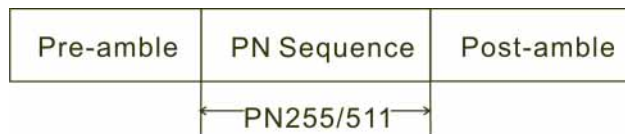


There are 3780 symbols in each FB including 3744 symbols carried data and 36 symbols carried the Transmission Parameter Signaling (TPS).

For the FH, there are three different construction mode.

- PN420. The construction is shown in [Figure 4-3](#). The PN sequence used is PN255. The lengths for Pre-amble and Post-amble are 82 and 83 separately. The FH of this structure is rotated in each Super Frame.
- PN945. The construction is similar to that of PN420. The PN sequence used here is PN511. The lengths for Pre-amble and Post-amble are both 217.
- PN595. PN595 is generated by taking the first 595 bits from an M-sequence of 1023 bit-long.

Figure 4-3 The structure for PN420 and PN945



Channel Power Measurement Concepts

Purpose

The Channel Power measurement is an important test in digital video industry. It measures the in-channel power characteristics of DTMB (CTTB) transmitters. First of all, it measures the integrated power in the DTMB (CTTB) defined bandwidth. Secondly, it measures and reports the shoulder attenuation. Thirdly, it provides a view comparing the input signal against the DTMB (CTTB) defined spectrum mask under the condition 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 Channel Power measurement reports the total transmitted power within the channel bandwidth (8 MHz for the DTMB (CTTB) mode). The integration bandwidth (IBW) method is used to determine the 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 measurements, the instrument first measures the power value at the center frequency f_c and $f_c \pm 4.2$ MHz, then calculates the power difference between f_c and $f_c \pm 4.2$ MHz. The smaller value is defined as shoulder attenuation.

The PASS/FAIL limit for shoulder attenuation is -36 dB when the device is a transmitter and -48 dB when the device is an exciter. [2] [3]

Spectrum Mask

For the spectrum mask which is used to compare with the input signal, refer to Table 4-2. [1]

Table 4-2 Breakpoint in the Spectrum Mask

Frequency offset (MHz)	Relative Power level (dB)
-12	-100

Table 4-2 Breakpoint in the Spectrum Mask

-10.75	-76.9
-9.75	-76.9
-5.75	-74.2
-4.94	-69.9
-3.9	-32.8
+3.9	-32.8
+4.25	-64.9
+5.25	-76.9
+6.25	-76.9
+10.25	-76.9
+12	-100

Adjacent Channel Power (ACP) Measurement Concepts

Purpose

Adjacent Channel Power (ACP), as it applies to DTMB (CTTB), 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.

To maintain a quality transmission by avoiding channel interference, it is important to measure and reduce any adjacent channel leakage power transmitted from a DTMB (CTTB) transmitter. The characteristics of adjacent channel leakage power are mainly determined by the transmitter design, particularly the low-pass filter.

Measurement Method

The ACP measurement measures the power inside and outside the adjacent channel.

The measurement method and PASS/FAIL limit for the different device types (Transmitter/Exciter) when the bandwidth is 8 MHz are described in [Table 4-3](#).

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 total power in the carrier channel and the offsets.

The default setting is IBW.

If **Total Pwr Ref** is selected as the measurement type, 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 results are displayed as relative power in dB, and as absolute power in dBm/Hz.

Table 4-3 Device and Measurement Method in ACP Measurement

Measurement	Device	Measurement Method	PASS/FAIL Limit
ACP	Transmitter	<p>There are two measurement ranges: Inside Adjacent Channel and Outside Adjacent Channel.</p> <p>1. Inside Adjacent Channel:</p> <p>(1) Offset Frequency: ± 8 MHz</p> <p>(2) Offset Integ BW: 7.56 MHz</p> <p>(3) Result: the MAX value of the Lower and Upper Offset Abs/Rel Power</p> <p>2. Outside Adjacent Channel:</p> <p>(1) Offset Frequency: ± 16 MHz, ± 24 MHz, ± 32 MHz</p> <p>(2) Offset Integ BW: 7.56 MHz</p> <p>(3) Result: the RMS value of the six Lower and Upper Offset Abs/Rel Power</p>	<p>Inside Adjacent Channel:</p> <p>Abs Limit ≤ 13 mW and</p> <p>Rel Limit ≤ -45 dB</p> <p>Outside Adjacent Channel:</p> <p>Abs Limit ≤ 13 mW or</p> <p>Rel Limit ≤ -60 dB</p>
	Exciter	<p>There is only one measurement range: Inside Adjacent Channel.</p> <p>Inside Adjacent Channel:</p> <p>(1) Offset Frequency: ± 8 MHz</p> <p>(2) Offset Integ BW: 7.56 MHz</p> <p>(3) Result: the MAX value of the Lower and Upper Offset Abs/Rel Power</p>	<p>Inside Adjacent Channel:</p> <p>Rel Limit < -50 dB</p>

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 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).

A CCDF curve is defined by how much time the waveform spends at or above a given power level. The percent of time the signal spends at or above the level

defines the probability for that particular power level. 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.

Spectrum Emission Mask Measurement Concepts

Purpose

Spectrum Emission Mask measurements include the in-band and out-of-band spurious emissions. As it applies to DTMB (CTTB), it is the power contained in a specified frequency bandwidth at certain offsets relative to the total carrier power. It is expressed as a ratio of power spectral densities between the carrier and the specified offset frequency band. To prevent interference from the DTMB (CTTB) transmitter, this measurement is needed in case of the television channels adjacent to other services (lower power or receive only).

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 spectrum mask used in this measurement can refer to the critical case in [Table 4-4](#). [1]

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.

Table 4-4 Breakpoint in Spectrum Mask in Critical Cases

Frequency offset (MHz)	Relative Power level (dB)
-12	-120
-6	-95
-4.2	-83
-3.8	-32.8
+3.8	-32.8
+4.2	-83
+6	-95
+12	-120

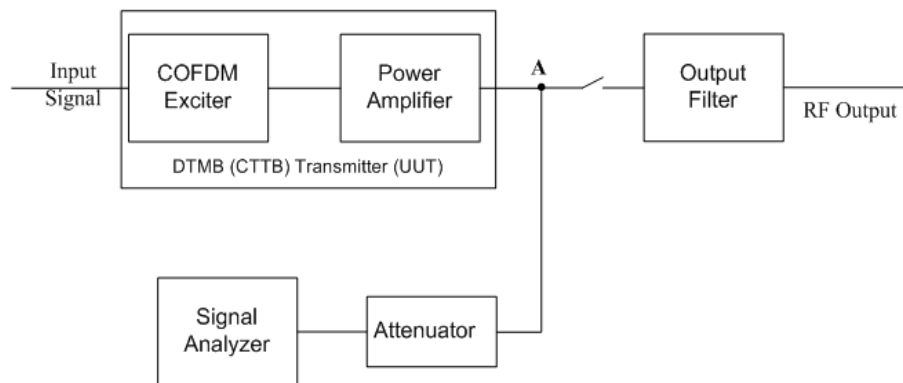
Using Amplitude Correction in Spectrum Emission Mask Measurement

The dynamic range of the RF output of a real DTMB (CTTB) 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 DTMB (CTTB) transmitter has a mask filter, the diagram for spectrum emission mask measurement is shown in [Figure 4-4](#).

Figure 4-4 Diagram for Spectrum Emission Mask Measurement on DTMB (CTTB) Transmitter



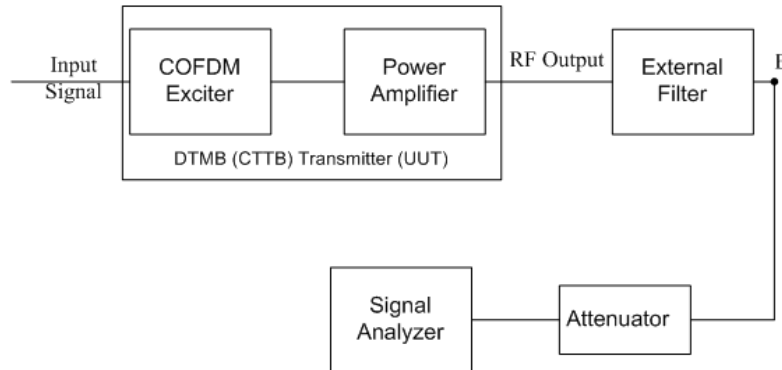
The steps for measuring the spectrum emission mask are as follows:

- Measure the frequency response of the output filter using a network analyzer or a combination of signal source and signal analyzer.
- Measure the signal transmitted at point A 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 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 4-5](#).

Figure 4-5 **Diagram for Spectrum Emission Mask Measurement on DTMB (CTTB) Transmitter without Output Filter**



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

- a. Measure the frequency response of the external filter using a network analyzer or a combination of signal source and signal analyzer.
- b. Measure the signal transmitted at point B as shown in [Figure 4-5](#).
- c. Apply amplitude correction on spectrum value measured in step b using the filter's response from step a.

The correction data is typically a table of the negative of filter's frequency response, 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 DTMB (CTTB) 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 provides an overall indication of the performance level of the transmitter.

Measurement Method

This procedure 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 data is 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

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:

$$EVM = \sqrt{\frac{\frac{1}{N} \sum_{i=1}^N (\delta I_i^2 + \delta Q_i^2)}{S_{max}^2}} \times 100\%$$

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

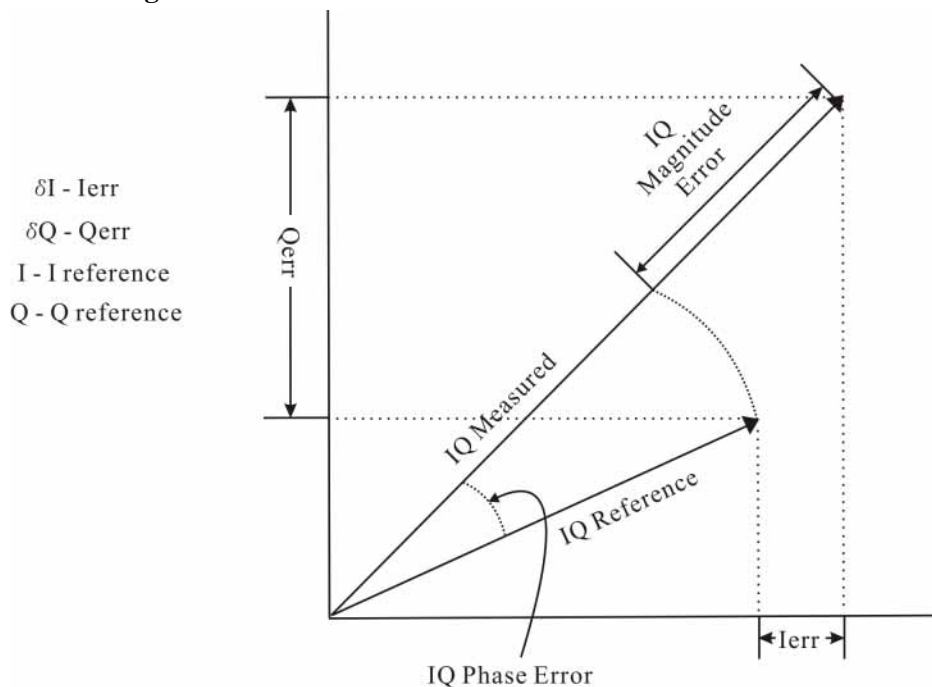
This definition is only used in broadcast industry, and in wireless industry EVM is defined as the ratio of error vector vs. RMS reference vector.

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

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 4-6.

Figure 4-6 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.

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 4-6](#).

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 4-6](#).

Phase Error

Phase error is the difference in phase between the I/Q measured signal and the I/Q reference signal. Phase Error is shown in [Figure 4-6](#).

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:

$$AI = 20 \log_{10} \frac{v_I}{v_Q} \text{ dB}$$

Where v_I and v_Q represent I and Q gain respectively.

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 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 performs the zero span functionality found in traditional spectrum analyzers.

Basic mode waveform measurement data can 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 84.

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 an 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, CDMA, GSM, 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 Ω 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 Ω 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 Ω 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 ^a	InfiniMax 3.5 GHz probe
	1132A ^a	InfiniMax 5 GHz probe
	1133A ^a	InfiniMax 7 GHz probe
Passive	1161A	Miniature passive probe, 10:1, 10 M Ω , 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

Go to 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

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] GB 20600-2006, Framing Structure, Channel Coding and Modulation for Digital Television Terrestrial Broadcasting system
- [2] GY/T 229.4-2008, Technical specifications and methods of measurement for digital terrestrial television broadcasting transmitters
- [3] GY/T 229.2-2008, Technical specifications and methods of measurement for digital terrestrial television broadcasting exciter