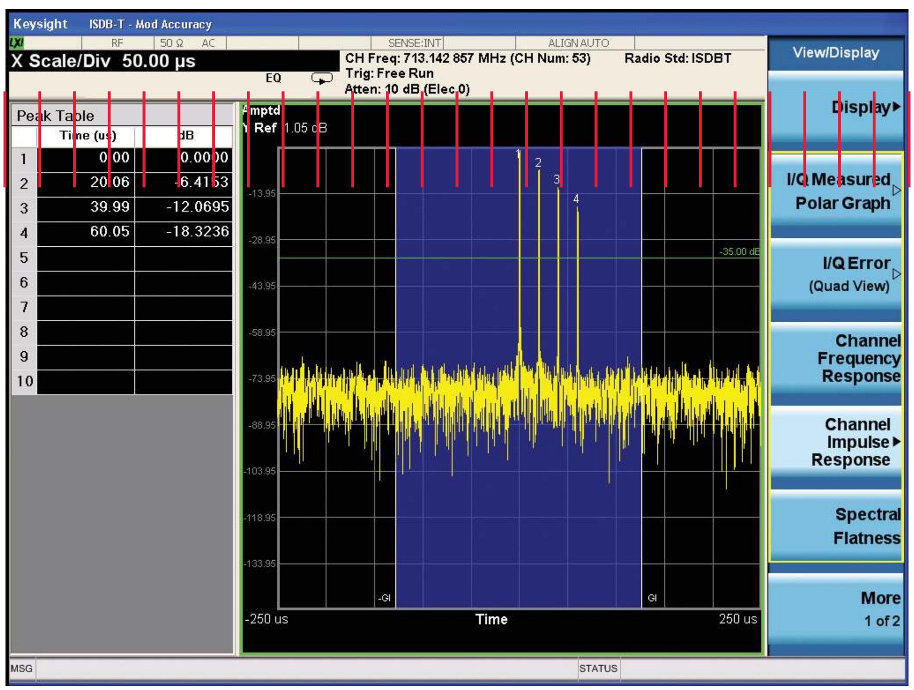
Keysight Technologies
N6155A & W6155A ISDB-T with Tmm
X-Series Measurement Application

Demo Guide



KEYSIGHT TECHNOLOGIES

ISDB-T with Tmm Digital Video Test Measurement Details

This demonstration guide follows the list on this page, which shows the demonstrations included in this document. Each demonstration is given a brief description of its function and the corresponding measurement steps on the signal generator and/or signal analyzer.

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

Analog baseband measurements are available on the Keysight Technologies, Inc. PXA or MXA signal analyzer equipped with BBIQ hardware. Supported baseband measurements include all of the modulation quality plus I/Q waveform measurements.

Technology	ISDB-T	ISDB-T_{SB}	ISDB-Tmm
Measurement application	N6155A, W6155A	N6155A, W6155A	N6155A, W6155A
X-Series analyzer	PXA, MXA, EXA, CXA[1]	PXA, MXA, EXA, CXA[1]	PXA, MXA, EXA, CXA[1]
Measurements			
Channel power			
RF spectrum	●	●	●
Shoulder attenuation	●	●	
Adjacent channel power	●	●	●[2]
Spectrum emission mask	●	●	●[2]
Power statistic CCDF	●	●	●
Occupied BW	●	●	●
Modulation accuracy			
RMS EVM (%)	●	●	●
Peak EVM (%)	●	●	●
Position of peak EVM	●	●	●
RMS MER (dB)	●	●	●
Peak MER (dB)	●	●	●
Position of peak MER	●	●	●
RMS mag error (%)	●	●	●
Peak mag error (%)	●	●	●
Position of peak Mag error	●	●	●
RMS phase error (deg)	●	●	●
Peak phase error (deg)	●	●	●
Position of peak phase error	●	●	●
Frequency error (Hz)	●	●	●
Tx power (dBm)	●	●	●
Quadrature error (deg)	●	●	●
Amplitude imbalance (dB)	●	●	●
In-band spectrum ripple			
Amax-Ac (dB)	●	●	●
Amin-Ac (dB)	●	●	●
MER/EVM vs. subcarriers/ frequency	●	●	●
MER by layer A/B/C (dB)	●	●	
MER by data, pilot, TMCC and AC1 (dB)	●	●	●
MER vs. segment	●	●	●
Amplitude vs. subcarriers (dB)	●	●	●
Phase vs. subcarriers (deg)	●	●	●
Group delay vs. subcarriers (ns)	●	●	●
Channel impulse response (dB)	●	●	●
Spectral flatness (dB)	●	●	●
TMCC decoding	●	●	
AC decoding	●	●	
ISDB-Tmm config			●

1. *N6155A operates in the PXA, MXA, and EXA signal analyzers. W6155A operates in the CXA signal analyzer.*
2. *This measurement on the ISDB-Tmm signal requires manual configuration.*

Demonstration Preparation

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

Minimum equipment configuration requirements

Product type	Model number	Required options
MXG vector signal generator	N5182A (Firmware revision A.01.20 or later)	– 651,652 or 654 – internal baseband generator (30 M/60 M/125 MSa/s, 8 MSa) – 019 – Upgrade baseband generator memory to 64 MSa (recommended)
Signal Studio for Digital Video, ISDB-T option	– N7623B – RFP advanced ISDB-T – N7623B – MFP advanced ISDB-Tmm (software revision 4.1.0.0 or later)	Please check N7623B signal studio web page for the latest version www.keysight.com/find/signal_studio
X-Series signal analyzer	N9000A, N9010A, N9020A, or N9030A firmware revision A.08.xx or later	Recommended: – EA3 – Electric attenuator, 3.6 GHz – P0x – Preamplifier – P0x (P03, P08 (P07 for CXA)) – BBA – Analog baseband IQ inputs (for analog baseband IQ analysis) Required: – 503, 508, 507, (EXA and CXA), 513 or 526–513 and 526 not available on CXA – B25 – Analysis bandwidth, 25 MHz
ISDB-T measurement application	N6155A – N9010A, N9020A, N9030A W6155A – N9000A only	Required: – 2FP: ISDB-T measurement application, fixed perpetual license – 3FP: ISDB-Tmm measurement application, fixed perpetual license OR – 2TP: ISDB-T measurement application, transportable license (Only for PXA/MXA/EXA) – 3TP: ISDB-T measurement application, transportable license (Only for PXA/MXA/EXA)
Controller PC for Digital Video Signal Studio[1]		Install N7623B to generate and download the signal waveform into the Keysight MXG via GPIB or LAN (TCP/IP)—please refer to the online documentation for installation and setup

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

Helpful tip:

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

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

Demonstration Setup

Connect the PC, X-Series, and MXG

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

A. Connect the MXG RF Output port to the X-Series signal analyzer RF Input port

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

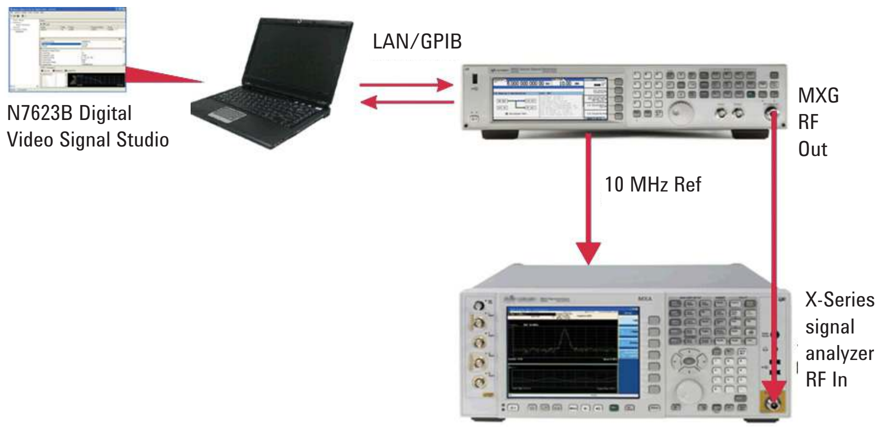


Figure 1. Demonstration setup

Demonstrations

Demonstration 1:

Set up ISDB-T/ISDB-Tmm Digital Video Signal Studio on MXG

The Keysight N7623B Signal Studio for Digital Video is a Windows-based utility that simplifies the creation of standards-based or customized digital video signals. The waveform is downloaded into the MXG vector signal generator, which generates RF or IQ signals.

Instructions	Keystrokes
On the MXG	
Preset the MXG Check the IP address	**[Preset]** **[Utility] {I/O Config} {LAN Setup}**
On the Signal Studio software	
Run the Keysight Signal Studio for Digital Video	Double-click on the **Digital Video** shortcut on the desktop or access the program via the Windows start menu
Verify the software is communicating with the instrument via the GPIB or LAN (TCP/IP) link	To establish a new connection, click on the **{System}** pull-down menu at the top of the Signal Studio program window. Next, select **{Run System Configuration Wizard}.**
To generate ISDB-T signals	
Select the ISDB-T format	Click on the **{Format}** pull-down menu at the top of the Signal Studio program window. Next, select **{ISDB-T}**
Set the parameters of the signal generator with center frequency 713.142857 MHz, amplitude –20 dBm, RF output turned On, and ALC On	Click **Signal Generator** at the left on the Explorer menu. Instrument Model Number: N5162A/N5182A Press **[Preset]** green button on the top. Frequency = 713.142857 MHz, Amplitude = –20 dBm, RF Output = On, ALC = On
Confirm the waveform setup from upper level	Click **Waveform Setup** to see the fundamental waveform signal setups. The default settings are used in this demo.
Configure a test signal for demonstrations	Click **Carrier0** under **Waveform Setup** on the left of the Explorer menu to see the setups on Carrier0, set the parameters for each layer as follows and leave the others as default. – Layer A: 1 Segment; Code Rate = 2/3; QPSK; I (Time Interleaving length) = 4 – Layer B: 4 Segment; Code Rate = 3 /4; 64QAM; I = 2 – Layer C: 8 Segment; Code Rate = 5/6; 16QAM; I = 4 Then select AC Builder Tool in the **AC setup** cell and configure the earthquake alarm information using the AC Builder in the **AC** cell. Figure 2 shows the look of the window after the ISDB-T setup finishes.
To Generate ISDB-Tmm signals	
Select the ISDB-Tmm format	Click on the **{Format}** pull-down menu at the top of the Signal Studio program window. Next, select **{ISDB-Tmm}.**
Set the parameters of the signal generator with center frequency 214.714286 MHz, amplitude –20 dBm, RF output turned On, and ALC On	Click **Signal Generator** at the left on the Explorer menu. Instrument Model Number: N5162A/N5182A Press **[Preset]** the green button on the top. Frequency = 214.714286 MHz, Amplitude = –20 dBm, RF Output = On, ALC = On
Confirm the waveform setup from upper level	Click **Waveform Setup** to see the fundamental waveform signal setups. The default settings are used in this demo.
Configure a test signal for demonstrations	Click **Carrier0** under **Waveform Setup** on the left of the Explorer menu to set the parameters of the ISDB-Tmm signal, and then click **Super Segment x** and **1-seg x** (if the super segment type is type B) to configure the ISDB-Tmm frame. In this demo, the default settings, which are compliant to the configuration A defined in the ISDB-Tmm operational guide, are used.
Download the signal to the MXG	Click (generate and download button) on the top tool bar. If you encounter any errors, please refer to the online help in the Signal Studio software
Save the signal file for future use	**File > Save Setting File > ISDB.scp** (name it)
Export the waveform file for future use	**File > Export Waveform Data > ISDB.wfm** (name it)

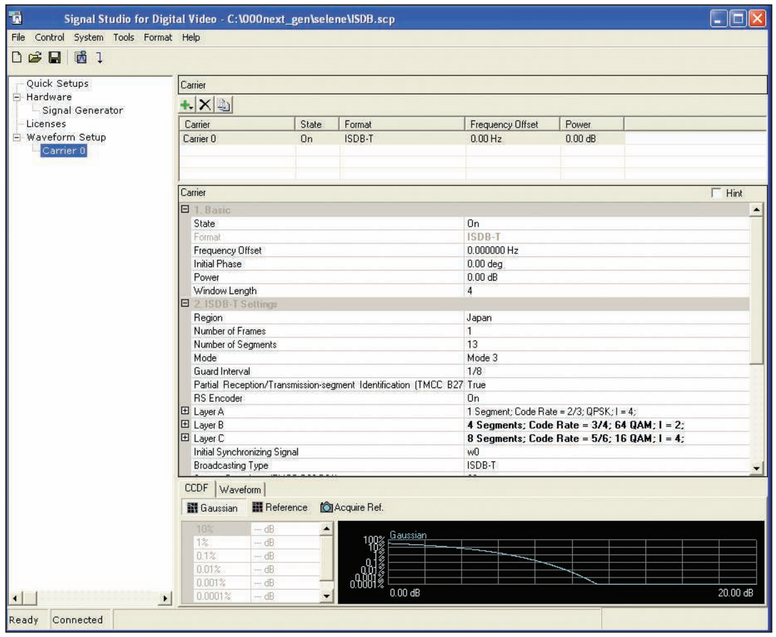


Figure 2. ISDB-T/T$_{SB}$ signal setup in the Keysight Signal Studio software

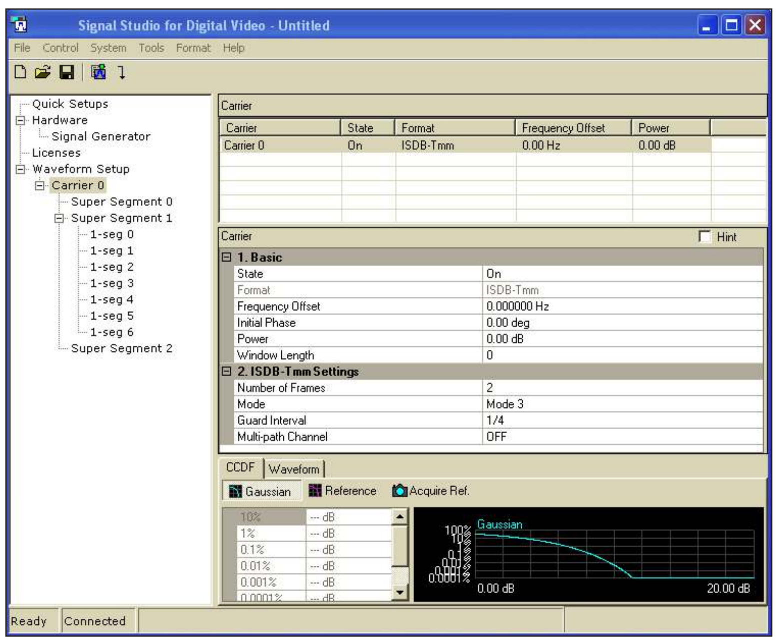


Figure 3. ISDB-Tmm signal setup in the Keysight Signal Studio Software

Demonstration 2:

Channel power

The channel power measurement has two views: RF spectrum and shoulder attenuation.

– **RF spectrum** view measures and reports the integrated power in an ISDB-T defined bandwidth and power spectral density (PSD) displayed in dBm/Hz or dBm/MHz.

– **Shoulder attenuation** view measures shoulder attenuation compliant with the ISDB-T standard.

Instructions	Keystrokes
On the X-Series signal analyzer:	
Preset the signal analyzer	**[Mode Preset]**
Select ISDB-T mode	**[Mode] {ISDB-T}**
Choose ISDB-T standard	**[Mode Setup] {Radio Std} {ISDB-T}**
Set a center frequency at 713.142857 MHz	**[FREQ Channel] {Center Freq} {713.142857} {MHz}**
Select channel power measurement (RF spectrum default)	**[Meas] {Channel Power}**
Switch to shoulder attenuation view	**[View/Display] {Shoulder Attenuation}**

Helpful tip:

To make RF spectrum and shoulder attenuation measurements according to the ISDB-T_{SB} standard, change the integration BW, shoulder offset start, and shoulder offset stop values under the meas setup menu manually as needed.during the demonstration.

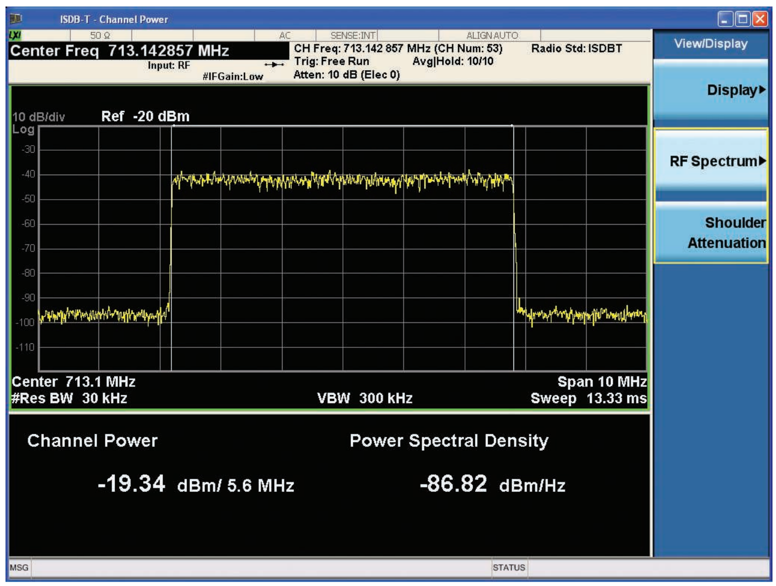


Figure 4 Channel power measurement with RF spectrum view

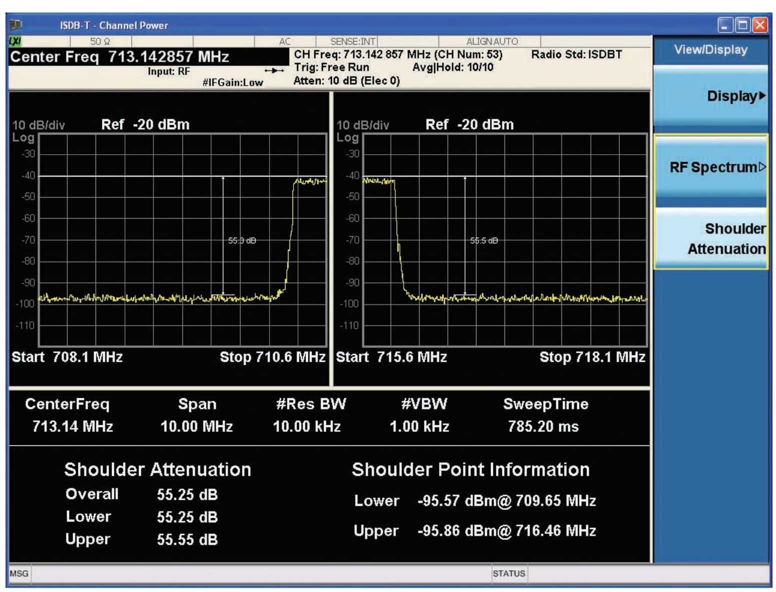


Figure 5. Channel power measurement with shoulder attenuation view

Demonstration 3:

Adjacent channel power (ACP)

The ACP test verifies the ability of the modulator or transmitter to limit the interference produced by the transmitted signal to other receivers operating in the adjacent in-band or adjacent out-band RF channel. The limit can be defined to measure the power in adjacent channels relative to the transmitted power.

The ACP measurement results should look like Figure 6. The text window shows the power in the adjacent channels.

Helpful tip:

To make the adjacent channel power measurement according to ISDB-Tmm standard, change the settings under the **Meas Setup** menu manually, as needed.

Instructions	Keystrokes
On the X-Series signal analyzer:	
Activate adjacent channel power (ACP) measurement	**[Meas] {ACP} {More 1 of 2}**
Compare the measurement result with noise correction turned on (default is off). A better ACP result is achieved with noise correction on (Figure 6)	**[Meas Setup] {More 1 of 3} {More 2 of 3} {Noise Correction On}**

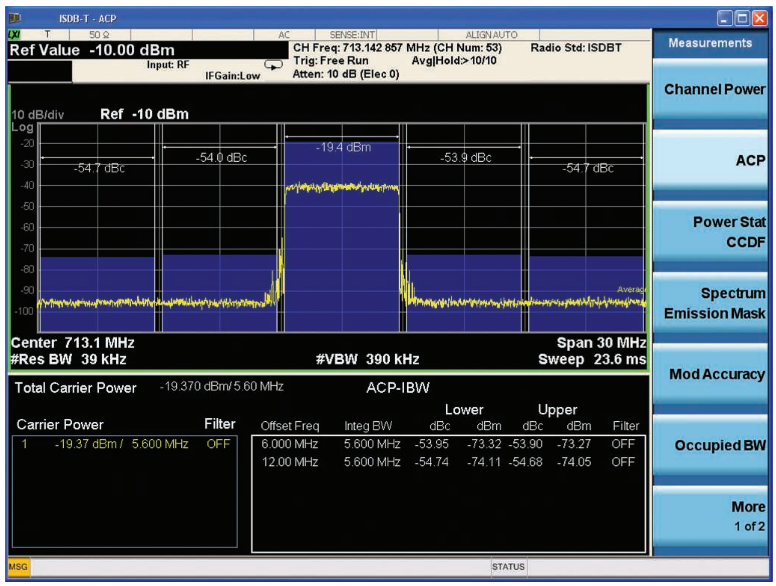


Figure 6. ACP measurement with noise correction on

Demonstration 4:

Power stat CCDF

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

Instructions	Keystrokes
On the X-Series signal analyzer:	
Activate the power stat CCDF measurement	**[Meas] {Power Stat CCDF}**
Store a reference trace	**[Trace/Detector] {Store Ref Trace}**
Turn on reference trace	**[Trace/Detector] {Ref Trace On}**

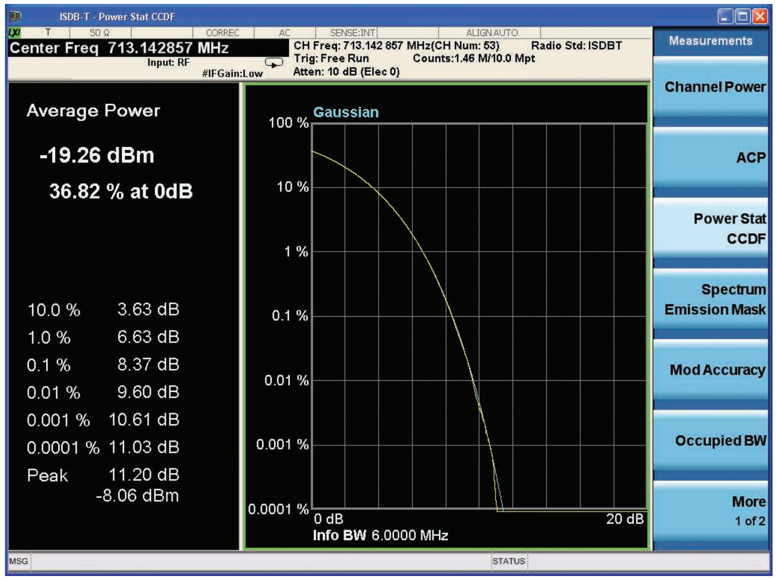


Figure 7. Power stat CCDF measurement

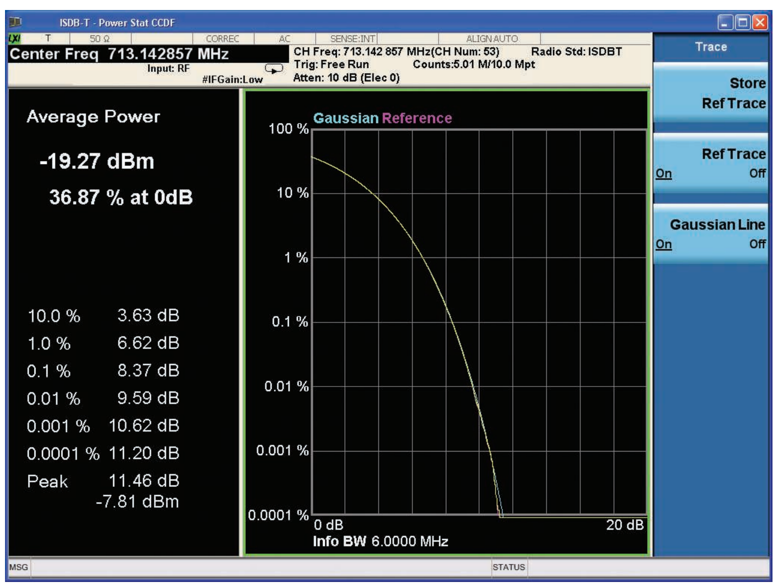


Figure 8. Power stat CCDF measurement with reference trace

Demonstration 5:

Spectrum emission mask

The spectrum emission mask (SEM) measurement can compare the total power level within the defined carrier bandwidth and the given offset channel on both sides of the carrier frequency to levels allowed by the ISDB-T/T_{SB}/Tmm standard. This measurement rebounds to the design of the power amplifier in the ISDB-T/T_{SB}/Tmm transmitter, and it is a key measurement linking amplifier inearity and other performance characteristics to the stringent system specifications.

During the SEM measurement process, the amplitude correction function is employed to address situations where the dynamic range of the input signal may be larger than that of the signal analyzer. For more details, refer to Appendix A.

To support all spectrum limits defined in ISDB-T/T_{SB} standards, six limit types are available under the **Meas Setup, Limit Type** panel, as follows:

- Manual
- JEITA: defined in ARIB STD B31
- ABNT non-critical:
  defined in ABNT NBR 15601
- ABNT sub-critical:
  defined in ABNT NBR 15601
- ABNT critical:
  defined in ABNT NBR 15601
- ISDB-T_{SB}: defined in ARIB STD B29

For JEITA limit type, there are another four options (auto sense, 30 dB mask, 40 dB mask, and 50 dB mask) that enable you to set the spectrum mask compliant with ARIB STD B31 version 1.7. For more details about ARIB STD B31 V.17 spectrum mask definition, use case, and settings in the N6155A and W6155A SEM measurement, refer to Appendix B.

Instructions	Keystrokes
On the X-Series signal analyzer:	
Activate spectrum emission mask	**[Meas] {Spectrum Emission Mask}**
Input the value of the attenuator (for the actual ISDB-T transmitter)	**[Input/Output] {External Gain} {Ext Preamp}**
Recall or edit the correction table	**[Input/Output] {More 1 of 2} {Corrections} {Edit}** or **[Recall] {Data}**
Turn correction on	**[Input/Output] {More 1 of 2} {Corrections} {On}**
Select the limit type	**[Meas Setup] {Limit Type} {JEITA} {Auto Sense}**

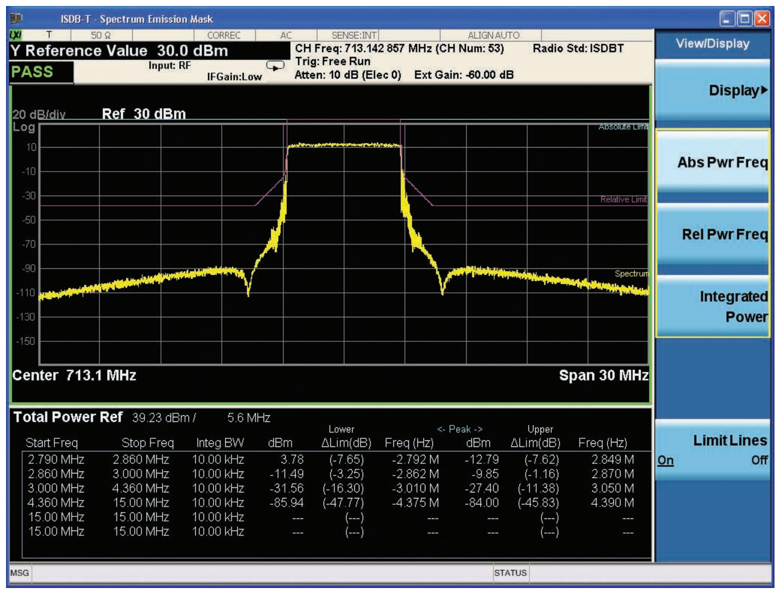


Figure 9. Spectrum emission mask measurement after amplitude correction

Helpful tips:

To get the format of the file to be recalled, first edit several points using the 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.

To measure the spectrum mask on ISDB-Tmm signals, you need to use the **Manual** limit type and specify the spectrum mask by setting the parameters under **Meas Setup, Ref Channel** and **Meas Setup, Offset/Limit** manually.

Demonstration 6:

Modulation accuracy

The modulation accuracy measurement is necessary to perform the ISDB-T-defined tests and to ensure proper operations. It provides the EVM, MER, magnitude error, phase error, frequency error, quadrature error, amplitude imbalance, channel frequency response, and channel impulse response results for ISDB-T/T_{SB}/Tmm signals. Additionally, for ISDB-T/T_{SB} signals, you can measure the EVM/MER results on each layer or segment in I/Q error view, TMCC decoding results in the TMCC decoding view, and AC decoding results in AC decoding view which lists the earthquake information carried in the AC bits. For ISDB-Tmm signals, you can measure the EVM/MER results on each super segment, layer, or segment and check the ISDB-Tmm configurations for the current signal in the ISDB-Tmm config view.

The procedure for and the results from making modulation accuracy measurements on ISDB-T/T_{SB} and ISDB-Tmm signals are different and are introduced separately in this demo.

Helpful tip:

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

To make modulation accuracy measurements on ISDB-T/T_{SB} signals

Instructions	Keystrokes
On the X-Series signal analyzer:	
Select the radio standard and Channel BW	**[Mode Setup] {Radio Std} {ISDB-T}** **[Mode Setup] {Channel BW} {6 MHz}**
Activate the modulation accuracy measurement	**[Meas] {Mod Accuracy}**
Select demodulation options; there are two methods	**[Mode Setup]** Select the demodulation options under this menu according to the transmitted signal's format or **[Meas Setup] {Auto Detect}**
View the I/Q measured polar graph (Figure 11)	**[View/Display] {I/Q Measured Polar Graph}**
Switch to the I/Q error view (Figure 12)	**[View/Display] {I/Q Error (Quad View)}**
View the channel frequency response (Figure 13)	**[View/Display] {Channel Frequency Response}**
View the channel impulse response and turn on the equalizer (Figure 14)	**[View/Display] {Channel Impulse Response}** **[Meas Setup] {Advanced} {Equalization} On**
View the spectrum flatness (Figure 15)	**[View/Display] {Spectrum Flatness}**
View the TMCC decoding results (Figure 16)	**[View/Display] {TMCC Decoding}**
View the AC decoding results (Figure 17)	**[View/Display] {AC Decoding}**
View the MER vs. Segment results (Figure 18)	**[View/Display] {MER vs. Segment}**
View result metrics (Figure 19)	**[View/Display] {Result Metrics}**

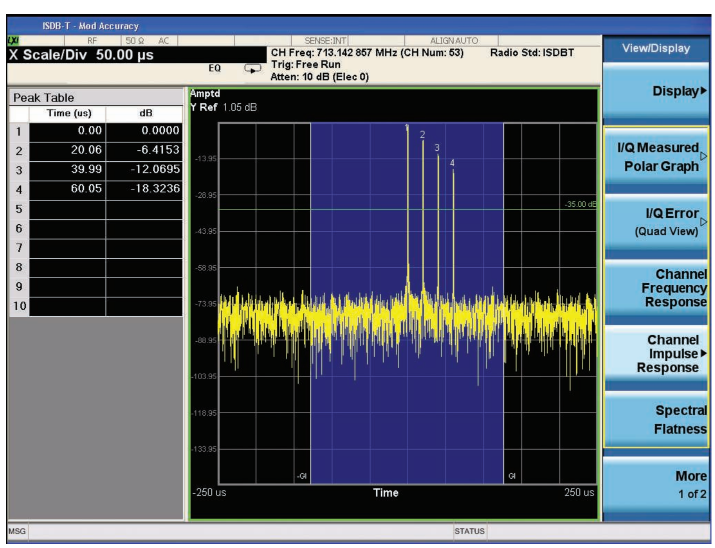


Figure 10. Channel impulse response view with multi-paths

Available views and traces in modulation accuracy:

- **I/Q measured polar graph** view (Figure 11): A view of I/Q measured data of the selected sub-carriers
  - Results metrics (left)
  - I/Q measured polar graph (right)

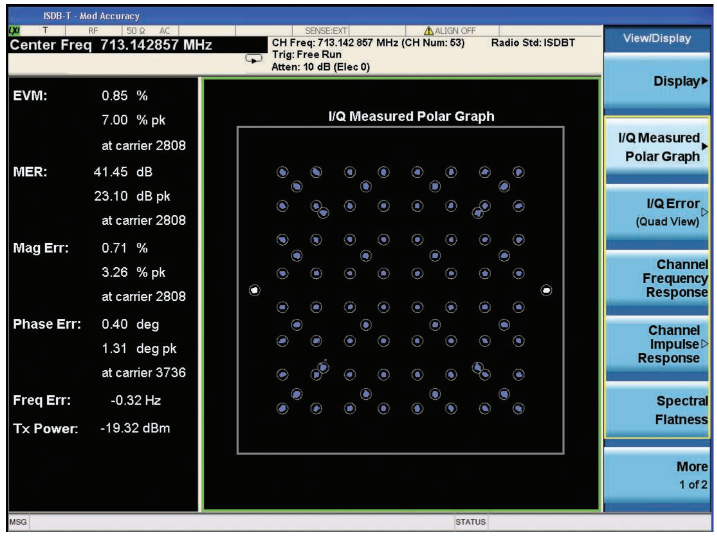


Figure 11. Modulation accuracy measurement with I/Q measured polar graph view

- **I/Q error** view (Figure 12): This is a four-window view which includes:
  - MER/EVM vs. sub-carrier/frequency (top left)
  - Segment map (top right)
  - Data segment/layer polar graph (bottom left)
  - Results metrics (bottom right)

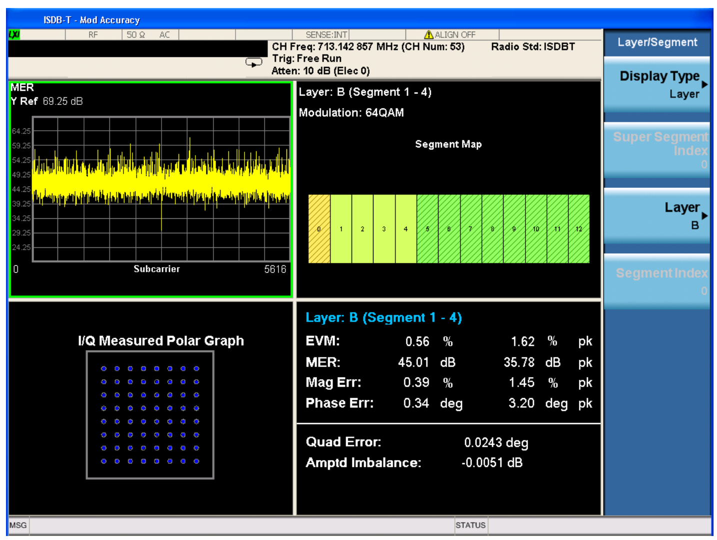


Figure 12. Modulation accuracy measurement with I/Q error view

Helpful tip:

In I/Q Error view, you can see the measurement results of each layer or segment by setting the display type. Four windows are displayed in Figure 12. The MER versus sub-carrier (top-left) window displays the MER result for the entire frame. The segment map window (top right), datasegment/layer polar graph window (bottom left), and result metrics window (bottom right) indicate the results for the selected display data.

– **Channel frequency response** view (Figure 13): This is a three-window view which includes:

– Amplitude vs. sub-carrier (top)

– Phase vs. sub-carrier (middle)

– Group delay vs. sub-carrier (bottom)

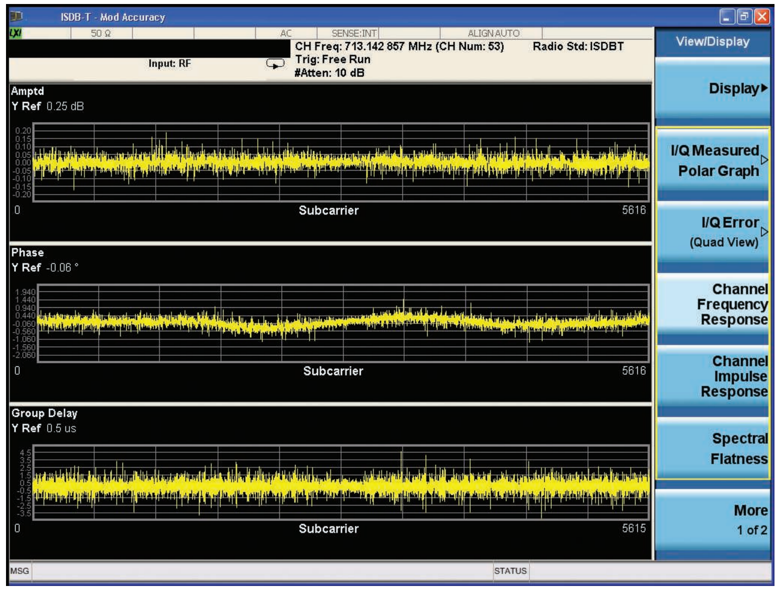


Figure 13. Modulation accuracy measurement with channel frequency response view

– **Channel impulse response** view (Figure 14): This two-window view displays the state of the channel in time domain which the signal has gone through.

◦ Peak table (left)

◦ Amplitude vs. time (right)

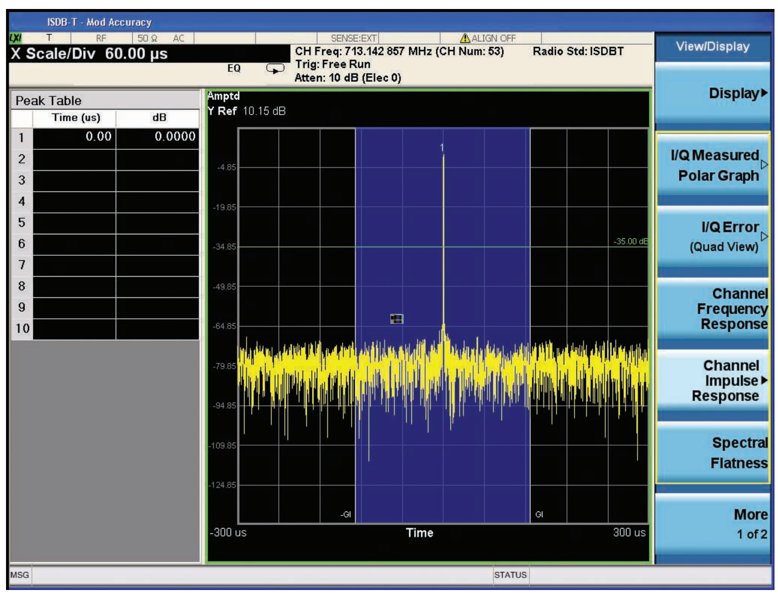


Figure 14. Modulation accuracy measurement with channel impulse response view

– **Spectrum flatness** view (Figure 15): This two-window view can be used to verify whether the spectrum flatness meets the transmitter or exciter device standard with a PASS/FAIL indicator and shows:

  – Amplitude vs. sub-carrier (top)

  – Results metrics (bottom)

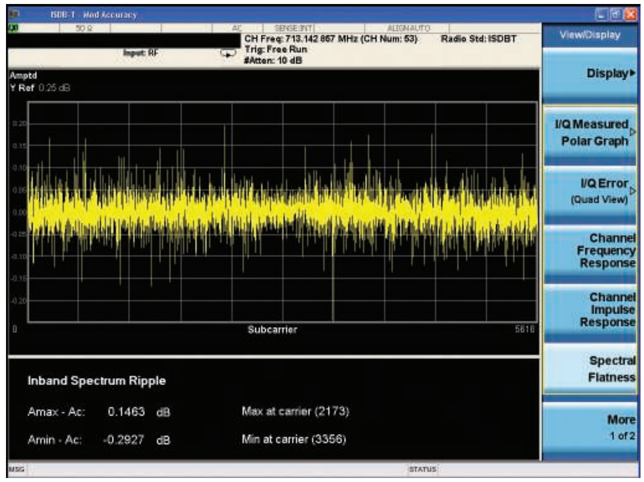


Figure 15. Modulation accuracy measurement with spectrum flatness view

– **TMCC decoding** view (Figure 16): This view displays TMCC decoding results and the corresponding current settings.

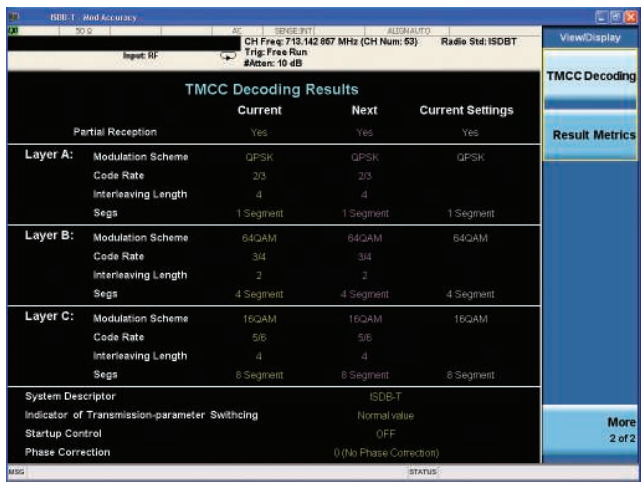


Figure 16. Modulation accuracy measurement with TMCC decoding view
The results in yellow with the title 'Current' show the current hierarchical configuration and transmission parameters, while the results in purple with the title 'Next' show the information for the next hierarchical configuration. The results in white in the right-most row indicate the current settings under mode setup, demod.

– **AC decoding** view (Figure 17): This view displays the earthquake alarm information carried in the AC bits.

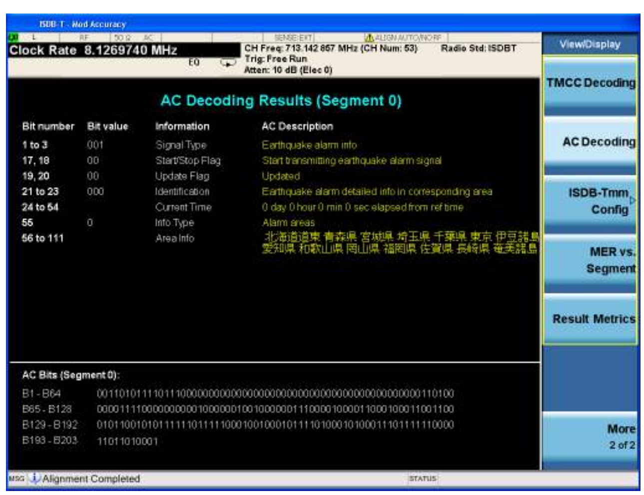


Figure 17. Modulation accuracy measurement with AC decoding view

– **MER vs. Segment** view (Figure 18): This view displays the MER result of each segment. The segment indexes numbered 13 to 32 are designed for ISDB-Tmm signals, so when the signal under test is an ISDB-T signal, the MER results for these indexes are all displayed as "---".

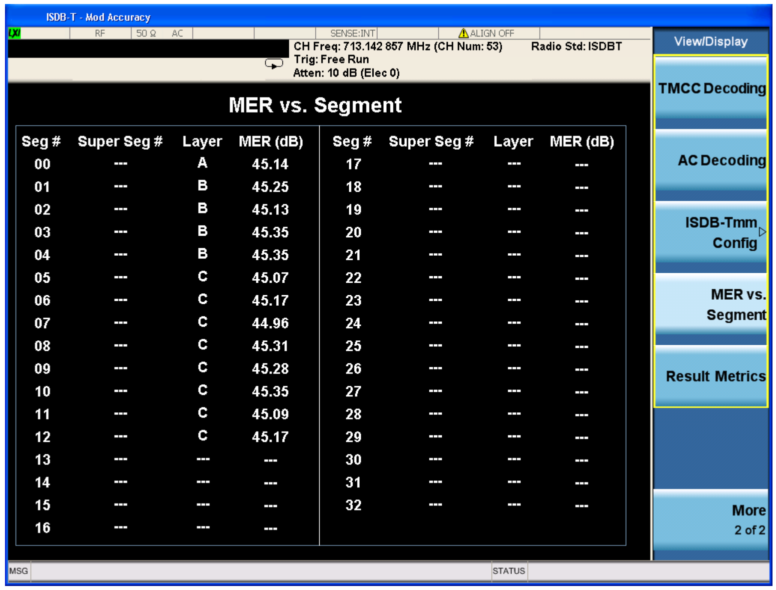


Figure 18. Modulation accuracy measurement with MER vs. Segment view

– **Result metrics** view (Figure 19): This view displays the summary of all the detailed numeric result metrics.

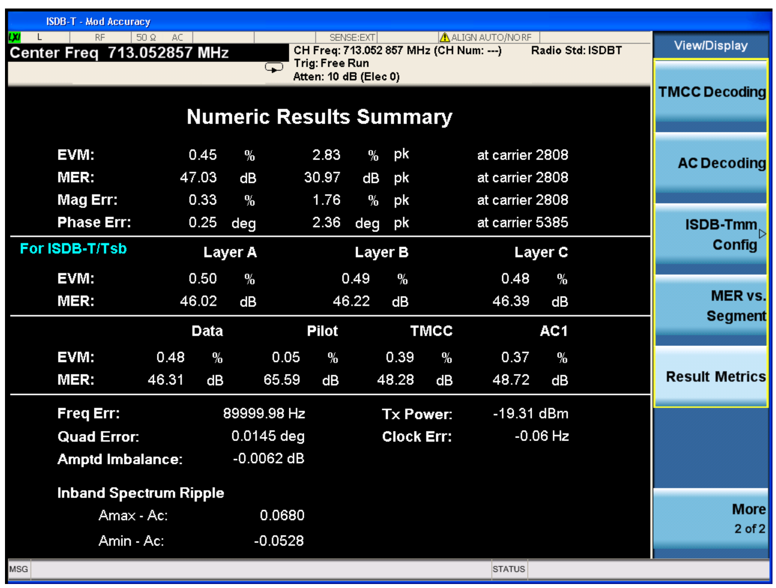


Figure 19. Modulation accuracy measurement with results metrics view

Helpful tip:

You can check the MER results using all the sub-carriers, layer A/B/C, data, pilot, TMCC, and AC1 in the result metrics view.

To make modulation accuracy measurements on ISDB-Tmm signals

Instructions	Keystrokes
On the X-Series signal analyzer:	
Select ISDB-Tmm standard	**[Mode Setup] {Radio Std} {ISDB-Tmm}**
Select the modulation accuracy measurement	**[Meas] {Mod Accuracy}**
If the signal under test is not compliant with the configuration A defined in the ISDB-Tmm operation guideline, import the configuration file [1] into the instrument.	**[Recall] {Data} {ISDB-Tmm Config} {Open ...}**
View the I/Q measured polar graph results (Figure 20)	**[View/Display] {I/Q Measured Polar Graph}**
View the I/Q error results (Figure 21)	**[View/Display] {I/Q Error (Quad View)}**
View the channel frequency response results (Figure 22)	**[View/Display] {Channel Frequency Response}**
View the channel impulse response results (Figure 23)	**[View/Display] {Channel Impulse Response}**
View the spectral flatness results (Figure 24)	**[View/Display] {Spectral Flatness}**
View the frame configuration of the current ISDB-Tmm signal (Figure 25)	**[View/Display] {ISDB-Tmm Config}**
View the MER vs. Segment results (Figure 26)	**[View/Display] {MER vs. Segment}**
View the result metrics (Figure 27)	**[View/Display] {Result Metrics}**

1. *The configuration file needs to be created according to the configuration of the Tmm signal under test. The configuration file of the default settings, named "ISDB-TmmConfig_Demo.csv" and located in the directory "D:\User_My_Documents\Instrument\My Documents\ISDBT\data\EVM", can be used as an example.*

Available views and traces in modulation accuracy for ISDB-Tmm signals:

- **I/Q measured polar graph** view (Figure 20): A view of I/Q measured data of the specified sub-carriers
  - Result metric (left)
  - I/Q measured polar graph (right)

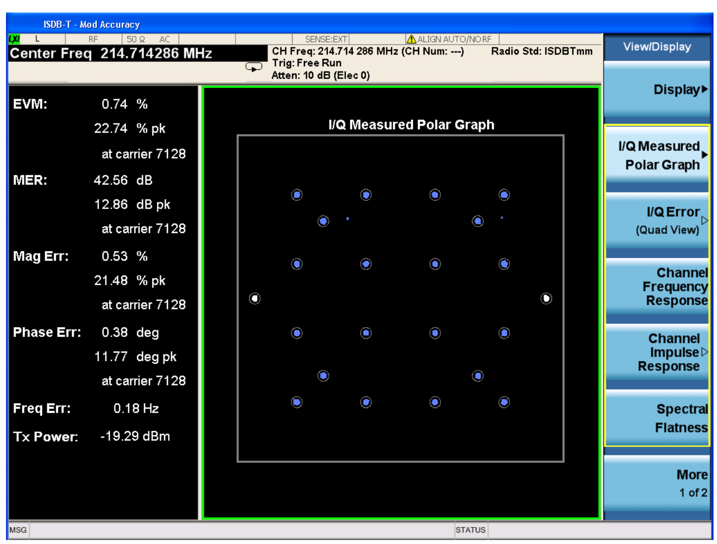


Figure 20. I/Q measured polar graph view for ISDB-Tmm signals

– **I/Q error (Quad View)** view (Figure 21): This is a four-window view which includes

  – MER/EVM vs. sub-carrier/ frequency (top left)

  – ISDB-Tmm frame structure (top right)

  – I/Q Measured Polar Graph (bottom left)

  – Results metrics (bottom right)

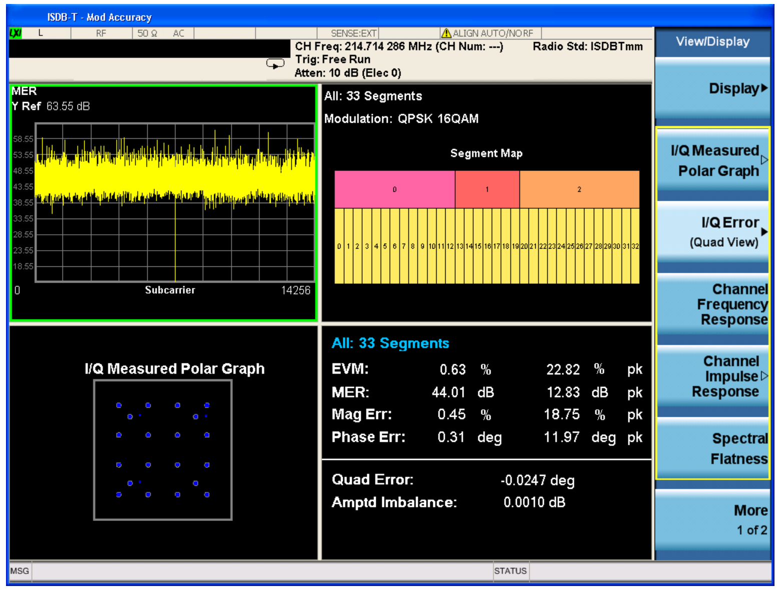


Figure 21. IQ error (Quad View) view for ISDB-Tmm signals

– **Channel frequency response** view (Figure 22): This is a three window view which includes:

  – Amplitude vs. sub-carrier (top)

  – Phase vs. sub-carrier (middle)

  – Group delay vs. sub-carrier (bottom)

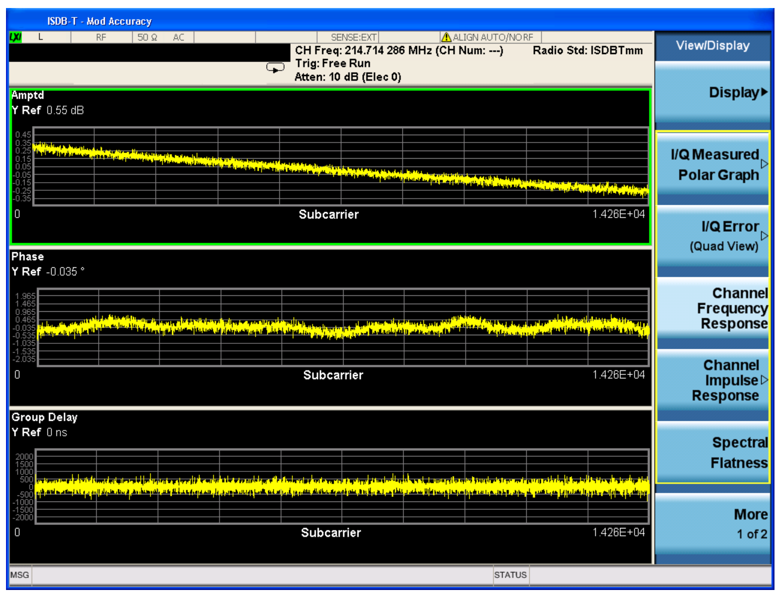


Figure 22. Channel frequency response view for ISDB-Tmm signals

Helpful tip:

Press **I/Q Error (Quad View)** again and then set the data to display on the screen using the keys in the menu. You can choose to see the results for a specified super segment, segment, or layer in a type A super segment.

– **Channel impulse response** view (Figure 23): This two-window view displays the state of the channel in time domain which the signal has gone through.

– Peak table (left)

– Amplitude vs. time (right)

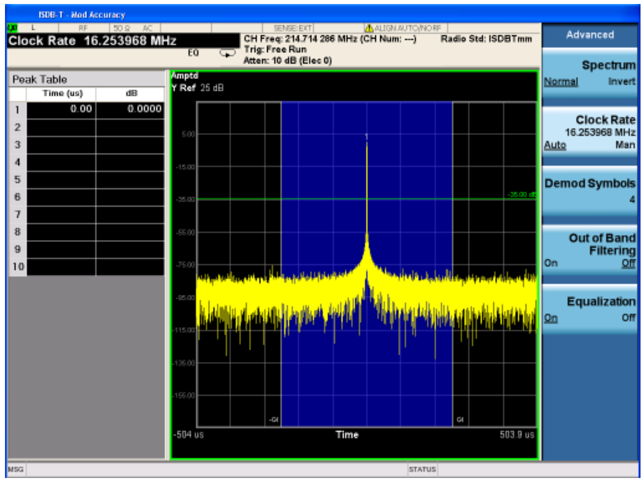


Figure 23. Channel impulse response view for ISDB-Tmm signals

– **Spectrum flatness** view (Figure 24): This two-window view shows the spectrum ripples in the transmission bandwidth.

– Amplitude vs. sub-carrier (top)

– Result metrics (bottom)

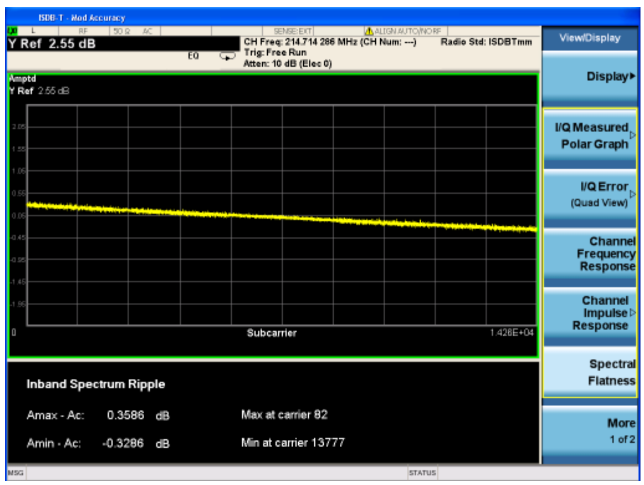


Figure 24. Spectrum flatness view for ISDB-Tmm signals

– **ISDB-Tmm Config** view (Figure 25): This view shows the configurations of each super segment of the ISDB-Tmm signal under test.

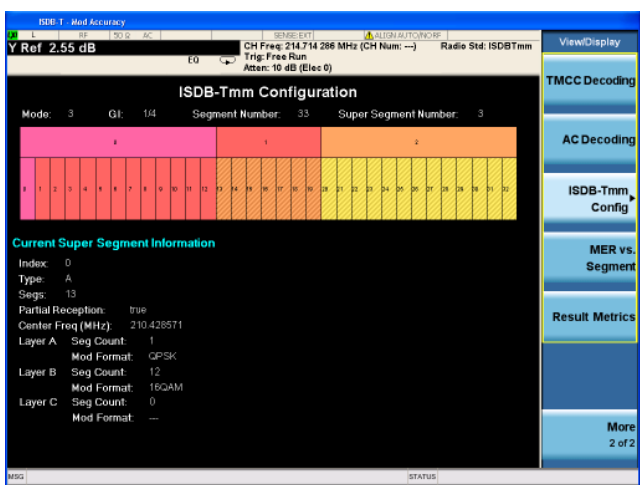


Figure 25. ISDB-Tmm config view for ISDB-Tmm signals

Helpful tip:

Press **ISDB-Tmm Config** again and enter the super segment index to view the configuration for a specified super segment.

– **MER vs. segment** view (Figure 26): This view shows the MER result on each segment.

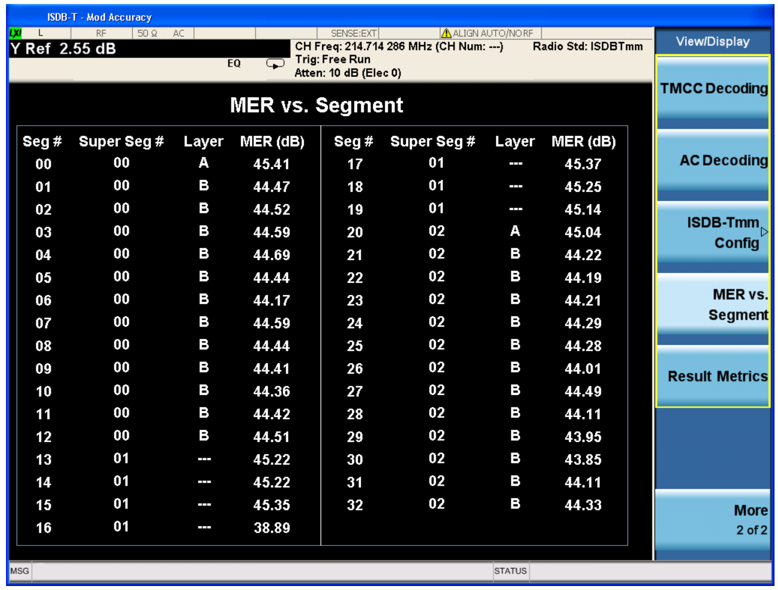


Figure 26. MER vs. Segment view for ISDB-Tmm signals

– **Result metrics** view (Figure 27): This view displays the summary of all the detailed numeric result metrics.

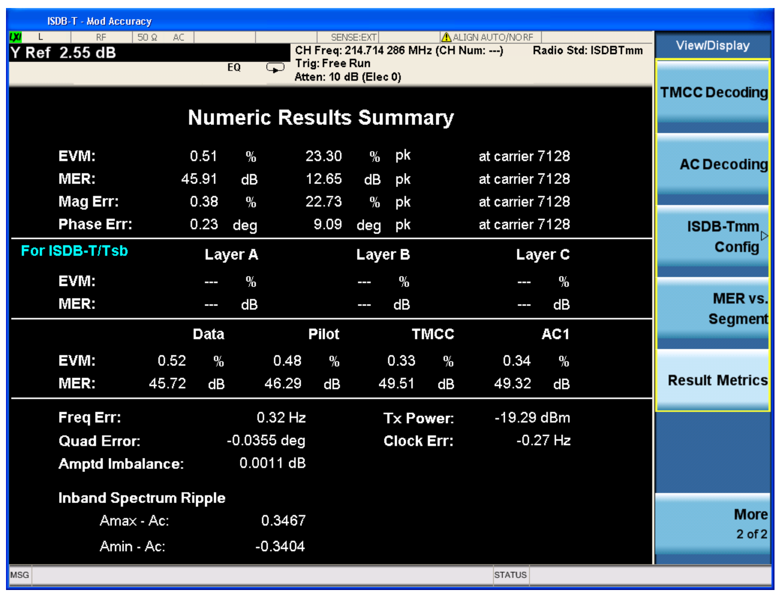


Figure 27. Result metrics view for ISDB-Tmm signals

Demonstration 7:

Occupied bandwidth

The ISDB-T specifications require the occupied frequency bandwidth of the ISDB-T signal to be less than 5.7 MHz. The occupied frequency bandwidth is defined as the bandwidth containing 99% of the total power.

Instructions	Keystrokes
On the X-Series signal analyzer:	
Measure the occupied bandwidth (Figure 28)	**[Meas] {Occupied BW}**
Adjust the parameters	**[Meas Setup]**

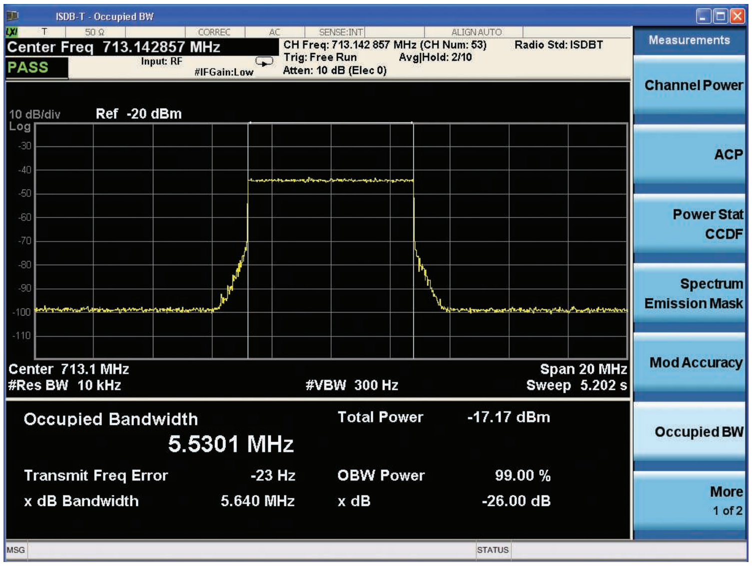


Figure 28. Occupied bandwidth measurement

Demonstration 8:

Monitor spectrum

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

Instructions	Keystrokes
On the X-Series signal analyzer:	
Activate monitor spectrum measurement	**[Meas] {Monitor Spectrum }**

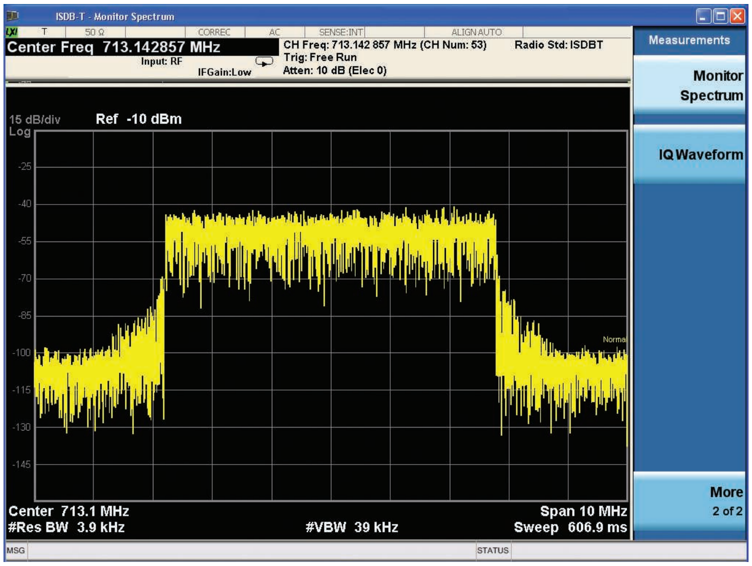


Figure 29. Monitor spectrum measurement

Demonstration 9:

IQ waveform

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

Instructions	Keystrokes
On the X-Series signal analyzer:	
Activate IQ waveform measurement (RF envelope default)	**[Meas] {IQ Waveform}**
View the I/Q waveform	**[View/Display] {I/Q Waveform}**

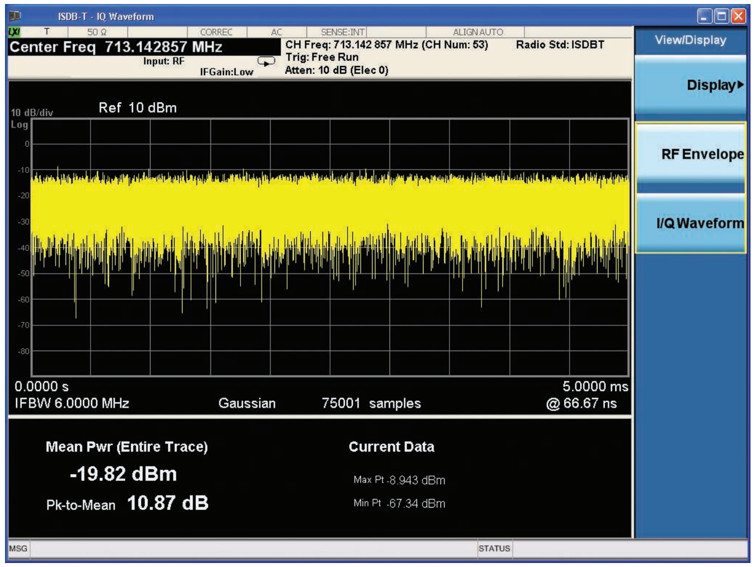


Figure 30. Waveform measurement with RF envelope view

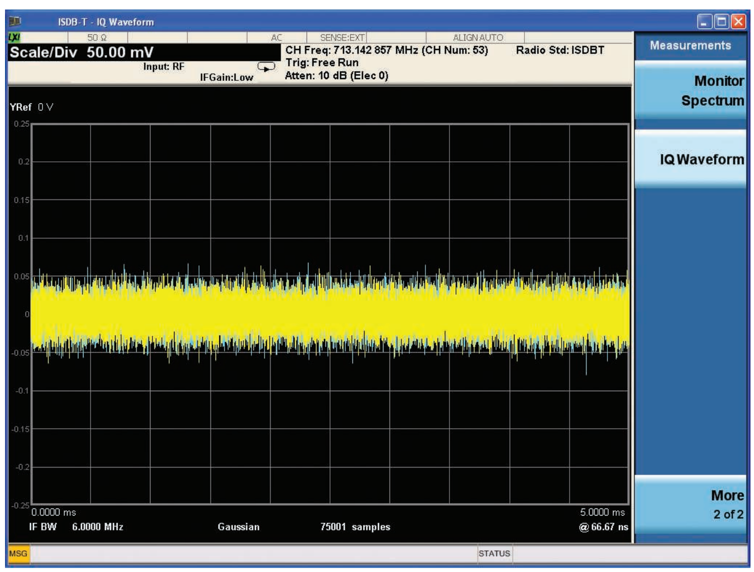


Figure 31. Waveform measurement with I/Q waveform view

Appendix A:

Using amplitude correction in the spectrum emission mask measurement

The dynamic range of the RF output of an actual ISDB-T/T_{SB} transmitter typically exceeds the dynamic range of the analyzer. Therefore, the direct measurement result is always "FAIL" and cannot reflect the actual RF output.

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

Method 1: Figure 32 shows a diagram of the spectrum mask measurement when the ISDB-T/T_{SB} transmitter has an output filter.

The steps for measuring the spectrum mask are as follows:

1. Measure the frequency response of the output filter using a network analyzer or a combination of signal source and signal analyzer.
2. Measure the signal transmitted at point A as shown in Figure 32.
3. Apply amplitude correction on the spectrum value measured in (2) using the filter's response from (1).

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

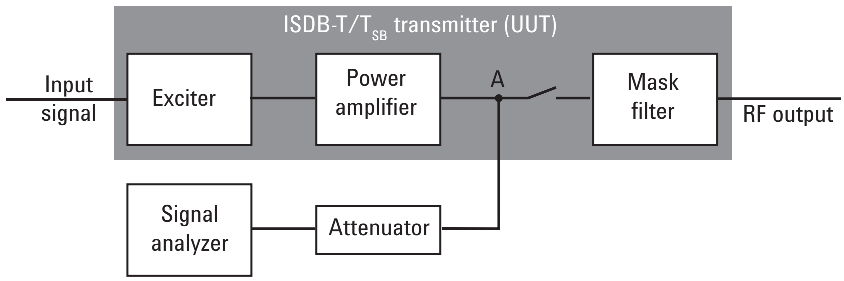


Figure 32. Diagram for spectrum mask measurement on ISDB-T/T_{SB} transmitter with mask filter

Method 2: If the transmitter does not have an output filter, an external filter with a band-block filter frequency response should be added after the transmitter for the measurement arrangement, as shown in Figure 33.

The steps for measuring the spectrum mask are as follows:

1. Measure the frequency response of the output filter using a network analyzer or a combination of signal source and signal analyzer.
2. Measure the signal transmitted at point B as shown in Figure 33.
3. Apply amplitude correction on the spectrum value measured in (2) using the filter's response from (1).

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

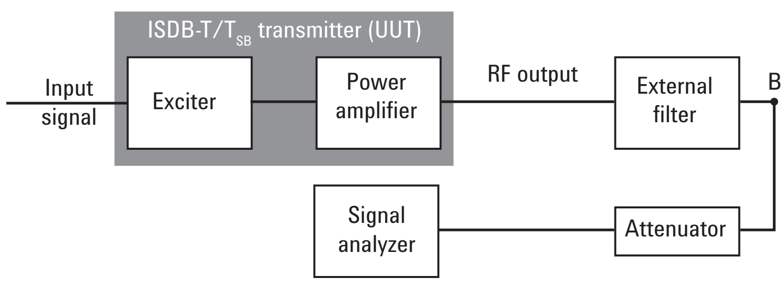


Figure 33. Diagram for spectrum mask measurement on an ISDB-T/T_{SB} transmitter without output filter

Appendix B:

The transmission spectrum mask defined in ARIB STD B31 (Version 1.7)

The ISDB-T transmission-spectrum mask defined in ARIB STD B31 is shown in Figure 34 and the related breakpoints are listed in Table 1.

Different spectrum masks should be applied if the following factors change:

– Whether an adjacent channel is used for analog TV or not
– Whether the power in the adjacent channel is more than or equal to 10 times the ISDB-T channel power or not

To correctly apply the spectrum mask in N6155A SEM measurement, follow the actions in Table 2 according to each use case.

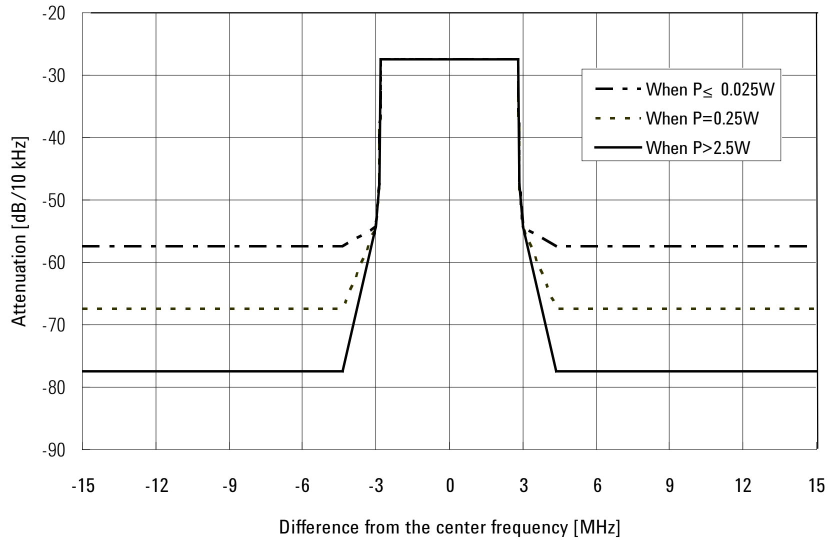


Figure 34. Transmission-spectrum mask for ISDB-T in ARIB STD B31 (Version 1.7)

Table 1. Breakpoints for the transmission-spectrum mask

Difference from the center frequency (MHz)	Attenuation relative to average power P (dB/10 kHz)	Type of stipulation
± 2.79	–27.4	Upper limit
± 2.86	–47.4	Upper limit
± 3.00	–54.4	Upper limit
± 4.36	–77.4/–67.4/–57.4/–(73.4+10logP)	Upper limit

Table 2. Actions required for compliance with the spectrum mask in ARIB STD B31 (Version 1.7)

Channel power P	Is adjacent channel used for analog TV?	Does the analog TV have more than or equal to 10 times the channel power?	Offset D limit (±(4.36~15) MHz from carrier frequency) (dB/10 KHz)	Mask under JEITA to be used
P > 2.5 W	Yes/No	Yes/No	–77.4	Auto sense
2.5 W ≥ P > 0.25 W	No	Yes/No	–(73.4+10logP)	Auto sense
	Yes	Yes	–(73.4+10logP)	Auto sense
	Yes	No	–77.4	50 dB mask
0.25 W ≥ P > 0.025 W	No	Yes/No	–(73.4+10logP)	Auto sense
	Yes	Yes	–67.4	40 dB mask
	Yes	No	–77.4	50 dB mask
0.025 W ≥ P	No	Yes/No	–57.4	Auto sense
	Yes	Yes	–67.4	40 dB mask
	Yes	No	–77.4	50 dB mask

Web Resources

Product page:
www.Keysight.com/find/n6155a and
www.Keysight.com/find/w6155a

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

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

Digital video industry web page:
www.Keysight.com/find/digitalvideo

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