Keysight Technologie's Conduct DVB-T/H Conformance Tests with Keysight's Real-Time DVB-T/H Digital Video Solution

Application Note

Introduction

DVB-T is the most widely used digital television standard for terrestrial television transmissions. DVB-H is an extension of DVB-T, which is optimized for mobile television transmissions. They use OFDM technology and a range of specifications including:

– 3 modulation options (QPSK, 16QAM, 64QAM): There is a balance between the rate at which data can be transmitted and the signal to noise ratio that can be tolerated
– Different FEC rates: Error correction uses convolutional coding and Reed Solomon coding with code rates of 1/2, 2/3, 3/4, 5/6, or 7/8, depending upon the requirements
– 2k, 4k, or 8k carriers with four guard interval options: 1/4, 1/8, 1/16, 1/32 to provide broadcasters with network planning flexibility
– 5, 6, 7, or 8 MHz channel bandwidths for variable available bandwidth and channel separation

Keysight Technologies, Inc. provides real-time and arbitrary DVB-T/H signal sources which fully support all of these features. Conformance test for DVB-T/H receivers can be conducted using the N5106A PXB, N7623B Signal Studio for digital video, and N5182A MXG.

This application note provides an introduction to the performance test requirements for DVB-T/H receivers, as defined in EICTA MBRAI 2.0, and describes test setup and configurations for N5106A PXB, N5182A MXG, and N7623B Signal Studio for digital video.

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Overview of Requirements for Receiver Performance

EICTA MBRAI 2.0[2][3] includes system information as well as specifications for minimum RF performance. The defined conformance measurements include:

- C/N performance, including Gaussian, indoor, outdoor, and mobile environments
- Receiver minimum and maximum input signal levels
- Immunity to analog and/or digital signals in other channels
- Immunity to co-channel interference from analog TV signals
- Guard interval utilization: echoes within guard interval
- Guard interval utilization: echoes outside the guard interval
- Tolerance to impulse interference
- GSM900 TX signal blocking test
- Mobile SFN channel test

Four different degradation criteria are used in MBRAI 2.0 Part 2[3]

a) Reference BER, defined as BER = 2 x 10^{-4} after Viterbi decoding
b) Picture failure point (PFP), defined as the C/N when picture errors become visible. This is preferred when BER measurements are unstable or unavailable.
c) Subjective failure point (SFP) in mobile reception
d) DVB-H error criterion: MPE-FEC frame error rate (MFER)

Some receivers can provide reference BER and some cannot, in which case b and c are used.

PXB and N7623B in Brief

The N5106A PXB baseband generator and channel emulator is a multi-channel baseband signal generator. At the heart of the PXB are its configurable DSP blocks which can be configured to act as baseband generators or faders to suit the test needs. The PXB has reconfigurable architecture with internal signal routing so it can be easily configured for different tests through the GUI and SCPI.

For DVB-T/H conformance testing, the PXB can be configured with one baseband card, including 2 DSP blocks. One DSP block can be used for real-time or arbitrary DVB-T/H signals; the other can be used for fading or interference signal generation if the dynamic range is enough, as with analog TV signals, GSM signals, etc. AWGN can also be added to the wanted signal in the PXB.

N7623B Signal Studio for digital video provides digital video signals for almost all main digital video standards, such as the DVB Series, CMMB, ISDB-T, and ATSC. The waveforms generated by N7623B can be downloaded and played back on the E4438C ESG, the N5182A MXG, and N5106A PXB. The memory size of the PXB is 512 MSa, so the playback time for DVB-T/H waveforms can be more than 1 minute, which is long enough for all the tests. Together with the PXB, N7623B can also provide real time DVB-T/H signal sources, in which the configurations for the DVB-T/H signals can be changed in real time. You can use the real time DVB-T/H signal sources as wanted signal and arb (arbitrary waveform) sources as interference signals.

Keysight also provides a tool, which works with MXG, to generate impulse noise for tolerance to impulse interference tests and provides analog TV signal waveforms which can be used as interference signals.

Test Setup and Configuration

Conformance testing requires wanted signals as well as impairments, such as interference signal, fading, and AWGN. The wanted DVB-T/H signal is generated by the N5106A PXB and then up-converted to RF frequency through the MXG.

Figure 1 shows the test system for C/N performance testing, receiver minimum and maximum input signal levels testing, guard interval utilization testing, and mobile SFN channel testing. Fading and AWGN can be added to the wanted signal in the N5106A PXB.

Figure 1. Conformance test system 1

Figure 2 shows the test system for immunity to interference testing, tolerance to impulse interference testing, and GSM900 TX signal blocking testing. The wanted signal and the interference signals are combined at RF level. Only for immunity to interference testing, with patterns L1, L2, and L4 is the third MXG needed.

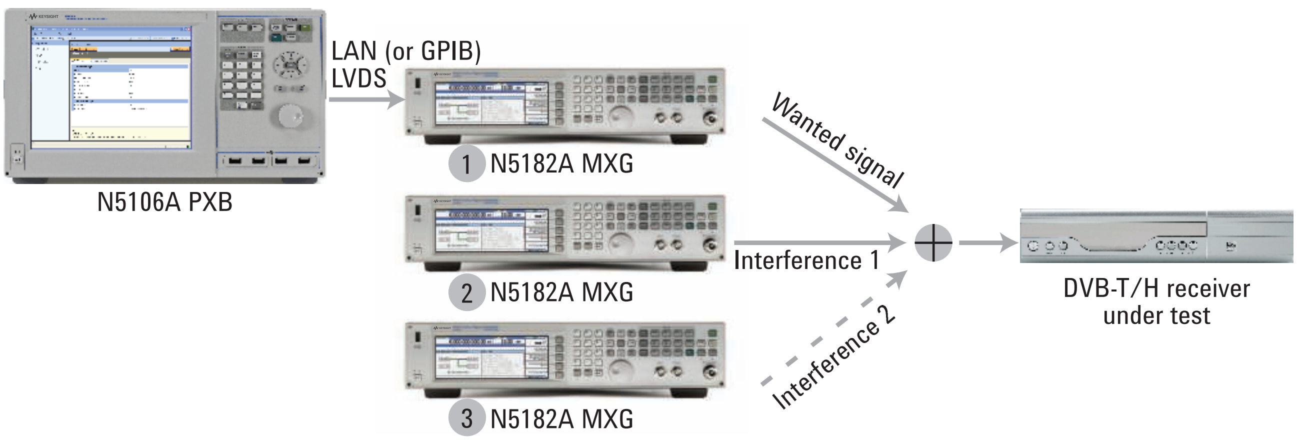


Figure 2. Conformance test system 2

MBRAI conformance measurements supported by the above test systems are listed in the table below.

Measurements	Test system
C/N performance	Conformance test system 1
Receiver minimum and maximum input signal levels	Conformance test system 1
Immunity to interference test	Conformance test system 2
Guard interval utilizations	Conformance test system 1
Tolerance to impulse interference	Conformance test system 2
GSM900 TX signal blocking test	Conformance test system 2
Mobile SFN channel test	Conformance test system 1

Table 1. Test system for each measurement

Test Setup and Configuration, Continued

The configurations for each model are listed in the following table.

Model number	Options	Description
N5106A PXB – Option 186	612	2 DSP blocks on 1 baseband card
	632	2 I/O ports - 2 analog I/Q out and 2 digital I/O on 1 I/O card
	EFP	Baseband generation
	JFP	Calibrated AWGN
	QFP	Fading with SISO channel models
1 N5182A MXG	503	Frequency range from 250 kHz to 3 GHz
2 N5182A MXG (as interference 1)	503	503 Frequency range from 250 kHz to 3 GHz
	652 or 654	Internal baseband generator
	UNT	AM, FM, phase modulation
	403	Calibrated AWGN
	099	Expanded license key upgradeability
	1EA	High output power with electronic attenuator (requires Option 099)
3 N5182A MXG (as interference 2 for analog interference)	503 651, 652, or 654	Frequency range from 250 kHz to 3 GHz Internal baseband generator
N7623B Signal Studio for digital video	6FP	Connect to N5106A PXB
	3FP	Connect to N5182A MXG (interference 1)
	QFP	Advanced DVB-T/H (interference 1)
	EFP	Advanced real-time DVB-T/H (in PXB)

Table 2. Configurations for each model

C/N performance

C/N performance testing is conducted to measure the receiver's performance with the presence of fading and noise. C/N performance in Gaussian channel, portable channel, portable indoor (PI), portable outdoor (PO), and mobile channels are defined in the specifications.

Using test system 1, set the output of the MXG to make sure the power of the DVB-T/H signal is -50 dBm (at the receiver point) and the frequency is 666 MHz. DVB-T/H signals with QPSK, 16-QAM, 64 QAM and code rates of 1/2, 2/3, and 3/4 are needed.

C/N performance in Gaussian channel

The PXB can add AWGN signals to the wanted signal to simulate the Gaussian channel.

The following section first introduces the settings in the PXB, and then describes the measurement procedure.

PXB settings

1. Configure the PXB as shown in Figure 3. One DSP is used as the baseband generator to generate real time DVB-T/H signals.
2. Configure the basic DVB-T/H settings (for example), as shown in Figure 4, and load the payloads needed as shown in Figure 5. The TS file can be stored on the hard disk of the PXB.
3. Turn on AWGN and set the bandwidth of the Gaussian signals and C/N as shown in Figure 6. The *Signal to Noise Ratio* on the interface corresponds to the C/N defined in the specifications.

Measurement procedure

Decrease the C/N by changing the signal-to-noise ratio value in Figure 6 until the degradation criteria is met. If this C/N is lower than that defined in the specifications, it means the receiver passes this test. Repeat the measurements to cover all the cases defined in the specifications[2][3].

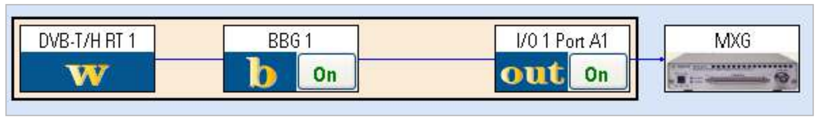


Figure 3. PXB configured as 1 channel

DVB-T/H Settings | Payload Settings

1. Basic Settings	
Mode	2K
Bandwidth	8 MHz
Modulation Type	QPSK
Guard Interval	1/4
Cell ID Enabled	On
Cell ID	0
Code Rate	1/2
Baseband Filter	On
2. DVB-H Settings	
DVB-H Enabled	Off
Interleaver	Native Interleaver

Figure 4. Basic DVB-T/H settings

DVB-T/H Settings | Payload Settings

1. Payload Settings	
Data Source Type	**TS File**
Packet Stuffing	On
PCR_PID	**0x0021**
File Name	**C:\agilent.ts**

Figure 5. Payload settings

General Settings | AWGN Settings | Marker Selection | AWGN Graphics

AWGN	
AWGN Enabled	**On**
Crest Factor	12.88 dB
Integration Bandwidth	**7.610000 MHz**
Noise Bandwidth	10.000000 MHz
Units	SNR
Signal To Noise Ratio	**20.00 dB**
Optimization	Constant Noise Power
Output MUX	Signal + Noise
Signal Power	
Total Power	-9999.99 dBm

Figure 6. AWGN settings in the PXB

C/N performance in fading channels

Fading channels include the portable channel, the PI/PO channel, and the mobile channel. This section first introduces the settings in the PXB, and then describes the measurement procedures.

PXB Settings

1. Configure the PXB as shown in Figure 7. Here, two DSP blocks are used, one DSP block to generate the baseband signal, and the other to simulate multi-path fading.
2. Set up the parameters for real-time DVB-T/H signals and load the payloads as shown in the example in Figure 8.
3. Choose the fading profiles to be used by exploring the channel models under *Fader 1 Channel Model, DVB on the interface* (see Figure 9). All the fading profiles defined in MBRAI 2.0 Part 1 have been preset in the N5106A PXB as shown in Figure 9, allowing users the convenience of selecting them directly instead of manually setting them up.

Figure 7. PXB configuration for multipath fading testing

DVB-T/H Settings | Payload Settings

1. Basic Settings	
Mode	2K
Bandwidth	8 MHz
Modulation Type	QPSK
Guard Interval	1/4
Cell ID Enabled	On
Cell ID	0
Code Rate	1/2
Baseband Filter	On
2. DVB-H Settings	
DVB-H Enabled	Off
Interleaver	Native Interleaver

Figure 8. DVB-T/H basic setting

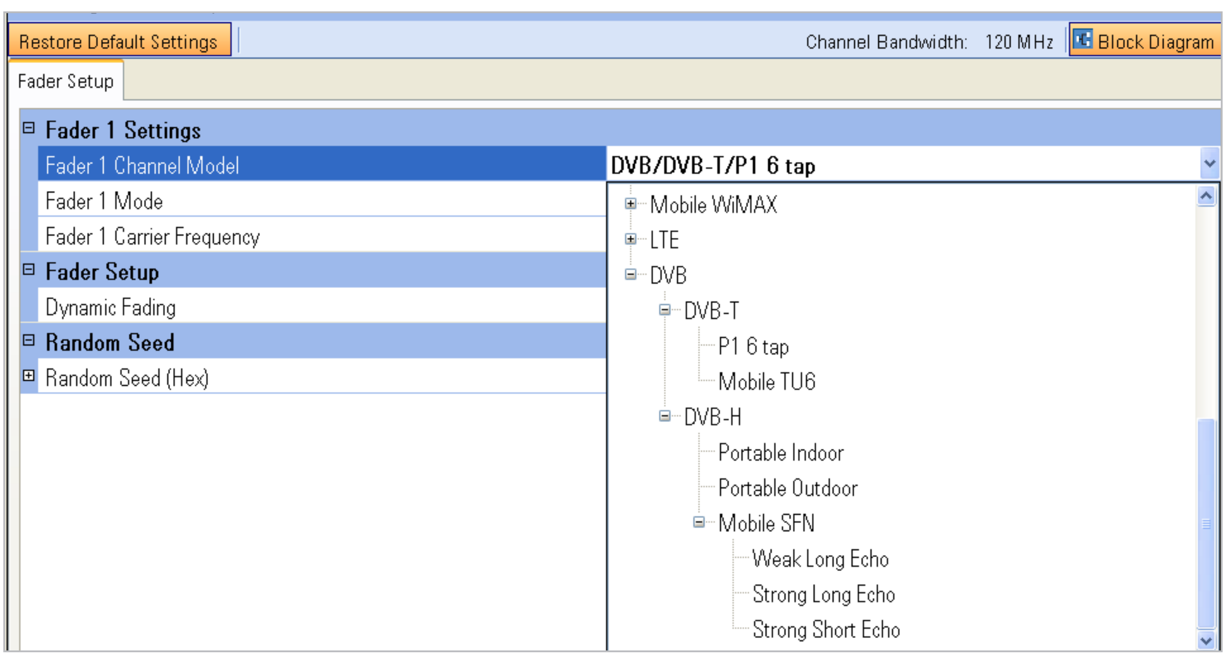


Figure 9. Preset channel profiles

Note that for mobile channel profiles, you need to adjust the Doppler frequency as defined in the specifications under *Fader 1 Paths*, as shown in Figure 10. Figure 10 is an example of the predefined TU 6 channel profile under mobile reception.

4. Set up the C/N as shown in Figure 11.

Measurement procedure for the portable and PI/PO channels

Decrease the C/N by changing the signal-to-noise ratio value in Figure 11 until the degradation criteria is met. If this C/N is lower than that defined in the specifications, it means the receiver passes the test. Repeat the measurement to cover all the cases defined in the specifications[3].

Measurement procedure for the mobile channel

1. Set the Doppler frequency to 10 Hz as shown in Figure 10, then decrease the C/N by changing the signal-to-noise ratio value in Figure 11 until the degradation criteria is met. Record this C/N as "C/N_{min}," which is for the TP4 point in MBRAI Part1.
2. Set the C/N to (specified C/N_{min} + 3 dB), increase the Doppler frequency until the degradation criteria is met. Record this Doppler frequency as "Fd_{3dB}."
3. Turn off the AWGN as shown in Figure 6, increase the Doppler frequency until the degradation criteria is met. Record this Doppler frequency as "Fd_{max}." Note that all C/N_{min}, Fd_{3dB}, and Fd_{max} need to meet the requirements in the specifications.
4. Repeat the measurement to cover all the cases defined in the specifications[3].

Fading : Fader1 Paths

Restore Default Settings | Columns | Channel Bandwidth: 120 MHz

Path	Enabled	Fading Type	Spectral Shape	Delay Type	Delay	Loss	Doppler Frequency	Phase Shift	Frequency Offset
1	☑	Rayleigh	Classical 6dB	Fixed	0.0000 µs	3.00 dB	10.000 Hz	0.00 °	0.00 Hz
2	☑	Rayleigh	Classical 6dB	Fixed	0.2000 µs	0.00 dB	10.000 Hz	0.00 °	0.00 Hz
3	☑	Rayleigh	Classical 6dB	Fixed	0.5000 µs	2.00 dB	10.000 Hz	0.00 °	0.00 Hz
4	☑	Rayleigh	Classical 6dB	Fixed	1.6000 µs	6.00 dB	10.000 Hz	0.00 °	0.00 Hz
5	☑	Rayleigh	Classical 6dB	Fixed	2.3000 µs	8.00 dB	10.000 Hz	0.00 °	0.00 Hz
6	☑	Rayleigh	Classical 6dB	Fixed	5.0000 µs	10.00 dB	10.000 Hz	0.00 °	0.00 Hz

Figure 10. Doppler frequency settings in mobile channels

General Settings | AWGN Settings | Marker Selection | AWGN Graphics

AWGN	
AWGN Enabled	On
Crest Factor	12.88 dB
Integration Bandwidth	**7.610000 MHz**
Noise Bandwidth	10.000000 MHz
Units	SNR
Signal To Noise Ratio	**20.00 dB**
Optimization	Constant Noise Power
Output MUX	Signal + Noise
Signal Power	

Figure 11. C/N settings

Receiver minimum and maximum input signal levels

The purpose of the receiver minimum and maximum input signal levels test is to measure the operational power range of DVB-T/H receiver under test. Refer back to Figure 1 to see this test system. The DVB-T/H signal to be tested is QPSK with a code rate of 1/2. The following section first introduces the settings in the PXB, and then describes the measurement procedures.

PXB settings

1. Configure the PXB as shown in Figure 12. One DSP is used as a baseband generator to generate real time DVB-T/H signals.
2. Set up the basic DVB-T/H settings and load the payloads as shown in the example in Figure 13.

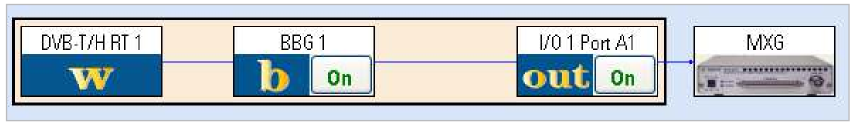


Figure 12. PXB configured as 1 channel

Measurement procedure

In this test, the loss of the cable (X dB) connecting the MXG and the DVB-T/H receiver needs to be taken into consideration. The measurement procedure is as follows:

1. Decrease the power level of the MXG output until the receiver meets the degradation criteria. Record the power level as “Min.” The minimum input level is (Min-X) dB, which needs to be lower than that defined in section 6.2, MBRAI 2.0 Part 2[3].
2. Increase the power level to the defined maximum power level plus X dB. If the signal’s quality is above the degradation criteria, it means the receiver passes this test.
3. Repeat the measurement to cover all the frequencies defined in the specifications[3].

DVB-T/H Settings | Payload Settings

1. Basic Settings	
Mode	2K
Bandwidth	8 MHz
Modulation Type	QPSK
Guard Interval	1/4
Cell ID Enabled	On
Cell ID	0
Code Rate	1/2
Baseband Filter	On
2. DVB-H Settings	
DVB-H Enabled	Off
Interleaver	Native Interleaver

Figure 13. Basic DVB-T/H settings

Immunity to interference

The immunity to interference test is conducted in order to ensure consistent receiver quality in the presence of strong interference neighboring the wanted signal channel.

The test system configuration in the immunity to interference test is shown in Figure 2. The interference signals are generated in one or two MXGs using their respective arbitrary waveform generators, together with the N7623B QFP advanced DVB-T/H option.

In MBRAI, immunities to S1, S2, L1, L2, L3, and L4 patterns and co-channel interference from analog TV signals are defined. Below, the patterns are described in two categories.

Category 1: Immunity to patterns S1, S2, L3, and co-channel interference from analog TV signals, where one MXG is used to generate interference signals.

- Pattern S1: Analog interference signal on N+1 or N+2 at channel 45 (666 MHz) in UHF and channel 8 (199 MHz) in VHF.
- Pattern S2: Interference DVB-T/H signal on N+1 or N+2 at channel 45 in UHF and channel 8 in VHF.
- Pattern L3: One DVB-T/H interference signal on N+4 and another DVB-T/H interference signal on N+2 at channels 21, 45 and 64 in UHF and channel 8 in VHF. Use the multi-carrier function of N7623B QFP to generate these two interference signals in one waveform.
- Co-channel analog interference at channel 45 in UHF.

Category 2: Immunity to patterns L1, L2, and L4, where two MXGs are used to generate interference signals.

- Pattern L1: One analog interference signal on N+4 and one DVB-T/H interference signal on N+2 at channels 21 (474 MHz), 45 and 64 (818 MHz) in UHF and channel 8 in VHF.
- Pattern L2: One analog interference signal on N+4 and another analog interference signal on N+2 at channels 21, 45 and 64 in UHF and channel 8 in VHF.
- Pattern L4: One analog interference signal at channel 5 (177.5 MHz) and one DVB-T/H interference signal at channel 21, while the wanted signal is at channel 43 (650 MHz).

The wanted and interference DVB-T/H signals, as well as the analog signals in the test are outlined in the following example:

- Wanted real-time DVB-T/H signals: 2k mode, 16 QAM, 1/2 code rate, and 1/8 guard interval (generated by N7623B-EFP)
- Interference DVB-T/H signals: 2k mode, 16 QAM, 1/2 code rate, and 1/8 guard interval (generated by N7623B-QFP)
- Analog signals: PAL-D. Keysight provides PAL-D waveforms which can be loaded directly into the MXG.

The following section first introduces the settings in the PXB and the N7623B, and then describes the measurement procedure.

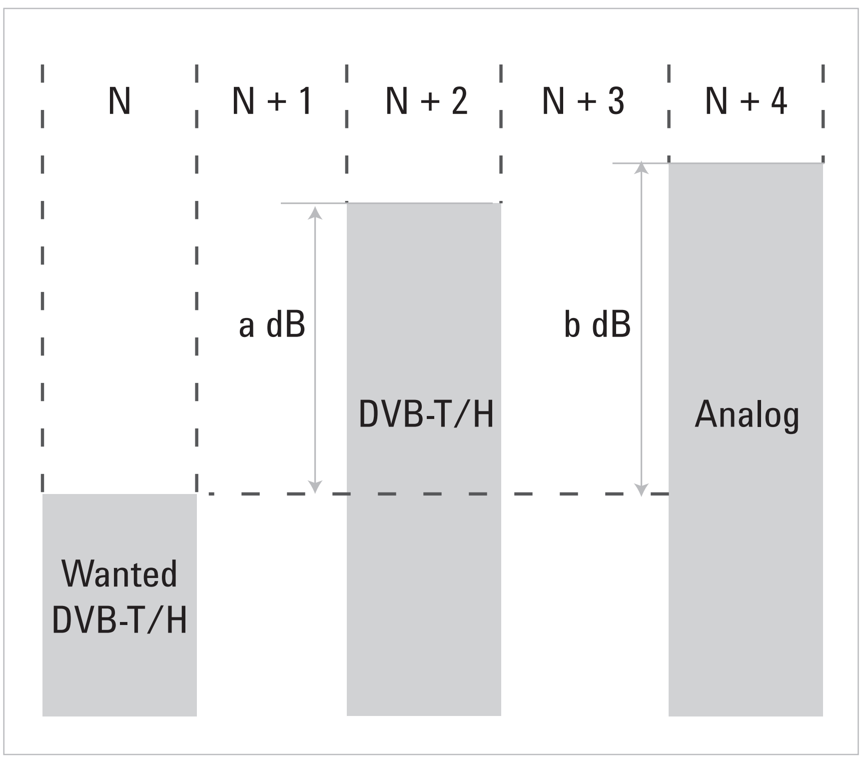


Figure 14. Immunity pattern (pattern L1 is shown as an example)

Setting up the PXB to generate wanted real-time DVB-T/H signals

1. Configure the PXB as 1 channel. One DSP is used as a baseband generator to generate real-time DVB-T/H signals.
2. Configure the basic DVB-T/H settings and load the payloads as shown in Figure 16.

Setting up the N7623B-QFP to generate DVB-T/H interference

The DVB-T/H interference waveform is generated with N7623B-QFP and then downloaded in to the N5182A MXG, which can generate RF signals. Set up the parameters for DVB-T/H interference as shown in Figure 17.

Note that the N7623B-QFP supports multi-carrier functions. By setting the frequency offset on each carrier, you can generate DVB-T/H waveforms with multiple carriers for different channels. This function can be used to generate the DVB-T/H interference waveform on the N+2 and N+4 channels in pattern L3 instead of using two MXGs. For the interference waveform on the N+2 and N+4 channels, the center frequency of the waveform should be on the N+3 channel, while the frequency offset for each of the carriers are +8 MHz and -8 MHz, respectively.

Measurement procedure

1. Set the power of the interference signals on MXGs to the maximum allowable levels (for example, -25 dBm) defined in section 7.2, in MBRAI 2.0 Part 2[3]. Set the center frequency of all MXGs according to the specifications to make sure the interference signals are on the required channels.
2. Configure the PXB and N7623B EFP/QFP to generate and load the wanted and interference signals as defined in sections 10.9 and 10.10, MBRAI 2.0 Part 1[2].
3. Decrease the power of the wanted DVB-T/H signals and observe the quality of the video on the receiver. Once the degradation criteria is met, record the difference between the interference signal and the wanted signal. If the difference is higher than the value defined in the specifications[3], it means the receiver passes this test.
4. Repeat the test to cover all the modes and interference patterns defined in the specifications[3].

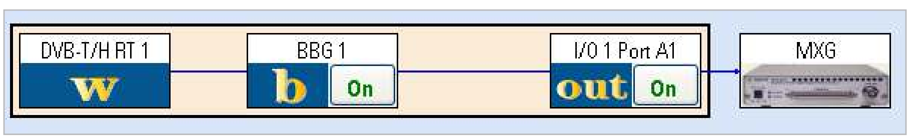


Figure 15. PXB configured as 1 channel

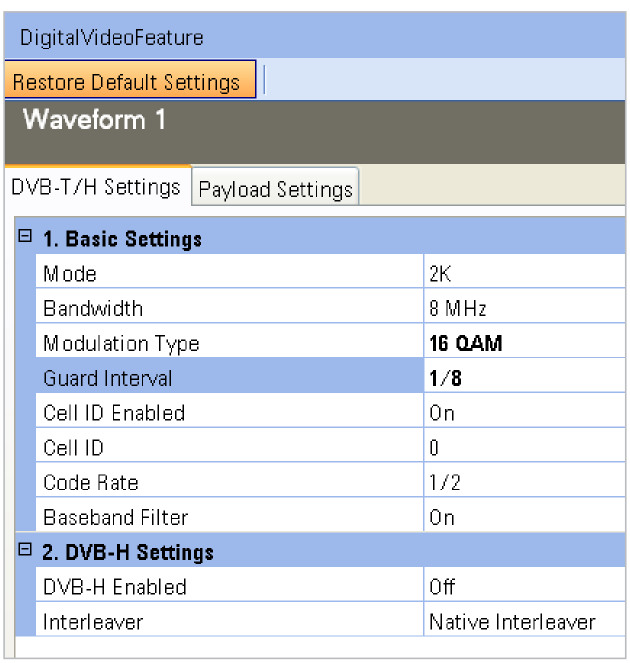


Figure 16. Basic DVB-T/H settings

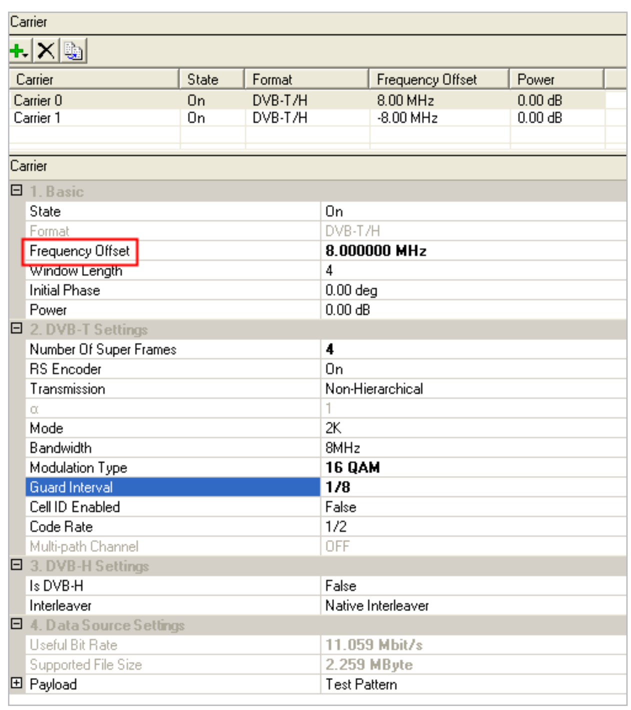


Figure 17. DVB-T/H interference generation

Guard interval utilization

The guard interval utilization test is conducted to measure the performance of the DVB-T/H receiver in the presence of echoes. The test system is shown in Figure 1. Set the output of the MXG to make sure the power level of the DVB-T/H signal is -40 dBm (at the receiver point) and the frequency is 666 MHz.

The following section first introduces the settings in the PXB, and then describes the measurement procedure.

PXB settings

1. Configure the PXB as shown in Figure 18. Here, two DSP blocks are used, one to generate the baseband signal, and the other to simulate multi-path fading.
2. Set up the parameters for real-time DVB-T/H signals and load the payloads as shown in the example in Figure 19.
3. Set up the echoes as defined in the specifications under Fader 1 Paths as shown on the screen in Figure 20, below. Take the DVB-T/H signal with the 8K mode and GI of 1/4 for example, while Tg is 224 µs and 0.9 x Tg = 201.6 µs.
4. Set up the C/N as shown in Figure 21. The signal-to-noise ratio corresponds to the C/N in the specifications.

Measurement procedure

Set up the echoes and C/N as defined in the specifications, and check whether the reception quality is better than the degradation criteria. If it is better, it means that the receiver passes the test. Repeat the measurement to cover all the cases defined in the specifications[3].

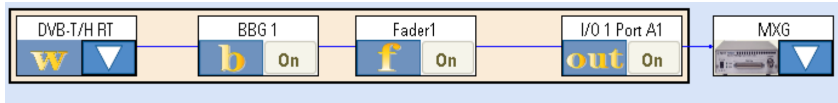
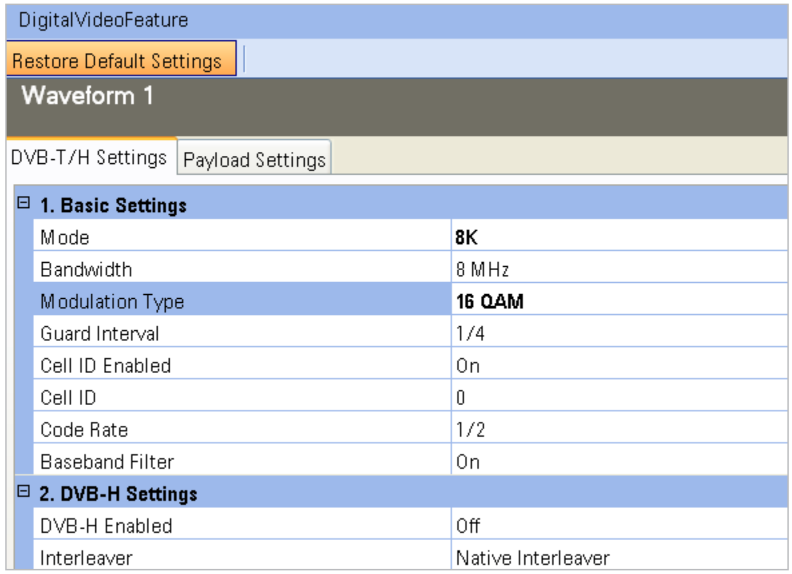


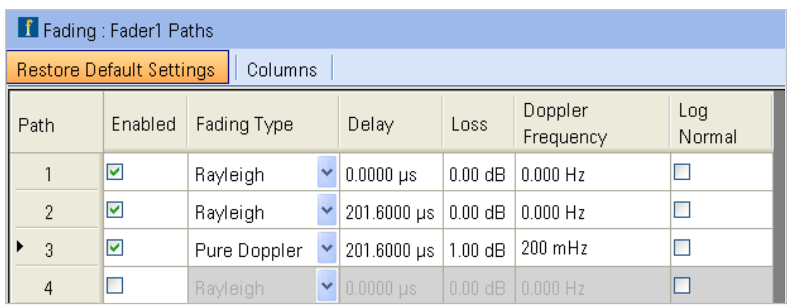
Figure 18. PXB configuration for multipath fading test



DigitalVideoFeature — Restore Default Settings — Waveform 1 — DVB-T/H Settings | Payload Settings

1. Basic Settings	
Mode	8K
Bandwidth	8 MHz
Modulation Type	16 QAM
Guard Interval	1/4
Cell ID Enabled	On
Cell ID	0
Code Rate	1/2
Baseband Filter	On
2. DVB-H Settings	
DVB-H Enabled	Off
Interleaver	Native Interleaver

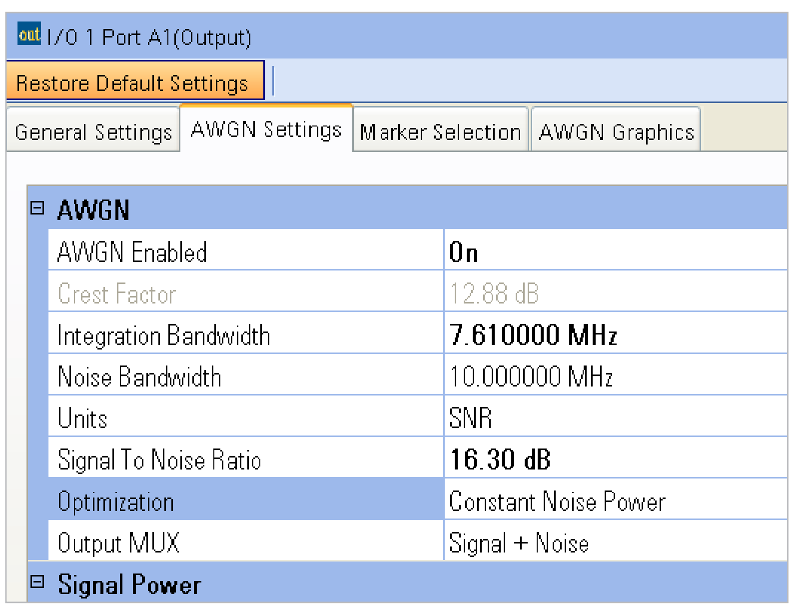
Figure 19. DVB-T/H basic settings



Fading : Fader1 Paths — Restore Default Settings — Columns

Path	Enabled	Fading Type	Delay	Loss	Doppler Frequency	Log Normal
1	☑	Rayleigh	0.0000 µs	0.00 dB	0.000 Hz	☐
2	☑	Rayleigh	201.6000 µs	0.00 dB	0.000 Hz	☐
3	☑	Pure Doppler	201.6000 µs	1.00 dB	200 mHz	☐
4	☐	Rayleigh	0.0000 µs	0.00 dB	0.000 Hz	☐

Figure 20. Echo setup



I/O 1 Port A1(Output) — Restore Default Settings — General Settings | AWGN Settings | Marker Selection | AWGN Graphics

AWGN	
AWGN Enabled	On
Crest Factor	12.88 dB
Integration Bandwidth	7.610000 MHz
Noise Bandwidth	10.000000 MHz
Units	SNR
Signal To Noise Ratio	16.30 dB
Optimization	Constant Noise Power
Output MUX	Signal + Noise
Signal Power	

Figure 21. C/N settings

Tolerance to impulse interference

The tolerance to impulse interference test is conducted to measure the performance of the DVB-T/H receiver in the presence of impulsive noise. In this test, both wanted DVB-T/H signals and impulsive noise are needed.

The connection to the instrument is shown in Figure 2. A real-time DVB-T/H signal is generated in the PXB and up-converted to RF frequency by an MXG. Impulsive noise is generated in another MXG using the Keysight impulsive noise generator tool.

The following section first introduces the settings in the PXB and the impulsive noise generator, and then describes the measurement procedure.

PXB settings

Set up the PXB with N7623B Option EFP to generate the wanted real-time DVB-T/H signal as follows:

1. Configure the PXB as 1 channel.
2. Set up the basic DVB-T/H settings and load the payloads as shown in Figure 23.

Setting up the impulsive noise generation tool

To comply with the measurement requirements in the MBRAI, Keysight provides a software tool to generate the impulse noise interferences. Use the software together with a signal generator (ESG or MXG) with Option 403 (calibrated AWGN).

The software generates waveforms according to the test patterns, as defined in the specifications, to control the markers in the signal generator, route these markers to RF blanking, and at the same time turn on the real-time AWGN in ARB mode. By routing the markers to RF blanking, the signal generator blanks the RF output according to the markers. Then the output of the signal generator is the real-time impulse noise.

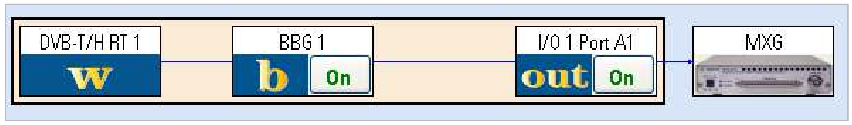


Figure 22. PXB configured as 1 channel

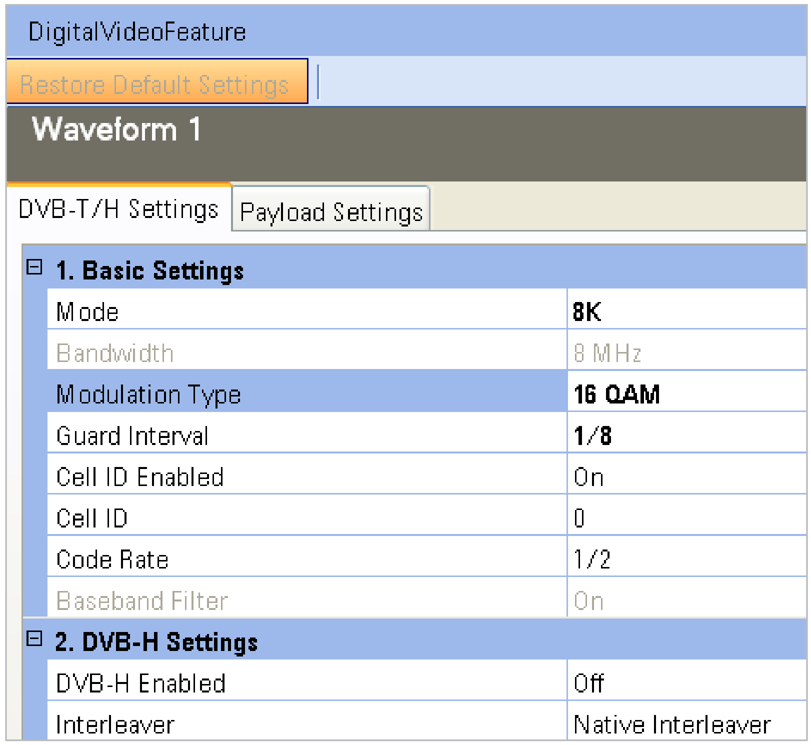


Figure 23. Basic DVB-T/H settings

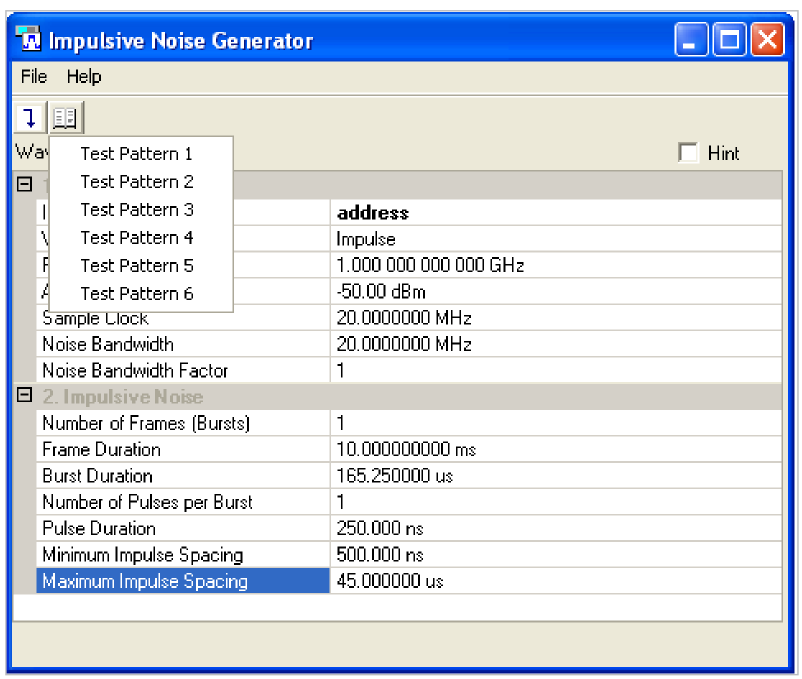


Figure 24. Impulsive noise generation tool

The six patterns defined in MBRAI are pre-defined in the impulsive noise generation tool. You can select them directly or set the pattern manually.

Figure 25 shows the generated impulsive noise, which is test pattern 6. It is viewed with an oscilloscope. The left graph represents a complete burst containing 40 pulses. The spacing between each pulse is random, between 0.5 ~ 1 µs. The right graph shows a larger view of the three pulses, circled in red. The signal in each pulse is real-time AWGN with the length of 250 ns. In the space between two pulses, the signal generator switches off the RF output, so the signal displayed is the noise floor of the oscilloscope.

Measurement procedure

1. Set the center frequency of both signal generators to 666 MHz, set the amplitude of the MXG for impulse noise generation to -35 dBm (at the receiver point) and the MXG for DVB-T/H signals to -30 dBm (at the receiver point).
2. Configure the PXB and the impulsive noise generator properly to generate the DVB-T/H and impulsive noise signal.
3. Decrease the amplitude of the signal generator for DVB-T/H until the degradation criteria is met. Record the power difference (I/C) between the impulse noise and DVB-T/H signal. If the power difference is higher than that defined in the specifications, it means the receiver passes the test.
4. Repeat the measurement to cover all the test cases defined in the specifications[3].

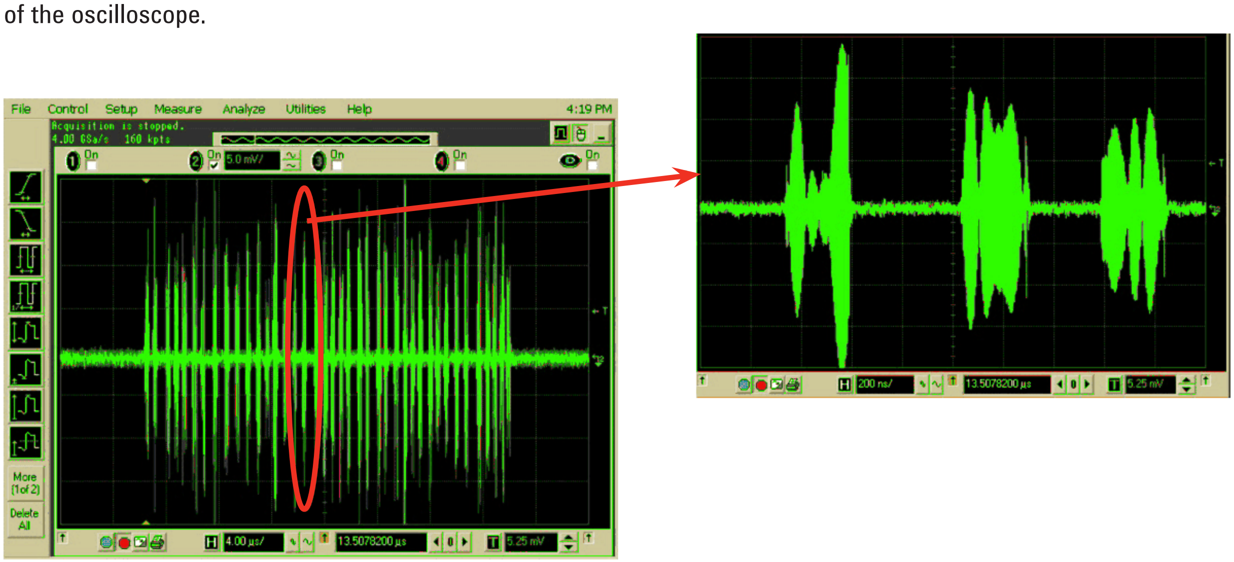


Figure 25. A view of the impulse noise

GSM900 TX signal blocking test

The GSM900 TX signal blocking test is conducted in order to verify that the sensitivity of DVB-H receiver does not degrade too heavily while the GSM900 TX blocking signal is present in the receiver input.

The test system is shown in Figure 2. The PXB is connected to one MXG to generate the wanted real time DVB-H signal. A different MXG is used to generate the GSM900 TX signal.

The DVB-H signal under test is: 8K OFDM, GI=1/4, QPSK, CR = 1/2, MPE-FEC CR = 3/4. Note that the MPE-FEC CR is set in the DVB-H video stream loaded in the PXB.

Setting up the MXG to generate a GSM900 TX signal

The GSM900 TX signal is simulated with a 1 KHz CW signal, which is FM modulated with ±50 kHz deviation. The frequency of the signal is 880 MHz. The MXG is set to transmit this signal as shown in Figure 26. The output power is 20 dBm, assuming the attenuation of the cable and connections between the MXG and the DVB-H receiver is 2 dB.

Setting up the PXB to generate the DVB-H signal

1. Configure the PXB as shown in Figure 27. Note that you need to choose *Real Time* as the Waveform Type and *DVB-T/H* as the Waveform Format under User File to generate real-time DVB-T/H signals.
2. Configure the basic DVB-T/H settings and load the payloads as shown in Figure 28.
3. Decrease the power of the DVB-T/H signal through the PXB or on the MXG directly. If the degradation criteria is reached, record the current value of the DVB-T/H signal. This value should be lower than or equal to the ones defined in the specifications[3].

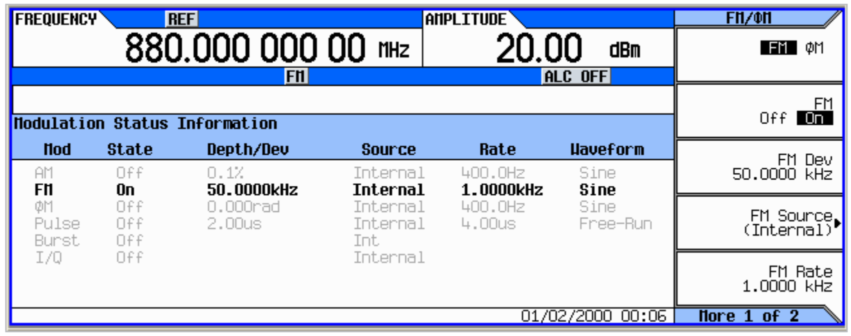


Figure 26. MXG settings

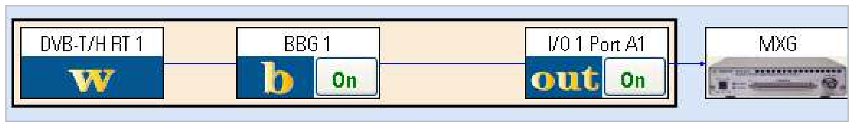
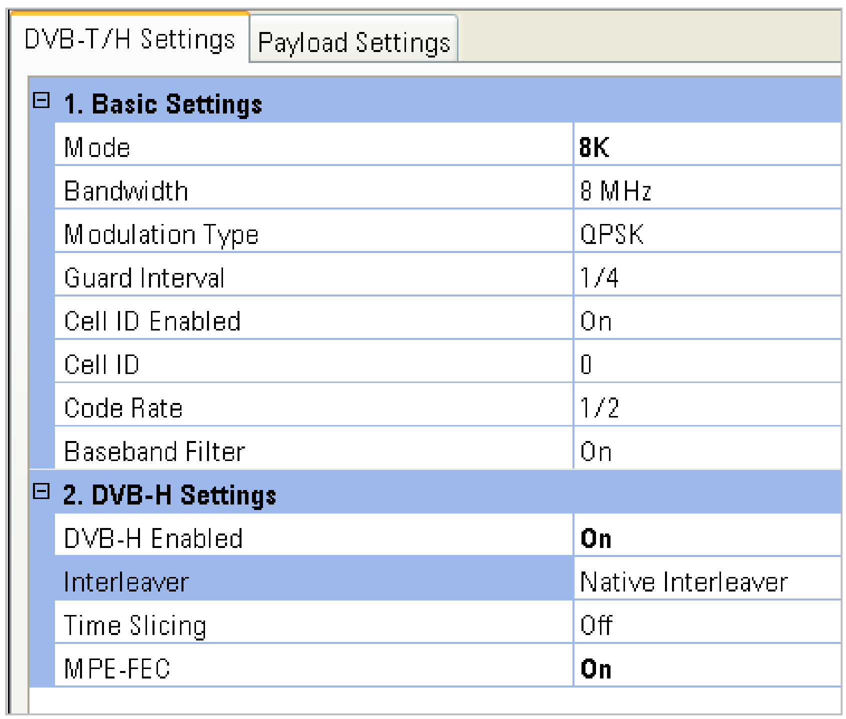


Figure 27. Configure the PXB as 1 channel



DVB-T/H Settings | Payload Settings

1. Basic Settings	
Mode	**8K**
Bandwidth	8 MHz
Modulation Type	QPSK
Guard Interval	1/4
Cell ID Enabled	On
Cell ID	0
Code Rate	1/2
Baseband Filter	On
2. DVB-H Settings	
DVB-H Enabled	**On**
Interleaver	Native Interleaver
Time Slicing	Off
MPE-FEC	**On**

Figure 28. Basic DVB-H settings

Mobile SFN channel test

The mobile SFN channel test is conducted in order to verify that the DVB-H receiver can work properly in the mobile SFN environment. The test system for the mobile SFN channel test is shown in Figure 1.

The DVB-H signal under test is: 8K OFDM, GI = 1/4, CR = 1/2, MPE-FEC CR = 3/4. The measurement frequency is channel 45 (666 MHz).

The following section first introduces the settings in the PXB, and then describes the measurement procedure.

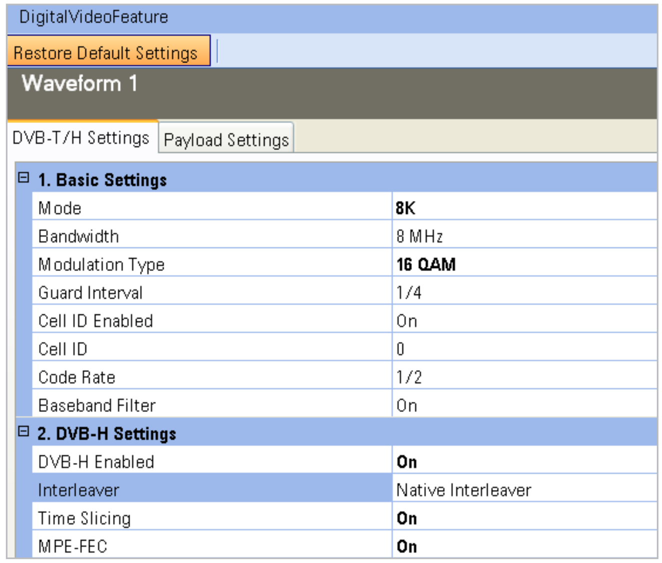
PXB settings

1. Configure the PXB as shown in Figure 29. Here, two DSP blocks are used, one to generate the baseband signal, and one to simulate echoes.
2. Configure the basic DVB-H settings and load the payloads.
3. Set the channel profiles as defined in the specifications in the Fader1 Paths screen shown, in Figure 31. Take weak long echo for example.
4. Configure the C/N as shown in Figure 32.

Measurement procedure

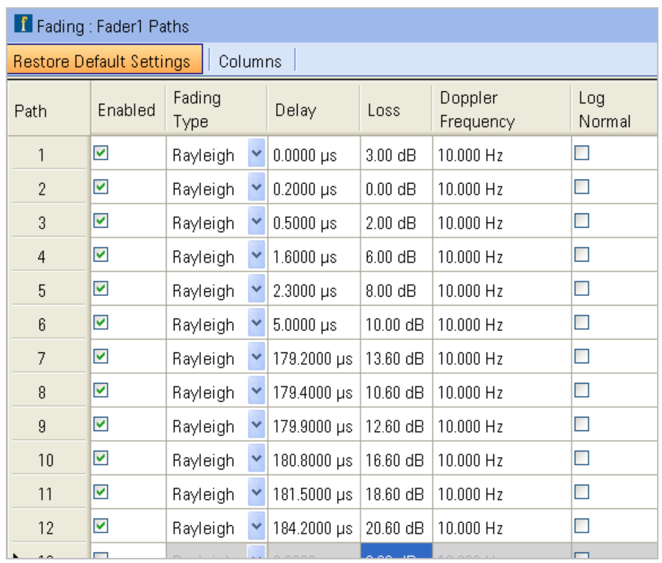
1. Set the Doppler frequency to 10 Hz as shown in Figure 31, then decrease the C/N by changing the signal-to-noise ratio value in Figure 32 until the degradation criteria is reached. Record this C/N as "C/N_{min}."
2. Set the C/N to (specified C/N_{min} + 3 dB), increase the Doppler frequency until the degradation criteria is reached. Record this Doppler frequency as "Fd_{3dB}." Note that C/N_{min} and Fd_{3dB} should meet the requirements in the specifications.
3. Repeat the measurement to cover all the cases defined in the specifications[3].

Figure 29. PXB configuration for multipath fading testing



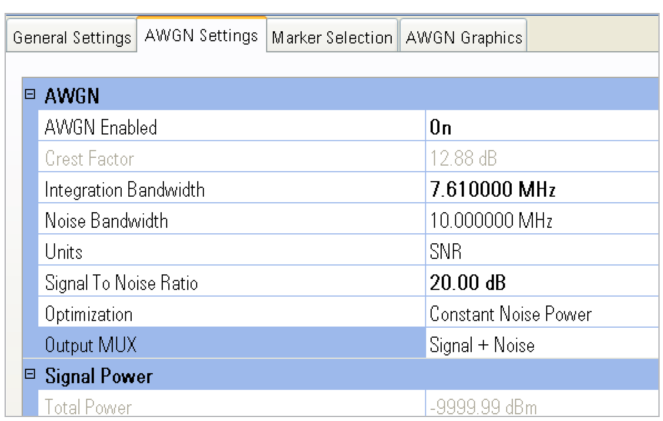
1. Basic Settings	
Mode	**8K**
Bandwidth	8 MHz
Modulation Type	**16 QAM**
Guard Interval	1/4
Cell ID Enabled	On
Cell ID	0
Code Rate	1/2
Baseband Filter	On
2. DVB-H Settings	
DVB-H Enabled	**On**
Interleaver	Native Interleaver
Time Slicing	**On**
MPE-FEC	**On**

Figure 30. DVB-H settings



Path	Enabled	Fading Type	Delay	Loss	Doppler Frequency	Log Normal
1	☑	Rayleigh	0.0000 µs	3.00 dB	10.000 Hz	☐
2	☑	Rayleigh	0.2000 µs	0.00 dB	10.000 Hz	☐
3	☑	Rayleigh	0.5000 µs	2.00 dB	10.000 Hz	☐
4	☑	Rayleigh	1.6000 µs	6.00 dB	10.000 Hz	☐
5	☑	Rayleigh	2.3000 µs	8.00 dB	10.000 Hz	☐
6	☑	Rayleigh	5.0000 µs	10.00 dB	10.000 Hz	☐
7	☑	Rayleigh	179.2000 µs	13.60 dB	10.000 Hz	☐
8	☑	Rayleigh	179.4000 µs	10.60 dB	10.000 Hz	☐
9	☑	Rayleigh	179.9000 µs	12.60 dB	10.000 Hz	☐
10	☑	Rayleigh	180.8000 µs	16.60 dB	10.000 Hz	☐
11	☑	Rayleigh	181.5000 µs	18.60 dB	10.000 Hz	☐
12	☑	Rayleigh	184.2000 µs	20.60 dB	10.000 Hz	☐

Figure 31. Mobile channel profile settings



AWGN	
AWGN Enabled	On
Crest Factor	12.88 dB
Integration Bandwidth	**7.610000 MHz**
Noise Bandwidth	10.000000 MHz
Units	SNR
Signal To Noise Ratio	**20.00 dB**
Optimization	Constant Noise Power
Output MUX	Signal + Noise
Signal Power	
Total Power	-9999.99 dBm

Figure 32. C/N settings

Conclusions

It is important for the DVB-T/H set-top-boxes or mobile phones with integrated DVB-T/H receivers to pass the conformance test in order to be used commercially. Keysight provides an efficient test system based on the PXB and MXG general purpose platforms, together with N7623B Signal Studio for digital video. This system enables successful receiver performance testing as defined in EICTA MBRAI 2.0.

Reference

[1] ETSI EN 300 744, "*Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television*".

[2] EICTA MBRAI, "*Mobile and Portable DVB-T/H Radio Access; Part 1: Interface specification*".

[3] EICTA MBRAI, "*Mobile and Portable DVB-T/H Radio Access; Part 2: Interface conformance testing*".

Related Literature

BER and Subjective Evaluation for DVB-T/H Receiver Test Application Note
Compliant digital video receiver and component test.
Test cases are given for DVB-T/H receivers.
http://literature.cdn.keysight.com/5989-8446EN.pdf

Signal Studio Software Brochure
http://literature.cdn.keysight.com/5989-6448EN.pdf

For more information, please visit:

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