Keysight Technologies
Digital Audio Broadcasting Receiver Testing Solutions

Demo Guide

Using Signal Studio software and PXB, MXG/ESG signal generators for digital audiobroadcasting receiver test

Featured Products:

- N7611B Signal Studio for broadcast radio
- N5106A PXB baseband generator and channel emulator
- N5182A MXG or E4438C ESG RF vector signal generator

KEYSIGHT TECHNOLOGIES

Introduction

Digital Audio Broadcasting (DAB) is the most widely adopted technology for digital radio broadcasting. DAB-based standards, including the recently developed DAB+ and DMB, support video and data services in addition to audio service.

The British standard, BS EN 50248 "Characteristics of DAB Receivers", describes DAB receiver characteristics for commercial equipment intended for terrestrial and cable reception in band III and L- band and for satellite reception in L-band.

This document discusses the measurement configurations and procedures for DAB receiver RF performance test using Keysight Technologies, Inc. instruments, according to BS EN 50248.

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Try before you buy!

FREE 14-day trial of Signal Studio software is available and provides unrestricted use of features and functionality. Redeem a trial license today for your existing MXG signal generator online at:

www.keysight.com/find/signalstudio_trial

Demonstration Preparation

Equipment requirements

Upgrade to the latest firmware

The following instruments and software are required to perform all of the demonstrations found in this guide. It is strongly recommended to update instrument firmware and software to the latest versions.

Signal Studio for broadcast radio software: www.keysight.com/find/N7611B
PXB baseband generator and channel emulator: www.keysight.com/find/sg_firmware
MXG vector signal generator firmware: www.keysight.com/find/sg_firmware

Product description	Model number	Required options
PXB baseband generator and channel emulator	N5106A	Option186, digital video application bundle, including - Option 612, 2 DSP blocks on 1 baseband card - Option 632, 2 I/O ports - 2 analog I/Q out and 2 digital I/O on 1 I/O card - Option EFP, baseband generation - Option JFP, calibrated AWGN - Option QFP, fading with SISO channel models
MXG RF vector signal generator	N5182A	Option 503/506, frequency range from 250 kHz to 3 GHz/6 GHz
Signal Studio for broadcast radio	N7611B	Option 6FP, connect to N5106A PXB Option RFP, advanced DAB Option SFP, ETI support Option QFP, advanced FM Stereo/RDS
PC with Signal Studio software installed	Install Signal Studio software to generate and download the signal waveform into the MXG signal generator via GPIB or LAN (TCP/IP). Please refer to the Signal Studio software Help for installation instructions and PC requirements.	

Setup diagrams

The setup diagrams of the test system are shown in Figure 1 and Figure 2, which are based on the equipment previously listed. The block diagrams are slightly different for different demonstrations.

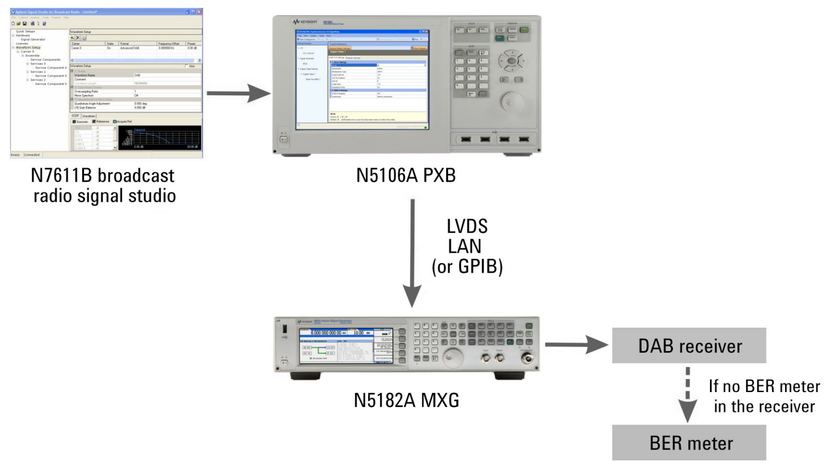

Figure 1. Setup diagram for sensitivity, maximum input power, and sensitivity in Rayleigh channel tests.

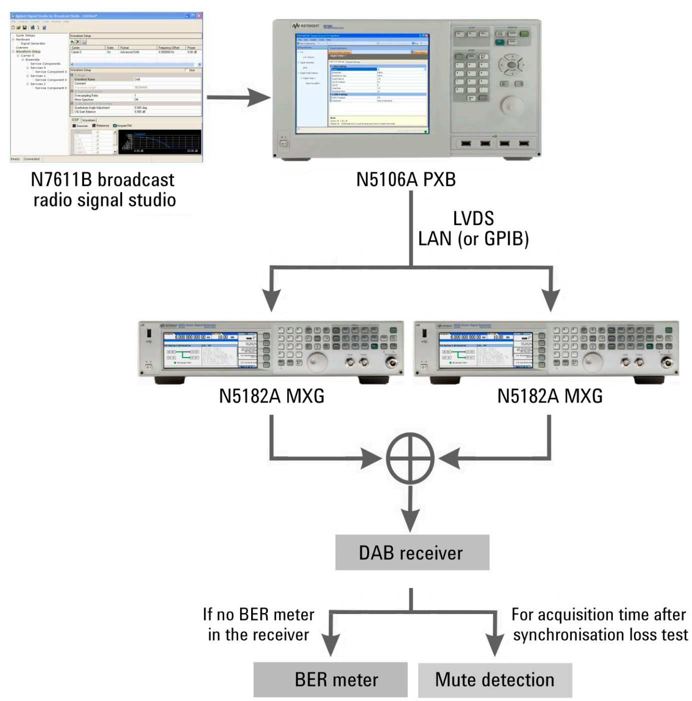

Figure 2. Setup diagram for selectivity and acquisition time after synchronization loss tests.

DAB Receiver Test Demonstrations

Overview of requirements for DAB receiver test

BS EN 50248 includes both basic and functional performance requirements for DAB receivers, as well as the minimum performance levels and measuring methods. The RF performance tests stipulated in the standard are as follows.

- Sensitivity in a Gaussian channel
- Maximum input power in a Gaussian channel
- Selectivity, including two parts:
  - Adjacent channel selectivity
  - Rejection of unwanted signals (far-off selectivity)
- Performance in a Rayleigh channel
  - Sensitivity
- Acquisition time after synchronization loss

All the measurements listed above need to be performed in both the VHF band and the L-Band as below:

- VHF Band III: 174 MHz ~ 240 MHz
- L-Band: 1452 MHz ~ 1492 MHz

The BER result of 10^{-4} is used as the criteria in all tests. The BER should be measured at the convolutional decoder output of the receiver and performed in the MSC (Main Service Channel) using an EEP (equal error protection) sub-channel with code rate ½. Note that while some receivers can provide BER results, if they cannot, an extra BER meter is required to measure the BER results. Any known digital pattern with a length of more than 1 symbol can be used as the test sequence – for example, all zero sequence.

Set up signal studio for broadcast radio

To make the test, first generate the required waveforms using N7611B. Waveforms of two standards are required:

- DAB waveforms as defined in EN 300 401 for the wanted signals
- Standard FM modulated waveform as defined in EN 60315-4 as the interference signal (this signal is used in the selectivity test)

Signal Studio software	Software operation
Start the Signal Studio for broadcast radio software.	Click Start > All Programs > Keysight Signal Studio > Broadcast Radio > **Broadcast Radio**
To generate DAB waveforms: Select the DAB format.	Click on the **Format** pull-down menu at the top of the Signal Studio program window. Next, select **DAB**
Configure the DAB signals to meet the requirements of the standard (BS EN 50248).	In the tree view, left pane of the main window, click **Carrier 0**, and then in the right pane, set the DAB transmission mode, for example: Transmission Mode = Mode 1. In the tree view, click **Ensemble** and set the payload. If the payload is set to **ETI(G.703)** or **ETI Demo (G.703)**, the software will read the parameters for services and service components from the ETI file; If the payload is set to **By Each Service Component**, click **Services** and **Service Components** in the tree view to configure the service. Note that the BER test should be made in the MSC (Main Service Channel) using an EEP (equal error protection) sub-channel with code rate ½. Then under **Service Components** in the tree view, on the right pane the settings should be: Long Form = True Protection Level = EEP 3-A Convolutional Coding Rate = ½
To generate FM waveforms: Select the FM format.	Click on the **Format** pull-down menu at the top of the Signal Studio program window. Next, select **FM Stereo/RDS**

Configure the software to generate standard FM waveforms as defined in EN60315-4.	In the tree view, left pane of the main window, click **Carrier 0** and in the right pane set: FM Deviation = 67.5 kHz Audio Source Pattern = L Only RDS = Off
Generation and save settings: Generate the required waveform.	Click the Generate Waveform button  on the tool bar
Export and save the waveform for future use.	**File > Export Waveform Data > DAB.wfm or FM.wfm** (create file name)

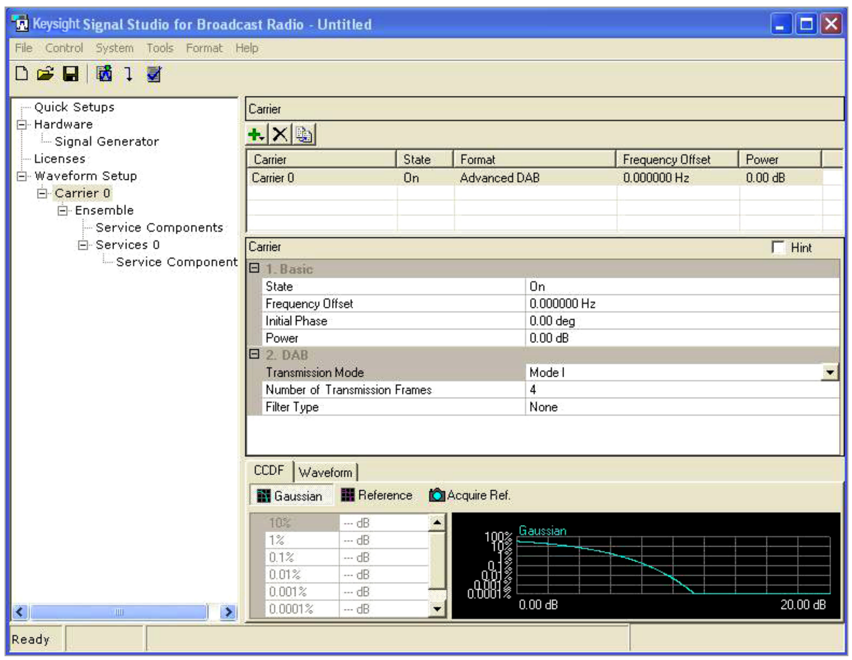

Figure 3. N7611B Signal Studio for broadcast radio

Sensitivity and maximum input power in a Gaussian channel

Sensitivity and maximum input power are the minimum and maximum input signal levels of the DAB receiver at which the BER result meets the criteria as stipulated in BS EN 50248. The setup diagram for this test is shown in Figure 1.

For the sensitivity test, the minimum requirement in EN 50248 is –81 dBm for both VHF band and L-band. If the measured power is lower than this value, it means the receiver passes the sensitivity test. For the maximum input power test, the minimum requirements for different types of DAB receivers defined in EN 50248 are listed in Table 1. If the measured power is higher than this value, it means the receiver passes the maximum input power test.

Signal Studio software	Software operation
Start N5106A PXB.	Start > All Programs > Keysight N5106A PXB > **N5106A PXB Baseband Generator and Channel Emulator**
Configure PXB to be a one-channel baseband generator to play the DAB waveform and connect it to MXG (Figure 4).	Select **1 Channel** configuration under **Generate** in the **Configuration Browser**. Under the **Block Diagram** tab in the **(Unassigned)** block, click the button to display the **Assign External Instrument** dialog box. Then follow the on-screen instructions to connect to the MXG. Click the **Load Configuration** button at the bottom to load the configuration
Load the DAB waveform generated by the N7611B software and play it. All required waveforms can be stored in the hard disk of the PXB (Figure 5).	Select **User File 1 (ARB)** in the **Settings Browser** and in the **Waveform Source Name** cell, load the DAB waveform generated with N7611B signal studio. Click Download Panel button to enter the window where you can download the selected waveform into PXB memory and click the **Start** button at the bottom of the window to start downloading
Set the frequency of the output signal and play the waveform. Note that the test needs to be performed in both VHF band and L-band.	Select the **MXG (output)** label in the **Settings Browser** and set the frequency of the DAB signal in the **Frequency** cell under **General Settings** tab. Click the Play button at the right top of the window to play the waveform

Reduce the input power of the DAB receiver until the BER reaches 10^{-4}, and then record this power value as sensitivity. Note that you may need to take the attenuation of the cable connecting the MXG and DAB receiver into consideration.	Select the **MXG (output)** label in the **Settings Browser** and adjust the amplitude of the DAB signal in the **Amplitude** cell under **General Settings** tab
Increase the input power of the DAB receiver until the BER reaches 10^{-4}, and then record this value as maximum input power.	Select the **MXG (output)** label in the **Settings Browser** and adjust the amplitude of the DAB signal in the **Amplitude** cell under **General Settings** tab

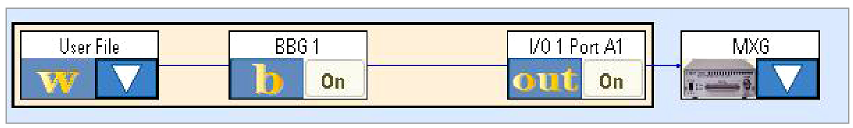

Figure 4. PXB configuration as 1 channel

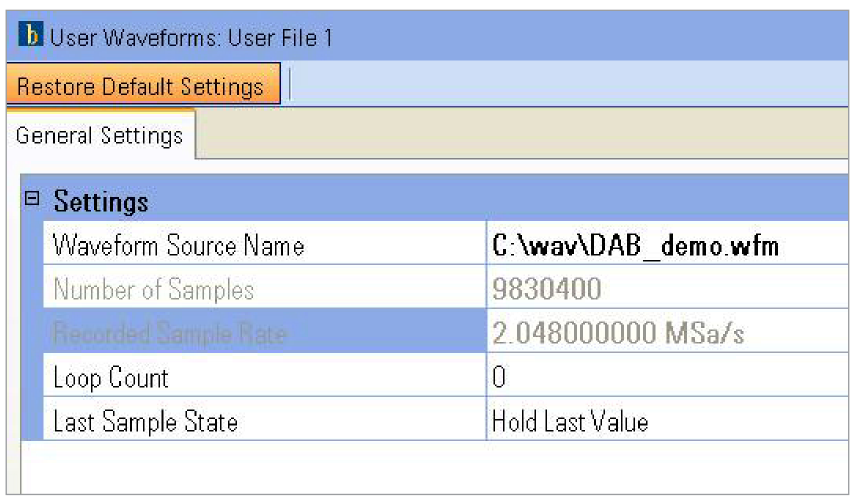

Figure 5. Loading the waveform

Table 1. Minimum requirements for maximum input power

Power requirement	Mobile receiver	Stationary receiver	Portable receiver
VHF band	–10 dBm	–15 dBm	–20 dBm
L-band	–25 dBm	–25 dBm	–25 dBm

Selectivity

Selectivity tests reception performance in the presence of unwanted signals. The setup diagram for this test is shown in Figure 2. Two types of measurements need to be conducted here: adjacent channel selectivity and far-off selectivity.

– For the adjacent channel selectivity measurement, both the wanted and unwanted signals are DAB signals and the frequency separation between them is 1.712 MHz. The adjacent channel selectivity (A_{cs}) is expressed as:

$$A_{cs} = P_{unwanted} – P_{wanted} = P_{unwanted} + 70 \text{ (dB)}$$

If Acs is larger than or equal to 30 dB in both the VHF band and the L-band, the DAB receiver passes the adjacent channel selectivity test.

– For the far-off selectivity test, the unwanted signal is the FM modulated signal and its center frequency needs to be more than or equal to 5 MHz away from the wanted DAB signal. The far-off selectivity, which is also called rejection of the unwanted signal, is expressed as:

$$R_r \text{ (rejection ratio)} = P_{unwanted} – P_{wanted} = P_{unwanted} + 70 \text{ (dB)}$$

If R_r is larger than or equal to 40 dB in both the VHF band and the L-band, the DAB receiver passes the far-off selectivity test.

On the PXB	Operation
Start the N5106A PXB.	Start > All Programs > Keysight N5106A PXB > **N5106A PXB Baseband Generator and Channel Emulator**
Configure the PXB to be a two-channel baseband generator, which plays two waveforms (the wanted and unwanted signal) separately.	Select the **2 Channels** configuration under **Generate** in the **Configuration Browser**. Under the **Block Diagram** tab in the two (Unassigned) blocks, click the button to display the **Assign External Instrument** dialog box. Then follow the onscreen instructions to connect to the two MXGs Click the **Load Configuration** button at the bottom to load the configuration

Load the required waveforms for each channel. The required waveforms are two DAB waveforms for the adjacent channel selectivity measurement and one DAB waveform and one FM waveform for the far-off selectivity measurement.	Select User **File 1 (ARB)** in the **Settings Browser** and in the **Waveform Source Name** cell, load the DAB waveform generated with N7611B signal studio as the wanted signal. Select **User File 2 (ARB)** in the S**ettings Browser** and in the **Waveform Source Name** cell, load the DAB or FM waveform generated with N7611B signal studio as the unwanted signal. Click Download Panel button to enter the window where you can download the selected waveforms into PXB memory and click the **Start** button at the bottom of the window to start downloading
Set the frequency of each channel in the PXB or MXG directly and maintain their difference as stipulated in the standard, then play the waveforms.	Select the **MXG1 (output)** label in the **Settings Browser** and set the frequency of the DAB signal in the **Frequency** cell under **General Settings** tab. Select the **MXG2 (output)** label in the **Settings Browser** and set the frequency of the unwanted FM or DAB signal in the **Frequency** cell under **General Settings** tab. Click the Play button at the right top of the window to play the waveforms.
Set the power level of the wanted signal to –70 dBm and increase the power level of the unwanted signal until the BER result reaches 10^{-4}, and then record this value as $P_{unwanted}$.	Select the **MXG1 (output)** label in the **Settings Browser** and set Amplitude = –70 dBm Select the **MXG2 (output)** label in the **Settings Browser** and adjust the amplitude of the unwanted signal in **Amplitude** cell

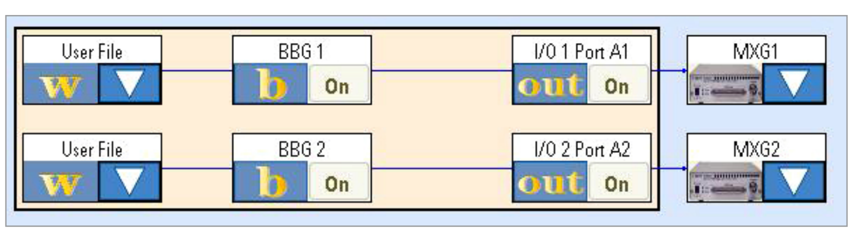

Figure 6. PXB configuration with two channels

Performance in a Rayleigh channel

The mobile environment is a typical reception condition for DAB receivers. Especially for car DAB receivers, the wireless channel is highly dynamic. Channel models will include the Doppler-effect, as well as multi-path reception, plus fast and slow fading. To simulate the transmission environment, BS EN 50248 defines several channel profiles. Different frequencies and DAB receive modes are defined for tests under different channel conditions, as listed in Table 2. See Appendix A for the details of the channel profile definitions. The setup diagram for this test is given in Figure 1.

Table 2. Channel simulation profiles of defined frequency bands and DAB modes

Frequency	DAB mode	Channel profiles
225.648 MHz	I	Urban at 25 km/h Rural at 120 km/h SFN at 60 km/h
1471.792 MHz	II	Urban at 25 km/h Rural at 120 km/h
1471.792 MHz	IV	Urban at 25 km/h Rural at 90 km/h

On the PXB	Operation
Start the N5106A PXB.	Start > All Programs > Keysight N5106A PXB > **N5106A PXB Baseband Generator and Channel Emulator**
Configure the PXB as shown in Figure 7. In this case, one DSP is used to play the DAB waveform and the other DSP is configured to be a fader to simulate the propagation channel.	Select the **1 Channel** configuration under **Generate and Fade** in the **Configuration Browser**. Under the **Block Diagram** tab in the (Unassigned) block, click the button to display the **Assign External Instrument** dialog box. Then follow the onscreen instructions to connect to the MXG. Click the **Load Configuration** button at the bottom to load the configuration.
Load the DAB waveform into the PXB. The mode of the DAB waveform needs to be compliant with Table 2.	Select **User File 1 (ARB)** in the **Settings Browser** and in the **Waveform Source Name** cell, load the DAB waveform generated with N7611B signal. Click Download Panel button to enter the window where you can download the selected waveforms into PXB memory and click the **Start** button at the bottom of the window to start downloading

Configure the channel profiles.	Select **Master Setup 1** label in the **Settings Browser** and set the **Fader 1 Carrier Frequency** to the frequency of the DAB signal, for example, 225.648 MHz. Note that the carrier frequency needs to be correct because the Doppler frequency and vehicle speed under Fader 1 Paths will be coupled with that value. Select **Fader1 Paths** label in the **Settings Browser** and set the parameters for each path as defined in Appendix A. Refer to *"Multipath fading settings on the PXB"* section below for the setup method of the five Doppler spectrums required in the channel profiles.
Set the frequency of the output signal and play the waveform.	Select the **MXG (output)** label in the **Settings Browser** and set the frequency of the DAB signal in the **Frequency** cell under **General Settings** tab. Click the Play button at the right top of the window to play the waveform
Adjust the power of the output signal to perform the test.	Select the **MXG (output)** label in the **Settings Browser** and adjust the amplitude of the DAB signal in **Amplitude** cell

The procedure of adjusting the output signal power is as below:

1) Set the input power of the DAB receiver to a value such that the DAB receiver is in an error- free reception mode, the BER is less than or equal to 10^{-4}, and synchronization is good.

2) Reduce power by 5 dB and make sure the synchronization is not lost.

3) Read the BER value on the BER meter. If the BER is better than 10^{-4} for one minute, repeat 2) and 3) until the BER value is less than 10^{-4}, and then record the power. If it is larger than –75 dBm, the DAB receiver passes this test for the current channel profile, mode, and frequency.

4) Repeat the test to cover all the cases and channel profiles listed in Table 2 and the Appendix.

Figure 7. PXB configuration including a baseband generator and a fader

Multipath fading settings on the PXB

Five Doppler spectrums are defined in the channel profiles in the Appendix, CLASS, RICE, GAUS1, GAUS2, and GAUSDAB. Below are the instructions for setting up these five Doppler spectrums in the PXB.

1) CLASS

This Doppler spectrum is used for paths with delays up to 0.5 μs.

$$S(\tau_i, f) = \frac{A}{\sqrt{1 - (\frac{f}{f_d})^2}} \quad \text{for } f \in [-f_d, f_d]$$

Where $\tau_i \leq 0.5$ μs and f_d is the maximum Doppler shift.

The Class Doppler spectrum is configured in the PXB as shown below. The fading type is set to Rayleigh and the spectral shape is set to the Classical 6 dB. The delay, loss, and vehicle speed are set as stipulated in the standard. The Doppler frequency is calculated automatically using the vehicle speed and the carrier frequency.

Path	Enabled	Fading Type	Spectral Shape	Delay	Loss	Vehicle Speed	Doppler Frequency	Carrier Frequency Coupling	Frequency Offset
1	☑	Rayleigh	Classical 6dB	0.2000 μs	2.00 dB	120.00 km/h	25.089 Hz	Doppler Frequency	0.00 Hz
2	☐	Rayleigh	Classical 6dB	0.0000 μs	0.00 dB	120.00 km/h	25.089 Hz	Doppler Frequency	0.00 Hz

Figure 8. Class Doppler spectrum configuration

2) RICE

RICE Doppler spectrum is the sum of a classical Doppler spectrum and a direct path, as defined below.

$$S(\tau_i, f) = \frac{0.41}{2\pi f_d \sqrt{1 - (\frac{f}{f_d})^2}} + 0.91\delta\,(f - 0.7f_d) \quad \text{for } f \in [-f_d, f_d]$$

Then the K factor is calculated as $K = 10^* \log_{10}\left(\frac{0.91}{0.41/2}\right) = 6.47$ dB.

The Doppler spectrum of the LOS (line of sight) path is 0.7 f_d, so the AOA (angle of arrival) is arccos (0.7) * $\frac{180}{\pi}$ = 45.57° .

Figure 9 shows the RICE Doppler spectrum configuration in the PXB. The Rician K is set to 6.47 dB and LOS AOA is set to 45.57°.

Path	Enabled	Fading Type	Rician K	Spectral Shape	Delay	Loss	Vehicle Speed	Doppler Frequency	Carrier Frequency Coupling	LOS AoA	Frequency Offset
1	☑	Rician	6.47 dB	Classical 6dB	0.0000 μs	0.00 dB	120.00 km/h	25.089 Hz	Doppler Frequency	45.57 °	0.00 Hz

Figure 9. RICE Doppler spectrum configuration

3) GAUS1 and GAUS2

Both GAUS1 and GAUS2 are the sum of two Gaussian functions. GAUS1 is for paths with delays from 0.5 µs to 2 µs, and GAUS2 is for paths with delays larger than 2 µs.

The definitions for GAUS1 and GAUS2 are shown below. In GAUS1, A1 is 10 dB below A. In GAUS2, B1 is 15 dB below B.

GAUS1: $S(\tau_i, f) = G(A, -0.8f_d, 0.05f_d) + G(A_1, 0.4f_d, 0.1f_d)$
GAUS2: $S(\tau_i, f) = G(B, 0.7f_d, 0.1f_d) + G(B_1, -0.4f_d, 0.15f_d)$

To simulate the GAUS1 or GAUS2 Doppler spectrum in the PXB, two paths are used to simulate one GAUS1 or GAUS2 path. Figure 10 is an example of setting the GAUS1 Doppler spectrum by using two paths in the PXB fader to simulate one GAUS1 path.

Path	Enabled	Fading Type	Spectral Shape	Std Dev of Gaussian	Delay	Loss	Vehicle Speed	Doppler Frequency	Carrier Frequency Coupling	Frequency Offset
1	☑	Rayleigh	Gaussian	0.05	0.2000 µs	6.00 dB	25.00 km/h	5.227 Hz	Doppler Frequency	-4.18 Hz
2	☑	Rayleigh	Gaussian	0.10	0.2000 µs	16.00 dB	25.00 km/h	5.227 Hz	Doppler Frequency	2.09 Hz

Figure 10. GAUS1 configuration

While configuring the GAUS1 or GUAS2 path, note the following:

- The two paths used to simulate one GAUS1 or GAUS2 path have the same spectral shape (Gaussian) and delay.
- The losses of the two paths are 6 dB and 16 dB respectively, in which 6 dB (A) is the loss of the current GAUS1 path and 16 dB (A1) is 10 dB below A.
- The frequency offset of each path is set to $-0.8f_d$ and $0.4f_d$ as in the GAUS1 equation, where f_d is the maximum Doppler shift. In this case, f_d is 5.227 Hz, so the frequency offset of the 1st path is set to –0.8*fd = 4.18 Hz and that of the 2nd path is set to 0.4*fd = 2.09 Hz. For GAUS2 Doppler spectrum, the frequency offsets should be $0.7f_d$ and $-0.4f_d$ respectively.

4) GAUSDAB

The GAUSDAB Doppler spectrum is defined as follows:

$S(\tau_i, f) = G\ (A, \pm 0.7f_d, 0.1f_d)$,

where $+0.7f_d$ applies for even paths and $-0.7f_d$ for the odd, except path 1.

Figure 11 shows the configurations for the SFN channel profile in which the GAUSDAB Doppler spectrum is used. The frequency offsets are set to $0.7f_d$ and $-0.7f_d$ for even paths and odd paths respectively.

Path	Enabled	Fading Type	Spectral Shape	Std Dev of Gaussian	Delay	Loss	Vehicle Speed	Doppler Frequency	Carrier Frequency Coupling	Frequency Offset
1	☑	Rayleigh	Classical 6dB	0.10	0.0000 μs	0.00 dB	60.00 km/h	12.545 Hz	Doppler Frequency	0.00 Hz
2	☑	Rayleigh	Gaussian	0.10	100.0000 μs	13.00 dB	60.00 km/h	12.545 Hz	Doppler Frequency	8.78 Hz
3	☑	Rayleigh	Gaussian	0.10	220.0000 μs	18.00 dB	60.00 km/h	12.545 Hz	Doppler Frequency	-8.78 Hz
4	☑	Rayleigh	Gaussian	0.10	290.0000 μs	22.00 dB	60.00 km/h	12.545 Hz	Doppler Frequency	8.78 Hz
5	☑	Rayleigh	Gaussian	0.10	385.0000 μs	26.00 dB	60.00 km/h	12.545 Hz	Doppler Frequency	-8.78 Hz
6	☑	Rayleigh	Gaussian	0.10	480.0000 μs	31.00 dB	60.00 km/h	12.545 Hz	Doppler Frequency	8.78 Hz
7	☑	Rayleigh	Gaussian	0.10	600.0000 μs	32.00 dB	60.00 km/h	12.545 Hz	Doppler Frequency	-8.78 Hz

Figure 11. GAUSDAB configuration in SFN channel profile

Acquisition time after synchronization loss

Acquisition time after synchronization loss tests the re-synchronization capability of DAB receivers. In BS EN 50248, it is defined as "the time of audio mute between switching off the received ensemble and re-synchronizing to the same ensemble at an offset frequency".

The setup diagram for this test is given in Figure 2. The PXB and two MXGs are used to generate the two DAB waveforms with the same ensemble at different frequencies. The frequency difference between the two MXGs shall be half a carrier spacing, which are 500 Hz, 2000 Hz, 4000 Hz, and 1000 Hz for DAB mode I, mode II, mode III, and mode IV respectively. A mute detection device is used to measure the time it takes for the DAB receiver to resynchronize to the same ensemble.

On the PXB	Operation
Start the N5106A PXB.	Start > All Programs > Keysight N5106A PXB > **N5106A PXB Baseband Generator and Channel Emulator**
Configure the PXB to be a two-channel baseband generator, which plays two waveforms separately.	Select the **2 Channels** configuration under **Generate** in the **Configuration Browser**. Under the **Block Diagram** tab in the two (Unassigned) blocks, click the button to display the **Assign External Instrument** dialog box. Then follow the onscreen instructions to configure the IP addresses of two MXGs. Click the **Load Configuration** button at the bottom to load the configuration.
Load the same DAB waveform for each channel.	Select **User File 1 (ARB)** in the **Settings Browser** and in the **Waveform Source Name** cell, load the DAB waveform generated with N7611B signal studio. Select **User File 2 (ARB)** in the **Settings Browser** and in the **Waveform Source Name** cell, load the same DAB waveform. Then click Download Panel button to enter the window where you can download the selected waveforms into PXB memory and click the **Start** button at the bottom of the window to start downloading
Set the amplitude and frequency for each channel and play the waveforms. The amplitudes of the two channels are the same and the frequency difference should be set according to the current mode of the DAB waveform (500 Hz for mode 1).	Select the **MXG 1 (output)** label in the **Settings Browser** and set the frequency in the **Frequency** cell and amplitude in the **Amplitude** cell under **General Settings** tab. Select the **MXG2 (output)** label in the **Settings Browser** and set the frequency in the **Frequency** cell and amplitude in the **Amplitude** cell under **General Settings** tab. Click the Play button at the right top of the window to play the waveforms

Then, on the two MXGs, turn on the RF outputs by pressing RF On/Off key and do the following:

1) Turn off the RF output of MXG 2 by pressing RF On/Off key on the MXG to let the DAB signal from MXG 1 feed into the DAB receiver.
2) Turn off the RF output of MXG 1. Wait at least 10 seconds, then turn on the RF output of MXG 2 and test the time it takes for the DAB receiver to resynchronize to the signal with the mute detection device.
3) Repeat steps 1) and 2) five times, and then average the results of the five measurements. The average result is then recorded as the acquisition time after synchronization loss. In BS EN 50248, it is required that the value be smaller than 3000 ms.

Note that the measurement needs to be performed separately for all four DAB transmission modes.

Appendix – Channel Profiles

This appendix lists the channel profiles used to simulate multipath fading in the wireless propagation channel for "Performance in a Rayleigh channel" test as defined in BS EN 50248. There are three types of channel profiles, which are for rural areas, urban areas, and SFN networks respectively.

Table 3 includes channel profiles for rural areas, including 4 paths and 6 paths respectively. Table 4 includes channel profiles for urban areas, including 12 paths and 6 paths respectively. Table 5 includes channel profiles for SFN (single frequency networks) in the VHF band.

Table 3. Channel profiles for typical rural (non-hilly) areas

4 paths

Path number	Delay (μs)	Loss (dB)	Doppler type	S_D (μs)
1	0	0	RICE	
2	0.2	–2	CLASS	0.1 ± 0.02
3	0.4	–10	CLASS	
4	0.6	–20	CLASS	

6 paths

Path number	Delay (μs)	Loss (dB)	Doppler type	S_D (μs)
1	0	0	RICE	
2	0.1	–4	CLASS	
3	0.2	–8	CLASS	0.1 ± 0.02
4	0.3	–12	CLASS	
5	0.4	–16	CLASS	
6	0.5	–20	CLASS	

Table 4. Channel profiles for typical urban (non-hilly) areas

12 paths

Path number	Delay (μs)	Loss (dB)	Doppler type	S_D (μs)
1	0	–4	CLASS	
2	0.1	–3	CLASS	
3	0.3	0	CLASS	
4	0.5	–2.6	CLASS	
5	0.8	–3	GAUS1	
6	1.1	–5	GAUS1	1.0 ± 0.1
7	1.3	–7	GAUS1	
8	1.7	–5	GAUS1	
9	2.3	–6.5	GAUS2	
10	3.1	–8.6	GAUS2	
11	3.2	–11	GAUS2	
12	5.0	–10	GAUS2	

6 paths

Path number	Delay (µs)	Loss (dB)	Doppler type	S_D (µs)
1	0	–3	CLASS	
2	0.2	0	CLASS	
3	0.5	–2	CLASS	1.0 ± 0.1
4	1.6	–6	GAUS1	
5	2.3	–8	GAUS2	
6	5.0	–10	GAUS2	

Table 5. Channel profile for single frequency networks (SFN) in the VHF band

Path number	Delay (µs)	Loss (dB)	Doppler type	S_D (µs)
1	0	0	CLASS	
2	100	–13	GAUSDAB	
3	220	–18	GAUSDAB	
4	290	–22	GAUSDAB	
5	385	–26	GAUSDAB	
6	480	–31	GAUSDAB	
7	600	–32	GAUSDAB	

Additional Resources

Standards referenced

[1] BS EN 50248 Characteristics of DAB Receivers
[2] ETSI 300 401 Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers
[3] BS EN 60315-4 Methods of measurement on radio receivers for various classes of emission – Part 4: Receivers for frequency-modulated sound broadcasting emissions

Web resources

Digital video industry webpage: www.keysight.com/find/digital_video
N7611B Signal Studio for broadcast radio: www.keysight.com/find/N7611B
N5106A PXB product webpage: www.keysight.com/find/N5106A
N5182A MXG product webpage: www.keysight.com/find/N5182A

Related literature

Signal Studio software brochure, literature number 5989-6448EN

N7611B software technical overview:

http://wireless.keysight.com/wireless/helpfiles/n7611b/n7611b_technical_overview.pdf myKeysight

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www.lxistandard.org
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