DTA-2115B
Verification of Specifations

APPLICATION NOTE

DekTec

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1. Introduction

1.1. General Description of the DTA-2115B

The DTA-2115B is DekTec's highest-end modulator on a PCIe gen3 x1 card. It is a general-purpose modulator for generating virtually any cable, terrestrial and satellite modulation standard currently in use around the world, including multi-PLP DVB-T2 and DVB-S2X. Advanced features include ultra-low phase noise, GPS synchronization, phase noise emulation and special firmware for eight-channel modulation. The output frequency of the DTA-2115B is agile in the range from 32 to 2186MHz.

Dependent on the firmware, the DTA-2115B operates as a single 72-MHz modulator in VHF, UHF or L-band, or as eight independent 8-MHz modulators in the VHF/UHF band.

For more information about the DTA-2115B and its specifications, please refer to the datasheet of the DTA-2115B, available on the DekTec website.

1.2. Purpose of this Application Note

This application note provides instructions on measuring the characteristics of the output signal of the DTA-2115B, and verifying that the modulated signal conforms to the specifications stated in the data sheet.

The DTA-2115B covers a wide range of settings including frequency, modulation standard, RF power-level. The settings used in this application note serve as an example and can be modified to accommodate specific application scenarios.

This application note provides measurement- and verification instructions for the following specification items:

- RF power-level accuracy;
- SNR accuracy when using the channel simulator;
- Carrier frequency accuracy;
- Phase noise.

2. Measurements

2.1. Hardware Setup

The measurements for verifying the performance of the DTA-2115B with respect to its specifications can all be performed with a DTA-2115B connected to a spectrum analyzer.

The following hardware setup is required:

50Ω RF   50Ω RF

Figure 1. Hardware setup for measuring the performance of the DTA-2115B.

Recommended hardware setup:

- PC/laptop running the latest version of *StreamXpress*, DekTec's play-out and modulation software.

- DTA-2115B, inserted in PCIe gen3 slot.

- Optional for analyzer with N-type connector: 50-ohm SMA to 50-ohm N-type RF adapter.

- The RF adapter and DTA-2115B should be connected directly without cables.

For power measurements an RF power sensor may also be used instead of a spectrum analyzer. An example of such an RF power sensor is Rohde & Schwarz NRP-Z11.

2.2. Generic Spectrum Analyzer Requirements

	Specification	Remarks
RF Input	50-ohm, preferably SMA-type	For N-type, use RF connector adapter
Frequency range	≥ 32 to 2186MHz	
Frequency accuracy	≤ 0.3ppm	
Absolute level uncertainty	≤ 0.5dB	From 32 to 2186MHz
Return Loss	≥ 20dB	From 32 to 2186MHz; Internal attenuation may be required
Channel power measurement	≥ 8MHz bandwidth	
Detector type	RMS	

Warm-up time recommended
Allow both the DTA-2115B and the spectrum analyzer to warm-up for a period of 30 minutes in full operation, before doing measurements.

3. RF Power-Level

3.1. Relevance

The DTA-2115B uses several analog components for generating an RF signal at a specified level. Aging of these analog components may influence the accuracy of the generated RF power-level over time.

3.2. StreamXpress Settings

Setting	Value
Frequency	32 to 1000MHz, e.g. 474MHz
Modulation standard	DVB-C
Constellation	256-QAM
Symbol rate	6.875MBaud
Channel simulator	Disabled
File	None
Test-signal generator	Enable; Mode PSBS23 / O151 on PID 0x0100
RF output level	-10dBm
Spectral inversion	Disabled
CW	Disabled
RF Enabled on Stop	Disabled
SNR	Disabled

3.3. Spectrum-Analyzer Settings

Setting	Value	Remarks
Frequency	Same as modulator	e.g. 474MHz
Span	16MHz	
Reference level	0dBm	
Attenuation	10dB	Commonly required to achieve return loss ≥ 20dB
Level range	100dB	
Trace mode	Clear write	
Detector	RMS	
Resolution bandwidth	100kHz	
Video bandwidth	300kHz	At least 3 times resolution bandwidth
Sweep time	500ms	Long sweep time usually gives more stable measurements, as the RMS detector averages over this time
Sweep mode	Auto sweep	Auto FFT is not recommended
Measurement mode	Channel power	
Channel bandwidth	8MHz	

3.4. Example

The screenshots below show the configuration described above.
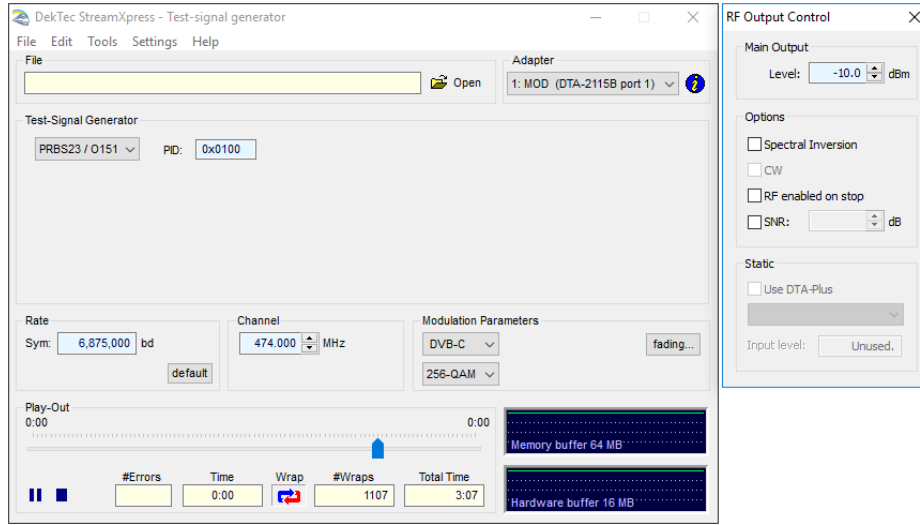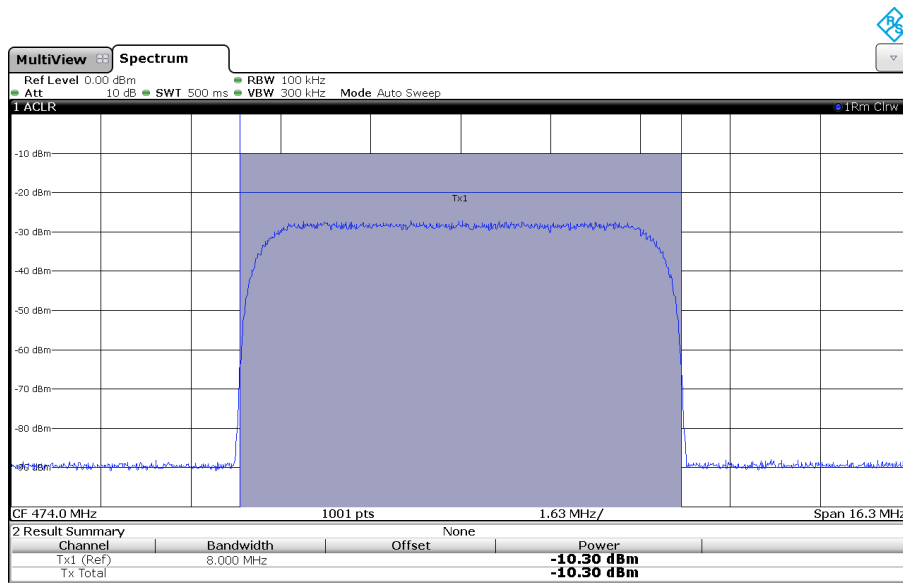

Figure 2. StreamXpress settings.

Figure 3. Rohde & Schwarz FSW signal and spectrum analyzer.

3.5. Expected Results

Measurement	Value	Units	Remarks
Channel power (typical)	-9.7 ≥ power ≥ -10.3	dBm	32 to 1000MHz
	-9.5 ≥ power ≥ -10.5	dBm	1000 to 2186MHz
Channel power (maximum)	-8 ≥ power ≥ -12	dBm	32 to 1000MHz
	-7 ≥ power ≥ -13	dBm	1000 to 2186MHz

4. Channel Simulator – SNR

4.1. Relevance

The DTA-2115B uses digital signal-processing circuitry to create additive white noise with an accurate SNR level. These digital circuits are not affected by ageing.

4.2. Measurement with Frequency Sweep

This method can be used for values of SNR ≥ 3dB.

4.2.1. StreamXpress Settings

Setting	Value
Frequency	32 to 1000MHz, e.g. 474MHz
Modulation standard	DVB-C
Constellation	256-QAM
Symbol rate	6.875MBaud
Channel simulator	Enabled
AWGN generation	Enabled
SNR	15dB
File	None
Test-signal generator	Enable; Mode PSBS23 / O151 on PID 0x0100
RF output level	-10dBm
Spectral inversion	Disabled
CW	Disabled
RF enabled on stop	Disabled
SNR	Disabled

4.2.2. Spectrum-Analyzer Settings

Setting	Value	Remarks
Frequency	Same as modulator	e.g. 474MHz
Span	16MHz	
Reference level	0dBm	
Attenuation	10dB	Commonly required to achieve return loss ≥ 20dB
Level range	100dB	
Trace mode	Clear write	
Detector	RMS	
Resolution bandwidth	100kHz	
Video bandwidth	300kHz	At least 3 times resolution bandwidth
Sweep time	5s	Long sweep time usually gives more stable measurements, as the RMS detector averages over this time
Sweep mode	Auto sweep	Auto FFT is not recommended
Measurement mode	Frequency sweep	
Marker #1 frequency	474MHz	
Marker #2 frequency	+4.25MHz	Delta marker
Marker #3 frequency	–4.25MHz	Delta marker

4.2.3. Example

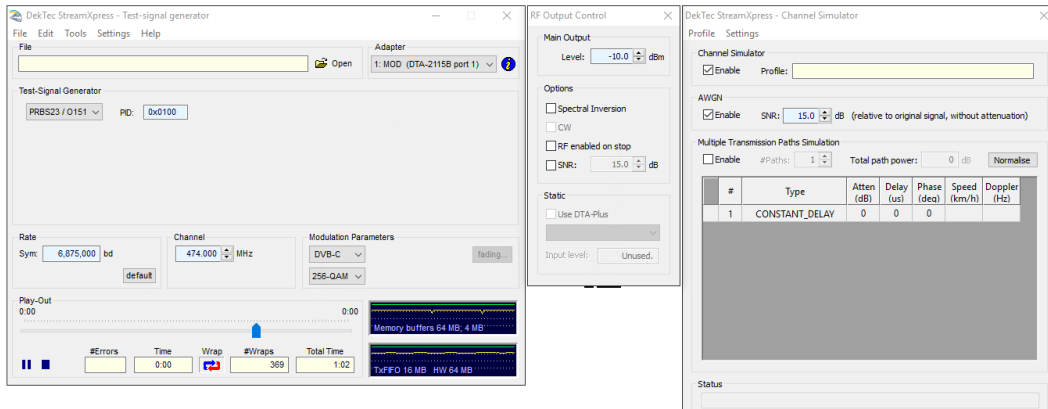The screenshots below are the instrument's main dialog with the configuration as mentioned above applied.
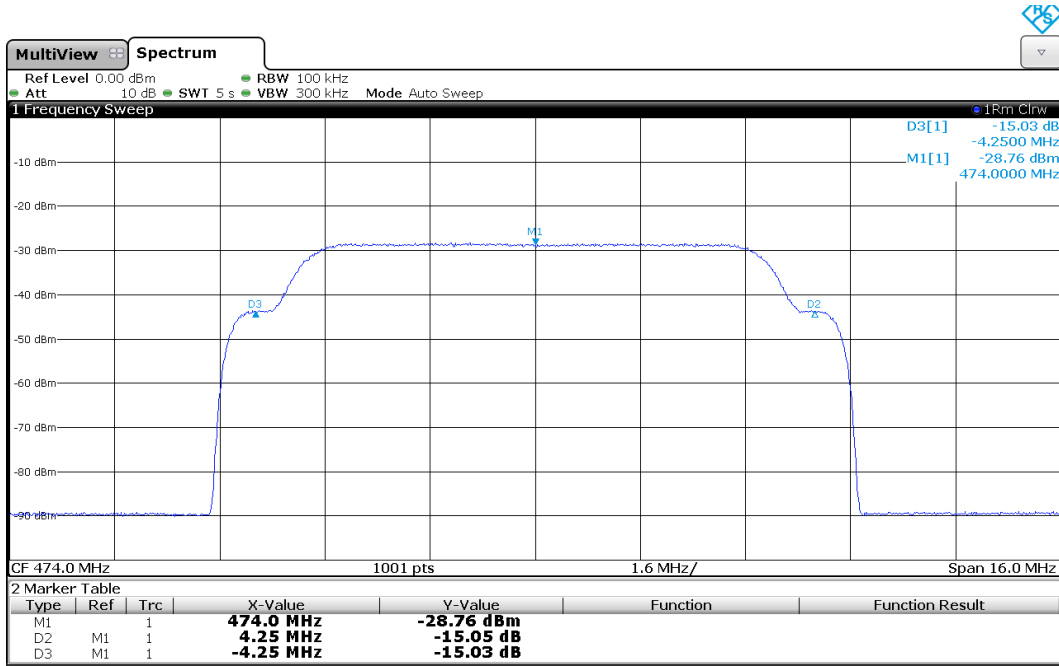

Figure 4. StreamXpress settings.

Figure 5. Rohde & Schwarz FSW signal and spectrum analyzer.

4.2.4. Expected Results

Measurement	Value	Units	Remarks
Signal Level Delta +4.25MHz	-14 ≥ Level ≥ -16	dB	
Signal Level Delta –4.25MHz	-14 ≥ Level ≥ -16	dB	

4.3. Measurement with Vector Signal Analyzer

This method can be used for values of SNR ≥ theoretical minimum MER for given constellation[1].

4.3.1. StreamXpress Settings

Setting	Value
Frequency	32 to 1000MHz, e.g. 474MHz
Modulation standard	DVB-C
Constellation	256-QAM
Symbol rate	6.875MBaud
Channel simulator	Enabled
AWGN generation	Enabled
SNR	25dB
File	None
Test-signal generator	Enable; Mode PSBS23 / O151 on PID 0x0100
RF output level	-10dBm
Spectral inversion	Disabled
CW	Disabled
RF enabled on Stop	Disabled
SNR	Disabled

4.3.2. Spectrum-Analyzer Settings

Setting	Value	Remarks
Frequency	Same as modulator	e.g. 474MHz
Reference level	0dBm	
Attenuation	10dB	Commonly required to achieve return loss ≥ 20dB
Measurement mode	Vector signal analyzer	
Modulation type	QAM	
Modulation order	256-QAM	
Mapping	DVB-C	
Symbol rate	6.875MBaud	
Transmit filter type	RRC	
Transmit filter alpha	0.15	
Equalizer	Disabled	

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[1] For 256-QAM this value is approximately 17dB. For more information on how a receiver computes MER, please refer to chapter 3 of DT-AN-2137-2 RF measurements with the DTA-2137(C).
Link: https://www.dektec.com/products/PCIe/DTA-2137C/downloads/DT-AN-2137-2.pdf

4.3.3. Example

The screenshots below are the instrument's main dialog with the configuration as mentioned above applied.
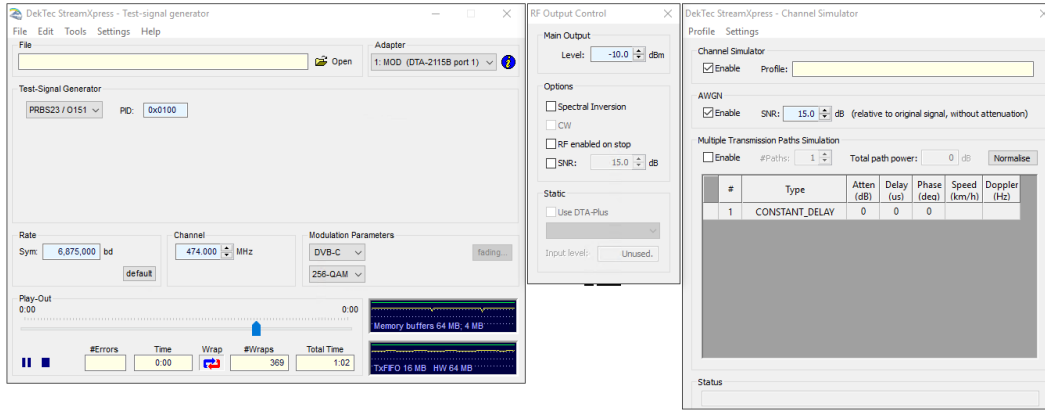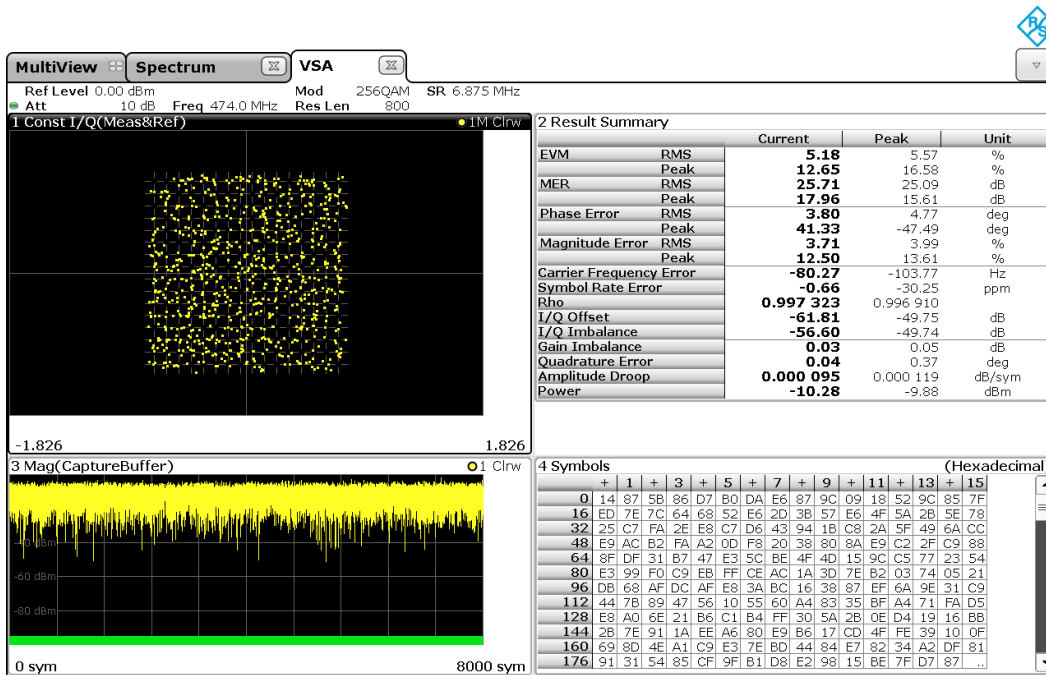

Figure 6. StreamXpress settings.

Figure 7. Rohde & Schwarz FSW signal and spectrum analyzer.

4.3.4. Expected Results

Measurement	Value	Units	Remarks
MER	24 ≥ Level ≥ 26	dB	

5. Carrier Frequency

5.1. Relevance

The DTA-2115B uses several analog components for generating an RF signal at a specified carrier frequency. Aging of these analog components may influence the frequency accuracy of the generated RF carrier over time.

5.2. StreamXpress Settings

Setting	Value
Frequency	32 to 1000MHz, e.g. 474MHz
Modulation standard	DVB-C
Constellation	256-QAM
Symbol rate	6.875MBaud
Channel simulator	Disabled
RF output level	-10dBm
Spectral inversion	Disabled
CW	Enabled
RF enabled on stop	Disabled
SNR	Disabled

5.3. Spectrum-analyzer settings

Setting	Value	Remarks
Frequency	Same as modulator	e.g. 474MHz
Span	5kHz	
Reference level	0dBm	
Attenuation	10dB	Commonly required to achieve return loss ≥ 20dB
Level range	140dB	
Trace mode	Clear write	
Resolution bandwidth	100Hz	
Video bandwidth	300Hz	At least 3 times Resolution bandwidth
Sweep time	5s	Long sweep time usually gives more stable measurements, as the RMS detector averages over this time
Sweep mode	Auto sweep	Auto FFT is not recommended
Marker #1 frequency	Peak search	

5.4. Example

The screenshots below are the instrument's main dialog with the configuration as mentioned above applied.
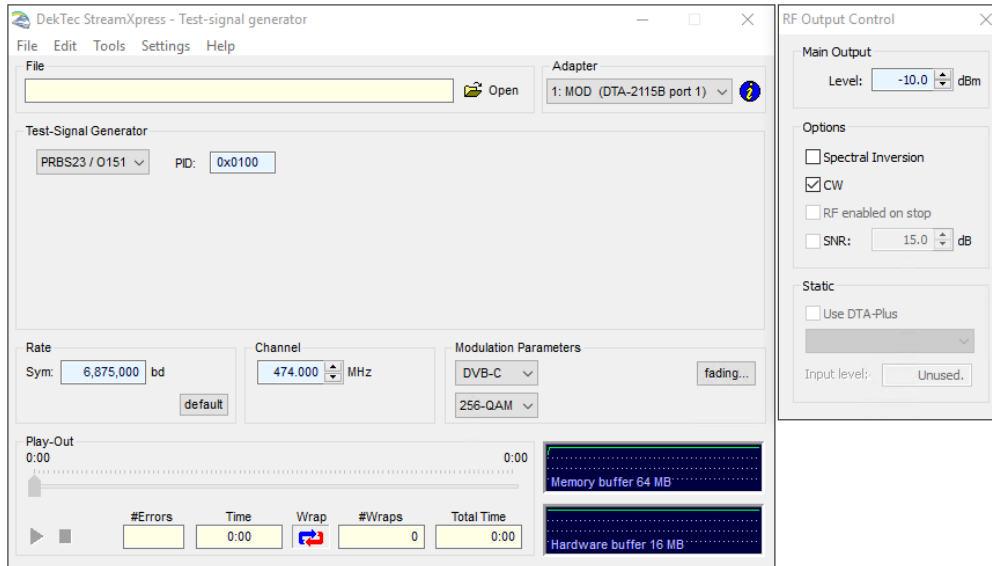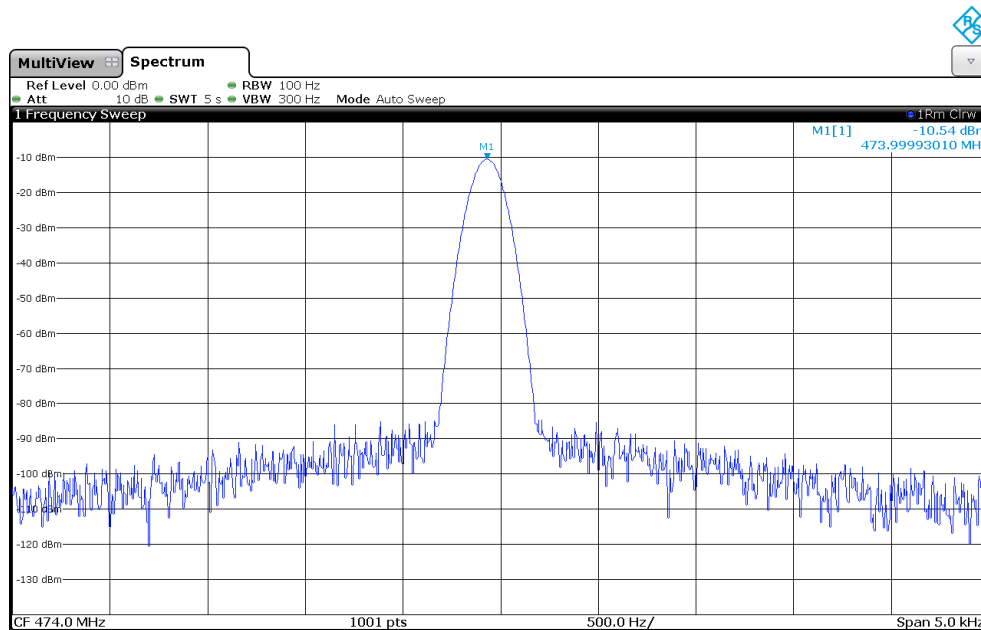

Figure 8. StreamXpress settings.

Figure 9. Rohde & Schwarz FSW signal and spectrum analyzer.

5.5. Expected Results

Measurement	Value	Units	Remarks
Marker frequency	473.999526 ≥ Frequency ≥ 474.000474	MHz	Initial accuracy incl. stability over temperature range
	473.999289 ≥ Frequency ≥ 474.000711	MHz	Including aging in first year

6. Phase Noise

6.1. Relevance

The DTA-2115B uses several analog components for generating an RF signal at an accurate carrier frequency with excellent phase noise performance. Aging of these analog components may influence the phase-noise performance of the generated RF carrier over time.

6.2. Specific Spectrum-Analyzer Requirements

	Specification	Remarks
Frequency accuracy	≤ 0.3ppm	
Phase noise @ 10kHz offset	≤ 145dBc	Up to 500MHz
	≤ 135dBc	Up to 1GHz
	≤ 126dBc	Up to 2GHz
Return loss	≥ 20dB	For above frequency range; Internal attenuation might be required
Measurement mode	Phase noise	

6.3. StreamXpress Settings

Setting	Value
Frequency	32 to 1000MHz, e.g. 474MHz
Modulation standard	DVB-C
Constellation	256-QAM
Symbol rate	6.875MBaud
Channel simulator	Disabled
RF output level	-10dBm
Spectral inversion	Disabled
CW	Enabled
RF enabled on stop	Disabled
SNR	Disabled

6.4. Spectrum-Analyzer Settings

Setting	Value	Remarks
Frequency	Same as modulator	e.g. 474MHz
Attenuation	10dB	Commonly required to achieve return loss ≥ 20dB
Measurement mode	Phase noise	
Nominal level	-10dBm	
Verify frequency	Enabled	
Verify level	Enabled	
Track frequency	Disabled	Only necessary for unstable DUTs
Track level	Disabled	Only necessary for unstable DUTs
Range	100Hz to 1MHz	
Trace mode	Clear write	
Trace smoothing	Enabled; 1%	
Spur removal	Disabled	

6.5. Example

The screenshots below are the instrument's main dialog with the configuration as mentioned above applied.
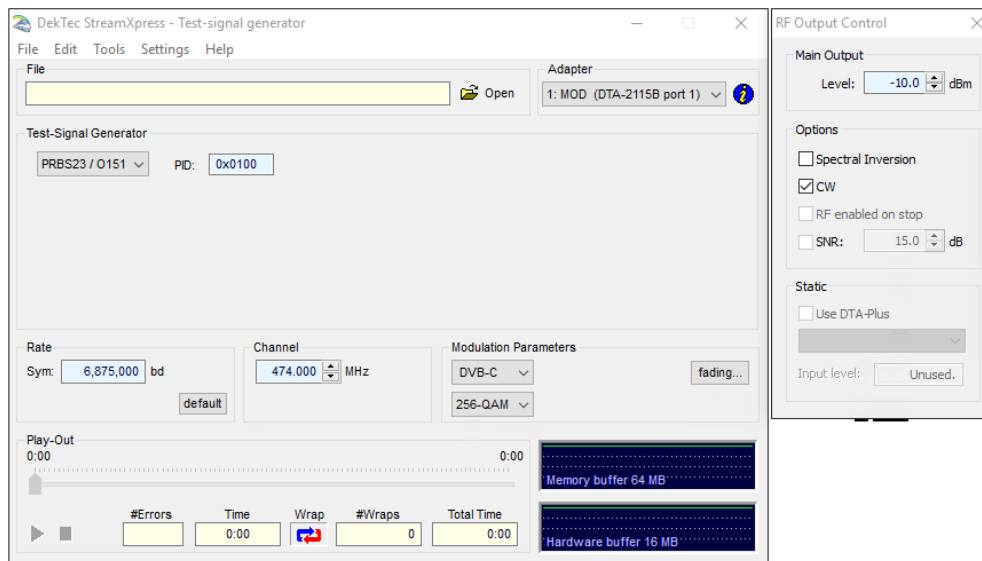

Figure 10. StreamXpress settings for phase-noise measurements.
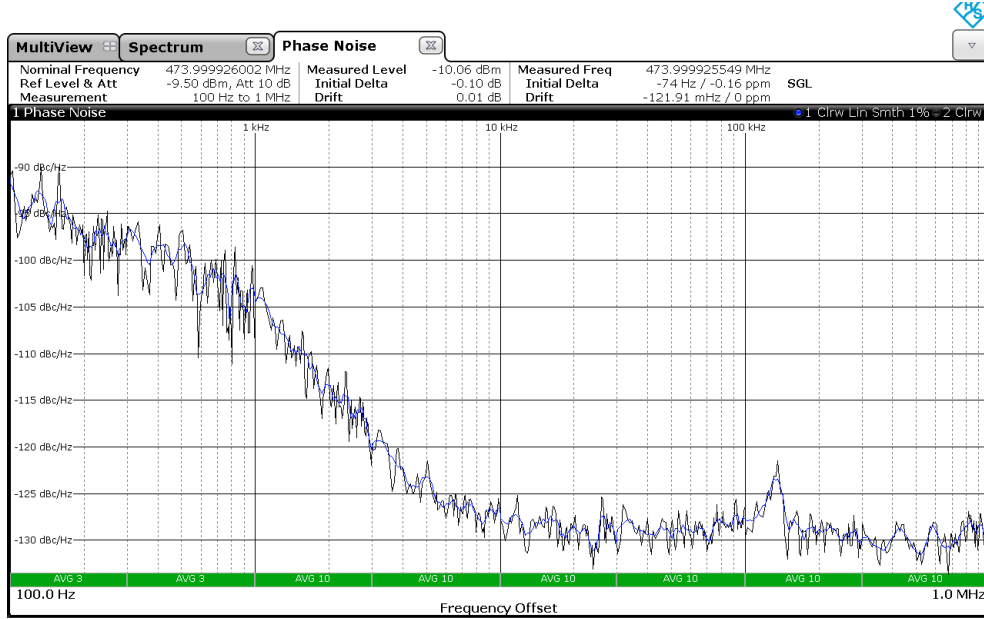
Figure 11. Rohde & Schwarz FSW signal and spectrum analyzer.

6.6. Expected Results

Measurement	Value	Units	Remarks
Phase Noise	Level ≤ -128	dBc/Hz	32MHz; 10kHz offset
	Level ≤ -125	dBc/Hz	500MHz; 10kHz offset
	Level ≤ -120	dBc/Hz	1.5GHz; 10kHz offset
	Level ≤ -115	dBc/Hz	2GHz; 10kHz offset