Test report

REP018182-2R1TRFWL

Date of issue: July 17, 2024

Applicant:

SOLiD

Product description:

Distributed Antenna System (DAS)

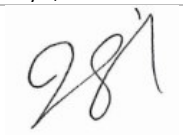
Model:	Product marketing name(s):
MRDU_AWS13_B66_B70	AWS13
FCC ID:	ISED certification number:
W6UHMAWS13B66B70	9354A-HMA13B66B70

Specifications:

- FCC 47 CFR Part 27 – Miscellaneous Wireless Communication Services
- RSS 131 Issue 4 – Zone Enhancers
- RSS-139 Issue 4 - Advanced Wireless Services Equipment Operating in the Bands 1710-1780 MHz and 2110 – 2200 MHz

Lab and test locations

Company name	Nemko USA Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
State	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com
FCC Site Number	Test Firm Registration Number: 392943; Designation Number: US3165
ISED Test Site	2040B

Tested by	Lan Sayasane, EMC Test Engineer
Reviewed by	James Cunningham, EMC/WL Manager
Review date	July 9, 2024
Reviewer signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.
This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, NIST, or any agency of the U.S. Government.

Copyright notification

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Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 27	Miscellaneous Wireless Communication Services
RSS-131 Issue 4	Zone Enhancers
RSS 139 Issue 4	Advanced Wireless Services Equipment Operating in the Bands 1710-1780 MHz and 2110 – 2200 MHz

1.2 Test methods

ANSI C63.26 – 2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Services; Section 7 – RF Repeaters, amplifiers, and boosters testing
FCC KDB 935210 D05 v01r04	Measurements Guidance for Industrial, and Non-Consumer Signal Booster, Repeater, and Amplifier Devices

1.3 Exclusions

None.

1.4 Statement of compliance

Testing was performed against all relevant requirements of the test standard(s).

Results obtained indicate that the product under test complies in full with the tested requirements.

The test results relate only to the item(s) tested.

See “Section 2 Summary of test results” for full details.

1.5 Test report revision history

Table 1.5-1: *Test report revision history*

Revision #	Issue Date	Details of changes made to test report
REP018182-2TRFEMC	March 26, 2024	Original report issued
REP018182-2R1TRFEMC	July 9, 2024	Split reports

Section 2 Summary of test results

2.1 Sample information

Receipt date	26-Oct-23
Nemko sample ID number	REP018182

2.2 Testing period

Test start date	26-Oct-23
Test end date	05-Dec-23

2.3 Test results

Table 2.3-1: *Summary of results*

FCC Part	ISED Part	Test method	Test description	Verdict
		KDB 935210 D05V01r04 (3.2) ANSI C63.26 7.2.2.1	AGC threshold	Pass
	RSS-131 Clause 9.1	KDB 935210 D05v01r04 (3.3) ANSI C63.26 7.2.2.2	Out of band rejection	Pass
FCC Part 2.1049	RSS-131 Clause 9.2	KDB 935210 D05v01r05 (3.4) ANSI C63.26 7.2.2.3	Occupied bandwidth / Input-versus-output spectrum	Pass
FCC Part 27.50(d) (band 66, 70 operation)	RSS-131 Clause 9.3	KDB 935210 D05v01r05 (3.5) ANSI C63.26 7.2.2.4	Input/output power and amplifier/booster gain	Pass
FCC Part 27.53(h) (band 66, 70 operation)	RSS-133 Clause 6.5.1 (band 25 operation) RSS-139 Clause 5.6 (band 66 operation)	KDB 935210 D05v01r05 (3.6) ANSI C63.26 7.2.2.5	Spurious emissions at RF antenna connector	Pass
FCC Part 27.54 (band 66, 70 operation)	RSS-131 Clause 9.4	KDB 935210 D05v01r05 (3.7) ANSI C63.26 7.2.2.6	Frequency stability	Not applicable [1]
FCC Part 27.53(h) (band 66, 70 operation)	RSS-133 Clause 6.5.1 (band 25 operation) RSS-139 Clause 5.6 (band 66 operation)	KDB 935210 D05v01r05 (3.8) ANSI C63.26 7.2.2.7	Radiated spurious emissions	Pass

Notes: [1] Per ANSI C63.26-2015 clause 7.2.2.6 and KDB 935210 Clause 3.7, frequency stability testing is not required if the EUT does not process the input signal in a manner that can influence the output signal frequency/frequencies.

Section 3 Equipment under test (EUT) details

3.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

3.2 Applicant

Company name	SOLiD
Address	800 Klein Road, Suite 200
City	Plano
State	TX
Postal/Zip code	75074
Country	USA

3.3 Manufacturer

Company name	SOLiD
Address	800 Klein Road, Suite 200
City	Plano
State	TX
Postal/Zip code	75074
Country	USA

3.4 EUT information

Product name	Distributed Antenna System (DAS)
Model	MRDU_AWS13_B66_B70
Variant(s)	None
Serial number	N/A
Part number	N/A
Power requirements	Input: 120Vac, 50/60Hz
Description/theory of operation	Distributed Antenna System (DAS) that efficiently delivers wireless RF signals into any indoor or outdoor location difficult to cover with traditional macro networks.
Operational frequencies	Band 70: 1995 – 2020 MHz DL / 1695 – 1710 UL Band 66: 2110 – 2220 MHz DL / 1710 – 1780 MHz UL
Software details	Alliance Rel6.0 Management Version 18.0.7
Type of signal booster	FCC: ☐ Consumer Signal Booster ☐ Provider-Specific Consumer Signal Booster ☒ Industrial Signal Booster ISED: ☐ Consumer Zone Enhancer ☐ Fixed Consumer Zone Enhancer ☒ Industrial Zone Enhancer ☐ Mobile Consumer Zone Enhancer ☐ Provider-Specific Consumer Zone Enhancer

3.5 Transmitter Information

Frequency band(s)	Band 70: 1995 – 2020 MHz DL / 1695 – 1710 UL Band 66: 2110 – 2220 MHz DL / 1710 – 1780 MHz UL
Antenna information	2 antenna ports (one for band 70 operation, one for band 66 operation). Antenna details None
Nominal gain (*)	Nominal gain 57 dB, 58 dB for band 66 operation.
Gain-versus-frequency response (*)	Gain is nominally flat across the frequency bands. See out-of-band rejection data in section 8.2 for verification.
Rated mean output power P_{rated} (*)	37 dBm (5 Watts)
Output signal coupling attenuation (*)	0 dB
Mobile Station Coupling Loss (*)	N/A (EUT is not a Wideband Consumer Zone Enhancer)
Base Station Coupling Loss (*)	N/A (EUT is not a Provider-Specific Consumer Zone Enhancer)
Input port impedance	50 ohms (note – input port(s) are situated on the iBIU system interface unit, connected via fiber to EUT
Output port impedance	50 ohms

(*) Information required per RSS-131

3.6 EUT setup details

Table 3.6-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number	Rev.
MRDU_AWS13_B66_B70	SOLiD	AWS13	N/A	--

Table 3.6-2: *EUT interface ports*

Description	Qty.
Power In	1
Power Out (Not Used)	1
ANT1	1
ANT2	1
Tx (Not Used)	1
Rx (Not Used)	1
I/O (Not Used)	1
Fan (Not Used)	1
Optic	1

Table 3.6-3: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
iBIU System Interface	SOLiD	iBIU_AC	65100122800159	--
Laptop	DELL	Latitude 5480	6KP16H2	--

Table 3.6-4: *Inter-connection cables*

Cable description	From	To	Length (m)
Fiber Optic	Distributed Antenna Systems	iBIU System Interface	10
Serial to USB	iBIU System Interface	Laptop	2

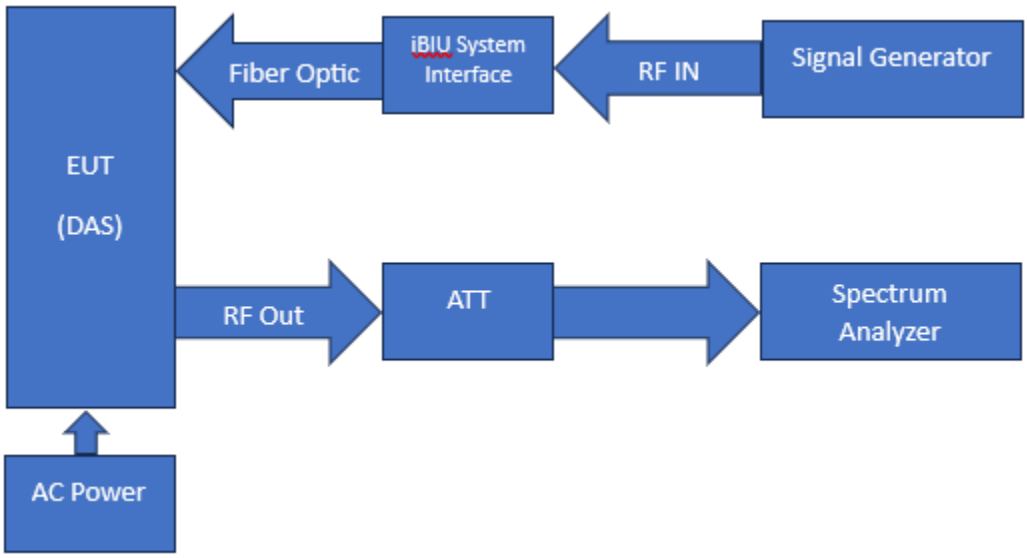


Figure 3.6-1: Test setup diagram

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

None.

4.2 Technical judgement

None.

4.3 Deviations from laboratory test procedures

None.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4-2 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics, and limit modelling – Measurement instrumentation uncertainty. The expression of Uncertainty in EMC testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Table 6.1-1: *Measurement uncertainty calculations*

Measurement		**U_{cispr} dB**	**U_{lab} dB**
Conducted disturbance at AC mains and other port power using a V-AMN	9 kHz to 150 kHz	3.8	2.9
	150 kHz to 30 MHz	3.4	2.3
Conducted disturbance at telecommunication port using AAN	150 kHz to 30 MHz	5.0	4.3
Conducted disturbance at telecommunication port using CVP	150 kHz to 30 MHz	3.9	2.9
Conducted disturbance at telecommunication port using CP	150 kHz to 30 MHz	2.9	1.4
Conducted disturbance at telecommunication port using CP and CVP	150 kHz to 30 MHz	4.0	3.1
Radiated disturbance (electric field strength in a SAC)	30 MHz to 1 GHz	6.3	5.5
Radiated disturbance (electric field strength in a FAR)	1 GHz to 6 GHz	5.2	4.7
Radiated disturbance (electric field strength in a FAR)	6 GHz to 18 GHz	5.5	5.0

Notes: Compliance assessment:

If U_{lab} is less than or equal to U_{cispr} then:

- compliance is deemed to occur is no measured disturbance level exceeds the disturbance limit.
- non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit

If U_{lab} is greater than U_{cispr} then:

- compliance is deemed to occur is no measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit.
- non-compliance is deemed to occur if any measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit

V-AMN: V type artificial mains network
AAN: Asymmetric artificial network
CP: Current probe
CVP: Capacitive voltage probe
SAC: Semi-anechoic chamber
FAR: Fully anechoic room

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: *Test Equipment List*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Signal and Spectrum Analyzer	Rohde & Schwarz	FSV40	E1120	2 years	14-Dec-2025
Vector Signal Generator	Rohde & Schwarz	SMW200A	E1156	3 years	10-May-2024
Power Sensor	ETS-Lindgren	7002-006	EW110	1 year	14-Apr-2024
EMI Test Receiver	Rohde & Schwarz	ESU 40	E1121	1 year	23-Aug-2024
System Controller	Sunol Sciences	SC104V	E1191	NCR	NCR
Antenna, Bilog	Schaffner-Chase	CBL6111C	1480	1 year	21-Feb-2024
Antenna, DRG Horn	ETS-Lindgren	3117-PA	E1160	1 year	13-Feb-2024
Antenna, Horn (18-26.5 GHz)	Eravant	SAZ-2410-42-S1	EW107	1 year	05-Dec-2024
Antenna, Horn (26.5-40 GHz)	Eravant	SAZ-2410-2-S1	EW108	1 year	05-Dec-2024
Termination, 50 ohms	Diamond Antenna	DC-500MHz	N/A	NCR	NCR
Attenuator, 30dB	Pasternack	PE7388-30	E1325	VBU	VBU

Notes: NCR: no calibration required
VBU: verify before use

7.2 Test software list

Table 7.2-1: *Test Software*

Manufacturer	Details
Rohde & Schwarz	EMC 32 V10.60.10 (AC conducted emissions)
Rohde & Schwarz	EMC 32 V10.60.15 (radiated emissions)

Section 8 Testing data

8.1 AGC Threshold

8.1.1 References and limits

- ANSI C63.26 Section 7.2.2.1
- KDB 935210 D05v01r04 Clause 3.2

8.1.2 Test summary

Verdict	Pass		
Test date	November 15, 2023	Temperature	21 °C
Test engineer	Lan Sayasane, EMC Test Engineer	Air pressure	1006 mbar
Test location	☐ 10m semi anechoic chamber ☐ 3m semi anechoic chamber ☒ Wireless bench ☐ Other:	Relative humidity	51 %

8.1.3 Notes

Per KDB 935210 D05 v01r04, Clause 3.1 and ANSI C63.26 Clause 7.2.2.1, testing was performed with a narrowband test signal (MSK modulated, gaussian filter of 0.3 and data rate 270 kbps) and a broadband signal (AWGN, 4.1 MHz 99% occupied bandwidth).

8.1.4 Setup details

EUT power input during test	120 VAC / 60 Hz
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:
Measurement details	The automatic gain control (AGC) threshold is determined as follows: a) Connect a signal generator to the input of the EUT. b) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation. c) The signal generator must be set to either of the required modulation signals. d) Set the frequency to the middle frequency of the EUT operating band. e) While monitoring the output of the EUT using the method of ANSI C63.26 7.2.2.4.2 or 7.2.2.4.3, increase the input level until a 1 dB increase in the input signal no longer causes a 1 dB increase in the output signal. f) This is the AGC threshold level of the EUT. g) Repeat for the other modulation signal.

8.1.5 Test data

Table 8.1-1: *AGC Threshold results*

Operating frequency band	Input signal type	AGC Threshold Level (dBm)
Band 70: 1995 – 2020 MHz	Narrowband	-21.0
	Broadband	-20.0
Band 66: 2110 – 2200 MHz	Narrowband	-24.0
	Broadband	-24.0

8.2 Out of band rejection

8.2.1 References and limits

- ANSI C63.26 Section 7.2.2.2
- KDB 935210 D05v01r04 Clause 3.3
- RSS-131 Clause 9.1

8.2.2 Test summary

Verdict	Pass		
Test date	October 26, 2023	Temperature	20 °C
Test engineer	Lan Sayasane, EMC Test Engineer	Air pressure	1010 mbar
Test location	☐ 10m semi anechoic chamber ☐ 3m semi anechoic chamber ☒ Wireless bench ☐ Other:	Relative humidity	55 %

8.2.3 Notes

None

8.2.4 Setup details

EUT power input during test	120 VAC / 60 Hz
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:
Measurement details	The out-of-band rejection is measured as follows: a. Connect a signal generator to the input of the EUT. b. Configure a swept CW signal with the following parameters: 1) Frequency range = ± 250 % of the passband from the center of the passband, for each applicable operating frequency band. 2) Level = a sufficient level to affirm that the out-of-band rejection is > 20 dB above the noise floor and will not engage the AGC during the entire sweep. 3) Dwell time = approximately 10 ms. 4) Number of points = SPAN/(RBW/2). c. Connect a spectrum analyzer to the output of the EUT using appropriate attenuation. d. Set the span of the spectrum analyzer to the same frequency range of the signal generator. e. Set the RBW of the spectrum analyzer to be 1% to 5% of the EUT passband and the VBW shall be set to ≥ 3 x RBW. f. Set the detector to Peak Max-Hold and wait for the spectrum analyzer's display to fill. g. Capture the frequency response of the EUT. h. Please a marker to the peak of the frequency response and record this frequency as f_0. i. Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the -20 dB down amplitude to determine the 20 dB bandwidth. j. Repeat for all frequency bands applicable for use by the EUT.

8.2.5 Test data

8.2.5.1 Operating frequency band: Band 25 and Band 70: 1930 – 2020 MHz

Note: Since Band 25 and Band 70 are adjacent to each other, a single measurement was performed across both bands.

Table 8.2-1: *Out of band rejection results, Band 25_Band 70*

Parameter	Value
f_0	1937.880
f_l	1925.310
f_h	2024.690
20 dB bandwidth	99.380

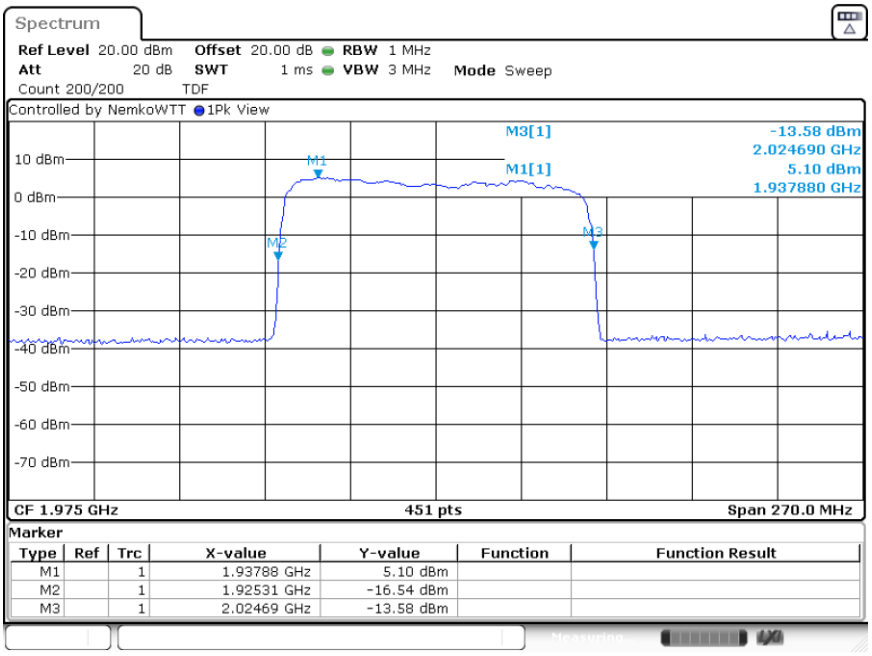


Figure 8.2-1: *Out of band rejection results, Band 25_Band 70*

8.2.5.2 Operating frequency band: Band 66: 2110 – 2200 MHz

Table 8.2-2: *Out of band rejection results, Band 66*

Parameter	Value
f_0	2102.902
f_l	2157.048
f_h	2211.193
20 dB bandwidth	108.291

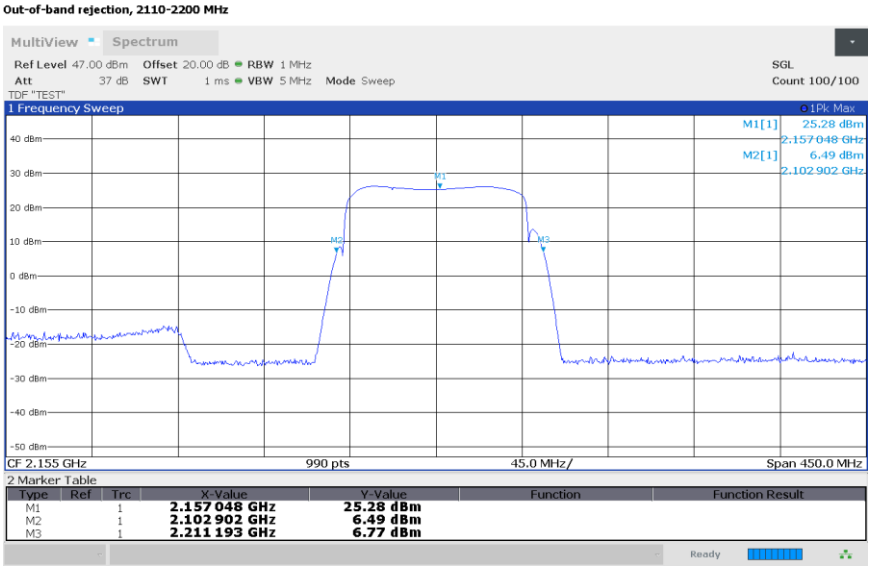


Figure 8.2-2: *Out of band rejection results, Band 66*

8.3 Occupied bandwidth / Input Versus Output Comparison

8.3.1 References and limits

- FCC 47 CFR Part 2.1049
- ANSI C63.26 Clause 7.2.2.4
- KDB 935210 D05v01r04 Clause 3.4
- RSS-131 Clause 9.2

8.3.2 Test summary

Verdict	Pass		
Test date	November 15, 2023	Temperature	21 °C
Test engineer	Lan Sayasane, EMC Test Engineer	Air pressure	1006 mbar
Test location	☐ 10m semi anechoic chamber ☐ 3m semi anechoic chamber ☒ Wireless bench ☐ Other:	Relative humidity	51 %

8.3.3 Notes

Per KDB 935210 D05 v01r04, Clause 3.3 and ANSI C63.26 Clause 7.2.2.3, testing was performed with a narrowband test signal (MSK modulated, gaussian filter of 0.3 and data rate 270 kbps) and a broadband signal (AWGN, 4.1 MHz 99% occupied bandwidth).

8.3.4 Setup details

EUT power input during test	120 VAC / 60 Hz
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:
Measurement details	A 26 dB bandwidth measurement shall be performed on the input and the output signal. a. Connect a signal generator to the EUT. b. Configure the signal generator to transmit the AWGN signal. c. Configure the signal level to be just below the AGC threshold, but not more than 0l5 dB below. d. Connect a spectrum analyzer to the output of the EUT using appropriate attenuation. e. Set the spectrum analyzer center frequency to the nominal EUT channel center frequency. The span range of the spectrum analyzer shall be between 2 x OBW and 5 x OBW. f. The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW and the VBW shall be ≥ 3 x RBW. g. Set the reference level of the instrument as required, to prevent the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than [10 log (OBW / RBW)] below the reference level. Step f) and step g) can require iteration to enable adjustments within the specified tolerances. h. The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below the reference level. i. Set spectrum analyzer detection mode to peak, and the trace mode to max hold. j. Determine the reference value: Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference level). k. Determine the -26 dB down amplitude by placing two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the-26 dB down amplitude. If a marker is below the -26 dB down value, it should be as close as possible to this value. The OBW is the positive frequency difference between the two markers. l. Repeat step 3) to step k) to measure the input signal to the EUT (i.e., signal generator output). Compare the 26 dB bandwidths to affirm they are similar. m. Repeat step e) to step l) with the input signal to the EUT set to 3 dB above the AGC threshold. n. Repeat step e) to step m) with the signal generator set to the narrowband signal. o. Repeat step e) to step n) for all bands used by the EUT.

8.3.5 Test data

8.3.5.1 Operating frequency band: Band 70: 1995 – 2020 MHz

Table 8.3-1: *Occupied bandwidth / Input Versus Output Comparison results*

Condition	Test Frequency (MHz)	26 dB Bandwidth (Input Signal) (MHz)	26 dB Bandwidth (Output Signal) (MHz)
Input Level = AGC Threshold - -0.5 dB Input signal = narrowband	2007.5	0.3084	0.3084
Input Level = AGC Threshold + 3 dB Input signal = narrowband	2007.5	0.3084	0.3074
Input Level = AGC Threshold - -0.5 dB Input signal = broadband	2007.5	4.667	4.667
Input Level = AGC Threshold + 3 dB Input signal = broadband	2007.5	4.667	4.667

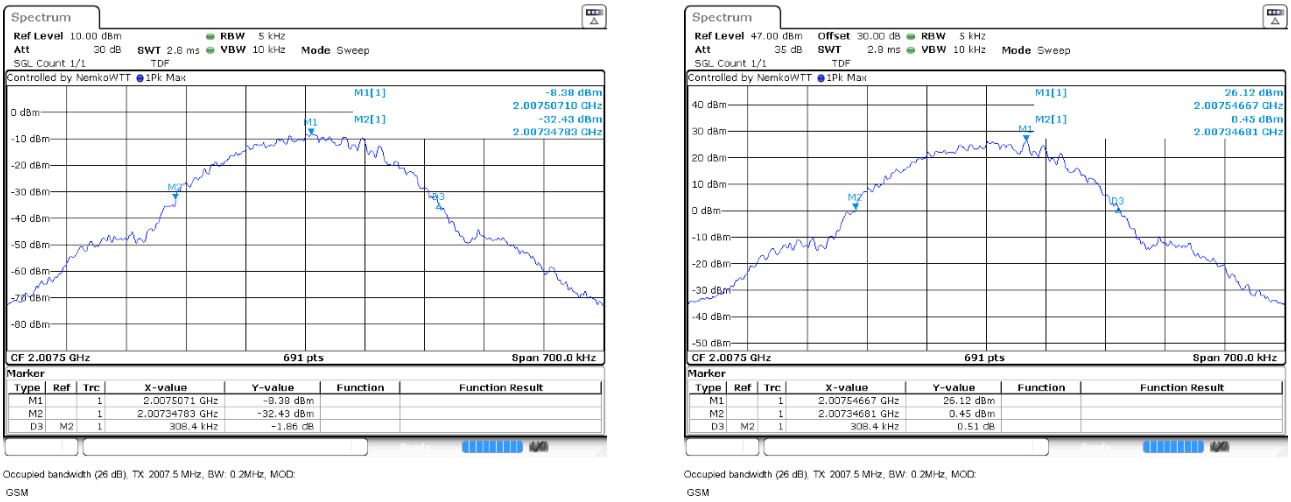


Figure 8.3-1: *Occupied bandwidth / Input Versus Output Comparison results, narrowband signal, 0.5 dB below AGC threshold, input and output signal respectively*

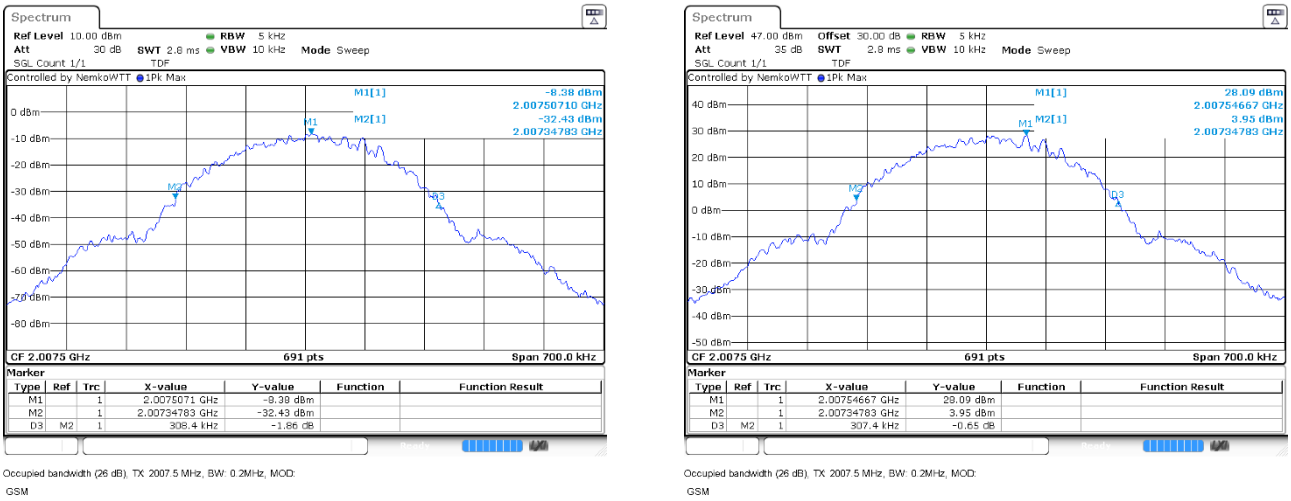
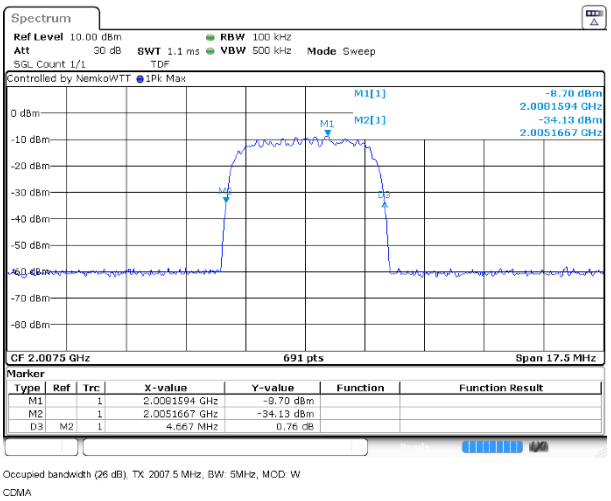


Figure 8.3-2: *Occupied bandwidth / Input Versus Output Comparison results, narrowband signal, 3.0 dB above AGC threshold, input and output signal respectively*



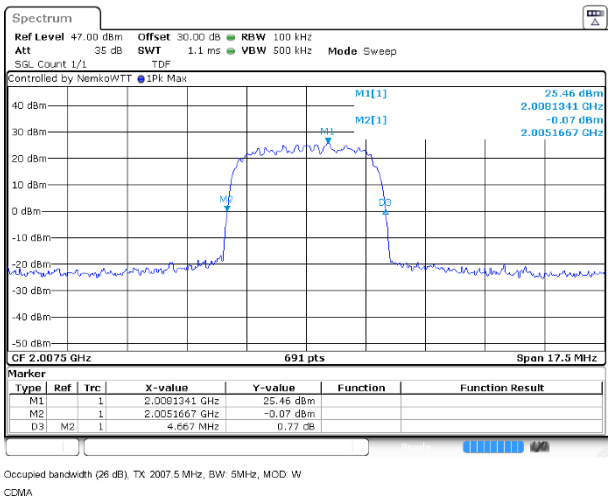
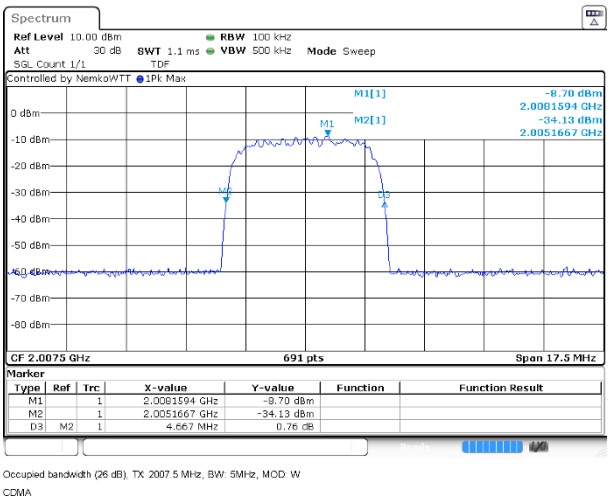


Figure 8.3-3: *Occupied bandwidth / Input Versus Output Comparison results, broadband signal, 0.5 dB below AGC threshold, input and output signal respectively*



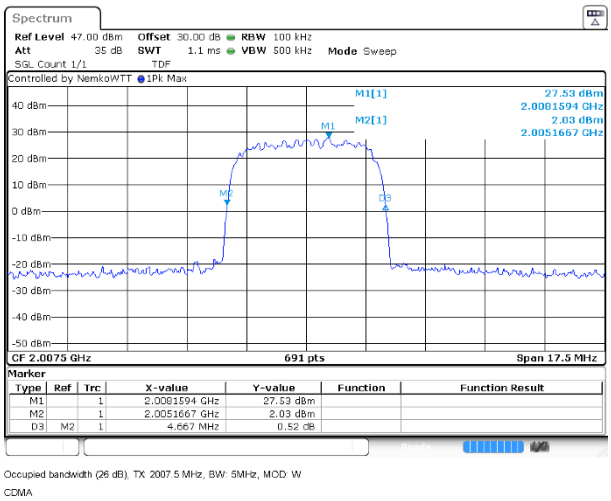


Figure 8.3-4: *Occupied bandwidth / Input Versus Output Comparison results, broadband signal, 3.0 dB above AGC threshold, input and output signal respectively*

8.3.5.2 Operating frequency band: Band 66: 2110 – 2200 MHz

Table 8.3-2: *Occupied bandwidth / Input Versus Output Comparison results*

Condition	Test Frequency (MHz)	26 dB Bandwidth (Input Signal) (MHz)	26 dB Bandwidth (Output Signal) (MHz)
Input Level = AGC Threshold - -0.5 dB Input signal = narrowband	2155	0.3087	0.3087
Input Level = AGC Threshold + 3 dB Input signal = narrowband	2155	0.3094	0.3087
Input Level = AGC Threshold - -0.5 dB Input signal = broadband	2155	4.6725	4.6375
Input Level = AGC Threshold + 3 dB Input signal = broadband	2155	4.6725	4.665

Figure 8.3-5: *Occupied bandwidth / Input Versus Output Comparison results, narrowband signal, 0.5 dB below AGC threshold, input and output signal respectively*

Figure 8.3-6: *Occupied bandwidth / Input Versus Output Comparison results, narrowband signal, 3.0 dB above AGC threshold, input and output signal respectively*

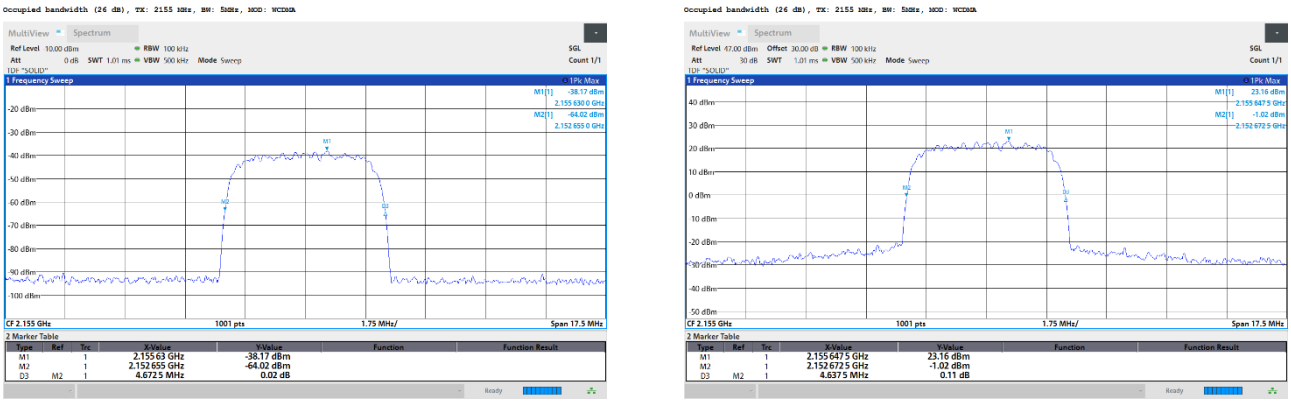


Figure 8.3-7: *Occupied bandwidth / Input Versus Output Comparison results, broadband signal, 0.5 dB below AGC threshold, input and output signal respectively*

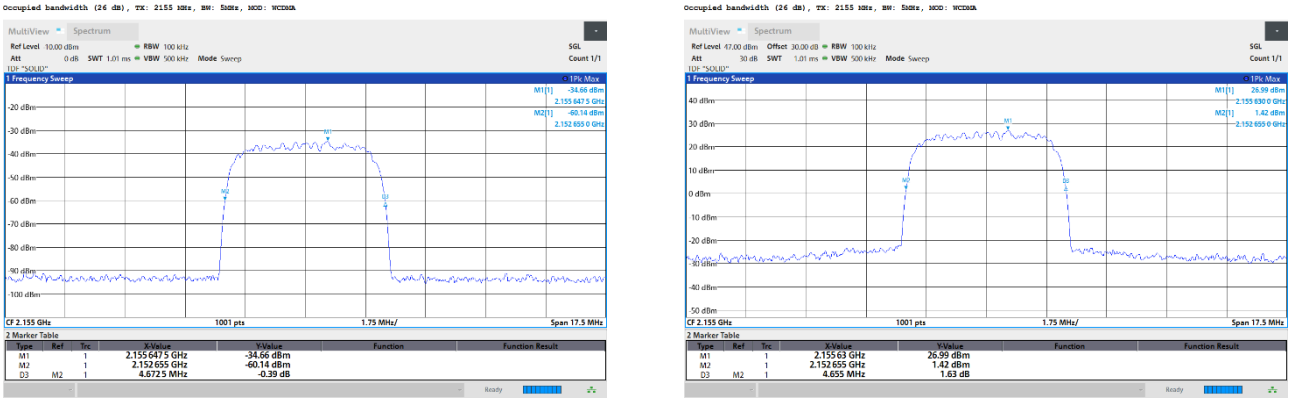


Figure 8.3-8: *Occupied bandwidth / Input Versus Output Comparison results, broadband signal, 3.0 dB above AGC threshold, input and output signal respectively*

8.4 Output power / Mean output power and amplifier gain

8.4.1 References and limits

- FCC Part 27.50(d) & RSS-139 (band 66 operation)
- FCC Part 27.50(d) (band 70 operation)
- ANSI C63.26 Clause 7.2.2.4
- KDB 935210 D05v01r05 Clause 3.5

8.4.2 Test summary

Verdict	Pass		
Test date	November 15, 2023	Temperature	21 °C
Test engineer	Lan Sayasane, EMC Test Engineer	Air pressure	1006 mbar
Test location	☐ 10m semi anechoic chamber ☐ 3m semi anechoic chamber ☒ Wireless bench ☐ Other:	Relative humidity	51 %

8.4.3 Notes

Per KDB 935210 D05 v01r04, Clause 3.4 and ANSI C63.26 Clause 7.2.2.4, testing was performed with a narrowband test signal (MSK modulated, gaussian filter of 0.3 and data rate 270 kbps) and a broadband signal (AWGN, 4.1 MHz 99% occupied bandwidth).

8.4.4 Setup details

EUT power input during test	120 VAC / 60 Hz
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:
Measurement details	Adjust the internal gain control of the EUT to the maximum gain for which the equipment certification is sought. Any EUT attenuation settings shall be set to their minimum value. a. Connect a signal generator to the input of the EUT. b. The modulation shall be set to the AWGN signal. c. The frequency of the signal generator shall be set to the frequency f_0 as determined during the out-of-band rejection measurement. d. Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation, e. Set the level of the signal generator to a level that produces an output just below the AGC threshold, but not more than 0l5 dB below. f. Measure the output power of the EUT. g. Remove the EUT from the measurement set-up. Using the same signal generator settings, repeat the power measurement on the input signal to the EUT (i.e., the signal generator output). Calculate the amplifier gain as follows: Gain (dB) = output (dBm) – input (dBm). h. Repeat step f) and g) with the input level set to a level that is 3 dB above the AGC threshold. i. Repeat step e) to step h) with the input signal set to narrowband modulation. j. Repeat step e) to step i) for all bands used by the EUT.

8.4.5 Test data

8.4.5.1 Operating frequency band: Band 70: 1995 – 2020 MHz

Table 8.4-1: *Output power / Mean output power and amplifier gain test data*

Condition	Test frequency (MHz)	Input power (dBm / MHz)	Output power (dBm/MHz)	Amplifier gain (dB)	0.1 % PAPR (dB)
Input Level = AGC Threshold - -0.5 dB Input signal = narrowband	2007.5	-20.78	35.68	56.46	0.43
Input Level = AGC Threshold + 3 dB Input signal = narrowband	2007.5	-17.26	35.62	52.88	0.38
Input Level = AGC Threshold - -0.5 dB Input signal = broadband	2007.5	-20.61	35.88	56.49	4.64
Input Level = AGC Threshold + 3 dB Input signal = broadband	2007.5	-17.11	35.85	52.96	4.52

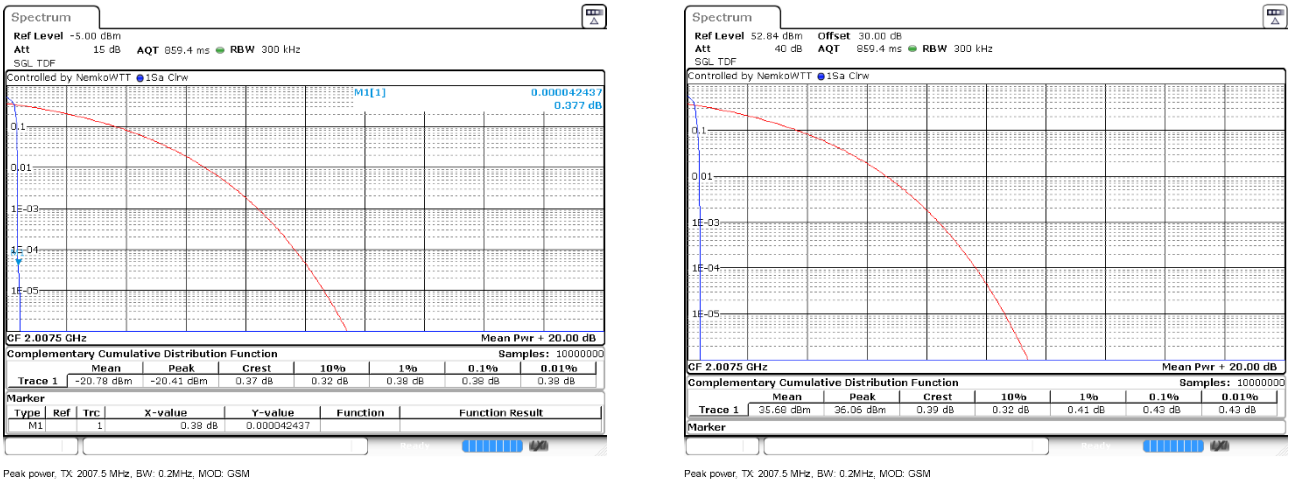


Figure 8.4-1: *Output power / Mean output power and amplifier gain results, narrowband signal, 0.5 dB below AGC threshold, input and output signal respectively*

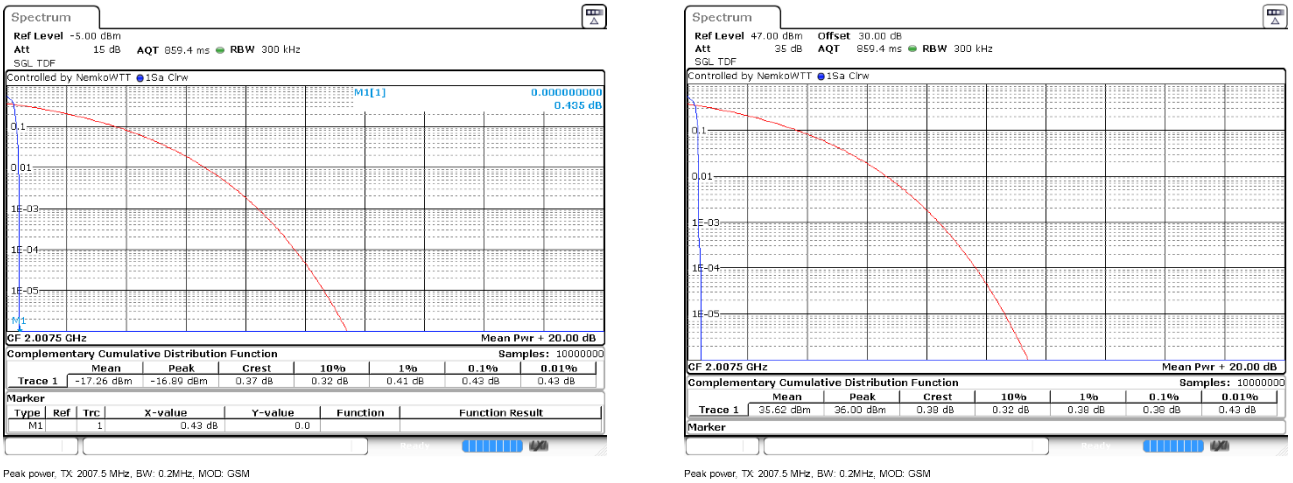
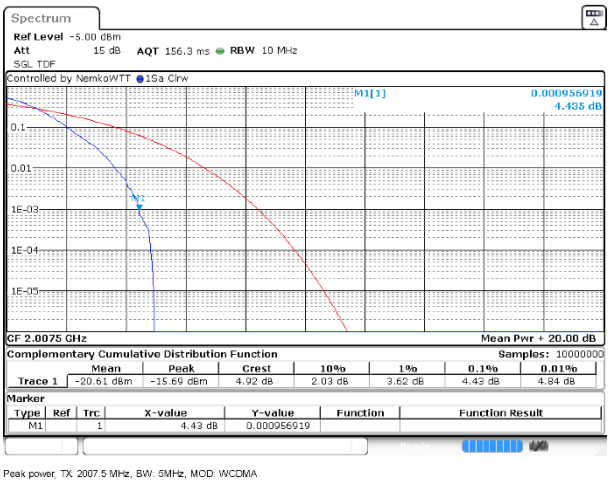
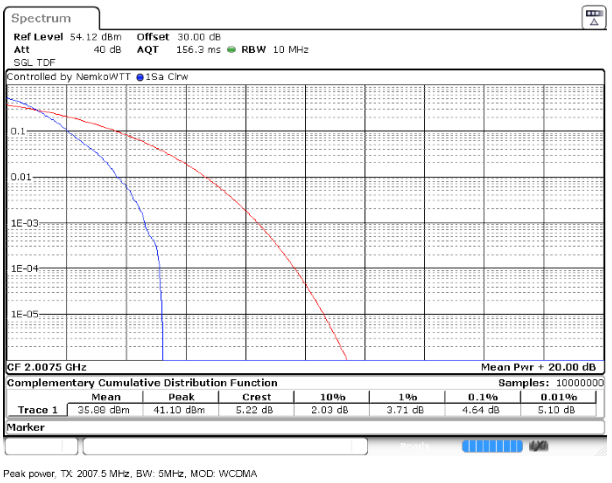


Figure 8.4-2: *Output power / Mean output power and amplifier gain results, narrowband signal, 3 dB above AGC threshold, input and output signal respectively*

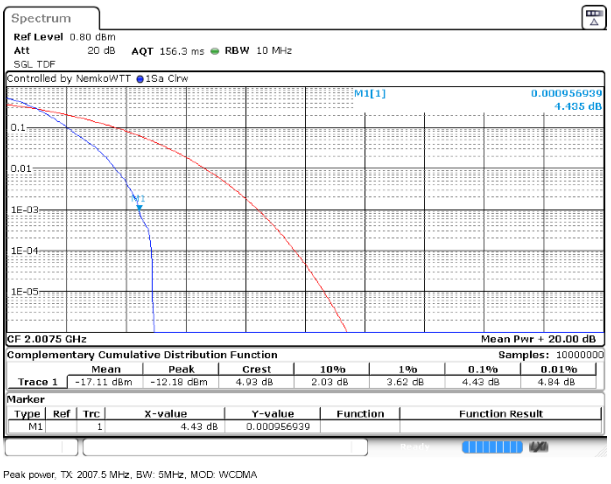


Peak power, TX: 2007.5 MHz, BW: 5MHz, MOD: WCDMA

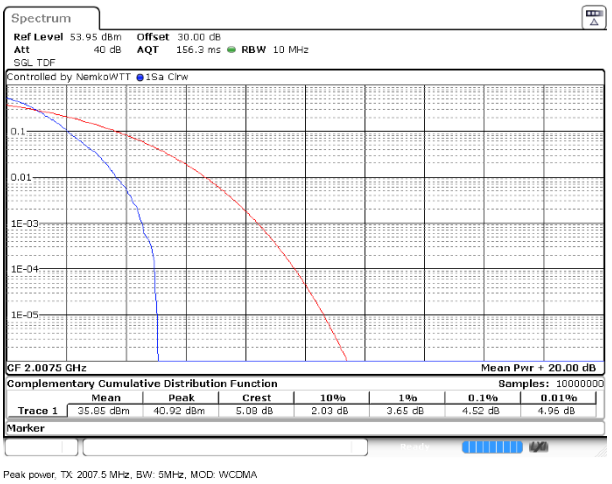


Peak power, TX: 2007.5 MHz, BW: 5MHz, MOD: WCDMA

Figure 8.4-3: *Output power / Mean output power and amplifier gain results, broadband signal, 0.5 dB below AGC threshold, input and output signal respectively*



Peak power, TX: 2007.5 MHz, BW: 5MHz, MOD: WCDMA



Peak power, TX: 2007.5 MHz, BW: 5MHz, MOD: WCDMA

Figure 8.4-4: *Output power / Mean output power and amplifier gain results, broadband signal, 3 dB above AGC threshold, input and output signal respectively*

8.4.5.2 Operating frequency band: Band 66: 2110 – 2200 MHz

Table 8.4-2: *Output power / Mean output power and amplifier gain test data*

Condition	Test frequency (MHz)	Input power (dBm / MHz)	Output power (dBm/MHz)	Amplifier gain (dB)	0.1 % PAPR (dB)
Input Level = AGC Threshold - -0.5 dB Input signal = narrowband	2157.503	-24.38	35.28	59.66	0.38
Input Level = AGC Threshold + 3 dB Input signal = narrowband	2157.503	-20.88	36.49	57.37	0.67
Input Level = AGC Threshold - -0.5 dB Input signal = broadband	2157.503	-24.23	37.15	61.38	4.46
Input Level = AGC Threshold + 3 dB Input signal = broadband	2157.503	-20.62	36.97	57.59	4.55

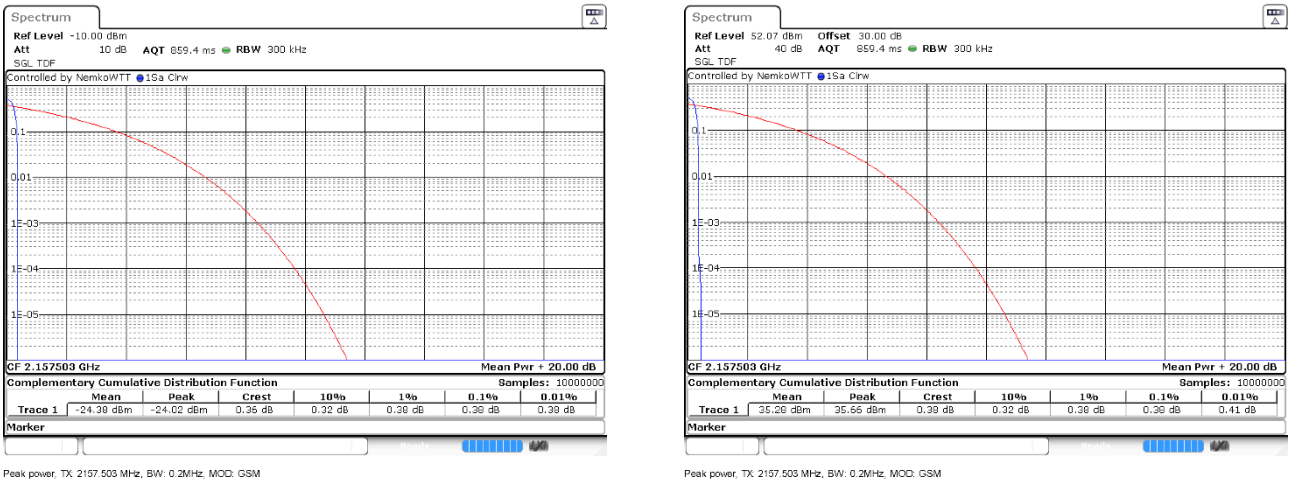


Figure 8.4-5: *Output power / Mean output power and amplifier gain results, narrowband signal, 0.5 dB below AGC threshold, input and output signal respectively*

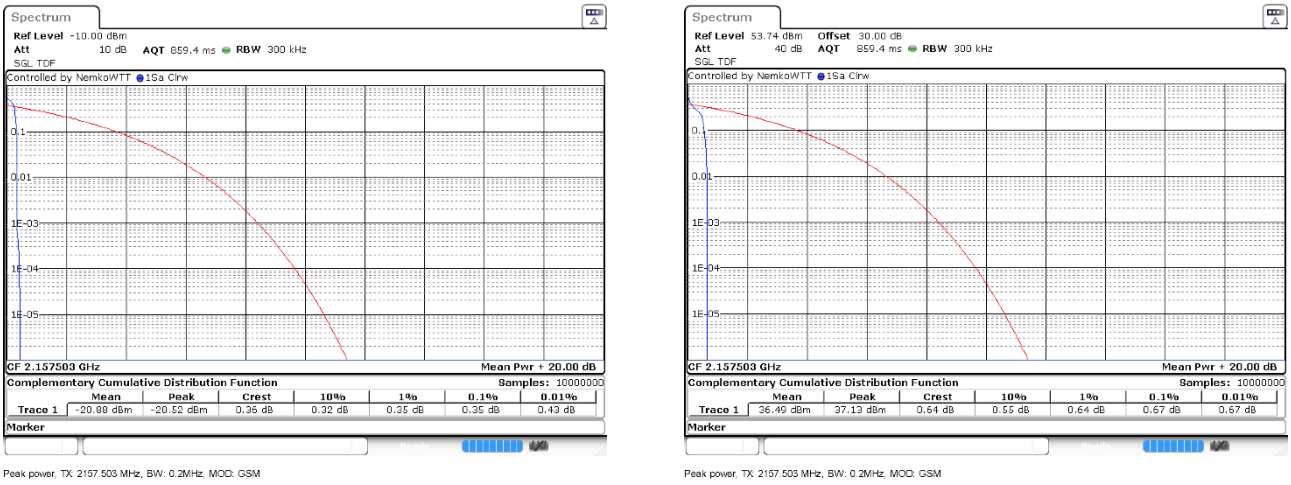


Figure 8.4-6: *Output power / Mean output power and amplifier gain results, narrowband signal, 3 dB above AGC threshold, input and output signal respectively*

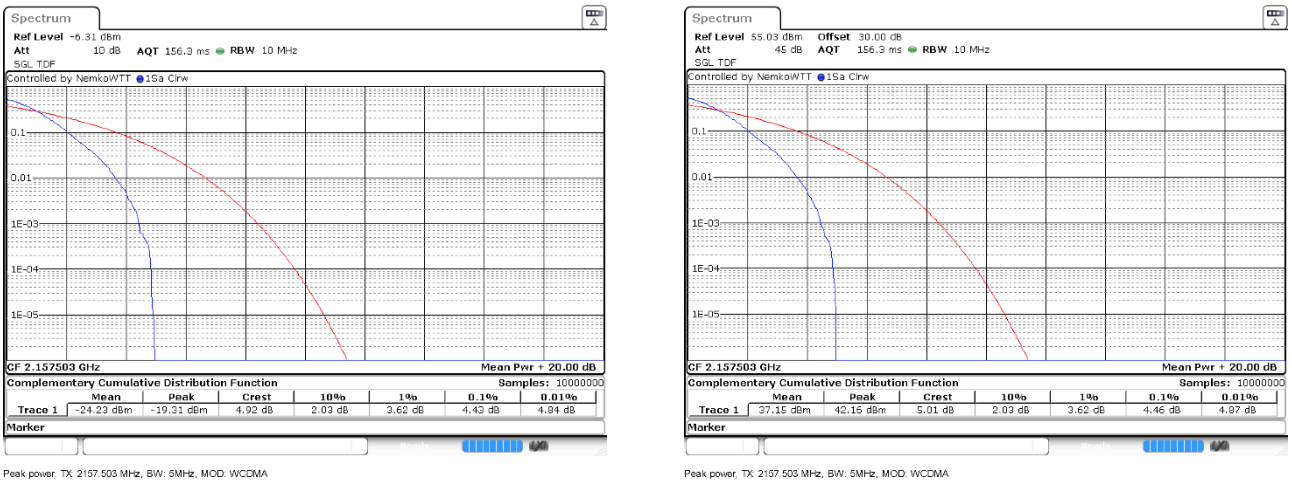


Figure 8.4-7: *Output power / Mean output power and amplifier gain results, broadband signal, 0.5 dB below AGC threshold, input and output signal respectively*

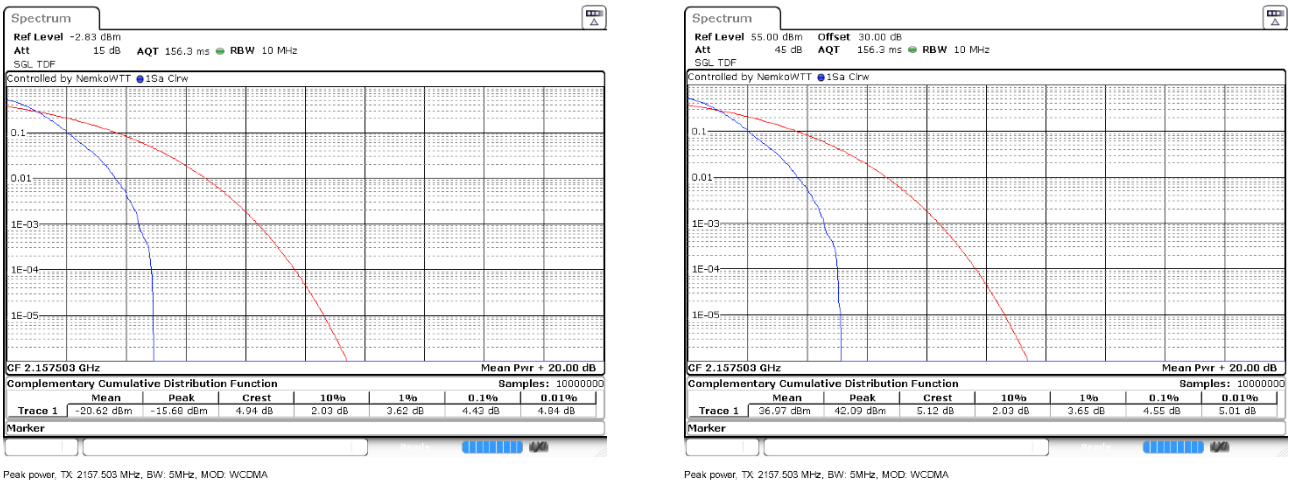


Figure 8.4-8: *Output power / Mean output power and amplifier gain results, broadband signal, 3 dB above AGC threshold, input and output signal respectively*

8.5 Spurious emissions at RF connector

8.5.1 References and limits

- FCC Part 27.53(h) & RSS-139 (band 66 operation)
- FCC Part 27.53(h) (band 70 operation)
- ANSI C63.26 Clause 7.2.2.5
- KDB 935210 D05v01r05 Clause 3.6

8.5.2 Test summary

Verdict	Pass		
Test date	November 15, 2023	Temperature	21 °C
Test engineer	Lan Sayasane, EMC Test Engineer	Air pressure	1006 mbar
Test location	☐ 10m semi anechoic chamber ☐ 3m semi anechoic chamber ☒ Wireless bench ☐ Other:	Relative humidity	51 %

8.5.3 Notes

Per KDB 935210 D05 v01r04, Clause 3.4 and ANSI C63.26 Clause 7.2.2.4, testing was performed with a narrowband test signal (MSK modulated, gaussian filter of 0.3 and data rate 270 kbps) and a broadband signal (AWGN, 4.1 MHz 99% occupied bandwidth).

For intermodulation products and out-of-channel block tests, testing is performed under the following two conditions (per ANSI C63.26 7.2.2.5.1 and KDB 935210 D05v01r04 Section 3.6):

a) Two modulated signals set to the lower or upper block edge.
b) A single modulated signal set to the low or high channel

8.5.4 Setup details

EUT power input during test	120 VAC / 60 Hz
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:
Measurement details	Out-of-channel-block and out-of-band emissions: a. Connect a signal generator to the input of the EUT. If the signal generator is not capable of generating two modulated carriers at one time, then it may be replaced by two signal generators connected with an appropriate combining network b. Set the signal generator to produce 2 AWGN signals. c. The frequencies shall be set so that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or3GPP2, at the upper block edge of the frequency band under test. d. The composite power levels shall be set so that the signal is just below the AGC threshold, but not more than 0.5 dB below. The composite power can be measured using the methods described in the output power methods, however, it will be necessary to measure the composite power by increasing the band power integration bandwidth to include both transmit channels, or alternatively, this measurement can be performed using an average power meter. e. Connect a spectrum analyzer to the output of the EUT using appropriate attenuation. f. Set the RBW= reference bandwidth in the applicable rule section for the supported frequency band (typically 1% of the EBW or 100 kHz or 1 MHz). g. Set the VBW = 3 x RBW. h. Set the detector to power averaging (rms) detector. i. Set the sweep time = auto couple. j. Set the spectrum analyzer start frequency to the upper block edge frequency and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz for frequencies below and above 1 GHz, respectively. k. Trace average at least one hundred traces in power averaging (i.e., rms) mode. l. Use the marker function to find the maximum power level. m. Capture the spectrum analyzer trace of the power level for inclusion in the test report. n. Repeat step k) and step m) with the input level set to 3 dB above the AGC threshold.

o. Set the frequencies of the input signals to the lower block edge of the frequency band under test.
p. Reset the analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz for frequencies below and above 1 GHZ, respectively, and the stop frequency to the lower block edge frequency.
q. Repeat step k) to step n).
r. Repeat step a) to step q) with the signal generator set to only a single signal closest to the block edges.
s. Repeat step a) to step r) with the narrowband signal.
t. Repeat step a) to step s) for all bands used by the EUT.

Conducted spurious:

a. Connect a signal generator to the input of the EUT.
b. Set the signal generator to produce the AWGN signal.
c. Set the frequency of the signal to the lowest channel within the frequency block.
d. The power levels shall be set so that the signal is just below the AGC threshold, but not more than 0.5 dB below.
e. Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
f. Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band (typically 100 kHz or 1 MHz).
g. Set the VBW = 3 x RBW.
h. Set the sweep time = auto-couple.
i. Set the spectrum analyzer start frequency to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz to 1 MHz, as specified in the applicable rule part. The number of measurement points in each sweep must be ≥ (2 x span/RBW), which may require that the measurement range defined by the start and stop frequencies be subdivided depending on the available number of measurement points provided by the spectrum analyzer.
j. Trace average at least ten traces in power averaging (i.e., rms) mode.
k. Use the peak marker function to identify the highest amplitude level over each of measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.
l. Reset the spectrum analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the spectrum analyzer stop frequency to ten times the highest frequency of the fundamental emission. The number of measurement points in each sweep must be ≥ (2 x span/RBW), which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.
m. Trace average at least ten traces in power averaging (i.e., rms) mode.
n. Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report; also provide tabular data, if required.
o. Repeat step i) to step n) with the input signal firstly set to a middle channel frequency and then tuned to a high channel frequency.
p. Repeat step c) to step o) with the narrowband signal.
q. Repeat step b) to step p) for all bands used by the EUT

8.5.5 Test data – out-of-channel block and out-of-band emissions

8.5.5.1 Operating frequency band: Band 70: 1995-2020 MHz

Table 8.5-1: *Spurious emissions at RF connector test data, narrowband*

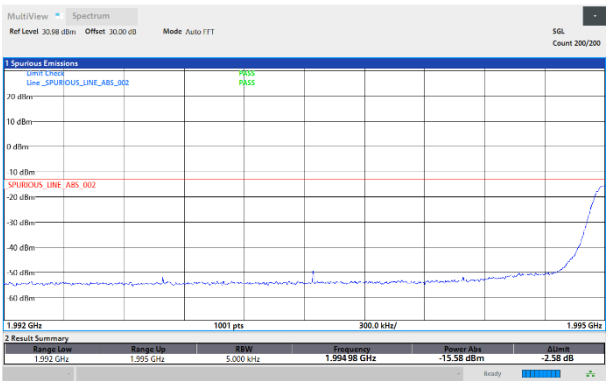
Condition	Frequency of highest emission (MHz)	Level (dBm)	Limit (dBm)
Input Level = **AGC Threshold - 0.5 dB** Input signal = **narrowband** Number of signals: **2** Low band edge	1994.984	-16.70	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **narrowband** Number of signals: **1** Low band edge	1994.989	-15.48	-13.00
Input Level = **AGC Threshold +3 dB** Input signal = **narrowband** Number of signals: **2** Low band edge	1994.987	-16.13	-13.00
Input Level = **AGC Threshold + 3 dB** Input signal = **narrowband** Number of signals: **1** Low band edge	1994.983	-15.58	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **narrowband** Number of signals: **2** High band edge	2020.013	-16.89	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **narrowband** Number of signals: **1** High band edge	2020.010	-15.45	-13.00
Input Level = **AGC Threshold +3 dB** Input signal = **narrowband** Number of signals: **2** High band edge	2020.013	-17.00	-13.00
Input Level = **AGC Threshold + 3 dB** Input signal = **narrowband** Number of signals: **1** High band edge	2020.019	-14.89	-13.00

Low band edge, 2 signals, level = AGC Threshold - 0.5

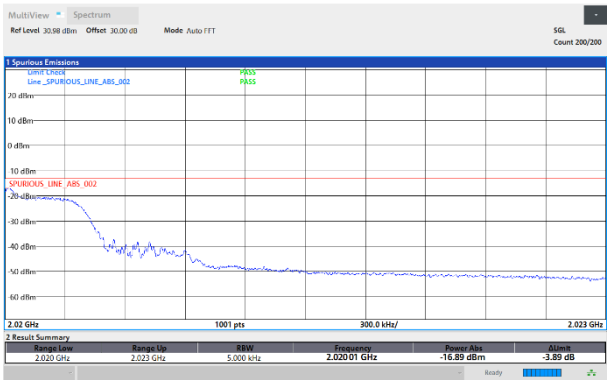
Low band edge, 1 signal, level = AGC Threshold - 0.5

Low band edge, 2 signals, level = AGC Threshold + 3

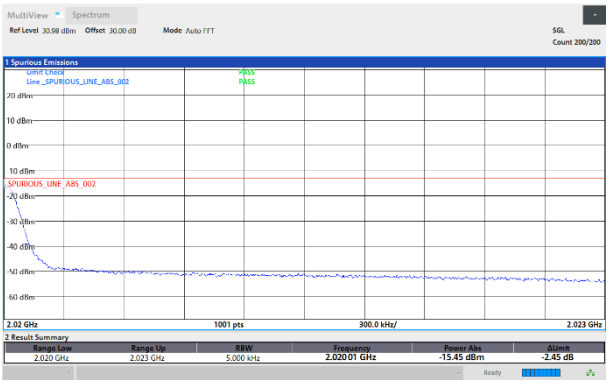
Low band edge, 1 signal, level = AGC Threshold + 3



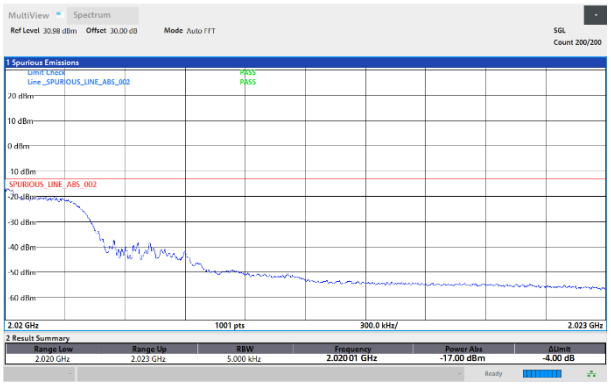
High band edge, 2 signals, level = AGC Threshold - 0.5



High band edge, 1 signal, level = AGC Threshold - 0.5



High band edge, 2 signals, level = AGC Threshold + 3

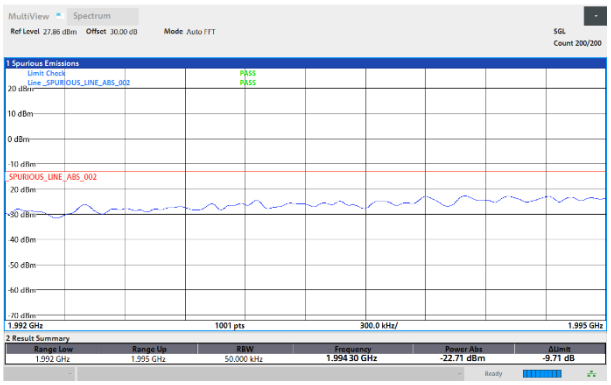


Low band edge, 1 signal, level = AGC Threshold + 3

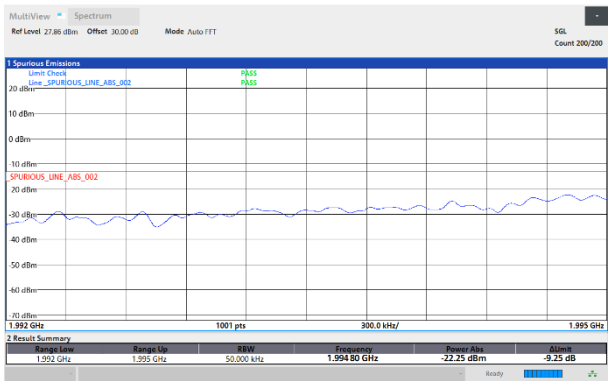
Table 8.5-2: *Spurious emissions at RF connector test data, broadband*

Condition	Frequency of highest emission (MHz)	Level (dBm)	Limit (dBm)
Input Level = **AGC Threshold - 0.5 dB** Input signal = **broadband** Number of signals: **2** Low band edge	1994.297	-22.71	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **broadband** Number of signals: **1** Low band edge	1994.804	-22.25	-13.00
Input Level = **AGC Threshold +3 dB** Input signal = **broadband** Number of signals: **2** Low band edge	1994.516	-18.82	-13.00
Input Level = **AGC Threshold + 3 dB** Input signal = **broadband** Number of signals: **1** Low band edge	1994.998	-25.75	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **broadband** Number of signals: **2** High band edge	2020.001	-28.29	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **broadband** Number of signals: **1** High band edge	2020.235	-21.01	-13.00
Input Level = **AGC Threshold +3 dB** Input signal = **broadband** Number of signals: **2** High band edge	2020.001	-28.64	-13.00
Input Level = **AGC Threshold + 3 dB** Input signal = **broadband** Number of signals: **1** High band edge	2020.001	-26.95	-13.00

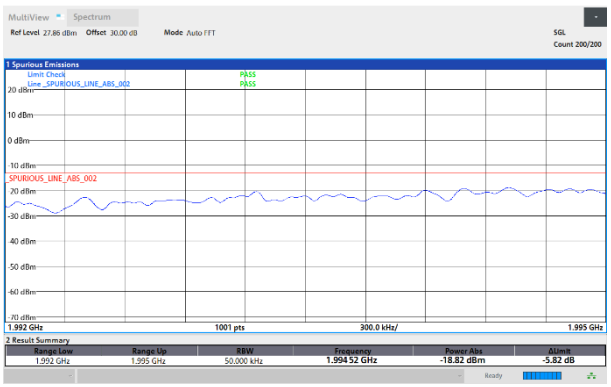
Low band edge, 2 signals, level = AGC Threshold - 0.5



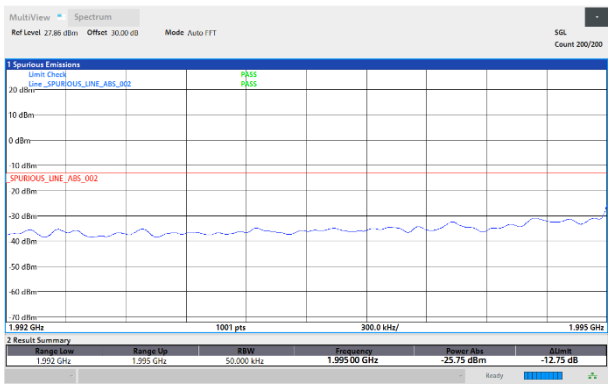
Low band edge, 1 signal, level = AGC Threshold - 0.5



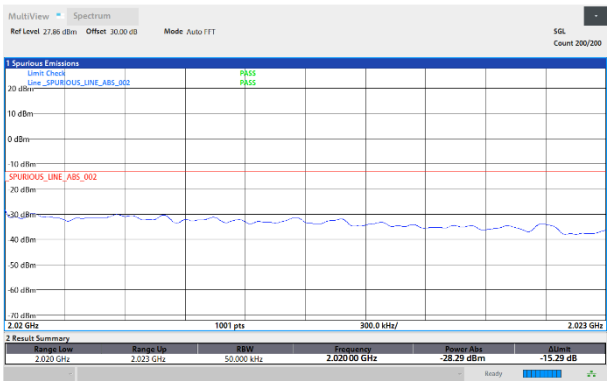
Low band edge, 2 signals, level = AGC Threshold + 3



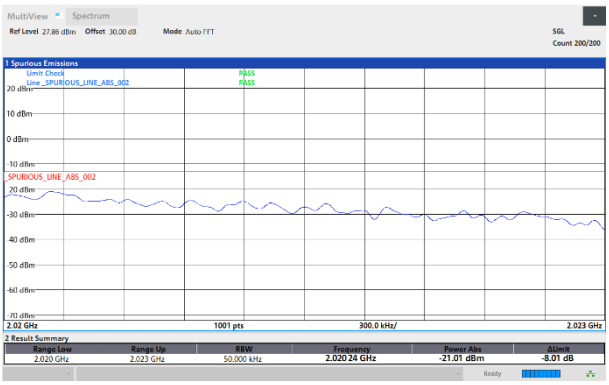
Low band edge, 1 signal, level = AGC Threshold + 3



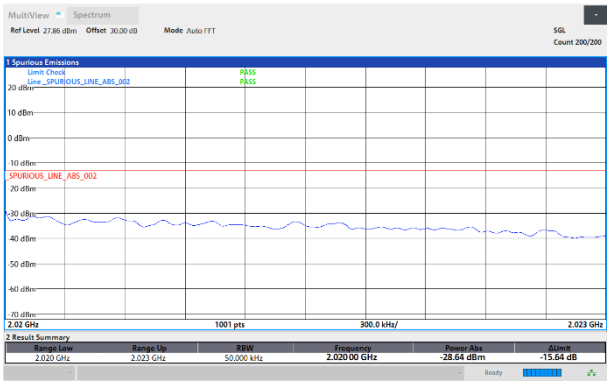
High band edge, 2 signals, level = AGC Threshold - 0.5



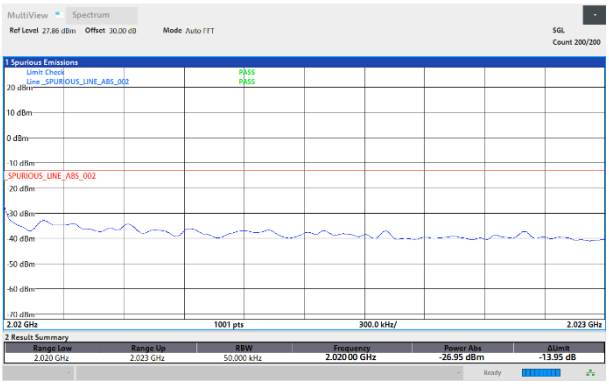
High band edge, 1 signal, level = AGC Threshold - 0.5



High band edge, 2 signals, level = AGC Threshold + 3



Low band edge, 1 signal, level = AGC Threshold + 3

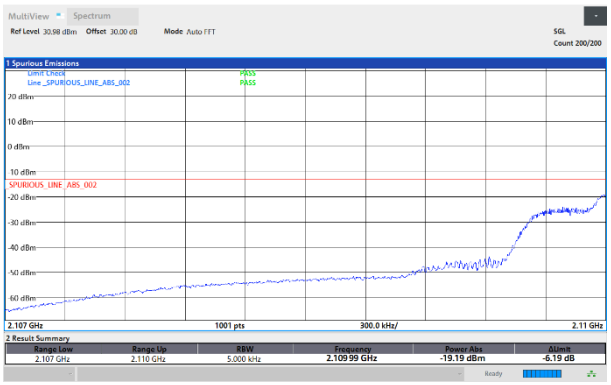


8.5.5.2 Operating frequency band: Band 66: 2110-2200 MHz

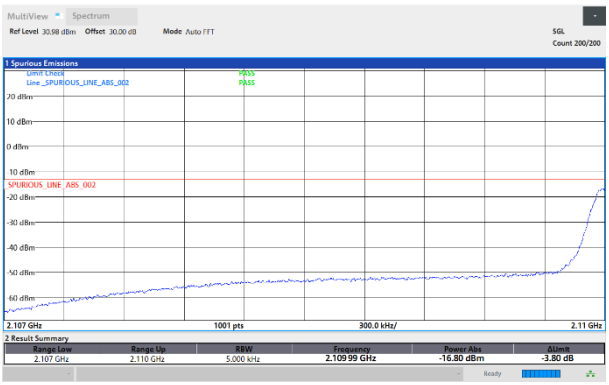
Table 8.5-3: *Spurious emissions at RF connector test data, narrowband*

Condition	Frequency of highest emission (MHz)	Level (dBm)	Limit (dBm)
Input Level = **AGC Threshold - 0.5 dB** Input signal = **narrowband** Number of signals: **2** Low band edge	2109.989	-19.19	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **narrowband** Number of signals: **1** Low band edge	2109.993	-16.80	-13.00
Input Level = **AGC Threshold +3 dB** Input signal = **narrowband** Number of signals: **2** Low band edge	2109.984	-16.61	-13.00
Input Level = **AGC Threshold + 3 dB** Input signal = **narrowband** Number of signals: **1** Low band edge	2109.996	-15.23	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **narrowband** Number of signals: **2** High band edge	2200.019	-17.25	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **narrowband** Number of signals: **1** High band edge	2200.025	-15.89	-13.00
Input Level = **AGC Threshold +3 dB** Input signal = **narrowband** Number of signals: **2** High band edge	2200.013	-16.84	-13.00
Input Level = **AGC Threshold + 3 dB** Input signal = **narrowband** Number of signals: **1** High band edge	2200.025	-14.74	-13.00

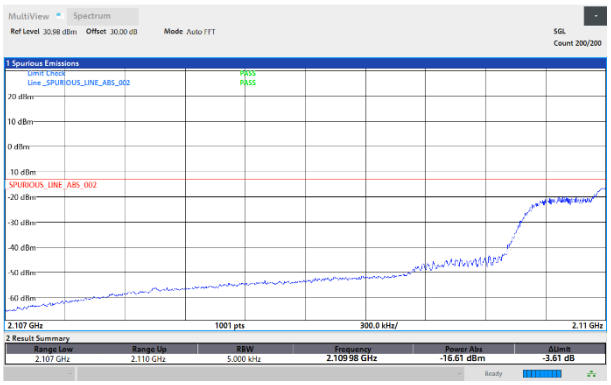
Low band edge, 2 signals, level = AGC Threshold - 0.5



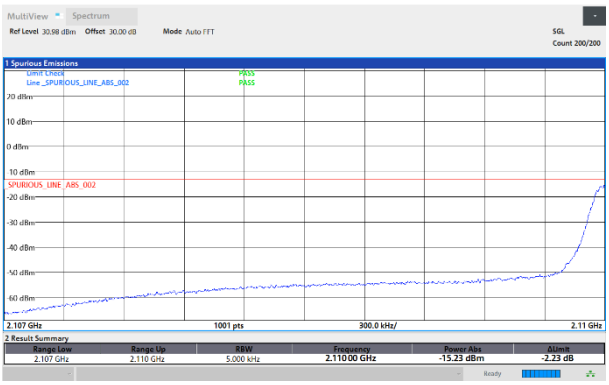
Low band edge, 1 signal, level = AGC Threshold - 0.5



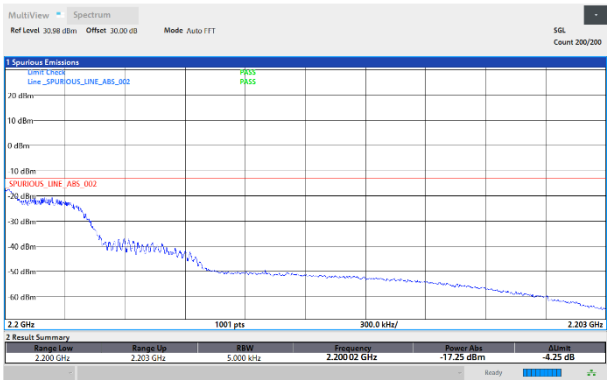
Low band edge, 2 signals, level = AGC Threshold + 3



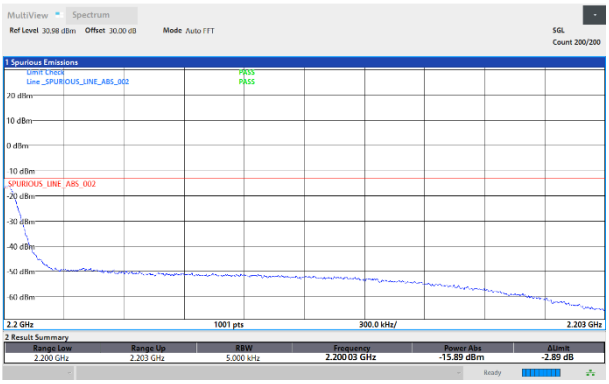
Low band edge, 1 signal, level = AGC Threshold + 3



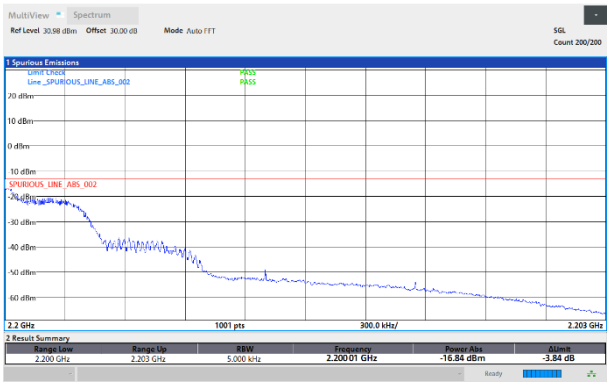
High band edge, 2 signals, level = AGC Threshold - 0.5



High band edge, 1 signal, level = AGC Threshold - 0.5



High band edge, 2 signals, level = AGC Threshold + 3



Low band edge, 1 signal, level = AGC Threshold + 3

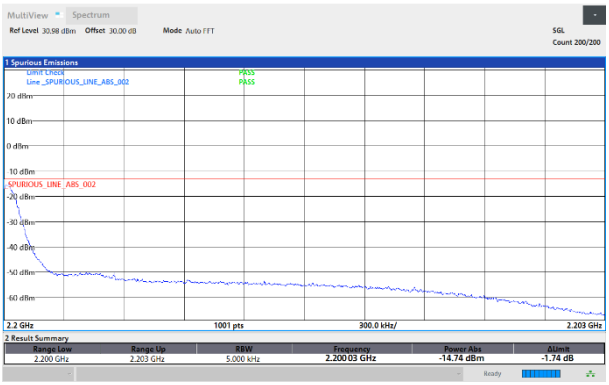
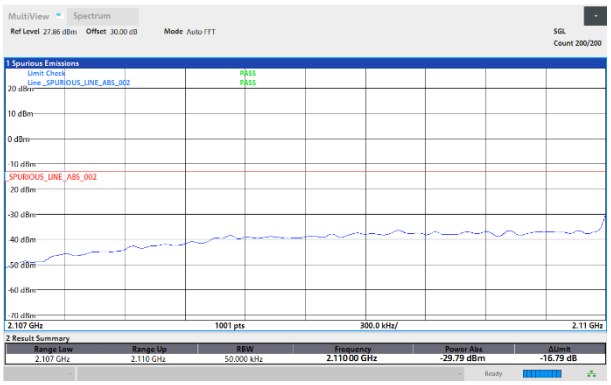


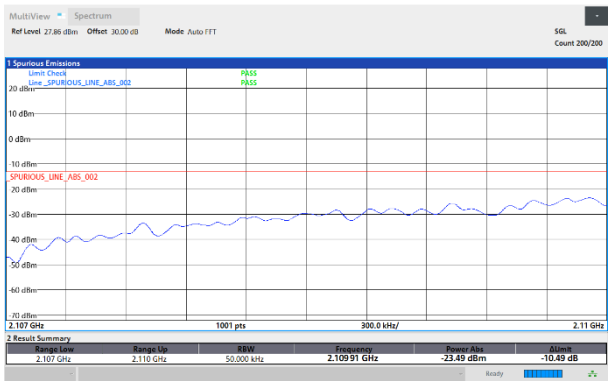
Table 8.5-4: *Spurious emissions at RF connector test data, broadband*

Condition	Frequency of highest emission (MHz)	Level (dBm)	Limit (dBm)
Input Level = **AGC Threshold - 0.5 dB** Input signal = **broadband** Number of signals: **2** Low band edge	2109.998	-29.79	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **broadband** Number of signals: **1** Low band edge	2109.912	-23.49	-13.00
Input Level = **AGC Threshold +3 dB** Input signal = **broadband** Number of signals: **2** Low band edge	2109.858	-27.02	-13.00
Input Level = **AGC Threshold + 3 dB** Input signal = **broadband** Number of signals: **1** Low band edge	2109.998	-27.44	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **broadband** Number of signals: **2** High band edge	2200.001	-28.68	-13.00
Input Level = **AGC Threshold - 0.5 dB** Input signal = **broadband** Number of signals: **1** High band edge	2200.001	-26.58	-13.00
Input Level = **AGC Threshold +3 dB** Input signal = **broadband** Number of signals: **2** High band edge	2200.001	-26.41	-13.00
Input Level = **AGC Threshold + 3 dB** Input signal = **broadband** Number of signals: **1** High band edge	2200.001	-25.72	-13.00

Low band edge, 2 signals, level = AGC Threshold - 0.5

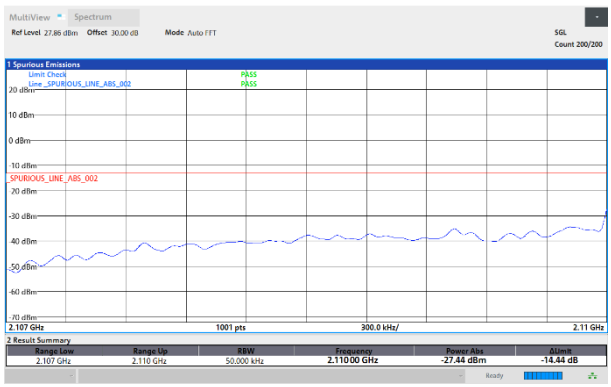


Low band edge, 1 signal, level = AGC Threshold - 0.5

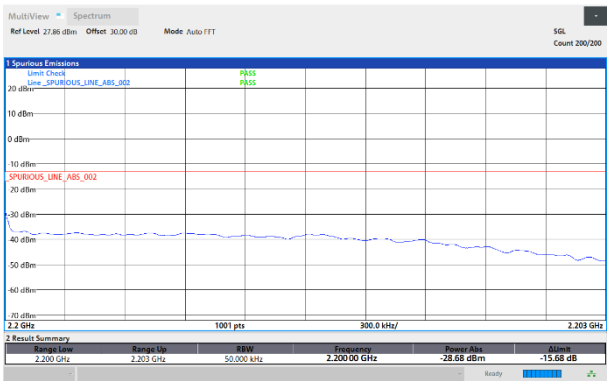


Low band edge, 2 signals, level = AGC Threshold + 3

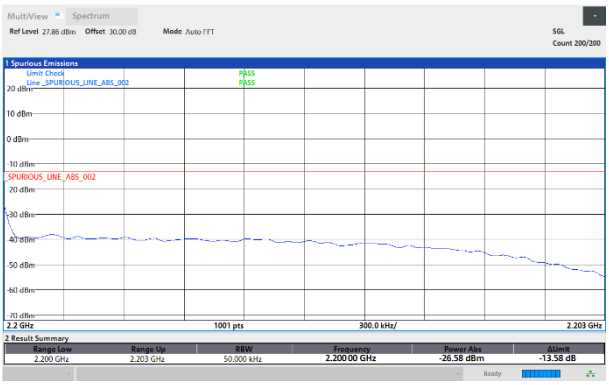
Low band edge, 1 signal, level = AGC Threshold + 3



High band edge, 2 signals, level = AGC Threshold - 0.5

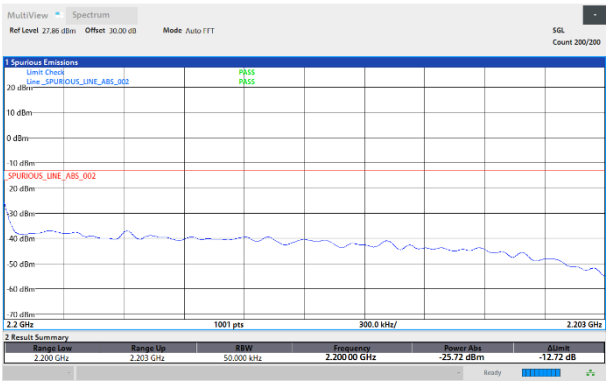


High band edge, 1 signal, level = AGC Threshold - 0.5



High band edge, 2 signals, level = AGC Threshold + 3

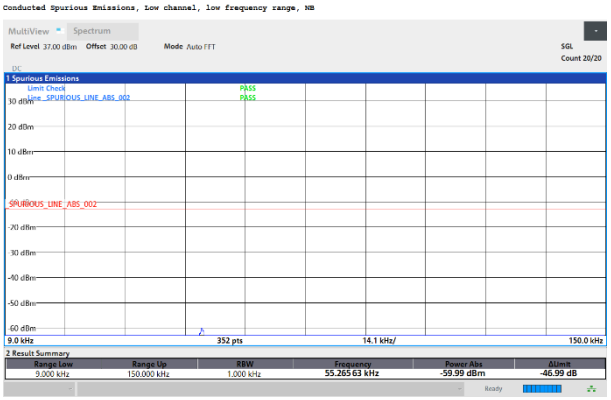
Low band edge, 1 signal, level = AGC Threshold + 3

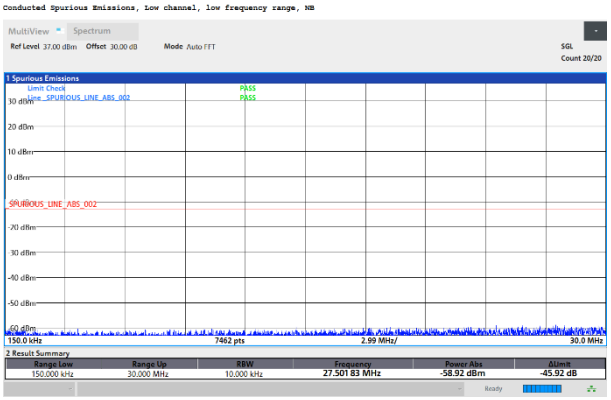


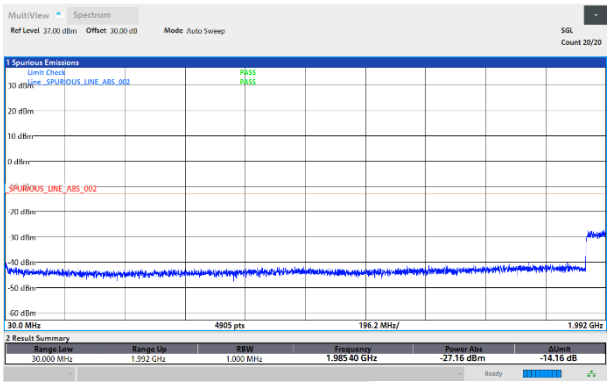
8.5.6 Test data - conducted spurious emissions:

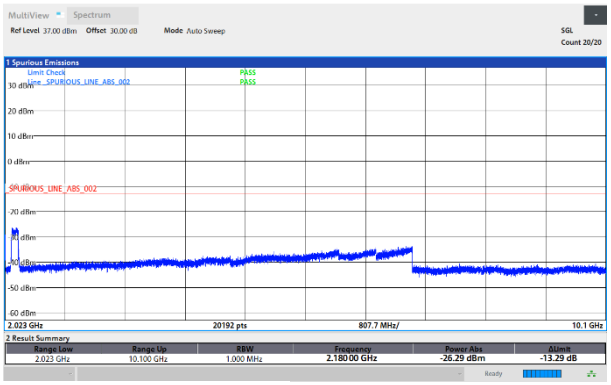
8.5.6.1 Operating frequency band: Band 70: 1995 – 2020 MHz

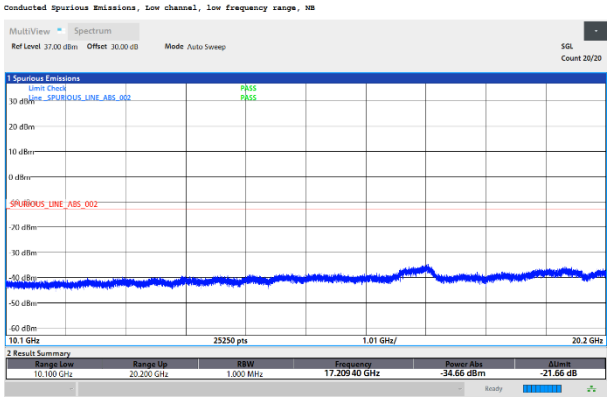
Input signal = **lowest channel** within the frequency block; **narrowband**:



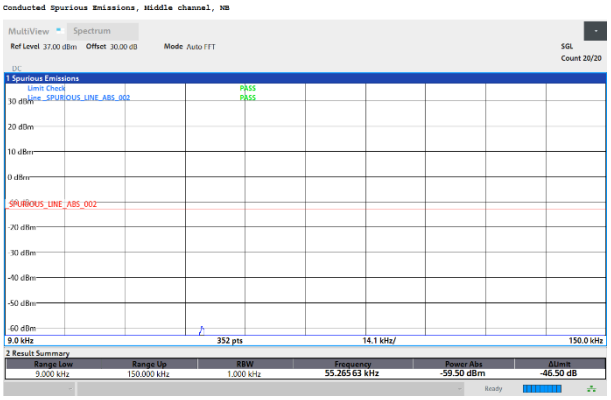


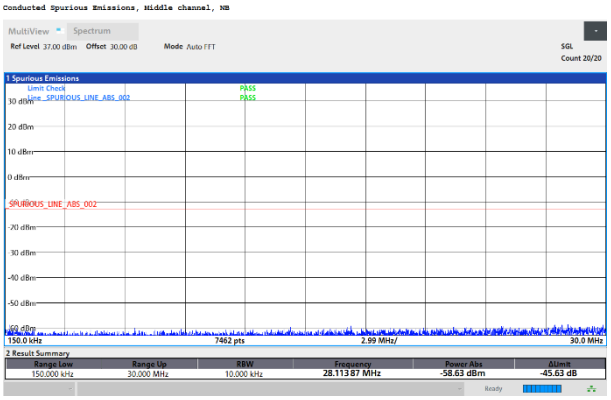


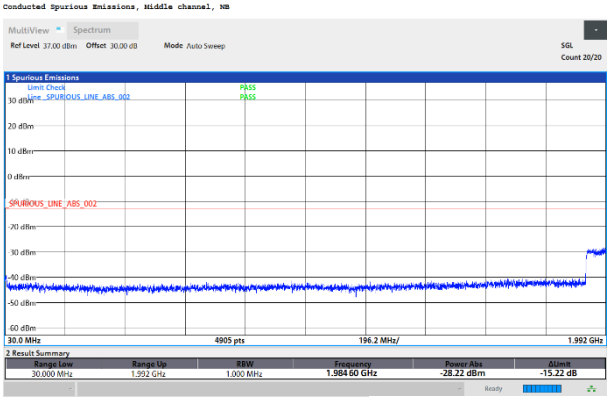


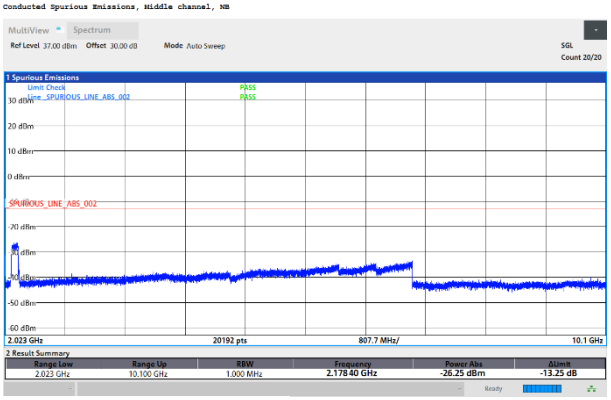


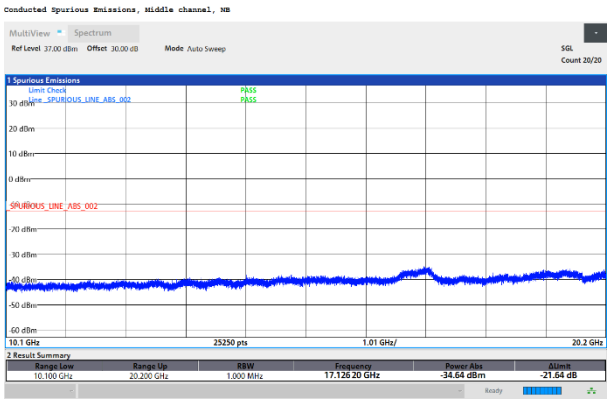
Input signal = **middle channel** within the frequency block; **narrowband**:







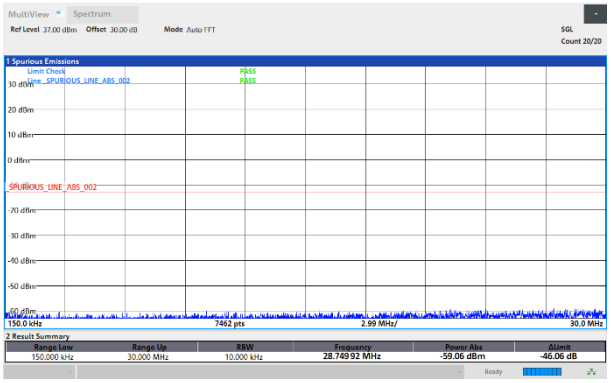




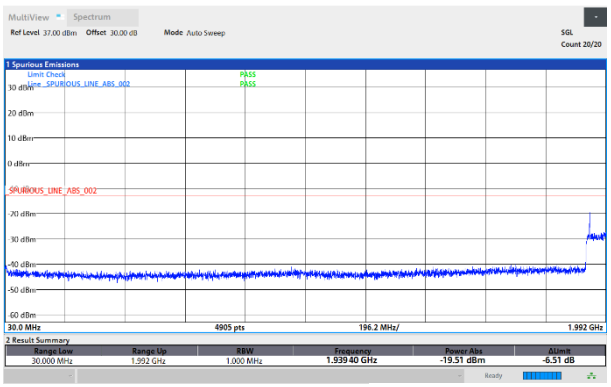
Input signal = **highest channel** within the frequency block; **narrowband**:

Conducted Spurious Emissions, High channel, NB

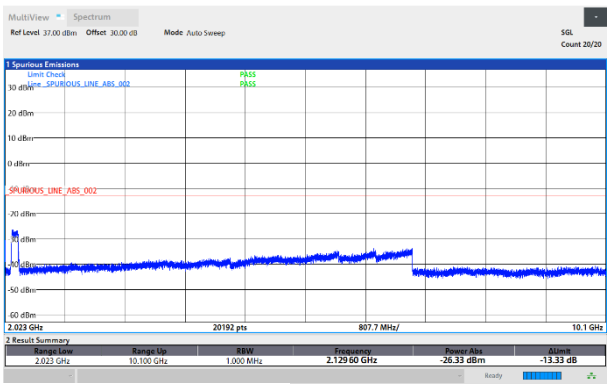
Conducted Spurious Emissions, High channel, NB



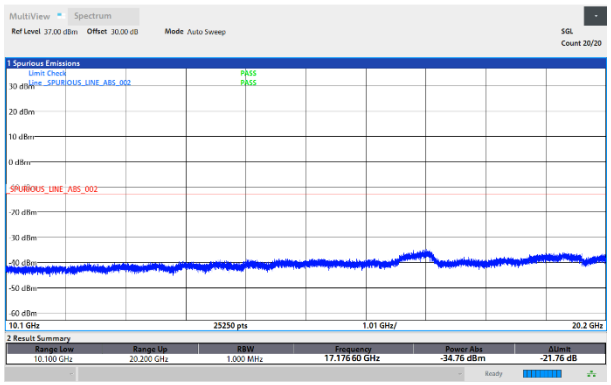
Conducted Spurious Emissions, High channel, NB



Conducted Spurious Emissions, High channel, NB



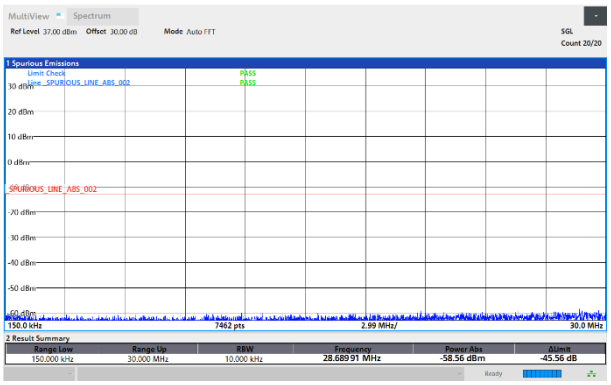
Conducted Spurious Emissions, High channel, NB



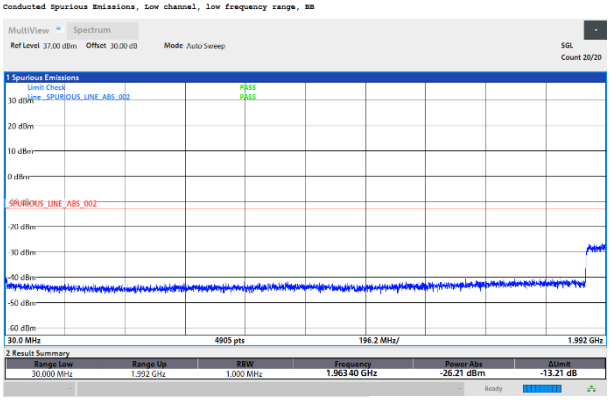
Input signal = **lowest channel** within the frequency block; **broadband**:

Conducted Spurious Emissions, Low channel, low frequency range, BB

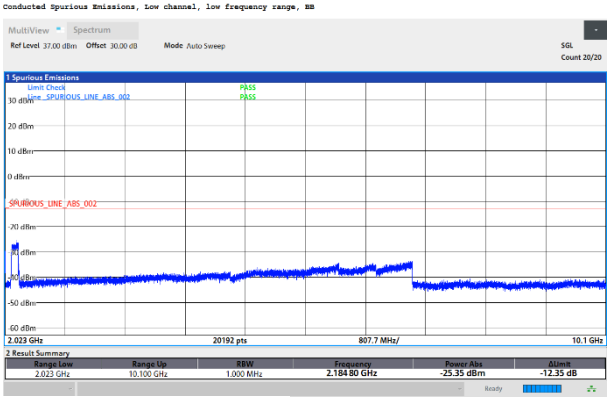
Conducted Spurious Emissions, Low channel, low frequency range, BB



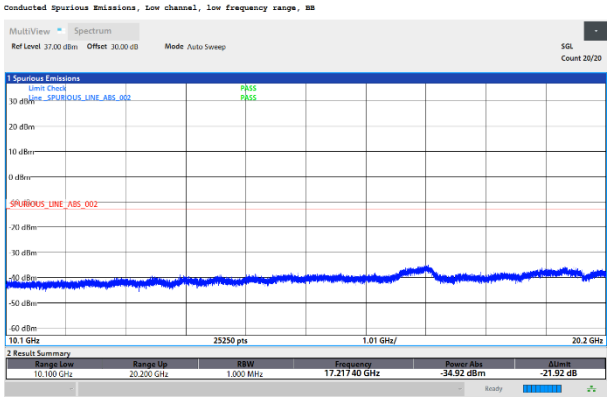
Conducted Spurious Emissions, Low channel, low frequency range, BB



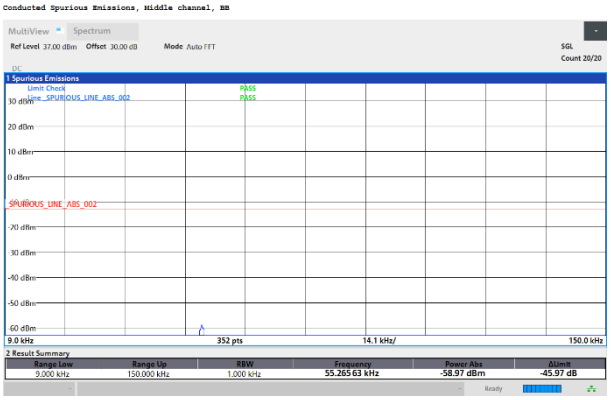
Conducted Spurious Emissions, Low channel, low frequency range, BB

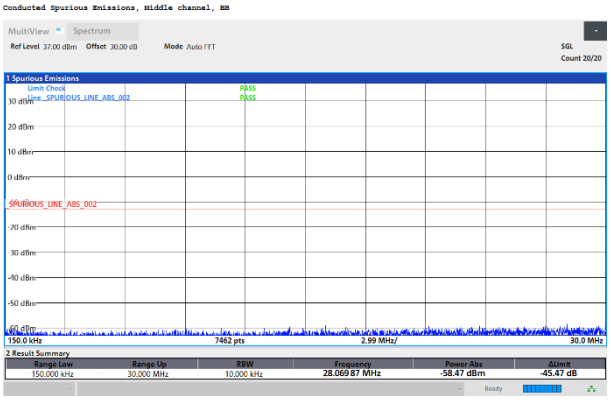


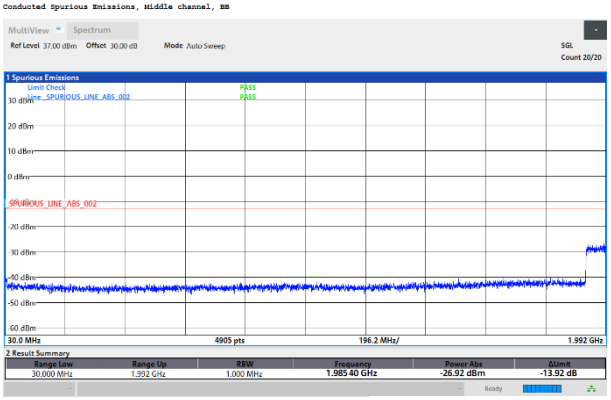
Conducted Spurious Emissions, Low channel, low frequency range, BB

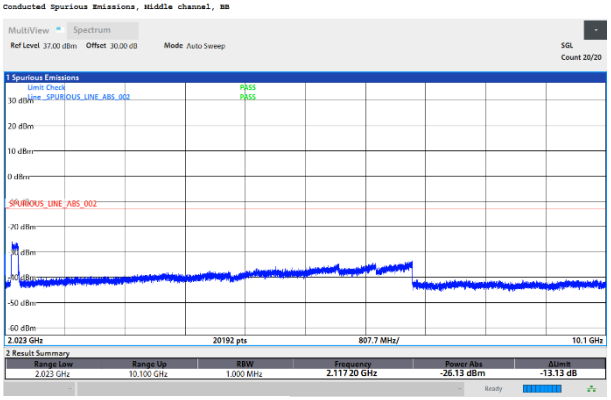


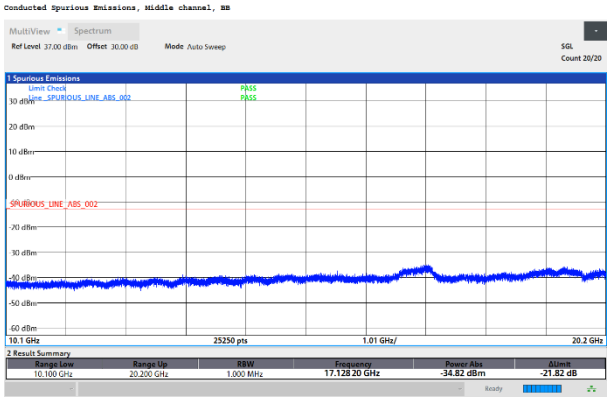
Input signal = **middle channel** within the frequency block; **broadband**:







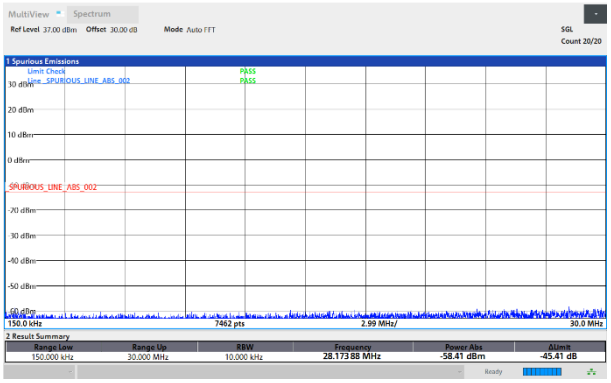




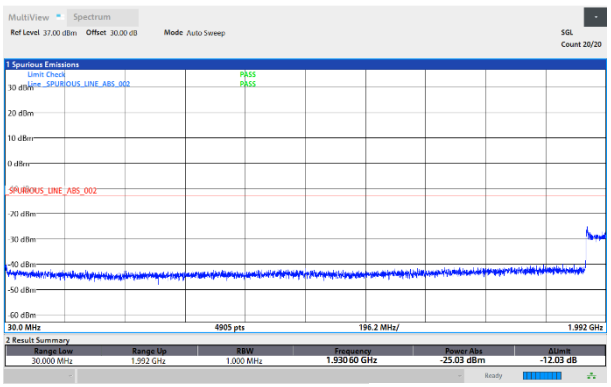
Input signal = **highest channel** within the frequency block; **broadband**:

Conducted Spurious Emissions, High channel, BB

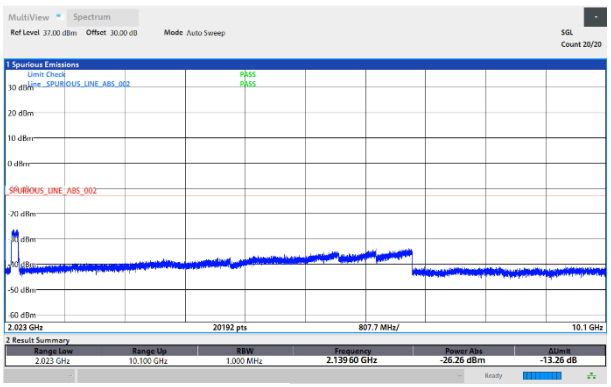
Conducted Spurious Emissions, High channel, BB



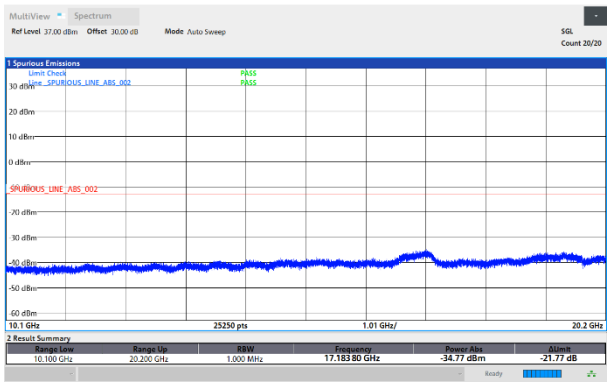
Conducted Spurious Emissions, High channel, BB



Conducted Spurious Emissions, High channel, BB

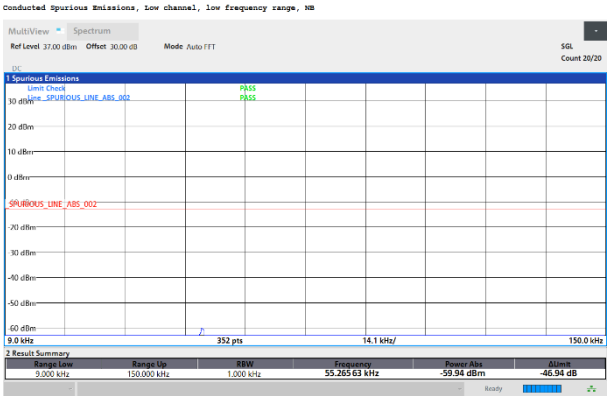


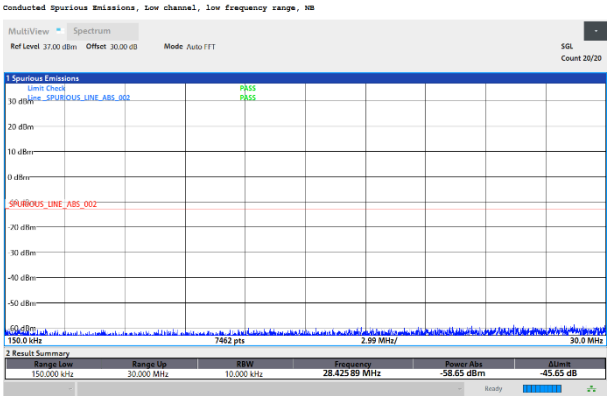
Conducted Spurious Emissions, High channel, BB

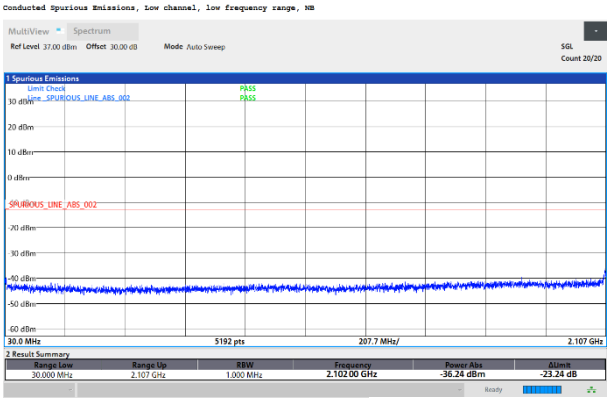


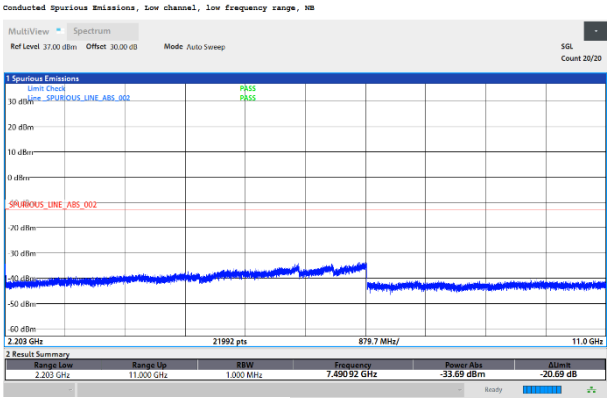
8.5.6.2 Operating frequency band: Band 66: 2110 – 2200 MHz

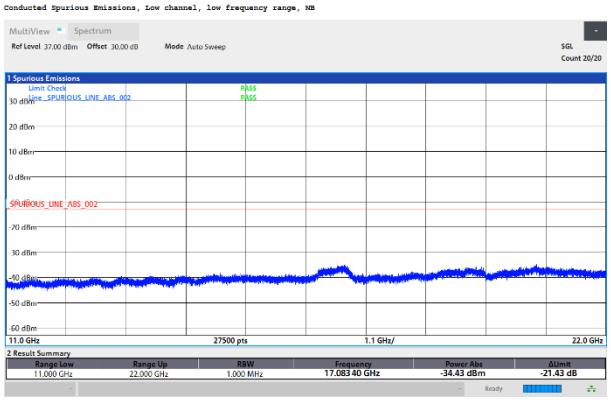
Input signal = **lowest channel** within the frequency block; **narrowband**:





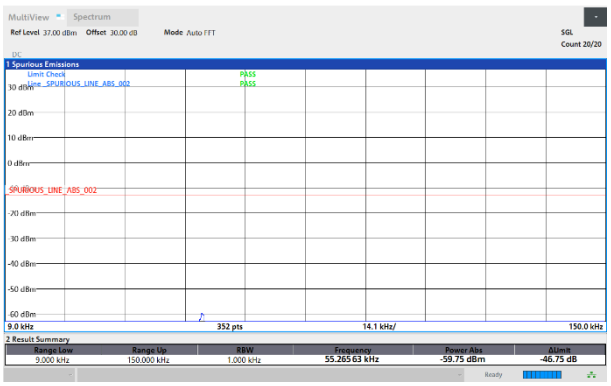




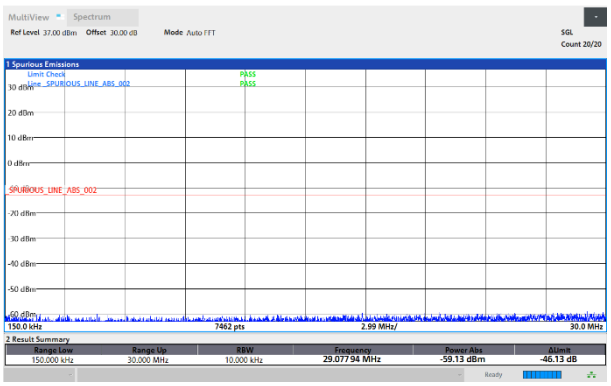


Input signal = **middle channel** within the frequency block; **narrowband**:

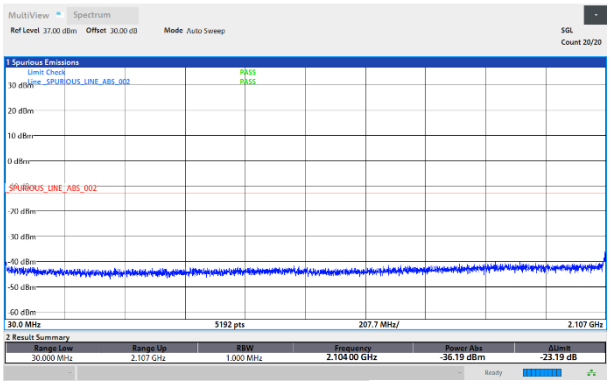
Conducted Spurious Emissions, Middle channel, NB



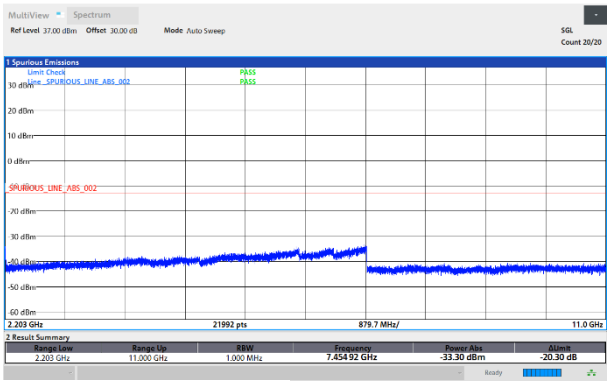
Conducted Spurious Emissions, Middle channel, NB



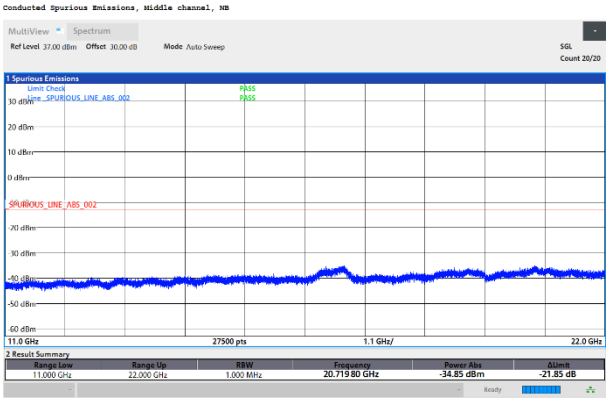
Conducted Spurious Emissions, Middle channel, NB



Conducted Spurious Emissions, Middle channel, NB



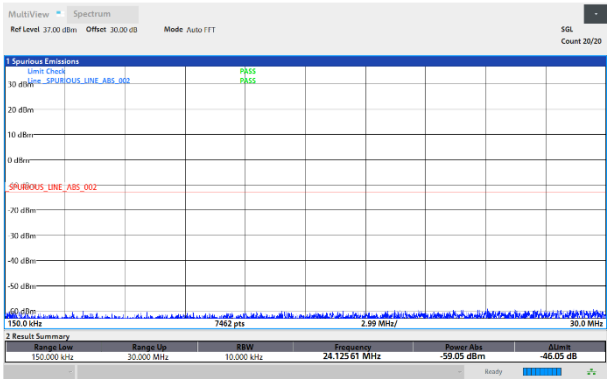
Conducted Spurious Emissions, Middle channel, NB



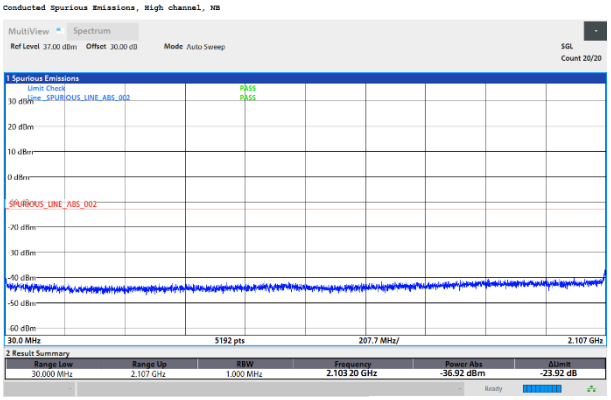
Input signal = **highest channel** within the frequency block; **narrowband**:

Conducted Spurious Emissions, High channel, NB

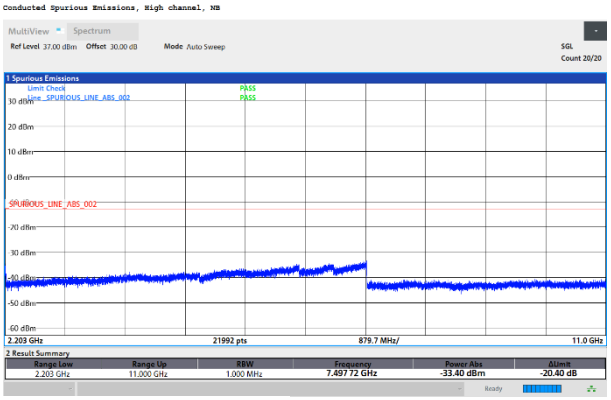
Conducted Spurious Emissions, High channel, NB



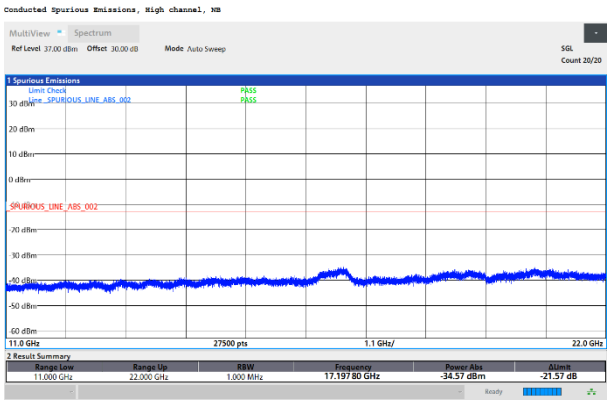
Conducted Spurious Emissions, High channel, NB



Conducted Spurious Emissions, High channel, NB



Conducted Spurious Emissions, High channel, NB



Input signal = **lowest channel** within the frequency block; **broadband**: