EMC Test Report
2024-0451-EMC-TR-25-0067-V01

Designation:	UAP-XR [AWS 1700]
Manufacturer:	CommScope
Serial No(s):	SZBEBF2452A0003
ID No.	7862380-00 Rev: 00
FCC ID	XS5-IONEUAPR
ISED ID	2237E-IONEUAPR
Test Specifications:	ANSI 63-26:2015 FCC Rules and Regulations as listed in 47 CFR, Part 20 and Part 27 RSS-139 Issue 4 with RSS-GEN Issue 5, RSS-131 Issue 4 and SRSP-513 Issue 3
Test Plan:	"BU-PC-2336-58" from customer
Test Result:	**Passed**

Date of issue:	12.06.2025		Signature:
Version:	01	Technical Reviewer:	Thomas Gerngroß Test Engineer Digitally signed by Thomas Gerngroß DN: cn=Thomas Gerngroß, o=Bureau Veritas CPS Germany GmbH, ou=ECL, email=thomas.gerngross@bureauveritas.com, c=DE Date: 2025.06.12 14:15:40 +02'00'
Date of receipt EUT:	26.02.2025		
Performance date:	14.03.2025 - 30.03.2025	Report Reviewer:	Thomas Hufnagel Test Engineer Digitally signed by Thomas Hufnagel Date: 2025.06.12 14:20:16 +02'00'

Bundesnetzagentur

BNetzA-CAB-19/21-20

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Versions management:

V 01.00	Initial release

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1 APPLIED STANDARDS AND TEST SUMMARY

1.1 CFR APPLIED STANDARDS

Type of Authorization
Certification for an Industrial Signal Booster.

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Chapter 1 Parts 2 and 20 and 27. The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 20, Commercial Mobiles Services

§ 20.21 Signal Boosters

Part 27; Miscellaneous Wireless Communications Services
Subpart C – Technical standards

§ 27.50 – Power and duty cycle limits
§ 27.54 – Frequency stability
§ 27.53 – Emission limits

The tests were selected and performed with reference to:

- FCC Public Notice 935210 applying "Signal Boosters Basic Certification Requirements" 935210 D02, 2024-11-20.
- FCC Public Notice 935210 applying "Measurement guidance for industrial and non-consumer signal booster, repeater and amplifier devices"
- 935210 D05, 2020-04-03.
- FCC Public Notice 971168 applying "Measurement guidance for certification of licensed digital transmitters" 971168 D01, 2018-04-09.

- ANSI C63.26: 2015 "American National Standard for Compliance Testing of Transmitters Used in Licensec Radio Services"
- RSS-139 Issue 4 "Advanced Wireless Services Equipment Operating in the Bands 1710-1780 MHz and 2110-2200 MHz"
- SRSP-513 Issue 3 "Technical Requirements for Advanced Wireless Services (AWS) in the Bands 1710-1780 MHz and 2110-2180 MHz"
- RSS-GEN Issue 5 "General Requirements for Compliance of Radio Apparatus"
- RSS-131 Issue 4 "Zone Enhancers"

1.2 FCC-ISED CORRELATION TABLE

Correlation of measurement requirements for Industrial signal booster from FCC and ISED Canada

Measurement	FCC reference	ISED reference
Effective radiated power, mean output power and zone enhancer gain	§ 27.50 KDB 935210 D05 v01r04: 3.5	RSS-GEN Issue 5, 6.12 RSS-139 Issue 4, 5.5 SRSP-513, Issue 3, 6.1.3
Peak to Average Ratio	§ 27.50	RSS-139 Issue 4, 5.5
Occupied bandwidth Input-versus-output spectrum	§ 2.1049 KDB 935210 D05 v01r04: 3.4	RSS-GEN Issue 5, 6.7 RSS-131 Issue 4: 9.2
Conducted spurious Emission at Antenna Terminal	§ 2.1051 § 27.53 KDB 935210 D05 v01r04: 3.6	RSS-GEN Issue 5, 6.13 RSS-139 Issue 4, 5.6
Out-of-band emissions limits	§ 2.1051 § 27.53 KDB 935210 D05 v01r04: 3.6	RSS-GEN Issue 5, 6.13 RSS-139 Issue 4, 5.6
Frequency stability	§ 2.1055 § 27.54	RSS-GEN Issue 5, 6.11 RSS-131 Issue 4: 9.4 RSS-139 Issue 3, 6.4
Out-of-band rejection	KDB 935210 D05 v01r04: 3.3	RSS-131 Issue 4: 9.1
Field strength of spurious radiation	§ 2.1053 § 27.53	RSS-GEN Issue 5, 6.13 RSS-139 Issue 4, 5.6
All measurements	ANSI 63.26	ANSI 63.26

The test case frequency stability was not performed since the EUT is not equipped with signal processing capabilities. According KDB 935210 D05 in this case a measurement is not required.

1.3 MEASUREMENT SUMMARY/SIGNATURES

47 CFR CHAPTER I FCC PART 27 Subpart C [Base Stations/Repeater] **§ 27.50**

Effective Radiated Power, mean output power and zone enhancer gain
The measurement was performed according to ANSI C63.26, KDB 935210 D05 v01r04: 3.5 — **Final Result**

OP-Mode	**FCC**	**ISED**
Frequency Band, Direction, Input Power, Signal Type		
AWS 1700, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
AWS 1700, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
AWS 1700, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
AWS 1700, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
AWS 1700, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed	Passed
AWS 1700, RF downlink, 3 dB > AGC, Wideband 5G	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C [Base Stations/Repeater] **§ 27.50**

Peak to Average Ratio
The measurement was performed according to ANSI C63.26 — **Final Result**

	FCC	**ISED**
AWS 1700, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
AWS 1700, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
AWS 1700, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
AWS 1700, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
AWS 1700, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed	Passed
AWS 1700, RF downlink, 3 dB > AGC, Wideband 5G	Passed	Passed

47 CFR CHAPTER I FCC PART 2 **§ 2.1049**

Occupied Bandwidth/Input-versus-output Spectrum
The measurement was performed according to ANSI C63.26, KDB 935210 D05 v01r04: 3.4 — **Final Result**

OP-Mode	**FCC**	**ISED**
Frequency Band, Direction, Input Power, Signal Type		
AWS 1700, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
AWS 1700, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
AWS 1700, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
AWS 1700, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
AWS 1700, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed	Passed
AWS 1700, RF downlink, 3 dB > AGC, Wideband 5G	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C [Base Stations/Repeater] § 2.1051, § 27.53

Conducted spurious emissions at antenna terminals
The measurement was performed according to ANSI C63.26

OP-Mode Frequency Band, Direction, Input Power, Signal Type	Final Result FCC	ISED
AWS 1700, low, RF downlink, Wideband	Passed	Passed
AWS 1700, mid, RF downlink, Wideband	Passed	Passed
AWS 1700, high, RF downlink, Wideband	Passed	Passed
AWS 1700low, RF downlink, Narrowband	Passed	Passed
AWS 1700, mid, RF downlink, Narrowband	Passed	Passed
AWS 1700, high, RF downlink, Narrowband	Passed	Passed
AWS 1700, low, RF downlink, Wideband 5G	Passed	Passed
AWS 1700, mid, RF downlink, Wideband 5G	Passed	Passed
AWS 1700, high, RF downlink, Wideband 5G	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C [Base Stations/Repeater] §2.1051, § 27.53

Out-of-band emission limits
The measurement was performed according to ANSI C63.26, KDB 935210 D05 v01r04: 3.6

OP-Mode Band Edge, Frequency Band, Number of signals, Direction, Input Power, Signal Type	FCC	ISED
Upper, Band 66 AWS 1700, 1, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
Upper, Band 66 AWS 1700, 1, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
Upper, Band 66 AWS 1700, 1, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed	Passed
Upper, Band 66 AWS 1700, 1, RF downlink, 3 dB > AGC, Wideband 5G	Passed	Passed
Upper, Band 66 AWS 1700, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
Upper, Band 66 AWS 1700, 1, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
Lower, Band 66 AWS 1700, 1, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
Lower, Band 66 AWS 1700, 1, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
Lower, Band 66 AWS 1700, 1, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed	Passed
Lower, Band 66 AWS 1700, 1, RF downlink, 3 dB > AGC, Wideband 5G	Passed	Passed
Lower, Band 66 AWS 1700, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
Lower, Band 66 AWS 1700, 1, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
Upper, Band 66 AWS 1700, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
Upper, Band 66 AWS 1700, 2, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
Upper, Band 66 AWS 1700, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
Upper, Band 66 AWS 1700, 2, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
Lower, Band 66 AWS 1700, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
Lower, Band 66 AWS 1700, 2, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
Lower, Band 66 AWS 1700, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
Lower, Band 66 AWS 1700, 2, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C [Base Stations/Repeater]	**KDB 935210 D05 v01r04: 3.3**		
Out-of-band rejection The measurement was performed according to ANSI C63.26; KDB 935210 D05 v01r04: 3.3		**Final Result**	
OP-Mode Frequency Band, Direction	**Setup**	**FCC**	**ISED**
Band 66 AWS 1700, RF downlink		Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C [Base stations/Repeater]	**§ 2.1053, § 27.53**		
Field strength of spurious radiation The measurement was performed according to ANSI C63.26		**Final Result**	
OP-Mode Frequency Band, Direction			
AWS 1700, RF downlink		Passed	Passed

The test case frequency stability was not performed, since the EUT is not equipped with signal processing capabilities.

2 ADMINISTRATIVE DATA

2.1 TESTING LABORATORY

Bureau Veritas Consumer Products Services
Germany GmbH
Thurn-und-Taxis-Straße 18
D-90411 Nürnberg
Tel.: +49 40 74041 0
Fax: +49 40 74041-2755

2.2 APPLICANT DATA

Company Name:	CommScope Andrew Wireless Systems GmbH
Address:	Industriering 10 86675 Buchdorf Germany
Contact Person:	Mr. Jiri Čečka

2.3 MANUFACTURER DATA

Company Name:	Please see applicant data.
Address:	

3 TEST OBJECT DATA

3.1 GENERAL EUT DESCRIPTION

Kind of Device product description	Cellular repeater
Product name	Cellular repeater
Type	UAP-XR
Declared EUT data by the supplier	
General Product Description	The EUT is an industrial signal booster supporting the following: Band 30/WCS 2300: 2350 – 2360 MHz Band 41 (BRS 2500), Broadband Radio Service: ● Lower Band Segment (LBS): 2496- 2568 MHz (Range for FCC) ● Lower Band Segment (LBS): 2500- 2568 MHz (Range for ISED) ● Middle Band Segment (MBS): 2572- 2614 MHz ● Upper Band Segment (UBS): 2618 – 2690 MHz Band 25/PCS 1900 Band 66/AWS 1700 A RF operation is only supported for the downlink.
Booster Type	Industrial signal booster
Voltage Type	DC, supply about PoE
Voltage Level	-60 V - -36 V, -57 V nominal
Maximum Output Donor Port [Uplink]	-
Maximum Output Server Port [Downlink]	18 dBm in all bands
Maximum Gain [Uplink]	-
Maximum Gain [Downlink]	20 dB in all bands

The main components of the EUT are listed and described in chapter 3.2 EUT Main components.

3.2 EUT MAIN COMPONENTS

Sample Parameter	Value
Serial Number	SZBEBF2452A0003
HW Version	7862380-00 Rev: 00
SW Version	01.03.0012
Comment	-----

NOTE: The short description is used to simplify the identification of the EUT in this test report.

3.3 ANCILLARY EQUIPMENT

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Device	**Details (manufacturer, type model, OUT code)**	**Description**
-	-	-

3.4 AUXILIARY EQUIPMENT

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it.
But nevertheless Auxiliary Equipment can influence the test results.

Device	**Details (manufacturer, type, S/N)**	**Description**
AUX1	CommScope; ION-E PSU Shelf AC; HD20882	Power supply rack
AUX1	CommScope; ION-E WCS-2; SZAEAJ1952A0032	Power supply rack
AUX3	GE Power Electronics Inc.; CAR1212FPBC-Z; FK69111	Power module
AUX4	GE Energy; CP2000AC54TEP-CM; LBLNPW13KZ07004506	Power module
AUX5	CommScope; ION E SUI; (e1)MA34	Ethernet module
AUX6	CommScope; ION E CAT; SZBEAE1810A0009	PoE module
AUX8	CommScope, ION E RFD, SZBEAG1825A0004	RF card plug-in module
AUX8	CommScope, ION E RFD, SZBEA G1849A0043	RF card plug-in module

3.5 EUT SETUPS

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup	**Combination of EUTs**	**Description and rationale**
	,	Setup for all tests

3.6 OPERATING MODES

This chapter describes the operating modes of the EUT used for testing.

3.6.1 TEST CHANNELS

Band	Direction	Lower Frequency Band Edge [MHz]	Upper Frequency Band Edge [MHz]	Center Frequency [MHz]	Port
66, AWS 1700	Downlink	2110.00	2180	2145.00	Donor

3.6.2 DEFINITION OF USED FREQUENCY BANDS

Narrowband: representation by a GSM signal
Wideband : representation by an AWGN signal with 4.1 MHz
Wideband 5G: representation by an AWGN signal with 43.6 MHz

3.6.3 AUTOMATIC GAIN CONTROL LEVELS

3.6.4 AUTOMATIC GAIN CONTROL LEVEL

AGC Levels							
Band	**Direction**	**Signal Type**	**AGC Start Pin [dBm]**	**AGC Start Pin -0.3 dB [dBm]**	**AGC Start Pin +3 dB [dBm]**	**Frequency [MHz]**	**Frequency**
66	Downlink	Narrowband	-0.6	-0.9	2.5	2145.0	Mid
66	Downlink	Wideband	-1.1	-1.4	-1,9	2145.0	
66	Downlink	Wideband 5G	-0.6	-0.9	2.5	2145.0	
66	Downlink	Narrowband	0.0	-0.3	3.0	2110.2	Low
66	Downlink	Wideband	0.4	0.1	3.4	2112.5	
66	Downlink	Wideband 5G	0.1	-0.2	2.8	2132.5	
66	Downlink	Narrowband	0.0	-0.3	3.0	2179.8	High
66	Downlink	Wideband	-0.2	-0.5	2.8	2177.5	
66	Downlink	Wideband 5G	-0.5	-0.8	2.2	2157.5	
66	Downlink	Narrowband	-1.0	-1.3	2.1	2152.6	Max.Power
66	Downlink	Wideband	-1.1	-1.4	1,9	2152.6	
66	Downlink	Wideband 5G	-0.6	-0.9	2.5	2145.0	

Remark:

If the measured frequency f_0 for the max power has a too low distance to the band edges, because in the tests modulated signals must be used: The next possible frequency to the according band edge was used.
For example for minimum distances to the band edges:

GSM signal (narrowband): 0.2 MHz
AWGN signal (wideband): 2.5 MHz
AWGN signal (wideband 5G): Here only measurements at the mid frequency were performed, because of the signal witdh.

3.7 PRODUCT LABELLING

3.7.1 FCC ID LABEL

Please refer to the documentation of the applicant.

3.7.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

4 DESCRIPTION OF EMC TEST CENTRE

4.1 CLIMATIC CONDITIONS DURING MEASUREMENTS

The climatic conditions were within the following ranges.
For ESD testing, the conditions during the test were denoted in the corresponding chapter.

Ambient temperature:	25 ± 10 °C
Relative humidity:	20 – 60 %
Air pressure:	860 - 1060 hPa

4.2 CONFORMITY STATEMENT/DECISION RULE

4.2.1 EMISSION

If the standard or the customer defines no decision rule, the laboratory applies a decision rule following the "Binary Statement for Simple Acceptance Rule (w=0)" (chapter 4.2.1) of ILAC Guidelines on Decision Rules and Statements of Conformity (ILAC-G8:09/2019). If the measured value is at the limit value, it is evaluated as PASS. The client has agreed with application of the decision rule prior testing and demanded a statement of conformity by the test laboratory.

4.3 MEASUREMENT UNCERTAINTIES

KDB 935210 D05	**Test laboratory**
Power measurement	0,68 dB
Measuring AGC threshold level	0,90 dB
Out of band rejection	0,90 dB
Input-versus-output signal comparison	0,91 dB
Mean power output	0,90 dB
Measuring out-of-band/out-of-block (including intermodulation) emissions and spurious emissions	0,90 dB
Out-of-band/out-of-block emissions conducted measurements	0,90 dB
Spurious emissions conducted	2,18 dB
Spurious emissions radiated mesurements	5,38 dB
Total frequency uncertainty	2×10^{-7}

Reference : ECL-MU5.4.6.3-EMC-14-001-V03.00 MU Wireless.xlsx

5 TEST RESULTS

5.1 EFFECTIVE RADIATED POWER, MEAN OUTPUT POWER AND ZONE ENHANCER GAIN

Standard FCC Part 27, §27.50

The test was performed according to:
ANSI C63.26, KDB 935210 D05 v01r04: 3.5

Test date: 2025-03-20 – 2025-03-21

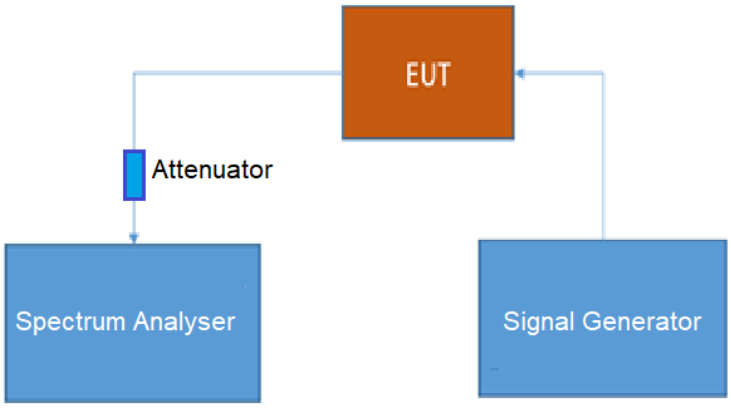
Environmental conditions: 24.7 °C; 23 % r. H./25.7 °C; 25 % r. H.

Test engineer: Thomas Hufnagel

5.1.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the signal booster power and gain limits and requirements for industrial signal boosters.

The EUT was connected to the test setup according to the following diagram:



The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

5.1.2 TEST REQUIREMENTS/LIMITS

Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§ 27.50

Abstract § 27.50 from FCC:

(d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(1) The power of each fixed or base station transmitting in the 1995-2000 MHz, 2110-2155 MHz, 2155-2180 MHz or 2180-2200 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 3280 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 3280 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(2) The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

Abstract RSS-139 from ISED:

5.5 Transmitter output power

The maximum output power of the equipment shall comply with the limits specified below. In the tables, maximum power refers to the equivalent isotropically radiated power (e.i.r.p.) or total radiated power (TRP), measured in terms of average values.

The limits in this RSS are specified for the purpose of certification and may not apply to all deployment scenarios. Consult SRSP-513 and SRSP-519 for more details on the bands 2110-2180 MHz and 2180-2200 MHz respectively.

Table 3: Maximum power of equipment in the band 1710-1780 MHz

Equipment type	Maximum power
Fixed station and base station	30 dBm e.i.r.p./channel bandwidth
Subscriber equipment	30 dBm e.i.r.p./channel bandwidth

Table 4: Maximum power of equipment in the band 2110-2180 MHz

Equipment type	Maximum power
Non-AAS fixed station and base station	65 dBm e.i.r.p./MHz
AAS fixed station and base station	46 dBm TRP/MHz
Subscriber equipment	30 dBm e.i.r.p./channel bandwidth

Table 5: Maximum power of equipment in the band 2180-2200 MHz

Equipment type	Maximum power
Non-AAS base station	65 dBm e.i.r.p./MHz
AAS base station	46 dBm TRP/MHz

Abstract RSS-132 from ISED:

6.1.3 E.i.r.p. limits and antenna height limits for non-AAS systems

19. In non-AAS uncorrelated transmission, multiple non-AAS antennas can be used at a station to each transmit different digital data in a given symbol period (i.e. space-time codes) or independent parallel data streams over the same frequency bandwidth in order to increase data rates (i.e. spatial multiplexing), or to form any other transmission mode where signals from different antennas are completely uncorrelated. For these uses, the e.i.r.p. shall be calculated based on the aggregate power conducted across all antennas and the maximum antenna gain (G_{max}).

6.1.3 E.i.r.p. limits and antenna height limits for non-AAS systems

20. For fixed and base stations operating in the band 2110-2180 MHz with a channel bandwidth equal to or less than 1 MHz, the maximum permissible e.i.r.p. is 62 dBm, with an antenna height above average terrain (HAAT) of up to 300 m.

21. For fixed and base stations operating in the band 2110-2180 MHz with a channel bandwidth greater than 1 MHz, the maximum permissible e.i.r.p. is 62 dBm/MHz (i.e. no more than 62 dBm e.i.r.p. in any 1 MHz band segment), with an antenna HAAT of up to 300 m.

22. Fixed and base stations operating in the band 2110-2180 MHz and located in geographic areas at a distance greater than 26 km from large or medium population centres may increase their e.i.r.p. to a maximum of 65 dBm/MHz (i.e. no more than 65 dBm e.i.r.p. in any 1 MHz band segment), with an antenna HAAT of up to 300 m. According to Statistics Canada's Census Dictionary, a large urban population centre has a population of 100,000 or more and a population density of 400 persons or more per km^2, and a medium population centre has a population of between 30,000 and 99,999 and a population density of 400 persons or more per km^2. MapInfo files describing the boundaries of these centres are available online.

23. Within 26 km of any large or medium population centre, fixed and base stations may operate with an increased e.i.r.p. if more than 50% of the population within a particular sector's coverage is located outside a large or medium population centre. The population within the sector's coverage may be determined using the MapInfo spectrum grid-cell data available online at ISED's Service areas for competitive licensing web page.

24. Fixed and base stations operating with an increased e.i.r.p., as specified above, must not be used to provide coverage to large and medium population centres. However, some incidental coverage of these population centres by stations operating with an increased e.i.r.p. is permitted.

25. The above provisions to allow increased e.i.r.p. limits also apply to fixed and base stations with a channel bandwidth equal to or less than 1 MHz. The e.i.r.p. may be increased up to a maximum of 65 dBm.

26. Fixed and base stations with an antenna HAAT exceeding 300 m shall apply a reduction in e.i.r.p. according to the following formula:

$$e.i.r.p._{reduction} = 20 \log_{10}(HAAT/300) \text{ dB}$$

HAAT of a fixed or base station with multiple antennas shall be calculated based on the measurements of the highest antenna.

5.1.3 TEST PROTOCOL

FCC Table

Band 66 AWS 1700, downlink,							
Signal type	**Input power**	**Frequency [MHz]**	**Input power [dBm]**	**Maximum average output power [dBm]**	**Limit average output power [dBm]**	**Margin to limit [dB]**	**Gain [dB]**
Wideband	0.3 dB < AGC	2152.6	-1.4	17.8	62.1	44.3	19.2
Wideband	3 dB > AGC	2152.6	1.9	17.5	62.1	44.6	15.6
Narrowband	0.3 dB < AGC	2152.6	-1.3	18.0	62.1	44.1	19.3
Narrowband	3 dB > AGC	2152.6	2.1	17.7	62.1	44.4	15.7
Wideband 5G	0.3 dB < AGC	2145.0	-0.9	18.0	62.1	44.1	18.9
Wideband 5G	3 dB > AGC	2145.0	2.5	18.2	62.1	43.9	15.8

For the output power limit the lowest value of the FCC table from § 27.50 is taken. This is 1640 W which equates 62.1. dBm according the given formula:

$$p_{dBm} = 10 \log_{10} \frac{1640\ W}{0.001\ W} = \text{dBm}$$

ISED Table

Band 66 AWS 1700, downlink,							
Signal type	**Input power**	**Frequency [MHz]**	**Input power [dBm]**	**Maximum average output power [dBm]**	**Limit average output power [dBm]**	**Margin to limit [dB]**	**Gain [dB]**
Wideband	0.3 dB < AGC	2152.6	-1.4	17.8	62.0	44.2	19.2
Wideband	3 dB > AGC	2152.6	1.9	17.5	62.0	44.5	15.6
Narrowband	0.3 dB < AGC	2152.6	-1.3	18.0	62.0	44.0	19.3
Narrowband	3 dB > AGC	2152.6	2.1	17.7	62.0	44.3	15.7
Wideband 5G	0.3 dB < AGC	2145.0	-0.9	18.0	62.0	44.0	18.9
Wideband 5G	3 dB > AGC	2145.0	-1.4	17.8	62.0	44.2	19.2

Remark:
Please see next sub-clause for the measurement plot.

5.1.4 SAMPLE CALCULATION OF OUTPUT POWER

FCC calculation:

Maximum output power (EIRP) in consideration together with the send antenna

The highest power level in the tables above is
$p_{highest}$ = 18.0 dBm at the channel which has the most output power of all channels.

Hereby at an antenna gain of G_{dBi} = 13 dB the highest effecitve radiated output power EIRP $p_{EIRP\ 1CH}$ of one channel is:

$p_{EIRP\ 1CH} = p_{highest} + G_{dBi}$

This results in:

$p_{EIRP\ 1CH}$ = 18.0 dBm + 13.0 dB = 31.0 dBm

The eqivalent power P is according the given formula:

$P_{EIRP\ 1CH}$ =

$$P\ EIRP\ 1CH\ [W] = 10EXP\quad \left(p\ EIRP\ 1CH\ [dBm]\quad /\quad 10\right) * 0.001\ [W]$$

This results in:

$$P\ EIRP\ 1CH\ [W] = 10EXP\quad \left(31.0\ [dBm]\quad /\quad 10\right) * 0.001\ [W] = 1.26\ W$$

Because only one conducted antenna port is available no calculation for MIMO operation must be done.

Final result of this consideration:

$p_{EIRP\ all\ channels}$ = 1.26 W < 1640 W/MHz, hereby 1640 W/MHz is the highest allowed limit in this band which equates 62.1 dBm/MHz.

The DUT doesn't exceed the limit.

ISED calculation:

Maximum output power (EIRP) in consideration together with the send antenna

The highest power level in the tables above is
$p_{highest}$ = 18.0 dBm at the channel which has the most output power of all channels.

Hereby at an antenna gain of G_{dBi} = 13 dB the highest effecitve radiated output power EIRP $p_{EIRP\ 1CH}$ of one channel is:

$p_{EIRP\ 1CH} = p_{highest} + G_{dBi}$

This results in:

$p_{EIRP\ 1CH}$ = 18.0 dBm + 13.0 dB = 31.0 dBm

Because only one conductedt antenna port is available no calculation for MIMO operation must be done.

Final result of this consideration:

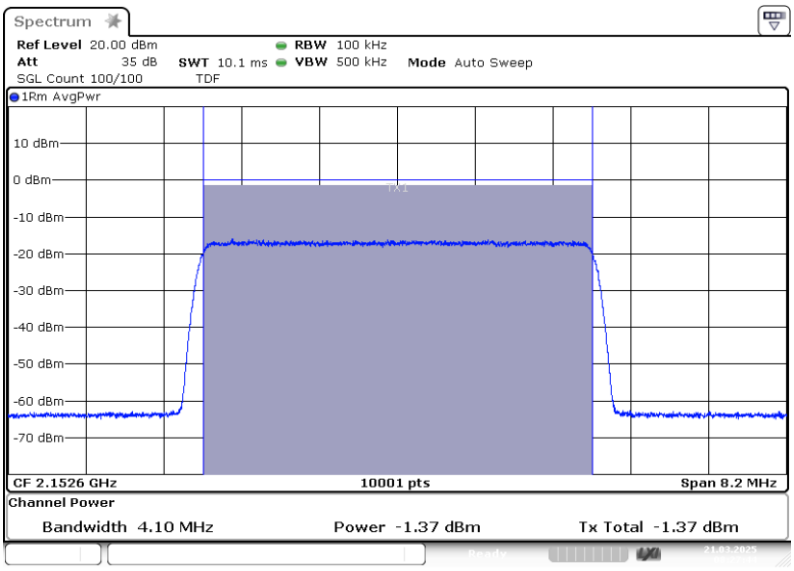
$p_{EIRP\ all\ channels}$ = 31.0 dBm < 61.0 dbm/MHz, hereby the limit of 61.0 dBm/MHz equates the ISED limit of 68 dBm/5 MHz

The DUT doesn't exceed the limit.

5.1.5 MEASUREMENT PLOT

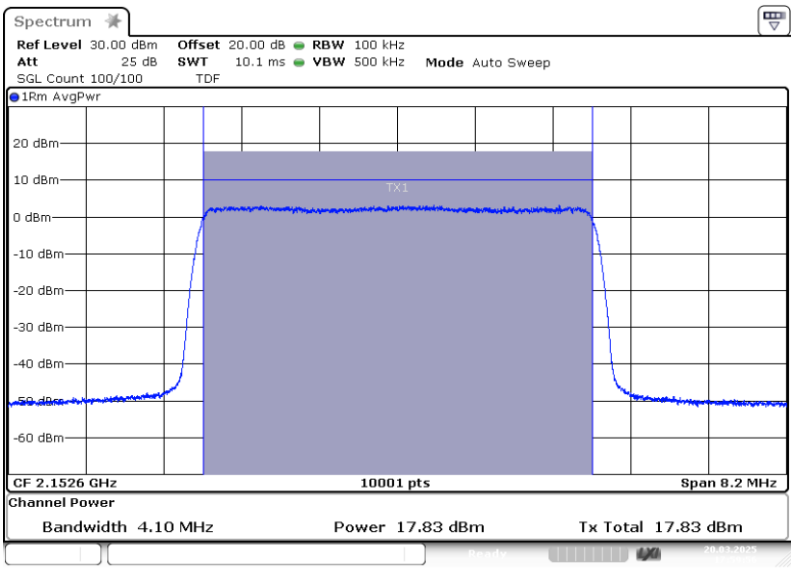
Combined FCC and ISED Plots

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: AWGN;
Input power 0.3 dB < AGC



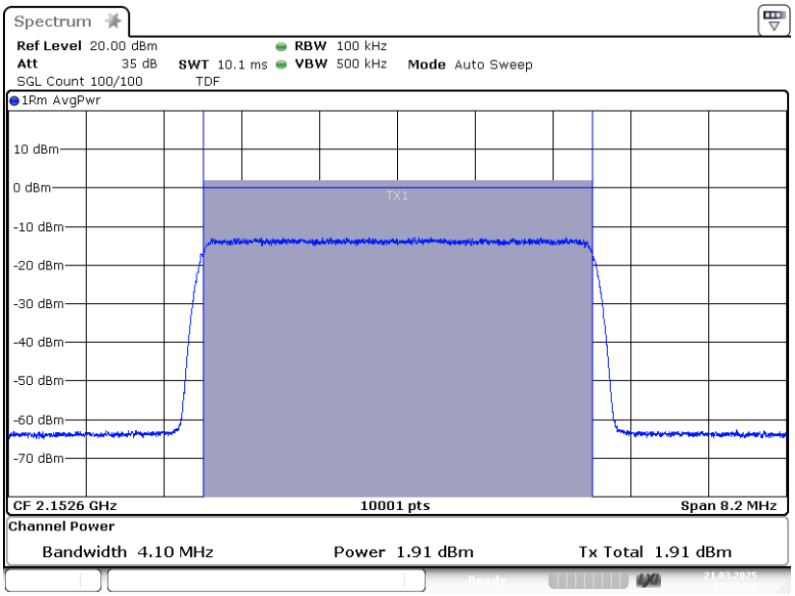
3.5.3 Power AWGN In-0.3 2.15260G

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: AWGN;
Output power 0.3 dB < AGC



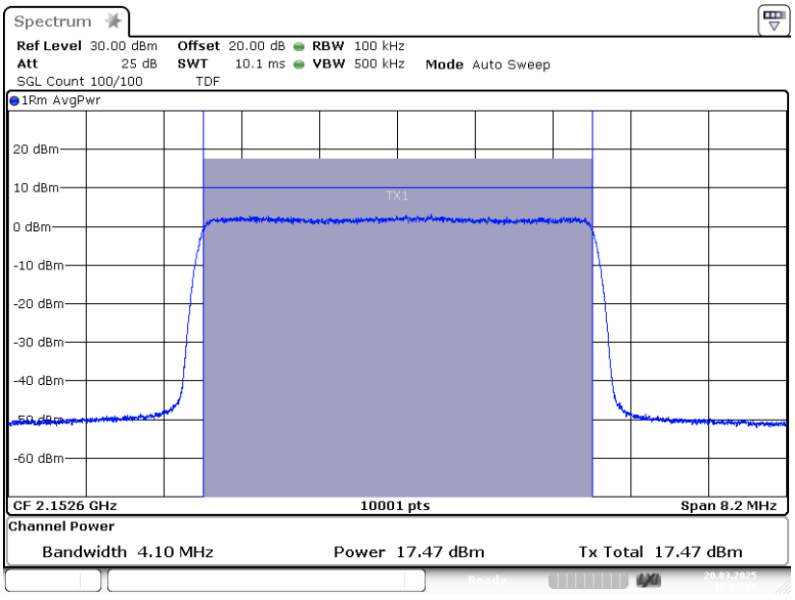
3.5.3 Power AWGN Out -0.3 2.15260G

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: AWGN;
Input power 3 dB > AGC



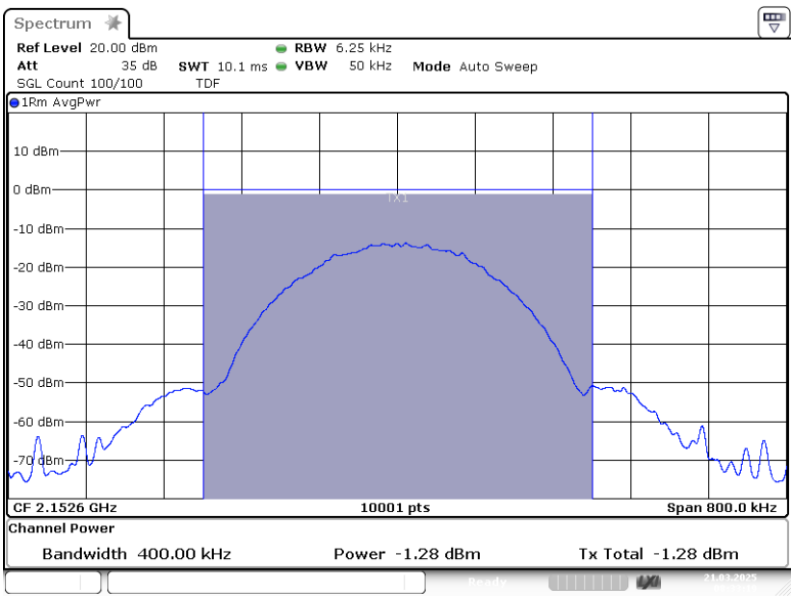
3.5.3 Power AWGN In+3 2.15260G

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: AWGN;
Output power 3 dB > AGC



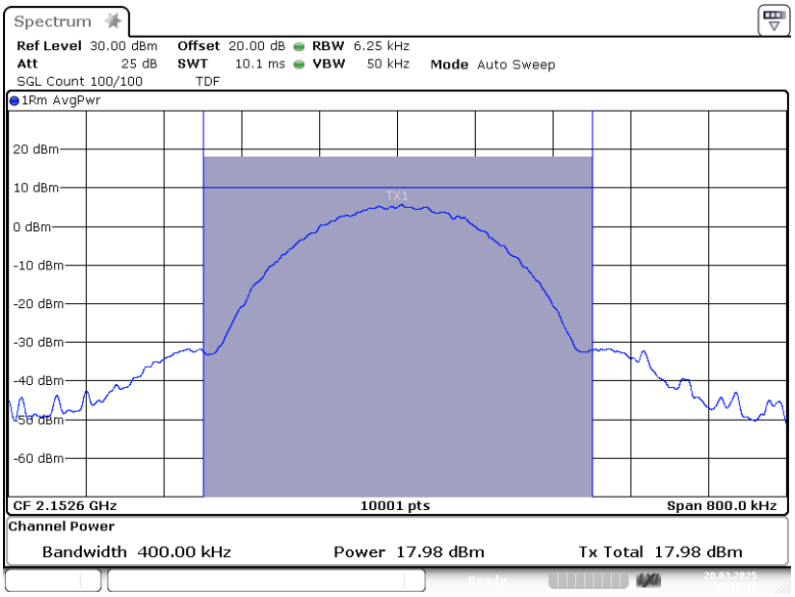
3.5.3 Power AWGN Out +3 2.15260G

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: GSM;
Input power 0.3 dB < AGC



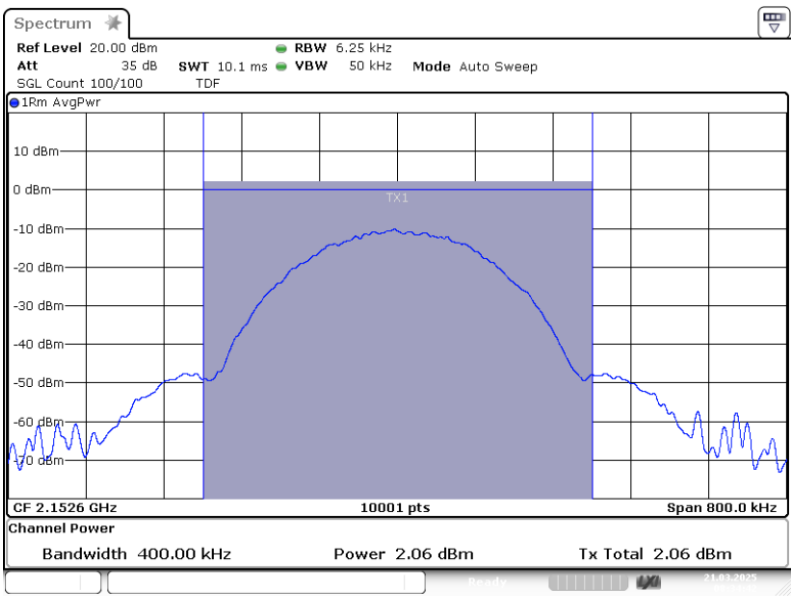
3.5.3 Power GSM In-0.3 2.15260G

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: GSM;
Output power 0.3 dB < AGC



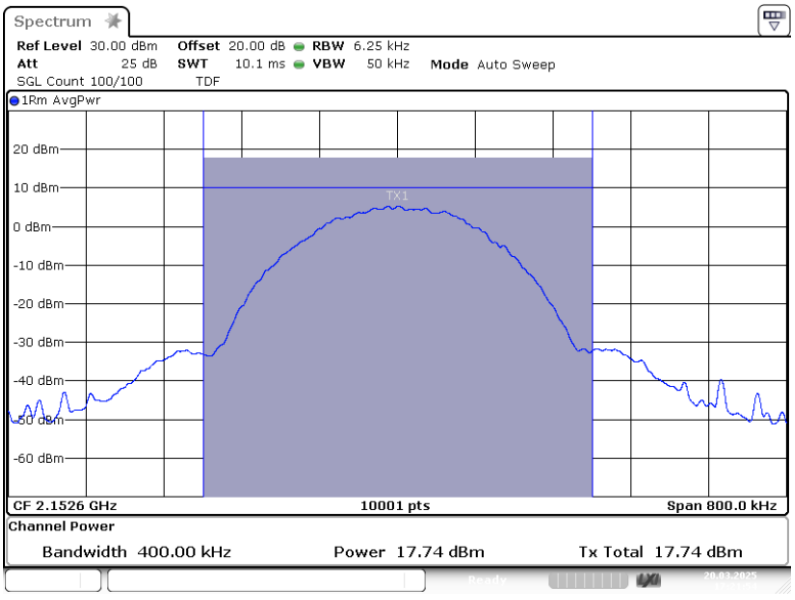
3.5.3 Power GSM Out -0.3 2.15260G

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: GSM;
Input power 3 dB > AGC



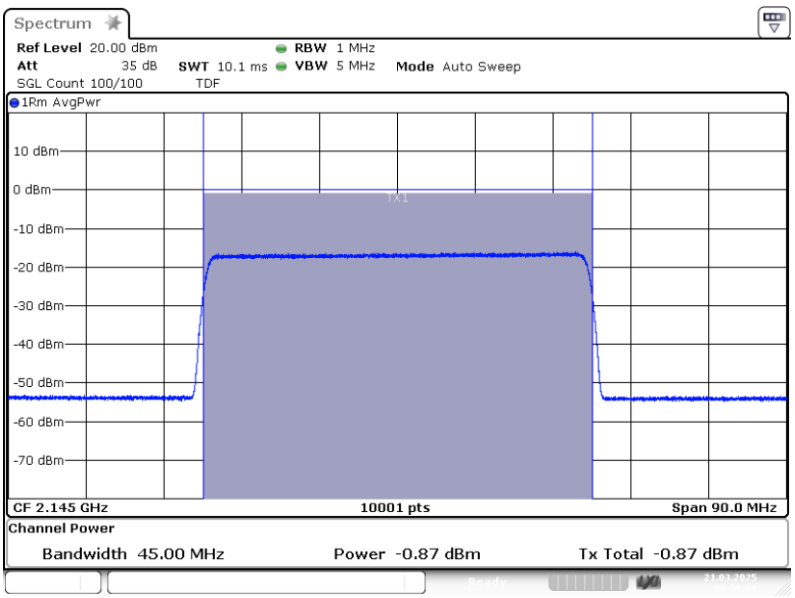
3.5.3 Power GSM In+3 2.15260G

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: GSM;
Output power 3 dB > AGC



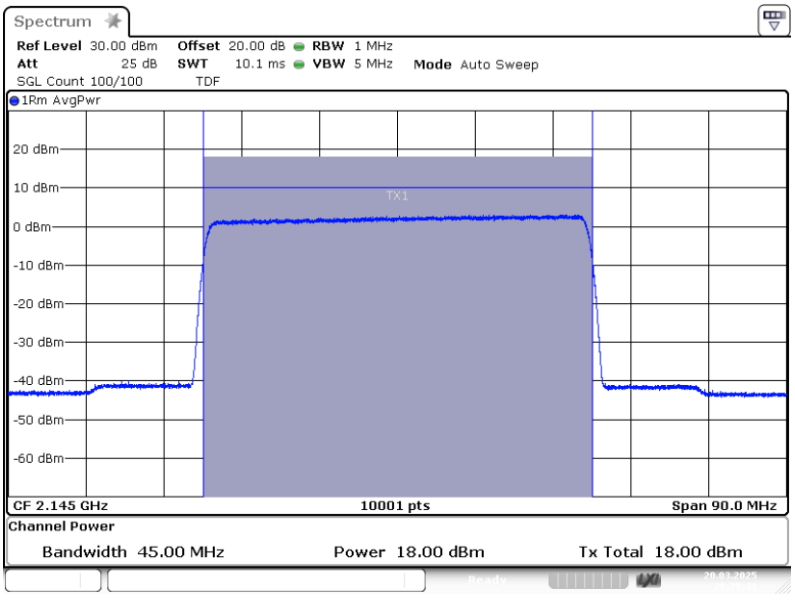
3.5.3 Power GSM Out +3 2.15260G

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN 45M;
Input power 0.3 dB < AGC



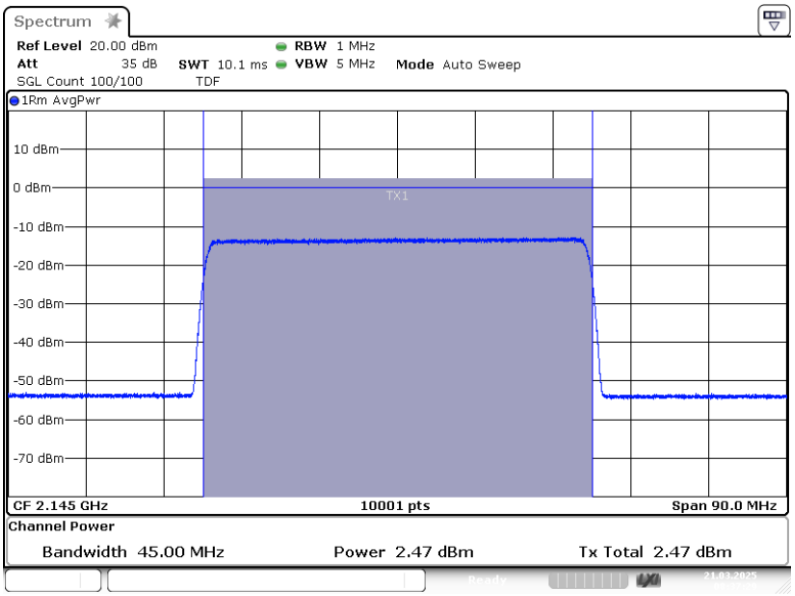
3.5.3 Power AWGN 45M In-0.3 2.14500G

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN 45M;
Output power 0.3 dB < AGC



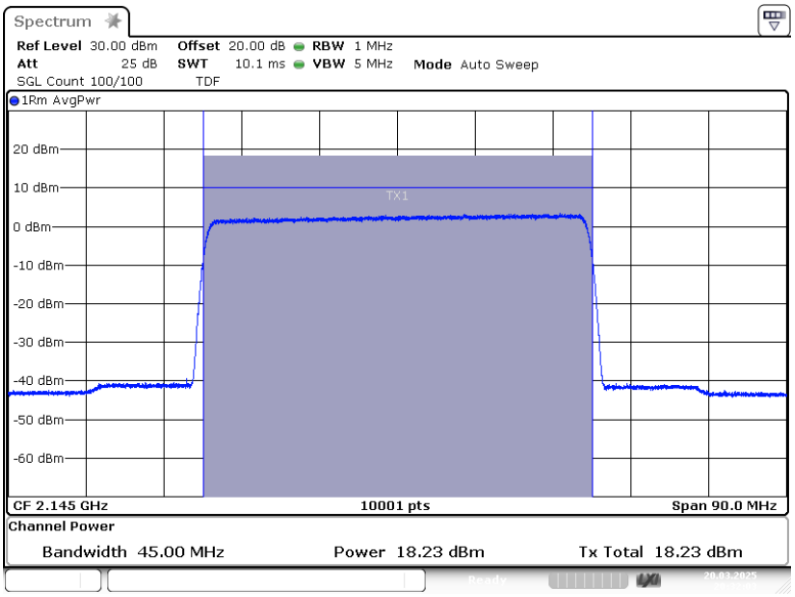
3.5.3 Power AWGN 45M Out -0.3 2.14500G

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN 45M;
Input power 3 dB > AGC



3.5.3 Power AWGN 45M In+3 2.14500G

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN 45M;
Output power 3 dB > AGC



3.5.3 Power AWGN 45M Out +3 2.14500G

5.1.6 TEST EQUIPMENT USED

- Conducted

5.2 PEAK TO AVERAGE RATIO

Standard FCC Part 27, §27.50

The test was performed according to:
ANSI C63.26

Test date: 2025-03-20 – 2025-03-21

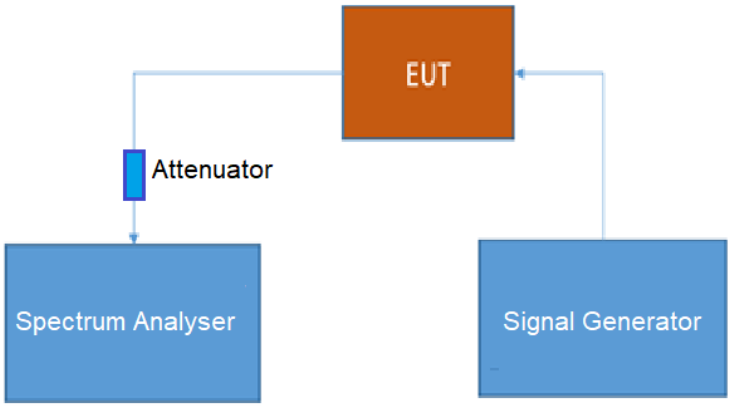
Environmental conditions: 24.7 °C; 23 % r. H./25.7 °C; 25 % r. H.

Test engineer: Thomas Hufnagel

5.2.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the signal booster power and gain limits and requirements for industrial signal boosters.

The EUT was connected to the test setup according to the following diagram:



The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

5.2.2 TEST REQUIREMENTS/LIMITS

Subpart C – Technical standards

§ 27.50

Abstract § 27.50 from FCC:

(d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(5) Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

Abstract RSS-139 from ISED:

5.5 Transmitter output power

In addition, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

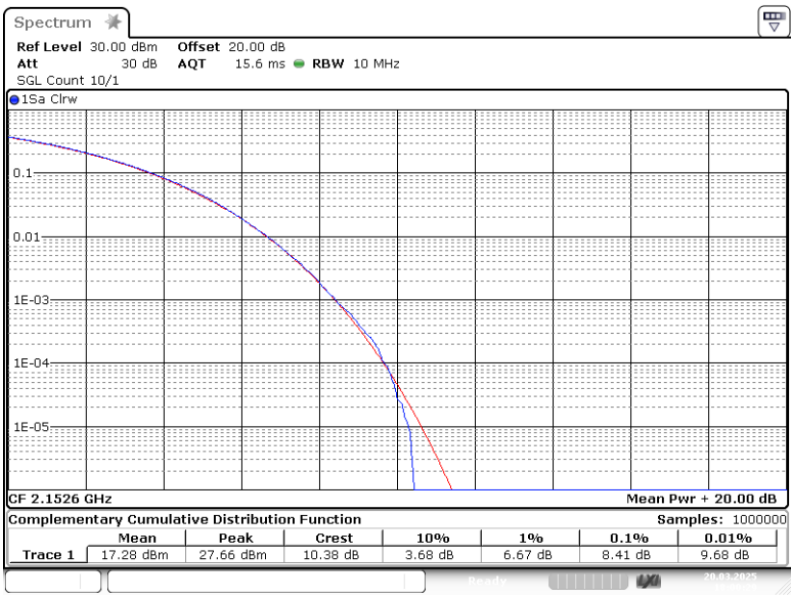
5.2.3 TEST PROTOCOL

Band 66 AWS 1700, downlink						
Signal type	**Input power**	**Frequency [MHz]**	**Input power [dBm]**	**PAPR [dB]**	**Limit PAPR [dB]**	**Margin to limit [dB]**
Wideband	0.3 dB < AGC	2152.6	8,4	8,4	13,0	4,6
Wideband	3 dB > AGC	2152.6	8,4	8,4	13,0	4,6
Narrowband	0.3 dB < AGC	2152.6	0,2	0,2	13,0	12,8
Narrowband	3 dB > AGC	2152.6	0,1	0,2	13,0	12,8
Wideband 5G	0.3 dB < AGC	2145.0	8,5	8,4	13,0	4,6
Wideband 5G	3 dB > AGC	2145.0	8,4	8,5	13,0	4,5

Remark: Please see next sub-clause for the measurement plot.

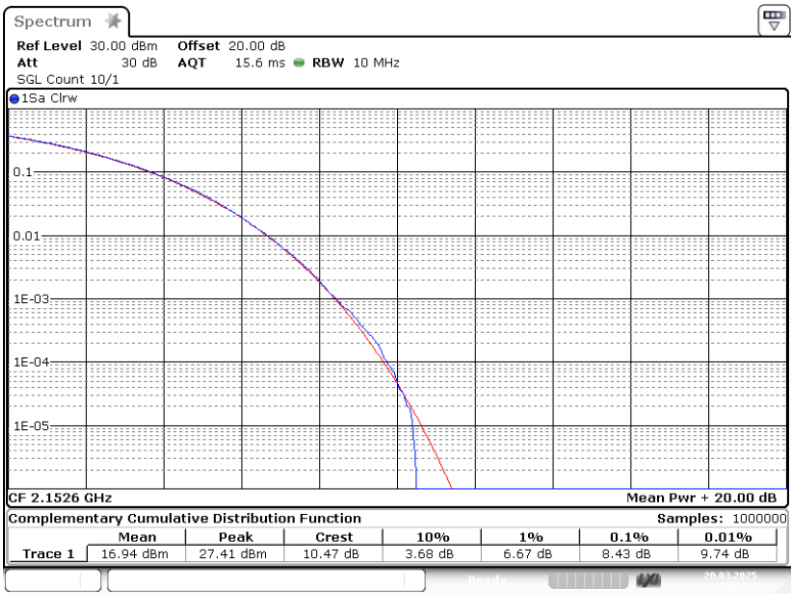
5.2.4 MEASUREMENT PLOT

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: AWGN; PAPR 0.3 dB < AGC



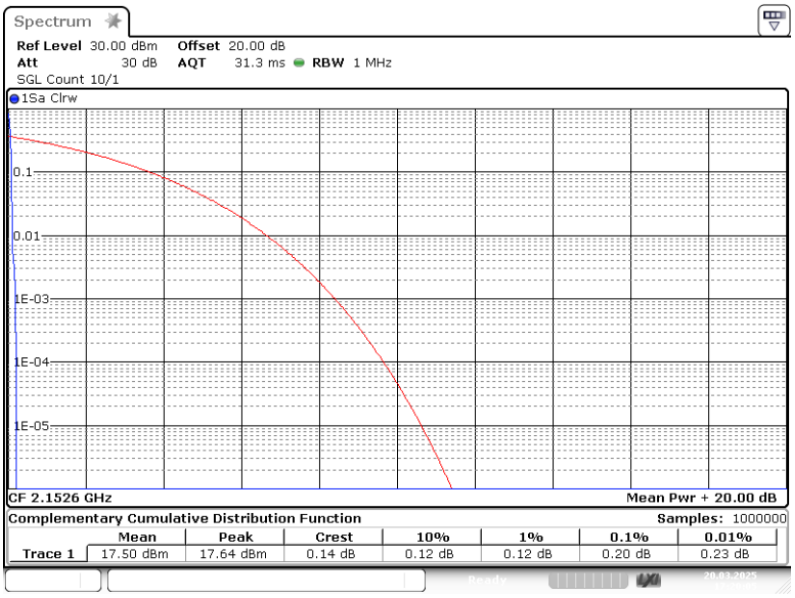
4.0 PAPR AWGN Out -0.3 2.153G

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: AWGN; PAPR 3 dB > AGC



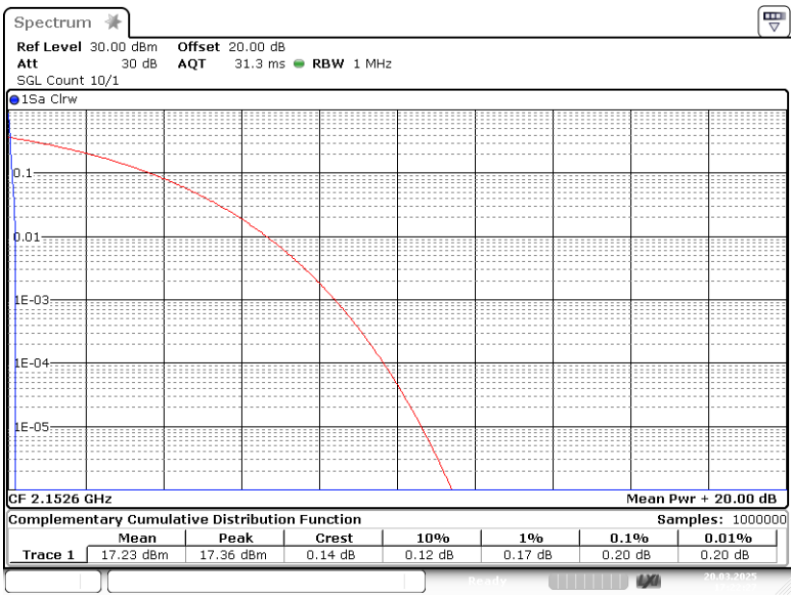
4.0 PAPR AWGN Out +3 2.153G

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: GSM; PAPR 0.3 dB < AGC



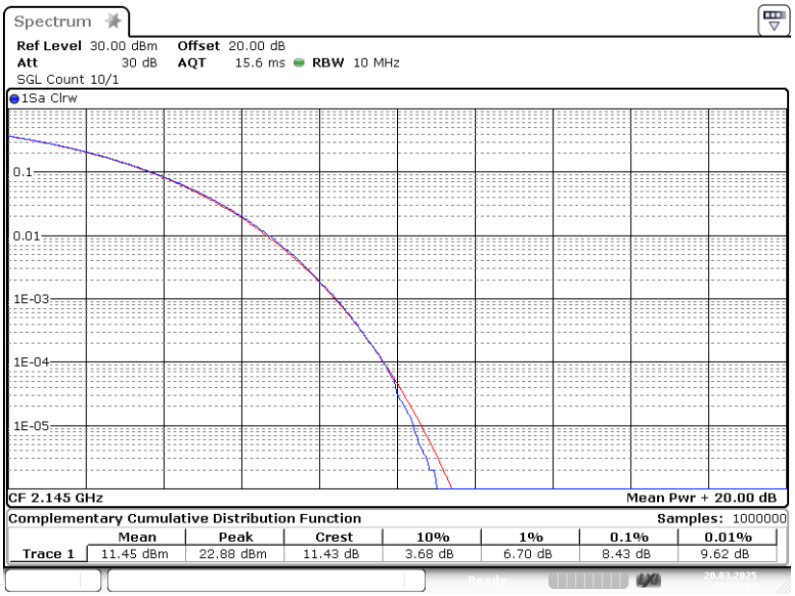
4.0 PAPR GSM Out -0.3 2.153G

Band: AWS 1700; Frequency: 2.1526 GHz; Band edge: f0; Mod: GSM; PAPR 3 dB > AGC



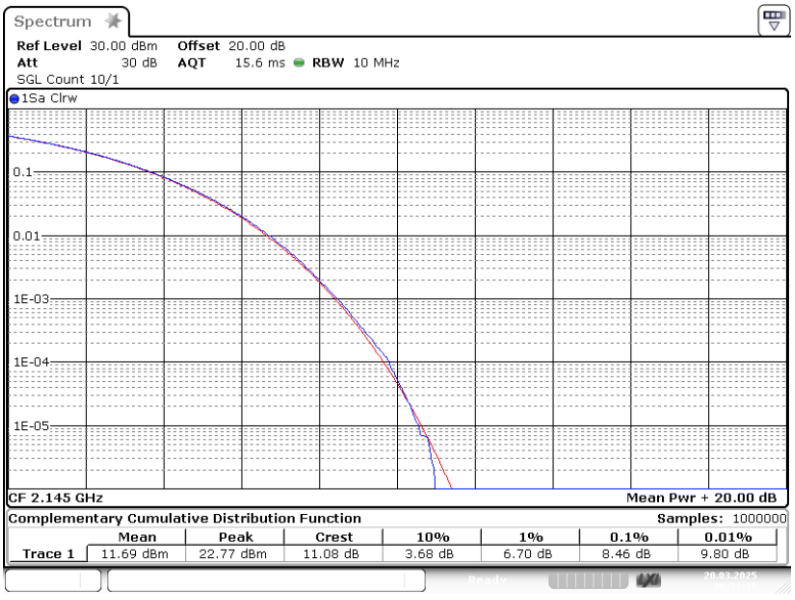
4.0 PAPR GSM Out +3 2.153G

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN 45M; PAPR 0.3 dB < AGC



4.0 PAPR AWGN 45M Out -0.3 2.145G

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN 45M; PAPR 3 dB > AGC



4.0 PAPR AWGN 45M Out +3 2.145G

5.2.5 TEST EQUIPMENT USED

- Conducted

5.3 OCCUPIED BANDWIDTH/INPUT-VERSUS-OUTPUT SPECTRUM

Standard FCC Part 2.1049; Occupied bandwidth

The test was performed according to:
ANSI C63.26, KDB 935210 D05 v01r04: 3.4

Test date: 2025-03-20 – 2025-03-21

Environmental conditions: 24.7 °C; 23 % r. H./25.7 °C; 25 % r. H.

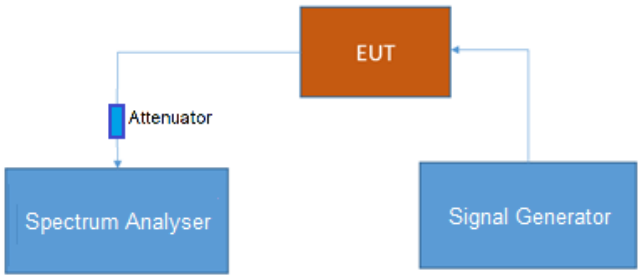
Test engineer: Thomas Hufnagel

5.3.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the occupied bandwith in comparison between the input and output signal of a bosster.

The EUT was connected to the test setups according to the following diagram:

Test Setup step 1: Measuring characteristics of test signals



Test Setup step 2; Occupied Bandwidth/Input-versus-output spectrum

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

5.3.2 TEST REQUIREMENTS/LIMITS

Abstract § 2.1049 from FCC:

FCC Part 2.1049; Occupied Bandwidth:

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.3 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

(i) Transmitters designed for other types of modulation—when modulated by an appropriate signal of sufficient amplitude to be representative of the type of service in which used. A description of the input signal should be supplied.

Abstract RSS-GEN from ISED:

RSS-GEN; 6.7 Occupied Bandwidth

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the "x dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

- The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.

- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

Abstract RSS-131 from ISED:

RSS-131; 9.2 Input-versus-output spectrum

The spectral growth of the 26 dB bandwidth or occupied bandwidth of the output signal shall be less than 5% of the input signal spectrum.

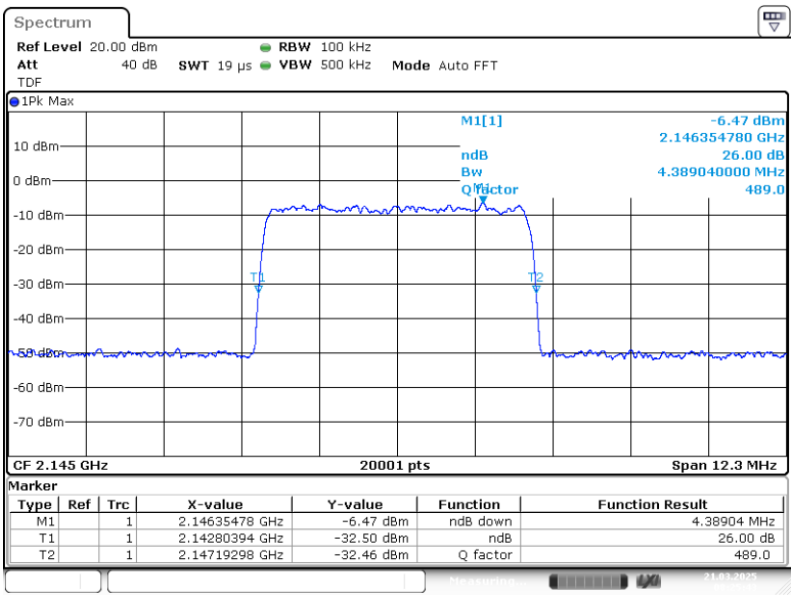
5.3.3 TEST PROTOCOL

Band 66 AWS 1700, downlink							
Signal type	**Input power**	**Signal frequency [MHz]**	**Occupied bandwidth SG [kHz]**	**Occupied bandwidth booster [kHz]**	**Delta occupied bandwidth [kHz]**	**Limit delta occupied bandwidth [kHz]**	**Margin to limit [kHz]**
Wideband	0.3 dB < AGC	2145.0	4389.0	4388.4	0.6	205.0	204.4
Wideband	3 dB > AGC	2145.0	4387.8	4390.3	2.5	205.0	202.5
Narrowband	0.3 dB < AGC	2145.0	314.1	314.7	0.7	10.0	9.3
Narrowband	3 dB > AGC	2145.0	314.4	315.8	1.3	10.0	8.7
Wideband 5G	0.3 dB < AGC	2145.0	46221.7	46059.7	162.0	1195.0	1033.0
Wideband 5G	3 dB > AGC	2145.0	46019.2	45965.2	54.0	1195.0	1141.0

Remark: Please see next sub-clause for the measurement plot.

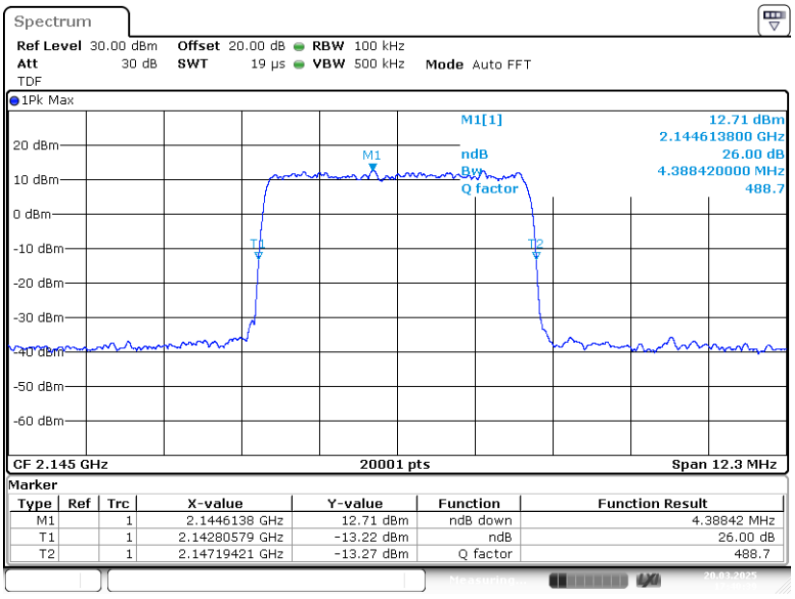
5.3.4 MEASUREMENT PLOT

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN;
Input OCBw 0.3 dB < AGC



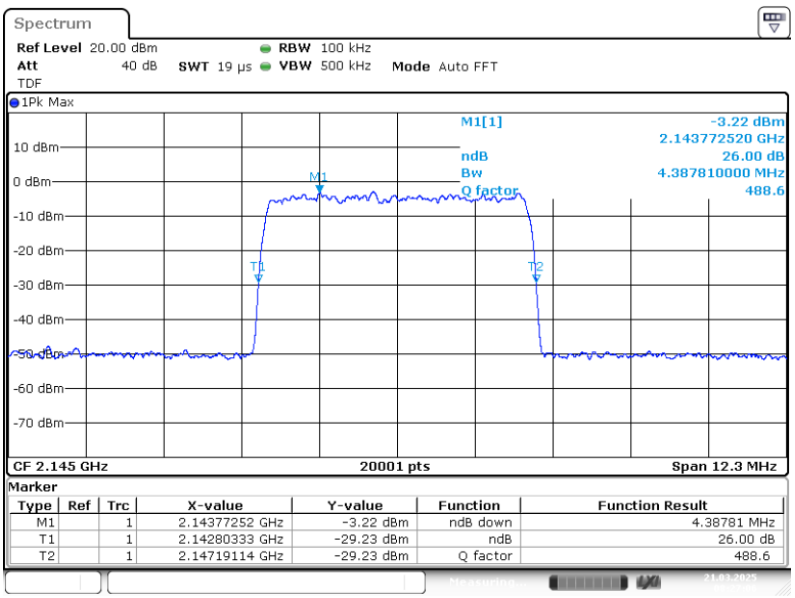
3.4 OCBw AWGN In-0.3 2.1450G _26dB

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN;
Output OCBw 0.3 dB < AGC



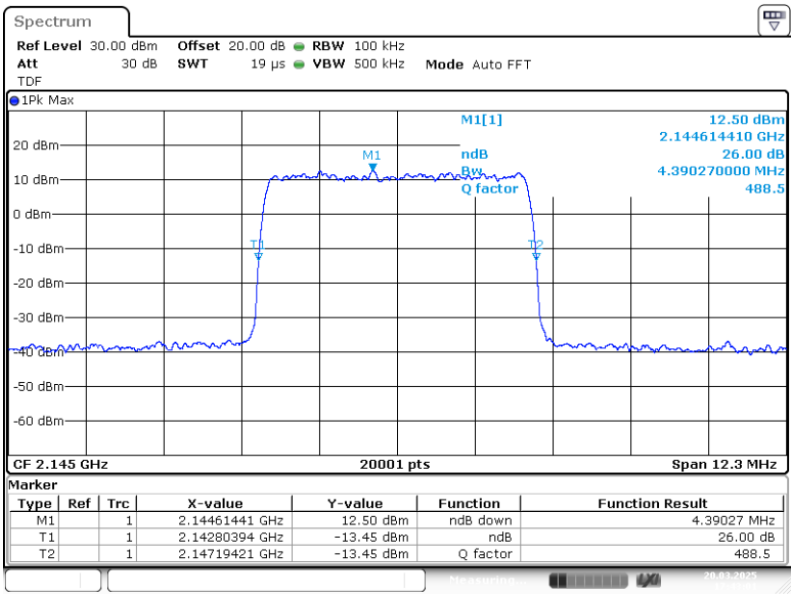
3.4 OCBw AWGN Out -0.3 2.1450G _26dB

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN;
Input OCBw 3 dB > AGC



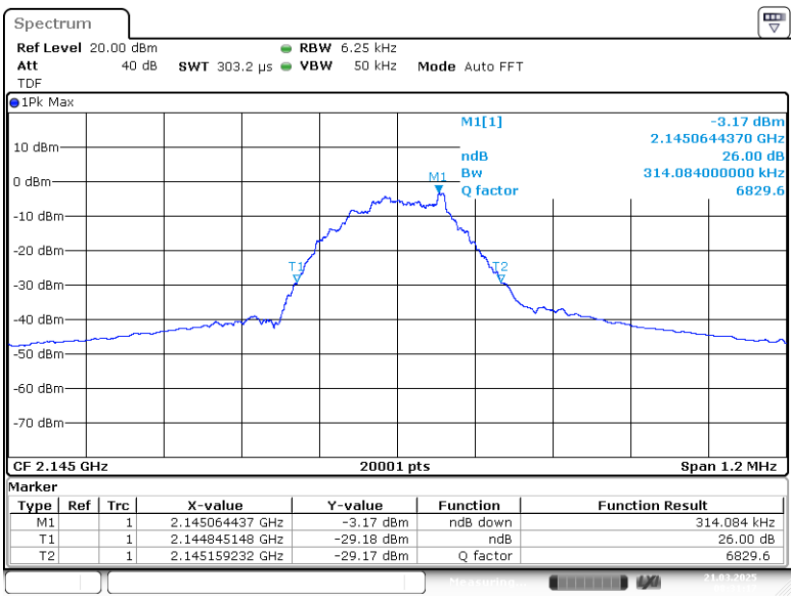
3.4 OCBw AWGN In+3 2.1450G _26dB

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN;
Output OCBw 3 dB > AGC



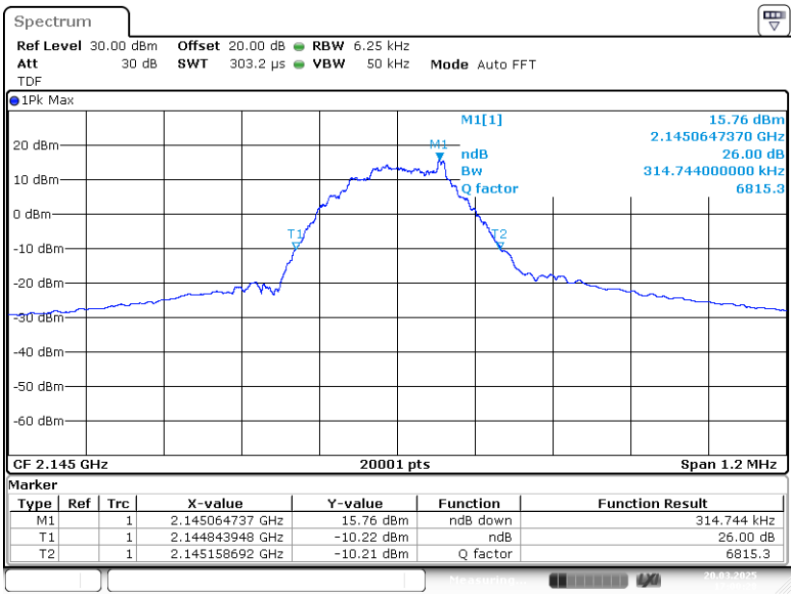
3.4 OCBw AWGN Out +3 2.1450G _26dB

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: GSM;
Input OCBw 0.3 dB < AGC



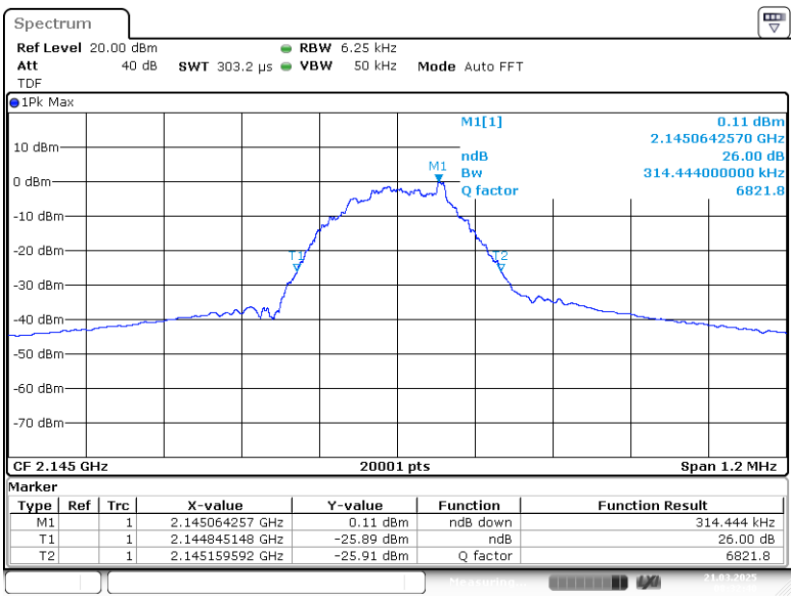
3.4 OCBw GSM In-0.3 2.1450G _26dB

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: GSM;
Output OCBw 0.3 dB < AGC



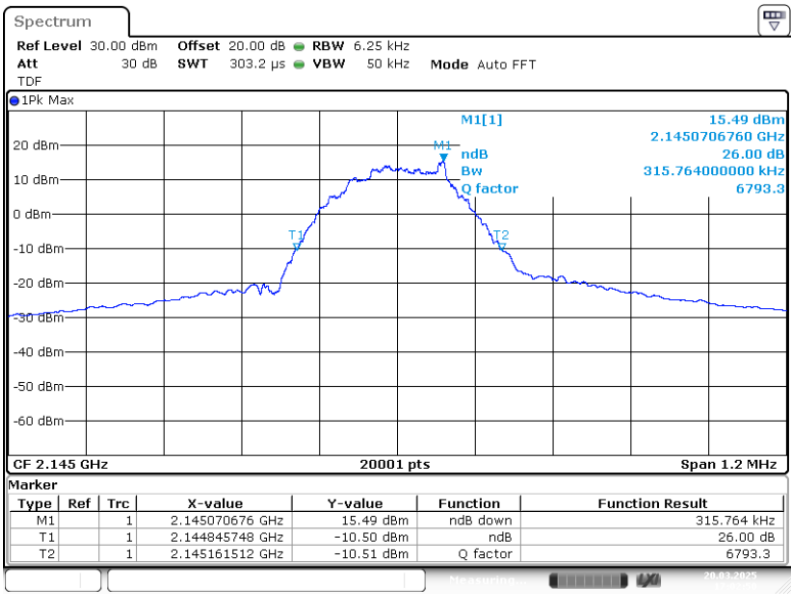
3.4 OCBw GSM Out -0.3 2.1450G _26dB

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: GSM;
Input OCBw 3 dB > AGC



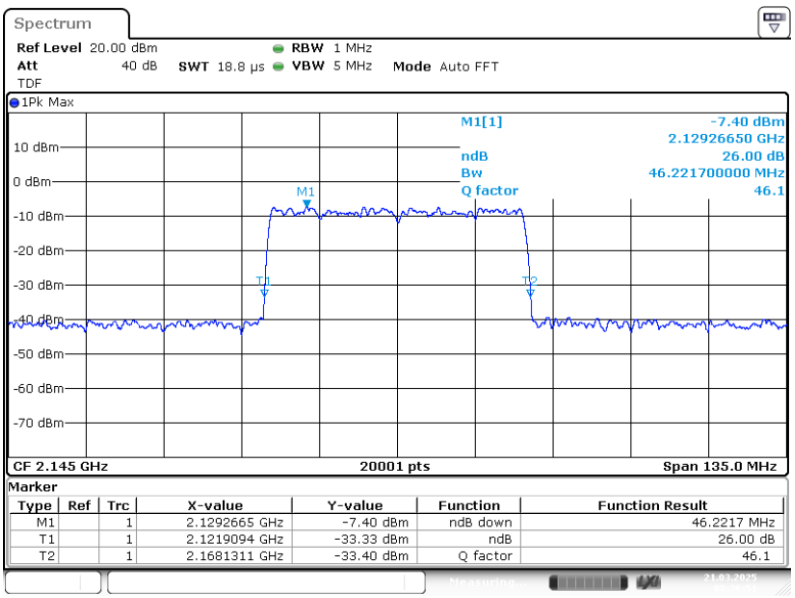
3.4 OCBw GSM In+3 2.1450G _26dB

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: GSM;
Output OCBw 3 dB > AGC



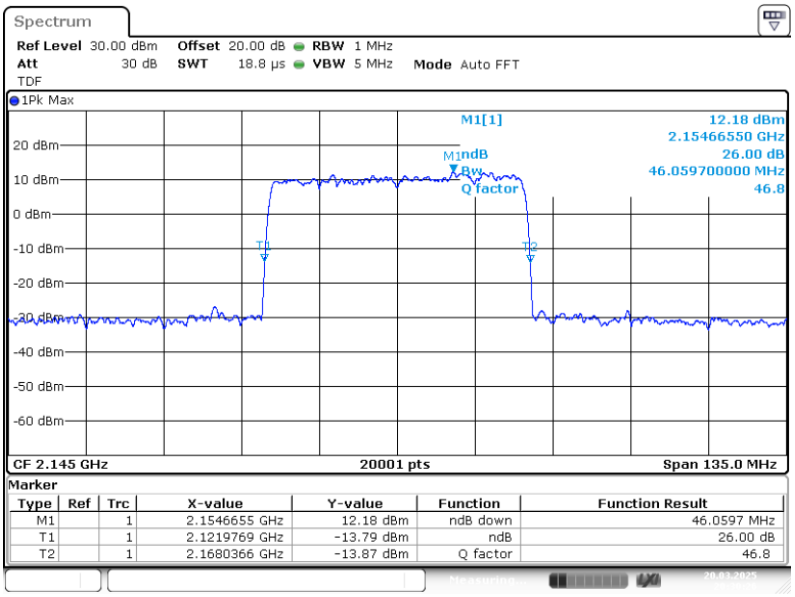
3.4 OCBw GSM Out +3 2.1450G _26dB

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN 45M;
Input OCBw 0.3 dB < AGC



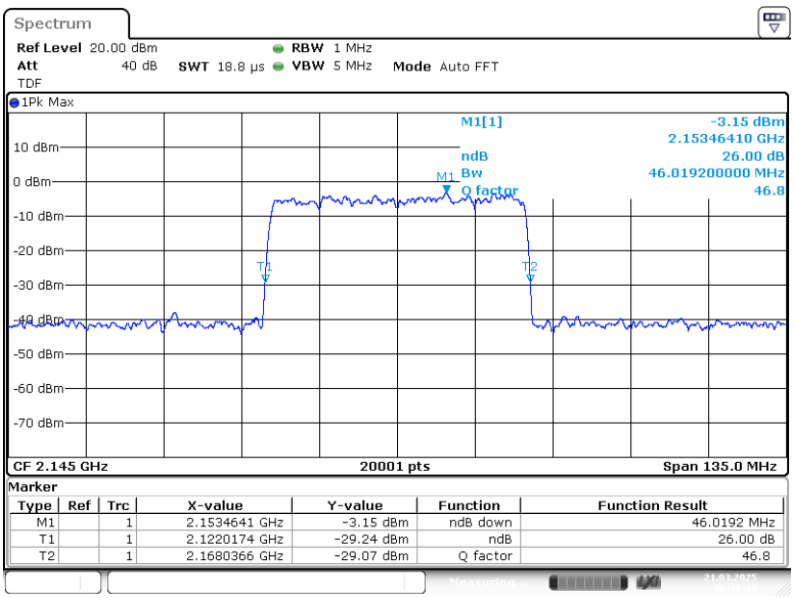
3.4 OCBw AWGN 45M In-0.3 2.1450G _26dB

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN 45M;
Output OCBw 0.3 dB < AGC



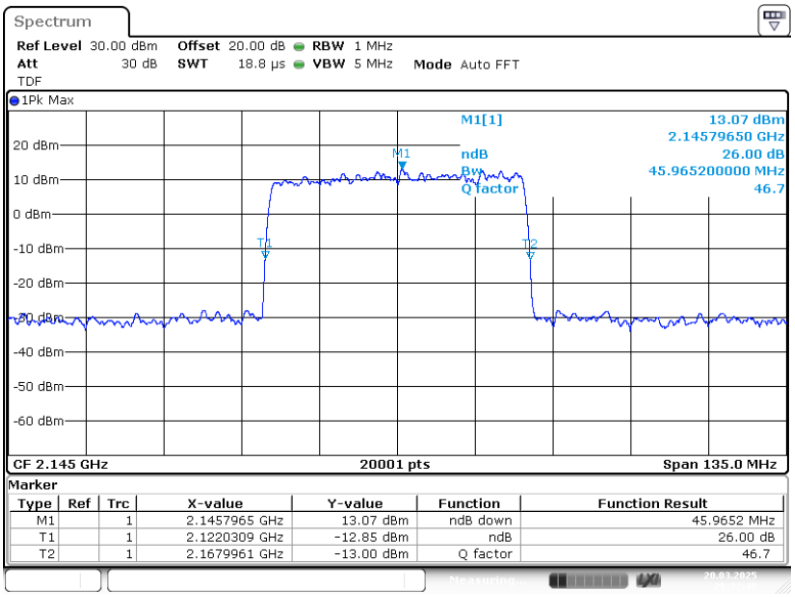
3.4 OCBw AWGN 45M Out -0.3 2.1450G _26dB

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN 45M;
Input OCBw 3 dB > AGC



3.4 OCBw AWGN 45M In+3 2.1450G _26dB

Band: AWS 1700; Frequency: 2.1450 GHz; Band edge: mid; Mod: AWGN 45M;
Output OCBw 3 dB > AGC



3.4 OCBw AWGN 45M Out +3 2.1450G _26dB

5.3.5 TEST EQUIPMENT USED

- Conducted

5.4 CONDUCTED SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Standard FCC Part §2.1051, §27.53

The test was performed according to:
ANSI C63.26

Test date: 2025-03-20 – 2025-03-21

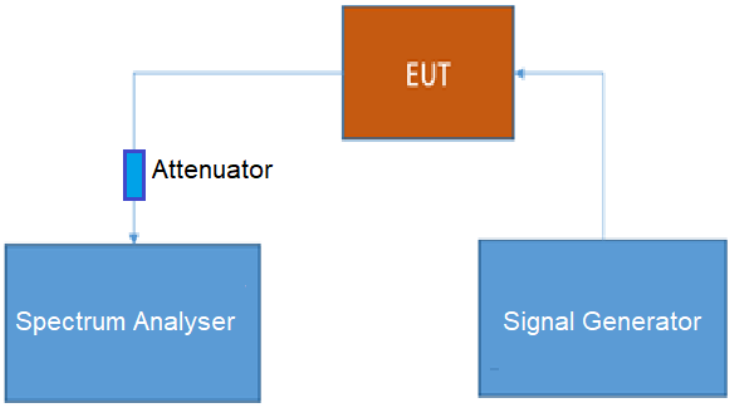
Environmental conditions: 24.7 °C; 23 % r. H./25.7 °C; 25 % r. H.

Test engineer: Thomas Hufnagel

5.4.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the signal booster power and gain limits and requirements for industrial signal boosters.

The EUT was connected to the test setup according to the following diagram:



The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

5.4.2 TEST REQUIREMENTS/LIMITS

Abstract § 2.1051 from FCC:

FCC Part 2.1051; Measurement required: Spurious emissions at antenna terminal:

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§27.53 – Emission limits

Abstract § 27.53 FCC:

(h) AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

Abstract RSS-133 from ISED

5.6 Unwanted emission limits

Unwanted emissions shall be measured in terms of average value.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors) of the unwanted emissions outside the frequency block or frequency block group shall not exceed the limits shown in table 6.

Table 6: Unwanted emission limts

Offset from the edge of the frequency block or frequency block group	**Unwanted emission limits**
≤1 MHz	-13 dBm/(1% of OB*)
>1 MHz	-13 dBm/MHz

*OB is the occupied bandwidth.

In addition to complying with the above limits, equipment operating in the band 2180-2200 MHz may require additional filtering (see SRSP-519).

5.4.3 TEST PROTOCOL

General considerations concerning the limits:

The measuring bandwidth of 1 MHz was chosen according the test requirements exept at the band edges: At the band edges reducing of measurement bandwidth was necessary to prevent overlaying the RF-signal over the spurious emissions.
Also outside the downlink frequency band at lower frequencies the measurement bandwidths were reduced to have the possibility to record the spurious emissions at these lower frequencies.

At frequencies were measuring bandwidths were reduced also the limit lines were reduced according the given formula:

$$p\ RBWreduced\ [dBm] = 10 * \log\left(RBWreduced\ [kHz] \quad / \quad 1000\ kHz\right) + pRBW\ 1000\ kHz[dBm]$$

Hereby "p" are the limit lines' values.

Band 66, AWS 1700, downlink							
Test frequency	**Signal type**	**Spurious freq. [MHz]**	**Spurious level [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to limit [dB]**
low	Wideband	0.01938	-74.0	RMS	1	-43.0	31.0
low	Wideband	0.31746	-63.9	RMS	10	-33.0	30.9
low	Wideband	951.3	-63.0	RMS	100	-23.0	40.0
low	Wideband	1784.4	-55.6	RMS	1000	-13.0	42.6
low	Wideband	2108.6	-55.7	RMS	100	-23.0	32.7
low	Wideband	2184.8	-65.9	RMS	100	-23.0	42.9
low	Wideband	2784.6	-41.1	RMS	1000	-13.0	28.1
low	Wideband	6857.1	-50.8	RMS	1000	-13.0	37.8
low	Wideband	19868.3	-51.1	RMS	1000	-13.0	38.1
low	Wideband	20312.2	-50.5	RMS	1000	-13.0	37.5
low	Wideband	30001.5	-51.4	RMS	1000	-13.0	38.4
low	Wideband	39983.8	-53.0	RMS	1000	-13.0	40.0
mid	Wideband	0.00955	-74.0	RMS	1	-43.0	31.0
mid	Wideband	0.36745	-64.7	RMS	10	-33.0	31.7
mid	Wideband	953.2	-64.2	RMS	100	-23.0	41.2
mid	Wideband	1821.4	-55.5	RMS	1000	-13.0	42.5
mid	Wideband	2106.6	-65.5	RMS	100	-23.0	42.5
mid	Wideband	2182.7	-66.7	RMS	100	-23.0	43.7
mid	Wideband	2784.6	-41.2	RMS	1000	-13.0	28.2
mid	Wideband	6889.1	-50.7	RMS	1000	-13.0	37.7
mid	Wideband	19530.3	-51.1	RMS	1000	-13.0	38.1
mid	Wideband	20303.2	-50.6	RMS	1000	-13.0	37.6
mid	Wideband	30313.0	-51.0	RMS	1000	-13.0	38.0
mid	Wideband	39983.3	-52.8	RMS	1000	-13.0	39.8
high	Wideband	0.00943	-74.0	RMS	1	-43.0	31.0
high	Wideband	0.25247	-65.6	RMS	10	-33.0	32.6
high	Wideband	949.6	-63.0	RMS	100	-23.0	40.0
high	Wideband	1751.4	-56.1	RMS	1000	-13.0	43.1
high	Wideband	2105.6	-66.5	RMS	100	-23.0	43.5
high	Wideband	2181.2	-58.0	RMS	100	-23.0	35.0
high	Wideband	2784.6	-41.0	RMS	1000	-13.0	28.0
high	Wideband	6926.6	-50.8	RMS	1000	-13.0	37.8
high	Wideband	19579.8	-50.8	RMS	1000	-13.0	37.8
high	Wideband	20368.7	-50.0	RMS	1000	-13.0	37.0
high	Wideband	30301.0	-51.7	RMS	1000	-13.0	38.7
high	Wideband	39991.3	-52.8	RMS	1000	-13.0	39.8

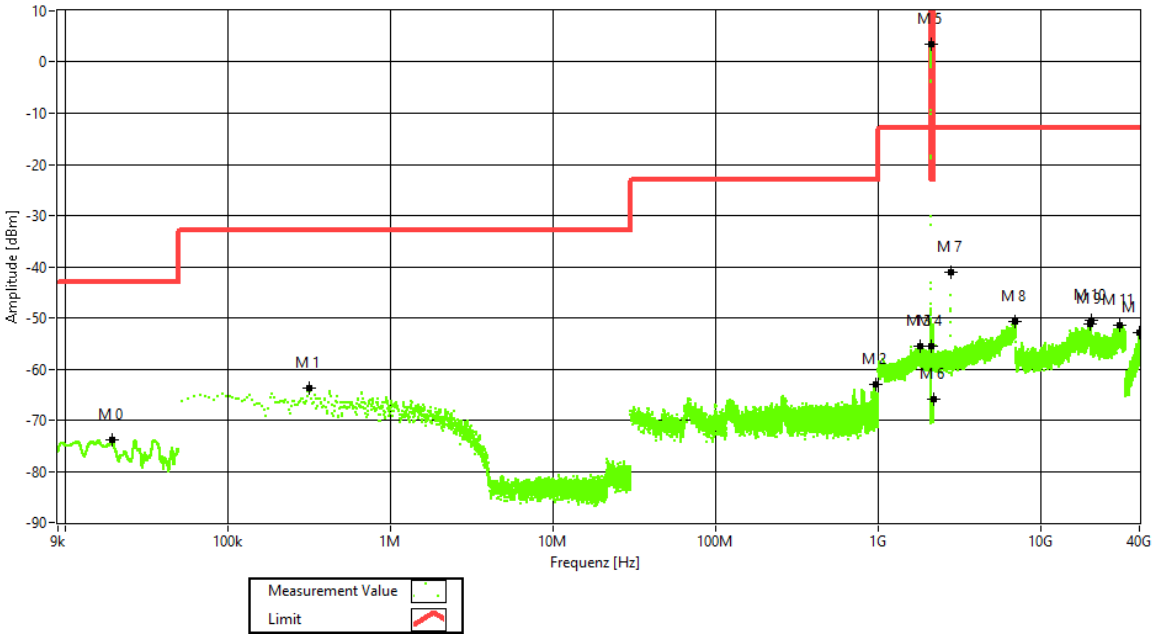
Band 66, AWS 1700, downlink							
Test frequency	**Signal type**	**Spurious freq. [MHz]**	**Spurious level [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to limit [dB]**
low	Narrowband	0.00902	-79.4	RMS	1	-43.0	36.4
low	Narrowband	0.08249	-73.7	RMS	10	-33.0	40.7
low	Narrowband	949.6	-64.1	RMS	100	-23.0	41.1
low	Narrowband	1759.4	-55.6	RMS	1000	-13.0	42.6
low	Narrowband	2108.5	-63.4	RMS	100	-23.0	40.4
low	Narrowband	2185.4	-66.5	RMS	100	-23.0	43.5
low	Narrowband	2784.6	-41.2	RMS	1000	-13.0	28.2
low	Narrowband	6856.6	-50.7	RMS	1000	-13.0	37.7
low	Narrowband	19560.3	-51.5	RMS	1000	-13.0	38.5
low	Narrowband	20301.2	-50.8	RMS	1000	-13.0	37.8
low	Narrowband	30317.0	-51.6	RMS	1000	-13.0	38.6
low	Narrowband	39985.3	-53.0	RMS	1000	-13.0	40.0
mid	Narrowband	0.01246	-79.5	RMS	1	-43.0	36.5
mid	Narrowband	0.06750	-73.7	RMS	10	-33.0	40.7
mid	Narrowband	953.7	-63.7	RMS	100	-23.0	40.7
mid	Narrowband	1600.0	-55.7	RMS	1000	-13.0	42.7
mid	Narrowband	2108.8	-65.5	RMS	100	-23.0	42.5
mid	Narrowband	2186.7	-66.4	RMS	100	-23.0	43.4
mid	Narrowband	2784.6	-41.2	RMS	1000	-13.0	28.2
mid	Narrowband	6927.6	-51.0	RMS	1000	-13.0	38.0
mid	Narrowband	19995.3	-51.2	RMS	1000	-13.0	38.2
mid	Narrowband	20317.2	-50.2	RMS	1000	-13.0	37.2
mid	Narrowband	30130.0	-51.7	RMS	1000	-13.0	38.7
mid	Narrowband	39963.3	-52.6	RMS	1000	-13.0	39.6
high	Narrowband	0.00902	-79.5	RMS	1	-43.0	36.5
high	Narrowband	0.07250	-73.7	RMS	10	-33.0	40.7
high	Narrowband	949.1	-63.7	RMS	100	-23.0	40.7
high	Narrowband	2040.8	-54.7	RMS	1000	-13.0	41.7
high	Narrowband	2108.5	-66.0	RMS	100	-23.0	43.0
high	Narrowband	2181.0	-61.0	RMS	100	-23.0	38.0
high	Narrowband	2784.6	-41.2	RMS	1000	-13.0	28.2
high	Narrowband	6877.1	-50.5	RMS	1000	-13.0	37.5
high	Narrowband	19206.8	-51.3	RMS	1000	-13.0	38.3
high	Narrowband	20310.2	-51.0	RMS	1000	-13.0	38.0
high	Narrowband	30305.5	-51.5	RMS	1000	-13.0	38.5
high	Narrowband	39988.8	-52.8	RMS	1000	-13.0	39.8

Band 66, AWS 1700, downlink							
Test frequency	**Signal type**	**Spurious freq. [MHz]**	**Spurious level [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to limit [dB]**
low	Wideband 5G	0.01537	-79.7	RMS	1	-43.0	36.7
low	Wideband 5G	0.13749	-72.7	RMS	10	-33.0	39.7
low	Wideband 5G	950.0	-63.8	RMS	100	-23.0	40.8
low	Wideband 5G	2099.3	-52.6	RMS	1000	-13.0	39.6
low	Wideband 5G	2105.3	-60.0	RMS	100	-23.0	37.0
low	Wideband 5G	2182.2	-64.6	RMS	100	-23.0	41.6
low	Wideband 5G	2784.6	-41.0	RMS	1000	-13.0	28.0
low	Wideband 5G	6821.6	-50.8	RMS	1000	-13.0	37.8
low	Wideband 5G	19897.8	-51.5	RMS	1000	-13.0	38.5
low	Wideband 5G	20323.2	-50.6	RMS	1000	-13.0	37.6
low	Wideband 5G	30306.0	-51.6	RMS	1000	-13.0	38.6
low	Wideband 5G	39969.3	-53.2	RMS	1000	-13.0	40.2
mid	Wideband 5G	0.00902	-78.5	RMS	1	-43.0	35.5
mid	Wideband 5G	0.05250	-71.5	RMS	10	-33.0	38.5
mid	Wideband 5G	953.5	-64.0	RMS	100	-23.0	41.0
mid	Wideband 5G	2098.8	-55.7	RMS	1000	-13.0	42.7
mid	Wideband 5G	2105.4	-60.0	RMS	100	-23.0	37.0
mid	Wideband 5G	2183.2	-65.5	RMS	100	-23.0	42.5
mid	Wideband 5G	2784.6	-41.0	RMS	1000	-13.0	28.0
mid	Wideband 5G	6909.1	-50.7	RMS	1000	-13.0	37.7
mid	Wideband 5G	19569.8	-51.3	RMS	1000	-13.0	38.3
mid	Wideband 5G	20289.7	-50.7	RMS	1000	-13.0	37.7
mid	Wideband 5G	29999.5	-51.3	RMS	1000	-13.0	38.3
mid	Wideband 5G	39985.8	-52.4	RMS	1000	-13.0	39.4
high	Wideband 5G	0.00902	-79.2	RMS	1	-43.0	36.2
high	Wideband 5G	0.05250	-72.4	RMS	10	-33.0	39.4
high	Wideband 5G	953.6	-63.3	RMS	100	-23.0	40.3
high	Wideband 5G	1600.5	-55.7	RMS	1000	-13.0	42.7
high	Wideband 5G	2108.1	-63.9	RMS	100	-23.0	40.9
high	Wideband 5G	2181.1	-63.0	RMS	100	-23.0	40.0
high	Wideband 5G	2784.6	-40.9	RMS	1000	-13.0	27.9
high	Wideband 5G	6938.1	-50.9	RMS	1000	-13.0	37.9
high	Wideband 5G	19560.8	-51.1	RMS	1000	-13.0	38.1
high	Wideband 5G	20336.2	-50.8	RMS	1000	-13.0	37.8
high	Wideband 5G	30011.5	-51.4	RMS	1000	-13.0	38.4
high	Wideband 5G	39986.7	-52.4	RMS	1000	-13.0	39.4

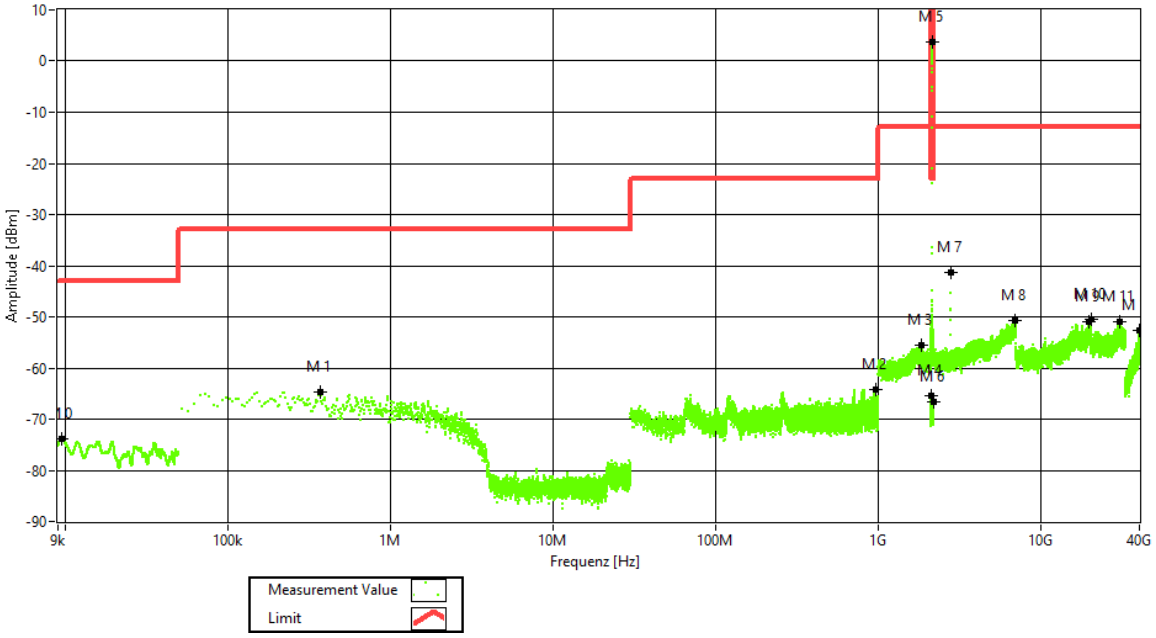
Remark: Please see next sub-clause for the measurement plot.

5.4.4 MEASUREMENT PLOT

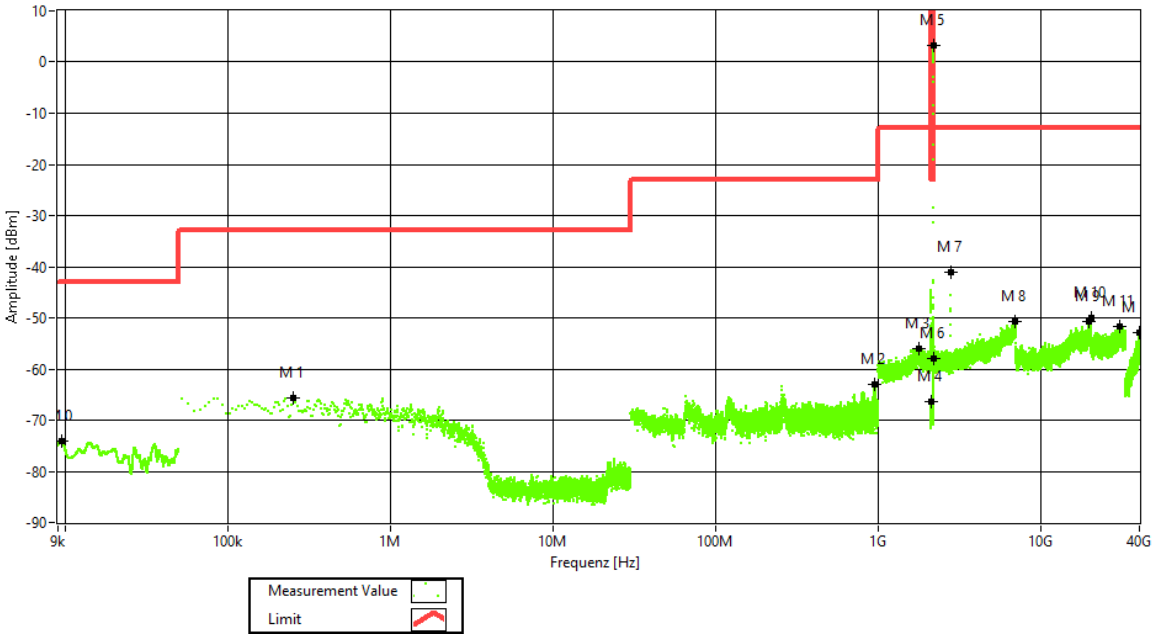
Frequency Band = AWS 1700; Test frequency = low; Direction = RF downlink;
Signal type = Wideband



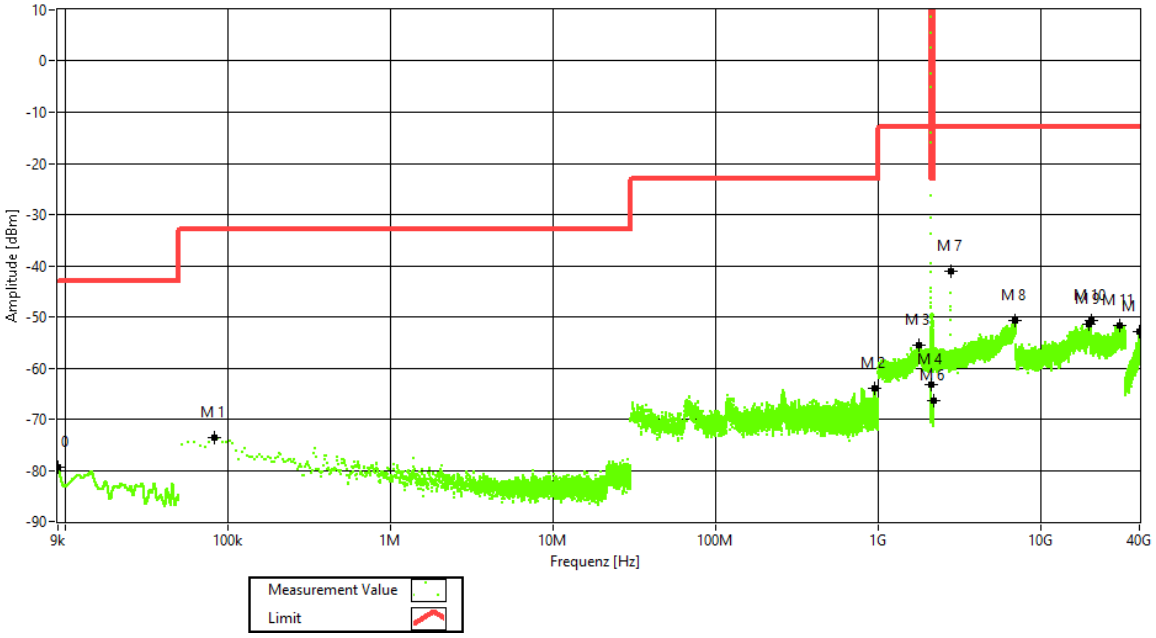
Frequency Band = AWS 1700; Test frequency = mid; Direction = RF downlink;
Signal type = Wideband



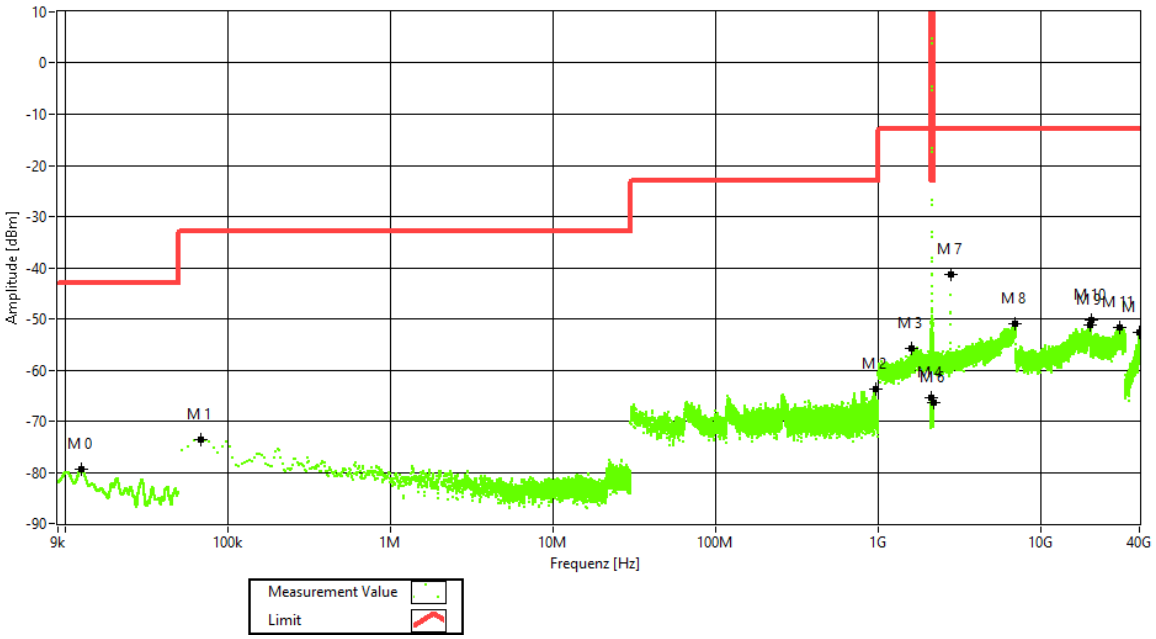
Frequency Band = AWS 1700; Test frequency = high; Direction = RF downlink;
Signal type = Wideband



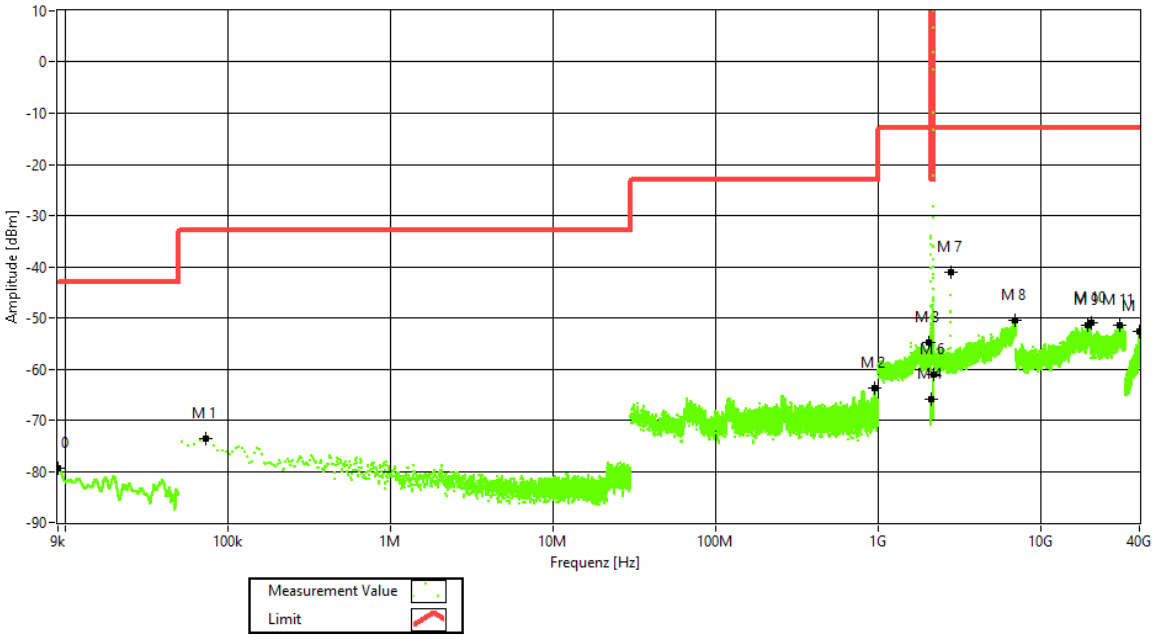
Frequency Band = AWS 1700; Test frequency = low; Direction = RF downlink;
Signal type = Narrowband



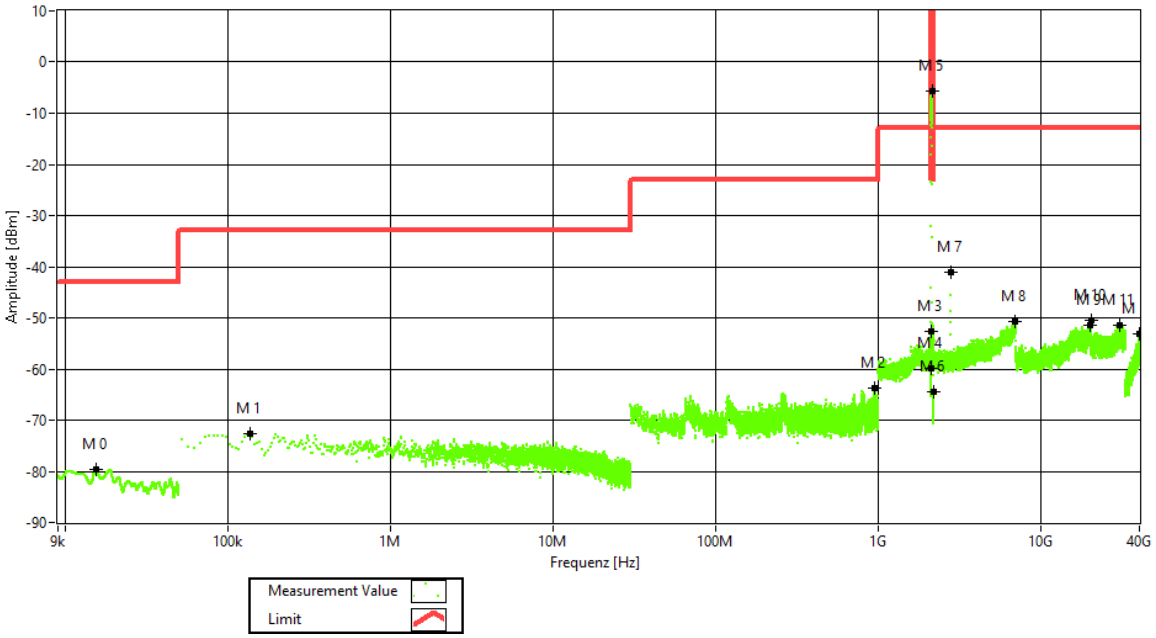
Frequency Band = AWS 1700; Test frequency = mid; Direction = RF downlink;
Signal type = Narrowband



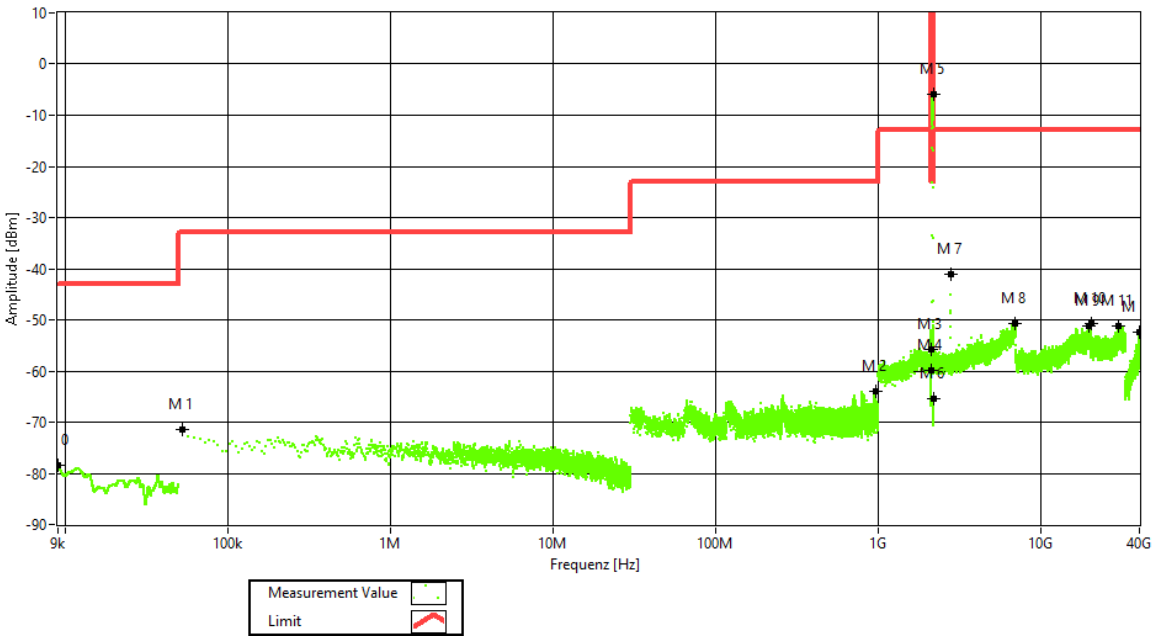
Frequency Band = AWS 1700; Test frequency = high; Direction = RF downlink;
Signal type = Narrowband



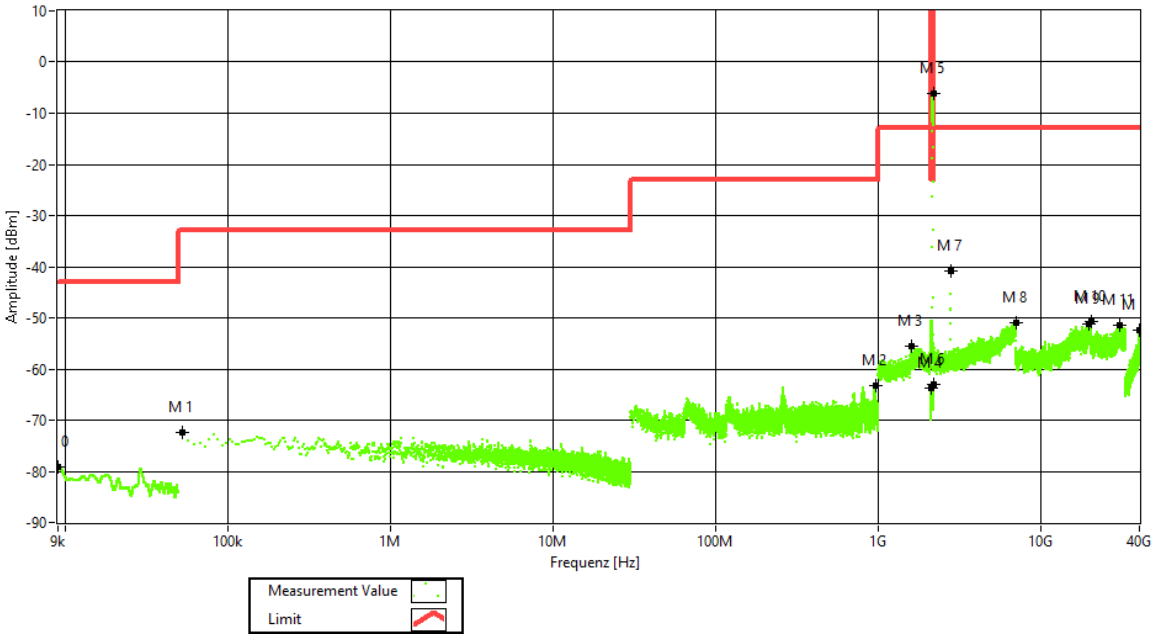
Frequency Band = AWS 1700; Test frequency = low; Direction = RF downlink;
Signal type = Wideband 5G



Frequency Band = AWS 1700; Test frequency = mid; Direction = RF downlink;
Signal type = Wideband 5G



Frequency Band = AWS 1700; Test frequency = high; Direction = RF downlink;
Signal type = Wideband 5G



5.4.5 TEST EQUIPMENT USED

- Conducted

5.5 OUT-OF-BAND EMISSION LIMITS

Standard FCC Part §2.1051, §27.53

The test was performed according to:
ANSI C63.26, KDB 935210 D05 v01r04: 3.6

Test date: 2025-03-20 – 2025-03-21

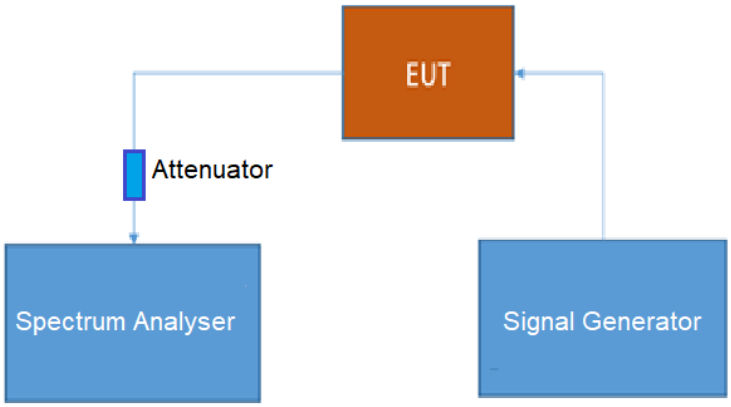
Environmental conditions: 24.7 °C; 23 % r. H./25.7 °C; 25 % r. H.

Test engineer: Thomas Hufnagel

5.5.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the out-of-band emission limit for industrial signal boosters. The limits itself come from the applicable rule part for each operating band.

The EUT was connected to the test setup according to the following diagram:



The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

5.5.2 TEST REQUIREMENTS/LIMITS

Abstract § 2.1051 from FCC:

FCC Part 2.1051; Measurement required: Spurious emissions at antenna terminal:

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§27.53 – Emission limits

Abstract § 27.53 FCC:

(h) AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

Abstract RSS-133 from ISED

5.6 Unwanted emission limits

Unwanted emissions shall be measured in terms of average value.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors) of the unwanted emissions outside the frequency block or frequency block group shall not exceed the limits shown in table 6.

Table 6: Unwanted emission limts

Offset from the edge of the frequency block or frequency block group	**Unwanted emission limits**
≤1 MHz	-13 dBm/(1% of OB*)
>1 MHz	-13 dBm/MHz

*OB is the occupied bandwidth.

In addition to complying with the above limits, equipment operating in the band 2180-2200 MHz may require additional filtering (see SRSP-519).

5.5.3 TEST PROTOCOL

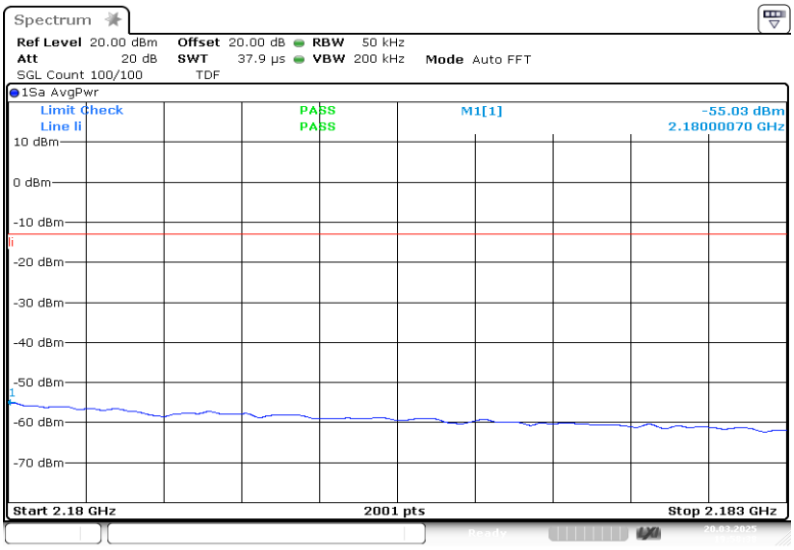
Band 66 AWS 1700, downlink, Number of input signals = 1							
Signal type	**Input power**	**Band edge**	**Signal frequency [MHz]**	**Input power [dBm]**	**Maximum out-of-band power [dBm]**	**Limit out-of-band power [dBm]**	**Margin to limit [dB]**
Wideband	0.3 dB < AGC	upper	2177.50	-0.5	-55.0	-13.0	42.0
Wideband	3 dB > AGC	upper	2177.50	2.8	-53.6	-13.0	40.6
Wideband 5G	0.3 dB < AGC	upper	2157.50	-0.8	-53.7	-13.0	40.7
Wideband 5G	3 dB > AGC	upper	2157.50	2.2	-53.1	-13.0	40.1
Narrowband	0.3 dB < AGC	upper	2179.80	-0.3	-42.3	-13.0	29.3
Narrowband	3 dB > AGC	upper	2179.80	3.0	-42.6	-13.0	29.6
Wideband	0.3 dB < AGC	lower	2112.50	0.1	-52.8	-13.0	39.8
Wideband	3 dB > AGC	lower	2112.50	3.4	-53.5	-13.0	40.5
Wideband 5G	0.3 dB < AGC	lower	2132.50	-0.2	-51.9	-13.0	38.9
Wideband 5G	3 dB > AGC	lower	2132.50	2.8	-52.6	-13.0	39.6
Narrowband	0.3 dB < AGC	lower	2110.20	-0.3	-40.7	-13.0	27.7
Narrowband	3 dB > AGC	lower	2110.20	3.0	-40.3	-13.0	27.3

Band 66 AWS 1700, downlink, Number of input signals = 2								
Signal type	**Input power**	**Band edge**	**Signal frequency f1 [MHz]**	**Signal frequency f2 [MHz]**	**Input power [dBm]**	**Maximum out-of-band power [dBm]**	**Limit out-of-band power [dBm]**	**Margin to limit [dB]**
Wideband	0.3 dB < AGC	upper	2177.5	2175.0	-0.7	-56.5	-13.0	43.5
Wideband	3 dB > AGC	upper	2177.5	2175.0	2.6	-57.6	-13.0	44.6
Narrowband	0.3 dB < AGC	upper	2179.8	2179.6	-0.3	-44.9	-13.0	31.9
Narrowband	3 dB > AGC	upper	2179.8	2179.6	3.0	-44.1	-13.0	31.1
Wideband	0.3 dB < AGC	lower	2112.5	2115.0	0.1	-55.9	-13.0	42.9
Wideband	3 dB > AGC	lower	2112.5	2115.0	3.4	-56.3	-13.0	43.3
Narrowband	0.3 dB < AGC	lower	2110.2	2110.4	-0.1	-44.0	-13.0	31.0
Narrowband	3 dB > AGC	lower	2110.2	2110.4	3.2	-43.8	-13.0	30.8

Remark: Please see next sub-clause for the measurement plot.

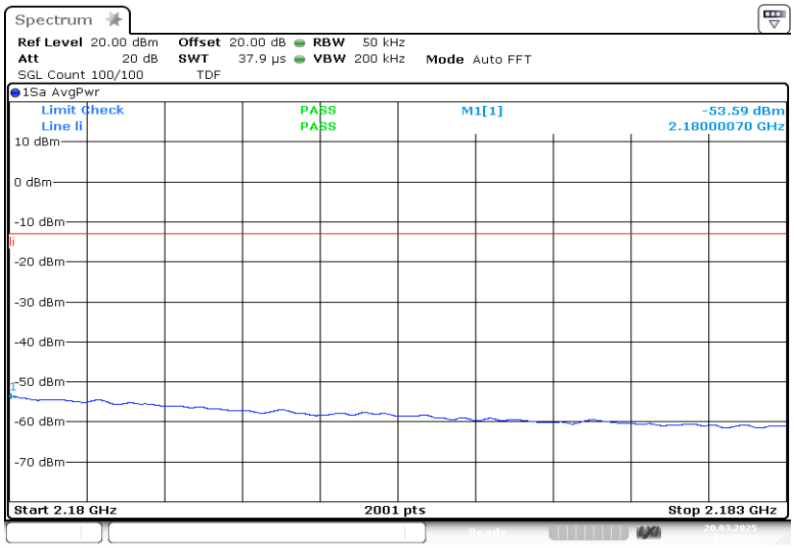
5.5.4 MEASUREMENT PLOT

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: upper; Mod: AWGN; Input power = 0.3 dB < AGC; Number of signals 1



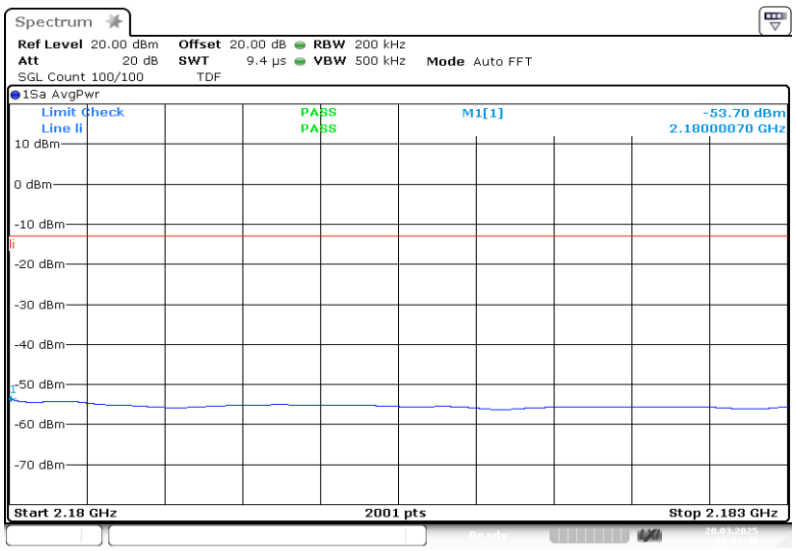
3.6.2 out of band emi AWS 1700 AWGN upper 1carrier -0.3 dB 2
.180G 2.183G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: upper; Mod: AWGN; Input power = 3 dB > AGC; Number of signals 1



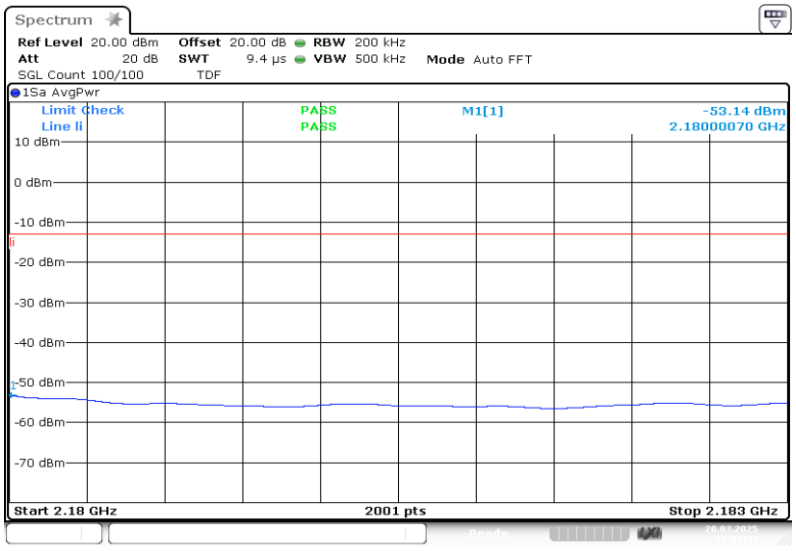
3.6.2 out of band emi AWS 1700 AWGN upper 1carrier +3.0 dB 2
.180G 2.183G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: upper;
Mod: AWGN 45M; Input power = 0.3 dB < AGC; Number of signals 1



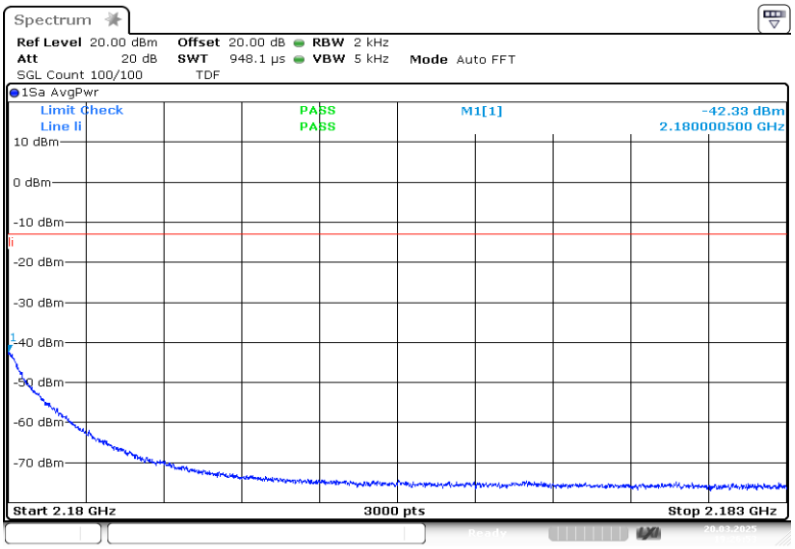
3.6.2 out of band emi AWS 1700 AWGN 45M upper 1carrier -0.3 dB 2.180G 2.183G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: upper;
Mod: AWGN 45M; Input power = 3 dB > AGC; Number of signals 1



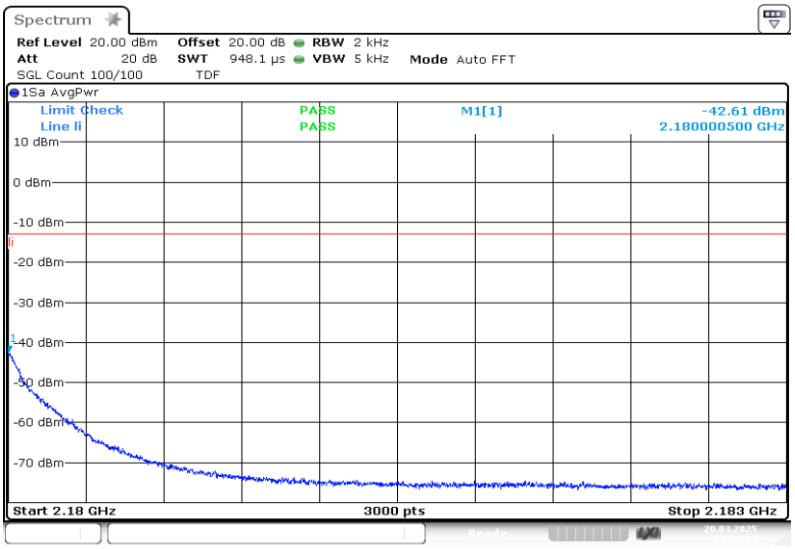
3.6.2 out of band emi AWS 1700 AWGN 45M upper 1carrier +3.0 dB 2.180G 2.183G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: upper; Mod: GSM; Input power = 0.3 dB < AGC; Number of signals 1



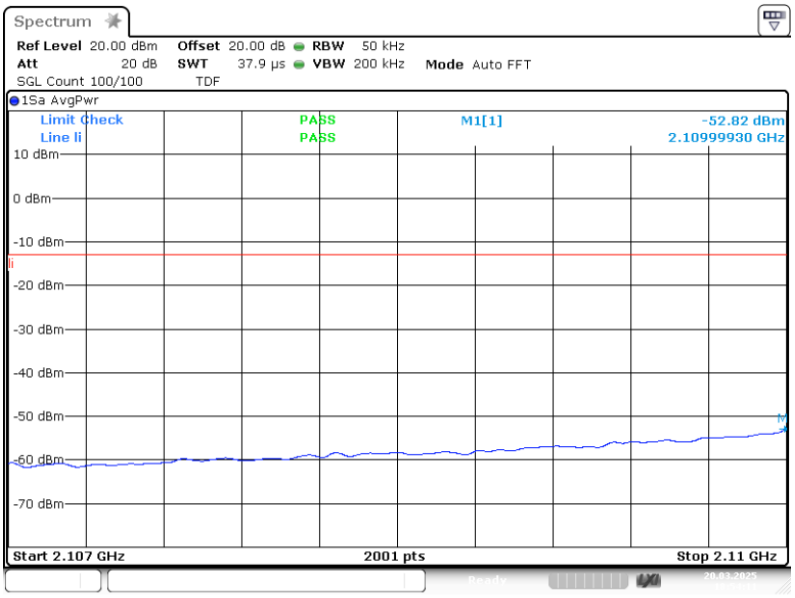
3.6.2 out of band emi AWS 1700 GSM upper lcarrier -0.3 dB 2.
180G 2.183G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: upper; Mod: GSM; Input power = 3 dB > AGC; Number of signals 1



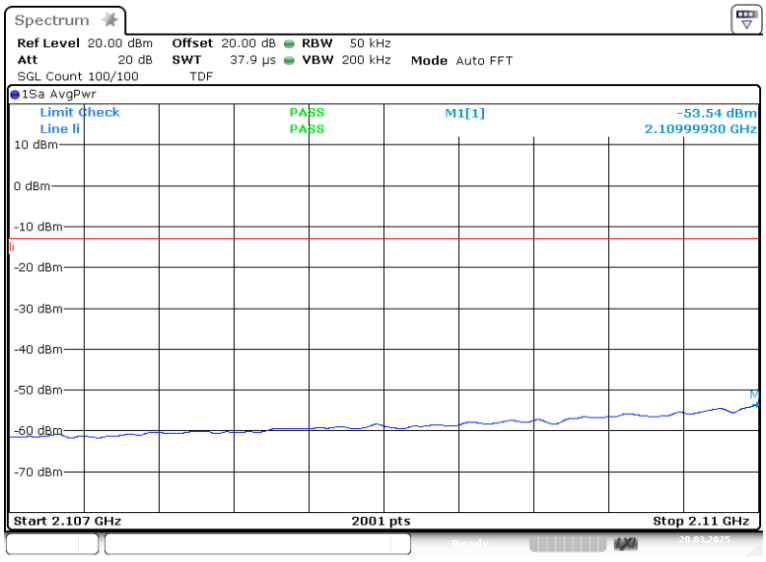
3.6.2 out of band emi AWS 1700 GSM upper lcarrier +3.0 dB 2.
180G 2.183G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: lower; Mod: AWGN; Input power = 0.3 dB < AGC; Number of signals 1



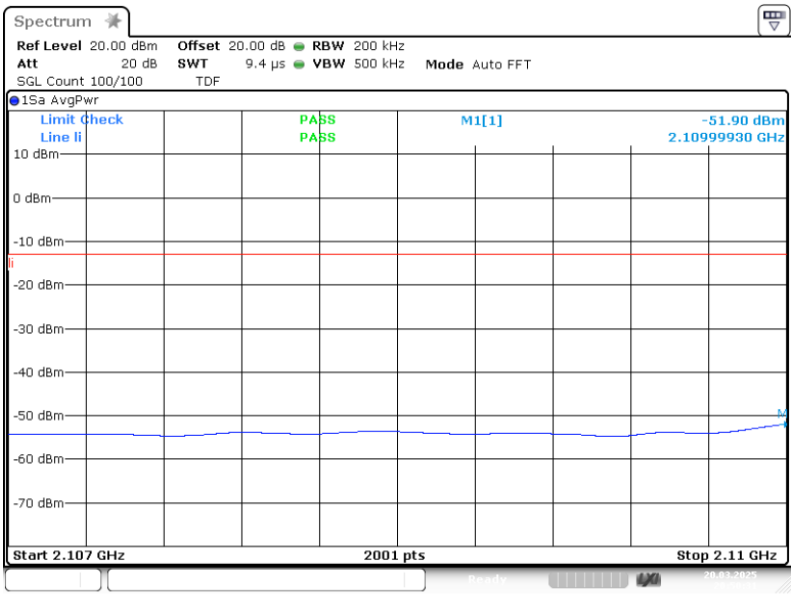
3.6.2 out of band emi AWS 1700 AWGN lower 1carrier -0.3 dB 2
.107G 2.110G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: lower; Mod: AWGN; Input power = 3 dB > AGC; Number of signals 1



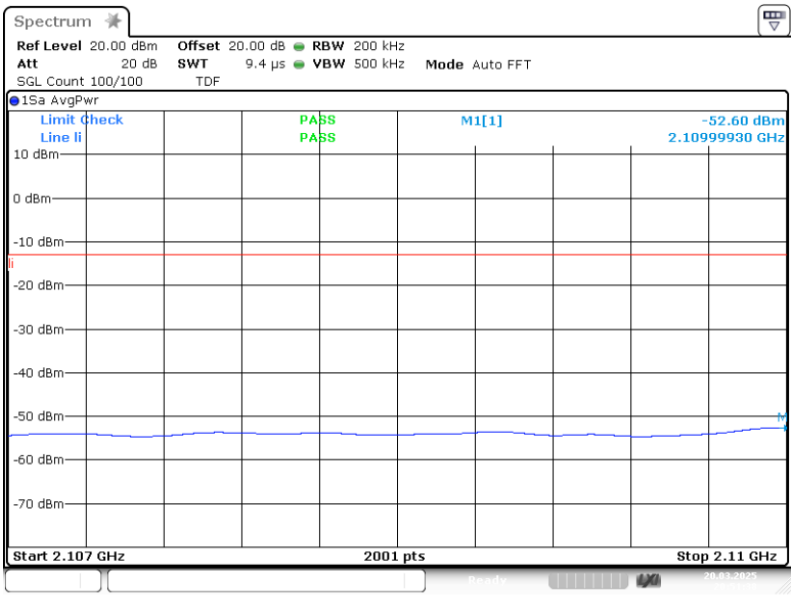
3.6.2 out of band emi AWS 1700 AWGN lower 1carrier +3.0 dB 2
.107G 2.110G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: lower; Mod: AWGN 45M; Input power = 0.3 dB < AGC; Number of signals 1



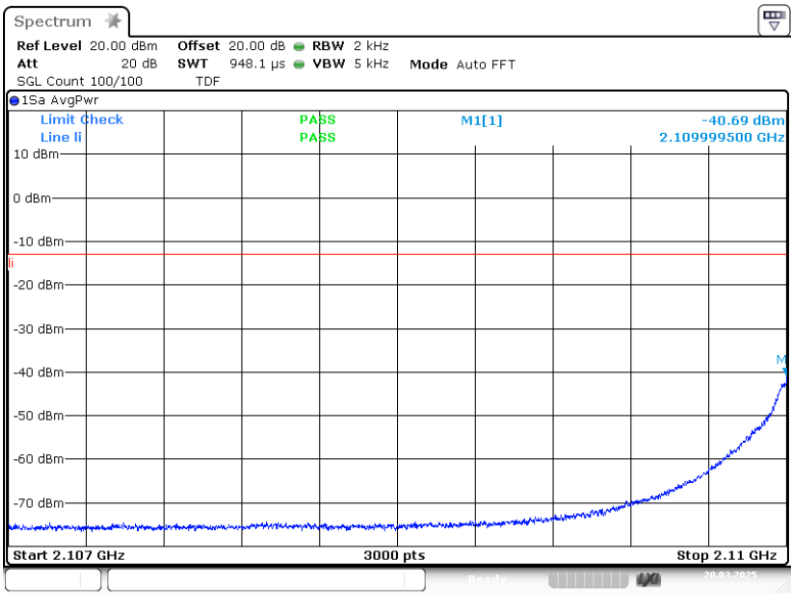
3.6.2 out of band emi AWS 1700 AWGN 45M lower 1carrier -0.3 dB 2.107G 2.110G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: lower; Mod: AWGN 45M; Input power = 3 dB > AGC; Number of signals 1



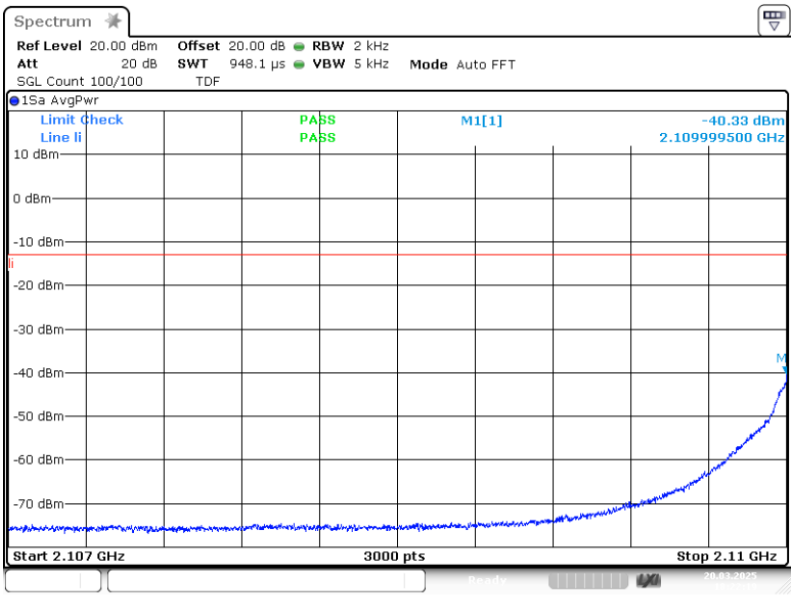
3.6.2 out of band emi AWS 1700 AWGN 45M lower 1carrier +3.0 dB 2.107G 2.110G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: lower; Mod: GSM; Input power = 0.3 dB < AGC; Number of signals 1



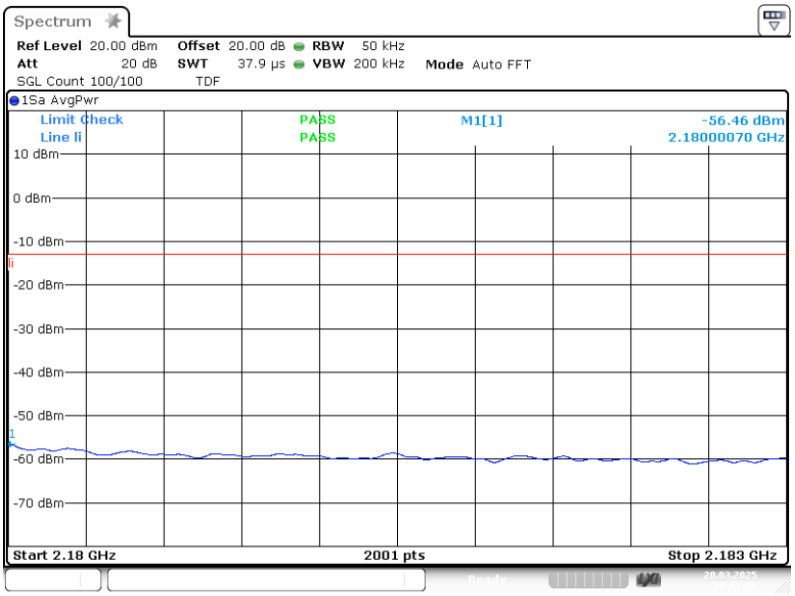
3.6.2 out of band emi AWS 1700 GSM lower 1carrier -0.3 dB 2.
107G 2.110G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: lower; Mod: GSM; Input power = 3 dB > AGC; Number of signals 1



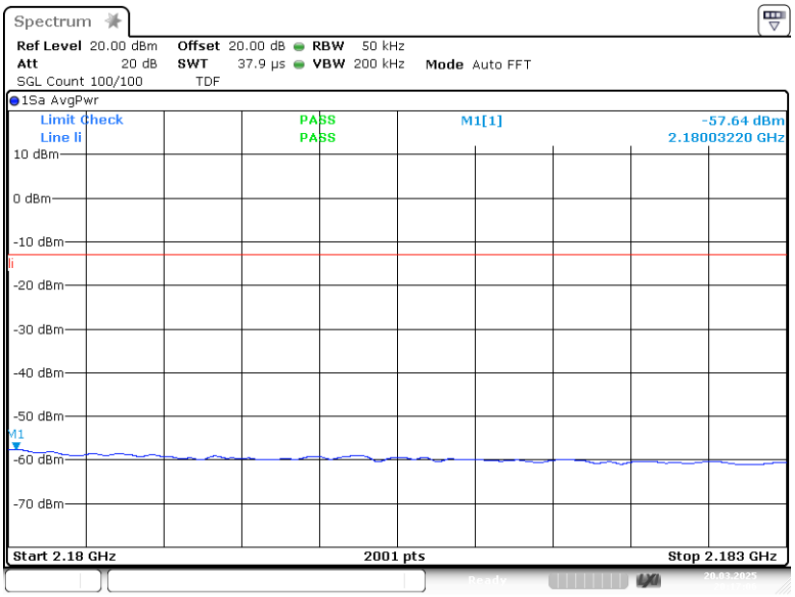
3.6.2 out of band emi AWS 1700 GSM lower 1carrier +3.0 dB 2.
107G 2.110G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: upper; Mod: AWGN; Input power = 0.3 dB < AGC; Number of signals 2



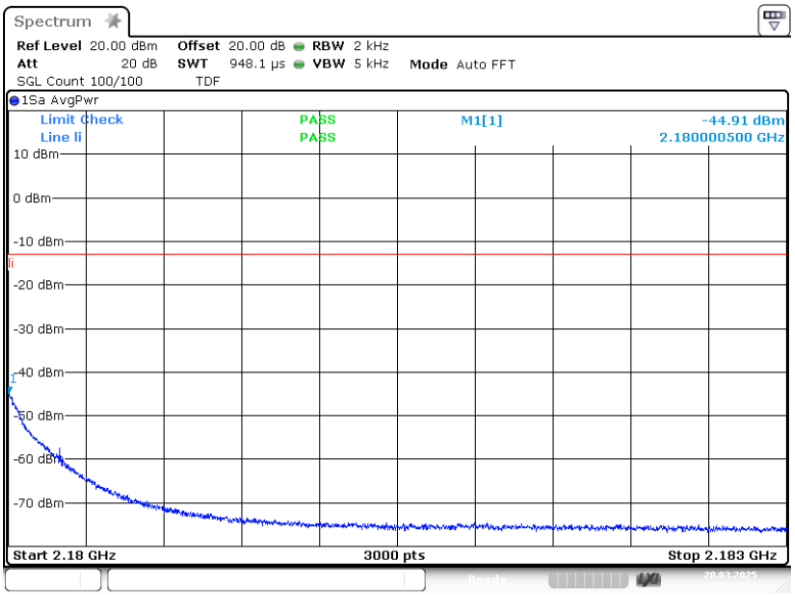
3.6.2 out of band emi AWS 1700 AWGN upper 2carriers -0.3 dB
2.180G 2.183G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: upper; Mod: AWGN; Input power = 3 dB > AGC; Number of signals 2



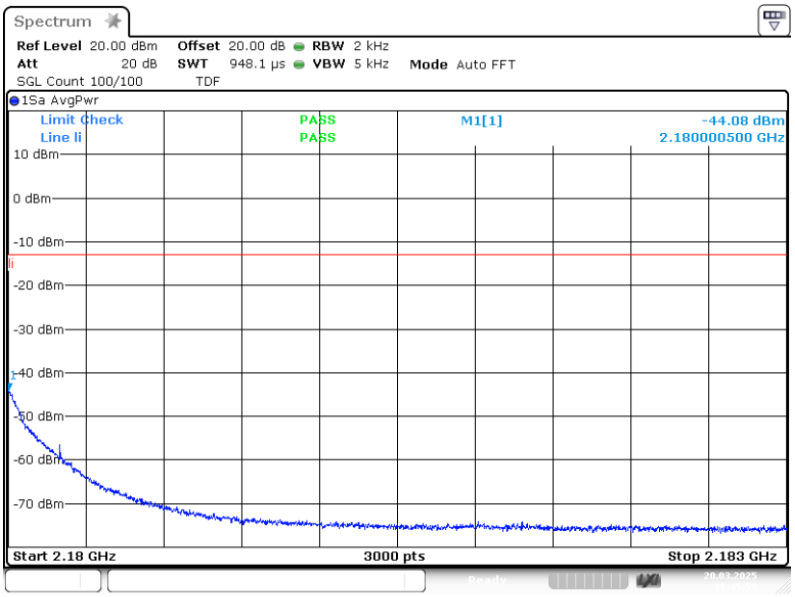
3.6.2 out of band emi AWS 1700 AWGN upper 2carriers +3.0 dB
2.180G 2.183G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: upper; Mod: GSM; Input power = 0.3 dB < AGC; Number of signals 2



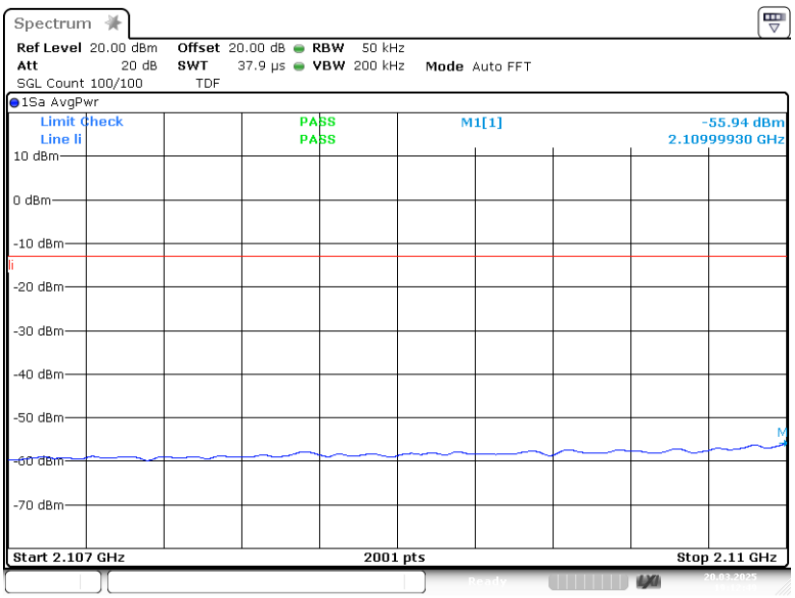
3.6.2 out of band emi AWS 1700 GSM upper 2carriers -0.3 dB 2
.180G 2.183G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: upper; Mod: GSM; Input power = 3 dB > AGC; Number of signals 2



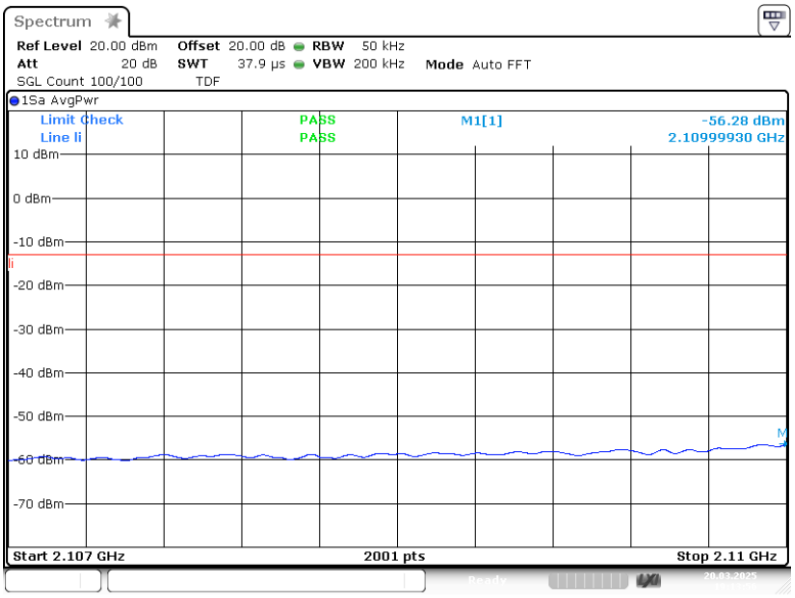
3.6.2 out of band emi AWS 1700 GSM upper 2carriers +3.0 dB 2
.180G 2.183G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: lower; Mod: AWGN; Input power = 0.3 dB < AGC; Number of signals 2



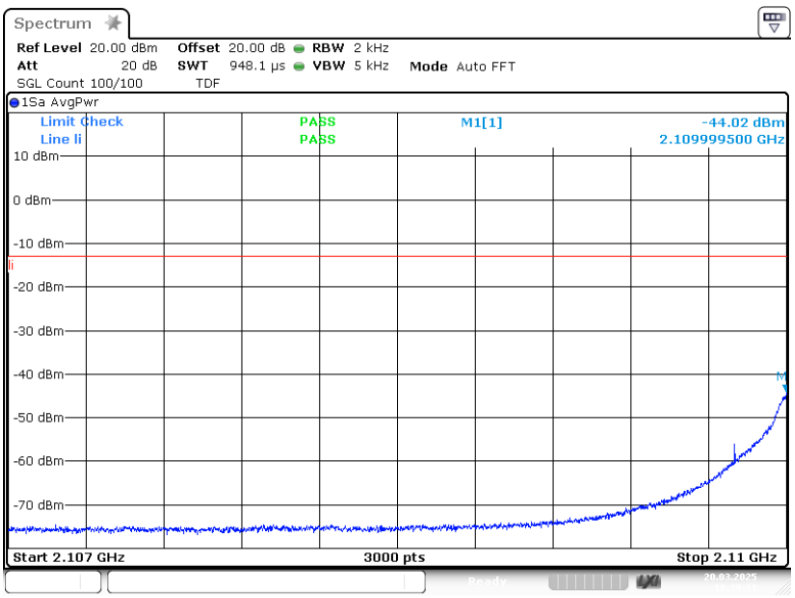
3.6.2 out of band emi AWS 1700 AWGN lower 2carriers -0.3 dB
2.107G 2.110G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: lower; Mod: AWGN; Input power = 3 dB > AGC; Number of signals 2



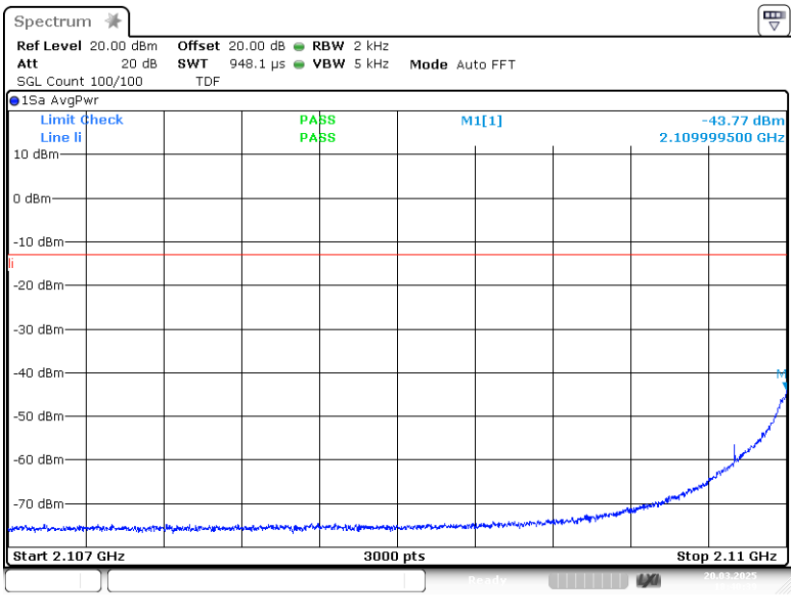
3.6.2 out of band emi AWS 1700 AWGN lower 2carriers +3.0 dB
2.107G 2.110G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: lower; Mod: GSM; Input power = 0.3 dB < AGC; Number of signals 2



3.6.2 out of band emi AWS 1700 GSM lower 2carriers -0.3 dB 2
.107G 2.110G

Band: AWS 1700; Frequency: 2.1100 GHz to 2.1800 GHz; Band edge: lower; Mod: GSM; Input power = 3 dB > AGC; Number of signals 2



3.6.2 out of band emi AWS 1700 GSM lower 2carriers +3.0 dB 2
.107G 2.110G

5.5.5 TEST EQUIPMENT USED

- Conducted

5.6 OUT-OF-BAND REJECTION

Standard FCC Part 27

The test was performed according to:
ANSI C63.26

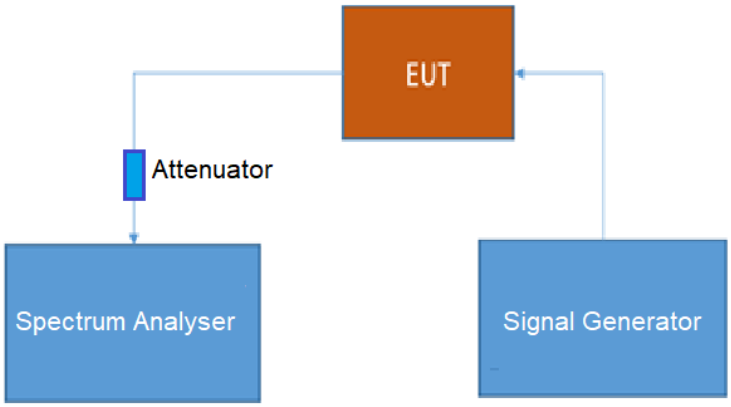
Test date: 2025-03-20

Environmental conditions: 24.7 °C; 23 % r. H.

Test engineer: Thomas Hufnagel

5.6.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the out-of-band rejection test case for industrial signal boosters.
The EUT was connected to the test setup according to the following diagram:



The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

5.6.2 TEST REQUIREMENTS/LIMITS

TEST REQUIREMENTS/LIMITS

Abstract RSS-131 from ISED:

9.1 Out-of-band rejection

The gain-versus-frequency response and the 20 dB passband bandwidth of the zone enhancer shall be reported. The zone enhancer shall reject amplification of other signals outside the passband of the zone enhancer.

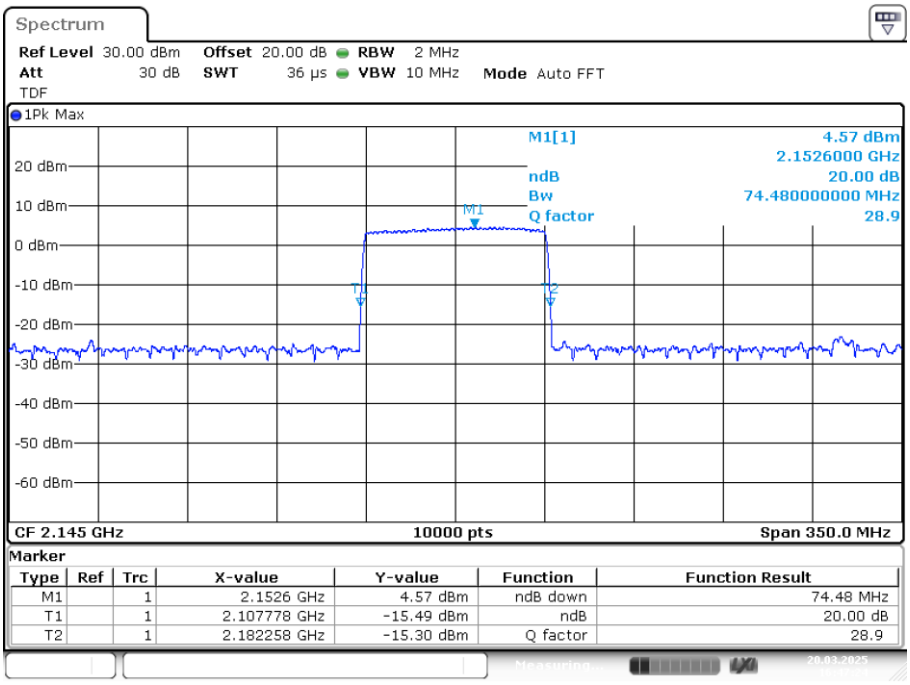
5.6.3 TEST PROTOCOL

Band 66 AWS 1700, downlink				
Highest power frequency [MHz]	**Output power [dBm]**	**Lower highest power -20 dB frequency [MHz]**	**Upper highest power -20 dB frequency [MHz]**	**20 dB bandwidth [MHz]**
2152.60	4.57	2107.778	2182.258	74.480

Remark: Please see next sub-clause for the measurement plot.

5.6.4 MEASUREMENT PLOT

Frequency Band = AWS 1700, Direction = RF downlink



3.3 Out of band rejection AWS 1700 2.14500G
_20dB

5.6.5 TEST EQUIPMENT USED

- Conducted

5.7 FREQUENCY STABILITY

The frequency stability test case was not carried out, as any frequency errors are eliminated by the given system architecture. This is achieved by generating the LOs in the head-end station and the LOs in the remote unit with a common reference clock. This reference clock is transmitted from the head-end station to the remote unit and regenerated there. This means that the same reference frequency is used for all signal conversions (up- and down-conversion as well as analog-to-digital and digital-to-analog conversion) and any frequency error in the reference clock is compensated therefore. This is already clear from the measurement markings for the occupied bandwidth (26dB bandwidth). It can be seen that the DUT has no influence on the frequency (comparison between input and output signal). In addition, it is operationally necessary for the frequency deviation to be significantly smaller than the spectral distance between the transmission bandwidth edge and the channel bandwidth edge in order to meet the signal quality requirement (signal purity) and such ensure that the fundamental emissions remain within the authorized bands of operation.

5.8 FIELD STRENGTH OF SPURIOUS RADIATION

Standard FCC Part 27, §24.53

The test was performed according to:
ANSI C63.26

Test date: 2025-03-30

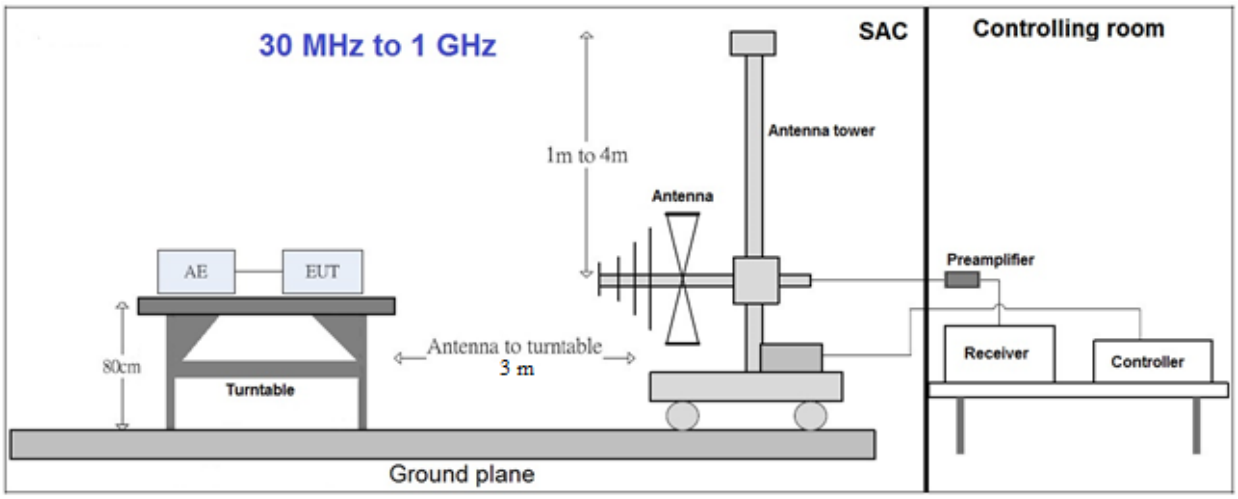
Environmental conditions: 23.5 °C; 28 % r. H.

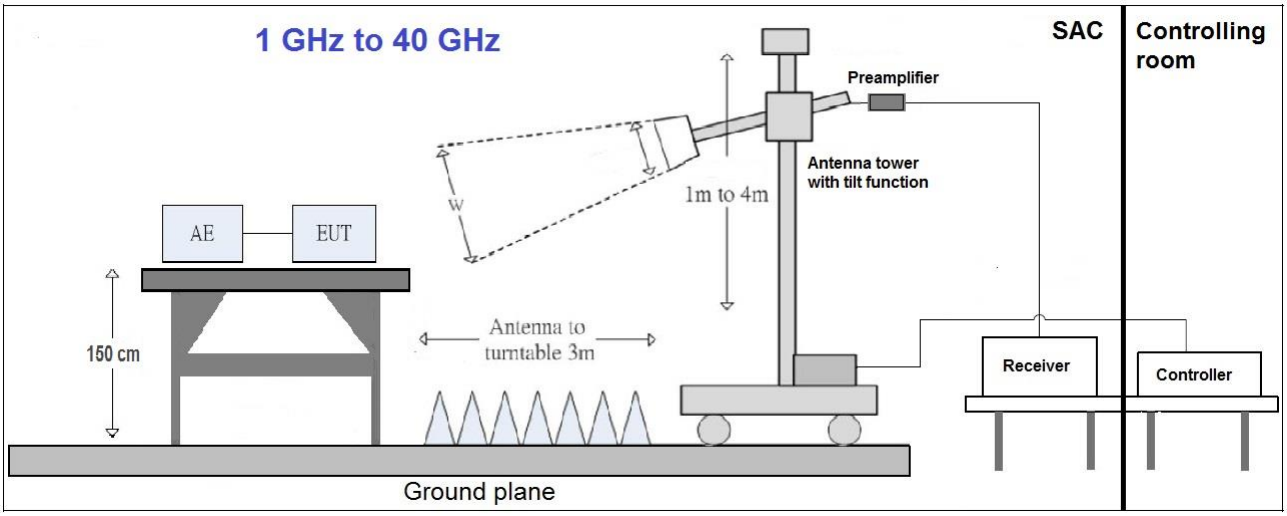
Test engineer: Thomas Hufnagel

5.8.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable radiated spurious emission measurements per § 2.1053

The EUT was connected to the test setup according to the following diagram:





The test set-up was made in accordance to the general provisions of ANSI C63.4 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.5 x 1.5 m² in the semi-anechoic chamber. 0.8 meters above the ground or floor-standing arrangement shall be placed on the horizontal ground reference plane. The influence of the EUT support table that is used between 30–1000 MHz was evaluated. For the initial measurements. the receiving antenna is varied from 1-4 meters height and is changed in the vertical plane from vertical to horizontal polarization at each frequency. The highest emissions between 30 MHz to 1000 MHz were analyzed in details by operating the spectrum analyzer and/or EMI receiver in quasi-peak mode to determine the precise amplitude of the emissions.

The measurement procedure is implemented into the EMI test software BAT EMC from NEXIO. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes. A pre-check is performed while the EUT is powered by a DC power source.

1. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- Detector: PEAK
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF–Bandwidth: 100 kHz
- Turntable angle range: –180° to 180°
- Turntable step size: 15°
- Height variation range: 1 – 4 m
- Height variation step size: 1 m
- Polarisation: Horizontal + Vertical

Intention of this step is. to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: Adjustment measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency. which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ±15° around this value. During this action. the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position. the antenna height will also slowly vary by ± 100 cm around the antenna height determined. During this action. the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.
- Detector: PEAK
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 100 kHz
- Turntable angle range: ±15 ° around the determined value
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement with RMS detector
With the settings determined in step 2. the final measurement will be performed:
EMI receiver settings for step 3:
- Detector: RMS (< 1 GHz)
- Measured frequencies: in step 1 and step 2 determined frequencies
- IF – Bandwidth: 100 kHz

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

3. Measurement above 1 GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

Step 1:

The Equipment Under Test (EUT) was set up on a non-conductive support at 1.5 m height in the semi-anechoic chamber. Absorbers are placed around and between the turn table and the antenna tower.
All steps were performed with one height (1.5 m) of the receiving antenna only.
The EUT is turned during the preliminary measurement across the elevation axis. with a step size of 15 °.
The turn table step size (azimuth angle) for the preliminary measurement is 15 °.

Step 2:

The maximum RFI field strength was determined during the measurement by rotating the turntable (±180 degrees) and varying the height of the receive antenna (h = 1 ... 4 m) with a additional tilt function of the antenna.The turn table azimuth will slowly vary by ±15°.
EMI receiver settings (for all steps):
- Detector: PEAK
- IF Bandwidth = 1 MHz

Step 3:

Final measurement with RMS detector
Spectrum analyser settings for step 3:
- Detector: RMS
- Measured frequencies: in step 2 determined frequencies
- IF – Bandwidth: 1 MHz

5.8.2 TEST REQUIREMENTS/LIMITS

Abstract from FCC Part 2:

FCC Part 2.1053; Measurement required: Field strength of spurious radiation:

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet. control circuits. power leads. or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test. single sideband. independent sideband. and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049. as appropriate.

Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§27.53 – Emission limits

Abstract § 27.53 FCC:

(h) AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

Abstract RSS-139 from ISED:

RSS-139; 6.6 Unwanted emission limits

Unwanted emissions shall be measured in terms of average values.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors) of the unwanted emissions outside the frequency block or frequency block group shall not exceed the limits shown in table 6.

Table 6: Unwanted emission limits

Offset from the edge of the frequency block or frequency block group	Unwanted emission limits
≤1 MHz	-13 dBm/(1% of OB*)
>1 MHz	-13 dBm/MHz

*OB is the occupied bandwidth.

In addition to complying with the above limits, equipment operating in the band 2180-2200 MHz may require additional filtering (see SRSP-519).

5.8.3 TEST PROTOCOL

General considerations concerning the limits:

The measuring bandwidth of 1 MHz was chosen according the test requirements exept at the bands from 30 MHz to 1 GHz: At these bands reducing of measurement bandwidth was done. Also outside the downlink frequency band at lower frequencies the measurement bandwidths were reduced to have the possibility to record the spurious emissions at these lower frequencies.

At frequencies were measuring bandwidths were reduced also the limit lines were reduced acoording the given formula:

$$p\ RBWreduced\ [dBm] = 10 * \log\left(RBWreduced\ [kHz] \quad / \quad 1000\ kHz\right) + pRBW\ 1000\ kHz[dBm]$$

Hereby "p" are the limit lines' values.

Considerations to MIMO operation:

Because only one antenna port is available not MIMO operation mode was tested.

Measurement tables with one antenna

30 MHz to 1 GHz:

Band 66, 2110 MHz – 2180 MHz, downlink;						
Spurious Freq. [MHz]	**Spurious Level [dBm]**	**Pin (Sum Level) [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
98.4/hor.	-77.1	-0.9	RMS	100	-23.0	54.1
158.7/hor	-86.4	-0.9	RMS	100	-23.0	63.4
359.5/hor	-75.3	-0.9	RMS	100	-23.0	52.3
98.4/vert.	-81.8	-0.9	RMS	100	-23.0	58.78
161.2/vert.	-89.0	-0.9	RMS	100	-23.0	66.0
359.8/vert.	-80.1	-0.9	RMS	100	-23.0	57.1

Above 1 GHz to 18 GHz:

Band 66, 2110 MHz – 2180 MHz, downlink;						
Spurious Freq. [MHz]	**Spurious Level [dBm]**	**Pin (Sum Level) [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
1875.2/hor	-58.8	-0.9	RMS	1000	-13.0	45.8
2144.8/hor	-36.2	-0.9	RMS	1000	-13.0	23.2
5122/hor	-53.7	-0.9	RMS	1000	-13.0	40.7
17093.2/hor	-56.1	-0.9	RMS	1000	-13.0	43.1
2110/vert.	-36.8	-0.9	RMS	1000	-13.0	23.8
2144.8/vert.	-40.9	-0.9	RMS	1000	-13.0	27.9
2179.8/vert.	-37.1	-0.9	RMS	1000	-13.0	24.1

Above 18 GHz to 27 GHz:

Band 66, 2110 MHz – 2180 MHz, downlink;						
Spurious Freq. [MHz]	**Spurious Level [dBm]**	**Pin (Sum Level) [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
18367.8/hor	-70.9	-0.9	RMS	1000	-13.0	57.9
20624.7/hor	-60.3	-0.9	RMS	1000	-13.0	47.3
18887.1/vert.	-71.6	-0.9	RMS	1000	-13.0	71.6
20624.7/vert.	-62.8	-0.9	RMS	1000	-13.0	62.8

Abbreviations:

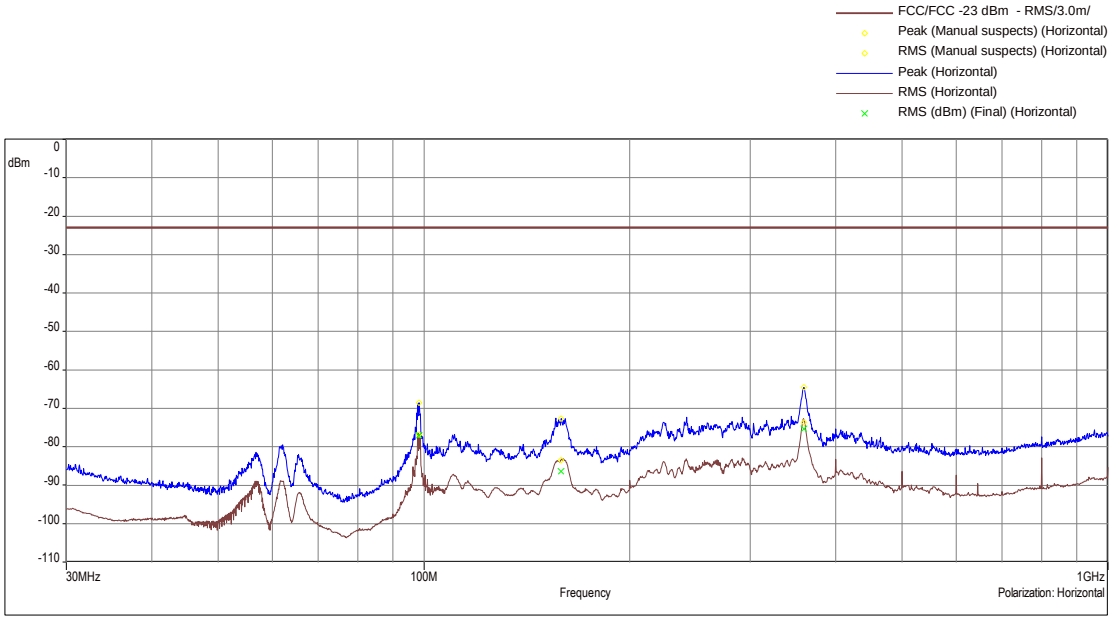
"hor.": horizontal position
"vert.": vertical position

Remarks: Please see next sub-clause for the measurement plot.

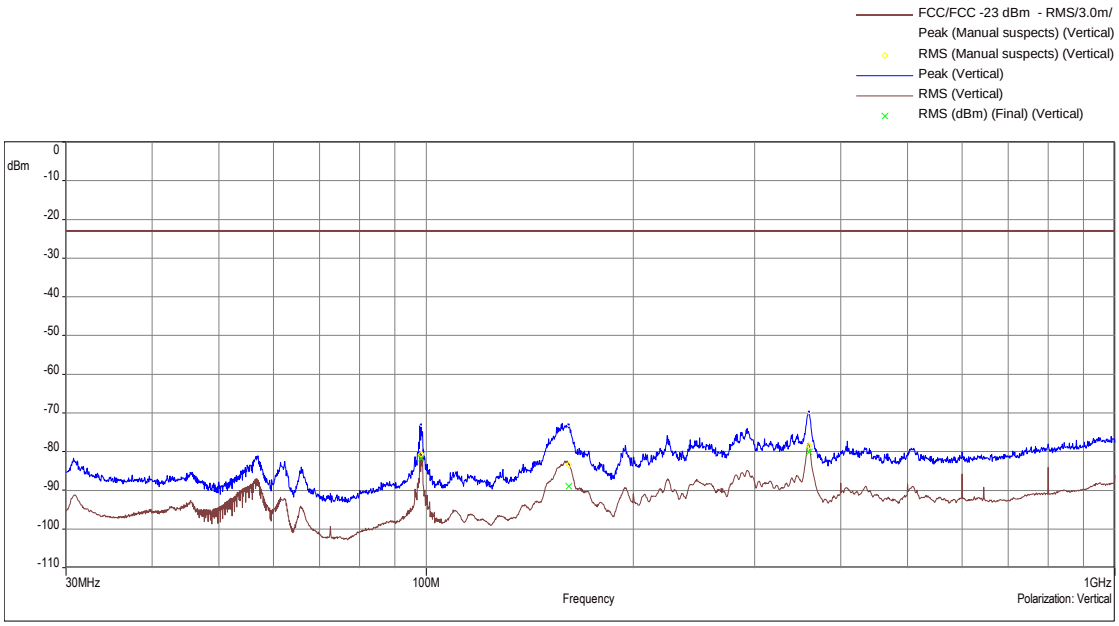
5.8.4 MEASUREMENT PLOT WITH ONE ANTENNA

5.8.4.1 Frequency band = ASW 1700; Direction = RF downlink

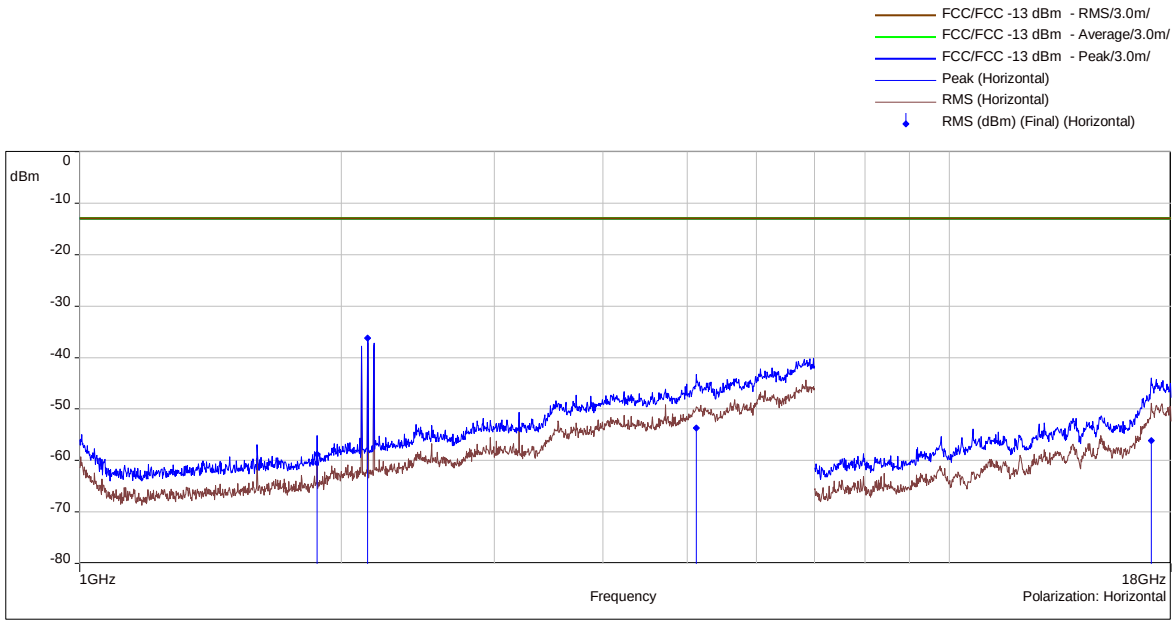
30 MHz - 1 GHz. horizontal



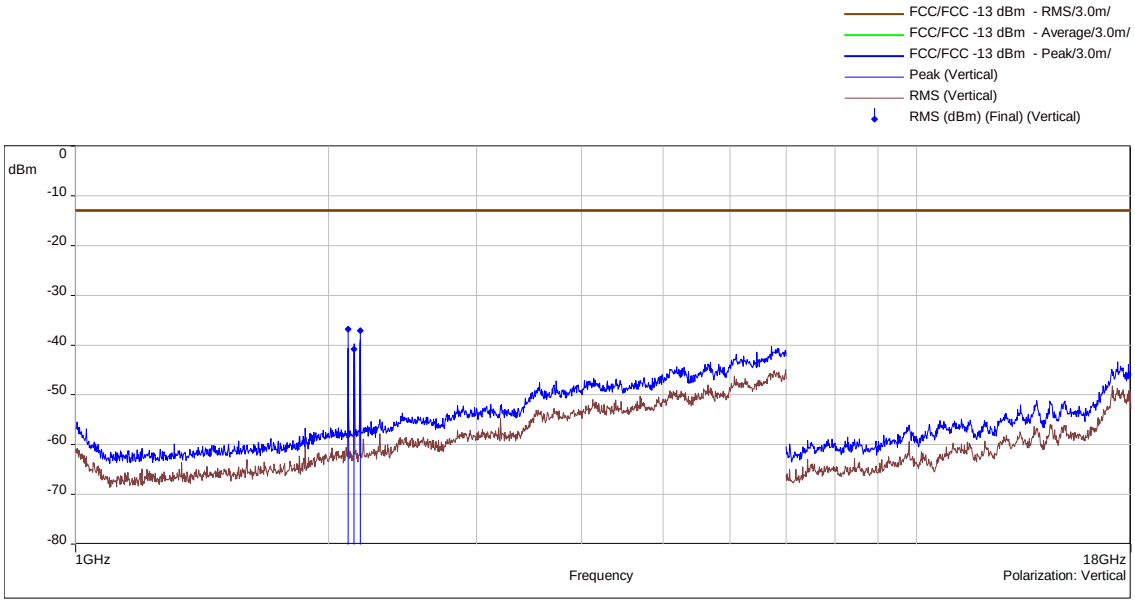
30 MHz - 1 GHz. vertical



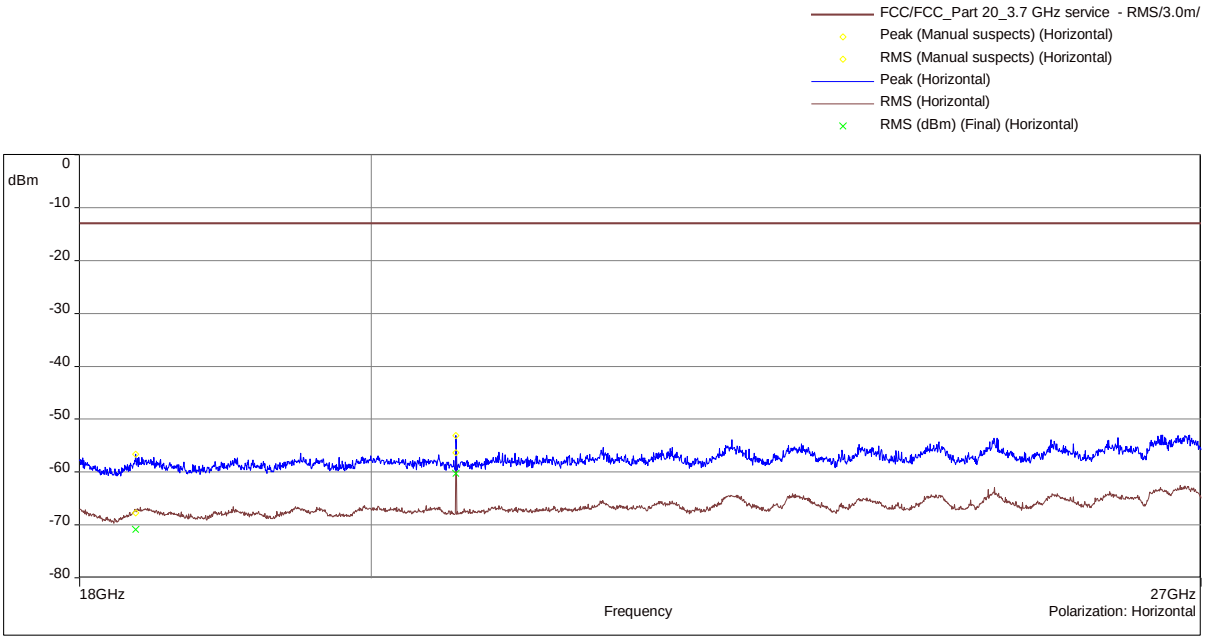
1 GHz - 18 GHz. horizontal



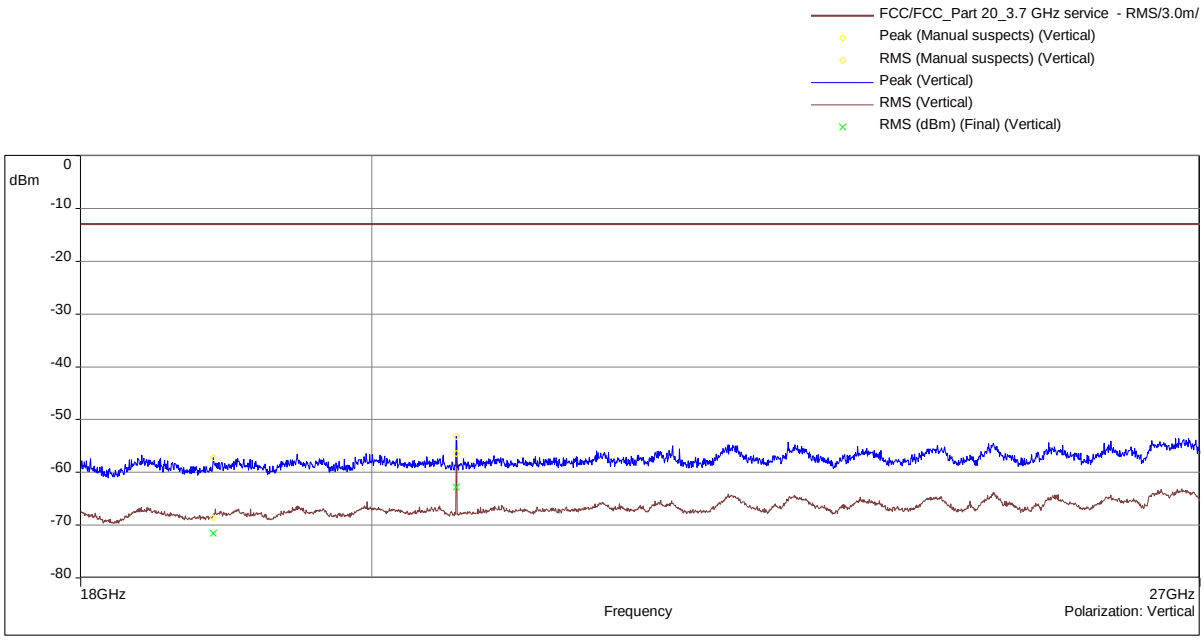
1 GHz - 18 GHz. vertical



18 GHz – 27 GHz. horizontal



18 GHz - 267 GHz. vertical



5.8.5 FIELD STRENGTH CALCULATIONS

FS = SA + AF + CL + PA

Where as:

FS = Field strength
SA = EMC test receiver reading
AF = Antenna factor
CL = Cable loss
PA = Preamplifier

5.8.6 TEST EQUIPMENT USED

- Radiated Emissions

6 TEST EQUIPMENT

6.1 CONDUCTED EMISSIONS

Ref.No.	Type	Description	Manufacturer	Inventory no.	Last calibration	Calibration due
1.1	FSV40	Signal Analyzer 10 Hz - 40 GHz	Rohde & Schwarz	E-003138	2023-10	2025-10
1.2	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	E-003206	2023-01	2026-01
1.3	CA-2.9MF-20-40-10W-RDC	Attenuator 20 dB	Tactron	E-004057	2024-10	2026-10
1.4	testo 175 H1	Thermo-Hygrometer	Testo	E-003922	2024-12	2025-12
1.5	Auto Messung 1 Channel V8.1	Software	Bureau Veritas	Software V8.1	---	---

The calibration interval is the time interval between "Last Calibration" and "Calibration Due".

6.2 RADIATED EMISSIONS

Ref.No.	Type	Description	Manufacturer	Inventory no.	Last calibration	Calibration due
1.6	ESU40	EMI test receiver 10 Hz - 40 GHz	Rohde & Schwarz	E-003138	2024-10	2025-10
1.7	CBL 6111C	Antenna 30 MHz – 1 GHz	Chase	E-003226	2024-02	2026-02
1.8	LB-8180-SF	Antenna 0.8 GHz - 18 GHz	A-Info Inc.	E-004052	2024-08	2025-08
1.9	MWH-1826/B	Antenna 18 GHz – 26.5 GHz	ARA Inc.	E-004044	2024-08	2025-08
1.10	AM1431	Pre amplifier 10 kHz – 1 GHz	Miteq	E-003365	2024-10	2025-10
1.11	ZX60-06183LN+	Pre amplifier 6 GHz – 18 GHz	Miteq	E-003952	2024-10	2025-10
1.12	AMP-18000-40000-60-18-2.9-F	Preaamplifier 18 GHz - 40 GHz	Miteq	E-004003	2024-10	2025-10
1.13	CO3000	Controller SAC	Innco systems GmbH	E-003052 with Software 1.02.62	---	---
1.14	testo 176 P1	Thermo-Hygrometer	Testo	E-003918	2024-07	2025-07
1.15	BAT-EMC	Software	Nexio	V 2024.0.12.0	---	---

The calibration interval is the time interval between "Last Calibration" and "Calibration Due".

6.3 ANTENNA FACTORS. CABLE LOSS AND SAMPLE CALCULATION

The used factors for antennas, cables etc. are deposited in the used test systems (LabView program and BAT EMC programm). They are actualised by the returing calibration control.

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables. switch unit. distance correction. amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

7 PHOTO REPORT

Please see separate photo report.

Annex A: Accreditation certificate (for information)

The accreditation relates to competences stated on the accreditation certificate. The current certificate is available on the homepage of the DAkkS and can be downloaded under accredited bodies with the processing number:

https://www.dakks.de/en

Annex B: Additional information provided by client

None.

****** End of test report *****