EMC Test Report
2024-0451-EMC-TR-25-0071-V01

Designation:	UAP-XR [PCS 1900]
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 24 RSS-133 Issue 7 with RSS-GEN Issue 5, RSS-131 Issue 4 and SRSP-510 Issue 6
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 14:16:41 +02'00'
Date of receipt EUT:	26.02.2025		
Performance date:	16.03.2025 - 31.03.2025	Report Reviewer:	Thomas Hufnagel Test Engineer Digitally signed by Thomas Hufnagel Date: 2025.06.12 14:18:59 +02'00'

Bundesnetzagentur

BNetzA-CAB-19/21-20

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Laboratory accreditation no:	DAkkS D-PL-12024-06-04 BNETZA-CAB-19/21-20
FCC Designation Number:	DE0023
FCC Test Firm Registration:	366481
ISED CAB Identifier	DE0016
ISED Company Number	3475A

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 24. 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 24, Subpart E – Broadband PCS

§ 24.232 – Power and antenna height limits
§ 24.235 – Frequency stability
§ 24.238 – Emission limitations for broadband PCS equuipment

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-133 Issue 7 "Personal Communications Service Equipment Operating in the Bands 1850-1915 MHz and 1930-1995 MHz"
- SRSP-510 Issue 6 "Technical Requirements for Personal Communications Services (PCS) in the Bands 1850-1915 MHz and 1930-1995 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	§ 24.232 KDB 935210 D05 v01r04: 3.5	RSS-GEN Issue 5, 6.12 RSS-133 Issue 7, 5.5 SRSP-510, Issue 6, 6.1.3
Peak to Average Ratio	§ 24.232	RSS-133 Issue 7, 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 § 24.238 KDB 935210 D05 v01r04: 3.6	RSS-GEN Issue 5, 6.13 RSS-133 Issue 7, 5.6
Out-of-band emissions limits	§ 2.1051 § 24.238 KDB 935210 D05 v01r04: 3.6	RSS-GEN Issue 5, 6.13 RSS-133 Issue 7, 5.6
Frequency stability	§ 2.1055 § 24.235	RSS-GEN Issue 5, 6.11 RSS-131 Issue 4: 9.4 RSS-133 Issue 7, 5.3
Field strength of spurious radiation	§ 2.1053 § 24.236	RSS-GEN Issue 5, 6.13 RSS-133 Issue 7, 5.6
Out-of-band rejection	KDB 935210 D05 v01r04: 3.3	RSS-131 Issue 4: 9.1
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 24 Subpart E [Broadband PCS] **§ 24.232**

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		
PCS 1900, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
PCS 1900, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
PCS 1900, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
PCS 1900, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
PCS 1900, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed	Passed
PCS 1900, RF downlink, 3 dB > AGC, Wideband 5G	Passed	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E [Broadband PCS] **§ 24.232**

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

	FCC	**ISED**
PCS 1900, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
PCS 1900, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
PCS 1900, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
PCS 1900, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
PCS 1900, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed	Passed
PCS 1900, 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		
PCS 1900, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
PCS 1900, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
PCS 1900, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
PCS 1900, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
PCS 1900, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed	Passed
PCS 1900, RF downlink, 3 dB > AGC, Wideband 5G	Passed	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E [Broadband PCS] § 2.1051, § 24.238

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**
PCS 1900, low, RF downlink, Wideband	Passed	Passed
PCS 1900, mid, RF downlink, Wideband	Passed	Passed
PCS 1900, high, RF downlink, Wideband	Passed	Passed
PCS 1900low, RF downlink, Narrowband	Passed	Passed
PCS 1900, mid, RF downlink, Narrowband	Passed	Passed
PCS 1900, high, RF downlink, Narrowband	Passed	Passed
PCS 1900, low, RF downlink, Wideband 5G	Passed	Passed
PCS 1900, mid, RF downlink, Wideband 5G	Passed	Passed
PCS 1900, high, RF downlink, Wideband 5G	Passed	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E [Broadband PCS] §2.1051, § 24.238

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, PCS 1900, 1, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
Upper, PCS 1900, 1, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
Upper, PCS 1900, 1, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed	Passed
Upper, PCS 1900, 1, RF downlink, 3 dB > AGC, Wideband 5G	Passed	Passed
Upper, PCS 1900, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
Upper, PCS 1900, 1, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
Lower, PCS 1900, 1, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
Lower, PCS 1900, 1, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
Lower, PCS 1900, 1, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed	Passed
Lower, PCS 1900, 1, RF downlink, 3 dB > AGC, Wideband 5G	Passed	Passed
Lower, PCS 1900, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
Lower, PCS 1900, 1, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
Upper, PCS 1900, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
Upper, PCS 1900, 2, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
Upper, PCS 1900, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
Upper, PCS 1900, 2, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed
Lower, PCS 1900, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed	Passed
Lower, PCS 1900, 2, RF downlink, 3 dB > AGC, Wideband	Passed	Passed
Lower, PCS 1900, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed	Passed
Lower, PCS 1900, 2, RF downlink, 3 dB > AGC, Narrowband	Passed	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E [Broadband PCS]	**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**
PCS 1900, RF downlink		Passed	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E [Broadband PCS]	**§ 2.1053, § 24.238**		
Field strength of spurious radiation The measurement was performed according to ANSI C63.26		**Final Result**	
OP-Mode Frequency Band, Direction			
PCS 1900, 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
25 (PCS 1900)	Downlink	1930.00	1995.00	1962.50	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

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
25	Downlink	Narrowband	-0.7	-1.0	2.3	1962.5	Mid
25	Downlink	Wideband	-0.7	-1.0	2.3	1962.5	
25	Downlink	Wideband 5G	-0.2	-0.5	2.8	1962.5	
25	Downlink	Narrowband	0.6	0.3	3.6	1930.2	Low
25	Downlink	Wideband	0.8	0.5	3.8	1932.5	
25	Downlink	Wideband 5G	-0.1	0.2	3.2	1952.5	
25	Downlink	Narrowband	-0.4	-0.7	2.6	1992.5	High
25	Downlink	Wideband	-0.6	-0.9	2.4	1992.5	
25	Downlink	Wideband 5G	-0.9	-1.2	1.8	1972.5	
25	Downlink	Narrowband	-0.7	-1.0	2.3	1973.6	Max.Power
25	Downlink	Wideband	-0.8	-1.1	2.2	1973.6	
25	Downlink	Wideband 5G	-0.2	-0.5	2.8	1962.5	

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): 22.5 MHz

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: 2025-03-16 – 2025-03-17

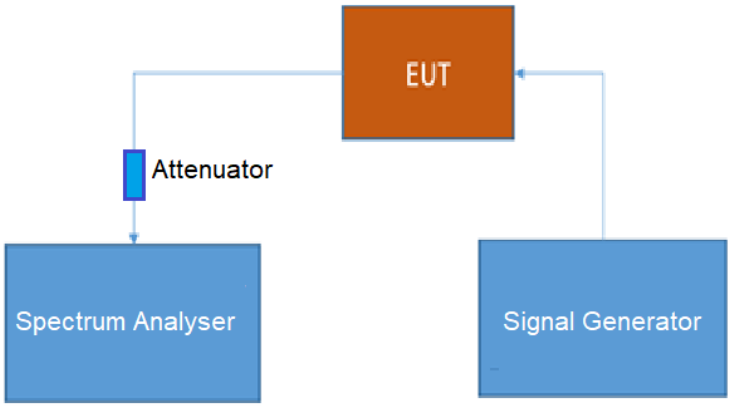
Environmental conditions: 23.2 °C; 27 % r. H./22.8 °C; 26 % r. H.

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 24; Personal Communication Services

Subpart E – Broadband PCS

§ 24.232

Abstract § 24.232 from FCC:

§ 24.232 Power and antenna height limits.

(a)(1) Base stations with an emission bandwidth of 1 MHz or less are limited to 1640 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.

(2) Base stations with an emission bandwidth greater than 1 MHz are limited to 1640 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.

(3) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; see Tables 1 and 2 of this section.

(4) The service area boundary limit and microwave protection criteria specified in §§24.236 and 24.237 apply.

TABLE 1—REDUCED POWER FOR BASE STATION ANTENNA HEIGHTS OVER 300 METERS, WITH EMISSION BANDWIDTH OF 1 MHZ OR LESS

HAAT in meters	Maximum EIRP watts
≤300	1640
≤500	1070
≤1000	490
≤1500	270
≤2000	160

TABLE 2—REDUCED POWER FOR BASE STATION ANTENNA HEIGHTS OVER 300 METERS, WITH EMISSION BANDWIDTH GREATER THAN 1 MHZ

HAAT in meters	Maximum EIRP watts/MHz
≤300	1640
≤500	1070
≤1000	490
≤1500	270
≤2000	160

(b)(1) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census, with an emission bandwidth of 1 MHz or less are limited to 3280 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.

(2) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census, with an emission bandwidth greater than 1 MHz are limited to 3280 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.

(3) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; see Tables 3 and 4 of this section.

(4) The service area boundary limit and microwave protection criteria specified in §§24.236 and 24.237 apply.

TABLE 3—REDUCED POWER FOR BASE STATION ANTENNA HEIGHTS OVER 300 METERS, WITH EMISSION BANDWIDTH OF 1 MHZ OR LESS

HAAT in meters	Maximum EIRP watts
≤300	3280
≤500	2140
≤1000	980
≤1500	540
≤2000	320

TABLE 4—REDUCED POWER FOR BASE STATION ANTENNA HEIGHTS OVER 300 METERS, WITH EMISSION BANDWIDTH GREATER THAN 1 MHZ

HAAT in meters	Maximum EIRP watts/MHz
≤300	3280
≤500	2140
≤1000	980
≤1500	540
≤2000	320

Abstract RSS-133 from ISED:

RSS-133; 5.5 Transmitter output power

The maximum power spectral density of the equipment, measured in terms of average values, shall comply with the limits specified in table 2. These limits are either specified in terms of equivalent isotropically radiated power (e.i.r.p.) or TRP for the purpose of certification and may not apply to all deployment scenarios. Consult SRSP-510 for more deployment details in the bands 1850-1915 MHz and 1930-1995 MHz.

AAS equipment with eight antenna elements or less can demonstrate compliance with the e.i.r.p limit specified for non-AAS equipment in table 2, instead of the TRP limit.

Table 2: Maximum power spectral density of equipment

Equipment type	**Maximum power spectral density**
Non-AAS fixed station and base station	3280 W/MHz e.i.r.p
AAS fixed station and base station	46 dBm/MHz TRP
Subscriber equipment	2 W /channel bandwidth e.i.r.p

Abstract SRSP-510 from ISED:

6.1.3 SRSP-510; 6.1.3 e.i.r.p. limits and antenna height limits for non-AAS systems

22. For fixed and base stations operating in the band 1930-1995 MHz with a channel bandwidth equal to or less than 1 MHz, the maximum permissible e.i.r.p. is 1640 W, with an antenna height above average terrain (HAAT) of up to 300 m.

23. For fixed and base stations operating in the band 1930-1995 MHz with a channel bandwidth greater than 1 MHz, the maximum permissible e.i.r.p. is 1640 W/MHz (i.e. no more than 1640 W e.i.r.p. in any 1 MHz band segment), with an antenna HAAT up to 300 m.

24. Fixed and base stations operating in the band 1930-1995 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 3280 W/MHz (i.e. no more than 3280 W 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. Relevant files describing the boundaries of these centres are available online.

25. 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.

26. 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.

27. Base stations deployed prior to July 24, 2024 and located in areas outside of urban areas (as defined in SRSP-510, issue 5, according to Statistics Canada's Census Dictionary and in *A National Overview – Population and Dwelling Counts* (Data Products: 1996 Census of Population), Catalogue number 93-357-XPB) and operating with e.i.r.p. above 1640 watts (up to 3280 watts) may continue to operate with such e.i.r.p.

28. 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 3280 W.

29. Fixed and base stations with an antenna HAAT exceeding 300 m shall apply a reduction in e.i.r.p. such that they are limited to the maximum permissible e.i.r.p. specfied in table 1.

Table 1: Maximum permissible e.i.r.p for non-AAS with HAAT > 300 m

HAAT (m)	Maximum e.i.r.p. (W for a channel bandwidth ≤1 MHz or W/MHz for a channel bandwidth >1 MHz)
300 < HAAT ≤ 500	1070
500 < HAAT ≤ 1000	490
1000 < HAAT ≤ 1500	270
1500 < HAAT ≤ 2000	160

30. The 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 25, 1930 MHz – 1995 MHz, downlink							
Signal type	**Input power**	**Frequency [MHz]**	**Input power [dBm]**	**Maximum average output power [dBm]**	**Limit average output power [dBm] EIRP**	**Margin to limit [dB]**	**Gain [dB]**
Wideband	0.3 dB < AGC	1973.60	-1.1	18.8	59.2	40.4	19.9
Wideband	3 dB > AGC	1973.60	2.2	18.5	59.2	40.7	16.3
Narrowband	0.3 dB < AGC	1973.60	-1.0	18.9	59.2	40.3	19.9
Narrowband	3 dB > AGC	1973.60	2.3	18.1	59.2	41.1	15.8
Wideband 5G	0.3 dB < AGC	1962.50	-0.5	18.9	59.2	40.4	19.4
Wideband 5G	3 dB > AGC	1962.50	2.8	18.6	59.2	40.6	15.8

For the output power limit the value of the FCC table from § 24.232 for a HAAT upt 300 meters is taken.
This is 1640 watts which equates 59.2 dBm according the given formula:

$$p_{dBm} = 10 \log \frac{1640\ W}{0.001\ W} = 59.2\ dBm$$

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

ISED Table

Band 25, 1930 MHz – 1995 MHz, downlink							
Signal type	**Input power**	**Frequency [MHz]**	**Input power [µW; dBm]**	**Maximum average output power [mW; dBm]**	**Limit average output power [W/MHz; dBm] EIRP**	**Margin to limit [dB]**	**Gain [dB]**
Wideband	0.3 dB < AGC	1973.60	776.8/-1.1	76.1/18.8	1640; 59.2	40.4	19.9
Wideband	3 dB > AGC	1973.60	1640/2.1	71.1/18.5	1640; 59.2	40.7	16.4
Narrowband	0.3 dB < AGC	1973.60	798.1/-1.0	74.5/18.7	1640; 59.2	40.5	19.7
Narrowband	3 dB > AGC	1973.60	1680/-0.5	66.2/18.2	1640; 59.2	41.0	16.0
Wideband 5G	0.3 dB < AGC	1962.50	888.3/-0.5	76.8/18.9	1640; 59.2	40.3	19.4
Wideband 5G	3 dB > AGC	1962.50	1910/2.8	72.8/18.6	1640; 59.2	40.6	15.8

For the output power limit the value of the ISED table at a height up to 300 m from SRSP-510 is taken.

For the input power, output power and the limit of output power the values in watts are also calculated in dBm values by the given formula:

$$p_{dBm} = 10 \log_{10} \frac{Table\ Value\ [w]}{0.001\ [W]}$$

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

5.1.4 SAMPLE CALCULATION OF OUTPUT POWER

FCC and ISED together:

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

Calculation for the highest power level of the test protocol table:

The highest power level in the table above is:

$p_{highest}$ = 18.9 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:

$p_{EIRP\ 1CH}$ = 18.9 dBm + 13.0 dB = 31.9 dBm

31.9 dBm < 59.2 dBm (FCC limit and ISED limit)

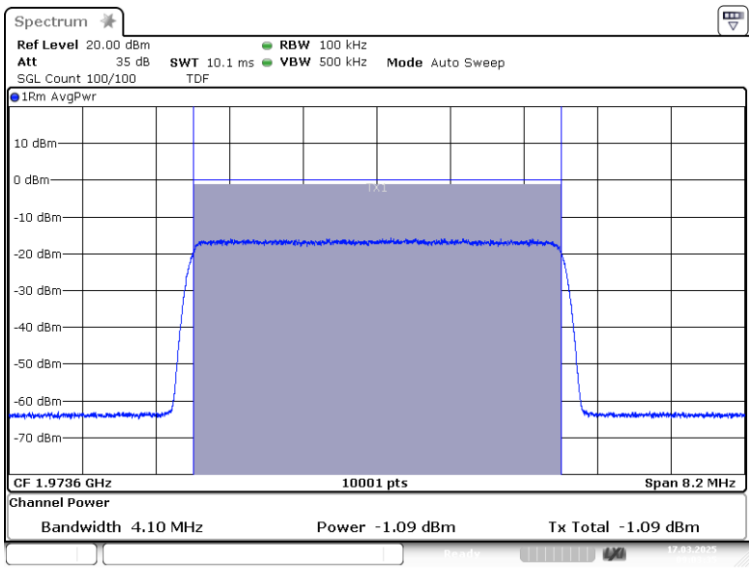
Because the EUT has only one antenna port no calculations for MIMO cases of more ports are needed.

The DUT doesn't exceed wheather the FCC limit nor the ISED limit.

5.1.5 MEASUREMENT PLOT

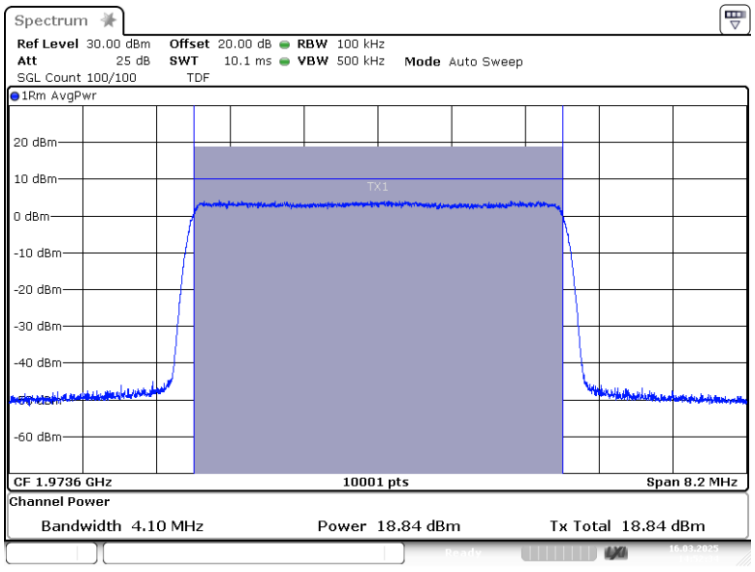
FCC Plots

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: AWGN;
Input power 0.3 dB < AGC



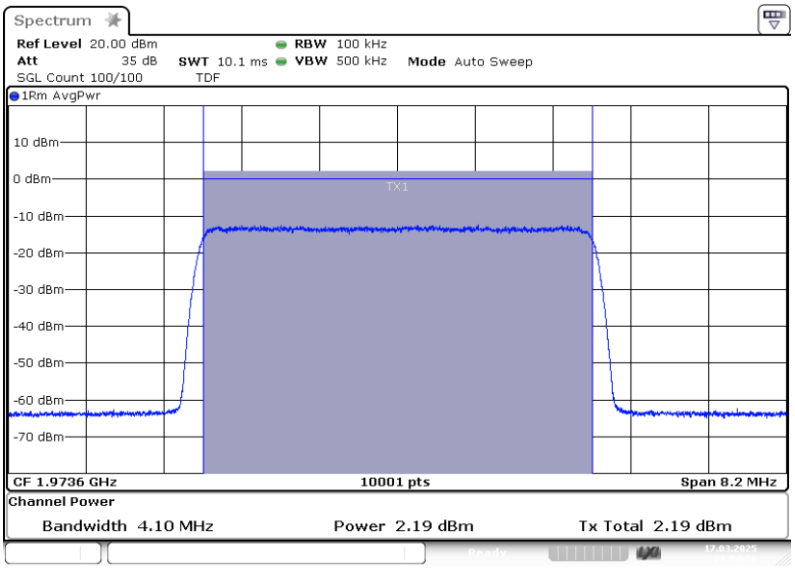
3.5.3 Power AWGN In-0.3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: AWGN;
Output power 0.3 dB < AGC



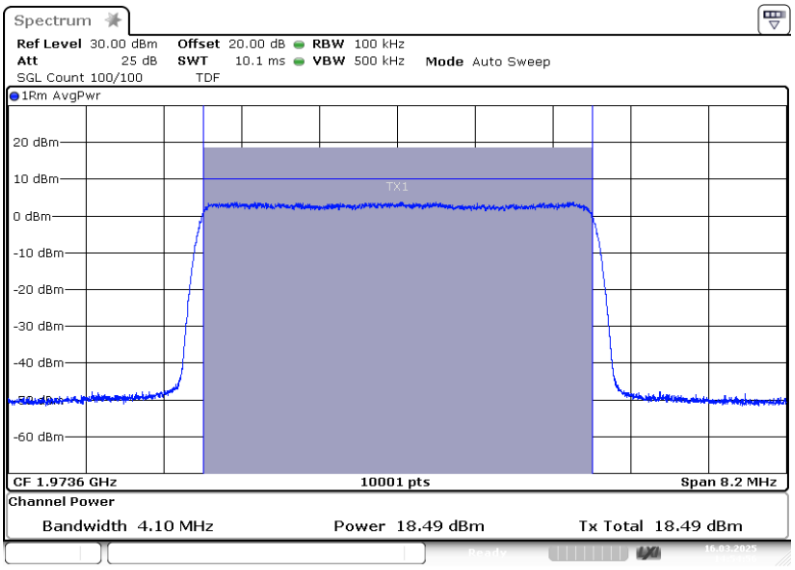
3.5.3 Power AWGN Out -0.3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: AWGN;
Input power 3 dB > AGC



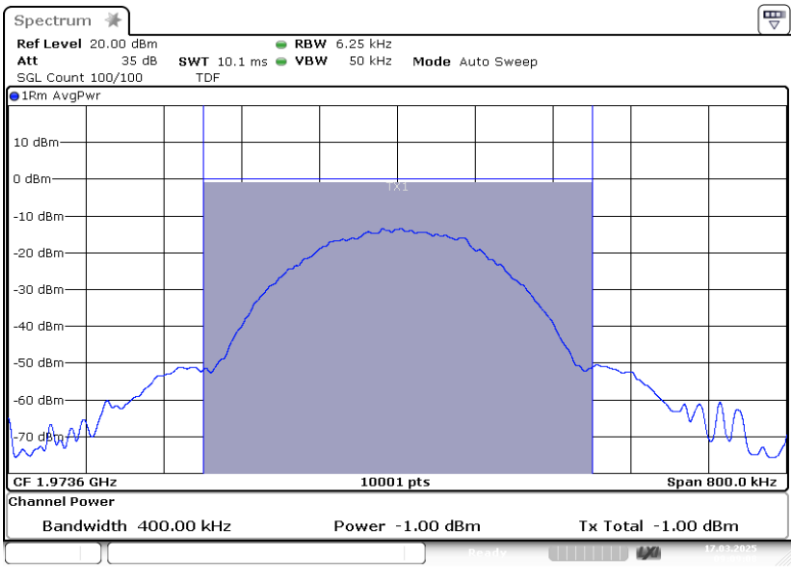
3.5.3 Power AWGN In+3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: AWGN;
Output power 3 dB > AGC



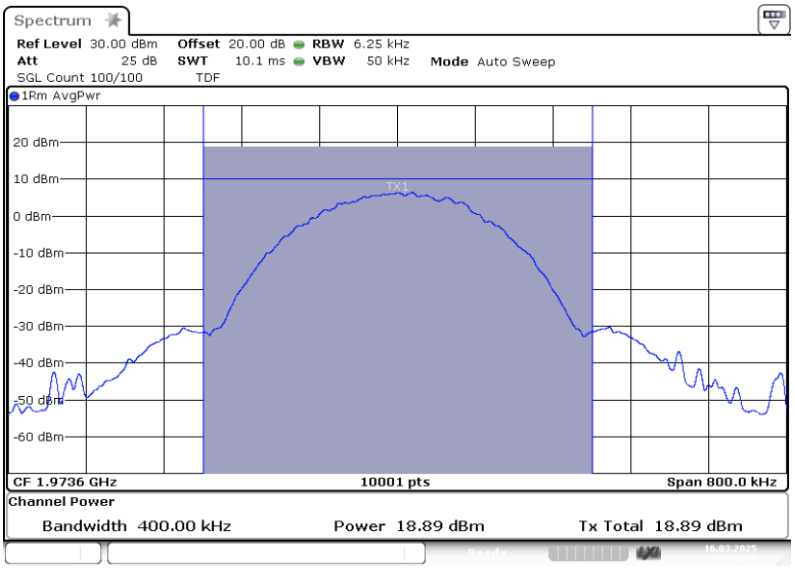
3.5.3 Power AWGN Out +3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: GSM;
Input power 0.3 dB < AGC



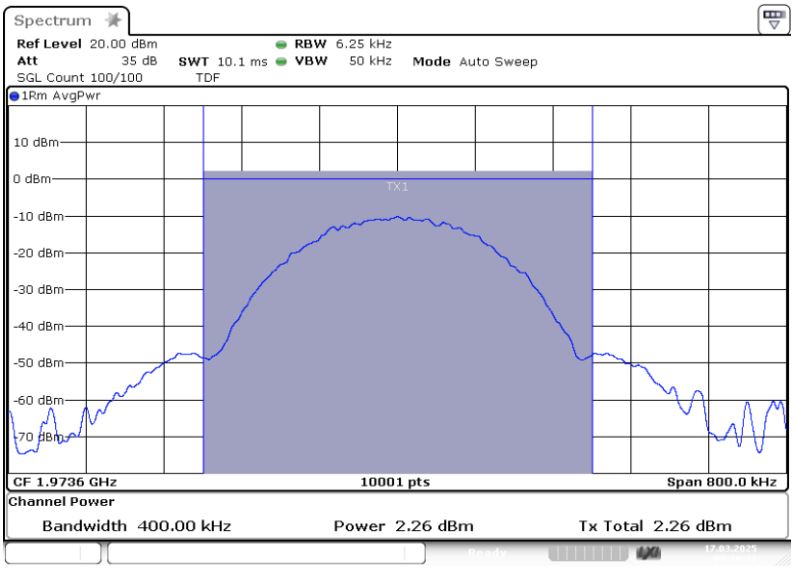
3.5.3 Power GSM In-0.3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: GSM;
Output power 0.3 dB < AGC



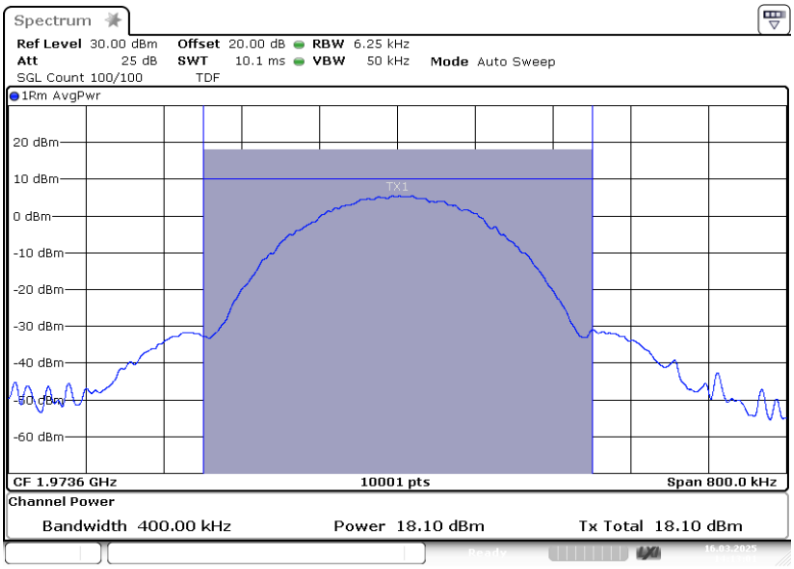
3.5.3 Power GSM Out -0.3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: GSM;
Input power 3 dB > AGC



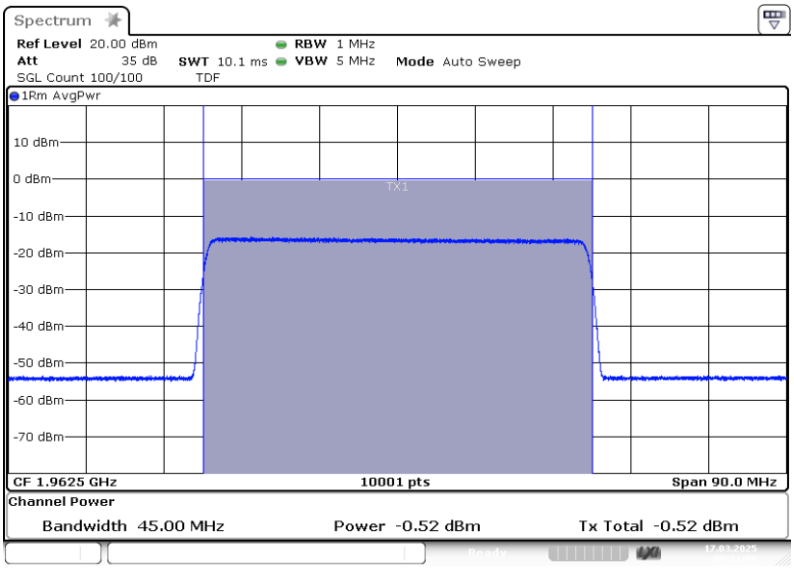
3.5.3 Power GSM In+3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: GSM;
Output power 3 dB > AGC



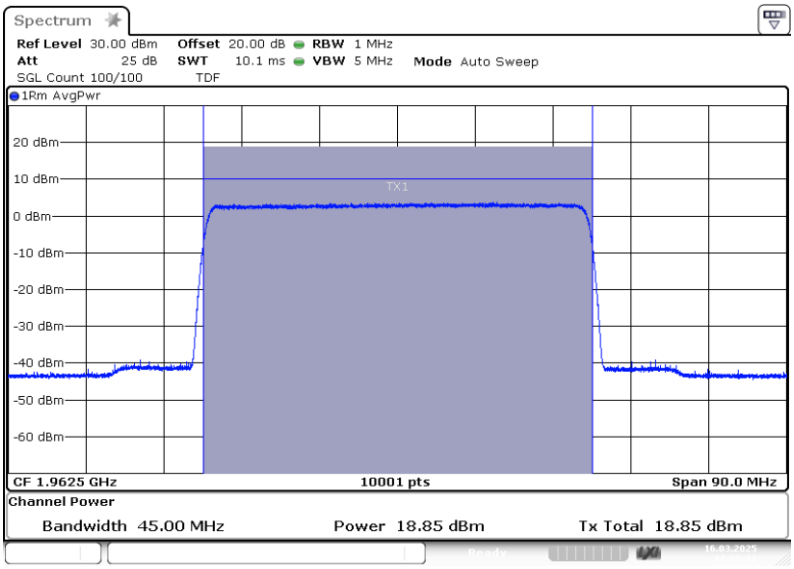
3.5.3 Power GSM Out +3 1.97360G

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Input power 0.3 dB < AGC



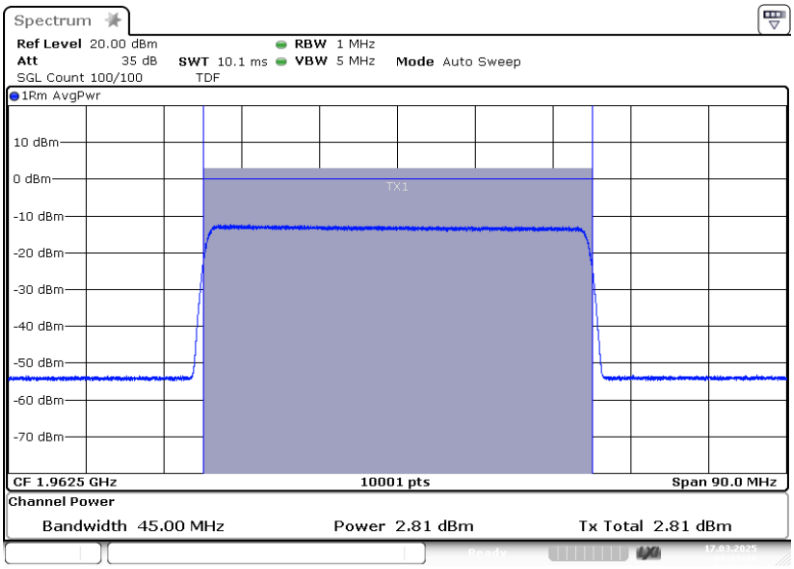
3.5.3 Power AWGN 45M In-0.3 1.96250G

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Output power 0.3 dB < AGC



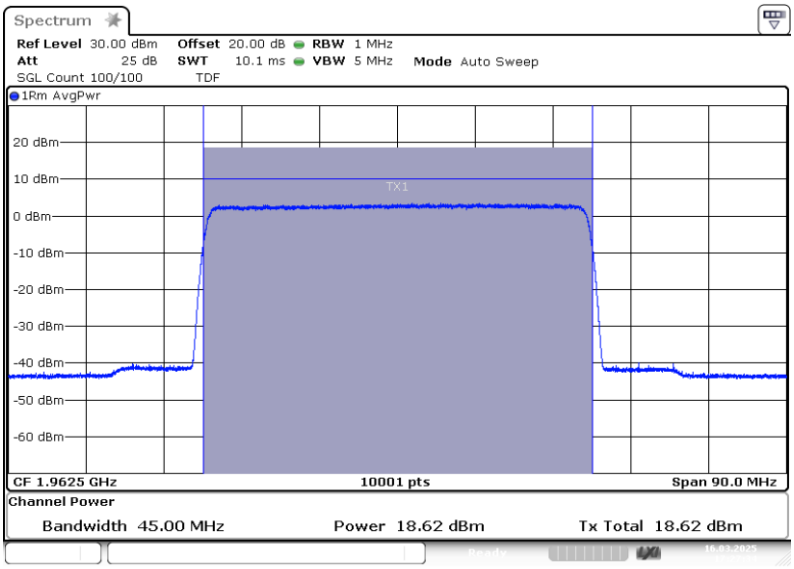
3.5.3 Power AWGN 45M Out -0.3 1.96250G

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Input power 3 dB > AGC



3.5.3 Power AWGN 45M In+3 1.96250G

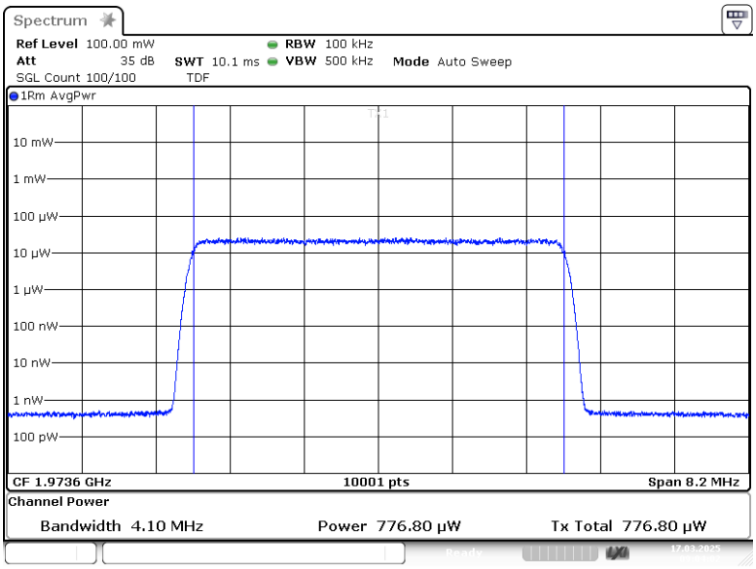
Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Output power 3 dB > AGC



3.5.3 Power AWGN 45M Out +3 1.96250G

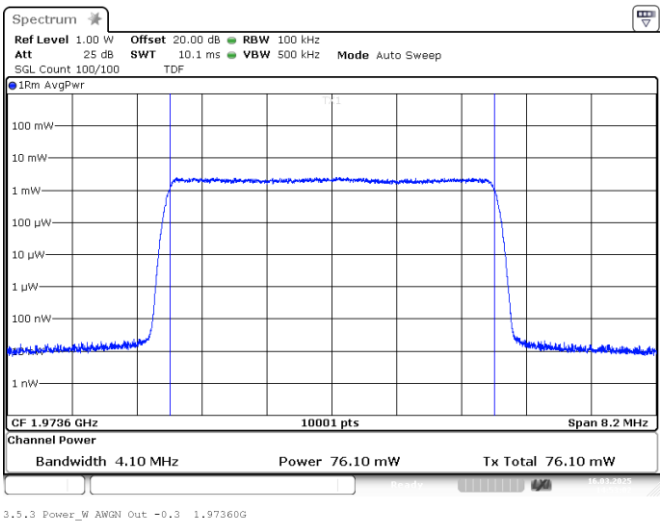
ISED Plots

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: AWGN;
Input power 0.3 dB < AGC



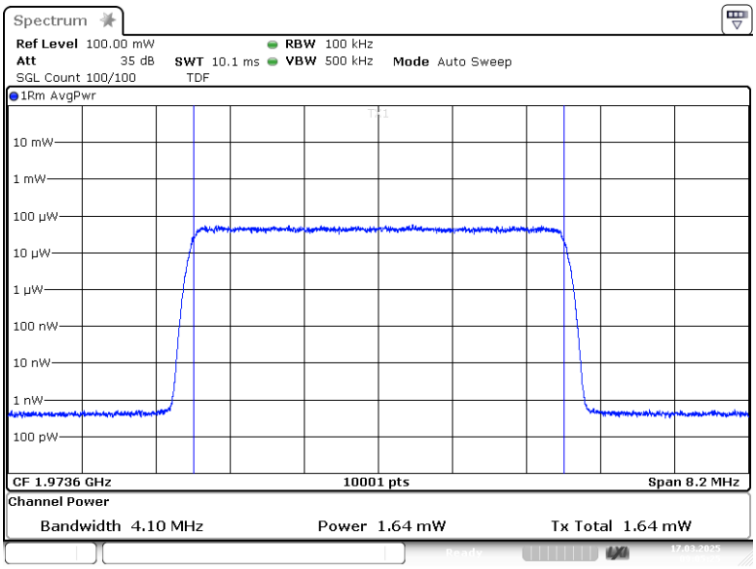
3.5.3 Power_W AWGN In-0.3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: AWGN;
Output power 0.3 dB < AGC



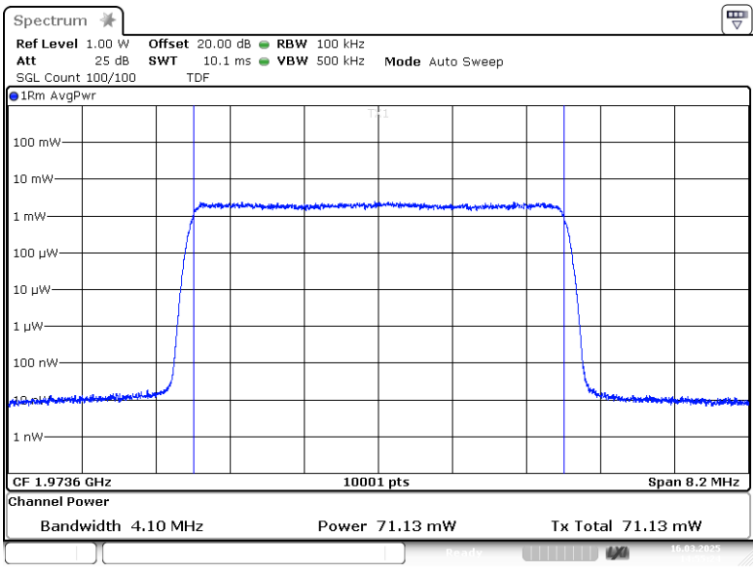
3.5.3 Power_W AWGN Out -0.3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: AWGN;
Input power 3 dB > AGC



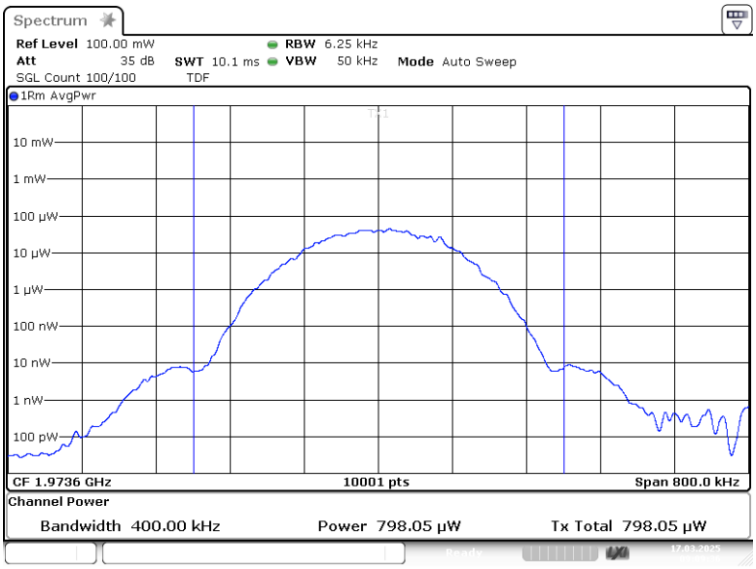
3.5.3 Power_W AWGN In+3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: AWGN;
Output power 3 dB > AGC



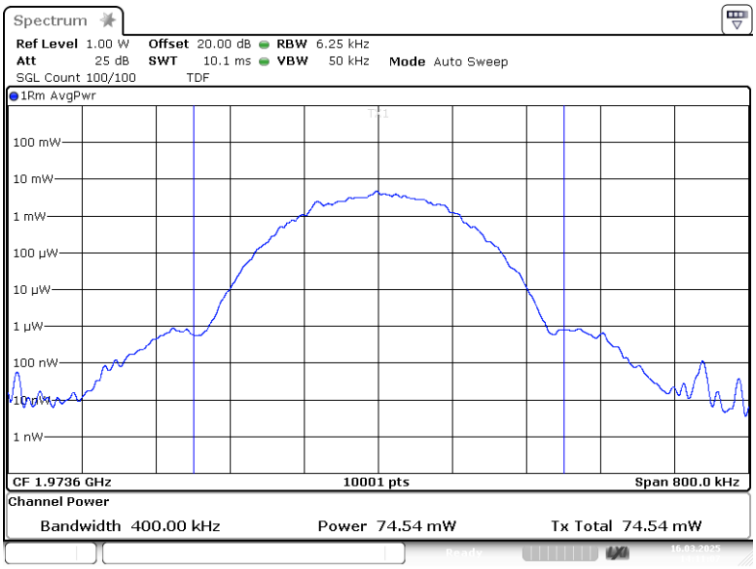
3.5.3 Power_W AWGN Out +3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: GSM;
Input power 0.3 dB < AGC



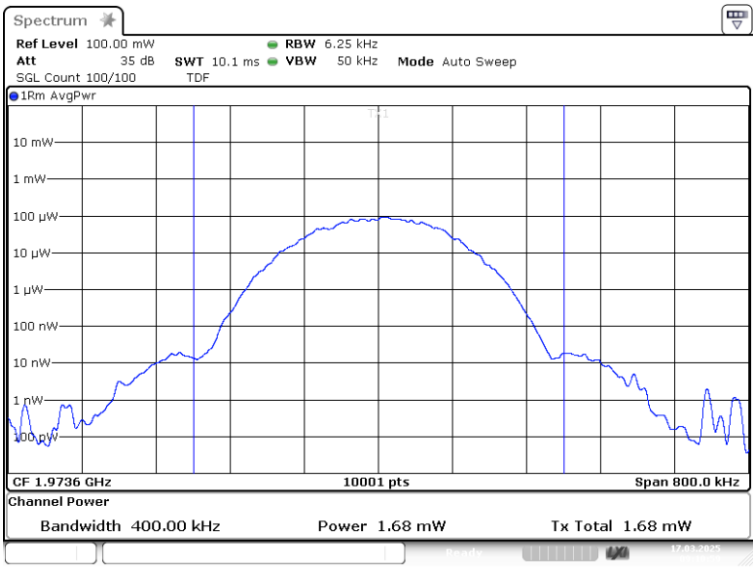
3.5.3 Power_W GSM In-0.3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: GSM;
Output power 0.3 dB < AGC



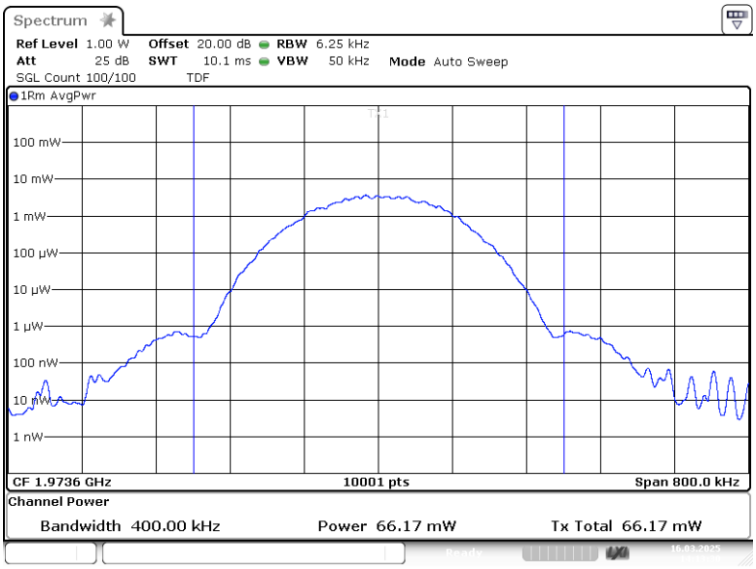
3.5.3 Power_W GSM Out -0.3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: GSM;
Input power 3 dB > AGC



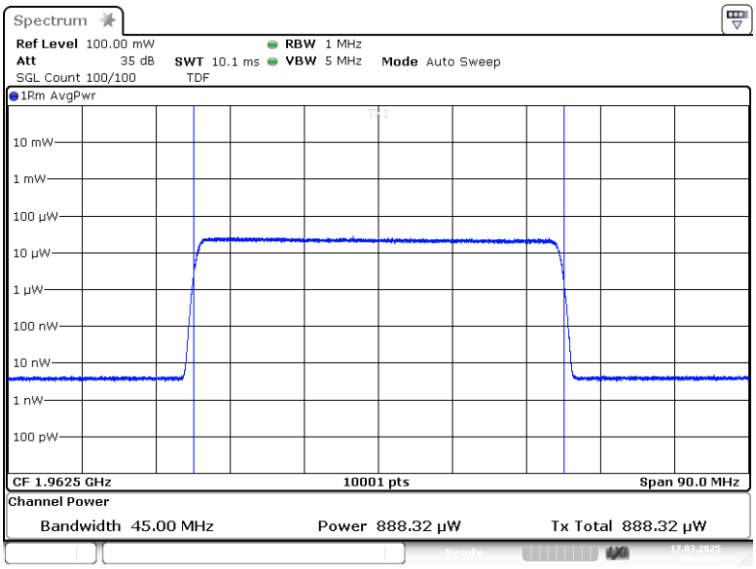
3.5.3 Power_W GSM In+3 1.97360G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: GSM;
Output power 3 dB > AGC



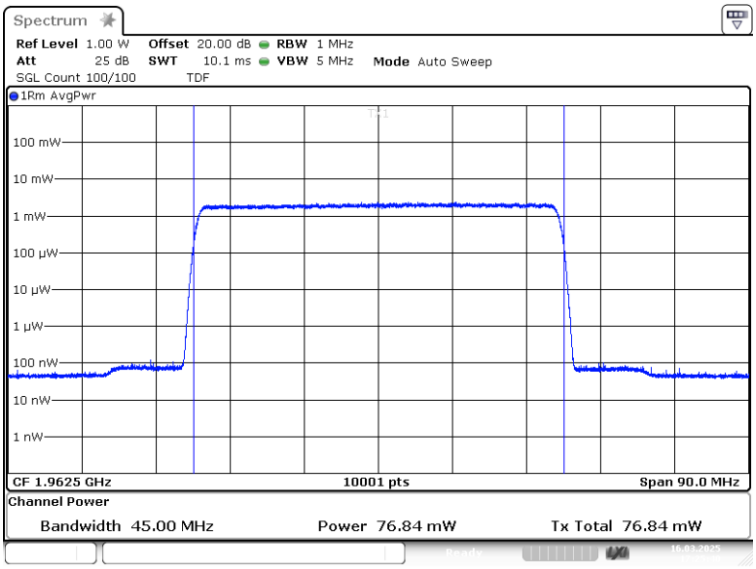
3.5.3 Power_W GSM Out +3 1.97360G

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Input power 0.3 dB < AGC



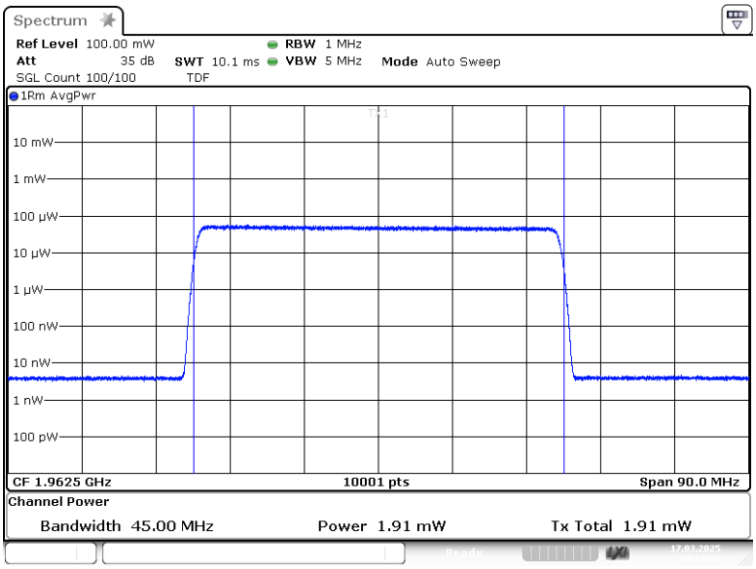
3.5.3 Power_W AWGN 45M In-0.3 1.96250G

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Output power 0.3 dB < AGC



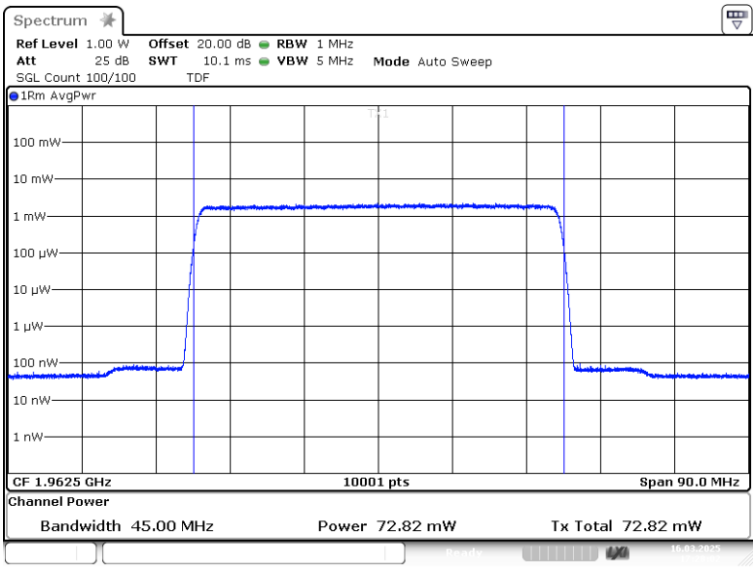
3.5.3 Power_W AWGN 45M Out -0.3 1.96250G

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Input power 3 dB > AGC



3.5.3 Power_W AWGN 45M In+3 1.96250G

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Output power 3 dB > AGC



3.5.3 Power_W AWGN 45M Out +3 1.96250G

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: 2025-03-16 – 2025-03-17

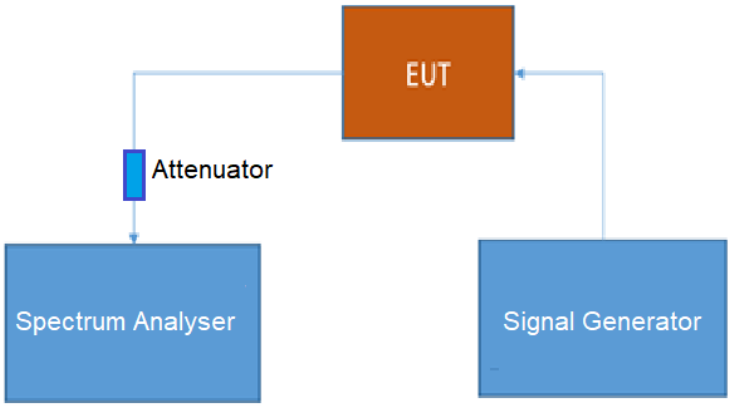
Environmental conditions: 23.2 °C; 27 % r. H./22.8 °C; 26 % r. H.

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 E – Broadband PCS

§ 24.232

Abstract § 24.232 from FCC:

(d) 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 (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. 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-133 from ISED:

RSS-133; 5.4 Transmitter Output Power

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

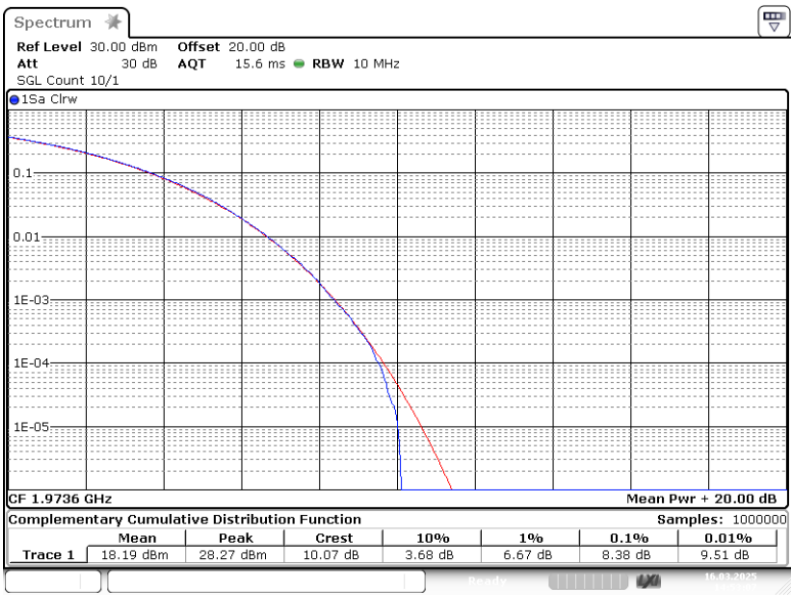
5.2.3 TEST PROTOCOL

Band 25, 1930 MHz – 1995 MHz, downlink						
Signal type	**Input power**	**Frequency [MHz]**	**Input power [dBm]**	**PAPR [dB]**	**Limit PAPR [dB]**	**Margin to limit [dB]**
Wideband	0.3 dB < AGC	1973.6	-1.1	8.4	13.0	4.6
Wideband	3 dB > AGC	1973.6	2.2	8.4	13.0	4.6
Narrowband	0.3 dB < AGC	1973.6	-1.0	0.1	13.0	12.9
Narrowband	3 dB > AGC	1973.6	2.3	0.2	13.0	12.8
Wideband 5G	0.3 dB < AGC	1962.5	-0.5	8.4	13.0	4.6
Wideband 5G	3 dB > AGC	1962.5	2.8	8.5	13.0	4.5

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

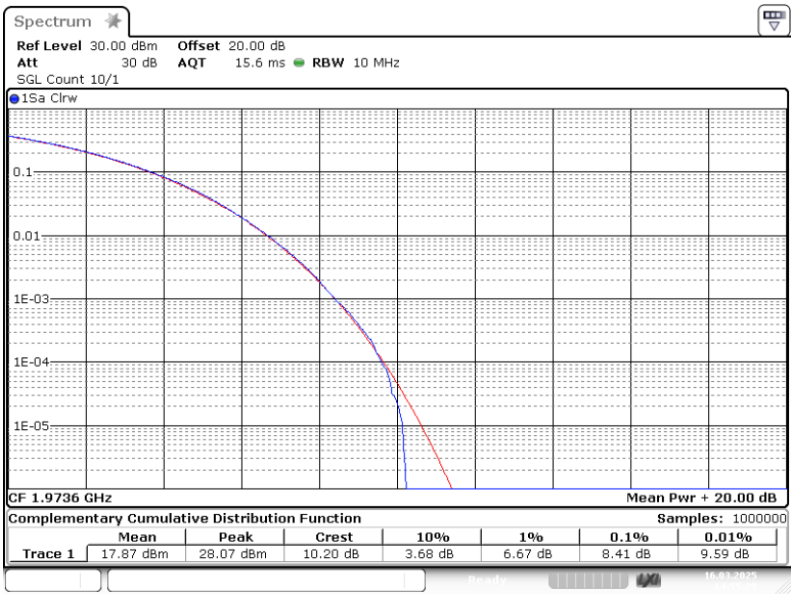
5.2.4 MEASUREMENT PLOT

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: AWGN; PAPR 0.3 dB < AGC



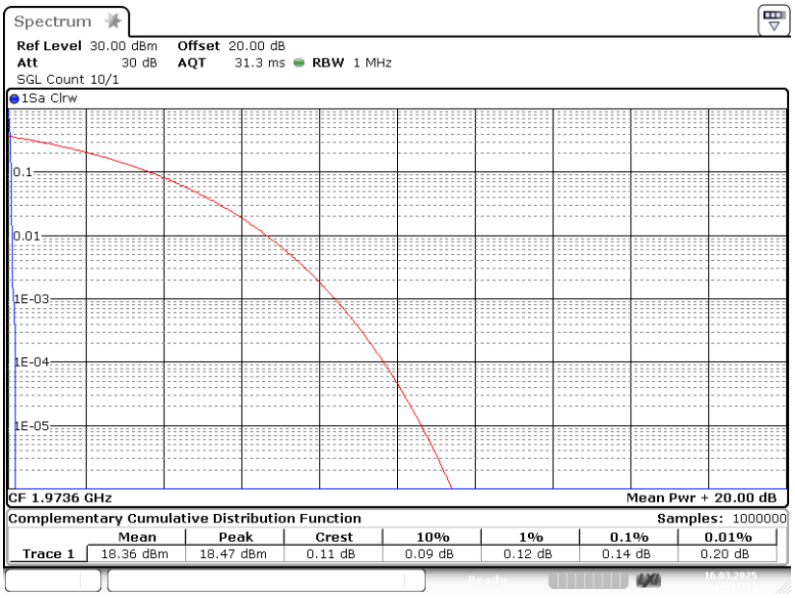
4.0 PAPR AWGN Out -0.3 1.974G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: AWGN; PAPR 3 dB > AGC



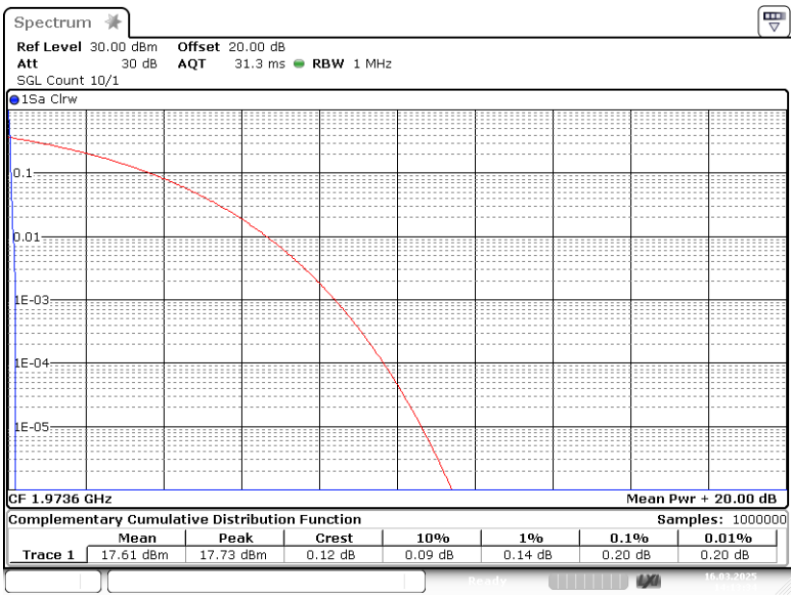
4.0 PAPR AWGN Out +3 1.974G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: GSM; PAPR 0.3 dB < AGC



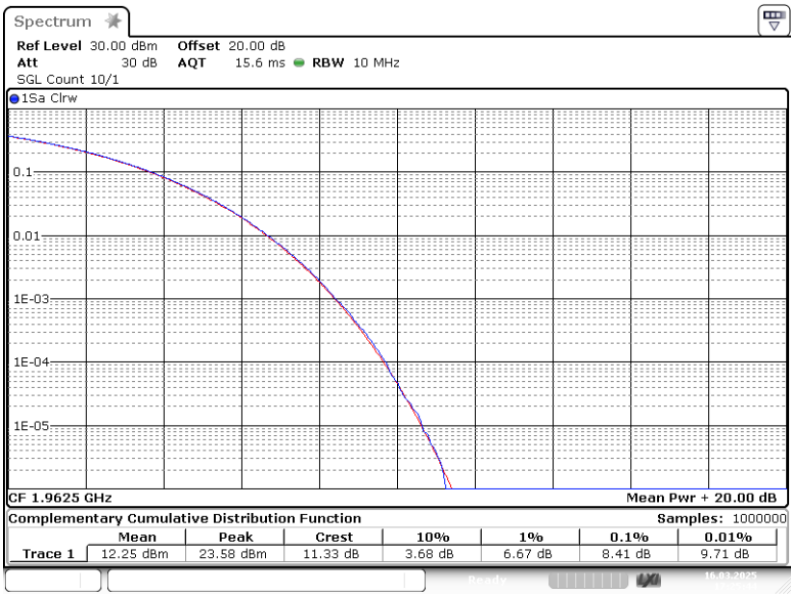
4.0 PAPR GSM Out -0.3 1.974G

Band: PCS 1900; Frequency: 1.9736 GHz; Band edge: f0; Mod: GSM; PAPR 3 dB > AGC



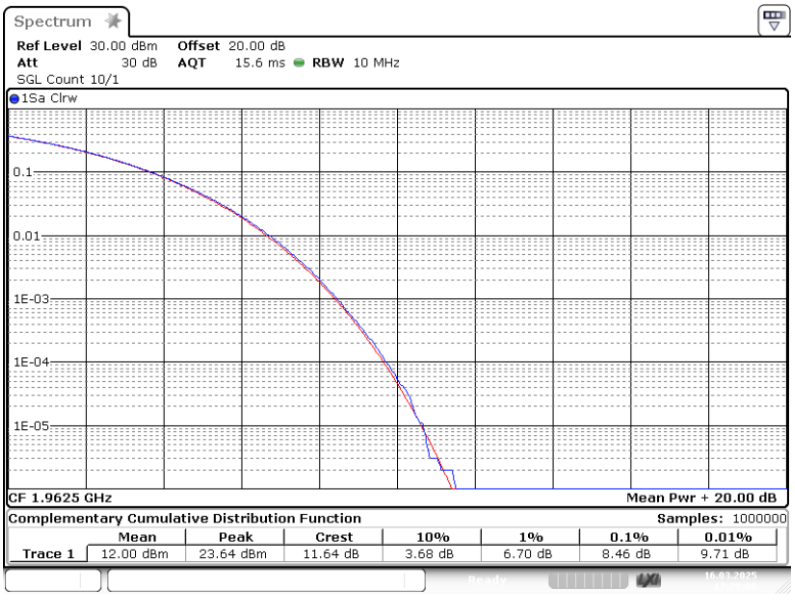
4.0 PAPR GSM Out +3 1.974G

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M; PAPR 0.3 dB < AGC



4.0 PAPR AWGN 45M Out -0.3 1.963G

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M; PAPR 3 dB > AGC



4.0 PAPR AWGN 45M Out +3 1.963G

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: 2025-03-16 – 2025-03-17

Environmental conditions: 23.2 °C; 27 % r. H./22.8 °C; 26 % r. H.

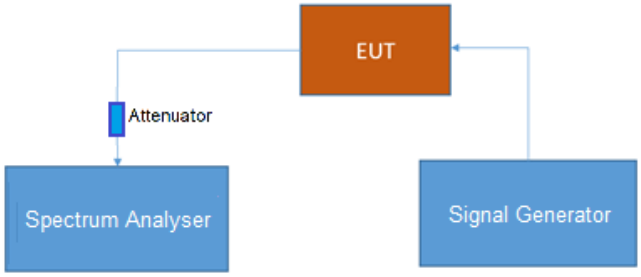
Test engineer: Thomas Hufnagel

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

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).

RSS-131; 9.2 Input-versus-output spectrum

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

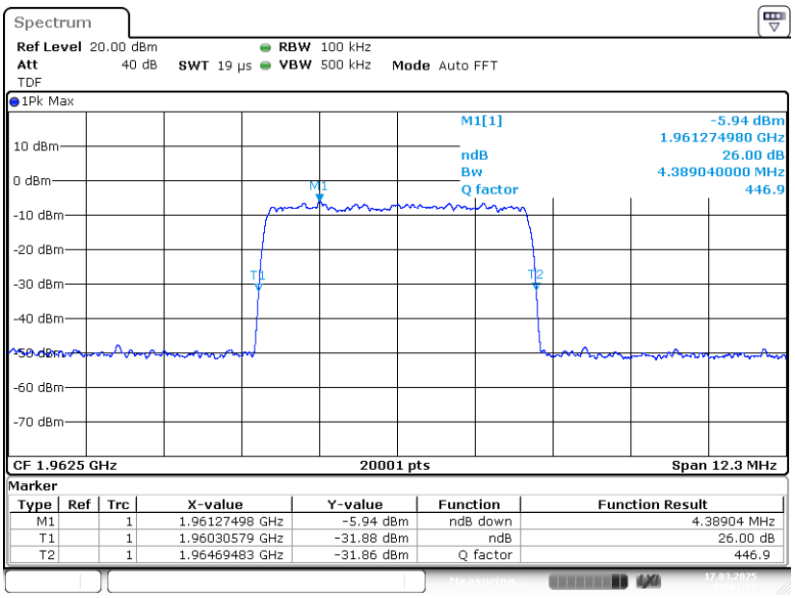
5.3.3 TEST PROTOCOL

Band 25, 1930 MHz – 1995 MHz, 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	1962.5	4389.0	4387.2	1.9	205.0	203.2
Wideband	3 dB > AGC	1962.5	4384.1	4389.0	4.9	205.0	200.1
Narrowband	0.3 dB < AGC	1962.5	319.4	313.9	5.5	10.0	4.5
Narrowband	3 dB > AGC	1962.5	316.8	316.7	0.1	10.0	9.9
Wideband 5G	0.3 dB < AGC	1962.5	46032.7	45918.0	114.7	1195.0	1080.3
Wideband 5G	3 dB > AGC	1962.5	46032.7	45985.5	47.2	1195.0	1147.8

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

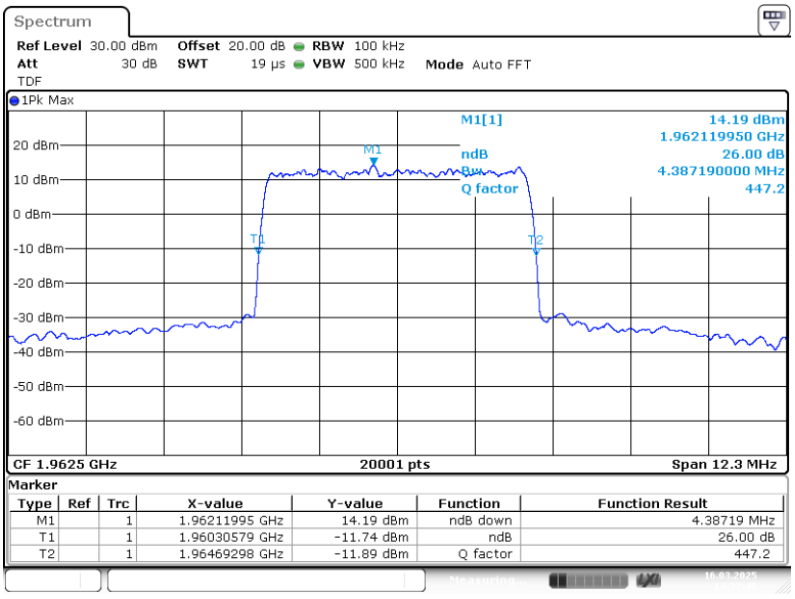
5.3.4 MEASUREMENT PLOT

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN;
Input OCBw 0.3 dB < AGC



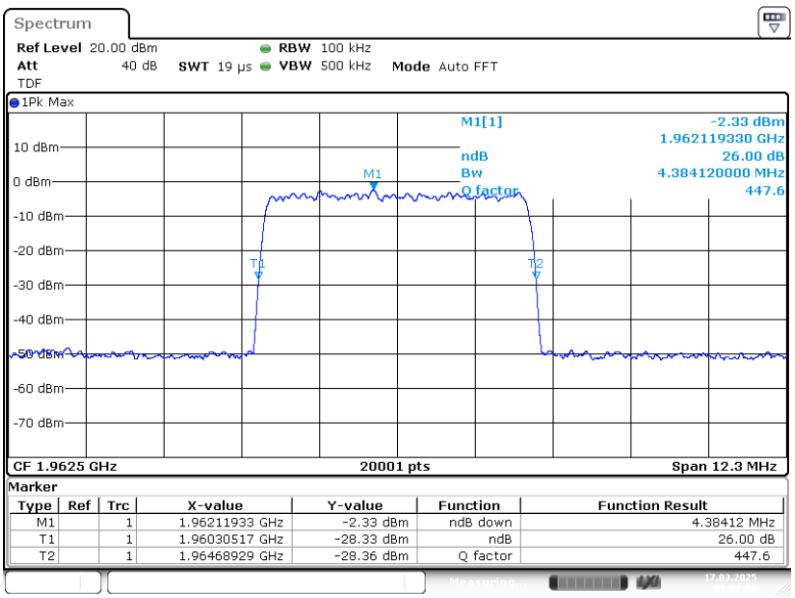
3.4 OCBw AWGN In-0.3 1.9625G _26dB

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN;
Output OCBw 0.3 dB < AGC



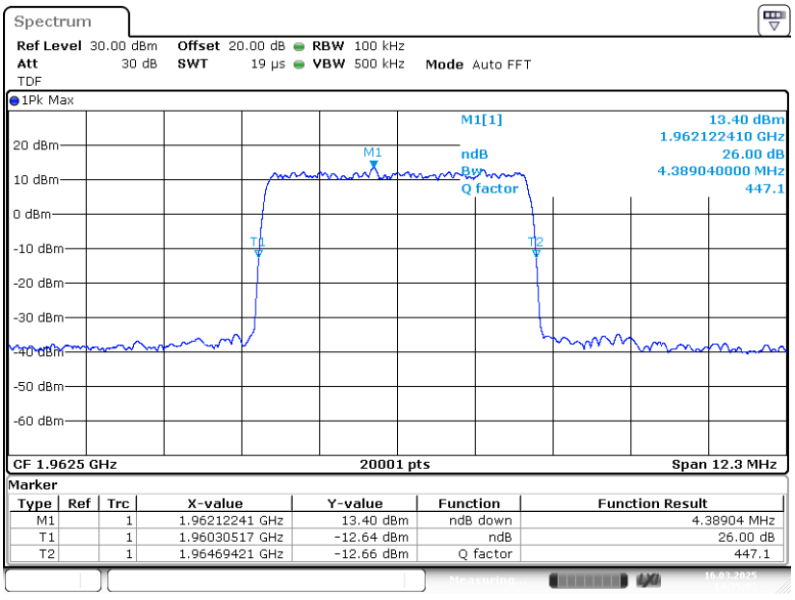
3.4 OCBw AWGN Out -0.3 1.9625G _26dB

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN;
Input OCBw 3 dB > AGC



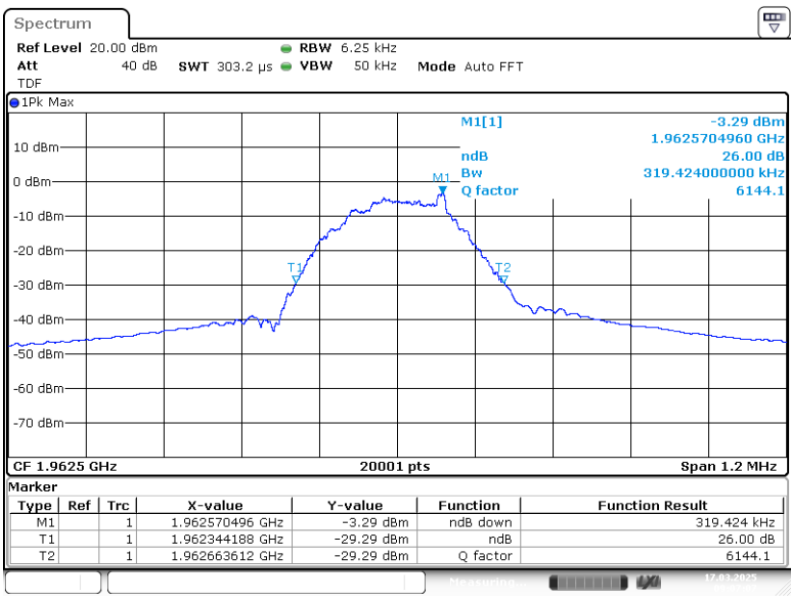
3.4 OCBw AWGN In+3 1.9625G _26dB

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN;
Output OCBw 3 dB > AGC



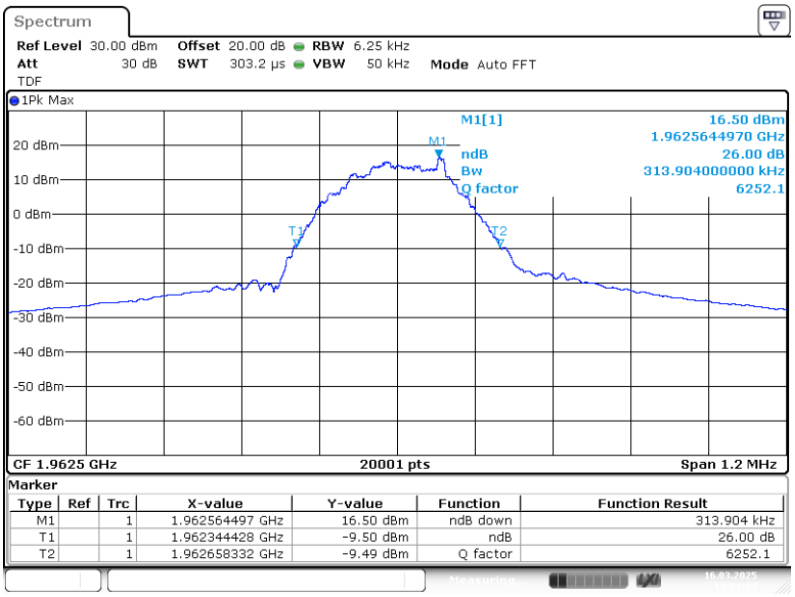
3.4 OCBw AWGN Out +3 1.9625G _26dB

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: GSM;
Input OCBw 0.3 dB < AGC



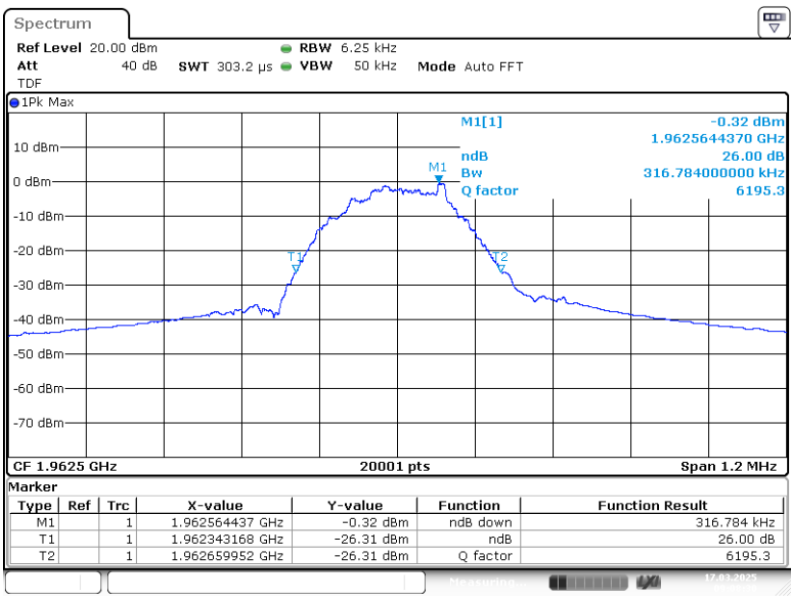
3.4 OCBw GSM In-0.3 1.9625G _26dB

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: GSM;
Output OCBw 0.3 dB < AGC



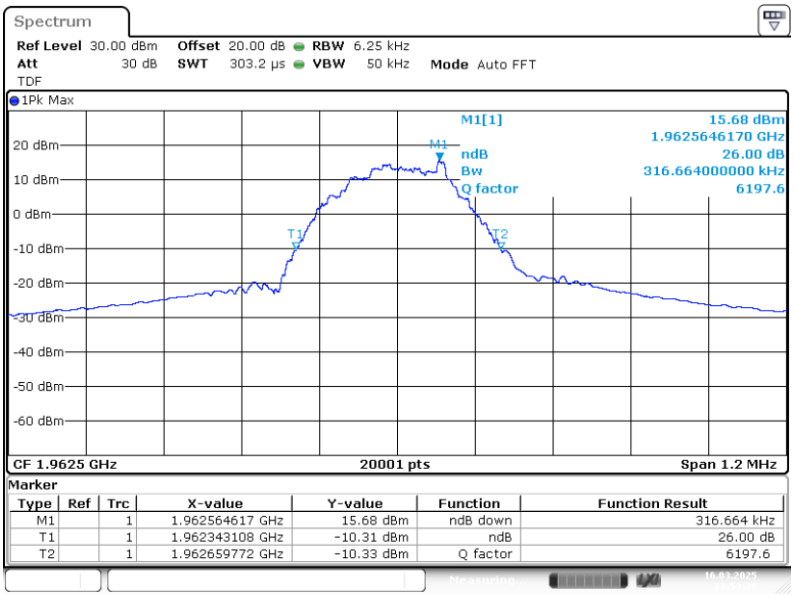
3.4 OCBw GSM Out -0.3 1.9625G _26dB

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: GSM;
Input OCBw 3 dB > AGC



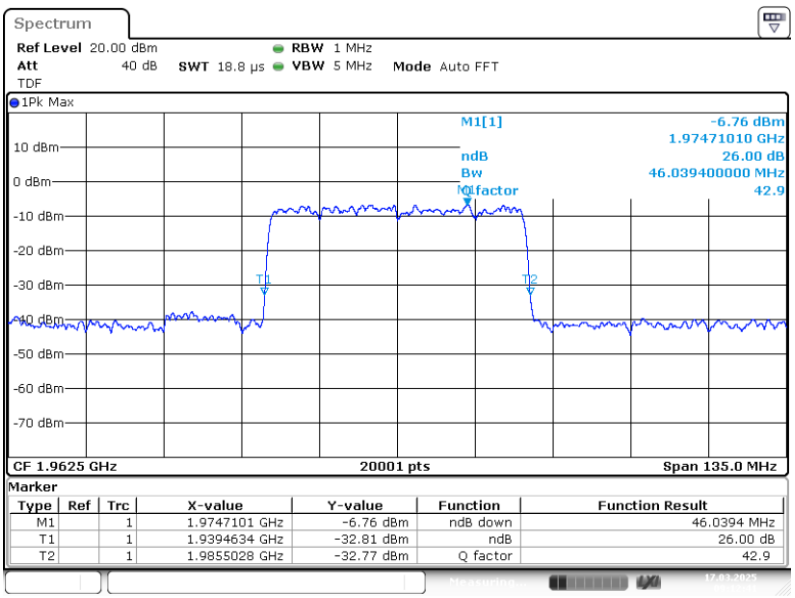
3.4 OCBw GSM In+3 1.9625G _26dB

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: GSM;
Output OCBw 3 dB > AGC



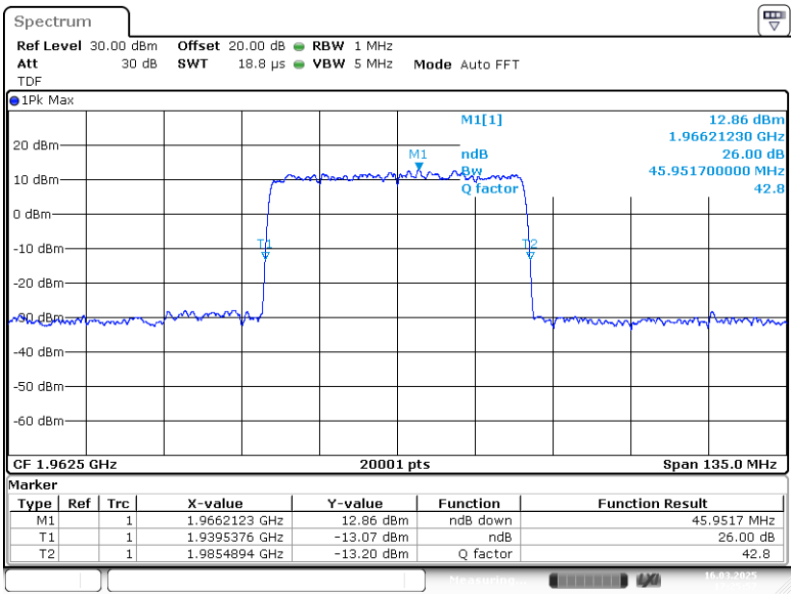
3.4 OCBw GSM Out +3 1.9625G _26dB

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Input OCBw 0.3 dB < AGC



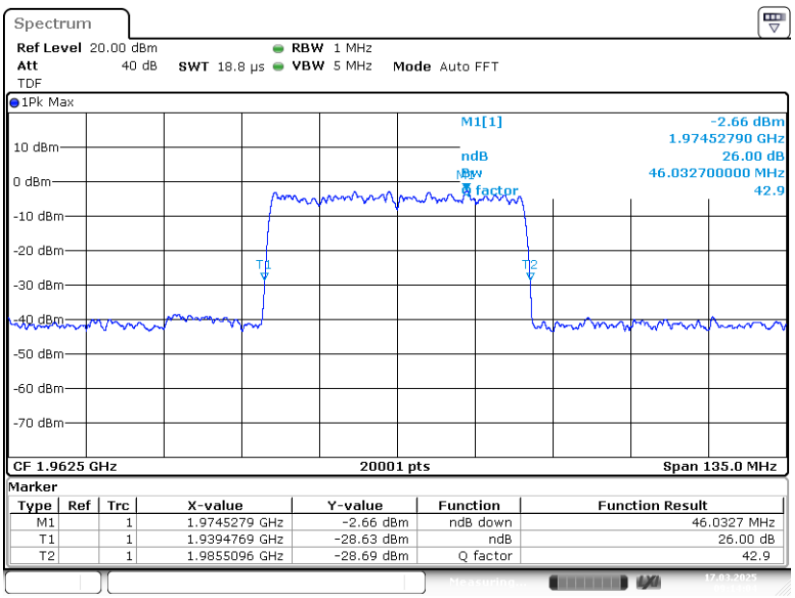
3.4 OCBw AWGN 45M In-0.3 1.9625G _26dB

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Output OCBw 0.3 dB < AGC



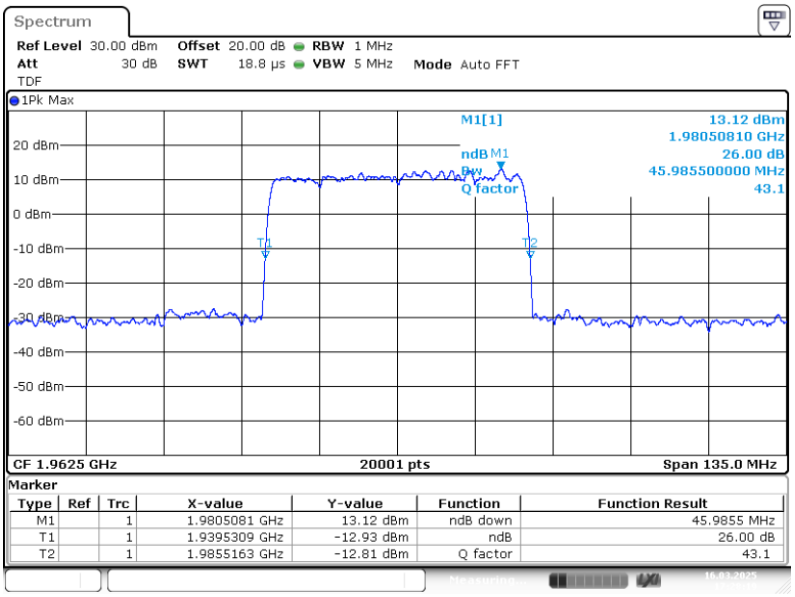
3.4 OCBw AWGN 45M Out -0.3 1.9625G _26dB

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Input OCBw 3 dB > AGC



3.4 OCBw AWGN 45M In+3 1.9625G _26dB

Band: PCS 1900; Frequency: 1.9625 GHz; Band edge: mid; Mod: AWGN 45M;
Output OCBw 3 dB > AGC



3.4 OCBw AWGN 45M Out +3 1.9625G _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: 2025-03-16 – 2025-03-17

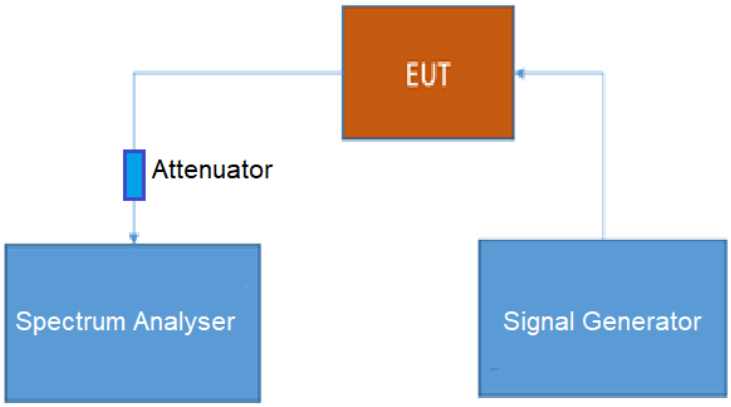
Environmental conditions: 23.2 °C; 27 % r. H./22.8 °C; 26 % r. H.

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

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 24, Subpart E – Cellular Radiotelephone Service

Abstract § 24.238 FCC:

§ 24.238 Emission limitations for cellular equipment.

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

(b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Abstract RSS-133 from ISED

RSS-133; 5.6 Unwanted Emission Limits

Unwanted emissions shall be measured in terms of average values while the transmitter is operating at the manufacturer's rated power and modulated as specified in RSS-Gen.

Equipment shall meet the unwanted emission limits, specified in table 3, outside each frequency block group. For each channel bandwidth supported by the equipment under test, the unwanted emissions shall be measured and reported for two channel frequencies: one located as close as possible to the low end and one located as close as possible to the high end of the equipment's operating frequency range.

For the unwanted emission limits, in the 1 MHz bands immediately outside and adjacent to the frequency block group, the power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth (OBW). Beyond these 1 MHz bands, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth may be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% of the OBW, as applicable.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors), where applicable, of the unwanted emissions outside the frequency block or frequency block group shall not exceed the limits shown in the table 3.

Table 3: Unwanted emission limits for all equipment

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

5.4.3 TEST PROTOCOL

General considerations concerning the limits:

The measuring bandwidth of 1 MHz is chosen for the wideband 1 and the narrowband. The limit here is at p = -13 dBm

For the wideband 5G a bandwidth of 100 kHz is necessary. Therefore the limit here is -23 dBm, 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.

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

Band 25, 1930 MHz – 1995 MHz, PCS 1900, downlink							
Test Frequency	**Signal Type**	**Spurious Freq. [MHz]**	**Spurious Level [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
low	Wideband	0.01455	-70.8	RMS	1	-43.0	27.8
low	Wideband	0.30746	-62.3	RMS	10	-33.0	29.3
low	Wideband	793.9	-63.2	RMS	100	-23.0	40.2
low	Wideband	1600.4	-52.6	RMS	1000	-13.0	39.6
low	Wideband	1928.6	-53.9	RMS	100	-23.0	30.9
low	Wideband	1997.0	-65.7	RMS	100	-23.0	42.7
low	Wideband	3055.1	-50.2	RMS	1000	-13.0	37.2
low	Wideband	6818.1	-51.0	RMS	1000	-13.0	38.0
low	Wideband	19542.8	-51.1	RMS	1000	-13.0	38.1
low	Wideband	20322.2	-50.5	RMS	1000	-13.0	37.5
low	Wideband	30322.5	-51.4	RMS	1000	-13.0	38.4
low	Wideband	39957.3	-52.9	RMS	1000	-13.0	39.9
mid	Wideband	0.00947	-71.8	RMS	1	-43.0	28.8
mid	Wideband	0.06750	-63.1	RMS	10	-33.0	30.1
mid	Wideband	950.1	-63.4	RMS	100	-23.0	40.4
mid	Wideband	1600.4	-54.1	RMS	1000	-13.0	41.1
mid	Wideband	1923.4	-66.4	RMS	100	-23.0	43.4
mid	Wideband	2002.3	-65.8	RMS	100	-23.0	42.8
mid	Wideband	3055.1	-49.7	RMS	1000	-13.0	36.7
mid	Wideband	6961.6	-50.8	RMS	1000	-13.0	37.8
mid	Wideband	19528.8	-51.0	RMS	1000	-13.0	38.0
mid	Wideband	20308.2	-50.5	RMS	1000	-13.0	37.5
mid	Wideband	30017.0	-51.5	RMS	1000	-13.0	38.5
mid	Wideband	39934.3	-52.7	RMS	1000	-13.0	39.7
high	Wideband	0.00959	-72.4	RMS	1	-43.0	29.4
high	Wideband	0.28246	-63.9	RMS	10	-33.0	30.9
high	Wideband	955.8	-63.6	RMS	100	-23.0	40.6
high	Wideband	1600.4	-53.7	RMS	1000	-13.0	40.7
high	Wideband	1925.7	-66.5	RMS	100	-23.0	43.5
high	Wideband	1996.0	-58.7	RMS	100	-23.0	35.7
high	Wideband	3055.6	-50.1	RMS	1000	-13.0	37.1
high	Wideband	6846.6	-50.9	RMS	1000	-13.0	37.9
high	Wideband	17875.4	-51.2	RMS	1000	-13.0	38.2
high	Wideband	20328.2	-50.6	RMS	1000	-13.0	37.6
high	Wideband	30342.0	-51.2	RMS	1000	-13.0	38.2
high	Wideband	39983.3	-52.5	RMS	1000	-13.0	39.5

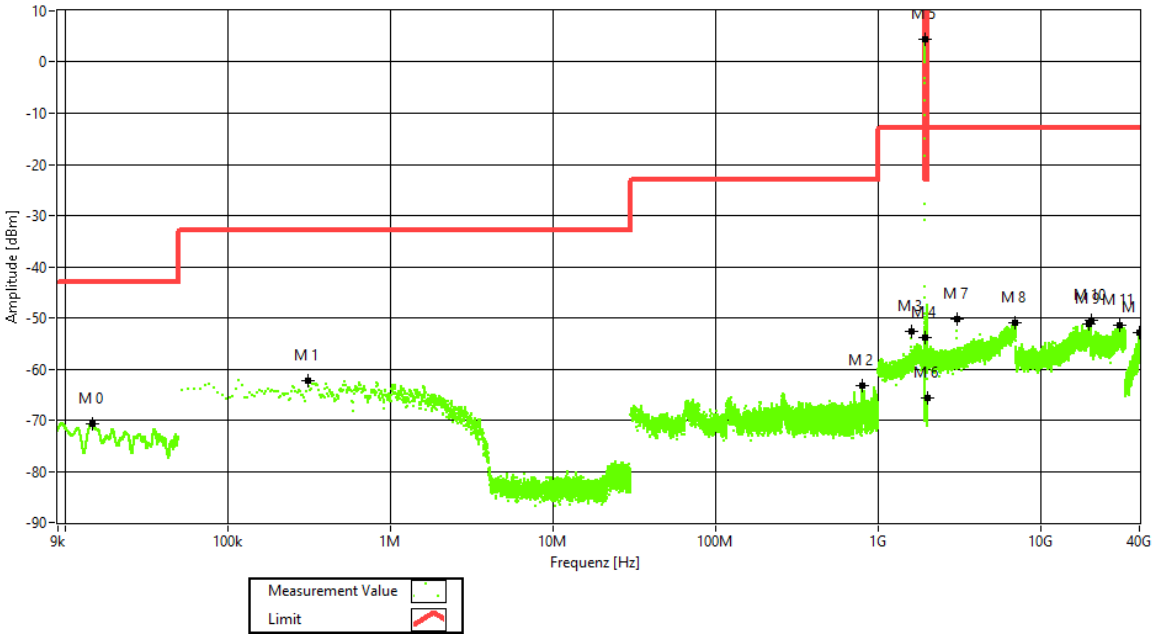
Band 25, 1930 MHz – 1995 MHz, PCS 1900, downlink							
Test Frequency	**Signal Type**	**Spurious Freq. [MHz]**	**Spurious Level [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
low	Narrowband	0.01770	-80.2	RMS	1	-43.0	37.2
low	Narrowband	0.05750	-74.0	RMS	10	-33.0	41.0
low	Narrowband	951.3	-64.0	RMS	100	-23.0	41.0
low	Narrowband	1600.4	-54.1	RMS	1000	-13.0	41.1
low	Narrowband	1928.9	-60.7	RMS	100	-23.0	37.7
low	Narrowband	1996.7	-64.5	RMS	100	-23.0	41.5
low	Narrowband	3055.6	-50.0	RMS	1000	-13.0	37.0
low	Narrowband	6965.6	-50.8	RMS	1000	-13.0	37.8
low	Narrowband	19547.8	-51.1	RMS	1000	-13.0	38.1
low	Narrowband	20254.7	-50.7	RMS	1000	-13.0	37.7
low	Narrowband	30258.0	-51.3	RMS	1000	-13.0	38.3
low	Narrowband	39968.8	-53.0	RMS	1000	-13.0	40.0
mid	Narrowband	0.00963	-80.0	RMS	1	-43.0	37.0
mid	Narrowband	0.05250	-74.0	RMS	10	-33.0	41.0
mid	Narrowband	949.1	-63.7	RMS	100	-23.0	40.7
mid	Narrowband	1600.4	-52.8	RMS	1000	-13.0	39.8
mid	Narrowband	1924.3	-66.0	RMS	100	-23.0	43.0
mid	Narrowband	1998.0	-65.8	RMS	100	-23.0	42.8
mid	Narrowband	3055.1	-50.4	RMS	1000	-13.0	37.4
mid	Narrowband	6943.1	-50.8	RMS	1000	-13.0	37.8
mid	Narrowband	19537.3	-51.3	RMS	1000	-13.0	38.3
mid	Narrowband	20292.7	-50.8	RMS	1000	-13.0	37.8
mid	Narrowband	30296.0	-51.4	RMS	1000	-13.0	38.4
mid	Narrowband	39982.8	-52.7	RMS	1000	-13.0	39.7
high	Narrowband	0.01881	-79.3	RMS	1	-43.0	36.3
high	Narrowband	0.05750	-73.2	RMS	10	-33.0	40.2
high	Narrowband	950.0	-63.1	RMS	100	-23.0	40.1
high	Narrowband	1600.4	-53.6	RMS	1000	-13.0	40.6
high	Narrowband	1926.2	-66.0	RMS	100	-23.0	43.0
high	Narrowband	1996.0	-61.2	RMS	100	-23.0	38.2
high	Narrowband	3055.1	-50.1	RMS	1000	-13.0	37.1
high	Narrowband	6866.1	-50.7	RMS	1000	-13.0	37.7
high	Narrowband	19990.8	-51.0	RMS	1000	-13.0	38.0
high	Narrowband	20293.7	-50.6	RMS	1000	-13.0	37.6
high	Narrowband	30274.5	-51.3	RMS	1000	-13.0	38.3
high	Narrowband	39986.7	-52.9	RMS	1000	-13.0	39.9

Band 25, 1930 MHz – 1995 MHz, PCS 1900, downlink							
Test Frequency	**Signal Type**	**Spurious Freq. [MHz]**	**Spurious Level [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
low	Wideband 5G	0.02413	-79.2	RMS	1	-43.0	36.2
low	Wideband 5G	0.12749	-70.1	RMS	10	-33.0	37.1
low	Wideband 5G	811.3	-63.4	RMS	100	-23.0	40.4
low	Wideband 5G	1600.4	-53.5	RMS	1000	-13.0	40.5
low	Wideband 5G	1927.0	-61.4	RMS	100	-23.0	38.4
low	Wideband 5G	1997.1	-65.0	RMS	100	-23.0	42.0
low	Wideband 5G	3055.1	-49.5	RMS	1000	-13.0	36.5
low	Wideband 5G	6848.1	-50.7	RMS	1000	-13.0	37.7
low	Wideband 5G	19512.8	-50.8	RMS	1000	-13.0	37.8
low	Wideband 5G	20269.7	-50.6	RMS	1000	-13.0	37.6
low	Wideband 5G	29987.0	-51.4	RMS	1000	-13.0	38.4
low	Wideband 5G	39998.3	-52.4	RMS	1000	-13.0	39.4
mid	Wideband 5G	0.01222	-79.3	RMS	1	-43.0	36.3
mid	Wideband 5G	0.05750	-71.5	RMS	10	-33.0	38.5
mid	Wideband 5G	810.0	-64.1	RMS	100	-23.0	41.1
mid	Wideband 5G	1599.9	-53.6	RMS	1000	-13.0	40.6
mid	Wideband 5G	1922.3	-63.1	RMS	100	-23.0	40.1
mid	Wideband 5G	1997.8	-65.2	RMS	100	-23.0	42.2
mid	Wideband 5G	3055.6	-50.5	RMS	1000	-13.0	37.5
mid	Wideband 5G	6842.1	-51.0	RMS	1000	-13.0	38.0
mid	Wideband 5G	19878.3	-51.5	RMS	1000	-13.0	38.5
mid	Wideband 5G	20291.2	-50.5	RMS	1000	-13.0	37.5
mid	Wideband 5G	30306.0	-51.0	RMS	1000	-13.0	38.0
mid	Wideband 5G	39989.8	-52.4	RMS	1000	-13.0	39.4
high	Wideband 5G	0.01336	-79.1	RMS	1	-43.0	36.1
high	Wideband 5G	0.05250	-69.9	RMS	10	-33.0	36.9
high	Wideband 5G	796.7	-63.5	RMS	100	-23.0	40.5
high	Wideband 5G	1600.4	-53.3	RMS	1000	-13.0	40.3
high	Wideband 5G	1928.3	-64.0	RMS	100	-23.0	41.0
high	Wideband 5G	1996.1	-64.8	RMS	100	-23.0	41.8
high	Wideband 5G	3055.1	-49.1	RMS	1000	-13.0	36.1
high	Wideband 5G	6874.1	-50.7	RMS	1000	-13.0	37.7
high	Wideband 5G	19554.3	-51.1	RMS	1000	-13.0	38.1
high	Wideband 5G	20309.7	-50.8	RMS	1000	-13.0	37.8
high	Wideband 5G	30310.0	-51.2	RMS	1000	-13.0	38.2
high	Wideband 5G	39922.3	-52.9	RMS	1000	-13.0	39.9

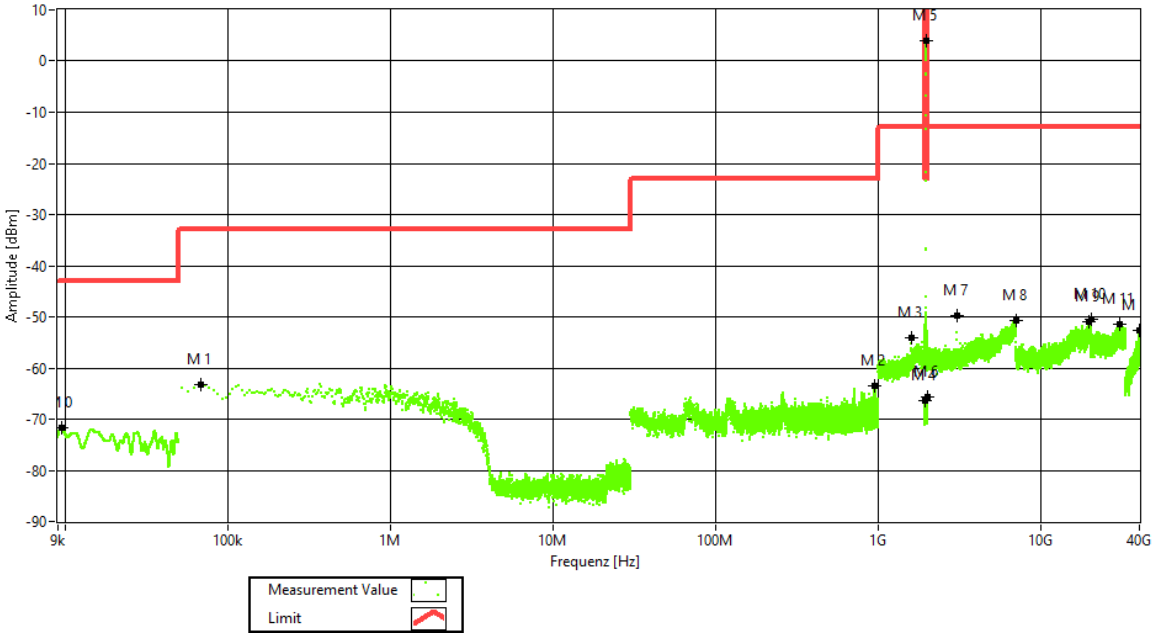
Remark: Please see next sub-clause for the measurement plot.

5.4.4 MEASUREMENT PLOT

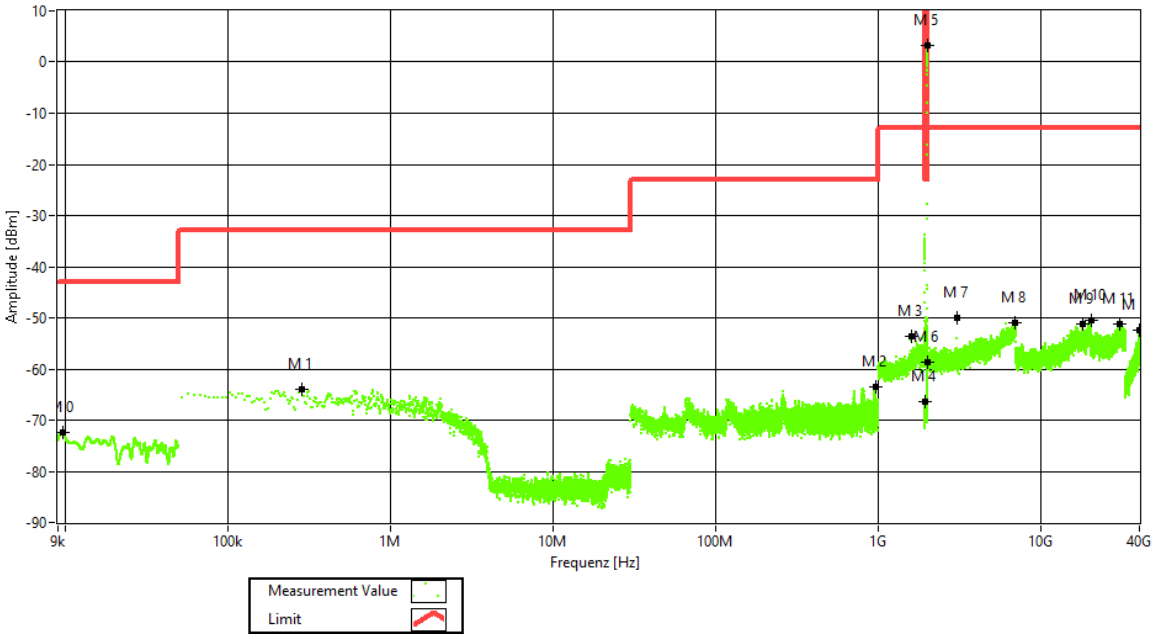
Frequency Band = PCS 1900; Test frequency = low; Direction = RF downlink;
Signal type = Wideband



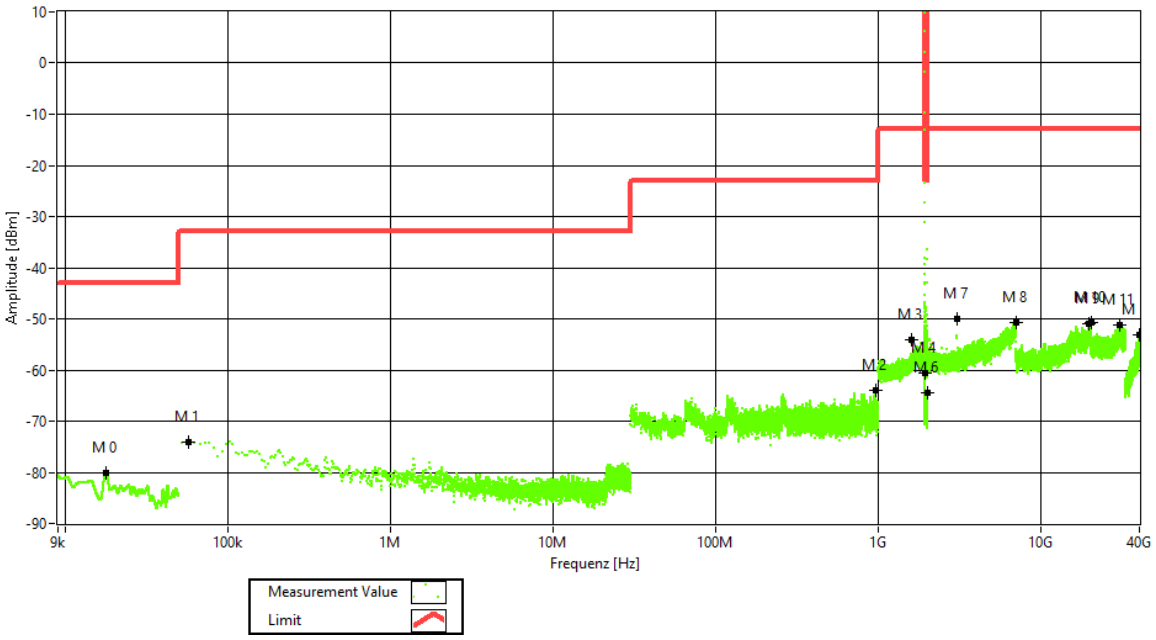
Frequency Band = PCS 1900; Test frequency = mid; Direction = RF downlink;
Signal type = Wideband



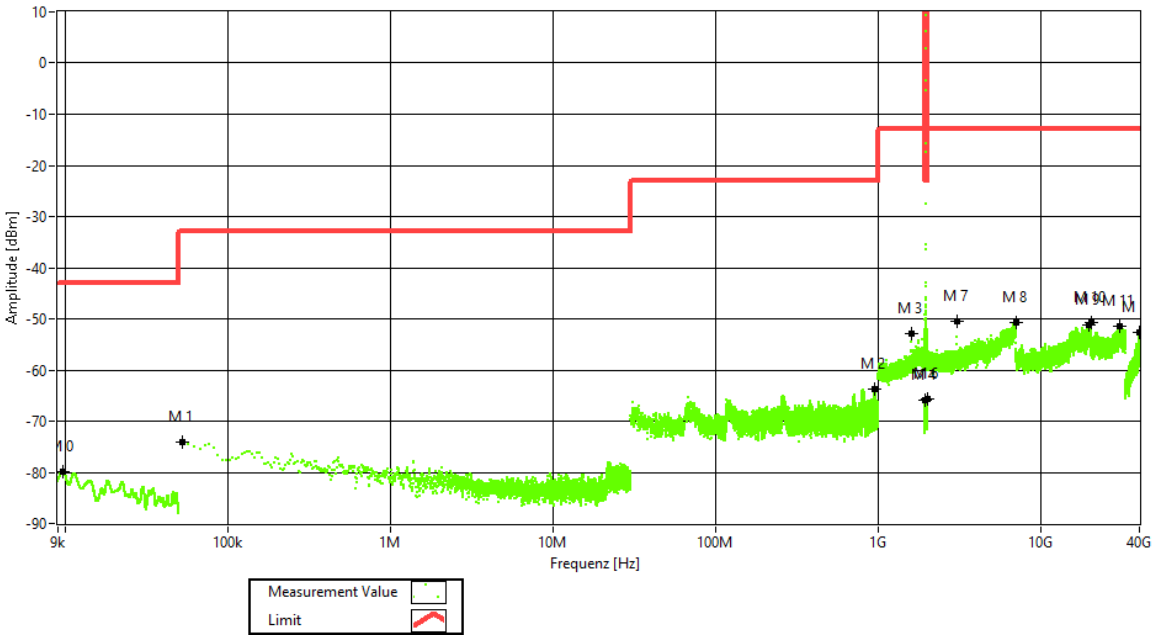
Frequency Band = PCS 1900; Test frequency = high; Direction = RF downlink;
Signal type = Wideband



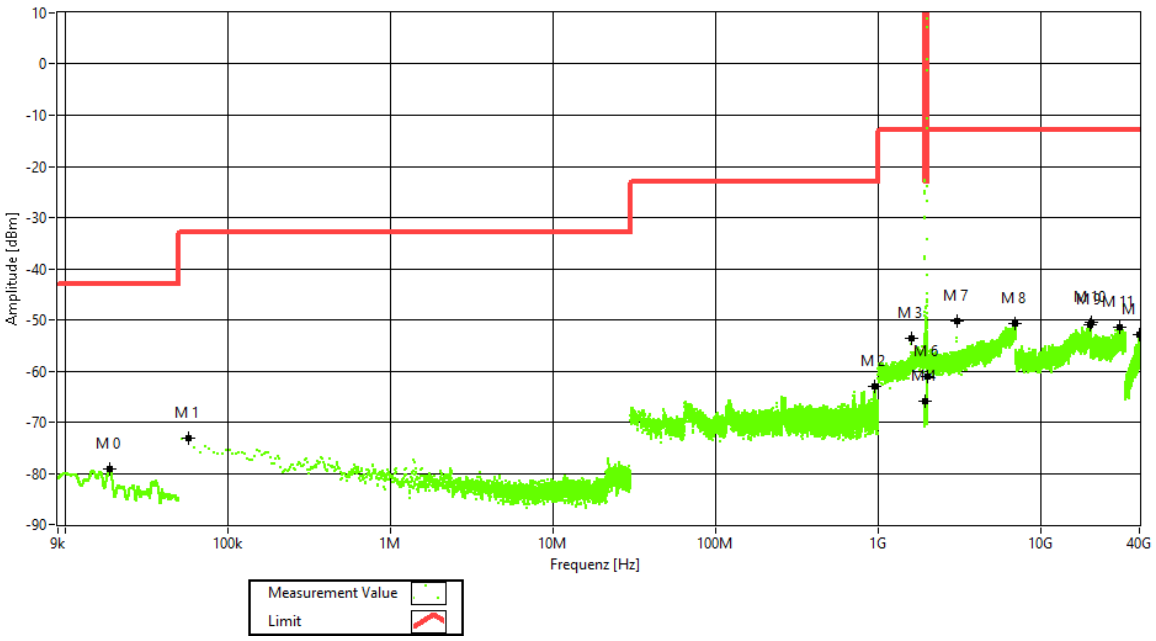
Frequency Band = PCS 1900; Test frequency = low; Direction = RF downlink;
Signal type = Narrowband



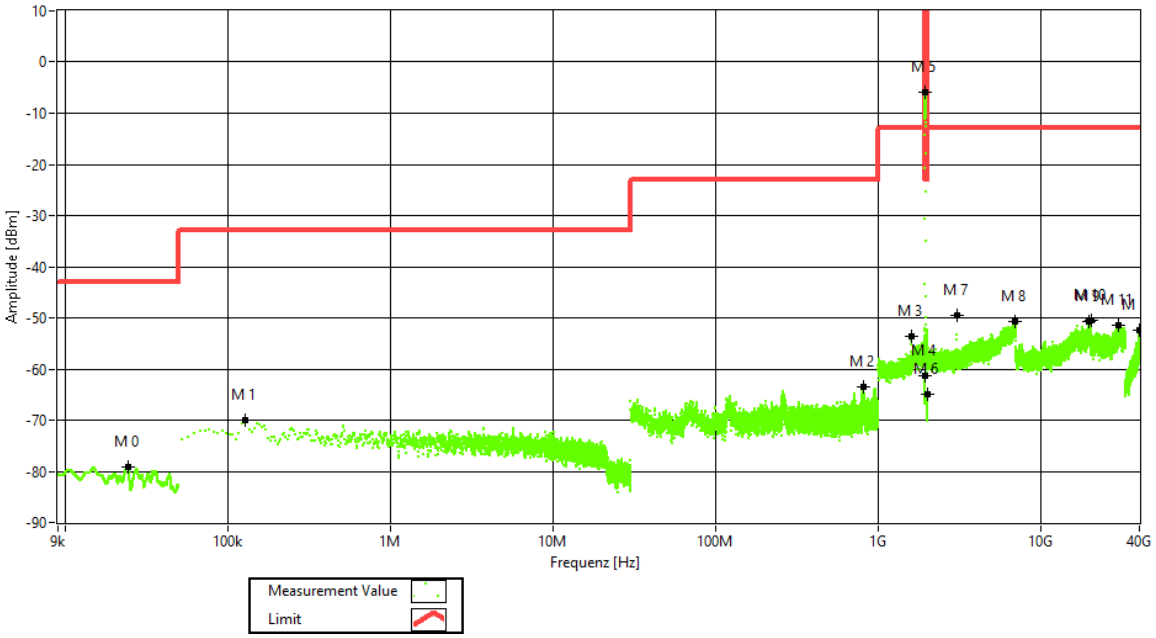
Frequency Band = PCS 1900; Test frequency = mid; Direction = RF downlink;
Signal type = Narrowband



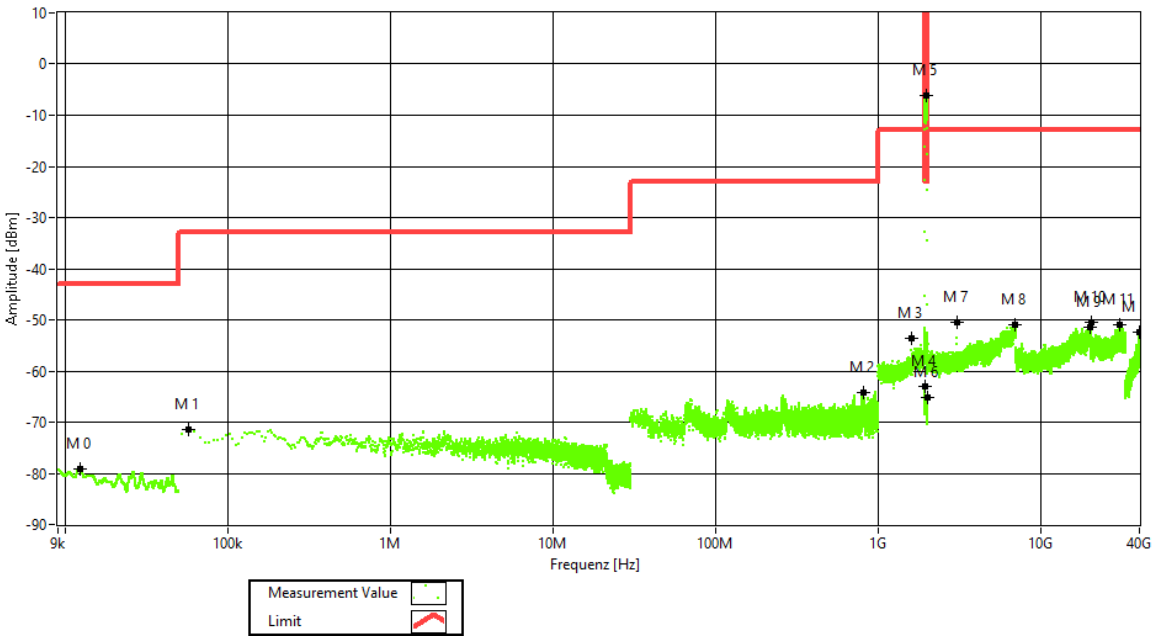
Frequency Band = PCS 1900; Test frequency = high; Direction = RF downlink;
Signal type = Narrowband



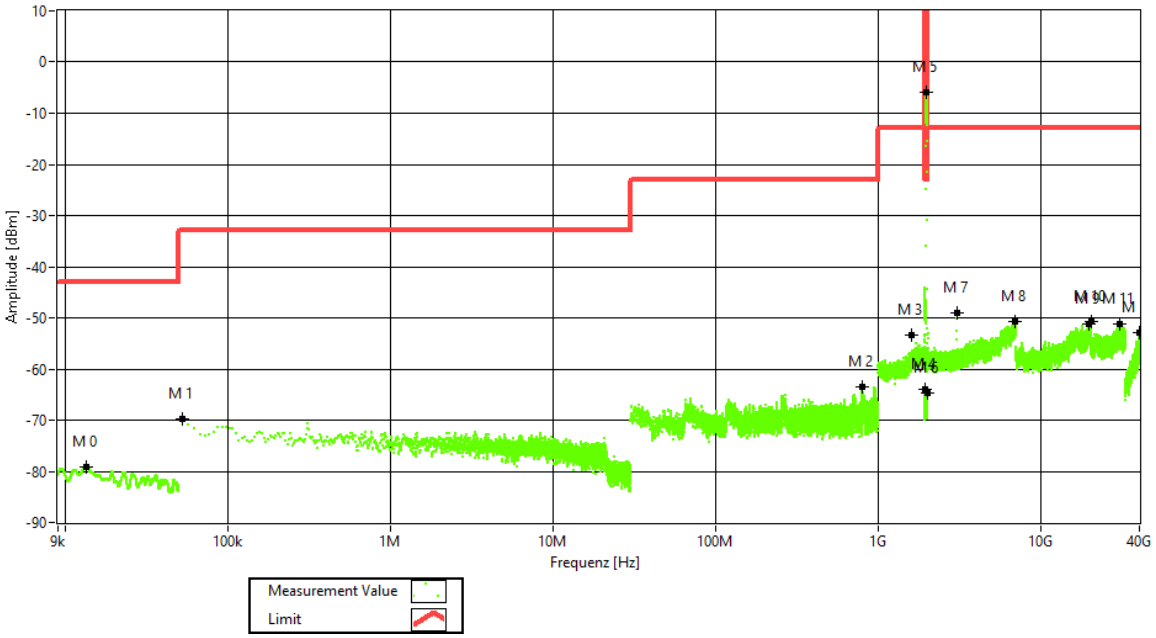
Frequency Band = PCS 1900; Test frequency = low; Direction = RF downlink;
Signal type = Wideband 5G



Frequency Band = PCS 1900; Test frequency = mid; Direction = RF downlink;
Signal type = Wideband 5G



Frequency Band = PCS 1900; 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: 2025-03-16 – 2025-03-17

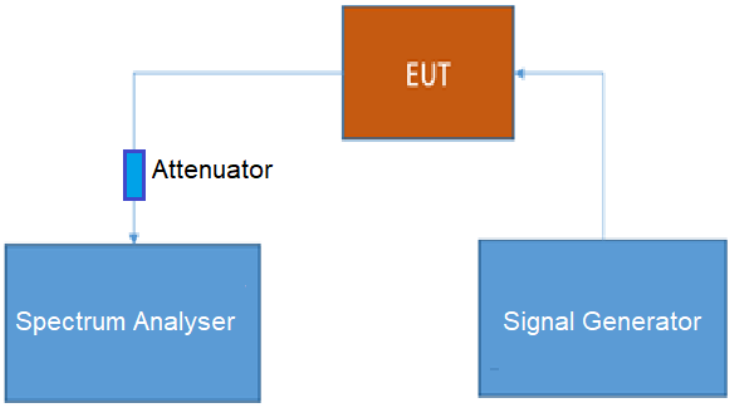
Environmental conditions: 23.2 °C; 27 % r. H./22.8 °C; 26 % r. H.

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

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 24, Subpart E – Cellular Radiotelephone Service

Abstract § 24.238 FCC:

§ 24.238 Emission limitations for cellular equipment.

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

(b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Abstract RSS-133 from ISED

RSS-133; 5.6 Unwanted Emission Limits

Unwanted emissions shall be measured in terms of average values while the transmitter is operating at the manufacturer's rated power and modulated as specified in RSS-Gen.

Equipment shall meet the unwanted emission limits, specified in table 3, outside each frequency block group. For each channel bandwidth supported by the equipment under test, the unwanted emissions shall be measured and reported for two channel frequencies: one located as close as possible to the low end and one located as close as possible to the high end of the equipment's operating frequency range.

For the unwanted emission limits, in the 1 MHz bands immediately outside and adjacent to the frequency block group, the power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth (OBW). Beyond these 1 MHz bands, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth may be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% of the OBW, as applicable.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors), where applicable, of the unwanted emissions outside the frequency block or frequency block group shall not exceed the limits shown in the table 3.

Table 3: Unwanted emission limits for all equipment

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

5.5.3 TEST PROTOCOL

5.5.4 TEST PROTOCOL

Band 25, 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	1992.50	-0.9	-52.9	-13.0	39.9
Wideband	3 dB > AGC	upper	1992.50	2.4	-57.0	-13.0	44.0
Wideband 5G	0.3 dB < AGC	upper	1972.50	-1.2	-53.5	-13.0	40.5
Wideband 5G	3 dB > AGC	upper	1972.50	1.8	-53.8	-13.0	40.8
Narrowband	0.3 dB < AGC	upper	1994.80	-0.7	-42.5	-13.0	29.5
Narrowband	3 dB > AGC	upper	1994.80	2.6	-43.0	-13.0	30.0
Wideband	0.3 dB < AGC	lower	1932.50	0.5	-52.6	-13.0	39.6
Wideband	3 dB > AGC	lower	1932.50	3.8	-54.0	-13.0	41.0
Wideband 5G	0.3 dB < AGC	lower	1952.50	0.2	-52.6	-13.0	39.6
Wideband 5G	3 dB > AGC	lower	1952.50	3.2	-52.5	-13.0	39.5
Narrowband	0.3 dB < AGC	lower	1930.20	0.3	-40.3	-13.0	27.3
Narrowband	3 dB > AGC	lower	1930.20	3.6	-41.8	-13.0	28.8

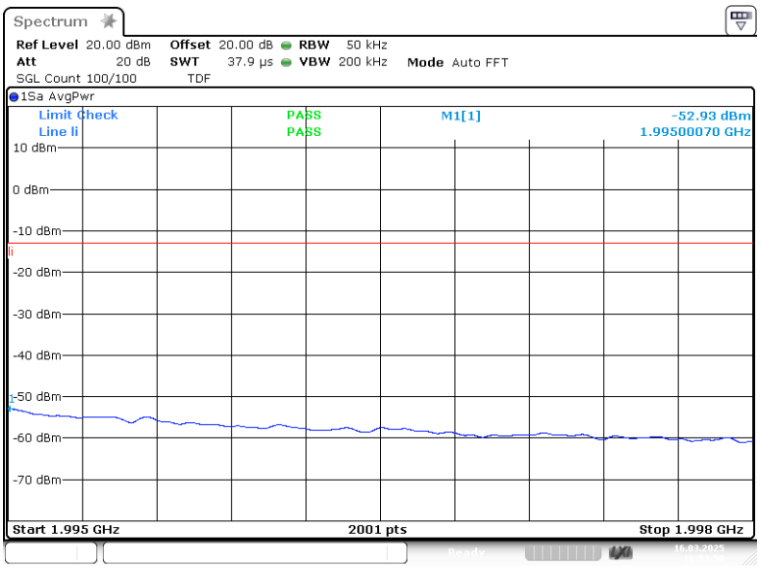
Band 25, downlink, Number of input signals = 2								
Signal type	**Input power**	**Band edge**	**Signal frequency f1 [MHz]**	**Signal frequency f2 [MHz]**	**Input power [dBm]**	**Maximum out-of-band power [dBm]**	**Limit out-of-band power [dBm]**	**Margin to limit [dB]**
WB	-0.3 dB < AGC	upper	1992.5	1990.0	-0.9	-56.8	-13.0	43.8
WB	3 dB > AGC	upper	1992.5	1990.0	2.4	-58.4	-13.0	45.4
NB	-0.3 dB < AGC	upper	1994.8	1994.6	-0.7	-45.1	-13.0	32.1
NB	3 dB > AGC	upper	1994.8	1994.6	2.6	-45.9	-13.0	32.9
WB	-0.3 dB < AGC	lower	1932.5	1935.0	0.5	-55.3	-13.0	42.3
WB	3 dB > AGC	lower	1932.5	1935.0	3.8	-55.5	-13.0	42.5
NB	-0.3 dB < AGC	lower	1930.2	1930.4	0.3	-44.0	-13.0	31.0
NB	3 dB > AGC	lower	1930.2	1930.4	3.6	-44.5	-13.0	31.5

"WB" means Wideband.
"NB" means Narrowband.

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

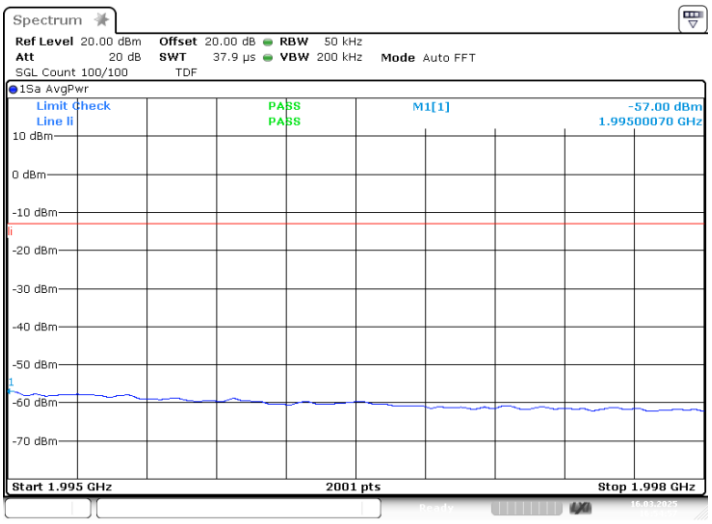
5.5.5 MEASUREMENT PLOT

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: upper; Mod: AWGN; Input power = 0.3 dB < AGC; Number of signals 1



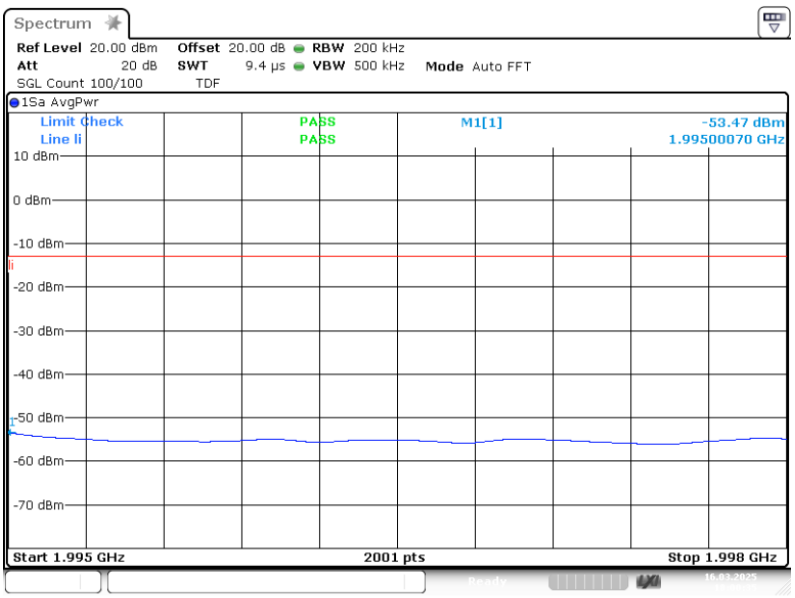
3.6.2 out of band emi PCS1900 AWGN upper 1carrier -0.3 dB 1.
995G 1.998G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: upper; Mod: AWGN; Input power = 3 dB > AGC; Number of signals 1



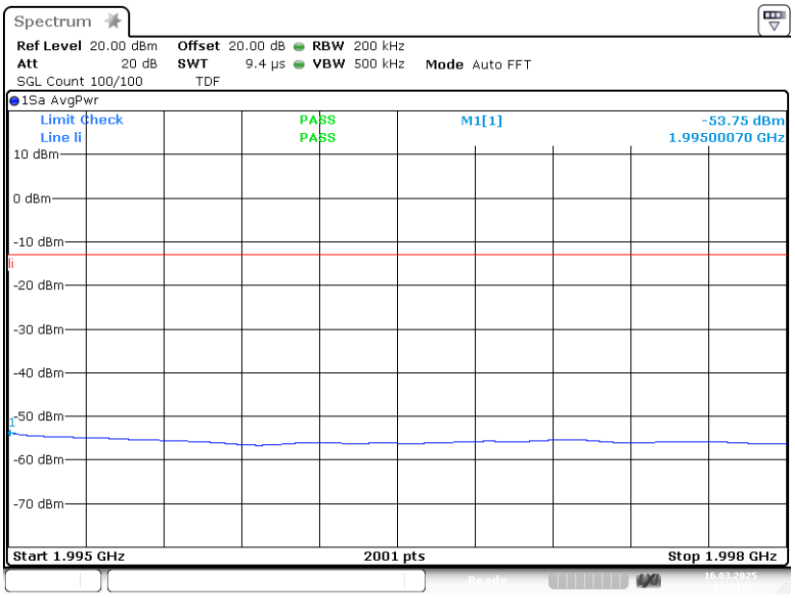
3.6.2 out of band emi PCS1900 AWGN upper 1carrier +3.0 dB 1.
995G 1.998G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: upper;Mod: AWGN 45M; Input power = 0.3 dB < AGC; Number of signals 1



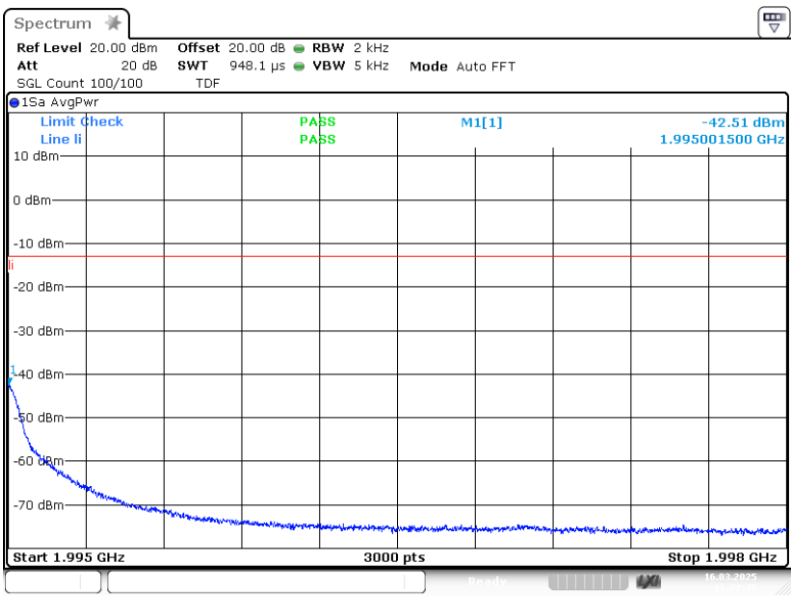
3.6.2 out of band emi PCS1900 AWGN 45M upper 1carrier -0.3 d
B 1.995G 1.998G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: upper;Mod: AWGN 45M; Input power = 3 dB > AGC; Number of signals 1



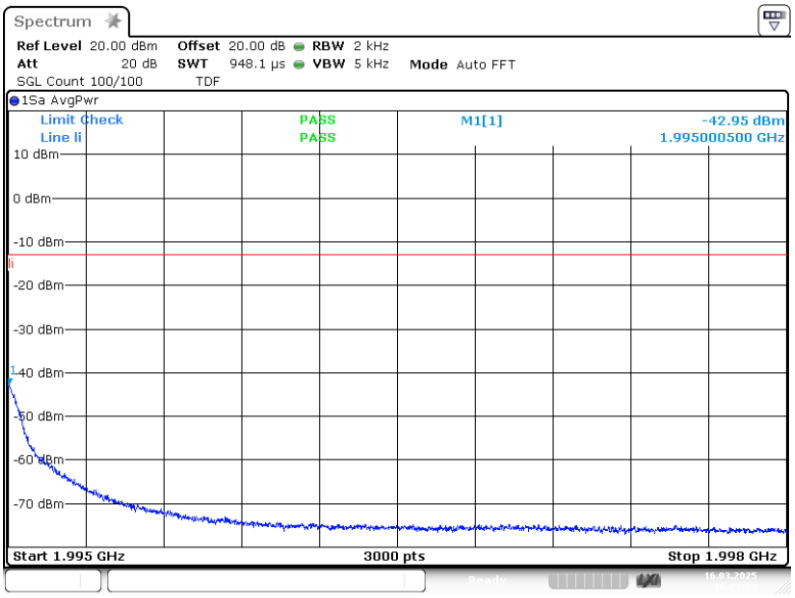
3.6.2 out of band emi PCS1900 AWGN 45M upper 1carrier +3.0 d
B 1.995G 1.998G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: upper; Mod: GSM; Input power = 0.3 dB < AGC; Number of signals 1



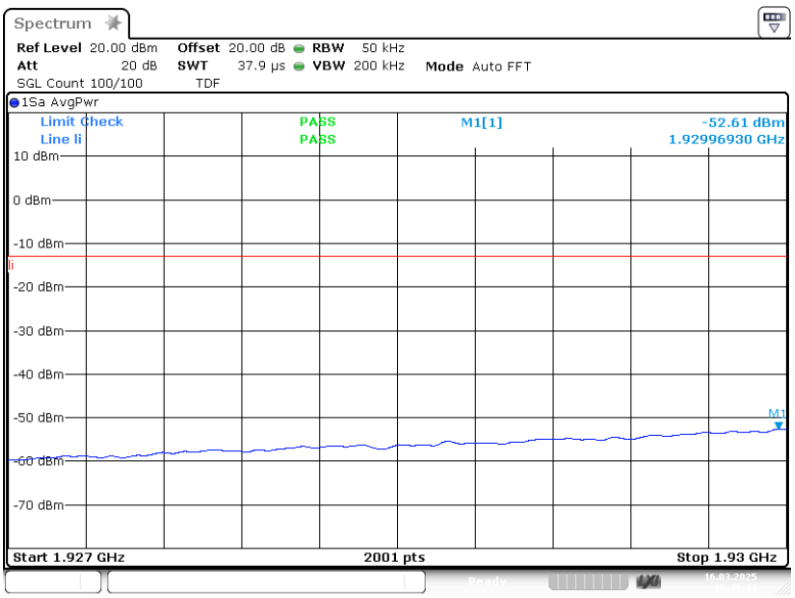
3.6.2 out of band emi PCS1900 GSM upper 1carrier -0.3 dB 1.9
95G 1.998G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: upper; Mod: GSM; Input power = 3 dB > AGC; Number of signals 1



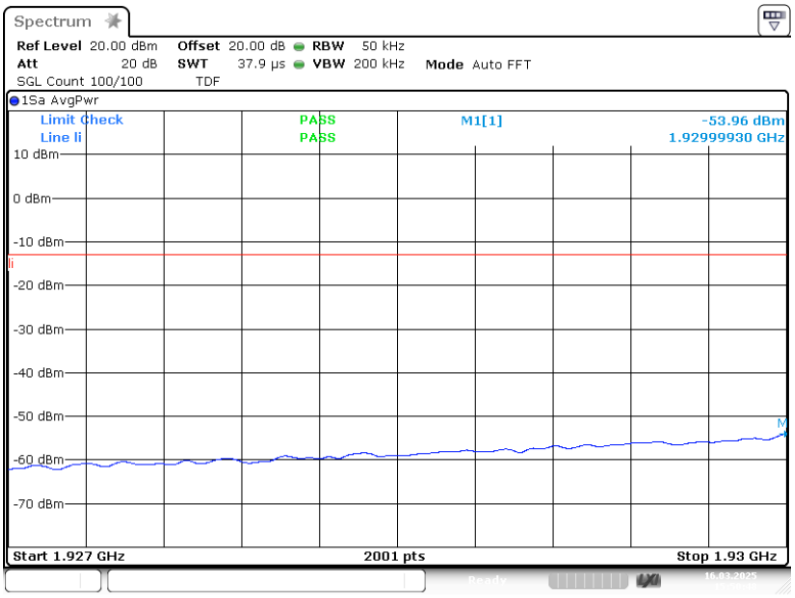
3.6.2 out of band emi PCS1900 GSM upper 1carrier +3.0 dB 1.9
95G 1.998G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: lower; Mod: AWGN;
Input power = 0.3 dB < AGC; Number of signals 1



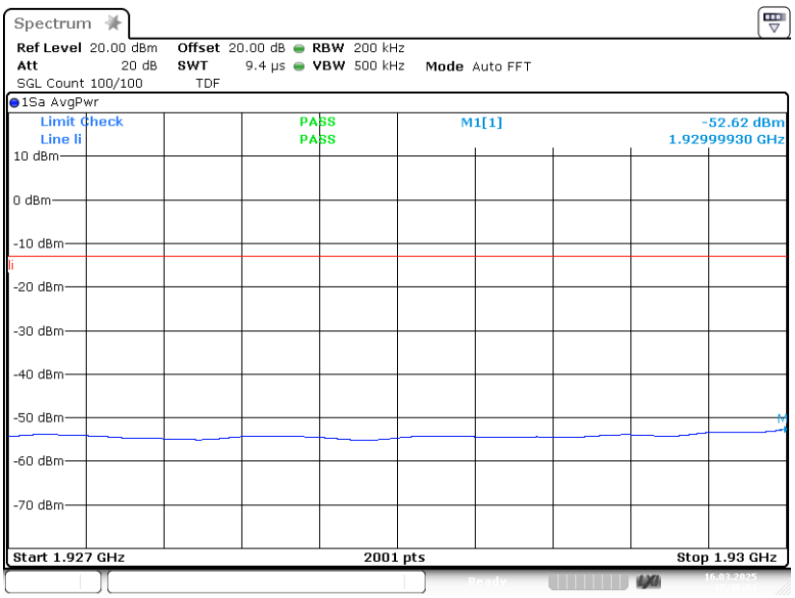
3.6.2 out of band emi PCS1900 AWGN lower 1carrier -0.3 dB 1.
927G 1.930G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: lower; Mod: AWGN;
Input power = 3 dB > AGC; Number of signals 1



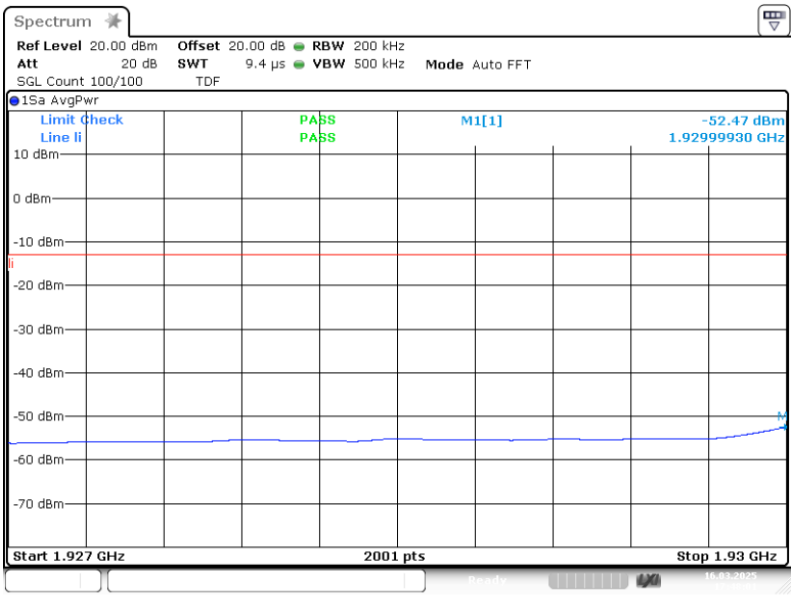
3.6.2 out of band emi PCS1900 AWGN lower 1carrier +3.0 dB 1.
927G 1.930G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: lower; Mod: AWGN 45M; Input power = 0.3 dB < AGC; Number of signals 1



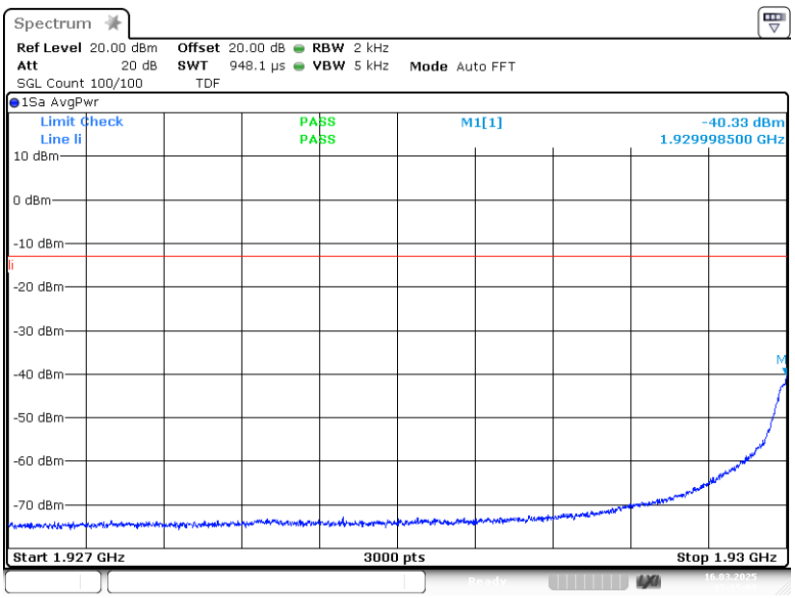
3.6.2 out of band emi PCS1900 AWGN 45M lower 1carrier -0.3 d
B 1.927G 1.930G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: lower; Mod: AWGN 45M; Input power = 3 dB > AGC; Number of signals 1



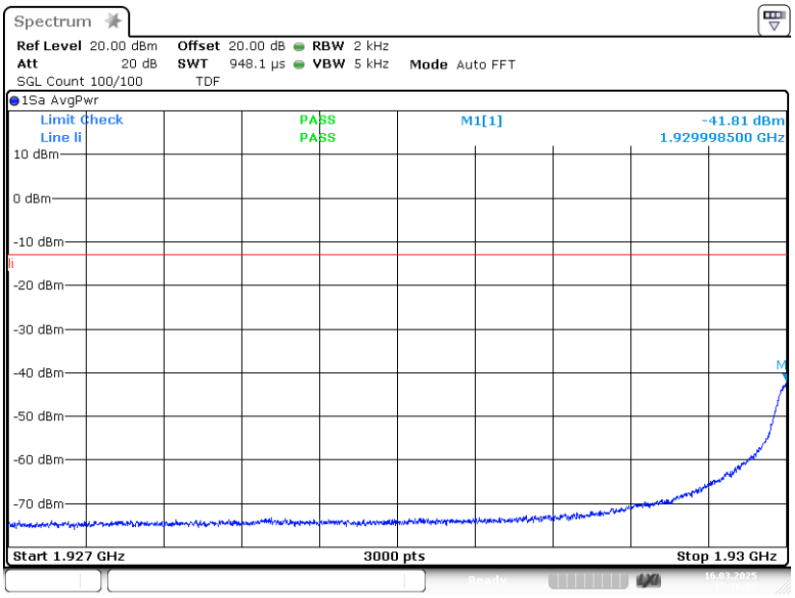
3.6.2 out of band emi PCS1900 AWGN 45M lower 1carrier +3.0 d
B 1.927G 1.930G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: lower; Mod: GSM; Input power = 0.3 dB < AGC; Number of signals 1



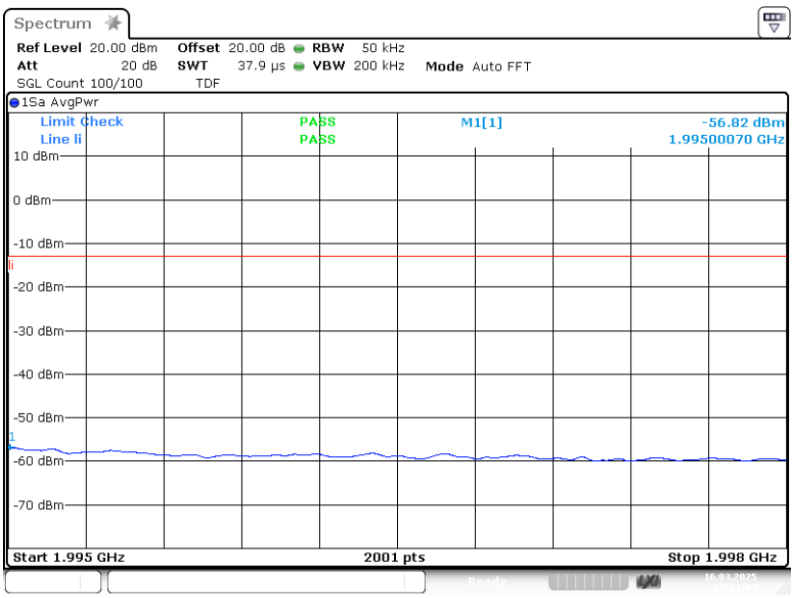
3.6.2 out of band emi PCS1900 GSM lower 1carrier -0.3 dB 1.9
27G 1.930G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: lower; Mod: GSM; Input power = 3 dB > AGC; Number of signals 1



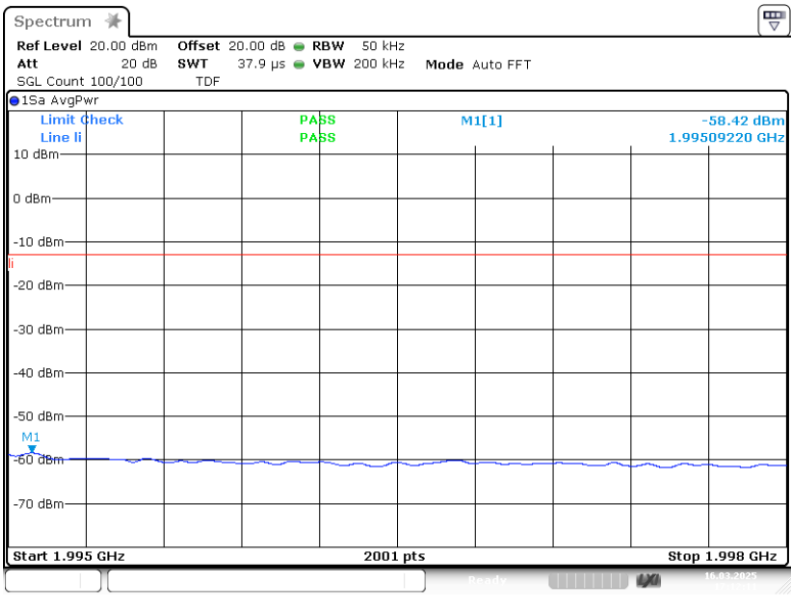
3.6.2 out of band emi PCS1900 GSM lower 1carrier +3.0 dB 1.9
27G 1.930G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: upper; Mod: AWGN; Input power = 0.3 dB < AGC; Number of signals 2



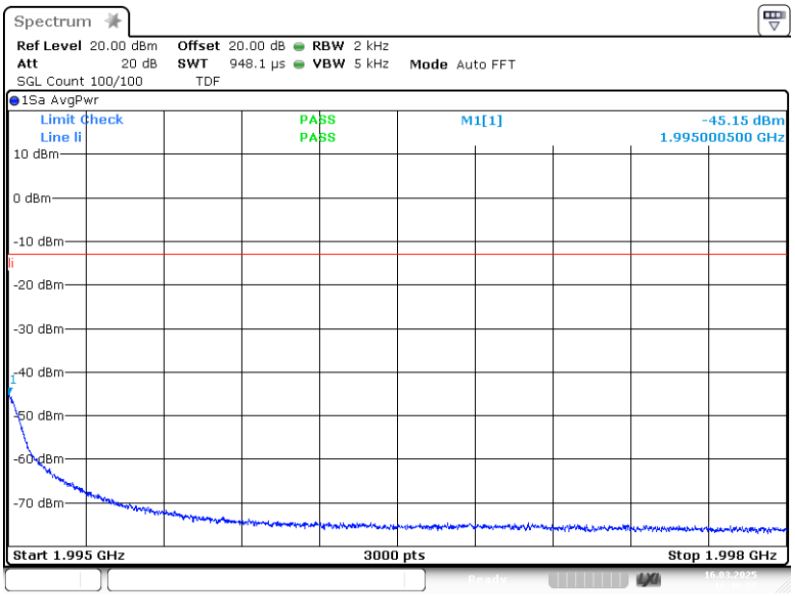
3.6.2 out of band emi PCS1900 AWGN upper 2carriers -0.3 dB 1
.995G 1.998G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: upper; Mod: AWGN; Input power = 3 dB > AGC; Number of signals 2



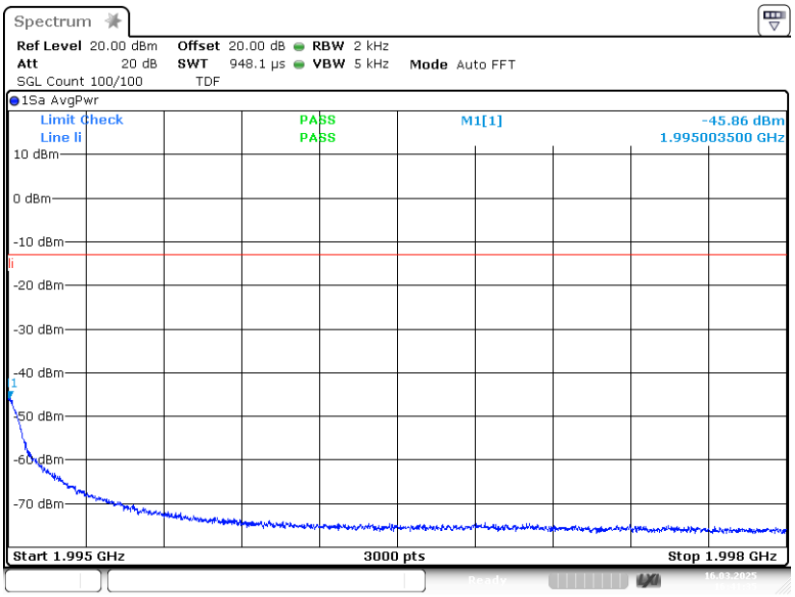
3.6.2 out of band emi PCS1900 AWGN upper 2carriers +3.0 dB 1
.995G 1.998G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: upper; Mod: GSM; Input power = 0.3 dB < AGC; Number of signals 2



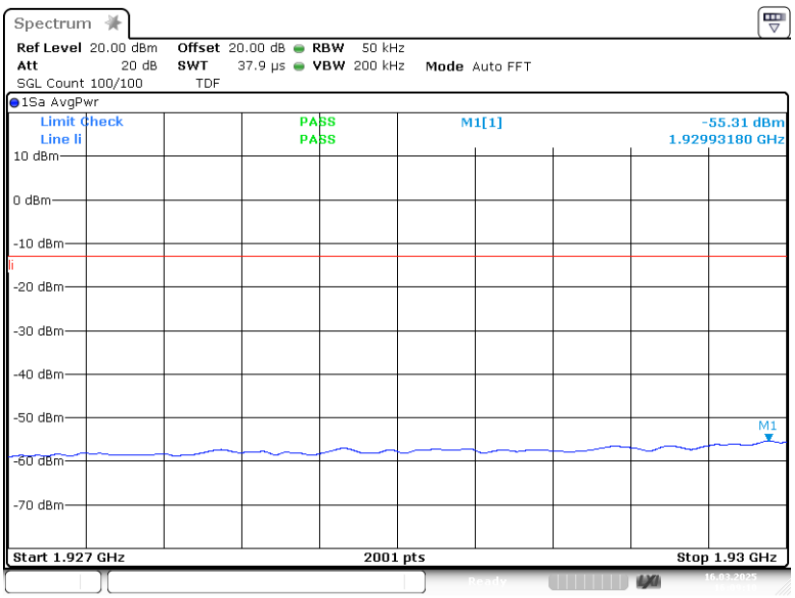
3.6.2 out of band emi PCS1900 GSM upper 2carriers -0.3 dB 1.
995G 1.998G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: upper; Mod: GSM; Input power = 3 dB > AGC; Number of signals 2



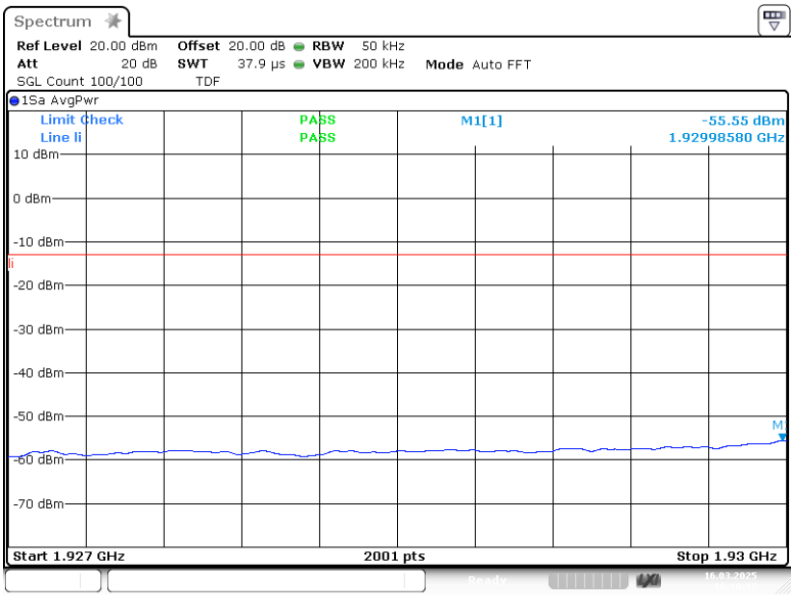
3.6.2 out of band emi PCS1900 GSM upper 2carriers +3.0 dB 1.
995G 1.998G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: lower; Mod: AWGN;
Input power = 0.3 dB < AGC; Number of signals 2



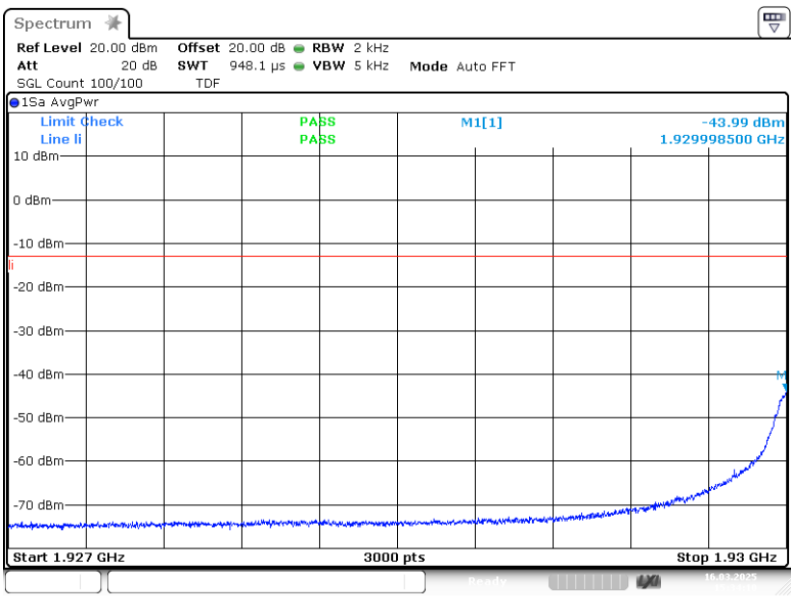
3.6.2 out of band emi PCS1900 AWGN lower 2carriers -0.3 dB 1
.927G 1.930G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: lower; Mod: AWGN;
Input power = 3 dB > AGC; Number of signals 2



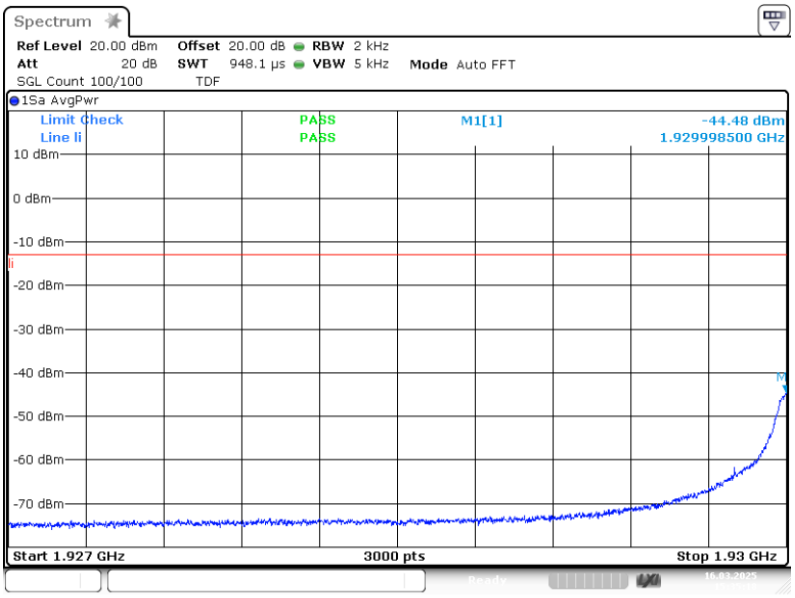
3.6.2 out of band emi PCS1900 AWGN lower 2carriers +3.0 dB 1
.927G 1.930G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: lower; Mod: GSM; Input power = 0.3 dB < AGC; Number of signals 2



3.6.2 out of band emi PCS1900 GSM lower 2carriers -0.3 dB 1.
927G 1.930G

Band: PCS 1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band edge: lower; Mod: GSM; Input power = 3 dB > AGC; Number of signals 2



3.6.2 out of band emi PCS1900 GSM lower 2carriers +3.0 dB 1.
927G 1.930G

5.5.6 TEST EQUIPMENT USED

- Conducted

5.6 OUT-OF-BAND REJECTION

Standard FCC Part 27

The test was performed according to:
ANSI C63.26

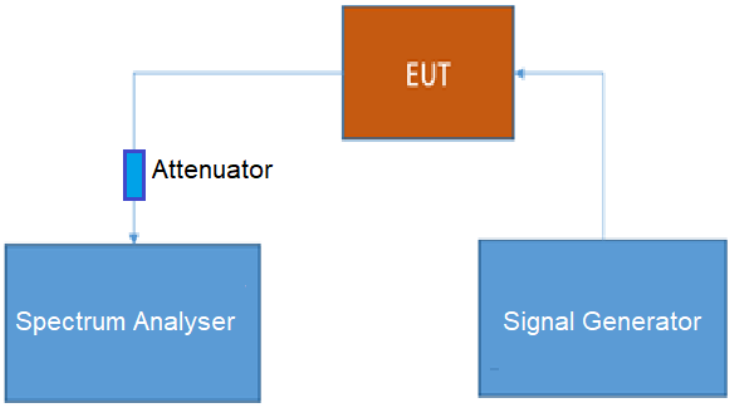
Test date: 2025-03-16 – 2025-03-17

Environmental conditions: 23.2 °C; 27 % r. H./22.8 °C; 26 % 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

Abstract RSS-131 from ISED:

RSS-131; 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.

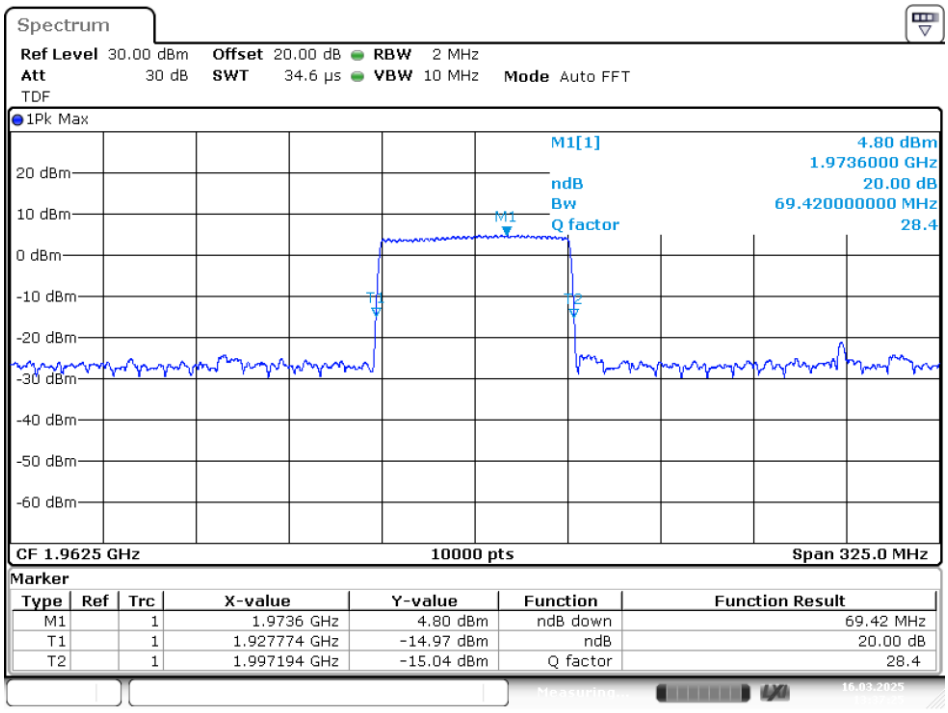
5.6.3 TEST PROTOCOL

Band 25, 1930 MHz – 1995 MHz, PCS 1900, 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]**
1973.6	4.80	1927.774	1997.194	69.420

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

5.6.4 MEASUREMENT PLOT

Frequency Band: PCS 1900, Direction = RF downlink



3.3 Out of band rejection PCS1900 1.96250G
_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 24, §24.238

The test was performed according to:
ANSI C63.26

Test date: 2025-03-31

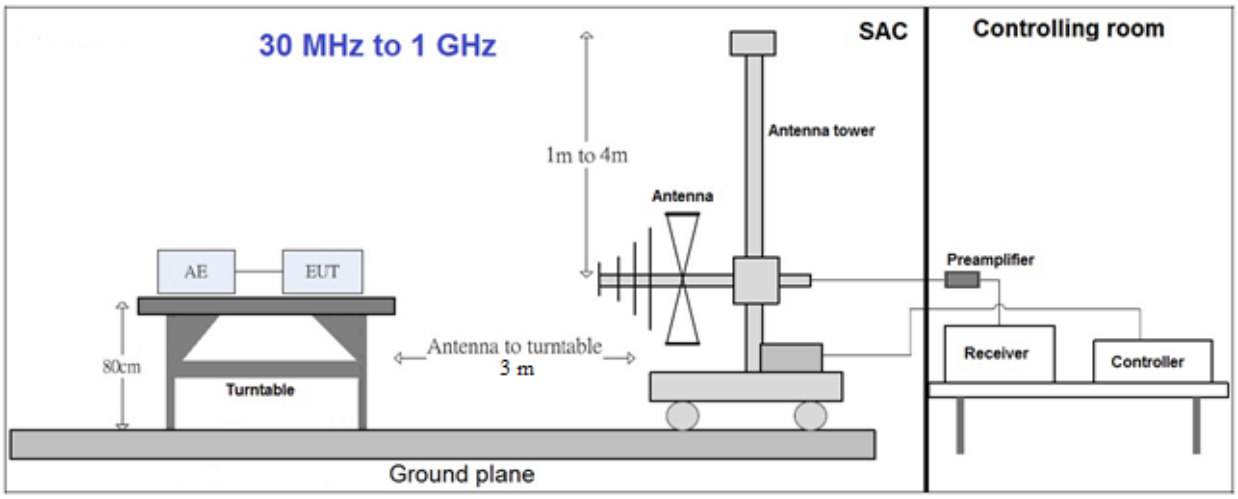
Environmental conditions: 22.5 °C; 28 % r. H.

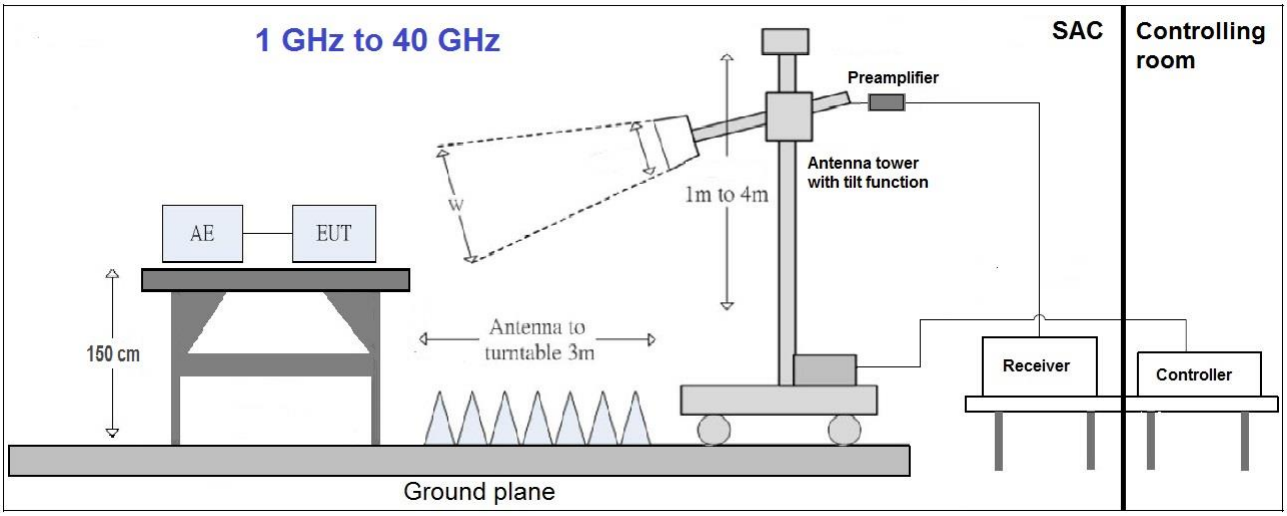
Test engineer: Thomas Hufnagel

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 E – Broadband PCS

§24.238 – Emission limitations for Broadband PCS equipment

Abstract § 27.53 FCC:

The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

(a) ***Out of band emissions.*** The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

(b) ***Measurement procedure.*** Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(c) ***Alternative out of band emission limit.*** Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.

(d) ***Interference caused by out of band emissions.*** If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

Abstract RSS-133 from ISED:

RSS-133; 5.6 Unwanted emission limits

Unwanted emissions shall be measured in terms of average values while the transmitter is operating at the manufacturer's rated power and modulated as specified in RSS-Gen.

Equipment shall meet the unwanted emission limits, specified in table 3, outside each frequency block group. For each channel bandwidth supported by the equipment under test, the unwanted emissions shall be measured and reported for two channel frequencies: one located as close as possible to the low end and one located as close as possible to the high end of the equipment's operating frequency range.

For the unwanted emission limits, in the 1 MHz bands immediately outside and adjacent to the frequency block group, the power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth (OBW). Beyond these 1 MHz bands, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth may be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% of the OBW, as applicable.

For all equipment, the TRP or total conducted power (sum of conducted power across all antenna connectors), where applicable, of the unwanted emissions outside the frequency block or frequency block group shall not exceed the limits shown in the table 3.

Table 3: Unwanted emission limits for all equipment

Offset frequency from the edge of the frequency block group (MHz)	Unwanted emission limit
≤ 1	-13 dBm/(1% of OBW)
> 1	-13 dBm/MHz

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 25, 1930 MHz – 1995 MHz, downlink;						
Spurious Freq. [MHz]	**Spurious Level [dBm]**	**Pin (Sum Level) [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
98.4/hor.	-81.3	-1.0	RMS	100	-23.0	58.3
160.7/hor.	-95.41	-1.0	RMS	100	-23.0	72.4
358.5/hor.	-79.9	-1.0	RMS	100	-23.0	56.9
98.4/vert.	-78.0	-1.0	RMS	100	-23.0	55.0
224.8/vert.	-85.9	-1.0	RMS	100	-23.0	62.9
357.8/vert.	-75.7	-1.0	RMS	100	-23.0	52.7

Above 1 GHz to 18 GHz:

Band 25, 1930 MHz – 1995 MHz, downlink;						
Spurious Freq. [MHz]	**Spurious Level [dBm]**	**Pin (Sum Level) [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
1930.2/hor.	-34.3	-1.0	RMS	1000	-13.0	21.3
1962.4/hor.	-34.2	-1.0	RMS	1000	-13.0	21.2
1994.6/hor.	-37.0	-1.0	RMS	1000	-13.0	24.0
3200/hor.	-50.4	-1.0	RMS	1000	-13.0	37.4
1930.2/vert.	-41.0	-1.0	RMS	1000	-13.0	28.0
1962.4/vert.	-41.9	-1.0	RMS	1000	-13.0	28.9
1994.8/vert.	-43.9	-1.0	RMS	1000	-13.0	30.9
3980.6/vert.	-57.2	-1.0	RMS	1000	-13.0	44.2

Above 18 GHz to 27 GHz:

Band 25, 1930 MHz – 1995 MHz, downlink;						
Spurious Freq. [MHz]	**Spurious Level [dBm]**	**Pin (Sum Level) [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
18000/hor.	-69.)	-1.0	RMS	1000	-13.0	56.)
18603.9/hor.	-70.7)	-1.0	RMS	1000	-13.0	57.7
20624.7/hor.	-64./	-1.0	RMS	1000	-13.0	51./
19129.8/vert.	-70.8	-1.0	RMS	1000	-13.0	57.8
20624.4/vert.	-66.1	-1.0	RMS	1000	-13.0	53.1
22789.8/vert.	-67.6	-1.0	RMS	1000	-13.0	54.6

Abbreviations:

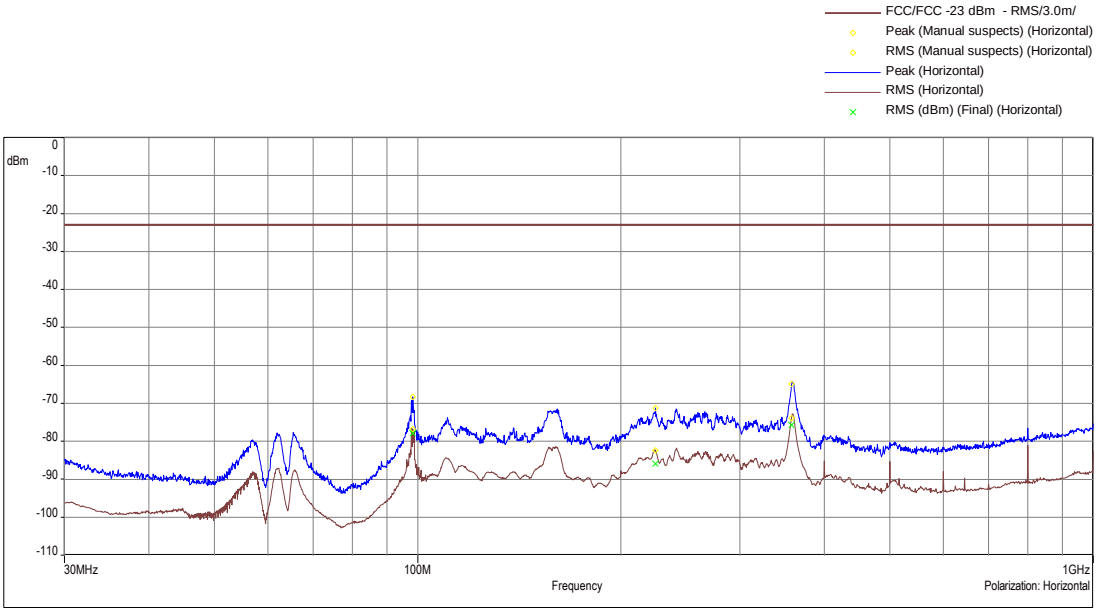
"hor.": horizontal position
"vert.": vertical position

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

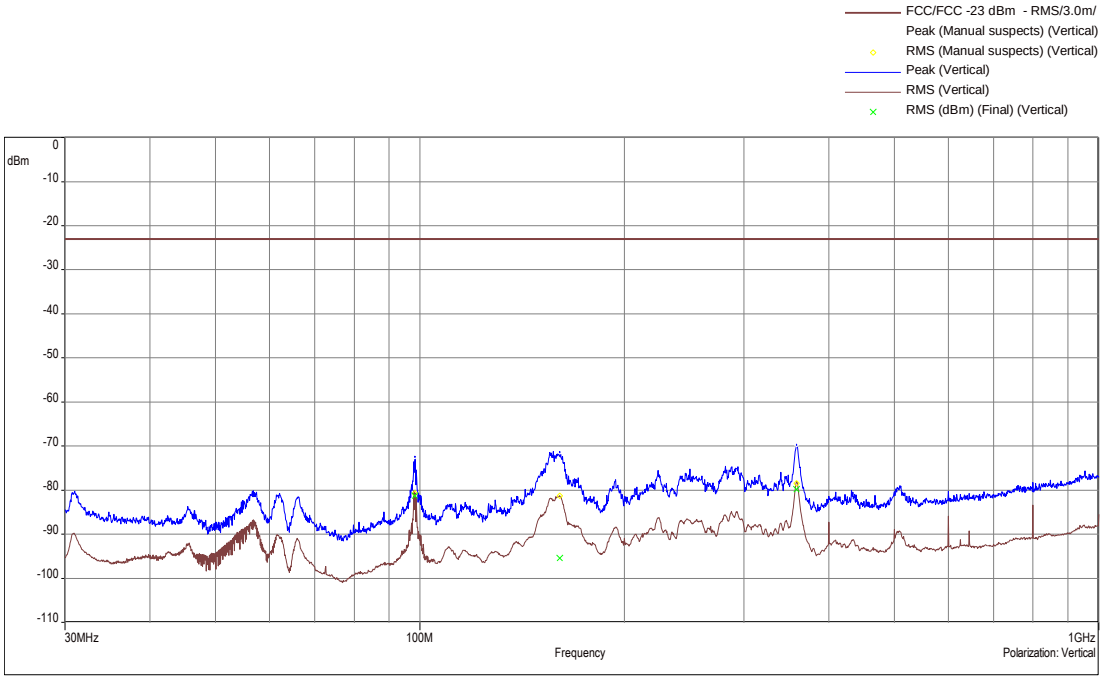
5.8.4 MEASUREMENT PLOT WITH ONE ANTENNA

5.8.4.1 Frequency band = PCS 1900; Direction = RF downlink

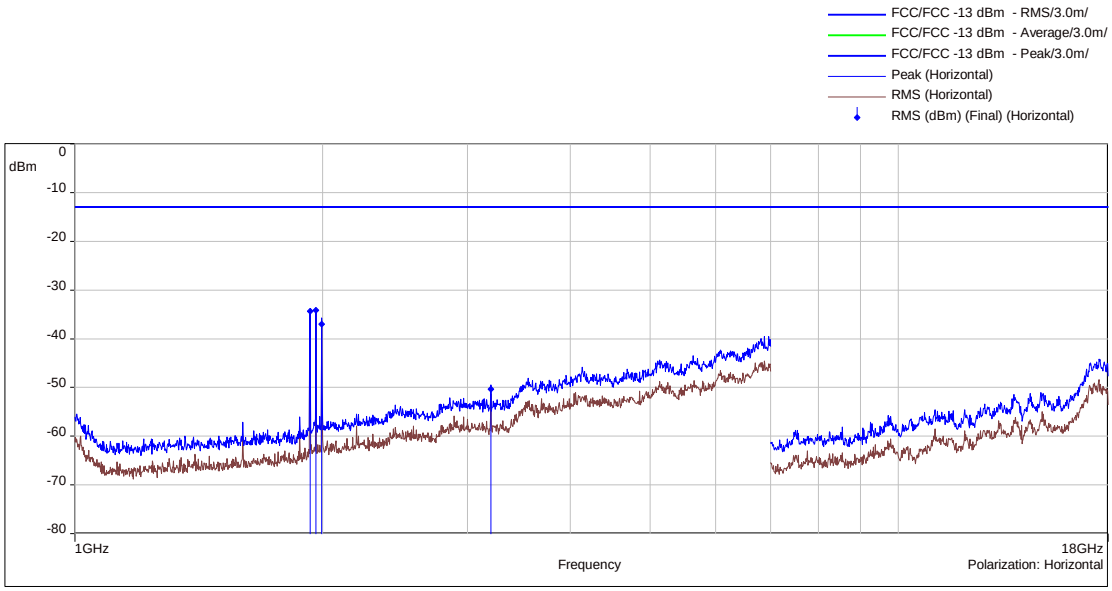
30 MHz - 1 GHz. horizontal



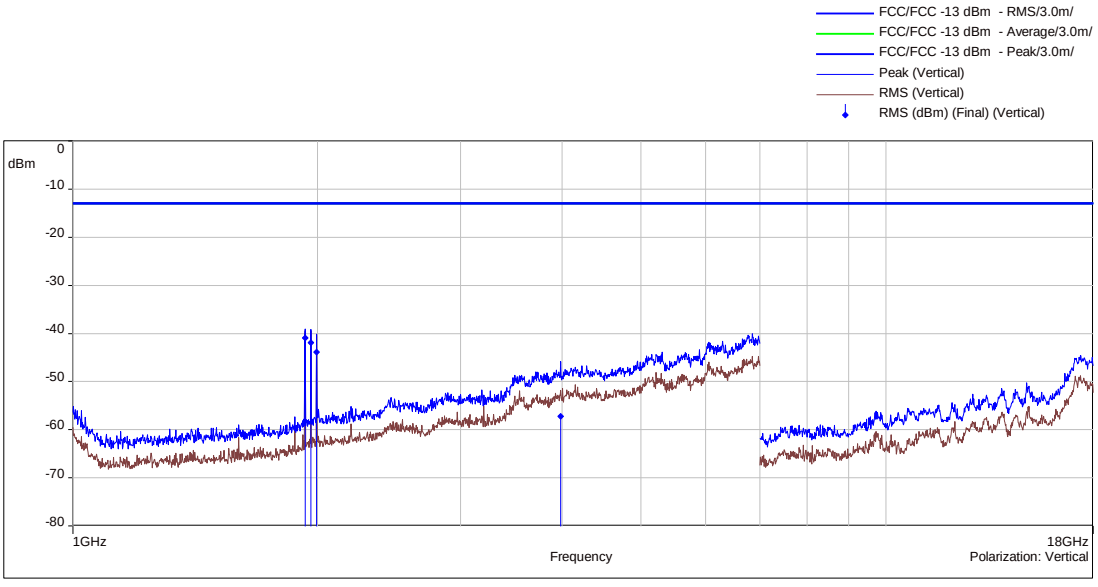
30 MHz - 1 GHz. vertical



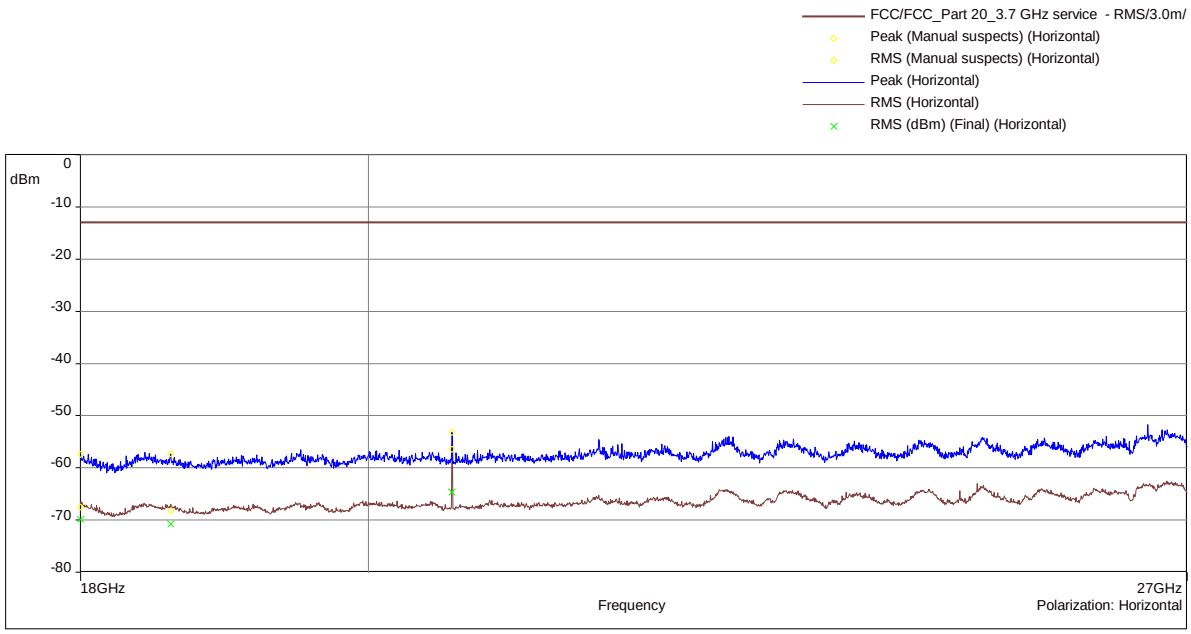
1 GHz - 18 GHz. horizontal



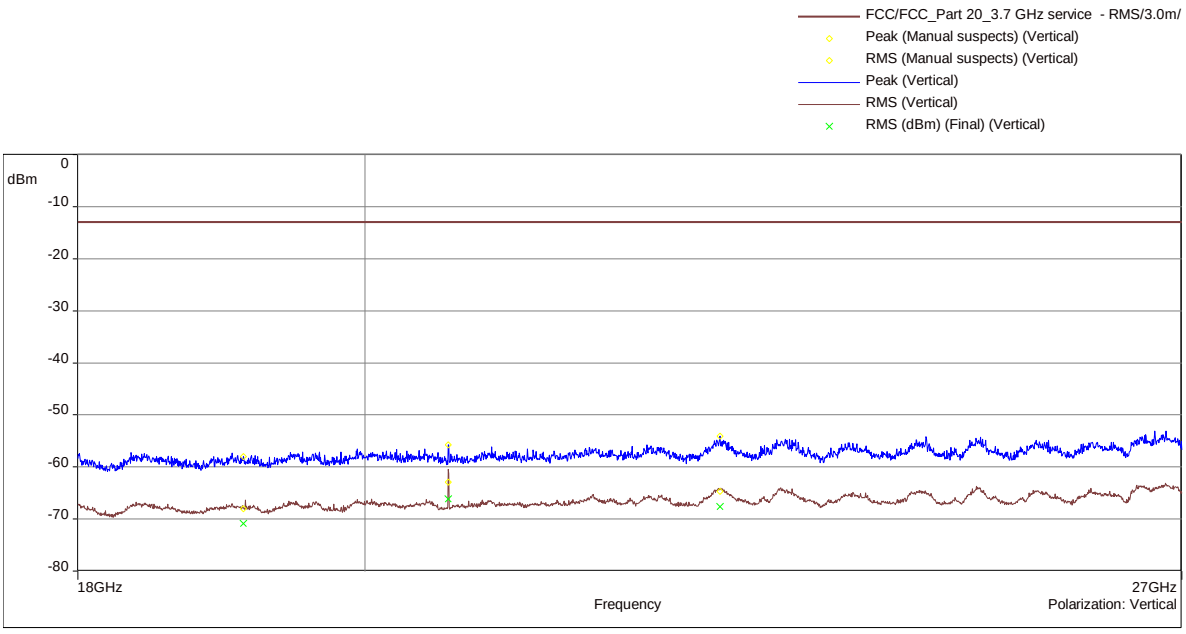
1 GHz - 18 GHz. vertical



18 GHz – 27 GHz. horizontal



18 GHz - 27 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 *****