Test Report

2023-0080-EMC-TR-23-0049-V01_Andrew_CAP MX Band PCS 1900_FCC

Designation:	CAP MX AC 6/7E/80-85/17E/19/23/25T
Manufacturer:	Andrew
Serial No(s):	TJCXAA2305302
ID No.	7830127-0001 Rev.: 04

Test Specification(s):	Class 2 Permissive Change ANSI C63.26:2015 Partly of FCC Rules and Regulations as listed in 47 CFR, Part 20:2019-10-01 EFFECTIVE RADIATED POWER, MEAN OUTPUT POWER AND ZONE ENHANCER GAIN OCCUPIED BANDWIDTH/INPUT-VERSUS-OUTPUT SPECTRUM OUT-OF-BAND EMISSION LIMITS OUT-OF-BAND REJECTION

Test Plan:	Measurement of Band 25/PCS 1900 downlink

Test Result:	**Passed**

Date of issue:	2023-04-27		Signature:
Version:	01	Technical Reviewer:	Thomas Hufnagel Test Engineer Digitally signed by Thomas Hufnagel Date: 2023.04.28 07:47:12 +02'00'
Date of receipt EUT:	2023-03		
Performance date:	2023-03-29 to 2023-04-17	Report Reviewer:	Gerhard Gass Test Engineer Digital unterschrieben von Gerhard Gass DN: cn=Gerhard Gass, o=Bureau Veritas CPS Germany GmbH, ou=EMC, email=gerhard.gass@bureauveritas.com, c=DE Datum: 2023.04.28 08:20:47 +02'00'

Bundesnetzagentur

BNetzA-CAB-19/21-20

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12024-06-04

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Test location:	Bureau Veritas Consumer Products Services Germany GmbH Thurn-und-Taxis-Straße 18 D-90411 Nürnberg

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

Table of Contents

1 APPLIED STANDARDS AND TEST SUMMARY

1.1 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 Ch.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, 2019-15-04.
- 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

Summary Test Results:

The EUT complies with all performed tests as listed in chapter 1.3 Measurement Summary/Signatures.

1.2 FCC-CORRELATION TABLE

Correlation of measurement requirements for Industrial Signal Booster from FCC

Measurement	FCC reference
Effective radiated power, mean output power and zone enhancer gain	§ 2.1046 § 24.232 KDB 935210 D05 v01r04: 3.5
Peak to Average Ratio	§ 24.232
Occupied bandwidth Input-versus-output spectrum	§ 2.1049 KDB 935210 D05 v01r04: 3.4
Conducted spurious Emission at Antenna Terminal	§ 2.1051 § 24.238 KDB 935210 D05 v01r04: 3.6
Out-of-band emissions limits	§ 2.1051 § 24.238 KDB 935210 D05 v01r04: 3.6
Frequency stability	§ 2.1055 § 24.235
Field strength of spurious radiation	§ 2.1053 § 24.236
Out-of-band rejection	KDB 935210 D05 v01r04: 3.3
All measurements	ANSI C63.26:2015

1.3 MEASUREMENT SUMMARY/SIGNATURES

47 CFR CHAPTER I FCC PART 24 Subpart E [Base Stations/Repeater] **§ 2.1046, § 24.232**

Effective Radiated Power, mean output power and zone enhancer gain
The measurement was performed according to ANSI C63.26:2015, KDB 935210 D05 v01r04: 3.5

Final Result

OP-Mode	**FCC**
Frequency Band, Direction, Input Power, Signal Type	
PCS 1900, RF downlink, 0.3 dB < AGC, Narrowband	Passed
PCS 1900, RF downlink, 0.3 dB < AGC, Wideband	Passed
PCS 1900, RF downlink, 3 dB > AGC, Narrowband	Passed
PCS 1900, RF downlink, 3 dB > AGC, Wideband	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E [Base Stations/Repeater] **§ 2.1049**

Occupied Bandwidth Output Spectrum
The measurement was performed according to ANSI C63.26:2015, KDB 935210 D05 v01r04: 3.4

Final Result

OP-Mode	**FCC**
Frequency Band, Direction, Input Power, Signal Type	
PCS 1900, RF downlink, 0.3 dB < AGC, Narrowband	Done
PCS 1900, RF downlink, 0.3 dB < AGC, Wideband	Done
PCS 1900, RF downlink, 3 dB > AGC, Narrowband	Done
PCS 1900, RF downlink, 3 dB > AGC, Wideband	Done

47 CFR CHAPTER I FCC PART 24 Subpart E [Base Stations/Repeater] **§ 2.1051, § 24.238**

Out-of-band emission limits
The measurement was performed according to ANSI C63.26:2015, KDB 935210 D05 v01r04: 3.6 **Final Result**

OP-Mode Band Edge, Frequency Band, Number of signals, Direction, Input Power, Signal Type	**FCC**
Lower, PCS 1900, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, PCS 1900, 1, RF downlink, 0.3 dB < AGC, Wideband	Passed
Lower, PCS 1900, 1, RF downlink, 3 dB > AGC, Narrowband	Passed
Lower, PCS 1900, 1, RF downlink, 3 dB > AGC, Wideband	Passed
Lower, PCS 1900, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, PCS 1900, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Lower, PCS 1900, 2, RF downlink, 3 dB > AGC, Narrowband	Passed
Lower, PCS 1900, 2, RF downlink, 3 dB > AGC, Wideband	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E [Base Stations/Repeater] **§ 2.1051, § 24.238**

Out-of-band emission limits
The measurement was performed according to ANSI C63.26:2015, KDB 935210 D05 v01r04: 3.6 **Final Result**

OP-Mode Band Edge, Frequency Band, Number of signals, Direction, Input Power, Signal Type	**FCC**
Upper, PCS 1900, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, PCS 1900, 1, RF downlink, 0.3 dB < AGC, Wideband	Passed
Upper, PCS 1900, 1, RF downlink, 3 dB > AGC, Narrowband	Passed
Upper, PCS 1900, 1, RF downlink, 3 dB > AGC, Wideband	Passed
Upper, PCS 1900, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, PCS 1900, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Upper, PCS 1900, 2, RF downlink, 3 dB > AGC, Narrowband	Passed
Upper, PCS 1900, 2, RF downlink, 3 dB > AGC, Wideband	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E [Base Stations/Repeater] **KDB 935210 D05 v01r04: 3.3**

Out-of-band rejection
The measurement was performed according to ANSI C63.26:2015; KDB 935210 D05 v01r04: 3.3 **Final Result**

OP-Mode Frequency Band, Direction	**Setup**	**FCC**
PCS 1900, RF downlink		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.Cecka

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	
Declared EUT data by the supplier	
General Product Description	The EUT is an industrial signal booster supporting the following: Band 71/USA 600 Band12/USA 700E Band 13/USA 750 Band 14/LMR 750 Band 27/CELL 800 Band 5/CELL 850 Band 70/Band 70 Band 66/AWS 1700E (partly) Band 25/PCS 1900 Band 30/WCS 2300 Band 41/BRS A RF operation is only supported for the downlink.
Booster Type	Industrial Signal Booster
Voltage Type	AC/50 Hz – 60 Hz
Voltage Level	100 V - 240 V
Maximum Output Donor Port [Uplink]	-
Nominal Output Server Port [Downlink]	All bands: between 29 dBm and 33 dBm
Nominal Gain [Uplink]	-
Nominal Gain [Downlink]	All bands: 33 dB

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

3.2 EUT MAIN COMPONENTS

Sample Name	**FCC-ID**
	XS5-CAPMX
Sample Parameter	**Value**
Serial Number	TJCXAA2305302
HW Version	7830127-0001 Rev.: 04
SW Version	4.15.10.5
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/General Electric; ION-E PSU Shelf, AC; 850017807 12	Rack in Conjunction with AUX 2
AUX2	Commsope/General Electric; Power Supply Unit; EC85946	Power Supply
AUX3	Commscope; ION-E WCS-2; SZAEAJ 17 44A0010	Subrack in Conjunction with AUX 4 - 9
AUX4	Commscope; ION-E OPT; SZBEAD 1951 AO 125	Optical Card
AUX5	Commscope; ION-E SUI; SZBEAC1934A0018	LAN System Interface
AUX6	Commscope; ION-E RFD; TJBEAP2042A0535	RF Card
AUX7	Commscope; ION-E RFD; TJBEAP2042A0504	RF Card
AUX 8	Commscope; ION-E RFD; TJBEAP2042A0510	RF Card
AUX 9	Commscope; ION-E RFD; SZBEAP1912A0050	RF Card

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		

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

3.5.1 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

3.5.2 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	2.2	1.9	5.2	1962.50	Mid
25	Downlink	Wideband	2.4	2.1	5.4	1962.50	
25	Downlink	Wideband G5	2.6	2.3	5.6	1962.50	
25	Downlink	Narrowband	3.2	2.9	6.2	1930.20	Low
25	Downlink	Wideband	3.4	3.1	6.4	1932.50	
25	Downlink	Narrowband	2.0	1.7	5.0	1994.80	High
25	Downlink	Wideband	1.8	1.5	4.8	1992.50	
25	Downlink	Narrowband	2.0	1.7	5.0	1964.00	Max.Power
25	Downlink	Wideband	2.2	1.9	5.2	1964.00	

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 is 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 G5): 22.5 MHz

3.6 PRODUCT LABELLING

3.6.1 FCC ID LABEL

Please refer to the documentation of the applicant.

3.6.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

4 TEST RESULTS

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

Standard FCC PART 24, § 24.232

The test was performed according to:
ANSI C63.26:2015, KDB 935210 D05 v01r04: 3.5

Test date: 2023-03-29 to 2023-04-17

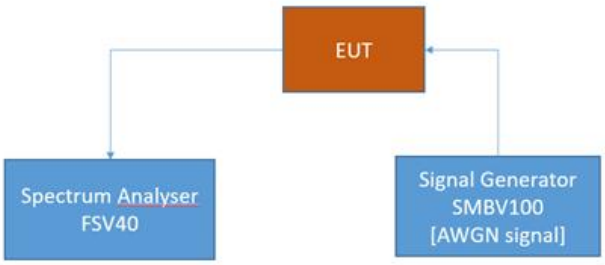
Environmental conditions: 21 … 26 °C; 25 .. 35 % r. H.

Test engineer: Thomas Hufnagel

4.1.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the signal booster power and gain limits and requirements for industrial signal boosters per FCC § 24.232.

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



FCC Part 22/24/27/90 Industrial signal booster – Test Setup; RF Output Power / Gain

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.

4.1.2 TEST REQUIREMENTS/LIMITS: ABSTRACTS FROM STANDARDS

24; Personal Communications Services

Subpart C – Technical standards

§ 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

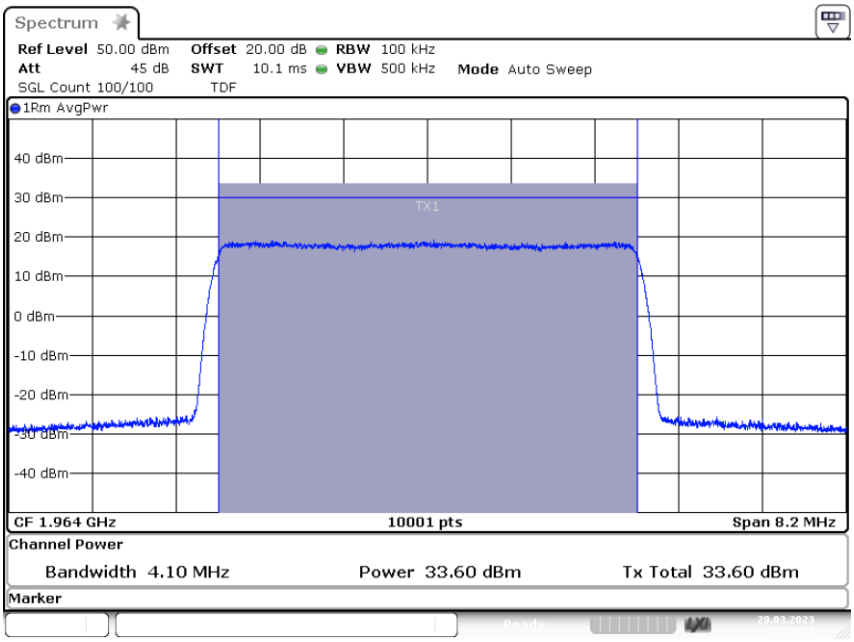
4.1.3 TEST PROTOCOL

Band 25, downlink							
Signal Type	**Input Power**	**Frequency [MHz]**	**Input Power [dBm]**	**Maximum Average Output Power [dBm]**	**Limit Average Output Power [dBm]**	**Margin to Limit [dB]**	**Gain [dB]**
Wideband	0.3 dB < AGC	1964.00	1.9	33.6	62.1	28.5	31.7
Wideband	3 dB > AGC	1964.00	5.2	32.9	62.1	29.2	27.7
Wideband 5G	0.3 dB < AGC	1962.50	2.3	33.3	62.1	28.8	31.0
Wideband 5G	3 dB > AGC	1962.50	5.6	32.6	62.1	29.5	27.0
Narrowband	0.3 dB < AGC	1964.00	1.7	33.8	62.1	28.3	32.1
Narrowband	3 dB > AGC	1964.00	5.0	33.3	62.1	28.8	28.3

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

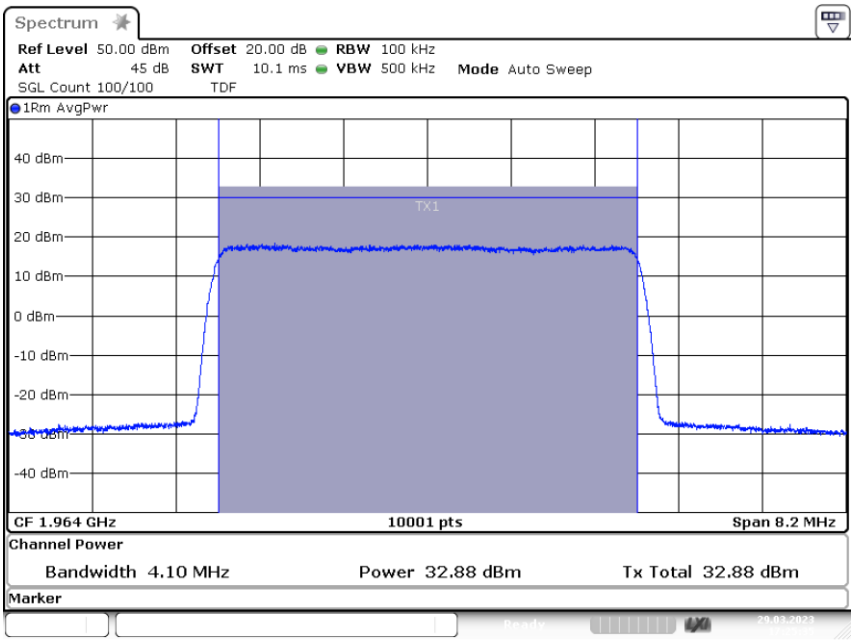
4.1.4 MEASUREMENT PLOT

Band: PCS1900; Frequency: 1.9640 GHz; Band Edge: f0; Mod: AWGN; Output Power 0.3 dB < AGC



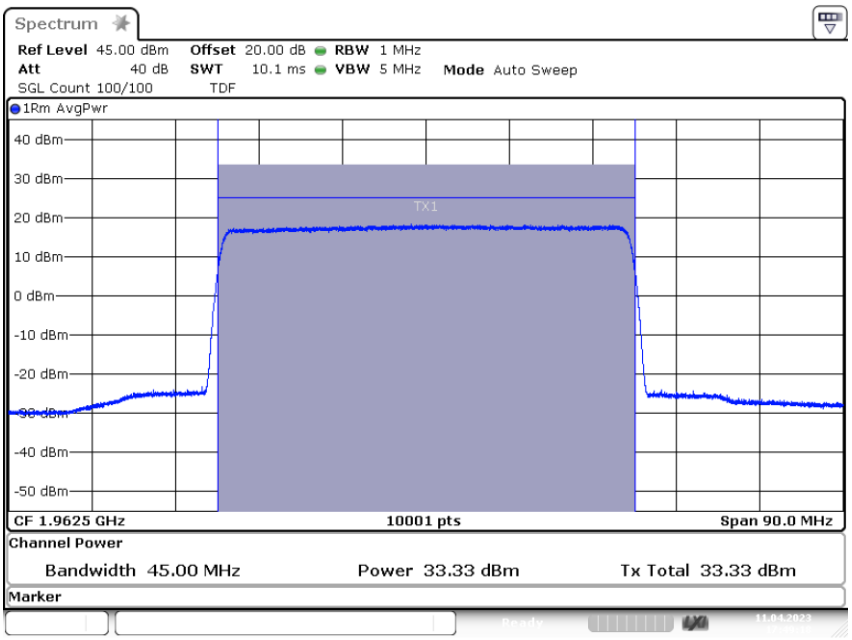
3.5.3 Power AWGN Out -0.3 1.96400G

Band: PCS1900; Frequency: 1.9640 GHz; Band Edge: f0; Mod: AWGN; Output Power 3 dB > AGC



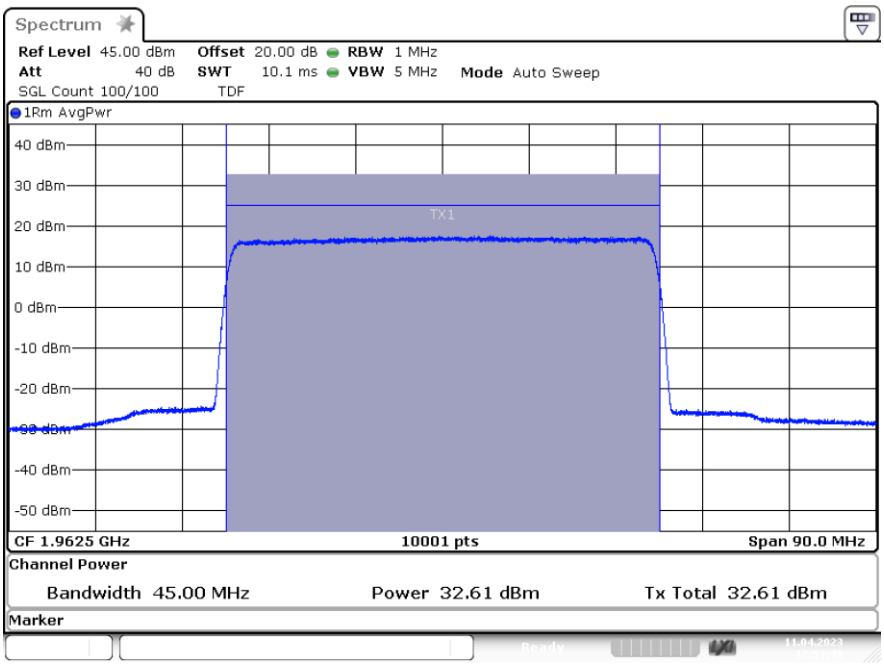
3.5.3 Power AWGN Out +3 1.96400G

Band: PCS1900; Frequency: 1.9625 GHz; Band Edge: mid;
Mod: AWGN 5G; Output Power 0.3 dB < AGC



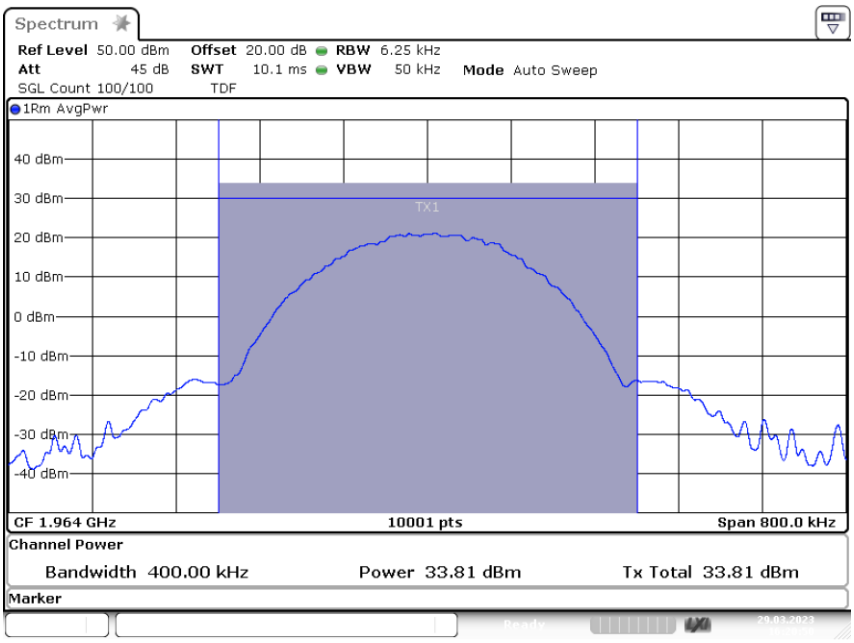
3.5.3 Power AWGN 45M-0.3 1.96250G

Band: PCS1900; Frequency: 1.9625 GHz; Band Edge: mid;
Mod: AWGN 5G; Output Power 3 dB > AGC



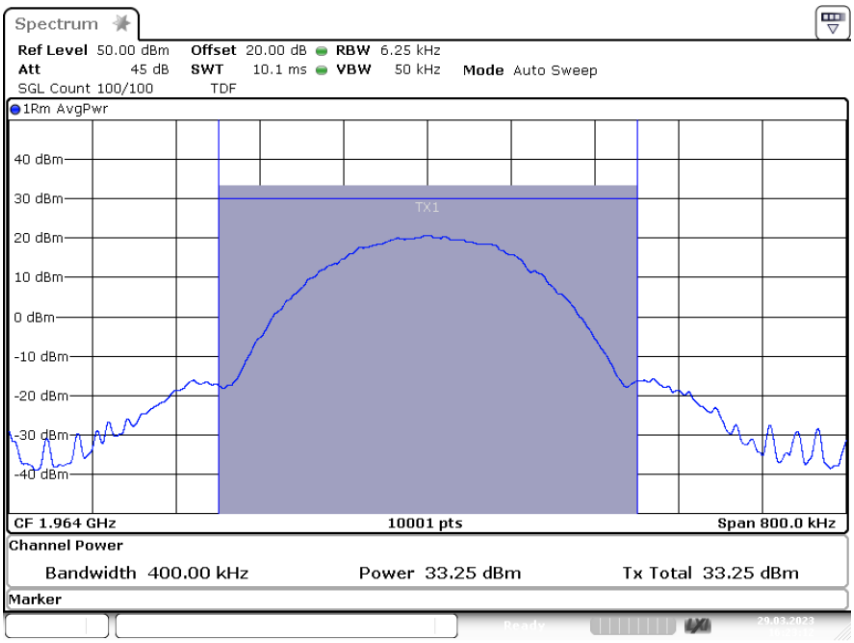
3.5.3 Power AWGN 45M+3 1.96250G

Band: PCS1900; Frequency: 1.9640 GHz; Band Edge: f0; Mod: GSM; Output Power 0.3 dB < AGC



3.5.3 Power GSM Out -0.3 1.96400G

Band: PCS1900; Frequency: 1.9640 GHz; Band Edge: f0; Mod: GSM; Output Power 3 dB > AGC



3.5.3 Power GSM Out +3 1.96400G

4.1.5 TEST EQUIPMENT USED

- Conducted

4.2 OCCUPIED BANDWIDTH OUTPUT SPECTRUM

Standard FCC Part 2.1049; Occupied Bandwidth

The test was performed according to:
ANSI C63.26:2015, KDB 935210 D05 v01r04: 3.4

Test date: 2023-03-29 to 2023-04-17

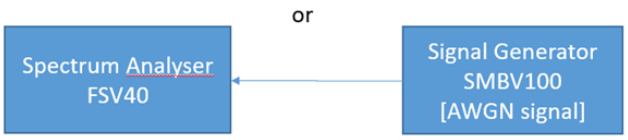
Environmental conditions: 21 … 26 °C; 25 .. 35 % r. H.

Test engineer: Thomas Hufnagel

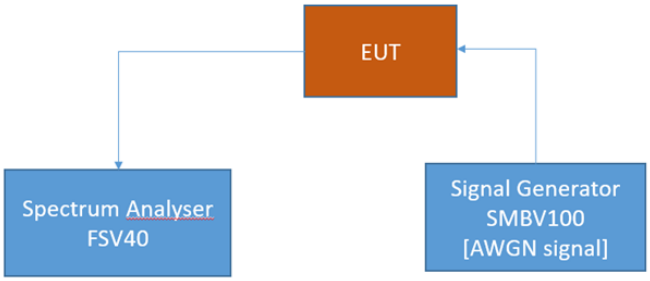
4.2.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission limits per FCC § 2.1049.

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



FCC Part 22/24/27/90; Industrial Signal Booster
Test Setup step 1: Measuring characteristics of test signals



FCC Part 22/24/27/90; Industrial Signal Booster
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.

4.2.2 TEST REQUIREMENTS/LIMITS

Abstract § 2.1049 from FCC:

FCC Part 2.1049; Occupied Bandwidth:

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

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

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

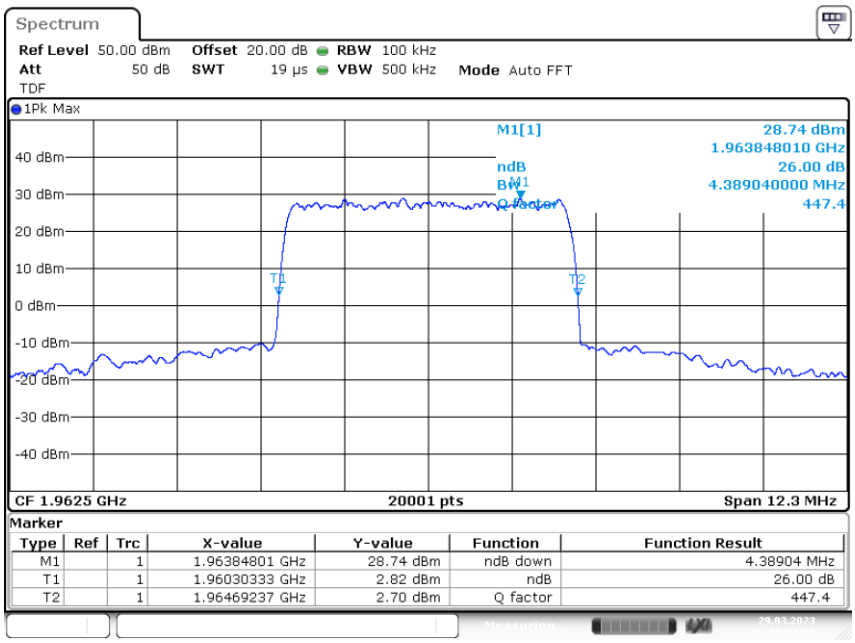
4.2.3 TEST PROTOCOL

Band 25 PCS 1900, downlink			
Signal Type	**Input Power**	**Signal Frequency [MHz]**	**Occupied Bandwidth Booster [kHz]**
Wideband	0.3 dB < AGC	1962.50	4389.0
Wideband	3 dB > AGC	1962.50	4393.3
Wideband 5G	0.3 dB < AGC	1962.50	46019.2
Wideband 5G	3 dB > AGC	1962.50	46093.4
Narrowband	0.3 dB < AGC	1962.50	323.5
Narrowband	3 dB > AGC	1962.50	314.3

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

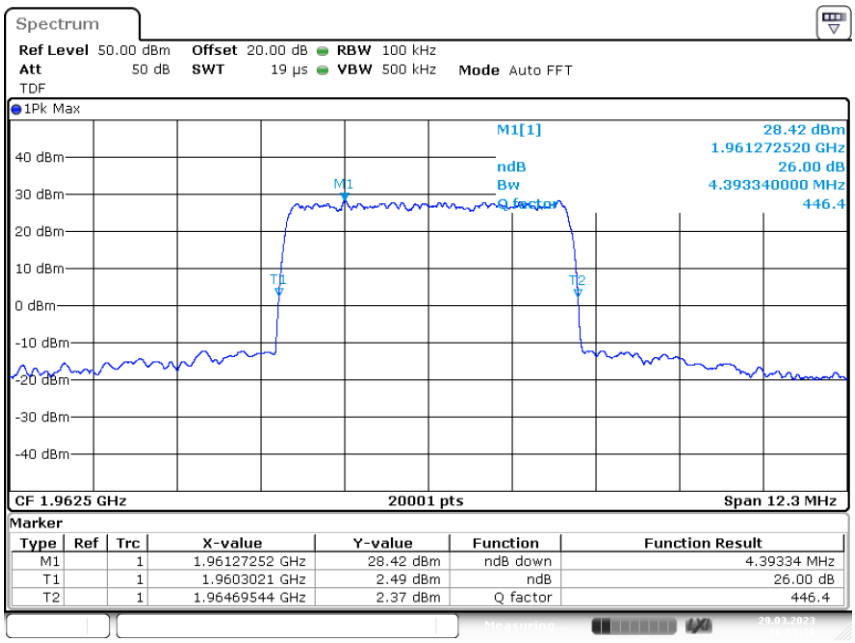
4.2.4 MEASUREMENT PLOT

Band: PCS1900; Frequency: 1.9625 GHz; Band Edge: mid;
Mod: AWGN; Output OCBw 0.3 dB < AGC



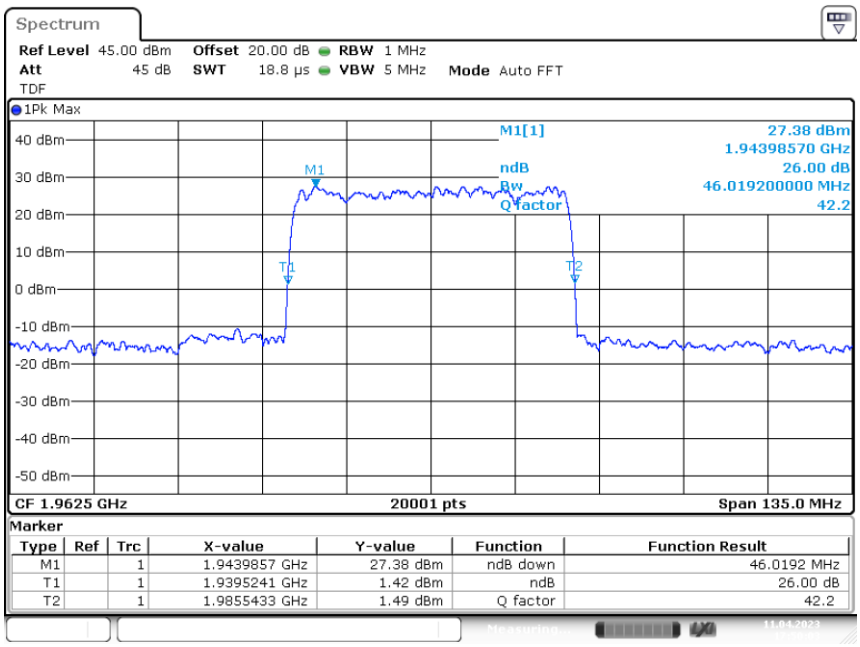
3.4 OCBw AWGN Out -0.3 1.9625G _26dB

Band: PCS1900; Frequency: 1.9625 GHz; Band Edge: mid;
Mod: AWGN; Output OCBw 3 dB > AGC



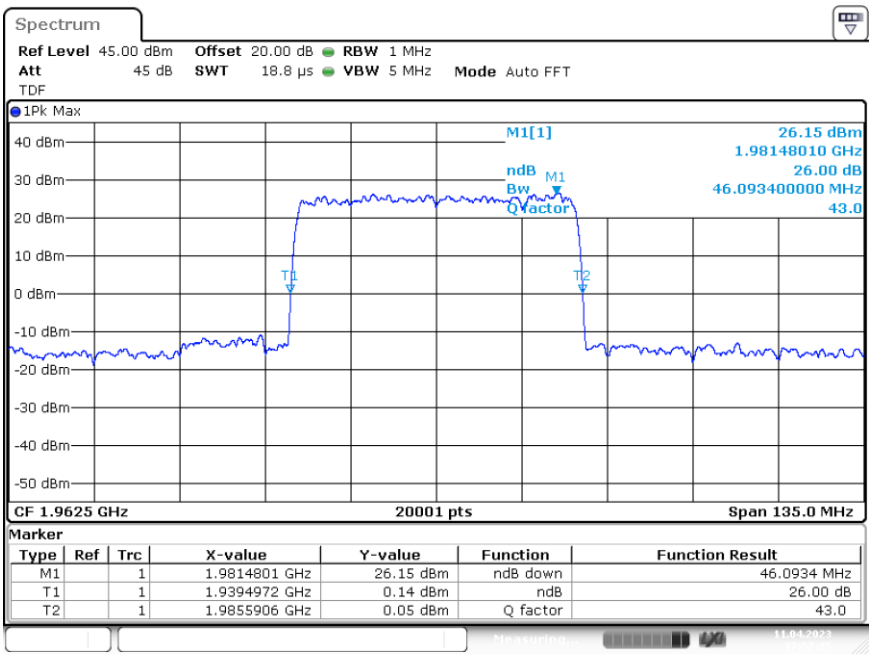
3.4 OCBw AWGN Out +3 1.9625G _26dB

Band: PCS1900; Frequency: 1.9625 GHz; Band Edge: mid;
Mod: AWGN 5G; Output OCBw 0.3 dB < AGC



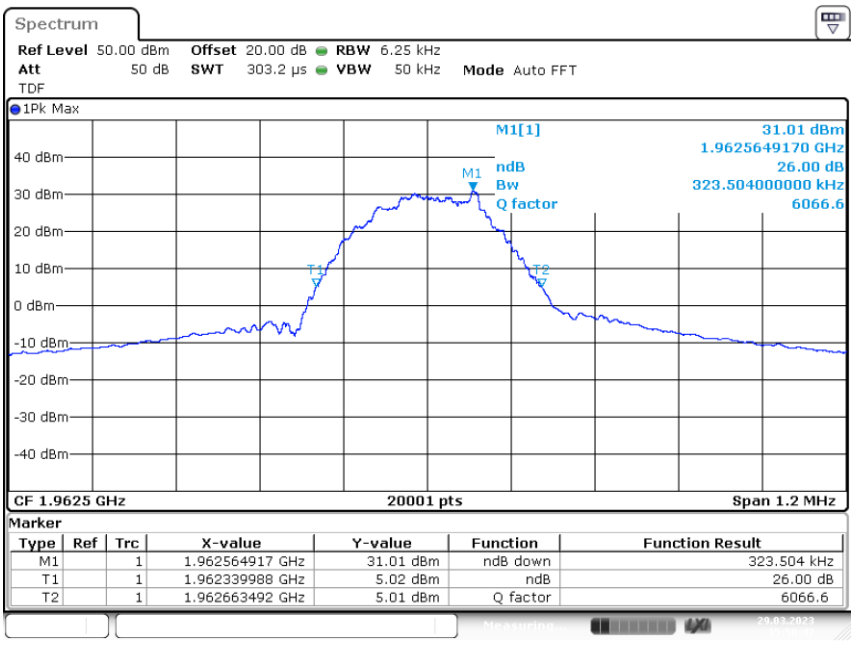
3.4 OCBw AWGN 45M-0.3 1.9625G _26dB

Band: PCS1900; Frequency: 1.9625 GHz; Band Edge: mid;
Mod: AWGN 5G; Output OCBw 3 dB > AGC



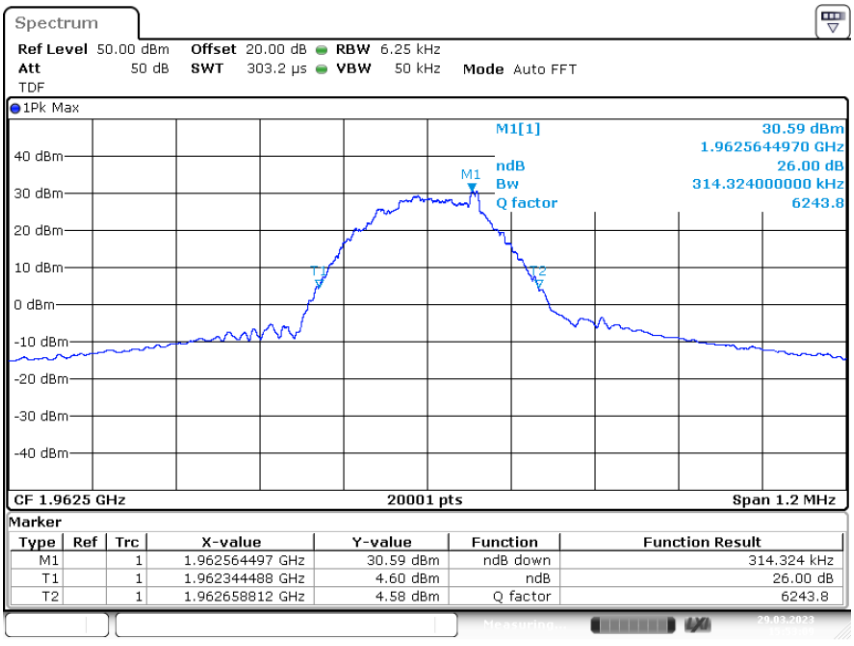
3.4 OCBw AWGN 45M+3 1.9625G _26dB

Band: PCS1900; 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: PCS1900; Frequency: 1.9625 GHz; Band Edge: mid;
Mod: GSM; Output OCBw 3 dB > AGC



3.4 OCBw GSM Out +3 1.9625G _26dB

4.3 OUT-OF-BAND EMISSION LIMITS

Standard FCC Part § 2.1051, § 24.238

The test was performed according to:
ANSI C63.26:2015, KDB 935210 D05 v01r04: 3.6

Test date: 2023-03-29 to 2023-04-17

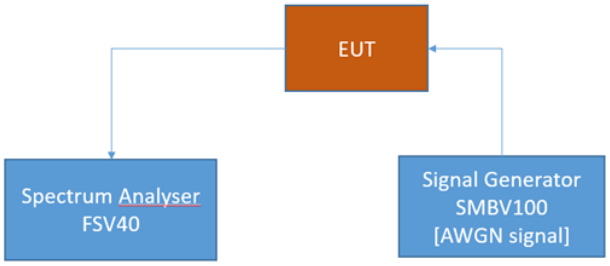
Environmental conditions: 21 … 26 °C; 25 .. 35 % r. H.

Test engineer: Thomas Hufnagel

4.3.1 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 per FCC § 2.1051 and FCC § 24.238.

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



FCC Part 22/24/27/90 Industrial signal booster – Test Setup; Out-of-band emissions

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.

4.3.2 TEST REQUIREMENTS/LIMITS

Abstract § 2.1051 from FCC:

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

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

Abstract § 24.238 FCC:

PART 24, Subpart E – Cellular Radiotelephone Service; Band 25

§ 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.

4.3.3 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	1.5	-29.2	-13.0	16.2
Wideband	3 dB > AGC	upper	1992.50	4.8	-29.4	-13.0	16.4
Wideband 5G	-0.3 dB < AGC	upper	1972.50	2.1	-36.2	-13.0	23.2
Wideband 5G	3 dB > AGC	upper	1972.50	5.4	-35.8	-13.0	22.8
Narrowband	-0.3 dB < AGC	upper	1994.80	1.7	-27.8	-13.0	14.8
Narrowband	3 dB > AGC	upper	1994.80	5.0	-28.4	-13.0	15.4
Wideband	-0.3 dB < AGC	lower	1932.50	3.1	-28.6	-13.0	15.6
Wideband	3 dB > AGC	lower	1932.50	6.4	-29.6	-13.0	16.6
Wideband 5G	-0.3 dB < AGC	lower	1952.50	2.9	-35.1	-13.0	22.1
Wideband 5G	3 dB > AGC	lower	1952.50	6.2	-35.6	-13.0	22.6
Narrowband	-0.3 dB < AGC	lower	1930.20	2.9	-28.4	-13.0	15.4
Narrowband	3 dB > AGC	lower	1930.20	6.2	-28.4	-13.0	25.4

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	1992.50	1990.00	1.5	-30.6	-13.0	17.6
WB	3 dB > AGC	upper	1992.50	1990.00	4.8	-30.9	-13.0	17.9
NB	-0.3 dB < AGC	upper	1994.80	1994.60	1.5	-29.3	-13.0	16.3
NB	3 dB > AGC	upper	1994.80	1994.60	4.8	-29.1	-13.0	16.1
WB	-0.3 dB < AGC	lower	1932.50	1935.00	3.1	-30.3	-13.0	17.3
WB	3 dB > AGC	lower	1932.50	1935.00	6.4	-30.8	-13.0	17.8
NB	-0.3 dB < AGC	lower	1930.20	1930.40	2.9	-29.6	-13.0	16.6
NB	3 dB > AGC	lower	1930.20	1930.40	6.2	-29.6	-13.0	16.6

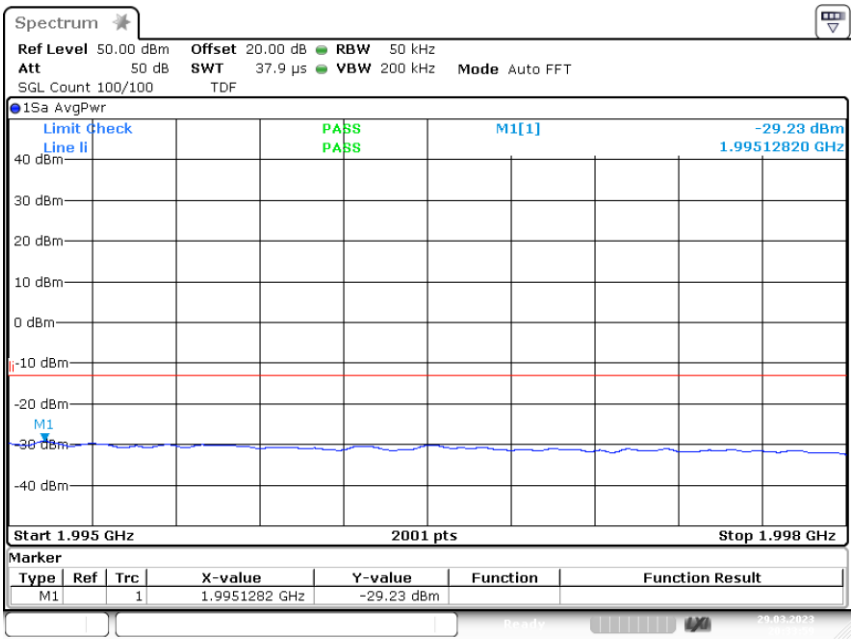
Remark: Please see next sub-clause for the measurement plot.

Explanations concering table with two input signals:

"WB" means Wideband.
"NB" means Narrowband.
Wideband 5G means Wideband 45M

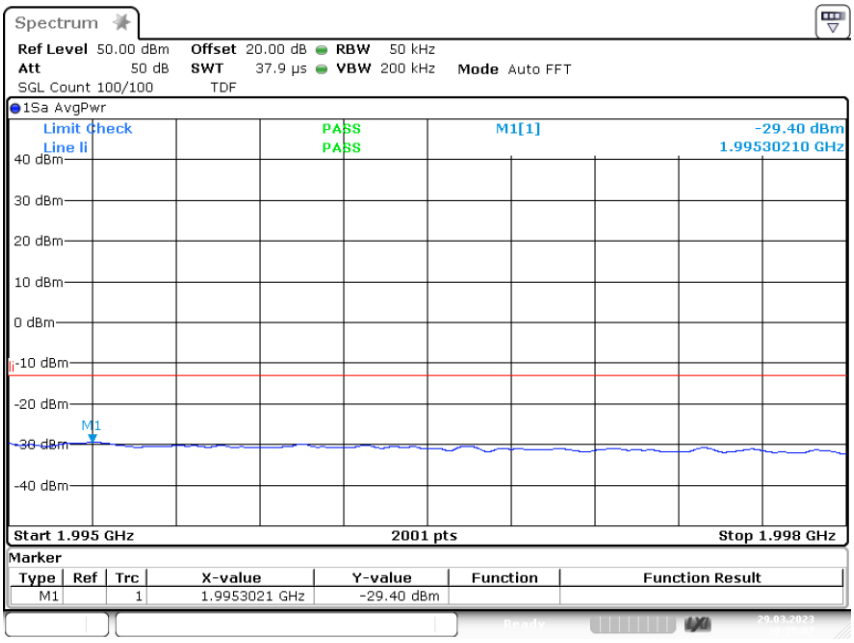
4.3.4 MEASUREMENT PLOT

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: upper; Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 1



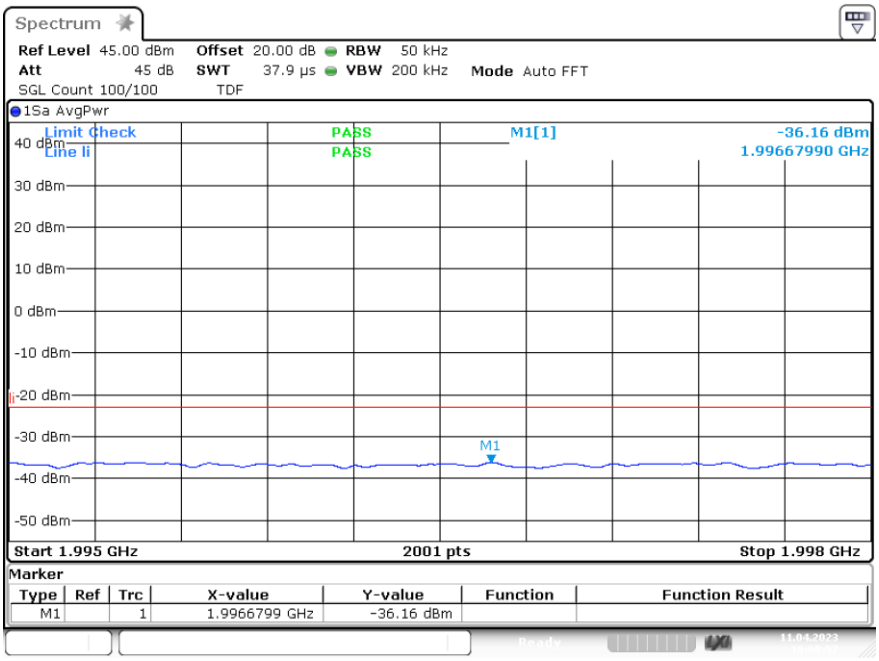
3.6.2 out of band emi PCS1900 AWGN upper 1carrier -0.3 dB 1.
995G 1.998G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: upper; Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 1



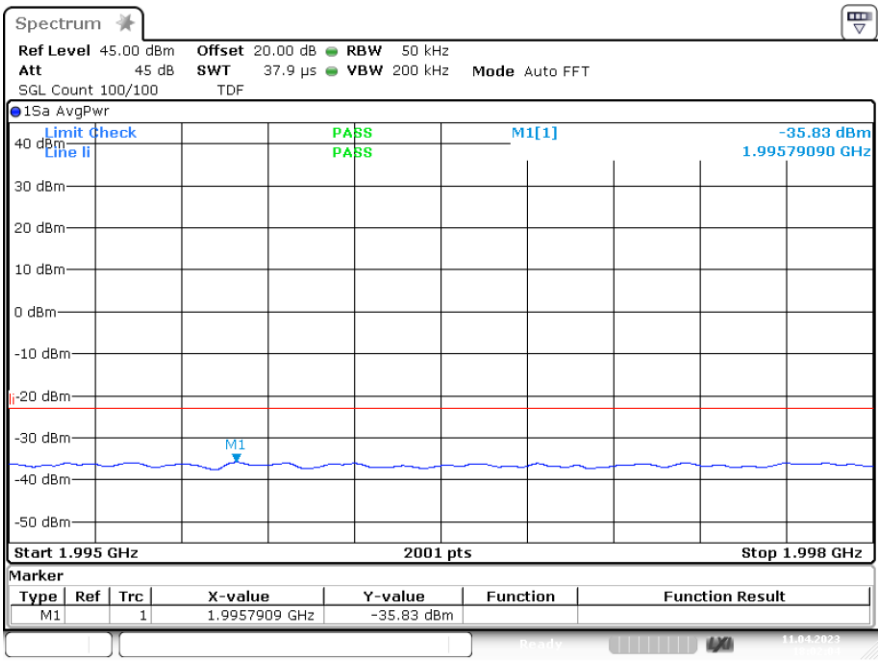
3.6.2 out of band emi PCS1900 AWGN upper 1carrier +3.0 dB 1.
995G 1.998G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: upper; Mod: AWGN 45M; Input Power = 0.3 dB < AGC; Number of signals 1



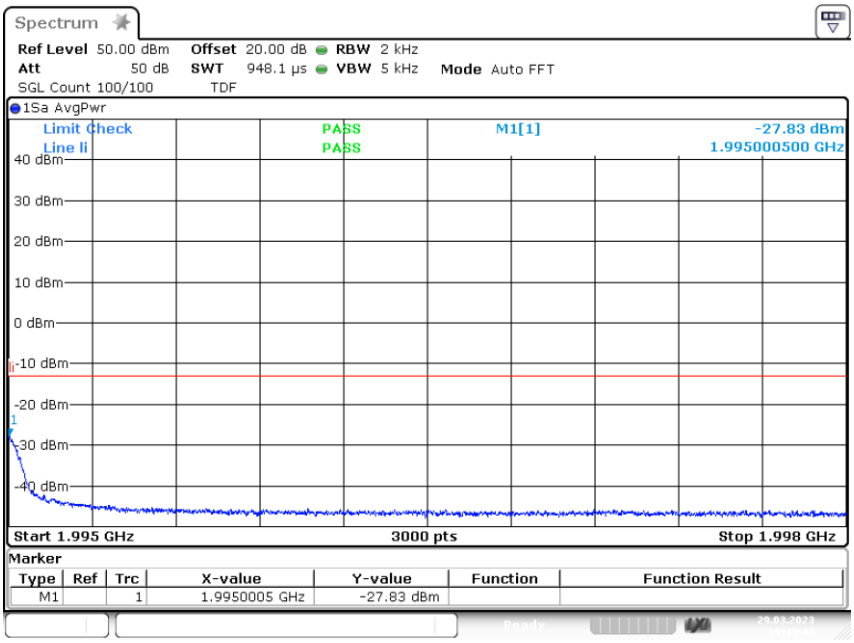
3.6.2 out of band emi PCS1900 AWGN 45M upper 1carrier -0.3 d
B 1.995G 1.998G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: upper; Mod: AWGN 45M; Input Power = 3 dB > AGC; Number of signals 1



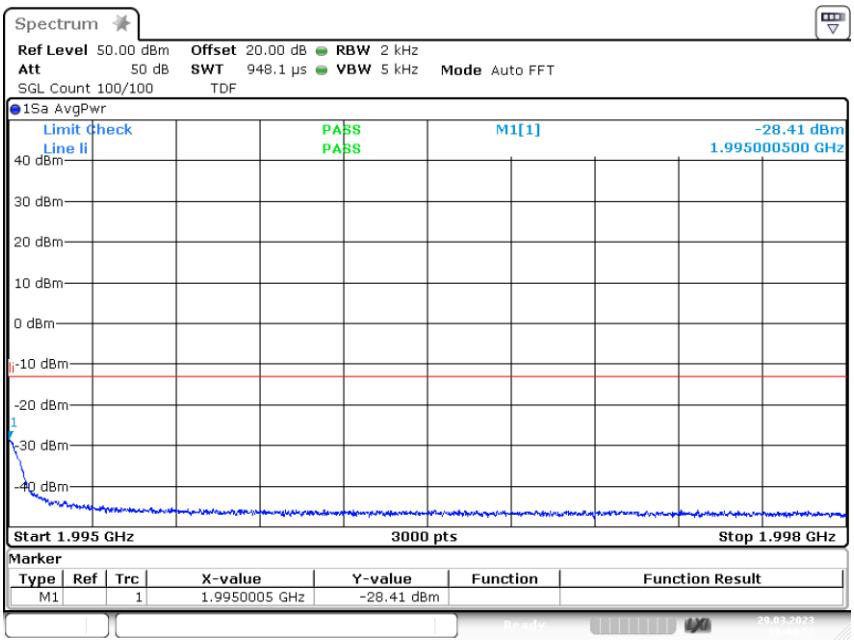
3.6.2 out of band emi PCS1900 AWGN 45M upper 1carrier +3.0 d
B 1.995G 1.998G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: upper; Mod: GSM;
Input Power = 0.3 dB < AGC; Number of signals 1



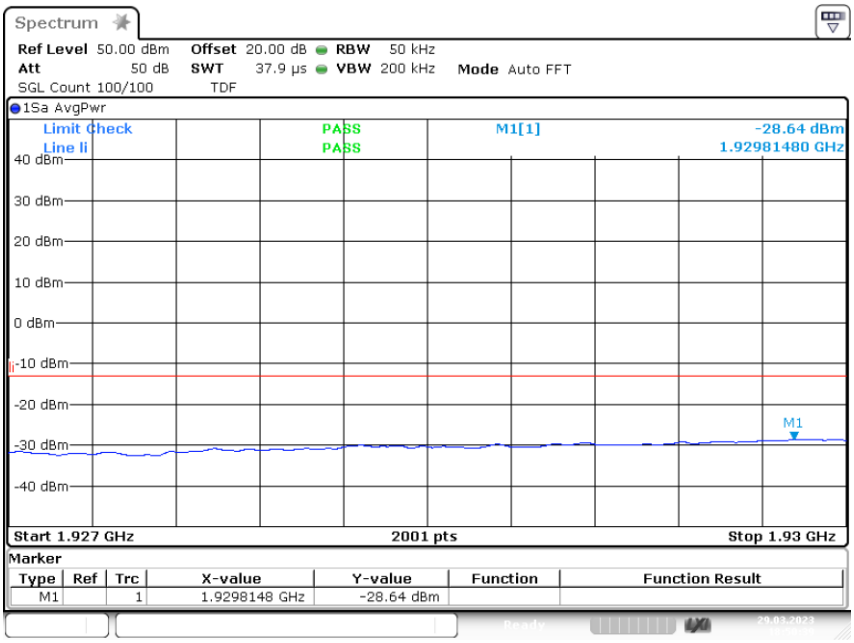
3.6.2 out of band emi PCS1900 GSM upper 1carrier -0.3 dB 1.9
95G 1.998G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: upper; Mod: GSM;
Input Power = 3 dB > AGC; Number of signals 1



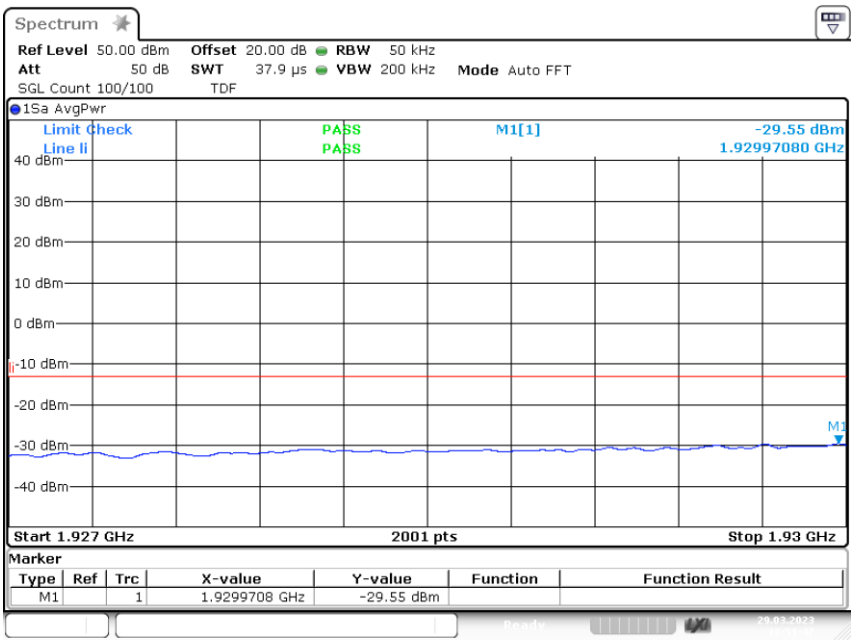
3.6.2 out of band emi PCS1900 GSM upper 1carrier +3.0 dB 1.9
95G 1.998G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: lower; Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 1



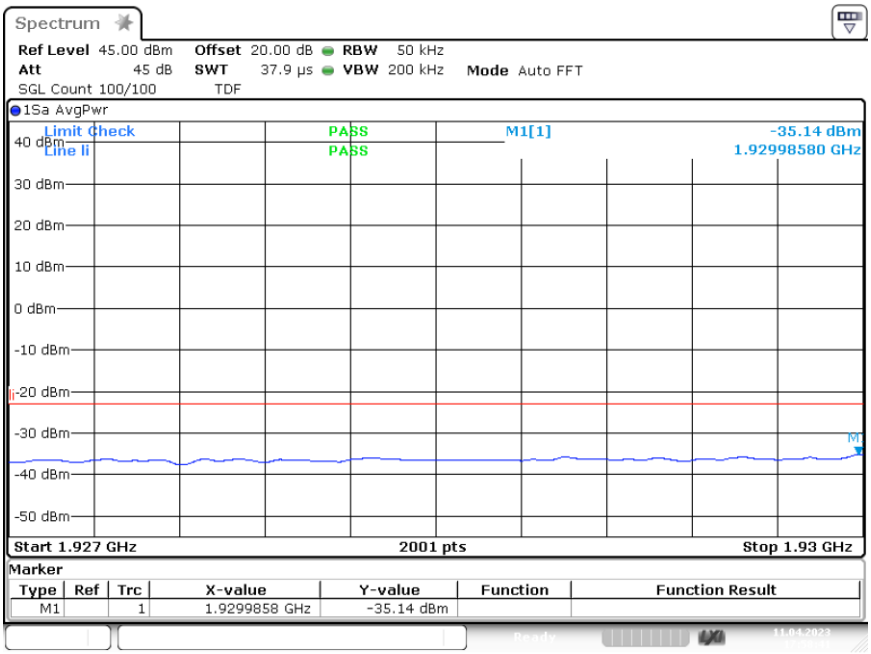
3.6.2 out of band emi PCS1900 AWGN lower 1carrier -0.3 dB 1.
927G 1.930G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: lower; Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 1



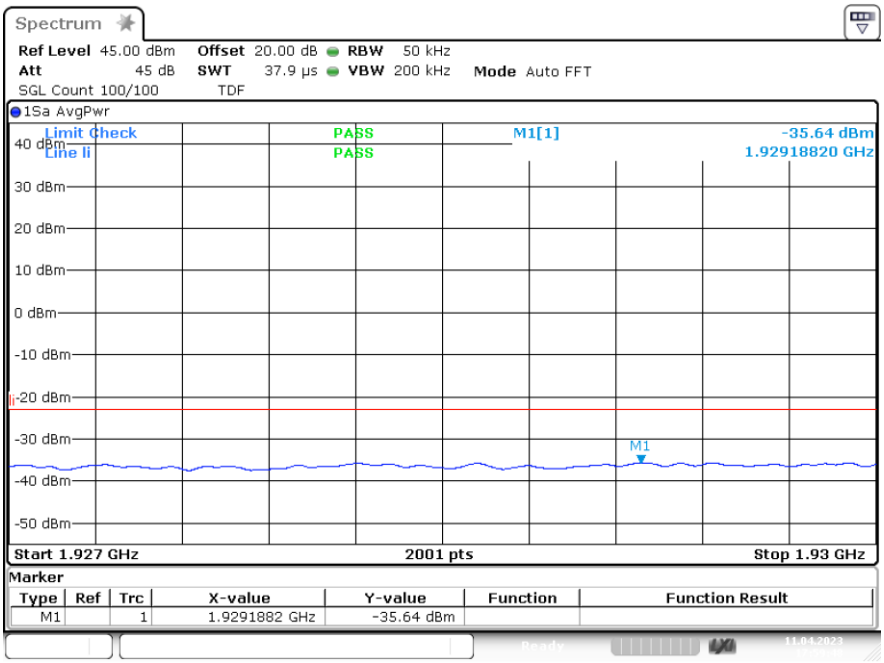
3.6.2 out of band emi PCS1900 AWGN lower 1carrier +3.0 dB 1.
927G 1.930G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: lower; Mod: AWGN 45M; Input Power = 0.3 dB < AGC; Number of signals 1



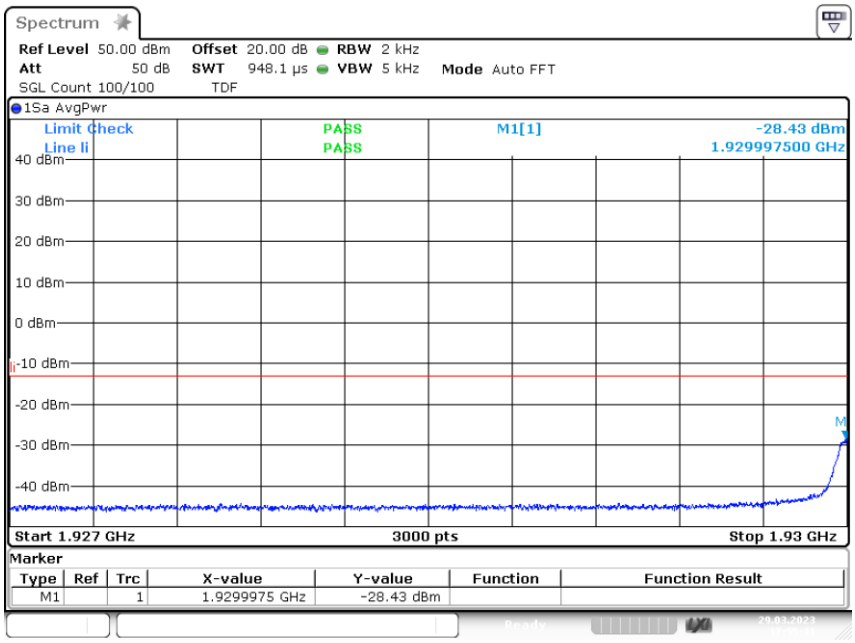
3.6.2 out of band emi PCS1900 AWGN 45M lower 1carrier -0.3 d
B 1.927G 1.930G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: lower; Mod: AWGN 45M; Input Power = 3 dB > AGC; Number of signals 1



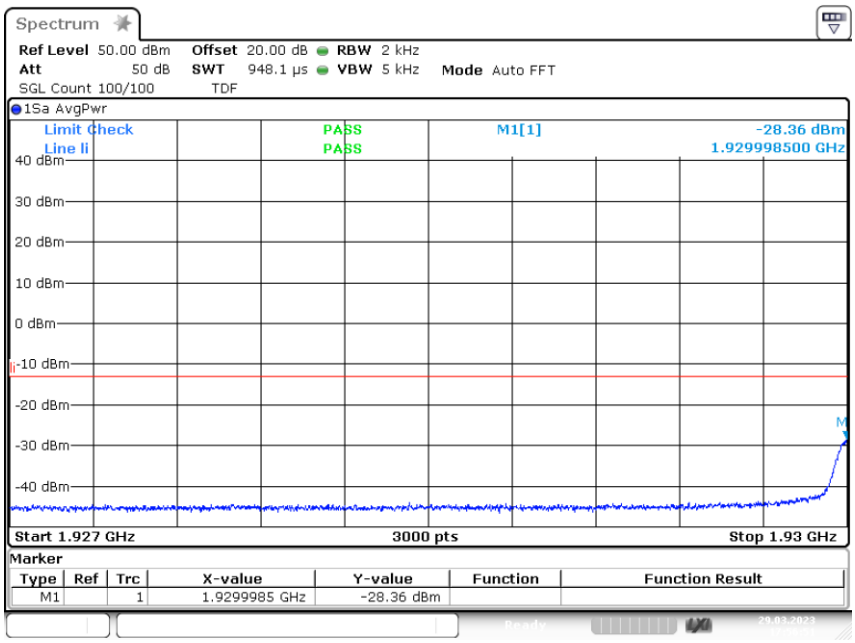
3.6.2 out of band emi PCS1900 AWGN 45M lower 1carrier +3.0 d
B 1.927G 1.930G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: lower;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 1



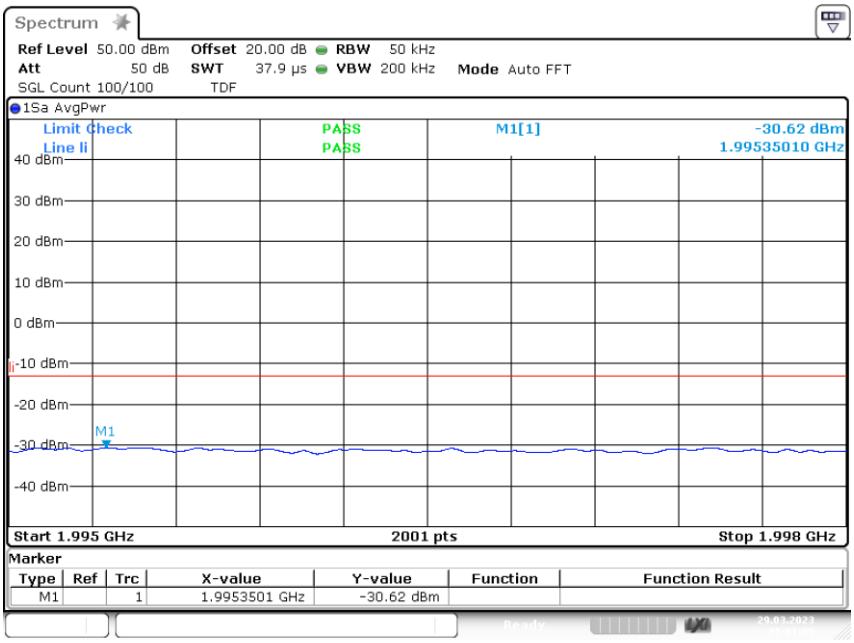
3.6.2 out of band emi PCS1900 GSM lower 1carrier -0.3 dB 1.9
27G 1.930G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: lower;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 1



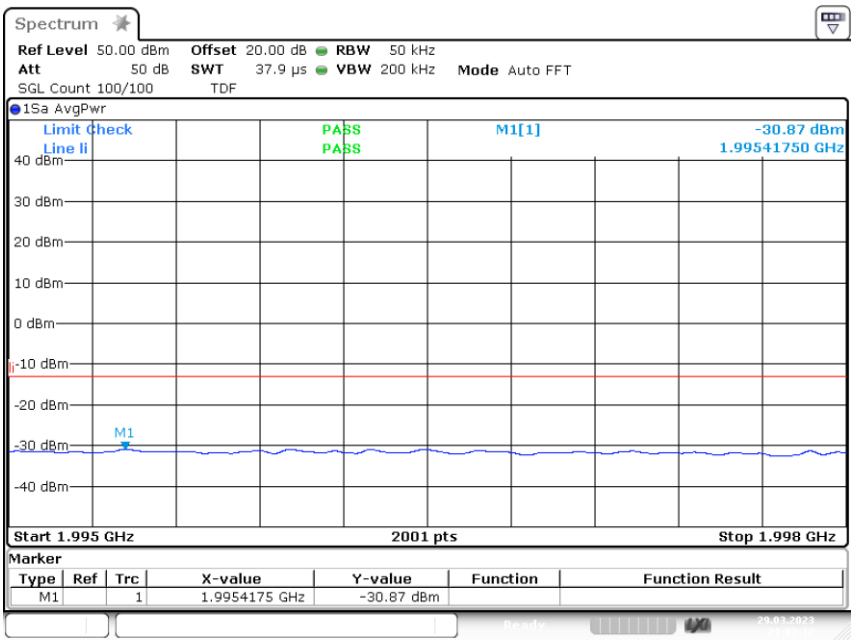
3.6.2 out of band emi PCS1900 GSM lower 1carrier +3.0 dB 1.9
27G 1.930G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: upper; Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 2



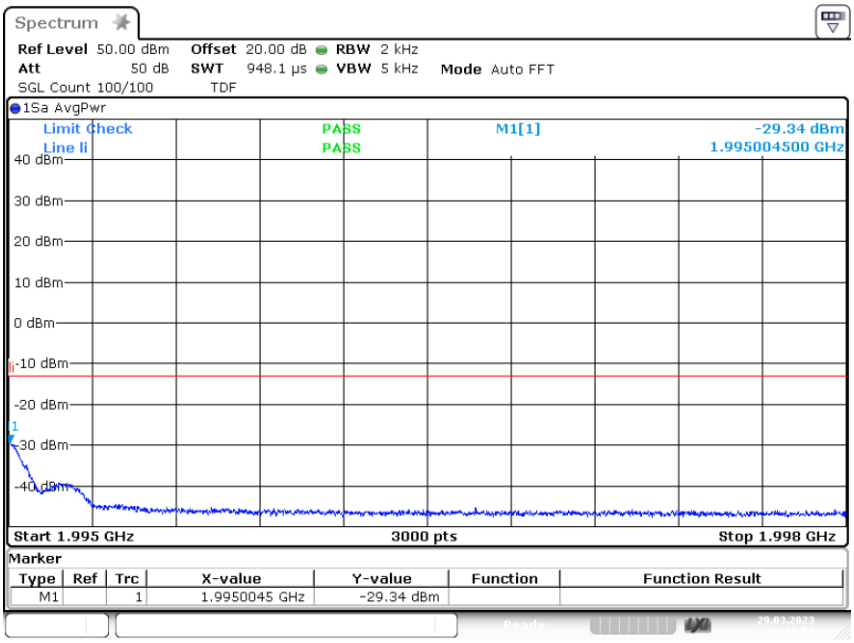
3.6.2 out of band emi PCS1900 AWGN upper 2carriers -0.3 dB 1
.995G 1.998G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: upper; Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 2



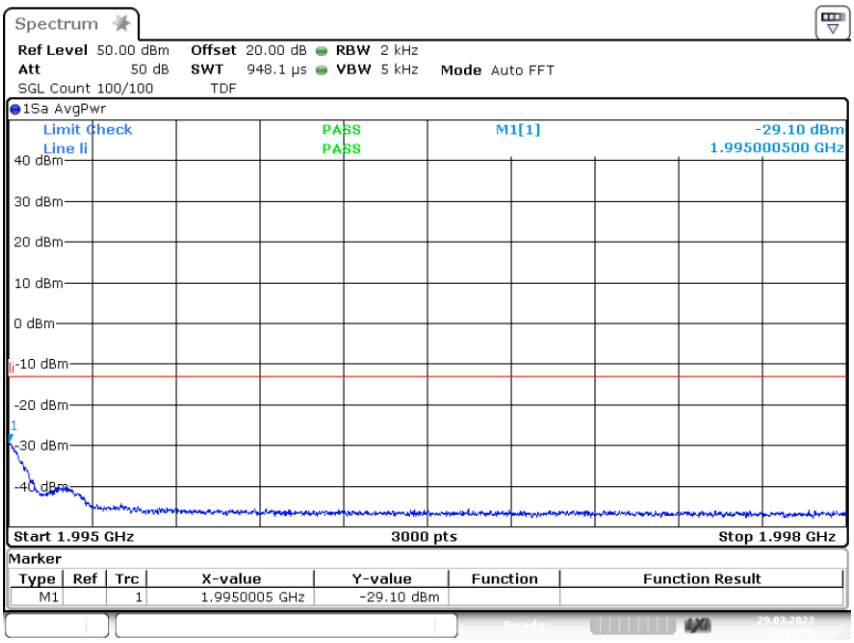
3.6.2 out of band emi PCS1900 AWGN upper 2carriers +3.0 dB 1
.995G 1.998G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: upper; Mod: GSM;
Input Power = 0.3 dB < AGC; Number of signals 2



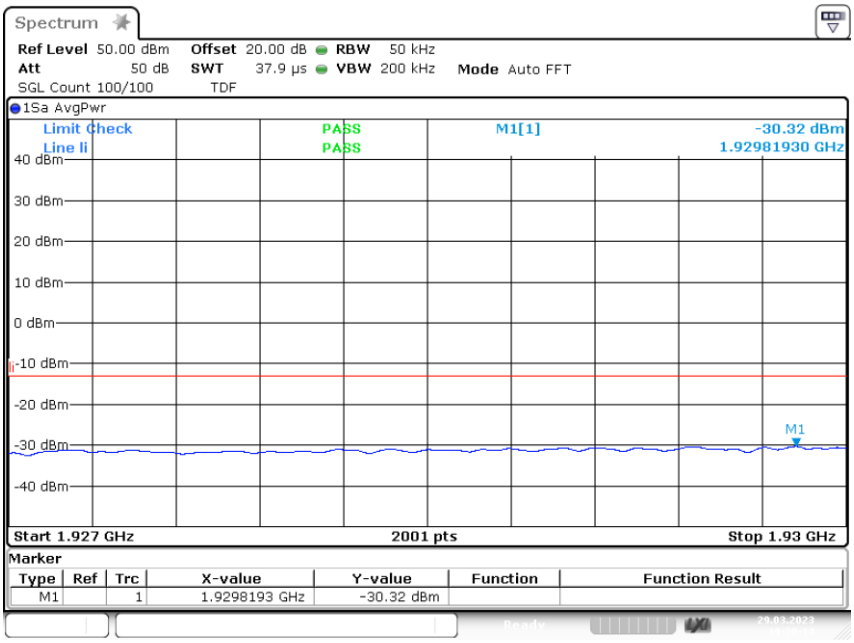
3.6.2 out of band emi PCS1900 GSM upper 2carriers -0.3 dB 1.
995G 1.998G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: upper; Mod: GSM;
Input Power = 3 dB > AGC; Number of signals 2



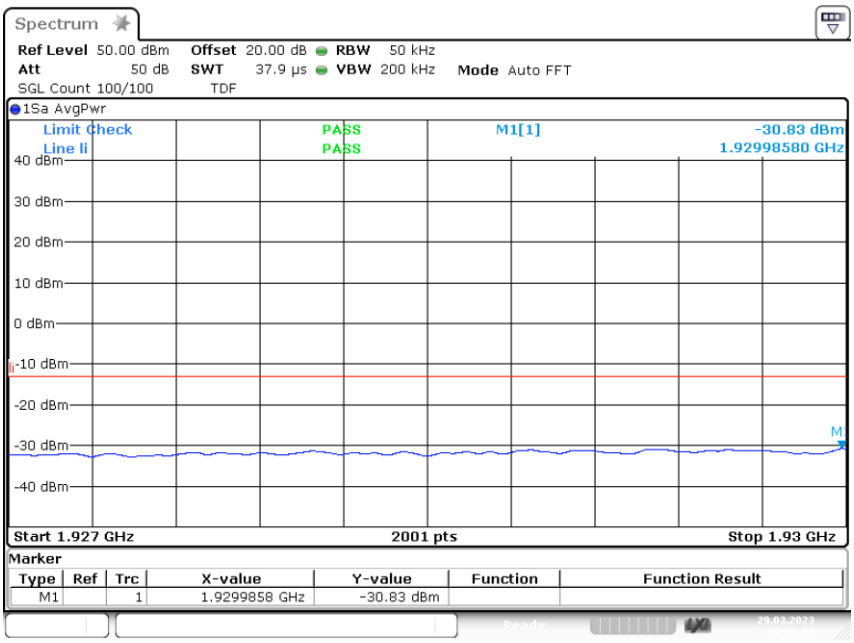
3.6.2 out of band emi PCS1900 GSM upper 2carriers +3.0 dB 1.
995G 1.998G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: lower;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 2



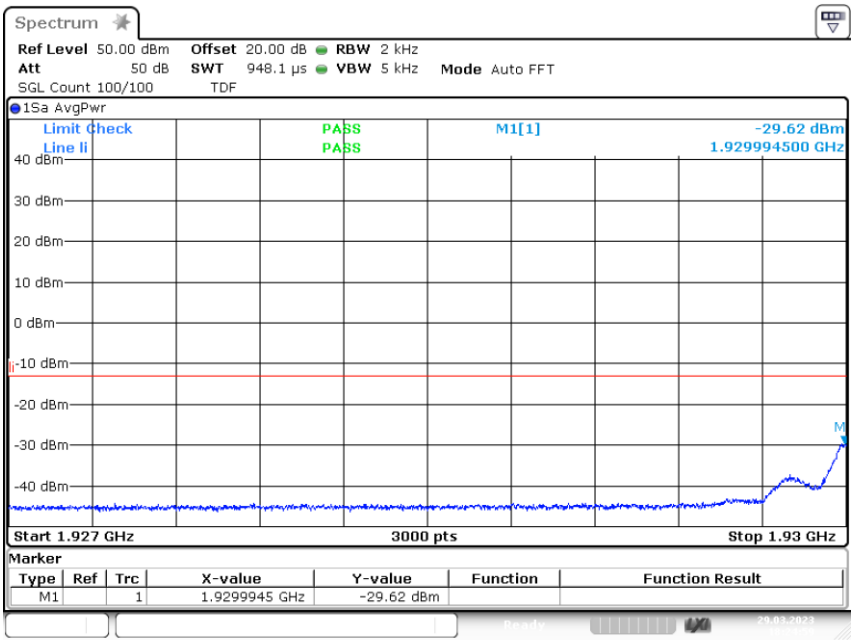
3.6.2 out of band emi PCS1900 AWGN lower 2carriers -0.3 dB 1
.927G 1.930G

Band: PCS1900; Frequency: 1.9300 GHz to 1.9950 GHz; Band Edge: lower;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 2



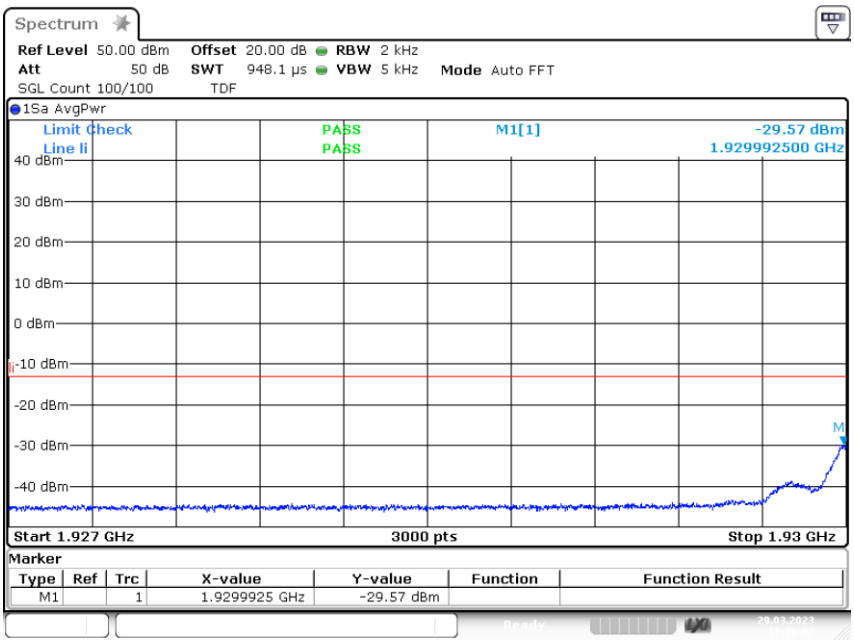
3.6.2 out of band emi PCS1900 AWGN lower 2carriers +3.0 dB 1
.927G 1.930G

Band: PCS1900; 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: PCS1900; 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

4.3.5 TEST EQUIPMENT USED

- Conducted

4.4 OUT-OF-BAND REJECTION

Standard FCC Part 20

The test was performed according to:
ANSI C63.26:2015; KDB 935210 D05

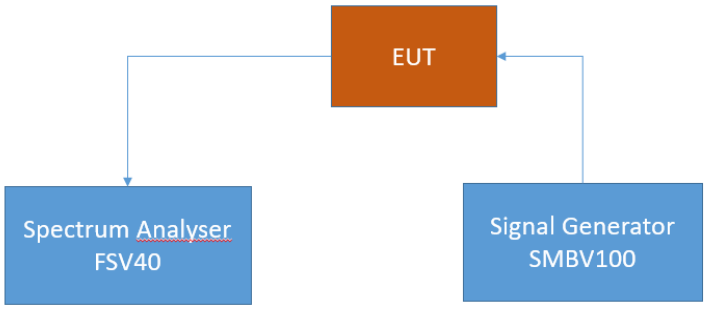
Test date: 2023-03-29 to 2023-04-17

Environmental conditions: 21 … 26 °C; 25 .. 35 % r. H.

Test engineer: Thomas Hufnagel

4.4.1 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:



FCC Part 22/24/27/90 Industrial signal booster – Test Setup; Out-of-band rejection

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.

4.4.2 TEST REQUIREMENTS/LIMITS

None.

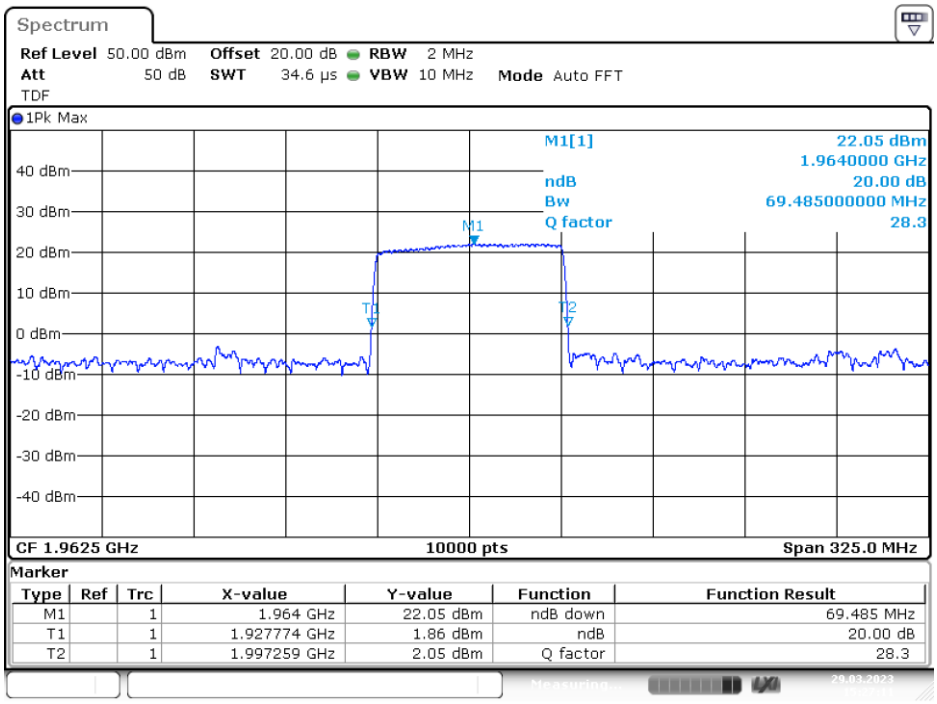
4.4.3 TEST PROTOCOL

Band 25 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]**
1964.00	22.05	1927.774	1997.259	69.485

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

4.4.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

Frequency Band = Band 25 PCS 1900, Direction = RF downlink



3.3 Out of band rejection PCS1900 1.96250G
_20dB

4.4.5 TEST EQUIPMENT USED

- Conducted

5 TEST EQUIPMENT

1 Conducted

Ref.No.	Type	Description	Manufacturer	Inventory no.	Last Calibration	Calibration Due
1.1	FSV40	Signal Analyzer 10 Hz - 40 GHz	Rohde & Schwarz	E-003139	2022-10	2023-10
1.2	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	E-003206	2023-01	2025-01
1.3	Arduino & HTY939	ThermoHygro Datalogger	Eigenbau	E-003998	2022-09	2023-09
1.4	LabVIEW	Software	NI	----	---	---

6 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas.

Frequency	20 dB attenuator Deviation to 20 dB	cable loss (to receiver)
MHz	dB	dB
100 MHz	-0.40	-0.19
200 MHz	-0.34	-0.29
300 MHz	-0.26	-0.37
400 MHz	-0.24	-0.41
500 MHz	-0.20	-0.45
600 MHz	-0.20	-0.51
700 MHz	-0.16	-0.56
800 MHz	-0.16	-0.58
900 MHz	-0.14	-0.63
1000 MHz	-0.12	-0.66
2000 MHz	0.02	-0.98
3000 MHz	0.10	-1.28
4000 MHz	0.09	-1.53
5000 MHz	0.01	-1.65
6000 MHz	-0.05	-1.77
7000 MHz	0.04	-2.07
8000 MHz	-0.07	-2.07
9000 MHz	-0.12	-2.55
10000 MHz	-0.08	-2.19
11000 MHz	-0.10	-2.37
12000 MHz	-0.12	-2.40
13000 MHz	-0.07	-2.29
14000 MHz	0.09	-2.57
15000 MHz	0.18	-2.42
16000 MHz	0.01	-2.59
17000 MHz	0.00	-2.75
18000 MHz	0.10	-2.83

Sample calculation

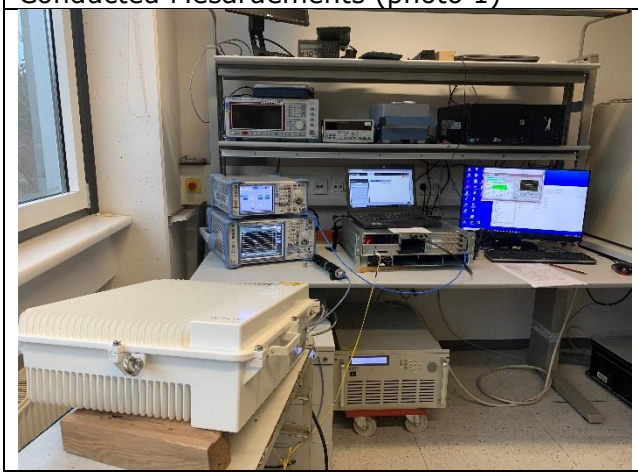
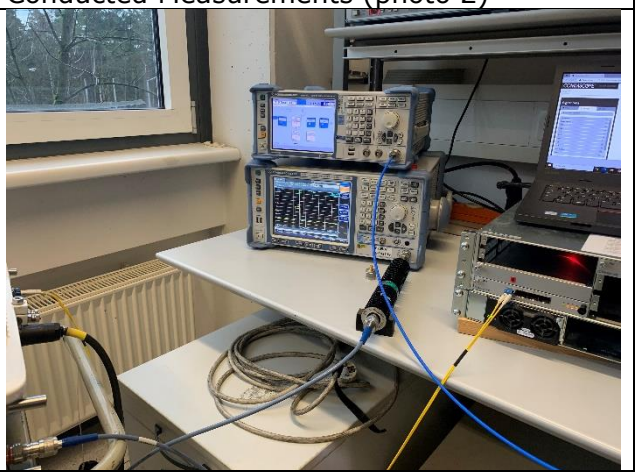
P_{ower} (dBm) = U (dBm) + $AT\Delta_{attenuator}$ (dB) + $AT_{attenuator}$ (dB) - AT_{Cable} (dB)
U = Receiver reading
$AT\Delta_{attenuator}$ = Deviation to 20 dB
$AT_{attenuator}$ = 20 dB
AT_{Cable}= cable loss

7 MEASUREMENT UNCERTAINTIES

KDB 935210 D05	
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

8 PHOTO REPORT

Conducted Mesaruements (photo 1)	Conducted Measurements (photo 2)
	

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 *****