Test Report

2023-0080-EMC-TR-23-0054-V01_Andrew_ CAP MX Band CELL 850_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 5 / CELL 850 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 07:57:13 +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 08:48:49 +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, 22. 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 22, Subpart H – Cellular Radiotelephone Service

§ 22.905 – Channesl for cellular service
§ 22.913 – Effective radiated power limits
§ 22.917 – Emission limitations for cellular 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-IC 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 § 22.913 KDB 935210 D05 v01r04: 3.5
Occupied bandwidth Input-versus-output spectrum	§ 2.1049 KDB 935210 D05 v01r04: 3.4
Out-of-band emissions limits	§ 2.1051 § 22.917 KDB 935210 D05 v01r04: 3.6
Frequency stability	§ 2.1055 § 22.355
Out-of-band rejection	KDB 935210 D05 v01r04: 3.3
All measurements	ANSI 63.26:2015

1.3 MEASUREMENT SUMMARY/SIGNATURES

47 CFR CHAPTER I FCC PART 22 Subpart H [Base Stations/Repeater] **§ 2.1046, § 22.913**

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 Frequency Band, Direction, Input Power, Signal Type	**FCC**
Band 5 CELL 850, RF downlink, 0.3 dB < AGC, Wideband	Passed
Band 5 CELL 850, RF downlink, 3 dB > AGC, Wideband	Passed
Band 5 CELL 850, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed
Band 5 CELL 850, RF downlink, 3 dB > AGC, Wideband 5G	Passed
Band 5 CELL 850, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Band 5 CELL 850, RF downlink, 3 dB > AGC, Narrowband	Passed

47 CFR CHAPTER I FCC PART 22 Subpart H [Base Stations/Repeater] **§ 2.1049**

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

OP-Mode Frequency Band, Direction, Input Power, Signal Type	**FCC**
Band 5 CELL 850, RF downlink, 0.3 dB < AGC, Wideband	Passed
Band 5 CELL 850, RF downlink, 3 dB > AGC, Wideband	Passed
Band 5 CELL 850, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed
Band 5 CELL 850, RF downlink, 3 dB > AGC, Wideband 5G	Passed
Band 5 CELL 850, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Band 5 CELL 850, RF downlink, 3 dB > AGC, Narrowband	Passed

47 CFR CHAPTER I FCC PART 22 Subpart H [Base Stations/Repeater] § 2.1051, § 22.917

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, Band 5 CELL 850, 1, RF downlink, 0.3 dB < AGC, Wideband	Passed
Lower, Band 5 CELL 850, 1, RF downlink, 3 dB > AGC, Wideband	Passed
Lower, Band 5 CELL 850, 1, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed
Lower, Band 5 CELL 850, 1, RF downlink, 3 dB > AGC, Wideband 5G	Passed
Lower, Band 5 CELL 850, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, Band 5 CELL 850, 1, RF downlink, 3 dB > AGC, Narrowband	Passed
Lower, Band 5 CELL 850, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Lower, Band 5 CELL 850, 2, RF downlink, 3 dB > AGC, Wideband	Passed
Lower, Band 5 CELL 850, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, Band 5 CELL 850, 2, RF downlink, 3 dB > AGC, Narrowband	Passed

47 CFR CHAPTER I FCC PART 22 Subpart H [Base Stations/Repeater] § 2.1051, § 22.917

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, Band 5 CELL 850, 1, RF downlink, 0.3 dB < AGC, Wideband	Passed
Upper, Band 5 CELL 850, 1, RF downlink, 3 dB > AGC, Wideband	Passed
Upper, Band 5 CELL 850, 1, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed
Upper, Band 5 CELL 850, 1, RF downlink, 3 dB > AGC, Wideband 5G	Passed
Upper, Band 5 CELL 850, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, Band 5 CELL 850, 1, RF downlink, 3 dB > AGC, Narrowband	Passed
Upper, Band 5 CELL 850, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Upper, Band 5 CELL 850, 2, RF downlink, 3 dB > AGC, Wideband	Passed
Upper, Band 5 CELL 850, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, Band 5 CELL 850, 2, RF downlink, 3 dB > AGC, Narrowband	Passed

47 CFR CHAPTER I FCC PART 22 Subpart H [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	Setup	FCC
Frequency Band, Direction		
Band 5 CELL 850, 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; DM77662	Rack in Conjunction with AUX 2
AUX2	Commsope/General Electric; Power Supply Unit; LBGEPE17KZ39047532	Power Supply
AUX3	Commscope; ION-E WCS-2; SZAEAJ1952A0032	Subrack in Conjunction with AUX 4, 5,6, 7 and 8
AUX4	Commscope; ION-E OPT; SZBEAD1951A0011	Optical Card
AUX5	Commscope; ION-E SUI; SZBEAC1746A0015	LAN System Interface
AUX6	Commscope; ION-E RFD; SZBEAP1920A0057	RF Card
AUX7	Commscope; ION-E RFD; SZBEAP1924A0023	RF Card
AUX 8	Commscope; ION-E RFD; SZBEAP1946A0003	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
5 (CELL 850)	Downlink	869.00	894.00	881.50	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
5	Downlink	Narrowband	-2.8	-3.1	0.2	881.50	Mid
5	Downlink	Wideband	-2.8	-3.1	0.2	881.50	
5	Downlink	Wideband G5	-2.8	-3.1	0.2	881.50	
5	Downlink	Narrowband	-2.8	-3.1	0.2	869.20	Low
5	Downlink	Wideband	-2.6	-2.9	0.4	871.50	
5	Downlink	Narrowband	-4.0	-4.3	-1.0	893.80	High
5	Downlink	Wideband	-3.6	-3.9	-0.6	891.50	
5	Downlink	Narrowband	-3.8	-4.1	-0.8	891.90	Max.Power
5	Downlink	Wideband	-3.6	-3.9	-0.6	891.50	

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): 12.5 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 22, § 22.913

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

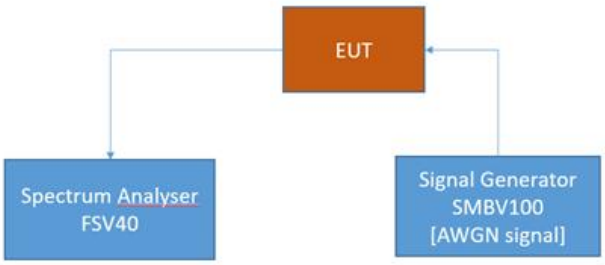
Environmental conditions: 21 … 26 °C; 25 .. 35 % r. H.

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 § 22.913.

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

Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§ 22.913

Abstract § 22.913 from FCC:

(a) *Maximum ERP.* The ERP of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section.

(1) Except as described in paragraphs (a)(2), (3), and (4) of this section, the ERP of base stations and repeaters must not exceed—

(i) 500 watts per emission; or

(ii) 400 watts/MHz (PSD) per sector.

(2) Except as described in paragraphs (a)(3) and (4) of this section, for systems operating in areas more than 72 kilometers (45 miles) from international borders that:

(i) 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; or

(ii) Extend coverage into Unserved Area on a secondary basis (*see* § 22.949), the ERP of base transmitters and repeaters must not exceed—

(A) 1000 watts per emission; or

(B) 800 watts/MHz (PSD) per sector.

(3) Provided that they also comply with paragraphs (b) and (c) of this section, licensees are permitted to operate their base transmitters and repeaters with an ERP greater than 400 watts/MHz (PSD) per sector, up to a maximum ERP of 1000 watts/MHz (PSD) per sector unless they meet the conditions in paragraph (a)(4) of this section.

(4) Provided that they also comply with paragraphs (b) and (c) of this section, licensees of systems operating in areas more than 72 kilometers (45 miles) from international borders that:

(i) 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; or

(ii) Extend coverage into Unserved Area on a secondary basis (*see* § 22.949), are permitted to operate base transmitters and repeaters with an ERP greater than 800 watts/MHz (PSD) per sector, up to a maximum of 2000 watts/MHz (PSD) per sector.

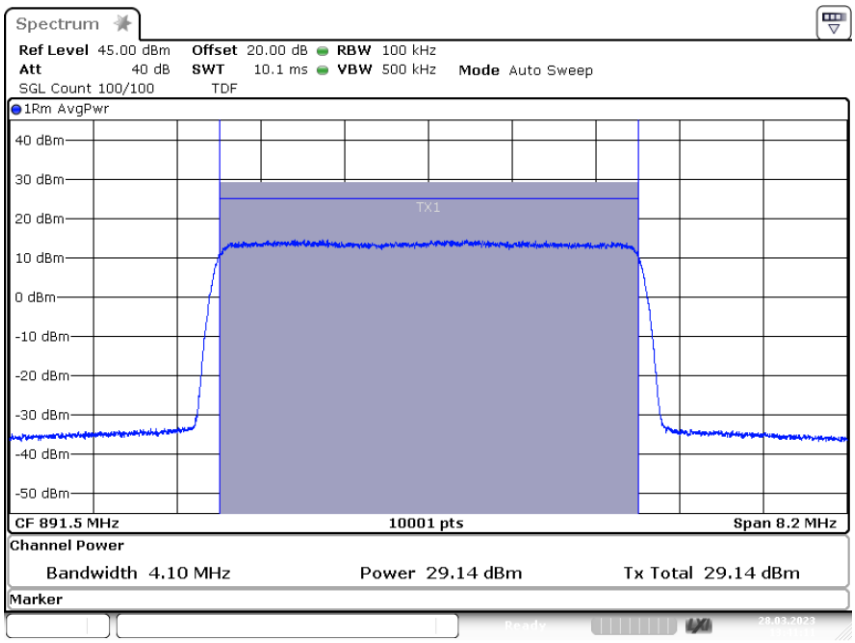
4.1.3 TEST PROTOCOL

Band 5, 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	891.50	-3.9	29.1	60.0	30.9	33.0
Wideband	3 dB > AGC	891.50	-0.6	28.8	60.0	31.2	29.4
Wideband 5G	0.3 dB < AGC	881.50	-3.1	29.1	60.0	30.9	32.2
Wideband 5G	3 dB > AGC	881.50	0.2	28.9	60.0	31.1	28.7
Narrowband	0.3 dB < AGC	891.90	-4.1	29.2	60.0	30.8	33.3
Narrowband	3 dB > AGC	891.90	-0.8	29.6	60.0	30.4	30.4

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

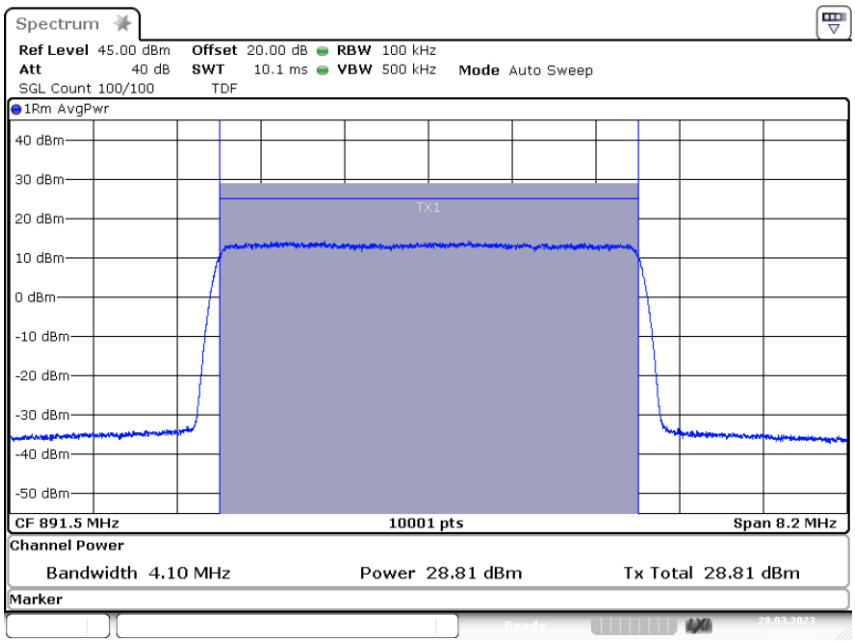
4.1.4 MEASUREMENT PLOT

Band: CEL850; Frequency: 891.9000 MHz; Band Edge: f0;
Mod: AWGN; Output Power 0.3 dB < AGC



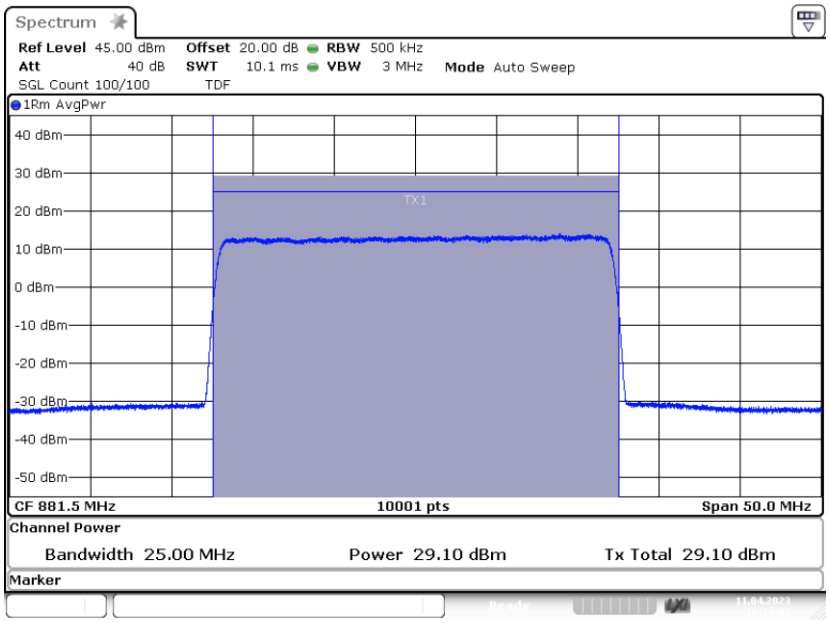
3.5.3 Power AWGN Out -0.3 891.50000M

Band: CEL850; Frequency: 891.9000 MHz; Band Edge: f0;
Mod: AWGN; Output Power 3 dB > AGC



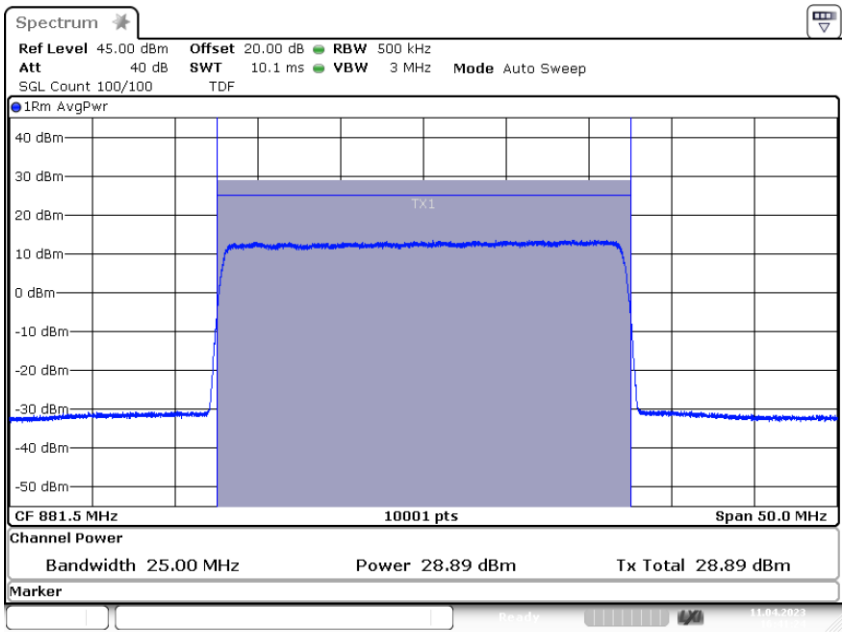
3.5.3 Power AWGN Out +3 891.50000M

Band: CEL850; Frequency: 881.500 MHz; Band Edge: mid;
Mod: AWGN 25M; Output Power 0.3 dB < AGC



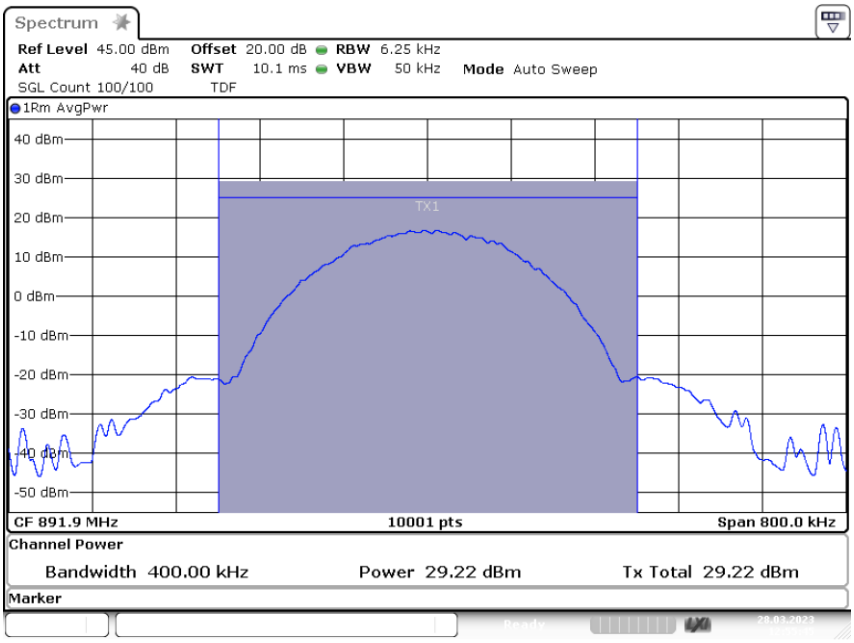
3.5.3 Power AWGN 25M-0.3 881.50000M

Band: CEL850; Frequency: 881.500 MHz; Band Edge: mid;
Mod: AWGN 25M; Output Power 3 dB > AGC



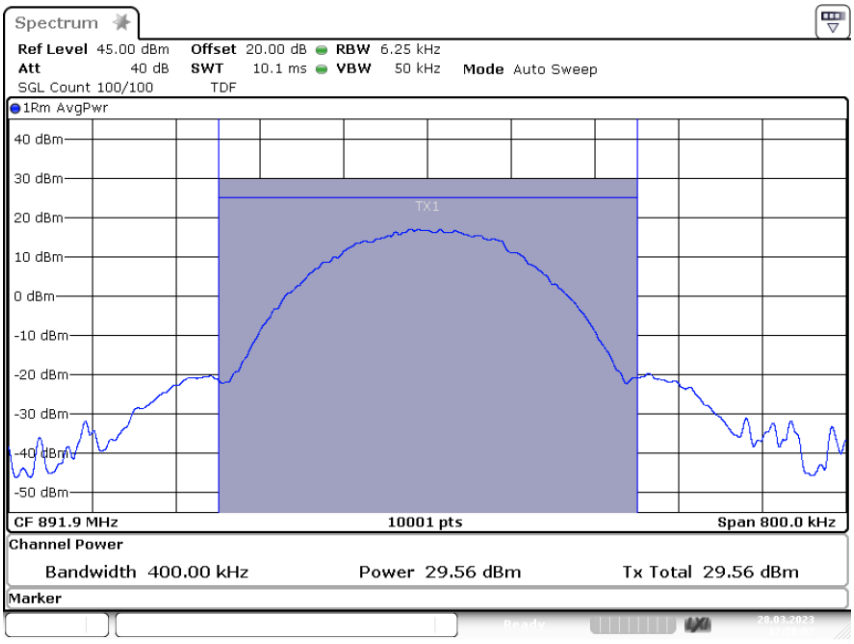
3.5.3 Power AWGN 25M+3 881.50000M

Band: CEL850; Frequency: 891.9000 MHz; Band Edge: f0;
Mod: GSM; Output Power 0.3 dB < AGC



3.5.3 Power GSM Out -0.3 891.90000M

Band: CEL850; Frequency: 891.9000 MHz; Band Edge: f0;
Mod: GSM; Output Power 3 dB > AGC



3.5.3 Power GSM Out +3 891.90000M

4.1.5 TEST EQUIPMENT USED

- Conducted

4.2 OCCUPIED BANDWIDTH/INPUT-VERSUS-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

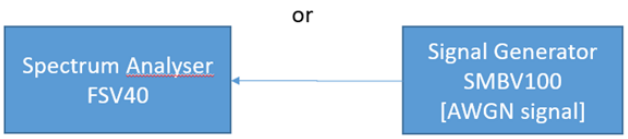
Environmental conditions: 21 … 26 °C; 25 .. 35 % r. H.

Test engineer: Thomas Hufnagel

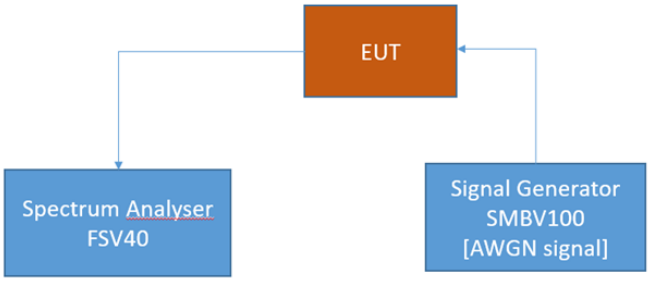
4.2.1 TEST DESCRIPTION

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.

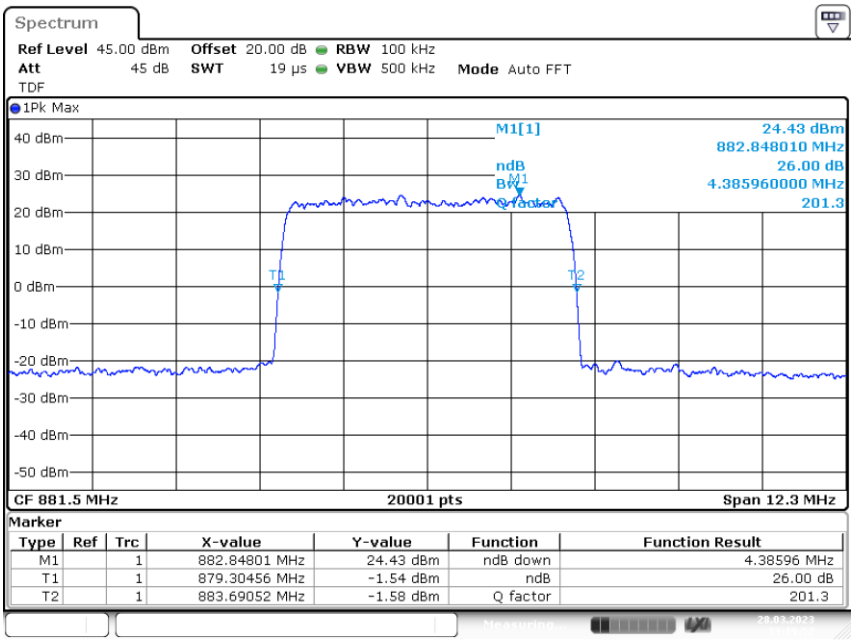
4.2.3 TEST PROTOCOL

Band 5 CELL 850, downlink			
Signal Type	**Input Power**	**Signal Frequency [MHz]**	**Occupied Bandwidth Booster [kHz]**
Wideband	0.3 dB < AGC	881.50	4385.96
Wideband	3 dB > AGC	881.50	4386.58
Wideband 5G	0.3 dB < AGC	881.50	25123.7
Wideband 5G	3 dB > AGC	881.50	25183.7
Narrowband	0.3 dB < AGC	881.50	316.18
Narrowband	3 dB > AGC	881.50	320.02

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

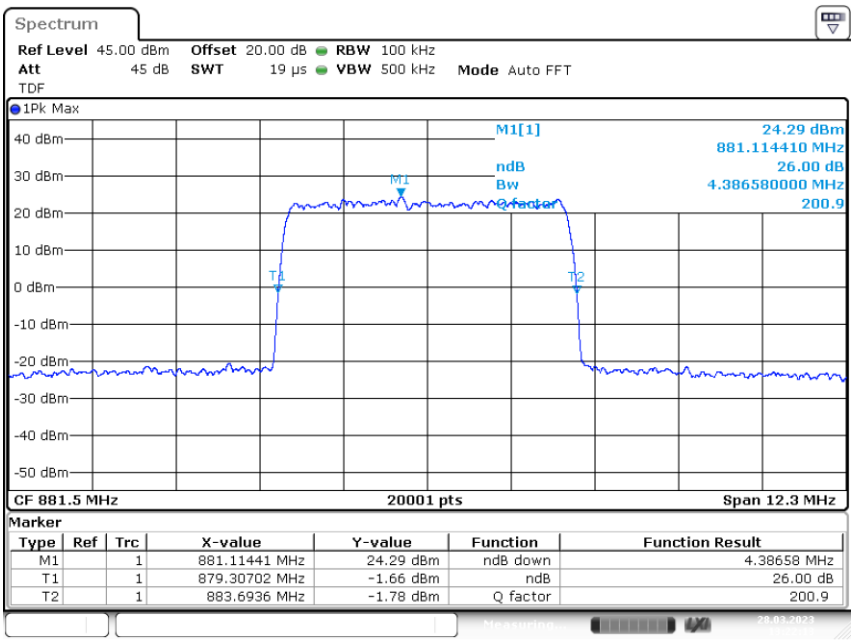
4.2.4 MEASUREMENT PLOT

Band: CEL850; Frequency: 881.5000 MHz; Band Edge: mid;
Mod: AWGN; Output OCBw 0.3 dB < AGC



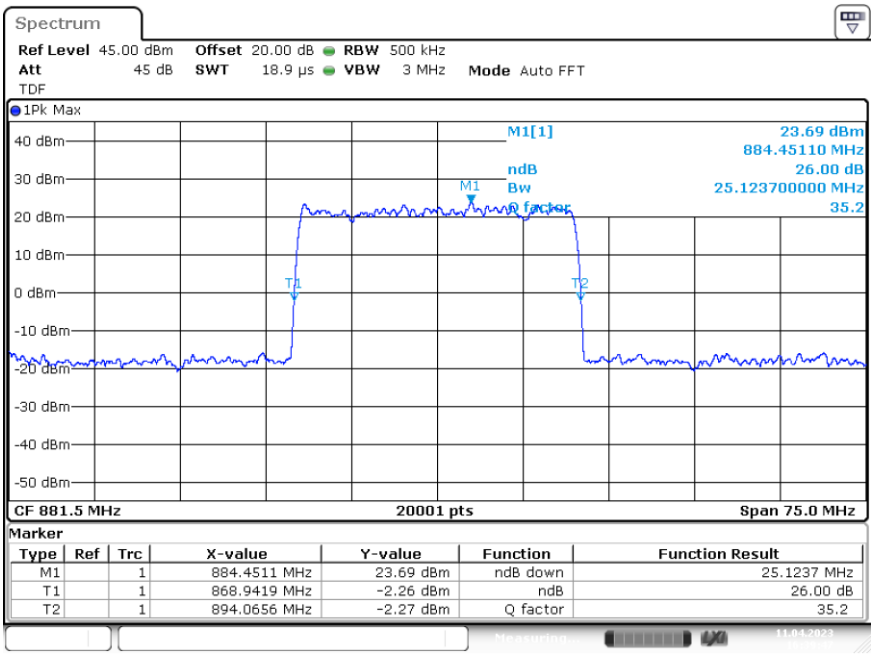
3.4 OCBw AWGN Out -0.3 881.5000M _26dB

Band: CEL850; Frequency: 881.5000 MHz; Band Edge: mid;
Mod: AWGN; Output OCBw 3 dB > AGC



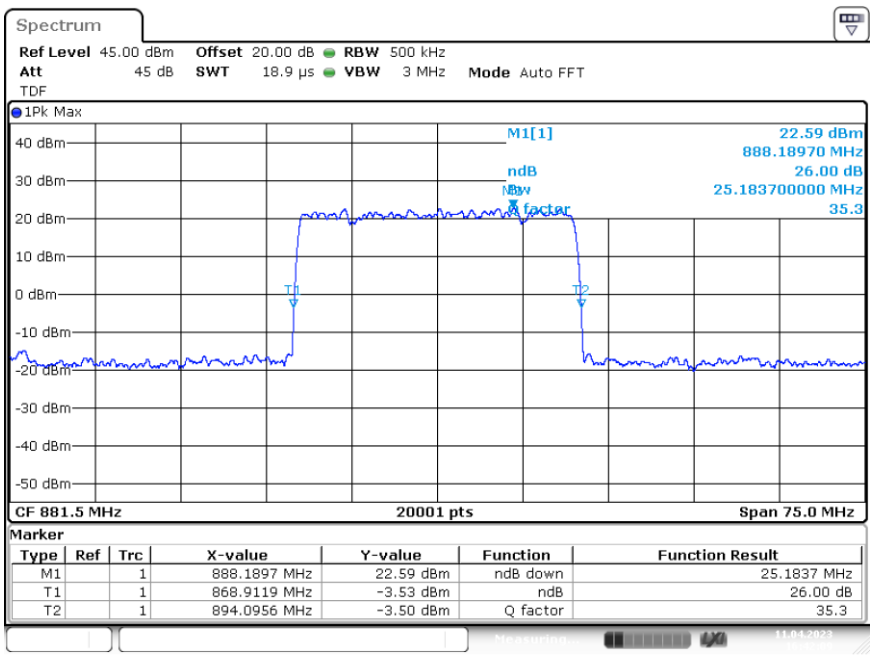
3.4 OCBw AWGN Out +3 881.5000M _26dB

Band: CEL850; Frequency: 881.5000 MHz; Band Edge: mid;
Mod: AWGN 25M; Output OCBw 0.3 dB < AGC



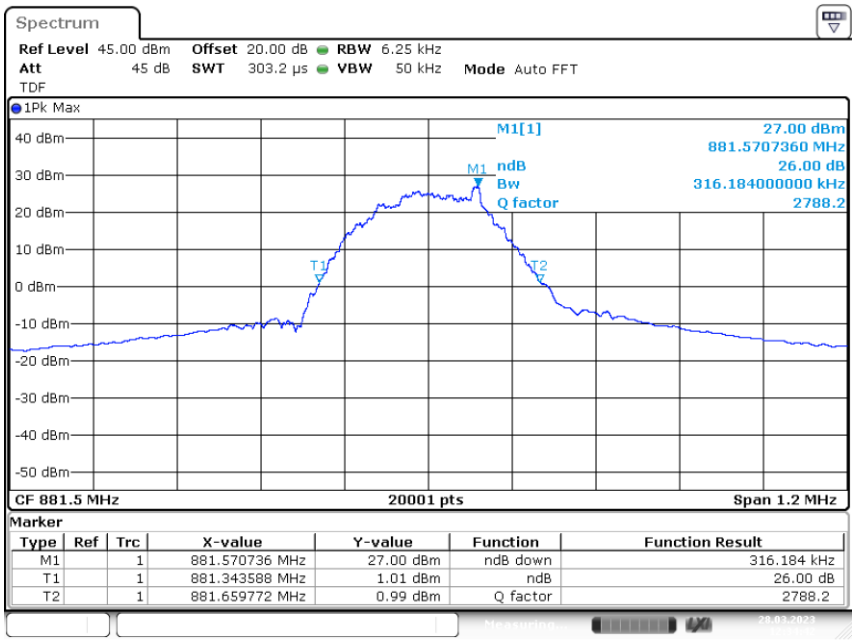
3.4 OCBw AWGN 25M-0.3 881.5000M _26dB

Band: CEL850; Frequency: 881.5000 MHz; Band Edge: mid;
Mod: AWGN 25M; Output OCBw 3 dB > AGC



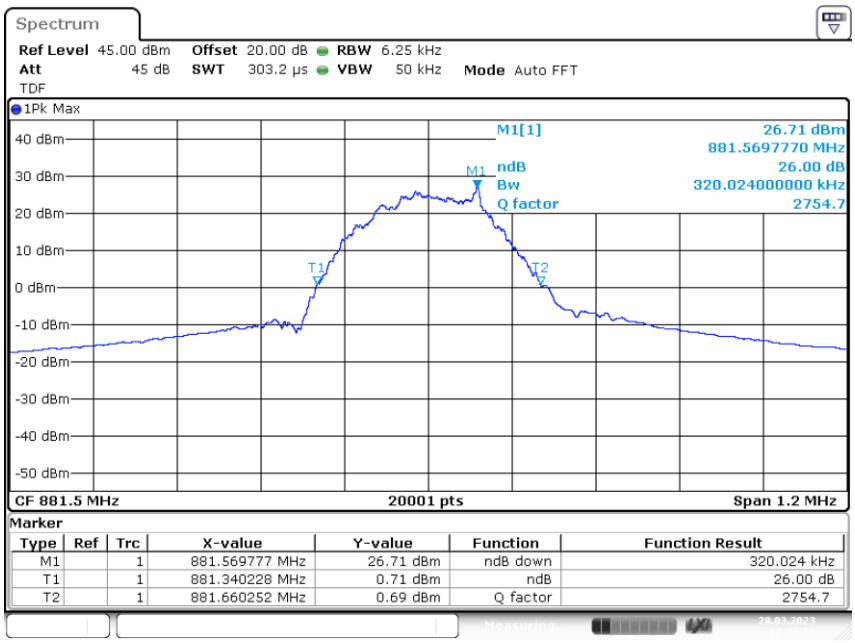
3.4 OCBw AWGN 25M+3 881.5000M _26dB

Band: CEL850; Frequency: 881.5000 MHz; Band Edge: mid;
Mod: GSM; Output OCBw 0.3 dB < AGC



3.4 OCBw GSM Out -0.3 881.5000M _26dB

Band: CEL850; Frequency: 881.5000 MHz; Band Edge: mid;
Mod: GSM; Output OCBw 3 dB > AGC



3.4 OCBw GSM Out +3 881.5000M _26dB

4.2.5 TEST EQUIPMENT USED

- Conducted

4.3 OUT-OF-BAND EMISSION LIMITS

Standard FCC Part § 2.1051, § 27.53

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

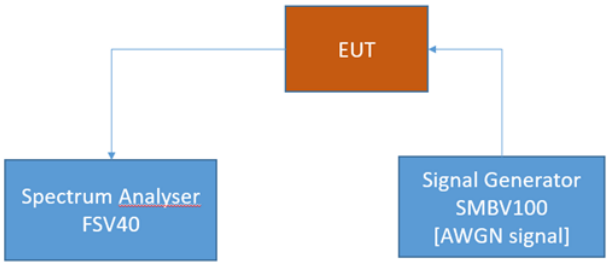
Environmental conditions: 21 … 26 °C; 25 .. 35 % r. H.

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 § 22.9172.

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 § 22.917 FCC:

Part 22, Subpart H – Cellular Radiotelephone Service; Band 5

§ 22.917 Emission limitations for cellular equipment.

The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone 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.

4.3.3 TEST PROTOCOL

Band 5, 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	891.50	-3.3	-34.6	-13	21.6
Wideband	3 dB > AGC	upper	891.50	0.0	-35.0	-13	22.0
Wideband 5G	-0.3 dB < AGC	upper	881.50	-3.1	-36.4	-13	23.4
Wideband 5G	3 dB > AGC	upper	881.50	0.2	-36.5	-13	23.5
Narrowband	-0.3 dB < AGC	upper	893.80	-4.3	-32.1	-13	19.1
Narrowband	3 dB > AGC	upper	893.80	-1.0	-32.1	-13	19.1
Wideband	-0.3 dB < AGC	lower	871.50	-2.3	-35.0	-13	22.0
Wideband	3 dB > AGC	lower	871.50	1.0	-34.3	-13	21.3
Wideband 5G	-0.3 dB < AGC	lower	881.50	-3.1	-36.6	-13	23.6
Wideband 5G	3 dB > AGC	lower	881.50	0.2	-36.7	-13	23.7
Narrowband	-0.3 dB < AGC	lower	869.20	-2.3	-32.6	-13	19.6
Narrowband	3 dB > AGC	lower	869.20	1.0	-32.3	-13	19.3

Band 5, 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	891.50	889.00	-3.3	-35.5	-13	22.5
WB	3 dB > AGC	upper	891.50	889.00	0.0	-36.0	-13	23.0
NB	-0.3 dB < AGC	upper	893.80	893.60	-3.3	-33.7	-13	20.7
NB	3 dB > AGC	upper	893.80	893.60	0.0	-33.9	-13	20.9
WB	-0.3 dB < AGC	lower	871.50	874.00	-2.3	-36.0	-13	23.0
WB	3 dB > AGC	lower	871.50	874.00	1.0	-35.6	-13	22.6
NB	-0.3 dB < AGC	lower	869.20	869.40	-2.3	-33.6	-13	20.6
NB	3 dB > AGC	lower	869.20	869.40	1.0	-33.3	-13	20.3

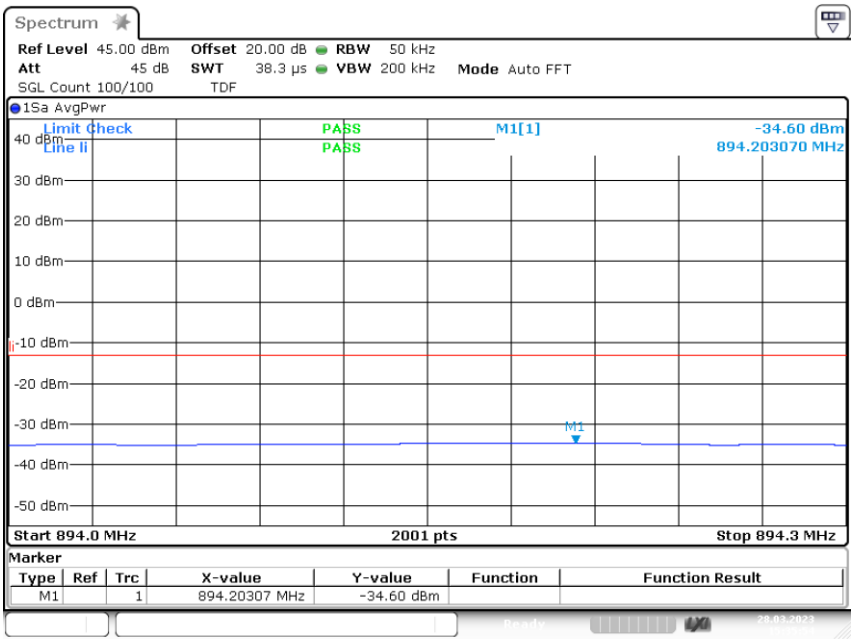
Remark: Please see next sub-clause for the measurement plot.

Explanations concering table with two input signals:

"WB" means Wideband.
"NB" means Narrowband.
Wideband 5G means Wideband 25M

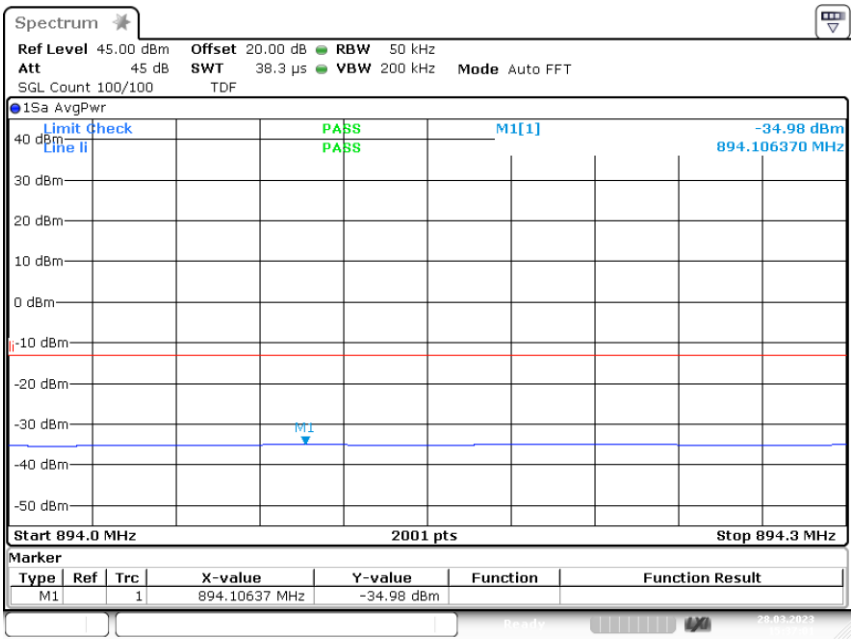
4.3.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: upper;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 1



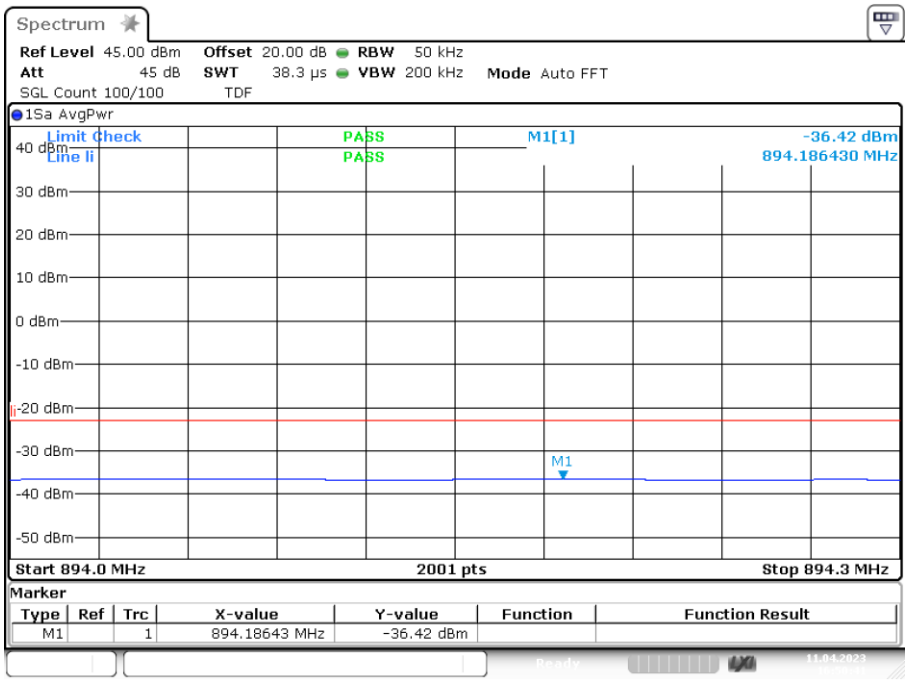
3.6.2 out of band emi CEL850 AWGN upper 1carrier -0.3 dB 894
.000M 894.300M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: upper;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 1



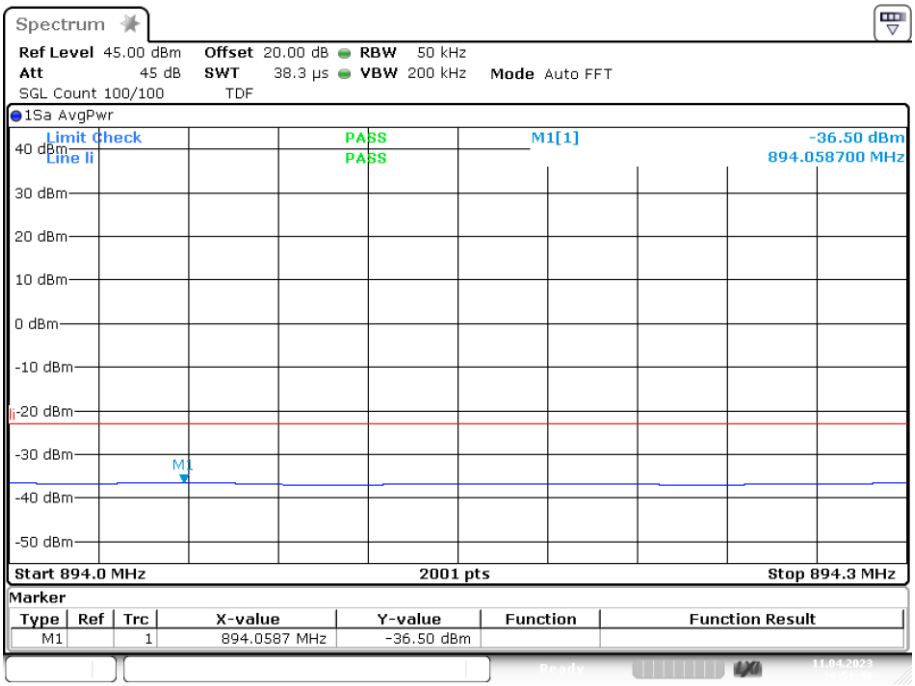
3.6.2 out of band emi CEL850 AWGN upper 1carrier +3.0 dB 894
.000M 894.300M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: upper;
Mod: AWGN 25M; Input Power = 0.3 dB < AGC; Number of signals 1



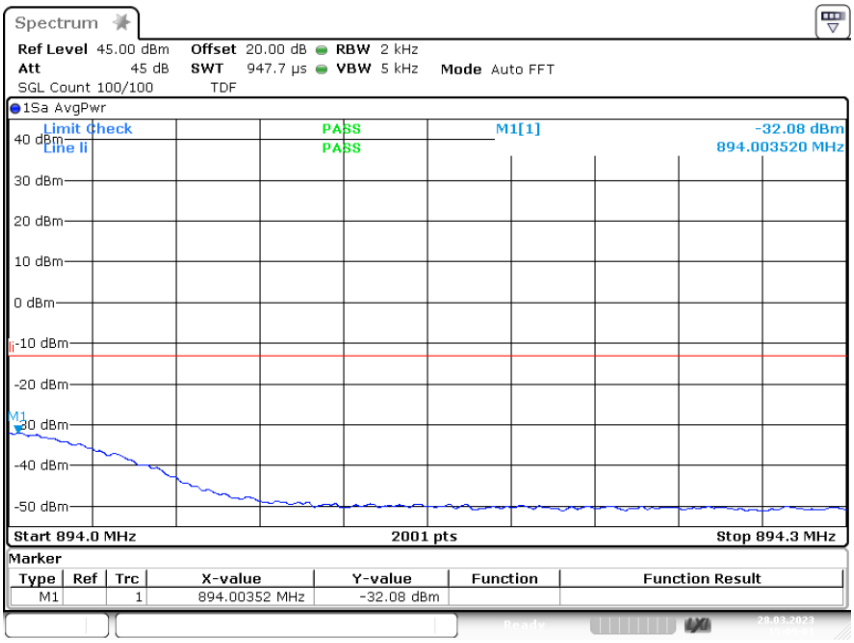
3.6.2 out of band emi CAL850 AWGN 25M upper 1carrier -0.3 dB
894.000M 894.300M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: upper;
Mod: AWGN 25M; Input Power = 3 dB > AGC; Number of signals 1



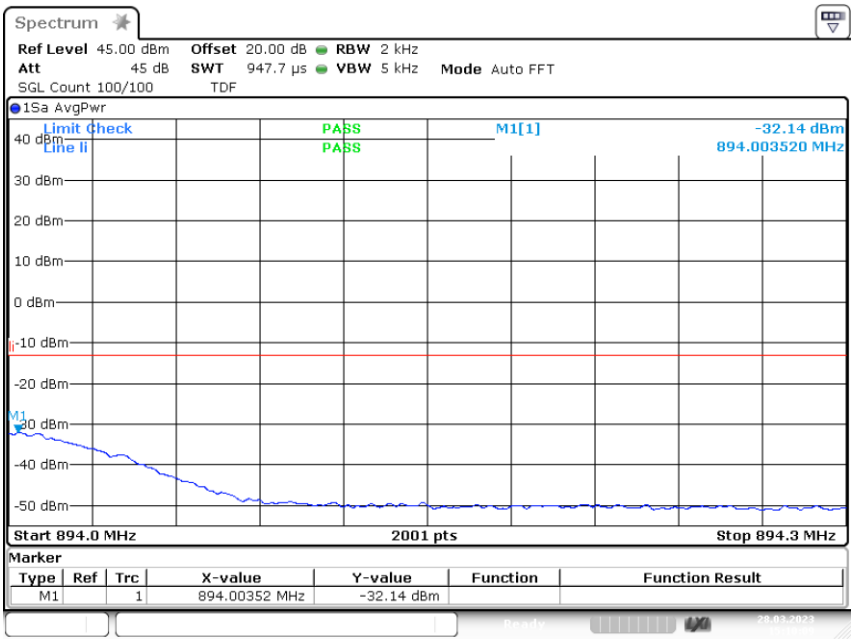
3.6.2 out of band emi CAL850 AWGN 25M upper 1carrier +3.0 dB
894.000M 894.300M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: upper;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 1



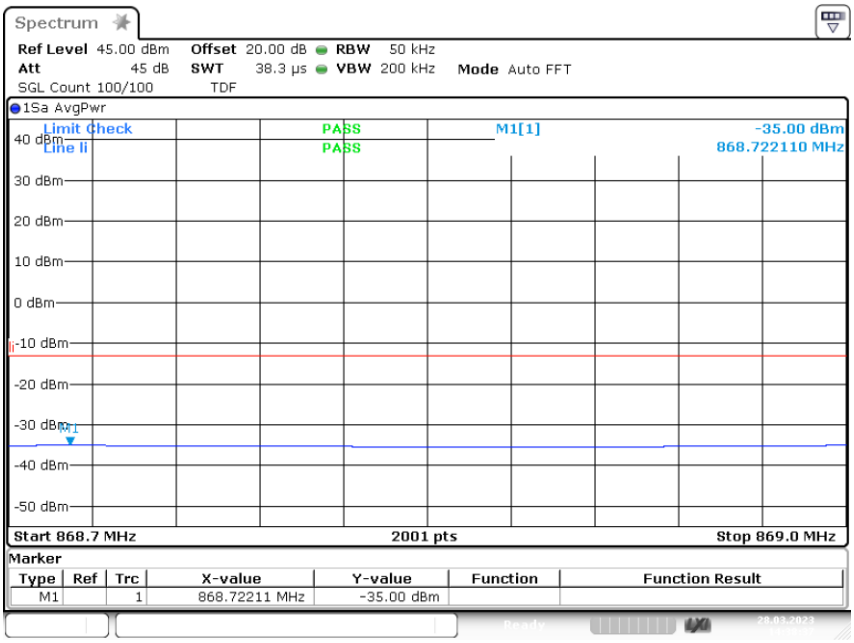
3.6.2 out of band emi CEL850 GSM upper 1carrier -0.3 dB 894.
000M 894.300M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: upper;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 1



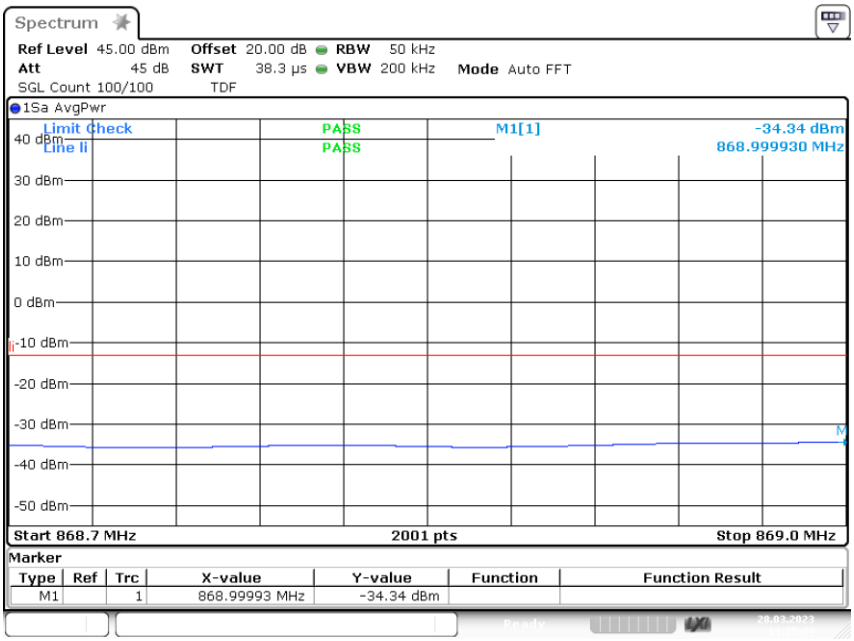
3.6.2 out of band emi CEL850 GSM upper 1carrier +3.0 dB 894.
000M 894.300M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: lower;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 1



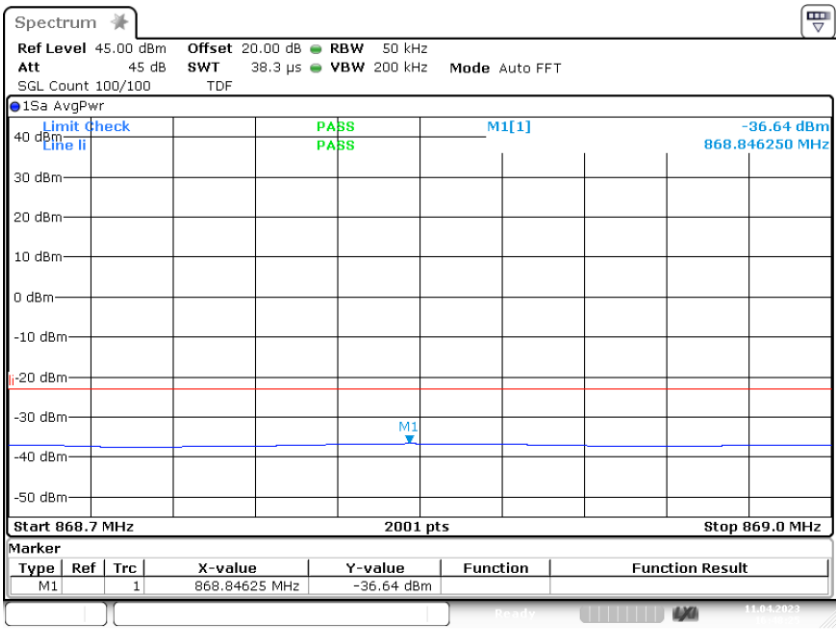
3.6.2 out of band emi CEL850 AWGN lower 1carrier -0.3 dB 868
.700M 869.000M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: lower;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 1



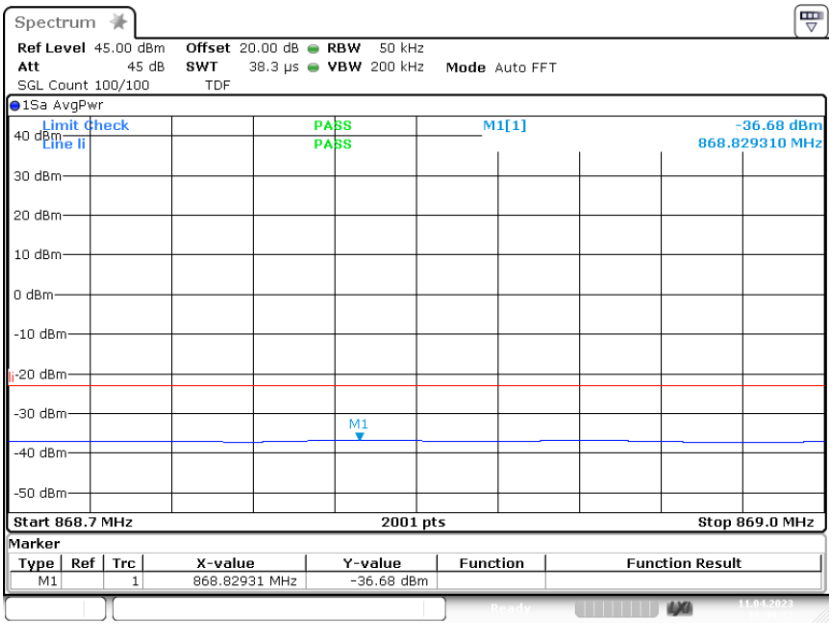
3.6.2 out of band emi CEL850 AWGN lower 1carrier +3.0 dB 868
.700M 869.000M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: lower;
Mod: AWGN 25M; Input Power = 0.3 dB < AGC; Number of signals 1



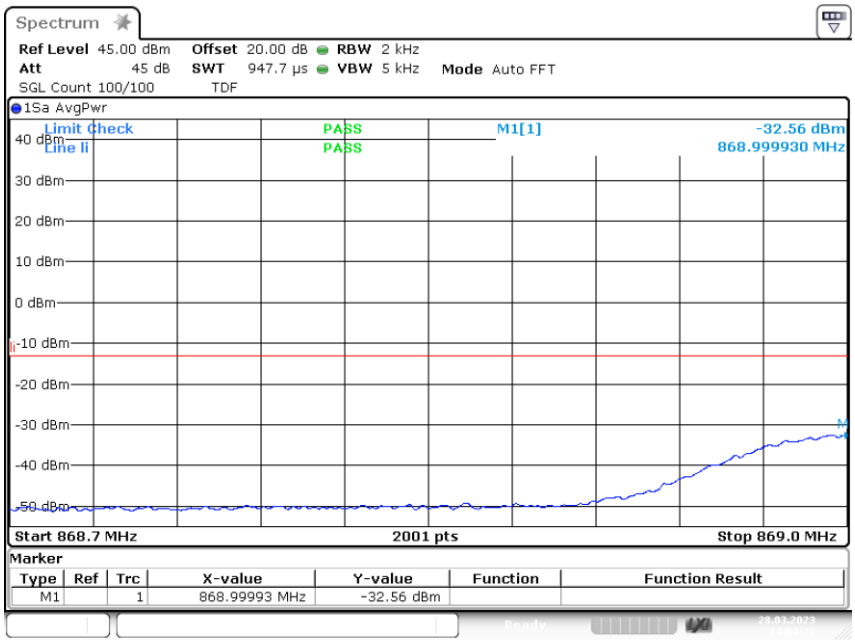
3.6.2 out of band emi CAL850 AWGN 25M lower 1carrier -0.3 dB
868.700M 869.000M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: lower;
Mod: AWGN 25M; Input Power = 3 dB > AGC; Number of signals 1



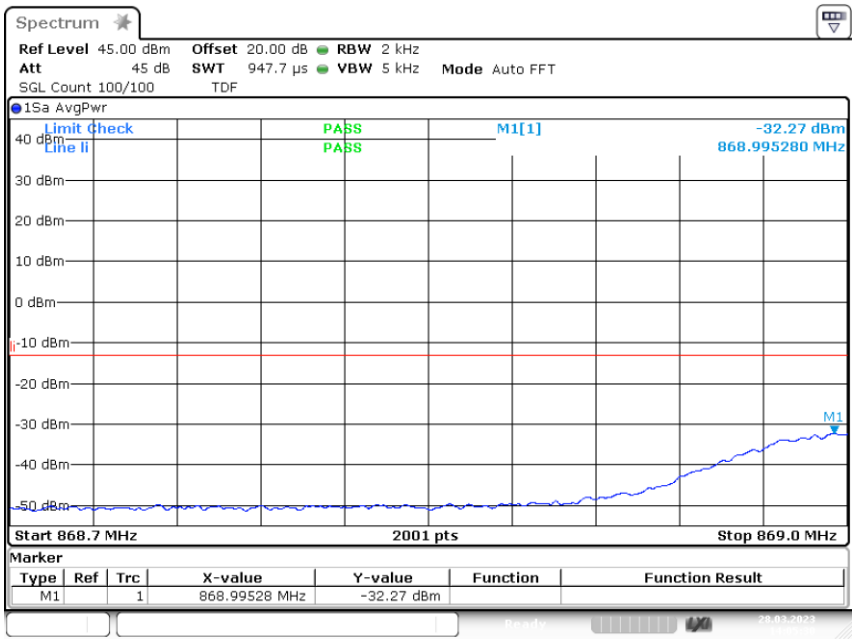
3.6.2 out of band emi CAL850 AWGN 25M lower 1carrier +3.0 dB
868.700M 869.000M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: lower;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 1



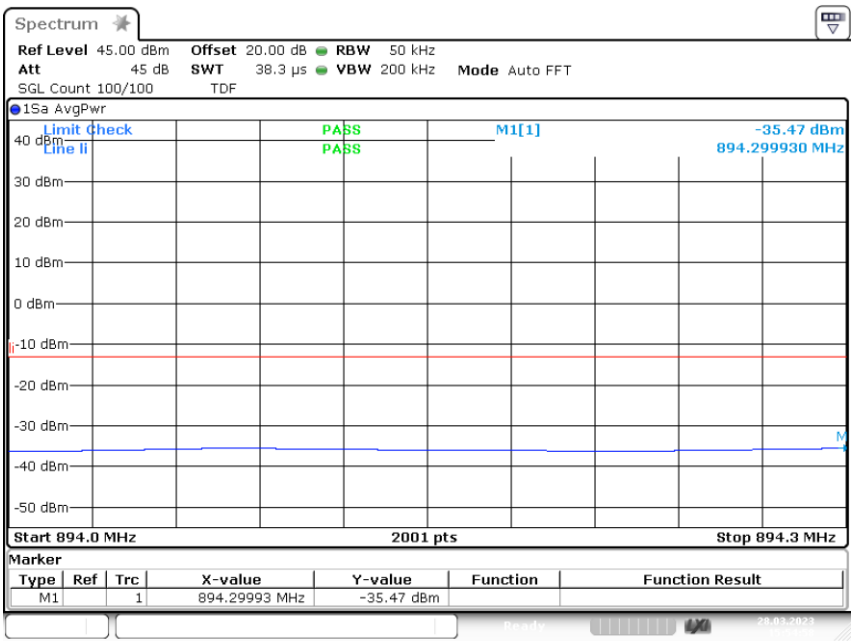
3.6.2 out of band emi CEL850 GSM lower 1carrier -0.3 dB 868.
700M 869.000M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: lower;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 1



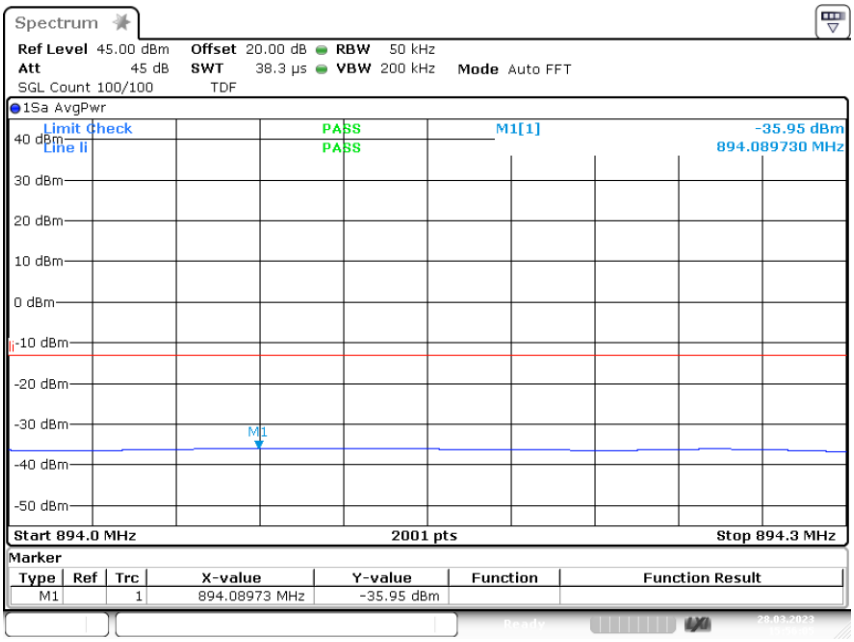
3.6.2 out of band emi CEL850 GSM lower 1carrier +3.0 dB 868.
700M 869.000M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: upper;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 2



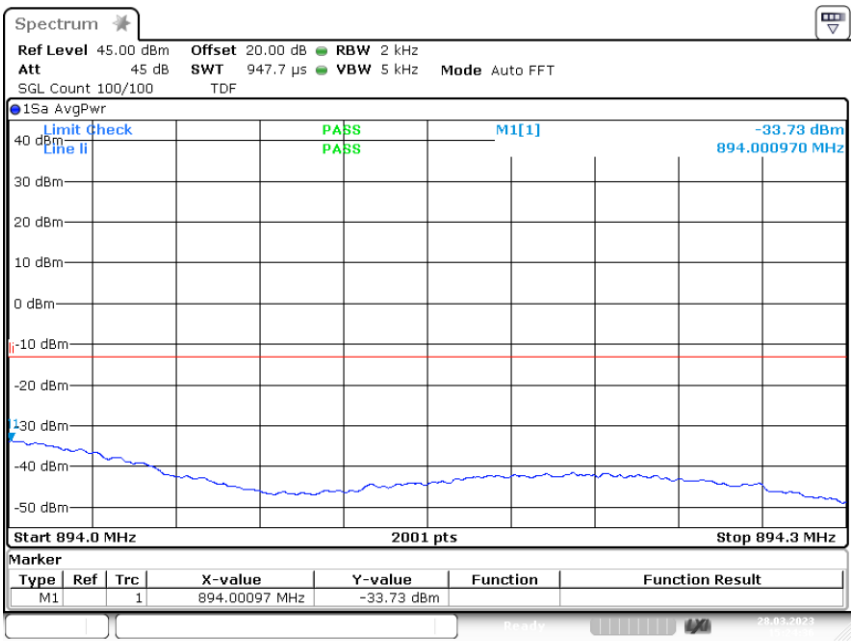
3.6.2 out of band emi CEL850 AWGN upper 2carriers -0.3 dB 89
4.000M 894.300M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: upper;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 2



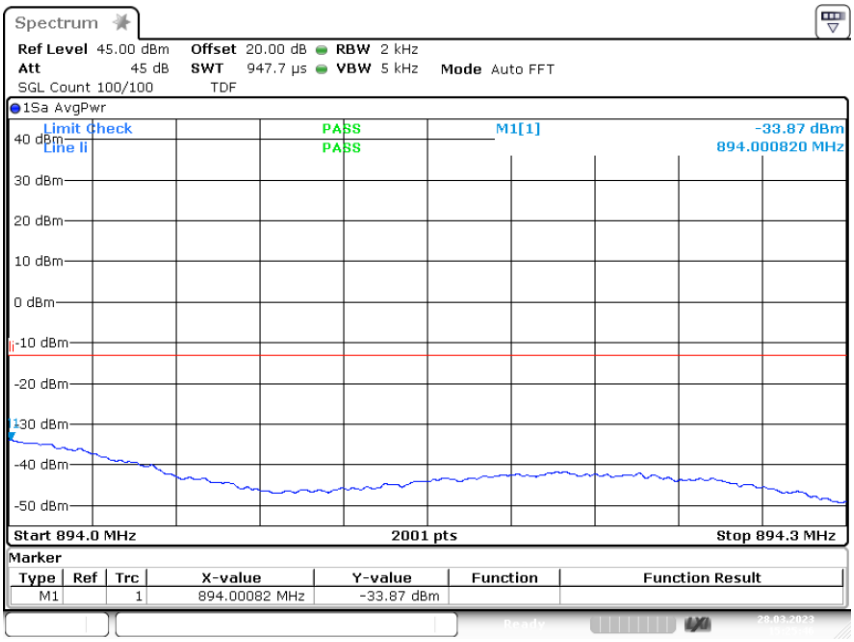
3.6.2 out of band emi CEL850 AWGN upper 2carriers +3.0 dB 89
4.000M 894.300M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: upper;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 2



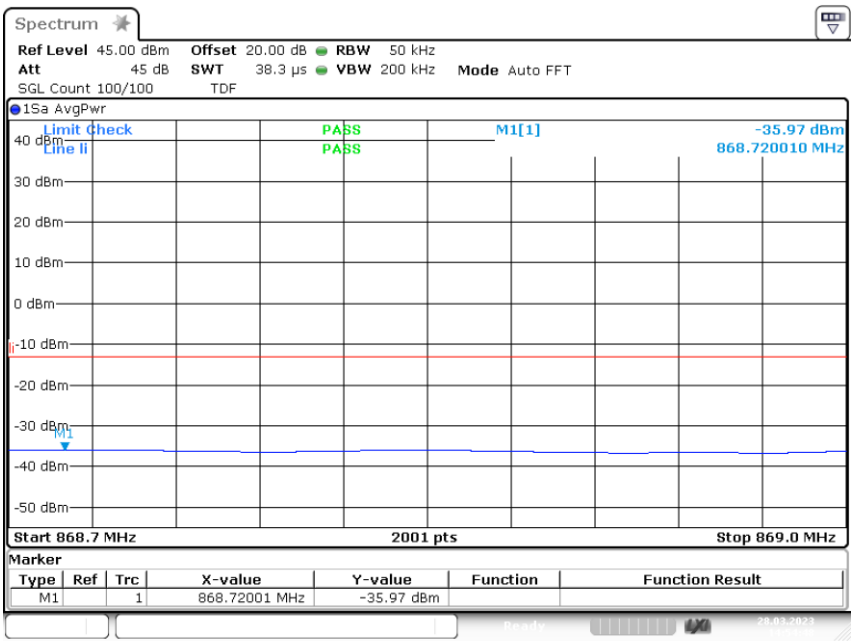
3.6.2 out of band emi CEL850 GSM upper 2carriers -0.3 dB 894
.000M 894.300M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: upper;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 2



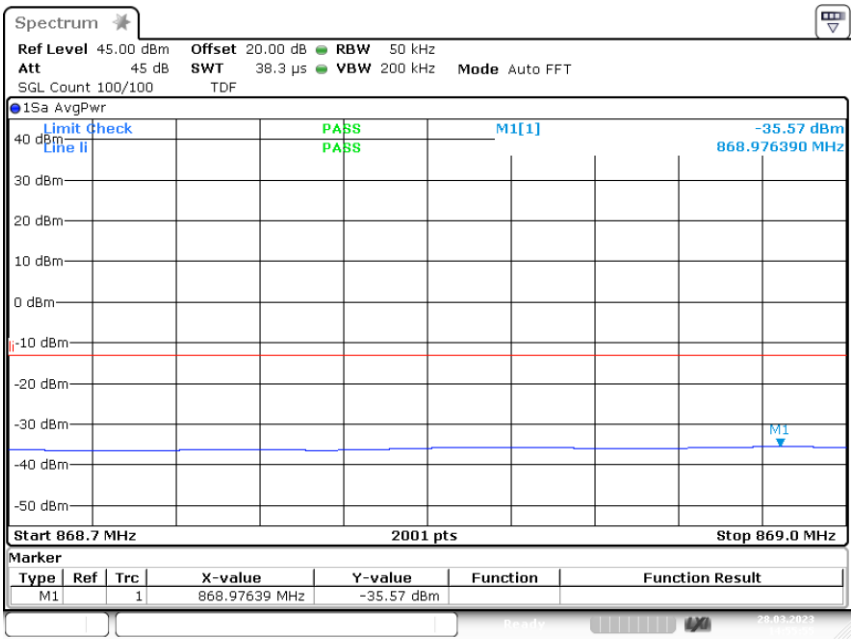
3.6.2 out of band emi CEL850 GSM upper 2carriers +3.0 dB 894
.000M 894.300M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: lower;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 2



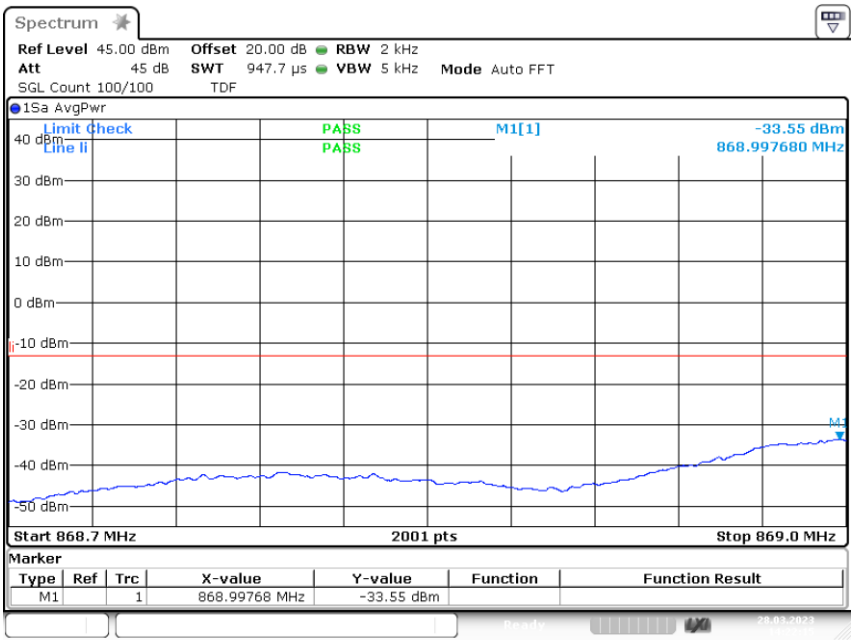
3.6.2 out of band emi CEL850 AWGN lower 2carriers -0.3 dB 86
8.700M 869.000M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: lower;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 2



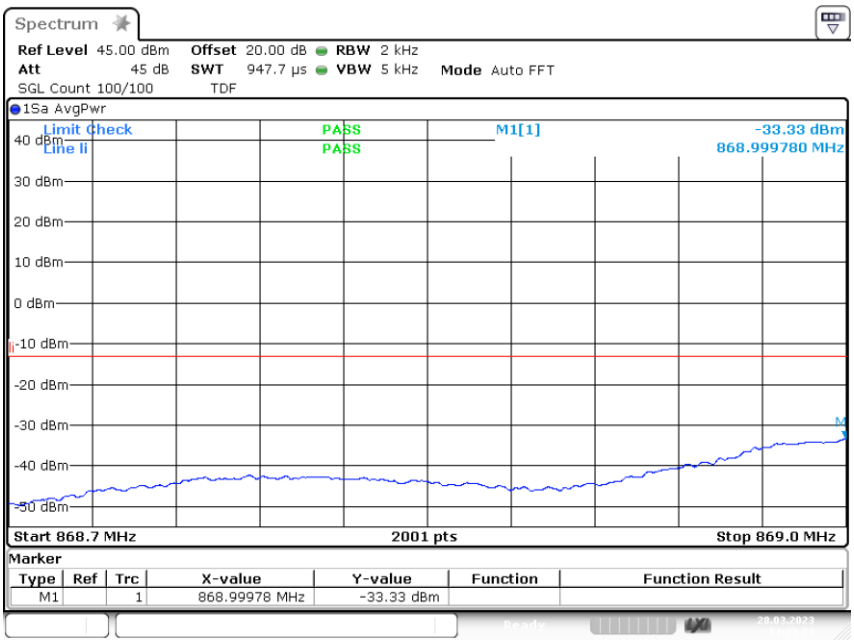
3.6.2 out of band emi CEL850 AWGN lower 2carriers +3.0 dB 86
8.700M 869.000M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: lower;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 2



3.6.2 out of band emi CEL850 GSM lower 2carriers -0.3 dB 868
.700M 869.000M

Band: CEL850; Frequency: 869.0000 MHz to 894.0000 MHz; Band Edge: lower;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 2



3.6.2 out of band emi CEL850 GSM lower 2carriers +3.0 dB 868
.700M 869.000M

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

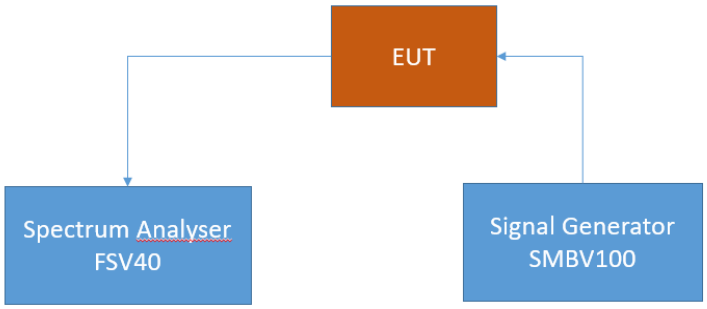
Test date: 2023-03-29 to 2023-04-17

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.

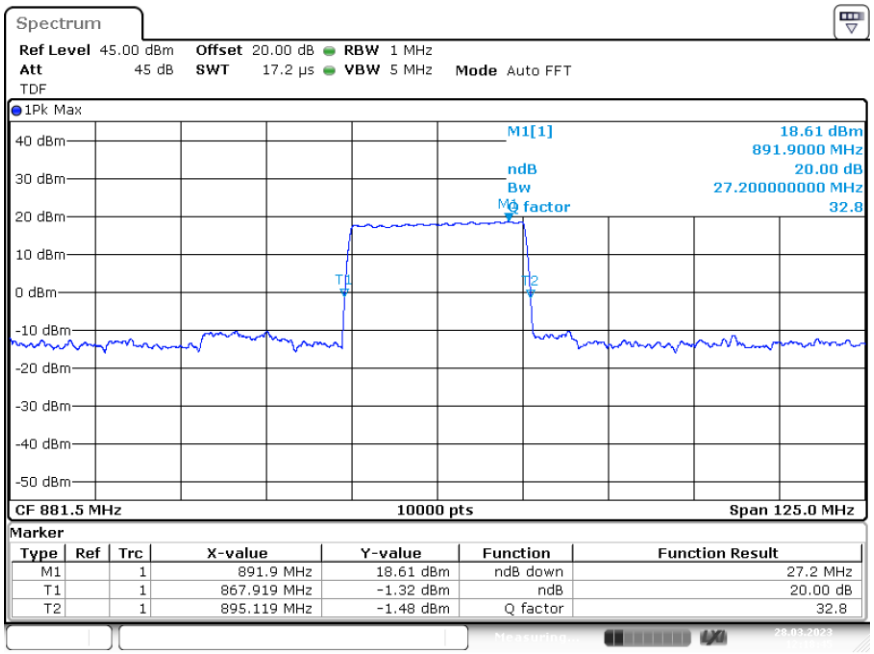
4.4.3 TEST PROTOCOL

Band 5 CELL 850, 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]**
891.90	18.61	867.919	895.119	27.200

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

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

Frequency Band = Band 5 CELL 850, Direction = RF downlink



3.3 Out of band rejection CEL850 881.50000M
_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

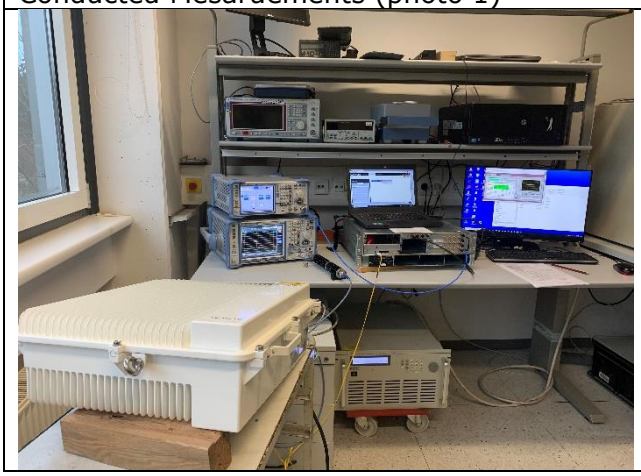
P_{ower} (dBm) = U (dBm) + $AT\Delta_{attenuator}$ (dB) + $AT_{attenuator}$ (dB) - AT_{Cable} (dB)
U = Receiver reading
$AT\Delta_{attenuator}$ = Deviation to 20 dB
$AT_{attenuator}$ = 20 dB
AT_{Cable}= cable loss

7 MEASUREMENT UNCERTAINTIES

KDB 935210 D05	ECL
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 Mesurements (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 *****