Test report 2023-0313-EMC-TR-23-0200-V02

Designation:	CAP M2 34T/37T/37T F-DC-F1 [34T]
Manufacturer:	Commscope
Serial No(s):	BGCMAD2321001
ID No.	7856326-1004 Rev: 00
FCC ID	XS5-CAPM2343737
Test Specification(s):	ANSI 63.26:2015 FCC Rules and Regulations as listed in 47 CFR, Part 20 and Part 27:2022-07-29
Test Plan:	"Info_Blatt_CAP-M2_34T-37T-37T_FCC" from customer.
Test Result:	**Passed**

Date of issue:	2023-12-08		Signature:
Version:	02	Technical Reviewer:	Thomas Hufnagel Test Engineer Digitally signed by Thomas Hufnagel Date: 2023.12.15 12:21:29 +01'00'
Date of delivery:	2023-08-28		
Performance date:	2023-09-06 – 2023-11-14	Report 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: 2023.12.15 13:47:10 +01'00'

Deutsche Akkreditierungsstelle D-PL-12024-06-02

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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

Versions management:

V 01.00	Initial release
V 02.00	Chapter 4.7 “Frequency Stability” added with corresponding commentary; Antenna gain on page 23 corrected from 9 dBi to 15 dBi; In chapter 4.8.3 the two antenna ports corrected to “ANT1 and ANT3”; Overlapping calibration data taken into account in the tables on page 95.

Table of Contents

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 Ch.1 Parts 2 and 20, 27, (07/29/2022 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 20, Commercial Mobiles Services

§ 20.21 Signal Boosters

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

§ 27.50 – Power and duty cycle limits
§ 27.53 – Emission limits

The tests were selected and performed with reference to:

- FCC Public Notice 935210 applying "Signal Boosters Basic Certification Requirements" 935210 D02 v04r02, 2019-04-15.
- FCC Public Notice 935210 applying "Measurement guidance for industrial and non-consumer signal booster, repeater and amplifier devices" 935210 D05 v01r04, 2020-04-03.
- FCC Public Notice 971168 applying "Measurement guidance for certification of licensed digital transmitters" 971168 D01 v03r01,2018-04-09
- 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 REFERENCE TABLE

Measurement	FCC reference
Effective radiated power, mean output power and zone enhancer gain	§ 2.1046 § 27.50 KDB 935210 D05 v01r04: 3.5
Peak to Average Ratio	§ 27.50
Occupied bandwidth Input-versus-output spectrum	§ 2.1049 KDB 935210 D05 v01r04: 3.4
Conducted spurious Emission at Antenna Terminal	§ 2.1051 § 27.53 KDB 935210 D05 v01r04: 3.6
Out-of-band emissions limits	§ 2.1051 § 27.53 KDB 935210 D05 v01r04: 3.6
Frequency stability	§ 2.1055 § 27.54
Field strength of spurious radiation	§ 2.1053 § 27.53
Out-of-band rejection	KDB 935210 D05 v01r04: 3.3
All measurements	ANSI 63.26

1.3 MEASUREMENT SUMMARY

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

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

OP-Mode Frequency Band, Direction, Input Power, Signal Type	**Final Result**
34T -Band, segment 1, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
34T -Band, segment 1, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
34T -Band, segment 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
34T -Band, segment 1, RF downlink, 3 dB > AGC, Narrowband	Passed
34T -Band, segment 2, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
34T -Band, segment 2, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
34T -Band, segment 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
34T -Band, segment 2, RF downlink, 3 dB > AGC, Narrowband	Passed
34T -Band, segment 3, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
34T -Band, segment 3, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
34T -Band, segment 3, RF downlink, 0.3 dB < AGC, Narrowband	Passed
34T -Band, segment 3, RF downlink, 3 dB > AGC, Narrowband	Passed

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

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

OP-Mode Frequency Band, Direction, Input Power, Signal Type	**Final Result**
34T -Band, segment 1, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
34T -Band, segment 1, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
34T -Band, segment 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
34T -Band, segment 1, RF downlink, 3 dB > AGC, Narrowband	Passed
34T -Band, segment 2, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
34T -Band, segment 2, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
34T -Band, segment 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
34T -Band, segment 2, RF downlink, 3 dB > AGC, Narrowband	Passed
34T -Band, segment 3, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
34T -Band, segment 3, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
34T -Band, segment 3, RF downlink, 0.3 dB < AGC, Narrowband	Passed
34T -Band, segment 3, RF downlink, 3 dB > AGC, Narrowband	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1049 [Base Stations/Repeater]

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 Frequency Band, Direction, Input Power, Signal Type	**Final Result**
34T -Band, segment 1, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
34T -Band, segment 1, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
34T -Band, segment 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
34T -Band, segment 1, RF downlink, 3 dB > AGC, Narrowband	Passed
34T -Band, segment 2, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
34T -Band, segment 2, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
34T -Band, segment 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
34T -Band, segment 2, RF downlink, 3 dB > AGC, Narrowband	Passed
34T -Band, segment 3, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
34T -Band, segment 3, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
34T -Band, segment 3, RF downlink, 0.3 dB < AGC, Narrowband	Passed
34T -Band, segment 3, RF downlink, 3 dB > AGC, Narrowband	Passed

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

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

OP-Mode Frequency Band, Direction, Signal Type	**Final Result**
34T -Band, segment 1, RF downlink, Wideband 1 and 2	Passed
34T -Band, segment 1, RF downlink, Narrowband	Passed
34T -Band, segment 2, RF downlink, Wideband 1 and 2	Passed
34T -Band, segment 2, RF downlink, Narrowband	Passed
34T -Band, segment 3, RF downlink, Wideband 1 and 2	Passed
34T -Band, segment 3, RF downlink, Narrowband	Passed

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

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

OP-Mode Band Edge, Frequency Band, Number of signals, Direction, Input Power, Signal Type	
Upper, 34T -Band segment 1, 1, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
Upper, 34T -Band segment 1, 1, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
Upper, 34T -Band segment 1, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, 34T -Band segment 1, 1, RF downlink, 3 dB > AGC, Narrowband	Passed
Lower, 34T -Band segment 1, 1, RF downlink, , 0.3 dB < AGC, Wideband 1 and 2	Passed
Lower, 34T -Band segment 1, 1, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
Lower, 34T -Band segment 1, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, 34T -Band segment 1, 1, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
Upper, 34T -Band segment 1, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Upper, 34T -Band segment 1, 2, RF downlink, 3 dB > AGC, Wideband	Passed
Upper, 34T -Band segment 1, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, 34T -Band segment 1, 2, RF downlink, 3 dB > AGC, Narrowband	Passed
Lower, 34T -Band segment 1, 2, RF downlink, , 0.3 dB < AGC, Wideband	Passed
Lower, 34T -Band segment 1, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Lower, 34T -Band segment 1, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, 34T -Band segment 1, 2, RF downlink, 3 dB > AGC, Wideband	Passed

OP-Mode

Band Edge, Frequency Band, Number of signals, Direction, Input Power, Signal Type	
Upper, 34T -Band segment 2, 1, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
Upper, 34T -Band segment 2, 1, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
Upper, 34T -Band segment 2, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, 34T -Band segment 2, 1, RF downlink, 3 dB > AGC, Narrowband	Passed
Lower, 34T -Band segment 2, 1, RF downlink, , 0.3 dB < AGC, Wideband 1 and 2	Passed
Lower, 34T -Band segment 2, 1, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
Lower, 34T -Band segment 2, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, 34T -Band segment 2, 1, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
Upper, 34T -Band segment 2, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Upper, 34T -Band segment 2, 2, RF downlink, 3 dB > AGC, Wideband	Passed
Upper, 34T -Band segment 2, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, 34T -Band segment 2, 2, RF downlink, 3 dB > AGC, Narrowband	Passed
Lower, 34T -Band segment 2, 2, RF downlink, , 0.3 dB < AGC, Wideband	Passed
Lower, 34T -Band segment 2, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Lower, 34T -Band segment 2, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, 34T -Band segment 2, 2, RF downlink, 3 dB > AGC, Wideband	Passed

OP-Mode

Band Edge, Frequency Band, Number of signals, Direction, Input Power, Signal Type	
Upper, 34T -Band segment 3, 1, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
Upper, 34T -Band segment 3, 1, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
Upper, 34T -Band segment 3, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, 34T -Band segment 3, 1, RF downlink, 3 dB > AGC, Narrowband	Passed
Lower, 34T -Band segment 3, 1, RF downlink, , 0.3 dB < AGC, Wideband 1 and 2	Passed
Lower, 34T -Band segment 3, 1, RF downlink, 0.3 dB < AGC, Wideband 1 and 2	Passed
Lower, 34T -Band segment 3, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, 34T -Band segment 3, 1, RF downlink, 3 dB > AGC, Wideband 1 and 2	Passed
Upper, 34T -Band segment 3, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Upper, 34T -Band segment 3, 2, RF downlink, 3 dB > AGC, Wideband	Passed
Upper, 34T -Band segment 3, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, 34T -Band segment 3, 2, RF downlink, 3 dB > AGC, Narrowband	Passed
Lower, 34T -Band segment 3, 2, RF downlink, , 0.3 dB < AGC, Wideband	Passed
Lower, 34T -Band segment 3, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Lower, 34T -Band segment 3, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, 34T -Band segment 3, 2, RF downlink, 3 dB > AGC, Wideband	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C [Base Stations/Repeater]	**KDB 935210 D05 v01r04: 3.3**
Out-of-band rejection	
The measurement was performed according to ANSI C63.26; KDB 935210 D05 v01r04: 3.3	**Final Result**

OP-Mode

Frequency Band, Direction	
34T -Band, segment 1, RF downlink	Passed
34T -Band, segment 2, RF downlink	Passed
34T -Band, segment 3, RF downlink	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C [Base Stations/Repeater]	**§ 2.1053, § 27.53**
Field strength of spurious radiation	
The measurement was performed according to ANSI C63.26	**Final Result**

OP-Mode

Frequency Band, Test Frequency, Direction	
34T -Band, segment 1, RF downlink	Passed
34T -Band, segment 2, RF downlink	Passed
34T -Band, segment 3, RF downlink	Passed

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	CAP M2 34T/37T/37T
Declared EUT data by the supplier	
General Product Description	The EUT is an industrial signal booster supporting the following: Band 34T: 3450 MHz - 3550 MHz A RF operation is only supported for the downlink.
Booster Type	Industrial Signal Booster
Voltage Type	DC
Voltage Level	48 V nominal
Maximum Output Donor Port [Uplink]	-
Maximum Output Server Port [Downlink]	32 dBm
Maximum Gain [Uplink]	-
Maximum Gain [Downlink]	37 dB

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	BGCMAD2321001
HW Version	7856326-1004 Rev.: 00
SW Version	V5.0.0.170
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, DM77521	Power supply rack
	GE Power Electronisc Inc., CAR1212FPBC-Z, EC84946	Power plug-in module
AUX2	Commscope, ION-E WCS-2, SZAEAJ1744A0010	Module rack
	Commscope, ION-E OPT, SZBEAD1951A0125	Optical plug-in module
	Commscope, ION-E SUI, SZBEAC1934A0018	Interface card plug-in module
	Commscope, RFD HB, SZBEAQ2140A0014	RF card plug-in module
	Commscope, RFD HB, SZBEAQ2224A0021	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 name	Direction	Lower Frequency Band Edge [MHz]	Upper Frequency Band Edge [MHz]	Center Frequency [MHz]	Port
34T	Downlink	3450.00	3550.00	3500.00	Donor

3.6.2 DEFINITION OF USED FREQUENCY BANDS

Narrowband: representation by a GSM signal
Wideband 1: representation by an AWGN signal with 4.1 MHz
Wideband 2: representation by an AWGN signal with 98.3 MHz

3.6.3 AUTOMATIC GAIN CONTROL LEVELS

AGC Levels

Segment of the Band	Direction	Signal Type	AGC Start Pin [dBm]	AGC Start Pin -0.3 dB [dBm]	AGC Start Pin +3 dB [dBm]	Frequency [MHz]	Frequency
34T	downlink	Narrowband	-4.00	-4.3	-1.0	3501.00	Mid (all AWGN) Mid+1 (GSM), also see chapter 3.5.4
34T	downlink	Wideband 1	-3.60	-3.9	-0.6	3500.00	
34T	downlink	Wideband 2	-4.80	-5.1	-1.8	3500.00	
34T	downlink	Narrowband	-4.00	-4.3	-1.0	3450.20	Low
34T	downlink	Wideband 1	-4.60	-4.9	-1.6	3452.50	
34T	downlink	Narrowband	-4.40	-4.7	-1.4	3549.80	High
34T	downlink	Wideband 1	-5.00	-5.3	-2.0	3547.50	
34T	downlink	Narrowband	-5.20	-5.5	-2.2	3512.70	Max.Power
34T	downlink	Wideband 1	-4.80	-5.1	-1.8	3512.70	

3.6.4 REMARKS TO THE MEASUREMENTS

Cause of an inappropriate control mode in the transmission of the narrowband signal (GSM signal) at f_{mid}, f_{mid} is increased by 1 MHz. Hereby the abbreviations are:

f_{mid} for wideband signals (AWGN signals)
f_{mid+1} for narrowband signals (GSM signals)

In the real use of the repeater narrowband signals aren't used.

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 TEST RESULTS

4.1 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 KDB 935210 D05 v01r04: 3.5

Test date: 2023-09-06 – 2023-11-14

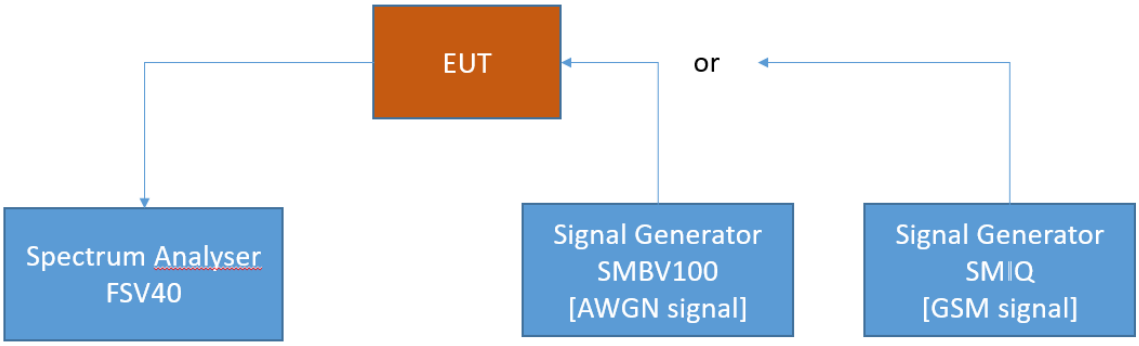
Environmental conditions: 23 ° C ± 5 K; 40 % r. F. ± 20 % r. F.

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.

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

Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§ 27.50

(k) The following power requirements apply to stations transmitting in the 3450-3550 MHz band:

(1) The power of each fixed or base station transmitting in the 3450-3550 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to an equivalent isotropically radiated power (EIRP) of 3280 Watts/MHz. This limit applies to the aggregate power of all antenna elements in any given sector of a base station.

(2) The power of each fixed or base station transmitting in the 3450-3550 MHz band and situated in any geographic location other than that described in paragraph (j)(1) of this section is limited to an EIRP of 1640 Watts/MHz. This limit applies to the aggregate power of all antenna elements in any given sector of a base station.

(3) Mobile and portable stations are limited to 1 Watt EIRP. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum necessary for successful communications.

(4) Equipment employed must be authorized in accordance with the provisions of § 27.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (j)(5) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(5) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, and any other relevant factors, so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

4.1.3 TEST PROTOCOL

Band, 34T, 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 1	0.3 dB < AGC	3512.70	-4.88	31.36	62.1	30,74	36,24
Wideband 1	3 dB > AGC	3512.70	-1.56	31.46	62.1	30,64	33,02
Wideband 2	0.3 dB < AGC	3500.00	-4.65	31.10	62.1	31,00	35,75
Wideband 2	3 dB > AGC	3500.00	-1.38	31.20	62.1	30,90	32,58
Narrowband	0.3 dB < AGC	3512.70	-5.13	31.10	62.1	31,00	36,23
Narrowband	3 dB > AGC	3512.70	-1.66	31.18	62.1	30,92	32,84

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

Maximum output power at the worst case consideration

The highest power level in the tables above is
$p_{highest}$ = 31.5 dBm at the channel which has the most output power of all channels.

Hereby at an antenna gain of G_{dB} = 15 dBi the highest effecitve radiated output power EIRP $p_{EIRP\ 1CH}$ of one channel is:

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

This results in:

$p_{EIRP\ 1CH}$ = 31.5 dBm + 15 dB = 46.5 dBm

The eqivalent power P is according the given formula:

$P_{EIRP\ 1CH}$ =

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

This results in:

$$P\ EIRP\ 1CH\ [W] = 10EXP\ \left(46.5\ [dBm] - 10\right) * 0.001\ [W] = 44.7\ W$$

Supposed all four antenna ports are working together in MIMO operation the worst case of the highest output power $p_{EIRP\ 4CH}$ is:

$p_{EIRP\ 2CH} = 2 * p_{EIRP\ 1CH}$

This results in:

$p_{EIRP\ 4CH}$ = 2 * 44.7 W =89.4 W

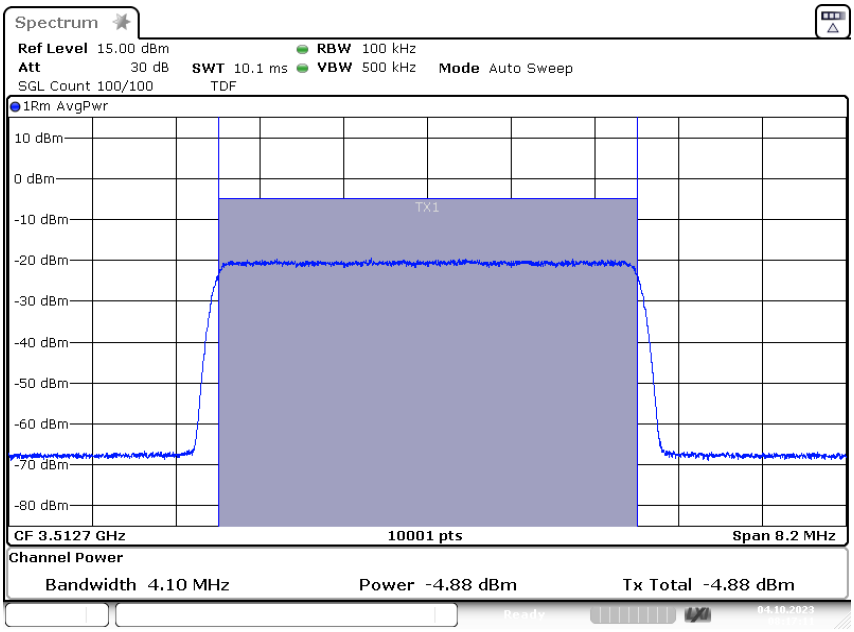
Final result of this consideration:

$p_{EIRP\ 4CH}$ = 89.4 W <1640 W, hereby 1640 W is the highest allowed limit in this band.

The DUT doesn't exceed the limit.

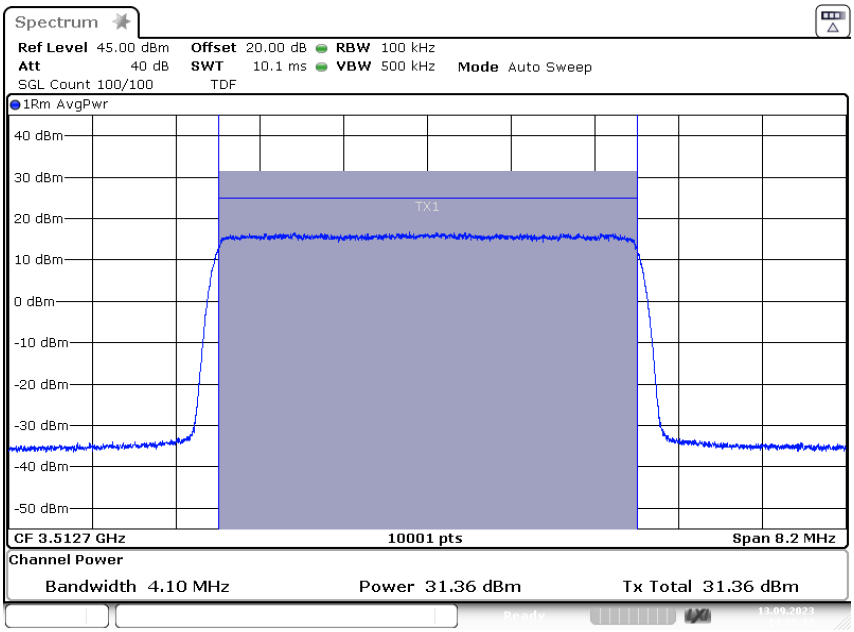
4.1.4 MEASUREMENT PLOT

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: AWGN;
Input Power 0.3 dB < AGC



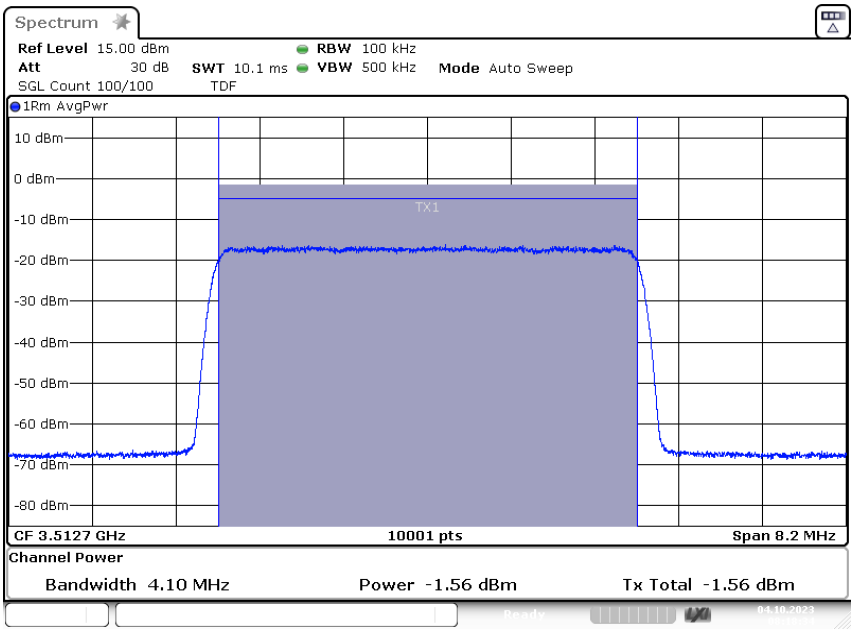
3.5.3 Power AWGN In-0.3 3.51270G

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: AWGN;
Output Power 0.3 dB < AGC



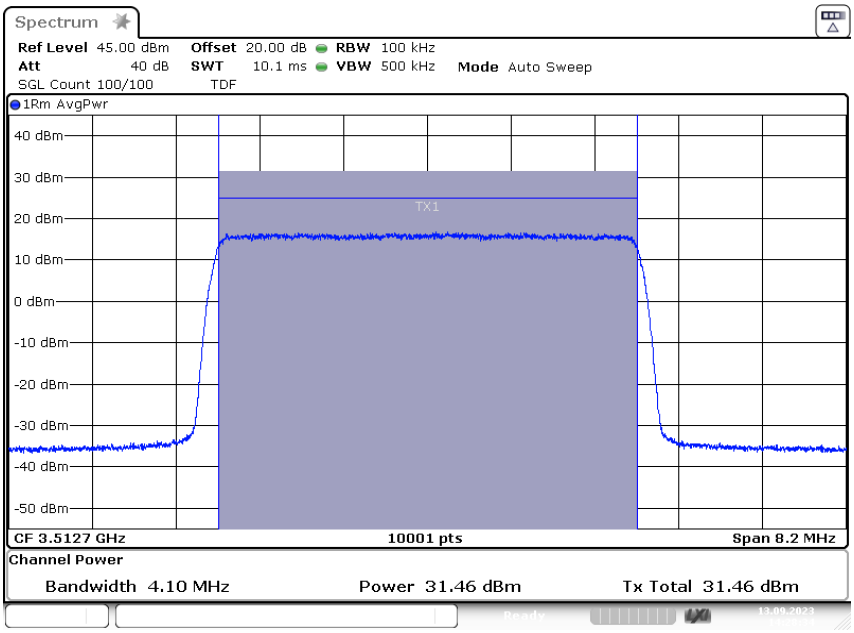
3.5.3 Power AWGN Out -0.3 3.51270G

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: AWGN;
Input Power 3 dB > AGC



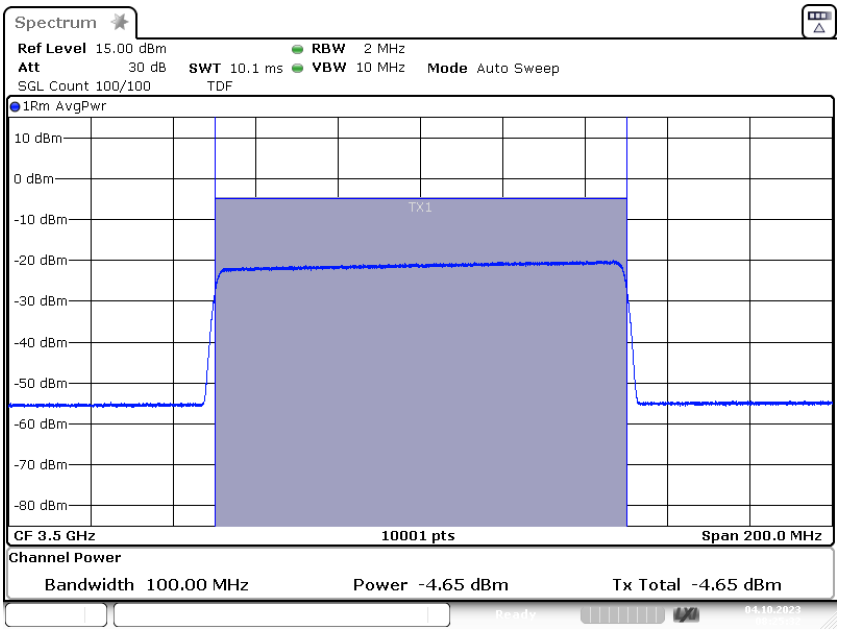
3.5.3 Power AWGN In+3 3.51270G

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: AWGN;
Output Power 3 dB > AGC



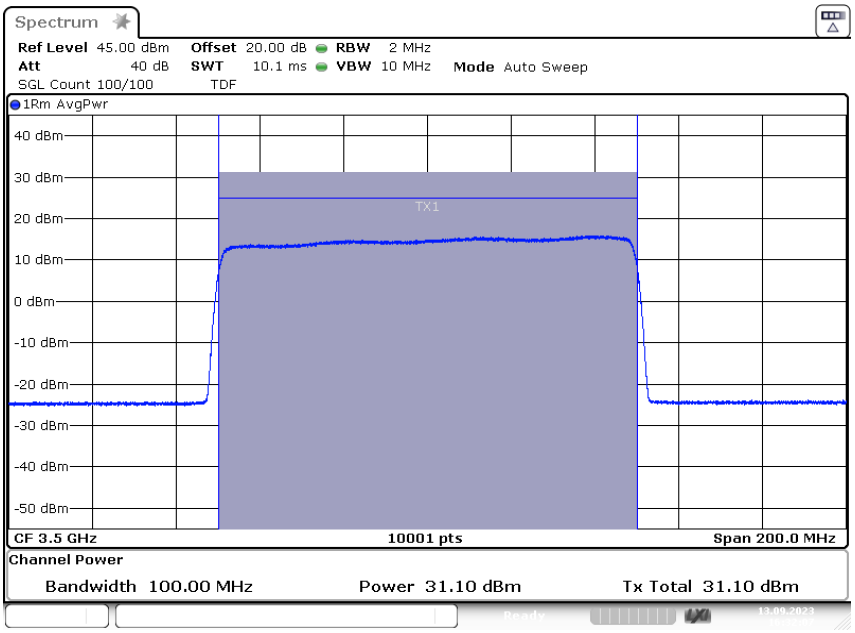
3.5.3 Power AWGN Out +3 3.51270G

Band: 34T A3; Frequency: 3.5000 GHz; Band Edge: mid; Mod: AWGN100;
Input Power 0.3 dB < AGC



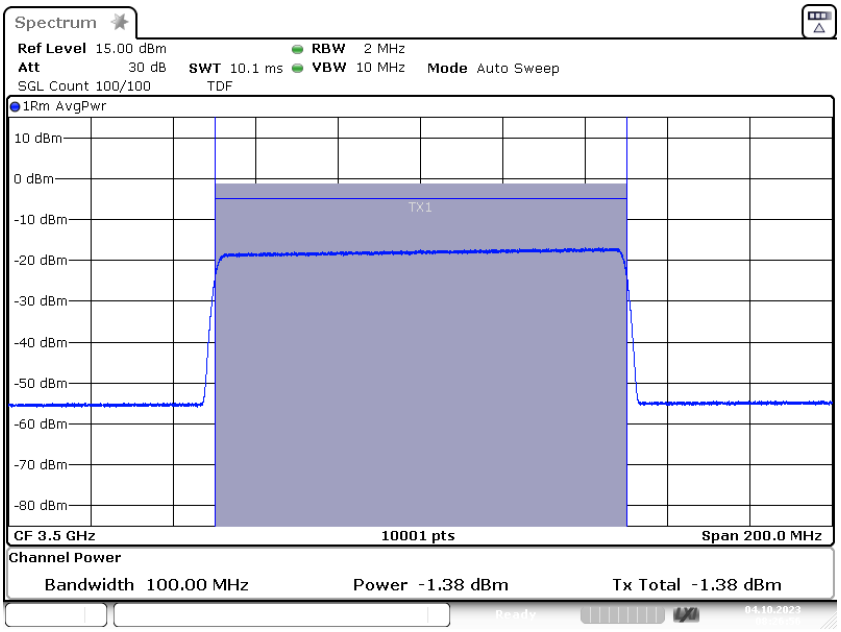
3.5.3 Power AWGN100 In-0.3 3.50000G

Band: 34T A3; Frequency: 3.5000 GHz; Band Edge: mid; Mod: AWGN100;
Output Power 0.3 dB < AGC



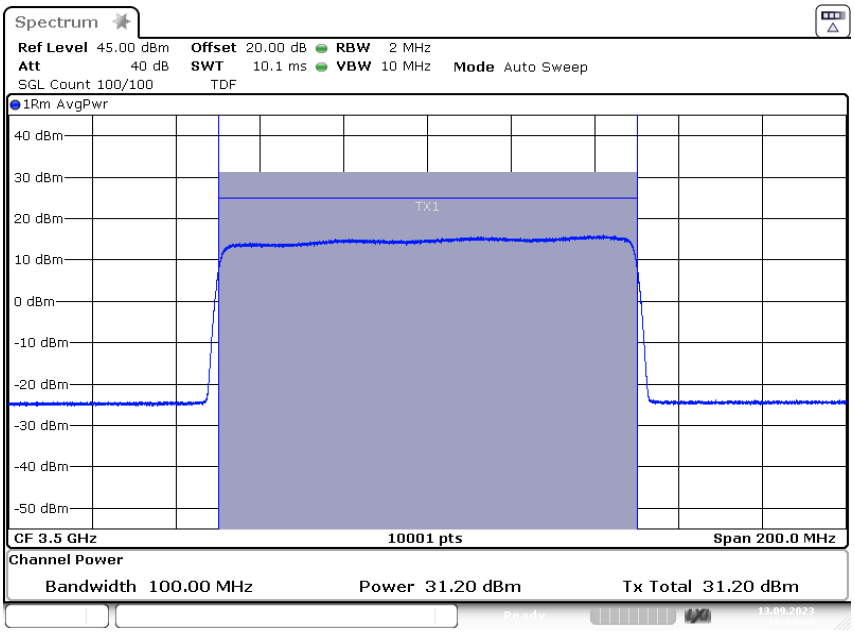
3.5.3 Power AWGN100-0.3 3.50000G

Band: 34T A3; Frequency: 3.5000 GHz; Band Edge: mid; Mod: AWGN100;
Input Power 3 dB > AGC



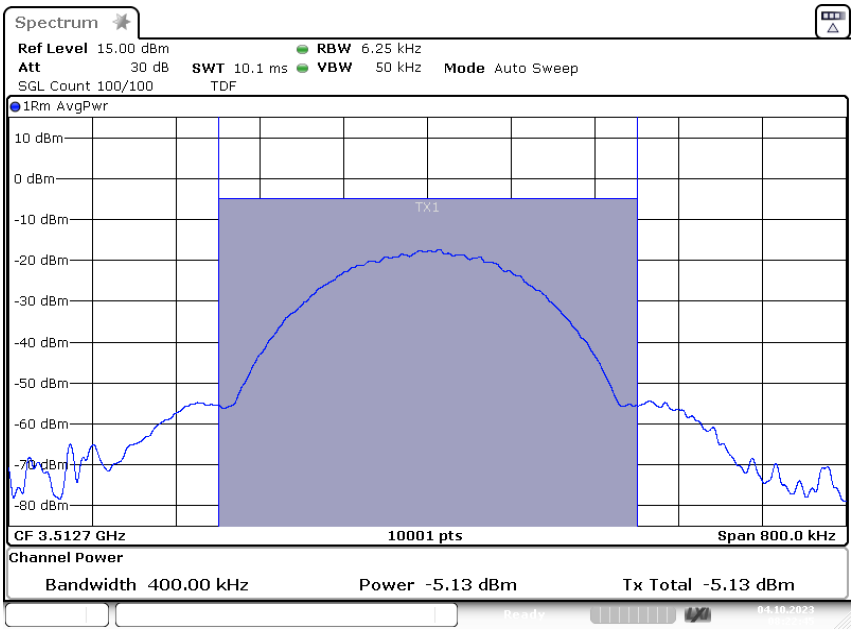
3.5.3 Power AWGN100 In+3 3.50000G

Band: 34T A3; Frequency: 3.5000 GHz; Band Edge: mid; Mod: AWGN100;
Output Power 3 dB > AGC



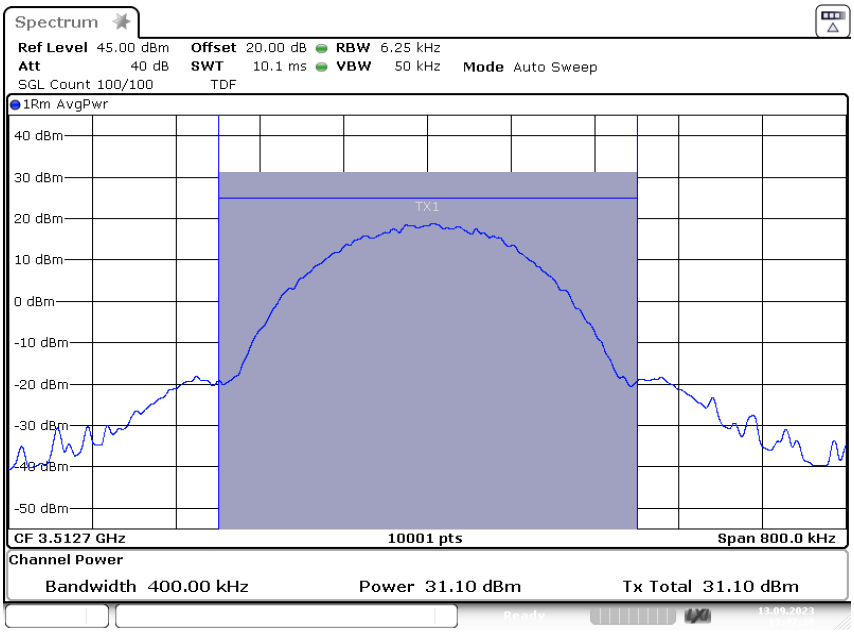
3.5.3 Power AWGN100+3 3.50000G

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: GSM;
Input Power 0.3 dB < AGC



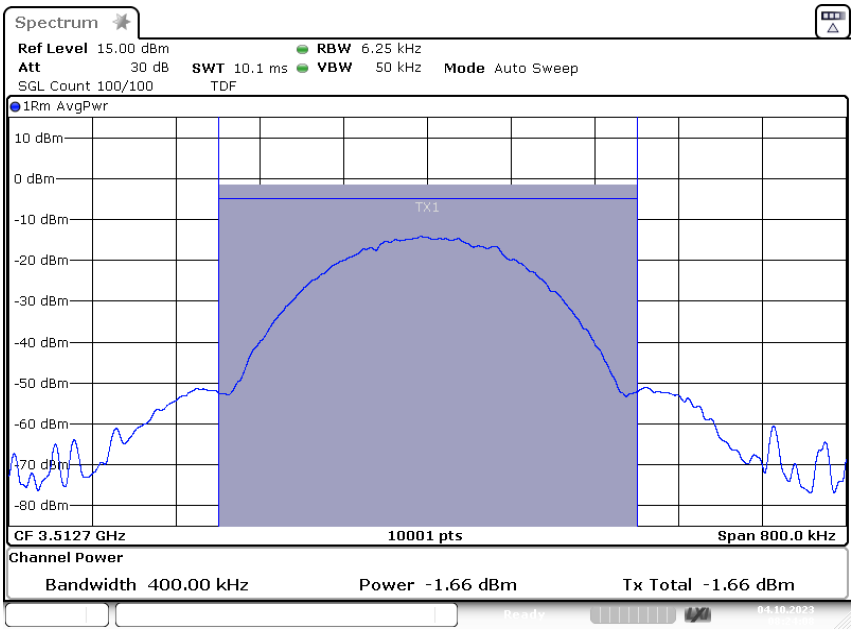
3.5.3 Power GSM In-0.3 3.51270G

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: GSM;
Output Power 0.3 dB < AGC



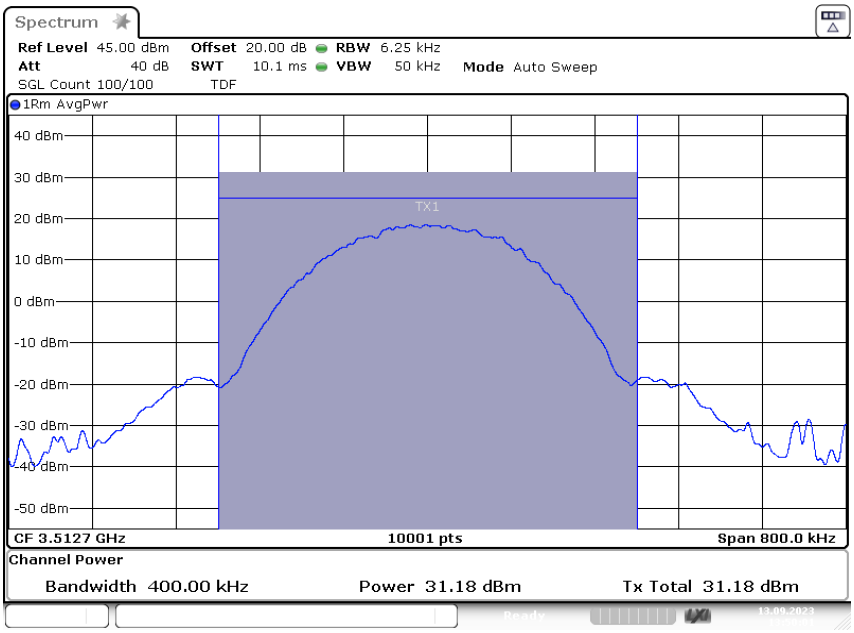
3.5.3 Power GSM Out -0.3 3.51270G

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: GSM;
Input Power 3 dB > AGC



3.5.3 Power GSM In+3 3.51270G

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: GSM;
Output Power 3 dB > AGC



3.5.3 Power GSM Out +3 3.51270G

4.1.5 TEST EQUIPMENT USED

- Conducted

4.2 PEAK TO AVERAGE RATIO

Standard FCC Part 27, §27.50

The test was performed according to:
ANSI C63.26

Test date: 2023-09-06 – 2023-11-14

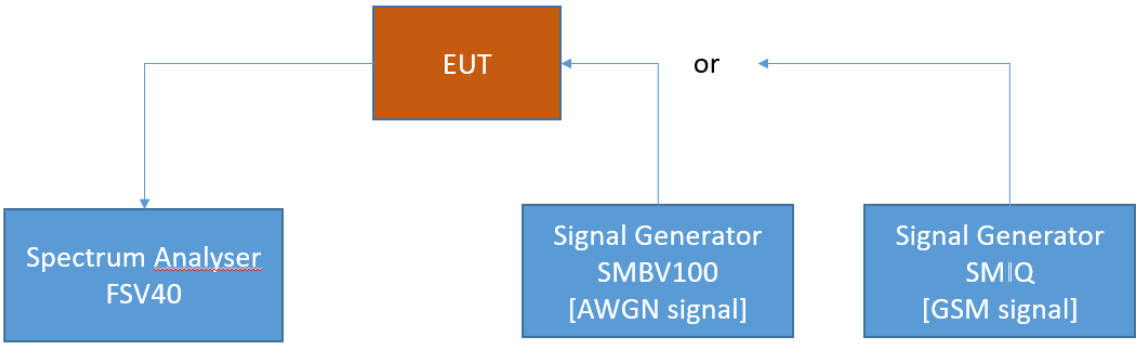
Environmental conditions: 23 ° C ± 5 K; 40 % r. F. ± 20 % r. F.

Test engineer: Thomas Hufnagel

4.2.1 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:



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.

4.2.2 TEST REQUIREMENTS/LIMITS

Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§ 27.50

(j) The following power requirements apply to stations transmitting in the 3450-3550 MHz band:

(4) Equipment employed must be authorized in accordance with the provisions of § 27.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (j)(5) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

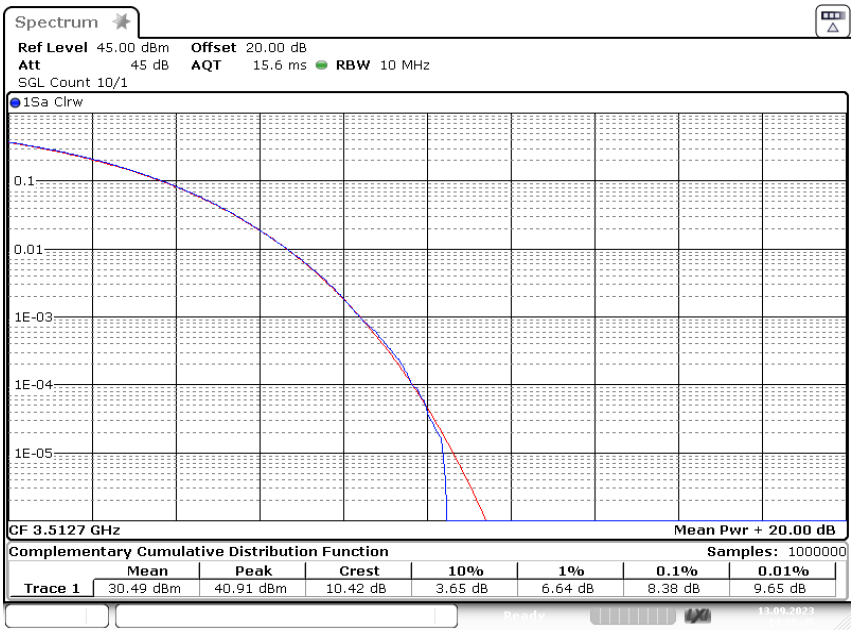
4.2.3 TEST PROTOCOL

Band, 34T, downlink						
Signal Type	**Input Power**	**Frequency [MHz]**	**Input Power [dBm]**	**PAPR [dB]**	**Limit PAPR [dB]**	**Margin to Limit [dB]**
Wideband 1	0.3 dB < AGC	3512.70	-4.88	8.38	13.0	4.62
Wideband 1	3 dB > AGC	3512.70	-1.56	8.32	13.0	4.68
Wideband 2	0.3 dB < AGC	3500.00	-4.65	8.43	13.0	4.57
Wideband 2	3 dB > AGC	3500.00	-1.38	8.49	13.0	4.51
Narrowband	0.3 dB < AGC	3512.70	-5.13	0.20	13.0	12.80
Narrowband	3 dB > AGC	3512.70	-1.66	0.17	13.0	12.83

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

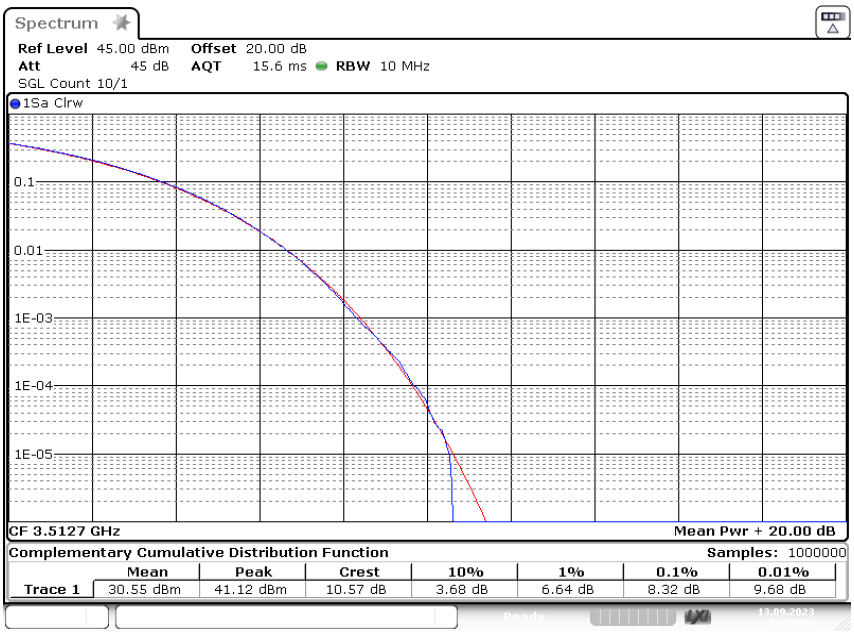
4.2.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE. "WORST CASE")

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: AWGN; PAPR 0.3 dB < AGC



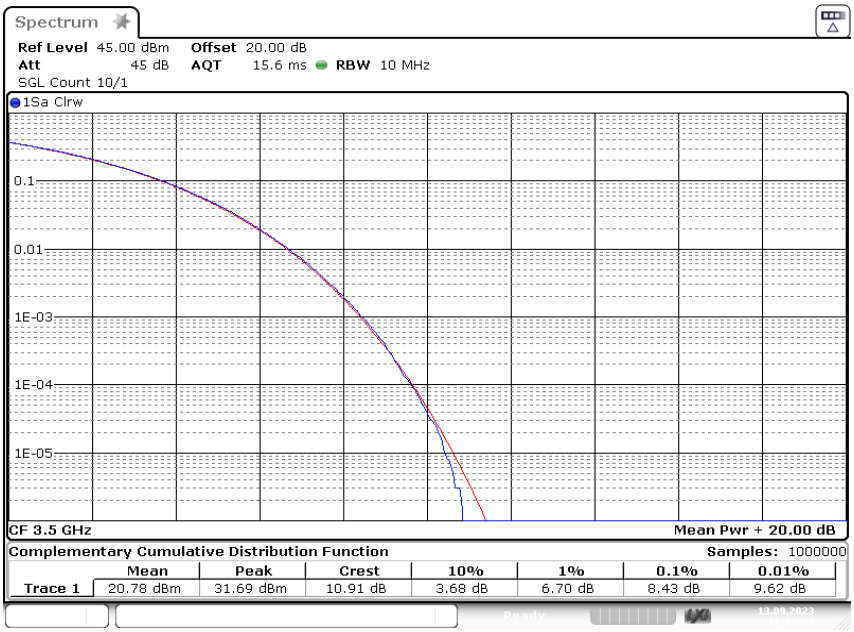
4.0 PAPR AWGN Out -0.3 3.513G

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: AWGN; PAPR 3 dB > AGC



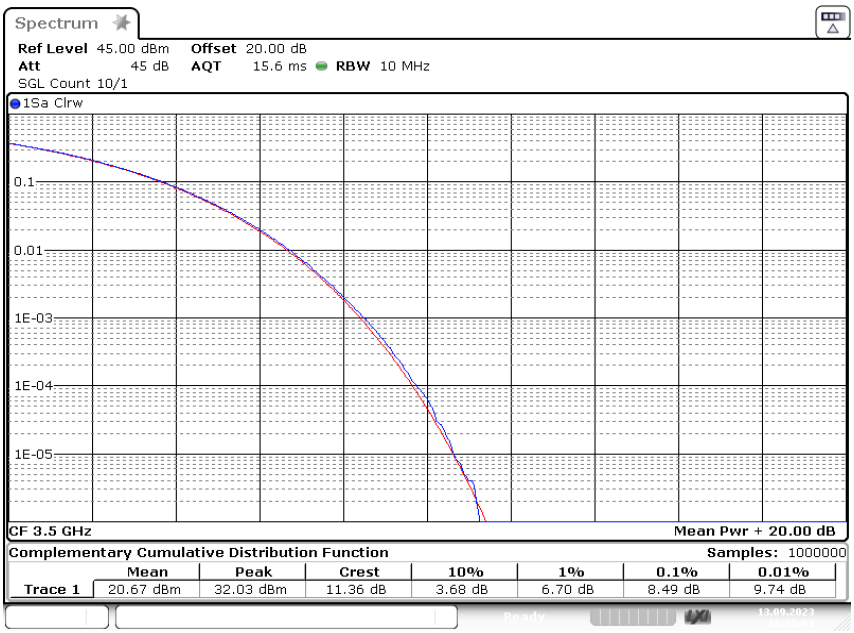
4.0 PAPR AWGN Out +3 3.513G

Band: 34T A3; Frequency: 3.5000 GHz; Band Edge: mid; Mod: AWGN100; PAPR 0.3 dB < AGC



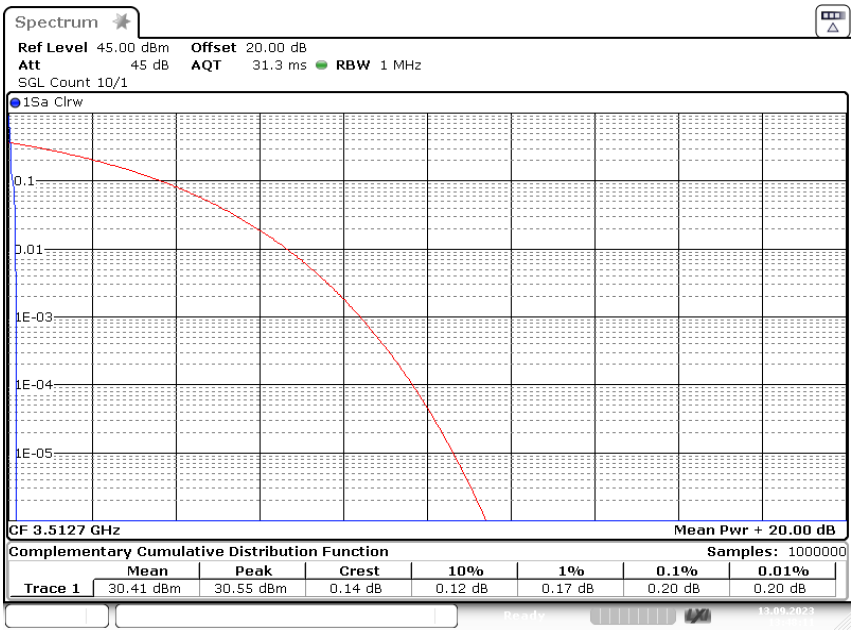
4.0 PAPR AWGN100-0.3 3.500G

Band: 34T A3; Frequency: 3.5000 GHz; Band Edge: mid; Mod: AWGN100; PAPR 3 dB > AGC



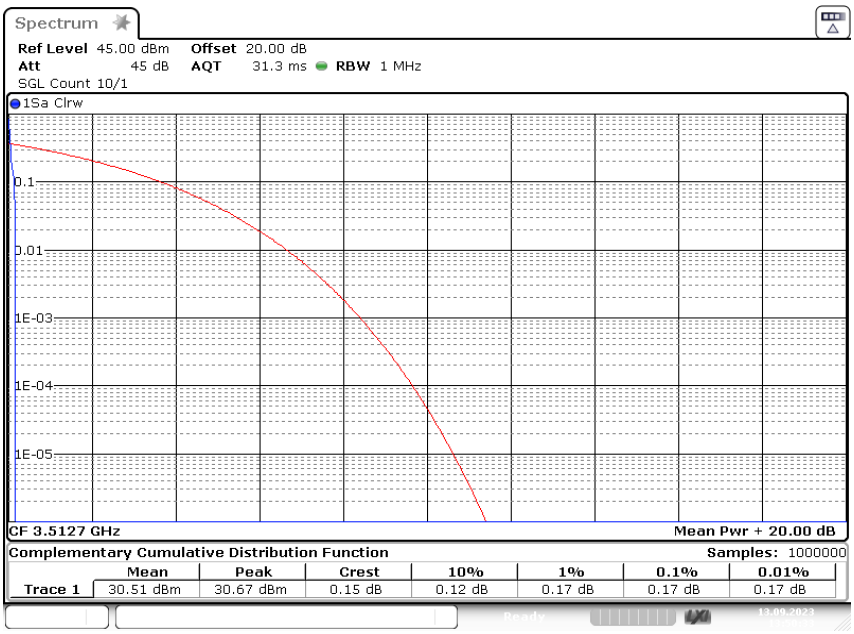
4.0 PAPR AWGN100+3 3.500G

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: GSM; PAPR 0.3 dB < AGC



4.0 PAPR GSM Out -0.3 3.513G

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: GSM; PAPR 3 dB > AGC



4.0 PAPR GSM Out +3 3.513G

4.2.5 TEST EQUIPMENT USED

- Conducted

4.3 OCCUPIED BANDWIDTH / INPUT-VERSUS-OUTPUT SPECTRUM

Standard FCC Part 2.1049; Occupied Bandwidth

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

Test date: 2023-09-06 – 2023-11-14

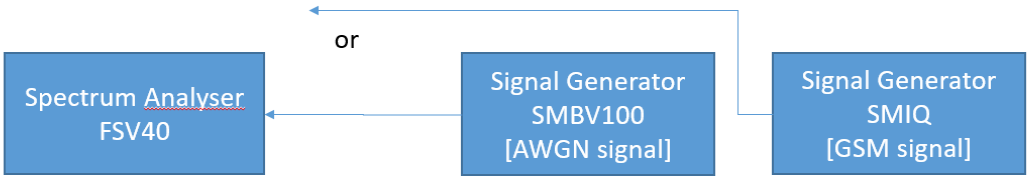
Environmental conditions: 23 ° C ± 5 K; 40 % r. F. ± 20 % r. F.

Test engineer: Thomas Hufnagel

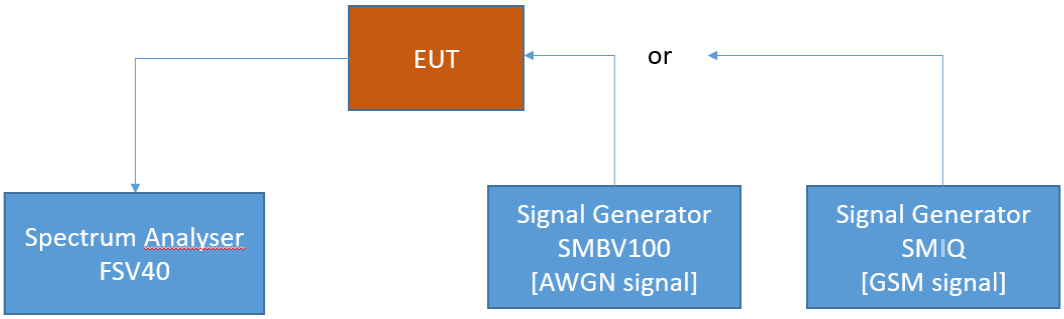
4.3.1 TEST DESCRIPTION

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.

4.3.2 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 0.5 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.

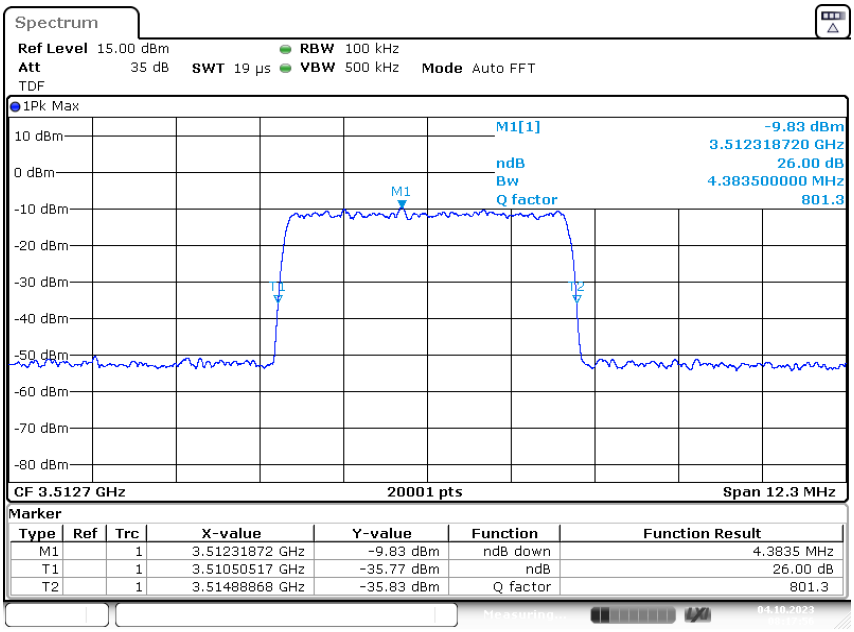
4.3.3 TEST PROTOCOL

Band 34T 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 1	0.3 dB < AGC	3512.70	4383.5	4382.3	1.2	205.0	203.8
Wideband 1	3 dB > AGC	3512.70	4389.0	4388.4	0.6	205.0	204.4
Wideband 2	0.3 dB < AGC	3500.00	103225	103180	45	4920	4875
Wideband 2	3 dB > AGC	3500.00	103045	103030	15	4920	4905
Narrowband	0.3 dB < AGC	3512.70	316.244	321.884	5.64	10.0	4.36
Narrowband	3 dB > AGC	3512.70	316.664	314.204	2.46	10.0	7.54

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

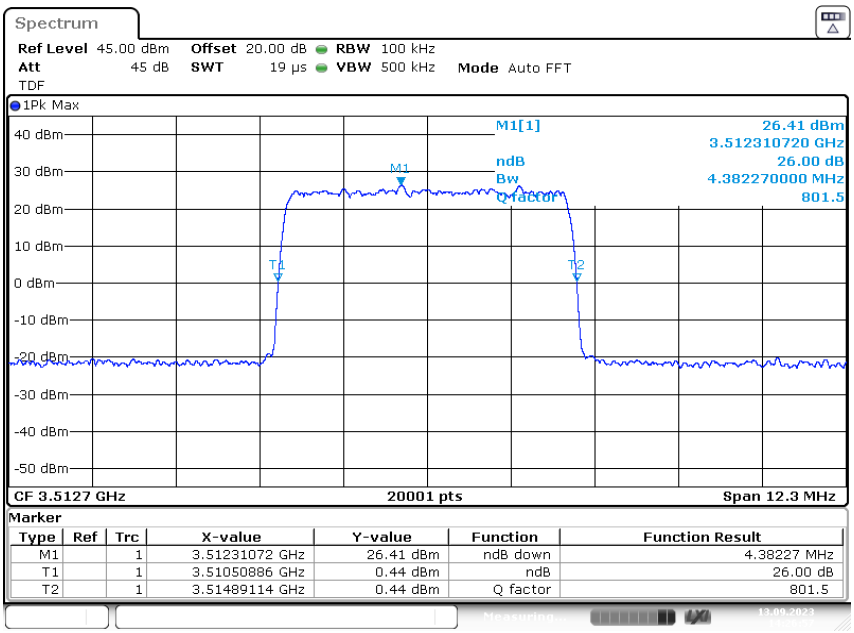
4.3.4 MEASUREMENT PLOT

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: AWGN;
Input OCBw 0.3 dB < AGC



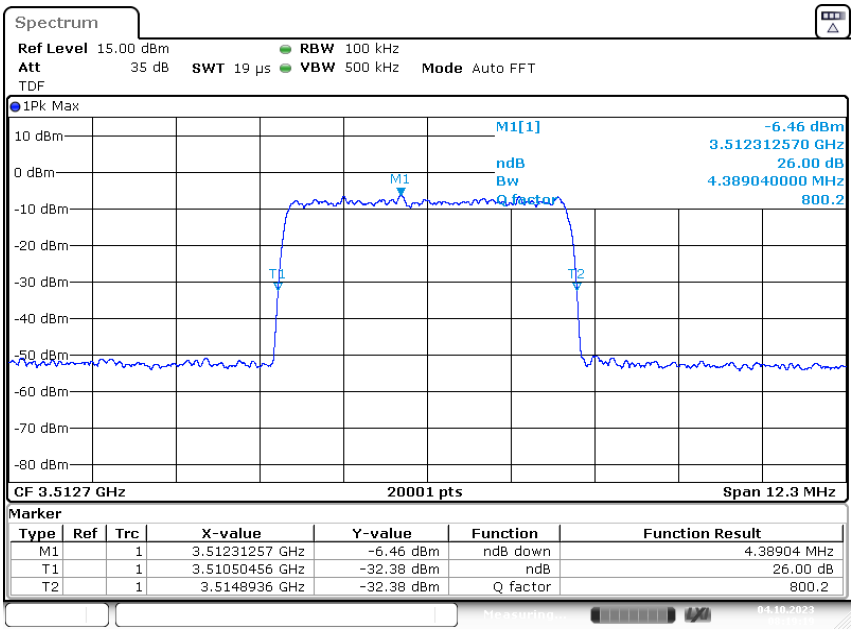
3.4 OCBw AWGN In-0.3 3.5127G _26dB

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: AWGN;
Output OCBw 0.3 dB < AGC



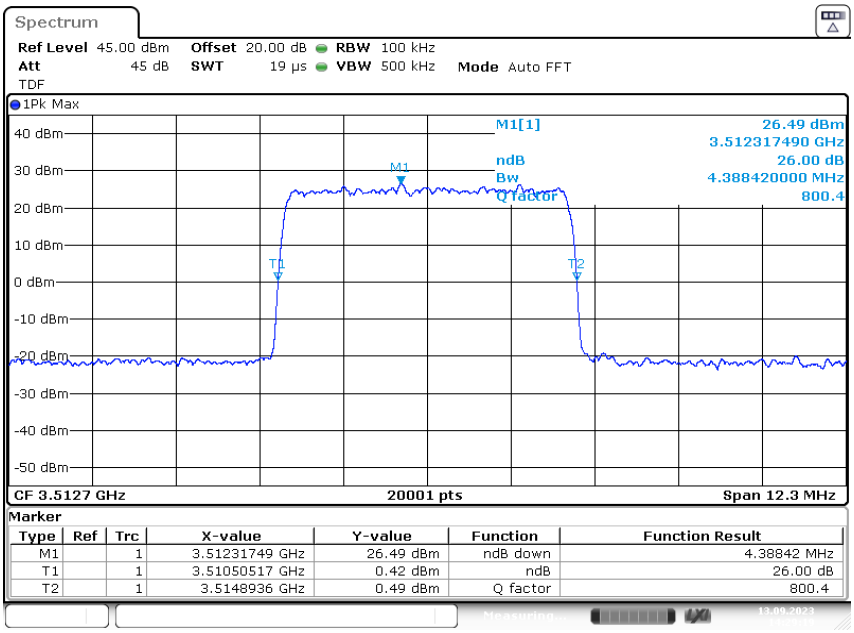
3.4 OCBw AWGN Out -0.3 3.5127G _26dB

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: AWGN;
Input OCBw 3 dB > AGC



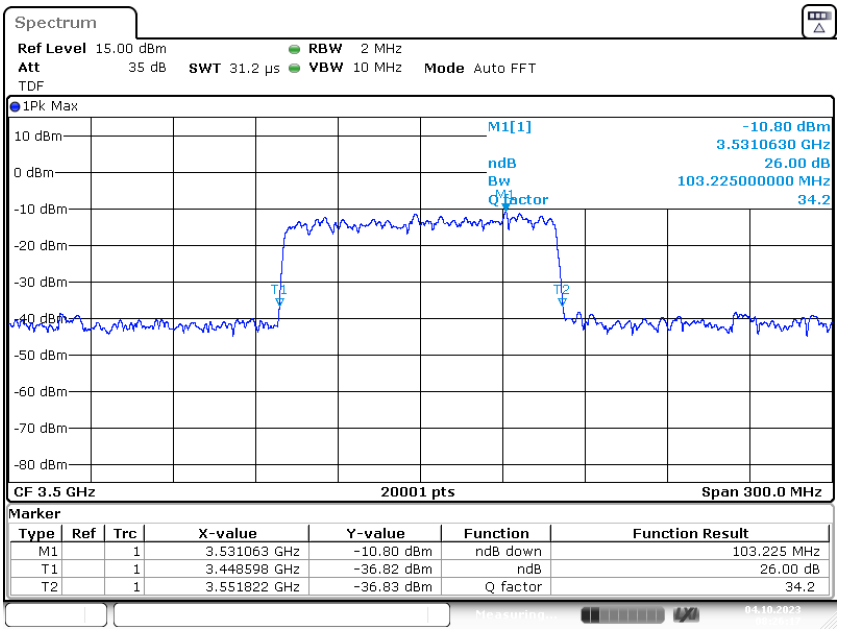
3.4 OCBw AWGN In+3 3.5127G _26dB

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: AWGN;
Output OCBw 3 dB > AGC



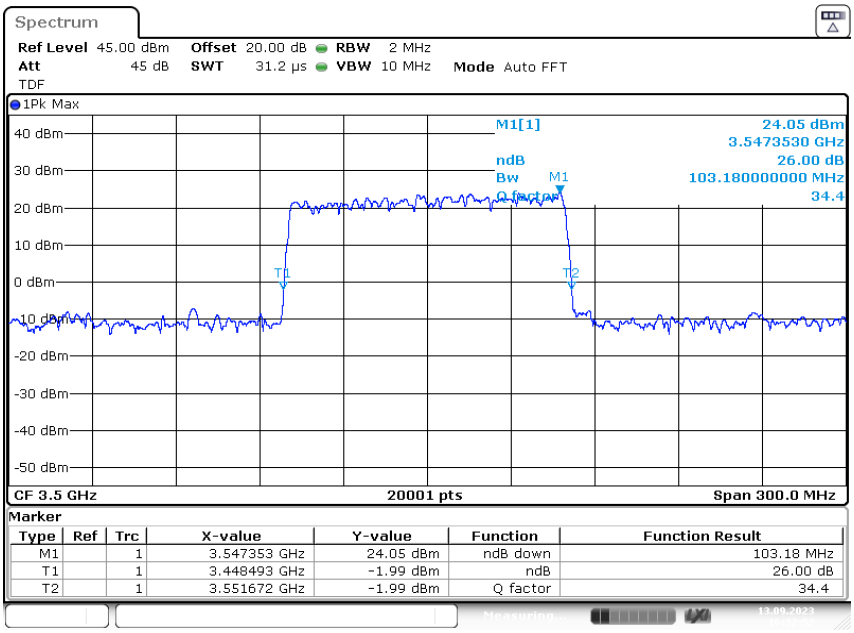
3.4 OCBw AWGN Out +3 3.5127G _26dB

Band: 34T A3; Frequency: 3.5000 GHz; Band Edge: mid; Mod: AWGN100;
Input OCBw 0.3 dB < AGC



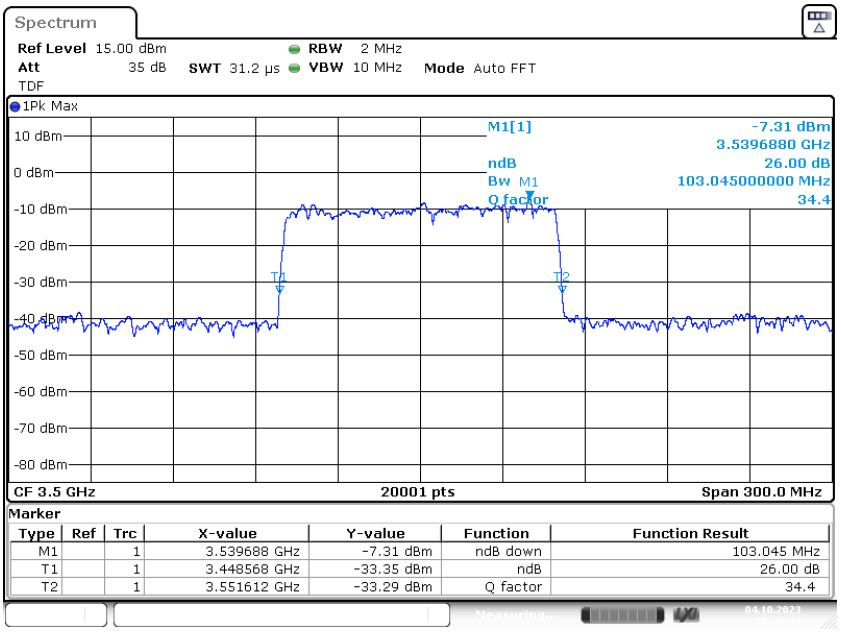
3.4 OCBw AWGN100 In-0.3 3.5000G _26dB

Band: 34T A3; Frequency: 3.5000 GHz; Band Edge: mid; Mod: AWGN100;
Output OCBw 0.3 dB < AGC



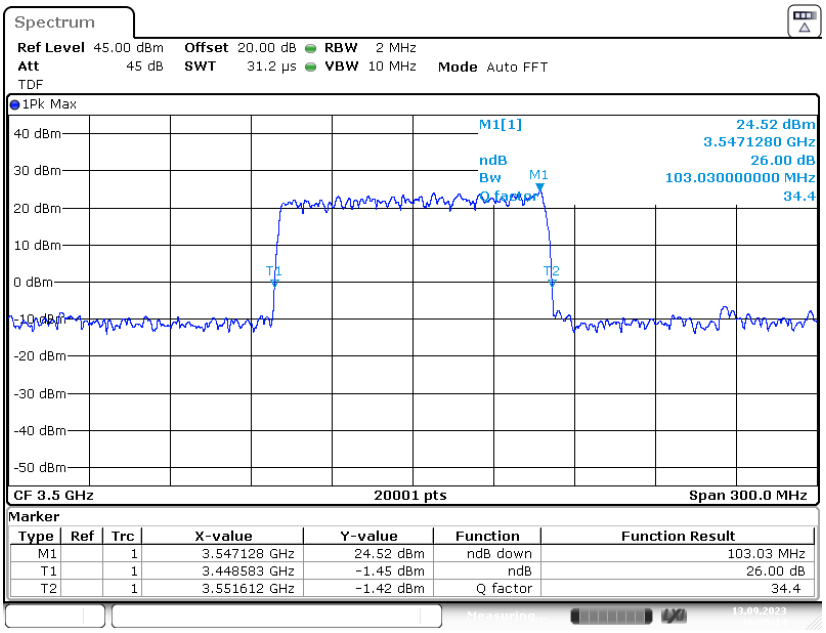
3.4 OCBw AWGN100-0.3 3.5000G _26dB

Band: 34T A3; Frequency: 3.5000 GHz; Band Edge: mid; Mod: AWGN100;
Input OCBw 3 dB > AGC



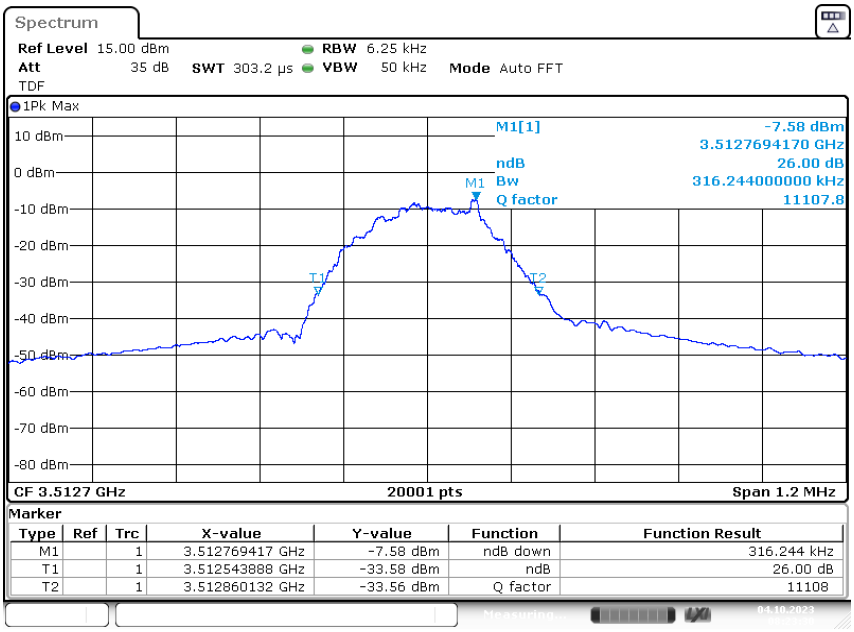
3.4 OCBw AWGN100 In+3 3.5000G _26dB

Band: 34T A3; Frequency: 3.5000 GHz; Band Edge: mid; Mod: AWGN100;
Output OCBw 3 dB > AGC



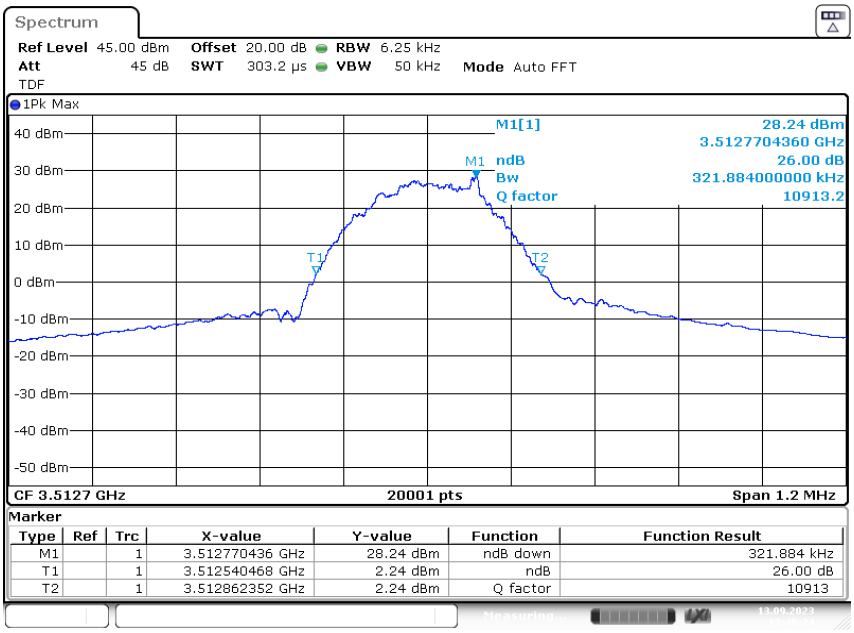
3.4 OCBw AWGN100+3 3.5000G _26dB

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: GSM;
Input OCBw 0.3 dB < AGC



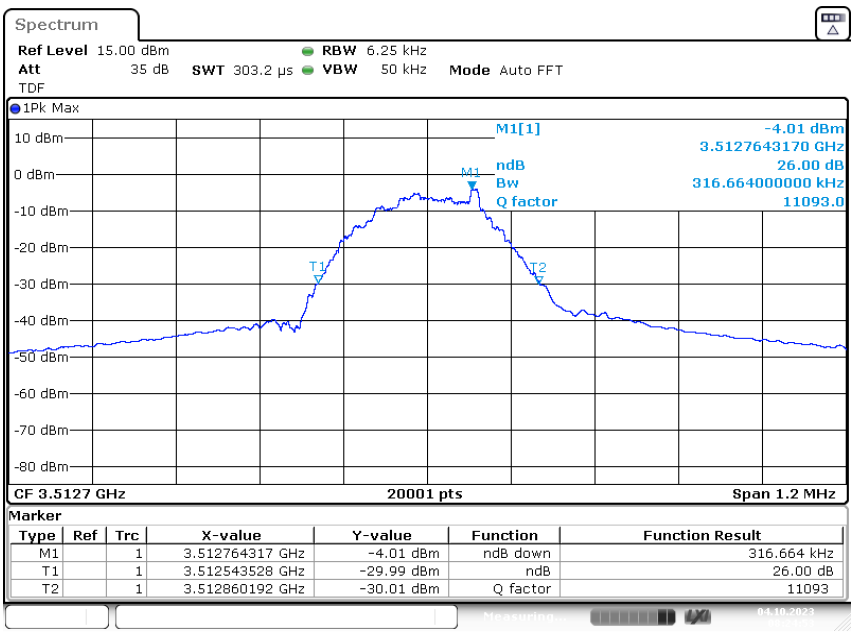
3.4 OCBw GSM In-0.3 3.5127G _26dB

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: GSM;
Output OCBw 0.3 dB < AGC



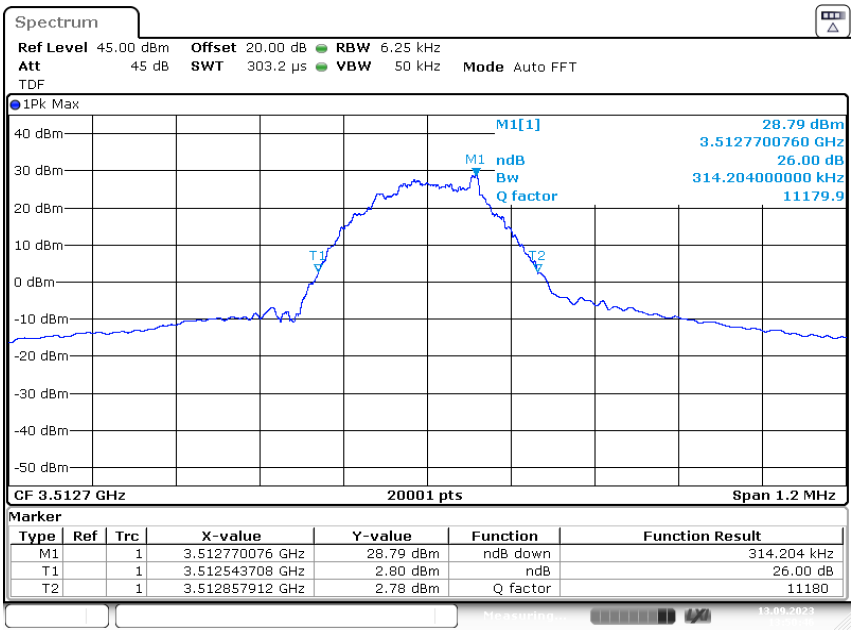
3.4 OCBw GSM Out -0.3 3.5127G _26dB

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: GSM;
Input OCBw 3 dB > AGC



3.4 OCBw GSM In+3 3.5127G _26dB

Band: 34T A3; Frequency: 3.5127 GHz; Band Edge: f0; Mod: GSM;
Output OCBw 3 dB > AGC



3.4 OCBw GSM Out +3 3.5127G _26dB

4.3.5 TEST EQUIPMENT USED

- Conducted

4.4 CONDUCTED SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Standard FCC Part §2.1051. §27.53

The test was performed according to:
ANSI C63.26

Test date: 2023-09-06 – 2023-11-14

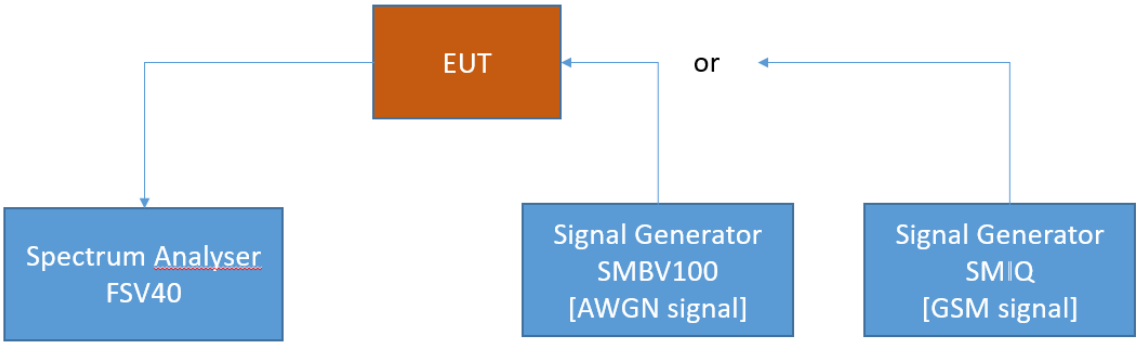
Environmental conditions: 23 ° C ± 5 K; 40 % r. F. ± 20 % r. F.

Test engineer: Thomas Hufnagel

4.4.1 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:



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.

4.4.2 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 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§27.53 – Emission limits

(n) **3.5 GHz Service**
The following emission limits apply to stations transmitting in the 3450-3550 MHz band:

(1) For base station operations in the 3450–3550 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed −13 dBm/MHz. Compliance with the provisions of this paragraph (n)(1) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed, but limited to a maximum of 200 kHz. 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. Notwithstanding the channel edge requirement of −13 dBm per megahertz, for base station operations in the 3450–3550 MHz band, the conducted power of any emission below 3440 MHz or above 3560 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3430 MHz or above 3570 MHz shall not exceed −40 dBm/MHz.

(2) For mobile operations in the 3450–3550 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed −13 dBm/MHz. Compliance with this paragraph (n)(2) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed, but limited to a maximum of 200 kHz. In the bands between 1 and 5 MHz removed from the licensee's frequency block, the minimum resolution bandwidth for the measurement shall be 500 kHz. 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.

4.4.3 TEST PROTOCOL

General considerations concerning the limits:

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

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

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

Hereby "p" are the limit lines' values.

Band 34T downlink

Test Frequency	Signal Type	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
low	Wideband 1	0.011232	-72.2	RMS	1	-70	2.2
low	Wideband 1	0.077495	-64.2	RMS	10	-60	4.2
low	Wideband 1	125.4	-55.6	RMS	100	-50	5.6
low	Wideband 1	952.8	-53.7	RMS	100	-50	3.7
low	Wideband 1	3179.8	-46.2	RMS	1000	-40	6.2
low	Wideband 1	3448.2	-41.4	RMS	100	-35	6.4
low	Wideband 1	3552.2	-50.9	RMS	100	-35	15.9
low	Wideband 1	6279.3	-41.9	RMS	1000	-40	1.9
low	Wideband 1	6848.2	-51.3	RMS	1000	-40	11.3
low	Wideband 1	19568.8	-51.0	RMS	1000	-40	11.0
low	Wideband 1	20280.2	-50.8	RMS	1000	-40	10.8
low	Wideband 1	30078.9	-50.9	RMS	1000	-40	10.9
low	Wideband 1	39970.3	-42.8	RMS	1000	-40	2.8
mid	Wideband 1	0.009594	-77.2	RMS	1	-70	7.2
mid	Wideband 1	0.097492	-65.3	RMS	10	-60	5.3
mid	Wideband 1	119.2	-54.8	RMS	100	-50	4.8
mid	Wideband 1	952.0	-53.7	RMS	100	-50	3.7
mid	Wideband 1	3375.3	-45.7	RMS	1000	-40	5.7
mid	Wideband 1	3446.5	-52.2	RMS	100	-35	17.2
mid	Wideband 1	3551.1	-49.3	RMS	100	-35	14.3
mid	Wideband 1	6153.8	-41.9	RMS	1000	-40	1.9
mid	Wideband 1	6943.7	-51.0	RMS	1000	-40	11.0
mid	Wideband 1	19557.3	-51.2	RMS	1000	-40	11.2
mid	Wideband 1	20305.2	-50.8	RMS	1000	-40	10.8
mid	Wideband 1	30092.5	-51.2	RMS	1000	-40	11.2
mid	Wideband 1	39972.3	-42.9	RMS	1000	-40	2.9
high	Wideband 1	0.012461	-75.8	RMS	1	-70	5.8
high	Wideband 1	0.057499	-63.9	RMS	10	-60	3.9
high	Wideband 1	119.5	-55.5	RMS	100	-50	5.5
high	Wideband 1	949.0	-54.3	RMS	100	-50	4.3
high	Wideband 1	3370.3	-46.0	RMS	1000	-40	6.0
high	Wideband 1	3448.2	-51.9	RMS	100	-35	16.9
high	Wideband 1	3551.2	-39.5	RMS	100	-35	4.5
high	Wideband 1	6019.8	-41.8	RMS	1000	-40	1.8
high	Wideband 1	6889.7	-51.2	RMS	1000	-40	11.2
high	Wideband 1	19564.3	-50.7	RMS	1000	-40	10.7
high	Wideband 1	20292.2	-50.7	RMS	1000	-40	10.7
high	Wideband 1	30056.5	-50.4	RMS	1000	-40	10.4
high	Wideband 1	39977.8	-42.6	RMS	1000	-40	2.6

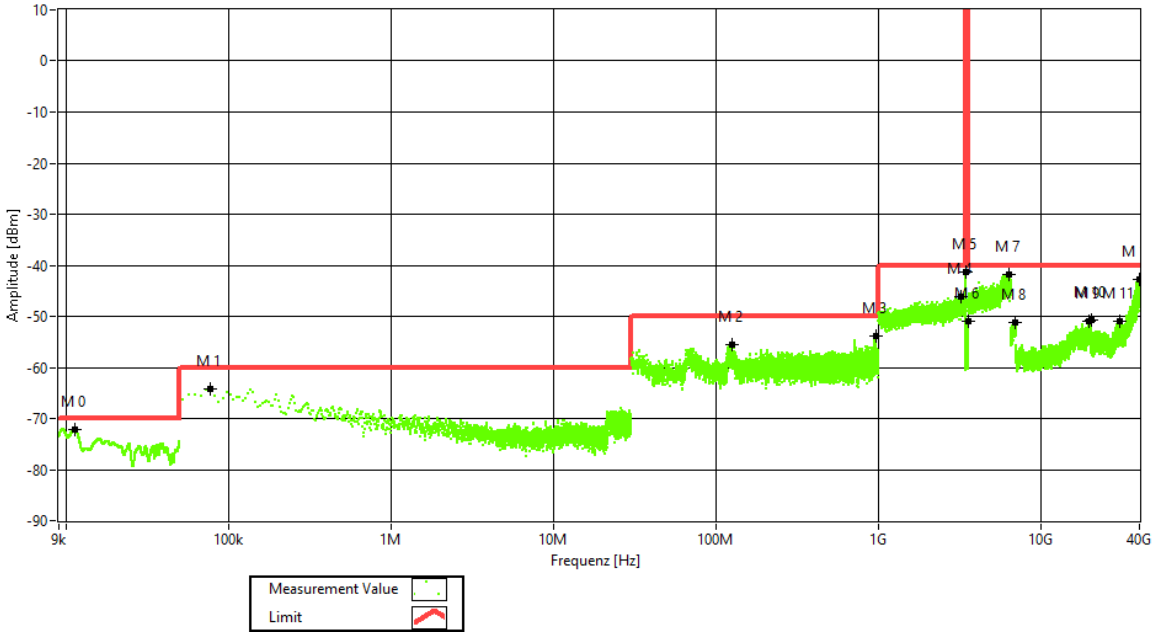
Band 34T downlink							
Test Frequency	**Signal Type**	**Spurious Freq. [MHz]**	**Spurious Level [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
mid	Wideband 2	0.023889	-74.4	RMS	1	-70	4.4
mid	Wideband 2	0.157482	-64.9	RMS	10	-60	4.9
mid	Wideband 2	69.9	-55.7	RMS	100	-50	5.7
mid	Wideband 2	950.0	-54.4	RMS	100	-50	4.4
mid	Wideband 2	3425.8	-45.7	RMS	1000	-40	5.7
mid	Wideband 2	3413.3	-46.0	RMS	100	-35	11.0
mid	Wideband 2	3551.2	-45.8	RMS	100	-35	10.8
mid	Wideband 2	6092.8	-41.6	RMS	1000	-40	1.6
mid	Wideband 2	6924.7	-50.7	RMS	1000	-40	10.7
mid	Wideband 2	19979.8	-50.9	RMS	1000	-40	10.9
mid	Wideband 2	20296.2	-50.7	RMS	1000	-40	10.7
mid	Wideband 2	30013.5	-51.3	RMS	1000	-40	11.3
mid	Wideband 2	39994.7	-42.6	RMS	1000	-40	2.6

Band 34T downlink							
Test Frequency	**Signal Type**	**Spurious Freq. [MHz]**	**Spurious Level [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
low	Narrowband	0.011232	-76.2	RMS	1	-70	6.2
low	Narrowband	0.152483	-63.9	RMS	10	-60	3.9
low	Narrowband	125.0	-56.0	RMS	100	-50	6.0
low	Narrowband	952.2	-54.3	RMS	100	-50	4.3
low	Narrowband	3415.8	-45.7	RMS	1000	-40	5.7
low	Narrowband	3449.0	-41.5	RMS	100	-35	6.5
low	Narrowband	3552.1	-50.3	RMS	100	-35	15.3
low	Narrowband	6188.8	-41.6	RMS	1000	-40	1.6
low	Narrowband	6874.2	-51.1	RMS	1000	-40	11.1
low	Narrowband	19551.8	-50.7	RMS	1000	-40	10.7
low	Narrowband	20336.2	-50.8	RMS	1000	-40	10.8
low	Narrowband	30103.5	-50.9	RMS	1000	-40	10.9
low	Narrowband	39993.7	-42.6	RMS	1000	-40	2.6
mid	Narrowband	0.009020	-77.1	RMS	1	-70	7.1
mid	Narrowband	0.052500	-64.1	RMS	10	-60	4.1
mid	Narrowband	119.3	-55.6	RMS	100	-50	5.6
mid	Narrowband	948.9	-53.6	RMS	100	-50	3.6
mid	Narrowband	3360.8	-45.5	RMS	1000	-40	5.5
mid	Narrowband	3447.7	-51.8	RMS	100	-35	16.8
mid	Narrowband	3551.0	-50.1	RMS	100	-35	15.1
mid	Narrowband	6163.3	-41.7	RMS	1000	-40	1.7
mid	Narrowband	6904.7	-50.6	RMS	1000	-40	10.6
mid	Narrowband	19600.3	-51.3	RMS	1000	-40	11.3
mid	Narrowband	20317.2	-50.4	RMS	1000	-40	10.4
mid	Narrowband	30044.0	-51.3	RMS	1000	-40	11.3
mid	Narrowband	39973.8	-42.7	RMS	1000	-40	2.7
high	Narrowband	0.023725	-77.2	RMS	1	-70	7.2
high	Narrowband	0.152483	-64.9	RMS	10	-60	4.9
high	Narrowband	123.7	-55.8	RMS	100	-50	5.8
high	Narrowband	952.2	-53.7	RMS	100	-50	3.7
high	Narrowband	3311.3	-46.3	RMS	1000	-40	6.3
high	Narrowband	3446.9	-52.2	RMS	100	-35	17.2
high	Narrowband	3551.1	-42.0	RMS	100	-35	7.0
high	Narrowband	6227.8	-41.4	RMS	1000	-40	1.4
high	Narrowband	6977.7	-50.9	RMS	1000	-40	10.9
high	Narrowband	19992.3	-50.6	RMS	1000	-40	10.6
high	Narrowband	20299.2	-51.0	RMS	1000	-40	11.0
high	Narrowband	30023.5	-51.2	RMS	1000	-40	11.2
high	Narrowband	39996.2	-42.8	RMS	1000	-40	2.8

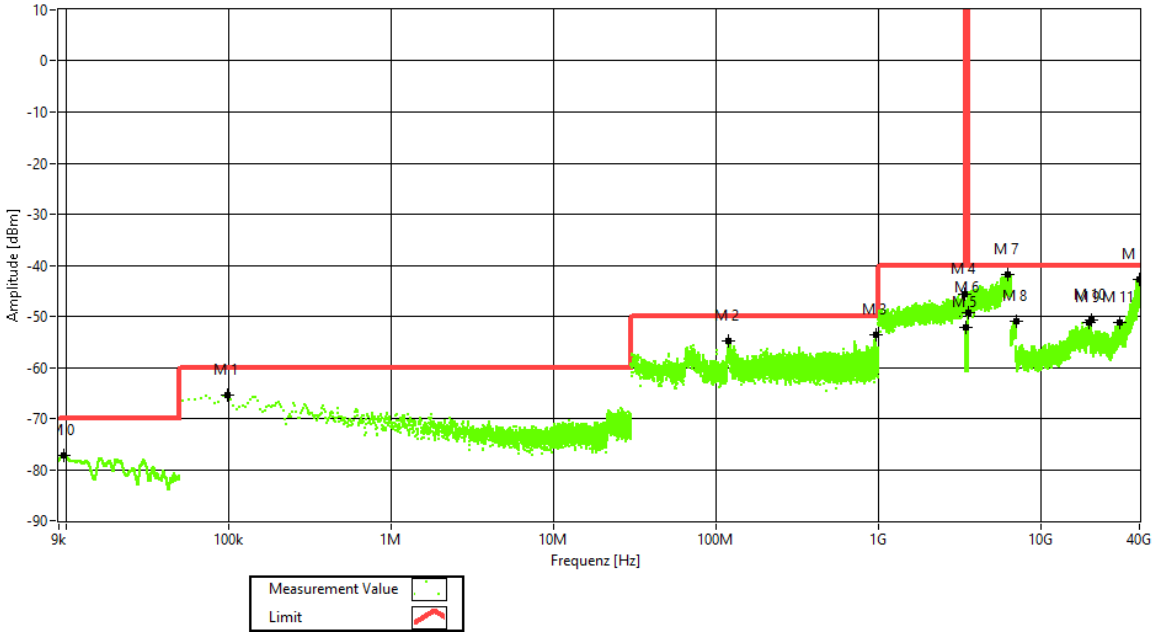
Remark: Please see next sub-clause for the measurement plot.

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

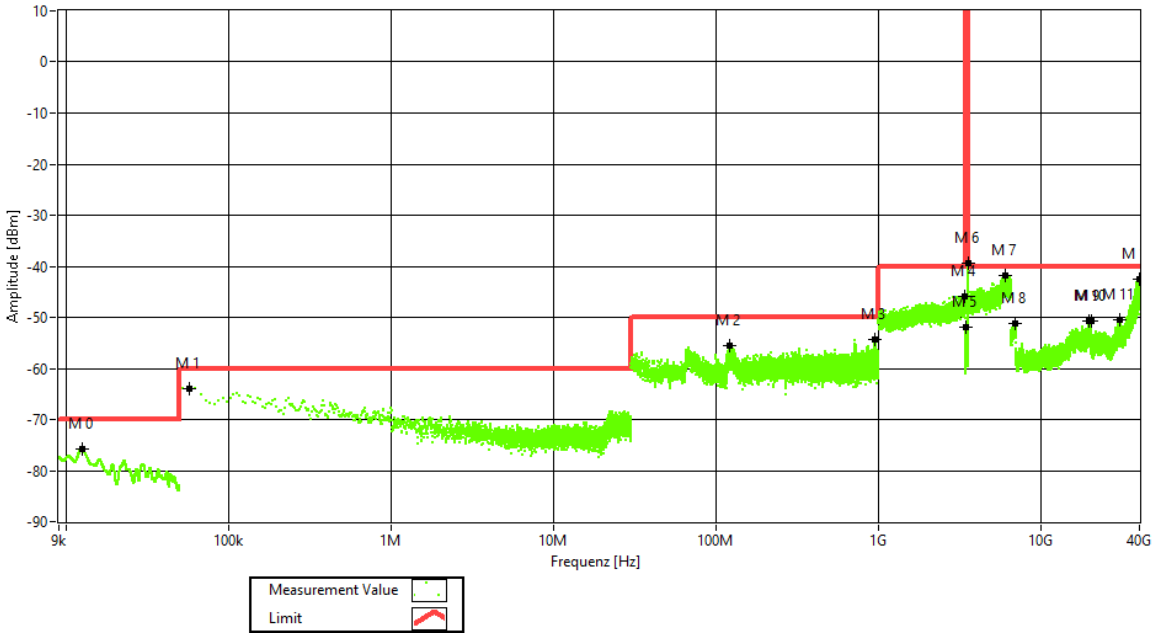
Frequency Band = 34T-Band. Segment 1. Test Frequency = low. Direction = RF downlink.
Signal Type = Wideband 1



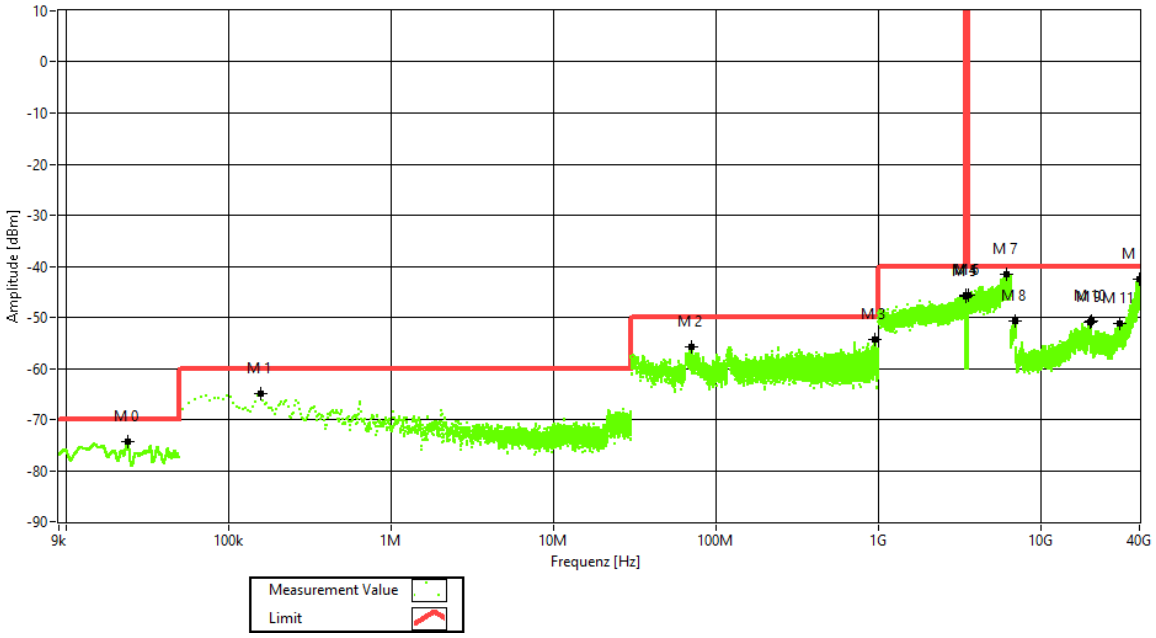
Frequency Band = 34T-Band. Segment 1. Test Frequency = mid. Direction = RF downlink.
Signal Type = Wideband 1



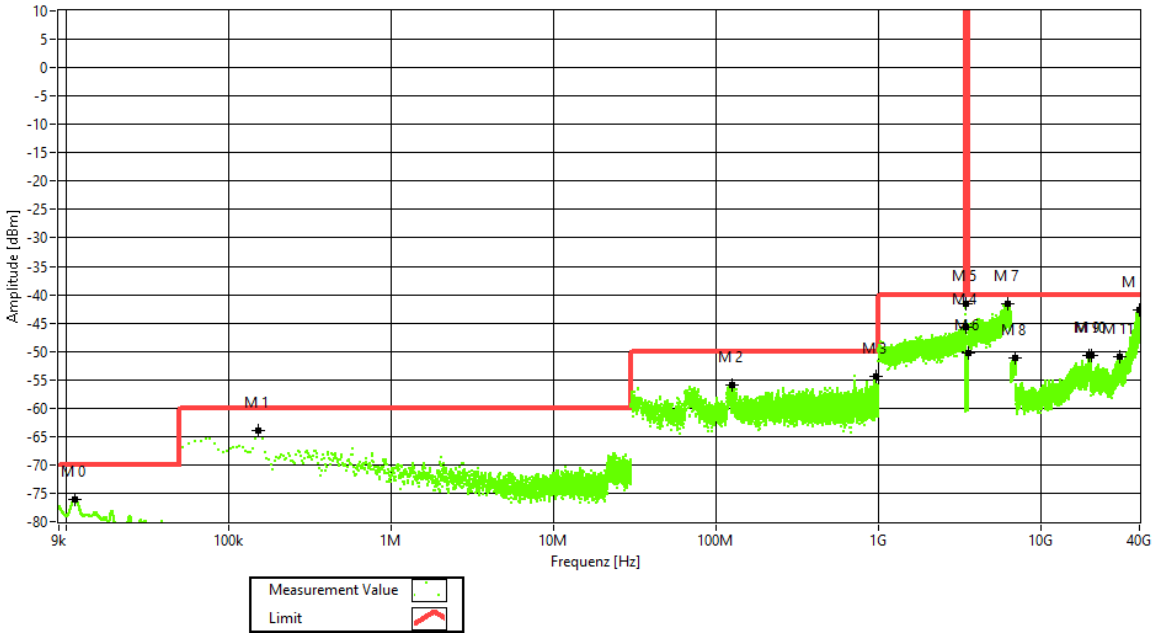
Frequency Band = 34T-Band. Segment 1. Test Frequency = high. Direction = RF downlink.
Signal Type = Wideband 1



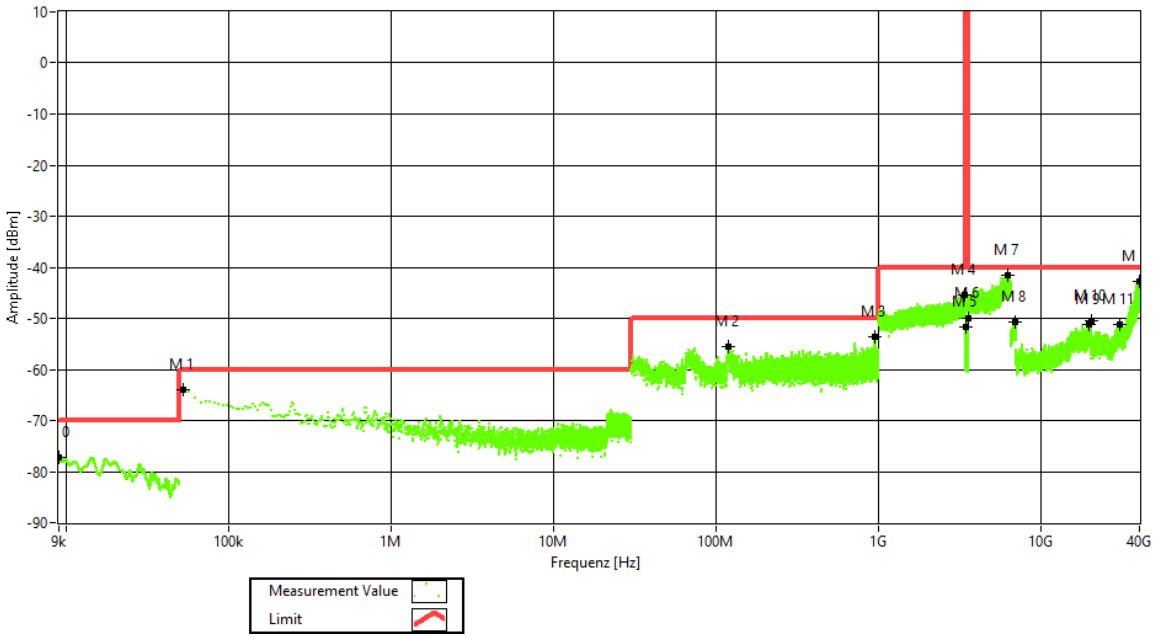
Frequency Band = 34T-Band. Segment 1. Test Frequency = mid. Direction = RF downlink.
Signal Type = Wideband 2



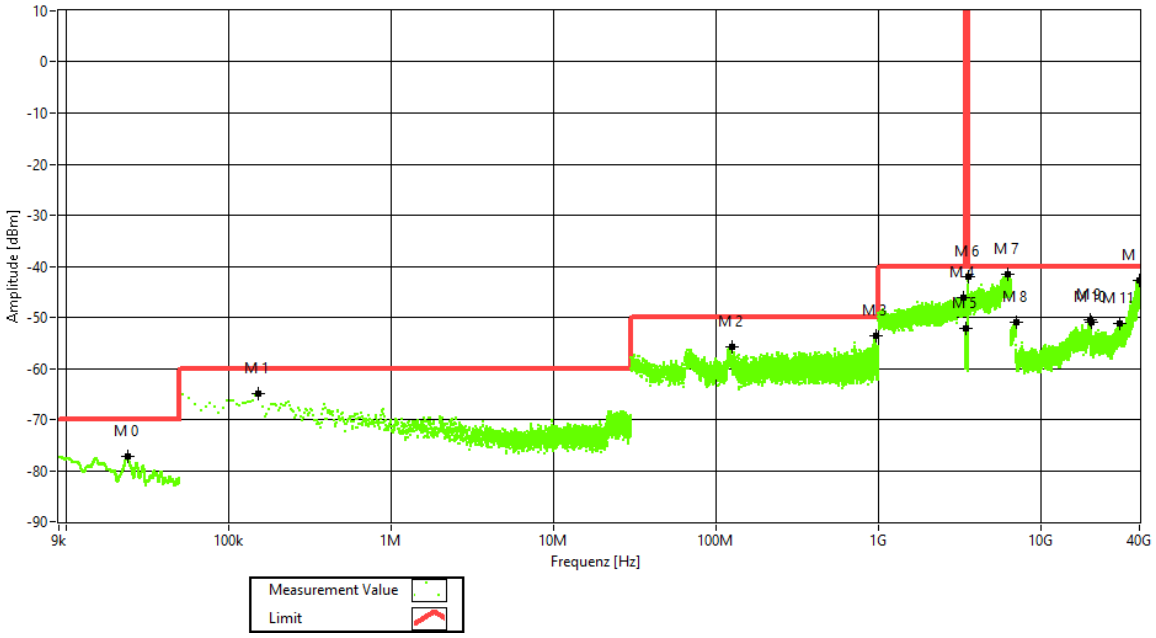
Frequency Band = 34T-Band. Segment 1. Test Frequency = low. Direction = RF downlink.
Signal Type = Narrowband



Frequency Band = 34T-Band. Segment 1. Test Frequency = mid. Direction = RF downlink.
Signal Type = Narrowband



Frequency Band = 34T-Band. Segment 1. Test Frequency = high. Direction = RF downlink.
Signal Type = Narrowband



4.4.5 TEST EQUIPMENT USED

- Conducted

4.5 OUT-OF-BAND EMISSION LIMITS

Standard FCC Part §2.1051. §27.53

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

Test date: 2023-09-06 – 2023-11-14

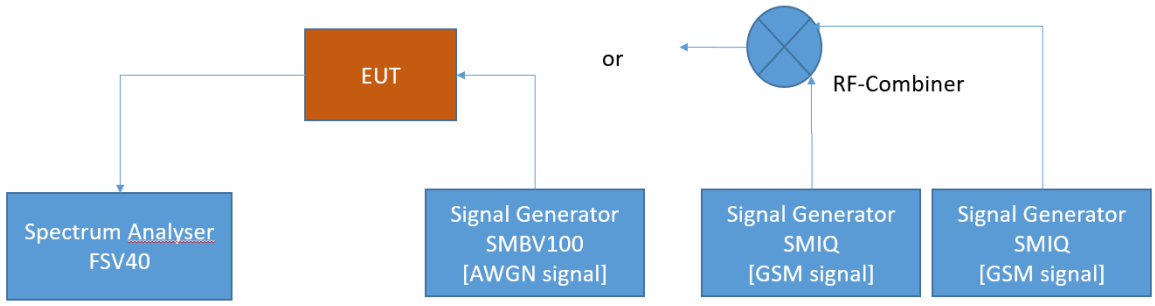
Environmental conditions: 23 ° C ± 5 K; 40 % r. F. ± 20 % r. F.

Test engineer: Thomas Hufnagel

4.5.1 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:



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.

4.5.2 TEST REQUIREMENTS/LIMITS

Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§27.53 – Emission limits

(n) **3.5 GHz Service**
The following emission limits apply to stations transmitting in the 3450-3550 MHz band:

(1) For base station operations in the 3450–3550 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed −13 dBm/MHz. Compliance with the provisions of this paragraph (n)(1) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed, but limited to a maximum of 200 kHz. 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. Notwithstanding the channel edge requirement of −13 dBm per megahertz, for base station operations in the 3450–3550 MHz band, the conducted power of any emission below 3440 MHz or above 3560 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3430 MHz or above 3570 MHz shall not exceed −40 dBm/MHz.

(2) For mobile operations in the 3450–3550 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed −13 dBm/MHz. Compliance with this paragraph (n)(2) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed, but limited to a maximum of 200 kHz. In the bands between 1 and 5 MHz removed from the licensee's frequency block, the minimum resolution bandwidth for the measurement shall be 500 kHz. 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.

4.5.3 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 2 a bandwidth of 100 kHz is necessary. Therefore the limit here is -23 dBm, according the given formula:

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

Hereby "p" are the limit lines' values.

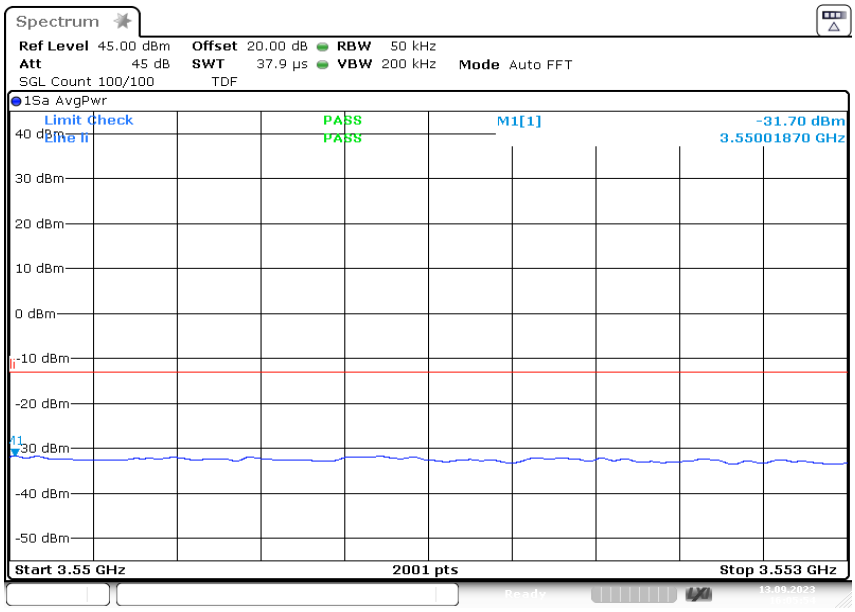
Band. Band34T. downlink. Number of input signals = 1							
Signal Type	**Input Power**	**Band Edge**	**Signal Frequency [MHz]**	**Input Power [dBm]**	**Maximum Out-of-band Power [dBm]**	**Limit Out-of-band Power [dBm]**	**Margin to Limit [dB]**
Wideband 1	0.3 dB < AGC	upper	3547.50	-4.3	-31.7	-13.0	18.7
Wideband 1	3 dB > AGC	upper	3547.50	-1.0	-31.5	-13.0	18.5
Wideband 2	0.3 dB < AGC	upper	3500.00	-4.6	-26.0	-13.0	13.0
Wideband 2	3 dB > AGC	upper	3500.00	-1.6	-25.7	-13.0	12.7
Narrowband	0.3 dB < AGC	upper	3549.80	-3.7	-30.0	-13.0	17.0
Narrowband	3 dB > AGC	upper	3549.80	-0.4	-30.9	-13.0	17.9
Wideband 1	0.3 dB < AGC	lower	3452.50	-3.9	-34.0	-13.0	21.0
Wideband 1	3 dB > AGC	lower	3452.50	-0.6	-34.2	-13.0	21.2
Wideband 2	0.3 dB < AGC	lower	3500.00	-4.2	-28.2	-13.0	15.2
Wideband 2	3 dB > AGC	lower	3500.00	-1.2	-28.0	-13.0	15.0
Narrowband	0.3 dB < AGC	lower	3450.20	-3.3	-31.4	-13.0	18.4
Narrowband	3 dB > AGC	lower	3450.20	0.0	-31.7	-13.0	18.7

Band. Band34T. 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	3547.50	3545.00	-4.3	-31.7	-13.0	18.7
WB	3 dB > AGC	upper	3547.50	3545.00	-1.0	-31.7	-13.0	18.7
NB	0.3 dB < AGC	upper	3549.80	3549.60	-3.7	-32.4	-13.0	19.4
NB	3 dB > AGC	upper	3549.80	3549.60	-0.4	-32.4	-13.0	19.4
WB	0.3 dB < AGC	lower	3452.50	3455.00	-3.9	-33.9	-13.0	20.9
WB	3 dB > AGC	lower	3452.50	3455.00	-0.6	-34.2	-13.0	21.2
NB	0.3 dB < AGC	lower	3450.20	3450.40	-3.9	-33.7	-13.0	20.7
NB	3 dB > AGC	lower	3450.20	3450.40	-0.6	-33.0	-13.0	20.0

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

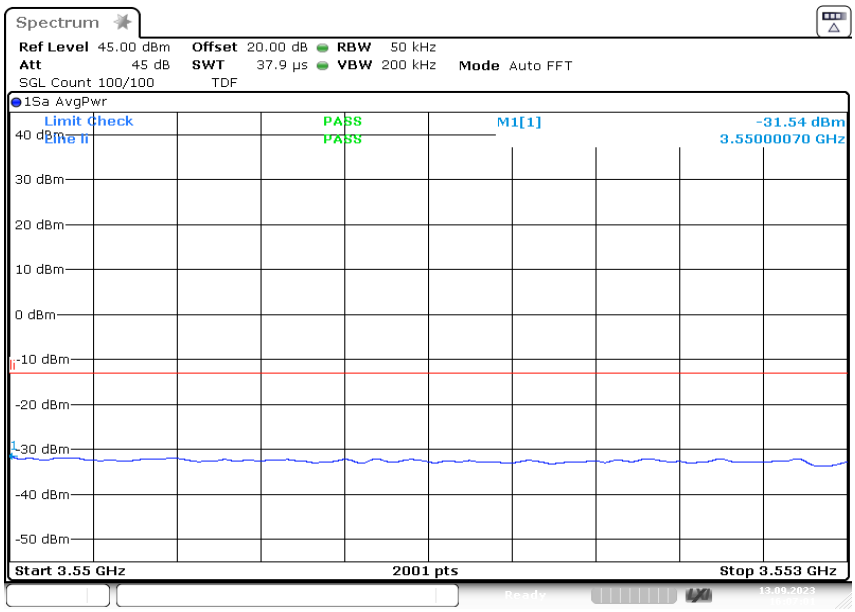
4.5.4 MEASUREMENT PLOT

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: upper;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 1



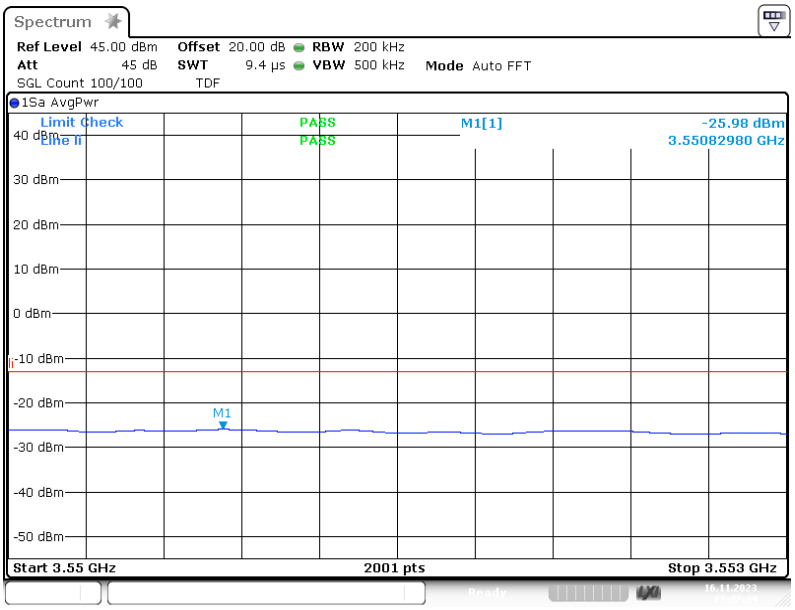
3.6.2 out of band emi 34T A3 AWGN upper 1carrier -0.3 dB 3.5
50G 3.553G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: upper;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 1



3.6.2 out of band emi 34T A3 AWGN upper 1carrier +3.0 dB 3.5
50G 3.553G

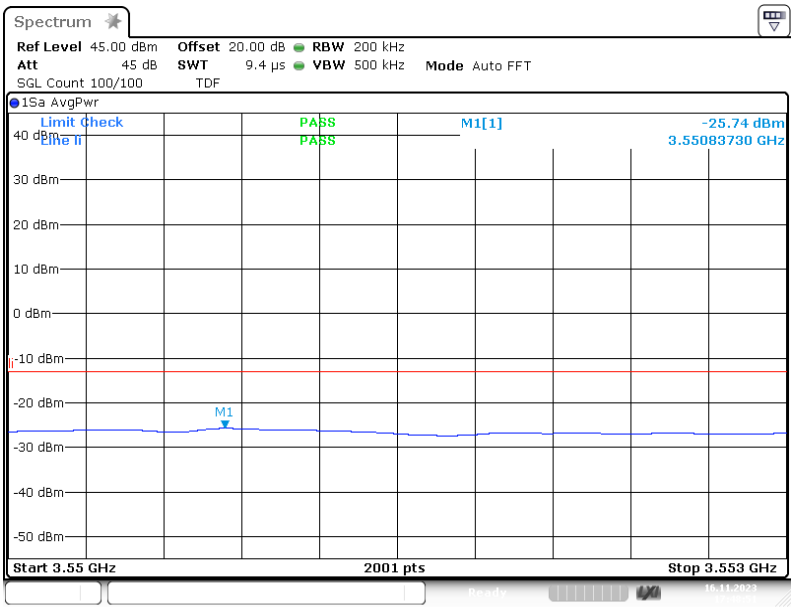
Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: upper;
Mod: AWGN100; Input Power = 0.3 dB < AGC; Number of signals 1



3.6.2 out of band emi 34T A3 AWGN100 upper 1carrier -0.3 dB

3.550G 3.553G

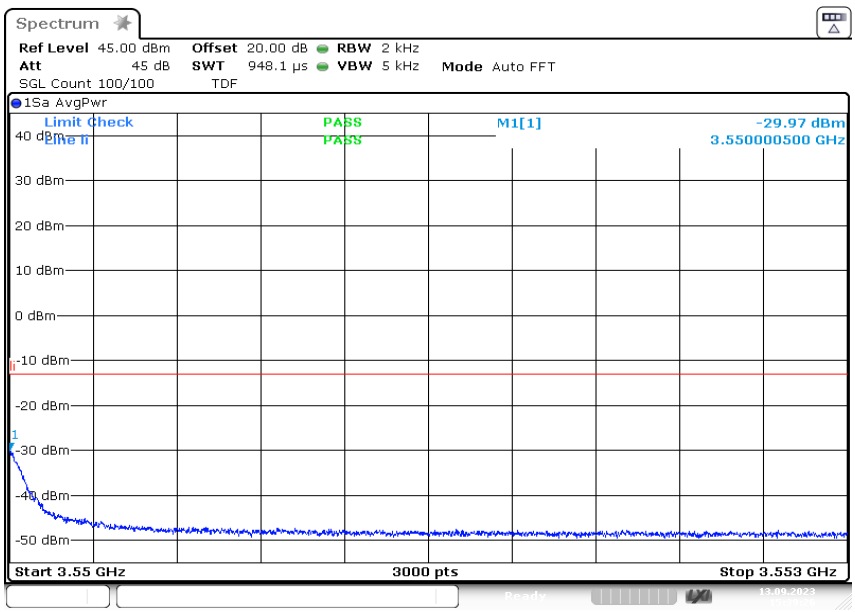
Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: upper;
Mod: AWGN100; Input Power = 3 dB > AGC; Number of signals 1



3.6.2 out of band emi 34T A3 AWGN100 upper 1carrier +3.0 dB

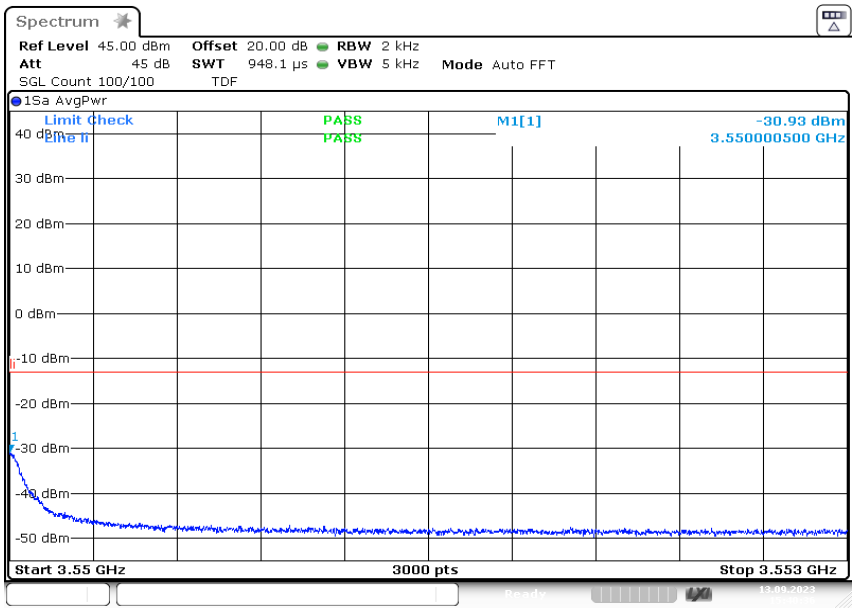
3.550G 3.553G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: upper;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 1



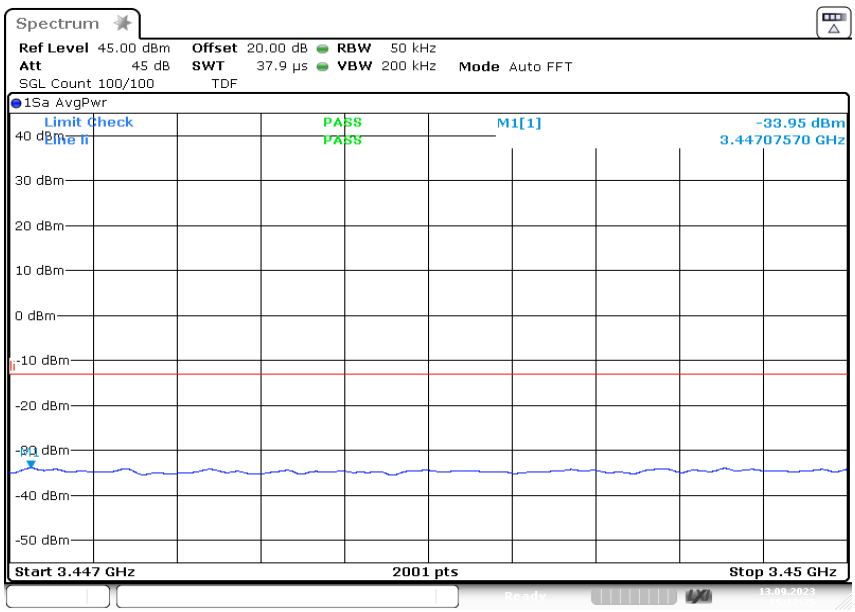
3.6.2 out of band emi 34T A3 GSM upper 1carrier -0.3 dB 3.55
0G 3.553G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: upper;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 1



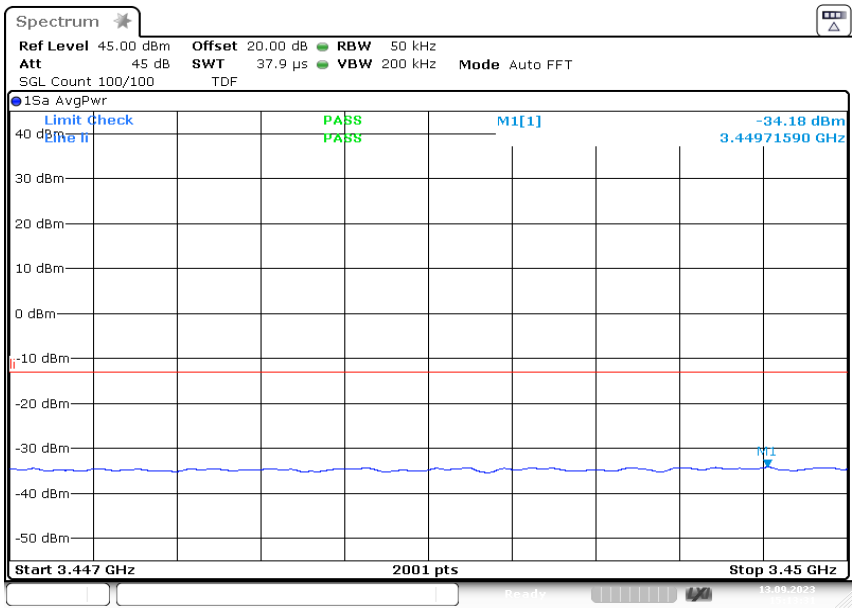
3.6.2 out of band emi 34T A3 GSM upper 1carrier +3.0 dB 3.55
0G 3.553G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: lower;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 1



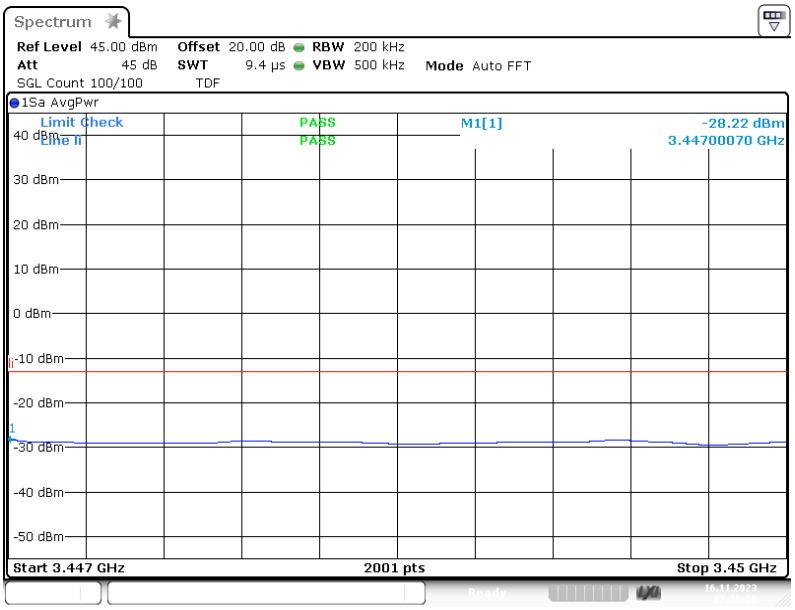
3.6.2 out of band emi 34T A3 AWGN lower 1carrier -0.3 dB 3.4
47G 3.450G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: lower;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 1



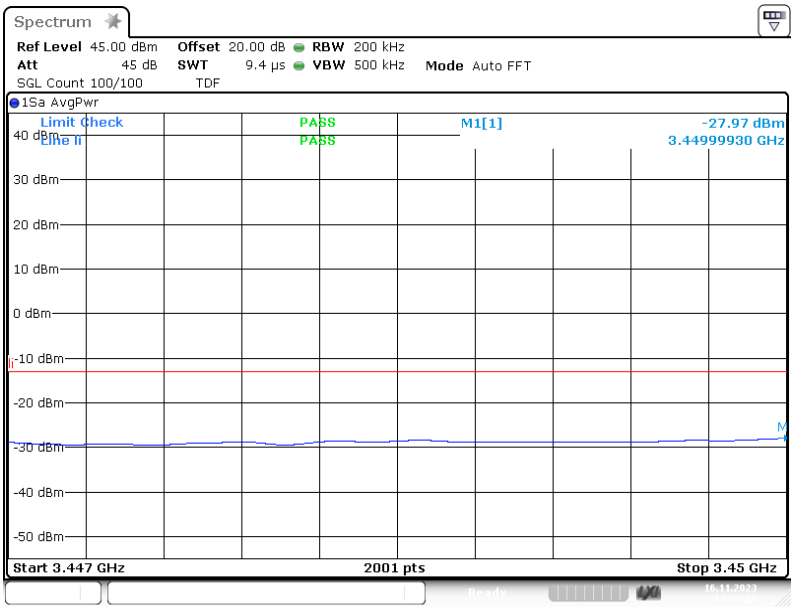
3.6.2 out of band emi 34T A3 AWGN lower 1carrier +3.0 dB 3.4
47G 3.450G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: lower;
Mod: AWGN100; Input Power = 0.3 dB < AGC; Number of signals 1



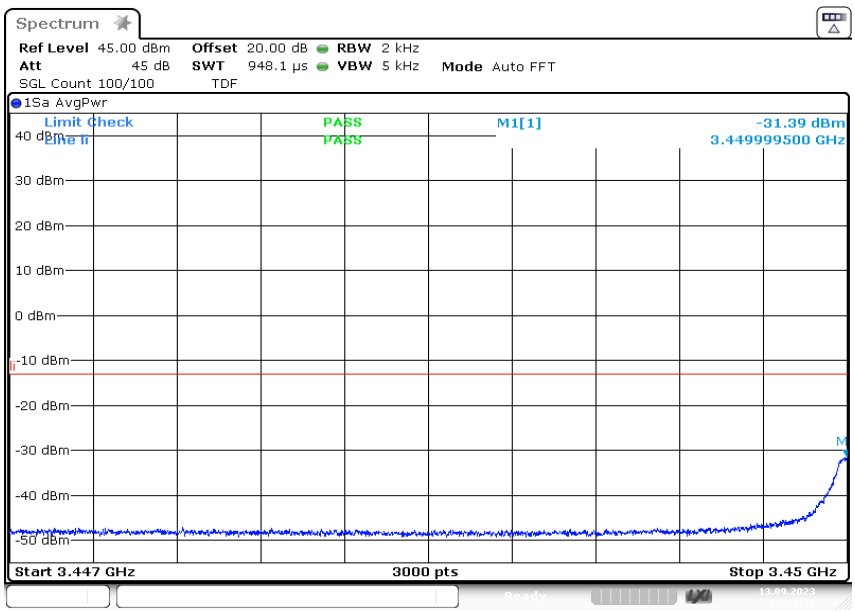
3.6.2 out of band emi 34T A3 AWGN100 lower 1carrier -0.3 dB
3.447G 3.450G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: lower;
Mod: AWGN100; Input Power = 3 dB > AGC; Number of signals 1



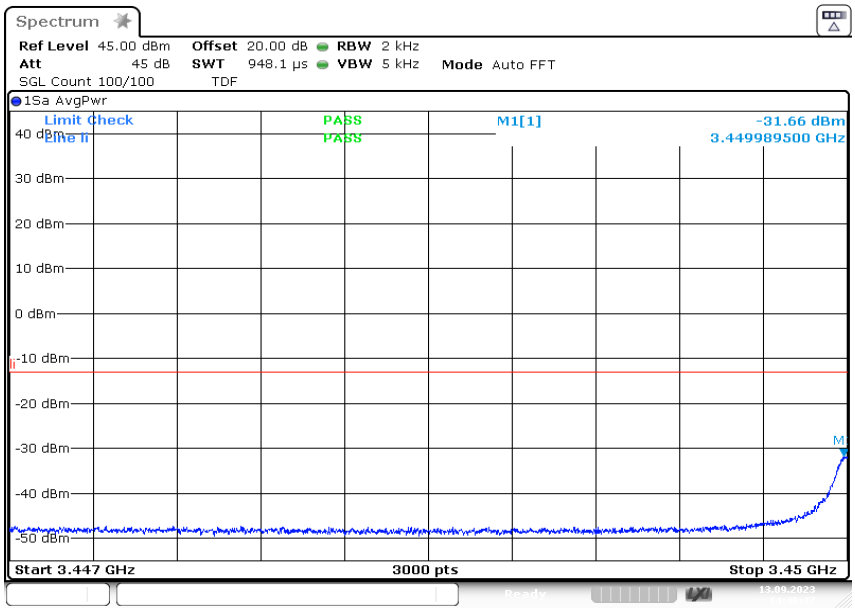
3.6.2 out of band emi 34T A3 AWGN100 lower 1carrier +3.0 dB
3.447G 3.450G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: lower;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 1



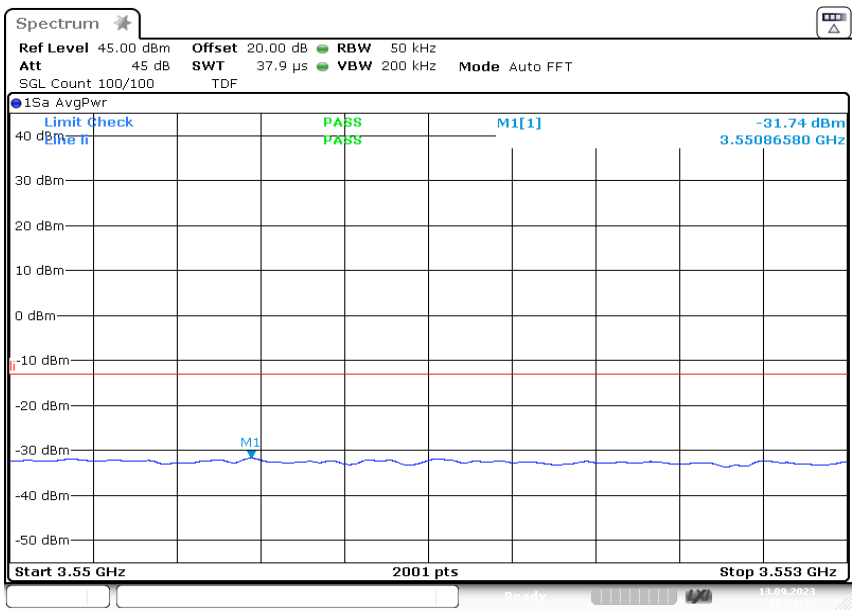
3.6.2 out of band emi 34T A3 GSM lower 1carrier -0.3 dB 3.44
7G 3.450G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: lower;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 1



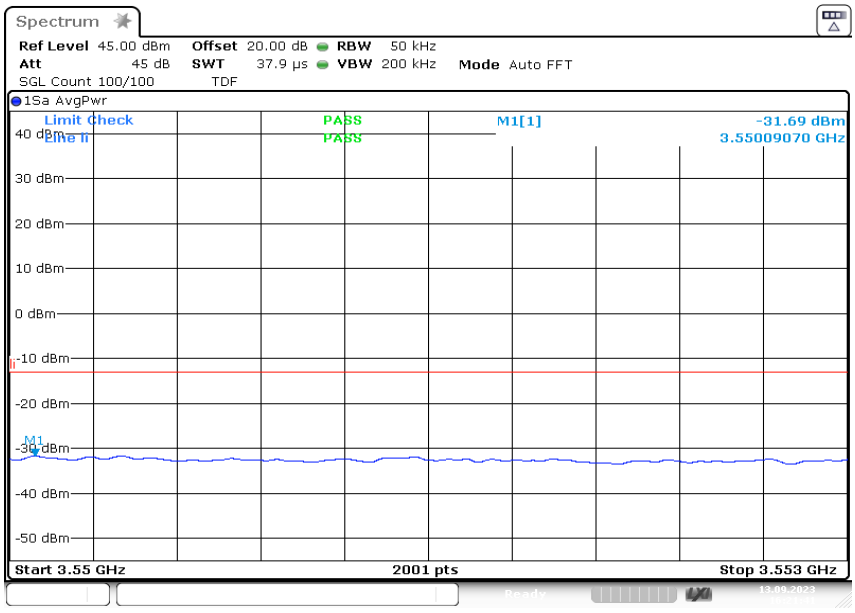
3.6.2 out of band emi 34T A3 GSM lower 1carrier +3.0 dB 3.44
7G 3.450G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: upper;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 2



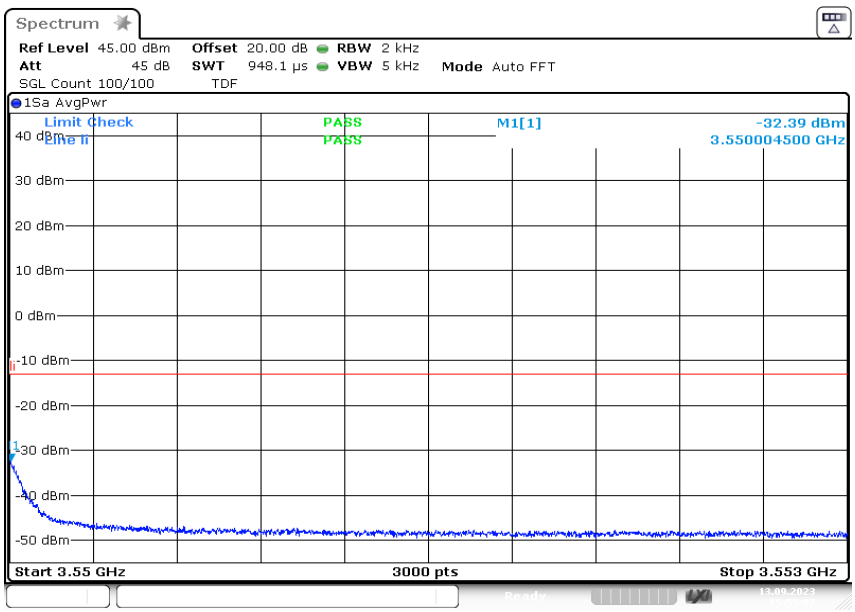
3.6.2 out of band emi 34T A3 AWGN upper 2carriers -0.3 dB 3.
550G 3.553G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: upper;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 2



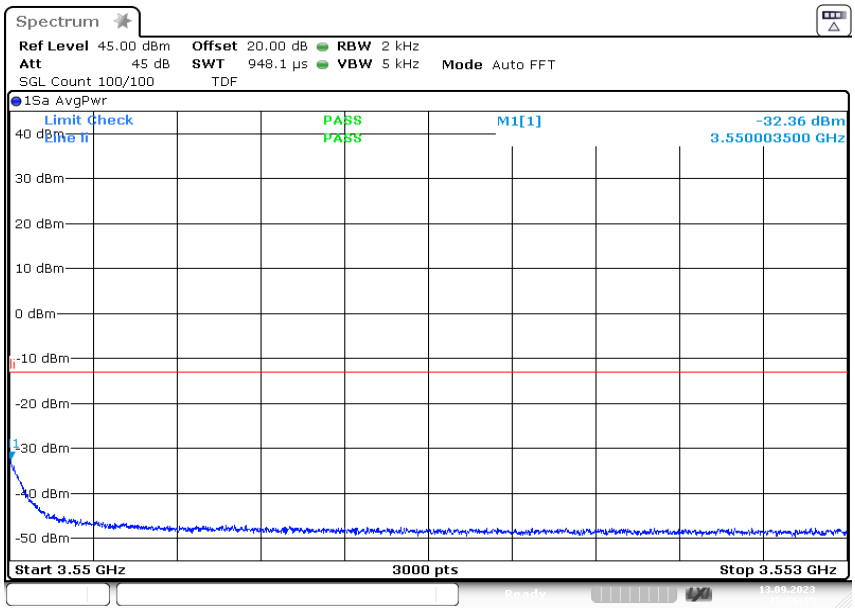
3.6.2 out of band emi 34T A3 AWGN upper 2carriers +3.0 dB 3.
550G 3.553G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: upper;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 2



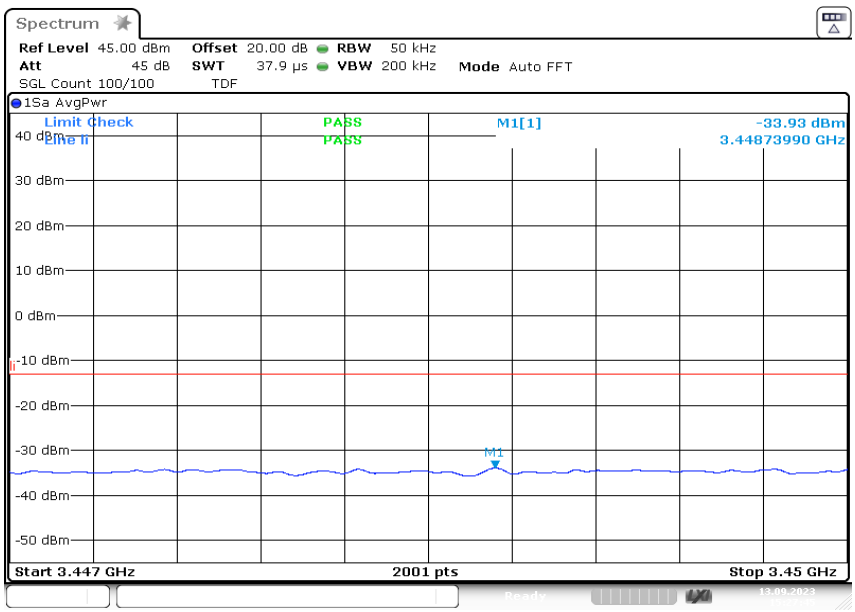
3.6.2 out of band emi 34T A3 GSM upper 2carriers -0.3 dB 3.5
50G 3.553G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: upper;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 2



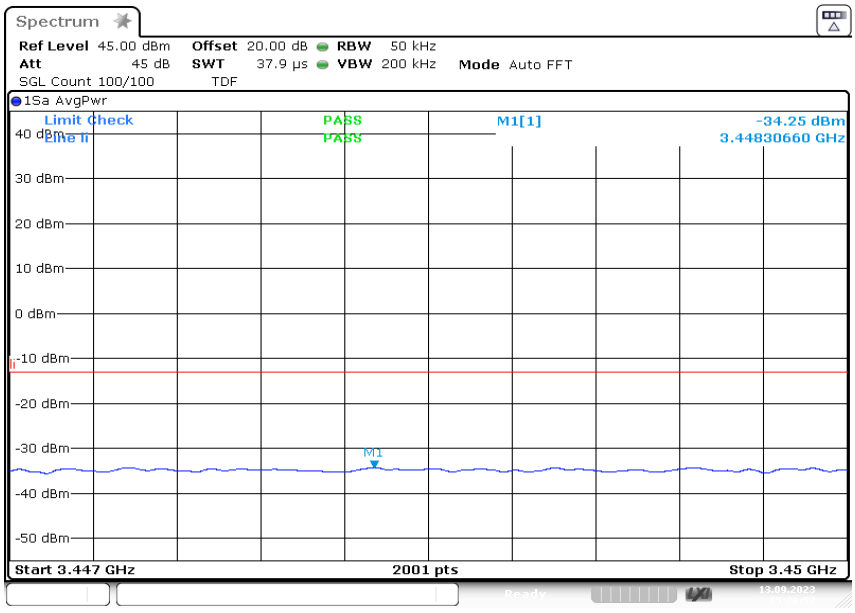
3.6.2 out of band emi 34T A3 GSM upper 2carriers +3.0 dB 3.5
50G 3.553G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: lower;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 2



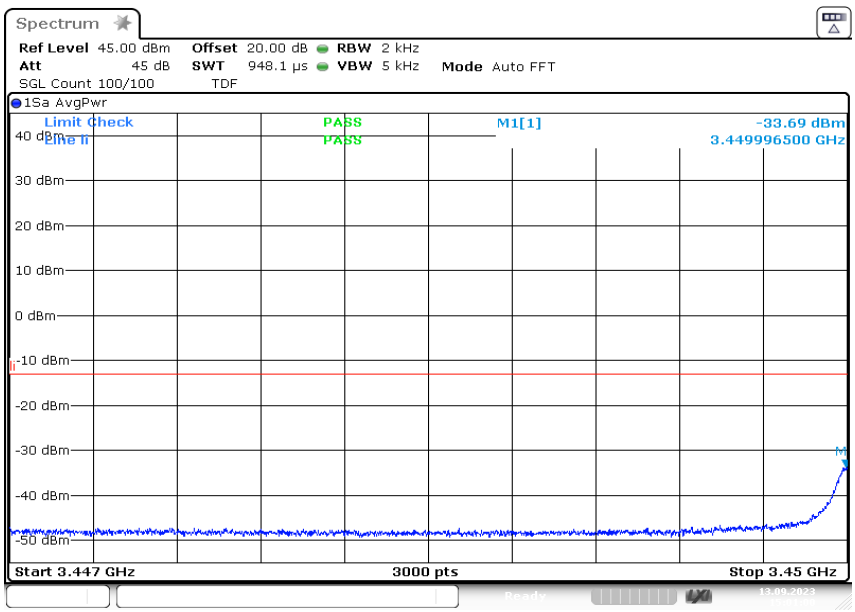
3.6.2 out of band emi 34T A3 AWGN lower 2carriers -0.3 dB 3.
447G 3.450G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: lower;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 2



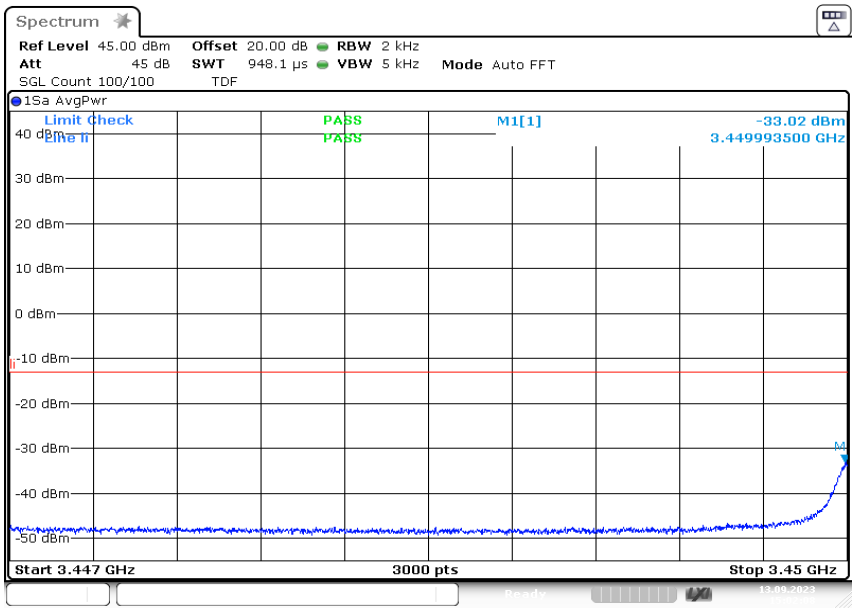
3.6.2 out of band emi 34T A3 AWGN lower 2carriers +3.0 dB 3.
447G 3.450G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: lower;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 2



3.6.2 out of band emi 34T A3 GSM lower 2carriers -0.3 dB 3.4
47G 3.450G

Band: 34T A3; Frequency: 3.4500 GHz to 3.5500 GHz; Band Edge: lower;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 2



3.6.2 out of band emi 34T A3 GSM lower 2carriers +3.0 dB 3.4
47G 3.450G

4.5.5 TEST EQUIPMENT USED

- Conducted

4.6 OUT-OF-BAND REJECTION

Standard FCC Part 27

The test was performed according to:
ANSI C63.26

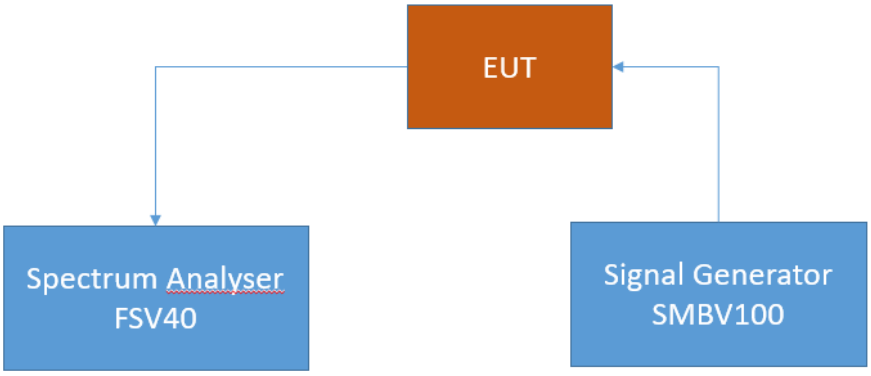
Test date: 2023-09-06 – 2023-11-14

Environmental conditions: 23 ° C ± 5 K; 40 % r. F. ± 20 % r. F.

Test engineer: Thomas Hufnagel

4.6.1 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:



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.

4.6.2 TEST REQUIREMENTS/LIMITS

For this test case exists no applicable limit

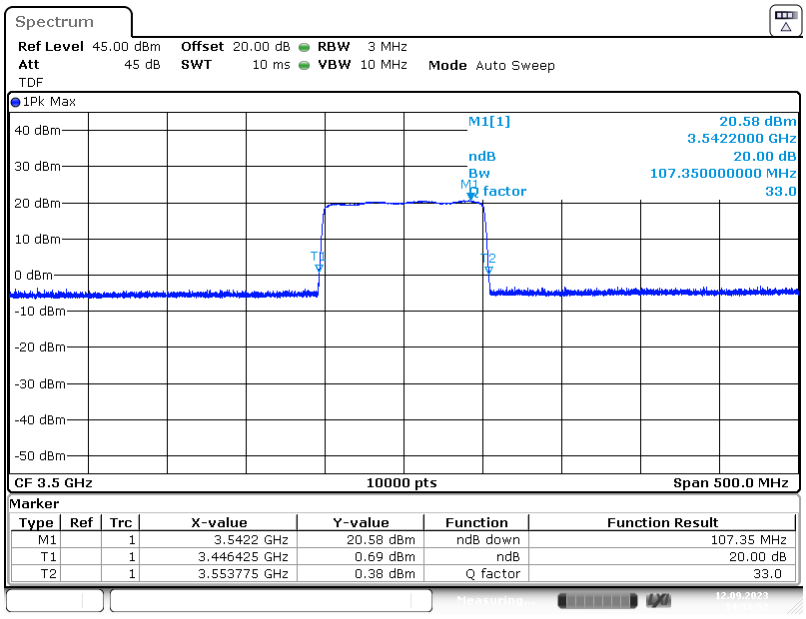
4.6.3 TEST PROTOCOL

Band 34T 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]**
3542.20	20.58	3446.425	3553.775	107.35

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

4.6.4 MEASUREMENT PLOTS

Frequency band = Band. 34T. Direction = RF downlink



3.3 Out of band rejection 34T A3 3.50000G

_20dB

4.6.5 TEST EQUIPMENT USED

- Conducted

4.7 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.

4.8 FIELD STRENGTH OF SPURIOUS RADIATION

Standard FCC Part 27. §27.53

The test was performed according to:
ANSI C63.26

Test date: 2023-10-04 - 2023-10-06

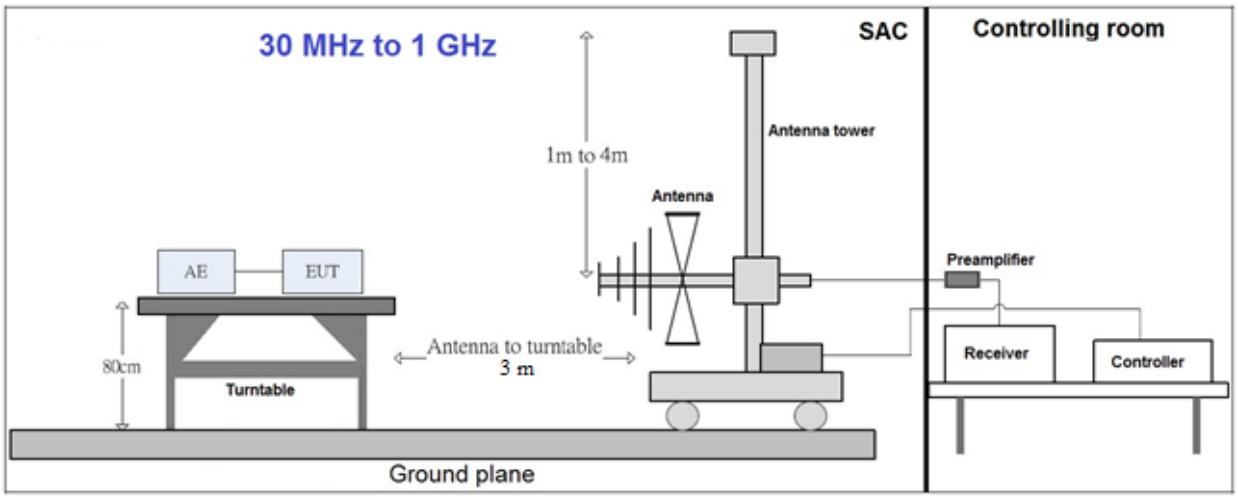
Environmental conditions: 23 ° C ± 5 K; 40 % r. F. ± 20 % r. F.

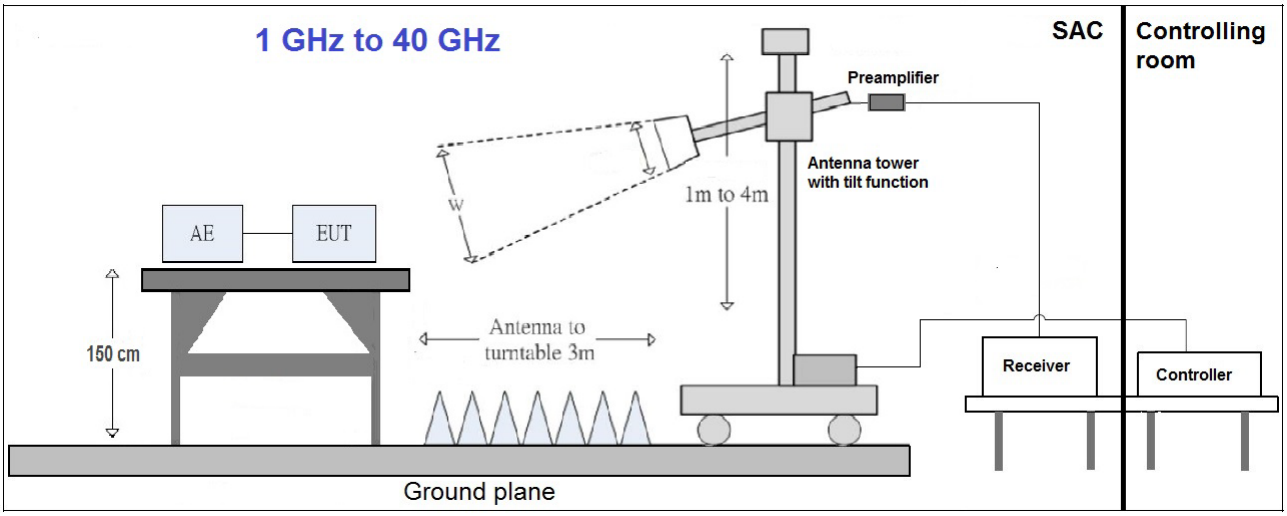
Test engineer: Thomas Hufnagel, Gerhard Gass

4.8.1 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 meter 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 meter 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 PEAK detector
With the settings determined in step 3. the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: PEAK (< 1 GHz)
- Measured frequencies: in step 1 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:

Spectrum analyser settings for step 3:
- Detector: PEAK
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 1 MHz

4.8.2 TEST REQUIREMENTS/LIMITS

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

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

Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§27.53 – Emission limits

(l) **3.5 GHz Service**.
The following emission limits apply to stations transmitting in the 3450-3550 MHz band:

(1) For base station operations in the 3450-3550 MHz band. the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed –13 dBm/MHz. Compliance with this paragraph (l)(1) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However. in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block. a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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.

(2) For mobile operations in the 3450-3550 MHz band. the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed –13 dBm/MHz. Compliance with this paragraph (l)(2) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However. in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block. the minimum resolution bandwidth for the measurement shall be either one percent of the emission bandwidth of the fundamental emission of the transmitter or 350 kHz. In the bands between 1 and 5 MHz removed from the licensee's frequency block. the minimum resolution bandwidth for the measurement shall be 500 kHz. 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.

4.8.3 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:

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

Hereby "p" are the limit lines' values.

Considerations to MIMO operation:

At this test the two output ports ANT 1 and ANT 3 are together in function according KDB 935210 D02 v04r02 chapter II (o) (2).

Measurement tables (showing the highest value. "worst case") whit one antenna

At this tables the highest peak value of spurious radiation per frequency test band is shown.

Band. 34T. downlink;						
Spurious Freq. [MHz]	**Spurious Level [dBm]**	**Pin [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
178.1/vert.	-60.7	-4.0	RMS	100	-23.0	37.7
500.0/vert.	-61.0	-4.0	RMS	100	-23.0	38.0
500/hor.	-63.3	-4.0	RMS	100	-23.0	40.3
16299/vert.	-24.4	-4.0	RMS	1000	-13.0	11.4
17288/hor.	-20.6	-4.0	RMS	1000	-13.0	7.6
39647/vert.	-45.3	-4.0	RMS	1000	-13.0	32.3
39156/hor.	-45.8	-4.0	RMS	1000	-13.0	32.8

Measurement tables (showing the highest value. "worst case") whit two antennas (MIMO)

At this tables the highest peak value of spurious radiation per frequency test band is shown.

Band. 34T. downlink;						
Spurious Freq. [MHz]	**Spurious Level [dBm]**	**Pin [dBm]**	**Detector**	**RBW [kHz]**	**Limit [dBm]**	**Margin to Limit [dB]**
177.7/vert.	-59.8	-4.0	RMS	100	-23.0	36.8
500.0/vert.	-61.5	-4.0	RMS	100	-23.0	38.5
500/hor.	-64.7	-4.0	RMS	100	-23.0	41.7
16239/vert.	-23.5	-4.0	RMS	1000	-13.0	10.5
17767/hor.	-24.1	-4.0	RMS	1000	-13.0	11.1
38897/vert.	-45.8	-4.0	RMS	1000	-13.0	32.8
39164/hor.	-45.9	-4.0	RMS	1000	-13.0	32.9

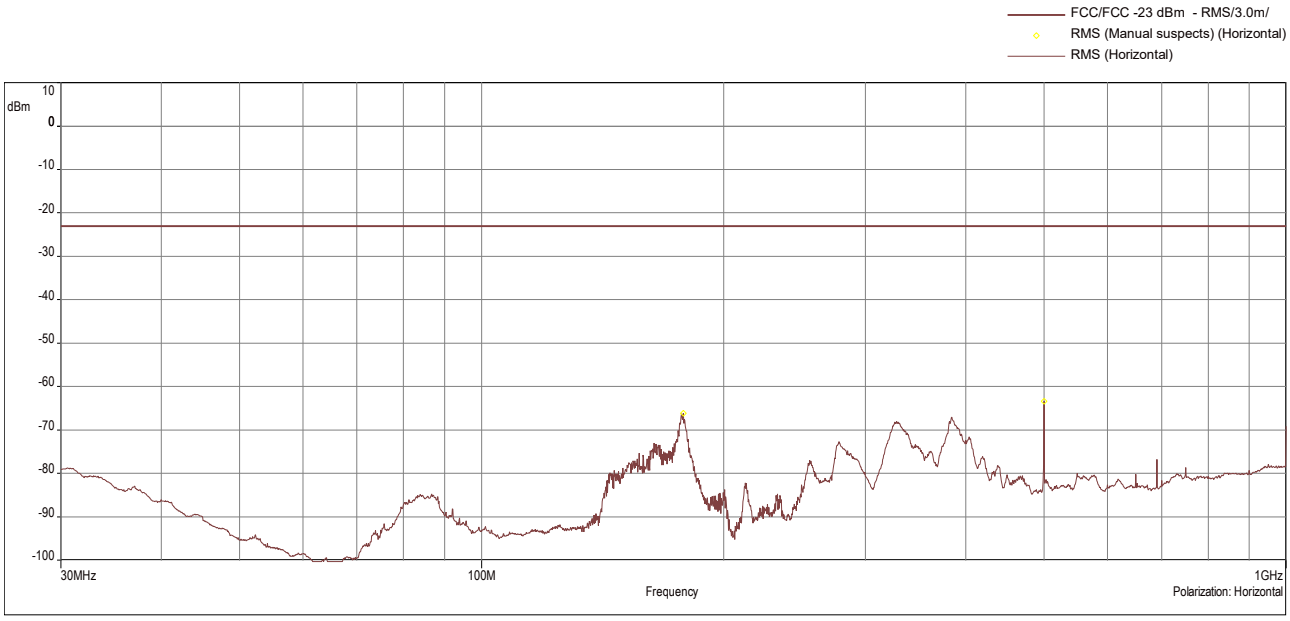
Abbreviations:
Hor.: horizontal position
Vert.: vertical position

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

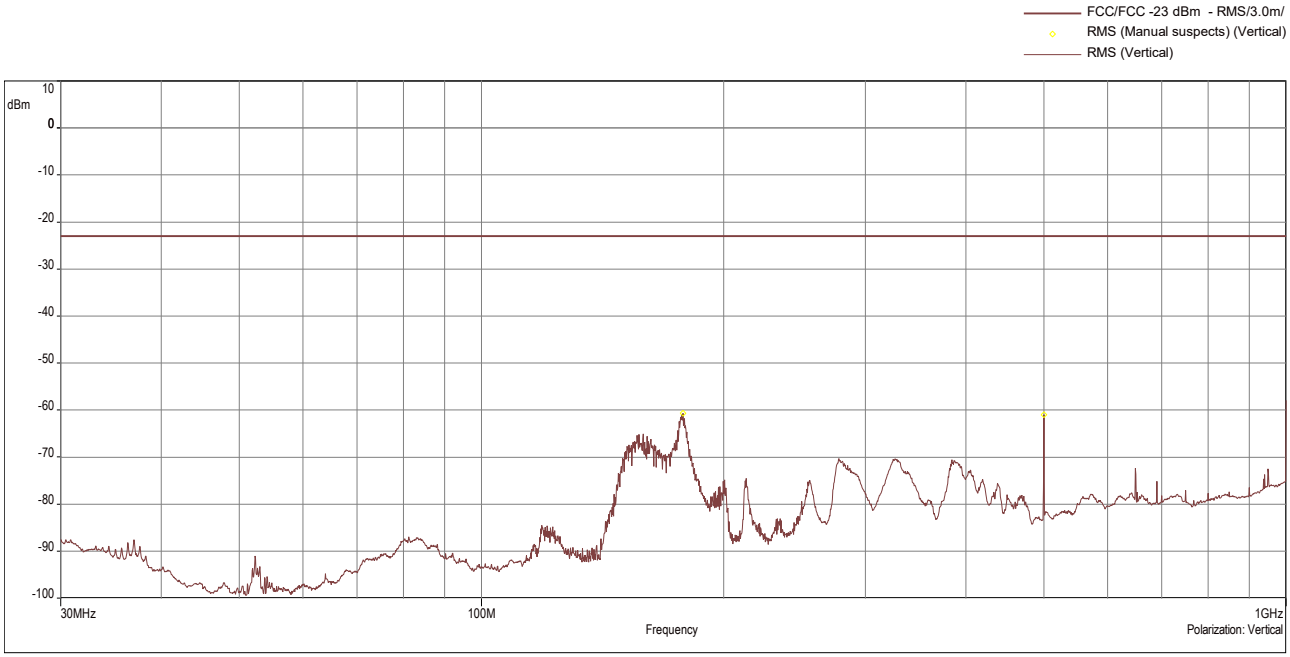
4.8.4 MEASUREMENT PLOTS (SHOWING THE HIGHEST VALUE. "WORST CASE") WHIT ONE ANTENNA

4.8.4.1 Frequency Band = Band. 34T. ANT 1. Direction = RF downlink

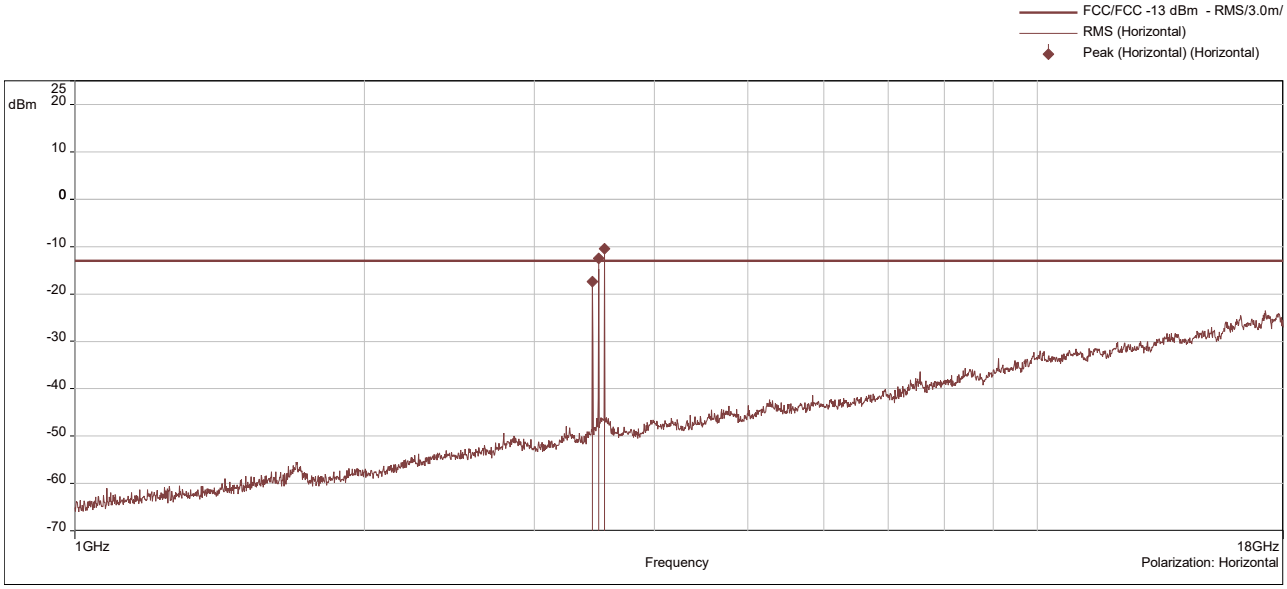
30 MHz - 1 GHz. Horizontal



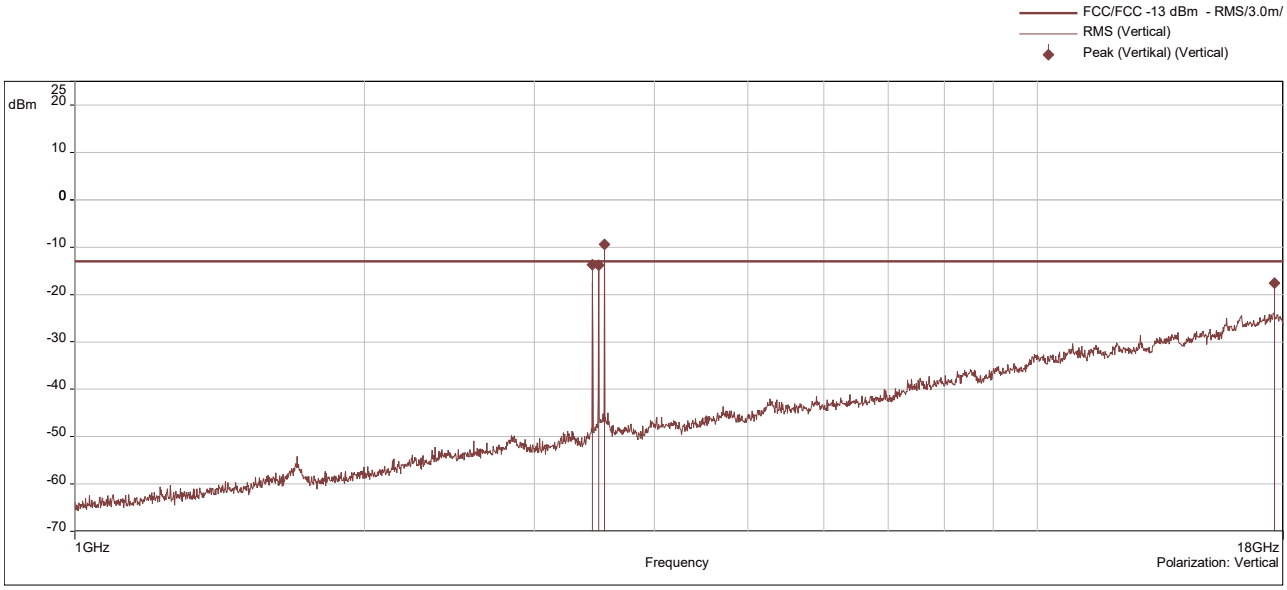
30 MHz - 1 GHz. Vertical



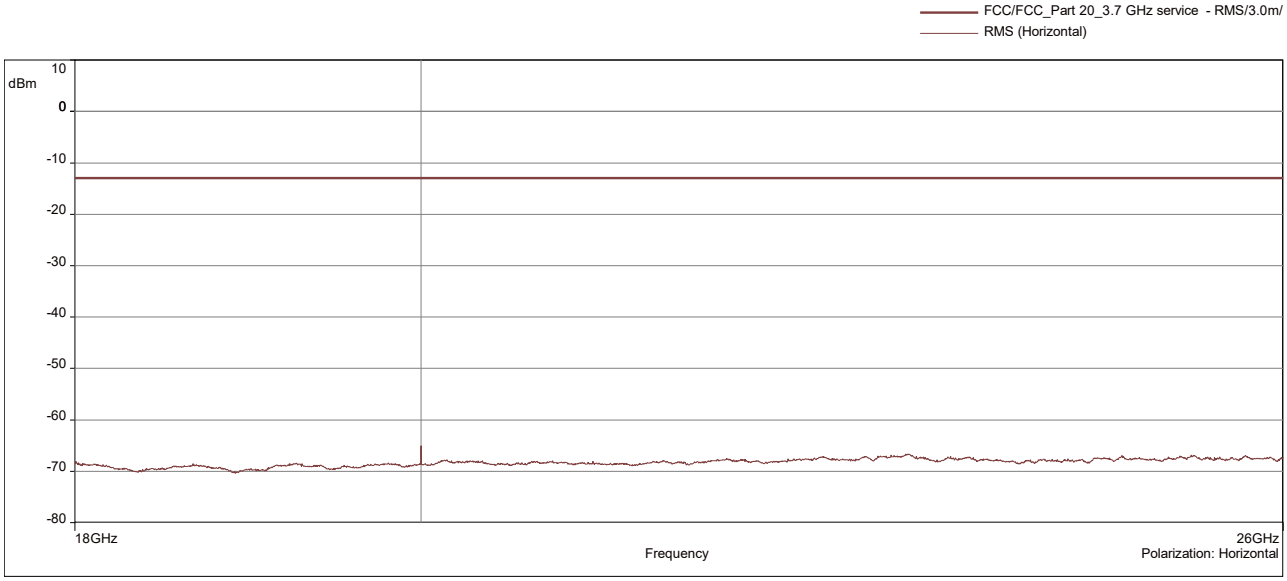
1 GHz - 18 GHz. horizontal



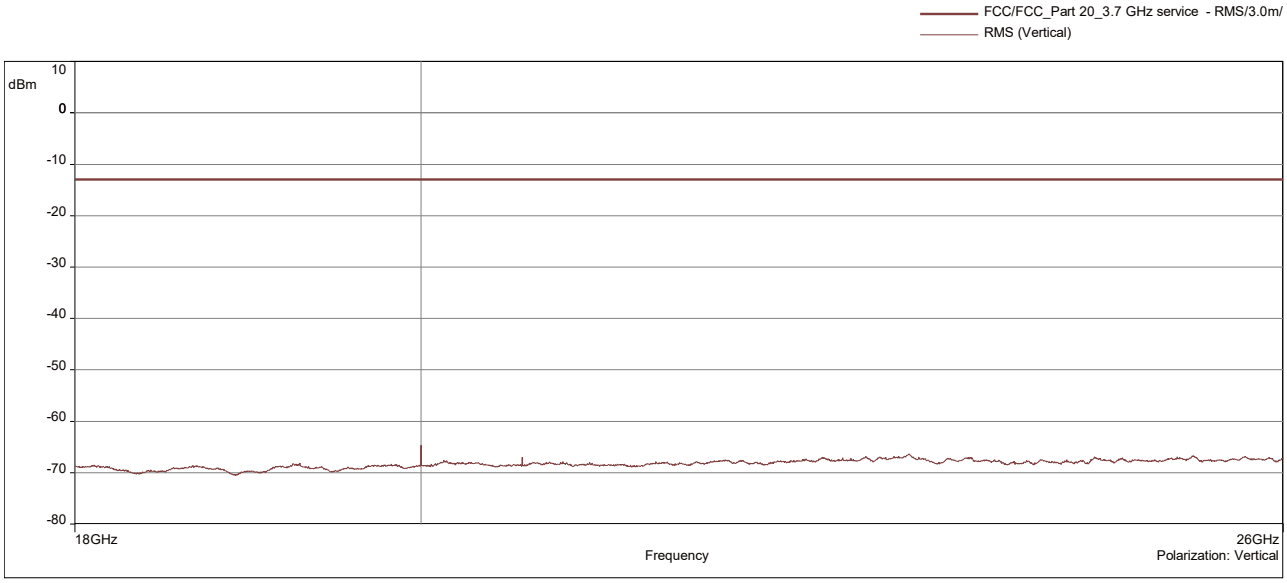
1 GHz - 18 GHz. vertical



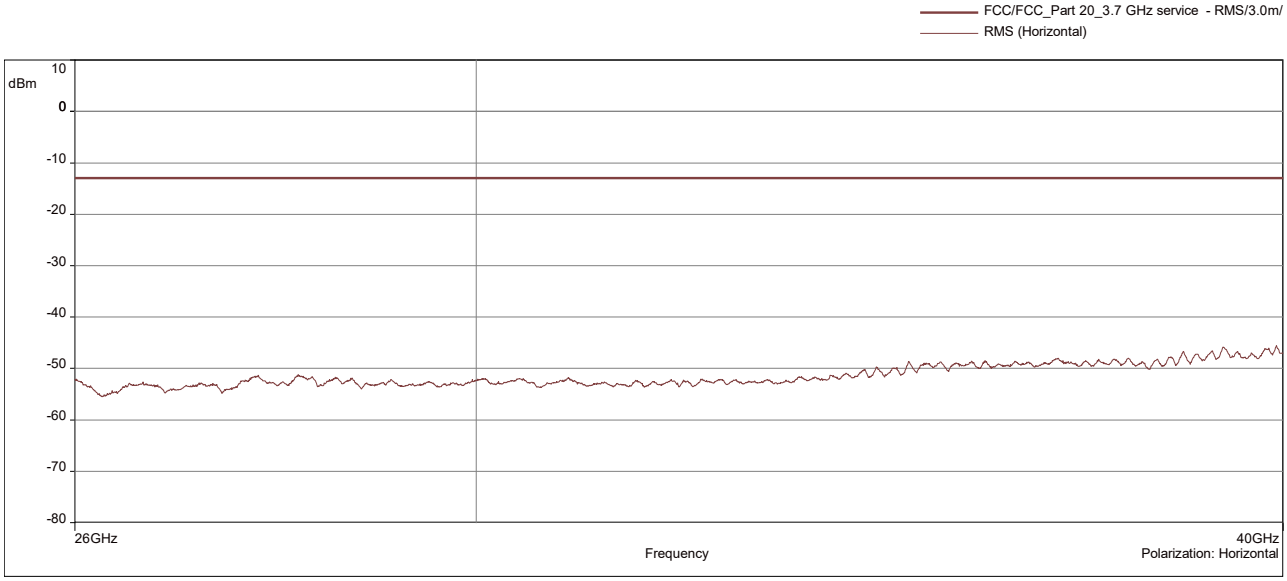
18 GHz - 26 GHz. horizontal



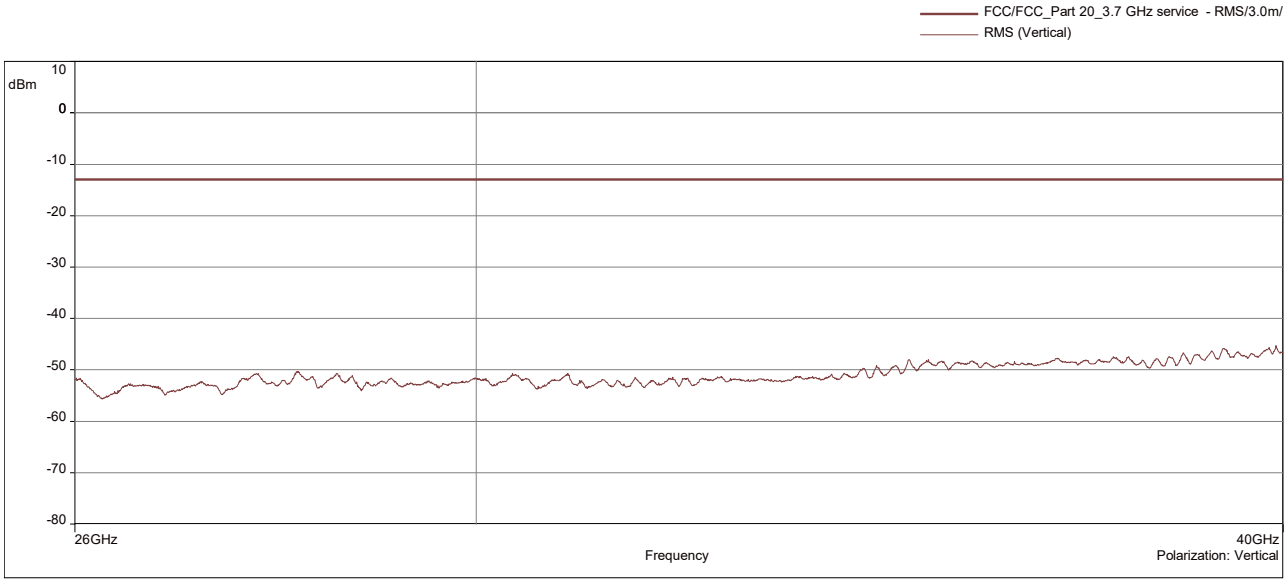
18 GHz - 26 GHz. vertical



26 GHz - 40 GHz. horizontal



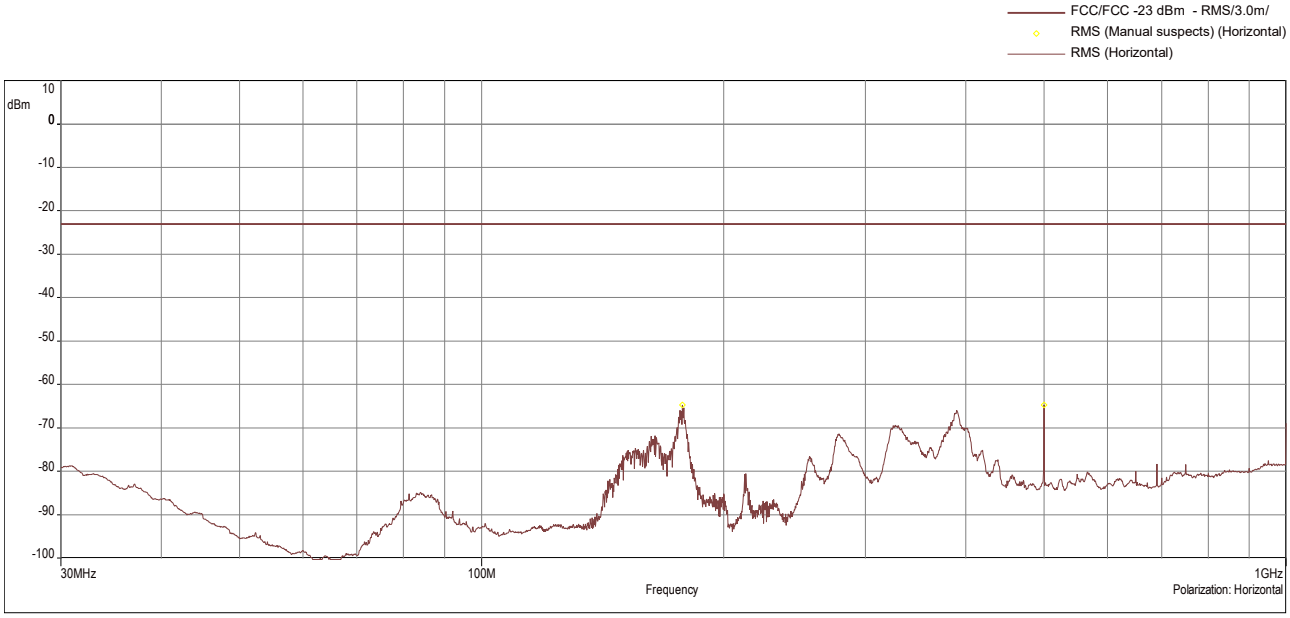
26 GHz - 40 GHz. vertical



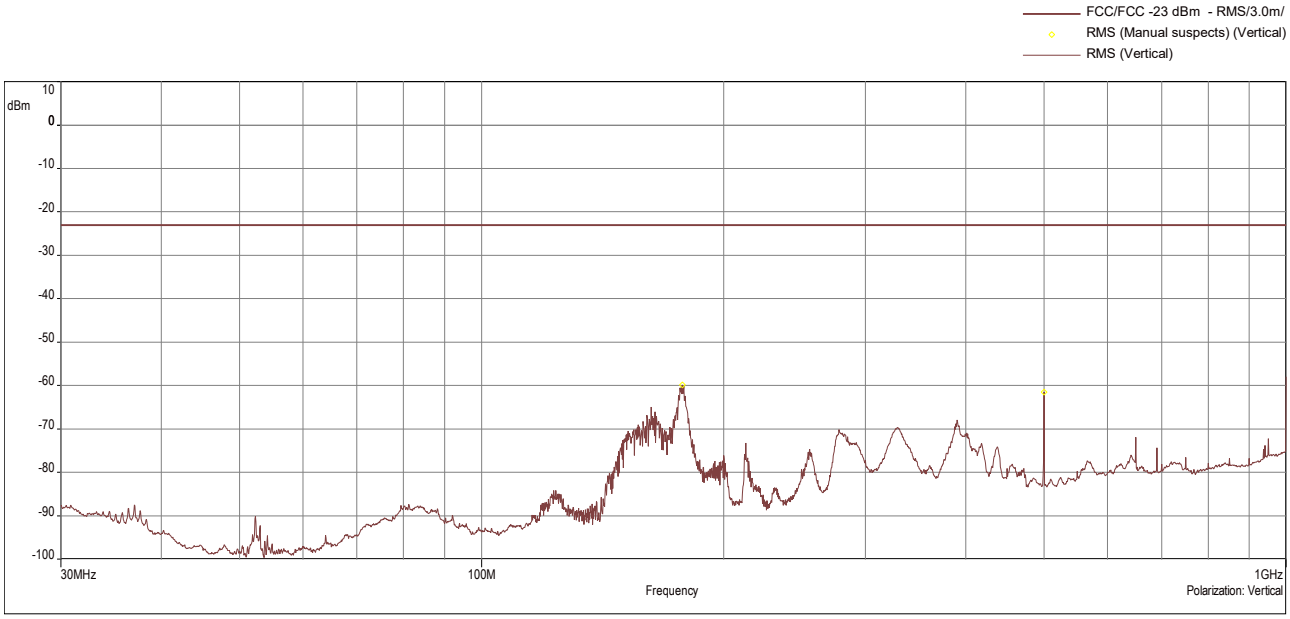
4.8.5 MEASUREMENT PLOTS (SHOWING THE HIGHEST VALUE. "WORST CASE") WHIT TWO ANTENNAS (MIMO)

4.8.5.1 Frequency Band = Band. 34T. ANT 1 and 3 (MIMO). Direction = RF downlink

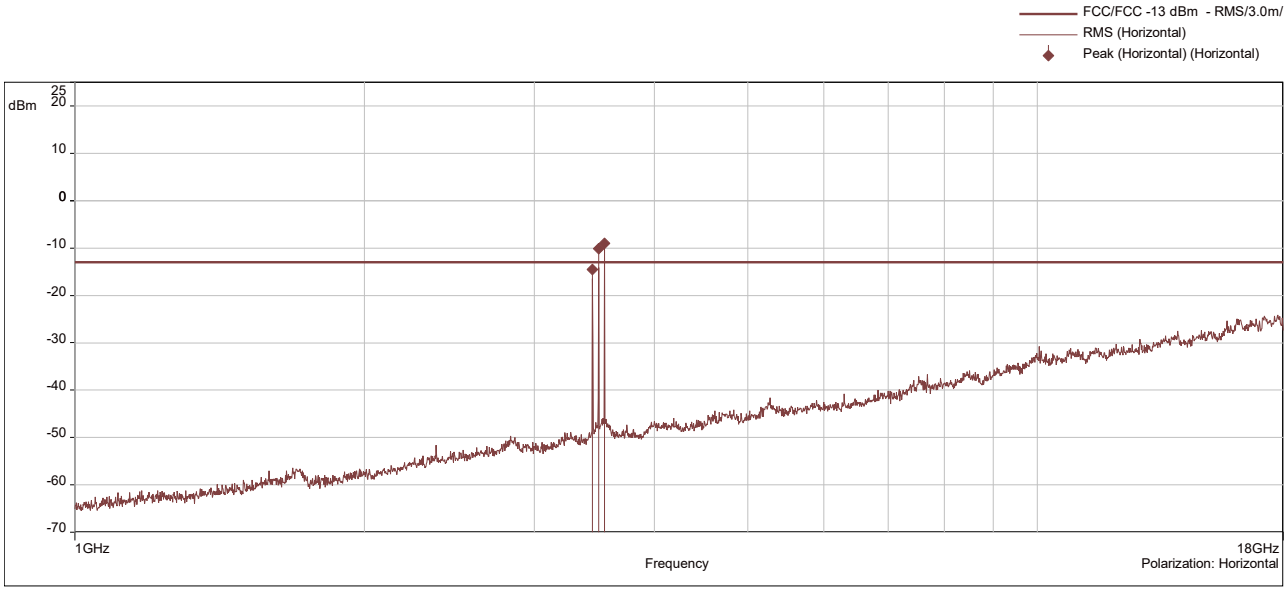
30 MHz - 1 GHz. Horizontal



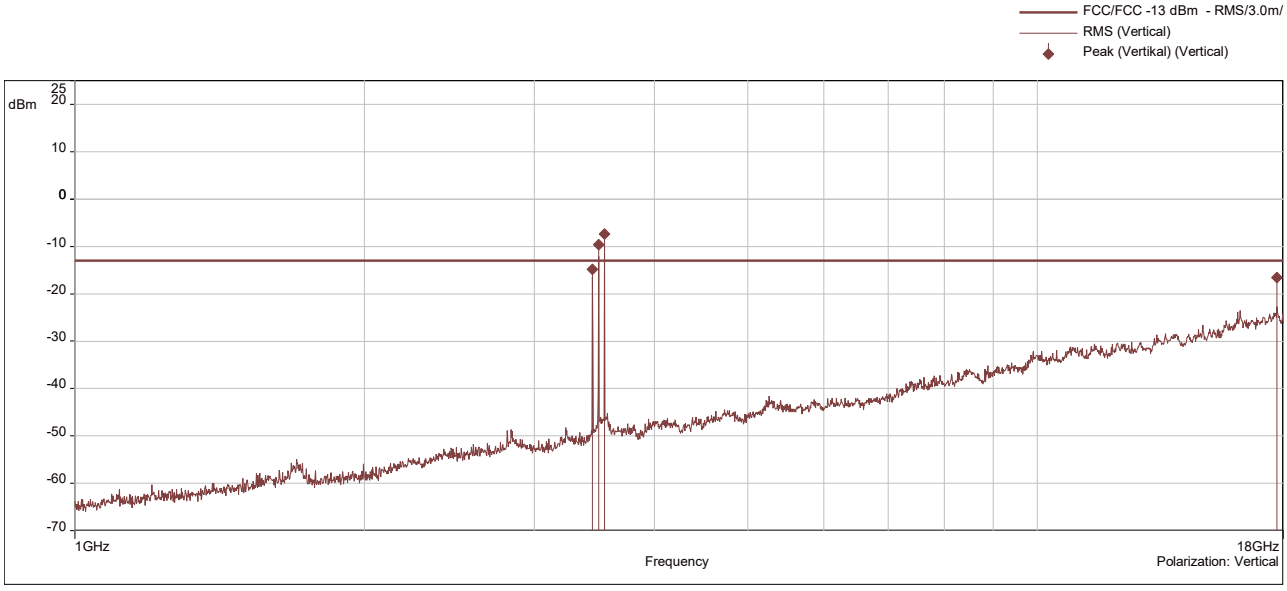
30 MHz - 1 GHz. Vertical



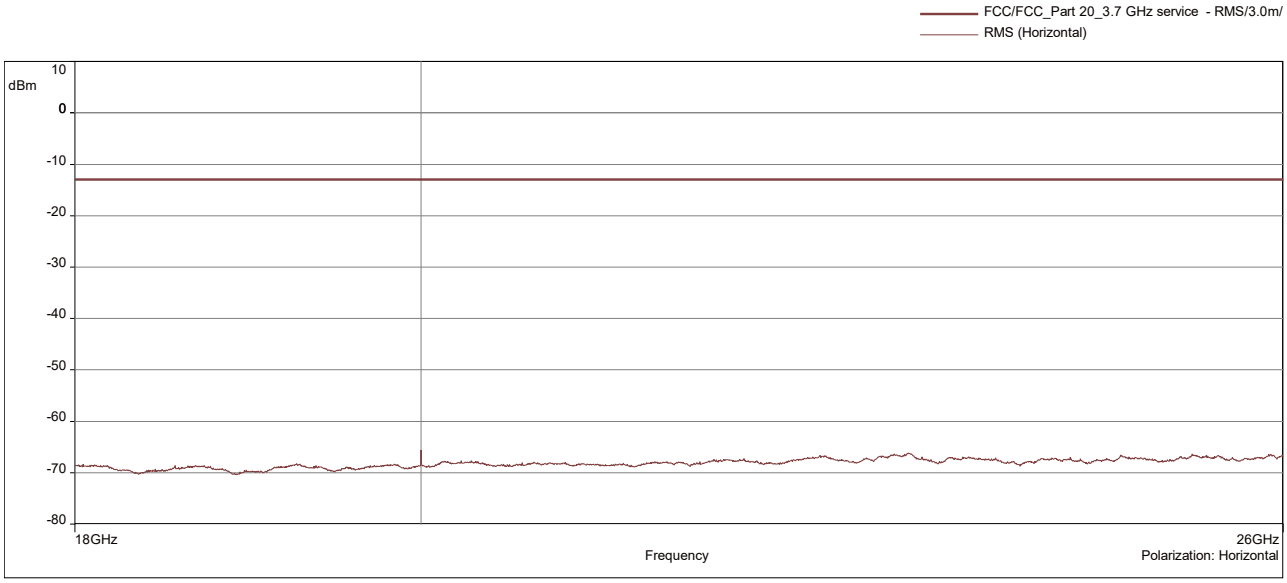
1 GHz - 18 GHz. horizontal



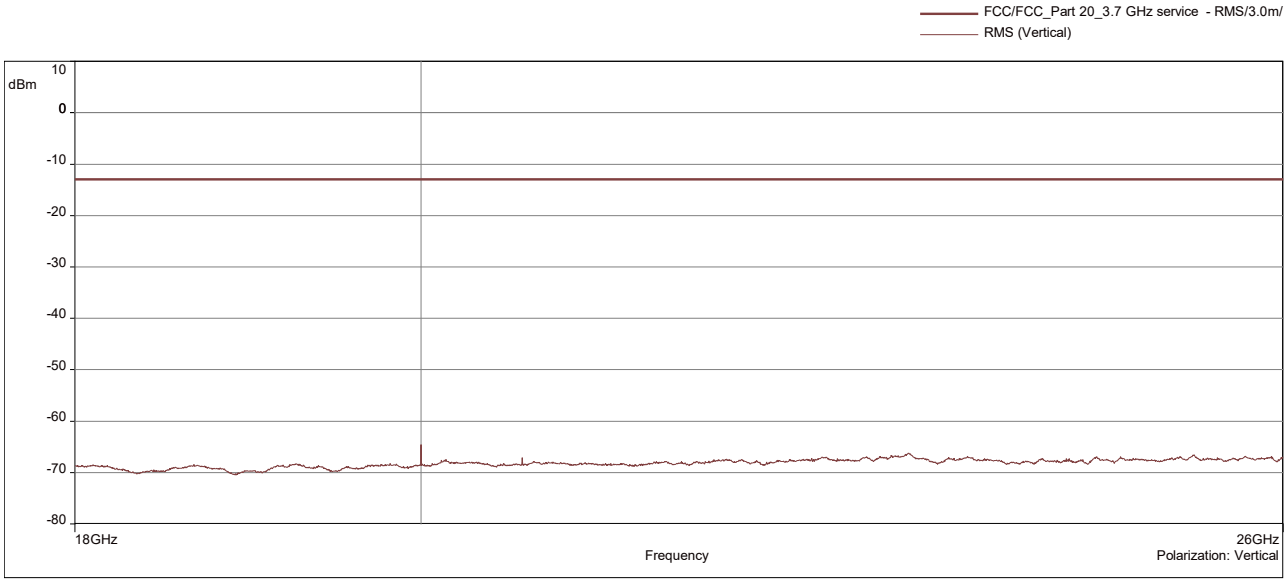
1 GHz - 18 GHz. vertical



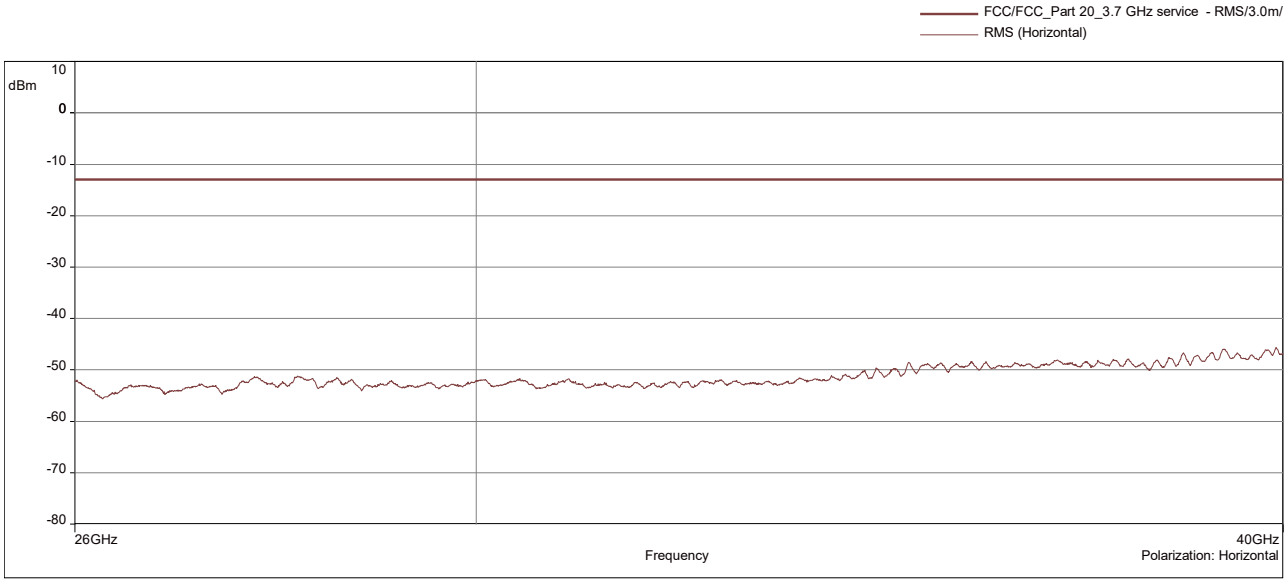
18 GHz - 26 GHz. horizontal



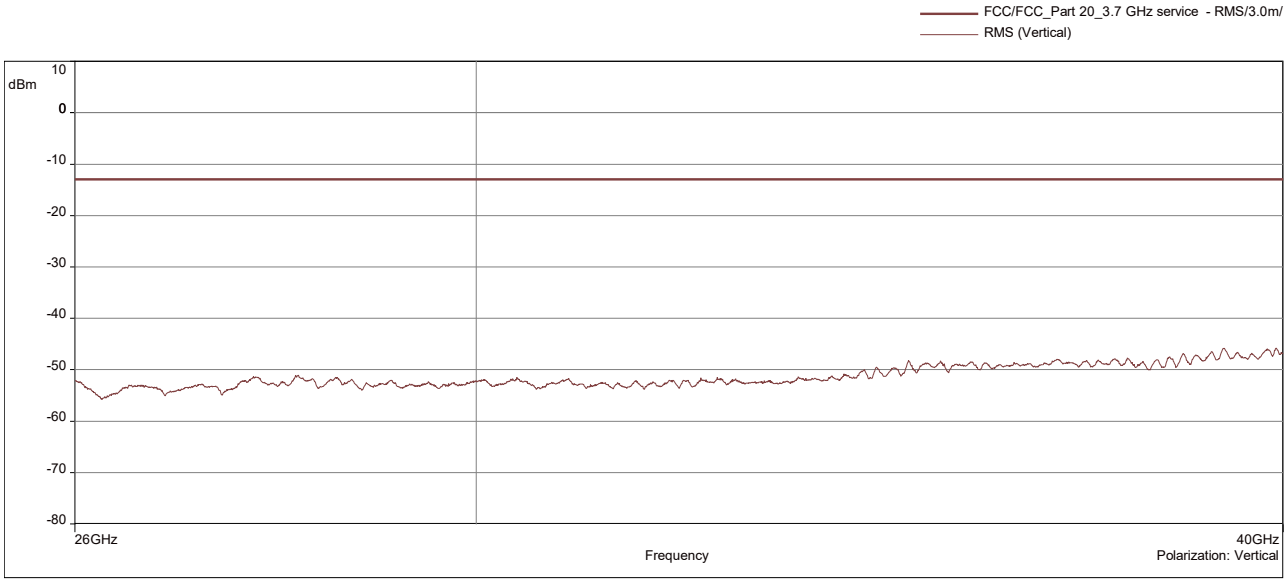
18 GHz - 26 GHz. vertical



26 GHz - 40 GHz. horizontal



26 GHz - 40 GHz. vertical



4.8.6 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

4.8.7 TEST EQUIPMENT USED

- Radiated Emissions

5 TEST EQUIPMENT

5.1 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-003139	2022-10	2023-10
1.2	FSV40 *	Signal Analyzer 10 Hz - 40 GHz	Rohde & Schwarz	E-003139	2023-10	2024-10
1.3	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	E-003206	2023-01	2025-01
1.4	BAT-EMC	Software	Nexio	V 2023.0.3.0	---	---

** Calibration took place during the period of the test specimen measurements, therefore both calibration data for the respective device were listed.*

5.2 RADIATED EMISSIONS

Ref.No.	Type	Description	Manufacturer	Inventory no.	Last Calibration	Calibration Due
1.5	ESU40 *	EMI test receiver 10 Hz - 40 GHz	Rohde & Schwarz	E-003138	2022-10	2023-10
1.6	ESU40 *	EMI test receiver 10 Hz - 40 GHz	Rohde & Schwarz	E-003138	2023-10	2024-10
1.7	CBL 6111C	Antenna 30 MHz – 1 GHz	Chase	E-003226	2021-10	2024-10
1.8	HL 025	Antenna 1 GHz - 18 GHz	Rohde & Schwarz	E-003259	2022-10	2024-10
1.9	MWH-1826/B	Antenna 18 GHz – 26.5 GHz	ARA Inc.	E-003233	2022-11	2024-11
1.10	MWH-2640/B	Antenna 26 GHz - 40 GHz	ARA Inc.	E-003234	2022-11	2024-11
1.11	AM1431 *	Pre amplifier 10 kHz – 1 GHz	Miteq	E-003365	2022-10	2023-10
1.12	AM1431 *	Pre amplifier 10 kHz – 1 GHz	Miteq	E-003365	2023-10	2024-10
1.13	AFS4-00102000 *	Preamplifier 100 MHz - 20 GHz	Miteq	E-003633	2022-10	2023-10
1.14	AFS4-00102000 *	Preamplifier 100 MHz - 20 GHz	Miteq	E-003633	2023-10	2024-10
1.15	AMP-2000-43000-50-10-2.9-F *	Preamplifier 2 GHz - 43 GHz	Miteq	E-003999	2022-10	2023-10
1.16	AMP-2000-43000-50-10-2.9-F *	Preamplifier 2 GHz - 43 GHz	Miteq	E-003999	2023-10	2024-10
1.17	CO3000	Controller SAC	Innco systems GmbH	E-003052 with Software 1.02.62	---	---
1.18	BAT-EMC	Software	Nexio	V 2023.0.3.0	---	---

** Calibration took place during the period of the test specimen measurements, therefore both calibration data for the respective device were listed.*

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

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 as well as the insertion loss of the LISN.

6.1 ANTENNA CHASE CBL 6111C (30 MHZ – 1 GHZ)

(d_{Limit} = 3 m)

Frequency	AF	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
30	18.6	0.6	0.29	0.04	0.23	0.02	0.0	3	3
50	6.0	0.9	0.39	0.09	0.32	0.08	0.0	3	3
100	9.7	1.2	0.56	0.14	0.47	0.08	0.0	3	3
150	7.9	1.6	0.73	0.20	0.59	0.12	0.0	3	3
200	7.6	1.9	0.84	0.21	0.70	0.11	0.0	3	3
250	9.5	2.1	0.98	0.24	0.80	0.13	0.0	3	3
300	11.0	2.3	1.04	0.26	0.89	0.15	0.0	3	3
350	12.4	2.6	1.18	0.31	0.96	0.13	0.0	3	3
400	13.6	2.9	1.28	0.35	1.03	0.19	0.0	3	3
450	14.7	3.1	1.39	0.38	1.11	0.22	0.0	3	3
500	15.6	3.2	1.44	0.39	1.20	0.19	0.0	3	3
550	16.3	3.5	1.55	0.46	1.24	0.23	0.0	3	3
600	17.2	3.5	1.59	0.43	1.29	0.23	0.0	3	3
650	18.1	3.6	1.67	0.34	1.35	0.22	0.0	3	3
700	18.5	3.6	1.67	0.42	1.41	0.15	0.0	3	3
750	19.1	4.1	1.87	0.54	1.46	0.25	0.0	3	3
800	19.6	4.1	1.90	0.46	1.51	0.25	0.0	3	3
850	20.1	4.4	1.99	0.60	1.56	0.27	0.0	3	3
900	20.8	4.7	2.14	0.60	1.63	0.29	0.0	3	3
950	21.1	4.8	2.22	0.60	1.66	0.33	0.0	3	3
1000	21.6	4.9	2.23	0.61	1.71	0.30	0.0	3	3

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)
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

6.2 ANTENNA ROHDE & SCHWARZ HL 025 (1 GHZ – 18 GHZ)

Frequency	AF	Corr.	cable loss 1 (relay + cable inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit. atten-uator & pre-amp)	cable loss 4 (to receiver)		
MHz	dB (1/m)	dB	dB	dB	dB	dB		
1000	24.4	-19.4	0.99	0.31	-21.51	0.79		
2000	28.5	-17.4	1.44	0.44	-20.63	1.38		
3000	31.0	-16.1	1.87	0.53	-19.85	1.33		
4000	33.1	-14.7	2.41	0.67	-19.13	1.31		
5000	34.4	-13.7	2.78	0.86	-18.71	1.40		
6000	34.7	-12.7	2.74	0.90	-17.83	1.47		
7000	35.6	-11.0	2.82	0.86	-16.19	1.46		

Frequency	AF	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (inside chamber)	cable loss 3 (outside chamber)	cable loss 4 (switch unit. atten-uator & pre-amp)	cable loss 5 (to receiver)	used for FCC 15.247
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	
3000	31.0	-23.4	0.47	1.87	0.53	-27.58	1.33	
4000	33.1	-23.3	0.56	2.41	0.67	-28.23	1.31	
5000	34.4	-21.7	0.61	2.78	0.86	-27.35	1.40	
6000	34.7	-21.2	0.58	2.74	0.90	-26.89	1.47	
7000	35.6	-19.8	0.66	2.82	0.86	-25.58	1.46	

Frequency	AF	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (High Pass)	cable loss 3 (pre-amp)	cable loss 4 (inside chamber)	cable loss 5 (outside chamber)	cable loss 6 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	dB
7000	35.6	-57.3	0.56	1.28	-62.72	2.66	0.94	1.46
8000	36.3	-56.3	0.69	0.71	-61.49	2.84	1.00	1.53
9000	37.1	-55.3	0.68	0.65	-60.80	3.06	1.09	1.60
10000	37.5	-56.2	0.70	0.54	-61.91	3.28	1.20	1.67
11000	37.5	-55.3	0.80	0.61	-61.40	3.43	1.27	1.70
12000	37.6	-53.7	0.84	0.42	-59.70	3.53	1.26	1.73
13000	38.2	-53.5	0.83	0.44	-59.81	3.75	1.32	1.83
14000	39.9	-56.3	0.91	0.53	-63.03	3.91	1.40	1.77
15000	40.9	-54.1	0.98	0.54	-61.05	4.02	1.44	1.83
16000	41.3	-54.1	1.23	0.49	-61.51	4.17	1.51	1.85
17000	42.8	-54.4	1.36	0.76	-62.36	4.34	1.53	2.00
18000	44.2	-54.7	1.70	0.53	-62.88	4.41	1.55	1.91

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.
Tables show an extract of values.

6.3 ANTENNA ARA INC. MWH-1826-B (18 GHZ – 26.5 GHZ) PARTIALLY IN CONJUNCTION WITH PRE-AMPLIFIER MITEQ JS43-1800-4000: THE USE OF THE PRE-AMPLIFIER IS DEPENDENT FROM THE FIELD STRENGTH

Frequency	AF	Corr.	cable loss 1 (inside chamber)	cable loss 2 (pre-amp)	cable loss 3 (inside chamber)	cable loss 4 (switch unit)	cable loss 5 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB
18000	40.2	-23.5	0.72	-35.85	6.20	2.81	2.65
18500	40.2	-23.2	0.69	-35.71	6.46	2.76	2.59
19000	40.2	-22.0	0.76	-35.44	6.69	3.15	2.79
19500	40.3	-21.3	0.74	-35.07	7.04	3.11	2.91
20000	40.3	-20.3	0.72	-34.49	7.30	3.07	3.05
20500	40.3	-19.9	0.78	-34.46	7.48	3.12	3.15
21000	40.3	-19.1	0.87	-34.07	7.61	3.20	3.33
21500	40.3	-19.1	0.90	-33.96	7.47	3.28	3.19
22000	40.3	-18.7	0.89	-33.57	7.34	3.35	3.28
22500	40.4	-19.0	0.87	-33.66	7.06	3.75	2.94
23000	40.4	-19.5	0.88	-33.75	6.92	3.77	2.70
23500	40.4	-19.3	0.90	-33.35	6.99	3.52	2.66
24000	40.4	-19.8	0.88	-33.99	6.88	3.88	2.58
24500	40.4	-19.5	0.91	-33.89	7.01	3.93	2.51
25000	40.4	-19.3	0.88	-33.00	6.72	3.96	2.14
25500	40.5	-20.4	0.89	-34.07	6.90	3.66	2.22
26000	40.5	-21.3	0.86	-35.11	7.02	3.69	2.28
26500	40.5	-21.1	0.90	-35.20	7.15	3.91	2.36

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.
Table shows an extract of values.

6.4 ANTENNA ARA INC. MWH-2640-B (26 GHZ – 40 GHZ)) PARTIALLY IN CONJUNCTION WITH PRE-AMPLIFIER MITEQ JS43-1800-4000: THE USE OF THE PRE-AMPLIFIER IS DEPENDENT FROM THE FIELD STRENGTH

Frequency	AF	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
GHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
26.5	43.4	-11.2	4.4				-9.6	3	1.0
27.0	43.4	-11.2	4.4				-9.6	3	1.0
28.0	43.4	-11.1	4.5				-9.6	3	1.0
29.0	43.5	-11.0	4.6				-9.6	3	1.0
30.0	43.5	-10.9	4.7				-9.6	3	1.0
31.0	43.5	-10.8	4.7				-9.6	3	1.0
32.0	43.5	-10.7	4.8				-9.6	3	1.0
33.0	43.6	-10.7	4.9				-9.6	3	1.0
34.0	43.6	-10.6	5.0				-9.6	3	1.0
35.0	43.6	-10.5	5.1				-9.6	3	1.0
36.0	43.6	-10.4	5.1				-9.6	3	1.0
37.0	43.7	-10.3	5.2				-9.6	3	1.0
38.0	43.7	-10.2	5.3				-9.6	3	1.0
39.0	43.7	-10.2	5.4				-9.6	3	1.0
40.0	43.8	-10.1	5.5				-9.6	3	1.0

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 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

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 *****