



Test Report

2023-0080-EMC-TR-23-0051-V01_Andrew_CAP MX LMR 750_FCC

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

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

Test Plan:	Measurement of Band 14/LMR 750, downlink
------------	--

Test Result:	Passed
--------------	--------

Date of issue:	2023-04-27		Signature:
Version:	01	Technical Reviewer:	
Date of receipt EUT:	2023-03		
Performance date:	2023-03-29 to 2023-04-17	Report Reviewer:	



BNetzA-CAB-19/21-20



Deutsche
Akkreditierungsstelle
D-PL-12024-06-04

The test results relates only to the tested item. The sample has been provided by the client.

Without the written consent of Bureau Veritas Consumer Products Services Germany GmbH excerpts of this report shall not be reproduced.

Bureau Veritas
Consumer Products Services Germany GmbH
www.bureauveritas.de/cps
Phone: +49 (0)40 – 740 41 – 0

Managing Director: Sebastian Doose
Reg.No.: Schwerin HRB 3564

Schwerin
Wilhelm-Hennemann-Str. 8, 19061 Schwerin
cps-schwerin@de.bureauveritas.com

Hamburg
Oehleckerring 40, 22419 Hamburg
cps-hamburg@de.bureauveritas.com

Tuerkheim
Businesspark A96, 86842 Tuerkheim
cps-tuerkheim@de.bureauveritas.com

Nuremberg
Thurn-und-Taxis-Str. 18, 90411 Nuremberg
cps-nuernberg@de.bureauveritas.com

Client: Commscope
Andrew Wireless System GmbH
Industriering 10
86675 Buchdorf
Germany

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

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

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

Versions management:
V 01.00 Initial release

Table of Contents

1	APPLIED STANDARDS AND TEST SUMMARY	4
1.1	APPLIED STANDARDS	4
1.1	FCC TABLE	5
1.2	MEASUREMENT SUMMARY/SIGNATURES	6
2	ADMINISTRATIVE DATA	8
2.1	TESTING LABORATORY	8
2.2	APPLICANT DATA	8
2.3	MANUFACTURER DATA	8
3	TEST OBJECT DATA	9
3.1	GENERAL EUT DESCRIPTION	9
3.2	EUT MAIN COMPONENTS	10
3.3	ANCILLARY EQUIPMENT	10
3.4	AUXILIARY EQUIPMENT	11
3.5	EUT SETUPS	12
3.6	PRODUCT LABELLING	13
4	TEST RESULTS	14
4.1	EFFECTIVE RADIATED POWER, MEAN OUTPUT POWER AND ZONE ENHANCER GAIN 14	
4.2	OCCUPIED BANDWIDTH/INPUT-VERSUS-OUTPUT SPECTRUM	19
4.3	OUT-OF-BAND EMISSION LIMITS	24
4.4	OUT-OF-BAND REJECTION	37
5	TEST EQUIPMENT	39
6	ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS	40
7	MEASUREMENT UNCERTAINTIES	41
8	PHOTO REPORT	42
	Annex A: Accreditation certificate (for information)	43
	Annex B: Additional information provided by client	44

1 APPLIED STANDARDS AND TEST SUMMARY

1.1 APPLIED STANDARDS

Type of Authorization

Certification for an Industrial Signal Booster.

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 20, 90. The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 20, Commercial Mobile Services

§ 20.21 Signal Boosters

Part 90; Private Land Mobile Radio Services

Subpart R – Regulations Governing the Licensing and Use of Frequencies in the 763 – 775,
and 793 – 805 MHz Bands

§ 90.635 – Limitations on power and antenna height

Subpart I – General Technical Standards

§ 90.213 – Frequency Stability

§ 90.219 – Use of signal boosters

§ 90.691 – Emission mask requirements for EA-based systems

The tests were selected and performed with reference to:

- FCC Public Notice 935210 applying "Signal Boosters Basic Certification Requirements" 935210 D02, 2019-15-04.
- FCC Public Notice 935210 applying "Measurement guidance for industrial and non-consumer signal booster, repeater and amplifier devices" 935210 D05, 2020-04-03.
- FCC Public Notice 971168 applying "Measurement guidance for certification of licensed digital transmitters" 971168 D01, 2018-04-09.
- ANSI C63.26:2015

Summary Test Results:

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

1.1 FCC TABLE

**Table of FCC references for
Industrial Signal Booster**

Measurement	FCC reference
Effective radiated power, mean output power and zone enhancer gain	§ 2.1046 § 90.542 KDB 935210 D05 v01r04: 3.5
Occupied bandwidth Input-versus-output spectrum	§ 2.1049 KDB 935210 D05 v01r04: 3.4
Out-of-band emissions limits	§ 2.1051 § 90.219 KDB 935210 D05 v01r04: 3.6
Frequency stability	§ 2.1055
Out-of-band rejection	KDB 935210 D05 v01r04: 3.3
All measurements	ANSI 63.26:2015

1.2 MEASUREMENT SUMMARY/SIGNATURES

47 CFR CHAPTER I FCC PART 90 Subpart R [Base Stations/Repeater] § 2.1046, § 90.542 (a), KDB 935210 D02 II (p)(4)

Effective Radiated Power, mean output power and zone enhancer gain

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

Final Result

OP-Mode

Frequency Band, Direction, Input Power, Signal Type

LMR 750, RF downlink, 0.3 dB < AGC, Wideband	Passed
LMR 750, RF downlink, 3 dB > AGC, Wideband	Passed
LMR 750, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed
LMR 750, RF downlink, 3 dB > AGC, Wideband 5G	Passed
LMR 750, RF downlink, 0.3 dB < AGC, Narrowband	Passed
LMR 750, RF downlink, 3 dB > AGC, Narrowband	Passed

47 CFR CHAPTER I FCC PART 90 Subpart R/I [Base Stations/Repeater] § 2.1049, KDB 935210 D02 II (p)(3)

Occupied Bandwidth

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

Final Result

OP-Mode

Frequency Band, Direction, Input Power, Signal Type

LMR 750, RF downlink, 0.3 dB < AGC, Wideband	Done
LMR 750, RF downlink, 3 dB > AGC, Wideband	Done
LMR 750, RF downlink, 0.3 dB < AGC, Wideband 5G	Done
LMR 750, RF downlink, 3 dB > AGC, Wideband 5G	Done
LMR 750, RF downlink, 0.3 dB < AGC, Narrowband	Done
LMR 750, RF downlink, 3 dB > AGC, Narrowband	Done



**47 CFR CHAPTER I FCC PART 90 Subpart R/I
[Base Stations/Repeater]**

**§ 2.1051, § 90.219,
KDB 935210 D02 II (p)(2)**

Out-of-band emission limits

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

Final Result

OP-Mode

Band Edge, Frequency Band, Number of signals, Direction, Input Power, Signal
Type

Lower, LMR 750, 1, RF downlink, 0.3 dB < AGC, Wideband	Passed
Lower, LMR 750, 1, RF downlink, 3 dB > AGC, Wideband	Passed
Lower, LMR 750, 1, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed
Lower, LMR 750, 1, RF downlink, 3 dB > AGC, Wideband 5G	Passed
Lower, LMR 750, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, LMR 750, 1, RF downlink, 3 dB > AGC, Narrowband	Passed
Lower, LMR 750, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Lower, LMR 750, 2, RF downlink, 3 dB > AGC, Wideband	Passed
Lower, LMR 750, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Lower, LMR 750, 2, RF downlink, 3 dB > AGC, Narrowband	Passed
Upper, LMR 750, 1, RF downlink, 0.3 dB < AGC, Wideband	Passed
Upper, LMR 750, 1, RF downlink, 3 dB > AGC, Wideband	Passed
Upper, LMR 750, 1, RF downlink, 0.3 dB < AGC, Wideband 5G	Passed
Upper, LMR 750, 1, RF downlink, 3 dB > AGC, Wideband 5G	Passed
Upper, LMR 750, 1, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, LMR 750, 1, RF downlink, 3 dB > AGC, Narrowband	Passed
Upper, LMR 750, 2, RF downlink, 0.3 dB < AGC, Wideband	Passed
Upper, LMR 750, 2, RF downlink, 3 dB > AGC, Wideband	Passed
Upper, LMR 750, 2, RF downlink, 0.3 dB < AGC, Narrowband	Passed
Upper, LMR 750, 2, RF downlink, 3 dB > AGC, Narrowband	Passed

**47 CFR CHAPTER I FCC PART 90 Subpart R/I
[Base Stations/Repeater]**

KDB 935210 D02 II (p)(2)

Out-of-band rejection

The measurement was performed according to ANSI C63.26:2015,
935210 D05 v01r04: 3.3

Final Result

OP-Mode

Frequency Band, Direction

Setup

LMR 750, RF downlink	Passed
----------------------	--------

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

2 ADMINISTRATIVE DATA

2.1 TESTING LABORATORY

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

2.2 APPLICANT DATA

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

2.3 MANUFACTURER DATA

Company Name:	Please see applicant data.
Address:	

3 TEST OBJECT DATA

3.1 GENERAL EUT DESCRIPTION

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

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

3.2 EUT MAIN COMPONENTS

Sample Name	FCC-ID	
	XS5-CAPMX	
Sample Parameter	Value	
Serial Number	TJCXAA2305302	
HW Version	7830127-0001 Rev.: 04	
SW Version	4.15.10.5	
Comment	-----	

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

3.3 ANCILLARY EQUIPMENT

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

Device	Details (Manufacturer, Type Model, OUT Code)	Description
-	-	-

3.4 AUXILIARY EQUIPMENT

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

Device	Details (Manufacturer; Type; S/N)	Description
AUX1	Commscope/General Electric; ION-E PSU Shelf, AC; DM77662	Rack in Conjunction with AUX 2
AUX2	Commscope/General Electric; Power Supply Unit; LBGEPE17KZ39047532	Power Supply
AUX3	Commscope; ION-E WCS-2; SZAEAJ1952A0032	Subrack in Conjunction with AUX 4, 5, 6, 7 and 8
AUX4	Commscope; ION-E OPT; SZBEAD1951A0011	Optical Card
AUX5	Commscope; ION-E SUI; SZBEAC1746A0015	LAN System Interface
AUX6	Commscope; ION-E RFD; SZBEAP1920A0057	RF Card
AUX7	Commscope; ION-E RFD; SZBEAP1924A0023	RF Card
AUX 8	Commscope; ION-E RFD; SZBEAP1946A0003	RF Card

3.5 EUT SETUPS

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

Setup	Combination of EUTs	Description and Rationale
		Setup for all tests

OPERATING MODES

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

3.5.1 TEST CHANNELS

Band	Direction	Lower Frequency Band Edge [MHz]	Upper Frequency Band Edge [MHz]	Center Frequency [MHz]	Port
14/LMR 750	Downlink	758.00	768.00	763.00	Donor

3.5.2 AUTOMATIC GAIN CONTROL LEVELS

AGC Levels							
Band	Direction	Signal Type	AGC Start Pin [dBm]	AGC Start Pin -0.3 dB [dBm]	AGC Start Pin +3 dB [dBm]	Frequency [MHz]	Frequency
14	Downlink	Narrowband	-4.2	-4.5	-1.2	763.00	Mid
14	Downlink	Wideband	-4.0	-4.3	-1.0	763.00	
14	Downlink	Wideband G5	-4.2	-4.5	-1.2	763.00	
14	Downlink	Narrowband	-4.0	-4.3	-1.0	758.20	Low
14	Downlink	Wideband	-4.2	-4.5	-1.2	760.50	
14	Downlink	Narrowband	-3.4	-3.7	-0.4	767.80	High
14	Downlink	Wideband	-3.8	-4.1	-0.8	765.50	
14	Downlink	Narrowband	-4.4	-4.7	-1.4	759.14	Max.Power
14	Downlink	Wideband	-4.2	-4.5	-1.2	760.50	

Remark:

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

For example for minimum distances to the band edges:

GSM-Signal (narrowband): 0.2 MHz

AWGN-signal (wideband): 2.5 MHz

AWGN-signal (wideband 5G): 5 MHz

3.6 PRODUCT LABELLING

3.6.1 FCC ID LABEL

Please refer to the documentation of the applicant.

3.6.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

4 TEST RESULTS

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

Standard FCC Part 27, § 27.50

The test was performed according to:

ANSI C63.26:2015, KDB 935210 D05 v01r04: 3.5

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

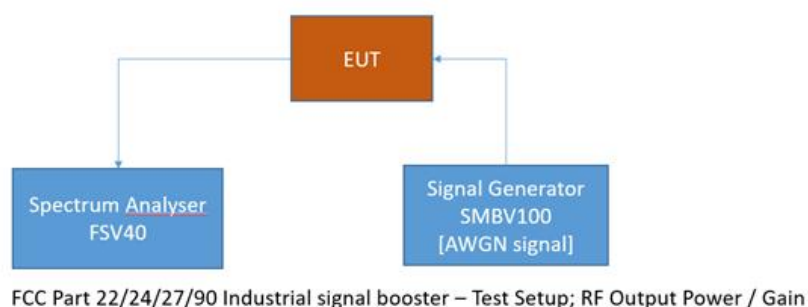
Environmental conditions: 21 ... 26 °C; 25 .. 35 % r. H.

Test engineer: Thomas Hufnagel

4.1.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the signal booster power and gain limits and requirements for industrial signal boosters per FCC § 90.542.

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



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

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

4.1.2 TEST REQUIREMENTS/LIMITS: ABSTRACTS FROM STANDARDS

Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§ 90.542

LMR 750:

Abstract § 90.542 from FCC:

§90.542 (a)(3)

(a) The following power limits apply to the 758-768/788-798 MHz band:

(3) Fixed and base stations transmitting a signal in the 758-768 MHz band with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP accordance with Table 3 of this section.

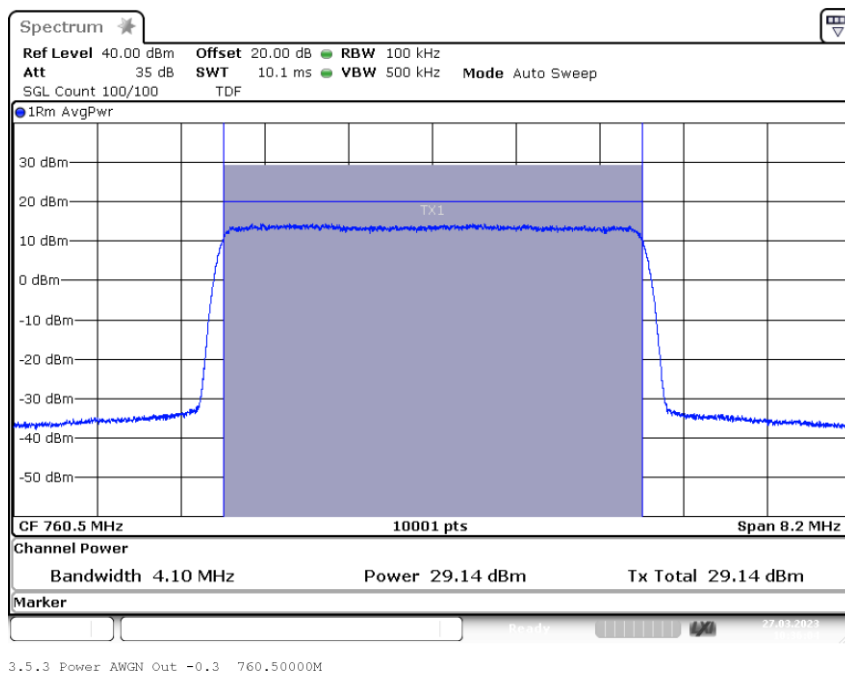
4.1.3 TEST PROTOCOL

LMR 750, downlink							
Signal Type	Input Power	Frequency [MHz]	Input Power [dBm]	Maximum Average Output Power [dBm]	Limit Average Output Power [dBm]	Margin to Limit [dB]	Gain [dB]
Wideband	0.3 dB < AGC	760.50	-4.5	29.1	60.0	30.9	33.6
Wideband	3 dB > AGC	760.50	-1.2	29.2	60.0	30.8	30.4
Wideband 5G	0.3 dB < AGC	763.00	-4.5	29.5	60.0	30.5	34.0
Wideband 5G	3 dB > AGC	763.00	-1.2	29.0	60.0	31.0	30.2
Narrowband	0.3 dB < AGC	759.14	-4.7	29.4	60.0	30.6	34.1
Narrowband	3 dB > AGC	759.14	-1.4	29.0	60.0	31.0	30.4

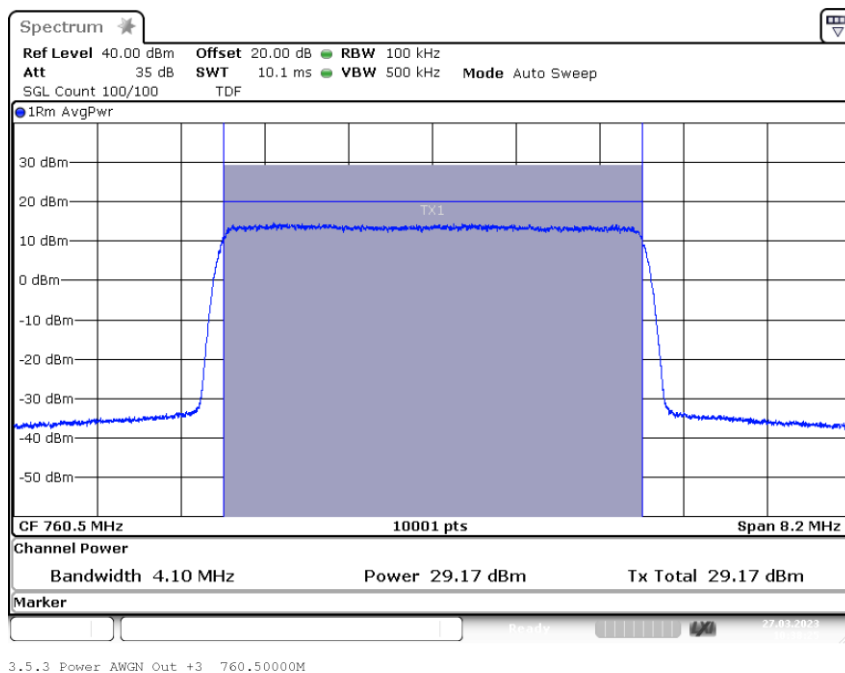
Remarks: Please see next sub-clause for the measurement plot.

4.1.4 MEASUREMENT PLOT

Band: LMR750; Frequency: 759.1400 MHz; Band Edge: f0;
 Mod: AWGN; Output Power 0.3 dB < AGC



Band: LMR750; Frequency: 759.1400 MHz; Band Edge: f0;
 Mod: AWGN; Output Power 3 dB > AGC

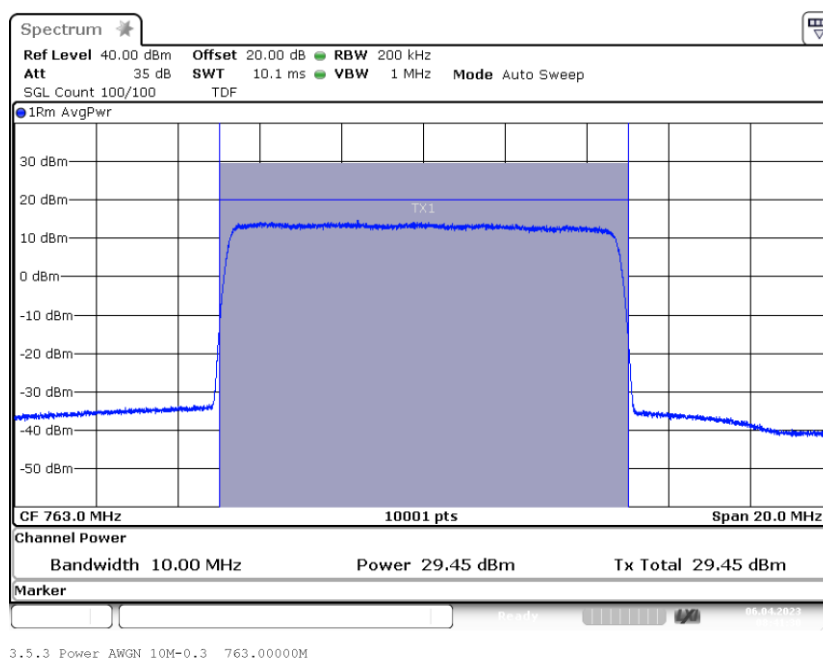




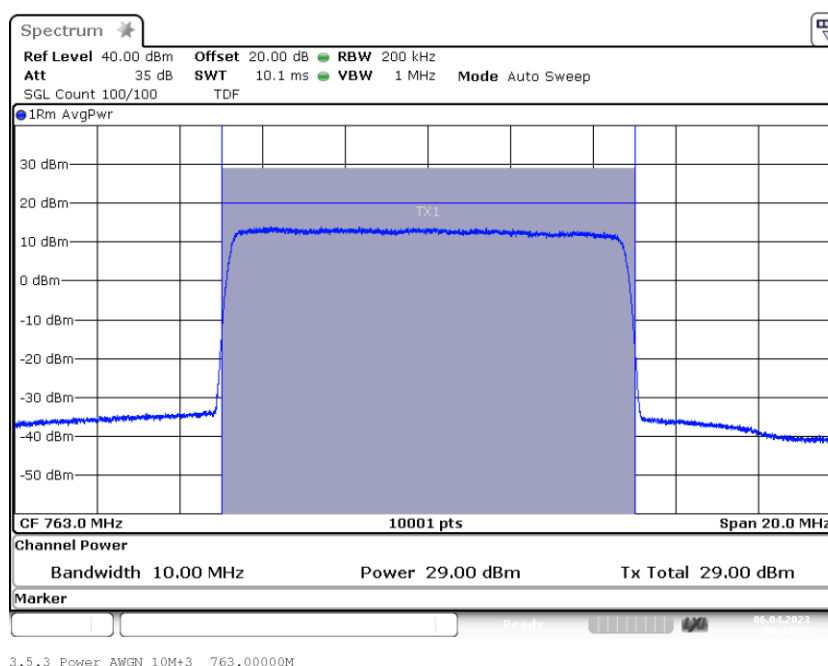
BUREAU
VERITAS

2023-0080-EMC-TR-23-0051-V01_Andrew_CAP MX CELL 800_FCC V01.00
Andrew_CAP MX AC 6/7E/80-85/17E/19/23/25T

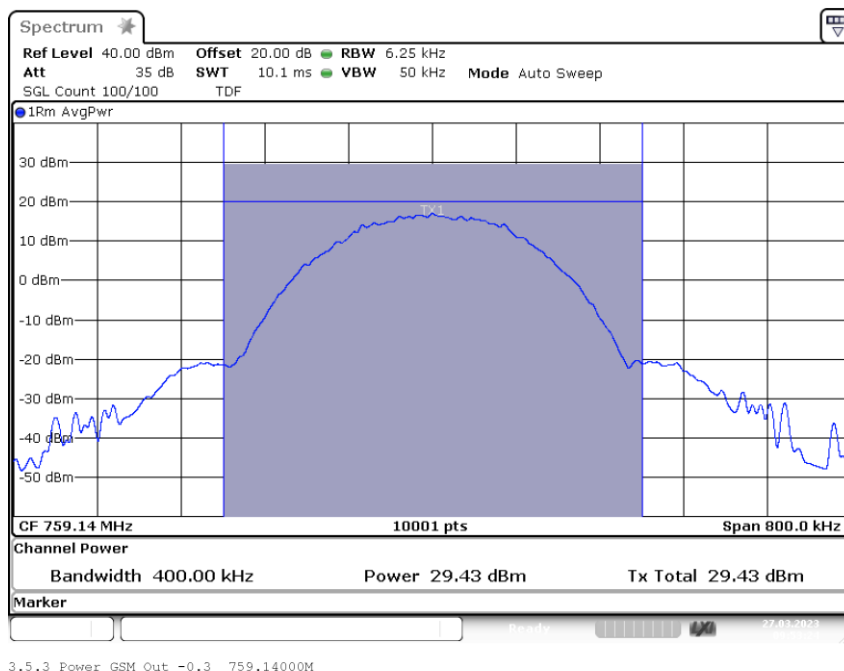
Band: LMR750; Frequency: 763.00 MHz; Band Edge: f0;
Mod: AWGN 10M; Output Power 0.3 dB < AGC



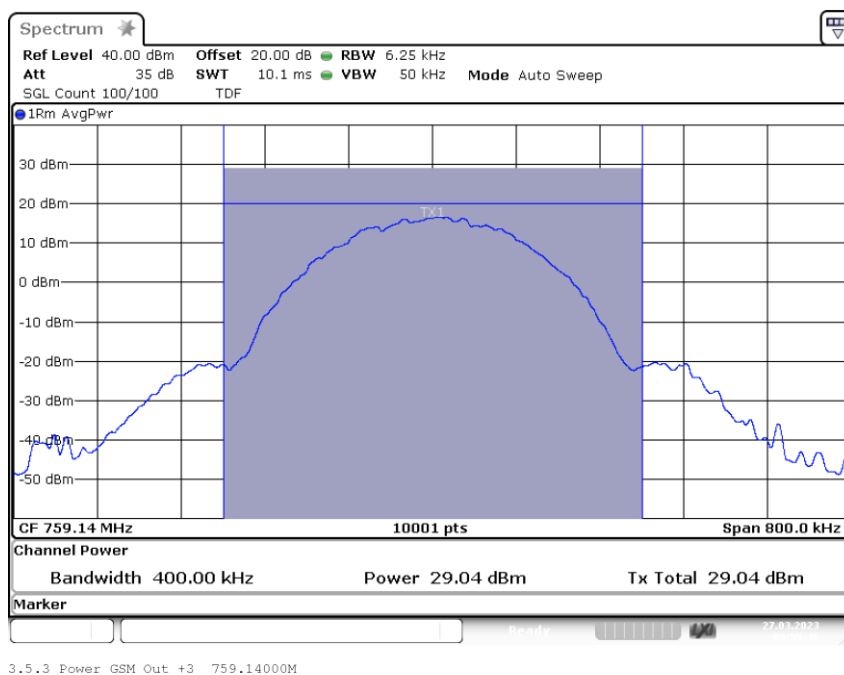
Band: LMR750; Frequency: 763.00 MHz; Band Edge: f0;
Mod: AWGN 10M; Output Power 3 dB > AGC



Band: LMR750; Frequency: 759.1400 MHz; Band Edge: f0;
 Mod: GSM; Output Power 0.3 dB < AGC



Band: LMR750; Frequency: 759.1400 MHz; Band Edge: f0;
 Mod: GSM; Output Power 3 dB > AGC



4.1.5 TEST EQUIPMENT USED

- Conducted

4.2 OCCUPIED BANDWIDTH/INPUT-VERSUS-OUTPUT SPECTRUM

Standard FCC Part 2.1049; Occupied Bandwidth

The test was performed according to:

ANSI C63.26:2015, KDB 935210 D05 v01r04: 3.4

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

|

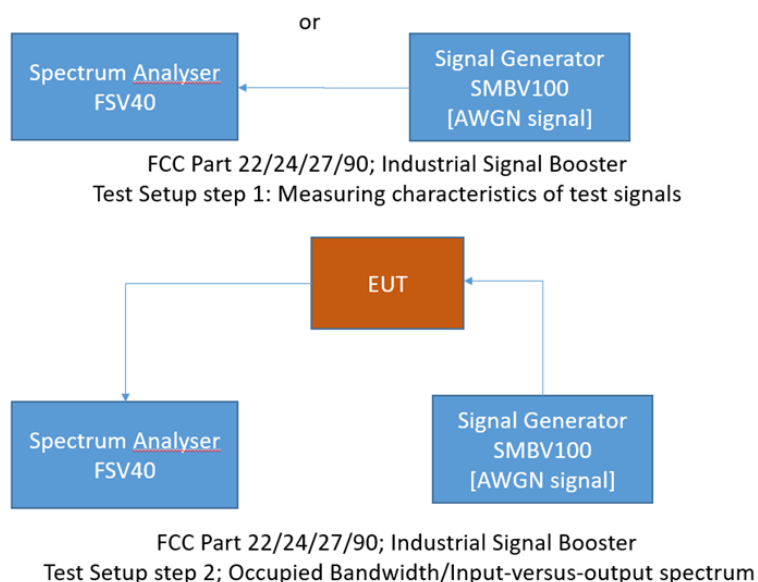
Environmental conditions: 21 ... 26 °C; 25 .. 35 % r. H.

Test engineer: Thomas Hufnagel

4.2.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission limits per FCC § 2.1049 and FCC § 90.219.

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



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

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

4.2.2 TEST REQUIREMENTS/LIMITS

Abstract § 2.1049 from FCC:

FCC Part 2.1049; Occupied Bandwidth:

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

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

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

Abstract § 90.219 from FCC:

FCC Part 90; §90.219(e)(ii)

There is no change in the occupied bandwidth of the signal.

4.2.3 TEST PROTOCOL

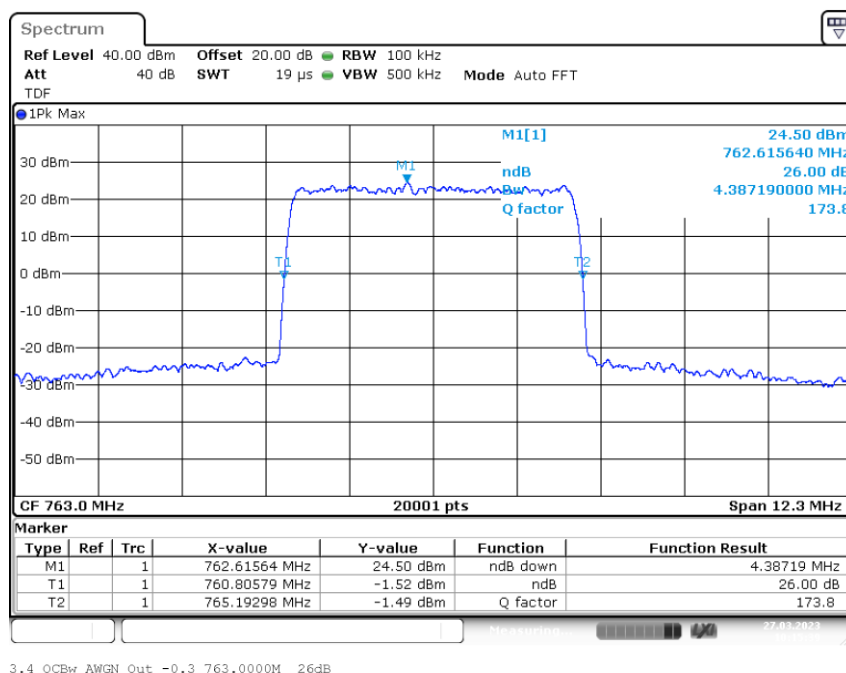
LMR 750, downlink			
Signal Type	Input Power	Signal Frequency [MHz]	Occupied Bandwidth Booster [kHz]
Wideband	0.3 dB < AGC	763.00	4387.2
Wideband	3 dB > AGC	763.00	4389.7
Wideband 5G	0.3 dB < AGC	763.00	9935.5
Wideband 5G	3 dB > AGC	763.00	9934.0
Narrowband	0.3 dB < AGC	763.00	313.8
Narrowband	3 dB > AGC	763.00	311.7

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

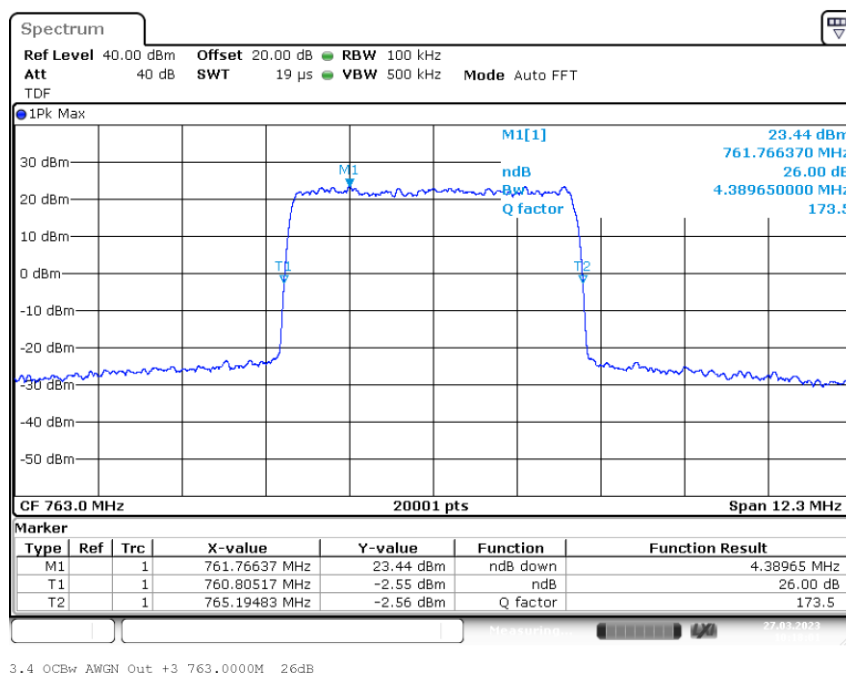


4.2.4 MEASUREMENT PLOT

Band: LMR750; Frequency: 763.0000 MHz; Band Edge: mid;
Mod: AWGN; Output OCBw 0.3 dB < AGC



Band: LMR750; Frequency: 763.0000 MHz; Band Edge: mid;
Mod: AWGN; Output OCBw 3 dB > AGC



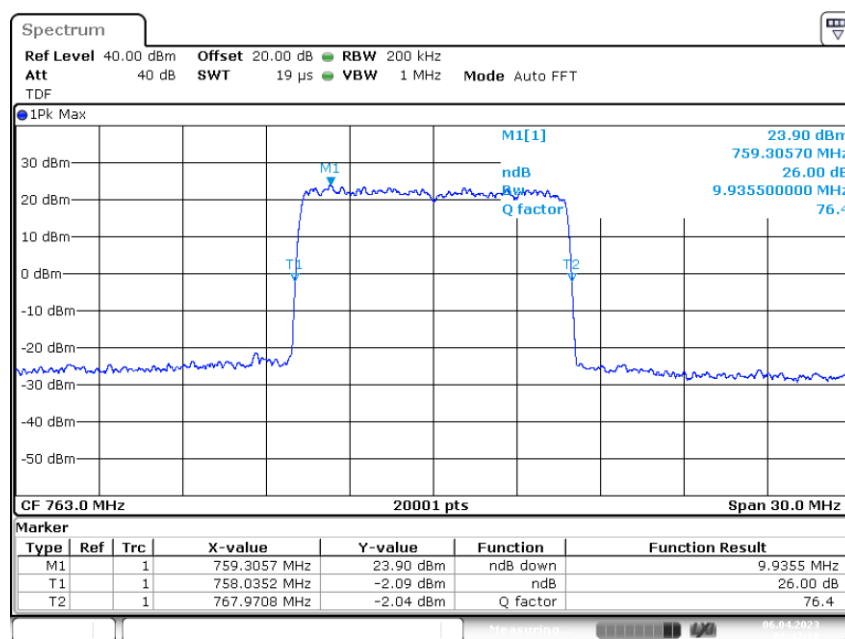


BUREAU
VERITAS

2023-0080-EMC-TR-23-0051-V01_Andrew_CAP MX CELL 800_FCC V01.00

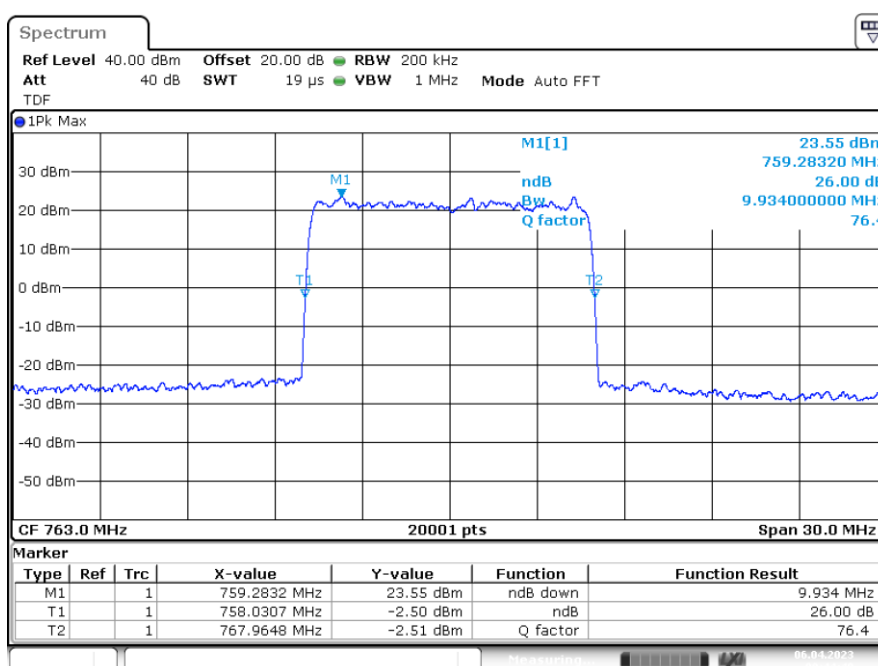
Andrew_CAP MX AC 6/7E/80-85/17E/19/23/25T

Band: LMR750; Frequency: 763.0000 MHz; Band Edge: mid;
Mod: AWGN 10M; Output OCBw 0.3 dB < AGC



3.4 OCBw AWGN 10M-0.3 763.0000M _26dB

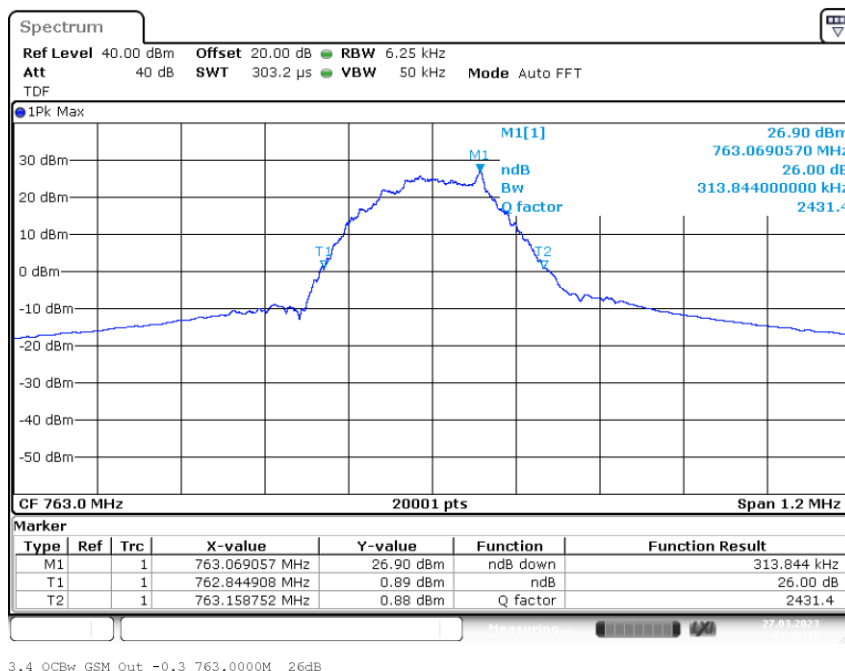
Band: LMR750; Frequency: 763.0000 MHz; Band Edge: mid;
Mod: AWGN 10M; Output OCBw 3 dB > AGC



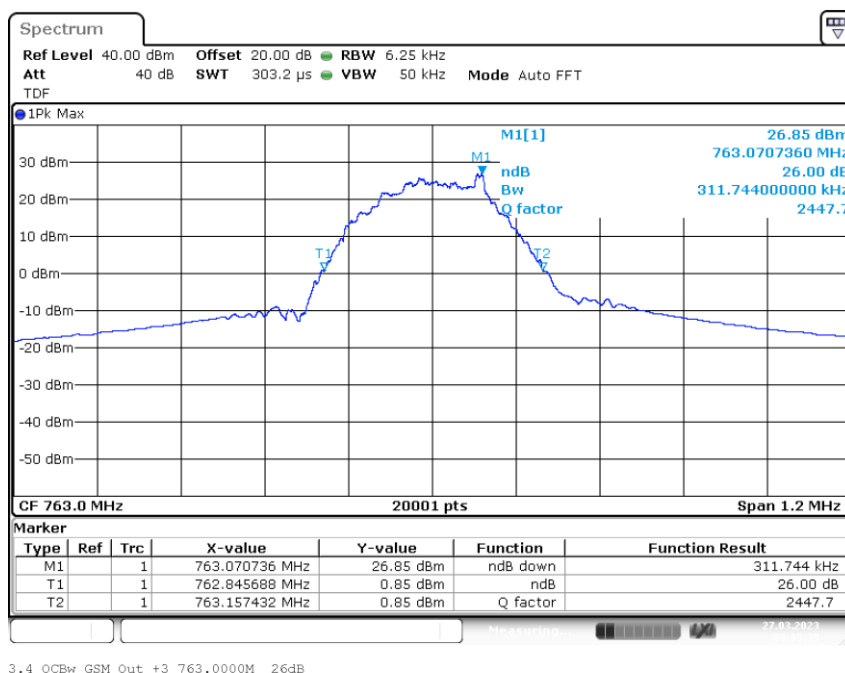
3.4 OCBw AWGN 10M+3 763.0000M _26dB



Band: LMR750; Frequency: 763.0000 MHz; Band Edge: mid;
 Mod: GSM; Output OCBw 0.3 dB < AGC



Band: LMR750; Frequency: 763.0000 MHz; Band Edge: mid;
 Mod: GSM; Output OCBw 3 dB > AGC



4.2.5 TEST EQUIPMENT USED

- Conducted

4.3 OUT-OF-BAND EMISSION LIMITS

Standard FCC Part § 2.1051, § 27.53

The test was performed according to:

ANSI C63.26:2015, KDB 935210 D05 v01r04: 3.6

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

|

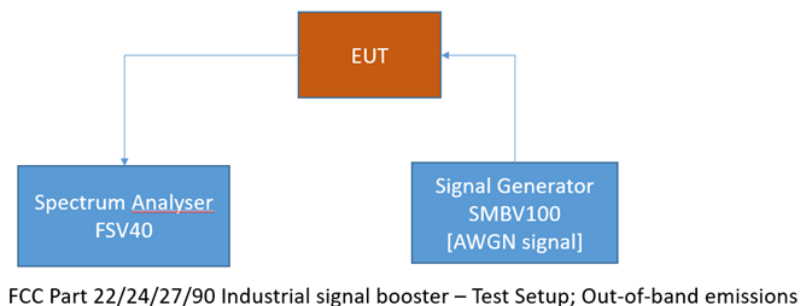
Environmental conditions: 21 ... 26 °C; 25 .. 35 % r. H.

Test engineer: Thomas Hufnagel

4.3.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the out-of-band emission limit for industrial signal boosters. The limits itself come from the applicable rule part for each operating band per FCC § 2.1053 and FCC § 90.219.

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



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

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

4.3.2 TEST REQUIREMENTS/LIMITS

Abstract § 2.1051 from FCC:

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

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

Abstract § 90.219 FCC:

§90.219 – Use of signal boosters

(e)(3) Spurious emissions from a signal booster must not exceed –13 dBm within any 100 kHz measurement bandwidth.

(d)(6)(i) In general, the ERP of intermodulation products should not exceed –30 dBm in 10 kHz measurement bandwidth.

4.3.3 TEST PROTOCOL

LMR 750, downlink, Number of input signals = 1							
Signal Type	Input Power	Band Edge	Signal Frequency [MHz]	Input Power [dBm]	Maximum Out-of-band Power [dBm]	Limit Out-of-band Power [dBm]	Margin to Limit [dB]
Wideband	-0.3 dB < AGC	upper	765.50	-4.1	-37.8	-13.0	24.8
Wideband	3 dB > AGC	upper	765.50	-0.8	-37.9	-13.0	24.9
Wideband 5G	-0.3 dB < AGC	upper	763.00	-4.5	-39.1	-13.0	26.1
Wideband 5G	3 dB > AGC	upper	763.00	-1.2	-39.6	-13.0	26.6
Narrowband	-0.3 dB < AGC	upper	767.80	-3.7	-32.8	-13.0	19.8
Narrowband	3 dB > AGC	upper	767.80	-0.4	-32.9	-13.0	19.9
Wideband	-0.3 dB < AGC	lower	760.50	-4.5	-36.7	-13.0	23.7
Wideband	3 dB > AGC	lower	760.50	-1.2	-36.7	-13.0	23.7
Wideband 5G	-0.3 dB < AGC	lower	763.00	-4.5	-39.5	-13.0	26.5
Wideband 5G	3 dB > AGC	lower	763.00	-1.2	-38.3	-13.0	25.3
Narrowband	-0.3 dB < AGC	lower	758.20	-4.3	-32.1	-13.0	19.1
Narrowband	3 dB > AGC	lower	758.20	-1.0	-32.4	-13.0	19.4

LMR 750, 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	765.50	763.00	-4.3	-39.3	-13.0	26.3
WB	3 dB > AGC	upper	765.50	763.00	-1.0	-39.5	-13.0	26.5
NB	-0.3 dB < AGC	upper	767.80	767.60	-3.3	-33.7	-13.0	20.7
NB	3 dB > AGC	upper	767.80	767.60	0.0	-33.2	-13.0	20.2
WB	-0.3 dB < AGC	lower	760.50	763.00	-4.3	-38.3	-13.0	25.3
WB	3 dB > AGC	lower	760.50	763.00	-1.0	-38.9	-13.0	25.9
NB	-0.3 dB < AGC	lower	758.20	758.40	-4.3	-32.9	-13.0	19.9
NB	3 dB > AGC	lower	758.20	758.40	-1.0	-32.8	-13.0	19.8

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

Explanations concerning table with two input signals:

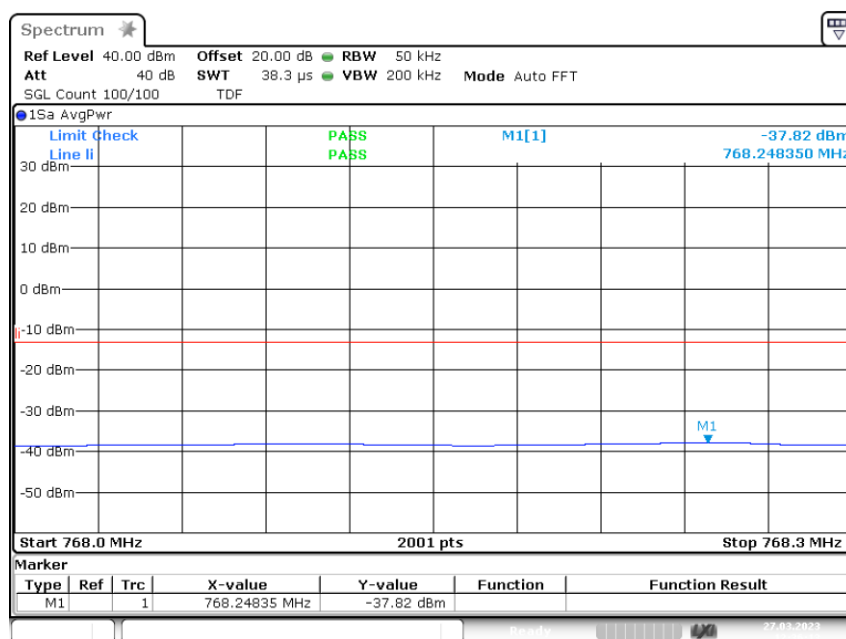
"WB" means Wideband.

"NB" means Narrowband.

Wideband 5G means Wideband 10M

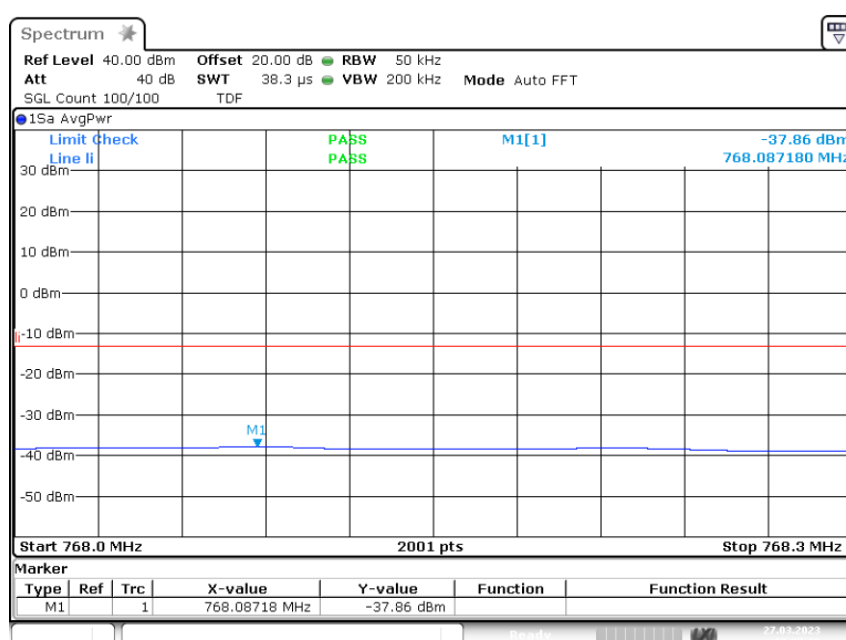
4.3.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: upper;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 1



3.6.2 out of band emi LMR750 AWGN upper lcarrier -0.3 dB 768
.000M 768.300M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: upper;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 1



3.6.2 out of band emi LMR750 AWGN upper lcarrier +3.0 dB 768
.000M 768.300M

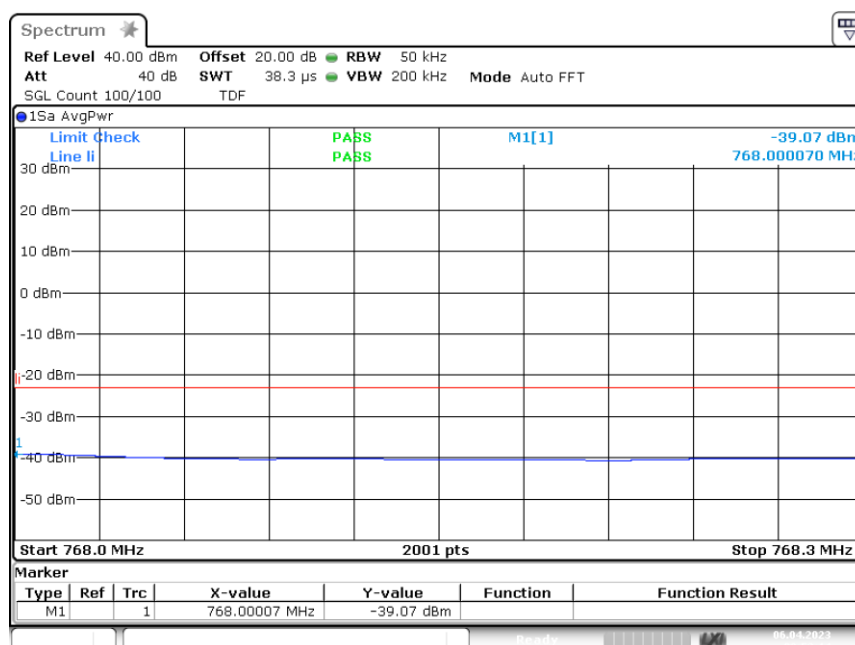


BUREAU
VERITAS

2023-0080-EMC-TR-23-0051-V01_Andrew_CAP MX CELL 800_FCC V01.00

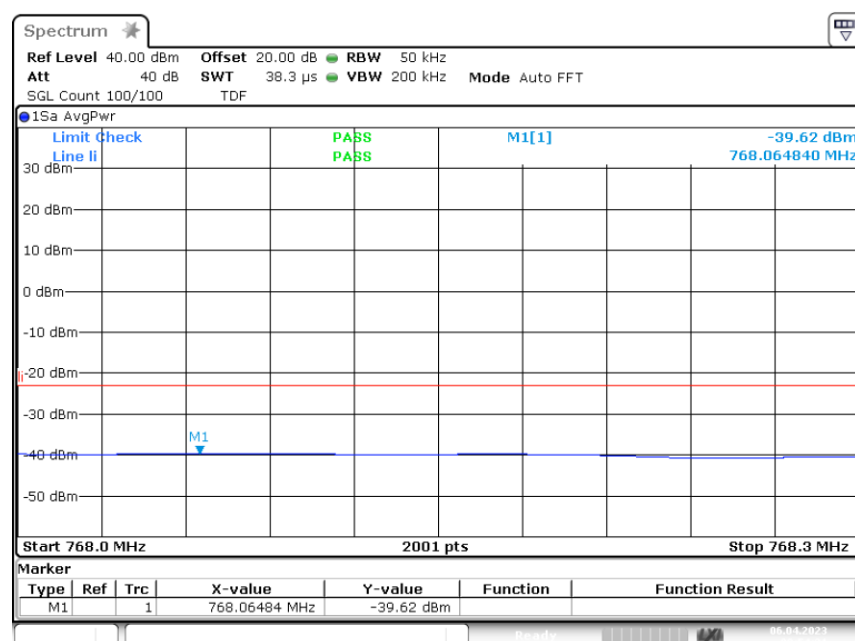
Andrew_CAP MX AC 6/7E/80-85/17E/19/23/25T

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: upper;
Mod: AWGN 10M; Input Power = 0.3 dB < AGC; Number of signals 1



3.6.2 out of band emi LMR750 AWGN 10M upper lcarrier -0.3 dB
768.000M 768.300M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: upper;
Mod: AWGN 10M; Input Power = 3 dB > AGC; Number of signals 1



3.6.2 out of band emi LMR750 AWGN 10M upper lcarrier +3.0 dB
768.000M 768.300M

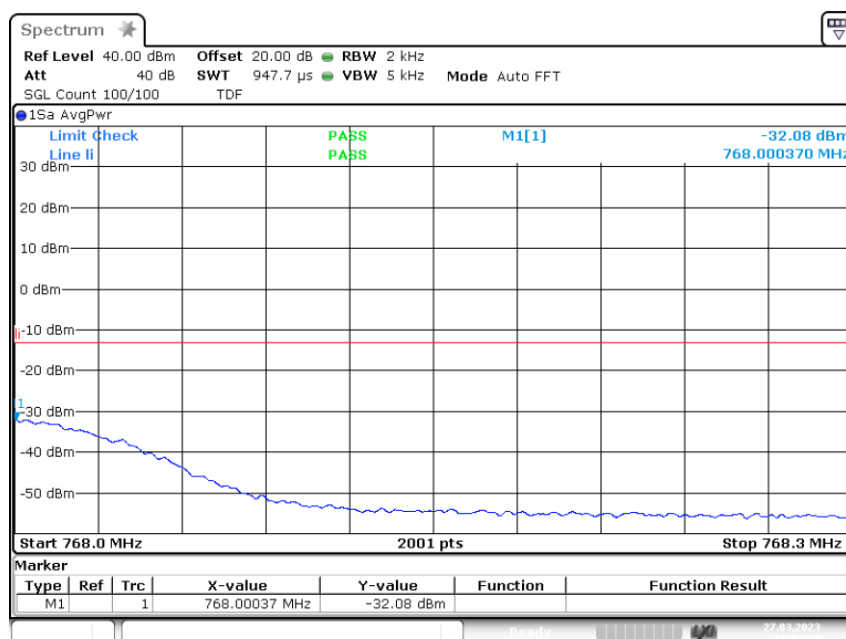


BUREAU
VERITAS

2023-0080-EMC-TR-23-0051-V01_Andrew_CAP MX CELL 800_FCC V01.00

Andrew_CAP MX AC 6/7E/80-85/17E/19/23/25T

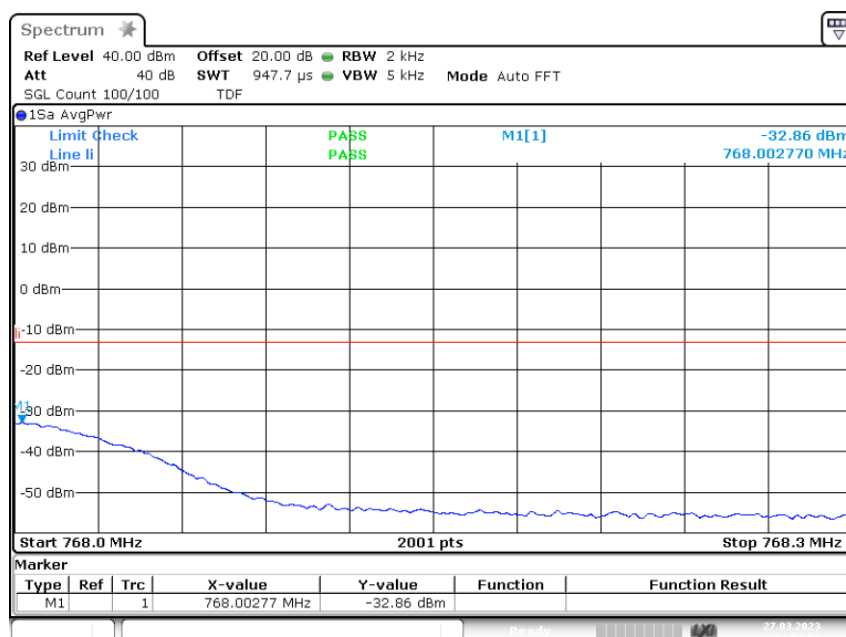
Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: upper;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 1



3.6.2 out of band emi LMR750 GSM upper 1carrier -0.3 dB 768.

000M 768.300M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: upper;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 1

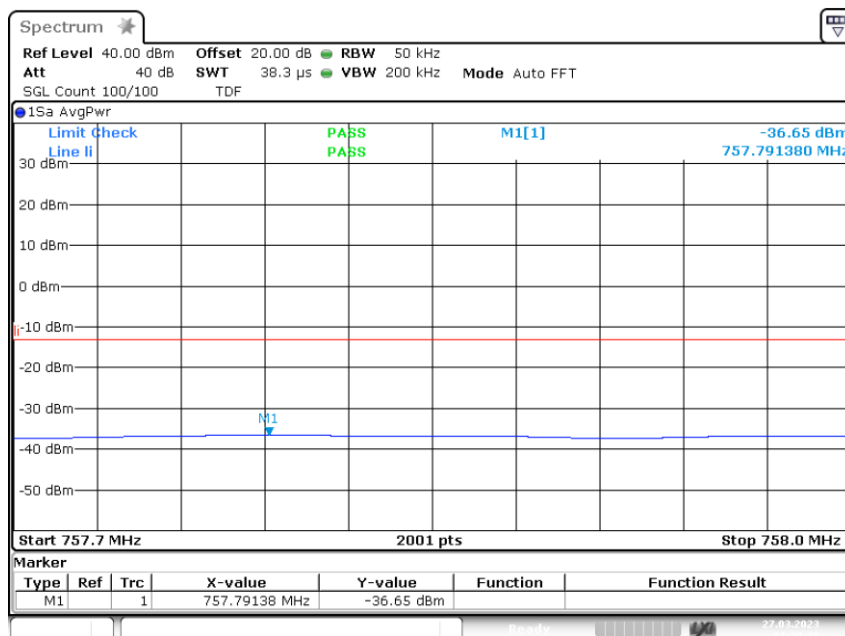


3.6.2 out of band emi LMR750 GSM upper 1carrier +3.0 dB 768.

000M 768.300M

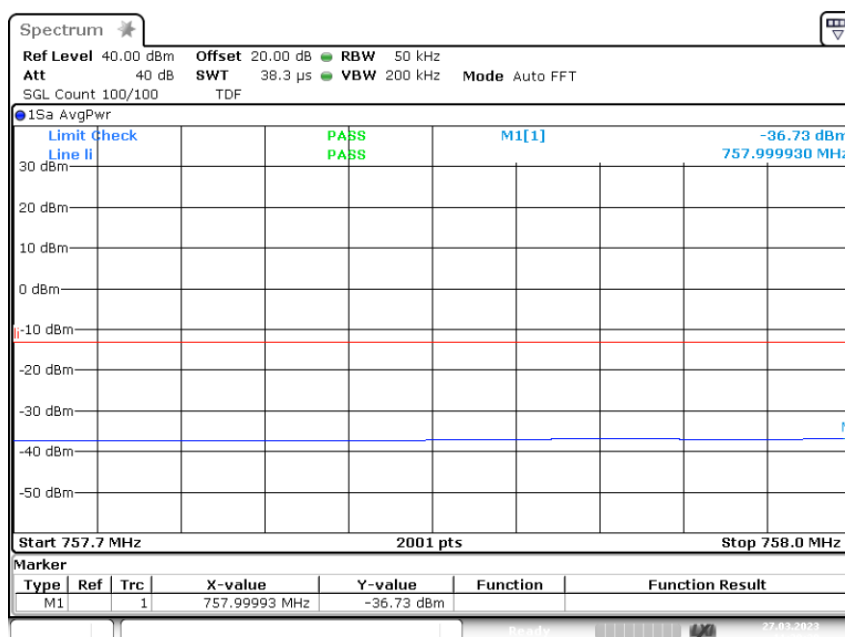


Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: lower;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 1



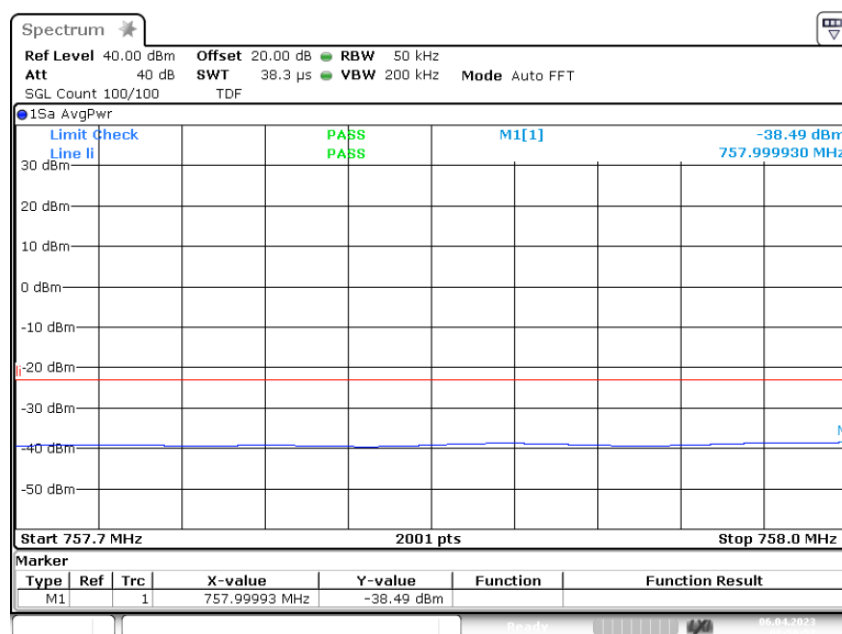
3.6.2 out of band emi LMR750 AWGN lower lcarrier -0.3 dB 757
.700M 758.000M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: lower;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 1



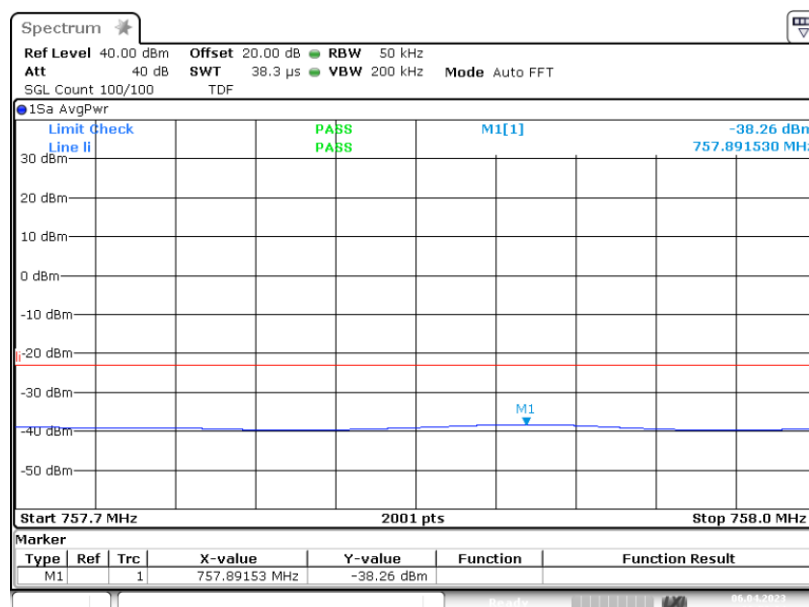
3.6.2 out of band emi LMR750 AWGN lower lcarrier +3.0 dB 757
.700M 758.000M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: lower;
Mod: AWGN 10M; Input Power = 0.3 dB < AGC; Number of signals 1



3.6.2 out of band emi LMR750 AWGN 10M lower lcarrier -0.3 dB
757.700M 758.000M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: lower;
Mod: AWGN 10M; Input Power = 3 dB > AGC; Number of signals 1



3.6.2 out of band emi LMR750 AWGN 10M lower lcarrier +3.0 dB
757.700M 758.000M

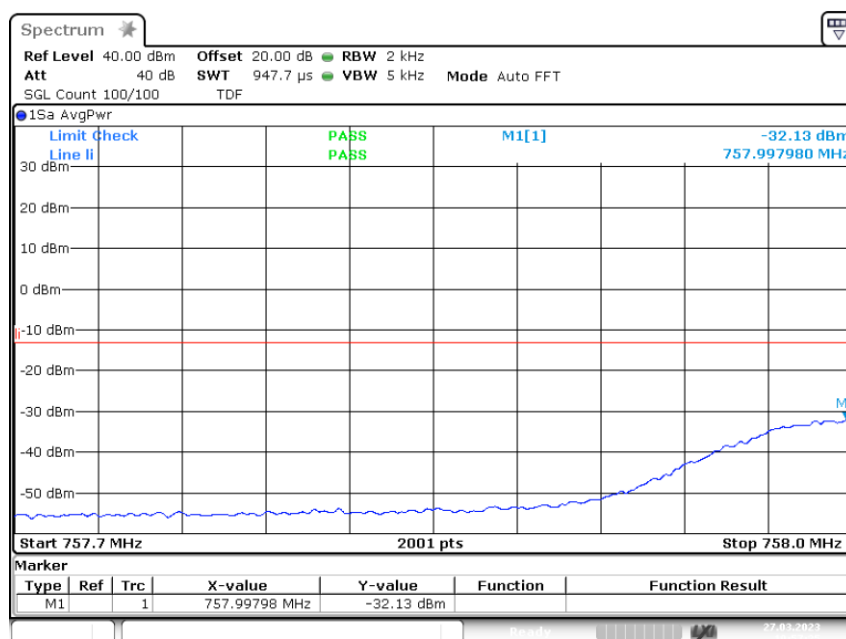


BUREAU
VERITAS

2023-0080-EMC-TR-23-0051-V01_Andrew_CAP MX CELL 800_FCC V01.00

Andrew_CAP MX AC 6/7E/80-85/17E/19/23/25T

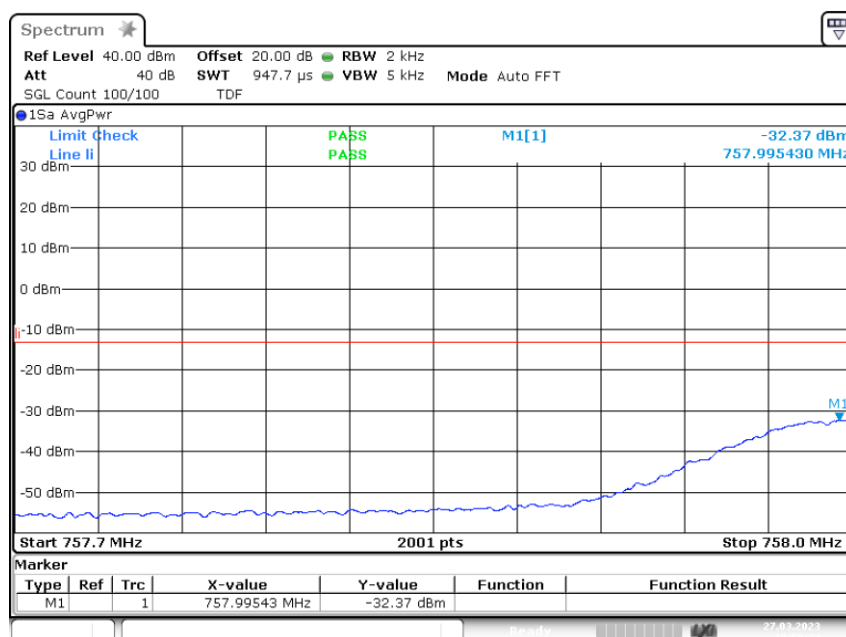
Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: lower;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 1



3.6.2 out of band emi LMR750 GSM lower lcarrier -0.3 dB 757.

700M 758.000M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: lower;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 1

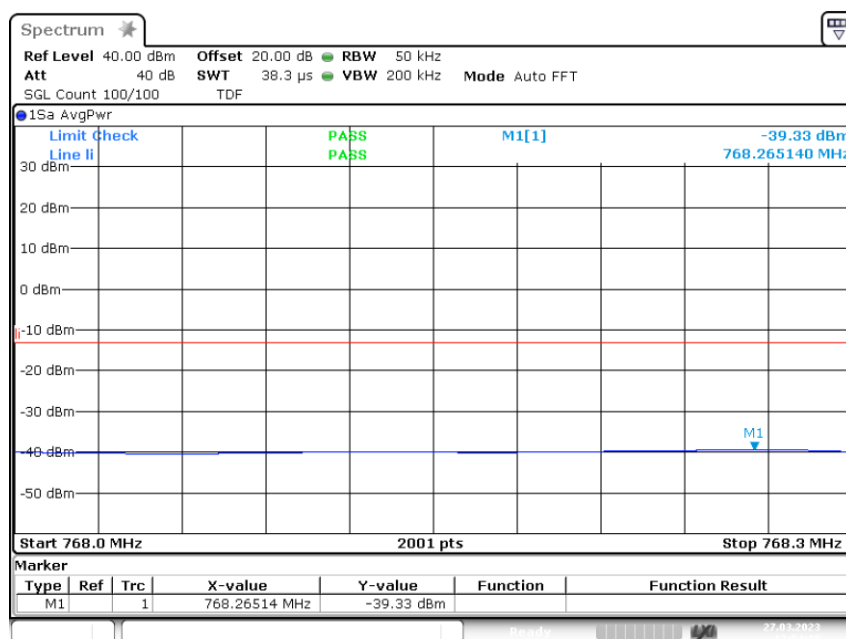


3.6.2 out of band emi LMR750 GSM lower lcarrier +3.0 dB 757.

700M 758.000M

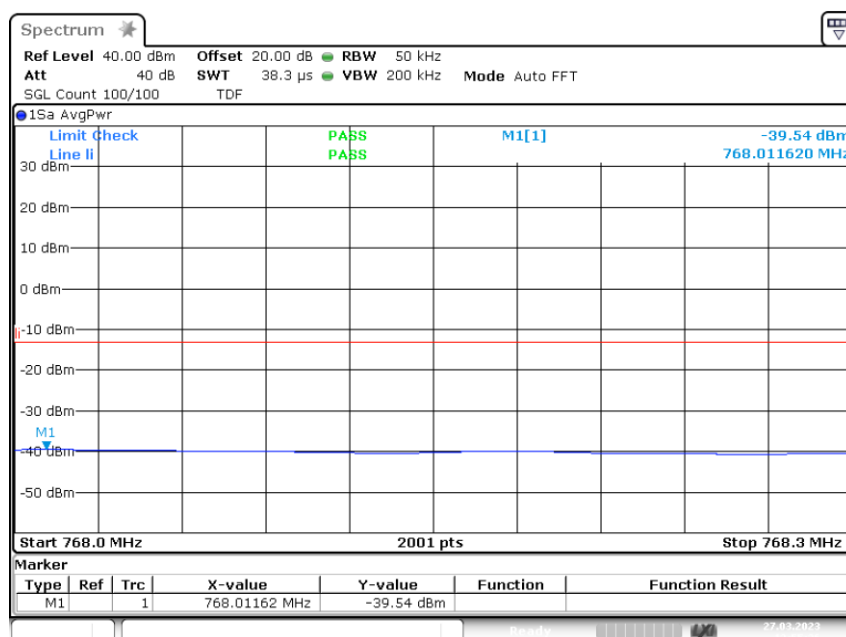


Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: upper;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 2



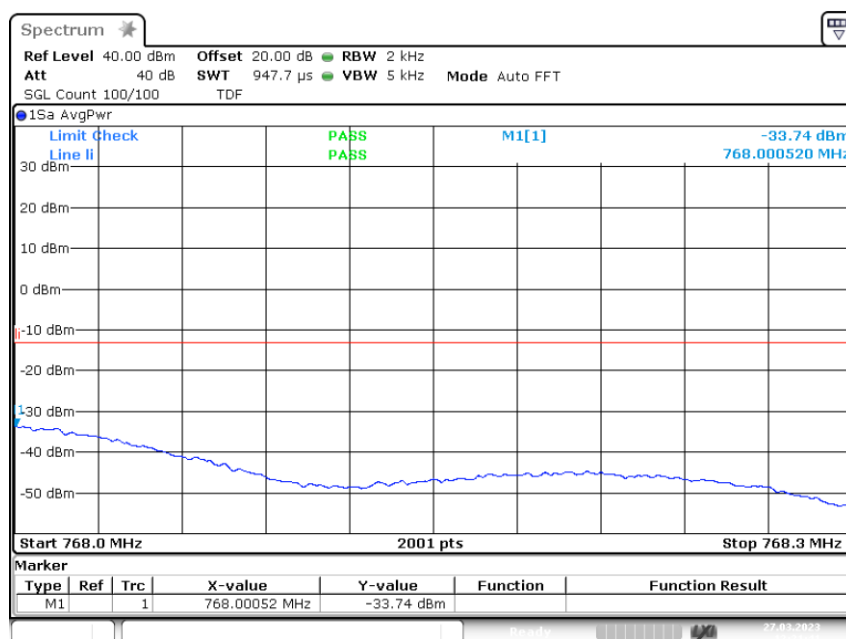
3.6.2 out of band emi LMR750 AWGN upper 2carriers -0.3 dB 76
8.000M 768.300M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: upper;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 2



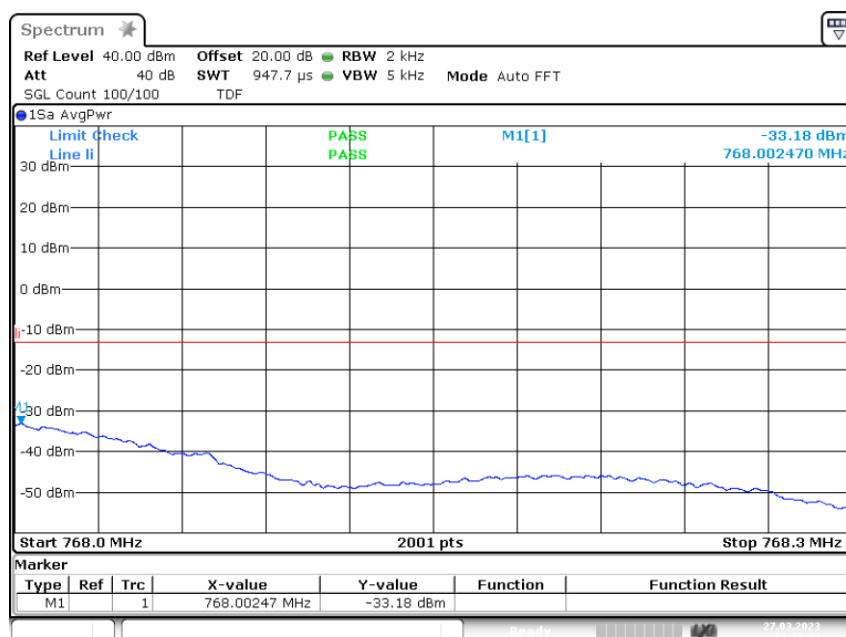
3.6.2 out of band emi LMR750 AWGN upper 2carriers +3.0 dB 76
8.000M 768.300M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: upper;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 2



3.6.2 out of band emi LMR750 GSM upper 2carriers -0.3 dB 768
.000M 768.300M

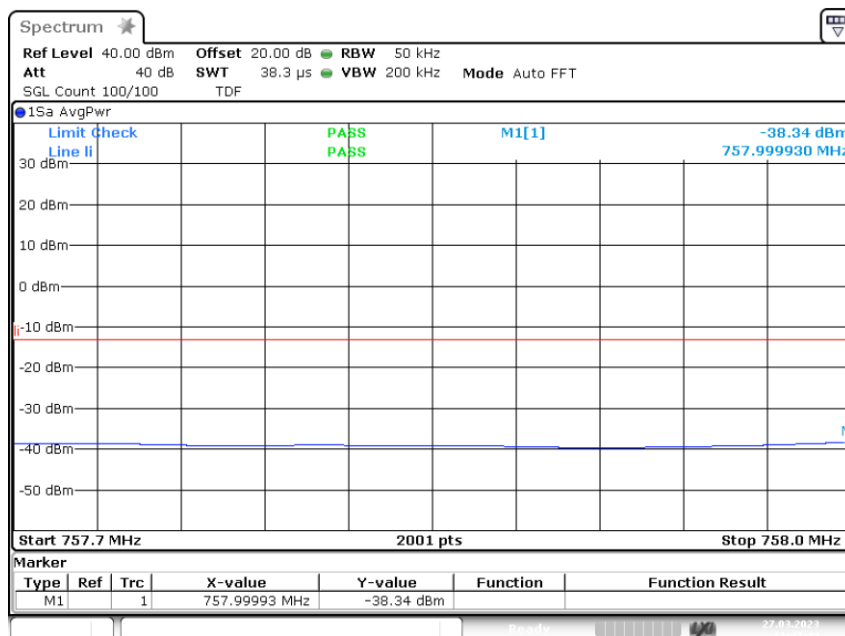
Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: upper;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 2



3.6.2 out of band emi LMR750 GSM upper 2carriers +3.0 dB 768
.000M 768.300M

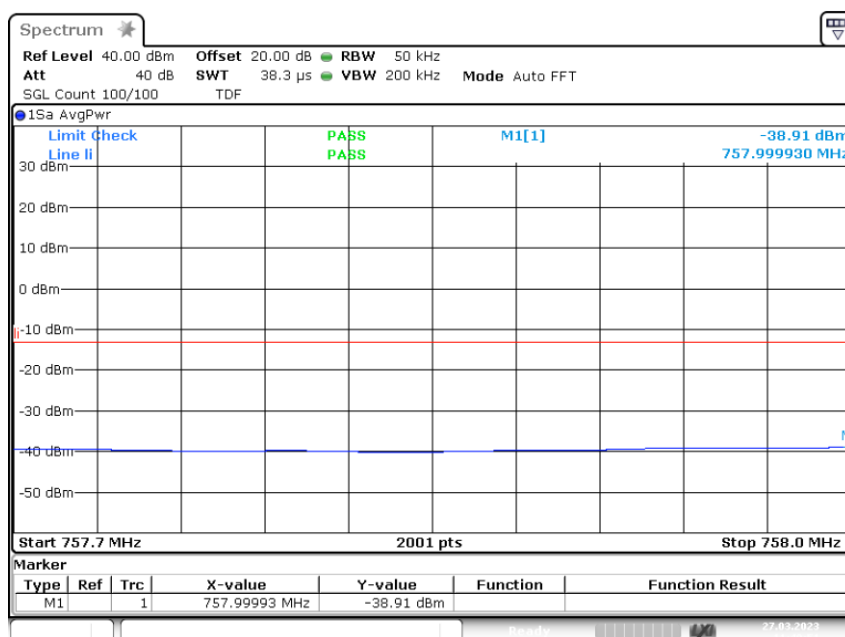


Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: lower;
Mod: AWGN; Input Power = 0.3 dB < AGC; Number of signals 2



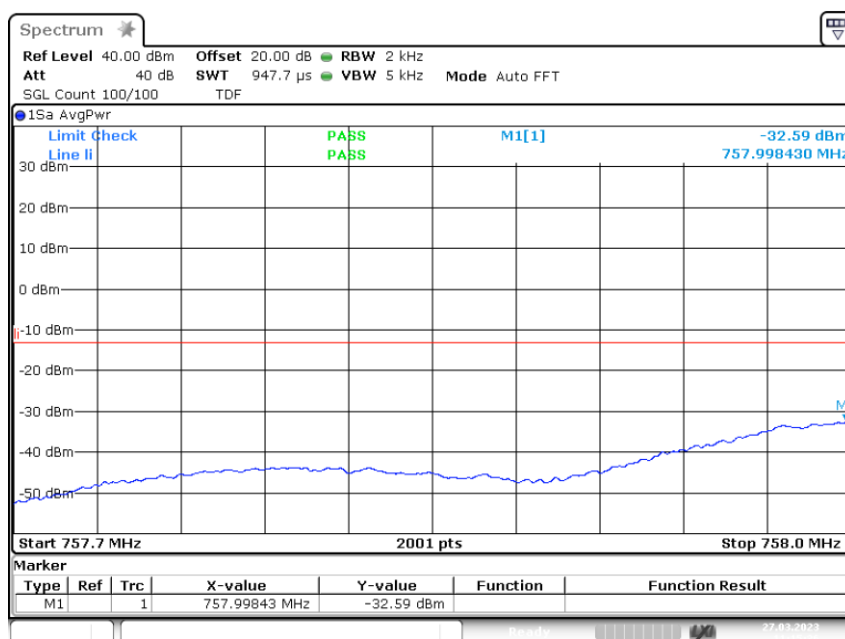
3.6.2 out of band emi LMR750 AWGN lower 2carriers -0.3 dB 75
7.700M 758.000M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: lower;
Mod: AWGN; Input Power = 3 dB > AGC; Number of signals 2



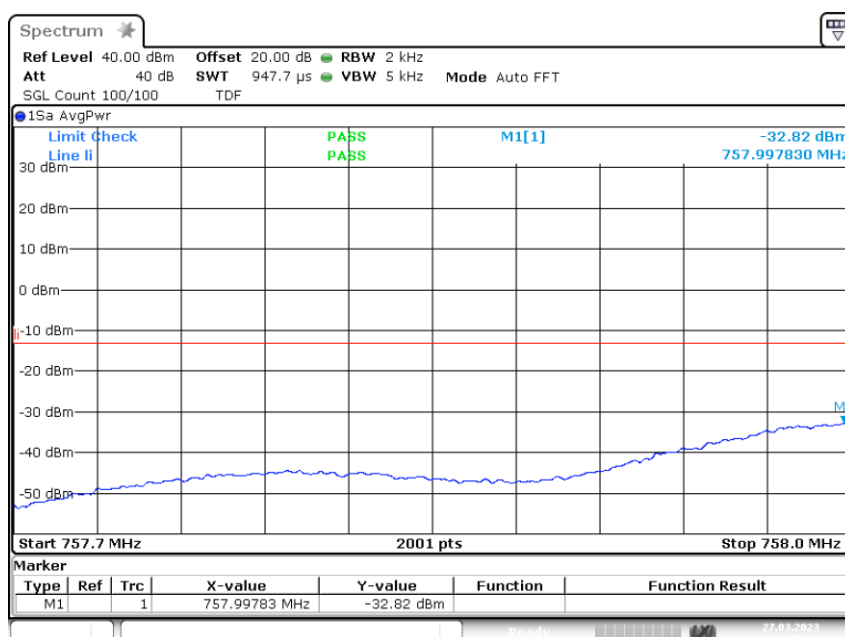
3.6.2 out of band emi LMR750 AWGN lower 2carriers +3.0 dB 75
7.700M 758.000M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: lower;
Mod: GSM; Input Power = 0.3 dB < AGC; Number of signals 2



3.6.2 out of band emi LMR750 GSM lower 2carriers -0.3 dB 757
.700M 758.000M

Band: LMR750; Frequency: 758.0000 MHz to 768.0000 MHz; Band Edge: lower;
Mod: GSM; Input Power = 3 dB > AGC; Number of signals 2



3.6.2 out of band emi LMR750 GSM lower 2carriers +3.0 dB 757
.700M 758.000M

4.3.5 TEST EQUIPMENT USED

- Conducted

4.4 OUT-OF-BAND REJECTION

Standard FCC Part 20

The test was performed according to:

ANSI C63.26:2015; KDB 935210 D05

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

|

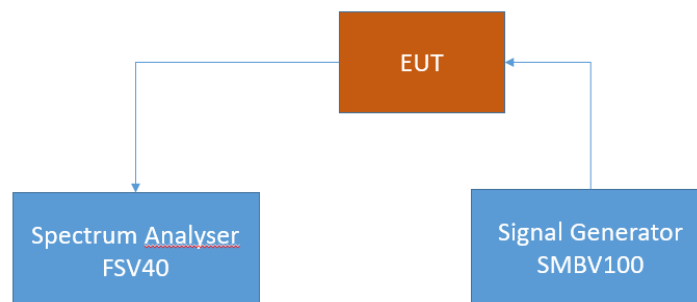
Environmental conditions: 21 ... 26 °C; 25 .. 35 % r. H.

Test engineer: Thomas Hufnagel

4.4.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the out-of-band rejection test case for industrial signal boosters.

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



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

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

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

4.4.2 TEST REQUIREMENTS/LIMITS

For this test case exists no applicable limit

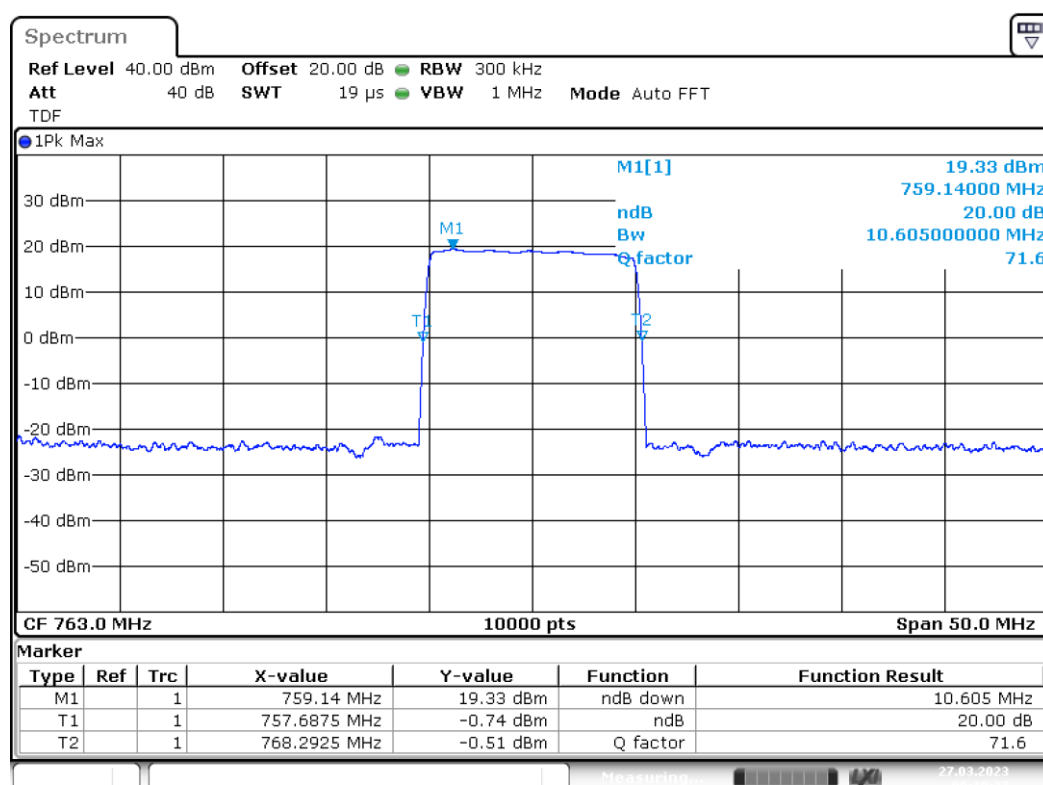
4.4.3 TEST PROTOCOL

LMR 750, 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]
759.14	19.33	757.6875	768.2925	10.61

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

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

Frequency Band = LMR 750, Direction = RF downlink



3.3 Out of band rejection LMR750 763.00000M
_20dB

4.4.5 TEST EQUIPMENT USED

- Conducted

5 TEST EQUIPMENT

1 Conducted

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

6 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

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

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

Sample calculation

$\text{Power (dBm)} = U \text{ (dBm)} + AT_{\Delta\text{attenuator}} \text{ (dB)} + AT_{\text{attenuator}} \text{ (dB)} - AT_{\text{Cable}} \text{ (dB)}$
 U = Receiver reading
 $AT_{\Delta\text{attenuator}} = \text{Deviation to 20 dB}$
 $AT_{\text{attenuator}} = 20 \text{ dB}$
 $AT_{\text{Cable}} = \text{cable loss}$

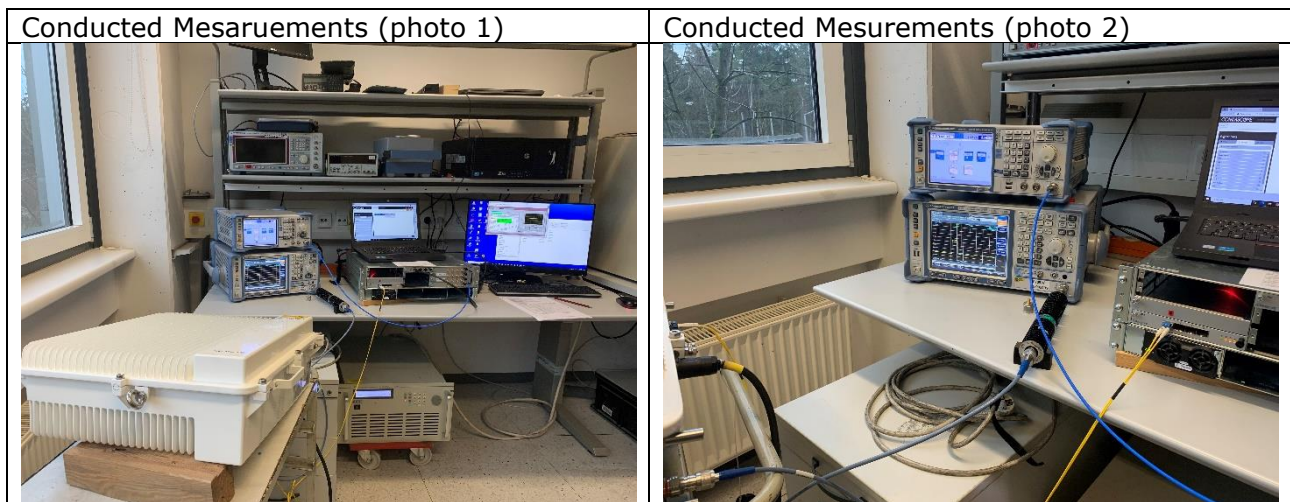
7 MEASUREMENT UNCERTAINTIES

KDB 935210 D05	ECL
Power measurement	0,68 dB
Measuring AGC threshold level	0,90 dB
Out of band rejection	0,90 dB
Input-versus-output signal comparison	0,91 dB
Mean power output	0,90 dB
Measuring out-of-band/out-of-block (including intermodulation) emissions and spurious emissions	0,90 dB
Out-of-band/out-of-block emissions conducted measurements	0,90 dB
Spurious emissions conducted	2,18 dB
Spurious emissions radiated measurements	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



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 *****