ECL-EMC Test Report No.: 17-064

Equipment under test: **Node DCM AF 727**
FCC ID: **BCR-AF727**

Type of test: **FCC 47 CFR Part 27 Subpart H, F: 2017**
Miscellaneous Wireless Communication Services

Measurement Procedures: 47 CFR Parts 2: 2017 (*Frequency Allocations and Radio Treaty Matters; General Rules and Regulations*),
Part 27: 2017 (Miscellaneous Wireless Communication Services),
ANSI/TIA-603-C:2004, *Land Mobile FM or PM Communications Equipment Measurement and Performance Standards*

Test result: **Passed**

Date of issue:	18.04.17	Signature:	
Issue-No.:	01	Author:	Tom Zahlmann Technical Leader EMC (CE) Digitally signed by Tom Zahlmann DN: cn=Tom Zahlmann, o=Bureau Veritas CPS, ou=ECL, email=tom.zahlmann@de.bureauveritas.com, c=DE Date: 2017.04.18 08:13:06 +02'00'
Date of delivery:	01.03.17	Checked:	Matthias Kräutlein Test engineer Digital unterschrieben von Matthias Kräutlein DN: cn=Matthias Kräutlein, o=Bureau Veritas CPS Germany GmBh, ou=ECL, email=matthias.kraeutlein@de.bureauveritas.com, c=DE Datum: 2017.04.18 08:35:48 +02'00'
Test dates:	01.03. – 29.03.17		
Pages:	67		

Manufacturer:	ANDREW Wireless Systems GmbH Industriering 10 D-86675 Buchdorf Tel.: +49 (0)9099 69 0 Fax: +49 (0)9099 69 140
Test Location:	Bureau Veritas Consumer Products Services Germany GmbH European Compliance Laboratory (ECL) Thurn-und-Taxis-Straße 18 D-90411 Nürnberg Tel.: +49 40 74041 0 Fax: +49 40 74041-2755

General:
The purpose of this report is to show compliance to the FCC regulations for devices operating under Part 27 of the Code of Federal Regulations title 47.
This report informs about the results of the EMC tests, it only refers to the equipment under test. No part of this report may be reproduced in any form, without written permission.

Table of contents

1 Test Results Summary

Name of Test	FCC Para. No.	FCC Method	FCC Spec.	Result
RF Power Output	27.50(b)(c)	2.1046	1000 Watts ERP	Complies
Occupied Bandwidth	2.1049	2.1049	Input/Output	Complies
Spurious Emissions at Antenna Terminals	27.53(c)(d)(g)	2.1051	-13dBm	Complies
Radiated Spurious emission	27.53(m)	2.1053 TIA/EA-603	-13dBm E.I.R.P	Complies
Intermodulation	KDB 935210 D02 v03r02 D.3(i)	KDB 935210 D02 v03r02 D.3(i)	KDB 935210 D02 v03r02 D.3(i)	Complies
*Frequency Stability	27.54	2.1055	Must stay in band	NA
Out of Band Rejection	KDB 935210 D02 v03r02	KDB 935210 D03 v04	KDB 935210 D03 v04	Complies

***Footnotes (Frequency Stability):**

(1) Modulation characteristics were not tested since the E.U.T processes but does not produce a modulated waveform.

(2) The equipment under test uses a common oscillator to down-convert the RF input to an intermediate frequency and to up-convert the IF to RF output. The RF input and output frequency are the same.

2 Equipment under test (E.U.T.)

2.1 Description

Kind of equipment	AF 727
Andrew Ident. Number	7577532-01
Serial no.(SN)	02ZCBF625815
Revision	00
Software version and ID	Node AM Software V1.7.6, 7613506-07
Type of modulation and Designator	CDMA (F9W) ☐ W-CDMA (F9W) ☐ LTE (G7D) ☒
Frequency Translation	F1-F1 ☒ F1-F2 ☐ N/A ☐
Band Selection	Software ☒ Duplexer ☒ Full band ☐

2.1.1 Downlink

Pass band	Path 728 MHz – 757 MHz
Pass band under test	Path 728 MHz – 746 MHz Path 746 MHz – 757 MHz
Max. composite output power based on one carrier per path (rated)	27.0 dBm = 0.5 W (LTE)
System Gain*	84 dB

2.1.2 Uplink

Pass band	Path 698 MHz – 716 MHz, 776 MHz - 787MHz
Maximum rated output power	30 dBm = 1 W
System Gain*	84 dB

2.1.3 Description of EUT

The Node A is an RF enhancer which is capable of filtering and amplifying a multitude of distinct sub-bands up to 120 MHz in total anywhere within multiple frequency bands. It is designed to be part of the primary infrastructure.

2.1.4 Block diagram of measurement reference points

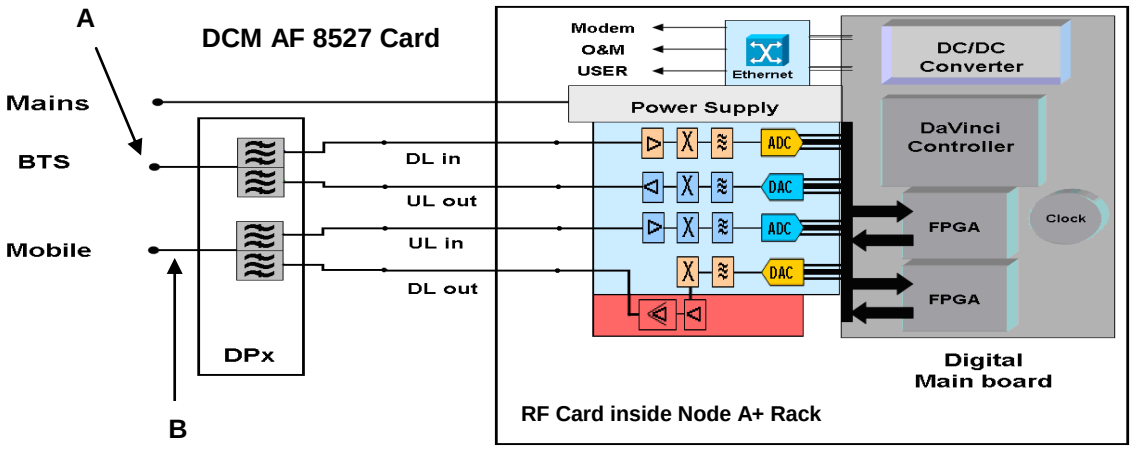


figure 2.1.4-#1 Block diagram of measurement reference points

DCM AF 727 is the EUT

Reference point A	UL output,	DL input
Reference point B	DL output,	UL input

3 Test site (Andrew Buchdorf)

3.1 Test environment

All tests were performed under the following environmental conditions:

Condition	Minimum value	Maximum value
Barometric pressure	86 kPa	106 kPa
Temperature	15°C	30°C
Relative Humidity	20 %	75 %
Power supply range	±5% of rated voltages	

3.2 Test equipment Test equipment

ANDREW Inv. No.	Test equipment	Type	Manufacturer	Serial No.	Calibration
8889	Network Analyzer	E5071C	Agilent	MY46100981	CIU
9126	Spectrum Analyzer	FSV 30	R&S	101237	08/2017
9069	Generator	SMBV100A	R&S	256275	08/2017
9046	Generator	SMBV100A	R&S	255090	05/2017
8542	Power Meter	E4418A	Agilent	GB38273230	01/2018
8544	Power Sensor	E8481H	Agilent	3318A19208	01/2018
7583	RF-Cable	Testpro 4.2	Radiall	---	CIU
7584	RF-Cable	Testpro 4.2	Radiall	---	CIU
7585	RF-Cable	Testpro 4.2	Radiall	---	CIU
7586	RF-Cable	Testpro 4.2	Radiall	---	CIU
7537	RF-Cable	Testpro 4.2 + Projack	Radiall	---	CIU
7542	RF-Cable	Testpro 4.2 + Projack	Radiall	---	CIU
7457	Notch Filter	WRCT728/757	Wainwright	1	CIU
7406	Matrix		COMMSCOPE	---	weekly

CIU = Calibrate in use

3.3 Input and output losses

All recorded power levels should be referenced to the input and output connectors of the repeater, unless explicitly stated otherwise.
The test equipment used in this test has to be calibrated, so that the functionality is also checked.
All cables, attenuators, splitter, isolator, circulator and combiner etc. must be measured before testing and used for compensation during testing.

3.4 Measurement uncertainty

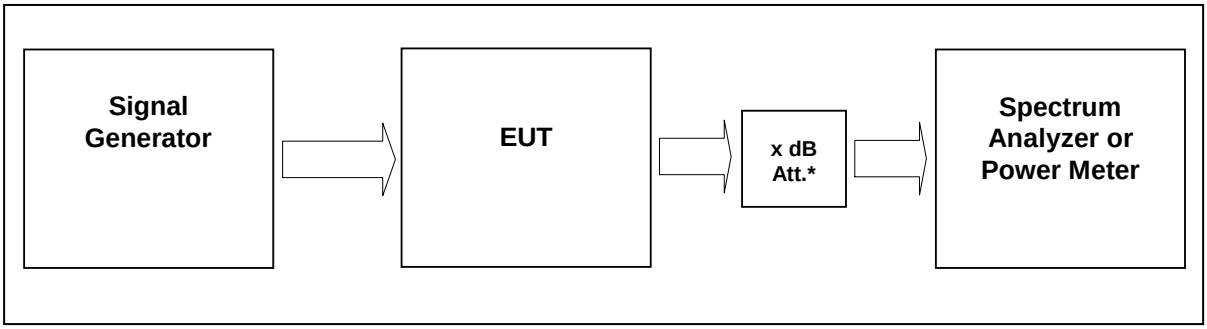
The extended measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor k=2. The true value is located in the corresponding interval with a probability of 95 %.

4 Test site (Bureau Veritas Consumer Products Services)

FCC Test site: **96997**

See relevant dates under section 10 of this test report.

5 RF Power Out: §27.50, §2.1046



External Attenuator DL x dB = 20 dB

figure 5-#1 Test setup: RF Power Out: §27.50, §2.1046

Measurement uncertainty	± 0,38 dB
Test equipment used	9046, 9126, 9784, 7537, 7584, 7542, 8542, 8544, 7370

5.1 Limit

Minimum standard:
Para. No.27.50(b)(4) and (c)(1) and (c) (3)

(b) The following power and antenna height limits apply to transmitters operating in the 746–763 MHz, 775–793 MHz and 805–806 MHz bands:

(4) Fixed and base stations transmitting a signal in the 746–757 MHz, 758–763 MHz, 776–787 MHz, and 788–793 MHz bands 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.

(c) The following power and antenna height requirements apply to stations transmitting in the 698–746 MHz band:

(1) Fixed and base stations transmitting a signal with an emission bandwidth of 1 MHz or less must not exceed an effective radiated power (ERP) of 1000 watts and an antenna height of 305 m height above average terrain (HAAT), except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section;

(3) Fixed and base stations transmitting a signal 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 in accordance with Table 3 of this section;

5.2 Test method

§ 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations

5.3 Test Results

Detector RMS.

Test signal LTE:
Signal waveform according to Test Model 1.1, E-TM1.1, clause 6.1.1.1-1, table 6.1.1.1-1 of standard specification 3GPP TS 36.141 V9.3.0 (2010-03).

5.3.1 Downlink

Modulation	Measured at	Path	RBW VBW Span	RF Power (dBm)	RF Power (W)	Plot -
LTE	Middle	737 MHz (Band 12 (Band Class 19))	3MHz 10MHz 15MHz	27.0	0.5	5.3.2.2 #1
LTE	Middle	751.5 MHz (Band 13 (Band Class 7))	3MHz 10MHz 15MHz	27.0	0.5	5.3.2.3 #1

table 5.3.1-#1 RF Power Out: §27.50, §2.1046 Test Results Downlink

The max RF Power out is 27 dBm, so the maximum antenna gain (x) can be calculated as follow:

Limit = 1000W (erp) = **60 dBm** Info: 1000W (erp) = 1640W (eirp)

60 dBm **>** 27 dBm + x ------> x = 60 dBm – 27 dBm = 33 dBd
x dBi = 33 dBd + 2.15 = 35.15 dBi

=> The antenna that will be used for the complete system have to have a gain lower than 35.15 dBi, relative to a dipol.

5.3.2 Uplink

Modulation	Measured at	Path	RBW VBW Span	RF Power (dBm)	RF Power (W)	Plot -
LTE	Middle	707.0 MHz (Band 12 (Band Class 19))	3MHz 10MHz 15MHz	30.0	1.0	5.3.2.2 #1
LTE	Middle	781.5 MHz (Band 13 (Band Class 7))	3MHz 10MHz 15MHz	30.0	1.0	5.3.2.3 #1

table 5.3.2-#2 RF Power Out: §27.50, §2.1046 Test Results Uplink

The max RF Power out is 25 dBm, so the maximum antenna gain (x) can be calculated as follow:

Limit = 1000W (erp) = **60 dBm** Info: 1000W (erp) = 1640W (eirp)

60 dBm **>** 30 dBm + x ------> x = 60 dBm – 30 dBm = 30 dBd
x dBi = 30 dBd + 2.15 = 32.15 dBi

=> The antenna that will be used for the complete system have to have a gain lower than 32.15 dBi, relative to a dipol.

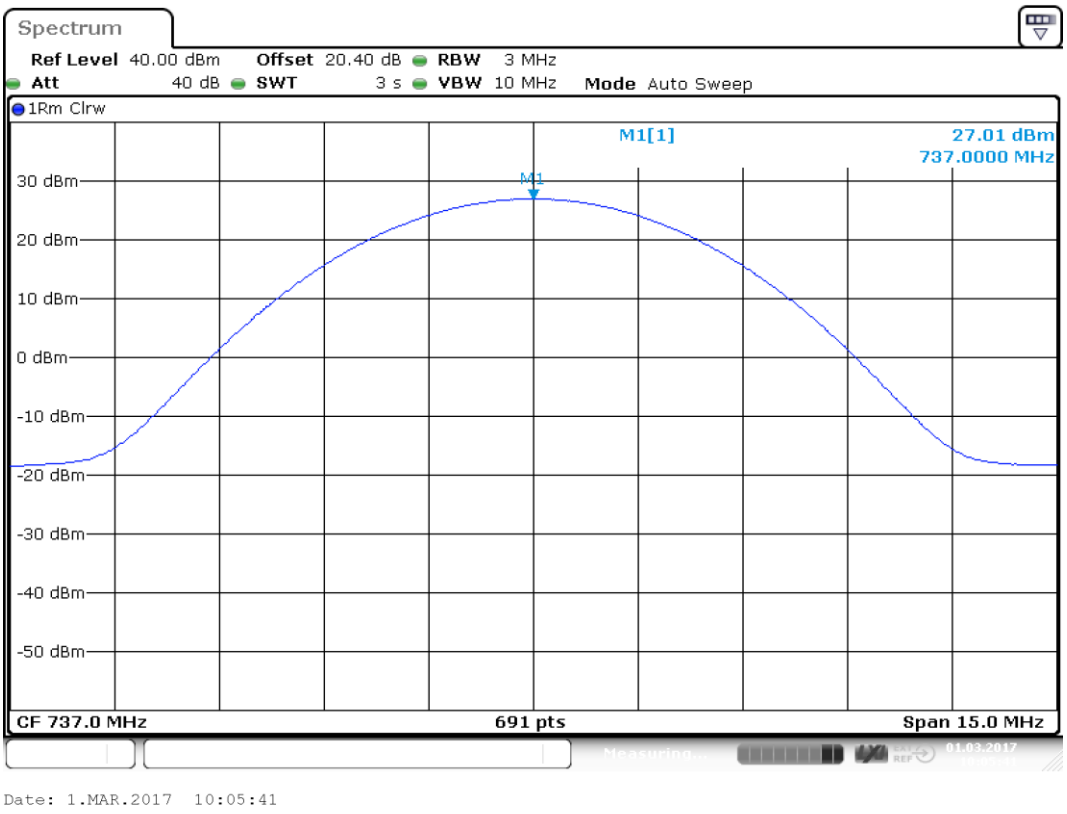
5.3.2.1 LTE Downlink

Modulation	Pin / dBm (Ref. point A)
LTE (Band 12 (Band Class 19))	-57.0
LTE (Band 13 (Band Class 7))	-57.0

*measured with 84dB gain

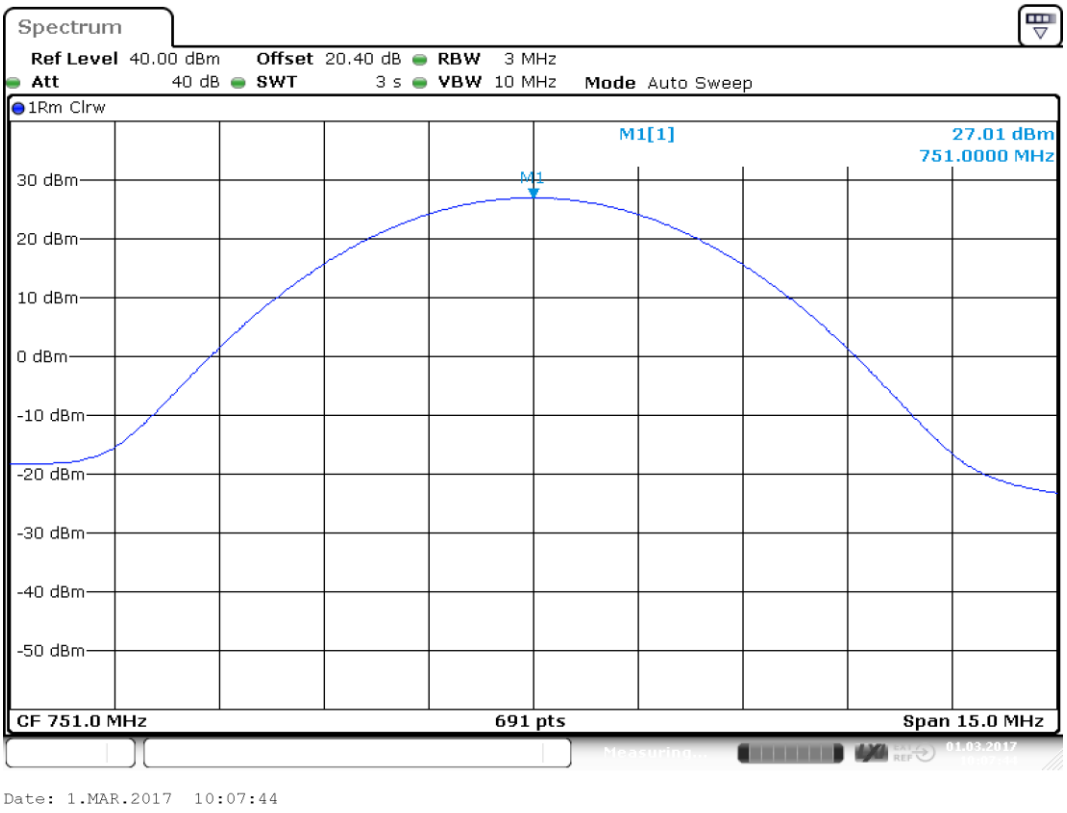
table 5.3.2-#3 RF Power Out: §27.50, §2.1046 Test Results LTE Downlink Input power

5.3.2.2 LTE 728 – 746MHz



plot 5.3.2.2-#1 RF Power Out: §27.50, §2.1046;; LTE 728 – 746MHz Middle

5.3.2.3 LTE 746 – 757MHz



plot 5.3.2.3-#1 RF Power Out: §27.50, §2.1046; Uplink; LTE 746 – 757MHz Middle

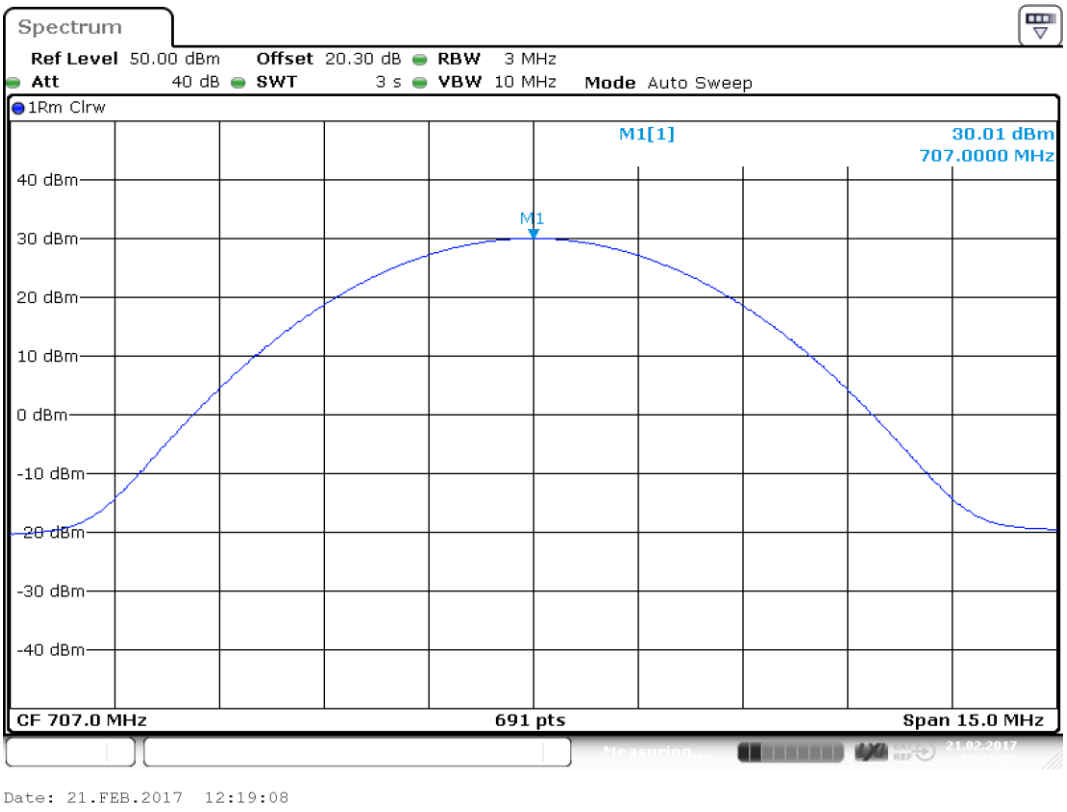
5.3.2.4 LTE Uplink

Modulation	Pin / dBm (Ref. point A)
LTE (Band 12 (Band Class 19))	-54.0
LTE (Band 13 (Band Class 7))	-54.0

*measured with 84dB gain

table 5.3.2-#4 RF Power Out: §27.50, §2.1046 Test Results Uplink Input power

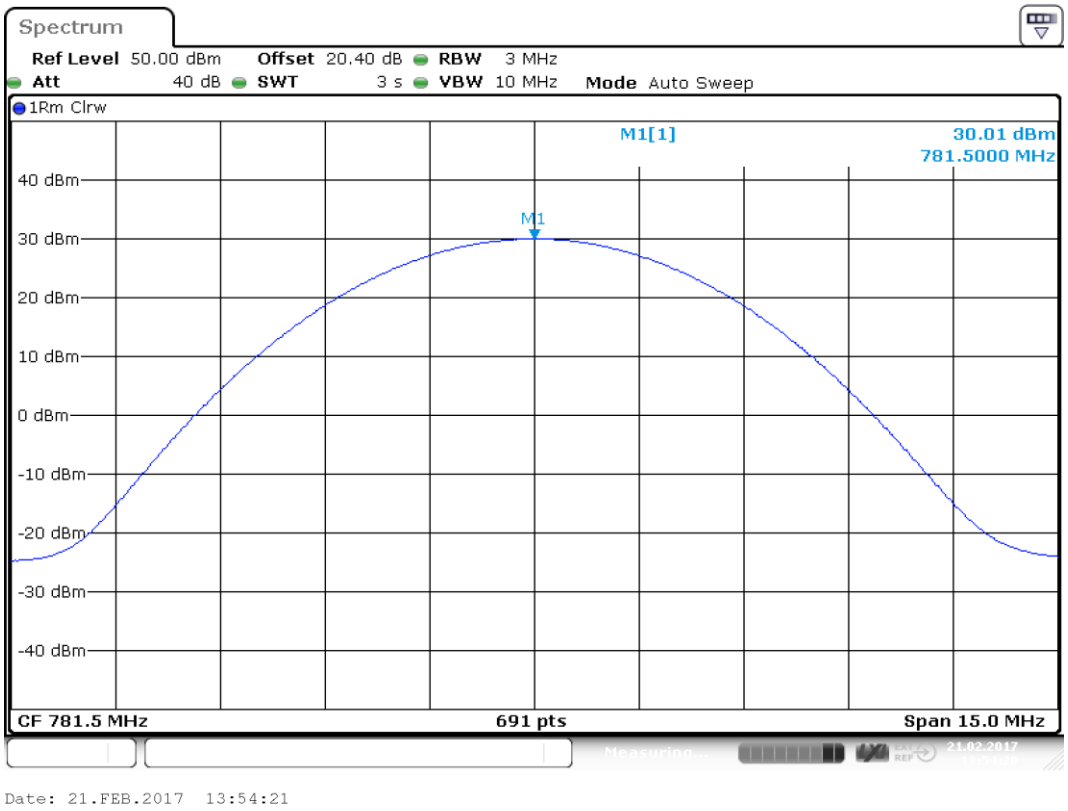
5.3.2.5 LTE 698 – 716MHz



Date: 21.FEB.2017 12:19:08

plot 5.3.2.5-#1 RF Power Out: §27.50, §2.1046; Uplink; LTE 698 – 716MHz Middle

5.3.2.6 LTE 776 – 787MHz

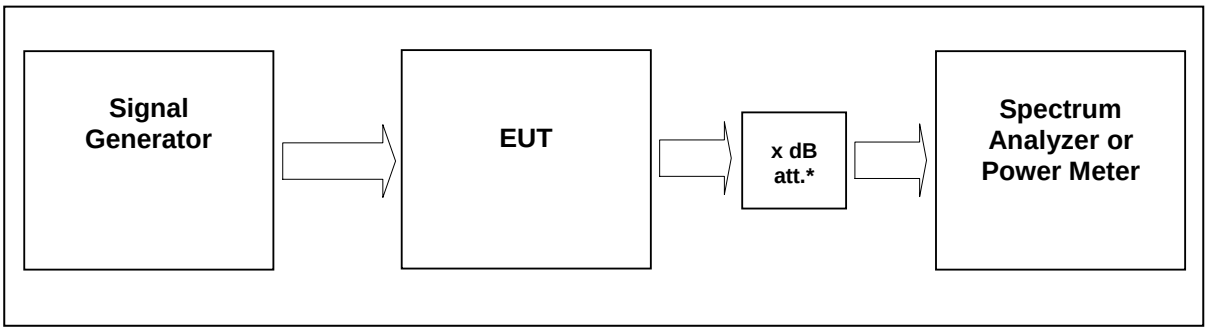


plot 5.3.2.6-#1 RF Power Out: §27.50, §2.1046; Uplink; LTE 776 – 787MHz Middle

5.4 Summary test result

Test result	complies, according the plots above
Tested by:	F. Bengesser
Date:	01.03.2017

6 Occupied Bandwidth: §2.1049



External Attenuator DL x dB = 20 dB

figure 6-#1 Test setup: Occupied Bandwidth: §2.1049

Measurement uncertainty	± 0,38 dB
Test equipment used	9236, 9123, 9300, 8990, 8668, 8667, 7406,

6.1 Limit

The spectral shape of the output should look similar to input for all modulations.

6.2 Test method

Para. No.2.1049

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:

6.3 Test results

6.3.1 Downlink

Detector PK.

Modulation	Measured at	Path	RBW VBW Span	Occupied Bandwidth / MHz	Plot #
LTE	Middle	737 MHz Band 12 (Band Class 19)	30 kHz 300 kHz 5 MHz	1.1	6.3.2.1 #1, #2
LTE	Middle	751.5 MHz Band 13 (Band Class 7)	30 kHz 300 kHz 5 MHz	1.1	6.3.2.2 #1, #2

Modulation	Measured at	Path	RBW VBW Span	26dB Bandwidth / MHz	Plot #
LTE	Middle	737 MHz Band 12 (Band Class 19)	30 kHz 300 kHz 5 MHz	1.3	6.3.3.1 #1, #2
LTE	Middle	751.5 MHz Band 13 (Band Class 7)	30 kHz 300 kHz 5 MHz	1.4	6.3.3.2 #1, #2

table 6.3-#1 Occupied Bandwidth: §2.1049 Test results Downlink

6.3.2 Uplink

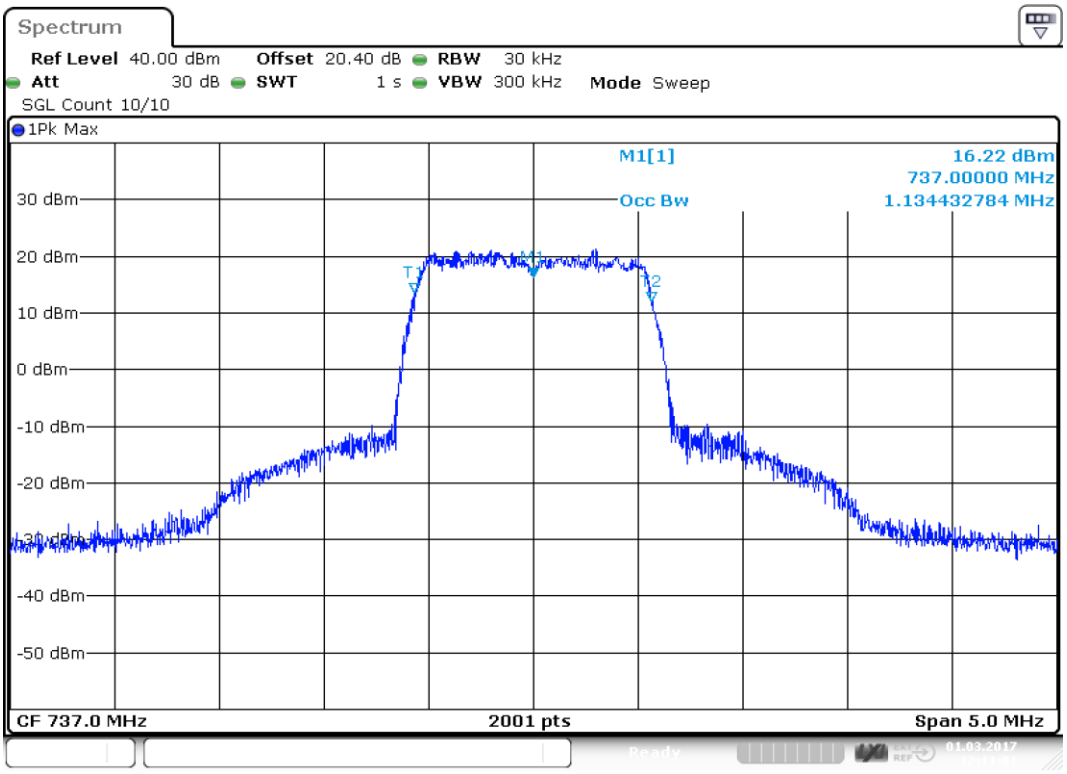
Detector PK.

Modulation	Measured at	Path	RBW VBW Span	Occupied Bandwidth / MHz	Plot #
LTE	Middle	707 MHz Band 12 (Band Class 19)	30 kHz 300 kHz 5 MHz	1.1	6.3.2.1 #1, #2
LTE	Middle	781.5 MHz Band 13 (Band Class 7)	30 kHz 300 kHz 5 MHz	1.1	6.3.2.2 #1, #2

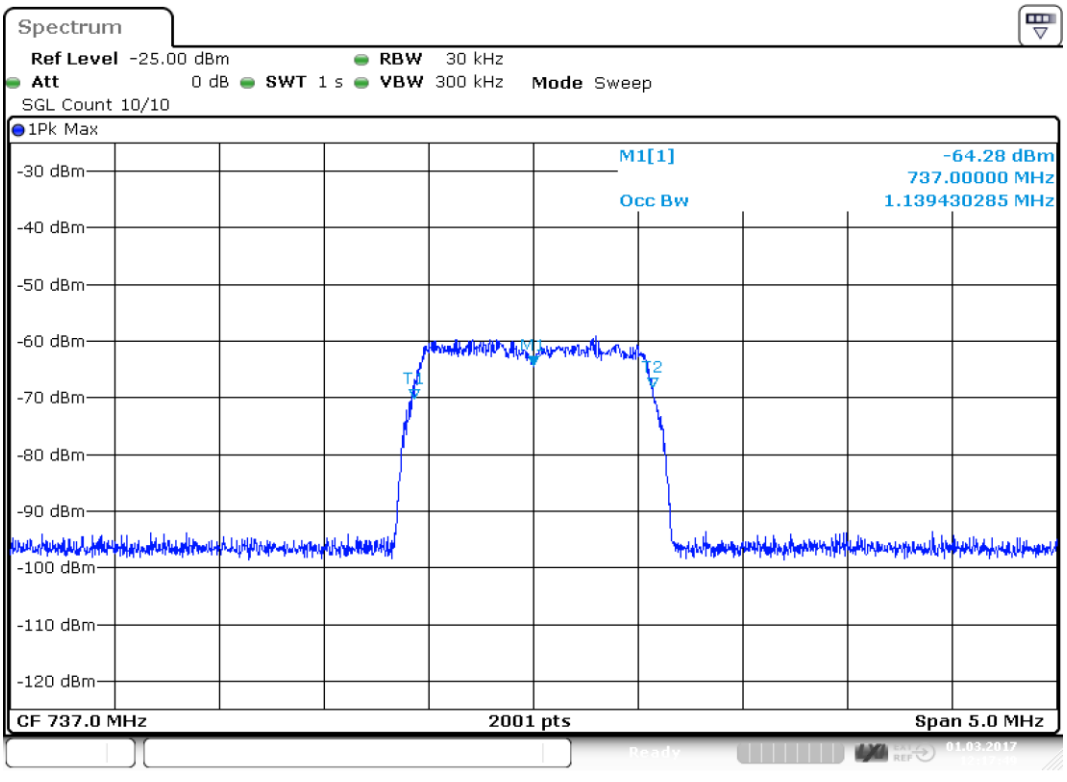
Modulation	Measured at	Path	RBW VBW Span	26dB Bandwidth / MHz	Plot #
LTE	Middle	707 MHz Band 12 (Band Class 19)	30 kHz 300 kHz 5 MHz	1.3	6.3.3.1 #1, #2
LTE	Middle	781.5 MHz Band 13 (Band Class 7)	30 kHz 300 kHz 5 MHz	1.3	6.3.3.2 #1, #2

table 6.3-#2 Occupied Bandwidth: §2.1049 Test results Uplink

6.3.2.1 Downlink LTE 728 – 746MHz

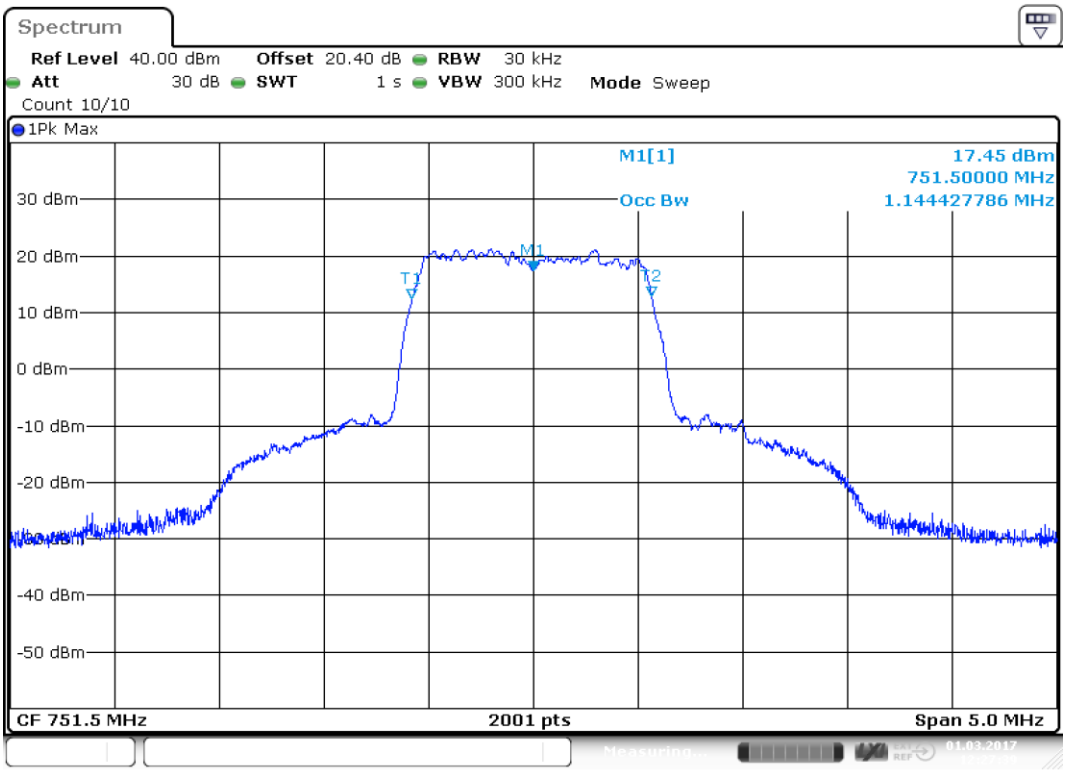


plot 6.3.2.1-#1 Occupied Bandwidth: §2.1049; Test results; Downlink LTE 728 – 746MHz Output



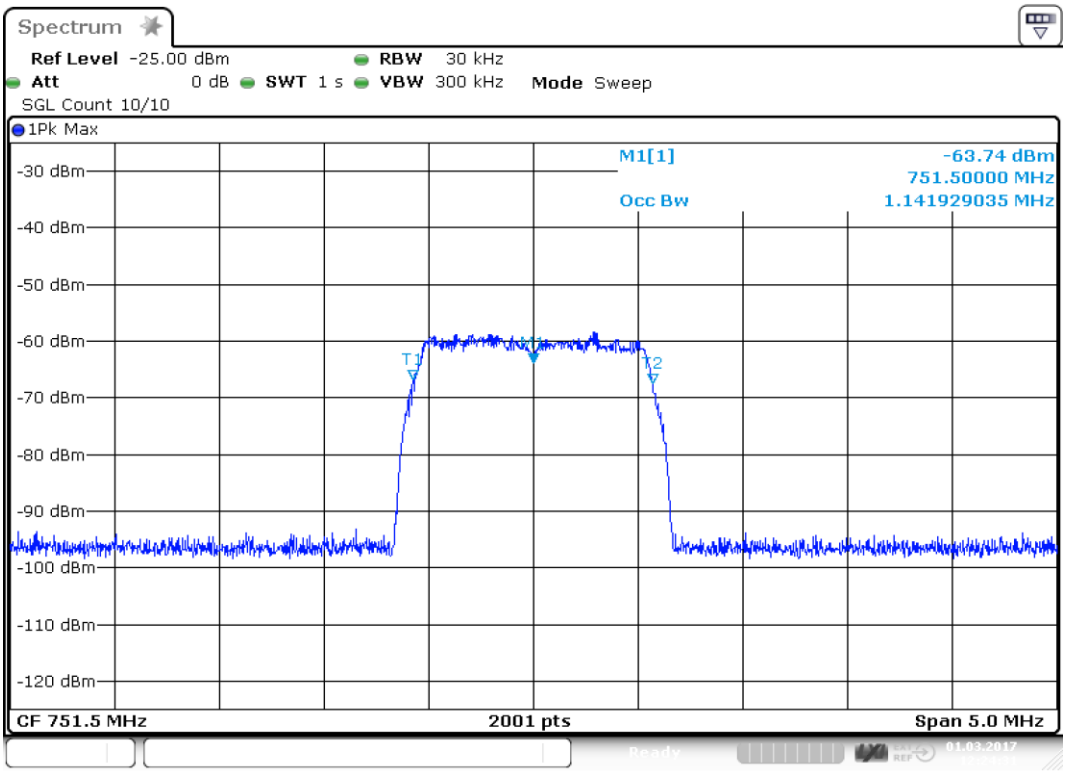
plot 6.3.2.1-#2 Occupied Bandwidth: §2.1049; Test results; Downlink LTE 728 – 746MHz Input

6.3.2.2 Downlink LTE 746 – 757MHz



Date: 1.MAR.2017 12:27:40

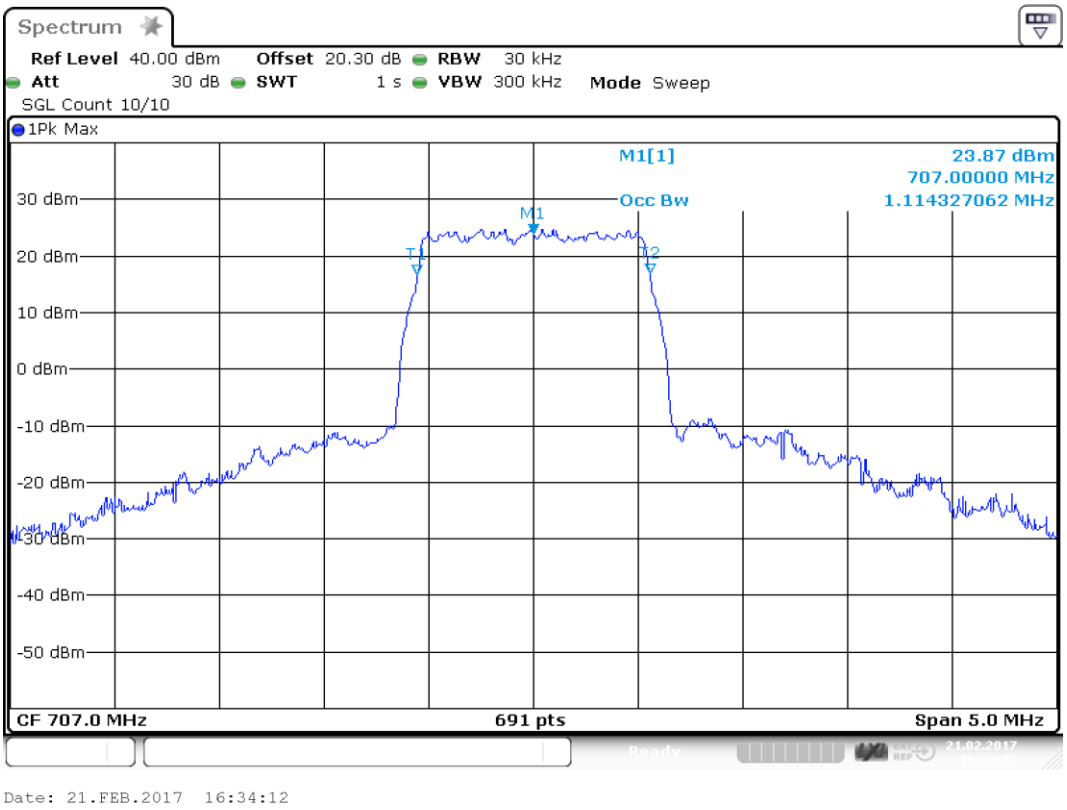
plot 6.3.2.2-#1 Occupied Bandwidth: §2.1049; Test results; Downlink LTE 746 – 757MHz Output



Date: 1.MAR.2017 12:24:31

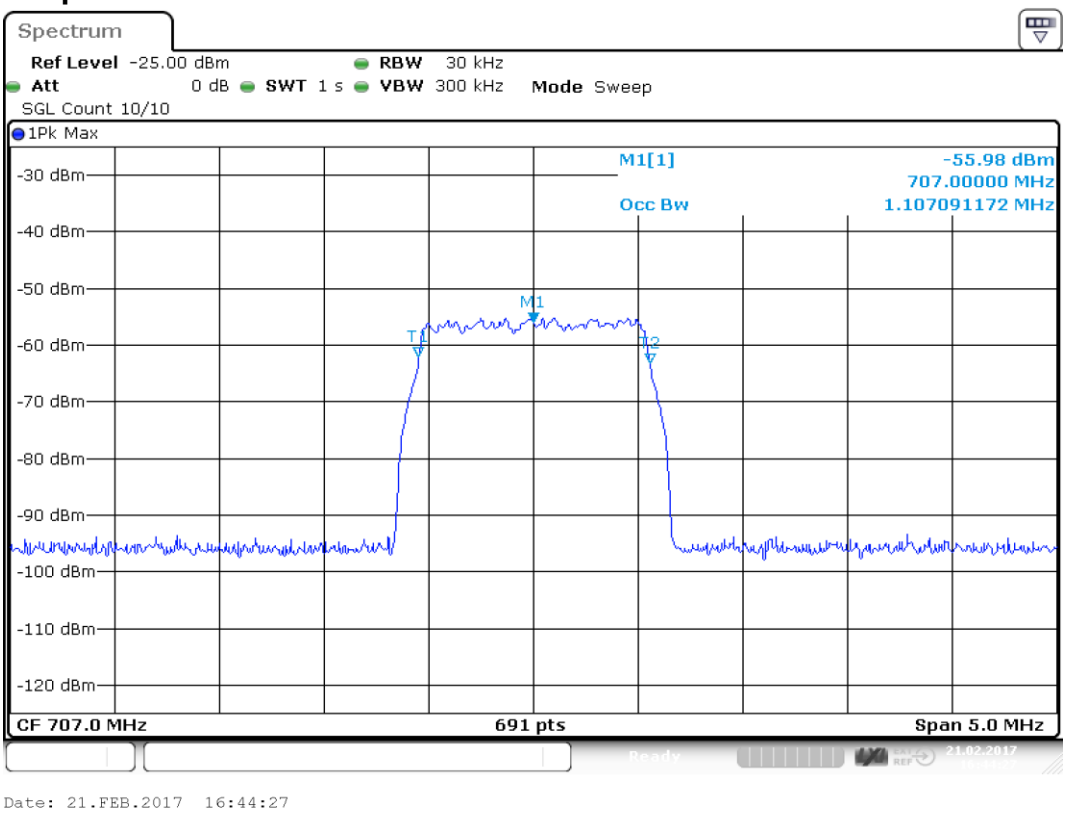
plot 6.3.2.2-#2 Occupied Bandwidth: §2.1049; Test results; Downlink LTE 746 – 757MHz Input

6.3.2.3 Uplink LTE 698 – 716MHz



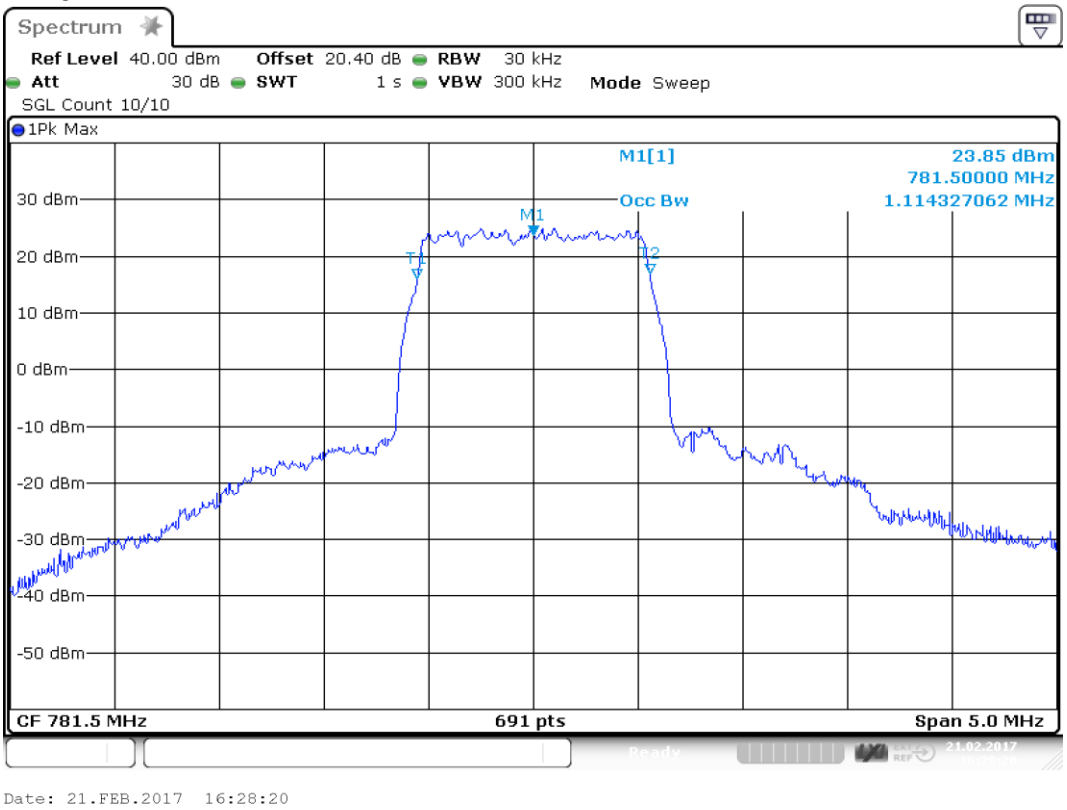
plot 6.3.2.3-#1 Occupied Bandwidth: §2.1049; Test results; Uplink LTE 698 – 716MHz Output

6.3.2.4 Uplink LTE 698 – 716MHz



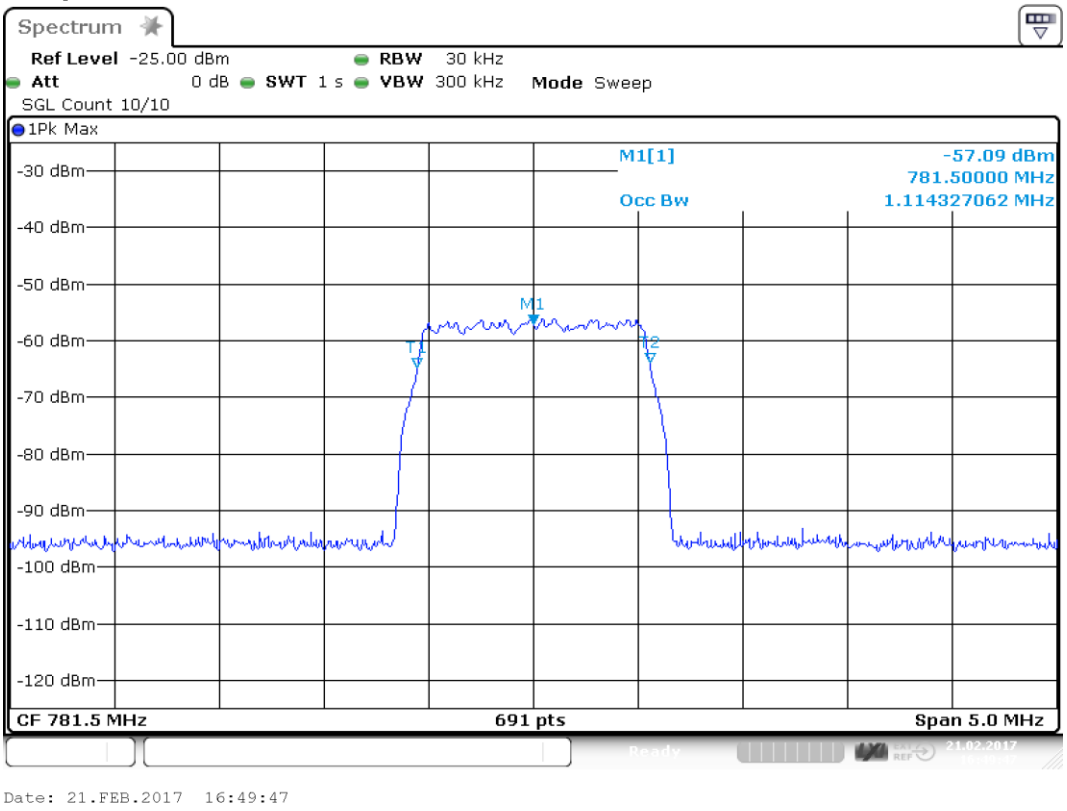
plot 6.3.2.4-#1 Occupied Bandwidth: §2.1049; Test results; Uplink LTE 698 – 716MHz Input

6.3.2.5 Uplink LTE 776 – 787MHz



plot 6.3.2.5-#1 Occupied Bandwidth: §2.1049; Test results; Uplink LTE 776 – 787MHz Output

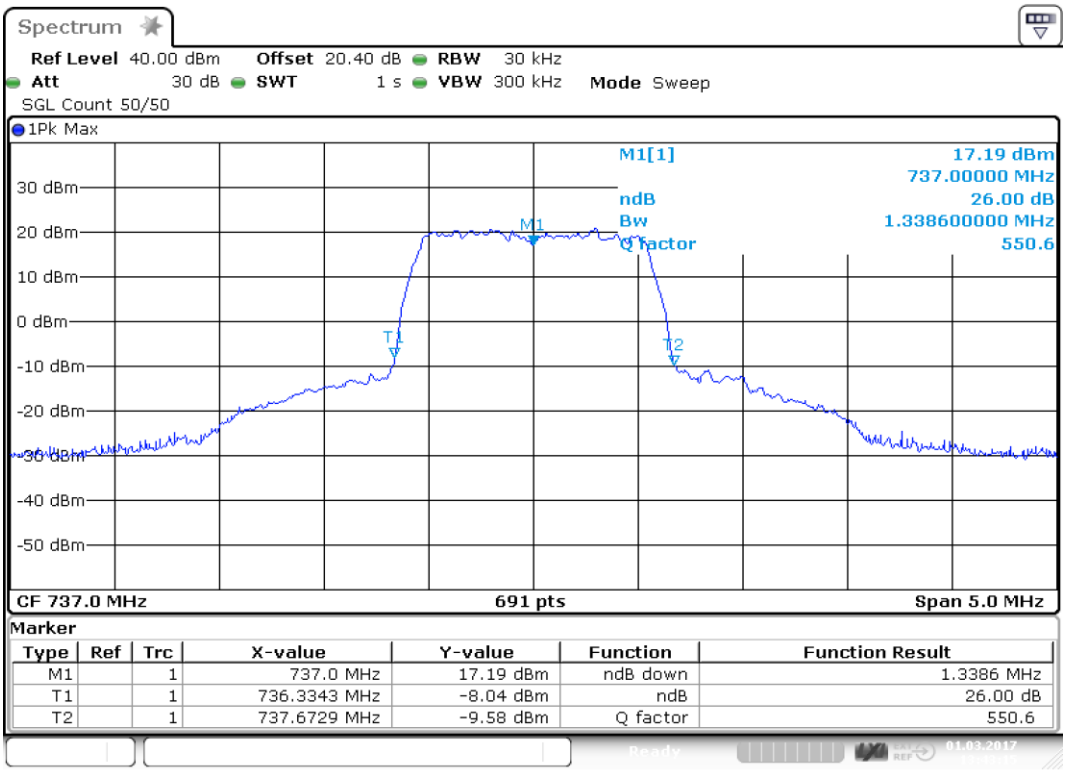
6.3.2.6 Uplink LTE 776 – 787MHz



plot 6.3.2.6-#1 Occupied Bandwidth: §2.1049; Test results; Uplink LTE 776 – 787MHz Input

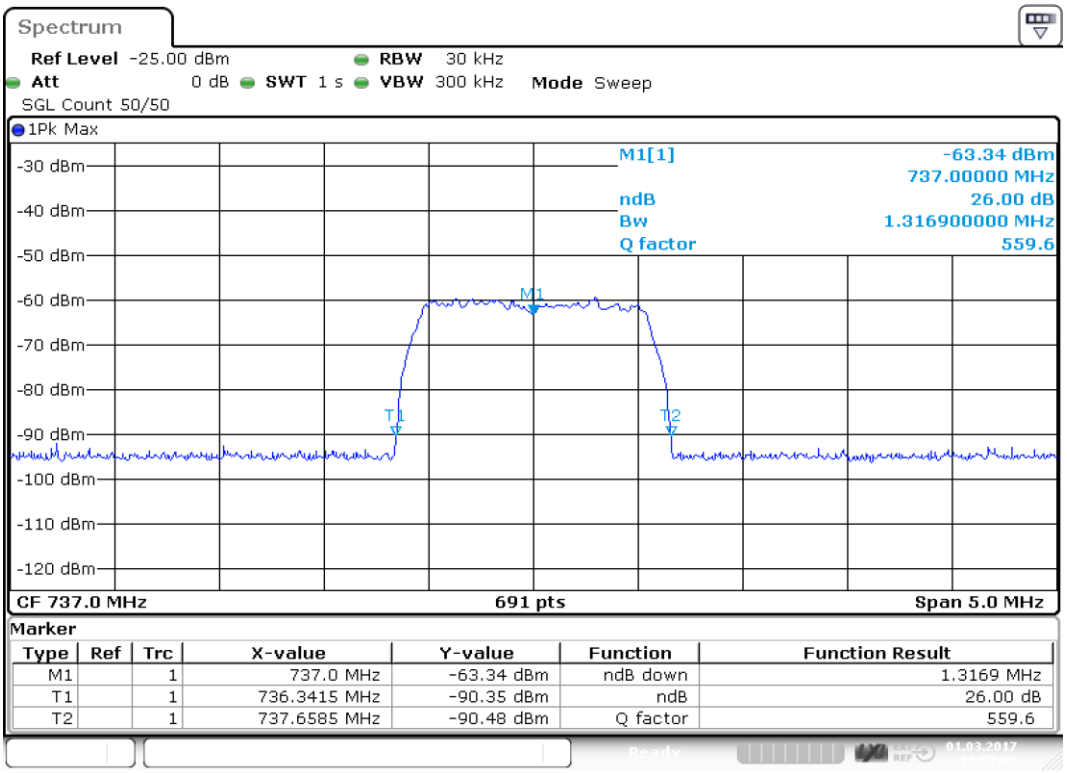
6.3.3 26 dB Bandwidth

6.3.3.1 Downlink LTE 728 – 746 MHz



Date: 1.MAR.2017 13:43:15

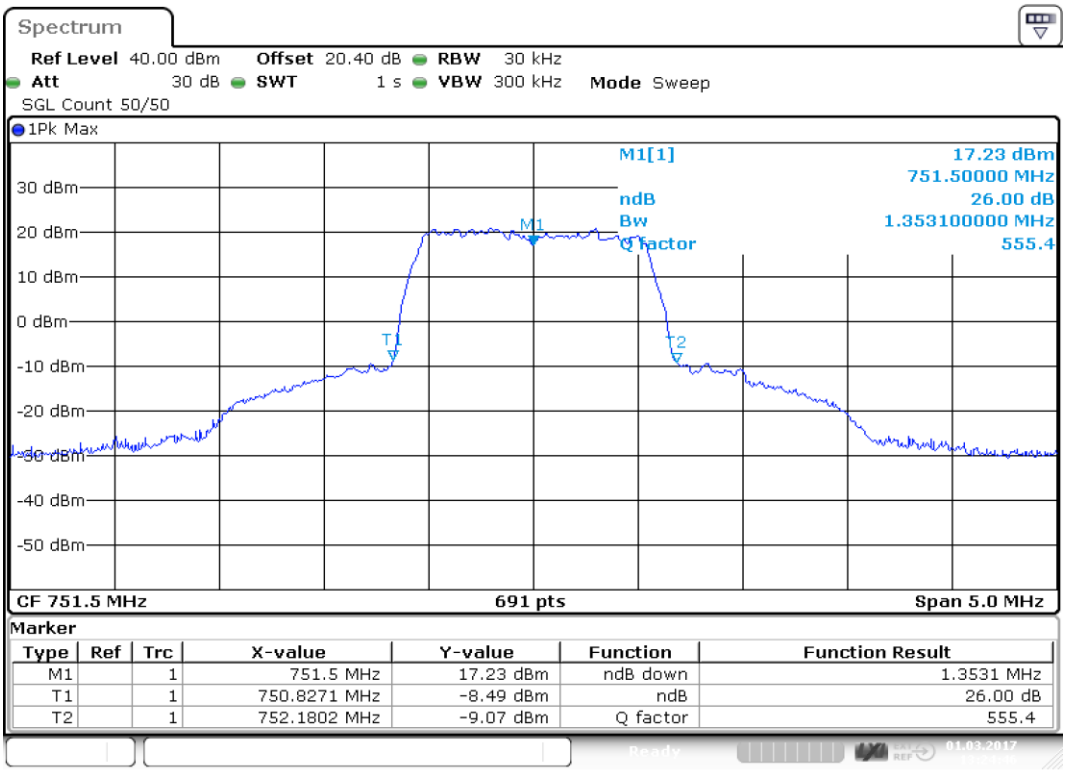
plot 6.3.3.1-#1 Occupied Bandwidth: §2.1049; Test results; 26 dB Bandwidth; Downlink LTE 728 – 746 MHz Output



Date: 1.MAR.2017 13:57:03

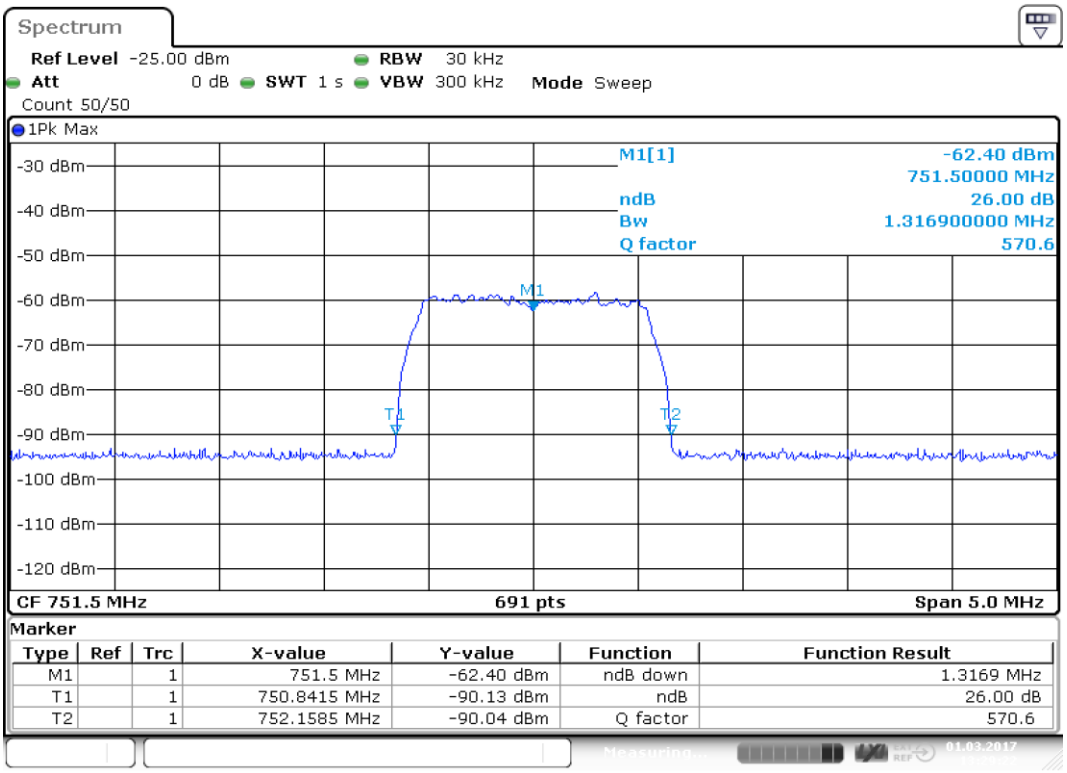
plot 6.3.3.1-#2 Occupied Bandwidth: §2.1049; Test results; 26 dB Bandwidth; Downlink LTE 728 – 746 MHz Input

6.3.3.2 Downlink LTE 746 – 757MHz



Date: 1.MAR.2017 13:24:46

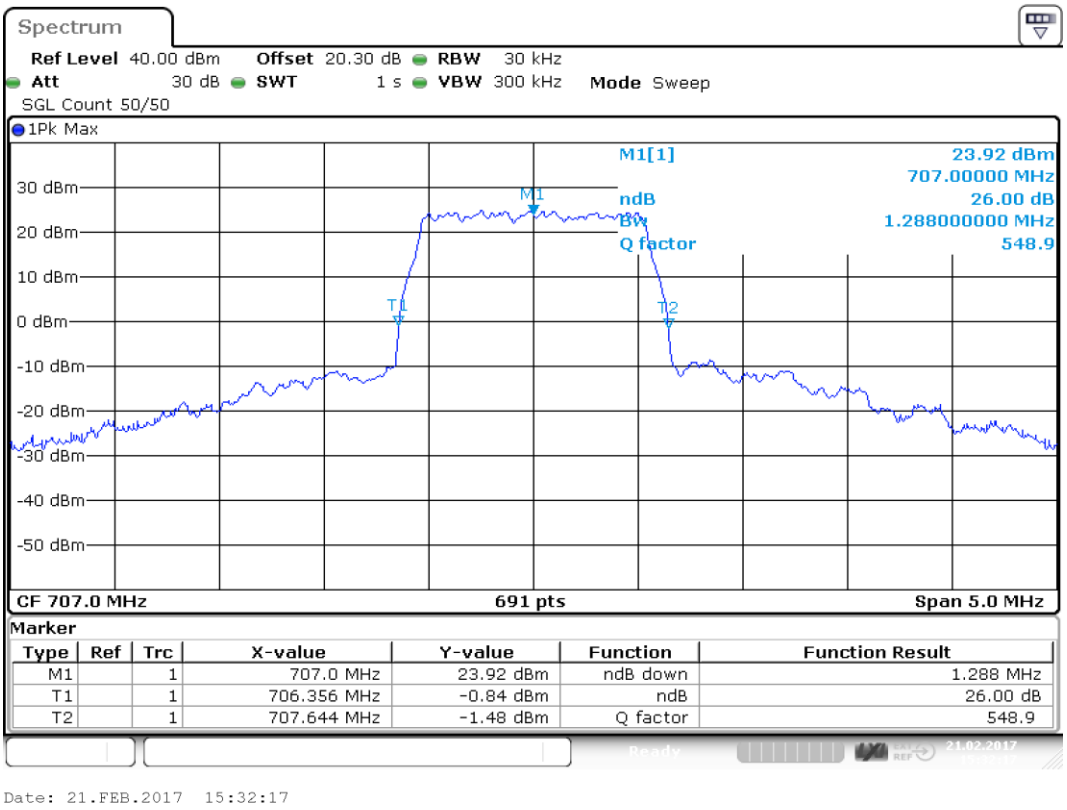
plot 6.3.3.2-#1 Occupied Bandwidth: §2.1049; Test results; 26 dB Bandwidth; Downlink LTE 746 – 757MHz Output



Date: 1.MAR.2017 13:29:22

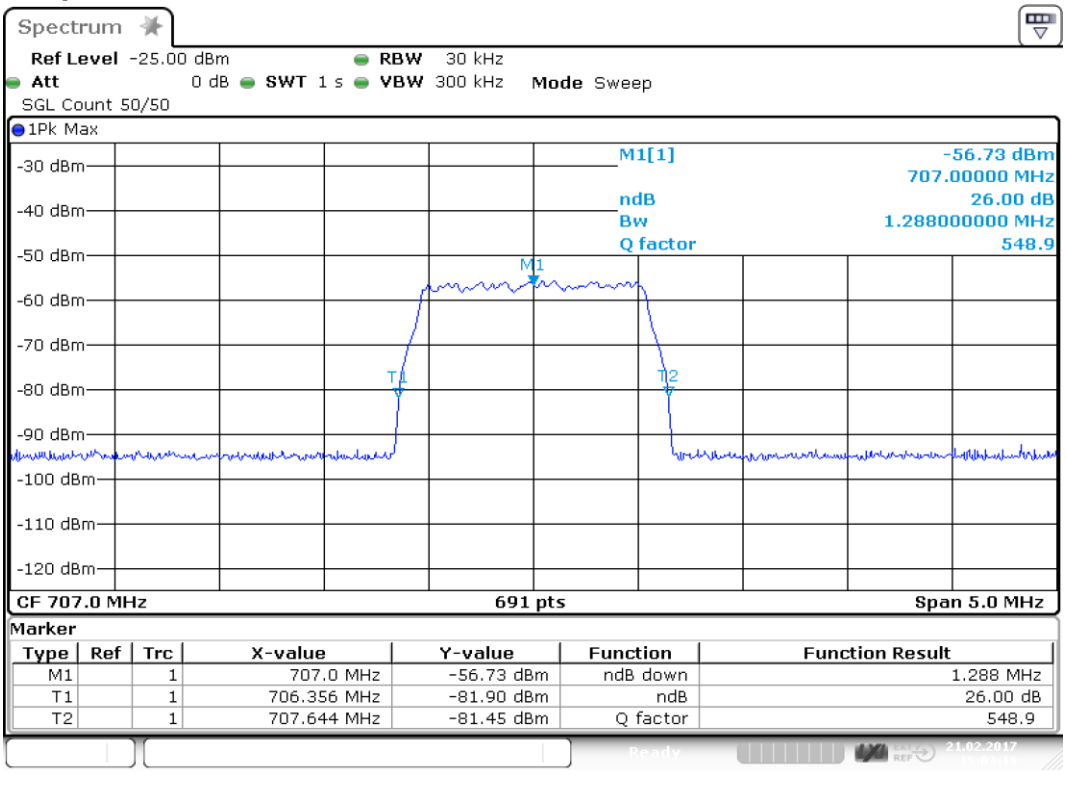
plot 6.3.3.2-#2 Occupied Bandwidth: §2.1049; Test results; 26 dB Bandwidth; Downlink LTE 746 – 757MHz Input

6.3.3.3 Uplink LTE 698 – 716 MHz



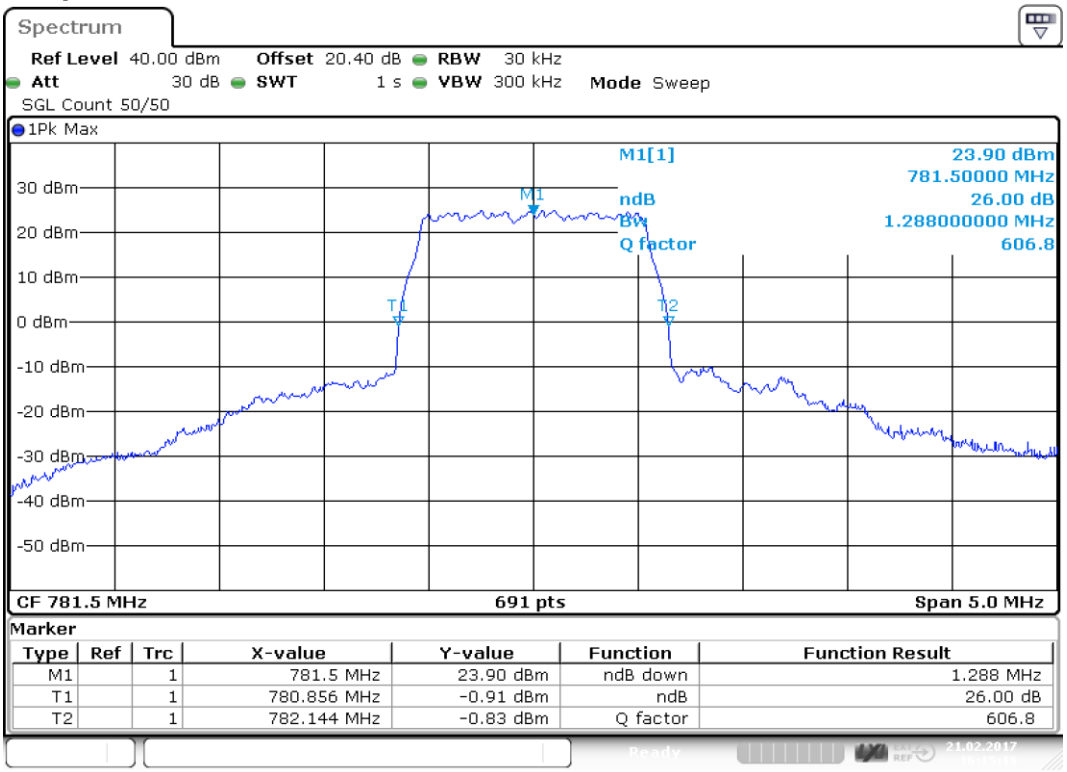
plot 6.3.3.3-#1 Occupied Bandwidth: §2.1049; Test results; 26 dB Bandwidth; Uplink LTE 698 – 716 MHz Output

6.3.3.4 Uplink LTE 698 – 716 MHz



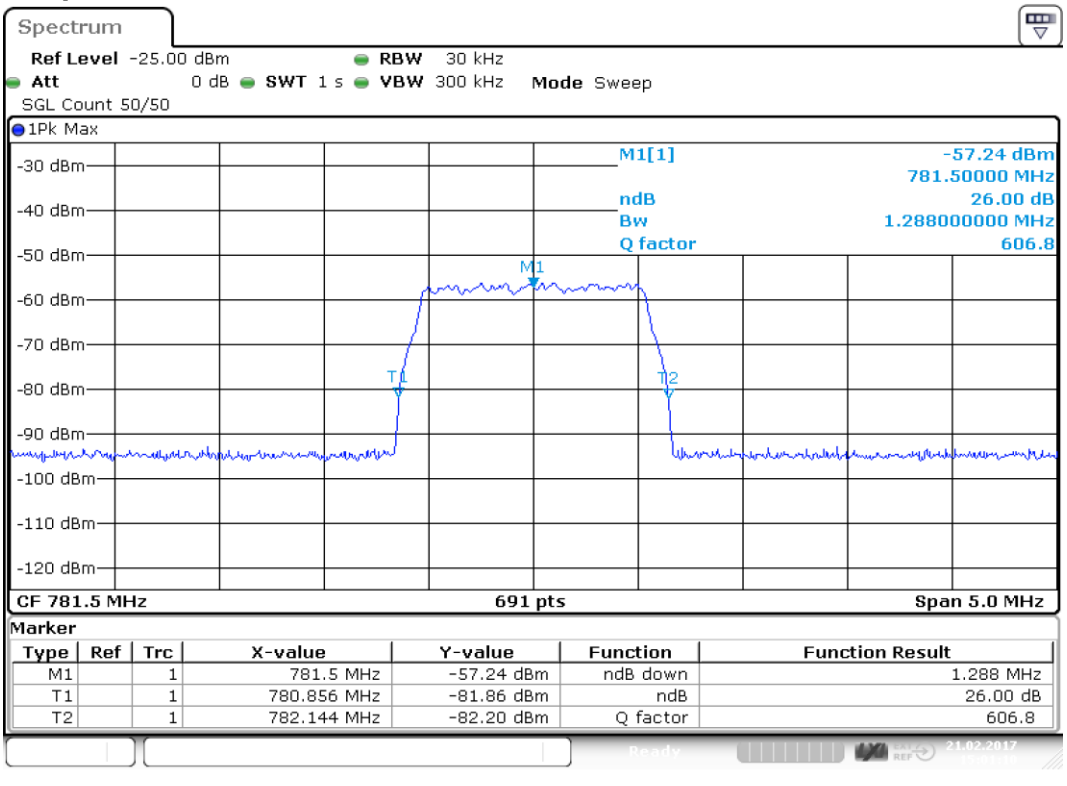
plot 6.3.3.4-#1 Occupied Bandwidth: §2.1049; Test results; 26 dB Bandwidth; Uplink LTE 698 – 716 MHz Input

6.3.3.5 Uplink LTE 776 – 787 MHz



plot 6.3.3.5-#1 Occupied Bandwidth: §2.1049; Test results; 26 dB Bandwidth; Uplink LTE 776 – 787 MHz Output

6.3.3.6 Uplink LTE 776 – 787 MHz

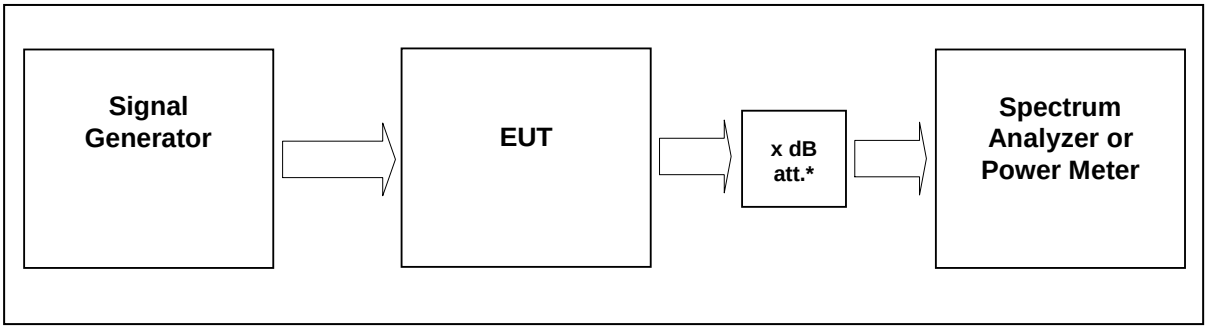


plot 6.3.3.6-#1 Occupied Bandwidth: §2.1049; Test results; 26 dB Bandwidth; Uplink LTE 776 – 787 MHz Input

6.4 Summary test result

Test result	complies, according the plots above
Tested by:	F. Bengesser
Date:	01.03.2017

7 Spurious Emissions at Antenna Terminals: §27.53, §2.1051



External Attenuator DL x dB = 20 dB

figure 7-#1 Test setup: Spurious Emissions at Antenna Terminals: §27.53, §2.1051

Measurement uncertainty	± 0,54 dB ± 1,2 dB ± 1,5 dB	9 kHz to 3 GHz 3 GHz to 7 GHz 7 GHz to 26 GHz
Test equipment used	9236, 9123, 9300, 8990, 8668, 8667, 7406, 7457	

7.1 Limit

Minimum standard:
Para. No.27.53 (c), (f) and (g)

(c) For operations in the 746–758 MHz band and the 776–788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763–775 MHz and 793–805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(f) For operations in the 746–763 MHz, 775–793 MHz, and 805–806 MHz bands, emissions in the band 1559–1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(g) For operations in the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed

7.2 Test method

Para. No 2.1051 Measurements required: Spurious emissions at antenna terminals.
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.
[39 FR 5919, Feb. 15, 1974. Redesignated andamended at 63 FR 36599, July 7, 1998]

7.3 Test results

7.3.1 Downlink

Detector: RMS.

Modulation	Carrier	RBW VBW Span	Max. level (dBm)	Plot -
LTE Band 12 (Band Class 19)	737 MHz	1MHz 3MHz 30MHz – 8GHz	-39.7	7.3.2.1 #1
LTE Band 13 (Band Class 7)	751.5 MHz	1MHz 3MHz 30MHz – 8GHz	-38.9	7.3.2.2 #1

table 7.3-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051 Test results

Calculation of the limit according to §27.53 (c)(3):
On all frequencies between 763–775 MHz and 793–805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

Pout = 27 dBm = 0.501 W

76+ 10*log(0,501W/1W) dB = 73 dB Attenuation => 27dBm – 73dB = -46 dBm in a 6.25 kHz band segment
Spurious measured in the plot with a RBW of 1MHz so the limit is calculated:

=> -46dBm / 6,25kHz + 10*log(1MHz/6,25kHz) = -23,96dBm / 1MHz
(in the frequency range 763–775 MHz and 793–805 MHz)

maximum measured emission level for frequencies between 763–775 MHz and 793–805 MHz is below -30 dBm / 1MHz.

Test passed.

Plots with test result see

plot 7.3.2.1 #2

plot 7.3.2.1 #3

plot 7.3.2.2 #2

plot 7.3.2.2 #3

Considerations to §27.53 (f):
To see if the standard 27.53(f) were met a calculation of the radiated power is necessary. The modulated carrier in the range of 747-757 MHz is working with maximum power and the frequency range of 1559-1610MHz is measured. For the calculation of the radiated power in this band, it was calculated with a typical antenna gain and typical cable loss.
Used 700 MHz narrow band antennas offer a gain of 0 dBi in the in the frequency range 1559 - 1610 MHz, furthermore an antenna cable with a loss of 2 dB is used.
The measured conducted emissions in the frequency range of 1599 - 1610 MHz are below -58,4 dBm/MHz (see at plot 7.3.2.3).
Conducted emissions (<-58.4 dBm) + antenna gain (0 dBi) - cable loss (0 dB) = radiated emissions (<-58.4 dBm) which is below the limit of Part 27.53(f).
Even with an antenna gain of 2 dBi (more than worst case) in the frequency range of 1599 - 1610 MHz, we are still under the limit of Part 27.53(f) with a radiated emission of -56.4 dBm.

Therefore the emission limit is met.

Test passed.

Plots with test result see7.3.2.3 Downlink Measurement in the band of 1559 MHz – 1610 MHz acc. to 27.53(f)

7.3.2 Uplink

Detector: RMS.

Modulation	Carrier	RBW VBW Span	Max. level (dBm)	Plot -
LTE Band 12 (Band Class 19)	707 MHz	1MHz 3MHz 30MHz – 8GHz	-25.4	7.3.2.1 #1
LTE Band 13 (Band Class 7)	781.5 MHz	1MHz 3MHz 30MHz – 8GHz	-27.1	7.3.2.2 #1

table 7.3-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051 Test results

Calculation of the limit according to §27.53 (c)(3):
On all frequencies between 763–775 MHz and 793–805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

Pout = 30 dBm = 1.0 W

76+ 10*log(1/1W) dB = 76 dB Attenuation => 30dBm – 76dB = -46 dBm in a 6.25 kHz band segment
Spurious measured in the plot with a RBW of 1MHz so the limit is calculated:

=> -46dBm / 6,25kHz + 10*log(1MHz/6,25kHz) = -23,96dBm / 1MHz
(in the frequency range 763–775 MHz and 793–805 MHz)

maximum measured emission level for frequencies between 763–775 MHz and 793–805 MHz is below -30 dBm / 1MHz.

Test passed.

Plots with test result see

plot 7.3.2.4 #2

plot 7.3.2.4 #3

plot 7.3.2.5 #2

plot 7.3.2.5 #3

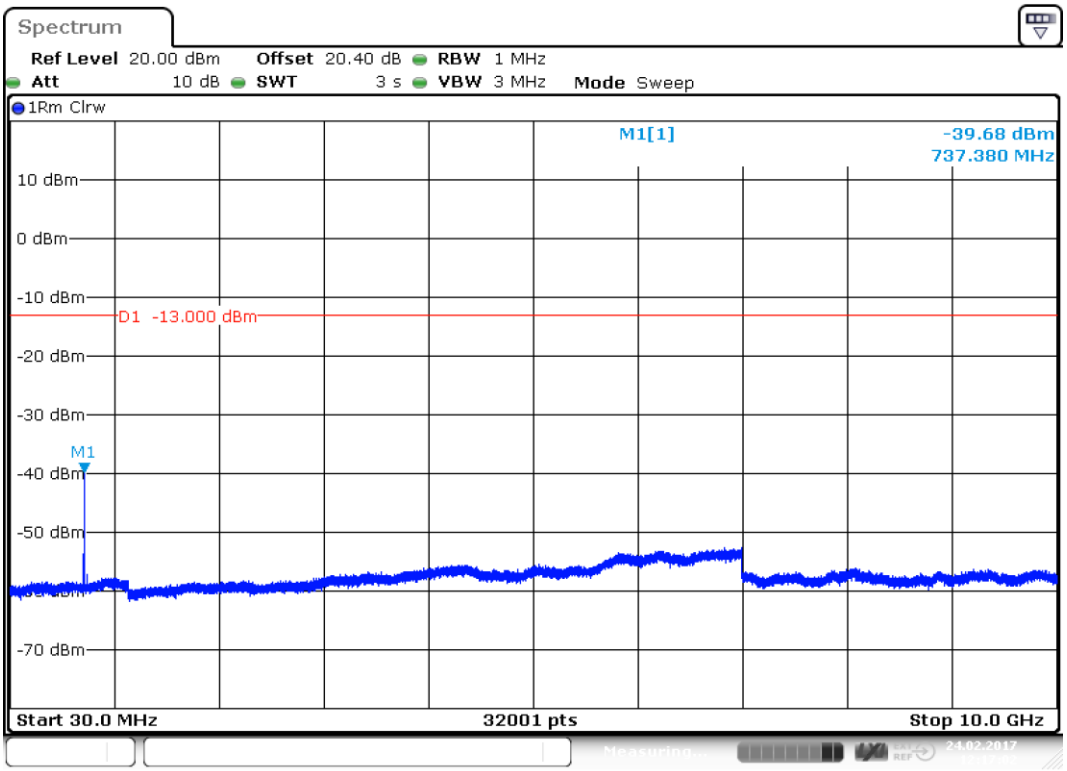
Considerations to §27.53 (f):
To see if the standard 27.53(f) were met a calculation of the radiated power is necessary. The modulated carrier in the range of 747-757 MHz is working with maximum power and the frequency range of 1559-1610MHz is measured. For the calculation of the radiated power in this band, it was calculated with a typical antenna gain and typical cable loss.
Used 700 MHz narrow band antennas offer a gain of 0 dBi in the in the frequency range 1559 - 1610 MHz, furthermore an antenna cable with a loss of 2 dB is used.
The measured conducted emissions in the frequency range of 1599 - 1610 MHz are below -58,4 dBm/MHz (see at plot 7.3.2.6).
Conducted emissions (<-58.4 dBm) + antenna gain (0 dBi) - cable loss (0 dB) = radiated emissions (<-58.4 dBm) which is below the limit of Part 27.53(f).
Even with an antenna gain of 2 dBi (more than worst case) in the frequency range of 1599 - 1610 MHz, we are still under the limit of Part 27.53(f) with a radiated emission of -56.4 dBm.

Therefore the emission limit is met.

Test passed.

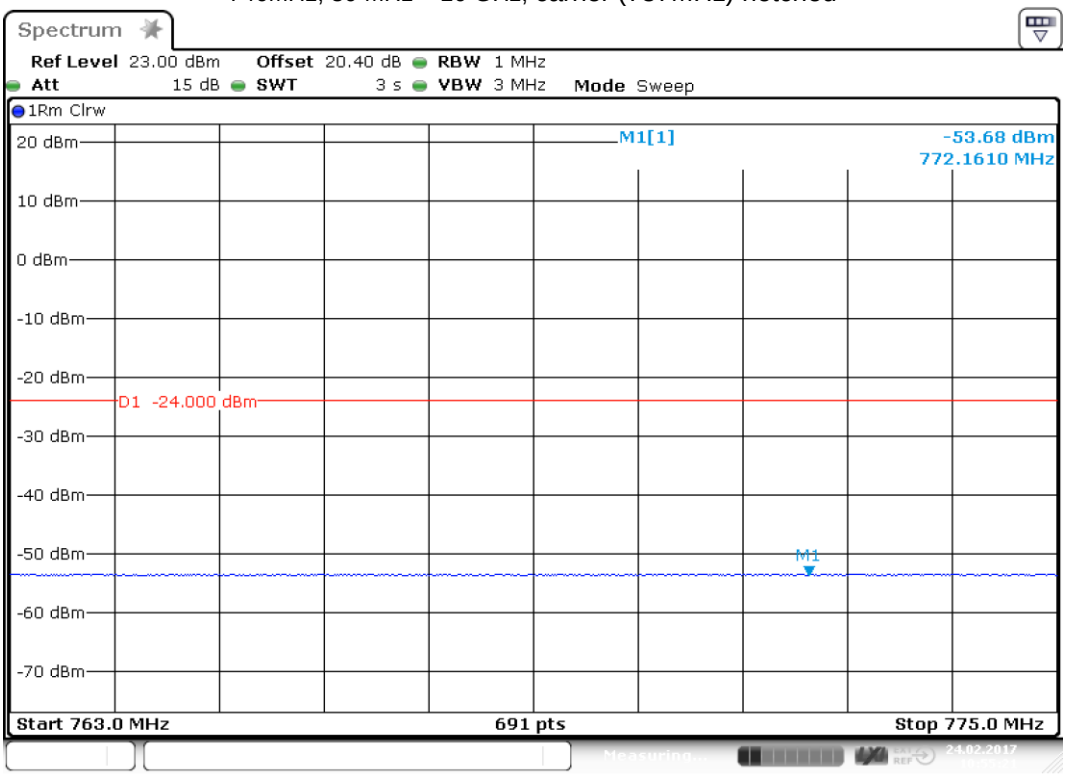
Plots with test result see 7.3.2.6 Uplink Measurement in the band of 1559 MHz – 1610 MHz acc. to 27.53(f)

7.3.2.1 Downlink LTE 728 – 746MHz



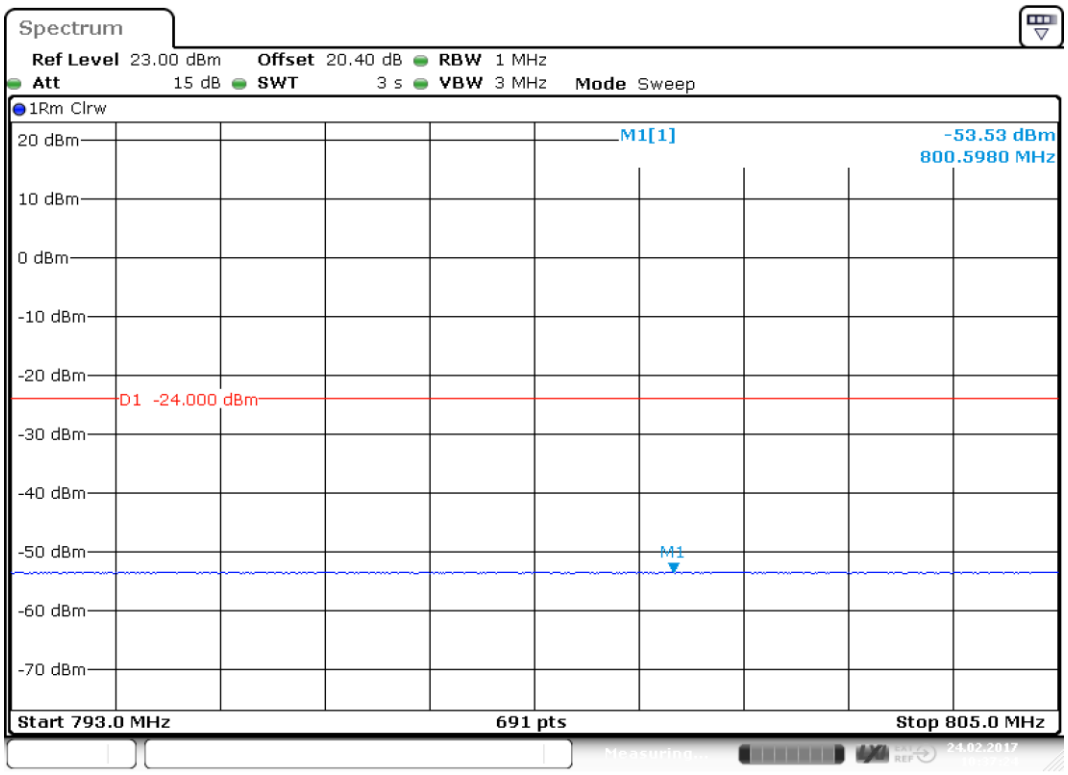
Date: 24.FEB.2017 12:17:02

plot 7.3.2.1-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink LTE 728 – 746MHz; 30 MHz – 10 GHz; carrier (737MHz) notched



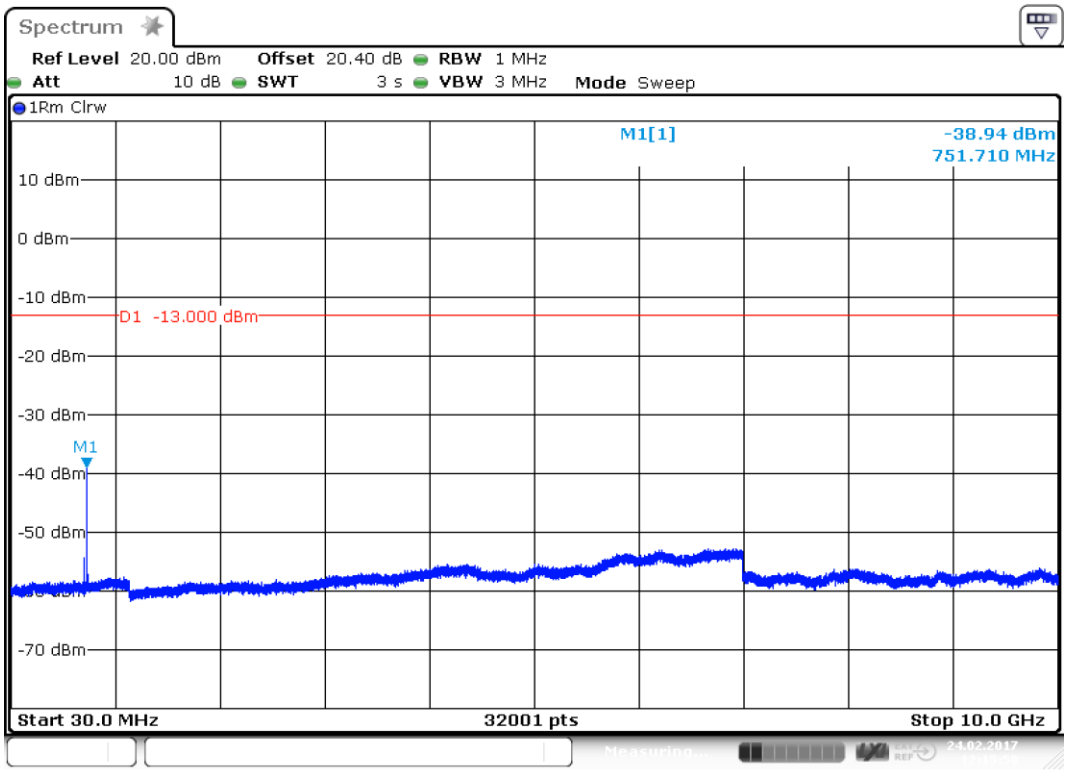
Date: 24.FEB.2017 10:55:21

plot 7.3.2.1-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink LTE 728 – 746MHz; 763 MHz – 775 MHz

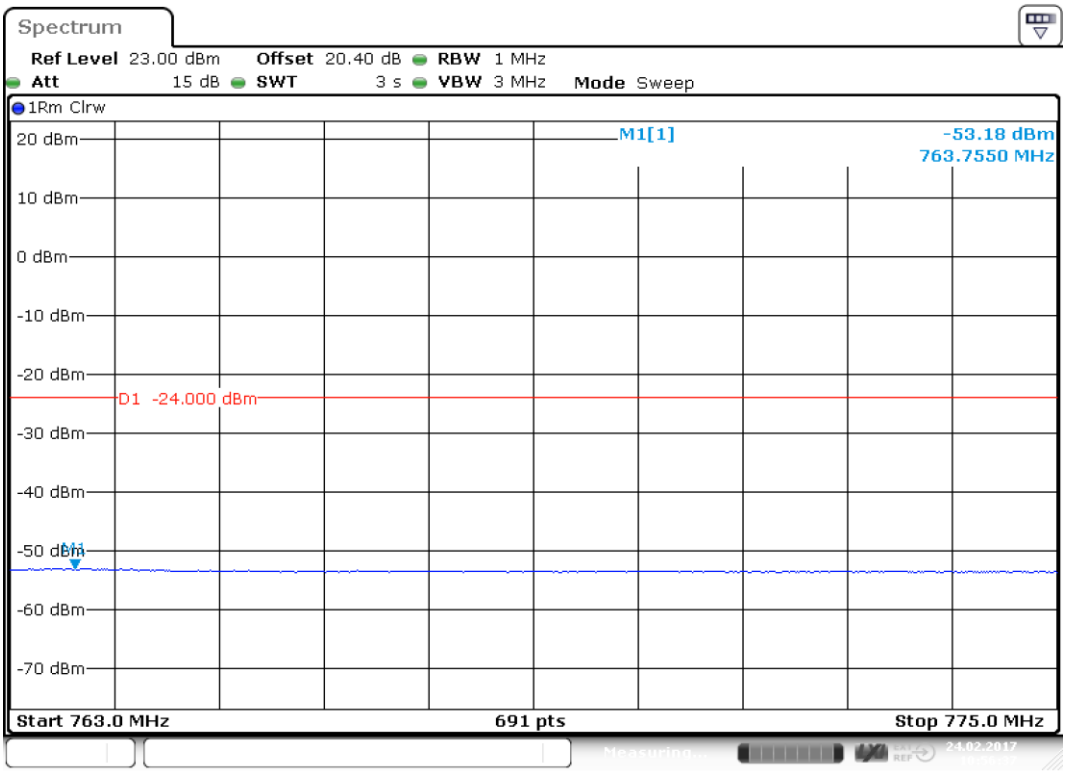


plot 7.3.2.1-#3 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink LTE 728 – 746MHz; 793 MHz – 805 MHz

7.3.2.2 Downlink LTE 746 – 757MHz

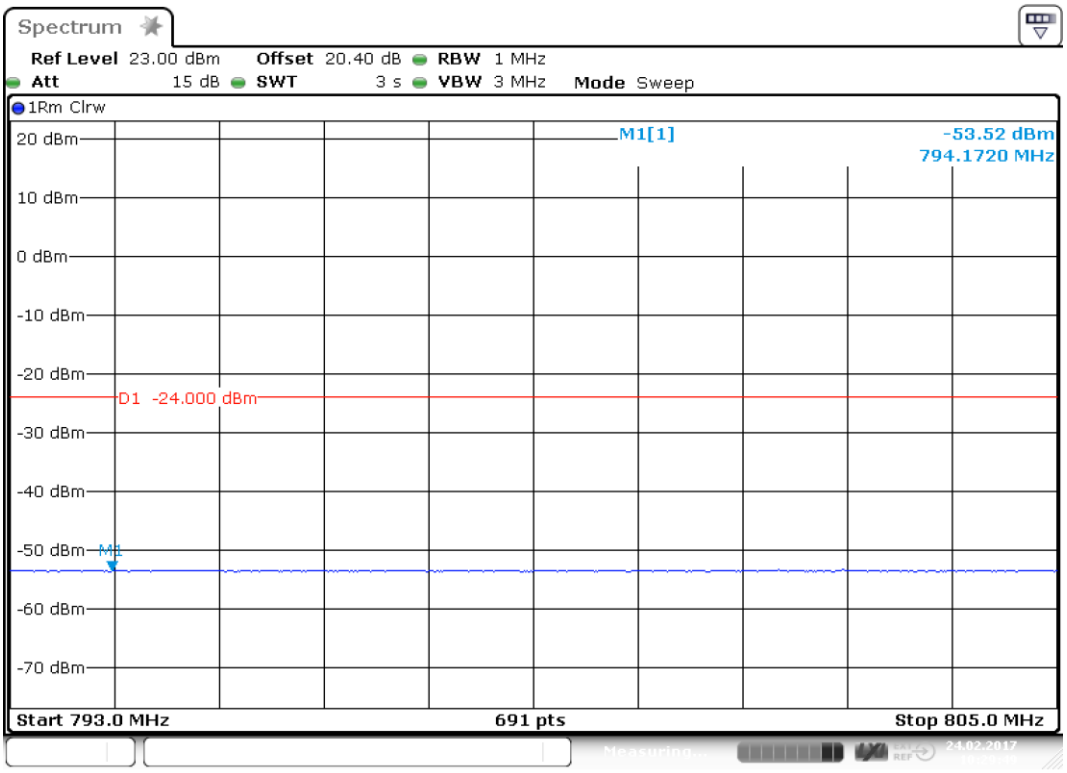


plot 7.3.2.2-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink LTE 746 – 757MHz; 30 MHz – 10 GHz; carrier (751,5MHz) notched



Date: 24.FEB.2017 10:56:37

plot 7.3.2.2-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink LTE 746 – 757MHz; 763 MHz – 775 MHz

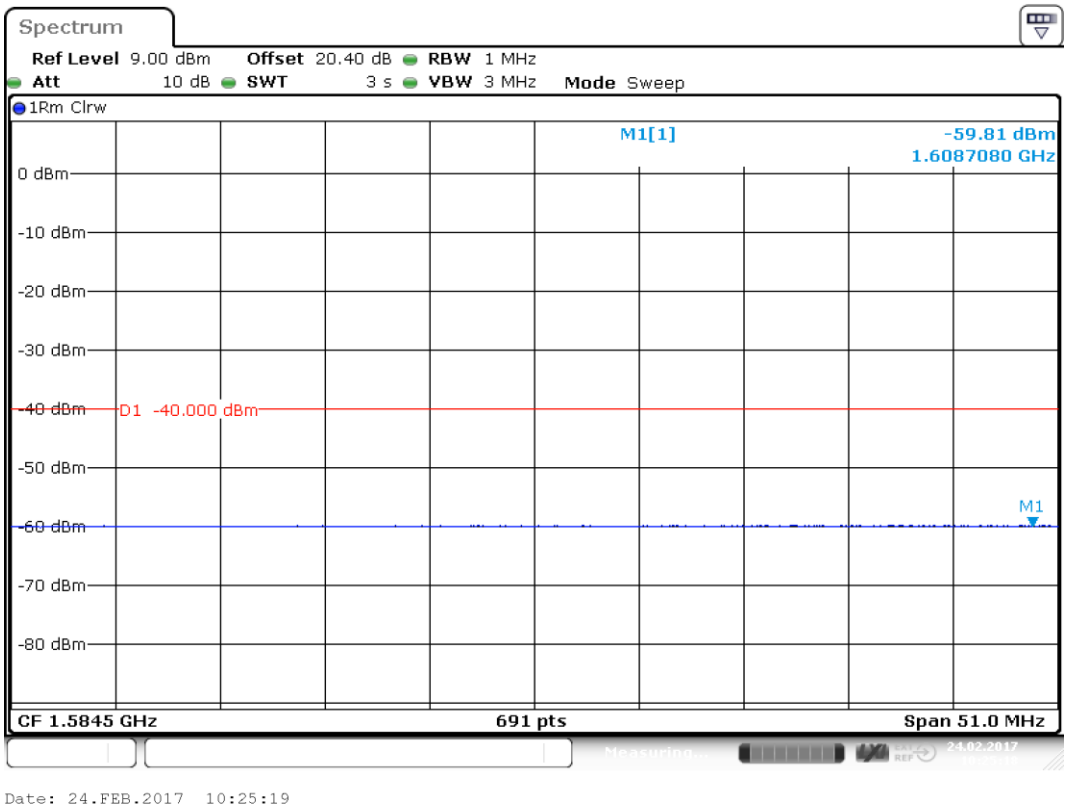


Date: 24.FEB.2017 10:29:50

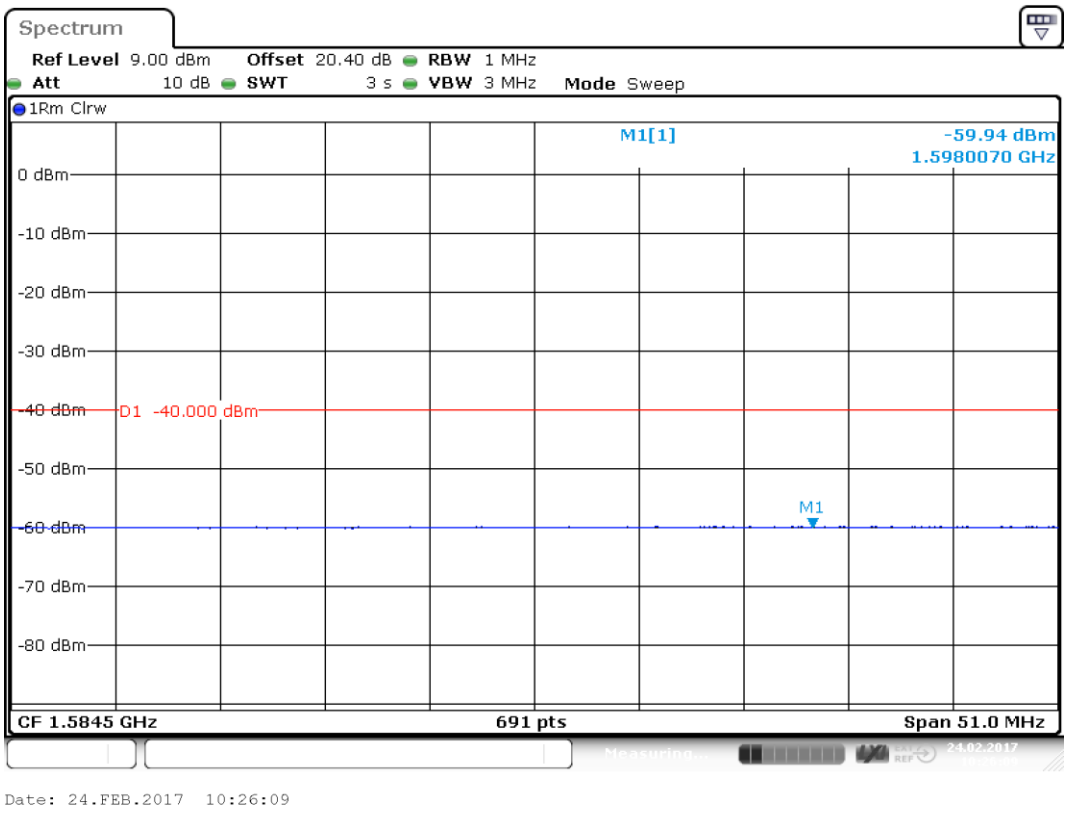
plot 7.3.2.2-#3 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink LTE 746 – 757MHz; 793 MHz – 805 MHz

7.3.2.3 Downlink Measurement in the band of 1559 MHz – 1610 MHz acc. to 27.53(f)

Calculation see 7.3.1 Test results Downlink

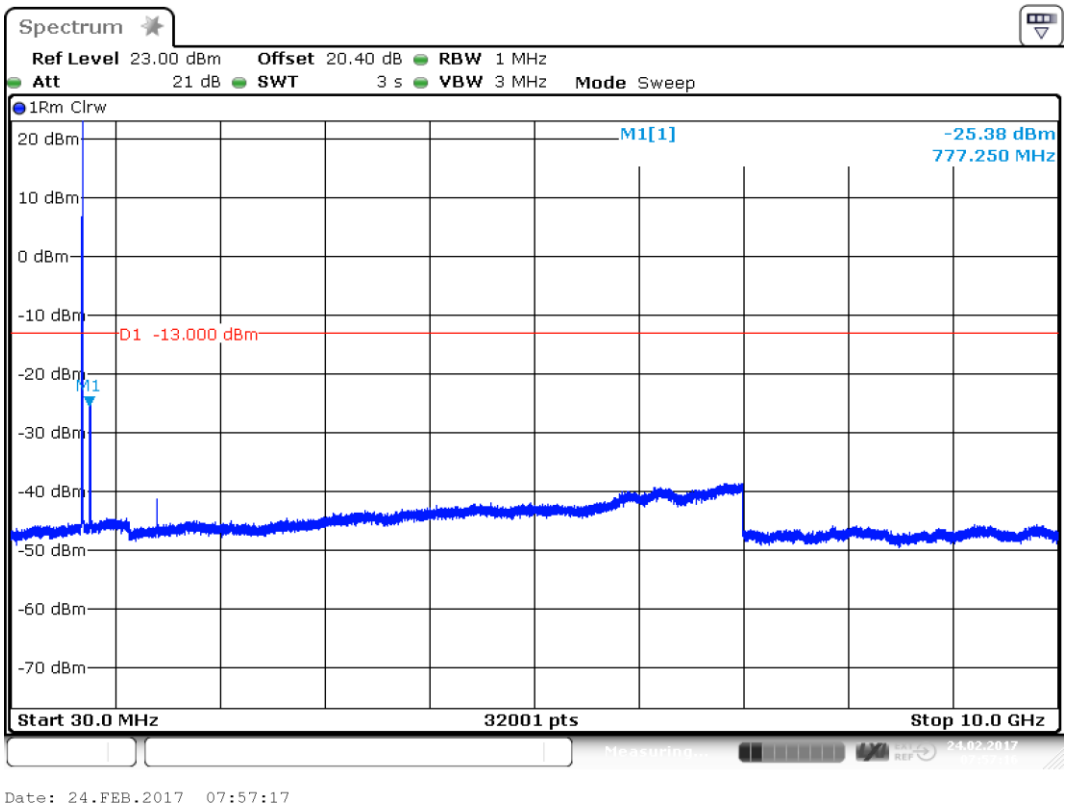


plot 7.3.2.3-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink Measurement in the band of 1559 MHz – 1610 MHz acc. to 27.53(f); LTE band 12



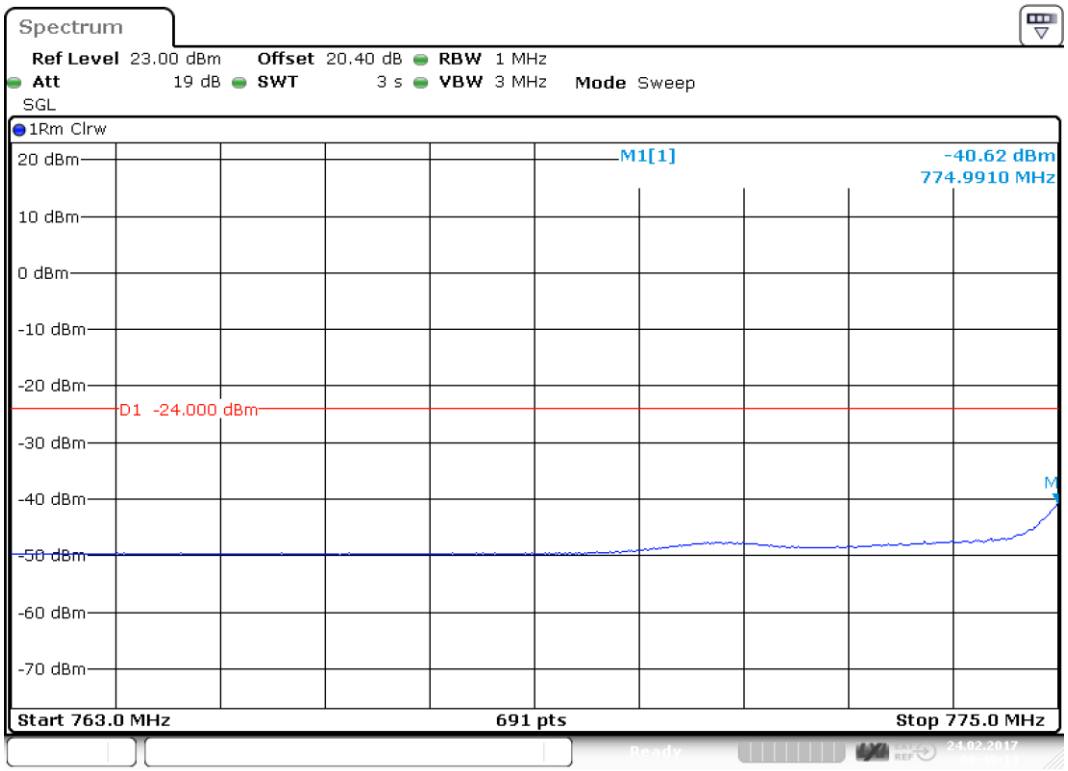
plot 7.3.2.3-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink Measurement in the band of 1559 MHz – 1610 MHz acc. to 27.53(f); LTE band 13

7.3.2.4 Uplink LTE 698 – 716MHz



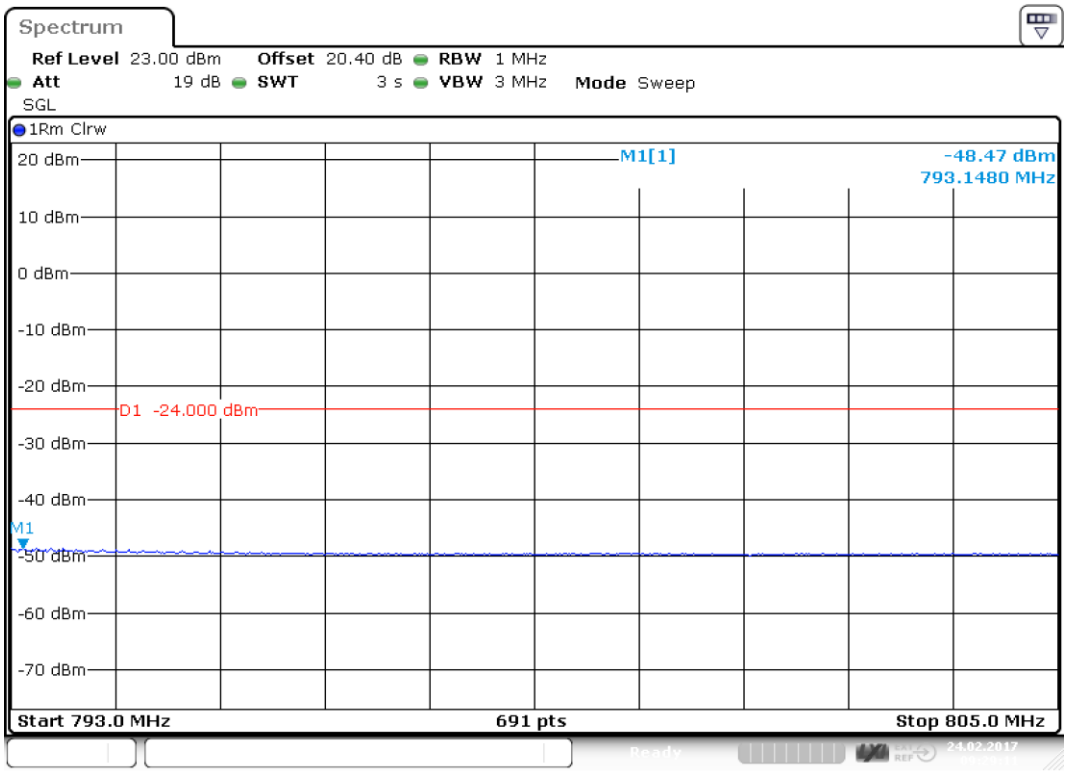
Date: 24.FEB.2017 07:57:17

plot 7.3.2.4-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Uplink LTE 698 – 716MHz; 30 MHz – 10 GHz; carrier (707MHz)



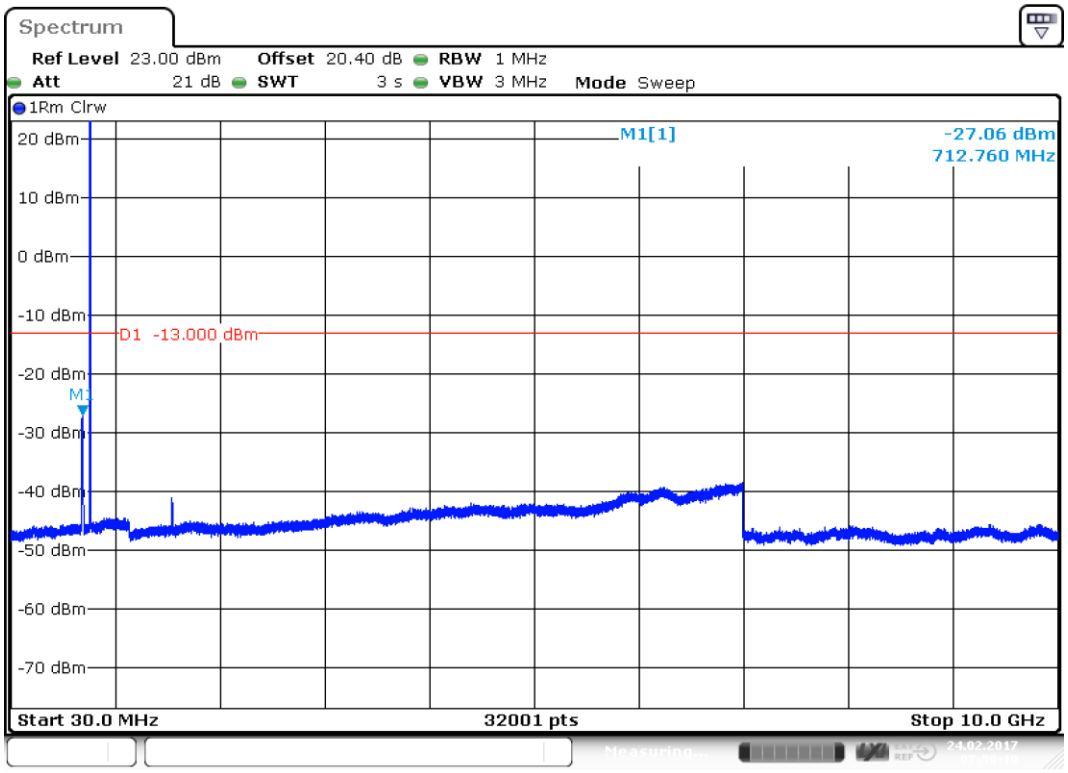
Date: 24.FEB.2017 08:49:14

plot 7.3.2.4-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Uplink LTE 698 – 716MHz; 763 MHz – 775 MHz

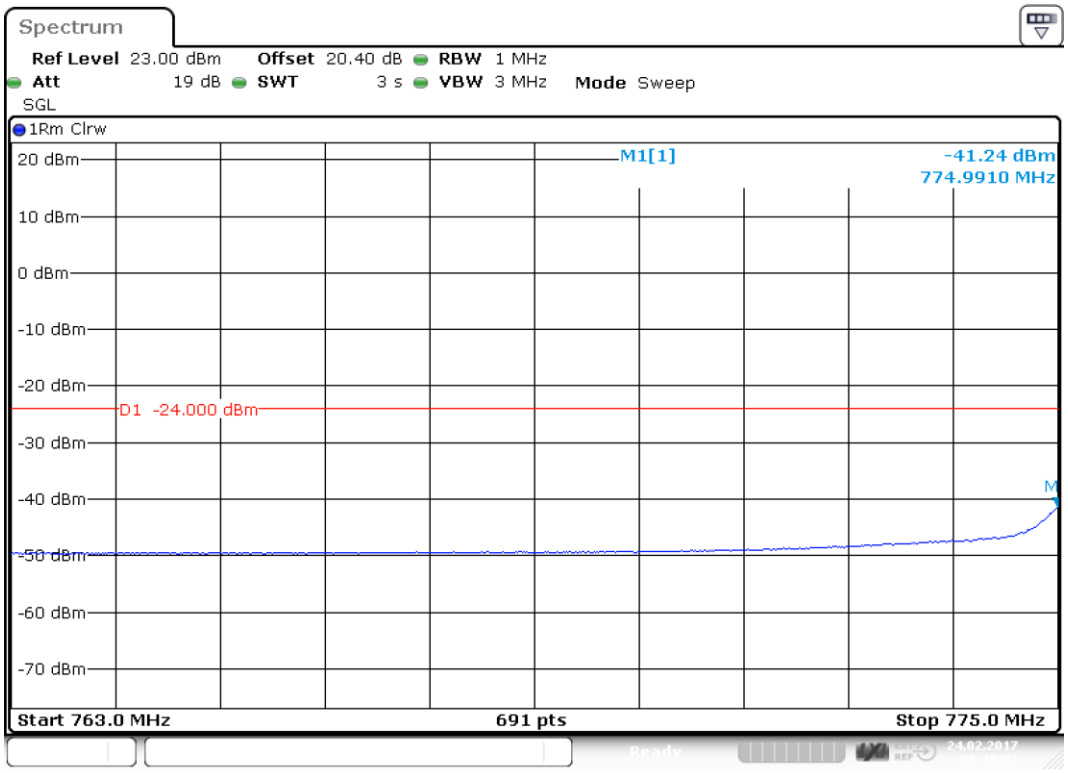


plot 7.3.2.4-#3 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Uplink LTE 698 – 716MHz; 793 MHz – 805 MHz

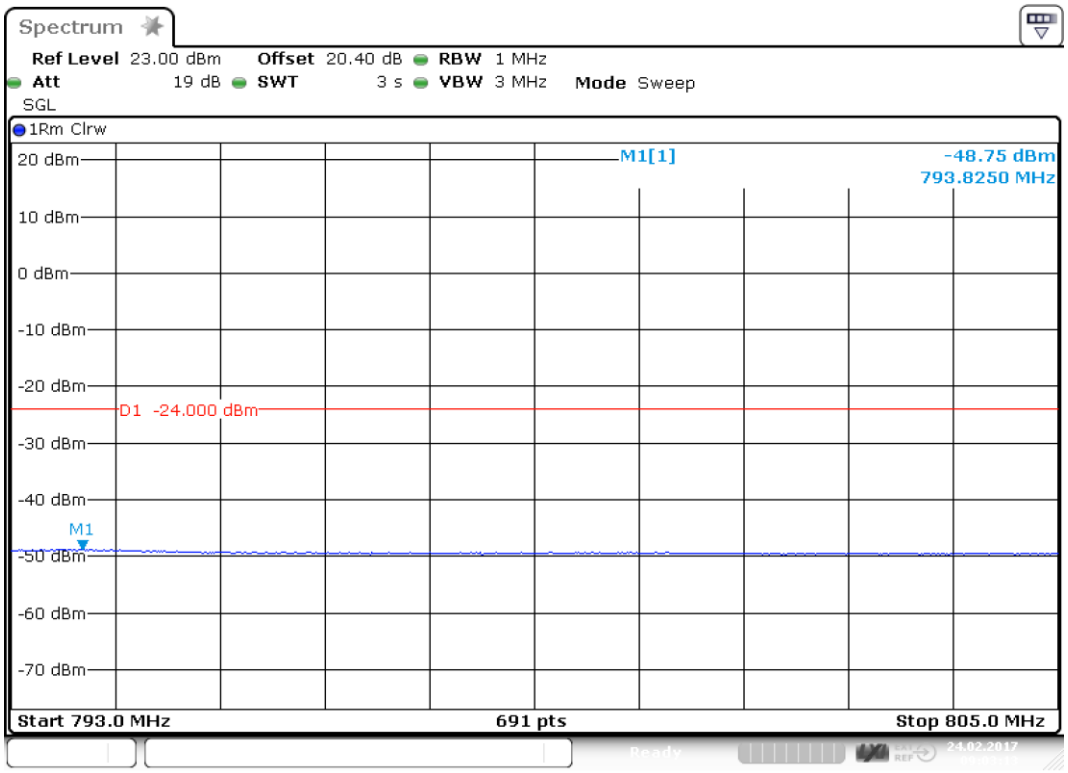
7.3.2.5 Uplink LTE 776 – 787MHz



plot 7.3.2.5-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Uplink LTE 776 – 787MHz; 30 MHz – 10 GHz; carrier (781,5MHz)



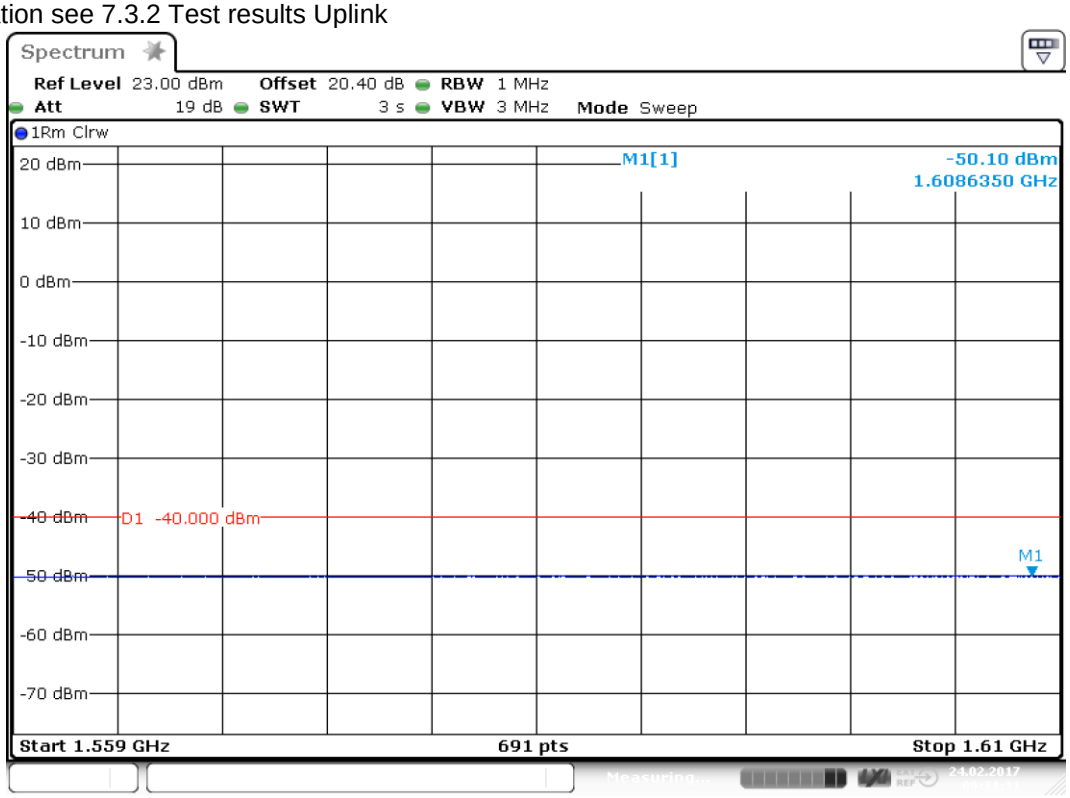
plot 7.3.2.5-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Uplink LTE 776 – 787MHz; 763 MHz – 775 MHz



plot 7.3.2.5-#3 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Uplink LTE 776 – 787MHz; 793 MHz – 805 MHz

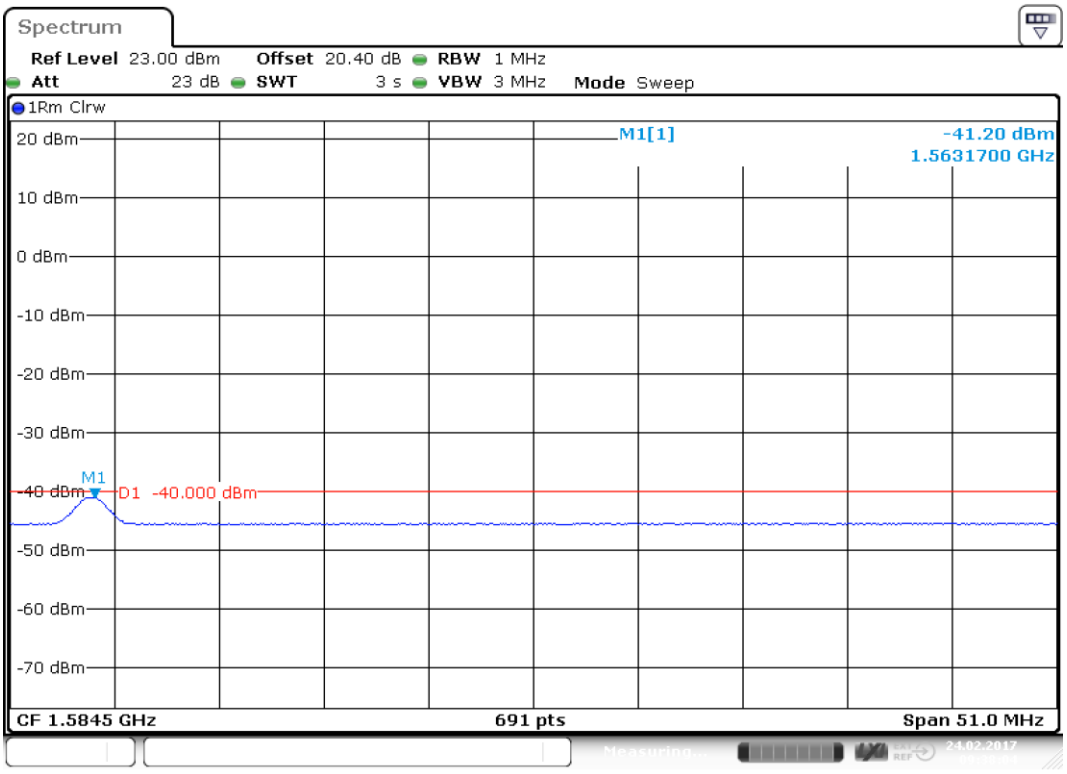
7.3.2.6 Uplink Measurement in the band of 1559 MHz – 1610 MHz acc. to 27.53(f)

Calculation see 7.3.2 Test results Uplink



Date: 24.FEB.2017 09:31:31

plot 7.3.2.6-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Uplink; Uplink Measurement in the band of 1559 MHz – 1610 MHz acc. to 27.53(f); LTE band 12



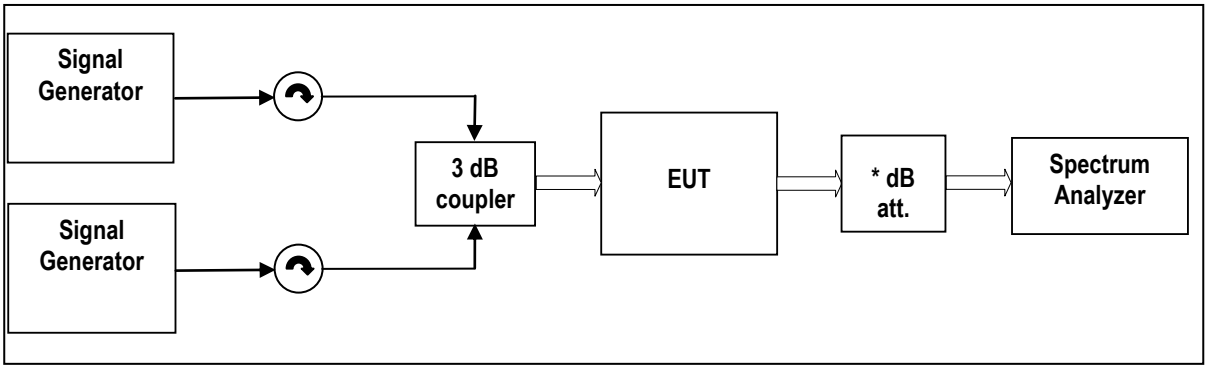
Date: 24.FEB.2017 09:38:05

plot 7.3.2.6-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Uplink; Uplink Measurement in the band of 1559 MHz – 1610 MHz acc. to 27.53(f); LTE band 13

7.4 Summary test result

Test result	complies, according the plots above
Tested by:	F. Bengesser
Date:	24.02.2017

8 Intermodulation: §27.53, §2.1051



External Attenuator DL x dB = 20 dB

figure 8-#1 Test setup: Intermodulation: §27.53, §2.1051

Measurement uncertainty	± 0,54 dB ± 1,2 dB ± 1,5 dB	9 kHz to 3 GHz 3 GHz to 7 GHz 7 GHz to 26 GHz
Test equipment used	9069, 9046, 9236, 7406, 7157, 7158, 7289, 7290, 7385	

8.1 Limit

Minimum standard:
Para. No.27.53 (c), (f) and (g)

(c) For operations in the 746–758 MHz band and the 776–788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763–775 MHz and 793–805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(f) For operations in the 746–763 MHz, 775–793 MHz, and 805–806 MHz bands, emissions in the band 1559–1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(g) For operations in the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed

8.2 Test method

Para. No 2.1051 Measurements required: Spurious emissions at antenna terminals.
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.
[39 FR 5919, Feb. 15, 1974. Redesignated andamended at 63 FR 36599, July 7, 1998]

8.3 Test results

8.3.1 Downlink

Detector: RMS.

Modulation	Measured at Band Edge	Carriers	RBW VBW Span	Max. level (dBm)	Plot -
LTE Band 12 (Band Class 19)	Lower Edge	728,7 MHz 730,1 MHz	30kHz 300kHz 6MHz	-24,8	8.3.2.1 #1
	Upper Edge	743,9 MHz 745,3 MHz			#2
LTE Band 13 (Band Class 7)	Lower Edge	746,7 MHz 748,1 MHz	30kHz 300kHz 6MHz	-24,3	8.3.2.2 #1
	Upper Edge	754,9 MHz 756,3 MHz			#2

table 8.3-#1 Intermodulation: §27.53, §2.1051 Test results

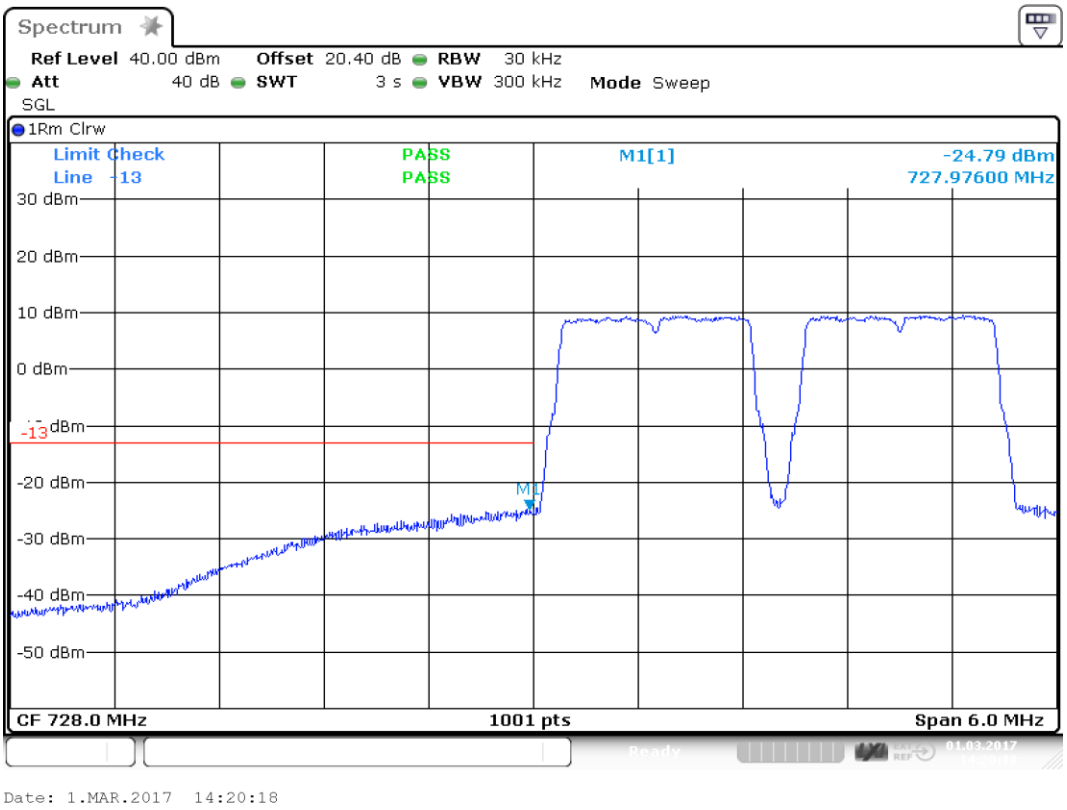
8.3.2 Uplink

Detector: RMS.

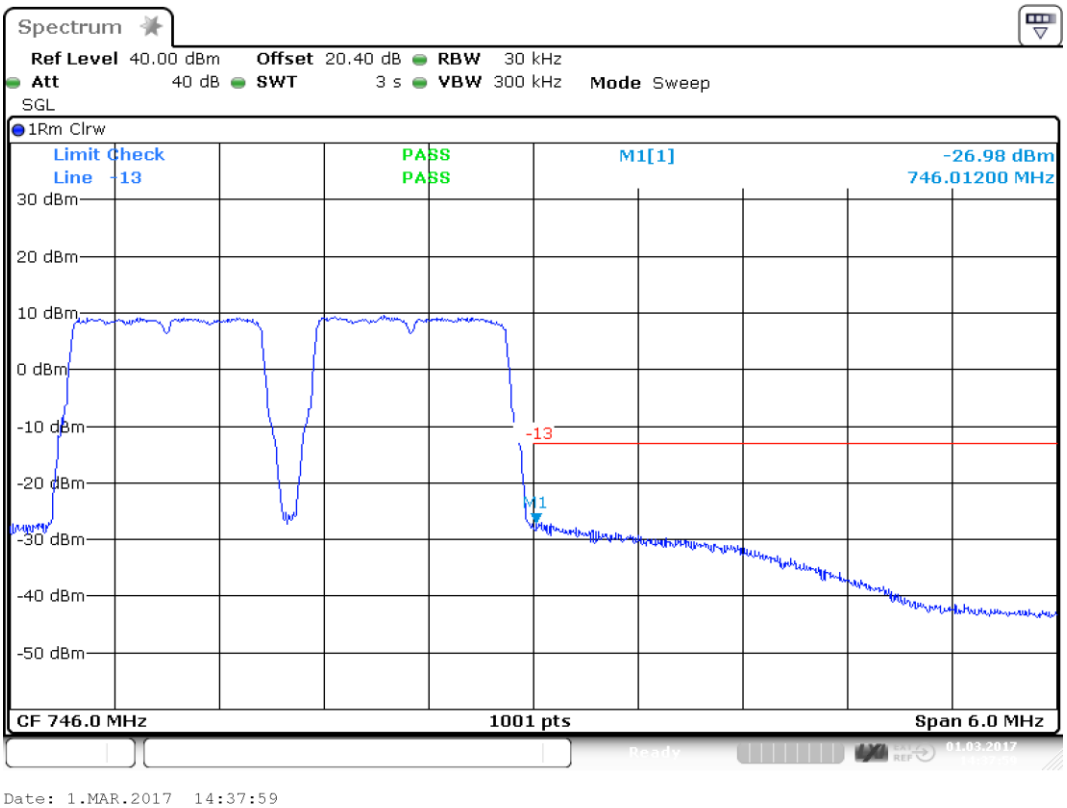
Modulation	Measured at Band Edge	Carriers	RBW VBW Span	Max. level (dBm)	Plot -
LTE Band 12 (Band Class 19)	Lower Edge	698,7 MHz 700,1 MHz	30kHz 300kHz 6MHz	-25,1	8.3.2.3 #1
	Upper Edge	713,9 MHz 715,3 MHz			#2
LTE Band 13 (Band Class 7)	Lower Edge	776,7 MHz 778,1 MHz	30kHz 300kHz 6MHz	-19,4	8.3.2.4 #1
	Upper Edge	784,9 MHz 786,3 MHz			#2

table 8.3-#2 Intermodulation: §27.53, §2.1051 Test results

8.3.2.1 Downlink LTE 728 – 746MHz

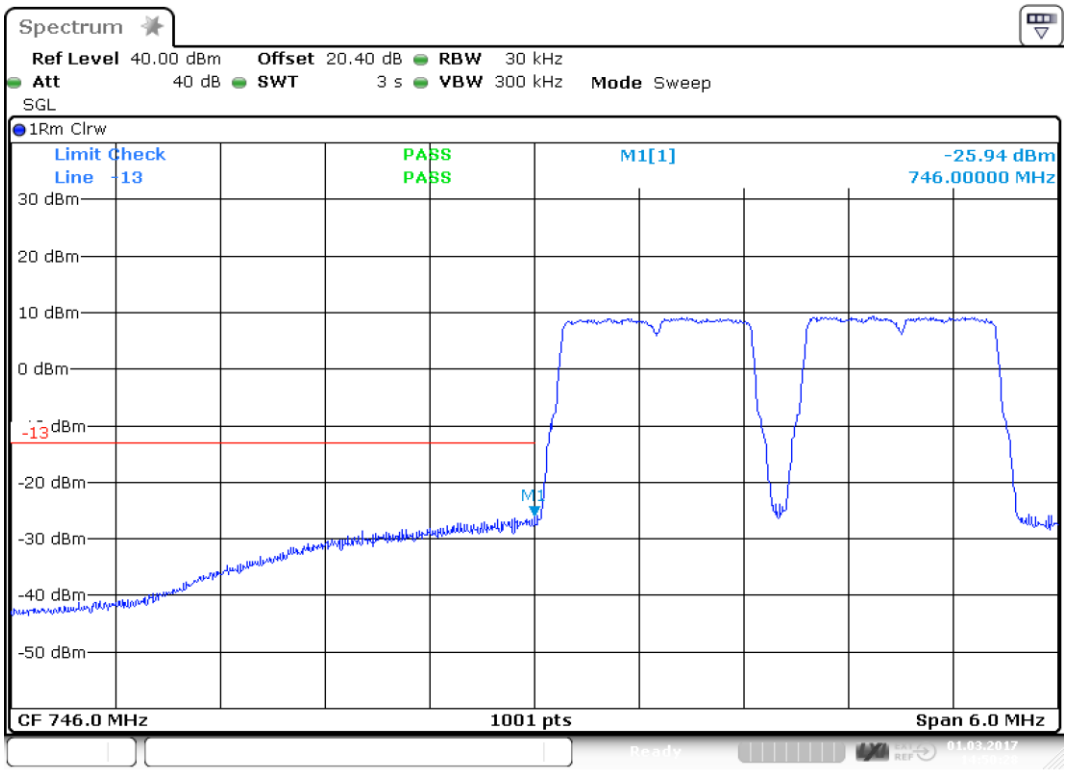


plot 8.3.2.1-#1 Intermodulation: §27.53, §2.1051; Test results; Downlink LTE 728 – 746MHz Lower Band Edge

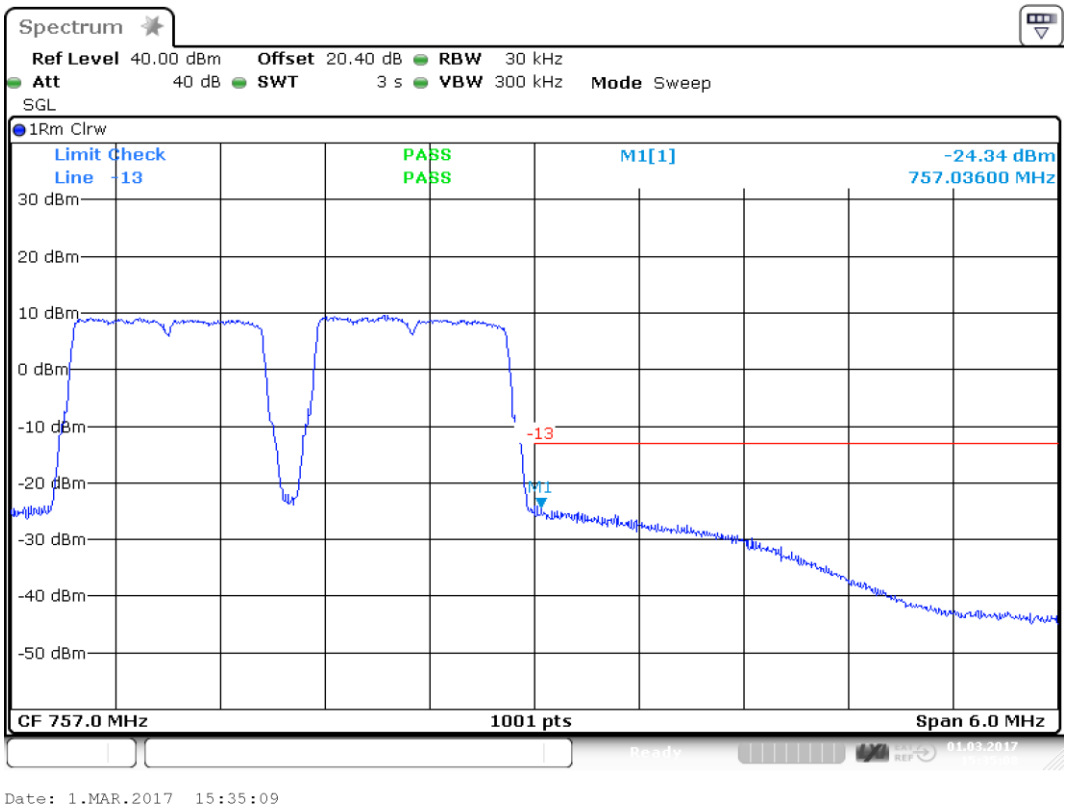


plot 8.3.2.1-#2 Intermodulation: §27.53, §2.1051; Test results; Downlink LTE 728 – 746MHz Upper Band Edge

8.3.2.2 Downlink LTE 746 – 757MHz

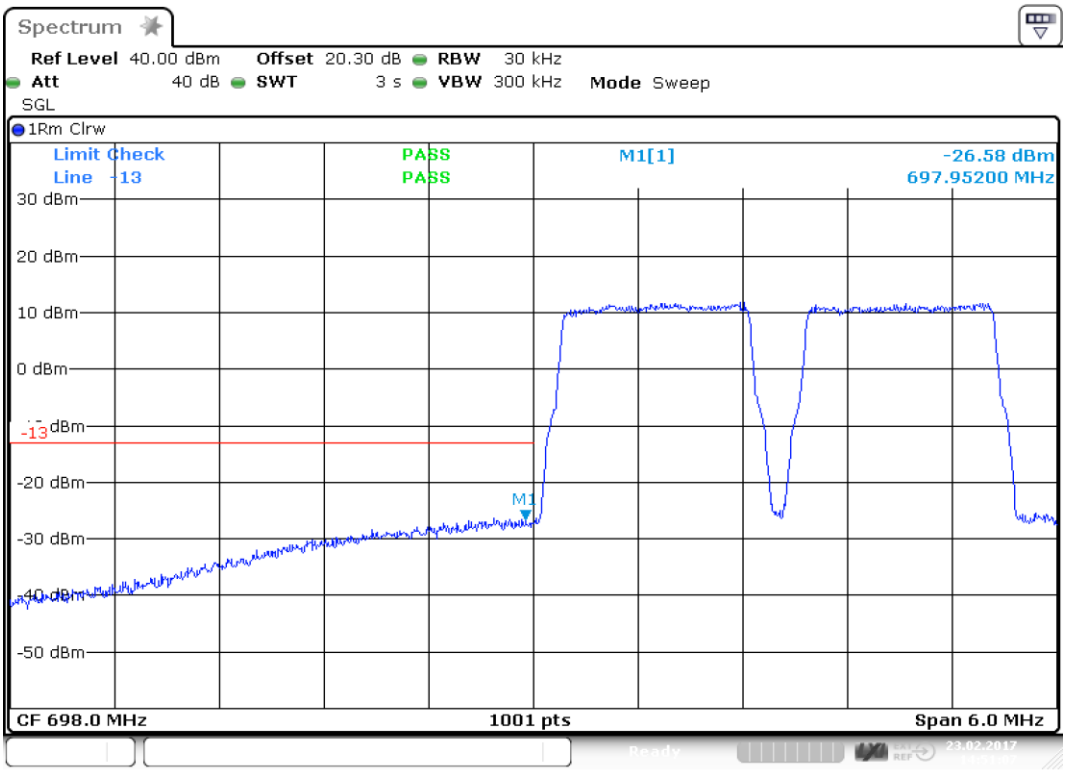


plot 8.3.2.2-#1 Intermodulation: §27.53, §2.1051; Test results; Downlink LTE 746 – 757MHz Lower Band Edge

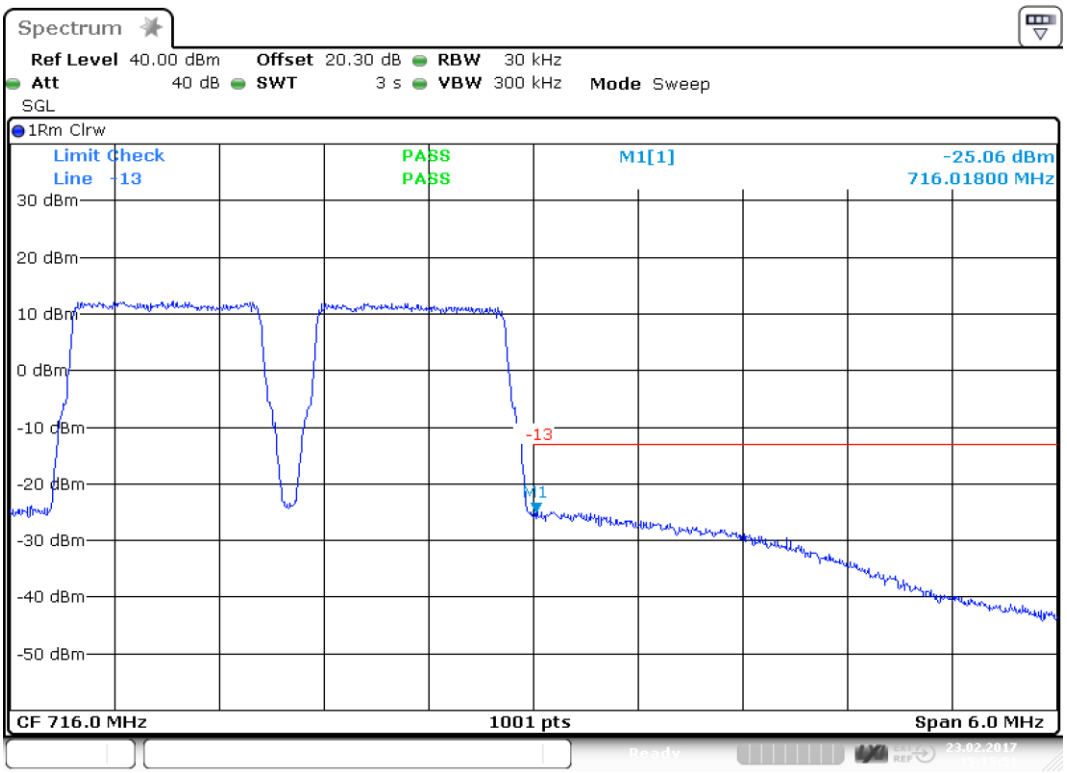


plot 8.3.2.2-#2 Intermodulation: §27.53, §2.1051; Test results; Downlink LTE 746 – 757MHz Upper Band Edge

8.3.2.3 Uplink LTE 698 – 716MHz

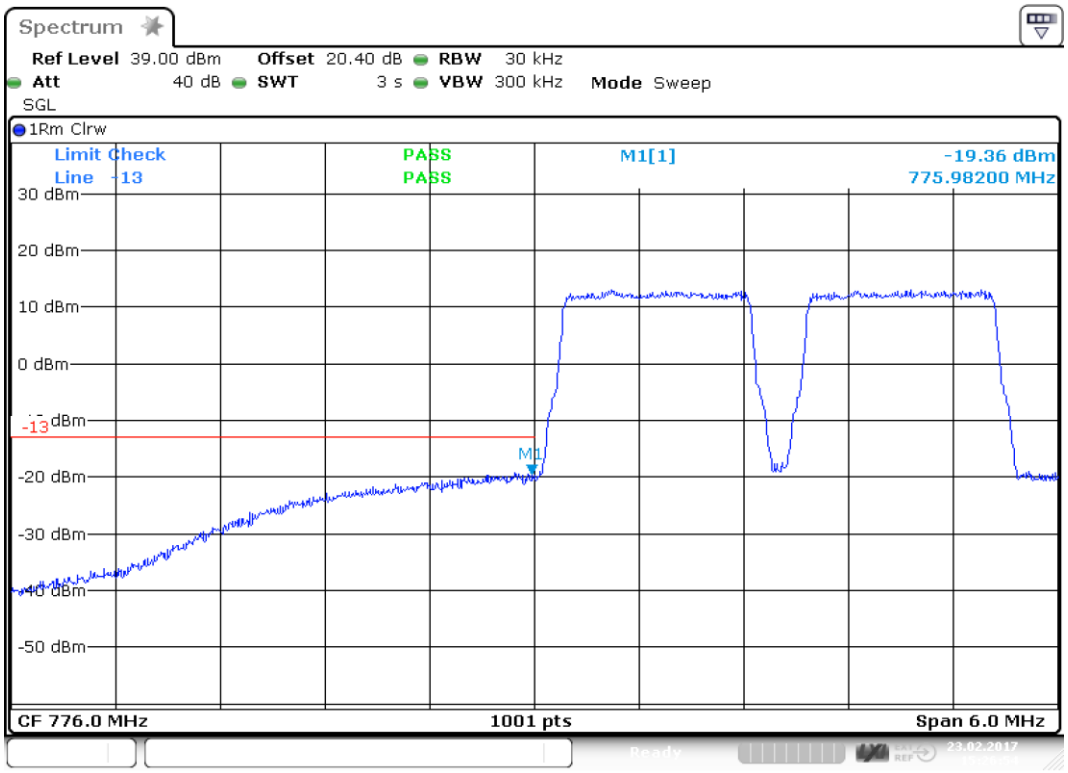


plot 8.3.2.3-#1 Intermodulation: §27.53, §2.1051; Test results; Uplink LTE 698 – 716MHz Lower Band Edge



plot 8.3.2.3-#2 Intermodulation: §27.53, §2.1051; Test results; Uplink LTE 698 – 716MHz Upper Band Edge

8.3.2.4 Uplink LTE 776 – 787MHz



plot 8.3.2.4-#1 Intermodulation: §27.53, §2.1051; Test results; Uplink LTE 776 – 787MHz Lower Band Edge

plot 8.3.2.4-#2 Intermodulation: §27.53, §2.1051; Test results; Uplink LTE 776 – 787MHz Upper Band Edge

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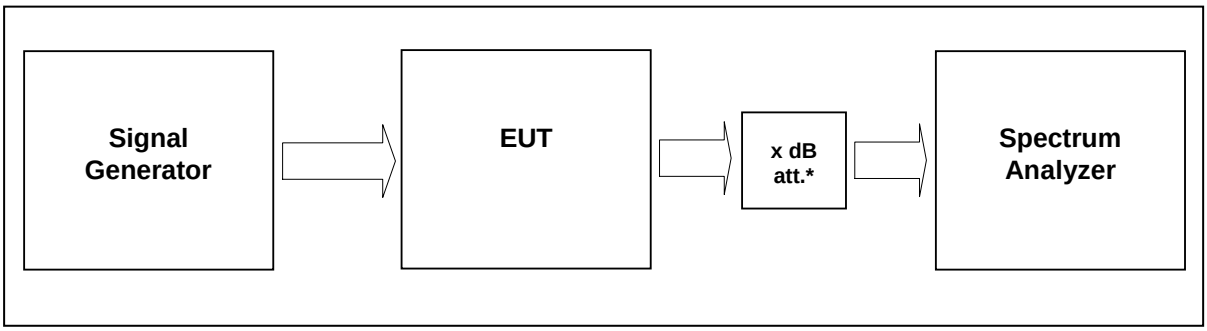
8.4 Summary test result

Test result	complies, according the plots above
Tested by:	F. Bengesser
Date:	01.03.2017

9 Out of Band Rejection



External Attenuator DL x dB = 20 dB

figure 9-#1 Test setup: Out of Band Rejection

Measurement uncertainty	± 0,38 dB
Test equipment used	9069, 9046, 9236, 7406, 7157, 7158, 7289, 7290, 7385

9.1 Limit

KDB 935210 D02 v03r02

Test for rejection of out of band signals. Filter frequency response plots are acceptable.

9.2 Test method

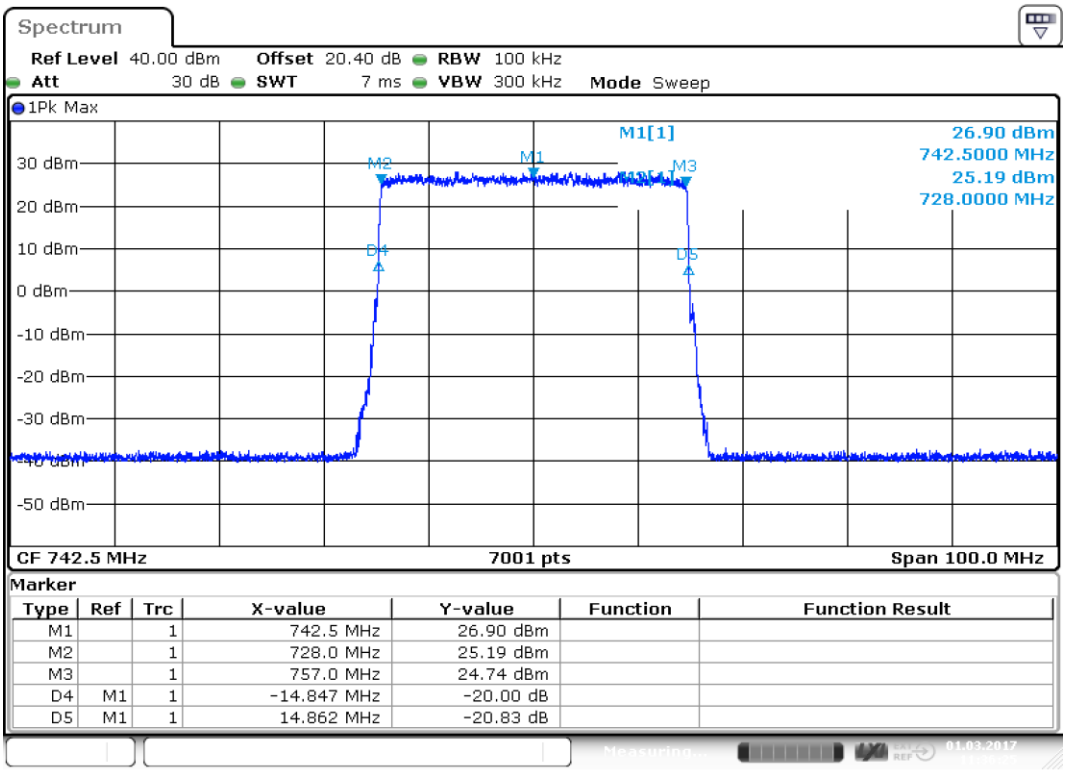
935210 D03 v04

7.1 Authorized frequency band verification test

9.3 Test results

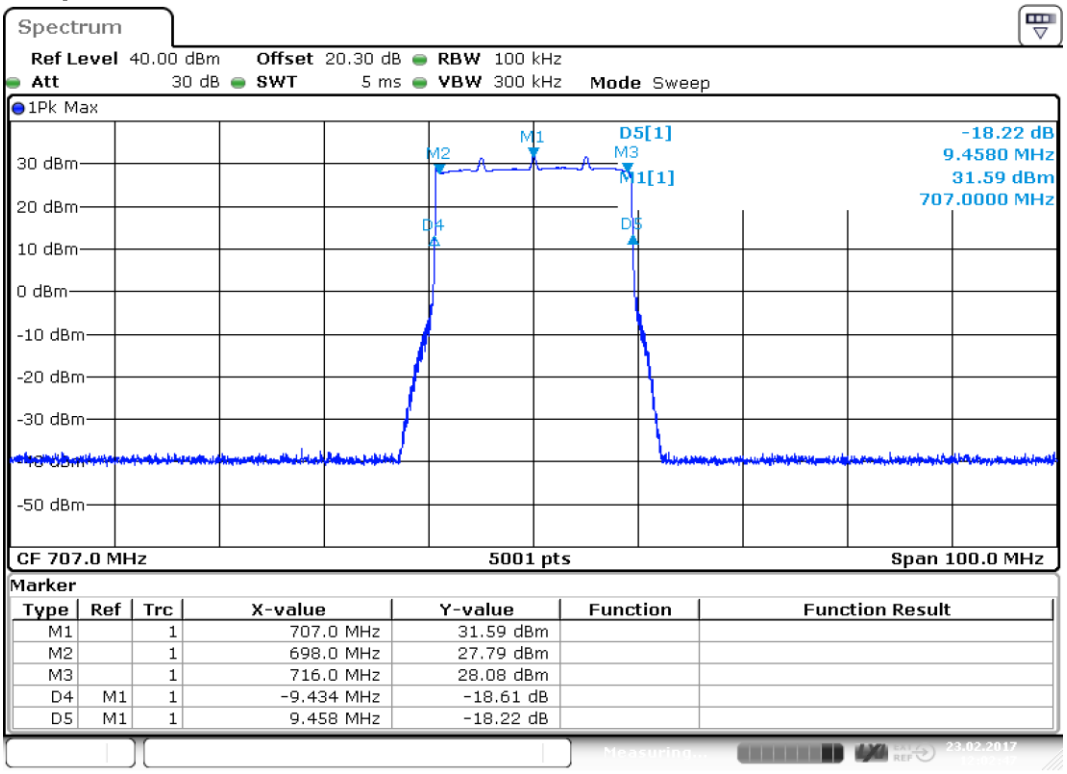
Detector Peak max hold

9.3.1.1 Downlink



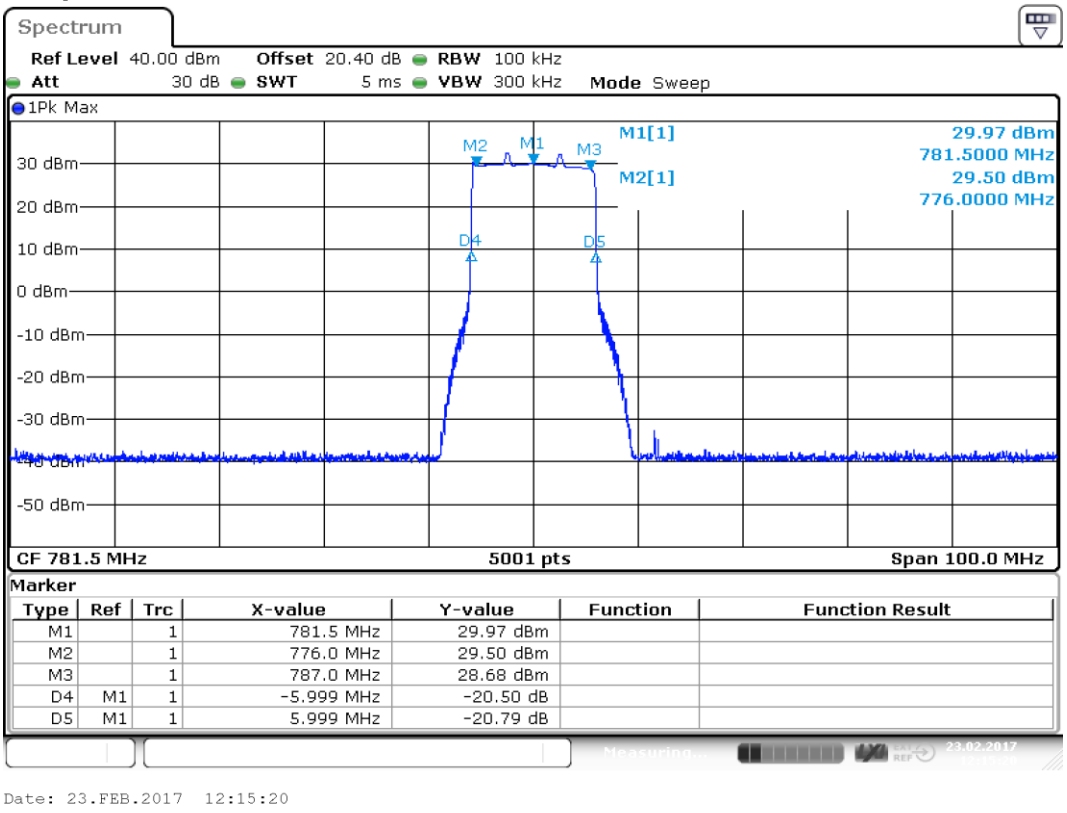
plot 8.3.2-#1 Out of Band Rejection; Test results; Uplink;

9.3.1.2 Uplink 698 – 716MHz



plot 8.3.2-#1 Out of Band Rejection; Test results;Uplink 698 – 716MHz;

9.3.1.3 Uplink 776 – 787MHz

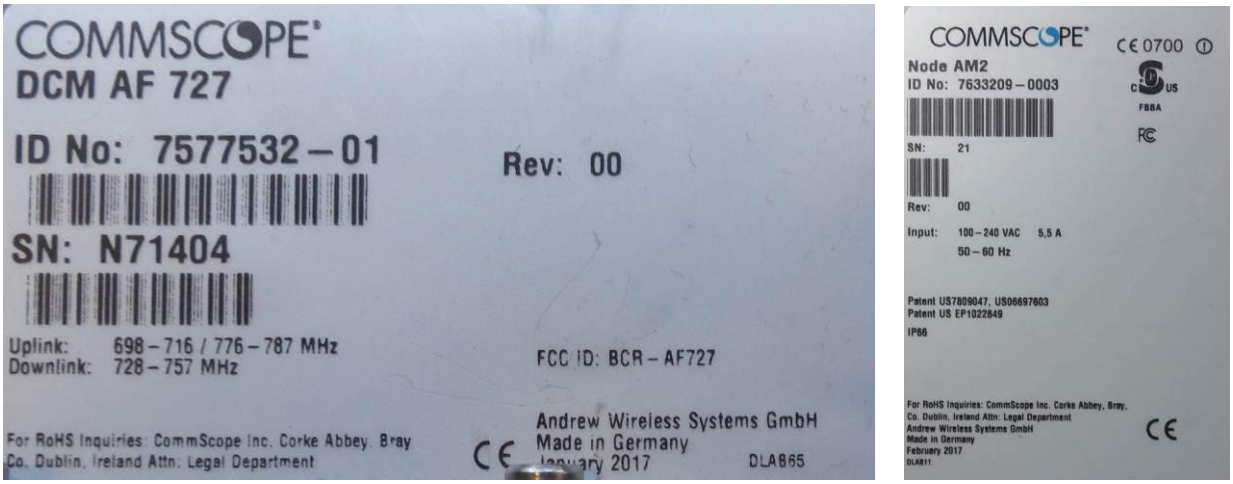


plot 8.3.2-#1 Out of Band Rejection; Test results;Uplink 776 – 787MHz;

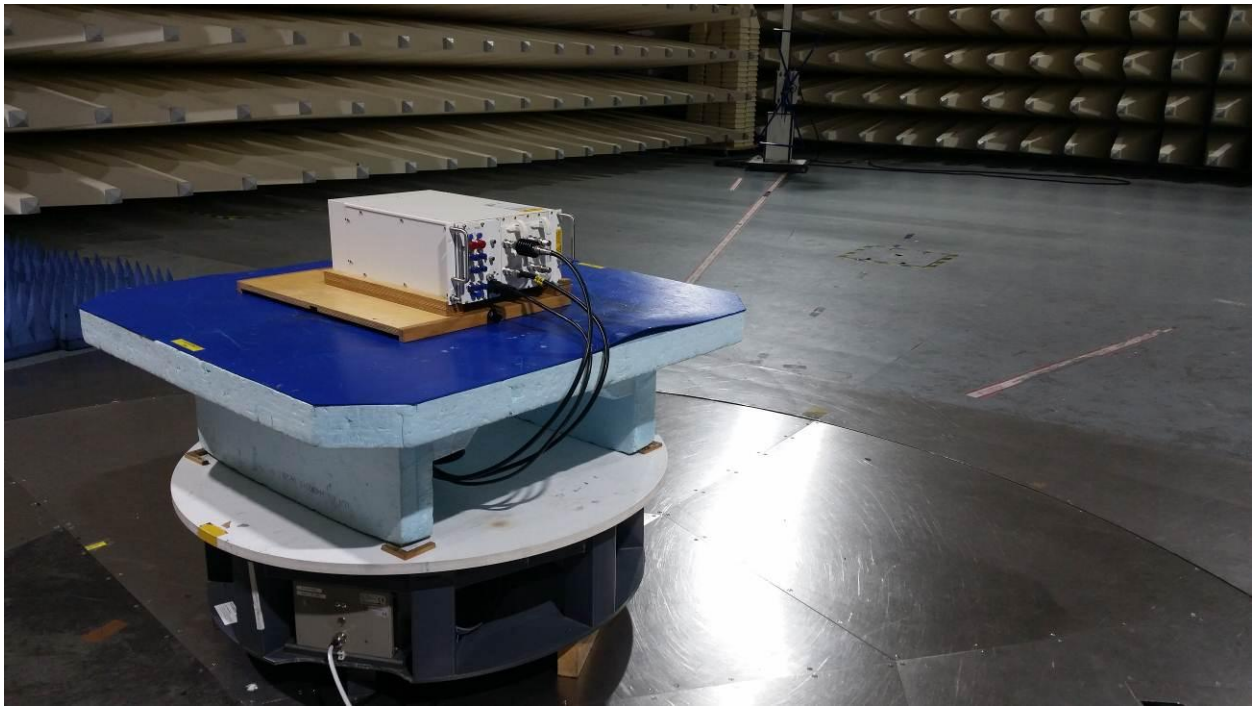
9.4 Summary test result

Test result	complies, according the plots above
Tested by:	F. Bengesser
Date:	01.03.2017

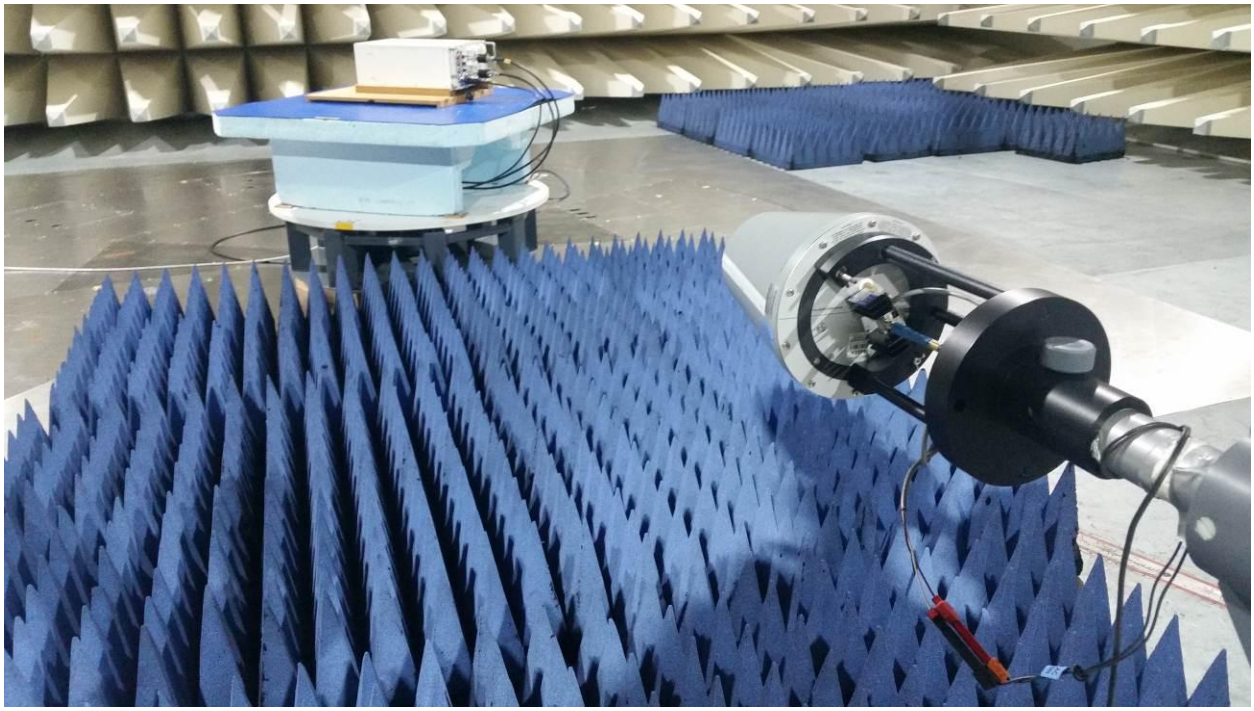
10 Radiated Spurious Emissions at the ECL (BV): §27.53, §2.1053



picture 8.1: label (left: RF Card DCM AF 727; right: Node AM2)



picture 8.3: Test setup: Field Strength Emission <1 GHz @10m in the SAC



picture 8.4: Test setup: Field Strength Emission >1 GHz @3m in the SAC

This clause specifies requirements for the measurement of radiated emission.

Frequency range	Distance: EUT <-> antenna / location	Limit	Test method
30 MHz – 1 GHz	10 metres / SAC	FCC 47 CFR Part 27.53	TIA/EIA-603-C:2004
1 GHz – 8 GHz	3 metres / SAC	IC RSS-131 sec. 4.4	

Test equipment used:

Designation	Type	Manufacturer	Invent.-no.	Cal.-date	due Cal.-date	used
EMI test receiver	ESU40	Rohde & Schwarz	E2025	18.10.2016	18.10.2017	X
Antenna	CBL 6111	Chase	K1026	12.02.2016	12.02.2018	X
RF Cable	RG214	Frankonia	K1121	16.04.2015	16.04.2017	X
Antenna	HL 025	R&S	K1114	09.02.2016	09.02.2018	X
Preamplifier	AFS4-00102000	Miteq	K838	17.06.2016	17.0.2017	X
RF Cable	Sucoflex 100	Suhner	K1760	04.08.2015	04.08.2017	X

The REMI version 2.135 has been used to maximize radiated emission from the EUT with regards to ANSI C63.4:2014.

Test set-up:

Test location:	SAC Both, the Fully Anechoic Chamber (FAC) and the Semi Anechoic Chamber (SAC) fulfil the requirements of ANSI C63.4 and CISPR 16-1-4 with regards to NSA and SVSWR.
Test Voltage:	110V / 60 Hz
Type of EUT:	Wall mounted

Measurement uncertainty:

Measurement uncertainty expanded (95% or K=2)	± 5,0 dB for ANSI C63.4 measurement ± 2,1 dB for TIA-603 measurement

10.1 Method of Measurement

Measurement procedure. **TIA-603-C**

The antenna substitution method is used to determine the equivalent radiated power at spurious frequencies. The spurious emissions are measured at a distance of 3 or 10 meters. The EUT is then replaced with a reference substitution antenna with a known gain referenced to a dipole. This antenna is fed with a signal at the spurious frequency. The level of the signal is adjusted to repeat the previously measured level. The resulting eirp is the signal level fed to the reference antenna corrected for gain referenced to an isotropic dipole (see Figure 7.2).

From KDB (AMPLIFIER, BOOSTER, AND REPEATER REMINDER SHEET):
Radiated spurs (enclosure) – Use of CW signal (low, mid. and high freq.) is acceptable rather than all modulations. The Bottom/Middle/Top frequencies for Part 27 F/H are as follows:

The maximum RFI field strength was determined during the measurement by rotating the turntable (±180 degrees) as like defined in ANSI C63.4. A measurement receiver has been used with a RBW 120 kHz up to 1 GHz and 1 MHz above 1 GHz. Steps width during the measurement was minimum of half of the RBW.

Both, the Fully Anechoic Chamber (FAC) and the Semi Anechoic Chamber (SAC) fulfil the requirements of ANSI C63.4 and CISPR 16-1-4 with regards to NSA and SVSWR.

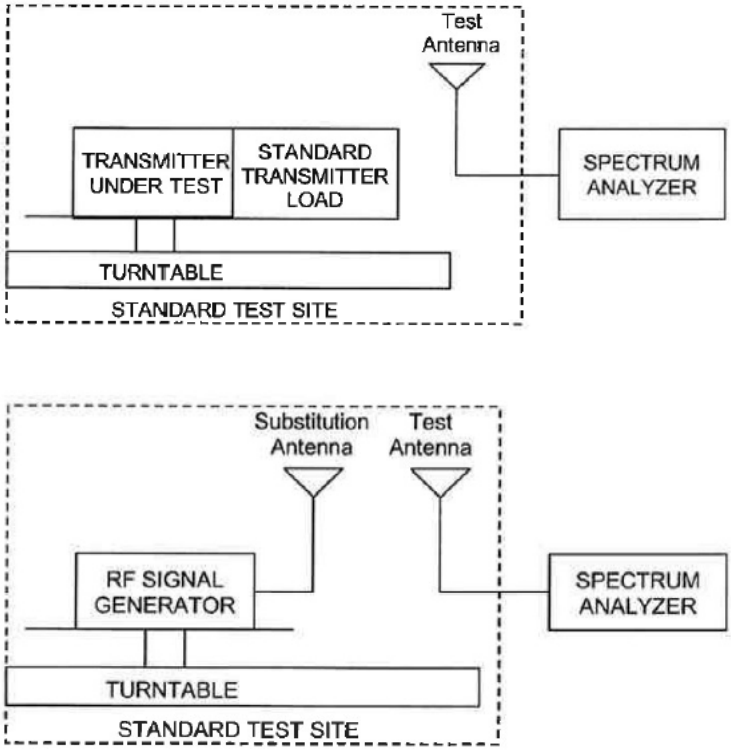


Figure #8.3 Substitution methods TIA/EIA-603-C

10.2 Limit

§27.53 Emission limitations / RSS-GEN sec. 4.9; RSS-131 sec. 4.4

Minimum standard:
Para. No.27.53 (c/d/g)

(c) For operations in the 746–758 MHz band and the 776–788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB.

(g) For operations in the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed

The Emission limit is **-13dBm**.

(d) For operations in the 758–763 MHz and 788–793 MHz bands, the power of any emission outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769–775 MHz and 799–805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

The Emission limit is:

- **-33dBm** for measurements up to 1GHz
- **-24dBm** for measurements above 1 GHz

These Values have been calculated by a formula, which was a result of an inquiry (No. 141765) of the KDB:

$$Limit = P_{OUT} - (76 + 10LOG(P_{OUT}) - 10LOG(Bwdth / 6.25kHz))$$

10.3 Receiver Settings

	up to 1 GHz	above 1 GHz
Measurement bandwidth	120 kHz	1 MHz
Step width	60 kHz	500 kHz
Dwell time	20ms	
Detector	Peak	Average

10.4 Climatic values in the lab

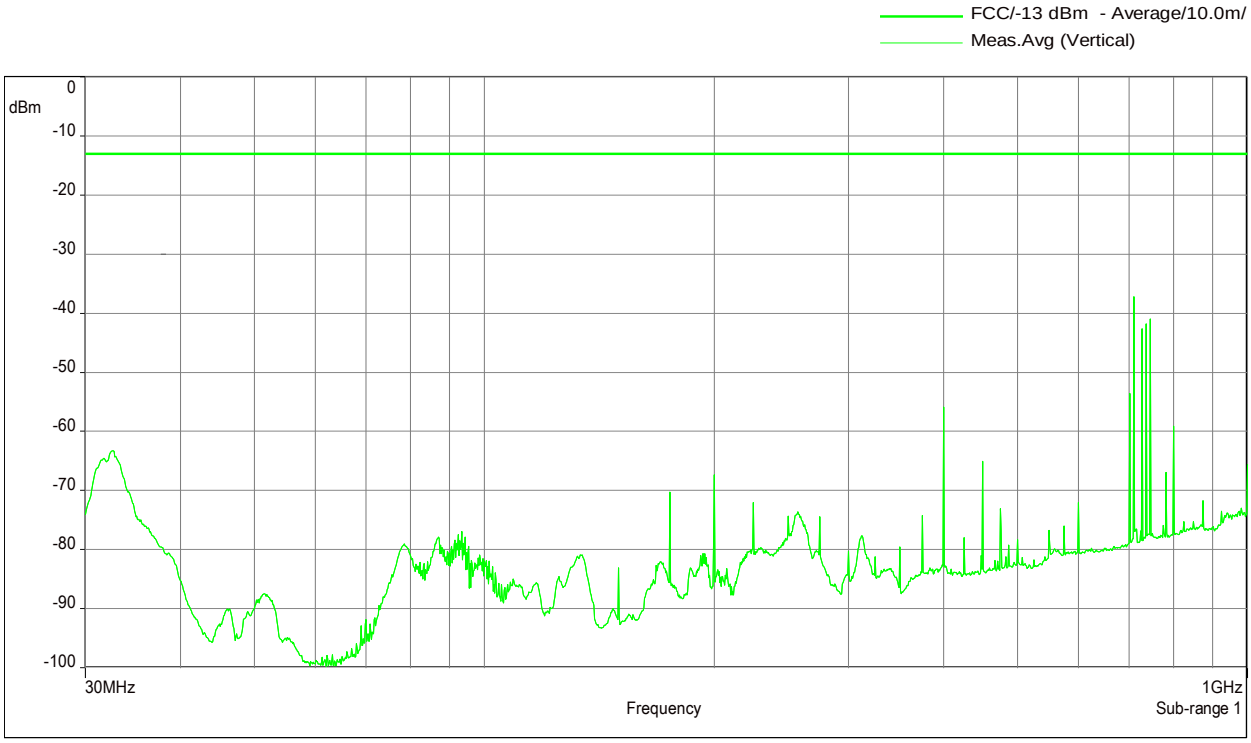
Temperature	18,5°C
Relative Humidity	45%
Air-pressure	1014 hPa

10.5 Test results Downlink

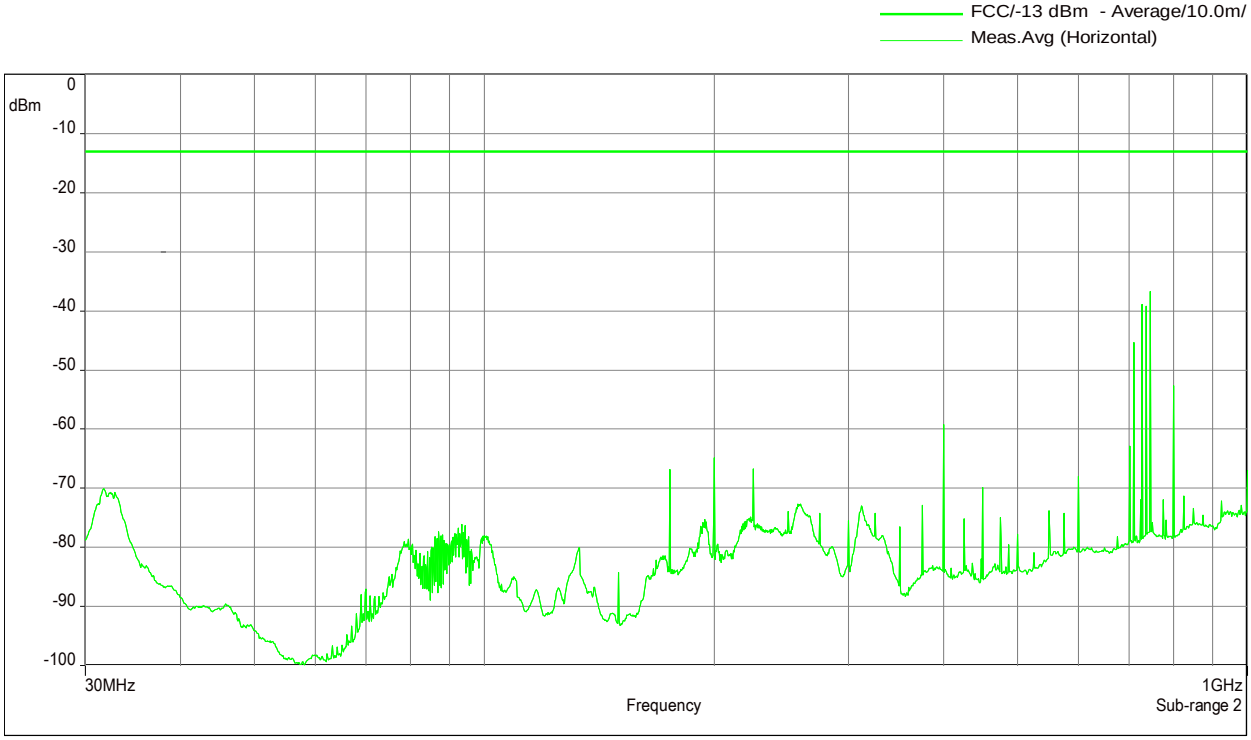
10.5.1 30 MHz to 1 GHz Downlink (Bottom – Middle – Top) Subpart H

Bottom: 728MHz; Middle: 737MHz; Top: 746MHz

Vertical



Horizontal

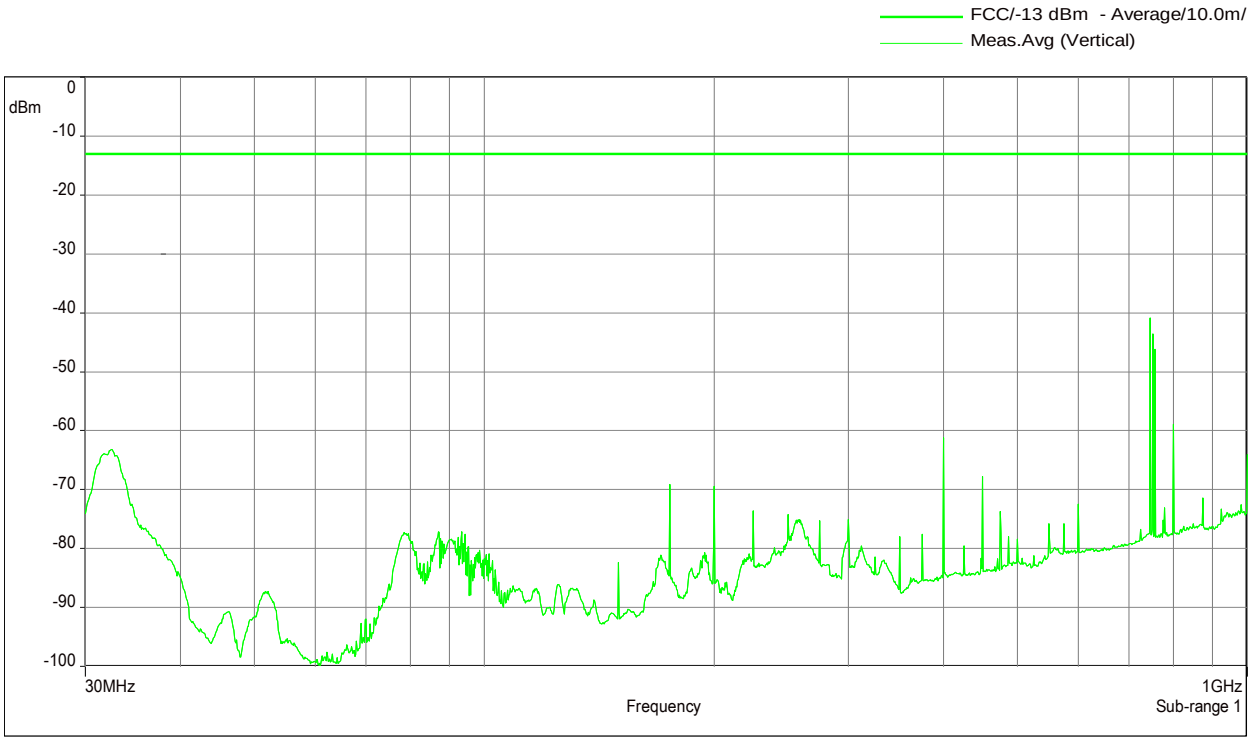


The RF output power is terminated.

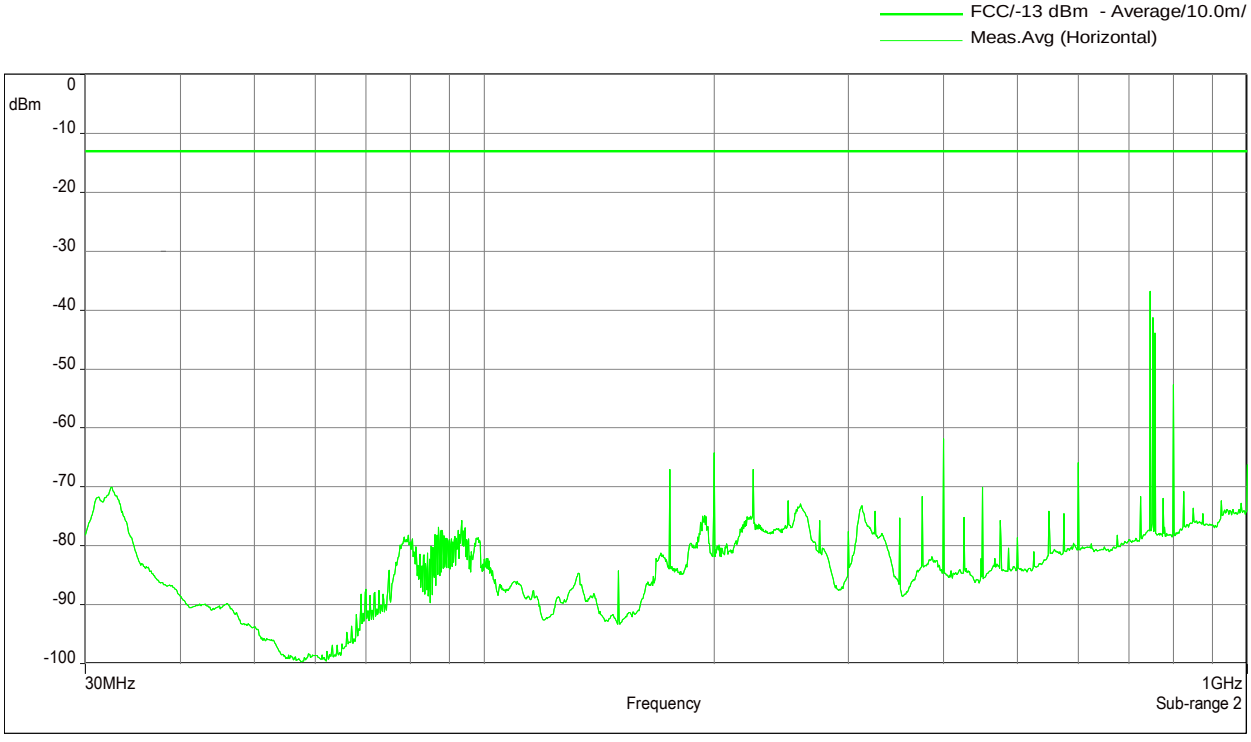
10.5.2 30 MHz to 1 GHz Downlink (Bottom – Middle – Top) Subpart F

Bottom: 746MHz; Middle: 751,5MHz; Top: 757MHz

Vertical



Horizontal

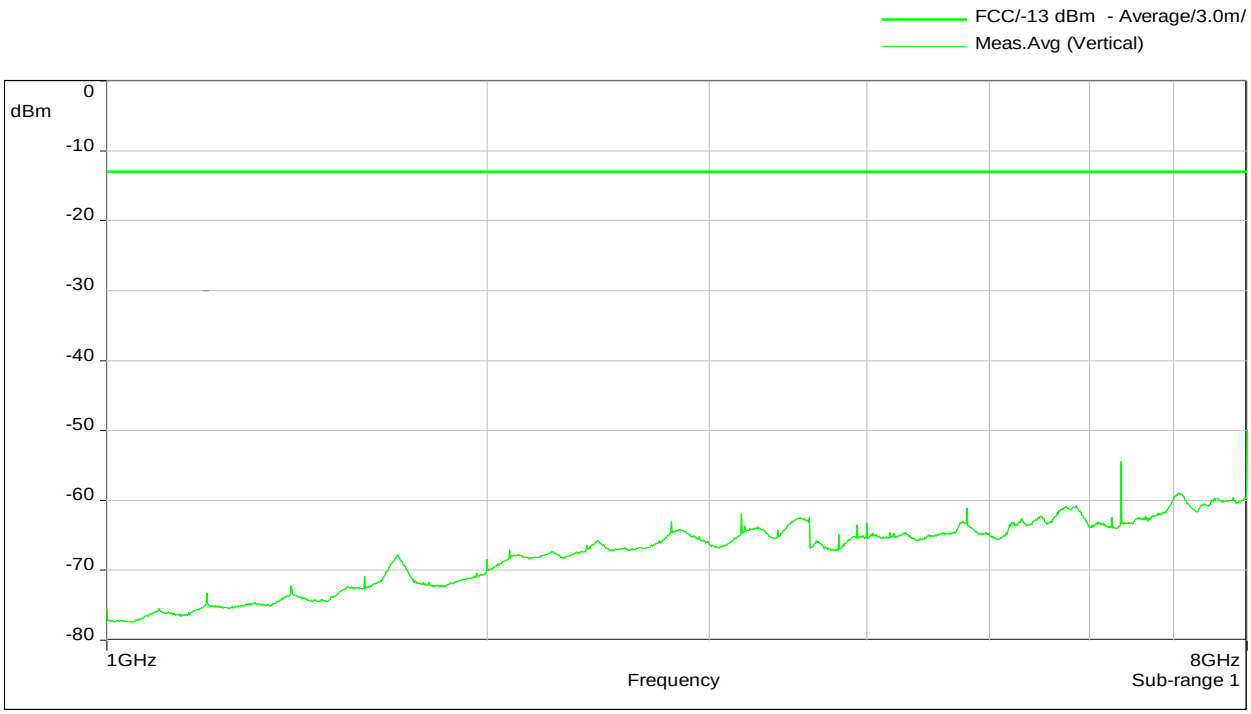


The RF output power is terminated.

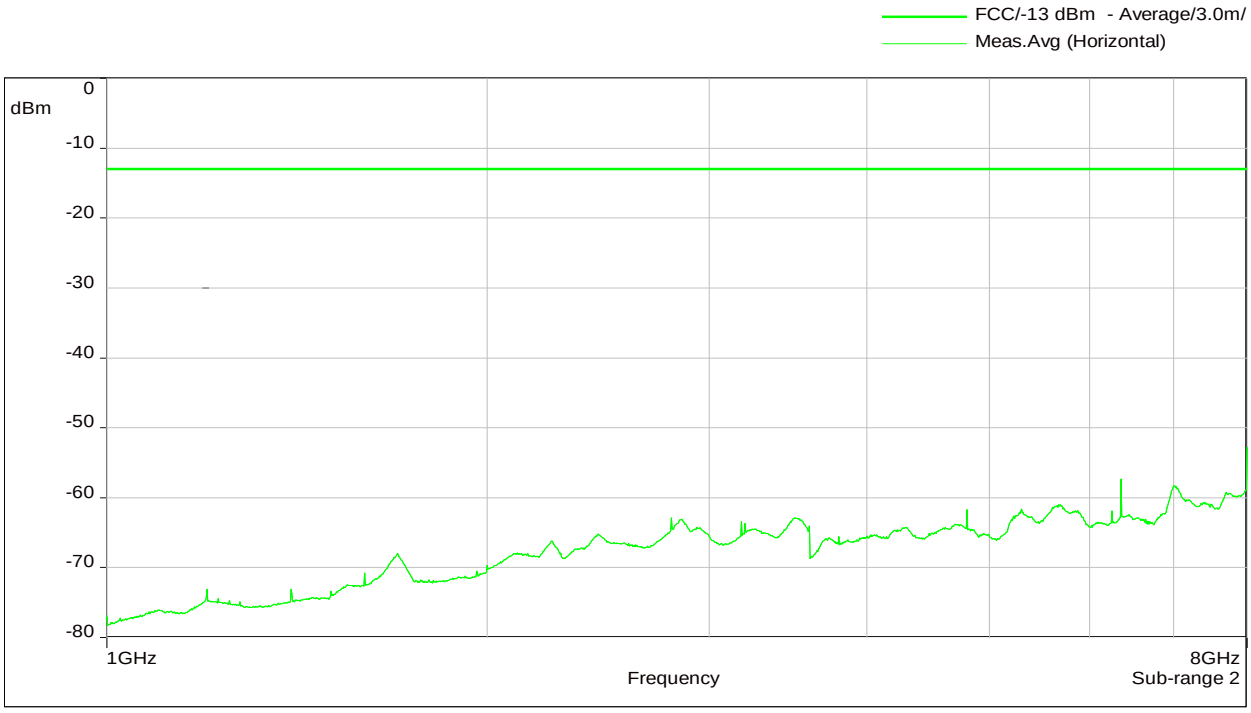
10.5.3
10.5.4 1 GHz to 8 GHz Downlink (Bottom – Middle – Top) Subpart H

Bottom: 728MHz; Middle: 737MHz; Top: 746MHz

Vertical



Horizontal

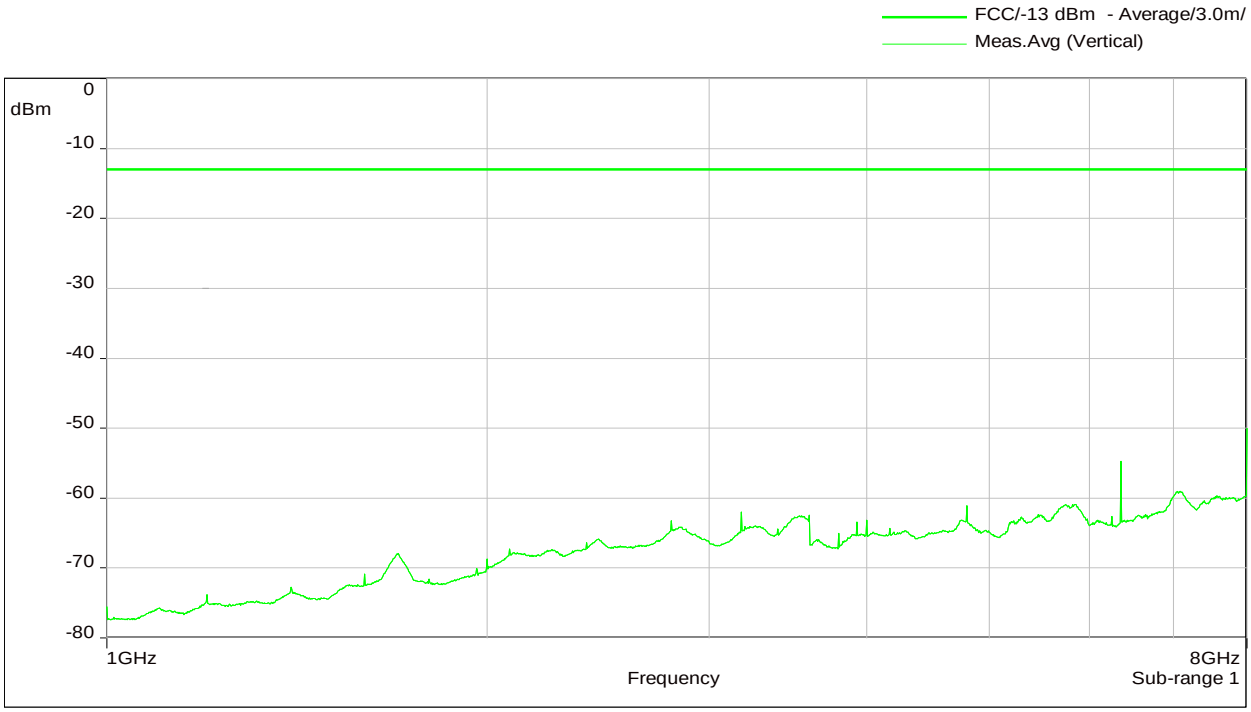


The RF output power is terminated.

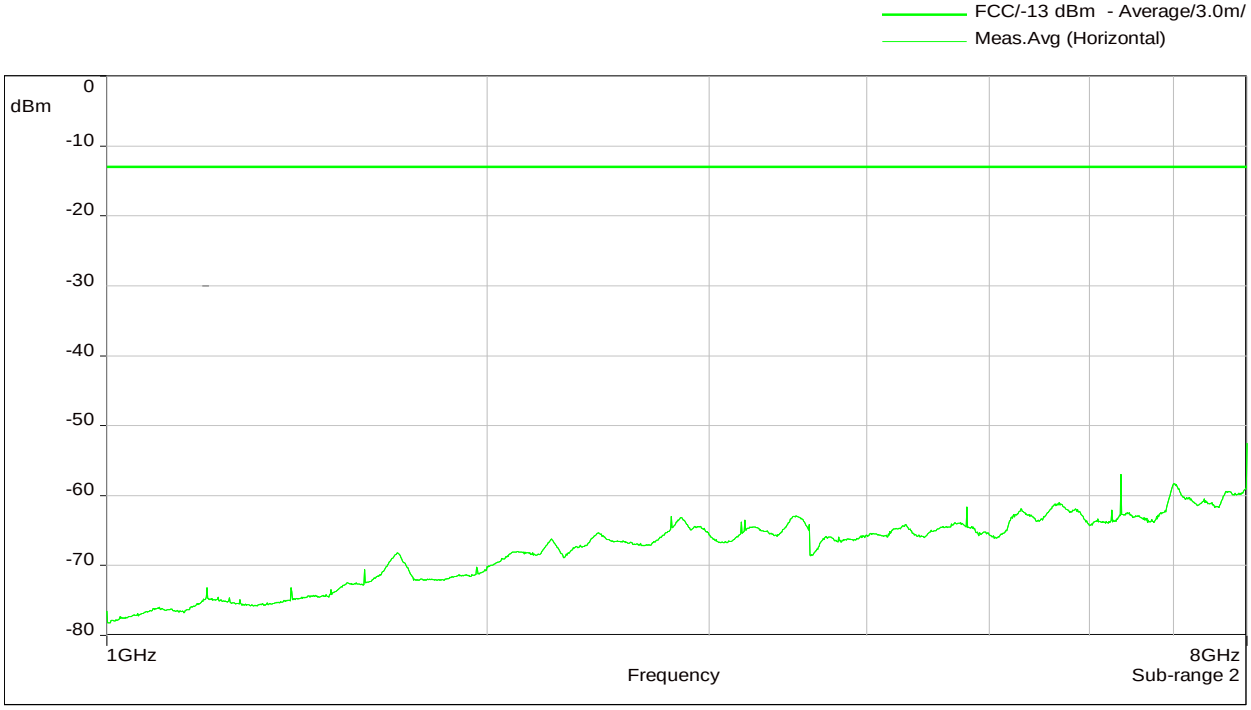
10.5.5 1 GHz to 8 GHz Downlink (Bottom – Middle – Top) Subpart F

Bottom: 746MHz; Middle: 751,5MHz; Top: 757MHz

Vertical



Horizontal



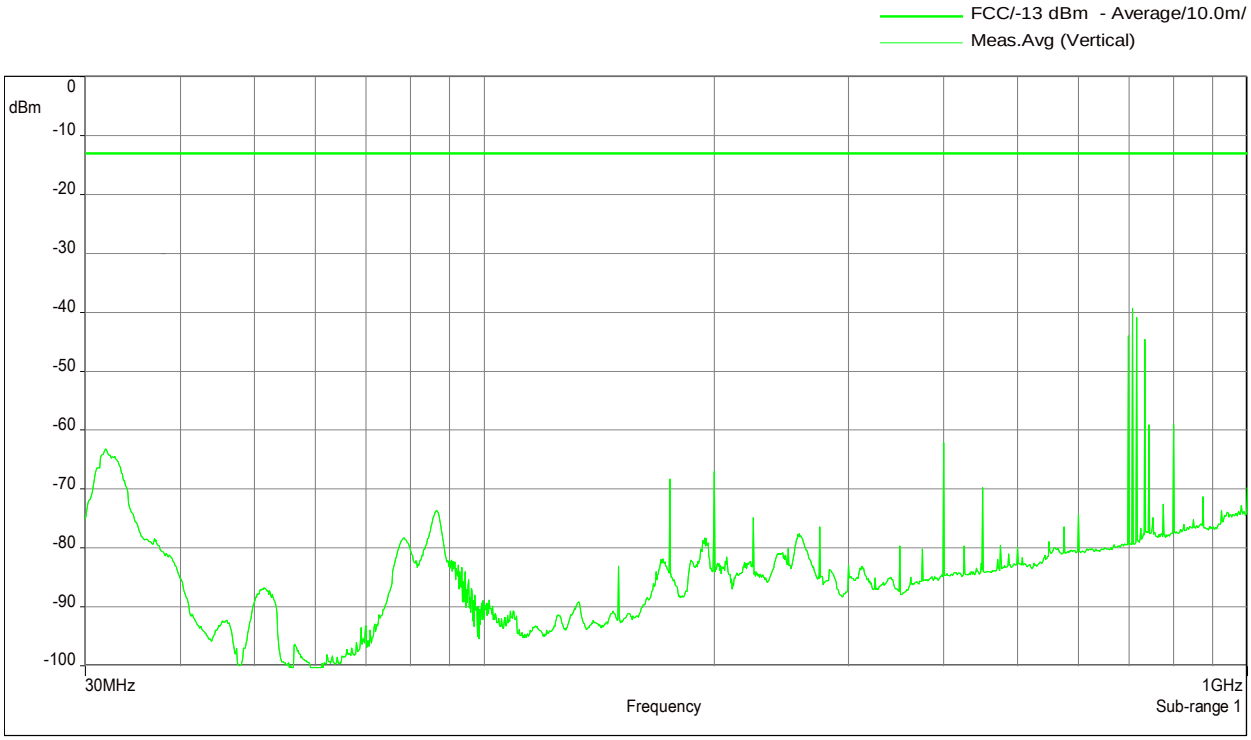
The RF output power is terminated.

10.6 Test results Uplink

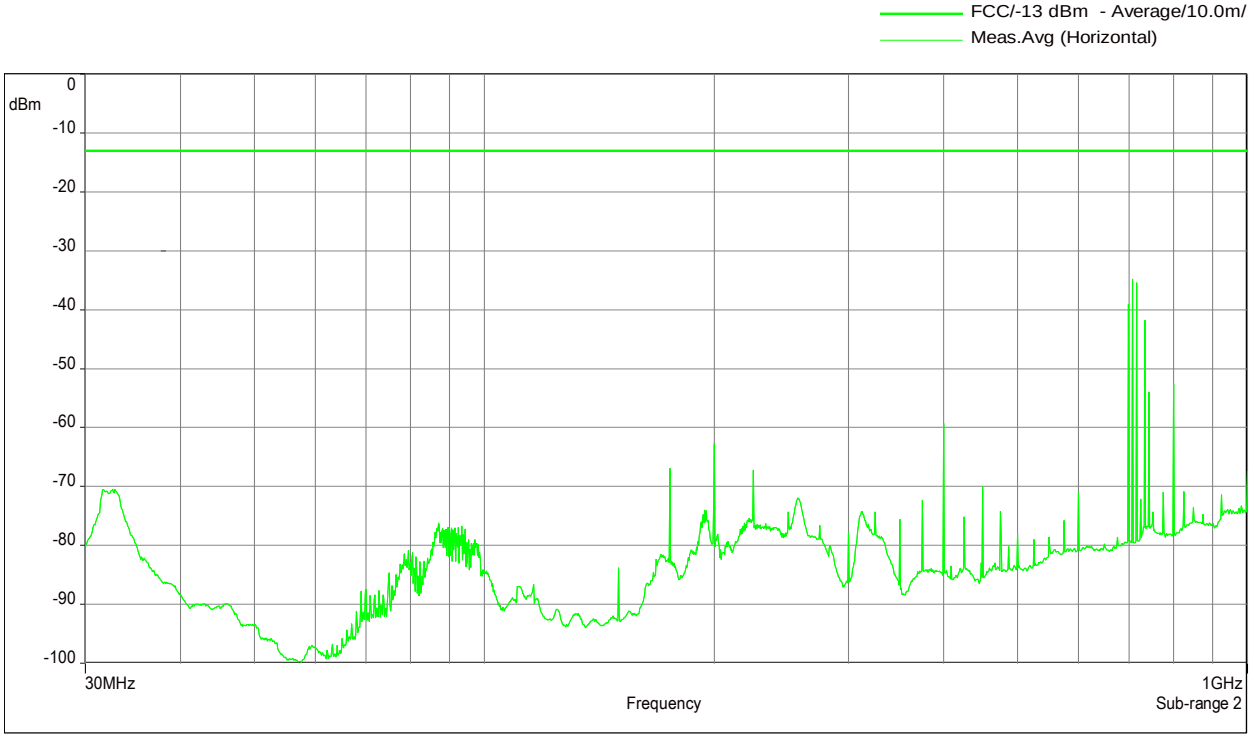
10.6.1 30 MHz to 1 GHz Uplink (Bottom – Middle – Top) Subpart H

Bottom: 698 MHz; Middle: 707 MHz; Top: 716 MHz

Vertical



Horizontal

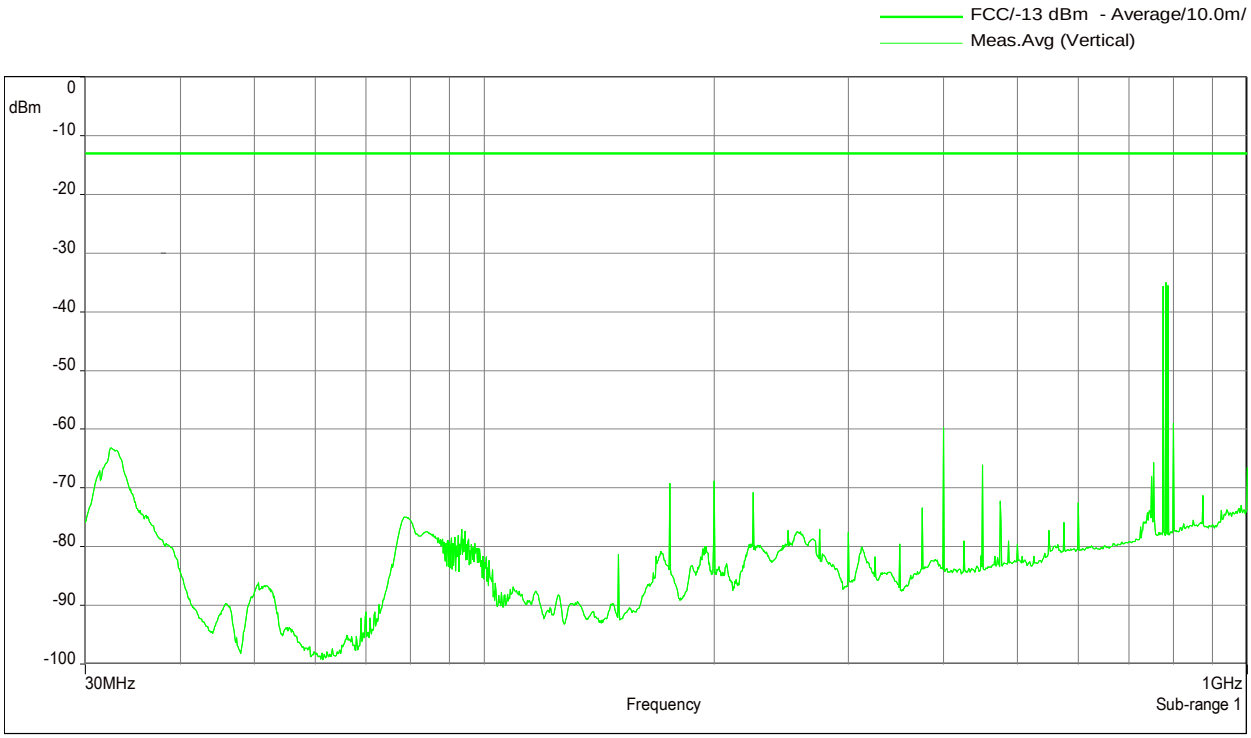


The RF output power is terminated.

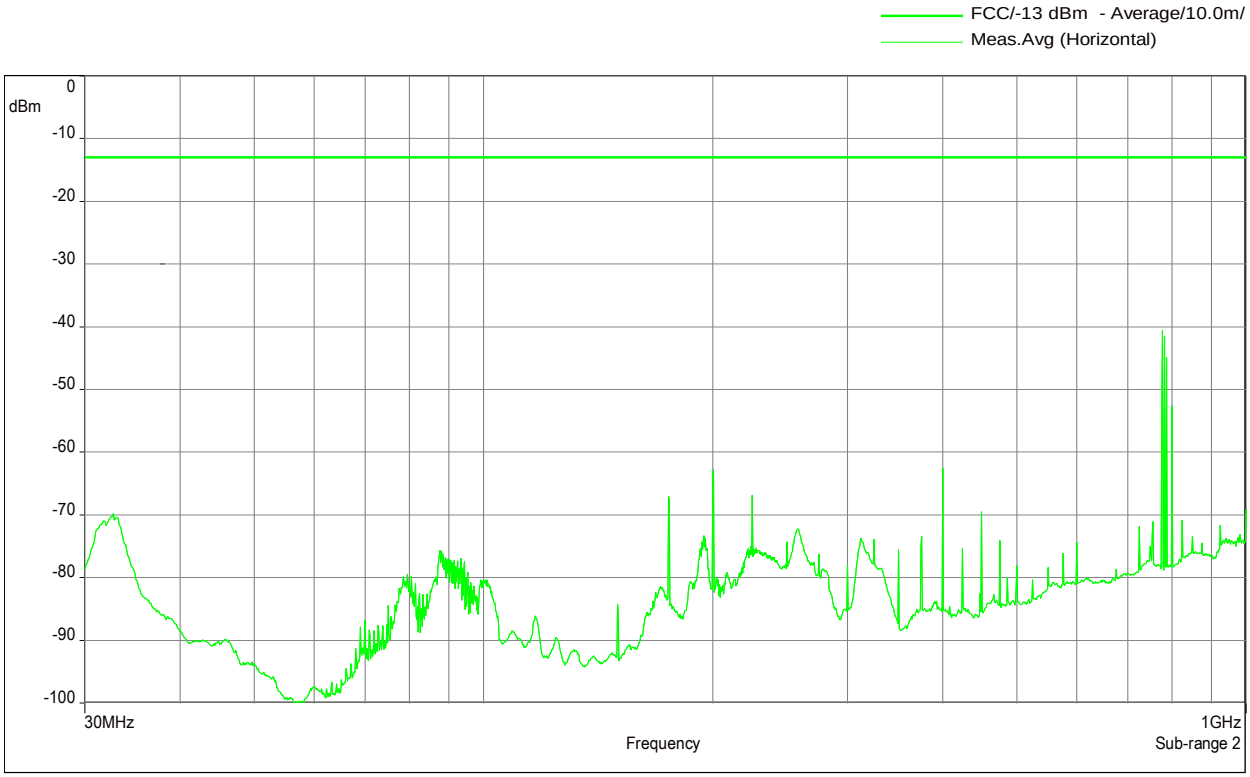
10.6.2 30 MHz to 1 GHz Uplink (Bottom – Middle – Top) Subpart F

Bottom: 776 MHz; Middle: 781,5 MHz; Top: 787 MHz

Vertical



Horizontal

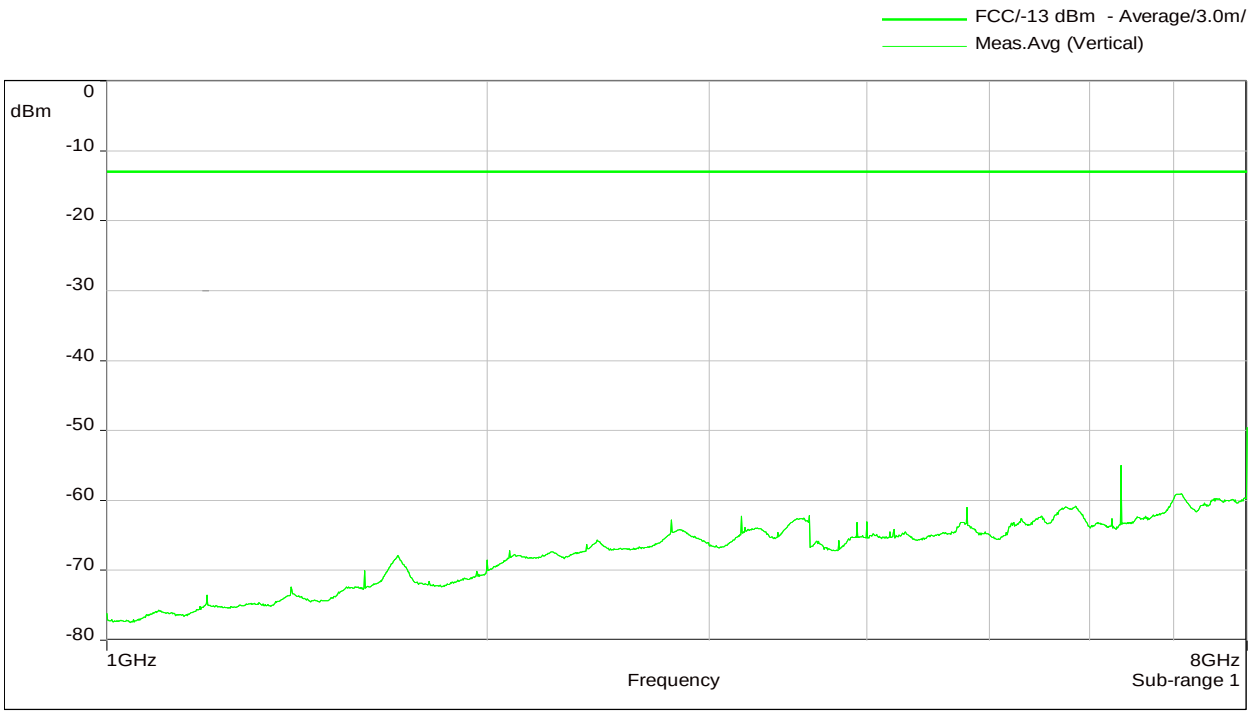


The RF output power is terminated.

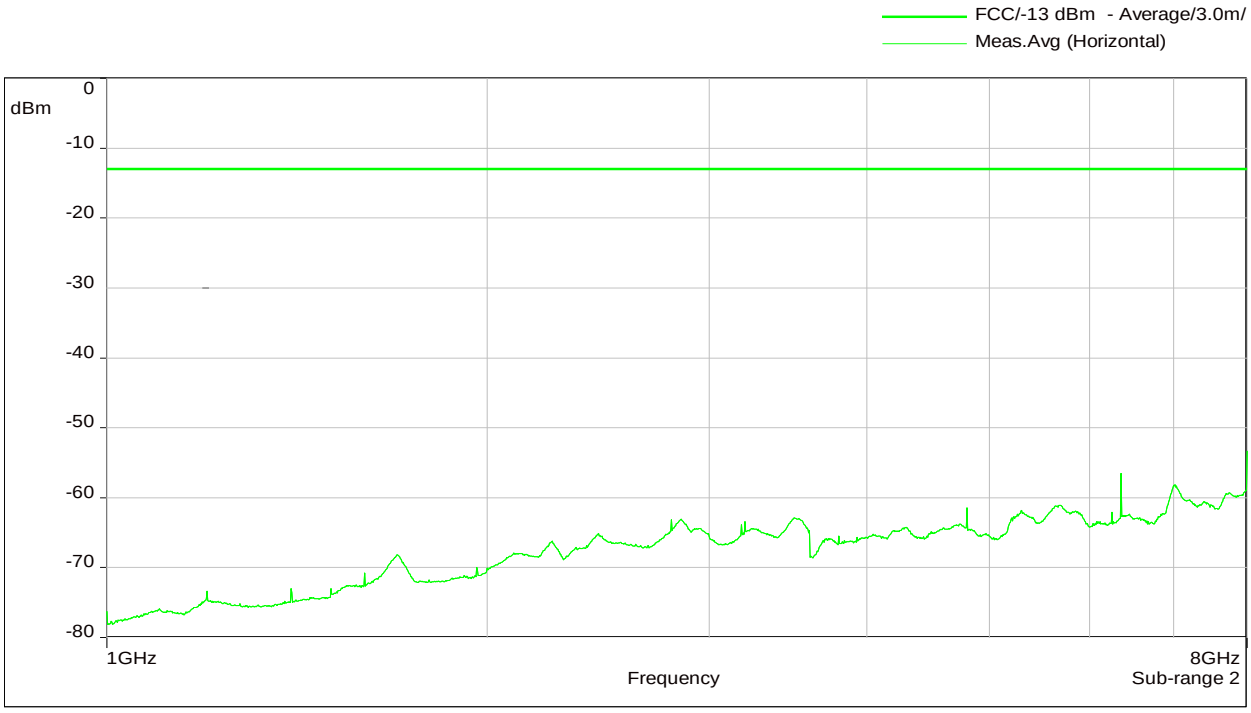
10.6.3
10.6.4 1 GHz to 8 GHz Uplink (Bottom – Middle – Top) Subpart H

Bottom: 698 MHz; Middle: 707 MHz; Top: 716 MHz

Vertical



Horizontal

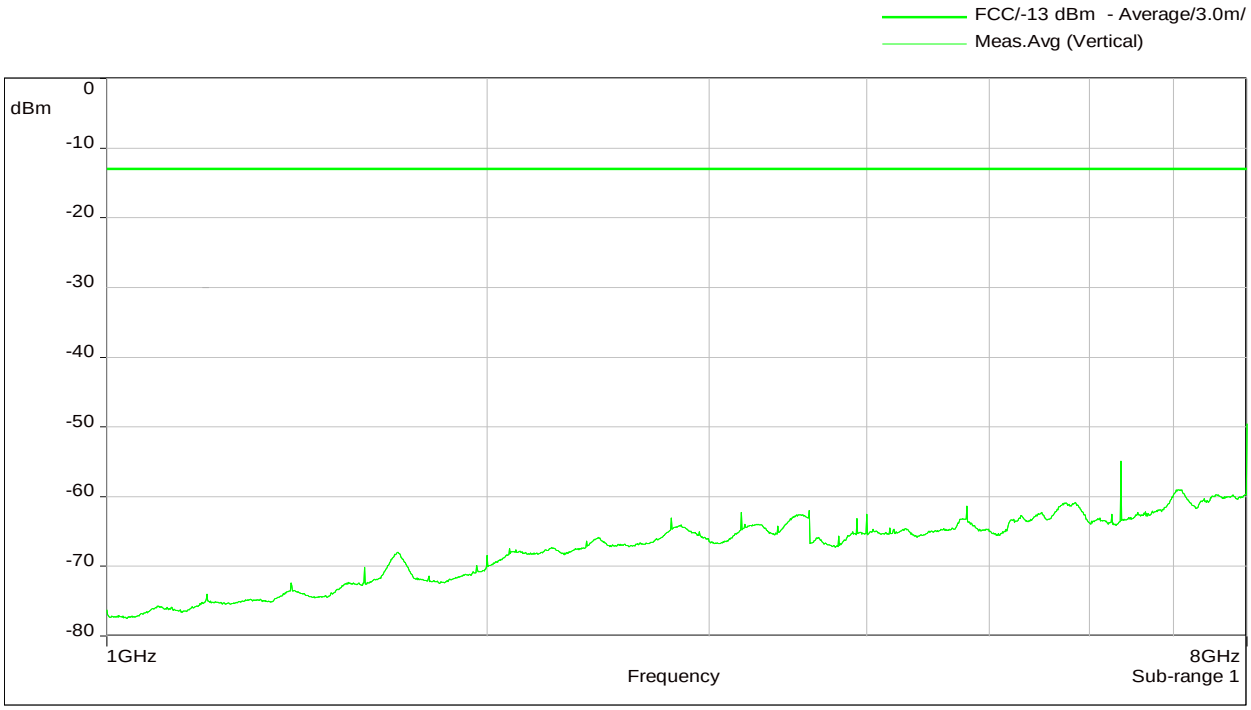


The RF output power is terminated.

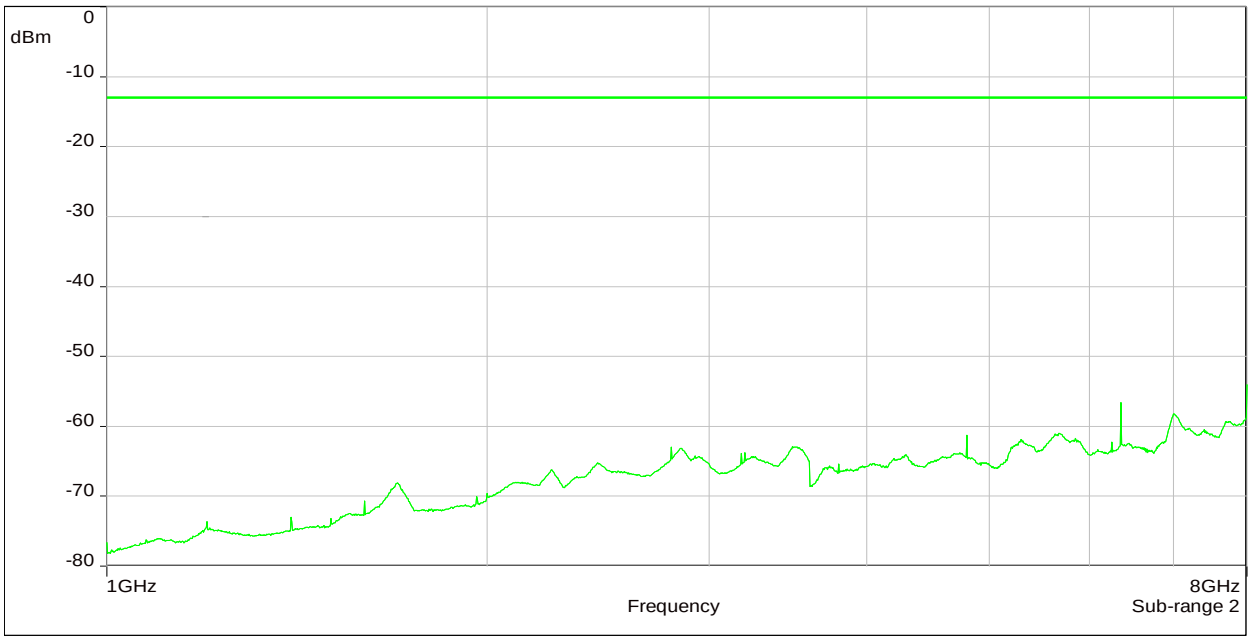
10.6.5 1 GHz to 8 GHz Uplink (Bottom – Middle – Top) Subpart F

Bottom: 776 MHz; Middle: 781,5 MHz; Top: 787 MHz

Vertical



Horizontal



The RF output power is terminated.

11 History

Revision	Modification	Date	Name
01.00	Initial Test report	18.04.2017	Tom Zahlmann

******** End of test report *******