ECL-EMC Test Report No.: 13-047

Equipment under test: **ION-U L 7/8/85/17P/19P Vac 700MHz Path**
FCC ID: **XS5-U7885L1719P**
IC ID: **2237E-U7885L1719P**
Type of test: **FCC 47 CFR Part 27 Subpart H, F: 2013**
Miscellaneous Wireless Communication Services

Measurement Procedures: 47 CFR Parts 2: 2013 (*Frequency Allocations and Radio Treaty Matters; General Rules and Regulations*),
Part 27: 2013 (Miscellaneous Wireless Communication Services),
ANSI/TIA-603-C:2004, *Land Mobile FM or PM Communications Equipment Measurement and Performance Standards*
IC RSS-GEN:2010 General Requirements and Information for the Certification of Radiocommunication Equipment

Test result: **Passed**

Date of issue:	25.06.13		Signature:
Issue-No.:	02	Author:	Tom Zahlmann Test engineer Digitally signed by Tom Zahlmann DN: cn=Tom Zahlmann, o=Bureau Veritas CPS, ou=ECL, email=tom.zahlmann@de.bureauveritas.com, c=DE Date: 2013.06.25 14:27:08 +02'00'
Date of delivery:	08.02.13	Checked:	Frank Tomandl Project manager EMC Digital unterschrieben von Frank Tomandl DN: cn=Frank Tomandl, o=Bureau Veritas CPS GmbH, ou=ECL, email=frank.tomandl@de.bureauveritas.com, c=DE Datum: 2013.06.26 16:13:12 +02'00'
Test dates:	14.01. – 08.02.13		
Pages:	60		

Manufacturer: ANDREW Wireless Systems GmbH
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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
Frequency Stability	27.54	2.1055	Must stay in band	NA

Frequency stability is given by: The system gets an electrical analog signal from the BSS which is converted into an analog optical signal, transmitted by the optical links and then reconverted in the Remote Unit into an analog electrical signal. During this process happens no frequency change/modification, so input and output have same frequency what can be seen under clause “Occupied Bandwidth”.

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

2.1 Description

Kind of equipment	ION-U L 7/8/85/17P/19P Vac
Andrew Ident. Number	Id. No. 7669582-00
Serial no.(SN)	11
Revision	00
Software version and ID	n. a.
Type of modulation and Designator	F3E (Voice) ☒ GSM (GXW) ☒ GSM EDGE (G7W) ☒ 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
Max. composite output power based on one carrier per path (rated)	29 dBm = 0.8 W
Gain	49 dB

2.1.2 Uplink

Pass band	n. a.
System Gain*	n. a.

Note: The EUT does not transmit over the air in the uplink direction.

2.1.3 Description of EUT

ION-U L 7/8/85/17P/19P Vac is a multi-band, multi-operator remote unit configuration used in conjunction with a master unit in the ION optical distribution system.
This system transports up to five frequency bands simultaneously (700 MHz, 800MHz, 850 MHz, 1900 MHz, 1700MHz), providing a cost-effective solution for distributing capacity from one or more base stations.

The ION-U L 7/8/85/17P/19P Vac Repeater consists of one 700 MHz, one 800 MHz, one 850 MHz, one 1900 MHz and one 1700 MHz (2100MHz in DL) path, with the intended use of simultaneous transmission. This Test Report describes only the approval of the 700 MHz path

2.1.4 Block diagram of measurement reference points

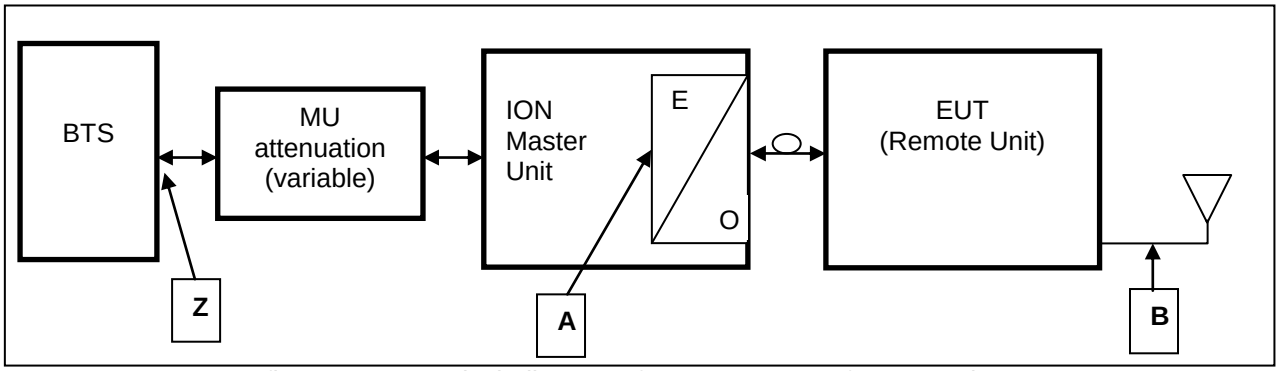


figure 2.1.4-#1 Block diagram of measurement reference points

Remote Unit is the EUT

O/E	Optical / Electrical converter
SRMU	Sub Rack Master Unit

Reference point A	SRMU	UL output,	DL input
Reference point B	Remote Unit	DL output,	UL input
Reference point Z	BTS	DL output,	UL input

Downlink: Measure from reference point A to B

Since a signal generator does not supply a good output signal with +33 or +43dBm, for the downlink measurement the MU Attenuation is not used.
That means for downlink measurements the signal generator is connected to measurement point A at the master optical / electrical converter and the analyzer to the measurement point B at the RU.

2.1.5 Downlink System Gain and Output Power

System optimized for BTS power *(fixed value)* **Z**	MU Attenuation *(manual leveling)*	Maximum rated input power at the MU OTRX *(fixed value)* **A**	RU Gain *(fixed value)* **A to B**	Maximum rated output power at RU Antenna port *(fixed value)* **B**
+33 dBm	**53 dB**	**-20 dBm**	**+49 dB**	**+29.0 dBm** *@ 1 carrier*
System Gain Z to A	**-4 dB**			
+43 dBm	**63 dB**	**-20 dBm**	**+49 dB**	**+29.0 dBm** *@ 1 carrier*
System Gain Z to A	**-14 dB**			

table 2.1.5-#1 Equipment under test (E.U.T.) Description Downlink System Gain and Output Power

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

ANDREW Inv. No.	Test equipment	Type	Manufacturer	Serial No.	Calibration
9102	Network Analyzer	ZVB14	R&S	100118	08/13
9054	Spectrum Analyzer	FSV13	R&S	100859	12/13
9046	Signal Generator	SMBV100A	R&S	255090	06/13
8849	Signal Generator	SMU200A	R&S	101732	04/13
8671	Power Meter	E4418B	Agilent	GB39513094	06/13
8672	Power Sensor	E9300H	Agilent	US41090179	06/13
7306	Circulator	C25E-1FFF	AEROTEK	12580	CIU
7307	Circulator	C25E-1FFF	AEROTEK	12581	CIU
7408	RF-Cable	2,0m; N-N	Andrew	---	CIU
7409	RF-Cable	2,0m; N-N	Andrew	---	CIU
7410	RF-Cable	1,0m; N-N	Andrew	---	CIU
7411	RF-Cable	2,0m; N-N	Andrew	---	CIU
7373	RF-Cable	Multiflex141	Andrew	---	CIU
7374	RF-Cable	Multiflex141	Andrew	---	CIU
7437	RF-Cable	Multiflex141	Andrew	---	CIU
7438	RF-Cable	Multiflex141	Andrew	---	CIU
7439	RF-Cable	Multiflex141	Andrew	---	CIU
7443	RF-Cable	Multiflex141	Andrew	---	CIU
7444	RF-Cable	Multiflex141	Andrew	---	CIU
7445	RF-Cable	Multiflex141	Andrew	---	CIU
7446	RF-Cable	Multiflex141	Andrew	---	CIU
7447	RF-Cable	Multiflex141	Andrew	---	CIU
7448	RF-Cable	Multiflex141	Andrew	---	CIU
7449	RF-Cable	Multiflex141	Andrew	---	CIU
7450	RF-Cable	Multiflex141	Andrew	---	CIU
7440	RF-Cable	RG-223 0.8m	Andrew	---	CIU
7441	RF-Cable	RG-223 0.8m	Andrew	---	CIU
7453	RF-Cable	RG223 2m SMA.	Andrew	---	CIU
7454	RF-Cable	RG223 2m SMA.	Andrew	---	CIU
7455	RF-Cable	RG223 2m SMA.	Andrew	---	CIU
7144	Attenuator	2N-20dB	Inmet 64671	---	CIU
7341	Power Attenuator	768-20	Narda	---	CIU
7368	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.

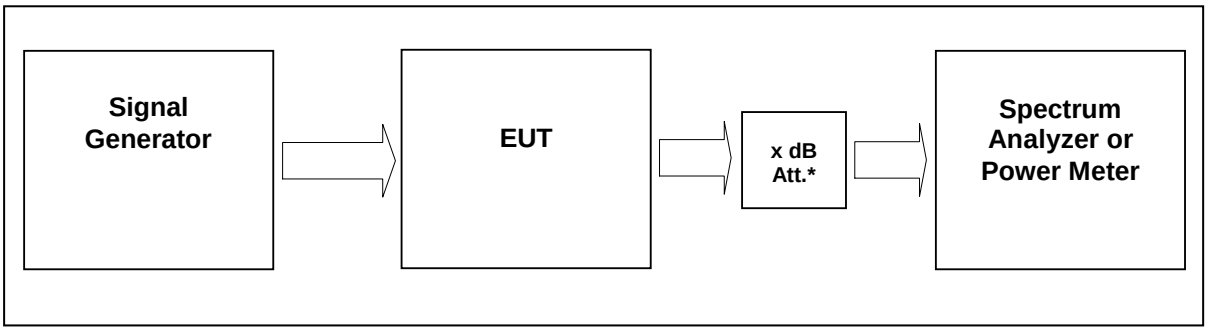
3.4 Measurement uncertainty

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)

FCC Test site: **96997**
IC OATS: **IC3475A-1**
See relevant dates under section 8 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	9054, 9046, 7444; 7306; 7144; 7454;7453; 7341; 7449; 7368

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 Analog:
FM signal with 3.0 kHz deviation and 2.5 kHz rate and sine waveform

Test signal GSM:
Signal waveform with GMSK modulation in all time slots according to 3GPP TS45.004

Test signal GSM EDGE:
Signal waveform with 8-PSK modulation in all time slots according to 3GPP TS45.004

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 -
Analog	Middle	737 MHz (Band 12 (Band Class 19))	100kHz 300kHz 1,5MHz	29.0	0.8	5.3.1.1 #1
Analog	Middle	751,5 MHz (Band 13 (Band Class 7))	100kHz 300kHz 1,5MHz	29.0	0.8	5.3.1.2 #1
GSM	Middle	737 MHz (Band 12 (Band Class 19))	1MHz 3MHz 10MHz	29.0	0.8	5.3.1.3 #2
GSM	Middle	751,5 MHz (Band 13 (Band Class 7))	1MHz 3MHz 10MHz	29.0	0.8	5.3.1.4 #1
EDGE	Middle	737 MHz (Band 12 (Band Class 19))	1MHz 3MHz 10MHz	29.0	0.8	5.3.1.5 #3
EDGE	Middle	751,5 MHz (Band 13 (Band Class 7))	1MHz 3MHz 10MHz	29.0	0.8	5.3.1.6 #1
LTE	Middle	737 MHz (Band 12 (Band Class 19))	3MHz 10MHz 50MHz	29.0	0.8	5.3.1.7 #4
LTE	Middle	751,5 MHz (Band 13 (Band Class 7))	3MHz 10MHz 50MHz	29.0	0.8	5.3.1.8 #1
Maximum output power = 29,0 dBm = 0.8 W						
Limit Maximum output power (erp) = 1000 W						

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

The max RF Power out is 29 dBm, so the maximum antenna gain (x) can be calculated as follow:

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

60 dBm **>** 29 dBm + x ------> x = 60 dBm – 29 dBm = 31 dBd

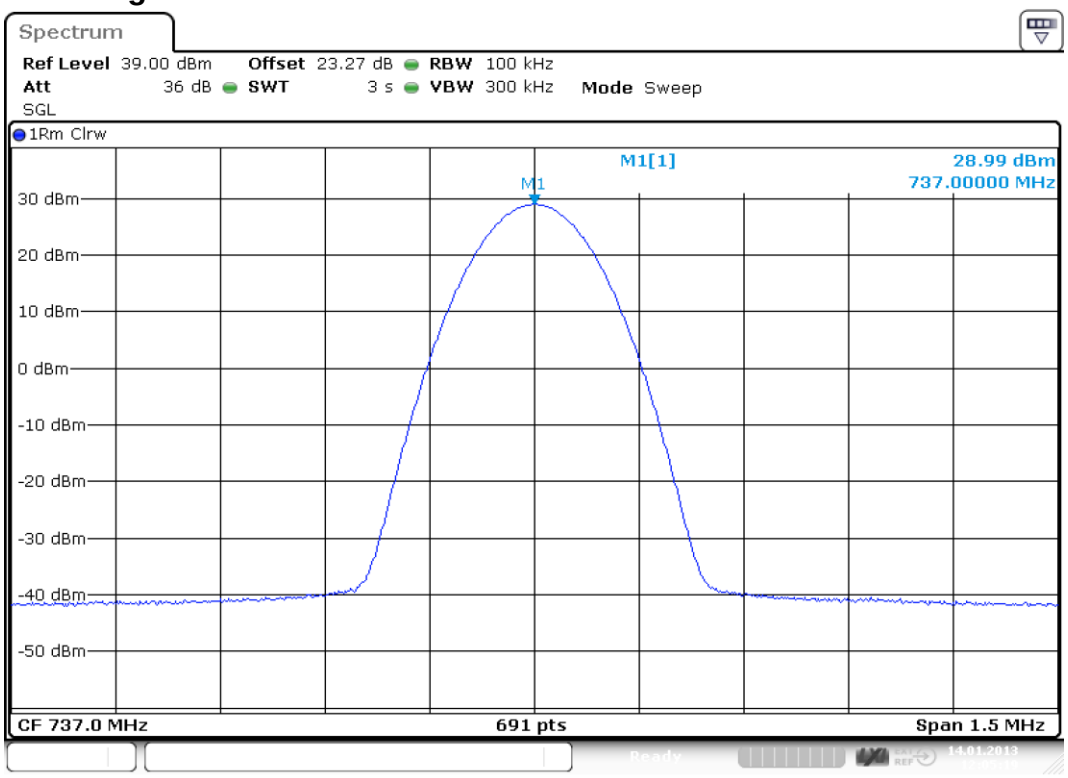
x dBi = 31 dBd + 2.15 dB = 33.15 dBi

=> The antenna that will use for the complete system have to have a gain lower than 33 dBi, relative to a dipol.

Modulation	Path	Pin / dBm (Ref. point A)
Analog	737 MHz (Band 12(Band Class 19))	-21.5
Analog	751,5 MHz(Band 13(Band Class 7))	-22.1
GSM	737 MHz (Band 12(Band Class 19))	-21.5
GSM	751,5 MHz(Band 13(Band Class 7))	-22.0
EDGE	737 MHz (Band 12(Band Class 19))	-21.5
EDGE	751,5 MHz(Band 13(Band Class 7))	-21.7
LTE	737 MHz (Band 12(Band Class 19))	-21.6
LTE	751,5 MHz(Band 13(Band Class 7))	-21.8

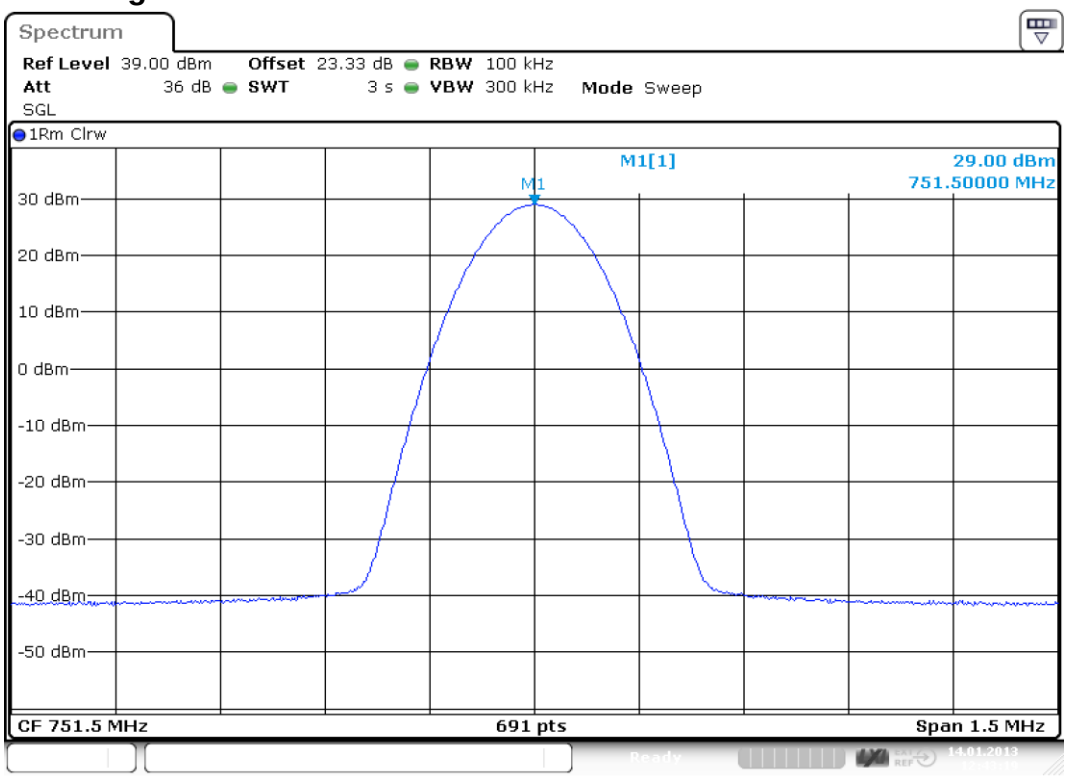
table 5.3.1-#2 RF Power Out: §27.50, §2.1046 Test Results Downlink Input power

5.3.1.1 Analog 728 – 746MHz



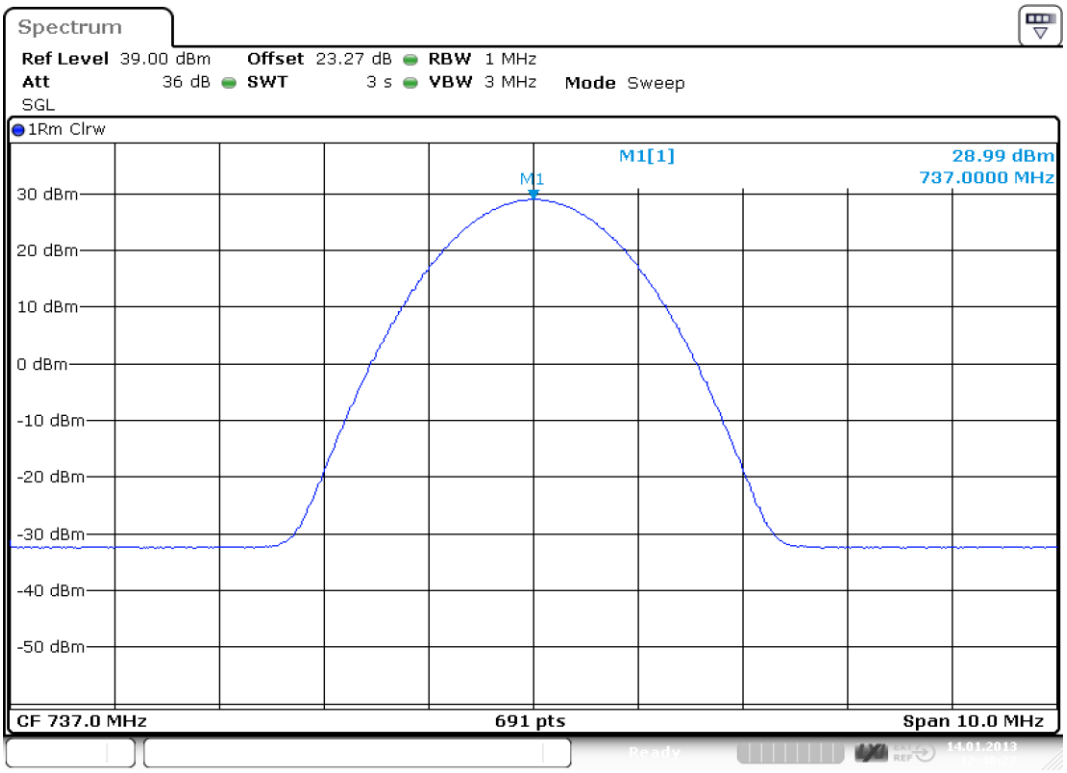
plot 5.3.1.1-#1 RF Power Out: §27.50, §2.1046; Downlink; Analog 728 – 746MHz Middle

5.3.1.2 Analog 746 – 757MHz



plot 5.3.1.2-#1 RF Power Out: §27.50, §2.1046; Downlink; Analog 746 – 757MHz Middle

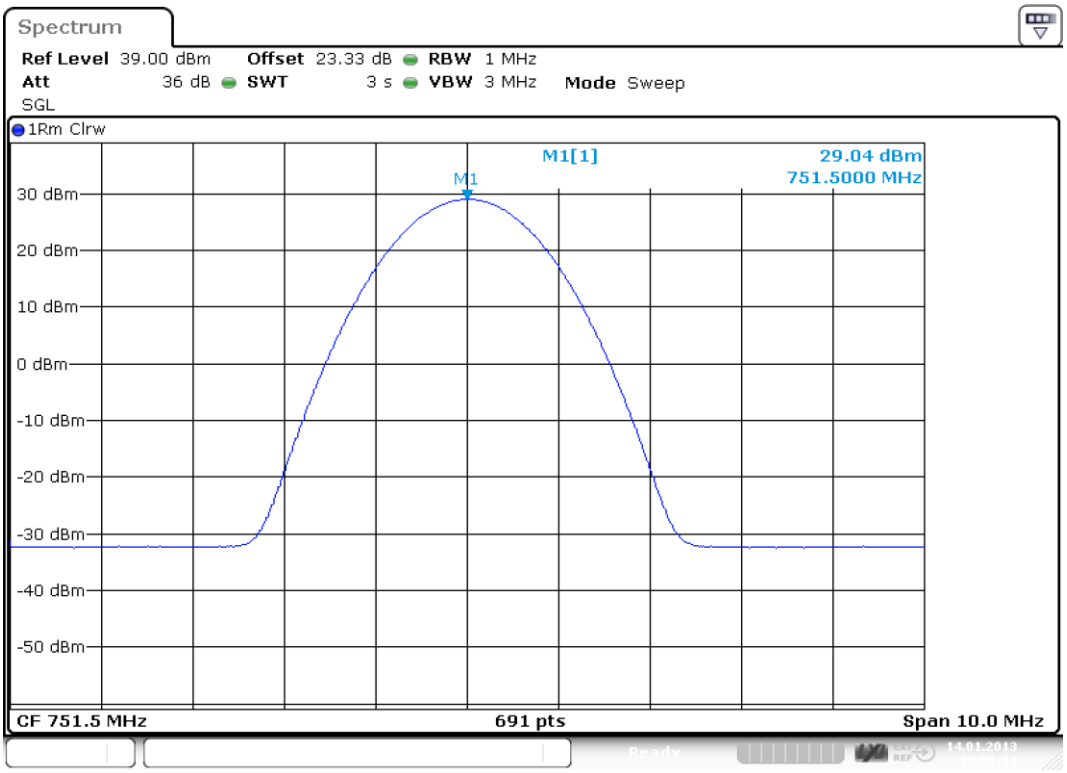
5.3.1.3 GSM 728 – 746MHz



Date: 14.JAN.2013 12:48:26

plot 5.3.1.3-#1 RF Power Out: §27.50, §2.1046; Downlink; GSM 728 – 746MHz Middle

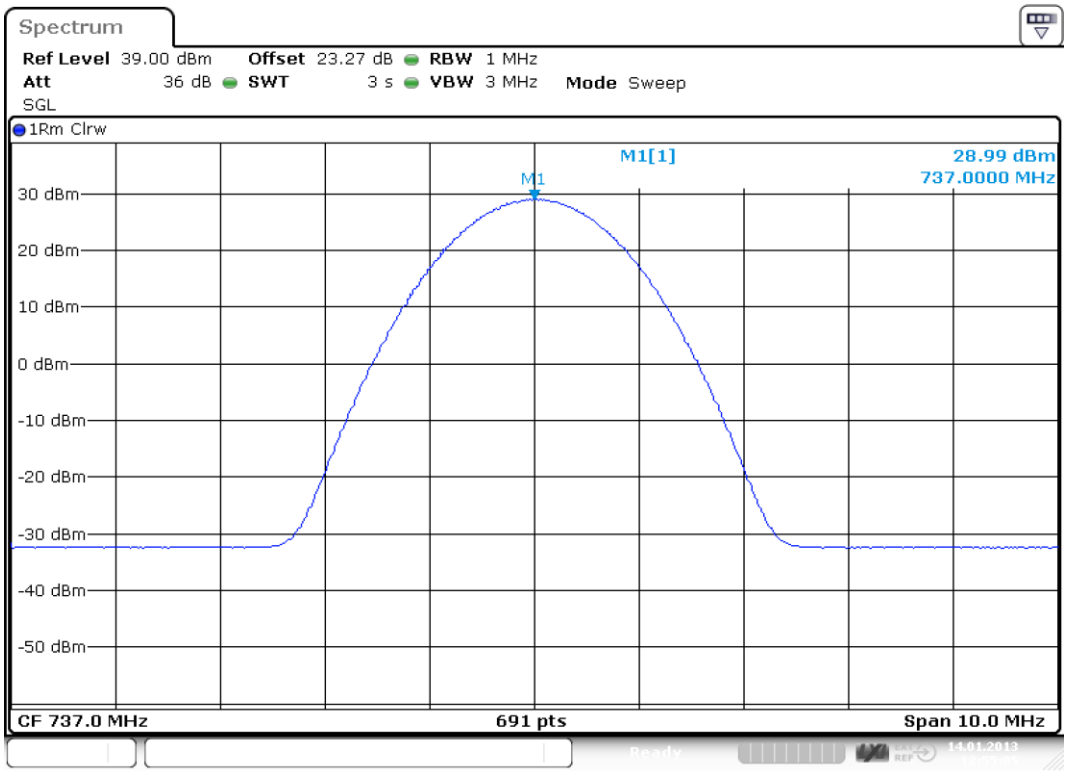
5.3.1.4 GSM 746 – 757MHz



Date: 14.JAN.2013 12:51:13

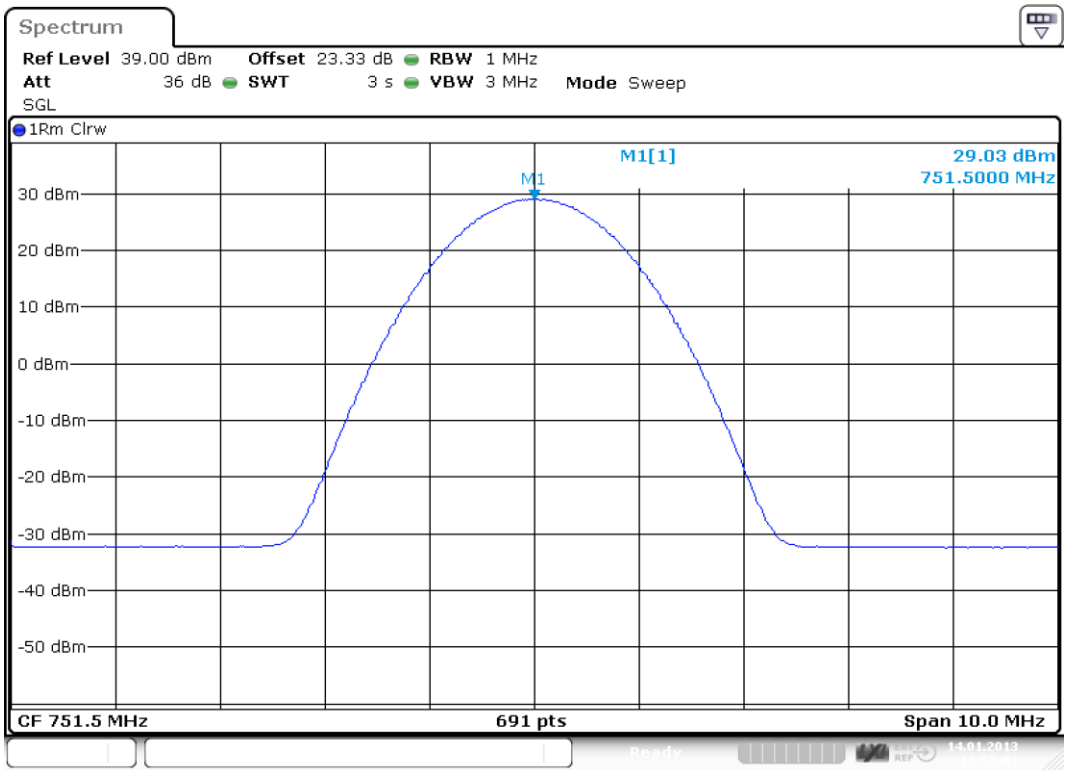
plot 5.3.1.4-#1 RF Power Out: §27.50, §2.1046; Downlink; GSM 746 – 757MHz Middle

5.3.1.5 EDGE 728 – 746MHz



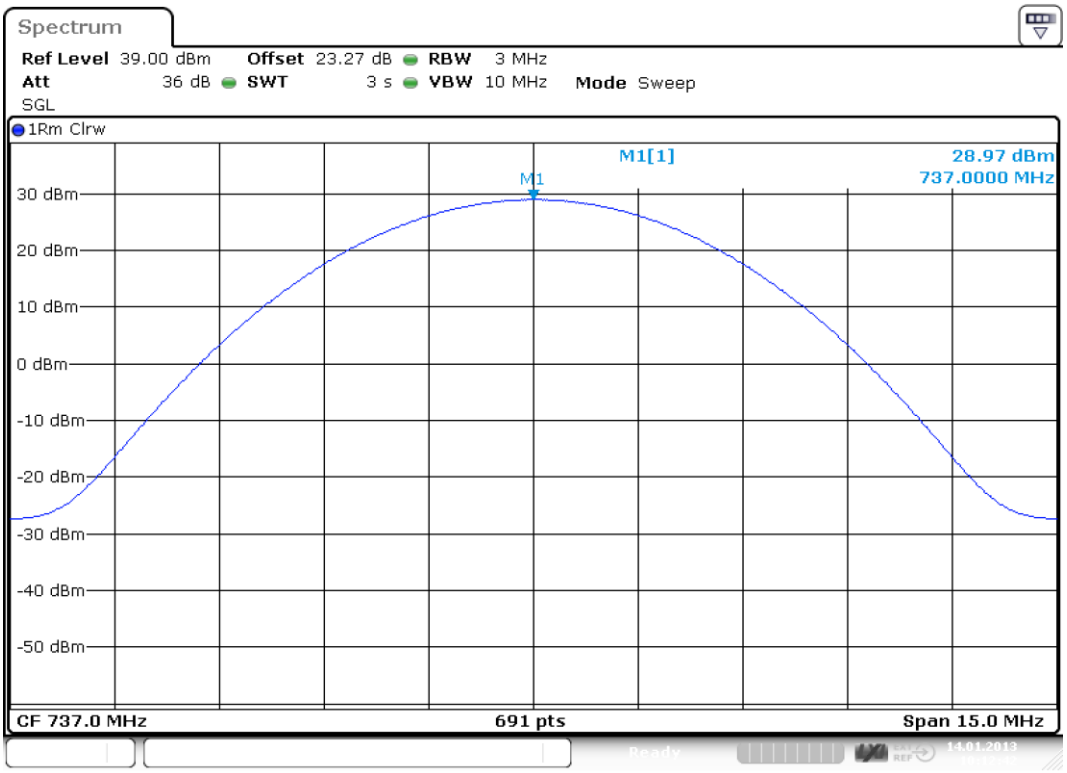
plot 5.3.1.5-#1 RF Power Out: §27.50, §2.1046; Downlink; EDGE 728 – 746MHz Middle

5.3.1.6 EDGE 746 – 757MHz



plot 5.3.1.6-#1 RF Power Out: §27.50, §2.1046; Downlink; EDGE 746 – 757MHz Middle

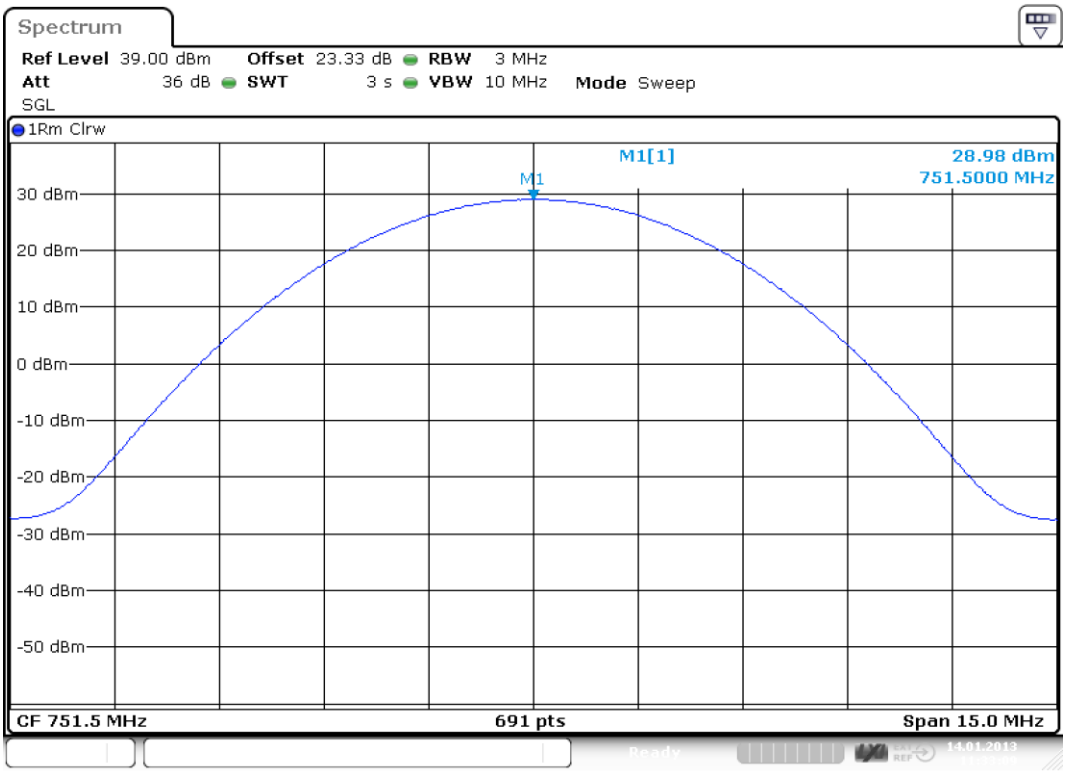
5.3.1.7 LTE 728 – 746MHz



Date: 14.JAN.2013 10:12:42

plot 5.3.1.7-#1 RF Power Out: §27.50, §2.1046; Downlink; LTE 728 – 746MHz Middle

5.3.1.8 LTE 746 – 757MHz



Date: 14.JAN.2013 11:33:09

plot 5.3.1.8-#1 RF Power Out: §27.50, §2.1046; Downlink; LTE 746 – 757MHz Middle

5.3.2 Uplink

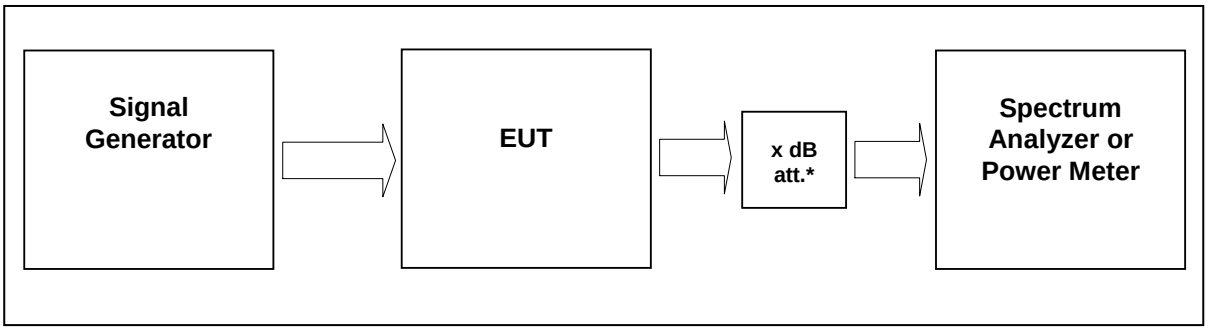
n.a.

Note: The EUT does not transmit over the air in the uplink direction.

5.4 Summary test result

Test result	complies, according the plots above
Tested by:	M. Leinfelder
Date:	14.01.2013

6 Occupied Bandwidth: §90.210, §2.1049



External Attenuator DL x dB = 20 dB

figure 6-#1 Test setup: Occupied Bandwidth: §90.210, §2.1049

Measurement uncertainty	± 0,38 dB
Test equipment used	9054, 9046, 7444; 7306; 7144; 7454;7453; 7341; 7449; 7368

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

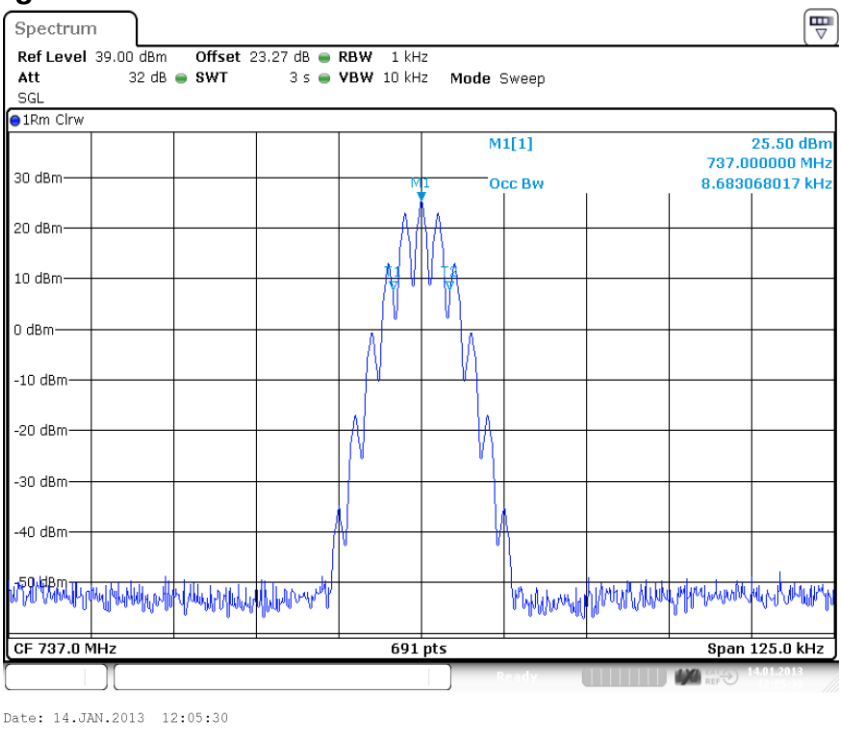
6.3.1 Downlink

Detector RMS.

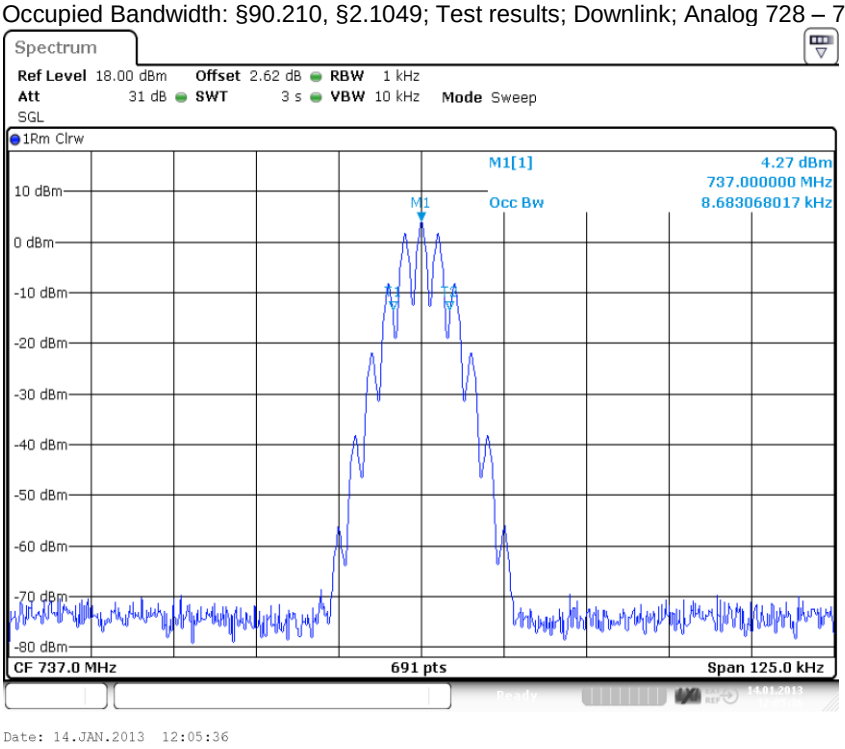
Modulation	Measured at	Path	RBW VBW Span	Occupied Bandwidth / MHz	Plot #
Analog	Middle	737 MHz (Band 12 (Band Class 19))	1 kHz 10 kHz 125 kHz	0.009	6.3.1.1 #1, #2
Analog	Middle	751,5 MHz (Band 13 (Band Class 7))	1 kHz 10 kHz 125 kHz	0.009	6.3.1.2 #1, #2
GSM	Middle	737 MHz (Band 12 (Band Class 19))	3 kHz 30 kHz 1 MHz	0.188	6.3.1.3 #1, #2
GSM	Middle	751,5 MHz (Band 13 (Band Class 7))	3 kHz 30 kHz 1 MHz	0.19	6.3.1.4 #1, #2
EDGE	Middle	737 MHz (Band 12 (Band Class 19))	3 kHz 30 kHz 1 MHz	0.193	6.3.1.5 #1, #2
EDGE	Middle	751,5 MHz (Band 13 (Band Class 7))	3 kHz 30 kHz 1 MHz	0.194	6.3.1.6 #1, #2
LTE	Middle	737 MHz (Band 12 (Band Class 19))	30 kHz 300 kHz 5 MHz	1.042	6.3.1.7 #1, #2
LTE	Middle	751,5 MHz (Band 13 (Band Class 7))	30 kHz 300 kHz 5 MHz	1.042	6.3.1.8 #1, #2

table 6.3-#1 Occupied Bandwidth: §90.210, §2.1049 Test results

6.3.1.1 Analog 728 – 746MHz

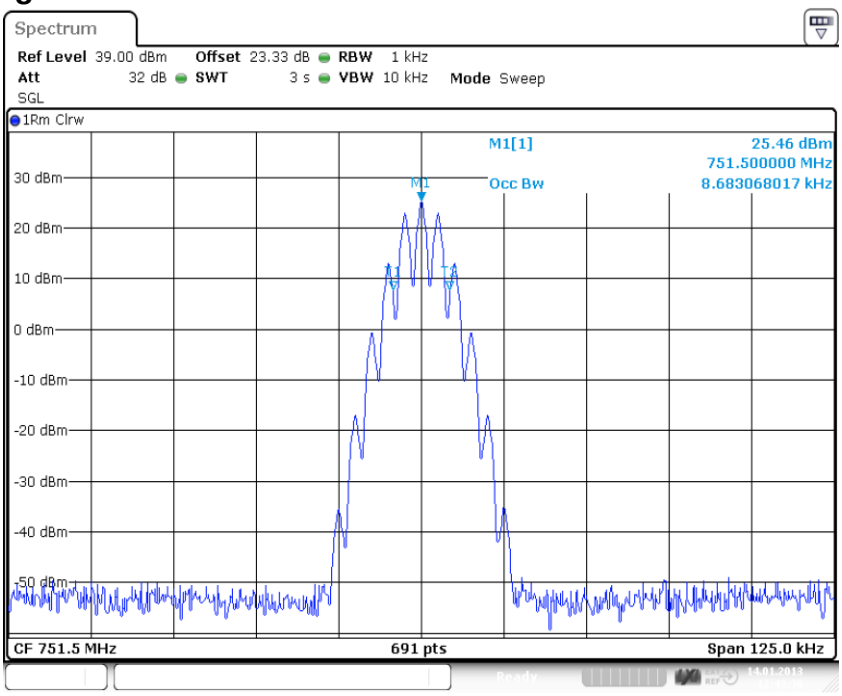


plot 6.3.1.1-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; Analog 728 – 746MHz Output

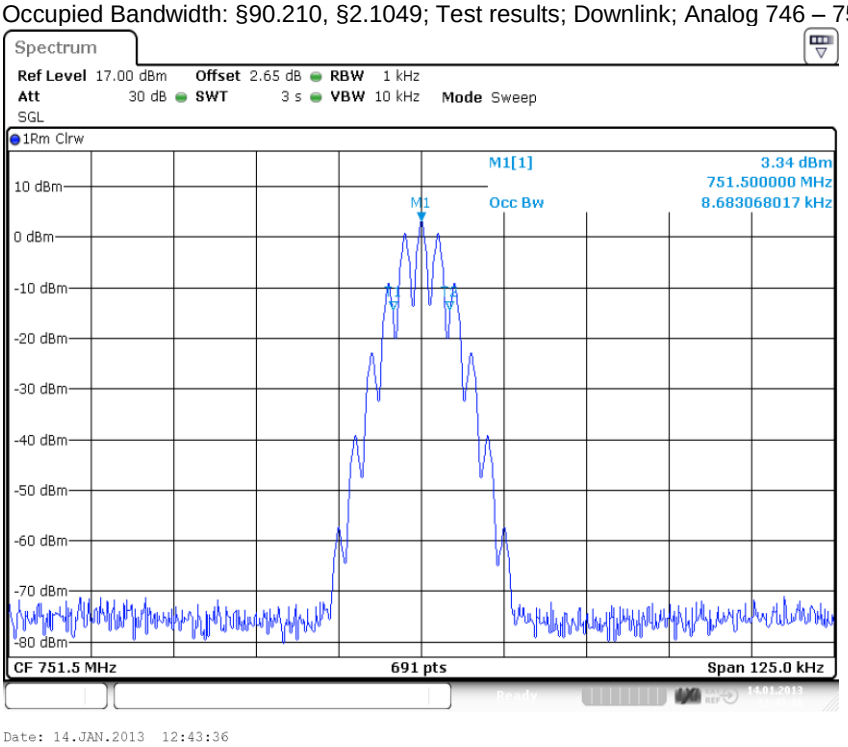


plot 6.3.1.1-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; Analog 728 – 746MHz Input

6.3.1.2 Analog 746 – 757MHz

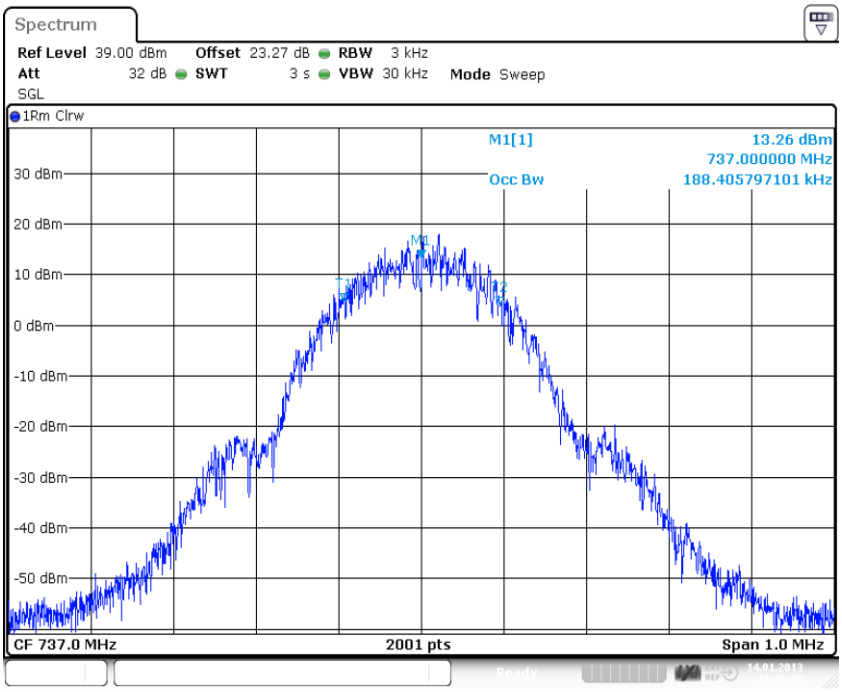


plot 6.3.1.2-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; Analog 746 – 757MHz Output

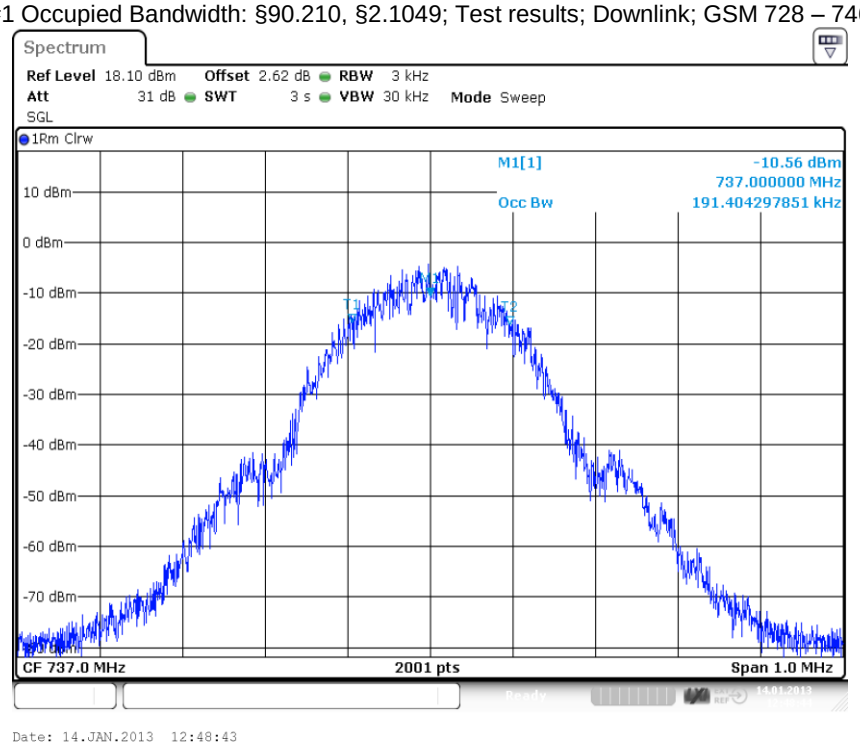


plot 6.3.1.2-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; Analog 746 – 757MHz Input

6.3.1.3 GSM 728 – 746MHz

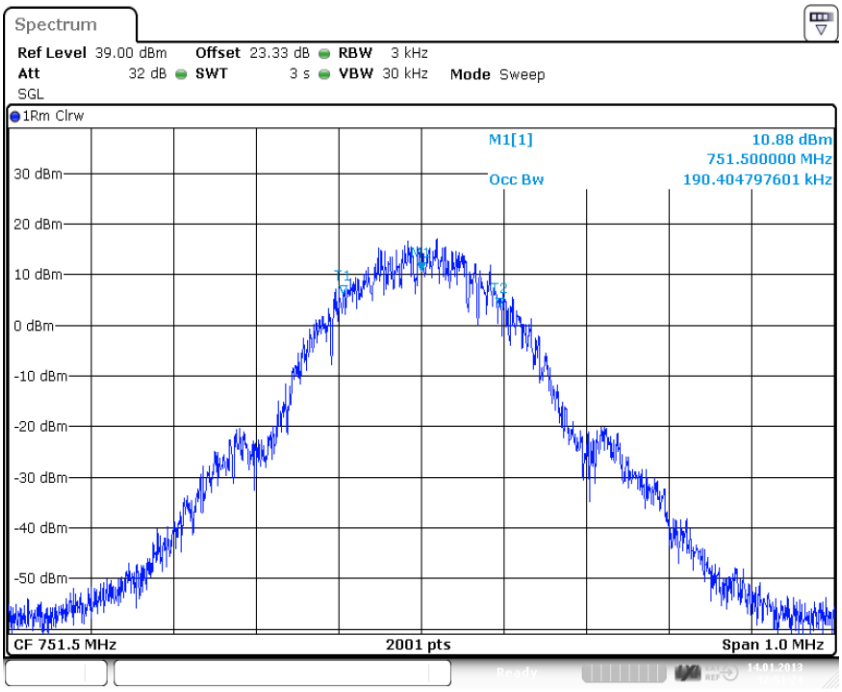


plot 6.3.1.3-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; GSM 728 – 746MHz Output

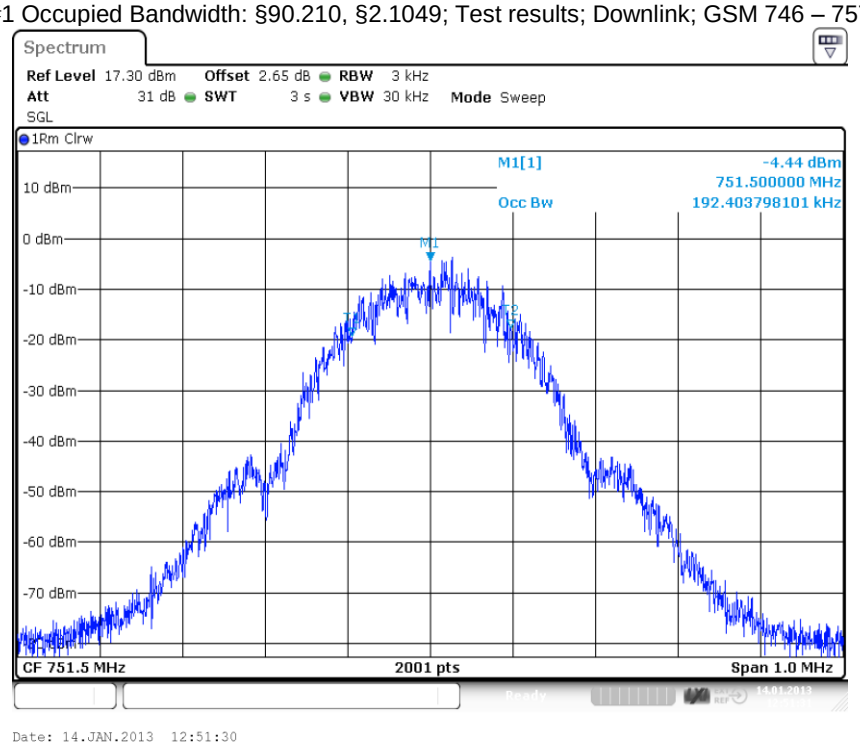


plot 6.3.1.3-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; GSM 728 – 746MHz Input

6.3.1.4 GSM 746 – 757MHz

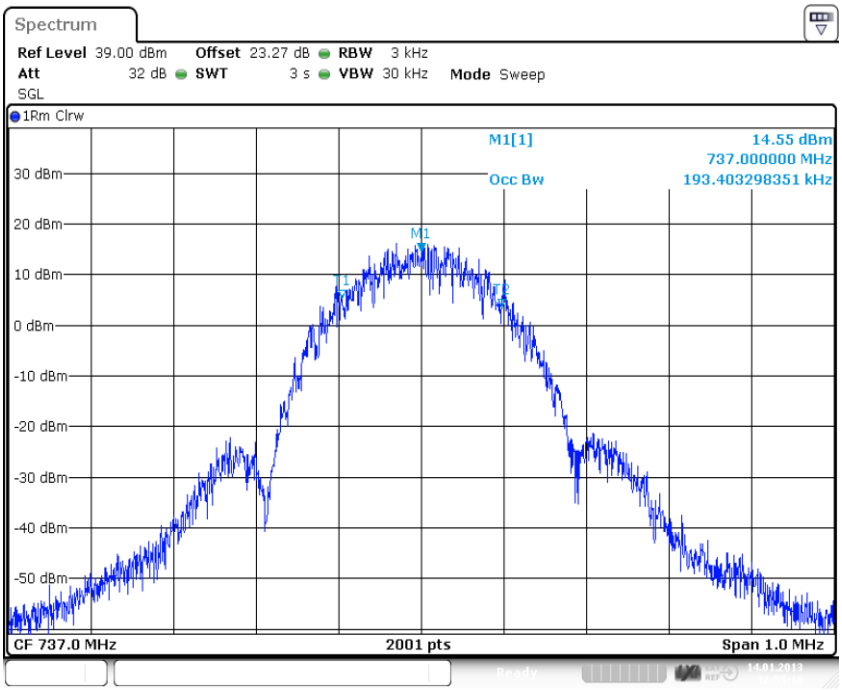


plot 6.3.1.4-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; GSM 746 – 757MHz Output

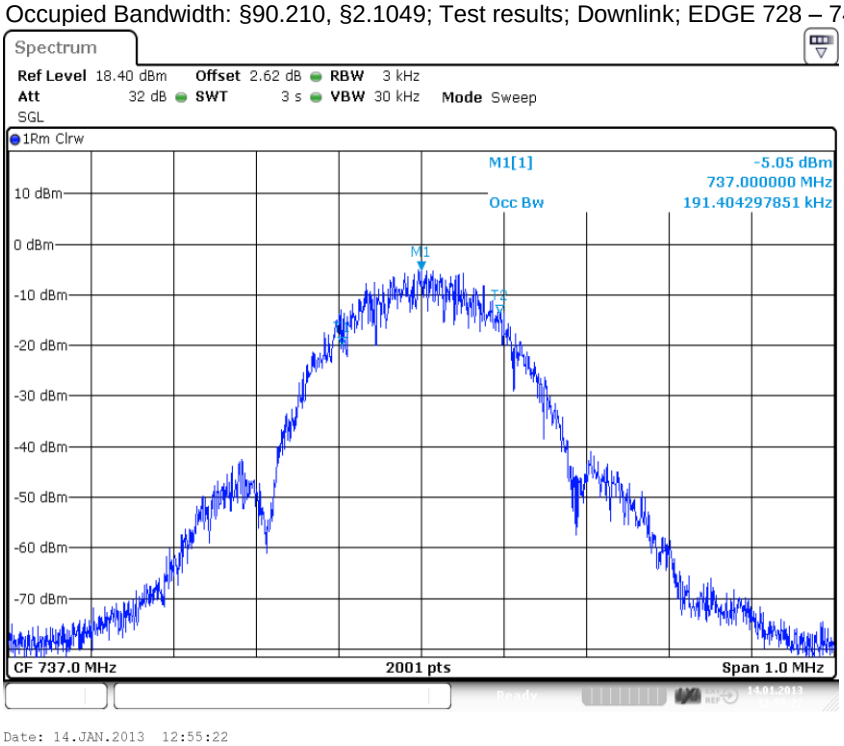


plot 6.3.1.4-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; GSM 746 – 757MHz Input

6.3.1.5 EDGE 728 – 746MHz

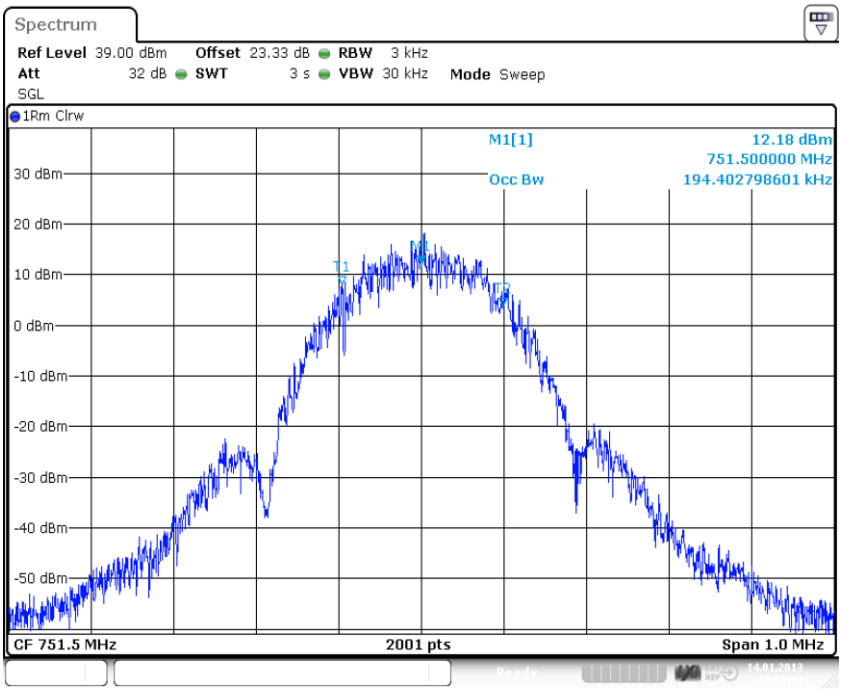


plot 6.3.1.5-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; EDGE 728 – 746MHz Output

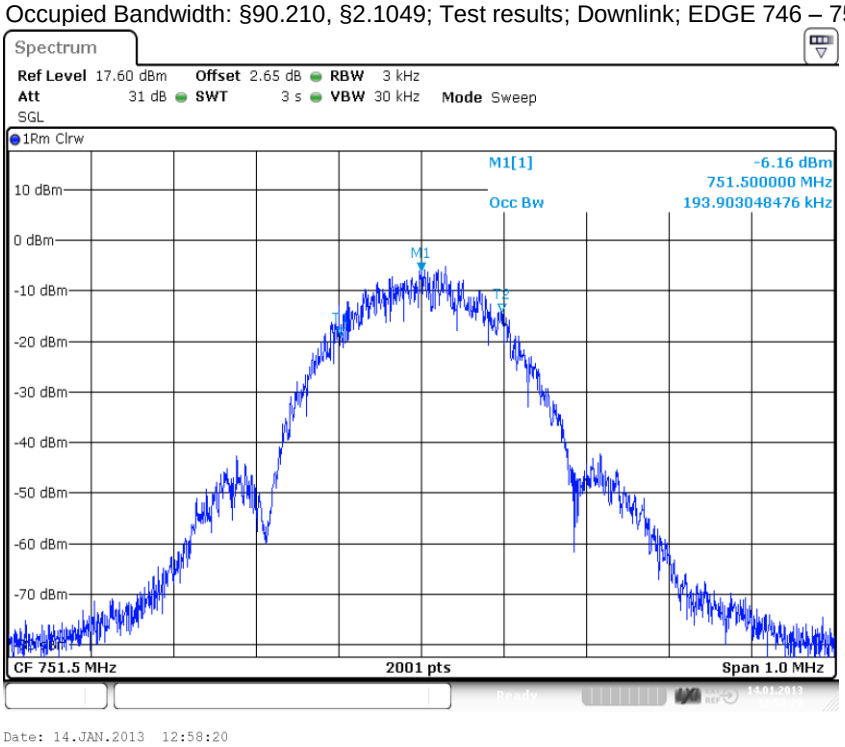


plot 6.3.1.5-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; EDGE 728 – 746MHz Input

6.3.1.6 EDGE 746 – 757MHz

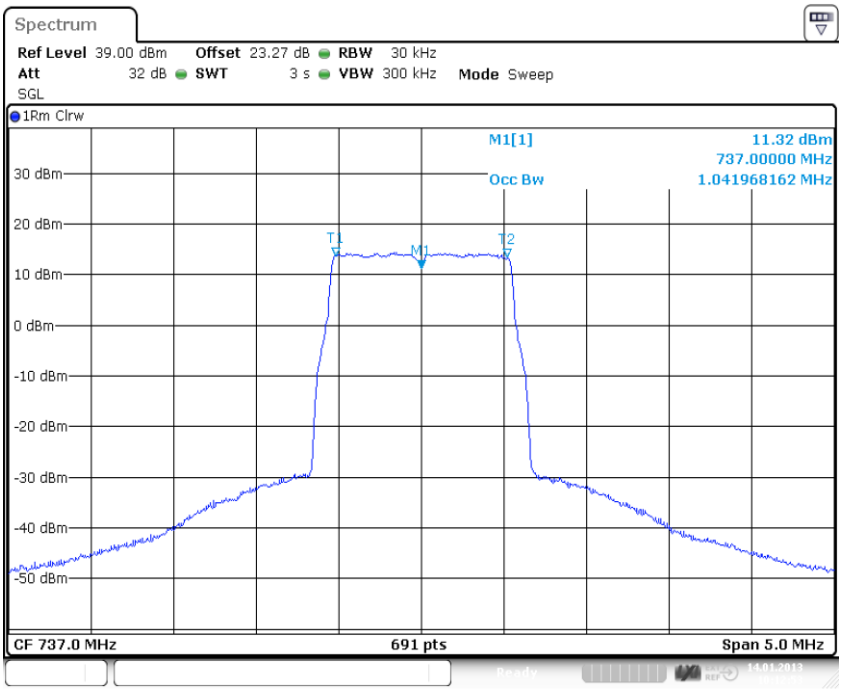


plot 6.3.1.6-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; EDGE 746 – 757MHz Output

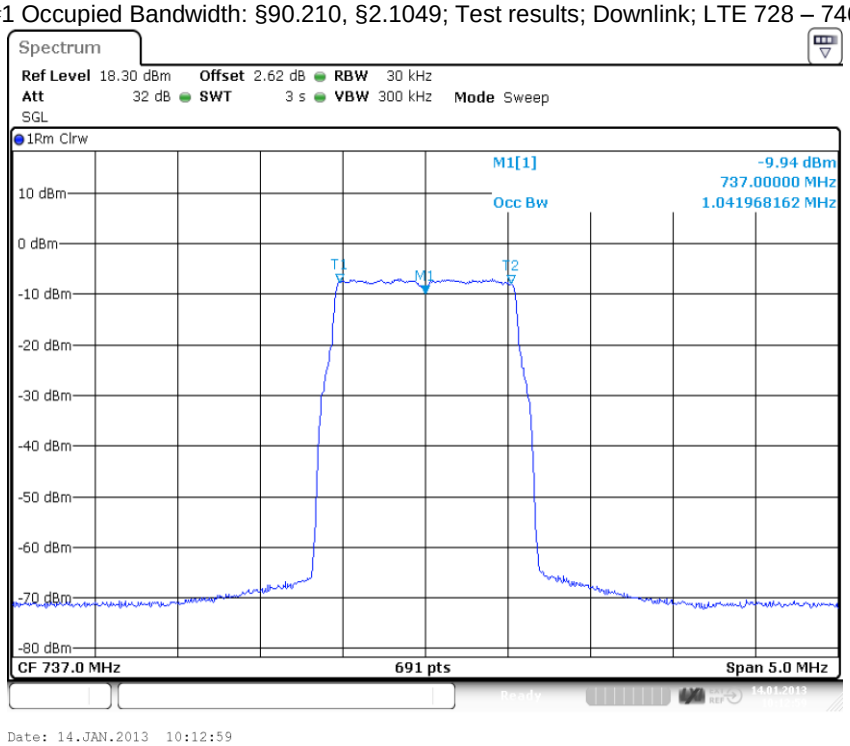


plot 6.3.1.6-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; EDGE 746 – 757MHz Input

6.3.1.7 LTE 728 – 746MHz

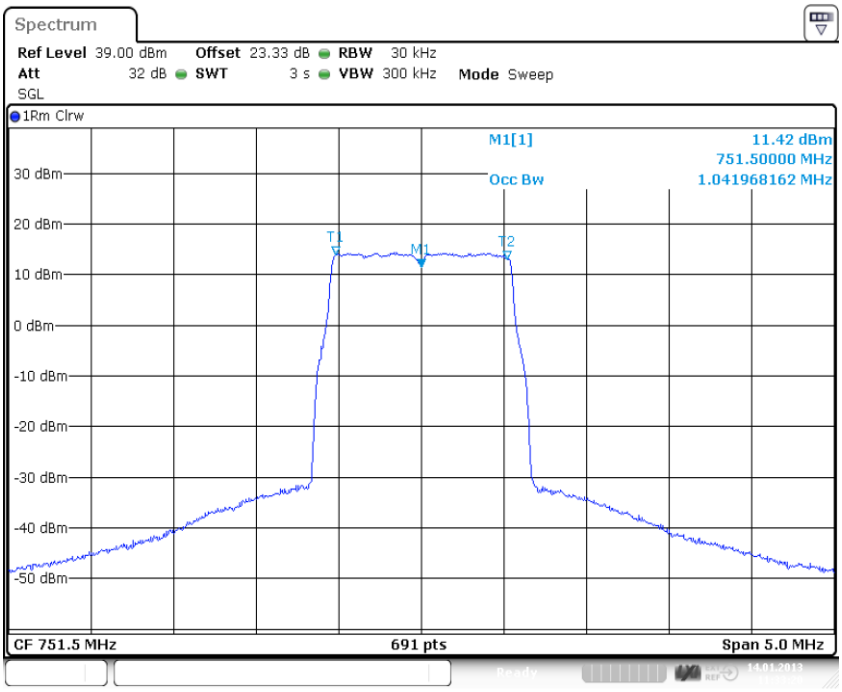


plot 6.3.1.7-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; LTE 728 – 746MHz Output

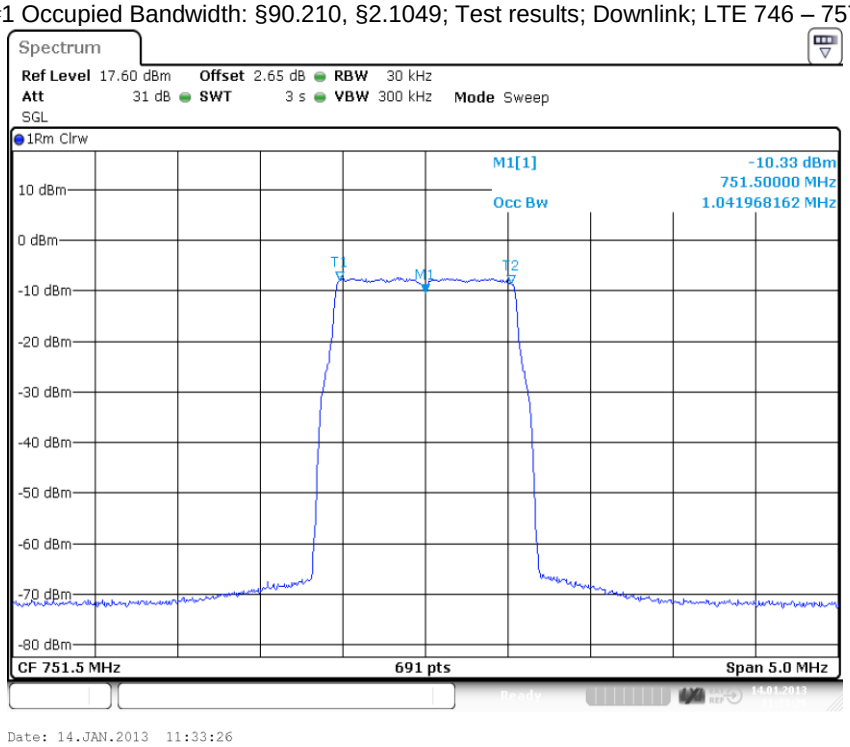


plot 6.3.1.7-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; LTE 728 – 746MHz Input

6.3.1.8 LTE 746 – 757MHz



plot 6.3.1.8-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; LTE 746 – 757MHz Output



plot 6.3.1.8-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; LTE 746 – 757MHz Input

6.3.2 Uplink

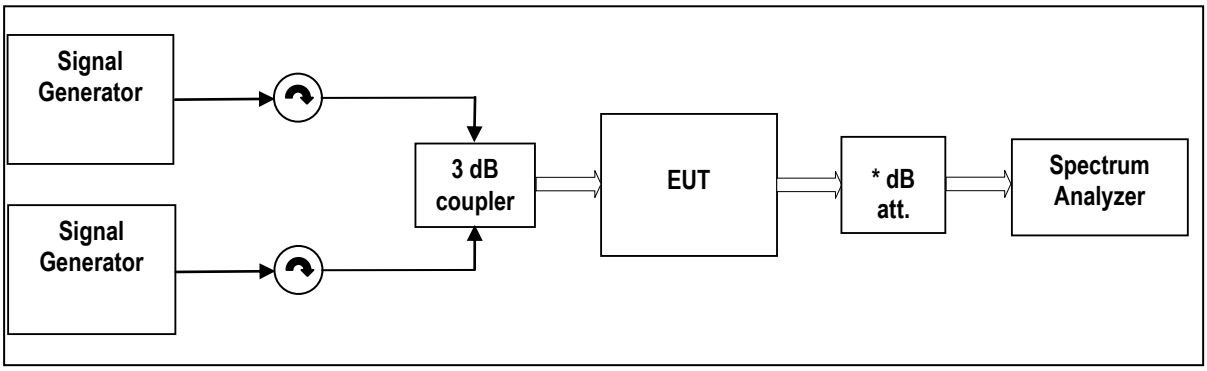
n.a.

Note: The EUT does not transmit over the air in the uplink direction.

6.4 Summary test result

Test result	complies, according the plots above
Tested by:	M. Leinfelder
Date:	14.01.2013

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	9054, 9046, 8849; 7444; 7443; 7306; 7307; 7144; 7454;7453; 7341; 7449; 7368	

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

<1MHz from Band Edge

Detector: RMS.

Modulation	Measured at Band Edge	Carriers (MHz)	RBW VBW Span	Max. level (dBm)	Plot -
Analog Band 12 (Band Class 19)	Lower Edge	728, 0125 728, 0375	300Hz 3kHz 100kHz	-39.4	7.3.1.1 #1
	Upper Edge	745, 9625 745, 9875			#2
Analog Band 13 (Band Class 7)	Lower Edge	746,0125 746,0375	300Hz 3kHz 100kHz	-39.6	7.3.1.2 #1
	Upper Edge	756,9625 756,9875			#2
GSM Band 12 (Band Class 19)	Lower Edge	728,3 728,7	3kHz 30kHz 2MHz	-43.0	7.3.1.3 #1
	Upper Edge	745,5 745,7			#2
GSM Band 13 (Band Class 7)	Lower Edge	748,3 748,7	3kHz 30kHz 2MHz	-43.0	7.3.1.4 #1
	Upper Edge	756,5 756,7			#2
EDGE Band 12 (Band Class 19)	Lower Edge	728,3 728,7	3kHz 30kHz 2MHz	-42.2	7.3.1.5 #1
	Upper Edge	745,5 745,7			#2
EDGE Band 13 (Band Class 7)	Lower Edge	748,3 748,7	3kHz 30kHz 2MHz	-41.9	7.3.1.6 #1
	Upper Edge	756,5 756,7			#2
LTE Band 12 (Band Class 19)	Lower Edge	728,7 730,1	30kHz 300kHz 6MHz	-30,8	7.3.1.7 #1
	Upper Edge	743,9 745,3			#2
LTE Band 13 (Band Class 7)	Lower Edge	746,7 748,1	30kHz 300kHz 6MHz	-35,5	7.3.1.8 #1
	Upper Edge	754,9 756,3			#2

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

>1MHz from Band Edge
Detector: RMS.

Modulation	Carrier	RBW VBW Span	Max. level (dBm)	Plot -
Analog Band 12 (Band Class 19)	737 MHz	1MHz 3MHz 30MHz – 8GHz	-26.6	7.3.1.9 #1
Analog Band 13 (Band Class 7)	751.5 MHz	1MHz 3MHz 30MHz – 8GHz	-26.5	7.3.1.10 #1
GSM Band 12 (Band Class 19)	737 MHz	1MHz 3MHz 30MHz – 8GHz	-26.5	7.3.1.11 #1
GSM Band 13 (Band Class 7)	751.5 MHz	1MHz 3MHz 30MHz – 8GHz	-26.5	7.3.1.12 #1
EDGE Band 12 (Band Class 19)	737 MHz	1MHz 3MHz 30MHz – 8GHz	-26.2	7.3.1.13 #1
EDGE Band 13 (Band Class 7)	751.5 MHz	1MHz 3MHz 30MHz – 8GHz	-26.5	7.3.1.14 #1
LTE Band 12 (Band Class 19)	737 MHz	1MHz 3MHz 30MHz – 8GHz	-26.4	7.3.1.15 #1
LTE Band 13 (Band Class 7)	751.5 MHz	1MHz 3MHz 30MHz – 8GHz	-26.4	7.3.1.16 #1

table 7.3-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051 Test results >1MHz from Band Edge

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 = 43dBm = 20W.

76+ 10*log(20W/1W) dB = 89 dB Attenuation => 43dBm – 89dB = -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
7.3.1.17 Measurement in the band of 763 MHz – 775 MHz acc. to §27.53 (c)(3)
7.3.1.18 Measurement in the band of 793 MHz – 805 MHz acc. to §27.53 (c)(3)

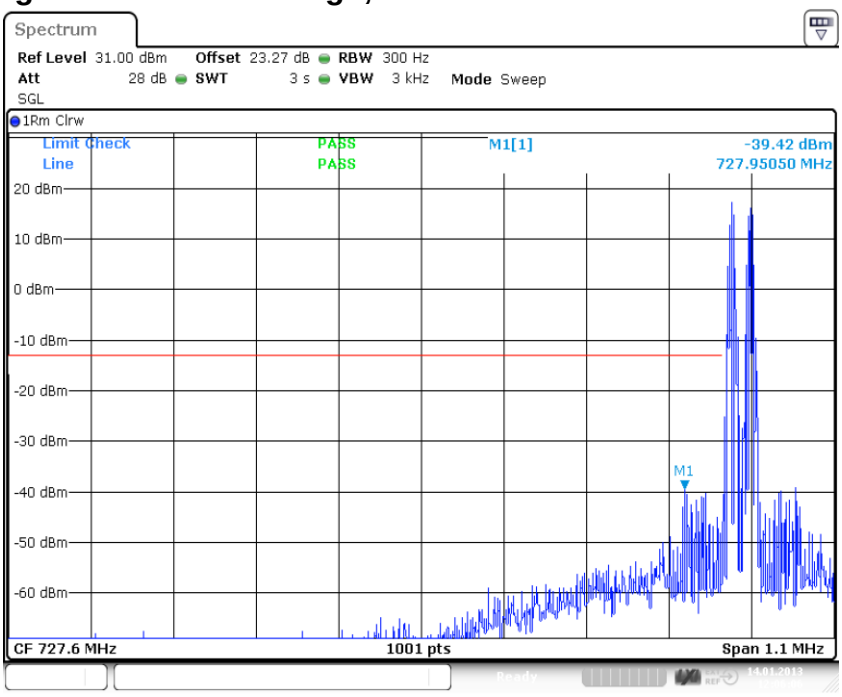
Considerations to §27.53 (f):
To see if the standard 27.53(f) were met a calculation of the radiated power is necessary. The modulated carrier in the range of 747-757 MHz is working with maximum power of 43dBm and the frequency range of 1559-1610MHz is measured. For the calculation of the radiated power 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 -67.7 dBm/MHz (see at plot 7.3.1.19).
Conducted emissions (<-69 dBm) + antenna gain (0 dBi) - cable loss (0 dB) = radiated emissions (<-67.7 dBm) which is below the limit of Part 27.53(f).
Even with an antenna gain of 20 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 -49 dBm.

Therefore the emission limit is met.

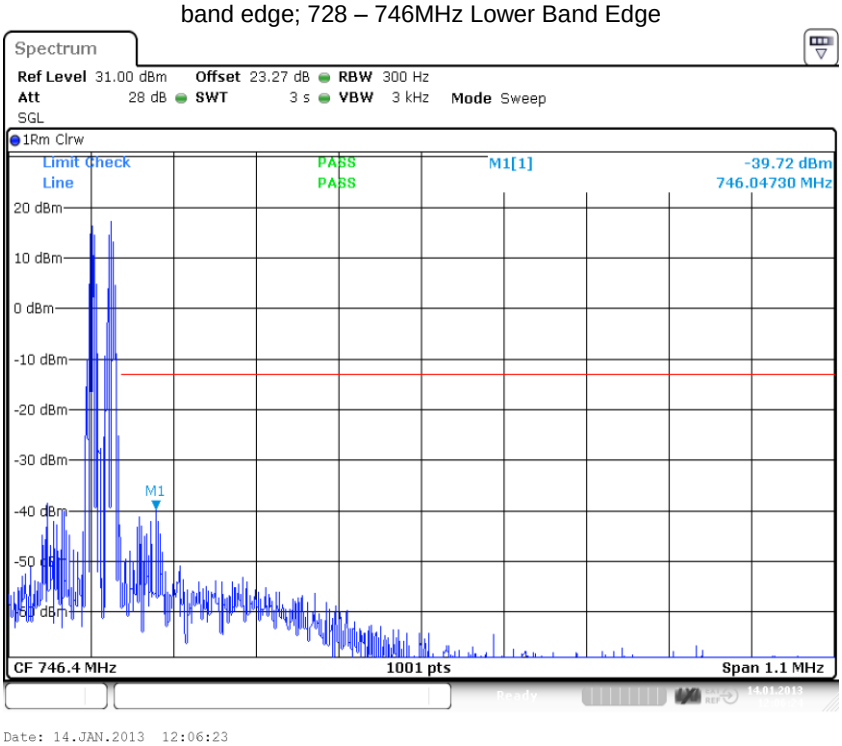
Test passed.

Plots with test result see
7.3.1.19 Measurement in the band of 1559 MHz – 1610 MHz

7.3.1.1 Analog < 1MHz to band edge; 728 – 746MHz

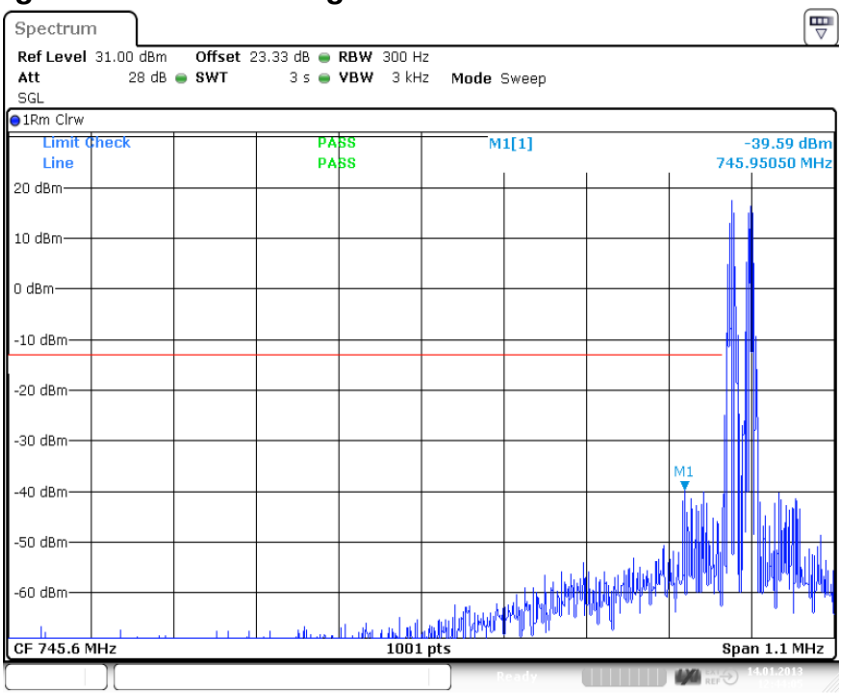


plot 7.3.1.1-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; Analog < 1MHz to band edge; 728 – 746MHz Lower Band Edge

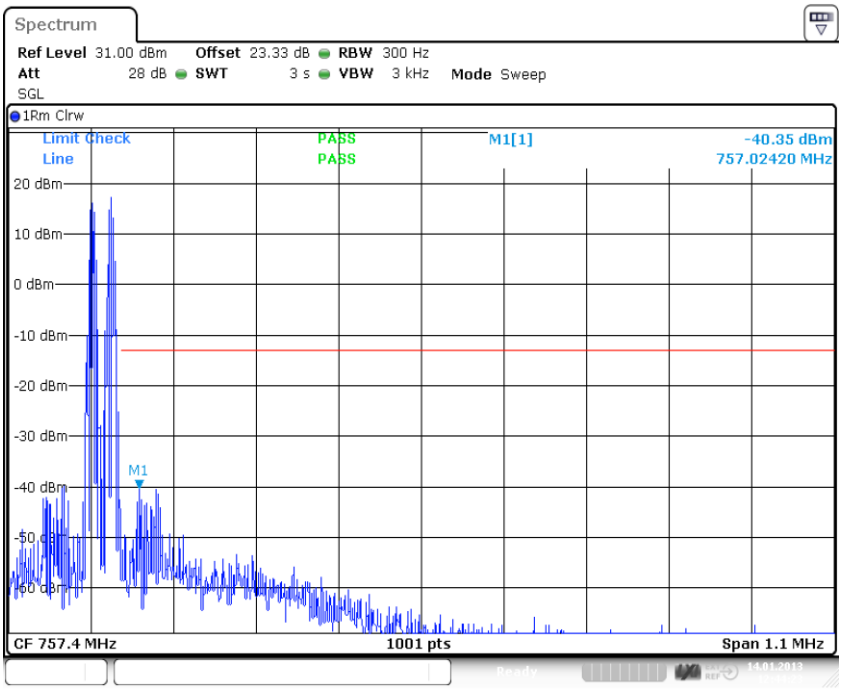


plot 7.3.1.1-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; Analog < 1MHz to band edge; 728 – 746MHz Upper Band Edge

7.3.1.2 Analog < 1MHz to band edge 746 – 757MHz

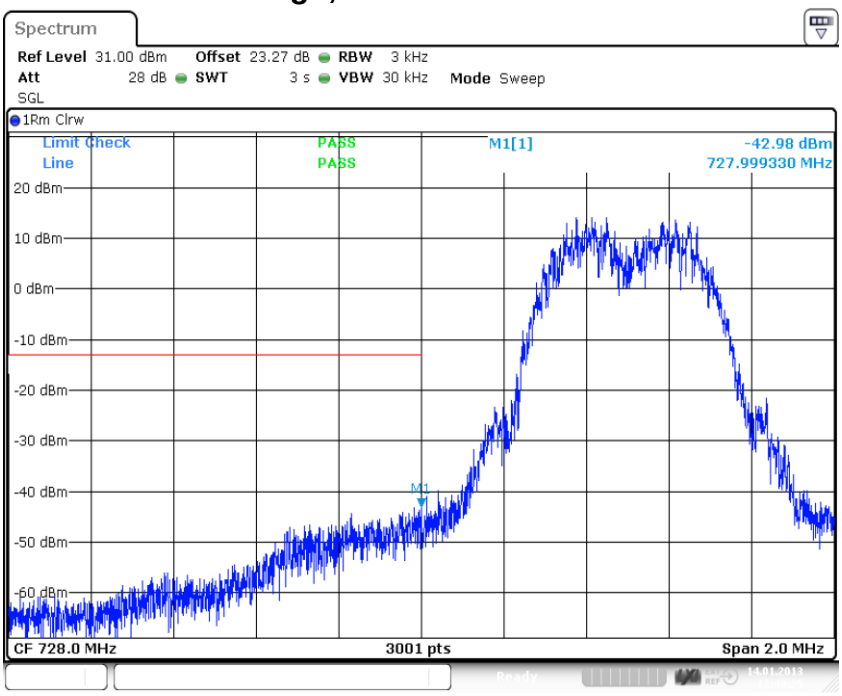


plot 7.3.1.2-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; Analog < 1MHz to band edge 746 – 757MHz Lower Band Edge

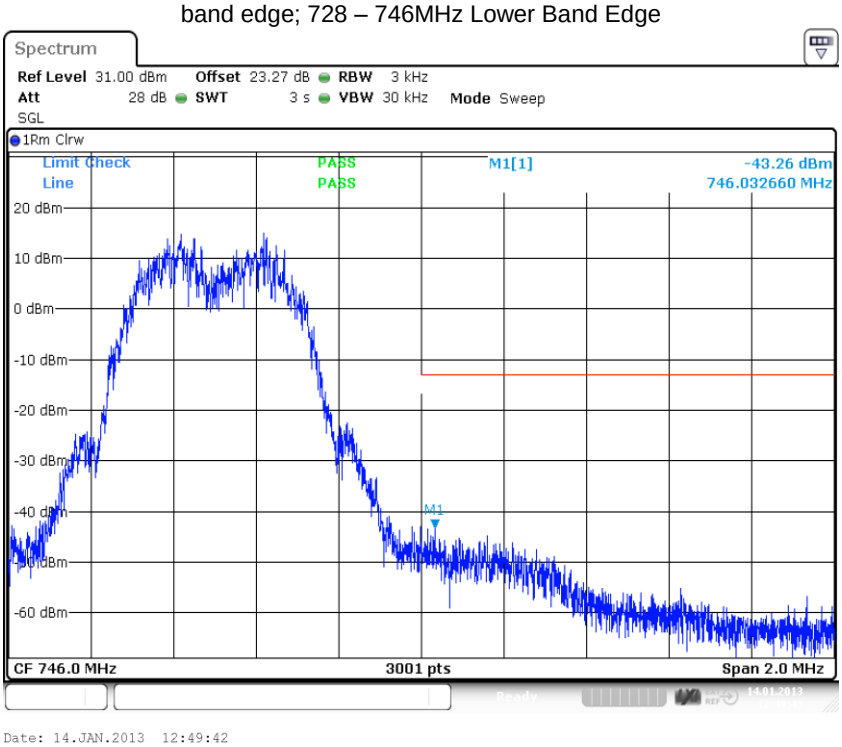


plot 7.3.1.2-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; Analog < 1MHz to band edge 746 – 757MHz Upper Band Edge

7.3.1.3 GSM < 1MHz to band edge; 728 – 746MHz

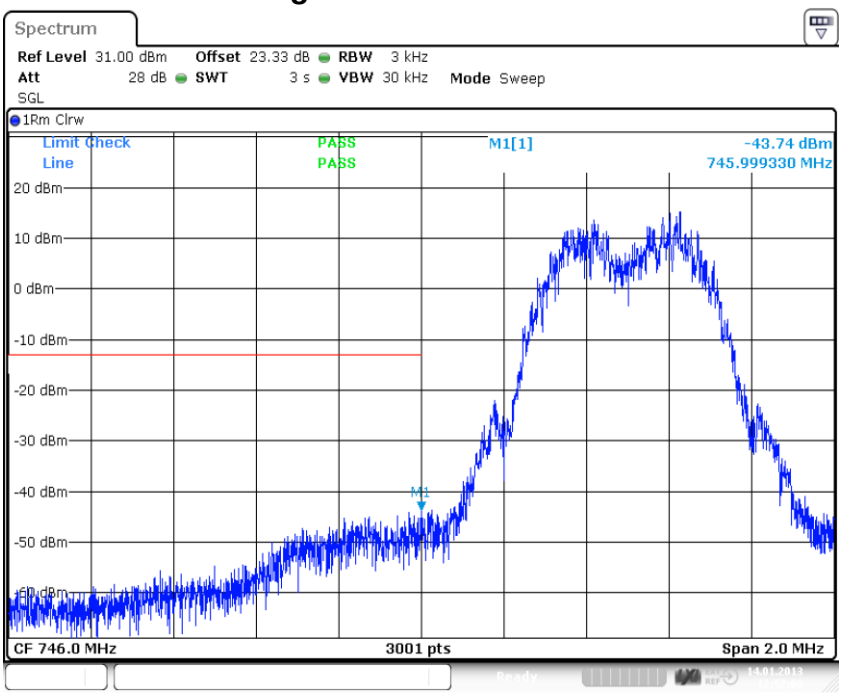


plot 7.3.1.3-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; GSM < 1MHz to band edge; 728 – 746MHz Lower Band Edge

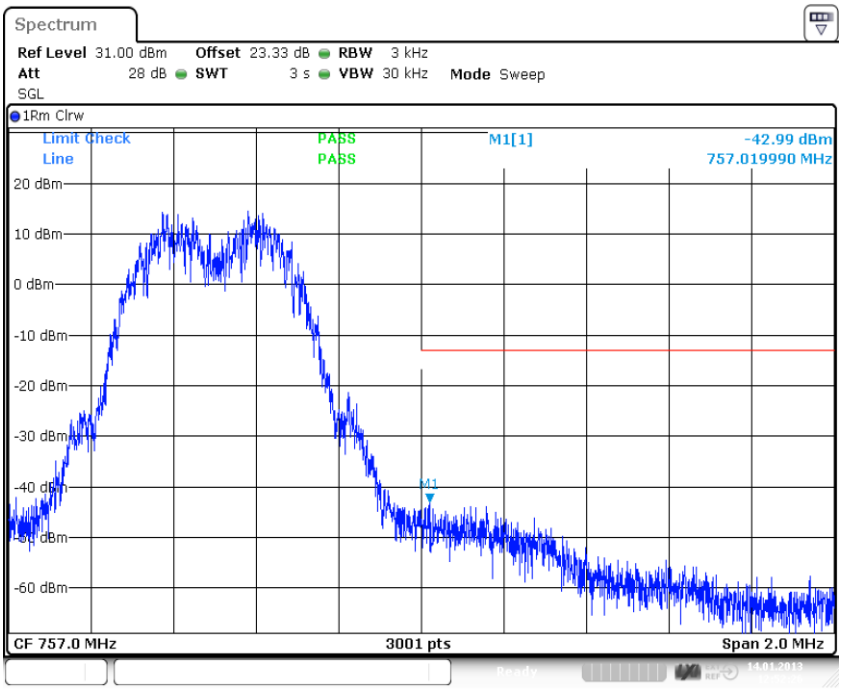


plot 7.3.1.3-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; GSM < 1MHz to band edge; 728 – 746MHz Upper Band Edge

7.3.1.4 GSM < 1MHz to band edge 746 – 757MHz

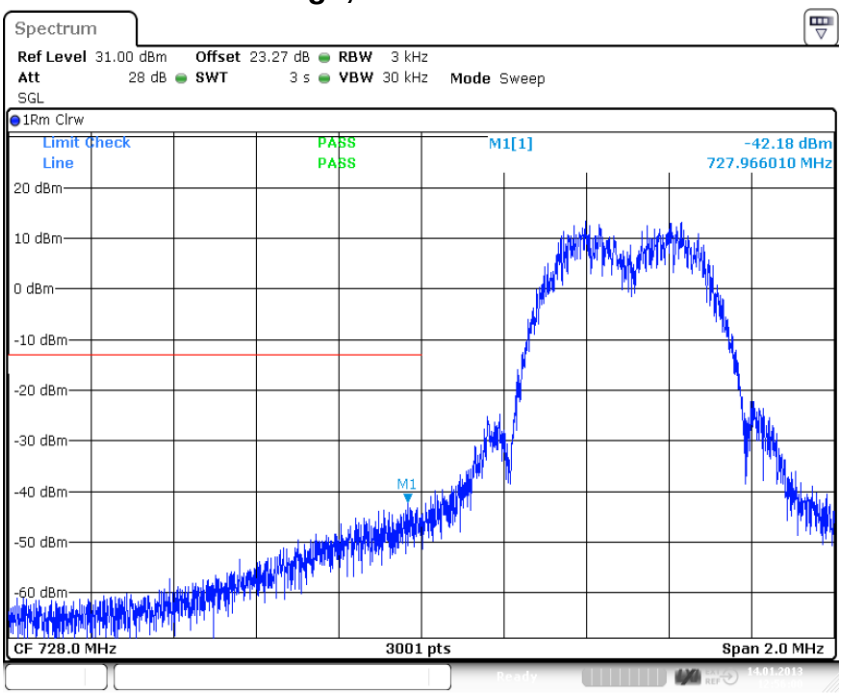


plot 7.3.1.4-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; GSM < 1MHz to band edge 746 – 757MHz Lower Band Edge

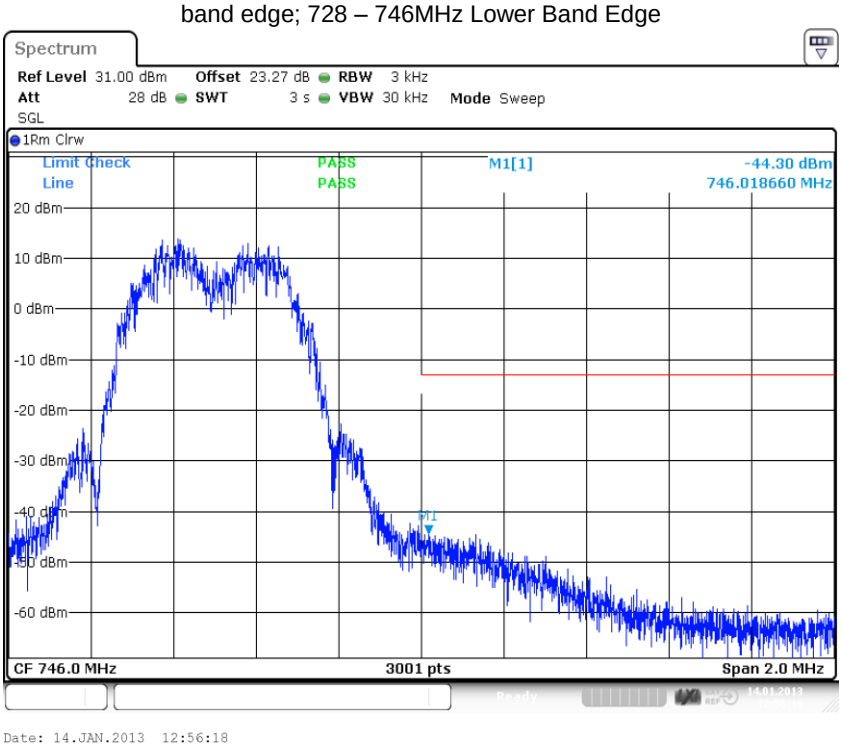


plot 7.3.1.4-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; GSM < 1MHz to band edge 746 – 757MHz Upper Band Edge

7.3.1.5 EDGE < 1MHz to band edge; 728 – 746MHz

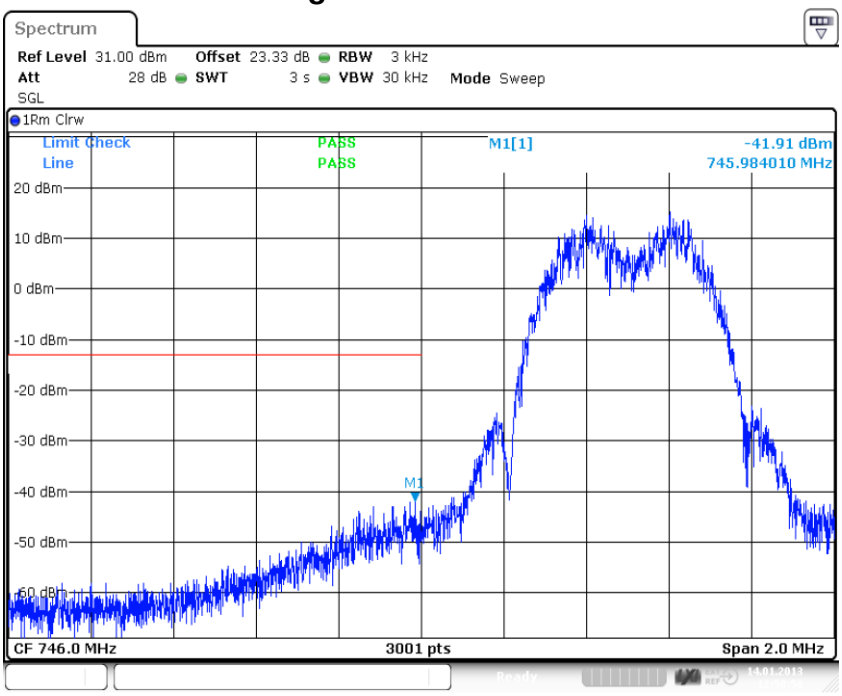


plot 7.3.1.5-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; EDGE < 1MHz to band edge; 728 – 746MHz Lower Band Edge

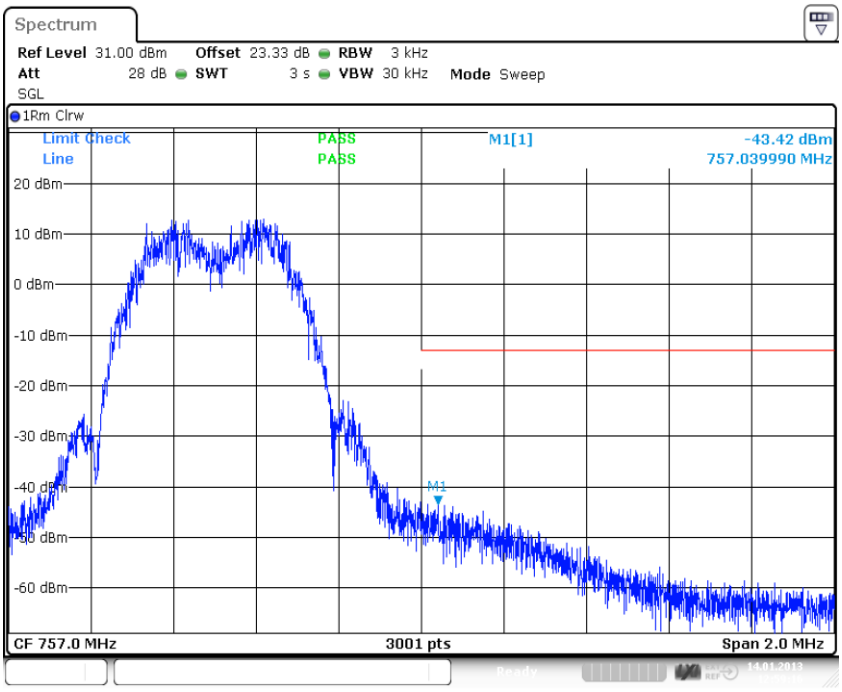


plot 7.3.1.5-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; EDGE < 1MHz to band edge; 728 – 746MHz Upper Band Edge

7.3.1.6 EDGE < 1MHz to band edge 746 – 757MHz

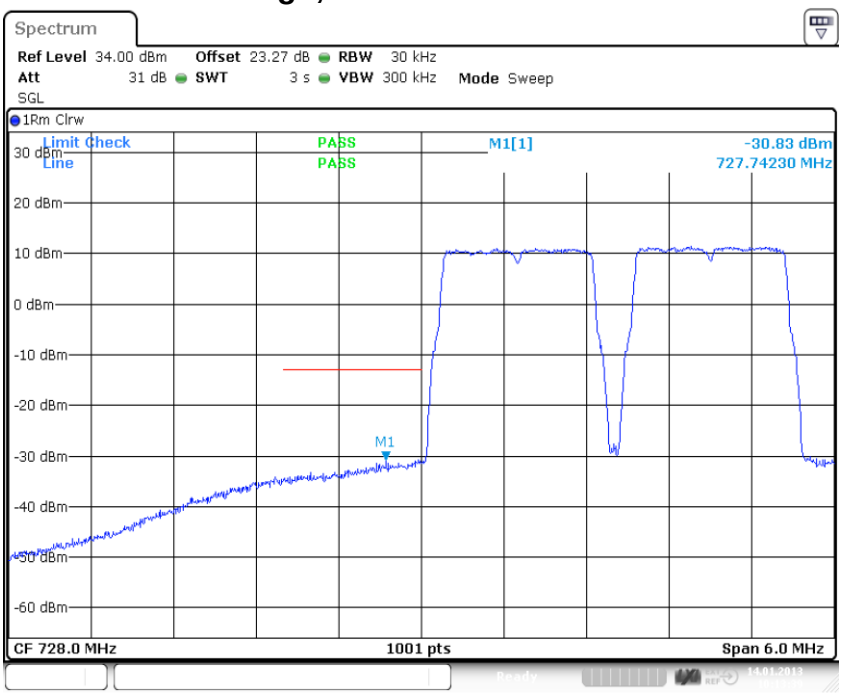


plot 7.3.1.6-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; EDGE < 1MHz to band edge 746 – 757MHz Lower Band Edge

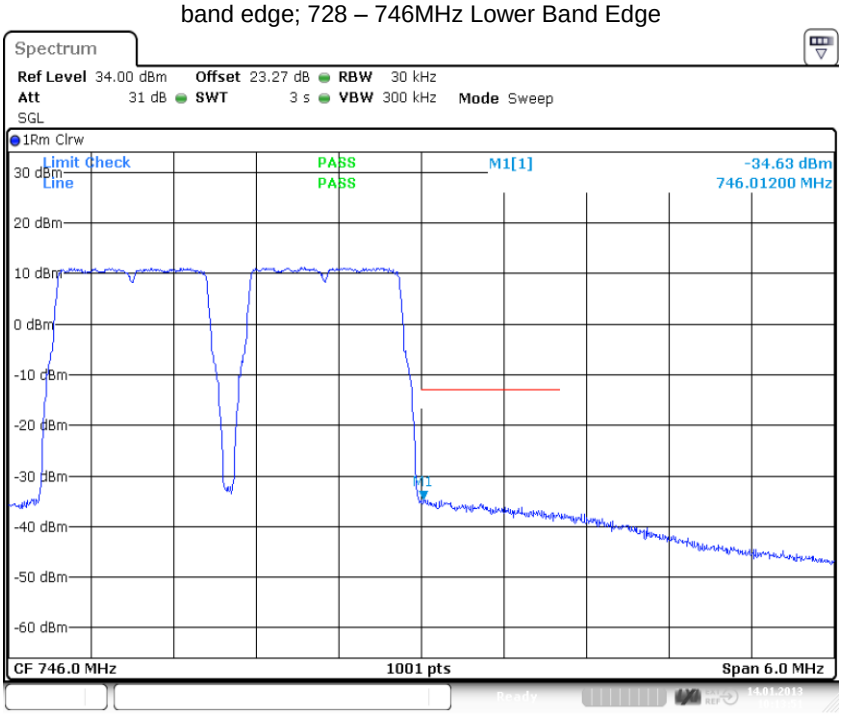


plot 7.3.1.6-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; EDGE < 1MHz to band edge 746 – 757MHz Upper Band Edge

7.3.1.7 LTE < 1MHz to band edge; 728 – 746MHz

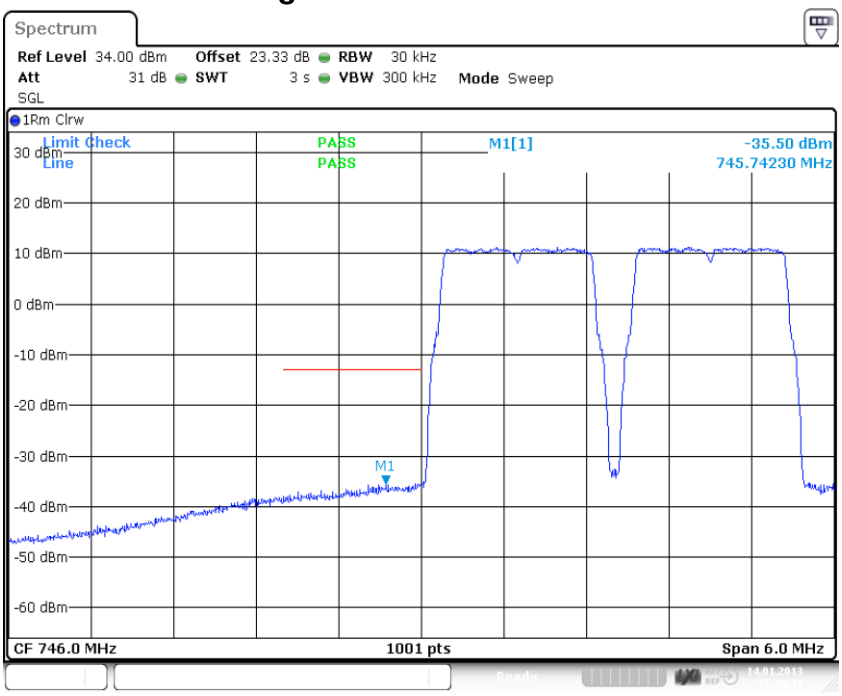


plot 7.3.1.7-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE < 1MHz to band edge; 728 – 746MHz Lower Band Edge

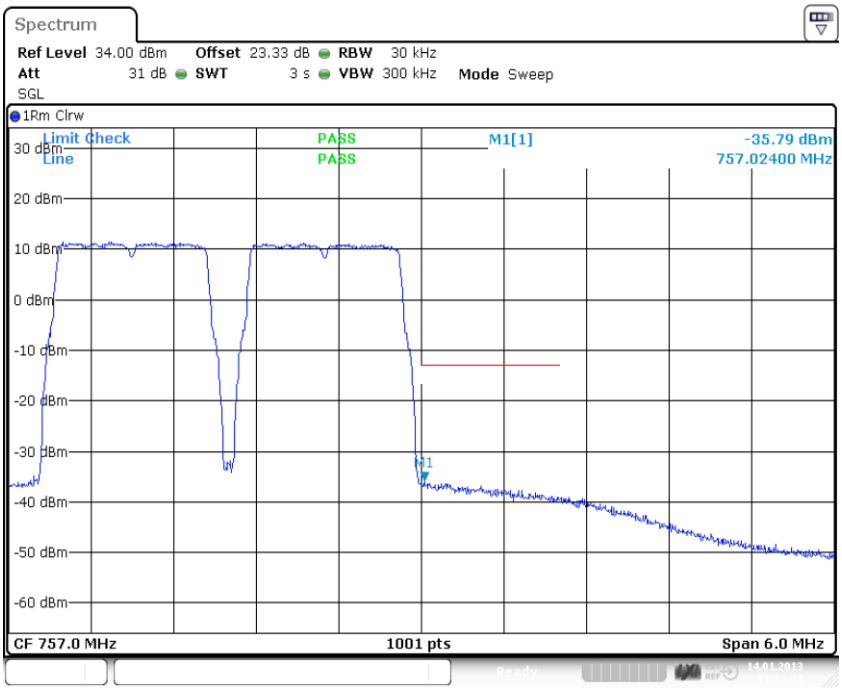


plot 7.3.1.7-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE < 1MHz to band edge; 728 – 746MHz Upper Band Edge

7.3.1.8 LTE < 1MHz to band edge 746 – 757MHz

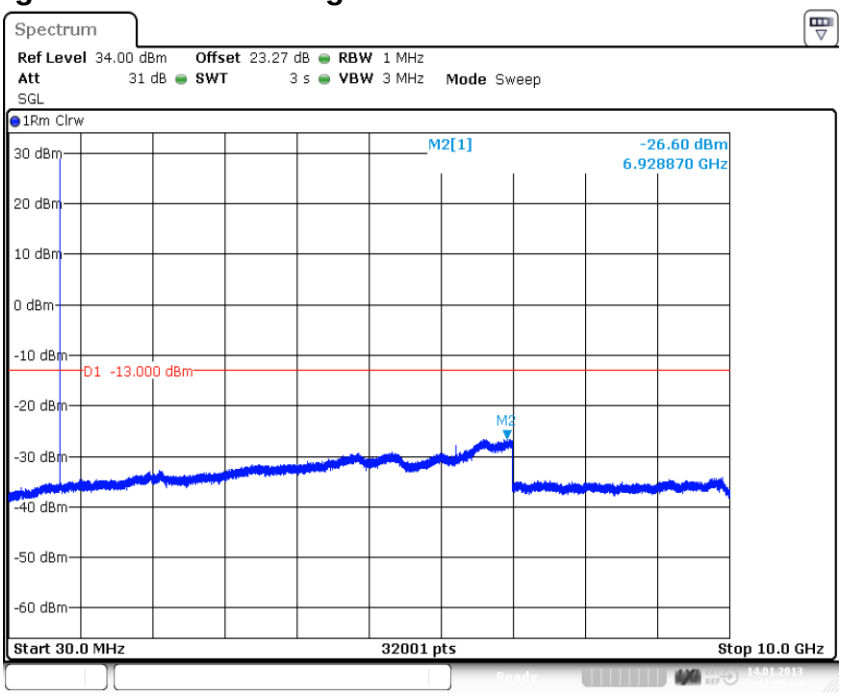


plot 7.3.1.8-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE < 1MHz to band edge 746 – 757MHz Lower Band Edge



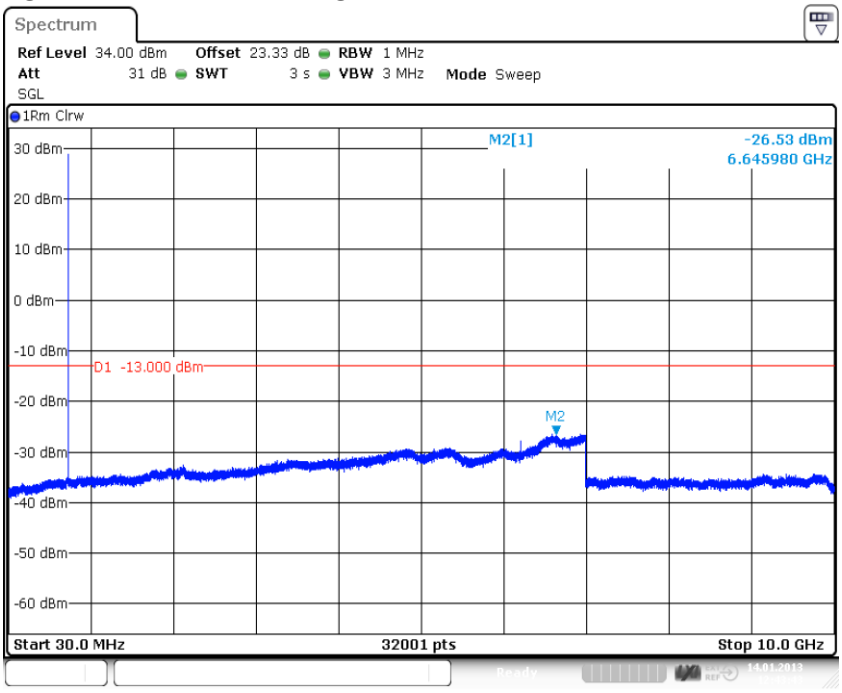
plot 7.3.1.8-#2 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE < 1MHz to band edge 746 – 757MHz Upper Band Edge

7.3.1.9 Analog > 1MHz to band edge 728 – 746MHz



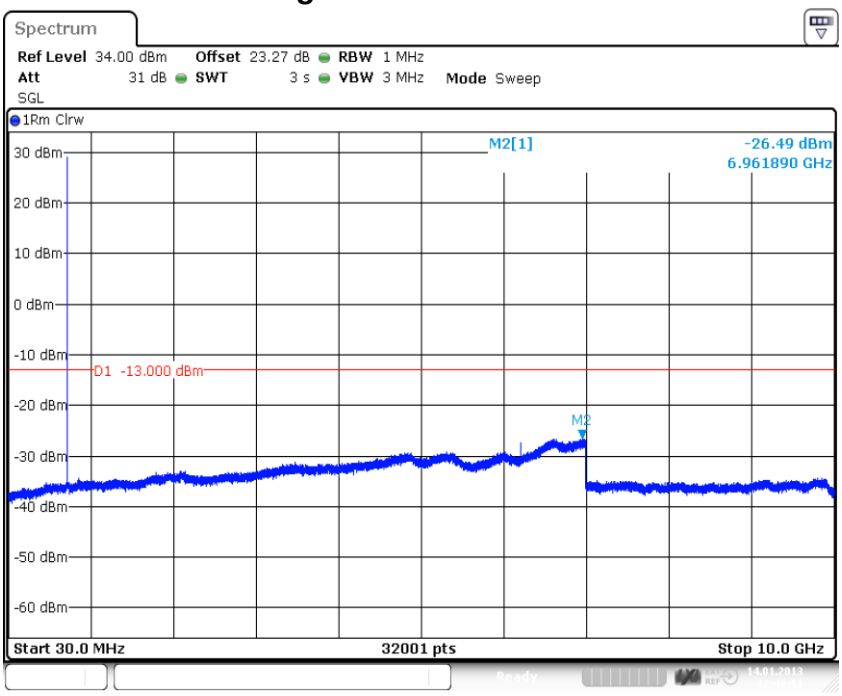
plot 7.3.1.9-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; Analog > 1MHz to band edge 728 – 746MHz

7.3.1.10 Analog > 1MHz to band edge 746 – 757MHz; carrier at 751,5MHz



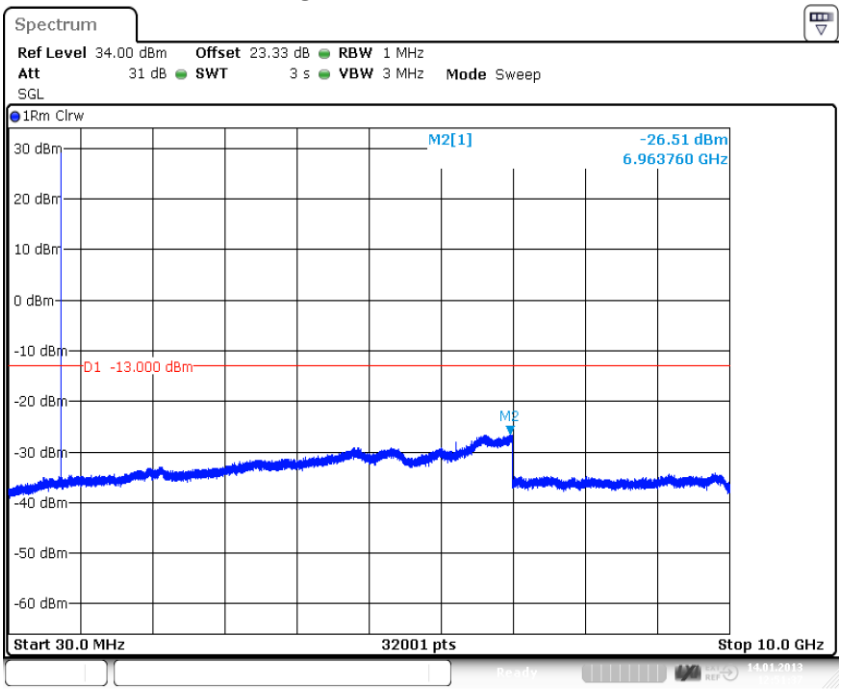
plot 7.3.1.10-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; Analog > 1MHz to band edge 746 – 757MHz; carrier at 751,5MHz;

7.3.1.11 GSM > 1MHz to band edge 728 – 746MHz



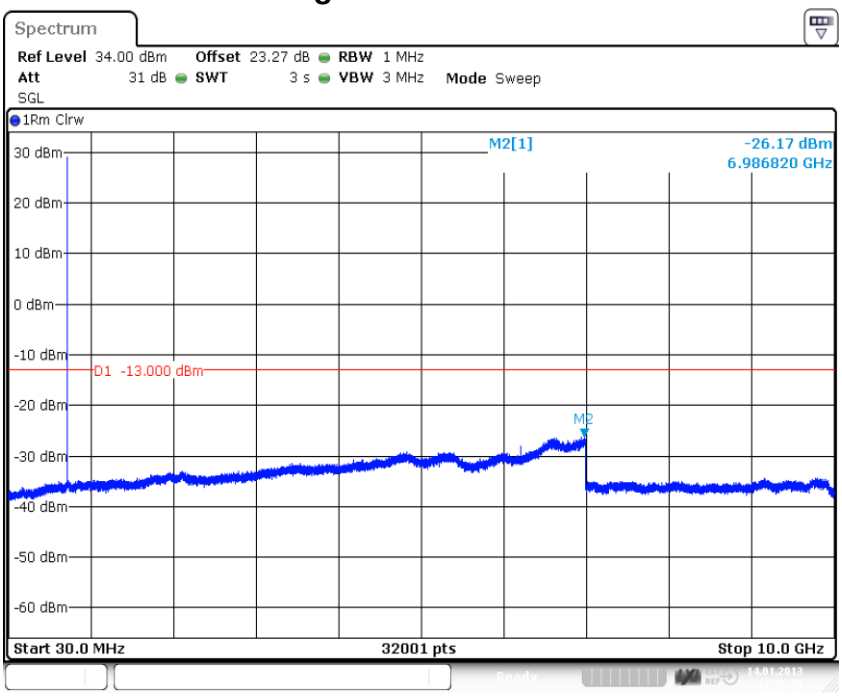
plot 7.3.1.11-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; GSM > 1MHz to band edge 728 – 746MHz

7.3.1.12 GSM > 1MHz to band edge 746 – 757MHz; carrier at 751,5MHz



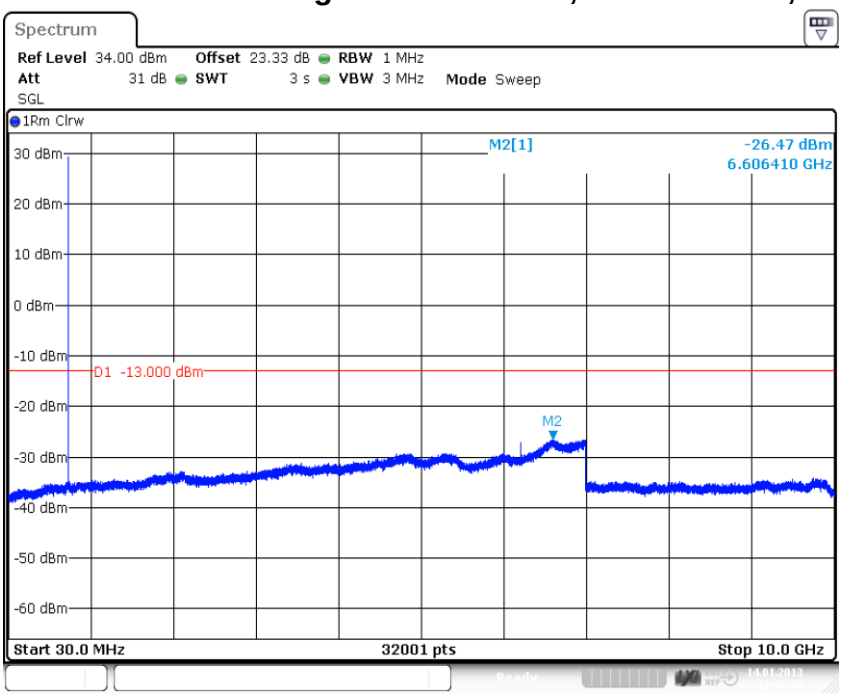
plot 7.3.1.12-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; GSM > 1MHz to band edge 746 – 757MHz; carrier at 751,5MHz;

7.3.1.13 EDGE > 1MHz to band edge 728 – 746MHz



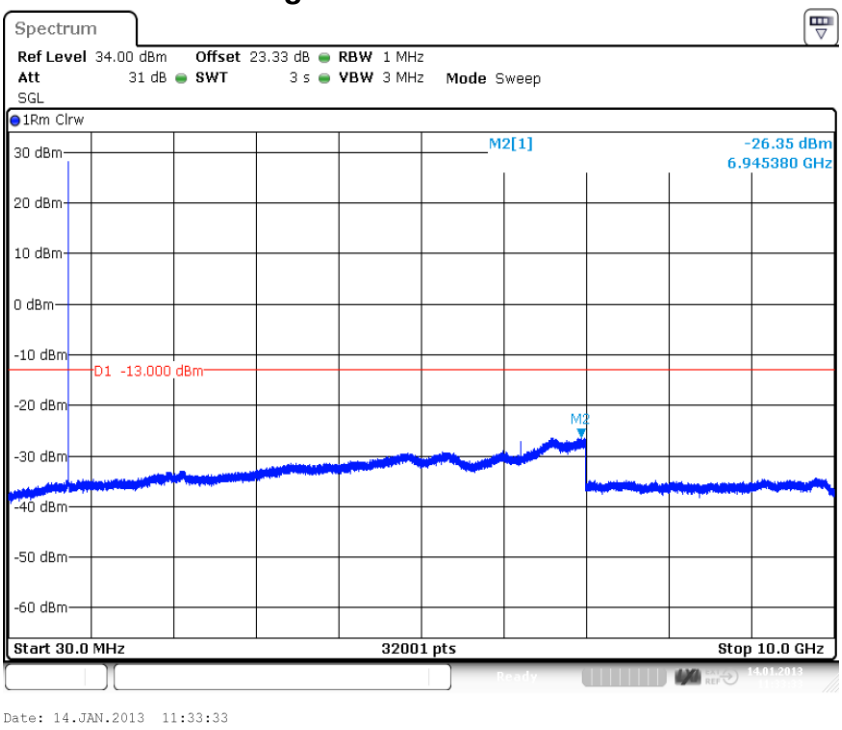
plot 7.3.1.13-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; EDGE > 1MHz to band edge 728 – 746MHz

7.3.1.14 EDGE > 1MHz to band edge 746 – 757MHz; carrier at 751,5MHz



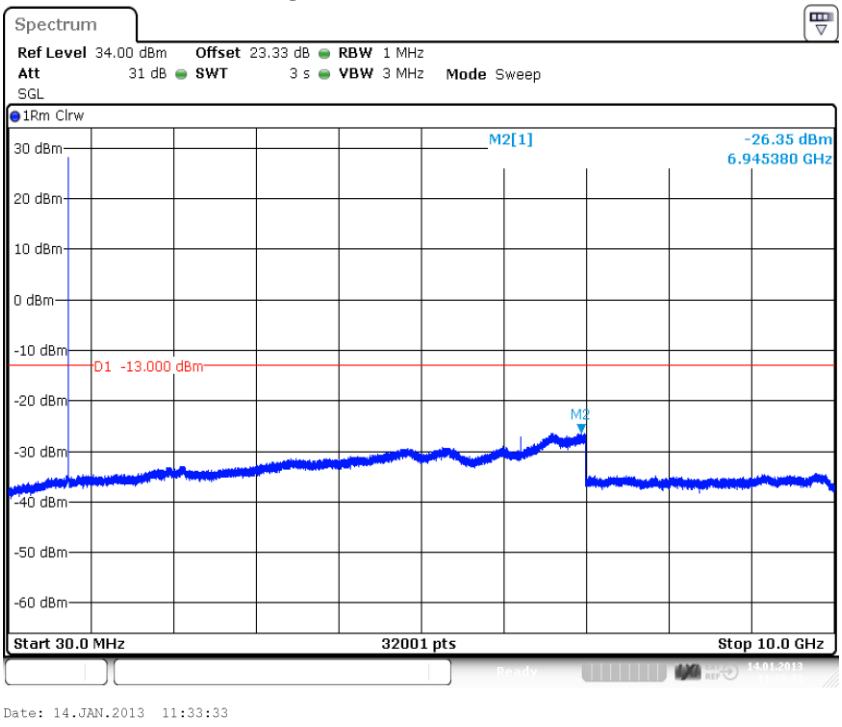
plot 7.3.1.14-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; EDGE > 1MHz to band edge 746 – 757MHz; carrier at 751,5MHz;

7.3.1.15 LTE > 1MHz to band edge 728 – 746MHz



plot 7.3.1.15-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE > 1MHz to band edge 728 – 746MHz

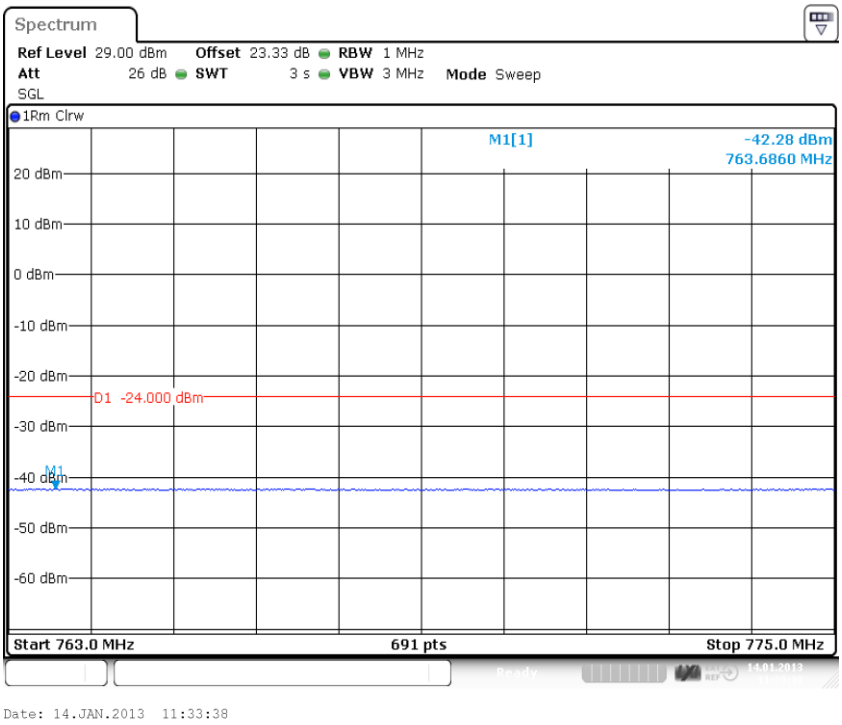
7.3.1.16 LTE > 1MHz to band edge 746 – 757MHz; carrier at 751,5MHz



plot 7.3.1.16-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; LTE > 1MHz to band edge 746 – 757MHz; carrier at 751,5MHz;

7.3.1.17 Measurement in the band of 763 MHz – 775 MHz acc. to §27.53 (c)(3)

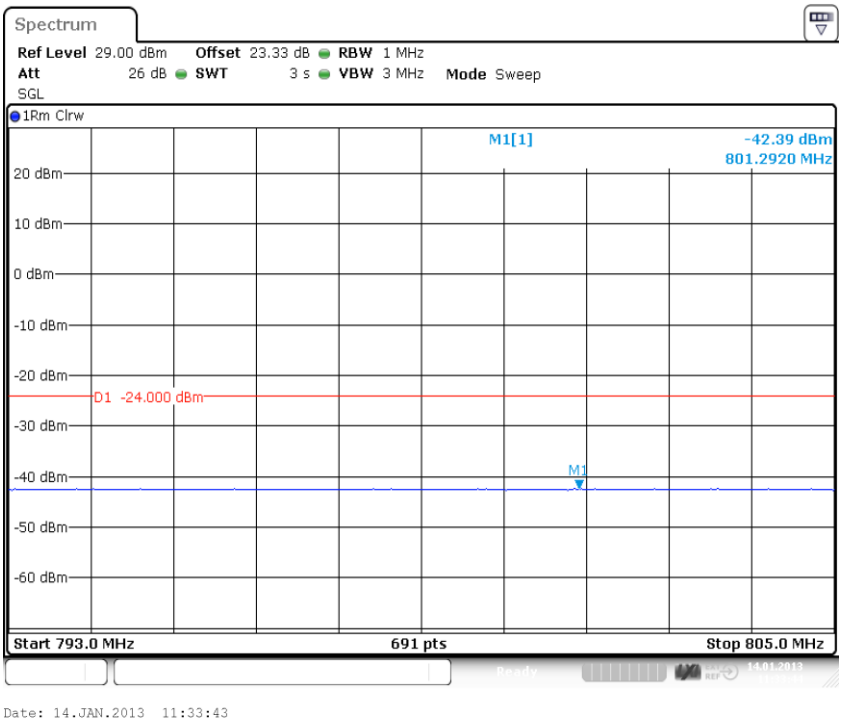
Calculation see 7.3.1 Test results Downlink



plot 7.3.1.17-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; Measurement in the band of 763 MHz – 775 MHz acc. to §27.53 (c)(3)

7.3.1.18 Measurement in the band of 793 MHz – 805 MHz acc. to §27.53 (c)(3)

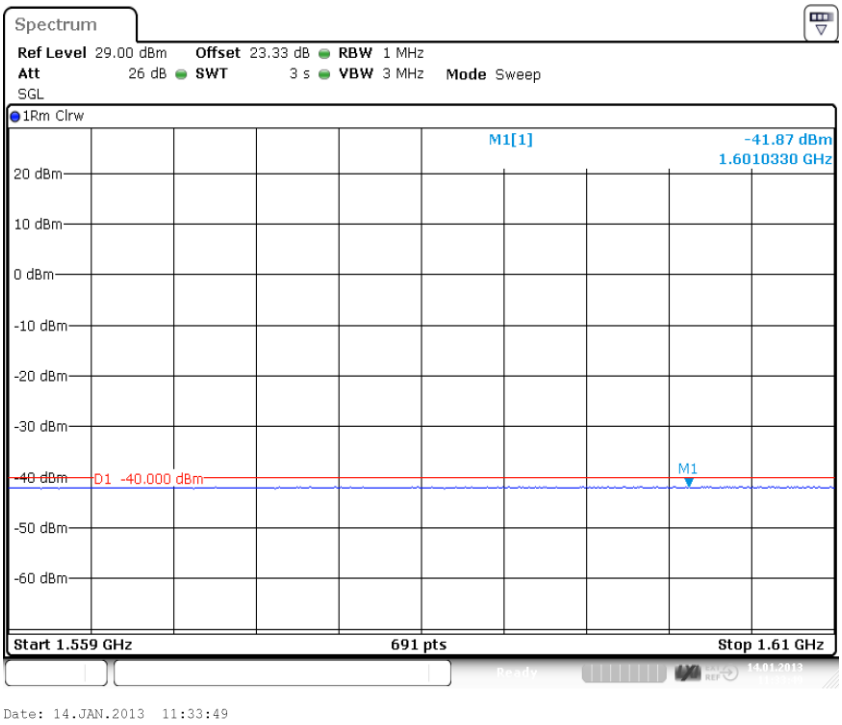
Calculation see 7.3.1 Test results Downlink



plot 7.3.1.18-#1 Spurious Emissions at Antenna Terminals: §27.53, §2.1051; Test results; Downlink; Measurement in the band of 793 MHz – 805 MHz acc. to §27.53 (c)(3)

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

Calculation see 7.3.1 Test results Downlink



plot 7.3.1.19-#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)

7.3.2 Uplink

n.a.

Note: The EUT does not transmit over the air in the uplink direction.

7.4 Summary test result

Test result	complies, according the plots above
Tested by:	M. Leinfelder
Date:	14.01.2013

8 Radiated Spurious Emissions at the ECL (Bureau Veritas): §27.53, §2.1053, RSS-Gen, RSS-131

picture 8.1: label

picture 8.2: Test setup: Field Strength Emission in the SAC

This clause specifies requirements for the measurement of radiated emission.

Frequency range	Distance: EUT <-> antenna / location	Limit	Test method
30 MHz – 22 GHz	3 metres / SAC	FCC 47 CFR Part 27.53 IC RSS-131 sec. 4.4	TIA/EIA-603-C:2004

Test equipment used:

Designation	Type	Manufacturer	Invent.-no.	Cal.-date	due Cal.-date	used
EMI test receiver	ESI40	Rohde & Schwarz	E1687	19.12.2012	19.12.2013	X
Antenna	CBL 6111	Chase	K1024	29.03.2012	29.03.2013	X
RF Cable	RG214	Frankonia	K1121 SET	20.02.2013	20.02.2014	X
Antenna	HL 025	R&S	K809	16.11.2012	16.11.2013	X
Preamplifier	AFS4-00102000	Miteq	K838	05.06.2012	05.06.2013	X
RF Cable	Sucoflex 100	Suhner	K1742	23.05.2012	23.05.2013	X

The REMI version 2.135 has been used to maximize radiated emission from the EUT with regards to ANSI C63.4:2009.

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)	± 4,7 dB for ANSI C63.4 measurement ± 0,5 dB for TIA-603 measurement

8.1 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 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:

- 728/737/746 MHz (§27 Subpart H)
- 746/755/763 MHz (§27 Subpart F)

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 half 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.

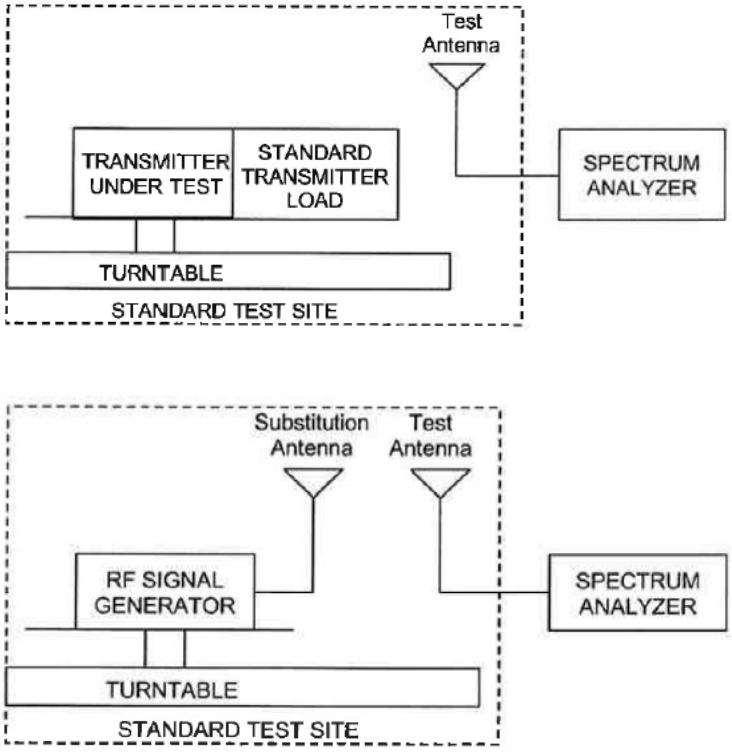


Figure #8.3 Substitution methods TIA/EIA-603-C

8.2 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:

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

8.3 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 (max hold over 360°)	Peak (max hold over 360°)

8.4 Climatic values in the lab

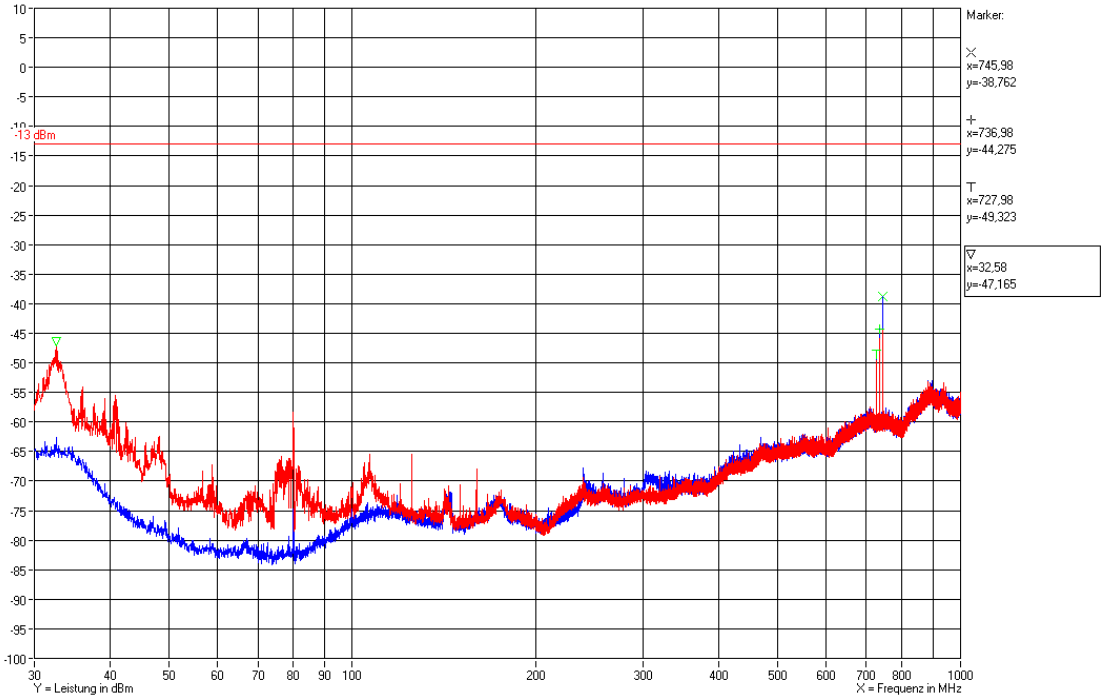
Temperature	18,5°C
Relative Humidity	45%
Air-pressure	1014 hPa

8.5 Test results

8.5.1 30 MHz to 1 GHz Downlink (Bottom – Middle – Top) Subpart H

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

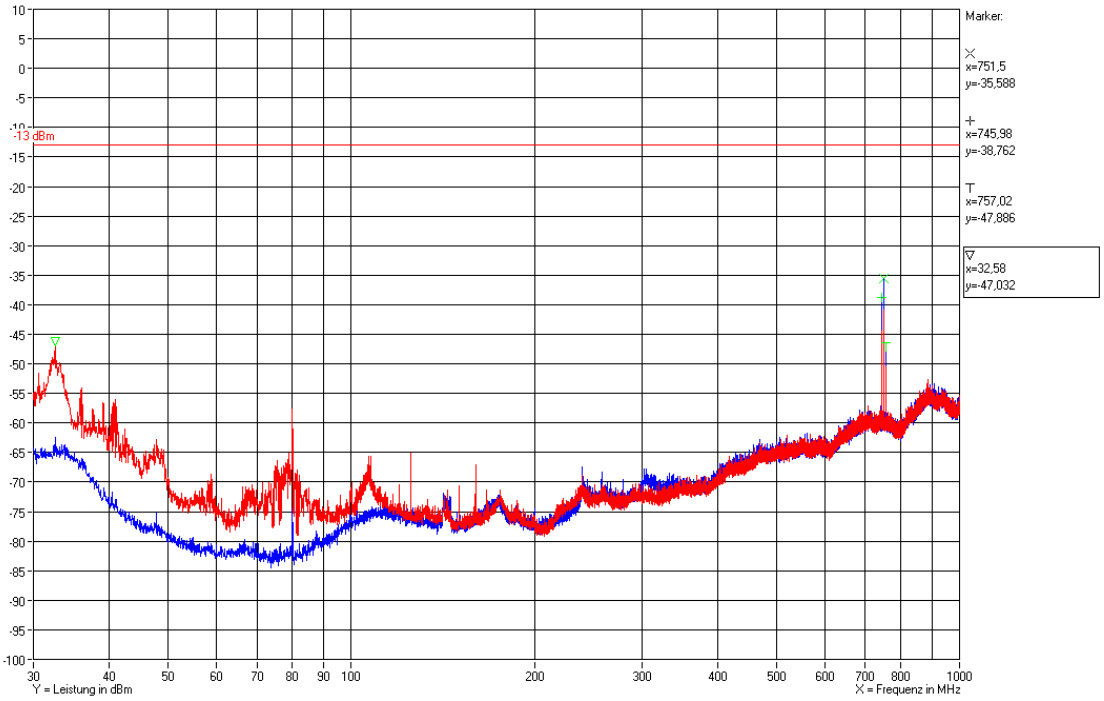
Vertikal / Horizontal



8.5.2 30 MHz to 1 GHz Downlink (Bottom – Middle – Top) Subpart F

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

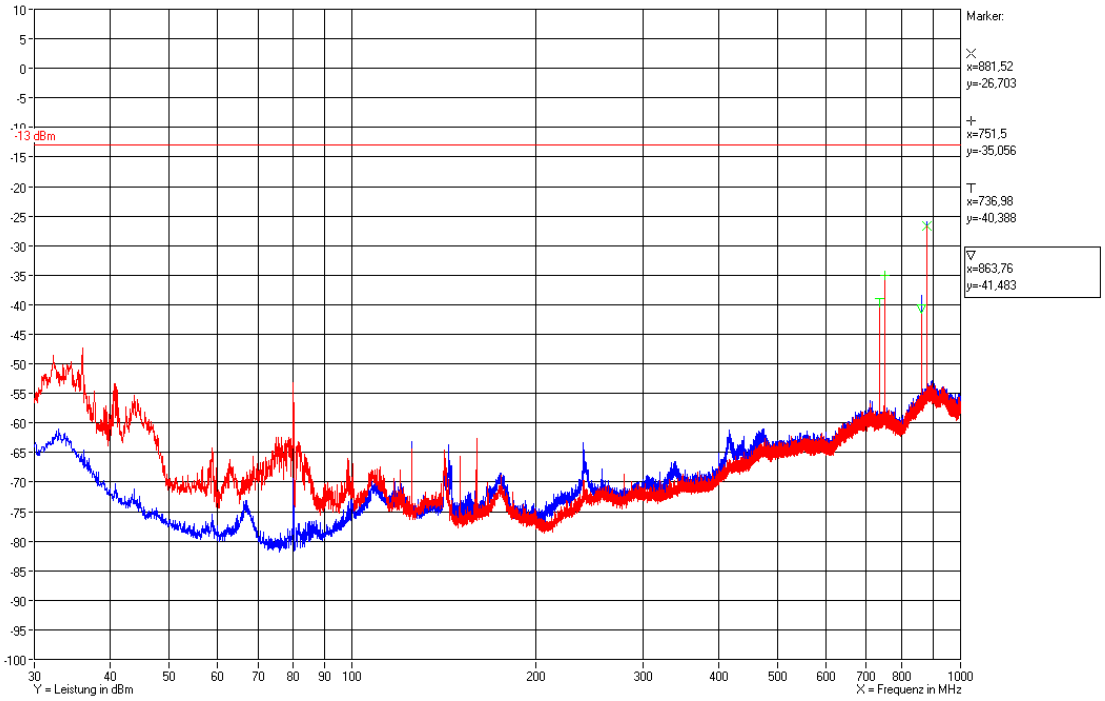
Vertikal / Horizontal



8.5.3 30 MHz to 1 GHz Downlink (Middle of all paths)

F1: 751.5 MHz; F2: 737 MHz; F3: 863.75 MHz; F4: 1962.5 MHz; F5: 2132.5 MHz

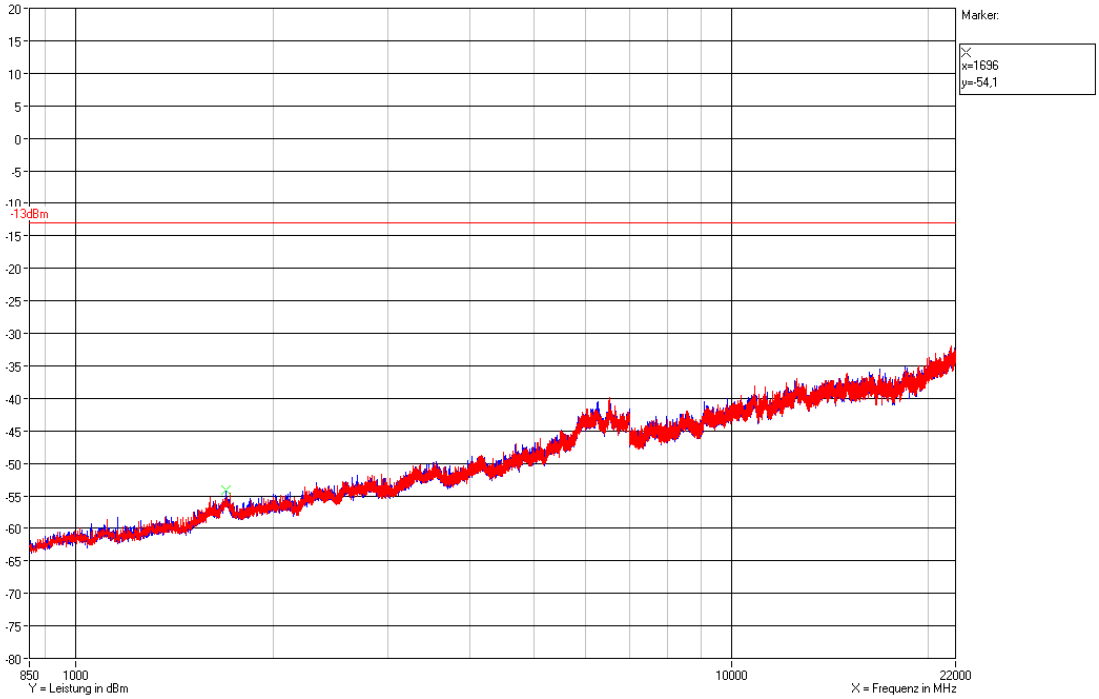
Vertikal / Horizontal



8.5.4 1 GHz to 22 GHz Downlink (Bottom – Middle – Top) Subpart H

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

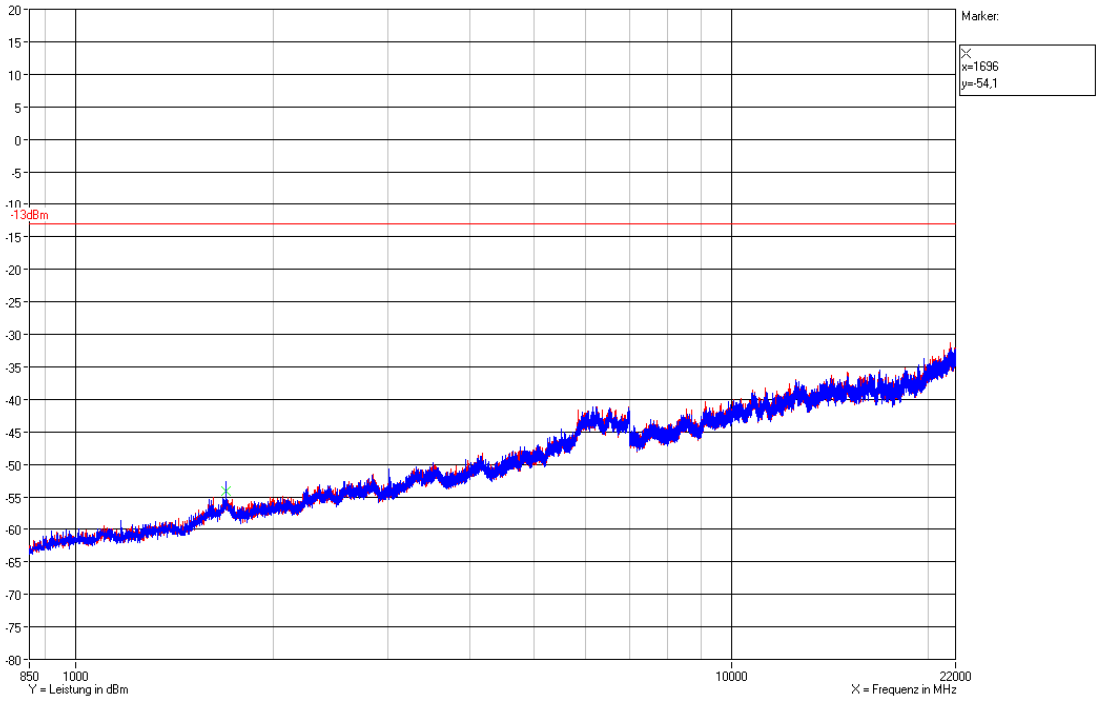
Vertikal / Horizontal



8.5.4.1 1 GHz to 22 GHz Downlink (Bottom – Middle – Top) Subpart F

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

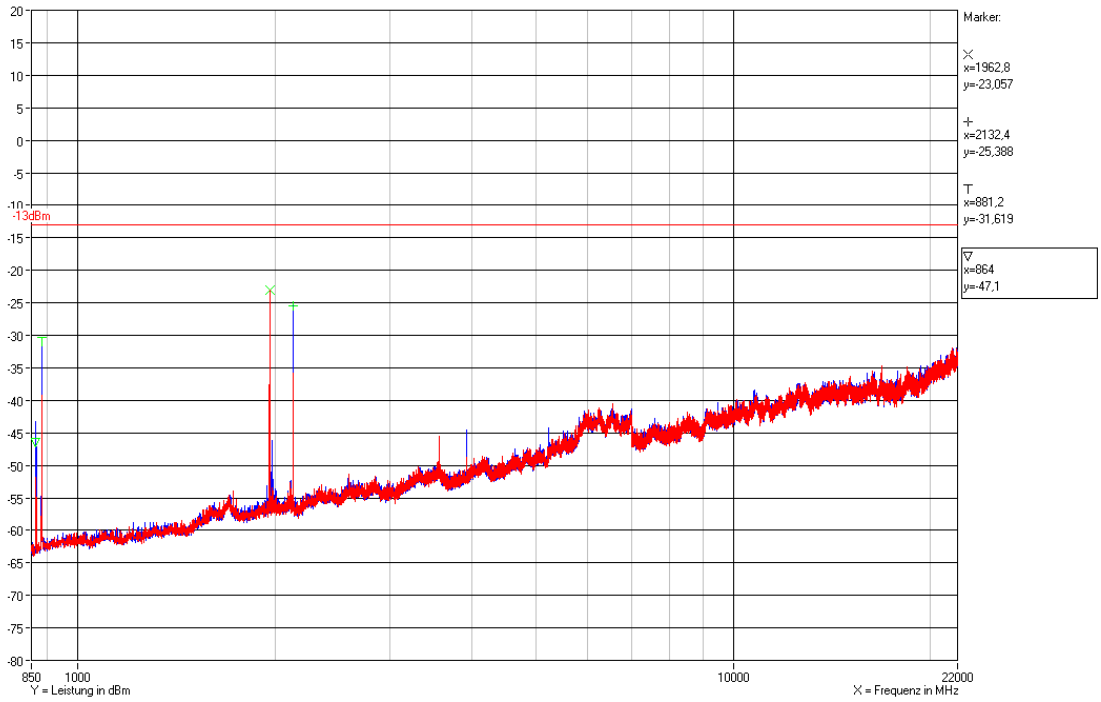
Vertikal / Horizontal



8.5.5 1 GHz to 22 GHz Downlink (Middle of all paths)

F1: 751.5 MHz; F2: 737 MHz; F3: 863.75 MHz; F4: 1962.5 MHz; F5: 2132.5 MHz

Vertikal / Horizontal



Za / 08.02.2013

The radiated spurious emission measurements have been passed!

9 History

Revision	Modification	Date	Name
01.00	Initial report	27.02.2013	Zahlmann
02.00	The block diagram on page 6 was deleted	25.06.2013	Zahlmann

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