

Test Site:
FCC Test Site No.: 96997
IC OATS No.: IC3475A-1



ECL-EMC Test Report No.: 10-183

Equipment under test: TFBM7/70 (LMR700 MHz range)
FCC ID: XS5-ION-BTFBM770
IC ID: 2237E-IONBTFBM770
Type of test: **FCC 47 CFR Part 90 Subpart R:2009**
Private Land Mobile Repeater
IC RSS-131:2003
Zone Enhancers for the Land Mobile Service

Measurement Procedures: 47 CFR Parts 2:2010 (*Frequency Allocations and Radio Treaty Matters; General Rules and Regulations*), Part 90 :2009 (Private Land Mobile), ANSI/TIA-603-C (2004), *Land Mobile FM or PM Communications Equipment Measurement and Performance Standards*
IC-GEN:2007 General Requirements and Information for the Certification of Radiocommunication Equipment

Test result: **Passed**

Date of issue:	26.07.10			Signature:
Issue-No.:	01	Author:	M. Lehmann Test engineer	
Date of delivery:	15.07.10	Checked:	M. Grytz Operational manager	
Test dates:	15.07. – 23.07.10			
Pages:	30			

Test Report No.: 10-183

FCC ID: XS5- ION-TFM770

IC ID: 2237E- IONBTFBM770



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General:

The purpose of this report is to show compliance to the FCC regulations for licensed devices operating under section 90 of the Code of Federal Regulations title 47.

This report informs about the results of the RF tests, it only refers to the equipment under test. No part of this report may be reproduced in any form, without written permission.



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1 Test Results Summary

Name of Test	FCC Para. No.	FCC Method	FCC Spec.	Result
RF Power Output	90.635	2.1046	1000 Watts	Complies
Occupied Bandwidth	90.210	2.1049	Input/Output	Complies
Spurious Emissions at Antenna Terminals	90.543	2.1051	-13dBm	Complies
Radiated Spurious emission	90.543	2.1053	-13dBm	Complies
Frequency Stability	90.539	2.1055	1 ppm	NA

Name of Test	IC Para. No.	IC Method	Result
RF Power Output	RSS-131	RSS-GEN 4.8	Complies
Occupied Bandwidth	RSS-131	RSS-GEN 4.6.1	Complies
Spurious Emissions at Antenna Terminals	RSS-131	RSS-GEN 4.9	Complies
Field Strength of Spurious Emissions	RSS-131 6.4	RSS-GEN 4.9	Complies
Frequency Stability	RSS-131	RSS-GEN 4.7	NA

Frequency stability is not applicable because the device uses a common oscillator to up convert and down convert the RF signal. The EUT does not contain modulation circuitry, or frequency generation, therefore the test was not performed.

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

2.1 Description

Kind of equipment	TFBM 7/70 Optical DAS repeater	
Andrew Ident. Number	Id.No. 7620491-00	
Serial no.(SN)	10	
Revision	00	
Software version and ID	n. a.	
Type of modulation and Designator	F3E (Voice)	<input checked="" type="checkbox"/>
	GSM (GXW)	<input checked="" type="checkbox"/>
Frequency Translation	F1-F1	<input checked="" type="checkbox"/>
	F1-F2	<input type="checkbox"/>
	N/A	<input type="checkbox"/>
Band Selection	Software	<input type="checkbox"/>
	Duplexer	<input checked="" type="checkbox"/>
	Full band	<input type="checkbox"/>

2.1.1 Downlink

Full pass band	Path 728 MHz – 775 MHz
Pass band under test	Path 763 MHz – 775 MHz
Max. composite output power based on one carrier per path (rated)	24 dBm = 0,25 W
Calculated maximum rated composite output power / Remote Unit	27 dBm = 0,5 W
Gain	33 dB

2.1.2 Uplink

Pass band	n. a.
Gain	n. a.

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

2.1.3 Description of EUT

The TFBM7/70 is a dual band medium power booster designed to distribute Cellular 700 and LMR700 band signals using the built-in auxiliary channel of a remote unit. The Automatic Level Control (ALC) compensates for level variations of the auxiliary channel.

This Test Report describes only the approval of the LMR700 MHz range 763 MHz – 775 MHz. The TFBM7/70 Repeater consists of two identical paths with one antenna port each. Each path covers Cellular 700 and LMR700, with the intended use of simultaneous transmission

2.1.4 System diagram of EUT

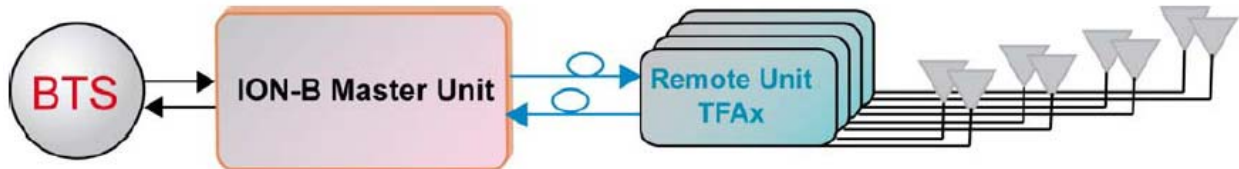


figure 2.1.4-#1 System diagram of EUT: ION-B

2.1.5 Block diagram of measurement reference points

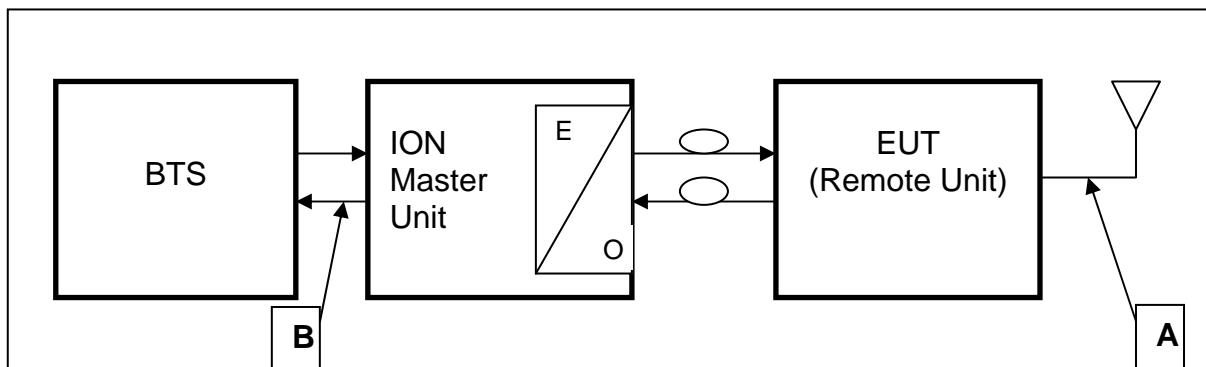


figure 2.1.5-#1 Block diagram of measurement reference points

Reference point A, Mobile: Optical DAS DL output, UL input

Reference point B, BTS: Optical DAS UL output, DL 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

ANDREW Inv. No.	Test equipment	Type	Manufacturer	Serial No.	Calibration
8917	Network Analyzer	ZVCE8	R&S	827712/009	12/10
9054	Spectrum Analyzer	FSV13	R&S	100859	01/11
8984	Signal Generator	E4438C	Agilent	MY45094089	11/10
8743	Signal Generator	SMIQ03B	R&S	101248	02/11
8671	Power Meter	E4418B	Agilent	GB39513094	06/11
8672	Power Sensor	E9300H	Agilent	US41090179	06/11
7341	Power Attenuator	768-20	Narda	---	CIU
7119	Divider	2way	Mikom	3512	CIU
7363	RF-Cable	2,0m; N-N	Huber & Suhner	28439/4PEA	CIU
7295	RF-Cable	2,5m; N-N	Huber & Suhner	28964/4PEA	CIU
7299	RF-Cable	2,5m; N-N	Huber & Suhner	28964/4PEA	CIU
7364	RF-Cable	1,0m; SMA	Huber & Suhner	36309/4P	CIU
7365	RF-Cable	1,0m; SMA	Huber & Suhner	36292/4P	CIU
7366	RF-Cable	2,0m; SMA	Huber & Suhner	36183/4P	CIU
7367	RF-Cable	2,0m; SMA	Huber & Suhner	36158/4P	CIU
7373	RF-Cable	Multiflex141 0,6m	Andrew	---	CIU
7374	RF-Cable	Multiflex141 0,6m	Andrew	---	CIU

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 %.

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4 Test site (TEMPTON)

FCC Test site: 96997

IC OATS: IC3475A-1

See relevant dates under section 8 of this test report.

5 RF Power Out: §90.635, §2.1046; RSS-131, RSS-GEN

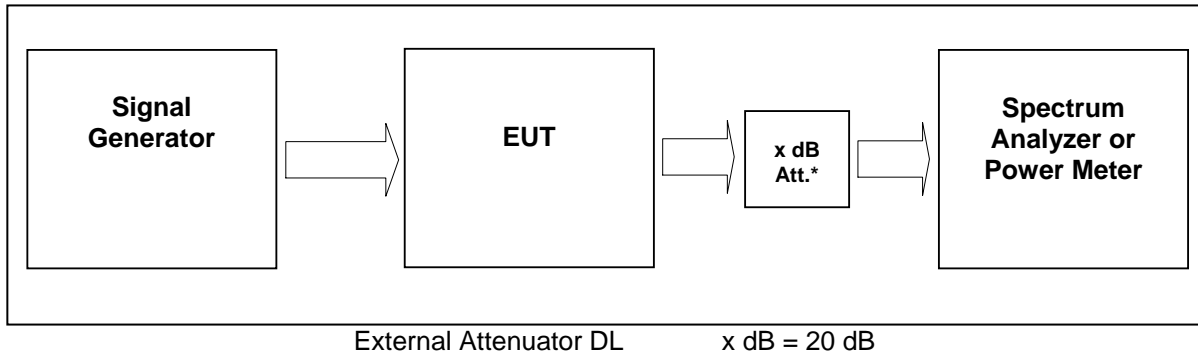


figure 5-#1 Test setup: RF Power Out: §90.635, §2.1046; RSS-131, RSS-GEN

Measurement uncertainty	± 0,38 dB
Test equipment used	9054, 8984, 7366, 7367, 7299, 7341, 7363

5.1 Limit

Minimum standard:

§ 90.635 Limitations on power and antenna height.

(a) The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values, and applicants will be required to justify power levels and antenna heights requested.

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 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

5.3.1 Downlink

Modulation	Measured at		RBW VBW Span	RF Power (dBm)	RF Power (W)	Plot -
Analog	Middle	769,5 MHz	100kHz 300kHz 1,5MHz	24,0	0,25	5.3.1.1 #1
GSM	Middle	769,5 MHz	1MHz 3MHz 10MHz	24,0	0,25	5.3.1.1 #1
Maximum output power = 24,0 dBm = 0,25 W						
Limit Maximum output power = 1000 W						

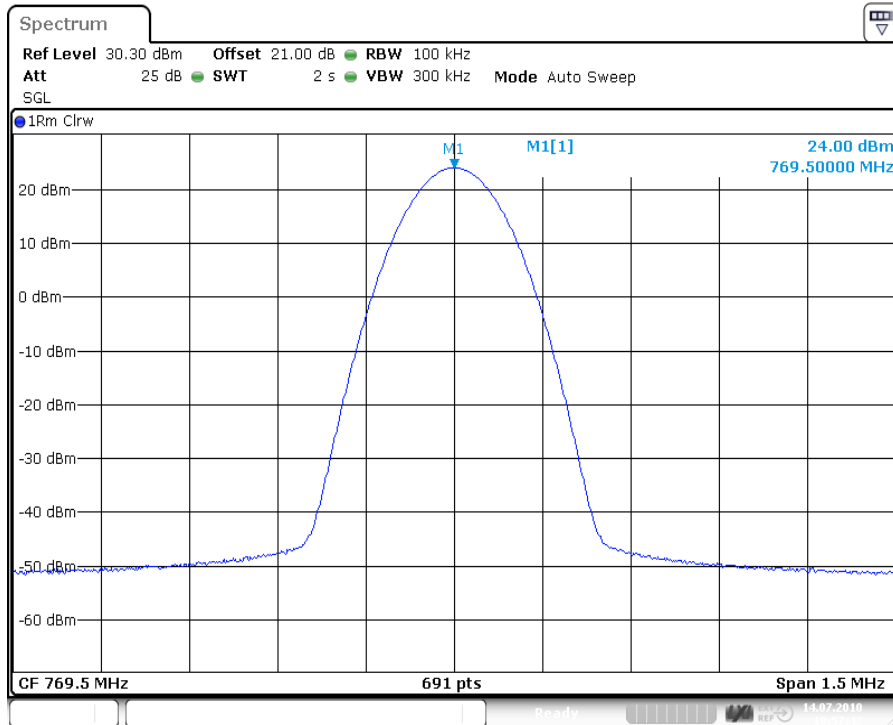
table 5.3.1-#1 RF Power Out: §90.635, §2.1046; RSS-131, RSS-GEN Test Results Downlink

Modulation	Pin / dBm (Ref. point B)
Analog	-9,1
GSM	-9,1

table 5.3.1-#2 RF Power Out: §90.635, §2.1046; RSS-131, RSS-GEN Test Results Downlink Input power

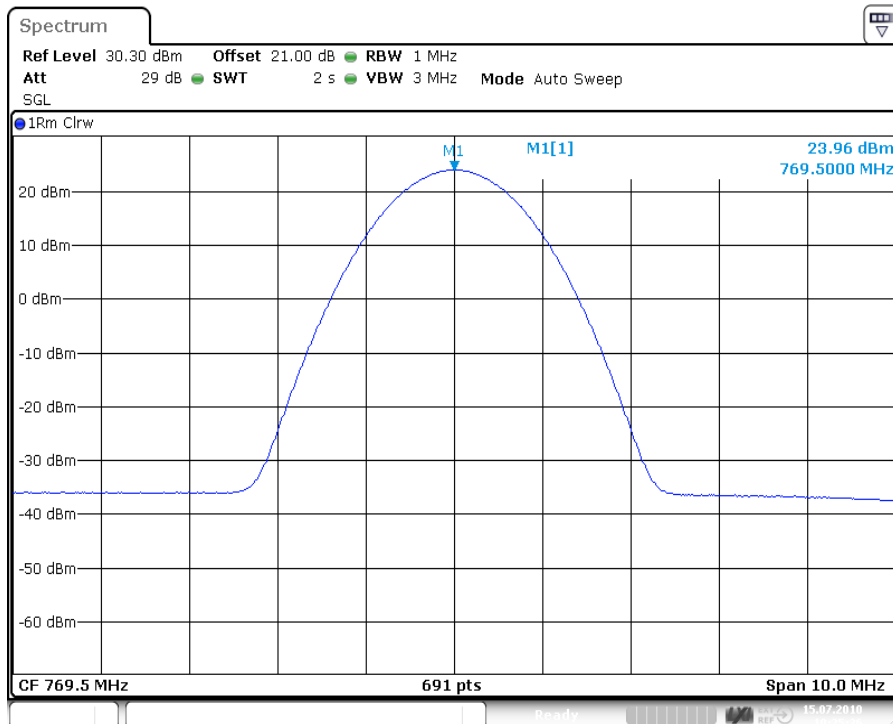


5.3.1.1 Analog



plot 5.3.1.1-#1 RF Power Out: §90.635, §2.1046; RSS-131, RSS-GEN; Test Results; Downlink; Analog Middle

5.3.1.2 GSM



plot 5.3.1.2-#1 RF Power Out: §90.635, §2.1046; RSS-131, RSS-GEN; Test Results; Downlink; GSM Middle

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5.3.2 Uplink

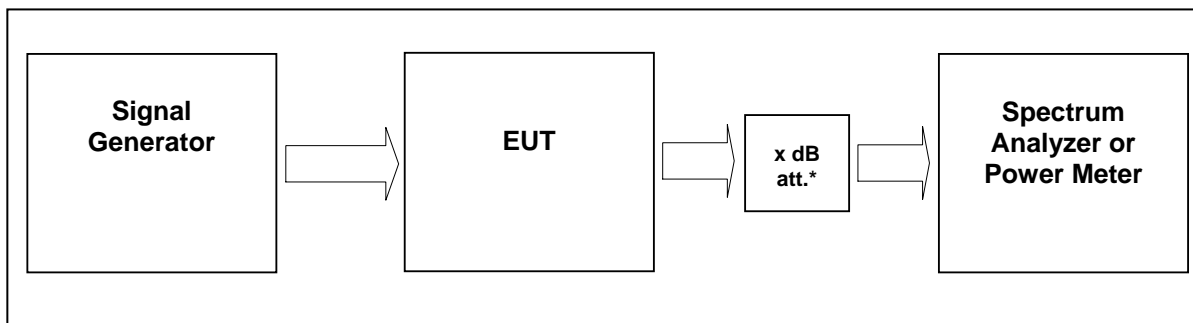
n.a.

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:	15.07.2010

6 Occupied Bandwidth: §90.210, §2.1049; RSS-GEN



External Attenuator DL x dB = 20 dB
 figure 6-#1 Test setup: Occupied Bandwidth: §90.210, §2.1049; RSS-GEN

Measurement uncertainty	± 0,38 dB
Test equipment used	9054, 8984, 7366, 7367, 7299, 7341, 7363

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

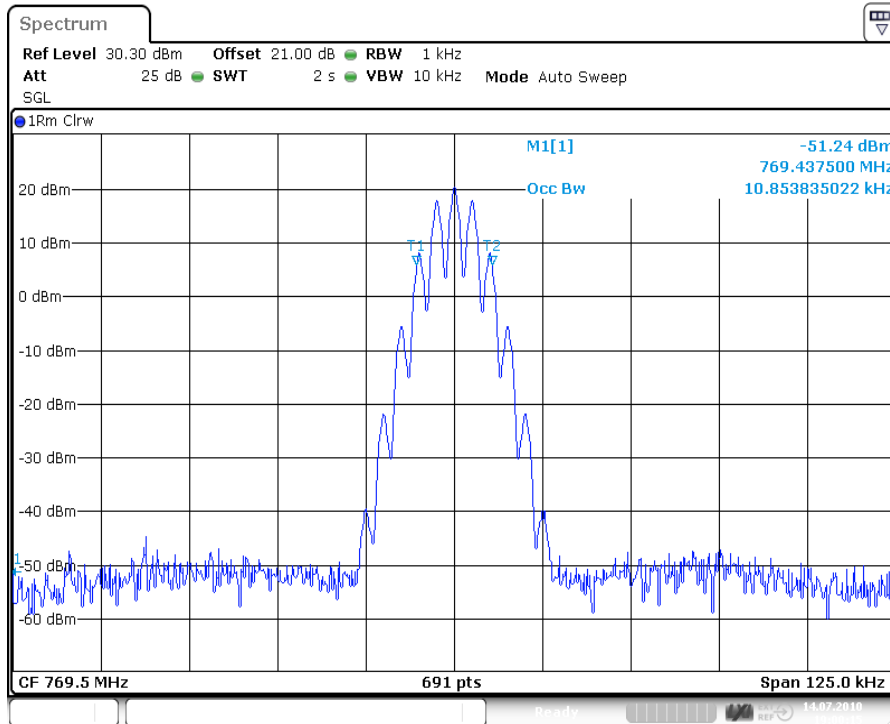
Detector RMS.

Modulation	Measured at		RBW VBW Span	Occupied Bandwidth / kHz	Plot #
Analog	Middle	769,5 MHz	1 kHz 10 kHz 125 kHz	10,8	6.3.1.1 #1, #2
GSM	Middle	769,5 MHz	3 kHz 30 kHz 1 MHz	244,6	6.3.1.2 #1, #2

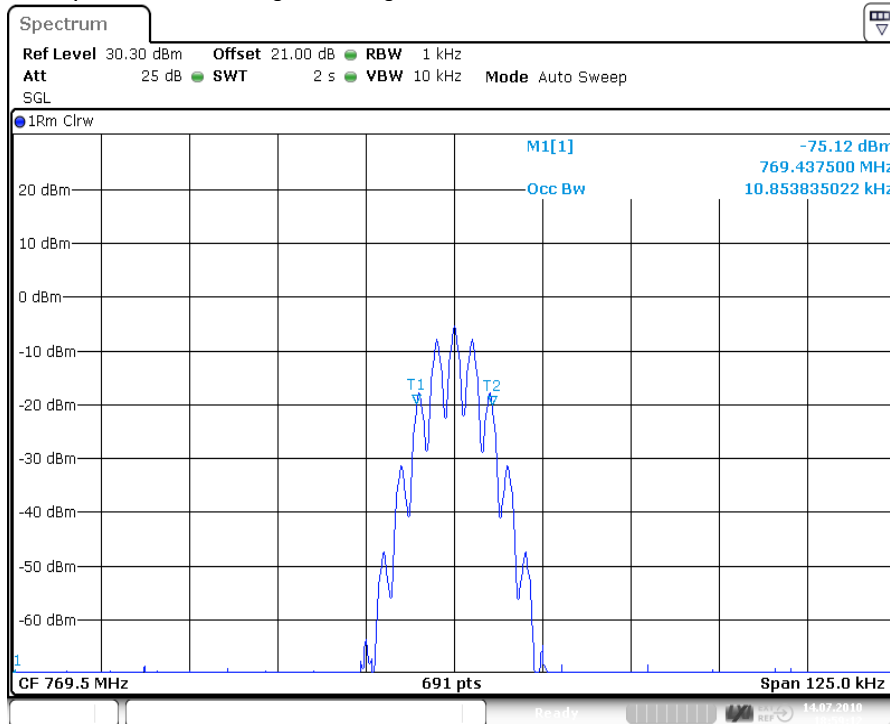
table 6.3-#1 Occupied Bandwidth: §90.210, §2.1049; RSS-GEN Test results



6.3.1.1 Analog



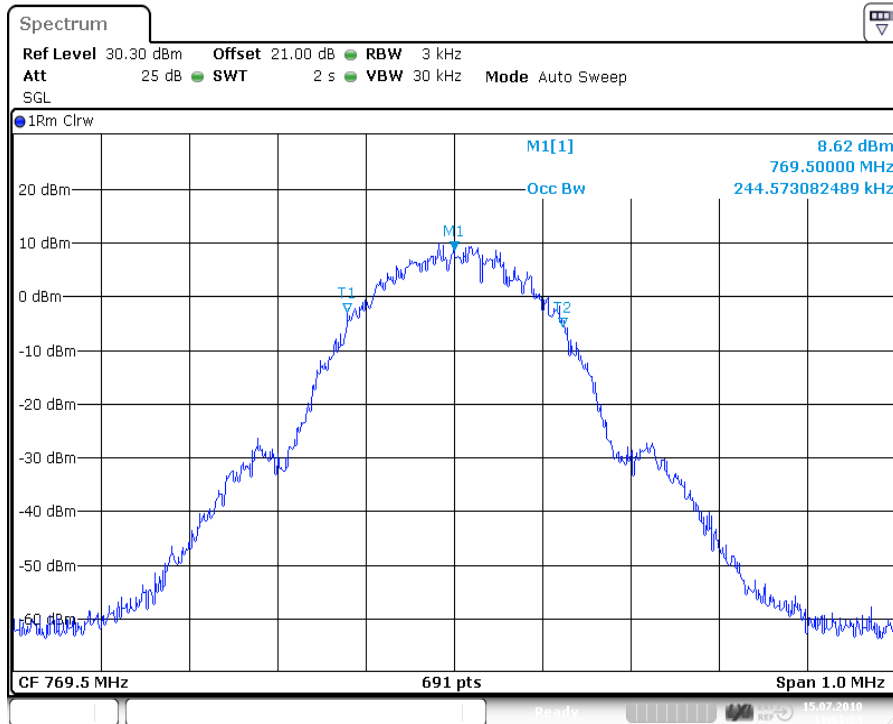
plot 6.3.1.1-#1 Occupied Bandwidth: §90.210, §2.1049; RSS-GEN; Test results; Downlink; Analog Output



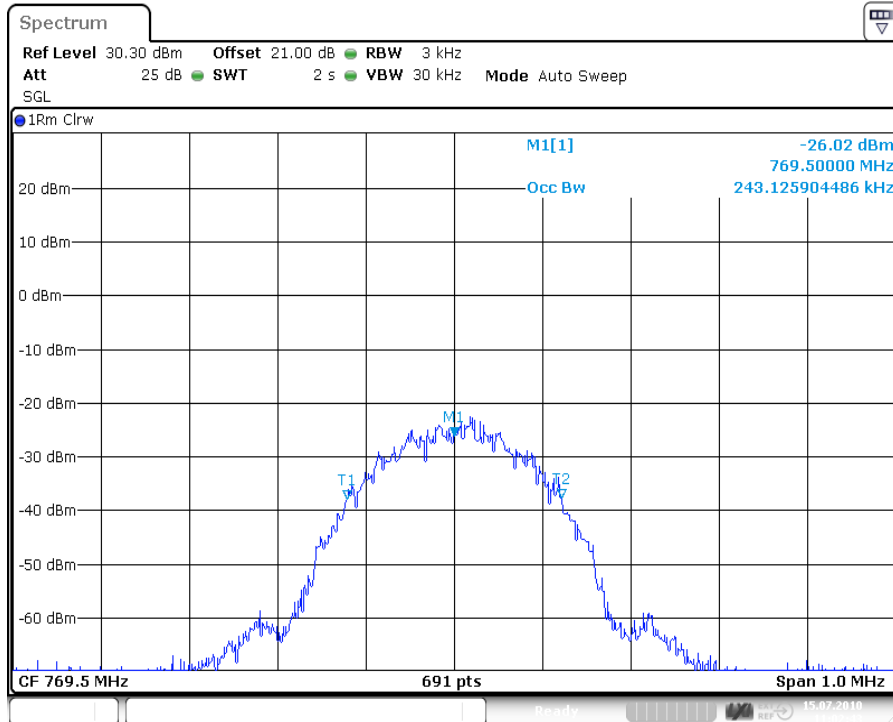
plot 6.3.1.1-#2 Occupied Bandwidth: §90.210, §2.1049; RSS-GEN; Test results; Downlink; Analog Input



6.3.1.2 GSM



plot 6.3.1.2-#1 Occupied Bandwidth: §90.210, §2.1049; RSS-GEN; Test results; Downlink; GSM Output



plot 6.3.1.2-#2 Occupied Bandwidth: §90.210, §2.1049; RSS-GEN; Test results; Downlink; GSM Input

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6.3.2 Uplink

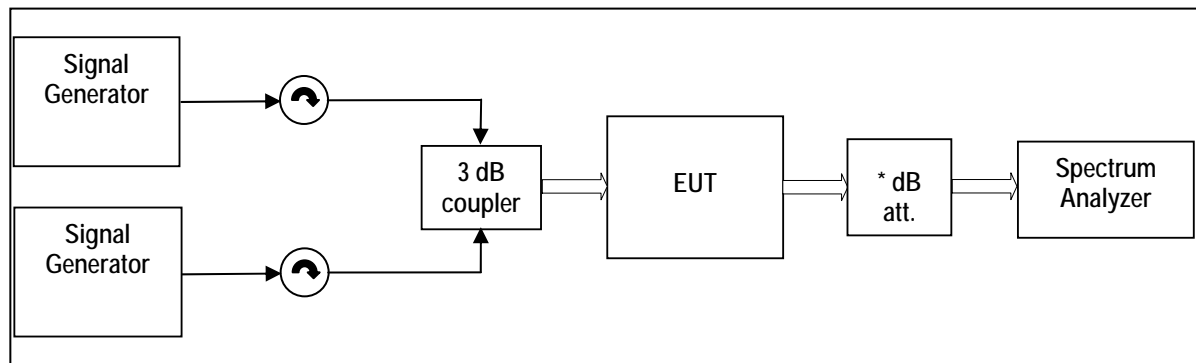
n.a.

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:	15.07.2010

7 Spurious Emissions at Antenna Terminals: §90.543, §2.1051; RSS-131, RSS-GEN



External Attenuator DL x dB = 20 dB

figure 7-#1 Test setup: Spurious Emissions at Antenna Terminals: §90.543, §2.1051; RSS-131, RSS-GEN

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, 8984, 8743, 7365, 7366, 7119, 7367, 7299, 7341, 7363	

7.1 Limit

§ 90.543 Emission limitations.

Transmitters designed to operate in 769–775 MHz and 799–805 MHz frequency bands must meet the emission limitations in paragraphs (a) through (d) of this section. Transmitters operating in 763–768 MHz and 793–798 MHz bands must meet the emission limitations in (e) of this section.

Limit -13dBm

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 and amended 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	RBW VBW Span	Max. level (dBm)	Plot -
Analog	Lower Edge Upper Edge	763,0125 MHz 763,0375 MHz 774,9625 MHz 774,9875 MHz	300Hz 3kHz 2MHz	- 43	7.3.1.1 #1 #2
GSM	Lower Edge Upper Edge	763,2 MHz 763,6 MHz 774,6 MHz 774,8 MHz	3kHz 30kHz 2MHz	- 29	7.3.1.2 #1 #2

table 7.3-#1 Spurious Emissions at Antenna Terminals: §90.543, §2.1051; RSS-131, RSS-GEN Test results <1MHz from Band

>1MHz from Band Edge

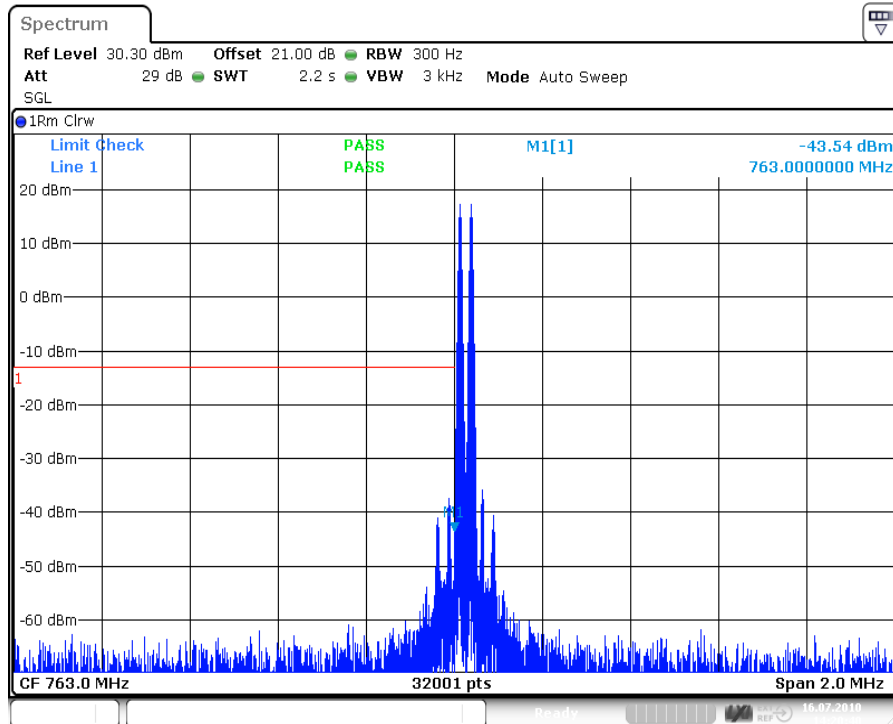
Detector: RMS.

Modulation	Carrier	RBW VBW Span	Max. level (dBm)	Plot -
Analog	769,5 MHz	1MHz 3MHz 30MHz – 8GHz	-38	7.3.1.3 #1
GSM	769,5 MHz	1MHz 3MHz 30MHz – 8GHz	-38	7.3.1.4 #1

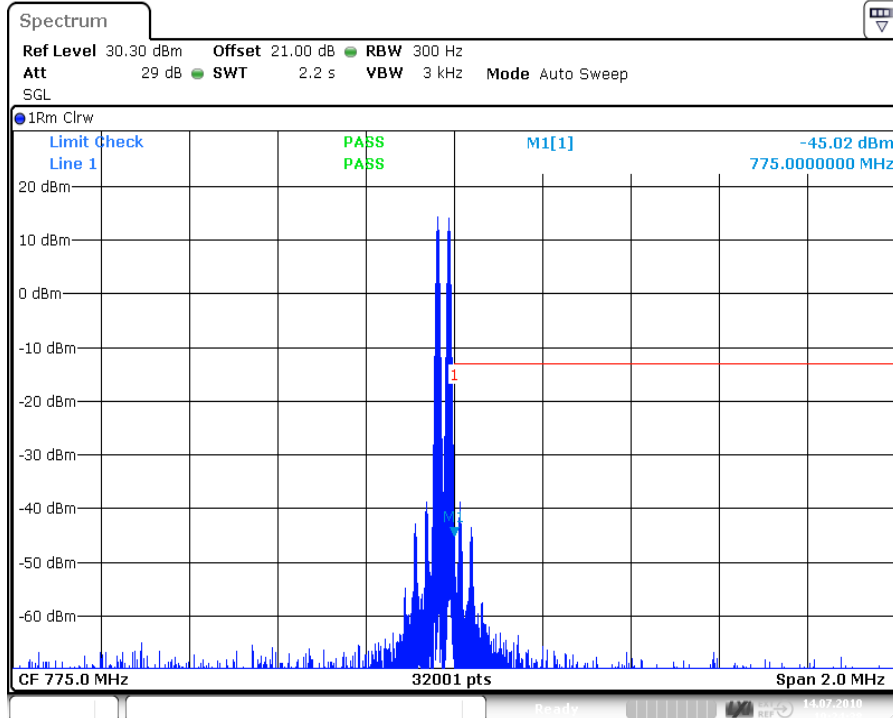
table 7.3-#2 Spurious Emissions at Antenna Terminals: §90.543, §2.1051; RSS-131, RSS-GEN Test results <1MHz from Band Edge



7.3.1.1 Analog < 1MHz to band edge



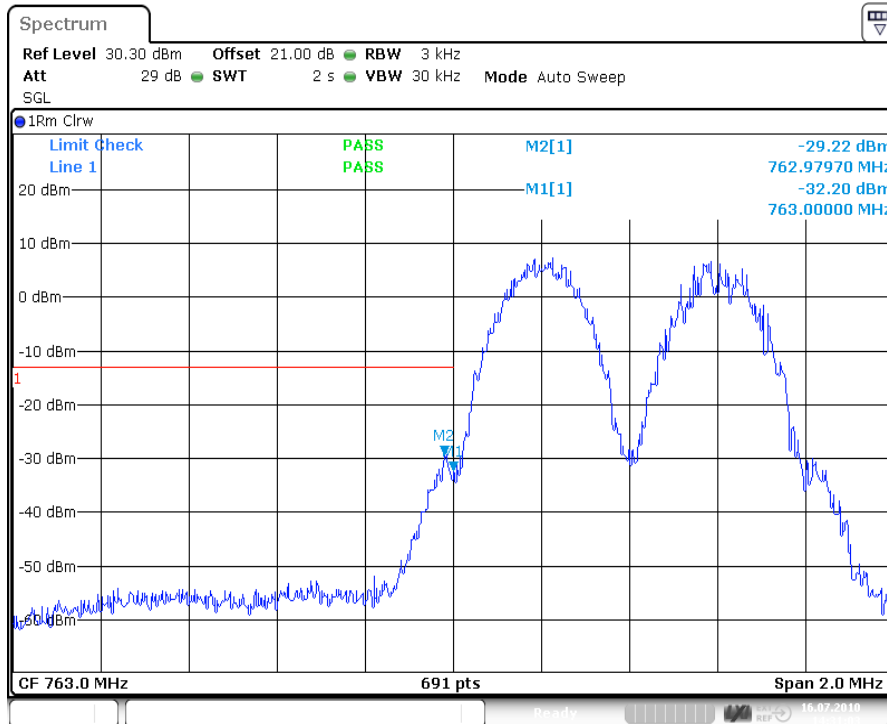
plot 7.3.1.1-#1 Spurious Emissions at Antenna Terminals: §90.543, §2.1051; RSS-131, RSS-GEN; Test results; Downlink; Analog < 1MHz to band edge Lower Band Edge



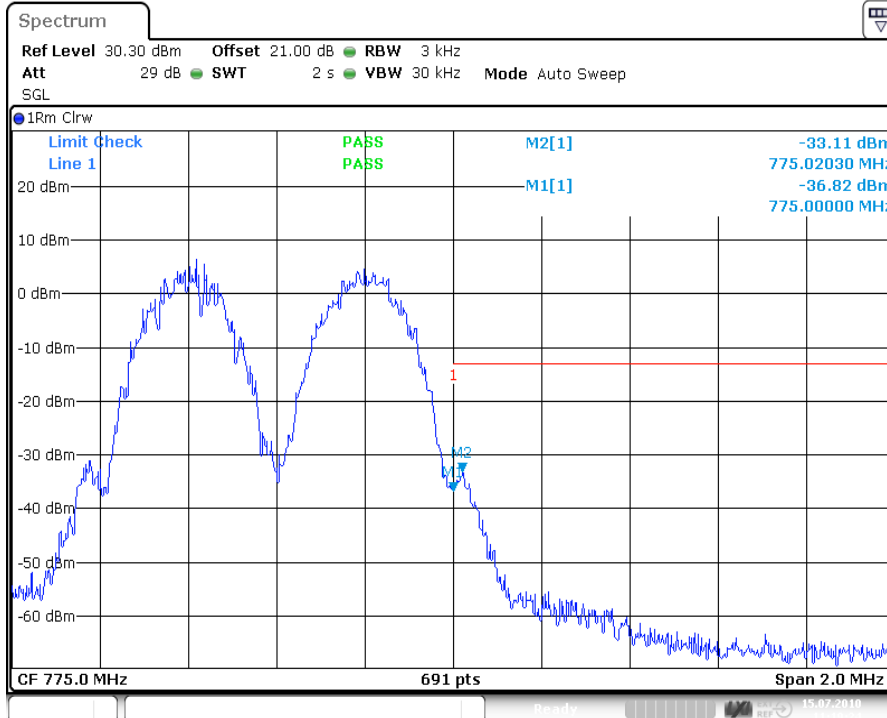
plot 7.3.1.1-#2 Spurious Emissions at Antenna Terminals: §90.543, §2.1051; RSS-131, RSS-GEN; Test results; Downlink; Analog < 1MHz to band edge Upper Band Edge



7.3.1.2 GSM < 1MHz to band edge



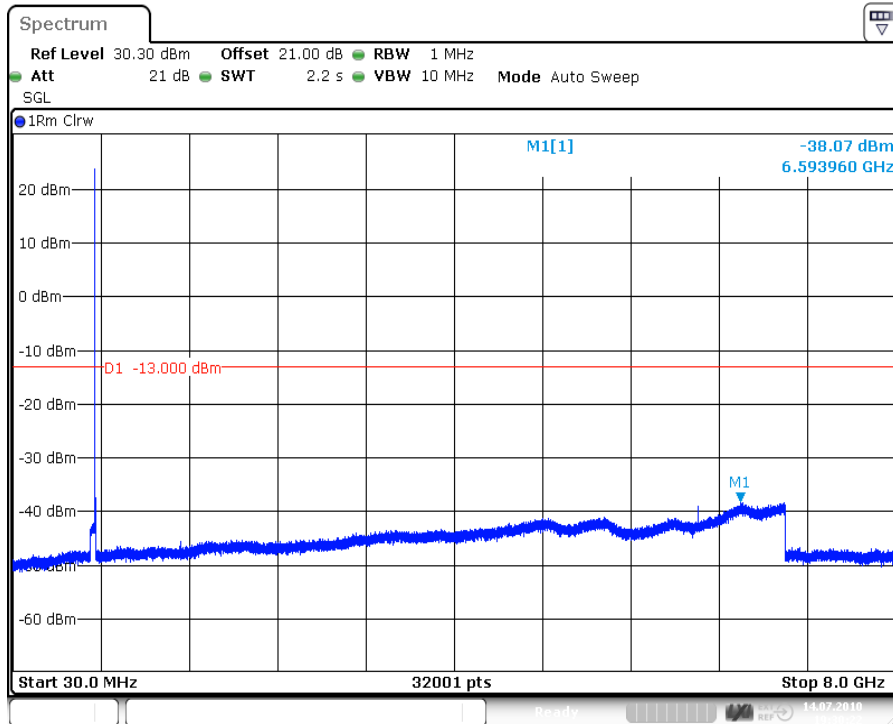
plot 7.3.1.2-#1 Spurious Emissions at Antenna Terminals: §90.543, §2.1051; RSS-131, RSS-GEN; Test results; Downlink; GSM < 1MHz to band edge Lower Band Edge



plot 7.3.1.2-#2 Spurious Emissions at Antenna Terminals: §90.543, §2.1051; RSS-131, RSS-GEN; Test results; Downlink; GSM < 1MHz to band edge Upper Band Edge

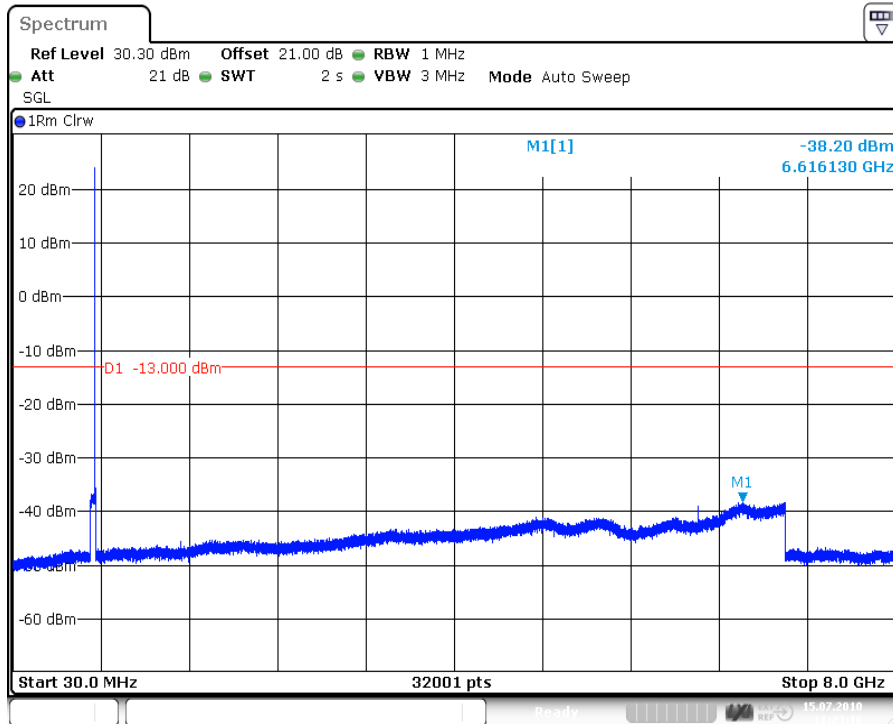


7.3.1.3 Analog > 1MHz to band edge



plot 7.3.1.3-#1 Spurious Emissions at Antenna Terminals: §90.543, §2.1051; RSS-131, RSS-GEN; Test results; Downlink; Analog > 1MHz to band edge;

7.3.1.4 GSM > 1MHz to band edge



plot 7.3.1.4-#1 Spurious Emissions at Antenna Terminals: §90.543, §2.1051; RSS-131, RSS-GEN; Test results; Downlink; GSM > 1MHz to band edge;

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7.3.2 Uplink

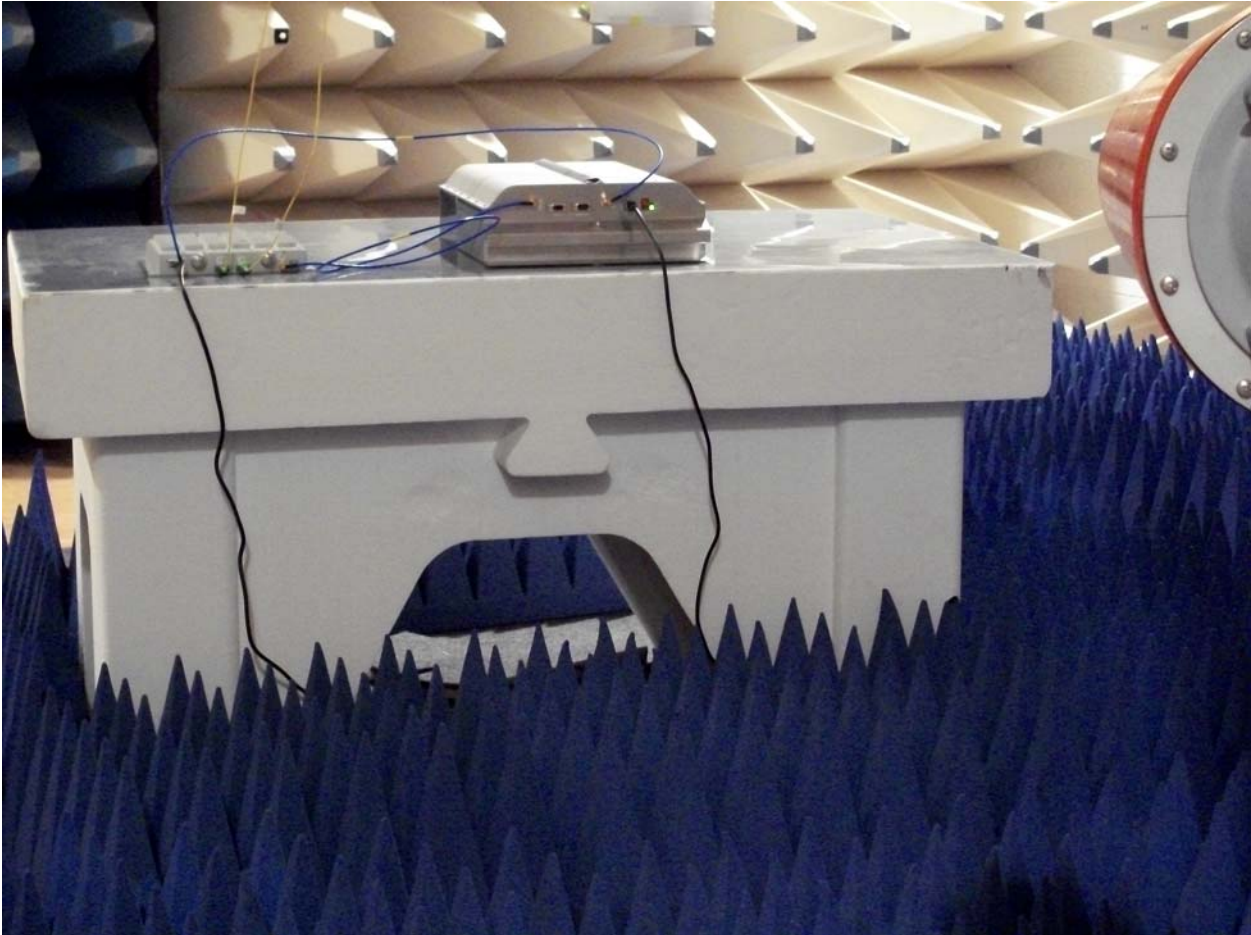
n.a.

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:	16.07.2010

8 Radiated Spurious Emissions at the ECL (TEMPTON): §90.543, §2.1053, RSS-Gen, RSS-131

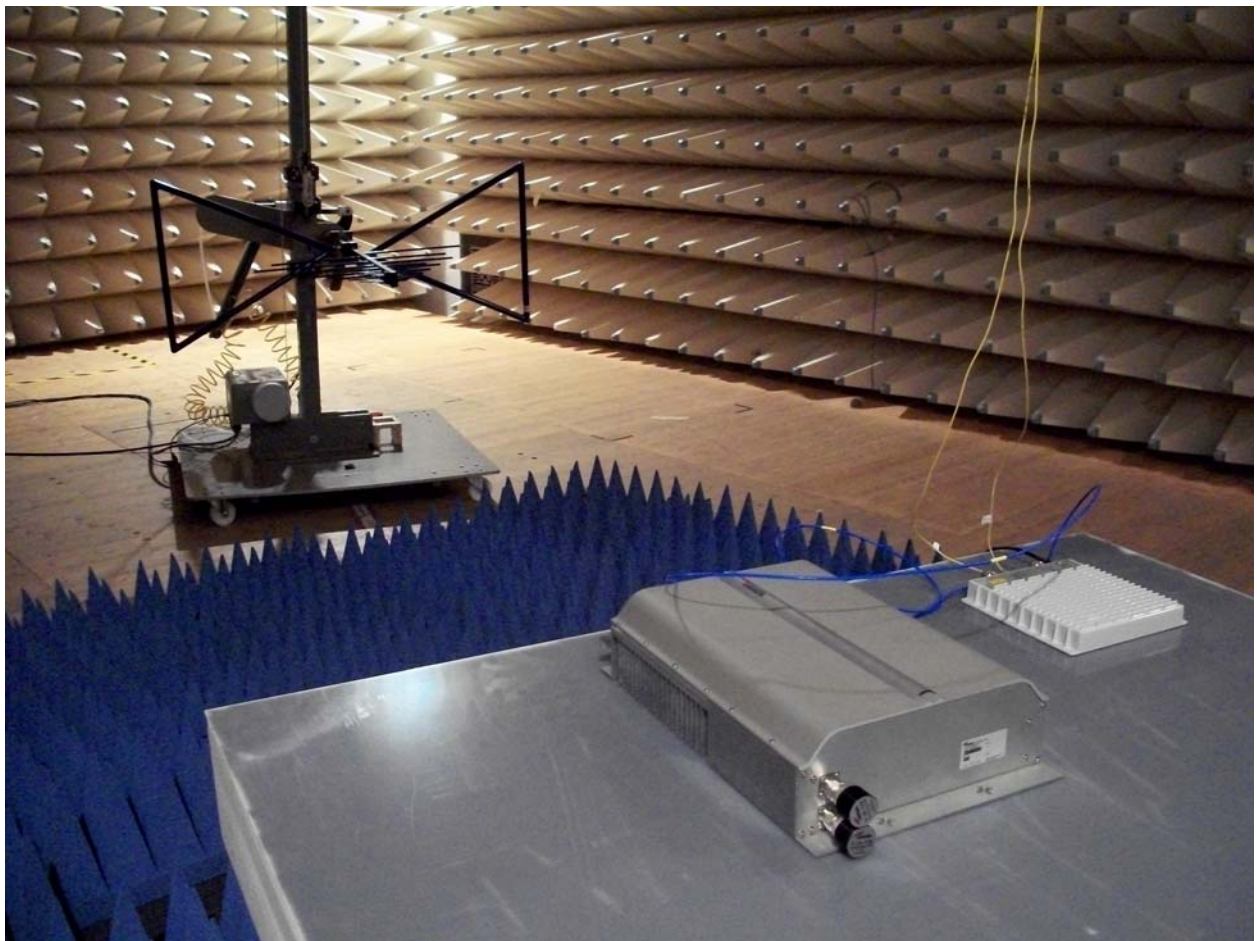


picture 8.1: Test setup: Field Strength Emission >1 GHz @3m in the FAC

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picture 8.2: Test setup: Field Strength Emission <1 GHz @3m in the FAC



This clause specifies requirements for the measurement of radiated emission.

Frequency range	Distance: EUT <-> antenna / location	Limit	Test method
30 MHz – 9 GHz	3 metres / FAC	FCC 47 CFR Part 90.543	TIA/EIA-603-C:2004
		IC RSS-131 sec. 4.4	

Test equipment used:

Designation	Type	Manufacturer	Invent.-no.	Cal.-date	due Cal.-date	used
EMI test receiver	ESI40	Rohde & Schwarz	E1687	20.10.2009	20.10.2010	X
EMI test receiver	ESI40	Rohde & Schwarz	E1607	04.03.2009	04.03.2010	
Antenna	CBL 6111	Chase	K1149	14.09.2009	14.09.2010	X
Antenna	CBL 6111	Chase	K1026	14.09.2009	14.09.2010	
RF Cable		Frankonia	K1121 SET	28.12.2009	28.12.2010	X
Pre amplifier	AM1431	Miteq	K1721	27.04.2009	27.04.2010	X
Antenna	HL 025	R&S	K809	06.05.2009	06.05.2010	X
Antenna	MWH-1826 / B	ARA Inc.	K1042	06.04.2009	06.04.2010	
Antenna	MWH-2640 / B	ARA Inc.	K1043	06.04.2009	06.04.2010	
Preamplifier	AFS4-00102000	Miteq	K817	11.11.2009	11.11.2010	X
Preamplifier	AFS4-00102000	Miteq	K838	06.10.2009	06.10.2010	
Preamplifier	JS43-1800-4000	Miteq	K1104	26.08.2009	26.08.2010	
RF Cable	Sucoflex 100	Suhner	K1742	09.04.2009	21.07.2010	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: FAC
 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: 115V / 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
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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 90 R are as follows:

- 763/769.5/775 MHz (§90 Subpart R)

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.

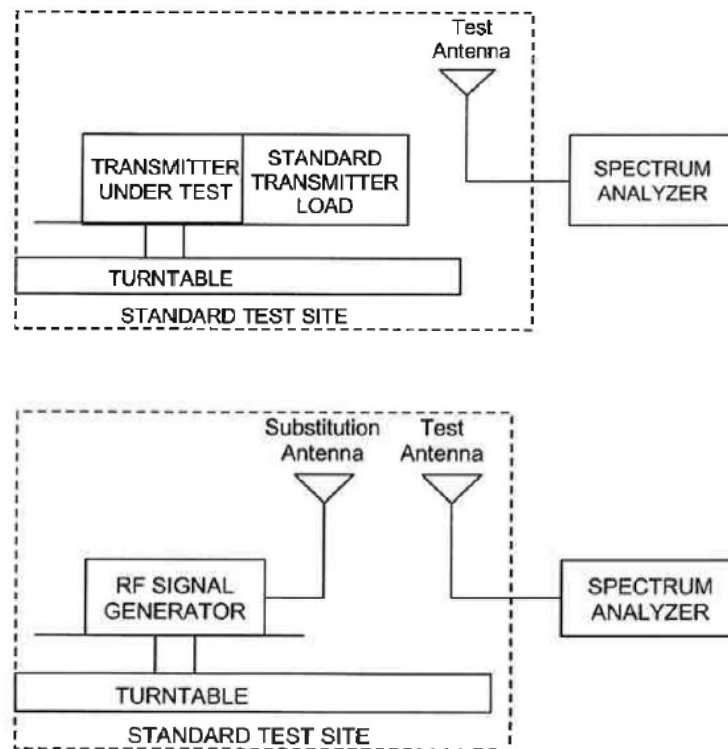


Figure #7.2 Substitution methods TIA/EIA-603-C



8.2 Limit

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

Transmitters designed to operate in **769–775 MHz** and 799–805 MHz frequency bands must meet the emission limitations in paragraphs (a) through (d) of this section.

(c) *Out-of-band emission limit.* On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least **43 + 10log (P) dB** measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

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

(e) For operations in the **763–768 MHz** and the 793–798 MHz bands, 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 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.

(2) On all frequencies between 769–775 MHz and 799–805 MHz, by a factor not less than **65 + 10 log (P) dB** in a 6.25 kHz band segment, for mobile and portable stations.

(3) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

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:

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

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	Average

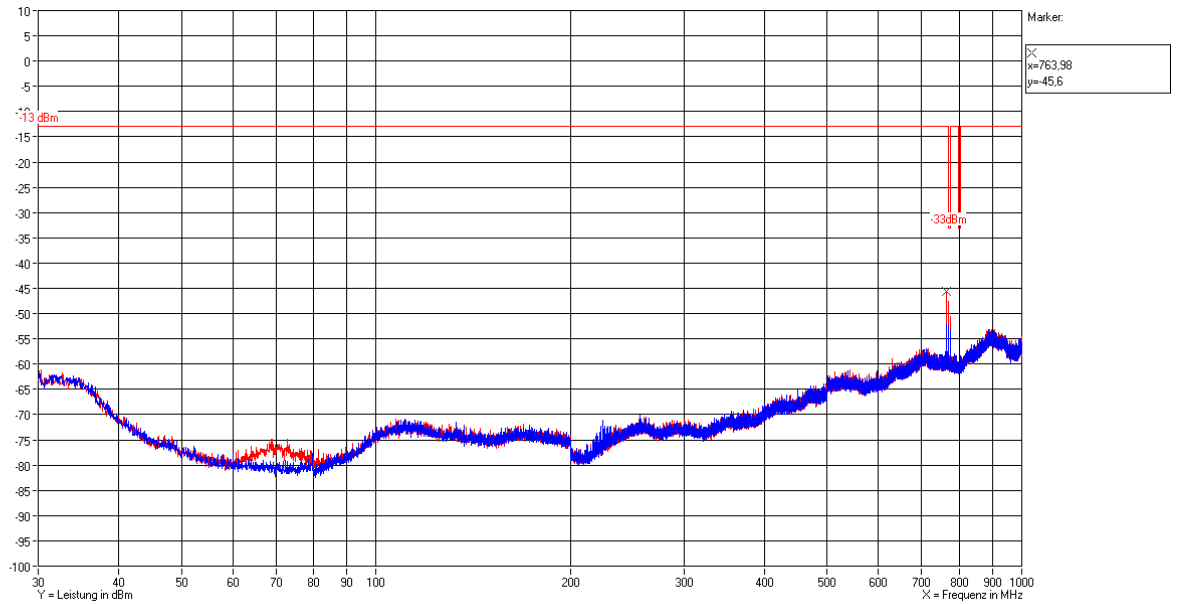
8.4 Climatic values in the lab

Temperature	21,5°C
Relative Humidity	47%
Air-pressure	1014 hPa

8.5 Test results

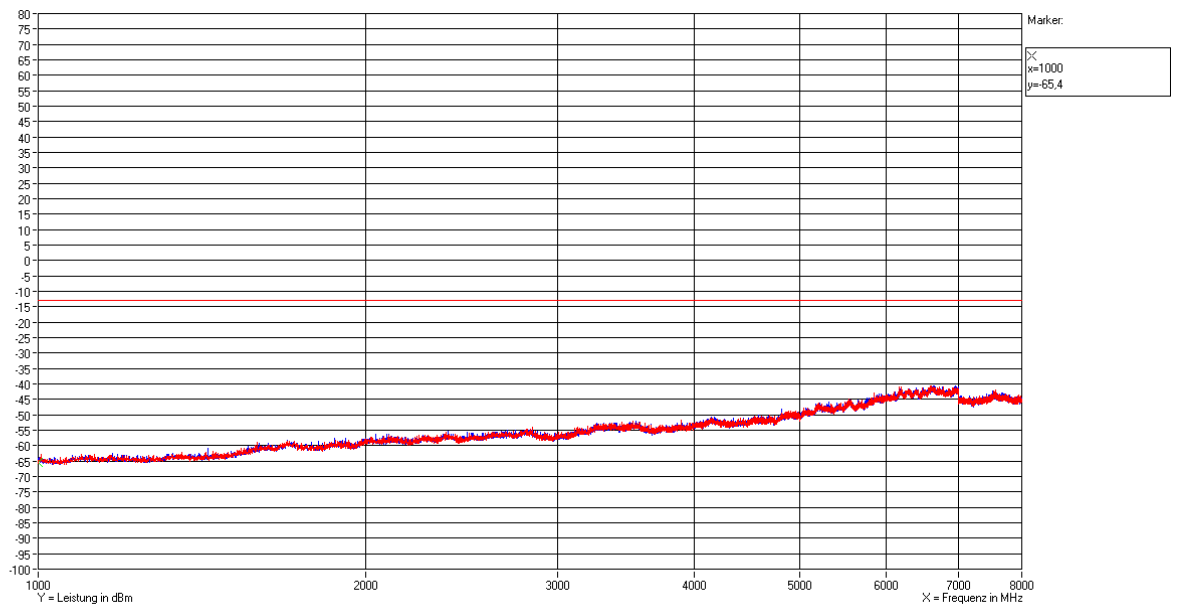
8.5.1 30 MHz to 1 GHz Downlink (Bottom – Middle – Top)

Vertikal / Horizontal



8.5.2 1 GHz to 8 GHz Downlink (Bottom – Middle – Top)

Vertikal / Horizontal



Lehmann / 23.07.2010

The radiated spurious emission measurements have been passed!

Test Report No.: 10-183

FCC ID: XS5- ION-TFM770

IC ID: 2237E- IONBTFBM770



9 History

Revision	Modification	Date	Name
01.00	Initial report	23.07.2010	Lehmann

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