

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



BUREAU  
VERITAS

## ECL-EMC Test Report No.: 12-193

Equipment under test: **ION-M4**  
FCC ID: **XS5-M4**

Type of test: **FCC 47 CFR Part 90 Subpart I:2012**  
Private Land Mobile Repeater

Measurement Procedures:  
47 CFR Parts 2 (*Frequency Allocations and Radio Treaty Matters; General Rules and Regulations*), 90 (Private Land Mobile), ANSI/TIA-603-C (2004), *Land Mobile FM or PM Communications Equipment Measurement and Performance Standards*

Test result: **Passed**

Date of issue:	24.10.12		Signature:
Issue-No.:	01	Author:	
Date of delivery:	22.10.12	Checked:	
Test dates:	16.10. – 23.10.12		
Pages:	34		

Test Report No.: 12-193

FCC ID: XS5-ML7851719P

IC ID: 2237E-ML7851719P



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**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 Product 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.



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## 1 Test Results Summary

Name of Test	FCC Para. No.	FCC Method	FCC Spec.	Result
RF Power Output	90.205(h)(1)	2.1046	500 Watts	Complies
Occupied Bandwidth	90.210	2.1049	Input/Output	Complies
Spurious Emissions at Antenna Terminals	90.210	2.1051	-25dBm	Complies
Radiated Spurious emission	90.210	2.1053	-25dBm	Complies
Frequency Stability	90.213	2.1055	1 ppm	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	ION-M4
Andrew Ident. Number	Id.No. 7659068-0001
Serial no.(SN)	12
Revision	00
Software version and ID	n. a.
Type of modulation and Designator	F3E (Voice) <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

Pass band	451,0625 MHz – 452,6500 MHz 461,4500 MHz- 461,8750 MHz
Max. composite output power based on one carrier per path (rated)	38 dBm = 6,31 W
Gain (see 2.14 and 2.15)	5 dB @ Pout BTS of 33 dBm

#### 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 ION-M4 ENW is a multi-operator Remote Unit used in conjunction with a Master Unit in the ION optical distribution system. This system transports LMR400 signals within the 400 MHz frequency range, providing a cost-effective solution for distributing capacity from one or more base stations.



### 2.1.4 Block diagram of measurement reference points

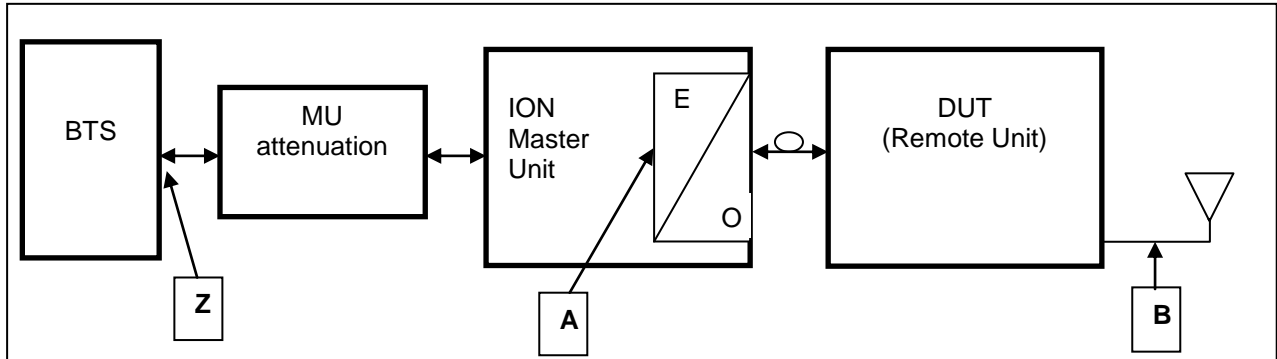


figure 2.1.4-#1 **Block diagram of measurement reference points**

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)	MU Attenuation (manual leveling)	Maximum rated input power at the MU OTRX (fixed value)	RU Gain (fixed value)	Maximum rated output power at RU Antenna port (fixed value)
Z		A	A to B	B
+33 dBm	33 dB	0 dBm	+38 dB	+38 dBm @ 1 carrier
<b>System Gain Z to A</b>	<b>+5 dB</b>			
+43 dBm	43 dB	0 dBm	+38 dB	+38 dBm @ 1 carrier
<b>System Gain Z to A</b>	<b>-5 dB</b>			

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
8741	Network Analyzer	8753D	HP	3410A08675	02/13
8961	Spectrum Analyzer	FSP-13	R&S	100147/013	07/13
8990	Signal Generator	SMJ100A	R&S	101732	06/13
7192	Power Attenuator	769-30	Narda	07448	CIU
7122	RF-Cable	2,0m; N-N	BR Elektronik	800.036.1002608	CIU
7156	RF-Cable	2,0m; SMA	BR Elektronik	28442/4PEA	CIU
7406	Matrix	-----	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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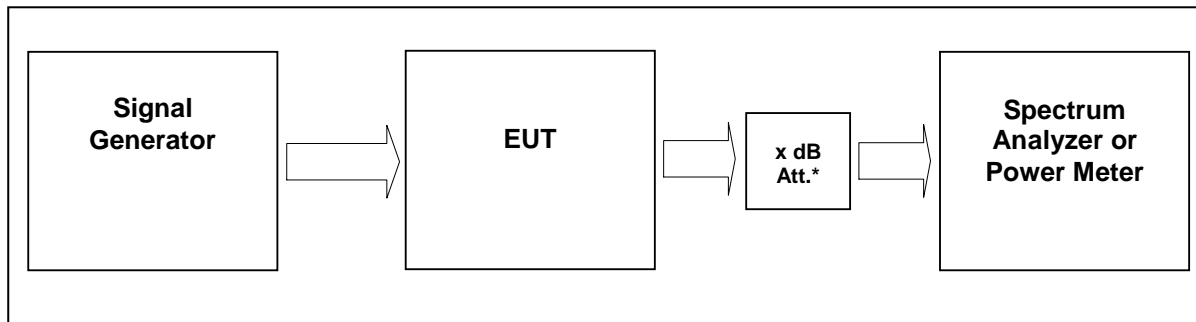
## 4 Test site (Bureau Veritas)

FCC Test site: 96997  
IC OATS: IC3475A-1

See relevant dates under section 8 of this test report.



## 5 RF Power Out: §90.205, §2.1046



External Attenuator DL x dB = 30,4 dB  
figure 5-#1 Test setup: **RF Power Out: §90.205, §2.1046**

Measurement uncertainty	± 0,38 dB
Test equipment used	8741, 8990, 8961, 7406

### 5.1 Limit

Minimum standard:

Para. No. 90.205 Power and antenna height limits.

(h) 450-470 MHz. (1) The maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 2. Applicants requesting an ERP in excess of that listed in table 2 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.

TABLE 2—450-470 MHz—MAXIMUM ERP/REFERENCE HAAT FOR A SPECIFIC SERVICE AREA RADIUS

	Service area radius (km)									
	3	8	13	16	24	32	40 <sup>4</sup>	48 <sup>4</sup>	64 <sup>4</sup>	80 <sup>4</sup>
Maximum ERP (w) <sup>1</sup> .....	2	100	<sup>2</sup> 500	<sup>2</sup> 500	<sup>2</sup> 500	<sup>2</sup> 500	<sup>2</sup> 500	<sup>2</sup> 500	<sup>2</sup> 500	<sup>2</sup> 500
Up to reference HAAT (m) <sup>3</sup>	15	15	15	27	63	125	250	410	950	2700

<sup>1</sup> Maximum ERP indicated provides for a 39 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 29 (See § 73.699, Fig. 10 b).

<sup>2</sup> Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 39 dBu.

<sup>3</sup> When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation:  $ERP_{allow} = ERP_{max} \times (HAAT_{ref} / HAAT_{actual})^2$ .

<sup>4</sup> Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 39 dBu.

### 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

#### 5.3.1 Downlink

Modulation	Measured at	Path	RBW VBW Span	RF Power (dBm)	RF Power (W)	Plot #
Analog	Middle	451,85625 MHz	100kHz 300kHz 1,5MHz	38,0	6,31	5.3.1.1 #1
Analog	Middle	461,6625 MHz	100kHz 300kHz 1,5MHz	38,0	6,31	5.3.1.2 #1
Maximum output power = 38,0 dBm = 6,31 W						
Limit Maximum output power (ERP) = 500 W						

table 5.3.1-#1 RF Power Out: §90.205, §2.1046 **Test Results Downlink**

The max RF Power out is 38 dBm, so the maximum antenna gain (x) can be calculated as follow:

**Limit = 500W (erp) = 57 dBm**

Info: 500W (erp) = 822W (eirp)

57 dBm > 38 dBm + x

**19 dBd = 21.15 dBi > x**

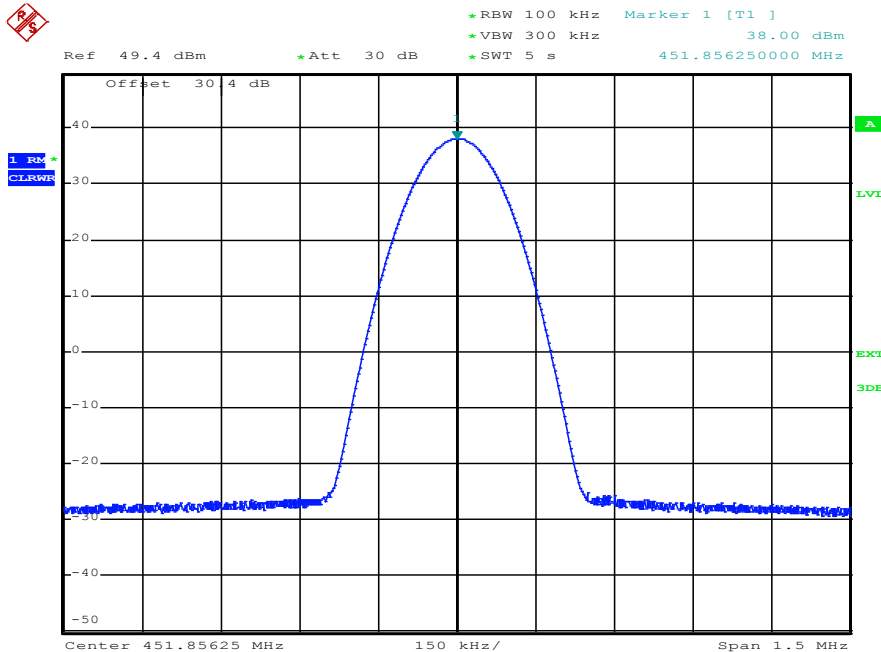
=> The antenna that will use in the complete system have to have a gain lower than 21 dBi, relative to a dipol.

Modulation	Pin / dBm (Ref. point A)
Analog	1,0

table 5.3.1-#2 RF Power Out: §90.205, §2.1046 **Test Results Downlink** Input power



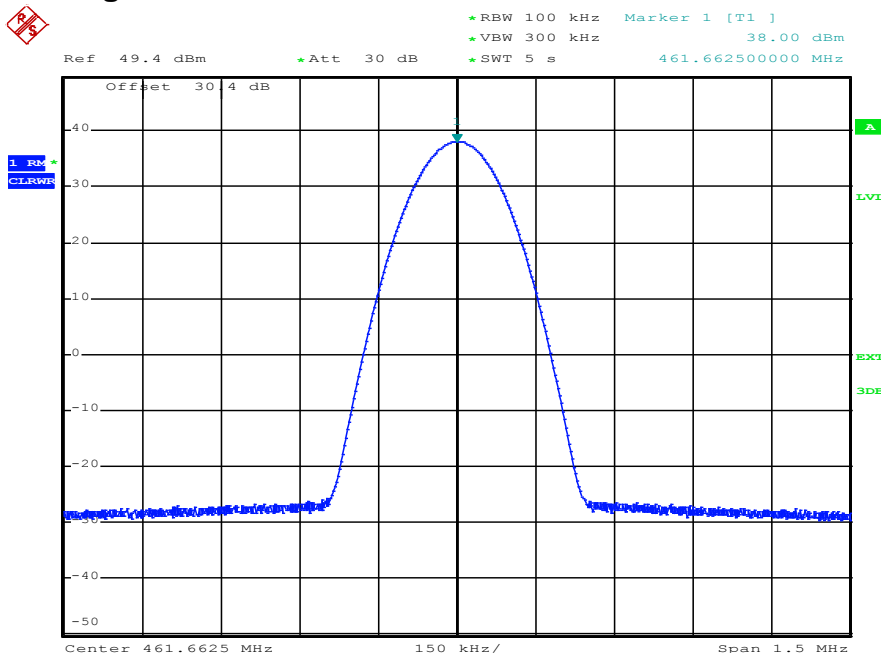
### 5.3.1.1 Analog 451.0625 – 452.6500 MHz



Date: 16.OCT.2012 14:47:59

plot 5.3.1.1-#1 RF Power Out: §90.205, §2.1046; Test Results; Downlink; Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here. Middle

### 5.3.1.2 Analog 461.4500 MHz- 461.8750 MHz



Date: 16.OCT.2012 14:43:30

plot 5.3.1.2-#1 RF Power Out: §90.205, §2.1046; Test Results; Downlink; Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here. 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:	W.Meir
Date:	16.10.2012



## 6 Occupied Bandwidth: §90.210, §2.1049

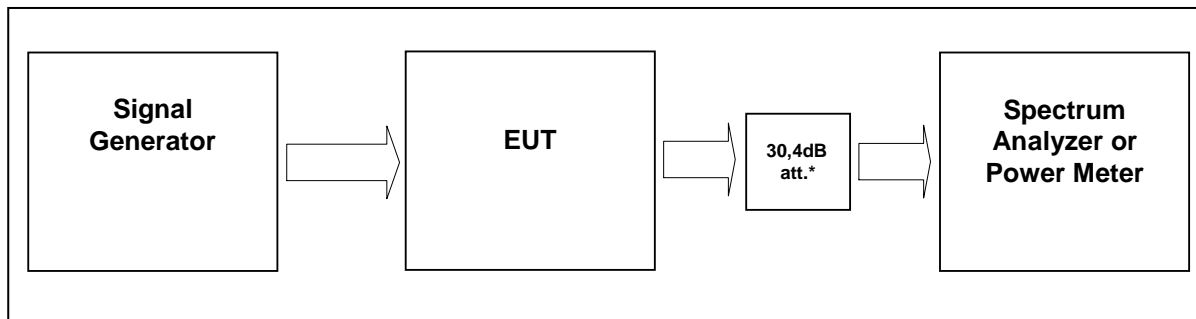


figure 6-#1 Test setup: Occupied Bandwidth: §90.210, §2.1049

Measurement uncertainty	± 0,38 dB
Test equipment used	8741, 8990, 8961, 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

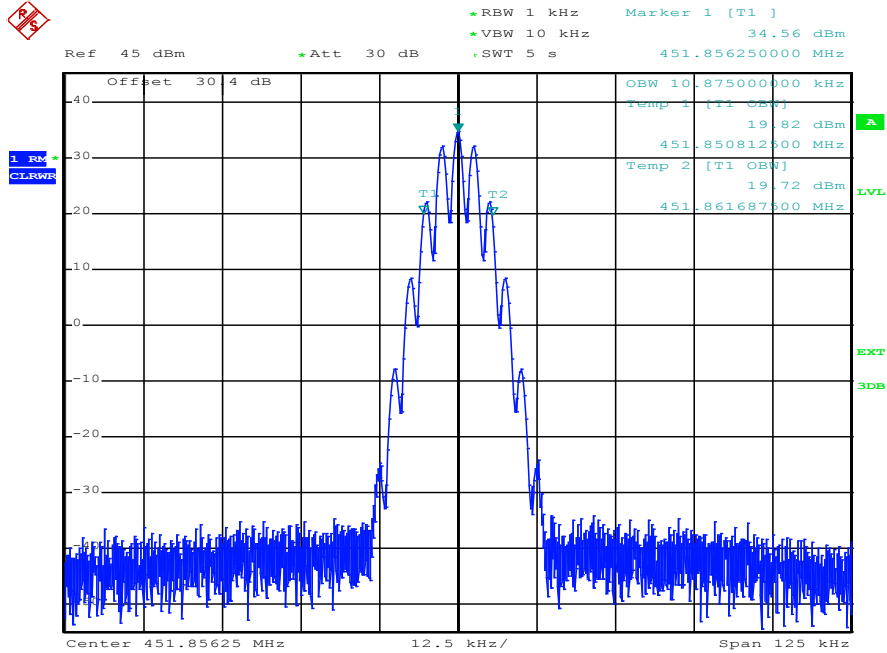
Detector RMS.

Modulation	Measured at		RBW VBW Span	Occupied Bandwidth / kHz	Plot #
Analog	Middle	451.85625 MHz	1 kHz 10 kHz 125 kHz	10.87	6.3.1.1 #1,#2
Analog	Middle	461.6625 MHz	1 kHz 10 kHz 125 kHz	10.87	6.3.1.2 #1,#2

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

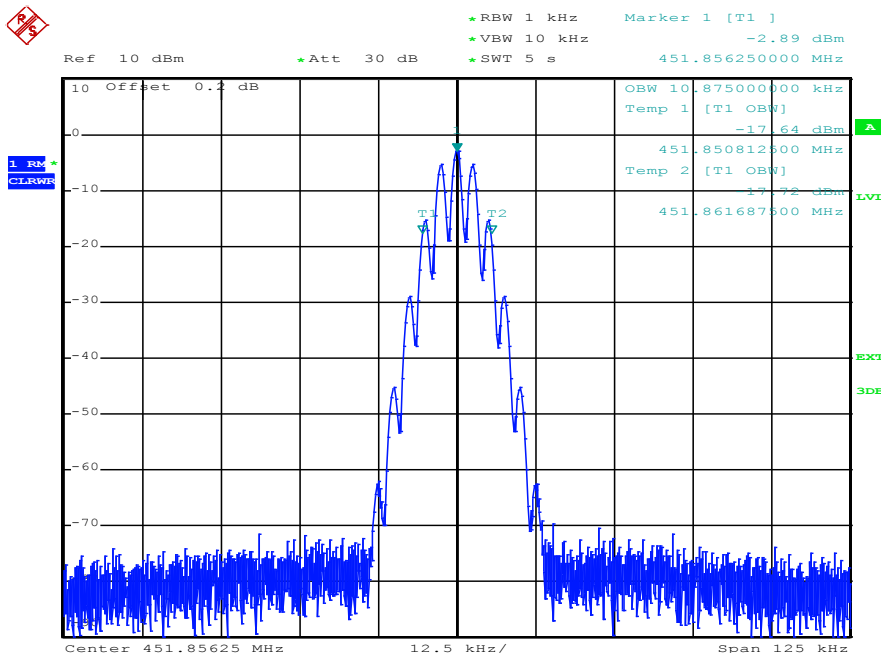


### 6.3.1.1 Analog 451.0625 – 452.6500 MHz



Date: 16.OCT.2012 15:37:38

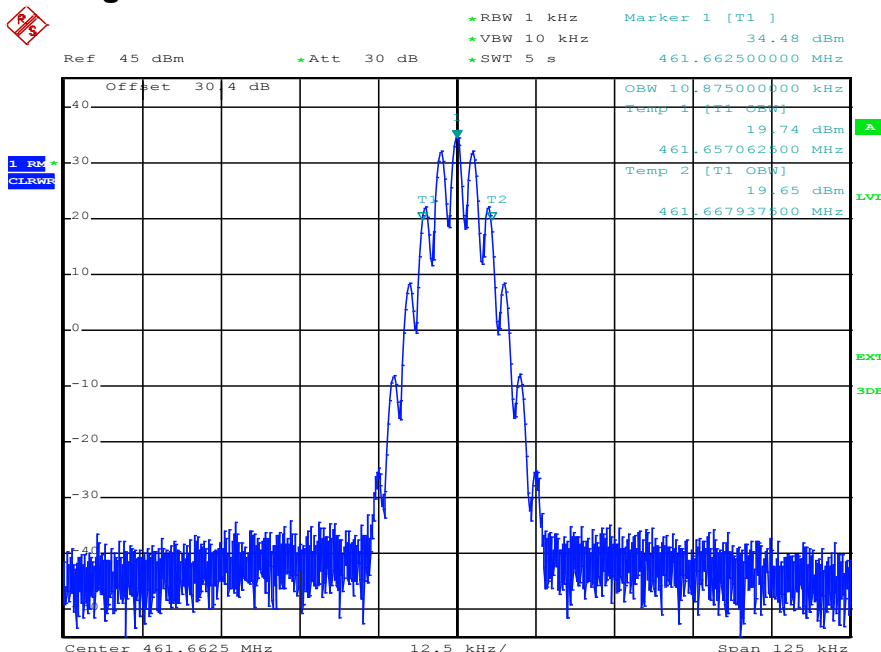
plot Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here.-#1  
Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; Error! Use the Home tab to apply  
Überschrift 4 to the text that you want to appear here. Output



Date: 16.OCT.2012 15:47:55

plot 6.3.1.1-#2 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here. Input

### 6.3.1.2 Analog 461.4500 MHz- 461.8750 MHz



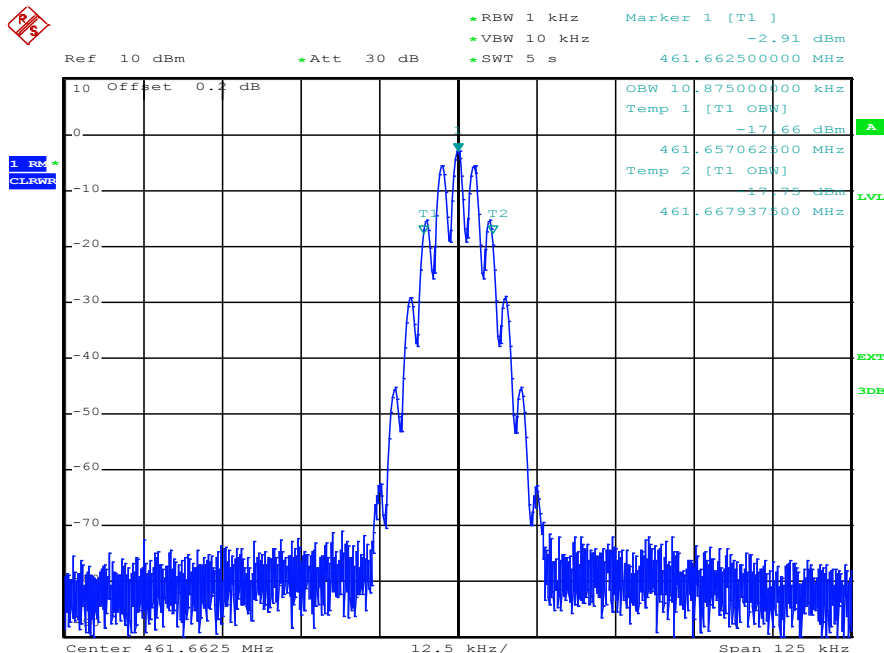
Date: 16.OCT.2012 15:43:42

plot 6.3.1.2-#1 Occupied Bandwidth: §90.210, §2.1049; Test results; Downlink; Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here. Output





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Date: 16.OCT.2012 15:45:29

plot 6.3.1.2-#2 Occupied Bandwidth: \$90.210, \$2.1049; Test results; Downlink;  
Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here. Input

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### 6.3.2 Uplink

n.a.

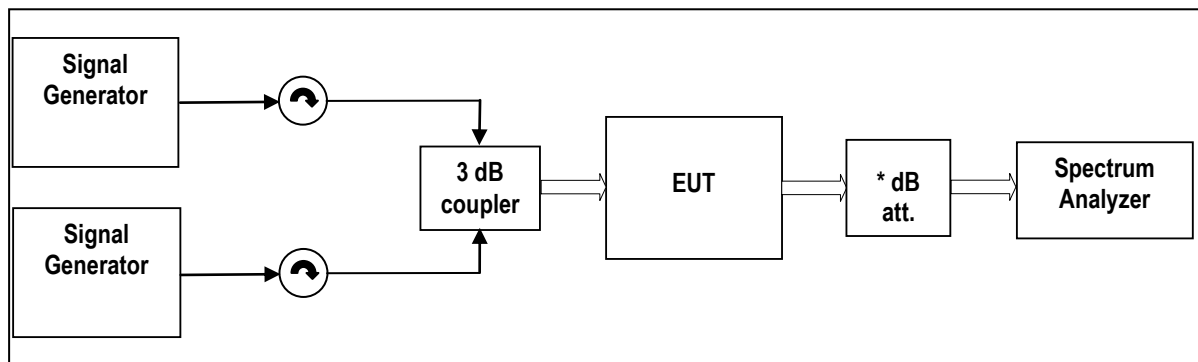
Note: The EUT does not transmit over the air in the uplink direction.

### 6.4 Summary test result

Test result	complies, according the plots above
Tested by:	W.Meir
Date:	16.10.2012



## 7 Spurious Emissions at Antenna Terminals: §90.210, §2.1051



External Attenuator DL x dB = 30,4 dB / 31,5 dB

figure 7-#1 Test setup: Spurious Emissions at Antenna Terminals: §90.210, §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	8741, 8990, 8961, 7406	

### 7.1 Limit

Minimum standard:  
Para. No.90.210

Frequency Band (MHz)	Mask for equipment with Audio Low pass filter	Mask for Equipment without audio low pass filter
421-512 <sup>2</sup>	B, D, or E	C, D or E

<sup>2</sup>Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.

MASK	Spurious Limit
E	-25dBm

### 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	Carrier		RBW VBW Span	Max. level (dBm)	Plot -
Analog	Lower Edge	451,0750 MHz 451.1000 MHz	300Hz 3kHz 2MHz	-29.9	7.3.1.1-#1
	Upper Edge	452.6125 MHz 452.6375 MHz			7.3.1.1-#2
Analog	Lower Edge	461.4625 MHz 461.4875 MHz	300Hz 3kHz 2MHz	-30.2	7.3.1.2-#1
	Upper Edge	461.8375 MHz 461.8625 MHz			7.3.1.2-#2

table 7.3-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051 **Test results** <1MHz from Band

**>1MHz from Band Edge**

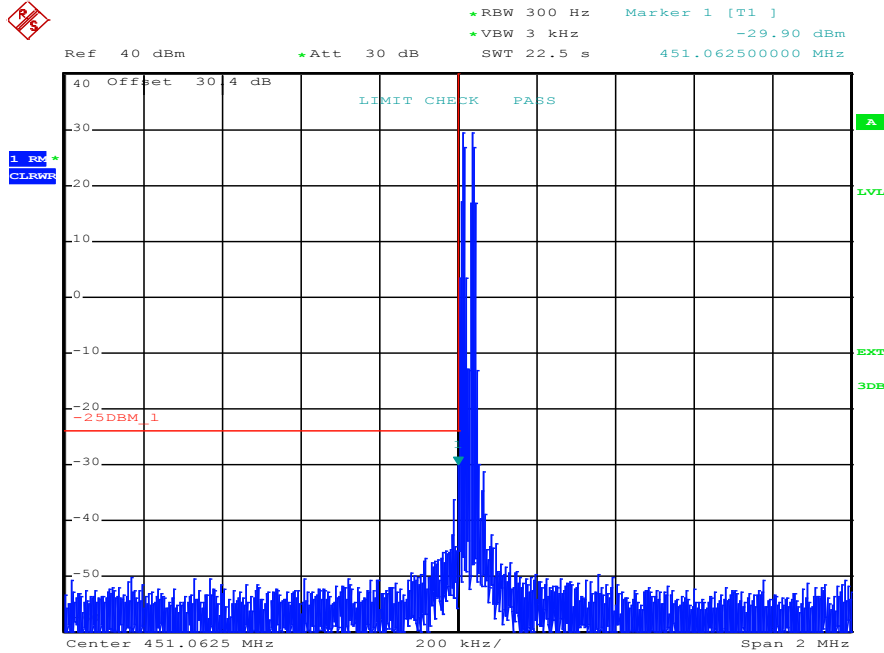
Detector: RMS.

Modulation	Carrier	RBW VBW Span	Max. level (dBm)	Plot -
Analog	451.27500 MHz	1MHz 3MHz 30MHz – 5GHz	<-55	7.3.1.3 #1
Analog	461.6625 MHz	1MHz 3MHz 30MHz – 5GHz	<-55	7.3.1.4 #1

table 7.3-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051 **Test results** >1MHz from Band Edge

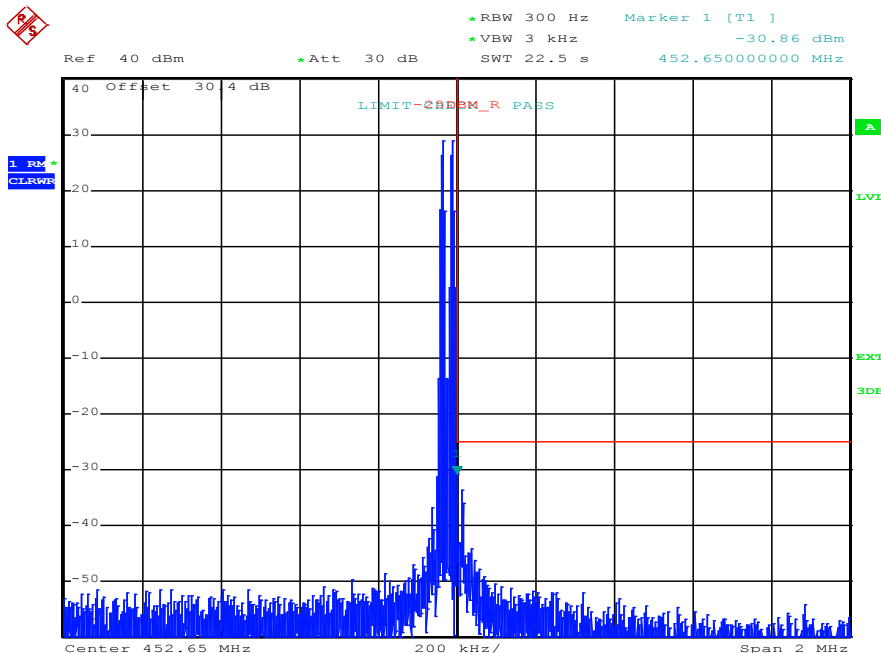


### 7.3.1.1 Analog 451.0625 - 452.6500 MHz < 1MHz to band edge



Date: 17.OCT.2012 11:07:11

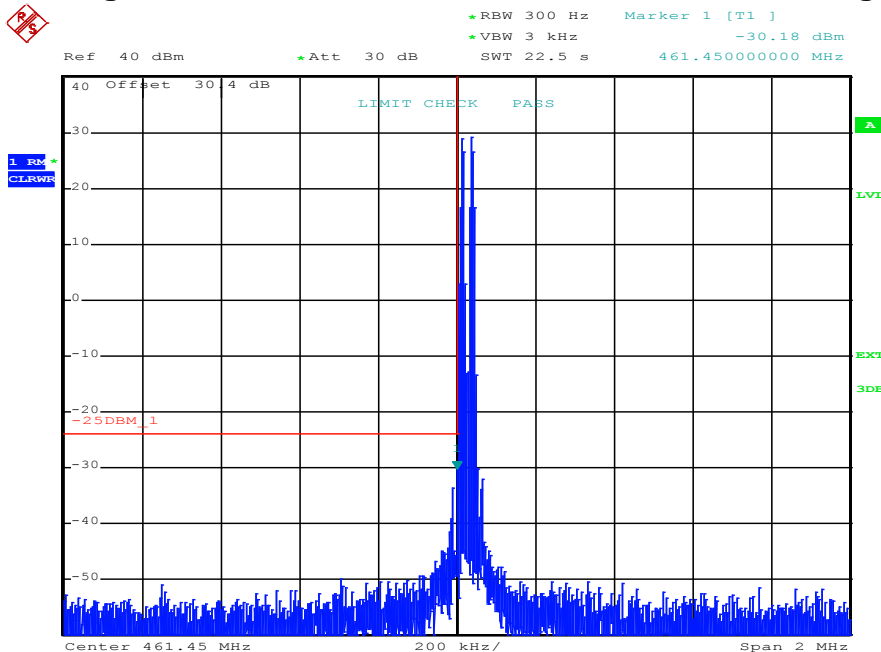
plot 7.3.1.1-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Downlink;  
Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here. Lower  
Band Edge



Date: 17.OCT.2012 11:11:33

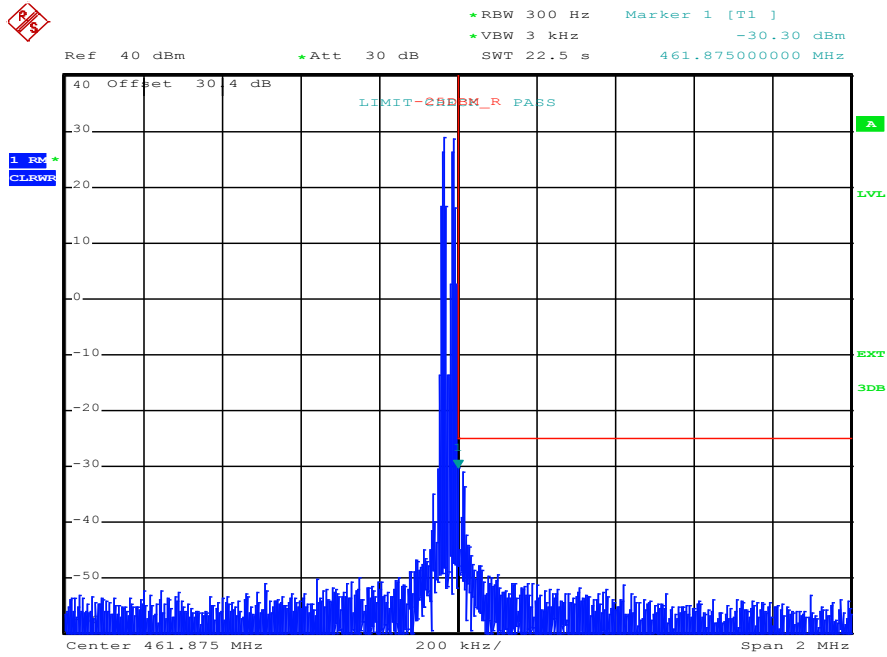
plot 7.3.1.1-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Downlink; Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here. Upper Band Edge

### 7.3.1.2 Analog 461.4500 MHz- 461.8750 MHz < 1MHz to band edge



Date: 17.OCT.2012 11:25:00

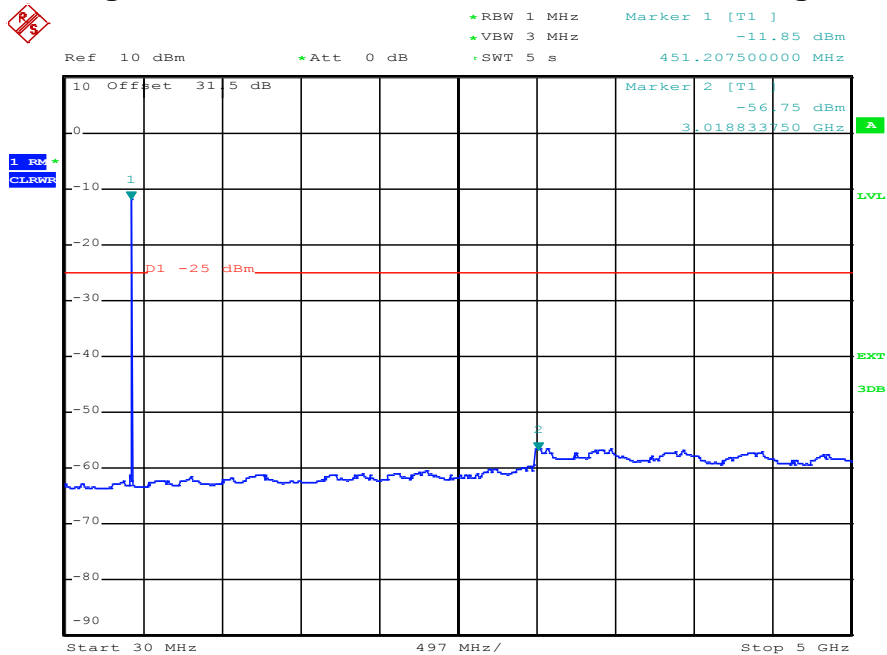
plot 7.3.1.2-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Downlink; Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here. Lower Band Edge



Date: 17.OCT.2012 11:33:12

plot 7.3.1.2-#2 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; Test results; Downlink; Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here. Upper Band Edge

### 7.3.1.3 Analog 451.0625 - 452.6500 MHz > 1MHz to band edge

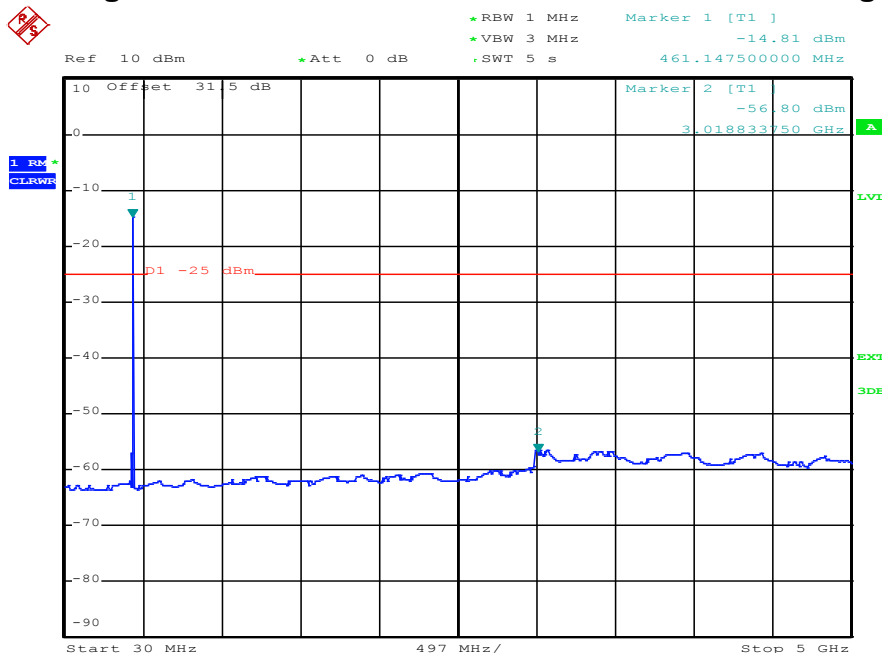


Date: 17.OCT.2012 13:35:56



plot 7.3.1.3-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; **Test results; Downlink;**  
**Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here.;** carrier notched

**7.3.1.4 Analog 461.4500 MHz- 461.8750 MHz > 1MHz to band edge**



Date: 17.OCT.2012 13:39:41

plot 7.3.1.4-#1 Spurious Emissions at Antenna Terminals: §90.210, §2.1051; **Test results; Downlink;**  
**Error! Use the Home tab to apply Überschrift 4 to the text that you want to appear here.;** carrier notched

**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:	W.Meir
Date:	17.10.2012



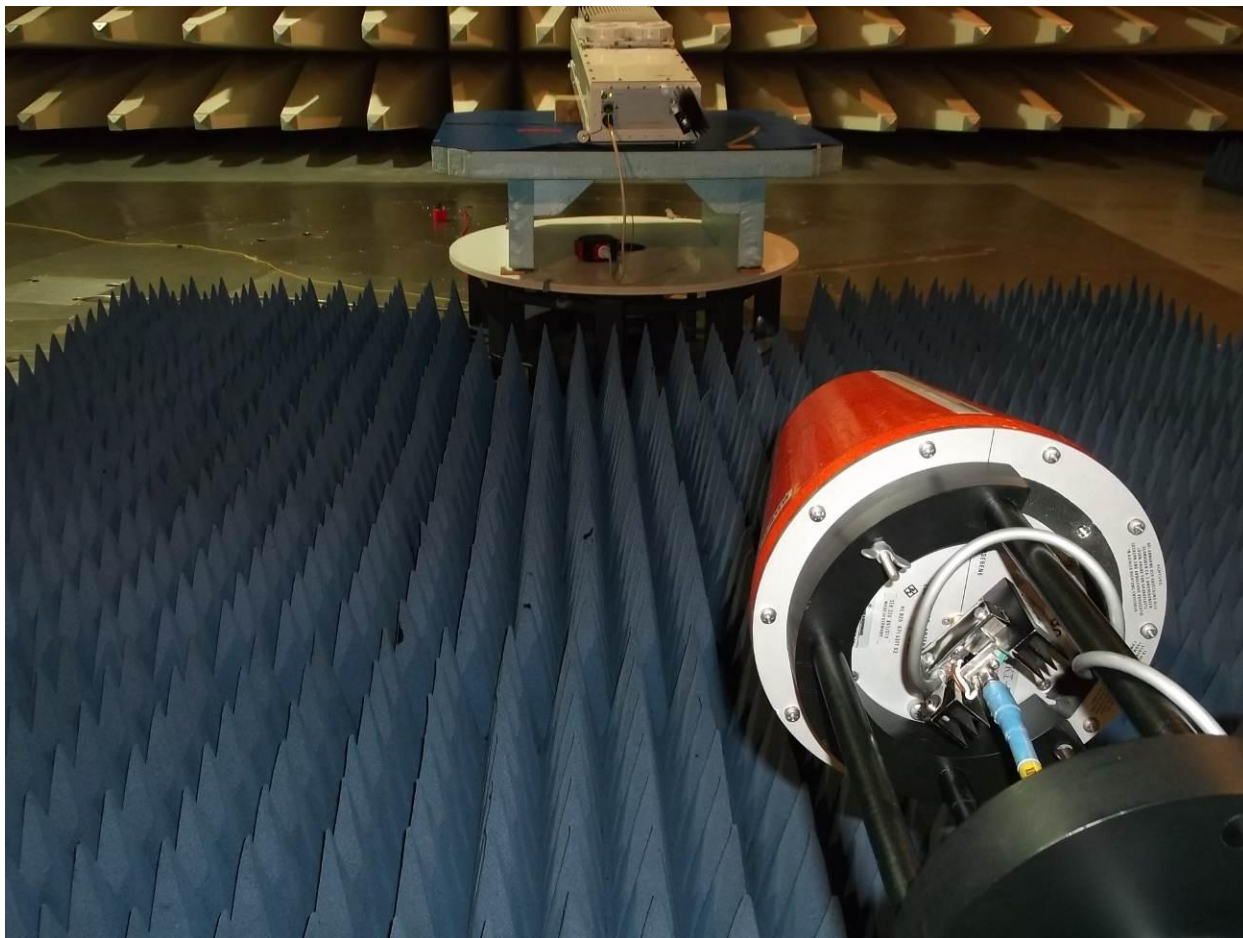
## 8 Radiated Spurious Emissions at the ECL (Bureau Veritas): §90.543, §2.1053



picture 8.1: label



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



**picture 8.6:** Test setup: Field Strength Emission >1 GHz @3m in the FAC

Test Report No.: 12-193

FCC ID: XS5-ML7851719P

IC ID: 2237E-ML7851719P



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This clause specifies requirements for the measurement of radiated emission.

Frequency range	Distance: EUT <-> antenna / location	Limit	Test method
30 MHz - 1 GHz	3 metres / FAC	FCC 47 CFR Part 90.210 IC RSS-131 sec. 4.4	TIA/EIA-603-C:2004
1 GHz – 22 GHz	3 metres / FAC	FCC 47 CFR Part 90.210 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	E1607	02.07.2012	02.07.2013	X
Antenna	CBL 6111	Chase	K1026	29.03.2012	29.03.2013	X
Antenna	HL 025	R&S	K809	19.12.2011	19.12.2012	X
Preamplifier	AFS4-00102000	Miteq	K838	13.10.2012	13.10.2013	X
RF Cable	Sucoflex 100	Suhner	K1742	23.05.2012	23.05.2013	X
RF Cable	RG214	-	K1738	23.05.2012	23.05.2013	X

The REMI version 2.135 has been used for max search.

**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
--	---

## 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 maximum RFI field strength was determined during the measurement by rotating the turntable ( $\pm 180$  degrees) and varying the height of the receive antenna ( $h = 1 \dots 4$  m) 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 with during pre 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.

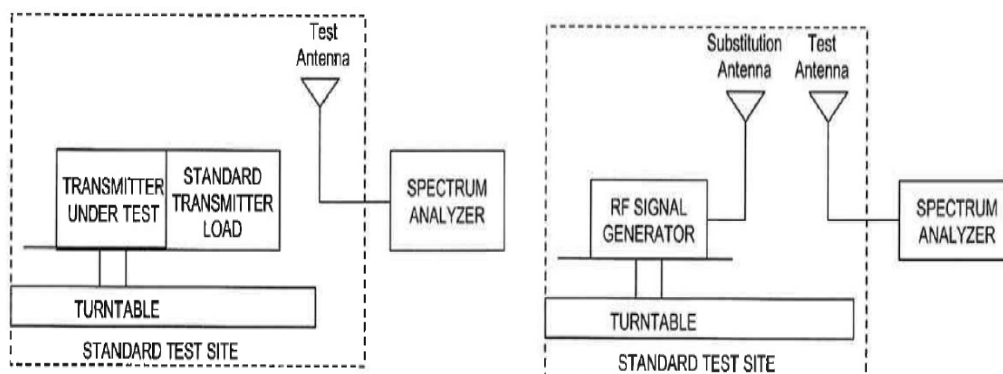


Figure #7.2 Substitution methods TIA/EIA-603-C

The  $P_{out}$  is independent from the frequency and constant by a constant  $P_{in}$ . For that reason the spurious emission are measured in the bandwidth as follow into the authorized bandwidth.

Downlink: 451.85625 MHz / 461.4625 MHz



## 8.2 Limit

### § 2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

[39 FR 5919, Feb. 15, 1974. Redesignated and amended at 63 FR 36599, July 7, 1998]



**§ 90.210 Emission masks.**

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Applicable Emission Masks

Frequency band (MHz)	Mask for equipment with Audio low pass filter	Mask for equipment without audio low pass filter
Below 25 <sup>1</sup>	A or B	A or C
25–50	B	C
72–76	B	C
150–174 <sup>2</sup>	B, D, or E	C, D, or E
150 Paging-only	B	C
220–222	F	F
421–512 <sup>2</sup>	B, D, or E	C, D, or E
450 Paging-only	B	G
806–809/851–854	B	H
809–824/854–869 <sup>3</sup>	B	G
896–901/935–940	I	J
902–928	K	K
929–930	B	G
4940–4990 MHz	L or M	L or M.
5850–5925 <sup>4</sup>		
All other bands	B	C

<sup>1</sup>Equipment using single sideband J3E emission must the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.

<sup>2</sup>Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth Must meet the requirements of Emission Mask E.

<sup>3</sup>Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of §90.691.

<sup>4</sup>DSRCS Roadside Units equipment in the 5850–5925 MHz band is governed under subpart M of this part.



**(e) Emission Mask E—6.25 kHz or less channel bandwidth equipment.** For transmitters designed to operate with a 6.25 kHz or less bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth  $f_0$  to 3.0 kHz removed from  $f_0$ : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least  $30 + 16.67(f_d - 3 \text{ kHz})$  or  $55 + 10 \log(P)$  or 65 dB, whichever is the lesser attenuation.
- (3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least  **$55 + 10 \log(P)$  or 65 dB**, whichever is the **lesser attenuation**.
- (4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two to three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emissions mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (m) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, then an alternate procedure may be used provided prior Commission approval is obtained.

Limits:

a = lesser attenuation /dB

$$a = 55 + 10 \cdot \log(P) = 55 + 10 \log(10^{P[\text{dBm}]/10} / 1000) = 55 + 10 \cdot [\log(10^{P[\text{dBm}]/10}) - \log(1000)] =$$

$$a = 55 + 10 \cdot P[\text{dBm}] / 10 - 10 \cdot 3 = 25 + P[\text{dBm}]$$

=> The less attenuation is the factor  $a_{\text{Downlink}}$

=> **Limit =  $P[\text{dBm}] - (a) = P[\text{dBm}] - (25 + P[\text{dBm}]) = -25\text{dBm}$**

	Downlink
$P_{\text{limit}}$	<b>-25dBm</b>

**8.3 Climatic values in the lab**

Temperature: 19°  
 Relative Humidity: 46%  
 Air-pressure: 998 hPa

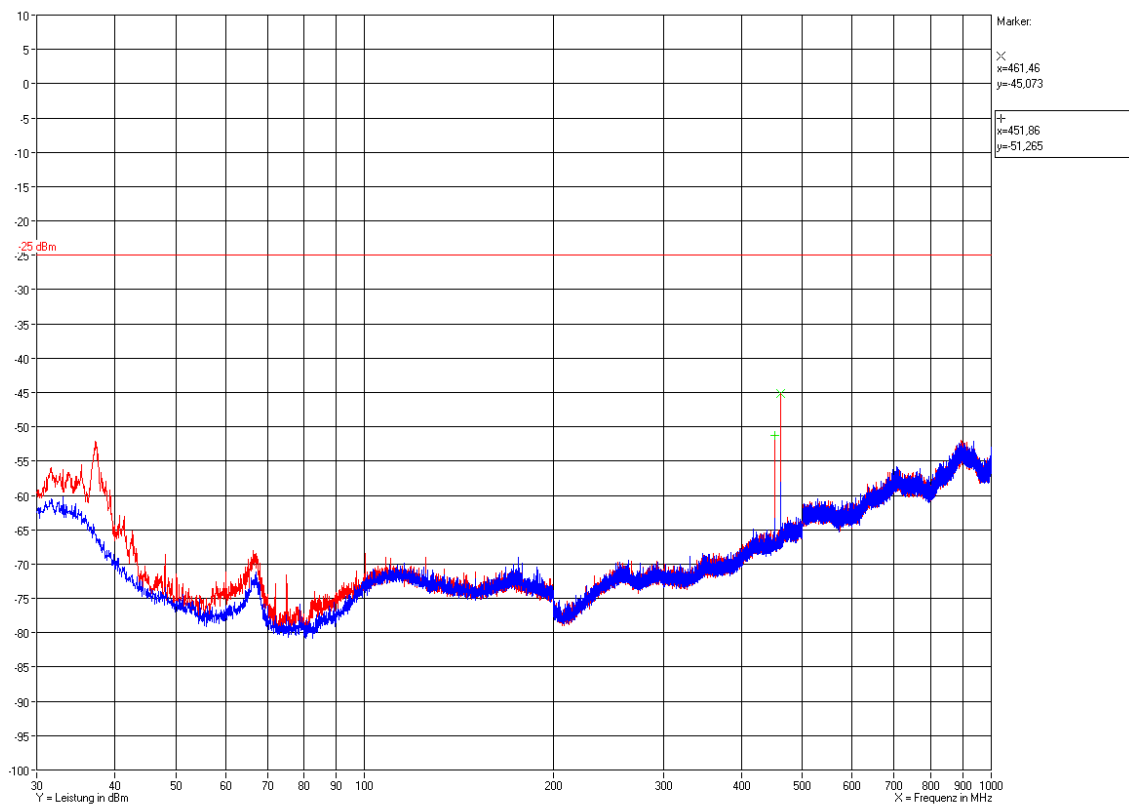


## 8.4 Test results

### 8.4.1 30 MHz to 1 GHz Downlink

Vertikal / Horizontal

The maximum unwanted radiated emission was searched by variation of the turn table from +180 to -180 degree and by moving the height of the antenna from 1m to 3m.



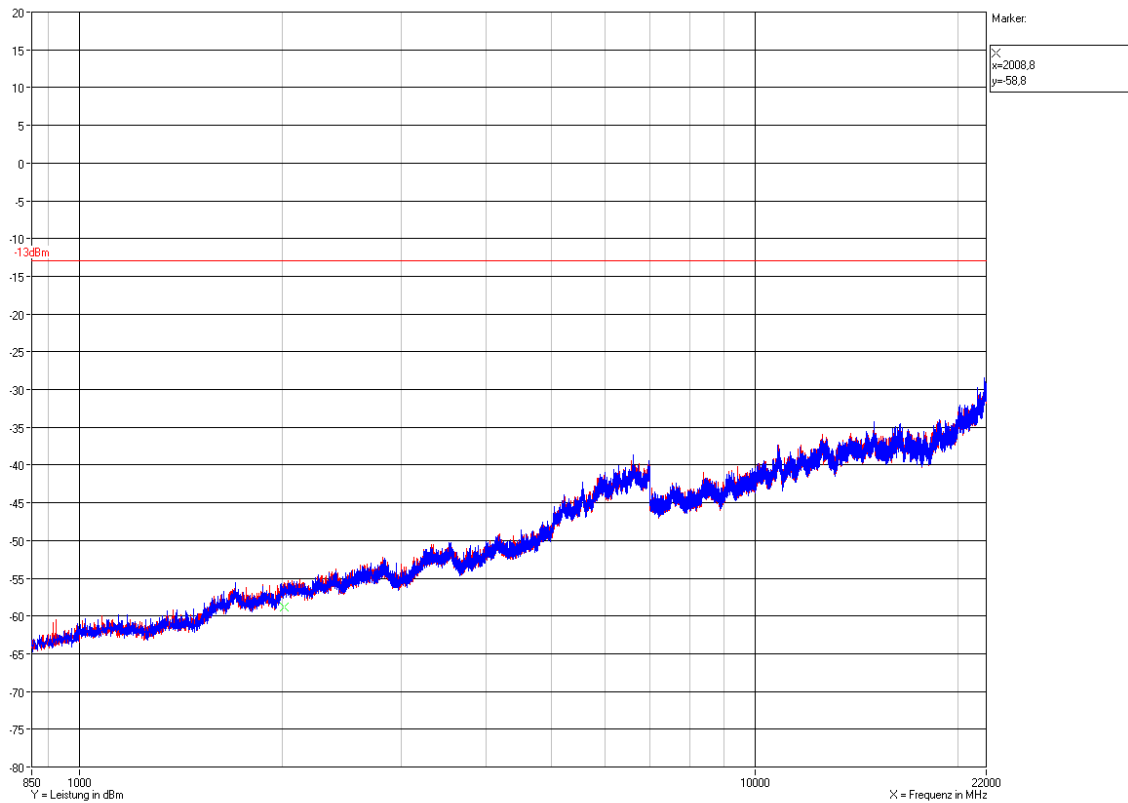




### 8.4.2 Over 1GHz Downlink

Vertikal / Horizontal

The maximum unwanted radiated emission was searched by variation of the turn table from +180 to -180 degree and by moving the height of the antenna from 1m to 3m.



**The radiated spurious emission measurements have been passed!**

Test Report No.: 12-193

FCC ID: XS5-ML7851719P

IC ID: 2237E-ML7851719P



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## 9 History

Revision	Modification	Date	Name
01.00	Initial report	24.10.2012	Zahlmann

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