PHOENIX TESTLAB
Königswinkel 10
32825 Blomberg
Germany
Phone: +49 (0) 52 35 95 00-0
Fax: +49 (0) 52 35 95 00-10

Test Report

Report Number: F120198E2

Applicant:

connectBlue AB

Manufacturer:

connectBlue AB

Equipment under Test (EUT):

OWS451x

Laboratory (CAB) accredited by
Deutsche Gesellschaft für Akkreditierung mbH
in compliance with DIN EN ISO/IEC 17025
under the Reg. No. DGA-PL-105/99-22,
FCC Test site registration number 90877 and
Industry Canada Test site registration IC3469A-1

REFERENCES

[1] **ANSI C63.4-2009** American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

[2] **FCC CFR 47 Part 15 (August 2011)** Radio Frequency Devices

[3] **Publication Number 789033 (September 2012)** D01 General UNII Test Procedures v01r02

[4] **RSS-210 Issue 8 (December 2010)** Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

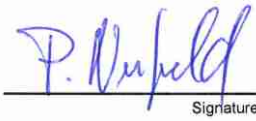
[5] **RSS-Gen Issue 3 (December 2010)** General Requirements and Information for the Certification of Radiocommunication Equipment

[6] **Publication Number 913591 (March 2007)** Measurement of radiated emissions at the edge of the band for a Part 15 RF Device

[7] **Publication Number 662911 (October 2011)** Emission Testing of Transmitters with Multiple Outputs in the Same Band.

TEST RESULT

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test.
The complete test results are presented in the following.

Test engineer:	Paul NEUFELD Name	 Signature	21 January 2013 Date
Authorized reviewer:	Bernd STEINER Name	 Signature	21 January 2013 Date

RESERVATION

This test report is only valid in its original form.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

Contents: Page

1 IDENTIFICATION

1.1 Applicant

Name:	connectBlue AB
Address:	Norra Vallgatan 64 3V Malmö SE-211 19
Country:	Sweden
Name for contact purposes:	Mr. Carl-Magnus STEMNO
Phone:	+ 46 40 630 71 13
Fax:	+ 46 40 23 71 37
eMail Address:	carl-magnus.stemno@connectblue.se
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	connectBlue AB
Address:	Norra Vallgatan 64 3V Malmö SE-211 19
Country:	Sweden
Name for contact purposes:	Mr. Carl-Magnus STEMNO
Phone:	+ 46 40 630 71 13
Fax:	+ 46 40 23 71 37
eMail Address:	carl-magnus.stemno@connectblue.se
Applicant represented during the test by the following person:	-

1.3 Test laboratory

The tests were carried out at: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

accredited by DGA Deutsche Gesellschaft für Akkreditierung mbH in compliance with DIN EN ISO/IEC 17025 under Reg. No. DGA-PL-105/99-22, FCC Test site registration number 90877 and Industry Canada Test site registration IC3469A-1.

1.4 EUT (Equipment Under Test)

Test object: *	WLAN module
Type: *	OWS451x
FCC ID: *	**PVH0941**
IC: *	**5325A-0941**
Serial number: *	02383-01-002043 (Mac-address: 0012F31306C6)
PCB identifier: *	cB-0941-03
Hardware version: *	3.1
Software version: *	2.4_2.1.9_RPS / ows451_pcti_firmware-2.5.0_release.cbz

1.5 Technical data of equipment

Channel 36	RX:	5180 MHz	TX:	5180 MHz
Channel 40	RX:	5200 MHz	TX:	5200 MHz
Channel 44	RX:	5220 MHz	TX:	5220 MHz
Channel 48	RX:	5240 MHz	TX:	5240 MHz
Channel 52	RX:	5260 MHz	TX:	5260 MHz
Channel 56	RX:	5280 MHz	TX:	5280 MHz
Channel 60	RX:	5300 MHz	TX:	5300 MHz
Channel 64	RX:	5300 MHz	TX:	5300 MHz
Channel 100	RX:	5500 MHz	TX:	5500 MHz
Channel 104	RX:	5520 MHz	TX:	5520 MHz
Channel 108	RX:	5540 MHz	TX:	5540 MHz
Channel 112	RX:	5540 MHz	TX:	5540 MHz
Channel 116	RX:	5560 MHz	TX:	5560 MHz
Channel 136	RX:	5680 MHz	TX:	5680 MHz
Channel 140	RX:	5700 MHz	TX:	5700 MHz

Fulfills WLAN specification: *	IEEE, 802.11b, 802.11g, 802.11a, 802.11n (20 MHz)
Antenna type: *	External (refer to table below)
Antenna gain: *	Refer to table below
Antenna connector: *	SMA Reverse (external connector) / UF.L (module on-board connector)
Power supply	3.3 - 5.5 VDC
Type of modulation: *	DSSS/OFDM
Operating frequency range:*	2.412 to 2.462 GHz (11 channels with 5 MHz channel separation) 5.180 to 5.320 GHz (8 channels with 20 MHz channel separation) 5.500 to 5.700 GHz (8 channels with 20 MHz channel separation)
Number of channels: *	11 (2.4 GHz) and 15 (5 GHz)
Temperature range: *	-40 °C to +85 °C
Lowest / highest Internal clock frequency: *	32 KHz / 5825 MHz

* declared by the applicant.

Used antennas:

Antenna name	Manufacturer	Antenna Type	Cable length / connector	Gain [dBi] *
BAT-ANT-N-6G-IP65 (943 981- 002)	Hirschmann	Omnidirectional antenna for 2.4 GHz band	1 m, 3.28 ft with N male connectors at both ends and a Pigtail, R-SMA male to N female / N female	6.0
BAT-ANT-N-6ABG-IP65 (943 981- 004)	Hirschmann	Hemispherical antenna for 2.4 and 5 GHz band	1 m, 3.28 ft with N male connectors at both ends and a Pigtail, R-SMA male to N female / N female	6.0 @ 2.4 GHz, 8.0 @ 5 GHz
BAT-ANT-N-5A- IP65 (943 981- 003)	Hirschmann	Omnidirectional antenna for 5 GHz band	1 m, 3.28 ft with N male connectors at both ends and a Pigtail, R-SMA male to N female / N female	5.0
BAT-ANT-N-3AGN-F (942 047- 001)	Hirschmann	Omnidirectional antenna for 2.4- and 5 GHz-Band	N male	2.5 @ 2.4 GHz 5.0 @ 5 GHz

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
AC/DC Adapter	DC plug	-	2 m *
RS232	RS232 plug	-	2 m *

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	25 September 2012
Start of test:	28 September 2012
End of test:	21 January 2013

2 OPERATIONAL STATES

The tested EUT is the RF-module as identified in clause 1.4, not the entire test board which was used for test purposes. One sample of the RF-module was implemented on the test-board to get it into operation. During operation, antenna port 2 was terminated symmetrically. The signals were only transmitted from antenna port 1, therefore all measurements were performed using this antenna port.

The tests were carried out with an unmodified sample of the EUT. Parts of the tests were carried out conducted by connected directly to the antenna ports. For the radiated tests, the antenna ports were terminated symmetrically by 50 Ω resistors. If tests did not pass during conducted measurements, the measurements were repeated as radiated tests, with the dedicated antennas attached.

The operational states of the EUT were controlled by software. This software was provided by the applicant and installed on a laptop PC, which was connected to the EUT via an RS232 cable. After adjusting the operation mode the Ethernet cable was removed.

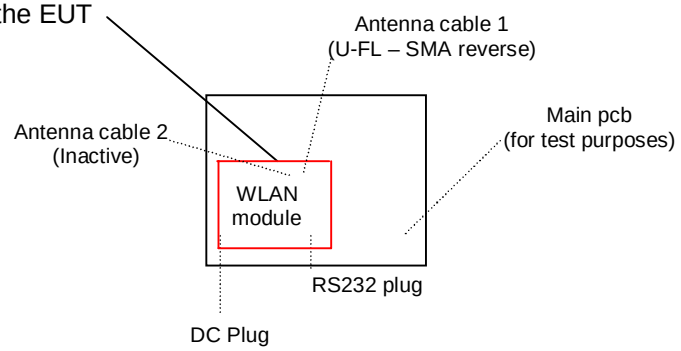
During the tests the test samples were powered with 5V, provided by an external laboratory power supply.

The following operation modes were used during the tests:

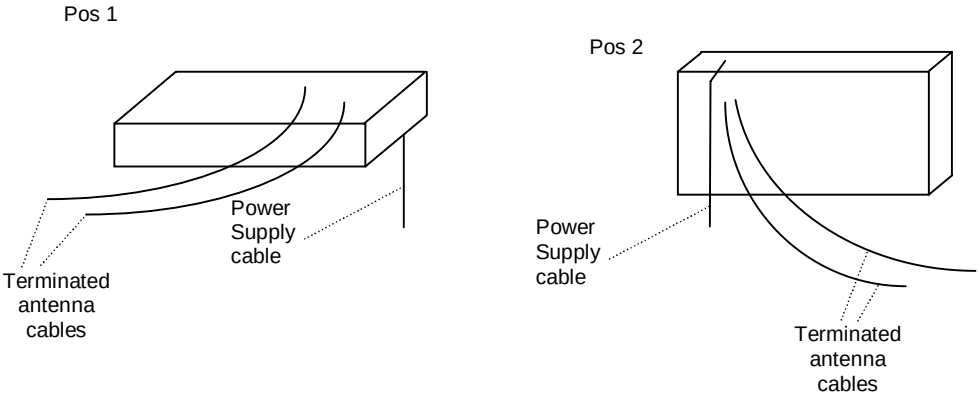
Operation mode	Description of the operation mode	WLAN mode	WLAN channel	Modulation	Data rate / Mbps
1	Continuous transmitting on 5180 MHz	a	36	OFDM	54 MBit/s
2	Continuous transmitting on 5200 MHz	a	40	OFDM	54 MBit/s
3	Continuous transmitting on 5240 MHz	a	48	OFDM	54 MBit/s
4	Continuous transmitting on 5260 MHz	a	52	OFDM	54 MBit/s
5	Continuous transmitting on 5280 MHz	a	56	OFDM	54 MBit/s
6	Continuous transmitting on 5320 MHz	a	64	OFDM	54 MBit/s
7	Continuous transmitting on 5500 MHz	a	100	OFDM	54 MBit/s
8	Continuous transmitting on 5580 MHz	a	116	OFDM	54 MBit/s
9	Continuous transmitting on 5700 MHz	a	140	OFDM	54 MBit/s
10	Continuous transmitting on 5180 MHz	n 20 MHz	36	OFDM	65 Mbit/s
11	Continuous transmitting on 5200 MHz	n 20 MHz	40	OFDM	65 Mbit/s
12	Continuous transmitting on 5240 MHz	n 20 MHz	48	OFDM	65 Mbit/s
13	Continuous transmitting on 5260 MHz	n 20 MHz	52	OFDM	65 Mbit/s
14	Continuous transmitting on 5280 MHz	n 20 MHz	56	OFDM	65 Mbit/s
15	Continuous transmitting on 5320 MHz	n 20 MHz	64	OFDM	65 Mbit/s
16	Continuous transmitting on 5500 MHz	n 20 MHz	100	OFDM	65 Mbit/s
17	Continuous transmitting on 5580 MHz	n 20 MHz	116	OFDM	65 Mbit/s
18	Continuous transmitting on 5700 MHz	n 20 MHz	140	OFDM	65 Mbit/s

Remark: the module does not support n 40 MHz mode

Physical boundary of the EUT



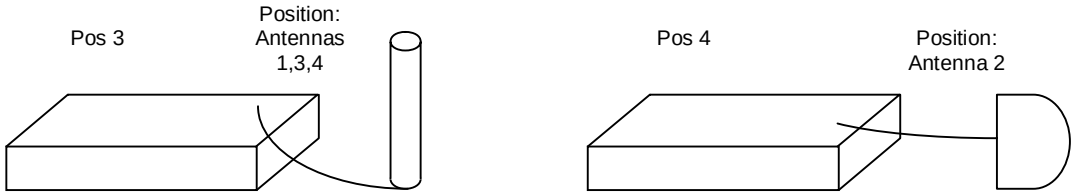
For the radiated cabinet emission tests, the worst case positioning of the EUT was investigated through measurements. The device has two possible operating positions:



Position 1: Device lying horizontally
Position 2: Device mounted vertically

Preliminary tests were performed in the two positions, to find worst-case configuration and position. The radiated emission measurements were carried out in the orthogonal direction that emits the highest spurious emission levels. This was found to be Position 2.

Because some conducted Band-Edge-compliance tests failed, they were repeated as radiated measurements. The following antenna positions were found to emit the highest field strength levels:



Position Antennas 1,2,4: Antenna standing vertically
Position Antenna 3: Antenna beam facing horizontally

The following test modes were adjusted during the tests:

Test items	Operation mode
Band edge compliance	1 - 12
Radiated emissions (transmitter)	1 - 12

3 ADDITIONAL INFORMATION

The goal of this report is to add the antennas (see clause 1.5) to the existing filing.

The applied powers settings are set by the specific test software and declared within the tune-up info.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS 210, Issue 8 [4] or RSS-Gen, Issue 3 [5]	Status	Refer page
Band edge compliance	5150 – 5250, 5250 – 5350, 5470 – 5725,	15.407 (b)	A8.5 [4]	Passed	12 et seq.
Conducted Output Power Verification	5150 – 5250, 5250 – 5350, 5470 – 5725,	15.407 (b)	A8.5 [4]	Passed	-
Radiated emissions (transmitter)	1000 - 40,000	15.205 (a) 15.209 (a)	7.2.2 [5], 2.5 [4]	Passed	18 et seq.

5 TEST RESULTS

5.1 Maximum peak output power

5.1.1 Method of measurement (maximum peak output power)

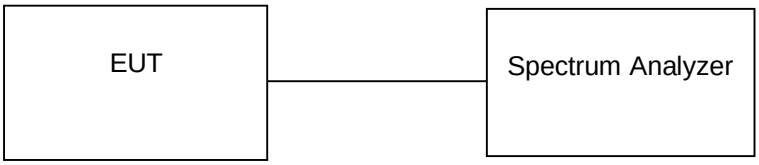
The measurement procedure to method 1 in part 6.10.3.1 in the ANSII C63 document.

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable.

Acceptable measurement configuration

1. Set the span to encompass the entire EBW of the Signal.
2. Set RBW = 1 MHz
3. Set VBW ≥ 3 MHz
4. Use sample detector mode if bin width (i.e. span/number of points in spectrum display) < 0.5 RBW. Otherwise use peak detector mode.
5. If the device transmits continuously no trigger has to be used and the trigger may be set on “free run”.
   Otherwise a trigger has to be used to trigger only on full power pulses. Unlicensed wireless devices must operate at full control power for entire sweep of every sweep.
   Power gated sweep may be used to ensure the analyser sweeps only while the device is transmitting.
6. Trace average across 100 traces in power averaging mode.
7. Compute power by integrating the spectrum across the 26 dB EBW of the signal. The integration can be performed using the spectrum analyser band-power measurement function with band limits set equal to EBW band edges or by summing power levels in each 1 MHz band in linear power terms. The 1 MHz power levels to be summed can be obtained by averaging, in linear power terms, power levels in each frequency bin across the 1 MHz.

Test set-up:



5.1.2 Test results (maximum peak output power)

Ambient temperature	21 °C

Relative humidity	40 %

Operation Mode	Channel frequency [MHz]	WLAN Mode	Max. Ant Gain [dBi]	Maximum peak output power [dBm]	Margin [dB]	Peak power limit [dBm]
1	5180	a	8	7.5	6.5	14
2	5200	a	8	7.9	6.1	14
3	5240	a	8	7.5	6.5	14
4	5260	a	8	8.0	14	22
5	5280	a	8	8.4	13.6	22
6	5320	a	8	7.1	14.9	22
7	5500	a	8	7.1	14.9	22
8	5580	a	8	7.3	14.7	22
9	5700	a	8	6.3	15.7	22
10	5180	n 20 MHz	8	7.6	6.4	14
11	5200	n 20 MHz	8	8.0	6.0	14
12	5240	n 20 MHz	8	7.6	6.4	14
13	5260	n 20 MHz	8	8.2	13.8	22
14	5280	n 20 MHz	8	8.5	13.5	22
15	5320	n 20 MHz	8	7.4	14.6	22
16	5500	n 20 MHz	8	7.4	14.6	22
17	5580	n 20 MHz	8	7.5	14.5	22
18	5700	n 20 MHz	8	6.6	15.4	22
Measurement uncertainty				+0.66 dB / -0.72 dB		

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

60; 61

5.2 Band-edge compliance

5.2.1 Method of measurement (band edges next to restricted bands (conducted))

The same test set-up as used for the final conducted emission measurement shall be used (refer also subclause 5.3.1 of this test report).

The preliminary measurements are performed using the following settings:

1. Span: Wide enough to capture the peak level of the emission on the channel closest to the band-edge, as well as any modulation products, which fall outside the authorized band of operation.
2. Resolution bandwidth: = 100 kHz
3. Video bandwidth: = 300 kHz
4. Sweep: Auto.
5. Detector function: Peak.
6. Trace mode: Max hold.

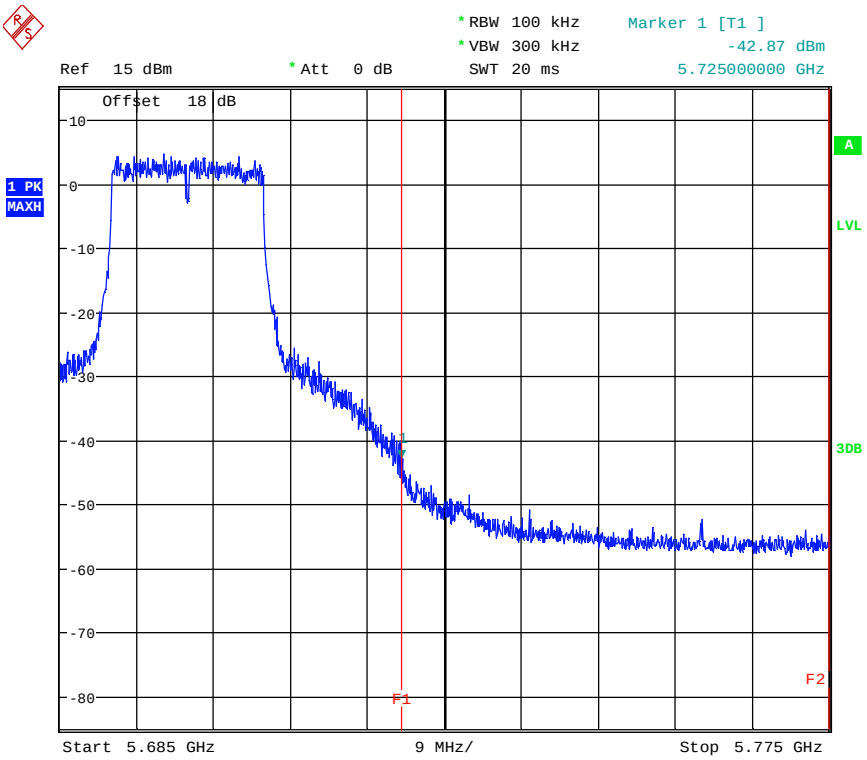
The final measurements of the detected frequencies in the in the preliminary measurement, are performed using the procedures G5 and G6 in [3]. See sub clause 5.3.1 for the separate measurement steps.

5.2.2 Test result (band edges next to restricted bands (conducted))

Ambient temperature	21 °C	Relative humidity	55 %

The plot shows an exemplary measurement result for the worst documented case. The other results are listed in the following table.

120198_UNII_BandEdge_n20_3up.wmf: Radiated band-edge compliance (operation mode 6):



Band-edge-compliance, a-mode							
WLAN channel	Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
36	5147	-21.3	-41.3	-32.7	-47.7	11.4	6.3
48	5400	-21.3	-41.3	-38.9	-48.9	17.6	7.6
52	5100	-21.3	-41.3	-40.4	-48.9	19.1	7.6
100	5469	-21.3	-41.3	-32.3	-50.3	11.0	9.0
140	5726	-21.3	-41.3	-31.6	-49.0	10.3	7.7

Band-edge-compliance, n-mode (20 MHz)							
WLAN channel	Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
36	5150	-21.3	-41.3	-31.8	-46.1	10.5	4.8
48	5400	-21.3	-41.3	-38.9	-48.9	17.6	7.6
52	5100	-21.3	-41.3	-40.4	-48.9	19.1	7.6
100	5467	-21.3	-41.3	-34.7	-49.7	13.4	8.4
140	5725	-21.3	-41.3	-26.9	-45.3	5.6	4.0

TEST EQUIPMENT USED FOR THE TEST:
30, 80, 81

5.2.3 Method of measurement (band edges next to restricted bands (radiated))

The same test set-up as used for the final radiated emission measurement shall be used (refer also subclause 5.3.3 of this test report).

The preliminary measurements are performed using the following settings:

- Span: Wide enough to capture the peak level of the emission on the channel closest to the band-edge, as well as any modulation products, which fall outside the authorized band of operation.
- Resolution bandwidth: = 100 kHz
- Video bandwidth: = 300 kHz
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

After trace stabilization the marker shall be set on the signal peak. The frequency line shall be set on the edge of the assigned frequency band. Now set the second marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is higher than that at the band-edge. This frequency shall be measured with the EMI receiver as described in subclause 5.3.3 of this test report. The level of the measured field strength shall be compared to the general limits specified in § 15.205.

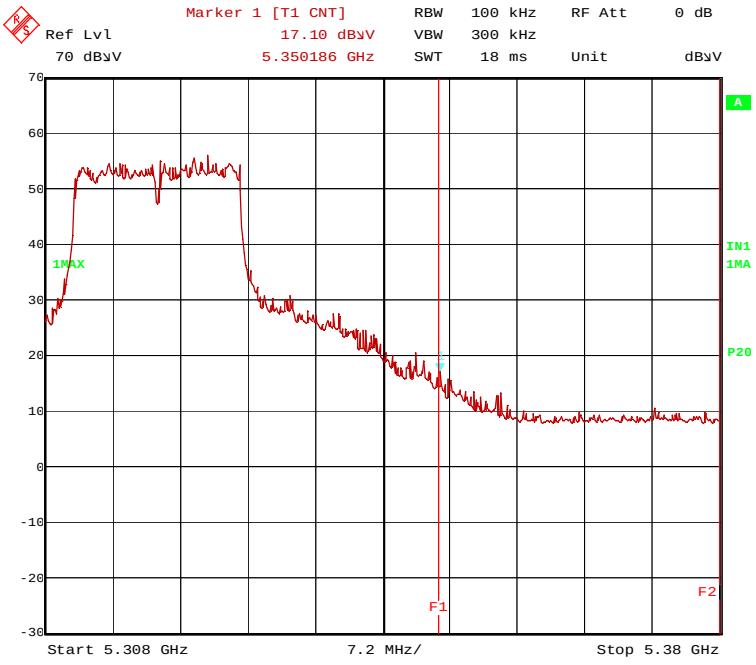
The measurement was performed at the upper end of the 5.25 – 5.35 GHz UNII-band.

5.2.4 Test result (band edges next to restricted bands (radiated))

Ambient temperature	21 °C	Relative humidity	55 %

The plot shows an exemplary measurement result for the worst documented case. The other results are listed in the following table.

0198_420.wmf: Radiated band-edge compliance (operation mode 15):



Band-edge compliance (upper band edge, Mode 6, Ant. 2)											
Result measured with the peak detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5351	66.2	74.0	7.8	26.8	33.7	0.0	5.7	150	Hor.	Yes	4
Result measured with the average detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5351	48.9	54.0	5.1	9.5	33.7	0.0	5.7	150	Hor.	Yes	4
Measurement uncertainty							+2.2 dB / -3.6 dB				

Band-edge compliance (upper band edge, Mode 6, Ant. 3)											
Result measured with the peak detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5120	47.6	74.0	26.4	34.1	33.5	25.6	5.6	150	Vert.	Yes	3
Result measured with the average detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5351	48.8	54.0	5.2	9.4	33.7	0.0	5.7	150	Vert.	Yes	3
Measurement uncertainty							+2.2 dB / -3.6 dB				

Band-edge compliance (upper band edge, Mode 6, Ant. 4)											
Result measured with the peak detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5351	65.0	74.0	9.0	25.6	33.7	0.0	5.7	150	Hor.	Yes	3
Result measured with the average detector:											
Frequency GHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5351	47.4	54.0	6.6	8.0	33.7	0.0	5.7	150	Hor.	Yes	3
Measurement uncertainty							+2.2 dB / -3.6 dB				

Band-edge compliance (upper band edge, Mode 15, Ant. 2)											
Result measured with the peak detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5351	69.9	74.0	4.1	30.5	33.7	0.0	5.7	150	Hor.	Yes	4
Result measured with the average detector:											
Frequency GHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5351	51.5	54.0	2.5	12.1	33.7	0.0	5.7	150	Hor.	Yes	4
Measurement uncertainty							+2.2 dB / -3.6 dB				

Band-edge compliance (upper band edge, Mode 15, Ant. 3)											
Result measured with the peak detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5351	67.4	74.0	6.6	28.0	33.7	0.0	5.7	150	Hor.	Yes	3
Result measured with the average detector:											
Frequency GHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5351	50.8	54.0	3.2	11.4	33.7	0.0	5.7	150	Hor.	Yes	3
Measurement uncertainty							+2.2 dB / -3.6 dB				

Band-edge compliance (upper band edge, Mode 15, Ant. 4)											
Result measured with the peak detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5351	66.1	74.0	7.9	26.7	33.7	0.0	5.7	150	Hor.	Yes	3
Result measured with the average detector:											
Frequency GHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5351	49.5	54.0	4.5	10.1	33.7	0.0	5.7	150	Hor.	Yes	3
Measurement uncertainty							+2.2 dB / -3.6 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 34, 36, 40, 41

5.3 Maximum unwanted emissions

5.3.1 Method of measurement (conducted emissions)

The relating measurements were carried out in a conducting manner. Therefore, the antenna connector was directly mounted to a spectrum analyser. The measurement procedure refers to part G)5) and G)6) in [3].

G)2)c)i) in [3] states that emissions above 1 GHz that are outside the restricted bands are subject to a peak emission limit of -27 dBm/MHz. The peak limit in the restricted bands is less strict (-21.3 dBm). Therefore satisfy the restricted-band emission limits is not always sufficient to be compliant to the limits in the unrestricted bands. To simplify the measurements, all results are compared to the concerning stricter limits (-27 dBm → peak limit, -41.3 → average limit).

If emissions were detected during the preliminary measurements, they were measured using the following measurement procedures:

Procedure for average measurement: G)6) – Procedures for Average Unwanted Emissions Measurements above 1000 MHz.:

1. RBW = 1 MHz.
2. VBW ≥ 3 MHz.
3. Detector = RMS, if span/(# of points in sweep) ≤ RBW/2.
4. Averaging type = power (i.e., RMS)
    - As an alternative, the detector and averaging type may be set for linear voltage averaging. Some analyzers require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
5. Sweep time = auto.
6. Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, the number of traces shall be increased by a factor of 1/x, where x is the duty cycle. For example, with 50 percent duty cycle, at least 200 traces should be averaged.
7. No correction factor has to be applies, because the duty cycle was greater than 98%.

Procedure for peak measurement: G)5) – Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz

1. RBW = 1 MHz.
2. VBW ≥ 3 MHz.
3. Detector = Peak.
4. Sweep time = auto.
5. Trace mode = max hold.
6. Allow sweeps to continue until the trace stabilizes.

5.3.1.1 Limit calculations

Chapter G)1)d) in [3] provides the following formula for converting EIRP to equivalent electric field strength:

$$E. = EIRP - 20\log(d) + 104.8 \qquad (1)$$

Where:

E. = electric field strength, in dBµV/m
EIRP = equivalent isotropic radiated power, in dBm
d = specified measurement distance, in meters

With the aid of this formula and the appropriate parts of [2], the EIRP limits in Table 1 were calculated.

Table 1EIRP Limit calculations from Radiated Limits

Frequency MHz	Field strength µV/m	Meas Distance m	RBW	EIRP Limit dBm
0.009 – 0.490	2400/F (kHz)	300	200 – 300 Hz	6.3 – 20logF (kHz)
0.490 – 1.705	24000/F (kHz)	30	200 – 300 Hz	6.3 – 20logF (kHz)
1.705 - 30	30	30	9 – 10 kHz	-51.7
30 – 88	100	3	100 kHz	-60
88 – 216	150	3	100 kHz	-56.4
216 - 960	200	3	100 kHz	-54
960 - 1000	500	3	100 kHz	-46
≥ 1000	500	3	1 MHz	-41.3

Document [7] states, that for transmitters with multiple outputs in the same band, summing of emissions and accounting for array gain have to be considered.

For combining emissions from multiple outputs, the spurious emissions at each output have to be measured and 10log(N) has to be added to the resulting value, whereby N refers to the number of outputs.

To account for directional gain which might occur in case of N transmit antennas, the directional has to be calculated as

$$G_{Dir} = G_{Ant} + 10\log(N)dBi\,,$$

whereby N is the number of antennas.

For the actual EUT with one antenna port and a maximum antenna gain value of **8 dBi**, a value of **8 dB** was added to the measured spectrum as an additional offset. The other 10 dB were added to correct a 10 dB attenuator at the RF port of the spectrum analyser.

5.3.2 Test results (conducted emissions)

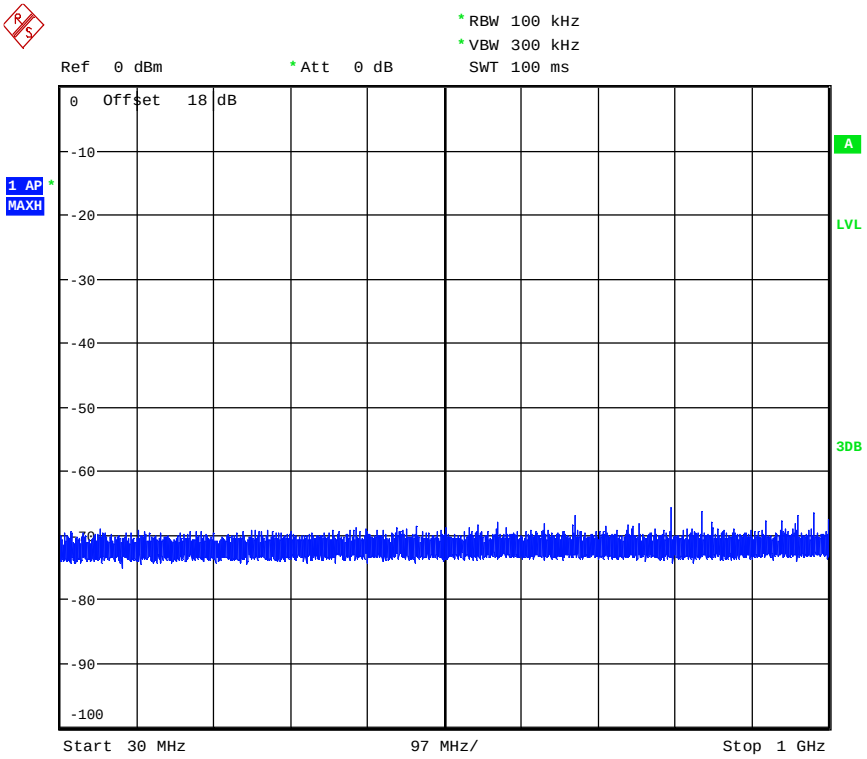
Ambient temperature	21 °C	Relative humidity	46 %

The measurements were only performed for frequencies above 30 MHz, because the device was already tested according to 15.109.

Measurements from 30 MHz – 1 GHz

No differences occurred between the different operations modes in the frequency band from 30 MHz to 1 GHz. Therefore only one operation mode is submitted below.

120198_SpurEm30M-1G_g_up.wmf: conducted spurious emissions (operation mode 6):



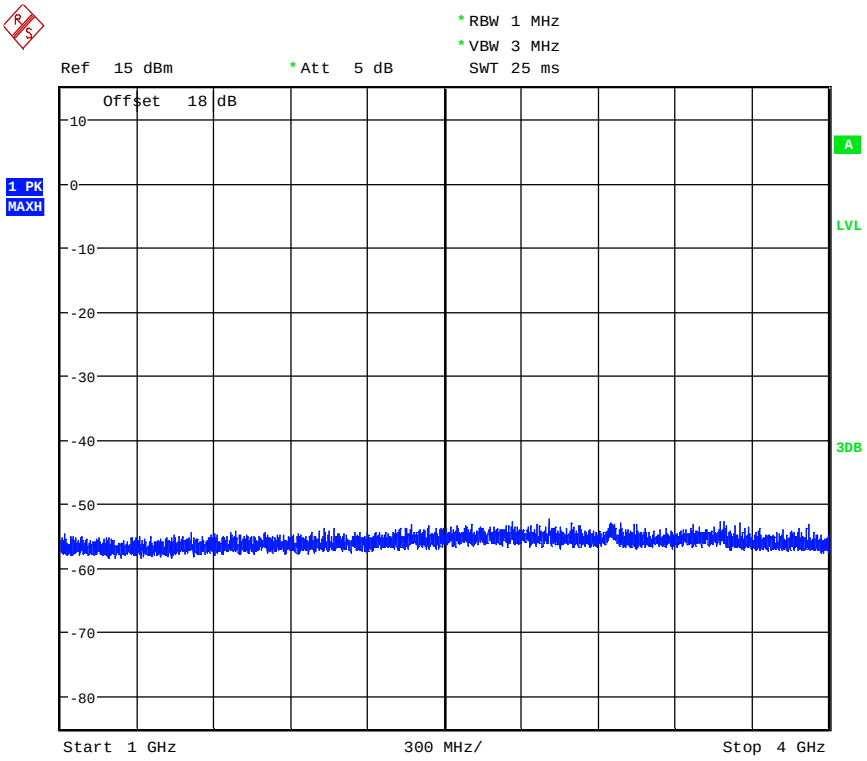
The following frequencies were found in the regarded frequency band. The results of the measurement are listed in the table below. (G)4)b) in [3] states that comparing to max peak is permitted).

Spurious Emissions, g-mode, channel 11 (Operation mode 6)			
Unwanted Emission Frequency MHz	CISPR Q Peak Limit dBm	Max Peak Emission dBm	Peak Margin dB
640	-54	-66.7	12.7
680	-54	-66.6	12.6
760	-54	-65.9	11.9
800	-54	-68.0	11.0
840	-54	-66.4	12.4
960	-46	-66.0	20.0

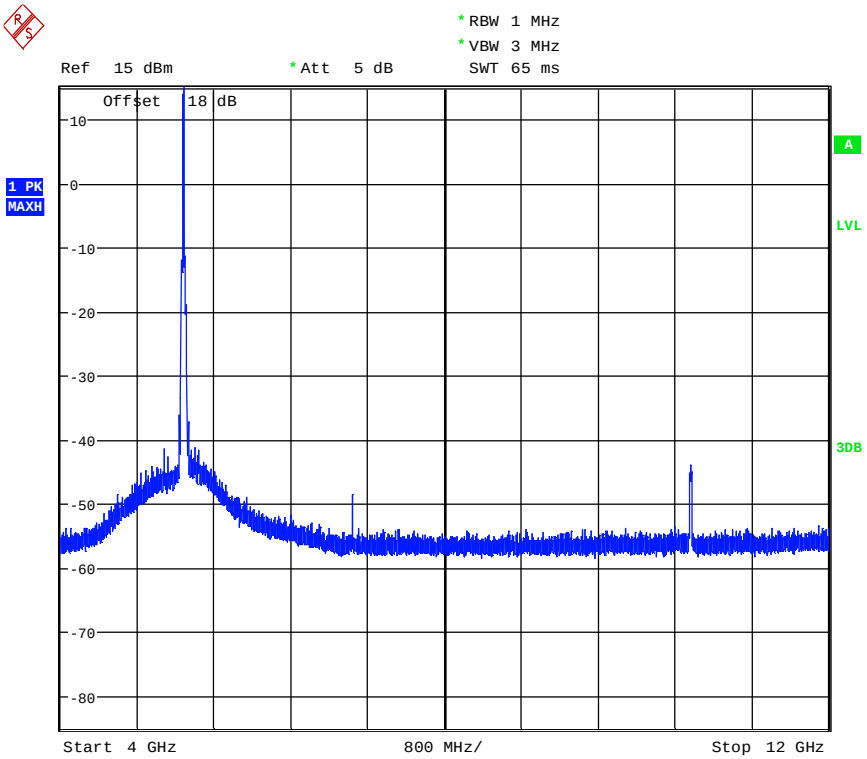
Measurments from 1 GHz – 40 GHz

The following results were measured at the antenna port of the EUT. The plots show exemplary measurement results for the worst documented case. The other results are listed in the following tables.

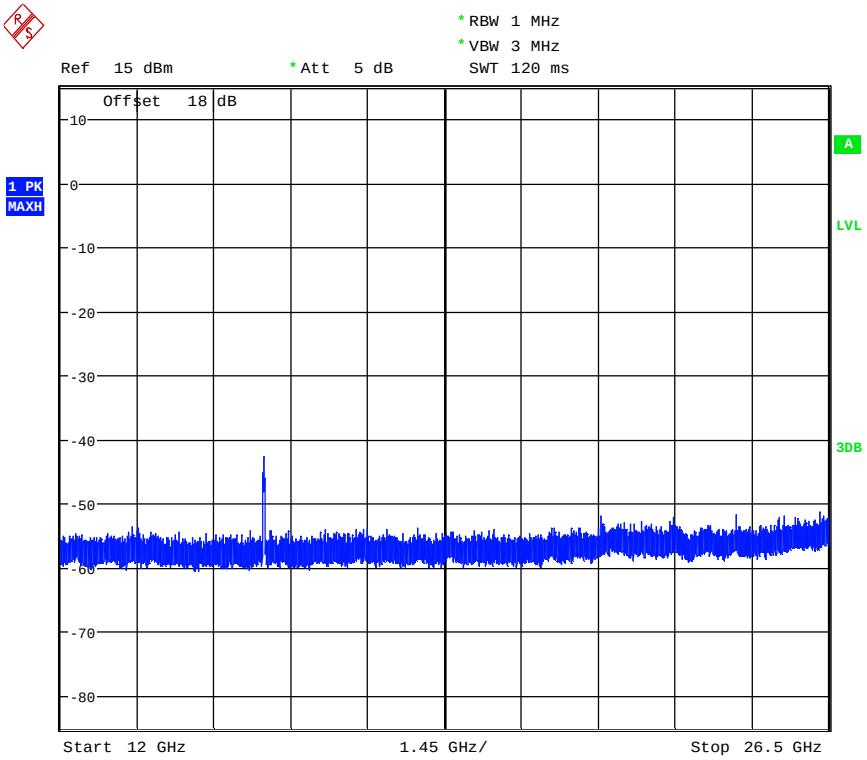
120198_SpurEmiss1-4G_a_56.wmf: conducted spurious emissions (operation mode 5):



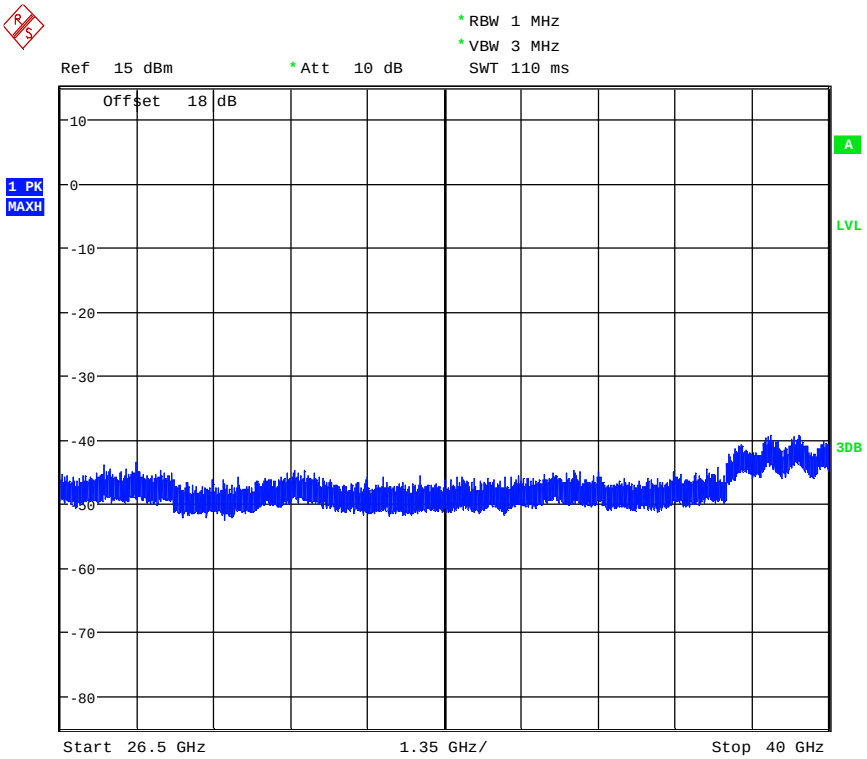
120198_SpurEmiss4-12G_a_56.wmf: conducted spurious emissions (operation mode 5):



120198_SpurEmiss12-26,5G_a_56: conducted spurious emissions (operation mode 5):



120198_SpurEmiss26,5-40G_a_56: conducted spurious emissions (operation mode 5):



Spurious Emissions, a-mode, channel 36 (Operation mode 1)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5093	-27	-41.3	-40.9	-50.9	14.0	9.6
5460	-27	-41.3	-43.2	-55.0	16.2	12.9
6907	-27	-41.3	-45.3	-48.8	18.3	7.5
10360	-27	-41.3	-39.5	-50.9	12.5	9.6
15541	-27	-41.3	-43.5	-56.1	16.5	14.8

Spurious Emissions, a-mode, channel 40 (Operation mode 2)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5040	-21.3	-41.3	-41.073	-49.43	19.773	8.1
5400	-21.3	-41.3	-42.272	-53.885	20.972	12.6
6933	-21.3	-41.3	-45.882	-49.771	24.582	8.5
10400	-21.3	-41.3	-40.724	-51.989	19.424	10.7
15601	-21.3	-41.3	-43.077	-54.741	21.777	13.4

Spurious Emissions, a-mode, channel 48 (Operation mode 3)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5053	-27	-41.3	-41.5	-49.9	14.5	8.6
5400	-27	-41.3	-39.8	-49.9	12.8	8.6
6987	-27	-41.3	-48.3	-52.5	21.3	11.2
10480	-27	-41.3	-42.1	-53.6	15.1	12.3
15719	-27	-41.3	-42.8	-54.7	15.8	13.4

Spurious Emissions, a-mode, channel 52 (Operation mode 4)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5100	-27	-41.3	-40.5	-49.1	13.5	7.8
5420	-27	-41.3	-39.0	-49.3	12.0	8.0
7013	-27	-41.3	-48.4	-52.6	21.4	11.3
10519	-27	-41.3	-41.6	-53.3	14.6	12.0
15781	-27	-41.3	-42.1	-53.7	15.1	12.4

Spurious Emissions, a-mode, channel 56 (Operation mode 5)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5080	-21.3	-41.3	-40.573	-47.094	19.273	5.8
5400	-21.3	-41.3	-39.603	-47.401	18.303	6.1
7040	-21.3	-41.3	-47.31	-52.549	26.01	11.3
10560	-21.3	-41.3	-42.965	-54.094	21.665	12.8
15839	-21.3	-41.3	-41.559	-52.993	20.259	11.7

Spurious Emissions, a-mode, channel 64 (Operation mode 6)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5067	-27	-41.3	-43.7	-53.7	16.7	12.4
5440	-27	-41.3	-39.1	-50.5	12.1	9.2
7093	-27	-41.3	-50.3	-55.9	23.3	14.6
10639	-27	-41.3	-44.0	-56.0	17.0	14.7
15960	-27	-41.3	-41.0	-53.3	14.0	12.0

Spurious Emissions, a-mode, channel 100 (Operation mode 7)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5380	-27	-41.3	-40.3	-49.1	13.3	7.8
5780	-27	-41.3	-46.4	-57.4	19.4	16.1
10999	-27	-41.3	-52.5	-64.0	25.5	22.7
16499	-27	-41.3	-47.9	-61.5	20.9	20.1

Spurious Emissions, a-mode, channel 116 (Operation mode 8)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5420	-21.3	-41.3	-41.303	-49.773	20.003	8.5
5740	-21.3	-41.3	-43.03	-53.26	21.73	12.0
16739	-21.3	-41.3	-48.034	-61.861	26.734	20.6

Spurious Emissions, a-mode, channel 140 (Operation mode 9)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
3800	-27	-41.3	-52.2	-57.3	25.2	16.0
5360	-27	-41.3	-40.9	-49.4	13.9	8.1
5780	-27	-41.3	-43.5	-55.4	16.5	14.1
9999	-27	-41.3	-57.8	-69.6	30.8	28.3
17101	-27	-41.3	-49.9	-65.3	22.9	24.0

Spurious Emissions, n20-mode, channel 36 (Operation mode 10)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5060	-27	-41.3	-40.4	-50.9	13.4	9.6
5453	-27	-41.3	-42.9	-54.5	15.9	13.2
6907	-27	-41.3	-45.5	-48.9	18.5	7.6
10361	-27	-41.3	-39.8	-51.0	12.8	9.7
15538	-27	-41.3	-43.4	-56.1	16.4	14.8

Spurious Emissions, n20-mode, channel 40 (Operation mode 11)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5080	-21.3	-41.3	-41.329	-50.613	20.029	9.3
5400	-21.3	-41.3	-42.476	-53.593	21.176	12.3
6933	-21.3	-41.3	-45.643	-49.897	24.343	8.6
10399	-21.3	-41.3	-40.926	-52.007	19.626	10.7
15599	-21.3	-41.3	-42.194	-54.552	20.894	13.3

Spurious Emissions, n20-mode, channel 48 (Operation mode 12)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5053	-27	-41.3	-41.5	-49.9	14.5	8.6
5400	-27	-41.3	-39.8	-49.9	12.8	8.6
6986	-27	-41.3	-48.3	-52.5	21.3	11.2
10480	-27	-41.3	-42.1	-53.6	15.1	12.2
15719	-27	-41.3	-42.8	-54.7	15.8	13.4

Spurious Emissions, n20-mode, channel 52 (Operation mode 13)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5067	-27	-41.3	-41.2	-49.6	14.2	8.3
5420	-27	-41.3	-39.0	-49.4	12.0	8.1
7013	-27	-41.3	-48.5	-52.9	21.2	11.6
10519	-27	-41.3	-42.2	-53.1	15.2	11.8
15778	-27	-41.3	-41.9	-53.7	14.9	12.4

Spurious Emissions, n20-mode, channel 56 (Operation mode 14)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5080	-21.3	-41.3	-41.59	-49.817	20.29	8.5
5400	-21.3	-41.3	-39.03	-49.204	17.73	7.9
7040	-21.3	-41.3	-47.507	-52.728	26.207	11.4
10559	-21.3	-41.3	-42.334	-53.991	21.034	12.7
15839	-21.3	-41.3	-41.59	-52.912	20.29	11.6

Spurious Emissions, n20-mode, channel 64 (Operation mode 15)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5067	-27	-41.3	-44.5	-54.6	27.6	13.3
5440	-27	-41.3	-40.1	-50.7	23.7	9.4
7093	-27	-41.3	-50.8	-56.0	29.0	14.7
10639	-27	-41.3	-44.3	-55.9	28.9	14.60
15959	-27	-41.3	-41.2	-53.3	26.3	12.0

Spurious Emissions, n20-mode, channel 100 (Operation mode 16)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5380	-27	-41.3	-41.1	-49.1	14.1	7.8
5780	-27	-41.3	-45.9	-57.4	18.9	16.1
11000	-27	-41.3	-52.1	-64.1	25.2	22.8
16498	-27	-41.3	-48.5	-61.3	21.5	20.0

Spurious Emissions, n20-mode, channel 116 (Operation mode 17)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
5420	-21.3	-41.3	-40.66	-49.228	19.36	7.9
57400	-21.3	-41.3	-42.816	-53.253	21.516	12.0
167400	-21.3	-41.3	-47.497	-61.525	26.197	20.2

Spurious Emissions, n20-mode, channel 140 (Operation mode 18)						
Unwanted Emission Frequency MHz	Max Peak Limit dBm	Average Limit dBm	Max Peak Emission dBm	Average Emission dBm	Peak Margin dB	Average Margin dB
3800	-27	-41.3	-52.1	-57.3	25.1	16.0
5360	-27	-41.3	-41.1	-49.3	14.1	8.0
5780	-27	-41.3	-43.8	-55.6	16.8	14.3

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30, 80, 81

5.3.3 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into four stages.

- A preliminary measurement carried out in a fully anechoic chamber with a variable antenna distance and height in the frequency range 1 GHz to 110 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 110 GHz.

All measurements will be carried out with the EUT working on the middle of the assigned frequency band.

Preliminary and final measurement (1 GHz to 110 GHz)

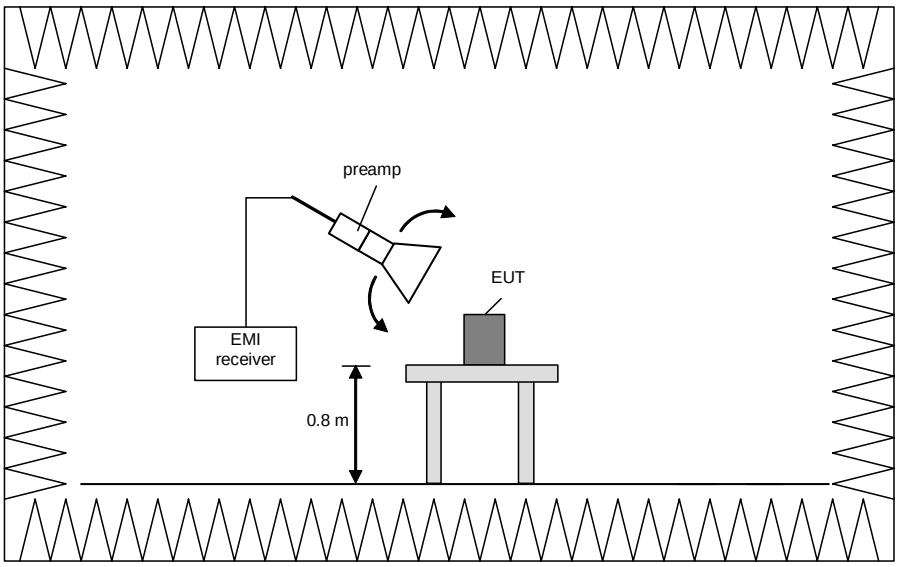
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The setup of the Equipment under test will be in accordance to ANSI C63.4-2009 [1].

Preliminary measurement (1 GHz to 110 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna, the antenna close to the EUT and while moving the antenna over all sides of the EUT. With the spectrum analyser in CLEAR / WRITE mode the cone of the emission should be found and then the measuring distance will be set to 3 m with the receiving antenna moving in this cone of emission. At this position the final measurement will be carried out.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	100 kHz
4 GHz to 12 GHz	100 kHz
12 GHz to 18 GHz	100 kHz
18 GHz to 26.5 GHz	100 kHz
26.5 GHz to 40 GHz	100 kHz
40 GHz to 60 GHz	100 kHz
50 GHz to 75 GHz	100 kHz
75 GHz to 110 GHz	100 kHz

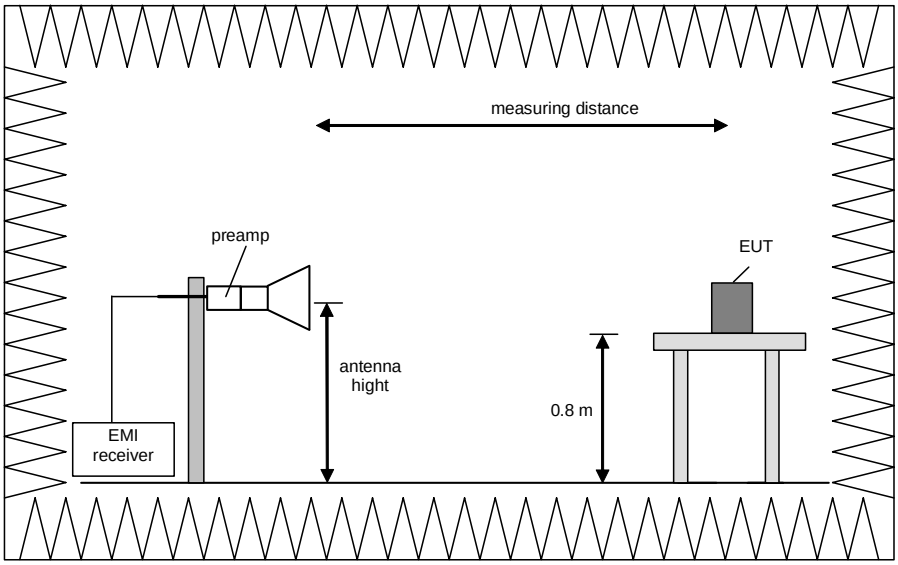


Final measurement (1 GHz to 110 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 ° in order to have the antenna inside the cone of radiation.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz
40 GHz to 60 GHz	1 MHz
50 GHz to 75 GHz	1 MHz
75 GHz to 110 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency range 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 26.5 GHz, 26.5 GHz to 40 GHz, 40 GHz to 60 GHz, 60 GHz to 75 GHz and 75 GHz to 110 GHz.
The following procedure will be used:

1) Monitor the frequency range at horizontal polarisation and move the antenna over all sides of the EUT (if necessary move the EUT to another orthogonal axis).
2) Change the antenna polarisation and repeat 1) with vertical polarisation.
3) Make a hardcopy of the spectrum.
4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
5) Change the analyser mode to Clear / Write and found the cone of emission.
6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3 m and the antenna will be still inside the cone of emission.
7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarisation and azimuth and the peak and average detector, which causes the maximum emission.
8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.

Step 1) to 6) are defined as preliminary measurement.

5.3.4 Test results (radiated emissions) – cabinet emissions

5.3.4.1 Preliminary radiated emission measurement

Ambient temperature	21 °C	Relative humidity	51 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

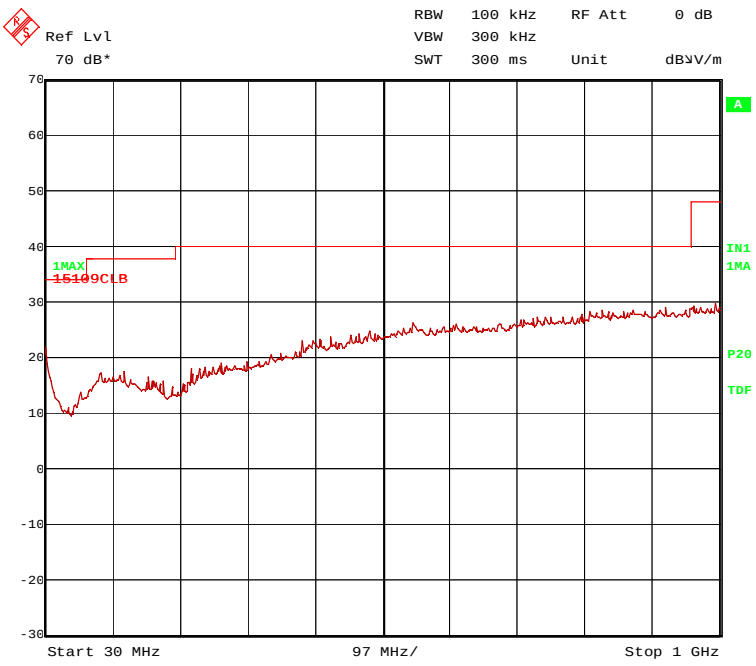
Supply voltage: During all measurements the EUT with 5 V.

Remark: Document [3] states in G)3)b)i), that in case of conducted measurements, additional radiated cabinet emission measurements must be performed. The measurements were performed at the worst case modulation, namely 802.11a mode at channel 36, 48, 52, 64, 100 and 140.
For this measurement the rf-ports of the EUT were terminated with 50 Ohm.

Results for the frequency band from 30 MHz to 1 GHz

No differences occurred between the different operations modes in the frequency band from 30 MHz to 1 GHz. Therefore only one operation mode is submitted below.

0198_400.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



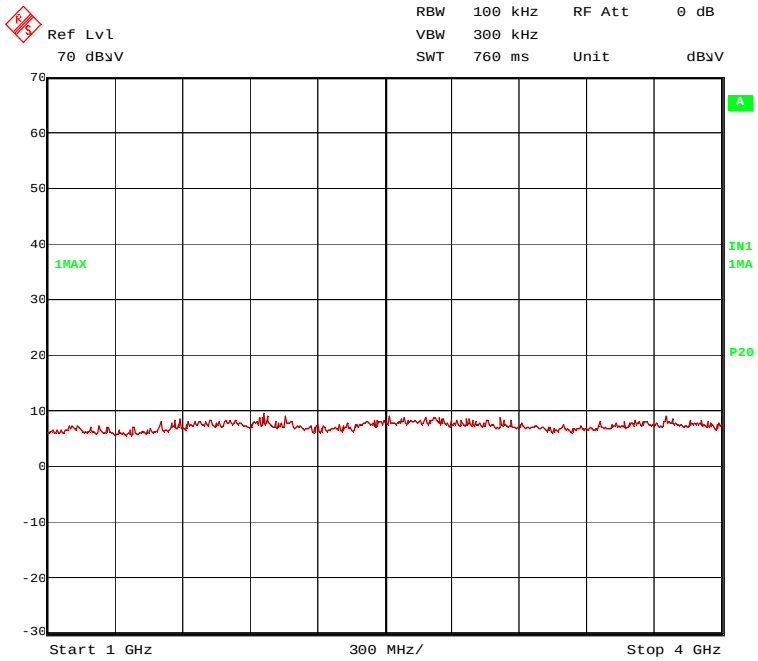
No emissions were found in the frequency band from 30 MHz to 1 GHz, therefore no final measurement on the open area test site was necessary.

Results for the frequency band from 1 GHz to 40 GHz

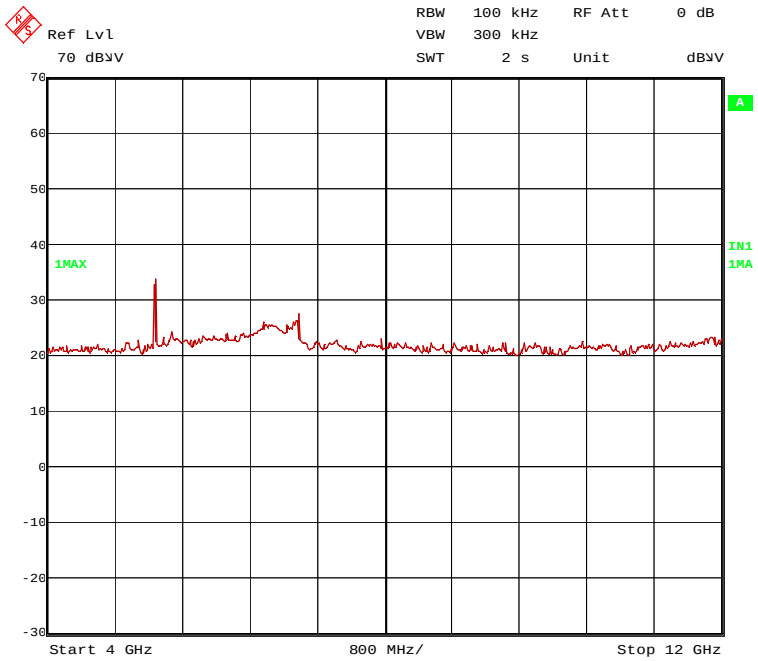
Only the plots of the worst case emissions are submitted for every frequency range above 1 GHz in the preliminary results.

Transmitter operates at the middle of the assigned frequency band (a-mode)

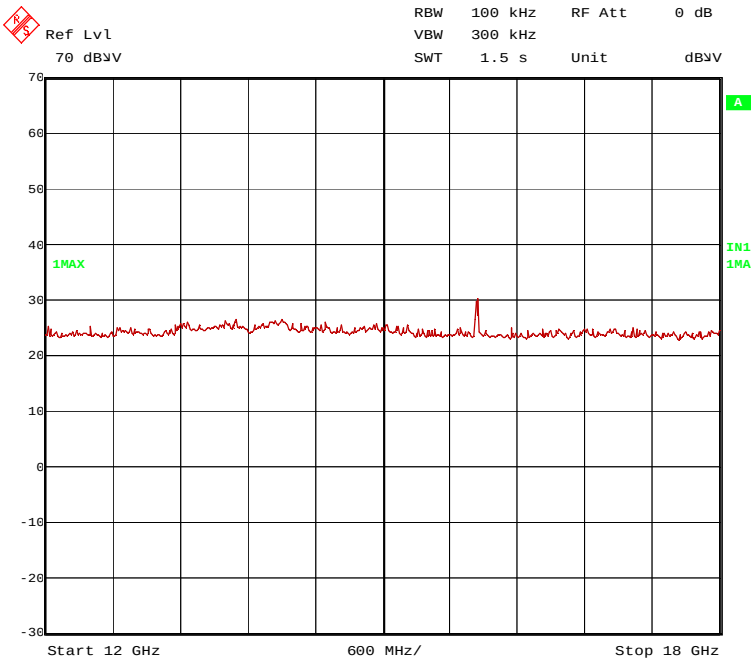
0198_490.WMF: Spurious emissions from 1 GHz to 4 GHz (operation mode 5):



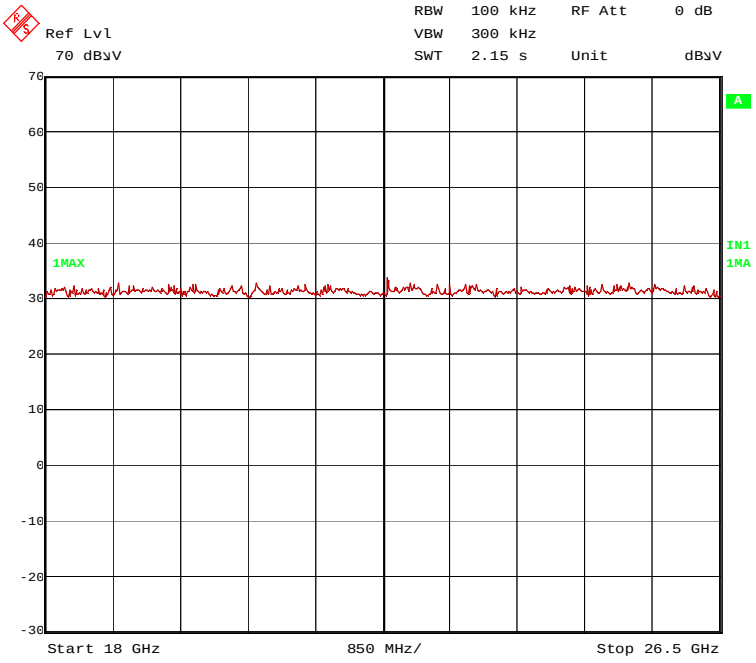
0198_491.WMF: Spurious emissions from 4 GHz to 12 GHz (operation mode 5):



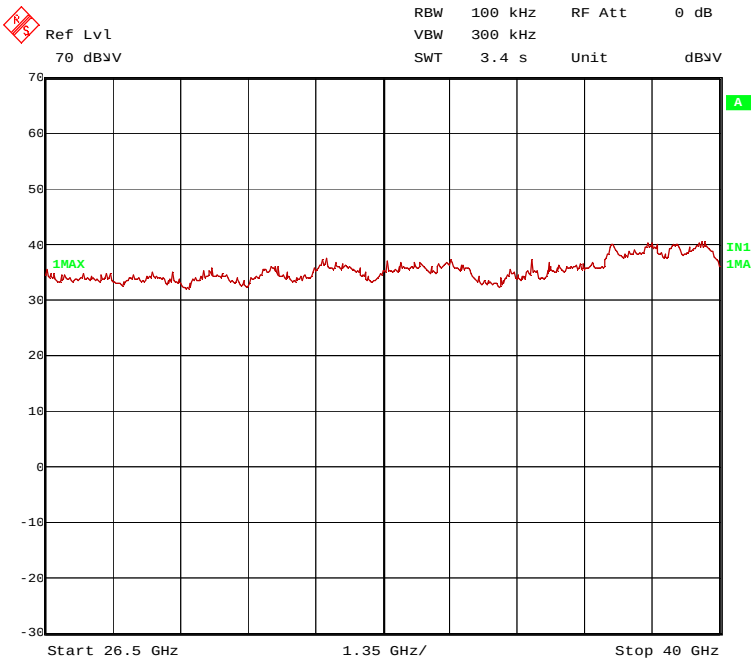
0198_483.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 5):



0198_481.WMF.wmf: Spurious emissions from 18 GHz to 26.5 GHz (operation mode 5):



0198_486.WMF.wmf: Spurious emissions from 26.5 GHz to 40 GHz (operation mode 5):



The following frequency was found inside the restricted bands during the preliminary radiated emission test:

- 5197 MHz

These frequencies have to be measured in a final measurement. The results are presented in the following.

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39 - 44, 46, 49 – 51, 55, 72, 73

5.3.4.2 Final radiated emission measurement (1 GHz to 25 GHz)

Ambient temperature	20 °C	Relative humidity	30 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was powered with 5 V.

Resolution bandwidth: For all measurements a resolution bandwidth of 1 MHz was used.

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)

Result measured with the peak detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5197	127.5	---	---	62.4	33.8	25.5	5.8	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5197	116.9	---	---	51.8	33.8	25.5	5.8	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the middle of the assigned frequency band (operation mode 2)

Result measured with the peak detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5204	82.6	---	---	43.0	33.8	0.0	5.8	150	Vert.	carrier	1
15600	48.1	74.0	25.9	39.0	33.7	27.1	2.5	150	Hor.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5204	71.3	---	---	31.7	33.8	0.0	5.8	150	Vert.	carrier	1
15600	35.7	54.0	18.3	26.6	33.7	27.1	2.5	150	Hor.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the upper end of the assigned frequency band (operation mode 3)

Result measured with the peak detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5243	125.8	---	---	60.8	33.7	25.5	5.8	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5243	115.6	---	---	50.6	33.7	25.5	5.8	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 4)

Result measured with the peak detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5197	127.5	---	---	62.4	33.8	25.5	5.8	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5259	115.6	---	---	50.6	33.7	25.5	5.8	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the middle of the assigned frequency band (operation mode 5)

Result measured with the peak detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5279	82.8	---	---	43.5	33.6	0.0	5.7	150	Vert.	carrier	1
15840	49.1	74.0	24.9	40.0	33.8	27.2	2.5	150	Vert.	Yes	1
21120	49.7	74.0	24.3	48.4	37.1	38.3	2.5	150	Vert.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5279	71.9	---	---	32.6	33.6	0.0	5.7	150	Vert.	carrier	1
15840	36.5	54.0	17.5	27.4	33.8	27.2	2.5	150	Vert.	Yes	1
21120	36.3	54.0	17.7	35.0	37.1	38.3	2.5	150	Vert.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the upper end of the assigned frequency band (operation mode 6)

Result measured with the peak detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5320	124.0	---	---	59.2	33.6	25.5	5.7	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5320	113.2	---	---	48.4	33.6	25.5	5.7	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 7)

Result measured with the peak detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5493	124.9	---	---	59.7	34.0	25.4	5.8	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5493	114.3	---	---	49.1	34.0	25.4	5.8	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the middle of the assigned frequency band (operation mode 8)

Result measured with the peak detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5586	85.2	---	---	45.2	34.0	0.0	6.0	150	Vert.	carrier	1
16740	51.1	74.0	22.9	42.4	33.8	27.6	2.5	150	Hor.	No	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5586	74.9	---	---	34.9	34.0	0.0	6.0	150	Vert.	carrier	1
16740	36.6	54.9	18.3	27.9	33.8	27.6	2.5	150	Hor.	No	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the upper end of the assigned frequency band (operation mode 9)

Result measured with the peak detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5702	121.7	---	---	56.7	33.8	25.3	5.9	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. Value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
5702	111.6	---	---	46.6	33.8	25.3	5.9	150	Vert.	carrier	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39 - 44, 46, 49 – 51, 55, 72, 73

6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. Due
1	Shielded chamber M47	-	Albatross Projects	B83117-C6439-T262 -	480662	Weekly verification (system cal.)	
2	EMI Receiver	ESIB 26	Rohde & Schwarz	1088.7490	481182	03/09/2012	03/2014
4	High pass filter	HR 0.13-5ENN	FSY Microwave Inc.	DC 0109 SN 002	480340	Weekly verification (system cal.)	
14	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
15	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	02/15/2012	02/2014
16	Controller	HD100	Deisel	100/670	480139	-	-
17	Turntable	DS420HE	Deisel	420/620/80	480087	-	-
18	Antenna support	MA240-0	Inn-Co GmbH	MA240-0/030/6600603	480086	-	-
19	Antenna	CBL6111 D	Chase	25761	480894	09/28/2011	09/2014
20	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	-
29	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
30	Spectrum analyser	FSU	Rohde & Schwarz	200125	480956	02/15/2012	02/2014
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	02/13/2012	02/2014
32	Controller	MCU	Maturo	MCU/043/971107	480832	-	-
33	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
34	Antenna support	AS615P	Deisel	615/310	480187	-	-
35	Antenna	CBL6112 B	Chase	2688	480328	04/21/2011	04/2014
36	Antenna	3115 A	EMCO	9609-4918	480183	11/09/2011	11/2014
37	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Six month verification (system cal.)	
39	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297	Six month verification (system cal.)	
40	Standard Gain Horn Antenne 26.4 – 40.1 GHz	22240-20	Flann Microwave	469	480229	Six month verification (system cal.)	
41	RF-cable No. 3	Sucoflex 106B	Huber&Suhner	0563/6B / Kabel 3	480670	Weekly verification (system cal.)	
42	RF-cable No. 40	Sucoflex 106B	Huber&Suhner	0708/6B / Kabel 40	481330	Weekly verification (system cal.)	
43	RF-cable No. 30	RTK 081	Rosenberger	-	410141	Weekly verification (system cal.)	
44	RF-cable No. 31	RTK 081	Rosenberger	-	410142	Weekly verification (system cal.)	
46	RF-cable 1 m	KPS-1533-400-KPS	Insulated Wire	-	480301	Six month verification (system cal.)	
49	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	Six month verification (system cal.)	
50	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	Six month verification (system cal.)	

51	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	Six month verification (system cal.)	
55	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	02/16/2012	02/2014
60	Power Meter	NRVD	Rohde & Schwarz	833697/030	480589	02/15/2012	02/2014
72	4 GHz High Pass Filter	WHKX4.0/18 G-8SS	Wainwright Instruments	1	480587	Weekly verification (system cal.)	
73	Single Control Unit	SCU	Maturo GmbH	SCU/006/971107	480831	Calibration not necessary	
80	High-pass Filter	H26G40G1	Microwave Circuits, Inc.	33471	480593	Six month verification (system cal.)	
81	Dämpfungsglied	WA54-10-12	Weinschel	-	481618	Six month verification (system cal.)	

7 REPORT HISTORY

Report Number	Date	Comment
F120198E2	21 January 2013	Document created

8 LIST OF ANNEXES

ANNEX A TEST SET-UP PHOTOS 6 pages

120198_01: Test setup - Radiated emission, Antennas terminated (fully anechoic chamber)
120198_02: Test setup - Radiated emission, Antennas terminated (fully anechoic chamber)
120198_17: Test setup - Radiated emission, Ant 3 (fully anechoic chamber)
120198_04: Test setup - Radiated emission, Ant 2 (fully anechoic chamber)
120198_05: Test setup - Radiated emission, Ant 4 (fully anechoic chamber)
120198_06: Test setup – conducted emissions

ANNEX B EXTERNAL PHOTOGRAPHS 2 pages

120198_07.JPG: EUT, 3D view 1
122165_08.JPG: EUT, 3D view 2

ANNEX C INTERNAL PHOTOGRAPHS 8 pages

120198_09.JPG: EUT - internal, top view
120198_10.JPG: EUT - internal, bottom view
122165_11.JPG: EUT, main PCB, top view
122165_12.JPG: EUT, main PCB, bottom view
122165_13.JPG: EUT, RF PCB, top view – with shielding
122165_15.JPG: EUT, RF PCB, top view – without shielding
120195_14.JPG: EUT, RF PCB, bottom view
120195_16.JPG: EUT, FCC label