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Test Report

Report Number: F120198E1

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 558074 (October 2012)** DTS Meas Guidance v01

[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 (September 2012)** 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		21 January 2013
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		21 January 2013
	Name	Signature	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.

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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 01	RX:	2412 MHz	TX:	2412 MHz
Channel 02	RX:	2417 MHz	TX:	2417 MHz
Channel 03	RX:	2422 MHz	TX:	2422 MHz
Channel 04	RX:	2427 MHz	TX:	2427 MHz
Channel 05	RX:	2432 MHz	TX:	2432 MHz
Channel 06	RX:	2437 MHz	TX:	2437 MHz
Channel 07	RX:	2442 MHz	TX:	2442 MHz
Channel 08	RX:	2447 MHz	TX:	2447 MHz
Channel 09	RX:	2452 MHz	TX:	2452 MHz
Channel 10	RX:	2457 MHz	TX:	2457 MHz
Channel 11	RX:	2462 MHz	TX:	2462 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 V DC
Type of modulation: *	DSSS/OFDM
Operating frequency range:*	2.412 to 2.462 GHz (11 channels with 5 MHz channel separation)
Number of channels: *	11 (2.4 GHz) and 19 (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 a RS232 cable. After adjusting the operation mode the Ethernet cable was removed.

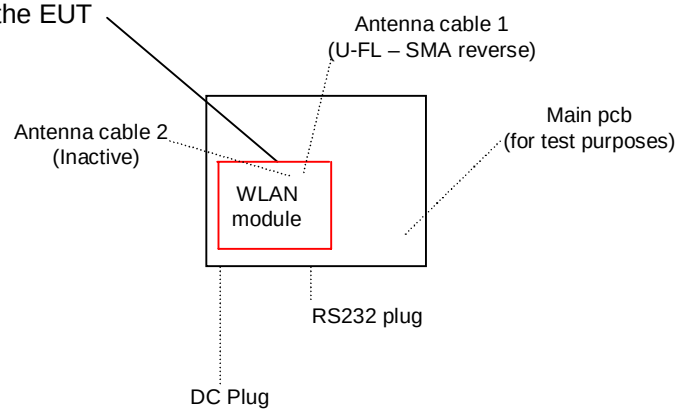
During the tests the test samples were powered with 5V, provided by an external laboratory power supply.

The following operation modes were used during the tests:

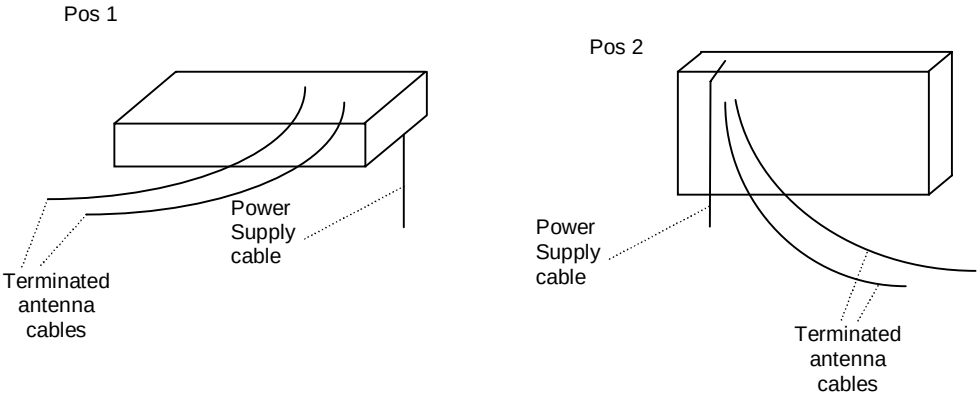
Operation mode	Description of the operation mode	WLAN mode	WLAN channel	Modulation	Data rate / Mbps
1	Continuous transmitting on 2412 MHz	b	1	DSSS	5.5 MBit/s
2	Continuous transmitting on 2437 MHz	b	6	DSSS	5.5 MBit/s
3	Continuous transmitting on 2462 MHz	b	11	DSSS	5.5 MBit/s
4	Continuous transmitting on 2412 MHz	g	1	OFDM	54 MBit/s
5	Continuous transmitting on 2437 MHz	g	6	OFDM	54 MBit/s
6	Continuous transmitting on 2462 MHz	g	11	OFDM	54 MBit/s
7	Continuous transmitting on 2412 MHz	n 20 MHz	1	OFDM	65 MBit/s
8	Continuous transmitting on 2437 MHz	n 20 MHz	6	OFDM	65 MBit/s
9	Continuous transmitting on 2462 MHz	n 20 MHz	11	OFDM	65 MBit/s

Remark: the module does not support n 40 MHz mode

Physical boundary of the EUT



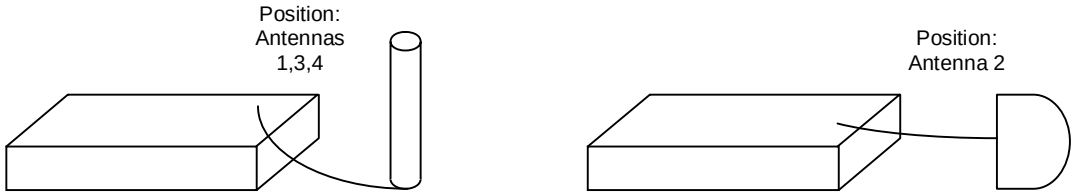
For the radiated cabinet emission tests, the worst case positioning of the EUT was investigated through measurements. The device has two possible operating positions:



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, 3, 4, 6, 7, 9
Radiated emissions (transmitter)	1 - 9

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
Maximum peak output power	2400.0 - 2483.5	15.247 (d)	A8.5 [4]	Passed	10 et seq.
Band edge compliance	2400.0 - 2483.5	15.247 (d)	A8.5 [4]	Passed	12 et seq.
Radiated emissions (transmitter)	1000 - 40,000	15.205 (a) 15.209 (a)	7.2.2 [5], 2.5 [4]	Passed	16 et seq.

5 TEST RESULTS

5.1 Maximum peak output power

5.1.1 Method of measurement (maximum peak output power)

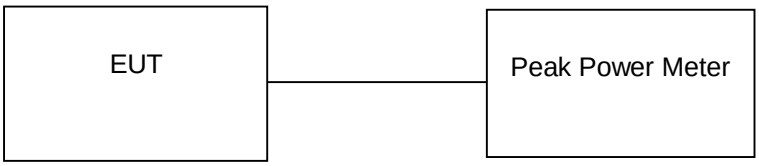
The measurement procedure refers to part 8.1.3 of the 558074 D01 DTS Meas Guidance v.02.

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

The maximum peak conducted output power can be measured using a broadband peak RF power meter. The power meter must have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast, average-responding diode type sensor.

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	2412	b	6	16.7	13.3	30
2	2437	b	6	16.4	13.6	30
3	2462	b	6	16.2	13.8	30
4	2412	g	6	15.7	14.3	30
5	2437	g	6	15.1	14.9	30
6	2462	g	6	14.7	15.3	30
7	2412	n20	6	16.0	14.0	30
8	2437	n20	6	15.4	14.6	30
9	2462	n20	6	16.1	13.9	30
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 unrestricted bands (conducted))

The relating measurements were carried out in a conducting manner. Therefore, the antenna connector was directly connected to a spectrum analyser. The measurement procedure refers to part 10.1 of the 558074 D01 DTS Meas Guidance v.02.

Measurement Procedure Reference – Reference Level (Part 9.1 – option 1):

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW ≥ 3 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Measurement Procedure – Unwanted Emissions

1. Set start frequency to DTS channel edge frequency.
2. Set stop frequency so as to encompass the spectrum to be examined.
3. Set RBW = 100 kHz.
4. Set VBW ≥ 300 kHz.
5. Detector = peak.
6. Trace Mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize (this may take some time, depending on the extent of the span).
9. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

The measurement procedure at the band edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission were be encompassed by the span. After trace stabilization, the maximum peak was be determined by a peak detector and the value was marked by an appropriate limit line. The second limit line, which is 20 dB below the first, marks the limit for the emissions in the unrestricted band. A maximum-peak-detector marks the highest emission in the unrestricted band next to the band edge.

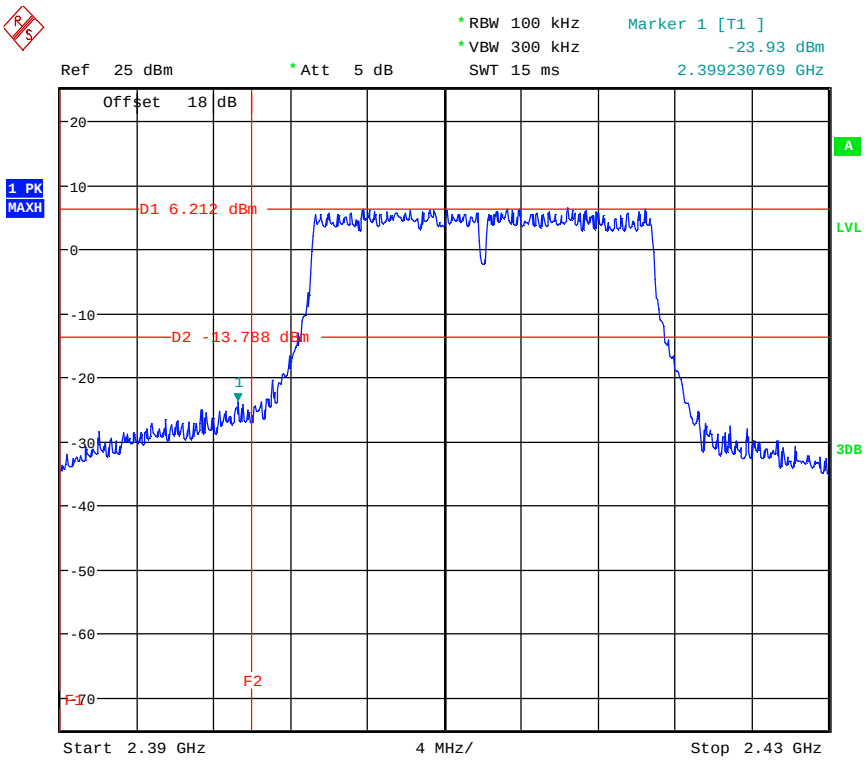
The measurements were performed at the lower end of the 2.4 GHz band.

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

Ambient temperature	21 °C	Relative humidity	60 %

The following results were measured at antenna port of the EUT. The plot shows an exemplary measurement result for the worst documented case. The other results are listed in the following table.

120198_BandEdgeUnrestr_n20_1.wmf: conducted band-edge compliance (operation mode 7):



Operation mode	WLAN channel	WLAN mode	Band-Edge	Unwanted Emission Frequency [MHz]	Reference Level [dBm]	Limit [dBm]	Unwanted Emission Value [dBm]	Margin [dB]
1	1	b	low	2400.000	14.58	-5.42	-25.67	20.25
4	1	g	low	2399.231	4.20	-15.80	-29.72	13.92
7	1	n20	low	2399.231	6.21	-13.79	-23.93	10.15

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30, 81

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

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 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 as described in subclause 5.3.3 of this test report.
The level of the measured field strength shall be compared to the the general limits specified in § 15.205.

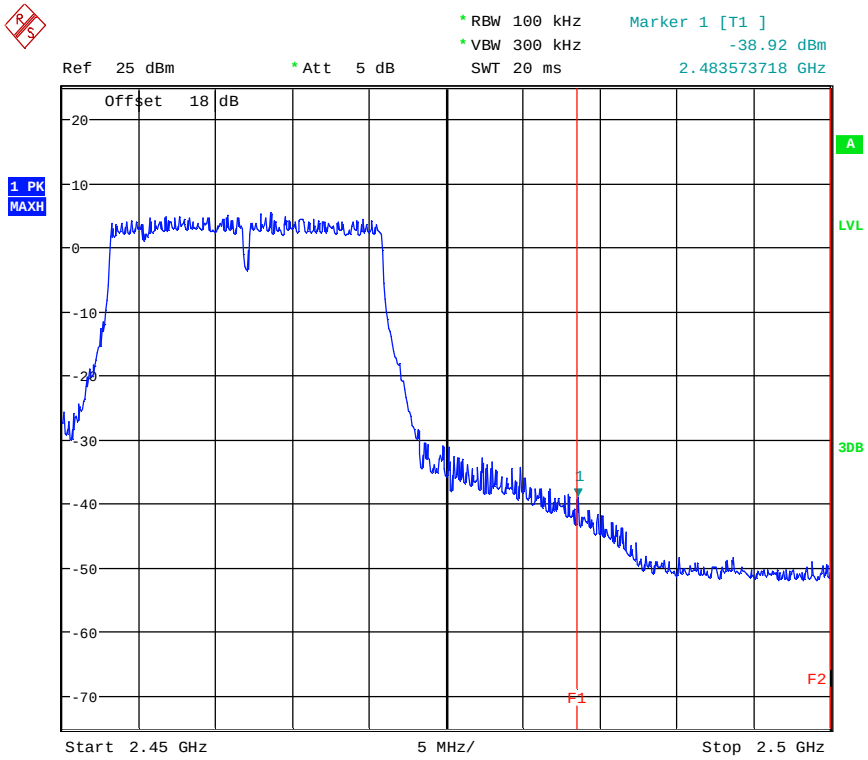
The measurement was performed at the upper end of the 2.4 GHz band.

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.

120198_BandEdgeRestr_n20_1: Radiated band-edge compliance (operation mode 9):



Operation mode	WLAN channel	WLAN mode	Band-Edge	Unwanted Emission Frequency [MHz]	Max Peak Limit [dBm]	Unwanted Emission Peak Value [dBm]	Margin [dB]
3	11	b	up	2389.969	-21.30	-34.53	13.23
6	11	g	up	2483.594	-21.30	-28.21	6.91
9	11	n20	up	2484.099	-21.30	-24.25	2.95

Operation mode	WLAN channel	WLAN mode	Band-Edge	Unwanted Emission Frequency [MHz]	Max average Limit [dBm]	Unwanted Emission average Value [dBm]	Margin [dB]
3	11	b	up	2389.969	-41.30	-45.59	4.29
6	11	g	up	2483.519	-41.30	-45.08	3.78
9	11	n20	up	2483.574	-41.30	-41.41	0.11

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30, 81

5.3 Maximum unwanted emissions

5.3.1 Method of measurement (conducted emissions – restricted bands)

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 10.2.3 and 10.2.4 in [3].

In 10.1 in [3] it is stated, that attenuation below the general emission limits specified in §15.209(a) limits is not required. Therefore to simplify measurements, all emissions are compared to the limit in §15.209(a).

As described in 10.2.4 in [3], a pre-scan using the peak power detector to identify emissions within the frequency bands was performed and the frequency of each identified restricted band emission was recorded.

The gain and limit calculations were performed as described in 5.3.1.1.

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

Procedure for average measurement: 10.2.3.3 in [3]:

1. Set the analyzer span to a minimum of 1.5 times the EBW.
2. Set the RBW = 1 MHz.
3. Set the VBW ≥ 3 MHz.
4. Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
5. Sweep time = auto couple.
6. Detector = power averaging (RMS) or sample detector when RMS not available.
7. Employ trace averaging in power averaging (RMS) mode over a minimum of 100 traces.
8. Use peak marker function to determine the highest amplitude within the RBW (1 MHz).

Procedure for peak measurement: 10.2.3.2 in [3]

1. Set the RBW = 1 MHz.
2. Set VBW ≥ 3 x RBW.
3. Set span ≥ RBW.
4. Sweep time = auto couple.
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use peak marker function to determine the peak amplitude level.

The measurements were carried out at each antenna port.

5.3.1.1 Limit calculations

Chapter 10.2.2.1 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 formula (1) 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, 1) summing of emissions and 2) accounting for array gain have to be considered.

1) 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.

2) 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.

As described in 10.2.2.2 in [3], 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)

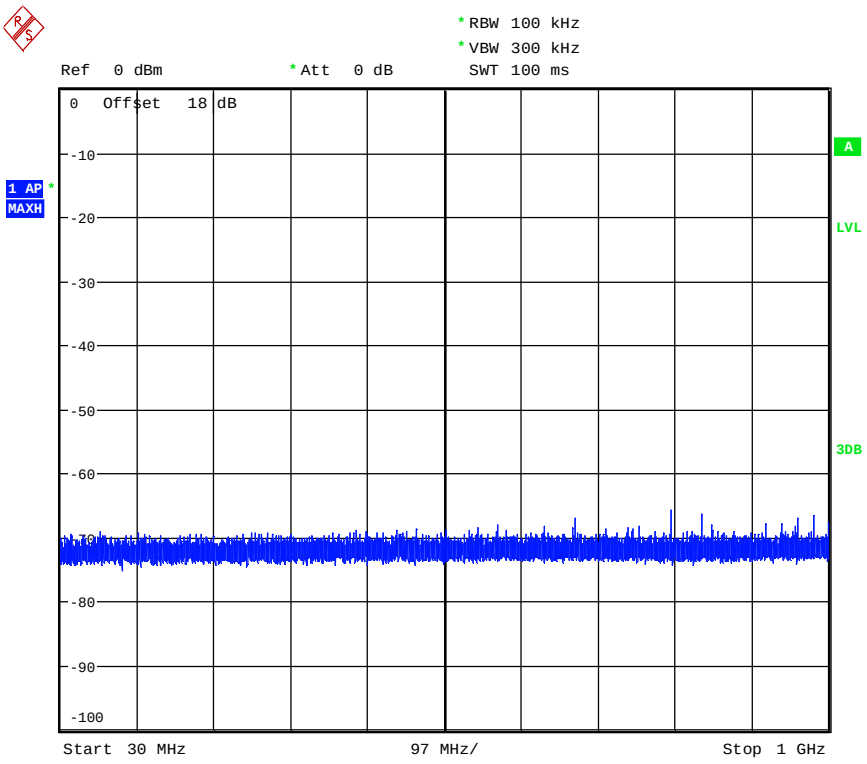
Ambient temperature	22 °C	Relative humidity	57 %

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):



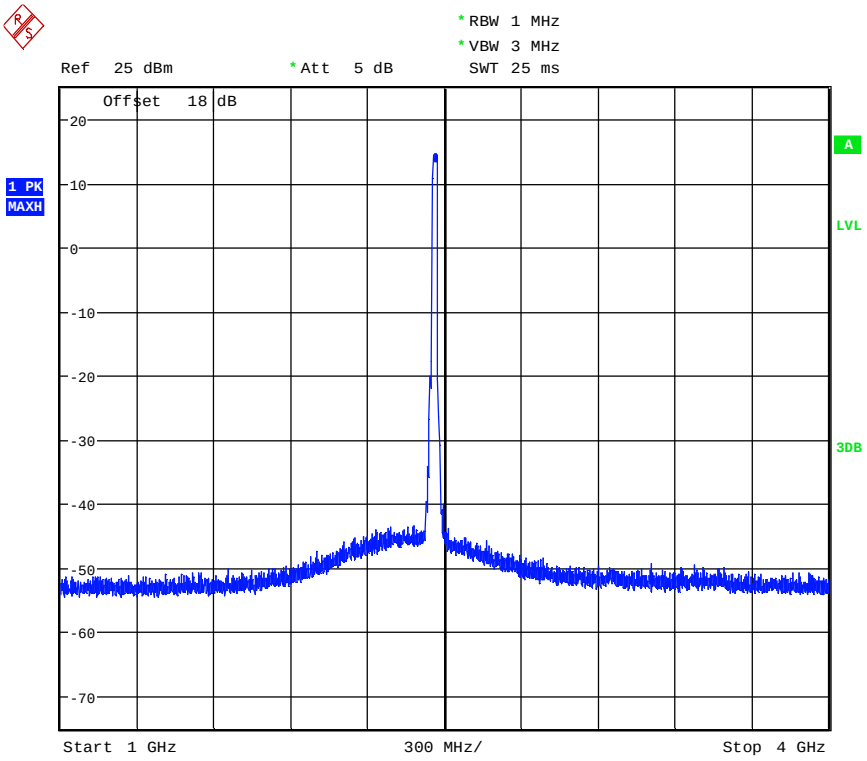
The following frequencies were found in the regarded frequency band. The results of the measurement are listed in the table below. (10.2.3.1 in [3] states that comparing to max peak is permitted).

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

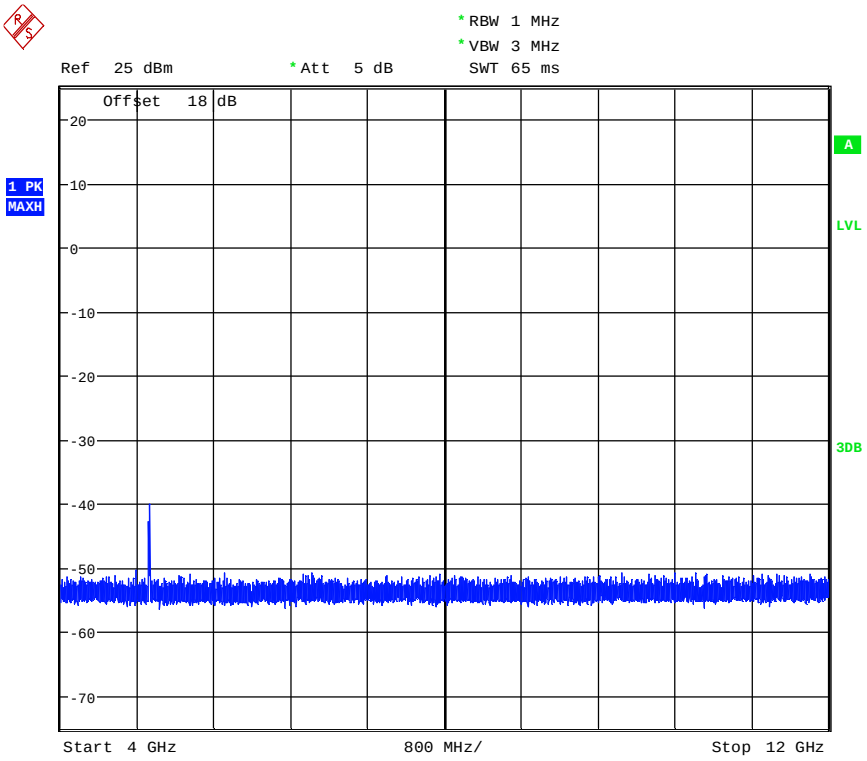
Measurements from 1 GHz – 25 GHz

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.

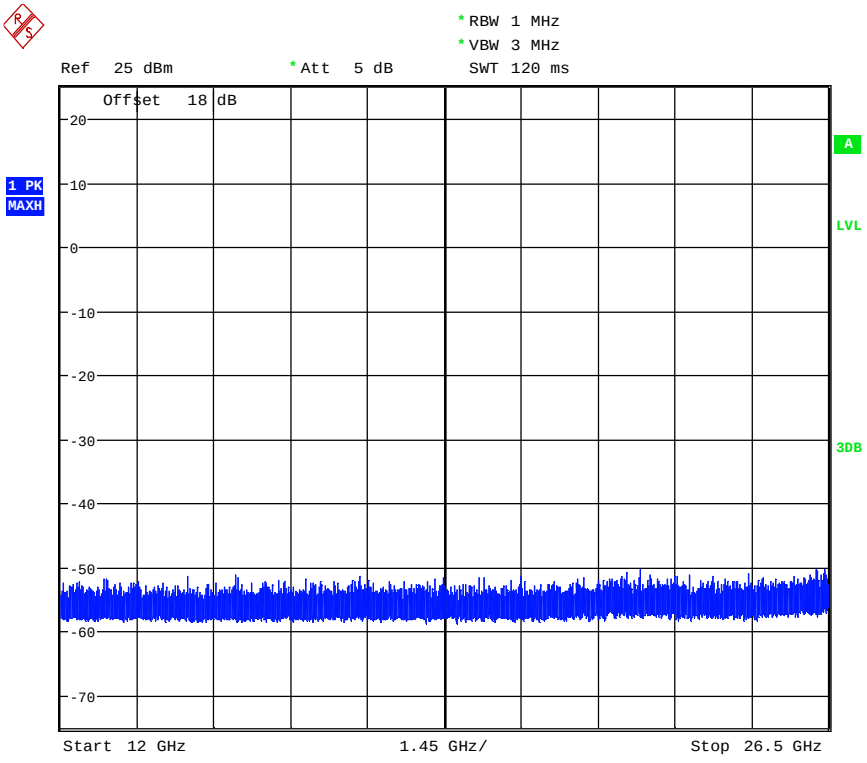
120198_SpurEmiss1-4G_g_11.wmf: conducted spurious emissions (operation mode 3):



120198_SpurEmiss4-12G_b_11.wmf: conducted spurious emissions (operation mode 3):



120198_SpurEmiss12-26,5G_b_11.wmf: conducted spurious emissions (operation mode 3):



Spurious Emissions, b-mode, channel 1 (Operation mode 1)			
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4823.825	-21.3	-43.42	22.12
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4823.975	-41.3	-54.7	13.4

Spurious Emissions, b-mode, channel 6 (Operation mode 2)			
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4873.975	-21.3	-41.35	20.05
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4873.825	-41.3	-52.21	10.91

Spurious Emissions, b-mode, channel 11 (Operation mode 3)			
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4923.9	-21.3	-38.94	17.64
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4923.975	-41.3	-50.36	9.06

Spurious Emissions, g-mode, channel 1 (Operation mode 4)			
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
No spurious emissions were found apart from the band edges			
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
No spurious emissions were found apart from the band edges			

Spurious Emissions, g-mode, channel 6 (Operation mode 5)			
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4875.6	-21.3	-46.93	25.63
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4873.875	-41.3	-57.73	16.43

Spurious Emissions, g-mode, channel 11 (Operation mode 6)			
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4923.475	-21.3	-46.24	24.94
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4924.075	-41.3	-57.01	15.71

Spurious Emissions, n20-mode, channel 1 (Operation mode 7)			
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
No spurious emissions were found apart from the band edges			
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
No spurious emissions were found apart from the band edges			

Spurious Emissions, n20-mode, channel 6 (Operation mode 8)			
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4875.625	-21.3	-45.89	24.59
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4873.9	-41.3	-57.27	15.97

Spurious Emissions, n20-mode, channel 11 (Operation mode 9)			
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4923.9	-21.3	-44.46	23.16
Unwanted Emission Frequency [MHz]	Max PeakLimit [dBm]	Max Peak Emission [dBm]	Peak Margin [dB]
4924.125	-41.3	-56.56	15.26

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30, 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 fixed antenna height in the frequency range 30 MHz to 1 GHz.
- 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 measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. 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 set up of the Equipment under test will be in accordance to ANSI C63.4-2009 [1].

The frequency range 30 MHz to 1 GHz will be measured with an EMI Receiver 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 and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °.

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

Frequency range	Resolution bandwidth
30 MHz to 230 MHz	100 kHz
230 MHz to 1 GHz	100 kHz

Procedure preliminary measurement:

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.
The following procedure will be used:

1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
6. Repeat 1) to 4) with the other orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).
7. Repeat 1) to 5) with the vertical polarisation of the measuring antenna.

Preliminary and final measurement (1 GHz to 110 GHz)

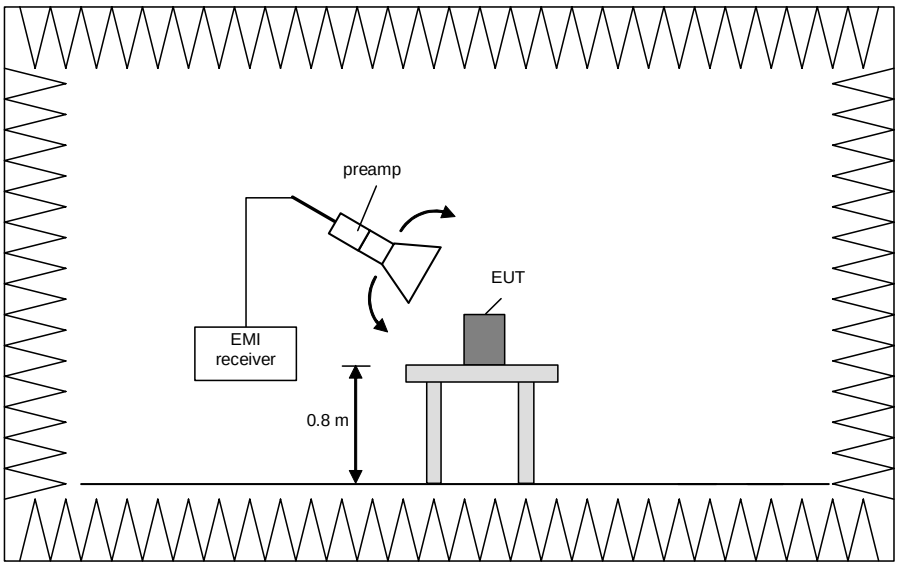
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The setup of the Equipment under test will be in accordance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

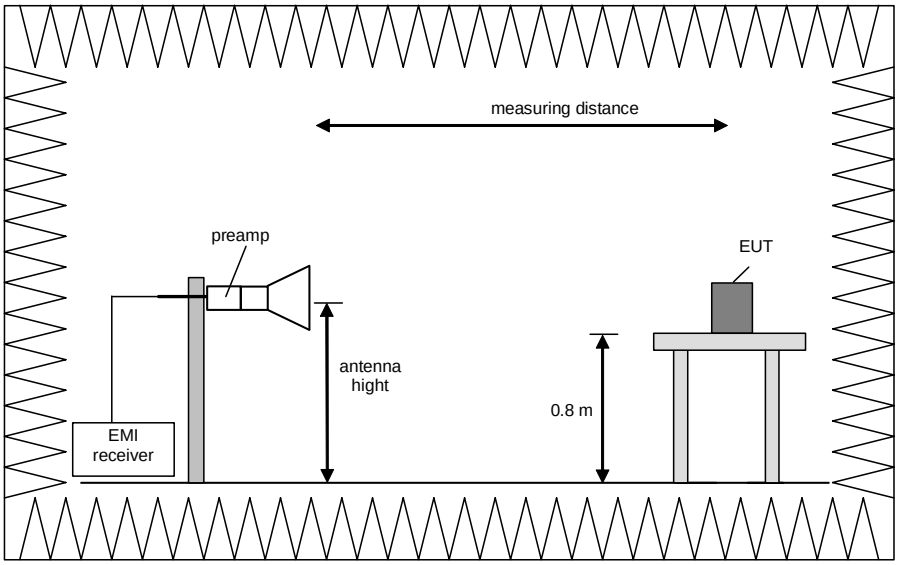


Final measurement (1 GHz to 110 GHz)

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.

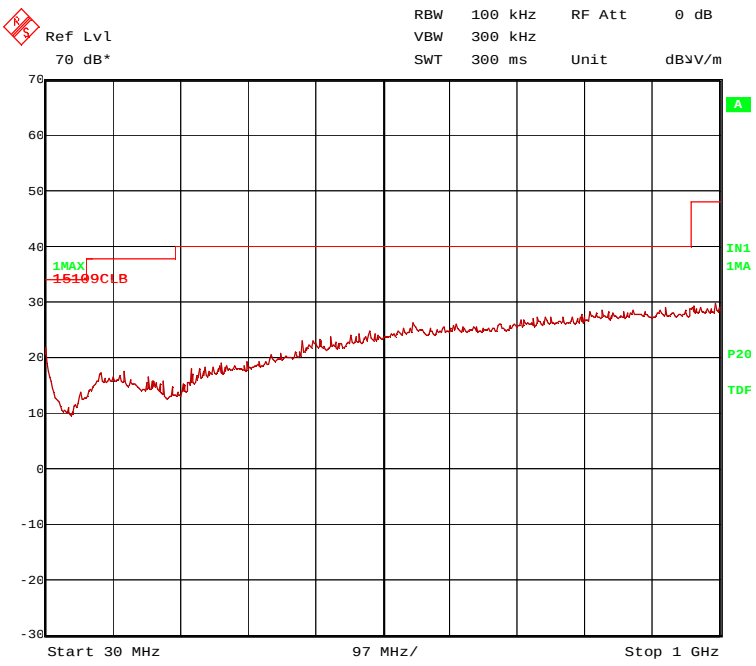
Supply voltage: During all measurements the EUT with 5 V DC.

Remark: Document [3] states in 10.2.2.3, that in case of conducted measurements, additional radiated cabinet emission measurements must be performed. The measurements were performed at the worst case modulation, namely 802.11b mode with 20 MHz at channel 1, 6 and 11.
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 2):



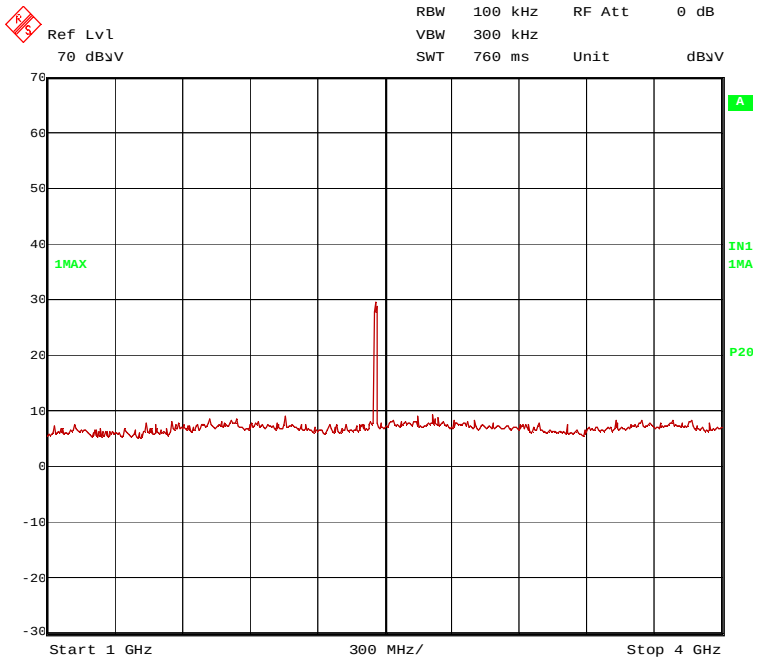
No emissions were found in the frequency band from 30 MHz to 1 GHz, therefore no final measurement on the open area test site was necessary.

Results for the frequency band from 1 GHz to 25 GHz

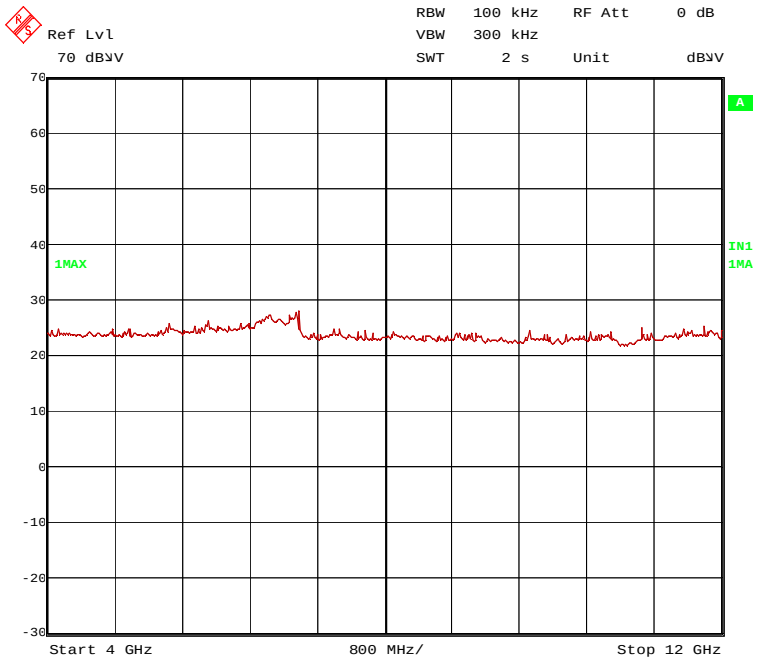
Only the plots of the worst case emissions are submitted for every frequency range above 1 GHz in the preliminary results.

Transmitter operates at the lower end of the assigned frequency band (n20-mode)

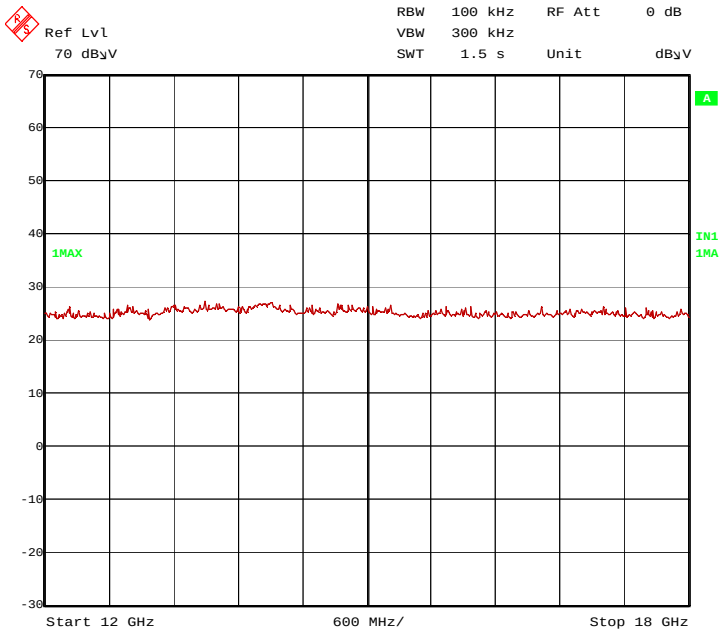
0198_438.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 3):



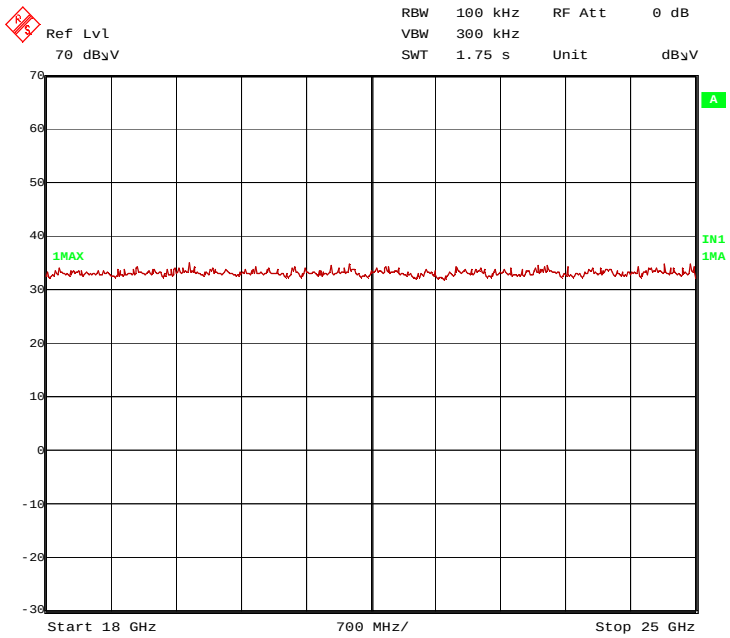
0198_447.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 3):



0198_456.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 7):



0198_465.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 7):



The following frequencies were found outside the restricted bands during the preliminary radiated emission test:

- 2459 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 with 5 V DC.

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.
2415	69.2			37.1	28.4	0.0	3.7	150	Hor.	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.
2415	59.9			27.8	28.4	0.0	3.7	150	Hor.	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.
2438	67.0			34.9	28.4	0.0	3.7	150	Hor.	carrier	n
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.
2438	60.2			28.1	28.4	0.0	3.7	150	Hor.	carrier	n
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.
2459	69.1			36.9	28.5	0.0	3.7	150	Hor.	carrier	n
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.
2459	60.8			28.6	28.5	0.0	3.7	150	Hor.	carrier	n
Measurement uncertainty						+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39, 41, 42, 46, 46, 49, 50

5.3.5 Test results radiated emissions

At some frequencies the level of the conducted emissions are above the limit. Therefore these test cases were repeated as radiated measurements. The concerning measurement results are listed below.

5.3.5.1 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 with 5 V DC.

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

Remark: This measurement was performed with an antenna connected to antenna port 1

Transmitter operates at the lower end of the assigned frequency band (operation mode 1) Ant 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.
2388	52.2	74.0	21.8	20.2	28.3	0.0	3.7	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.
2388	40.4	54.0	13.6	8.4	28.3	0.0	3.7	150	Vert.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 1) Ant 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.
2384	48.0	74.0	26.0	16.0	28.3	0.0	3.7	150	Hor.	Yes	n
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.
2384	35.4	54.0	18.6	3.4	28.3	0.0	3.7	150	Hor.	Yes	n
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 1) Ant 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.
2386	51.0	74.0	23.0	19.0	28.3	0.0	3.7	150	Vert.	Yes	n
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.
2386	38.2	54.0	15.8	6.2	28.3	0.0	3.7	150	Vert.	Yes	n
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the upper end of the assigned frequency band (operation mode 3) Ant 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.
2497	51.6	74.0	22.4	19.3	28.5	0.0	3.8	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.
2497	39.0	54.0	15.0	6.7	28.5	0.0	3.8	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 3) Ant 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.
2489	47.9	74.0	26.1	15.6	28.5	0.0	3.8	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.
2489	35.7	54.0	18.3	3.4	28.5	0.0	3.8	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) Ant 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.
2489	50.9	74.0	23.1	18.6	28.5	0.0	3.8	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.
2489	38.7	54.0	15.3	6.4	28.5	0.0	3.8	150	Hor.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 4) Ant 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.
2390	72.4	74.0	1.6	40.4	28.3	0.0	3.7	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.
2390	53.9	54.0	0.1	21.9	28.3	0.0	3.7	150	Vert.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 4) Ant 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.
2389	62.9	74.0	11.1	30.9	28.3	0.0	3.7	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.
2389	44.4	54.0	9.6	12.4	28.3	0.0	3.7	150	Hor.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 4) Ant 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.
2386	68.5	74.0	5.5	36.5	28.3	0.0	3.7	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.
2386	52.2	54.0	1.8	20.2	28.3	0.0	3.7	150	Vert.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 6) Ant 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.
2484	72.5	74.0	1.5	40.2	28.5	0.0	3.8	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.
2484	52.4	54.0	1.6	20.1	28.5	0.0	3.8	150	Vert.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 6) Ant 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.
2484	64.4	74.0	9.6	32.1	28.5	0.0	3.8	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.
2484	45.8	54.0	8.2	13.5	28.5	0.0	3.8	150	Hor.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 6) Ant 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.
2484	68.3	74.0	5.7	36.0	28.5	0.0	3.8	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.
2484	51.9	54.0	2.1	19.6	28.5	0.0	3.8	150	Hor.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 7) Ant 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.
2390	68.0	74.0	6.0	36.0	28.3	0.0	3.7	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.
2390	53.1	54.0	0.9	21.1	28.3	0.0	3.7	150	Vert.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 7) Ant 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.
2390	62.0	74.0	12.0	30.0	28.3	0.0	3.7	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.
2390	45.7	54.0	8.3	13.7	28.3	0.0	3.7	150	Hor.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at the lower end of the assigned frequency band (operation mode 7) Ant 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.
2386	67.6	74.0	6.4	35.6	28.3	0.0	3.7	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.
2386	50.4	54.0	3.6	18.4	28.3	0.0	3.7	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 9) Ant 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.
2484	69.1	74.0	4.9	36.8	28.5	0.0	3.8	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.
2484	52.3	54.0	1.7	20.0	28.5	0.0	3.8	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 9) Ant 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.
2484	62.3	74.0	11.7	30.0	28.5	0.0	3.8	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.
2484	45.1	54.0	8.9	12.8	28.5	0.0	3.8	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 9) Ant 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.
2485	67.7	74.0	6.3	35.4	28.5	0.0	3.8	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.
2485	50.5	54.0	3.5	18.2	28.5	0.0	3.8	150	Hor.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39, 41, 42, 46, 46, 49, 50

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
61	Power probe	NRV-Z32	Rohde & Schwarz	849745/016	480551	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	RF-Attenuator	WA2-10	Weinschel	8260	410122	09/2012	09/2013

7 REPORT HISTORY

Report Number	Date	Comment
F120198E1	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_03: Test setup - Radiated emission, Ant 1 (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