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Test Report

Report Number: F124266E2

Applicant:

connectBlue AB

Manufacturer:

connectBlue AB

Equipment under Test (EUT):

cB-0946

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] **558074 DTS Meas Guidance v02 (October 2012)** Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

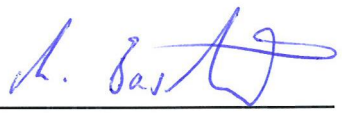
[4] **RSS-210 Issue 8 (December 2010)** Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

[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

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.

	Name	Signature	Date
Test engineer:	Manuel BASTERT		12 November 2012
Authorized reviewer:	Bernd STEINER		12 November 2012

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 generalizations 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. Martin Engdahl
Phone:	+ 46 40 63 07 100
Fax:	+ 46 40 23 71 37
eMail Address:	martin.engdahl@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. Martin Engdahl
Phone:	+ 46 40 63 07 100
Fax:	+ 46 40 23 71 37
eMail Address:	martin.engdahl@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: *	**Bluetooth module**
Type: *	cB-0946
FCC ID: *	**PVH0946**
IC: *	**5325A-0946**
Serial number: *	None
PCB identifier: *	cB-0946-A2
Hardware version: *	1.0
Software version: *	1.0

1.5 Technical data of equipment

Channel 0	RX:	2402 MHz	TX:	2402 MHz
Channel 19	RX:	2441 MHz	TX:	2441 MHz
Channel 39	RX:	2480 MHz	TX:	2480 MHz

Fulfills Bluetooth specification: *	3.0 with EDR (class 1) and 4.0 (BLE)					
Adaptive frequency hopping: *	Yes					
Antenna type: *	ANT-2.4-WRT-xxx (external ¼ wave antenna)					
Antenna gain: *	1 dBi					
Antenna connector: *	Hirose U.FL connector					
Power supply: *	U_{nom}=	3.3 V DC	U_{min}=	3.0 V DC	U_{max}=	6.0 V DC
Type of modulation: *	FHSS: GFSK (1 Mbps), π/4-DPQSK (2 Mbps), 8DPSK (3 Mbps)					
Operating frequency range:*	2402 MHz to 2480 MHz					
Number of channels: *	79 / 40					
Temperature range: *	-40 °C to +85 °C					
Lowest / highest internal clock frequency: *	32.768 kHz / 72.00 MHz					

* declared by the applicant.

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
DC in (carrier board)	6.3 mm jack plug	-	2 m *

*: Length during the test if not otherwise specified.

1.6 Dates

Date of receipt of test sample:	19 October 2012
Start of test:	22 October 2012
End of test:	09 November 2012

2 OPERATIONAL STATES

The EUT is intended to be used in several Bluetooth applications. Because the cB-0946 is a module, which will be implemented in a final application, it was mounted on a carrier board to connect the power supply and change the operation modes of the EUT from a Laptop with test software. As pretests have shown there was no measurable difference between the version with pin list connector or without pin list connector. Therefore all measurements were carried out with the version with pin list connector.

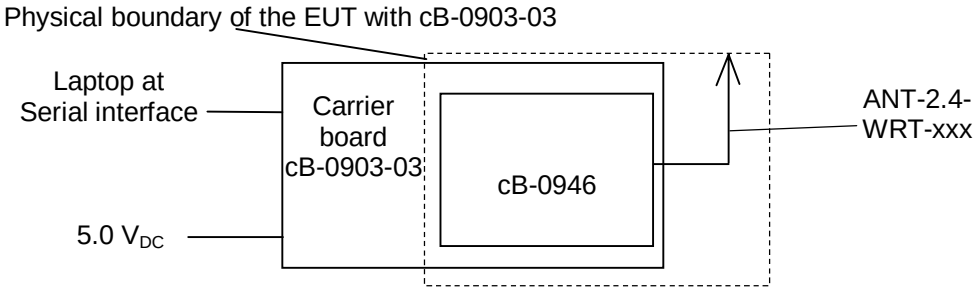
The tests were carried out with an unmodified sample with an antenna connector (cB-0946-A2-02), sample marked with “82”.

During the tests the test sample was powered with 3.3 V_{DC} via the carrier board cB-0903-02.

For selecting an operation mode, a personal computer with test software delivered by the applicant was connected to the carrier board.

The following operation modes were used during the tests in Bluetooth Low Energy (BLE) mode:

Operation mode	Description of the operation mode	Modulation	Data rate / Mbps
6	Continuous transmitting on 2402 MHz	GFSK	1
7	Continuous transmitting on 2440 MHz	GFSK	1
8	Continuous transmitting on 2480 MHz	GFSK	1
9	Transmitter hopping on all channels	GFSK	1



Pretests were carried out in 3 orthogonal axes to find out the position with the maximum wanted and unwanted emissions. It is position 1 (antenna is standing upright).

The following test modes were adjusted during the tests:

Test items	Operation mode
Maximum peak conducted output power	1, 2, 3
Band edge compliance	1, 3, 4
Radiated emissions (transmitter)	1, 2, 3

3 ADDITIONAL INFORMATION

The module is already tested (test report reference F111592E3, 2nd version for BLE and F111592E2 for BT) and certified under the above-mentioned ID's. Reason for the new assessment is the addition of a further antenna (type Antenna Factor ANT-2.4-WRT-xxx).

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 conducted output power	General	15.247 (b) (3), (4)	A8.4 (4) [4]	Passed	8 et seq.
Band edge compliance	2400.0 - 2483.5	15.247 (d)	A8.5 [4]	passed	10 et seq.
Radiated emissions (transmitter)	0.009 - 25,000	15.205 (a) 15.209 (a)	7.2.2 [5], 2.5 [4]	passed	15 et seq.

5 TEST RESULTS

5.1 Maximum peak conducted output power

5.1.1 Method of measurement

Used measurement procedure: **Option 3 [3]**

Peak power meter method

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.

The measurement will be performed at the upper and lower end and the middle of the assigned frequency band.

Test set-up:

5.1.2 Test results (maximum peak output power)

Ambient temperature	20 °C	Relative humidity	43 %

Operation mode 6 to 8				
Channel number	Channel frequency [MHz]	Maximum peak output power [dBm]	Antenna gain [dBi]	Peak power limit [dBm]
0	2402	4.6	1.0	30.0
19	2440	3.5	1.0	30.0
39	2480	2.9	1.0	30.0
Measurement uncertainty			+0.66 dB / -0.72 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
166, 167

5.2 Band-edge compliance (radiated)

5.2.1 Method of measurement

The same test set-up as used for the final radiated emission measurement shall be used (refer also subclause 5.7.1 of this test report). The measurements shall be carried out with using a resolution bandwidth of 100 kHz.

The following spectrum analyser settings shall be used:

- 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 assigned frequency band.
- Resolution bandwidth: 100 kHz.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 20 dB below the first line (or the peak marker). The frequency line shall be set on the edge of the assigned frequency band. 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 5.7.1 of this test report, but 100 kHz resolution bandwidth shall be used.

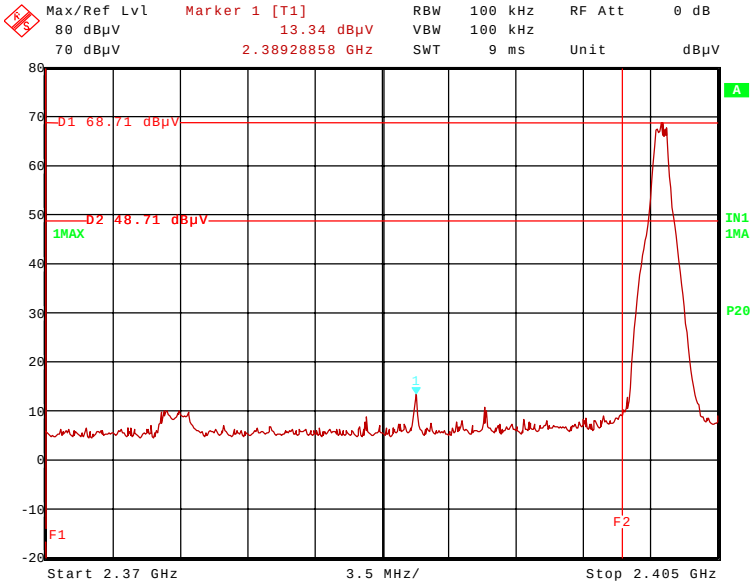
The measurement will be performed at the upper end of the assigned frequency band and with hopping on and off.

5.2.2 Test result

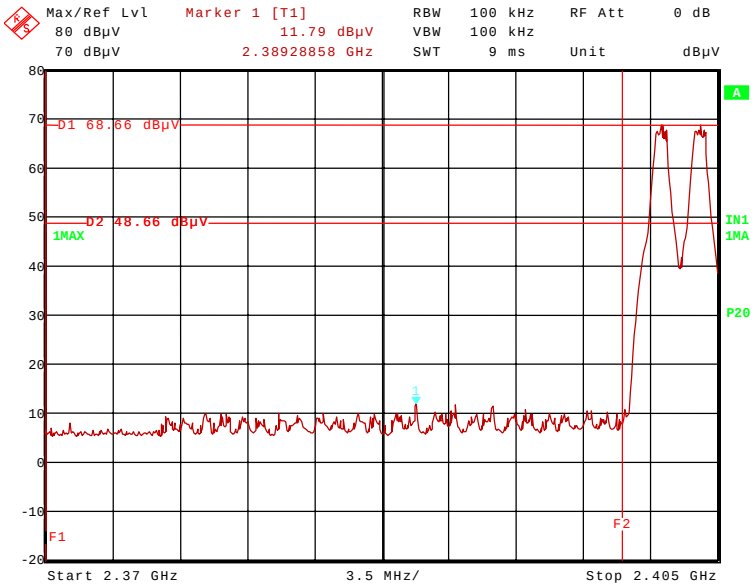
Ambient temperature	21 °C	Relative humidity	45 %

Remark: This measurement was carried out by using external antenna type Antenna factor ANT-2.4-WRT-xxx, because pre-tests have shown that this antenna causes the highest emissions of internal antennas in question.

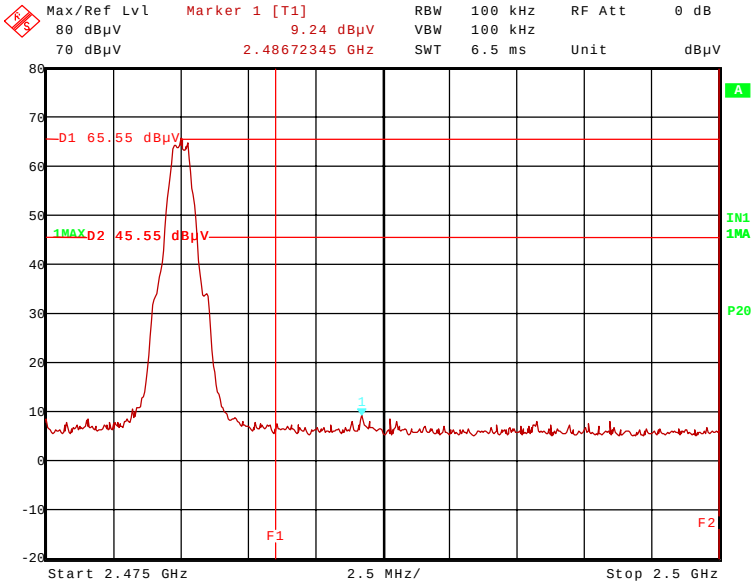
124266_14.wmf: Radiated band-edge compliance, lower band edge, hopping off (operation mode 1):



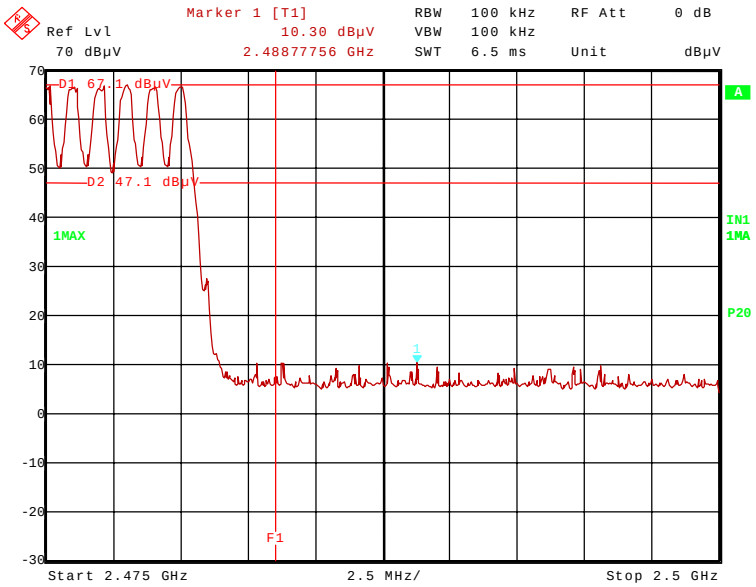
124266_13.wmf: Radiated band-edge compliance, lower band edge, hopping on (operation mode 4):



124266_7.wmf: Radiated band-edge compliance, upper band edge, hopping off (operation mode 3):



124266_8.wmf: Radiated band-edge compliance, upper band edge, hopping on (operation mode 4):



The plots on the page before are showing the radiated band-edge compliance for the upper band-edge, with and without hopping. The display line 1 (D1) in these plots represents the highest level within the assigned frequency band. The display line 2 (D2) represents the 20 dB offset to this highest level and shows the compliance with FCC 47 CFR Part 15.247 (d). The frequency line 1 (F1) shows the edge of the assigned frequency.

Band-edge compliance (lower band edge. hopping disabled)										
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
2402.00	100.2	-	-	68.2	28.3	0.0	3.7	150	Vert.	-
2389.29	44.2	74.0	29.8	12.2	28.3	0.0	3.7	150	Vert.	Yes
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
2402.00	88.5	-	-	56.5	28.3	0.0	3.7	150	Vert.	-
2389.29	27.9	54.0	26.1	-4.1	28.3	0.0	3.7	150	Vert.	Yes
Measurement uncertainty							+2.2 dB / -3.6 dB			

Band-edge compliance (lower band edge. hopping enabled)										
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
2402.00	100.3	-	-	68.3	28.3	0.0	3.7	150	Vert.	-
2389.29	40.4	74.0	33.6	8.4	28.3	0.0	3.7	150	Vert.	Yes
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
2402.00	66.8			34.8	28.3	0.0	3.7	150	Vert.	carrier
2389.29	25.9	54.0	28.1	-6.1	28.3	0.0	3.7	150	Vert.	Yes
Measurement uncertainty							+2.2 dB / -3.6 dB			

Band-edge compliance (upper band edge. hopping disabled)										
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
2480.00	98.3	-	-	66.0	28.5	0.0	3.8	150	Vert.	-
2486.70	43.4	74.0	30.6	11.1	28.5	0.0	3.8	150	Vert.	Yes
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
2480.00	93.4	-	-	61.1	28.5	0.0	3.8	150	Vert.	-
2486.70	27.3	54.0	26.7	-5.0	28.5	0.0	3.8	150	Vert.	Yes
Measurement uncertainty							+2.2 dB / -3.6 dB			

Band-edge compliance (upper band edge. hopping enabled)										
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
2476.00	97.5	-	-	65.2	28.5	0.0	3.8	150	Vert.	-
2493.23	41.7	74.0	32.3	9.4	28.5	0.0	3.8	150	Vert.	Yes
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
2476.00	63.7	-	-	31.4	28.5	0.0	3.8	150	Vert.	-
2493.23	26.6	54.0	27.4	-5.7	28.5	0.0	3.8	150	Vert.	Yes
Measurement uncertainty							+2.2 dB / -3.6 dB			

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 34, 36, 44

5.3 Radiated emissions

5.3.1 Method of measurement

The radiated emission measurement is subdivided into six stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- A final measurement carried out on an outdoor test site without reflecting ground plane and a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- 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 final measurement carried out on an open area test side with reflecting ground plane and various antenna heights 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 and upper and lower edge of the assigned frequency band.

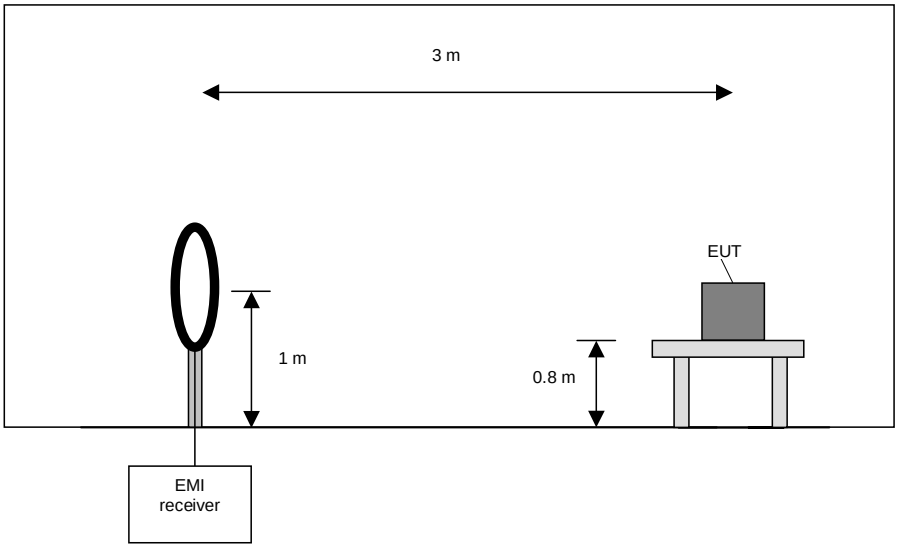
Preliminary measurement (9 kHz to 30 MHz):

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. 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 9 kHz to 30 MHz will be monitored with a spectrum analyser while the system and its cables will be manipulated to find out the configuration with the maximum emission levels if applicable. The EMI Receiver will be set to MAX Hold mode. The EUT and the measuring antenna will be rotated around their vertical axis to find the maximum emissions.

The resolution bandwidth of the spectrum analyser will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	10 kHz



Preliminary measurement procedure:

Prescans were performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

The following procedure will be used:

1) Monitor the frequency range at “face-to-face” 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 frequencies of the highest detected emission with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
6) Repeat steps 1) to 4) with the other orthogonal axes of the EUT.
7) Rotate the measuring antenna and repeat steps 1) to 5).

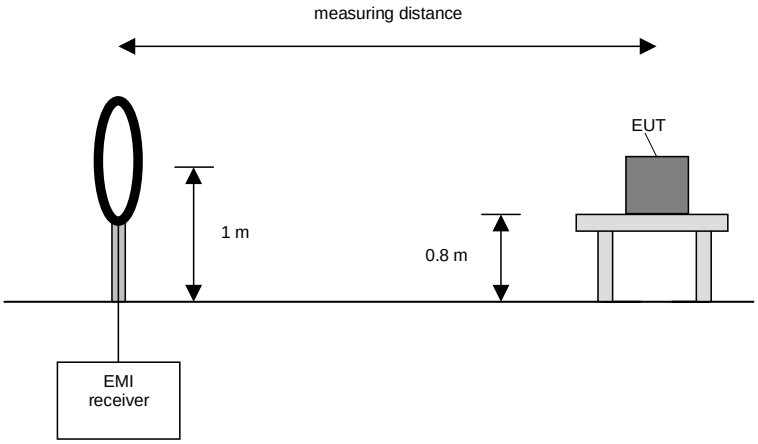
Final measurement (9 kHz to 30 MHz):

In the second stage a final measurement will be performed on an outdoor test site with no conducting ground plane in a measuring distance of 3 m, 10 m and 30 m. In the case where larger measuring distances is required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with an EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an average detector will be used according Section 15.209 (d) [2].

On the during the preliminary measurement detected frequencies the final measurement will be performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum value is found.

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

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



Final measurement procedure:

The following procedure will be used:

1) Monitor the frequency range with the measuring antenna at “face-to-face” orientation parallel to the EUT at an azimuth of 0 °.
2) Rotate the EUT by 360 ° to maximize the detected signals and note the azimuth and orientation.
3) Rotate the measuring antenna to find the maximum and note the value.
4) Rotate the measuring antenna and repeat steps 1) to 3) until the maximum value is found.
5) Repeat steps 1) to 4) with the other orthogonal axes of the EUT if applicable (handheld equipment).

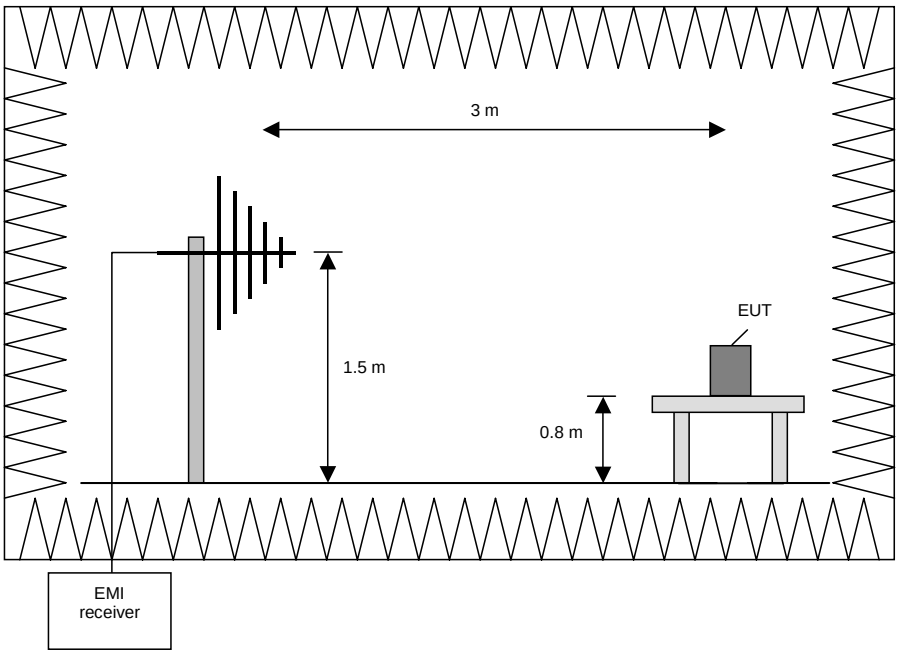
Preliminary measurement (30 MHz to 1 GHz)

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:

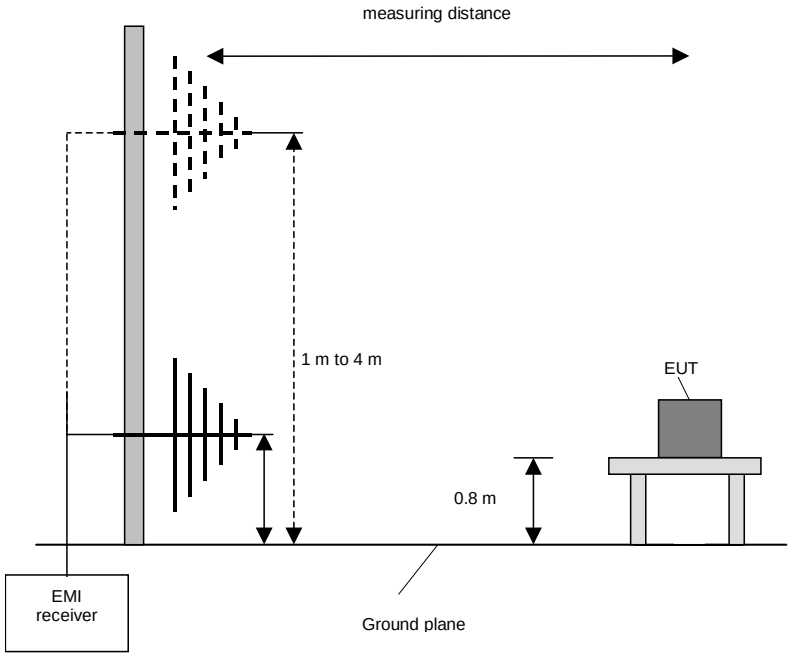
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the 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.

Final measurement (30 MHz to 1 GHz)

A final measurement on an open area test site will be performed on selected frequencies found in the preliminary measurement. During this test the EUT will be rotated in the range of 0 ° to 360 °. The measuring antenna will be set to horizontal and vertical polarisation and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

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

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

1) Measure on the selected frequencies at an antenna height of 1 m and a EUT azimuth of 23 °.
2) Move the antenna from 1 m to 4 m and note the maximum value at each frequency.
3) Rotate the EUT by 45 ° and repeat 2) until an azimuth of 337 ° is reached.
4) Repeat 1) to 3) for the other orthogonal antenna polarization.
5) Move the antenna and the turntable to the position where the maximum value is detected.
6) Measure while moving the antenna slowly +/- 1 m.
7) Set the antenna to the position where the maximum value is found.
8) Measure while moving the turntable +/- 45 °.
9) Set the turntable to the azimuth where the maximum value is found.
10) Measure with Final detector (QP and AV) and note the value.
11) Repeat 5) to 10) for each frequency.
12) Repeat 1) to 11) for each orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).

Preliminary and final measurement (1 GHz to 110 GHz)

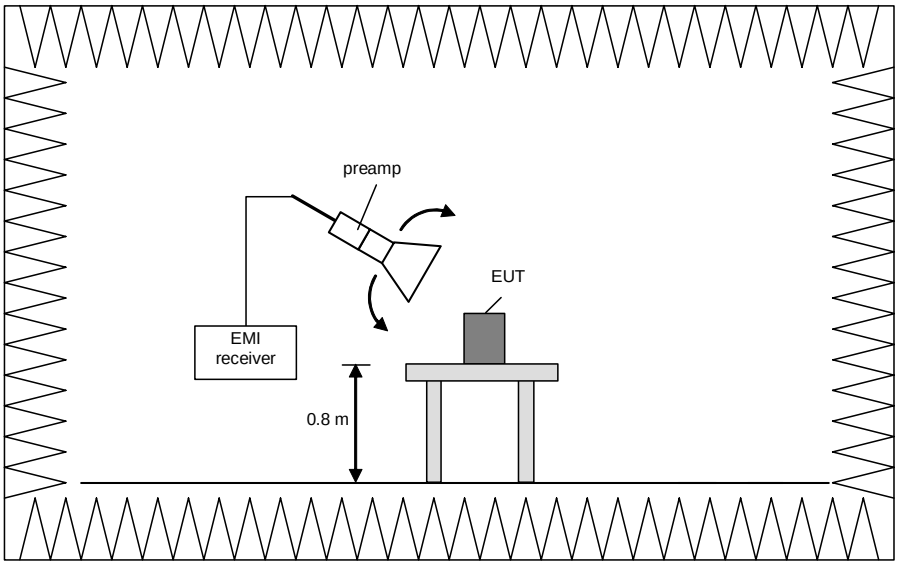
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance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

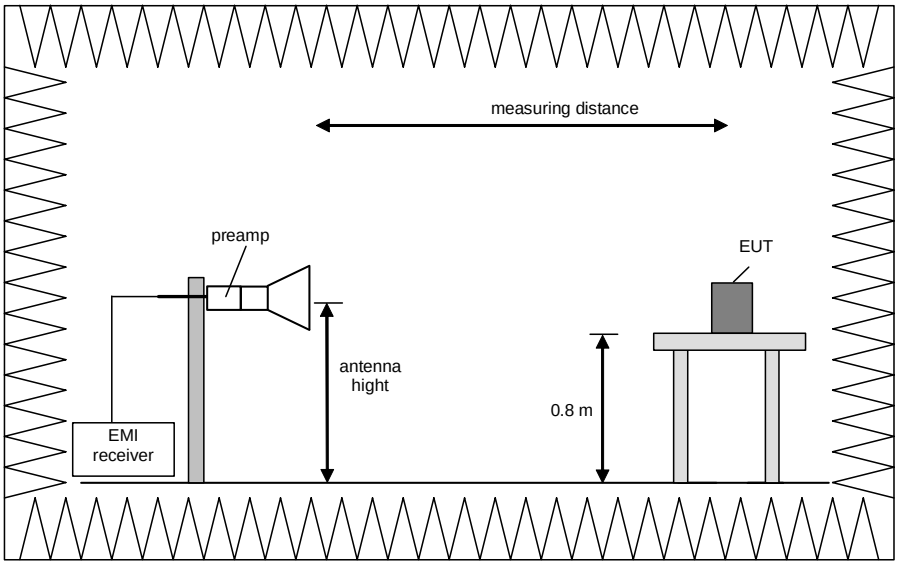


Final measurement (1 GHz to 110 GHz)

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.

5.3.2 Test results

5.3.2.1 Preliminary radiated emission measurement (30 MHz – 1 GHz)

Ambient temperature	20 °C	Relative humidity	40 %

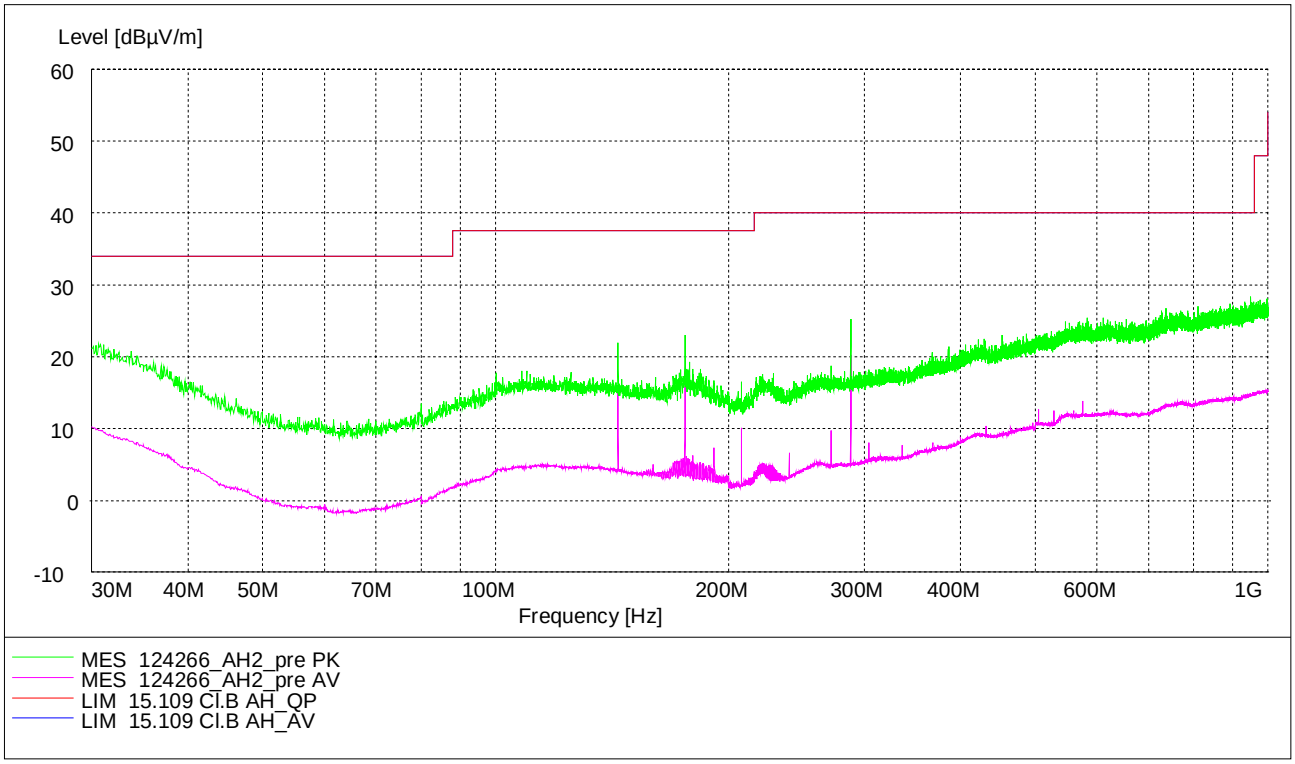
Position of EUT: The EUT was placed on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test setup refer to the pictures in annex A of this test report. No cables were connected to the EUT.

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 3.3 V_{DC} via the carrier board.

Remark: This measurement was carried out by using the external ¼-wave antenna type Antenna Factor ANT-2.4-WRT-xxx. As pre-tests have shown the emissions are independent of the operation mode. Therefore this emission measurement was performed in operation mode 7.



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

144.000 MHz, 176.000 MHz and 288.000 MHz.

No frequencies were found inside the restricted bands during the radiated emission test.

These frequencies have to be measured on the open area test site. Please refer to clause 5.3.2.3 for results.

5.3.2.2 Preliminary radiated emission measurement (1 GHz – 25 GHz)

Ambient temperature	20 °C	Relative humidity	30 %

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

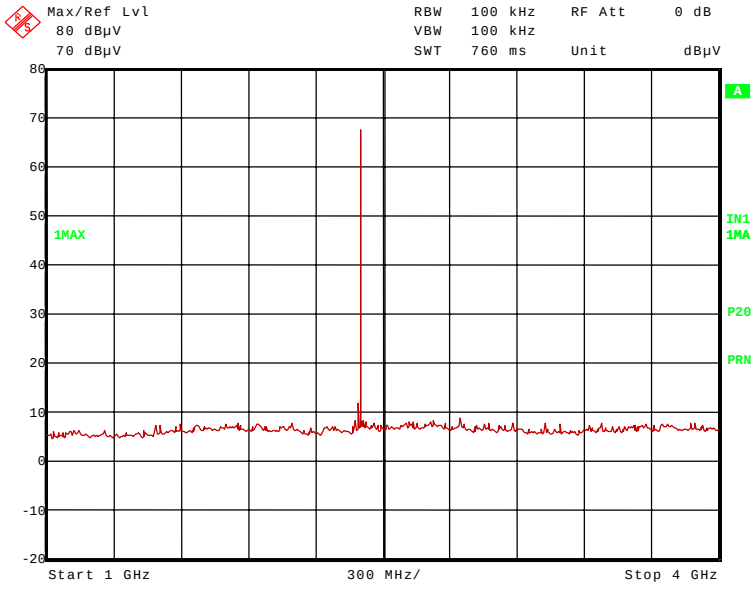
Cable guide: For detail information of test setup refer to the pictures in annex A of this test report. No cables were connected to the EUT.

Test record: All results are shown in the following.

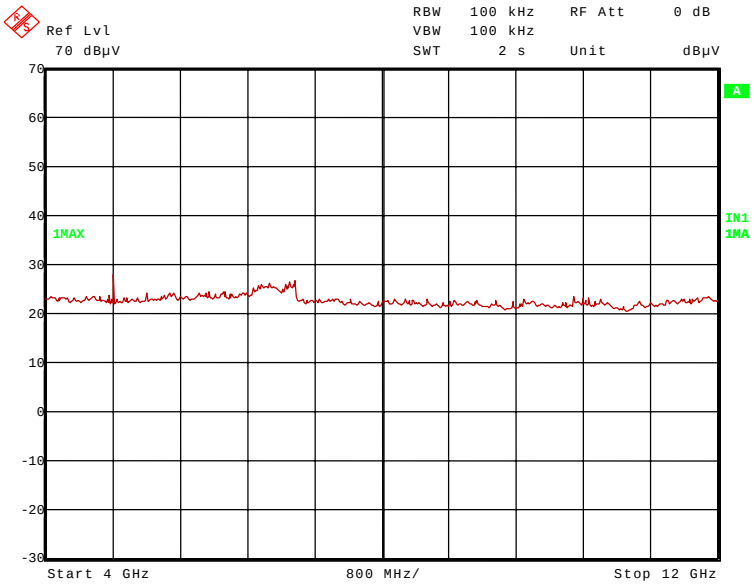
Supply voltage: During all measurements the EUT was supplied with 3.3 V_{DC} via the carrier board.

Transmitter operates at channel 0 (BLE)

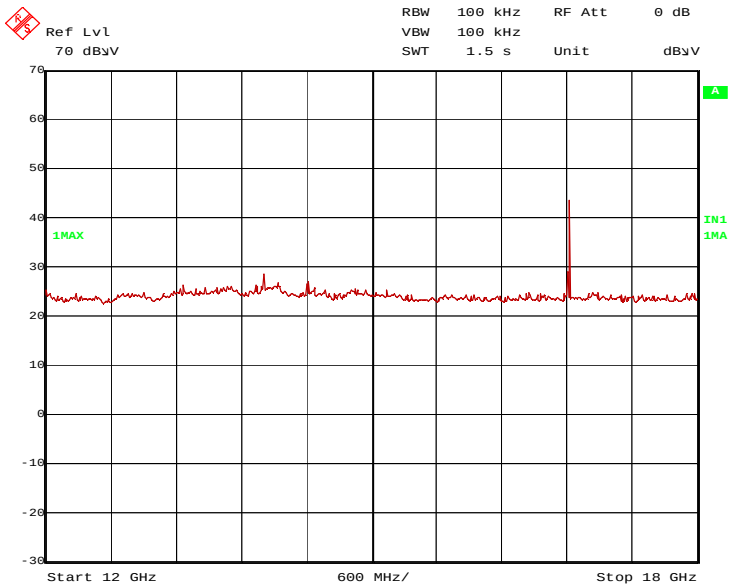
124266_4.wmf: Spurious emissions from 1 GHz to 4 GHz:



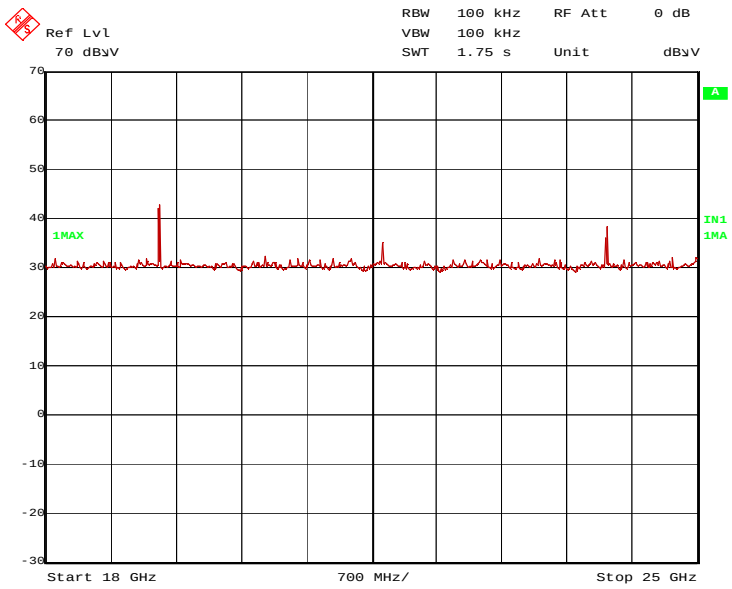
124266_15.wmf: Spurious emissions from 4 GHz to 12 GHz:



124266_24.wmf: Spurious emissions from 12 GHz to 18 GHz:



124266_29.wmf: Spurious emissions from 18 GHz to 25 GHz:



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

- 4.804 GHz and 19.216 GHz.

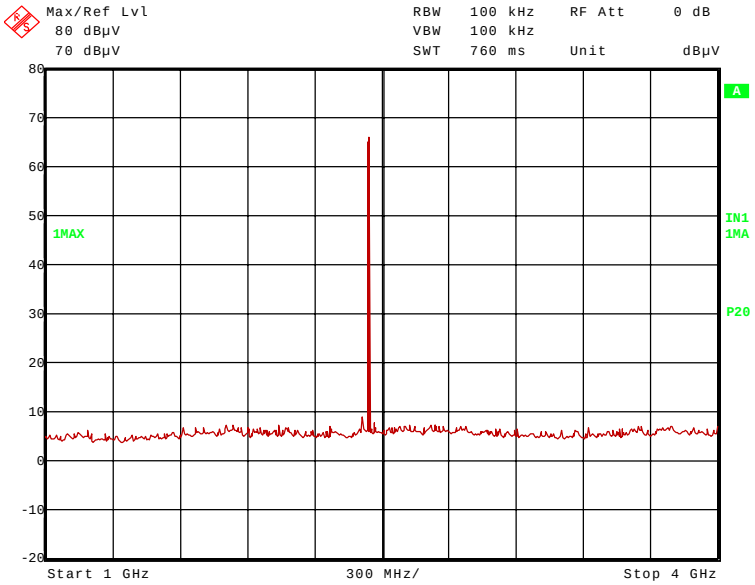
The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 16.814 GHz, 21.618 GHz and 24.02 GHz.

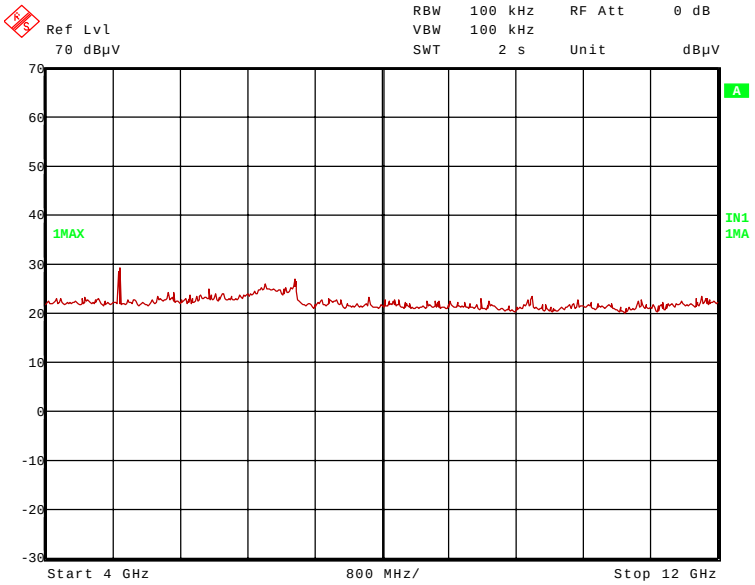
These frequencies have to be measured in a final measurement. Please refer to clause 5.3.2.4 for results.

Transmitter operates at channel 19 (BLE)

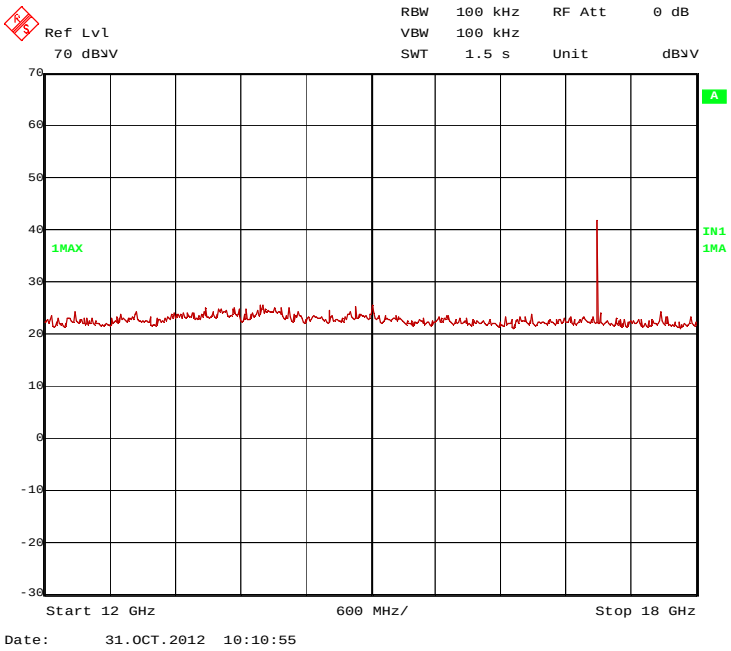
124266_5.wmf: Spurious emissions from 1 GHz to 4 GHz:



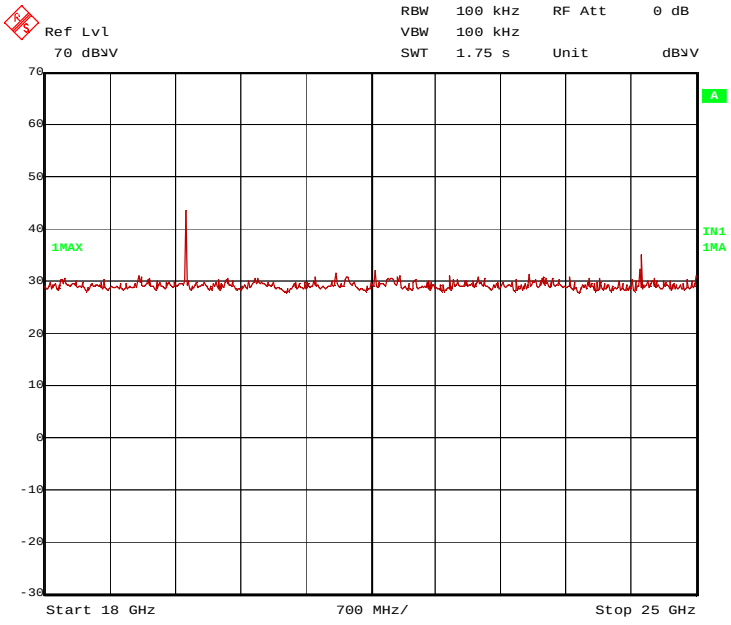
124266_16.wmf: Spurious emissions from 4 GHz to 12 GHz:



124266_25.wmf: Spurious emissions from 12 GHz to 18 GHz:



124266_28.wmf: Spurious emissions from 18 GHz to 25 GHz:



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

- 4.88 GHz and 19.52 GHz.

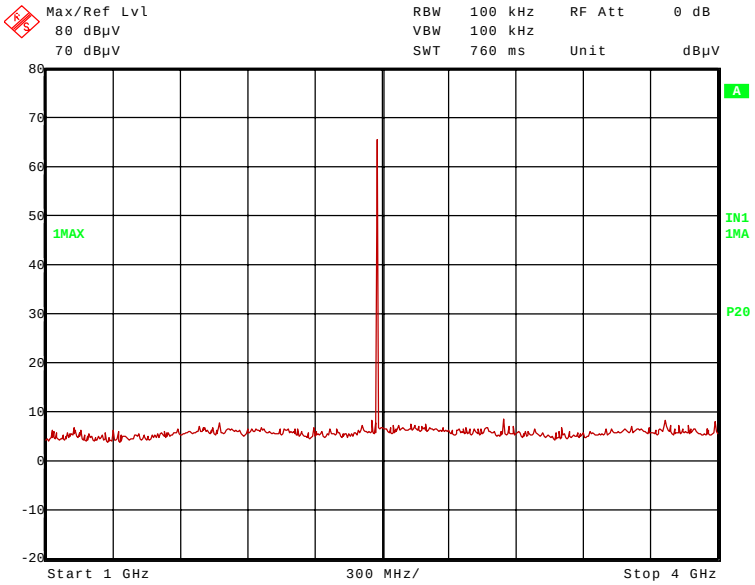
The following frequencies were found outside the restricted bands during the preliminary radiated emission test:

- 17.08 GHz and 24.4 GHz.

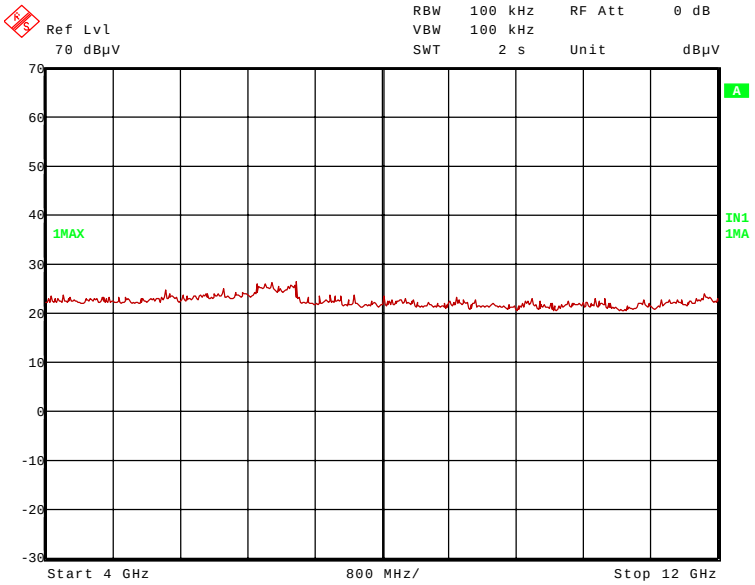
These frequencies have to be measured in a final measurement. Please refer to clause 5.3.2.4 for results.

Transmitter operates at channel 39 (BLE)

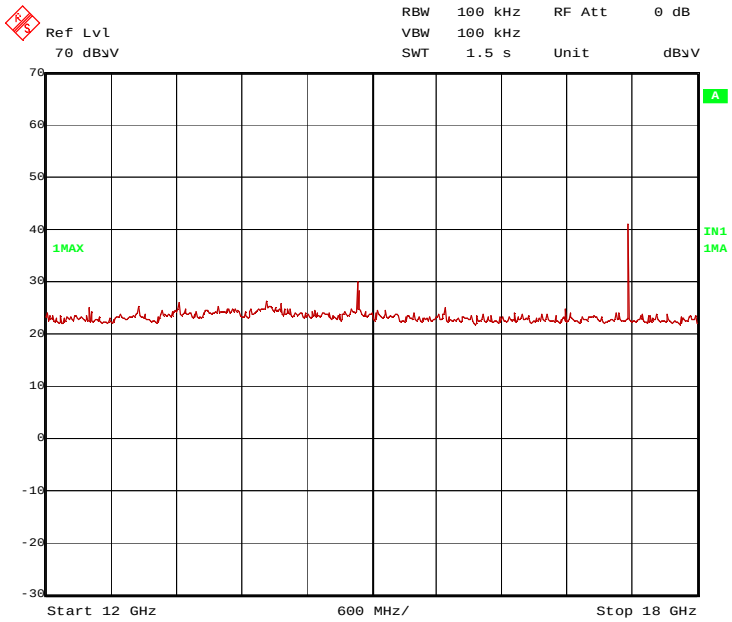
124266_6.wmf: Spurious emissions from 1 GHz to 4 GHz:



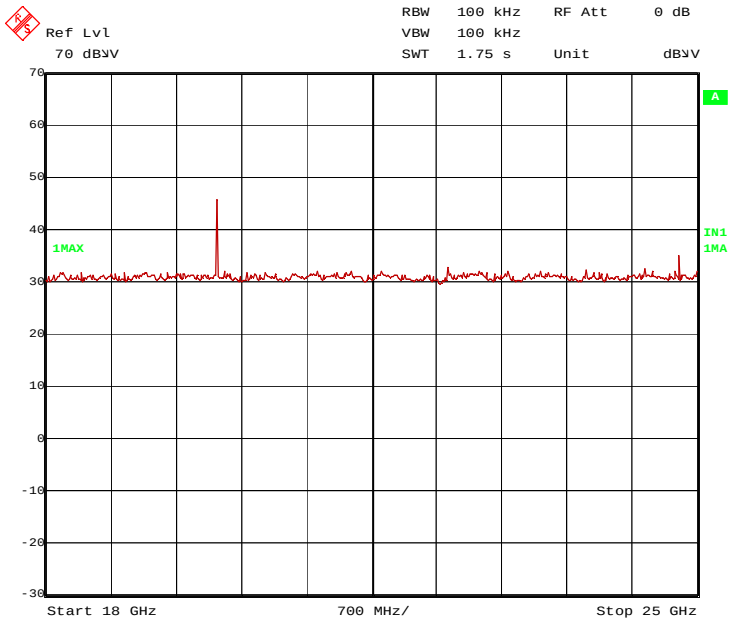
124266_17.wmf: Spurious emissions from 4 GHz to 12 GHz:



124266_26.wmf: Spurious emissions from 12 GHz to 18 GHz:



124266_27.wmf: Spurious emissions from 18 GHz to 25 GHz:



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

- 19.84 GHz.

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

- 14.88 GHz, 17.36 GHz and 24.8 GHz.

These frequencies have to be measured in a final measurement. Please refer to clause 5.3.2.4 for results.

Test equipment used:

29, 31 – 34, 36, 37, 39, 41, 42, 47, 49 – 51, 72

5.3.2.3 Final radiated emission measurement (30 MHz to 1 GHz)

Ambient temperature	20 °C	Relative humidity	45 %

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.

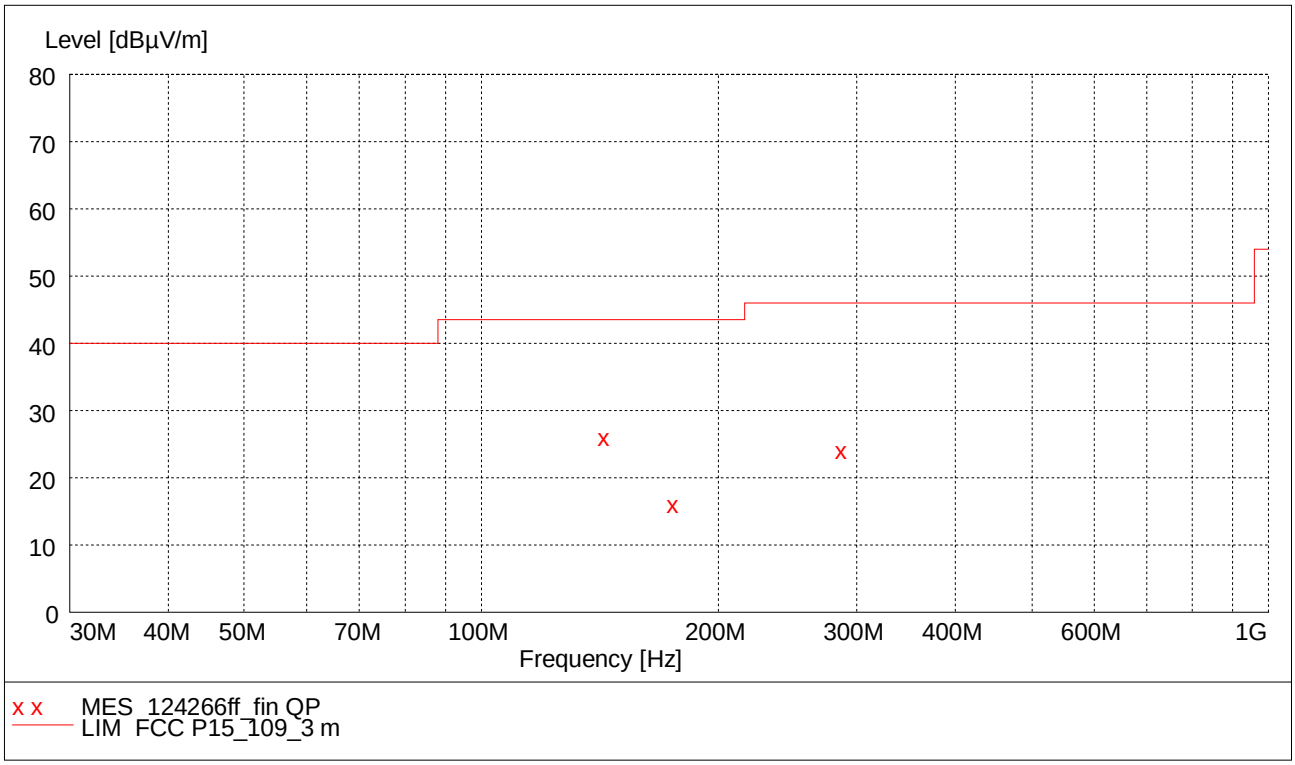
Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 3.3 V DC via the carrier board.

Test results: The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m]

Remark: This measurement was carried out by using the external ¼-wave antenna type Antenna Factor ANT-2.4-WRT-xxx while the is operation in operation mode 7



The results of the standard subsequent measurement on the open area test site are indicated in the table below. The limits as well as the measured results (levels) refer to the above mentioned standard while taking account of the specified requirements for a 3 m measuring distance.

The measurement time with the quasi-peak measuring detector is 1 second.

Result measured with the quasipeak detector:
(This value is marked in the diagram by an x)

Spurious emissions outside restricted bands										
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.	Pos.
144.00	26.4	43.5	17.1	13.3	11.8	1.3	100	135	Vert.	1
176.00	16.4	43.5	27.1	5.1	9.8	1.5	100	75	Vert.	1
288.00	24.5	46.0	21.5	9.7	12.9	1.9	119	89	Hor.	1
Measurement uncertainty				+2.2 dB / -3.6 dB						

The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m]

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
14 – 20

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

Ambient temperature	20 °C	Relative humidity	40 %

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 setup 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 supplied with 3.3 V DC via the carrier board.

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

Transmitter operates at channel 0 (BLE)

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.
2402	100.7	-	-	68.7	28.3	0.0	3.7	150	Vert.	-	1
4804	45.7	74.0	28.3	33.5	32.6	25.7	5.3	150	Hor.	Yes	1
16814	61.0	80.7	19.7	52.2	33.8	27.5	2.5	150	Vert.	No	1
19216	49.7	74.0	24.3	48.3	37.1	38.2	2.5	150	Vert.	Yes	1
21618	45.1	80.7	35.6	43.7	37.2	38.3	2.5	150	Vert.	No	1
24020	46.2	80.7	34.5	45.3	37.2	38.8	2.5	150	Vert.	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.
2402	95.8	-	-	63.8	28.3	0.0	3.7	150	Vert.	-	1
4804	34.7	54.0	19.3	22.5	32.6	25.7	5.3	150	Hor.	Yes	1
16814	44.8	75.8	31.0	36.0	33.8	27.5	2.5	150	Vert.	No	1
19216	33.7	54.0	20.3	32.3	37.1	38.2	2.5	150	Vert.	Yes	1
21618	30.2	75.8	45.6	28.8	37.2	38.3	2.5	150	Vert.	No	1
24020	30.5	75.8	45.3	29.6	37.2	38.8	2.5	150	Vert.	No	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at channel 19 (BLE)

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.
2440	98.4	-	-	66.3	28.4	0.0	3.7	150	Vert.	-	1
4880	46.8	74.0	27.2	34.4	32.8	25.7	5.3	150	Hor.	Yes	1
17080	55.9	78.4	22.5	47.0	33.8	27.4	2.5	150	Vert.	No	1
19520	51.9	74.0	22.1	50.5	37.1	38.2	2.5	150	Vert.	Yes	1
24400	43.8	78.4	34.6	43.0	37.2	38.9	2.5	150	Vert.	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.
2440	93.5	-	-	61.4	28.4	0.0	3.7	150	Vert.	-	1
4880	36.1	54.0	17.9	23.7	32.8	25.7	5.3	150	Hor.	Yes	1
17080	35.2	73.5	38.3	26.3	33.8	27.4	2.5	150	Vert.	No	1
19520	35.5	54.0	18.5	34.1	37.1	38.2	2.5	150	Vert.	Yes	1
24400	29.0	73.5	44.5	28.2	37.2	38.9	2.5	150	Vert.	No	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at channel 39 (BLE)

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.
2480	98.3	-	-	66.0	28.5	0.0	3.8	150	Vert.	-	1
14880	46.0	78.3	32.3	36.5	33.7	26.7	2.5	150	Vert.	No	1
17360	81.2	78.3	-2.9	44.8	33.9	0.0	2.5	150	Vert.	No	1
19840	49.9	74.0	24.1	48.7	37.0	38.3	2.5	150	Vert.	Yes	1
24800	41.0	78.3	37.3	40.2	37.3	39.0	2.5	150	Vert.	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.
2480	93.4	-	-	61.1	28.5	0.0	3.8	150	Vert.	-	1
14880	31.3	73.4	42.1	21.8	33.7	26.7	2.5	150	Vert.	No	1
17360	62.8	73.4	10.6	26.4	33.9	0.0	2.5	150	Vert.	No	1
19840	34.0	54.0	20.0	32.8	37.0	38.3	2.5	150	Vert.	Yes	1
24800	28.1	73.4	45.3	27.3	37.3	39.0	2.5	150	Vert.	No	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Test: Passed

Test equipment used:
29, 31 – 34, 36, 37, 39, 41, 42, 47, 49 – 51, 72

6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
14	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
15	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	02/15/2010	02/2014
16	Controller	MCU	Maturo	MCU/043/971107	480832	-	-
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	28/09/2011	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	AS620P	Deisel	620/375	480325	-	-
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.)	
41	RF-cable No. 3	Sucoflex 106B	Huber&Suhner	0563/6B	480670	Weekly verification (system cal.)	
42	RF-cable No. 40	Sucoflex 106B	Huber&Suhner	0708/6B	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.)	
47	RF-cable No. 36	Sucoflex 106B	Huber&Suhner	0587/6B	480865	Weekly 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
72	4 GHz High Pass Filter	WHKX4.0/18G-8SS	Wainwright Instruments	1	480587	Weekly verification (system cal.)	

7 REPORT HISTORY

Report Number	Date	Comment
F124266E2	12 November 2012	Document created

8 LIST OF ANNEXES

ANNEX A TEST SETUP PHOTOS 5 pages

124266_1.JPG	cB-0946 with ¼-wave antenna, test setup fully anechoic chamber
124266_2.JPG	cB-0946 with ¼-wave antenna; test setup fully anechoic chamber
124266_3.JPG	cB-0946 with ¼-wave antenna, test setup fully anechoic chamber
124266_4.JPG	cB-0946 with ¼-wave antenna, test setup fully anechoic chamber
124266_5.JPG	cB-0946 with ¼-wave antenna, test setup open area test site

ANNEX B INTERNAL PHOTOS 6 pages

124266_10.JPG	cB-0946 mounted on the cB-0903-03 (carrier board)
124266_12.JPG	cB-0946 with antenna connector, PCB top view
124266_11.JPG	cB-0946 PCB, bottom view
124266_13.JPG	cB-0946 Shielding removed, top view
124266_7.JPG	cB-0946 mounted on cB-0903-03 with connected ANT-2.4-WRT-xxx
124266_8.JPG	ANT-2.4-WRT-xxx