

Test Report

Report Number: F124266E1

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] **FCC Public Notice DA 00-705 (March 2000)**
- [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.

Test engineer: Manuel BASTERT	Name <hr/> Name	 Signature	12 November 2012 <hr/> Date
Authorized reviewer: Bernd STEINER	<hr/> Name	 Signature	12 November 2012 <hr/> Date

RESERVATION

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1 IDENTIFICATION

1.1 Applicant

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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 39	RX:	2441 MHz	TX:	2441 MHz
Channel 78	RX:	2480 MHz	TX:	2480 MHz

Fulfils Bluetooth specification: *	3.0 with EDR (class 1) and 4.0 (BLE)					
Adaptive frequency hopping: *	Yes					
Antenna type: *	ANT-2.4-WRT-xxx (external 1/4 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.

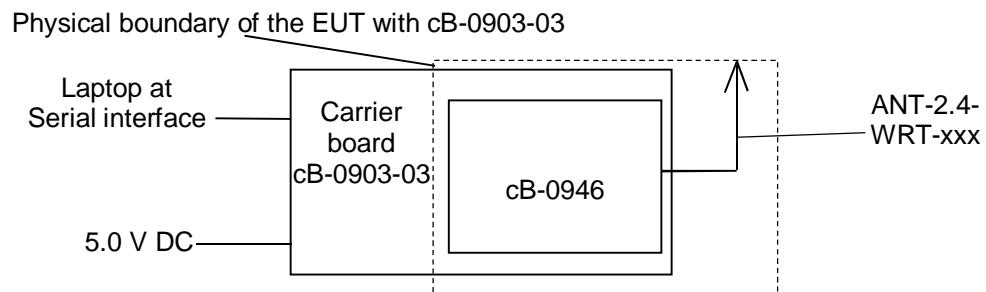
The tests were carried out with an unmodified sample with an antenna connector (cB-0946-A2-02), sample marked with "82"

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:

Operation mode	Description of the operation mode	Modulation	Data rate / Mbps
1	Continuous transmitting on 2402 MHz	GFSK	1
1a		$\pi/4$ -DQPSK	2
1b		8DPSK	3
2	Continuous transmitting on 2441 MHz	GFSK	1
2a		$\pi/4$ -DQPSK	2
2b		8DPSK	3
3	Continuous transmitting on 2480 MHz	GFSK	1
3a		$\pi/4$ -DQPSK	2
3b		8DPSK	3
4	Transmitter hopping on all channels	GFSK	1
4a		$\pi/4$ -DQPSK	2
4b		8DPSK	3



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 output power	1, 1a, 1b, 2, 2a, 2b, 3, 3a and 3b (1-, 2- and 3 Mbps)
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 output power	2400.0 - 2483.5	15.247 (b) (1)	A8.4 (2) [4]	Passed	8 et seq.
Band edge compliance	2400.0 - 2483.5	15.247 (d)	A8.5 [4]	Passed	11 et seq.
Radiated emissions (transmitter)	0.009 - 25,000	15.205 (a) 15.209 (a)	7.2.2 [5] 2.5 [4]	Passed	20 et seq.

5 TEST RESULTS

5.1 Maximum peak output power

5.1.1 Method of measurement

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. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed. The EUT has to be switched on and the hopping function has to be disabled.

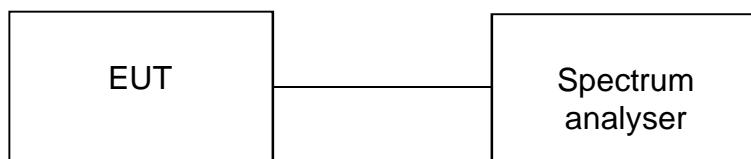
The following spectrum analyser settings shall be used:

- Span: Approx. 5 times the 20 dB bandwidth, centred on a hopping channel.
- Resolution bandwidth: > the 20 dB bandwidth of the emission being measured.
- Video bandwidth: \geq 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 indicated level is the peak output power, which has to be corrected with the value of the cable loss and an external attenuation (if necessary).

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

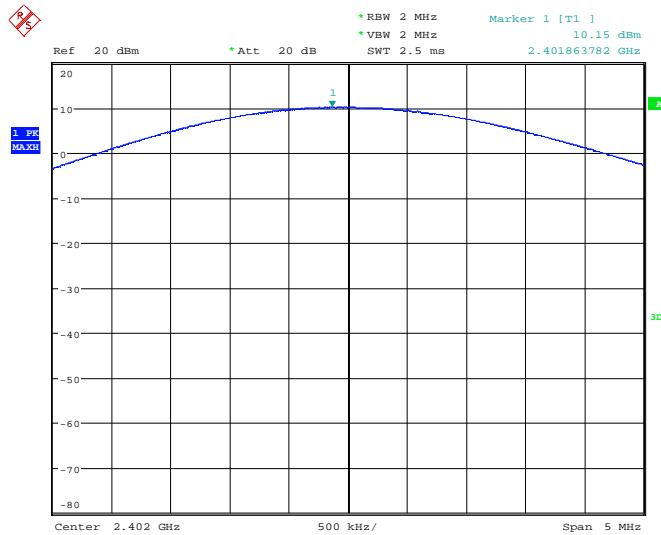
Test set-up:



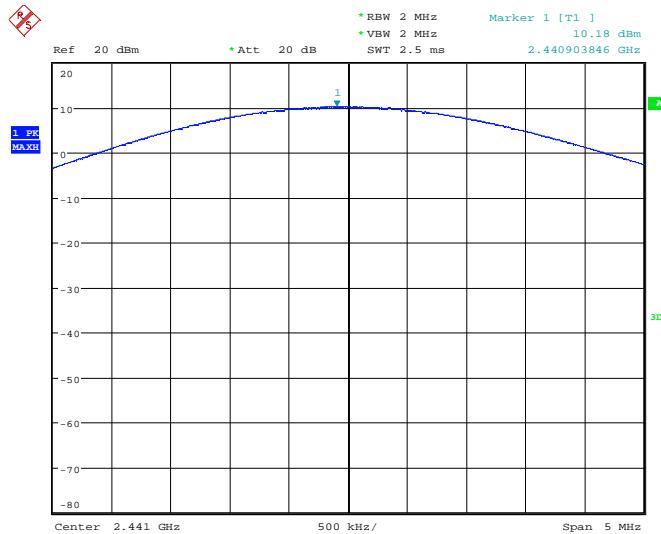
5.1.2 Test results

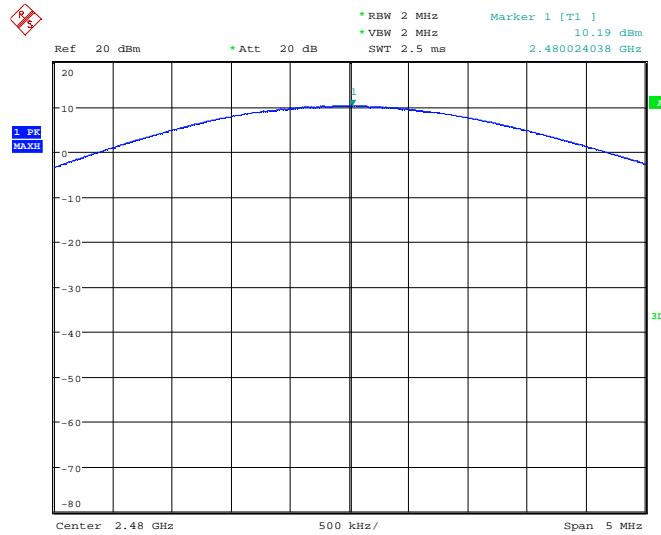
Ambient temperature	21 °C	Relative humidity	45 %
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124266_LOW.wmf: Maximum peak output power at channel 0 (operation mode 1):



124266_MID.wmf: Maximum peak output power at channel 39 (operation mode 2):



124266 HIGH.wmf: Maximum peak output power at channel 78 (operation mode 3):


Operation mode	Channel number	Channel frequency [MHz]	Maximum peak output power [dBm]	Antenna gain [dBi]	Peak power limit [dBm]
1	0	2402	10.2	1.0	30.0
2	39	2441	10.2	1.0	30.0
3	78	2480	10.2	1.0	30.0
Measurement uncertainty					+0.66 dB / -0.72 dB

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

30

5.2 Band-edge compliance

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: \geq the resolution bandwidth.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

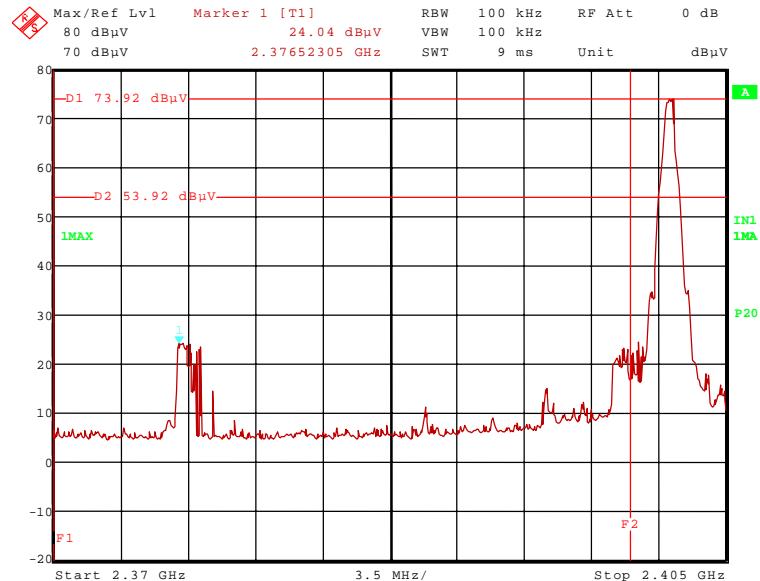
After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 20 dB below the first line (or the peak marker). The frequency line shall be set on the edge of the assigned frequency band. Set the second marker 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.

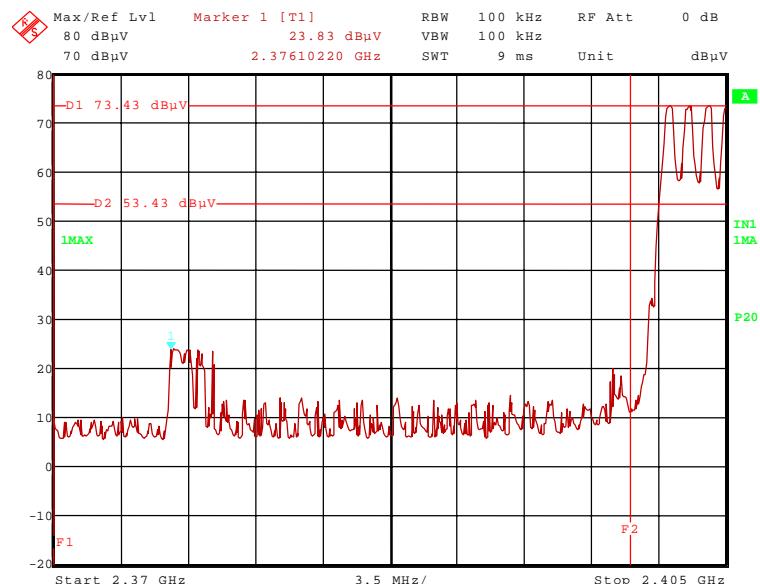
5.2.2 Test result

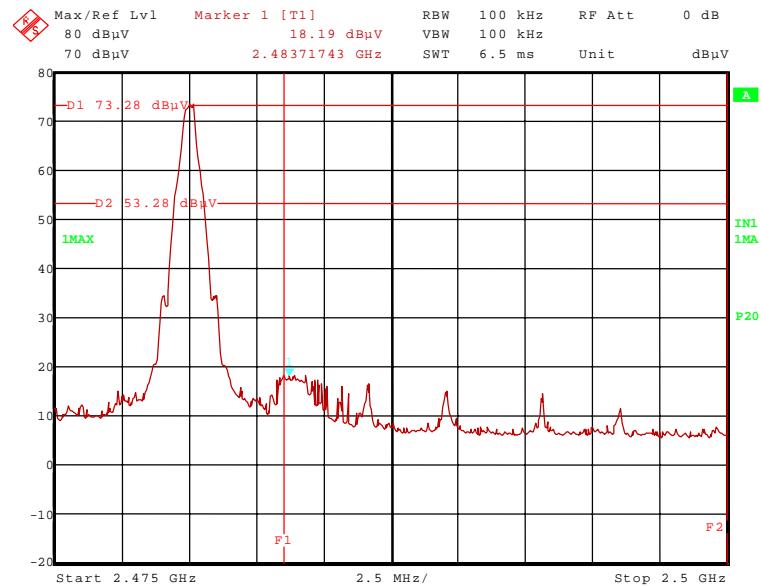
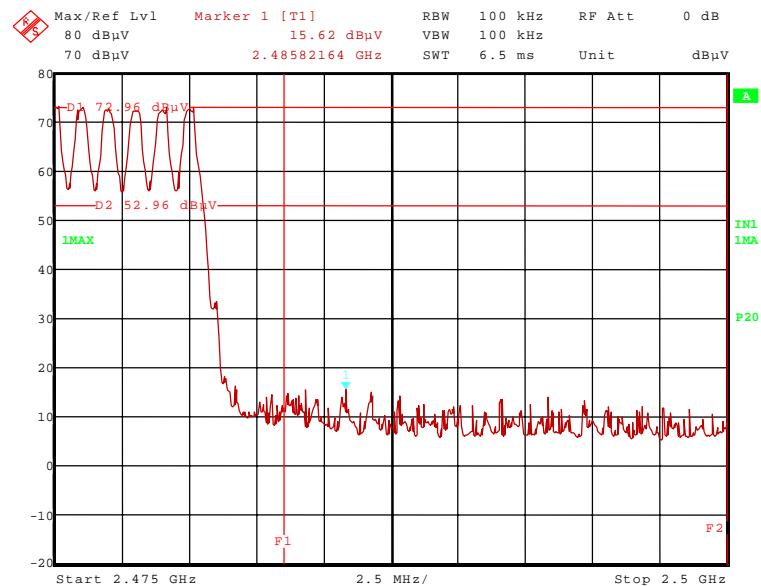
Ambient temperature	21 °C	Relative humidity	40 %
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123266_11.wmf: Radiated band-edge compliance, lower band edge, hopping off (operation mode 1):



124266_12.wmf: Radiated band-edge compliance, lower band edge, hopping on (operation mode 4):



124266_9.wmf: Radiated band-edge compliance, upper band edge, hopping off (operation mode 3):

124266_10.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 dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
2402.00	105.2	-	-	73.2	28.3	0.0	3.7	150	Vert.	-
2376.52	54.8	74.0	19.3	22.9	28.2	0.0	3.7	150	Vert.	Yes
Result measured with the average detector:										
Frequency MHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
2402.00	96.6	-	-	64.6	28.3	0.0	3.7	150	Vert.	-
2376.52	26.0	54.0	28.0	-5.9	28.2	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 dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
2402.00	105.2	-	-	73.2	28.3	0.0	3.7	150	Vert.	-
2376.10	55.1	74.0	18.9	23.2	28.2	0.0	3.7	150	Vert.	Yes
Result measured with the average detector:										
Frequency MHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
2402.00	64.7	-	-	32.7	28.3	0.0	3.7	150	Vert.	-
2376.10	26.0	54.0	28.0	-5.9	28.2	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 dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
2480.00	105.7	-	-	73.4	28.5	0.0	3.8	150	Vert.	-
2483.72	49.6	74.0	24.4	17.3	28.5	0.0	3.8	150	Vert.	Yes
Result measured with the average detector:										
Frequency MHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
2480.00	102.9	-	-	70.6	28.5	0.0	3.8	150	Vert.	-
2483.72	29.4	54.0	24.6	-2.9	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 dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
2480.00	105.2	-	-	72.9	28.5	0.0	3.8	150	Vert.	-
2485.82	46.1	74.0	27.9	13.8	28.5	0.0	3.8	150	Vert.	Yes
Result measured with the average detector:										
Frequency MHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
2480.00	64.2	-	-	31.9	28.5	0.0	3.8	150	Vert.	-
2485.82	26.9	54.0	27.1	-5.4	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 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 final measurement carried out on an open area test side with reflecting ground plane and various 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.

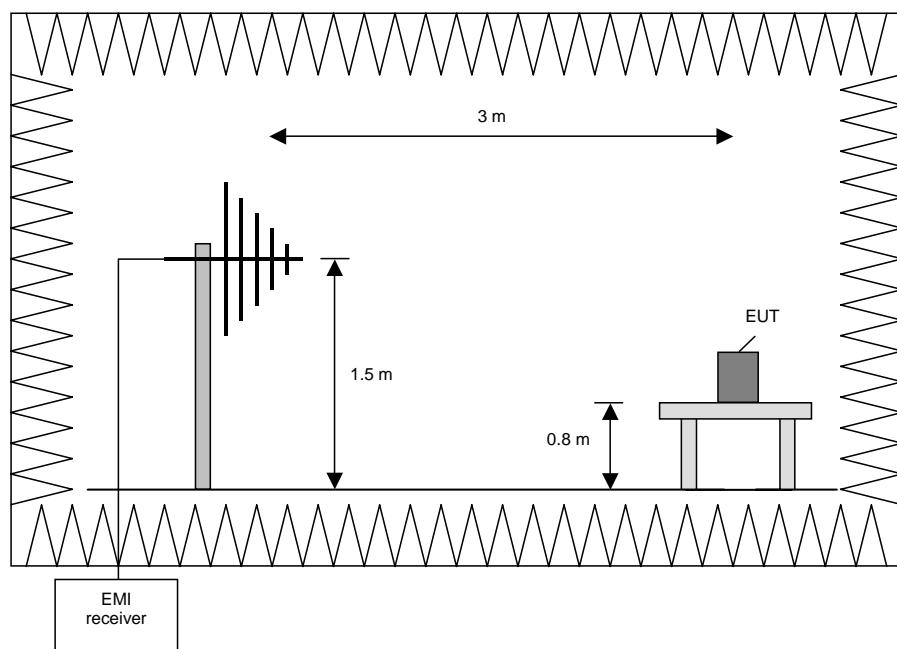
Preliminary measurement (30 MHz to 1 GHz)

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 setup 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:

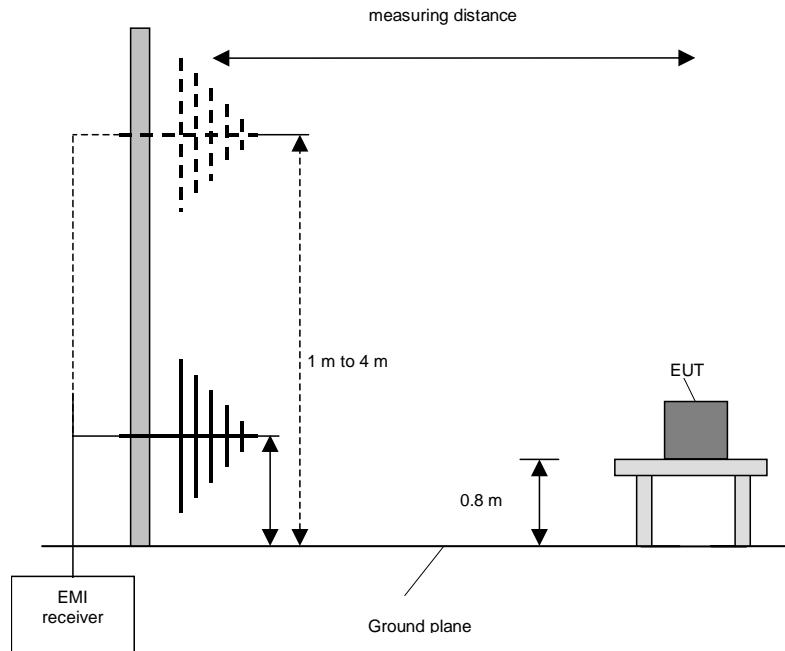
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the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

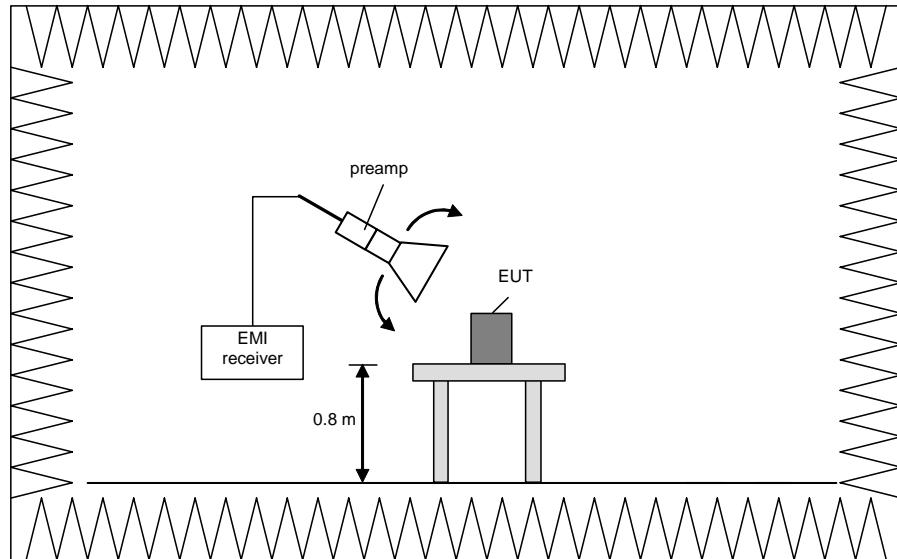
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance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

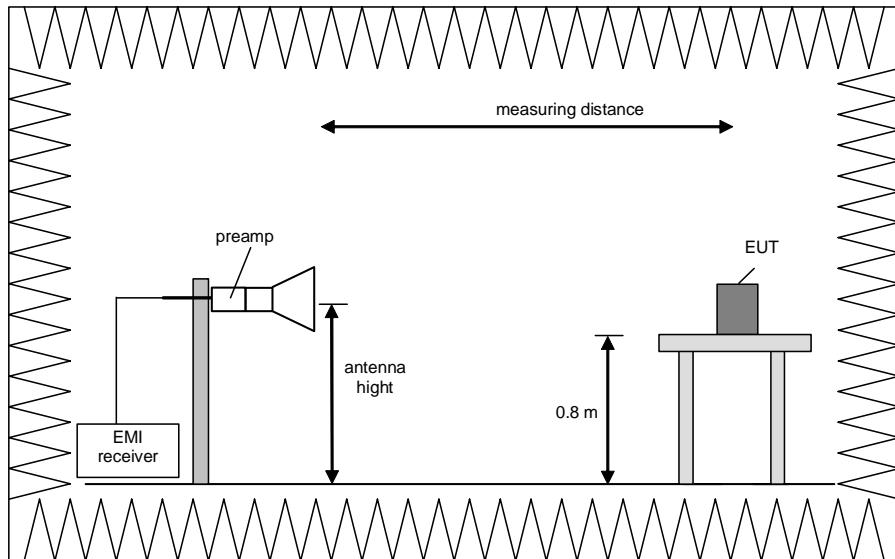


Final measurement (1 GHz to 110 GHz)

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 measurement (30 MHz to 1 GHz)

Ambient temperature	20 °C	Relative humidity	40 %
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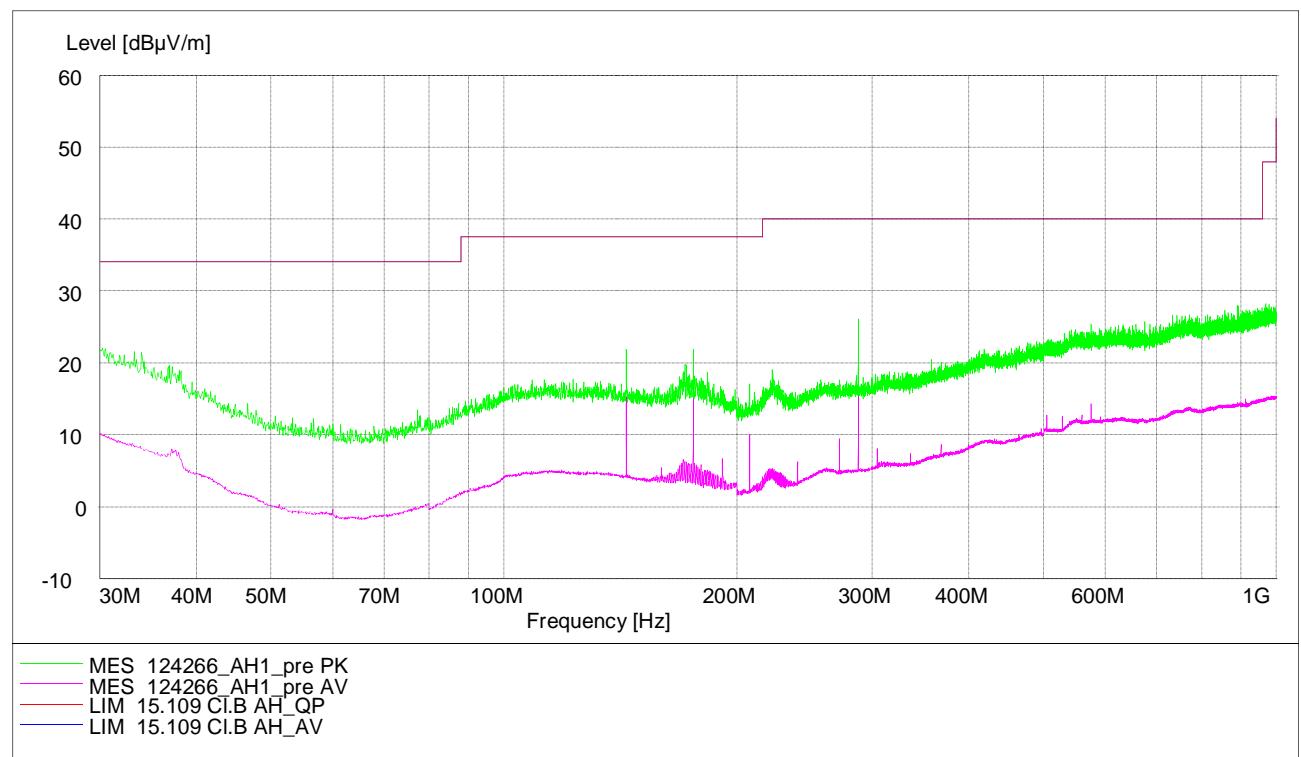
Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test setup 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.

Remark: This measurement was carried out by using the external 1/4-wave antenna type Antenna Factor ANT-2.4-WRT-xxx. As pre-tests have shown, the emissions are independent of the operation mode. So the test was carried out at 2441 MHz with coding scheme DH5.



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 details.

5.3.2.2 Preliminary measurement (1 GHz to 25 GHz)

Ambient temperature	20 °C	Relative humidity	45 %
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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.

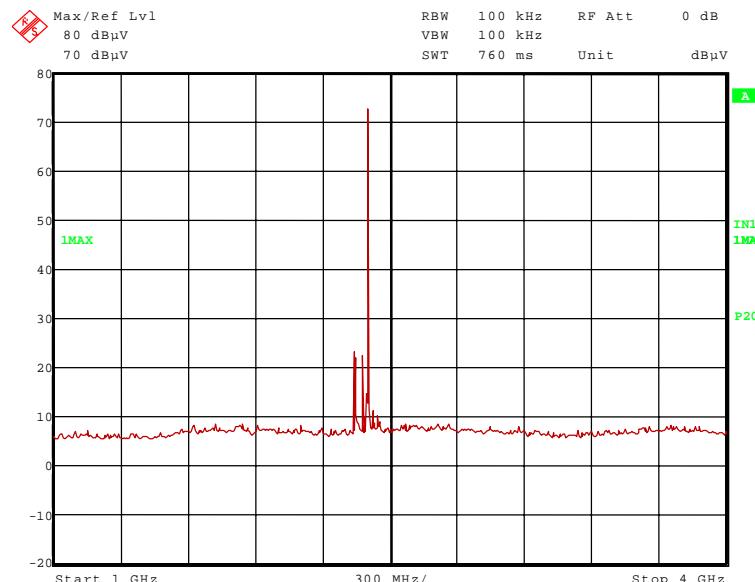
Test record: All results are shown in the following.

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

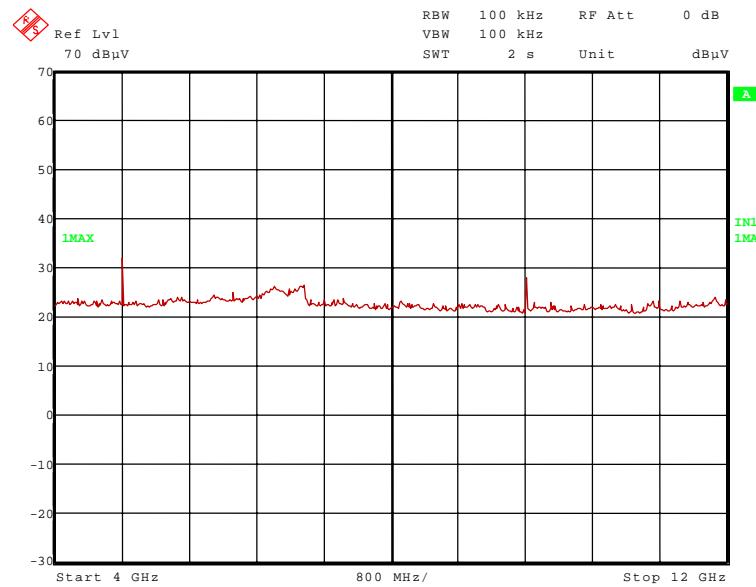
Remark: This measurement was carried out by using the external 1/4-wave antenna type Antenna Factor ANT-2.4-WRT-xxx.

Channel 0 (2402 MHz, DH5)

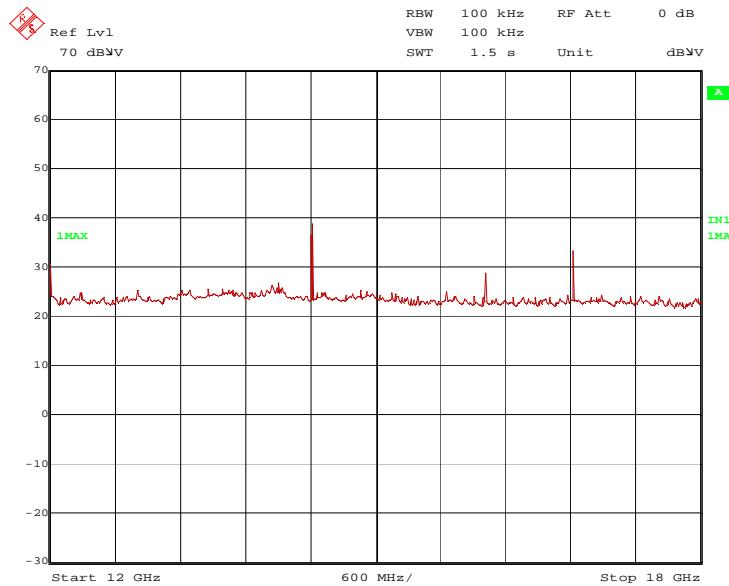
124266_1.wmf: Spurious emissions from 1 GHz to 4 GHz:



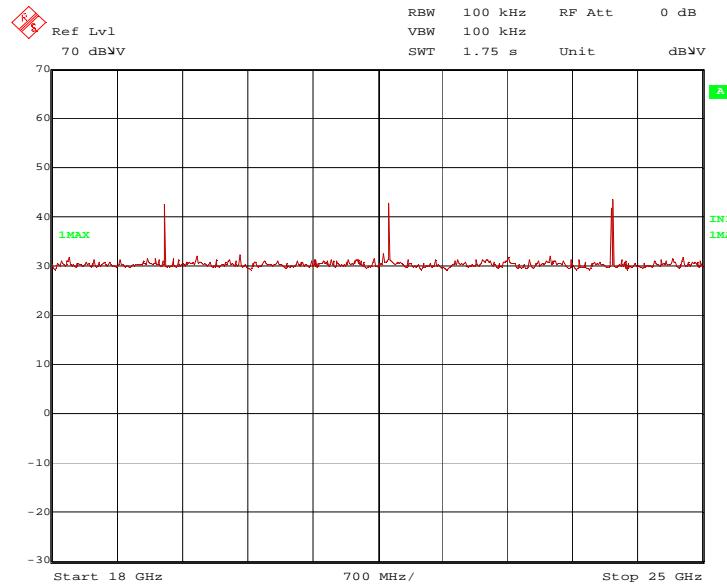
124266_18.wmf: Spurious emissions from 4 GHz to 12 GHz:



124266_21.wmf: Spurious emissions from 12 GHz to 18 GHz:



124266_30.wmf: Spurious emissions from 18 GHz to 25 GHz:



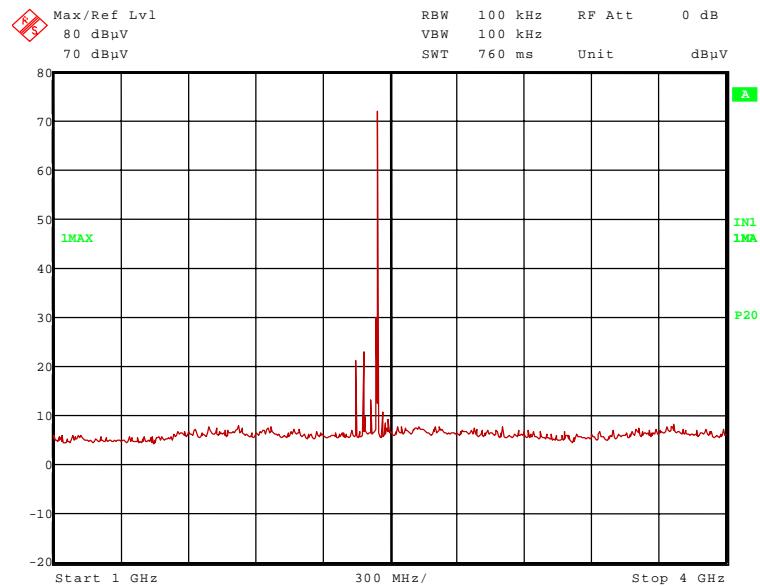
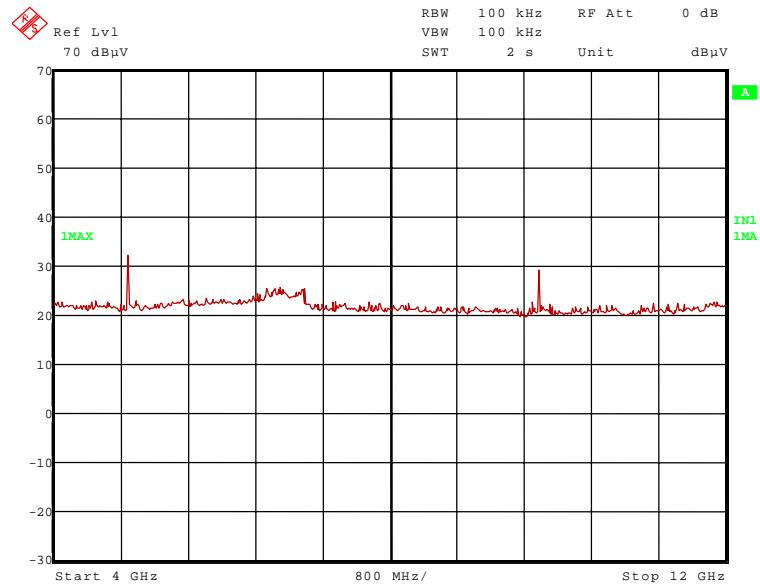
The following frequencies were found inside the restricted bands during the preliminary radiated emission test:

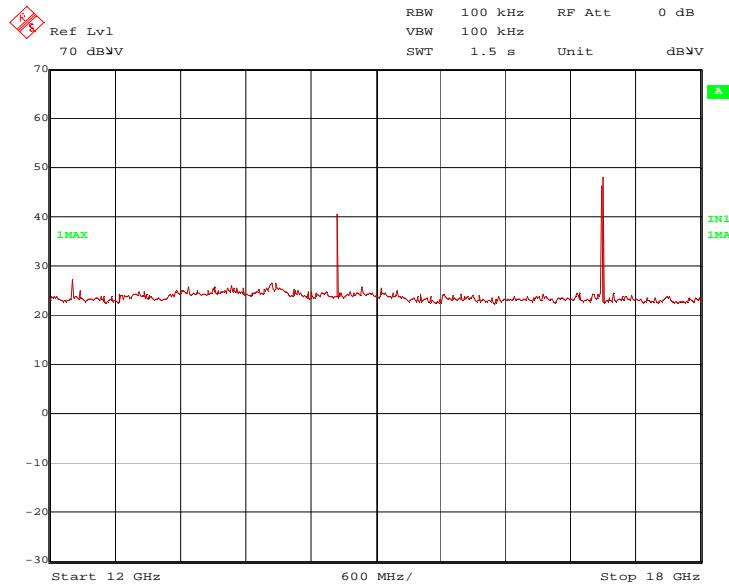
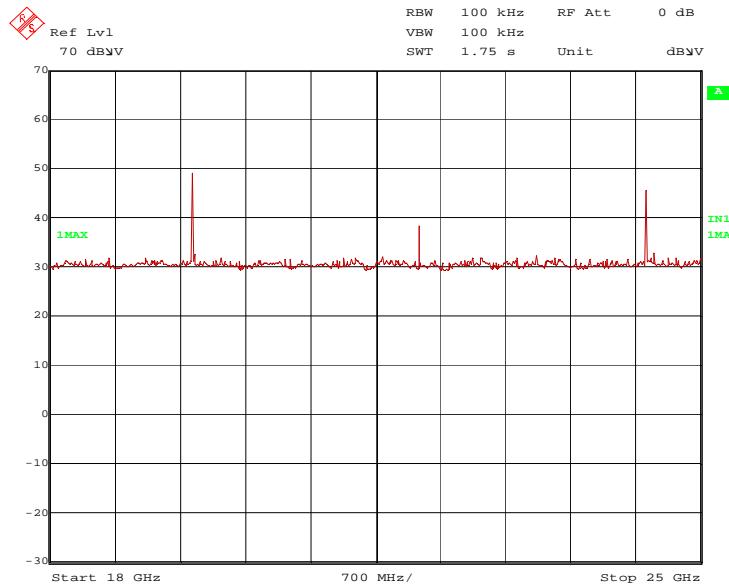
- 2.343 GHz, 2.376 GHz, 4.804 GHz, 12.01 GHz, 16.008 GHz and 19.216 GHz.

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

- 9.608 GHz, 14.412 GHz 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.

Channel 39 (2441 MHz, DH5)
124266_2.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):

124266_19.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 2):


124266_22.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 2):

124266_31.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 2):


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

- 2.343 GHz, 2.38 GHz, 4.882 GHz 12.205 GHz and 19.528 GHz.

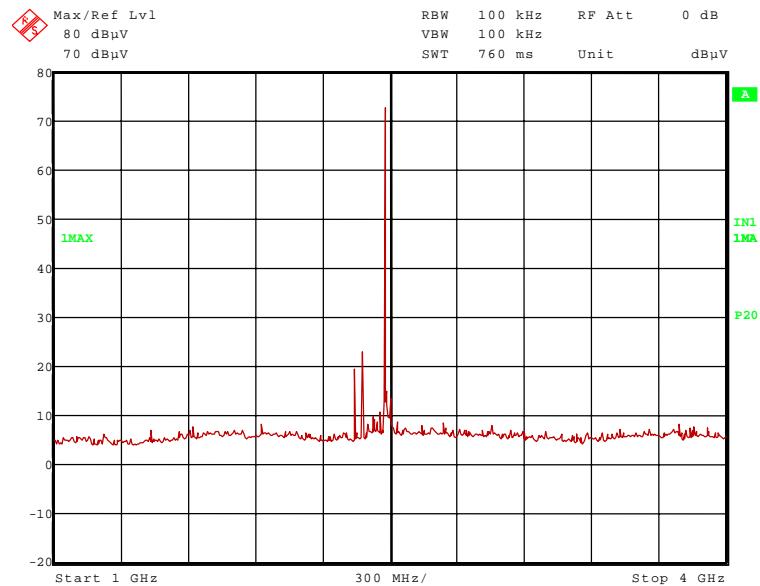
The following frequencies were found outside the restricted bands during the preliminary radiated emission test:

- 9.764 GHz, 14.646 GHz, 17.087 GHz, 21.969 GHz and 24.41 GHz.

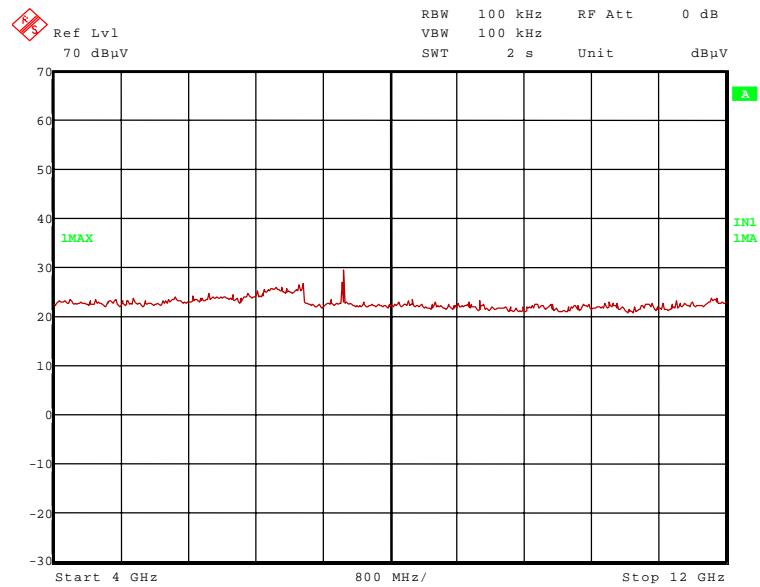
These frequencies have to be measured in a final measurement. Please refer to clause 5.3.2.4 for results.

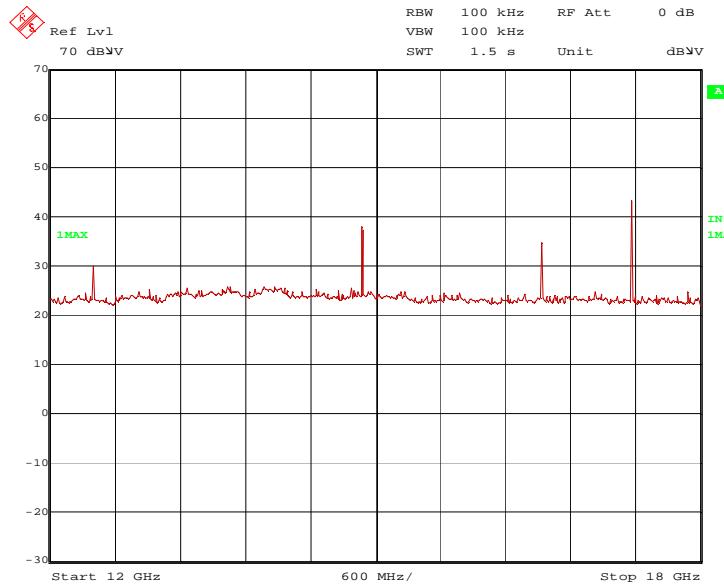
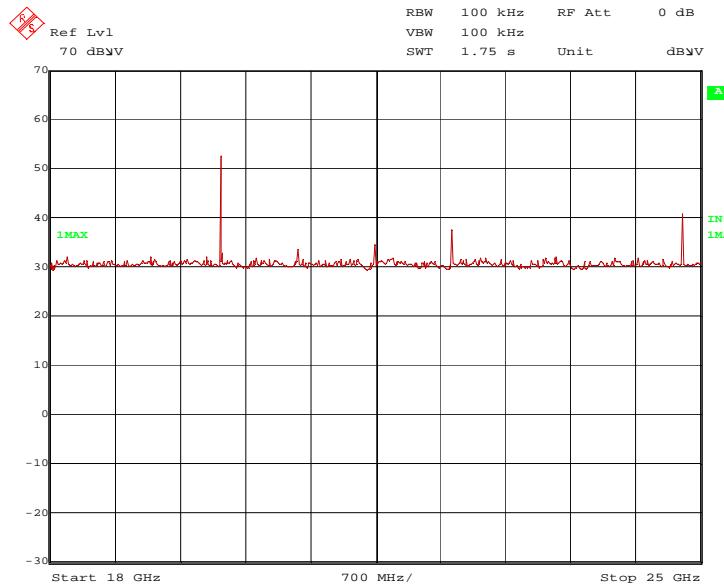
Channel 78 (2480 MHz, DH5)

124266_3.wmf: Spurious emissions from 1 GHz to 4 GHz:



124266_20.wmf: Spurious emissions from 4 GHz to 12 GHz:



124266_23.wmf: Spurious emissions from 12 GHz to 18 GHz:

124266_32.wmf: Spurious emissions from 18 GHz to 25 GHz:


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

- 2.343 GHz, 2.38GHz, 7.44 GHz, 12.4 GHz, 19.84 GHz and 22.32 GHz.

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

- 14.88 GHz, 16.524 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 FOR THE TEST:

29, 31 - 36, 43 – 45, 49, 72

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

Ambient temperature	20 °C	Relative humidity	45 %
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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.

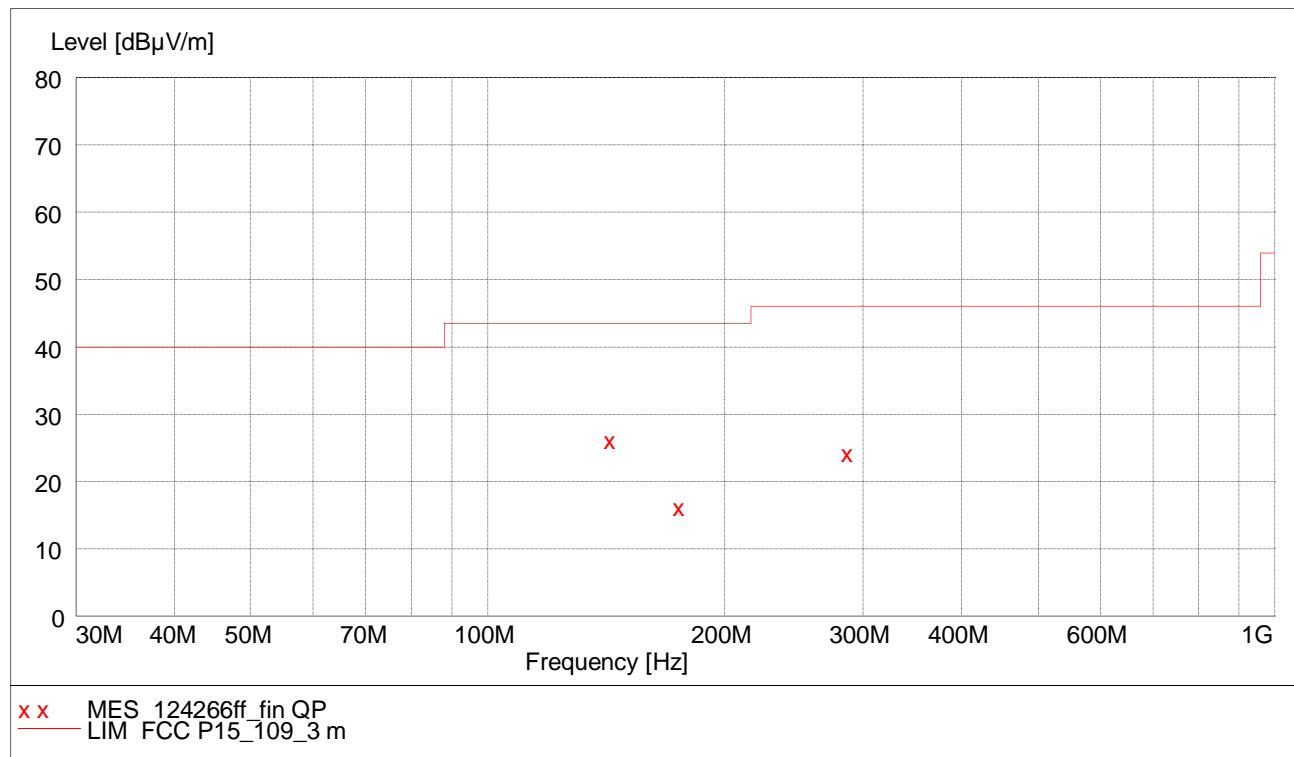
Test record: All results are shown in the following.

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 [dB μ V/m] = reading [dB μ V] + cable loss [dB] + antenna factor [dB/m]

Remark: This measurement was carried out by using the external 1/4-wave antenna type Antenna Factor ANT-2.4-WRT-xxx.



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 dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	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:

$$\text{Result [dB}\mu\text{V/m]} = \text{reading [dB}\mu\text{V]} + \text{cable loss [dB]} + \text{antenna factor [dB/m]}$$

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	45 %
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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 by the carrier board.

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

Remark: This measurement was carried out by using the external ¼-wave antenna type Antenna Factor ANT-2.4-WRT-xxx.

Transmitter operates at channel 0 (2402 MHz, DH5):

Result measured with the peak detector:

Frequency MHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2343	63.0	74.0	11.0	31.3	28.1	0.0	3.6	150	Vert.	Yes	1
2376	62.7	74.0	11.3	30.8	28.2	0.0	3.7	150	Vert.	Yes	1
2402	104.8	-	-	72.8	28.3	0.0	3.7	150	Vert.	-	1
4804	48.2	74.0	25.8	36.0	32.6	25.7	5.3	150	Vert.	Yes	1
9608	35.9	84.8	48.9	14.7	37.3	23.9	7.8	150	Vert.	No	1
12010	52.7	74.0	21.3	42.5	33.6	25.9	2.5	150	Vert.	Yes	1
14412	56.3	84.8	28.5	46.6	33.7	26.5	2.5	150	Vert.	No	1
16008	42.2	74.0	31.8	33.2	33.8	27.3	2.5	150	Vert.	Yes	1
16814	46.3	84.8	38.5	37.5	33.8	27.5	2.5	150	Vert.	No	1
19216	48.9	74.0	25.1	47.5	37.1	38.2	2.5	150	Hor.	Yes	1
21618	48.6	84.8	36.2	47.2	37.2	38.3	2.5	150	Hor.	No	1
24020	50.1	84.8	34.7	49.2	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 dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2343	45.6	54.0	8.4	13.9	28.1	0.0	3.6	150	Vert.	Yes	1
2376	45.2	54.0	8.8	13.3	28.2	0.0	3.7	150	Vert.	Yes	1
2402	101.9	-	-	69.9	28.3	0.0	3.7	150	Vert.	-	1
4804	41.2	54.0	12.8	29.0	32.6	25.7	5.3	150	Vert.	Yes	1
9608	24.6	81.9	57.3	3.4	37.3	23.9	7.8	150	Vert.	No	1
12010	39.6	54.0	14.4	29.4	33.6	25.9	2.5	150	Vert.	Yes	1
14412	42.5	81.9	39.4	32.8	33.7	26.5	2.5	150	Vert.	No	1
16008	28.5	54.0	25.5	19.5	33.8	27.3	2.5	150	Vert.	Yes	1
16814	29.9	81.9	52.0	21.1	33.8	27.5	2.5	150	Vert.	No	1
19216	33.9	54.0	20.1	32.5	37.1	38.2	2.5	150	Hor.	Yes	1
21618	33.0	81.9	48.9	31.6	37.2	38.3	2.5	150	Hor.	No	1
24020	34.1	81.9	47.8	33.2	37.2	38.8	2.5	150	Vert.	No	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at channel 39 (2441 MHz. DH5):

Result measured with the peak detector:

Frequency MHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2343	63.5	74.0	10.5	31.8	28.1	0.0	3.6	150	Vert.	Yes	1
2380	63.1	74.0	10.9	31.2	28.2	0.0	3.7	150	Vert.	Yes	1
2441	104.9	-	-	72.8	28.4	0.0	3.7	150	Vert.	-	1
4882	48.9	74.0	25.1	36.5	32.8	25.7	5.3	150	Vert.	Yes	1
9764	37.5	84.9	47.4	16.2	37.3	23.9	7.9	150	Hor.	No	1
12205	44.0	74.0	30.0	33.8	33.6	25.9	2.5	150	Hor.	Yes	1
14646	47.6	84.9	37.3	38.0	33.7	26.6	2.5	150	Hor.	No	1
17087	59.0	84.9	25.9	50.1	33.8	27.4	2.5	150	Hor.	No	1
19528	56.6	74.0	17.4	55.2	37.1	38.2	2.5	150	Hor.	Yes	1
21969	46.0	84.9	38.9	44.6	37.2	38.3	2.5	150	Hor.	No	1
24410	48.7	84.9	36.2	47.9	37.2	38.9	2.5	150	Hor.	No	1
Measurement uncertainty										+2.2 dB / -3.6 dB	

Result measured with the average detector:

Frequency MHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2343	45.6	54.0	8.4	13.9	28.1	0.0	3.6	150	Vert.	Yes	1
2380	45.1	54.0	8.9	13.2	28.2	0.0	3.7	150	Vert.	Yes	1
2441	102.0	-	-	69.9	28.4	0.0	3.7	150	Vert.	-	1
4882	42.2	54.0	11.8	29.8	32.8	25.7	5.3	150	Hor.	Yes	1
9764	26.0	82.0	56.0	4.7	37.3	23.9	7.9	150	Hor.	No	1
12205	30.5	54.0	23.5	20.3	33.6	25.9	2.5	150	Vert.	Yes	1
14646	34.2	82.0	47.8	24.6	33.7	26.6	2.5	150	Hor.	No	1
17087	44.8	82.0	37.2	35.9	33.8	27.4	2.5	150	Hor.	No	1
19528	41.1	54.0	12.9	39.7	37.1	38.2	2.5	150	Hor.	Yes	1
21969	30.7	82.0	51.3	29.3	37.2	38.3	2.5	150	Hor.	No	1
24410	32.7	82.0	49.3	31.9	37.2	38.9	2.5	150	Hor.	No	1
Measurement uncertainty										+2.2 dB / -3.6 dB	

Transmitter operates at channel 78 (2480 MHz. DH5):

Result measured with the peak detector:

Frequency MHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2343	63.5	74.0	10.5	31.8	28.1	0.0	3.6	150	Vert.	Yes	1
2380	63.1	74.0	10.9	31.2	28.2	0.0	3.7	150	Vert.	Yes	1
2480	105.7	-	-	73.4	28.5	0.0	3.8	150	Vert.	-	1
7440	34.5	74.0	39.6	15.9	36.3	24.5	6.8	150	Vert.	Yes	1
12400	47.2	74.0	26.8	36.9	33.7	25.9	2.5	150	Vert.	Yes	1
14880	51.8	85.7	33.9	42.3	33.7	26.7	2.5	150	Vert.	No	1
16524	47.9	85.7	37.8	39.2	33.8	27.6	2.5	150	Hor.	No	1
17360	58.4	85.7	27.3	49.2	33.9	27.2	2.5	150	Hor.	No	1
19840	58.5	74.0	15.5	57.3	37.0	38.3	2.5	150	Hor.	Yes	1
22320	46.9	74.0	27.1	45.5	37.2	38.3	2.5	150	Hor.	Yes	1
24800	47.9	85.7	37.8	47.1	37.3	39.0	2.5	150	Hor.	No	1
Measurement uncertainty										+2.2 dB / -3.6 dB	

Result measured with the average detector:

Frequency MHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2343	45.6	54.0	8.4	13.9	28.1	0.0	3.6	150	Vert.	Yes	1
2380	45.1	54.0	8.9	13.2	28.2	0.0	3.7	150	Vert.	Yes	1
2480	102.9	-	-	70.6	28.5	0.0	3.8	150	Vert.	-	1
7440	23.9	54.0	30.1	5.3	36.3	24.5	6.8	150	Vert.	Yes	1
12400	35.4	54.0	18.6	25.1	33.7	25.9	2.5	150	Vert.	Yes	1
14880	40.1	82.9	42.8	30.6	33.7	26.7	2.5	150	Vert.	No	1
16524	32.9	82.9	50.0	24.2	33.8	27.6	2.5	150	Hor.	No	1
17360	32.1	82.9	50.8	22.9	33.9	27.2	2.5	150	Hor.	No	1
19840	42.9	54.0	11.1	41.7	37.0	38.3	2.5	150	Hor.	Yes	1
22320	31.7	54.0	22.3	30.3	37.2	38.3	2.5	150	Hor.	Yes	1
24800	31.6	82.9	51.3	30.8	37.3	39.0	2.5	150	Hor.	No	1
Measurement uncertainty										+2.2 dB / -3.6 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

29. 31 – 34. 35. 44. 45. 49. 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	02/15/2012	02/2014
16	Controller	HD100	Deisel	100/670	480139	-	-
17	Turntable	DS420HE	Deisel	420/620/80	480087	-	-
18	Antenna support	AS615P	Deisel	615/310	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	13/02/2012	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	21/04/2011	04/2014
36	Antenna	3115 A	EMCO	9609-4918	480183	11/09/2011	11/2014
43	RF-cable No. 36	Sucoflex 106B	Suhner	0522/6B	480571	Weekly verification (system cal.)	
44	RF-cable No. 40	Sucoflex 106B	Suhner	0708/6B	481330	Weekly verification (system cal.)	
45	RF-cable No. 3	Sucoflex 106B	Suhner	0563/6B	480670	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.)	
72	4 GHz High Pass Filter	WHKX4.0/18 G-8SS	Wainwright Instruments	1	480587	Weekly verification (system cal.)	
166	Power Meter	NRVD	Rohde & Schwarz	833697/030	480589	02/15/2012	02/2014
167	Peak Power Sensor	NRV-Z32	Rohde & Schwarz	849745/016	480551	02/15/2012	02/2014

7 REPORT HISTORY

Report Number	Date	Comment
F124266E1	12 November 2012	Document created

8 LIST OF ANNEXES

ANNEX A TEST SETUP PHOTOS 5 pages

124266_1.JPG	cB-0946 with 1/4-wave antenna, test setup fully anechoic chamber
124266_2.JPG	cB-0946 with 1/4-wave antenna; test setup fully anechoic chamber
124266_3.JPG	cB-0946 with 1/4-wave antenna, test setup fully anechoic chamber
124266_4.JPG	cB-0946 with 1/4-wave antenna, test setup fully anechoic chamber
124266_5.JPG	cB-0946 with 1/4-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