PHOENIX TESTLAB
Königswinkel 10
32825 Blomberg
Germany
Phone +49 5235 9500-0
Fax +49 5235 9500-10

TEST REPORT

Test Report Reference: F082155E01

Equipment under Test: cB-0922-02

FCC ID: PVH092202

IC: 5325A-092202

Applicant: connectBlue AB

Manufacturer: connectBlue AB

Test Laboratory
(CAB)

accredited by DATech in der TGA GmbH
in compliance with DIN EN ISO/IEC 17025
under the Reg. No. DAT-P-105/99-21,

recognized by Bundesnetzagentur
under the Reg.-No. BNetzA-CAB-02/21-104/1,

CAB Designation Number DE0004,

listed by
FCC 31040/SIT1300F2
FCC Test site registration number 90877
Industry Canada Test site registration IC3469A-1

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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. Martin Engdahl
Tel:	+ 46 40 63 07 100
Fax:	+ 46 40 23 71 37
e-mail address:	martin.engdahl@connectblue.se

1.2 MANUFACTURER

Name:	connectBlue AB
Address:	Norra Vallgatan 64 3V
	Malmö SE-211 19
Country:	Sweden
Name for contact purposes:	Mr. Martin Engdahl
Tel:	+ 46 40 63 07 100
Fax:	+ 46 40 23 71 37
e-mail address:	martin.engdahl@connectblue.se

1.3 DATES

Date of receipt of test sample:	04 September 2008
Start of test:	04 September 2008
End of test:	19 September 2008

1.4 TEST LABORATORY

The tests were carried out at: **PHOENIX TESTLAB GmbH**
Königswinkel 10
D-32825 Blomberg **Phone:** **+49 (0) 52 35 / 95 00-0**
Germany **Fax:** **+49 (0) 52 35 / 95 00-10**

Test engineer:	Thomas KÜHN		28 October 2008
	Name	Signature	Date
Test report checked:	Bernd STEINER		28 October 2008
	Name	Signature	Date

PHOENIX TESTLAB GmbH
Königswinkel 10
32825 Blomberg
Tel. 0 52 35 / 95 00-0
Fax 0 52 35 / 95 00-10

Stamp

1.5 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 REFERENCE.

1.6 NORMATIVE REFERENCES

[1] **ANSI C63.4:2003** 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 47 CFR Part 2** General Rules and Regulations

[3] **FCC 47 CFR Part 15** Radio Frequency Devices (Subpart C)

[4] **RSS-210 Issue 7 June 2007** Low power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment

[5] **RSS-Gen Issue 2 June 2007** General Requirements and Information for the Certification of Radiocommunication Equipment

1.7 TEST RESULTS

The requirements of this test document are fulfilled by the equipment under test. The complete test results are presented in the following.

2 TECHNICAL DATA OF EQUIPMENT

2.1 DEVICE UNDER TEST

Type of equipment: *	802.15.4 module (modular approval)
Type designation: *	cB-0922-02
FCC ID: *	PVH092202
IC: *	5325A-092202
Antenna type: *	External or internal
Antenna gain: *	Refer table below
Antenna connector: *	UFL connector (if external antenna is used)
Power supply: *	3.3 V DC to 6.0 V DC
Type of modulation: *	OQPSK
Operating frequency range:*	2.405 to 2.480 GHz
Number of channels: *	16
Temperature range: *	-40 °C to 85 °C

*: declared by the applicant

Used antennas:

model name*	Antenna type	Rated Antenna gain*
Mica	Internal	+2.5
NanoBlue-IP04	External patch	+2
InSide-2400	External patch	+3
WCR2400-SMA (SMA), WCR2400-SMRP (RPSMA), WCR2400-IP04 (10 cm cable/U.FL), WCR2400-IP10 (25 cm cable/U.FL)	External monopole	+2
R380.500.139 (RPSMA)	External monopole	+2
PlanTec m70cxr	External patch	+1
PSTG0-2400HS	External monopole	+0
IHF-242	External monopole	+2
IW-145	External monopole	+4
IH-151	External monopole	+5
SPA 2400/75/8/0/V	External patch	+7.5
SOA 2400/360/4/20/V	External monopole	+4
FlatWhip-2400	External monopole	+3
TwinGain-2400	External patch	+8
Outside-2400	External monopole	+3
Ex-IT 2400 SMA 28-001 Ex-IT 2400 RP-SMA 28-001	External monopole	+3
Ex-IT 2400 RP-SMA 70-002 Ex-IT 2400 SMA 70-002	External monopole	+3
Ex-IT 2400 SMA 70-001 Ex-IT 2400 RP-SMA 70-001	External monopole	+3
Ex-IT 2400 MHF 70-001	External monopole	+3

*: declared by the applicant

The following external I/O cables were used:

Cable	Length	Shielding	Connector
DC in	2 m *	No	6.3 mm jack plug

*: Length during the test if no other specified.

2.2 PERIPHERY DEVICES

The following equipment was used as control unit and ancillary equipment:

- The ZigBee module was connected to a carrier board (cB-0903-03), which was delivered by the applicant The carrier board was supplied via an external power supply with 5.0 V DC.
- A personal computer with a terminal-software was used, connected temporary to the carrier board, for setting the equipment into the necessary operation mode. During the measurement procedures the personal computer was disconnected

3 OPERATIONAL STATES AND PHYSICAL BOUNDARIES

The EUT is intended to be used in several ZigBee applications. Because the cB-0922-02 is a module, which will be implemented in a final application, it was mounted on a carrier board to change the operation modes of the EUT from a Laptop with test software. The tests were carried out with one unmodified sample integral antenna connector (sample marked with “105”) and one unmodified sample with an antenna connector (sample marked with “144”).

During the tests the test sample was powered by an external power supply via the carrier board with 5.0 V DC.

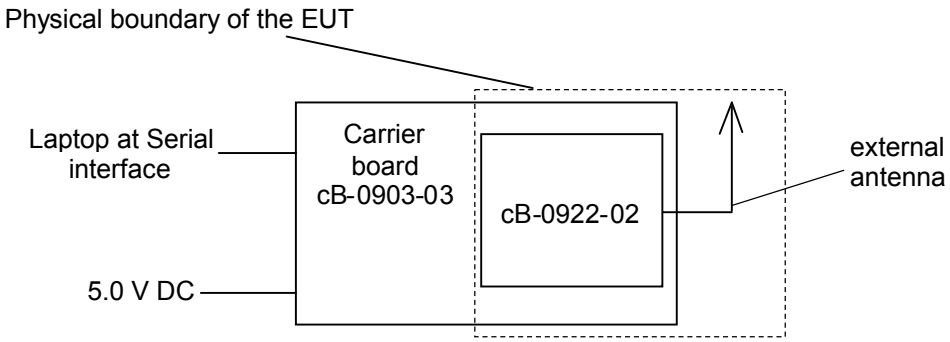
If not otherwise stated, for modulating the transmitter, a pseudo random bit sequence was used.

For selecting an operation mode, a personal computer with a software delivered by the applicant was connected to the carrier board. After adjusting the operating mode, the personal computer was removed. To do this the test-engineer was instructed by the applicant.

During the tests, the EUT was not labelled with a FCC-label.

The following operation modes were used during the tests:

Operation mode	Description of the operation mode
1	Continuous transmitting on channel 11 (2405 MHz)
2	Continuous transmitting on channel 19 (2445 MHz)
3	Continuous transmitting on channel 26 (2480 MHz)
4	-
6	Continuous receiving on channel 11 (2405 MHz)
7	Continuous receiving on channel 19 (2445 MHz)
8	Continuous receiving on channel 26 (2480 MHz)



4 APPLICATION OVERVIEW

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section	RSS 210, Issue 7 [4] or RSS-Gen, Issue 2 [5]	Status	Refer page
6 dB bandwidth	General	15.247 (a) (2)	A8.2 (1) [2]	Passed	9 et seq.
Maximum peak output power	2400.0 – 2483.5	15.247 (b) (3), (4)	A8.4 (4) [2], 7.1.4 [3]	Passed	12 et seq.
Power spectral density	2400.0 – 2483.5	15.247 (e)	A8.2 (2) [2]	Passed	14 et seq.
Band edge compliance	2400.0 – 2483.5	15.247 (d)	A8.5 [2]	Passed	17 et seq.
Radiated emissions (transmitter)	30 – 25,000	15.205 (a), 15.209 (a)	A8.5 [2], 4.7 [3]	Passed	24 et seq.
Conducted emissions on supply line	0.15 – 30	15.207 (a)	7.2.2 [3]	Passed	63 et seq.
Radiated emissions (receiver)	30 – 12,500	15.109	2.6 [2], 7.2.3 [3]	Passed	et seq of Annex D of this test report

5 TEST RESULTS

5.1 6 dB BANDWIDTH

5.1.1 METHOD OF MEASUREMENT (6 dB BANDWIDTH)

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, the transmitter shall work with its maximum data rate.

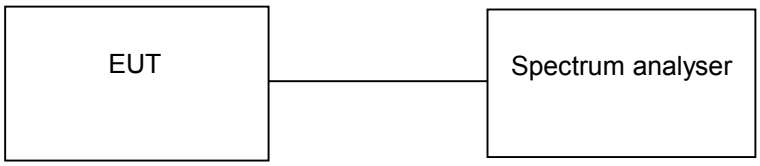
The following spectrum analyser settings shall be used:

- Span: App. 2 to 3 times the 6 dB bandwidth, centred on the actual channel.
- Resolution bandwidth: 100 kHz.
- Video bandwidth: 100 kHz.
- 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 6 dB below the first line (or the peak marker). The frequency lines shall be set on the intersection points between the second display line and the measured curve.

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

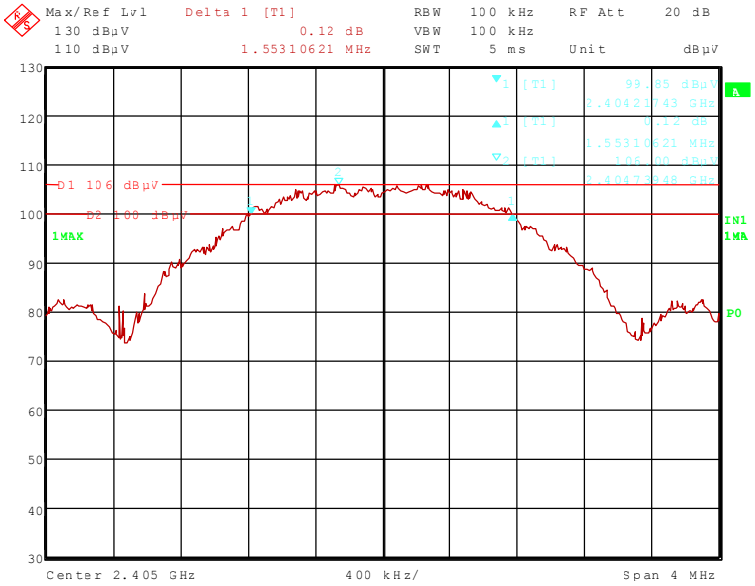
Test set-up:



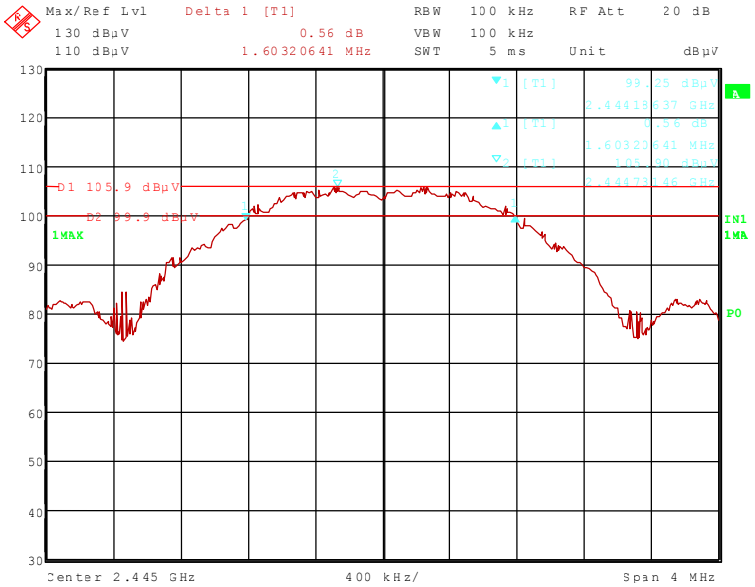
5.1.2 TEST RESULTS (6 dB BANDWIDTH)

Ambient temperature	20 °C	Relative humidity	45 %

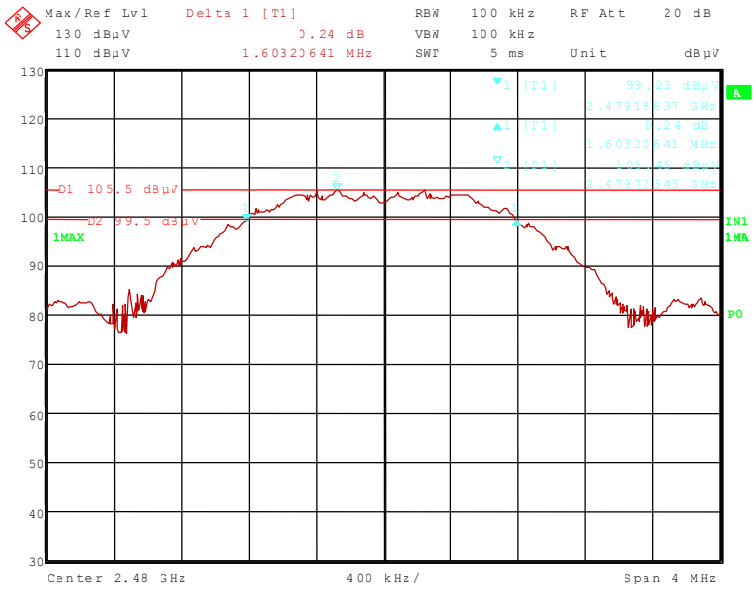
82155_88.wmf: (6 dB bandwidth at the lower end of the assigned frequency band, operation mode 1):



82155_89.wmf: (6 dB bandwidth at the middle of the assigned frequency band, operation mode 2):



82155_90.wmf: (6 dB bandwidth at the upper end of the assigned frequency band, operation mode 3):



Operation mode 1 to 3		
Channel number	Channel frequency [MHz]	6dB bandwidth [MHz]
11	2405	1.553
19	2445	1.603
26	2480	1.603
Measurement uncertainty		$< \pm 1*10^{-7}$

TEST EQUIPMENT USED FOR THE TEST:
31, 46, 54

5.2 MAXIMUM PEAK OUTPUT POWER

5.2.1 METHOD OF MEASUREMENT (MAXIMUM PEAK OUTPUT POWER)

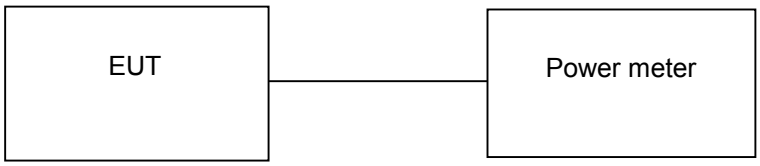
The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed. The EUT has to be switched on.

The following power meter settings shall be used:

- Filter No. auto.
- Measuring time 0.136 s to 26 s.
- Used peak sensor NRV –Z32.

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

Test set-up:



5.2.2 TEST RESULTS (MAXIMUM PEAK OUTPUT POWER)

Ambient temperature	20 °C	Relative humidity	45 %

Because the maximum antenna gain exceed the 6.0 dBi, the limit is reduced by the amount of the exceedance.

Operation mode 1 to 3				
Channel number	Channel frequency [MHz]	Maximum peak output power [dBm]	Antenna gain [dBi]	Peak power limit [dBm]
11	2405	3.2	8.0	28.0
19	2445	3.0	8.0	28.0
26	2480	2.7	8.0	28.0
Measurement uncertainty			+0.66 dB / -0.72 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
46, 54, 55

5.3 POWER SPECTRAL DENSITY

5.3.1 METHOD OF MEASUREMENT (POWER SPECTRAL DENSITY)

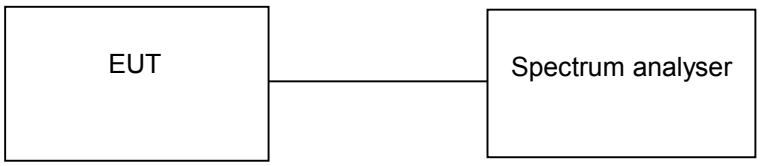
The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed.

The following spectrum analyser settings shall be used:

- Span: 1.5 MHz, centred on the actual channel.
- Resolution bandwidth: 3 kHz.
- Video bandwidth: 30 kHz.
- Sweep: 500 s.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The indicated level is the power spectral density.

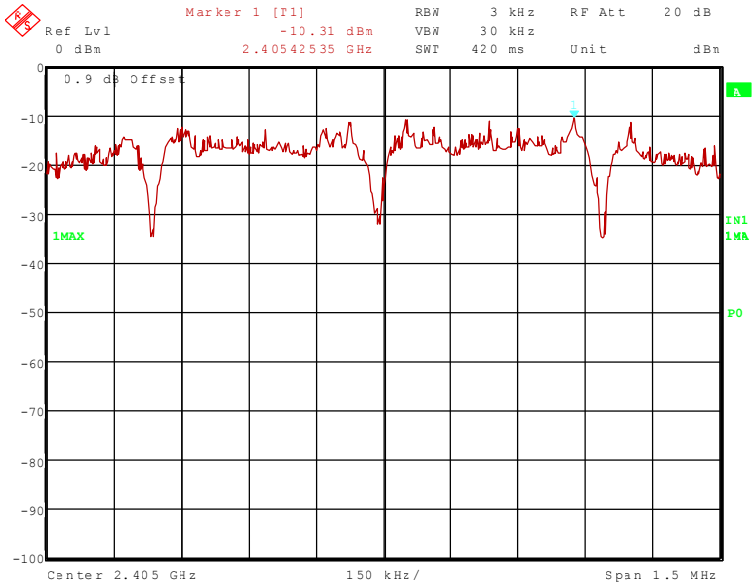
Test set-up:



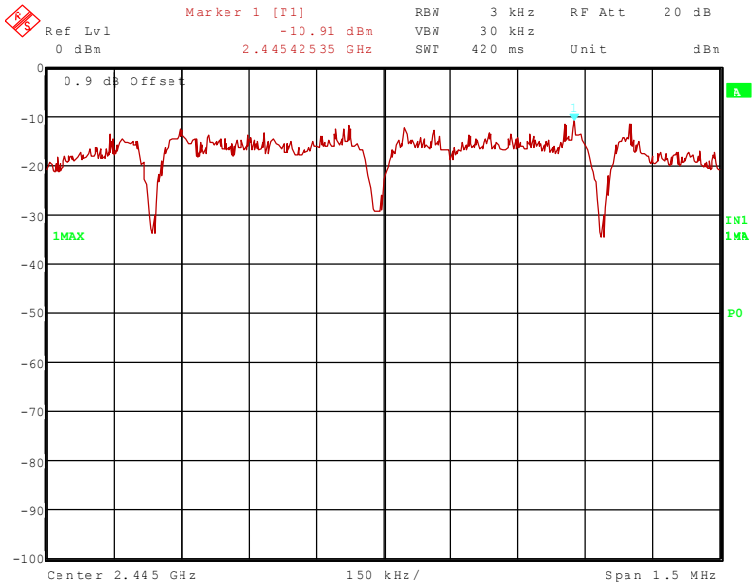
5.3.2 TEST RESULTS (POWER SPECTRAL DENSITY)

Ambient temperature	20 °C	Relative humidity	45 %

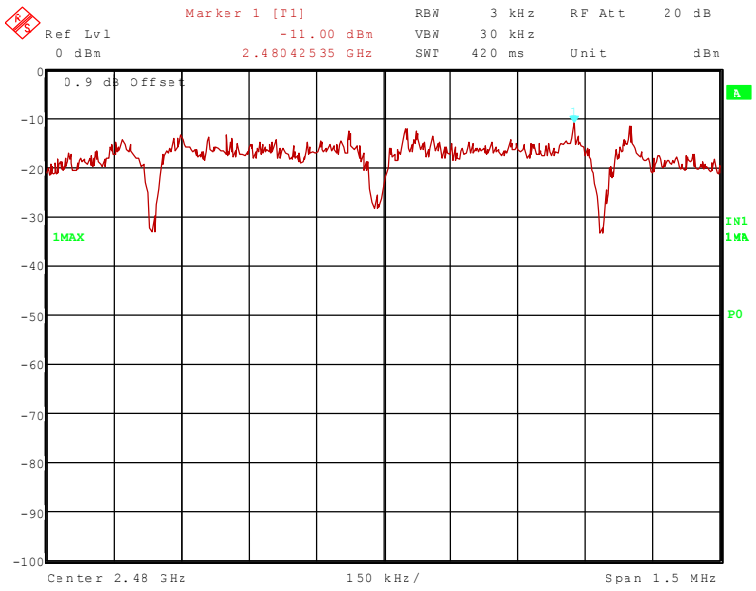
82155_91.wmf (power spectral density (transmit on channel 11), operation mode 1):



82155_92.wmf (power spectral density (transmit on channel 19), operation mode 2):



82155_93.wmf (power spectral density (transmit on channel 26), operation mode 3):



Because the maximum antenna gain exceed the 6.0 dBi, the limit is reduced by the amount of the exceedance.

Operation mode 1 to 3				
Channel number	Channel frequency [MHz]	Power spectral density [dBm / 3 kHz]	Antenna gain [dBi]	Power spectral density limit [dBm / 3 kHz]
11	2405	-10.3	8.0	6.0
19	2445	-10.9	8.0	6.0
26	2480	-11.0	8.0	6.0
Measurement uncertainty			+1.1 dB / -1.5 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
31, 46, 54

5.4 BAND-EDGE COMPLIANCE

5.4.1 METHOD OF MEASUREMENT (BAND-EDGE COMPLIANCE)

The same test set-up as used for the final radiated emission measurement shall be used (refer also subclause 5.8.1 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.

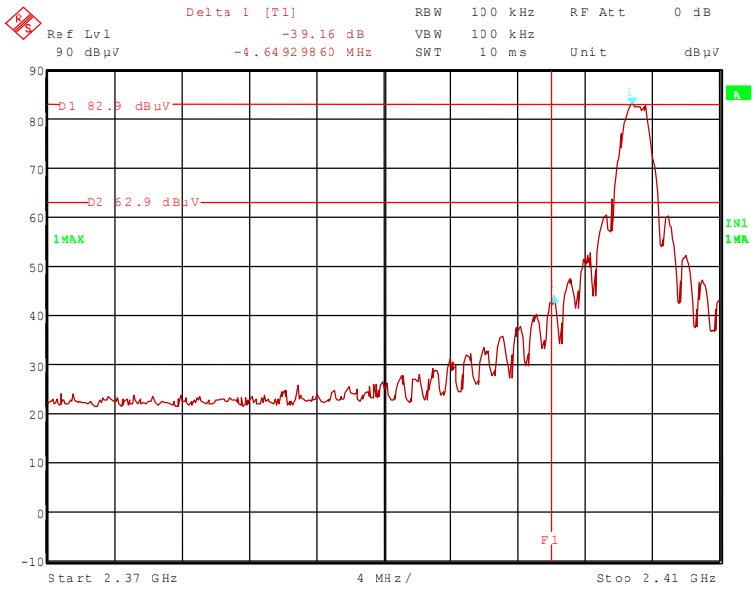
After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 20 dB below the first line (or the peak marker). The frequency line shall be set on the edge of the assigned frequency band. Set the second marker 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 5.5.1 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.

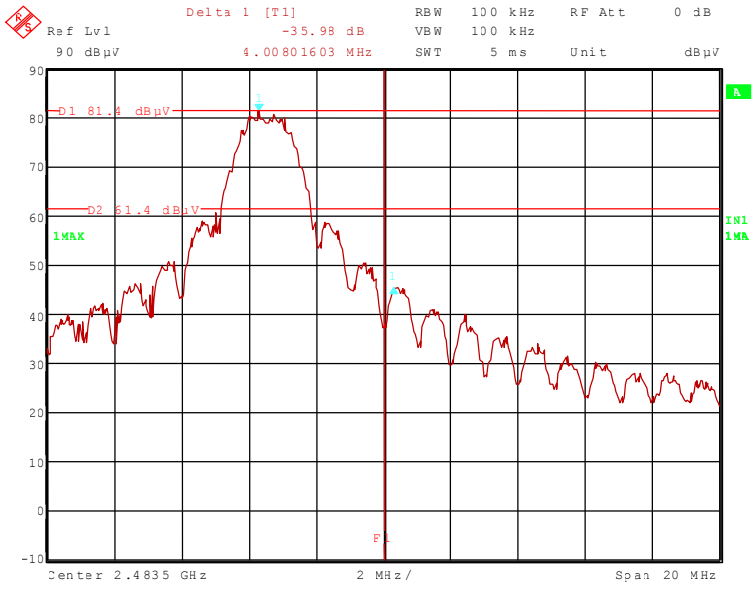
5.4.2 TEST RESULT (BAND-EDGE COMPLIANCE) with internal antenna

Ambient temperature	21 °C	Relative humidity	52 %

82155_18.wmf (radiated band-edge compliance, lower band edge):



82155_15.wmf (radiated band-edge compliance, upper band edge):



The plots on the page before are showing the radiated band-edge compliance for the upper amd lower band-edge. 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)										
Result measured with the peak detector:										
Frequency GHz	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
2.405	93.3	-	-	87.3	28.8	26.5	3.7	150	Vert.	-
2.400	54.1	74.0	19.9	48.1	28.8	26.5	3.7	150	Vert.	No
Result measured with the average detector:										
Frequency GHz	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
2.405	73.8	-	-	67.8	28.8	26.5	3.7	150	Vert.	-
2.400	34.6	54.0	19.4	28.6	28.8	26.5	3.7	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Band-edge compliance (upper band edge)										
Result measured with the peak detector:										
Frequency GHz	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
2.480	90.5	-	-	84.2	29.0	26.5	3.8	150	Vert.	-
2.484	54.5	74.0	19.5	48.2	29.0	26.5	3.8	150	Vert.	Yes
Result measured with the average detector:										
Frequency GHz	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
2.480	71.3	-	-	65.0	29.0	26.5	3.8	150	Vert.	-
2.484	35.3	54.0	18.7	29.0	29.0	26.5	3.8	150	Vert.	Yes
Measurement uncertainty							+2.2 dB / -3.6 dB			

Test: Passed

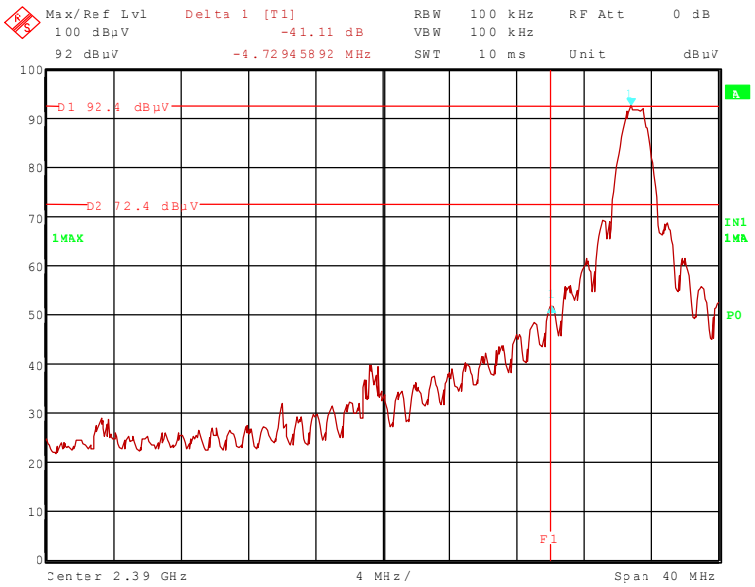
TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39, 43, 46, 49 – 51, 54

5.4.3 TEST RESULT (BAND-EDGE COMPLIANCE) with external monopole antenna

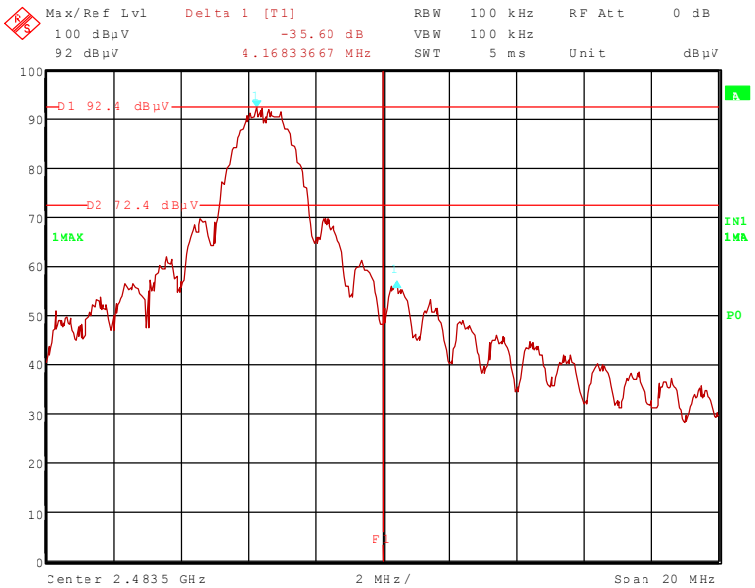
Ambient temperature	21 °C	Relative humidity	52 %

Remark: This test was carried out with the IH-151 antenna, because this antenna has the highest gain of all monopole antennas. Additional pretests has shown that this antenna causes the highest spurious emissions of all monopole antennas in question.

82155_8.wmf (radiated band-edge compliance, lower band edge):



82155_7.wmf (radiated band-edge compliance, upper band edge):



The plots on the page before are showing the radiated band-edge compliance for the upper and lower band-edge. 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)										
Result measured with the peak detector:										
Frequency GHz	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
2.405	101.8	-	-	95.8	28.8	26.5	3.7	150	Vert.	-
2.400	60.7	81.8	21.1	54.7	28.8	26.5	3.7	150	Vert.	No
Result measured with the average detector:										
Frequency GHz	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
2.405	82.5	-	-	76.5	28.8	26.5	3.7	150	Vert.	-
2.400	41.4	62.5	21.1	35.4	28.8	26.5	3.7	150	Vert.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Band-edge compliance (upper band edge)										
Result measured with the peak detector:										
Frequency GHz	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
2.480	101.6	-	-	95.3	29.0	26.5	3.8	150	Vert.	-
2.484	66.6	74.0	7.4	59.7	29.0	26.5	3.8	150	Vert.	Yes
Result measured with the average detector:										
Frequency GHz	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
2.480	82.1	-	-	75.8	29.0	26.5	3.8	150	Vert.	-
2.484	46.5	54.0	7.5	40.2	29.0	26.5	3.8	150	Vert.	Yes
Measurement uncertainty							+2.2 dB / -3.6 dB			

Test: Passed

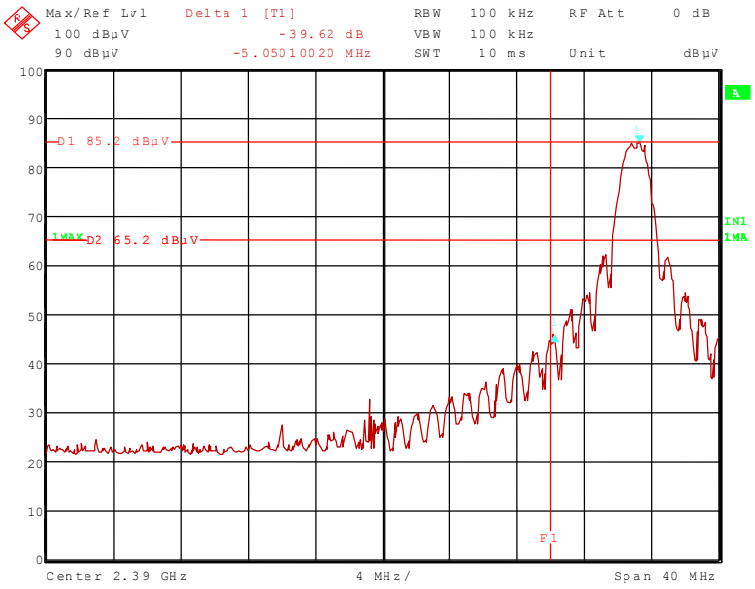
TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39, 43, 46, 49 – 51, 54

5.4.4 TEST RESULT (BAND-EDGE COMPLIANCE) with external patch antenna

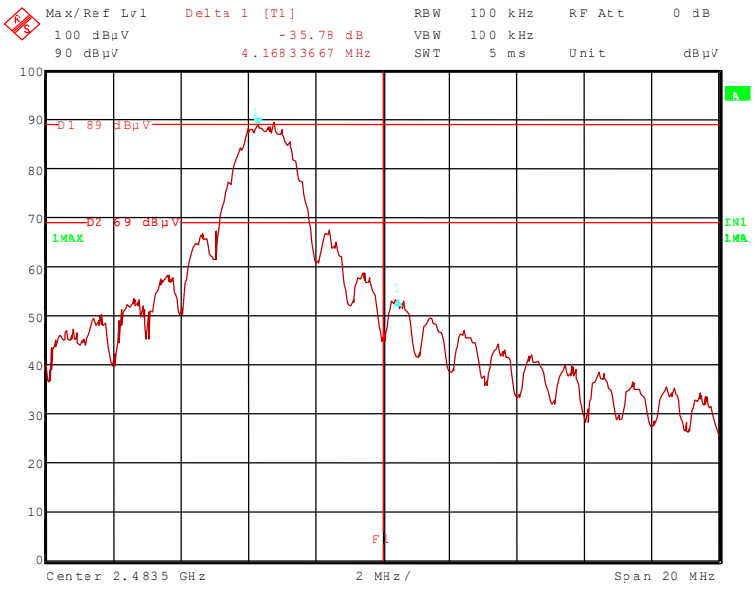
Ambient temperature	21 °C	Relative humidity	52 %

Remark: This test was carried out with the Twin Gain 2400 SMA 001 antenna, because this antenna has the highest gain of all patch antennas. Additional pretests has shown that this antenna causes the highest spurious emissions of all patch antennas in question which has a unique antenna connector.

82155_32.wmf (radiated band-edge compliance, lower band edge):



82155_27.wmf (radiated band-edge compliance, upper band edge):



The plots on the page before are showing the radiated band-edge compliance for the upper and lower band-edge. 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)										
Result measured with the peak detector:										
Frequency GHz	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
2405	95.9	-	-	89.9	28.8	26.5	3.7	150	Hor.	-
2400	56.3	75.9	19.6	50.3	28.8	26.5	3.7	150	Hor.	No
Result measured with the average detector:										
Frequency GHz	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
2405	76.9	-	-	70.9	28.8	26.5	3.7	150	Hor.	-
2400	37.3	56.9	19.6	31.3	28.8	26.5	3.7	150	Hor.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Band-edge compliance (upper band edge)										
Result measured with the peak detector:										
Frequency GHz	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	99.1	-	-	92.8	29.0	26.5	3.8	150	Vert.	-
2484	63.3	74.0	10.7	57.0	29.0	26.5	3.8	150	Vert.	Yes
Result measured with the average detector:										
Frequency GHz	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	79.9	-	-	73.6	29.0	26.5	3.8	150	Vert.	-
2484	44.0	54.0	10.0	37.7	29.0	26.5	3.8	150	Vert.	Yes
Measurement uncertainty							+2.2 dB / -3.6 dB			

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39, 43, 46, 49 – 51, 54

5.5 RADIATED EMISSIONS

5.5.1 METHOD OF MEASUREMENT (RADIATED EMISSIONS)

The radiated emission measurement is subdivided into five stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 9 kHz to 1 GHz.
- A final measurement carried out on an outdoor test side without reflecting ground plane and a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- 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 25 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 25 GHz.

All measurements will be carried out with the EUT working on the middle and upper and lower edge of the assigned frequency band. For this reason the hopping function of the EUT has to be disenabled.

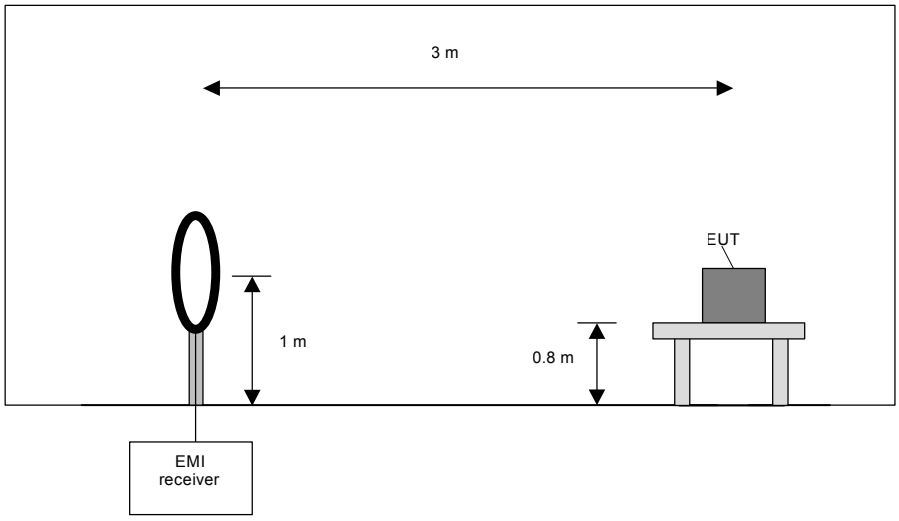
Preliminary measurement (9 kHz to 30 MHz):

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 C63.4-2003 [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 found 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 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 frequencies of highest detected emission with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
6) Repeat steps 1) to 5) with the other orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).
7) Rotate the measuring antenna and repeat steps 1) to 5).

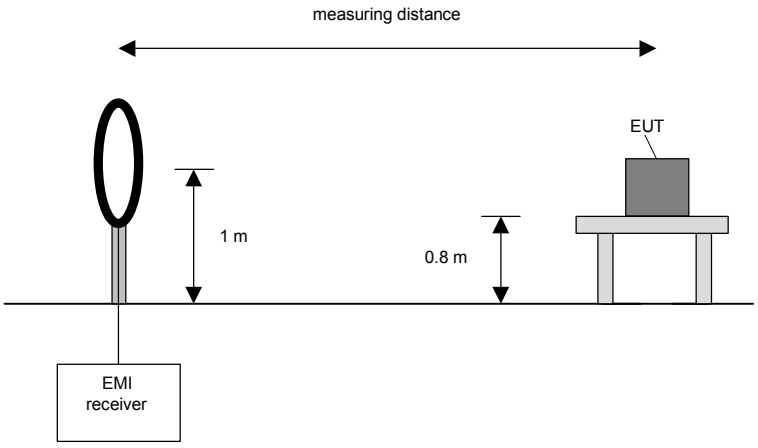
Final measurement (9 kHz to 30 MHz):

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m and 30 m. In the case where larger measuring distances are 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 a 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 vertical 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 (because of EUT is a module and might be used in a handheld equipment application).

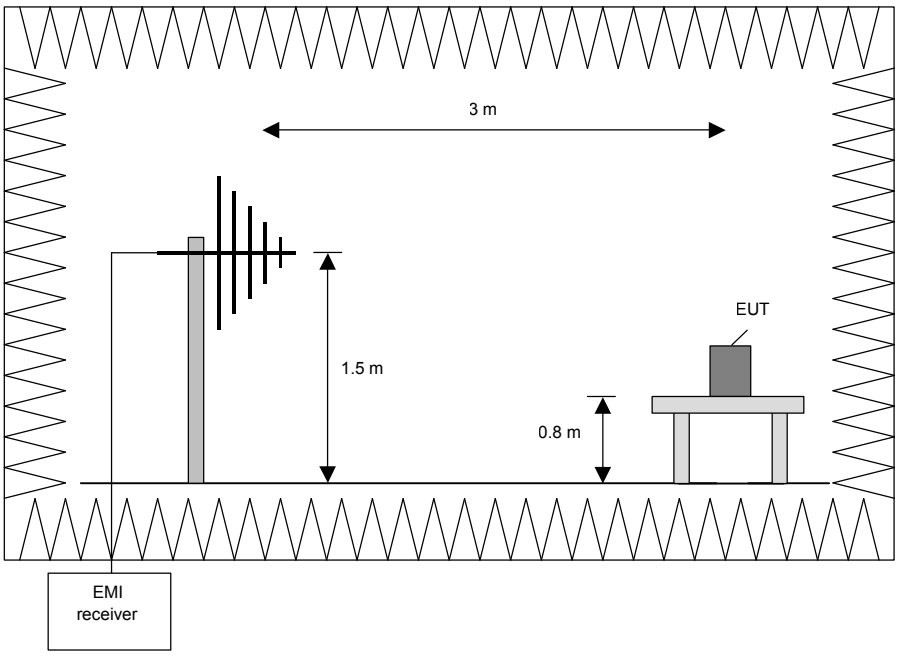
Preliminary measurement (30 MHz to 1 GHz)

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 C63.4-2003 [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:

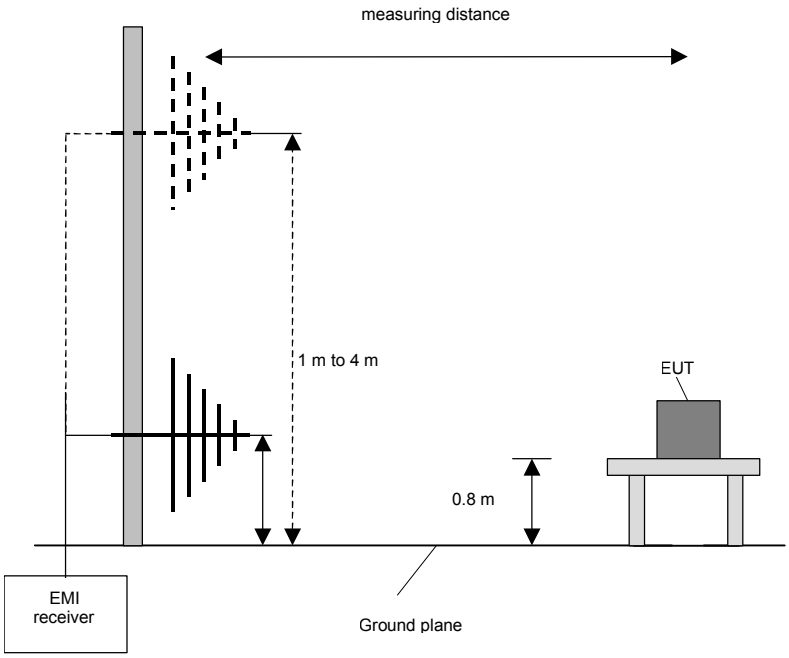
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the 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 25 GHz)

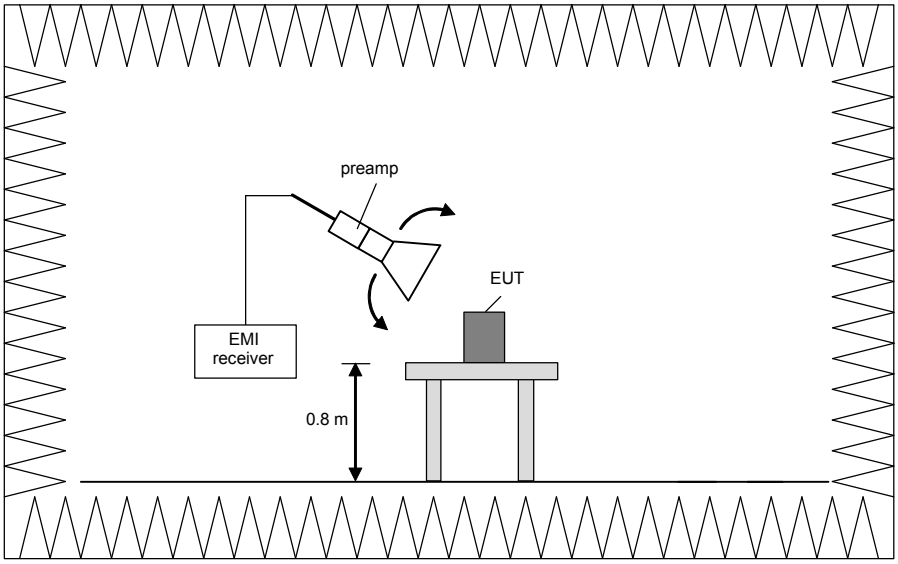
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003 [1].

Preliminary measurement (1 GHz to 25 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 25 GHz	100 kHz

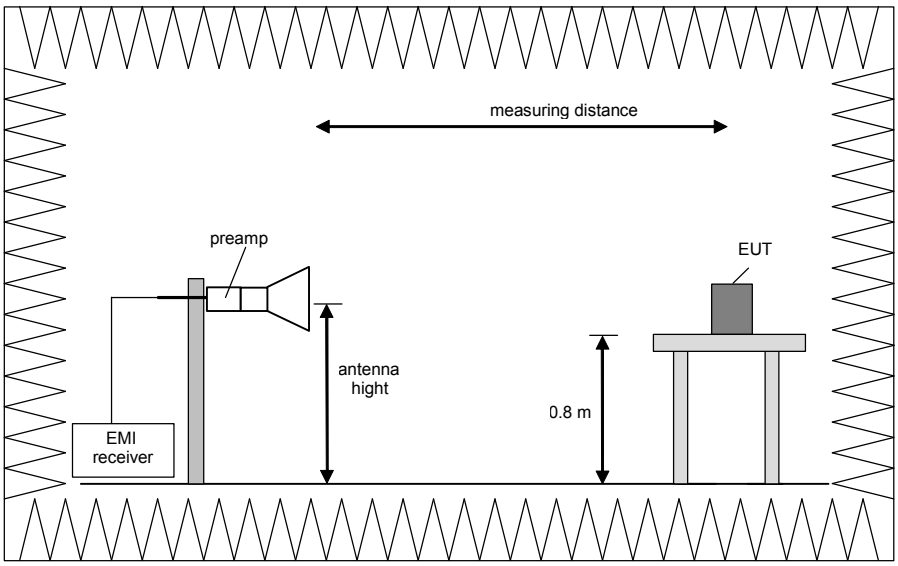


Final measurement (1 GHz to 25 GHz)

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 25 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 and 18 GHz to 25 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.

5.5.2 TEST RESULTS (RADIATED EMISSIONS)

5.5.2.1 PRELIMINARY MEASUREMENT (9 kHz to 25 GHz) with external monopole antenna

Ambient temperature	20 °C	Relative humidity	50 %

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.

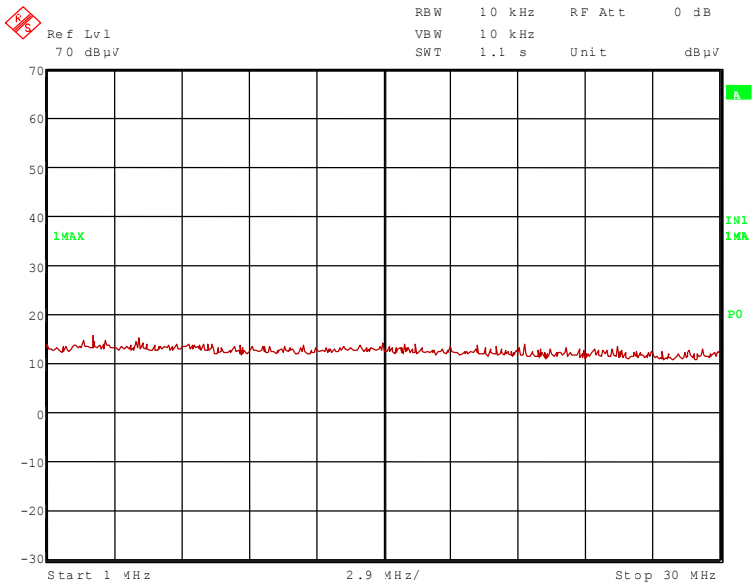
Cable guide: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: Where not otherwise stated the test was carried out in test mode 2 of the EUT, because there was no difference to the other test modes. All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 5.0 V DC via the carrier board.

Remark: As pre-tests have shown, the emissions in the frequency range 30 kHz to 1 GHz are not depending on the used antenna or the antenna cable length. Therefore the emissions in this frequency range were measured only with the IH-151 antenna, because this antenna has the highest gain of all monopole antennas. Additional pretests have shown that this antenna causes the highest spurious emissions of all monopole antennas in question in the frequency range 1 GHz to 25 GHz.

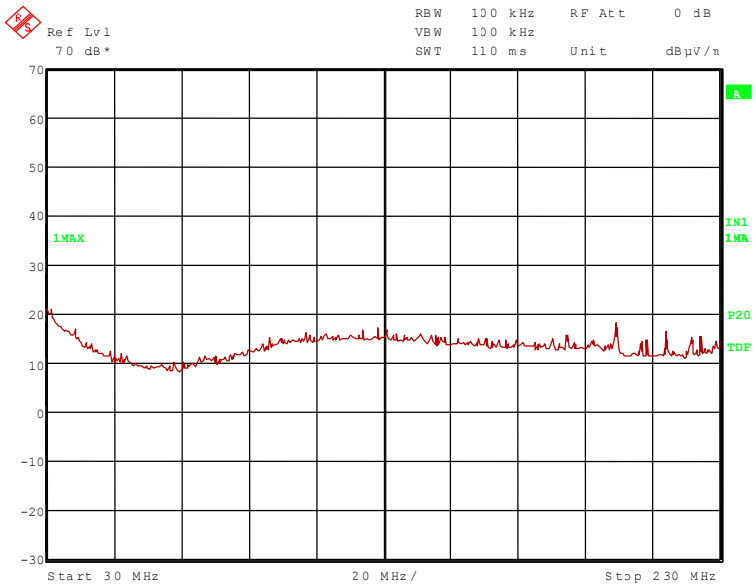
82155_47.wmf: Spurious emissions from 1 MHz to 30 MHz with external monopole antenna:



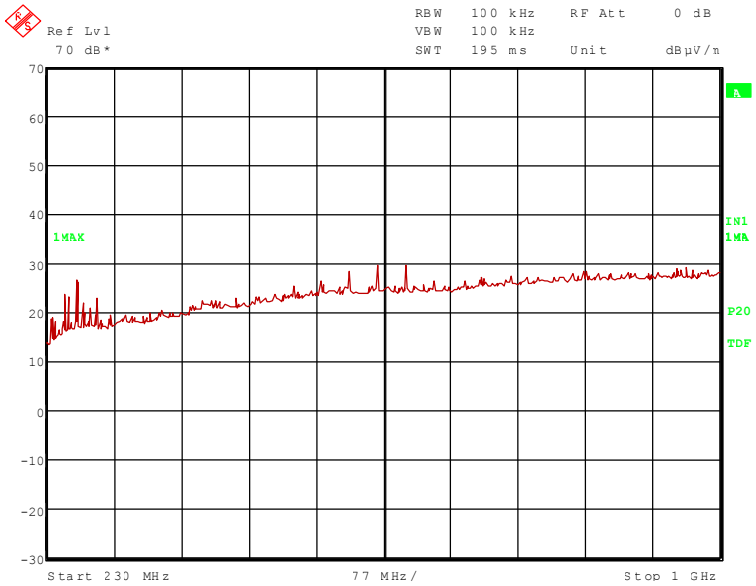
No significant frequencies above the noise floor of the system were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39, 43, 46, 49 – 51, 54

82155_9.wmf: Spurious emissions, from 30 MHz to 230 MHz with external monopole antenna:



82155_10.wmf: Spurious emissions, from 230 MHz to 1 GHz with external monopole antenna:



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

- 199.101 MHz, 213.791 MHz, 576.002 MHz, 607.994 MHz and 639.994 MHz.

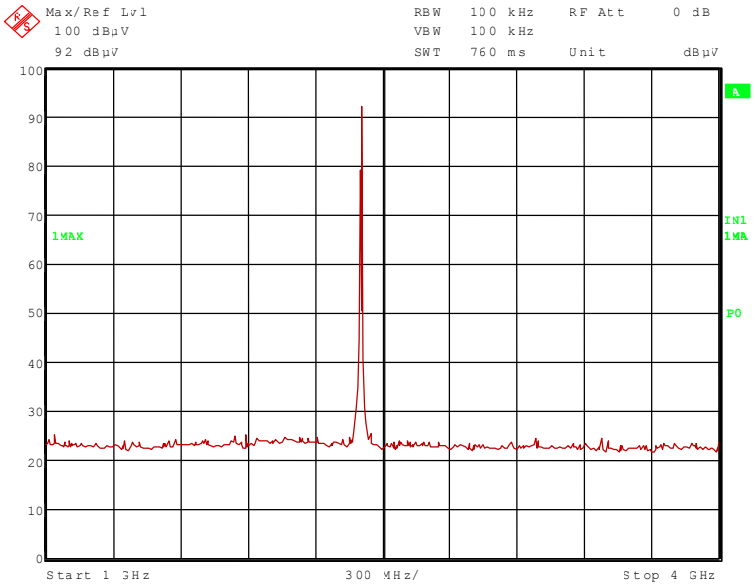
The following frequency was found inside the restricted bands:

- 265.338 MHz.

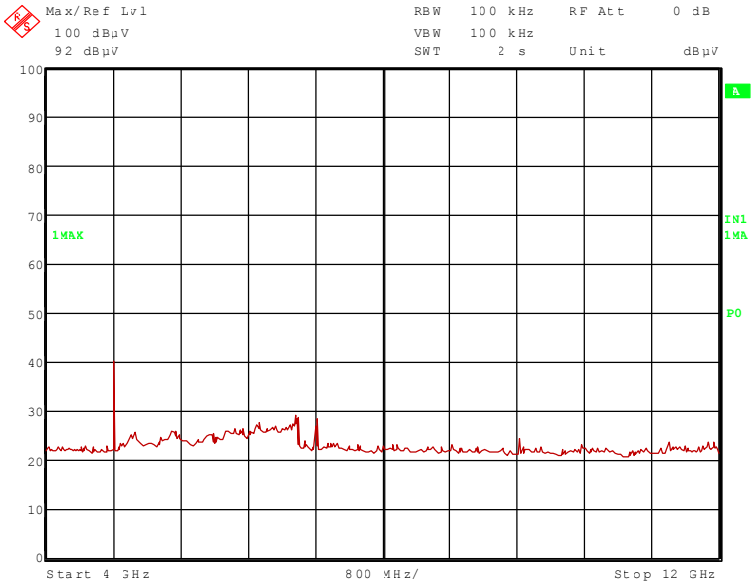
These frequencies have to be measured on the open area test site. The results were presented in the following

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

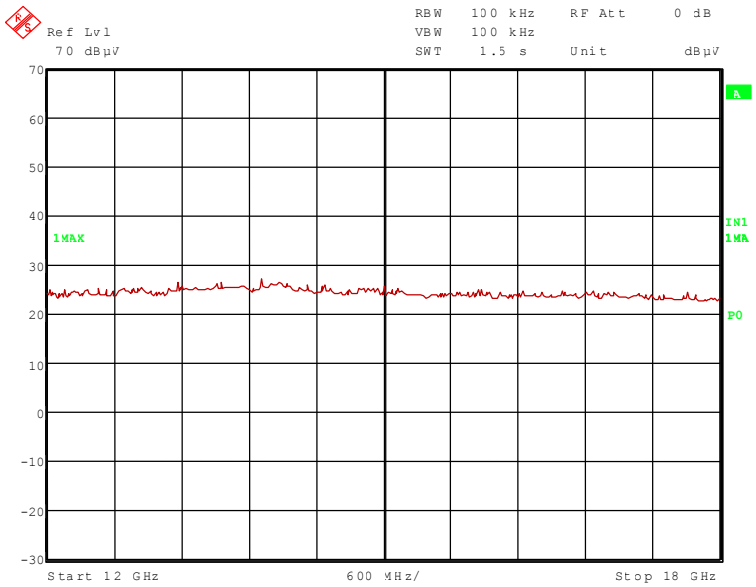
82155_3.wmf (1 GHz to 4 GHz) with external monopole antenna:



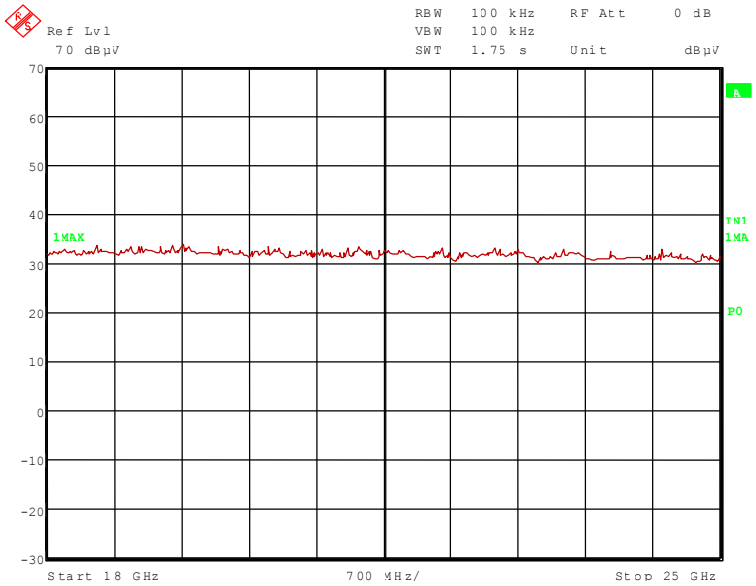
82155_4.wmf (4 GHz to 12 GHz) with external monopole antenna:



82155_52.wmf (12 GHz to 18 GHz) with external monopole antenna:



82155_53.wmf (18 GHz to 25 GHz) with external monopole antenna:



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

- 4.810 GHz.

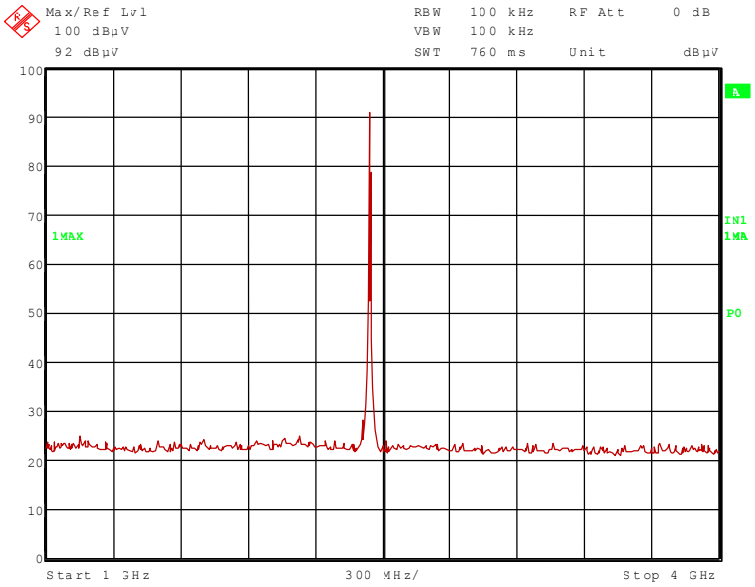
The following frequencies were found outside the restricted bands during the preliminary radiated emission test:

- 2.405 GHz and 9.620 GHz.

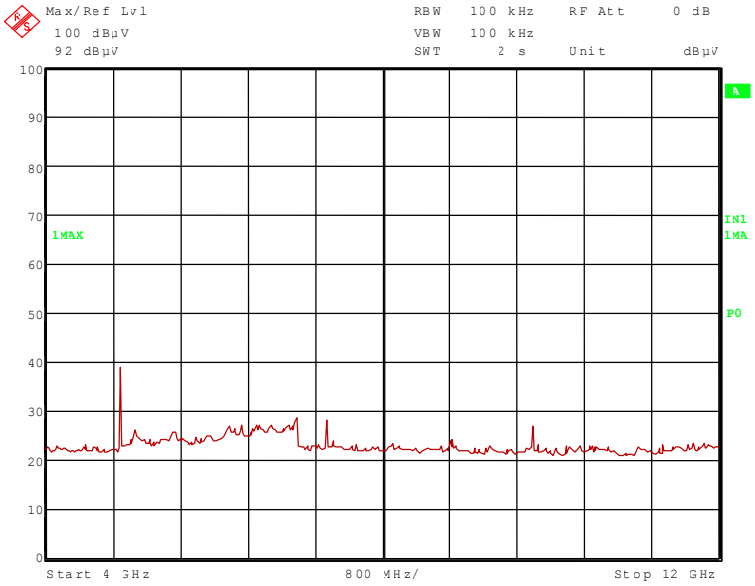
These frequencies have to be measured in a final measurement. The results were presented in the following.

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

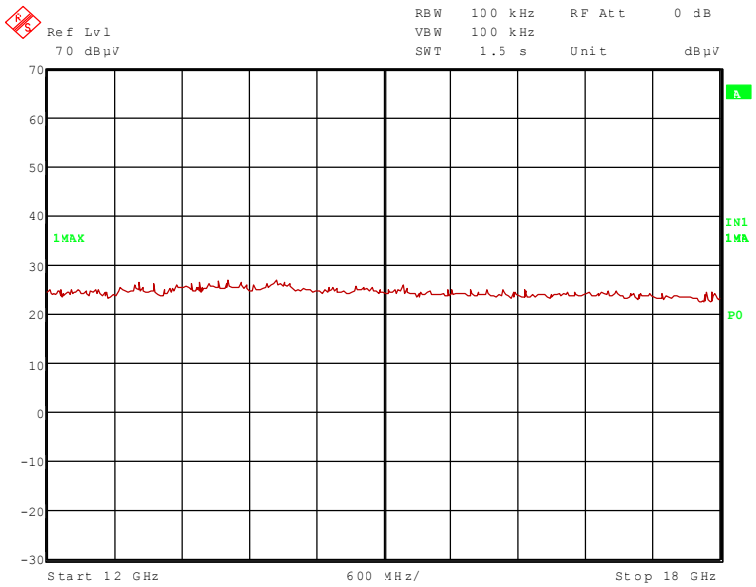
82155_1.wmf (1 GHz to 4 GHz) with external monopole antenna:



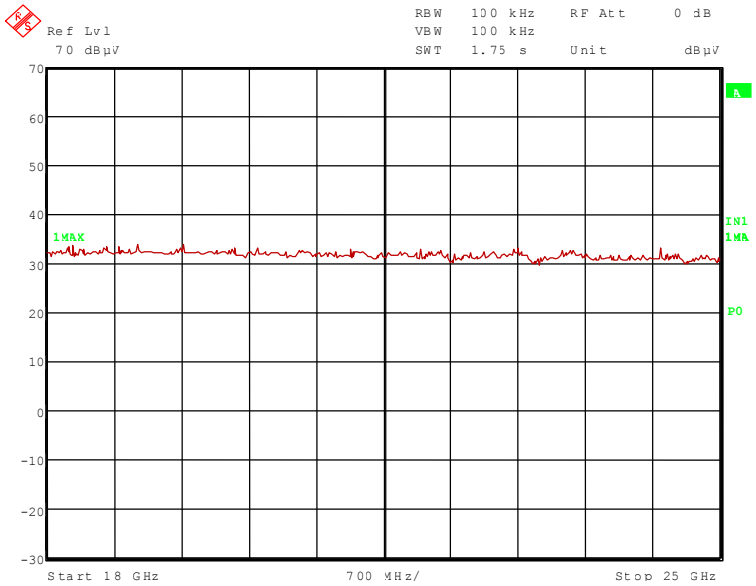
82155_2.wmf (4 GHz to 12 GHz) with external monopole antenna:



82155_48.wmf (12 GHz to 18 GHz) with external monopole antenna:



82155_49.wmf (18 GHz to 25 GHz) with external monopole antenna:



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

- 4.890 GHz.

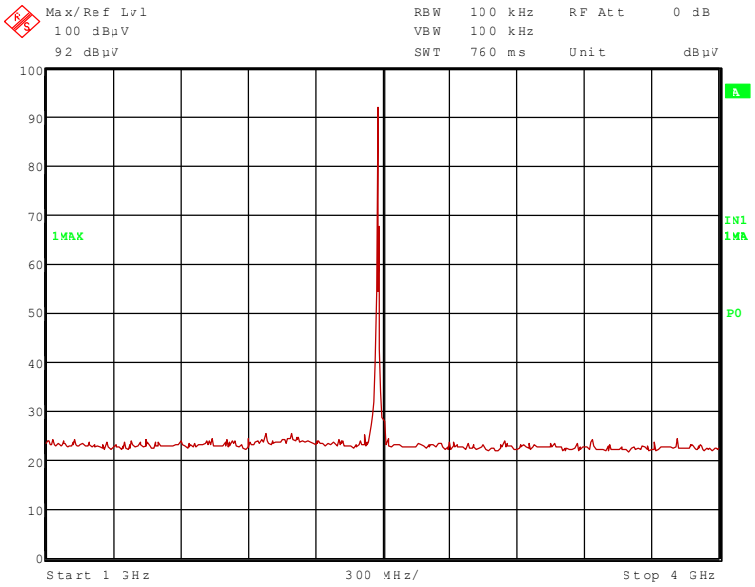
The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 2.445 GHz and 9.780 GHz.

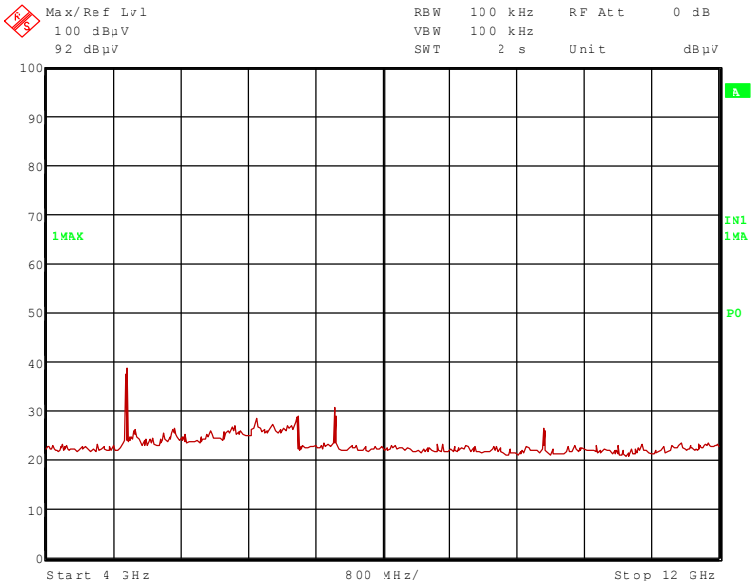
These frequencies have to be measured in a final measurement. The results were presented in the following.

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

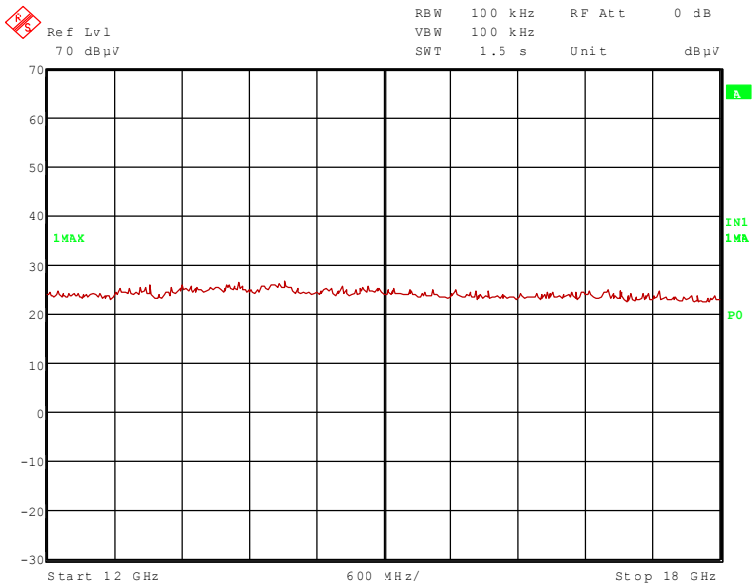
82155_5.wmf (1 GHz to 4 GHz) with external monopole antenna:



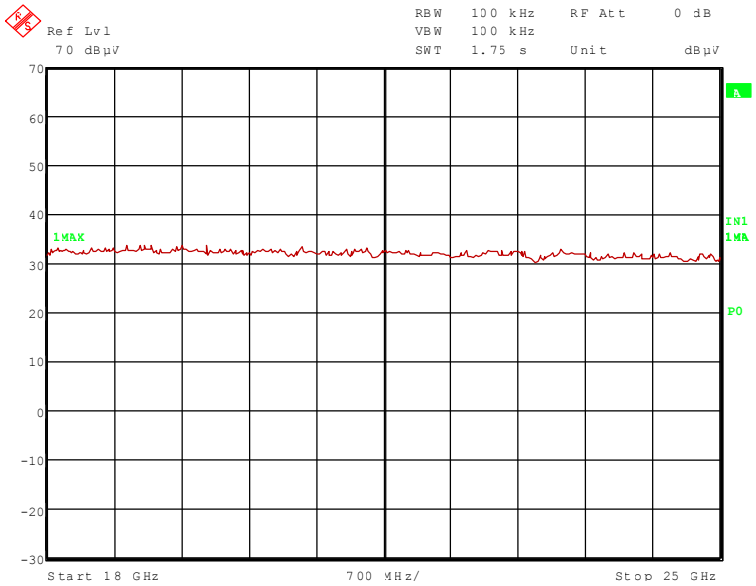
82155_6.wmf (4 GHz to 12 GHz) with external monopole antenna:



82155_51.wmf (12 GHz to 18 GHz) with external monopole antenna:



82155_50.wmf (18 GHz to 25 GHz) with external monopole antenna:



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

- 4.960 GHz and 7.440 GHz.

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

- 2.480 GHz and 9.920 GHz.

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

5.5.2.2 FINAL MEASUREMENT (30 MHz to 1 GHz) with external monopole antenna

Ambient temperature	20 °C	Relative humidity	49 %

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: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

Supply voltage: During all measurements the EUT was supplied with 5.0 V DC via the carrier board.

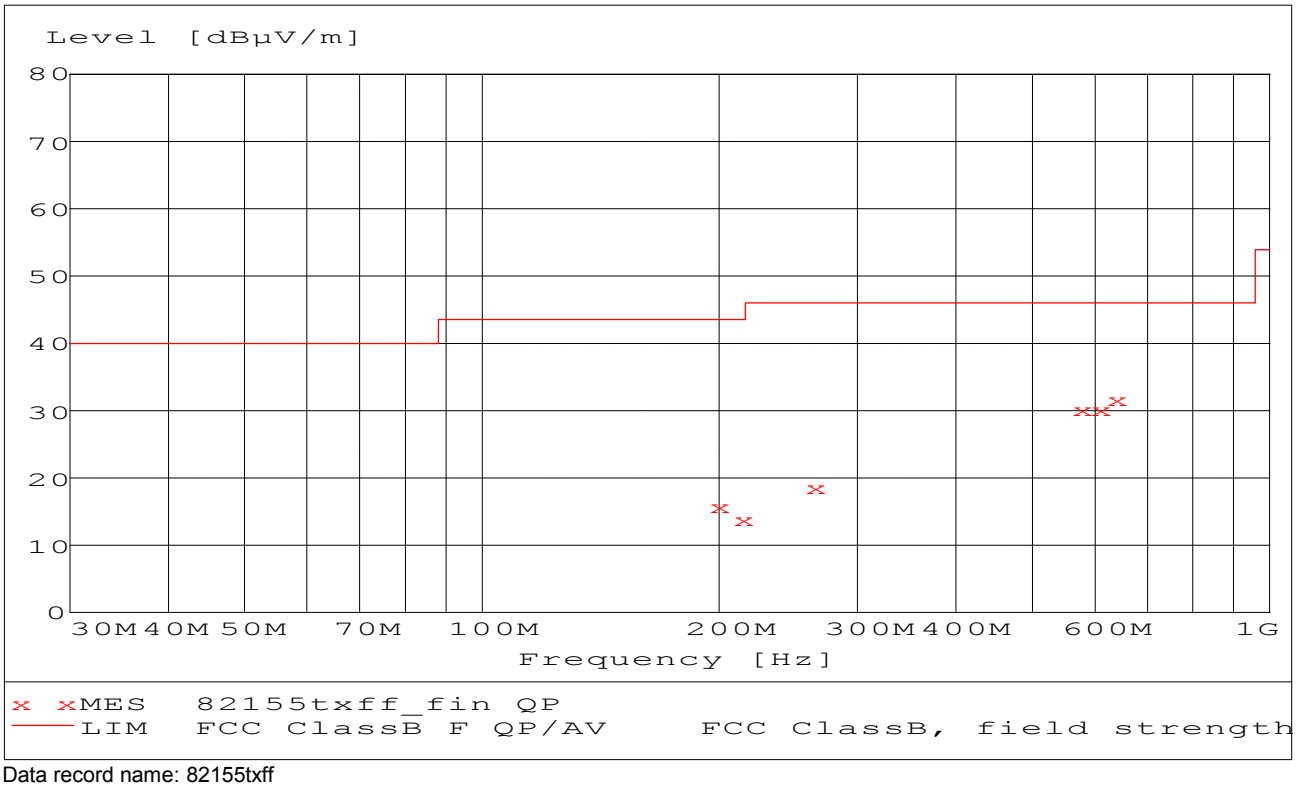
Test record: The test was carried out in test mode 2 of the EUT, because there was no difference to the other test modes.

Resolution bandwidth: For all measurements a resolution bandwidth of 120 kHz was used.

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

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

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above mentioned standard. The measured points marked with x are the measured results of the standard subsequent measurement on the open area test site.



Data record name: 82155txff

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:

(These values are marked in the above diagram by 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.
199.101	16	43.5	27.5	5.6	8.9	1.5	395.0	225.0	Vert.
213.791	14.1	43.5	29.4	3.1	9.4	1.6	366.0	31.0	Hor.
576.002	30.1	46.0	15.9	8.1	19.2	2.8	100.0	135.0	Vert.
607.994	30.2	46.0	15.8	8.0	19.4	2.8	100.0	27.0	Vert.
639.994	31.8	46.0	14.2	9.2	19.7	2.9	151.0	66.0	Vert.
Spurious emissions in 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.
265.338	18.9	46.0	27.1	4.9	12.2	1.8	140.0	47.0	Vert.
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

5.5.2.3 FINAL MEASUREMENT (1 GHz to 25 GHz) with external monopole antenna

Ambient temperature	20 °C	Relative humidity	50 %

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.

Supply voltage: During all measurements the EUT was supplied with 5.0 V DC via the carrier board.

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 GHz	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
2.405	101.8	-	-	95.8	28.8	26.5	3.7	150	Vert.	-
4.810	59.8	74.0	14.2	46.5	33.7	25.7	5.3	150	Vert.	Yes
9.620	56.6	81.8	25.2	34.4	38.3	23.9	7.8	150	Vert.	No
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	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
2.405	82.5	-	-	76.5	28.8	26.5	3.7	150	Vert.	-
4.810	39.5	54.0	14.5	26.2	33.7	25.7	5.3	150	Vert.	Yes
9.620	40.7	62.5	21.8	18.5	38.3	23.9	7.8	150	Vert.	No
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 GHz	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
2.445	101.8	-	-	95.7	28.9	26.5	3.7	150	Vert.	-
4.890	58.8	74.0	15.2	45.3	33.9	25.7	5.3	150	Vert.	Yes
9.780	59.0	81.8	22.8	36.5	38.4	23.9	8.0	150	Vert.	No
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	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
2.445	82.6	-	-	76.5	28.9	26.5	3.7	150	Vert.	-
4.890	38.7	54.0	15.3	25.2	33.9	25.7	5.3	150	Vert.	Yes
9.780	42.4	62.6	20.2	19.9	38.4	23.9	8.0	150	Vert.	No
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 GHz	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
2.480	101.6	-	-	95.3	29.0	26.5	3.8	150	Vert.	-
4.960	56.9	74.0	17.1	43.2	34.0	25.6	5.3	150	Vert.	Yes
7.440	57.0	74.0	17.0	37.4	37.3	24.5	6.8	150	Vert.	Yes
9.920	58.3	81.6	23.3	35.8	38.5	23.9	7.9	150	Vert.	No
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	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
2.480	82.1	-	-	75.8	29.0	26.5	3.8	150	Vert.	-
4.960	37.8	54.0	16.2	24.1	34.0	25.6	5.3	150	Vert.	Yes
7.440	40.3	54.0	13.7	20.7	37.3	24.5	6.8	150	Vert.	Yes
9.920	42.0	62.1	20.1	19.5	38.5	23.9	7.9	150	Vert.	No
Measurement uncertainty						+2.2 dB / -3.6 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39, 43, 46, 49 – 51, 54

5.5.2.4 PRELIMINARY MEASUREMENT (1 GHz to 25 GHz) with internal antenna

Ambient temperature	21 °C	Relative humidity	52 %

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.

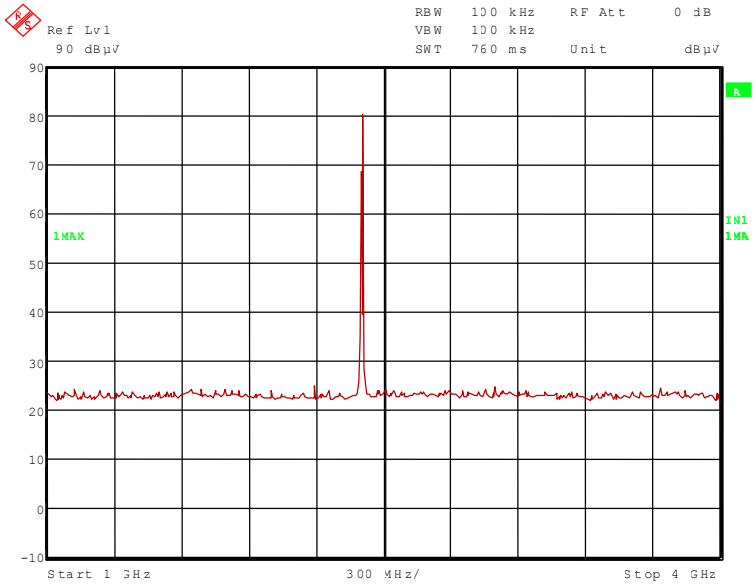
Cable guide: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

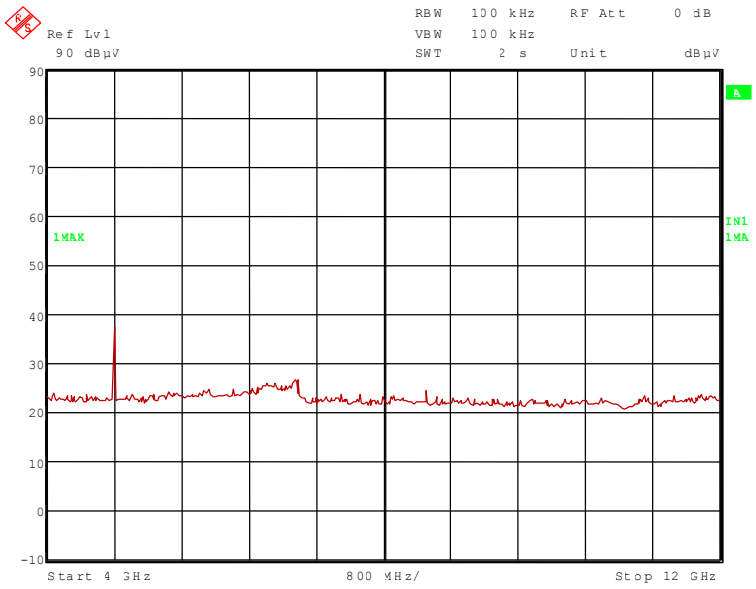
Supply voltage: During all measurements the EUT was supplied with 5.0 V DC via the carrier board.

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

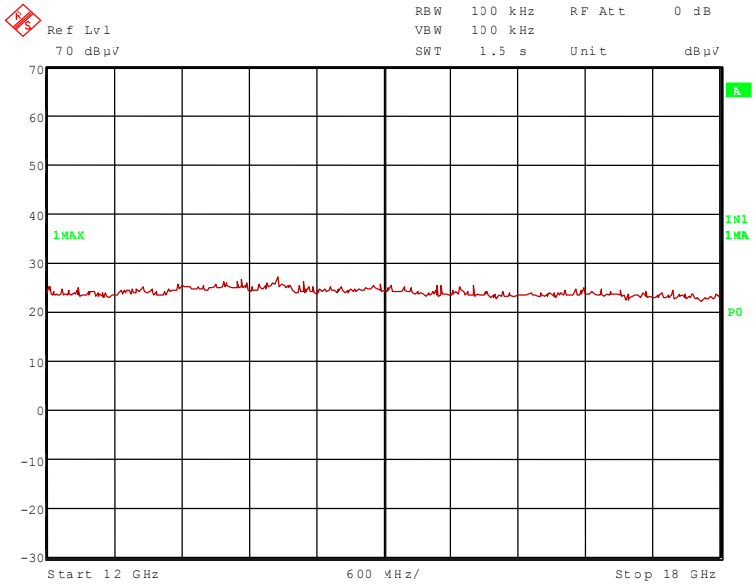
82155_16.wmf (1 GHz to 4 GHz) with internal antenna:



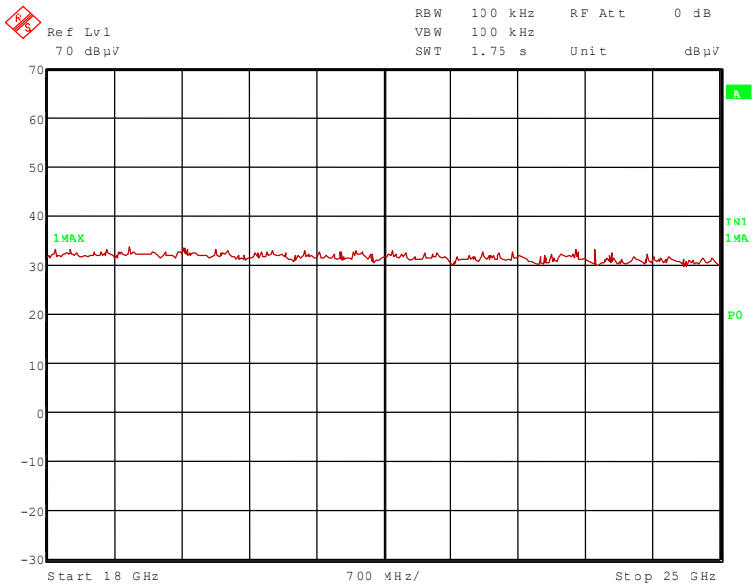
82155_17.wmf (4 GHz to 12 GHz) with internal antenna:



82155_67.wmf (12 GHz to 18 GHz) with internal antenna:



82155_66.wmf (18 GHz to 25 GHz) with internal antenna:



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

- 4.810 GHz.

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

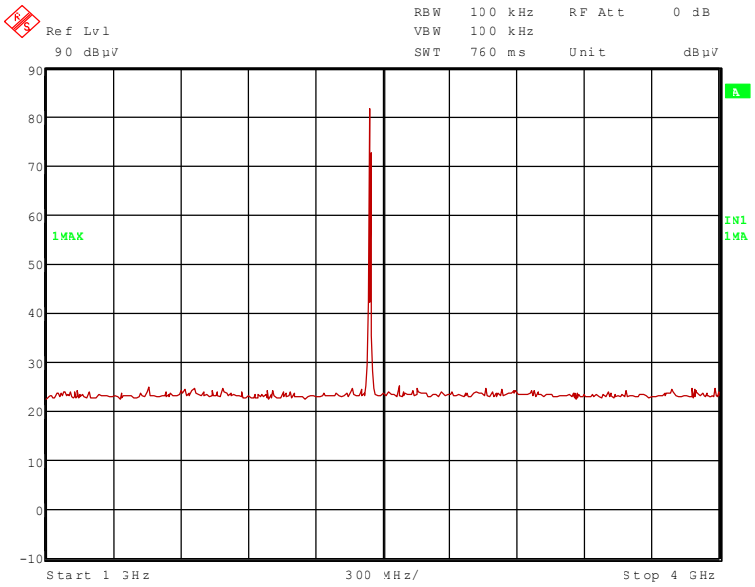
- 2.405 GHz.

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

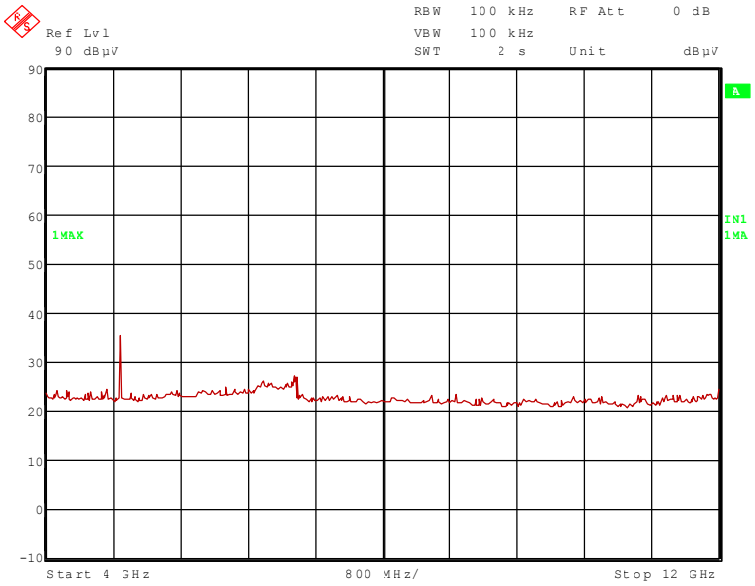
TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39, 43, 46, 49 – 51, 54

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

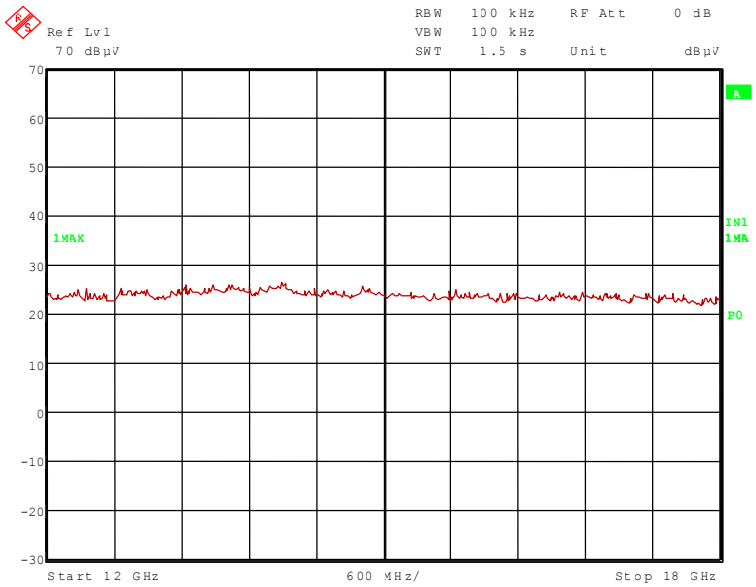
82155_11.wmf (1 GHz to 4 GHz) with internal antenna:



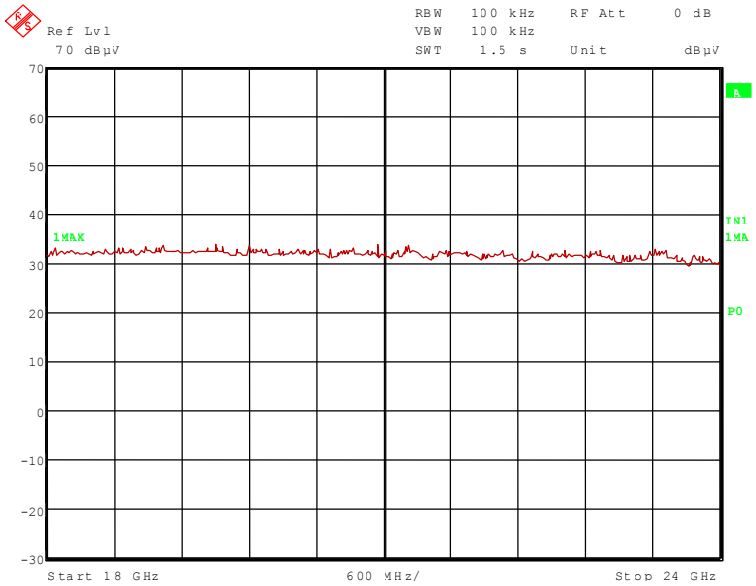
82155_12.wmf (4 GHz to 12 GHz) with internal antenna:



82155_68.wmf (12 GHz to 18 GHz) with internal antenna:



82155_69.wmf (18 GHz to 25 GHz) with internal antenna:



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

- 4.890 GHz.

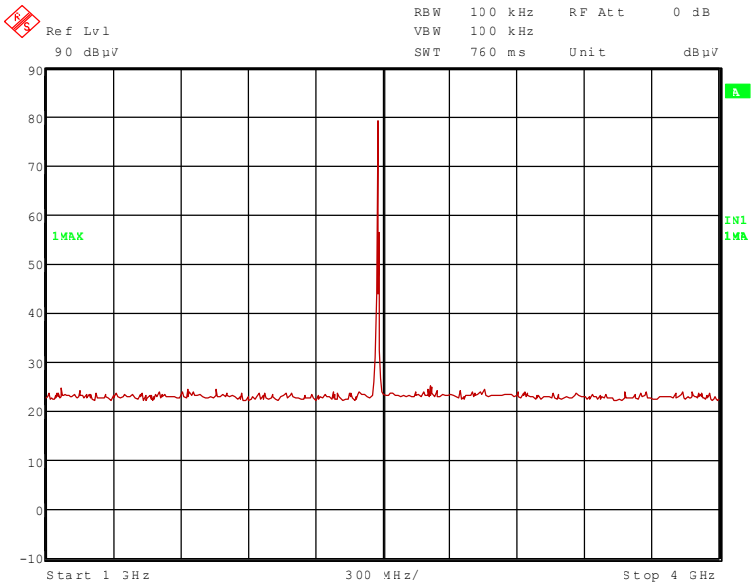
The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 2.445 GHz.

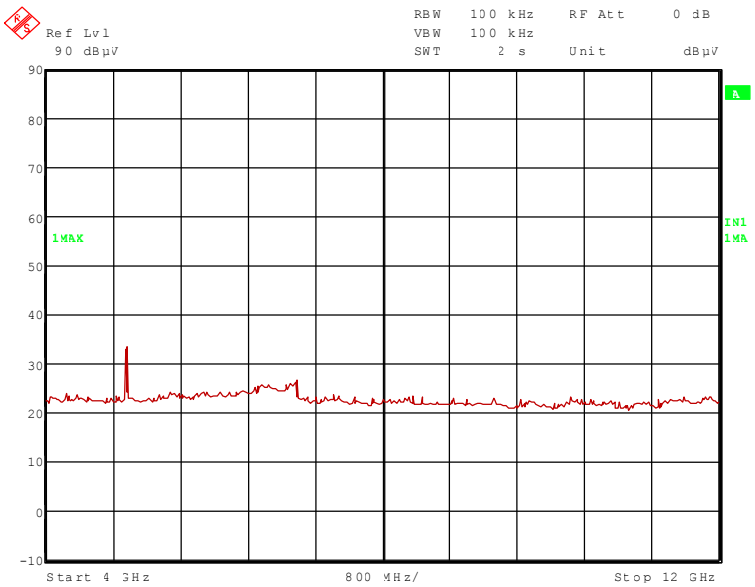
These frequencies have to be measured in a final measurement. The results were presented in the following.

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

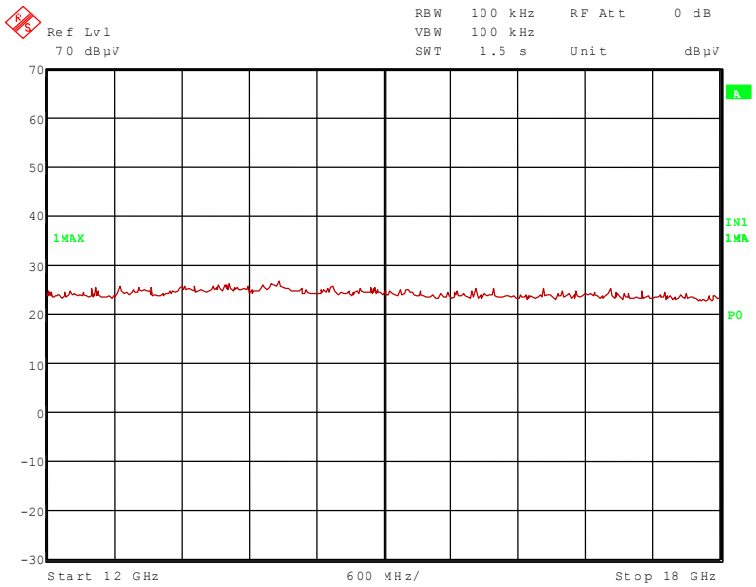
82155_13.wmf (1 GHz to 4 GHz) with internal antenna:



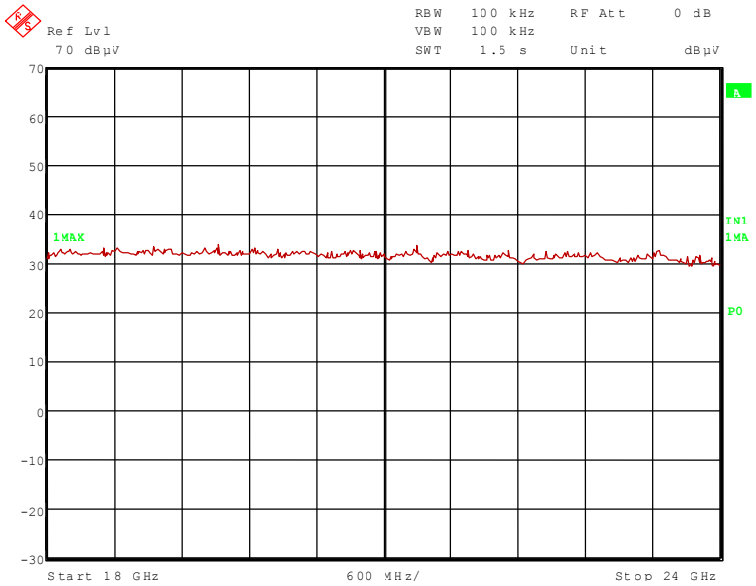
82155_14.wmf (4 GHz to 12 GHz) with internal antenna:



82155_71.wmf (12 GHz to 18 GHz) with internal antenna:



82155_70.wmf (18 GHz to 25 GHz) with internal antenna:



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

- 4.960 GHz.

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

- 2.480 GHz.

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

5.5.2.5 FINAL MEASUREMENT (1 GHz to 25 GHz) with internal antenna

Ambient temperature	21 °C	Relative humidity	52 %

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.

Supply voltage: During all measurements the EUT was supplied with 5.0 V DC via the carrier board.

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 GHz	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
2.405	93.3	-	-	87.3	28.8	26.5	3.7	150	Vert.	-
4.810	56.1	74.0	17.9	42.8	33.7	25.7	5.3	150	Hor.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	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
2.405	73.8	-	-	67.8	28.8	26.5	3.7	150	Vert.	-
4.810	37.1	54.0	16.9	23.8	33.7	25.7	5.3	150	Hor.	Yes
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 GHz	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
2.445	91.6	-	-	85.5	28.9	26.5	3.7	150	Vert.	-
4.890	55.8	74.0	18.2	42.3	33.9	25.7	5.3	150	Hor.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	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
2.445	72.2	-	-	66.1	28.9	26.5	3.7	150	Vert.	-
4.890	36.7	54.0	17.3	23.2	33.9	25.7	5.3	150	Hor.	Yes
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 GHz	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
2.480	90.5	-	-	84.2	29.0	26.5	3.8	150	Vert.	-
4.960	54.8	74.0	19.2	41.1	34.0	25.6	5.3	150	Hor.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	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
2.480	71.3	-	-	65.0	29.0	26.5	3.8	150	Vert.	-
4.960	36.1	54.0	17.9	22.4	34.0	25.6	5.3	150	Hor.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39, 43, 46, 49 – 51, 54

5.5.2.6 PRELIMINARY MEASUREMENT (9 kHz to 25 GHz) with external patch antenna (TwinGain-2400)

Ambient temperature	21 °C	Relative humidity	52 %

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: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

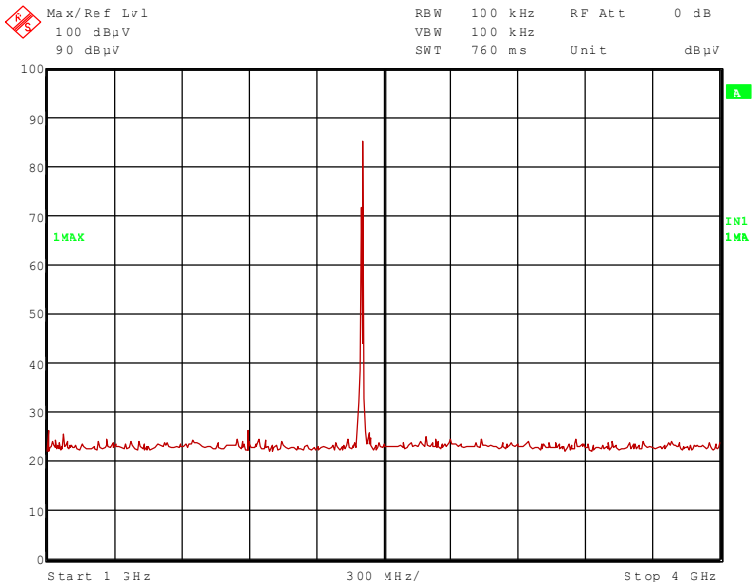
Test record: Where not otherwise stated the test was carried out in test mode 2 of the EUT, because there was no difference to the other test modes. All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 5.0 V DC via the carrier board.

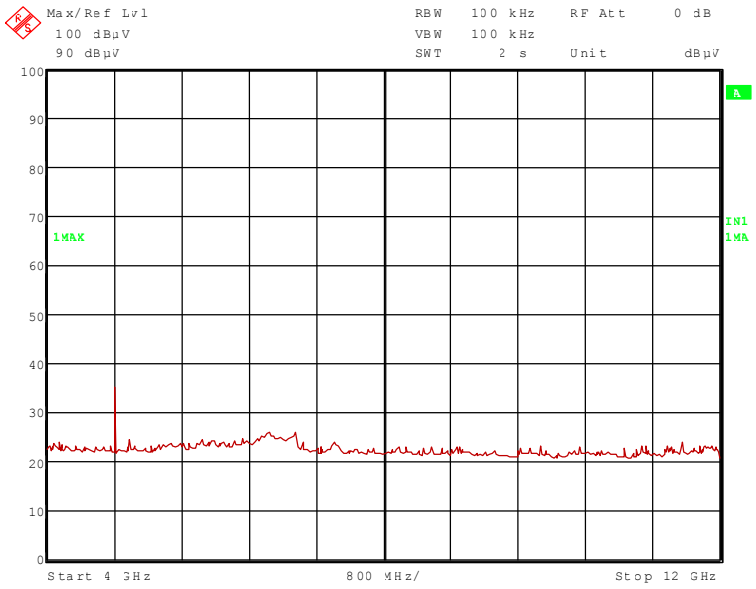
Remark: This test was carried out with the TwinGain antenna, because this antenna has the highest gain of all patch antennas. Additional pretests has shown that this antenna causes the highest spurious emissions of all patch antennas in question which has a unique antenna connector.

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

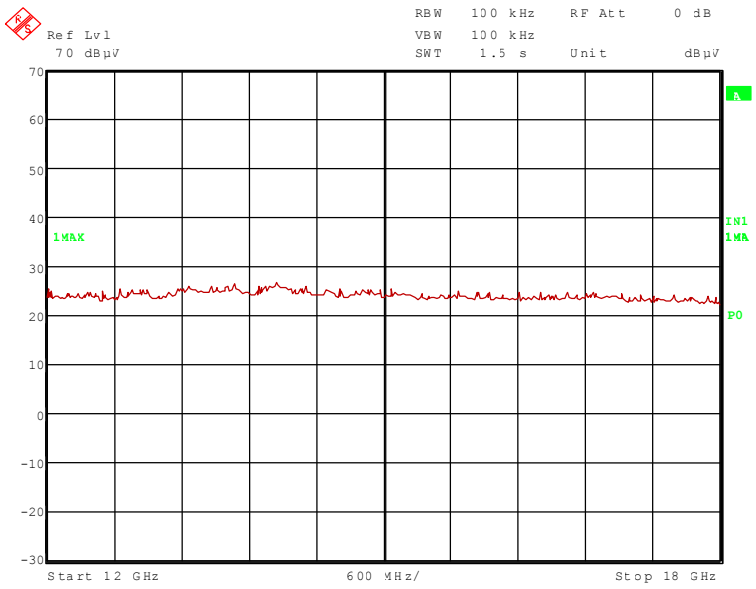
82155_30.wmf (1 GHz to 4 GHz) with TwinGain-2400:



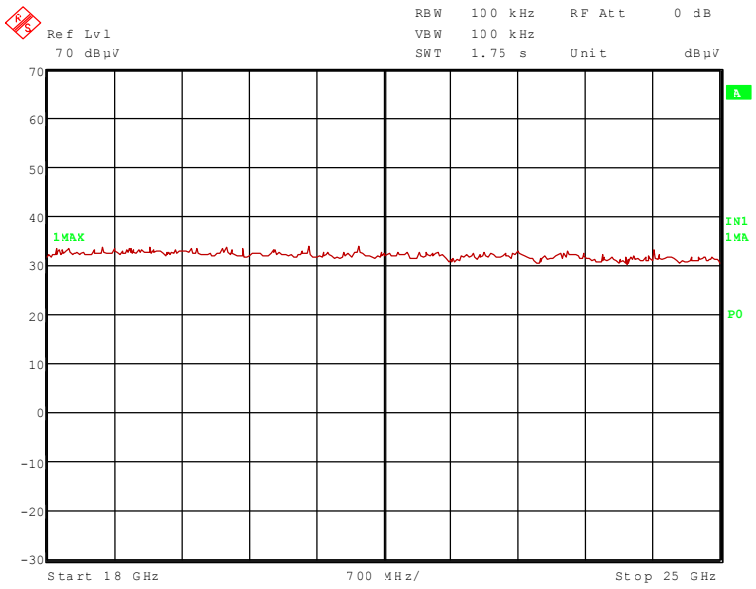
82155_31.wmf (4 GHz to 12 GHz) with TwinGain-2400:



82155_55.wmf (12 GHz to 18 GHz) with TwinGain-2400:



82155_54.wmf (18 GHz to 25 GHz) with TwinGain-2400:



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

- 4.810 GHz.

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

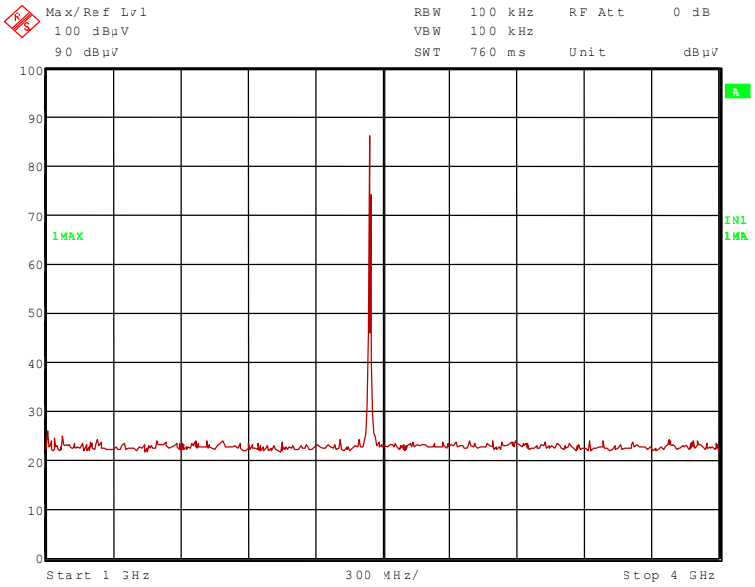
- 2.405 GHz.

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

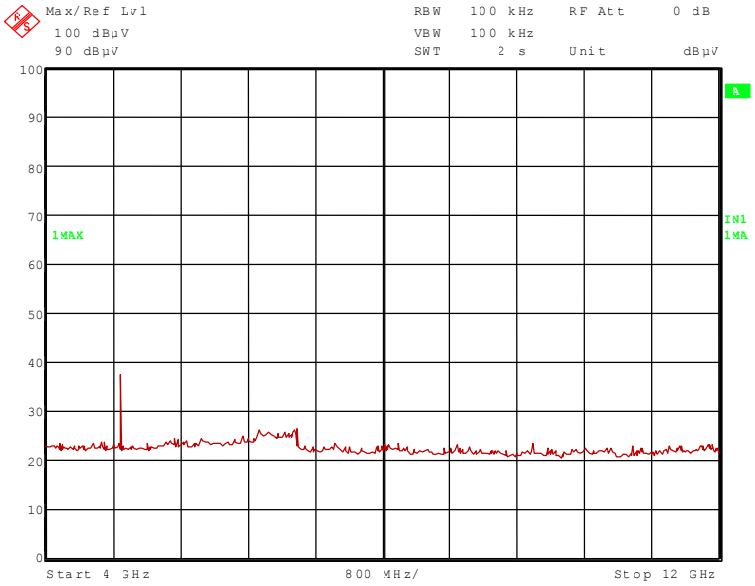
TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39, 43, 46, 49 – 51, 54

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

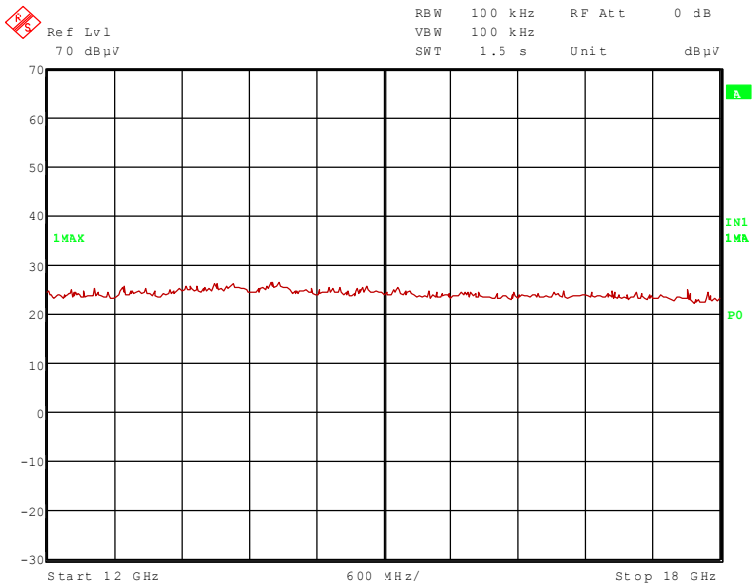
82155_33.wmf (1 GHz to 4 GHz) with TwinGain-2400:



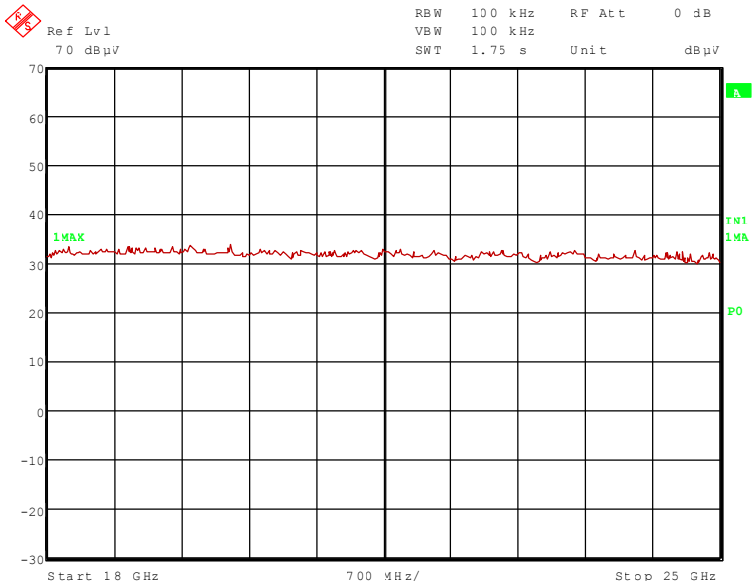
82155_34.wmf (4 GHz to 12 GHz) with TwinGain-2400:



82155_56.wmf (12 GHz to 18 GHz) with TwinGain-2400:



82155_57.wmf (18 GHz to 25 GHz) with TwinGain-2400:



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

- 4.890 GHz.

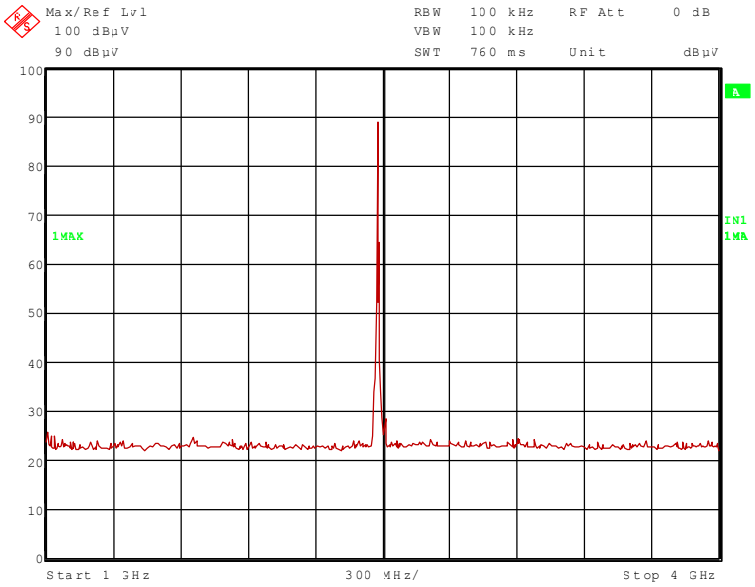
The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 2.445 GHz.

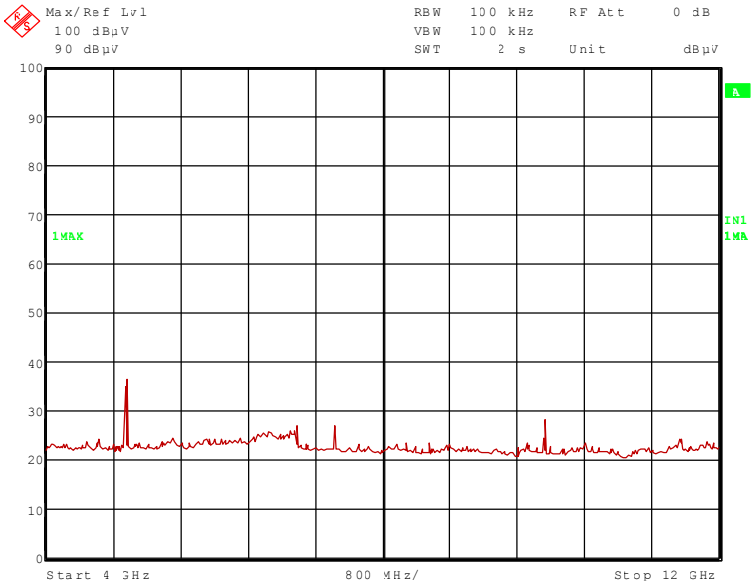
These frequencies have to be measured in a final measurement. The results were presented in the following.

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

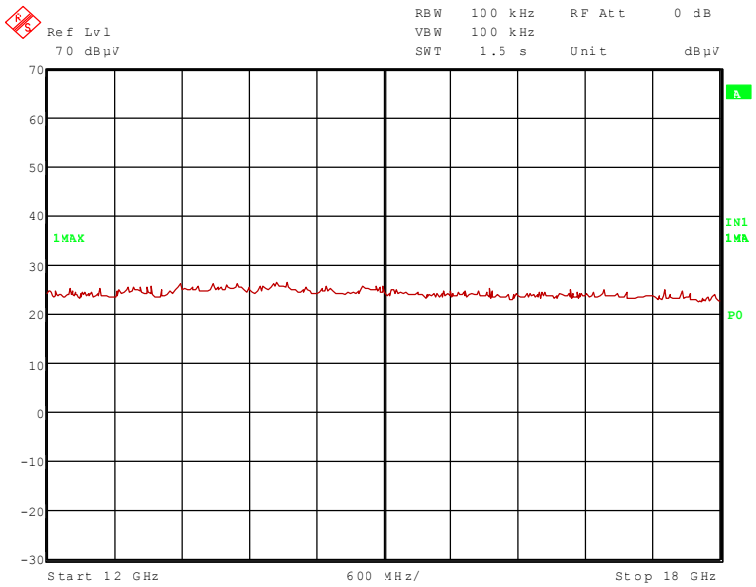
82155_28.wmf (1 GHz to 4 GHz) with TwinGain-2400:



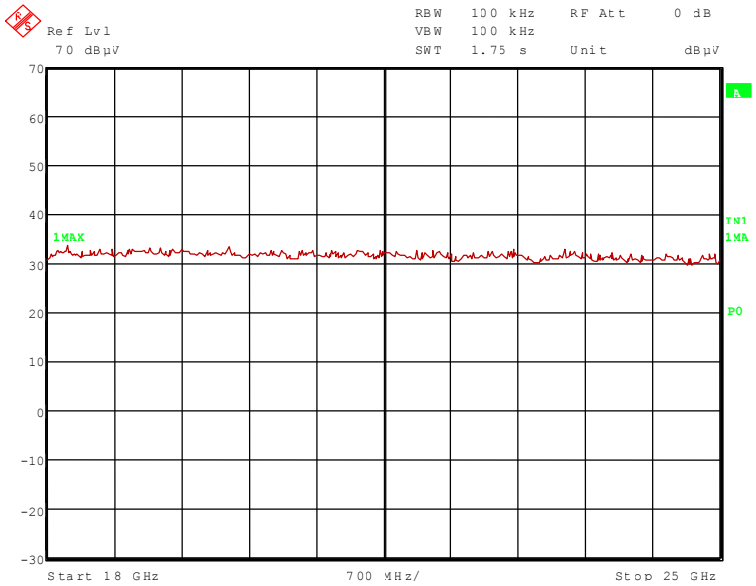
82155_29.wmf (4 GHz to 12 GHz) with TwinGain-2400:



82155_59.wmf (12 GHz to 18 GHz) with TwinGain-2400:



82155_58.wmf (18 GHz to 25 GHz) with TwinGain-2400:



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

- 4.960 GHz and 7.440 GHz.

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

- 2.480 GHz.

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

5.5.2.7 FINAL MEASUREMENT (1 GHz to 25 GHz) with external patch antenna (TwinGain-2400)

Ambient temperature	21 °C	Relative humidity	52 %

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.

Supply voltage: During all measurements the EUT was supplied with 5.0 V DC via the carrier board.

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 GHz	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
2.405	95.9	-	-	89.9	28.8	26.5	3.7	150	Hor.	-
4.810	55.6	74.0	18.4	42.3	33.7	25.7	5.3	150	Hor.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	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
2.405	76.9	-	-	70.9	28.8	26.5	3.7	150	Hor.	-
4.810	36.6	54.0	17.4	23.3	33.7	25.7	5.3	150	Hor.	Yes
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 GHz	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
2.445	97.1	-	-	91.0	28.9	26.5	3.7	150	Vert.	-
4.890	56.7	74.0	17.3	43.2	33.9	25.7	5.3	150	Hor.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	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
2.445	77.8	-	-	71.7	28.9	26.5	3.7	150	Vert.	-
4.890	37.2	54.0	16.8	23.7	33.9	25.7	5.3	150	Hor.	Yes
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 GHz	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
2.480	99.1	-	-	92.8	29.0	26.5	3.8	150	Vert.	-
4.960	53.2	74.0	20.8	39.5	34.0	25.6	5.3	150	Hor.	Yes
7.440	48.5	74.0	25.5	28.9	37.3	24.5	6.8	150	Vert.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	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
2.480	79.9	-	-	73.6	29.0	26.5	3.8	150	Vert.	-
4.960	34.9	54.0	19.1	21.2	34.0	25.6	5.3	150	Hor.	Yes
7.440	31.6	54.0	22.4	12.0	37.3	24.5	6.8	150	Vert.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 37, 39, 43, 46, 49 – 51, 54

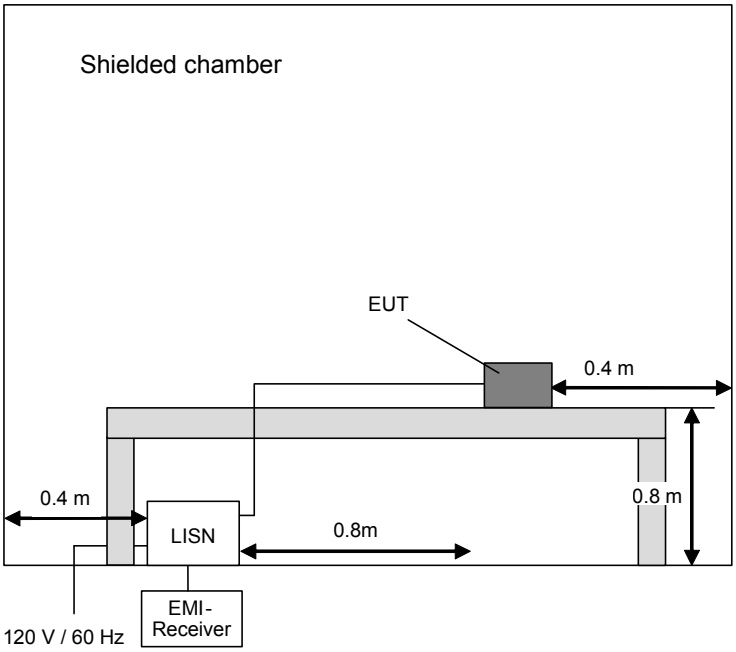
5.6 CONDUCTED EMISSIONS ON POWER SUPPLY LINES (150 KHZ TO 30 MHZ)

5.6.1 METHOD OF MEASUREMENT

This test will be carried out in a shielded 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 above the ground plane. Floor-standing devices will be placed directly on the ground plane. The set up of the Equipment under test will be in accordance to
ANSI C63.4-2003 [1].

The frequency range 150 kHz to 30 MHz will be measured with an EMI Receiver set to MAX Hold mode with peak and average detector and a resolution bandwidth of 9 kHz. A scan will be carried out on the phase (or plus pole in case of DC powered devices) of the AC mains network. If levels detected 10 dB below the appropriable limit, this emission will be measured with the average and quasi-peak detector on all lines.

Frequency range	Resolution bandwidth
150 kHz to 30 MHz	9 kHz



5.6.2 TEST RESULTS (CONDUCTED EMISSIONS ON POWER SUPPLY LINES)

Ambient temperature	20 °C	Relative humidity	49 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m.

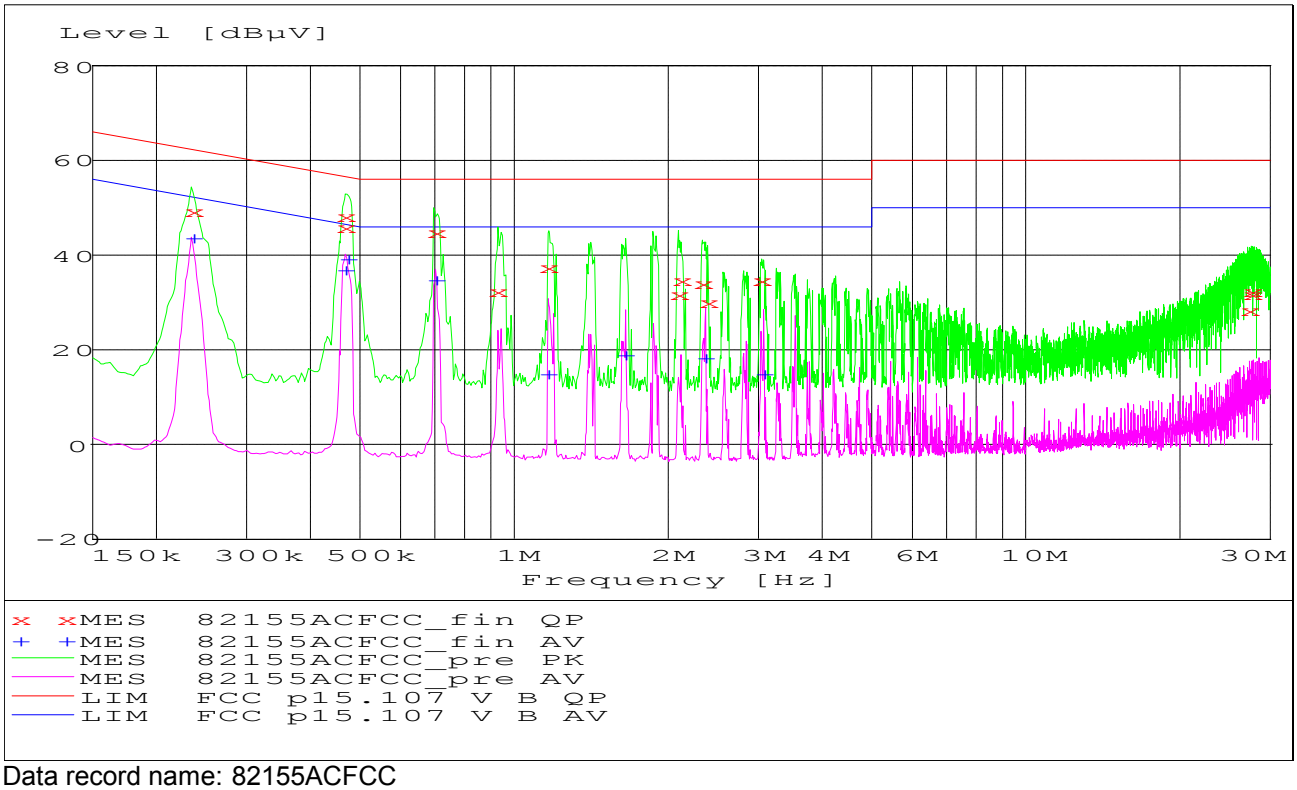
Cable guide: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

Title: AC Powerline Conducted Emission Test with protective ground conductor simulating network

EUT: cB-0922-02
Manufacturer: connectBlue AB
Operating Condition: Echo mode
Test site: PHOENIX TESTLAB Blomberg M4
Operator: Th. KÜHN
Test Specification: 120V 60 Hz at mascot power supply type 2121
Comment:

The curves in the diagram only represent for each frequency point the maximum measured value of all preliminary measurements which were made for each power supply line. The top measured curve represents the peak measurement and the bottom measured curve the average measurement. The quasi-peak measured points are marked by x and the average measured points by +.



Data record name: 82155ACFCC

Result measured with the quasipeak detector:

(These values are marked in the above diagram by x)

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.235140	49.50	1.0	62.3	12.8	N	FLO
0.465810	46.30	0.9	56.6	10.2	N	FLO
0.469590	48.20	0.9	56.5	8.3	L1	FLO
0.699450	44.90	0.8	56.0	11.1	L1	FLO
0.925800	32.60	0.7	56.0	23.4	N	FLO
1.167090	37.80	0.7	56.0	18.2	N	FLO
2.091840	31.90	0.7	56.0	24.1	L1	FLO
2.123430	34.70	0.8	56.0	21.3	L1	FLO
2.328450	34.20	0.7	56.0	21.8	N	FLO
2.391990	30.40	0.7	56.0	25.6	N	FLO
3.043680	34.60	0.8	56.0	21.4	L1	FLO
27.384810	28.80	3.0	60.0	31.2	N	FLO
27.548250	32.20	3.0	60.0	27.8	L1	FLO
27.630150	32.40	3.0	60.0	27.6	L1	FLO

Data record name: 82155ACFCC_fin QP

Result measured with the average detector:

(These values are marked in the above diagram by +)

Frequency MHz	Level dBµV	Transducer DB	Limit dBµV	Margin dB	Line	PE
0.235410	43.70	1.0	52.3	8.5	L1	FLO
0.466080	36.90	0.9	46.6	9.7	L1	FLO
0.472110	39.30	0.9	46.5	7.1	L1	FLO
0.705750	35.00	0.8	46.0	11.0	L1	FLO
1.163580	14.90	0.7	46.0	31.1	N	FLO
1.653000	18.80	0.7	46.0	27.2	N	FLO
2.365620	18.20	0.7	46.0	27.8	L1	FLO
3.074550	15.30	0.7	46.0	30.7	L1	FLO

Data record name: 82155ACFCC_fin AV

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
1 – 3, 5, 6

6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
1	Shielded chamber M4	-	Siemens	B83117S1-X158	480088	Weekly verification (system cal.)	
2	Measuring receiver	ESAI	Rohde & Schwarz	831953/001 833181/018	480025 480026	02/26/2008 02/26/2008	02/2010 02/2010
3	LISN	NSLK8128	Schwarzbeck	8128155	480058	01/09/2008	01/2009
5	AC-filter	B84299-D87-E3	Siemens	930262292	480097	Weekly verification (system cal.)	
6	EMI-Software	ES-K1	Rohde & Schwarz	-	480111	not applicable	
14	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
15	Measuring receiver	ESCS30	Rohde & Schwarz	828985/014	480270	02/27/2008	02/2010
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 A	Chase	1643	480147	08/01/2007	08/2012
20	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	-
29	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	02/25/2008	02/2010
32	Controller	HD100	Deisel	100/670	480326	-	
33	Turntable	DS420HE	Deisel	420/620/80	480315	-	
34	Antenna support	AS615P	Deisel	615/310	480187	-	
35	Antenna	CBL6112 B	Chase	2688	480328	10/11/2005	10/2010
36	Antenna	3115 A	EMCO	9609-4918	480183	09/11/2008	09/2013
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.)	
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 1m	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.)	
54	Power supply	TOE 8852	Toellner	51712	480233	11/27/2006	11/2008
58	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	02/19/2008	02/2013

7 LIST OF ANNEXES

ANNEX A	**PHOTOGRAPHS OF THE TEST SET-UPS**:	**6 pages**
	cB-0922-02, test set-up fully anechoic chamber	82155_b.jpg
	cB-0922-02, test set-up fully anechoic chamber	82155_n.jpg
	cB-0922-02, test set-up fully anechoic chamber	82155_m.jpg
	cB-0922-02, test set-up fully anechoic chamber	82155_a.jpg
	cB-0922-02, test set-open area test site	82155_c1.jpg
	cB-0922-02, test set-up conducted emission measurement	82155_b1.jpg
ANNEX B	**INTERNAL PHOTOGRAPHS OF THE TEST SAMPLE:**	**7 pages**
	cB-0922-02 sample “144”, top view	82155_9.jpg
	cB-0922-02 sample “144”, shielding removed, top view	82155_8.jpg
	cB-0922-02 sample “105”, top view	82155_9.jpg
	cB-0922-02 sample “105”, shielding removed, top view	82155_10.jpg
	cB-0922-02 bottom view	82155_6.jpg
	cB-0903-02-01 carrier board, top view	82155_11.jpg
	cB-0903-03 carrier board, bottom view	82155_12.jpg
ANNEX C	**EXTERNAL PHOTOGRAPHS OF THE TEST SAMPLE**:	**- pages**
	Because the EUT is a module, which is intended to be implemented inside a final application, no external photographs were available	
ANNEX D	**ADDITIONAL RESULTS FOR INDUSTRY CANADA**:	**4 pages**
ANNEX E	**ADDITIONAL MEASUREMENT RESULTS WITH ANTENNAS HAVING A NON UNIQUE ANTENNA CONNECTOR**	**13 pages**