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Test Report

Report Number: F112920E1

Applicant:

Atlas Material Testing Technology GmbH

Manufacturer:

Atlas Material Testing Technology GmbH

Equipment under Test (EUT):

TX-RX01

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

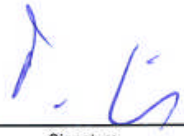

REFERENCES

- [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:	Thomas KÜHN		05 October 2011
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		05 October 2011
	Name	Signature	Date

RESERVATION

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1 IDENTIFICATION

1.1 Applicant

Name:	Atlas Material Testing Technology GmbH
Address:	Vogelsbergstraße 22 63589 Linsengericht-Altenhaßlau
Country:	Germany
Name for contact purposes:	Mr. Christian BERNATEK
Phone:	+ 49 60 51 707 – 206
Fax:	+ 49 60 51 707 – 207
eMail Address:	christian.bernatek@ametek.de
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	Atlas Material Testing Technology GmbH
Address:	Vogelsbergstraße 22 63589 Linsengericht-Altenhaßlau
Country:	Germany
Name for contact purposes:	Mr. Christian BERNATEK
Phone:	+ 49 60 51 707 – 206
Fax:	+ 49 60 51 707 – 207
eMail Address:	christian.bernatek@ametek.de
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: *	Transceiver module for sensor data transmission
Model name: *	TX-RX01
FCC ID: *	XL4-TXRX01
IC: *	8716A-TXRX01
PCB identifier: *	56 079 470 Rev. 0 (with internal antenna), 56 079 471 Rev. 0 (with external antenna)
Hardware version: *	Rev. 0
Software version: *	None

1.5 Technical data of equipment

Channel 1	RX:	2402 MHz	TX:	2402 MHz
Channel 39	RX:	2441 MHz	TX:	2441 MHz
Channel 79	RX:	2480 MHz	TX:	2480 MHz

Antenna type: *	Integral and external (ID 56079475)					
Antenna gain: *	0 dBi					
Antenna connector: *	None with internal antenna, Hirose U.FL connector with external antenna					
Power supply: *	U _{nom} =	3.3 V DC	U _{min} =	3.0 V DC	U _{max} =	4.0 V DC
Type of modulation: *	GFSK					
Data rate: *	Max. 2 Mbps					
Operating frequency range: *	2402 MHz to 2480 MHz					
Number of channels: *	79					
Temperature range: *	-40 °C to +85 °C					
Lowest internal clock frequency: *	16.000 MHz					

* declared by the applicant.

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
Antenna (external antenna version only)	U.FL	SMA	10 cm
-	-	-	-

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	12 September 2011
Start of test:	12 September 2011
End of test:	19 September 2011

2 OPERATIONAL STATES

The EUT is intended to be used for sensor data transmission inside environmental simulation chambers. Because the EUT 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.

The tests were carried out with an unmodified sample with internal antenna and an unmodified sample with an antenna connector. The external antenna intended to be used in combination with the EUT is the same type that it is used as internal antenna. If the external antenna is used a cable will be used to connect the antenna to the antenna connector of the EUT. As additional pre-tests have shown the highest emissions were caused by the use of the shortest possible antenna connection cable (10 cm).

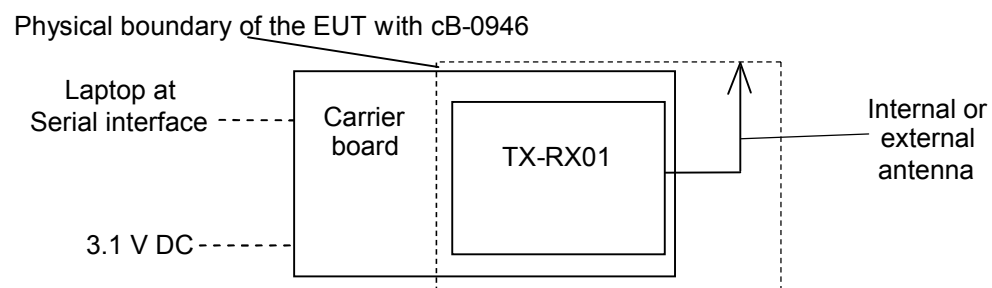
During the tests the test sample was powered with 3.1 V DC via the carrier board. The carrier board was powered by an internal 9.0 V DC block battery.

During the conducted emission measurement on the AC supply line the voltage supply of the carrier board was disconnected and an external AC/DC adaptor type enerCELL type CAT.No. 273-316 was used. During this measurement a data link with a continuous data transfer between the EUT and a second sample was set up.

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.

The following operation modes were used during the tests in Bluetooth mode:

Operation mode	Description of the operation mode
1	Continuous transmitting on 2402 MHz
2	Continuous transmitting on 2441 MHz
3	Continuous transmitting on 2480 MHz
4	Continuous transmitting and receiving on 2441 MHz
5	Continuous receiving on 2441 MHz



Preliminary tests were performed in different orthogonal directions, to find worst-case position. The radiated emission measurement was carried out in the orthogonal direction that emits the highest spurious emission levels.

3 ADDITIONAL INFORMATION

The external antenna will be also implemented inside the environmental simulation chamber and not reachable by the final user.

The 3 orthogonal axes were defined as Pos.1 EUT standing vertically on the shorter side, Pos.2 EUT standing vertical on the longer side and Pos 3 EUT lying. For details of the different positions, please refer also the photographs in Annex A of this test report.

During the tests the EUT was not labeled as required by FCC / IC.

4 OVERVIEW

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section	RSS 210, Issue 8 [4] or RSS-Gen, Issue 3 [5]	Status	Refer page
6 dB bandwidth	General	15.247 (a) (2)	A8.2 (a) [4]	Passed	8 et seq.
Power spectral density	2400.0 – 2483.5	15.247 (e)	A8.2 (b) [4]	Passed	11 et seq.
Maximum peak output power	2400.0 – 2483.5	15.247 (b) (3), (4)	A8.4 (2) [4]	Passed	14 et seq.
Band edge compliance	2400.0 – 2483.5	15.247 (d)	A8.5 [4]	Passed	16 et seq.
Radiated emissions (transmitter)	30 – 25,000	15.205 (a) 15.209 (a)	7.2.2 [5] 2.5 [4]	Passed	21 et seq.
Conducted emissions on supply line	0.15 – 30	15.207 (a)	7.2.4 [5]	Passed	50 et seq.
Radiated emissions (receiver)	0.009 – 12,500	15.109 (a)	6.1 [5]	Passed	Annex D

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.

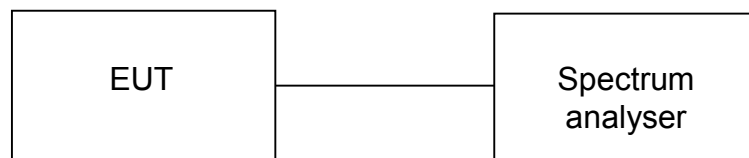
The following spectrum analyser settings shall be used:

- 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.

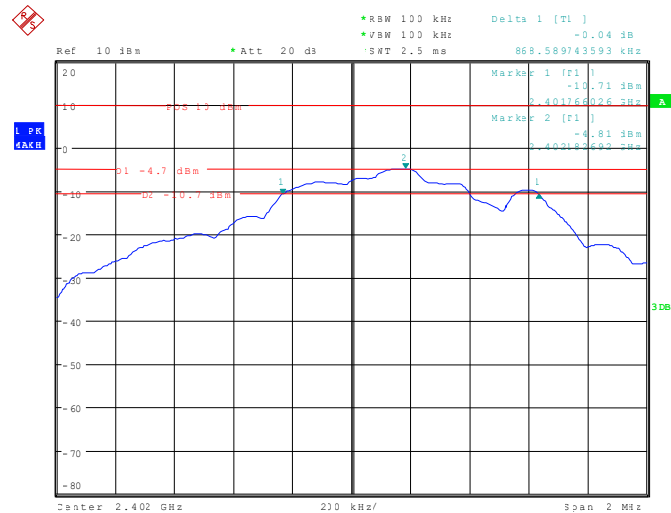
Test set-up:



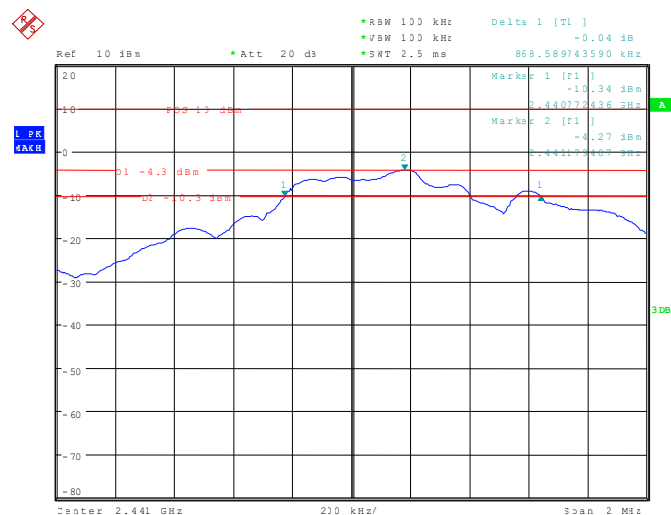
5.1.2 Test results (6 dB bandwidth)

Ambient temperature	20 °C	Relative humidity	40 %
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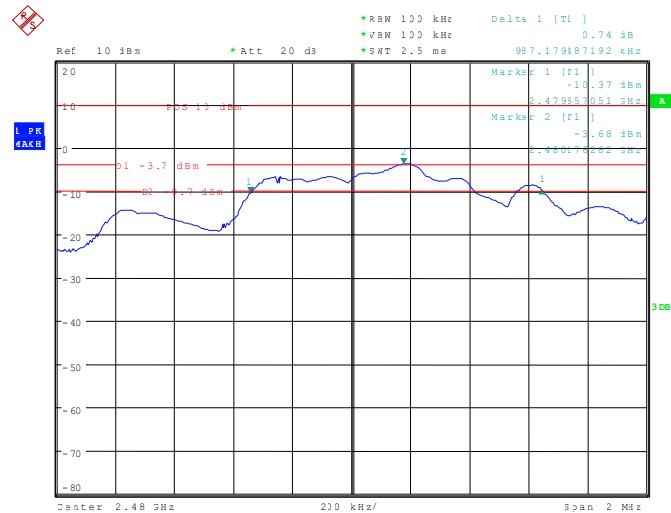
112920_60.wmf: 6 dB bandwidth at the lower end of the assigned frequency band:



112920_61.wmf: 6 dB bandwidth at the middle of the assigned frequency band:



112920_62.wmf: 6 dB bandwidth at the upper end of the assigned frequency band:



Channel number	Channel frequency [MHz]	6 dB bandwidth [kHz]
Operation mode 1, 2, 3		
0	2402	868.590
39	2441	868.590
79	2480	987.179
Measurement uncertainty		+0.66 dB / -0.72 dB

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

30

5.2 Power spectral density

5.2.1 Method of measurement (power spectral density)

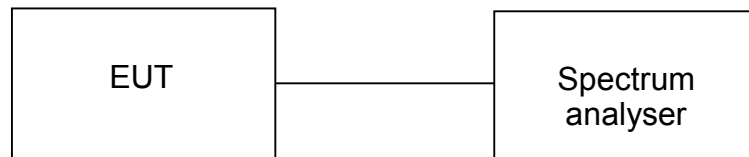
The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed.

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.

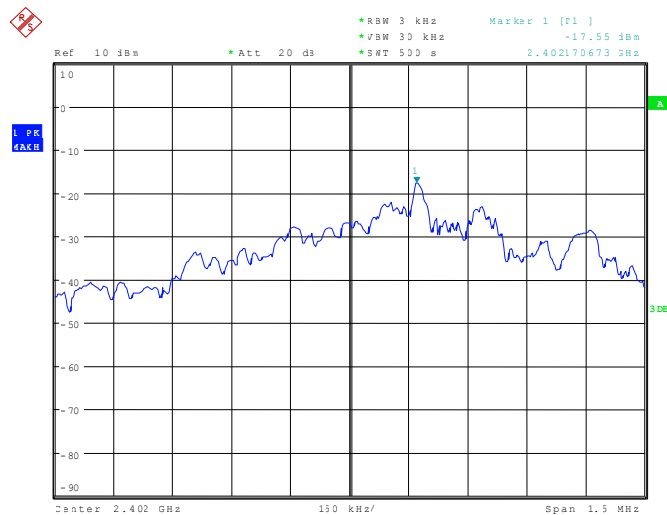
Test set-up:



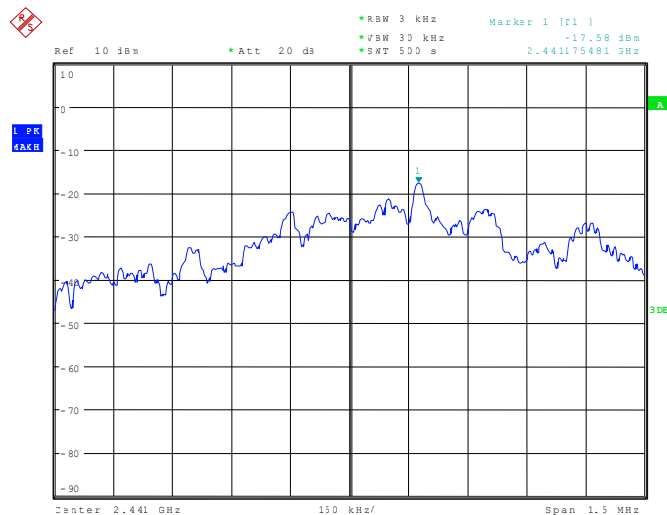
5.2.2 Test results (power spectral density)

Ambient temperature	20 °C	Relative humidity	40 %
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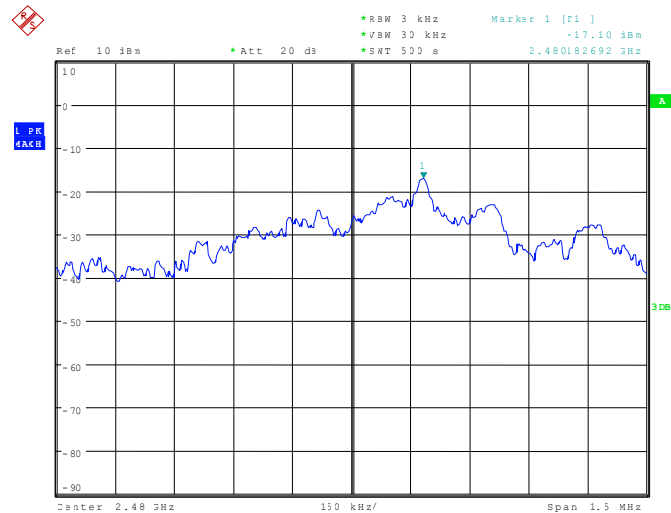
112920_65.wmf: Power spectral density, operation mode 1:



112920_64.wmf: Power spectral density, operation mode 2:



112920_63.wmf: Power spectral density, operation mode 3:



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]
0	2402	-17.6	0.0	8.0
39	2441	-17.6	0.0	8.0
79	2480	-17.1	0.0	8.0
Measurement uncertainty			+1.1 dB / -1.5 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

30

5.3 Maximum peak output power

5.3.1 Method of measurement (maximum peak output power)

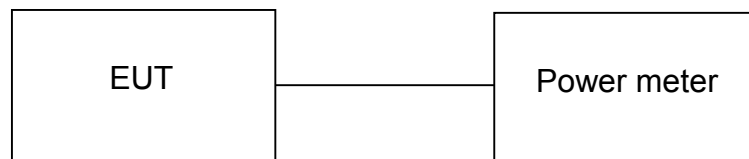
The calibration of the power meter has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the power meter via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed. The EUT has to be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



5.3.2 Test results (maximum peak output power)

Ambient temperature	20 °C	Relative humidity	40 %
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Operation mode 1 to 3				
Channel number	Channel frequency [MHz]	Maximum peak output power [dBm]	Antenna gain [dBi]	Peak power limit [dBm]
0	2402	-4.7	0.0	30.0
39	2441	-4.1	0.0	30.0
79	2480	-3.5	0.0	30.0
Measurement uncertainty			+0.66 dB / -0.72 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
170, 172

5.4 Band-edge compliance

5.4.1 Method of measurement (band-edge compliance (radiated))

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.

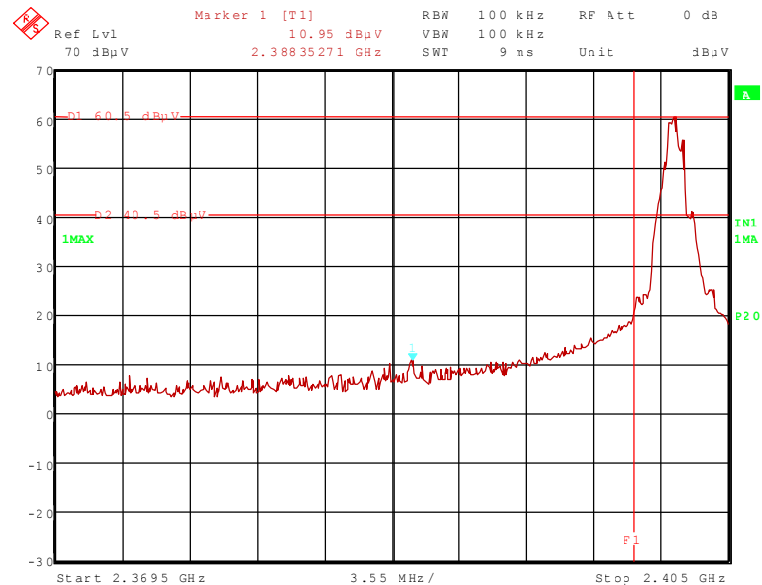
After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 20 dB below the first line (or the peak marker). The frequency line shall be set on the edge of the assigned frequency band. Set the second marker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

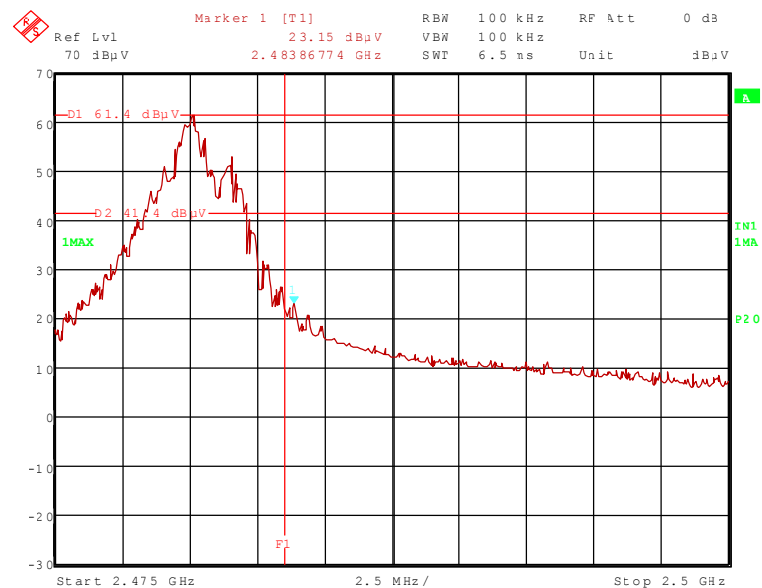
5.4.2 Test result (band-edge compliance (radiated)) with internal antenna

Ambient temperature	21 °C	Relative humidity	53 %
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112920_6.wmf: Radiated band-edge compliance, lower band edge (operation mode 1):



112920_2.wmf: Radiated band-edge compliance, upper band edge (operation mode 3):



The plots on the page before are showing the radiated band-edge compliance for the upper 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
2.4020	92.8	-	-	60.8	28.3	0.0	3.7	150	Hor.	-
2.3883	44.0	74.0	30.0	12.0	28.3	0.0	3.7	150	Hor.	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
2.4020	79.4	-	-	47.4	28.3	0.0	3.7	150	Hor.	-
2.3883	26.5	54.0	27.5	-5.5	28.3	0.0	3.7	150	Hor.	Yes
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
2.4800	94.0	-	-	61.7	28.5	0.0	3.8	150	Hor.	-
2.4839	54.7	74.0	19.3	22.4	28.5	0.0	3.8	150	Hor.	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
2.4800	80.1	-	-	47.8	28.5	0.0	3.8	150	Hor.	-
2.4839	31.0	54.0	23.0	-1.3	28.5	0.0	3.8	150	Hor.	Yes
Measurement uncertainty							+2.2 dB / -3.6 dB			

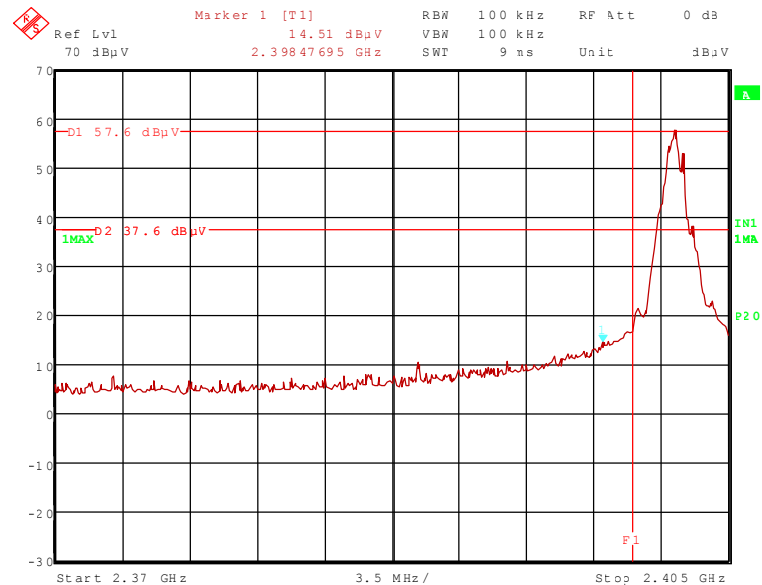
Test: Passed

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

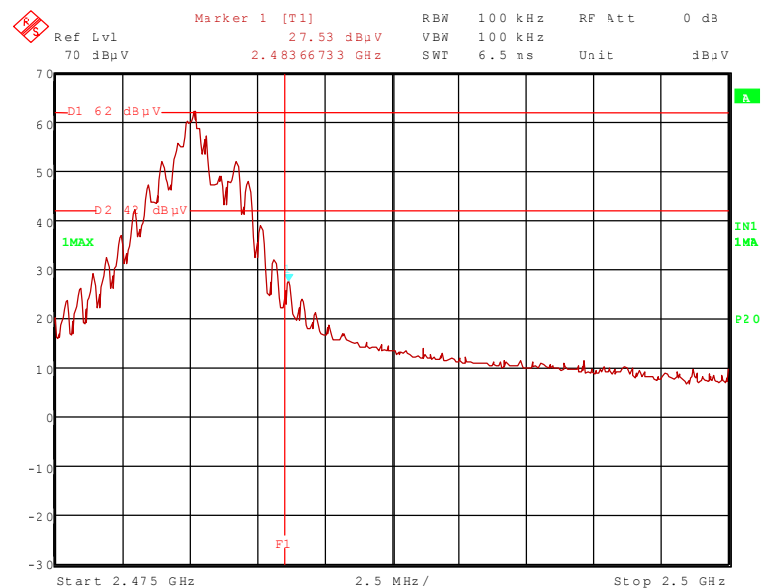
5.4.3 Test result (band-edge compliance (radiated)) with external antenna

Ambient temperature	21 °C	Relative humidity	52 %
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112920_14.wmf: Radiated band-edge compliance, lower band edge (operation mode 1):



112920_12.wmf: Radiated band-edge compliance, upper band edge (operation mode 3):



The plots on the page before are showing the radiated band-edge compliance for the upper 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
2.4020	89.5	-	-	57.5	28.3	0.0	3.7	150	Hor.	-
2.3985	46.1	74.0	27.9	14.1	28.3	0.0	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
2.4020	76.1	-	-	44.1	28.3	0.0	3.7	150	Hor.	-
2.3985	26.9	56.1	29.2	-5.1	28.3	0.0	3.7	150	Hor.	No
Measurement uncertainty							+2.2 dB / -3.6 dB			

Band-edge compliance (upper band edge, hopping disabled)										
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
2.4800	94.5	-	-	62.2	28.5	0.0	3.8	150	Hor.	-
2.4837	58.5	74.0	15.5	26.2	28.5	0.0	3.8	150	Hor.	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
2.4800	80.2	-	-	47.9	28.5	0.0	3.8	150	Hor.	-
2.4837	32.8	54.0	21.2	0.5	28.5	0.0	3.8	150	Hor.	Yes
Measurement uncertainty							+2.2 dB / -3.6 dB			

Test: Passed

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

5.5 Radiated emissions

5.5.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into four stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 30 MHz to 1 GHz.
- A final measurement carried out on an open area test site 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.

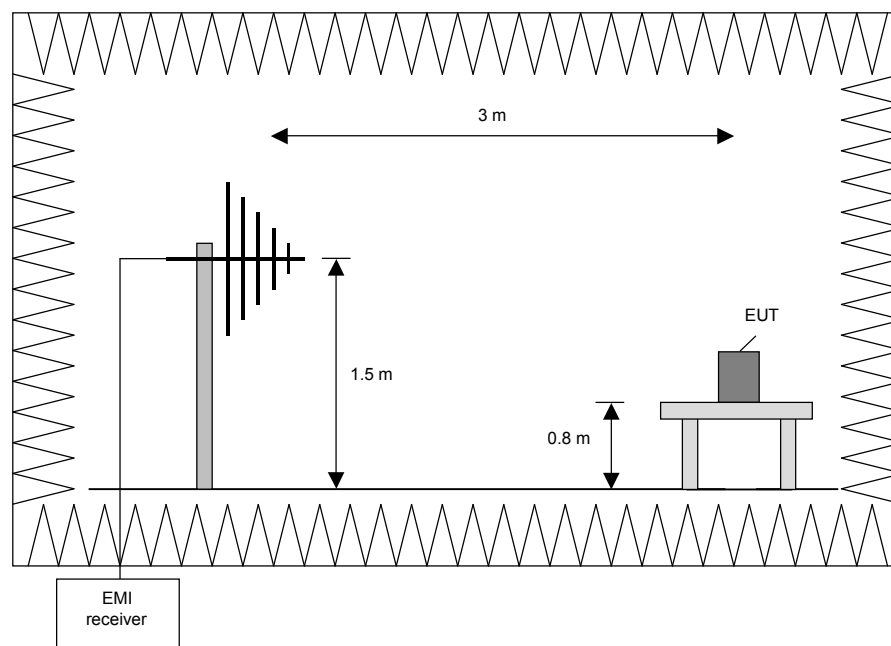
Preliminary measurement (30 MHz to 1 GHz)

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 set up of the Equipment under test will be in accordance to ANSI C63.4-2009 [1].

The frequency range 30 MHz to 1 GHz will be measured with an EMI Receiver set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °.

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

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



Procedure preliminary measurement:

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.

The following procedure will be used:

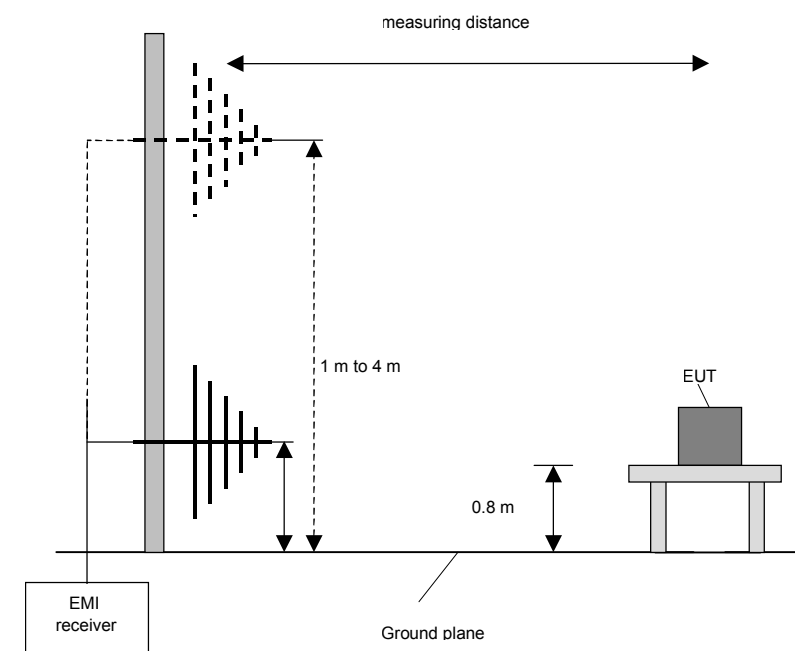
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the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

Final measurement (30 MHz to 1 GHz)

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

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

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

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

Preliminary and final measurement (1 GHz to 110 GHz)

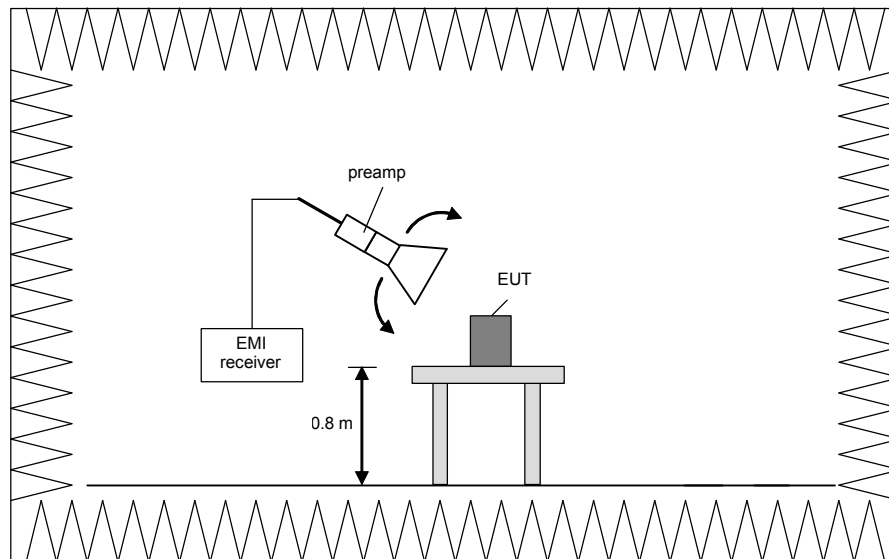
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance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

Preliminary measurement (1 GHz to 110 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna, 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

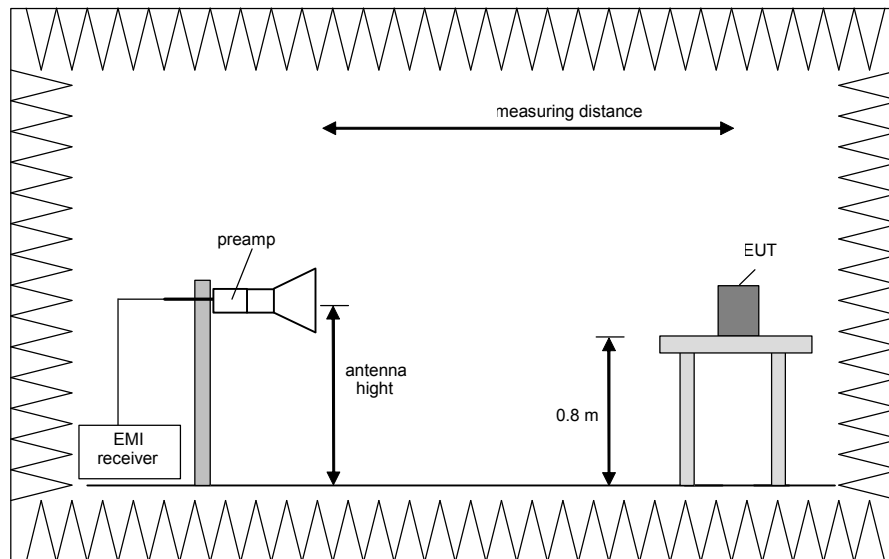


Final measurement (1 GHz to 110 GHz)

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.

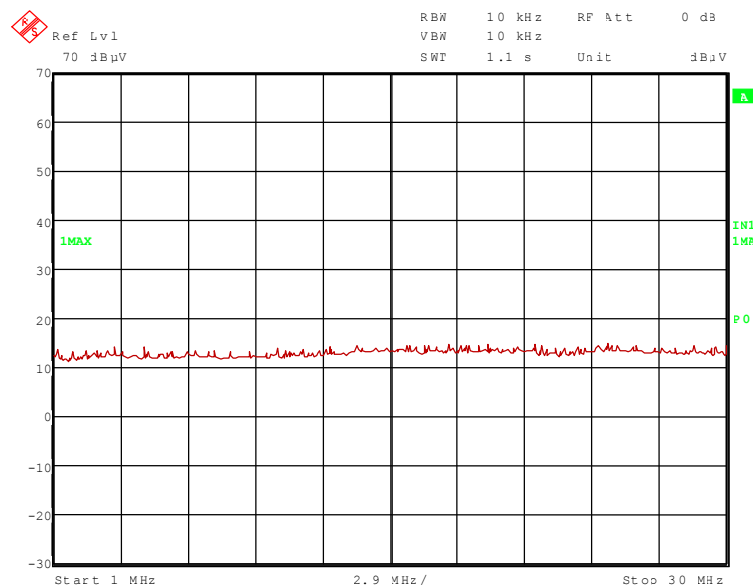
5.5.2 Test results (radiated emissions)

5.5.2.1 Preliminary radiated emission measurement with external antenna

Ambient temperature	20 °C	Relative humidity	50 %
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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:	No cable was connected to the EUT. For detail information of test set-up 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:	As pre-tests have shown, the emissions in the frequency range 9 kHz to 1 GHz are not depending on the transmitter operation mode. Therefore the emissions in this frequency range were measured only with the transmitter operates in operation mode 2.

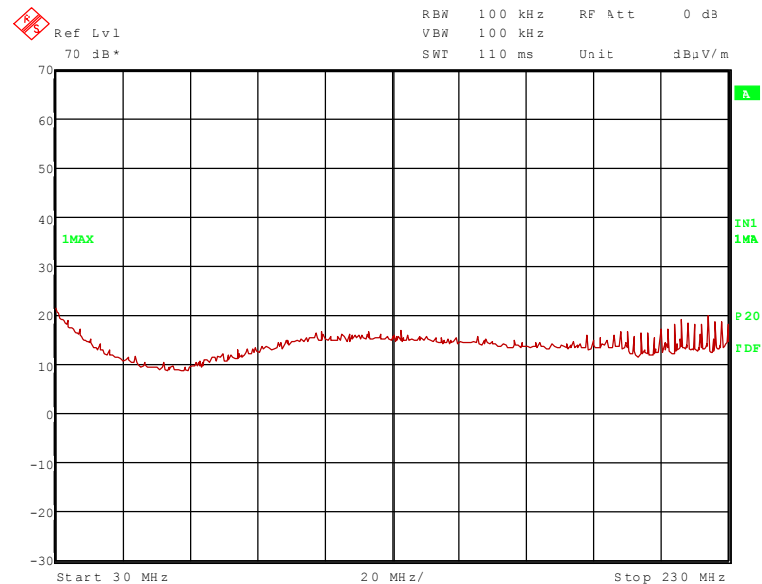
112920_20.wmf: Spurious emissions from 1 MHz to 30 MHz (operation mode 2):



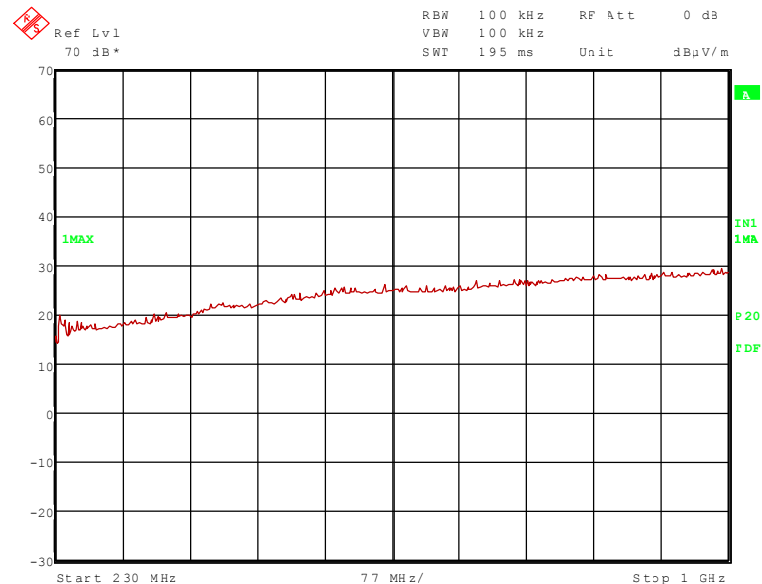
No significant frequencies above the noise floor of the system were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 39, 43, 44, 46, 49 - 51, 55, 72

112920_18.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 2):



112920_19.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 2):



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

199.860 MHz, 215.760 MHz, 221.750 MHz and 233.670 MHz.

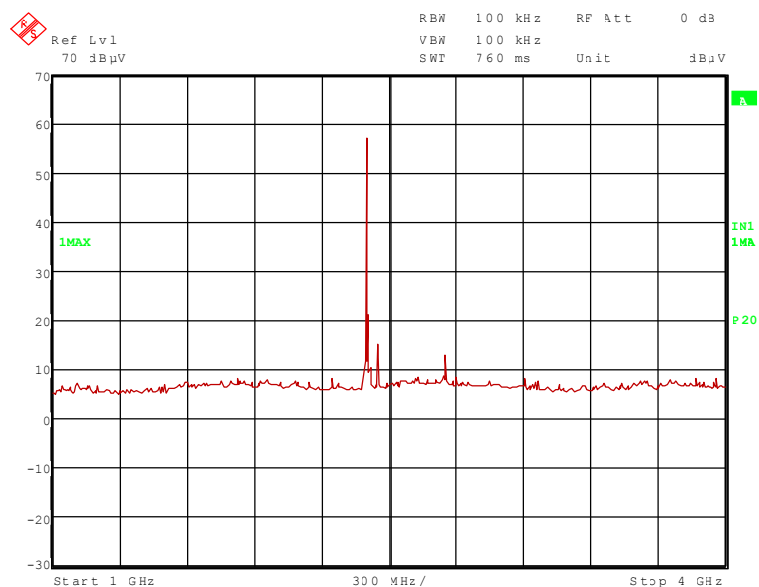
The following frequency was found inside the restricted bands during the radiated emission test.

253.720 MHz.

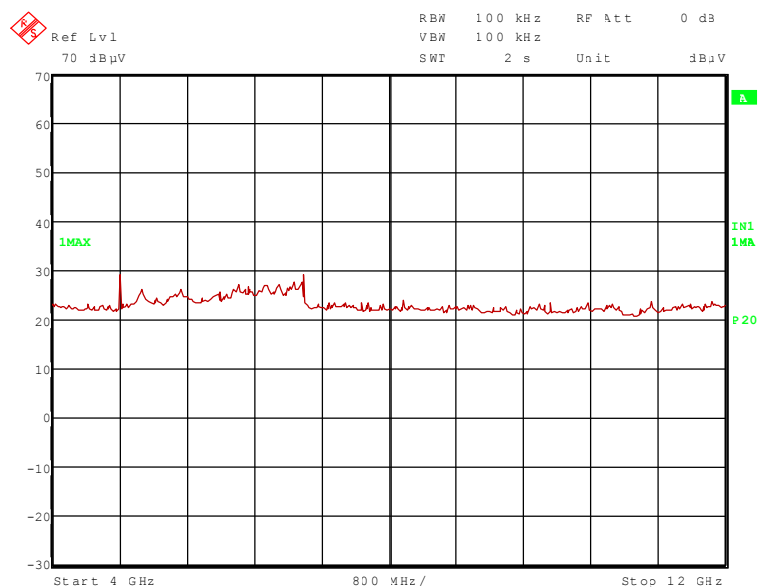
These frequencies have to be measured on the open area test site. The result is presented in the following.

Transmitter operates at the lower end of the assigned frequency band

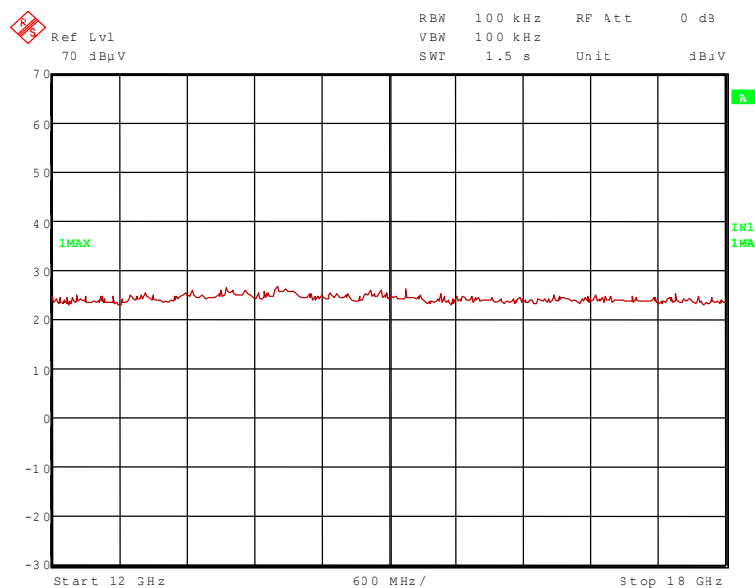
112920_13.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



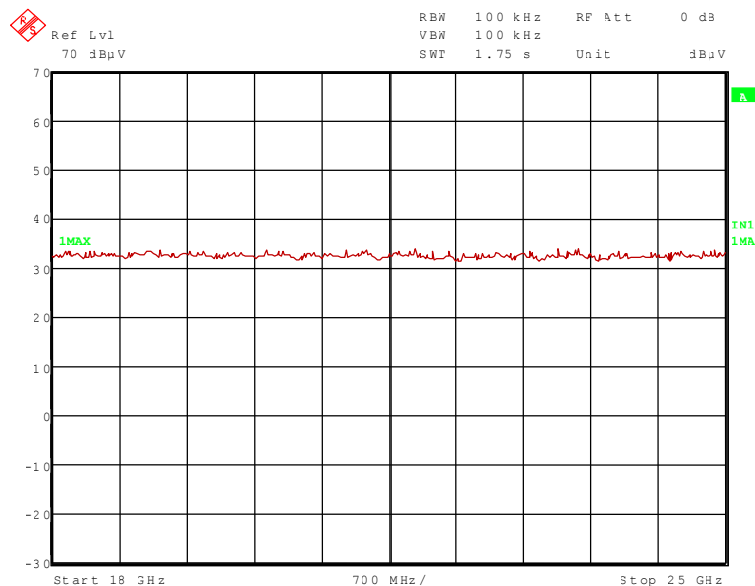
112920_15.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 1):



112920_35.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 1):



112920_30.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 1):



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

- 2.7476 GHz and 4.8040 GHz.

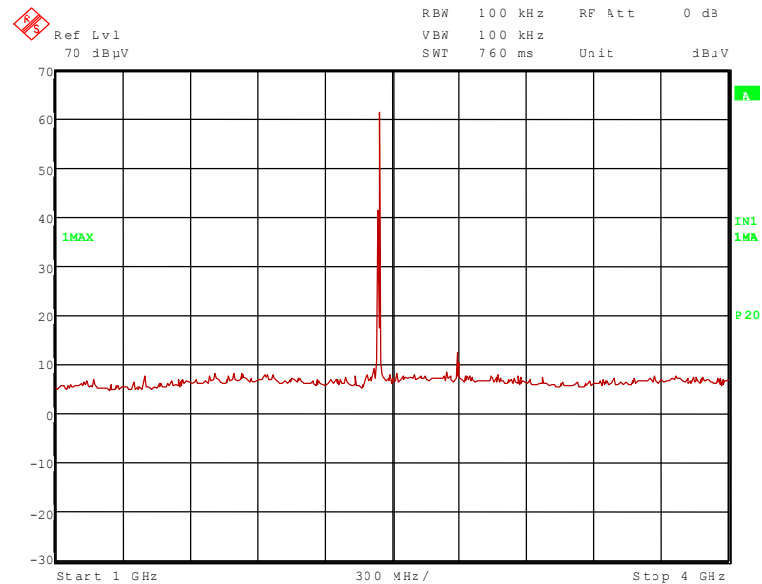
The following frequencies were found outside the restricted bands during the preliminary radiated emission test:

- 2.4020 GHz and 2.4487 GHz.

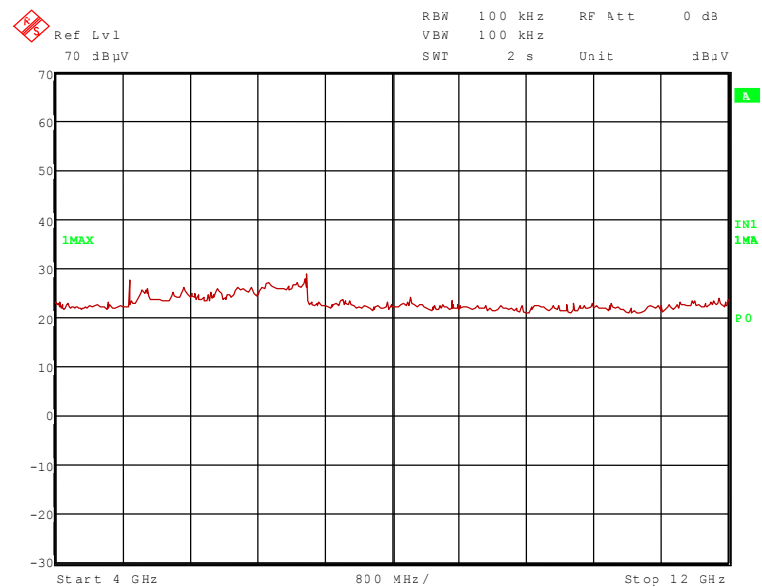
These frequencies have to be measured in a final measurement. The results were presented in the following.

Transmitter operates on the middle of the assigned frequency band

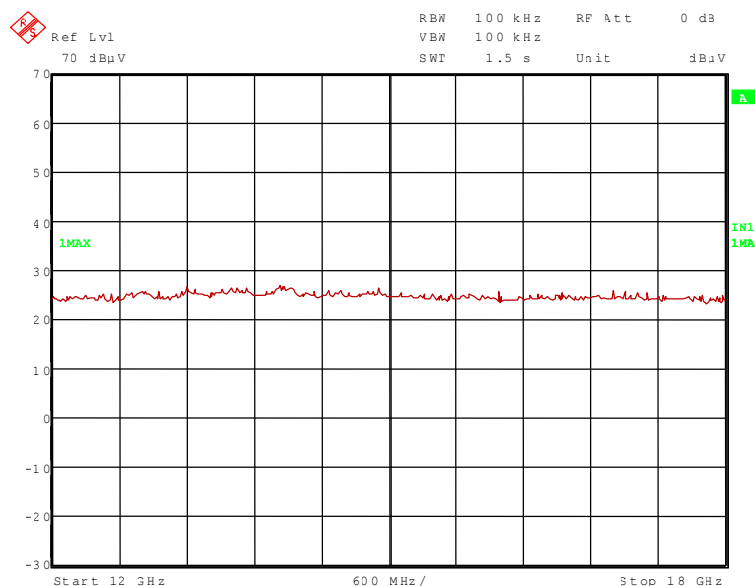
112920_10.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



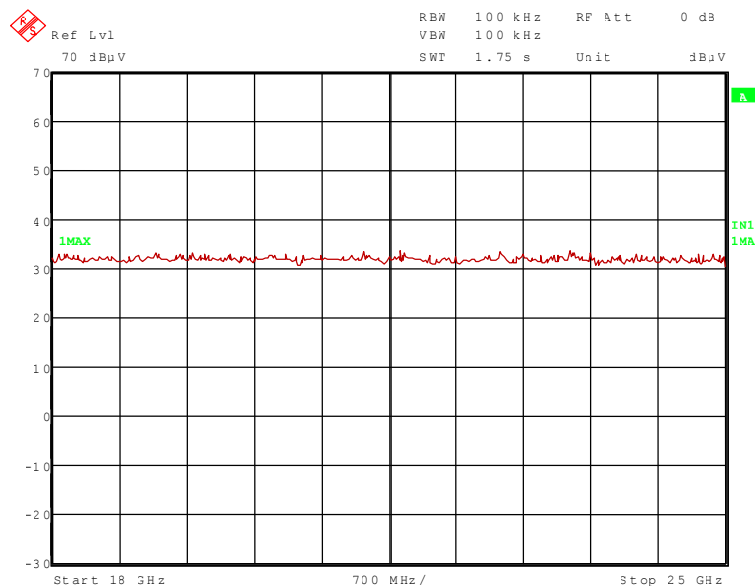
112920_16.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 2):



112920_34.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 2):



112920_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:

- 1.3961 GHz, 2.7922 GHz and 4.8820 GHz.

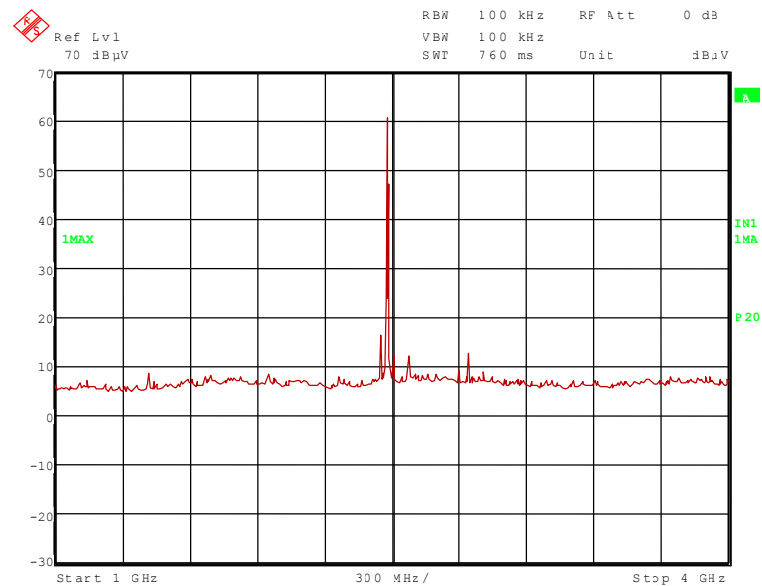
The following frequencies were found outside the restricted bands during the preliminary radiated emission test:

- 2.4177 GHz and 2.4410 GHz.

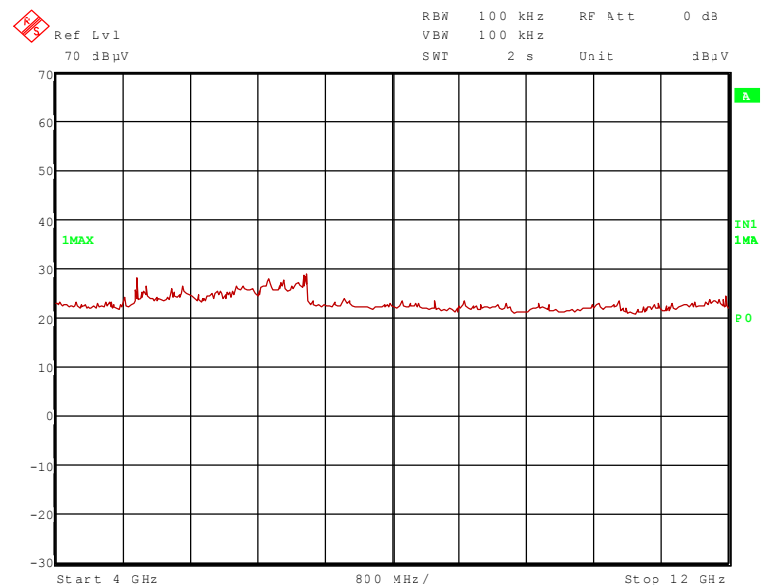
These frequencies have to be measured in a final measurement. The results were presented in the following.

Transmitter operates on the upper end of the assigned frequency

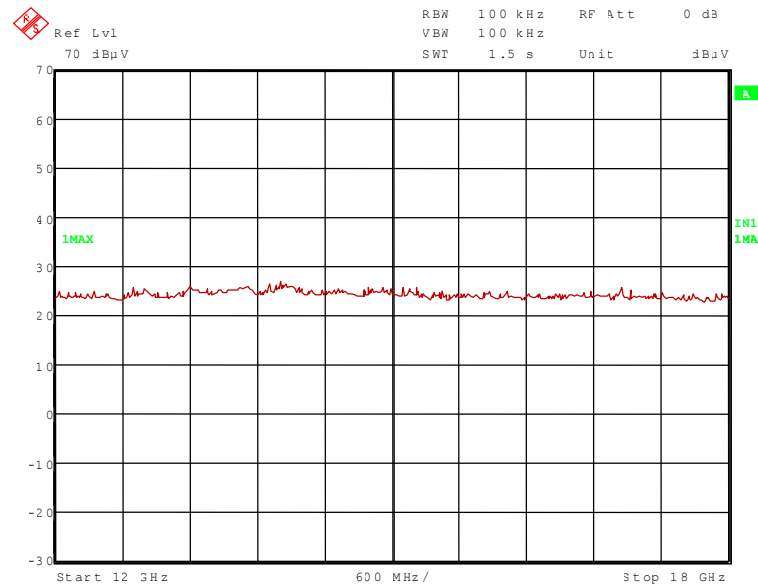
112920_11.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 3):



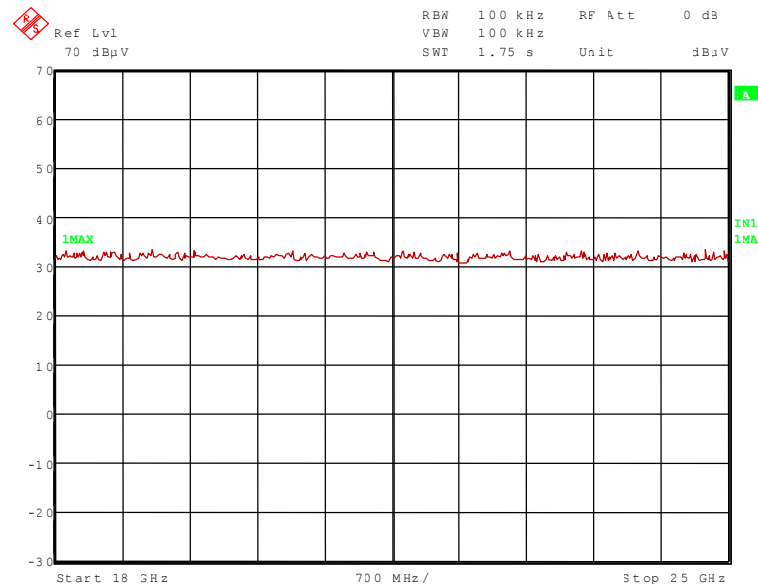
112920_17.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 3):



112920_33.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 3):



112920_32.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 3):



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

- 1.4141 GHz, 2.8367 GHz and 4.9600 GHz.

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

- 2.4486 GHz, 2.4800 GHz and 2.5751 GHz.

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

5.5.2.2 Final radiated emission measurement (30 MHz to 1 GHz) with external antenna

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: No cable was connected to the EUT. For detail information of test set-up refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

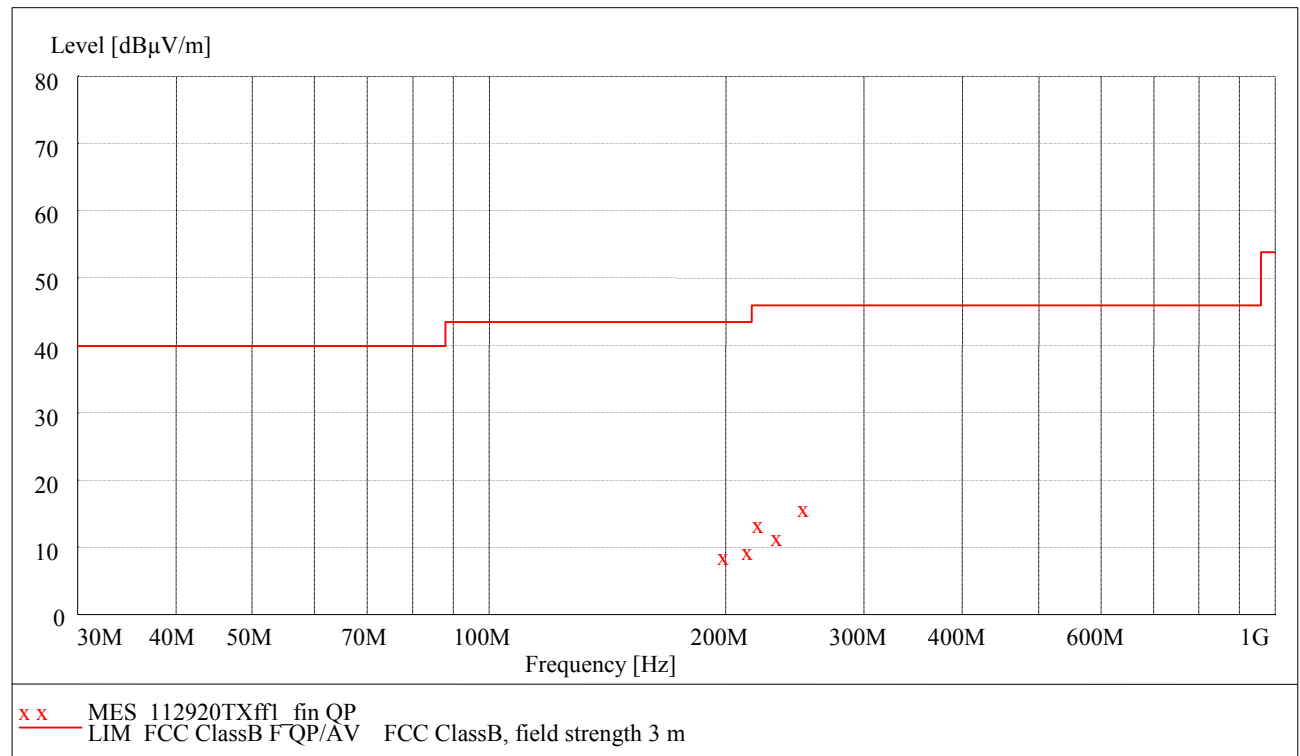
Supply voltage: During all measurements the EUT was supplied with 3.3 V DC via the carrier board.

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

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

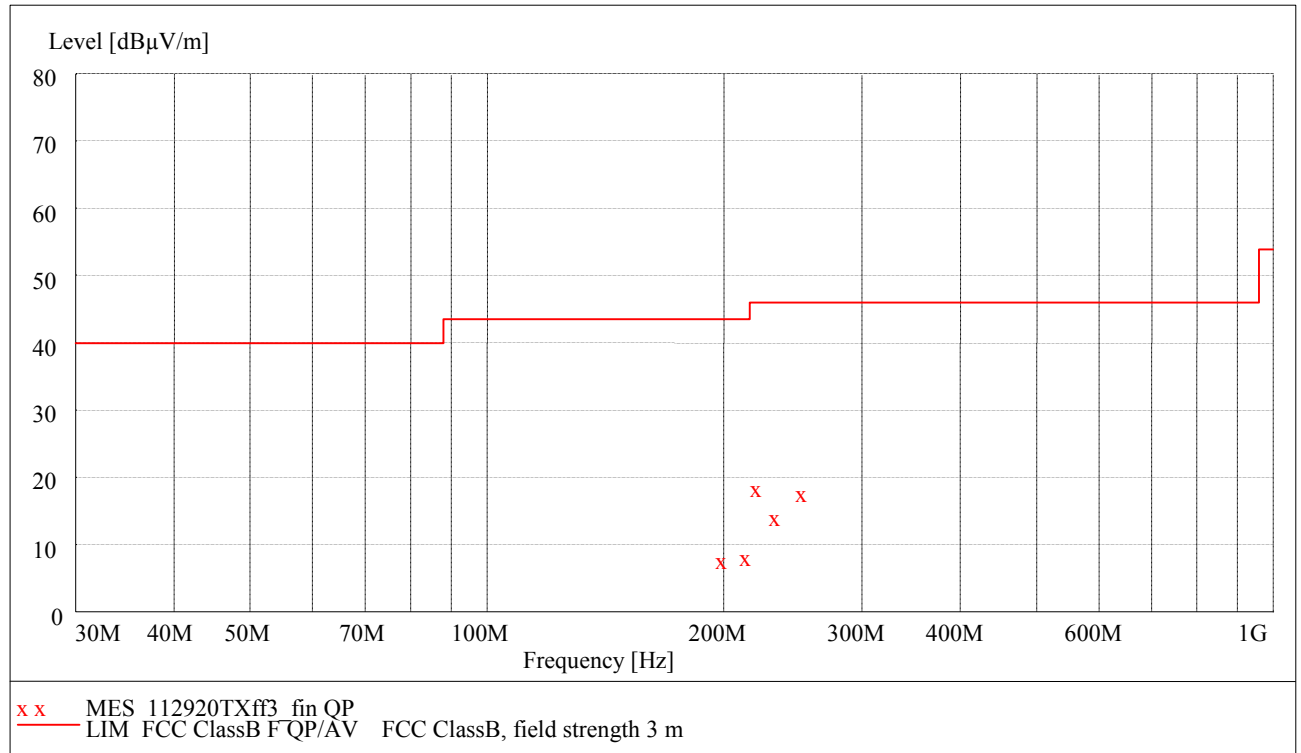
The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with an x are the measured results of the standard final measurement on the open area test site.

EUT position 1:



Data record name: 112920TXff1

EUT position 3:



Data record name: 112920TXff3

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

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

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

Spurious emissions outside restricted bands										
Frequency MHz	Result dBμV/m	Limit dBμV/m	Margin dB	Readings dBμV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.	Pos.
199.860	9.4	59.6	50.2	-1.0	8.9	1.5	259.0	317.0	Vert.	1
215.760	9.9	59.6	49.7	-1.2	9.5	1.6	327.0	45.0	Vert.	1
221.750	18.90	59.6	40.7	7.4	9.9	1.6	141.0	277.0	Hor.	3
233.670	14.60	59.6	45.0	2.4	10.5	1.7	114.0	315.0	Hor.	3
Spurious emissions inside restricted bands										
Frequency MHz	Result dBμV/m	Limit dBμV/m	Margin dB	Readings dBμV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.	Pos.
253.720	18.00	46.0	28.0	3.7	12.5	1.8	137.0	90.0	Hor.	3
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 radiated emission measurement (1 GHz to 25 GHz) with external antenna

Ambient temperature	20 °C	Relative humidity	50 %
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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: No cable was connected to the EUT. For detail information of test set-up 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: The emission measurement in this frequency range was carried out by using the external patch antenna type Huber+Suhner SPA 2400/70/9/0/RCP, because of this antenna has the highest antenna gain of all external patch antennas in question. Additional pre-tests have shown that this antenna causes the highest emissions of all patch antennas in question.

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	Pos.
2.4020	89.5	-	-	57.5	28.3	0.0	3.7	150	Hor.	-	2
2.4487	53.0	74.0	21.0	20.9	28.4	0.0	3.7	150	Vert.	No	2
2.7476	52.3	74.0	21.7	19.3	28.9	0.0	4.1	150	Hor.	Yes	2
4.8040	46.5	74.0	27.5	34.3	32.6	25.7	5.3	150	Hor.	Yes	2
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	Pos.
2.4020	76.1	-	-	44.1	28.3	0.0	3.7	150	Hor.	-	2
2.4487	35.1	56.1	21.0	3.0	28.4	0.0	3.7	150	Vert.	No	2
2.7476	40.2	54.0	13.8	7.2	28.9	0.0	4.1	150	Hor.	Yes	2
4.8040	32.2	54.0	21.8	20.0	32.6	25.7	5.3	150	Hor.	Yes	2
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	Pos.
1.3961	43.6	74.0	30.4	15.6	25.1	0.0	2.9	150	Vert.	Yes	2
2.4177	51.8	74.0	22.2	19.7	28.4	0.0	3.7	150	Vert.	No	2
2.4410	93.8	-	-	61.7	28.4	0.0	3.7	150	Hor.	-	2
2.7922	52.2	74.0	21.8	19.0	29.1	0.0	4.1	150	Hor.	Yes	2
4.8820	47.8	74.0	26.2	35.4	32.8	25.7	5.3	150	Hor.	Yes	2
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	Pos.
1.3961	31.1	54.0	22.9	3.1	25.1	0.0	2.9	150	Vert.	Yes	2
2.4177	34.6	59.6	25.0	2.5	28.4	0.0	3.7	150	Vert.	No	2
2.4410	79.6	-	-	47.5	28.4	0.0	3.7	150	Hor.	-	2
2.7922	40.0	54.0	14.0	6.8	29.1	0.0	4.1	150	Hor.	Yes	2
4.8820	33.0	54.0	21.0	20.6	32.8	25.7	5.3	150	Hor.	Yes	2
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	Pos.
1.4141	42.1	74.0	31.9	14.1	25.1	0.0	2.9	150	Vert.	Yes	2
2.4486	53.5	74.5	21.0	21.4	28.4	0.0	3.7	150	Hor.	No	2
2.4800	94.5	-	-	62.2	28.5	0.0	3.8	150	Hor.	-	2
2.5751	48.8	74.5	25.7	16.3	28.6	0.0	3.9	150	Vert.	No	2
2.8367	52.0	74.0	22.0	18.8	29.2	0.0	4.0	150	Hor.	Yes	2
4.9600	49.1	74.0	24.9	36.5	32.9	25.6	5.3	150	Hor.	Yes	2
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	Pos.
1.4141	29.2	54.0	24.8	1.2	25.1	0.0	2.9	150	Vert.	Yes	2
2.4486	35.2	60.2	25.0	3.1	28.4	0.0	3.7	150	Hor.	No	2
2.4800	80.2	-	-	47.9	28.5	0.0	3.8	150	Hor.	-	2
2.5751	35.2	60.2	25.0	2.7	28.6	0.0	3.9	150	Vert.	No	2
2.8367	40.3	54.0	13.7	7.1	29.2	0.0	4.0	150	Hor.	Yes	2
4.9600	34.2	54.0	19.8	21.6	32.9	25.6	5.3	150	Hor.	Yes	2
Measurement uncertainty						+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

29, 31 - 34, 36, 37, 39, 44, 46, 49 - 51, 72

5.5.2.4 Preliminary radiated emission measurement with internal antenna

Ambient temperature	20 °C	Relative humidity	50 %
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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.

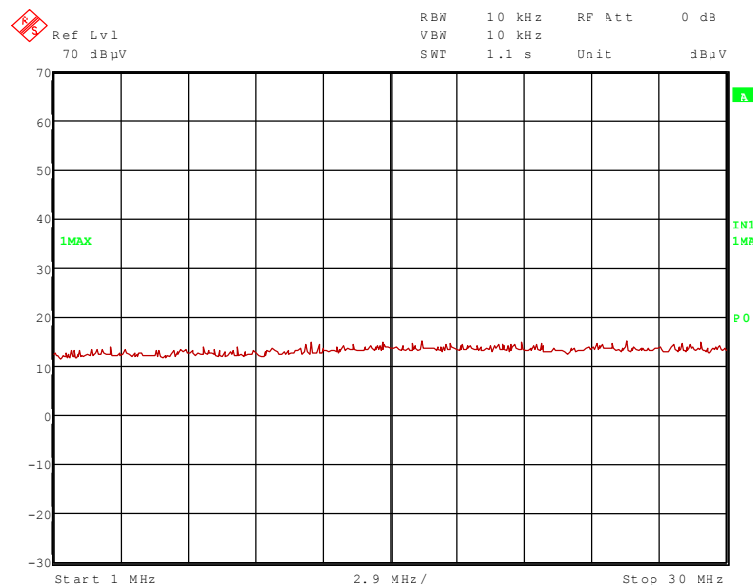
Cable guide: No cables were connected to the EUT. For detail information of test set-up refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 3.1 V DC via the carrier board.

Remark: As pre-tests have shown, the emissions in the frequency range 9 kHz to 1 GHz are not depending on the transmitter operation mode. Therefore the emissions in this frequency range were measured only with the transmitter operates in operation mode 2.

112920_21.wmf: Spurious emissions from 1 MHz to 30 MHz (operation mode 2):

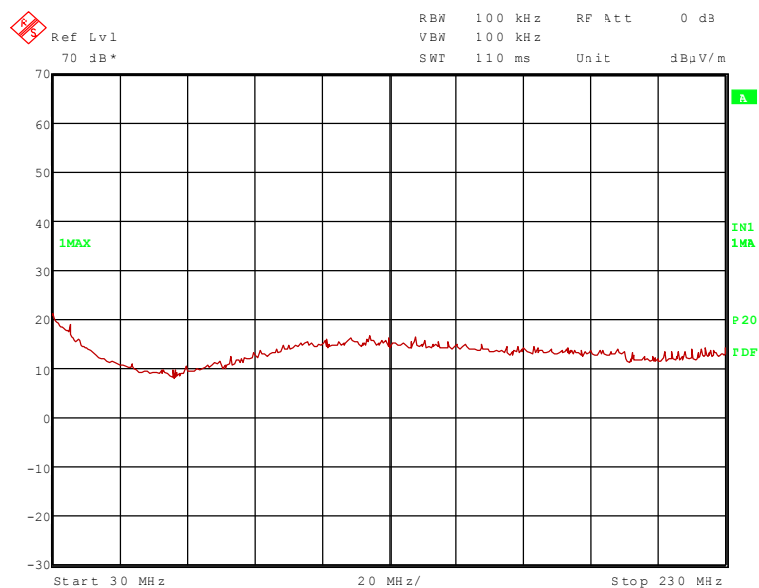


No significant frequencies above the noise floor of the system were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.

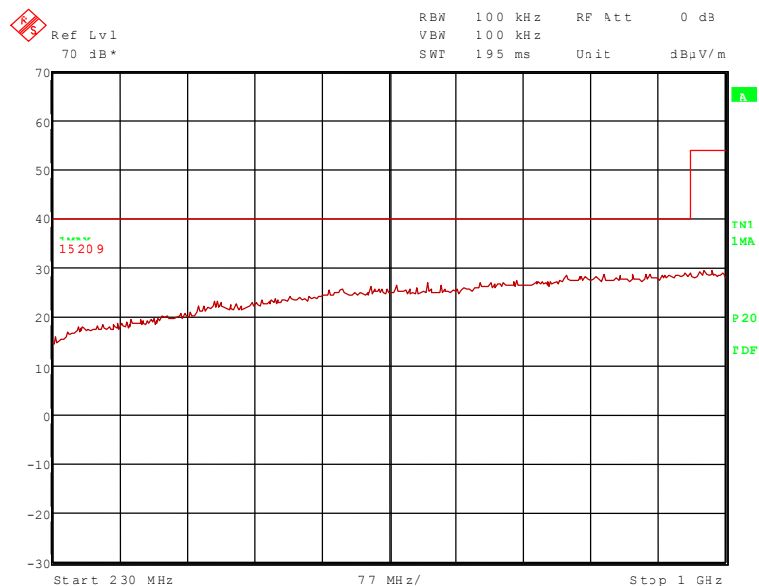
TEST EQUIPMENT USED FOR THE TEST:

29, 31 - 39, 43, 44, 46, 49 - 51, 55, 72

112920_22.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 2):



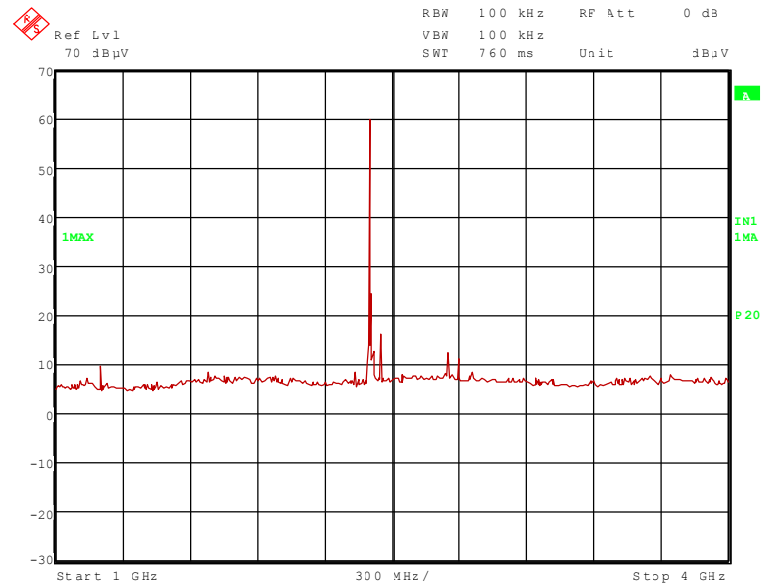
112920_23.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 2):



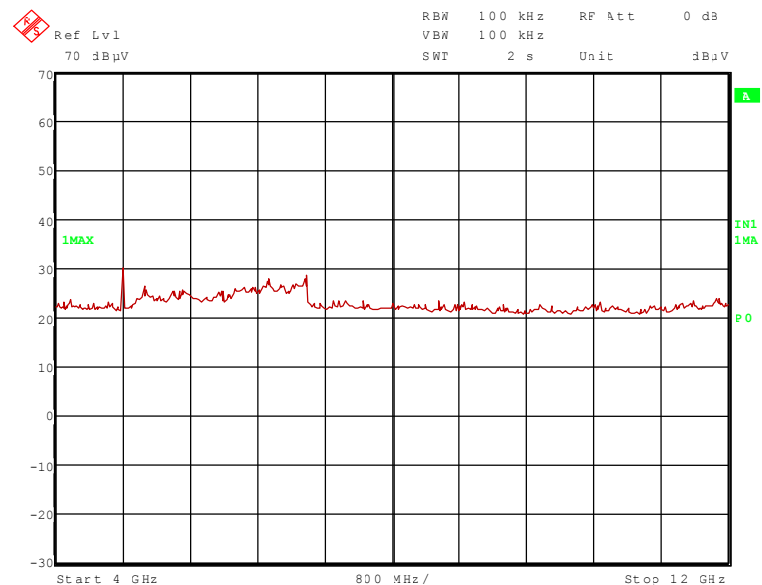
No significant frequencies above the noise floor of the system were found during the preliminary radiated emission test, so no measurements were carried out on the open area test site.

Transmitter operates at the lower end of the assigned frequency band

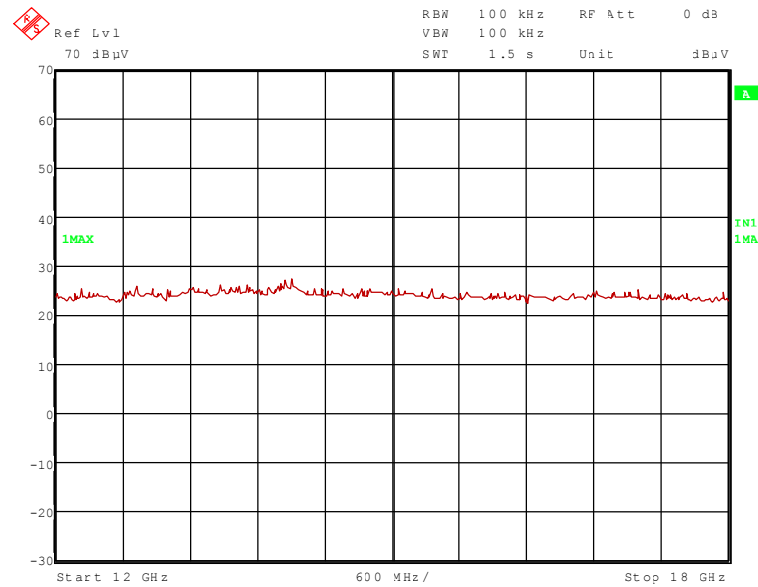
112920_5.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



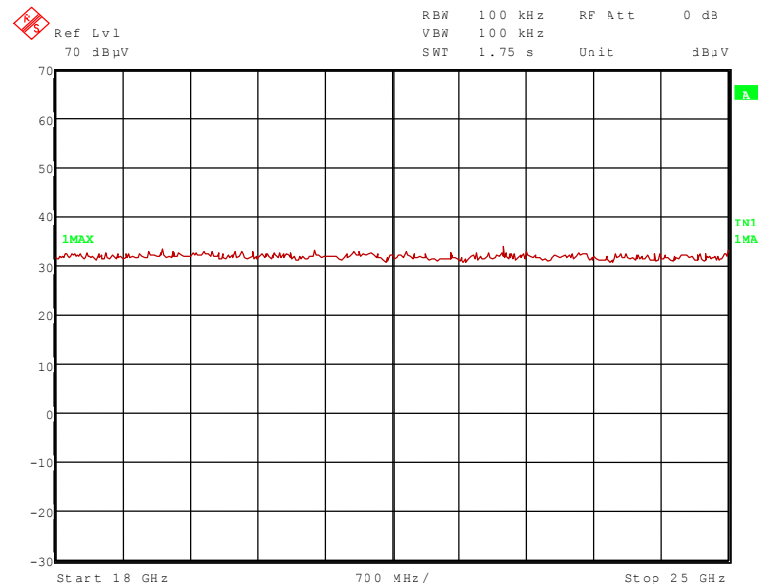
112920_7.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 1):



112920_24.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 1):



112920_29.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 1):



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

- 1.2011 GHz, 2.7476 GHz, 2.7970 GHz and 4.8040 GHz

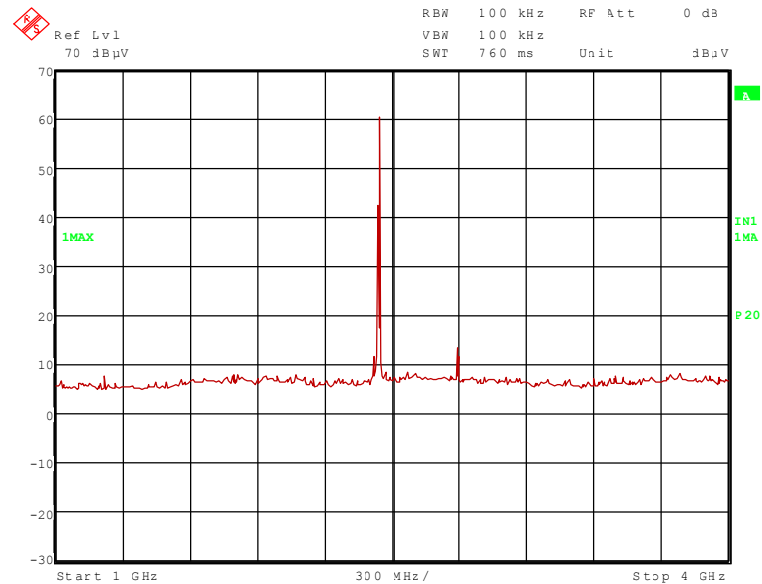
The following frequencies were found outside the restricted bands during the preliminary radiated emission test:

- 2.4020 GHz and 2.4487 GHz.

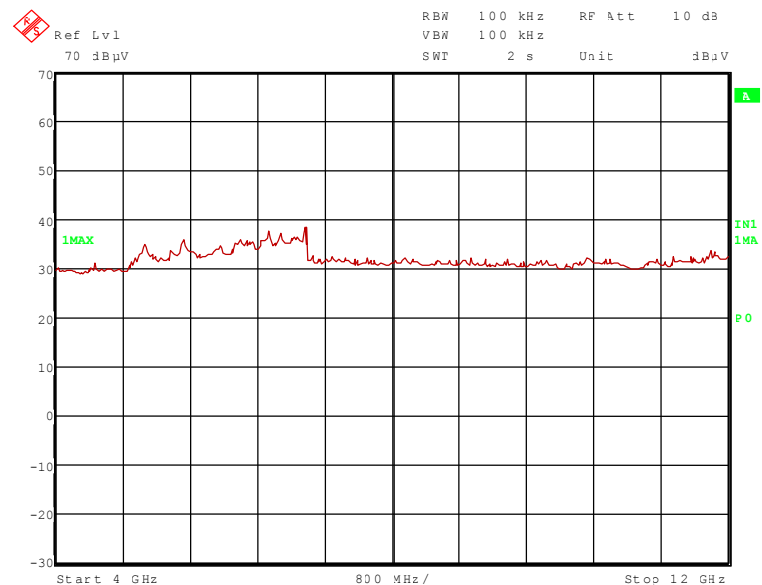
These frequencies have to be measured in a final measurement. The results were presented in the following.

Transmitter operates on the middle of the assigned frequency band

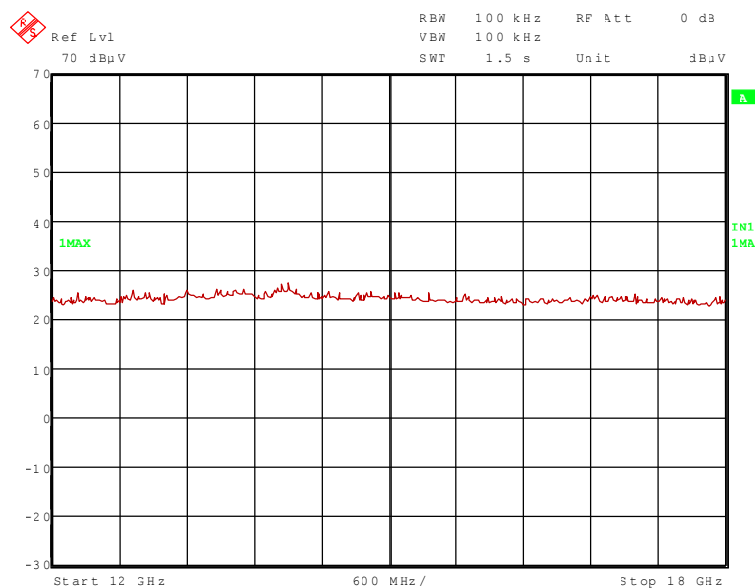
112920_4.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



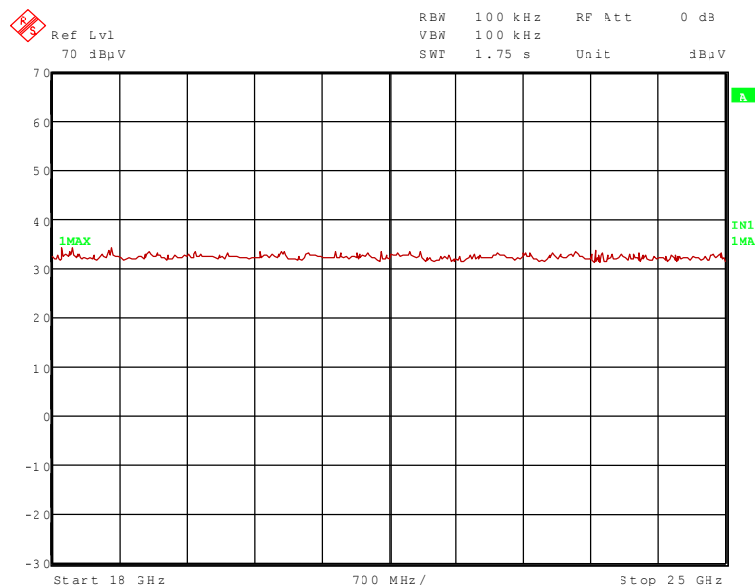
112920_8.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 2):



112920_25.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 2):



112920_28.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 2):



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

- 2.7922 GHz.

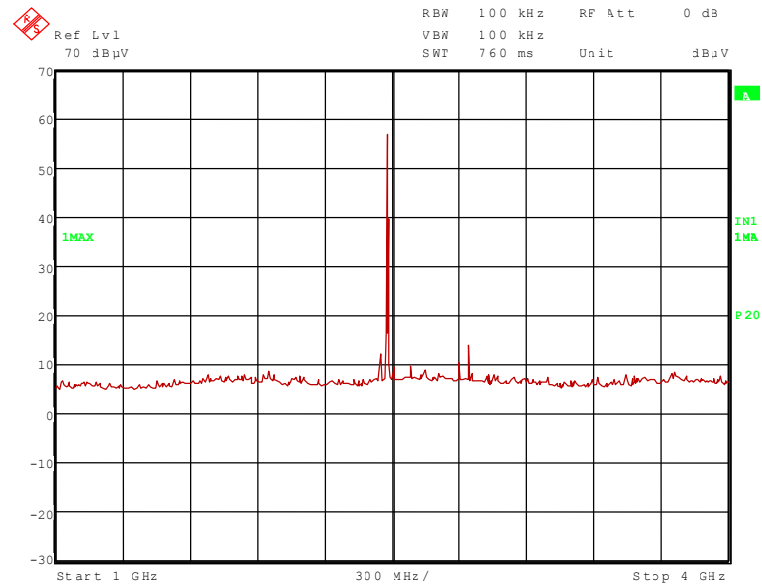
The following frequencies were found outside the restricted bands during the preliminary radiated emission test:

- 2.4177 GHz and 2.4410 GHz.

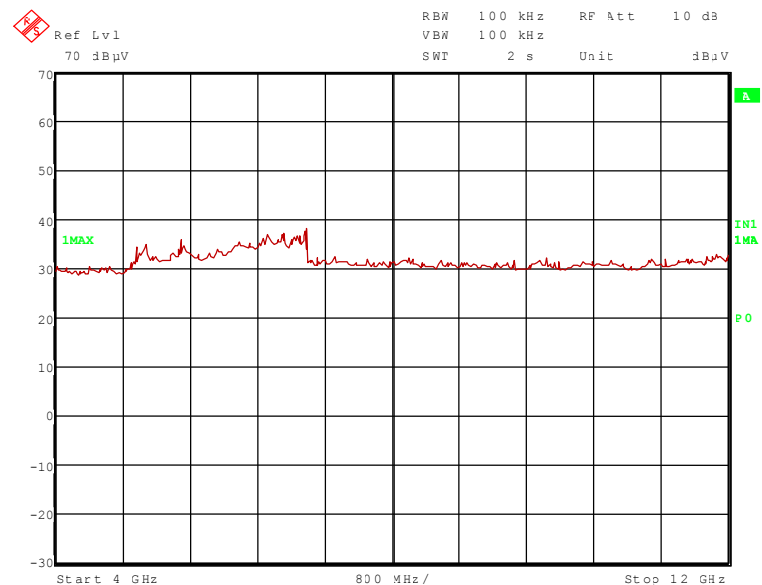
These frequencies have to be measured in a final measurement. The results were presented in the following.

Transmitter operates on the upper end of the assigned frequency

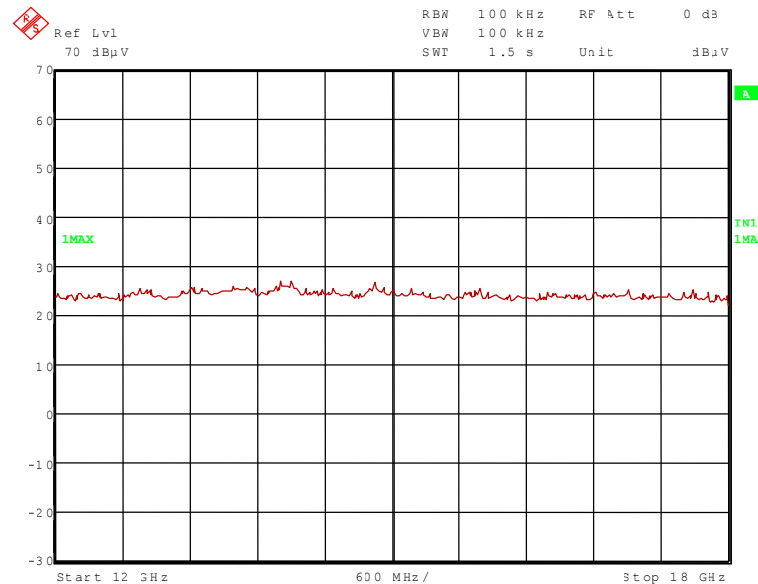
112920_1.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 3):



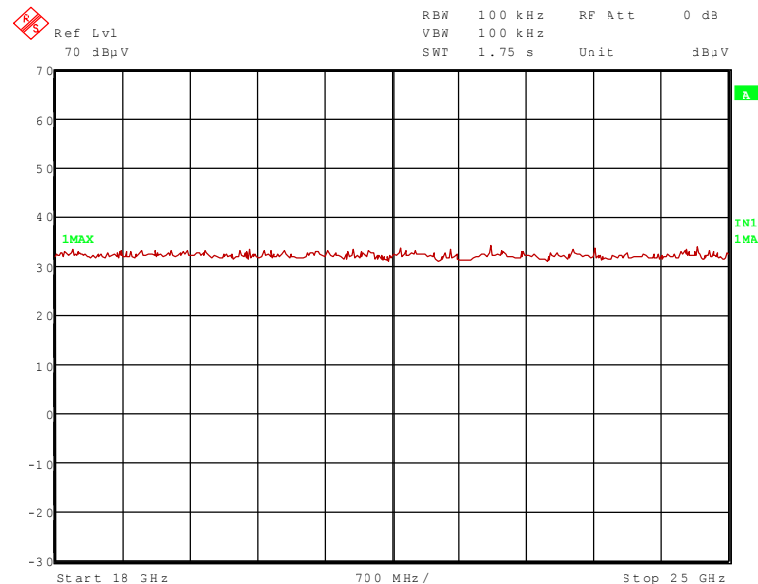
112920_9.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 3):



112920_26.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 3):



112920_27.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 3):



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

- 2.8367 GHz and 4.9600 GHz.

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

- 2.4486 GHz and 2.4800 GHz.

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

5.5.2.5 Final radiated emission measurement (1 GHz to 25 GHz) with internal antenna

Ambient temperature	21 °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: The cable of the EUT is running vertically to the false floor. 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.

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	Pos.
1.2011	44.0	74.0	30.0	16.5	24.9	0.0	2.6	150	Hor.	Yes	2
2.4020	92.8	-	-	60.8	28.3	0.0	3.7	150	Hor.	-	2
2.4487	54.7	74.0	19.3	22.6	28.4	0.0	3.7	150	Hor.	No	2
2.7476	52.4	74.0	21.6	19.4	28.9	0.0	4.1	150	Vert.	Yes	2
2.7970	52.1	74.0	21.9	18.9	29.1	0.0	4.1	150	Vert.	Yes	2
4.8040	51.8	74.0	22.2	39.6	32.6	25.7	5.3	150	Vert.	Yes	2
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	Pos.
1.2011	30.6	54.0	23.4	3.1	24.9	0.0	2.6	150	Hor.	Yes	2
2.4020	79.4	-	-	47.4	28.3	0.0	3.7	150	Hor.	-	2
2.4487	35.3	59.4	24.1	3.2	28.4	0.0	3.7	150	Hor.	No	2
2.7476	40.1	54.0	13.9	7.1	28.9	0.0	4.1	150	Vert.	Yes	2
2.7970	35.9	54.0	18.1	2.7	29.1	0.0	4.1	150	Vert.	Yes	2
4.8040	37.1	54.0	16.9	24.9	32.6	25.7	5.3	150	Vert.	Yes	2
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	Pos.
2.4177	54.2	74.9	20.7	22.1	28.4	0.0	3.7	150	Vert.	No	2
2.4410	94.9	-	-	62.8	28.4	0.0	3.7	150	Hor.	-	2
2.7922	53.4	74.0	20.6	20.2	29.1	0.0	4.1	150	Vert.	Yes	2
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	Pos.
2.4177	34.6	61.2	26.6	2.5	28.4	0.0	3.7	150	Vert.	No	2
2.4410	81.2	-	-	49.1	28.4	0.0	3.7	150	Hor.	-	2
2.7922	41.3	54.0	12.7	8.1	29.1	0.0	4.1	150	Vert.	Yes	2
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	Pos.
2.4800	94.0	-	-	61.7	28.5	0.0	3.8	150	Hor.	-	2
2.8367	53.2	74.0	20.8	20.0	29.2	0.0	4.0	150	Vert.	Yes	2
2.4486	55.1	74.0	18.9	23.0	28.4	0.0	3.7	150	Vert.	No	2
4.9600	48.4	74.0	25.6	35.8	32.9	25.6	5.3	150	Hor.	Yes	2
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	Pos.
2.4486	35.5	60.1	24.6	3.4	28.4	0.0	3.7	150	Vert.	No	2
2.4800	80.1	-	-	47.8	28.5	0.0	3.8	150	Hor.	-	2
2.8367	42.2	54.0	11.8	9.0	29.2	0.0	4.0	150	Vert.	Yes	2
4.9600	33.9	54.0	20.1	21.3	32.9	25.6	5.3	150	Hor.	Yes	2
Measurement uncertainty						+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

29, 31 - 34, 36, 37, 39, 44, 46, 49 - 51, 72

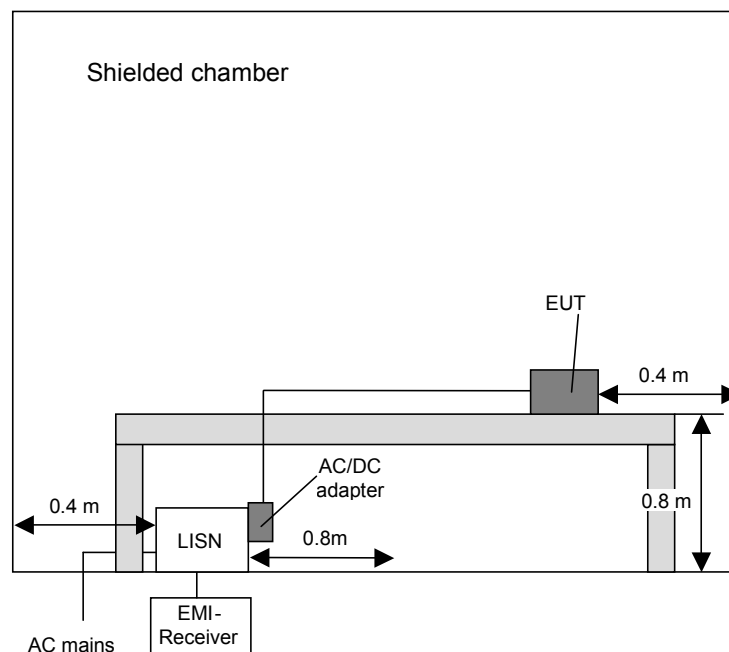
5.6 Conducted emissions on power supply lines (150 kHz to 30 MHz)

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 C63.4-2009 [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	66 %
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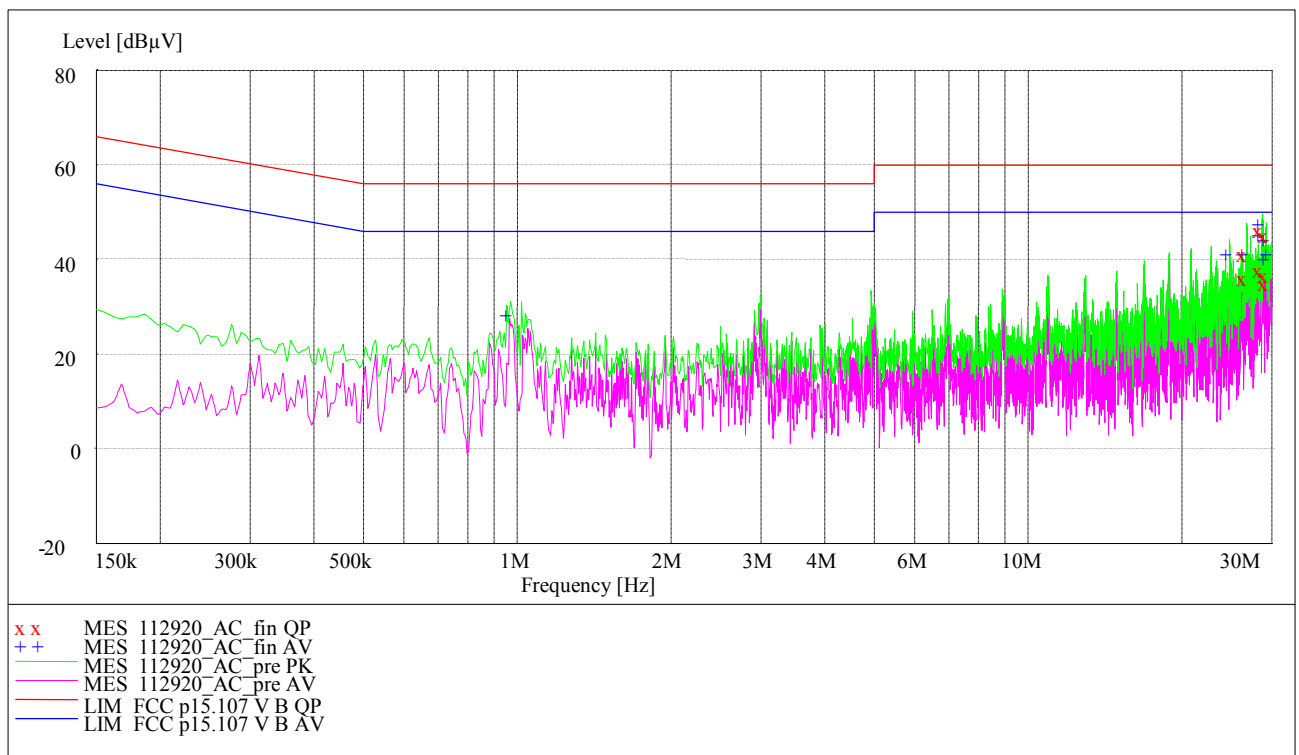
Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m.

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: The EUT operates in operation mode 4. All results are shown in the following.

Supply voltage: During the measurement the EUT was supplied 3.1 V DC by an AC / DC adaptor type enerCELL CAT.No 273-316, which was supplied by 120 V AC / 60 Hz.

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 an x and the average measured points by an +.



Data record name: 112920_AC

Result measured with the quasipeak detector:

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

Frequency MHz	Level dBμV	Transducer dB	Limit dBμV	Margin dB	Line	PE
26.7603	37.0	5.4	60.0	23.0	L1	FLO
26.8269	42.0	5.4	60.0	18.0	L1	FLO
28.7772	47.3	5.8	60.0	12.7	L1	FLO
28.8474	38.4	5.9	60.0	21.6	L1	FLO
29.2236	45.7	6.0	60.0	14.3	L1	FLO
29.2569	37.7	6.0	60.0	22.3	L1	FLO
29.3271	35.7	6.0	60.0	24.3	L1	FLO
Measurement uncertainty				+3.6 dB / -4.5 dB		

Data record name: 112920_AC_fin QP

Result measured with the average detector:

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

Frequency MHz	Level dBμV	Transducer dB	Limit dBμV	Margin dB	Line	PE
0.9681	29.3	0.6	46.0	16.7	N	FLO
24.8028	41.9	5.0	50.0	8.1	L1	FLO
26.8224	42.1	5.4	50.0	7.9	N	FLO
28.7709	48.0	5.8	50.0	2.0	N	FLO
28.8051	45.8	5.8	50.0	4.2	N	FLO
29.2245	44.7	6.0	50.0	5.3	N	FLO
29.2722	40.8	6.0	50.0	9.2	N	FLO
29.5845	42.0	6.0	50.0	8.0	L1	FLO
Measurement uncertainty				+3.6 dB / -4.5 dB		

Data record name: 112920_AC_fin AV

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
1 - 4, 20

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	EMI Receiver	ESIB 26	Rohde & Schwarz	1088.7490	481182	02/08/2010	02/2012
3	LISN	NSLK8128	Schwarzbeck	8128161	480138	05/07/2010	05/2012
4	High pass filter	HR 0.13-5ENN	FSY Microwave Inc.	DC 0109 SN 002	480340	Weekly verification (system cal.)	
14	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
15	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	03/15/2010	03/2012
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	22921	480674	08/27/2011	08/2014
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	04/15/2010	04/2012
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	03/17/2010	03/2012
32	Controller	MCU	Maturo	MCU/043/971107	480832	-	-
33	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
34	Antenna support	AS615P	Deisel	615/310	480187	-	-
35	Antenna	CBL6112 B	Chase	2688	480328	04/21/2011	04/2014
36	Antenna	3115 A	EMCO	9609-4918	480183	11/04/2008	11/2011
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 1 m	KPS-1533-400-KPS	Insulated Wire	-	480301	Six month verification (system cal.)	
49	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	Six month verification (system cal.)	
50	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	Six month verification (system cal.)	
51	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	Six month verification (system cal.)	
55	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	03/10/2010	03/2012
72	4 GHz High Pass Filter	WHKX4.0/18 G-8SS	Wainwright Instruments	1	480587	Weekly verification (system cal.)	
170	Power Meter	NRVD	Rohde & Schwarz	828110/026	480267	03/17/2010	03/2012
172	Peak Power Sensor	NRV-Z32	Rohde & Schwarz	849745/016	480247	03/17/2010	03/2012

7 REPORT HISTORY

Report Number	Date	Comment
F112920E1	05 October 2011	Document created

8 LIST OF ANNEXES

ANNEX A TEST SET-UP PHOTOS 11 pages

112920_3.JPG: TX-RX01 with internal antenna, test setup fully anechoic chamber (Pos. 1)
 112920_2.JPG: TX-RX01 with internal antenna, test setup fully anechoic chamber (Pos. 2)
 112920_4.JPG: TX-RX01 with internal antenna, test setup fully anechoic chamber (Pos. 3)
 112920_8.JPG: TX-RX01 with external antenna, test setup fully anechoic chamber (Pos. 1)
 112920_6.JPG: TX-RX01 with external antenna, test setup fully anechoic chamber (Pos. 2)
 112920_9.JPG: TX-RX01 with external antenna, test setup fully anechoic chamber (Pos. 3)
 112920_11.JPG: TX-RX01, test setup fully anechoic chamber
 112920_13.JPG: TX-RX01, test setup fully anechoic chamber
 112920_1.JPG: TX-RX01, test setup fully anechoic chamber
 112920_22.JPG: TX-RX01, test setup open area test site
 112920_39.JPG: TX-RX01, test setup shielded chamber

ANNEX B INTERNAL PHOTOGRAPHS 13 pages

112920_b.JPG: TX-RX01, mounted on carrier board, 3-D-view 1
 112920_c.JPG: TX-RX01, mounted on carrier board, 3-D-view 2
 112920_e.JPG: TX-RX01 with internal antenna, mounted on adapter PCB, top view
 112920_f.JPG: TX-RX01 with external antenna, mounted on adapter PCB, top view
 112920_g.JPG: TX-RX01, mounted on adapter PCB, bottom view
 112920_h.JPG: TX-RX01 with internal antenna, PCB, top view
 112920_i.JPG: TX-RX01 with internal antenna, PCB, top view, shielding removed
 112920_j.JPG: TX-RX01 with external antenna, PCB, top view
 112920_m.JPG: TX-RX01 with external antenna, PCB, top view, shielding removed
 112920_n.JPG: TX-RX01, PCB, bottom view
 112920_q.JPG: TX-RX01, external antenna, top view
 112920_p.JPG: TX-RX01, external antenna, bottom view
 112920_o.JPG: TX-RX01, carrier board, internal view

Annex C EXTERNAL PHOTOGRAPHS - pages

Because the EUT is a module, which is intended to be implemented inside a final application, no external photographs were available

ANNEX D RESULTS OF THE RECEIVER MEASUREMENTS 8 PAGES