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Test Report

Report Number: F125162E2

Applicant:

IMST GmbH

Manufacturer:

LNT Automation GmbH

Equipment under Test (EUT):

Wireless dongle DXX

Laboratory (CAB) accredited by
Deutsche Akkreditierungsstelle GmbH (DAkkS)
in compliance with DIN EN ISO/IEC 17025
under the Reg. No. D-PL-17186-01-02,
FCC Test site registration number 90877 and
Industry Canada Test site registration IC3469A-1

REFERENCES

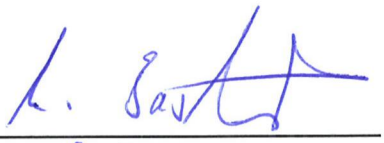
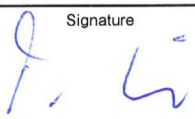
[1] **ANSI C63.4-2009** American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

[2] **FCC CFR 47 Part 15 (June 2013)** Radio Frequency Devices

[3] **Publication Number 913591 (March 2007)** Measurement of radiated emissions at the edge of the band for a Part 15 RF Device

TEST RESULT

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test.
The complete test results are presented in the following.

	Name	Signature	Date
Test engineer:	Manuel BASTERT		04 June 2013
Authorized reviewer:	Thomas KÜHN		04 June 2013

RESERVATION

This test report is only valid in its original form.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalizations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

Contents: Page

1 IDENTIFICATION

1.1 Applicant

Name:	IMST GmbH
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Country:	Germany
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Phone:	+ 49 (0) 2842-981-312
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eMail Address:	schneider@imst.de
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	LNT Automation GmbH
Address:	Hans-Paul-Kaysser-Str. 1 71397 Leutenbach-Nellmersbach
Country:	Germany
Name for contact purposes:	Mr. Walter HEINZ
Phone:	+49 (0) 7195 58889 - 13
Fax:	+49 (0) 7195 58889 - 913
eMail Address:	walter.heinz@lnt-automation.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 Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under the Reg. No. D-PL-17186-01-02, FCC Test site registration number 90877 and Industry Canada Test site registration IC3469A-1.

1.4 EUT (Equipment Under Test)

Test object: *	USB dongle
Type: *	DXX
FCC ID: *	T26-TKR01
IC: *	11150A-NRF24LU1P
Serial numbers: *	02587
PCB identifiers: *	105223
Hardware versions: *	P1
Software versions: *	V101

1.5 Technical data of equipment

Antenna type: *	Internal, PCB antenna					
Antenna gain: *	0 dBi					
Rated output power: *	0 dBm					
Power supply: *	U_{nom}=	5.0 V_{DC}	U_{min}=	4.0 V_{DC}	U_{max}=	5.25 V_{DC}
Type of modulation: *	GFSK					
Operating frequency: *	2.402 GHz to 2.481 GHz					
Number of channels: *	80					
Temperature range: *	0 °C up to 55 °C (storage), 5 °C up to 35 °C (operating)					
Lowest / highest Internal clock frequency: *	µC: 16 MHz (crystal), USB: 48 MHz (from 16 MHz crystal), µC: 32 kHz (RC oscillator)					
Ancillary equipment:	Fujitsu Lifebook S7110					

* declared by the applicant.

The following external I/O cables were used:

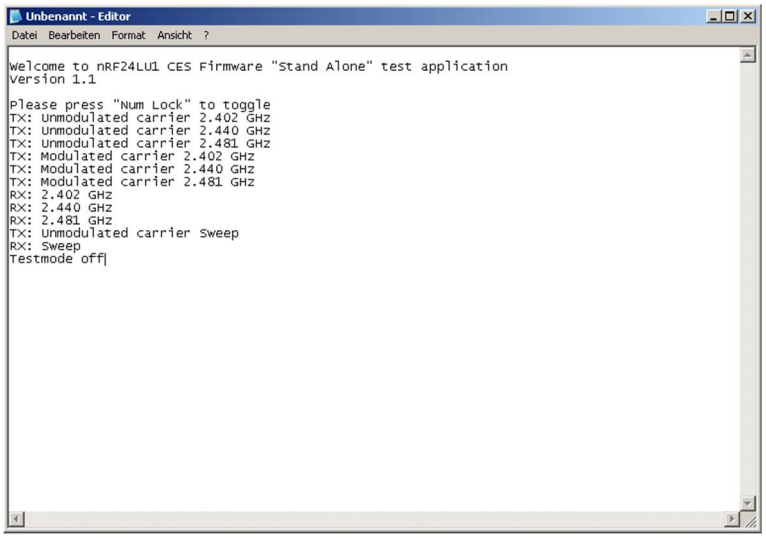
No cables are connectable to the EUT.

1.6 Dates

Date of receipt of test sample:	14 December 2012
Start of test:	20 December 2012
End of test:	09 January 2013

2 OPERATIONAL STATES

The tests were carried out with a modified sample, able to operate in a test mode. The operation modes could be set by using a script on an ancillary notebook. The script was started by pressing the “NumLock”-Key while the text program “Editor” was opened. By repeating of pressing the “NumLock”-Key the operation modes could be toggled. The following picture shows a screenshot of the opened window.

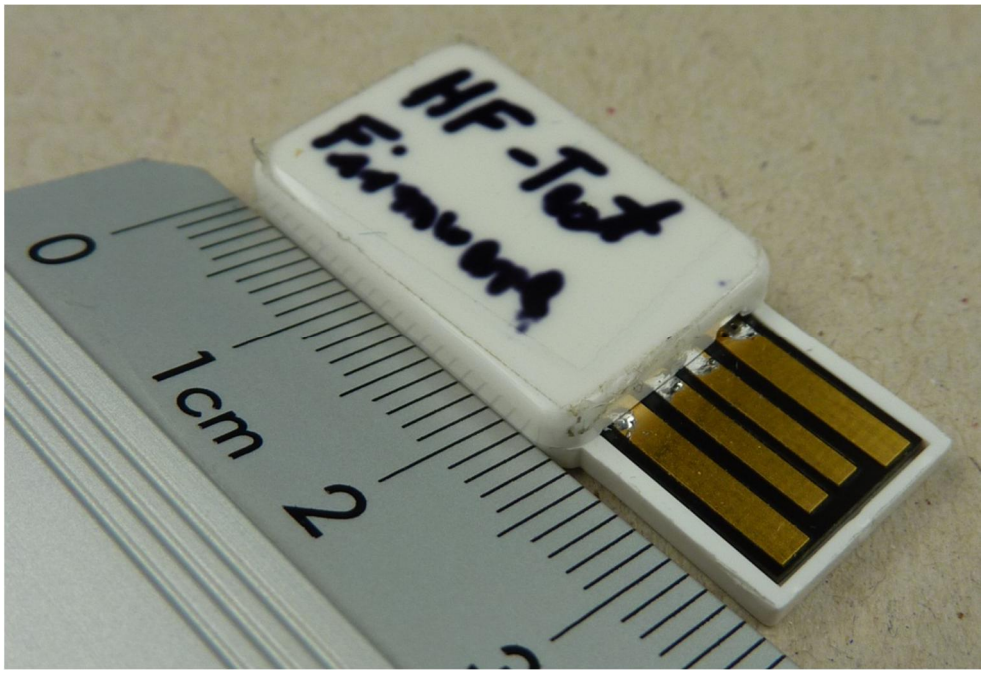


For the tests the continuous modulated transmission mode with maximum output power was used.

During the tests the sample was powered with 5.0 V_{DC} by the USB interface of an ancillary notebook PC.

Operation mode	Description	Modulation
1	Continuous modulated transmission at 2402 MHz	GFSK
2	Continuous modulated transmission at 2440 MHz	GFSK
3	Continuous modulated transmission at 2481 MHz	GFSK

Physical boundary of the EUT



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

The 3 orthogonal axes were defined as Pos.1 EUT lying flat, Pos.2 EUT standing vertical and Pos. 3 EUT standing vertical. The measurements were carried out in Pos. 1 (plugged into USB port of ancillary notebook PC).

3 ADDITIONAL INFORMATION

None.

4 OVERVIEW

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	Status	Refer page
20 dB bandwidth	General	15.215 (c)	Passed	9 et seq.
Radiated emissions (transmitter)	0.009 - 25,000	15.249 (a), (c), (e) 15.205 (a) 15.209 (a)	Passed	12 et seq.
Conducted emissions on supply line (transmitter)	0.15 - 30	15.207 (a)	Passed	32 et seq.

5 TEST RESULTS

5.1 20 dB bandwidth

5.1.1 Method of measurement

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

The following spectrum analyser settings shall be used:

- Span: App. 2 times the 20 dB bandwidth, centred on the actual channel.
- Resolution bandwidth: 1% to 5% of the signal bandwidth requirements. When no bandwidth requirements are specified, the minimum resolution bandwidth of the measuring instrument is given in the table below.
- Video bandwidth: 3 times the resolution bandwidth.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

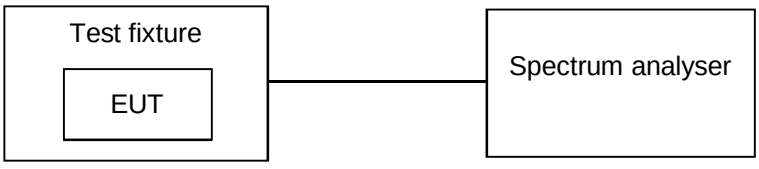
Minimum instrument bandwidth

Fundamental frequency	Minimum resolution bandwidth
9 kHz to 30 MHz	1 kHz
30 MHz to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

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 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.

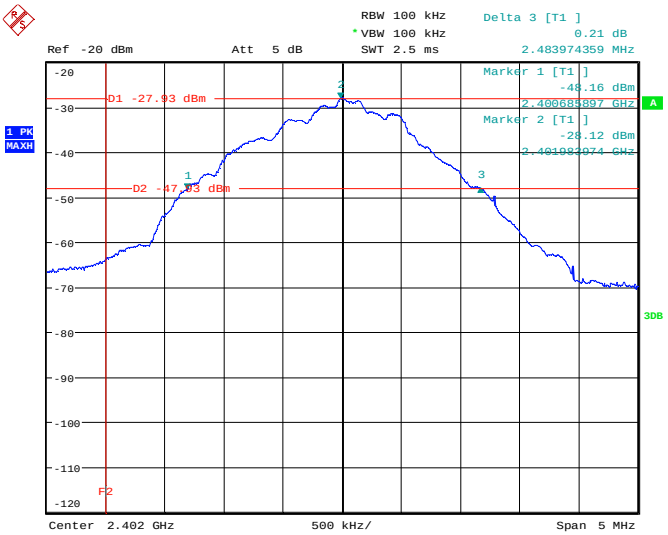
Test set-up:



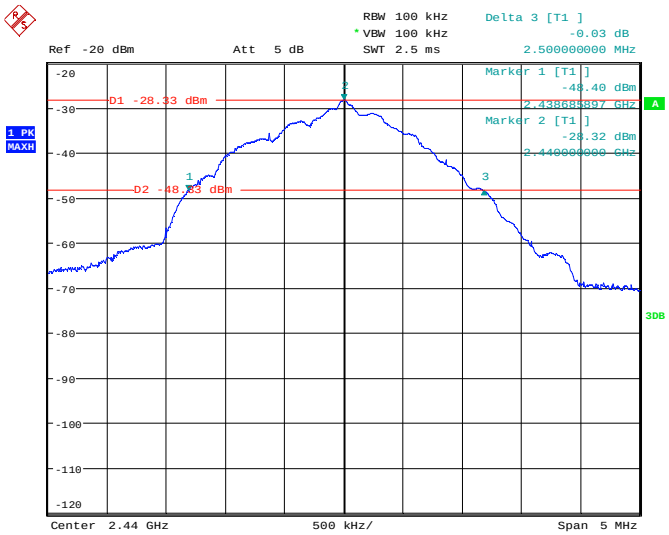
5.1.2 Test results

Ambient temperature	20 °C	Relative humidity	32 %

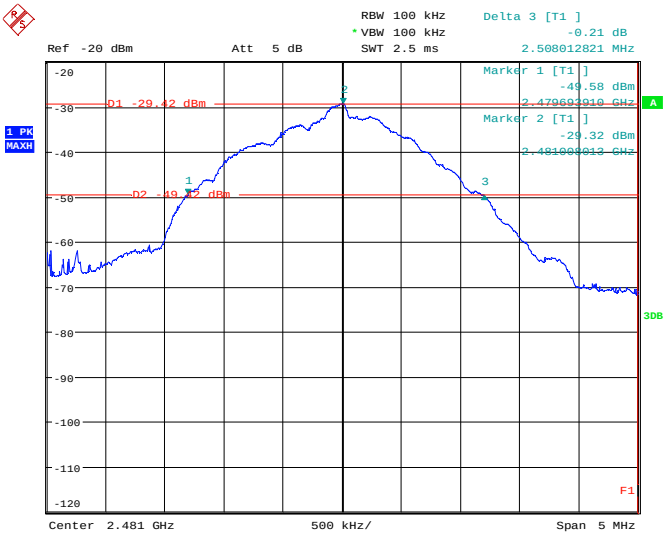
125162_20dB_low.wmf: 20 dB bandwidth of lowest channel (2402 MHz)



125162_20dB_mid.wmf: 20 dB bandwidth of channel in middle of the band (2440 MHz)



125162_20dB_low.wmf: 20 dB bandwidth of lowest channel (2481 MHz)



Continuous modulated transmission		
Channel frequency [MHz]	20 dB bandwidth [kHz]	Bandwidth limit [kHz]
2402	2483.97	Within the assigned frequency band
2440	2500.00	Within the assigned frequency band
2481	2508.01	Within the assigned frequency band
Measurement uncertainty: $< \pm 1*10^{-7}$		

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
26, 30

5.2 Band-edge compliance

5.2.1 Method of measurement

The measurement of unwanted emissions at the edge of the authorized frequency bands can be complicated by the capture of RF energy from the fundamental emission within the RBW passband. The following techniques are permitted for use in performing a measurement of the unwanted emission level at the band edges.

Marker-Delta Method
The marker-delta method, as described in KDB 913591 and in C63.10, can be used to perform measurements of the unwanted emissions level at the band-edges.

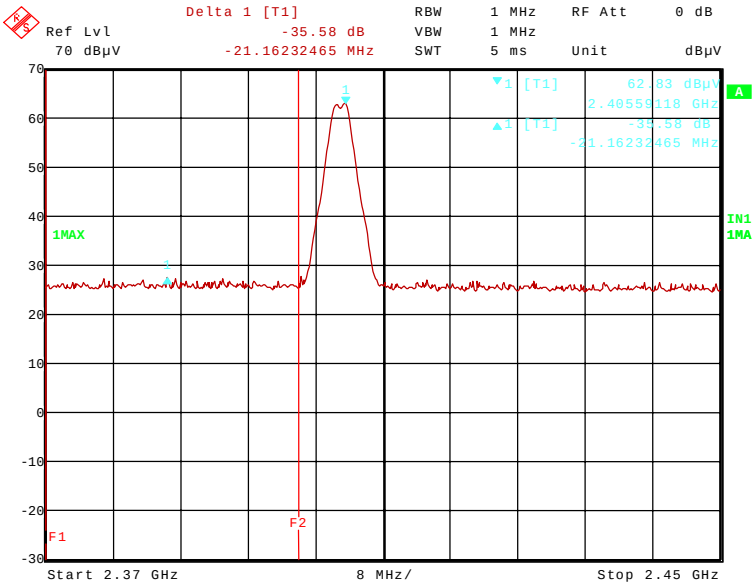
Integrated Power Measurement
A narrower resolution bandwidth can be used at the band edge to improve the measurement accuracy provided that the measurement is subsequently integrated to the relevant bandwidth specification (e.g., 100 kHz within non-restricted bands and 1 MHz within restricted frequency bands).

Used measurement procedure: Marker-Delta Method.

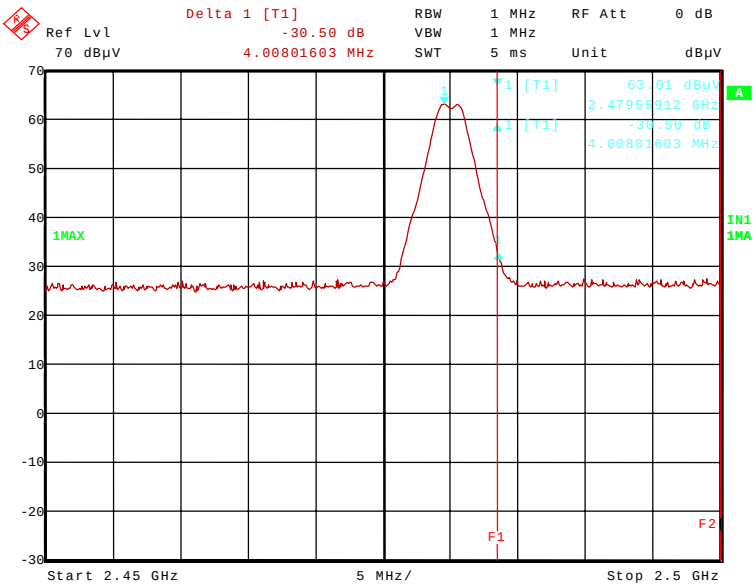
5.2.2 Test result

Ambient temperature	20 °C	Relative humidity	40 %

125162_wmf: Radiated band-edge compliance, lower band edge:



125162_wmf: Radiated band-edge compliance, upper band edge:



Band-edge compliance (lower band edge)											
Result measured with the peak detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2402.00	94.1	-	-	62.1	28.3	0.0	3.7	150	Vert.	-	1
2384.43	59.0	74.0	15.0	27.0	28.3	0.0	3.7	150	Hor.	Yes	1
Result measured with the average detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2402.00	90.9	-	-	58.9	28.3	0.0	3.7	150	Vert.	-	1
2384.43	45.1	54.0	8.9	13.1	28.3	0.0	3.7	150	Hor.	Yes	1
Measurement uncertainty							+2.2 dB / -3.6 dB				

Band-edge compliance (upper band edge)											
Result measured with the peak detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2480.00	94.8	-	-	62.5	28.5	0.0	3.8	150	Vert.	-	1
2483.57	64.3	74.0	9.7	32.0	28.5	0.0	3.8	150	Hor.	Yes	1
Result measured with the average detector:											
Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Reading dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2480.00	91.7	-	-	59.4	28.5	0.0	3.8	150	Vert.	-	1
2483.57	53.0	54.0	1.0	20.7	28.5	0.0	3.8	150	Hor.	Yes	1
Measurement uncertainty							+2.2 dB / -3.6 dB				

Test: Passed

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

5.3 Radiated emissions

5.3.1 Method of measurement

The radiated emission measurement is subdivided into four stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 30 MHz to 1 GHz.
- A final measurement carried out on an open area test side with reflecting ground plane and various antenna height in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with a variable antenna distance and height in the frequency range 1 GHz to 110 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 110 GHz.

All measurements will be carried out with the EUT working on the middle of the assigned frequency band.

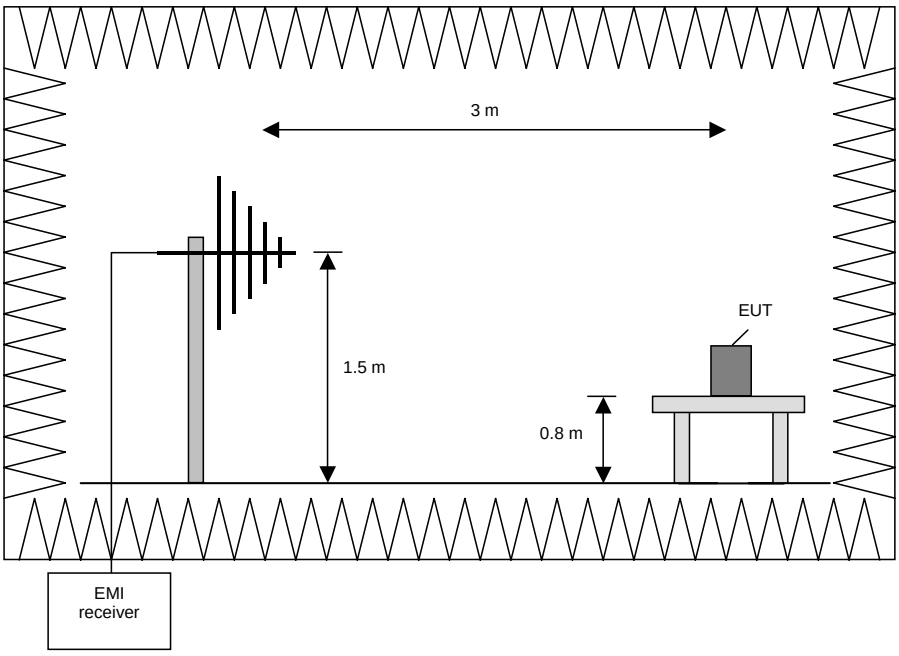
Preliminary measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The setup of the Equipment under test will be in accordance to ANSI C63.4-2009 [1].

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

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

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



Procedure preliminary measurement:

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

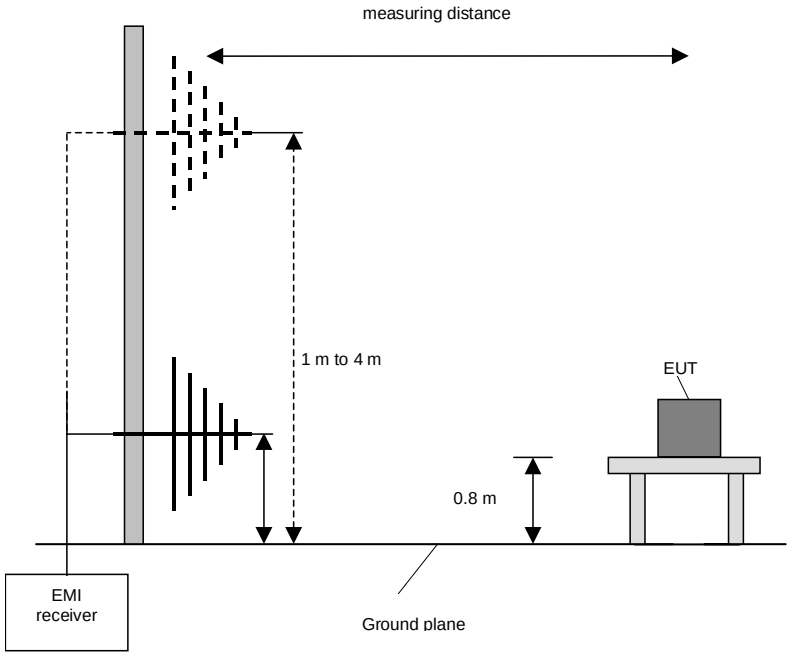
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the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

Final measurement (30 MHz to 1 GHz)

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

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

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

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

Preliminary and final measurement (1 GHz to 110 GHz)

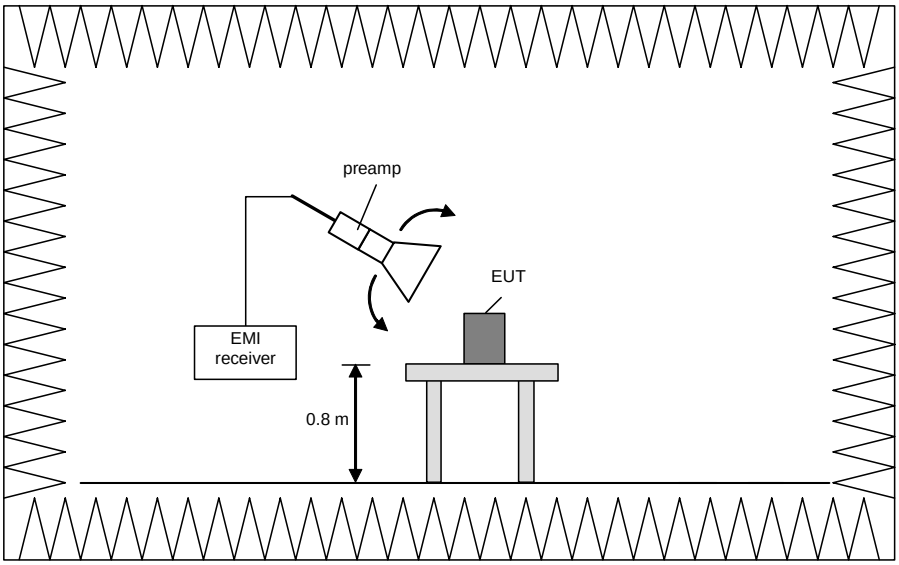
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The setup of the Equipment under test will be in accordance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

Preliminary measurement (1 GHz to 110 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna, the antenna close to the EUT and while moving the antenna over all sides of the EUT. With the spectrum analyser in CLEAR / WRITE mode the cone of the emission should be found. Then the measuring distance will be set to 3 m with the receiving antenna moving in this cone of emission. At this position the final measurement will be carried out.

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

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	100 kHz
4 GHz to 12 GHz	100 kHz
12 GHz to 18 GHz	100 kHz
18 GHz to 26.5 GHz	100 kHz
26.5 GHz to 40 GHz	100 kHz
40 GHz to 60 GHz	100 kHz
50 GHz to 75 GHz	100 kHz
75 GHz to 110 GHz	100 kHz

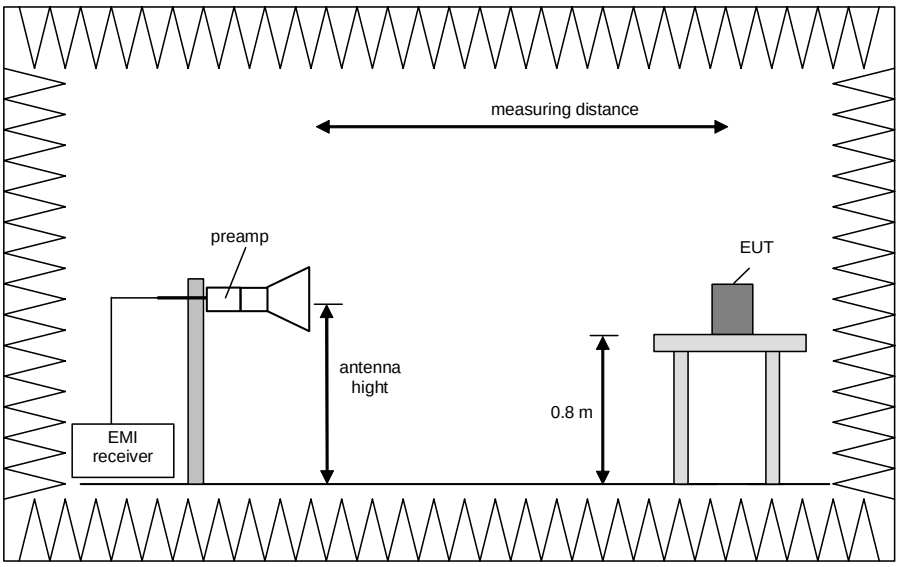


Final measurement (1 GHz to 110 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 ° in order to have the antenna inside the cone of radiation.

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

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz
40 GHz to 60 GHz	1 MHz
50 GHz to 75 GHz	1 MHz
75 GHz to 110 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency range 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 26.5 GHz, 26.5 GHz to 40 GHz, 40 GHz to 60 GHz, 60 GHz to 75 GHz and 75 GHz to 110 GHz.
The following procedure will be used:

1) Monitor the frequency range at horizontal polarisation and move the antenna over all sides of the EUT (if necessary move the EUT to another orthogonal axis).
2) Change the antenna polarisation and repeat 1) with vertical polarisation.
3) Make a hardcopy of the spectrum.
4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
5) Change the analyser mode to Clear / Write and found the cone of emission.
6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3 m and the antenna will be still inside the cone of emission.
7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarisation and azimuth and the peak and average detector, which causes the maximum emission.
8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beam width.

Step 1) to 6) are defined as preliminary measurement.

5.3.2 Test results

5.3.2.1 Preliminary emission measurement (9 kHz to 30 MHz)

Ambient temperature	20 °C	Relative humidity	32 %

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 connectable to the EUT. For detail information of test set-up refer to the pictures in annex A of this test report.

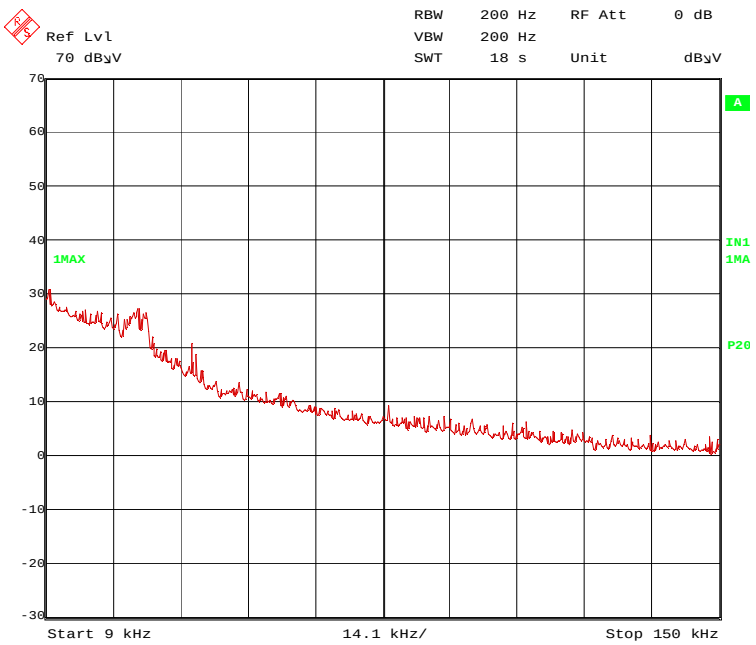
Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 5 V_{DC} by USB.

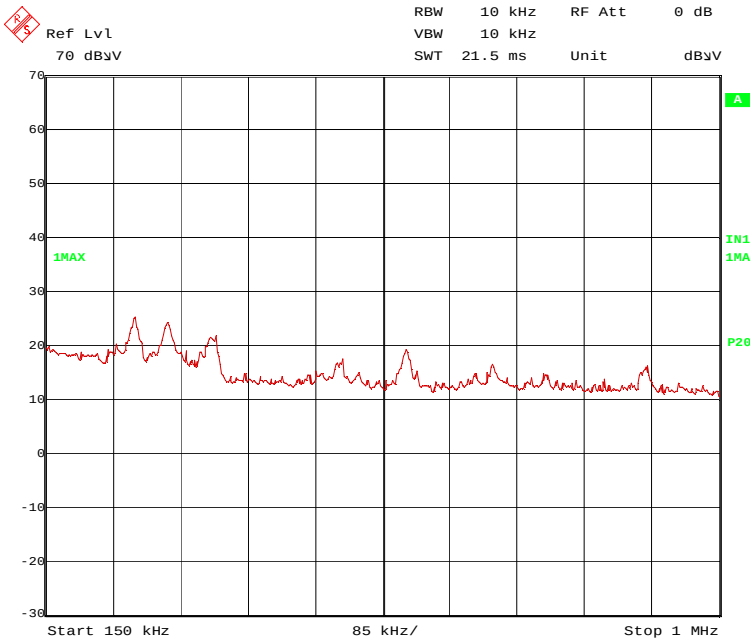
Remark: No emissions were emitted in the frequency range 9 kHz to 1 GHz independent of the transmitter operation mode. Therefore the emissions in this frequency range were documented only with the transmitter operates at 2440 MHz.

Transmitter operates at 2440 MHz

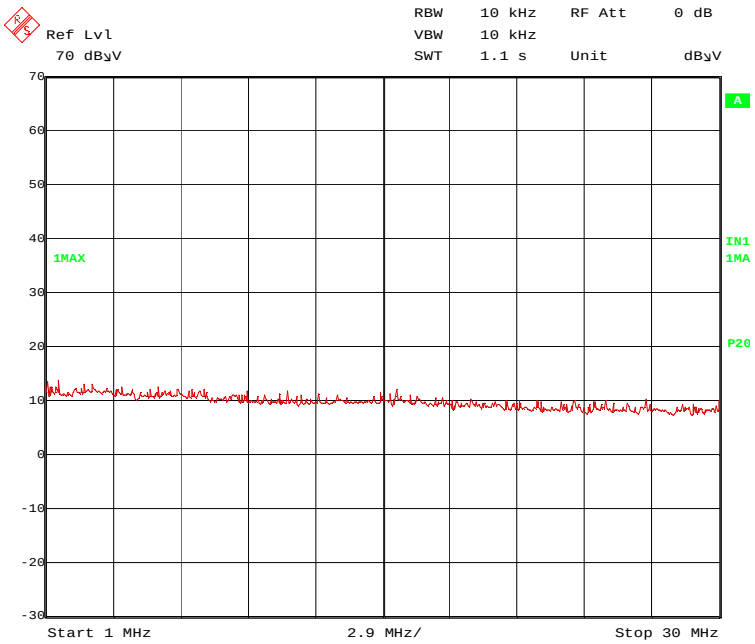
125162_30.wmf: Spurious emissions from 9 kHz to 150 kHz (operation mode 2):



125162_31.wmf: Spurious emissions from 150 kHz to 1 MHz (operation mode 2):

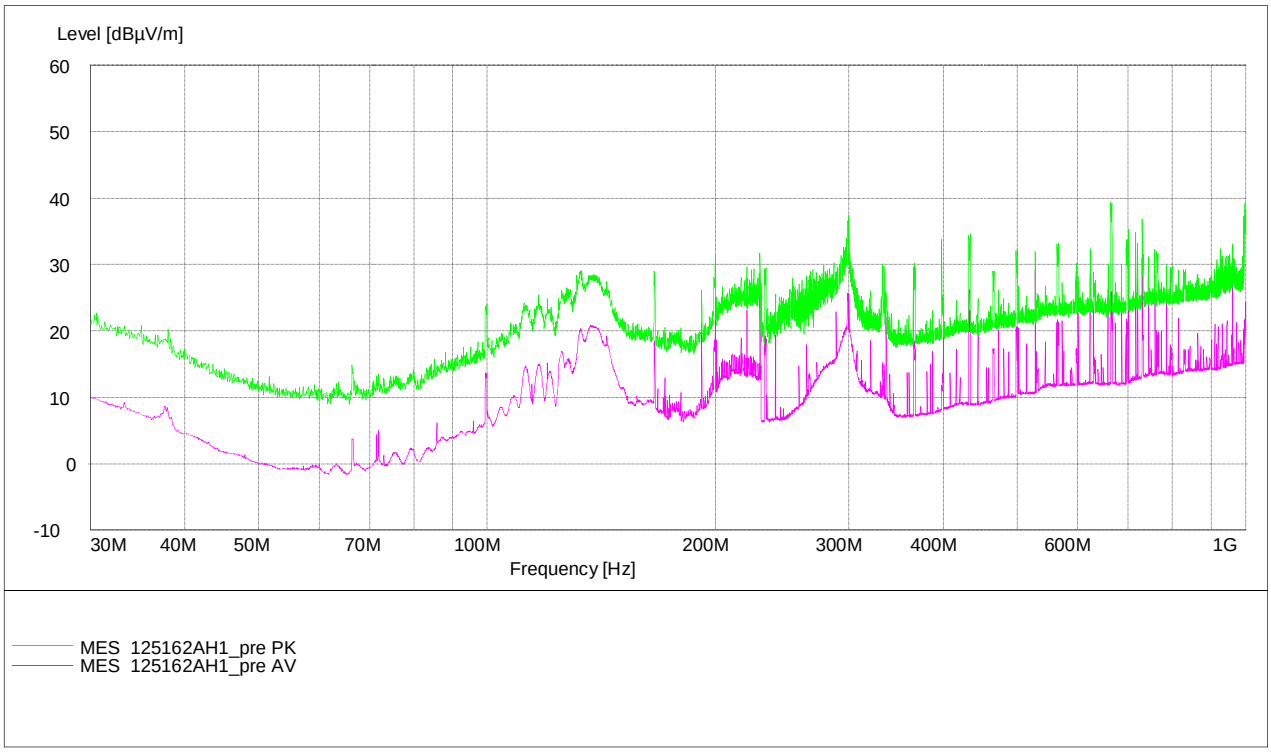


125162_32.wmf: Spurious emissions from 1 MHz to 30 MHz (operation mode 2):



The emissions in the frequency range between 9 kHz and 1 MHz are caused by the ancillary notebook PC. From the EUT 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.

Title:	Emission measurement according to FCC 15.247 EMI Test receiver ESI Rohde & Schwarz
EUT:	USB dongle
Manufacturer:	IC Medical GmbH
Operating Condition:	Continuous modulated transmission @ 2440 MHz
Test site:	fully anechoic chamber M20; PHOENIX TEST LAB GmbH
Operator:	M. Bastert
Test Specification:	USB powered
Comment:	Plugged into ancillary notebook PC (Fujitsu Siemens Lifebook S7110)



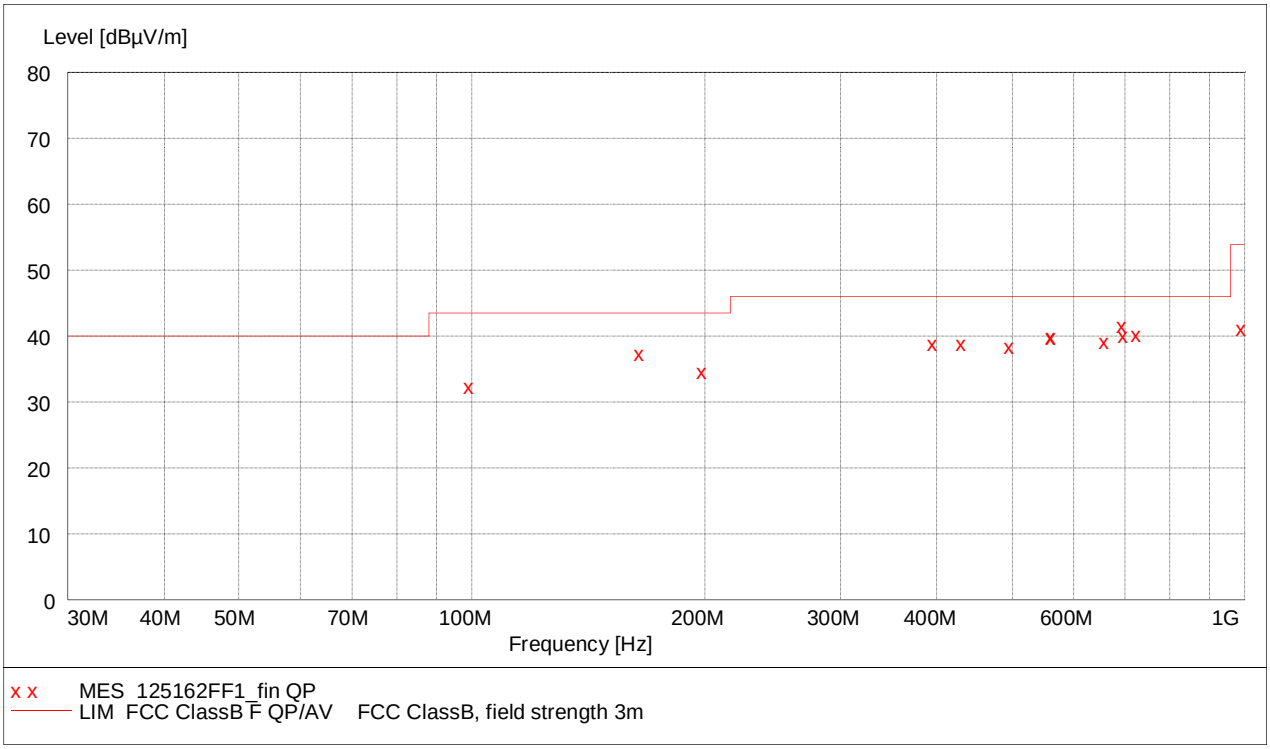
The following emissions were found during the preliminary measurement in this frequency range, so a final measurement was carried out on the open area test site. The results are presented in the following clause 5.3.2.2.

The following frequencies were found during the preliminary emission measurement:

Inside restricted bands	165.920 MHz, 998.560 MHz
Outside restricted bands	99.920 MHz, 199.992 MHz, 397.504 MHz, 433.168 MHz, 499.840 MHz, 566.480 MHz, 663.592 MHz, 699.724 MHz, 701.596 MHz, 730.240 MHz

5.3.2.2 Final emission measurement from 30 MHz to 1 GHz

Title:	Final measurement with receiver ESIB26 by Rohde & Schwarz
EUT:	Dongle
Manufacturer:	IC Medical GmbH
Operating Condition:	Continuous modulated transmission @ 2440 MHz
Test site:	PHOENIX TESTLAB GmbH; Open area test site M6
Operator:	M. Bastert
Test Specification:	USB powered
Comment:	Plugged into ancillary notebook PC (Fujitsu Siemens Lifebook S7110)

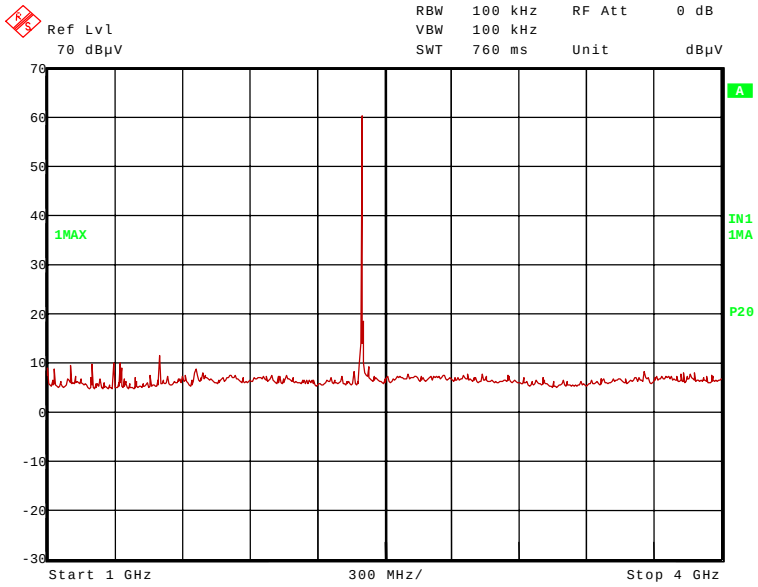


Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
99.920	32.5	43.5	11.0	20.6	10.8	1.1	397	85	Hor.	No	1
165.920	37.5	43.5	6.0	25.4	10.7	1.4	224	270	Hor.	Yes	1
199.992	34.9	43.5	8.6	24.5	8.9	1.5	104	23	Hor.	No	1
397.504	39	46.0	7.0	21.2	15.6	2.2	137	45	Vert.	No	1
433.168	39	46.0	7.0	20.3	16.4	2.3	118	14	Vert.	No	1
499.840	38.7	46.0	7.3	18.8	17.4	2.5	100	54	Vert.	No	1
566.480	40.1	46.0	5.9	17.7	19.6	2.8	269	268	Vert.	No	1
663.592	39.4	46.0	6.6	16.8	19.7	2.9	156	45	Vert.	No	1
699.724	41.8	46.0	4.2	18.8	20.0	3.0	112	43	Hor.	No	1
701.596	32.5	46.0	13.5	9.4	20.1	3.0	110	26	Hor.	No	1
730.240	37.5	46.0	8.5	12.9	21.5	3.1	225	67	Vert.	No	1
998.560	34.9	54.0	19.1	7.7	23.7	3.5	104	46	Vert.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

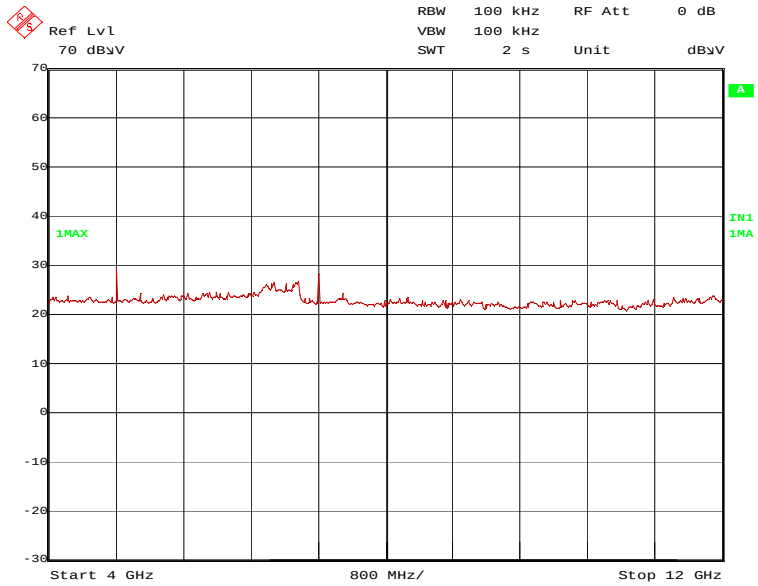
5.3.2.3 Preliminary emission measurement (1 GHz to 25 GHz)

Transmitter operates at 2402 MHz

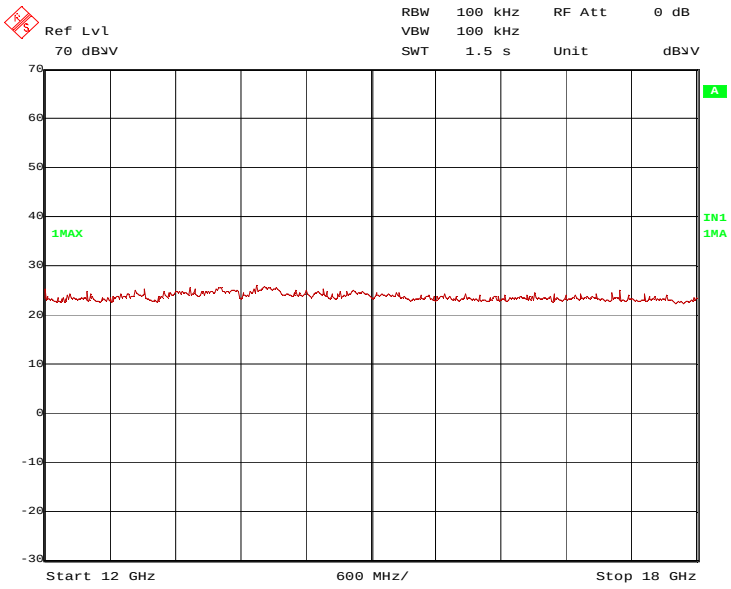
125162_12.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



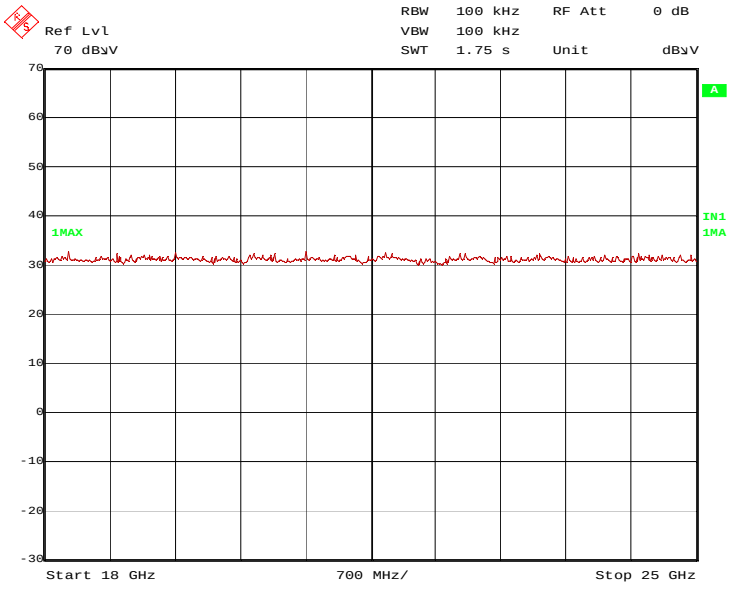
125162_7.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 1):



125162_13.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 1):



125162_18.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 1):



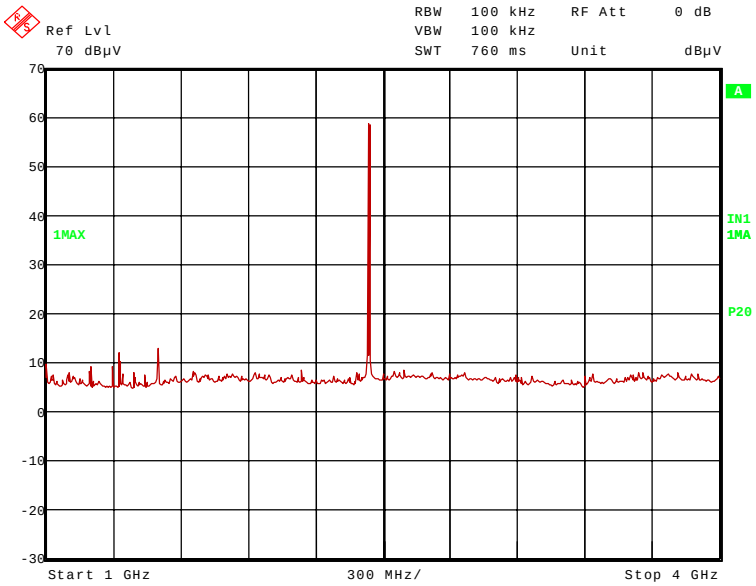
The following frequencies were found during the preliminary radiated emission test:

Inside restricted bands	4.804 GHz
Outside restricted bands	2.402 GHz, 7.206 GHz

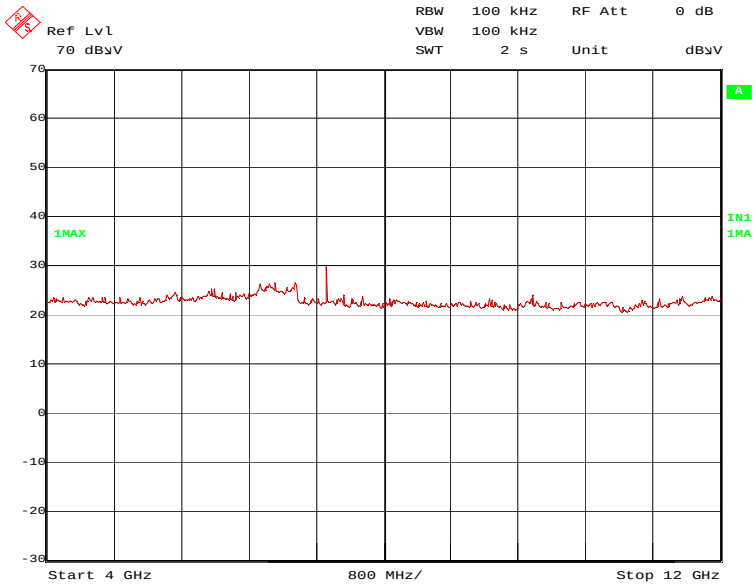
These frequencies have to be measured in a final measurement. The results were presented in the following.

Transmitter operates at 2440 MHz

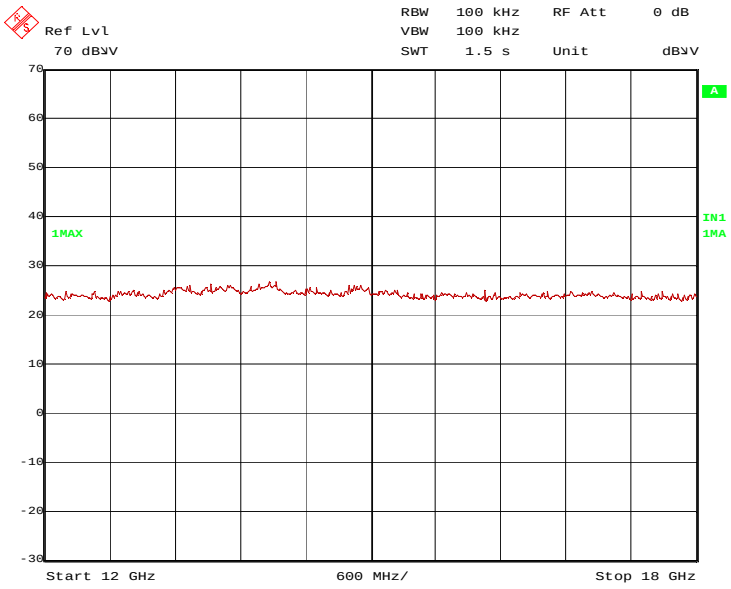
125162_11.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



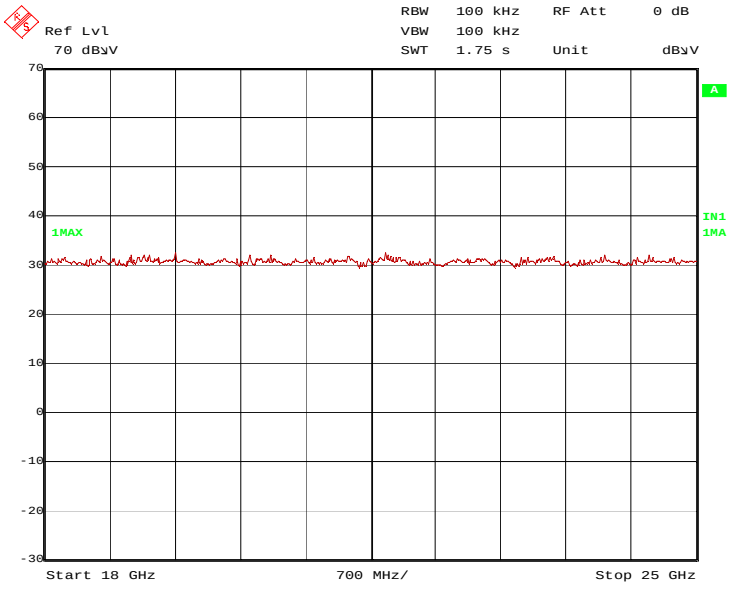
125162_8.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 2):



125162_14.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 2):



125162_17.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 2):



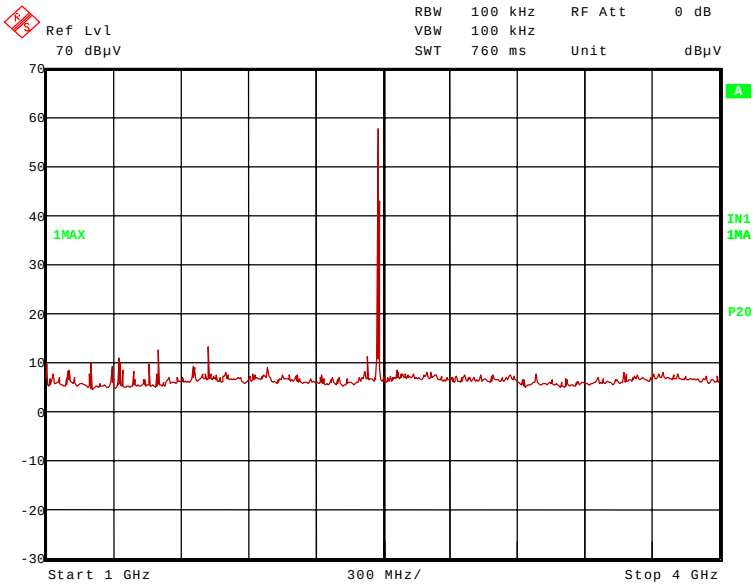
The following frequencies were found during the preliminary radiated emission test:

Inside restricted bands	7.320 GHz
Outside restricted bands	2.440 GHz

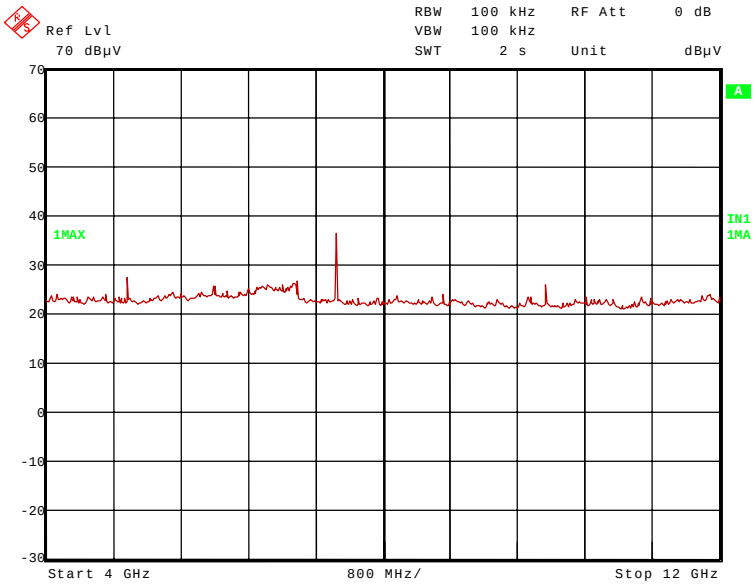
These frequencies have to be measured in a final measurement. The results were presented in the following.

Transmitter operates at 2481 MHz

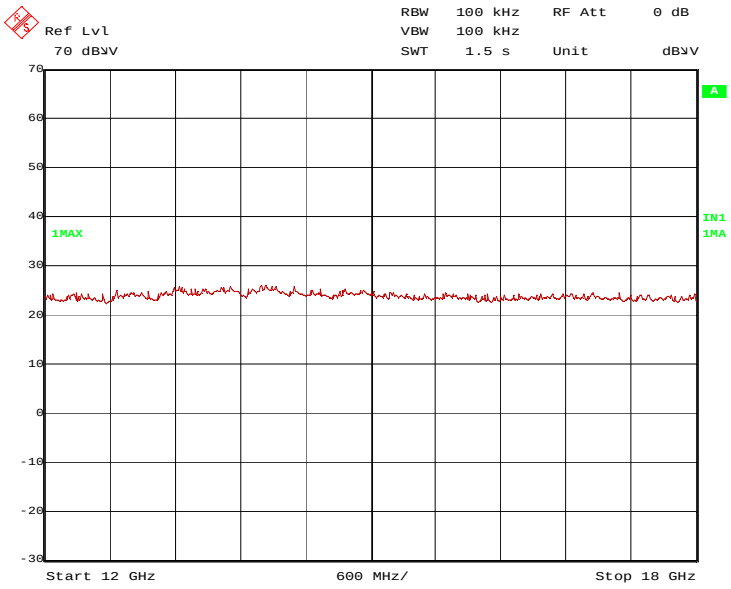
125162_10.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 3):



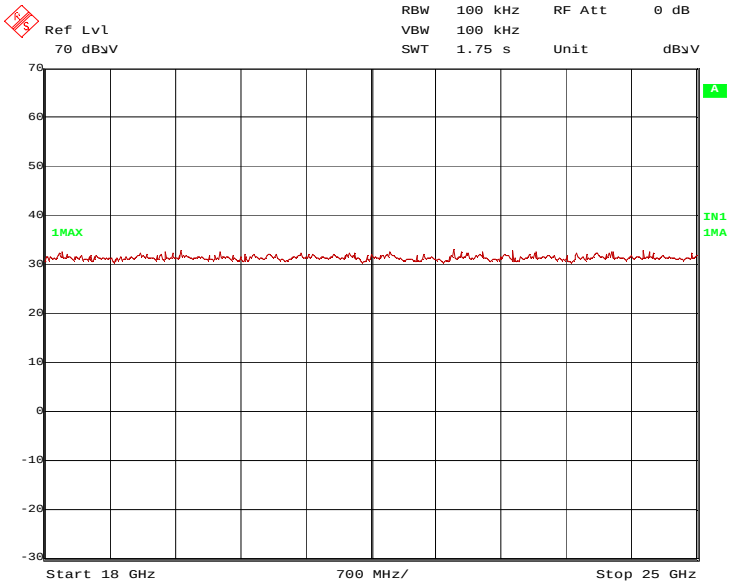
125162_9.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 3):



125162_15.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 3):



125162_16.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 3):



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

Inside restricted bands	4.962 GHz, 7.443 GHz
Outside restricted bands	2.481 GHz, 9.924 GHz

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

The frequencies between 1 GHz and the wanted signal are caused by the ancillary laptop PC.

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 37, 39, 43, 44, 46, 49 - 51, 55

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

Ambient temperature	20 °C	Relative humidity	32 %

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 connectable 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 5 V_{DC} by USB.

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

Transmitter operates at 2402 MHz

Result measured with the peak detector:

Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2402	90.8	114.0	23.2	58.8	28.3	0.0	3.7	150	Vert.	-	1
4804	45.1	74.0	28.9	32.9	32.6	25.7	5.3	150	Vert.	Yes	1
7206	49.1	74.0	24.9	31.2	35.7	24.6	6.8	150	Vert.	No	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2402	88.1	94.0	5.9	56.1	28.3	0.0	3.7	150	Vert.	-	1
4804	31.1	54.0	22.9	18.9	32.6	25.7	5.3	150	Vert.	Yes	1
7206	35.1	54.0	18.9	17.2	35.7	24.6	6.8	150	Vert.	No	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at 2440 MHz

Result measured with the peak detector:

Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2440	91.7	114.0	22.3	59.6	28.4	0.0	3.7	150	Vert.	-	1
7320	58.3	74.0	15.7	39.9	36.2	24.6	6.8	150	Vert.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2440	89.1	94.0	4.9	57.0	28.4	0.0	3.7	150	Vert.	-	1
7320	47.9	54.0	6.1	29.5	36.2	24.6	6.8	150	Vert.	Yes	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Transmitter operates at 2481 MHz

Result measured with the peak detector:

Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2481	92.0	114.0	22.0	59.7	28.5	0.0	3.8	150	Vert.	-	1
4962	48.1	74.0	25.9	35.5	32.9	25.6	5.3	150	Vert.	Yes	1
7443	60.4	74.0	13.6	41.8	36.3	24.5	6.8	150	Hor.	Yes	1
9924	57.3	74.0	16.8	35.9	37.4	23.9	7.9	150	Hor.	No	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Result measured with the average detector:

Frequency MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band	Pos.
2481	89.6	94.0	4.4	57.3	28.5	0.0	3.8	150	Vert.	-	1
4962	45.5	54.0	8.5	32.9	32.9	25.6	5.3	150	Vert.	Yes	1
7443	53.9	54.0	0.1	35.3	36.3	24.5	6.8	150	Hor.	Yes	1
9924	51.8	54.0	2.2	30.4	37.4	23.9	7.9	150	Hor.	No	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 34, 36, 44, 46, 49, 58

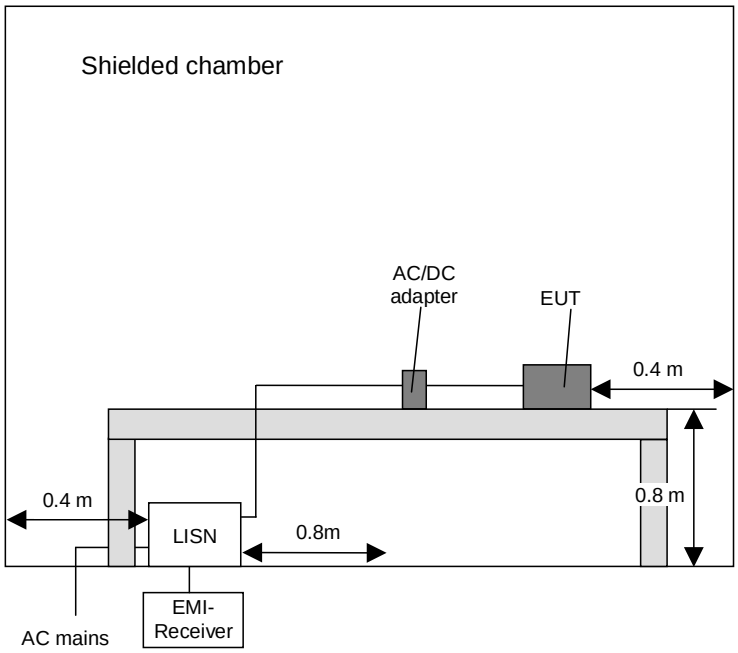
5.4 Conducted emissions on power supply lines

5.4.1 Method of measurement

This test will be carried out in a shielded chamber. Table top 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 setup 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



5.4.2 Test results

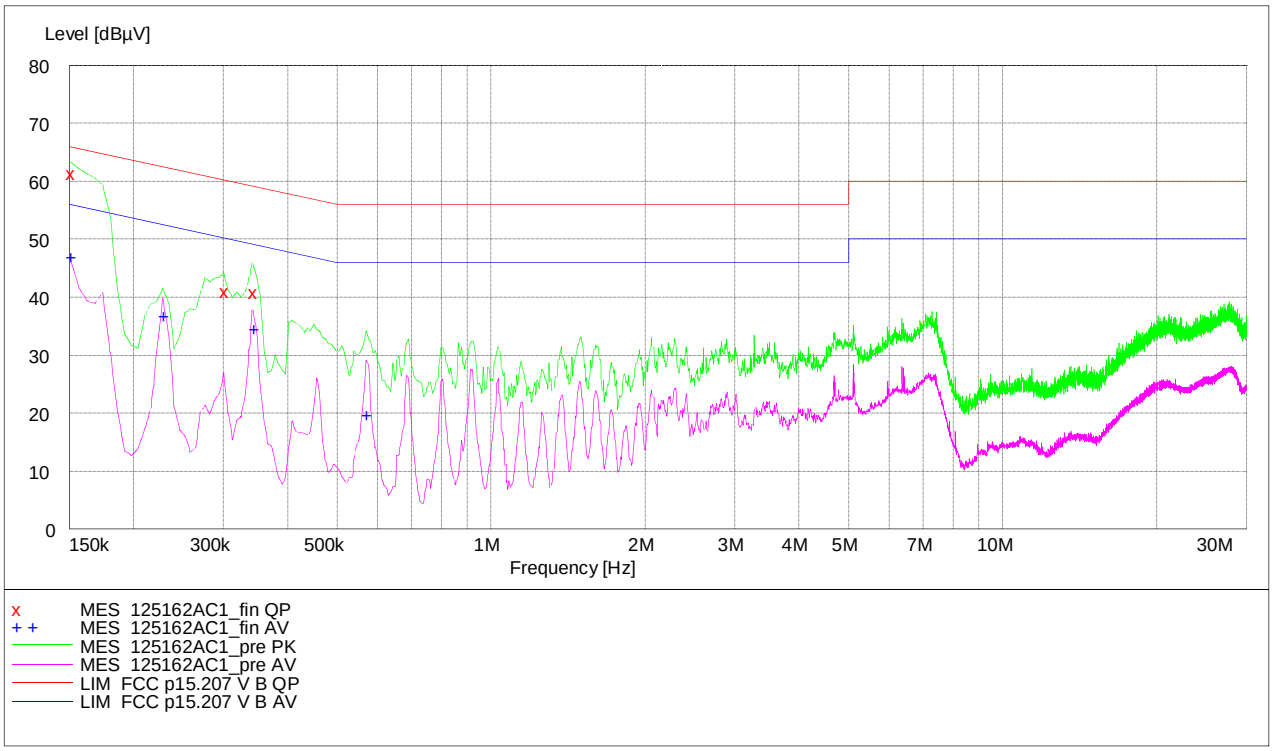
Ambient temperature	20 °C	Relative humidity	40 %

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

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 2. All results are shown in the following.

Supply voltage: During the measurement the EUT was supplied via the USB interface with 5 V_{DC} by a laptop computer (Fujitsu Siemens Lifebook S7110) which was supplied with 120 V_{AC} / 60 Hz.



Result measured with the quasipeak detector (marked by an x):

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.150000	61.60	2.1	66.0	4.4	N	FLO
0.303900	41.20	0.9	60.1	18.9	N	GND
0.346200	41.00	0.9	59.1	18.1	N	FLO

Result measured with the average detector (marked by a +):

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.150000	47.10	2.1	56.0	8.9	N	FLO
0.231000	36.90	1.0	52.4	15.5	N	GND
0.347100	34.70	0.9	49.0	14.3	L1	GND
0.576600	19.70	0.8	46.0	26.3	N	GND

Test: Passed

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

6 TEST EQUIPMENT AND ANCILLARIES

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
1	Shielded chamber M4	-	Siemens AG	B83117-S1-X158	480088	Weekly verification (system cal.)	
2	EMI Receiver	ESIB 26	Rohde & Schwarz	1088.7490	481182	03/09/2012	03/2014
3	LISN	NSLK8128	Schwarzbeck	8128161	480138	12/20/2012	12/2013
4	High pass filter	HR 0.13-5ENN	FSY Microwave Inc.	DC 0109 SN 002	480340	Weekly verification (system cal.)	
14	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
15	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	02/15/2012	02/2014
16	Controller	HD100	Deisel	100/670	480139	-	-
17	Turntable	DS420HE	Deisel	420/620/80	480087	-	-
18	Antenna support	AS615P	Deisel	615/310	480086	-	-
19	Antenna	CBL6111 D	Chase	25761	480894	09/28/2011	09/2014
20	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	-
26	Test fixture	-	Phoenix Test-Lab	-	410160	Weekly verification (system cal.)	
29	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
30	Spectrum analyser	FSU	Rohde & Schwarz	200125	480956	02/15/2012	02/2014
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	02/13/2012	02/2014
32	Controller	MCU	Maturo	MCU/043/971107	480832	-	-
33	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
34	Antenna support	AS615P	Deisel	615/310	480187	-	-
35	Antenna	CBL6112 B	Chase	2688	480328	04/21/2011	04/2014
36	Antenna	3115 A	EMCO	9609-4918	480183	11/09/2011	11/2014
37	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Six month verification (system cal.)	
39	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297	Six month verification (system cal.)	
43	RF-cable No. 36	Sucoflex 106B	Suhner	0522/6B	480571	Weekly verification (system cal.)	
44	RF-cable No. 31	RTK 081	Rosenberger	-	410142	Weekly verification (system cal.)	
46	RF-cable 1 m	KPS-1533-400-KPS	Insulated Wire	-	480301	Six month verification (system cal.)	
49	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	Six month verification (system cal.)	
50	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	Six month verification (system cal.)	
51	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	Six month verification (system cal.)	
55	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	02/16/2012	02/2014
58	4 GHz High Pass Filter	WHKX4.0/18G-8SS	Wainwright Instruments	1	480587	Weekly verification (system cal.)	

7 REPORT HISTORY

Report Number	Date	Comment
F125162E2	04 June 2013	Document created

8 LIST OF ANNEXES

ANNEX A TEST SET-UP PHOTOS 5 pages

125162_12.jpg	Test setup fully anechoic chamber
125162_13.jpg	Test setup fully anechoic chamber
125162_14.jpg	Test setup fully anechoic chamber
125162_15.jpg	Test setup open area test site
125162_23.jpg	Test setup shielded chamber

ANNEX B EXTERNAL PHOTOS 2 pages

125162_16.jpg	3D view 1
125162_17.jpg	3D view 2

ANNEX C INTERNAL PHOTOS 2 pages

125162_18.jpg	PCB, top view
125162_19.jpg	PCB, bottom view