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Test Report

Report Number: F125162E1

Applicant:

IMST GmbH

Manufacturer:

LNT Automation GmbH

Equipment under Test (EUT):

Wireless Keyboard 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] **558074 D01 DTS Meas Guidance v03r01 (April 2013)** Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

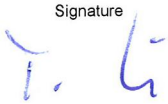
[4] **RSS-210 Issue 8 (December 2010)** Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

[5] **RSS-Gen Issue 3 (December 2010)** General Requirements and Information for the Certification of Radiocommunication Equipment

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

TEST RESULT

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

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

RESERVATION

This test report is only valid in its original form.

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

Contents: Page

1 IDENTIFICATION

1.1 Applicant

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Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	LNT Automation GmbH
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Country:	Germany
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Fax:	+49 (0) 7195 58889 - 913
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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: *	Wireless keyboard for use in medical environment
Type: *	DXX
FCC ID: *	T26-TKK01
IC: *	11150A-NRF24LE1
Serial number: *	2279
PCB identifier: *	104790
Hardware version: *	P9
Software version: *	V2.6.511

1.5 Technical data of equipment

RX:	2402 MHz	TX:	2402 MHz
RX:	2440 MHz	TX:	2440 MHz
RX:	2480 MHz	TX:	2480 MHz

Antenna type: *	Internal, PCB antenna					
Antenna gain: *	0 dBi					
Rated output power: *	0 dBm					
Antenna connector: *	None					
Power supply: *	U_{nom}=	6.0 V_{DC}	U_{min}=	4.3 V_{DC}	U_{max}=	7.0 V_{DC}
Type of modulation: *	GFSK					
Operating frequency range:*	2.402 GHz to 2.480 GHz					
Number of channels: *	79					
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: 30 kHz (min. RC oscillator), nRF24LE1: 16 MHz (crystal)					

* declared by the applicant.

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
USB	USB Mini B	USB A	1.8 m
-	-	-	-

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	14 December 2012
Start of test:	20 December 2012
End of test:	04 June 2013

2 OPERATIONAL STATES

The tests were carried out with a modified test sample. The operation modes could be set by the input of a string on the keyboard like “mc40” followed by pressing “ENTER” for modulated transmission at 2440 MHz.

During the tests the sample was powered with 6.0 V_{DC} by four type AA batteries.

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 2480 MHz	GFSK

Physical boundary of the EUT

The EUT was tested in its dedicated position.

The following test modes were adjusted during the tests:

Test item	Operation mode
6 dB bandwidth (radiated)	1, 2, 3
Maximum peak output power (radiated)	1, 2, 3
Power spectral density (radiated)	1, 2, 3
Band edge compliance (radiated)	1, 3
Radiated emissions (transmitter) (radiated)	1, 2, 3

3 ADDITIONAL INFORMATION

All measurements were carried out in radiated manner. As described in clause 3.0 in [3] a radiated measurement configuration is acceptable to show compliance with §15.247.

4 OVERVIEW

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS 210, Issue 8 [4] or RSS-Gen, Issue 3 [5]	Status	Refer page
6 dB bandwidth	General	15.247 (a) (2)	A8.2 (a) [4]	Passed	8 et seq.
Maximum peak output power	General	15.247 (b) (3), (4)	A8.4 (4) [4]	Passed	11 et seq.
Power spectral density	2400.0 - 2483.5	15.247 (e)	A8.2 (b) [4]	Passed	14 et seq.
Band edge compliance	2400.0 - 2483.5	15.247 (d)	A8.5 [4]	Passed	17 et seq.
Radiated emissions (transmitter)	0.009 - 25,000	15.205 (a) 15.209 (a)	7.2.2 [5], 2.5 [4]	Passed	20 et seq.
AC powerline conducted	0.15 - 30	15.207 (a)	7.2.4 [5]	Not applicable	-

The radio link is terminated if an USB cable is connected. Therefore no measurement according to 15.207 is applicable

5 TEST RESULTS

5.1 DTS (6 dB) bandwidth

5.1.1 Method of measurement

Option 1 according to [3]:

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 x RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

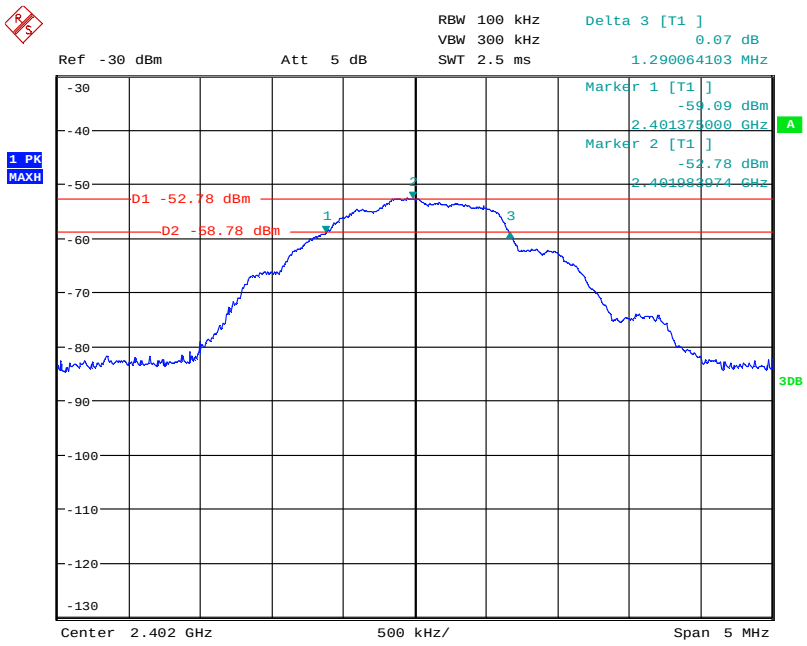
The measurement will be performed at the upper, the lower end and the middle of the assigned frequency band.

Test setup

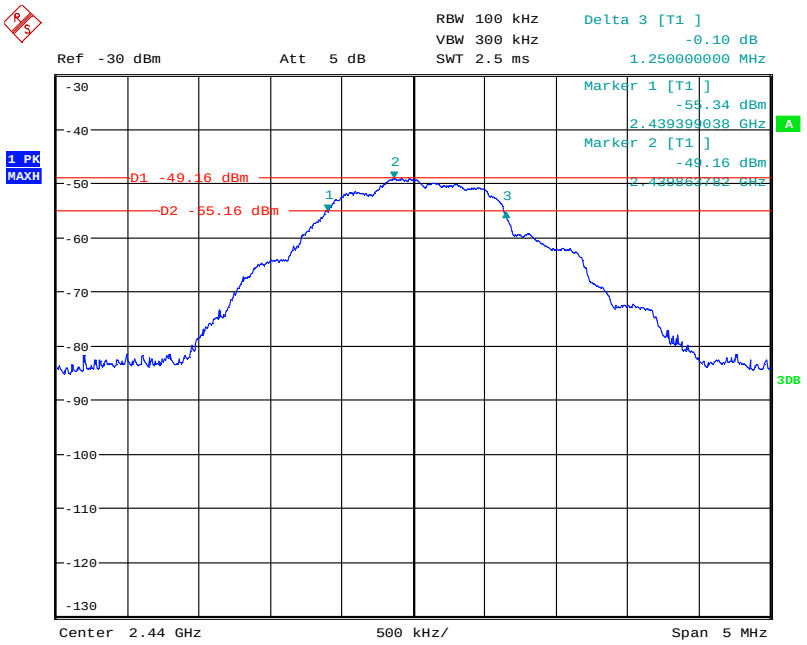
5.1.2 Test results

Ambient temperature	21 °C	Relative humidity	50 %

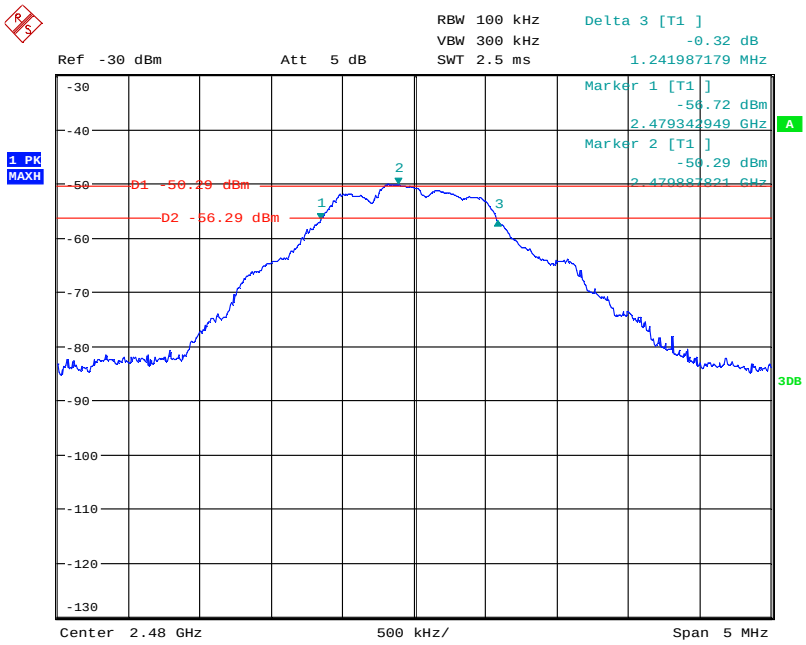
125162_6dB_keyboard_2402.wmf: 6 dB bandwidth at the lower end of the assigned frequency band:



125162_6dB_keyboard_2440: 6 dB bandwidth at the middle of the assigned frequency band:



125162_6dB_keyboard_2480.wmf: 6 dB bandwidth at the upper end of the assigned frequency band:



Operation mode 1 to 3		
Channel frequency [MHz]	6 dB bandwidth [kHz]	Bandwidth limit [kHz]
2402	1290.064	>500 kHz
2440	1250.000	>500 kHz
2480	1241.987	>500 kHz
Measurement uncertainty: $< \pm 1*10^{-7}$		

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
26, 30

5.2 Maximum peak output power (radiated)

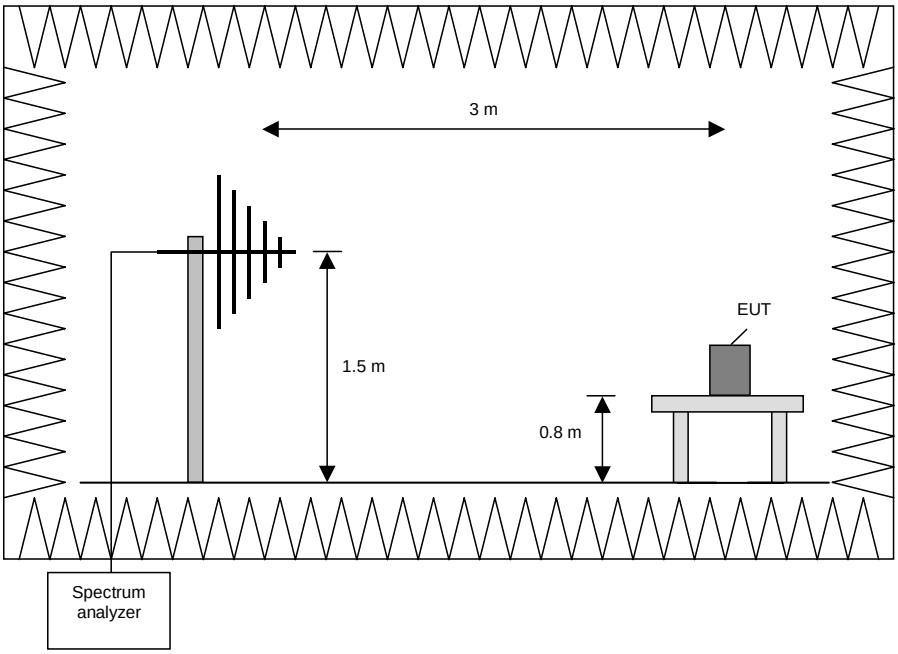
5.2.1 Method of measurement

Option 1 (RBW ≥ DTS BW) according to [3]

This procedure should be used when a spectrum/signal analyzer with a resolution bandwidth that is greater than or equal to the DTS bandwidth can be used to perform the measurement.

1. Set the RBW ≥ DTS bandwidth.
2. Set VBW ≥ 3 x RBW.
3. Set span ≥ RBW.
4. Sweep time = auto couple.
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use peak marker function to determine the peak amplitude level.

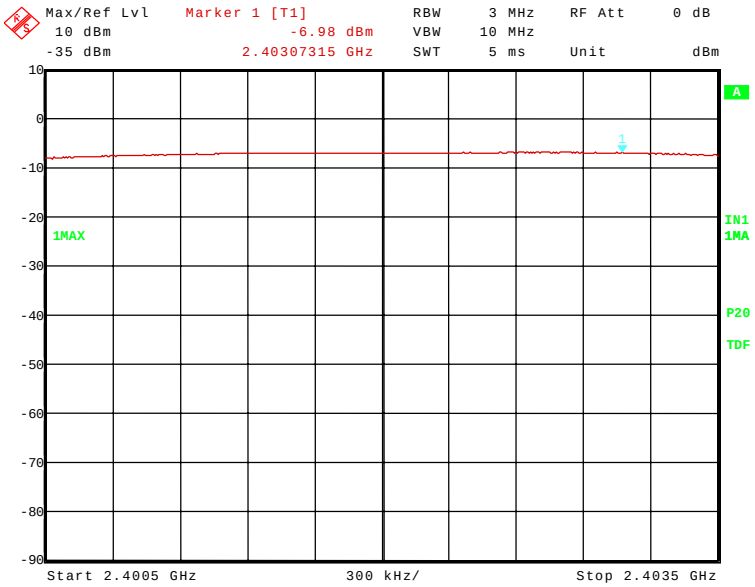
Test set-up:



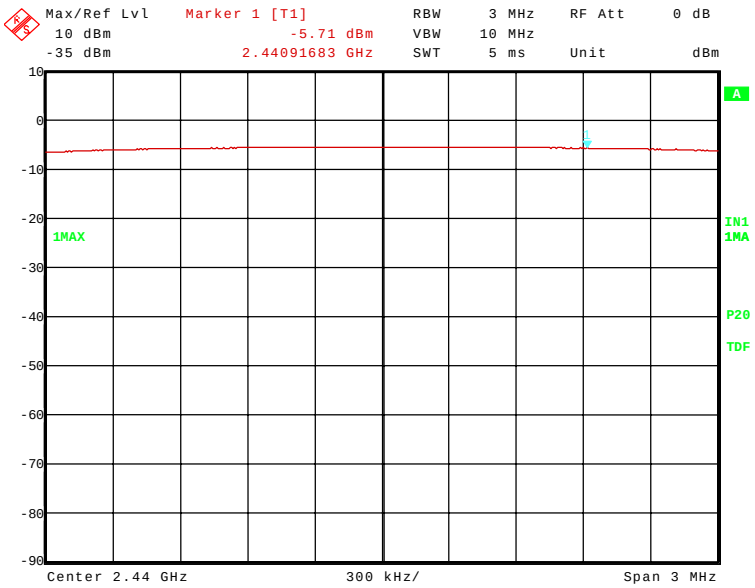
5.2.2 Test results

Ambient temperature	21 °C	Relative humidity	50 %

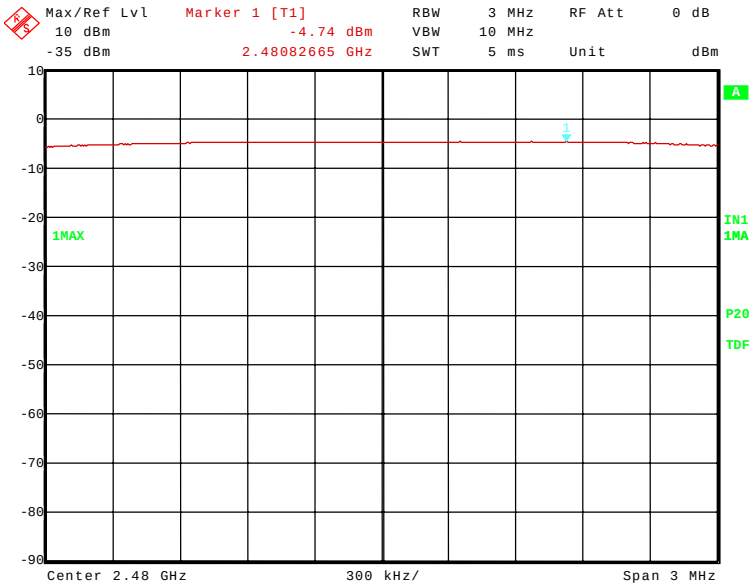
125162_36.wmf: Equivalent isotropic radiated power at 2402 MHz:



125162_37.wmf: Equivalent isotropic radiated power at 2440 MHz:



125162_38.wmf: Equivalent isotropic radiated power at 2480 MHz:



Operation mode 1 to 3			
Channel frequency [MHz]	Maximum EIRP peak output power [dBm]	Antenna gain [dBi]	Peak power limit [dBm]
2402	-7.0	0	30.0
2440	-5.7	0	30.0
2480	-4.7	0	30.0
Measurement uncertainty: +2.2 dB / -3.6 dB			

Test: Passed

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

5.3 Power spectral density

5.3.1 Method of measurement

The DTS rules specify a conducted PSD limit within the DTS bandwidth during any time interval of continuous transmission. Such specifications require that the same method as used to determine the conducted output power shall also be used to determine the power spectral density. Therefore, if maximum peak conducted output power was measured to demonstrate compliance to the output power limit, then the peak PSD procedure below (Method PKPSD) shall be used. If maximum conducted output power was measured to demonstrate compliance to the output power limit, then one of the average PSD procedures shall be used, as applicable based on the criteria stated in [3], chapter 10 (the peak PSD procedure is also an acceptable option).

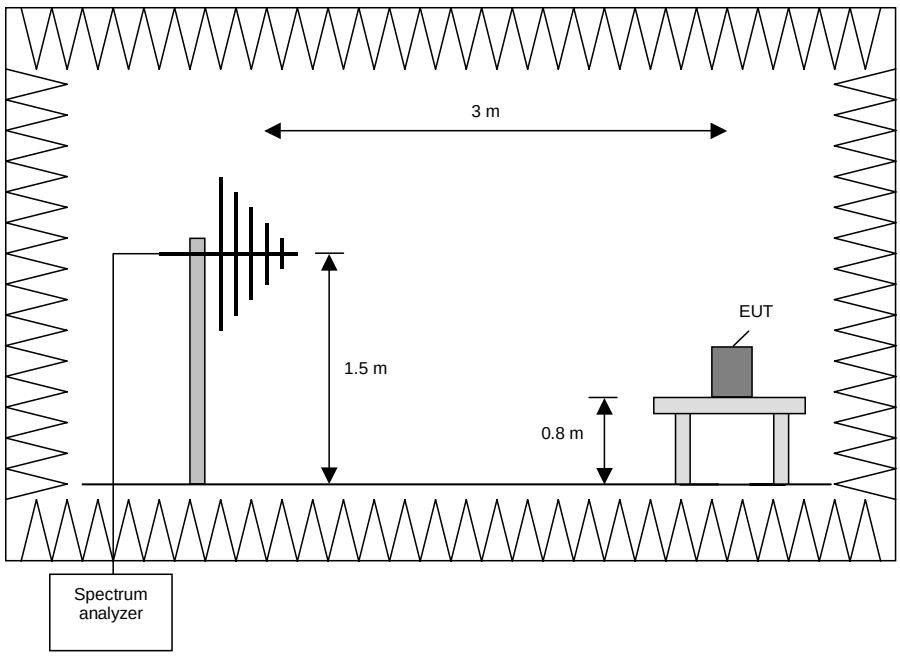
The following procedure was used to determine the DTS PSD.

Method PKPSD (peak PSD)

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the *DTS bandwidth*.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

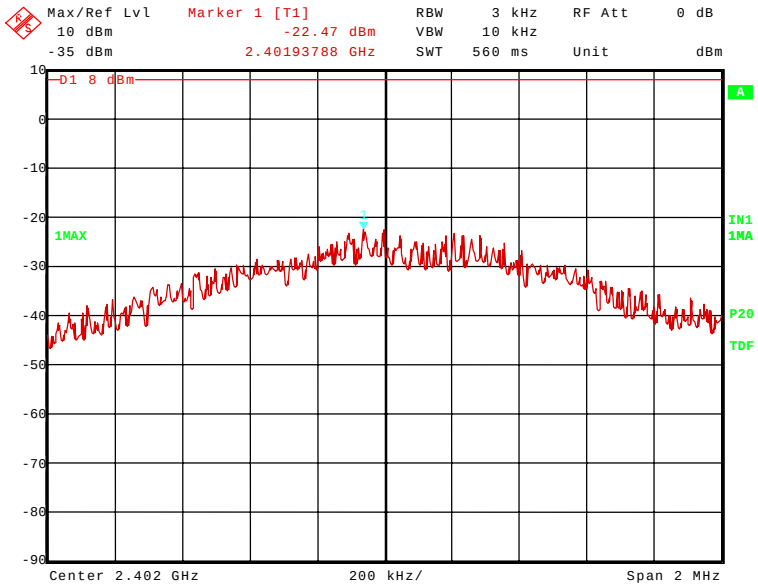
Test set-up:



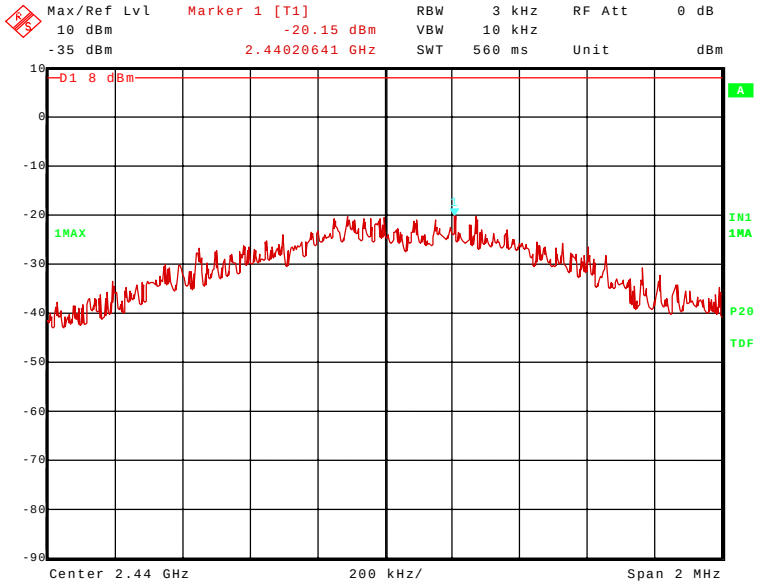
5.3.2 Test results

Ambient temperature	21 °C	Relative humidity	30 %

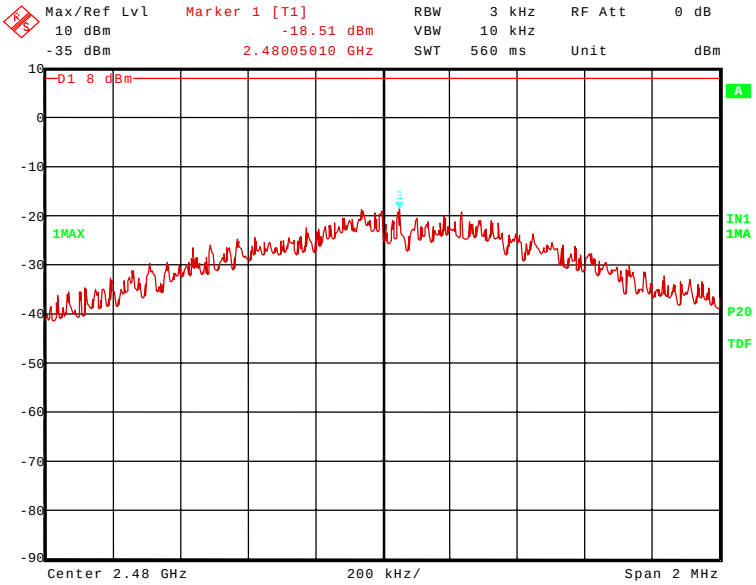
125162_41.wmf: Power spectral density at the lower end of the assigned frequency band:



125162_40.wmf: Power spectral density at the middle of the assigned frequency band:



125162_39.wmf: Power spectral density at the upper end of the assigned frequency band:



Operation mode 1 to 3			
Channel frequency [MHz]	Measured Power spectral density [dBm / 3 kHz]	Antenna gain [dBi]	Power spectral density limit [dBm / 3 kHz]
2402	-22.5	0	8.0
2442	-20.2	0	8.0
2480	-18.5	0	8.0
Measurement uncertainty: +2.2 dB / -3.6 dB			

Test: Passed

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

5.4 Band-edge compliance (radiated)

5.4.1 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.

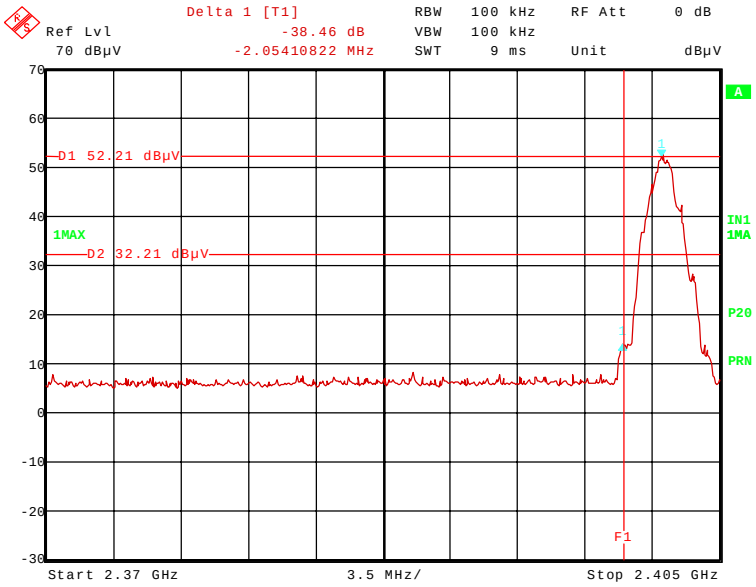
Integrated Power Measurement
A narrower resolution bandwidth can be used at the band edge to improve the measurement accuracy provided that the measurement is subsequently integrated to the relevant bandwidth specification (e.g., 100 kHz within non-restricted bands and 1 MHz within restricted frequency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

Used measurement procedure: Marker-Delta Method.

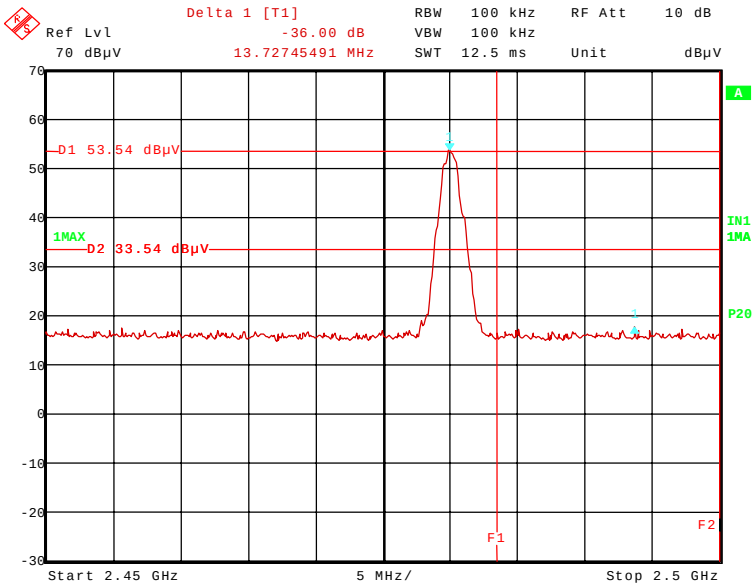
5.4.2 Test result

Ambient temperature	20 °C	Relative humidity	40 %

125162_25.wmf: Radiated band-edge compliance, lower band edge:



125162_26.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
2401.00	94.1	-	-	62.1	28.3	0.0	3.7	150	Vert.	-
2399.95	59.0	74.0	15.0	27.0	28.3	0.0	3.7	150	Hor.	Yes
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
2402.00	90.9	-	-	58.9	28.3	0.0	3.7	150	Vert.	-
2399.95	45.1	54.0	8.9	13.1	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 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
2480.00	94.8	-	-	62.5	28.5	0.0	3.8	150	Vert.	-
2483.57	64.3	74.0	9.7	32.0	28.5	0.0	3.8	150	Hor.	Yes
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
2480.00	91.7	-	-	59.4	28.5	0.0	3.8	150	Vert.	-
2483.57	53.0	54.0	1.0	20.7	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 – 33, 36, 44

5.5 Radiated emissions

5.5.1 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.

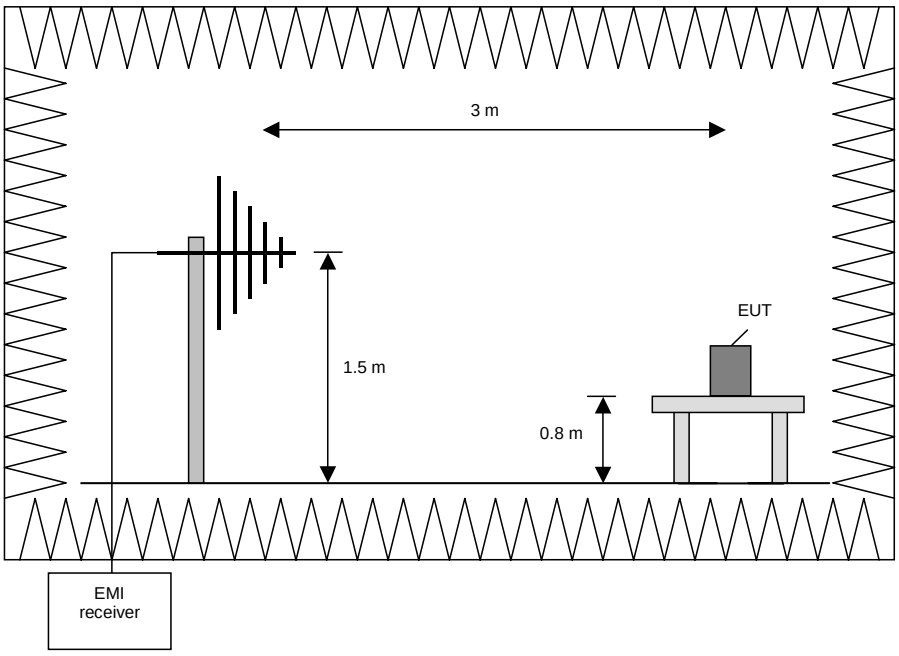
Preliminary measurement (30 MHz to 1 GHz)

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 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:

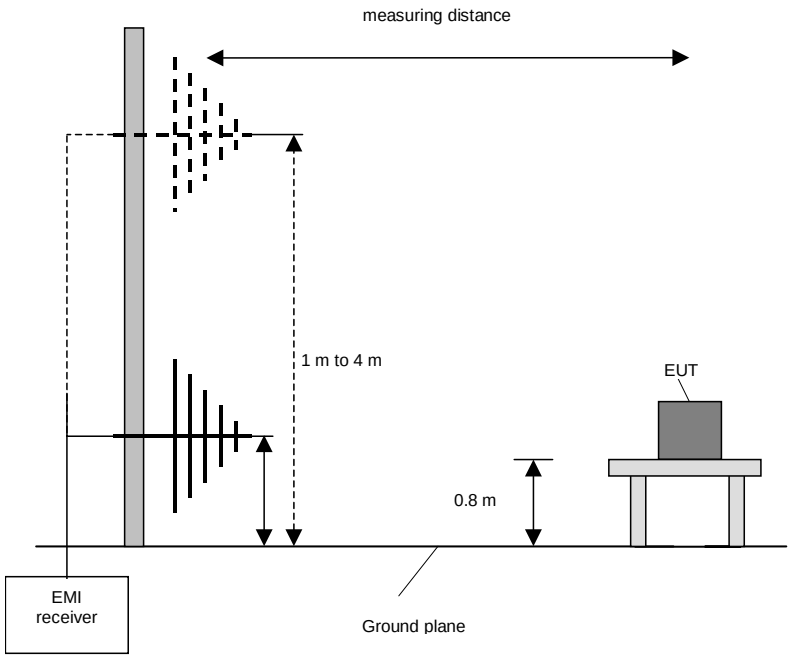
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the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

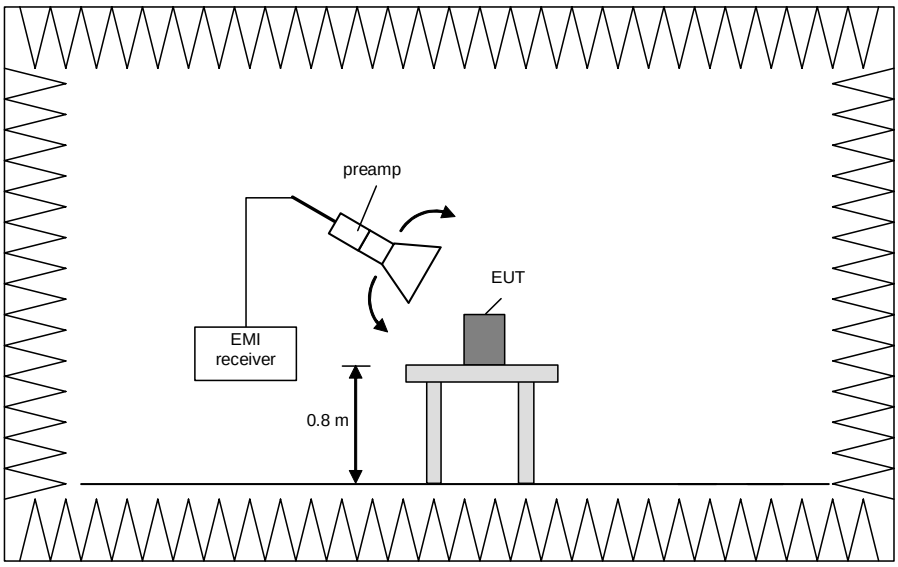
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance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

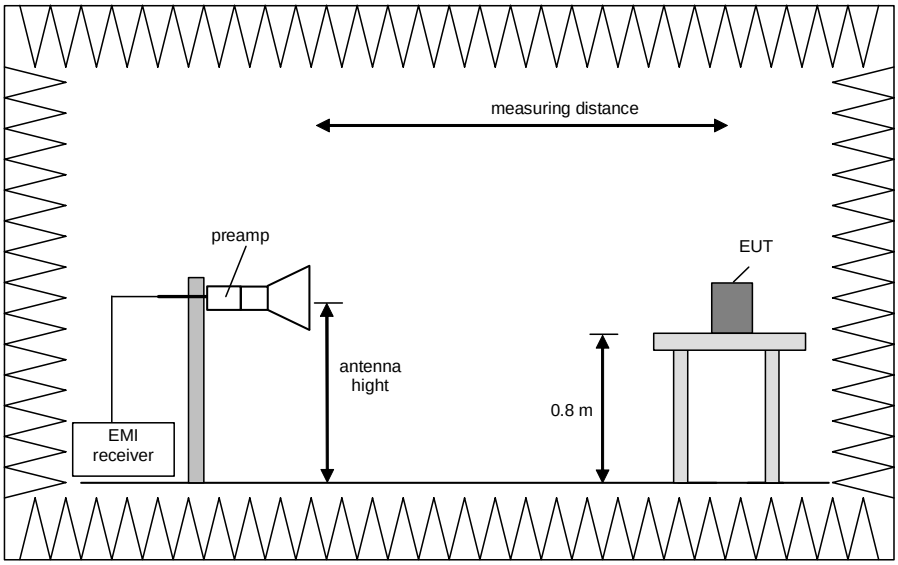


Final measurement (1 GHz to 110 GHz)

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 beam width.

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

5.5.2 Test results

5.5.2.1 Preliminary radiated emission measurement

Ambient temperature	21 °C	Relative humidity	28 %

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

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.

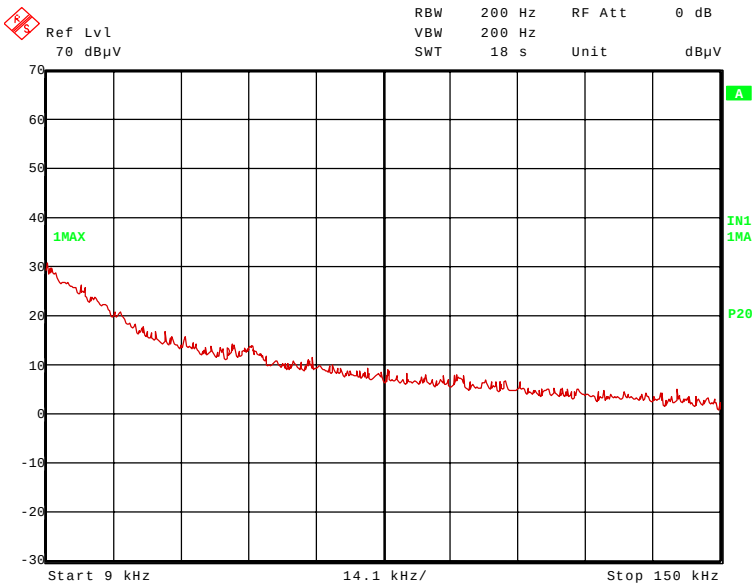
Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 6.0 V_{DC} by four type AA batteries.

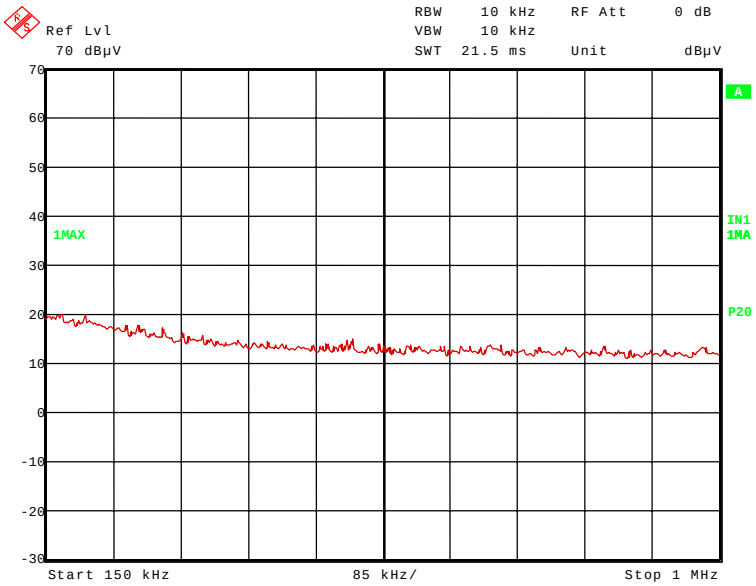
Remark: No emissions were emitted in the frequency range 9 kHz to 1 GHz independent of the transmitter operation mode. Therefore the emissions in this frequency range were documented only with the transmitter operates at 2440 MHz.

Transmitter operates at 2440 MHz

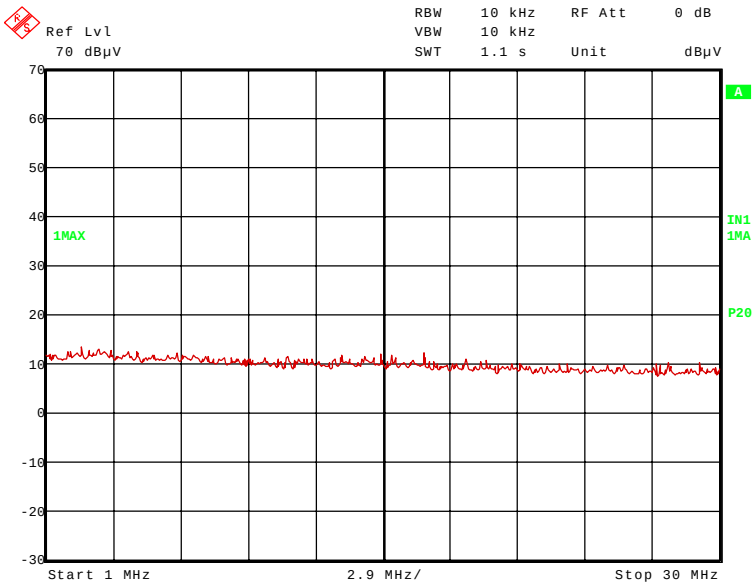
125162_27.wmf: Spurious emissions from 9 kHz to 150 kHz (operation mode 2):



125162_28.wmf: Spurious emissions from 150 kHz to 1 MHz (operation mode 2):

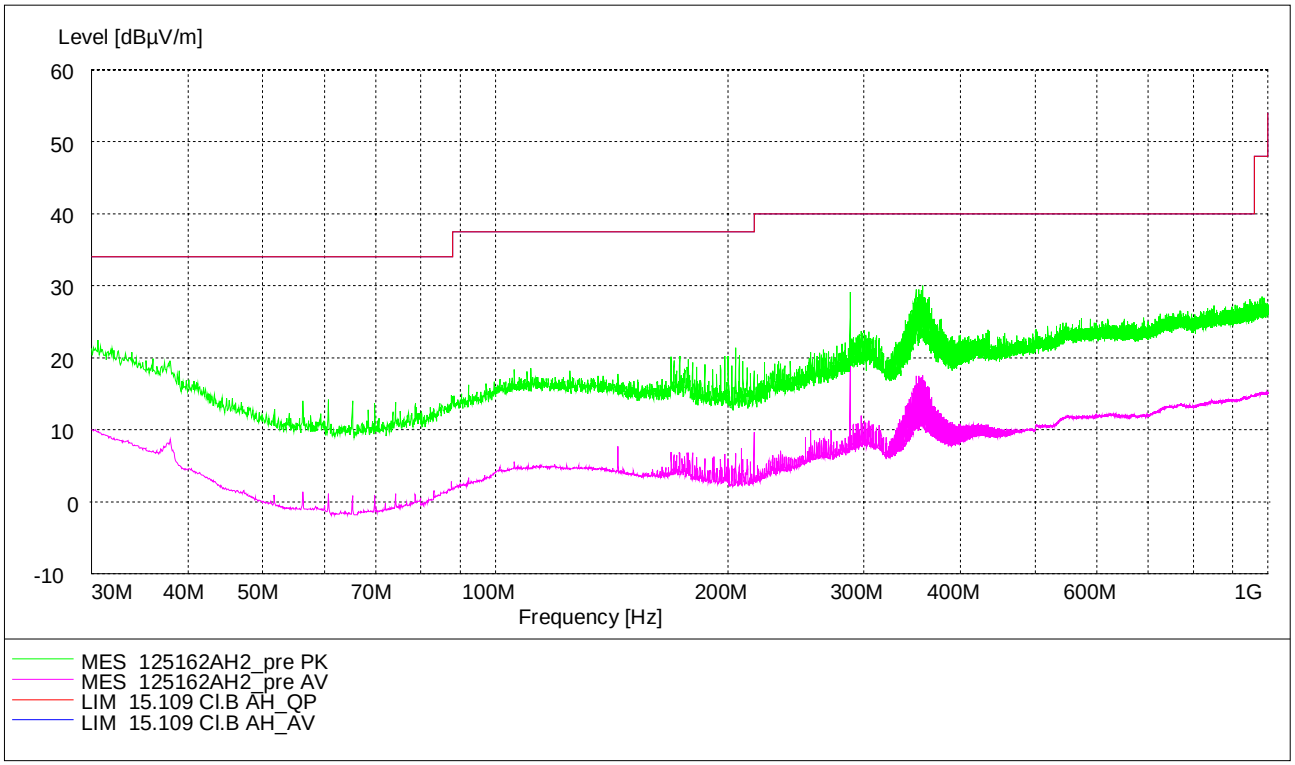


125162_29.wmf: Spurious emissions from 1 MHz to 30 MHz (operation mode 2):



No significant spurious emissions were found, so no final measurements were carried out on the outdoor test site.

Title:	Emission measurement according to FCC 15.247 EMI Test receiver ESI Rohde & Schwarz
EUT:	Keyboard
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:	Battery supplied with 6 V_{DC}
Comment:	4 type AA batterys



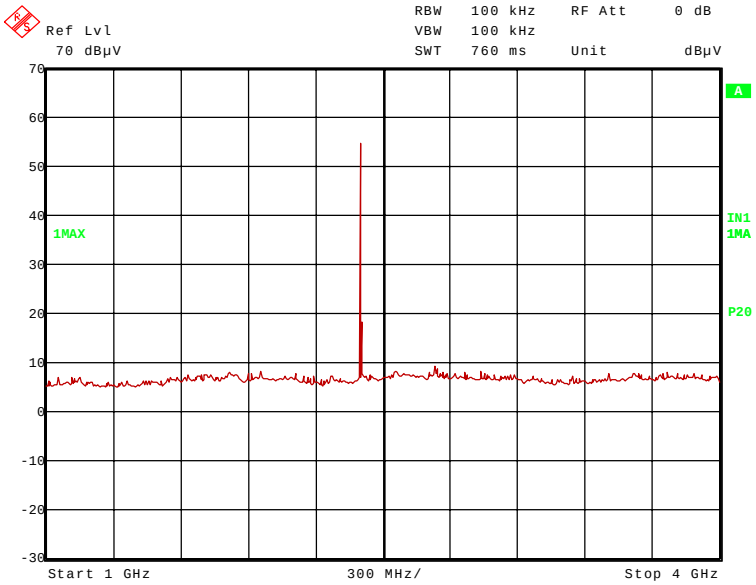
The following frequencies were found during the preliminary radiated emission test:

204.8 MHz, 288.0 MHz and 357.04 MHz

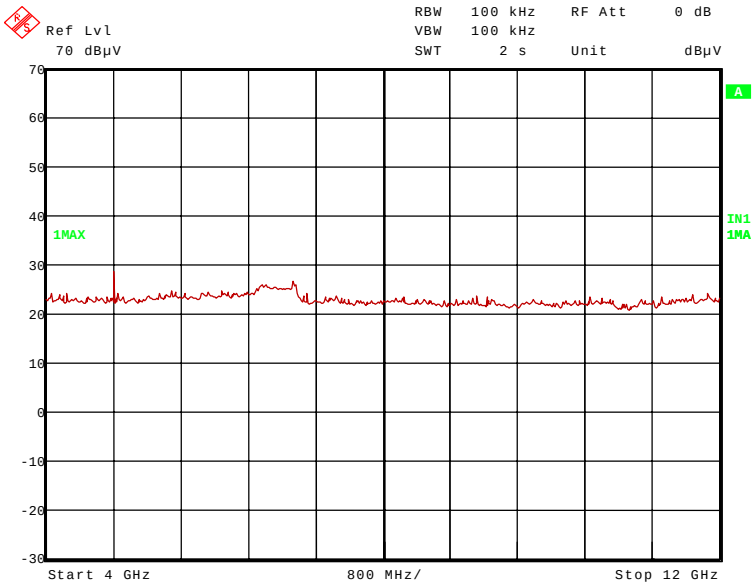
These frequencies had to be measured on the open area test site. The results are to find in the following.

Transmitter operates at 2402 MHz

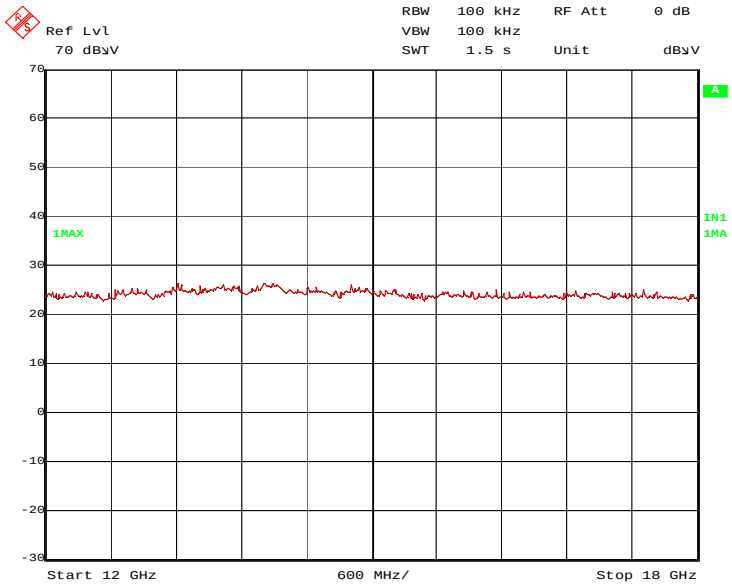
125162_1.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



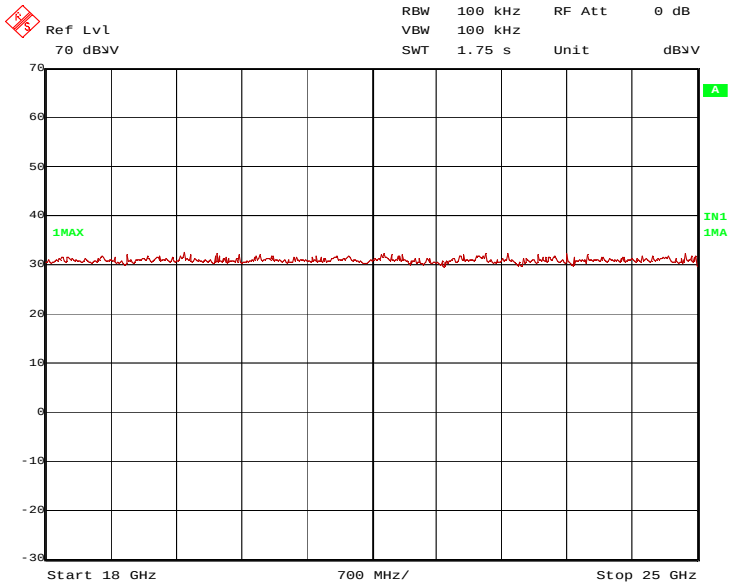
125162_4.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 1):



125162_24.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 1):



125162_19.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:

- 4.804 GHz.

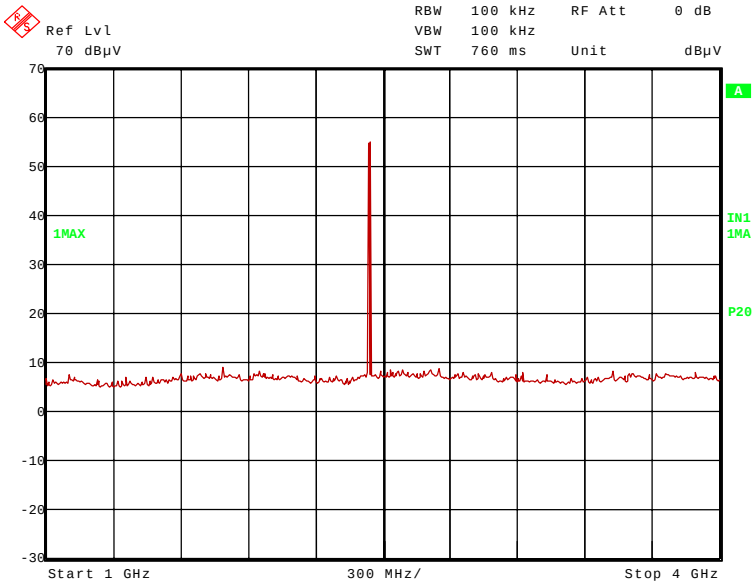
The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 2.402 GHz.

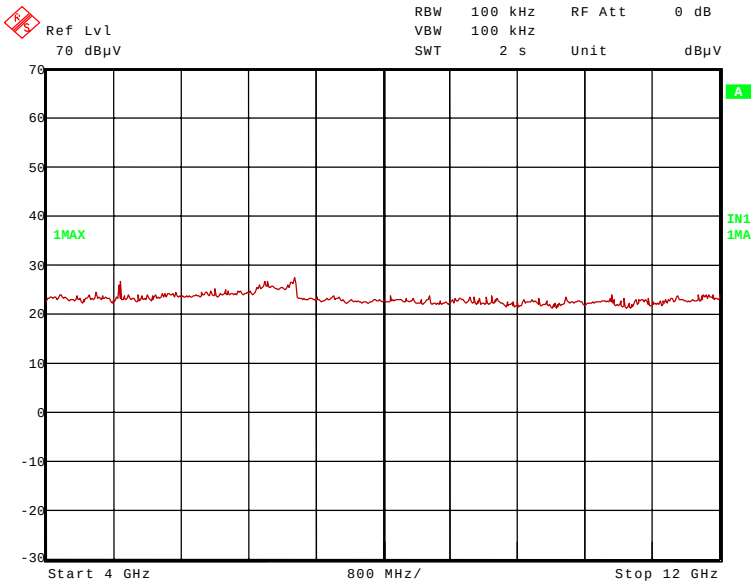
These frequencies have to be measured in a final measurement. The results were presented in the following.

Transmitter operates at 2440 MHz

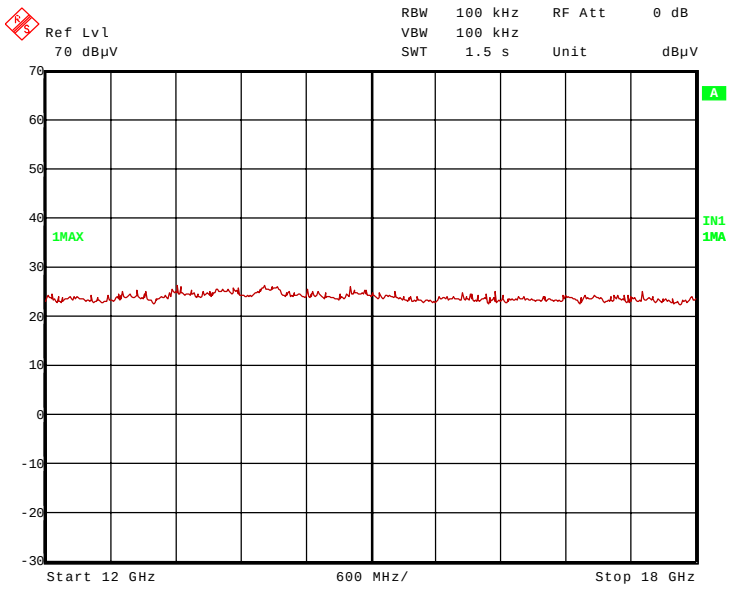
125162_2.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



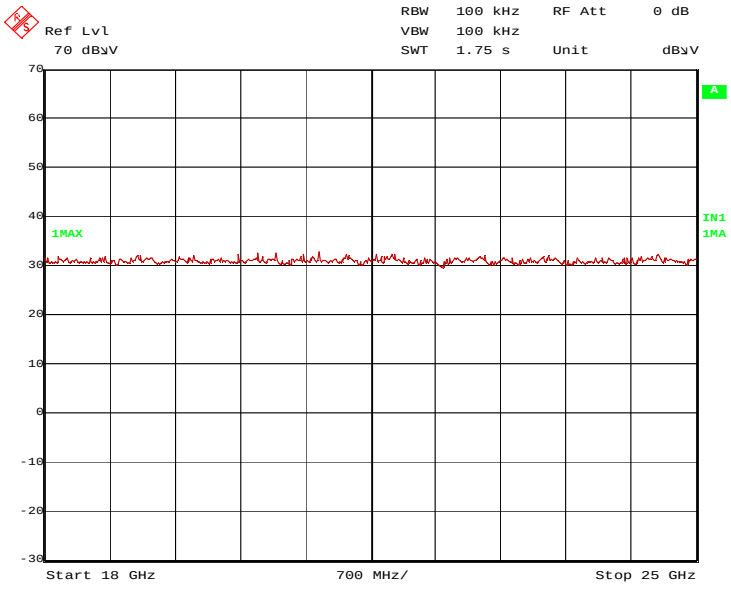
125162_5.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 2):



125162_23.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 2):



125162_20.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:

- 4.880 GHz.

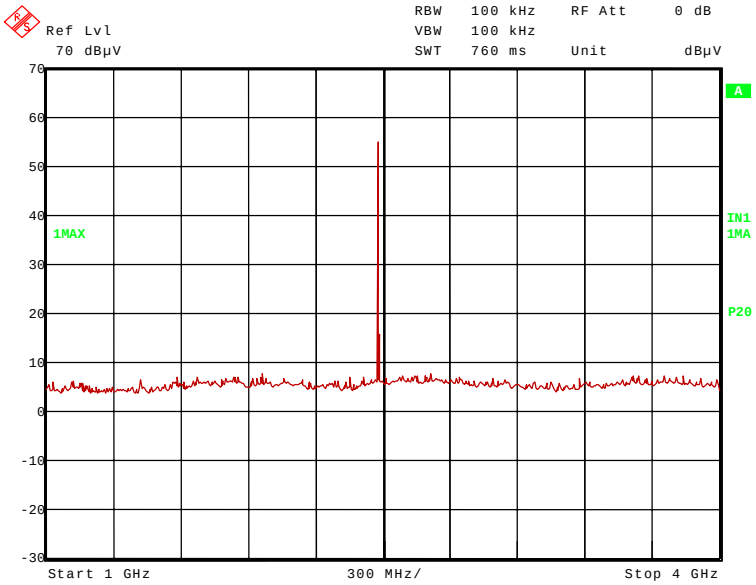
The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 2.440 GHz.

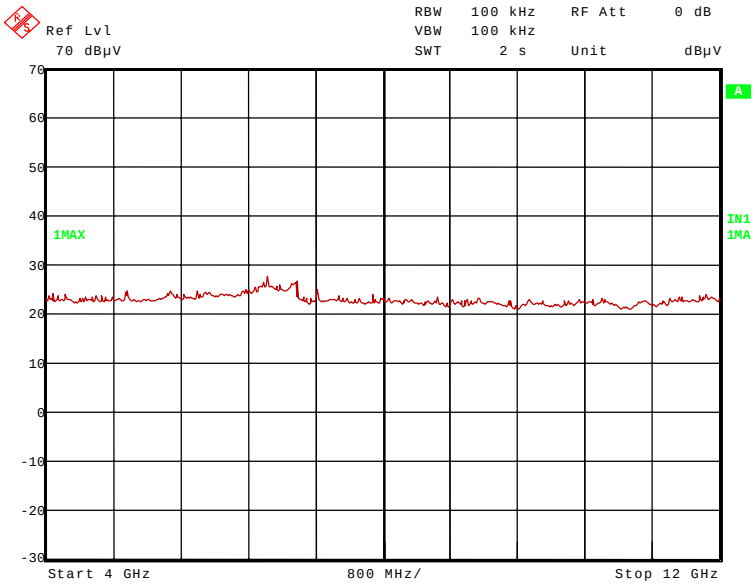
These frequencies have to be measured in a final measurement. The results were presented in the following.

Transmitter operates at 2480 MHz

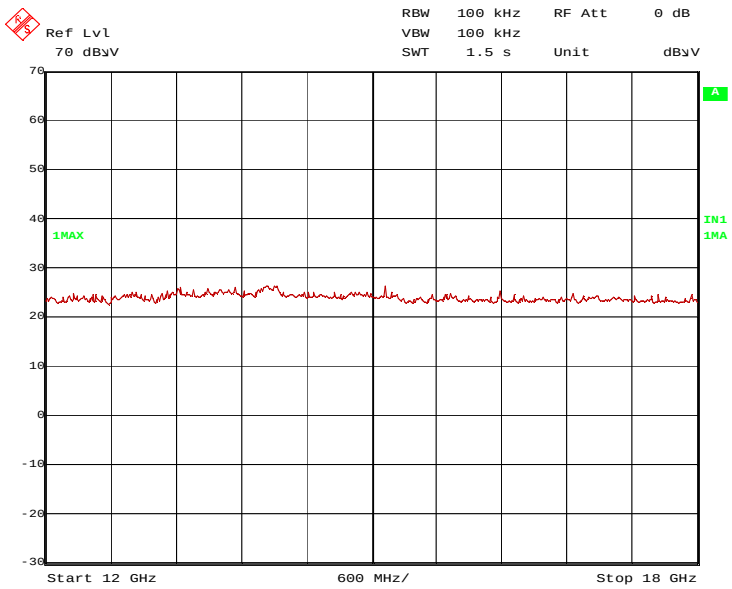
125162_3.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 3):



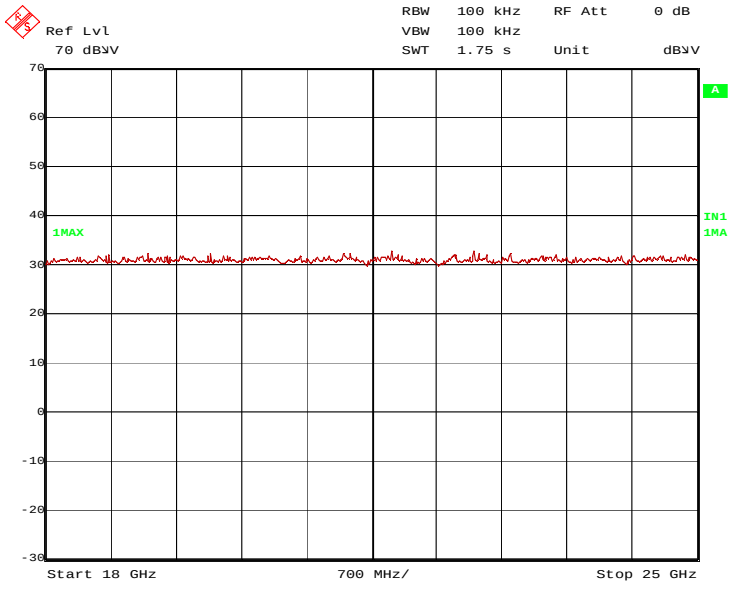
125162_6.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 3):



125162_22.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 3):



125162_21.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 3):



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

- 4.960 GHz.

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

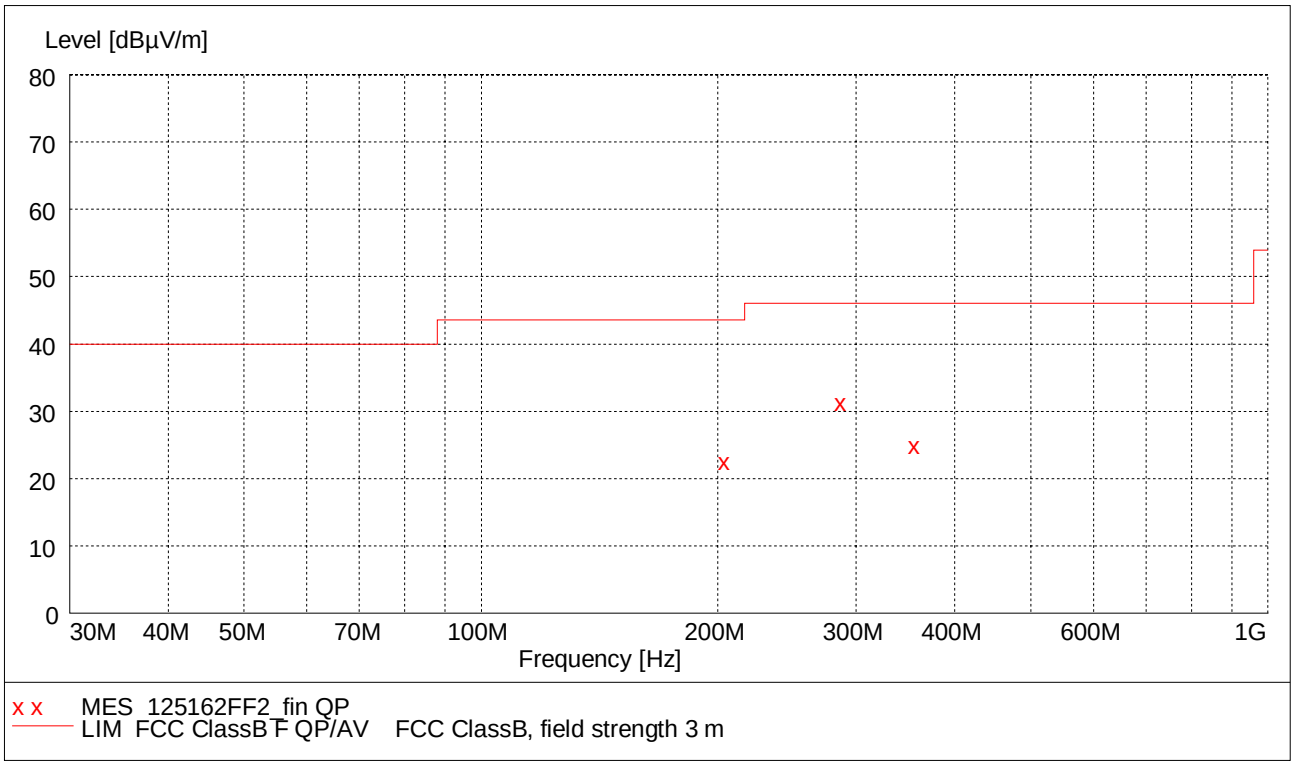
- 2.480 GHz.

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

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 37, 39, 43, 44, 46, 49 - 51, 55, 72

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

Title:	Final measurement on open area test site M6 receiver ESIB26 by Rohde & Schwarz
EUT:	Keyboard
Manufacturer:	IMST GmbH
Operating Condition:	Continuous modulated transmission
Test site:	PHOENIX TESTLAB GmbH; Open area test site M6
Operator:	M. Bastert
Test Specification:	Battery powered
Comment:	6 V_{DC} with 4 AA type batteries



Result measured with the quasi-peak detector:

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

Transmitter operates in the middle of the assigned frequency band (operation mode 2)									
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.
204.800	22.8	43.5	20.7	12.1	9.2	1.5	142.0	343.0	Hor.
288.000	31.6	46.0	14.4	16.8	12.9	1.9	104.0	167.0	Hor.
357.040	25.3	46.0	20.7	9.1	14.2	2.0	104.0	225.0	Hor.
Measurement uncertainty				+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
14 – 20

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

Ambient temperature	21 °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: 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 6.0 V_{DC} by four type AA batteries.

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 MHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
2402	88.7	-	-	56.7	28.3	0.0	3.7	150	Vert.	-
4804	45.1	74.0	28.9	32.9	32.6	25.7	5.3	150	Vert.	Yes
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
2402	85.8	-	-	53.8	28.3	0.0	3.7	150	Vert.	-
4804	31.1	54.0	22.9	18.9	32.6	25.7	5.3	150	Vert.	Yes
Measurement uncertainty										

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

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
2440	88.9	-	-	56.8	28.4	0.0	3.7	150	Vert.	-
4880	45.7	74.0	28.3	33.3	32.8	25.7	5.3	150	Vert.	Yes
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
2440	86.8	-	-	54.7	28.4	0.0	3.7	150	Vert.	-
4880	36.6	54.0	17.4	24.2	32.8	25.7	5.3	150	Vert.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

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

Result measured with the peak detector:

Frequency GHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
2480	89.2	-	-	56.9	28.5	0.0	3.8	150	Vert.	-
4960	44.8	74.0	29.2	32.2	32.9	25.6	5.3	150	Vert.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	Corr. value dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
2480	87.0	-	-	54.7	28.5	0.0	3.8	150	Vert.	-
4960	34.0	54.0	20.0	21.4	32.9	25.6	5.3	150	Hor.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Test: Passed

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

6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
14	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
15	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	02/15/2012	02/2014
16	Controller	HD100	Deisel	100/670	480139	-	-
17	Turntable	DS420HE	Deisel	420/620/80	480087	-	-
18	Antenna support	AS615P	Deisel	615/310	480086	-	-
19	Antenna	CBL6111 D	Chase	25761	480894	09/28/2011	09/2014
20	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	-
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. 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	02/16/2012	02/2014
72	4 GHz High Pass Filter	WHKX4.0/18G-8SS	Wainwright Instruments	1	480587	Weekly verification (system cal.)	
166	Power Meter	NRVD	Rohde & Schwarz	833697/030	480589	02/15/2012	02/2014
167	Peak Power Sensor	NRV-Z32	Rohde & Schwarz	849745/016	480551	02/15/2012	02/2014
168	Attenuator 10 dB	WA-8-10	Weinschel	7538	410112	Six month verification (system cal.)	

7 REPORT HISTORY

Report Number	Date	Comment
F125162E1	04 June 2013	Document created

8 LIST OF ANNEXES

ANNEX A TEST SETUP PHOTOS 4 pages

125162_1.JPG: Test setup fully anechoic chamber
125162_2.JPG: Test setup fully anechoic chamber
125162_3.JPG: Test setup fully anechoic chamber
125162_20.JPG: Test setup open area test site

ANNEX B EXTERNAL PHOTOS 3 pages

125162_7.JPG: EUT, 3D view 1
125162_8.JPG: EUT, 3D view 2
125162_11.JPG: Label

ANNEX C INTERNAL PHOTOS 2 pages

125162_9.JPG: PCB, top view
125162_10.JPG: PCB, bottom view