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Test Report

Report Number: F151497E9

Applicant:

Dräger Safety AG & Co. KGaA

Manufacturer:

Dräger Safety AG & Co. KGaA

Equipment under Test (EUT):

FPS COM 7000



Deutsche
Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03


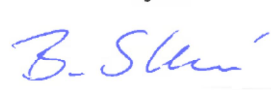
References

- [1] **ANSI C63.4: 2014** American National Standard for Methods of Measurement 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** Radio Frequency Devices
- [3] **RSS-Gen Issue 4 (November 2014)** General Requirements for Compliance of Radio Apparatus

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 <small>Name</small>	 <small>Signature</small>	12/17/2015 <small>Date</small>
Authorized reviewer:	Bernd STEINER <small>Name</small>	 <small>Signature</small>	12/17/2015 <small>Date</small>

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This test report is valid in hardcopy form as well as in electronic form.

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1 Identification

1.1 Applicant

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eMail Address:	Sebastian.Kleiner@draeger.com
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	Dräger Safety AG & Co. KGaA
Address:	Revalstr. 1 23560 Lübeck
Country:	Germany
Name for contact purposes:	Mr. Sebastian KLEINER
Phone:	+49 451 – 882 – 19 51
Fax:	+49 451 – 882 – 20 80
eMail Address:	Sebastian.Kleiner@draeger.com
Manufacturer 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 Gesellschaft Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under 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: *	Cordless audio device for respirator masks
Model name / HVIN: *	FPS COM 7000
FCC ID:*	X6O-FPSCOM7000
IC: *	5895F-FPSCOM7000
Serial number: *	ARHE-0002
PCB identifier: *	Right main: 8325042-04, Left Main: 8325132-03, Tactical Radio: 8325102-04, UI PTT: 8325172-03, UI ON OFF: 8325182-03, UI CH: 8325192-03, Main2ACC: 8325162-02
Hardware version: *	Right main: 8325041-05,8325043-02 Left Main: 8325131-04, 8325133-02, Tactical Radio: 8325103-03, 8325101-04, UI PTT: 8325171-04, UI ON OFF: 8325181-03, UI CH: 8325191-03, Main2ACC: 8325161-02
Software version / FVIN: *	R61407-00 (DSP 2.2), R61409-00 (μ C1.19), R61514-00 (TR1.10)
Lowest internal frequency	12 MHz

1.5 Technical data of equipment

Channel 1	RX:	903.500 MHz	TX:	-
Channel 41	RX:	915.150 MHz	TX:	-
Channel 81	RX:	926.800 MHz	TX:	-

Rated RF output power: *	None (EUT is a receiver only)					
Number of channels	81					
Channel spacing	291,25 kHz					
Antenna type: *	Internal only					
Antenna gain: *	0 dBi					
Antenna connector: *	None (internal antenna only)					
Adaptive frequency agility: *	No					
Modulation: *	4GFSK / FHSS					
Supply Voltage: *	$U_{nom} =$	3.0 V DC	$U_{min} =$	2.3 V DC	$U_{max} =$	3.3 V DC
Type of power supply: *	Two batteries AA size					
Temperature range: *	-35 °C to +60 °C (operating temperature range)					
Ancillary used for test:	-					

* declared by the applicant.

The following external I/O cables were used:

Identification	Connector		Length *
	EUT	Ancillary	
None	None	-	-
-	-	-	-

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	08/25/2015
Start of test:	08/28/2015
End of test:	09/09/2015

2 Operational states

The EUT is a cordless audio device used in combination with a respirator masks. All tests were carried out with an unmodified EUT.

The EUT is a composite device, which contains two radio units:

- The left hand unit is a transceiver unit and
- the right hand unit is a receiver unit.

Object of this test report is the receiver (right hand) unit of the EUT. The results of the measurements of the transceiver (right hand) unit are documented under the PHOENIX-Testlab GmbH test report reference F151497E8.

Because the EUT is body worn, in the frequency range 30 MHz to 1 GHz it was measured in three orthogonal directions as follows:

Pos. 1: Position as it is in normal standing position of the recipient.

Pos. 2: Position as it is if the recipient is lying with the face downwards.

Pos. 3: Position as it is if the recipient is lying with the face sideways.

For details of the different positions refer Annex A of this test report.

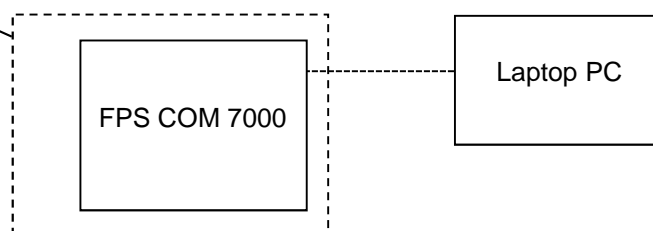
Above 1 GHz a positioner was used.

The operation mode could be chosen with the help of a laptop computer with a test-software, communicates with the EUT via a program interface, connected to the system connector of the EUT. This connection was not maintained during the tests, the program interface was removed and a system plug with a helix cable was inserted instead.

The following test modes were adjusted during the tests:

Test items	Operation	Operation mode
Radiated emissions (receiver)	Receive on channel 1, 41 or 81	1, 2, 3

Physical boundary of the EUT



3 Additional information

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

Because the antenna of the EUT is glued, some internal photographs were supplied by the applicant or made from PCBs supplied by the applicant in order to keep the tested sample operational.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-Gen, Issue 4 [3]	Status	Refer page
Radiated emissions (receiver)	30.0 – 5,000	15.109 (a)	7.1.2 [4]	Passed	
Conducted emissions on supply line	0.15 - 30	15.107 (a)	8.8 [4]	Not applicable *	

*: Not applicable, because the EUT is intended to be used with batteries and has no charging possibilities.

5 Test results

5.1 Radiated emissions

5.1.1 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 40 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 40 GHz.

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

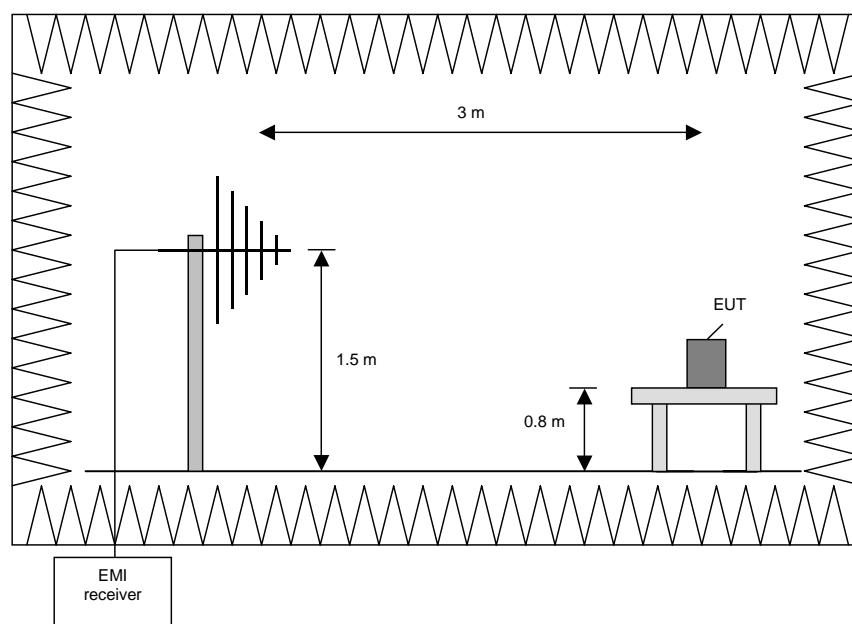
Preliminary measurement (30 MHz to 1 GHz)

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 [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:

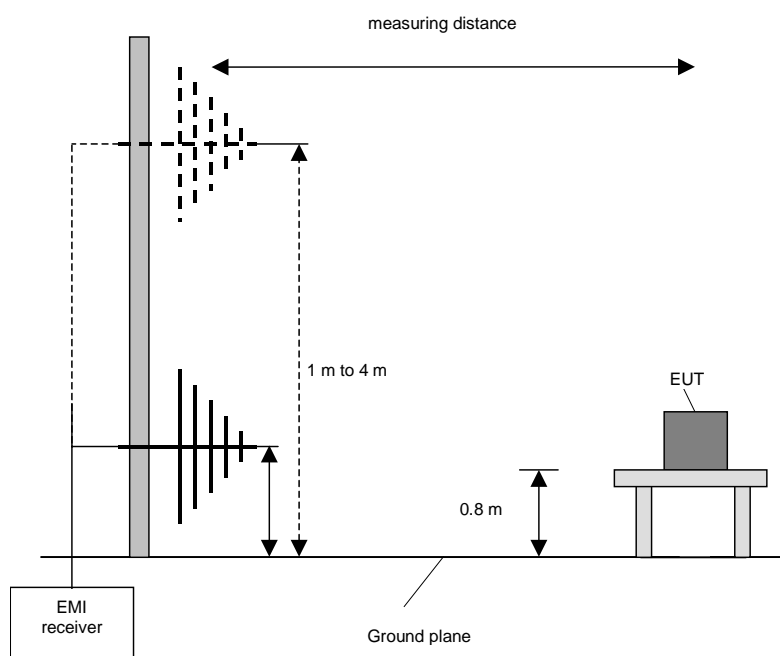
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the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

Preliminary and final measurement (1 GHz to 40 GHz)

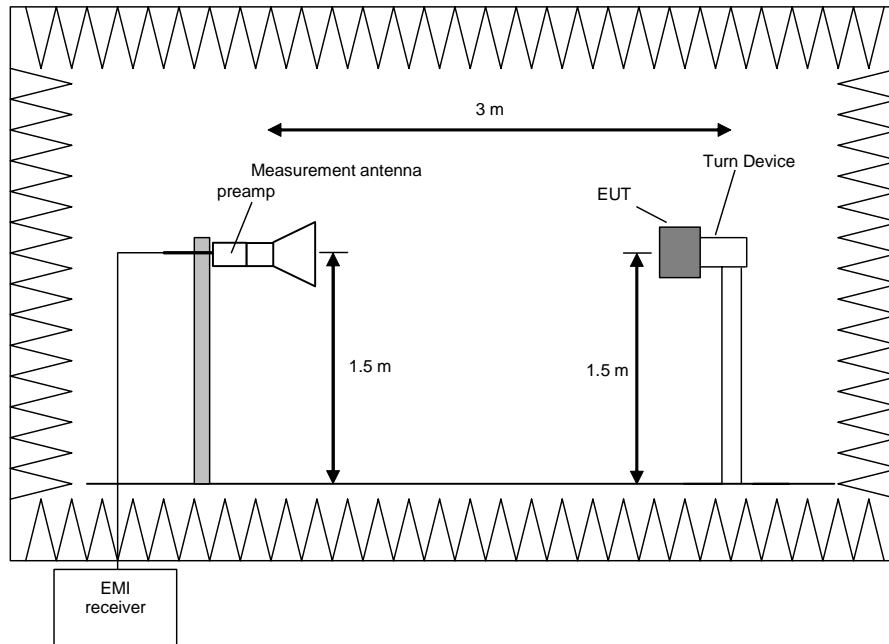
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5 m. The set-up of the Equipment under test will be in accordance to [1].

Preliminary measurement (1 GHz to 40 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 and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30 ° steps according 6.6.5.4 in [1].

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

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	100 kHz
4 GHz to 12 GHz	100 kHz
12 GHz to 18 GHz	100 kHz
18 GHz to 25 / 26.5 GHz	100 kHz
26.5 GHz to 40 GHz	100 kHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 1 to 40 GHz.

The following procedure will be used:

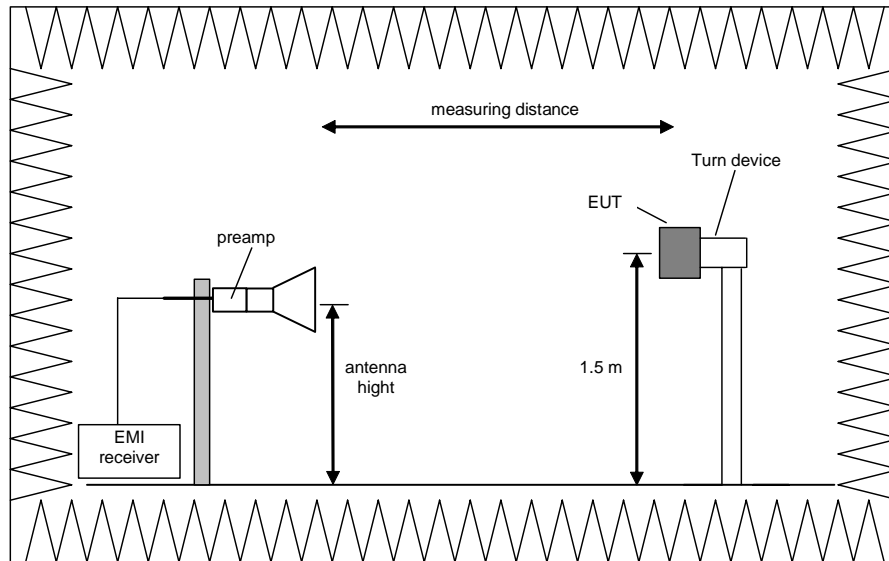
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°) according to 6.6.5.4 in [1].
6. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
7. The measurement antenna polarisation, with the according EUT position (Turntable and Turn device) which produces the highest emission for each frequency will be used for the final measurement. The six closest values to the applicable limit will be used for the final measurement.

Final measurement (1 GHz to 40 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 by rotating the turntable through 0 to 360° in the worst-case EUT orientation which was obtained during the preliminary measurements.

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

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency ranges 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 25 /26.5 GHz and 26.5 GHz to 40 GHz.

The following procedure will be used:

- 1) Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
- 2) Set the measurement antenna polarisation to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
- 3) Set the spectrum analyser to EMI mode with peak and average detector activated.
- 4) Rotate the turntable from 0° to 360° to find the EUT angle that produces the highest emissions.
- 5) Note the highest displayed peak and average values
- 6) Repeat the steps 1) to 5) for each frequency detected during the preliminary measurements.

5.1.2 Test results (radiated emissions)

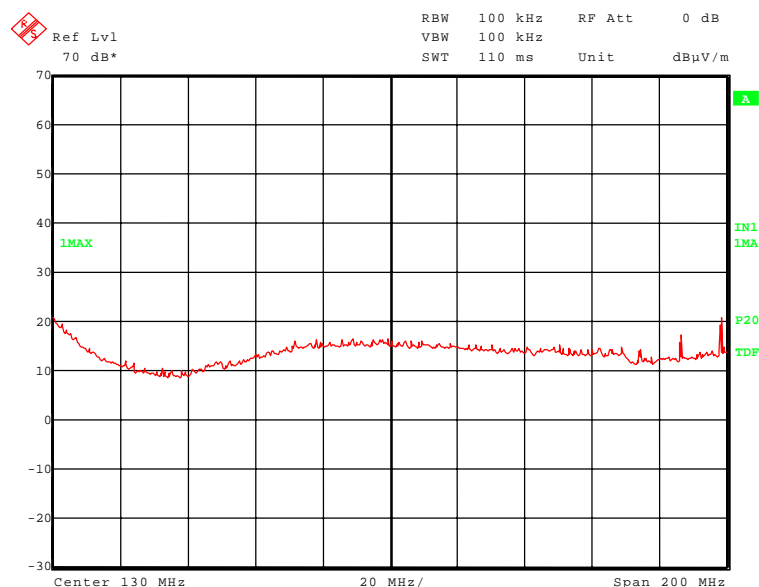
5.1.2.1 Preliminary radiated emission measurement (30 MHz to 5 GHz)

Ambient temperature	21 °C	Relative humidity	58 %
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Position of EUT:	The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.
Cable guide:	For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.
Test record:	All results are shown in the following.
Supply voltage:	During all measurements the EUT was supplied by new internal batteries.
Frequency range:	The preliminary measurement was carried out in the frequency range 30 MHz to 5 GHz according to [2].
Remark:	Because the EUT is body worn, the measurements were made in three orthogonal directions. The plots below are showing the maximum results of all three directions.

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

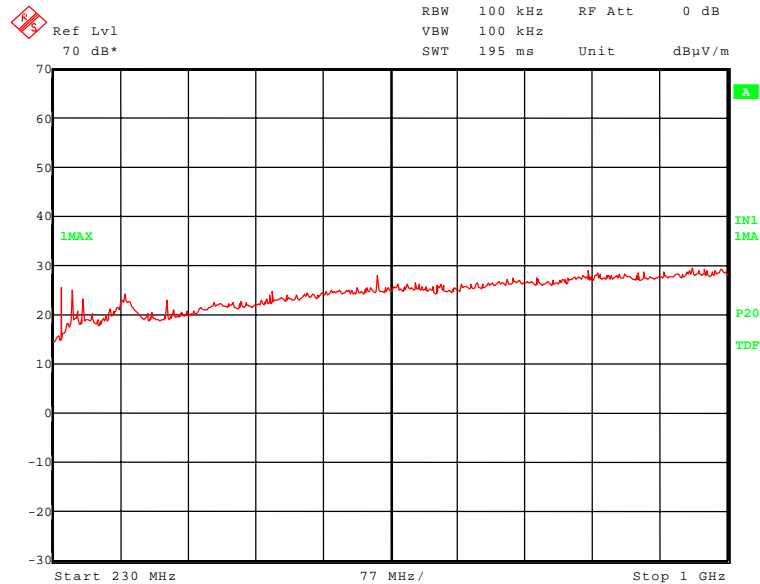
151497_213.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 1):



Test equipment used (see chapter 6):

19, 31 – 37, 43 – 45, 49

151497_214.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 1):

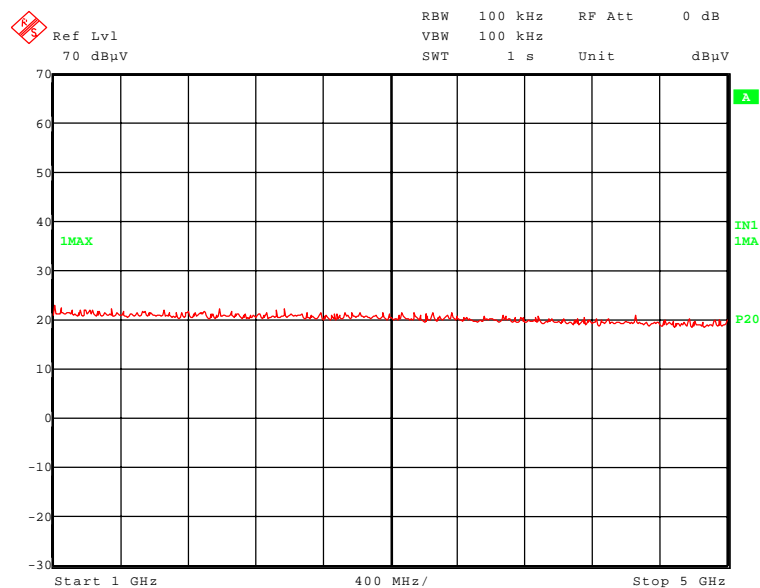


The following frequencies were found during the preliminary radiated emission test:

- 216.000 MHz, 228.000 MHz, 240.000 MHz, 252.000 MHz, 264.000 MHz, 360.000 MHz and 600.000 MHz.

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

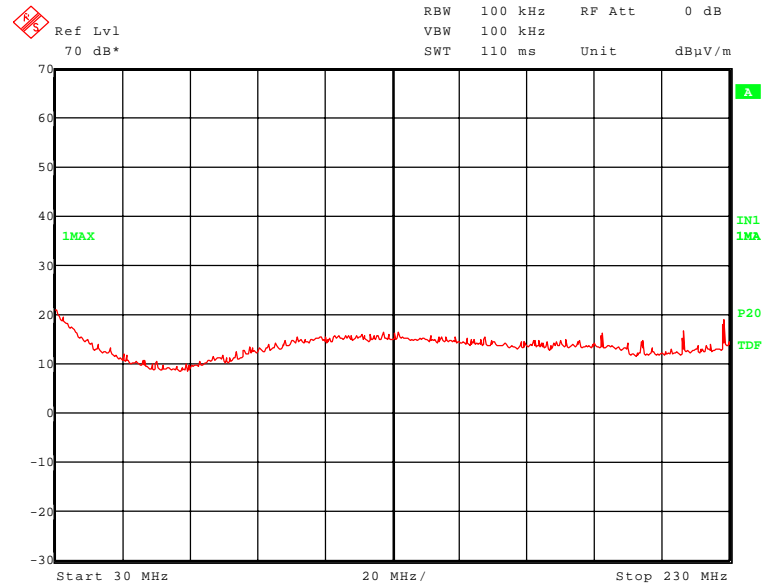
151497_221.wmf: Spurious emissions from 1 GHz to 5 GHz (operation mode 1):



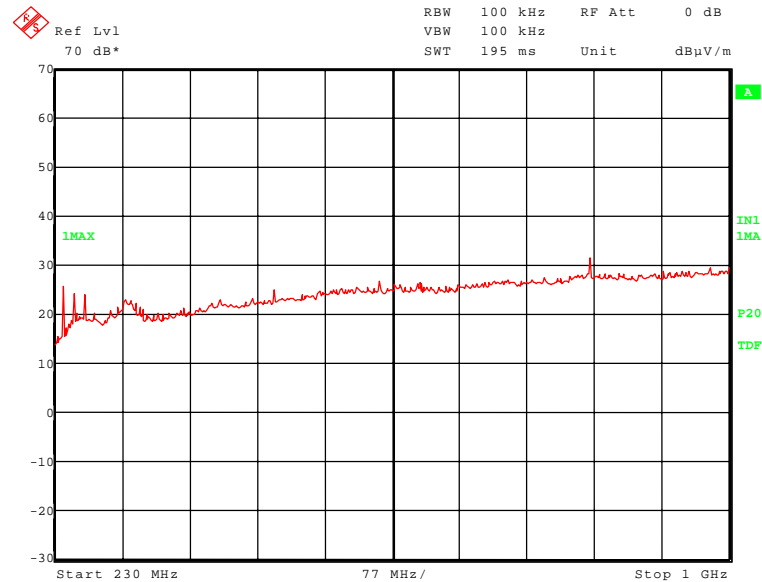
No emissions above the noise floor of the measuring system were found during the preliminary radiated emission test. So no final measurement was carried out in this frequency range.

Receiver operates on the middle of the assigned frequency band (operation mode 2)

151497_216.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 2):



151497_215.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 2):

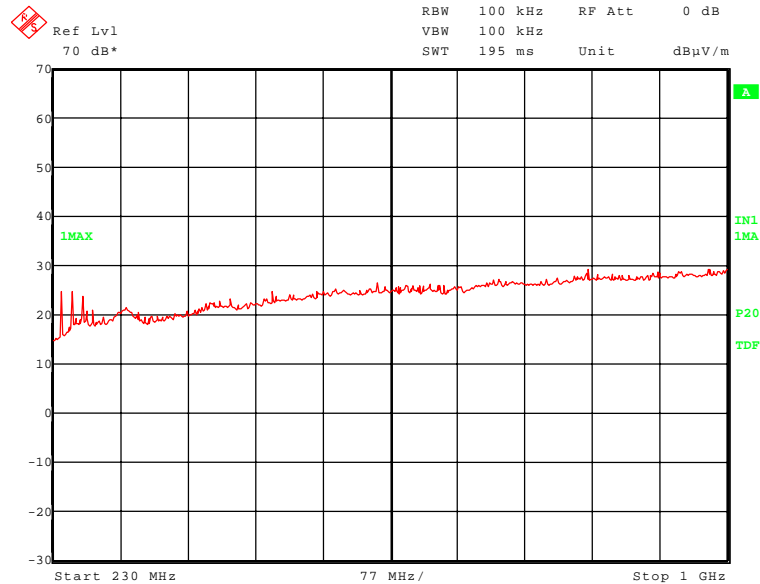


The following frequencies were found during the preliminary radiated emission test:

- 192.000 MHz, 216.000 MHz, 228.000 MHz, 240.000 MHz, 252.000 MHz, 264.000 MHz, 480.000 MHz, 600.000 MHz and 840.000 MHz.

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

151497_218.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 3):

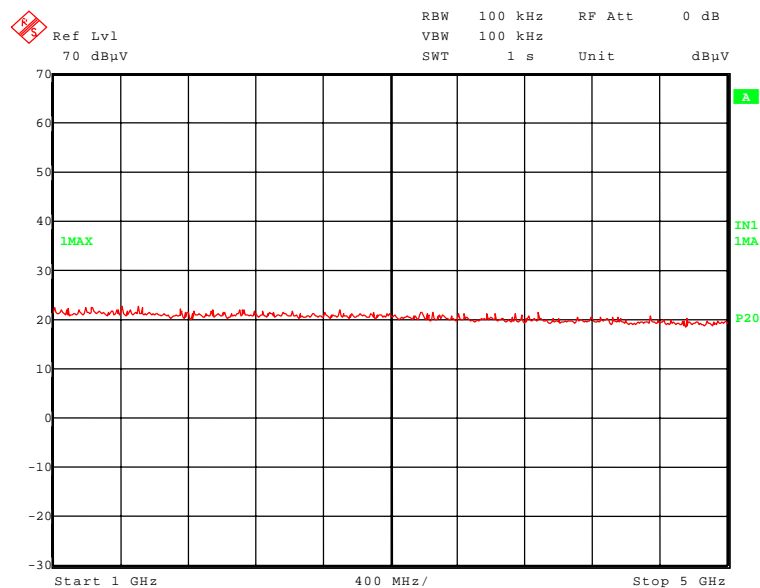


The following frequencies were found bands during the preliminary radiated emission test:

- 216.000 MHz, 228.000 MHz, 240.000 MHz, 252.000 MHz, 264.000 MHz 480.000 MHz, 600.000 MHz and 840.000 MHz.

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

151497_219.wmf: Spurious emissions from 1 GHz to 5 GHz (operation mode 3):



No emissions above the noise floor of the measuring system were found during the preliminary radiated emission test. So no final measurement was carried out in this frequency range.

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

Ambient temperature	21 °C	Relative humidity	52 %
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Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

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

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied by new internal batteries.

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

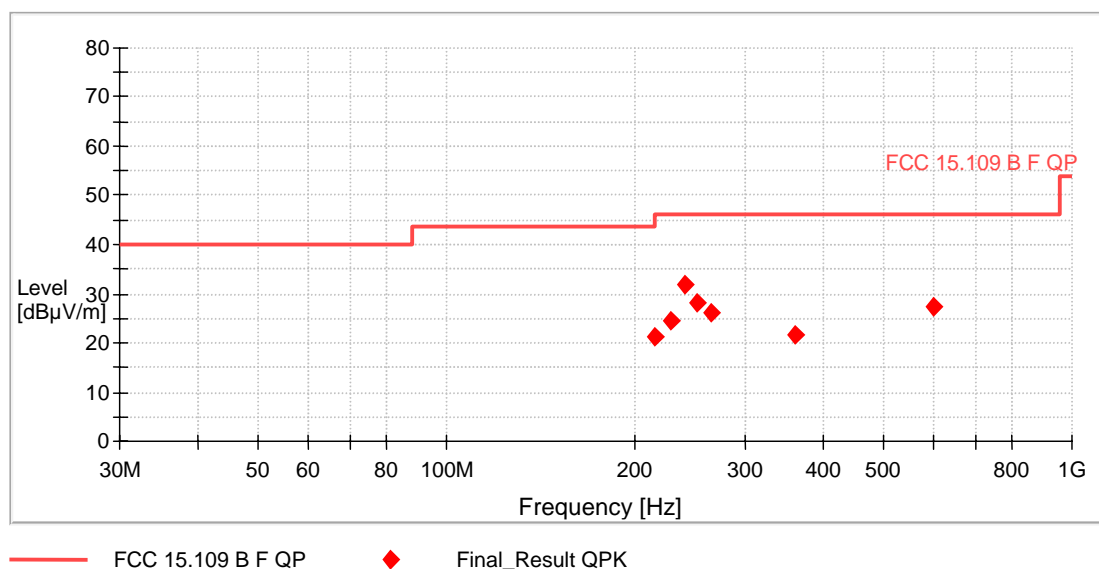
$$\text{Result [dB}\mu\text{V/m]} = \text{reading [dB}\mu\text{V]} + \text{cable loss [dB]} + \text{antenna factor [dB/m]} + 6 \text{ dB}$$

The measured points and the limit line in the following diagrams 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.

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.

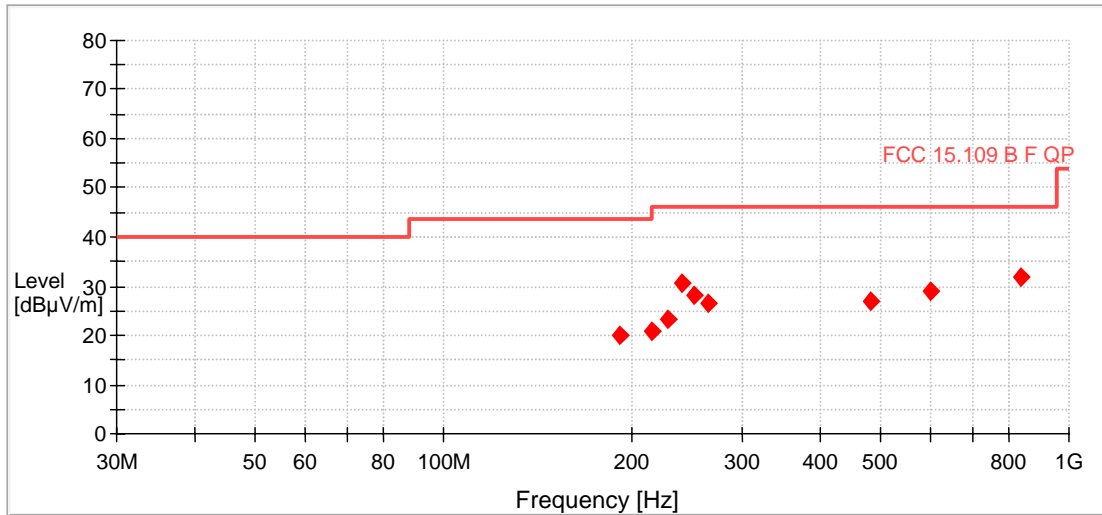
The measurement time with the quasi-peak measuring detector is 1 second.

Receiver operates on the lower end of the assigned frequency (operation mode 1, Pos. 1)



Data record name: 151497R1ff1

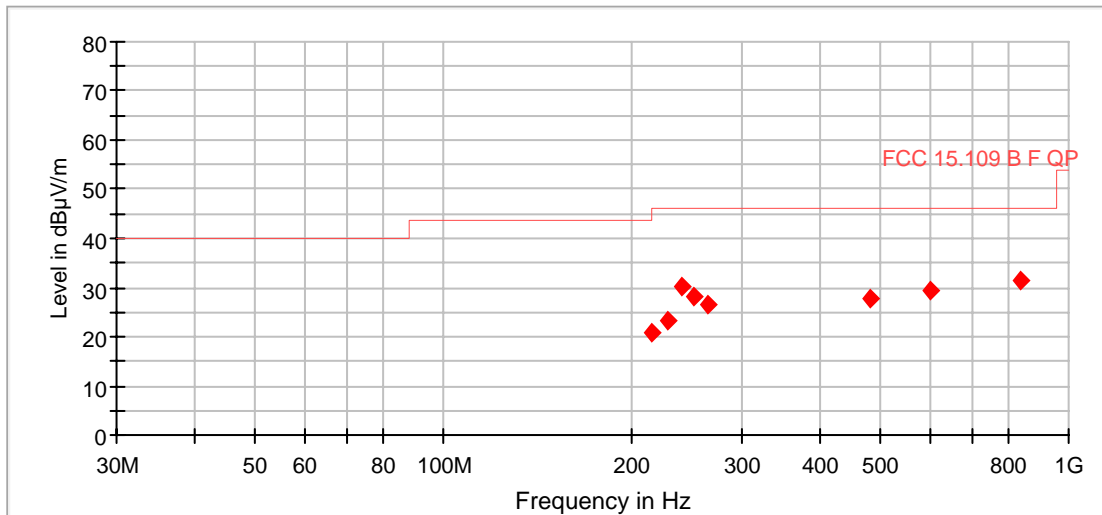
Receiver operates on the middle of the assigned frequency (operation mode 2, Pos. 2)



— FCC 15.109 B F QP ◆ Final_Result QPK

Data record name: 151497R2ff41

Receiver operates on the upper end of the assigned frequency (operation mode 3, Pos. 2)



— FCC 15.109 B F QP ◆ Final_Result QPK

Data record name: 151497R2ff81

Result measured with the quasi-peak detector:
(These values were marked in the diagrams by an x)

Receiver operates on the lower end of the assigned frequency band (operation mode 1)										
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.
216.000	21.4	43.5	24.6	4.3	9.5	1.6	141.0	23.0	Hor.	1
228.000	24.6	46.0	21.4	6.8	10.2	1.6	128.0	17.0	Hor.	1
240.000	31.7	46.0	14.3	12.8	11.2	1.7	133.0	29.0	Hor.	1
252.000	24.6	46.0	21.4	4.5	12.3	1.8	188.0	119.0	Vert.	3
264.000	26.8	46.0	19.2	6.7	12.3	1.8	106.0	1.0	Hor.	2
360.000	21.7	46.0	24.3	-0.7	14.3	2.1	100.0	271.0	Hor.	1
360.000	22.0	46.0	24.0	-0.4	14.3	2.1	124.0	136.0	Vert.	2
600.000	29.5	46.0	16.5	1.5	19.2	2.8	102.0	145.0	Vert.	2
Receiver operates on the middle of the assigned frequency band (operation mode 2)										
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.
192.000	20.07	43.5	23.4	3.5	9.0	1.5	154.0	1.0	Vert.	2
216.000	20.83	43.5	22.7	3.7	9.5	1.6	138.0	177.0	Hor.	2
228.000	23.14	46.0	22.9	5.3	10.2	1.6	115.0	16.0	Hor.	2
240.000	30.42	46.0	15.6	11.5	11.2	1.7	117.0	18.0	Hor.	2
252.000	28.19	46.0	17.8	8.1	12.3	1.8	104.0	19.0	Hor.	2
264.000	26.4	46.0	19.6	6.3	12.3	1.8	100.0	15.0	Hor.	2
480.000	26.94	46.0	19.1	1.5	17.0	2.4	102.0	316.0	Vert.	2
600.000	28.94	46.0	17.1	1.0	19.2	2.8	150.0	100.0	Vert.	2
840.000	31.91	46	14.1	0.0	22.7	3.2	105.0	91.0	Vert.	2
Receiver operates on the upper end of the assigned frequency band (operation mode 3)										
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.
216.000	21.25	43.5	22.3	14.2	9.5	1.6	132.0	31.0	Hor.	1
228.000	24.07	46.0	21.9	6.2	10.2	1.6	123.0	30.0	Hor.	1
240.000	31.43	46.0	14.6	12.5	11.2	1.7	126.0	28.0	Hor.	1
252.000	28.25	46.0	17.8	8.2	12.3	1.8	117.0	181.0	Hor.	2
264.000	26.45	46.0	19.6	6.3	12.3	1.8	102.0	1.0	Hor.	2
480.000	27.69	46.0	18.3	2.2	17.0	2.4	104.0	235.0	Vert.	2
600.000	29.4	46.0	16.6	1.4	19.2	2.8	102.0	136.0	Vert.	2
840.000	32.57	46.0	13.4	0.6	22.7	3.2	108.0	347.0	Hor.	3

Test: Passed

Test equipment used (see chapter 6):

14 – 21

5.1.2.3 Final radiated emission measurement (1 GHz to 5 GHz)

No emissions above the noise floor of the measuring system (25 dB μ V/m (measured with 3 m measuring distance and peak detector)) were found during the preliminary radiated emission test. So no final measurement was carried out in this frequency range.

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	03/06/2015	03/2017
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	09/18/2014	09/2017
20	EMI Software	EMC 32	Rohde & Schwarz	100061	481022	-	-
21	6 dB attenuator	R412706000	Radiall	9833	410082	Weekly verification (system cal.)	
29	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	03/02/2015	03/2016
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	04/14/2014	04/2017
36	Antenna	HL50	Rohde & Schwarz	100438	481170	08/27/2014	08/2017
37	Positioner	TDF1.5-10kg	Maturo	-	482034	-	-
43	RF-cable No. 36	Sucoflex 106B	Suhner	0587/6B	480865	Weekly verification (system cal.)	
44	RF-cable No. 3	Sucoflex 106B	Suhner	0563/6B	480670	Weekly verification (system cal.)	
45	RF-cable No. 40	Sucoflex 106B	Suhner	0708/6B	481330	Weekly verification (system cal.)	
49	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	Six month verification (system cal.)	

