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Test Report

Report Number:

F161065E8

Equipment under Test (EUT):

FPS COM 7000 with BT 7000

Applicant:

Dräger Safety AG & Co. KGaA

Manufacturer:

Dräger Safety AG & Co. KGaA



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

References

- [1] **ANSI C63.10-2013** 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** Radio Frequency Devices
- [3] **RSS-210 Issue 8 (December 2010)** Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
- [4] **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 (chapter 4 of this test report) were fulfilled by the equipment under test.

The complete test results are presented in the following.

Test engineer:	<u>Manuel BASTERT</u> <small>Name</small>	 <small>Signature</small>	<u>08/24/2016</u> <small>Date</small>
Authorized reviewer:	<u>Bernd STEINER</u> <small>Name</small>	 <small>Signature</small>	<u>08/24/2016</u> <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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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. Lutz RÜFFERT
Phone:	+49 451 – 882 – 16 23
Fax:	+49 451 – 882 – 71 623
eMail Address:	lutz.rueffert@draeger.com
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 Reg. No. D-PL-17186-01-02, FCC Test Firm Accreditation with the registration number 469623, designation number DE0004 and Industry Canada Test site registration SITE# IC3469A-1.

1.4 EUT (Equipment Under Test)

Type object: *	FPS COM 7000 with BT 7000
Model name / HVIN: *	FPS COM 7000
Serial No.:	None
FCC ID: *	X6O-BT7000 and QOQWT12
IC: *	5895F-BT7000 and 5123A-BGTWT12

1.5 Technical data of equipment

Bluetooth part (BT7000)

Power supply EUT:	Battery of FPS COM 7000					
Supply voltage:	U _{nom} =	3.75 V DC	U _{min} =	- V DC	U _{max} =	- V DC
Antenna type: *	Internal antenna - AT3216					
Antenna gain: *	0.5 dBi					
Antenna connector: *	-					
Type of modulation: *	GFSK (1 Mbps), p/4 DQPSK (2 Mbps), 8DPSK (3 Mbps)					
Operating frequency range:*	2400 – 2483.5 MHz					
Number of channels: *	79					
Temperature range EUT: *	-35 °C to +60 °C					
Lowest / highest internal clock frequency: *	1200 Hz / 2 MHz					

915 MHz transceiver part

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

Rated RF output power: *	10 dBm (e.r.p.)					
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:

None.

1.6 Dates

Date of receipt of test sample:	06/23/2016
Start of test:	07/07/2016
End of test:	07/07/2016

2 Operational states and test setup

Object of this test report is to find out if unwanted emissions caused by using two radio transmission technologies at the same time in the same device. Therefore both transmitters (Bluetooth and proprietary 915 MHz communication) were set to transmit at a fixed frequency to become a reproducible result. 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. The connection was maintained during the tests.

The following operation mode was used during the tests:

Operation mode	Description of the operation mode	Modulation
1	Transmission at Ch. 41 (915.15 MHz)	4GFSK
	Transmission at Bluetooth Ch. 41 (2441 MHz)	8DPSK

3 Additional information

In this test report only the simultaneous transmission measurement is described. The Bluetooth part and the 915 MHz part of the system are already tested.

The EUT was not labelled with an IC or FCC ID during the tests.

This report does not include an Annex with internal photos of the EUT. Please refer to test report F151497E8 for the FPS COM 7000 and to test report F161065E2 for the BT 7000 to get more detailed information.

Ancillary equipment used to perform the measurements:

- Laptop (Fujitsu Lifebook S7110) with installed terminal software to enable the test mode.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS 210, Issue 8 [3] or RSS-Gen, Issue 4 [4]	Status	Refer page
Radiated emissions (transmitter)	30 - 25,000	15.205 15.209	A8.5 [3] 2.5 [3]	Passed	8 et seq.

5 Results

5.1 Radiated emissions

5.1.1 General method of measurement (radiated emissions)

The radiated emission measurement is subdivided into six stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 9 kHz to 1 GHz.
- A final measurement carried out on an outdoor test site without reflecting ground plane and a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- 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 heights in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 5 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 5 GHz.

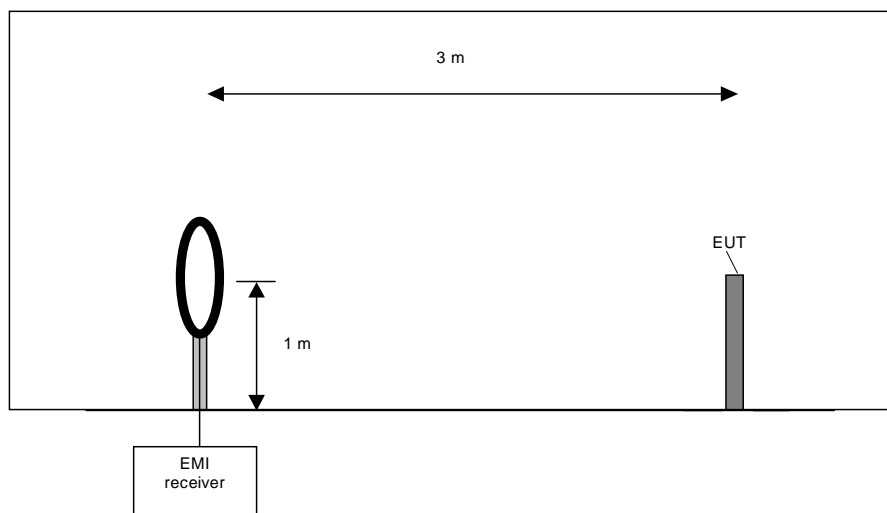
Preliminary measurement (9 kHz to 30 MHz):

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. 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. Floor-standing devices will be placed directly on the turntable/ground plane. The setup of the Equipment under test will be in accordance to [1].

The frequency range 9 kHz to 30 MHz will be monitored with a spectrum analyser while the system and its cables will be manipulated to find out the configuration with the maximum emission levels if applicable. The EMI Receiver will be set to MAX Hold mode. The EUT and the measuring antenna will be rotated around their vertical axis to found the maximum emissions.

The resolution bandwidth of the spectrum analyser will be set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	10 kHz



Preliminary measurement procedure:

Prescans were performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

The following procedure will be used:

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

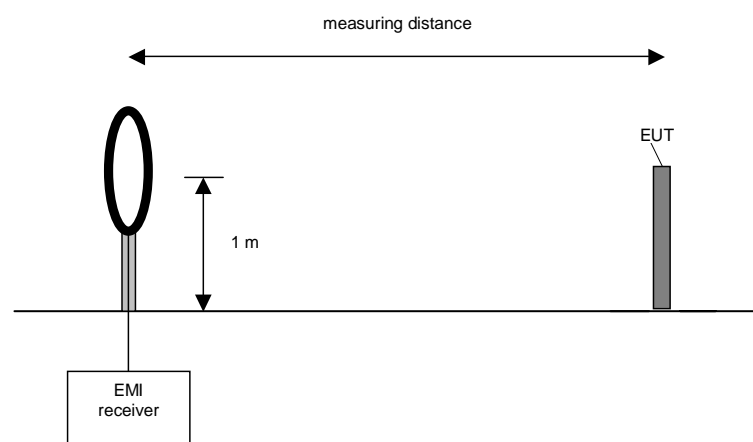
Final measurement (9 kHz to 30 MHz):

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in a measuring distance of 3 m, 10 m and 30 m. In the case where larger measuring distances required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with a EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an average detector will be used according Section 15.209 (d) [2].

On the frequencies, which were detected during the preliminary measurements, the final measurement will be performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum value is found.

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

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



Final measurement procedure:

The following procedure will be used:

- 1) Monitor the frequency range with the measuring antenna at vertical orientation parallel to the EUT at an azimuth of 0 °.
- 2) Rotate the EUT by 360 ° to maximize the detected signals and note the azimuth and orientation.
- 3) Rotate the measuring antenna to find the maximum and note the value.
- 4) Rotate the measuring antenna and repeat steps 1) to 3) until the maximum value is found.
- 5) Repeat steps 1) to 4) with the other orthogonal axes of the EUT (if the EUT is a module and might be used in a handheld equipment application).

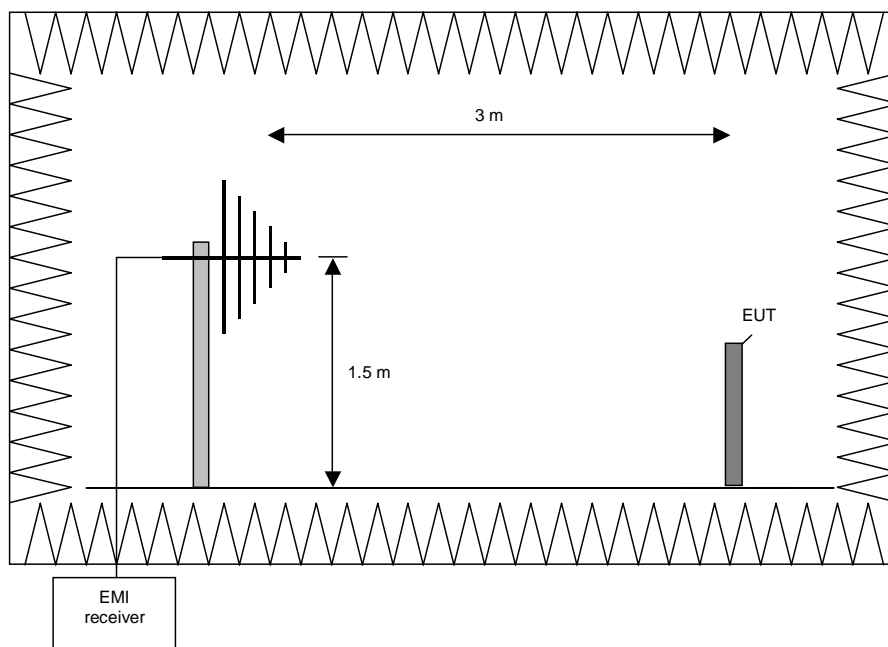
Preliminary measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The setup 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 120 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 1 GHz	120 kHz



Procedure preliminary measurement:

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

The following procedure will be used:

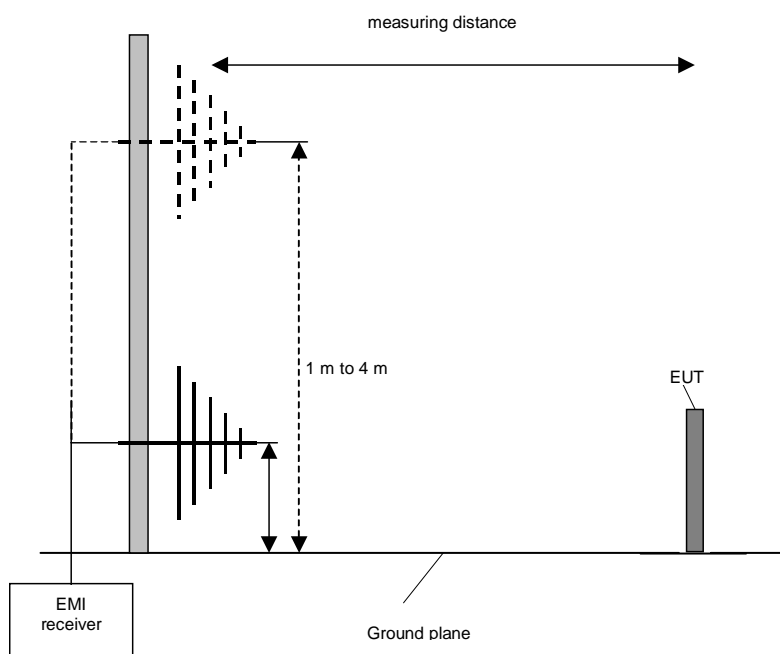
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the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

Preliminary and final measurement (1 GHz to 110 GHz)

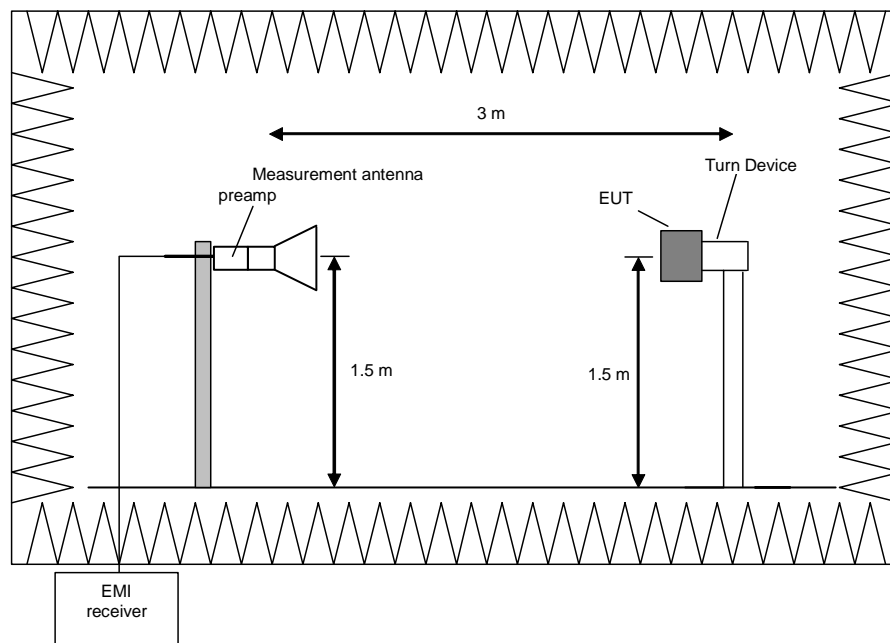
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5 m. The set-up of the Equipment under test will be in accordance to [1].

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	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 preliminary measurement:

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

The following procedure will be used:

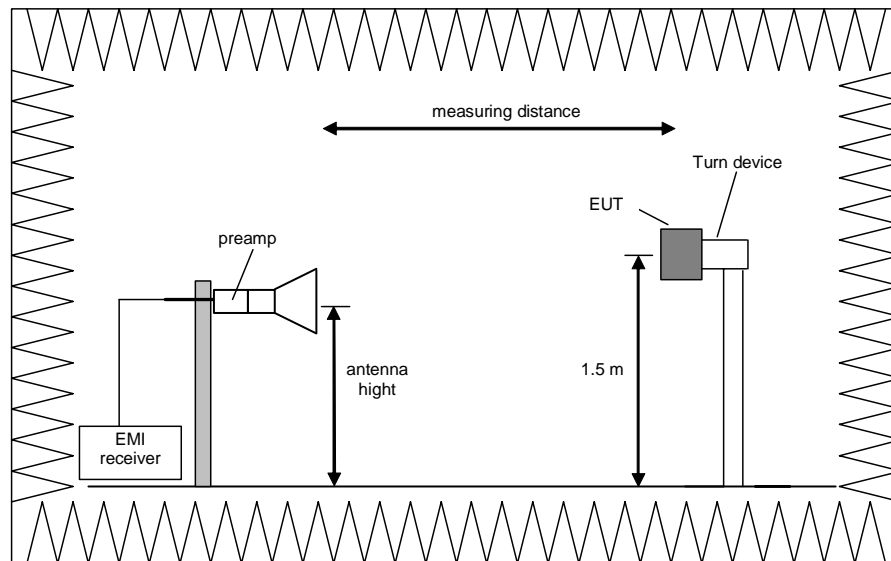
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an 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 110 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used 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 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 110 GHz.

The following procedure will be used:

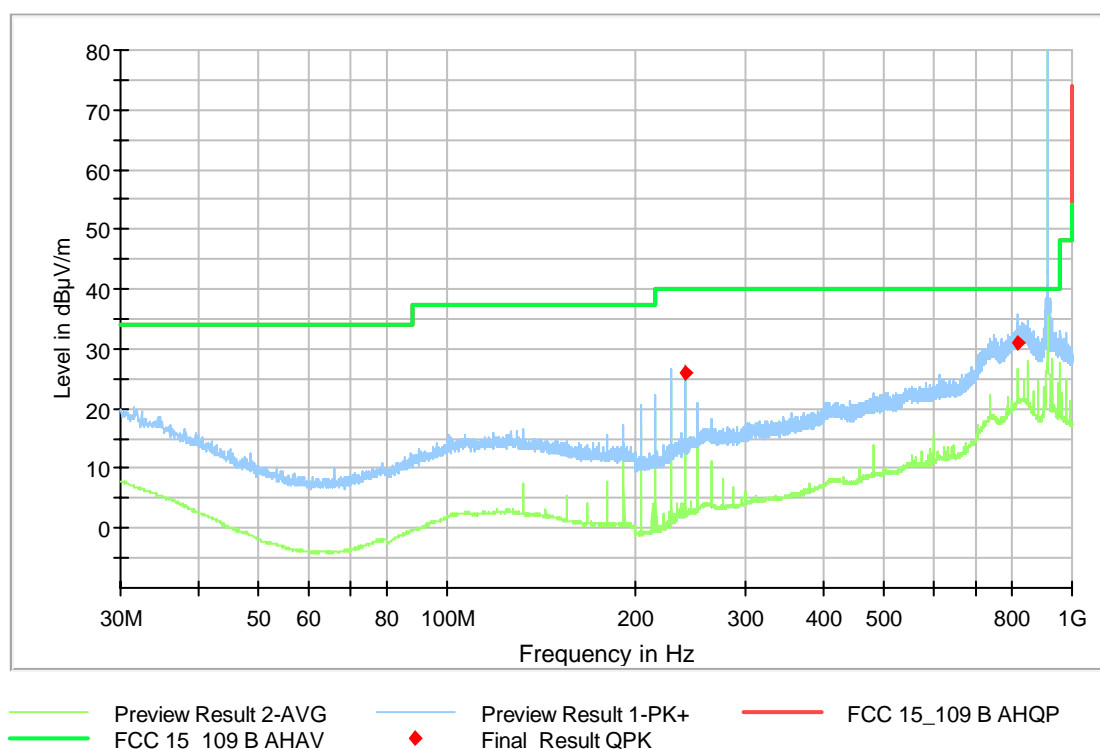
- 1) Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
- 2) Set the measurement antenna polarisation to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
- 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 Radiated emissions in simultaneous transmission mode (Bluetooth and 915 MHz)

5.1.2.1 Preliminary radiated emission measurement (30 MHz to 1 GHz)

Ambient temperature	21 °C	Relative humidity	54 %
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Spurious emissions from 30 MHz to 1000 MHz



The following frequency was found during the preliminary measurement inside restricted bands:

240.012 MHz.

The following frequency was found during the preliminary measurement outside restricted bands

818.868 MHz.

These frequencies have to be measured on the open area test site. The results are shown in clause 5.1.2.2.

The peak at 915 MHz is the wanted signal and was not investigated.

Test equipment (refer chapter 6 for details)

9 – 14, 19

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

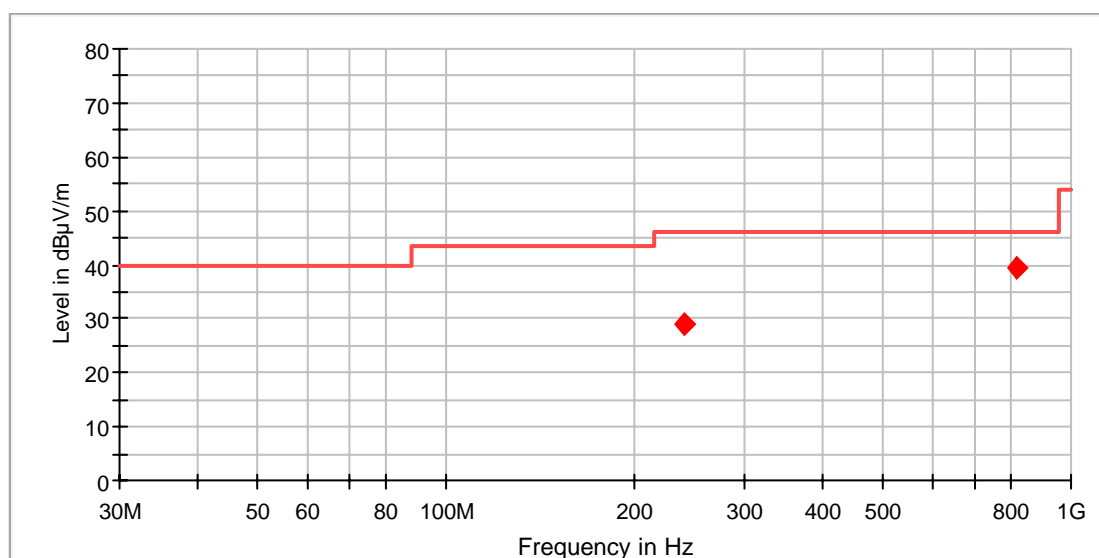
Ambient temperature	20 °C	Relative humidity	54 %
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Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: No cables were connected to the EUT during the tests.

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was battery supplied with 3.0 V_{DC}.



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 5 seconds.

Result measured with the quasi-peak detector:

Spurious emissions inside restricted bands									
Frequency MHz	Result dBμV/m	Limit dBμV/m	Margin dB	Readings dBμV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
240.012	29.09	46.0	16.9	16.2	11.2	1.7	100	49	Hor.
Spurious emissions outside restricted bands									
818.868	39.42	46.0	6.6	14.3	21.9	3.2	137	83	Hor.
Measurement uncertainty: +2.2 dB / -3.6 dB									

Test result: Passed.

Test equipment (refer chapter 6 for details)

1 - 8

5.1.2.3 Preliminary emission measurement (1 GHz to 25 GHz)

Ambient temperature	21 °C	Relative humidity	54 %
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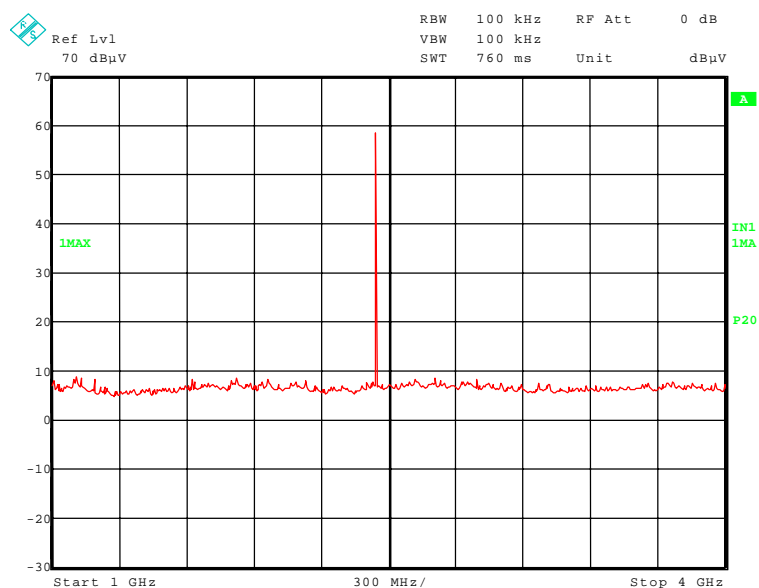
Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: No cables were connected to the EUT during the tests.

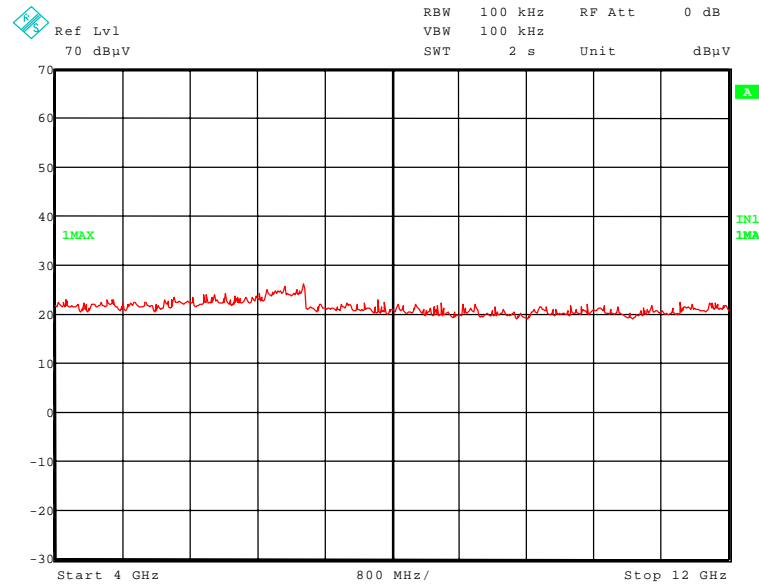
Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 3.0 V_{DC}.

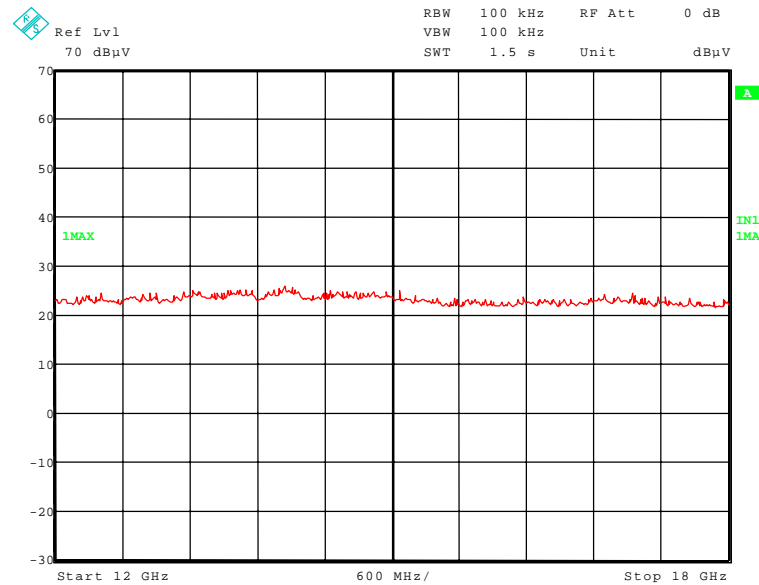
161065 SIM1.wmf: Simultaneous transmission from 1 GHz to 4 GHz



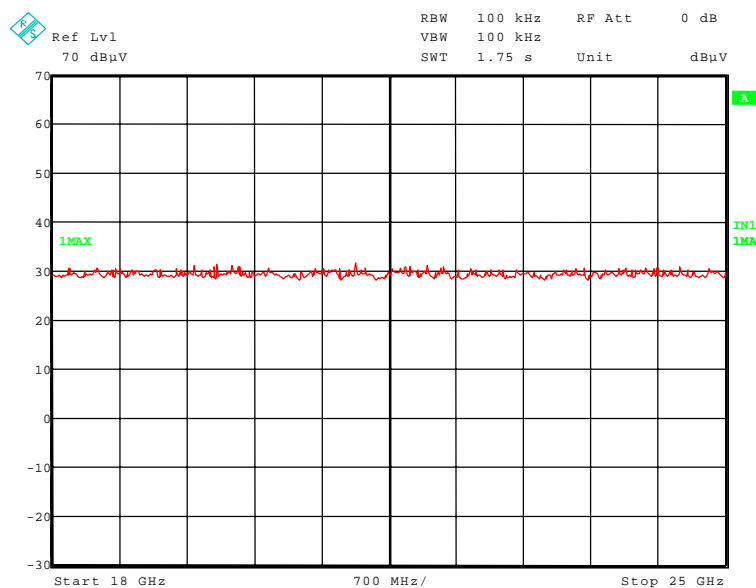
161065_SIM2.wmf: Simultaneous transmission from 4 GHz to 12 GHz



161065_SIM3.wmf: Simultaneous transmission from 12 GHz to 18 GHz



161065_SIM4.wmf: Simultaneous transmission from 18 GHz to 25 GHz



No emission was found. The peak at 2441 MHz is the wanted Bluetooth emission and was not investigated.

Test equipment (refer chapter 6 for details)

9 – 13, 16 – 27

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

No significant frequencies were found during the preliminary measurement. Therefore no final measurement was carried out.

No intermodulation is caused by the co-located transmitters.

Test result: Passed

6 Test equipment

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
1	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
2	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	02/18/2016	02/2018
3	Controller	HD100	Deisel	100/670	480139	-	-
4	Turntable	DS420HE	Deisel	420/620/80	480087	-	-
5	Antenna support	AS615P	Deisel	615/310	480086	-	-
6	Antenna	CBL6111 D	Chase	25761	480894	09/18/2014	09/2017
7	EMI-Software	EMC 32	Rohde & Schwarz	-	481022	-	-
8	6 dB attenuator	R412706000	Radiall	9833	410082	Annual verification	
9	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
10	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	02/16/2016	02/2017
11	Controller	MCU	Maturo	MCU/043/971107	480832	-	-
12	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
13	Antenna support	AS615P	Deisel	615/310	480187	-	-
14	Antenna	CBL6112 B	Chase	2688	480328	04/14/2014	04/2017
16	Antenna	HL50	Rohde & Schwarz	100438	481170	08/27/2014	08/2017
17	Standard gain horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Calibration not necessary	
18	Standard gain horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	410	480296	Calibration not necessary	
19	RF-cable No. 36	Sucoflex 106B	Suhner	0587/6B	480865	Weekly verification (system cal.)	
20	RF-cable No. 3	Sucoflex 106B	Suhner	0563/6B	480670	Weekly verification (system cal.)	
21	RF-cable No. 40	Sucoflex 106B	Suhner	0708/6B	481330	Weekly verification (system cal.)	
22	Positioner	TDF 1.5- 10Kg	Maturo	15920215	482034	-	-
23	Preamplifier 100 MHz - 13 GHz	JS3-00101200-23-5A	MITEQ Hauppauge N.Y.	681851	480337	02/18/2016	02/2018
24	Preamplifier 12 GHz - 18 GHz	JS3-12001800-16-5A	MITEQ Hauppauge N.Y.	571667	480343	02/18/2016	02/2018
25	Preamplifier 18 GHz - 26 GHz	JS4-18002600-20-5A	MITEQ Hauppauge N.Y.	658697	480342	02/17/2016	02/2018
26	High Pass Filter	WHKX4.0/18G-8SS	Wainwright Instruments GmbH	1	480587	Weekly verification (system cal.)	
27	RF-cable 2m	KPS-1533-400-KPS	Insulated Wire	-	480302	Weekly verification (system cal.)	

