

TEST REPORT  
No.: 16-1-0068501T09a

According to:  
**FCC Regulations**  
Part 15.247

**IC-Regulations**  
RSS-Gen, Issue 4  
RSS-247, Issue 1

for

Pugz Gear AB

PUGZ Bluetooth Headset PUGZ-L

**FCC-ID:** 2AIYL-01  
**IC:** 21670-01

Laboratory Accreditation and Listings			
 <b>DAkkS</b> Deutsche Akkreditierungsstelle D-PL-12047-01-01	 FEDERAL COMMUNICATIONS COMMISSION U.S.A. MRA US-EU 0003	 Industry Canada Reg. No.: 3462D-2 Reg. No.: 3462D-3	 Voluntary Controls for Electromagnetic Emissions Reg. No.: R-2666 C-2914, T-1967, G-301
 <b>Wi-Fi</b> <sup>TM</sup> AUTHORIZED RF LABORATORY	 <b>ctia</b> Authorized <sup>TM</sup> Test Lab Lab Code: 20011130-00	accredited according to DIN EN ISO/IEC 17025	
<b>CETECOM GmbH</b> Laboratory Radio Communications & Electromagnetic Compatibility Im Teelbruch 116 • 45219 Essen • Germany Registered in Essen, Germany, Reg. No.: HRB Essen 8984 Tel.: + 49 (0) 20 54 / 95 19-954 • Fax: + 49 (0) 20 54 / 95 19-964 E-mail: info@cetecom.com • Internet: www.cetecom.com			

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The listed attachments are an integral part of this report.

## 1. Summary of test results

The test results apply exclusively to the test samples as presented in this Report. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests.

**The test results apply exclusively to the test samples as presented in this report. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests. Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.**

The presented Equipment Under Test (in this report, hereinafter referred as EUT) integrates a Bluetooth® transmitter. Other implemented wireless technologies are not considered within this test report.

Following test cases have been performed to show compliance with applicable FCC Part 2 and Part 15 rules of the FCC CFR Title 47 Rules, Edition 4<sup>th</sup> November 2015 and IC RSS-247 Issue 1/ RSS-Gen Issue 4 standards.

### 1.1. Tests overview of US CFR (FCC) and Canada IC (RSS) Standards

Test cases	Port	References and Limits			EUT set-up	EUT op. mode	Result
		FCC Standard	RSS Section	Test limit			
TX-Mode							
20 dB bandwidth	Antenna terminal (conducted)	§15.247 (a)(1)	RSS-247, Issue 1: 5.1 (1)	At least 25 kHz or 2/3 of 20 dB bandwidth	4	1	passed
Channel carrier frequency separation			RSS-247, Issue 1: 5.1 (2)		4	2	
99% occupied bandwidth	Antenna terminal (conducted)	2.1049(h)	RSS-Gen, Issue 4: Chapter 6.6	99% Power bandwidth	4	1	passed
Channel use, average channel use, input bandwidth and synchronization between signals	--	§15.247 (a)(1)	RSS-247, Issue 1: 5.1	See specification	--	--	not performed Remark 1
Channel average Occupancy time and number of channels	Antenna terminal (conducted)	§15.247 (a)(1) (iii)	RSS-247, Issue 1: 5.1 (3)	0.4 seconds	4	1	passed
Transmitter Peak output power	Antenna terminal (conducted)	§15.247 (b)(1)	RSS-247, Issue 1: 5.1 (2)	< 125 mW	4	1	passed
Transmitter frequency stability	Antenna terminal (conducted)	--	RSS-Gen, Chapter 4.7	Operation within designated operational band	--	--	Not tested
Transmitter Peak output power radiated	Enclosure (radiated)	§15.247 (b)(4)	RSS-247, Issue 1: 5.1 (2)	< 125 mW (EIRP) for antenna with directional gain less 6 dBi	--	--	Passed antenna gain lower 6dBi
Out-Of-Band RF- emissions Band-Edge emissions	Antenna terminal (conducted)	§15.247 (d)	RSS-247, Issue 1, Chapter 5.5	20 dBc and Emissions in restricted bands must meet the general fieldstrength radiated limits	4	1+2	passed

General field strength emissions + restricted bands	Enclosure + Interconnecting cables (radiated)	§15.247 (d) §15.205 §15.209	RSS-247, Issue 1, Chapter 5.5  RSS-Gen: Issue 4: §8.9 Table 4+5+6	Emissions in restricted bands must meet the general field-strength radiated limits	1+2+3	1+2	passed
AC-Power Lines  Conducted Emissions	AC-Power lines	§15.207	RSS-Gen, Issue 4: Chapter 8.8 Table 3	FCC §15.107 class B limits §15.207 limits  IC: Table 3, Chapter 8.8	--	--	Not performed (remark 2)
<b>RX Mode</b>							
RECEIVER  Radiated emissions	Enclosure+ Inter-connecting cables (radiated)	§15.109 §15.33 §15.35	RSS-Gen, Issue 4: Chapter 7.1	FCC 15.109 class B limits  IC-limits: Table 2, Chapter 7.1.2	--	--	Not performed (Transceiver)

**Remark:**

- 1.) Bluetooth® Core internal parameters (applicant's declaration)
- 2.) no direct connection to AC-mains, charging indirect from Mobile phone

**Attestation:**

I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Industry Canada standards. All requirements as shown in above table are met in accordance with enumerated standards.

.....  
Dipl.-Ing. Rachid Acharkaoui  
Responsible for test section

.....  
Dipl.-Ing. Ninovic Perez  
Responsible for test report

## 2. Administrative Data

### 2.1. Identification of the testing laboratory

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116 45219 Essen - Kettwig Germany
Responsible for testing laboratory:	Dipl.-Ing. Rachid Acharkaoui
Deputy:	Dipl.-Ing. Niels Jeß

### 2.2. Test location

#### 2.2.1. Test laboratory “CTC”

Company name:	see chapter 2.1. Identification of the testing laboratory
---------------	---

### 2.3. Organizational items

Responsible for test report and project leader:	Dipl.-Ing. Ninovic Perez
Receipt of EUT:	2016-07-07
Date(s) of test:	2016-07-16 - 2016-08-11
Date of report:	2016-08-12
<hr/>	
Version of template:	13.02

### 2.4. Applicant's details

Applicant's name:	Pugz Gear AB
Address:	Döbelnsgatan 40 113 52 Stockholm
	Sveridge
Contact person:	Mr. Hamid Toosi

### 2.5. Manufacturer's details

Manufacturer's name:	Sigma Connectivity AB
Address:	Mobilvägen 10 223 62 Lund
	Sveridge

### 3. Equipment under test (EUT)

#### 3.1. Technical data of main EUT declared by applicant

Frequency range and channels (US/Canada -bands)	2402 MHz to 2480 MHz <input checked="" type="checkbox"/> Ch. 0 to Ch. 78 <input type="checkbox"/> Ch. 0 to Ch. 40		
Type of modulation (packet types)	<input checked="" type="checkbox"/> BT 1.0 / BT 1.1: DH1/DH3/DH5 – GFSK <input checked="" type="checkbox"/> BT 2.0 / BT 2.1: DH1/2DH3/2DH5 3DH1/3DH3/3DH5 – Pi/4 DQPSK,8DPSK <input type="checkbox"/> BT 3.0: additional PTY <input type="checkbox"/> BT 4.0: DH1/DH3/DH5 – GFSK		
Number of channels (USA/Canada -bands)	<input checked="" type="checkbox"/> 0 to 78 <input type="checkbox"/> 0 to 40		
Antenna Type	<input checked="" type="checkbox"/> Integrated <input type="checkbox"/> External, no RF- connector <input type="checkbox"/> External, separate RF-connector		
Antenna Gain	Maximum 1.7 dBi gain according applicants information in 2.4 GHz band		
Power supply	<input checked="" type="checkbox"/> Internal battery Li-Io: Nominal voltage: 3.7V, range 3.0V to 4.2 V		
Special EMI components	--		
EUT sample type	<input type="checkbox"/> Production	<input checked="" type="checkbox"/> Pre-Production	<input type="checkbox"/> Engineering
Firmware		<input type="checkbox"/> for normal use	<input checked="" type="checkbox"/> Special version for test execution
FCC label attached	<input type="checkbox"/> yes	<input checked="" type="checkbox"/> no	
IC label attached	<input type="checkbox"/> yes	<input checked="" type="checkbox"/> no	
HVIN / PMN designated	<input type="checkbox"/> yes	<input checked="" type="checkbox"/> no	<input checked="" type="checkbox"/> to be defined

#### 3.2. EUT: Type, S/N etc. and short descriptions used in this test report

Short description*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	PUGZ Bluetooth Headset	PUGZ-L	17	1.0	1.0
EUT B	PUGZ Bluetooth Headset	PUGZ-L	18	1.0	1.0
EUT C	Charging pad Micro USB cable	PUGZ-C	#1	1.0	--
EUT D	PUGZ Bluetooth Headset Remark 1	PUGZ-S	--	--	--

\*) EUT short description is used to simplify the identification of the EUT in this test report.

Remark 1: Variant of EUT A – not tested see declarations of applicant

### 3.3. Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

AE short description *)	Auxiliary Equipment	Type	S/N serial number	HW hardware status	SW software status
AE 1	Smartphone	LG Nexus 5	048C9A092522 7620-	--	Android 6.0.1
AE 2	Smartphone	Samsung S5 (SM-G900F)	IMEI: 357749067360 132/83	No info	Android 5.0

\*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

### 3.4. EUT set-ups

EUT set-up no.*)	Combination of EUT and AE	Remarks
set. 1	EUT A	Radiated measurements. A full battery was used.
set. 2	EUT A + EUT C	Radiated measurements. A full battery was used.
set. 3	EUT A + EUT C + AE 2	Radiated measurements using also charging possibility over AE2
set. 4	EUT B + AE 1	Used for conducted measurements (AE1 used to activate Bluetooth® test mode)

\*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

### 3.5. EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	TX-Mode	With help of special test firmware a continuous traffic mode could be established with help of a Bluetooth base simulator. (R&S CBT32)
op. 2	TX-Mode hopping on	Hopping mode was activated with help of a Bluetooth base simulator. (R&S CBT32)

\*) EUT operating mode no. is used to simplify the test report.

### 3.6. Configuration of cables used for testing

Cable number	Item	Type	S/N serial number	HW hardware status	Cable length
Cable 1	EUT C	--	#1	--	1m

## 4. Description of test system set-up's

### 4.1. Test system set-up for conducted measurements on antenna port

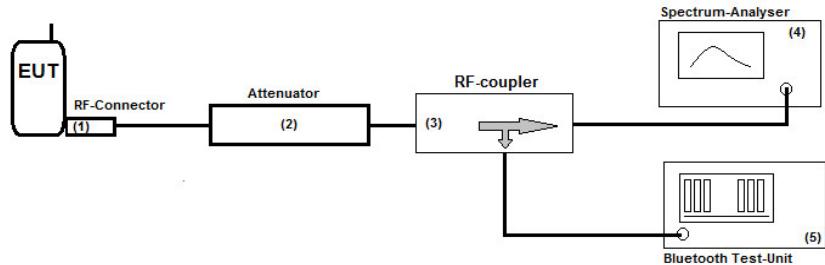
#### Conducted Set-up B1

##### Bluetooth conducted RF-Setup 1 (BT1 Set-up)

###### General description:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then on the RF-coupler the coupled RF-path is connected to a Bluetooth test unit communication tester (5). The direct RF-path is connected to the spectrum – analyzer (4) for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

###### Schematic:



###### Testing method:

ANSI C63.10:2013

###### Used Equipment

	Passive Elements	Test Equipment	Remark:
	<input checked="" type="checkbox"/> 10 dB Attenuator	<input checked="" type="checkbox"/> CBT32 Communication Test-Unit for Bluetooth	See List of equipment under each test case and chapter 8 for calibration info
	<input checked="" type="checkbox"/> Low loss RF-cables	<input checked="" type="checkbox"/> DC-Power Supply	
	<input checked="" type="checkbox"/> RF-Coupler	<input checked="" type="checkbox"/> Spectrum-Analyser	

###### Measurement uncertainty

See chapter 5.12

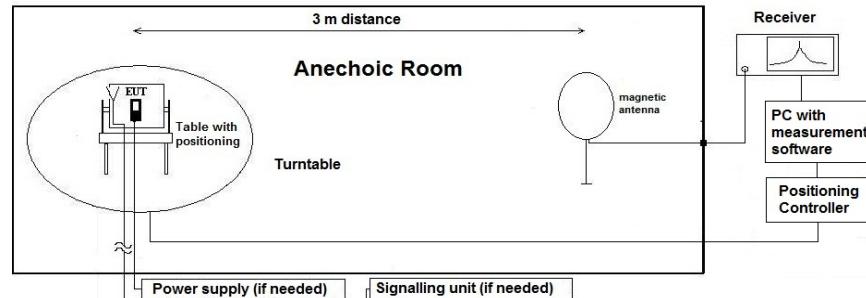
## 4.2. Test system set-up for radiated magnetic field measurements below 30 MHz

**Specification:** ANSI C63.4-2014 §5.3, §8.2.1, §8.3.1.1+§8.3.2.1 , ANSI C63.10-2013 chapter 6.4 (§6.4.4.2)

**General Description:** Evaluating the radiated field emissions are done first by an exploratory emission measurement and a final measurement for most critical frequencies determined.

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied, as stated in chapter “General Limit - Radiated field strength emissions below 30 MHz“. The tests are performed in the semi anechoic room recognized by the regulatory commission.

**Schematic:**



**Testing method:**

### Exploratory, preliminary measurement

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (step 90°, range 0° to 360°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT), the emission spectrum was recorded. The loop antenna was moved at least to 2-perpendicular axes (antenna vector in direction of EUT and parallel to EUT) in order to maximize the emissions. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a data reduction table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

### Final measurement on critical frequencies

Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position).

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

**Formula:**

$$E_C = E_R + AF + C_L + D_F - G_A$$

$$M = L_T - E_C$$

AF = Antenna factor

C<sub>L</sub> = Cable loss

D<sub>F</sub> = Distance correction factor

E<sub>C</sub> = Electrical field – corrected value

E<sub>R</sub> = Receiver reading

G<sub>A</sub> = Gain of pre-amplifier (if used)

L<sub>T</sub> = Limit

M = Margin

All units are dB-units, positive margin means value is below limit.

**Distance correction:**

Reference for applied correction (extrapolating) factors due to reduced measurement distance:

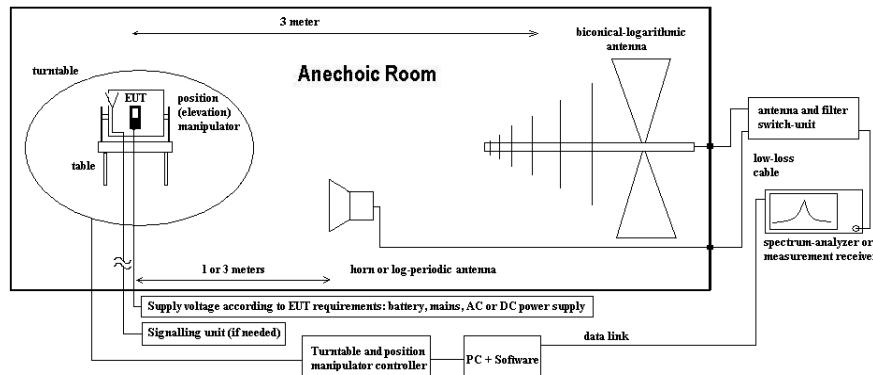
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

### 4.3. Test system set-up for radiated electric field measurement 30 MHz to 1 GHz

**Specification:** ANSI C63.4-2014 chapter 8.2.3, ANSI C63.10-2013 chapter 6.5

**General Description:** Evaluating the field emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a NSA-compliant semi anechoic room (SAR) recognized by the regulatory commissions.

**Schematic:**



**Testing method:**

#### Exploratory, preliminary measurements

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 90°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and it's characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1,0 m and 1,82 m as worst-case determined by an exploratory emission measurements. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

**Formula:**

$$E_C = E_R + AF + C_L + D_F - G_A \quad (1)$$

$$M = L_T - E_C \quad (2)$$

#### Final measurement on critical frequencies

Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc. either on 10m OATS or 3m semi-anechoic room.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height between 1 m and 4 m.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

AF = Antenna factor

C<sub>L</sub> = Cable loss

D<sub>F</sub> = Distance correction factor (if used)

E<sub>C</sub> = Electrical field – corrected value

E<sub>R</sub> = Receiver reading

G<sub>A</sub> = Gain of pre-amplifier (if used)

L<sub>T</sub> = Limit

M = Margin

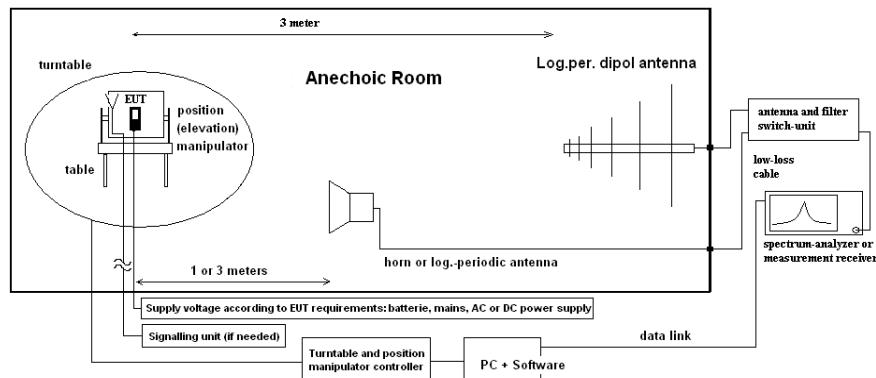
All units are dB-units, positive margin means value is below limit.

#### 4.4. Test system set-up for radiated electric field measurement above 1 GHz

**Specification:** ANSI C63.4-2014 chapter 8.3, ANSI C63.10-2013 chapter 6.6.3.3 & 6.6.4

**General Description:** Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 16-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

**Schematic:**



**Testing method:**

**Exploratory, preliminary measurements**

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software. The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

**Final measurement on critical frequencies**

Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined. Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out. On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

**Formula:**

$$E_C = E_R + AF + C_L + D_F - G_A \quad (1)$$

$$M = L_T - E_C \quad (2)$$

$E_C$  = Electrical field – corrected value

$E_R$  = Receiver reading

$M$  = Margin

$L_T$  = Limit

$AF$  = Antenna factor

$C_L$  = Cable loss

$D_F$  = Distance correction factor (if used)

$G_A$  = Gain of pre-amplifier (if used)

All units are dB-units, positive margin means value is below limit.

## 5. Measurements

### 5.1. RF-Parameter - 20 dB Bandwidth

#### 5.1.1. Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input type="checkbox"/> Please see Chapter. 2.2.2	<input type="checkbox"/> Please see Chapter. 2.2.3
test site	<input type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 487 SAR NSA	<input type="checkbox"/> 337 OATS
receiver	<input type="checkbox"/> 377 ESCS30	<input type="checkbox"/> 001 ESS	<input checked="" type="checkbox"/> 489 ESU
otherwise	<input type="checkbox"/> 530 10dB Att.	<input checked="" type="checkbox"/> 613 20dB Att.	<input type="checkbox"/> <input checked="" type="checkbox"/> cable K4

#### 5.1.2. Requirements:

FCC	<input checked="" type="checkbox"/> §15.247 (a) (1)
IC	<input checked="" type="checkbox"/> RSS-247, Issue 1, chapter 5.1, Point 1
Remark	<i>(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.</i>

#### 5.1.3. EUT settings

For FHSS-systems hopping mode was switched-off so fixed three different channels could be measured. The EUT was instructed to send with maximum power (if adjustable) according applicants instructions. Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

#### 5.1.4. Measurement method

The measurement was performed with the RBW set to 10kHz. The span was set to cover the complete carrier. Three carrier frequencies (low/middle/high) were used for showing the compliance with this requirement. A DELTA Marker method was set to measure the bandwidth compared to the highest In-Band power. The operating modes have been varied (e.g. data rate, modulation scheme, etc.). The hopping-mode is switched off.

#### 5.1.5. Spectrum-Analyzer Settings

Span	Set as to fully display the emissions and approximate 20dB below the PEAK level
Resolution Bandwidth (RBW)	Set to approx 1% ... 3% of the emission width
Video Bandwidth (VBW)	3 times the resolution bandwidth
Sweep time	Coupled and low enough to have no gaps within power envelope
Detector	Sample (if bin width: Span/no. of frequency points SA < 0.5*RBW SA otherwise Peak detector)
Sweep mode	Repetitive Mode, Max hold

**5.1.6. Results:**

Measurement value was recorded on middle channel 39 = 2441 MHz for each modulation type

**DH3 packet type (GFSK-Modulation)**

Set-up no.: 4	20 dB Bandwidth [MHz]		
Op. mode: 1	Low channel = 0 (2402 MHz)	Middle channel = 39 (2441 MHz)	High channel = 78 (2480 MHz)
T <sub>Nom</sub> = 21°C V <sub>Nom</sub> = 3.7 V	--	1.037335165	--
Maximum Value	--	1.037335165	--

**Remark:** see diagrams in separate annex 1

**2DH3 Packet type (Pi/4-QPSK Modulation)**

Set-up no.: 4	20 dB Bandwidth [MHz]		
Op. mode: 1	Low channel = 0 (2402 MHz)	Middle channel = 39 (2441 MHz)	High channel = 78 (2480 MHz)
T <sub>Nom</sub> = 21°C V <sub>Nom</sub> = 3.7 V	--	1.157527473	--
Maximum Value	--	1.157527473	--

**Remark:** see diagrams in separate annex 1

**3DH5 packet type (8DPSK Modulation)**

Set-up no.: 4	20 dB Bandwidth [MHz]		
Op. mode: 1	Low channel = 0 (2402 MHz)	Middle channel = 39 (2441 MHz)	High channel = 78 (2480 MHz)
T <sub>Nom</sub> = 21°C V <sub>Nom</sub> = 3.7 V	--	1.186373626	--
Maximum Value	--	1.186373626	--

**Remark:** see diagrams in separate annex 1

**5.1.7. Verdict: pass**

**5.1.8. 99% Bandwidth**

Measurement value was recorded on middle channel 39 = 2441 MHz for each modulation type

**DH3 Modulation**

Set-up no.: 4	99 % Bandwidth [kHz]		
Op. mode: 1	Low channel = 0 (2402 MHz)	Middle channel =39 (2441 MHz)	High channel = 78 (2480 MHz)
T <sub>Nom</sub> = 21°C V <sub>Nom</sub> = 3.7 V	--	991.428571428	--
Maximum Value	--		--

**Remark:** see diagrams in separate annex1

**2DH3 Modulation**

Set-up no.: 4	99% Bandwidth [kHz]		
Op. mode: 1	Low channel = 0 (2402 MHz)	Middle channel =39 (2441 MHz)	High channel = 78 (2480 MHz)
T <sub>Nom</sub> = 21°C V <sub>Nom</sub> = 3.7 V	--	1078.571429	--
Maximum Value	--		--

**Remark:** see diagrams in separate annex1

**3DH5 Modulation**

Set-up no.: 4	99% Bandwidth [kHz]		
Op. mode: 1	Low channel = 0 (2402 MHz)	Middle channel =39 (2441 MHz)	High channel = 78 (2480 MHz)
T <sub>Nom</sub> = 21°C V <sub>Nom</sub> = 3.7 V	--	1128.571429	--
Maximum Value	--		--

**Remark:** see diagrams in separate annex1

**RESULT 99 dB Bandwidth:** pass

## 5.2. RF-Parameter – RF Power conducted

### 5.2.1. Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input checked="" type="checkbox"/> 443 System CTC-FAR-EMI-	<input type="checkbox"/> Please see Chapter. 2.2.3
test site	<input type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 487 SAR NSA	<input type="checkbox"/> 337 OATS
receiver	<input type="checkbox"/> 377 ESCS30	<input type="checkbox"/> 001 ESS	<input checked="" type="checkbox"/> 347 Radio.lab.
spectr. analys.	<input type="checkbox"/> 489 ESU	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 264 FSEK
power supply	<input type="checkbox"/> 456 EA 3013A	<input type="checkbox"/> 457 EA 3013A	<input type="checkbox"/> 459 EA 2032-50
otherwise	<input checked="" type="checkbox"/> 613 20dB Attenuator		<input checked="" type="checkbox"/> Directional Coupler 1539R-10

### 5.2.2. Requirements:

FCC	§15.247 (b) (1) for FHSS
IC	RSS-247, Issue 1. Chapter 5.4, Point 2
ANSI	C63.10-2013 (chapt 6.101) (

### 5.2.3. Reference: EUT antenna characteristics:

Directional Gain < 6 dBi (measured: difference between measured conducted and radiated eirp. power)  
 Directional Gain > 6 dBi (measured / applicant's declaration) -> conducted power reduction necessary

### 5.2.4. EUT settings:

For FHSS-systems hopping mode was switched-off so fixed three different channels could be measured. The EUT was instructed to send with maximum power (if adjustable) according applicants instructions. Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

### 5.2.5. Measurement method:

The measurement was performed in non-hopping transmission mode with the carrier set to lowest/middle and highest channel. The power was also checked for different data rates, modulation scheme or packet types if applicable.

Set of RBW

RBW > 20 dB bandwith of the emission (for FHSS)

**5.2.6. Settings on Spectrum-Analyzer:**

Center Frequency	Nominal channel frequency
Span	8 MHz
Resolution Bandwidth (RBW)	3 MHz > 20dB-Bandwidth of the signal
Video Bandwidth (VBW)	3 times the resolution bandwidth = 10MHz
Sweep time	coupled
Detector	Peak, Max hold mode
Sweep Mode	Repetitive mode

**5.2.7. Conducted measurement: Max. Peak Power**

- Maximum declared antenna gain [isotropical]: 1.7 dBi

MAX PEAK POWER (conducted)			
Set-up no.: 4	Low channel = 0 (2402 MHz)	Middle channel = 39 (2441 MHz)	High channel = 78 (2480 MHz)
Op-Mode: 1			
Correction factor - Path loss: [dB]	1.26 (DH1-packet type)	4.33 (DH5-packet type)	<b>4.85</b> (DH1-packet type)
Max. Resulting Peak Power		4.85 dBm (3.05 mW)	
Limit		0.125 Watt (21dBm)	

Remark: here only the maximum power value is reported, see separate annex 1 for full results

**TEST RESULT:**

passed

### 5.3. RF-Parameter - Channel carrier frequency separation for FHSS-systems

#### 5.3.1. Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input type="checkbox"/> Please see Chapter. 2.2.2	<input type="checkbox"/> Please see Chapter. 2.2.3
test site	<input type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 487 SAR NSA	<input type="checkbox"/> 337 OATS
receiver	<input type="checkbox"/> 377 ESCS30	<input type="checkbox"/> 001 ESS	<input checked="" type="checkbox"/> 489 ESU
spectr. analys.	<input type="checkbox"/> 381 380 FSBS	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 264 FSEK
otherwise	<input type="checkbox"/> 530 10dB Att.	<input checked="" type="checkbox"/> 613 20dB Att.	<input type="checkbox"/> cable K4
			<input checked="" type="checkbox"/> cable K5

#### 5.3.2. Requirements:

FCC	<input checked="" type="checkbox"/> §15.247 (a) (1)
IC	<input checked="" type="checkbox"/> RSS-247, Issue 1, Chapter 5.1, Point 2
Remark	<i>FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the -20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.</i>

#### 5.3.3. EUT settings

For FHSS-systems hopping mode was switched-off so fixed three different channels could be measured. The EUT was instructed to send with maximum power (if adjustable) according applicants instructions. Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

#### 5.3.4. Measurement method

The measurement to prove this requirement was performed with a low RBW of 100kHz, peak detector and trace Hold-Max function in order to resolve each frequency carrier separately.

The span of the frequency analyzer was set to cover the carrier investigated as well as its neighbour channels. A frequency DELTA Marker method was set to measure the frequency separation between the channels.

#### 5.3.5. Limits

Either:

1. 25 kHz or 20dB BW  
or
2. 25kHz and 2/3of BW if Power<125mW

#### 5.3.6. Measurement Results

Set-up no.:	1	Channel separation
Op. mode:	2	
T <sub>Nom</sub> =	21°C	Measured around middle channel
V <sub>Nom</sub> =	3.7 V	(2441 MHz)
DH5		1.003 MHz
2DH5		1.0183 MHz
3DH5		1.008 MHz
Applicants declared value		1 MHz according BT-core spec.

Remark: see diagrams enclosed in annex 1 for different modulations

#### 5.3.7. Result: passed

## 5.4. RF-Parameter - 20 dBc power specification

### 5.4.1. Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input checked="" type="checkbox"/> 443 System CTC-FAR-EMI-	<input type="checkbox"/> Please see Chapter. 2.2.3
test site	<input type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 487 SAR NSA	<input type="checkbox"/> 337 OATS
receiver	<input type="checkbox"/> 377 ESCS30	<input type="checkbox"/> 001 ESS	<input checked="" type="checkbox"/> 347 Radio.lab.
spectr. analys.	<input type="checkbox"/> 489 ESU	<input type="checkbox"/> 120 FSEM	<input checked="" type="checkbox"/> 489 ESU
power supply	<input type="checkbox"/> 456 EA 3013A	<input type="checkbox"/> 457 EA 3013A	<input type="checkbox"/> 264 FSEK
otherwise	<input type="checkbox"/> 613 20 dB Attenuator		<input checked="" type="checkbox"/> 268 EA- 3050
			<input type="checkbox"/> 494 AG6632A
			<input type="checkbox"/> 498 NGPE 40
			<input checked="" type="checkbox"/> cable K4

### 5.4.2. Reference: §15.247, §15.205, RSS-247 chapter 5.5

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

### 5.4.3. EUT settings:

For FHSS-systems hopping mode was switched-off so fixed three different channels could be measured. The EUT was instructed to send with maximum power (if adjustable) according to applicants instructions.

### 5.4.4. Measurement method:

The frequency spectrum was investigated for **conducted** spurious emissions values lower than 20dB related to the RF-carrier power value measured on 1 RBW reference of 100kHz. Three carrier frequencies (low/middle/high channel) were used for showing the compliance with this requirement. A Peak detector was chosen. The video bandwidth (VBW) was chosen 10 times the resolution bandwidth (RBW). The frequency scan was up to 10 times the highest channel frequency within the operational mode. The spectrum-analyzer was set to MAX-PEAK Detector, MAX-Hold Mode.

For FHSS-systems hopping mode was switched-off so fixed three different channels could be measured. The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.

### 5.4.5. Results: Hopping mode off

Set-up no.: 4 Op-Mode: 1		RF-Conducted test: 20 dBc spurious emissions					
Frequency Range		Modulation 8-DPSK		Modulation Pi/4-QPSK		Modulation GFSK	
		Low channel =0 (2402 MHz)	Level Reference (In-Band) = -1.52 dBm Limit = 21.52 dBm	Middle channel = 39 (2441 MHz)	Level Reference (In-Band) = 1.85 dBm Limit= -18.15 dBm	High channel = 78 (2480 MHz)	Level Reference (In-Band)= 4.04 dBm Limit= -15.96 dBm
Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]
150kHz to 30 MHz	--	> 40	--	> 40	--	> 40	
30MHz to 2.8 GHz	--	> 40	--	> 40	--	> 40	
2.8 to 25 GHz	--	> 40	--	> 40	--	> 40	
Band-Edge (no hopping)	--	> 40	--	--	--	> 40	

**Remark:** see diagrams in separate document A1

The limit on the diagrams is 20dB under the reference level measured In-Band for each channel

**5.4.6. Results: Hopping mode on**

Set-up no.: 4 Op-Mode: 3	<b>RF-Conducted test: 20 dBc spurious emissions</b>					
Frequency Range	<b>Modulation GFSK</b> Level Reference (In-Band) = 4.03 dBm Limit = -15.97 dBm		<b>Modulation Pi/4-QPSK</b> Level Reference (In-Band) = 2.27 dBm Limit= -17.73 dBm		<b>Modulation 8-DPSK</b> Level Reference (In-Band)= 1.95 dBm Limit= -18.05 dBm	
	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]
150kHz to 30 MHz	--	> 40	--	> 40	--	> 40
30MHz to 2.8 GHz	--	> 40	--	> 40	--	> 40
2.8 to 25 GHz	--	> 40	--	> 40	--	> 40
Band-Edge (hopping)	--	> 40	--	> 40	--	> 40

**Remark:** see diagrams in separate document A1

The limit on the diagrams is 20dB under the reference level measured In-Band for each channel

**5.4.7. Verdict: pass**

## 5.5. RF-Parameter - Specification for hopping channel numbers for FHSS systems

### 5.5.1. Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input type="checkbox"/> Please see Chapter. 2.2.2	<input type="checkbox"/> Please see Chapter. 2.2.3
test site	<input type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 487 SAR NSA	<input type="checkbox"/> 337 OATS
receiver	<input type="checkbox"/> 377 ESCS30	<input type="checkbox"/> 001 ESS	<input checked="" type="checkbox"/> 347 Radio.lab.
specatr. analys.	<input type="checkbox"/> 489 ESU	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 584 FSU
power supply	<input type="checkbox"/> 456 EA 3013A	<input type="checkbox"/> 457 EA 3013A	<input type="checkbox"/> 459 EA 2032-50
otherwise	<input checked="" type="checkbox"/> 613 20dB Attenuator		
	<input checked="" type="checkbox"/> cable K4		

### 5.5.2. Requirements:

FCC	<input checked="" type="checkbox"/> §15.247 (a) (1) iii
IC	<input checked="" type="checkbox"/> RSS-247, Issue 1, Chapter 5.1, Point 4
Remark	<p><i>Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.</i></p> <p><i>Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.</i></p>

### 5.5.3. Method for measurement of the channel numbers:

The measurement was performed with spectrum analyzer's RBW set to 500kHz. The device was set to work within the defined specification with frequency hopping mode set to on. The spectrum-analyzer was set to MAX-Hold positive peak detector mode. After a trace stabilization period the trace is recorded and the number of channels counted.

### 5.5.4. Results without suppression of certain channels.

Set-up no. 1 Op. Mode 2	Number of channels
DH5	79
2DH5	79
3DH5	79

#### Remark:

1. see diagrams enclosed in the separate annex A1, for better accuracy reading the sweep was splitted in two separated sweeps
2. according Bluetooth® Spec. at least 20 channels will be maintained under all conditions under AFH operating mode. Details can be found in the Bluetooth® Core standard which EUT whould also comply.

### 5.5.5. Verdict: passed

## 5.6. RF-Parameter - Time of occupancy for FHSS systems

### 5.6.1. Requirements:

FCC	<input checked="" type="checkbox"/> §15.247 (a) (1) iii
IC	<input checked="" type="checkbox"/> RSS-247, Issue 1, Chapter 5.1, Point 4
Remark	<i>Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.</i>

### 5.6.2. Method for measuring the occupancy time:

The measurement was performed with a spectrum analyzer set to ZERO span. The device was set to work within the defined specification with frequency hopping mode to on. The spectrum-analyzer was set the MAX-Hold positive peak detector mode. The sweep time set as long as necessary to capture the full signal burst per hopping channel. The burst on-period is captured by setting appropriate markers in the rising and falling edges.

### 5.6.3. Calculations:

Formula for calculating the dwell time (pseudo-hopping sequence over all channels assumed):

$$\text{Average Dwell Time: } \text{Timeslot length} \cdot \frac{\text{Hop rate}}{\text{number of hopping channels}} \cdot \text{time period}$$

For Bluetooth® following is valid:

The maximum time of 0.4 seconds within a 31.6 second period in data mode is constant for Bluetooth® devices and independent from the packet type. For longer packet types the hopping data rate is reduced according the packet type length in order to comply with this requirement.

Calculated according mentioned-above formula:					
Packet types	Hop rate[1/s]	Channels	Hop rate per channels	Time period	Transmissions
DH1/2DH1/3DH1	1600	79	20.25	31.6	640
DH3/2DH3/3DH3	533,33		6.75		214
DH5/2DH5/3DH5	320		4.05		128

Test are performed at normal conditions regarding temperature and voltage:

Measured pulse width for <b>different</b> packet types/modulations (see annex 1 for diagrams):			
Packet types	Dwell time per transmission	Transmissions	Average Dwell time [ms] (approx transmissions on one channel per one milli second)
DH1/DH3/DH5:	423.937729 µs	640	271.320
DH3/2DH3/3DH3:	1.678745 ms	214	359.25143
DH5/2DH5/3DH5:	2.944771 ms	128	376.930

Remarks: diagrams can be found in separate annex 1

**5.6.4. Test result:** passed < 400 msec.

## 5.7. RF-Parameter - Requirements on channel use, average channel use, input bandwidth and synchronization between signals for FHSS systems

### 5.7.1. Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input type="checkbox"/> Please see Chapter. 2.2.2	<input type="checkbox"/> Please see Chapter. 2.2.3
test site	<input type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 487 SAR NSA	<input type="checkbox"/> 337 OATS
receiver	<input type="checkbox"/> 377 ESCS30	<input type="checkbox"/> 001 ESS	<input type="checkbox"/> 489 ESU
spectr. analys.	<input type="checkbox"/> 381 380 FSBS	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 264 FSEK
otherwise	<input type="checkbox"/> 613 20dB Attenuator		<input type="checkbox"/> cable K4

For this part of the tests are no instruments required.

### 5.7.2. Requirements:

FCC	<input checked="" type="checkbox"/> § 15.247(a)(1)
IC	<input checked="" type="checkbox"/> RSS-247, Issue 1
ANSI	C63.10: 2013
Remark	<i>The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.</i>

### 5.7.3. Requirement

*"The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter"*

The above requirement is implemented in the firmware of the device. A pseudo – random code is generated prior to transmissions and used for determination of the hopping channel sequence according Bluetooth® Core standard. Please find applicants separate declaration for detailed information. (document not supplied herewith)

### 5.7.4. Requirement

*"The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters.."*

Please find applicants separate declaration for detailed information. (document not supplied herewith)

### 5.7.5. Requirement

*The system receivers shall shift frequencies in synchronization with the transmitted signals.*

The synchronization requirement is implemented in the firmware of the device and is Bluetooth® Core requirement – please find applicants separate declaration for detailed information. (document not supplied herewith)

## 5.8. General Limit - Radiated field strength emissions below 30 MHz

### 5.8.1. Test location and equipment

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input type="checkbox"/> Please see Chapter. 2.2.2	<input type="checkbox"/> Please see Chapter. 2.2.3
test site	<input checked="" type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 487 SAR NSA	<input type="checkbox"/> 347 Radio.lab.
receiver	<input type="checkbox"/> 377 ESCS30	<input checked="" type="checkbox"/> 001 ESS	<input type="checkbox"/>
spectr. analys.	<input checked="" type="checkbox"/> 584 FSU	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 264 FSEK
antenna	<input type="checkbox"/> 574 BTA-L	<input type="checkbox"/> 133 EMCO3115	<input type="checkbox"/> 302 BBHA9170
signaling	<input type="checkbox"/> 392 MT8820A	<input checked="" type="checkbox"/> 371 CBT32	<input type="checkbox"/> 547 CMU
otherwise	<input type="checkbox"/> 400 FTC40x15E	<input type="checkbox"/> 401 FTC40x15E	<input type="checkbox"/> 110 USB LWL
DC power	<input type="checkbox"/> 456 EA 3013A	<input type="checkbox"/> 457 EA 3013A	<input type="checkbox"/> 459 EA 2032-50
line voltage	<input type="checkbox"/> 230 V 50 Hz via public mains	<input type="checkbox"/> 060 120 V 60 Hz via PAS 5000	

### 5.8.2. Requirements

FCC	Part 15, Subpart C, §15.205 & §15.209		
IC	RSS-Gen: Issue 4: §8.9 Table 5		
ANSI	C63.10-2013		
Frequency [MHz]	Field strength limit [ $\mu$ V/m]	[dB $\mu$ V/m]	Distance [m]
0.009 – 0.490	2400/f (kHz)	67.6 – 20Log(f) (kHz)	300
0.490 – 1.705	24000/f (kHz)	87.6 – 20Log(f) (kHz)	30
1.705 – 30	30	29.5	30

### 5.8.3. Test condition and test set-up

Signal link to test system (if used):	<input checked="" type="checkbox"/> air link	<input type="checkbox"/> cable connection	<input type="checkbox"/> none
EUT-grounding	<input checked="" type="checkbox"/> none	<input type="checkbox"/> with power supply	<input type="checkbox"/> additional connection
Equipment set up	<input checked="" type="checkbox"/> table top	<input type="checkbox"/> floor standing	
Climatic conditions	Temperature: (22±3°C)	Rel. humidity: (40±20)%	
EMI-Receiver or Analyzer Settings	Scan data	<input checked="" type="checkbox"/> 9 – 150 kHz RBW/VBW = 200 Hz Scan step = 80 Hz <input checked="" type="checkbox"/> 150 kHz – 30 MHz RBW/VBW = 9 kHz Scan step = 4 kHz <input type="checkbox"/> other:	
	Scan-Mode Detector Mode: Sweep-Time	<input checked="" type="checkbox"/> 6 dB EMI-Receiver Mode <input type="checkbox"/> 3dB Spectrum analyser Mode Peak (pre-measurement) and Quasi-PK/Average (final if applicable) Repetitive-Scan, max-hold Coupled – calibrated display if continuous signal otherwise adapted to EUT's individual transmission duty-cycle	
General measurement procedures	Please see chapter "Test system set-up radiated magnetic field measurements below 30 MHz"		

### 5.8.4. Measurement Results

The results are presented below in summary form only. For more information please consult the diagrams included in annex 1.

The EUT is put on operation on high channel only. If critical peaks are found (Margin <10 dB) the lowest and highest channels will be performed too. For more information please see the diagrams.

Table of measurement results:

Diagram No.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
2.05	High	78	9 kHz-30 MHz	1	1	DH5 packet type, no spurious emission found within noise level	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	passed
2.06	High	78	9 kHz-30 MHz	1	1	3DH5 packet type, no spurious emission found within noise level	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	passed

### 5.8.5. Correction factors due to reduced meas. distance (f< 30 MHz)

The used correction factors when the measurement distance is reduced compared to regulatory measurement distance, are calculated according Extrapolation formulas valid for EUT's with maximum dimension of 0.625xLambda. Formula 2+3+4 as presented in ANSI C63.10, Chapter 6.4.4 are used for the calculations of proper extrapolation factors.

Frequency -Range	f [kHz/MHz]	Lambda [m]	Far-Field Point [m]	Distance Limit accord. 15.209 [m]	1st Condition (d <sub>meas</sub> < D <sub>near-field</sub> )	2te Condition (Limit distance bigger d <sub>near-field</sub> )	Distance Correction accord. Formula
kHz	9.00E+03	33333,33	5305,17	300	fulfilled	not fulfilled	-80,00
	1.00E+04	30000,00	4774,65		fulfilled	not fulfilled	-80,00
kHz	2.00E+04	15000,00	2387,33		fulfilled	not fulfilled	-80,00
	3.00E+04	10000,00	1591,55		fulfilled	not fulfilled	-80,00
	4.00E+04	7500,00	1193,66		fulfilled	not fulfilled	-80,00
	5.00E+04	6000,00	954,93		fulfilled	not fulfilled	-80,00
	6.00E+04	5000,00	795,78		fulfilled	not fulfilled	-80,00
	7.00E+04	4285,71	682,09		fulfilled	not fulfilled	-80,00
	8.00E+04	3750,00	596,83		fulfilled	not fulfilled	-80,00
	9.00E+04	3333,33	530,52		fulfilled	not fulfilled	-80,00
	1.00E+05	3000,00	477,47		fulfilled	not fulfilled	-80,00
	1.25E+05	2400,00	381,97		fulfilled	not fulfilled	-80,00
	2.00E+05	1500,00	238,73		fulfilled	fulfilled	-78,02
	3.00E+05	1000,00	159,16		fulfilled	fulfilled	-74,49
	4.00E+05	750,00	119,37		fulfilled	fulfilled	-72,00
	4.90E+05	612,24	97,44		fulfilled	fulfilled	-70,23
	5.00E+05	600,00	95,49	30	fulfilled	not fulfilled	-40,00
	6.00E+05	500,00	79,58		fulfilled	not fulfilled	-40,00
	7.00E+05	428,57	68,21		fulfilled	not fulfilled	-40,00
	8.00E+05	375,00	59,68		fulfilled	not fulfilled	-40,00
	9.00E+05	333,33	53,05		fulfilled	not fulfilled	-40,00
MHz	1,00	300,00	47,75		fulfilled	not fulfilled	-40,00
	1,59	188,50	30,00		fulfilled	not fulfilled	-40,00
	2,00	150,00	23,87		fulfilled	fulfilled	-38,02
	3,00	100,00	15,92		fulfilled	fulfilled	-34,49
	4,00	75,00	11,94		fulfilled	fulfilled	-32,00
	5,00	60,00	9,55		fulfilled	fulfilled	-30,06
	6,00	50,00	7,96		fulfilled	fulfilled	-28,47
	7,00	42,86	6,82		fulfilled	fulfilled	-27,13
	8,00	37,50	5,97		fulfilled	fulfilled	-25,97
	9,00	33,33	5,31		fulfilled	fulfilled	-24,95
	10,00	30,00	4,77		fulfilled	fulfilled	-24,04
	10,60	28,30	4,50		fulfilled	fulfilled	-23,53
	11,00	27,27	4,34		fulfilled	fulfilled	-23,21
	12,00	25,00	3,98		fulfilled	fulfilled	-22,45
	13,56	22,12	3,52		fulfilled	fulfilled	-21,39
	15,00	20,00	3,18		fulfilled	fulfilled	-20,51
	15,92	18,85	3,00		fulfilled	fulfilled	-20,00
	17,00	17,65	2,81		not fulfilled	fulfilled	-20,00
	18,00	16,67	2,65		not fulfilled	fulfilled	-20,00
	20,00	15,00	2,39		not fulfilled	fulfilled	-20,00
	21,00	14,29	2,27		not fulfilled	fulfilled	-20,00
	23,00	13,04	2,08		not fulfilled	fulfilled	-20,00
	25,00	12,00	1,91		not fulfilled	fulfilled	-20,00
	27,00	11,11	1,77		not fulfilled	fulfilled	-20,00
	29,00	10,34	1,65		not fulfilled	fulfilled	-20,00
	30,00	10,00	1,59		not fulfilled	fulfilled	-20,00

## 5.9. General Limit - Radiated field strength emissions, 30 MHz - 1 GHz

### 5.9.1. Test location and equipment

test location	<input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1)	<input type="checkbox"/> Please see Chapter. 2.2.2	<input type="checkbox"/> Please see Chapter. 2.2.3
test site	<input checked="" type="checkbox"/> 441 EMI SAR	<input checked="" type="checkbox"/> 487 SAR NSA	
receiver	<input type="checkbox"/> 377 ESCS30	<input checked="" type="checkbox"/> 001 ESS	<input type="checkbox"/> 489 ESU 40
spectr. analys.	<input type="checkbox"/> 584 FSU	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 264 FSEK
antenna	<input checked="" type="checkbox"/> 574 BTA-L	<input type="checkbox"/> 133 EMCO3115	<input type="checkbox"/> 302 BBHA9170
signaling	<input type="checkbox"/> 392 MT8820A	<input checked="" type="checkbox"/> 371 CBT32	<input type="checkbox"/> 547 CMU
otherwise	<input type="checkbox"/> 400 FTC40x15E	<input type="checkbox"/> 401 FTC40x15E	<input type="checkbox"/> 110 USB LWL
DC power	<input type="checkbox"/> 456 EA 3013A	<input type="checkbox"/> 457 EA 3013A	<input type="checkbox"/> 459 EA 2032-50
line voltage	<input type="checkbox"/> 230 V 50 Hz via public mains	<input type="checkbox"/> 060 120 V 60 Hz via PAS 5000	<input type="checkbox"/> 289 CBL 6141
			<input type="checkbox"/> 030 HPH-Z2
			<input type="checkbox"/> 477 GPS
			<input type="checkbox"/> 482 Filter Matrix
			<input type="checkbox"/> 268 EA- 3050
			<input type="checkbox"/> 494 AG6632A
			<input type="checkbox"/> 498 NGPE

### 5.9.2. Requirements/Limits

FCC		<input type="checkbox"/> Part 15 Subpart B, §15.109, class B <input checked="" type="checkbox"/> Part 15 Subpart C, §15.209 @ frequencies defined in §15.205	
IC		<input type="checkbox"/> RSS-Gen., Issue 4, Chapter 8.9, Table 4+6 (licence-exempt radio apparatus) <input type="checkbox"/> RSS-Gen., Issue 4, Chapter 7.1.2, Table 2 (receiver) <input type="checkbox"/> ICES-003, Issue 6, Table 5 (Class B) <input checked="" type="checkbox"/> RSS-247, Issue 1, Chapter 5	
ANSI		<input type="checkbox"/> C63.4-2014 <input checked="" type="checkbox"/> C63.10-2013	
Limit	Frequency [MHz]	Radiated emissions limits, 3 meters	
		QUASI Peak [ $\mu$ V/m]	
		30 - 88	100
		88 - 216	150
		216 - 960	200
		above 960	500
			40.0
			43.5
			46.0
			54.0

### 5.9.3. Restricted bands of operation (FCC §15.205/ RSS-Gen, Issue 4 Chapter 8.9, Table 4)

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.20725-4.20775	37.5-38.25	1645.5-1646.5	9.3-9.5
6.215-6.218	73-74.6	1660-1710	10.6-12.7
6.26775-6.26825	74.8-75.2	1718.8-1722.2	13.25-13.4
6.31175-6.31225	108-121.94	2200-2300	14.47-14.5
8.291-8.294	123-138	2310-2390	15.35-16.2
8.362-8.366	149.9-150.05	2483.5-2500	17.7-21.4
8.37625-8.38675	156.52475-156.52525	2690-2900	22.01-23.12
8.41425-8.41475	156.7-156.9	3260-3267	23.6-24.0
12.29-12.293	162.0125-167.17	3332-3339	31.2-31.8
12.51975-12.52025	167.72-173.2	3345.8-3358	36.43-36.5
12.57675-12.57725	240-285	3600-4400	--
13.36-13.41	322-335.4	--	--

Remark: only spurious emissions are allowed within these frequency bands not exceeding the limits per §15.209

#### 5.9.4. Test condition and measurement test set-up

Signal link to test system (if used):	<input checked="" type="checkbox"/> air link <input type="checkbox"/> cable connection <input type="checkbox"/> none
EUT-grounding	<input checked="" type="checkbox"/> none <input type="checkbox"/> with power supply <input type="checkbox"/> additional connection
Equipment set up	<input checked="" type="checkbox"/> table top 0.8m height <input type="checkbox"/> floor standing
Climatic conditions	Temperature: (22±3°C) Rel. humidity: (40±20)%
EMI-Receiver (Analyzer) Settings	<p>Scan frequency range: <input checked="" type="checkbox"/> 30 – 1000 MHz <input type="checkbox"/> other:  <input checked="" type="checkbox"/> 6 dB EMI-Receiver Mode <input type="checkbox"/> 3 dB spectrum analyser mode</p> <p>Detector</p> <p>RBW/VBW</p> <p>Mode:</p> <p>Scan step</p> <p>Sweep-Time</p> <p>Repetitive-Scan, max-hold 80 kHz</p> <p>Coupled – calibrated display if continuous tx-signal otherwise adapted to EUT's individual duty-cycle</p>
General measurement procedures	Please see chapter "Test system set-up for electric field measurement in the range 30 MHz to 1 GHz"

#### 5.9.5. MEASUREMENT RESULTS

The results are presented below in summary form only. For more information please consult the diagrams included in annex 1.

Table of measurement results:

Dia-gram no.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
3.10	Low	0	30 MHz – 1 GHz	1	1	2DH5 packet type	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	passed
3.09	Middle	39	30 MHz – 1 GHz	1	1	DH5 packet type	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	passed
3.05	High	78	30 MHz – 1 GHz	1	1	DH5 packet type	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	passed
3.06	High	78	30 MHz – 1 GHz	1	1	3DH5 packet type	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	passed

Remark: see annex 1 for measurement diagrams

## 5.10. General Limit - Radiated emissions, above 1 GHz

### 5.10.1. Test location and equipment FAR

test site	<input type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 348 EMI cond.	<input checked="" type="checkbox"/> 443 EMI FAR	<input type="checkbox"/> 347 Radio.lab.	<input type="checkbox"/> 337 OATS	<input type="checkbox"/>
spectr. analys.	<input type="checkbox"/> 584 FSU	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 264 FSEK	<input checked="" type="checkbox"/> 489 ESU 40	<input type="checkbox"/> C	<input type="checkbox"/>
antenna meas	<input type="checkbox"/> 574 BTA-L	<input type="checkbox"/> 289 CBL 6141	<input type="checkbox"/> 608 HL 562	<input checked="" type="checkbox"/> 549 HL025	<input checked="" type="checkbox"/> 302 BBHA9170	<input type="checkbox"/> 477 GPS
antenna meas	<input type="checkbox"/> 123 HUF-Z2	<input type="checkbox"/> 132 HUF-Z3	<input type="checkbox"/> 030 HFH-Z2	<input checked="" type="checkbox"/> 376 BBHA9120E		<input type="checkbox"/>
antenna subst	<input type="checkbox"/> 071 HUF-Z2	<input type="checkbox"/> 020 EMC03115	<input type="checkbox"/> 063 LP 3146	<input type="checkbox"/> 303 BBHA9170	<input type="checkbox"/> C	<input type="checkbox"/>
multimeter	<input type="checkbox"/> 341 Fluke 112	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> C	<input type="checkbox"/>
signaling	<input type="checkbox"/> 392 MT8820A	<input checked="" type="checkbox"/> 371 CBT32	<input type="checkbox"/> 547 CMU	<input type="checkbox"/> 594 CMW		
DCpower	<input type="checkbox"/> 086 LNG50-10	<input type="checkbox"/> 087 EA3013	<input type="checkbox"/> 354 NGPE 40	<input type="checkbox"/> 349 car battery	<input type="checkbox"/> 350 Car battery	<input type="checkbox"/>
line voltage	<input type="checkbox"/> 230 V 50 Hz via public mains		<input type="checkbox"/> 060 120 V 60 Hz via PAS 5000			

### 5.10.2. Requirements/Limits (CLASS B equipment)

FCC	<input type="checkbox"/> Part 15 Subpart B, §15.109 class B <input checked="" type="checkbox"/> Part 15 Subpart C, §15.209 for frequencies defined in §15.205 <input type="checkbox"/> Part 15 Subpart C, §15.407(b)(1)(2)(3) 9																
IC	<input checked="" type="checkbox"/> RSS-Gen., Issue 4, Chapter 8.9, Table 4+6 (transmitter licence exempt) <input type="checkbox"/> RSS-Gen., Issue 4, Chapter 8.9, Table 2 (receiver) <input type="checkbox"/> ICES-003, Issue 6, Chapter 6.2.2, Table 7 (class B) <input checked="" type="checkbox"/> RSS-247, Issue 1, Chapter 5.5																
ANSI	<input type="checkbox"/> C63.4-2014 <input checked="" type="checkbox"/> C63.10-2013																
Frequency [MHz]	<table border="1"> <thead> <tr> <th colspan="4">Limits</th> </tr> <tr> <th></th> <th>AV [<math>\mu</math>V/m]</th> <th>AV [dB<math>\mu</math>V/m]</th> <th>Peak [<math>\mu</math>V/m]</th> </tr> </thead> <tbody> <tr> <td>above 1 GHz for frequencies as defined in §15.205 or RSS-Gen., Issue 4, §8.10 - Table 6</td> <td>500</td> <td>54.0</td> <td>5000</td> </tr> <tr> <td></td> <td></td> <td></td> <td>74.0 dB<math>\mu</math>V/m</td> </tr> </tbody> </table>	Limits					AV [ $\mu$ V/m]	AV [dB $\mu$ V/m]	Peak [ $\mu$ V/m]	above 1 GHz for frequencies as defined in §15.205 or RSS-Gen., Issue 4, §8.10 - Table 6	500	54.0	5000				74.0 dB $\mu$ V/m
Limits																	
	AV [ $\mu$ V/m]	AV [dB $\mu$ V/m]	Peak [ $\mu$ V/m]														
above 1 GHz for frequencies as defined in §15.205 or RSS-Gen., Issue 4, §8.10 - Table 6	500	54.0	5000														
			74.0 dB $\mu$ V/m														

### 5.10.3. Test condition and measurement test set-up

Signal link to test system (if used):	<input checked="" type="checkbox"/> air link	<input type="checkbox"/> cable connection	<input type="checkbox"/> none
EUT-grounding	<input checked="" type="checkbox"/> none	<input type="checkbox"/> with power supply	<input type="checkbox"/> additional connection
Equipment set up	<input checked="" type="checkbox"/> table top 1.5m height	<input type="checkbox"/> floor standing	
Climatic conditions	Temperature: (22±3°C)	Rel. humidity: (40±20)%	
Spectrum-Analyzer settings	Scan frequency range: <input checked="" type="checkbox"/> 1 – 18 GHz <input type="checkbox"/> 18 – 25 GHz <input type="checkbox"/> 18 – 40 GHz <input type="checkbox"/> other: <input checked="" type="checkbox"/> 6 dB EMI-Receiver Mode <input type="checkbox"/> 3 dB Spectrum analyser Mode Detector RBW/VBW Mode: Scan step Sweep-Time	Peak and Average 1 MHz / 3 MHz Repetitive-Scan, max-hold 400 kHz Coupled – calibrated display if CW signal otherwise adapted to EUT's individual duty-cycle	
General measurement procedures	Please see chapter "Test system set-up for radiated electric field measurements above 1 GHz"		

#### 5.10.4. Measurement Results

The results are presented below in summary form only. For more information please consult the diagrams included in annex 1.

Dia-gram no.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
4.09	Low	0	1-18GHz	3	1	2DH5 packet type	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	passed
4.11	Middle	39	1-18GHz	2	1	DH5 packet type	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	passed
4.05	High	78	1-18GHz	1	1	DH5 packet type	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	passed
4.05a	High		18-25GHz				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	passed
4.06	High	78	1-18GHz	1	1	3DH5 packet type	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	passed
4.06a	High		18-25GHz	1	1		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	passed

Remark: see diagrams in annex 1 for more details

## 5.11. Radiated Band-Edge compliance, field strength measurements accord. §15.205

### 5.11.1. Test location and equipment FAR

test site	<input type="checkbox"/> 441 EMI SAR	<input type="checkbox"/> 348 EMI cond.	<input checked="" type="checkbox"/> 443 EMI FAR	<input type="checkbox"/> 347 Radio.lab.	<input type="checkbox"/> 337 OATS	<input type="checkbox"/>
spectr. analys.	<input type="checkbox"/> 584 FSU	<input type="checkbox"/> 120 FSEM	<input type="checkbox"/> 264 FSEK	<input checked="" type="checkbox"/> 489 ESU 40	<input type="checkbox"/>	<input type="checkbox"/>
antenna meas	<input type="checkbox"/> 574 BTA-L	<input type="checkbox"/> 289 CBL 6141	<input type="checkbox"/> 608 HL 562	<input checked="" type="checkbox"/> 549 HL025	<input type="checkbox"/> 302 BBHA9170	<input type="checkbox"/> 477 GPS
antenna meas	<input type="checkbox"/> 123 HUF-Z2	<input type="checkbox"/> 132 HUF-Z3	<input type="checkbox"/> 030 HFH-Z2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
antenna subst	<input type="checkbox"/> 071 HUF-Z2	<input type="checkbox"/> 020 EMC03115	<input type="checkbox"/> 063 LP 3146	<input type="checkbox"/> 303 BBHA9170	<input type="checkbox"/>	<input type="checkbox"/>
multimeter	<input type="checkbox"/> 341 Fluke 112	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
signaling	<input checked="" type="checkbox"/> 371 CBT32	<input type="checkbox"/> 298 CMU 200	<input type="checkbox"/>	<input type="checkbox"/>		
DCpower	<input type="checkbox"/> 086 LNG50-10	<input type="checkbox"/> 087 EA3013	<input type="checkbox"/> 354 NGPE 40	<input type="checkbox"/> 349 car battery	<input type="checkbox"/> 350 Car battery	<input type="checkbox"/>
line voltage	<input type="checkbox"/> 230 V 50 Hz via public mains	<input type="checkbox"/>	<input type="checkbox"/> 060 120 V 60 Hz via PAS 5000			

### 5.11.2. Requirements/Limits

FCC	<input type="checkbox"/> Part 15 Subpart B, §15.109 class B <input checked="" type="checkbox"/> Part 15 subpart C, §15.209 @ frequencies defined in §15.205			
IC	<input checked="" type="checkbox"/> RSS-247 Issue 1, Chapter 5.5, RSS-Gen: Issue 4: §8.9 Table 4+5+6			
ANSI	<input type="checkbox"/> C63.4-2009 <input checked="" type="checkbox"/> C63.10-2013			
Frequency [MHz]	Right Band-Edge Limits beginning on 2483.5MHz@3 meters			
	AV [ $\mu$ V/m]	AV [dB $\mu$ V/m]	Peak [ $\mu$ V/m]	Peak [dB $\mu$ V/m]
above 1 GHz	500	54.0	5000	74.0

### 5.11.3. MEASUREMENT METHOD FOR BAND-EDGE:

For uncritical results where a measurement bandwidth of 1MHz can clearly show the compliance without influencing the results, a field strength measurement was performed only.

For critical results a Marker-Delta marker method was used for showing compliance to restricted bands according §15.205. The method is according ANSI 63.10:2013 “Marker-Delta method”, §6.9.3. The method consists of three independent steps:

1. Step: Prior to the measurement the fundamental radiated In-Band field strength was performed. The determined value is used as reference value.
2. Step: Second step consist of finding the relative attenuation between the fundamental emission and the maximum local out-of-band emission (within 2 MHz range around the band edge either on the band-edge directly or some modulation product if the level is greater than that on the band-edge) when measured with lower resolution bandwidth.
3. Step: The delta value recorded in step 2 will be subtracted from value recorded in step 1, thus giving the required field strength at the band-edge. This value must fulfil the requirements for radiated spurious emissions in restricted bands in §15.205 with the general limits of §15.209.

### 5.11.4. RESULTS – LEFT BAND-EDGE

Diagram no.	Channel no.	Restricted band ?	Fundamental Value [dB $\mu$ V/m]		Peak-Value at Band- Edge [dB $\mu$ V/m]	Difference [dB]	Limit [dBc]	Margin [dB]	Verdict	Remark:
			Peak-Value	Average-Value						
9.11_BE_Ch0	0	no	100,56	99,8	50,7	49,84	20	29,84	PASS	DH5 packet type, 4dBm power level
9_13_BE_Ch0	0	no	88,21	88,08	52,0	36,21	20	16,21	PASS	2DH5 packet type, 4dBm power level
9.15_BE_Ch0	0	no	88,40	83,11	52,0	36,4	20	16,4	PASS	3DH5 packet type, 4dBm power level
9.17_BE_Low	0	no	88,00	68,83	49,92	38,08	20	18,08	PASS	Hopping-on mode, Reference is channel 0 4dBm power level, DH5 packet type

### 5.11.5. RESULTS – RIGHT BAND-EDGE

Diagram No.	Channel no.	Restricted band ?	Fundamental Value [dBuV/m]		Value at Band-Edge [dBuV/m]		Limits [dBuV/m]		Margin [dB]		Verdict	Remark:
			Peak-Value	Average-Value	Peak-Value	Average-Value	Peak-Value	Average-Value	Peak	Average		
9.12_BE_Ch78	78	yes	102,23	101,54	58,5	46,8	74	54	15,5	7,2	PASS	DH5 packet type, 4dBm power level
9.14_BE_Ch78	78	yes	100,24	99,49	57,46	46,03	74	54	16,54	7,97	PASS	2DH5 packet type, 4dBm power level
9.16_BE_Ch78	78	yes	96,09	93,06	56,92	46,02	74	54	17,08	7,98	PASS	3DH5 packet type, 4dBm power level
9.18_BE_High	78	yes	94,56	94,56	56,76	45,95	74	54	17,24	8,05	PASS	DH5 packet type, Hopping-on mode, 4dBm power level

### 5.11.6. VERDICT: PASS

## 5.12. Measurement uncertainties

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor  $k$ , such that a confidence level of approximately 95% is achieved.

For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it's contribution to the overall uncertainty according it's statistical distribution calculated.

Following table shows expectable uncertainties for each measurement type performed.

RF-Measurement	Reference	Frequency range	Calculated uncertainty based on a confidence level of 95%						Remarks
Conducted emissions (U <sub>CISPR</sub> )	CISPR 16-2-1	9 kHz - 150 kHz 150 kHz - 30 MHz	4.0 dB 3.6 dB						-
Radiated emissions Enclosure	CISPR 16-2-3	30 MHz - 1 GHz 1 GHz - 18 GHz	4.2 dB 5.1 dB						E-Field
Disturbance power	CISPR 16-2-2	30 MHz - 300 MHz	-						-
Power Output radiated	-	30 MHz - 4 GHz	3.17 dB						Substitution method
Power Output conducted	-	Set-up No.	Cel-C1	Cel-C2	BT1	W1	W2	--	
		9 kHz - 12.75 GHz	N/A	0.60	0.7	0.25	N/A	--	-
		12.75 - 26.5GHz	N/A	0.82	--	N/A	N/A	--	
Conducted emissions on RF-port	-	9 kHz - 2.8 GHz	0.70	N/A	0.70	N/A	0.69	--	N/A - not applicable
		2.8 GHz - 12.75GHz	1.48	N/A	1.51	N/A	1.43	--	
		12.75 GHz - 18GHz	1.81	N/A	1.83	N/A	1.77	--	
		18 GHz - 26.5GHz	1.83	N/A	1.85	N/A	1.79	--	
Occupied bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
			1.0 dB						Power
Emission bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
			See above: 0.70 dB						Power
Frequency stability	-	9 kHz - 20 GHz	0.0636 ppm						-
Radiated emissions Enclosure	-	150 kHz - 30 MHz	5.0 dB						Magnetic field
		30 MHz - 1 GHz	4.2 dB						E-field
		1 GHz - 20 GHz	3.17 dB						Substitution

Table: measurement uncertainties, valid for conducted/radiated measurements

## 6. Abbreviations used in this report

<b>The abbreviations</b>	
ANSI	American National Standards Institute
AV , AVG, CAV	Average detector
EIRP	Equivalent isotropically radiated power, determined within a separate measurement
EGPRS	Enhanced General Packet Radio Service
EUT	Equipment Under Test
FCC	Federal Communications Commission, USA
IC	Industry Canada
n.a.	not applicable
Op-Mode	Operating mode of the equipment
PK	Peak
RBW	resolution bandwidth
RF	Radio frequency
RSS	Radio Standards Specification, Dokuments from Industry Canada
Rx	Receiver
TCH	Traffic channel
Tx	Transmitter
QP	Quasi peak detector
VBW	Video bandwidth
ERP	Effective radiated power

## 7. Accreditation details of CETECOM's laboratories and test sites

Ref.-No.	Accreditation Certificate	Valid for laboratory area or test site	Accreditation Body
-	D-PL-12047-01-01	All laboratories and test sites of CETECOM GmbH, Essen	DAkkS, Deutsche Akkreditierungsstelle GmbH
337 487 558 348 348	(MRA US-EU 0003)	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measurem.	FCC, Federal Communications Commission Laboratory Division, USA
337 487 550 558	3462D-1 3462D-2 3462D-2 3462D-3	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR)	IC, Industry Canada Certification and Engineering Bureau
487 550 348 348	R-2666 G-301 C-2914 T-1967	Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measurem.	VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan

OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room

## 8. Instruments and Ancillary

### 8.1. Used equipment “CTC”

The “Ref.-No” in the left column of the following tables allows the clear identification of the laboratory equipment.

#### 8.1.1. Test software and firmware of equipment

Ref.-No.	Equipment	Type	Serial-No.	Version of Firmware or Software during the test
001	EMI Test Receiver	ESS	825132/017	Firm.= 1.21 , OTP=2.0, GRA=2.0
012	Signal Generator (EMS-cond.)	SMY 01	839069/027	Firm.= V 2.02
013	Power Meter (EMS cond.)	NRVD	839111/003	Firm.= V 1.51
017	Digital Radiocommunication Tester	CMD 60 M	844365/014	Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99
053	Audio Analyzer	UPA3	860612/022	Firm. V 4.3
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	Firm.= V 3.1DHG
140	Signal Generator	SMHU	831314/006	Firm.= 3.21
261	Thermal Power Sensor	NRV-Z55	825083/0008	EPROM-Datum 02.12.04, SE EE 1 B
262	Power Meter	NRV-S	825770/0010	Firm.= 2.6
263	Signal Generator	SMP 04	826190/0007	Firm.=3.21
295	Racal Digital Radio Test Set	6103	1572	UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04, SW-DSP=1.02, Hardboot=1.02, Softboot=2.02
298	Univ. Radio Communication Tester	CMU 200	832221/091	R&S Test Firmware =3.53 /3.54 (current Testsoftw. f. all band used)
323	Digital Radiocommunication Tester	CMD 55	825878/0034	Firm.= 3.52 .22.01.99
335	CTC-EMS-Conducted	System EMS Conducted	-	EMC 32 V 8.52
340	Digital Radiocommunication Tester	CMD 55	849709/037	Firm.= 3.52 .22.01.99
355	Power Meter	URV 5	891310/027	Firm.= 1.31
365	10V Insertion Unit 50 Ohm	URV5-Z2	100880	Eeprom Data = 31.03.08
366	Ultra Compact Simulator	UCS 500 M4	V0531100594	Firm. UCS 500=001925/3.06a02, rc=ISMIEC 4.10
371	Bluetooth Tester	CBT32	100153	CBT V5.30+ SW-Option K55, K57
377	EMI Test Receiver	ESCS 30	100160	Firm.= 2.30, OTP= 02.01, GRA= 02.36
378	Broadband RF Field Monitor	RadiSense III	03D00013SNO-08	Firm.= V.03D13
389	Digital Multimeter	Keithley 2000	0583926	Firm. = A13 (Mainboard) A02 (Display)
392	Radio Communication Tester	MT8820A	6K00000788	Firm.= 4.50 #005, IPL=4.01#001,OS=4.02#001, GSM=4.41#013, W-CDMA= 4.54#004, scenario= 4.52#002
436	Univ. Radio Communication Tester	CMU 200	103083	R&S Test Firmware Base=5.14, Mess-Software= GSM:5.14 WCDMA:5.14 (current Testsoftw. f. all band
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR)	-	EMC 32 Version 8.52
442	CTC-SAR-EMS	System EMS field (SAR)	-	EMC 32 Version 8.40
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	Spuri 7.2.5 or EMC 32 Ver. 9.15.00
444	CTC-FAR-EMS field	System-EMS-Field (FAR)	-	EMC 32 Version 9.15.00
460	Univ. Radio Communication Tester	CMU 200	108901	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used,
489	EMI Test Receiver	ESU40	1000-30	Firmware=4.43 SP3, Bios=V5.1-16-3, Spec. =01.00
491	ESD Simulator dito	ESD dito	dito307022	V 2.30
524	Voltage Drop Simulator	VDS 200	0196-16	Software Nr: 000037 Version V4.20a01
526	Burst Generator	EFT 200 A	0496-06	Software Nr. 000034 Version V2.32
527	Micro Pulse Generator	MPG 200 B	0496-05	Software-Nr. 000030 Version V2.43
528	Load Dump Simulator	LD 200B	0496-06	Software-Nr. 000031 Version V2.35a01
546	Univ. Radio Communication Tester	CMU 200	106436	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used
547	Univ. Radio Communication Tester	CMU 200	835390/014	R&S Test Firmware Base=V5.1403 (current Testsoftw., f. all band used, GSM = 5.14 WCDMA: = 5.14
584	Spectrum Analyzer	FSU 8	100248	2.82_SP3
597	Univ. Radio Communication Tester	CMU 200	100347	R&S Test Firmware Base=5.01, GSM=5.02 WCDMA= not installed, Mainboard= $\mu$ P1=V.850
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Firmware Bios 3.40 , Analyzer 3.40 Sp 2
620	EMI Test Receiver	ESU 26	100362	4.43_SP3
642	Wideband Radio Communication Tester	CMW 500	126089	Setup V03.26, Test programm component V03.02.20
670	Univ. Radio Communication Tester	CMU 200	106833	$\mu$ P1=V8.50, Firmware = V.20
689	Vector Signal Generator	SMU200	100970	02.20.360.142
692	Bluetooth Tester	CBT 32	100236	CBT V 5.40, FW: V.2.41 (FPGA Digital, V. 3.09 FPGA RF)

### 8.1.2. Single instruments and test systems

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
001	EMI Test Receiver	ESS	825132/017	Rohde & Schwarz	12 M	-	30.05.2017
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	12 M	-	30.05.2017
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	12 M	-	30.05.2017
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	30.04.2017
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	30.05.2019
020	Horn Antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.03.2017
021	Loop Antenna (H-Field)	6502	9206-2770	EMCO	36 M	-	30.04.2018
030	Loop Antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz	36 M	-	30.04.2018
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	30.04.2017
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz	pre-m	1a	
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
066	notch filter (WCDMA; FDD1)	WRCT 1900/2200-5/40-10EEK	5	Wainwright GmbH	12 M	1g	30.06.2016
086	DC - power supply, 0 -10 A	LNG 50-10	-	Heinzinger Electronic	pre-m	2	
087	DC - power supply, 0 -5 A	EA-3013 S	-	Elektro Automatik	pre-m	2	
091	USB-LWL-Converter	OLS-1	007/2006	Ing. Büro Scheiba	-	4	
099	passive voltage probe	ESH2-Z3	299.7810.52	Rohde & Schwarz	36 M	-	30.04.2018
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	36 M	-	30.04.2018
110	USB-LWL-Converter	OLS-1	-	Ing. Büro Scheiba	-	4	
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	BOCONSULT	36 M	-	30.05.2019
136	adjustable dipole antenna (Dipole 1)	3121C-DB4	9105-0697	EMCO	36 M	-	30.04.2018
140	Signal Generator	SMHU	831314/006	Rohde & Schwarz	24 M	-	30.05.2018
248	attenuator	SMA 6dB 2W	-	Radiall	pre-m	2	
249	attenuator	SMA 10dB 10W	-	Radiall	pre-m	2	
252	attenuator	N 6dB 12W	-	Radiall	pre-m	2	
256	attenuator	SMA 3dB 2W	-	Radiall	pre-m	2	
257	hybrid	4031C	04491	Narda	pre-m	2	
260	hybrid coupler	4032C	11342	Narda	pre-m	2	
261	Thermal Power Sensor	NRV-Z55	825083/0008	Rohde & Schwarz	24 M	-	30.05.2018
262	Power Meter	NRV-S	825770/0010	Rohde & Schwarz	24 M	-	30.05.2018
263	Signal Generator	SMP 04	826190/0007	Rohde & Schwarz	36 M	-	30.05.2019
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24 M	-	30.05.2018
266	Peak Power Sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24 M	-	30.05.2018
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainwright GmbH	pre-m	2	
270	termination	1418 N	BB6935	Weinschel	pre-m	2	
271	termination	1418 N	BE6384	Weinschel	pre-m	2	
272	attenuator (20 dB) 50 W	Model 47	BF6239	Weinschel	pre-m	2	
273	attenuator (10 dB) 100 W	Model 48	BF9229	Weinschel	pre-m	2	
274	attenuator (10 dB) 50 W	Model 47 (10 dB) 50 W	BG0321	Weinschel	pre-m	2	
275	DC-Block	Model 7003 (N)	C5129	Weinschel	pre-m	2	
276	DC-Block	Model 7006 (SMA)	C7061	Weinschel	pre-m	2	
279	power divider	1515 (SMA)	LH855	Weinschel	pre-m	2	
287	pre-amplifier 25MHz - 4GHz	AMF-2D-100M4G-35-10P	379418	Miteq	12 M	1c	30.06.2017
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH	12 M	1c	30.06.2017
298	Univ. Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz	pre-m	3	
300	AC LISN (50 Ohm/50µH, 1-phase)	ESH3-Z5	892 239/020	Rohde & Schwarz	12 M	-	30.05.2017
301	attenuator (20 dB) 50W, 18GHz	47-20-33	AW0272	Lucas Weinschel	pre-m	2	
302	horn antenna 40 GHz (Meas 1)	BBHA9170	155	Schwarzbeck	36 M	-	31.03.2017
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	31.03.2017
331	Climatic Test Chamber -40/+80 Grad	HC 4055	43146	Heraeus Vötsch	Pre-m	2	
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	30.05.2018
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	30.04.2017
347	laboratory site	radio lab.	-	-	-	5	
348	laboratory site	EMI conducted	-	-	-	5	
354	DC - Power Supply 40A	NGPE 40/40	448	Rohde & Schwarz	pre-m	2	
355	Power Meter	URV 5	891310/027	Rohde & Schwarz	24 M	-	30.05.2018
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	30.04.2017
371	Bluetooth Tester	CBT32	100153	R&S	36 M	-	30.05.2019
373	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	100535	Rohde & Schwarz	12 M	-	30.05.2017
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	30.05.2017
389	Digital Multimeter	Keithley 2000	0583926	Keithley	24 M	-	30.04.2017
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	30.05.2017
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	30.04.2017
439	UltraLog-Antenna	HL 562	100248	Rohde & Schwarz	36 M	-	31.03.2017
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren / CETECOM	12 M	5	30.06.2017
448	notch filter WCDMA_FDD II	WRCT 1850.0/2170.0-5/40-	5	Wainwright Instruments GmbH	12 M	1c	30.06.2017

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-8SSK	1	Wainwright	12 M	1c	30.06.2017
454	Oscilloscope	HM 205-3	9210 P 29661	Hameg	-	4	
456	DC-Power supply 0-5 A	EA 3013 S	207810	Elektro Automatik	pre-m	2	
459	DC-Power supply 0-5 A , 0-32 V	EA-PS 2032-50	910722	Elektro Automatik	pre-m	2	
460	Univ. Radio Communication Tester	CMU 200	108901	Rohde & Schwarz	12 M	-	30.04.2017
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	30.05.2018
467	Digital Multimeter	Fluke 112	89680306	Fluke USA	36 M	-	30.04.2018
468	Digital Multimeter	Fluke 112	90090455	Fluke USA	36 M	-	30.04.2018
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
480	power meter (Fula)	NRVS	838392/031	Rohde & Schwarz	24 M	-	30.04.2017
482	filter matrix	Filter matrix SAR 1	-	CETECOM (Brl)	-	1d	
484	pre-amplifier 2,5 - 18 GHz	AMF-5D-02501800-25-10P	1244554	Miteq	12 M	-	30.06.2017
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	31.07.2017
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	30.05.2017
502	band reject filter	WRCG 1709/1786-1699/1796-	SN 9	Wainwright	pre-m	2	
503	band reject filter	WRCG 824/849-814/859-	SN 5	Wainwright	pre-m	2	
512	notch filter GSM 850	WRCA 800/960-02/40-6EEK	SN 24	Wainwright	12 M	1c	30.06.2017
517	relais switch matrix	HF Relais Box Keithley	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	30.04.2017
529	6 dB Broadband resistive power divider	Model 1515	LH 855	Weinschel	pre-m	2	
530	10 dB Broadband resistive power divider	R 416110000	LOT 9828	-	pre-m	2	
546	Univ. Radio Communication Tester	CMU 200	106436	R&S	12 M	-	30.05.2017
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	30.04.2017
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36/12 M	-	31.07.2018
550	System CTC S-VSWR Verification SAR-EMI	System EMI Field SAR S-VSWR	-	ETS Lindgren/CETECOM	24 M	-	31.07.2017
552	high pass filter 2,8-18GHz	WHKX 2.8/18G-10SS	4	Wainwright	12 M	1c	30.06.2017
557	System CTC-OTA-2	R&S TS8991	-	Rohde & Schwarz	12 M	5	30.09.2016
558	System CTC FAR S-VSWR	System CTC FAR S-VSWR	-	CTC	24 M	-	19.04.2017
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	31.03.2019
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	pre-m	-	
594	Wideband Radio Communication Tester	CMW 500	101757	Rohde & Schwarz	12 M	-	30.04.2017
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	pre-m	-	
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Rohde & Schwarz	24 M	-	30.04.2017
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	30.04.2017
601	medium-sensitivity diode sensor	NRV-Z5 (Reserve)	8435323/003	Rohde & Schwarz	24 M	-	30.04.2017
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	
611	DC power supply	E3632A	KR 753050854	Agilent	pre-m	2	
612	DC power supply	E3632A	MY 40001321	Agilent	pre-m	2	
613	Attenuator	R416120000 20dB 10W	Lot. 9828	Radiall	pre-m	2	
616	Digitalmultimeter	Fluke 177	88900339	Fluke	24 M	-	30.05.2018
617	Power Splitter/Combiner	ZFSC-2-2-S+	S F987001108	Mini Circuits	-	2	
618	Power Splitter/Combiner	50PD-634	600994	JFW Industries USA	-	2	
619	Power Splitter/Combiner	50PD-634	600995	JFW Industries, USA	-	3	
620	EMI Test Receiver	ESU 26	100362	Rohde-Schwarz	12 M	-	30.05.2017
621	Step Attenuator 0-139 dB	RSP	100017	Rohde & Schwarz	pre-m	2	
625	Generic Test Load USB	Generic Test Load USB	-	CETECOM	-	2	
627	data logger	OPUS 1	201.0999.9302.6.4.1.4 3	G. Luft GmbH	24 M	-	30.04.2017
634	Spectrum Analyzer	FSM (HF-Unit)	826188/010	Rohde & Schwarz	pre-m	2	
637	High Speed HDMI with Ethernet 1m	HDMI cable with Ethernet 1m	-	KogiLink	-	2	
638	HDMI Kabel with Ethernet 1,5 m flach	HDMI cable with Ethernet	-	Reichelt	-	2	
640	HDMI cable 2m rund	HDMI cable 2m rund	-	Reichelt	-	2	
641	HDMI cable with Ethernet	Certified HDMI cable with	-	PureLink	-	2	
644	Amplifier	ZX60-2534M+	SN865701299	Mini-Circuits	-	-	
670	Univ. Radio Communication Tester	CMU 200	106833	Rohde & Schwarz	24 M	-	30.05.2018
671	DC-power supply 0-5 A	EA-3013S	-	Elektro Automatik	pre-m	2	
678	Power Meter	NRP	101638	Rohde&Schwarz	pre-m	-	
683	Spectrum Analyzer	FSU 26	200571	Rohde & Schwarz	12 M	-	30.05.2017
686	Field Analyzer	EHP-200A	160WX30702	Narda Safety Test Solutions	24 M	-	30.04.2017
687	Signal Generator	SMF 100A	102073	Rohde&Schwarz	12 M	-	30.05.2017
688	Pre Amp	JS-18004000-40-8P	1750117	Miteq	pre-m	-	
690	Spectrum Analyzer	FSU	100302/026	Rohde&Schwarz	12 M	-	30.05.2017
692	Bluetooth Tester	CBT 32	100236	Rohde & Schwarz	36 M	-	31.03.2017

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
697	Power Splitter	ZN4PD-642W-S+	165001445	Mini-Circuits	-	2	

### 8.1.3. Legend

Note / remarks	Calibrated during system calibration:	
1a	System CTC-SAR-EMS (Ref.-No. 442)	
1b	System-CTC-EMS-Conducted (Ref.-No. 335)	
1c	System CTC-FAR-EMI-RSE (Ref.-No. 443)	
1d	System CTC-SAR-EMI (Ref.-No. 441)	
1e	System CTC-OATS (EMI radiated) (Ref.-No. 337)	
1 f	System CTC-CTIA-OTA (Ref.-No. 420)	
1 g	System CTC-FAR-EMS (Ref.-No. 444)	
2	Calibration or equipment check immediately before measurement	
3	Regulatory maintained equipment for functional check or support purpose	
4	Ancillary equipment without calibration e.g. mechanical equipment or monitoring equipment	
5	Test System	

Interval of calibration	12 M	12 month
	24 M	24 month
	36 M	36 month
	24/12 M	Calibration every 24 months, between this every 12 months internal validation
	36/12 M	Calibration every 36 months, between this every 12 months internal validation
	Pre-m	Check before starting the measurement
	-	Without calibration

## 9. Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2016-08-10
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