

# Test Report

Report Number:  
**F134429E1**

Applicant:

**CeoTronics AG**

Manufacturer:

**CeoTronics AG**

Equipment under Test (EUT):

**CT-Bluetoothmodule / CT-DECT Modul M6CEO1\_FP / CT-DECT Modul M6CEO1\_PP**



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

## REFERENCES

- [1] **ANSI C63.4-2009** American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- [2] **FCC CFR 47 Part 15 (January 2014)** Radio Frequency Devices
- [3] **FCC Public Notice DA 00-705 (March 2000)**
- [4] **RSS-210 Issue 8 (December 2010)** Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
- [5] **RSS-Gen Issue 3 (December 2010)** General Requirements and Information for the Certification of Radio Apparatus

## TEST RESULT

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

The complete test results are presented in the following.

Test engineer:	Manuel BASTERT		27 January 2014
	_____ Name	_____ Signature	_____ Date
Authorized reviewer:	Bernd STEINER		27 January 2014
	_____ Name	_____ Signature	_____ Date

## RESERVATION

This test report is only valid in its original form.

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# 1 IDENTIFICATION

## 1.1 Applicant

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Phone:	+49 (0) 6074-8751-631
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Mail address:	thorsten.neuhaus@ceotronics.com

## 1.3 Test laboratory

The tests were carried out at: **PHOENIX TESTLAB GmbH**  
**Königswinkel 10**  
**32825 Blomberg**  
**Germany**

Test Laboratory (CAB) accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under the Reg. No. D-PL-17186-01-02, recognized by Bundesnetzagentur under the Reg.-No. BNetzA-CAB-02/21-104.  
 CAB Designation Number DE0004, listed by FCC 31040/SIT1300F2, IC OATS Listing 3469A-1.

#### 1.4 EUT (Equipment Under Test)

Equipment under test: *	Bluetooth audio module
Model name: *	CT-Bluetoothmodule
Brand name: *	Bluegiga
Article number: *	-
FCC ID:	QQQWT32AE (Bluegiga), L52-CTBT32AE (CeoTronics)
IC:	5123A-BGTWT32AE (Bluegiga), 9714A-CTM6CEO1 (CeoTronics)
Serial number:	Evaboard S/N 131437
Hardware version:	V2.0
Software version:	3.0.0-165

Equipment under test: *	DECT module
Model name: *	CT-DECT Modul M6CEO1_FP CT-DECT Modul M6CEO1_PP
Brand name: *	CeoTronics AG
Article number: *	9803900, 9803901
FCC ID:	L52CT-M6CEO1
IC:	9714A-CTM6CEO1
Serial number:	n.a.
Hardware version:	n.a.
Software version:	1000313_1000479_2_1_0_50

## 1.5 Technical data of equipment

### Bluetooth module

Fulfills Bluetooth specification: *	V.2.1 with EDR		
Antenna type: *	SMD antenna		
Antenna gain: *	0 dBi		
Rated output power: *	0.0 dBm (50 $\Omega$ )		
Antenna connector: *	None		
Power supply: *	$U_{nom} = 3.7 V_{DC}$	$U_{min} = -$	$U_{max} = -$
Type of modulation: *	FHSS (GFSK, $\pi/4$ -DQPSK, 8DPSK)		
Operating frequency range: *	2402 MHz to 2480 MHz		
Number of channels: *	79		

### DECT module

Antenna type: *	Inverted F, 2 Printed Circuit Board Antennas ( $\frac{1}{4}$ wave antenna )		
Channel spacing: *	1.728 MHz		
Bit rate of transmitter: *	1152 kbps		
Power supply: *	$U_{nom} = 3.6 V_{DC}$	$U_{nom} = -$	$U_{nom} = -$
Type of modulation: *	GFSK		
Operating frequency range: *	1920 MHz to 1930 MHz		
Number of channels: *	5		

\*: Declared by the applicant.

The following external I/O cables were used:

None.

## 1.6 Dates

Date of receipt of test sample:	04 October 2013
Start of test:	05 November 2013
End of test:	18 November 2013

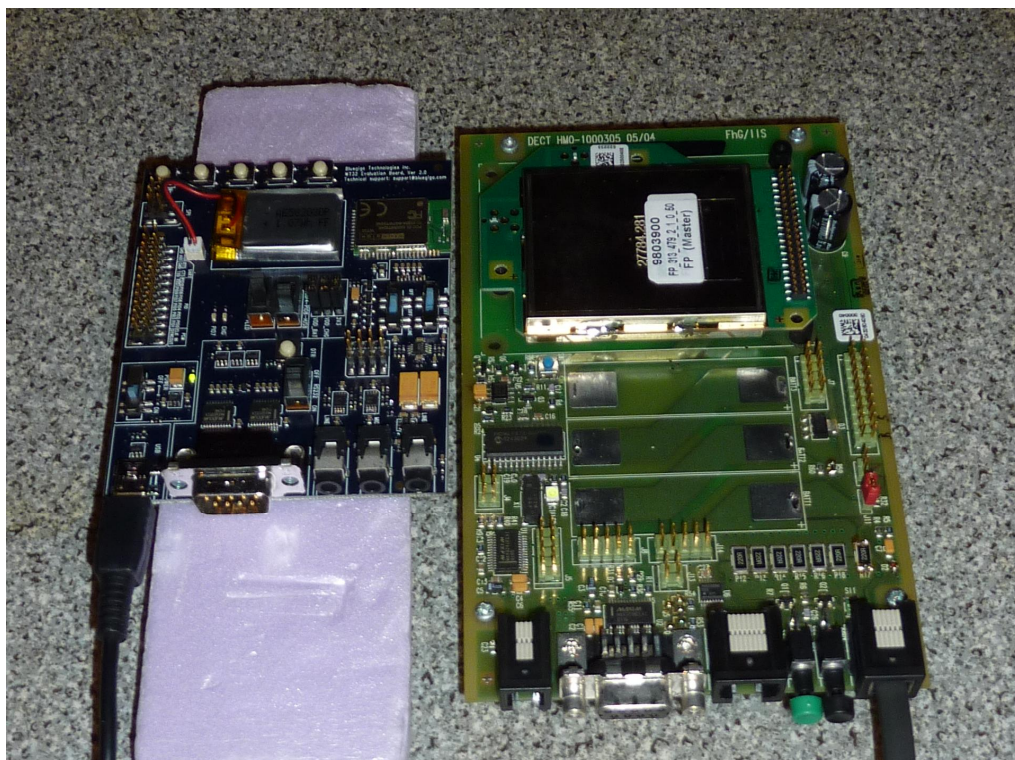
## 2 OPERATIONAL STATES

Because of using radio modules with different wireless techniques (DECT and Bluetooth) in one final application co-location measurements were carried out to exclude additional intermodulation. Therefore the antennas of both transmitters were adjusted as near as possible to each other and the power of each transmitter was set to its allowed maximum. This setup was assumed as worst case setup. The operation in the necessary test modes was realized using two evaluation boards on which the modules were mounted. For details

The following operation mode was used during the tests:

Operation mode	Description of the operation mode	Modulation	Data rate (Bluetooth / DECT)
1	Bluetooth TX on channel 39 DECT transmission at channel 25	8DPSK (Bluetooth) GFSK (DECT)	3 Mbps / 1152 kbps
2	Hopping on all channels DECT transmission at channel 25	8DPSK (Bluetooth) GFSK (DECT)	3 Mbps / 1152 kbps

### Setup



### 3 ADDITIONAL INFORMATION

In this test report only the simultaneous transmission measurement is described. The Bluetooth part as well as the DECT part is already tested.

**Ancillary equipment used to perform the measurements:**

Laptop Fujitsu Siemens 7100

### 4 OVERVIEW

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS 210, Issue 8 [4] or RSS-Gen, Issue 3 [5]	Status	Refer page
Radiated emissions (transmitter)	0.009 - 25,000	15.205 (a) 15.209 (a)	A8.5 [4] 2.5 [4]	Passed	9 et seq.



## 5 TEST RESULTS

### 5.1 Radiated emissions

#### 5.1.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into four stages.

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

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

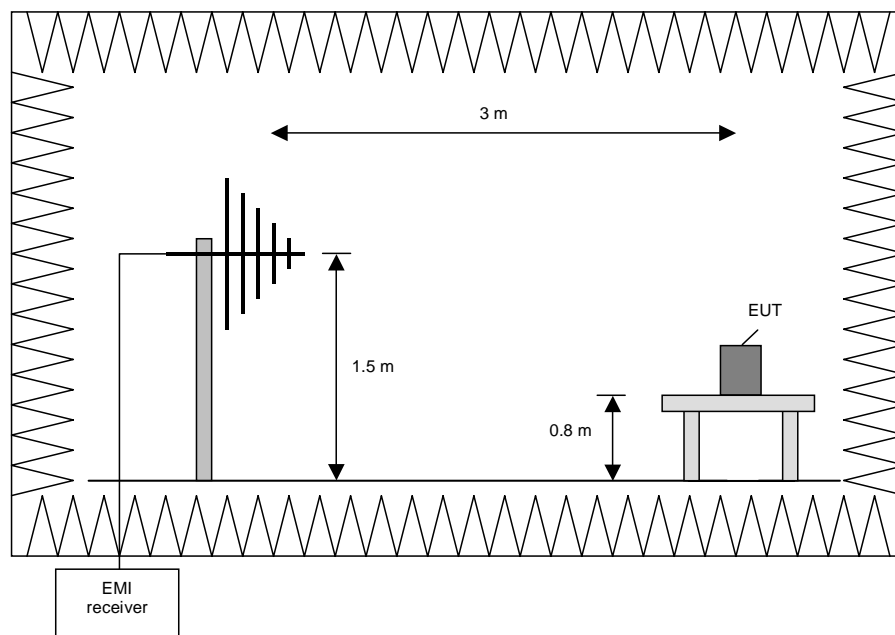
##### Preliminary measurement (30 MHz to 1 GHz)

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

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

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

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



#### Procedure preliminary measurement:

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.

The following procedure will be used:

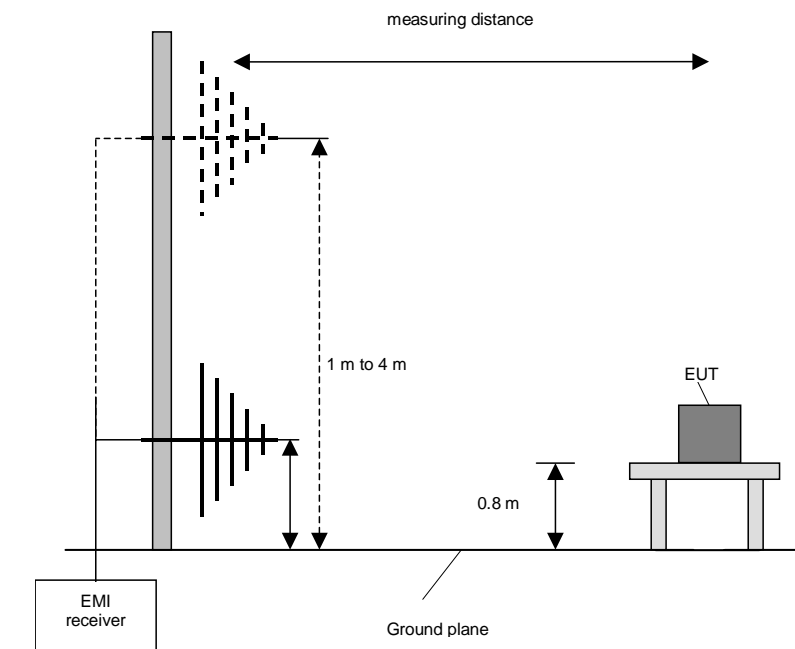
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the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

#### Final measurement (30 MHz to 1 GHz)

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

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

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



#### Procedure final measurement:

The following procedure will be used:

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

#### **Preliminary and final measurement (1 GHz to 110 GHz)**

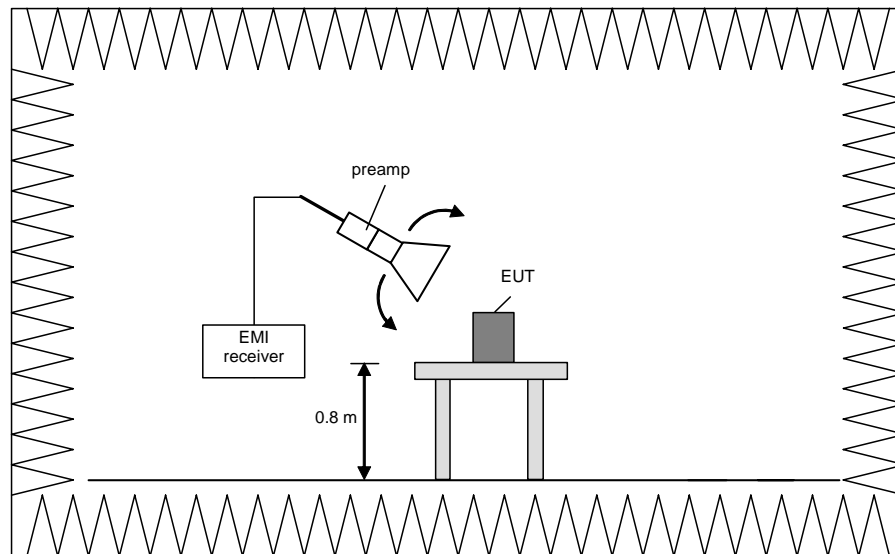
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The setup of the Equipment under test will be in accordance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

#### **Preliminary measurement (1 GHz to 110 GHz)**

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

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

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

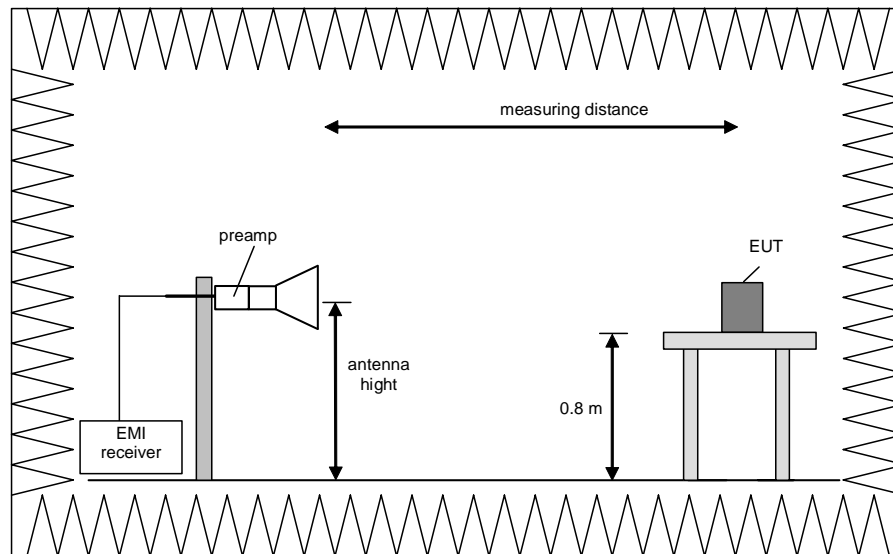


### **Final measurement (1 GHz to 110 GHz)**

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

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

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



#### Procedure of measurement:

The measurements were performed in the frequency range 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 26.5 GHz, 26.5 GHz to 40 GHz, 40 GHz to 60 GHz, 60 GHz to 75 GHz and 75 GHz to 110 GHz.

The following procedure will be used:

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

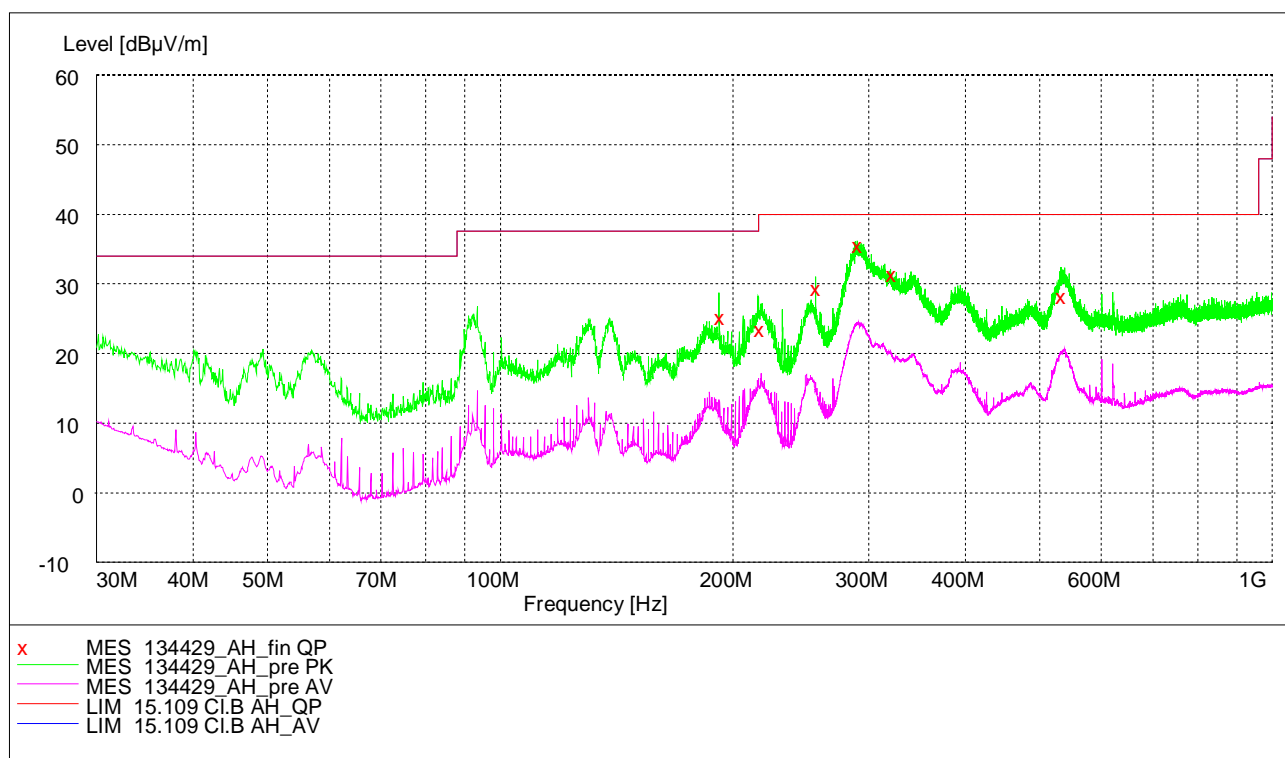
Step 1) to 6) are defined as preliminary measurement.

## 5.1.2 Test results (radiated emissions of simultaneous transmission of Bluetooth and DECT)

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

Ambient temperature	21 °C	Relative humidity	40 %
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Spurious emissions from 30 MHz to 1000 MHz



The following frequencies were found during the preliminary measurement and are marked by an x in the diagram above:

191.976 MHz, 215.952 MHz, 256.012 MHz, 289.672 MHz, 319.948 MHz and 531.544 MHz.

In this case it was necessary to carry out subsequent measurements on the open area test site. The results are shown in the following clause 5.1.2.2.

TEST EQUIPMENT USED FOR THE TEST:
20, 29, 31 – 35, 45

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

Ambient temperature	20 °C	Relative humidity	40 %
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Position of EUT: The EUT was setup on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

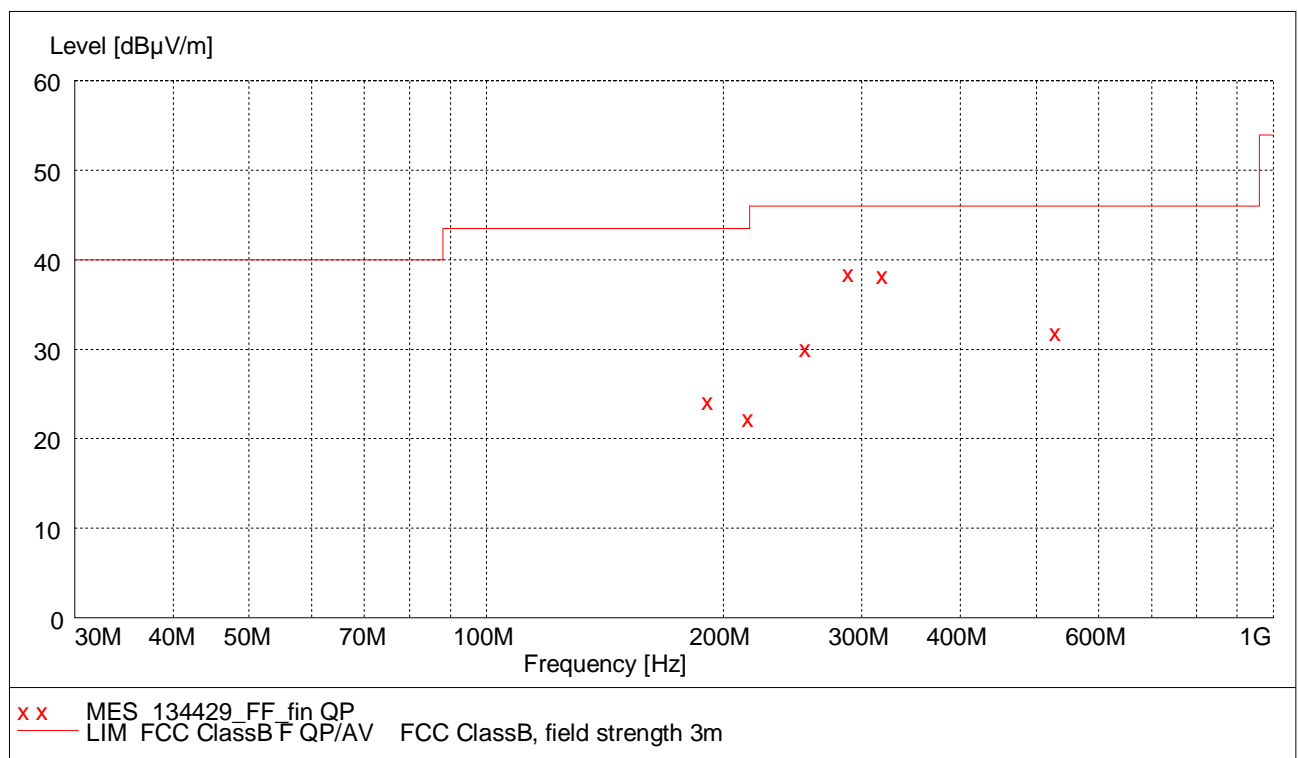
Cable guide: The cables of the EUT's are running vertically to the false floor. For detail information of test setup and the cable guide refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

Supply voltage: During all measurements the Bluetooth module was supplied via evaluation board with 3.7 V<sub>DC</sub> and the DECT module via evaluation board with 3.6 V<sub>DC</sub>.

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

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



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.

Frequency [MHz]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Readings [dBμV]	Antenna factor [1/m]	Cable loss [dB]	Height [cm]	Azim. [deg]	Pol.
191.976	24.5	43.5	19.0	14.0	9.0	1.5	119	69	Hor.
215.952	22.6	43.5	20.9	11.5	9.5	1.6	125	90	Hor.
256.012	30.4	46.0	15.6	16.0	12.6	1.8	100	107	Hor.
289.672	38.8	46.0	7.2	23.9	13.0	1.9	100	112	Vert.
319.948	38.5	46.0	7.5	23.2	13.4	1.9	100	126	Vert.
531.544	32.1	46.0	13.9	11.4	18.0	2.7	246	147	Hor.

Test result:     Passed.

TEST EQUIPMENT USED FOR THE TEST:

14 - 20



### 5.1.2.3 Preliminary radiated emission measurement (1 GHz to 25 GHz)

Ambient temperature	21 °C	Relative humidity	38 %
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Position of EUT: The EUT was setup on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

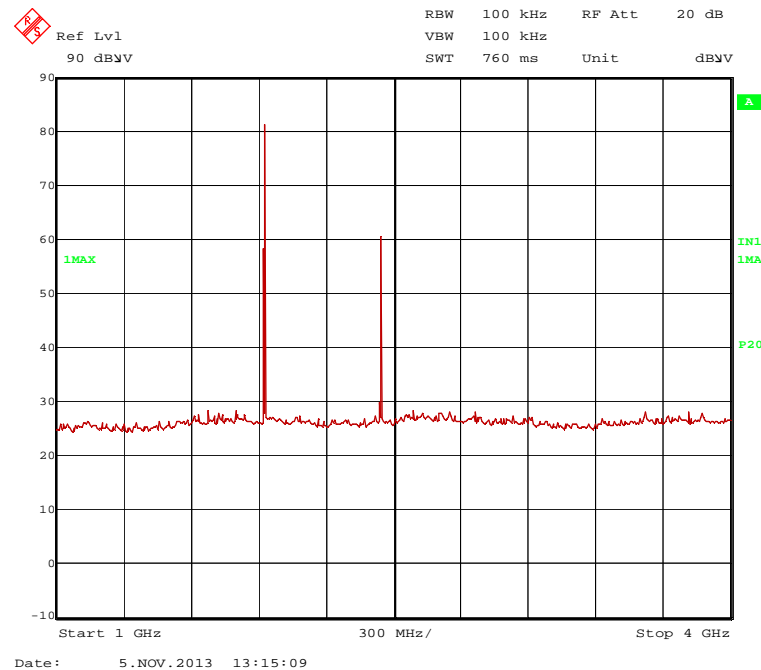
Cable guide: The cables of the EUTs are running vertically to the false floor. For detail information of test setup and the cable guide refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

Supply voltage: During all measurements the Bluetooth module was supplied via evaluation board with 3.7 V<sub>DC</sub> and the DECT module via evaluation board with 3.6 V<sub>DC</sub>.

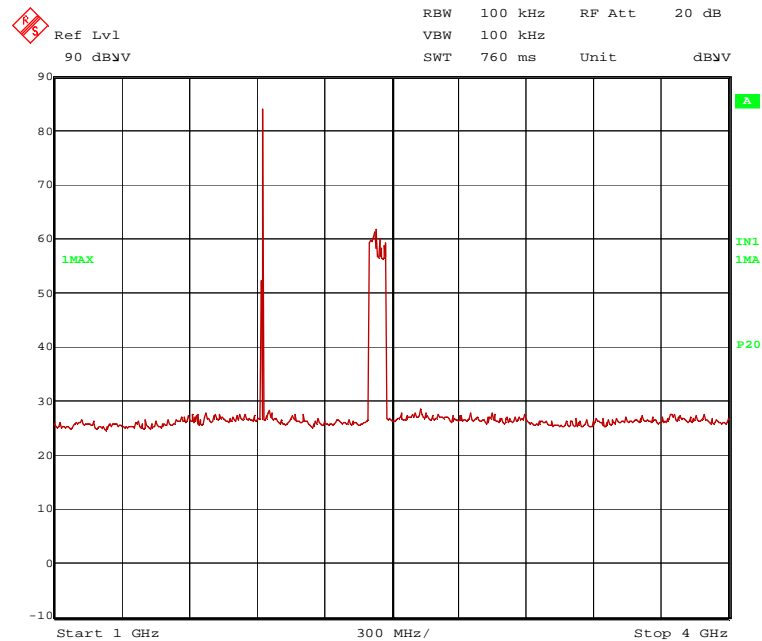
### Continuous DECT transmission at Channel 2 and Bluetooth Channel 39 (DH5, hopping off)

#### 134429 1.wmf: Spurious emissions from 1 GHz to 4 GHz



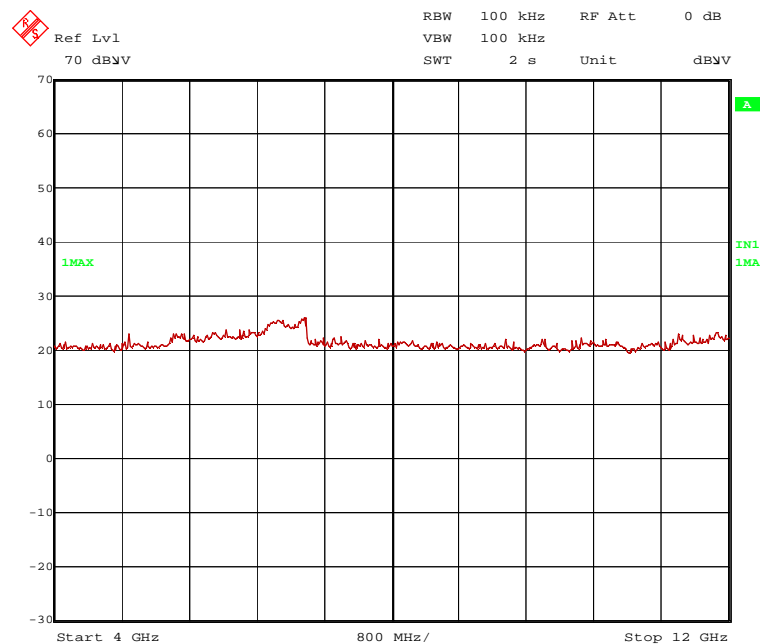
### Continuous DECT transmission at Channel 2 and Bluetooth (DH5, hopping on)

134429\_2.wmf: Spurious emissions from 1 GHz to 4 GHz:

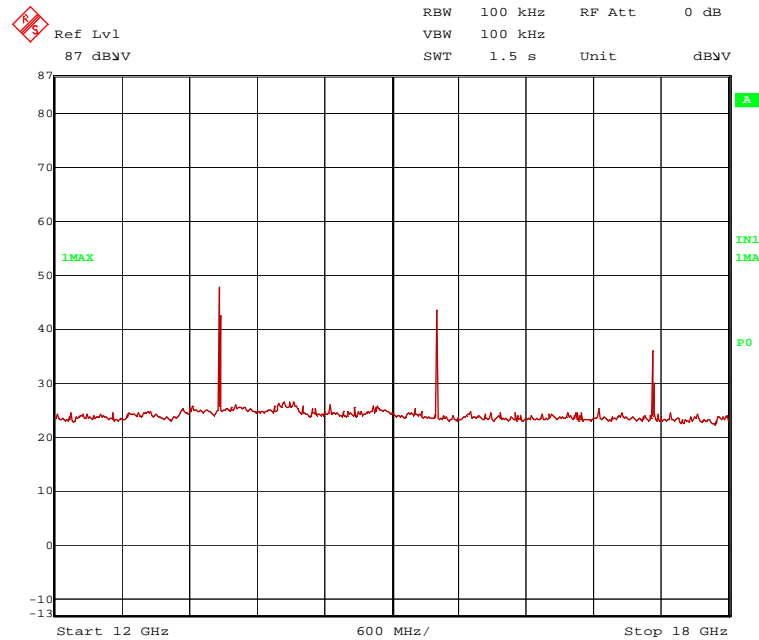


### Continuous DECT transmission at Channel 2 and Bluetooth Channel 39 (DH5, hopping off)

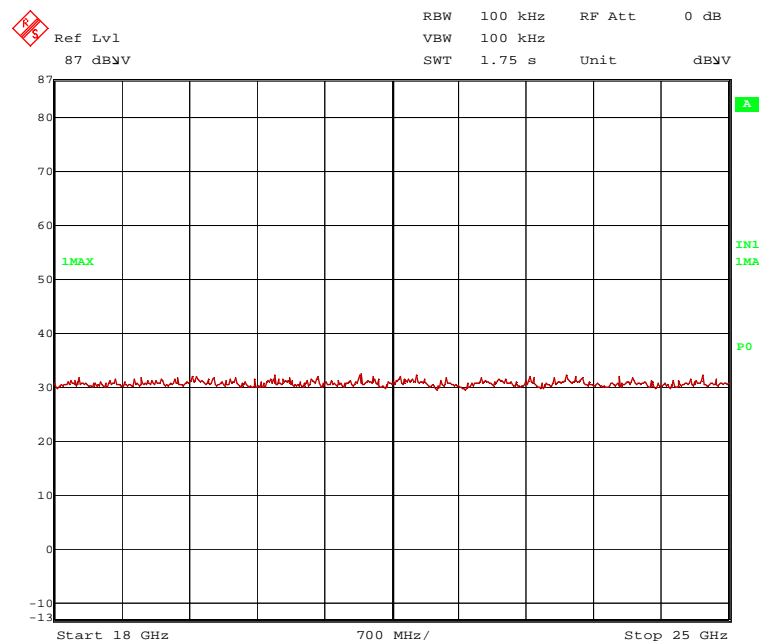
134429\_3.wmf: Spurious emissions from 4 GHz to 12 GHz:



134429\_4.wmf: Spurious emissions from 12 GHz to 18 GHz:



134429\_5.wmf: Spurious emissions from 18 GHz to 25 GHz:



Because only DECT harmonics are found (13.475 GHz, 15.4 GHz and 17.325 GHz) but no intermodulation products caused by simultaneous transmission, no final measurements were carried out. The measurement of DECT spurious emissions is not part of this report because the module is already tested.

Test result: Passed.

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 34, 36, 37, 39, 43, 44, 46, 49 - 51, 72

## 6 Test equipment

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
14	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
15	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	02/15/2010	02/2014
16	Controller	HD100	Deisel	100/670	480139	-	-
17	Turntable	DS420HE	Deisel	420/620/80	480087	-	-
18	Antenna support	AS615P	Deisel	615/310	480086	-	-
19	Antenna	CBL6111 D	Chase	25761	480894	28/09/2011	09/2014
20	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	-
29	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
30	Spectrum analyser	FSU	Rohde & Schwarz	200125	480956	07/15/2012	07/2015
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	02/13/2012	02/2014
32	Controller	MCU	Maturo	MCU/043/971107	480832	-	-
33	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
34	Antenna support	AS615P	Deisel	615/310	480187	-	-
35	Antenna	CBL6112 B	Chase	2688	480328	04/21/2011	04/2014
36	Antenna	3115	EMCO	9609-4918	480183	11/09/2011	11/2014
37	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Six month verification (system cal.)	
39	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297	Six month verification (system cal.)	
43	RF-cable No. 3	RTK 081	Rosenberger	-	481330	Weekly verification (system cal.)	
44	RF-cable No. 40	RTK 081	Rosenberger	-	480670	Weekly verification (system cal.)	
45	RF-cable No. 36	RTK 081	Rosenberger	-	410571	Weekly verification (system cal.)	
46	RF-cable 1 m	KPS-1533-400-KPS	Insulated Wire	-	480301	Six month verification (system cal.)	
49	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	Six month verification (system cal.)	
50	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	Six month verification (system cal.)	
51	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	Six month verification (system cal.)	
55	Antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	02/16/2012	02/2014
72	4 GHz High Pass Filter	WHKX4.0/18 G-8SS	Wainwright Instruments	1	480587	Weekly verification (system cal.)	
73	Measuring receiver	ESPC	Rohde & Schwarz	843756/006	480150	02/09/2012	02/2014

## 7 REPORT HISTORY

Report Number	Date	Comment
F134429E1	27 January 2014	Document created

## 8 LIST OF ANNEXES

### ANNEX A TEST SETUP PHOTOS 6 pages

134429_1.jpg	Test setup fully anechoic chamber
134429_2.jpg	Test setup fully anechoic chamber
134429_3.jpg	Test setup fully anechoic chamber
134429_4.jpg	Test setup fully anechoic chamber
134429_5.jpg	Test setup fully anechoic chamber
134429_6.jpg	Test setup open area test site

### ANNEX B EXTERNAL PHOTOS 7 pages

134429_7.jpg	DECT module, top view
134429_8.jpg	DECT module, bottom view
134429_9.jpg	DECT evaluation board, top view
134429_10.jpg	DECT evaluation board, bottom view
134429_11.jpg	Bluetooth module, top view
134429_12.jpg	Bluetooth evaluation board, top view
134429_13.jpg	Bluetooth evaluation board, bottom view

### ANNEX C INTERNAL PHOTOS 4 pages

134429_14.jpg	DECT module, outer shielding removed, top view
134429_15.jpg	DECT module, inner shielding removed, top view
134429_16.jpg	DECT module, shielding removed, bottom view
134429_17.jpg	Bluetooth module, shielding removed, top view