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Test Report

Report Number:

154064

Equipment under Test (EUT):

Transmitter / Smart Connect
Bluetooth Low Energy - / Gazell Mode transmitter

Applicant:

Jura Elektroapparate AG

Manufacturer:

Jura Elektroapparate AG

ilac-MRA
DAkkS Deutsche Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

References

[1] ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

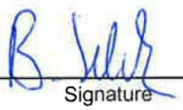
[2] FCC CFR 47 Part 15 (March 2016), Radio Frequency Devices

[2] RSS-247 (May 2015), Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

[2] RSS-Gen Issue 4 (November 2014), General Requirements for Compliance of Radio Apparatus

Test Result

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

Test engineer:	Paul NEUFELD		29.03.2016
	Name	Signature	Date
Authorized reviewer:	Bernd SELCK		29.03.2016
	Name	Signature	Date

This test report is only valid in its original form.

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

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

Contents

Page

1 Identification

1.1 Applicant

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Applicant represented during the test by the following person:	-

1.2 Manufacturer

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Applicant represented during the test by the following person:	-

1.3 Test Laboratory

The tests were carried out by:

PHOENIX TESTLAB GmbH
Königswinkel 10
32825 Blomberg
Germany

Accredited by *Deutsche Akkreditierungsstelle GmbH* in compliance with DIN EN ISO/IEC 17025 under Reg. No. ***< D-PL-17186-01-01 >***.

1.4 EUT (Equipment Under Test)

Test object: *	Bluetooth Low Energy - / Gazell mode RF transmitter
Type: *	Transmitter / Smart Connect
Order number: *	(Blue Frog) Smart Connect Art. Nr. 72167 (Device Frog) Transmitter Art. Nr. 72169
PMN: *	Smart Connect / Transmitter
FCC ID: *	ZJXBDFROG001
IC Company number / UPN: *	9685A-BDFROG001
Model / HVIN: * (Hardware Identification Number)	Smart Connect Transmitter
Serial number: *	V00 WW1409
PCB identifier: *	TT214XX-PRD-10 V00 WW1409 (Transmitter) TT214XX-PRD-10 V00 WW1409 + TT214XX-PRD-11 V00 WW1523 (Smart Connect)
Hardware version: *	V04.40F (Transmitter) V01.39F (Smart Connect)
Software version / FVIN: *	TS=1.0

*Declared by the applicant.

Gazell Mode

Channel 04	RX:	2404 MHz	TX:	2404 MHz
Channel 25	RX:	2425 MHz	TX:	2425 MHz
Channel 42	RX:	2442 MHz	TX:	2442 MHz
Channel 63	RX:	2463 MHz	TX:	2463 MHz
Channel 77	RX:	2477 MHz	TX:	2477 MHz

Bluetooth Low Energy Mode

Channel 00	RX:	2402 MHz	TX:	2402 MHz
Channel 19	RX:	2440 MHz	TX:	2440 MHz
Channel 39	RX:	2480 MHz	TX:	2480 MHz

1.5 Technical Data of Equipment

Fulfills RF version: *	Bluetooth Low Energy and proprietary Gazell Mode					
Antenna type: *	PCB antenna stripe type					
Antenna gain: *	0 dBi					
Antenna connector: *	None					
Power supply EUT	U_{nom}=	5 V DC	U_{min}=	4.75 V DC	U_{max}=	5.25 V DC
Type of modulation: *	Bluetooth Low Energy – 1 Mbps: GFSK Gazell Mode – 2 Mbps: GFSK					
Operating frequency range:*	Bluetooth Low Energy: 2402 – 2480 MHz Gazell Mode: 2404 – 2477 MHz					
Number of channels: *	Gazell Mode: 5 Bluetooth Low Energy : 40					
Temperature range: *	5 °C to 40 °C					
Lowest / highest internal clock frequency: *	32 kHz / 16 MHz					

*Declared by the applicant.

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
DC in (carrier board)	9 V Battery connector	Enercon 07A10 AC/DC adaptor	2 m *

*: Length during the test if not other specified.

1.6 Dates

Date of receipt of test sample:	23.11.2015
Start of test:	24.11.2015
End of test:	15.12.2015

2 Operational States

The EUT is a RF module intended for integration into coffee machines, which can be performed by the end user. It operates with Bluetooth Low Energy and the proprietary Gazell mode. The EUT has an internal antenna and cannot be equipped with other antennas.

The EUT is available in two different versions Smart Connect and Transmitter. The only differences between those versions are the connectors. Both Frogs have a serial interface, whereby the Smart Connect has a 5 pin connector and the Smart Connect has a D-Sub connector.

The EUT was loaded with a special application for test purposes through a Bluetooth Low Energy connection with an Android smartphone. The connection was established by an Android application called “nRF Master Control” provided by “Nordic Semiconductor”. With the aid of that application the application for Bluetooth Low Energy mode or for Gazell mode could be loaded to the EUT. The application for Gazell mode was named “RF_Testing_Bluefrog_BLE_PHOENIX.hex” and the application for testing Bluetooth Low Energy mode was named “RF_Testing_Bluefrog_GAZELL_PHOENIX.hex”.

After the test application was active on the EUT, the different test modes could be cycled by pressing a button on the EUT. The possible test modes are listed in the table below.

For the test, the EUT was connected to a docking station which contained the power supply, in the form of a 9 V DC battery, and an ON/OFF switch. For the test of the Smart Connect, a serial to pin converter was used.

The following operation modes were used during the test and represent all the possible modulations the EUT is capable of.

Operation mode	Description of the operation mode	BT mode	BT channel	Modulation	Data rate
1	Continuous transmitting on 2402 MHz	Low energy	0	GFSK	1 MBit/s
2	Continuous transmitting on 2440 MHz	Low energy	19	GFSK	1 MBit/s
3	Continuous transmitting on 2480 MHz	Low energy	39	GFSK	1 MBit/s
Operation mode	Description of the operation mode	Gazell mode	Gazell channel	Modulation	Data rate
4	Continuous transmitting on 2404 MHz	Gazell	4	FHSS	2 MBit/s
5	Continuous transmitting on 2440 MHz	Gazell	42	FHSS	2 MBit/s
6	Continuous transmitting on 2477 MHz	Gazell	77	FHSS	2 MBit/s

Each test case was performed in the following operation modes:

Test case	Operation mode
Maximum Peak Output Power	1 - 6
DTS Bandwidth	1 - 6
Peak Power Spectral Density	1 - 6
Band Edge Compliance	1, 3, 4, 6
Maximum Unwanted Emissions	1 - 6

3 Additional Information

The standard power levels of the EUT can not be changed by software or firmware, therefore the test was carried out with the standard power level of the RF IC manufacturer.

This report contains the results of the Gazell and the Bluetooth Low Energy mode.

Transmitter	Smart Connect
	

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [3] or RSS-Gen, Issue 4 [4]	Status	Refer page
Maximum Peak Output Power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (4) [3]	Passed	12 et seq
DTS Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (1) [3]	Passed	15 et seq
Peak Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (2) [3]	Passed	18 et seq
Band edge compliance	2400.0 - 2483.5	15.247 (d)	5.5 [3] 8.9 [4], 8.10 [4]	Passed	21 et seq.
Radiated emissions (transmitter)	0.009 – 26,500	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [3] 8.9 [4], 8.10 [4]	Passed	29 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Passed	45 et seq.

5 Results

5.1 Duty Cycle

5.1.1 Method of measurement

The measurement was performed as described in chapter 5.6.1 of this test report.

The measurement procedures described herein are based on the use of radiated measurements.

The method described in chapter 11.6.0 b) of document [1] was used to perform the following test.

The measurement was only performed on only one frequency, because the timing behaviour was found to be independent of the selected channel.

The following measurement technique was used:

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

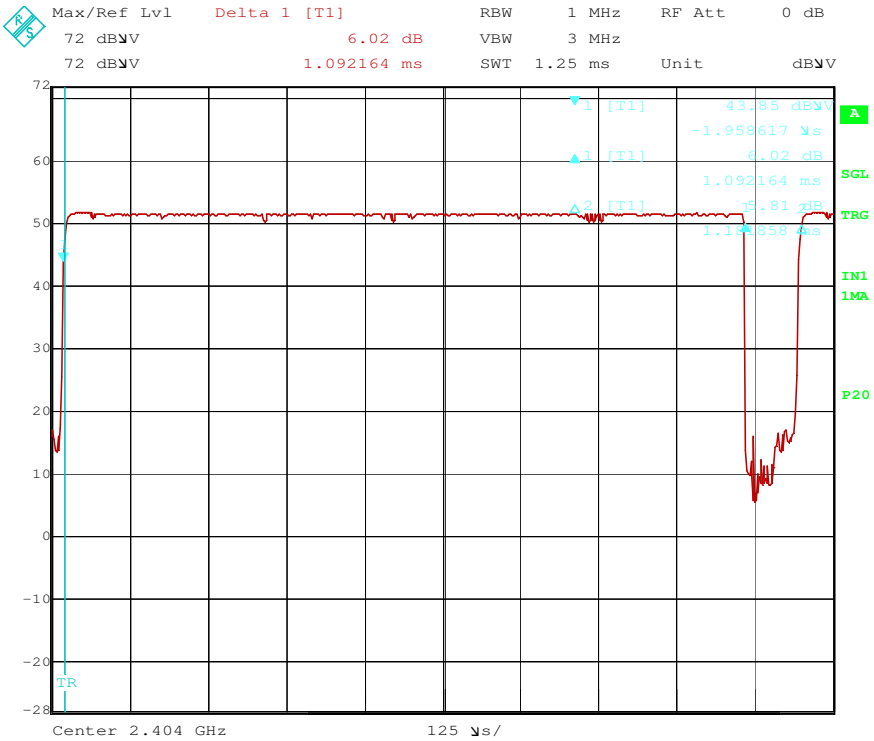
- Set the center frequency of the instrument to the center frequency of the transmission.
- Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value.
- Set VBW ≥ RBW.
- Set detector = peak or average.
- The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

5.1.2 Test results

Ambient temperature	22 °C		Relative humidity	25 %

The following plot only shows the worst case for the duty cycle correction, the other results are only submitted in the calculations below.

154064_Low_DutyCycle_0°.wmf: Duty cycle measurement on channel 04 in Gazell mode with 2 Mbps:



The following calculations for the settings are only submitted for the worst case, therefore the other results can be assumed to be passed as well.

$$T_{TX} = 1.092ms \quad (1)$$

$$\frac{50}{T_{TX}} = \frac{50}{1.092ms} = 45.788kHz \leq RBW \leq VBW \quad (2)$$

Measurement Points 500 for 1.25 ms → 1.092 ms = 436.8 measurement points → Signal has 436.8 measurement points (and fulfils the requirement of at least 100 Points resolution for the signal)

$$T_{TX\_On} = 1.092ms \quad (3)$$

$$T_{TX\_Period} = 1.182ms \quad (4)$$

If power averaging (RMS) mode was used in step f), then the applicable correction factor is 10 log(1/x), where x is the duty cycle.

$$x = \frac{1.092ms}{1.182ms} = 0.924 = 92.4\% \quad (5)$$

Correction factor: $10 \cdot \log\left(\frac{1}{x}\right) = 10 \cdot \log\left(\frac{1}{0.778}\right) = 0.4dB$ (6)

Therefore, for average measurements a correction factor of 0.4 dB is use in all tests with Gazell mode and 0.2 dB for in test with Bluetooth Low Energy mode. The results for the other modulation are submitted without calculation below:

Bluetooth Low Energy mode: 0.2 dB correction factor
Gazell mode: 0.4 dB correction factor

TEST EQUIPMENT USED FOR THE TEST:

6, 8 -11, 13, 17, 18, 33

5.2 Maximum peak output power

5.2.1 Method of measurement

The EUT was measured in a radiated setup within an anechoic chamber. The radiated measurement setup was made according to chapter 5.6.1 of this test report.

Acceptable measurement configurations

Annex G in [1] is used for calculating radiated values to conducted values.

Procedure 11.9.1.2 in [1] was used for the following test.

The measurement was performed at the upper and lower end and the middle of the assigned frequency band.

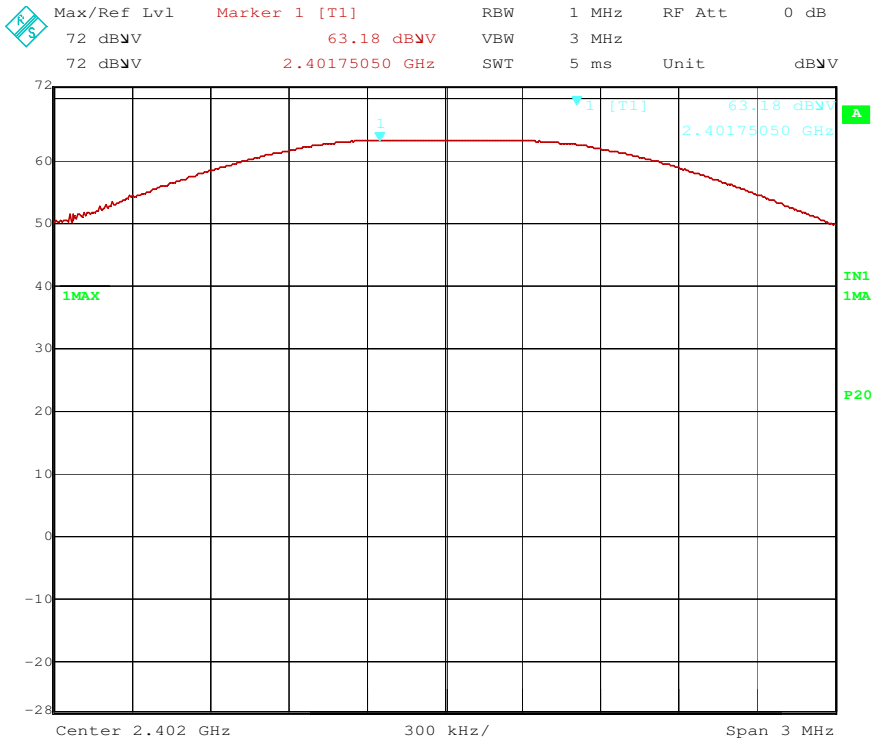
The measurement result in [dBµV/m] was calculated to [dBm] using the formula
in chapter 11.12.2.2 e) in [1].

5.2.2 Test results

Ambient temperature	21 °C	Relative humidity	40 %

The following results were measured in a radiated setup. The plot shows an exemplary measurement result for the worst documented case. The other results are listed in the following table.

154064_Low_PeakPower_90°.wmf: Maximum peak output power (operation mode 1):



The highest antenna gain is 0 dBi. Therefore no reduction of the Peak power limit is necessary and the EIRP is the same as the conducted power.

Results for Transmitter:

Operation Mode	Frequency [MHz]	Antenna gain combined [dBi]	Reading [dBµV]	Antenna factor [1/m]	Cable Loss [dB]	Meas. Result [dBµV/m]	EIRP Power [dBm]	Conducted Power [dBm]	Limit [dBm]
1	2402	0	63.2	28.3	3.0	94.5	-0.8	-0.8	30
2	2440	0	60.1	28.4	3.0	91.5	-3.8	-3.8	30
3	2480	0	56.5	28.5	2.9	87.9	-7.4	-7.4	30
4	2404	0	60.1	28.3	3.0	91.4	-3.9	-3.9	30
5	2440	0	59.7	28.4	3.0	91.1	-4.2	-4.2	30
6	2477	0	57.8	28.5	3.1	89.4	-5.9	-5.9	30
Measurement uncertainty				+2.2 dB / -3.6 dB					

Results for Smart Connect:

Operation Mode	Frequency [MHz]	Antenna gain combined [dBi]	Reading [dBµV]	Antenna factor [1/m]	Cable Loss [dB]	Meas. Result [dBµV/m]	EIRP Power [dBm]	Conducted Power [dBm]	Limit [dBm]
1	2402	0	63.2	28.3	3.0	94.5	-0.8	-0.8	30
2	2440	0	60.5	28.4	3.0	91.9	-3.4	-3.4	30
3	2480	0	56.8	28.5	2.9	88.2	-7.1	-7.1	30
4	2404	0	63.9	28.3	3.0	95.2	-0.1	-0.1	30
5	2440	0	60.0	28.4	3.0	91.4	-3.9	-3.9	30
6	2477	0	57.3	28.5	3.1	88.9	-6.4	-6.4	30
Measurement uncertainty				+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

6, 8 -11, 13, 17, 18, 33

5.3 DTS Bandwidth

5.3.1 Method of measurement

The EUT was measured in a radiated setup within an anechoic chamber. The radiated measurement setup was made according to chapter 5.6.1 of this test report.

The measurement procedure refers to part 11.8.1 of document [1].

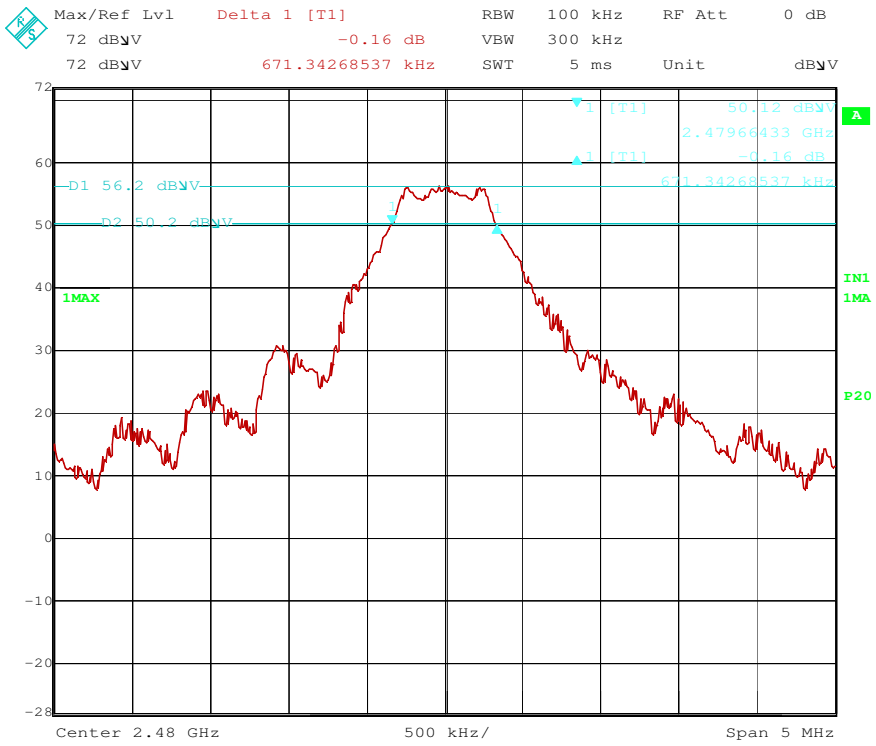
- Set RBW = 100 kHz.
- Set the video bandwidth (VBW) ≥ 3 x RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper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

5.3.2 Test result

Ambient temperature	21 °C		Relative humidity	40 %

The following results were measured in a radiated setup. The plot shows an exemplary measurement result for the worst documented case. The other results are listed in the following table.

154064_High_OBW_90°.wmf: DTS Bandwidth (operation mode 3):



Results for Transmitter:

Operation Mode	Center Frequency [MHz]	Minimum 6-dB Bandwidth Limit [MHz]	6 dB Bandwidth [MHz]	Result
1	2402	0.5	0.691	Passed
2	2440	0.5	0.701	Passed
3	2480	0.5	0.671	Passed
4	2404	0.5	0.902	Passed
5	2440	0.5	0.852	Passed
6	2477	0.5	0.812	Passed
Measurement uncertainty		+2.2 dB / -3.6 dB		

Results for Smart Connect:

Operation Mode	Center Frequency [MHz]	Minimum 6-dB Bandwidth Limit [MHz]	6 dB Bandwidth [MHz]	Result
1	2402	0.5	0.732	Passed
2	2440	0.5	0.742	Passed
3	2480	0.5	0.711	Passed
4	2404	0.5	0.892	Passed
5	2440	0.5	0.902	Passed
6	2477	0.5	0.862	Passed
Measurement uncertainty		+2.2 dB / -3.6 dB		

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

6, 8 -11, 13, 17, 18, 33

5.4 Peak Power Spectral Density

5.4.1 Method of measurement

The EUT was measured in a radiated setup within an anechoic chamber. The radiated measurement setup was made according to chapter 5.6.1 of this test report.

The measurement procedure refers to part 10.10.2 of document [1].

- Set analyser center frequency to DTS channel center frequency
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
- Set the VBW ≥ 3 x RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds limit, reduce RBW (not less than 3 kHz) and repeat.

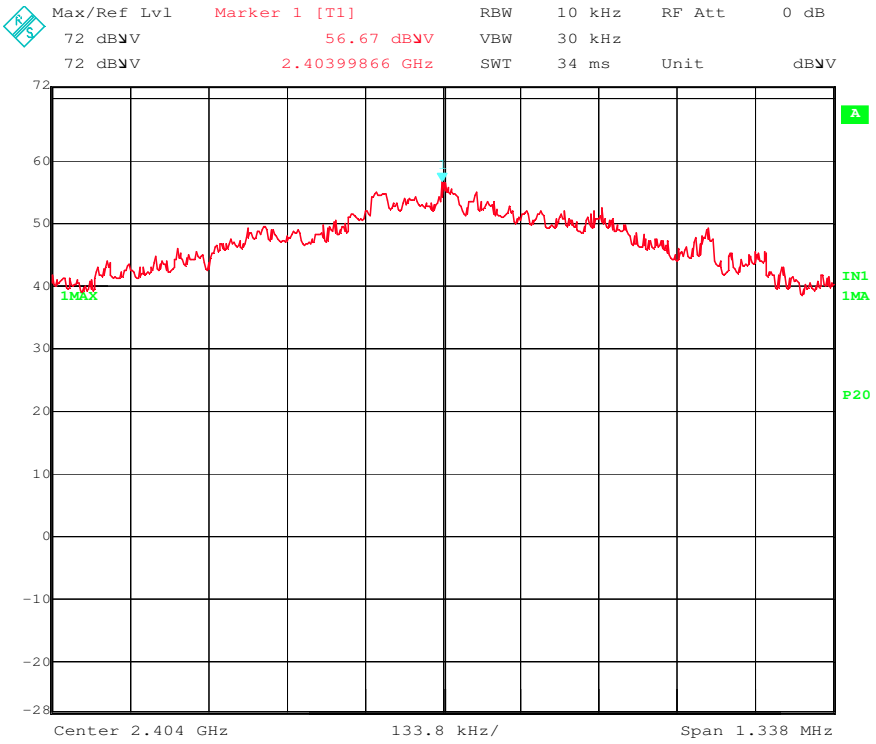
The measurement result in [dBµV/m] was calculated to [dBm] using the formula
in chapter 11.12.2.2 e) in [1].

5.4.2 Test result

Ambient temperature	21 °C		Relative humidity	40 %

The following results were measured in a radiated setup. The plot shows an exemplary measurement result for the worst documented case. The other results are listed in the following table.

154064_Low_PSD_150°.wmf: Power Spectral Density (operation mode 4):



Results for Transmitter:

Operation Mode	Centre Frequency [MHz]	Reading [dBµV/10 kHz]	Antenna factor [1/m]	Cable Loss [dB]	Meas. Result [dBµV/m / 10 kHz]	Power Spectral Density Level [dBm / 10 kHz]	Margin	Limit [dBm/3kHz]
1	2401.993	55.4	28.3	3.0	86.7	-8.6	16.6	8
2	2440.012	53.3	28.4	3.0	84.7	-10.6	18.6	8
3	2479.965	49.6	28.5	2.9	81.0	-14.3	22.3	8
4	2403.991	54.1	28.3	3.0	85.4	-9.9	17.9	8
5	2439.978	51.6	28.4	3.0	83.0	-12.3	20.3	8
6	2476.992	50.1	28.5	3.1	81.7	-13.6	21.6	8
Measurement uncertainty				+2.2 dB / -3.6 dB				

Results for Smart Connect:

Operation Mode	Centre Frequency [MHz]	Reading [dBµV/10 kHz]	Antenna factor [1/m]	Cable Loss [dB]	Meas. Result [dBµV/m / 10 kHz]	Power Spectral Density Level [dBm / 10 kHz]	Margin	Limit [dBm/3kHz]
1	2401.990	55.2	28.3	3.0	86.5	-8.8	16.8	8
2	2440.124	53.5	28.4	3.0	84.9	-10.4	18.4	8
3	2480.012	49.1	28.5	2.9	80.5	-14.8	22.8	8
4	2403.999	56.7	28.3	3.0	88.0	-7.3	15.3	8
5	2440.004	52.7	28.4	3.0	84.1	-11.2	19.2	8
6	2477.001	50.0	28.5	3.1	81.6	-13.7	21.7	8
Measurement uncertainty				+2.2 dB / -3.6 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

6, 8 -11, 13, 17, 18, 33

5.5 Band-edge compliance

5.5.1 Method of measurement (band edges next to unrestricted bands (radiated))

The EUT was measured in a radiated setup within an anechoic chamber. The radiated measurement setup was made according to chapter 5.6.1 of this document.

The measurement procedure refers to part 11.11.2 and 11.11.3 of document [1].

Measurement Procedure Reference – Reference Level:

- RBW = 100 kHz.
- VBW ≥ 300 kHz.
- Set the span to ≥ 1.5 times the DTS Bandwidth.
- Detector = Peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilise.
- Use the peak marker function to determine the the maximum PSD level.

Measurement Procedure – Unwanted Emissions

- Set the center frequency and span to encompass the frequency range to be measured.
- RBW = 100 kHz.
- VBW ≥ 300 kHz.
- Detector = Peak.
- Ensure that the number of measurement points ≥ span/RBW.
- Sweep time = auto couple.
- Trace Mode = max hold.
- Allow the trace to stabilise.
- Use the peak marker function to determine the maximum amplitude level.

The measurement procedure at the band edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission were be encompassed by the span. After trace stabilization, the maximum peak was be determined by a peak detector and the value was marked by an appropriate limit line. The second limit line, which is 20 dB below the first, marks the limit for the emissions in the unrestricted band. A maximum-peak-detector marks the highest emission in the unrestricted band next to the band edge.

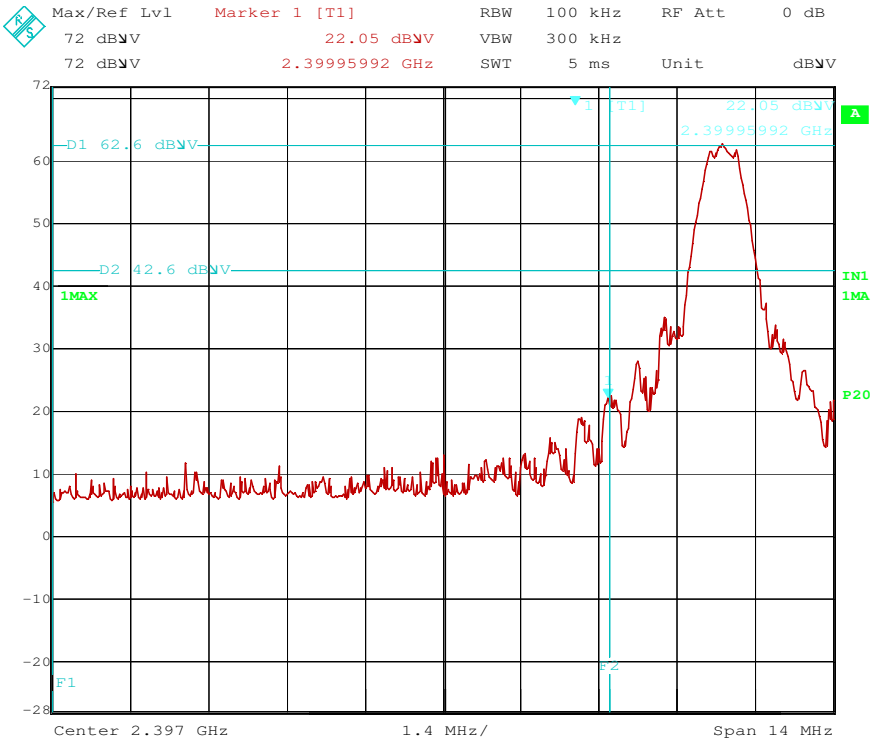
The measurements were performed at the lower end of the 2.4 GHz band.

5.5.2 Test result (band edges next to unrestricted bands (radiated))

Ambient temperature	21 °C		Relative humidity	40 %

The following results were measured in a radiated setup. The plot shows an exemplary measurement result for the worst documented case. The other results are listed in the following table.

154064_Low_BandEdgeUnRestr_90°.wmf: conducted band-edge compliance (operation mode 1):



Results for Transmitter:

Operation Mode	channel	Band-Edge	Reference Level [dBµV]	Limit [dBµV]	Unwanted Emission Frequency MHz	Unwanted Emission Value [dBµV]	Margin dB
1	0	low	62.6	42.6	2399.960	22.1	20.5
4	4	low	61.4	41.4	2396.060	11.9	29.5
Measurement uncertainty			+2.2 dB / -3.6 dB				

Results for Smart Connect:

Operation Mode	channel	Band-Edge	Reference Level [dBµV]	Limit [dBµV]	Unwanted Emission Frequency MHz	Unwanted Emission Value [dBµV]	Margin dB
1	0	low	62.0	42.0	2399.940	20.3	21.7
4	4	low	63.6	43.6	2399.178	14.1	29.5
Measurement uncertainty			+2.2 dB / -3.6 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
6, 8 -11, 13, 17, 18, 33

5.5.3 Method of measurement (band edges next to restricted bands (radiated))

The EUT was measured in a radiated setup within an anechoic chamber. The radiated measurement setup was made according to chapter 5.6.1 of this test report.

After trace stabilisation the marker shall be set on the signal peak. The frequency line shall be set on the edge of the assigned frequency band. Now set the second marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is higher than that at the band-edge. The level of the measured field strength shall be compared to the general limits specified in § 15.205.

The measurement was performed at the lower and the upper end of the 2.4 GHz band.

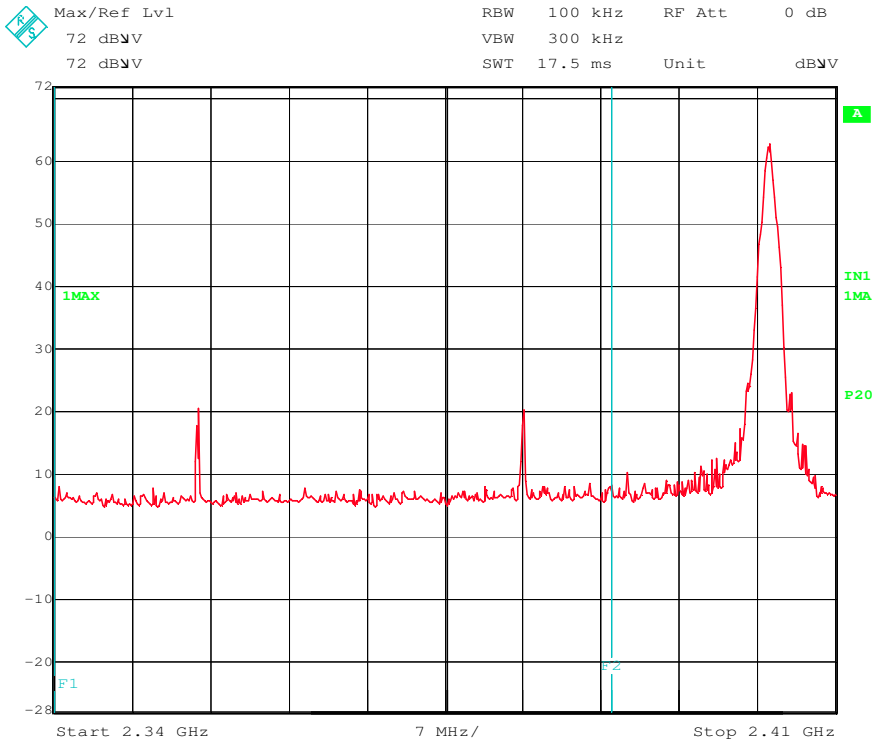
All average results are corrected by a correction factor of 0.4 dB for Bluetooth Low Energy mode and 0.2 dB for Gazell mode as described in chapter 5.1 of this document.

5.5.4 Test result (band edges next to restricted bands (radiated))

Ambient temperature	22 °C	Relative humidity	59 %

The plot shows an exemplary measurement result for the worst documented case. The other results are listed in the following table.

154064_Low_BandEdgeRestr_150°.wmf: conducted band-edge compliance (operation mode 4):



Results for Transmitter:

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

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2383.7	57.5	74.0	16.5	26.3	28.3	0.0	3.0	150	Vert.	120
2354.3	57.9	74.0	16.1	26.8	28.1	0.0	3.0	150	Vert.	120
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2383.7	34.1	54.0	19.9	2.5	28.3	0.0	3.0	150	Vert.	120
2354.3	33.5	54.0	20.5	2.0	28.1	0.0	3.0	150	Vert.	120
Measurement uncertainty				+2.2 dB / -3.6 dB						

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

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2508.0	49.6	74.0	24.4	18.0	28.6	0.0	3.1	150	Hor.	90
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2508.0	34.6	54.0	19.4	2.5	28.6	0.0	3.1	150	Hor.	90
Measurement uncertainty				+2.2 dB / -3.6 dB						

Transmitter operates at the lower end of the assigned frequency band (operation mode 4)

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2354.2	58.5	74.0	15.5	27.5	28.1	0.0	3.0	150	Vert.	90
2383.5	57.8	74.0	16.2	26.6	28.3	0.0	3.0	150	Vert.	90
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2354.2	33.5	54.0	20.5	2.2	28.1	0.0	3.0	150	Vert.	90
2383.5	34.1	54.0	19.9	2.6	28.3	0.0	3.0	150	Vert.	90
Measurement uncertainty				+2.2 dB / -3.6 dB						

Transmitter operates at the upper end of the assigned frequency band (operation mode 6)

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2507.8	52.1	74.0	21.9	20.4	28.6	0.0	3.1	150	Vert.	90
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2507.8	34.4	54.0	19.6	2.5	28.6	0.0	3.1	150	Vert.	90
Measurement uncertainty				+2.2 dB / -3.6 dB						

Results for Smart Connect:

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

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2382.2	58.2	74.0	15.8	26.9	28.3	0.0	3.0	150	Hor.	120
2352.9	57.5	74.0	16.5	26.4	28.1	0.0	3.0	150	Hor.	120
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2382.2	34.1	54.0	19.9	2.4	28.3	0.0	3.0	150	Hor.	120
2352.9	33.5	54.0	20.5	2.0	28.1	0.0	3.0	150	Hor.	120
Measurement uncertainty				+2.2 dB / -3.6 dB						

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

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2506.7	52.8	74.0	21.2	21.1	28.6	0.0	3.1	150	Vert.	30
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2506.7	34.6	54.0	19.4	2.6	28.6	0.0	3.1	150	Vert.	30
Measurement uncertainty				+2.2 dB / -3.6 dB						

Transmitter operates at the lower end of the assigned frequency band (operation mode 4)

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2352.9	58.8	74.0	15.2	27.72	28.1	0.0	3.0	150	Hor.	150
2382.1	58.6	74.0	15.4	27.33	28.3	0.0	3.0	150	Hor.	150
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2352.9	33.5	54.0	20.5	2.2	28.1	0.0	3.0	150	Hor.	150
2382.1	34.0	54.0	20.0	2.6	28.3	0.0	3.0	150	Hor.	150
Measurement uncertainty				+2.2 dB / -3.6 dB						

Transmitter operates at the upper end of the assigned frequency band (operation mode 6)

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2506.5	52.6	74.0	21.4	20.9	28.6	0.0	3.1	150	Vert.	60
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
2506.5	34.6	54.0	19.4	2.7	28.6	0.0	3.1	150	Vert.	60
Measurement uncertainty				+2.2 dB / -3.6 dB						

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
6, 8 -11, 13, 17, 18, 33

5.6 Maximum unwanted emissions

5.6.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into five stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 9 kHz to 1 GHz.
- A final measurement carried out on an outdoor test side without reflecting ground plane and a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- A final measurement carried out on an open area test side with reflecting ground plane and various antenna height in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with a variable antenna distance and height in the frequency range 1 GHz to 25 / 40 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 25 / 40 GHz.

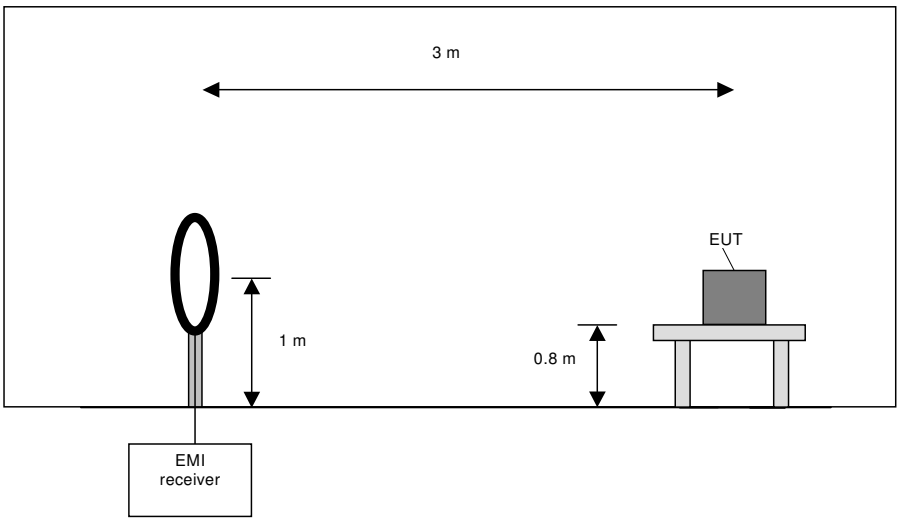
Preliminary measurement (9 kHz to 30 MHz):

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

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

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

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



Preliminary measurement procedure:

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

The following procedure will be used:

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

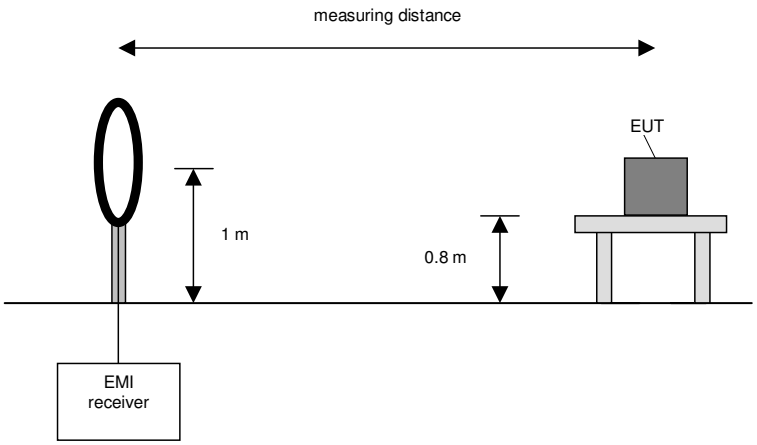
Final measurement (9 kHz to 30 MHz):

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

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

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

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



Final measurement procedure:

The following procedure will be used:

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

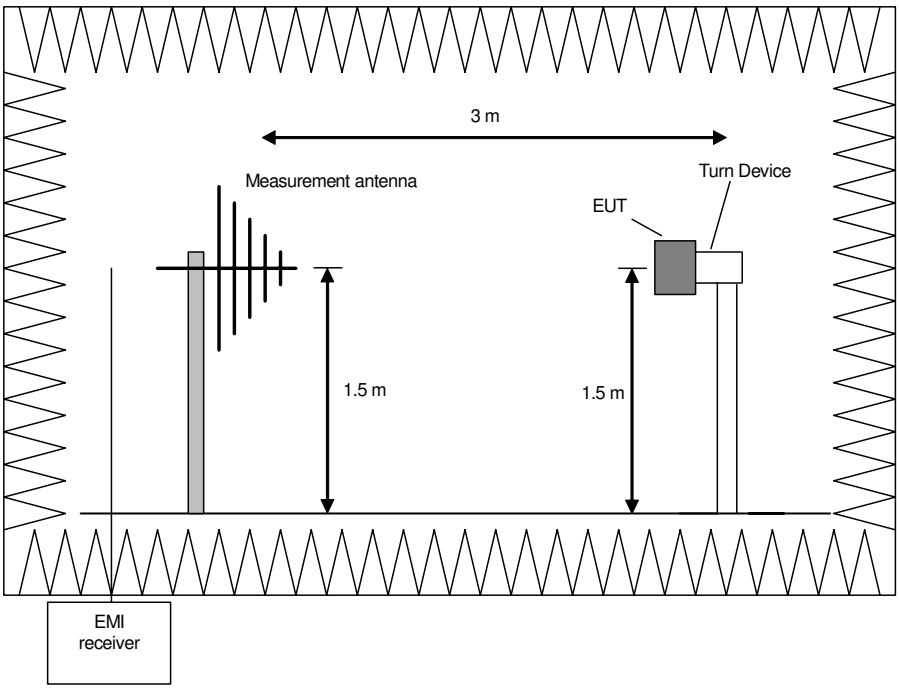
Preliminary measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. Table top devices will set up on a non-conducting turn device on the height of 1.5m. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to [1].

The frequency range 30 MHz to 1 GHz will be measured with an EMI Receiver set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30° steps according 6.6.5.4 in [1].

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

Frequency range	Resolution bandwidth
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:

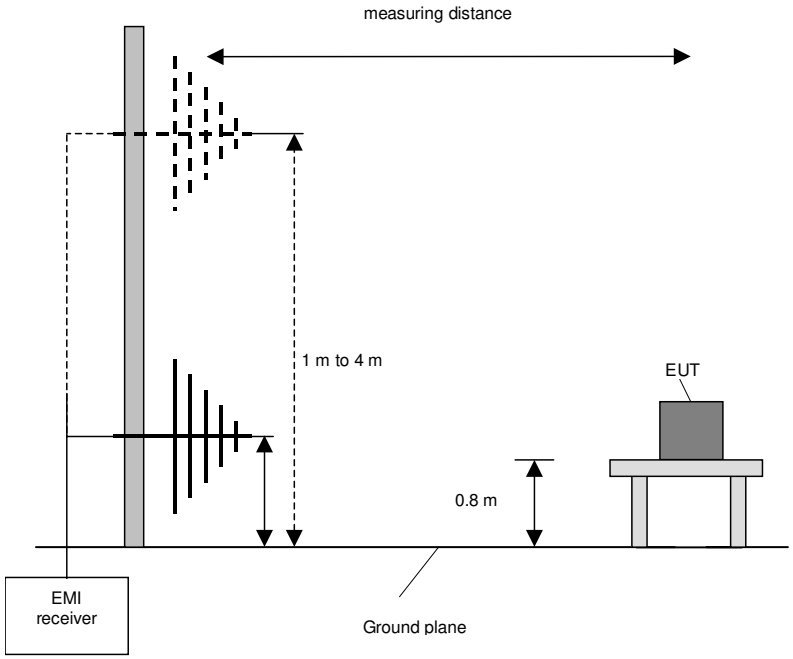
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Repeat 1) to 3) with the vertical polarisation of the measuring antenna.
5. Make a hardcopy of the spectrum.
6. Repeat 1) to 5) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°) according to 6.6.5.4 in [1].
7. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.

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 25 GHz)

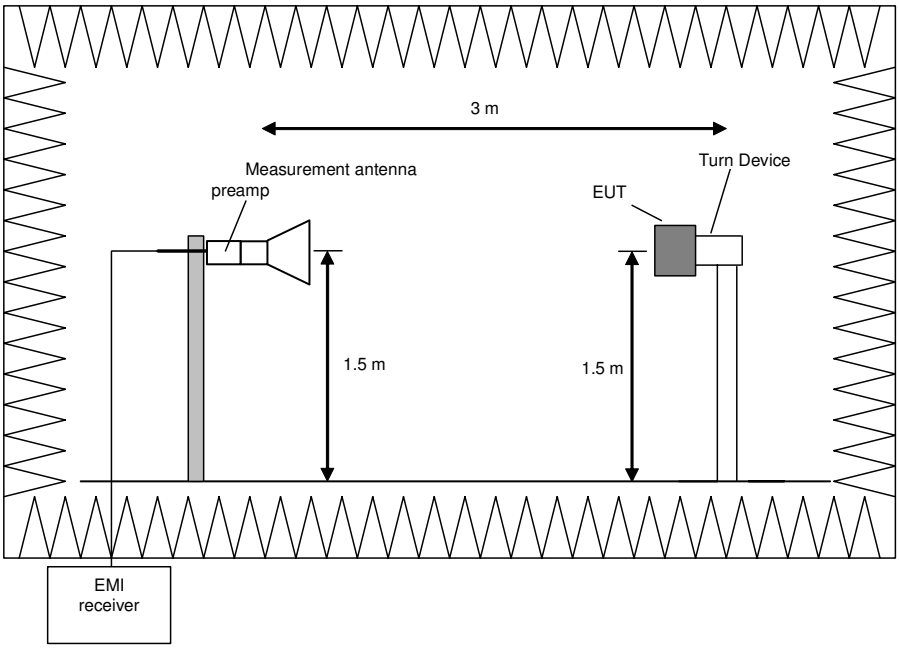
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

Preliminary measurement (1 GHz to 25 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30° steps according 6.6.5.4 in [1].

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

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



Procedure preliminary measurement:

Prescans were performed in the frequency range 1 to 40 GHz.
The following procedure will be used:

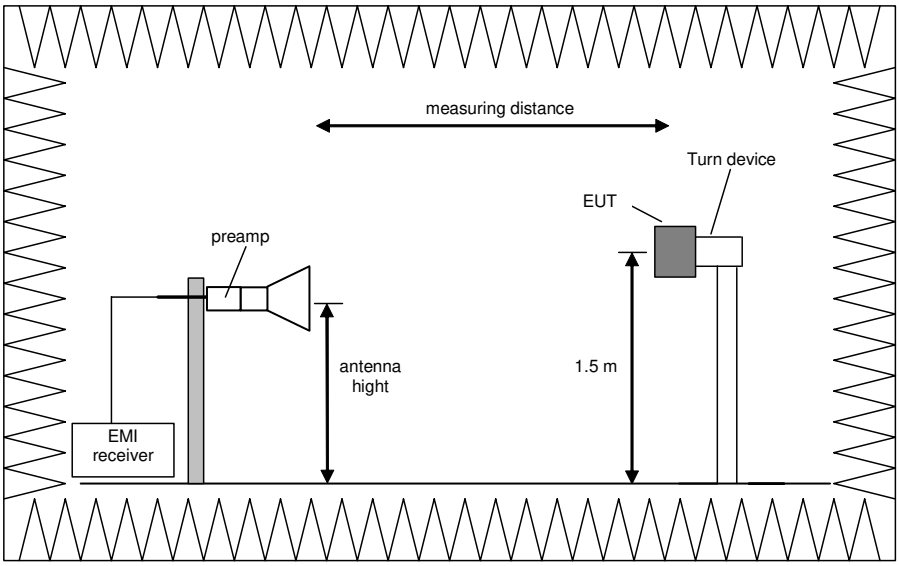
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an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

Final measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed by rotating the turntable through 0 to 360° in the worst-case EUT orientation which was obtained during the preliminary measurements.

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

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



Procedure of measurement:

The measurements were performed in the frequency ranges 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 26.5 GHz and 26.5 – 40 GHz.
The following procedure will be used:

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

5.6.2 Test results (radiated emissions) – antenna and cabinet emissions

5.6.2.1 Preliminary radiated emission measurement

Ambient temperature	21 °C	Relative humidity	40 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m and on a turn device on a height of 1.5 m. The distance between EUT and antenna was 3 m.

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

Test record: All results are shown in the following.

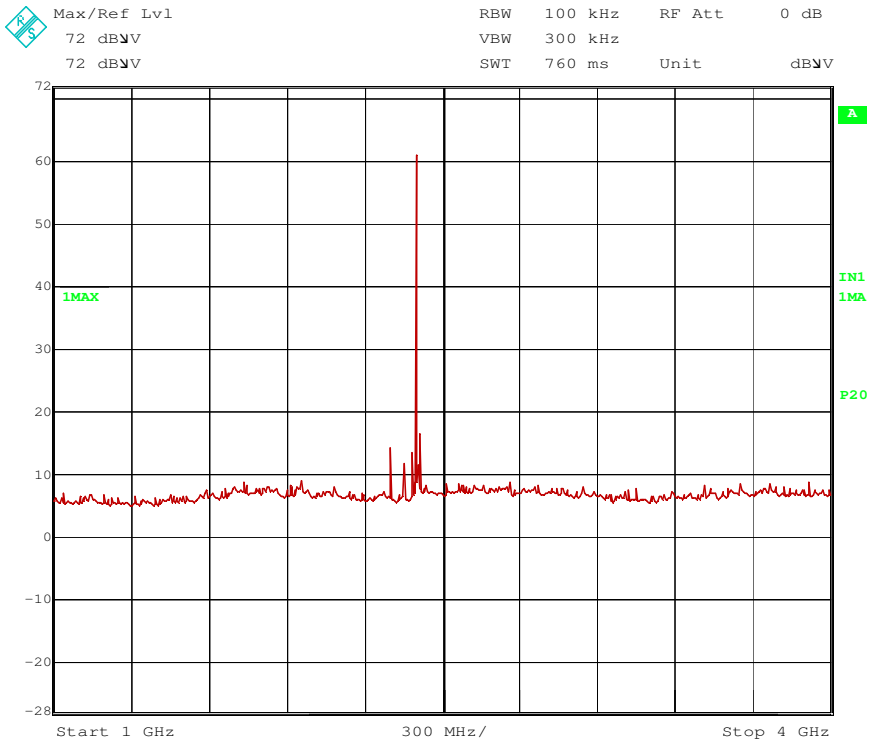
Supply voltage: During all measurements the host of the EUT was powered with 5 V DC via a 9 V block battery inside a test aperture.

Remark: Only the plots of the worst case emissions are submitted for every frequency range above 1 GHz in the preliminary results.

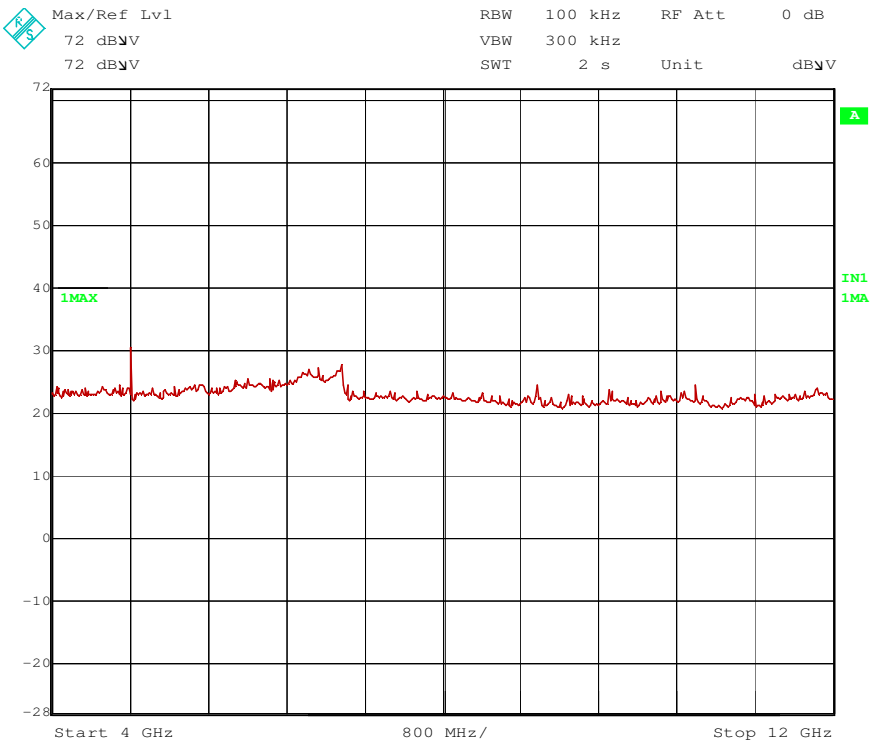
No emissions were found for the frequencies below 1 GHz, therefore no plots of that frequency range are submitted below.

Transmitter operates at the upper end of the assigned frequency band (operation mode 1)

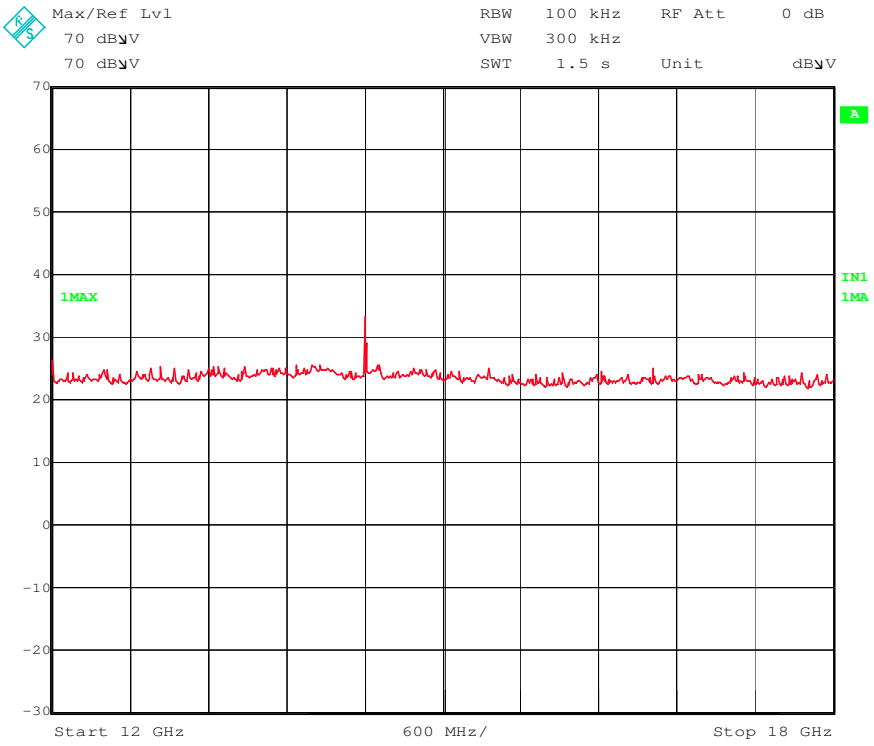
154064_Low_1-4G_90°.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



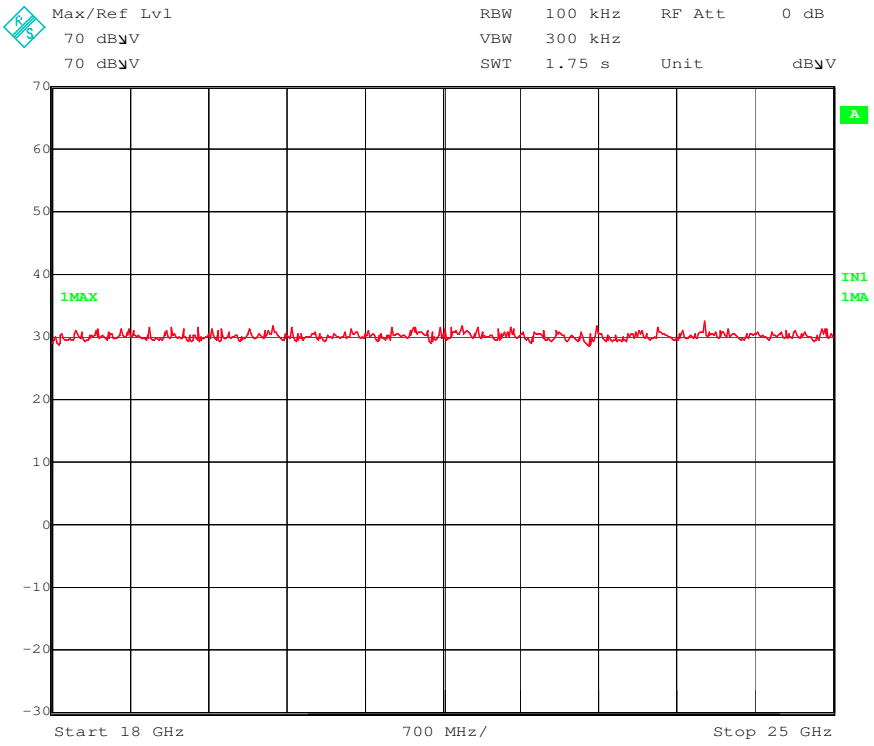
154064_Low_4-12G_120°.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 1):



154064_Low_12-18G_AntHor0°.wmf: Spurious emissions from 12 to 18 GHz
Horizontal antenna polarization (operation mode 1):



154064_Low_18-25G_AntHor0°.wmf: Spurious emissions from 18 – 25 GHz
Horizontal antenna polarization (operation mode 1):



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

- 4804.0 MHz.

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

- 14410.7 MHz.

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

TEST EQUIPMENT USED FOR THE TEST:
6, 8 – 15, 17 – 19, 21 - 25, 28, 33

5.6.2.2 Final radiated emission measurement (9 kHz to 1 GHz)

No emissions were found during the preliminary measurement. Therefore no results for the final measurements are submitted.

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

Ambient temperature	21 °C	Relative humidity	40 %

Position of EUT: The EUT was set-up on a on a turn device on a height of 1.5 m. The distance between EUT and the measurement antenna was 3 m.

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

Test record: All results are shown in the following.

Supply voltage: During all measurements the host of the EUT was powered with 5 V DC via a 9 V block battery inside a test aperture.

Resolution bandwidth: For all measurements a resolution bandwidth of 1 MHz was used.

Additional information: For simplification all values were compared to the restricted band limits.
All Emissions were measured in the EUT angle that had the highest spurious emissions. All average results are corrected by a correction factor of 0.4 dB for Bluetooth Low Energy mode and 0.2 dB for Gazell mode as described in 5.1.2.

Results for Transmitter:

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

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4804.0	48.1	74.0	25.9	36.0	32.6	24.9	4.4	150	Hor.	120
14410.7	49.2	74.0	24.8	38.9	33.7	26.8	3.4	150	Hor.	0°
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4804.0	40.7	54.0	13.3	28.6	32.6	24.9	4.4	150	Hor.	120
14410.7	38.0	54.0	16.0	27.7	33.7	26.8	3.4	150	Hor.	0°
Measurement uncertainty				+2.2 dB / -3.6 dB						

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

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4880.00	46.5	74.0	27.5	34.4	32.8	25.1	4.4	150	Hor.	60
14641.5	47.3	74.0	26.7	37.1	33.7	27.0	3.5	150	Hor.	0°
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4880.0	37.7	54.0	16.3	25.6	32.8	25.1	4.4	150	Hor.	60
14641.5	35.0	54.0	19.0	24.8	33.7	27.0	3.5	150	Hor.	0°
Measurement uncertainty				+2.2 dB / -3.6 dB						

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

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4960.00	47.6	74.0	26.4	35.5	32.9	25.3	4.5	150	Hor.	120
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4960.00	39.1	54.0	14.9	27.0	32.9	25.3	4.5	150	Hor.	120
Measurement uncertainty				+2.2 dB / -3.6 dB						

Transmitter operates at the lower end of the assigned frequency band (operation mode 4)

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4808.00	48.0	74.0	26.0	35.9	32.6	24.9	4.4	150	Vert.	60
14424	48.9	74.0	25.1	38.6	33.7	26.8	3.4	150	Hor.	60
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4808.00	39.9	54.0	14.1	27.8	32.6	24.9	4.4	150	Vert.	60
14424.00	34.3	54.0	19.7	24.0	33.7	26.8	3.4	150	Hor.	60
Measurement uncertainty				+2.2 dB / -3.6 dB						

Transmitter operates at the middle of the assigned frequency band (operation mode 5)

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4880.00	47.5	74.0	26.5	35.4	32.8	25.1	4.4	150	Hor.	120
14640	47.9	74.0	26.1	37.7	33.7	27.0	3.5	150	Hor.	30
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4880.00	38.9	54.0	15.1	26.8	32.8	25.1	4.4	150	Hor.	120
14640.00	32.9	54.0	21.1	22.7	33.7	27.0	3.5	150	Hor.	30
Measurement uncertainty				+2.2 dB / -3.6 dB						

Transmitter operates at the higher end of the assigned frequency band (operation mode 6)

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4954.00	47.1	74.0	26.9	35.0	32.9	25.2	4.4	150	Hor.	60
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4954.00	36.4	54.0	17.6	24.3	32.9	25.2	4.4	150	Vert.	60
Measurement uncertainty				+2.2 dB / -3.6 dB						

Results for Smart Connect:

The emissions above 4 GHz were only retested for the worst care mode compared to the Smart Connect module.

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

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4804.00	48.7	74.0	25.3	36.6	32.6	24.9	4.4	150	Hor.	90
14413.6	49.2	74.0	24.8	38.9	33.7	26.8	3.4	150	Hor.	0°
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4804.00	39.9	54.0	14.1	27.8	32.6	24.9	4.4	150	Hor.	90
14413.60	38.2	54.0	15.8	27.9	33.7	26.8	3.4	150	Hor.	0°
Measurement uncertainty				+2.2 dB / -3.6 dB						

Transmitter operates at the middle of the assigned frequency band (operation mode 5)

Result measured with the peak detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4880.00	47.1	74.0	26.9	35.0	32.8	25.1	4.4	150	Hor.	30
14640	47.5	74.0	26.5	37.3	33.7	27.0	3.5	150	Hor.	30
Measurement uncertainty				+2.2 dB / -3.6 dB						

Result measured with the average detector:

Frequency MHz	Meas. Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Angle / °
4880.00	37.5	54.0	16.5	25.4	32.8	25.1	4.4	150	Hor.	30
14640.00	32.0	54.0	22.0	21.8	33.7	27.0	3.5	150	Hor.	30
Measurement uncertainty				+2.2 dB / -3.6 dB						

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
6, 8 – 15, 17 – 19, 21 - 25, 28, 33

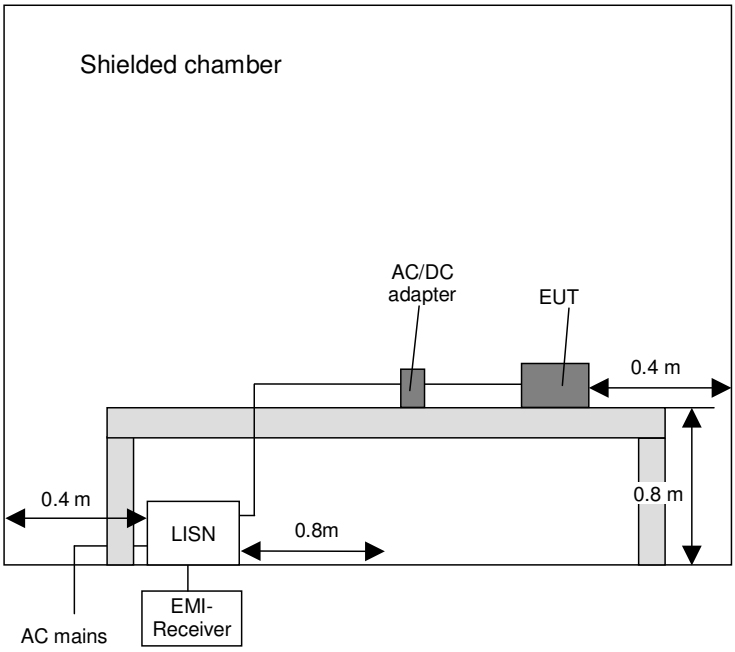
5.7 Conducted emissions on power supply lines (150 kHz to 30 MHz)

5.7.1 Method of measurement

This test will be carried out in a shielded 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 above the ground plane. Floor-standing devices will be placed directly on the ground plane. The setup of the Equipment under test will be in accordance to ANSI C63.4-2009 [6].

The frequency range 150 kHz to 30 MHz will be measured with an EMI Receiver set to MAX Hold mode with peak and average detector and a resolution bandwidth of 9 kHz. A scan will be carried out on the phase (or plus pole in case of DC powered devices) of the AC mains network. If levels detected 10 dB below the appropriable limit. this emission will be measured with the average and quasi-peak detector on all lines.

Frequency range	Resolution bandwidth
150 kHz to 30 MHz	9 kHz



5.7.2 Test results (conducted emissions on power supply lines)

Ambient temperature	22 °C	Relative humidity	44 %

Position of EUT: For the test the EUT was in test mode in either Bluetooth Low Energy mode or Gazell mode.
The EUT was set to continuous transmission on 2440 MHz.
The test was repeated with the Smart Connect and the Smart Connect module.
The EUT was set-up on a non-conducting table of a height of 0.8 m.

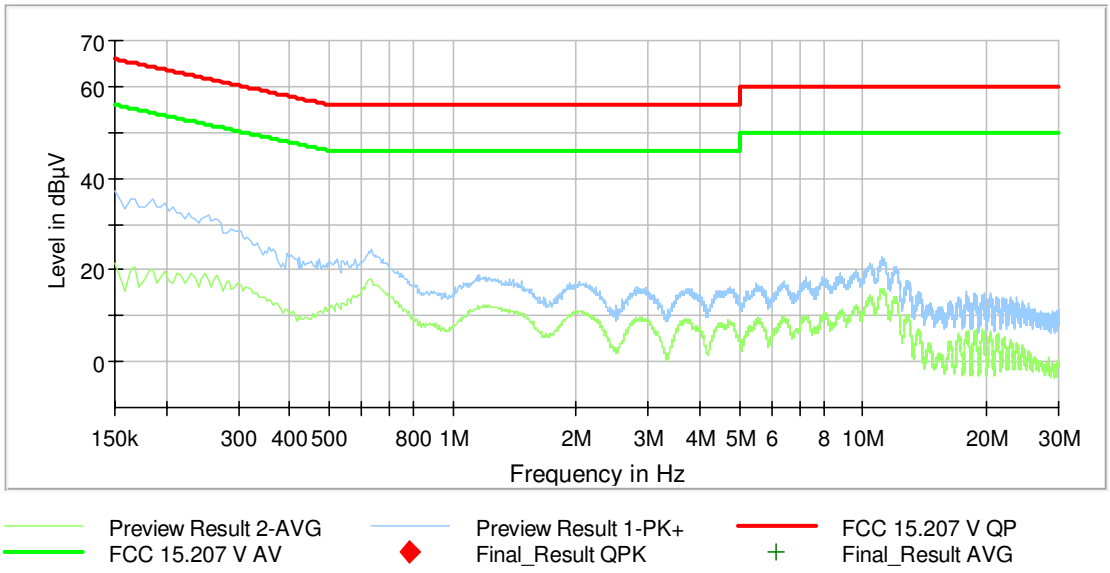
Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

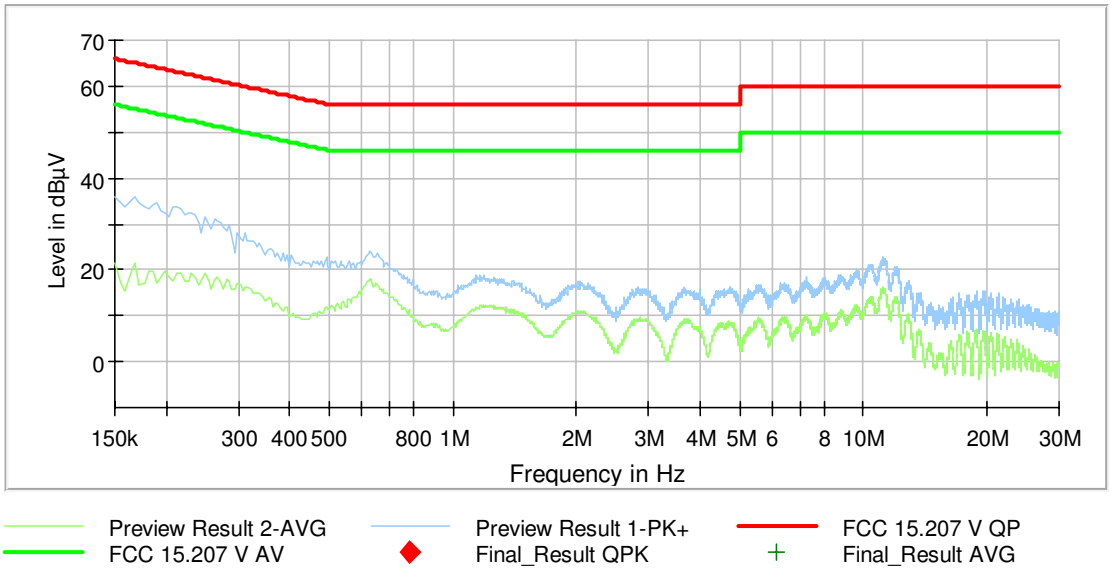
Supply voltage: Measurement performed with US 120V/60Hz. For the test an AC/DC adaptor Model “07A10” from Enercell was used. The 9 V Battery in the test aperture was replaced by a connector which was attached to the AC/DC adaptor, which was set to 9 V DC output voltage.

The curves in the diagram only represent for each frequency point the maximum measured value of all preliminary measurements. which were made for each power supply line. The top-measured curve represents the peak measurement and the bottom-measured curve the average measurement. The quasi-peak measured points are marked by an x and the average measured points by an +.

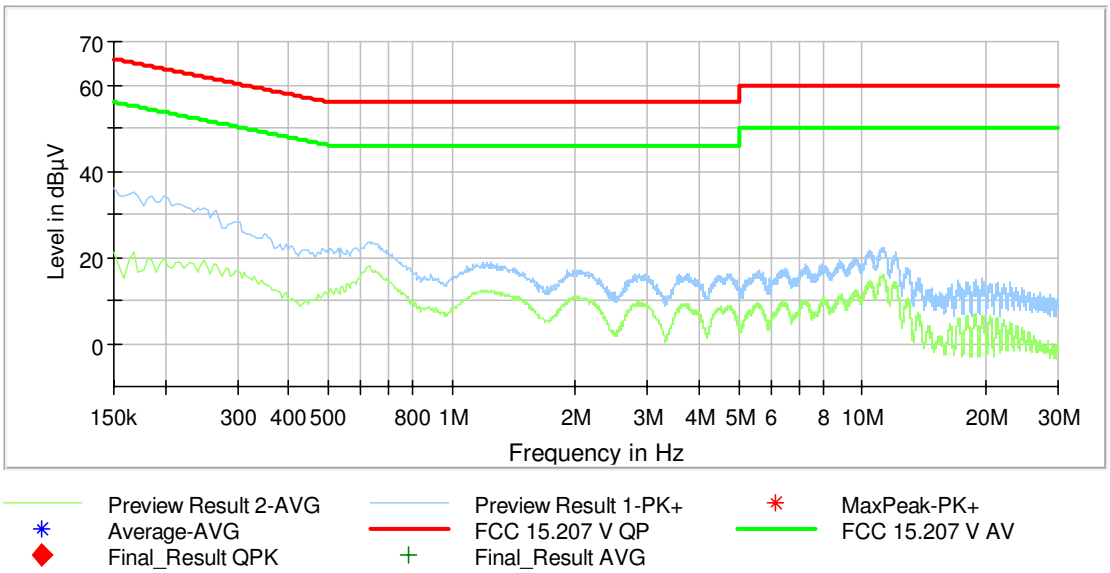
Transmitter (Bluetooth Low Energy mode)



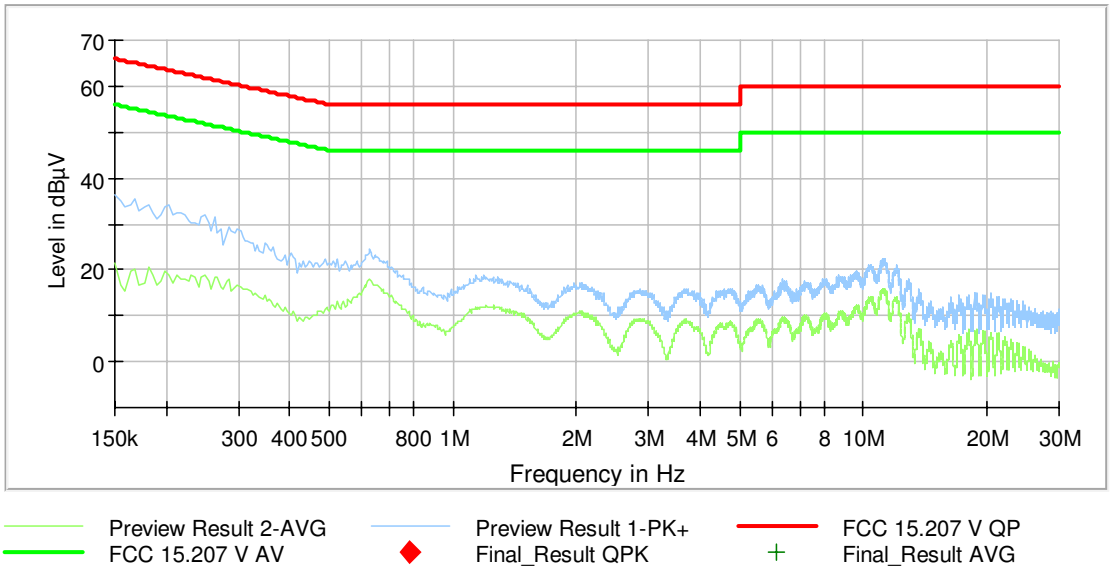
Transmitter (Gazell mode)



Smart Connect (Bluetooth Low Energy mode)



Smart Connect (Gazell mode)



Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
1 – 5

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. Due
1	Shielded chamber M47	-	Albatross Projects	B83117-C6439-T262 -	480662	Weekly verification (system cal.)	
2	EMI Receiver	ESIB 26	Rohde & Schwarz	1088.7490	481182	03/21/2014	03/2016
3	LISN	NSLK8128	Schwarzbeck	8128155	480058	21/03/2014	03/2016
4	High pass filter	HR 0.13-5ENN	FSY Microwave Inc.	DC 0109 SN 002	480340	Weekly verification (system cal.)	
5	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	-
6	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
7	Spectrum analyser	FSU	Rohde & Schwarz	200125	480956	02/24/2014	03/2016
8	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	02/26/2014	02/2016
9	Controller	MCU	Maturo	MCU/043/971107	480832	-	-
10	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
11	Antenna support	AS615P	Deisel	615/310	480187	-	-
12	Antenna	CBL6112 B	Chase	2688	480328	04/14/2014	04/2017
13	Antenna	3115 A	EMCO	9609-4918	480183	11/2014	11/2017
14	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Six month verification (system cal.)	
15	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297	Six month verification (system cal.)	
16	Standard Gain Horn Antenne 26.4 – 40.1 GHz	22240-20	Flann Microwave	469	480229	Six month verification (system cal.)	
17	RF-cable No. 3	Sucoflex 106B	Huber&Suhner	0563/6B / Kabel 3	480670	Weekly verification (system cal.)	
18	RF-cable No. 40	Sucoflex 106B	Huber&Suhner	0708/6B / Kabel 40	481330	Weekly verification (system cal.)	
19	RF-cable No. 36	Sucoflex 106B	Huber&Suhner	500003/6B / Kabel 36-	481680	Weekly verification (system cal.)	
20	RF-cable 1 m	KPS-1533-400-KPS	Insulated Wire	-	480300	Six month verification (system cal.)	
21	RF-cable 2 m	KPS-1533-800-KPS	Insulated Wire		480302	Six month verification (system cal.)	
22	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	Six month verification (system cal.)	
23	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	Six month verification (system cal.)	
24	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	Six month verification (system cal.)	
25	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	02/2014	02/2016
26	Power Meter	NRVD	Rohde & Schwarz	833697/030	480589	02/2014	02/2016
27	Peak Power Sensor	NRV-Z32	Rohde & Schwarz	849745/016	480551	03/2015	03/2016
28	4 GHz High Pass Filter	WHKX4.0/18 G-8SS	Wainwright Instruments	1	480587	Weekly verification (system cal.)	

29	Single Control Unit	SCU	Maturo GmbH	SCU/006/971107	480831	Calibration not necessary	
30	High-pass Filter	H26G40G1	Microwave Circuits, Inc.	33471	480593	Six month verification (system cal.)	
31	Temperature Test Chamber	MK 240	Binder	05-79022	480462	02/18/2014	08/2016
32	Multimeter	Fluke 175	Fluke Deutschland GmbH	18660318	481515	10/2014	10/2016
33	Turn Device	TDF 1.5-10Kg	Maturo	-	482034	-	

7 Report History

Report Number	Date	Comment
F154064E1	29.03.2016	Initial Test Report

8 List of Annexes

ANNEX A TEST SETUP PHOTOS 10 pages

154064_01.jpg	Test setup Device Frog- Radiated emission < 1 GHz (fully anechoic chamber)
154064_02.jpg	Test setup Blue Frog- Radiated emission < 1 GHz (fully anechoic chamber)
154064_03.jpg	Test setup Device Frog- Radiated emission < 1 GHz (fully anechoic chamber)
154064_04.jpg	Test setup Blue Frog- Radiated emission < 1 GHz (fully anechoic chamber)
154064_05.jpg	Test setup Device Frog- Radiated emission > 1 GHz (fully anechoic chamber)
154064_06.jpg	Test setup Blue Frog- Radiated emission > 1 GHz (fully anechoic chamber)
154064_07.jpg	Test setup Device Frog- Radiated emission > 1 GHz (fully anechoic chamber)
154064_08.jpg	Test setup Blue Frog- Radiated emission > 1 GHz (fully anechoic chamber)
154064_09.jpg	Test setup – conducted emissions on power supply lines (Device Frog)
154064_10.jpg	Test setup – conducted emissions on power supply lines (Blue Frog)

ANNEX B EXTERNAL EUT PHOTOS 13 pages

154064_11.jpg	Device-Frog 3D view 1
154064_12.jpg	Device-Frog 3D view 2
154064_13.jpg	Device-Frog - Interface
154064_14.jpg	Device-Frog – CE label
154064_15.jpg	Device-Frog with interface adaptor
154064_16.jpg	Device-Frog – interface adaptor – 3D view 1
154064_17.jpg	Device-Frog – interface adaptor – 3D view 2
154064_18.jpg	Device-Frog – interface adaptor – connector
154064_19.jpg	Device-Frog – interface adaptor – inside view
154064_20.jpg	Blue-Frog – 3D view 1
154064_21.jpg	Blue-Frog – 3D view 2
154064_22.jpg	Blue-Frog – connector view
154064_23.jpg	Blue-Frog – CE label

ANNEX C INTERNAL EUT PHOTOS 10 pages

154064_24.jpg	Device Frog with serial adapter – 3D view 1
154064_25.jpg	Device Frog with serial adapter – 3D view 2
154064_26.jpg	Device Frog - serial adapter – top view
154064_27.jpg	Device Frog - serial adapter – bottom view
154064_28.jpg	Device Frog – top view
154064_29.jpg	Device Frog – top view without shielding
154064_30.jpg	Device Frog – bottom view
154064_31.jpg	Blue Frog – top view
154064_32.jpg	Blue Frog – top view without shielding
154064_33.jpg	Blue Frog – bottom view