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Test Report

Report Number: F136117E9

Applicant:

u-blox Malmö AB

Manufacturer:

u-blox Malmö AB

Equipment under Test (EUT):

ODIN-W160

Laboratory 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 (September 2013)** Radio Frequency Devices

[3] **Publication Number 558074 (April 2013)** DTS Meas Guidance v03r01

[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 Radiocommunication Equipment

[6] **Publication Number 662911 (May 2013)** Emission Testing of Transmitters with Multiple Outputs in the Same Band v02

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		10 July 2014
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		10 July 2014
	Name	Signature	Date

RESERVATION

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.

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1 IDENTIFICATION

1.1 Applicant

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Fax:	+ 46 40 23 71 37
eMail Address:	mats.andersson@u-blox.com
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	u-blox Malmö AB
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Country:	Sweden
Name for contact purposes:	Mr. Mats ANDERSSON
Phone:	+ 46 40 63 07 100
Fax:	+ 46 40 23 71 37
eMail Address:	mats.andersson@u-blox.com
Applicant represented during the test by the following person:	-

1.3 Test laboratory

The tests were carried out at: **PHOENIX TESTLAB GmbH**
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Germany

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.

1.4 EUT (Equipment Under Test)

Test object: *	Bluetooth module
Type: *	ODIN-W160
FCC ID: *	**PVH0953**
IC: *	**5325A-0953**
Serial number: *	Bluetooth: 292006260225, 292006260219
PCB identifier: *	0953-03
Hardware version: *	3.1
Software version: *	cB-2284(bt_hci_release_1.1.1) cB-2285(bt_spa_release_1.1.1)

1.5 Technical data of equipment

Channel 0	RX:	2402 MHz	TX:	2402 MHz
Channel 19	RX:	2441 MHz	TX:	2441 MHz
Channel 39	RX:	2480 MHz	TX:	2480 MHz

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
DC in (carrier board)	2.1 mm power jack	-	2 m *
RS 232 Interface (carrier board)	9-pin D-Sub plug	Laptop PC	2 m *

*: Length during the test if no other specified.

1.6 Product Information

The type of modulation used by the equipment	FHSS
Fulfills Bluetooth specification	Bluetooth Low Energy
The number of Hopping Frequencies	40
The Dwell Time	3.75 ms
The Minimum Channel Occupation Time	625 µs
The maximum RF Output Power (e.i.r.p.)	<10 dBm
Operating Frequency Range	2402 MHz to 2480 MHz
Type of Equipment	Module mounted on an evaluation board
Operating temperature range	-40 °C to 85 °C
Operating voltage range (Host)	3.6 V to 6.0 V DC
Operating voltage range (EUT)	3.0 to 3.6 V DC
Details provided are for the	stand-alone equipment
Antenna Type	Integral Antenna
Antenna Type	Dedicated Antennas (See antenna list below)
Antenna power settings	Single power level with corresponding antenna(s)
Antenna Gain	3 dBi
Corresponding conducted power setting (for the antenna gain)	11 dBm
Antenna connector:	Internal, Hirose U.FL
Power Supply	External Power Supply or AC/DC adapter
Test modes available which can facilitate testing	Test modes are described in the test object specification
The equipment type	Bluetooth using one specific fixed configuration setting
Internal clock frequencies	32768 Hz / 26.000 MHz
Type of modulation:	GFSK

Used antennas:

Antenna name	Manufacturer	Type	Comment	Gain [dBi]
WCR-2400 -IP04 -IP10 -SMA -SMRP	Centurion	Monopole	10cm flying lead U.FL 25cm flying lead U.FL SMA RSMA	2 dBi @ 2.4 GHz
SDM2-2400/1575	Mobile Mark	Patch	flying lead U.FL	2 dBi @ 2.4 GHz
PSTG0-2400HS	Mobile Mark	Monopole	SMA/RSMA	0 dBi @ 2.4 GHz
FlatWhip-2400	ProAnt	Monopole	SMA/RSMA	3 dBi @ 2.4 GHz
“InSide-EPA 2400”	ProAnt	Patch	circular polarization	3 dBi @ 2.4 GHz
InSide-2400	ProAnt	Patch	10cm flying lead U.FL	3 dBi @ 2.4 GHz
InSide-WLAN	ProAnt	Patch	dual band 10cm flying lead U.FL	3 dBi @ 2.4 GHz 3 dBi @ 5 GHz
Outside-2400	ProAnt	Patch	10 cm flying lead U.FL 25 cm flying lead U.FL	3 dBi @ 2.4 GHz
Ex-IT 2400 -SMA 28-001 -RP-SMA 28-001 - MHF 28-001	ProAnt	Monopole	SMA RSMA 10 cm flying lead U.FL	3 dBi @ 2.4 GHz
Ex-IT WLAN - SMA - RP-SMA -MHF	ProAnt	Monopole	dual band SMA RSMA 10cm flying lead U.FL	3 dBi @ 2.4 GHz 3 dBi @ 5 GHz
Ex-IT 2400 -MHF 70-001	ProAnt	Monopole	10cm flying lead U.FL	3 dBi @ 2.4 GHz
Ex-IT 2400 -SMA 70-002 -RP-SMA 70-002	ProAnt	Monopole	SMA RSMA	3 dBi @ 2.4 GHz
InSide Fold-2400	ProAnt	Patch	10 cm flying lead U.FL	3 dBi @ 2.4 GHz
InSide Fold-WLAN	ProAnt	Patch	10 cm flying lead U.FL	3 dBi @ 2.4 GHz 3 dBi @ 5 GHz
InSide-WLAN Square	ProAnt	Patch	10 cm flying lead U.FL	3 dBi @ 2.4 GHz 3 dBi @ 5 GHz

1.7 Dates

Date of receipt of test sample:	21 January 2014
Start of test:	21 January 2014
End of test:	31 March 2014

2 OPERATIONAL STATES

The equipment under test (EUT) is a WLAN dual band and Bluetooth dual mode module soldered on to a carrier board. The WLAN / Bluetooth module is equipped with an U.FL. antenna connector.

The module is a WLAN dual band and Bluetooth dual mode HCI module that executes the low level radio firmware and requires an external host that executes the upper layer WLAN and Bluetooth stack. Because the ODIN-W160 is a module, which will be implemented in a final application, it was mounted on a carrier board (cB-0964-A1) to connect it to a Laptop with the test software and the external power supply.

All tests were carried out with an unmodified sample.

Operation mode:

With a test software which was provided by the applicant the hopping can be enabled and disabled. Furthermore the equipment could be set to transmit only and receive only mode with a certain modulation scheme and data rate on a certain frequency. This software was installed on a laptop PC, which was connected to the Equipment under test via the carrier board.

The EUT was a Bluetooth Low Energy device. The table below shows the available modulations and data rates for the appropriate test cases.

Operation mode	Description of the operation mode	mode	channel	Modulation	Data rate / Mbps
1	Continuous transmitting on 2402 MHz	BTLE	0	GFSK	1 MBit/s
2	Continuous transmitting on 2440 MHz	BTLE	19	GFSK	1 MBit/s
3	Continuous transmitting on 2480 MHz	BTLE	39	GFSK	1 MBit/s
4	Normal operation mode (hopping on all channels)	BTLE	0 – 39	GFSK	1 MBit/s

Physical boundaries of the ODIN-W160:

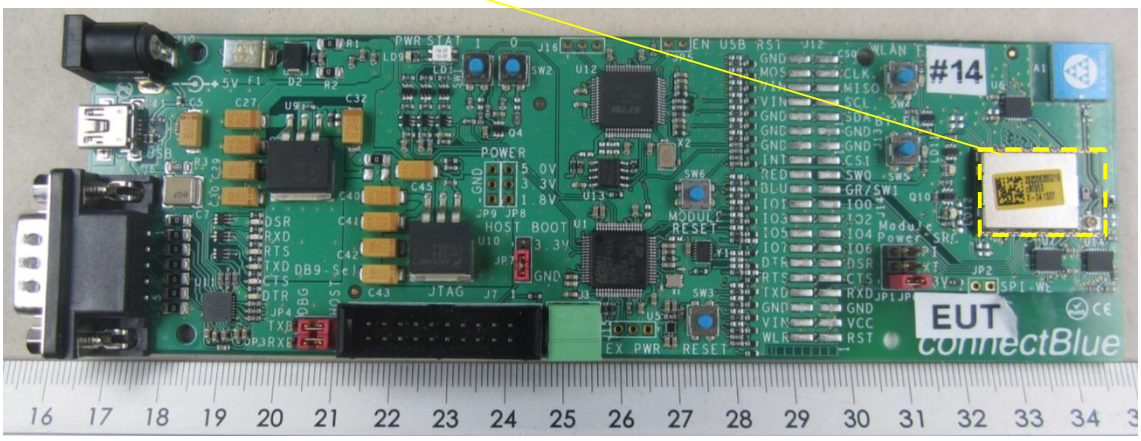
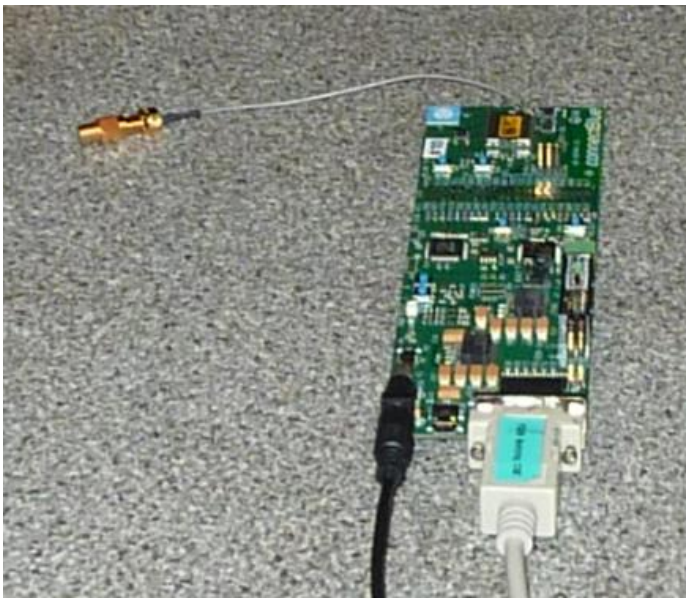
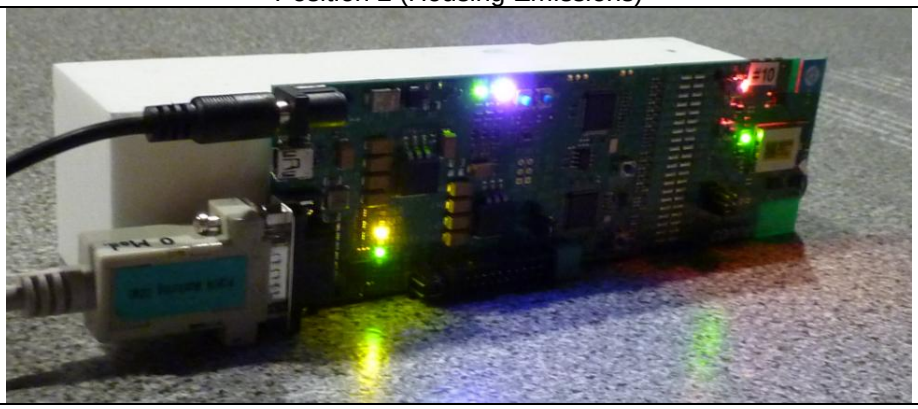


Table 1 Worst case test setup

Position 1 (Housing Emissions)	Position 3 (Housing Emissions)
	
Position 2 (Housing Emissions)	
	

Preliminary tests were performed to find worst-case configuration and position. The radiated emission measurements were carried out in the orthogonal direction that emits the highest spurious emission levels.

The following test modes were adjusted during the tests:

Test items	Operation mode
Maximum Peak Output Power	1 – 3
DTS Bandwidth	1 – 3
Peak Power Spectral Density	1 – 3
Band Edge Compliance	1, 3
Maximum Unwanted Emissions	1 - 3
Conducted emissions on supply line	4

3 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
Maximum Peak Output Power	2400.0 - 2483.5	15.247 (b) (3), (4)	A8.4 (4) [4]	Passed	12 et seq
DTS Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	A8.2 (a) [4]	Passed	14 et seq
Peak Power Spectral Density	2400.0 - 2483.5	15.247 (e)	A8.2 (b) [4]	Passed	16 et seq
Band edge compliance	2400.0 - 2483.5	15.247 (d)	A8.5 [4]	Passed	18 et seq.
Unwanted emissions (transmitter)	0.009 – 26,500	15.247 (d) 15.205 (a) 15.209 (a)	A8.5 [4] 7.2.2 [5], 2.5 [4]	Passed	22 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	7.2.4 [5]	Passed	44 et seq.

4 TEST RESULTS

4.1 Maximum peak output power

4.1.1 Method of measurement

The EUT has to be connected to the power meter via a low loss cable.

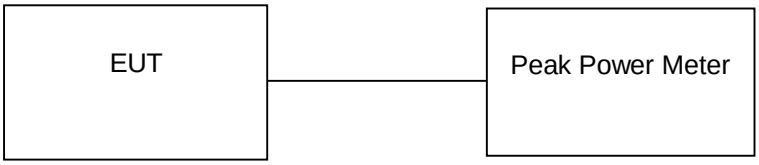
Acceptable measurement configurations

The measurement procedures described herein are based on the use of an antenna-port conducted test configuration.

PKPM1 – Peak power meter method was used for this test. The procedure is described in chapter 9.1.3 of document [3].

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

Test set-up:



4.1.2 Test results

Ambient temperature	21 °C	Relative humidity	42 %

The highest antenna gain is 3.0 dBi. Therefore no reduction of the Peak power limit is necessary.

Operation Mode	Antenna gain combined [dBi]	Maximum peak output power [dBm]	Margin [dB]	Peak power limit [dBm]
1	3.0	5.7	24.3	30
2	3.0	5.9	24.1	30
3	3.0	5.9	24.1	30
Measurement uncertainty		+0.66 dB / -0.72 dB		

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

26, 27

4.2 DTS Bandwidth

4.2.1 Method of measurement

The relating measurements were carried out in a conducting manner. Therefore, the antenna connector was directly connected to a spectrum analyser. The measurement procedure refers to part 8.1 of document [3].

- 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.

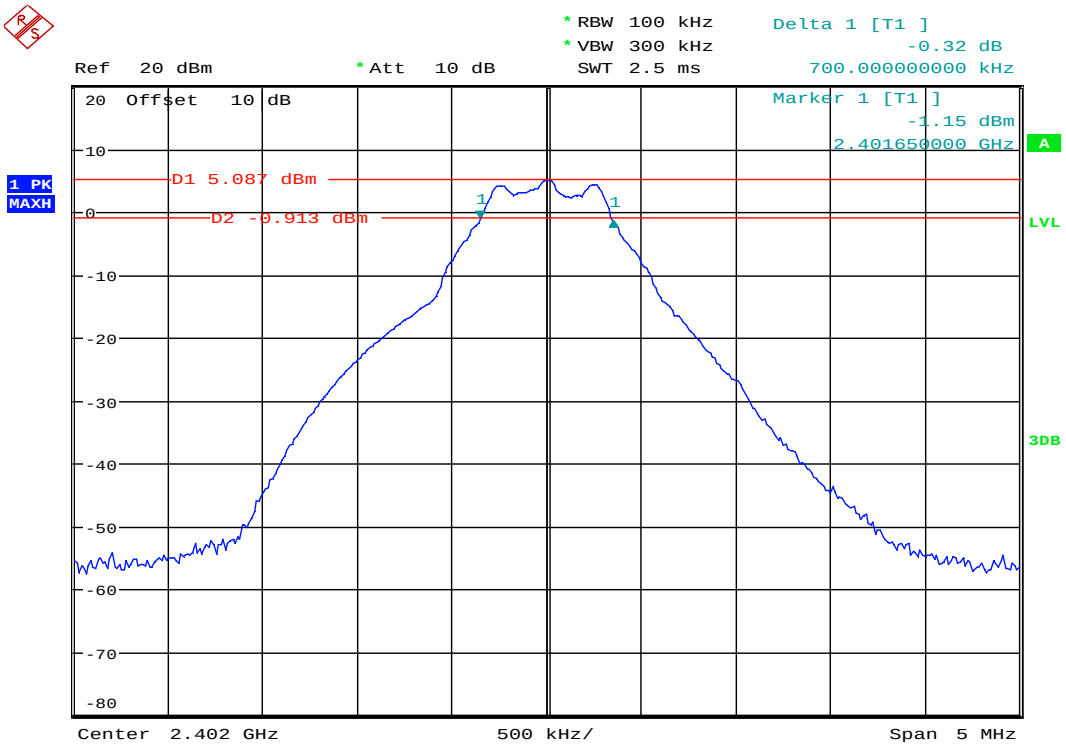
4.2.2 Test result

Ambient temperature	21 °C

Relative humidity	42 %

The following results were measured at the antenna port of the EUT. The plot shows an exemplary measurement result for the worst documented case. The other results are listed in the following table.

136117_6dB-BW_BTLE_BT1.wmf: DTS Bandwidth (operation mode 1):



Operation Mode	Center Frequency [MHz]	Minimum 6-dB Bandwidth Limit [MHz]	6 dB Bandwidth [MHz]	Result
1	2402.000	0.500	0.700	Passed
2	2440.000	0.500	0.687	Passed
3	2480.000	0.500	0.700	Passed
Measurement uncertainty		+0.66 dB / -0.72 dB		

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

7

4.3 Peak Power Spectral Density

4.3.1 Method of measurement

The relating measurements were carried out in a conducting manner. Therefore, the antenna connector was directly connected to a spectrum analyser. The measurement procedure refers to part 10.2 of document [3].

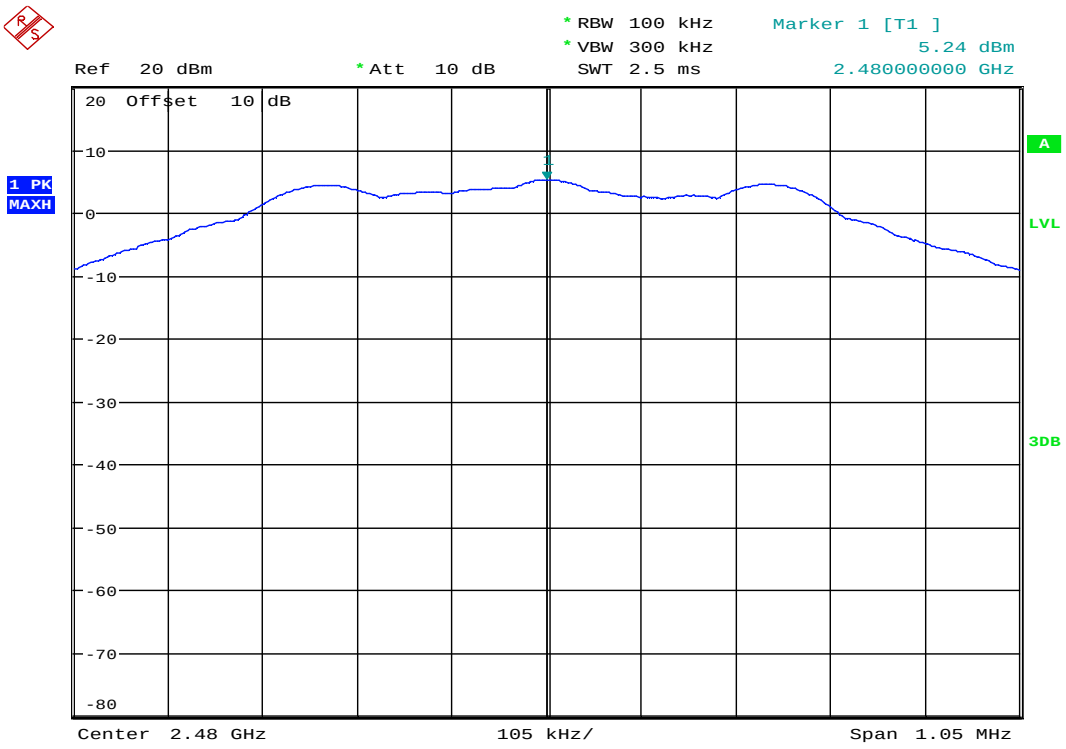
- Set analyser center frequency to DTS channel center frequency
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
- Set the VBW ≥ 3 x RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker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

4.3.2 Test result

Ambient temperature	21 °C	Relative humidity	42 %

The following results were measured at the antenna port of the EUT. The plot shows an exemplary measurement result for the worst documented case. The other results are listed in the following table.

136117_PwrSpecDens_BTLE_BT79.wmf: Power Spectral Density (operation mode 3):



Operation Mode	Peak Frequency [MHz]	Power Spectral Density Limit [dBm/3kHz]	Power Spectral Density Reading [dBm/100kHz]	Array Gain [dB]	Power Spectral Density Level [dBm/100kHz]	Margin [dB]	Result
1	2402.000	8.0	5.1	0.0	5.1	2.9	Passed
2	2441.159	8.0	5.2	0.0	5.2	2.8	Passed
3	2480.157	8.0	5.2	0.0	5.2	2.8	Passed
Measurement uncertainty			+0.66 dB / -0.72 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

7

4.4 Band-edge compliance

4.4.1 Method of measurement (band edges next to unrestricted bands (conducted))

The relating measurements were carried out in a conducting manner. Therefore, the antenna connector was directly connected to a spectrum analyser. The measurement procedure refers to part 11.2 and 11.3 of document [3].

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.

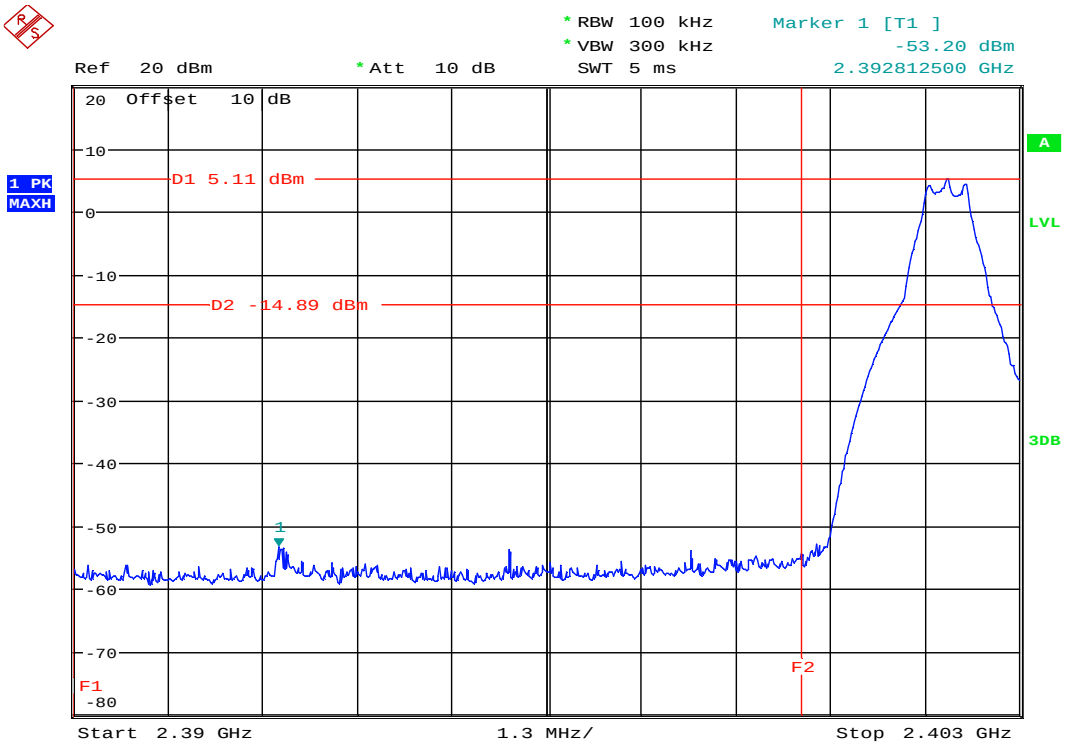
The measurements were performed at the lower end of the 2.4 GHz band.

4.4.2 Test result (band edges next to unrestricted bands (conducted))

Ambient temperature	21 °C	Relative humidity	42 %

The following results were measured at antenna port 1 of the EUT.

136117_BandEdgeUnrestr_BTLE_BT1.wmf: conducted band-edge compliance (operation mode 1):



Operation Mode	BT channel	BT mode	Band-Edge	Emission Frequency [MHz]	Reference Level [dBm]	Limit [dBm]	Emisson Level [dBm]	Margin [dB]	Result
1	0	BLE	low	2392.812	5.1	-14.9	-53.2	38.3	Passed
Measurement uncertainty				+0.66 dB / -0.72 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
7

4.4.3 Method of measurement (band edges next to restricted bands (conducted))

The same test set-up as used for the final conducted emission measurement shall be used (refer also subclause 4.5.1 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 the general limits specified in § 15.205.

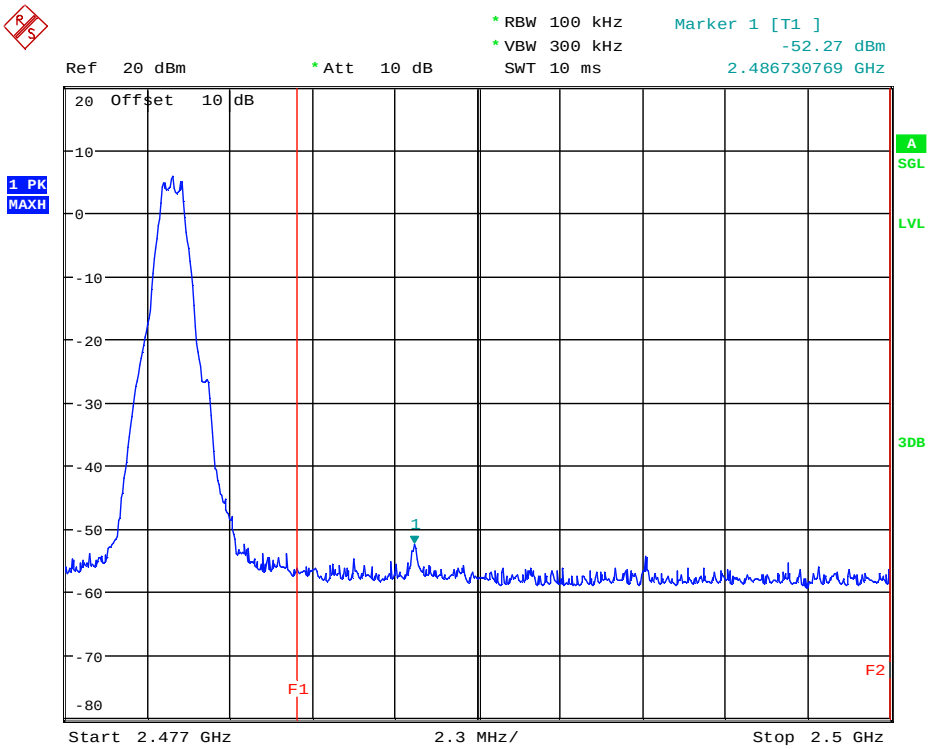
The measurement was performed at the lower and the upper end of the 2.4 GHz band.

4.4.4 Test result (band edges next to restricted bands (conducted))

Ambient temperature	21 °C	Relative humidity	42 %

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

136117_BandEdgeRestr_BTLE_BTLE39.wmf: conducted band-edge compliance (operation mode 3):



Band Edge Compliance, BTLE, channel 0 (Operation mode 1)									
Mode	Channel	Frequency [MHz]	Field Strength [dBµV/m]	Peak Limit [dBµV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
BTLE	BTLE0	2376.328	57.9	74.0	16.1	-40.7	3.4	Passed	Y
Mode	Channel	Frequency [MHz]	Field Strength [dBµV/m]	Average Limit [dBµV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
BTLE	BTLE0	2377.153	37.7	54.0	16.3	-61.0	3.4	Passed	Y
Measurement uncertainty				+0.66 dB / -0.72 dB					

Band Edge Compliance, BTLE, channel 39 (Operation mode 3)									
Mode	Channel	Frequency [MHz]	Field Strength [dBµV/m]	Peak Limit [dBµV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
BTLE	BTLE39	2484.243	50.2	74.0	23.8	-48.0	3	Passed	Y
Mode	Channel	Frequency [MHz]	Field Strength [dBµV/m]	Average Limit [dBµV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
BTLE	BTLE39	2484.231	41.2	54.0	12.8	-57.0	3	Passed	Y
Measurement uncertainty				+0.66 dB / -0.72 dB					

TEST EQUIPMENT USED FOR THE TEST:
7

4.5 Maximum unwanted emissions

4.5.1 Method of measurement (conducted emissions in the restricted bands)

The relating measurements were carried out in a conducting manner. Therefore, the antenna connector was directly mounted to a spectrum analyser. The measurement procedure refers to part 12.2 D01 DTS Meas Guidance v03r01.

If emissions were detected during the preliminary measurements, they were measured using the following measurement procedures:

Procedure for average measurement: 12.2.5.1 – Trace averaging with continuous EUT transmission at full power:

The following method is valid if the EUT transmits continuously (duty cycle ≥ 98%)

- Set the RBW = 1 MHz.
- Set the VBW ≥ 3 x RBW.
- Detector = power average (RMS).
- Ensure that the number of measurement points in the sweep to ≥ 2 x (span/RBW).
- Averaging type = power
- Sweep time = auto
- Perform a trace average of at least 100 traces

Peak measurement procedure: 12.2.4

- Set the analyzer span to encompass the entire unwanted emission bandwidth.
- Set the RBW = specified in Table 2.
- Set the VBW ≥ RBW.
- Set sweep time = auto.
- Detector = peak.
- Trace mode = max hold.
- Allow the trace to stabilize.
- Use the peak marker function to determine the peak power over the emission bandwidth.

Table 2 RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

4.5.1.1 Limit calculations

The following general procedure is described in chapter 12.2.2 of the D01 DTS Meas Guidance v03r01.

a) Measure the conducted output power (in dBm) using the procedures described in 4.5.1.
b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level
c) Add the appropriate maximum ground reflections factor to the EIRP level (6 dB for frequencies ≤, 30 MHz, 4.7 for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz)
d) For devices with multiple antenna ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW)
e) Convert the resultant level to an equivalent electric field strength using the following relationships:

$$E. = EIRP - 20\log(d) + 104.8 \qquad (1)$$

Where:

E. = electric field strength, in dBμV/m
EIRP = equivalent isotropic radiated power, in dBm
d = specified measurement distance, in meters

f) Compare the resultant electric field strength to the applicable limit

Document [6] states, that for transmitters with multiple outputs in the same band, summing of emissions and accounting for array gain have to be considered.

For combining emissions from multiple outputs, the spurious emissions at each output have to be measured and 10log(N) has to be added to the resulting value, whereby N refers to the number of outputs.

To account for directional gain which might occur in case of N transmit antennas, the directional has to be calculated as

$$G_{Dir} = G_{Ant} + 10\log(N)dBi\,,$$

whereby N is the number of antennas.

For the actual EUT the highest combination of antenna gain and used number of ports results in an additional value, added to the conducted spurious emission level, of 13 dB. Whereby the antenna has a gain of 3.5 dBi and the number of used ports is 3.

4.5.2 Method of measurement (conducted emissions in the unrestricted bands)

In any 100 kHz outside the authorized frequency band, the power shall be attenuated by 20 dB, compared to the highest in band power in any 100 kHz. This shall be demonstrated by using the peak power procedure. The reference level shall be measured using the procedure described in 4.5.2.1 and the emission level according to procedure 4.5.2.2.

4.5.2.1 Reference level measurement

a) Set instrument center frequency to DTS channel center frequency.
b) Set the span to ≥ 1.5 times the DTS bandwidth.
c) Set the RBW = 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.+
i) Use the peak marker function to determine the maximum PSD level.

4.5.2.2 Emission level measurement

a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100 kHz.
c) Set the VBW ≥ 3 x RBW.
d) Detector = peak.
e) Ensure that the number of measurement points ≥ span/RBW
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level.

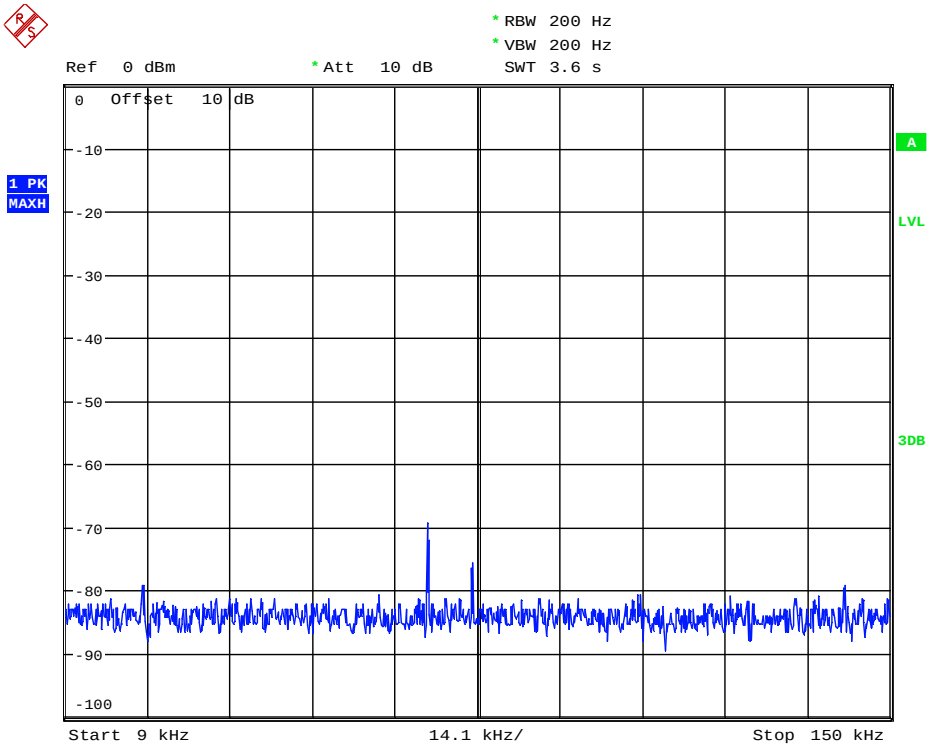
4.5.3 Test results (conducted emissions)

4.5.3.1 Emissions below 30 MHz

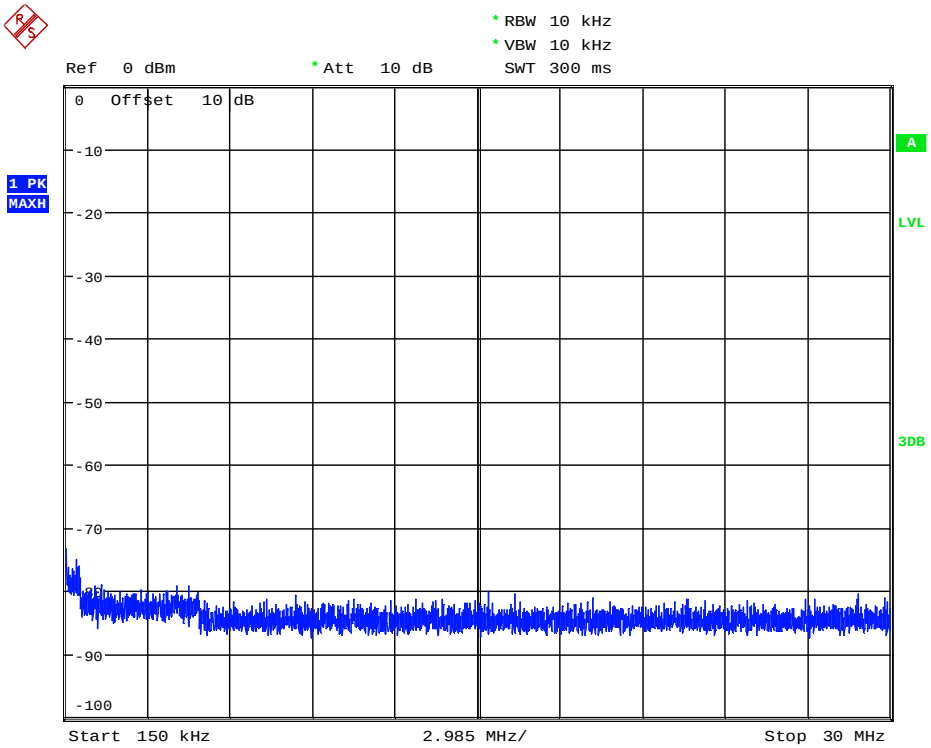
Ambient temperature	21 °C	Relative humidity	42 %

The Emissions below 30 MHz were similar for all channels, modulations and data rates. Therefore only the results of an exemplary test case are submitted below.

136117_SpurEmiss9-150k_BTLE_BT1.wmf: conducted spurious emissions (operation mode 1):



136117_SpurEmiss150k-30M_BTLE_BT1.wmf: conducted spurious emissions (operation mode 1):



Spurious Emissions f < 30 MHz						
Peak Emission – Restricted Band						
Frequency [MHz]	Field Strength [dBµV/m]	Max Peak Limit [dBµV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result
0.07	-3.4	30.6	34.5	-68.5	3.0	Passed
0.078	-10.8	29.7	40.1	-75.0	3.0	Passed
0.058	-12.6	24.6	36.7	-76.8	3.0	Passed
0.142	-4.3	30.6	34.5	-68.5	3.0	Passed

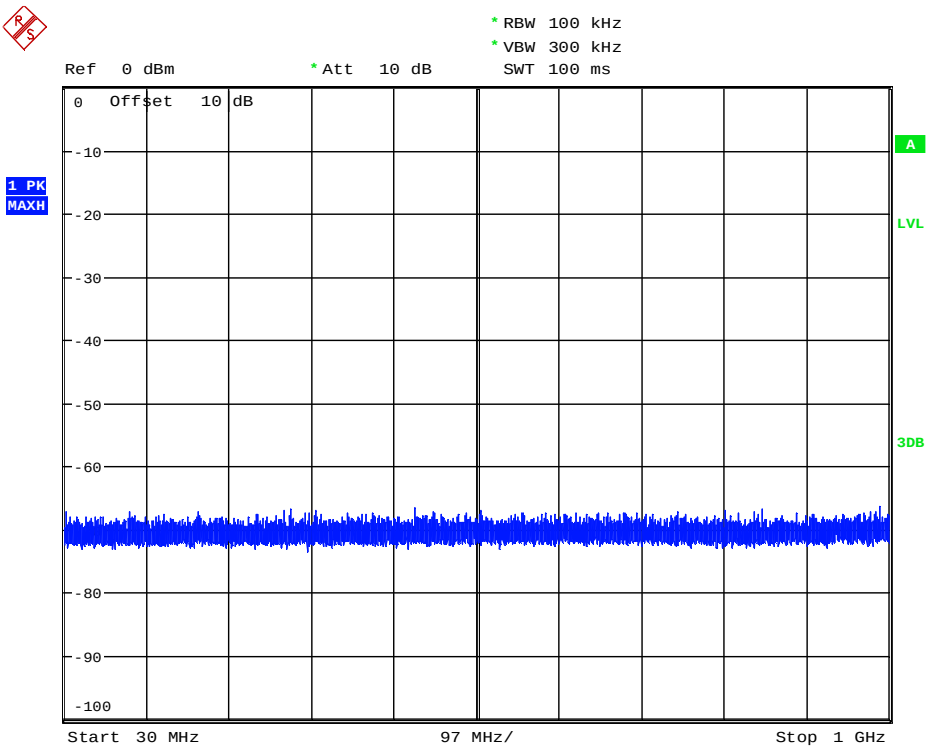
4.5.3.2 Emissions above 30 MHz

Ambient temperature	21 °C	Relative humidity	42 %

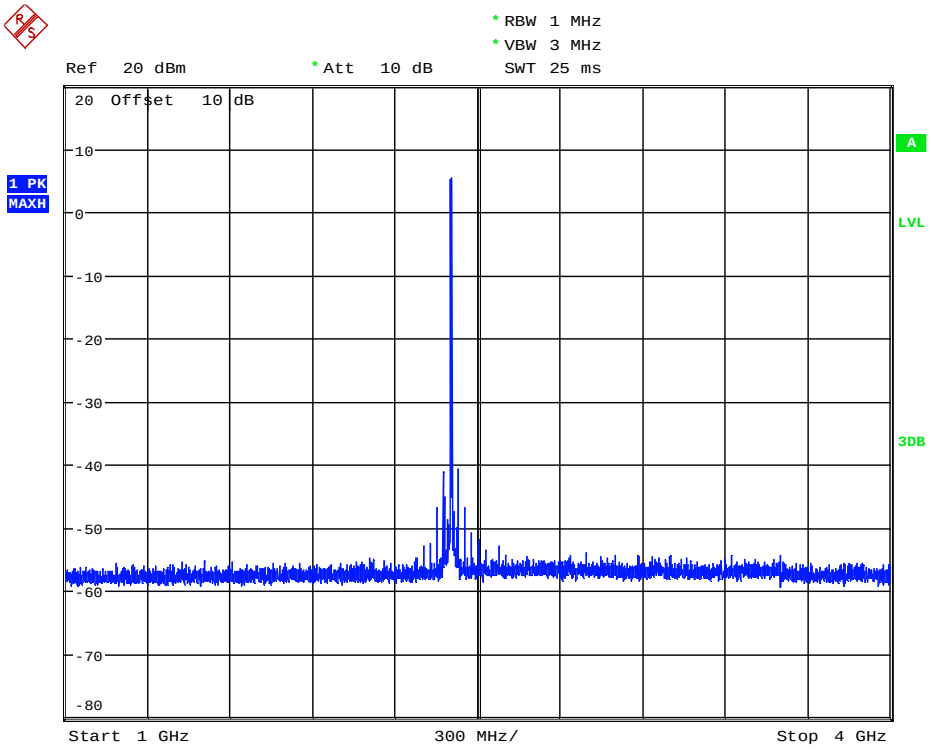
The following results were measured at antenna port of the EUT. The plots show exemplary measurement results for the worst documented case. The other results are listed in the following tables.

If an emission failed to pass the conducted test, the measurement was repeated in a radiated measurement with all applicable antenna types.

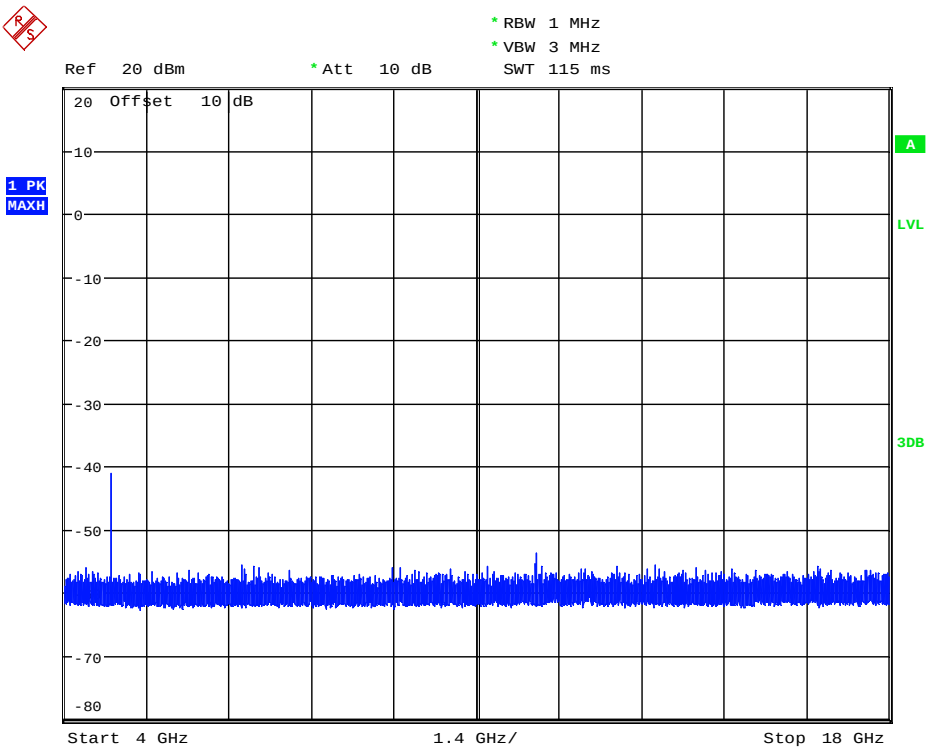
136117_SpurEmiss0.03-1G_BTLE_BT1.wmf: conducted spurious emissions (operation mode 1):



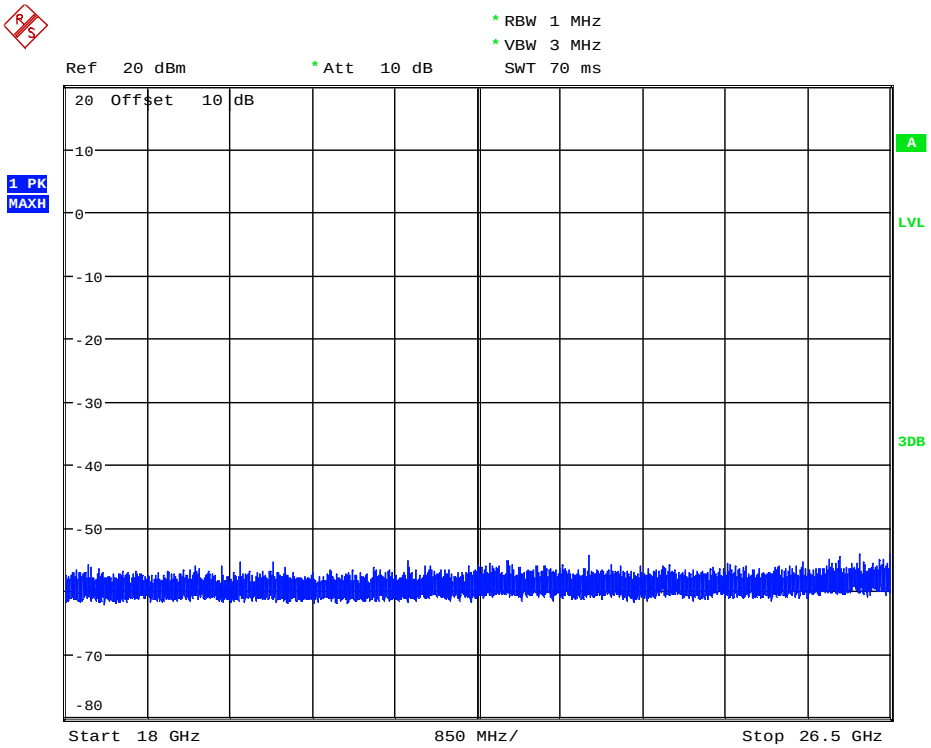
136117_SpurEmiss1-4G_BTLE_BT1.wmf: conducted spurious emissions (operation mode 1):



136117_SpurEmiss4-18G_BTLE_BT1.wmf: conducted spurious emissions (operation mode 1):



136117_SpurEmiss18-26,5G_BTLE_BT1.wmf: conducted spurious emissions (operation mode 1):



Spurious Emissions, BTLE, channel 0 (Operation mode 1)									
Peak Emission – Restricted Band									
Mode	Channel	Frequency [MHz]	Field Strength [dBµV/m]	Max Peak Limit [dBµV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
BTLE	BTLE0	4803.525	58.4	74.0	15.6	-40.2	3.4	Passed	Y
Average Emission – Restricted Band									
Mode	Channel	Frequency [MHz]	Field Strength [dBµV/m]	Max Peak Limit [dBµV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
BTLE	BTLE0	4803.850	53.4	54.0	0.6	-45.3	3.4	Passed	Y
Emissions in the non-restricted Bands									
Mode	Channel	Frequency [MHz]	Reading [dBm]	Limit [dBm]	Margin [dB]	Result	Restricted Band?		
BTLE	BT1	2392.812	5.1	-14.9	-53.2	38.3	Passed		

Spurious Emissions, BTLE, channel 19 (Operation mode 2)									
Peak Emission – Restricted Band									
Mode	Channel	Frequency [MHz]	Field Strength [dBµV/m]	Max Peak Limit [dBµV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
BTLE	BTLE19	4879.925	57.4	74.0	16.7	-41.3	3.4	Passed	Y
BTLE	BTLE19	12198.650	49.3	74.0	24.7	-49.4	3.4	Passed	Y
Average Emission – Restricted Band									
Mode	Channel	Frequency [MHz]	Field Strength [dBµV/m]	Max Peak Limit [dBµV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
BTLE	BTLE19	4879.825	52.1	54.0	1.9	-46.6	3.4	Passed	Y
BTLE	BTLE19	12198.725	39.8	54.0	14.2	-58.9	3.4	Passed	Y
Emissions in the non-restricted Bands									
No spurious Emissions were found in the restricted band during the preliminary measurements									

Spurious Emissions, BTLE, channel 39 (Operation mode 3)
No conducted final measurement for this transmit mode *

* The final conducted measurement for this test case was failed and repeated as a radiated measurement in 4.5.5.

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
7, 30

4.5.4 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 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 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 and final measurement (1 GHz to 110 GHz)

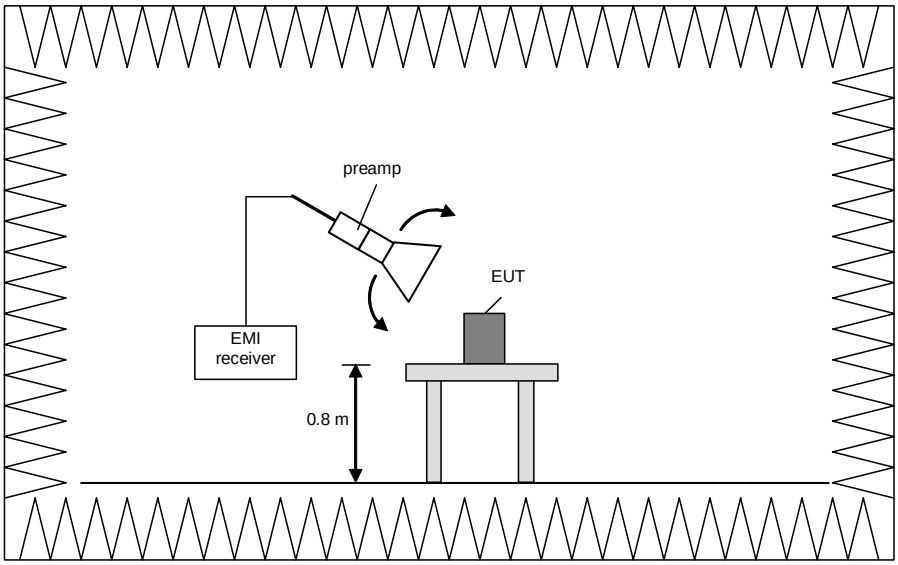
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance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

Preliminary measurement (1 GHz to 110 GHz)

The frequency range will be divided into different sub ranges depending on 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 than 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

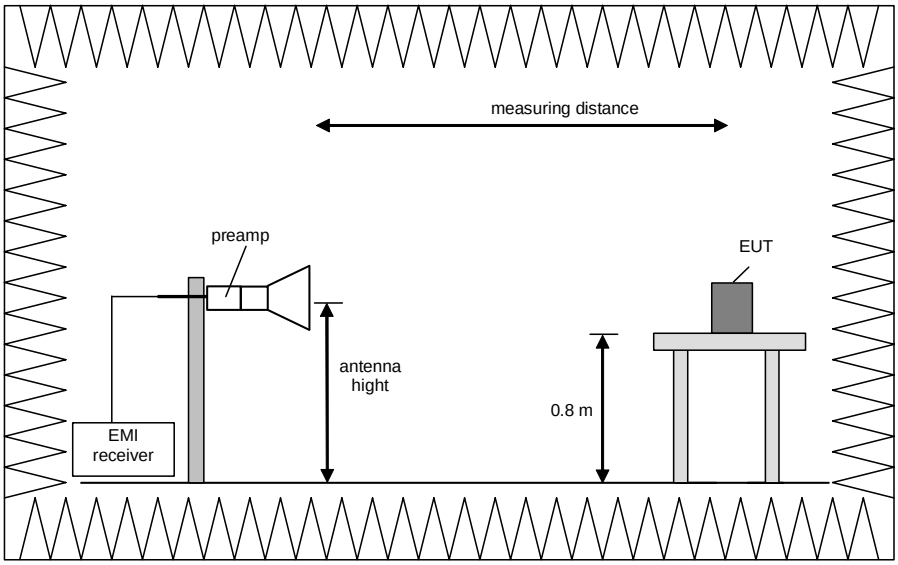


Final measurement (1 GHz to 110 GHz)

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.

4.5.5 Test results (radiated emissions) – Antenna Emissions

4.5.5.1 Preliminary radiated emission measurement

The preliminary measurements were already performed during the conducted measurements, therefore only the failed measurements were repeated at the given frequencies.

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

Ambient temperature	23 °C	Relative humidity	42 %

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

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in Table 1.

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 an laboratory power supply.

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

Remark: Only the frequencies that failed the conducted spurious emissions tests are repeated in the following radiated antenna measurements.

4.5.5.2.1 InSide-EPA 2400

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.	Turntable Angle	Pos.
4960	53.4	74.00	20.6	40.81	32.89	25.60	5.30	150	Hor.	29	1
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.	Turntable Angle	Pos.
4960	44.26	54.00	9.74	31.67	32.89	25.6	5.30	150	Hor.	59	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

4.5.5.2.2 InSide Fold-2400

Transmitter operates at the upper 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.	Turntable Angle	Pos.
4960	55.2	74.0	18.8	42.6	32.9	25.6	5.3	150	Vert.	231	1
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.	Turntable Angle	Pos.
4960	46.0	54.0	8.0	33.4	32.9	25.6	5.3	150	Vert.	298	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

4.5.5.2.3 Ex-IT WLAN

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.	Turntable Angle	Pos.
4960	51.5	74.0	22.5	38.9	32.9	25.6	5.3	150	Vert.	222	1
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.	Turntable Angle	Pos.
4960	42.2	54.0	11.8	29.6	32.9	25.6	5.3	150	Vert.	308	1
Measurement uncertainty						+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
6, 8 - 11, 13-15, 17 - 24

4.5.6 Test results (radiated emissions) – cabinet emissions

4.5.6.1 Preliminary radiated emission measurement

Ambient temperature	23 °C	Relative humidity	30 %

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

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in Table 1.

Test record: All results are shown in the following.

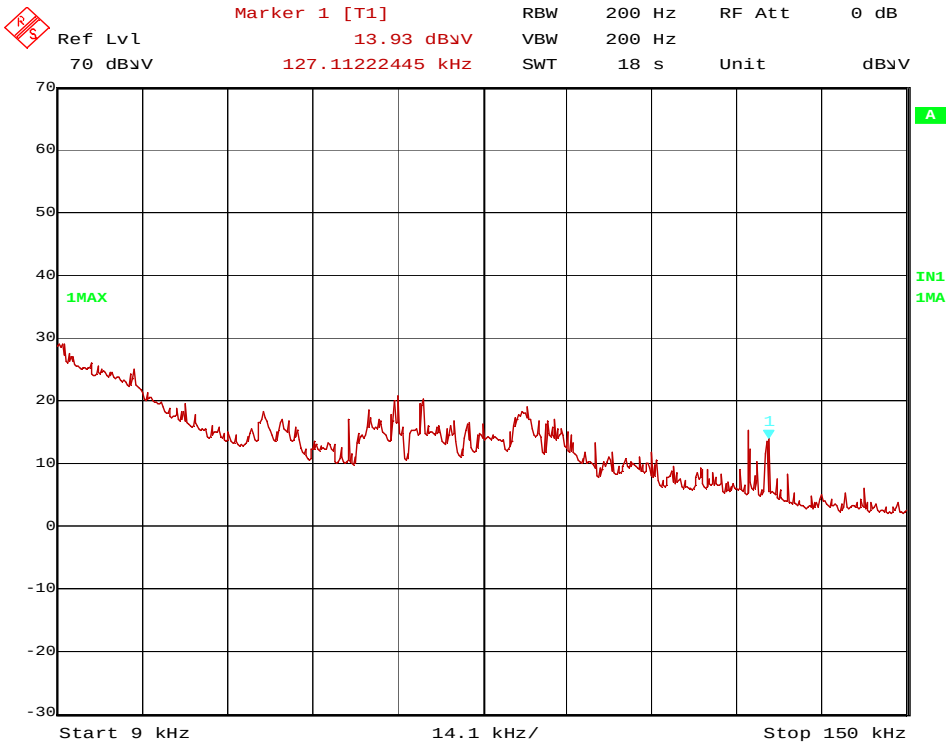
Supply voltage: During all measurements the host of the EUT was powered with 5 V DC via a laboratory power supply.

Remark: Document [3] states in 12.2.1, that in case of conducted measurements, additional radiated cabinet emission measurements must be performed. The measurements were performed at channel 0, 19 and 39.

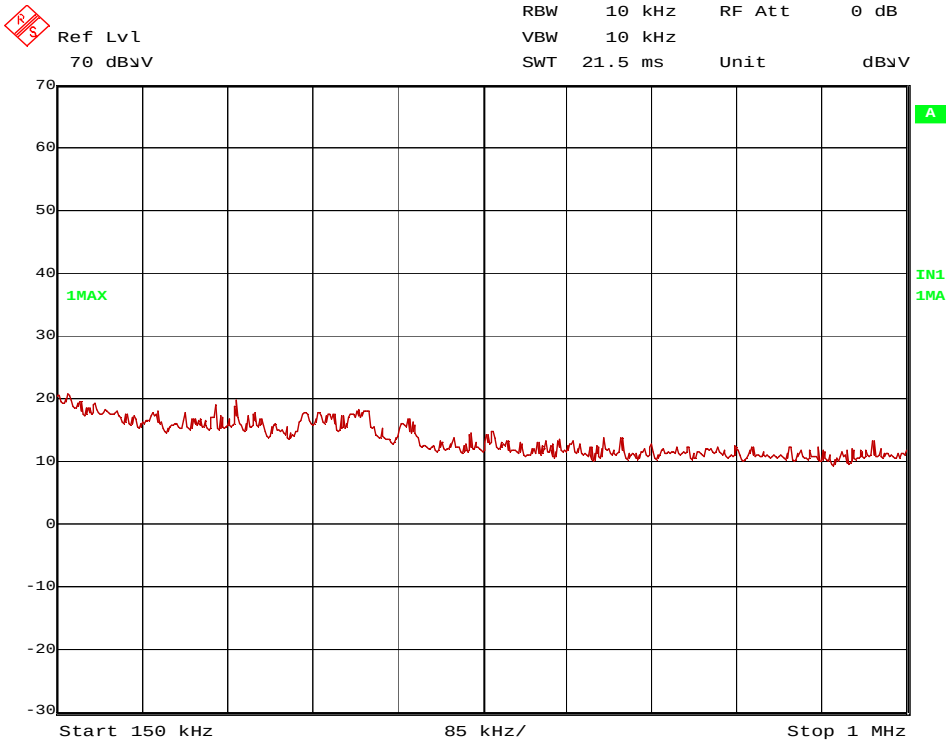
Only the plots of the worst case emissions are submitted for every frequency range above 1 GHz in the preliminary results.

The Emissions below 1 GHz were equal for all antenna ports, transmit frequencies, modulation schemes and data rates. Therefore only the results of an exemplary test case are submitted below.

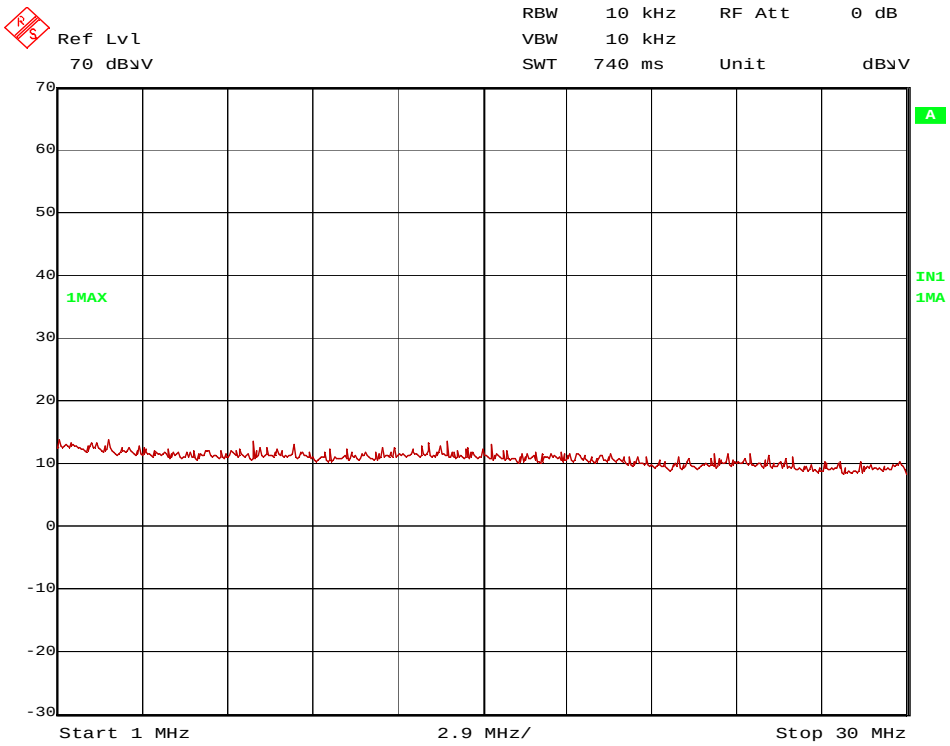
117_W26.wmf: Spurious emissions from 9 kHz to 150 kHz:



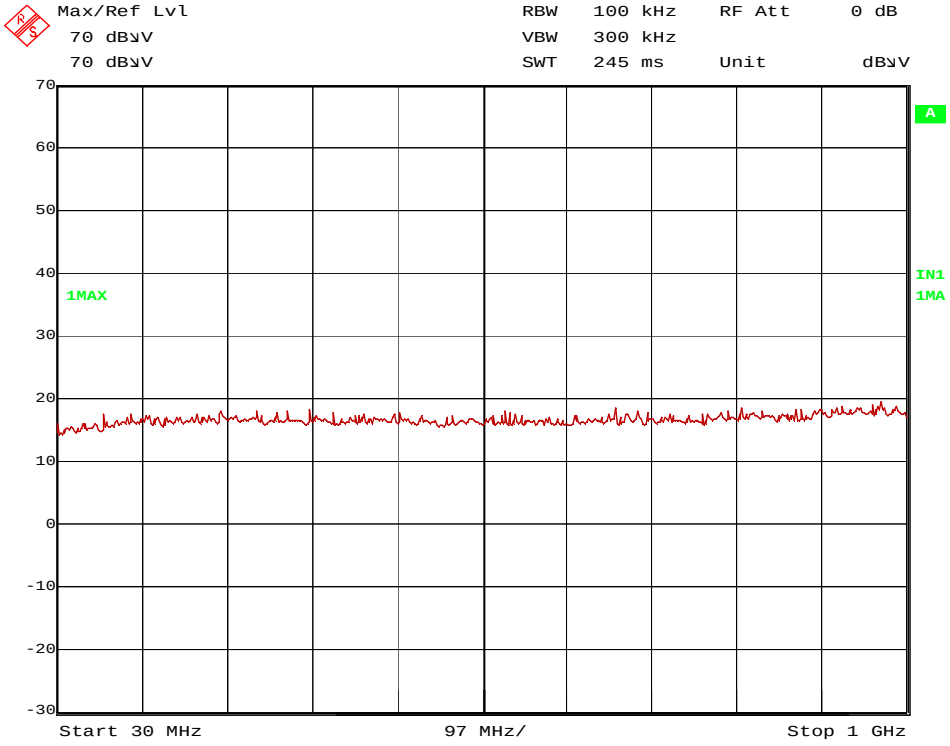
117_W27.wmf: Spurious emissions from 150 kHz to 1 MHz:



117_W28: Spurious emissions from 1 MHz to 30 MHz:

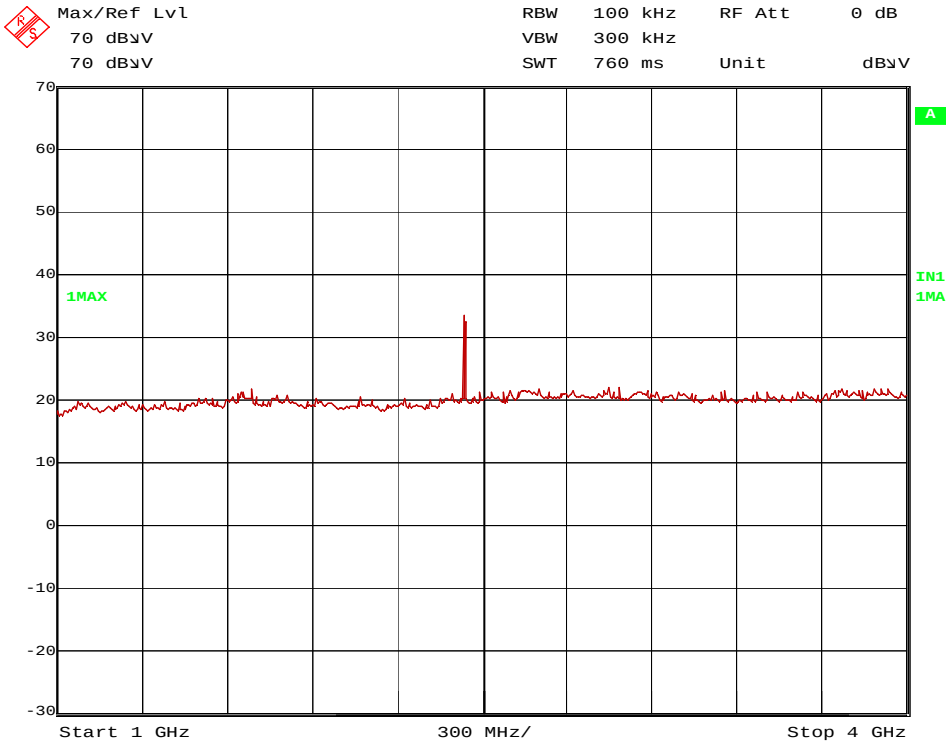


136117_BLE__30M-1G.wmf: Spurious emissions from 30 MHz to 1 GHz:

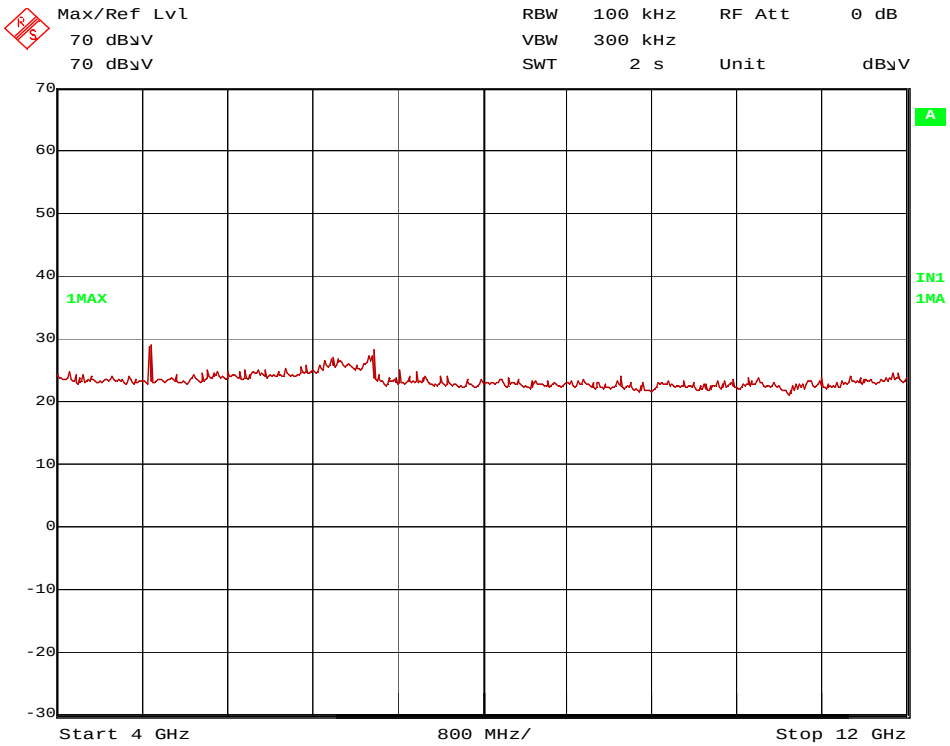


Transmitter operates at the middle of the assigned frequency band (operation mode 2)

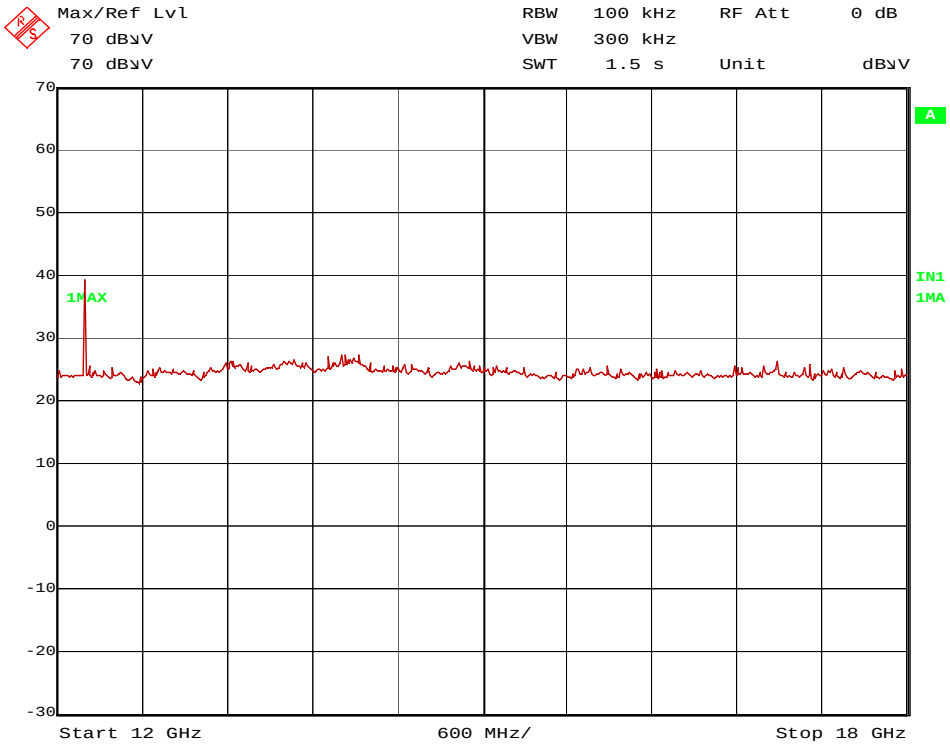
136117_BTLE_mid_1-4G.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



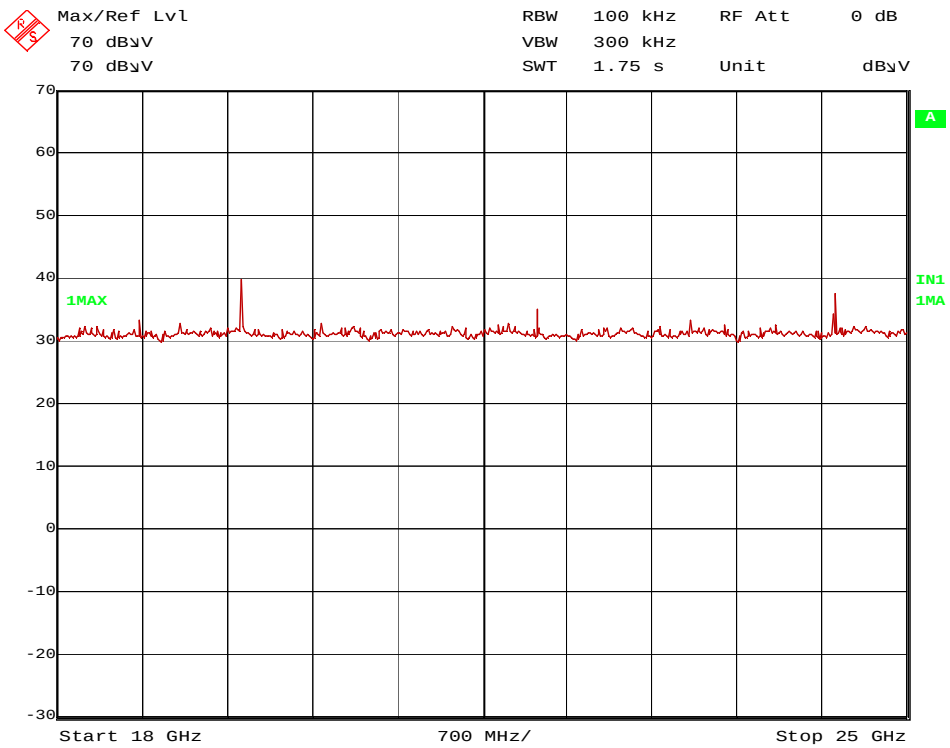
136117_BTLE_Mid_4-12G.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 2):



117_BLE_mid ch_12-18G.wmf: Spurious emissions from 12 to 18 GHz, g-mode, ch6(operation mode 2):



117_BTL_MID_18-25G.wmf: Spurious emissions from 18 – 25 GHz, g-mode, ch6(operation mode 2):



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

- 12199 and 19521 MHz.

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

- 21960 and 24400 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 – 25, 29

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

No emissions could be found in the final measurement on the open area test site, therefore no results for the final measurements are submitted.

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

Ambient temperature	23 °C	Relative humidity	30 %

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

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

Test record: All results are shown in the following.

Supply voltage: During all measurements the host of the EUT was powered with 5 V via an laboratory power supply.

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. Position 2 was found to have the worst case emissions.

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.	Restr. Band
12009	51.8	74.0	22.2	41.5	33.6	26.4	3.1	150	Hor.	Hor.
14411	44.1	74.0	29.9	33.8	33.7	26.8	3.4	150	Vert.	Vert.
16815	43.2	74.0	30.8	34.0	33.8	28.4	3.8	150	Hor.	Hor.
24020	47.3	74.0	26.7	43.5	37.2	38.2	4.8	150	Vert.	Vert.
+2.2 dB / -3.6 dB				+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.	Restr. Band
12009	40.6	54.0	13.4	30.3	33.6	26.4	3.1	150	Hor.	Hor.
14411	31.4	54.0	22.6	21.1	33.7	26.8	3.4	150	Vert.	Vert.
16815	30.3	54.0	23.7	21.1	33.8	28.4	3.8	150	Hor.	Hor.
24020	32.2	54.0	21.8	28.4	37.2	38.2	4.8	150	Vert.	Vert.
+2.2 dB / -3.6 dB				+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.	Restr. Band
12199	53.8	74.0	20.2	43.5	33.6	26.4	3.1	150	Hor.	Yes
19521.0	46.5	74.0	27.5	43.1	37.1	38.0	4.2	150	Vert.	Yes
21960.0	45.8	74.0	28.2	42.1	37.2	37.9	4.4	150	Hor.	No
24400.0	47.8	74.0	26.2	44.2	37.2	38.4	4.8	150	Vert.	No
+2.2 dB / -3.6 dB				+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.	Restr. Band
12199	42.9	54.0	11.1	32.6	33.6	26.4	3.1	150	Hor.	Yes
19521	33.2	54.0	20.8	29.8	37.1	38.0	4.2	150	Vert.	Yes
21960	31.6	54.0	22.4	27.9	37.2	37.9	4.4	150	Hor.	No
24400	32.5	54.0	21.5	28.9	37.2	38.4	4.8	150	Vert.	No
+2.2 dB / -3.6 dB				+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.	Restr. Band
12400	53.2	74.0	20.8	42.7	33.7	26.3	3.1	150	Hor.	Yes
19840.0	45.8	74.0	28.2	42.1	37.0	37.6	4.3	150	Vert.	Yes
24800.0	48.8	74.0	25.2	45.2	37.3	38.3	4.7	150	Hor.	No
+2.2 dB / -3.6 dB				+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.	Restr. Band
12400	42.3	54.0	11.7	31.8	33.7	26.3	3.1	150	Hor.	Yes
19840	32.3	54.0	21.7	28.6	37.0	37.6	4.3	150	Vert.	Yes
24800	33.5	54.0	20.5	29.9	37.3	38.3	4.7	150	Hor.	No
+2.2 dB / -3.6 dB				+2.2 dB / -3.6 dB						

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
6, 8 - 15, 17 – 25, 29

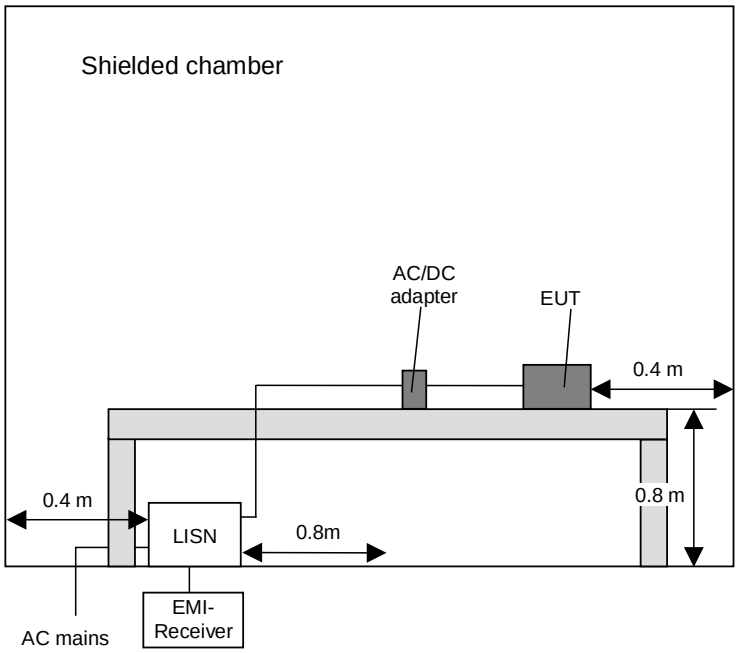
4.6 Conducted emissions on power supply lines (150 kHz to 30 MHz)

4.6.1 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 [1].

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

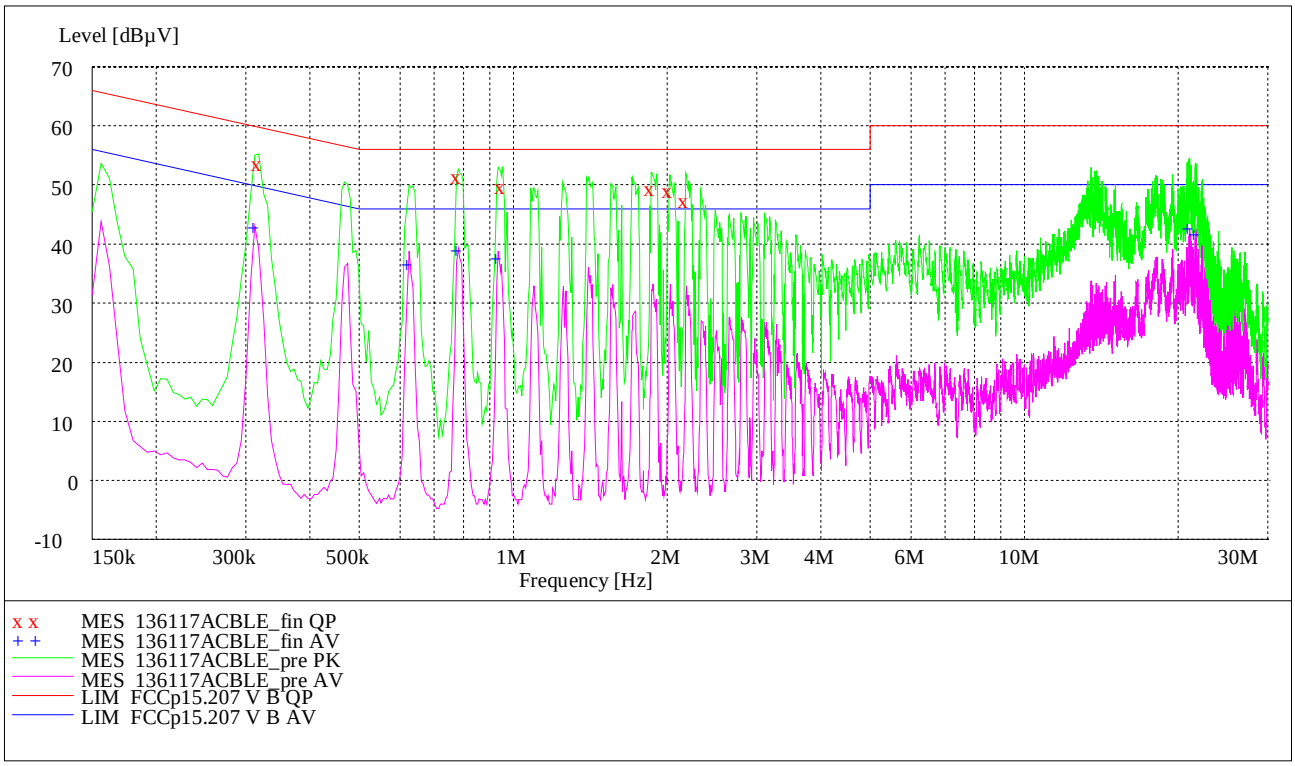


4.6.2 Test results (conducted emissions on power supply lines)

Ambient temperature	21 °C	Relative humidity	27 %

Position of EUT:	For the test the EUT were plugged into a laptop PC via a RS232 cable. The A Bluetooth Low Energy connection was established between the EUT and an ancillary device with a data transfer via iperf. The laptop PC with the inserted 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 a power supply type 2121 from Mascot was used.

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 +.



Data record name: 136117ACBLE

Result measured with the quasipeak detector (marked by an x):

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.318000	54.00	0.9	59.8	5.8	L1	FLO
0.780000	51.80	0.8	56.0	4.2	L1	FLO
0.954000	50.10	0.8	56.0	5.9	L1	FLO
1.866000	49.60	0.7	56.0	6.4	L1	GND
2.022000	49.50	0.8	56.0	6.5	L1	FLO
2.172000	47.70	0.8	56.0	8.3	L1	FLO

Result measured with the average detector (marked by a +):

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.312000	43.00	0.8	49.9	6.9	L1	GND
0.624000	37.00	0.8	46.0	9.0	L1	GND
0.780000	39.30	0.8	46.0	6.7	L1	GND
0.936000	37.80	0.7	46.0	8.2	L1	GND
21.084000	42.80	2.5	50.0	7.2	N	GND
21.672000	42.10	2.6	50.0	7.9	N	FLO

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
1 – 5

5 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	04/05/2012	05/2014
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	07/15/2013	07/2015
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	11/09/2011	11/2014
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	02/16/2012	02/2014
26	Power Meter	NRVD	Rohde & Schwarz	833697/030	480589	07/2013	07/2015
27	Peak Power Sensor	NRV-Z32	Rohde & Schwarz	849745/016	480551	07/2013	07/2015
28	4 GHz High Pass Filter	WHKX4.0/18G-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	08/2015

6 REPORT HISTORY

Report Number	Date	Comment
F136117E9	10 July 2014	Document created

7 LIST OF ANNEXES

ANNEX A TEST SET-UP PHOTOS 7 pages

136117_01: Test setup - Radiated emission. Antennas terminated (fully anechoic chamber)
136117_02: Test setup - Radiated emission. Antennas terminated (fully anechoic chamber)
136117_03: Test setup - Radiated emission. Antennas terminated (fully anechoic chamber)
136117_28: Test setup - Radiated emission, InSide-EPA 2400 Antenna (fully anechoic chamber)
136117_29: Test setup - Radiated emission, Ex-IT WLAN Antenna (fully anechoic chamber)
136117_30: Test setup - Radiated emission, Inside Fold-2400 Antenna (fully anechoic chamber)
136117_04: Test setup – conducted emissions on power supply lines

ANNEX B EXTERNAL PHOTOGRAPHS 3 pages

136117_18.JPG: EUT + Carrier Board – Top View
136117_19.JPG: EUT + Carrier Board – Bottom View
136117_10.JPG: EUT + Carrier Board – Connectors

ANNEX C INTERNAL PHOTOGRAPHS 3 pages

133448_13.JPG: EUT - top view. with shielding
136117_14.JPG: EUT - top view. shielding removed
136117_12.JPG: EUT – bottom view