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Test Report

Report Number:

F160785E3

Equipment under Test (EUT):

Lily-W1

Applicant:

u-blox AG

Manufacturer:

u-blox 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 (June 2016)**, Radio Frequency Devices

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

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

Test Result

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

Test engineer:	Paul NEUFELD Name	 Signature	27.06.2016 Date
Authorized reviewer:	Bernd STEINER Name	 Signature	27.06.2016 Date

This test report is only valid in its original form.

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

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1 Identification

1.1 Applicant

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Applicant represented during the test by the following person:	

1.2 Manufacturer

Name:	u-blox AG
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Country:	Schwitzerland
Name for contact purposes:	Giulio Comar
Phone:	+39 040 2603 757
Fax:	+39 040 2529 394
eMail Address:	giulio.comar@u-blox.com
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 (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-02, FCC Test Firm Accreditation with the registration number 469623, designation number DE0004 and Industry Canada Test site registration SITE# IC3469A-1.

1.4 EUT (Equipment Under Test)

Test object: *	WLAN IEE 802.11 g/b/n transceiver module
Type / PMN: *	LILY-W1
FCC ID: *	XPYLILYW1
IC: *	8595A-LILYW1
Serial number: *	LILY-W131: Radiated/conducted Emissions #215: 549D4CA6E9004740300 LILY-W132: Radiated Emissions #223: 550D4CA6E9001BC0300 Conducted Emissions #122B: 550D4CA6EFFC0A00200
PCB identifier: *	LILY-W131: 549 LILY-W132: 550
HVIN (Hardware Version Identification Number): *	LILY-W131 and LILY-W132
FVIN (Firmware Version Identification Number): *	N/A
Hardware version: *	3.0
Software version: *	1.0

Channel 1	RX:	2412 MHz	TX:	2412 MHz
Channel 2	RX:	2417 MHz	TX:	2417 MHz
Channel 3	RX:	2422 MHz	TX:	2422 MHz
Channel 4	RX:	2427 MHz	TX:	2427 MHz
Channel 5	RX:	2432 MHz	TX:	2432 MHz
Channel 6	RX:	2437 MHz	TX:	2437 MHz
Channel 7	RX:	2442 MHz	TX:	2442 MHz
Channel 8	RX:	2447 MHz	TX:	2447 MHz
Channel 9	RX:	2452 MHz	TX:	2452 MHz
Channel 10	RX:	2457 MHz	TX:	2457 MHz
Channel 11	RX:	2462 MHz	TX:	2462 MHz

1.5 Technical Data of Equipment

Fulfills WLAN specification: *	IEEE, 802.11b, 802.11g, 802.11n20					
Antenna type: *	LILY-W131: See antenna list below. LILY-W132: SMD PIFA antenna (Manufacturer ProAnt.)					
Antenna gain: *	LILY-W131: See antenna list below. LILY-W132: -1 dBi					
Antenna connector: *	LILY-W131: U-FL connector LILY-W132: no antenna connector					
Power supply - EUT	U_{nom}=	3.3 V DC	U_{min}=	3.0 V DC	U_{max}=	3.6 V DC
Type of modulation: *	802.11b: CCK, DQPSK, DBPSK 802.11g: OFDM 802.11n: OFDM					
Operating frequency range:*	2412 MHz to 2462 MHz					
Number of channels: *	11					
Temperature range: *	-40 °C to +85 °C					
Lowest / highest Internal clock frequency: *	26 MHz / 128 MHz					

* Declared by the applicant

Ancillary devices (supplied by the applicant):

Carrier Board	EVB LILY-W1 Rev. B					
Power Supply	U_{nom}=	5.0 V DC	U_{min}=	4.5 V DC	U_{max}=	5.5 V DC

Linux development board	cB-0962-02-02-1					
Power Supply	U_{nom}=	12 V DC	U_{min}=	9.0 V DC	U_{max}=	24.0 V DC

Test Laptop	Think Pad

Table 1 Antenna specifications

Antenna name	Comment	Manufacturer	Antenna type	Gain
WCR-2400-IP04, WCR-2400-IP10, WCR-2400-SMA, WCR-2400-SMRP	10 cm cable/U.FL, 25 cm cable/U.FL SMA RSMA	Centurion	External monopole	+2 dBi
SDM2-2400/1575	cable/U.FL	Mobile Mark	External patch	+2 dBi
PSTG0-2400HS-SMA PSTG0-2400HS-RSMA	SMA RSMA	Mobile Mark	External monopole	+0 dBi
FlatWhip-2400	SMA/RSMA	ProAnt	External monopole	+3 dBi
InSide-2400	10 cm cable/U.FL	ProAnt	External patch	+3 dBi
InSide-WLAN	10 cm cable/U.FL	ProAnt	External patch	+3 dBi
Outside-2400	7 cm cable/U.FL, 10 cm cable/U.FL, 25 cm cable/U.FL	ProAnt	External patch	+3 dBi
Ex-IT 2400-SMA 28-001, Ex-IT 2400-RP-SMA 28-001, Ex-IT 2400-MHF 28-001	SMA, RSMA, 10 cm cable/U.FL	ProAnt	External monopole	+3 dBi
Ex-IT WLAN-SMA, Ex-IT WLAN-RP-SMA, Ex-IT WLAN-MHF	SMA, RSMA, 10 cm cable/U.FL	ProAnt	External monopole	+3 dBi
Ex-IT 2400 -MHF 70-001	10 cm cable/U.FL	ProAnt	External monopole	+3 dBi
Ex-IT 2400-SMA 70-002, Ex-IT 2400-RP-SMA 70-002	SMA RSMA	ProAnt	External monopole	+3 dBi
InSide-WLAN Square	10 cm cable/U.FL	ProAnt	External patch	+3 dBi
u-blox LILY Antenna	SMD PIFA	ProAnt	Internal	-1 dBi
R380.500.127 R380.500.125 R380.500.124 R380.500.139	SMA, RSMA, SMA+SEAL, RSMA+SEAL	Pulse	External monopole	+2 dBi
SOA 2400/360/3/20/V	150 cm cable/SMA (P/N 1324.99.0033), 150 cm cable/MCX (P/N 1324.99.0036)	Huber+Suhner	External monopole	+3 dBi
NanoBlue-IP04	10 cm cable/U.FL	Laird Technologies	External patch	+2 dBi
GW26.0111.HT	SMA	Taoglas	External monopole	0 dBi
ANT-2.4-CW-RH-RPS ANT-2.4-CW-RH-SMA	RP-SMA, SMA	Linx	External monopole	-1 dBi

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
EVB LILY-W1 Carrier Board to Linux development board	USB-micro plug	USB-Plug	1 m *

Identification	Connector		Length
	Linux development board	Think Pad laptop	
Linux development board to Think Pad laptop	Ethernet plug	Ethernet plug	1 m *
Linux development board to Think Pad laptop	USB-mini plug	USB Plug	1 m *

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	17.05.2016
Start of test:	18.05.2016
End of test:	20.06.2016

2 Operational States

The EUT is a WLAN module targeted for integration into different OEM products.

For the test the EUT was soldered on an EVB LILY-W1 Rev. B carrier-board. This carrier board is connected to a u-blox cB-0962-02-02-1 Linux development board via an USB-mini cable. The linux development board is connected to a laptop-PC via a micro-USB cable and an Ethernet cable. The module on the linux board is not part of this test report and was not active during any of the test, performed for this test report. The connection between Linux evaluation board and laptop is established by using Tera Term commands and the test cases are started by using a tool named “Labtool”. All ancillary devices and the software were provided by the applicant.

The test was performed using the following power settings in the test software:

channel	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Power [dBm] b-mode	16	16	16	16	16	16	16	16	16	16	16
Power [dBm] g-mode	14	16	16	16	16	16	16	16	16	16	13
Power [dBm] n20-mode	13	16	16	16	16	16	16	16	16	16	11

The following operation modes were identified as worst case condition and used during the tests:

Operation mode	Description of the operation mode	WLAN mode	WLAN channel	Modulation	Data rate / Mbps
1	Continuous transmitting on 2412 MHz	b	1	DSSS	1 MBit/s
2	Continuous transmitting on 2437 MHz	b	6	DSSS	1 MBit/s
3	Continuous transmitting on 2462 MHz	b	11	DSSS	1 MBit/s
4	Continuous transmitting on 2412 MHz	g	1	OFDM	6 MBit/s
5	Continuous transmitting on 2437 MHz	g	6	OFDM	6 MBit/s
6	Continuous transmitting on 2462 MHz	g	11	OFDM	6 MBit/s
7	Continuous transmitting on 2412 MHz	n 20 MHz	1	OFDM	6.5 MBit/s
8	Continuous transmitting on 2437 MHz	n 20 MHz	6	OFDM	6.5 MBit/s
9	Continuous transmitting on 2462 MHz	n 20 MHz	11	OFDM	6.5 MBit/s

3 Additional Information

All tests were performed with unmodified samples.

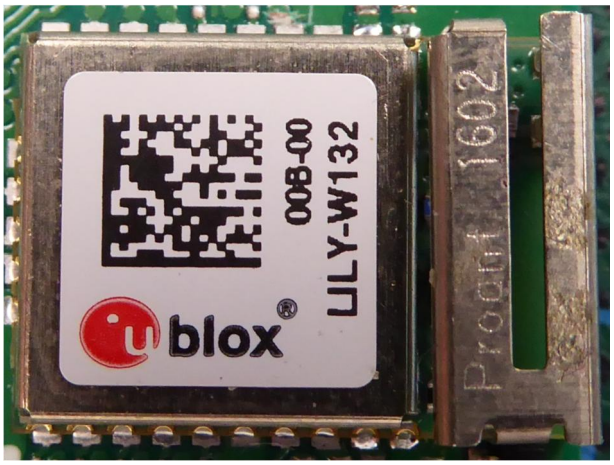
This test includes both, the LILY-W131 and the LILY-W132 sample.

The conducted tests were carried out with the LILY-W131 (#215) sample, whereby delta tests were performed with a LILY-W132 (#122B) sample with a temporary antenna connector which was provided by the applicant.

The radiated tests were carried out with a LILY-W132 (#223) sample, whereby delta tests were performed with a LILY-W131 (#215) sample with terminated antenna port.

No differences greater than the measurement uncertainty (apart from the power spectral density measurements) were found between the respective measurement samples (radiated and conducted).

LILY-W131 as marketed



LILY-W132 as marketed

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 (2) [3]	Passed	11 et seq
DTS Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (1) [3]	Passed	13 et seq
Peak Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (2) [3]	Passed	15 et seq
Band edge compliance	2400.0 - 2483.5	15.247 (d)	5.5 [3] 8.9 [4], 8.10 [4]	Passed	18 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	23 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Passed	41 wet seq.

5 Results

5.1 Duty cycle

The EUT was transmitting in testmode with 100 % duty cycle, therefore no duty cycle measurements and duty cycle related reductions needed to be performed for the following test cases.

5.2 Maximum conducted output power

5.2.1 Method of measurement

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

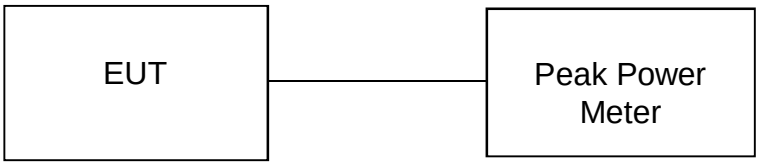
Acceptable measurement configurations

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 11.9.1.3 of document [1].

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

Test set-up:



5.2.2 Test results

Ambient temperature	22 °C	Relative humidity	62 %

The highest antenna gain is 3 dBi, therefore no peak power limit reduction is necessary.

Results for Lily-W131:

Operation Mode	Antenna gain combined [dBi]	Maximum Peak output power [dBm]	Margin [dB]	Peak limit [dBm]
1	3	17.7	12.3	30.0
2	3	16.8	13.2	30.0
3	3	17.0	13.0	30.0
4	3	19.6	10.4	30.0
5	3	20.7	9.3	30.0
6	3	18.7	11.3	30.0
7	3	18.9	11.1	30.0
8	3	20.9	9.1	30.0
9	3	16.8	13.2	30.0
Measurement uncertainty			+0.66 dB / -0.72 dB	

Results for Lily-W132:

Operation Mode	Antenna gain combined [dBi]	Maximum Peak output power [dBm]	Margin [dB]	Peak limit [dBm]
1	3	18.1	11.9	30.0
2	3	16.9	13.1	30.0
3	3	17.2	12.8	30.0
4	3	19.7	10.3	30.0
5	3	21.5	8.5	30.0
6	3	18.5	11.5	30.0
7	3	18.7	11.3	30.0
8	3	21.5	8.5	30.0
9	3	17.2	12.8	30.0
Measurement uncertainty			+0.66 dB / -0.72 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

60, 61

5.3 DTS Bandwidth

5.3.1 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 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.

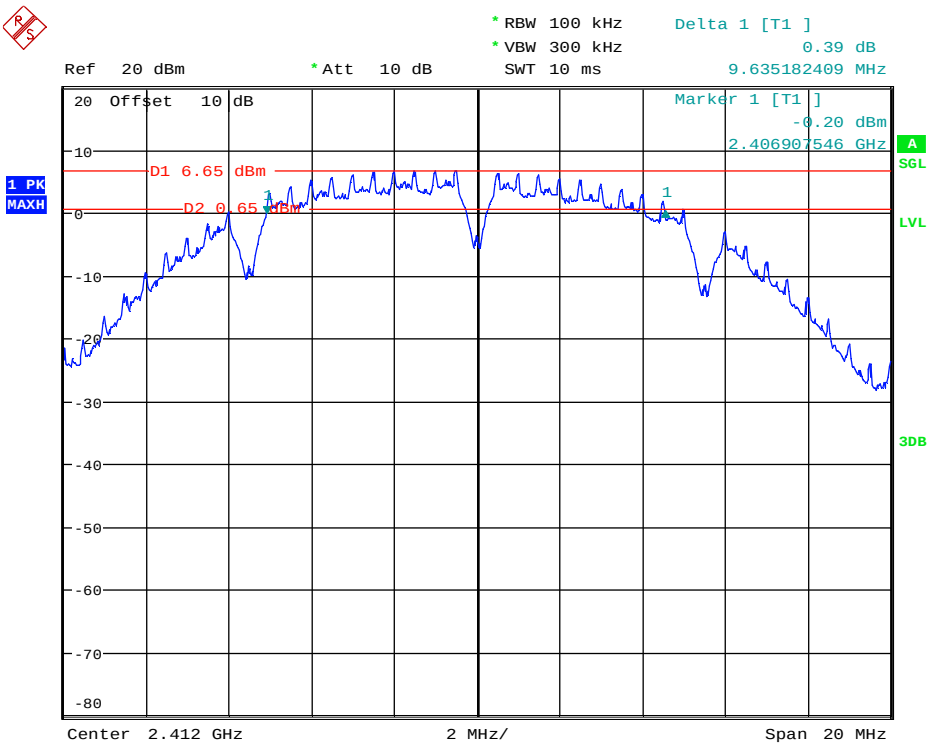
5.3.2 Test result

Ambient temperature	22 °C

Relative humidity	59 %

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.

160785_6dB-BW_b_1.wmf: 6-dB Bandwidth (operation mode 1):



Lily-W131:

Operation Mode	Center Frequency [MHz]	Minimum 6-dB Bandwidth Limit [MHz]	6 dB Bandwidth [MHz]	Result
1	2412	0.5	10.045	Passed
2	2437	0.5	10.045	Passed
3	2462	0.5	10.055	Passed
4	2412	0.5	16.582	Passed
5	2437	0.5	16.597	Passed
6	2462	0.5	16.597	Passed
7	2412	0.5	17.631	Passed
8	2437	0.5	17.841	Passed
9	2462	0.5	17.826	Passed
Measurement uncertainty		+0.66 dB / -0.72 dB		

Lily-W132:

Operation Mode	Center Frequency [MHz]	Minimum 6-dB Bandwidth Limit [MHz]	6 dB Bandwidth [MHz]	Result
1	2412	0.5	9.635	Passed
2	2437	0.5	10.105	Passed
3	2462	0.5	9.625	Passed
4	2412	0.5	15.757	Passed
5	2437	0.5	16.102	Passed
6	2462	0.5	15.757	Passed
7	2412	0.5	16.387	Passed
8	2437	0.5	17.586	Passed
9	2462	0.5	16.402	Passed
Measurement uncertainty		+0.66 dB / -0.72 dB		

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

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5.4 Peak Power Spectral Density

5.4.1 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 11.10.2 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.

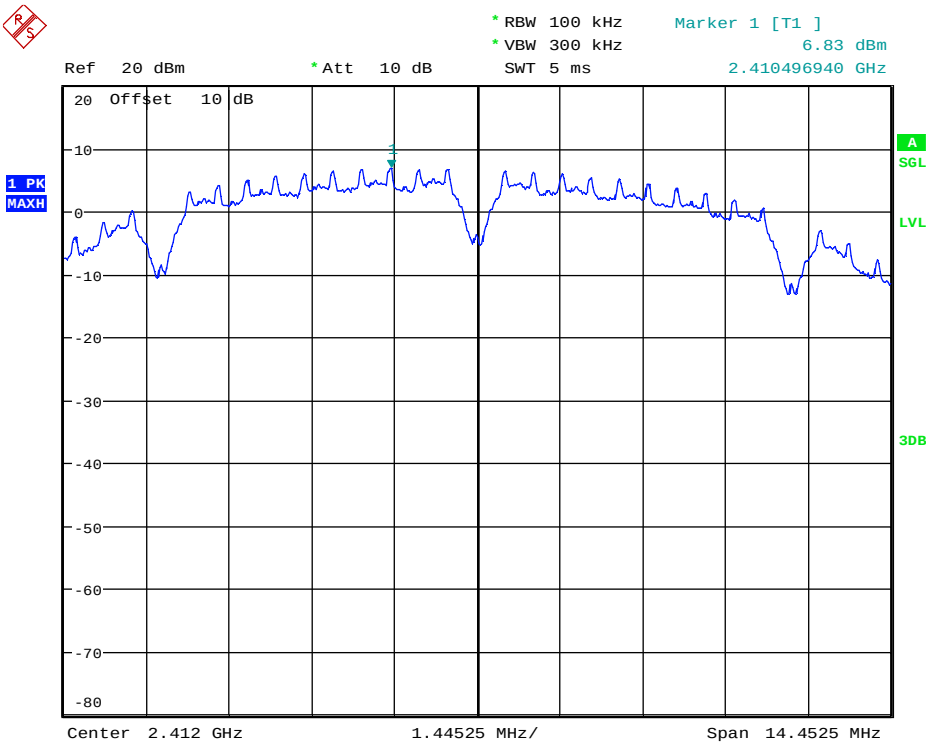
5.4.2 Test result

Ambient temperature	22 °C		Relative humidity	59 %

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.

The highest antenna gain is 3 dBi, therefore no power spectral density limit reduction is necessary.

160785_PwrSpecDens_b_1.wmf: Power Spectral Density (operation mode 1):



Lily-W131:

Operation Mode	Peak Frequency [MHz]	Power Spectral Density Limit [dBm/3kHz]	Power Spectral Density Reading [dBm / 100 kHz]	Margin [dB]	Result
1	2411.488	8	5.2	2.8	Passed
2	2436.488	8	4.5	3.5	Passed
3	2461.487	8	4.6	3.4	Passed
4	2409.239	8	-2.1	10.1	Passed
5	2440.734	8	1.5	6.5	Passed
6	2468.871	8	-3.2	11.2	Passed
7	2413.217	8	-2.7	10.7	Passed
8	2438.258	8	2.1	5.9	Passed
9	2468.631	8	-5.0	13.0	Passed
Measurement uncertainty			+0.66 dB / -0.72 dB		

Lily-W132:

Operation Mode	Peak Frequency [MHz]	Power Spectral Density Limit [dBm/3kHz]	Power Spectral Density Reading [dBm / 100 kHz]	Margin [dB]	Result
1	2410.497	8	6.8	1.2	Passed
2	2437.985	8	5.6	2.4	Passed
3	2461.466	8	5.5	2.5	Passed
4	2405.713	8	4.2	3.8	Passed
5	2444.487	8	4.8	3.2	Passed
6	2455.737	8	2.3	5.7	Passed
7	2406.986	8	2.7	5.3	Passed
8	2444.492	8	4.4	3.6	Passed
9	2455.726	8	0.3	7.7	Passed
Measurement uncertainty			+0.66 dB / -0.72 dB		

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

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5.5 Band-edge compliance

5.5.1 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 11.11.2 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.

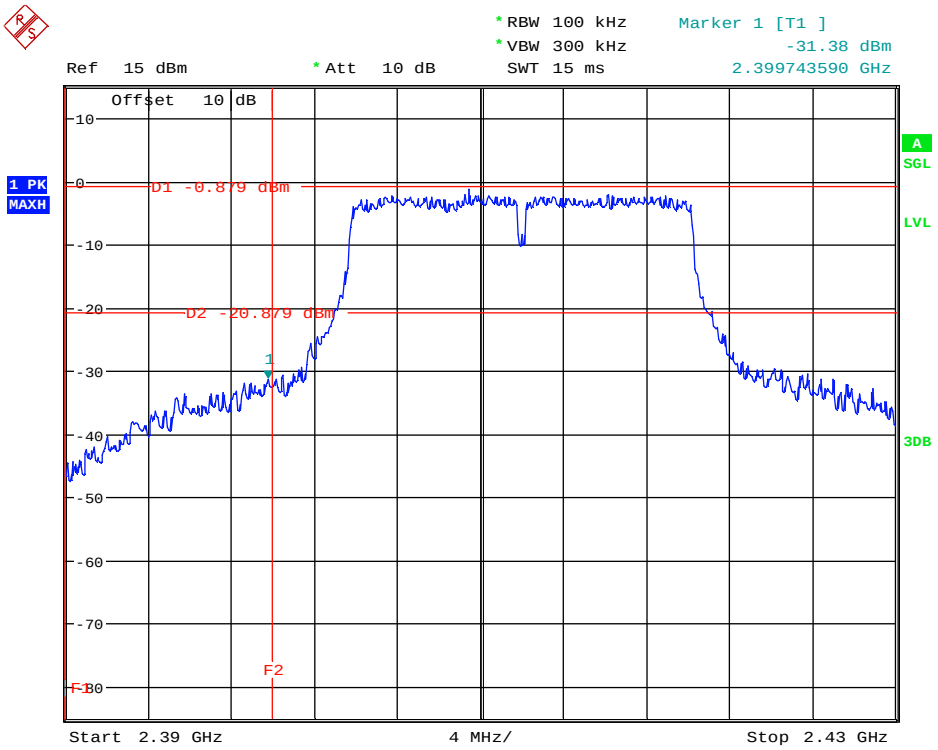
The measurement procedure at the band edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission were be encompassed by the span. After trace stabilization, the maximum peak was be determined by a peak detector and the value was marked by 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

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.

160785_14dBm__BandEdgeUnrestr_g_1.wmf: conducted band-edge compliance (operation mode 4):



Lily-W131:

WLAN Mode	WLAN Channel	Emission Frequency [MHz]	Reference Level [dBm]	Limit [dBm]	Emisson Level [dBm]	Margin [dB]	Result
b	1	2397.436	5.4	-14.6	-35.8	21.2	Passed
g	1	2399.744	-0.9	-20.9	-31.1	10.2	Passed
n20	1	2399.936	-0.3	-20.3	-34.1	13.8	Passed

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
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5.5.3 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 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.

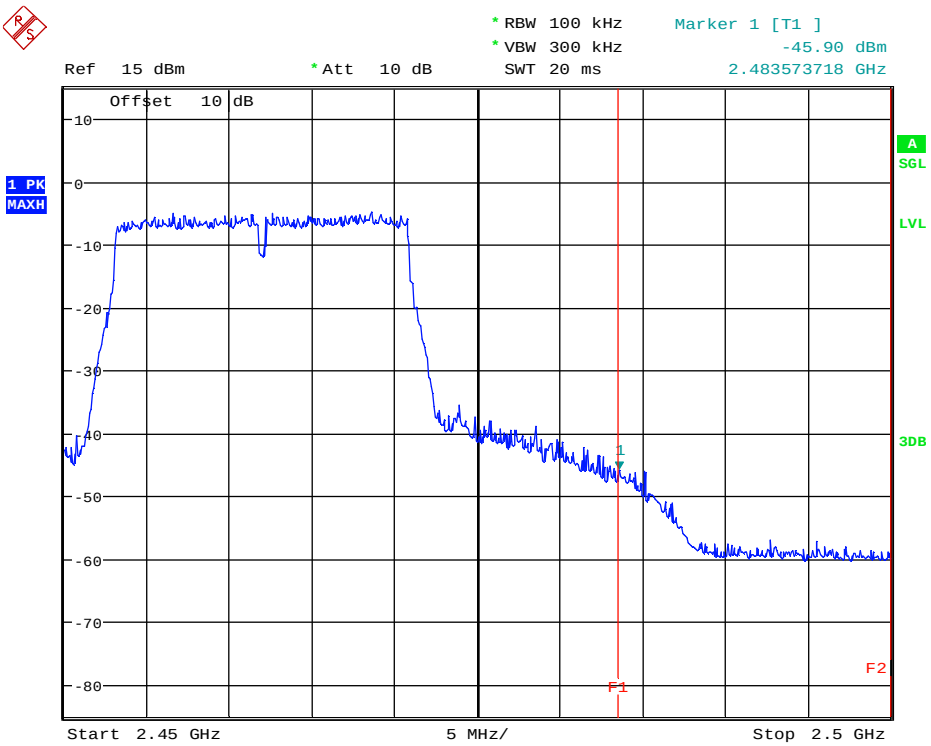
The measurement was performed at the lower and the upper end of the 2.4 GHz band.

5.5.4 Test results

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.

160785_11dBm__BandEdgeRestr_n20_11.wmf: conducted band-edge compliance (operation mode 9):



Lily-W131:

Band Edge Compliance, b-mode, channel 1 (Operation mode 1)									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
b	1	2389.380	51.8	74.0	22.2	-46.7	3.0	Passed	Y
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
b	1	2389.990	41.2	54.0	12.8	-57.4	3.0	Passed	Y
Measurement uncertainty				+0.66 dB / -0.72 dB					

Band Edge Compliance, b-mode, channel 11 (Operation mode 3)									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
b	11	2491.800	70.5	74.0	3.5	-28.1	3.0	Passed	Y
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
b	11	2493.215	42.6	54.0	11.4	-55.9	3.0	Passed	Y
Measurement uncertainty				+0.66 dB / -0.72 dB					

Band Edge Compliance, g-mode, channel 1 (Operation mode 4)									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
g	1	2389.973	70.4	74.0	3.6	-28.1	3.0	Passed	Y
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
g	1	2389.988	52.6	54.0	1.4	-46.0	3.0	Passed	Y
Measurement uncertainty				+0.66 dB / -0.72 dB					

Band Edge Compliance, g-mode, channel 11 (Operation mode 6)									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
g	11	2483.520	71.9	74.0	2.1	-26.6	3.0	Passed	Y
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
g	11	2483.510	52.2	54.0	1.8	-46.3	3.0	Passed	Y
Measurement uncertainty				+0.66 dB / -0.72 dB					

Band Edge Compliance, n20-mode, channel 1 (Operation mode 7)									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
n20	1	2389.991	72.5	74.0	1.5	-26.1	3.0	Passed	Y
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
n20	1	2389.961	51.4	54.0	2.6	-47.2	3.0	Passed	Y
Measurement uncertainty				+0.66 dB / -0.72 dB					

Band Edge Compliance, n20-mode, channel 11 (Operation mode 9)									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
n20	11	2484.455	73.5	74.0	0.5	-25.1	3.0	Passed	Y
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
n20	11	2483.565	51.0	54.0	3.0	-47.6	3.0	Passed	Y
Measurement uncertainty				+0.66 dB / -0.72 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30

5.6 Maximum unwanted emissions

5.6.1 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 11.12.2.2 in document [1].

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

Procedure for average measurement: 11.12.2.5.2 – Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction:

If continuous transmission of the EUT (D ≥ 98%) cannot be achieved and the duty cycle is constant (duty cycle variations are less than ±2%), then the following procedure shall be used:

- The EUT shall be configured to operate at the maximum achievable duty cycle.
- Measure the duty cycle D of the transmitter output signal as described in 11.6 in [1].
- Set the RBW = 1 MHz (unless otherwise specified).
- 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
- Correct the resulting measurement value by adding the duty cycle correction value (only applicable if not transmit continuously).

Peak measurement procedure: 11.12.2.4 in [1]

- 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

5.6.1.1 Limit calculations

The following general procedure is described in chapter 11.12.2.2 in [1].

a) Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency (see 11.12.2.3 through 11.12.2.5 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP (see 11.12.2.6 for guidance on determining the applicable antenna gain).
c) Add the appropriate maximum ground reflection factor to the EIRP (6 dB for frequencies ≤ 30 MHz; 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive; and 0 dB for frequencies > 1000 MHz).
d) For MIMO devices, measure the power of each chain and sum the EIRP of all chains in linear terms (i.e., watts and mW).
e) Convert the resultant EIRP to an equivalent electric field strength using the following relationship:

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

where

E is the electric field strength in dBµV/m
EIRP is the equivalent isotropically radiated power in dBm
d is the specified measurement distance in m

f) Compare the resultant electric field strength level with the applicable regulatory limit.
g) C Perform the radiated spurious emission test.

Chapter 14 in [1] states, that for transmitters with multiple outputs in the same band, summing of emissions and accounting for array gain have to be considered.

For this test report the procedure of summing of emissions as described in 14.3.2.2 in [1] was used.

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

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

whereby N is the number of antennas.

This EUT has only one antenna port, therefore no calculation for multiple ports have to be performed.

5.6.2 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 5.6.2.1 and the emission level according to procedure 5.6.2.2. The procedures are based on chapter 11.11.2 and 11.11.3 in [1].

5.6.2.1 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.

5.6.2.2 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.

5.6.3 Test results (conducted emissions)

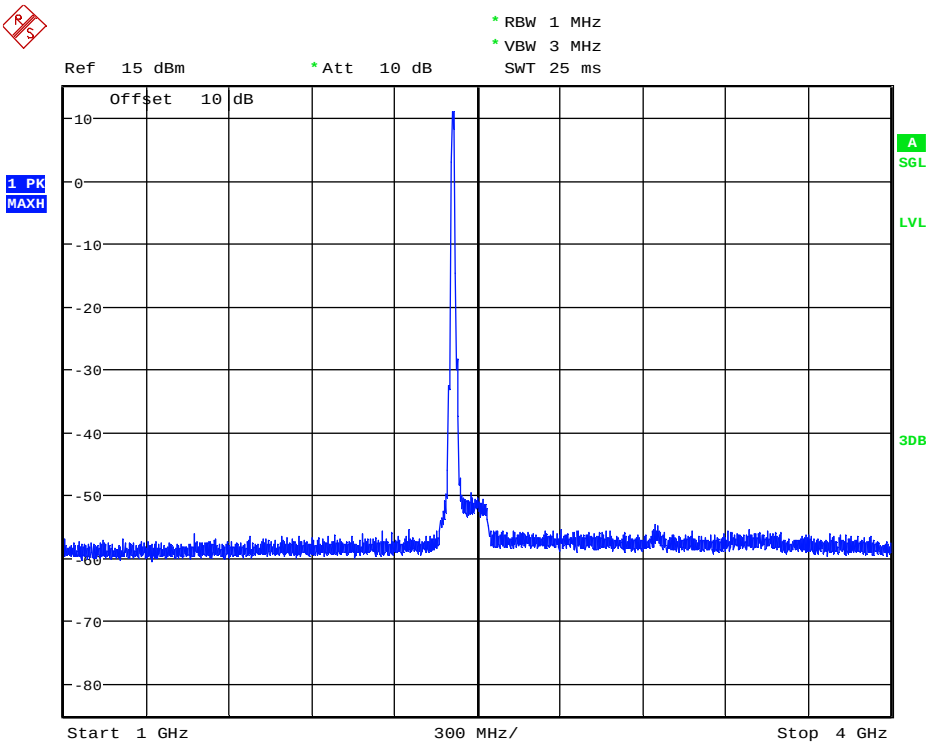
5.6.3.1 Emissions below 1 GHz

No significant emissions were found in the frequency range below 1 GHz, therefore no results are submitted below.

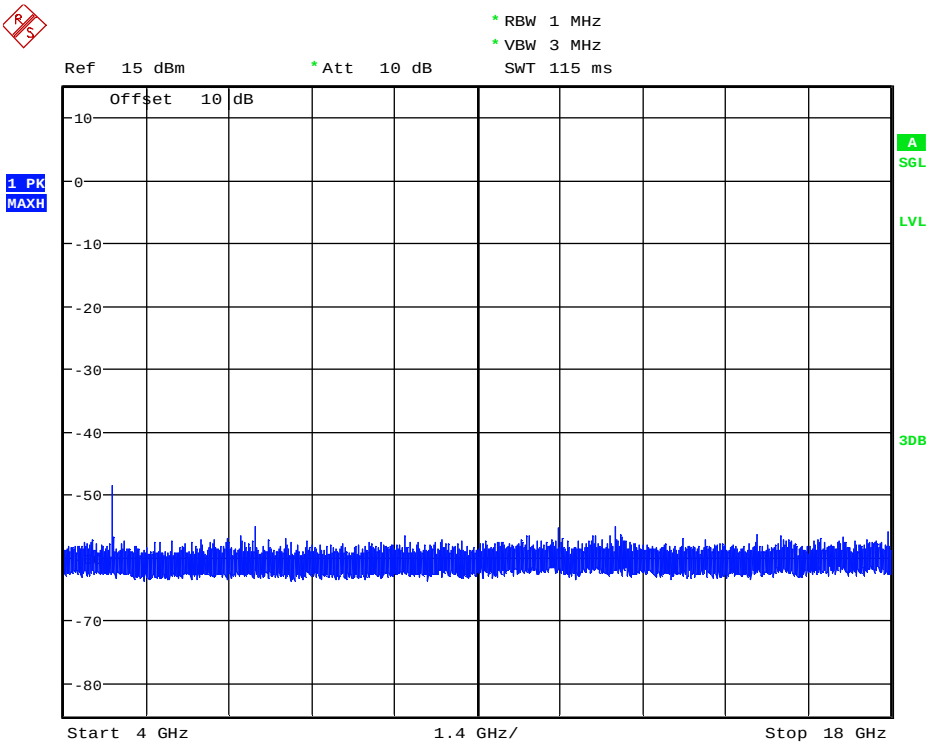
5.6.3.2 Emissions above 1 GHz

Ambient temperature	22 °C		Relative humidity	59 %

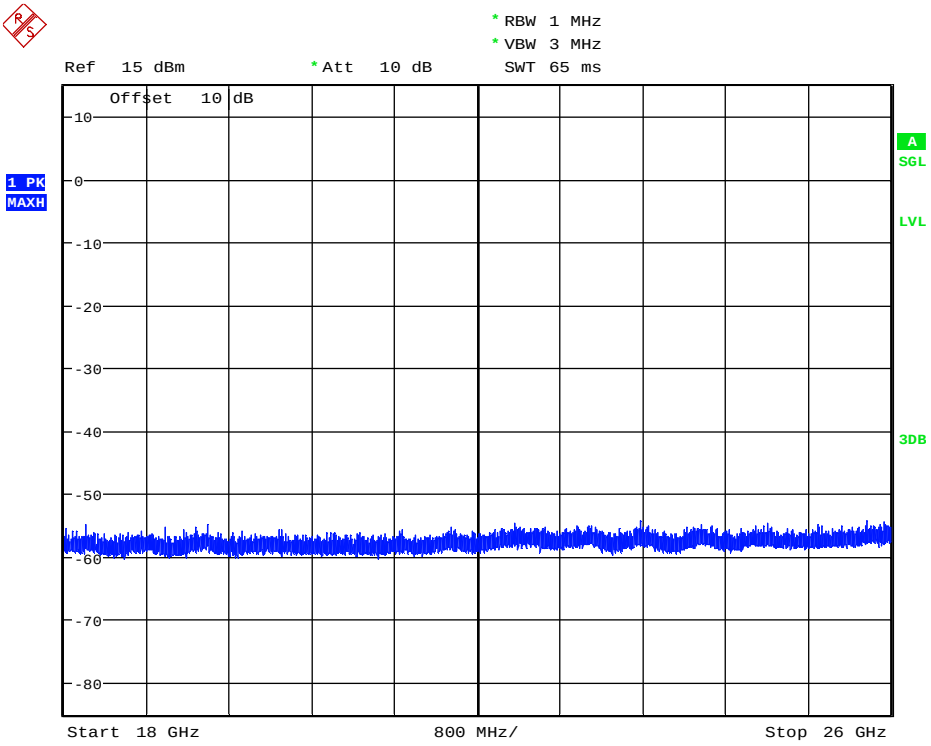
160785_16dBm__SpurEmiss1-4G_b_1.emf: conducted spurious emissions (operation mode 1):



160785_16dBm__SpurEmiss4-18G_b_1.emf: conducted spurious emissions (operation mode 1):



160785_16dBm__SpurEmiss18-26G_b_1.emf: conducted spurious emissions (operation mode 1):



Spurious Emissions, b-mode, channel 1 (Operation mode 1)									
Peak Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Max Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
b	1	4824.150	52.0	74.0	22.0	-46.6	3.0	Passed	Y
Average Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
b	1	4823.950	48.4	54.0	5.6	-50.2	3.0	Passed	Y
No emissions were found in the non-restricted Bands									

Spurious Emissions, b-mode, channel 6 (Operation mode 2)									
Peak Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Max Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
b	6	4873.900	50.3	74.0	23.7	-48.2	3.0	Passed	Y
Average Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
b	6	4873.900	46.5	54.0	7.5	-52.0	3.0	Passed	Y
Emissions in the non-restricted Bands									

Spurious Emissions, b-mode, channel 11 (Operation mode 3)									
Peak Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Max Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
b	11	4923.940	48.4	74.0	25.6	-50.2	3.0	Passed	Y
Average Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
b	11	4923.960	43.0	54.0	11.0	-55.5	3.0	Passed	Y
No emissions were found in the non-restricted Bands									

Spurious Emissions, g-mode, channel 1 (Operation mode 4)									
Peak Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Max Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
g	1	4826.100	48.7	74.0	25.3	-49.9	3.0	Passed	Y
Average Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
g	1	4825.950	35.6	54.0	18.4	-63.0	3.0	Passed	Y
No emissions were found in the non-restricted Bands									

Spurious Emissions, g-mode, channel 6 (Operation mode 5)									
Peak Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Max Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
g	6	4874.460	49.9	74.0	24.1	-48.7	3.0	Passed	Y
Average Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
g	6	4873.950	37.1	54.0	16.9	-61.4	3.0	Passed	Y
No emissions were found in the non-restricted Bands									

Spurious Emissions, n20-mode, channel 1 (Operation mode 7)									
Peak Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Max Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
n20	1	4825.060	47.8	74.0	26.2	-50.7	3.0	Passed	Y
Average Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
n20	1	4823.820	34.2	54.0	19.8	-64.3	3.0	Passed	Y
No emissions were found in the non-restricted Bands									

Spurious Emissions, n20-mode, channel 6 (Operation mode 8)									
Peak Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Max Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
n20	6	4873.460	50.1	74.0	23.9	-48.4	3.0	Passed	Y
Average Emission – Restricted Band									
WLAN Mode	Channel	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result	Restricted Band?
n20	6	4873.760	36.6	54.0	17.4	-62.0	3.0	Passed	Y
No emissions were found in the non-restricted Bands									

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
30

5.6.4 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 above 1 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range above 1 GHz.

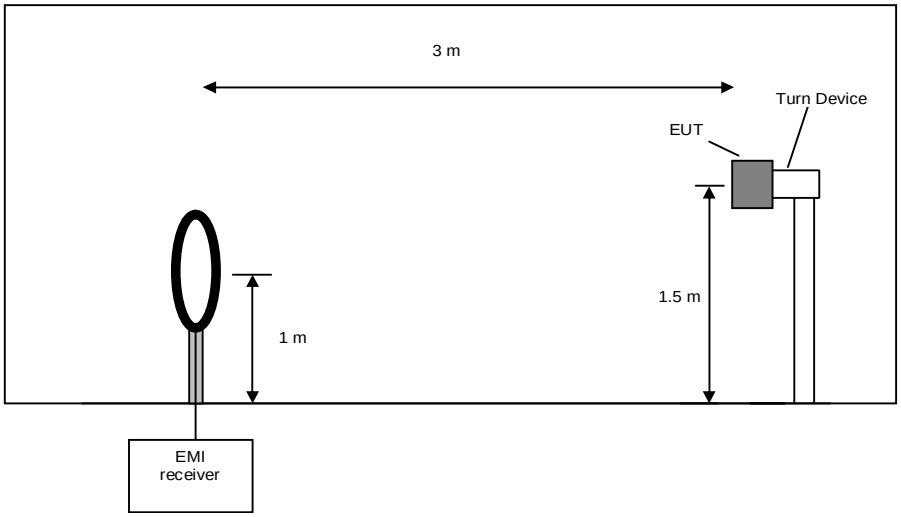
Preliminary measurement (9 kHz to 30 MHz):

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. Table top devices will set up on a non-conducting 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 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.

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 0° (45°, 90°) 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.

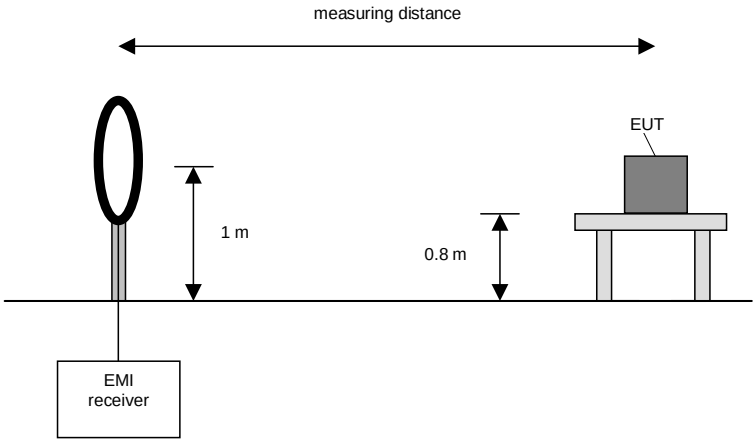
Final measurement (9 kHz to 30 MHz):

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).

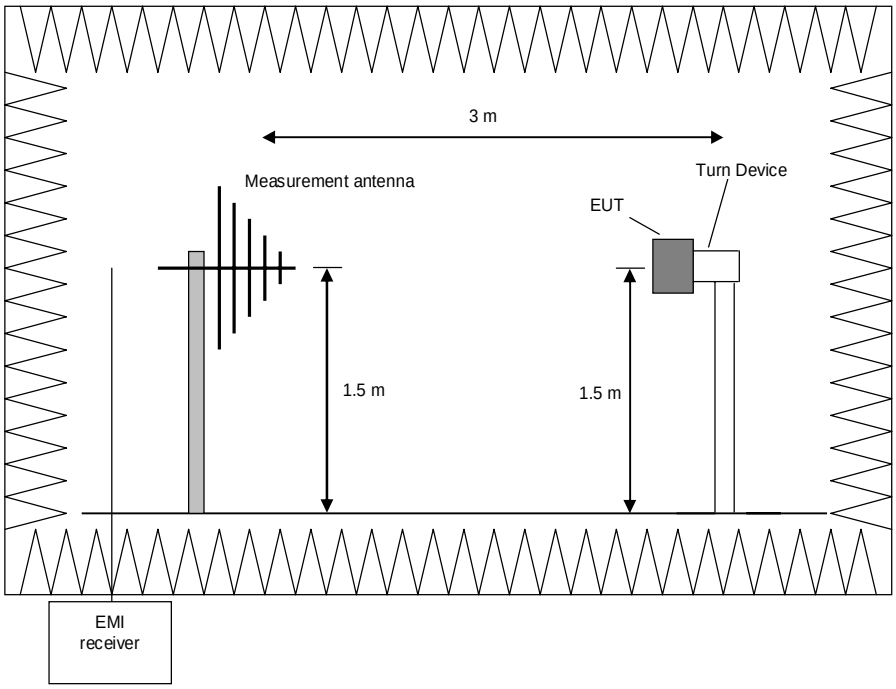
Preliminary measurement (30 MHz to 1 GHz)

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:

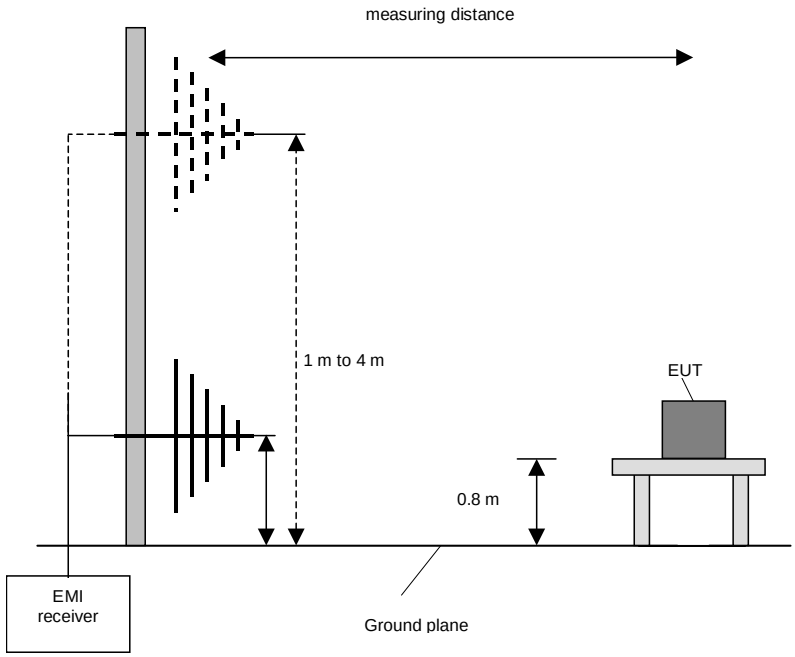
8. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
9. Manipulate the system cables within the range to produce the maximum level of emission.
10. Rotate the EUT by 360 ° to maximize the detected signals.
11. Repeat 1) to 3) with the vertical polarisation of the measuring antenna.
12. Make a hardcopy of the spectrum.
13. Repeat 1) to 5) with the EUT raised by an angle of 0° (45°, 90°) according to 6.6.5.4 in [1].
14. 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 40 GHz)

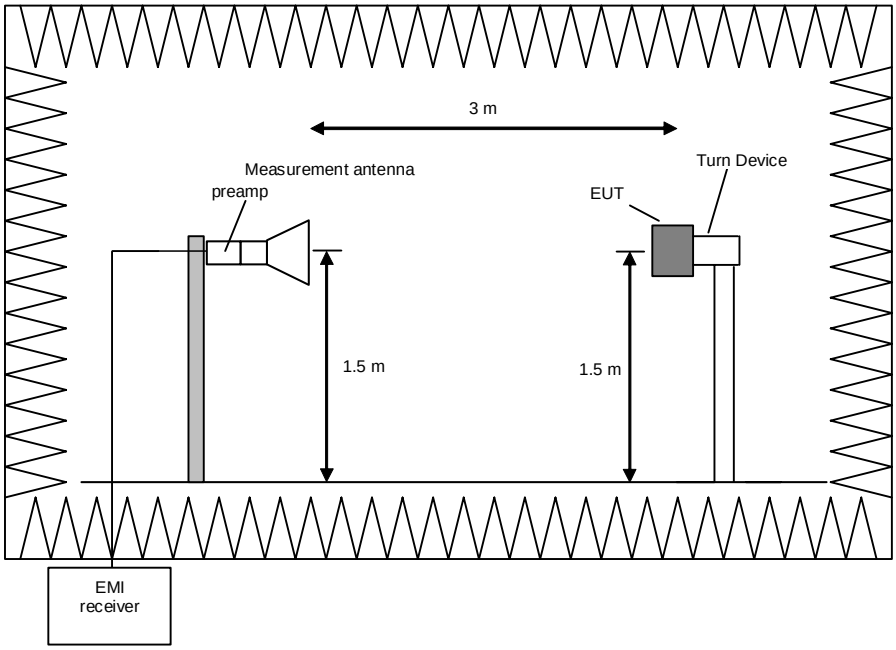
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

Preliminary measurement (1 GHz to 40 GHz)

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

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

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	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:

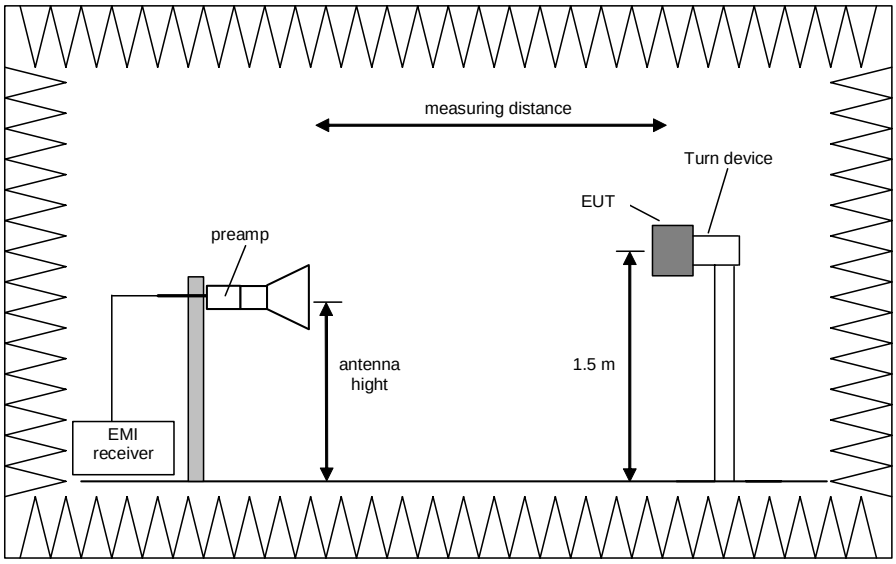
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an 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 25 /26.5 GHz and 26.5 GHz to 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 TT Pos. 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.

5.6.5 Test results (radiated emissions) – cabinet emissions

5.6.5.1 Preliminary radiated emission measurement

Ambient temperature	22 °C	Relative humidity	59 %

Position of EUT: The EUT was set-up on an EUT turn device of 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 in the test report.

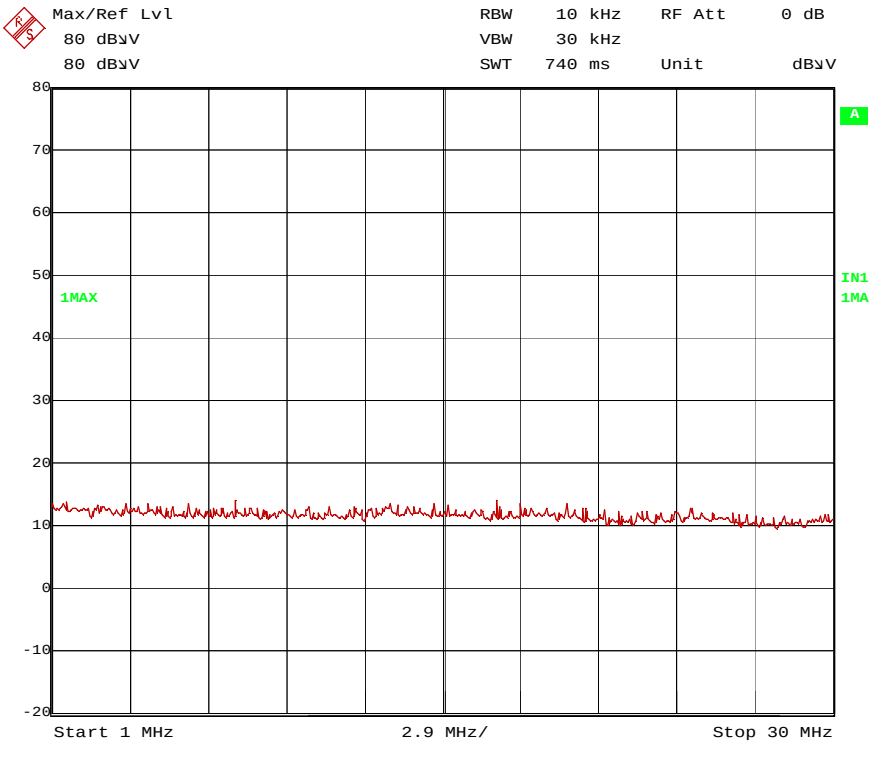
Test record: Since the lowest internal frequency is 26 MHz, the radiated tests were performed starting at 1 MHz.

Supply voltage: During all measurements the host of the EUT was powered with 24 V via an AC/DC Adapter.

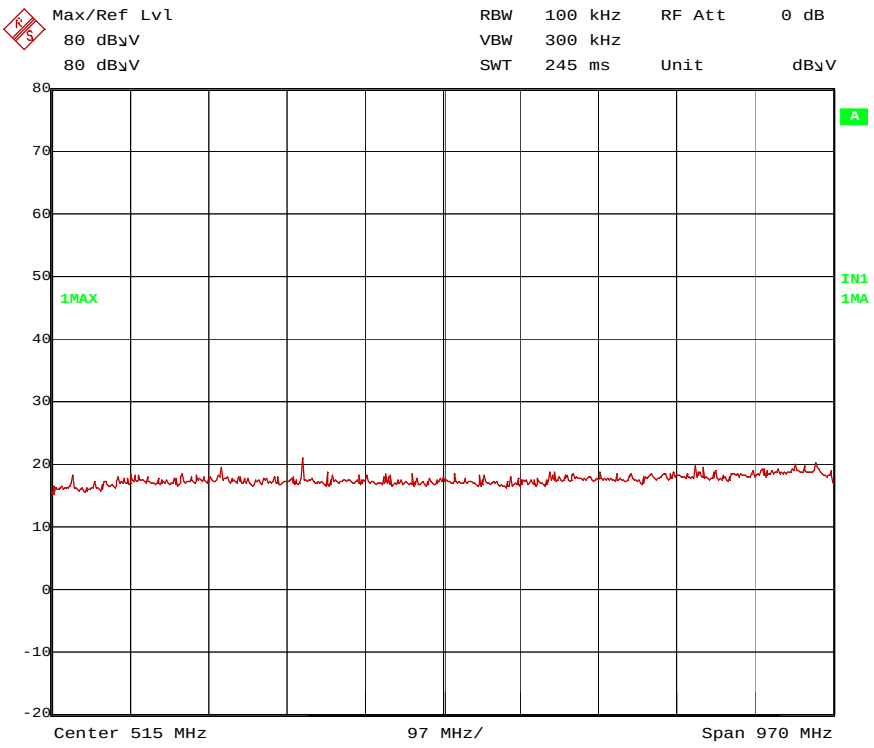
Remark: Document [3] states in 12.7.4.2, that in case of conducted measurements, additional radiated cabinet emission measurements must be performed. The radiated tests were performed using the LILY-W132, additionally spot checks were performed with the LILY-W131. The documented plots show the results from the measurement with the LILY-W132.

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

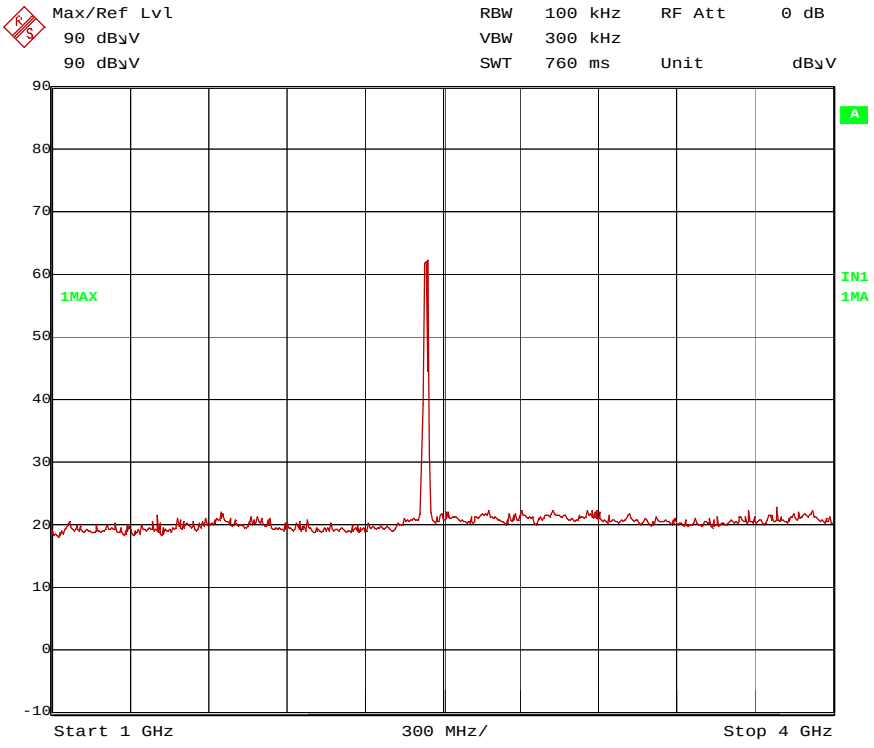
160785_SpurEm1-30M_ch6_6M_16dBm_90°.wmf: Spurious emissions from 1 GHz to 30 MHz' (operation mode 5):



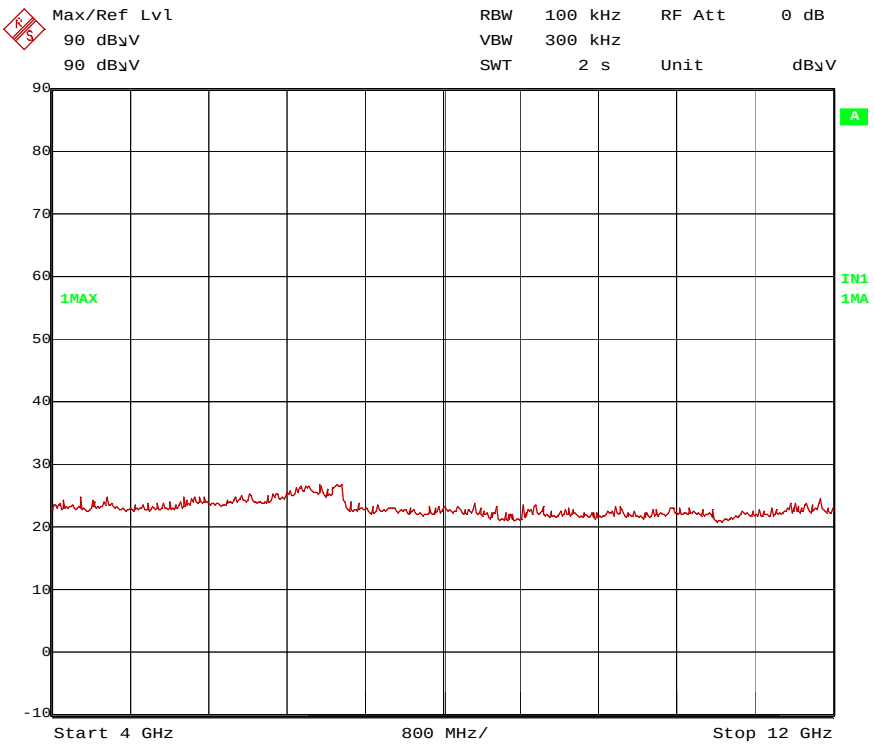
160785_SpurEm30M-1G_6M_ch6_16dBm_60°.wmf: Spurious emissions from 30 MHz to 1 GHz (operation mode 5):



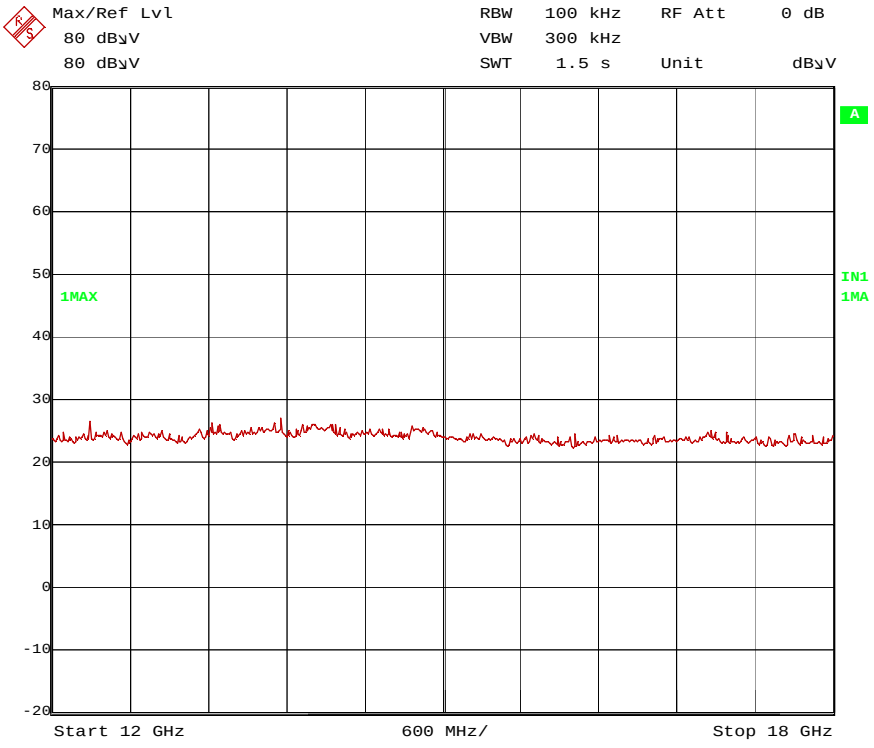
160785_SpurEm1-4G_6M_ch6_16dBm_90°.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 5):



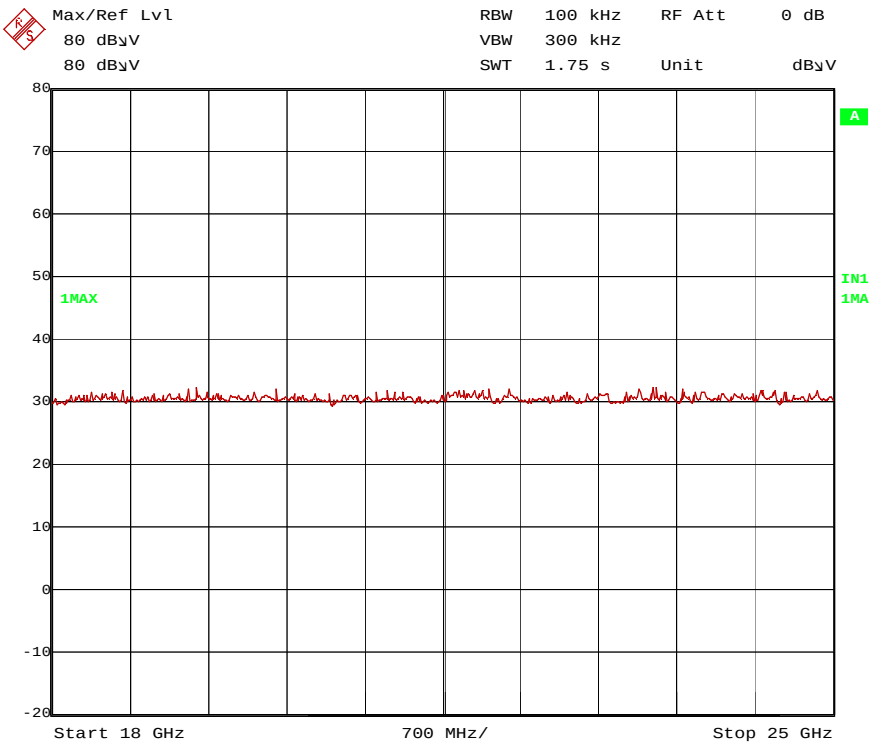
160785_SpurEm4-12G_6M_ch6_16dBm_0°.wmf: Spurious emissions from 4 GHz to 12 GHz (operation mode 5):



160785_SpurEm12-18G_6M_ch6_16dBm_0°.wmf: Spurious emissions from 12 GHz to 18 GHz (operation mode 5):



160785_SpurEm18-25G_6M_ch6_16dBm_0°.wmf: Spurious emissions from 18 GHz to 25 GHz (operation mode 5):



5.6.5.2 Final radiated measurements

No emissions were found during the preliminary measurement, therefore no final measurements were performed.

TEST EQUIPMENT USED FOR THE TEST:
29, 31 – 51

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

Ambient temperature	20 °C	Relative humidity	52 %

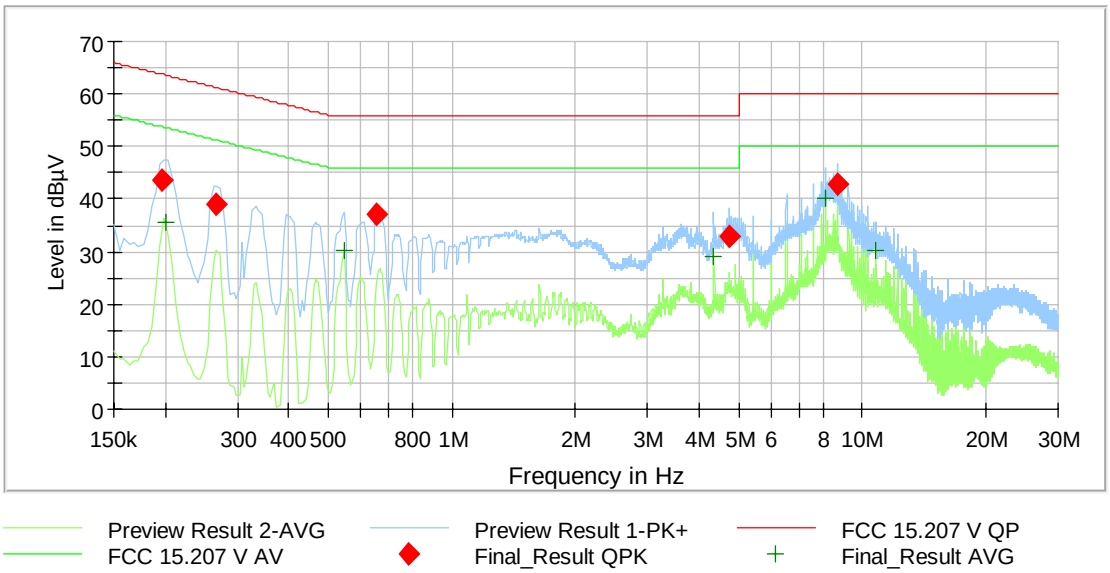
Position of EUT: For the test the EUT was powered by an typical AC/DC power supply. The LILY-W132 (#223) was set to transmit continuously in test mode on channel 6 with 16 dBm.
The Laptop with the Linux board was set-up on a non-conducting table of a height of 0.8 m.

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 273-316 from enercell 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 "◊" and the average measured points by "+".



Data record name: 160785.Rtf

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.195900	43.80	---	63.78	19.99	5000.0	9.000	L1	GND	9.8
0.200400	---	35.42	53.59	18.17	5000.0	9.000	L1	FLO	9.8
0.265200	39.15	---	61.27	22.12	5000.0	9.000	L1	GND	9.9
0.544200	---	30.31	46.00	15.69	5000.0	9.000	L1	GND	9.9
0.654000	37.07	---	56.00	18.93	5000.0	9.000	L1	GND	9.9
4.354800	---	29.23	46.00	16.77	5000.0	9.000	L1	GND	10.3
4.740900	32.78	---	56.00	23.22	5000.0	9.000	N	GND	10.3
8.168100	---	40.25	50.00	9.75	5000.0	9.000	L1	GND	10.5
8.715300	42.91	---	60.00	17.09	5000.0	9.000	L1	GND	10.5
10.793400	---	30.25	50.00	19.75	5000.0	9.000	L1	GND	10.6

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	15.02.2016	15.02.2018
3	LISN	NSLK8128	Schwarzbeck	8128155	480058	16.02.2016	16.02.2018
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	-	-
29	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
30	Spectrum analyser	FSU	Rohde & Schwarz	200125	480956	17.02.2016	17.02.2017
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	16.04.2016	16.04.2017
32	Controller	MCU	Maturo	MCU/043/971107	480832	-	-
33	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
34	Antenna support	AS615P	Deisel	615/310	480187	-	-
36	Antenna	3115 A	EMCO	9609-4918	480183	10.11.2014	10.11.2016
37	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Six month verification (system cal.)	
39	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297	Six month verification (system cal.)	
40	Standard Gain Horn Antenne 26.4 – 40.1 GHz	22240-20	Flann Microwave	469	480299	Six month verification (system cal.)	
41	RF-cable No. 3	Sucoflex 106B	Huber&Suhner	0563/6B / Kabel 3	480670	Weekly verification (system cal.)	
42	RF-cable No. 40	Sucoflex 106B	Huber&Suhner	0708/6B / Kabel 40	481330	Weekly verification (system cal.)	
43	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	29.02.2016	29.02.2018
44	Antenna	CBL6112 B	Chase	2688	480328	14.04.2014	14.04.2017
46	RF-cable 2 m	KPS-1533-800-KPS	Insulated Wire	-	480302	Six month verification (system cal.)	
49	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	18.02.2016	18.02.2018
50	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	18.02.2016	18.02.2018
51	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	17.02.2016	17.02.2018
60	Power Meter	NRVD	Rohde & Schwarz	833697/030	480589	18.02.2016	18.02.2018
61	Peak Power Sensor	NRV-Z32	Rohde & Schwarz	849745/016	480551	18.02.2016	18.02.2018
72	4 GHz High Pass Filter	WHKX4.0/18 G-8SS	Wainwright Instruments	1	480587	Weekly verification (system cal.)	

7 Report History

Report Number	Date	Comment
F160785E3	20.05.2016	Initial Test Report

8 List of Annexes

ANNEX A TEST SETUP PHOTOS 8 pages

160785_20.jpg	Test setup - conducted tests
160785_12.jpg	Test setup - Radiated emission anechoic chamber, Lily-W132
160785_13.jpg	Test setup - Radiated emission anechoic chamber, Lily-W131
160785_21.jpg	Test setup - Radiated emission anechoic chamber
160785_22.jpg	Test setup - Radiated emission anechoic chamber
160785_23.jpg	Test setup - Radiated emission anechoic chamber
160785_24.jpg	Test setup - Radiated emission anechoic chamber
160785_25.jpg	Test setup – conducted emissions on power supply lines

ANNEX B EXTERNAL PHOTOS 9 pages

160875_p.jpg	Lily-W132 (#223) on EVB LILY-W1 carrier-board – top view
160875_q.jpg	Lily-W132 (#122B) with temporary antenna connector on EVB LILY-W1 carrier-board – top view
160875_r.jpg	Lily-W131 (#215) on EVB LILY-W1 carrier-board – top view
160875_s.jpg	Lily-W132 (#223) with shielding on EVB LILY-W1 carrier-board close up – top view
160875_t.jpg	Lily-W132 (#122B) with temporary antenna connector and shielding on EVB LILY-W1 carrier-board close up – top view
160875_u.jpg	Lily-W131 (#215) with shielding on EVB LILY-W1 carrier-board close up – top view
160875_i.jpg	Lily-W131/132 on EVB LILY-W1 carrier-board – bottom view
160875_a.jpg	Linux board cB0962 – top view
160875_b.jpg	Linux board cB0962 – bottom view

ANNEX C INTERNAL PHOTOS 3 page

160875_m.jpg	Lily-W131 module without shielding – top view
160875_n.jpg	Lily-W132 module without shielding – top view
160875_k.jpg	Lily-W131/132 module – bottom view