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Test Report

Report Number:

F170756E2

Equipment under Test (EUT):

Control Panel for welding inverters

Einschub TT/MW Smart 210mm

Applicant:

Fronius International GmbH

Manufacturer:

Fronius International GmbH

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**, Radio Frequency Devices

[3] **RSS-247 Issue 2 (February 2017)**, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

[4] **RSS-Gen Issue 5 (April 2018)**, General Requirements for Compliance of Radio Apparatus

[5] **508074 D01 DTS Meas Guidance v04 (April 2017),** Guidance for performing compliance measurements on transmission systems (DTS) operating under section 15.247

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.

Tested and written by:	Bernward ROHDE		03.06.2019
	Name	Signature	Date
Reviewed and approved by:	Bernd STEINER		03.06.2019
	Name	Signature	Date

This test report is only valid in its original form.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalizations 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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Applicant partly represented during the test by the following person:	Jan HERNDLER

1.2 Manufacturer

Name:	Fronius International GmbH
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Applicant partly represented during the test by the following person:	Jan HERNDLER

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)

EUT	
Test object: *	Control panel for welding inverters
Type / PMN	Einschub TT/MW Smart 210mm
FCC ID: *	QKWSPBBCU1
ISED Certification number: * IC: *	12270A-SPBBCU1
HVIN (Hardware Version Identification Number): *	Einschub TT/MW Smart 210mm
FVIN (Firmware Version Identification Number): *	V1.4B
HMN (Host model name): *	N/A
Order number:*	43,0001,3533
Serial number: *	N/A
PCB identifier: *	1654600

* Declared by the applicant

Frequency List WLAN (IEEE, 802.11b, 802.11g, 802.11n HT20)				
Channel 01	RX:	2412 MHz	TX:	2412 MHz
Channel 02	RX:	2417 MHz	TX:	2417 MHz
Channel 03	RX:	2422 MHz	TX:	2422 MHz
Channel 04	RX:	2427 MHz	TX:	2427 MHz
Channel 05	RX:	2432 MHz	TX:	2432 MHz
Channel 06	RX:	2437 MHz	TX:	2437 MHz
Channel 07	RX:	2442 MHz	TX:	2442 MHz
Channel 08	RX:	2447 MHz	TX:	2447 MHz
Channel 09	RX:	2452 MHz	TX:	2452 MHz
Channel 10	RX:	2457 MHz	TX:	2457 MHz
Channel 11	RX:	2462 MHz	TX:	2462 MHz

Frequency List WLAN (IEEE, 802.11n HT40)				
Channel 03	RX:	2422 MHz	TX:	2422 MHz
Channel 04	RX:	2427 MHz	TX:	2427 MHz
Channel 05	RX:	2432 MHz	TX:	2432 MHz
Channel 06	RX:	2437 MHz	TX:	2437 MHz
Channel 07	RX:	2442 MHz	TX:	2442 MHz
Channel 08	RX:	2447 MHz	TX:	2447 MHz
Channel 09	RX:	2452 MHz	TX:	2452 MHz

1.5 Technical Data of Equipment

Radio mode						
Fulfils radio specification: *	IEEE 802.11 b/g/HT20/HT40					
Antenna type: *	Dipole Antenna					
Antenna name: *	GW.40.2153					
Antenna gain: *	3.74 dBi					
Antenna connector: *	RP SMA					
Power supply EUT: *	DC					
Supply voltage EUT – Control Unit:*	U_{nom} =	24 V DC	U_{min} =	21.6 V DC	U_{max} =	26.4 V DC
Supply voltage Wi-Fi module:*	U_{nom} =	3.3 V DC	U_{min} =	2.5 V DC	U_{max} =	3.6 V DC
Type of modulation: *	802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g: OFDM (BPSK, QPSK, 16-QAM, 64-QAM) 802.11n: OFDM (BPSK, QPSK, 16-QAM, 64-QAM)					
Operating frequency range: *	2412 – 2462 MHz (IEEE, 802.11b, 802.11g, 802.11n HT20) 2422 – 2452 MHz (IEEE, 802.11n HT40)					
Number of channels: *	11 (IEEE, 802.11b, 802.11g, 802.11n HT20) or 7 (IEEE, 802.11n HT40)					
Temperature range: *	-10 °C to +60 °C					
Lowest / highest internal clock frequency: *	32.768 kHz / 2480 MHz					

* Declared by the applicant

Ancillary Equipment:	
Laptop PC:*	Fujitsu Lifebook S751 (PM No. 201036)
Power (AC-Adaptor)	UE36LCP1-240150SPA** by UE electronic

*Provided by the laboratory
**Provided by the applicant

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
Power (DC)*	2 x Measuring cables were used		~2 m
Ethernet*	HSD	RJ45	3 m
Power (AC-Adaptor)**		CE	~2 m

*: Length during the test if no other specified.
** Used for the “Conducted emissions on power supply lines”, delivered by the applicant

1.6 Dates

Date of receipt of test sample:	13.10.2017
Start of test:	19.10.2017
End of test:	20.08.2018

2 Operational States

2.1 Description of function of the EUT

The equipment under test (EUT) is the WLAN-radio part of a control panel for welding units.

During the WLAN tests the RFID module was active and continuously transmitting.
So both transmitters were operating simultaneously.

EUT:

As declared by the applicant, only the 13.56.MHz RFID, Bluetooth low energy and Wi-Fi (2.4 GHz) will be used in the final application.

During the Wi-Fi radio tests the RFID module was active and continuously transmitting.
So Wi-Fi and RFID were operating simultaneously. BT/BLE and Wi-Fi share the same antenna and can't send simultaneously.

For the radio tests the "Dut labtool" as provided by the applicant was used to configure the rf-parameter of the EUT via a controlling laptop. A LAN connection was used to control the settings of the EUT.

2.2 The following states were defined as the operating conditions

For the tests the EUT was supplied with 24 V DC via laboratory power supply if not otherwise mentioned.
As pre-tests have shown the following operation modes are the worst cases:

Operation mode	Description of the operation mode	channel	mode	Data rate / Mbps	Power setting
1	Continuous transmitting on 2412 MHz	1	802.11b	1 Mbps	15
2	Continuous transmitting on 2437 MHz	6	802.11b	1 Mbps	15
3	Continuous transmitting on 2462 MHz	11	802.11b	1 Mbps	15
4	Continuous transmitting on 2412 MHz	1	802.11g	6 Mbps	15
5	Continuous transmitting on 2437 MHz	6	802.11g	6 Mbps	15
6	Continuous transmitting on 2462 MHz	11	802.11g	6 Mbps	15
7	Continuous transmitting on 2412 MHz	1	802.11n HT20	MCS7	14
8	Continuous transmitting on 2437 MHz	6	802.11n HT20	MCS7	14
9	Continuous transmitting on 2462 MHz	11	802.11n HT20	MCS7	14
10	Continuous transmitting on 2422 MHz	3	802.11n HT40	MCS7	14
11	Continuous transmitting on 2437 MHz	6	802.11n HT40	MCS7	14
12	Continuous transmitting on 2452 MHz	9	802.11n HT40	MCS7	14

This test-report incorporates the worst case results for the Wi-Fi (2.4GHz) only.

3 Additional Information

All tests were done with an unmodified sample.

The EUT was not labeled with the final label.

As declared by the applicant, the USB port of the EUT is only used for service purposes. Therefore no lines were connected to the USB port of the EUT during the tests.

This test-report covers the simultaneous transmission of the Wi-Fi part with the 13.56 MHz NFC part only. The NFC specific test-cases are documented in PHOENIX TESTLAB test report F170756E1.

Bluetooth low energy test cases are documented in in PHOENIX TESTLAB test report F170756E3.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [3] or RSS-Gen, Issue 5 [4]	Status	Refer page
Maximum Conducted Average Output Power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [3]	Passed	17 et seq.
DTS Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (a) [3]	Passed	19 et seq.
Average Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [3]	Passed	22 et seq.
Band edge compliance	2400.0 - 2483.5	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [3] 8.9 [4], 8.10 [4]	Passed	24 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	35 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Passed	51 et seq.

Antenna requirements fulfilled, EUT is fixed installed in a host (welding machine), the antenna is therefore not accessible.

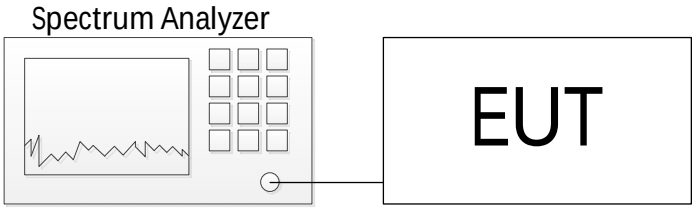
5 Results

5.1 Duty cycle

5.1.1 Method of measurement

The measurement was performed as an antenna port conducted measurement, as shown below.

Test Setup:



The method described in chapter 11.6.0 b) of document [1] or 6.0 b) of document [5] was used to perform the following test.

Only the worst case plot for each mode was submitted below.

The following measurement technique was used:

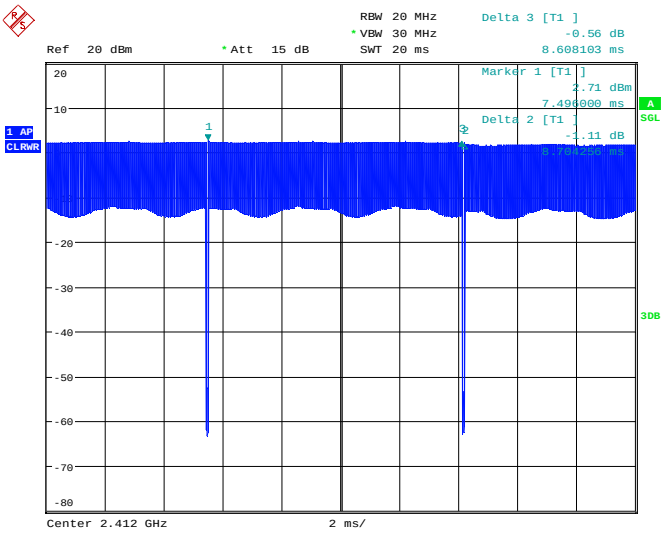
The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between two bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

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

6.1.1 Test results

Ambient temperature	22 °C
Relative humidity	52 %

Date	20.08.2018
Tested by	B. ROHDE



Operation mode	TX_on [µs]	TX_ges [µs]	RBW [MHz]	50/T [kHz]	50/T < RBW?
1 – 3	8608	8704	20	6	Yes
3 – 6	1428	1490	20	35	Yes
7 – 9	167	227	20	299	Yes
10 – 12	99	159	50	505	Yes

Operation Mode	Sweep points	Sweep time [µs]	Meas points	Meas points >100?	Duty cycle %	DCCF [dB]
1 – 3	10001	20000	4352	Yes	98.90	0.05
3 – 6	10001	3000	4967	Yes	95.84	0.18
7 – 9	10001	500	4540	Yes	73.57	1.33
10 – 12	10001	300	5301	Yes	62.26	2.06

The DCCF (duty cycle correction factor) is calculated by:

$$DCCF = 10 * log_{10}\left(\frac{1}{Duty\ cycle}\right)$$

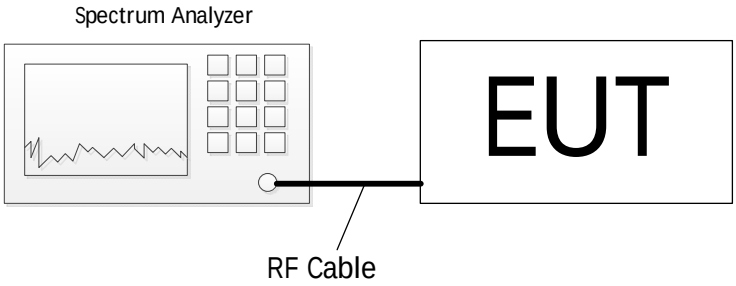
Therefore, for average measurements no correction factor is used for all tests in test mode 1 -3.
Therefore, for average measurements a correction factor of 0.18 dB is used for all tests in test mode 4 - 6.
Therefore, for average measurements a correction factor of 1.33 dB is used for all tests in test mode 7 - 9.
Therefore, for average measurements a correction factor of 2.06 dB is used for all tests in test mode 10 - 12.

Test equipment (please refer to chapter 6 for details)
1

6.2 Maximum conducted (average) output power

6.2.1 Method of measurement (conducted)

The EUT was measured conducted at the antenna ports with the aid of a spectrum analyzer.



Acceptable measurement configurations

Procedure 11.9.2.2.4 in [1] was used for the following test.

Method AVGSA-2 uses trace averaging across ON and OFF times of the EUT transmissions, followed by duty cycle correction. The procedure for this method is as follows:

- - Measure the duty cycle D of the transmitter output signal as described in 11.6 [1].
- - Set span to at least 1.5 times the OBW.
- - Set RBW = 1% to 5% of the OBW, not to exceed 1 MHz.
- - Set VBW ≥ [3 × RBW].
- Number of points in sweep ≥ [2 × span / RBW]. (This gives bin-to-bin spacing ≤ RBW / 2, so that narrowband signals are not lost between frequency bins.)
- Sweep time = auto.
- Detector = RMS (i.e., power averaging), if available. Otherwise, use the sample detector mode.
- Do not use sweep triggering. Allow the sweep to “free run.”
- Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the ON and OFF periods of the transmitter.
- Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, then sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
- Add [10 log (1 / D)], where D is the duty cycle, to the measured power to compute the average power during the actual transmission times (because the measurement represents an average over both the ON and OFF times of the transmission). For example, add [10 log (1/0.25)] = 6 dB if the duty cycle is 25%.

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

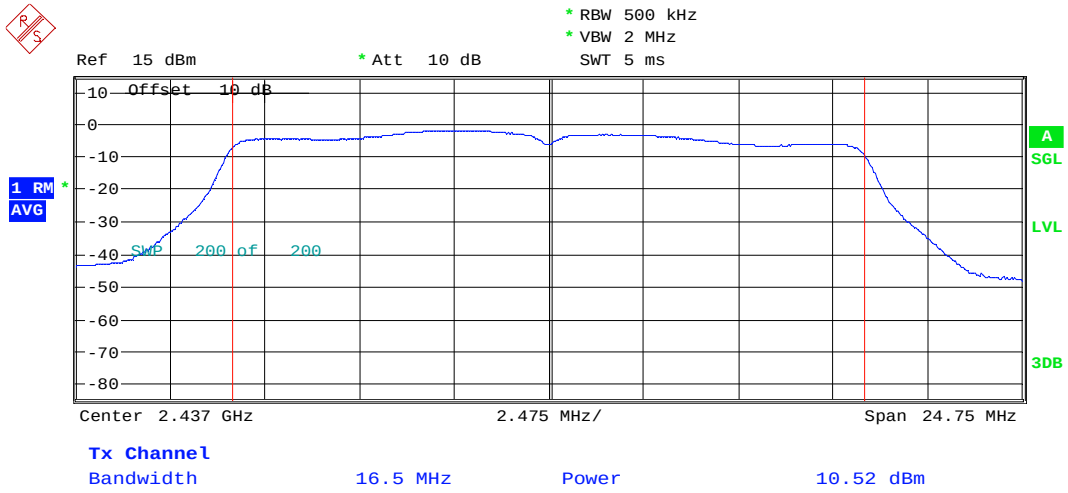
Antenna gain below 6 dBi, therefore no power reduction was necessary.

6.2.1.1 Test results (conducted)

Ambient temperature	22 °C
Relative humidity	56 %

Date	20.08.2018
Tested by	B. ROHDE

Maximum conducted output power (Operation mode 5):



Operation mode		Frequency [MHz]	Duty cycle correction [dB]	Conducted output power [dBm]	Limit [dBm]
1	b	2412	0.00	7.7	30
2	b	2437	0.00	10.6	30
3	b	2462	0.00	9.2	30
4	g	2412	0.18	8.7	30
5	g	2437	0.18	10.7	30
6	g	2462	0.18	9.8	30
7	n20	2412	1.33	8.0	30
8	n20	2437	1.33	9.9	30
9	n20	2462	1.33	9.0	30
10	n40	2422	2.06	8.9	30
11	n40	2437	2.06	9.2	30
12	n40	2452	2.06	9.3	30

Test equipment (please refer to chapter 6 for details)
1

6.3 DTS Bandwidth / 99% Bandwidth

6.3.1 Method of measurement (conducted)

The EUT was tested with a spectrum analyzer connected directly to the EUT.

DTS bandwidth:

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.

The following procedure was used for measuring the 99 % bandwidth:

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

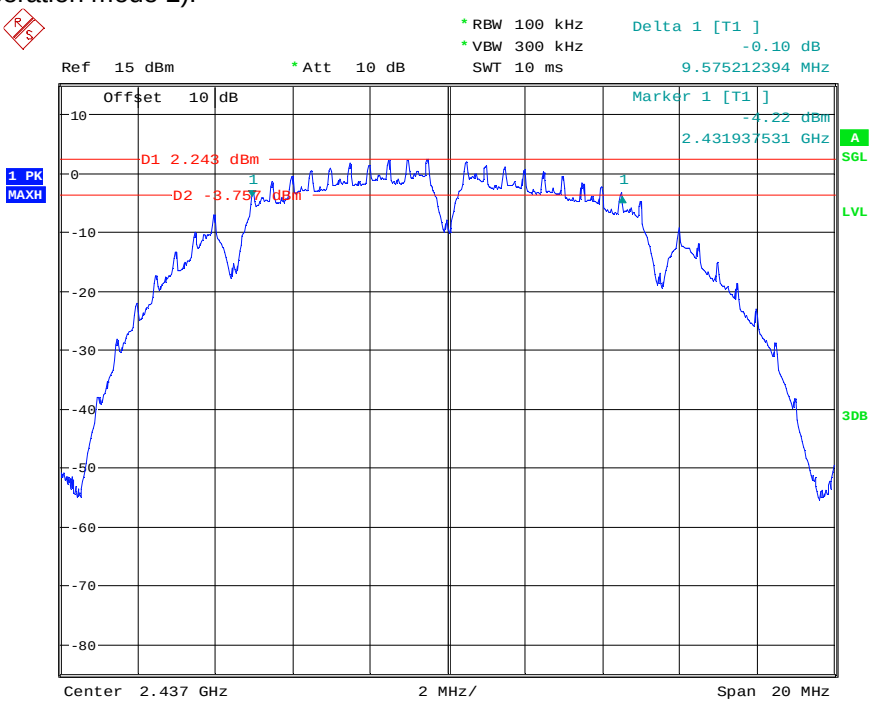
- The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
- Step a) through step c) might require iteration to adjust within the specified range.
- e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data maybe reported in addition to the plot(s).

6.3.1.1 Test results (conducted)

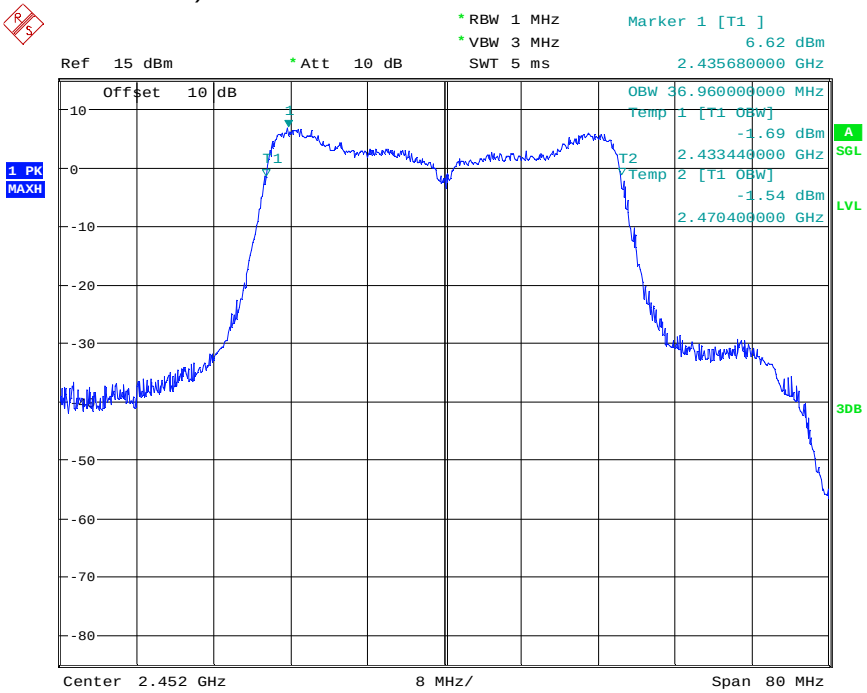
Ambient temperature	22 °C
Relative humidity	45 %

Date	20.08.2018
Tested by	B. ROHDE

DTS bandwidth (Operation mode 2):



99% bandwidth (Operation mode 12):



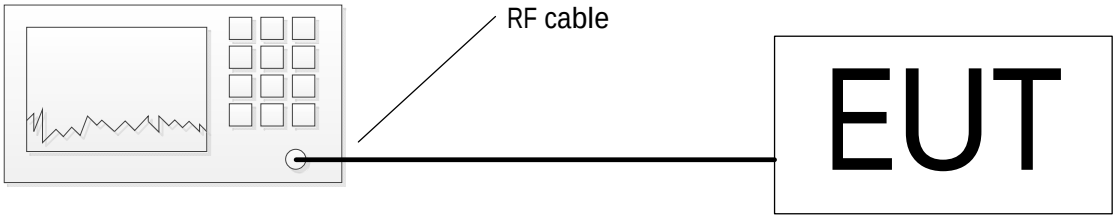
Operation Mode	Center Frequency [MHz]	Minimum 6-dB Bandwidth Limit [MHz]	6 dB Bandwidth [MHz]	99 % Bandwidth [MHz]	Result
1	2412	0.5	10.545	13.500	Passed
2	2437	0.5	9.575	12.810	Passed
3	2462	0.5	9.615	13.170	Passed
4	2412	0.5	15.772	16.900	Passed
5	2437	0.5	15.487	16.500	Passed
6	2462	0.5	15.757	16.700	Passed
7	2412	0.5	17.031	17.750	Passed
8	2437	0.5	16.582	17.550	Passed
9	2462	0.5	16.402	17.650	Passed
10	2422	0.5	35.507	36.720	Passed
11	2437	0.5	31.659	35.840	Passed
12	2452	0.5	36.407	36.960	Passed
Measurement uncertainty			+1.8 dB / -2.4 dB		

Test equipment (please refer to chapter 6 for details)
1

6.4 Average Power Spectral Density

6.4.1 Method of measurement (conducted)

The EUT was tested with a spectrum analyzer connected directly to the EUT.



The measurement procedure refers to part 11.10.5 of document [1].

Method AVGPSD-2 uses trace averaging across ON and OFF times of the EUT transmissions, followed by duty cycle correction.

The following procedure is applicable when the EUT cannot be configured to transmit continuously (i.e., D < 98%), when sweep triggering/signal gating cannot be used to measure only when the EUT is transmitting at its maximum power control level, and when the transmission duty cycle is constant (i.e., duty cycle variations are less than ±2%):

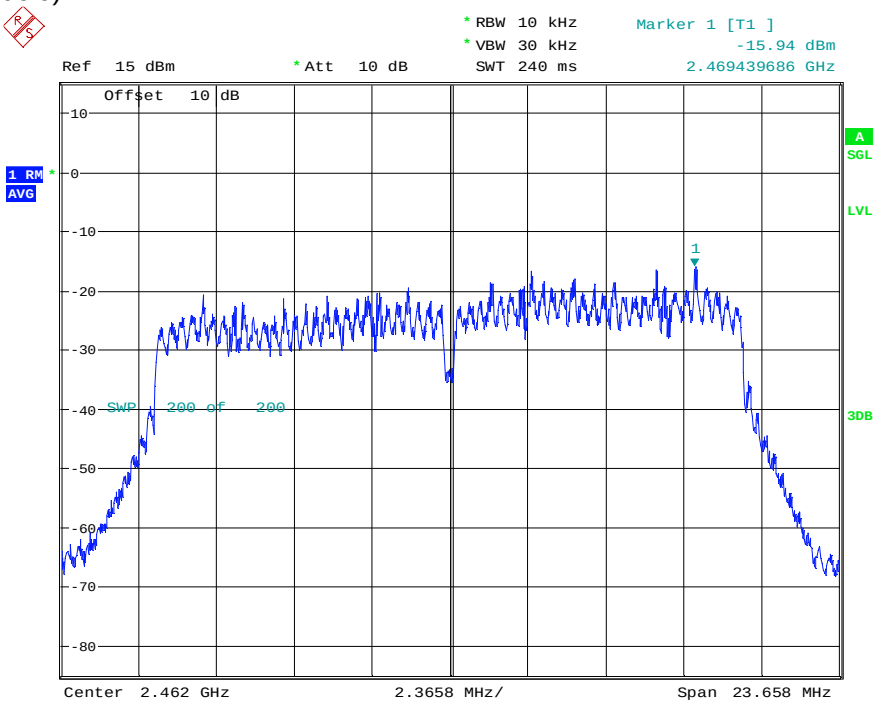
- Measure the duty cycle (D) of the transmitter output signal as described in 11.6.
- Set instrument center frequency to DTS channel center frequency.
- Set span to at least 1.5 times the OBW.
- Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
- Set VBW ≥ [3 × RBW].
- Detector = power averaging (rms) or sample detector (when rms not available).
- Ensure that the number of measurement points in the sweep ≥ [2 × span / RBW].
- Sweep time = auto couple.
- Do not use sweep triggering; allow sweep to “free run.”
- Employ trace averaging (rms) mode over a minimum of 100 traces.
- Use the peak marker function to determine the maximum amplitude level.
- Add [10 log (1 / D)], where D is the duty cycle measured in step a), to the measured PSD to compute the average PSD during the actual transmission time.
- m) If measured value exceeds requirement specified by regulatory agency, then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced).

6.4.1.1 Test results (conducted)

Ambient temperature	22 °C
Relative humidity	54 %

Date	20.08.2018
Tested by	B. ROHDE

PSD (Operation mode 9):



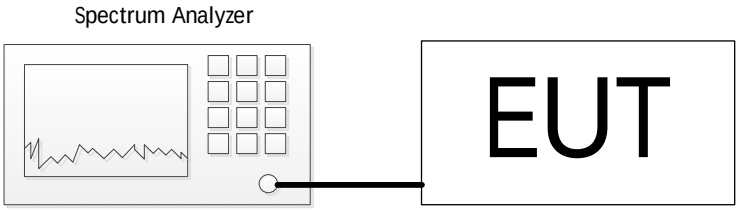
Operation Mode		Peak Frequency [MHz]	Power Spectral Density Limit [dBm/3kHz]	Duty cycle correction [dB]	Power Spectral Density Reading [dBm / 10 kHz]	Result
1	b	2411.165	8	0.0	-19.2	Passed
2	b	2436.198	8	0.0	-15.7	Passed
3	b	2462.552	8	0.0	-17.4	Passed
4	g	2404.475	8	0.2	-17.8	Passed
5	g	2434.485	8	0.2	-16.2	Passed
6	g	2469.463	8	0.2	-17.6	Passed
7	n20	2404.511	8	1.3	-16.1	Passed
8	n20	2435.722	8	1.3	-14.8	Passed
9	n20	2469.440	8	1.3	-14.6	Passed
10	n40	2436.973	8	2.1	-16.3	Passed
11	n40	2434.441	8	2.1	-15.4	Passed
12	n40	2436.940	8	2.1	-15.9	Passed
Measurement uncertainty					+1.8 dB / -2.4 dB	

Test equipment (please refer to chapter 6 for details)
1

6.5 Band-edge compliance

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

The EUT was tested with a spectrum analyzer connected directly to the EUT.



The relating measurements were carried out in a conducting manner. Therefore, the antenna connector was directly connected to a spectrum analyzer. 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 stabilize.
- Use the peak marker function to determine the maximum amplitude 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 stabilize.
- 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.

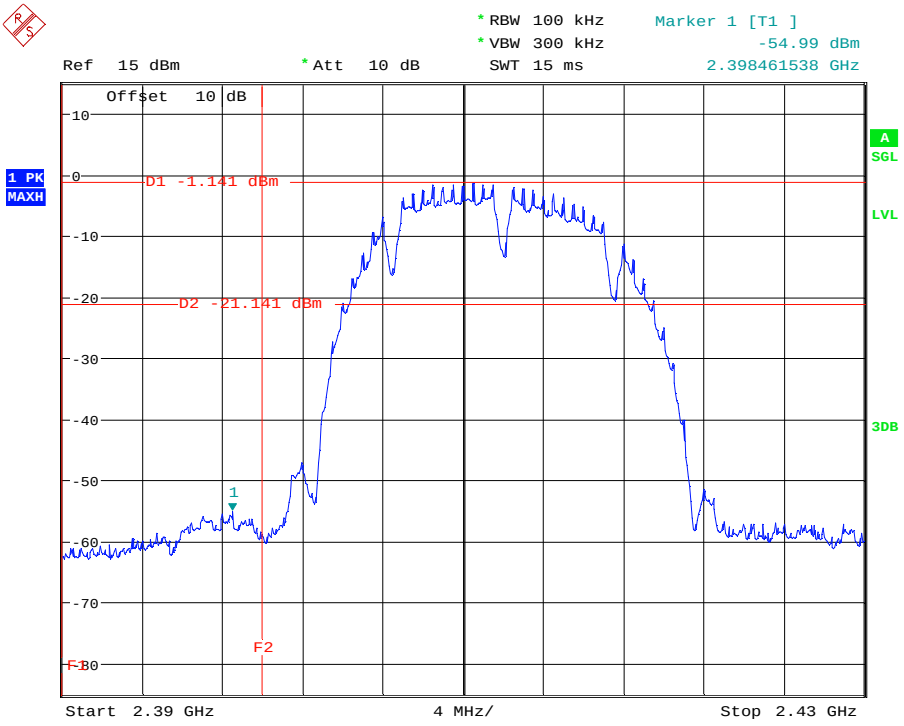
The measurements were performed at the lower end of the 2.4 GHz band.

6.5.1.1 Test results (conducted)

Ambient temperature	22 °C
Relative humidity	45 %

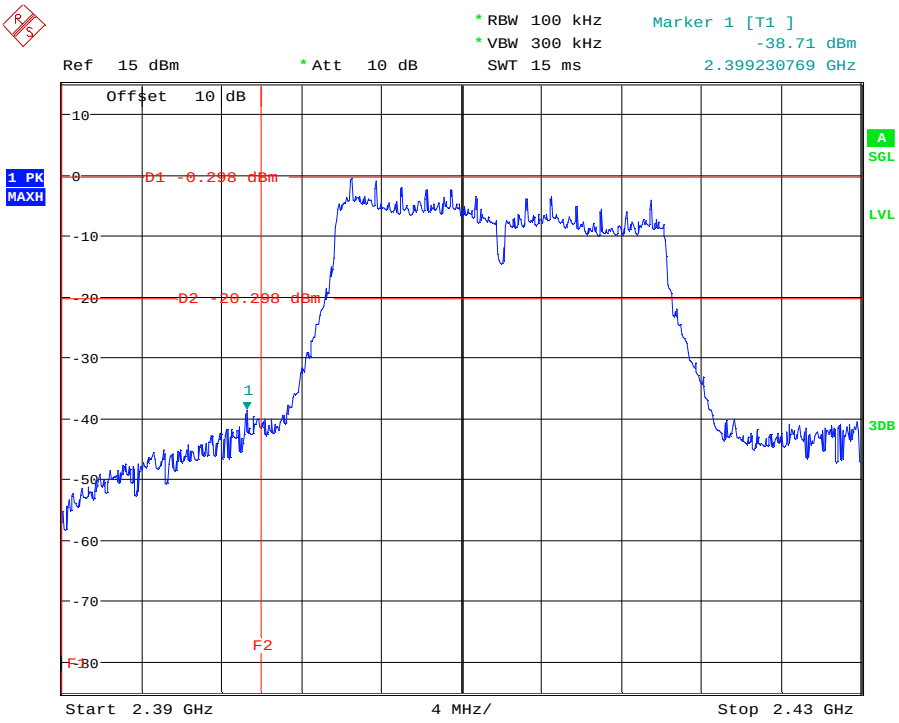
Date	20.08.2018
Tested by	B. ROHDE

Unrestricted band edge (Operation mode 1):



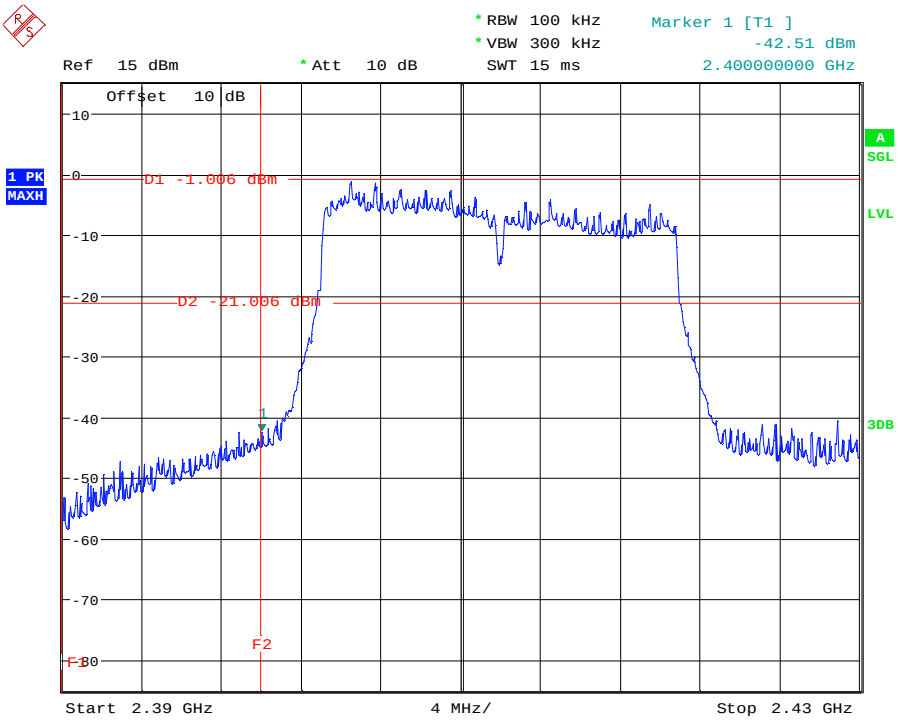
Operation mode	Data rate	Frequency [MHz]	Reference Level [dBm]	Limit [dBm]	Emission Level [dBm]	Margin [dB]	Result
1	b-mode, 1 Mbit/s	2398.462	-1.1	-21.1	-54.7	33.6	Passed

Unrestricted band edge (Operation mode 4):



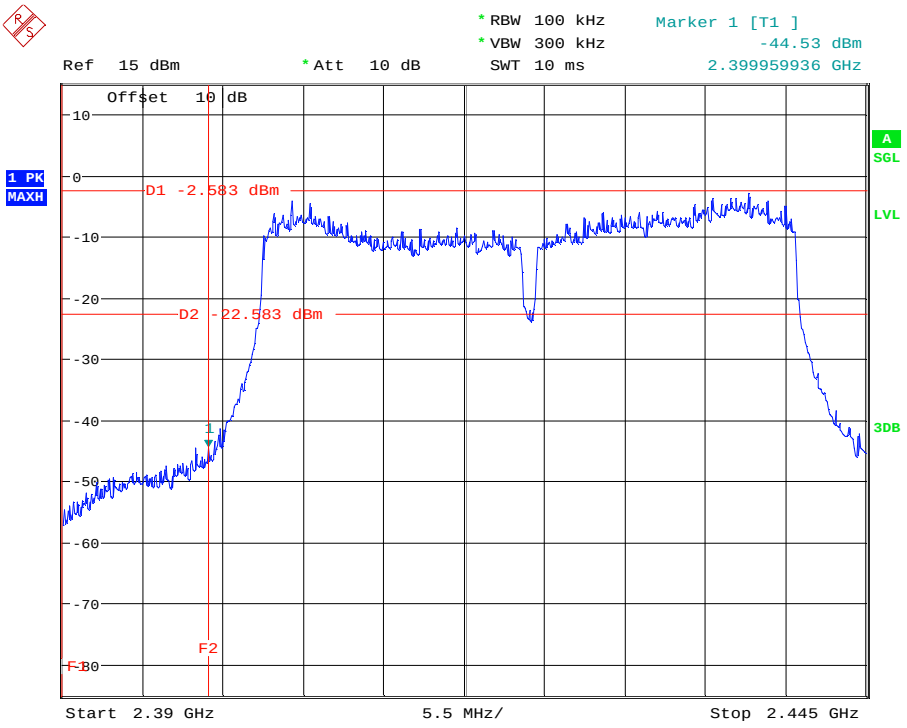
Operation mode	Data rate	Frequency [MHz]	Reference Level [dBm]	Limit [dBm]	Emission Level [dBm]	Margin [dB]	Result
4	g-mode, 6 Mbit/s	2399.231	-0.3	-20.3	-38.4	18.1	Passed

Unrestricted band edge (Operation mode 7):



Operation mode	Data rate	Frequency [MHz]	Reference Level [dBm]	Limit [dBm]	Emission Level [dBm]	Margin [dB]	Result
7	HT20, MCS7	2400	-1	-21	-42.2	21.2	Passed

Unrestricted band edge (Operation mode 10):



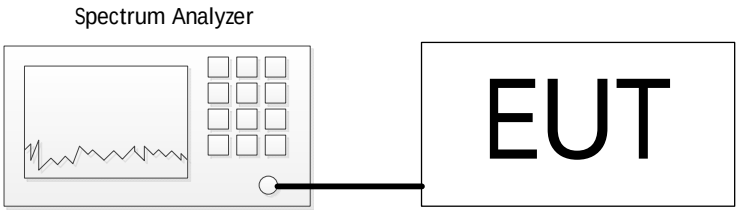
Date: 20.AUG.2018 16:20:22

Operation mode	Data rate	Frequency [MHz]	Reference Level [dBm]	Limit [dBm]	Emission Level [dBm]	Margin [dB]	Result
10	HT40, MCS7	2399.96	-2.6	-22.6	-44.2	21.6	Passed

Test equipment (please refer to chapter 6 for details)
1

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

The EUT was tested with a spectrum analyzer connected directly to the EUT.



The same test set-up as used for the final conducted emission measurement shall be used (refer also sub-clause 6.6 of this test report).

After trace stabilization 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 upper end of the 2.4 GHz band.

The calculation was performed with the following formula as described in chapter 11.12.2.2 e) in [1]:

E [dBµV/m] = $EIRP$ [dBm] – 20log(d) + 104.8 + G_{Ant} [dBi] + G_{Array} [dB] + $Att_{MeasCable}$ [dB] + $Att_{RF\text{-}Switch}$ [dB]

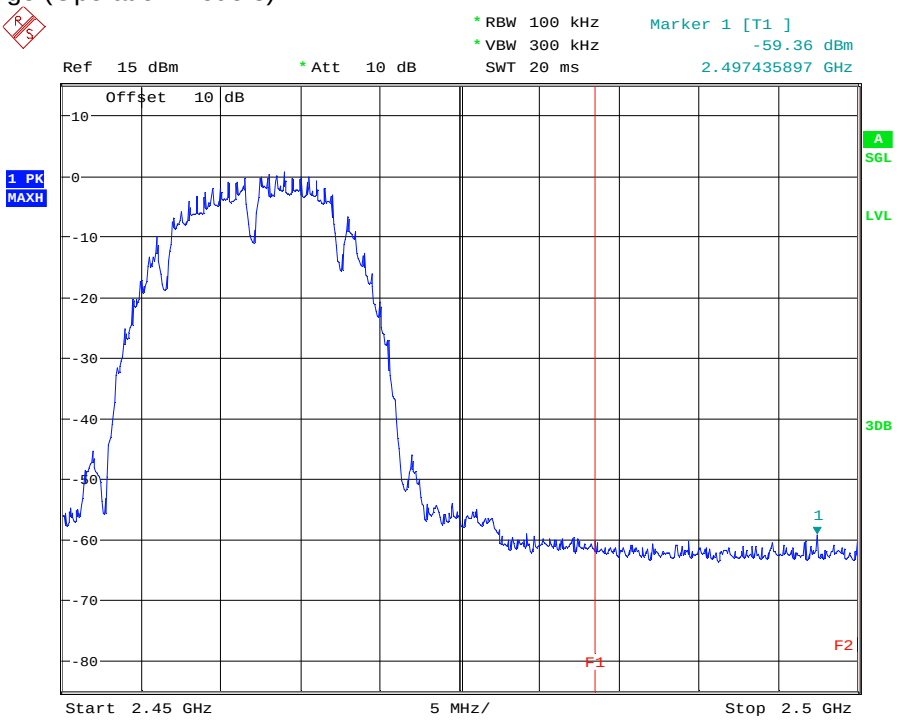
E [dBµV/m] = Field Strength [dBuV/m]
$EIRP$ [dBm] = Reading [dBm]
d = measurement distance in m
G_{Ant} [dBi] = Gain of the EUT antenna
G_{Array} [dB] = Array Gain [in case of multiple transmitting antenna port]
$Att_{MeasCable}$ [dB] = Attenuation of the measurement cables
$Att_{RF\text{-}Switch}$ [dB] = Attenuation of the RF Switch

6.5.2.1 Test results (conducted)

Ambient temperature	22 °C
Relative humidity	45 %

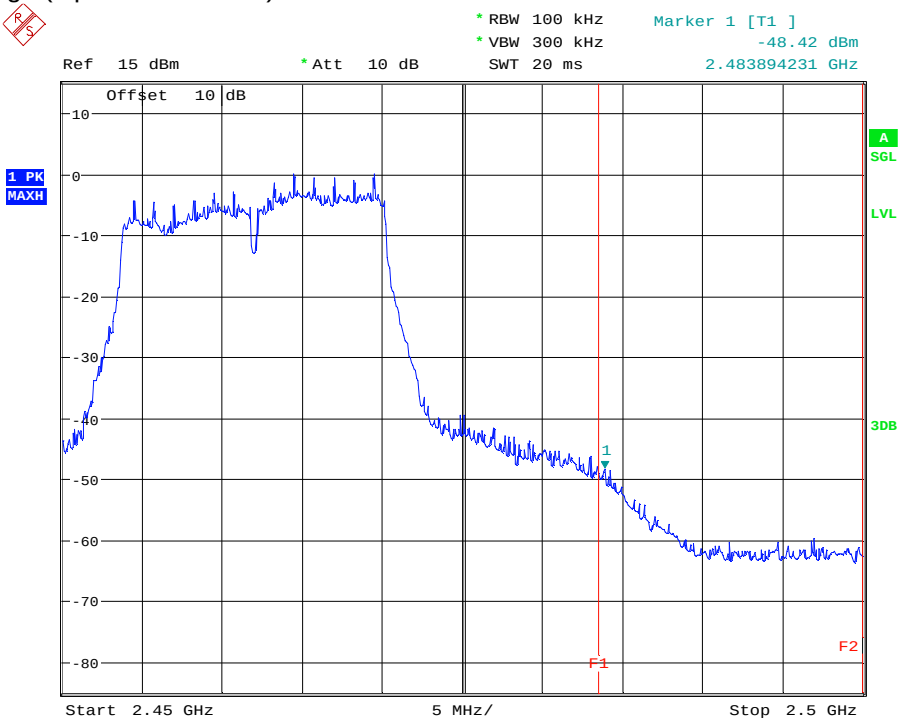
Date	20.08.2018
Tested by	B. ROHDE

Restricted band edge (Operation mode 3):



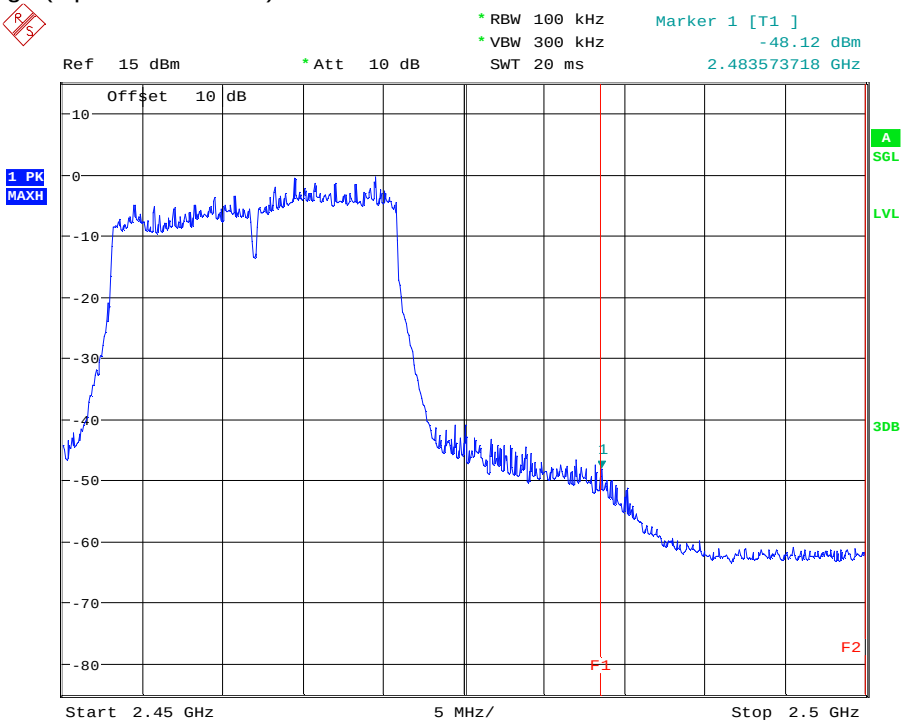
Upper band edge							
Operation Mode	Frequency [MHz]	Field Strength [dBuV/m]	Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result
3	2498.831	45.1	74	28.9	-53.9	3.7	Passed
Operation Mode	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result
3	2495.676	33.6	54	20.4	-65.4	3.7	Passed
Measurement uncertainty				+0.66 dB / -0.72 dB			

Restricted band edge (Operation mode 6):



Upper band edge							
Operation Mode	Frequency [MHz]	Field Strength [dBuV/m]	Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result
6	2483.569	69.9	74	4.1	-29.1	3.7	Passed
Operation Mode	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result
6	2483.529	50.2	54	3.8	-49	3.7	Passed
Measurement uncertainty				+0.66 dB / -0.72 dB			

Restricted band edge (Operation mode 9):



Upper band edge							
Operation Mode	Frequency [MHz]	Field Strength [dBuV/m]	Peak Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result
9	2484.079	65.6	74	8.4	-33.4	3.7	Passed
Operation Mode	Frequency [MHz]	Field Strength [dBuV/m]	Average Limit [dBuV/m]	Margin [dB]	Reading [dBm]	Antenna Gain + Array Gain [dBi]	Result
9	2483.674	48.7	54	5.3	-51.6	3.7	Passed
Measurement uncertainty				+0.66 dB / -0.72 dB			

Test equipment (please refer to chapter 6 for details)
1

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

For the measurement, the EUT was measured radiated in the anechoic chamber using the procedures described in 6.6.1.

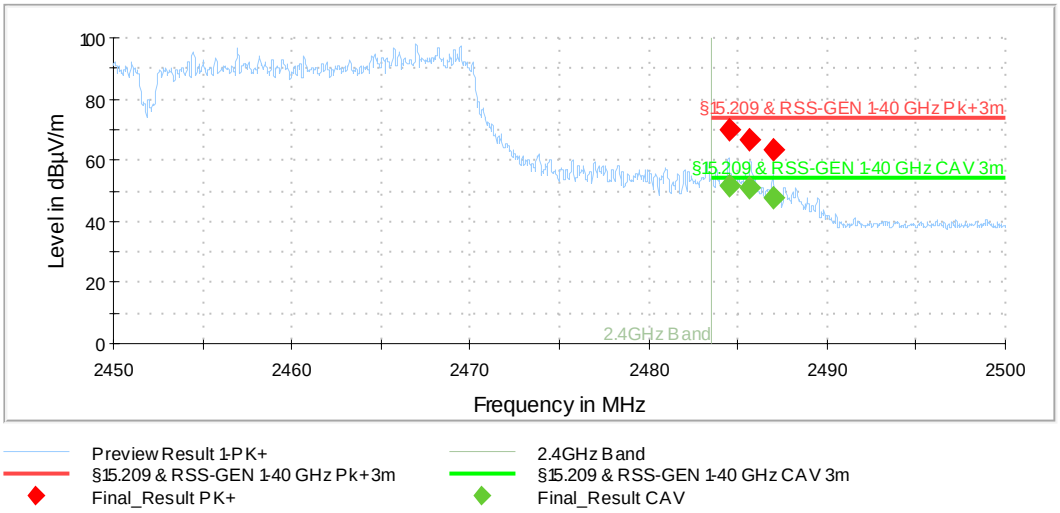
The relating measurements were carried radiated. The measurement procedure refers to part 6.10.5.2 of document [1].

6.5.3.1 Test results (radiated)

Ambient temperature	22 °C
Relative humidity	52 %

Date	26.10.2017
Tested by	B. ROHDE

Restricted band edge (Operation mode 12):



Upper band edge									
Operation mode 12			Duty cycle correction factor of 2.06 dB was applied for the Average reading						
Frequency	Max Peak	Average	Limit	Margin	Pol	Azimuth	Elevation	Correction	Result
[MHz]	[dBµV/m]	[dBµV/m]	[dBµV/m]	dB		[°]	[°]	[dB]	
2484.500000	69.8	---	74	4.2	V	183	90	34.0	Passed
2484.500000	---	53.9	54	0.1	V	183	90	36.1	Passed
2485.700000	66.8	---	74	7.2	H	177	0	34.0	Passed
2485.700000	---	52.9	54	1.1	H	177	0	36.1	Passed
2487.000000	---	49.8	54	4.2	V	183	120	36.1	Passed
2487.000000	63.1	---	74	10.9	V	183	120	34.0	Passed
Measurement uncertainty			+2.2 dB / -3.6 dB						

Test equipment (please refer to chapter 6 for details)
2 - 11

6.6 Maximum unwanted emissions

6.6.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into five stages.

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

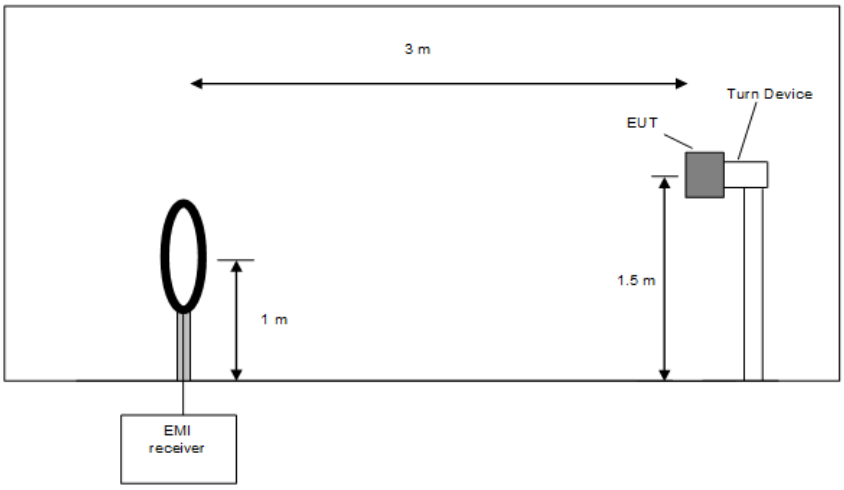
Preliminary measurement (9 kHz to 30 MHz):

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 analyzer 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 analyzer 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:

Pre-scans were performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

Pre-scans 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 polarization 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 polarization 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.

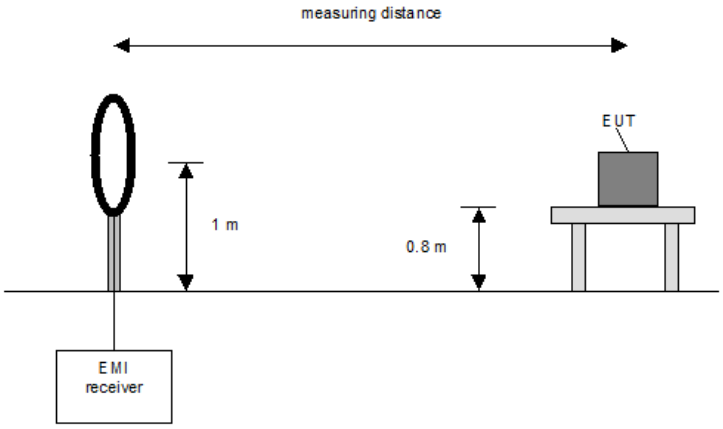
Final measurement (9 kHz to 30 MHz):

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in measuring distances of 3 m, 10 m and 30 m. In the case where larger measuring distances is 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).

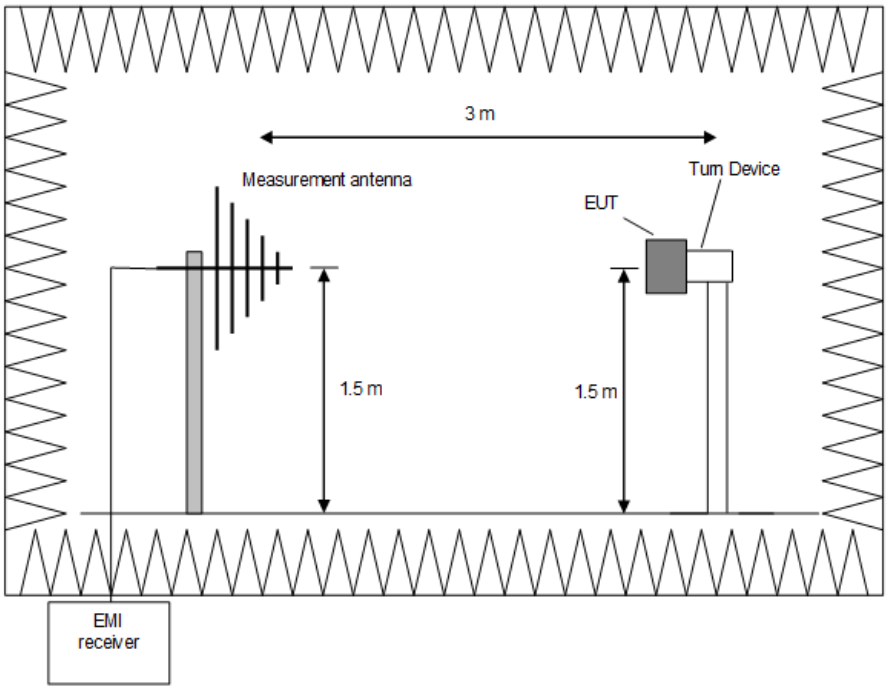
Preliminary measurement (30 MHz to 1 GHz)

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 setup 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 polarization 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:

Pre-scans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.
The following procedure will be used:

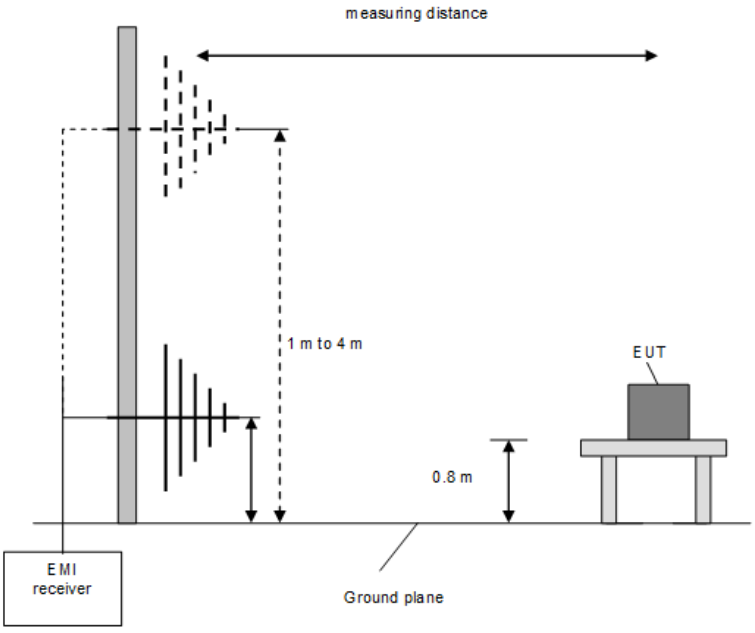
8. Monitor the frequency range at horizontal polarization and a EUT azimuth of 0 °.
9. Manipulate the system cables within the range to produce the maximum level of emission.
10. Rotate the EUT by 360 ° to maximize the detected signals.
11. Repeat 1) to 3) with the vertical polarization of the measuring 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 polarization 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)

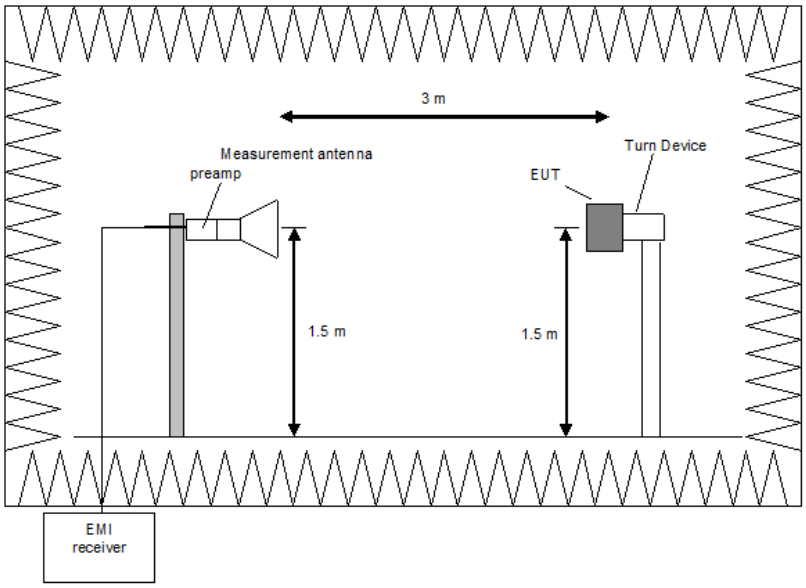
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

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 analyzer set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarization 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:

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

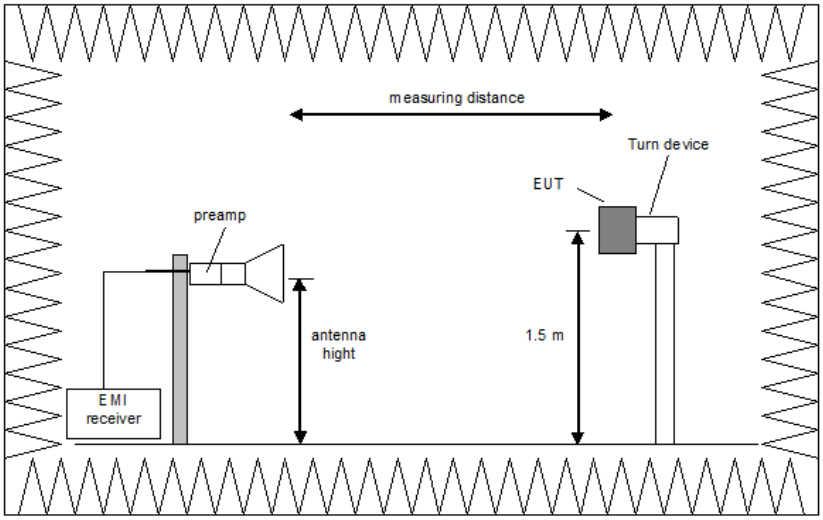
1. Monitor the frequency range at horizontal polarization and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarization of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an 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 polarization, 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 polarization to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
3) Set the spectrum analyzer 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.

6.6.1.1 Test results (radiated emissions)

6.6.1.1.1 Preliminary radiated emission measurement

6.6.1.1.1.1 Emissions below 1 GHz

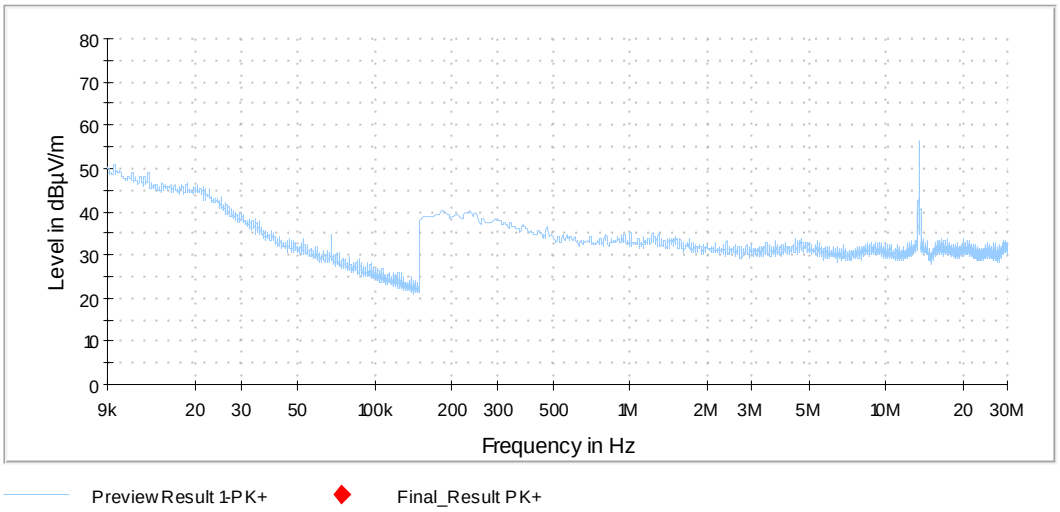
Ambient temperature	22 °C
Relative humidity	45 %

Date	24.11.2017[*1] 26.10.2017[*2]
Tested by	M. BASTERT B. ROHDE

[*1] Preliminary measurement 9 kHz – 30 MHz
[*2] Preliminary measurement 30 MHz – 1 GHz

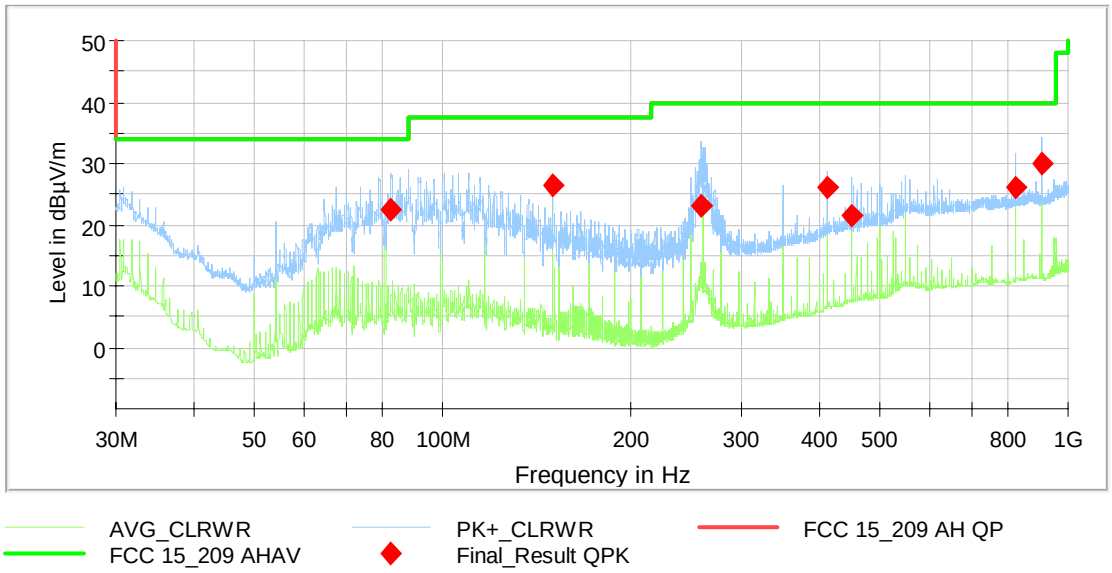
Position of EUT:	The EUT was set-up on an EUT turn device of a height of 1.5 m. The distance between EUT and antenna was 3 m.
Cable guide:	For detail information of test set-up and the cable guide refer to the pictures in Test setup Photo annex.
Test record:	All results are shown in the following.
Supply voltage:	During all measurements the host of the EUT was powered with 24 V DC via an laboratory power supply.

Spurious emissions from 30 MHz – 1 GHz (All operation modes; preliminary plot):



The emission at 68 kHz is caused by the measuring system and is therefore not measured.
The emission at 13.56 MHz is a wanted signal and is therefore not rated, in this test report.

Spurious emissions from 30 MHz – 1 GHz (All operation modes; preliminary plot):



The following frequencies were found for final measurement:

Frequency [MHz]
13.560000
82.746000
150.000000
259.158000
411.444000
450.000000
822.870000
909.492000

Test equipment (please refer to chapter 6 for details)	
Preliminary measurements 9 kHz - 30 MHz	4, 6, 11 - 14
Preliminary measurements 30 MHz - 1 GHz	2 - 4, 6, 10 - 11, 15 - 18

6.6.1.1.1.2 Emissions above 1 GHz

Ambient temperature	22 °C
Relative humidity	45 %

Date	19.10.2017 20.10.2017 27.10.2017
Tested by	B. ROHDE

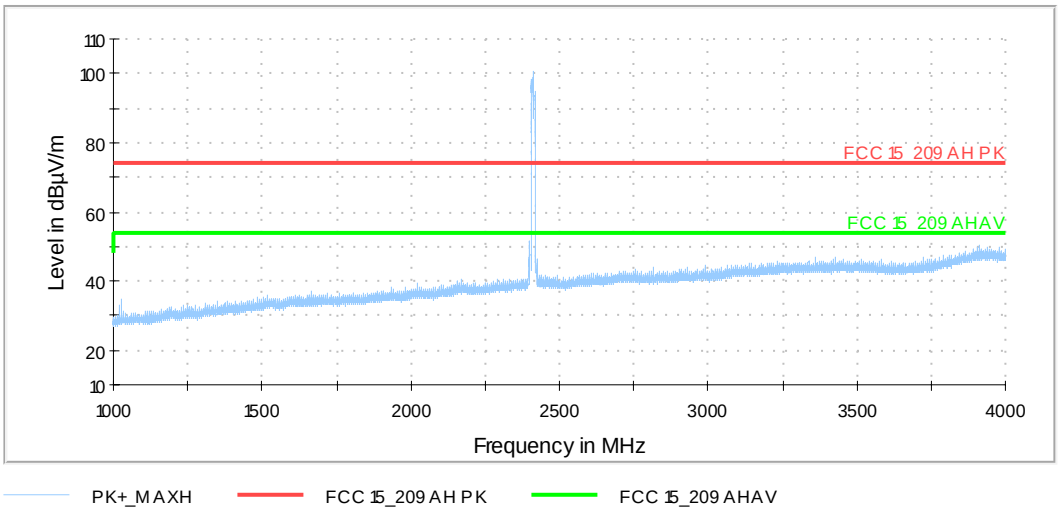
Position of EUT: The EUT was set-up on an EUT turn device of a height of 1.5 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in Test setup Photo annex.

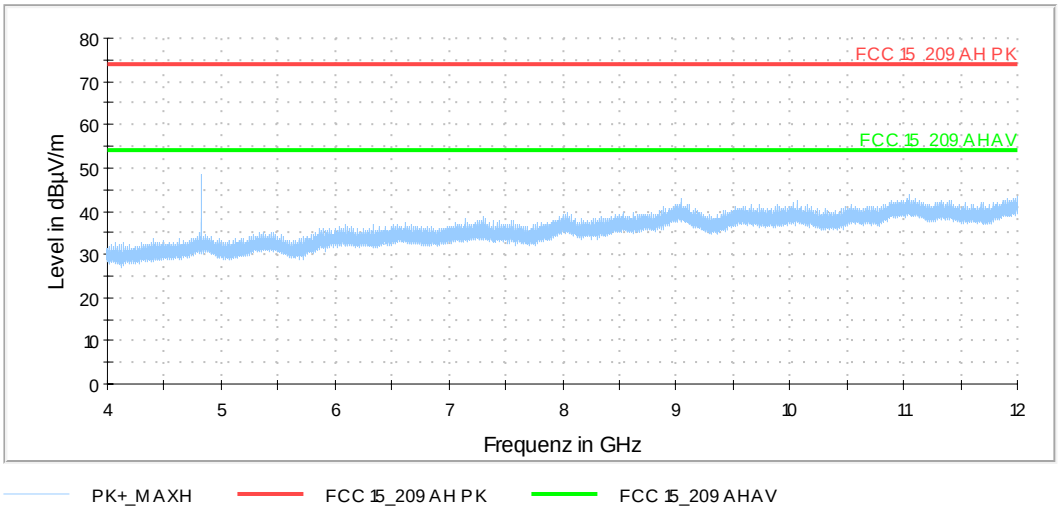
Test record: All results are shown in the following.

Supply voltage: During all measurements the host of the EUT was powered with 24 V DC via a laboratory power supply.

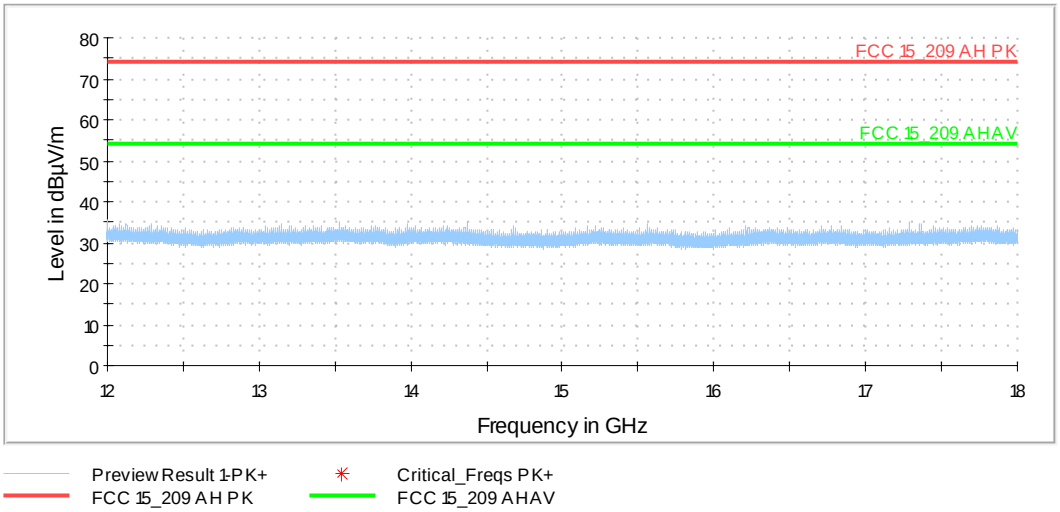
Spurious emissions from 1 – 4 GHz (Operation mode 1; Preliminary plot):
no significant emission, no final measurement



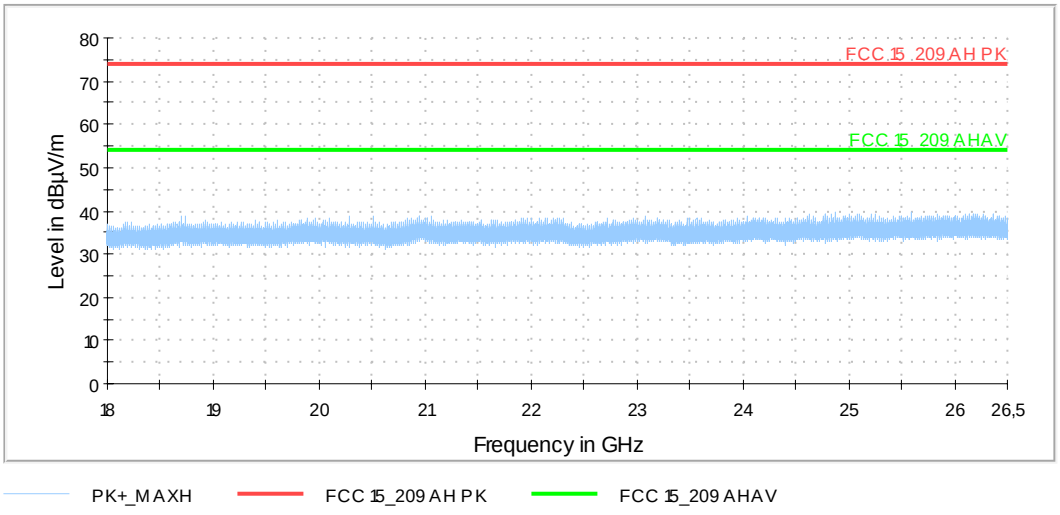
Spurious emissions from 4 - 12 GHz (Operation mode 1; Preliminary and final plot):



Spurious emissions from 12 - 18 GHz (Operation mode 1; Preliminary plot):
no significant emission, no final measurement



Spurious emissions from 18 – 26.5 GHz (Operation mode 2; Preliminary plot):
no significant emission, no final measurement



Test equipment (please refer to chapter 6 for details)	
Preliminary measurements above 1 GHz	2 - 8, 10 - 11, 16, 19 - 25

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

Ambient temperature	22 °C	Date	27.04.2018
Relative humidity	45 %	Tested by	M. Bastert

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 test setup photos.

Test record: All results are shown in the following.

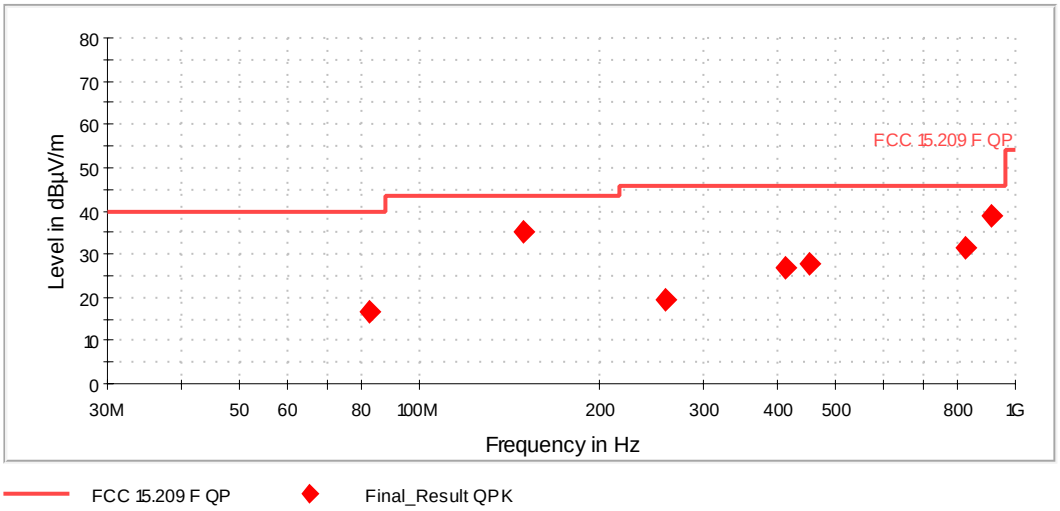
Supply voltage: During all measurements the host of the EUT was powered with 24 V DC via an laboratory power supply.

The correction factor is calculated as Antenna Factor [dB] + Cable Attenuation [dB] - Amplifier Gain [dB]

The result Peak/Average is the result of Reading [dBµV/m] – Correction factor [dB]

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.

Spurious emissions from 30 MHz – 1 GHz (All operation modes; final plot):



Spurious Emissions (All Operation modes) 9kHz - 30 MHz								
Frequency [MHz]	Reading [dBµV]	Result* [dBµV/m]	Limit acc. 15.209 [dBµV/m]	Margin [dB]	Detector (acc. to §15.209 (d)	Antenna factor [dB/m]	Measuring Distance [m]	Distance correction factor** [dB]
No emission found, so no final measurement was carried out								

Spurious Emissions (All Operation modes) 30 MHz - 1 GHz								
Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin dB	Pol	Azimuth [°]	Height [cm]	Correction [dB]	Result
82.746000	16.8	40	23.2	V	0	353	16.2	Passed
150.000000	35.0	43.5	8.5	V	90	235	19.1	Passed
259.158000	19.5	46	26.5	H	22	228	21.6	Passed
411.444000	26.9	46	19.1	V	110	103	25.1	Passed
450.000000	27.6	46	18.4	V	115	226	25.4	Passed
822.870000	31.3	46	14.7	V	7	102	29.9	Passed
909.492000	38.9	46	7.1	H	13	109	30.4	Passed
Measurement uncertainty				+/- 4.78 dB				

Test equipment (please refer to chapter 6 for details)
Final measurements 9 kHz - 30 MHz 26 - 28
Final measurements 30 MHz - 1 GHz 29 – 34, 37

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

Ambient temperature	22 °C		Date	19.10.2017 20.10.2017 27.10.2017
Relative humidity	45 %		Tested by	B. ROHDE

Position of EUT:	The EUT was set-up on a 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 test setup photos.
Test record:	All results are shown in the following.
Supply voltage:	During all measurements the host of the EUT was powered with 24 V DC 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.

Spurious Emissions 1 – 25 GHz (Operation mode 1)									
Operation mode 1			Duty cycle correction factor of 0 dB was applied for the Average reading						
Frequency	Max Peak	Average	Limit	Margin	Pol	Azimuth	Elevation	Correction	Result
[MHz]	[dBµV/m]	[dBµV/m]	[dBµV/m]	dB		[°]	[°]	[dB]	
4823.950000	---	48.4	54	5.6	V	274	90	-1.7	Passed
4823.950000	51.8	---	74	22.2	V	274	90	-1.7	Passed
4831.950000	---	36.0	54	18.0	V	261	90	-1.6	Passed
4831.950000	46.0	---	74	28.0	V	261	90	-1.6	Passed
9048.900000	---	38.0	54	16.0	V	123	150	9.3	Passed
9048.900000	50.3	---	74	23.7	V	123	150	9.3	Passed
Measurement uncertainty			+/- 5.38 dB						

Spurious Emissions 1 – 25 GHz (Operation mode 2)									
Operation mode 2			Duty cycle correction factor of 0 dB was applied for the Average reading						
Frequency	Max Peak	Average	Limit	Margin	Pol	Azimuth	Elevation	Correction	Result
[MHz]	[dBµV/m]	[dBµV/m]	[dBµV/m]	dB		[°]	[°]	[dB]	
4873.950000	---	46.7	54	7.3	V	254	90	-1.5	Passed
4873.950000	50.7	---	74	23.3	V	254	90	-1.5	Passed
10746.250000	---	36.7	54	17.3	H	101	90	6.9	Passed
10746.250000	49.1	---	74	24.9	H	101	90	6.9	Passed
11897.100000	---	38.3	54	15.7	H	322	120	6.3	Passed
11897.100000	50.4	---	74	23.6	H	322	120	6.3	Passed
Measurement uncertainty			+/- 5.38 dB						

Spurious Emissions 1 – 25 GHz (Operation mode 3)									
Operation mode 3			Duty cycle correction factor of 0 dB was applied for the Average reading						
Frequency	Max Peak	Average	Limit	Margin	Pol	Azimuth	Elevation	Correction	Result
[MHz]	[dBµV/m]	[dBµV/m]	[dBµV/m]	dB		[°]	[°]	[dB]	
4923.950000	---	46.2	54	7.8	V	247	90	-1.6	Passed
4923.950000	50.3	---	74	23.7	V	247	90	-1.6	Passed
7255.650000	---	33.2	54	20.8	V	112	60	4.6	Passed
7255.650000	46.1	---	74	27.9	V	112	60	4.6	Passed
11032.150000	---	38.4	54	15.6	H	218	0	8.3	Passed
11032.150000	50.7	---	74	23.3	H	218	0	8.3	Passed
Measurement uncertainty			+/- 5.38 dB						

Test equipment (please refer to chapter 6 for details)
2 - 8, 10 - 11, 16, 19 - 25

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

Ambient temperature	22 °C
Relative humidity	45 %

Date	29.03.2018
Tested by	B. ROHDE

Position of EUT: Tabletop equipment, see photos in annex A of this test report

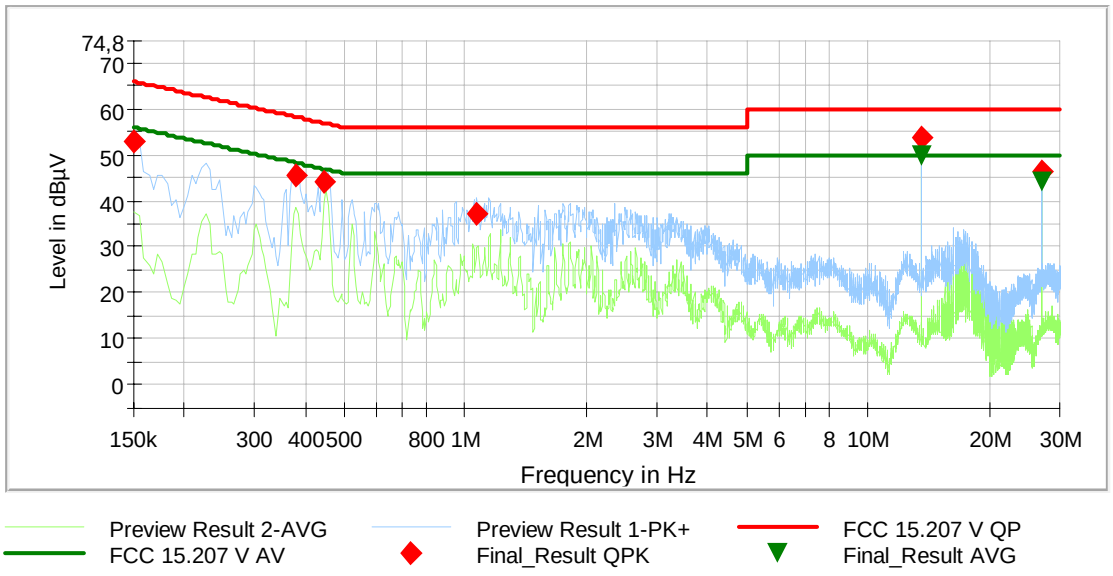
Cable guide: For detail information of test set-up and the cable guide refer to the photos in annex A of this test report.

Test record: All results are shown in the following.

Supply voltage: For the test the evaluation board of the EUT was connected to an ancillary laptop “P/N CA01007-0920” by “FUJITSU LIMITED” via Ethernet The EUT was connected to a power supply “Phoenix contact type: STEP-PS/277AC/24DC/3.5 which was itself powered with 120V/60Hz. The AC mains emissions were tested at the power supply.

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 “ ▼

Conducted emissions on power supply (all operation modes):



Frequency [MHz]	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Meas. Time [ms]	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150000	53.02	---	66.00	12.98	5000.0	9.000	N	GND	9.8
0.381300	45.34	---	58.25	12.91	5000.0	9.000	N	GND	9.9
0.445200	44.04	---	56.96	12.93	5000.0	9.000	N	GND	9.9
1.060800	37.37	---	56.00	18.63	5000.0	9.000	N	FLO	9.9
13.560000	---	49.92	50.00	0.08	5000.0	9.000	N	GND	10.8
13.560000	53.61	---	60.00	6.39	5000.0	9.000	N	FLO	10.8
27.119400	---	44.02	50.00	5.98	5000.0	9.000	N	GND	11.2
27.119400	46.19	---	60.00	13.81	5000.0	9.000	N	GND	11.2
Measurement uncertainty				+/- 2.76 dB					

Test: Passed

Test equipment (please refer to chapter 6 for details)
33, 35 - 38

7 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Spectrum Analyser	FSU46	Rohde & Schwarz	200125	480956	01.03.2018	03.2019
2	Antenna mast	AS615P	Deisel	615/310	480187	Calibration not necessary	
3	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	Calibration not necessary	
4	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
5	RF-cable No.3	Sucoflex 106B	Suhner	0563/6B / Kabel 3	480670	Calibration not necessary	
6	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/971107	480832	Calibration not necessary	
7	Antenna (Log.Per.)	HL050	Rohde & Schwarz	100438	481170	09.10.2017	10.2020
8	RF-Cable No. 40	Sucoflex 106B	Suhner	0708/6B / Kabel 40	481330	Calibration not necessary	
9	HF-Cable	Sucoflex 104	Huber+Suhner	517406	482391	Calibration not necessary	
10	Positioners	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	
11	EMI Receiver / Spectrum Analyser	ESW44	Rohde & Schwarz	101635	482467	22.06.2017	06.2019
12	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	Calibration not necessary	
13	Antenna support	AS620P	Deisel	620/375	480325	Calibration not necessary	
14	loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	29.02.2016	03.2018
15	Antenna (Bilog)	CBL6112B	Schaffner EMV GmbH (-Chase)	2688	480328	19.06.2017	06.2020
16	Software	WMS32	Rohde & Schwarz		481800	Calibration not necessary	
17	RF-cable No.36	Sucoflex 106B	Suhner	0587/6B / Kabel 36	480865	Calibration not necessary	
18	HF-Cable	Sucoflex 104	Huber+Suhner	517402	482392	Calibration not necessary	
19	standard gain horn antenna	18240-20	Flann Microwave	483	480294	Calibration not necessary	
20	standard gain horn antenna	20240-20	Flann Microwave	411	480297	Calibration not necessary	
21	Microwave cable 2m	Insulated Wire Inc.	Insulated Wire	KPS-1533-800-KPS	480302	Calibration not necessary	
22	Preamplifier 100 MHz - 13 GHz	JS3-00101200-23-5A	MITEQ Hauppauge N.Y.	681851	480337	18.02.2016	02.2018
23	Preamplifier 18 GHz - 26 GHz	JS4-18002600-20-5A	MITEQ Hauppauge N.Y.	658697	480342	17.02.2016	02.2018
24	Preamplifier 12 GHz - 18 GHz	JS3-12001800-16-5A	MITEQ Hauppauge N.Y.	571667	480343	18.02.2016	02.2018
25	High pass Filter	WHKX4.0/18G-8SS	Wainwright Instruments GmbH	1	480587	Calibration not necessary	
26	Outdoor test site	-	PHOENIX TESTLAB GmbH	-	480293	Calibration not necessary	
27	EMI Receiver / Spectrum Analyser	ESI 40	Rohde & Schwarz	100064/040	480355	27.02.2018	02.2019

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
28	loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	19.12.2017	12.2018
29	Open area test site M6	Freifeld M6	Phoenix Contact	-	480085	Calibration not necessary	
30	Antenna mast	MA240-0	Inn-Co GmbH	MA240-0/030/6600603	480086	Calibration not necessary	
31	Turntable	DS412	Deisel	412/316	480087	Calibration not necessary	
32	Controller	HD100	Deisel	100/349	480139	Calibration not necessary	
33	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
34	Antenna (Bilog)	CBL6111D	Schaffner Elektrotest GmbH / Teseq GmbH	25761	480894	19.10.2017	10.2020
35	LISN	NSLK8128	Schwarzbeck	8128155	480058	14.03.2018	03.2020
36	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
37	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	28.02.2018	02.2020
38	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	14.03.2018	03.2020

8 Report History

Report Number	Date	Comment
F170756E2	03.06.2019	Initial Test Report

9 List of Annexes

Annex A Test Setup Photos 9 pages