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Test Report

Report Number:

F170754E2

Equipment under Test (EUT):

Control Panel for welding inverters

Einschub TPS/i Touch G2

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 (March 2018)**, 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 4 (November 2014)**, General Requirements for Compliance of Radio Apparatus

[5] **KDB 558074 D01 DTS Meas Guide v04 (April 2017),** Guidance for Performing compliance measurements on digital 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.

Test engineer:	Bernward ROHDE		13.08.2018
	Name	Signature	Date
Authorized reviewer:	Michael DINTER		13.08.2018
	Name	Signature	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 partly represented during the test by the following person:	Mr. Jan HERNDLER, Mr. Franz NIEDEREDER

1.2 Manufacturer

Name:	Fronius International GmbH
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email Address:	herndler.jan@fronius.com
Manufacturer partly represented during the test by the following person:	Mr. Jan HERNDLER, Mr. Franz NIEDEREDER

1.3 Test Laboratory

The tests were carried out by:

PHOENIX TESTLAB GmbH
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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 TPS/i Touch G2**
FCC ID: *	QKWSPBMCU2
IC: *	12270A-SPBMCU2
HVIN (Hardware Version Identification Number): *	Einschub TPS/i Touch G2
FVIN (Firmware Version Identification Number): *	V1.8 Beta
HMN (Host model name):*	N/A
Order number	43,0001,3547
Serial number: *	Engineering sample
PCB identifier: *	1614685

* As 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

Technical Data of Equipment						
Fulfills Wi-Fi specification:*	IEEE 802.11 b/g/n20/n40					
Antenna type:*	External Dipole Antenna					
Antenna name:*	FXP832					
Antenna gain:*	3.66 dBi (on plastic according to the datasheet)					
Antenna connector:*	RP-SMA					
Power supply:*	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 (1Mbps DBPSK, 2Mbps DQPSK, 5.5/11Mbps CCK) 802.11g: OFDM (6/9Mbps BPSK, 12/18Mbps QPSK, 24/36Mbps 16-QAM, 48/54Mbps 64-QAM) 802.11n: OFDM (6.5 BPSK, QPSK, 16-QAM, 64-QAM)					
Operating frequency range:*	2412 – 2462 MHz (b/g/n20 mode) 2422 – 2452 MHz (n40 mode)					
Channel spacing:*	5 MHz					
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)
AC-Adaptor**	ITE Power supply Model number: UE36LCP1-240150SPA, 24 V DC / 1.5 A

*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

1.5 Dates

Date of receipt of test sample:	07.09.2017
Start of test:	08.09.2017
End of test:	14.06.2018

2 Operational States

The equipment under test (EUT) is the WLAN-radio part of a control panel for welding units.
During all test the EUT was operating in test modes.

Physical Boundaries of the 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 Wi-Fi 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.

For the tests the EUT was supplied with 24 V DC via laboratory power supply.

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	18
2	Continuous transmitting on 2437 MHz	6	802.11b	1 Mbps	18
3	Continuous transmitting on 2462 MHz	11	802.11b	1 Mbps	18
4	Continuous transmitting on 2412 MHz	1	802.11g	6 Mbps	18
5	Continuous transmitting on 2437 MHz	6	802.11g	6 Mbps	18
6	Continuous transmitting on 2462 MHz	11	802.11g	6 Mbps	18
7	Continuous transmitting on 2412 MHz	1	802.11n HT20	MCS7	17
8	Continuous transmitting on 2437 MHz	6	802.11n HT20	MCS7	17
9	Continuous transmitting on 2462 MHz	11	802.11n HT20	MCS7	17
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.

All tests were done with an unmodified sample.

3 Additional Information

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 F170754E1, the simultaneous transmission of the BLE part with the 13.56 MHz NFC specific test-cases are documented in PHOENIX TESTLAB test report F170754E3.

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 conducted average output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [3]	Passed	13 et seq.
DTS bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (a) [3]	Passed	15 et seq.
Average power spectral density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [3]	Passed	18 et seq.
Band edge compliance	2400.0 - 2483.5	15.247 (d)	5.5 [3] 8.9 [4], 8.10 [4]	Passed	20 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	24 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Passed	40 et seq.
Antenna requirement	-	15.203	-	Passed *	-

*: Integrated antenna only, requirement fulfilled.

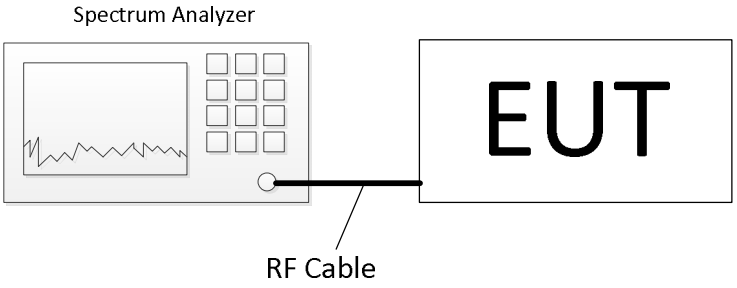
5 Results

5.1 Duty cycle

5.1.1 Method of measurement (Duty cycle)

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

Test Setup:



The method described in chapter 11.6 b) of document [1] was used to perform the following test.

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

The following measurement technique was used:

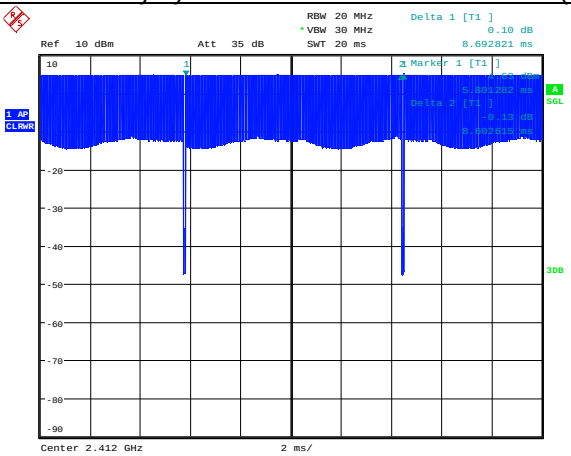
The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between two bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

- 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.)

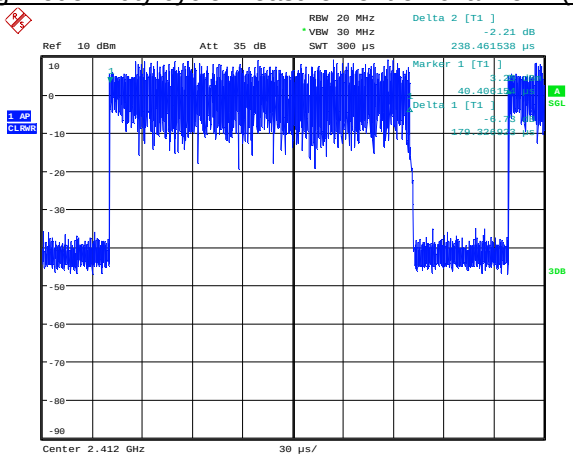
5.1.2 Test results (Duty cycle)

Ambient temperature	22 °C	Relative humidity	40 %
Tested by	B. Rohde	Date	14.06.2018

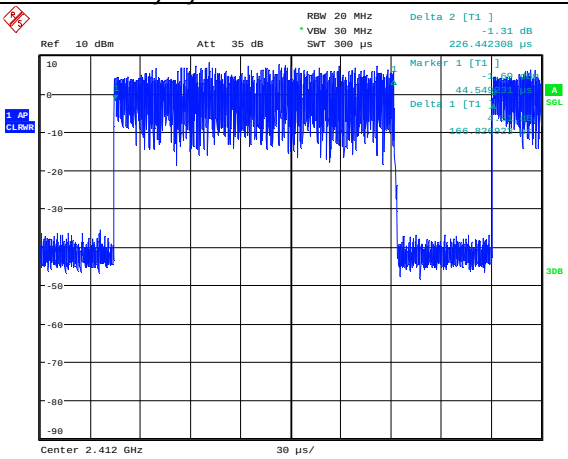
Duty Cycle b-mode: Duty cycle measurement on channel 1 (operation mode 1):



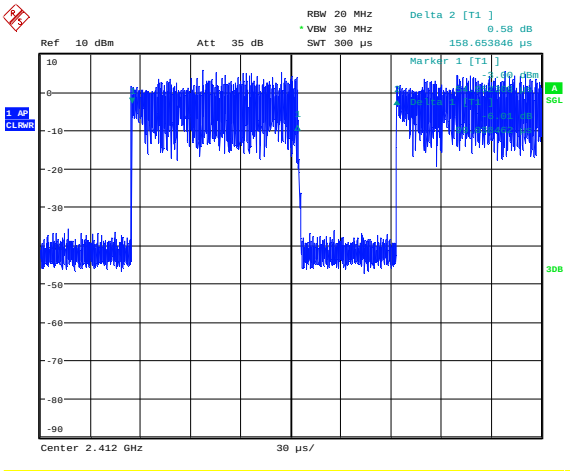
Duty Cycle g-mode: Duty cycle measurement on channel 1 (operation mode 4):



Duty Cycle n20 mode: Duty cycle measurement on channel 1 (operation mode 7):



Duty Cycle n40 mode: Duty cycle measurement on channel 3 (operation mode 10):



Operation mode	TX_on [µs]	TX_ges [µs]	RBW [MHz]	50/T [kHz]	50/T < RBW?
1-3	8603	8693	20	6	Yes
4-6	179	238	20	279	Yes
7-9	167	226	20	299	Yes
10-12	99	159	20	505	Yes

Operation mode	Sweep points	Sweep time [µs]	Meas points	Meas points >100?	Duty cycle %	DCCF [dB]
1-3	10001	20000	4347	Yes	98.96	0.05
4-6	10001	300	7934	Yes	75.21	1.24
7-9	10001	300	7534	Yes	73.89	1.31
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, no average correction factor is used for all tests in test mode 1-3.
Therefore, for average measurements a correction factor of 1.24 dB is used for all tests in test mode 4-6.
Therefore, for average measurements a correction factor of 1.31 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 used (refer clause 6):

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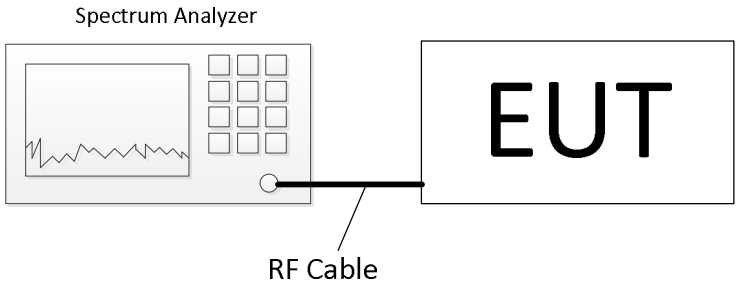
5.2 Maximum conducted (average) output power

5.2.1 Method of measurement

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.

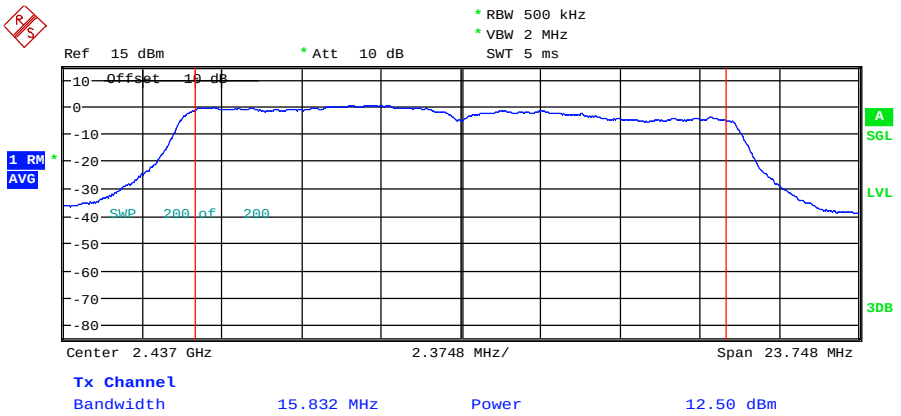
5.2.2 Test result

Ambient temperature	22 °C
Tested by	B. Rohde

Relative humidity	40 %
Date	14.06.2018

The plots represent the worst cases only:

Average conducted output power (operation mode 5):



Operation mode		Frequency [MHz]	Duty cycle correction [dB]	Conducted output power [dBm]	Limit [dBm]
1	b	2412	0.05	10.8	30
2	b	2437	0.05	12.9	30
3	b	2462	0.05	13.0	30
4	g	2412	1.24	11.7	30
5	g	2437	1.24	13.7	30
6	g	2462	1.24	12.0	30
7	n20	2412	1.31	10.8	30
8	n20	2437	1.31	12.7	30
9	n20	2462	1.31	10.9	30
10	n40	2422	2.06	9.5	30
11	n40	2437	2.06	9.3	30
12	n40	2452	2.06	9.2	30

Test: Passed

Test equipment used (refer clause 6):

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5.3 DTS Bandwidth / 99% Bandwidth

5.3.1 Method of measurement (DTS Bandwidth / 99% Bandwidth)

For the DTS bandwidth measurement, the EUT was measured radiated in the anechoic chamber using the procedures described in 5.6.1; respectively 8.1 option 1 of [5].

Acceptable measurement configurations

The measurement for the DTS bandwidth 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.

Procedure 6.9.3 [1] 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 [1].
- 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 labelled. Tabular data maybe reported in addition to the plot(s).

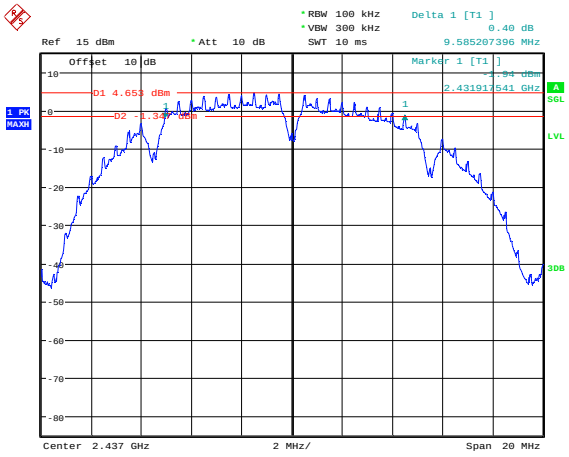
Since this is only a relative measurement, no measurement level correction was performed.

5.3.2 Test result (DTS Bandwidth / 99% Bandwidth)

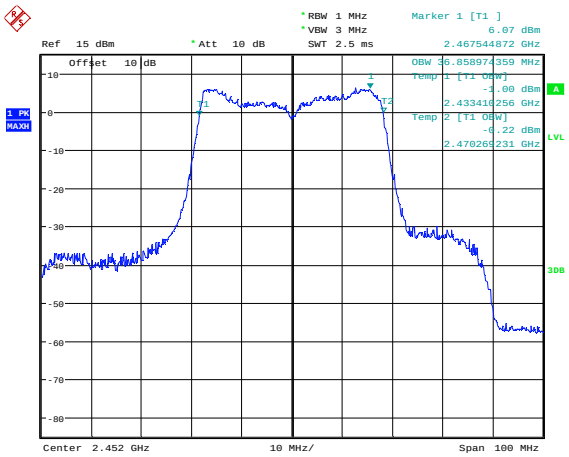
Ambient temperature	22 °C
Tested by	B. Rohde

Relative humidity	59 %
Date	14.06.2018

6-dB 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	10.105	13.526	Passed
2	2437	0.5	9.585	13.013	Passed
3	2462	0.5	9.585	12.821	Passed
4	2412	0.5	16.462	16.987	Passed
5	2437	0.5	15.832	16.410	Passed
6	2462	0.5	15.757	16.346	Passed
7	2412	0.5	17.646	17.628	Passed
8	2437	0.5	16.912	16.410	Passed
9	2462	0.5	16.057	16.410	Passed
10	2422	0.5	36.082	36.538	Passed
11	2437	0.5	33.858	36.058	Passed
12	2452	0.5	36.132	36.859	Passed
Measurement uncertainty			+1.8 dB / -2.4 dB		

Test: Passed

Test equipment used (refer clause 6):

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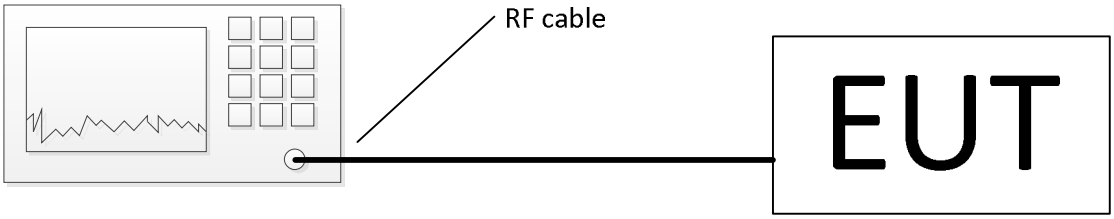
5.4 Average Power Spectral Density

5.4.1 Method of measurement

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%):

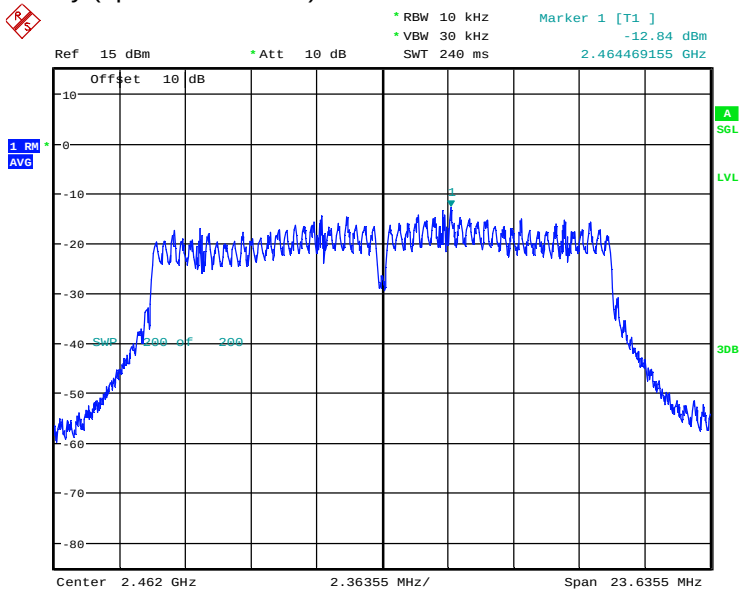
- Measure the duty cycle (D) of the transmitter output signal as described in 11.6.
- Set instrument center frequency to DTS channel center frequency.
- Set span to at least 1.5 times the OBW.
- Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
- Set VBW ≥ [3 × RBW].
- Detector = power averaging (rms) or sample detector (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).

5.4.2 Test result

Ambient temperature	22 °C	Relative humidity	59 %
Tested by	B. Rohde	Date	14.06.2018

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

Average power spectral density (operation mode 6):



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	2411.197	8	0.05	-15.9	Passed
2	b	2436.271	8	0.05	-13.4	Passed
3	b	2462.739	8	0.05	-13.0	Passed
4	g	2404.501	8	1.24	-13.4	Passed
5	g	2434.807	8	1.24	-12.0	Passed
6	g	2464.469	8	1.24	-11.6	Passed
7	n20	2404.519	8	1.31	-13.1	Passed
8	n20	2433.269	8	1.31	-12.3	Passed
9	n20	2464.484	8	1.31	-11.7	Passed
10	n40	2430.735	8	2.06	-15.9	Passed
11	n40	2434.446	8	2.06	-15.5	Passed
12	n40	2436.945	8	2.06	-16.5	Passed
Measurement uncertainty					+1.8 dB / -2.4 dB	

Test: Passed

Test equipment used (refer clause 6):

37

5.5 Band-edge compliance

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

Acceptable measurement configurations

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 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 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.

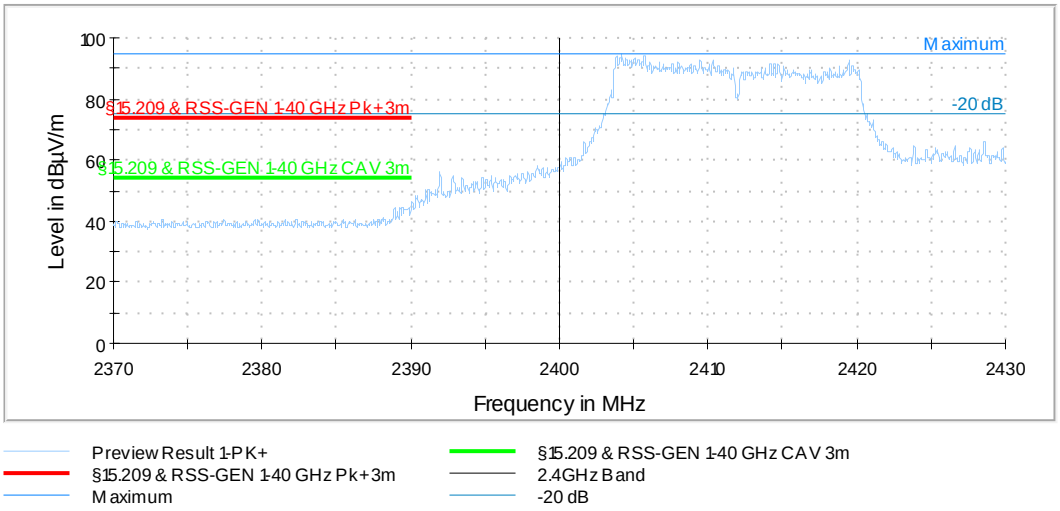
5.5.2 Test result (band edges next to unrestricted bands (radiated))

Ambient temperature	22 °C	Relative humidity	59 %
Tested by	B. Rohde	Date	08.09.2017

Worst case was reported only:

The EUT was measured radiated in the anechoic chamber using the procedures described in 5.6.1, respectively see chapter 11.0 in [5].

Radiated band-edge compliance at an unrestricted band-edge (operation mode 4):



Operation Mode	Tx Frequency [MHz]	Emission Frequency [MHz]	Reference Level [dBµV/m]	Limit [dBµV/m]	Emission Level [dBµV/m]	Margin [dB]	Result
4	2412	2398.53	95.0	75.0	58.1	16.9	Passed
Measurement uncertainty			+/- 5.14 dB				

Test: Passed

Test equipment used (refer clause 6):

1- 9

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

Acceptable measurement configurations

The same measurement configuration as described in 5.6.1. was used for the preview and final measurement.

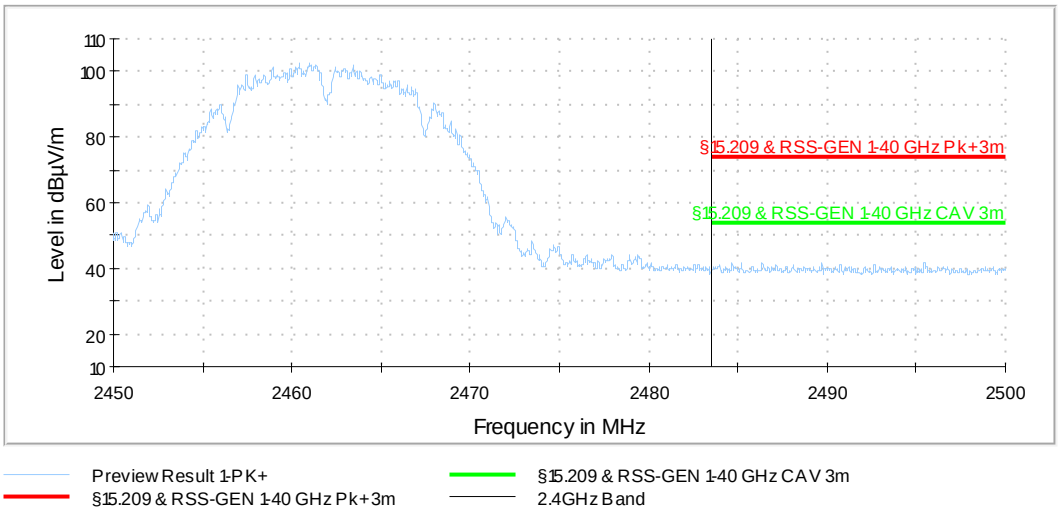
5.5.4 Test result (band edges next to restricted bands (radiated))

Ambient temperature	22 °C
Tested by	B. Rohde

Relative humidity	59 %
Date	08.09.2017

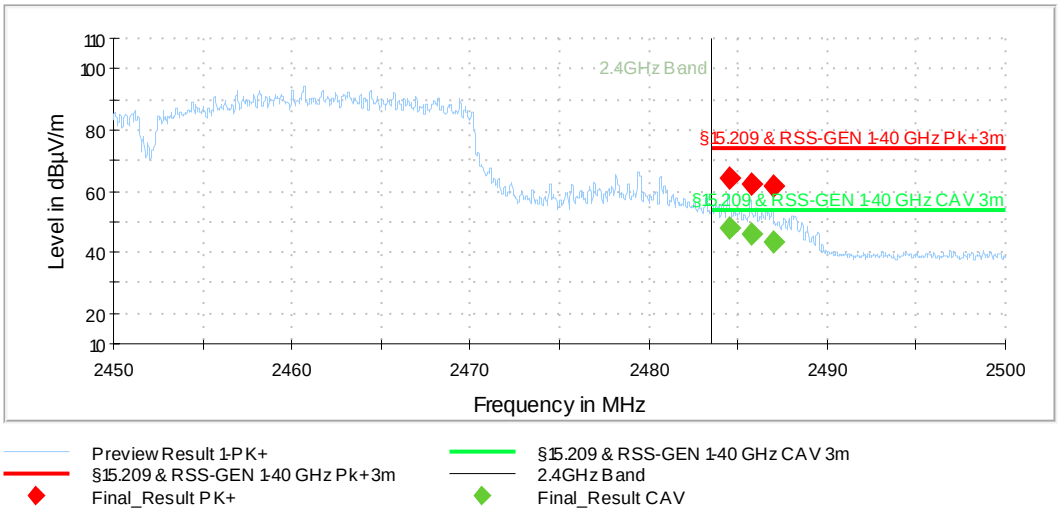
The EUT was measured radiated in the anechoic chamber using the procedures described in 5.6.1 respectively chapter 12.0 of [5].

Radiated band-edge compliance at a restricted band-edge (operation mode 3):



No emission found, so no final measuremnt done.

Radiated band-edge compliance at a restricted band-edge (operation mode 12):



Band edge compliance			Upper band edge			Operation mode 12			
Frequency [MHz]	Max Peak [dBµV/m]	Average [dBµV/m]	Limit [dBµV/m]	Margin dB	Pol	Azimuth [°]	Elevation [°]	Correction [dB]	Result
2484.500000	64.1	---	74	9.9	H	143	120	34.0	Passed
2484.500000	---	47.8	54	6.2	H	143	120	36.0	Passed
2485.725000	62.1	---	74	11.9	H	130	120	34.0	Passed
2485.725000	---	46.0	54	8.0	H	130	120	36.0	Passed
2486.950000	---	43.2	54	10.8	V	235	0	36.0	Passed
2486.950000	61.7	---	74	12.3	V	235	0	34.0	Passed
Measurement uncertainty				+/- 5.14 dB					

Test: Passed

Test equipment used (refer clause 6):

1 - 9

5.6 Maximum unwanted emissions

5.6.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into five stages.

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

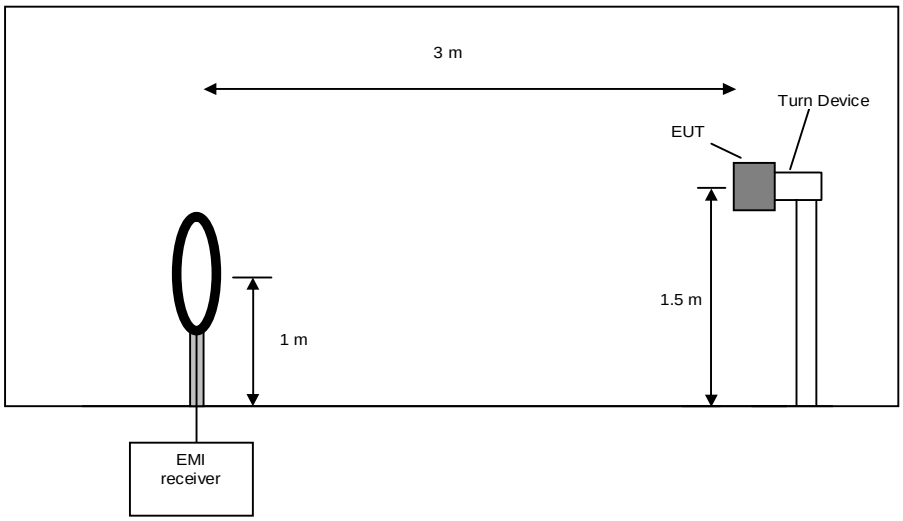
Preliminary measurement (9 kHz to 30 MHz):

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.

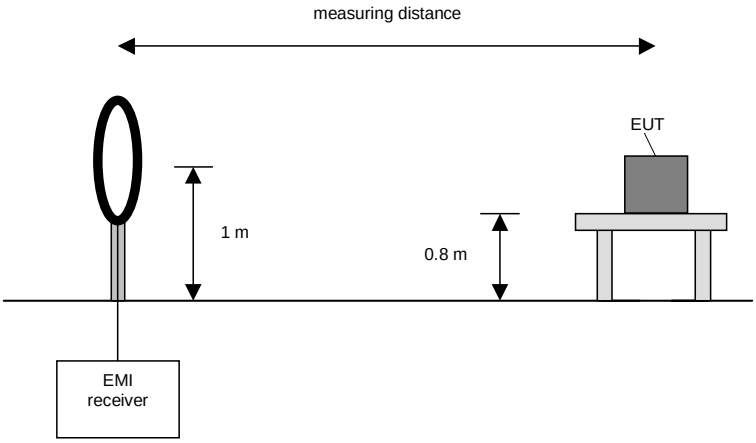
Final measurement (9 kHz to 30 MHz):

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).

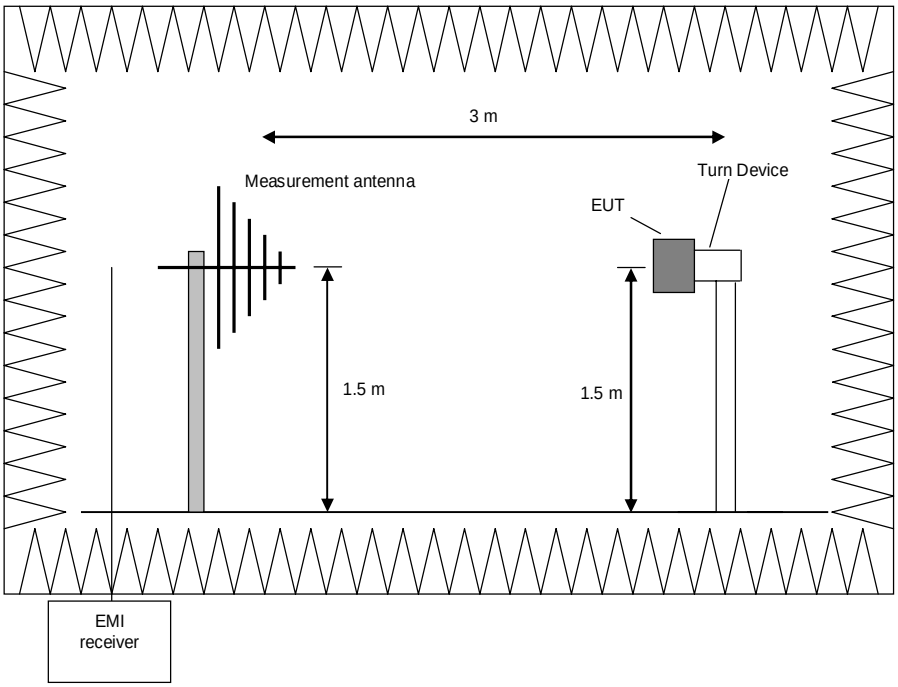
Preliminary measurement (30 MHz to 1 GHz)

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:

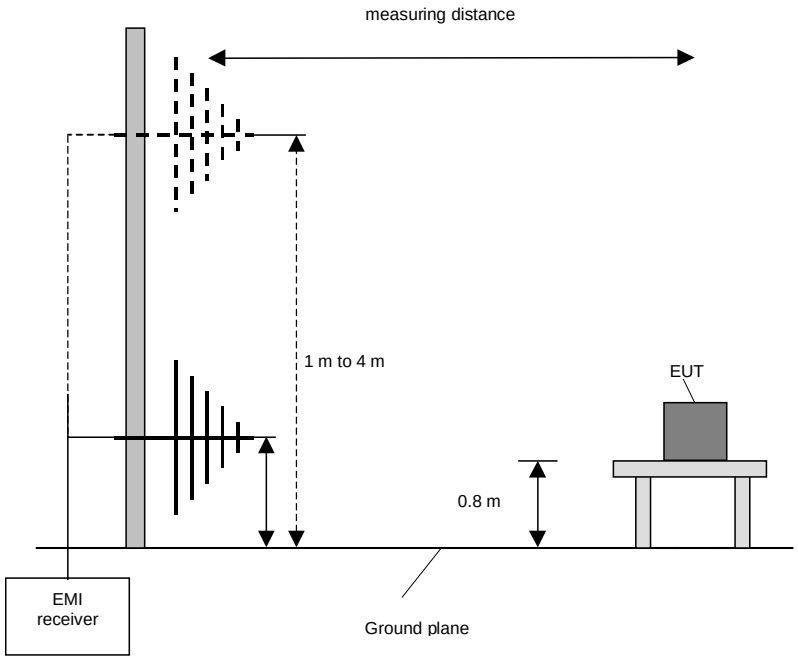
8. Monitor the frequency range at horizontal polarization and a EUT azimuth of 0 °.
9. Manipulate the system cables within the range to produce the maximum level of emission.
10. Rotate the EUT by 360 ° to maximize the detected signals.
11. Repeat 1) to 3) with the vertical polarization of the measuring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

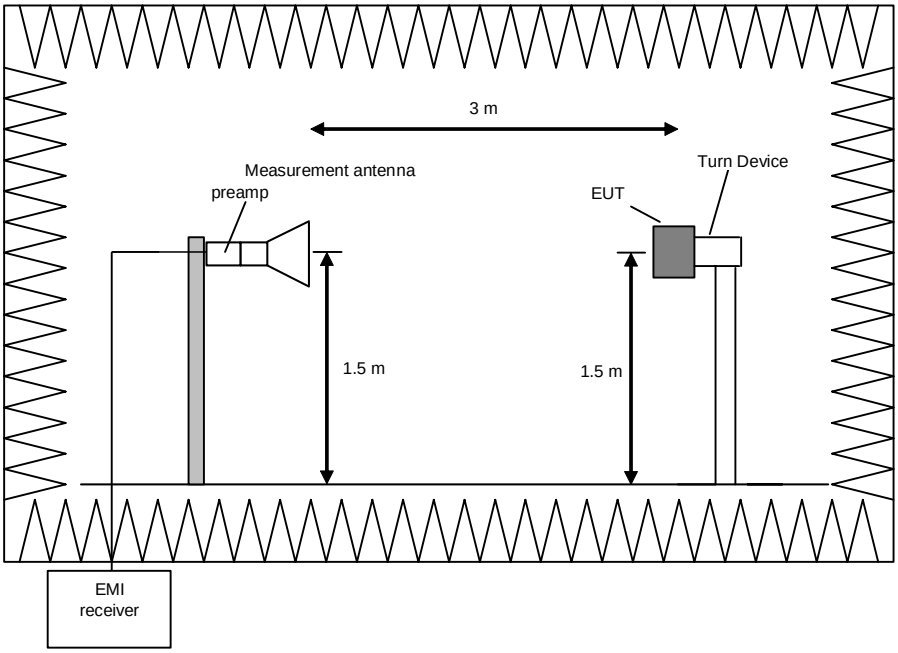
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

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:

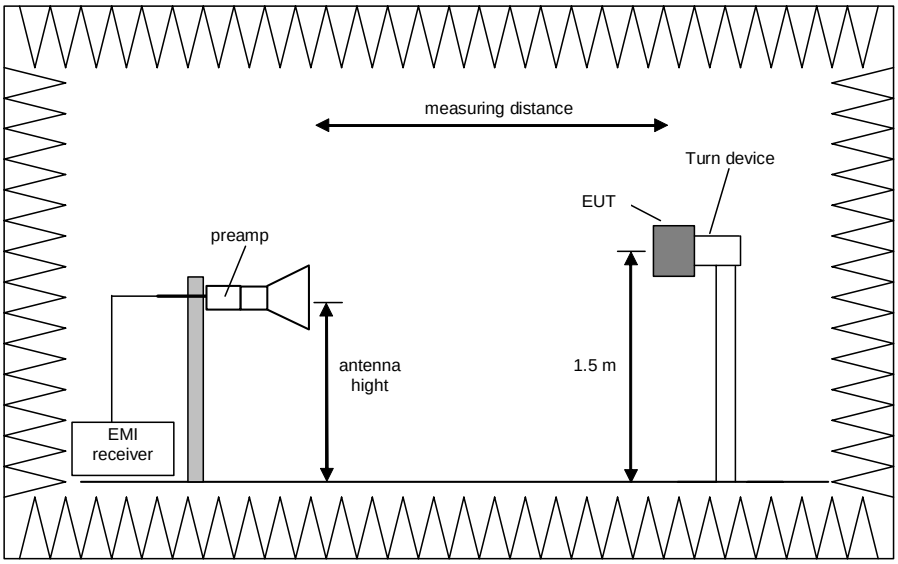
1. Monitor the frequency range at horizontal polarization and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarization of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an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

5.6.2 Test results (radiated emissions) – Emissions from 9 kHz – 26.5 GHz

Measurements were done with a sample with integral antenna.

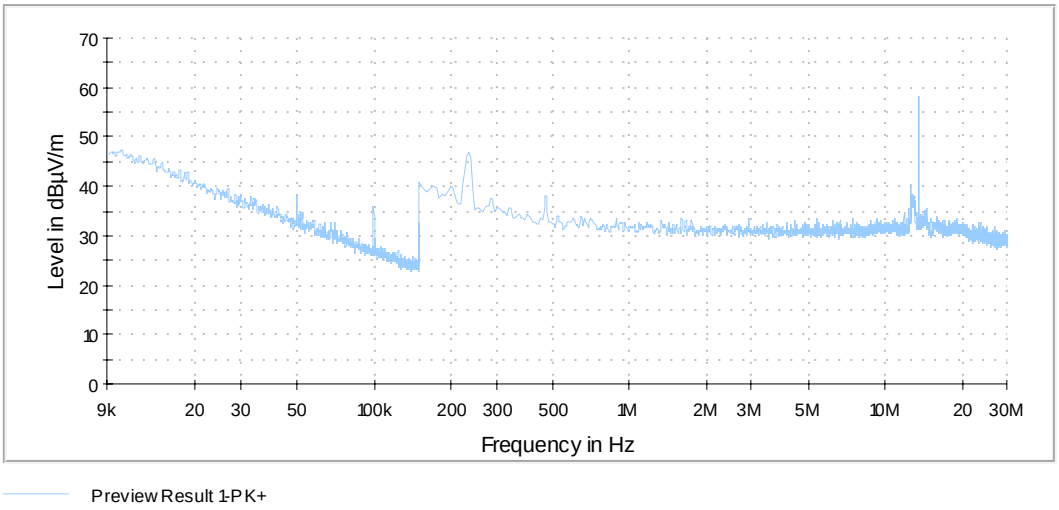
5.6.2.1 Preliminary radiated emission measurement 9 kHz – 26.5 GHz

Ambient temperature	22 °C
Tested by	B. Rohde

Relative humidity	59 %
Date	08.09.2017 11.09.2017

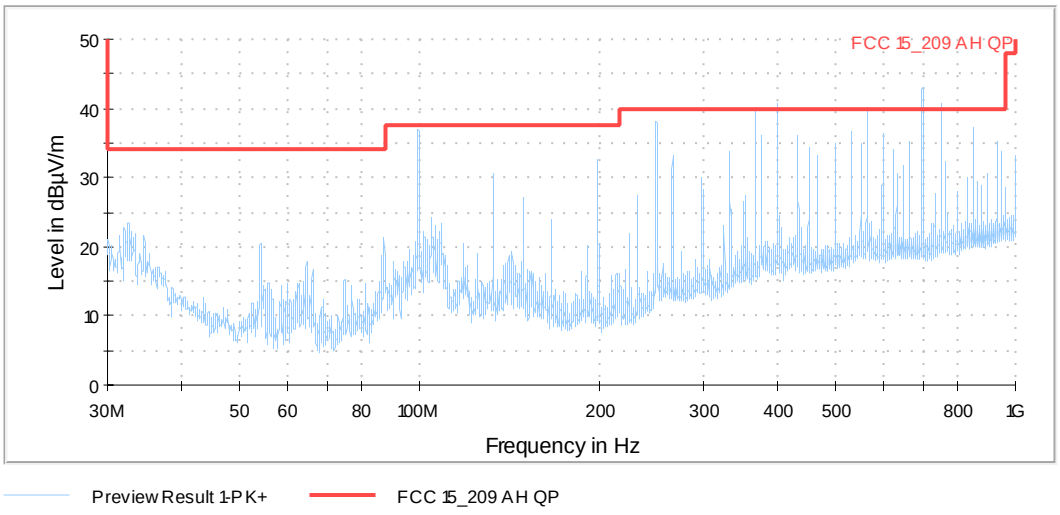
Position of EUT:	The EUT was set-up on a EUT turn device of a height of 1.5 m. The distance between EUT and antenna was 3 m.
Cable guide:	For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.
Test record:	Only the plot of the worst case emission is submitted below.
Supply voltage:	During all measurements the EUT was powered with 24 V DC by a laboratory power supply.
Remark:	Since there were no differences in the spectrum for f < 1 GHz, only one representative plot is submitted below.

Spurious emissions from 9 kHz to 30 MHz (operation mode 2):

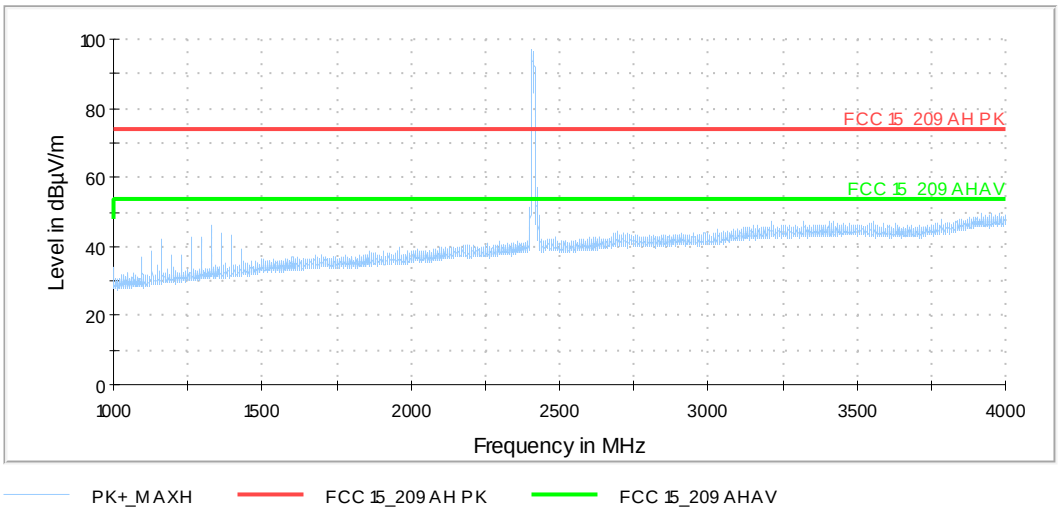


Remark: The peak at 13.56 MHz is a wanted signal of the EUT (NFC/RFID),
The 13.56 MHz signal is part of test report 170754E1.

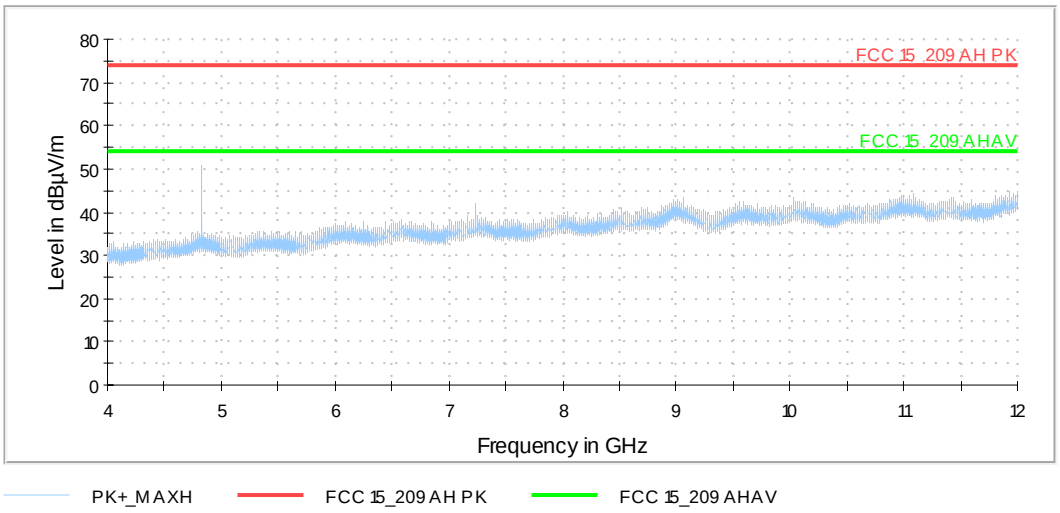
Spurious emissions from 30 MHz to 1 GHz (operation mode 1; preliminary plot):



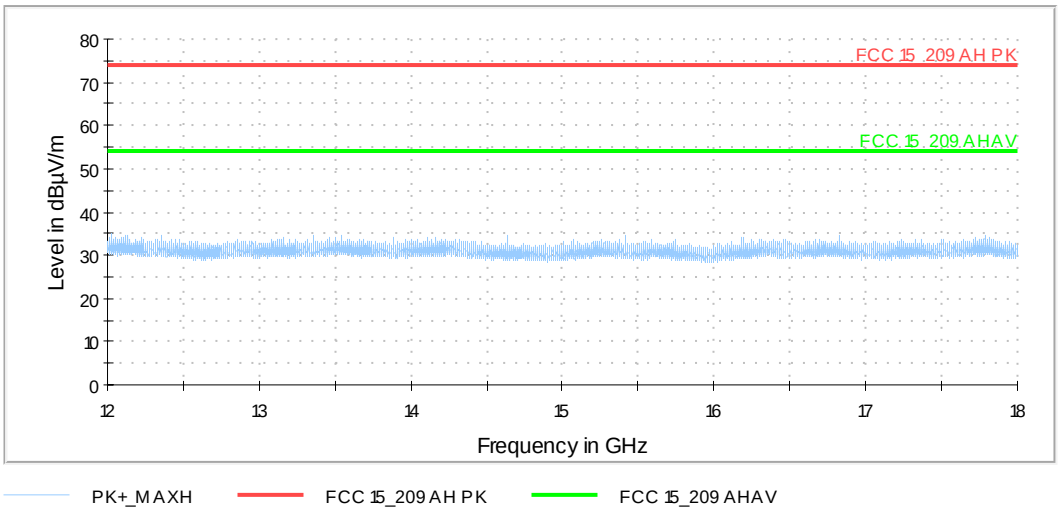
Spurious emissions from 1 GHz to 4 GHz (operation mode 1; preliminary and final plot):



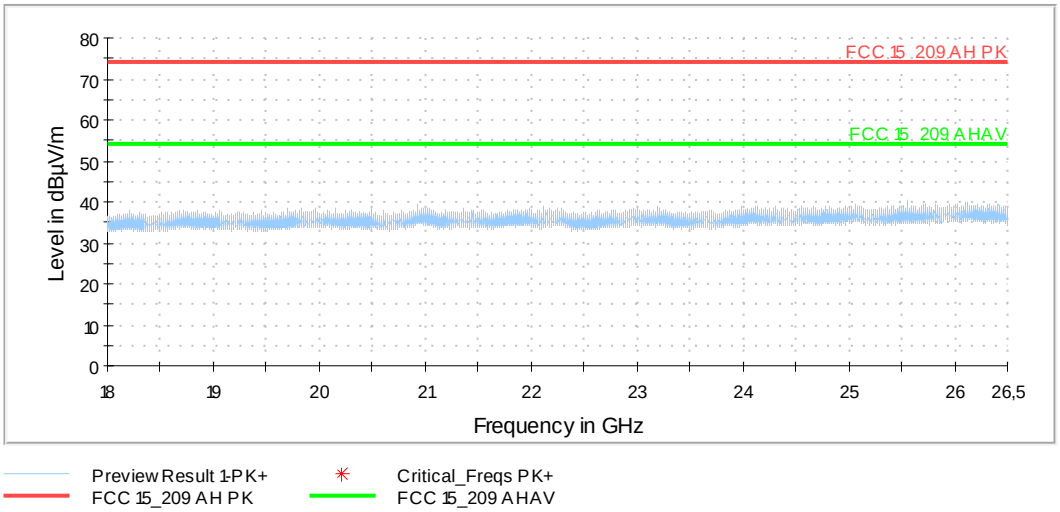
Spurious emissions from 4 GHz to 12 GHz (operation mode 1 preliminary and final plot):



Spurious emissions from 12 GHz to 18 GHz (operation mode 1; preliminary and final plot):



Spurious emissions from 18 GHz to 26.5 GHz (operation mode 1; preliminary and final plot):



Test equipment used (refer clause 6):

9 kHz - 30 MHz GHz preliminary	2, 4, 8 - 11
30 MHz – 1 GHz preliminary	1 - 2, 4, 8, 12 - 16
1 – 26.5 GHz preliminary	1 - 6, 8 - 9, 13, 16 - 23

5.6.2.2 Final radiated emission measurement 9 kHz – 26.5 GHz

Ambient temperature	22 °C
Tested by	B. Rohde

Relative humidity	59 %
Date	14.09.2017[*1] 17.11.2017[*1] 08.09.2017[*3] 11.09.2017[*3]

[*1] Final radiated measurement 9 kHz – 30 MHz
[*2] Final radiated measurement 30 MHz – 1 GHz
[*3] Final radiated measurement 1 – 26.5 GHz

Position of EUT: For the final test on the open area and outdoor test site the EUT was placed on a table with the height of 0.8 m. For final test inside the anechoic chamber the EUT was placed on the turn device. The distance between EUT and antenna was 3 m for all measurements.

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: Only the plot of the worst case emission is submitted below.

Supply voltage: During all measurements the EUT was powered with 24 V DC by a laboratory power supply except during the measurement below 30 MHz where a battery pack was used.

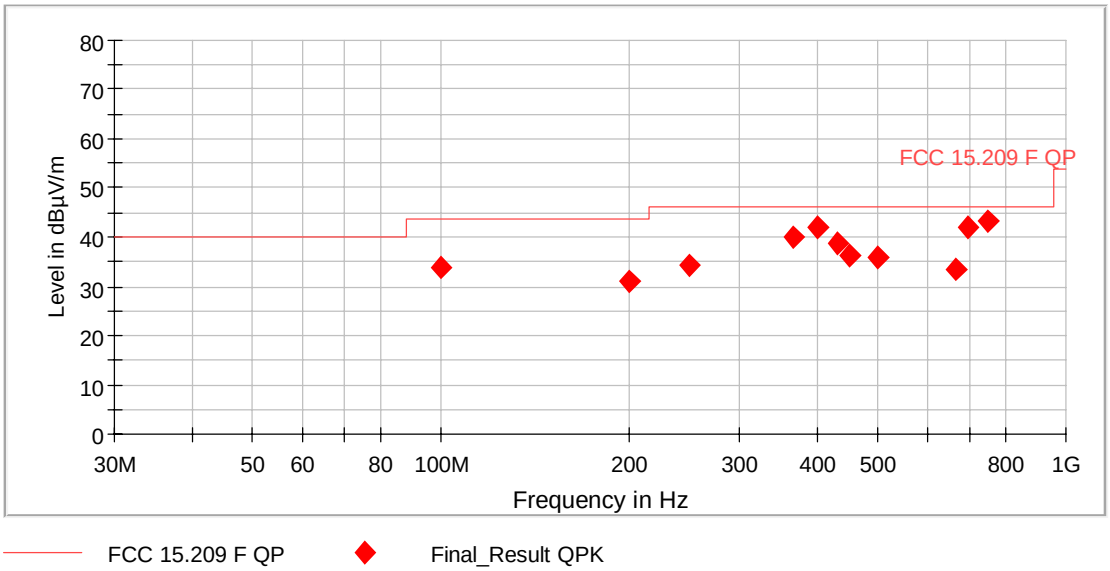
Remark: Since there were no differences in the spectrum for f < 1 GHz, only one representative plot is submitted below.

Common Results (All operation modes)

Results 9 kHz – 30 MHz								
No difference in this frequency range between the operation modes								
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]
0.049820	24.9	-34.8 @ 300m	33.7	68.5	AV	20.3	3	80.0
0.099734	18.5	-41.3 @ 300m	27.6	68.9	QP	20.2	3	80.0
0.234575	32.9	-26.8 @ 300m	20.2	47.0	AV	20.3	3	80.0
12.711875	17.2	-2.5 @ 30m	29.5	32.0	QP	20.3	3	40.0
13.557625	36.3	16.6 @ 30m	29.5	12.9	QP	20.3	3	40.0
Measurement uncertainty			+/- 4.78 dB					

Note: *Result @ norm dist = Reading + Antenna factor - Distance Extrapolation Factor
** 40dB/decade according Part §15.31 (f) (2)

Spurious emissions from 30 MHz to 1 GHz (operation mode 2):



Results 30 MHz - 1 GHz								
Operation mode 2		No difference in this frequency range between the operation modes						
Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin dB	Pol	Azimuth [°]	Height [cm]	Correction [dB]	Result
99.743000	34.0	43.5	9.5	V	130	102	18.8	Passed
199.459000	31.1	43.5	12.4	V	340	102	18.0	Passed
249.947500	34.4	46	11.6	H	127	121	21.0	Passed
365.765500	39.8	46	6.2	H	346	100	24.1	Passed
398.988000	42.0	46	4.0	V	336	112	25.0	Passed
432.259000	38.8	46	7.2	V	192	102	26.0	Passed
450.010000	36.5	46	9.5	H	233	206	26.1	Passed
498.752500	35.9	46	10.1	V	139	104	27.4	Passed
664.962000	33.4	46	12.6	H	214	107	30.2	Passed
698.281500	42.2	46	3.8	H	168	115	30.8	Passed
750.031000	43.3	46	2.7	H	317	107	32.6	Passed
Measurement uncertainty		+/- 4.78						

Radiated unwanted emissions 1 – 25 GHz (operation mode 1)									
Operation mode 1			Duty cycle correction factor of 0 dB was applied for the Average reading						
Frequency [MHz]	Max Peak [dBµV/m]	Average [dBµV/m]	Limit [dBµV/m]	Margin dB	Pol	Azimuth [°]	Elevation [°]	Correction [dB]	Result
1097.200000	---	33.7	54	20.3	H	121	59	25.3	Passed
1097.200000	42.6	---	74	31.4	H	121	59	25.3	Passed
1130.500000	---	34.3	54	19.7	H	146	59	25.8	Passed
1130.500000	42.2	---	74	31.8	H	146	59	25.8	Passed
1163.680000	---	39.0	54	15.0	H	118	59	26.2	Passed
1163.680000	47.1	---	74	26.9	H	118	59	26.2	Passed
1263.520000	---	40.4	54	13.6	H	118	59	26.8	Passed
1263.520000	47.2	---	74	26.8	H	118	59	26.8	Passed
1296.820000	---	42.1	54	11.9	H	128	59	27.0	Passed
1296.820000	50.9	---	74	23.1	H	128	59	27.0	Passed
1330.000000	---	41.2	54	12.8	V	227	0	27.5	Passed
1330.000000	49.0	---	74	25.0	V	227	0	27.5	Passed
1363.300000	---	39.6	54	14.4	H	181	90	27.8	Passed
1363.300000	47.8	---	74	26.2	H	181	90	27.8	Passed
1396.540000	---	36.9	54	17.1	H	198	60	27.8	Passed
1396.540000	48.7	---	74	25.3	H	198	60	27.8	Passed
4823.900000	---	50.5	54	3.5	V	198	29	-0.9	Passed
4823.900000	53.4	---	74	20.6	V	198	29	-0.9	Passed
7236.350000	---	40.1	54	13.9	H	134	90	5.4	Passed
7236.350000	49.8	---	74	24.2	H	134	90	5.4	Passed
Measurement uncertainty				+/- 5.38					

Radiated unwanted emissions 1 – 25 GHz (operation mode 2)									
Operation mode 2			Duty cycle correction factor of 0 dB was applied for the Average reading						
Frequency [MHz]	Max Peak [dBµV/m]	Average [dBµV/m]	Limit [dBµV/m]	Margin dB	Pol	Azimuth [°]	Elevation [°]	Correction [dB]	Result
1097.380000	42.7	---	74	31.3	H	146	60	25.3	Passed
1097.380000	---	33.6	54	20.4	H	146	60	25.3	Passed
1130.500000	---	34.3	54	19.7	V	147	0	25.8	Passed
1130.500000	42.6	---	74	31.4	V	147	0	25.8	Passed
1163.860000	---	39.2	54	14.8	H	125	60	26.2	Passed
1163.860000	47.9	---	74	26.1	H	125	60	26.2	Passed
1263.460000	---	38.0	54	16.0	V	242	29	26.8	Passed
1263.460000	46.1	---	74	27.9	V	242	29	26.8	Passed
1296.520000	49.8	---	74	24.2	H	121	60	27.0	Passed
1296.520000	---	40.5	54	13.5	H	121	60	27.0	Passed
1329.940000	49.6	---	74	24.4	H	128	60	27.5	Passed
1329.940000	---	41.8	54	12.2	H	128	60	27.5	Passed
1363.420000	49.1	---	74	24.9	H	125	60	27.8	Passed
1363.420000	---	40.0	54	14.0	H	125	60	27.8	Passed
1396.600000	---	41.7	54	12.3	H	132	150	27.8	Passed
1396.600000	53.9	---	74	20.1	H	132	150	27.8	Passed
1429.660000	---	32.0	54	22.0	H	235	150	28.1	Passed
1429.660000	42.1	---	74	31.9	H	235	150	28.1	Passed
4873.900000	---	49.8	54	4.2	H	274	29	-0.8	Passed
4873.900000	52.8	---	74	21.2	H	274	29	-0.8	Passed
7309.100000	---	43.5	54	10.5	H	150	90	5.7	Passed
7309.100000	51.5	---	74	22.5	H	150	90	5.7	Passed
7311.150000	---	41.9	54	12.1	H	150	90	5.7	Passed
7311.150000	51.4	---	74	22.6	H	150	90	5.7	Passed
Measurement uncertainty				+/- 5.38					

Radiated unwanted emissions 1 – 25 GHz (operation mode 3)									
Operation mode 3			Duty cycle correction factor of 0 dB was applied for the Average reading						
Frequency [MHz]	Max Peak [dBµV/m]	Average [dBµV/m]	Limit [dBµV/m]	Margin dB	Pol	Azimuth [°]	Elevation [°]	Correction [dB]	Result
1163.740000	---	37.9	54	16.1	V	253	0	26.2	Passed
1163.740000	45.1	---	74	28.9	V	253	0	26.2	Passed
1263.520000	---	40.1	54	13.9	V	223	30	26.8	Passed
1263.520000	46.1	---	74	27.9	V	223	30	26.8	Passed
1296.640000	53.3	---	74	20.7	V	212	0	27.0	Passed
1296.640000	---	42.5	54	11.5	V	212	0	27.0	Passed
1330.120000	49.1	---	74	24.9	H	117	60	27.5	Passed
1330.120000	---	40.2	54	13.8	H	117	60	27.5	Passed
1363.120000	53.7	---	74	20.3	H	114	60	27.8	Passed
1363.120000	---	41.9	54	12.1	H	114	60	27.8	Passed
1396.420000	---	39.9	54	14.1	H	188	60	27.8	Passed
1396.420000	49.4	---	74	24.6	H	188	60	27.8	Passed
4923.900000	---	48.9	54	5.1	H	274	29	-1.0	Passed
4923.900000	52.0	---	74	22.0	H	274	29	-1.0	Passed
7385.350000	---	44.1	54	9.9	H	145	90	5.8	Passed
7385.350000	51.5	---	74	22.5	H	145	90	5.8	Passed
7386.550000	---	45.1	54	8.9	H	150	90	5.8	Passed
7386.550000	52.2	---	74	21.8	H	150	90	5.8	Passed
Measurement uncertainty				+/- 5.38					

Test equipment used (refer clause 6):

9 kHz - 30 MHz GHz final	11, 24 - 25
30 MHz – 1 GHz final	26 - 32
1 – 26.5 GHz final	1 - 6, 8 - 9, 13, 16 - 23

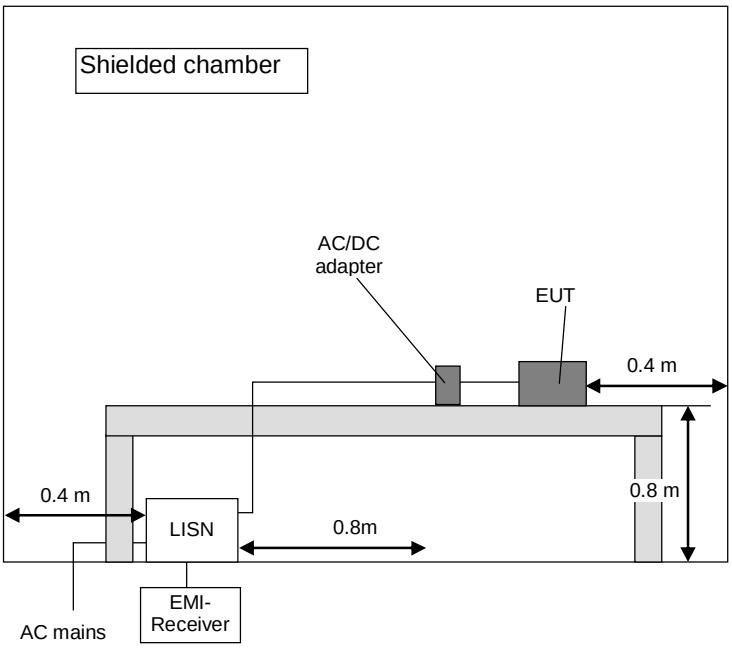
5.7 Conducted emissions on power supply lines (150 kHz to 30 MHz)

5.7.1 Method of measurement (Conducted emissions on power supply lines)

This test will be carried out in a shielded chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm above the ground plane. Floor-standing devices will be placed directly on the ground plane. The setup of the Equipment under test will be in accordance to [1].

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

Frequency range	Resolution bandwidth
150 kHz to 30 MHz	9 kHz



The conducted emission on power supply lines was tested for the simultaneous transmission in steps:

- Wi-Fi only active
- Wi-Fi and NFC active
  - In this measurement the emissions on the power line were above the limit
- Wi-Fi and NFC active, NFC antenna not connected
  - In this measurement the emissions on the power line were below the limit

So it could be shown, that the emissions were not caused by the digital part, but coupled to the measurement equipment directly with the aid of the NFC antenna.

5.7.2 Test results (Conducted emissions on power supply lines)

5.7.2.1 Mode: WLAN only

Ambient temperature	21 °C	Relative humidity	51 %
Tested by	B. Rohde M. Bastert	Date	18.04.2018

Position of EUT: For this test, the EUT was set to transmit at channel 6

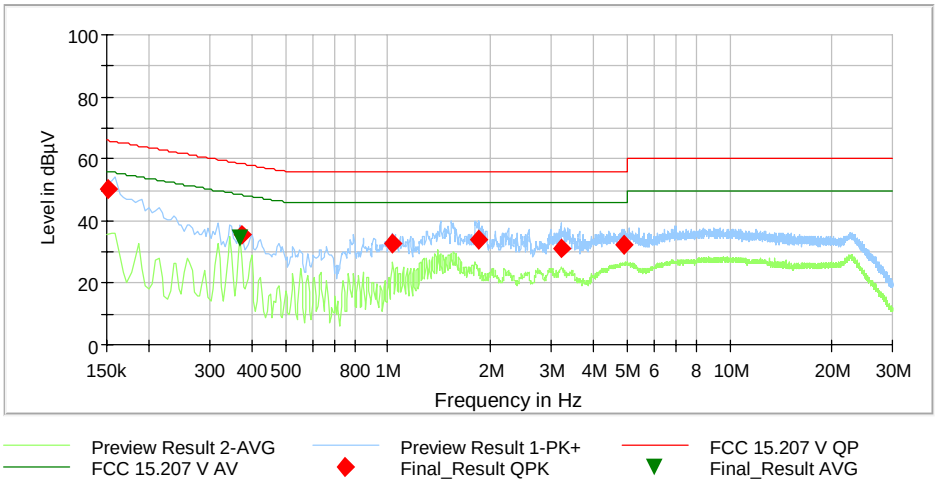
Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

Supply voltage: For the test a power supply model number: UE36LCP1-240150SPA, which was delivered by the applicant was connected to an AC mains network with 120V / 60Hz. The power supply provided 24 V DC up to 1.5A.

Remark: Worst case reported only.

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 "▼".



Results 150 kHz – 30 MHz									
Frequency [MHz]	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Meas. Time [ms]	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150900	50.41	---	65.95	15.54	5000.0	9.000	N	FLO	9.8
0.369600	---	34.48	48.51	14.03	5000.0	9.000	N	FLO	9.9
0.371400	35.45	---	58.47	23.02	5000.0	9.000	N	FLO	9.9
1.026600	32.92	---	56.00	23.08	5000.0	9.000	L1	FLO	9.9
1.842000	33.94	---	56.00	22.06	5000.0	9.000	L1	FLO	10.0
3.227100	30.91	---	56.00	25.09	5000.0	9.000	N	FLO	10.2
4.916400	32.48	---	56.00	23.52	5000.0	9.000	L1	FLO	10.3

Test: Passed

5.7.2.2 Mode: colocation (WLAN and NFC active)

Ambient temperature	21 °C
Tested by	B. Rohde M. Bastert

Relative humidity	51 %
Date	18.04.2018

Position of EUT: For this test, the EUT was set to transmit at channel 6
The NFC part was continuously active

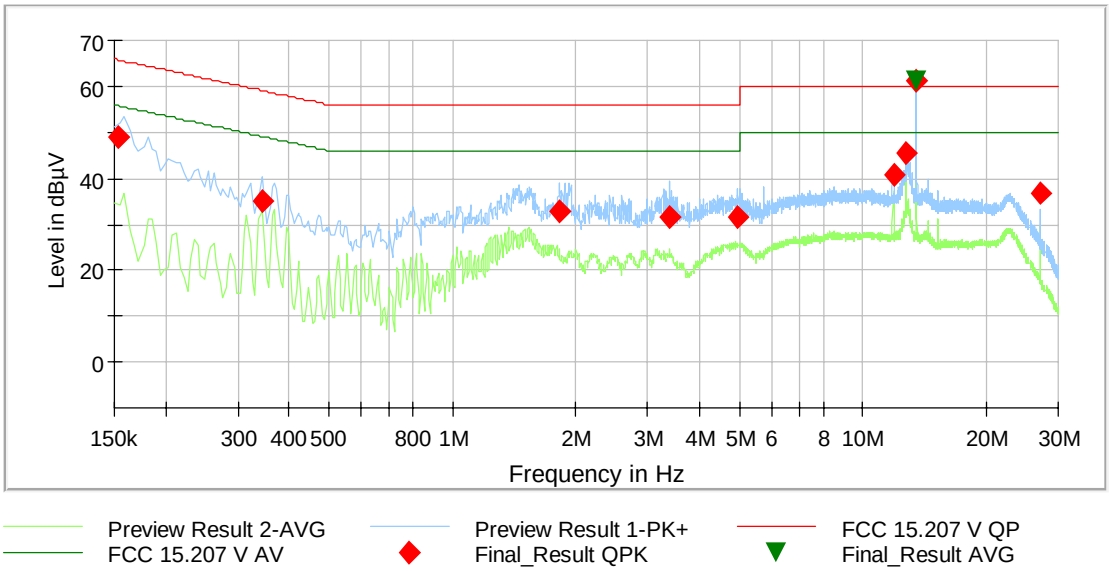
Cable guide: For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

Supply voltage: For the test a power supply type Model number: UE36LCP1-240150SPA, which was delivered by the applicant was connected to an AC mains network with 120V / 60Hz. The power supply provided 24 V DC up to 1.5A.

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 "▼".

Remark: Test failed - reorientation not successful, the antenna was disconnected.
No dummy load connectable.



Results 150 kHz – 30 MHz									
Frequency [MHz]	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Meas. Time [ms]	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.152700	48.92	---	65.85	16.94	5000.0	9.000	L1	GND	9.8
0.343500	35.08	---	59.12	24.04	5000.0	9.000	L1	GND	9.9
1.824000	32.88	---	56.00	23.12	5000.0	9.000	L1	FLO	10.0
3.367500	31.55	---	56.00	24.45	5000.0	9.000	N	GND	10.3
4.980300	31.45	---	56.00	24.55	5000.0	9.000	L1	FLO	10.3
11.864400	40.84	---	60.00	19.16	5000.0	9.000	L1	GND	10.7
12.713100	45.64	---	60.00	14.36	5000.0	9.000	L1	FLO	10.7
13.559100	61.19	---	60.00	-1.19	5000.0	9.000	L1	FLO	10.7
13.560000	---	61.41	50.00	-11.41	5000.0	9.000	L1	GND	10.7
27.120300	36.62	---	60.00	23.38	5000.0	9.000	L1	GND	11.1

5.7.2.3 Mode: WLAN and NFC active, NFC antenna not connected

Ambient temperature	21 °C	Relative humidity	51 %
Tested by	B. Rohde M. Bastert	Date	18.04.2018

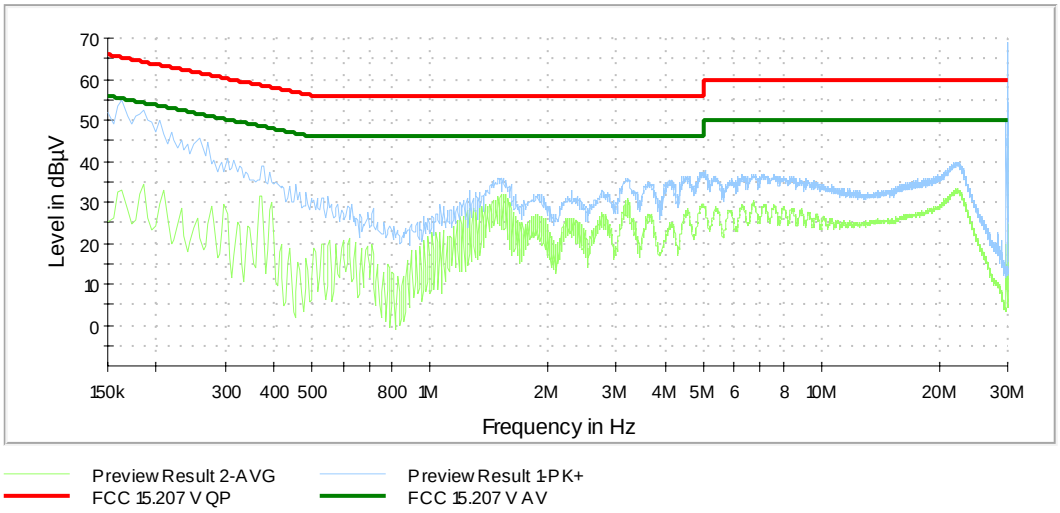
Position of EUT: For this test, the EUT was set to transmit at channel 6
The NFC part was continuously active

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: For the test a power supply type Model number: UE36LCP1-240150SPA, which was delivered by the applicant was connected to an AC mains network with 120V / 60Hz. The power supply provided 24 V DC up to 1.5A.

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 "▼".



Results 150 kHz – 30 MHz									
Frequency [MHz]	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Meas. Time [ms]	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.155400	46.1	---	65.71	19.6	5000.0	9.0	L1	FLO	9.8
0.253500	36.9	---	61.64	24.7	5000.0	9.0	L1	GND	9.9
1.547700	33.4	---	56	22.6	5000.0	9.0	N	FLO	9.9
3.208200	31.5	---	56	24.5	5000.0	9.0	L1	FLO	10.2
4.903800	34.2	---	56	21.8	5000.0	9.0	L1	FLO	10.3
29.858100	30.6	---	60	29.4	5000.0	9.0	L1	FLO	11.2

Test: Passed

Test equipment used (refer clause 6):

30, 33 - 36

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Antenna mast	AS615P	Deisel	615/310	480187	Calibration not necessary	
2	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
3	RF-cable No.3	Sucoflex 106B	Suhner	0563/6B / Kabel 3	480670	Calibration not necessary	
4	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/971107	480832	Calibration not necessary	
5	Antenna (Log.Per.)	HL050	Rohde & Schwarz	100438	481170	09.10.2017	10.2020
6	RF-Cable No. 40	Sucoflex 106B	Suhner	0708/6B / Kabel 40	481330	Calibration not necessary	
7	HF-Cable	Sucoflex 104	Huber+Suhner	517406	482391	Calibration not necessary	
8	EMI Receiver / Spectrum Analyzer	ESW44	Rohde & Schwarz	101635	482467	22.06.2017	06.2019
9	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	29.11.2016	11.2017
10	Antenna support	AS620P	Deisel	620/375	480325	Calibration not necessary	
11	loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	20.10.2016	10.2017
12	Antenna (Bilog)	CBL6112B	Schaffner EMV GmbH (-Chase)	2688	480328	19.06.2017	06.2020
13	Software	WMS32	Rohde & Schwarz		481800	Calibration not necessary	
14	RF-cable No.36	Sucoflex 106B	Suhner	0587/6B / Kabel 36	480865	Calibration not necessary	
15	HF-Cable	Sucoflex 104	Huber+Suhner	517402	482392	Calibration not necessary	
16	Positioners	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	
17	standard gain horn antenna	18240-20	Flann Microwave	483	480294	Calibration not necessary	
18	standard gain horn antenna	20240-20	Flann Microwave	411	480297	Calibration not necessary	
19	Microwave cable 2m	Insulated Wire Inc.	Insulated Wire	KPS-1533-800-KPS	480302	Calibration not necessary	
20	Preamplifier 100 MHz - 13 GHz	JS3-00101200-23-5A	MITEQ Hauppauge N.Y.	681851	480337	18.02.2016	02.2018
21	Preamplifier 18 GHz - 26 GHz	JS4-18002600-20-5A	MITEQ Hauppauge N.Y.	658697	480342	17.02.2016	02.2018
22	Preamplifier 12 GHz - 18 GHz	JS3-12001800-16-5A	MITEQ Hauppauge N.Y.	571667	480343	18.02.2016	02.2018
23	High pass filter	WHKX4.0/18G-8SS	Wainwright Instruments GmbH	1	480587	Calibration not necessary	
24	Outdoor test site	-	PHOENIX TESTLAB GmbH	-	480293	Calibration not necessary	
25	EMI Receiver / Spectrum Analyzer	ESI 40	Rohde & Schwarz	100064/040	480355	15.02.2017	02.2018
26	Open area test site M6	OATS M6	Phoenix Contact	-	480085	Calibration not necessary	
27	Antenna mast	MA240-0	Inn-Co GmbH	MA240-0/030/6600603	480086	Calibration not necessary	
28	Turntable	DS412	Deisel	412/316	480087	Calibration not necessary	
29	Controller	HD100	Deisel	100/349	480139	Calibration not necessary	

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
30	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
31	Antenna (Bilog)	CBL6111D	Schaffner Elektrotest GmbH / Teseq GmbH	25761	480894	19.10.2017	10.2020
32	EMI Receiver / Spectrum Analyzer	ESIB 26	Rohde & Schwarz	100292	481182	15.02.2016	02.2018
33	LISN	NSLK8128	Schwarzbeck	8128155	480058	14.03.2018	03.2020
34	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
35	EMI Receiver / Spectrum Analyzer	ESIB 26	Rohde & Schwarz	100292	481182	28.02.2018	02.2020
36	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	14.03.2018	03.2020
37	Spectrum Analyzer	FSU46	Rohde & Schwarz	200125	480956	01.03.2018	03.2019

7 Report History

Report Number	Date	Comment
F170754E2	13.08.2018	Initial Test Report

8 List of Annexes

Annex A	Test Setup Photos	10 pages
Annex B	Internal Photos	9 pages
Annex C	External Photos	2 pages