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Test Report

Report Number:

F200540E2

Equipment under Test (EUT):

FieldPort SWA50

Applicant:

Endress+Hauser SE+Co. KG

Manufacturer:

Endress+Hauser SE+Co. KG

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 (March 2017)**, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

[4] **RSS-Gen Issue 5 (March 2019)**, General Requirements for Compliance of Radio Apparatus

Test Result

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

Test engineer:	Paul NEUFELD		27.08.2020
	Name	Signature	Date
Authorized reviewer:	Manuel BASTERT		27.08.2020
	Name	Signature	Date

This test report is only valid in its original form.

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1 Identification

1.1 Applicant

Name:	Endress+Hauser SE+Co. KG
Address:	Hauptstr. 1, 79689 Maulburg
Country:	Germany
Name for contact purposes:	Mr. Ralph Stib
Phone:	+49 7622 28 1943
eMail Address:	ralph.stib@endress.com
Applicant represented during the test by the following person:	None

1.2 Manufacturer

Name:	Endress+Hauser SE+Co. KG
Address:	Hauptstr. 1, 79689 Maulburg
Country:	Germany
Name for contact purposes:	Mr. Ralph Stib
Phone:	+49 7622 28 1943
eMail Address:	ralph.stib@endress.com
Applicant represented during the test by the following person:	None

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-17186-01-05 and D-PL-17186-01-06, FCC Test Firm Accreditation designation number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment Under Test)

Test object: *	FieldPort SWA50
Type / PMN: *	SWA50
FCC ID: *	LCGSWA50
IC: *	2519A-SWA50
Serial number (Radiated meas.): *	71448937R51F3F01BF8*
Serial number (Antenna port cond. meas.): *	-*1
EUT marking: *	Radiated sample
PCB identifier: *	961004385 A
HVIN (Hardware Version Identification Number): *	SWA50
FVIN (Firmware Version Identification Number): *	S140 v6.1.1
Hardware version: *	01.00
Software version: *	S140 v6.1.1

* PCB identification number
*1 No PCB sticker for identification available

Note: Phoenix Testlab GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

Bluetooth LE frequencies				
Channel 00	RX	2402 MHz	TX	2402 MHz
Channel 19	RX	2440 MHz	TX	2440 MHz
Channel 39	RX	2480 MHz	TX	2480 MHz

WirelessHART frequencies				
Channel 11	RX	2405 MHz	TX	2405 MHz
Channel 18	RX	2440 MHz	TX	2440 MHz
Channel 26	RX	2480 MHz	TX	2480 MHz

1.5 Technical Data of Equipment

Fulfills specifications: *	Bluetooth 5.0 low energy only (1 + 2 Mbps, 125*1 + 500*1 kBps) 802.15.4 - WirelessHART (250 kbps)					
Antenna type: *	PCB antenna					
Antenna name: *	Lambda/4 monopole					
Antenna gain: *	-0.6 dBi					
Antenna connector: *	None					
Supply voltage EUT: *	U_{nom}=	24.0 V DC	U_{min}=	4 V DC	U_{max}=	30.0 V DC
Supply voltage radiated test sample: *	U_{nom}=	1.8 V DC	U_{min}=	1.7 DC	U_{max}=	3.6 V DC
Type of modulation: *	BLE: GFSK WirelessHART: O-QPSK					
Operating frequency range: *	BLE: 2402 – 2480 MHz WirelessHART: 2405 – 2480 MHz					
Number of channels: *	BLE: 40 WirelessHART: 16					
Temperature range: *	-40 °C to +85 °C					
Lowest / highest Internal clock frequency: *	32.768 kHz / 2480 MHz					

* Declared by the applicant
*1 Not tested, because the symbol rate and modulation are the same as 1 Mbps as declared by Bluetooth SIG.

Equipment used for testing	
Cables (connected to the EUT): *1*3	USB cable with serial to USB converter (~ 1.5m)
USB adaptor: *1*3	Type FTDI TTL-232R-3V3-WE
Laptop PC:*2*3	Fujitsu Lifebook S751 (PM No. 201036)

*1 Provided by the applicant
*2 Provided by the laboratory
*3 Only used for antenna port conducted tests at the sample with the temporary antenna connector.

1.6 Dates

Date of receipt of test sample:	08.07.2020
Start of test:	10.07.2020
End of test:	23.07.2020

2 Operational States

The EUT is a FieldPort device that converts the HART signal of the connected HART field device into a reliable and encrypted Bluetooth® or WirelessHART signal.

The antenna port conducted tests were performed using a sample with a temporary antenna connector, which was provided by the applicant. A temporary USB-to-Serial converter, which was soldered to the EUT by the applicant was used to connect the EUT to a laptop computer. A terminal application was used to set the test modes on the EUT.

To set the test modes for the radio tests, the EUT had to be opened and the mode had to be set using 4 binary dip switches on the PCB. After a power cycle, the new test mode was activated. This functionality was set by the special test firmware installed on the device by the applicant.

During the tests the EUT was supplied with 1.78 V DC via a laboratory power supply.

Maximum power Settings for all measurements:

Modulation	Power setting ch. 0 - 39
All modulations and data rates	8 dBm

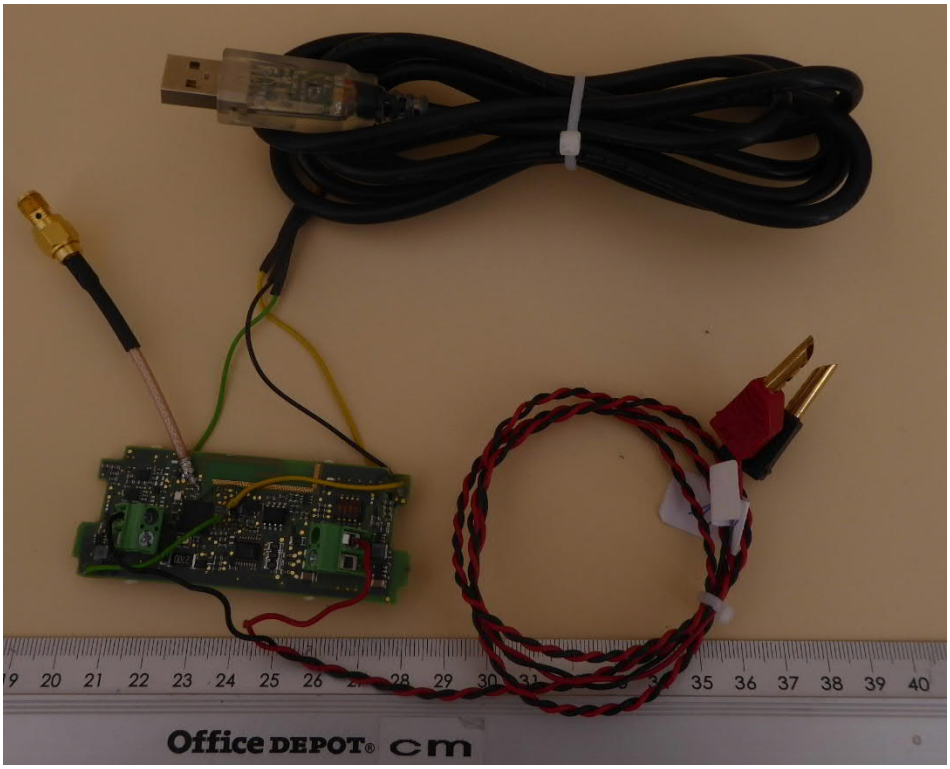
Operation mode	Description of the operation mode	mode	channel	Modulation	Data rate / Mbps
1	Continuous transmitting on 2402 MHz	BLE	0	GFSK	1 Mbps
2	Continuous transmitting on 2440 MHz	BLE	19	GFSK	1 Mbps
3	Continuous transmitting on 2480 MHz	BLE	39	GFSK	1 Mbps
4	Continuous transmitting on 2402 MHz	BLE	0	GFSK	2 Mbps
5	Continuous transmitting on 2440 MHz	BLE	19	GFSK	2 Mbps
6	Continuous transmitting on 2480 MHz	BLE	39	GFSK	2 Mbps
7	Continuous transmitting on 2405 MHz	WHART	11	O-QPSK	250 kbps
8	Continuous transmitting on 2440 MHz	WHART	18	O-QPSK	250 kbps
9	Continuous transmitting on 2480 MHz	WHART	26	O-QPSK	250 kbps

3 Additional Information

All tests were performed with an unmodified sample.

The in-band and unrestricted band-edge tests were performed using a sample with temporary antenna connector, which was provided by the applicant.

The photograph below shows the EUT with the temporary antenna connector, which was used for the antenna port conducted measurements:



4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [3] or RSS-Gen [4]	Status	Refer page
Maximum conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [3]	Passed	10 et seq
DTS Bandwidth / 99% Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (a) [3]	Passed	12 et seq
Average Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [3]	Passed	17 et seq
Band edge compliance	2400.0 - 2483.5	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [3]	Passed	19 et seq.
Maximum unwanted emissions	0.009 – 26,500	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [3] 8.9 [4], 8.10 [4]	Passed	25 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Passed	36 et seq.

5 Results

5.1 Duty cycle

Since the EUT was tested with continuous transmission without gaps, no duty cycle measurement was necessary.

5.2 Maximum conducted output power

5.2.1 Method of measurement

The EUT was measured conducted on a sample with a temporary antenna connector, which was provided by the applicant.

Acceptable measurement configurations

Procedure 11.9.2.2.2 in [1] was used for the following test.

Method AVGSA-1 uses trace averaging with the EUT transmitting at full power throughout each sweep. The procedure for this method is as follows:

a) Set span to at least 1.5 times the OBW.
b) Set RBW = 1% to 5% of the OBW, not to exceed 1 MHz.
c) Set VBW ≥ [3 × RBW]. d) 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.)
e) Sweep time = auto. f) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
g) If transmit duty cycle < 98%, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at the maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no OFF intervals) or at duty cycle ≥ 98%, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run.”
h) Trace average at least 100 traces in power averaging (rms) mode.
i) 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, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

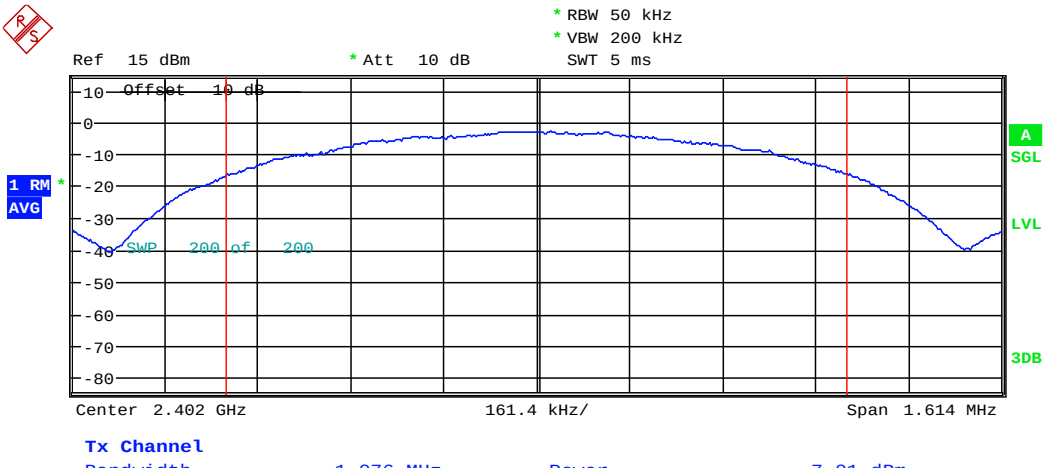
The measurement was performed at the upper and lower end and the middle of the assigned frequency band.

5.2.2 Test results

Ambient temperature	22 °C	Relative humidity	62 %

The plot below shows the worst-case result. All other results are submitted in the table below

200540_1M_AvOutpPwr_BTLE_BT1.wmf: Maximum output power measured on channel 1 (operation mode 1):



The antenna gain is below 6 dBi, therefore no conducted output limit reduction is necessary.

Operation mode		Frequency [MHz]	Reading [dBm]	DC Corr. [dB]	Corr. Reading [dBm]	Margin [dB]	Limit [dBm]
1	GFSK	2402	7.0	0.0	7.0	23.0	30
2	GFSK	2440	6.4	0.0	6.4	23.6	30
3	GFSK	2480	5.5	0.0	5.5	24.5	30
4	GFSK	2402	6.9	0.0	6.9	23.1	30
5	GFSK	2440	6.3	0.0	6.3	23.7	30
6	GFSK	2480	5.5	0.0	5.5	24.5	30
7	O-QPSK	2405	6.9	0.0	6.9	23.1	30
8	O-QPSK	2440	6.4	0.0	6.4	23.6	30
9	O-QPSK	2480	5.5	0.0	5.5	24.5	30

The maximum antenna gain was declared to be below 0 dBi, as declared by the applicant. Therefore, the antenna gain for the calculation above was calculated with 0 dBi as worst case.

Test: Passed

Test equipment (refer to chapter 6)

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5.3 Maximum peak conducted output power

5.3.1 Method of measurement

The EUT was measured conducted on a sample with a temporary antenna connector, which was provided by the applicant.

Acceptable measurement configurations

Procedure 11.9.1.1 in [1] was used for the following test.

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ [3 × RBW].
c) Set span ≥ [3 × RBW].
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level. The measurement was performed at the upper and lower end and the middle of the assigned frequency band.

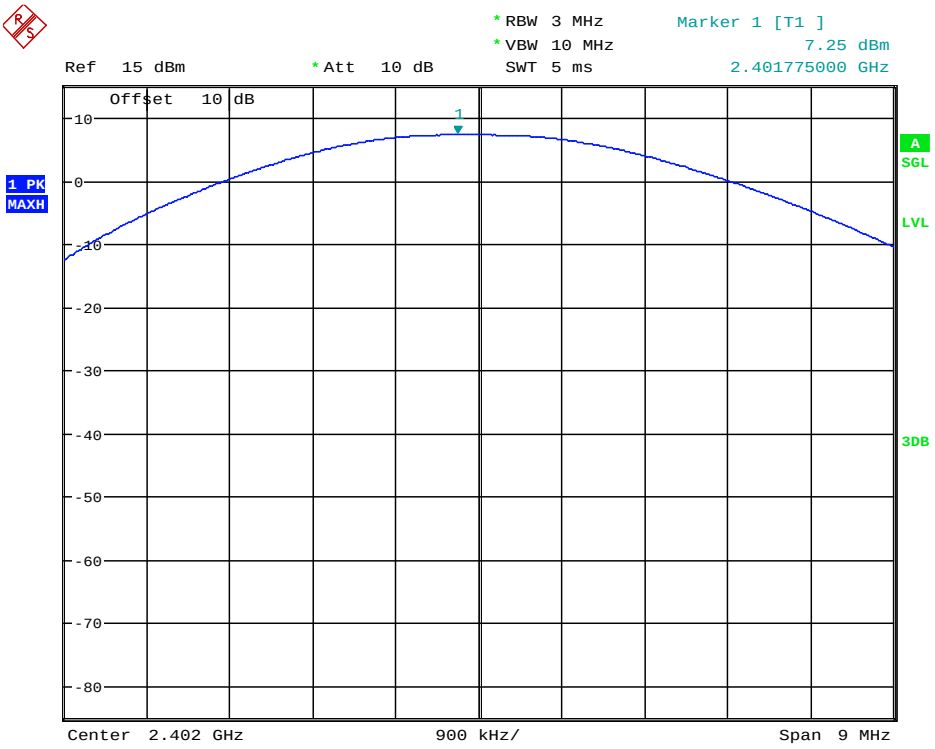
The measurement was performed at the upper and lower end and the middle of the assigned frequency band.

5.3.2 Test results

Ambient temperature	22 °C	Relative humidity	62 %

The plot below shows the worst-case result. All other results are submitted in the table below

200540_1M_MaxPeakPwr_BTLE_BT1.wmf: Maximum output power measured on channel 1 (operation mode 1):



The antenna gain is below 6 dBi, therefore no conducted output limit reduction is necessary.

Operation mode		Frequency [MHz]	Reading [dBm]	DC Corr. [dB]	Corr. Reading [dBm]	Margin [dB]	Limit [dBm]
1	GFSK	2402	7.3	0.00	7.3	22.7	30
2	GFSK	2440	6.6	0.00	6.6	23.4	30
3	GFSK	2480	5.8	0.00	5.8	24.2	30
4	GFSK	2402	7.2	0.00	7.2	22.8	30
5	GFSK	2440	6.6	0.00	6.6	23.4	30
6	GFSK	2480	5.8	0.00	5.8	24.2	30
7	O-QPSK	2405	7.2	0.00	7.2	22.8	30
8	O-QPSK	2440	6.6	0.00	6.6	23.4	30
9	O-QPSK	2480	5.8	0.00	5.8	24.2	30

Test: Passed

Test equipment (refer to chapter 6)

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5.4 DTS Bandwidth / 99% Bandwidth

5.4.1 Method of measurement

The EUT was measured conducted on a sample with a temporary antenna connector, which was provided by the applicant.

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.

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:

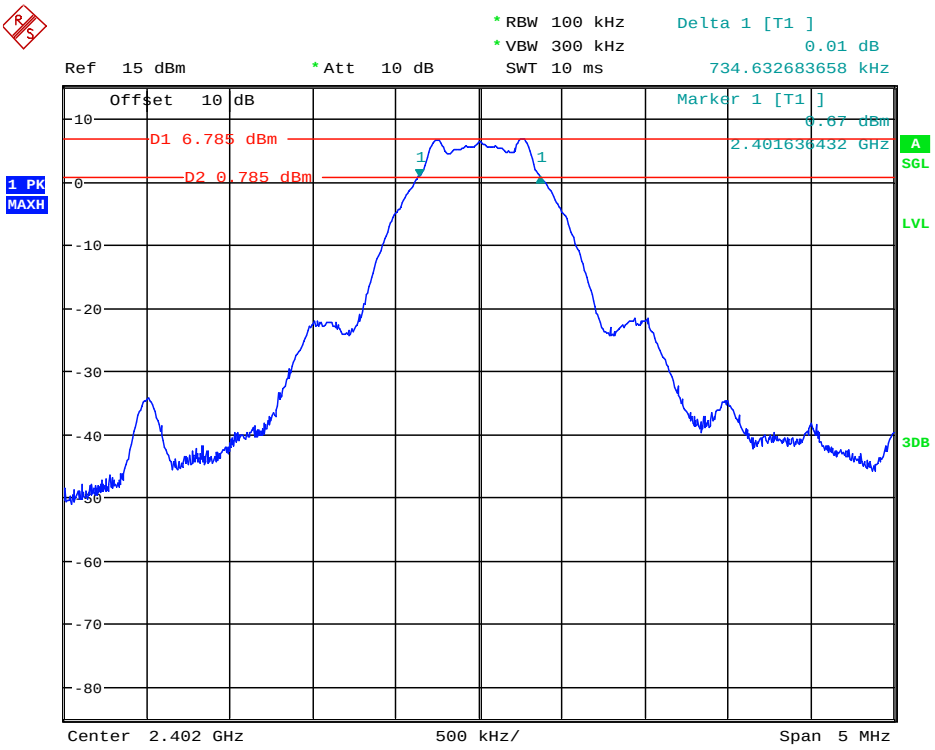
- The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately 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 labelled. Tabular data maybe reported in addition to the plot(s).

5.4.2 Test result

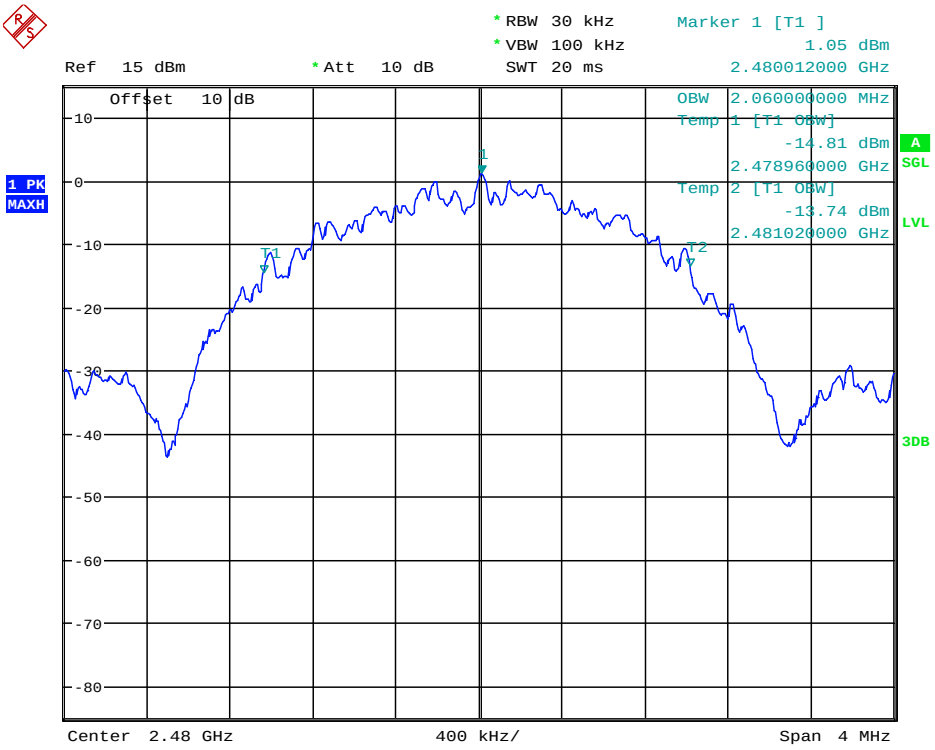
Ambient temperature	22 °C	Relative humidity	59 %

The plots show an exemplary measurement result for the worst documented case. The other results are listed in the following tables.

200540_1M_6dB-BW_BTLE_BT1.wmf: 6-dB Bandwidth (operation mode 1):



200540_2M_99%BW_BTLE_BTLE39.wmf: 99% Bandwidth (operation mode 9):



Operation Mode		Center Frequency [MHz]	Minimum 6-dB Bandwidth Limit [MHz]	6 dB Bandwidth [MHz]	99 % Bandwidth [MHz]	Result
1	GFSK	2402	0.5	0.734	1.076	Passed
2	GFSK	2440	0.5	0.737	1.060	Passed
3	GFSK	2480	0.5	0.757	1.072	Passed
4	GFSK	2402	0.5	1.322	2.084	Passed
5	GFSK	2440	0.5	1.332	2.084	Passed
6	GFSK	2480	0.5	1.267	2.060	Passed
7	O-QPSK	2405	0.5	1.562	2.262	Passed
8	O-QPSK	2440	0.5	1.544	2.268	Passed
9	O-QPSK	2480	0.5	1.562	2.274	Passed

Test: Passed

Test equipment (refer to chapter 6)

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5.5 Average Power Spectral Density

5.5.1 Method of measurement

The EUT was measured conducted on a sample with a temporary antenna connector, which was provided by the applicant.

Acceptable measurement configurations

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.
- 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).

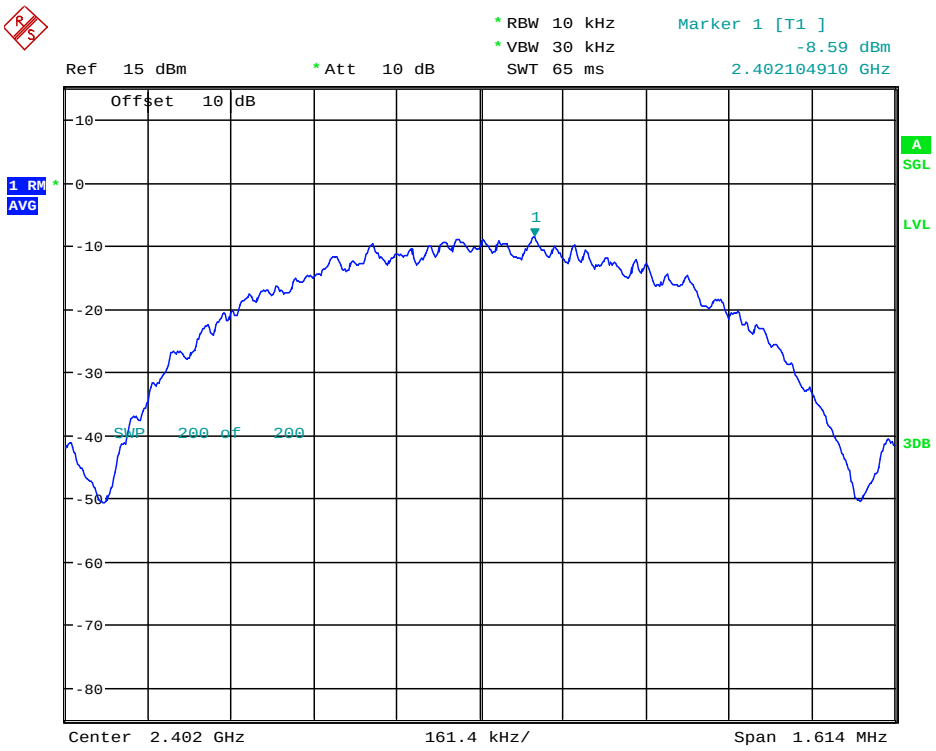
The measurement was performed at the upper and lower end and the middle of the assigned frequency band.

5.5.2 Test result

Ambient temperature	22 °C	Relative humidity	59 %

The plots show an exemplary measurement result for the worst documented case. The other results are listed in the following tables.

200540_1M_AVPwrSpecDens_BTLE_BT1.wmf: Average Power Spectral Density (operation mode 1):



Operation Mode		Peak Frequency [MHz]	AvPSD Reading [dBm/10 kHz]	Duty Cycle Corr. [dB]	Corr. Reading [dBm /10 kHz]	Margin [dB]	AvPSD Limit [dBm/3kHz]
1	GFSK	2402.105	-8.6	0.0	-8.6	16.6	8
2	GFSK	2440.000	-8.6	0.0	-8.6	16.6	8
3	GFSK	2479.934	-10.0	0.0	-10.0	18.0	8
4	GFSK	2401.903	-11.0	0.0	-11.0	19.0	8
5	GFSK	2440.028	-10.8	0.0	-10.8	18.8	8
6	GFSK	2480.006	-12.3	0.0	-12.3	20.3	8
7	O-QPSK	2405.441	-10.7	0.0	-10.7	18.7	8
8	O-QPSK	2440.065	-11.9	0.0	-11.9	19.9	8
9	O-QPSK	2480.068	-12.4	0.0	-12.4	20.4	8

Test: Passed

Test equipment (refer to chapter 6)

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5.1 Peak Power Spectral Density

5.1.1 Method of measurement

The EUT was measured conducted on a sample with a temporary antenna connector, which was provided by the applicant.

Acceptable measurement configurations

The measurement procedure refers to part 11.10.2 of document [1].

The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ [3 × RBW].
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

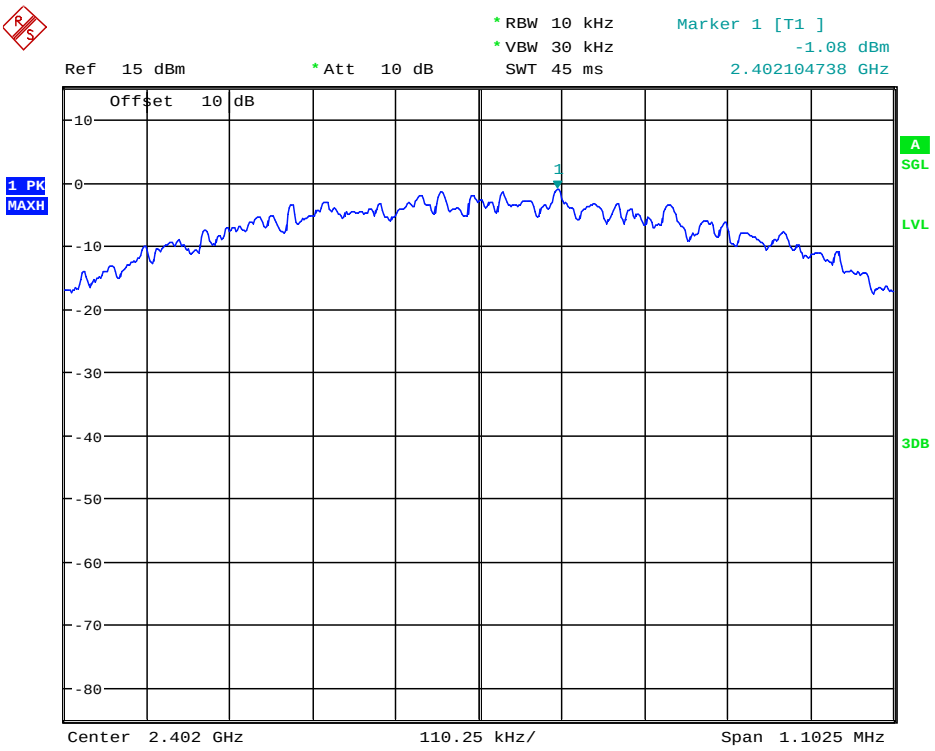
The measurement was performed at the upper and lower end and the middle of the assigned frequency band.

5.1.2 Test result

Ambient temperature	22 °C	Relative humidity	59 %

The plots show an exemplary measurement result for the worst documented case. The other results are listed in the following tables.

200540_1M_PwrSpecDens_BTLE_BT1.wmf: Average Power Spectral Density (operation mode 1):



Operation Mode		Peak Frequency [MHz]	AvPSD Reading [dBm/10 kHz]	Duty Cycle Corr. [dB]	Corr. Reading [dBm /10 kHz]	Margin [dB]	AvPSD Limit [dBm/3kHz]
1	GFSK	2402.105	-1.1	0.0	-1.1	9.1	8
2	GFSK	2440.196	-1.6	0.0	-1.6	9.6	8
3	GFSK	2480.027	-2.6	0.0	-2.6	10.6	8
4	GFSK	2401.796	-3.5	0.0	-3.5	11.5	8
5	GFSK	2440.054	-4.6	0.0	-4.6	12.6	8
6	GFSK	2480.144	-3.8	0.0	-3.8	11.8	8
7	O-QPSK	2405.066	-2.4	0.0	-2.4	10.4	8
8	O-QPSK	2440.067	-3.0	0.0	-3.0	11.0	8
9	O-QPSK	2480.068	-3.9	0.0	-3.9	11.9	8

Test: Passed

Test equipment (refer to chapter 6)

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5.2 Band-edge compliance

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

The EUT was measured conducted on a sample with a temporary antenna connector, which was provided by the applicant.

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 stabilise.
- Use the peak marker function to determine the the maximum PSD level.

Measurement Procedure – Unwanted Emissions

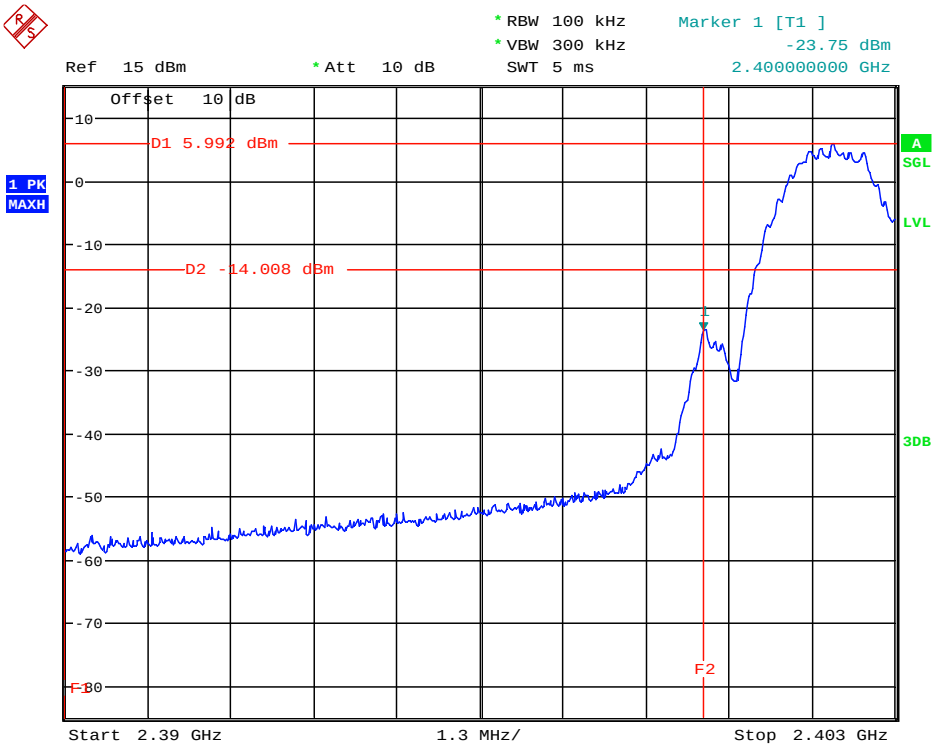
- Set the center frequency and span to encompass the frequency range to be measured.
- RBW = 100 kHz.
- VBW ≥ 300 kHz.
- Detector = Peak.
- Ensure that the number of measurement points ≥ span/RBW.
- Sweep time = auto couple.
- Trace Mode = max hold.
- Allow the trace to stabilise.
- Use the peak marker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

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

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

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

200540_2M_BandEdgeUnrestr_BTLE_BT1.wmf: Antenna port conducted band-edge compliance at an unrestricted band-edge (operation mode 4):



Operation Mode		Tx Frequency [MHz]	Emission Frequency [MHz]	Reference Level [dBm]	Limit [dBm]	Emisson Level [dBm]	Margin [dB]	Result
1	GFSK	2402	2400.000	6.9	-13.1	-34.7	31.6	Passed
4	GFSK	2402	2400.000	6.0	-14.0	-23.8	9.8	Passed
7	O-QPSK	2405	2400.000	4.5	-15.5	-42.6	27.1	Passed

Test: Passed

Test equipment (refer to chapter 6)

27, 28, 29

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

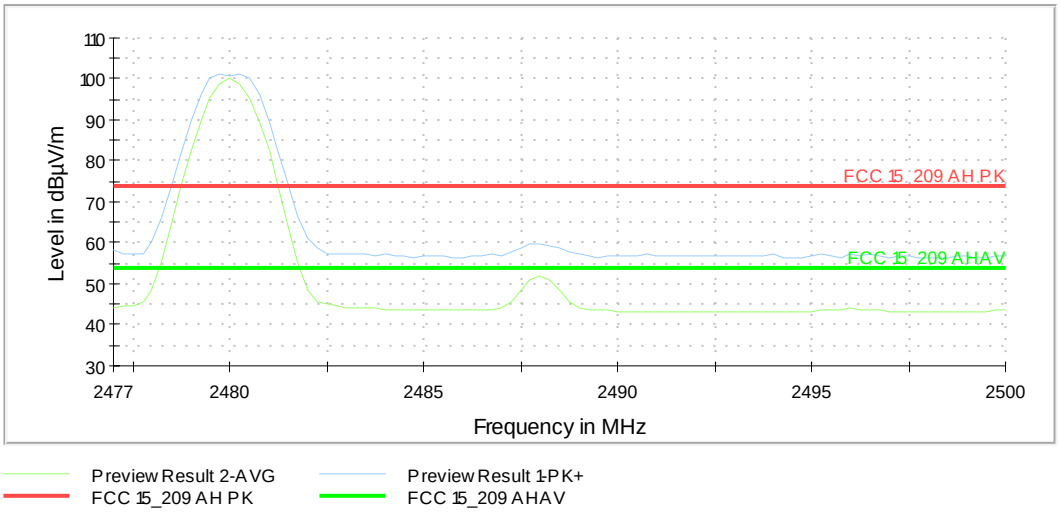
The EUT was measured radiated in the anechoic chamber using the procedures described in 5.3.1.

Acceptable measurement configurations

The same measurement configurations as described in 5.3.1. were used for the preview and final measurement.

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

200540_1Mbps_8 dBm_ch0_1-4G: radiated band-edge compliance at a restricted band-edge (operation mode 3):



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

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2386.000	---	39.97	54.00	14.03	H	289.0	90.0	33.2
2386.000	47.93	---	74.00	26.07	H	289.0	90.0	33.2
Measurement uncertainty				+2.2 dB / -3.6 dB				

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

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2488.000	---	50.61	54.00	3.39	H	292.0	60.0	33.4
2488.000	54.32	---	74.00	19.69	H	292.0	60.0	33.4
Measurement uncertainty				+2.2 dB / -3.6 dB				

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

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2386.000	---	40.75	54.00	13.25	H	339.0	90.0	33.2
2386.000	49.61	---	74.00	24.39	H	339.0	90.0	33.2
Measurement uncertainty				+2.2 dB / -3.6 dB				

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

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2488.000	55.69	---	74.00	18.31	H	319.0	30.0	33.4
2488.000	---	49.47	54.00	4.53	H	319.0	30.0	33.4
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the lower end of the assigned frequency band (operation mode 7 O-QPSK)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2389.000	---	35.40	54.00	18.60	H	343.0	90.0	33.2
2389.000	46.17	---	74.00	27.83	H	343.0	90.0	33.2
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the upper end of the assigned frequency band (operation mode 9 O-QPSK)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2488.000	---	49.66	54.00	4.34	H	311.0	120.0	33.4
2488.000	56.09	---	74.00	17.91	H	311.0	120.0	33.4
Measurement uncertainty				+2.2 dB / -3.6 dB				

Test: Passed

Test equipment (refer to chapter 6)

7 – 14, 17, 18, 28, 29

5.3 Maximum unwanted emissions

5.3.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into five stages.

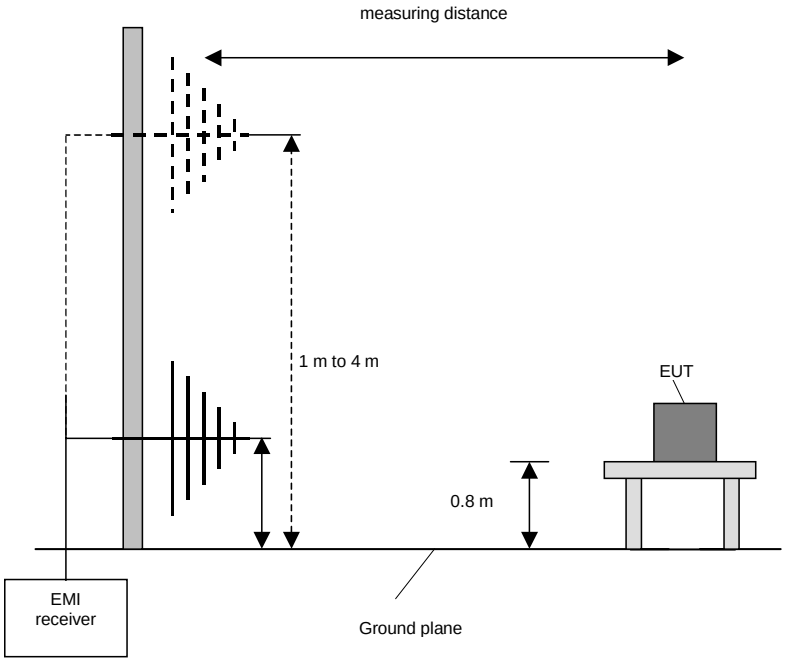
- A preliminary and final measurement was carried out in semi-anechoic chamber with reflecting ground plane and various antenna height in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with a variable antenna distance and height in the frequency 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 and final measurement (30 MHz to 1 GHz)

A final measurement on an open area test site will be performed on selected frequencies found in the preliminary measurement. During this test the EUT will be rotated in the range of
0 ° to 360 °, the measuring antenna will be set to horizontal and vertical polarisation and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

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

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

1) Measure the frequency range 30 MHz to 1 GHz at an antenna height of 1 m and a EUT azimuth of 6 °.
2) Move the antenna from 1 m to 4 m and note the maximum value at each frequency.
3) Rotate the Turntable by 30 ° and repeat 2) until an azimuth of 366 ° 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 values are 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 final frequency.
12) Repeat 1) to 11) for each orthogonal axes of the EUT (if the EUT is a module and might be used in a handheld equipment application).

Preliminary and final measurement (1 GHz to 40 GHz)

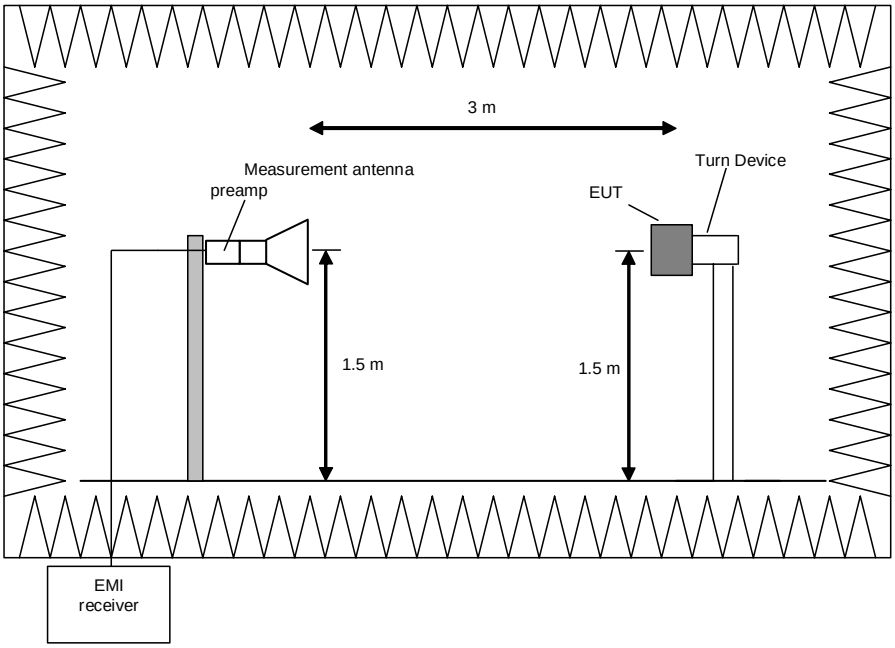
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

Preliminary measurement (1 GHz to 40 GHz)

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

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

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



Procedure preliminary measurement:

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

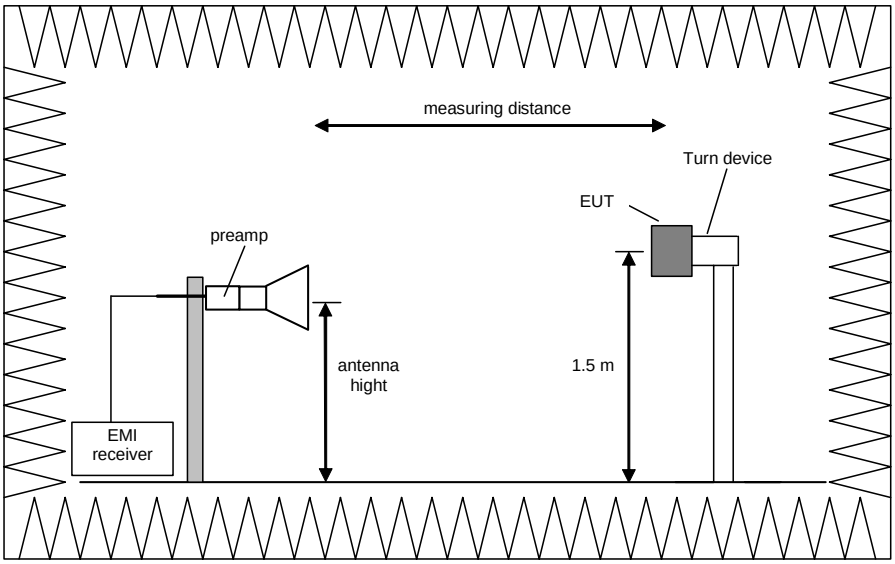
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an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

Final measurement (1 GHz to 40 GHz)

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

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

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



Procedure of measurement:

The measurements were performed in the frequency ranges 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 25 /26.5 GHz and 26.5 GHz to 40 GHz.
The following procedure will be used:

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

5.3.2 Test results (radiated emissions) – Emissions from 30 MHz – 26.5 GHz (internal antenna)

5.3.2.1 Preliminary radiated emission measurement 9 kHz – 26.5 GHz

Ambient temperature	22 °C	Relative humidity	59 %

Position of EUT: The EUT was set-up on an EUT turn device of a height of 1.5 m for f > 1 GHz and f < 30 MHz. The distance between EUT and antenna was 3 m.

For the test for 30 MHz < f < 1 GHz on the open area test site the EUT was placed on a table with the 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 the annex A in the test report.

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

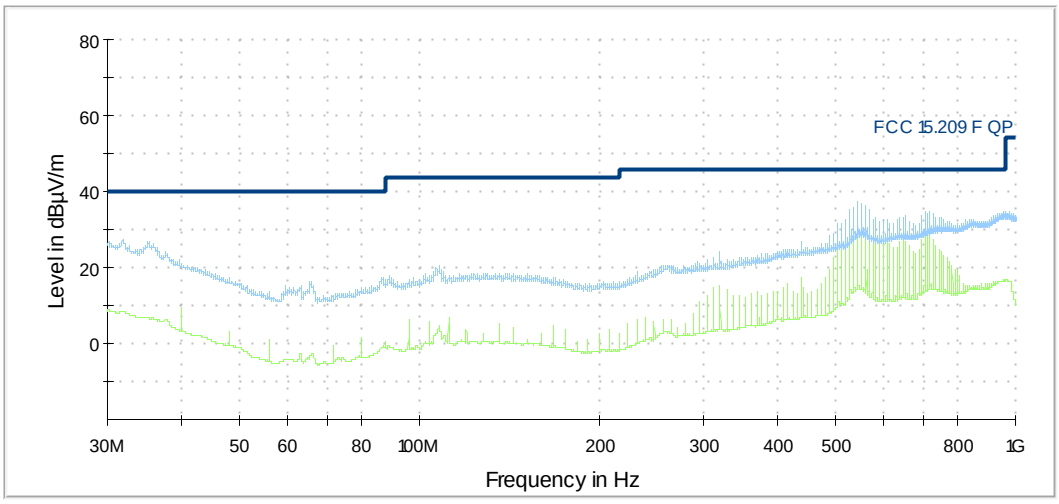
Remark: Since there were no differences in the spectrum for 30 MHz < f < 1 GHz, only one representative plot is submitted below.

Since no significant emissions were found during the preliminary measurement for f < 30 MHz, no final measurement was performed, and no plot is submitted below.

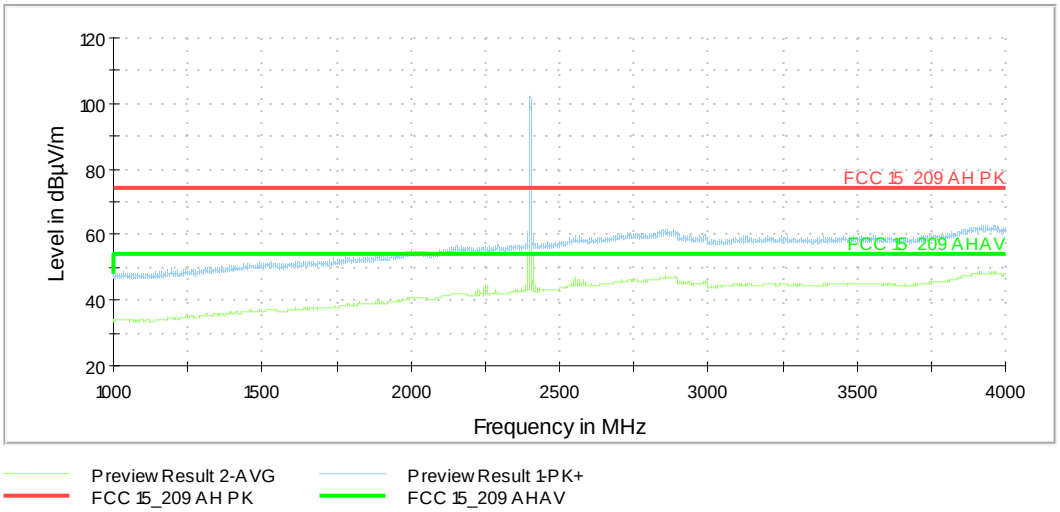
Pre-tests have shown that the fundamental and spurious emissions for BLE with 2 Mbps were in all cases lower than for BLE with 1 Mbps. Therefore, only the results for BLE with 1 Mpbs are submitted below.

Plots of the worst-case transmitter spurious emissions

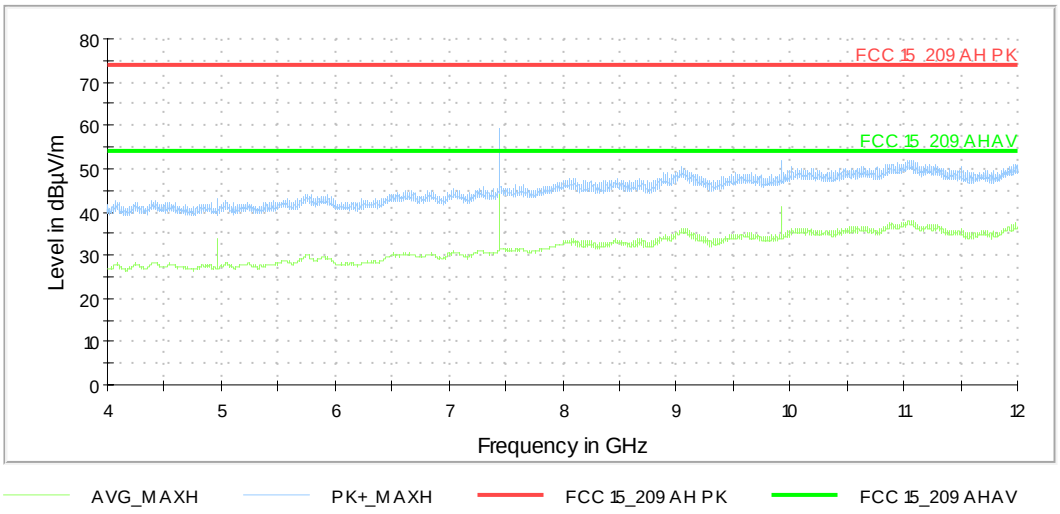
200540_Tx_802.15.4_ch18_30M-1G: Spurious emissions from 30 MHz to 1 GHz (operation mode 8):



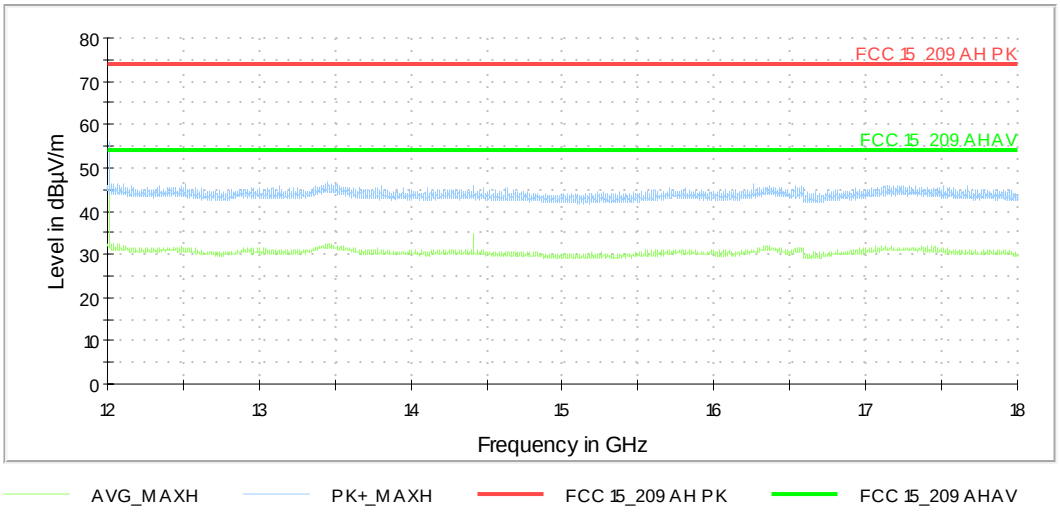
200540_1Mbps_8 dBm_ch0_1-4G: Spurious emissions from 1 GHz to 4 GHz (operation mode 1)



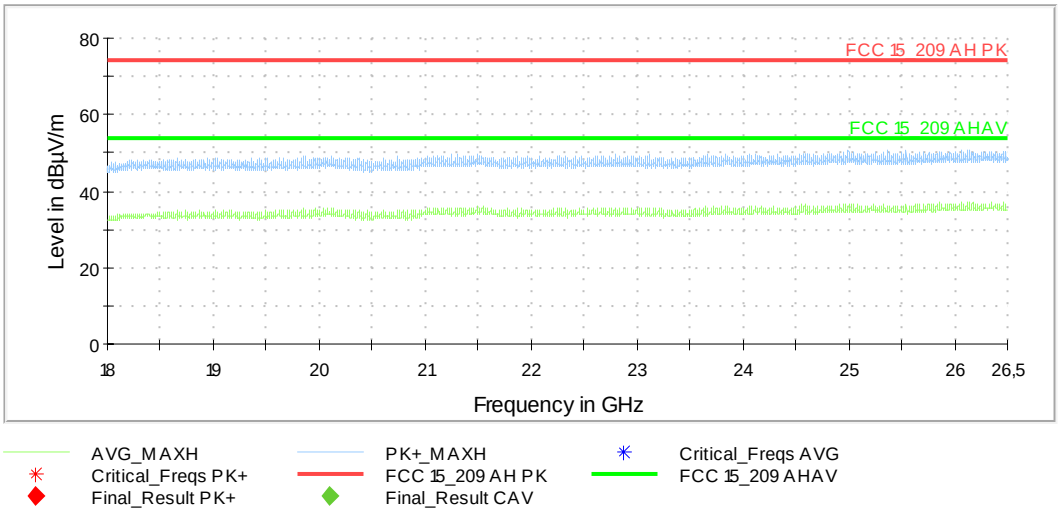
200540_1Mbps_8 dBm_ch39_4-12G: Spurious emissions from 4 GHz to 12 GHz (operation mode 3):



200540_1Mbps_8 dBm_ch0_12-18G: Spurious emissions from 12 GHz to 18 GHz (operation mode 1):



200540_1Mbps_8 dBm_ch0_18-26,5G: Spurious emissions from 18 GHz to 26.5 GHz (operation mode 1):



5.3.2.2 Final radiated measurements

All TX modes (no difference detected when comparing channel / modulation)

Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB]
528.000000	33.37	46.00	12.63	1000.0	120.000	181.0	H	351.0	26.5
536.000000	35.13	46.00	10.87	1000.0	120.000	183.0	H	358.0	26.7
544.000000	36.30	46.00	9.70	1000.0	120.000	159.0	H	172.0	27.4
552.000000	36.23	46.00	9.77	1000.0	120.000	146.0	H	171.0	28.4
560.000000	35.06	46.00	10.94	1000.0	120.000	140.0	H	178.0	28.5
568.000000	33.18	46.00	12.82	1000.0	120.000	148.0	H	170.0	28.3
Measurement uncertainty					+2.2 dB / -3.6 dB				

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

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2258.000	---	34.33	54.00	19.67	V	209.0	150.0	32.4
2258.000	45.02	---	74.00	28.98	V	209.0	150.0	32.4
2402.000	---	101.60	-	Fund.	H	295.0	150.0	33.3
2402.000	102.36	---	-	Fund.	H	295.0	150.0	33.3
2554.000	---	44.45	54.00	9.55	H	221.0	60.0	33.9
2554.000	51.00	---	74.00	23.00	H	221.0	60.0	33.9
4804.000	---	40.15	54.00	13.85	H	236.0	150.0	-2.1
4804.000	46.42	---	74.00	27.58	H	236.0	150.0	-2.1
7206.500	---	44.19	54.00	9.81	V	170.0	150.0	3.9
7206.500	51.56	---	74.00	22.44	V	170.0	150.0	3.9
12011.250	---	49.42	54.00	4.58	H	357.0	120.0	7.3
12011.250	58.28	---	74.00	15.72	H	357.0	120.0	7.3
14413.500	---	34.02	54.00	19.98	H	354.0	120.0	11.5
14413.500	45.09	---	74.00	28.91	H	354.0	120.0	11.5
Measurement uncertainty				+2.2 dB / -3.6 dB				

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

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2296.000	---	42.24	54.00	11.76	H	291.0	90.0	32.8
2296.000	49.53	---	74.00	24.47	H	291.0	90.0	32.8
2440.000	---	101.19	-	Fund.	H	303.0	120.0	33.5
2440.000	101.97	---	-	Fund.	H	303.0	120.0	33.5
2592.000	---	41.16	54.00	12.84	H	256.0	90.0	34.1
2592.000	49.54	---	74.00	24.46	H	256.0	90.0	34.1
4880.000	---	40.14	54.00	13.86	H	71.0	90.0	-1.8
4880.000	46.61	---	74.00	27.39	H	71.0	90.0	-1.8
7320.750	---	51.04	54.00	2.96	H	161.0	30.0	4.6
7320.750	57.86	---	74.00	16.14	H	161.0	30.0	4.6
12201.250	---	45.48	54.00	8.52	H	7.0	150.0	6.8
12201.250	54.93	---	74.00	19.07	H	7.0	150.0	6.8
14641.500	---	33.79	54.00	20.21	H	7.0	90.0	11.4
14641.500	44.76	---	74.00	29.24	H	7.0	90.0	11.4
Measurement uncertainty				+2.2 dB / -3.6 dB				

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

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2328.000	---	43.38	54.00	10.62	H	284.0	90.0	33.0
2328.000	49.51	---	74.00	24.49	H	284.0	90.0	33.0
2480.000	---	100.10	-	Fund.	H	207.0	90.0	33.4
2480.000	100.86	---	-	Fund.	H	207.0	90.0	33.4
2656.000	---	38.71	54.00	15.29	H	350.0	90.0	34.6
2656.000	48.32	---	74.00	25.68	H	350.0	90.0	34.6
4959.750	---	32.70	54.00	21.30	H	115.0	90.0	-2.0
4959.750	42.15	---	74.00	31.85	H	115.0	90.0	-2.0
7439.500	---	52.79	54.00	1.21	H	166.0	0.0	4.9
7439.500	58.63	---	74.00	15.37	H	166.0	0.0	4.9
9920.750	---	40.52	54.00	13.48	H	339.0	90.0	7.3
9920.750	50.54	---	74.00	23.46	H	339.0	90.0	7.3
12401.250	---	40.41	54.00	13.59	H	4.0	0.0	6.9
12401.250	51.50	---	74.00	22.50	H	4.0	0.0	6.9
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the lower end of the assigned frequency band (operation mode 7, O-QPSK)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2253.000	---	40.71	54.00	13.29	H	294.0	90.0	32.4
2253.000	48.29	---	74.00	25.71	H	294.0	90.0	32.4
2405.000	---	98.85	-	Fund.	H	303.0	90.0	33.3
2405.000	101.93	---	-	Fund.	H	303.0	90.0	33.3
2549.000	---	41.35	54.00	12.65	H	222.0	90.0	33.8
2549.000	50.41	---	74.00	23.59	H	222.0	90.0	33.8
4809.000	---	37.92	54.00	16.08	H	224.0	120.0	-2.1
4809.000	46.74	---	74.00	27.26	H	224.0	120.0	-2.1
7213.750	---	44.94	54.00	9.06	H	163.0	150.0	4.0
7213.750	52.30	---	74.00	21.70	H	163.0	150.0	4.0
12022.750	---	45.54	54.00	8.46	V	1.0	60.0	7.4
12022.750	54.58	---	74.00	19.42	V	1.0	60.0	7.4
14433.000	---	34.27	54.00	19.73	H	-6.0	120.0	11.5
14433.000	45.13	---	74.00	28.87	H	-6.0	120.0	11.5
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the middle of the assigned frequency band (operation mode 8, O-QPSK)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2280.000	---	40.26	54.00	13.74	H	176.0	90.0	32.8
2280.000	49.04	---	74.00	24.96	H	176.0	90.0	32.8
2440.000	---	99.82	-	Fund.	H	299.0	90.0	33.5
2440.000	102.97	---	-	Fund.	H	299.0	90.0	33.5
2608.000	---	38.00	54.00	16.00	H	257.0	90.0	34.3
2608.000	48.02	---	74.00	25.98	H	257.0	90.0	34.3
4879.000	---	36.22	54.00	17.78	H	71.0	120.0	-1.8
4879.000	45.62	---	74.00	28.38	H	71.0	120.0	-1.8
7321.250	---	50.68	54.00	3.32	H	145.0	30.0	4.6
7321.250	57.48	---	74.00	16.52	H	145.0	30.0	4.6
12202.250	---	44.27	54.00	9.73	V	-3.0	60.0	6.8
12202.250	53.80	---	74.00	20.20	V	-3.0	60.0	6.8
14643.000	---	33.05	54.00	20.95	H	10.0	90.0	11.4
14643.000	44.21	---	74.00	29.79	H	10.0	90.0	11.4
Measurement uncertainty				+2.2 dB / -3.6 dB				

Transmitter operates at the upper end of the assigned frequency band (operation mode 9, O-QPSK)

Frequency [MHz]	MaxPeak [dBµV/m]	Caverage [dBµV/m]	Limit [dBµV/m]	Margin (dB)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB)
2320.000	---	41.19	54.00	12.81	H	181.0	90.0	32.9
2320.000	49.68	---	74.00	24.32	H	181.0	90.0	32.9
2480.000	---	98.62	-	Fund.	H	303.0	120.0	33.4
2480.000	101.83	---	-	Fund.	H	303.0	120.0	33.4
4959.000	---	32.63	54.00	21.37	H	74.0	90.0	-2.0
4959.000	43.30	---	74.00	30.70	H	74.0	90.0	-2.0
7441.250	---	51.13	54.00	2.87	H	165.0	0.0	5.0
7441.250	57.87	---	74.00	16.13	H	165.0	0.0	5.0
9922.000	---	41.59	54.00	12.41	H	338.0	90.0	7.3
9922.000	51.82	---	74.00	22.18	H	338.0	90.0	7.3
12402.500	---	40.82	54.00	13.18	H	-10.0	0.0	6.9
12402.500	51.97	---	74.00	22.03	H	-10.0	0.0	6.9
14877.000	---	33.96	54.00	20.04	V	8.0	0.0	11.2
14877.000	44.33	---	74.00	29.67	V	8.0	0.0	11.2
Measurement uncertainty				+2.2 dB / -3.6 dB				

Test equipment (refer to chapter 6)
7 – 26, 28 - 36

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

Ambient temperature	20 °C	Relative humidity	52 %

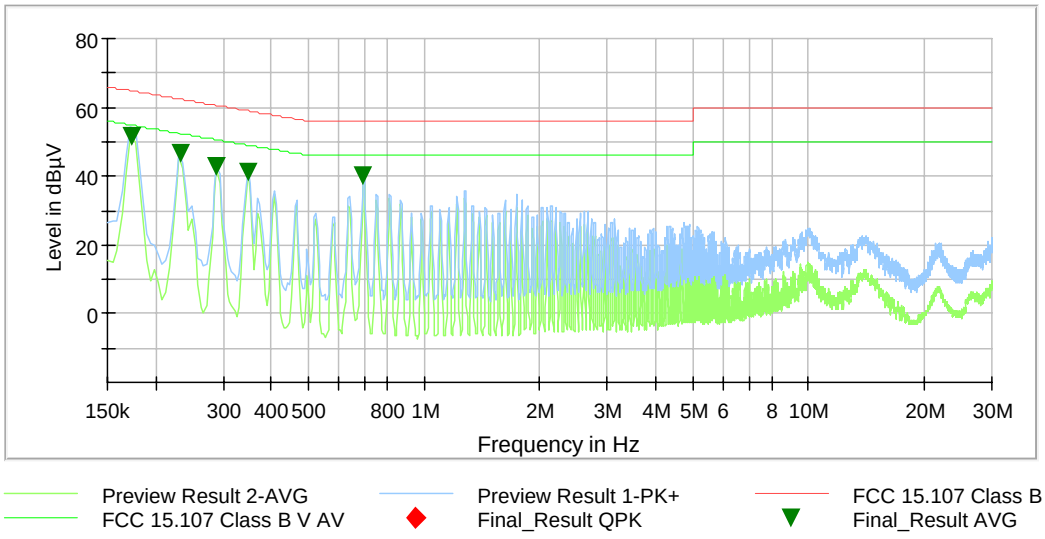
Position of EUT: For this test, the EUT was operated in normal mode. The Bluetooth communication with the use of the ancillary Bluetooth adapter labelled “USB_BT_51” was active together with the WirelessHART connection using an ancillary device named LTP5903-WHR by Analog Devices Inc.

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

Test record: All results are shown in the following.

Supply voltage: Measurement performed with US 120V/60Hz.
For the test an AC/DC Adaptor from Phoenix Contact Model MINI-PS-100-240AC/24DC/2 was used, which had an output voltage of 24.0 V DC.

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 “▼”.



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Transducer (dB)
0.173400	---	51.84	54.80	2.95	5000.0	9.000	L1	FLO	9.8
0.231900	---	46.50	52.38	5.88	5000.0	9.000	L1	FLO	9.9
0.289500	---	42.73	50.54	7.81	5000.0	9.000	L1	FLO	9.9
0.348000	---	41.46	49.01	7.55	5000.0	9.000	L1	GND	9.9
0.695400	---	40.30	46.00	5.70	5000.0	9.000	L1	FLO	9.9
Measurement uncertainty				+2.76 dB / -2.76 dB					

Test: Passed

Test equipment (refer to chapter 6)
1 – 7, 28, 29

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. Due
1	Shielded chamber M4	-	Albatross Projects	B83117-C6439-T262	480662	Calibration not necessary	
2	EMI Receiver	ESIB 26	Rohde & Schwarz	1088.7490	481182	12.02.2020	02.2022
3	LISN	NSLK8128	Schwarzbeck	8128155	480058	11.02.2020	02.2022
4	High pass filter	HR 0.13-5ENN	FSY Microwave	DC 0109 SN 002	480340	Calibration not necessary	
5	EMI Software	ES-K1	Rohde & Schwarz	-	480111	Calibration not necessary	
6	AC power supply	AC6803A	Keysight	JPVJ002509	482350	Calibration not necessary	
7	EMI Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
8	HF-Cable	Sucoflex 104	Huber+Suhner	517406	482391	Calibration not necessary	
9	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Calibration not necessary	
10	Signal & Spectrum Analyzer	ESW44	Rohde & Schwarz	101635	482467	18.02.2020	02.2022
11	Controller	MCU	Maturo	MCU/043/971107	480832	Calibration not necessary	
12	Turntable	DS420HE	Deisel	420/620/80	480315	Calibration not necessary	
13	Antenna support	AS615P	Deisel	615/310	480187	Calibration not necessary	
14	Antenna (Log.Per.)	HL050	Rohde & Schwarz	100438	481170	09.10.2017	10.2020
15	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Calibration not necessary	
16	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297	Calibration not necessary	
17	RF-cable 3	Sucoflex 106B	Huber&Suhner	500234/6B	482644	Calibration not necessary	
18	RF-cable 40	Sucoflex106B	Huber&Suhner	SF106B/11N/11N/1500MM	482125	Calibration not necessary	
19	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	14.02.2020	02.2022
21	RF-cable 2 m	KPS-1533-800-KPS	Insulated Wire	-	480302	Calibration not necessary	
22	RF cable 36	Sucoflex 106B	Suhner	500003/6B / Kabel 36	481680	Calibration not necessary	
23	Preamplifier 100 MHz - 16 GHz	AFS6-00101600-23-10P-6-R	Narda MITEQ	2011215	482333	13.02.2020	07.2022
24	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	13.02.2020	02.2022
25	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	13.02.2020	02.2022
26	4 GHz High Pass Filter	WHKX4.0/18G-8SS	Wainwright Instruments	1	480587	Calibration not necessary	
27	Spectrum Analyser	FSU46	Rohde & Schwarz	200125	480956	13.02.2020	03.2021
28	Power Supply	TOE8752-32 (DC)	Toellner Electronic Inst.	31566	480010	Calibration not necessary	
29	Multimeter	971A	Hewlett Packard	JP39009358	480721	16.01.2020	01.2021
30	Semi anechoic chamber	M276	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
31	Antenna mast	BAM4.5-P-10kg	maturo	222/2612.01	483225	Calibration not necessary	

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. Due
32	Turntable	DS412	Deisel	412/316	480087	Calibration not necessary	
33	Controller	HD100	Deisel	100/349	480139	Calibration not necessary	
34	Software	EMC32	Rohde & Schwarz	ID: 1300.7010.12-100970-Be	482972	Calibration not necessary	
35	Antenne (Bilog)	CBL6111D	Schaffner	22921	480674	27.03.2018	03.2021
36	EMI Testreceiver	ESW	Rohde & Schwarz	101828	482979	12.04.2019	04.2021

7 Test site Validation

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA	ANSI C63.4-2017	19.09.2019	09.2021
Semi anechoic chamber M276	483227	1 -18 GHz	SVSWR*1	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	19.09.2019	09.2021
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 Amd. 1	13.07.2018	07.2020*
Shielded chamber M4	480088	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	06.11.2018	11.2020

* All measurements in the frequency range 1 – 18 GHz were performed during the validation period.

8 Report History

Report Number	Date	Comment
F200540E2	01.09.2020	Initial Test Report

9 List of Annexes

ANNEX A	TEST SETUP PHOTOS	8 pages
ANNEX B	EXTERNAL PHOTOS	2 pages
ANNEX C	INTERNAL PHOTOS	6 pages