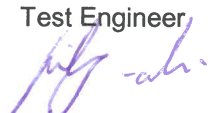


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Kunden Referenz-Nr.: Client Reference No.: -		Auftragsdatum Order date: 2019-03-18			
Auftraggeber: Client: myUpTech AB Box 14, 285 21 Markaryd Sweden		Kara Wills kara@nibeipi.com +1 618 690-3271			
Prüfgegenstand: Test item: HMI-L					
Bezeichnung / Typ-Nr.: Identification / Type No.: Model: 10000033 & 10000070		FCC ID: 2AS2W-10000026			
Auftrags-Inhalt: Order content: Partial FCC Certification testing – IEEE 802.15.4 radio protocol					
Prüfgrundlage: Test specification: FCC Part 15 Subpart C 15.205, 15.207 & 15.209 FCC Part 15 Subpart B 15.107 & 15.109 ANSI C63.4-2014 & ANSI C63.10-2013					
Wareneingangsdatum: Date of receipt: 2019-02-26					
Prüfmuster-Nr.: Test sample No.: A000225900-002					
Prüfzeitraum: Testing period: 2019-03-22 => 2019-04-12					
Ort der Prüfung: Place of testing: Lund, Sweden					
Prüflaboratorium: Testing laboratory: TÜV Rheinland Sweden					
Prüfergebnis: Test results: PASS					
Geprüft von Tested by: Fariborz Abasi Test Engineer 		Kontrolliert von Reviewed by: Per Isacson Lab Manager 			
2019-10-24		2019-10-24			
Datum Date	Name / Stellung Name / Position	Unterschrift Signature	Datum Date	Name / Stellung Name / Position	Unterschrift Signature
Sontiges / Other: Only Conducted and Radiated Emissions, FCC Rule parts 15.107 15.109, 15.205, 15.207 and 15.209 are covered in this report					
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts.					



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Revisions Revisions			
Revision Revision	Datum Date	Anmerkung Remark	Verfasser Author
001	2019-09-23	First release	Stefan Olsson
002	2019-10-15	-Page 16: Channel frequency changed to "Idle mode". -Page 18: Extrapolation factor changed to $20\log(3/1)$. -Page 35: Sweep frequency corrected to "1GHz-18GHz". -Pages 37 to 42: corrected the standard FCC subpart 15B. -Pages 24/30/36/42: corrected limit lines in the graphs.	Fariborz Abasi
003	2019-10-24	-Page 1 & 6: Added model number 10000070 -Page 28: Corrected typo on detector type -Annex 1: Added setup picture for AC conducted emissions	Fariborz Abasi
Note: Latest revision report will replace all previous reports			

Summary of Test Results

FCC Rule Part	Test item	Result	Remarks
15.107 15.207	AC POWER CONDUCTED EMISSION	PASS	Meets the requirement of limit
15.205 15.109 15.209	RADIATED EMISSIONS	PASS	Meets the requirement of limit
15.247(a)(2)	6dB BANDWIDTH	n.p	
15.247(b)(3)	OUTPUT POWER	n.p	
15.247(d)	OUT OF BAND EMISSIONS	n.p	
15.247(d)	100 kHz Bandwidth of Frequency Band Edges	n.p	
15.247(e)	POWER SPECTRAL DENSITY	n.p	
15.203	ANTENNA REQUIREMENT	n.p	

Possible test case verdicts:

- test case does not apply to the test object: N/A
- test object does meet the requirement: PASS
- test object does not meet the requirement: FAIL
- test case not performed on the test object: n.p.

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1 TEST SITES

Testing facility

TÜV Rheinland Sweden AB
Mobilvägen 10
223 62 Lund
Sweden

FCC Test Firm Registration Number: 517458

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2 PRODUCT INFORMATION

2.1 General description

Model name:	HMI-L
Manufacturer:	myUpTech AB
Model number:	10000033 and 10000070
FCC ID:	2AS2W-10000026
Description:	Independently mounted, temperature/humidity sensing electronic control
Supported Radio Technologies:	IEEE 802.15.4 protocol operating at 2400–2483.5 MHz
Highest internal frequency	2480 MHz
Supply Voltage to Product:	Powered by cable from the power supply 12VDC or 24VAC
Ancillary Equipment:	See section 2.4 §

2.2 Radio specific details

2.2.1 Bluetooth Low Energy radio

Operating Frequency Range	2405 MHz – 2480 MHz
Radio Protocol	IEEE 802.15.4
Channel Spacing	5 MHz
Number of channels	16
Modulation	FSK
Number of antennas	1
Antenna type	PCB Inverted-F type antenna
Antenna gain	+ 2.98 dBi

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2.3 Equipment Under Test (EUT) identification

TÜV Rheinland ID	S/N	HW	SW
A000225900-002	-	Version 3	1.0.0
A000225900-006	-	Version 3	1.0.0

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2.4 Ancillary equipment identification

Equipment inside the chamber

TÜV Rheinland ID	Type	Model	Manufacturer	S/N
A000225900-023	DC power supply	-	-	-

3 TEST METHODS AND OPERATION MODES

3.1 Test Methods

The following standards/references has been considered for the testing

Standard	Description
FCC Part 15 (Subpart C)	§15.205 Restricted bands of operation
FCC Part 15 (Subpart B)	§15.109 Radiated emission limits; general requirements, unintentional radiators
FCC Part 15 (Subpart C)	§15.209 Radiated emission limits; general requirements, intentional radiators
ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

3.2 Operation modes

Testing was performed at the lowest operating frequency, at the operating frequency in the middle of the specified frequency band and at the highest operating frequency of each supported technology as per below.

A special test software was used to enable a modulated transmission of each channel with maximum power, this was considered to be the worst cases.

3.2.1 Tested channels/Frequencies

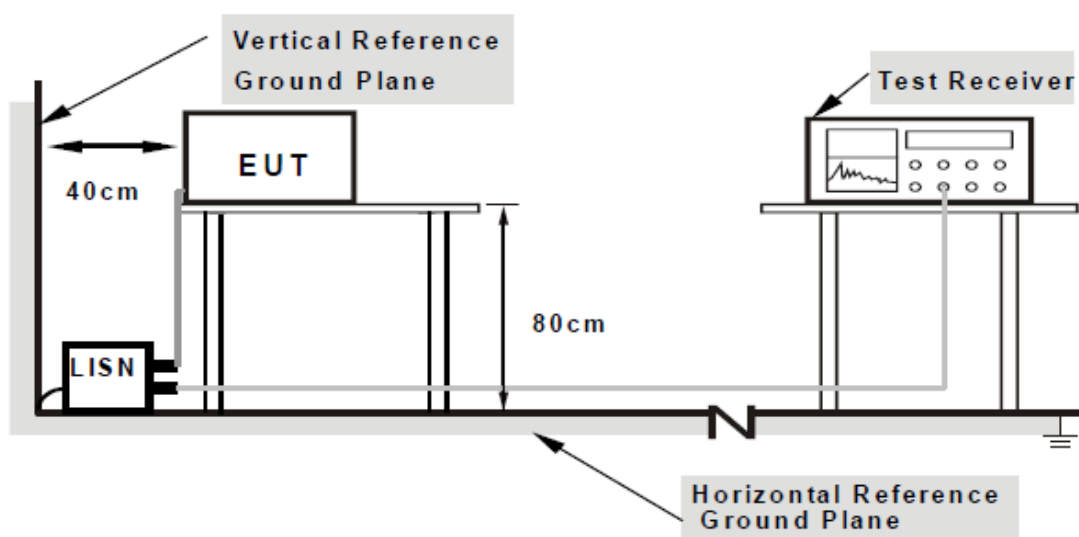
Frequency Band (MHz)	Channel No.	Channel Frequency (MHz)
IEEE 802.15.4 protocol (2.4GHz)	11	2405
	19	2445
	26	2480

4 TEST METHODOLOGY

4.1 Conducted Emission Test

- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The LISNs provide $50\Omega / 50\mu\text{H}$ of coupling impedance for the measuring instrument.
- The lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.

A NSG 1007 from Schaffner was used to support 60Hz power to the LISN.



4.2 Radiated Emission Test

The radiated emission measurement was performed according to the procedures in ANSI C63.10-2013. The equipment under test (EUT) was placed at the middle of the turntable on an 80cm high table for below 1 GHz & 1.5 m height for above 1 GHz measurement, for frequencies up to 18GHz the EUT is 3 meters far from the measuring antenna, above 18GHz the distance is 1 meter. The turntable was rotated 360° for obtaining the maximum emission. The height of the measuring antennas was scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained. The measurements above 1000 MHz was performed by 3 different horn antennas, the measurement below 30 MHz was performed by loop antenna and measurement from 30 MHz to 1 GHz was performed by Log-Periodic Antenna.

Test Setup Configuration

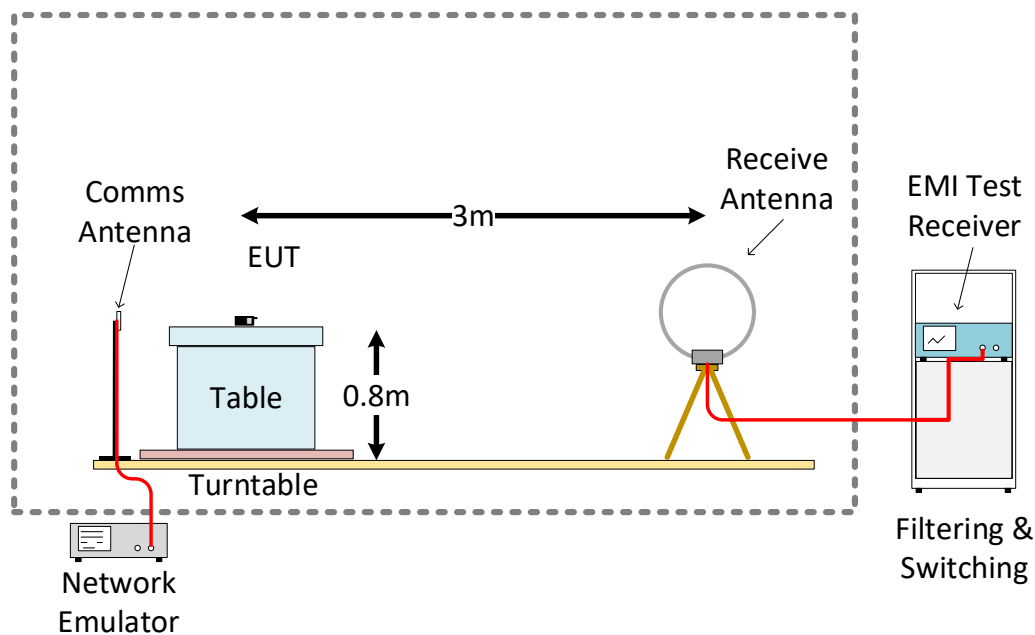


Figure 1: Frequency range 9 KHz – 30 MHz

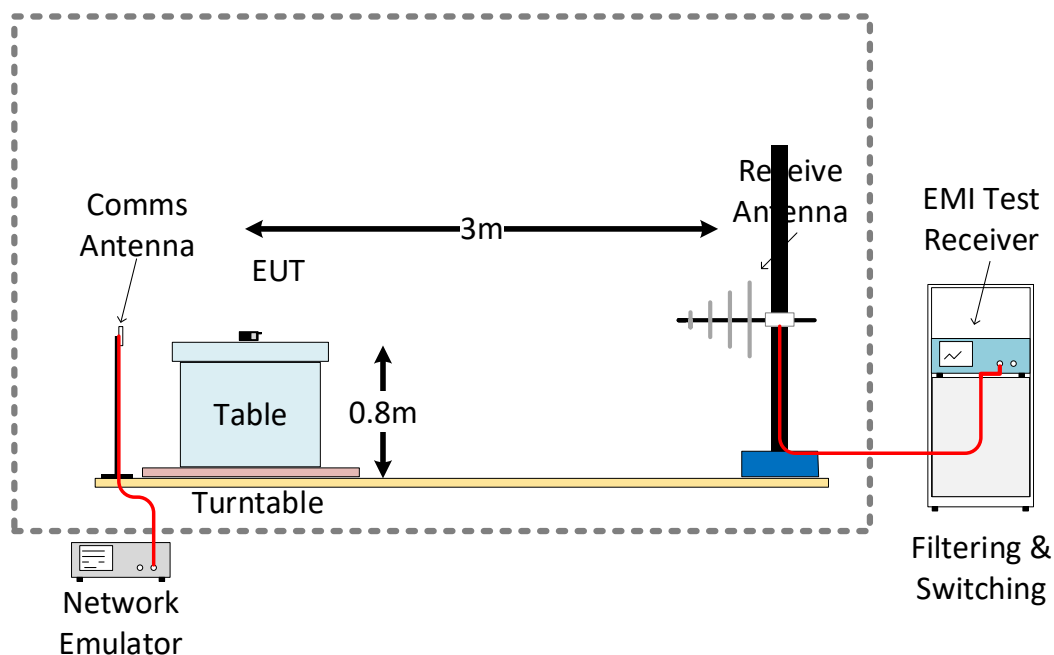


Figure 2: Frequency range 30 MHz – 1 GHz

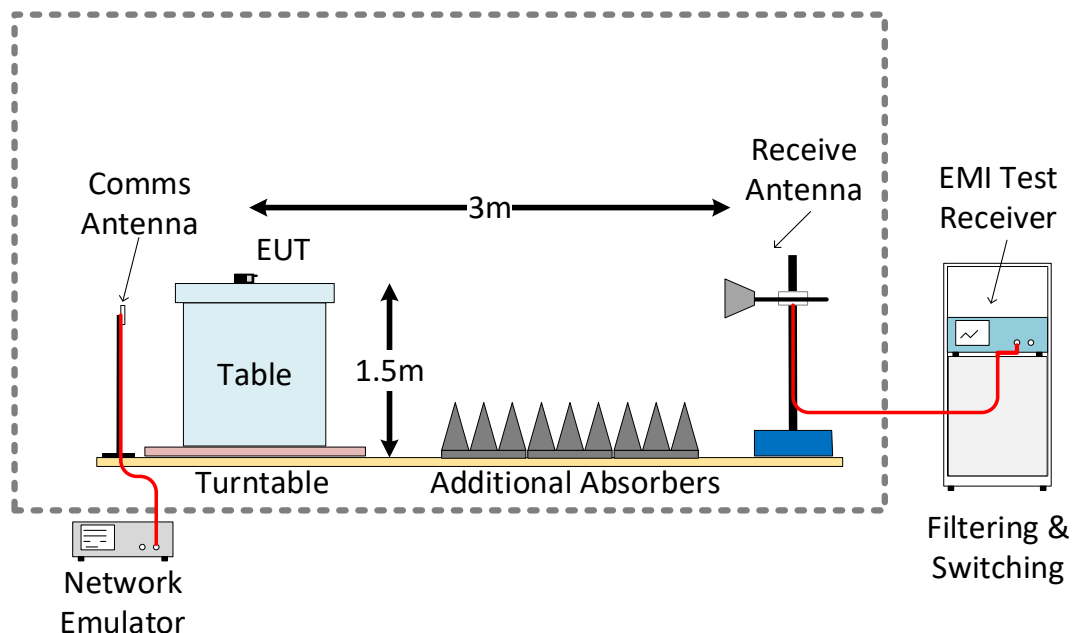


Figure 3: Frequency range 1 GHz – 18 GHz

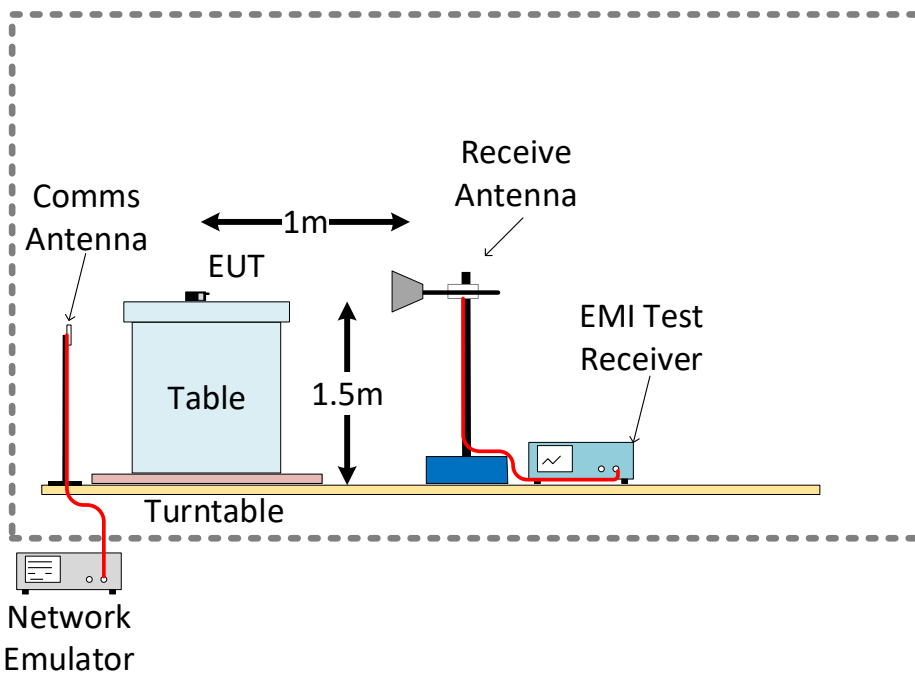


Figure 4: Frequency range 18 GHz – 40 GHz

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5 TEST RESULTS – CONDUCTED EMISSIONS

5.1 Conducted emissions

Result	Pass
Test period	2019-03-22
Test Engineer	Stefan Olsson
Test Specification	FCC part 15 Subpart C Section 15.207 FCC Part 15 Subpart B Section 15.107
Test Method	ANSI C 63.10 - 2013
Measurement Location	Conducted Emissions laboratory
Detector	QP and Average
Requirement	As per the limits mentioned in the below table
Test conditions	24 VAC 60Hz from transformer
Environmental conditions	Temperature: + 18 - 25 °C Relative Humidity: 20 - 40 %

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

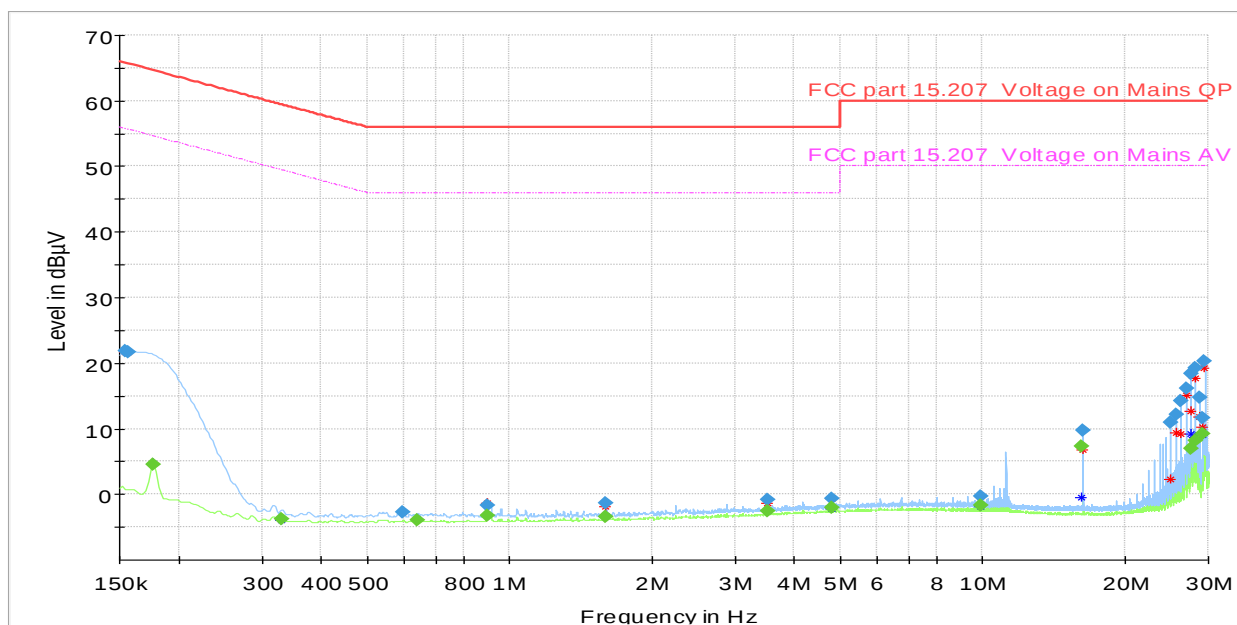
*Decreases with the logarithm of the frequency.

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Test results

Test mode condition	Traffic mode	
Test Description	Conducted Emission	
Channel frequency	2441 MHz	
Sweep frequency	150 KHz – 30 MHz	
Standard	FCC Part 15.207	
EUT	A000225900-006	
Comment	Input to chamber: 220V, 60Hz, Transformer inside chamber to 24V, 60Hz 1,2m cable between LISN and Transformer.	
Test Engineer	Stefan Olsson	Date: 2019-03-22
Environmental conditions	Temperature: 23,1 °C	Humidity: 31,5 %
Chamber details	Chamber: SAC 5	Test 29

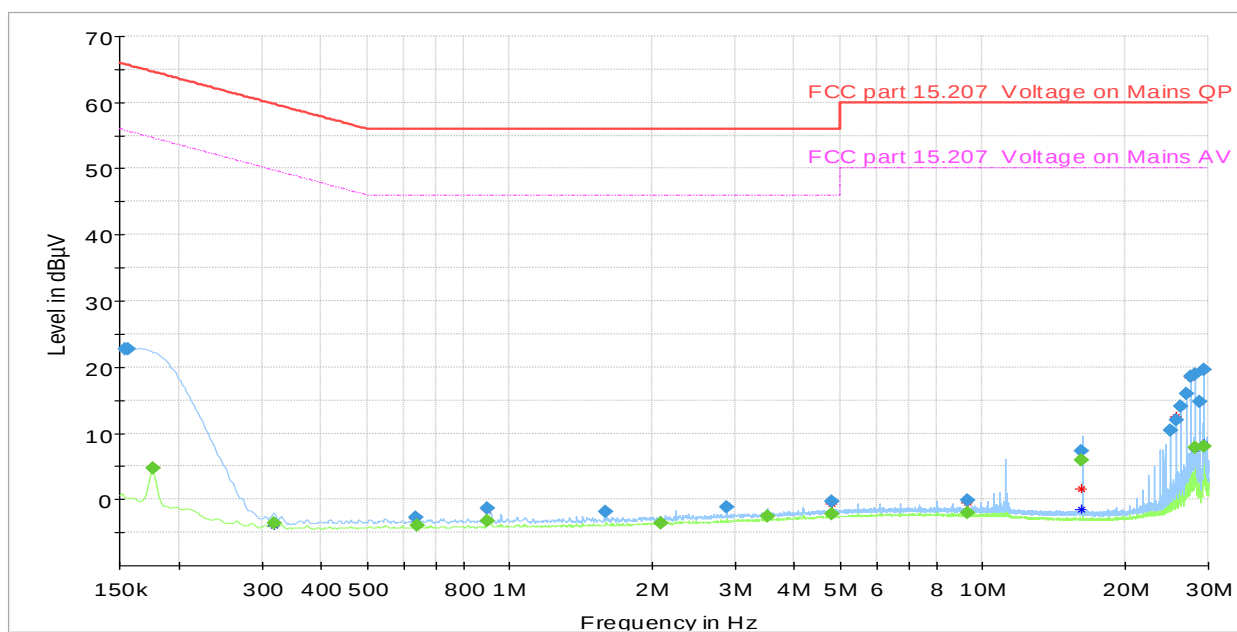


Frequency (MHz)	QuasiPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Line	Filter
16.2285	---	7.33	50	42.67	9	N	ON
27.5415	18.38	---	60	41.62	9	L1	ON
28.17825	---	8.12	50	41.88	9	N	ON
28.1805	19.23	---	60	40.77	9	N	ON
29.26275	---	9.19	50	40.81	9	N	ON
29.46075	20.28	---	60	39.72	9	N	ON

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Test mode condition	Radio Idle – All other functions active	
Test Description	Conducted Emission	
Channel frequency	Idle	
Sweep frequency	150 KHz – 30 MHz	
Standard	FCC Part 15.107	
EUT	A000225900-006	
Comment	Input to chamber: 220V, 60Hz, Transformer inside chamber to 24 V, 60Hz 1,2m cable between LISN and Transformer.	
Test Engineer	Stefan Olsson	Date: 2019-03-22
Environmental conditions	Temperature: 23,1 °C	Humidity: 31,5 %
Chamber details	Chamber: SAC 5	Test 30



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter
0.15675	22.77	---	65.63	42.87	9	L1	ON
27.53925	18.51	---	60	41.49	9	N	ON
28.17825	18.93	---	60	41.07	9	N	ON
28.17825	---	7.84	50	42.16	9	N	ON
29.46075	19.56	---	60	40.44	9	N	ON
29.46075	---	7.96	50	42.04	9	N	ON

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6 TEST RESULTS - RADIATED EMISSIONS

Result	PASS
Test period	2019-04-08 – 2019-04-12
Test Engineer	Martin Stump
Test Specification	FCC part 15 Subpart C Section 15.209 & 15.205 FCC Part 15 Subpart B Section 15.109
Test Method	ANSI C63.10 – 2013 ANSI C63.4 - 2014
Measurement Location	Semi Anechoic Chamber
Measuring Distance	3 m for 9 KHz to 18 GHz 1 m for 18 GHz to 40 GHz
Detector	Quasi-peak, except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz where an Average detector is used.
Requirement	As per the limits mentioned in the below table
Ancillary equipment	See section 2.4
Environmental conditions	Temperature: + 18 - 20 °C Relative Humidity: 20 - 40 %

Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Distance of Measurement (m)
0.009 – 0.490	2400/F(kHz)	48.50 – 13.80	300*
0.490 – 1.705	24000/F(kHz)	33.80 – 23.00	30*
1.705 -30	30	29.54	30*
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Remark: * The limit shows in the table above of frequency range 0.009 – 0.490, 0.490 – 1.705 MHz and 1.705-30MHz is at 300 meter, 30 meter and 30 meter range respectively, which corresponds to 128.51 – 93.80, 73.80 – 62.96 and 69.54 dBμV/m at 3m range by extrapolation calculation and the measurement of loop antenna.

For measurements above 18GHz the measurement was performed at 1m distance, the limit line has been adjusted for this using the following formula: Extrapolation (dB) = 20log (3meter / 1meter) = +9,54db

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector.

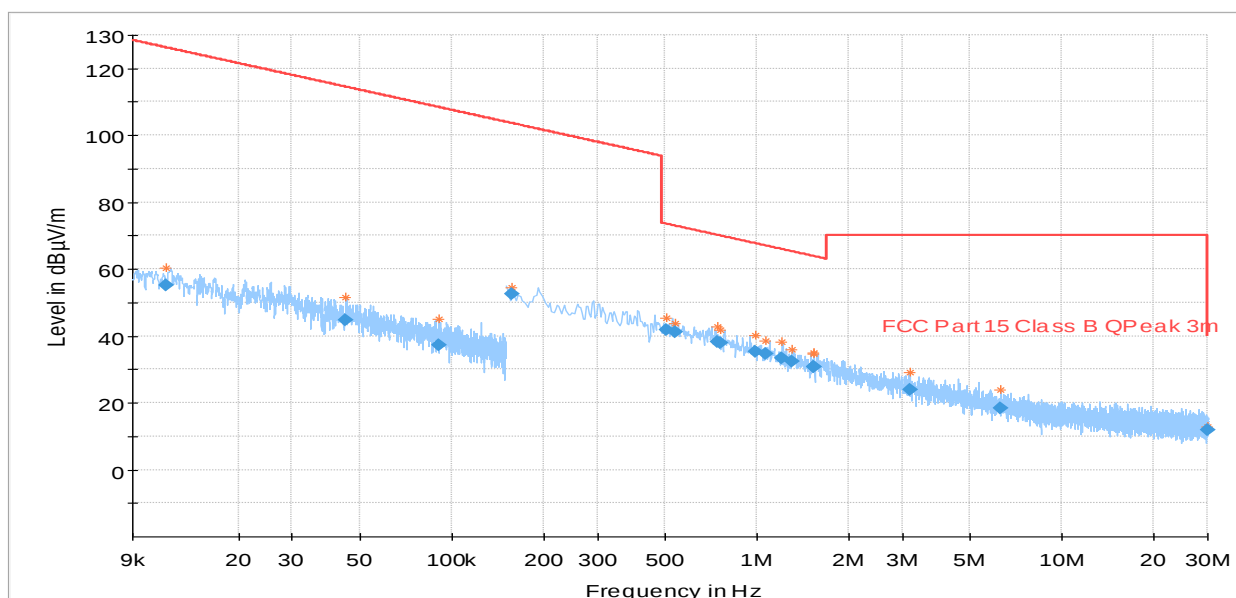
6.1 Test setups

Test	Constellation (see also notes below)	EUT Radio	Result
1	EUT(A000225900-002) + DC Power supply (A000225900-023)	IEEE 802.15.4 protocol	PASS

6.2 Test results

6.2.1 Channel frequency 2405 MHz (Low)

Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Perpendicular to axis	
Channel frequency	2405 MHz (Low)	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-11
Environmental conditions	Temperature: 18,8 °C	Humidity: 28,4 %
Chamber details	Chamber: SAC 5	Test 14

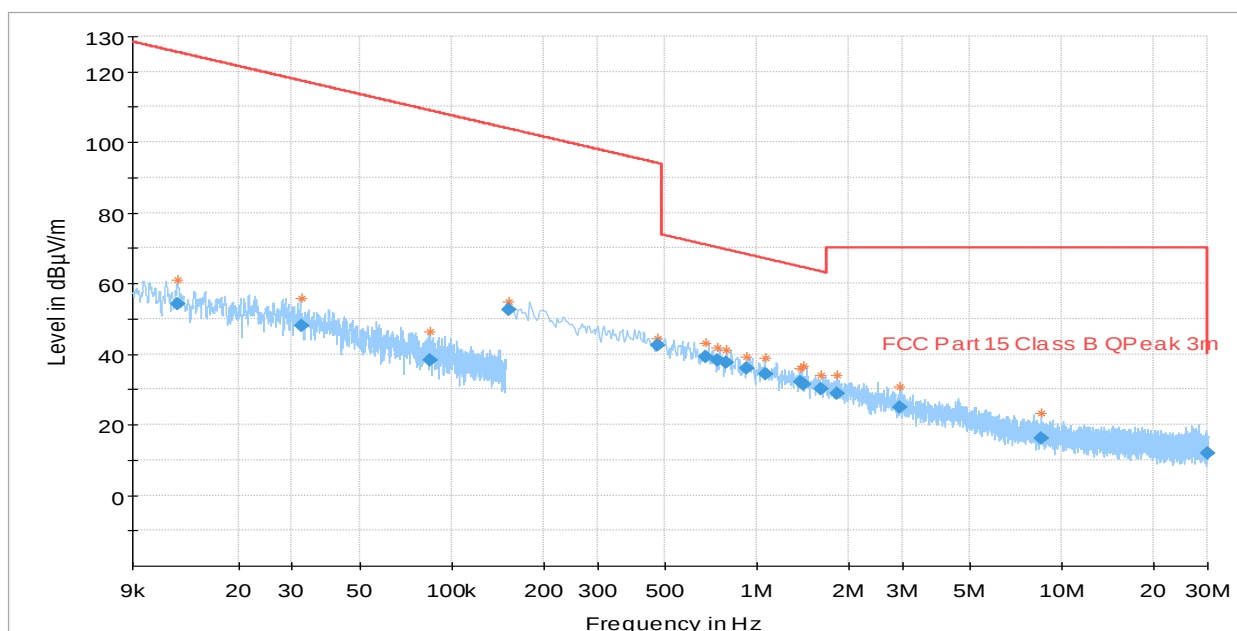


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.505614	41.93	73.53	31.60	9.000	100.0	H	184.0
0.542511	41.24	72.92	31.68	9.000	100.0	H	22.0
0.741618	38.13	70.21	32.08	9.000	100.0	H	316.0
0.762084	37.85	69.98	32.12	9.000	100.0	H	292.0
0.992253	35.44	67.69	32.25	9.000	100.0	H	68.0
1.074207	34.56	67.00	32.45	9.000	100.0	H	47.0

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Parallel to axis	
Channel frequency	2405 MHz (Low)	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-11
Environmental conditions	Temperature: 18,8 °C	Humidity: 28,4 %
Chamber details	Chamber: SAC 5	Test 15

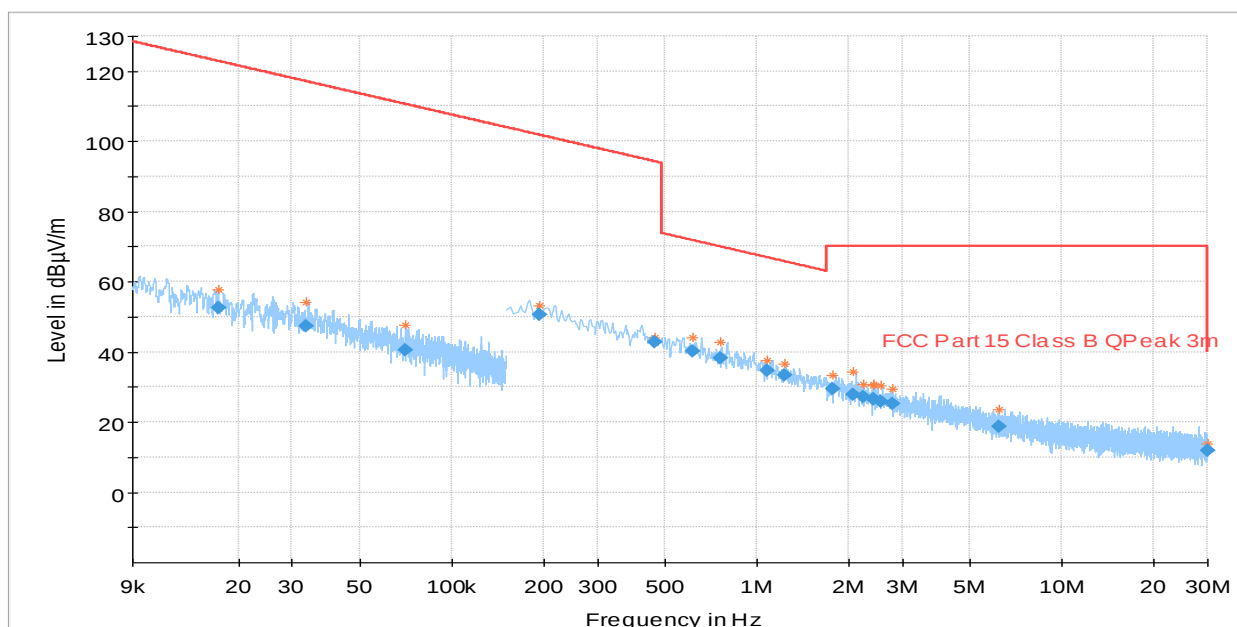


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.677616	39.09	70.99	31.90	9.000	100.0	H	205.0
0.745086	38.18	70.17	31.99	9.000	100.0	H	70.0
0.790464	37.45	69.66	32.21	9.000	100.0	H	160.0
0.921957	36.05	68.33	32.27	9.000	100.0	H	225.0
1.069446	34.38	67.04	32.66	9.000	100.0	H	19.0
1.383942	32.06	64.81	32.74	9.000	100.0	H	199.0

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Parallel to Ground	
Channel frequency	2405 MHz (Low)	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-11
Environmental conditions	Temperature: 18,8 °C	Humidity: 28,4 %
Chamber details	Chamber: SAC 5	Test 23

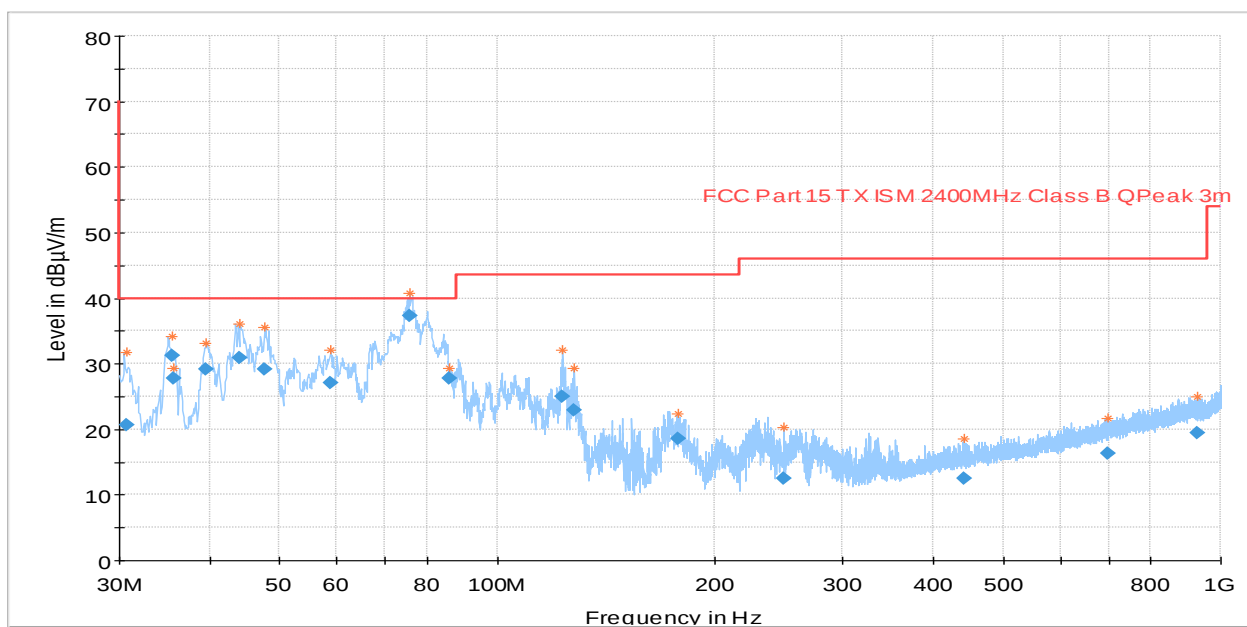


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.617445	40.27	71.80	31.52	9.000	100.0	H	157.0
0.758547	38.10	70.02	31.91	9.000	100.0	H	108.0
1.082922	34.78	66.93	32.16	9.000	100.0	H	244.0
1.226793	33.34	65.85	32.51	9.000	100.0	H	179.0
1.774842	29.44	70.10	40.66	9.000	100.0	H	-1.0
2.078763	27.82	70.10	42.28	9.000	100.0	H	90.0

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Horizontal and Vertical	
Channel frequency	2405 MHz (Low)	
Sweep frequency	30 MHz – 1 GHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-08
Environmental conditions	Temperature: 18,9 °C	Humidity: 32,0 %
Chamber details	Chamber: SAC 5	Test 1



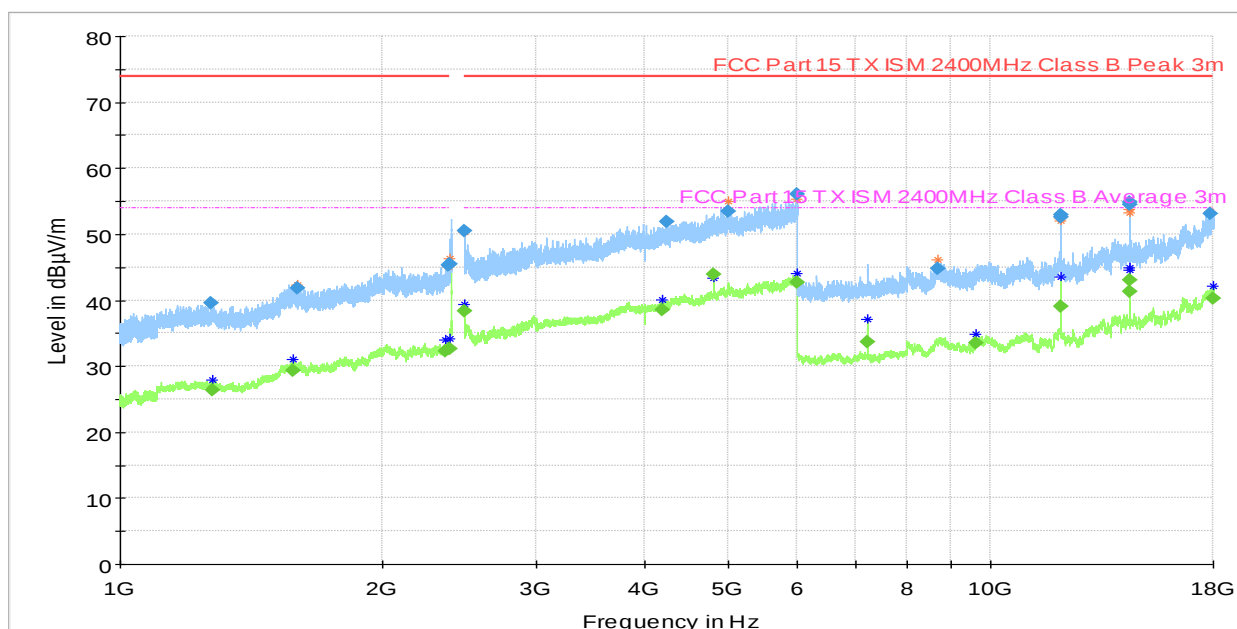
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
35.48404	31.29	40	8.71	120	100	V	-23
35.72504	27.84	40	12.16	120	100	V	22
39.57252	29.17	40	10.83	120	100	V	155
43.96816	30.96	40	9.04	120	100	V	206
47.63876	29.17	40	10.83	120	100	V	-19
75.79224*	37.25	40	2.75*	120	175	V	317

*Remark: Emission at 75.79224 MHz is closer to the margin than the given measurement uncertainty for the used measurement system. This emission peaks could be challenged please consider this. For this frequency the measurement uncertainties is 3, 38 dB (given in section 8 in this rapport with a 95% confidence).

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Horizontal and Vertical	
Channel frequency	2405 MHz (Low)	
Sweep frequency	1 GHz – 18 GHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-10
Environmental conditions	Temperature: 19,1 °C	Humidity: 31,5 %
Chamber details	Chamber: SAC 5	Test 6

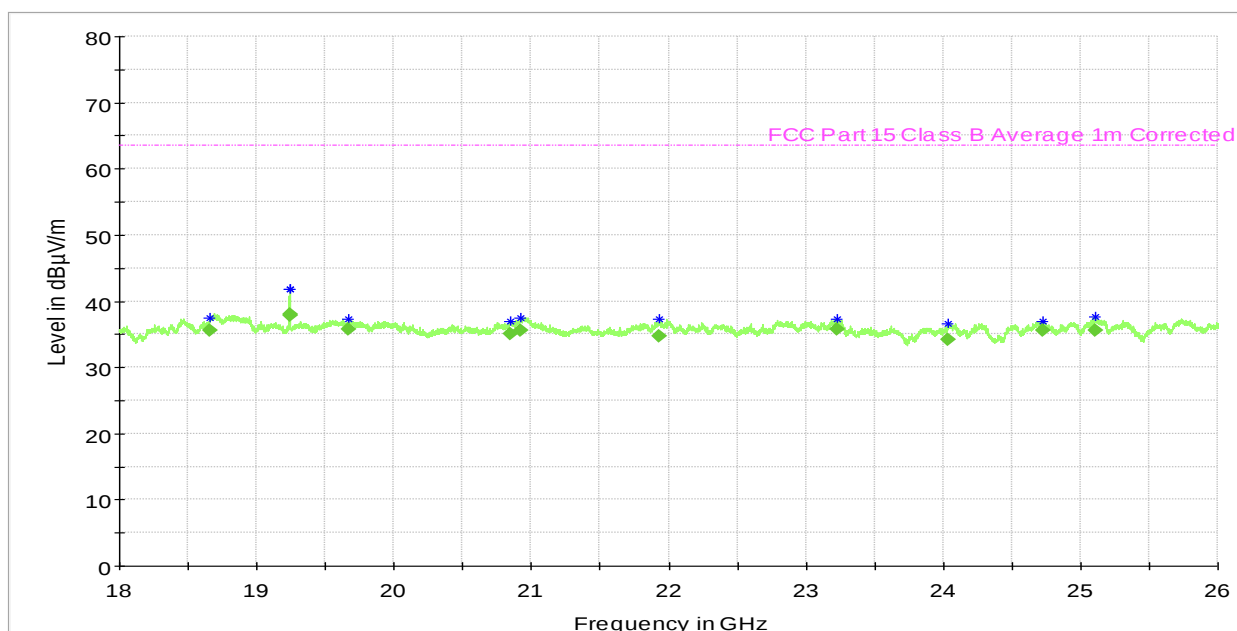


Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
2391.32	32.63	---	---	1000	115	H	188
4809.806	43.89	54	10.11	1000	102	V	307
5981.18	42.72	54	11.28	1000	188	H	262
14426.266	41.22	54	12.78	1000	115	V	225
14432.359	43.04	54	10.96	1000	210	H	220
17978.23	40.3	54	13.7	1000	102	V	40

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Horizontal and Vertical	
Channel frequency	2405 MHz (Low)	
Sweep frequency	18 GHz – 26 GHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-12
Environmental conditions	Temperature: 19,1 °C	Humidity: 24,9 %
Chamber details	Chamber: SAC 5	Test 26



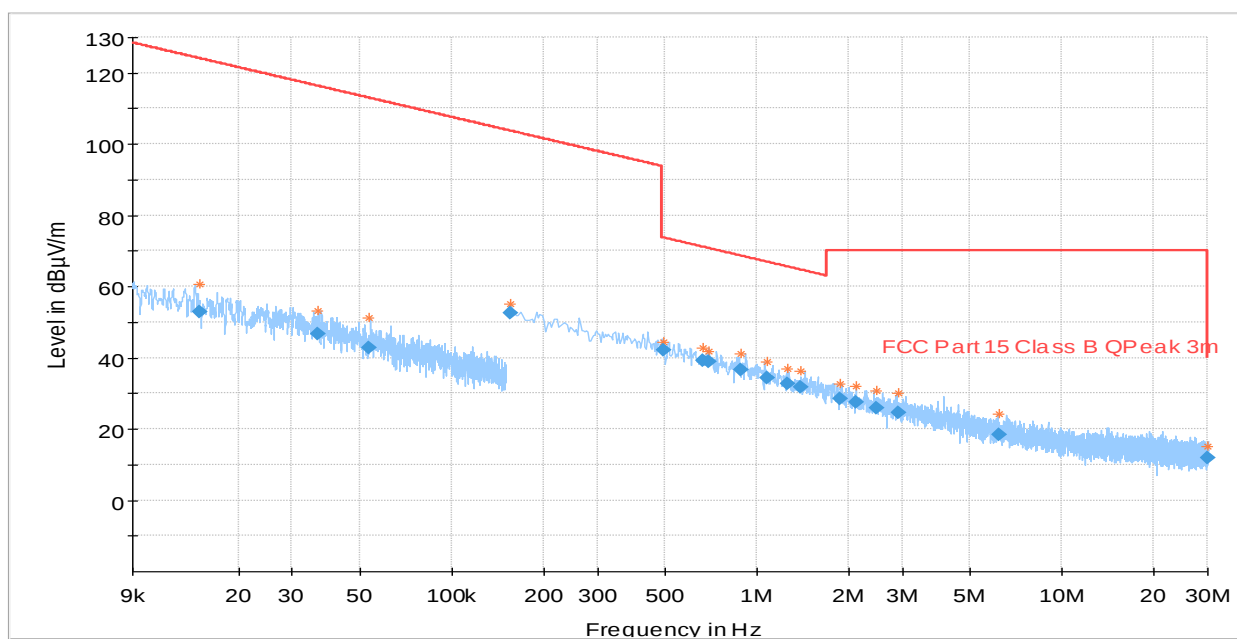
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
19243.193	37.95	63.52	25.57	1000	155	H	161
19243.222	37.91	63.52	25.61	1000	155	H	161
19671.423	35.8	63.52	27.72	1000	155	H	127
20920.826	35.65	63.52	27.87	1000	155	H	142
23231.058	35.75	63.52	27.77	1000	155	H	-8
24720.23	35.66	63.52	27.86	1000	155	H	247

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6.2.2 Channel frequency 2445 MHz (Mid)

Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Perpendicular to axis	
Channel frequency	2445 MHz (Mid)	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-11
Environmental conditions	Temperature: 18,8 °C	Humidity: 28,4 %
Chamber details	Chamber: SAC 5	Test 18

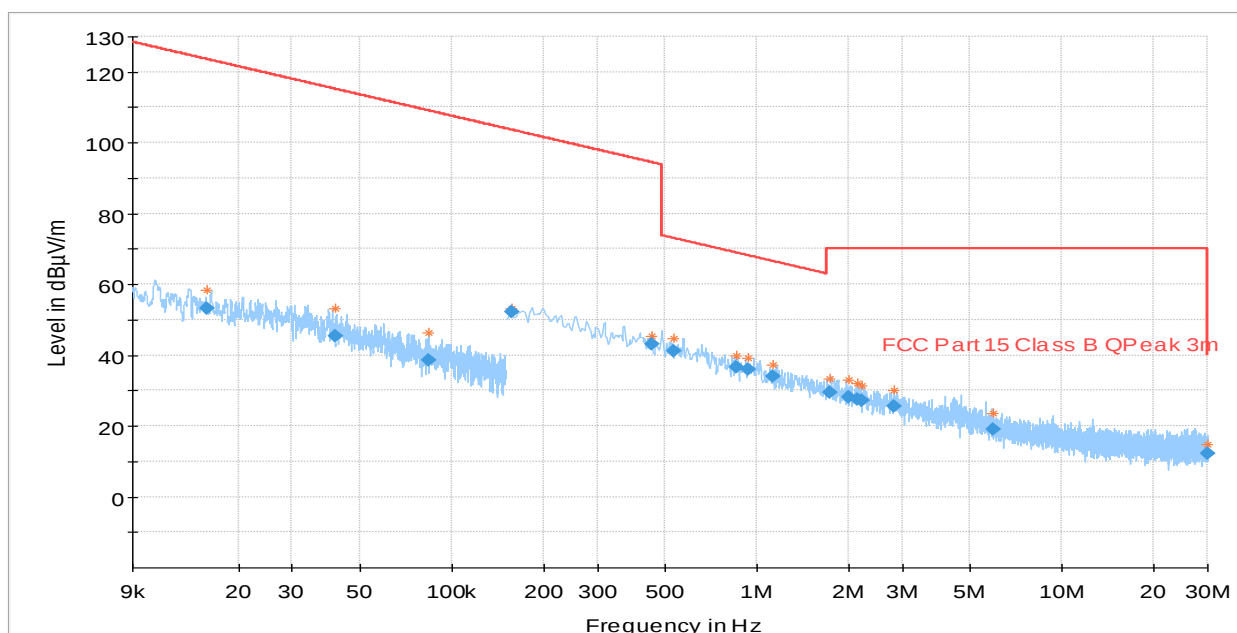


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.493236	42.22	73.74	31.52	9.000	100.0	H	45.0
0.665373	39.24	71.15	31.91	9.000	100.0	H	-20.0
0.697014	38.78	70.75	31.96	9.000	100.0	H	247.0
0.882072	36.51	68.71	32.20	9.000	100.0	H	243.0
1.084014	34.33	66.92	32.60	9.000	100.0	H	290.0
1.262043	32.85	65.61	32.76	9.000	100.0	H	112.0

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Parallel to axis	
Channel frequency	2445 MHz (Mid)	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-11
Environmental conditions	Temperature: 18,8 °C	Humidity: 28,4 %
Chamber details	Chamber: SAC 5	Test 17

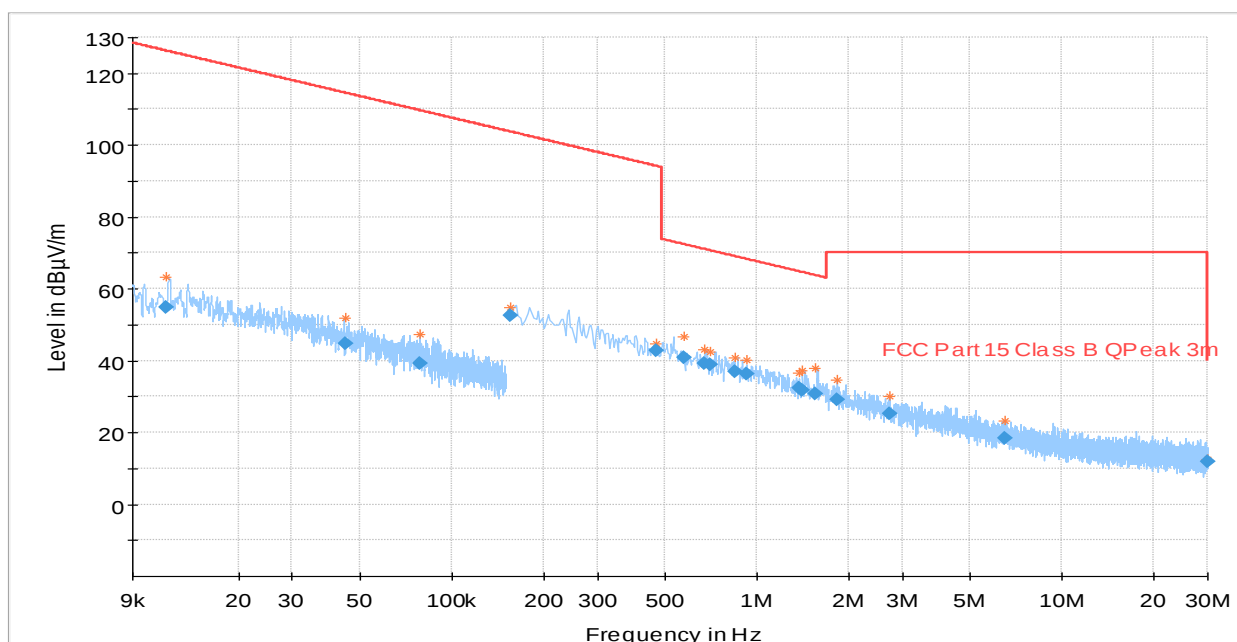


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.535548	41.31	73.03	31.72	9.000	100.0	H	-20.0
0.853710	36.72	68.99	32.27	9.000	100.0	H	338.0
0.936156	35.89	68.19	32.30	9.000	100.0	H	205.0
1.128042	33.99	66.58	32.59	9.000	100.0	H	22.0
1.732272	29.46	70.10	40.64	9.000	100.0	H	-1.0
1.990734	28.25	70.10	41.85	9.000	100.0	H	153.0

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Parallel to Ground	
Channel frequency	2445 MHz (Mid)	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-11
Environmental conditions	Temperature: 18,8 °C	Humidity: 28,4 %
Chamber details	Chamber: SAC 5	Test 22

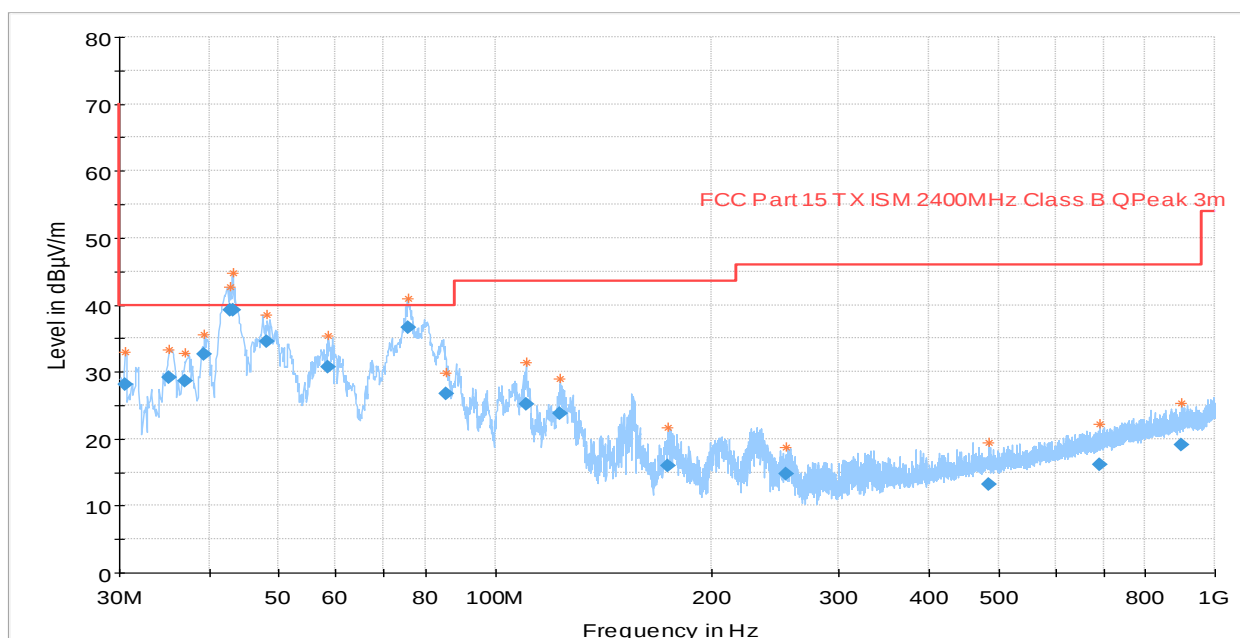


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.576648	40.88	72.39	31.5	9	100	H	67
0.673413	39.31	71.05	31.74	9	100	H	67
0.702825	38.93	70.68	31.74	9	100	H	338
0.852648	37.05	69	31.96	9	100	H	292
0.923943	36.41	68.31	31.89	9	100	H	115
1.371942	32.34	64.88	32.54	9	100	H	70

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Horizontal and Vertical	
Channel frequency	2445 MHz (Mid)	
Sweep frequency	30 MHz – 1 GHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-09
Environmental conditions	Temperature: 19,1 °C	Humidity: 31,5 %
Chamber details	Chamber: SAC 5	Test 2



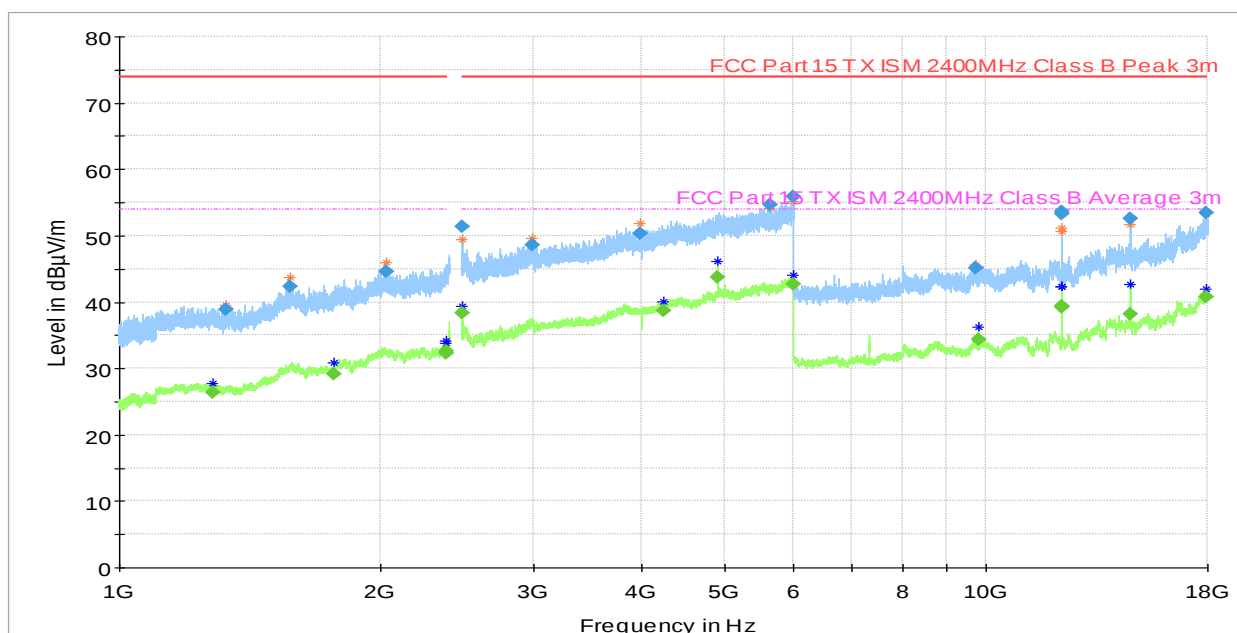
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
30.528709	28.12	40	11.88	120	100	V	113
35.23616	29.13	40	10.87	120	100	V	292
37.07416	28.66	40	11.34	120	100	V	157
42.86116*	39.28	40	0.72*	120	100	V	-18
43.11012*	39.24	40	0.76*	120	100	V	314
85.5338	26.77	40	13.23	120	104	V	-23

*Remark: Emission at (42.86116 and 43.11012) MHz is closer to the margin than the given measurement uncertainty for the used measurement system. This emission peaks could be challenged please consider this. For this frequency the measurement uncertainties is 3, 38 dB (given in section 8 in this rapport with a 95% confidence).

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Horizontal and Vertical	
Channel frequency	2445 MHz (Mid)	
Sweep frequency	1 GHz – 18 GHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-10
Environmental conditions	Temperature: 19,0 °C	Humidity: 29,9 %
Chamber details	Chamber: SAC 5	Test 9

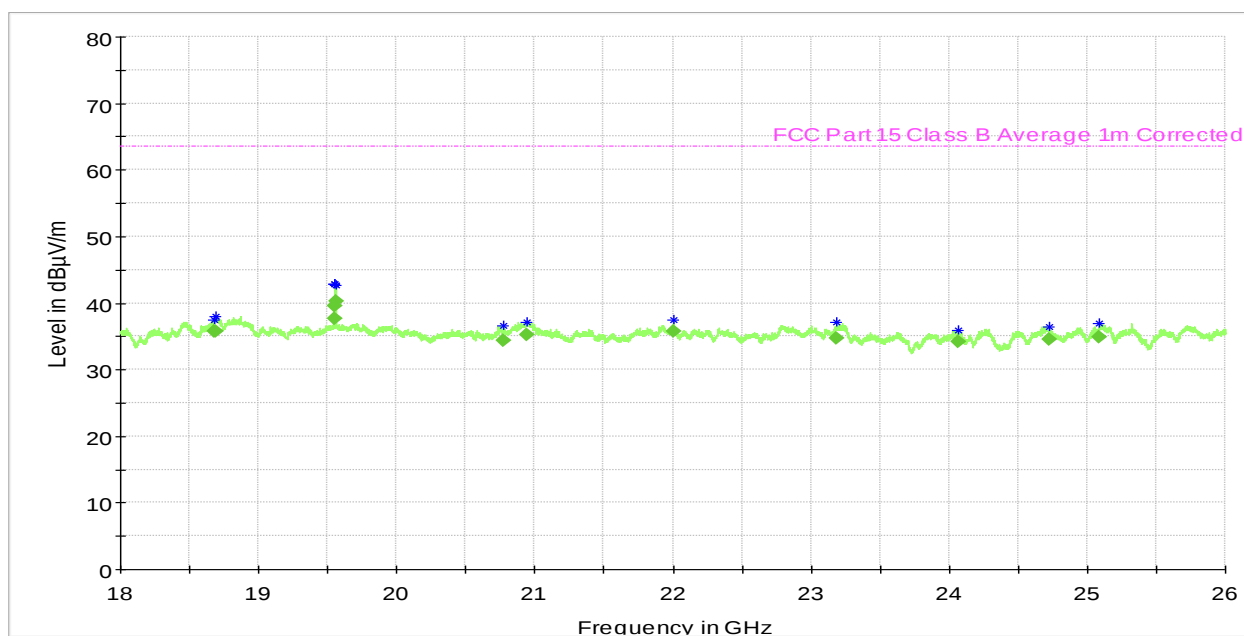


Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
4244.224	38.69	54	15.31	1000	135	V	41
4889.831	43.71	54	10.29	1000	100	V	187
5981.017	42.69	54	11.31	1000	165	V	37
12226.845	39.14	54	14.86	1000	102	V	1
12226.874	39.41	54	14.59	1000	101	V	41
17898.634	40.72	54	13.28	1000	165	V	232

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Horizontal and Vertical	
Channel frequency	2445 MHz (Mid)	
Sweep frequency	18 GHz – 26 GHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-12
Environmental conditions	Temperature: 19,1 °C	Humidity: 24,9 %
Chamber details	Chamber: SAC 5	Test 27



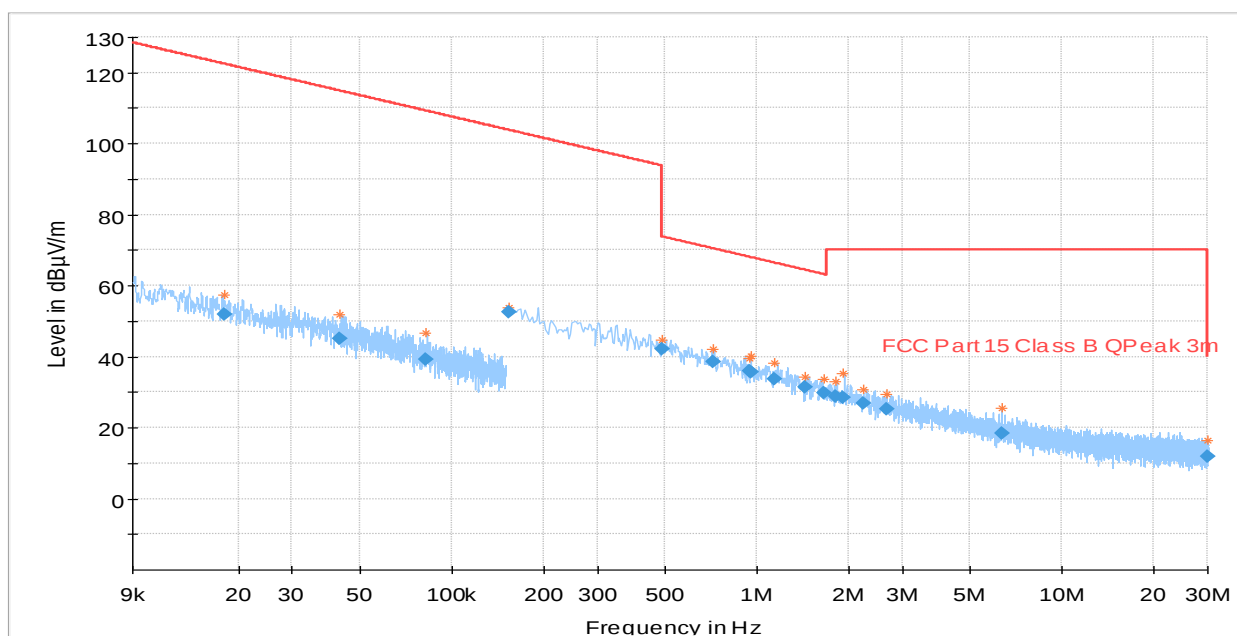
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
18676.525	35.68	63.52	27.84	1000	155	V	161
18685.429	35.77	63.52	27.75	1000	155	V	307
19555.121	37.6	63.52	25.92	1000	155	H	-4
19555.129	39.63	63.52	23.89	1000	155	H	5
19563.14	40.27	63.52	23.25	1000	155	H	4
22008.534	35.73	63.52	27.79	1000	155	H	280

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6.2.3 Channel frequency 2480 MHz (High)

Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Perpendicular to axis	
Channel frequency	2480 MHz (High)	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-11
Environmental conditions	Temperature: 18,8 °C	Humidity: 28,4 %
Chamber details	Chamber: SAC 5	Test 19

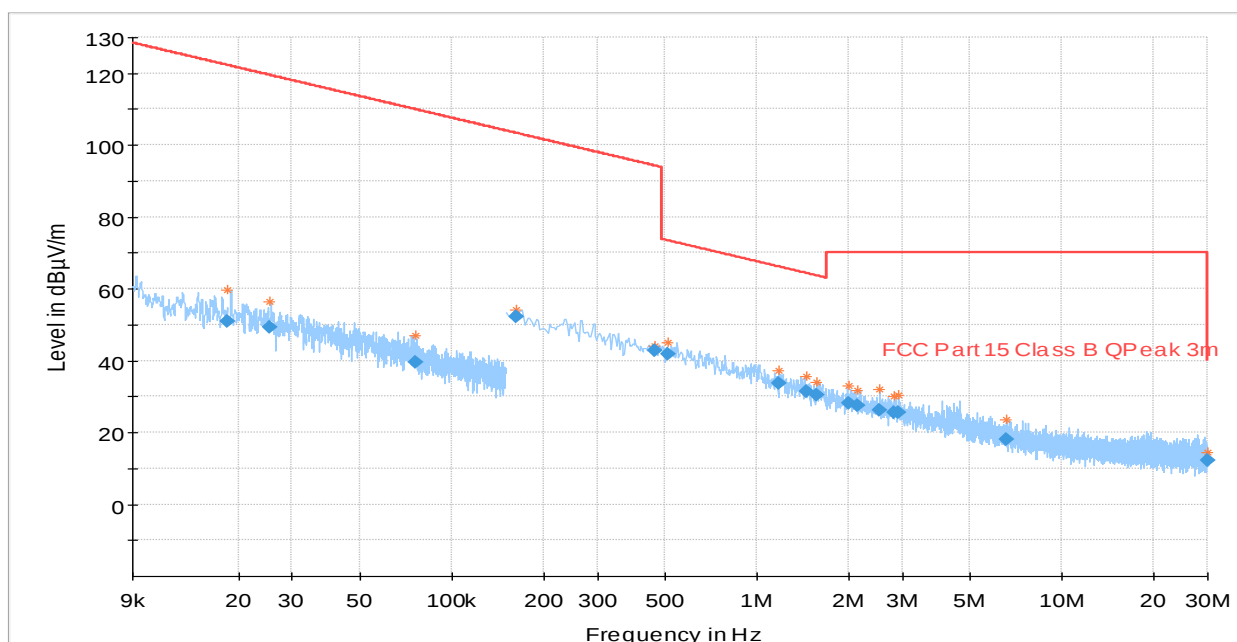


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.722067	38.43	70.44	32.01	9	100	H	160
0.944238	35.83	68.12	32.29	9	100	H	109
0.959031	35.71	67.98	32.28	9	100	H	44
1.143726	33.82	66.46	32.64	9	100	H	205
1.44558	31.3	64.43	33.13	9	100	H	157
1.657845	29.92	63.24	33.32	9	100	H	-23

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Parallel to axis	
Channel frequency	2480 MHz (High)	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-11
Environmental conditions	Temperature: 18,8 °C	Humidity: 28,4 %
Chamber details	Chamber: SAC 5	Test 20

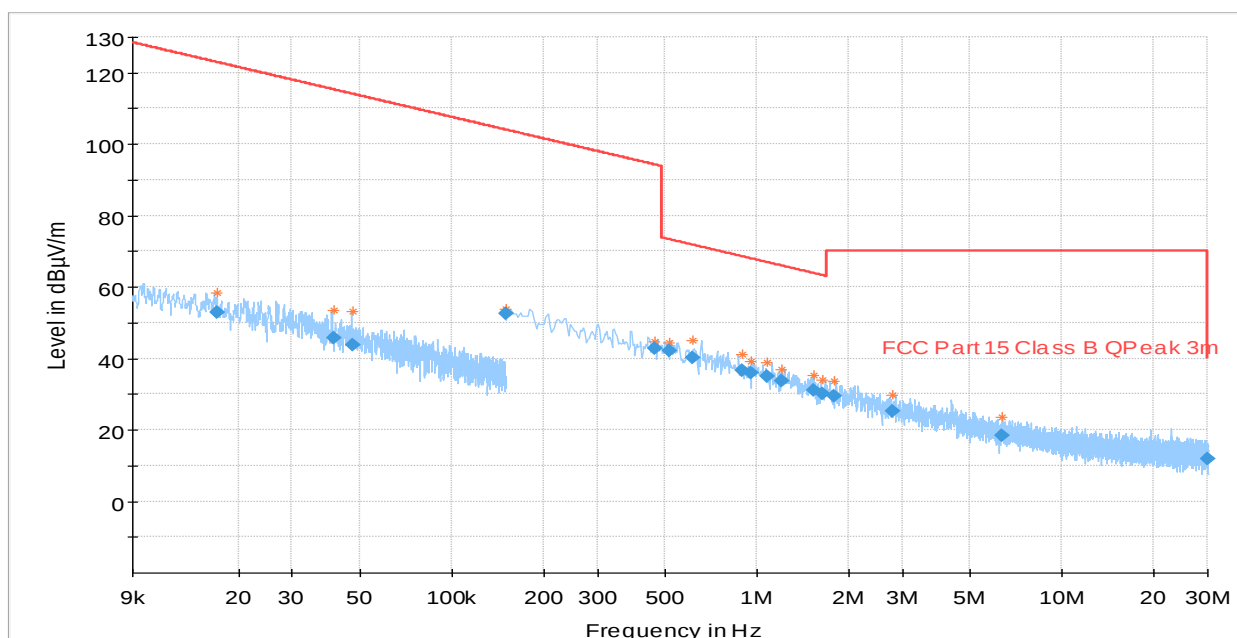


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.513444	41.71	73.40	31.69	9.000	100.0	H	225.0
1.179987	33.59	66.19	32.60	9.000	100.0	H	273.0
1.456014	31.29	64.37	33.08	9.000	100.0	H	0.0
1.577559	30.44	63.67	33.24	9.000	100.0	H	269.0
1.994823	28.09	70.10	42.01	9.000	100.0	H	108.0
2.130135	27.54	70.10	42.56	9.000	100.0	H	338.0

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Parallel to Ground	
Channel frequency	2480 MHz (High)	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-11
Environmental conditions	Temperature: 18,8 °C	Humidity: 28,4 %
Chamber details	Chamber: SAC 5	Test 21

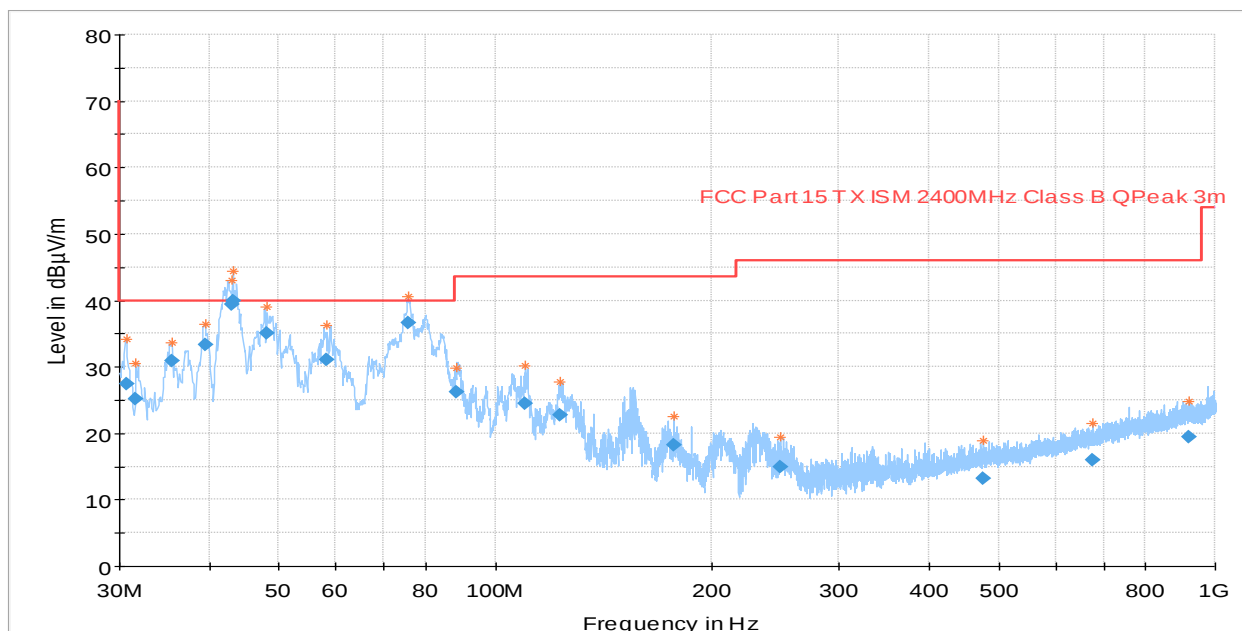


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.515592	41.99	73.36	31.37	9.000	100.0	H	292.0
0.616650	40.31	71.81	31.50	9.000	100.0	H	247.0
0.895998	36.67	68.57	31.91	9.000	100.0	H	247.0
0.958494	36.07	67.99	31.92	9.000	100.0	H	90.0
1.082145	34.86	66.94	32.08	9.000	100.0	H	288.0
1.204860	33.68	66.01	32.33	9.000	100.0	H	205.0

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Horizontal and Vertical	
Channel frequency	2480 MHz (High)	
Sweep frequency	30 MHz – 1 GHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-09
Environmental conditions	Temperature: 19,1 °C	Humidity: 31,5 %
Chamber details	Chamber: SAC 5	Test 3



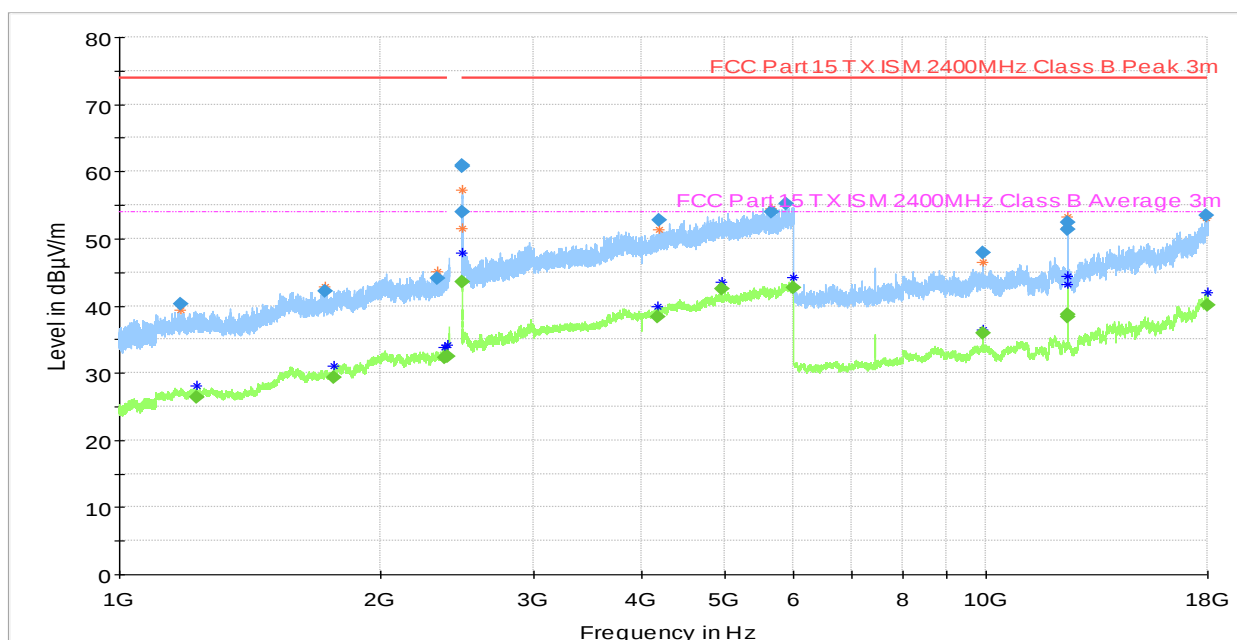
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
30.649	27.49	40	12.51	120	100	V	67
31.64452	25.19	40	14.81	120	100	V	65
42.90812*	39.44	40	0.56*	120	100	V	316
43.13508*	39.94	40	0.06*	120	100	V	64
88.21772	26.19	43.5	17.31	120	100	V	247
109.71288	24.51	43.5	18.99	120	103	V	247

Remark: Emission at (42.90812 and 43.13508) MHz is closer to the margin than the given measurement uncertainty for the used measurement system. This emission peaks could be challenged please consider this. For this frequency the measurement uncertainties is 3, 38 dB (given in section 8 in this rapport with a 95% confidence).

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Horizontal and Vertical	
Channel frequency	2480 MHz (High)	
Sweep frequency	1 GHz – 18 GHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-10
Environmental conditions	Temperature: 19,0 °C	Humidity: 29,9 %
Chamber details	Chamber: SAC 5	Test 10

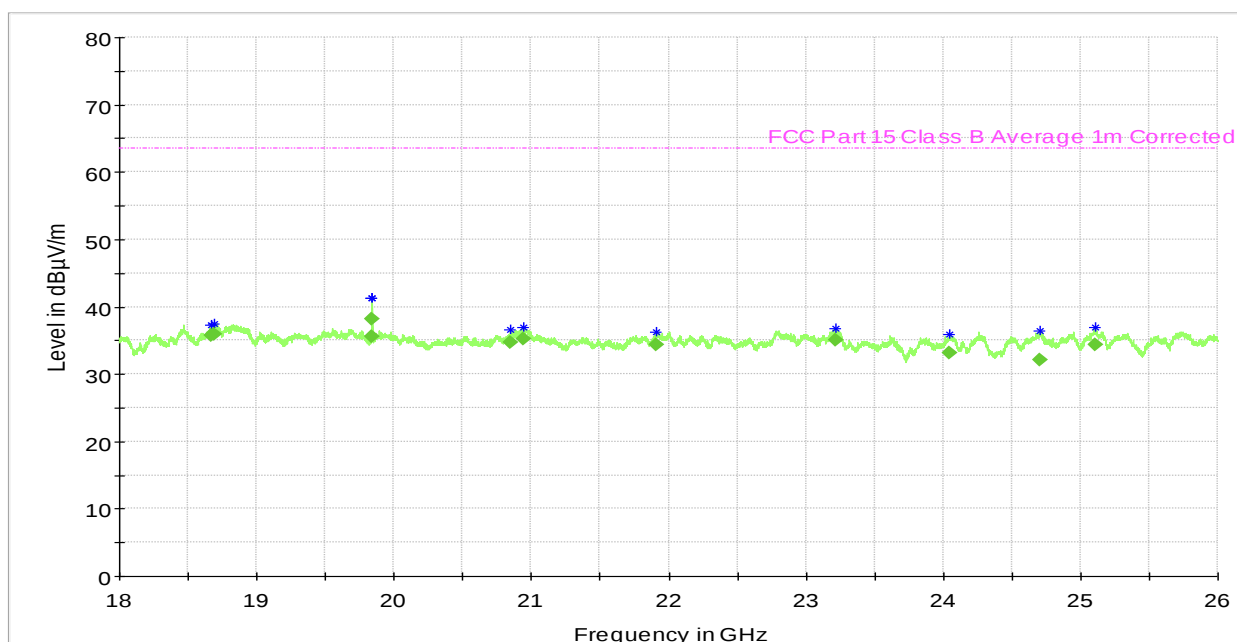


Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
2483.5126	---	61	74	13	1000	200	H	225
2483.7387	---	60.76	74	13.24	1000	150	H	225
2483.7675	43.59	---	54	10.41	1000	198	H	217
4959.847	42.43	---	54	11.57	1000	115	H	-8
5981.729	42.63	---	54	11.37	1000	115	V	232
17971.782	40.03	---	54	13.97	1000	145	H	172

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Test mode condition	IEEE 802.15.4 protocol	
Antenna orientation	Horizontal and Vertical	
Channel frequency	2480 MHz (High)	
Sweep frequency	18 GHz – 26 GHz	
Standard	FCC Part 15 subpart C	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-12
Environmental conditions	Temperature: 19,1 °C	Humidity: 24,9 %
Chamber details	Chamber: SAC 5	Test 28



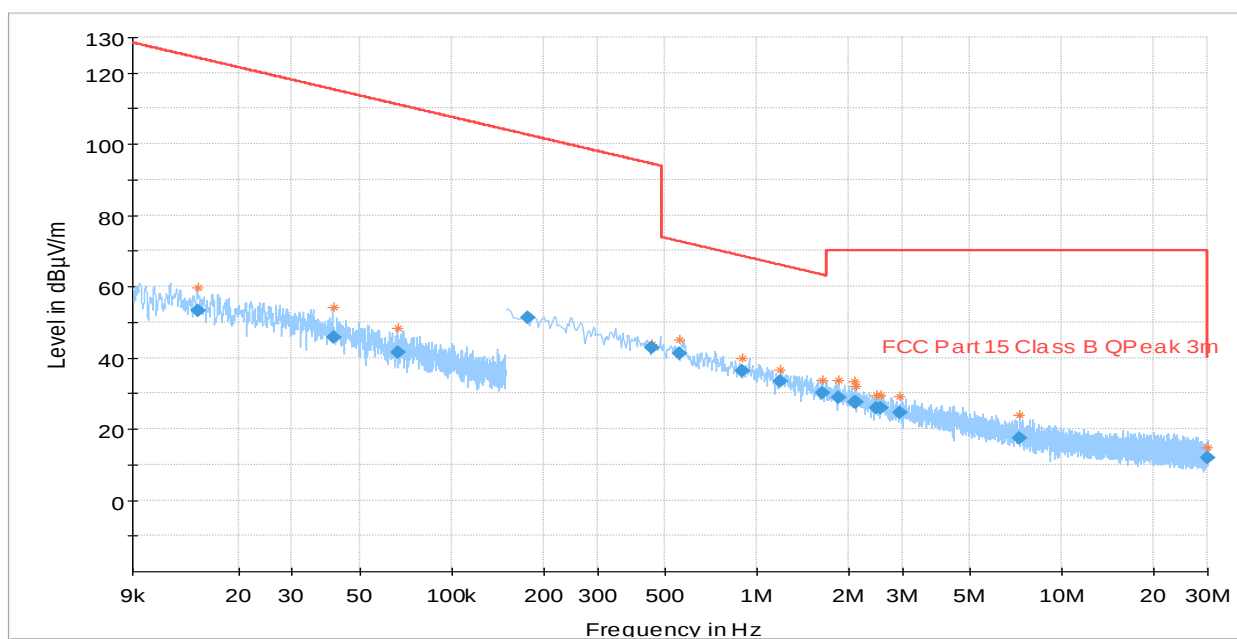
Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
18674.569	35.77	63.52	27.75	1000	155	V	-8
18689.893	35.95	63.52	27.57	1000	155	V	37
19843.064	35.53	63.52	27.99	1000	155	H	7
19843.166	38.17	63.52	25.35	1000	155	H	7
20940.028	35.23	63.52	28.29	1000	155	V	67
23220.888	35.12	63.52	28.4	1000	155	V	202

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6.2.4 Idle

Test mode condition	Radio Idle – All other functions active	
Antenna orientation	Perpendicular to axis	
Channel frequency	Idle	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart B (Part 15.109)	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-10
Environmental conditions	Temperature: 19,0 °C	Humidity: 29,9 %
Chamber details	Chamber: SAC 5	Test 13

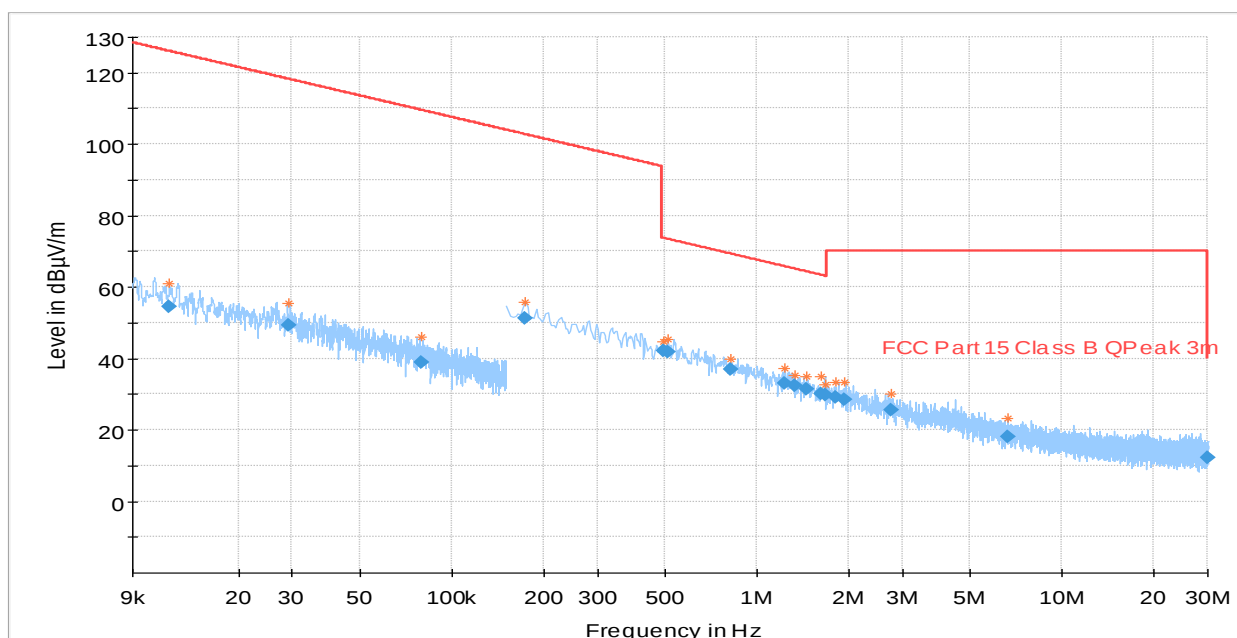


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.557157	41.15	72.69	31.54	9.000	100.0	H	180.0
0.900486	36.20	68.53	32.33	9.000	100.0	H	338.0
1.188984	33.50	66.12	32.62	9.000	100.0	H	115.0
1.643904	30.06	63.32	33.26	9.000	100.0	H	338.0
1.850214	28.85	70.10	41.25	9.000	100.0	H	90.0
2.095491	27.66	70.10	42.44	9.000	100.0	H	-20.0

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Test mode condition	Radio Idle – All other functions active	
Antenna orientation	Parallel to axis	
Channel frequency	Idle	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart B (Part 15.109)	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-11
Environmental conditions	Temperature: 18,8 °C	Humidity: 28,4 %
Chamber details	Chamber: SAC 5	Test 16

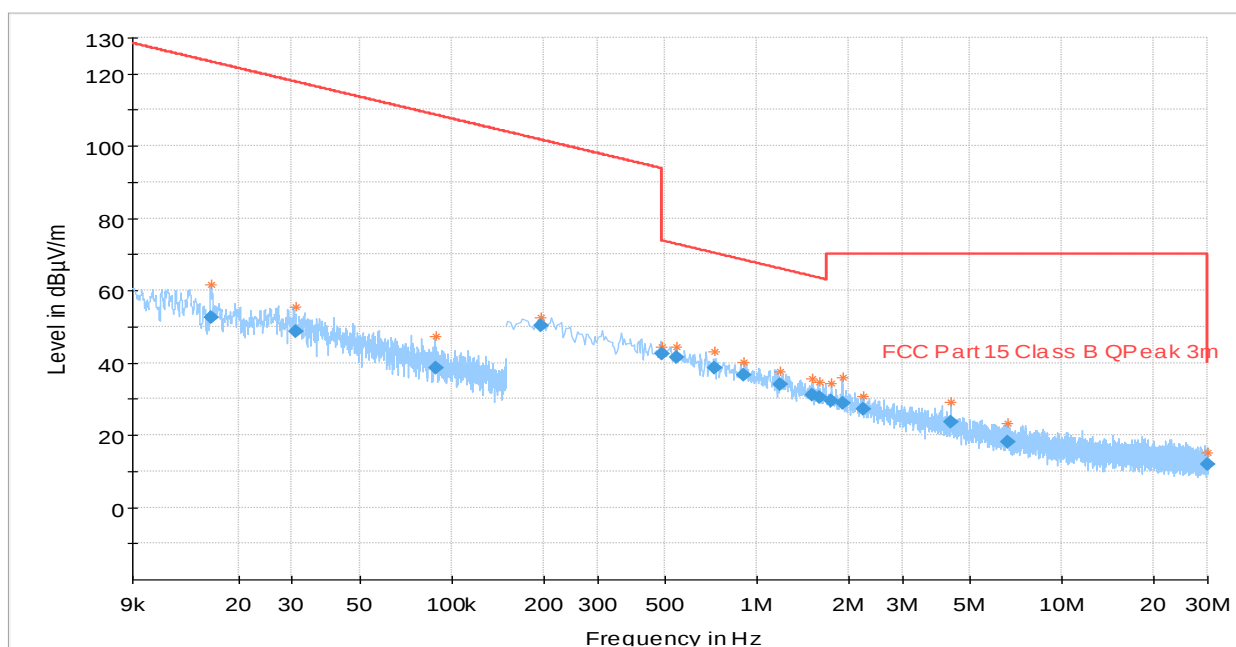


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.493347	42.07	73.74	31.68	9	100	H	0
0.509019	41.81	73.47	31.66	9	100	H	1
0.824715	37.01	69.29	32.28	9	100	H	22
1.235838	33.1	65.79	32.69	9	100	H	22
1.324299	32.33	65.19	32.85	9	100	H	250
1.457217	31.34	64.36	33.02	9	100	H	90

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Test mode condition	Radio Idle – All other functions active	
Antenna orientation	Parallel to Ground	
Channel frequency	Idle	
Sweep frequency	9 KHz - 30 MHz	
Standard	FCC Part 15 subpart B (Part 15.109)	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-11
Environmental conditions	Temperature: 18,8 °C	Humidity: 28,4 %
Chamber details	Chamber: SAC 5	Test 24

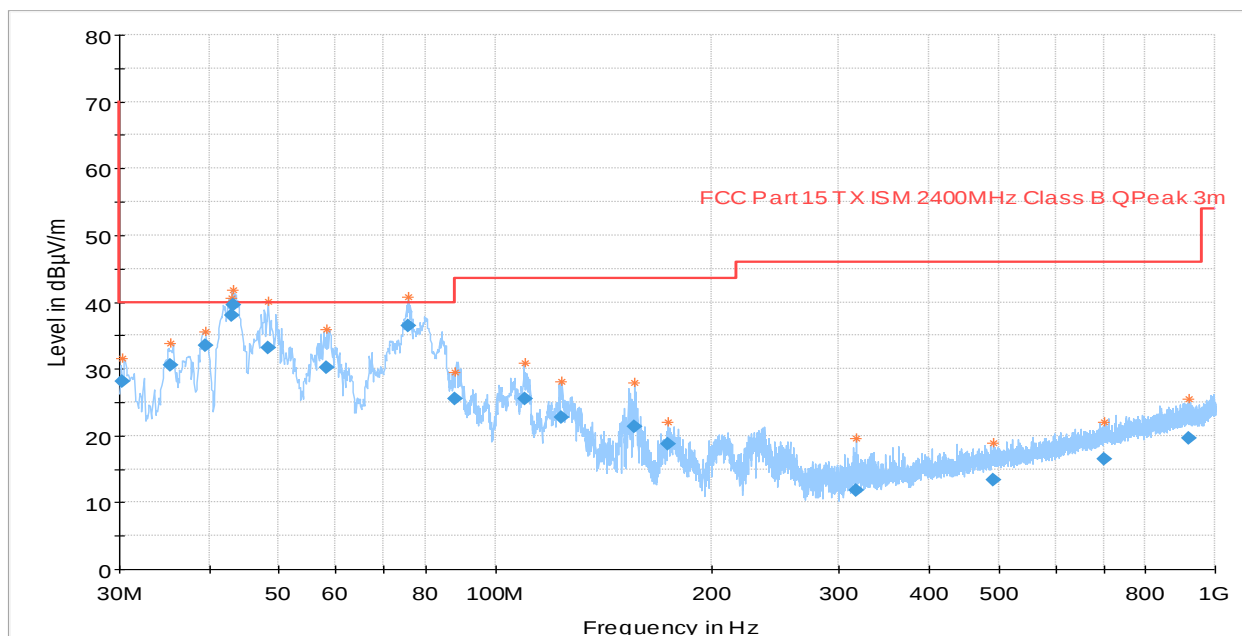


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
0.543039	41.49	72.91	31.42	9	100	H	112
0.724467	38.62	70.41	31.79	9	100	H	70
0.901443	36.6	68.52	31.92	9	100	H	46
1.188951	33.85	66.12	32.27	9	100	H	108
1.518699	31	64	33	9	100	H	179
1.611567	30.58	63.49	32.91	9	100	H	292

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Test mode condition	Radio Idle – All other functions active	
Antenna orientation	Horizontal and Vertical	
Channel frequency	Idle	
Sweep frequency	30 MHz – 1 GHz	
Standard	FCC Part 15 subpart B (Part 15.109)	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-09
Environmental conditions	Temperature: 19,1 °C	Humidity: 31,5 %
Chamber details	Chamber: SAC 5	Test 4



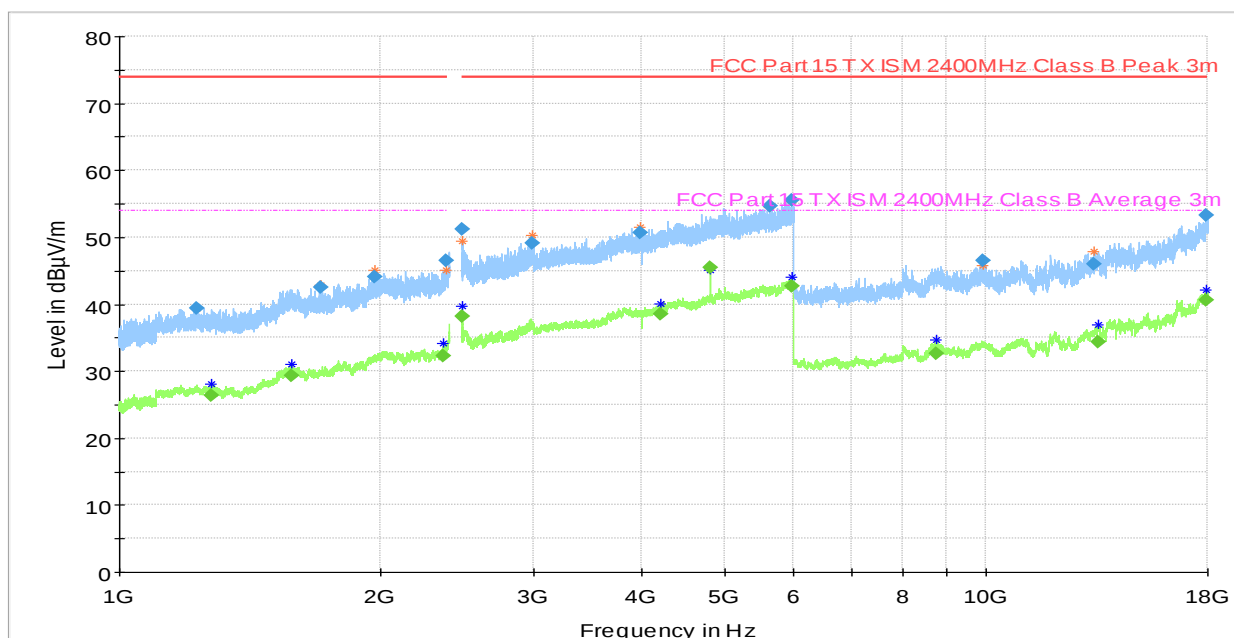
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
30.220906	28.06	40	11.94	120	100	V	157
42.95688*	38.08	40	1.92*	120	125	V	184
43.22396*	39.54	40	0.46*	120	100	V	296
87.75636	25.59	40	14.41	120	125	V	296
110.02824	25.45	43.5	18.05	120	175	V	202
123.27912	22.75	43.5	20.75	120	175	V	203

*Remark: Emission at (42.95688 and 43.22396) MHz is closer to the margin than the given measurement uncertainty for the used measurement system. This emission peaks could be challenged please consider this. For this frequency the measurement uncertainties is 3, 38 dB (given in section 8 in this rapport with a 95% confidence).

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Test mode condition	Radio Idle – All other functions active	
Antenna orientation	Horizontal and Vertical	
Channel frequency	Idle	
Sweep frequency	1 GHz – 18 GHz	
Standard	FCC Part 15 subpart B (Part 15.109)	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-09
Environmental conditions	Temperature: 1,1 °C	Humidity: 31,5 %
Chamber details	Chamber: SAC 5	Test 5

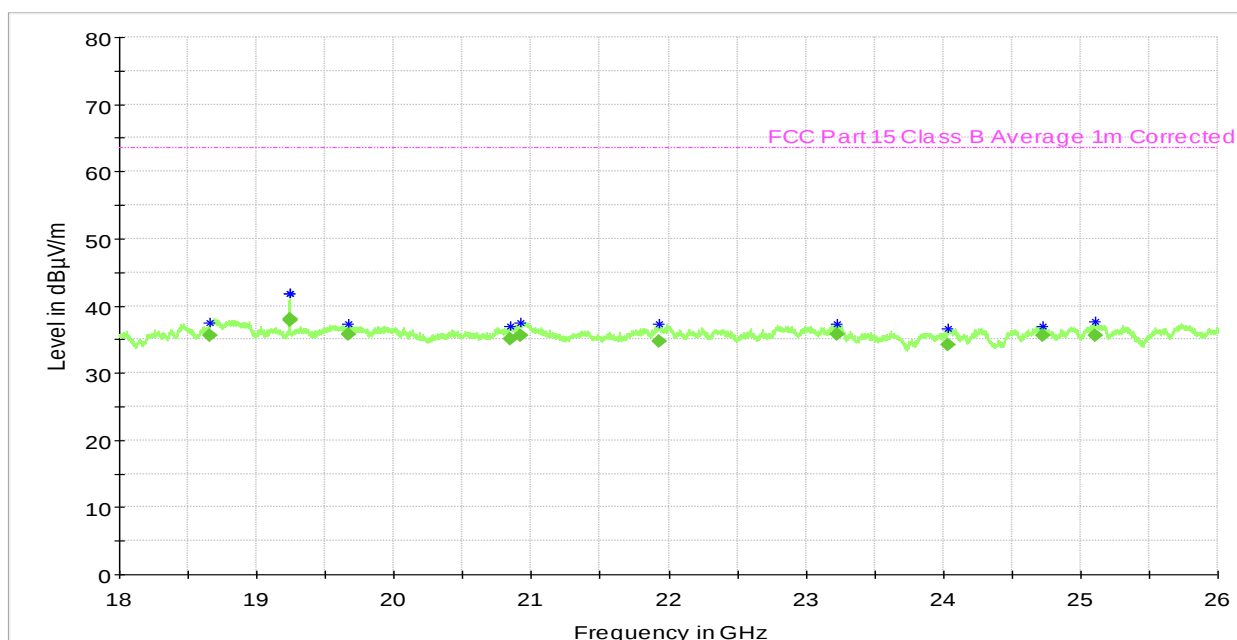


Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
2483.611	38.17	---	54	15.83	1000	115	V	277
4206.965	38.6	---	54	15.4	1000	100	V	307
5639.43	---	54.66	74	19.34	1000	100	V	0
5971.04	42.7	---	54	11.3	1000	165	H	266
5976.863	---	55.55	74	18.45	1000	150	H	90
17909.687	40.52	---	54	13.48	1000	101	V	142

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Test mode condition	Radio Idle – All other functions active	
Antenna orientation	Horizontal and Vertical	
Channel frequency	Idle	
Sweep frequency	18 GHz – 26 GHz	
Standard	FCC Part 15 subpart B (Part 15.109)	
EUT	A000225900-002	
Ancillary Equipment	DC power supply A000225900-023	
Test Engineer	Martin Stump	Date: 2019-04-12
Environmental conditions	Temperature: 19,1 °C	Humidity: 24,9 %
Chamber details	Chamber: SAC 5	Test 25



Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height(cm)	Pol	Azimuth (deg)
19243.193	37.95	63.52	25.57	1000	155	H	161
19243.222	37.91	63.52	25.61	1000	155	H	161
19671.423	35.8	63.52	27.72	1000	155	H	127
20920.826	35.65	63.52	27.87	1000	155	H	142
23231.058	35.75	63.52	27.77	1000	155	H	-8
24720.23	35.66	63.52	27.86	1000	155	H	247

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7 TEST EQUIPMENT LIST

SAC 5 – Radiated emissions

Type:	Manufacturer	Model	Serial Number	GTEM ID	Calibration date	Calibration Due:
EMI Test Receiver	Rohde & Schwarz	ESW44	101760	2881044	27.07.2018	27.07.2019
Active Loop Antenna	EMCO	6502	9206-2775	2759035	31.10.2018	31.10.2019
Ultra Broadband Antenna	Rohde & Schwarz	HL562E	100988	2823181	08.03.2018	08.03.2020
Double Ridged Waveguide Horn Antenna	Rohde & Schwarz	HF907	102678	2823164	13.02.2018	13.02.2020
Horn Antenna – 18 GHz – 26 GHz	ETS Lindgren	UG-596A/U	20898	2814839	10.08.2018	10.08.2019
Horn Antenna – 26 GHz - 40 GHz	ETS Lindgren	UG-600A/U	20623	2814834	10.08.2018	10.08.2019
Frequency Multiplier	Rohde & Schwarz	SMZ-90	101350	2886126	13.08.2018	13.08.2019
Control device	Maturo	NCD	NCD/393/2 372.01	2884216	N/A	N/A
Open Switch & Control Unit	Rohde & Schwarz	OSP150	100081	2884198	09.09.2018	09.09.2019
Open Switch & Control Unit	Rohde & Schwarz	OSP120	100084	2761253	09.09.2018	09.09.2019
Shielded Filter Unit	Rohde & Schwarz	OSP-F Extension 1	101333	2761265	09.09.2018	09.09.2019
Shielded Filter Unit	Rohde & Schwarz	OSP-F Extension 2	101335	2761266	09.09.2018	09.09.2019
Shielded Filter Unit	Rohde & Schwarz	OSP-F Base Unit	101330	2761262	09.09.2018	09.09.2019
Humidity Temperature Probe	Rotronic	HF532-DG1XX21X	006182928 0	2926379	14.08.2018	14.08.2020

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Conducted emissions						
Type:	Manufacturer	Model	Serial Number	GTEM ID	Calibration date	Calibration Due:
Two-Line V-network	Rohde & Schwarz	ENV216	845268/010	2704076	09.05.2018	09.05.2019
Test Receiver 9KHz to 3.5 GHz	Rohde & Schwarz	ESR3	101674	2704016	19.07.2018	19.07.2019
Transformer	RS Pro	880-2609		2983757	-	-
AC Power source	Schaffner	NSG 1007	L07538	2704051	-	-

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8 MEASUREMENT UNCERTAINTY

Measurement uncertainty has been calculated according to the principles contained in EN 55016-4-2:2011

Measurement Uncertainty for Conducted Emission (Coverage Factor k=2)	
Parameter	Uncertainty
Conducted emissions with LISN 150KHz to 30 MHz	2,98

Measurement Uncertainty for Radiated Emission (Coverage Factor k=2)	
Parameter	Uncertainty
Field Strength 10 Hz -9 kHz	3,38 dB
Field Strength 9 kHz -30 MHz	3,38 dB
Field Strength 30 MHz -1000 MHz	3,38 dB
Field Strength 1 GHz -18 GHz	4,88 dB
Field Strength 18 GHz - 40 GHz	5,14 dB

9 APPENDIX 1 – TEST SETUP PHOTOS

See report no. 60266363-002 Appendix 1