

Test report

Number: T251-0110/19 A1

Project file: C20190486

Date: 2019-02-11

Pages: 58

Product: IoT module

Type reference: NB S

Ratings: 12 Vdc (adapter 100-240 V~; 50/60 Hz)
Protection class: I

Trademark: COMODULE

Applicant: COMODULE OÜ
Dunkri 9, EE-10123 Talin, Estonia

Manufacturer: COMODULE OÜ
Dunkri 9, EE-10123 Talin, Estonia

Place of manufacture: Oshino Electronics Estonia OÜ
J.V. Jannseni 26, EE-80010 Pärnu, Estonia

Summary of testing

Testing method: 47 CFR Part 15, Subpart B (Clause 15.107 and 15.109)

Testing location: SIQ Ljubljana, Mašera-Spasičeva ulica 10, SI-1000 Ljubljana, Slovenia

Remarks: Date of receipt of test items: 2019-02-01
Number of items tested: 2
Date of performance of tests: 2019-02-04 - 2019-02-07
The test results presented in this report relate only to the items tested.
The product complies with the requirements of the testing methods.

/

Tested by: Aljaž Bajec



Approved by: Marjan Mak



The report shall not be reproduced except in full.



CONTENTS	page
<u>1 GENERAL</u>	<u>3</u>
1.1 EQUIPMENT UNDER TEST	3
1.2 OPERATING MODES	4
1.3 ANSI C63.4 SUBPART SELECTION	5
1.4 CLASS STATEMENT REQUIREMENTS	5
1.5 OCCUPIED BANDWIDTH MEASUREMENT	5
1.6 QUASI-PEAK DETECTOR	5
1.7 PEAK, RMS, AND AVERAGE DETECTORS	5
<u>2 LIMITS FOR ALL SUBPARTS</u>	<u>6</u>
2.1 SUBPART B: UNINTENTIONAL RADIATORS	6
2.2 SUBPART C: INTENTIONAL RADIATORS	7
<u>3 ALL TEST EQUIPMENT AND THEIR DESCRIPTION</u>	<u>8</u>
3.1 GENERAL INFORMATION	8
3.2 OTHER INSTRUMENT INFORMATION AND AUXILIARY EQUIPMENT	9
<u>4 CONVERSION FACTORS AND ALL OTHER FORMULAS</u>	<u>29</u>
<u>5 GENERAL AND SPECIAL CONDITIONS DESCRIPTION</u>	<u>30</u>
5.1 GENERAL CONDITION DESCRIPTION	30
5.2 SPECIAL CONDITION DESCRIPTION	33
<u>6 TEST SUMMARY</u>	<u>34</u>
6.1 OPERATING VOLTAGES/FREQUENCIES USED FOR TESTING	34
<u>7 EMISSION TESTS</u>	<u>35</u>
7.1 CONDUCTED EMISSION MEASUREMENT (UNINTENTIONAL RADIATOR)	35
7.2 RADIATED EMISSION MEASUREMENT (UNINTENTIONAL RADIATOR)	42

1 GENERAL

History sheet			
Date	Report No.	Change	Revision
2019-02-07	T251-0110/19	Initial Test Report issued.	--
2019-02-11	T251-0110/19 A1	Correction of initial test report issued due to missing photo of Radiated emission above 1000 MHz.	1.0

Environmental conditions:

Ambient temperature: 15 °C to 35 °C

Relative humidity: 30 % to 60 %

Atmospheric pressure: 860 mbar to 1060 mbar

1.1 Equipment under test

IoT module

Type: NB S

Tested SIQ sample number: S20191069 (only radiated emission test)
S20191070

Auxiliary equipment used during testing:

- AC/DC adapter: Switching power supply XPOWER, model no.: VEL05US120-EU-JA

Input: 100-240 V~; 50/60 Hz; 0.18 A

Output: 12 vdc; 0.42 A max

Input/Output ports:

Port No.	Name	Type*	Cable Length / m	Cable Shielded	Connected during tests	Comments
0	Enclosure	N/E	—	—	—	/
1	DC Power input port	DC	2.06	No	To AC/DC adapter	In bundle
2	Extension cable	AC	1.42	No	To AC mains	/

*Note: AC = AC Power Port DC = DC Power Port
I/O = Signal Input or Output Port TP = Telecommunication Ports
GND = grounding N/E = Non-Electrical



Picture of EUT

Pictures of AC/DC adapter:



1.2 Operating modes

No.	Operating mode
1	Normal operating of device, GPS and GSM active during the tests

1.3 ANSI C63.4 Subpart selection

Subpart B: Unintentional Radiators

Subpart C: Intentional Radiators

1.4 Class statement requirements

- The Class A statement cautions that operation of the device in a residential area is likely to cause harmful interference.
- The Class B statement offers several suggestions for minimizing interference to radio or TV receivers, including reorienting the receiving antenna and moving the Class B device farther away from the receiver.

1.5 Occupied bandwidth measurement

Fundamental frequency	Minimum resolution bandwidth
9 kHz to 30 MHz	1 kHz
30 to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

1.6 Quasi-peak detector

Frequency range	Bandwidth (-6dB)
10 Hz to 20 kHz	Full range (wideband)
10 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz
30 MHz to 1 GHz	120 kHz

1.7 Peak, rms, and average detectors

Frequency range	Bandwidth (-6dB)
10 Hz to 20 kHz	10, 100, 1000 Hz
10 kHz to 150 kHz	1 and 10 kHz
150 kHz to 30 MHz	1 and 10 kHz
30 MHz to 1 GHz	10 and 100 kHz
1 GHz to 40 GHz	0.1, 1.0 and 10 MHz

2 LIMITS FOR ALL SUBPARTS

2.1 Subpart B: Unintentional Radiators

2.1.1 Conducted emission limits (according to FCC15):

CLASS B limits:

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.5	66 – 56*	56 – 46*
0.5 to 5.0	56	46
5.0 to 30.0	60	50

* Decreases with the logarithm of the frequency.

CLASS A limits:

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.5	79	66
0.5 to 30.0	73	60

2.1.2 Radiated emission limits (according to FCC15):

CLASS B limits:

Frequency Range (MHz)	Limits (dB μ V/m)		Test distance (m)
	VERTICAL	HORIZONTAL	
30 to 88	40	40	3
88 to 216	43.5	43.5	3
216 to 960	46	46	3
Above 960	54	54	3

CLASS A limits:

Frequency Range (MHz)	Limits (dB μ V/m)		Test distance (m)
	VERTICAL	HORIZONTAL	
30 to 88	39	39	10
88 to 216	43.5	43.5	10
216 to 960	46.4	46.4	10
Above 960	49.5	49.5	10

2.2 Subpart C: Intentional Radiators

2.2.1 Conducted emission limits:

CLASS B limits:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.5	66 – 56*	56 – 46*
0.5 to 5.0	56	46
5.0 to 30.0	60	50

* Decreases with the logarithm of the frequency.

The shown limits in table shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

- For carrier current systems containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.
- For all other carrier current systems: 1000 μV within the frequency band 535-1705 kHz, as measured using a 50 μH/50 ohms LISN.
- Carrier current systems operating below 30 MHz are also subject to the radiated emission limits as appropriate.

2.2.2 Radiated emission limits:

CLASS B limits:

Frequency Range (MHz)	Limits (dBμV/m)		Test distance (m)
	VERTICAL	HORIZONTAL	
0,009 to 0,490	$20 \cdot \log(2400/F(\text{kHz}))$	$20 \cdot \log(2400/F(\text{kHz}))$	300
0,490 to 1,705	$20 \cdot \log(24000/F(\text{kHz}))$	$20 \cdot \log(24000/F(\text{kHz}))$	30
1,705 to 30,0	29.5	29.5	30
30 to 88	40**	40**	3
88 to 216	43.5**	43.5**	3
216 to 960	46**	46**	3
Above 960	54	54	3

** Except as provided in paragraph below, fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz.

Perimeter protection systems may operate in the 54-72 MHz and 76-88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

NOTE: For special limits refer to standard

3 ALL TEST EQUIPMENT AND THEIR DESCRIPTION

3.1 General information

Description	Model No.	SIQ No.	Last calibration	Calibrated until	Calibration period	Used
Rohde-Schwarz, RFI receiver	ESU8	105187	2017-11	2019-11	24 months	X
Rohde-Schwarz, RFI receiver	ESU26	100428	2018-02	2020-02	24 months	X
Rohde & Schwarz, Artificial main network	ESH2-Z5	106899	2017-05	2019-05	24 months	
Rohde & Schwarz, Artificial main network	ENV216	106765	2018-09	2020-09	24 months	X
Comtest Engineering, Semi Anechoic Chamber SAC 1	SAC 3m	NPS001	2017-05	2019-05	24 months	
Comtest Engineering, Semi Anechoic Chamber SAC 2	SAC 3m	NPS002	2017-05	2019-05	24 months	X
Rohde & Schwarz, Horn Antenna	HF907 (SN 102508)	102508	2018-05	2020-05	24 months	
Rohde & Schwarz, Ultra Broadband Antenna	HL562E (SN 100842)	100842	2017-07	2019-07	24 months	
Rohde & Schwarz, Horn Antenna	HF907 (SN 102494)	102494	2018-05	2020-05	24 months	X
Rohde & Schwarz, Ultra Broadband Antenna	HL562E (SN 100843)	100843	2017-07	2019-07	24 months	X
Maturo, Turn table (2 m diameter)	TT 2.0 SI	/	N/A	N/A	N/A	X
Maturo, Bore-sight antenna mast	BAM-4.0-P	/	N/A	N/A	N/A	X
Maturo, Multi-channel positioning equipment	Maturo NCD	/	N/A	N/A	N/A	X
Schwarzbeck, Biconical antenna	VHBB9124 (SN 9124-317)	105112	2018-11	2020-11	24 months	X
Rohde & Schwarz, Loop Antenna	FMZB 1519 B	/	2018-08	2020-08	24 months	

3.2 Other instrument information and auxiliary equipment

Description	Model No.	Bandwidth	Detector functions	Antenna factors	Cable loss	Range
Rohde-Schwarz, AMN	ENV216	/	/	/	/	9 kHz – 30 MHz
Rohde & Schwarz, Artificial main network	ESH 2-Z5	/	/	/	/	9 kHz – 30 MHz
Rohde-Schwarz, RFI receiver	ESU8	200Hz, 9kHz, 120kHz, 1MHz	Peak, Q-peak, Average	/	/	20 Hz – 8 GHz
Rohde-Schwarz, RFI receiver	ESU26	200Hz, 9kHz, 120kHz, 1MHz	Peak, Q-peak, Average	/	/	20 Hz – 26.5 GHz
Hewlett Packard, RF Spectrum Analyzer	8593E	200Hz, 9kHz, 120kHz, 1MHz	Peak, Q-peak, Average	/	/	9 kHz – 26.5 GHz
Comtest Engineering, Semi Anechoic Chamber SAC 1	SAC 3m	/	/	/	/	30 MHz – 18 GHz
Comtest Engineering, Semi Anechoic Chamber SAC 2	SAC 3m	/	/	/	/	30 MHz – 18 GHz
Rohde & Schwarz, Horn Antenna	HF907 (SN 102508)	/	/	See section 3.2.2	/	0.8 GHz – 18 GHz
Rohde & Schwarz, Ultra Broadband Antenna	HL562E (SN 100842)	/	/	See section 3.2.2	/	30 MHz – 6 GHz
Rohde & Schwarz, Horn Antenna	HF907 (SN 102494)	/	/	See section 3.2.2	/	0.8 GHz – 18 GHz
Rohde & Schwarz, Ultra Broadband Antenna	HL562E (SN 100843)	/	/	See section 3.2.2	/	30 MHz – 6 GHz
Schwarzbeck, Biconical antenna	VHBB9124 (SN 9124-317)	/	/	See section 3.2.2	/	30 MHz – 300 MHz
Rohde & Schwarz, Loop Antenna	FMZB 1519 B	/	/	See section 3.2.2	/	9 kHz – 30 MHz

3.2.1 Cable loss and attenuation of radiated emission

3.2.1.1 Conducted emission cable (SIQ-K024)

Point	Frequency (9kHz-30MHz)	Cable length (meters)	Loss (dB)
1	190 kHz	1	0,4
2	530 kHz	1	0,26
3	2,53 MHz	1	0,16
4	5,19 MHz	1	0,07
5	11,05 MHz	1	0,03
6	22,01 MHz	1	0,06
7	24,03 MHz	1	0,04

3.2.1.2 Radiated emission attenuation

Point	Frequency (30 MHz – 26,5 GHz)	Attenuation (dB)
1	30 MHz	0,501
2	150 MHz	1,174
3	400 MHz	2,034
4	800 MHz	2,995
5	1 GHz	3,416
6	1,363	1,666667
7	2,686	3,583333
8	5,332	5,25
9	7,978	6,25
10	10,624	7,5
11	13,27	8,333333
12	15,916	9,166666
13	18,562	9,833333
14	21,208	10,666667
15	23,854	11,5
16	26,5	12,166667

3.2.2 Antenna factors

3.2.2.1 Antenna VHBB9124

Frequency (MHz)	Antenna factor VHBB9124 (SN 9124-317)
20	15,3
21	15,1
22	14,8
23	14,5
24	14,3
25	14,1
26	13,8
27	13,6
28	13,3
29	13,1
30	12,6
31	12,4
32	12,2
33	12,0
34	11,8
35	11,7
36	11,4
37	11,3
38	11,1
39	11,0
40	10,8
41	10,7
42	10,5
43	10,3
44	10,2
45	10,1
46	9,9
47	9,9
48	9,7
49	9,7
50	9,5
51	9,5
52	9,3
53	9,3
54	9,2
55	9,1
56	9,0
57	9,0
58	9,0
59	9,0
60	9,0
61	9,0
62	8,9
63	8,9
64	8,8
65	8,8
66	8,8
67	8,9
68	8,9

69	8,9
70	8,9
71	8,9
72	8,9
73	8,9
74	8,9
75	8,9
76	8,9
77	8,9
78	8,9
79	9,0
80	9,0
81	9,0
82	9,1
83	9,0
84	9,0
85	9,0
86	9,1
87	9,1
88	9,2
89	9,2
90	9,3
91	9,3
92	9,3
93	9,3
94	9,3
95	9,3
96	9,4
97	9,4
98	9,5
99	9,5
100	9,6
102	9,7
104	9,7
106	9,9
108	10,0
110	10,2
112	10,2
114	10,3
116	10,4
118	10,5
120	10,5
122	10,7
124	10,7
126	10,8
128	10,9
130	11,0
132	11,1
134	11,2
136	11,4
138	11,5
140	11,6
142	11,8
144	11,8
146	12,0
148	11,9
150	12,0

152	12,1
154	12,4
156	12,6
158	12,8
160	12,9
162	12,9
164	13,0
166	13,0
168	12,8
170	12,8
172	12,9
174	13,0
176	13,2
178	13,3
180	13,4
182	13,5
184	13,5
186	13,5
188	13,6
190	13,7
192	13,8
194	13,8
196	13,9
198	14,0
200	14,1
202	14,2
204	14,3
206	14,4
208	14,3
210	14,4
212	14,7
214	14,6
216	14,5
218	14,5
220	14,6
222	14,4
224	14,6
226	14,8
228	14,9
230	15,0
232	15,0
234	15,0
236	15,0
238	15,2
240	15,3
242	15,3
244	15,4
246	15,3
248	15,2
250	15,2
252	15,2
254	15,4
256	15,4
258	15,5
260	15,6
262	15,7
264	15,7



266	15,8
268	15,9
270	15,9
272	16,0
274	16,0
276	16,2
278	16,2
280	16,4
282	16,7
284	16,8
286	17,0
288	16,9
290	16,9
292	17,2
294	17,4
296	17,6
298	17,9
300	18,2

3.2.2.2 Antenna FMZB 1519 B

Frequency (MHz)	Antenna factor (dB)
0,009	-30,60
0,010	-30,80
0,020	-31,80
0,030	-32,00
0,040	-32,10
0,050	-32,20
0,060	-32,20
0,070	-32,20
0,080	-32,20
0,090	-32,30
0,100	-32,30
0,150	-32,30
0,200	-32,40
0,300	-32,40
0,400	-32,40
0,500	-32,40
0,600	-32,40
0,700	-32,50
0,800	-32,50
0,900	-32,50
1,000	-32,50
2,000	-32,50
3,000	-32,50
4,000	-32,50
5,000	-32,50
6,000	-32,50
7,000	-32,50
8,000	-32,50
9,000	-32,50
10,000	-32,50
11,000	-32,50
12,000	-32,50
13,000	-32,50
14,000	-32,40
15,000	-32,40
16,000	-32,40
17,000	-32,40
18,000	-32,30
19,000	-32,30
20,000	-32,20
21,000	-32,10
22,000	-32,10
23,000	-32,00
24,000	-31,90
25,000	-31,80
26,000	-31,70
27,000	-31,60
28,000	-31,50
29,000	-31,40
30,000	-31,30



3.2.2.3 Antenna HL562E

Frequency (MHz)	Antenna factor HL562E (SN 100842)	Antenna factor HL562E (SN 100843)
30	18.12	18.17
32	17.08	17.07
34	16.01	16.00
36	14.91	14.94
38	13.76	13.75
40	12.64	12.61
42	11.43	11.40
44	10.17	10.15
46	8.86	8.81
48	7.42	7.44
50	6.01	5.96
52	4.59	4.56
54	3.38	3.37
56	2.84	2.85
58	3.06	3.14
60	3.78	3.76
62	4.44	4.40
64	5.36	5.32
66	6.19	6.18
68	6.96	6.92
70	7.56	7.52
72	8.04	8.01
74	8.38	8.35
76	8.67	8.64
78	8.88	8.85
80	9.04	9.03
82	9.14	9.09
84	9.20	9.14
86	9.22	9.16
88	9.22	9.17
90	9.21	9.17
92	9.22	9.15
94	9.22	9.16
96	9.21	9.16
98	9.22	9.17
100	9.33	9.05
105	9.38	9.39
110	9.67	9.74
115	9.55	10.33
120	10.51	9.88
125	10.15	9.87
130	9.23	9.13
135	8.79	8.71
140	8.40	8.40
145	7.93	7.82
150	7.74	7.75
155	7.68	7.76
160	7.86	7.78
165	8.47	8.33
170	9.83	9.66
175	10.29	10.30
180	7.86	7.93

185	7.19	7.27
190	7.54	7.21
195	7.32	7.20
200	7.56	7.49
205	7.56	7.68
210	7.71	7.95
215	8.68	8.29
220	8.43	8.49
225	8.51	8.62
230	8.85	8.82
235	9.10	9.05
240	9.31	9.29
245	9.33	9.33
250	9.50	9.45
255	9.71	9.64
260	9.86	9.81
265	9.95	9.90
270	10.00	10.02
275	10.15	10.15
280	10.37	10.36
285	10.58	10.61
290	10.76	10.80
295	10.84	10.90
300	10.83	11.12
305	11.38	11.37
310	11.36	11.32
315	11.53	11.48
320	11.70	11.67
325	11.84	11.81
330	11.98	11.94
335	12.32	12.13
340	12.19	12.22
345	12.29	12.35
350	12.43	12.47
355	12.59	12.61
360	12.72	12.73
365	12.83	12.81
370	12.99	12.99
375	13.08	13.10
380	13.12	13.11
385	13.21	13.20
390	13.38	13.33
395	13.54	13.50
400	13.65	13.63
405	13.74	13.73
410	13.84	13.83
415	14.14	13.96
420	14.10	14.00
425	14.13	14.08
430	14.24	14.20
435	14.40	14.40
440	14.55	14.49
445	14.70	14.65
450	14.82	14.79
455	14.89	14.91
460	14.90	15.09
465	15.16	15.19



470	15.24	15.22
475	15.31	15.25
480	15.38	15.32
485	15.48	15.43
490	15.58	15.52
495	15.66	15.60
500	15.72	15.70
505	15.74	15.75
510	15.83	15.82
515	16.05	15.92
520	15.95	15.93
525	15.97	15.97
530	16.05	16.01
535	16.09	16.07
540	16.16	16.15
545	16.21	16.21
550	16.29	16.30
555	16.38	16.41
560	16.51	16.53
565	16.67	16.68
570	16.78	16.85
575	16.87	17.02
580	17.03	17.11
585	17.06	17.08
590	17.10	17.09
595	17.15	17.13
600	17.22	17.18
605	17.28	17.25
610	17.35	17.33
615	17.42	17.37
620	17.41	17.42
625	17.48	17.48
630	17.56	17.55
635	17.67	17.65
640	17.80	17.79
645	17.94	17.95
650	18.08	18.13
655	18.16	18.12
660	18.18	18.03
665	18.12	17.99
670	18.13	18.01
675	18.19	18.09
680	18.26	18.24
685	18.42	18.41
690	18.56	18.56
695	18.62	18.61
700	18.67	18.67
705	18.70	18.74
710	18.74	18.79
715	18.81	18.86
720	18.89	18.95
725	19.09	19.09
730	19.22	19.26
735	19.17	19.23
740	19.19	19.14
745	19.14	19.10
750	19.13	19.09

755	19.17	19.10
760	19.19	19.15
765	19.24	19.21
770	19.34	19.29
775	19.37	19.36
780	19.36	19.36
785	19.43	19.41
790	19.51	19.48
795	19.59	19.56
800	19.70	19.66
805	19.83	19.79
810	19.98	19.95
815	20.07	20.04
820	20.10	19.96
825	20.11	19.92
830	20.09	19.94
835	20.09	19.96
840	20.14	20.05
845	20.19	20.11
850	20.27	20.20
855	20.36	20.29
860	20.42	20.37
865	20.46	20.44
870	20.50	20.51
875	20.52	20.55
880	20.59	20.61
885	20.70	20.69
890	20.82	20.77
895	20.89	20.83
900	20.88	20.92
905	20.83	21.08
910	20.93	21.21
915	21.19	21.17
920	21.22	21.10
925	21.09	21.03
930	20.98	21.00
935	20.95	21.00
940	20.96	21.01
945	21.00	21.04
950	21.05	21.06
955	21.09	21.07
960	21.15	21.13
965	21.23	21.20
970	21.27	21.26
975	21.31	21.30
980	21.36	21.37
985	21.43	21.44
990	21.52	21.53
995	21.63	21.64
1000	21.73	21.73

3.2.2.4 Antenna HF907

Frequency (GHz)	Antenna factor HF907 (SN 102508)	Antenna factor HF907 (SN 102494)
1.00	24.36	24.36
1.01	24.34	24.38
1.02	24.53	24.55
1.03	24.60	24.63
1.04	24.46	24.51
1.05	24.35	24.41
1.06	24.48	24.49
1.07	24.51	24.56
1.08	24.32	24.37
1.09	24.26	24.29
1.10	24.33	24.35
1.11	24.38	24.44
1.12	24.23	24.25
1.13	24.18	24.19
1.14	24.23	24.24
1.15	24.35	24.38
1.16	24.30	24.30
1.17	24.23	24.26
1.18	24.37	24.40
1.19	24.56	24.57
1.20	24.52	24.55
1.21	24.39	24.42
1.22	24.51	24.52
1.23	24.66	24.70
1.24	24.64	24.68
1.25	24.51	24.54
1.26	24.53	24.55
1.27	24.69	24.72
1.28	24.65	24.65
1.29	24.46	24.47
1.30	24.48	24.52
1.31	24.66	24.68
1.32	24.64	24.65
1.33	24.49	24.50
1.34	24.53	24.53
1.35	24.75	24.75
1.36	24.73	24.76
1.37	24.62	24.65
1.38	24.74	24.76
1.39	24.96	24.99
1.40	25.02	25.05
1.41	24.94	24.95
1.42	25.02	25.03
1.43	25.31	25.37
1.44	25.39	25.43
1.45	25.27	25.29
1.46	25.37	25.42
1.47	25.70	25.70
1.48	25.77	25.76
1.49	25.66	25.67
1.50	25.76	25.77

1.51	26.04	26.03
1.52	26.12	26.12
1.53	26.01	26.03
1.54	26.06	26.03
1.55	26.29	26.29
1.56	26.35	26.36
1.57	26.25	26.25
1.58	26.27	26.27
1.59	26.41	26.45
1.60	26.51	26.50
1.61	26.37	26.36
1.62	26.33	26.33
1.63	26.48	26.52
1.64	26.58	26.57
1.65	26.42	26.44
1.66	26.35	26.37
1.67	26.51	26.53
1.68	26.64	26.59
1.69	26.46	26.47
1.70	26.36	26.34
1.71	26.52	26.50
1.72	26.70	26.70
1.73	26.54	26.53
1.74	26.40	26.38
1.75	26.62	26.64
1.76	26.85	26.83
1.77	26.72	26.73
1.78	26.59	26.57
1.79	26.75	26.80
1.80	27.08	27.07
1.81	26.92	26.92
1.82	26.77	26.76
1.83	27.00	27.00
1.84	27.26	27.23
1.85	27.09	27.06
1.86	26.92	26.88
1.87	27.17	27.14
1.88	27.40	27.35
1.89	27.27	27.22
1.90	27.14	27.12
1.91	27.43	27.38
1.92	27.72	27.71
1.93	27.59	27.56
1.94	27.55	27.52
1.95	27.90	27.90
1.96	28.25	28.24
1.97	28.13	28.10
1.98	28.06	28.04
1.99	28.43	28.44
2.00	28.67	28.63
2.01	28.50	28.45
2.02	28.37	28.39
2.03	28.67	28.63
2.04	28.76	28.76
2.05	28.48	28.46
2.06	28.37	28.36
2.07	28.49	28.48



2.08	28.52	28.51
2.09	28.31	28.29
2.10	28.16	28.14
2.11	28.24	28.23
2.12	28.28	28.27
2.13	28.15	28.13
2.14	28.01	28.00
2.15	28.10	28.09
2.16	28.22	28.21
2.17	28.14	28.10
2.18	28.02	28.00
2.19	28.11	28.08
2.20	28.29	28.28
2.21	28.24	28.21
2.22	28.11	28.08
2.23	28.21	28.18
2.24	28.37	28.36
2.25	28.31	28.28
2.26	28.16	28.13
2.27	28.21	28.19
2.28	28.40	28.38
2.29	28.37	28.35
2.30	28.21	28.19
2.31	28.28	28.25
2.32	28.46	28.43
2.33	28.47	28.44
2.34	28.35	28.33
2.35	28.41	28.38
2.36	28.56	28.54
2.37	28.62	28.59
2.38	28.54	28.49
2.39	28.56	28.55
2.40	28.73	28.71
2.41	28.77	28.74
2.42	28.72	28.69
2.43	28.74	28.72
2.44	28.86	28.85
2.45	28.90	28.89
2.46	28.86	28.84
2.47	28.89	28.88
2.48	29.02	29.01
2.49	29.08	29.07
2.50	29.05	29.03
2.51	29.10	29.09
2.52	29.30	29.29
2.53	29.39	29.39
2.54	29.38	29.35
2.55	29.39	29.38
2.56	29.58	29.57
2.57	29.74	29.73
2.58	29.65	29.62
2.59	29.54	29.52
2.60	29.71	29.68
2.61	29.90	29.87
2.62	29.71	29.68
2.63	29.53	29.50
2.64	29.67	29.65

2.65	29.87	29.84
2.66	29.72	29.66
2.67	29.50	29.48
2.68	29.60	29.58
2.69	29.82	29.79
2.70	29.71	29.69
2.71	29.51	29.48
2.72	29.59	29.55
2.73	29.77	29.76
2.74	29.72	29.68
2.75	29.56	29.51
2.76	29.59	29.56
2.77	29.74	29.71
2.78	29.69	29.63
2.79	29.53	29.48
2.80	29.54	29.51
2.81	29.65	29.61
2.82	29.60	29.55
2.83	29.44	29.42
2.84	29.49	29.47
2.85	29.63	29.60
2.86	29.60	29.56
2.87	29.49	29.47
2.88	29.59	29.57
2.89	29.79	29.78
2.90	29.79	29.77
2.91	29.73	29.71
2.92	29.88	29.86
2.93	30.10	30.09
2.94	30.16	30.14
2.95	30.08	30.06
2.96	30.23	30.21
2.97	30.54	30.52
2.98	30.57	30.55
2.99	30.46	30.43
3.00	30.58	30.56
3.05	31.17	31.18
3.10	31.68	31.64
3.15	31.58	31.55
3.20	31.75	31.72
3.25	31.89	31.85
3.30	31.71	31.68
3.35	31.64	31.60
3.40	31.70	31.67
3.45	31.84	31.83
3.50	31.95	31.91
3.55	32.01	31.96
3.60	32.09	32.07
3.65	32.32	32.29
3.70	32.52	32.48
3.75	32.62	32.57
3.80	32.85	32.80
3.85	32.93	32.89
3.90	32.94	32.91
3.95	33.02	32.98
4.00	32.97	32.91
4.05	33.07	33.01



4.10	33.21	33.17
4.15	33.33	33.31
4.20	33.48	33.43
4.25	33.71	33.66
4.30	33.87	33.83
4.35	34.02	33.99
4.40	33.83	33.82
4.45	33.57	33.53
4.50	33.61	33.58
4.55	33.61	33.59
4.60	33.51	33.49
4.65	33.44	33.39
4.70	33.60	33.58
4.75	33.93	33.92
4.80	34.06	34.05
4.85	34.13	34.13
4.90	34.27	34.25
4.95	34.38	34.36
5.00	34.38	34.34
5.05	34.19	34.17
5.10	33.99	33.97
5.15	33.93	33.93
5.20	33.97	33.96
5.25	33.92	33.91
5.30	33.93	33.93
5.35	34.17	34.18
5.40	34.37	34.38
5.45	34.43	34.44
5.50	34.38	34.38
5.55	34.42	34.42
5.60	34.45	34.45
5.65	34.28	34.28
5.70	34.05	34.04
5.75	34.04	34.05
5.80	34.20	34.20
5.85	34.31	34.31
5.90	34.35	34.35
5.95	34.47	34.49
6.00	34.69	34.70
6.05	34.87	34.86
6.10	34.82	34.82
6.15	34.75	34.75
6.20	34.78	34.79
6.25	34.77	34.79
6.30	34.68	34.69
6.35	34.66	34.68
6.40	34.84	34.87
6.45	35.03	35.07
6.50	35.13	35.14
6.55	35.13	35.13
6.60	35.26	35.26
6.65	35.36	35.36
6.70	35.29	35.29
6.75	35.17	35.16
6.80	35.16	35.15
6.85	35.26	35.28
6.90	35.37	35.38

6.95	35.35	35.36
7.00	35.44	35.45
7.05	35.59	35.61
7.10	35.74	35.76
7.15	35.73	35.74
7.20	35.61	35.63
7.25	35.65	35.66
7.30	35.65	35.67
7.35	35.64	35.64
7.40	35.63	35.64
7.45	35.71	35.74
7.50	35.89	35.90
7.55	35.99	36.01
7.60	36.09	36.10
7.65	36.18	36.21
7.70	36.23	36.25
7.75	36.26	36.29
7.80	36.21	36.22
7.85	36.20	36.20
7.90	36.14	36.16
7.95	36.16	36.17
8.00	36.14	36.15
8.05	36.19	36.19
8.10	36.30	36.32
8.15	36.46	36.47
8.20	36.50	36.50
8.25	36.51	36.53
8.30	36.51	36.50
8.35	36.48	36.48
8.40	36.46	36.45
8.45	36.40	36.39
8.50	36.41	36.40
8.55	36.45	36.45
8.60	36.56	36.58
8.65	36.70	36.71
8.70	36.71	36.70
8.75	36.79	36.83
8.80	36.85	36.88
8.85	36.88	36.85
8.90	36.79	36.75
8.95	36.79	36.81
9.00	36.87	36.84
9.05	36.82	36.75
9.10	36.85	36.81
9.15	36.90	36.88
9.20	36.89	36.90
9.25	36.92	36.91
9.30	36.97	36.97
9.35	37.07	37.07
9.40	37.11	37.11
9.45	37.14	37.16
9.50	37.20	37.19
9.55	37.10	37.08
9.60	37.06	37.03
9.65	37.04	37.05
9.70	36.96	36.97
9.75	36.93	36.93



9.80	37.00	37.00
9.85	37.15	37.16
9.90	37.23	37.24
9.95	37.25	37.22
10.00	37.31	37.30
10.05	37.31	37.30
10.10	37.23	37.20
10.15	37.15	37.13
10.20	37.11	37.13
10.25	37.11	37.15
10.30	37.11	37.13
10.35	37.15	37.19
10.40	37.21	37.24
10.45	37.25	37.27
10.50	37.27	37.28
10.55	37.24	37.24
10.60	37.18	37.18
10.65	37.17	37.19
10.70	37.19	37.19
10.75	37.16	37.17
10.80	37.16	37.18
10.85	37.26	37.26
10.90	37.32	37.32
10.95	37.33	37.32
11.00	37.36	37.35
11.05	37.34	37.33
11.10	37.34	37.36
11.15	37.35	37.34
11.20	37.34	37.33
11.25	37.29	37.29
11.30	37.28	37.29
11.35	37.34	37.31
11.40	37.31	37.30
11.45	37.32	37.33
11.50	37.38	37.39
11.55	37.41	37.42
11.60	37.44	37.43
11.65	37.44	37.42
11.70	37.43	37.42
11.75	37.48	37.48
11.80	37.39	37.38
11.85	37.40	37.38
11.90	37.45	37.39
11.95	37.45	37.43
12.00	37.48	37.47
12.05	37.51	37.50
12.10	37.54	37.51
12.15	37.58	37.58
12.20	37.59	37.60
12.25	37.62	37.60
12.30	37.62	37.60
12.35	37.61	37.62
12.40	37.61	37.65
12.45	37.65	37.63
12.50	37.67	37.66
12.55	37.71	37.71
12.60	37.80	37.76

12.65	37.86	37.82
12.70	37.89	37.86
12.75	37.92	37.90
12.80	38.00	37.98
12.85	38.05	38.02
12.90	38.06	38.02
12.95	38.09	38.05
13.00	38.14	38.10
13.05	38.21	38.19
13.10	38.29	38.24
13.15	38.36	38.35
13.20	38.44	38.47
13.25	38.57	38.55
13.30	38.63	38.59
13.35	38.68	38.67
13.40	38.77	38.73
13.45	38.84	38.77
13.50	38.90	38.80
13.55	38.92	38.88
13.60	39.03	39.00
13.65	39.15	39.11
13.70	39.30	39.23
13.75	39.42	39.33
13.80	39.53	39.49
13.85	39.66	39.59
13.90	39.74	39.65
13.95	39.81	39.70
14.00	39.89	39.83
14.05	39.96	39.92
14.10	40.02	39.96
14.15	40.08	40.04
14.20	40.16	40.11
14.25	40.25	40.18
14.30	40.33	40.27
14.35	40.37	40.28
14.40	40.44	40.32
14.45	40.50	40.40
14.50	40.62	40.56
14.55	40.70	40.61
14.60	40.77	40.64
14.65	40.83	40.71
14.70	40.86	40.77
14.75	40.83	40.72
14.80	40.79	40.65
14.85	40.76	40.65
14.90	40.84	40.76
14.95	40.87	40.77
15.00	40.89	40.79
15.05	40.95	40.85
15.10	41.03	40.94
15.15	41.08	40.96
15.20	41.02	40.93
15.25	40.99	40.88
15.30	41.01	40.91
15.35	41.04	40.88
15.40	41.08	40.92
15.45	41.12	40.96



15.50	41.15	40.97
15.55	41.18	41.00
15.60	41.14	41.01
15.65	41.05	40.99
15.70	40.99	40.95
15.75	40.99	40.92
15.80	41.03	41.00
15.85	41.14	41.11
15.90	41.18	41.15
15.95	41.27	41.22
16.00	41.34	41.33
16.05	41.40	41.36
16.10	41.39	41.34
16.15	41.33	41.32
16.20	41.31	41.31
16.25	41.40	41.37
16.30	41.47	41.43
16.35	41.53	41.52
16.40	41.66	41.66
16.45	41.77	41.75
16.50	41.82	41.77
16.55	41.84	41.87
16.60	41.83	41.95
16.65	41.85	41.94
16.70	41.91	42.00
16.75	42.09	42.20
16.80	42.23	42.35
16.85	42.36	42.39
16.90	42.50	42.49
16.95	42.61	42.59
17.00	42.63	42.60
17.05	42.63	42.57
17.10	42.64	42.54
17.15	42.76	42.58
17.20	42.82	42.63
17.25	42.86	42.75
17.30	43.02	42.90
17.35	43.15	42.98
17.40	43.28	43.10
17.45	43.30	43.17
17.50	43.32	43.16
17.55	43.37	43.19
17.60	43.39	43.23
17.65	43.50	43.35
17.70	43.52	43.41
17.75	43.62	43.49
17.80	43.74	43.60
17.85	43.89	43.69
17.90	43.92	43.81
17.95	44.02	43.89
18.00	44.18	43.98

4 CONVERSION FACTORS AND ALL OTHER FORMULAS

Unit	Conversion unit	Formula of conversion
$\text{dB}\mu\text{V}$	$\text{dB}\mu\text{V}/\text{m}$	$\text{dB}\mu\text{V}/\text{m} = \text{dB}\mu\text{V} + \text{AF}$
$\mu\text{V}/\text{m}$	$\text{dB}\mu\text{V}/\text{m}$	$\text{dB}\mu\text{V}/\text{m} = 20\log(X(\mu\text{V}/\text{m})/1\mu\text{V})$

	Test distance stated in standard	Test distance of measurement	Conversion factor
Class B	3 m	3 m	/
Class A	10 m	3 m	20dB/decade



5 GENERAL AND SPECIAL CONDITIONS DESCRIPTION

5.1 General condition description

Interconnect and power cabling (or wiring)

5.1.1 Test arrangement for conducted emissions

Interconnecting cables that hang closer than 40 cm to the ground-plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω . LISN can be placed on top of, or immediately beneath, reference ground-plane.

All other equipment powered from additional LISN(s).

Multiple outlet strip can be used for multiple power cords of non-EUT equipment.

LISN at least 80 cm from nearest part of EUT chassis.

Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use.

Non-EUT components of EUT system being tested.

Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.

Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground-plane.

5.1.2 Test arrangement for conducted emissions- floor-standing equipment

Excess I/O cables shall be bundled in the center. If bundling is not possible, the cables shall be arranged in serpentine fashion. Bundling shall not exceed 40 cm in length.

Excess power cords shall be bundled in the center or shortened to appropriate length.

I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. If bundling is not possible, the cable shall be arranged in serpentine fashion.

EUT and all cables shall be insulated, if required, from the ground-plane by up to 12 mm of insulating material.

EUT connected to one LISN. LISN can be placed on top of, or immediately beneath, the ground-plane.

All other equipment powered from a second LISN or additional LISN(s).

Multiple outlet strip can be used for multiple power cords of non-EUT equipment.

5.1.3 Test arrangement for radiated emissions tabletop equipment

Interconnecting cables that hang closer than 40 cm to the ground-plane shall be folded back and forth in the center, forming a bundle 30 to 40 cm long.

I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated if required using the correct terminating impedance. The total length shall not exceed 1 m.

If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground-plane with the receptacle flush with the ground-plane.

Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use.

Non-EUT components of EUT system being tested.

Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.

No vertical conducting plane used.

Power cords drape to the floor and are routed over to receptacle.

5.1.4 Test arrangement for radiated emissions floor-standing equipment

Excess I/O cables shall be bundled in center. If bundling is not possible, the cables shall be arranged in serpentine fashion. Bundling not to exceed 40 cm in length.

Excess power cords shall be bundled in the center or shortened to appropriate length.

I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. If bundling is not possible, the cable shall be arranged in a serpentine fashion.

EUT and all cables shall be insulated, if required, from the ground-plane by up to 12 mm of insulating material.

If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground-plane with the receptacle flush with the ground plane.



Overhead cable trays and suspended ceilings

5.1.5 Test arrangement for floor-standing equipment

Only one vertical riser may be used where typical of system under test.

Excess power cord shall be bundled in the center or shortened to appropriate length.

EUT and cables shall be insulated from ground-plane by up to 12 mm. Where the manual has specified or there exists a code of practice for installation of the EUT, the test arrangement shall allow the use of this practice for the tests.

Power cords being measured connected to one LISN. All other system power cords powered through other LISN(s). A multiple receptacle strip may be used for other power cords.

For *conducted* tests, the LISNs may be placed on top of or immediately beneath and bonded directly to the ground-plane. For *radiated* tests, the LISN(s), if used, should be installed under, with the receptacle flush with the ground-plane.

5.1.6 Placement and manipulation of interconnect cabling (or wiring) of tabletop equipment

LISN(s) may have to be positioned to the side of the table to meet the criterion that the LISN receptacle shall be 80 cm away from the EUT. LISN(s) may be above ground-plane only for conducted emission measurements.

Accessories, such as ac power adapter, if typically table-mounted, shall occupy peripheral positions as is applicable.

Accessories, which are typically floor-mounted, shall occupy a floor position directly below the portion of the EUT to which they are typically connected. T

Table length may be extended beyond 1.5 m with peripherals aligned with the back edge. The table depth may be extended beyond 1 m. The 40 cm distance to the vertical conducting plane shall be maintained for conducted emission testing.

Placement of wall-mounted equipment

5.1.7 Test configuration/arrangement for combination floor-standing and tabletop equipment

Interconnecting cables that hang closer than 40 cm to the ground-plane shall be folded back and forth in the center, forming a bundle 30 to 40 cm long.

I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated if required using the correct terminating impedance.

If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground-plane with the receptacle flush with the ground-plane.

Cables of hand-operated devices, such as keyboards, mice, etc., have to be placed as for normal use.

Non-EUT components of EUT system being tested.

I/O cable to floor-standing unit drapes to the ground-plane and shortened or excess bundled. Cables not reaching the metal ground-plane are draped to the height of the connector or 40 cm, whichever is lower.

Power cords and signal cables shall drape to the floor. No extension cords shall be used to the power receptacles.

The floor-standing unit can be placed under the table if its height permits.

5.2 Special condition description

If for some reason the above measurement conditions can't be met, the description below should be used as an appropriate measurement condition and placement.

(Description is written additionally as the measurements differ – all is within test procedure)

6 TEST SUMMARY

STANDARDS (details on first page)	Tested		Sample	
	yes	no	pass	not pass
47 CFR Part 15, Subpart B (Clause 15.107 and 15.109) ANSI C63.4:2014	☒	☐	☒	☐

Test	Section within the report	Class	Conclusion
Conducted emission measurement (unintentional radiator)	7.1	B	PASS
Radiated emission measurement (unintentional radiator)	7.2	B	PASS

6.1 Operating voltages/frequencies used for testing

Section	Test	Operating conditions
7.1	Conducted emission measurement	On adapter (120 V; 60 Hz)
7.2	Radiated emission measurement	On adapter (120 V; 60 Hz); internal battery

7 EMISSION TESTS

7.1 Conducted emission measurement (unintentional radiator)

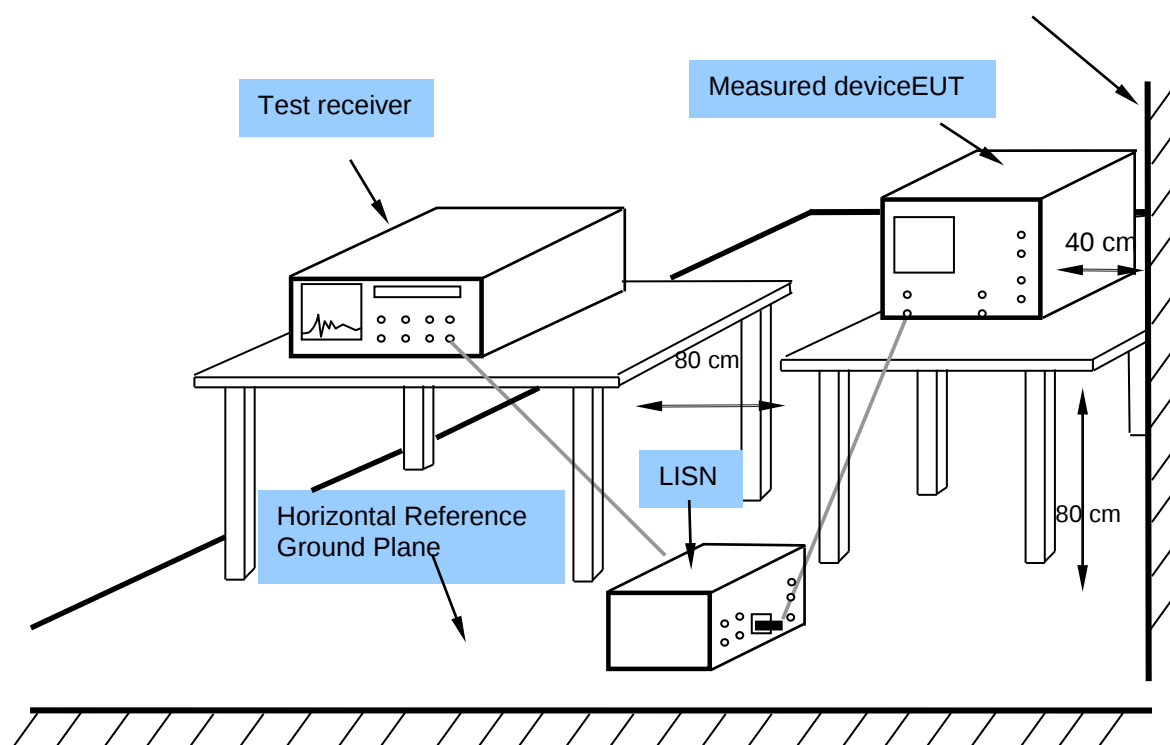
7.1.1 Test instruments

Description	Model No.	SIQ No.	Last calibration	Calibrated until	Calibration period	Used
Rohde-Schwarz, RFI receiver	ESU8	105187	2017-11	2019-11	24 months	X
Rohde-Schwarz, RFI receiver	ESU26	100428	2018-02	2020-02	24 months	
Rohde & Schwarz, Artificial main network	ESH2-Z5	106899	2017-05	2019-05	24 months	
Rohde & Schwarz, Artificial main network	ENV216	106765	2018-09	2020-09	24 months	X

7.1.2 Test procedure

- The EUT is placed on a non-conductive 0.8 meters high table, 0.4 meters from the vertical conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). LISN provide 50 Ohm / 50 μ H + 5 Ohm of coupling impedance for the measuring instrument.
- Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.
- AC power lines of EUT are checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz is searched using PEAK, QUASI-PEAK and AVERAGE function of the receiver. Bandwidth is set to 9 kHz.
- If applicable functions are changed (data transfer speed, clock speed,...) it should be noted in the test report.

7.1.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

7.1.4 Test result

S20191070

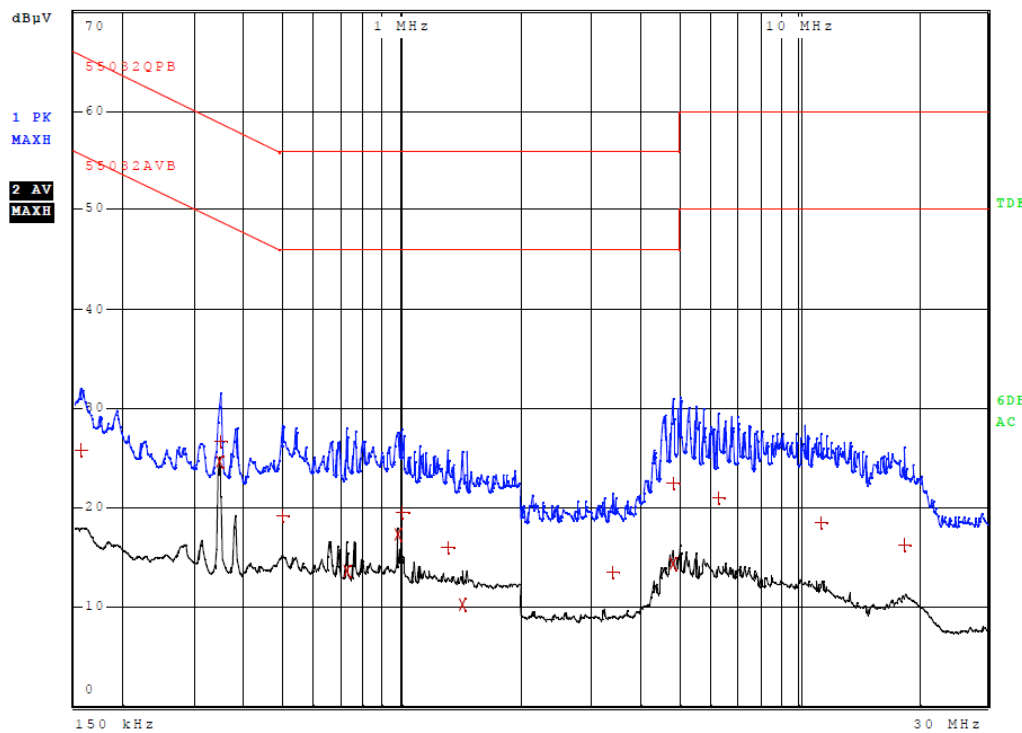
Meas Type CONDUCTED EMISSION
Equipment under Test IoT module
Manufacturer COMODULE OÜ
OP Condition 120 V, 60 Hz
Operator Aljaz Bajec
Test Spec
LINE L



RBW 9 kHz

MT 1 s

Step TD AUTO PULSE Att 10 dB AUTO PREAMP OFF



S20191070

Meas Type CONDUCTED EMISSION
Equipment under Test IoT module
Manufacturer xx
OP Condition 120 V, 60 Hz
Operator Aljaz Bajec
Test Spec
 LINE L

Final Measurement

Meas Time: 1 s
Margin: 35 dB
Subranges: 15

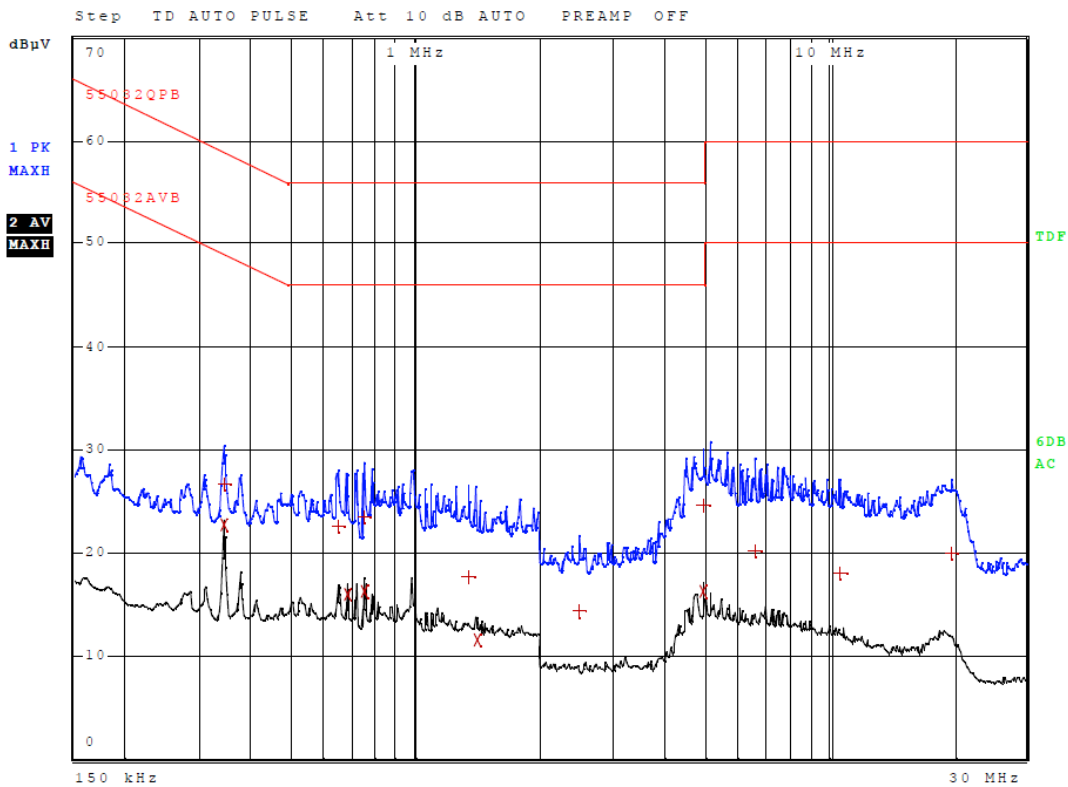
Trace	Frequency	Level (dBμV)	Detector	Delta Limit/dB
2	345.750000000 kHz	24.63	CISPR Averag	-24.43
2	978.000000000 kHz	17.23	CISPR Averag	-28.77
2	4.841250000 MHz	14.39	CISPR Averag	-31.61
1	348.000000000 kHz	26.72	Quasi Peak	-32.29
2	728.250000000 kHz	13.60	CISPR Averag	-32.40
1	4.848000000 MHz	22.44	Quasi Peak	-33.56
2	1.421250000 MHz	10.24	CISPR Averag	-35.76
1	1.005000000 MHz	19.56	Quasi Peak	-36.44
1	498.750000000 kHz	19.25	Quasi Peak	-36.77
1	6.294750000 MHz	20.94	Quasi Peak	-39.06
1	156.750000000 kHz	25.75	Quasi Peak	-39.88
1	1.308750000 MHz	15.89	Quasi Peak	-40.11
1	11.370750000 MHz	18.53	Quasi Peak	-41.47
1	3.410250000 MHz	13.49	Quasi Peak	-42.51
1	18.417750000 MHz	16.29	Quasi Peak	-43.71

S20191070

Meas Type CONDUCTED EMISSION
Equipment under Test IoT module
Manufacturer COMODULE OÜ
OP Condition 120 V, 60 Hz
Operator Aljaz Bajec
Test Spec
LINE N



RBW 9 kHz
 MT 1 s



S20191070

Meas Type CONDUCTED EMISSION
Equipment under Test IoT module
Manufacturer xx
OP Condition 120 V, 60 Hz
Operator Aljaz Bajec
Test Spec
 LINE N

Final Measurement

Meas Time: 1 s
Margin: 35 dB
Subranges: 14

Trace	Frequency	Level (dBμV)	Detector	Delta Limit/dB
2	343.500000000 kHz	22.67	CISPR Averag	-26.45
2	4.985250000 MHz	16.27	CISPR Averag	-29.73
2	753.000000000 kHz	16.24	CISPR Averag	-29.76
2	685.500000000 kHz	15.94	CISPR Averag	-30.06
1	4.978500000 MHz	24.68	Quasi Peak	-31.32
1	343.500000000 kHz	26.65	Quasi Peak	-32.47
1	748.500000000 kHz	23.48	Quasi Peak	-32.52
1	649.500000000 kHz	22.63	Quasi Peak	-33.37
2	1.403250000 MHz	11.55	CISPR Averag	-34.45
1	1.338000000 MHz	17.77	Quasi Peak	-38.23
1	6.607500000 MHz	20.29	Quasi Peak	-39.71
1	19.763250000 MHz	19.96	Quasi Peak	-40.04
1	2.492250000 MHz	14.32	Quasi Peak	-41.68
1	10.639500000 MHz	18.09	Quasi Peak	-41.91

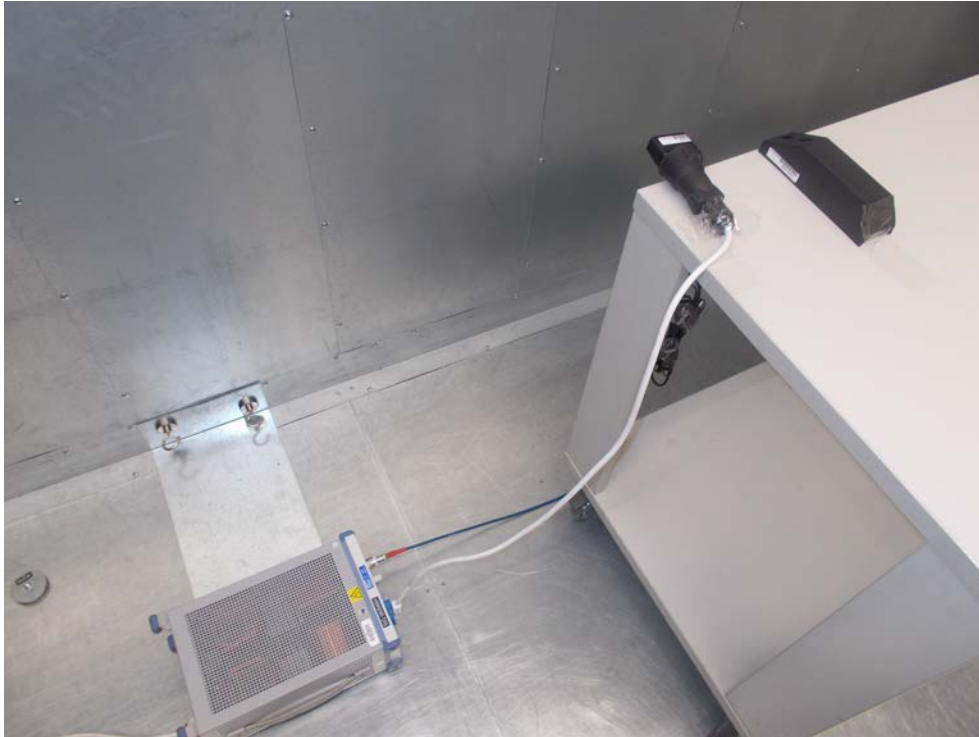


Figure 1: Conducted emission test

7.2 Radiated emission measurement (unintentional radiator)

7.2.1 Test instruments

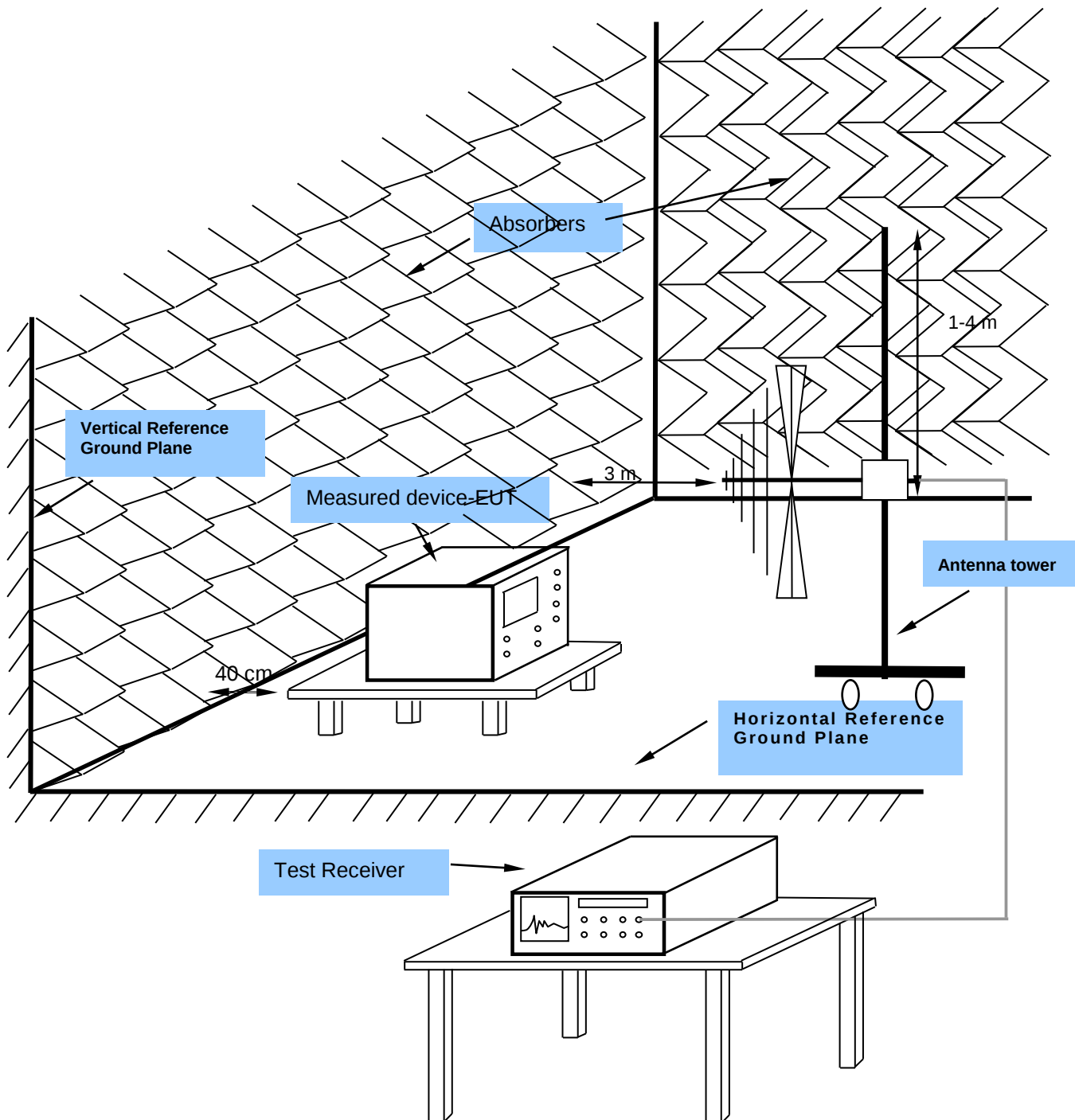
Description	Model No.	SIQ No.	Last calibration	Calibrated until	Calibration period	Used
Rohde-Schwarz, RFI receiver	ESU8	105187	2017-11	2019-11	24 months	
Rohde-Schwarz, RFI receiver	ESU26	100428	2018-02	2020-02	24 months	X
Comtest Engineering, Semi Anechoic Chamber SAC 1	SAC 3m	NPS001	2017-05	2019-05	24 months	
Comtest Engineering, Semi Anechoic Chamber SAC 2	SAC 3m	NPS002	2017-05	2019-05	24 months	X
Rohde & Schwarz, Horn Antenna	HF907 (SN 102508)	102508	2018-05	2020-05	24 months	
Rohde & Schwarz, Ultra Broadband Antenna	HL562E (SN 100842)	102842	2017-07	2019-07	24 months	
Rohde & Schwarz, Horn Antenna	HF907 (SN 102494)	102494	2018-05	2020-05	24 months	X
Rohde & Schwarz, Ultra Broadband Antenna	HL562E (SN 100843)	102843	2017-07	2019-07	24 months	X
Maturo, Turn table (2 m diameter)	TT 2.0 SI	/	N/A	N/A	N/A	X
Maturo, Bore-sight antenna mast	BAM-4.0-P	/	N/A	N/A	N/A	X
Maturo, Multi-channel positioning equipment	Maturo NCD	/	N/A	N/A	N/A	X
Schwarzbeck, Biconical antenna	VHBB9124 (SN 9124-317)	105112	2018-11	2020-11	24 months	X
Rohde & Schwarz, Loop Antenna	FMZB 1519 B	/	2018-08	2020-08	24 months	

7.2.2 Test procedure

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground in an Anechoic Chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 m away from the interference-receiving antenna, which was mounted on the top of variable-height antenna tower.

3. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the turn table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to PEAK and QUASI-PEAK Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. The highest points would be re-tested one by one using the quasi-peak method.

7.2.3 Test setup



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

7.2.4 Test result

1 / 1

Radiated emission

EUT Information

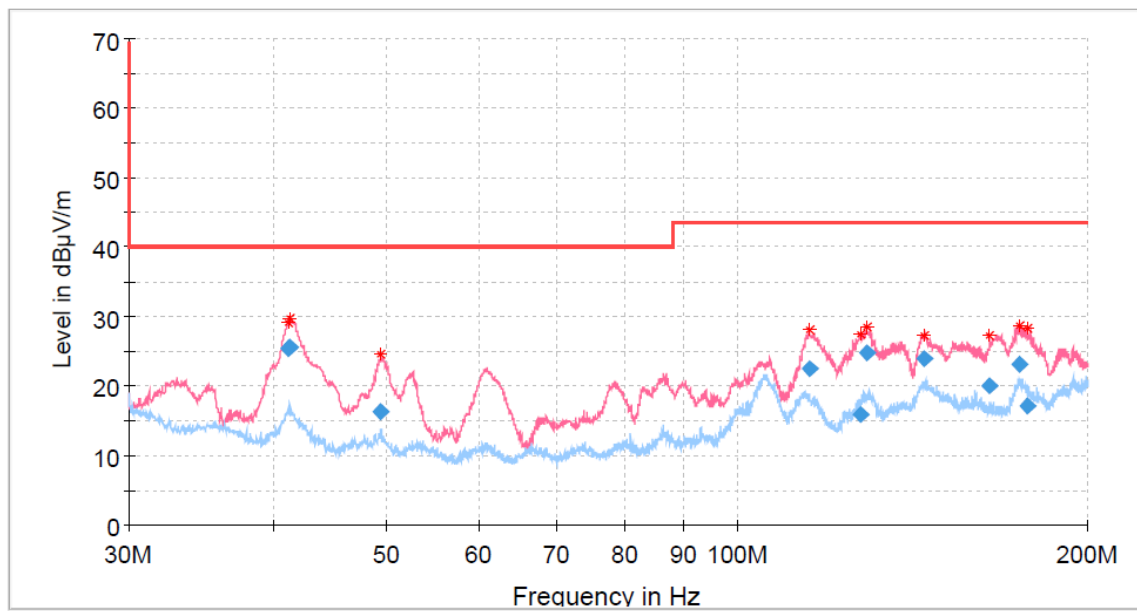
EUT

S20191070

Operating condition:

with charger

Full Spectrum



— Preview Result 1V-PK+
★ Critical_Freqs PK+
◆ Final_Result QPK
— Preview Result 1H-PK+
— FCC Part 15 Class B

Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)
41.210000	25.53	40.00	14.47	100.0	V	245.0
41.120000	25.45	40.00	14.55	100.0	V	2.0
129.200000	24.84	43.50	18.66	100.0	V	115.0
144.470000	23.93	43.50	19.57	100.0	V	33.0
174.440000	23.08	43.50	20.42	100.0	V	108.0
115.400000	22.43	43.50	21.07	100.0	V	97.0
164.630000	20.08	43.50	23.42	100.0	V	101.0
49.310000	16.27	40.00	23.73	100.0	V	23.0
177.290000	17.08	43.50	26.42	100.0	V	147.0
127.490000	15.93	43.50	27.57	100.0	V	105.0

EMI Auto Test(1)

1 / 1

EUT Information

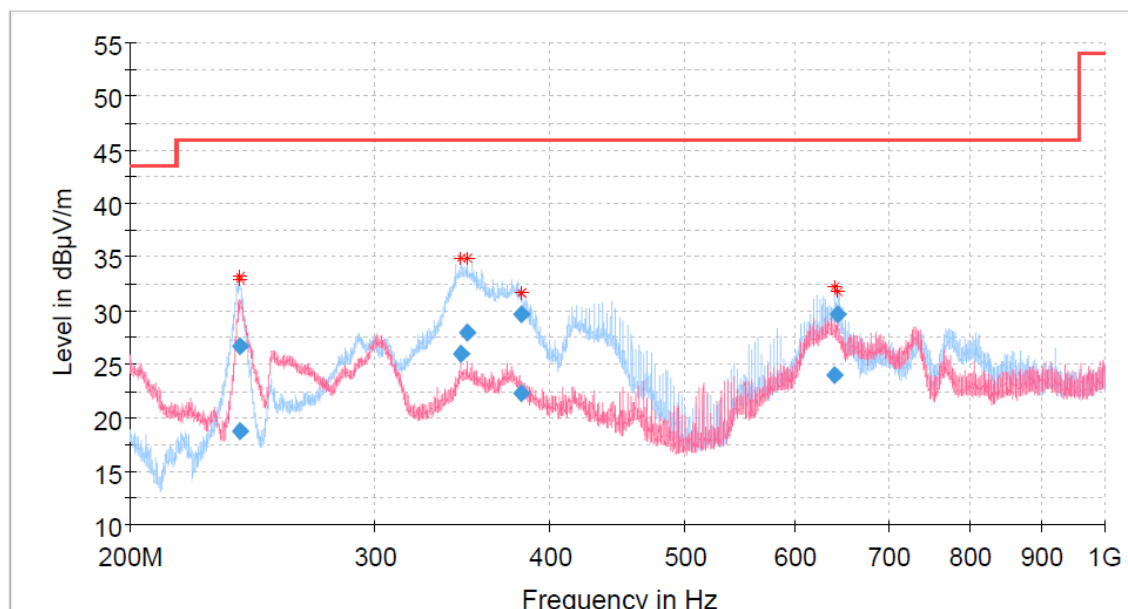
EUT

S20191070

Operating condition:

with charger

Full Spectrum



— Preview Result 1H-PK+ — Preview Result 1V-PK+
* Critical_Freqs PK+ — FCC Part 15 Class B
◆ Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
382.010000	29.71	46.00	16.29	2000.0	120.000	100.0	H	-14.0	14.3
642.680000	29.62	46.00	16.38	2000.0	120.000	125.0	H	90.0	18.8
348.680000	27.91	46.00	18.09	2000.0	120.000	104.0	H	11.0	13.6
239.480000	26.73	46.00	19.27	2000.0	120.000	104.0	H	271.0	10.9
345.620000	26.04	46.00	19.96	2000.0	120.000	128.0	H	331.0	13.5
639.740000	24.00	46.00	22.00	2000.0	120.000	128.0	H	87.0	18.7
381.230000	22.38	46.00	23.62	2000.0	120.000	100.0	H	336.0	14.2
239.570000	18.72	46.00	27.28	2000.0	120.000	175.0	H	293.0	10.9

EUT Information

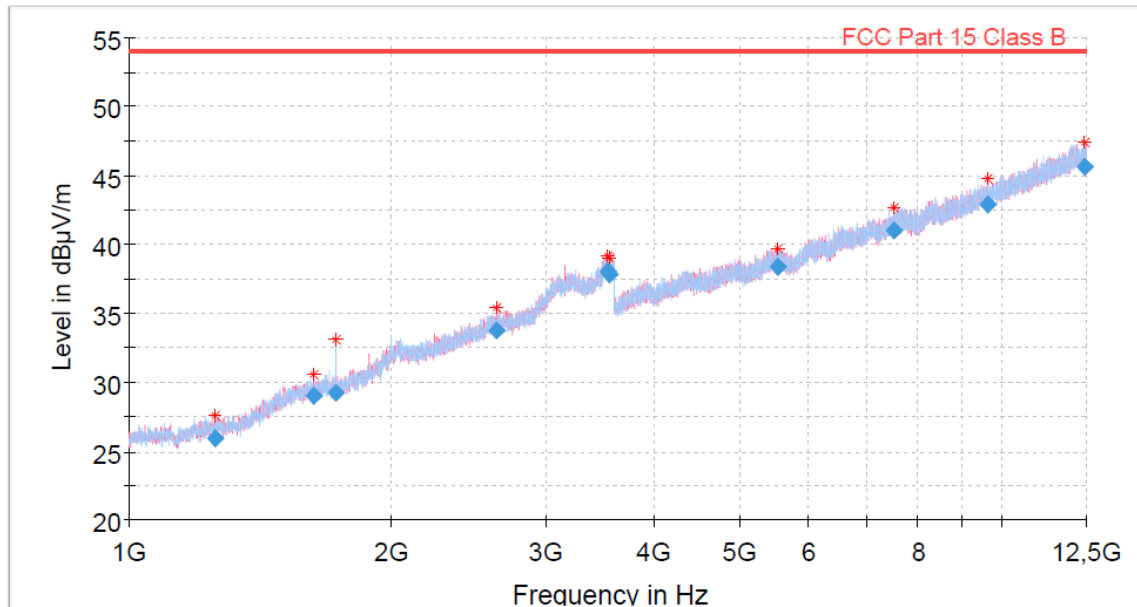
EUT

S20191070

Operating condition:

with charger

Full Spectrum



Preview Result 1V-AVG
 Critical_Freqs AVG
 Final_Result CAV

Preview Result 1H-AVG
 FCC Part 15 Class B

Final Result

Frequency (MHz)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Corr. (dB)	Comment
12444.000000	45.67	54.00	8.33	1000.0	1000.000	100.0	V	47.3	
9636.000000	42.88	54.00	11.12	1000.0	1000.000	100.0	V	45.3	
7523.500000	40.99	54.00	13.01	1000.0	1000.000	100.0	H	43.1	
5529.750000	38.36	54.00	15.64	1000.0	1000.000	100.0	V	40.4	
3532.000000	38.00	54.00	16.00	1000.0	1000.000	100.0	V	36.6	
3549.000000	37.84	54.00	16.16	1000.0	1000.000	100.0	V	36.6	
2638.750000	33.80	54.00	20.20	1000.0	1000.000	100.0	V	33.6	
1722.500000	29.29	54.00	24.71	1000.0	1000.000	100.0	H	29.8	
1625.750000	28.98	54.00	25.02	1000.0	1000.000	100.0	V	29.4	
1256.500000	25.94	54.00	28.06	1000.0	1000.000	100.0	H	27.1	

Radiated emission

EUT Information

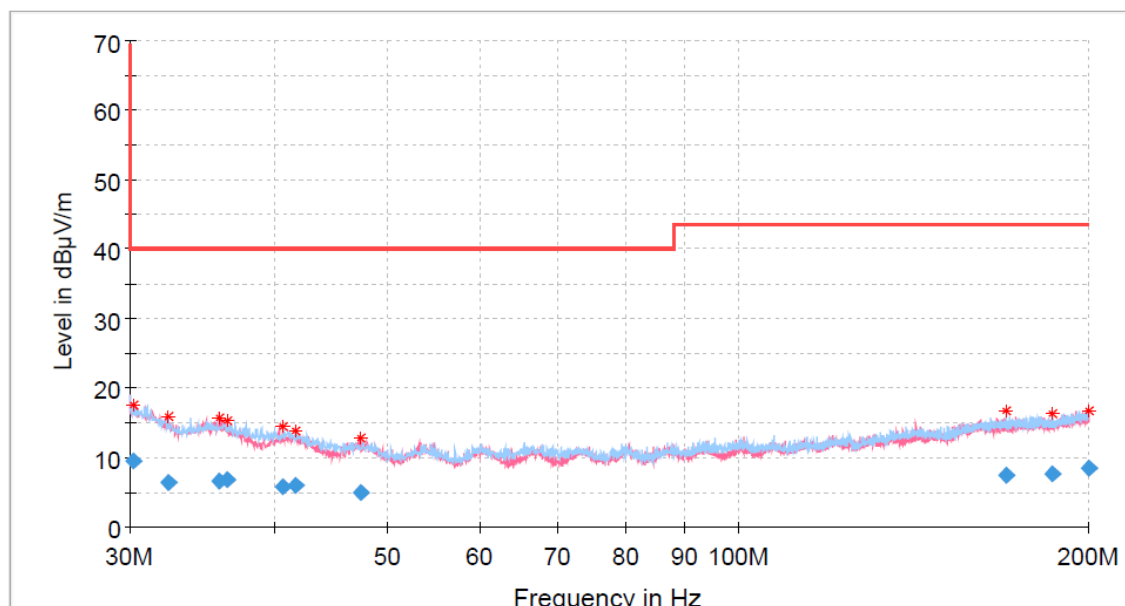
EUT

lot module, S20191070

Operating condition:

Battery mode

Full Spectrum



— Preview Result 1V-PK+
* Critical_Freqs PK+
— Preview Result 1H-PK+
— FCC Part 15 Class B
◆ Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)
30.170000	9.48	40.00	30.52	100.0	H	207.0
32.330000	6.41	40.00	33.59	100.0	V	78.0
35.810000	6.56	40.00	33.44	100.0	V	60.0
36.350000	6.84	40.00	33.16	200.0	V	328.0
40.580000	5.88	40.00	34.12	200.0	V	237.0
41.600000	6.06	40.00	33.94	100.0	H	207.0
47.300000	5.02	40.00	34.98	200.0	V	96.0
169.640000	7.34	43.50	36.16	100.0	H	0.0
186.290000	7.56	43.50	35.94	100.0	H	270.0
199.790000	8.38	43.50	35.12	100.0	H	95.0

EUT Information

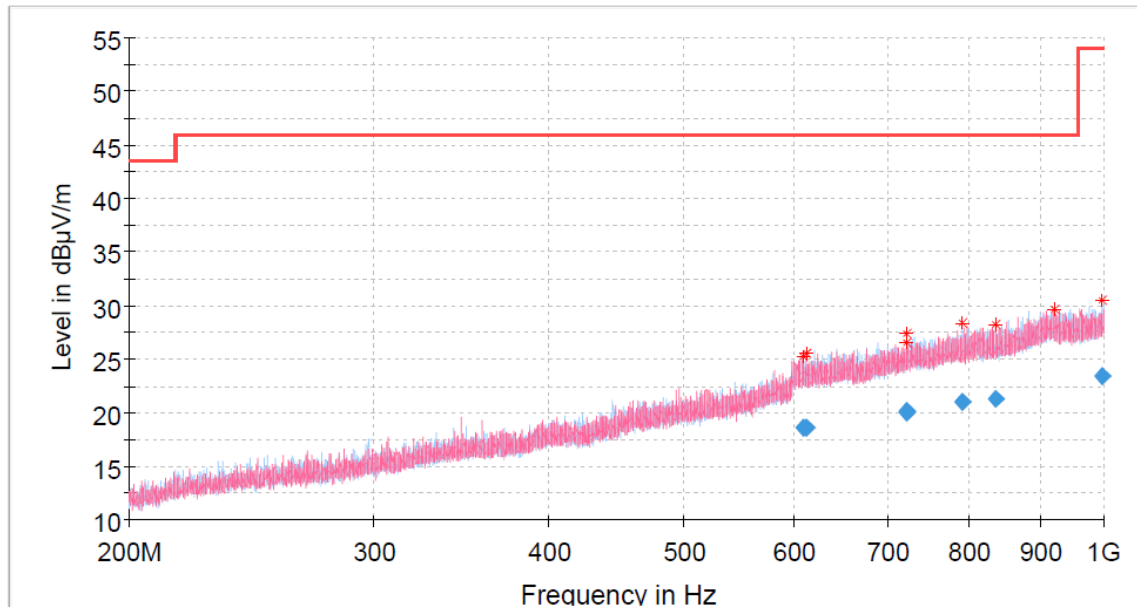
EUT

S20191070

Operating condition:

without charger

Full Spectrum



— Preview Result 1H-PK+ — Preview Result 1V-PK+
* Critical_Freqs PK+ — FCC Part 15 Class B
◆ Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
836.060000	21.28	46.00	24.72	2000.0	120.000	100.0	V	257.0	21.0
790.910000	20.99	46.00	25.01	2000.0	120.000	175.0	H	181.0	20.5
721.970000	20.12	46.00	25.88	2000.0	120.000	225.0	V	99.0	20.0
722.210000	20.10	46.00	25.90	2000.0	120.000	125.0	V	173.0	20.0
611.750000	18.66	46.00	27.34	2000.0	120.000	100.0	V	118.0	18.3
608.090000	18.58	46.00	27.42	2000.0	120.000	100.0	V	96.0	18.3
997.430000	23.45	54.00	30.55	2000.0	120.000	100.0	H	68.0	22.8

EMI Auto Test(1)

1 / 1

EUT Information

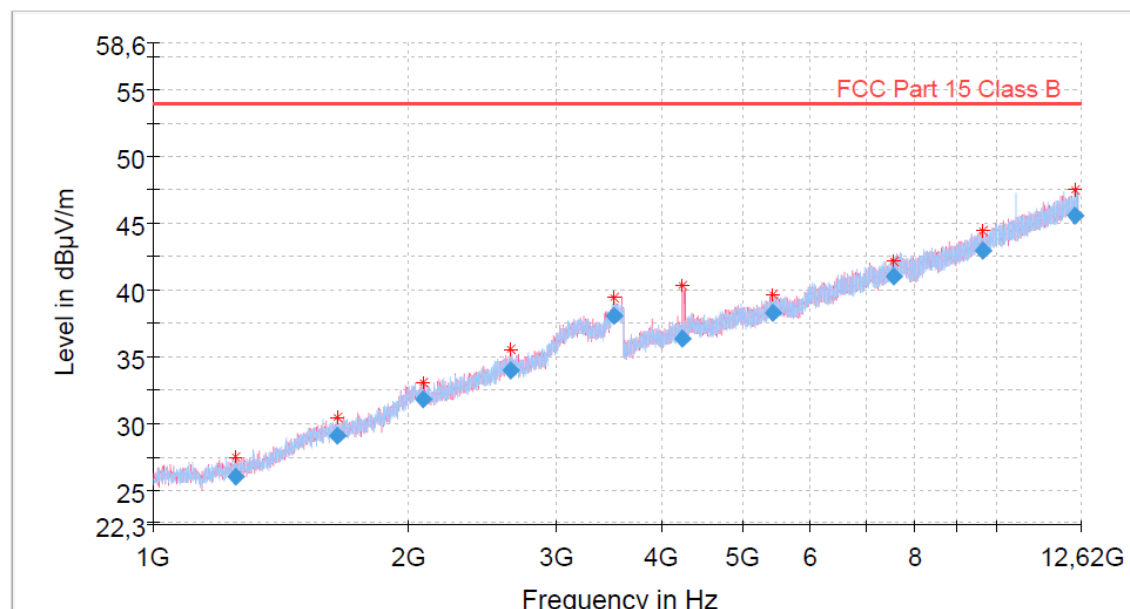
EUT

S20191070

Operating condition:

without charger

Full Spectrum



— Preview Result 1V-AVG
— Preview Result 1H-AVG
* Critical_Freqs AVG
◆ Final_Result CAV
— FCC Part 15 Class B

Final Result

Frequency (MHz)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Corr. (dB)	Comment
12425.250000	45.55	54.00	8.45	1000.0	1000.000	100.0	V	47.2	
9650.500000	42.91	54.00	11.09	1000.0	1000.000	100.0	H	45.3	
7535.500000	40.98	54.00	13.02	1000.0	1000.000	100.0	H	43.2	
5431.750000	38.25	54.00	15.75	1000.0	1000.000	100.0	V	40.3	
3511.500000	38.09	54.00	15.91	1000.0	1000.000	100.0	H	36.6	
4242.000000	36.40	54.00	17.60	1000.0	1000.000	100.0	V	38.8	
2652.250000	34.01	54.00	19.99	1000.0	1000.000	100.0	H	33.8	
2081.250000	31.73	54.00	22.27	1000.0	1000.000	100.0	H	31.9	
1645.750000	29.01	54.00	24.99	1000.0	1000.000	100.0	V	29.5	
1250.250000	26.00	54.00	28.00	1000.0	1000.000	100.0	V	27.1	

Radiated emission

EUT Information

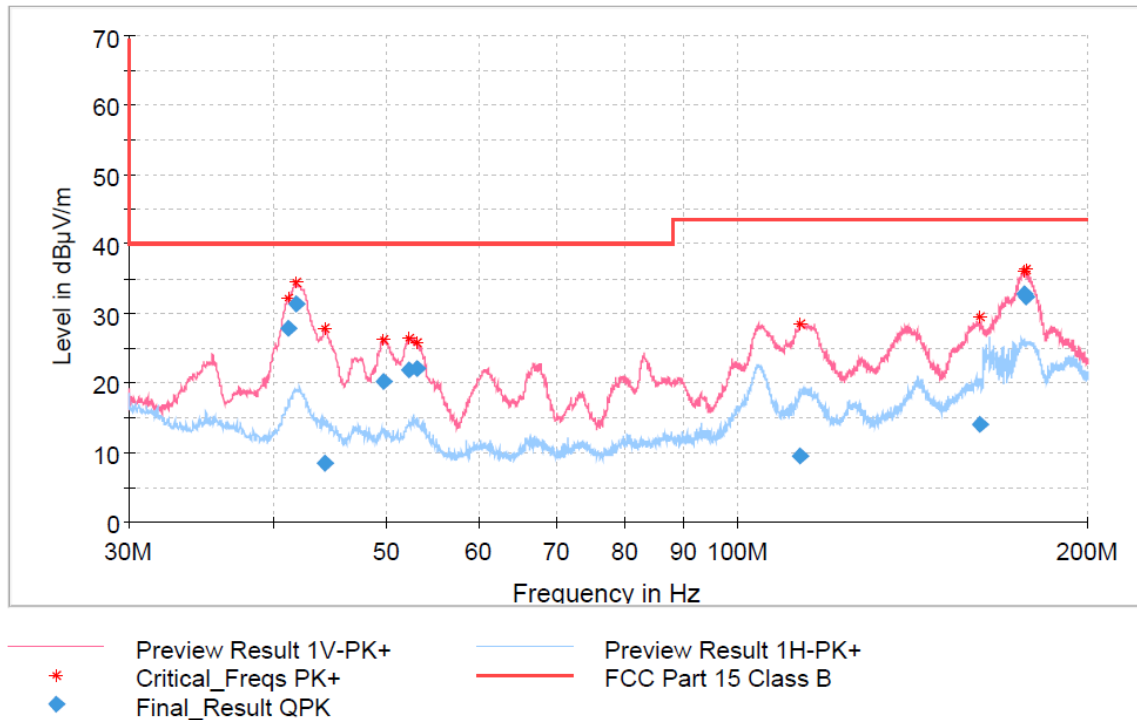
EUT

lot module, S20191069

Operating condition:

with charging adapter (230V/50Hz)

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)
41.720000	31.36	40.00	8.64	100.0	V	171.0
176.150000	32.85	43.50	10.65	100.0	V	186.0
176.990000	32.51	43.50	10.99	100.0	V	152.0
41.120000	27.89	40.00	12.11	100.0	V	70.0
53.000000	22.08	40.00	17.92	100.0	V	284.0
52.130000	21.94	40.00	18.06	100.0	V	103.0
49.610000	20.17	40.00	19.83	100.0	V	204.0
161.390000	14.04	43.50	29.46	100.0	V	145.0
44.210000	8.38	40.00	31.62	100.0	V	125.0
113.330000	9.43	43.50	34.07	100.0	V	178.0

EMI Auto Test(1)

1 / 1

EUT Information

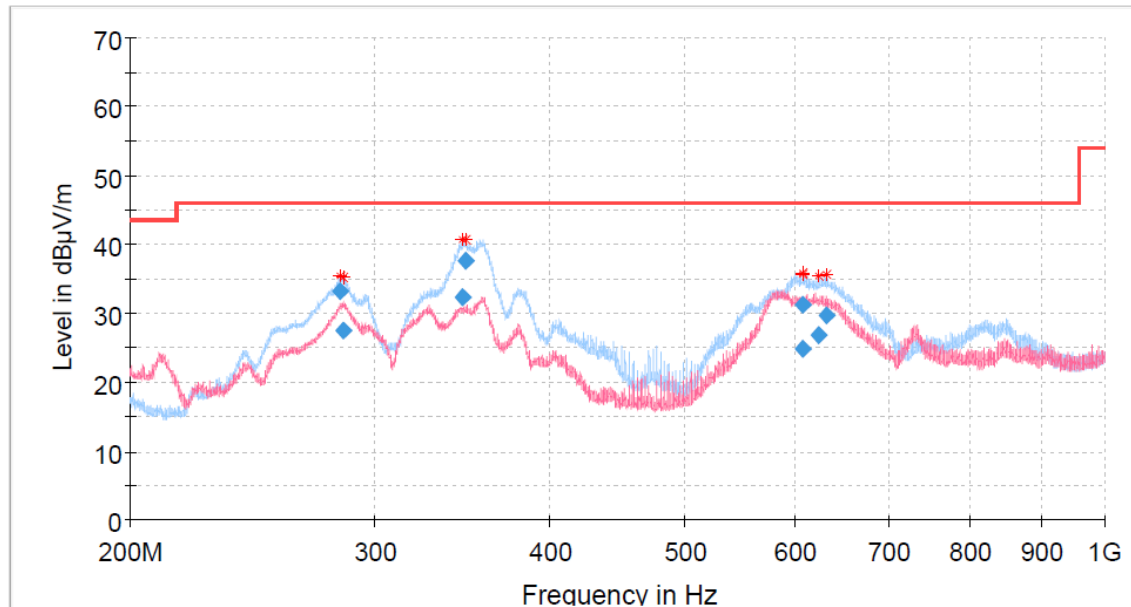
EUT

lot module, S20191069

Operating condition:

with charging adapter (230V/50Hz)

Full Spectrum



— Preview Result 1H-PK+
* Critical_Freqs PK+
◆ Final_Result QPK
— Preview Result 1V-PK+
— FCC Part 15 Class B

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
348.320000	37.61	46.00	8.39	2000.0	120.000	100.0	H	101.0	13.6
283.040000	33.29	46.00	12.71	2000.0	120.000	106.0	H	284.0	11.9
346.010000	32.39	46.00	13.61	2000.0	120.000	100.0	H	101.0	13.6
607.640000	31.28	46.00	14.72	2000.0	120.000	104.0	H	219.0	18.3
632.450000	29.79	46.00	16.21	2000.0	120.000	103.0	H	219.0	18.6
284.630000	27.42	46.00	18.58	2000.0	120.000	104.0	H	257.0	12.0
623.240000	26.93	46.00	19.07	2000.0	120.000	100.0	H	219.0	18.4
607.400000	24.84	46.00	21.16	2000.0	120.000	100.0	H	219.0	18.3

EUT Information

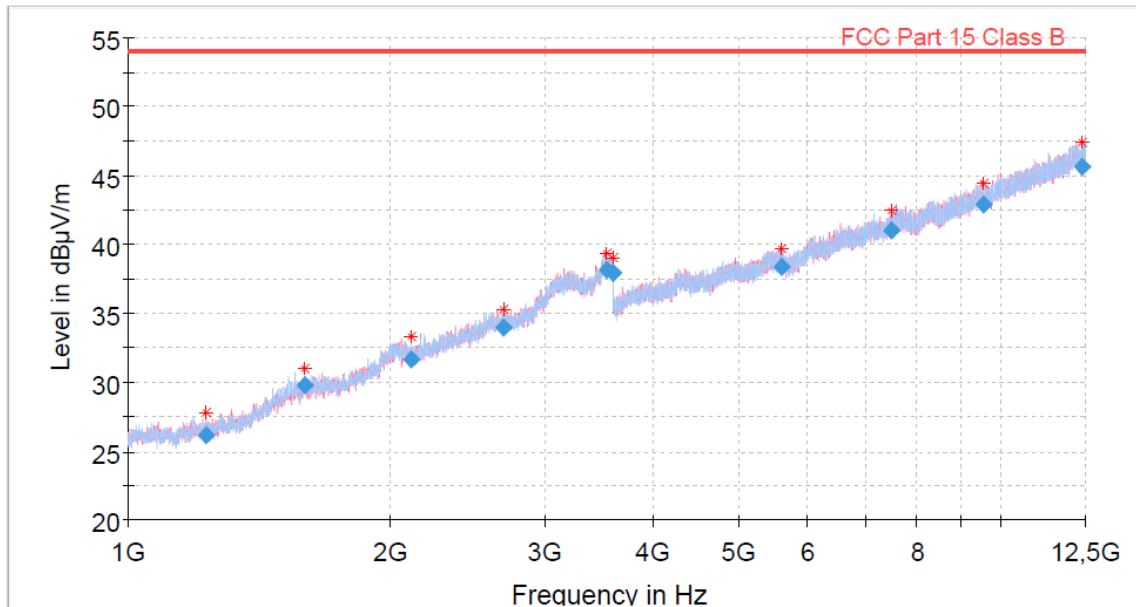
EUT

lot module, S20191069

Operating condition:

with charging adapter (230V/50Hz)

Full Spectrum



Preview Result 1V-AVG
 * Critical_Freqs AVG
 ◆ Final_Result CAV
 Preview Result 1H-AVG
 FCC Part 15 Class B

Final Result

Frequency (MHz)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Corr. (dB)	Comment
12371.750000	45.69	54.00	8.31	1000.0	1000.000	100.0	H	47.2	
9546.500000	42.92	54.00	11.08	1000.0	1000.000	100.0	V	45.4	
7505.000000	41.07	54.00	12.93	1000.0	1000.000	100.0	H	43.1	
5601.500000	38.36	54.00	15.64	1000.0	1000.000	100.0	V	40.5	
3530.500000	38.14	54.00	15.86	1000.0	1000.000	100.0	H	36.6	
3596.500000	37.89	54.00	16.11	1000.0	1000.000	100.0	V	36.7	
2693.750000	34.00	54.00	20.00	1000.0	1000.000	100.0	H	33.7	
2111.250000	31.66	54.00	22.34	1000.0	1000.000	100.0	H	31.7	
1592.000000	29.75	54.00	24.25	1000.0	1000.000	100.0	H	29.4	
1227.000000	26.17	54.00	27.83	1000.0	1000.000	100.0	V	27.2	

Radiated emission

EUT Information

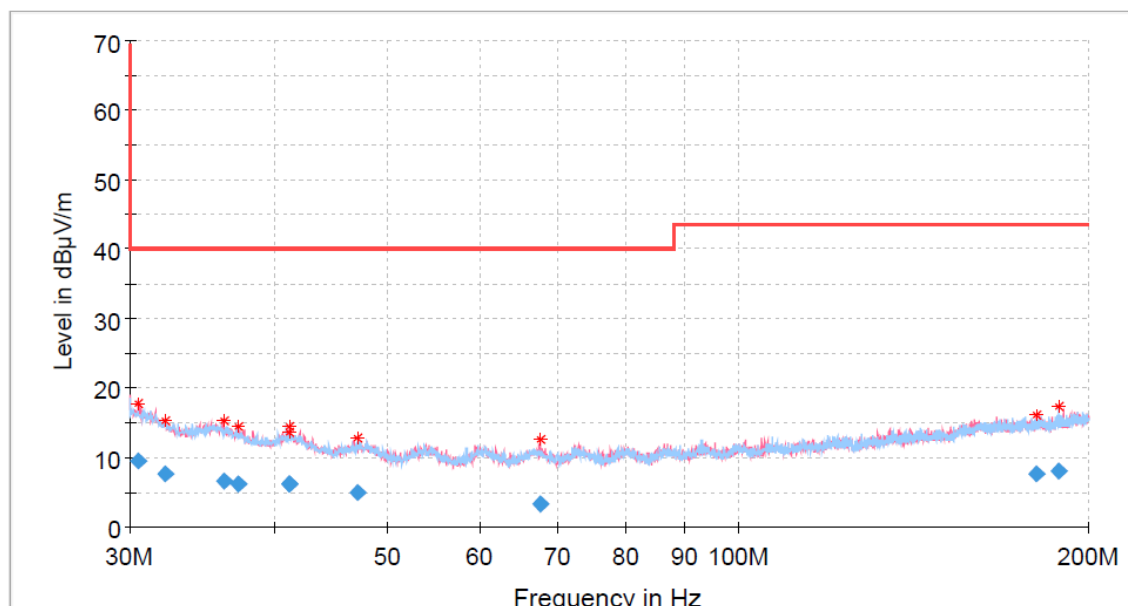
EUT

lot module, S20191069

Operating condition:

Battery mode

Full Spectrum



—* Preview Result 1V-PK+
* Critical_Freqs PK+
◆ Final_Result QPK

— Preview Result 1H-PK+
— FCC Part 15 Class B

Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)
30.500000	9.59	40.00	30.41	200.0	V	5.0
32.120000	7.67	40.00	32.33	200.0	H	255.0
36.080000	6.55	40.00	33.45	200.0	V	356.0
37.100000	6.29	40.00	33.71	100.0	H	69.0
41.150000	6.11	40.00	33.89	100.0	V	154.0
41.120000	6.09	40.00	33.91	100.0	V	154.0
47.060000	5.05	40.00	34.95	100.0	H	238.0
188.330000	8.04	43.50	35.46	100.0	H	154.0
180.050000	7.68	43.50	35.82	200.0	V	303.0
67.550000	3.35	40.00	36.65	200.0	V	356.0

EUT Information

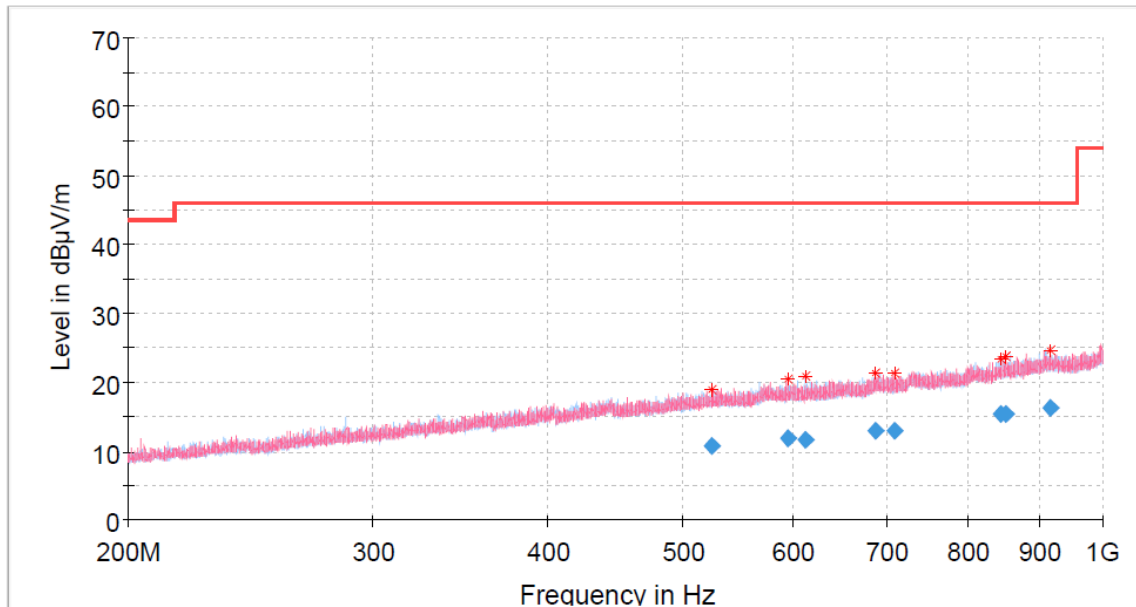
EUT

lot module, S20191069

Operating condition:

Battery mode

Full Spectrum



— Preview Result 1H-PK+ — Preview Result 1V-PK+
* Critical_Freqs PK+ — FCC Part 15 Class B
◆ Final_Result QPK

Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
917.810000	16.31	46.00	29.69	2000.0	120.000	175.0	V	89.0	22.2
846.410000	15.32	46.00	30.68	2000.0	120.000	175.0	H	334.0	21.2
851.000000	15.32	46.00	30.68	2000.0	120.000	179.0	V	194.0	21.3
686.930000	12.98	46.00	33.02	2000.0	120.000	125.0	V	-14.0	19.5
708.410000	12.90	46.00	33.10	2000.0	120.000	225.0	V	342.0	19.8
594.620000	11.81	46.00	34.19	2000.0	120.000	175.0	V	269.0	18.1
612.290000	11.77	46.00	34.24	2000.0	120.000	100.0	H	115.0	18.3
523.730000	10.85	46.00	35.15	2000.0	120.000	165.0	H	135.0	17.0

EMI Auto Test(1)

1 / 1

EUT Information

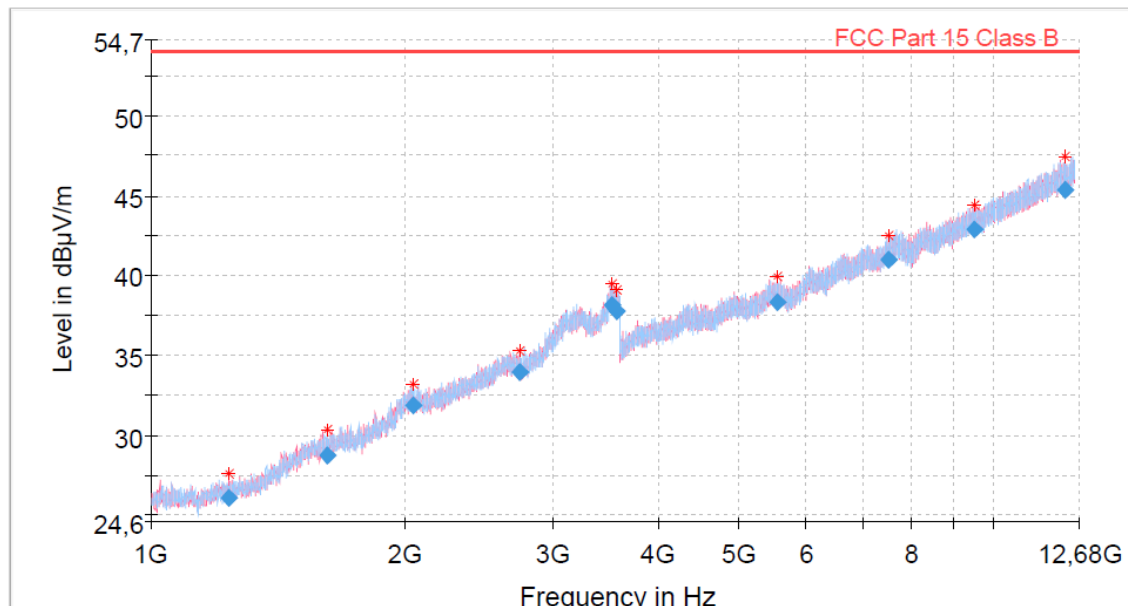
EUT

lot module, S20191069

Operating condition:

Battery mode

Full Spectrum



— Preview Result 1V-AVG
— Preview Result 1H-AVG
* Critical_Freqs AVG
◆ Final_Result CAV
— FCC Part 15 Class B

Final Result

Frequency (MHz)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Corr. (dB)	Comment
12197.000000	45.40	54.00	8.60	1000.0	1000.000	100.0	H	47.1	
9507.750000	42.90	54.00	11.10	1000.0	1000.000	100.0	V	45.4	
7513.750000	41.01	54.00	12.99	1000.0	1000.000	100.0	V	43.1	
5550.000000	38.34	54.00	15.66	1000.0	1000.000	100.0	V	40.4	
3525.500000	38.12	54.00	15.88	1000.0	1000.000	100.0	H	36.6	
3576.000000	37.77	54.00	16.23	1000.0	1000.000	100.0	H	36.7	
2733.500000	33.93	54.00	20.07	1000.0	1000.000	100.0	V	33.8	
2042.750000	31.83	54.00	22.17	1000.0	1000.000	100.0	H	32.1	
1615.000000	28.77	54.00	25.23	1000.0	1000.000	100.0	H	29.3	
1233.250000	26.05	54.00	27.95	1000.0	1000.000	100.0	V	27.2	

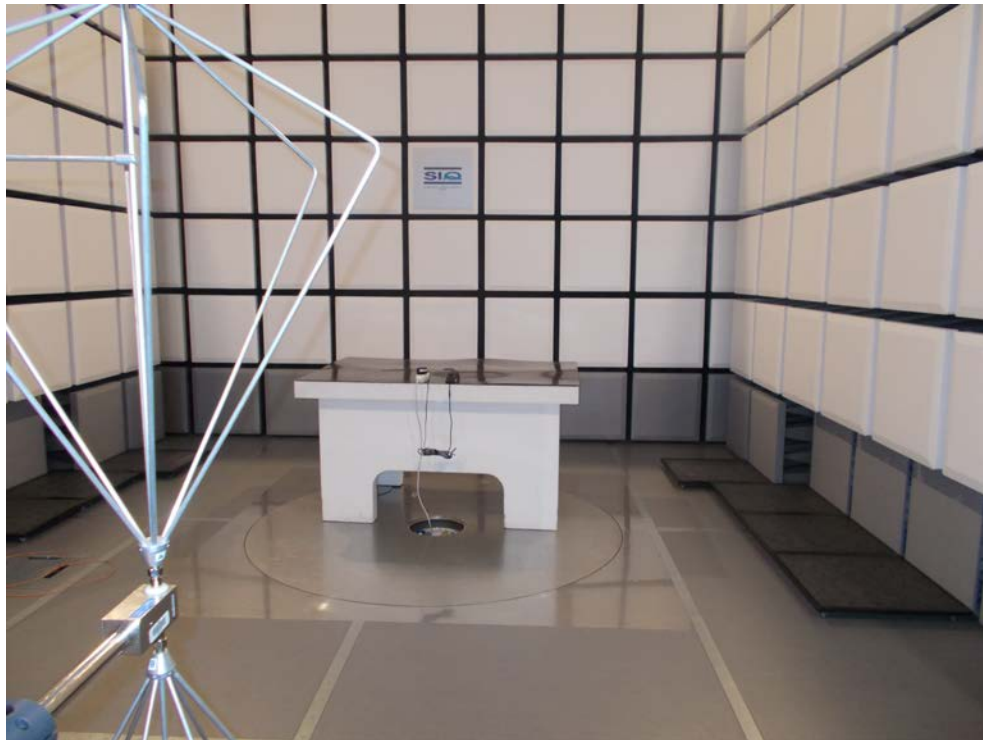


Figure 2: Radiated emission test 30 MHz – 200 MHz (with charger)

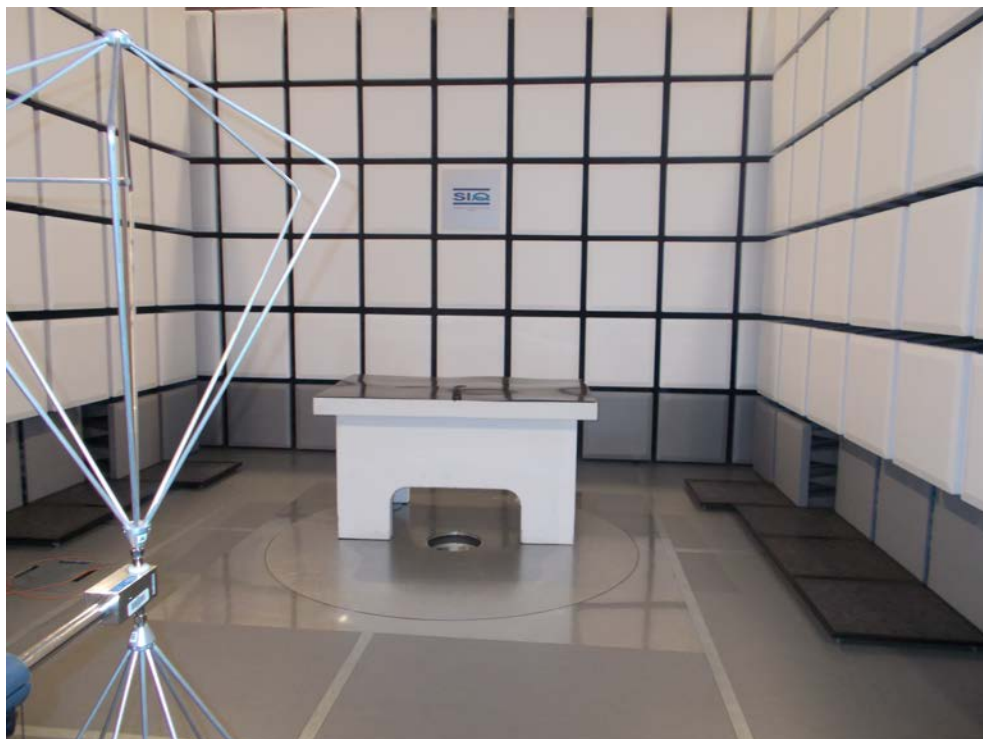


Figure 3: Radiated emission test 30 MHz – 200 MHz (without charger)



Figure 4: Radiated emission test – 200 MHz – 1000 MHz (with charger)



Figure 5: Radiated emission test – 200 MHz – 1000 MHz (without charger)



Figure 6: Radiated emission test – 1000 MHz – 6000 MHz (with charger)

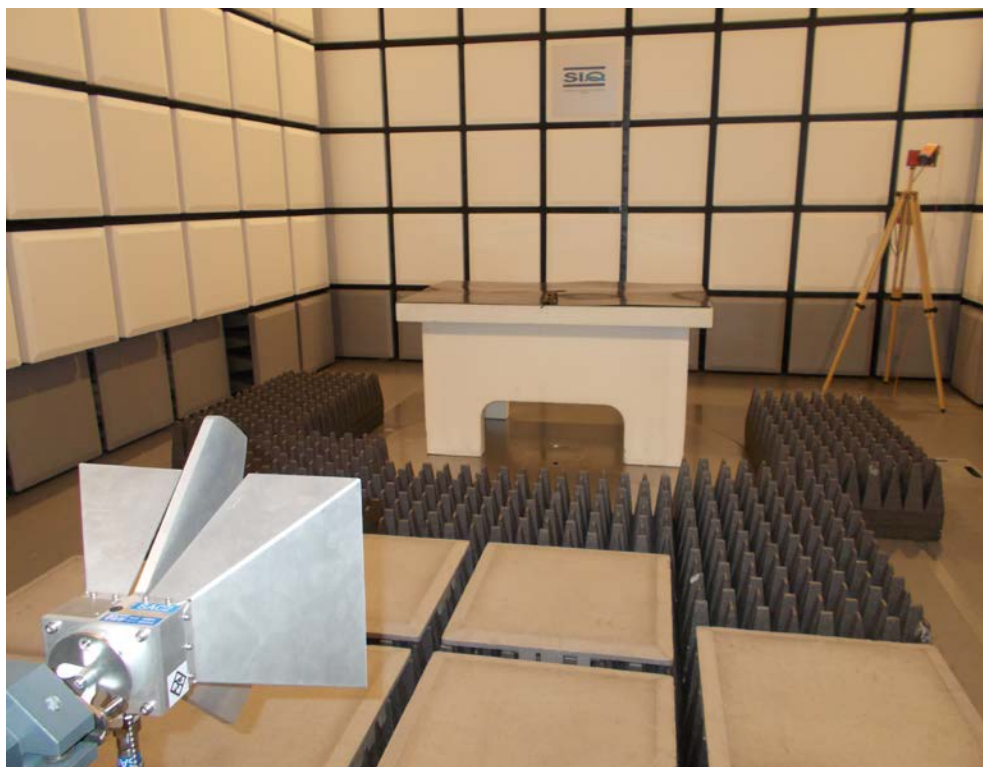


Figure 7: Radiated emission test – 1000 MHz – 6000 MHz (without charger)