

Test report

Number T251-0209/24 M1

Project file: C20240185

Date: 2024-11-22

Pages: 40

Product: Symbios Tank Pod

Type reference: O2S002

Ratings: 3 V d.c. (battery powered)
Class III

Trademark: Oxygen Scientific

Applicant: Halcyon Manufacturing
24587 NW 178th Pl, 32643 High Springs, Florida, USA

Manufacturer: Oxygen Scientific GmbH
Eichbachgasse 151, 8041 Graz, Austria

Place of manufacture: Oxygen Scientific GmbH
Eichbachgasse 151, 8041 Graz, Austria

Summary of testing

Testing method: ANSI C63.10:2013 (Clause 6.3, 6.4, 6.5, 6.9)

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

Remarks: Date of receipt of test items: 2024-01-31
Number of items tested: 1
Date of performance of tests: 2024-02-09 – 2024-03-07
The test results presented in this report relate only to the items tested.
The test items were tested in the condition as received.
The product complies with the requirements of the testing methods.
The product also complies with: 47 CFR Part 15, Subpart C (§15.203, §15.207 (a), §15.205; §15.209; §15.215) RSS-210 Issue 10 with Amendment (Clause 7.2), RSS-Gen, Issue 5 with Amendment 1 & 2 (Clause 6.5, 6.6, 8.8, 8.9, 8.10).

Tested by: Luka Cvajnar

Approved by: Marjan Mak

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1 GENERAL

History sheet			
Date	Report No.	Change	Revision
2024-11-11	T251-0209/24	Initial Test Report issued.	--
2024-11-22	T251-0209/24 M1	This report substitutes previously issued test report T251-0209/24, dated 2024-11-11, due to amendment of the test report. The applicant was changed. No additional testing was performed.	1.0

Environmental conditions:

Ambient temperature: 15 °C to 35 °C

Relative humidity: 30 % to 60 %

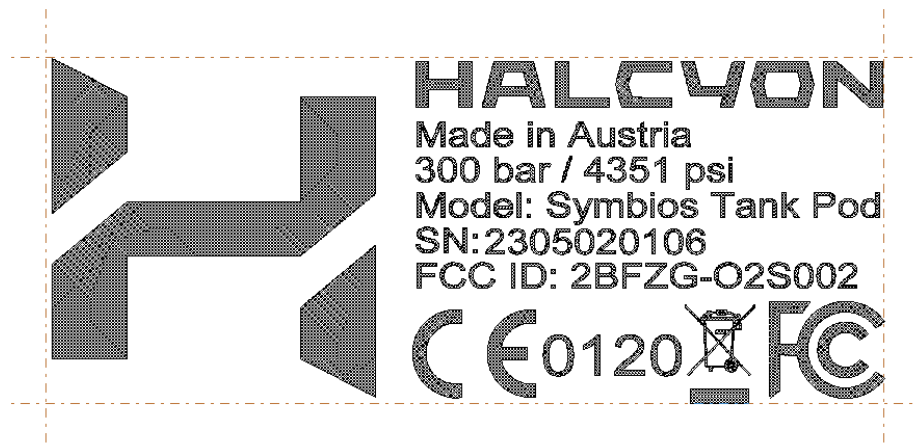
Atmospheric pressure: 860 mbar to 1060 mbar

1.1 Equipment under test

Tank pressure transmitter

Model: Symbios Tank Pod

FCC ID: 2BFZG-02S002



Marking plate

General product information

Tank pressure transmitter for SCUBA divers. The device is mounted on a high pressure port on a first stage of a SCUBA breathing regulator. It is measuring the pressure of the breathing gas in the scuba diving tank. The pressure value is transmitted wireless via a 125kHz magnetic transmission protocol.

Operating frequency (kHz)
125

Operating mode	
1	Transmitting pressure values to dive computers

1.2 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

1.3 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

1.4 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

2.1 Subpart C: Intentional Radiators

2.1.1 Section 15.207; 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.

2.1.2 Section 15.209; Radiated emission limits:

CLASS B limits:

Frequency Range (MHz)	Limits (dBμV/m)		Test distance (m)
0,009 to 0,490	$20 \cdot \log(2400/F(\text{kHz}))$	Quasi Peak	300
0,490 to 1,705	$20 \cdot \log(24000/F(\text{kHz}))$	Quasi Peak	30
1,705 to 30,0	29.5	Quasi Peak	30
30 to 88	40**	Quasi Peak	3
88 to 216	43.5**	Quasi Peak	3
216 to 960	46**	Quasi Peak	3
960 to 1000	54	Quasi Peak	3
above 1000	54	Average	3
above 1000	74	Peak	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, EMI receiver	ESW44	112470	2023-03-09	2024-09-09	18 months	X
Comtest Engineering, Semi Anechoic Chamber SAC 2	SAC 3m	NPS002	2022-04-14	2025-04-14	36 months	X
Rohde & Schwarz, Ultra Broadband Antenna	HL562E (SN 100842)	100842	2023-09-26	2026-09-26	36 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, Loop Antenna	FMZB 1519 B	109082	2023-03-16	2024-09-16	18 months	X

3.2 Other instrument information and auxiliary equipment

Description	Model No.	Bandwidth	Detector functions	Antenna factors	Cable loss	Range
Rohde-Schwarz, EMI receiver	ESW	200Hz, 9kHz, 120kHz, 1MHz	Peak, Q-peak, Average	/	/	2 Hz – 44 GHz
Comtest Engineering, Semi Anechoic Chamber SAC 2	SAC 3m	/	/	/	/	30 MHz – 18 GHz
Rohde & Schwarz, Ultra Broadband Antenna	HL562E (SN 100842)	/	/	See section 3.2.2	/	30 MHz – 6 GHz
Schwarzbeck Active loop antenna	FMZB 1519B	/		See section 3.2.2	/	9 kHz – 30 MHz

3.2.1 Antenna factors

3.2.2.1 Antenna FMZB 1519

Frequency (MHz)	Antenna factor FMZB 1519 B
0,01	20,66
0,01	20,38
0,02	19,31
0,03	19,05
0,04	18,93
0,05	18,87
0,06	18,82
0,07	18,79
0,08	18,76
0,09	18,74
0,10	18,72
0,11	18,71
0,12	18,69
0,13	18,68
0,14	18,67
0,15	18,66
0,20	18,63
0,30	18,59
0,40	18,56
0,50	18,54
0,60	18,53
0,70	18,51
0,80	18,50
0,90	18,50
1,00	18,49
2,00	18,43
3,00	18,40
4,00	18,37
5,00	18,35
6,00	18,26
7,00	18,21
8,00	18,14
9,00	18,07
10,00	17,99
11,00	17,91
12,00	17,84
13,00	17,77
14,00	17,71
15,00	17,66
16,00	17,61
17,00	17,57
18,00	17,53
19,00	17,51
20,00	17,49
21,00	17,49
22,00	17,50
23,00	17,53
24,00	17,56
25,00	17,59
26,00	17,64
27,00	17,70
28,00	17,77
29,00	17,85
30,00	17,94

3.2.2.2 Antenna HL562E

Frequency (MHz)	Antenna factor HL562E (SN 100843)	Antenna factor HL562E (SN 100842)
30,00	18,86	18,95
31,00	18,27	18,43
32,00	17,68	17,88
33,00	17,11	17,33
34,00	16,57	16,79
35,00	16,00	16,23
36,00	15,41	15,67
37,00	14,84	15,10
38,00	14,25	14,53
39,00	13,65	13,94
40,00	13,04	13,34
41,00	12,40	12,72
42,00	11,77	12,07
43,00	11,09	11,42
44,00	10,41	10,72
45,00	9,71	10,02
46,00	9,00	9,30
47,00	8,28	8,58
48,00	7,57	7,84
49,00	6,87	7,13
50,00	6,22	6,44
51,00	5,60	5,81
52,00	5,07	5,26
53,00	4,64	4,83
54,00	4,35	4,54
55,00	4,19	4,41
56,00	4,17	4,45
57,00	4,30	4,59
58,00	4,54	4,79
59,00	4,84	5,07
60,00	5,17	5,38
61,00	5,50	5,66
62,00	5,79	5,88
63,00	6,06	6,15
64,00	6,33	6,53
65,00	6,59	6,89
66,00	6,85	7,18
67,00	7,09	7,41
68,00	7,32	7,63
69,00	7,55	7,82
70,00	7,75	7,99
71,00	7,93	8,15
72,00	8,10	8,27
73,00	8,24	8,37
74,00	8,38	8,48
75,00	8,51	8,63
76,00	8,62	8,78
77,00	8,74	8,90
78,00	8,85	9,00
79,00	8,96	9,09
80,00	9,05	9,18
81,00	9,14	9,24
82,00	9,21	9,29
83,00	9,27	9,36
84,00	9,33	9,41
85,00	9,39	9,46
86,00	9,43	9,51
87,00	9,48	9,57

88,00	9,49	9,60
89,00	9,52	9,63
90,00	9,54	9,68
91,00	9,57	9,73
92,00	9,60	9,77
93,00	9,63	9,82
94,00	9,66	9,87
95,00	9,70	9,92
96,00	9,74	9,97
97,00	9,79	10,03
98,00	9,85	10,10
99,00	9,92	10,18
100,00	9,99	10,25
101,00	10,05	10,33
102,00	10,16	10,42
103,00	10,23	10,50
104,00	10,32	10,58
105,00	10,40	10,65
106,00	10,48	10,73
107,00	10,53	10,79
108,00	10,55	10,84
109,00	10,55	10,87
110,00	10,54	10,89
111,00	10,53	10,91
112,00	10,54	10,93
113,00	10,54	10,94
114,00	10,53	10,93
115,00	10,52	10,90
116,00	10,49	10,87
117,00	10,48	10,84
118,00	10,44	10,78
119,00	10,38	10,72
120,00	10,32	10,63
121,00	10,26	10,52
122,00	10,21	10,41
123,00	10,16	10,30
124,00	10,02	10,26
125,00	10,06	10,21
126,00	10,01	10,10
127,00	9,93	9,98
128,00	9,71	9,86
129,00	9,74	9,89
130,00	9,70	9,87
131,00	9,61	9,78
132,00	9,52	9,68
133,00	9,44	9,58
134,00	9,35	9,47
135,00	9,25	9,36
136,00	9,16	9,26
137,00	9,07	9,16
138,00	8,97	9,05
139,00	8,88	8,95
140,00	8,79	8,85
141,00	8,70	8,74
142,00	8,60	8,65
143,00	8,51	8,55
144,00	8,42	8,46
145,00	8,34	8,38
146,00	8,26	8,31
147,00	8,18	8,23
148,00	8,11	8,17
149,00	8,04	8,11
150,00	7,97	8,06

151,00	7,92	8,02
152,00	7,88	8,00
153,00	7,84	7,97
154,00	7,82	7,98
155,00	7,83	8,03
156,00	7,87	8,07
157,00	7,88	8,05
158,00	7,89	8,05
159,00	7,88	8,06
160,00	7,87	8,08
161,00	7,88	8,12
162,00	7,89	8,14
163,00	7,91	8,17
164,00	7,94	8,19
165,00	7,98	8,22
166,00	8,03	8,24
167,00	8,09	8,24
168,00	8,14	8,37
169,00	8,21	8,46
170,00	8,31	8,54
171,00	8,39	8,64
172,00	8,48	8,71
173,00	8,59	8,81
174,00	8,76	8,92
175,00	8,95	9,06
176,00	9,17	9,23
177,00	9,37	9,42
178,00	9,42	9,50
179,00	9,24	9,39
180,00	8,88	9,09
181,00	8,48	8,70
182,00	8,16	8,37
183,00	7,94	8,14
184,00	7,82	8,01
185,00	7,74	7,93
186,00	7,70	7,89
187,00	7,69	7,89
188,00	7,69	7,91
189,00	7,72	7,97
190,00	7,78	8,05
191,00	7,81	8,01
192,00	7,78	7,97
193,00	7,77	7,97
194,00	7,80	8,01
195,00	7,85	8,07
196,00	7,91	8,14
197,00	7,98	8,21
198,00	8,05	8,26
199,00	8,14	8,25
200,00	8,22	8,49
202,00	8,41	8,65
204,00	8,56	8,77
206,00	8,68	8,88
208,00	8,79	8,98
210,00	8,85	9,06
212,00	8,84	9,02
214,00	8,80	8,96
216,00	8,67	8,83
218,00	8,40	8,56
220,00	8,28	8,41
222,00	8,43	8,55
224,00	8,69	8,79
226,00	8,91	9,04

228,00	9,09	9,21
230,00	9,25	9,36
232,00	9,39	9,48
234,00	9,52	9,60
236,00	9,68	9,71
238,00	9,76	9,82
240,00	9,83	9,91
242,00	9,83	9,93
244,00	9,83	9,94
246,00	9,86	9,97
248,00	9,91	10,01
250,00	10,00	10,03
252,00	10,04	10,16
254,00	10,13	10,25
256,00	10,22	10,34
258,00	10,31	10,42
260,00	10,39	10,51
262,00	10,48	10,60
264,00	10,50	10,61
266,00	10,54	10,63
268,00	10,61	10,70
270,00	10,67	10,77
272,00	10,73	10,82
274,00	10,79	10,89
276,00	10,85	10,95
278,00	10,92	11,02
280,00	11,00	11,07
282,00	11,08	11,16
284,00	11,14	11,23
286,00	11,20	11,28
288,00	11,26	11,33
290,00	11,30	11,37
292,00	11,37	11,40
294,00	11,43	11,44
296,00	11,46	11,49
298,00	11,52	11,54
300,00	11,64	11,65
302,00	11,77	11,82
304,00	11,81	11,91
306,00	11,83	11,93
308,00	11,87	11,95
310,00	11,91	11,99
312,00	11,97	12,03
314,00	12,02	12,12
316,00	12,09	12,20
318,00	12,16	12,26
320,00	12,21	12,33
322,00	12,27	12,39
324,00	12,34	12,46
326,00	12,38	12,49
328,00	12,39	12,48
330,00	12,41	12,49
332,00	12,46	12,57
334,00	12,54	12,67
336,00	12,58	12,65
338,00	12,66	12,69
340,00	12,72	12,78
342,00	12,76	12,82
344,00	12,81	12,87
346,00	12,87	12,93
348,00	12,93	12,99
350,00	13,01	13,05
352,00	13,09	13,13

354,00	13,17	13,20
356,00	13,23	13,27
358,00	13,28	13,34
360,00	13,32	13,38
362,00	13,38	13,41
364,00	13,44	13,44
366,00	13,49	13,49
368,00	13,55	13,55
370,00	13,63	13,64
372,00	13,73	13,75
374,00	13,78	13,80
376,00	13,82	13,83
378,00	13,85	13,87
380,00	13,89	13,90
382,00	13,93	13,95
384,00	14,00	14,02
386,00	14,06	14,09
388,00	14,13	14,14
390,00	14,22	14,17
392,00	14,23	14,27
394,00	14,29	14,33
396,00	14,35	14,40
398,00	14,41	14,47
400,00	14,45	14,50
402,00	14,50	14,51
404,00	14,54	14,51
406,00	14,57	14,52
408,00	14,62	14,56
410,00	14,68	14,63
412,00	14,73	14,74
414,00	14,79	14,86
416,00	14,84	14,94
418,00	14,86	14,98
420,00	14,88	14,99
422,00	14,89	15,01
424,00	14,93	15,04
426,00	14,97	15,07
428,00	15,01	15,11
430,00	15,06	15,16
432,00	15,11	15,20
434,00	15,16	15,26
436,00	15,21	15,28
438,00	15,26	15,36
440,00	15,31	15,40
442,00	15,36	15,45
444,00	15,41	15,49
446,00	15,47	15,54
448,00	15,54	15,60
450,00	15,57	15,66
452,00	15,62	15,70
454,00	15,66	15,73
456,00	15,72	15,78
458,00	15,79	15,84
460,00	15,89	15,95
462,00	15,99	16,10
464,00	16,08	16,19
466,00	16,12	16,20
468,00	16,15	16,21
470,00	16,16	16,22
472,00	16,16	16,22
474,00	16,17	16,23
476,00	16,19	16,25
478,00	16,22	16,28

480,00	16,27	16,31
482,00	16,31	16,36
484,00	16,37	16,41
486,00	16,45	16,48
488,00	16,50	16,59
490,00	16,55	16,63
492,00	16,60	16,68
494,00	16,63	16,72
496,00	16,64	16,75
498,00	16,65	16,78
500,00	16,66	16,77
502,00	16,67	16,77
504,00	16,66	16,77
506,00	16,65	16,75
508,00	16,65	16,73
510,00	16,66	16,73
512,00	16,69	16,78
514,00	16,75	16,88
516,00	16,84	16,96
518,00	16,89	17,00
520,00	16,91	16,99
522,00	16,92	16,97
524,00	16,92	16,95
526,00	16,93	16,95
528,00	16,94	16,97
530,00	16,95	16,99
532,00	16,97	17,00
534,00	16,98	17,01
536,00	17,00	17,02
538,00	17,01	17,04
540,00	17,04	17,06
542,00	17,06	17,09
544,00	17,10	17,11
546,00	17,14	17,18
548,00	17,17	17,21
550,00	17,20	17,25
552,00	17,25	17,29
554,00	17,30	17,34
556,00	17,33	17,39
558,00	17,36	17,44
560,00	17,39	17,47
562,00	17,42	17,51
564,00	17,45	17,52
566,00	17,47	17,54
568,00	17,51	17,57
570,00	17,57	17,63
572,00	17,64	17,69
574,00	17,75	17,79
576,00	17,86	17,90
578,00	17,96	17,99
580,00	18,02	18,04
582,00	18,04	18,07
584,00	18,04	18,08
586,00	18,04	18,08
588,00	18,04	18,09
590,00	18,04	18,09
592,00	18,06	18,10
594,00	18,07	18,10
596,00	18,08	18,11
598,00	18,10	18,13
600,00	18,13	18,15
602,00	18,17	18,18
604,00	18,20	18,20

606,00	18,23	18,22
608,00	18,26	18,24
610,00	18,28	18,24
612,00	18,31	18,25
614,00	18,33	18,27
616,00	18,35	18,34
618,00	18,36	18,35
620,00	18,37	18,36
622,00	18,38	18,37
624,00	18,39	18,37
626,00	18,40	18,37
628,00	18,40	18,37
630,00	18,41	18,37
632,00	18,43	18,39
634,00	18,43	18,42
636,00	18,45	18,45
638,00	18,48	18,47
640,00	18,52	18,51
642,00	18,57	18,57
644,00	18,65	18,66
646,00	18,73	18,79
648,00	18,79	18,93
650,00	18,86	19,08
652,00	18,91	19,17
654,00	18,96	19,22
656,00	18,98	19,19
658,00	18,99	19,17
660,00	18,99	19,13
662,00	18,99	19,10
664,00	18,98	19,09
666,00	18,98	19,08
668,00	18,99	19,08
670,00	19,01	19,09
672,00	19,00	19,10
674,00	19,00	19,11
676,00	18,99	19,13
678,00	19,00	19,14
680,00	19,02	19,16
682,00	19,04	19,19
684,00	19,07	19,21
686,00	19,09	19,24
688,00	19,10	19,26
690,00	19,12	19,28
692,00	19,14	19,30
694,00	19,15	19,34
696,00	19,18	19,38
698,00	19,20	19,42
700,00	19,22	19,44
702,00	19,25	19,44
704,00	19,28	19,44
706,00	19,30	19,44
708,00	19,35	19,45
710,00	19,40	19,46
712,00	19,46	19,48
714,00	19,51	19,49
716,00	19,55	19,51
718,00	19,59	19,56
720,00	19,63	19,61
722,00	19,70	19,68
724,00	19,78	19,76
726,00	19,86	19,84
728,00	19,94	19,93
730,00	20,02	20,04

732,00	20,06	20,12
734,00	20,08	20,16
736,00	20,07	20,15
738,00	20,04	20,09
740,00	20,01	20,05
742,00	19,99	19,99
744,00	19,98	19,97
746,00	19,97	19,94
748,00	19,95	19,94
750,00	19,94	19,93
752,00	19,93	19,92
754,00	19,93	19,93
756,00	19,95	19,94
758,00	19,95	19,96
760,00	19,98	19,97
762,00	20,00	19,98
764,00	20,02	19,99
766,00	20,04	20,01
768,00	20,09	20,02
770,00	20,13	20,04
772,00	20,18	20,06
774,00	20,22	20,10
776,00	20,22	20,17
778,00	20,24	20,20
780,00	20,25	20,22
782,00	20,27	20,24
784,00	20,27	20,24
786,00	20,28	20,24
788,00	20,28	20,23
790,00	20,30	20,24
792,00	20,31	20,25
794,00	20,32	20,25
796,00	20,32	20,26
798,00	20,35	20,29
800,00	20,39	20,32
802,00	20,43	20,39
804,00	20,48	20,45
806,00	20,52	20,56
808,00	20,57	20,65
810,00	20,66	20,77
812,00	20,74	20,87
814,00	20,80	20,94
816,00	20,83	20,95
818,00	20,84	20,96
820,00	20,85	20,93
822,00	20,84	20,90
824,00	20,81	20,89
826,00	20,82	20,86
828,00	20,81	20,86
830,00	20,81	20,87
832,00	20,82	20,86
834,00	20,84	20,86
836,00	20,85	20,86
838,00	20,86	20,87
840,00	20,86	20,88
842,00	20,85	20,88
844,00	20,85	20,90
846,00	20,84	20,91
848,00	20,86	20,93
850,00	20,89	20,93
852,00	20,91	20,94
854,00	20,94	20,95
856,00	20,96	20,96

858,00	20,98	20,98
860,00	21,01	20,99
862,00	21,04	21,02
864,00	21,08	21,05
866,00	21,12	21,09
868,00	21,14	21,12
870,00	21,14	21,14
872,00	21,16	21,19
874,00	21,19	21,23
876,00	21,23	21,28
878,00	21,25	21,31
880,00	21,29	21,34
882,00	21,33	21,36
884,00	21,37	21,38
886,00	21,40	21,41
888,00	21,45	21,43
890,00	21,49	21,44
892,00	21,51	21,45
894,00	21,55	21,46
896,00	21,58	21,46
898,00	21,61	21,48
900,00	21,65	21,51
902,00	21,70	21,55
904,00	21,76	21,61
906,00	21,83	21,70
908,00	21,90	21,78
910,00	21,95	21,87
912,00	21,98	21,92
914,00	21,98	21,94
916,00	21,97	21,93
918,00	21,96	21,90
920,00	21,94	21,88
922,00	21,92	21,84
924,00	21,88	21,80
926,00	21,85	21,79
928,00	21,82	21,77
930,00	21,81	21,77
932,00	21,80	21,78
934,00	21,79	21,77
936,00	21,79	21,75
938,00	21,78	21,74
940,00	21,80	21,73
942,00	21,80	21,74
944,00	21,82	21,75
946,00	21,84	21,75
948,00	21,86	21,76
950,00	21,88	21,77
952,00	21,91	21,78
954,00	21,93	21,80
956,00	21,96	21,80
958,00	22,00	21,81
960,00	22,03	21,81
962,00	22,07	21,81
964,00	22,12	21,83
966,00	22,15	21,86
968,00	22,16	21,95
970,00	22,16	22,00
972,00	22,18	22,01
974,00	22,20	22,01
976,00	22,23	22,02
978,00	22,26	22,03
980,00	22,29	22,04
982,00	22,32	22,07

984,00	22,35	22,09
986,00	22,39	22,13
988,00	22,42	22,15
990,00	22,43	22,20
992,00	22,42	22,27
994,00	22,44	22,36
996,00	22,46	22,42
998,00	22,48	22,47
1000,00	22,52	22,54

CONVERSION FACTORS AND ALL OTHER FORMULAS

Unit	Conversion unit	Formula of conversion
dB μ V	dB μ V/m	dB μ V/m = dB μ V + AF
μ V/m	dB μ V/m	dB μ V/m = 20log(X(μ V/m)/1 μ 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

4 GENERAL AND SPECIAL CONDITIONS DESCRIPTION

4.1 General condition description

Interconnect and power cabling (or wiring)

4.1.1 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.

4.1.2 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.

4.1.3 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.

4.1.4 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

4.1.5 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.

4.1.6 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

4.1.7 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.

4.2 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)

5 MEASUREMENT UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the product, as specified in ETSI TR 100 028-2 and C63.23. This represents an expanded uncertainty expressed at 95% confidence level using a coverage factor $k=2$.

Measurements	U_{LAB}	$U_{ETSI\ TR\ 100\ 028-2}$	$U_{C63.23}$
AC Line Conducted Emission	3.2 dB	/	$\pm 4,13$
Spurious emission 30 – 300 MHz	4.2 dB	± 6	/
Spurious emission 300 – 1000 MHz	4.4 dB	± 6	/
Spurious emission 1 GHz – 18 GHz	5.1 dB	± 6	
Occupied bandwidth (99% emission bandwidth)	< 2%	$\pm 5\%$	/

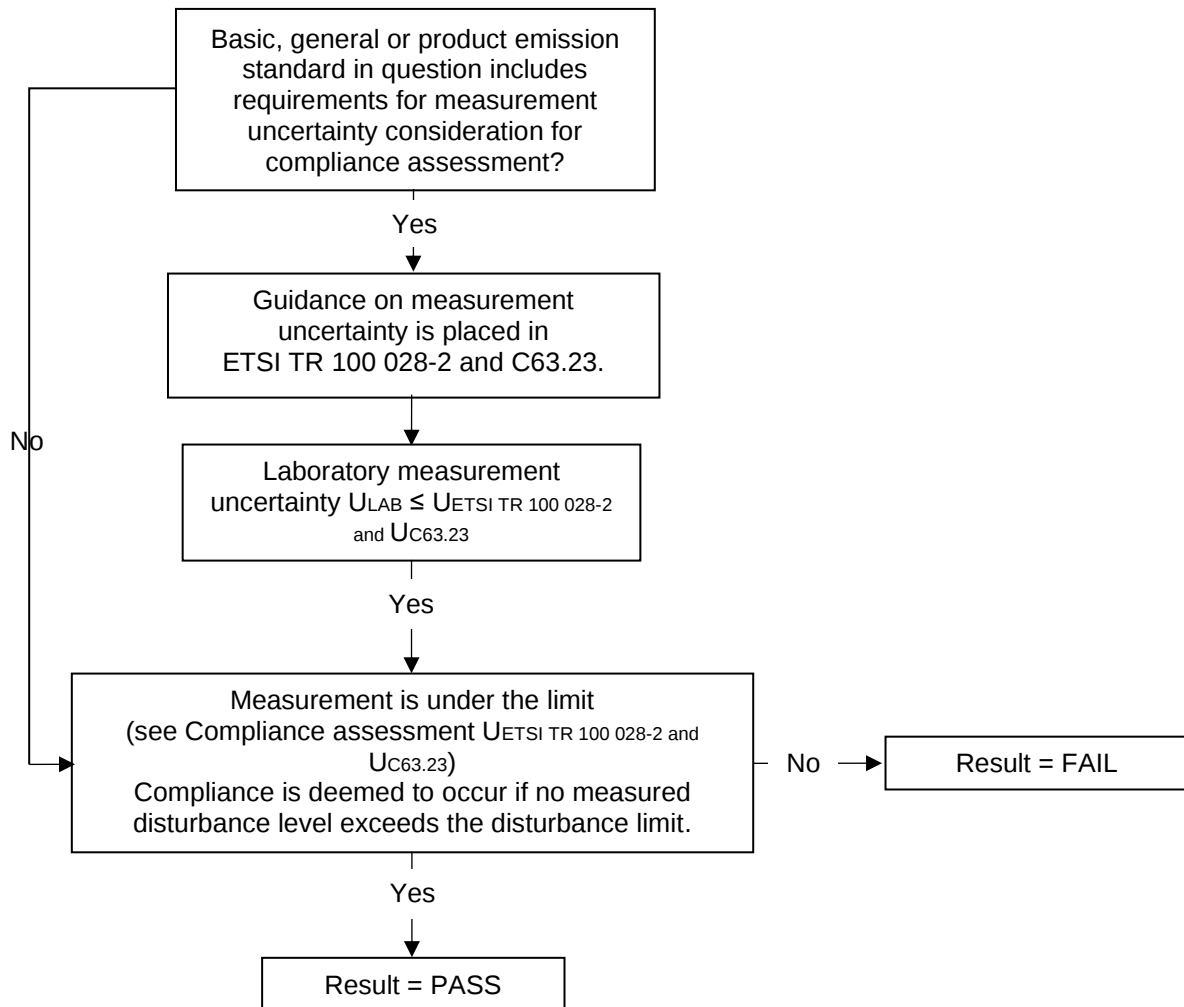
Note: Measurement uncertainty calculated in accordance with ETSI TR 100 028-2 and C63.23.

5.1 Application of decision rule

Application of decision rule and statement of conformity is defined in document TN023 Decision rule and measurement uncertainty.

As a general rule Pass/Fail decisions are based on simple acceptance rule and acceptance limits chosen based on simple acceptance ($w = 0$, $AL = TL$) except if a decision rule is governed by particular standard or guidance document.

Decision rule:



6 TEST SUMMARY

STANDARDS (details on first page)	Tested		Sample	
	yes	no	pass	not
ANSI C63.10-2013 (Clause 6.3, 6.4, 6.5, 6.6, 6.9); The product also complies with: 47 CFR Part 15, Subpart C: (§15.203, §15.207 (a), §15.205; §15.209; §15.215) RSS-210 Issue 10 (Clause 7.2), RSS-Gen, Issue 5 (Clause 6.7, 8.8, 8.9)	☒	☐	☒	☐

Test	Section within the report	47 CFR Part 15	RSS 210, Issue 10 (*1) or RSS-Gen, Issue 5 (*2)	Conclusion
Antenna requirement	8.1	15.203	-	PASS
Conducted emission	8.2	15.207	8.8 (*2)	N/A
Radiated emission	8.3	15.205, 15.209	8.9 (*2), 8.10(*2), 7.2 (*1)	PASS
99% Bandwidth	8.4	-	6.7 (*2)	PASS
20 dB Bandwidth	8.5	15.215(c)	-	PASS
*Note: Radiated measurements performed in laboratory recognized by ISED Canada: – CAB identifier: SI0001 – ISED#: 21434				

6.1 Operating voltages/frequencies used for testing

Section	Test	Operating conditions
8.3	Radiated emission	3 V d.c.
8.4	99% Bandwidth	3 V d.c.
8.5	20 dB Bandwidth	3 V d.c.

7 EMISSION TESTS

7.1 47 CFR § 15.203 Antenna requirements

Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Conclusion:

PASS

Note: Wire antenna installed within enclosure.

7.2 47 CFR § 15.207 Conducted emission measurement (intentional radiator)

Test is not applicable, EUT is powered from CR123 battery – 3 V d.c.

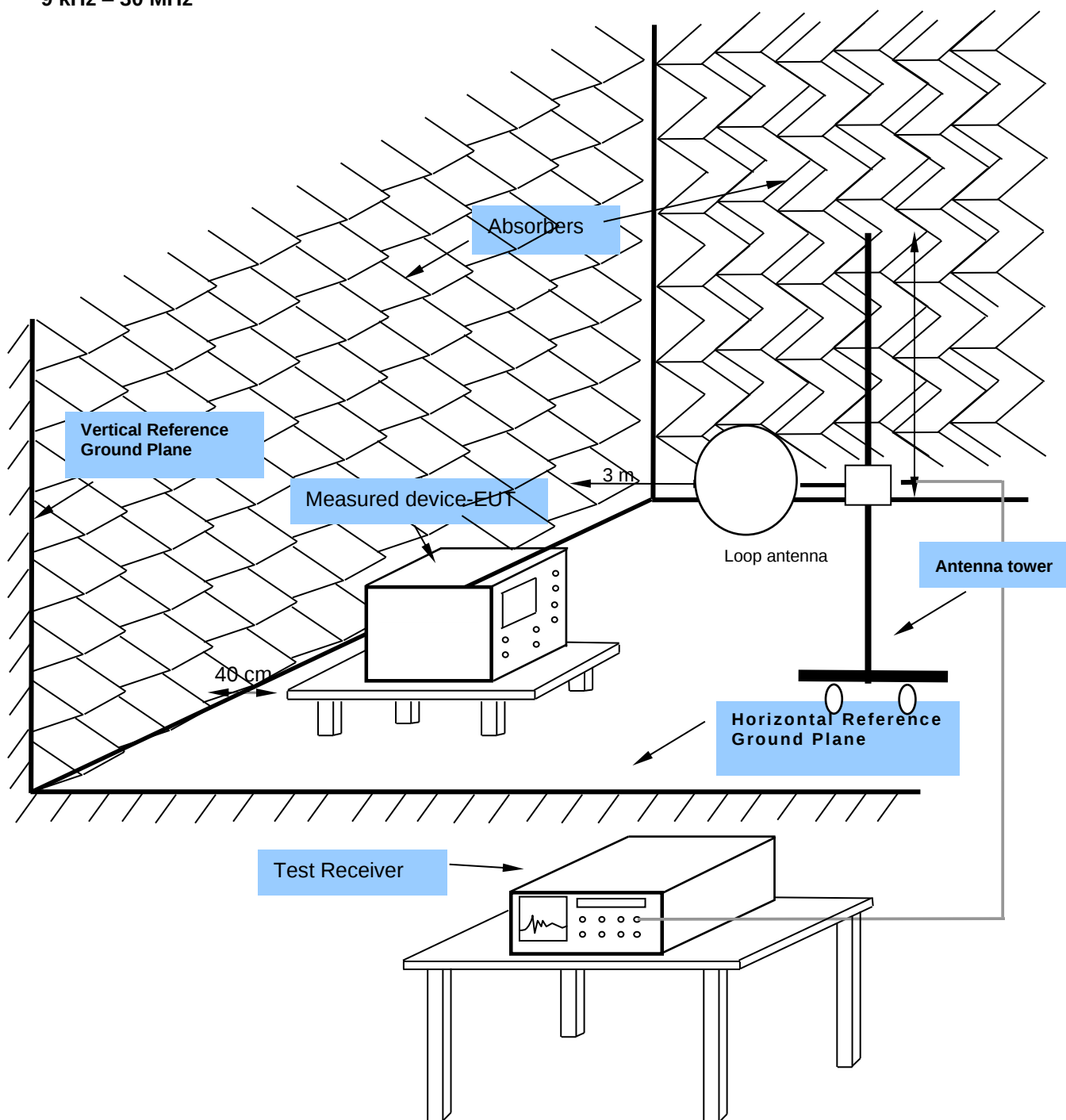
7.3 47 CFR § 15.205, § 15.209 Radiated emission measurement (intentional radiator)

7.3.1 Test procedure

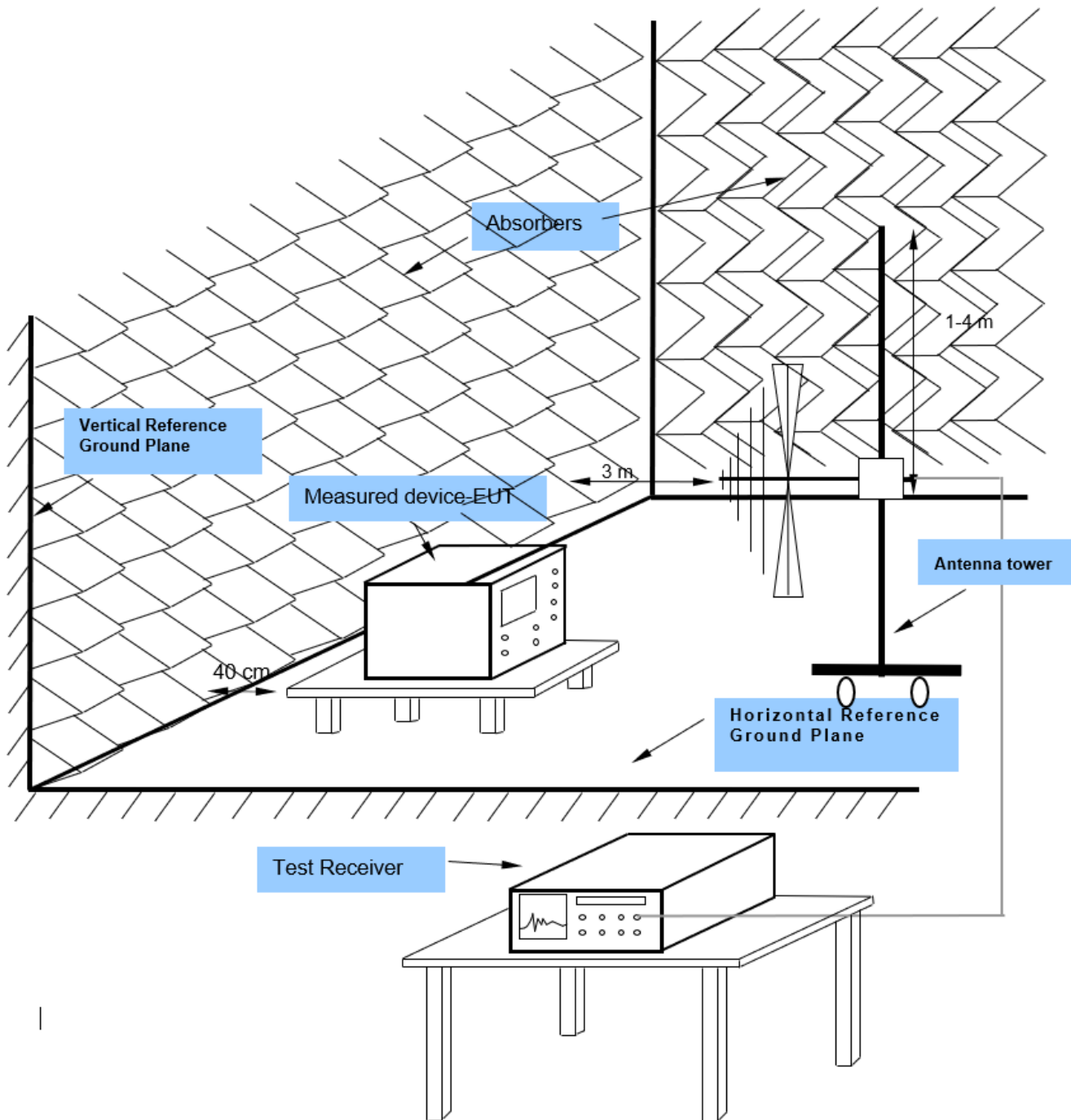
1. The EUT was placed on the top of a rotating table 0.8 meters above the ground in an Anechoic Chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 m away from the interference-receiving antenna, which was mounted on the top of variable-height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

7.3.2 Test setup

9 kHz – 30 MHz



30 MHz – 1000 MHz



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

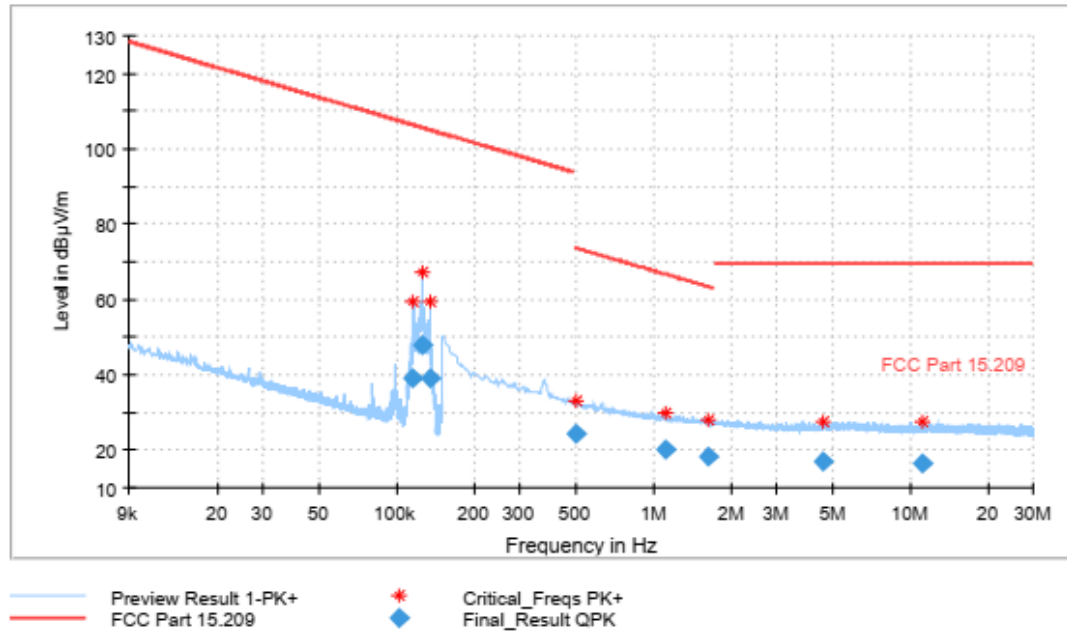
7.3.3 Test result

Preliminary test results at 3 meters distance 9 kHz – 30 MHz

EUT Information

EUT: RNO TANKPOD
 Operating mode: TX 125 kHz
 Antenna polarization: Antenna X

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azim uth (deg)	Corr. (dB/m)
0.115900	39.03	106.32	67.28	1000.0	0.200	H	333.0	18.3
0.124800	48.08	105.67	57.60	1000.0	0.200	H	333.0	18.3
0.133700	39.24	105.08	65.83	1000.0	0.200	H	333.0	18.3
0.501000	24.37	73.61	49.24	1000.0	9.000	H	353.0	18.0
1.101750	20.00	66.78	46.78	1000.0	9.000	H	104.0	18.1
1.630500	18.46	63.39	44.92	1000.0	9.000	H	91.0	18.1
4.571250	16.85	69.50	52.65	1000.0	9.000	H	313.0	18.3
11.053500	16.31	69.50	53.19	1000.0	9.000	H	156.0	18.3

EUT Information

EUT:

RNO TANKPOD

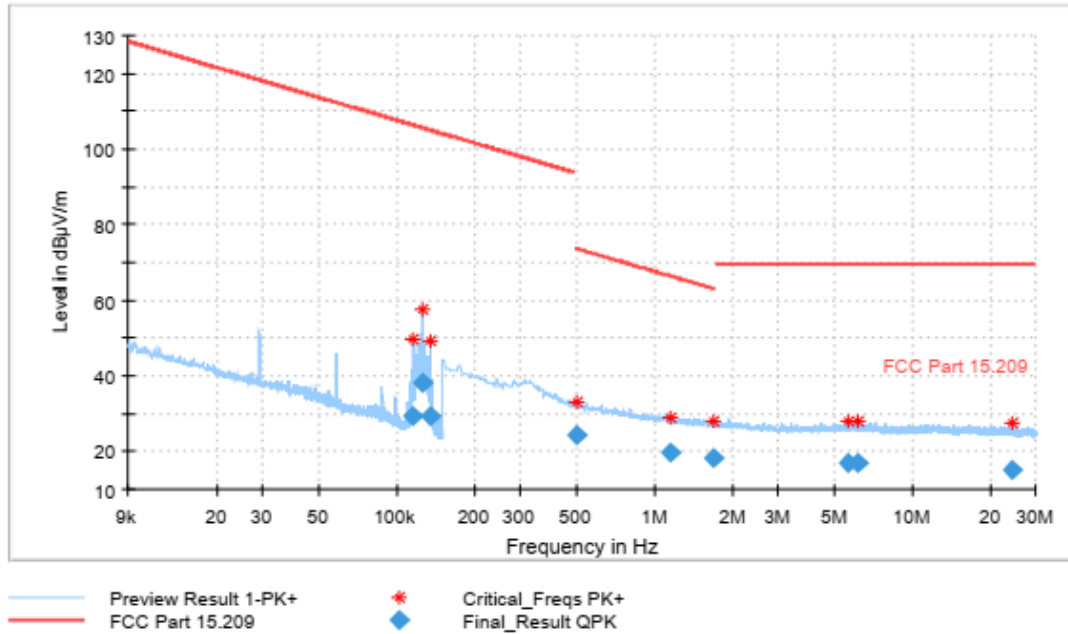
Operating mode:

TX 125 kHz

Antenna polarization:

Antenna Y

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.115900	29.31	106.32	77.00	1000.0	0.200	H	268.0	18.3
0.124800	38.11	105.67	67.56	1000.0	0.200	H	268.0	18.3
0.133700	29.36	105.08	75.72	1000.0	0.200	H	190.0	18.3
0.496500	24.33	73.69	49.35	1000.0	9.000	H	100.0	18.0
1.151250	19.67	66.40	46.73	1000.0	9.000	H	151.0	18.1
1.677750	18.51	63.14	44.63	1000.0	9.000	H	164.0	18.1
5.604000	16.73	69.50	52.77	1000.0	9.000	H	48.0	18.3
6.123750	16.99	69.50	52.51	1000.0	9.000	H	0.0	18.3
24.202500	15.24	69.50	54.26	1000.0	9.000	H	3.0	18.3

EUT Information

EUT:

RNO TANKPOD

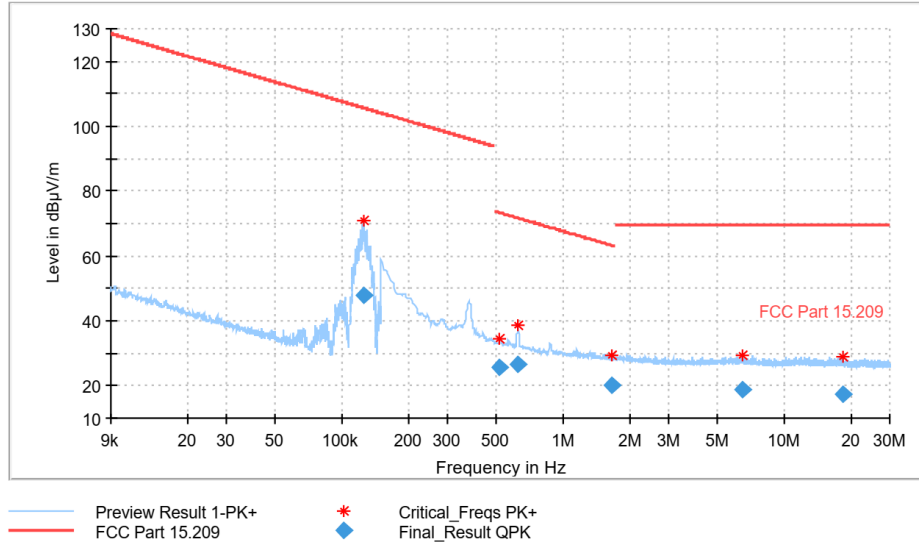
Operating mode:

TX 125 kHz

Antenna polarization:

Antenna Z

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
1.655250	20.13	63.26	43.13	1000.0	9.000	H	348.0	18.1
0.624750	26.75	71.70	44.95	1000.0	9.000	H	340.0	18.1
0.516750	25.52	73.34	47.82	1000.0	9.000	H	48.0	18.1
6.490500	18.60	69.50	50.90	1000.0	9.000	H	213.0	18.3
18.334500	17.53	69.50	51.97	1000.0	9.000	H	10.0	18.4
0.124400	47.71	105.70	57.99	1000.0	0.200	H	352.0	18.3

Final test results at 10 meters distance

Operating mode	DUT Frequency (kHz)	Measured level at 10 m distance (dBμV/m)	Conversion factor	Calculated level (dBμV/m)	Limit at 300 m (dBμV/m)	Result
1	124.800	56.73	-120	-63.27	25.66	PASS

Recalculation based on the clause 47 CFR § 15.31

$$FS_{limit} = FS_{max} - 40 \log(d_{limit} / d_{measure})$$

Where:

FS_{limit} is the calculation of field strength at the limit distance, expressed in dBμV/m

FS_{max} is the measured field strength, expressed in dBμV/m

$d_{measure}$ is the distance of the measurement point from the EUT

d_{limit} is the reference distance or the distance of the $\lambda/2\pi$ point

Test results 30 MHz – 1 GHz

EUT Information

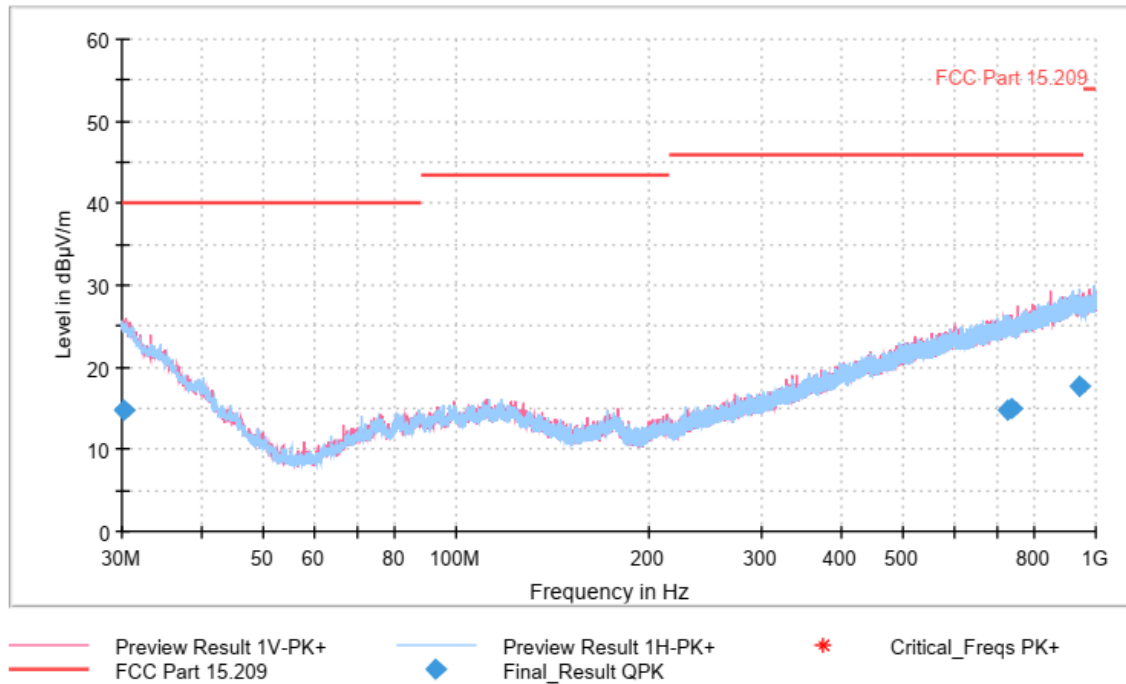
EUT:

RNO TANKPOD

Operating mode:

TX 125 kHz

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.300000	14.76	40.00	25.24	1000.0	120.000	126.0	V	340.0	19.7
727.080000	14.86	46.00	31.14	1000.0	120.000	237.0	V	0.0	21.2
736.380000	14.94	46.00	31.06	1000.0	120.000	100.0	V	83.0	21.3
941.820000	17.64	46.00	28.36	1000.0	120.000	104.0	H	343.0	23.2

7.4 99% Occupied bandwidth

7.4.1 Test procedure

The emission bandwidth ($\times$ dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated $\times$ dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least $3\times$ the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately $3\times$ RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.



7.4.2 Test results



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DUT Frequency (kHz)	99% Bandwidth (kHz)	Band Edge Left (kHz)	Band Edge Right (kHz)	Max Level (dBμV/m)	Result
124.70	25.413	111.789	137.203	64.72	PASS

7.5 20 dB Emission Bandwidth(15.215 (c))

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

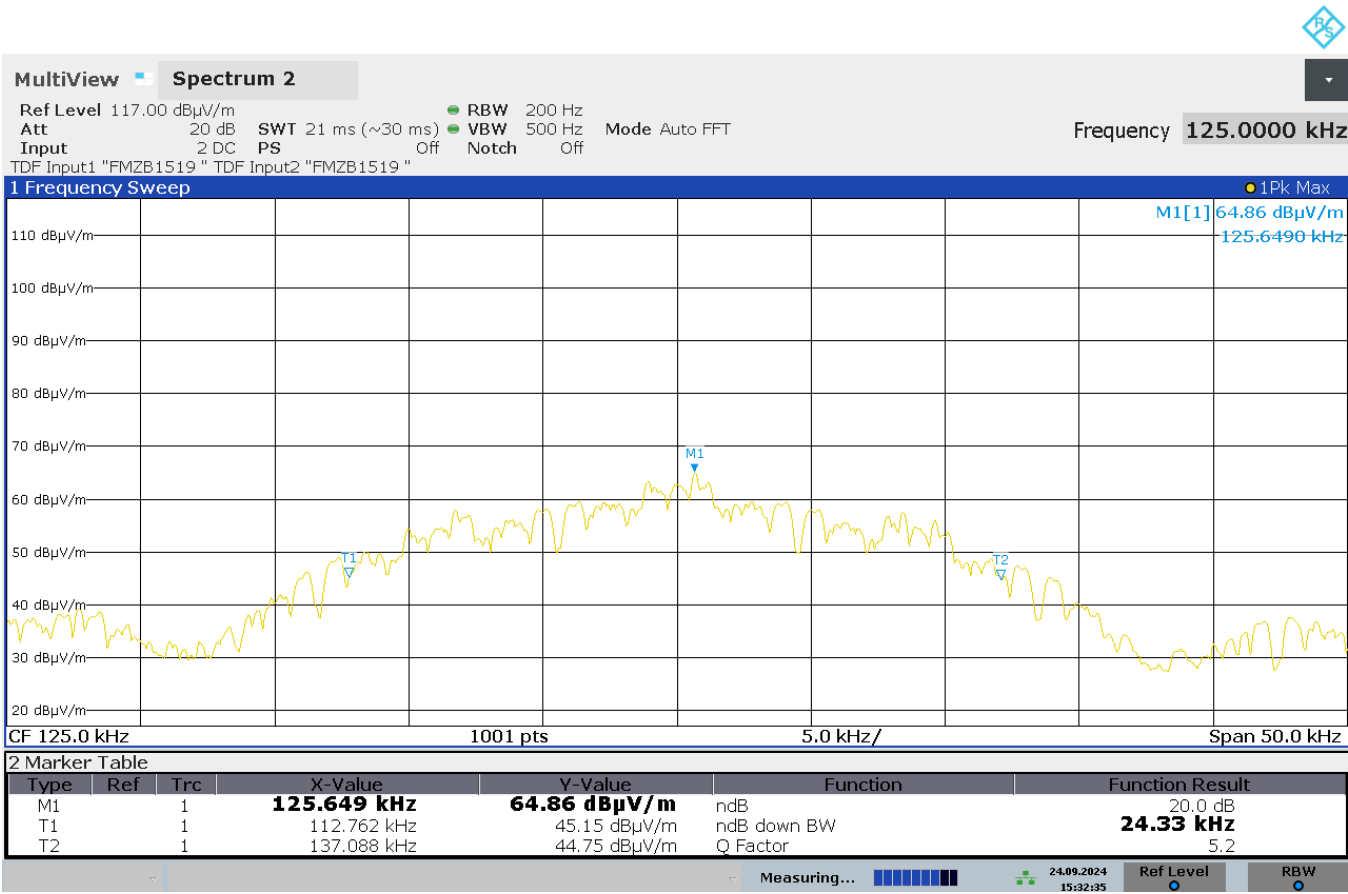
7.5.1 Test procedure

As per ANSI C63:10-2013:

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (OBW/RBW)]$ below the reference level. Specific guidance is given in 4.1.5.2.
- d) Steps a) through c) might require iteration to adjust within the specified tolerances.
- e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
- f) Set detection mode to peak and trace mode to max hold.
- g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyser marker to the highest level of the displayed trace (this is the reference value).
- h) Determine the “-xx dB down amplitude” using $[(\text{reference value}) - xx]$. Alternatively, this calculation may be made by using the marker-delta function of the instrument.
- i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyser and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).
- j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.
- k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).



7.5.2 Test results



1 Frequency Sweep

1Pk Max

110 dBµV/m

100 dBµV/m

90 dBµV/m

80 dBµV/m

70 dBµV/m

60 dBµV/m

50 dBµV/m

40 dBµV/m

30 dBµV/m

20 dBµV/m

CF 125.0 kHz

1001 pts

5.0 kHz/

Span 50.0 kHz

M1[1] 64.86 dBµV/m

125.6490 kHz

T1

T2

2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1	1	1	125.649 kHz	64.86 dBµV/m	ndB	20.0 dB
T1	1	1	112.762 kHz	45.15 dBµV/m	ndB down BW	24.33 kHz
T2	1	1	137.088 kHz	44.75 dBµV/m	Q Factor	5.2

Measuring...

24.09.2024 15:32:35

Ref Level

RBW

DUT Frequency (kHz)	20 dB Bandwidth (kHz)	Band Edge Left (kHz)	Band Edge Right (kHz)	Max Level (dBµV/m)
125.649	24.33	112.762	137.088	64.86

-----END OF TEST REPORT-----