FCC RADIO TEST REPORT

FCC ID	:	**W22-ETAG21**
Equipment	:	**Electronic Shelf Label E-paper 2.1" Display**
Brand Name	:	**Store Intelligence Inc.**
Model Name	:	**ETAG 210E5 ELT**
Marketing Name		**ETAG 210E5 ELT NFC LED BW**
Applicant	:	**Store Intelligence** **6700 Koll Center Parkway, Suite 109,** **Pleasanton, CA, 94566, USA**
Manufacturer	:	**Team Precision Public Company Limited** **198 Moo 13 Suwansorn Rd. ,** **Dong-Khee-Lek, Muang Prachinburi 25000,** **Thailand**
Standard	:	**FCC Part 15 Subpart C §15.249**

The product was received on Dec. 17, 2021 and testing was started from Dec. 27, 2021 and completed on Feb. 09, 2022. We, Sporton International (USA) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (USA) Inc., the test report shall not be reproduced except in full.

Neil Kao

Approved by: Neil Kao

Sporton International (USA) Inc.
1175 Montague Expressway, Milpitas, CA 95035

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History of this test report

Report No.	Version	Description	Issued Date
FR211110002	01	Initial issue of report	Feb. 16, 2022
FR211110002	02	Revise Summary of Test Result	Apr. 06, 2022

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.249(a)	Field Strength of Fundamental	Pass	17.73 dB under the limit at 2469.000 MHz
3.2	15.249(d)	Radiated Spurious Emission	Pass	3.86 dB under the limit at 16821.000 MHz
-	15.207	AC Conducted Emission	Not Required	See Note 1
-	15.249(b)	Frequency Stability	Not Required	See Note 2
3.2	15.203	Antenna Requirements	Pass	-

Note:

1. The EUT is powered by batteries which is deemed DC power source, it does not operate from the AC power lines or contain provisions for operation while connected to the AC power lines, according to 47 CFR § 15.207(c), the conducted emission limits are not applicable to the device hence the test is not performed.
2. Only applicable to fixed point to point systems.

Declaration of Conformity:
1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results. 2. The measurement uncertainty please refer to this report "Uncertainty of Evaluation".
Comments and Explanations:
The product specifications of the EUT presented in the report are declared by the manufacturer who shall take full responsibility for the authenticity.

1 General Description

1.1 Product Feature of Equipment Under Test

Proprietary hopping in 2.4GHz band

Product Feature	
Antenna Type	Internal Antenna

Antenna information		
2403 MHz ~ 2469 MHz	Peak Gain (dBi)	0

Remark: The EUT's information above is declared by manufacturer. Please refer to Comments and Explanations in report summary.

1.2 Modification of EUT

No modifications are made to the EUT during all test items.

1.3 Testing Location

Test Site	Sporton International (USA) Inc.
Test Site Location	1175 Montague Expressway, Milpitas, CA 95035 TEL : 408 9043300
Test Site No.	**Sporton Site No.**
	03CH02-CA

Note: The test site complies with ANSI C63.4 2014 requirement.

1.4 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.249
- ANSI C63.10-2013
- FCC KDB 414788 D01 Radiated Test Site v01r01

Remark:

1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

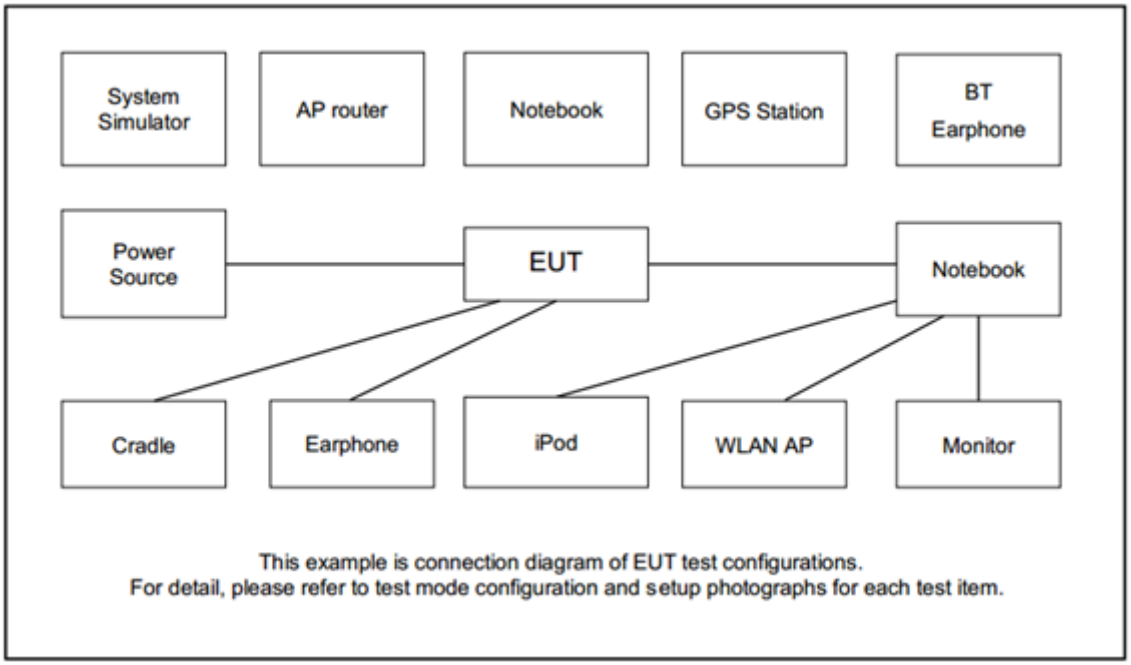
Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2403	8	2427	16	2451
	1	2406	9	2430	17	2454
	2	2409	10	2433	18	2457
	3	2412	11	2436	19	2460
	4	2415	12	2439	20	2463
	5	2418	13	2442	21	2466
	6	2421	14	2445	22	2469
	7	2424	15	2448		

2.2 Test Mode

The EUT has been configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and find X plane as worst plane.

Frequency Band	Frequency (MHz)	Modulation
2400-2483.5 MHz	2403	GFSK
2400-2483.5 MHz	2439	GFSK
2400-2483.5 MHz	2469	GFSK

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Laptop	Lenovo	TP00049A	NPD97260SD	Unshielded, 1.0 m	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

2.5 EUT Operation Test Setup

The RF test items, utility “Simplicity studio SV4.1.14.0” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

3 Test Result

3.1 99% Occupied Bandwidth Measurement

3.1.1 Limit of 99% Occupied Bandwidth

Reporting only

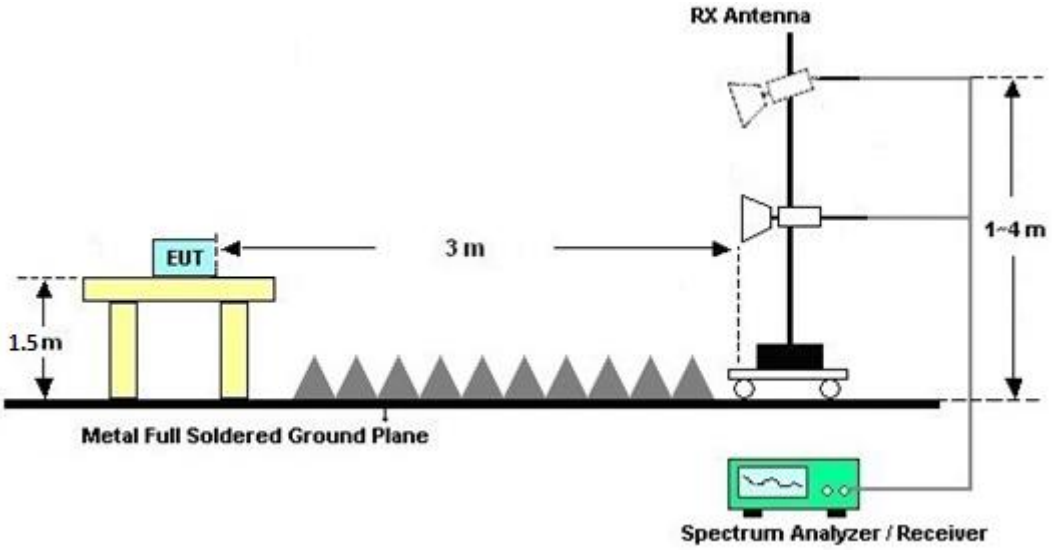
3.1.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

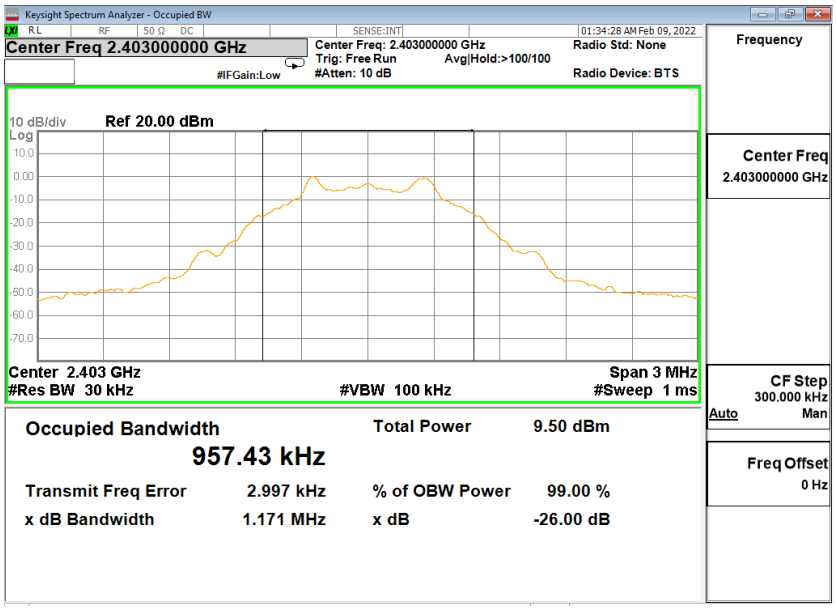
1. The EUT is placed on a turntable with 1.5 meter height above ground and 3 meter distance from receiving antenna.
2. Set the maximum power setting and enable the EUT to transmit continuously.
3. Use the following spectrum analyzer settings for 99 % occupied bandwidth measurement.
   Span = approximately 1.5 to 5 times the 99% occupied bandwidth, centered on a hopping channel; RBW = 1-5% of the 99% occupied bandwidth; VBW ≥ 3 * RBW; Sweep time = 1ms; Detector function = Peak; Trace = max hold.

3.1.4 Test Setup

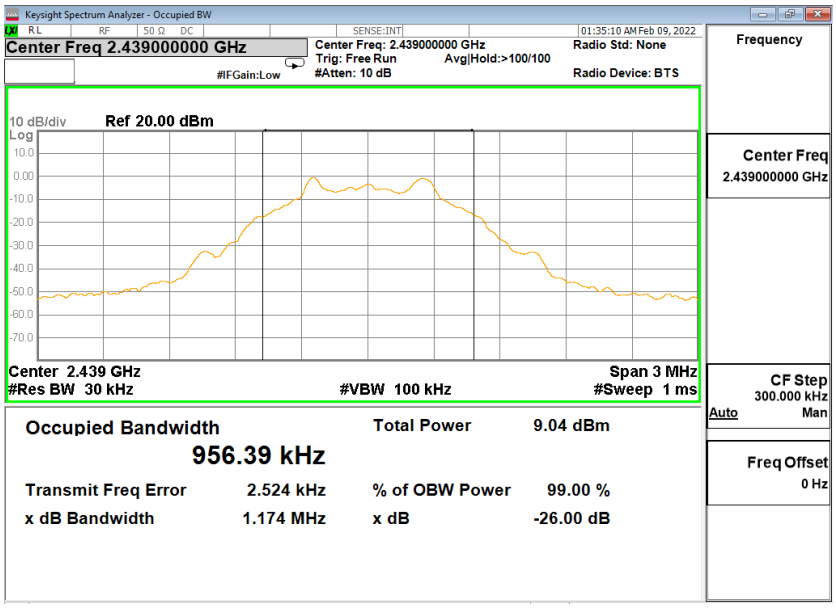


3.1.5 Test Result of 99% Occupied Bandwidth

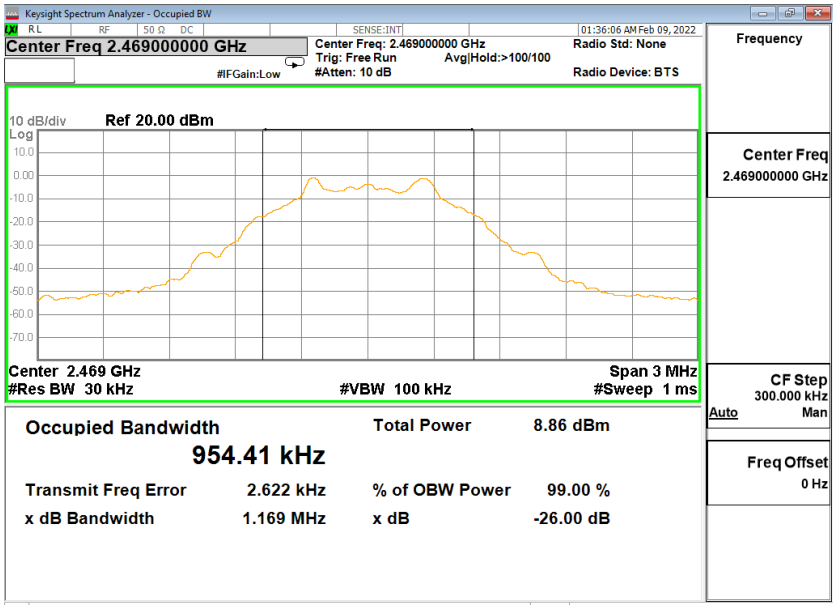
Frequency (MHz)	99% Bandwidth (MHz)
2403	0.95743



Frequency (MHz)	99% Bandwidth (MHz)
2439	0.95639



Frequency (MHz)	99% Bandwidth (MHz)
2469	0.95441



3.2 Field Strength of Fundamental/Harmonics and Radiated Spurious Emission Measurement

3.2.1 Limit

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)	Measurement Distance (meters)
902 – 928	50	500	3
2400 – 2483.5	50	500	3
5725 – 5875	50	500	3
24000 – 24250	250	2500	3

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

General radiated emission limits in § 15.209 is listed in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

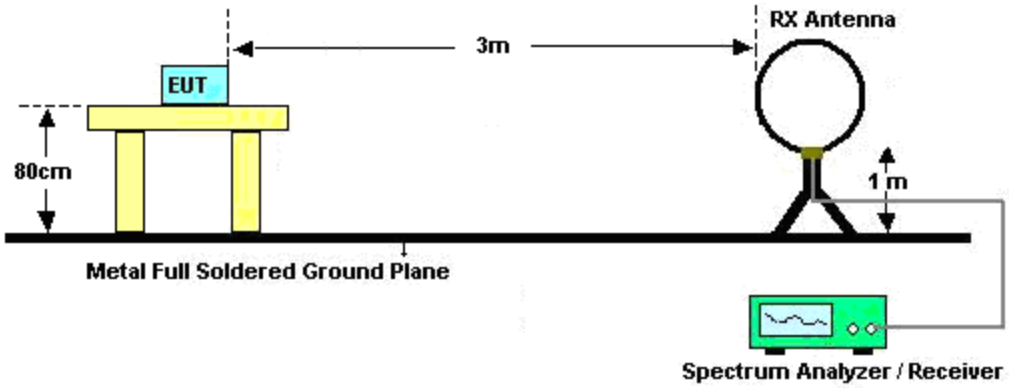
3.2.3 Test Procedures

1. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
2. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT is arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set the maximum power setting and enable the EUT to transmit continuously.
5. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW = 100 kHz for f < 1 GHz, RBW = 1 MHz for f>1 GHz ; VBW RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement: use duty cycle correction factor method per 15.35(c).
   Duty cycle = On time / (signal cycle or 100 milliseconds, which is less)
   On time = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+N_n*L_n$
   Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log (Duty cycle)
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
7. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as "-".
8. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as "-".

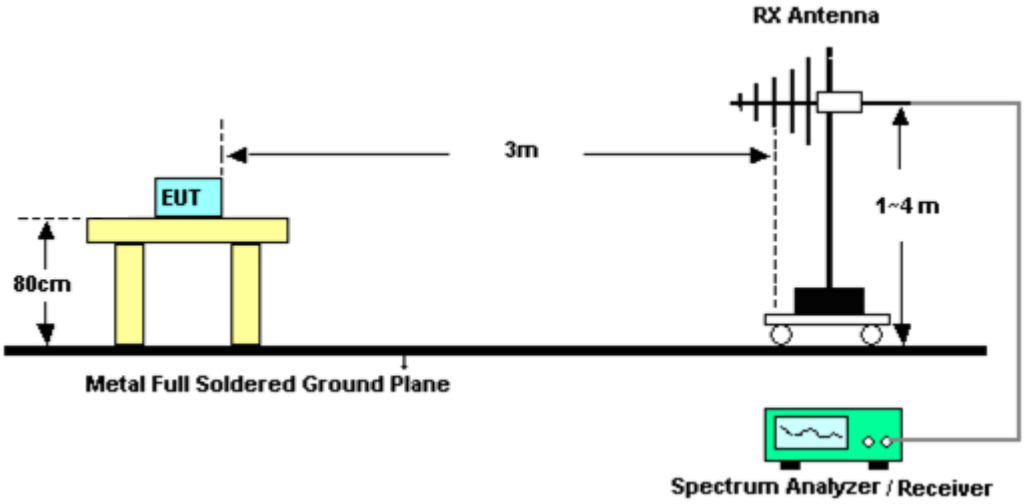
Note: The average levels are calculated from the peak level corrected with duty cycle correction factor (-52.40dB) derived from 20log (dwell time/(signal cycle or 100 milliseconds, which is less)). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

3.2.4 Test Setup

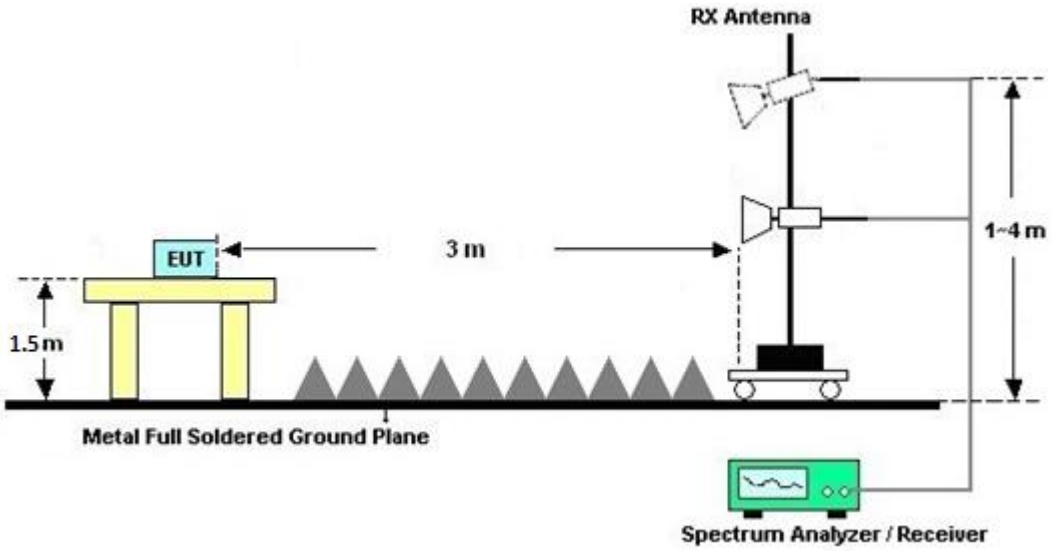
<For radiated emissions below 30MHz>



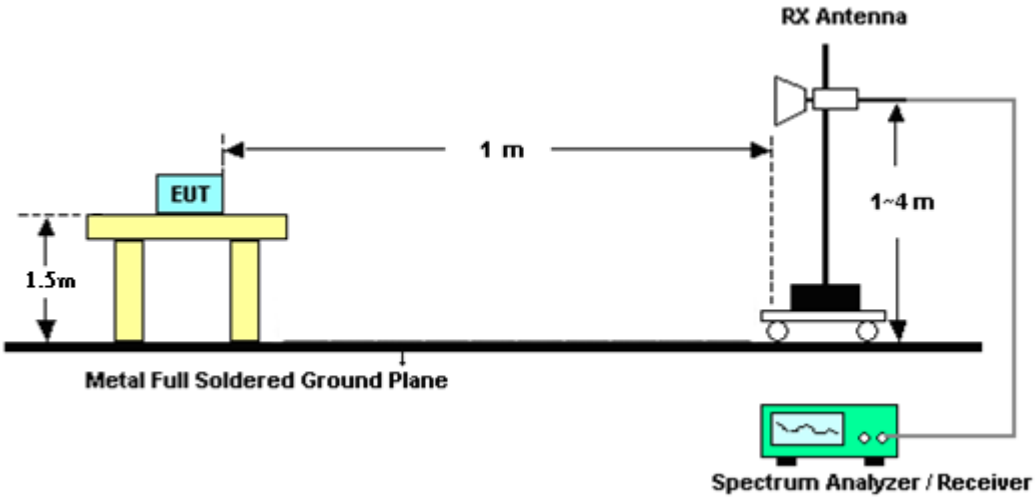
<For radiated emissions from 30MHz ~ 1GHz>



<For radiated emissions from 1 ~ 18GHz>



<For radiated emissions above 18GHz>



3.2.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result comes out very similar.

3.2.6 Test Result of Field Strength of Fundamental and Radiated Spurious Emission

Please refer to Appendix A and B.

3.3 Antenna Requirements

3.3.1 Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. 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 the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

3.3.2 Antenna Connector Construction

Enbedded in Antenna.

4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	R&S	HFH2-Z2E	100840	9kHz~30MHz	Jun. 21, 2021	Dec. 27, 2021~ Feb. 09, 2022	Jun. 20, 2022	Radiation (03CH02-CA)
Bilog Antenna	TESEQ	6111D	54683	30MHz~1GHz	Oct. 15, 2021	Dec. 27, 2021~ Feb. 09, 2022	Oct. 14, 2022	Radiation (03CH02-CA)
Horn Antenna	SCHWARZBECK	BBHA 9120D	01895	1GHz~18GHz	Aug. 25, 2021	Dec. 27, 2021~ Feb. 09, 2022	Aug. 24, 2022	Radiation (03CH02-CA)
Horn Antenna	SCHWARZBECK	BBHA 9170D	00842	18GHz~40GHz	Jul. 20, 2021	Dec. 27, 2021~ Feb. 09, 2022	Jul. 19, 2022	Radiation (03CH02-CA)
Amplifier	SONOMA	310N	372240	N/A	Aug. 09, 2021	Dec. 27, 2021~ Feb. 09, 2022	Aug. 08, 2022	Radiation (03CH02-CA)
Preamplifier	Keysight	83017A	MY53270323	1GHz~26.5GHz	Jul. 27, 2021	Dec. 27, 2021~ Feb. 09, 2022	Jul. 26, 2022	Radiation (03CH02-CA)
Preamplifier	E-instrument	ERA-100M-18G-56-01-A70	EC1900251	1GHz~18GHz	Mar. 30, 2021	Dec. 27, 2021~ Feb. 09, 2022	Mar. 29, 2022	Radiation (03CH02-CA)
Preamplifier	EMEC	EMC18G40G	060725	18GHz-40GHz	Jul. 21, 2021	Dec. 27, 2021~ Feb. 09, 2022	Jul. 20, 2022	Radiation (03CH02-CA)
Spectrum Analyzer	Keysight	N9010A	MY57420221	10Hz~44GHz	Sep. 22, 2021	Dec. 27, 2021~ Feb. 09, 2022	Sep. 21, 2022	Radiation (03CH02-CA)
Filter	Wainwright	WHKX12-2700-3000-18000-60ST	SN10	3G Highpass	Jul. 23, 2021	Dec. 27, 2021~ Feb. 09, 2022	Jul. 22, 2022	Radiation (03CH02-CA)
Filter	Wainwright	WLK12-1200-1272-11000-40SS	SN1	1.2G Low Pass	Jul. 23, 2021	Dec. 27, 2021~ Feb. 09, 2022	Jul. 22, 2022	Radiation (03CH02-CA)
Hygrometer	TESEO	608-H1	45142602	N/A	Aug. 04, 2021	Dec. 27, 2021~ Feb. 09, 2022	Aug. 03, 2022	Radiation (03CH02-CA)
Controller	ChainTek	EM-1000	060876	NA	N/A	Dec. 27, 2021~ Feb. 09, 2022	N/A	Radiation (03CH02-CA)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Dec. 27, 2021~ Feb. 09, 2022	N/A	Radiation (03CH02-CA)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Dec. 27, 2021~ Feb. 09, 2022	N/A	Radiation (03CH02-CA)
Software	Audix	E3	N/A	N/A	N/A	Dec. 27, 2021~ Feb. 09, 2022	N/A	Radiation (03CH02-CA)

5 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.7 dB**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.2 dB**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.4 dB**

Appendix A. Radiated Spurious Emission

Test Engineer :	Michael Bui and Fu Chen	Temperature :	20-25°C
		Relative Humidity :	40-60%

2.4GHz 2400~2483.5MHz

15.249 (Band Edge @ 3m)

15.249	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2403MHz		2394	54.95	-19.03	73.98	41.12	27.67	17.44	31.28	121	302	P	H
		2394	2.55	-51.43	53.98	-	-	-	-	-	-	A	H
	*	2403	95.68	-18.3	113.98	81.84	27.66	17.45	31.27	121	302	P	H
	*	2403	43.28	-50.7	93.98	-	-	-	-	-	-	A	H
													H
													H
		2343.48	54.64	-19.34	73.98	40.7	27.91	17.34	31.31	376	359	P	V
		2343.48	2.24	-51.74	53.98	-	-	-	-	-	-	A	V
	*	2403	91.92	-22.06	113.98	78	27.74	17.45	31.27	376	359	P	V
	*	2403	39.52	-54.46	93.98	-	-	-	-	-	-	A	V
													V
													V
2439MHz		2359.44	55.53	-18.45	73.98	41.69	27.76	17.38	31.3	100	306	P	H
		2359.44	3.13	-50.85	53.98	-	-	-	-	-	-	A	H
	*	2439	96.19	-17.79	113.98	82.29	27.66	17.5	31.26	100	306	P	H
	*	2439	43.79	-50.19	93.98	-	-	-	-	-	-	A	H
		2498.16	55.3	-18.68	73.98	41.33	27.61	17.59	31.23	100	306	P	H
		2498.16	2.9	-51.08	53.98	-	-	-	-	-	-	A	H
		2345.36	55.38	-18.6	73.98	41.44	27.91	17.34	31.31	373	359	P	V
		2345.36	2.98	-51	53.98	-	-	-	-	-	-	A	V
	*	2439	90.74	-23.24	113.98	76.9	27.6	17.5	31.26	373	359	P	V
	*	2439	38.34	-55.64	93.98	-	-	-	-	-	-	A	V
		2497.28	54.46	-19.52	73.98	40.61	27.49	17.59	31.23	373	359	P	V
		2497.28	2.06	-51.92	53.98	-	-	-	-	-	-	A	V

2469MHz	*	2469	96.25	-17.73	113.98	82.31	27.64	17.55	31.25	110	305	P	H
	*	2469	43.85	-50.13	93.98	-	-	-	-	-	-	A	H
		2498.08	55.58	-18.4	73.98	41.61	27.61	17.59	31.23	110	305	P	H
		2498.08	3.18	-50.8	53.98	-	-	-	-	-	-	A	H
													H
													H
	*	2469	91.59	-22.39	113.98	77.76	27.53	17.55	31.25	363	360	P	V
	*	2469	39.19	-54.79	93.98	-	-	-	-	-	-	A	V
		2493.28	55.01	-18.97	73.98	41.16	27.5	17.58	31.23	363	360	P	V
		2493.28	2.61	-51.37	53.98	-	-	-	-	-	-	A	V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.

15.249 (Harmonic @ 3m)

15.249	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
2403MHz		4806	47.97	-26.01	73.98	73.18	31.5	11.21	67.92	-	-	P	H
		4806	-4.43	-58.41	53.98	-	-	-	-	-	-	A	H
		7209	57.62	-16.36	73.98	73.46	36.17	13.66	65.67	-	-	P	H
		7209	5.22	-48.76	53.98	-	-	-	-	-	-	A	H
		12015	58.14	-15.84	73.98	68.98	39.19	17.69	67.72	-	-	P	H
		12015	5.74	-48.24	53.98	-	-	-	-	-	-	A	H
		14418	56.27	-17.71	73.98	62.6	41.86	19.54	67.73	-	-	P	H
		14418	3.87	-50.11	53.98	-	-	-	-	-	-	A	H
		16821	65.68	-8.3	73.98	72.46	40.4	21.2	68.38	102	303	P	H
		16821	13.28	-40.7	53.98	-	-	-	-	-	-	A	H
		17985	59.83	-14.15	73.98	58.57	48.43	22.42	69.59	-	-	P	H
		17985	49.45	-4.53	53.98	48.19	48.43	22.42	69.59	-	-	A	H
		4806	46.76	-27.22	73.98	71.93	31.54	11.21	67.92	-	-	P	V
		4806	-5.64	-59.62	53.98	-	-	-	-	-	-	A	V
		7209	56.27	-17.71	73.98	72.11	36.17	13.66	65.67	-	-	P	V
		7209	3.87	-50.11	53.98	-	-	-	-	-	-	A	V
		12015	65.69	-8.29	73.98	76.56	39.16	17.69	67.72	-	-	P	V
		12015	13.29	-40.69	53.98	-	-	-	-	-	-	A	V
		14418	61.42	-12.56	73.98	67.78	41.83	19.54	67.73	-	-	P	V
		14418	9.02	-44.96	53.98	-	-	-	-	-	-	A	V
		16821	70.12	-3.86	73.98	76.76	40.54	21.2	68.38	101	324	P	V
		16821	17.72	-36.26	53.98	-	-	-	-	-	-	A	V
		18000	59.87	-14.11	73.98	57.81	49.04	22.44	69.42	-	-	P	V
		18000	50.17	-3.81	53.98	48.11	49.04	22.44	69.42	-	-	A	V

15.249	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
2439MHz		4878	47.7	-26.28	73.98	72.62	31.45	11.54	67.91	-	-	P	H
		4878	-4.7	-58.68	53.98	-	-	-	-	-	-	A	H
		7317	55.19	-18.79	73.98	71.86	36.33	13.79	66.79	-	-	P	H
		7317	2.79	-51.19	53.98	-	-	-	-	-	-	A	H
		12195	59.7	-14.28	73.98	69.63	39.26	17.82	67.01	100	331	P	H
		12195	7.3	-46.68	53.98	-	-	-	-	-	-	A	H
		14634	53.41	-20.57	73.98	59.04	42.12	19.68	67.43	-	-	P	H
		14634	1.01	-52.97	53.98	-	-	-	-	-	-	A	H
		17073	62.31	-11.67	73.98	69.29	40.4	21.4	68.78	-	-	P	H
		17073	9.91	-44.07	53.98	-	-	-	-	-	-	A	H
		17985	59.17	-14.81	73.98	57.91	48.43	22.42	69.59	-	-	P	H
		17985	49.47	-4.51	53.98	48.21	48.43	22.42	69.59	-	-	A	H
		4878	44.91	-29.07	73.98	69.89	31.39	11.54	67.91	-	-	P	V
		4878	-7.49	-61.47	53.98	-	-	-	-	-	-	A	V
		7317	56.72	-17.26	73.98	73.33	36.39	13.79	66.79	-	-	P	V
		7317	4.32	-49.66	53.98	-	-	-	-	-	-	A	V
		12195	67.05	-6.93	73.98	76.97	39.27	17.82	67.01	100	67	P	V
		12195	14.65	-39.33	53.98	-	-	-	-	-	-	A	V
		14634	58.81	-15.17	73.98	64.46	42.1	19.68	67.43	-	-	P	V
		14634	6.41	-47.57	53.98	-	-	-	-	-	-	A	V
		17073	66.09	-7.89	73.98	72.95	40.52	21.4	68.78	-	-	P	V
		17073	13.69	-40.29	53.98	-	-	-	-	-	-	A	V
		18000	59.86	-14.12	73.98	57.8	49.04	22.44	69.42	-	-	P	V
		18000	50.39	-3.59	53.98	48.33	49.04	22.44	69.42	-	-	A	V

15.249	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
2469MHz		4938	45.6	-28.38	73.98	70.51	31.46	11.62	67.99	-	-	P	H
		4938	-6.8	-60.78	53.98	-	-	-	-	-	-	A	H
		7407	55.99	-17.99	73.98	73.08	36.44	13.86	67.39	-	-	P	H
		7407	3.59	-50.39	53.98	-	-	-	-	-	-	A	H
		12345	59.39	-14.59	73.98	70.06	38.79	17.93	67.39	100	300	P	H
		12345	6.99	-46.99	53.98	-	-	-	-	-	-	A	H
		14814	52.39	-21.59	73.98	57.82	41.93	19.8	67.16	-	-	P	H
		14814	-0.01	-53.99	53.98	-	-	-	-	-	-	A	H
		17283	62.62	-11.36	73.98	68.71	41.04	21.63	68.76	-	-	P	H
		17283	10.22	-43.76	53.98	-	-	-	-	-	-	A	H
		17985	59.62	-14.36	73.98	58.36	48.43	22.42	69.59	-	-	P	H
		17985	49.45	-4.53	53.98	48.19	48.43	22.42	69.59	-	-	A	H
		4938	43.52	-30.46	73.98	68.53	31.36	11.62	67.99	-	-	P	V
		4938	-8.88	-62.86	53.98	-	-	-	-	-	-	A	V
		7407	55.77	-18.21	73.98	72.82	36.48	13.86	67.39	-	-	P	V
		7407	3.37	-50.61	53.98	-	-	-	-	-	-	A	V
		12345	67.2	-6.78	73.98	77.87	38.79	17.93	67.39	100	67	P	V
		12345	14.8	-39.18	53.98	-	-	-	-	-	-	A	V
		14814	57.53	-16.45	73.98	62.92	41.97	19.8	67.16	-	-	P	V
		14814	5.13	-48.85	53.98	-	-	-	-	-	-	A	V
		17283	65.42	-8.56	73.98	71.32	41.23	21.63	68.76	-	-	P	V
		17283	13.02	-40.96	53.98	-	-	-	-	-	-	A	V
		17985	60.02	-13.96	73.98	58.49	48.7	22.42	69.59	-	-	P	V
		17985	49.64	-4.34	53.98	48.11	48.7	22.42	69.59	-	-	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. The emission position marked as "-" means no suspected emission found and emission level has at least 6dB margin against limit or noise floor only. 4. The emission level close to 18GHz is checked that the average emission level is noise floor only.												

Emission above 18GHz

15.249 (SHF)

15.249	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
SHF		19224	39.46	-34.52	73.98	41.54	37.66	12.87	52.61	-	-	P	H
		19224	-12.94	-66.92	53.98	-	-	-	-	-	-	A	H
		21627	49.02	-24.96	73.98	48.46	38.25	14.52	52.21	150	353	P	H
		21627	-3.38	-57.36	53.98	-	-	-	-	-	-	A	H
													H
													H
													H
													H
													H
													H
													H
													H
		19224	43.46	-30.52	73.98	45.51	37.69	12.87	52.61	-	-	P	V
		19224	-8.94	-62.92	53.98	-	-	-	-	-	-	A	V
		21627	56	-17.98	73.98	55.56	38.13	14.52	52.21	150	60	P	V
		21627	3.6	-50.38	53.98	-	-	-	-	-	-	A	V
													V
													V
													V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.
3. The emission position marked as “-” means no suspected emission found and emission level has at least 6dB margin against limit or noise floor only.
4. The emission level close to 18GHz is checked that the average emission level is noise floor only.

Emission below 1GHz

15.249 (LF)

15.249	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
LF		37.76	33.21	-6.79	40	43.5	21.12	1.03	32.44	-	-	P	H
		47.46	22.31	-17.69	40	37.7	15.92	1.13	32.44	-	-	P	H
		105.66	28.16	-15.34	43.5	41.88	16.97	1.72	32.41	-	-	P	H
		754.59	29.72	-16.28	46	29.37	28.3	4.42	32.37	-	-	P	H
		881.66	30.73	-15.27	46	28.39	29.23	4.84	31.73	-	-	P	H
		949.56	33.8	-12.2	46	29.03	30.98	4.99	31.2	-	-	P	H
													H
													H
													H
													H
													H
													H
		37.76	28.9	-11.1	40	39.19	21.12	1.03	32.44	-	-	P	V
		47.46	24.42	-15.58	40	39.81	15.92	1.13	32.44	-	-	P	V
		105.66	31.02	-12.48	43.5	44.74	16.97	1.72	32.41	-	-	P	V
		855.47	30.34	-15.66	46	28.25	29.3	4.7	31.91	-	-	P	V
		888.45	31.54	-14.46	46	29.17	29.23	4.83	31.69	-	-	P	V
		957.32	33.16	-12.84	46	28.15	31.15	5	31.14	-	-	P	V
													V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. The emission position marked as "-" means no suspected emission found and emission level has at least 6dB margin against limit or noise floor only.

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
Proprietary CH 00 2403MHz		4806	47.97	-26.01	73.98	73.18	31.5	11.21	67.92	-	-	P	H
		4806	-4.43	-58.41	53.98	-	-	-	-	-	-	A	H

For Peak Limit @ 4806MHz:

1. Level(dBµV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

= 31.5(dB/m) + 11.21(dB) + 73.18(dBµV) – 67.92 (dB)

= 47.97 (dBµV/m)

2. Over Limit(dB)

= Level(dBµV/m) – Limit Line(dBµV/m)

= 47.97(dBµV/m) – 73.98(dBµV/m)

= -26.01(dB)

For Average Limit @ 4806MHz:

1. Level(dBµV/m)

= Peak Level(dBµV/m) + 20 * log(Duty)

= 47.97(dBµV/m) – 52.4

= -4.43(dBµV/m)

2. Over Limit(dB)

= Level(dBµV/m) – Limit Line(dBµV/m)

= -4.43(dBµV/m) – 53.98(dBµV/m)

= -58.41(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.

Appendix B. Radiated Spurious Emission Plots

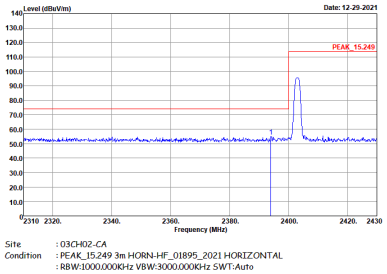
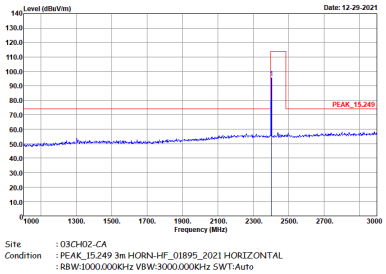
Test Engineer :	Michael Bui and Fu Chen	**Temperature :**	20-25°C
		Relative Humidity :	40-60%

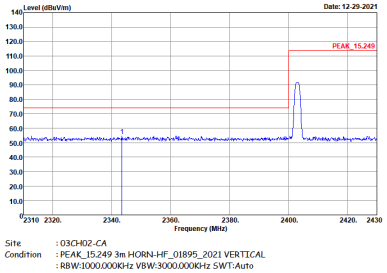
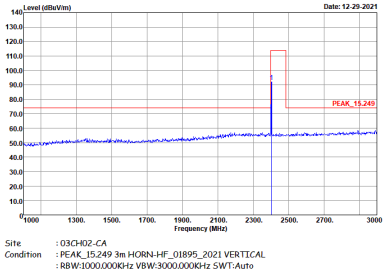
Note symbol

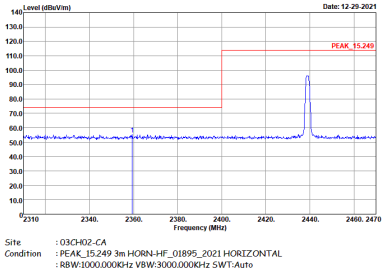
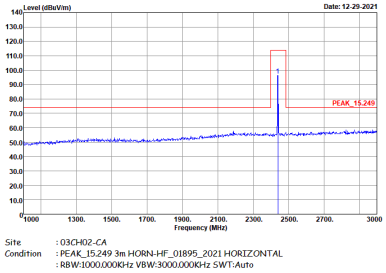
-L	**Low channel location**
-R	**High channel location**

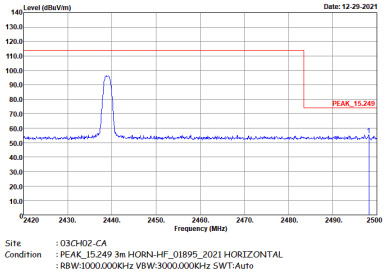
2.4GHz 2400~2483.5MHz

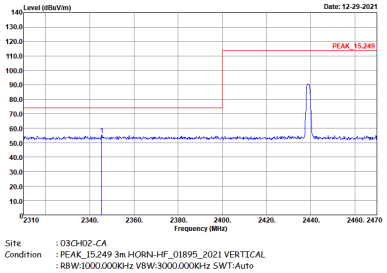
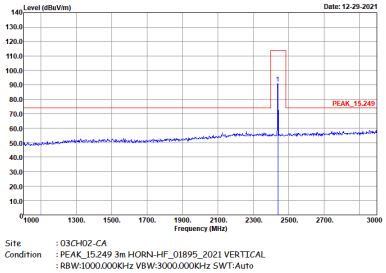
15.249 (Band Edge @ 3m)

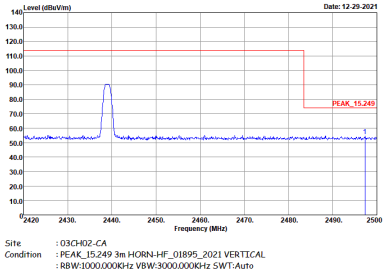
15.249	**2.4GHz 2400~2483.5MHz Band Edge @ 3m**	
	2403MHz	
	Horizontal	**Fundamental**
Peak		

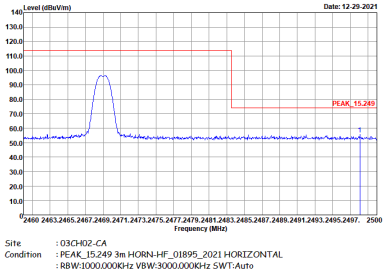
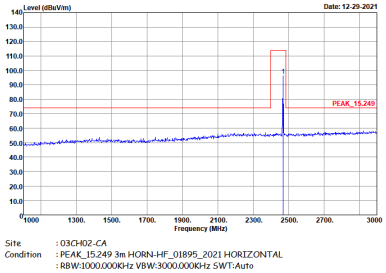
15.249	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	2403MHz	
	Vertical	Fundamental
Peak		

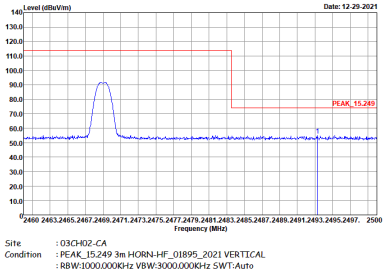
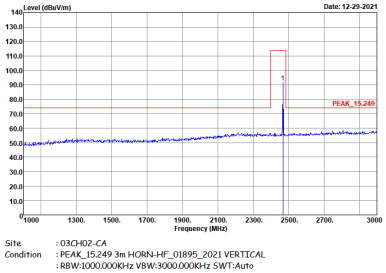
15.249	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	2439MHz - L	
	Horizontal	Fundamental
Peak		

15.249	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	2439MHz - R	
	Horizontal	
Peak	 Site : 03CH02-CA Condition : PEAK_15.249 3m HORN-HF_01895_2021 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Left blank

15.249	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	2439MHz - L	
	Vertical	Fundamental
Peak		

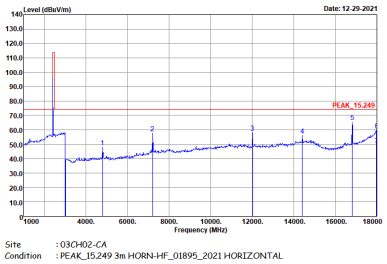
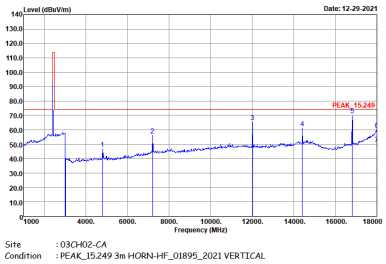
15.249	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	2439MHz - R	
	Vertical	
Peak	 Site : 03CH02-CA Condition : PEAK_15.249 3m HORN-HF_01895_2021 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	Left blank

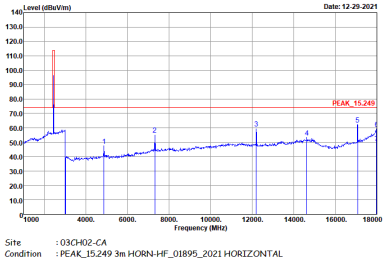
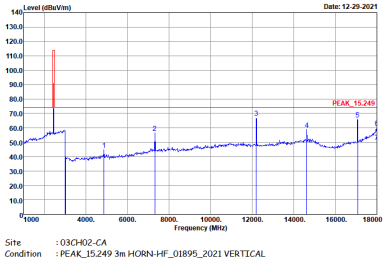
15.249	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	2469MHz	
	Horizontal	Fundamental
Peak		

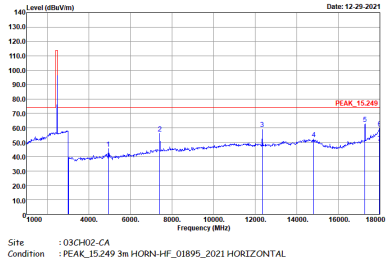
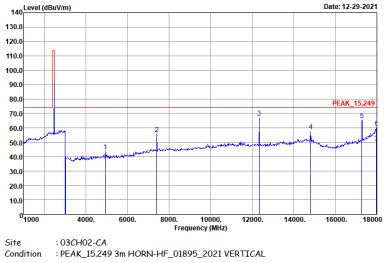
15.249	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	2469MHz	
	Vertical	Fundamental
Peak		

2.4GHz 2400~2483.5MHz

15.249 (Harmonic @ 3m)

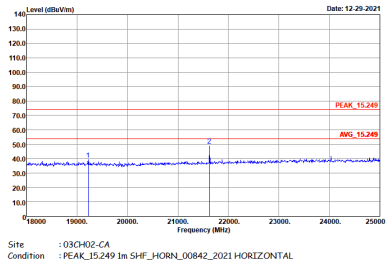
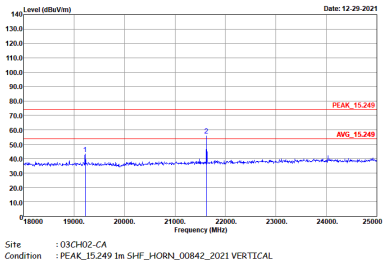
15.249	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	2403MHz	
	Horizontal	Vertical
Peak Avg.		

15.249	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	2439MHz	
	Horizontal	Vertical
Peak Avg.		

15.249	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	2469MHz	
	Horizontal	Vertical
Peak Avg.		

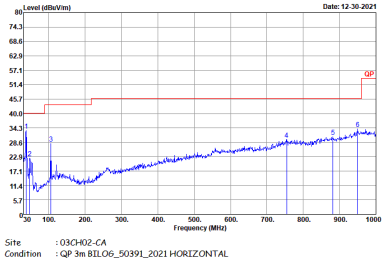
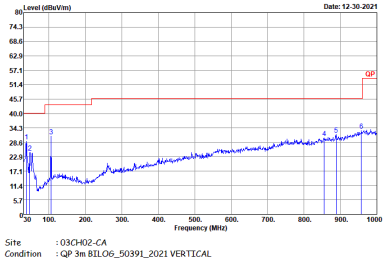
Emission above 18GHz

15.249 (SHF @ 1m)

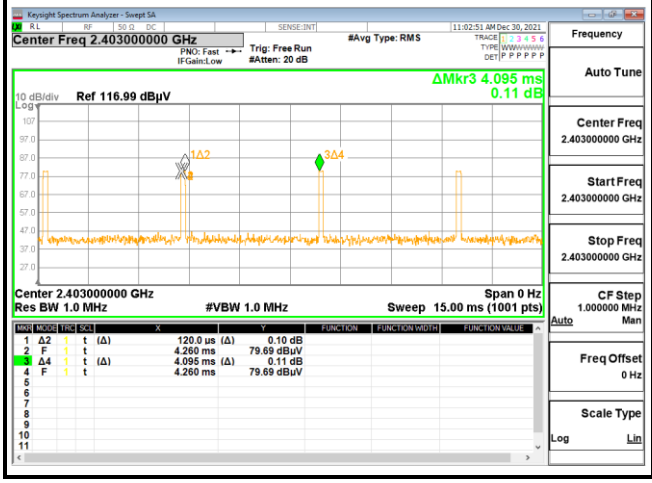
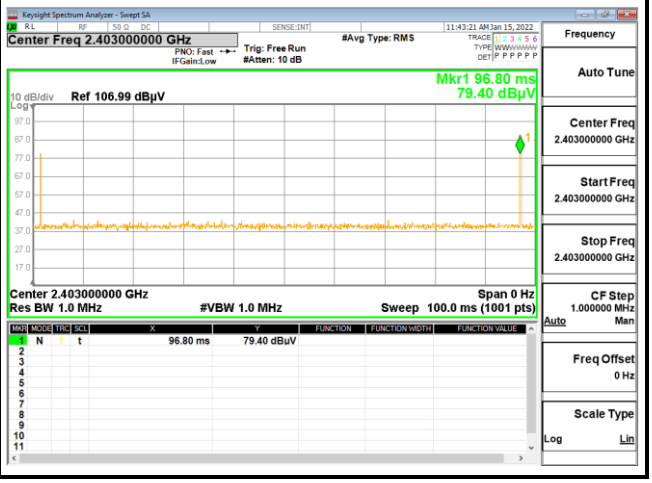
15.249	2.4GHz 2400~2483.5MHz	
	SHF	
	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

15.249 (LF)

15.249	2.4GHz 2400~2483.5MHz	
	LF	
	Horizontal	Vertical
QP / Peak		

Appendix C. Duty Cycle Plots

on time (One Pulse) Plot on Channel 00	Number of pulses on 100 ms on Channel 00
	

Note:

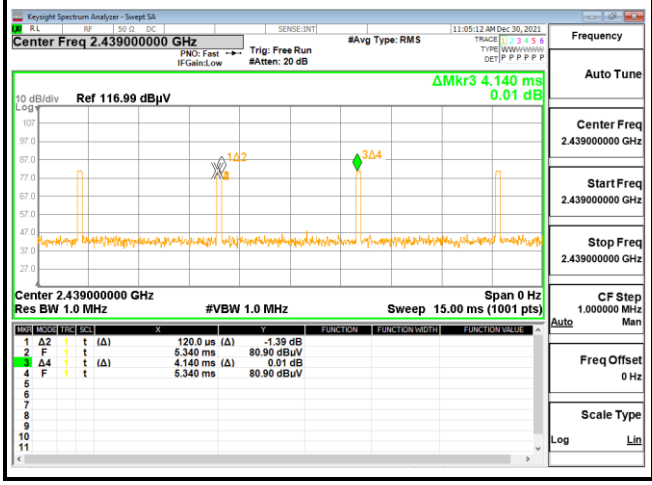
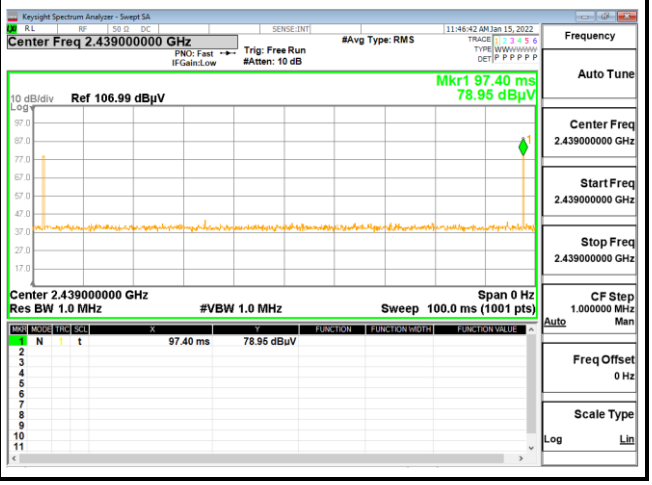
1. On time of one pulse = 0.12 millisecond
2. Number of pulses found in any 100 millisecond in worst case = 2
3. Worst case Duty cycle = on time/100 milliseconds = 2 * 0.12 / 100 = 0.24 %
4. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -52.40 dB

Duty Cycle Correction Factor Consideration

The device is operating in hopping mode in its normal use condition.

In worst case, the device will have two pulses on certain channel in any 100 miliseconds.

In order to measure on time of one pulse, control tool “Simplicity studio SV4.1.14.0” was used to make the device get into the engineering modes to provide shorter signal cycle on certain channel.

on time (One Pulse) Plot on Channel 12	Number of pulses on 100 ms on Channel 12
	

Note:

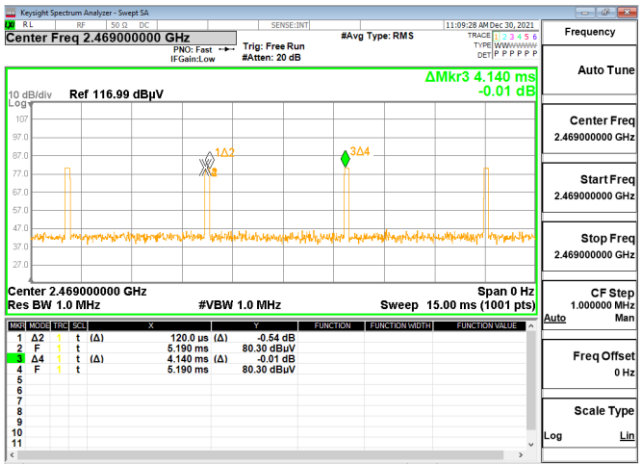
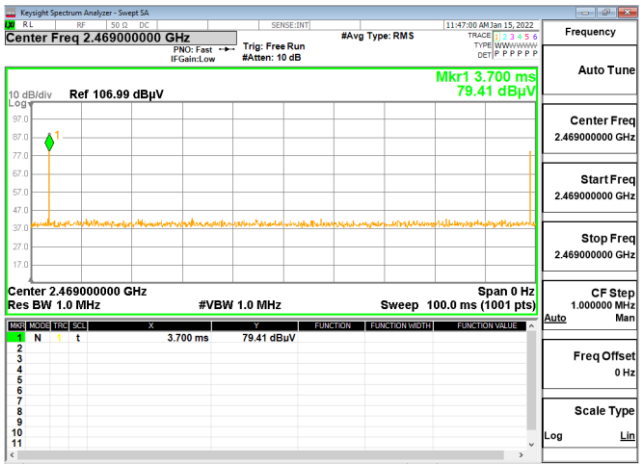
1. On time of one pulse = 0.12 millisecond
2. Number of pulses found in any 100 millisecond in worst case = 2
3. Worst case Duty cycle = on time/100 milliseconds = 2 * 0.12 / 100 = 0.24 %
4. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -52.40 dB

Duty Cycle Correction Factor Consideration

The device is operating in hopping mode in its normal use condition.

In worst case, the device will have two pulses on certain channel in any 100 miliseconds.

In order to measure on time of one pulse, control tool "Simplicity studio SV4.1.14.0" was used to make the device get into the engineering modes to provide shorter signal cycle on certain channel.

on time (One Pulse) Plot on Channel 22	on time (Count Pulses) Plot on Channel 22
	

Note:

1. On time of one pulse = 0.12 millisecond
2. Number of pulses found in any 100 millisecond in worst case = 2
3. Worst case Duty cycle = on time/100 milliseconds = 2 * 0.12 / 100 = 0.24 %
4. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -52.40 dB

Duty Cycle Correction Factor Consideration

The device is operating in hopping mode in its normal use condition.

In worst case, the device will have two pulses on certain channel in any 100 miliseconds.

In order to measure on time of one pulse, control tool "Simplicity studio SV4.1.14.0" was used to make the device get into the engineering modes to provide shorter signal cycle on certain channel.