FCC CO-LOCATION RADIO TEST REPORT

FCC ID	:	U8G-P1AX11
Equipment	:	PEPWAVE / peplink Wireless Product
Brand Name	:	PEPWAVE / peplink
Model Name	:	MAX Transit Pro MAX Transit Pro LTEA MAX-TST-PRO-DUO-LTEA-US-T-PRM MAX-TST-PRO-DUO-LTEA-R-T-PRM
Applicant	:	PISMO LABS TECHNOLOGY LIMITED A8, 5/F, HK Spinners Industrial Building, Phase 6, 481 Castle Peak Road, Cheung Sha Wan, Hong Kong
Manufacturer	:	PISMO LABS TECHNOLOGY LIMITED A8, 5/F, HK Spinners Industrial Building, Phase 6, 481 Castle Peak Road, Cheung Sha Wan, Hong Kong
Standard	:	FCC Part 15 Subpart E §15.407

The product was received on Jan. 18, 2022 and testing was started from Apr. 30, 2022 to Jun. 09, 2022. We, Sporton International Inc. Wensan Laboratory, 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 Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory
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Table of Contents

History of this test report

Report No.	Version	Description	Issued Date
FR211326D	01	Initial issue of report	Jun. 27, 2022

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.407(b)	Unwanted Emissions	Pass	3.65 dB under the limit at 2390.000 MHz
3.2	15.203 15.407(a)	Antenna Requirement	Pass	-

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.

Reviewed by: Lewis Ho

Report Producer: Rachel Hsieh

1 General Description

1.1 Product Feature of Equipment Under Test

WCDMA/LTE, Wi-Fi 2.4GHz 802.11b/g/n/ac/ax, WiFi 5GHz 802.11a/n/ac/ax, and GPS

Product Feature	
Equipment Name	PEPWAVE / peplink Wireless Product
Brand Name	PEPWAVE / peplink
Model Name	MAX Transit Pro MAX Transit Pro LTEA MAX-TST-PRO-DUO-LTEA-US-T-PRM MAX-TST-PRO-DUO-LTEA-R-T-PRM
Integrated WWAN Module 1	**Brand Name:** Sierra **Model Name:** EM7411 **FCC ID:** N7NEM74B
Integrated WWAN Module 2	**Brand Name:** Sierra **Model Name:** EM7511 **FCC ID:** N7NEM75S
Sample 1	MAX-TST-PRO-DUO-LTEA-US-T-PRM with WWAN Module 1 (EM7411)
Sample 2	MAX-TST-PRO-DUO-LTEA-R-T-PRM with WWAN Module 2 (EM7511)
Antenna Type	WWAN **<For EM7511>:** Omni-directional Antenna **<For EM7411>:** Omni-directional Antenna WLAN <Ant. 1>: Omni-directional Antenna <Ant. 2>: Omni-directional Antenna GPS: Directional Antenna

WLAN Antenna information		
2400 MHz ~ 2483.5 MHz	Peak Gain (dBi)	Ant. 1: 2.44 Ant. 2: 2.44
5725 MHz ~ 5850 MHz	Peak Gain (dBi)	Ant. 1: 4.73 Ant. 2: 4.73

Remark: The above EUT's information was 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 Inc. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	03CH15-HY

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

FCC designation No.: TW3786

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 E
- FCC Part 15 Subpart C §15.247
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. 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

The EUT has been associated with peripherals and 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).

2.1 Carrier Frequency and Channel

2400-2483.5 MHz		5725~5850 MHz	
802.11ax HE40		802.11ax HE20	
Channel	Freq. (MHz)	Channel	Freq. (MHz)
03	2422	149	5745

Remark: During the Radiated Spurious Emission test, the EUT turn on the WWAN functions simultaneously.

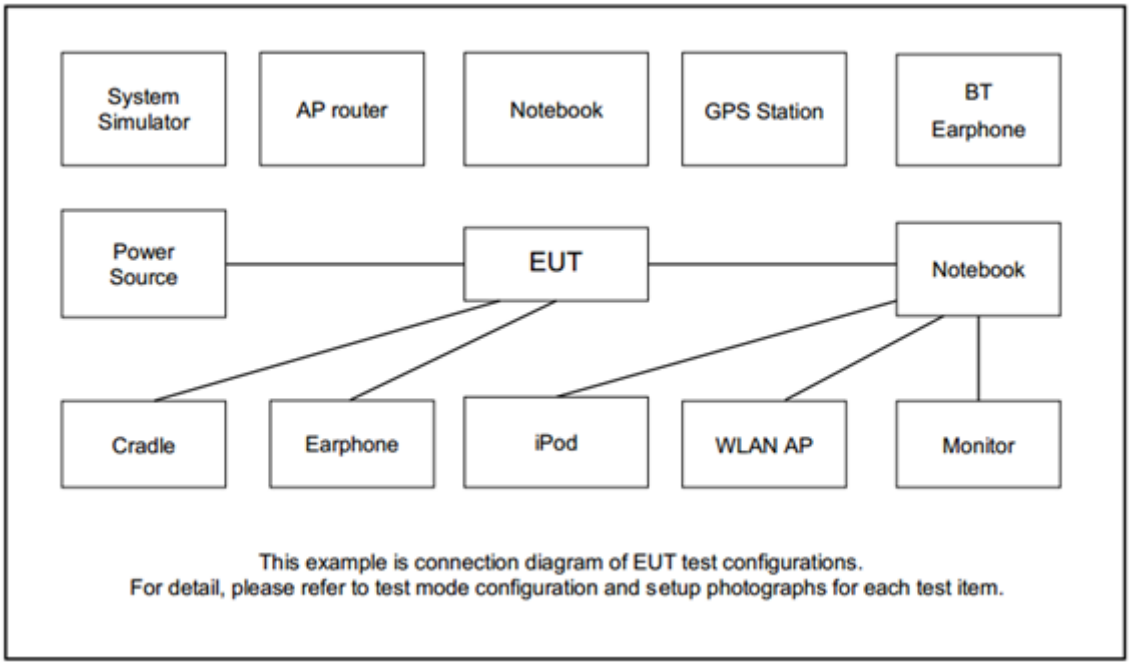
2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

<Co-Location>

Test Mode	Modulation	Data Rate
Mode 1	LTE Band 7 (EM7411) + LTE Band 7 (EM7411) + 802.11ax HE40 for MIMO <Ant. 1+2> + 802.11ax HE20 for MIMO <Ant. 1+2> for Sample 1	QPSK + MCS0
Mode 2	LTE Band 7 (EM7511) + LTE Band 7 (EM7511) + 802.11ax HE40 for MIMO <Ant. 1+2> + 802.11ax HE20 for MIMO <Ant. 1+2> for Sample 2	QPSK + MCS0

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.	Notebook	Dell	Latitude 3400	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

2.5 EUT Operation Test Setup

For WLAN test items, the EUT links with Notebook, and test program was provided and enabled EUT to transmit and receive signals continuously.

3 Test Result

3.1 Unwanted Emissions Measurement

This section is to measure unwanted eissions through radiated measurement for band edge spurious emissions and out of band emissions measurement.

3.1.1 Limit of Unwanted Emissions

(1) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below 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

Note: The following formula is used to convert the EIRP to field strength.

$$E=\frac{1000000\sqrt{30P}}{3}$$ μV/m, where P is the eirp (Watts)

EIRP (dBm)	Field Strength at 3m (dBμV/m)
- 27	68.3

(2) KDB789033 D02 v02r01 G)2)c)

(i) Sections 15.407(b)(1-3) specifies the unwanted emissions limit for the U-NII-1 and U-NII-2 bands. As specified, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of −27 dBm/MHz.

(ii) Section 15.407(b)(4) specifies the unwanted emissions limit for the U-NII-3 band. A band emissions mask is specified in Section 15.407(b)(4)(i). The emission limits are based on the use of a peak detector.

3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

3.1.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section G) Unwanted emissions measurement.

   (1) Procedure for Unwanted Emissions Measurements Below 1000MHz

   - RBW = 120 kHz
   - VBW = 300 kHz
   - Detector = Peak
   - Trace mode = max hold

   (2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz

   - RBW = 1 MHz
   - VBW ≥ 3 MHz
   - Detector = Peak
   - Sweep time = auto
   - Trace mode = max hold

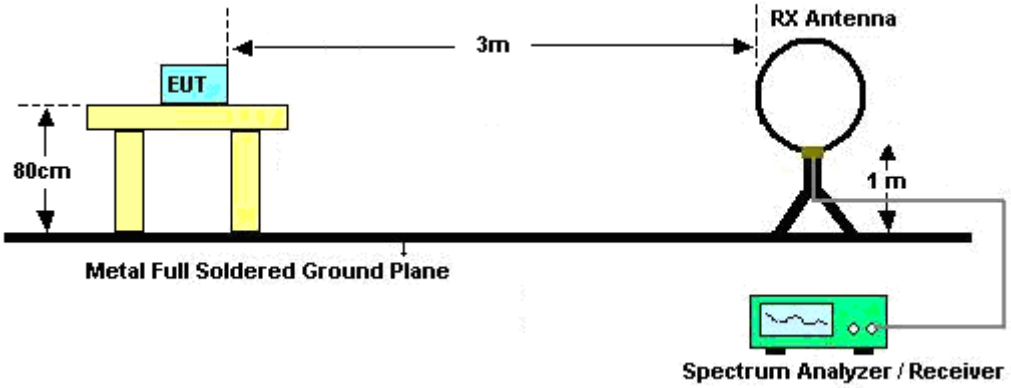
   (3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz

   - RBW = 1 MHz
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

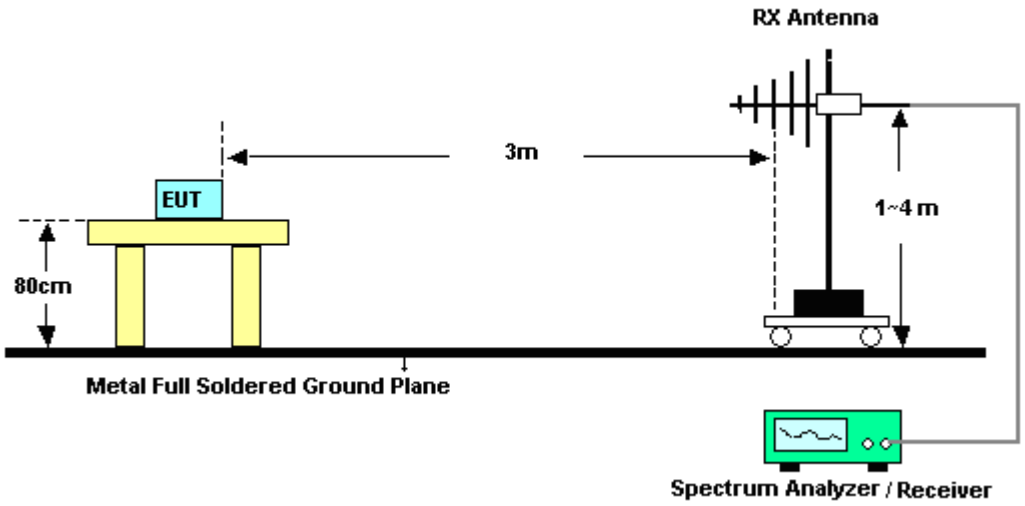
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

3.1.4 Test Setup

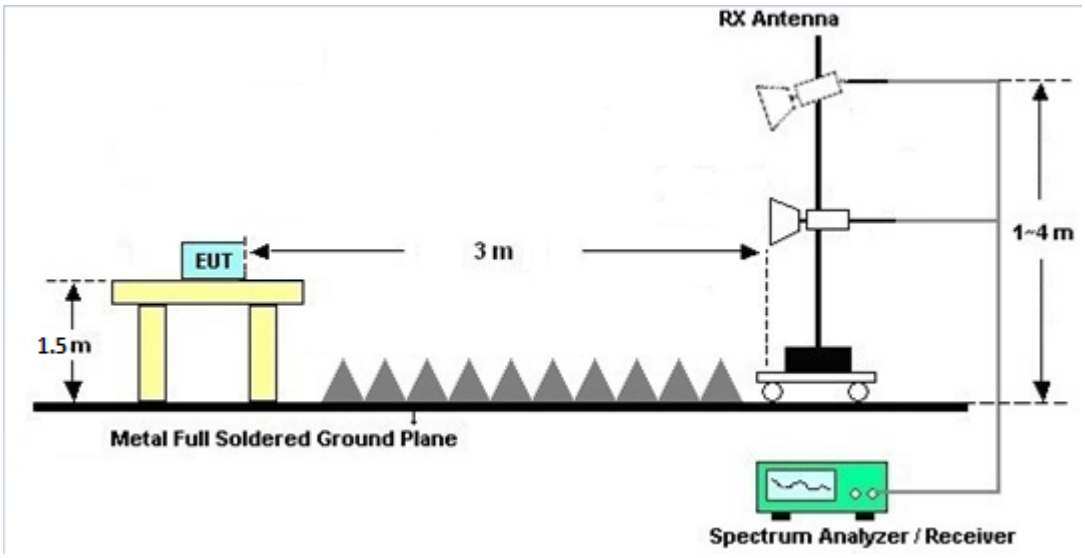
For radiated emissions below 30MHz



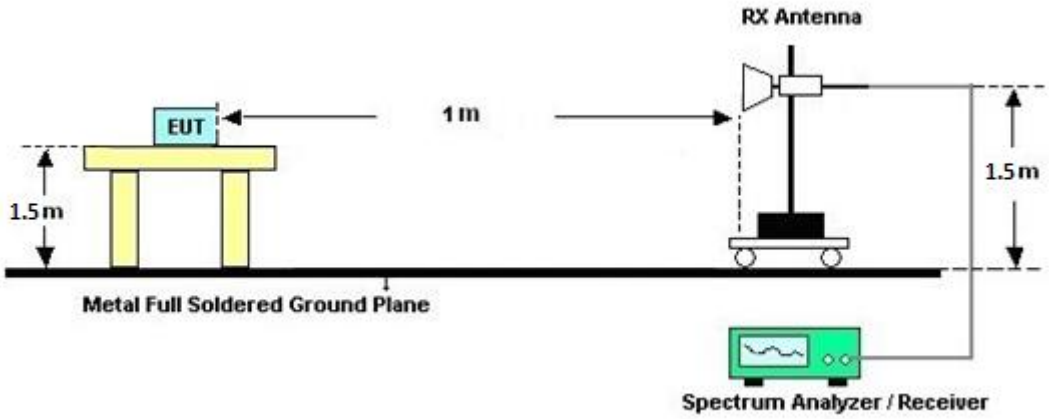
For radiated emissions from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



3.1.5 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 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 came out very similar.

3.1.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A and B.

3.1.7 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic)

Please refer to Appendix A and B.

3.2 Antenna Requirements

3.2.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power and the peak power spectral density shall be reduced by the same level in dB comparing to gain minus 6dBi. 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 rule.

3.2.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.2.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 09, 2021	Apr. 30, 2022~ Jun. 09, 2022	Sep. 08, 2022	Radiation (03CH15-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N-06	41912 & 05	30MHz~1GHz	Feb. 06, 2022	Apr. 30, 2022~ Jun. 09, 2022	Feb. 05, 2023	Radiation (03CH15-HY)
Amplifier	SONOMA	310N	363440	9kHz~1GHz	Dec. 27, 2021	Apr. 30, 2022~ Jun. 09, 2022	Dec. 26, 2022	Radiation (03CH15-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-02038	1GHz~18GHz	Aug. 04, 2021	Apr. 30, 2022~ Jun. 09, 2022	Aug. 03, 2022	Radiation (03CH15-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	18GHz~40GHz	Nov. 30, 2021	Apr. 30, 2022~ Jun. 09, 2022	Nov. 29, 2022	Radiation (03CH15-HY)
Preamplifier	Jet-Power	JPA0118-55-303	17100018000 55006	1GHz~18GHz	May 06, 2021	Apr. 30, 2022~ May 04, 2022	May 05, 2022	Radiation (03CH15-HY)
Preamplifier	Jet-Power	JPA0118-55-303	17100018000 55006	1GHz~18GHz	May 05, 2022	May 05, 2022~ Jun. 09, 2022	May 04, 2023	Radiation (03CH15-HY)
Preamplifier	EM Electronics	EM01G18G	060803	1GHz-18GHz	Dec. 16, 2021	Apr. 30, 2022~ Jun. 09, 2022	Dec. 15, 2022	Radiation (03CH15-HY)
Preamplifier	EMEC	EM18G40G	060801	18-40GHz	Jun. 22, 2021	Apr. 30, 2022~ Jun. 09, 2022	Jun. 21, 2022	Radiation (03CH15-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY54130085	20MHz~8.4GHz	Oct. 21, 2021	Apr. 30, 2022~ Jun. 09, 2022	Oct. 20, 2022	Radiation (03CH15-HY
Spectrum Analyzer	Agilent	E4446A	MY50180136	3Hz~44GHz	May 07, 2021	Apr. 30, 2022~ May 05, 2022	May 06, 2022	Radiation (03CH15-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200485	10Hz~44GHz	Mar. 07, 2022	May 05, 2022~ Jun. 09, 2022	Mar. 06, 2023	Radiation (03CH15-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Apr. 30, 2022~ Jun. 09, 2022	N/A	Radiation (03CH15-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Apr. 30, 2022~ Jun. 09, 2022	N/A	Radiation (03CH15-HY)
Software	Audix	E3 6.2009-8-24(k5)	RK-000451	N/A	N/A	Apr. 30, 2022~ Jun. 09, 2022	N/A	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104, 102E	MY36980/4, MY9838/4PE, 508405/2E	30MHz~18G	Nov. 15, 2021	Apr. 30, 2022~ May 11, 2022	Nov. 14, 2022	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104, 102E	MY9838/4PE, 508405/2E,582185/4	30MHz~18G	May 12, 2022	May 12, 2022~ Jun. 09, 2022	May 11, 2023	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	804011/2,804012/2	30MHz-40GHz	Jan. 04, 2022	Apr. 30, 2022~ Jun. 09, 2022	Jan. 03, 2023	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	9kHz~30MHz	Mar. 10, 2022	Apr. 30, 2022~ Jun. 09, 2022	Mar. 09, 2023	Radiation (03CH15-HY)

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))	**5.8 dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.3 dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.6 dB**

Appendix A. Radiated Spurious Emission

Test Engineer :	Bigshow Wang	**Temperature :**	22.1~23.1°C
		Relative Humidity :	55~60%

<Sample 1>

2.4GHz 2400~2483.5MHz

LTE Band 7 (EM7411) + LTE Band 7 (EM7411) +

802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2>

WIFI 802.11ax HE40 Full (Band Edge @ 3m)

WIFI	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
		2389.857	53.08	-20.92	74	46.35	27.36	16.2	36.83	150	270	P	H
		2390	50.35	-3.65	54	43.62	27.36	16.2	36.83	150	270	A	H
	*	2422	105.8	-	-	98.92	27.44	16.26	36.82	150	270	P	H
	*	2422	102.45	-	-	95.57	27.44	16.26	36.82	150	270	A	H
802.11ax		2492.16	50.96	-23.04	74	43.7	27.67	16.37	36.78	150	270	P	H
HE40 Full		2499.86	43.83	-10.17	54	36.53	27.7	16.38	36.78	150	270	A	H
CH 03		2379.426	50.89	-23.11	74	44.22	27.32	16.19	36.84	350	199	P	V
2422MHz		2334.453	43.35	-10.65	54	36.96	27.14	16.11	36.86	350	199	A	V
	*	2422	95.34	-	-	88.46	27.44	16.26	36.82	350	199	P	V
	*	2422	91.43	-	-	84.55	27.44	16.26	36.82	350	199	A	V
		2484.67	51.82	-22.18	74	44.61	27.64	16.36	36.79	350	199	P	V
		2484.18	44.02	-9.98	54	36.81	27.64	16.36	36.79	350	199	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Band 4 - 5725~5850MHz

WIFI 802.11ax HE20_Full (Band Edge @ 3m)

WIFI Ant. 1+2	Note	Frequency (MHz)	Level (dBμV/m)	Margin (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)
		5617.6	48.75	-19.45	68.2	41.46	33	11.08	36.79	350	268	P	H
		5696.8	48.91	-53.93	102.84	41.5	33.09	11.17	36.85	350	268	P	H
		5718.4	48.98	-61.37	110.35	41.46	33.21	11.18	36.87	350	268	P	H
		5725	54.82	-67.38	122.2	47.25	33.25	11.19	36.87	350	268	P	H
	*	5745	112.72	-	-	105.03	33.37	11.21	36.89	350	268	P	H
	*	5745	106.17	-	-	98.48	33.37	11.21	36.89	350	268	A	H
802.11ax													H
HE20 Full													H
CH 149		5649	49.21	-18.99	68.2	41.92	33	11.11	36.82	150	206	P	V
5745MHz		5656.4	49.15	-23.8	72.95	41.84	33.01	11.12	36.82	150	206	P	V
		5712	48.62	-59.94	108.56	41.14	33.17	11.17	36.86	150	206	P	V
		5723.6	47.92	-71.09	119.01	40.36	33.24	11.19	36.87	150	206	P	V
	*	5745	102.18	-	-	94.49	33.37	11.21	36.89	150	206	P	V
	*	5745	95.78	-	-	88.09	33.37	11.21	36.89	150	206	A	V
													V
													V

Remark

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

Band 4 5725~5850MHz

LTE Band 7 (EM7411) + LTE Band 7 (EM7411) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2> (Harmonic @ 3m)

WIFI Ant. Simultaneously	Note	Frequency (MHz)	Level (dBµV/m)	Margin (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)
Band 7 + 11ax(HE40)_TX_Ch03 + 11ax(HE20)_TX_Ch149		4844	47.59	-26.41	74	42.6	32.39	9.68	37.08	-	-	P	H
		7266	46.23	-27.77	74	56.14	36.67	11.53	58.11	-	-	P	H
		11490	53.8	-20.2	74	62.05	38.83	13.68	60.76	350	271	P	H
		11490	46.7	-7.3	54	54.95	38.83	13.68	60.76	350	271	A	H
		12016	51.72	-22.28	74	60.39	38.65	14.03	61.35	-	-	P	H
		12016	41.94	-12.06	54	50.61	38.65	14.03	61.35	-	-	A	H
		14491	50.82	-23.18	74	58.94	40.51	14.85	63.48	-	-	P	H
		14491	42.14	-11.86	54	50.26	40.51	14.85	63.48	-	-	A	H
		17235	52.38	-15.82	68.2	56.06	37.97	16.64	58.29	-	-	P	H
		18000	56.51	-17.49	74	53.53	43.1	17.05	57.17	-	-	P	H
		18000	47.77	-6.23	54	44.79	43.1	17.05	57.17	-	-	A	H
													H
		4844	47.76	-26.24	74	42.77	32.39	9.68	37.08	-	-	P	V
		7266	45.91	-28.09	74	55.82	36.67	11.53	58.11	-	-	P	V
		10740	50.84	-23.16	74	59.46	38.88	13.38	60.88	-	-	P	V
		10740	41.16	-12.84	54	49.78	38.88	13.38	60.88	-	-	A	V
		11490	53.15	-20.85	74	61.4	38.83	13.68	60.76	150	231	P	V
		11490	46.35	-7.65	54	54.6	38.83	13.68	60.76	150	231	A	V
		14491	50.15	-23.85	74	58.27	40.51	14.85	63.48	-	-	P	V
		14491	41.37	-12.63	54	49.49	40.51	14.85	63.48	-	-	A	V
		17235	49.7	-18.5	68.2	53.38	37.97	16.64	58.29	-	-	P	V
		17989	56.49	-17.51	74	53.63	43	17.04	57.18	-	-	P	V
		17989	46.73	-7.27	54	43.87	43	17.04	57.18	-	-	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 with sufficient margin against limit line 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

LTE Band 7 (EM7411) + LTE Band 7 (EM7411) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> +

802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2> (SHF)

WIFI Ant. Simultaneously	Note	Frequency (MHz)	Level (dBµV/m)	Margin (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)
Band 7 + 11ax(HE40) _TX_Ch03 + 11ax(HE20) _TX_Ch149		25000	41.68	-32.32	74	57.75	39.2	-2.17	53.1	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		39552	46.4	-27.6	74	58.42	44.66	-0.43	56.25	-	-	P	V
													V
													V
													V
													V
													V
													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 with sufficient margin against limit line or noise floor only.												

Emission below 1GHz

LTE Band 7 (EM7411) + LTE Band 7 (EM7411) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax (HE20)_TX_Ch149 MIMO <Ant. 1+2> (LF)

WIFI Ant. Simultaneously	Note	Frequency (MHz)	Level (dBµV/m)	Margin (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)
Band 7 + 11ax(HE40) _TX_Ch03 + 11ax(HE20) _TX_Ch149		62.98	27.89	-12.11	40	47.65	11.76	1.02	32.54	-	-	P	H
		129.91	26.95	-16.55	43.5	40.48	17.5	1.49	32.52	-	-	P	H
		223.03	28.4	-17.6	46	43.64	15.29	1.95	32.48	-	-	P	H
		424.79	33.86	-12.14	46	41.2	22.55	2.56	32.45	-	-	P	H
		745.86	36.89	-9.11	46	37.97	27.82	3.39	32.29	-	-	P	H
		925.31	33.95	-12.05	46	32.11	29.32	3.88	31.36	-	-	P	H
													H
													H
													H
													H
													H
													H
		59.1	34.71	-5.29	40	54.54	11.73	0.99	32.55	200	185	Q	V
		130.88	27.33	-16.17	43.5	40.82	17.51	1.51	32.51	-	-	P	V
		221.09	26.01	-19.99	46	41.4	15.16	1.93	32.48	-	-	P	V
		375.32	28.27	-17.73	46	37.46	20.85	2.42	32.46	-	-	P	V
		428.67	33.44	-12.56	46	40.68	22.63	2.57	32.44	-	-	P	V
		959.26	33.93	-12.07	46	30.15	30.95	3.97	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 emission is noise floor only.

<Sample 2>

2.4GHz 2400~2483.5MHz

LTE Band 7 (EM7511) + LTE Band 7 (EM7511) +

802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2>

WIFI 802.11ax HE40 Full (Band Edge @ 3m)

WIFI	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
		2389.857	52.32	-21.68	74	45.59	27.36	16.2	36.83	150	263	P	H
		2390	49.33	-4.67	54	42.6	27.36	16.2	36.83	150	263	A	H
	*	2422	105.31	-	-	98.43	27.44	16.26	36.82	150	263	P	H
	*	2422	101.89	-	-	95.01	27.44	16.26	36.82	150	263	A	H
802.11ax		2495.8	51.82	-22.18	74	44.54	27.68	16.38	36.78	150	263	P	H
HE40 Full		2492.23	43.79	-10.21	54	36.53	27.67	16.37	36.78	150	263	A	H
CH 03		2390	51.42	-22.58	74	44.69	27.36	16.2	36.83	350	200	P	V
2422MHz		2390	43.21	-10.79	54	36.48	27.36	16.2	36.83	350	200	A	V
	*	2422	99.49	-	-	92.61	27.44	16.26	36.82	350	200	P	V
	*	2422	92.28	-	-	85.4	27.44	16.26	36.82	350	200	A	V
		2494.82	51.29	-22.71	74	44.01	27.68	16.38	36.78	350	200	P	V
		2488.38	43.71	-10.29	54	36.48	27.65	16.37	36.79	350	200	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Band 4 - 5725~5850MHz

WIFI 802.11ax HE20_Full (Band Edge @ 3m)

WIFI Ant. 1+2	Note	Frequency (MHz)	Level (dBµV/m)	Margin (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)
		5602	49.64	-18.56	68.2	42.36	33	11.06	36.78	100	90	P	H
		5667.4	49.31	-31.8	81.11	41.98	33.03	11.13	36.83	100	90	P	H
		5718.6	50.86	-59.55	110.41	43.34	33.21	11.18	36.87	100	90	P	H
		5725	52.86	-69.34	122.2	45.29	33.25	11.19	36.87	100	90	P	H
	*	5745	114.08	-	-	106.39	33.37	11.21	36.89	100	90	P	H
	*	5745	108.16	-	-	100.47	33.37	11.21	36.89	100	90	A	H
802.11ax													H
HE20 Full													H
CH 149		5600.4	50.26	-17.94	68.2	42.98	33	11.06	36.78	350	186	P	V
5745MHz		5692	48.96	-50.34	99.3	41.57	33.08	11.16	36.85	350	186	P	V
		5715.2	49.28	-60.18	109.46	41.77	33.19	11.18	36.86	350	186	P	V
		5722.4	48.83	-67.44	116.27	41.29	33.23	11.18	36.87	350	186	P	V
	*	5745	103.98	-	-	96.29	33.37	11.21	36.89	350	186	P	V
	*	5745	97.35	-	-	89.66	33.37	11.21	36.89	350	186	A	V
													V
													V

Remark

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

Band 4 5725~5850MHz

LTE Band 7 (EM7511) + LTE Band 7 (EM7511) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> +

802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2> (Harmonic @ 3m)

WIFI Ant. Simultaneously	Note	Frequency (MHz)	Level (dBμV/m)	Margin (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)
Band 7 + 11ax(HE40)_TX _Ch03 + 11ax(HE20)_TX _Ch149		4844	49.8	-24.2	74	44.81	32.39	9.68	37.08	-	-	P	H
		7266	46.29	-27.71	74	56.2	36.67	11.53	58.11	-	-	P	H
		11490	53.53	-20.47	74	61.78	38.83	13.68	60.76	100	95	P	H
		11490	46.75	-7.25	54	55	38.83	13.68	60.76	100	95	A	H
		12203	51.1	-22.9	74	59.58	38.9	14.1	61.48	-	-	P	H
		12203	41.34	-12.66	54	49.82	38.9	14.1	61.48	-	-	A	H
		14491	50.14	-23.86	74	58.26	40.51	14.85	63.48	-	-	P	H
		14491	41.36	-12.64	54	49.48	40.51	14.85	63.48	-	-	A	H
		17235	49.63	-18.57	68.2	53.31	37.97	16.64	58.29	-	-	P	H
		17989	54.9	-19.1	74	52.04	43	17.04	57.18	-	-	P	H
		17989	45.12	-8.88	54	42.26	43	17.04	57.18	-	-	A	H
													H
		4844	49.58	-24.42	74	44.59	32.39	9.68	37.08	-	-	P	V
		7266	46.2	-27.8	74	56.11	36.67	11.53	58.11	-	-	P	V
		11490	53.85	-20.15	74	62.1	38.83	13.68	60.76	350	190	P	V
		11490	47.1	-6.9	54	55.35	38.83	13.68	60.76	350	190	A	V
		12357	50.65	-23.35	74	59.33	38.74	14.16	61.58	-	-	P	V
		12357	40.9	-13.1	54	49.58	38.74	14.16	61.58	-	-	A	V
		14480	50.24	-23.76	74	58.35	40.52	14.84	63.47	-	-	P	V
		14480	41.28	-12.72	54	49.39	40.52	14.84	63.47	-	-	A	V
		17235	49.7	-18.5	68.2	53.38	37.97	16.64	58.29	-	-	P	V
		18000	55.66	-18.34	74	52.68	43.1	17.05	57.17	-	-	P	V
		18000	45.91	-8.09	54	42.93	43.1	17.05	57.17	-	-	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 with sufficient margin against limit line 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

LTE Band 7 (EM7511) + LTE Band 7 (EM7511) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> +

802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2> (SHF)

WIFI Ant. Simultaneously	Note	Frequency (MHz)	Level (dBµV/m)	Margin (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)
Band 7 + 11ax(HE40) _TX_Ch03 + 11ax(HE20) _TX_Ch149		23136	41.52	-32.48	74	59.62	38.9	-2.78	54.22	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		39720	47.26	-26.74	74	59.11	44.52	-0.29	56.08	-	-	P	V
													V
													V
													V
													V
													V
													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 with sufficient margin against limit line or noise floor only.												

Emission below 1GHz

LTE Band 7 (EM7511) + LTE Band 7 (EM7511) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> +

802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2> (LF)

WIFI Ant. Simultaneously	Note	Frequency (MHz)	Level (dBµV/m)	Margin (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)
Band 7 + 11ax(HE40) _TX_Ch03 + 11ax(HE20) _TX_Ch149		62.98	31.18	-8.82	40	50.94	11.76	1.02	32.54	-	-	P	H
		73.65	31.01	-8.99	40	49.8	12.61	1.09	32.49	-	-	P	H
		129.91	26.57	-16.93	43.5	40.1	17.5	1.49	32.52	-	-	P	H
		413.15	30.21	-15.79	46	38.05	22.08	2.54	32.46	-	-	P	H
		687.66	31.43	-14.57	46	34.37	26.19	3.29	32.42	-	-	P	H
		955.38	34.34	-11.66	46	30.63	30.92	3.96	31.17	-	-	P	H
													H
													H
													H
													H
													H
													H
		30.97	33.77	-6.23	40	41.54	24.01	0.7	32.48	-	-	Q	V
		59.1	34.39	-5.61	40	54.22	11.73	0.99	32.55	200	188	P	V
		124.09	29.45	-14.05	43.5	43.17	17.38	1.42	32.52	-	-	P	V
		189.08	23.6	-19.9	43.5	39.73	14.62	1.74	32.49	-	-	P	V
		418	30.09	-15.91	46	37.73	22.26	2.55	32.45	-	-	P	V
		950.53	33.28	-12.72	46	29.91	30.64	3.95	31.22	-	-	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 emission is 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 Ant. 1+2	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)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =

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

3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

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

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

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

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

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

Appendix B. Radiated Spurious Emission Plots

Test Engineer :	Bigshow Wang	**Temperature :**	22.1~23.1°C
		Relative Humidity :	55~60%

<Sample 1>

Note symbol

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

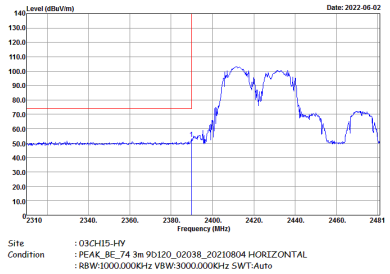
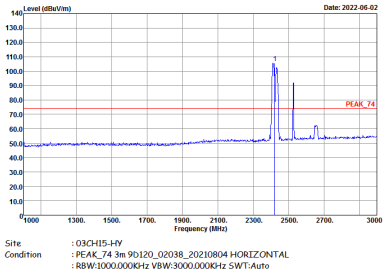
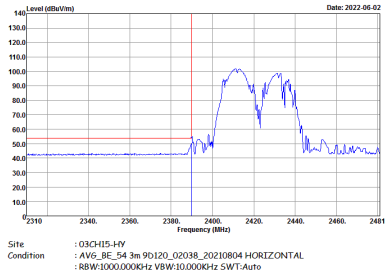
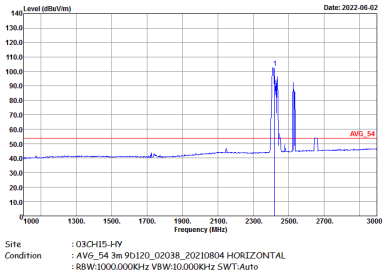
<Sample 1>

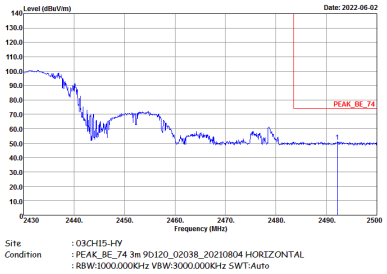
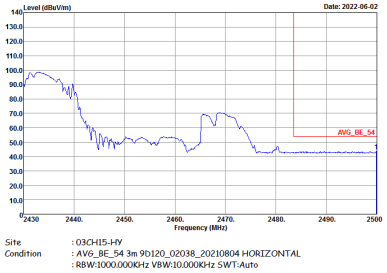
2.4GHz 2400~2483.5MHz

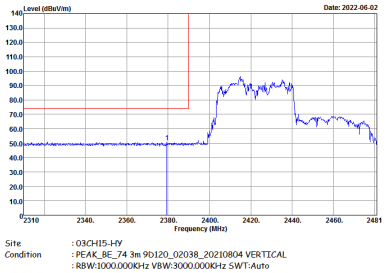
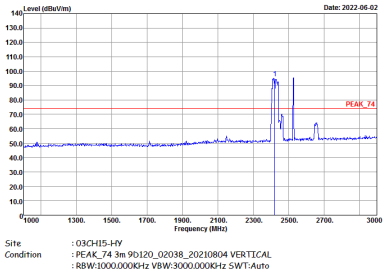
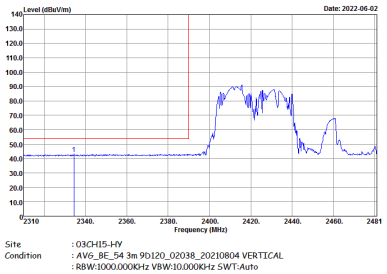
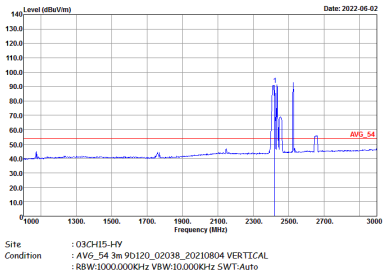
LTE Band 7 (EM7411) + LTE Band 7 (EM7411) +

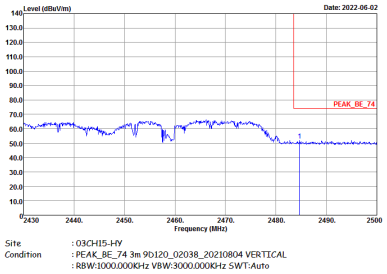
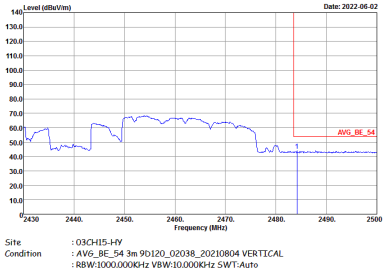
802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2>

WIFI 802.11ax HE40 Full (Band Edge @ 3m)

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11ax HE40 Full CH03 2422MHz - L	
1+2	Horizontal	Fundamental
Peak		
Avg.		

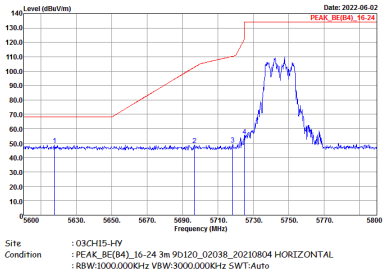
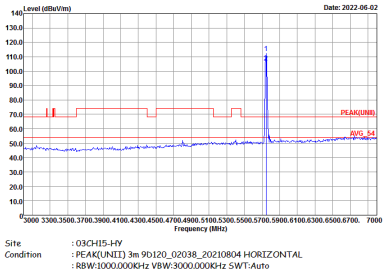
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11ax HE40 Full CH03 2422MHz - R	
1+2	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

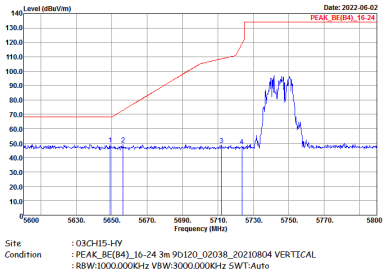
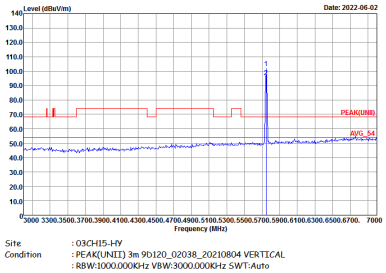
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11ax HE40 Full CH03 2422MHz - L	
1+2	Vertical	Fundamental
Peak		
Avg.		

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11ax HE40 Full CH03 2422MHz - R	
1+2	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

Band 4 - 5725~5850MHz

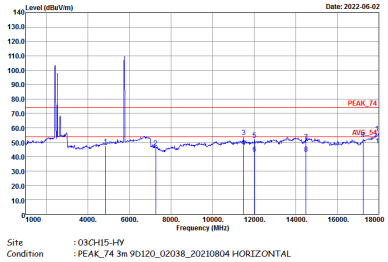
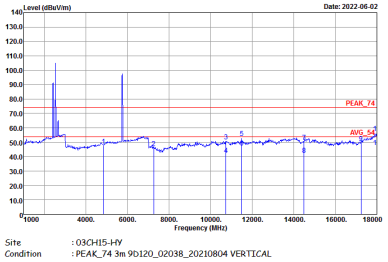
WIFI 802.11ax HE20 Full (Band Edge @ 3m)

WIFI	Band 4 5725~5850MHz Band Edge @ 3m	
ANT	802.11ax HE20 Full CH149 5745MHz	
1+2	Horizontal	Fundamental
Peak		

WIFI	Band 4 5725~5850MHz Band Edge @ 3m	
ANT	802.11ax HE20 Full CH149 5745MHz	
1+2	Vertical	Fundamental
Peak		

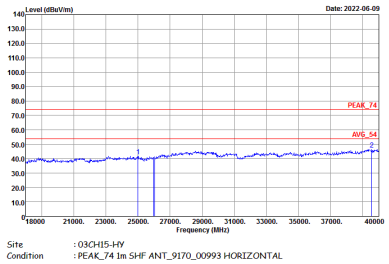
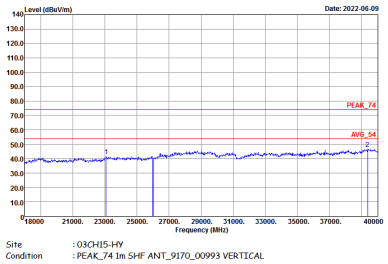
2.4GHz 2400~2483.5MHz

LTE Band 7 (EM7411) + LTE Band 7 (EM7411) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2> (Harmonic @ 3m)

WIFI	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	Band 7+11ax(HE40)_TX_Ch03+11ax(HE20)_TX_Ch149	
Simultaneously	Horizontal	Vertical
Peak Avg.		

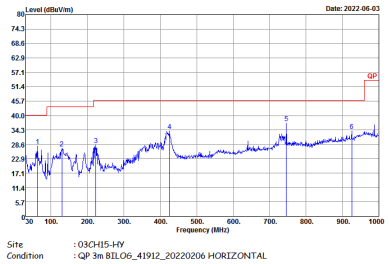
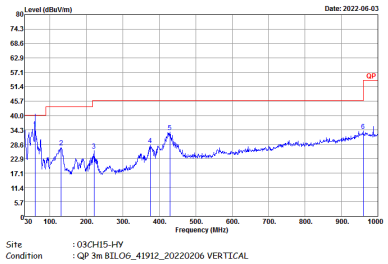
Emission above 18GHz

LTE Band 7 (EM7411) + LTE Band 7 (EM7411) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2> (SHF)

WIFI	2.4GHz 2400~2483.5MHz	
ANT	Band 7+11ax(HE40)_TX_Ch03+11ax(HE20)_TX_Ch149 SHF	
Simultaneously	Horizontal	Vertical
QP / Peak		

Emission below 1GHz

LTE Band 7 (EM7411) + LTE Band 7 (EM7411) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2> (LF)

WIFI	2.4GHz 2400~2483.5MHz	
ANT	Band 7+11ax(HE40)_TX_Ch03+11ax(HE20)_TX_Ch149 LF	
Simultaneously	Horizontal	Vertical
QP / Peak		

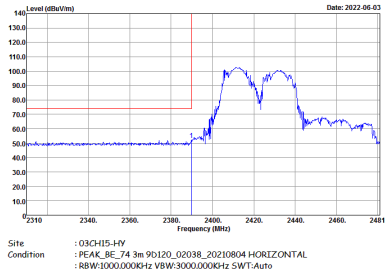
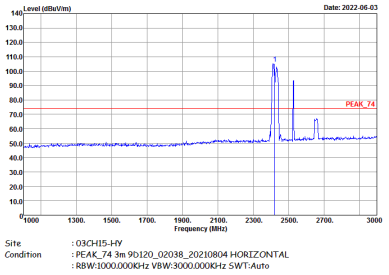
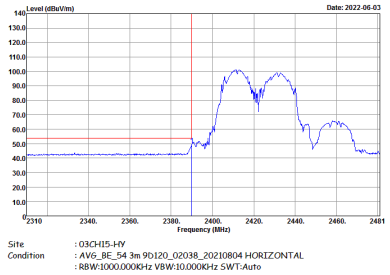
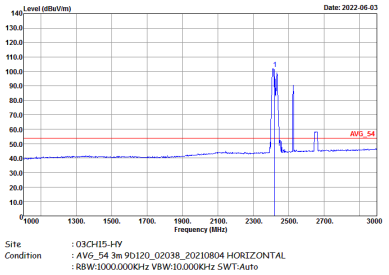
<Sample 2>

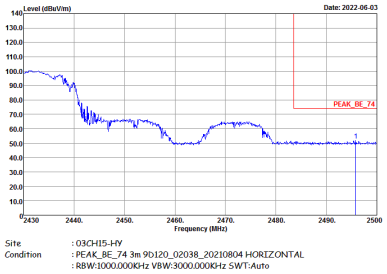
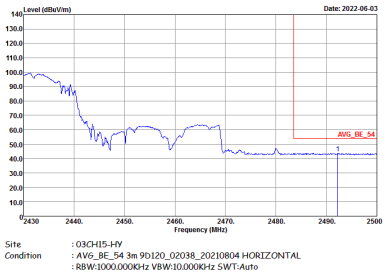
2.4GHz 2400~2483.5MHz

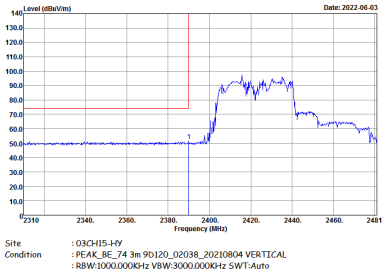
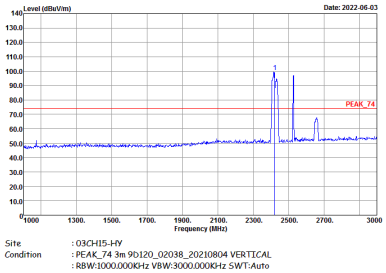
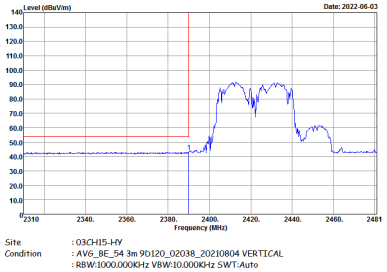
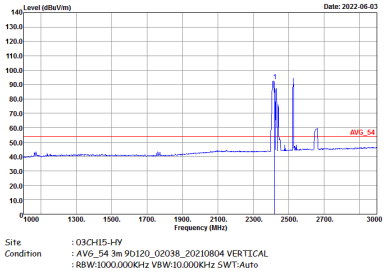
LTE Band 7 (EM7511) + LTE Band 7 (EM7511) +

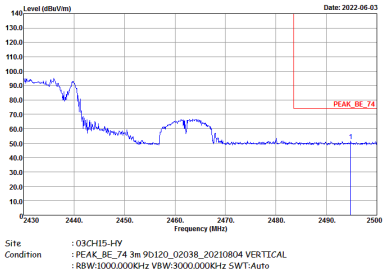
802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2>

WIFI 802.11ax HE40 Full (Band Edge @ 3m)

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11ax HE40 Full CH03 2422MHz - L	
1+2	Horizontal	Fundamental
Peak		
Avg.		

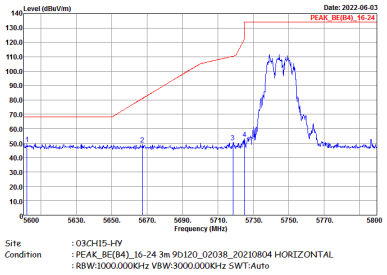
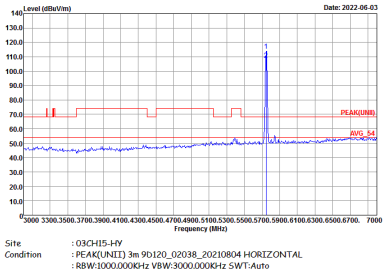
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11ax HE40 Full CH03 2422MHz - R	
1+2	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

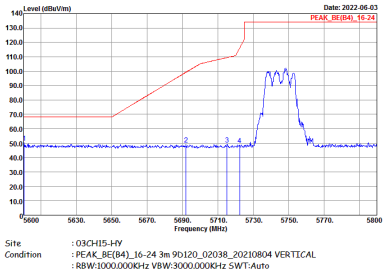
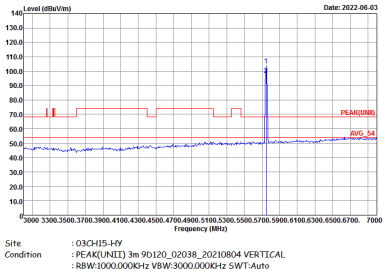
WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11ax HE40 Full CH03 2422MHz - L	
1+2	Vertical	Fundamental
Peak		
Avg.		

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11ax HE40 Full CH03 2422MHz - R	
1+2	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

Band 4 - 5725~5850MHz

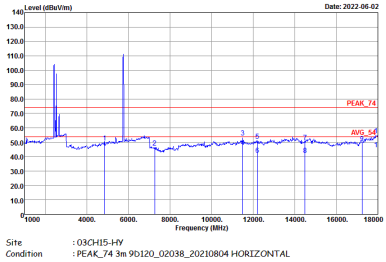
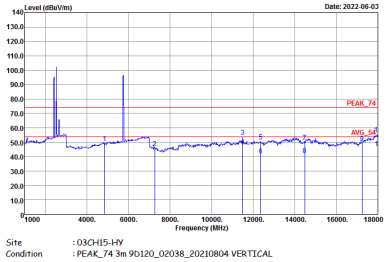
WIFI 802.11ax HE20 Full (Band Edge @ 3m)

WIFI	Band 4 5725~5850MHz Band Edge @ 3m	
ANT	802.11ax HE20 Full CH149 5745MHz	
1+2	Horizontal	Fundamental
Peak		

WIFI	Band 4 5725~5850MHz Band Edge @ 3m	
ANT	802.11ax HE20 Full CH149 5745MHz	
1+2	Vertical	Fundamental
Peak		

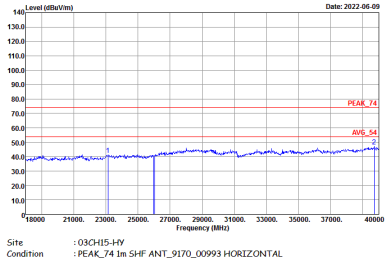
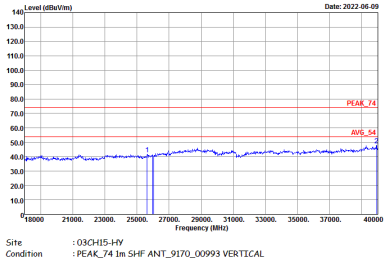
2.4GHz 2400~2483.5MHz

LTE Band 7 (EM7511) + LTE Band 7 (EM7511) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2> (Harmonic @ 3m)

WIFI	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	Band 7+11ax(HE40)_TX_Ch03+11ax(HE20)_TX_Ch149	
Simultaneously	Horizontal	Vertical
Peak Avg.		

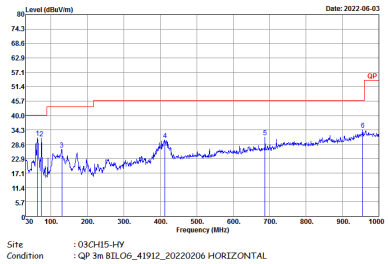
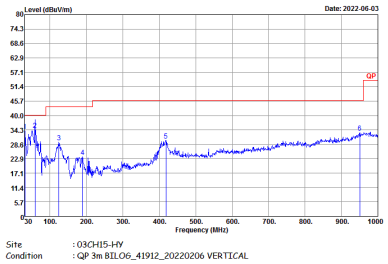
Emission above 18GHz

LTE Band 7 (EM7511) + LTE Band 7 (EM7511) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2> (SHF)

WIFI	2.4GHz 2400~2483.5MHz	
ANT	Band 7+11ax(HE40)_TX_Ch03+11ax(HE20)_TX_Ch149 SHF	
Simultaneously	Horizontal	Vertical
QP / Peak		

Emission below 1GHz

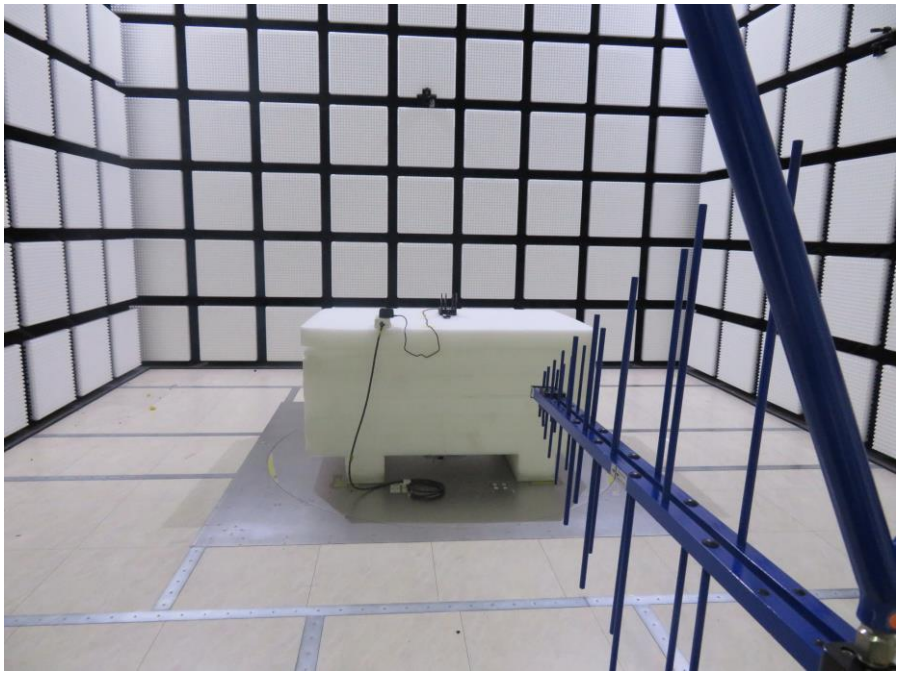
LTE Band 7 (EM7511) + LTE Band 7 (EM7511) + 802.11ax HE40_TX_Ch03 MIMO <Ant. 1+2> + 802.11ax HE20_TX_Ch149 MIMO <Ant. 1+2> (LF)

WIFI	2.4GHz 2400~2483.5MHz	
ANT	Band 7+11ax(HE40)_TX_Ch03+11ax(HE20)_TX_Ch149 SHF	
Simultaneously	Horizontal	Vertical
QP / Peak		

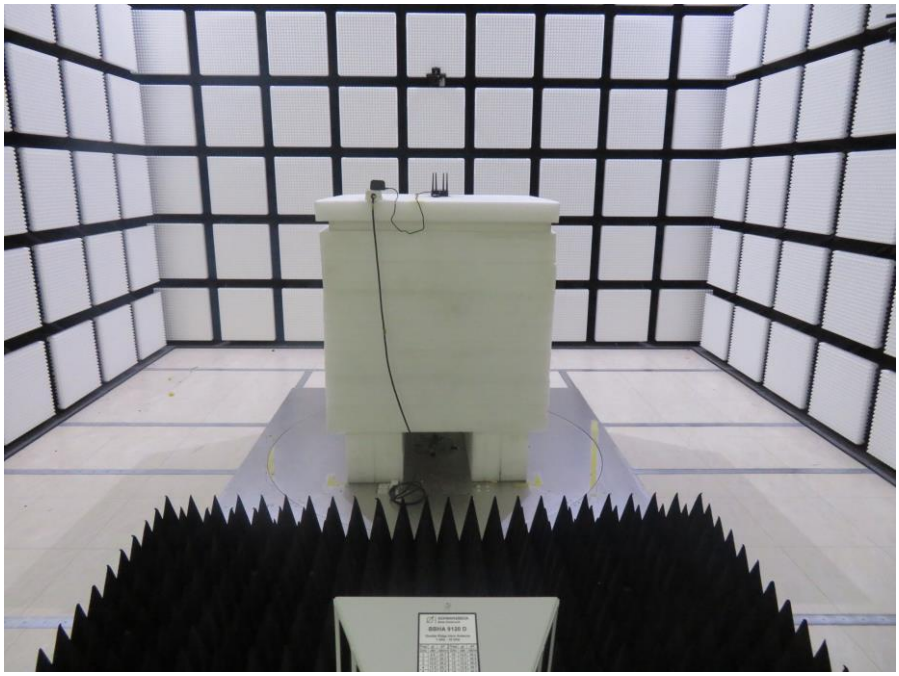
Appendix C. Setup Photographs

<Radiated Emission>

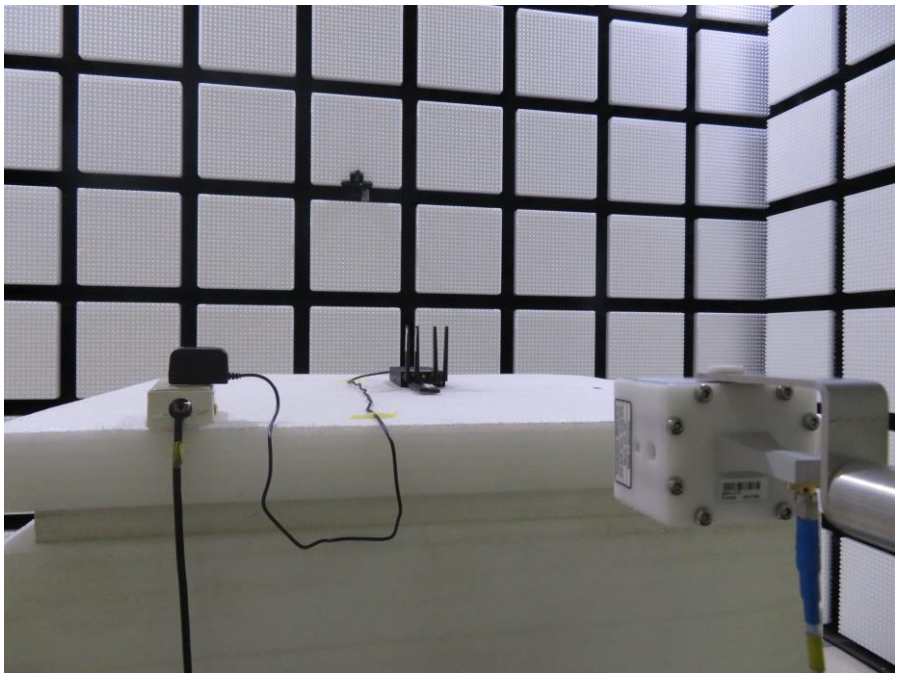
LF



HF



SHF



———THE END———