



FCC EMI TEST REPORT

FCC ID : U8G-P1MBX
Equipment : PEPWAVE / peplink Wireless Product
Brand Name : PEPWAVE / peplink
Model Name : 1. MAX-HD4-MBX-LTEA-R-T
2. MAX HD4 MBX
3. HD4 MBX
4. MBX
5. MAX HD4 MBX LTEA
6. EXM-T4-LTEA-R
7. Peplink Balance 310X
8. Balance 310X
Applicant : PISMO LABS TECHNOLOGY LIMITED
A8, 5/F, HK Spinners Industrial Building, Phase 6,
481 Castle Peak Road, Cheung Sha Wan, Hong Kong
Manufacturer : ISMO LABS TECHNOLOGY LIMITED
A8, 5/F, HK Spinners Industrial Building, Phase 6,
481 Castle Peak Road, Cheung Sha Wan, Hong Kong
Standard : FCC 47 CFR FCC Part 15 Subpart B

The product was received on Dec. 06, 2018 and testing was started from Mar. 01, 2019 and completed on Mar. 13, 2019. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI C63.4-2014 and has been in compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Jones Tsai

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)



Table of Contents

History of this test report.....	3
Summary of Test Result.....	4
1. General Description	5
1.1. Product Feature of Equipment Under Test	5
1.2. Modification of EUT	5
1.3. Test Location	5
1.4. Applicable Standards	6
2. Test Configuration of Equipment Under Test	7
2.1. Test Mode	7
2.2. Connection Diagram of Test System	7
2.3. Support Unit used in test configuration and system	8
2.4. EUT Operation Test Setup	8
3. Test Result	9
3.1. Test of AC Conducted Emission Measurement	9
3.2. Test of Radiated Emission Measurement	11
4. List of Measuring Equipment.....	14
5. Uncertainty of Evaluation	16
Appendix A. AC Conducted Emission Test Result	
Appendix B. Radiated Emission Test Result	
Appendix C. Setup Photographs	



History of this test report

Report No.	Version	Description	Issued Date
FC8D0607	01	Initial issue of report	Jul. 22, 2019



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.107	AC Conducted Emission	Pass	Under limit 4.01 dB at 21.406 MHz
3.2	15.109	Radiated Emission	Pass	Under limit 1.76 dB at 163.730 MHz for Quasi-Peak

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Louis Wu

Report Producer: Aileen Huang

1. General Description

1.1. Product Feature of Equipment Under Test

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

Product Specification subjective to this standard	
Integrated WWAN Module	Brand Name: Sierra Model Name: EM7511
Antenna Type	WWAN: Replacement Antenna WLAN: Replacement Antenna

1.2. Modification of EUT

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

1.3. Test Location

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	Sporton Site No. CO05-HY
Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	Sporton Site No. 03CH10-HY
Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
Test Site Location	No. 3, Lane 238, Kangle St., Neihu Chiu, Taipei, Taiwan 114, R.O.C. TEL : +886-2-2631-5551 FAX: +886-2-2631-9740
Test Site No.	Sporton Site No. OS02-NH

FCC Designation No. TW1093, TW1094, and TW1098



1.4. Applicable Standards

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

- ♦ FCC 47 CFR FCC Part 15 Subpart B
- ♦ ANSI C63.4-2014

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.

2. Test Configuration of Equipment Under Test

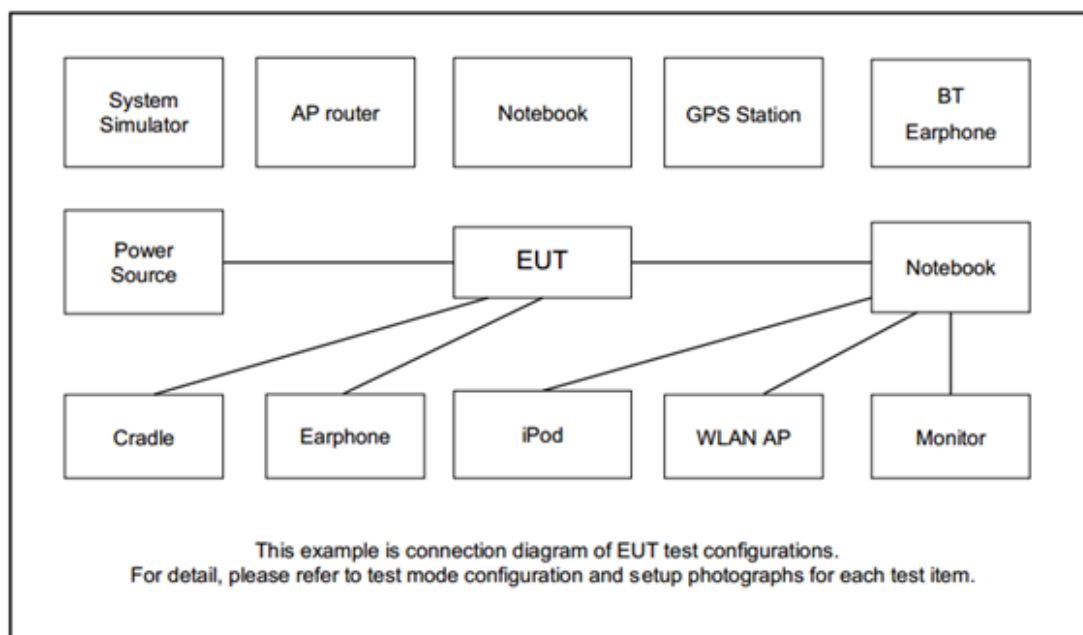
2.1. Test Mode

The EUT has been associated with peripherals pursuant to ANSI C63.4-2014 and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (30MHz to the 5th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

Test Items	Function Type
AC Conducted Emission	Mode 1: LTE Band 12 Idle + WLAN (2.4GHz) Idle + WLAN (5GHz) Idle+ GPS Rx + RJ-45 (LAN) Link + RJ-45 (WAN) Link + WWAN Antenna*8 + WLAN Antenna*4 + USB Flash Drive (Electricity only) + Adapter + SIM 1
	Mode 2: WCDMA Band V Idle + WLAN (2.4GHz) Idle + WLAN (5GHz) Idle+ GPS Rx + RJ-45 (LAN) Link + RJ-45 (WAN) Link + WWAN Antenna*8 + WLAN Antenna*4 + USB Flash Drive (Electricity only) + Adapter + SIM 2
Radiated Emissions	Mode 1: LTE Band 12 Idle + WLAN (2.4GHz) Idle + WLAN (5GHz) Idle+ GPS Rx + RJ-45 (LAN) Link + RJ-45 (WAN) Link + WWAN Antenna*8 + WLAN Antenna*4 + USB Flash Drive (Electricity only) + Adapter + SIM 1
	Mode 2: WCDMA Band V Idle + WLAN (2.4GHz) Idle + WLAN (5GHz) Idle+ GPS Rx + RJ-45 (LAN) Link + RJ-45 (WAN) Link + WWAN Antenna*8 + WLAN Antenna*4 + USB Flash Drive (Electricity only) + Adapter + SIM 2
Remark: 1. The worst case of AC is mode 2; only the test data of this mode was reported. 2. The worst case of RE is mode 1; only the test data of this mode was reported.	

2.2. Connection Diagram of Test System



2.3. Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8 m
2.	GPS Station	Pendulum	GSG-54	N/A	N/A	Unshielded, 1.8 m
3.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded, 1.8 m
4.	Notebook	DELL	Latitude E6320	FCC DoC/ Contains FCC ID: QDS-BRCM1054	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
5.	Notebook	DELL	Latitude 3480	FCC DoC/	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
6.	Notebook	MI	171501-AL	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
7.	USB Flash Drive	SanDisk	N/A	N/A	N/A	N/A

2.4. EUT Operation Test Setup

The EUT was in WCDMA and LTE idle mode during the testing. The EUT was synchronized to the BCCH, and is in continuous receiving mode by setting system simulator's paging reorganization.

At the same time, the EUT was attached to the Notebook, and the following programs installed in the EUT were programmed during the test:

1. Execute "GPS Test" to make the EUT receive continuous signals from GPS station.
2. EUT links with Notebook via RJ-45 and executes ping.

3. Test Result

3.1. Test of AC Conducted Emission Measurement

3.1.1 Limits of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	79	66
0.5-30	73	60

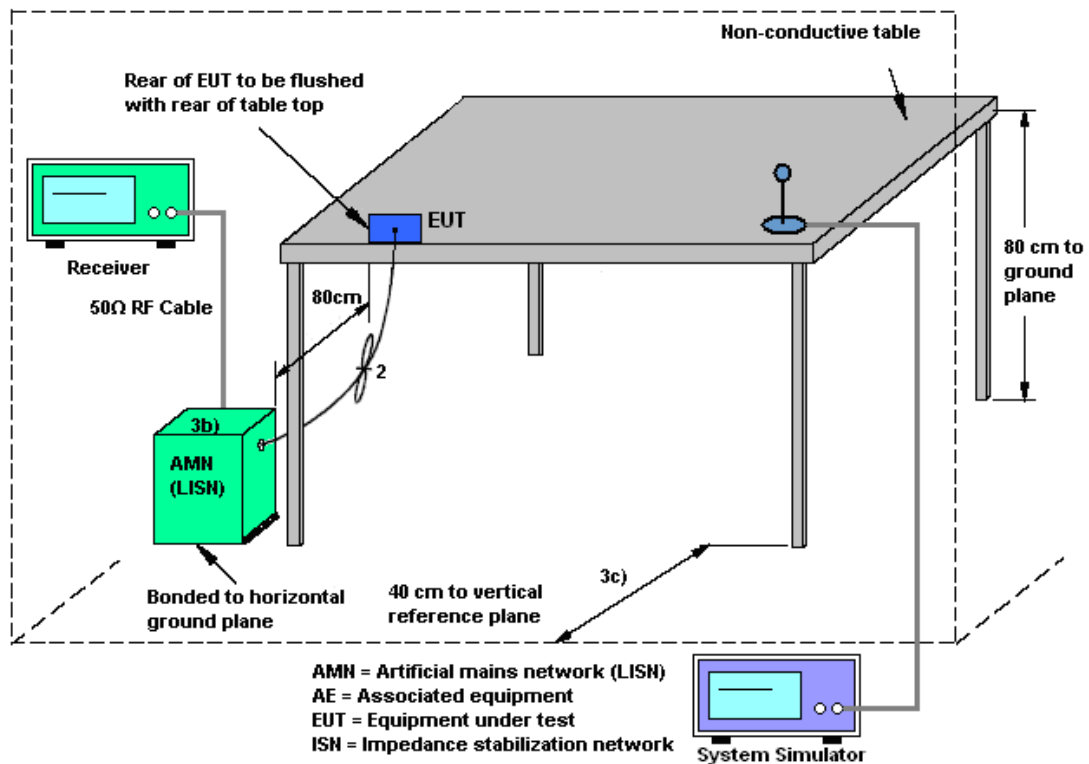
3.1.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedure

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.1.4 Test Setup



3.1.5 Test Result of AC Conducted Emission

Please refer to Appendix A.

3.2. Test of Radiated Emission Measurement

3.2.1. Limit of Radiated Emission

The emissions from an unintentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
Above 960	300	10

Frequency (MHz)	Field Strength (dBuV/meter)	Measurement Distance (meters)
30 - 230	40	10
230 - 1000	47	10

Note: Measurement follows the CISPR 22 limit line as below :

15.109 (g) As an alternative to the radiated emission limits shown in paragraphs (a) and (b) of this section, digital devices may be shown to comply with the standards contained in Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22, "Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement"

3.2.2. Measuring Instruments

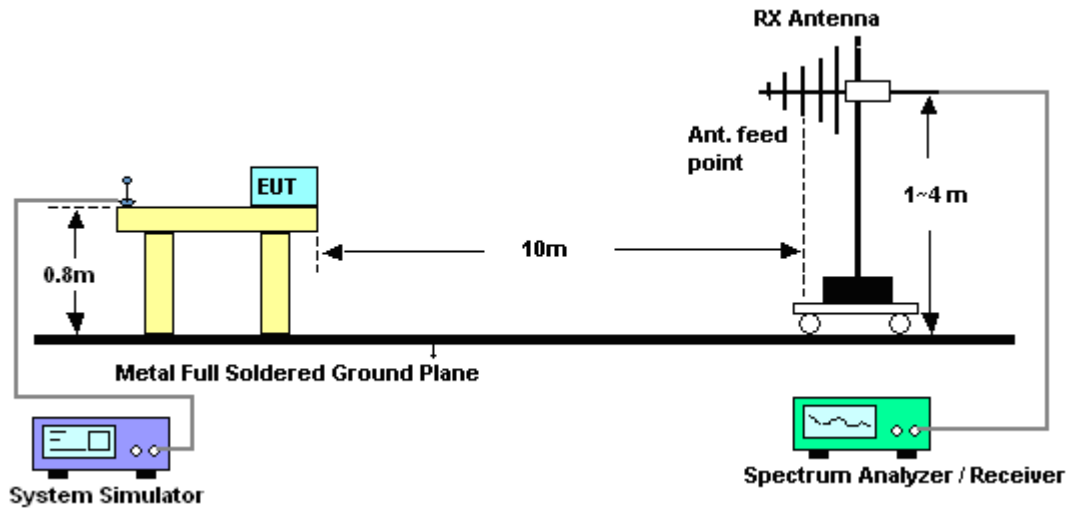
Refer a test equipment and calibration data table in this test report.

3.2.3. Test Procedures

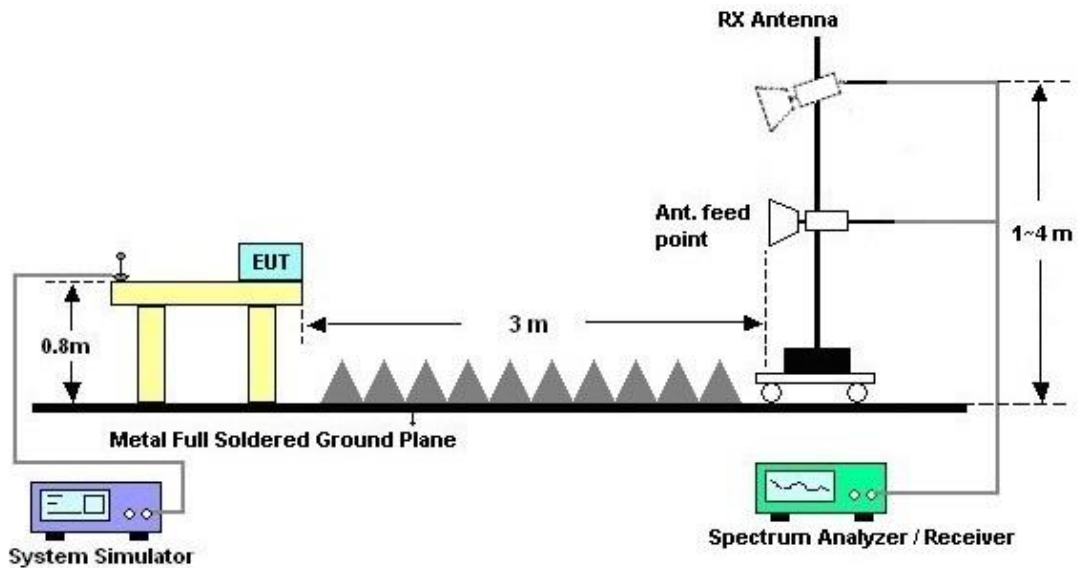
1. The EUT was placed on a turntable with 0.8 meter above ground.
2. The EUT was set 10 meters (30M~1G) and 3 meters (1G~ 13G) from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest radiation.
4. The antenna height is adjusted between one to 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 tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode (RBW=120kHz/VBW=300kHz for frequency below 1GHz; RBW=1MHz VBW=3MHz (Peak), RBW=1MHz/VBW=10Hz (Average) for frequency above 1GHz).
7. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, peak values of EUT will be reported. Otherwise, the emission will be repeated by using the quasi-peak method and reported.
8. Emission level (dB μ V/m) = 20 log Emission level (μ V/m)
9. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

3.2.4. Test Setup of Radiated Emission

For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.2.5. Test Result of Radiated Emission

Please refer to Appendix B.

4. List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Amplifier	SONOMA	310N	187311	9kHz~1GHz	Oct. 23, 2018	Mar. 05, 2019	Oct. 22, 2019	Radiation (03CH10-HY)
Bi-log Antenna	TESEQ	CBL 6111D&00800N1 D01N-06	35413&02	30MHz~1GHz	Feb. 12, 2019	Mar. 05, 2019	Feb. 11, 2020	Radiation (03CH10-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1325	1GHz ~ 18GHz	Oct. 02, 2018	Mar. 05, 2019	Oct. 01, 2019	Radiation (03CH10-HY)
Preamplifier	Jet-Power	JAP00101800-30-10P	160118550004	1GHz~18GHz	Apr. 17, 2018	Mar. 05, 2019	Apr. 16, 2019	Radiation (03CH10-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200485	10Hz ~ 44GHz	Nov. 02, 2018	Mar. 05, 2019	Nov. 01, 2019	Radiation (03CH10-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Mar. 05, 2019	N/A	Radiation (03CH10-HY)
Turn Table	EMEC	TT 2200	N/A	0~360 Degree	N/A	Mar. 05, 2019	N/A	Radiation (03CH10-HY)
Software	Audix	E3 6.2009-8-24	RK-001042	N/A	N/A	Mar. 05, 2019	N/A	Radiation (03CH10-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY54130085	20Hz ~ 8.4GHz	Nov. 01, 2018	Mar. 05, 2019	Oct. 31, 2019	Radiation (03CH10-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104 / 102	MY11692/4 PE, MY11693/4 PE, MY2855/2	30M-1G	Nov. 08, 2018	Mar. 05, 2019	Nov. 07, 2019	Radiation (03CH10-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104 / 102	MY11692/4 PE, MY11693/4 PE, MY2855/2	1G-18G	Nov. 08, 2018	Mar. 05, 2019	Nov. 07, 2019	Radiation (03CH10-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30M~40GHz	Oct. 16, 2018	Mar. 05, 2019	Oct. 15, 2019	Radiation (03CH10-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	800740/2	30M~40GHz	Oct. 16, 2018	Mar. 05, 2019	Oct. 15, 2019	Radiation (03CH10-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Dec. 05, 2018	Mar. 05, 2019	Dec. 04, 2019	Radiation (03CH10-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz ~ 40GHz	Dec. 06, 2018	Mar. 05, 2019	Dec. 05, 2019	Radiation (03CH10-HY)
Amplifier	HP	8447D	2944A06292	0.1 MHz - 1.3 GHz	May 14, 2018	Mar. 01, 2019	May 13, 2019	Radiation (OS02-NH)
Receiver	R&S	ESCI	100497	kHz – 3 GHz	May 22, 2018	Mar. 01, 2019	May 21, 2019	Radiation (OS02-NH)
Bi-log Antenna With 5dB Attenuator	TESEO	CBL6112D	35376	30 MHz - 2 GHz	Apr. 28, 2018	Mar. 01, 2019	Apr. 27, 2019	Radiation (OS02-NH)
Turn Table	EMCO	2080	9508-1805	0 - 360 degree	NCR	Mar. 01, 2019	NCR	Radiation (OS02-NH)
Antenna Mast	ETS	2075-2	2385	1 m - 4 m	NCR	Mar. 01, 2019	NCR	Radiation (OS02-NH)
RF Cable-R10m	MIYAZAKI	5DFB	CB044	30 MHz - 1 GHz	Aug. 24, 2018	Mar. 01, 2019	Aug. 23, 2019	Radiation (OS02-NH)
Software	Audix	E3	Ver.4	-	NCR	Mar. 01, 2019	NCR	Radiation (OS02-NH)
AVR	ACPOWER	AFC-1KV	F103030011	-	NCR	Mar. 01, 2019	NCR	Radiation (OS02-NH)



Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Mar. 13, 2019	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9KHz~3.6GHz	Nov. 12, 2018	Mar. 13, 2019	Nov. 11, 2019	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Nov. 14, 2018	Mar. 13, 2019	Nov. 13, 2019	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 09, 2018	Mar. 13, 2019	Nov. 08, 2019	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Mar. 13, 2019	N/A	Conduction (CO05-HY)
RF Cable	HUBER + SUHNER	RG 214/U	1358175	9kHz~30MHz	Sep. 14, 2018	Mar. 13, 2019	Sep. 13, 2019	Conduction (CO05-HY)
Pulse Limiter	SCHWARZBECK	VTSD 9561-F N	9561-F N00373	9kHz~200MHz	Nov. 08, 2018	Mar. 13, 2019	Nov. 07, 2019	Conduction (CO05-HY)

5. Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.2
--	-----

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.0
--	-----

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.9
--	-----

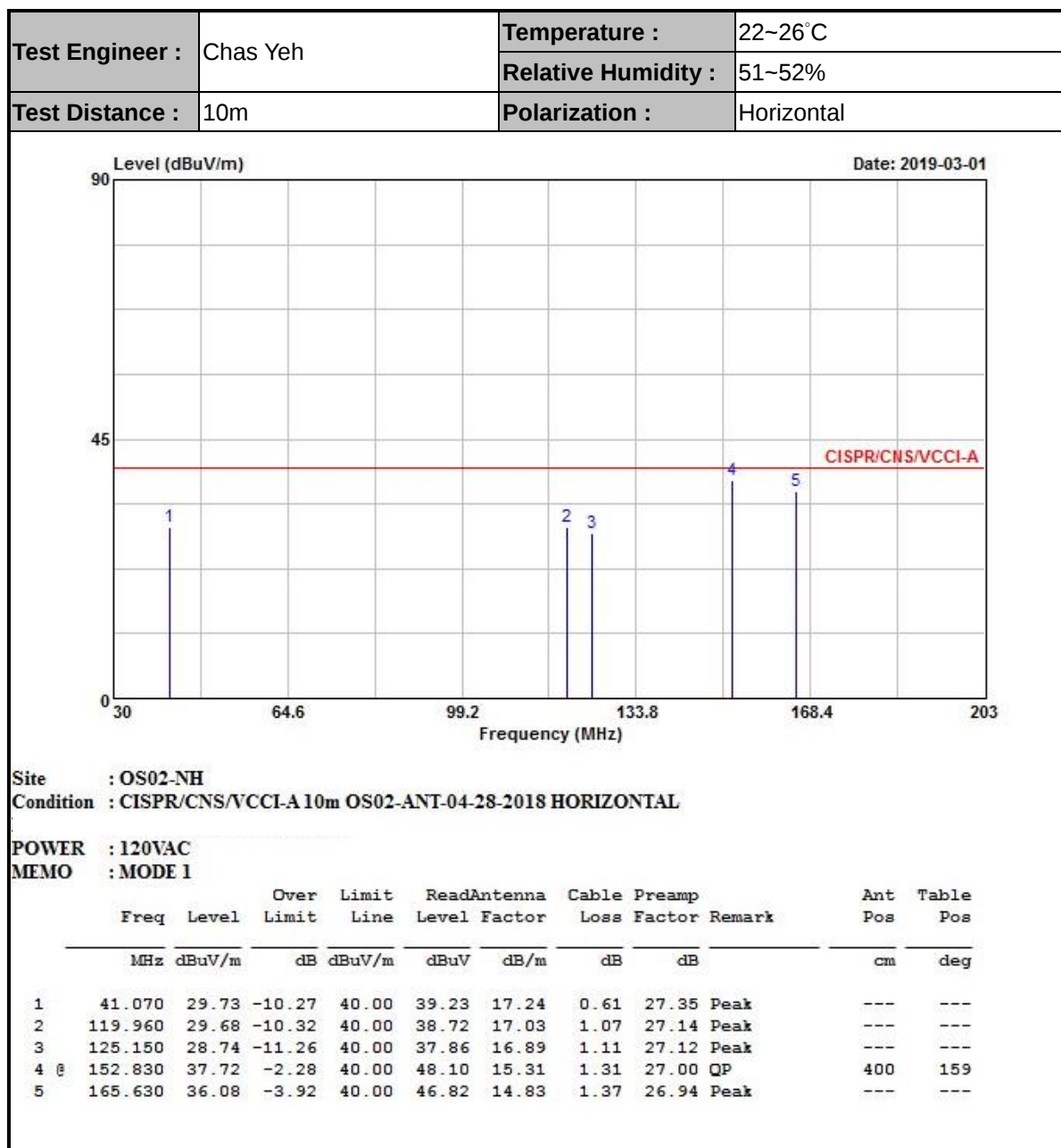


Appendix A. AC Conducted Emission Test Results

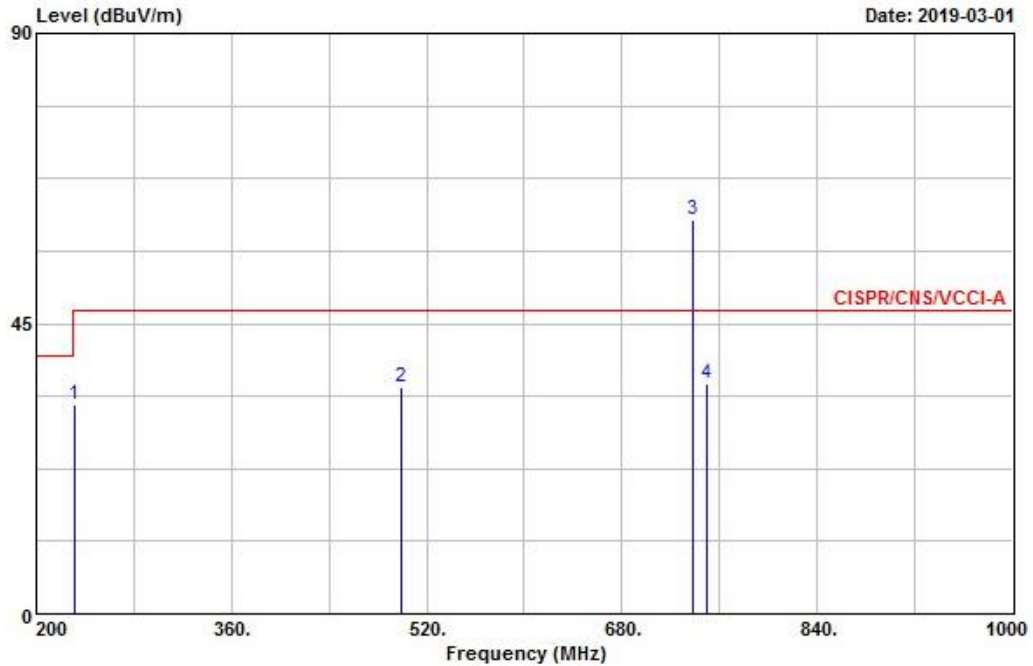
Test Engineer :	Jimmy Chang	Temperature :	24~26℃
		Relative Humidity :	52~54%



Appendix B. Radiated Emission Test Result



Test Engineer :	Chas Yeh	Temperature :	22~26°C
		Relative Humidity :	51~52%
Test Distance :	10m	Polarization :	Horizontal
Remark :	#3 is system simulator signal which can be ignored.		



Site : OS02-NH

Condition : CISPR/CNS/VCCI-A 10m OS02-ANT-04-28-2018 HORIZONTAL

POWER : 120VAC

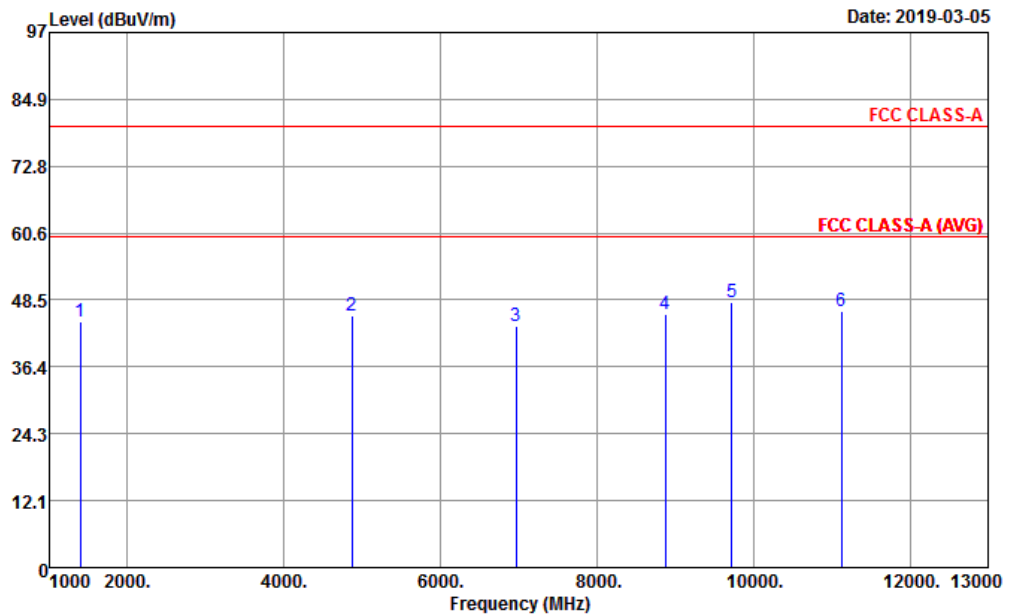
MEMO : MODE 1

: Freq. 737.5MHz is LTE Band 12 Signal

	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamplifier Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	231.200	32.51	-14.49	47.00	41.46	16.12	1.67	26.74	Peak	---	---
2	499.200	35.15	-11.85	47.00	37.85	22.42	2.86	27.98	Peak	---	---
3	737.500	61.15			61.32	24.33	3.58	28.08	Peak	---	---
4	749.600	35.78	-11.22	47.00	35.76	24.46	3.61	28.05	Peak	---	---



Test Engineer :	Yu Wang	Temperature :	21~23°C
		Relative Humidity :	54~57%
Test Distance :	3m	Polarization :	Horizontal

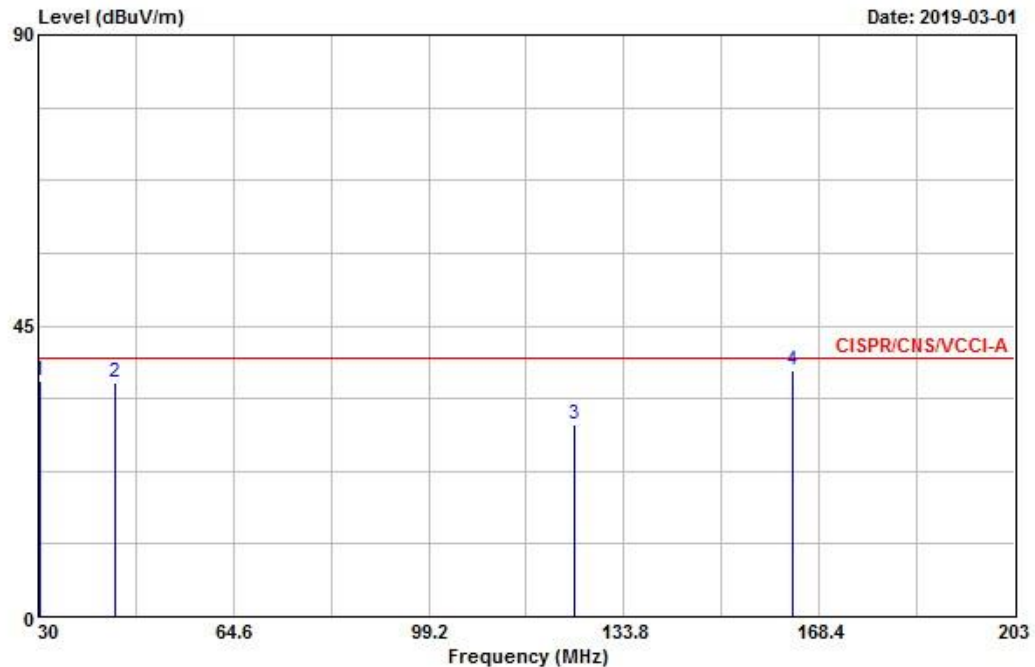


Site : 03CH10-HY
Condition : FCC CLASS-A 3m HORN 9120D-HF HORIZONTAL
Project : 8D0607
Power : 120Vac/60Hz
Mode : 1

	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Factor	Cable Loss	Preamp Factor	A/Pos	T/Pos	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg	
1	1400.00	44.65	-35.35	80.00	76.03	25.70	4.58	61.66	---	---	Peak
2	4864.00	45.71	-34.29	80.00	68.26	31.07	8.68	62.30	---	---	Peak
3	6970.00	43.84	-36.16	80.00	61.72	35.28	10.40	63.56	---	---	Peak
4	8878.00	45.97	-34.03	80.00	61.12	37.59	11.81	64.55	---	---	Peak
5	9728.00	47.99	-32.01	80.00	61.83	38.77	12.14	64.75	100	0	Peak
6	11130.00	46.59	-33.41	80.00	57.56	39.54	13.32	63.83	---	---	Peak



Test Engineer :	Chas Yeh	Temperature :	22~26°C
		Relative Humidity :	51~52%
Test Distance :	10m	Polarization :	Vertical

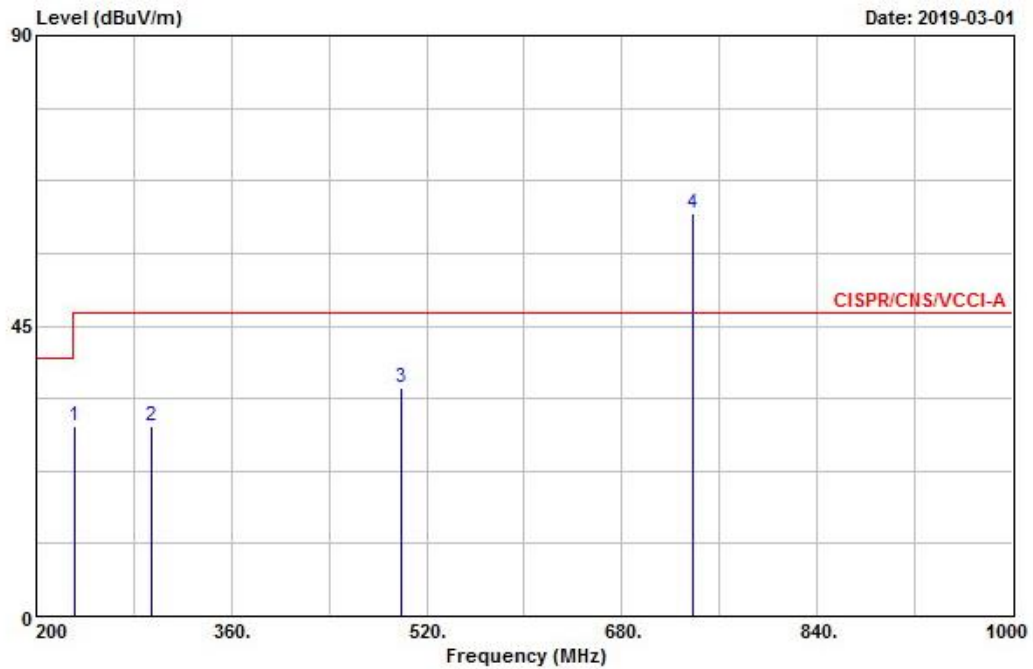


Site : OS02-NH
Condition : CISPR/CNS/VCCI-A 10m OS02-ANT-04-28-2018 VERTICAL

POWER : 120VAC
MEMO : MODE 1

	Freq	Level	Over	Limit	ReadAntenna	Cable	Preamp		Ant	Table
	MHz	dBuV/m	Limit	Line	Level	Loss	Factor	Remark	Pos	Pos
			dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg
1	30.260	36.62	-3.38	40.00	40.30	23.19	0.50	27.37 QP	---	---
2	43.700	36.24	-3.76	40.00	47.20	15.75	0.64	27.35 QP	---	---
3	125.150	29.86	-10.14	40.00	38.98	16.89	1.11	27.12 Peak	---	---
4	163.730	38.24	-1.76	40.00	48.90	14.92	1.37	26.95 QP	100	249

Test Engineer :	Chas Yeh	Temperature :	22~26°C
		Relative Humidity :	51~52%
Test Distance :	10m	Polarization :	Vertical
Remark :	#4 is system simulator signal which can be ignored.		



Site : OS02-NH
Condition : CISPR/CNS/VCCI-A 10m OS02-ANT-04-28-2018 VERTICAL

POWER : 120VAC

MEMO : MODE 1

: Freq. 737.5MHz is LTE Band 12 Signal

	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamplifier Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	231.200	29.37	-17.63	47.00	38.32	16.12	1.67	26.74	Peak	---	---
2	294.400	29.43	-17.57	47.00	35.90	18.12	2.04	26.63	Peak	---	---
3	499.200	35.54	-11.46	47.00	38.24	22.42	2.86	27.98	Peak	---	---
4	737.500	62.54			62.71	24.33	3.58	28.08	Peak	---	---

