

3.9 AC Conducted Emission Measurement

3.9.1 Limit 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 (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

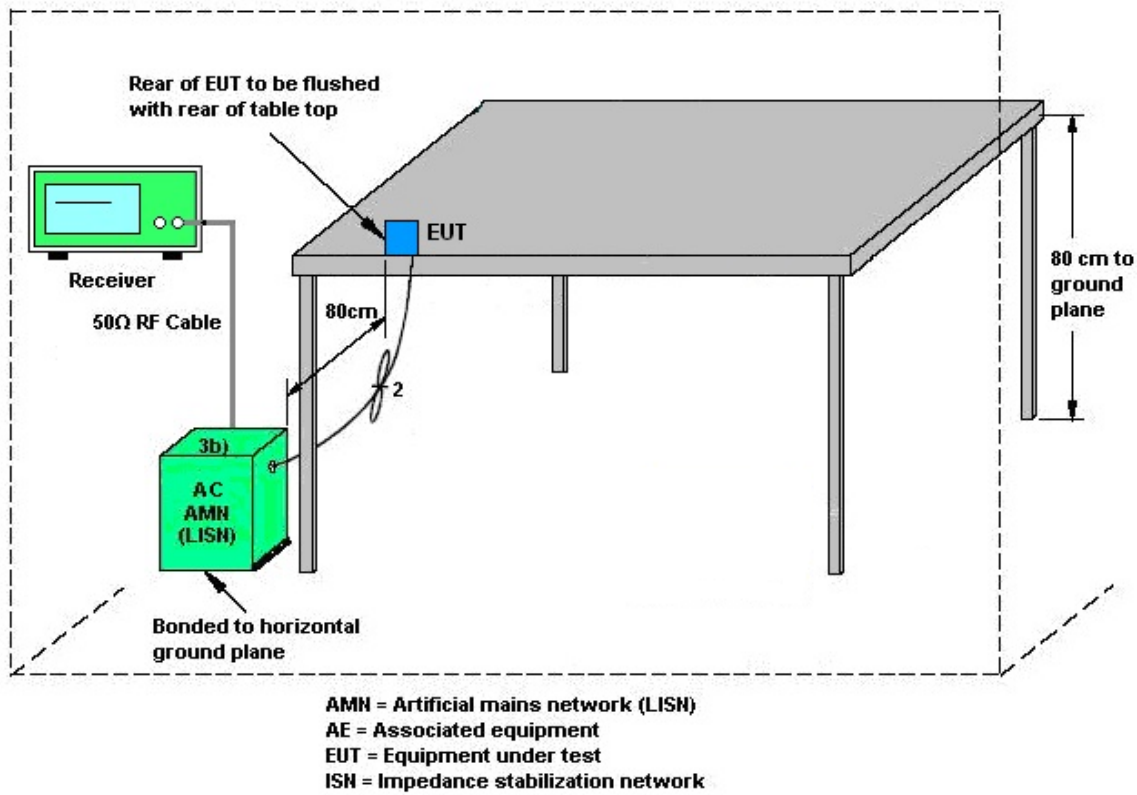
3.9.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.9.3 Test Procedures

9. 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.
10. Connect EUT to the power mains through a line impedance stabilization network (LISN).
11. All the support units are connecting to the other LISN.
12. The LISN provides 50 ohm coupling impedance for the measuring instrument.
13. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
14. Both sides of AC line were checked for maximum conducted interference.
15. The frequency range from 150 kHz to 30 MHz was searched.
16. 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.

3.9.4 Test Setup



3.9.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



3.10 Antenna Requirements

3.10.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power 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.

3.10.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.10.3 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	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Nov. 01, 2020	Nov. 03, 2020~ Jan. 04, 2022	Oct. 31, 2021	Conducted (TH01-KS)
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 14, 2021		Oct. 13, 2022	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 08, 2020	Nov. 03, 2020~ Jan. 04, 2022	Jan. 07, 2021	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 06, 2021		Jan. 05, 2022	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 08, 2020	Nov. 03, 2020~ Jan. 04, 2022	Jan. 07, 2021	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 06, 2021		Jan. 05, 2022	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz; Max 30dBm	Oct. 17, 2020	May 27, 2021	Oct. 16, 2021	Radiation (03CH04-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150208	10Hz~44GHz	Apr. 12, 2021	May 27, 2021	Apr. 11, 2022	Radiation (03CH04-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Nov. 01, 2020	May 27, 2021	Oct. 31, 2021	Radiation (03CH04-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz~1GHz	May 29, 2020	May 27, 2021	May 28, 2021	Radiation (03CH04-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 25, 2021	May 27, 2021	Apr. 24, 2022	Radiation (03CH04-KS)
Amplifier	SONOMA	310N	187289	9KHz ~1GHZ	Apr. 12, 2021	May 27, 2021	Apr. 11, 2022	Radiation (03CH04-KS)
high gain Amplifier	MITEQ	AMF-7D-0010 1800-30-10P	2025788	1Ghz-18Ghz	Jan. 06, 2021	May 27, 2021	Jan. 05, 2022	Radiation (03CH04-KS)
Amplifier	Keysight	83017A	MY53270203	500MHz~26.5GHz	Apr. 13, 2021	May 27, 2021	Apr. 12, 2022	Radiation (03CH04-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	May 27, 2021	NCR	Radiation (03CH04-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	May 27, 2021	NCR	Radiation (03CH04-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	May 27, 2021	NCR	Radiation (03CH04-KS)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz; Max 30dBm	Oct. 16, 2021	Mar. 23, 2022	Oct. 15, 2022	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150208	10Hz~44GHz	Apr. 12, 2021	Mar. 23, 2022	Apr. 11, 2022	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 30, 2021	Mar. 23, 2022	Oct. 29, 2022	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz~1GHz	May 27, 2021	Mar. 23, 2022	May 26, 2022	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 25, 2021	Mar. 23, 2022	Apr. 24, 2022	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	187289	9KHz ~1GHZ	Apr. 12, 2021	Mar. 23, 2022	Apr. 11, 2022	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-0010 1800-30-10P	2025788	1Ghz-18Ghz	Jul. 30, 2021	Mar. 23, 2022	Jul. 29, 2022	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270203	500MHz~26.5GHz	Apr. 13, 2021	Mar. 23, 2022	Apr. 12, 2022	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Mar. 23, 2022	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Mar. 23, 2022	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Mar. 23, 2022	NCR	Radiation (03CH06-KS)
EMI Receiver	R&S	ESC17	100768	9kHz~7GHz;	Apr. 21, 2021	Jan. 05, 2022	Apr. 20, 2022	Conduction (CO01-KS)



AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 14, 2021	Jan. 05, 2022	Oct. 13, 2022	Conduction (CO01-KS)
AC LISN	R&S	ENV216	100334	9kHz~30MHz	Oct. 14, 2021	Jan. 05, 2022	Oct. 13, 2022	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP00000 0811	AC 0V~300V, 45Hz~1000Hz	Oct. 14, 2021	Jan. 05, 2022	Oct. 13, 2022	Conduction (CO01-KS)

NCR: No Calibration Required.

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage $K=2$ to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.94dB
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For 03CH04-KS

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.0dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.0dB
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For 03CH06-KS

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.0dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.0dB
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Appendix A. Conducted Test Results

LoRa-FHSS-Spreading Factor 7

Test Engineer:	Aly Cao	Temperature:	20~26	°C
Test Date:	2020/11/3~2020/11/4	Relative Humidity:	40~51	%

TEST RESULTS DATA**20dB and 99% Occupied Bandwidth and Hopping Channel Separation**

Mod.	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
SF7	1	1	902.2	0.146	0.129	0.273	0.146	Pass
SF7	1	65	915	0.148	0.130	0.267	0.148	Pass
SF7	1	129	927.8	0.147	0.130	0.207	0.147	Pass

TEST RESULTS DATA**Dwell Time**

Mod.	CH.	DT On-time per hop (ms)	Total hops over 20sec	Dwell Time (sec)	Limits (sec)	Pass/Fail
SF7	hopping	282.443	1.00	0.28	0.4	Pass

TEST RESULTS DATA**Peak Power Table**

mode	Freq. (MHz)	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
SF7	902.2	1	26.73	30.00	Pass
	915	1	26.59	30.00	Pass
	927.8	1	26.46	30.00	Pass

TEST RESULTS DATA**Number of Hopping Frequency**

Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
129	> 50	Pass

LoRa-FHSS-Spreading Factor 8

Test Engineer:	Aly Cao	Temperature:	20~26	°C
Test Date:	2022/1/4	Relative Humidity:	40~51	%

TEST RESULTS DATA**20dB and 99% Occupied Bandwidth and Hopping Channel Separation**

Mod.	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
SF8	1	1	902.2	0.151	0.132	0.224	0.151	Pass
SF8	1	65	915	0.153	0.131	0.229	0.153	Pass
SF8	1	129	927.8	0.153	0.132	0.280	0.153	Pass

TEST RESULTS DATA**Dwell Time**

Mod.	CH.	DT On-time per hop (ms)	Total hops over 20sec	Dwell Time (sec)	Limits (sec)	Pass/Fail
SF8	hopping	294.01	1.00	0.29	0.4	Pass

TEST RESULTS DATA**Peak Power Table**

mode	Freq. (MHz)	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
SF8	902.2	1	26.63	30.00	Pass
	915	1	26.31	30.00	Pass
	927.8	1	26.12	30.00	Pass

TEST RESULTS DATA**Number of Hopping Frequency**

Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
129	> 50	Pass

LoRa-FHSS-Spreading Factor 9

Test Engineer:	Aly Cao	Temperature:	20~26	°C
Test Date:	2020/11/3~2020/11/4	Relative Humidity:	40~51	%

TEST RESULTS DATA**20dB and 99% Occupied Bandwidth and Hopping Channel Separation**

Mod.	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
SF9	1	1	902.2	0.147	0.131	0.252	0.147	Pass
SF9	1	65	915	0.147	0.130	0.203	0.147	Pass
SF9	1	129	927.8	0.147	0.130	0.252	0.147	Pass

TEST RESULTS DATA**Dwell Time**

Mod.	CH.	DT On-time per hop (ms)	Total hops over 20sec	Dwell Time (sec)	Limits (sec)	Pass/Fail
SF9	hopping	167.772	1.00	0.17	0.4	Pass

TEST RESULTS DATA**Peak Power Table**

DH	Freq. (MHz)	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
SF9	902.2	1	26.64	30.00	Pass
	915	1	26.65	30.00	Pass
	927.8	1	25.71	30.00	Pass

TEST RESULTS DATA**Number of Hopping Frequency**

Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
129	> 50	Pass

LoRa-FHSS-Spreading Factor 10

Test Engineer:	Aly Cao	Temperature:	20~26	°C
Test Date:	2020/11/3~2020/11/4	Relative Humidity:	40~51	%

TEST RESULTS DATA**20dB and 99% Occupied Bandwidth and Hopping Channel Separation**

Mod.	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
SF10	1	1	902.2	0.148	0.132	0.247	0.148	Pass
SF10	1	65	915	0.147	0.132	0.222	0.147	Pass
SF10	1	129	927.8	0.148	0.132	0.234	0.148	Pass

TEST RESULTS DATA**Dwell Time**

Mod.	CH.	DT On-time per hop (ms)	Total hops over 20sec	Dwell Time (sec)	Limits (sec)	Pass/Fail
SF10	hopping	345.778	1.00	0.35	0.4	Pass

TEST RESULTS DATA**Peak Power Table**

DH	Freq. (MHz)	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
SF10	902.2	1	26.71	30.00	Pass
	915	1	26.64	30.00	Pass
	927.8	1	25.76	30.00	Pass

TEST RESULTS DATA**Number of Hopping Frequency**

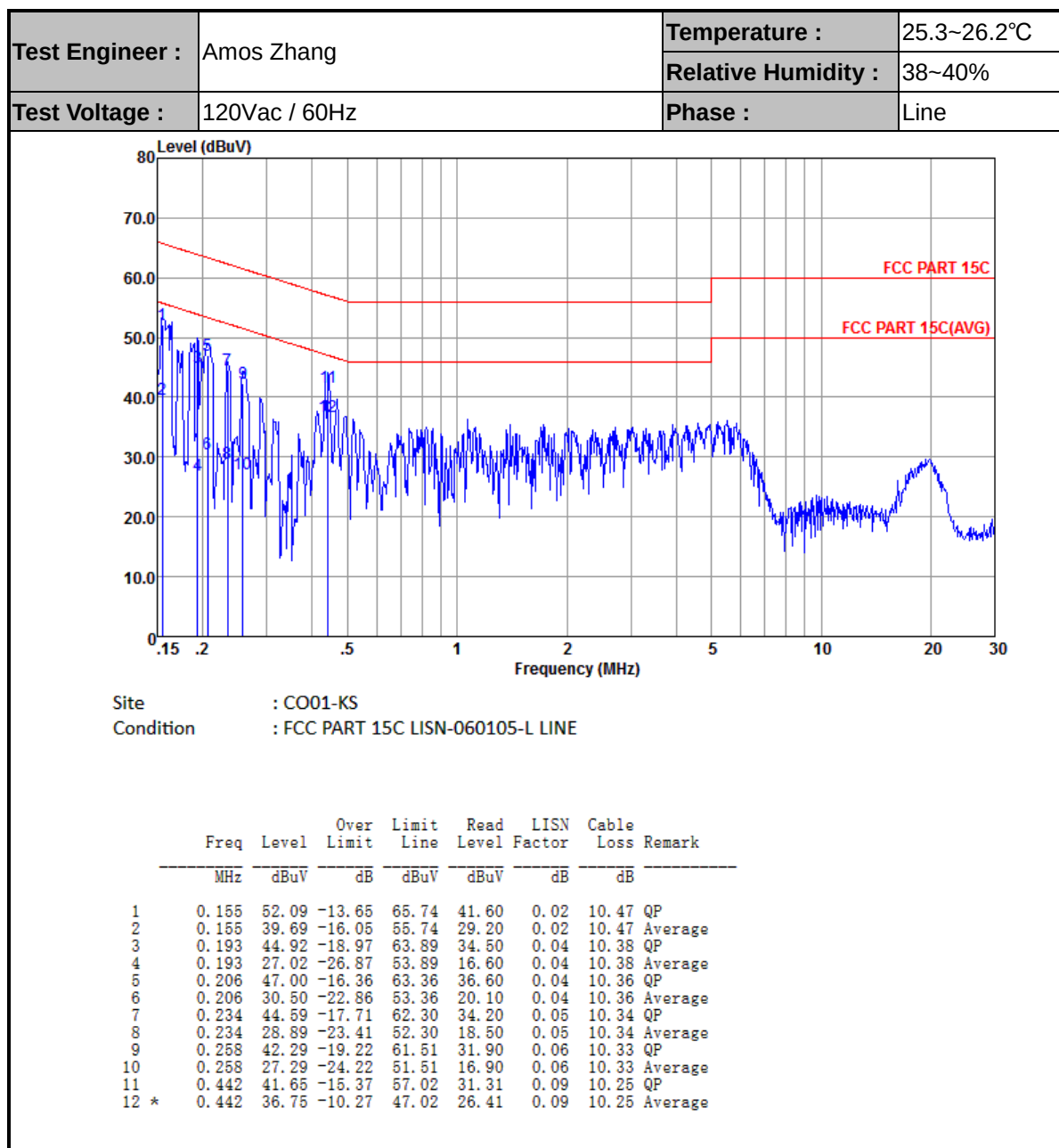
Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
129	> 50	Pass

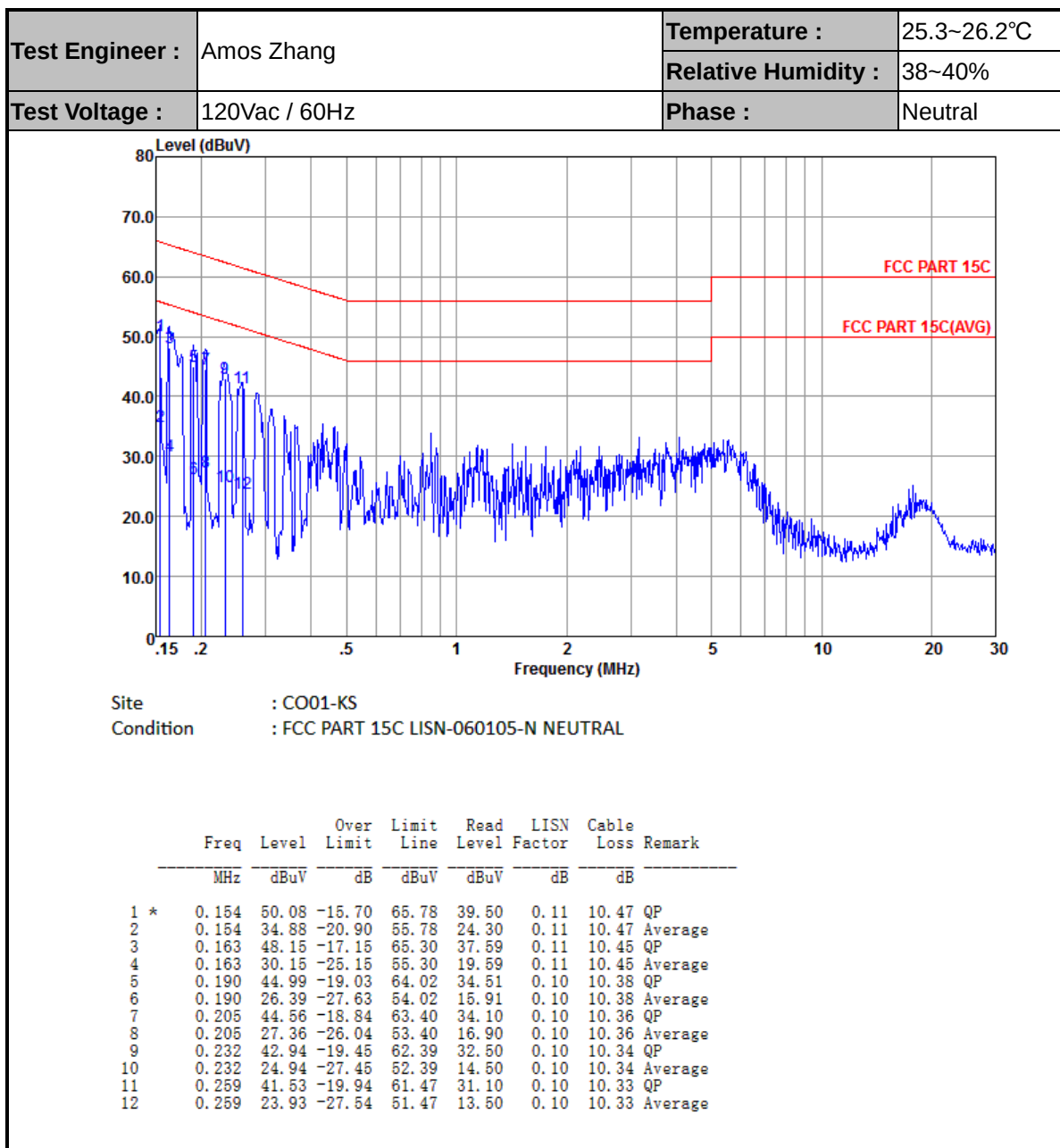
Power Setting Table Summary (for reference only)

Modulation type	LR1110 power setting
LoRa DTS 500KHz SF5	-11
LoRa DTS 500KHz SF7	0
LoRa DTS 500KHz SF8	0
LoRa DTS 500KHz SF9	0
LoRa DTS 500KHz SF10	0
LoRa DTS 500KHz SF11	0
LoRa FHSS 125KHz SF7	0
LoRa FHSS 125KHz SF8	0
LoRa FHSS 125KHz SF9	0
LoRa FHSS 125KHz SF10	0
FSK 50kbps	0
FSK 150kbps	0
FSK 250kbps	0



Appendix B. AC Conducted Emission Test Results





Note:

1. $\text{Level(dBuV)} = \text{Read Level(dBuV)} + \text{LISN Factor(dB)} + \text{Cable Loss(dB)}$
2. $\text{Over Limit(dB)} = \text{Level(dBuV)} - \text{Limit Line(dBuV)}$



Appendix C. Radiated Spurious Emission

LoRa FHSS SF=7 (Band Edge @ 3m)

LoRa FHSS	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable 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)
902.2MHz		870.02	43.15	-50.95	94.1	41.85	29.24	4.32	32.26	100	18	P	H
		902.03	114.1	-	-	112.55	29.36	4.39	32.2	100	18	P	H
		934.04	45.43	-48.67	94.1	42.76	30.33	4.47	32.13	100	18	P	H
		870.02	38.71	-47.71	86.42	37.41	29.24	4.32	32.26	167	130	P	V
		902.03	106.42	-	-	104.87	29.36	4.39	32.2	167	130	P	V
		964	39.53	-46.89	86.42	36.31	30.77	4.53	32.08	167	130	P	V
915MHz		882.63	39.21	-54.88	94.09	37.83	29.27	4.34	32.23	287	170	P	H
		914.64	114.09	-	-	112.1	29.74	4.42	32.17	287	170	P	H
		946.65	46.35	-47.74	94.09	43.25	30.71	4.5	32.11	287	170	P	H
		914.64	107.06	-	-	105.07	29.74	4.42	32.17	164	298	P	V
		946.65	40.87	-46.19	87.06	37.77	30.71	4.5	32.11	164	298	P	V
927.8MHz		895.24	42.21	-54.73	96.94	40.76	29.29	4.37	32.21	100	343	P	H
		928.22	116.94	-	-	114.48	30.15	4.45	32.14	100	343	P	H
		959.26	45.9	-51.04	96.94	42.69	30.76	4.53	32.08	100	343	P	H
		895.24	37.4	-52.26	89.66	35.95	29.29	4.37	32.21	155	133	P	V
		928.22	109.66	-	-	107.2	30.15	4.45	32.14	155	133	P	V
		959.26	43.91	-45.75	89.66	40.7	30.76	4.53	32.08	155	133	P	V
Remark	1. No other spurious found.												
	2. All results are PASS against Peak and Average limit line.												
	3. Non-restricted band limit is 100kHz-PSD down 20dB.												



LoRa FHSS SF=7 (Harmonic @ 3m)

LoRa FHSS	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamplifier 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)
902.2MHz		1801	47.87	-46.23	94.1	77.27	27.98	6.27	63.65	300	0	P	H
		1801	41.71	-44.71	86.42	71.11	27.98	6.27	63.65	300	360	P	V
915MHz		1828	51.02	-43.07	94.09	80.2	28.15	6.31	63.64	100	360	P	H
		1828	44.73	-42.33	87.06	73.91	28.15	6.31	63.64	300	0	P	V
		9154	47.68	-26.32	74	59.76	37.53	14.3	63.91	300	0	P	V
927.8MHz		1855	57.81	-39.13	96.94	86.87	28.23	6.34	63.63	300	360	P	H
		8353	46.77	-27.23	74	60.25	36.51	13.63	63.62	300	360	P	H
		9280	48.2	-48.74	96.94	60.3	37.56	14.39	64.05	300	360	P	H
		1855	50.62	-39.04	89.66	79.68	28.23	6.34	63.63	100	360	P	V
		9280	48.48	-41.18	89.66	60.58	37.56	14.39	64.05	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. Non-restricted band limit is 100kHz-PSD down 20dB.												



LORA FHSS SF=8 (Band Edge @ 3m)

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable 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)
902.2MHz		609.09	31.96	-14.04	46	36.44	25.14	3.66	33.28	100	360	P	H
		902.03	110.45	-	-	111.61	26.72	4.49	32.37	100	360	P	H
		612.97	32.46	-13.54	46	36.49	25.6	3.66	33.29	100	0	P	V
		902.03	110.29	-	-	110.75	27.42	4.49	32.37	100	0	P	V
915MHz		610.06	32.05	-13.95	46	36.53	25.14	3.66	33.28	100	0	P	H
		914.64	111	-	-	111.87	26.85	4.51	32.23	100	0	P	H
		609.09	32.06	-13.94	46	36.11	25.57	3.66	33.28	100	0	P	V
		914.64	109.25	-	-	109.42	27.55	4.51	32.23	100	0	P	V
927.8MHz		612	32.28	-13.72	46	39.6	25.96	0	33.28	100	360	P	H
		928.22	113.63	-	-	115.54	30.18	0	32.09	100	360	P	H
		608.12	32.2	-13.8	46	39.57	25.91	0	33.28	100	360	P	V
		928.22	112.22	-	-	114.13	30.18	0	32.09	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



LORA FHSS SF=8 (Harmonic @ 3m)

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable 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)
902.2MHz		1801	54.89	-35.56	90.45	82.67	30.6	6.34	64.72	100	360	P	H
		2710	46.5	-27.5	74	71.41	32.3	7.89	65.1	100	360	P	H
		9019	48.48	-25.52	74	63.13	36.51	14.89	66.05	100	360	P	H
		1801	52.79	-32.5	90.29	80.57	30.6	6.34	64.72	100	0	P	V
		2710	43.54	-30.46	74	68.45	32.3	7.89	65.1	100	0	P	V
915MHz		1833	60.55	-30.45	91	88.09	30.78	6.4	64.72	300	0	P	H
		2742.5	45.57	-28.43	74	70.44	32.3	7.93	65.1	300	0	P	H
		9151.5	50.61	-23.39	74	64.85	36.59	15.25	66.08	300	0	P	H
		1833	53	-36.25	89.25	80.54	30.78	6.4	64.72	300	360	P	V
		2742.5	40.8	-33.2	74	65.67	32.3	7.93	65.1	300	360	P	V
		9151.5	50.66	-23.34	74	64.9	36.59	15.25	66.08	300	360	P	V
927.8MHz		1855	66.94	-26.69	93.63	94.35	30.88	6.43	64.72	300	0	P	H
		2782	47.83	-26.17	74	72.63	32.3	8.02	65.12	300	0	P	H
		9280	48.88	-44.75	93.63	62.87	36.67	15.45	66.11	300	0	P	H
		1855	65.34	-26.88	92.22	92.75	30.88	6.43	64.72	100	0	P	V
		2782	44.78	-29.22	74	69.58	32.3	8.02	65.12	100	0	P	V
		9280	48.19	-44.03	92.22	62.18	36.67	15.45	66.11	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



LoRa FHSS SF=9 (Band Edge @ 3m)

LoRa FHSS	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable 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)
902.2MHz		870.02	44.44	-49.94	94.38	43.14	29.24	4.32	32.26	100	183	P	H
		902.03	114.38	-	-	112.83	29.36	4.39	32.2	100	183	P	H
		934.04	45.8	-48.58	94.38	43.13	30.33	4.47	32.13	100	183	P	H
		870.02	38.56	-47.84	86.4	37.26	29.24	4.32	32.26	172	285	P	V
		902.03	106.4	-	-	104.85	29.36	4.39	32.2	172	285	P	V
		934.04	38.43	-47.97	86.4	35.76	30.33	4.47	32.13	172	285	P	V
915MHz		882.63	41.3	-54.8	96.1	39.92	29.27	4.34	32.23	164	355	P	H
		914.64	116.1	-	-	114.11	29.74	4.42	32.17	164	355	P	H
		946.65	46.16	-49.94	96.1	43.06	30.71	4.5	32.11	164	355	P	H
		914.64	108.22	-	-	106.23	29.74	4.42	32.17	270	111	P	V
		946.65	41.82	-46.4	88.22	38.72	30.71	4.5	32.11	270	111	P	V
927.8MHz		895.24	42.86	-54.64	97.5	41.41	29.29	4.37	32.21	100	355	P	H
		928.22	117.5	-	-	115.04	30.15	4.45	32.14	100	355	P	H
		959.26	45.68	-51.82	97.5	42.47	30.76	4.53	32.08	100	355	P	H
		895.24	38.87	-52.06	90.93	37.42	29.29	4.37	32.21	160	96	P	V
		928.22	110.93	-	-	108.47	30.15	4.45	32.14	160	96	P	V
		959.26	44.34	-46.59	90.93	41.13	30.76	4.53	32.08	160	96	P	V
Remark	1. No other spurious found.												
	2. All results are PASS against Peak and Average limit line.												
	3. Non-restricted band limit is 100kHz-PSD down 20dB.												



LoRa FHSS SF=9 (Harmonic @ 3m)

LoRa FHSS	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamplifier 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)
902.2MHz		1801	47.51	-46.87	94.38	76.91	27.98	6.27	63.65	300	0	P	H
		2710	42.35	-31.65	74	64.57	32.54	7.71	62.47	300	0	P	H
		1801	40.77	-45.63	86.4	70.17	27.98	6.27	63.65	100	0	P	V
915MHz		1828	54.31	-41.79	96.1	83.49	28.15	6.31	63.64	100	360	P	H
		8236	46.63	-27.37	74	60.14	36.61	13.64	63.76	100	360	P	H
		1828	47.28	-40.94	88.22	76.46	28.15	6.31	63.64	300	360	P	V
		8236	46.14	-27.86	74	59.65	36.61	13.64	63.76	300	360	P	V
927.8MHz		1855	62.12	-35.38	97.5	91.18	28.23	6.34	63.63	100	360	P	H
		2782	43.27	-30.73	74	65.3	32.59	7.83	62.45	100	360	P	H
		8353	46.93	-27.07	74	60.41	36.51	13.63	63.62	100	360	P	H
		1855	54.74	-36.19	90.93	83.8	28.23	6.34	63.63	100	360	P	V
		8353	46.89	-27.11	74	60.37	36.51	13.63	63.62	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. Non-restricted band limit is 100kHz-PSD down 20dB.												



LoRa FHSS SF=10 (Band Edge @ 3m)

LoRa FHSS	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable 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)
902.2MHz		870.02	44.34	-50.54	94.88	43.04	29.24	4.32	32.26	100	187	P	H
		902.03	114.88	-	-	113.33	29.36	4.39	32.2	100	187	P	H
		934.04	46.58	-48.3	94.88	43.91	30.33	4.47	32.13	100	187	P	H
		870.02	38.14	-48.92	87.06	36.84	29.24	4.32	32.26	170	286	P	V
		902.03	107.06	-	-	105.51	29.36	4.39	32.2	170	286	P	V
		934.04	39.58	-47.48	87.06	36.91	30.33	4.47	32.13	170	286	P	V
915MHz		882.63	40.81	-55.19	96	39.43	29.27	4.34	32.23	170	350	P	H
		914.64	116	-	-	114.01	29.74	4.42	32.17	170	350	P	H
		946.65	45.16	-50.84	96	42.06	30.71	4.5	32.11	170	350	P	H
		914.64	108.11	-	-	106.12	29.74	4.42	32.17	160	108	P	V
		946.65	42.95	-45.16	88.11	39.85	30.71	4.5	32.11	160	108	P	V
927.8MH		895.24	42.02	-55.04	97.06	40.57	29.29	4.37	32.21	100	332	P	H
		928.22	117.06	-	-	114.6	30.15	4.45	32.14	100	332	P	H
		959.26	44.79	-52.27	97.06	41.58	30.76	4.53	32.08	100	332	P	H
		895.24	37.6	-53.22	90.82	36.15	29.29	4.37	32.21	155	129	P	V
		928.22	110.82	-	-	108.36	30.15	4.45	32.14	155	129	P	V
		959.26	44.22	-46.6	90.82	41.01	30.76	4.53	32.08	155	129	P	V
Remark	1. No other spurious found.												
	2. All results are PASS against Peak and Average limit line.												
	3. Non-restricted band limit is 100kHz-PSD down 20dB.												



LoRa FHSS SF=10 (Harmonic @ 3m)

LoRa FHSS	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamplifier 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)
902.2MHz		1801	50.58	-44.3	94.88	79.98	27.98	6.27	63.65	100	360	P	H
		1801	43.58	-43.48	87.06	72.98	27.98	6.27	63.65	300	360	P	V
915MHz		1828	54.61	-41.39	96	83.79	28.15	6.31	63.64	100	360	P	H
		1828	47.41	-40.7	88.11	76.59	28.15	6.31	63.64	300	360	P	V
927.8MHz		1855	61.29	-35.77	97.06	90.35	28.23	6.34	63.63	300	360	P	H
		2782	43.99	-30.01	74	66.02	32.59	7.83	62.45	300	360	P	H
		1855	55.49	-35.33	90.82	84.55	28.23	6.34	63.63	300	360	P	V
		8353	47.79	-26.21	74	61.27	36.51	13.63	63.62	300	360	P	V
		9280	47.65	-43.17	90.82	59.75	37.56	14.39	64.05	300	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. Non-restricted band limit is 100kHz-PSD down 20dB.												



Emission below 1GHz

FHSS SF=8(LF)

LoRa FHSS	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
FHSS SF=8 LF		30	24.14	-15.86	40	33.56	23	0.68	33.1	-	-	P	H
		157.07	19.87	-23.63	43.5	34.04	17	1.82	32.99	-	-	P	H
		256.98	22.35	-23.65	46	34.09	18.7	2.35	32.79	-	-	P	H
		483.96	28.72	-17.28	46	34.11	23.77	3.24	32.4	-	-	P	H
		736.16	35.21	-10.79	46	35.87	27.93	3.98	32.57	-	-	P	H
		812.79	36.86	-9.14	46	36.31	28.53	4.17	32.15	100	332	P	H
		31.94	22.8	-17.2	40	32.66	22.48	0.72	33.06	-	-	P	V
		43.58	22.7	-17.3	40	37.26	17.6	0.94	33.1	-	-	P	V
		491.72	29.57	-16.43	46	34.83	23.93	3.26	32.45	-	-	P	V
		620.73	33.28	-12.72	46	36.08	26.25	3.67	32.72	-	-	P	V
		726.46	33.88	-12.12	46	34.88	27.6	3.95	32.55	-	-	P	V
		850.62	35.45	-10.55	46	34.28	29.2	4.27	32.3	155	129	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												



For co-location:

LORA FHSS SF=8 + BLE (Band Edge @ 3m)

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable 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)
BLE CH 39 2480MHz		2483.62	59.01	-14.99	74	49.23	32.12	8.33	30.67	126	18	P	H
		2483.5	48.71	-5.29	54	38.93	32.12	8.33	30.67	126	18	A	H
		2480	98.95	-	-	89.19	32.12	8.31	30.67	126	18	P	H
		2480	97.71	-	-	87.95	32.12	8.31	30.67	126	18	A	H
		2483.56	58.42	-15.58	74	48.64	32.12	8.33	30.67	345	107	P	V
		2483.56	48.38	-5.62	54	38.6	32.12	8.33	30.67	345	107	A	V
		2480	97.12	-	-	87.36	32.12	8.31	30.67	345	107	P	V
		2480	95.8	-	-	86.04	32.12	8.31	30.67	345	107	A	V
915MHz		610.06	34.05	-11.95	46	38.53	25.14	3.66	33.28	100	0	P	H
		915.61	111.26	-	-	112.1	26.86	4.52	32.22	100	0	P	H
		609.09	31.06	-14.94	46	35.11	25.57	3.66	33.28	100	0	P	V
		915.61	108.09	-	-	108.23	27.56	4.52	32.22	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



LORA FHSS SF=8 + BLE (Harmonic @ 3m)

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable 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)
BLE CH 39 2480MHz		4965	40.19	-33.81	74	60.65	34.1	10.89	65.45	300	0	P	H
		7440	43.13	-30.87	74	59.11	35.8	13.55	65.33	300	0	P	H
		4965	40.44	-33.56	74	60.9	34.1	10.89	65.45	100	0	P	V
		7440	43.51	-30.49	74	59.49	35.8	13.55	65.33	100	0	P	V
915MHz		1833	64.21	-27.05	91.26	91.75	30.78	6.4	64.72	100	0	P	H
		2742	39.55	-34.45	74	64.42	32.3	7.93	65.1	100	0	P	H
		2742	39.55	-14.45	54	64.42	32.3	7.93	65.1	100	0	A	H
		1833	64.15	-23.94	88.09	91.69	30.78	6.4	64.72	300	0	P	V
		2742.5	40.27	-33.73	74	65.14	32.3	7.93	65.1	300	0	P	V
		2742.5	40.27	-13.73	54	65.14	32.3	7.93	65.1	300	0	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



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)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11b CH 01		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
2412MHz		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable 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) + Cable 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”.