

FCC Test Report

FCC ID : MXF-WAPD246ACN
Equipment : WAPD-246ACN_LoRa gateway
Model No. : WAPD-246ACN
Brand Name : Gemtek
Applicant : Gemtek Technology Co., Ltd.
Address : No.15-1 Zhonghua Road, Hsinchu Industrial
Park, Hukou, Hsinchu, Taiwan, 30352
Standard : 47 CFR FCC Part 15.247
Received Date : Jul. 26, 2017
Tested Date : Jul. 26 ~ Aug. 23, 2017

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:


Along Chen / Assistant Manager

Approved by:


Gary Chang / Manager



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Release Record

Report No.	Version	Description	Issued Date
FR780201	Rev. 01	Initial issue	Sep. 06, 2017

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	[dBuV]: 0.476MHz 43.38 (Margin -3.03dB) - AV	Pass
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 35.44MHz 38.98 (Margin -1.02dB) - QP	Pass
15.247(b)(3)	Maximum Output Power	Max Power [dBm]: 28.90	Pass
15.247(a)(2)	6dB Bandwidth	Meet the requirement of limit	Pass
15.247(e)	Power Spectral Density	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information					
Frequency Range (MHz)	Ch. Freq. (MHz)	Channel Number	Data Rate (bit/sec)	Spread Factor	Channel Bandwidth (kHz)
902 ~ 928	923.3 ~ 927.5	73 ~ 80 [8]	980 ~ 21900	12 ~ 7	500
Note 1: RF output power specifies that Maximum Conducted (Average) Output Power. Note 2: The device uses CSS modulation. Note 3: The device contains 2 same Lora cards. Both Lora cards can transmit simultaneously but different channel					

1.1.2 Antenna Details

Ant. No.	Type	Connector	Gain (dBi)	Remark
1	Dipole	N type	0	---

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	55Vdc from POE
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1.1.4 Accessories

N/A

1.1.5 Channel List

Channel	Frequency(MHz)
73	923.3
74	923.9
75	924.5
76	925.1
77	925.7
78	926.3
79	926.9
80	927.5

1.1.6 Test Tool and Duty Cycle

Test Tool	Putty, version: 0.6	
Duty Cycle and Duty Factor	Duty Cycle (%)	Duty Factor (dB)
	100%	0

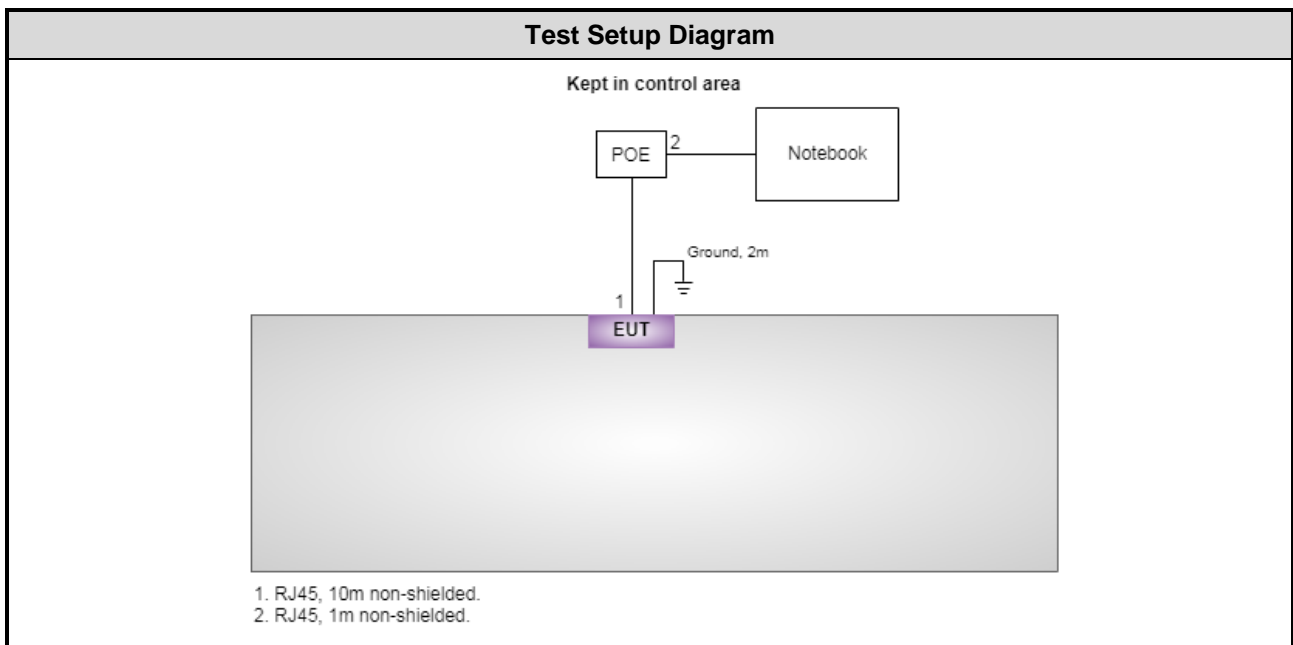
1.1.7 Power Setting

Modulation Mode	Test Frequency (MHz)	
	923.3	927.5
CSS	pa 3 --dig 0 --mix 13	pa 3 --dig 0 --mix 13

1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Signal cable / Length (m)
1	Notebook	DELL	Latitude E6430	DoC	USB, 1m non-shielded.

1.3 Test Setup Chart



1.4 The Equipment List

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Tested Date	Aug. 22, 2017				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101657	Dec. 21, 2016	Dec. 20, 2017
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 08, 2016	Nov. 07, 2017
RF Cable-CON	EMC	EMCCFD300-BM-B M-6000	50821	Dec. 20, 2016	Dec. 19, 2017
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Tested Date	Jul. 26, 2017				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101498	Nov. 25, 2016	Nov. 24, 2017
Receiver	R&S	ESR3	101658	Nov. 24, 2016	Nov. 23, 2017
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-524	Oct. 13, 2016	Oct. 12, 2017
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 21, 2016	Dec. 20, 2017
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Oct. 25, 2016	Oct. 24, 2017
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 10, 2016	Nov. 09, 2017
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Dec. 09, 2016	Dec. 08, 2017
Preamplifier	EMC	EMC02325	980146	Oct. 08, 2016	Oct. 07, 2017
Preamplifier	Agilent	83017A	MY39501308	Oct. 06, 2016	Oct. 05, 2017
Preamplifier	EMC	EMC184045B	980192	Aug. 24, 2016	Aug. 23, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Dec. 09, 2016	Dec. 08, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Dec. 09, 2016	Dec. 08, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16139/4	Dec. 09, 2016	Dec. 08, 2017
LF cable 1M	EMC	EMCCFD400-NM-N M-1000	16052	Dec. 09, 2016	Dec. 08, 2017
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Dec. 09, 2016	Dec. 08, 2017
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Dec. 09, 2016	Dec. 08, 2017
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Tested Date	Aug. 23, 2017				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101498	Nov. 25, 2016	Nov. 24, 2017
Receiver	R&S	ESR3	101658	Nov. 24, 2016	Nov. 23, 2017
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jul. 25, 2017	Jul. 24, 2018
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 21, 2016	Dec. 20, 2017
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Oct. 25, 2016	Oct. 24, 2017
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 10, 2016	Nov. 09, 2017
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Dec. 09, 2016	Dec. 08, 2017
Preamplifier	EMC	EMC02325	980225	Jul. 28, 2017	Jul. 27, 2018
Preamplifier	Agilent	83017A	MY39501308	Oct. 06, 2016	Oct. 05, 2017
Preamplifier	EMC	EMC184045B	980192	Aug. 22, 2017	Aug. 21, 2018
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Dec. 09, 2016	Dec. 08, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Dec. 09, 2016	Dec. 08, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16139/4	Dec. 09, 2016	Dec. 08, 2017
LF cable 1M	EMC	EMCCFD400-NM-N M-1000	16052	Dec. 09, 2016	Dec. 08, 2017
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Dec. 09, 2016	Dec. 08, 2017
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Dec. 09, 2016	Dec. 08, 2017
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Tested Date	Aug. 09 ~ Aug. 10, 2017				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101063	Mar. 15, 2017	Mar. 14, 2018
Power Meter	Anritsu	ML2495A	1241002	Oct. 06, 2016	Oct. 05, 2017
Power Sensor	Anritsu	MA2411B	1207366	Oct. 06, 2016	Oct. 05, 2017
DC POWER SOURCE	GW INSTRUK	GPC-6030D	EM892433	Oct. 20, 2016	Oct. 19, 2017
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.247

ANSI C63.10-2013

FCC KDB 558074 D01 DTS Meas Guidance v04

1.6 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor ($k=2$))

Measurement Uncertainty	
Parameters	Uncertainty
Bandwidth	± 34.134 Hz
Conducted power	± 0.808 dB
Power density	± 0.463 dB
Conducted emission	± 2.670 dB
AC conducted emission	± 2.90 dB
Radiated emission ≤ 1 GHz	± 3.66 dB
Radiated emission > 1 GHz	± 5.63 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
AC Conduction	CO01-WS	25°C / 60%	Howard Huang
Radiated Emissions	03CH01-WS	24°C / 60-62%	Vincent Yeh
RF Conducted	TH01-WS	23°C / 61%	Felix Sung

- FCC Designation No.: TW2732
- FCC site registration No.: 181692
- IC site registration No.: 10807A-1

2.2 The Worst Test Modes and Channel Details

Test item	Test Frequency (MHz)	Channel Bandwidth (kHz)	Modulation / SF	Test Configuration
Conducted Emissions	923.3 / 927.5 923.3 + 927.5	500	CSS / 12	1 1 + 2
Maximum Output Power 6dB Bandwidth Power Spectral Density	923.3 / 927.5	500	CSS / 12	1, 2
Radiated Emissions ≤1GHz Radiated Emissions >1GHz	923.3 / 927.5	500	CSS / 12	1
Note: 1. Two Lora card was selected to perform radiated emission test that listed as below configuration. Test Configuration 1: Lora card 0 Test Configuration 2: Lora card 1 2. Radiated emission under simultaneous transmission is evaluated and recorded in FR780201CO test report.				

3 Transmitter Test Results

3.1 Conducted Emissions

3.1.1 Limit of Conducted Emissions

Conducted Emissions Limit		
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50

Note 1: * Decreases with the logarithm of the frequency.

3.1.2 Test Procedures

1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V / 60Hz.

3.1.3 Test Setup

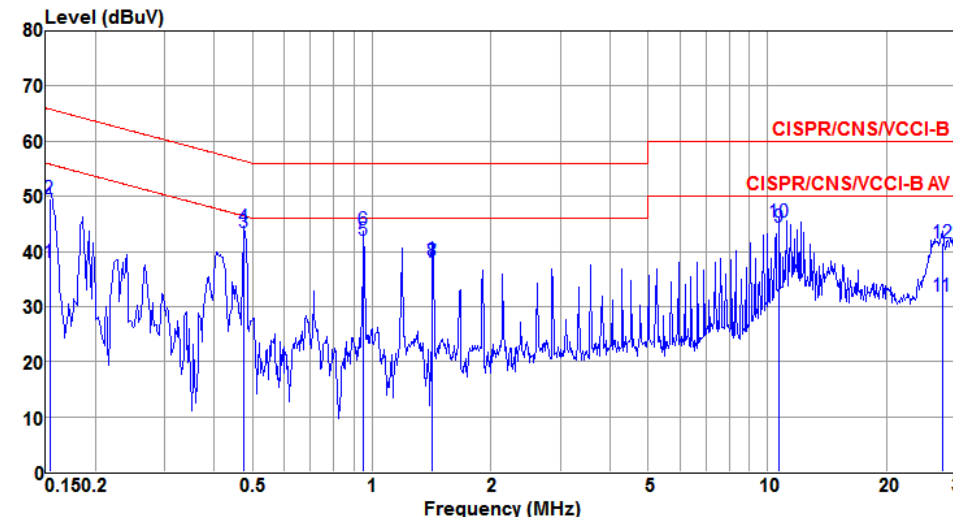


Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.1.4 Test Result of Conducted Emissions

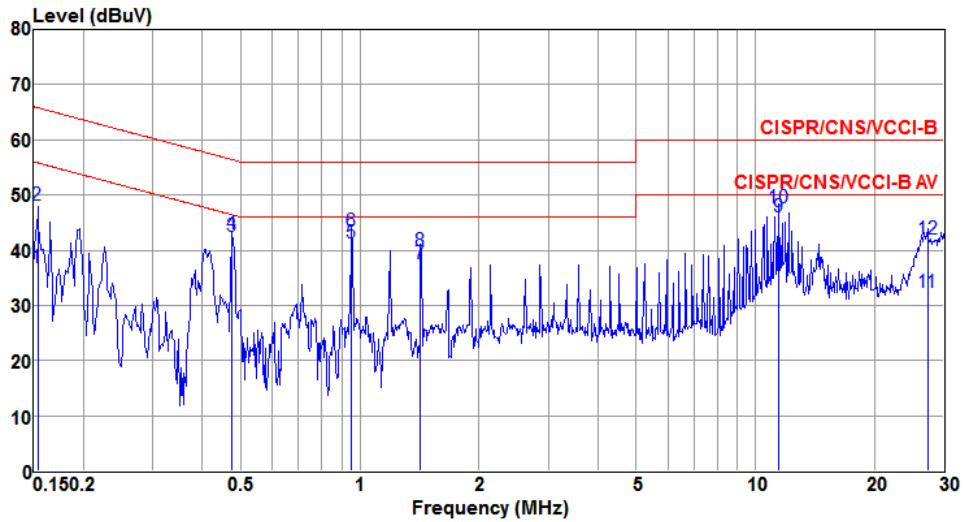
Modulation / SF	CSS / 12	Test Freq. (MHz)	923.3
Power Phase	Line		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.153	37.97	55.82	-17.85	37.86	0.07	0.04	Average
2	0.153	49.48	65.82	-16.34	49.37	0.07	0.04	QP
3	0.476	43.35	46.41	-3.06	43.25	0.06	0.04	Average
4	0.476	44.35	56.41	-12.06	44.25	0.06	0.04	QP
5	0.953	42.11	46.00	-3.89	42.00	0.07	0.04	Average
6	0.953	43.84	56.00	-12.16	43.73	0.07	0.04	QP
7	1.426	38.02	46.00	-7.98	37.88	0.10	0.04	Average
8	1.426	38.22	56.00	-17.78	38.08	0.10	0.04	QP
9	10.718	44.44	50.00	-5.56	44.00	0.22	0.22	Average
10	10.718	45.35	60.00	-14.65	44.91	0.22	0.22	QP
11	27.708	31.82	50.00	-18.18	31.06	0.44	0.32	Average
12	27.708	41.47	60.00	-18.53	40.71	0.44	0.32	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 Note 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

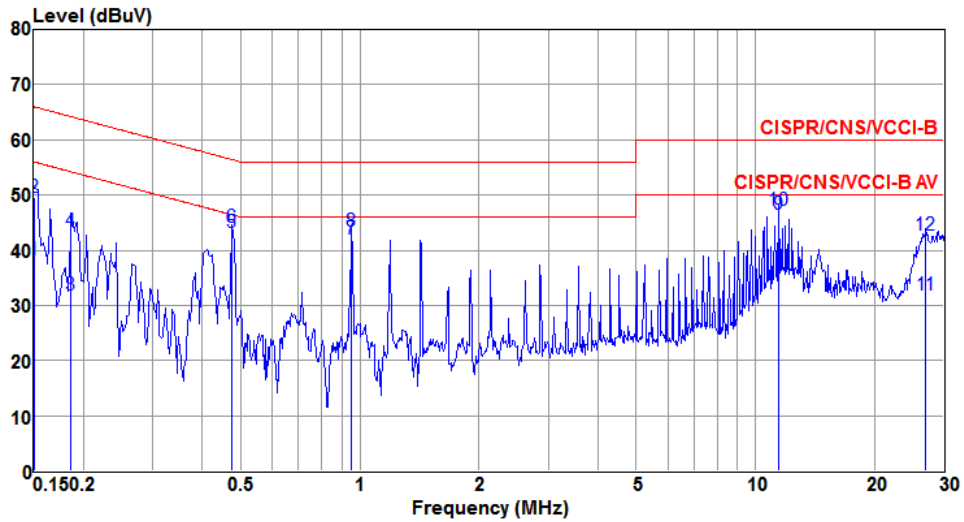
Modulation / SF	CSS / 12	Test Freq. (MHz)	923.3
Power Phase	Neutral		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.153	36.92	55.82	-18.90	36.78	0.10	0.04	Average
2	0.153	48.08	65.82	-17.74	47.94	0.10	0.04	QP
3@	0.476	42.46	46.41	-3.95	42.30	0.12	0.04	Average
4	0.476	42.95	56.41	-13.46	42.79	0.12	0.04	QP
5	0.953	41.32	46.00	-4.68	41.19	0.09	0.04	Average
6	0.953	43.43	56.00	-12.57	43.30	0.09	0.04	QP
7	1.426	37.56	46.00	-8.44	37.39	0.13	0.04	Average
8	1.426	39.87	56.00	-16.13	39.70	0.13	0.04	QP
9	11.433	45.93	50.00	-4.07	45.38	0.33	0.22	Average
10	11.433	47.68	60.00	-12.32	47.13	0.33	0.22	QP
11	27.271	32.30	50.00	-17.70	31.51	0.47	0.32	Average
12	27.271	42.07	60.00	-17.93	41.28	0.47	0.32	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

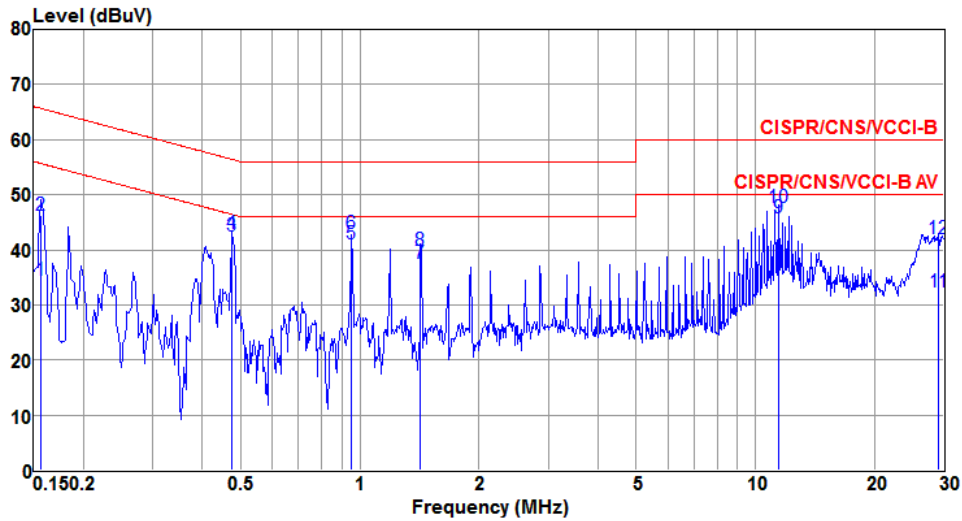
Modulation / SF	CSS / 12	Test Freq. (MHz)	927.5
Power Phase	Line		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.150	38.18	56.00	-17.82	38.07	0.07	0.04	Average
2	0.150	49.51	66.00	-16.49	49.40	0.07	0.04	QP
3	0.186	31.93	54.20	-22.27	31.80	0.09	0.04	Average
4	0.186	43.41	64.20	-20.79	43.28	0.09	0.04	QP
5	0.476	43.20	46.41	-3.21	43.10	0.06	0.04	Average
6	0.476	44.19	56.41	-12.22	44.09	0.06	0.04	QP
7	0.953	42.12	46.00	-3.88	42.01	0.07	0.04	Average
8	0.953	43.52	56.00	-12.48	43.41	0.07	0.04	QP
9	11.433	46.48	50.00	-3.52	46.02	0.24	0.22	Average
10	11.433	47.16	60.00	-12.84	46.70	0.24	0.22	QP
11	26.984	31.88	50.00	-18.12	31.13	0.44	0.31	Average
12	26.984	42.61	60.00	-17.39	41.86	0.44	0.31	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

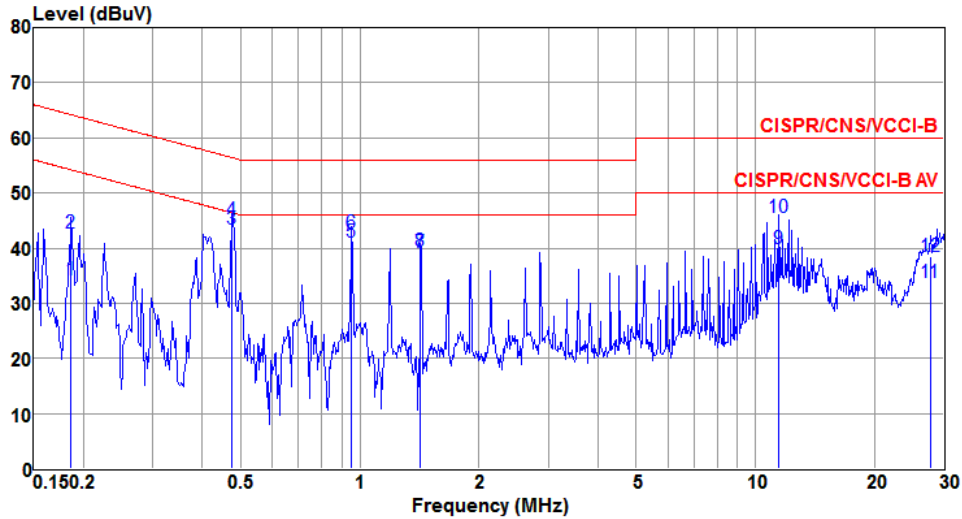
Modulation / SF	CSS / 12	Test Freq. (MHz)	927.5
Power Phase	Neutral		



	Freq	Level	Limit	Over	Read	LISN	cable	Remark
	MHz	dBuV	Line	Limit	Level	factor	loss	
			dBuV	dB	dBuV	dB	dB	
1	0.156	34.40	55.69	-21.29	34.26	0.10	0.04	Average
2	0.156	46.15	65.69	-19.54	46.01	0.10	0.04	QP
3@	0.476	42.46	46.41	-3.95	42.30	0.12	0.04	Average
4	0.476	42.99	56.41	-13.42	42.83	0.12	0.04	QP
5	0.953	41.17	46.00	-4.83	41.04	0.09	0.04	Average
6	0.953	42.96	56.00	-13.04	42.83	0.09	0.04	QP
7	1.426	37.56	46.00	-8.44	37.39	0.13	0.04	Average
8	1.426	39.88	56.00	-16.12	39.71	0.13	0.04	QP
9	11.432	45.87	50.00	-4.13	45.32	0.33	0.22	Average
10	11.432	47.57	60.00	-12.43	47.02	0.33	0.22	QP
11	29.061	32.30	50.00	-17.70	31.48	0.48	0.34	Average
12	29.061	42.09	60.00	-17.91	41.27	0.48	0.34	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 Note 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

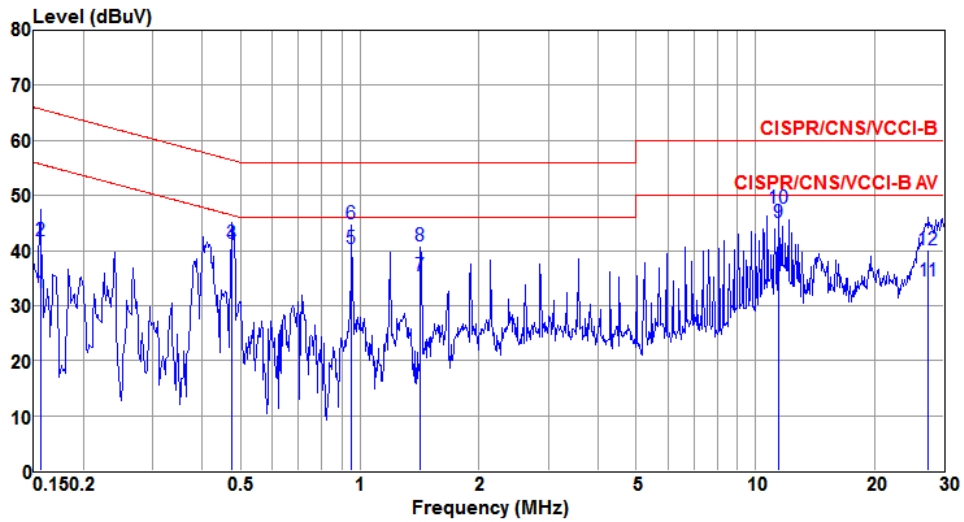
Modulation / SF	CSS / 12	Test Freq. (MHz)	923.3 + 927.5
Power Phase	Line		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.186	34.26	54.20	-19.94	34.13	0.09	0.04	Average
2	0.186	42.67	64.20	-21.53	42.54	0.09	0.04	QP
3	0.476	43.38	46.41	-3.03	43.28	0.06	0.04	Average
4	0.476	45.04	56.41	-11.37	44.94	0.06	0.04	QP
5	0.953	41.14	46.00	-4.86	41.03	0.07	0.04	Average
6	0.953	42.73	56.00	-13.27	42.62	0.07	0.04	QP
7	1.426	39.22	46.00	-6.78	39.08	0.10	0.04	Average
8	1.426	39.38	56.00	-16.62	39.24	0.10	0.04	QP
9	11.438	39.91	50.00	-10.09	39.45	0.24	0.22	Average
10	11.438	45.48	60.00	-14.52	45.02	0.24	0.22	QP
11	27.708	33.65	50.00	-16.35	32.89	0.44	0.32	Average
12	27.708	38.50	60.00	-21.50	37.74	0.44	0.32	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Modulation / SF	CSS / 12	Test Freq. (MHz)	923.3 + 927.5
Power Phase	Neutral		



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.156	32.45	55.69	-23.24	32.31	0.10	0.04	Average
2	0.156	41.79	65.69	-23.90	41.65	0.10	0.04	QP
3@	0.476	41.43	46.41	-4.98	41.27	0.12	0.04	Average
4	0.476	41.11	56.41	-15.30	40.95	0.12	0.04	QP
5	0.953	40.27	46.00	-5.73	40.14	0.09	0.04	Average
6	0.953	44.86	56.00	-11.14	44.73	0.09	0.04	QP
7	1.426	35.49	46.00	-10.51	35.32	0.13	0.04	Average
8	1.426	40.81	56.00	-15.19	40.64	0.13	0.04	QP
9	11.432	44.98	50.00	-5.02	44.43	0.33	0.22	Average
10	11.432	47.71	60.00	-12.29	47.16	0.33	0.22	QP
11	27.416	34.37	50.00	-15.63	33.58	0.47	0.32	Average
12	27.416	40.10	60.00	-19.90	39.31	0.47	0.32	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
 2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

3.2 6dB and Occupied Bandwidth

3.2.1 Limit of 6dB Bandwidth

The minimum 6dB bandwidth shall be at least 500 kHz.

3.2.2 Test Procedures

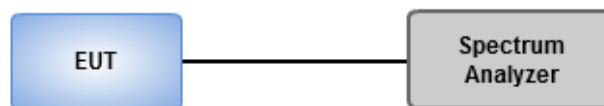
6dB Bandwidth

1. Set resolution bandwidth (RBW) = 100 kHz, Video bandwidth = 300 kHz.
2. Detector = Peak, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

1. Set resolution bandwidth (RBW) = 10kHz, Video bandwidth = 30kHz.
2. Detector = Sample, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Use the OBW measurement function of spectrum analyzer to measure the occupied bandwidth.

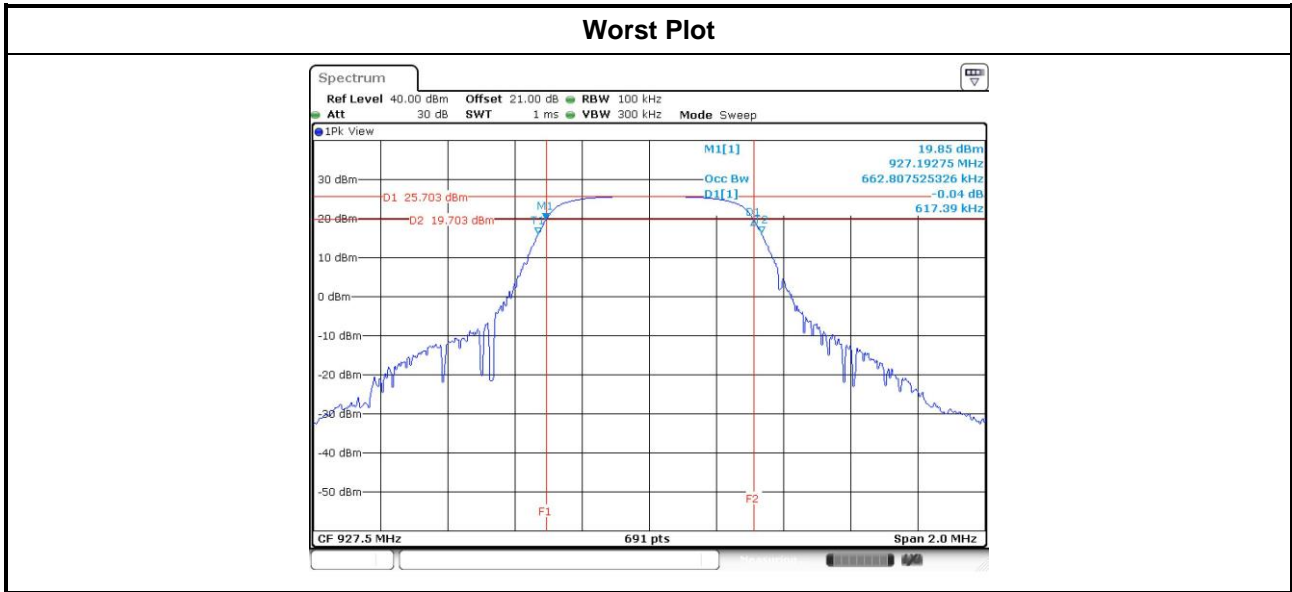
3.2.3 Test Setup



3.2.4 Test Result of 6dB and Occupied Bandwidth

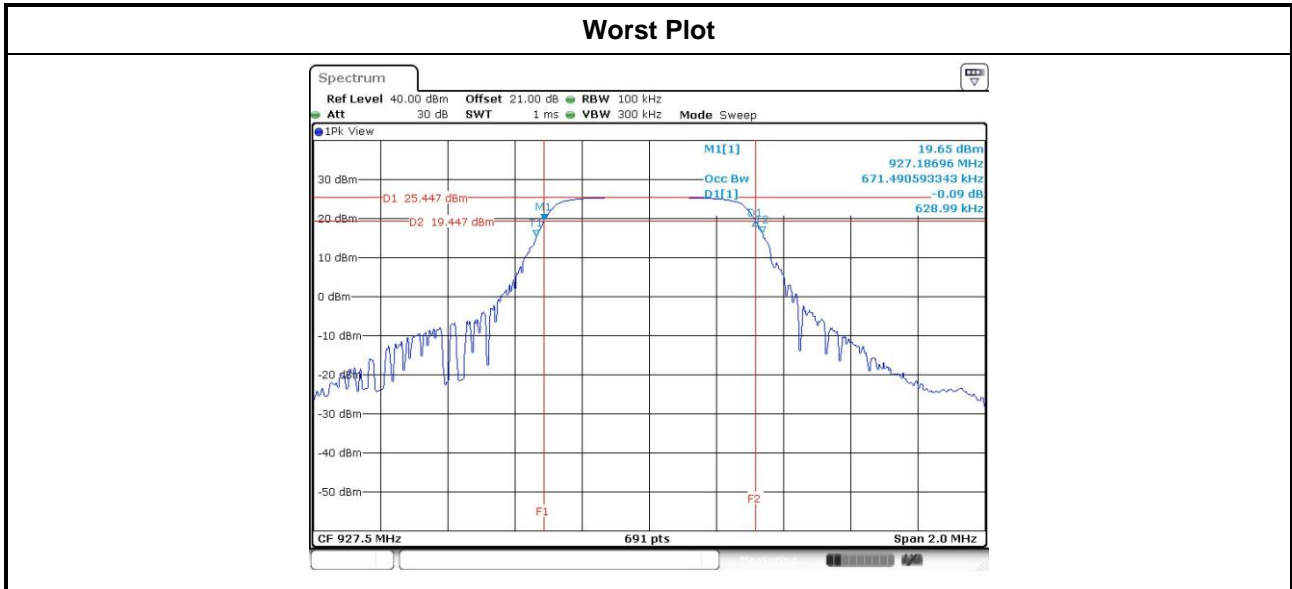
Lora card 0

Modulation / SF	Freq. (MHz)	6dB Bandwidth (MHz)	Limit (MHz)
CSS / 12	923.3	0.620	0.5
CSS / 12	927.5	0.617	0.5



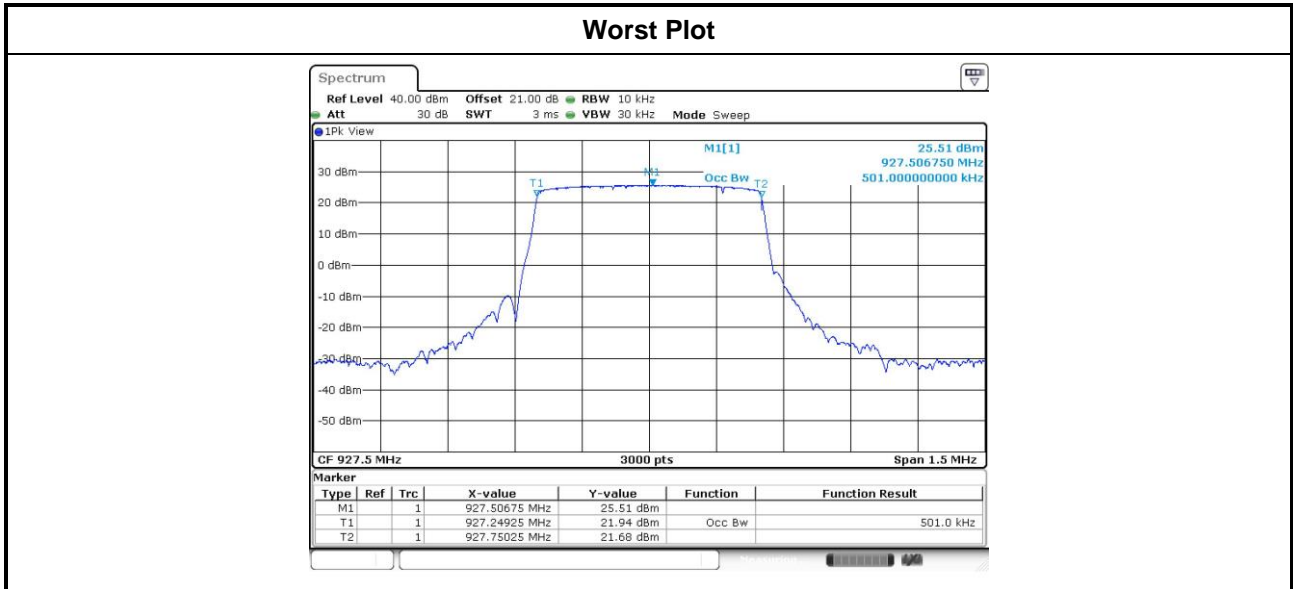
Lora card 1

Modulation / SF	Freq. (MHz)	6dB Bandwidth (MHz)	Limit (MHz)
CSS / 12	923.3	0.629	0.5
CSS / 12	927.5	0.629	0.5



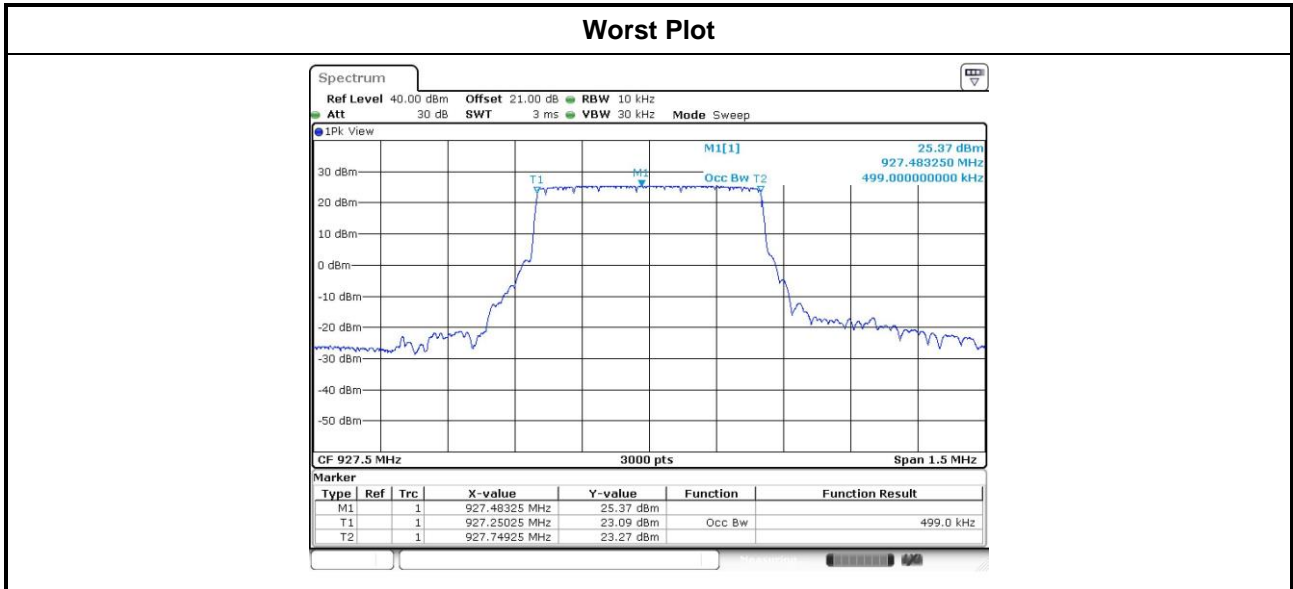
Lora card 0

Modulation / SF	Freq. (MHz)	99% Occupied Bandwidth (MHz)
CSS / 12	923.3	0.500
CSS / 12	927.5	0.501



Lora card 1

Modulation / SF	Freq. (MHz)	99% Occupied Bandwidth (MHz)
CSS / 12	923.3	0.499
CSS / 12	927.5	0.499



3.3 RF Output Power

3.3.1 Limit of RF Output Power

Conducted power shall not exceed 1Watt.

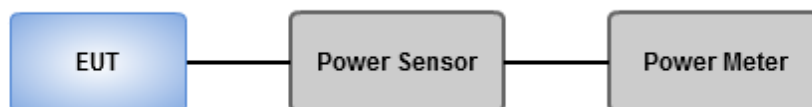
- Antenna gain \leq 6dBi, no any corresponding reduction is in output power limit.
- Antenna gain $>$ 6dBi

Transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi

3.3.2 Test Procedures

- Maximum Peak Conducted Output Power
 - Spectrum analyzer**
 1. Set RBW = 1MHz, VBW = 3MHz, Detector = Peak.
 2. Sweep time = auto, Trace mode = max hold, Allow trace to fully stabilize.
 3. Use the spectrum analyzer channel power measurement function with the band limits set equal to the DTS bandwidth edges.
 - Power meter**
 1. A broadband Peak RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.
- Maximum Conducted Output Power
 - Power meter**
 1. A broadband Average RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.

3.3.3 Test Setup



3.3.4 Test Result of Maximum Output Power

Lora Card 0

Modulation / SF	Freq. (MHz)	Output Power (mW)	Output Power (dBm)	Limit (dBm)
CSS / 12	923.3	409.2607	26.12	27
CSS / 12	927.5	372.3917	25.71	27

Lora Card 1

Modulation / SF	Freq. (MHz)	Output Power (mW)	Output Power (dBm)	Limit (dBm)
CSS / 12	923.3	403.6454	26.06	27
CSS / 12	927.5	364.7539	25.62	27

Total Power in the same band

Both Lora cards can transmit simultaneously but different channel

Mode	Card	Freq. (MHz)	Output Power (dBm)	Total Power (mW)	Total Power (dBm)	Limit (dBm)
1	Lora Card 0	923.3	26.12	774.01	28.89	30
	Lora Card 1	927.5	25.62			
2	Lora Card 0	927.5	25.71	776.04	28.90	30
	Lora Card 1	923.3	26.06			

3.4 Power Spectral Density

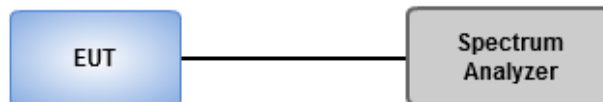
3.4.1 Limit of Power Spectral Density

Power spectral density shall not be greater than 8 dBm in any 3 kHz band.

3.4.2 Test Procedures

- Maximum peak conducted output power was used to demonstrate compliance to the fundamental output power limit.
 1. Set the RBW = 3kHz, VBW = 10kHz.
 2. Detector = Peak, Sweep time = auto couple.
 3. Trace mode = max hold, allow trace to fully stabilize.
 4. Use the peak marker function to determine the maximum amplitude level.
- Maximum (average) conducted output power was used to demonstrate compliance to the fundamental output power limit.
 1. Set the RBW = 3kHz, VBW = 10 kHz.
 2. Detector = RMS, Sweep time = auto couple.
 3. Employ trace averaging (RMS) mode over a minimum of 100 traces
 4. Use the peak marker function to determine the maximum amplitude level.

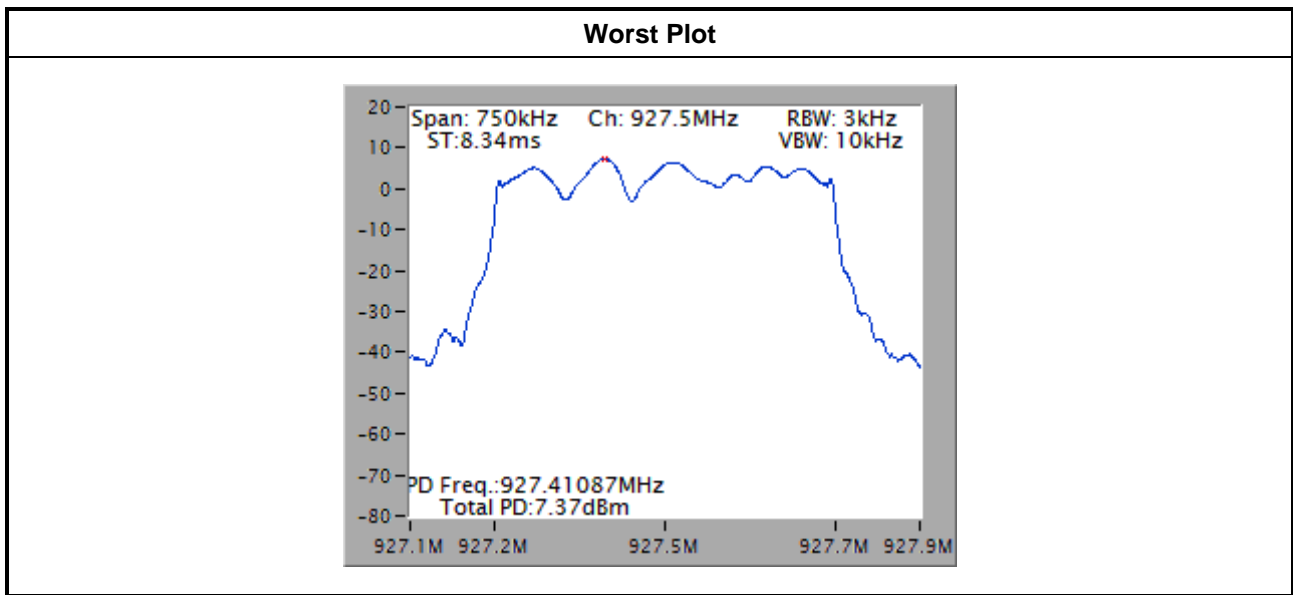
3.4.3 Test Setup



3.4.4 Test Result of Power Spectral Density

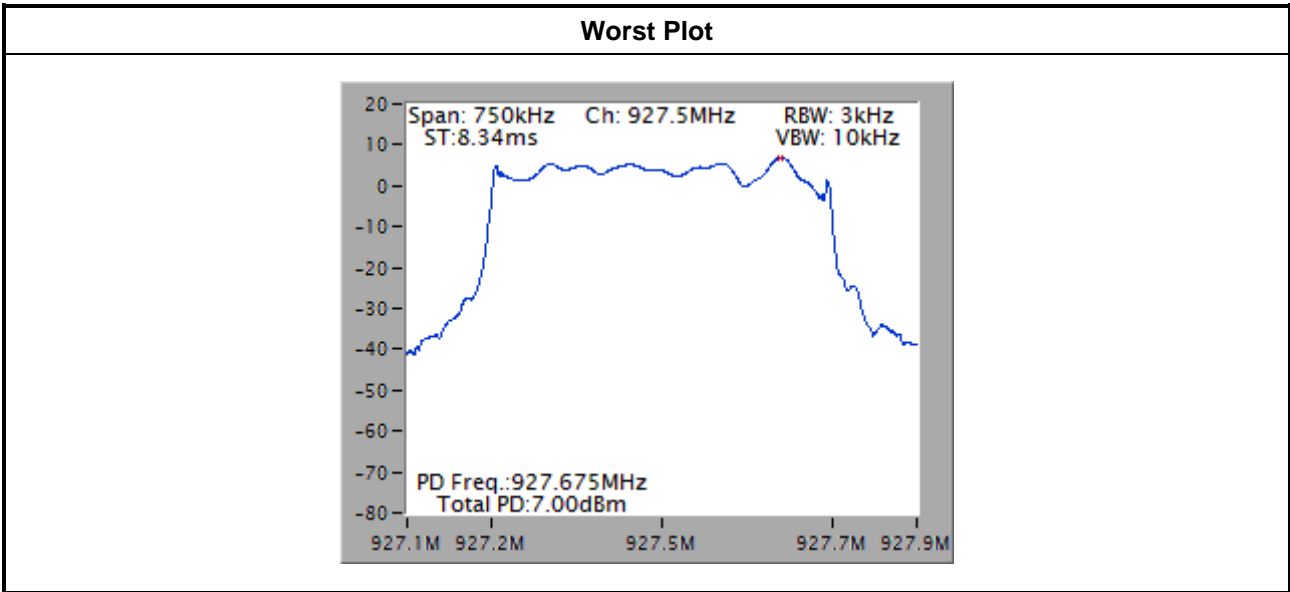
Lora Card 0

Modulation / SF	Freq. (MHz)	Total Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
CSS / 12	923.3	7.12	8.00
CSS / 12	927.5	7.37	8.00



Lora Card 1

Modulation / SF	Freq. (MHz)	Total Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
CSS / 12	923.3	6.80	8.00
CSS / 12	927.5	7.00	8.00



3.5 Unwanted Emissions into Restricted Frequency Bands

3.5.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Quasi-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

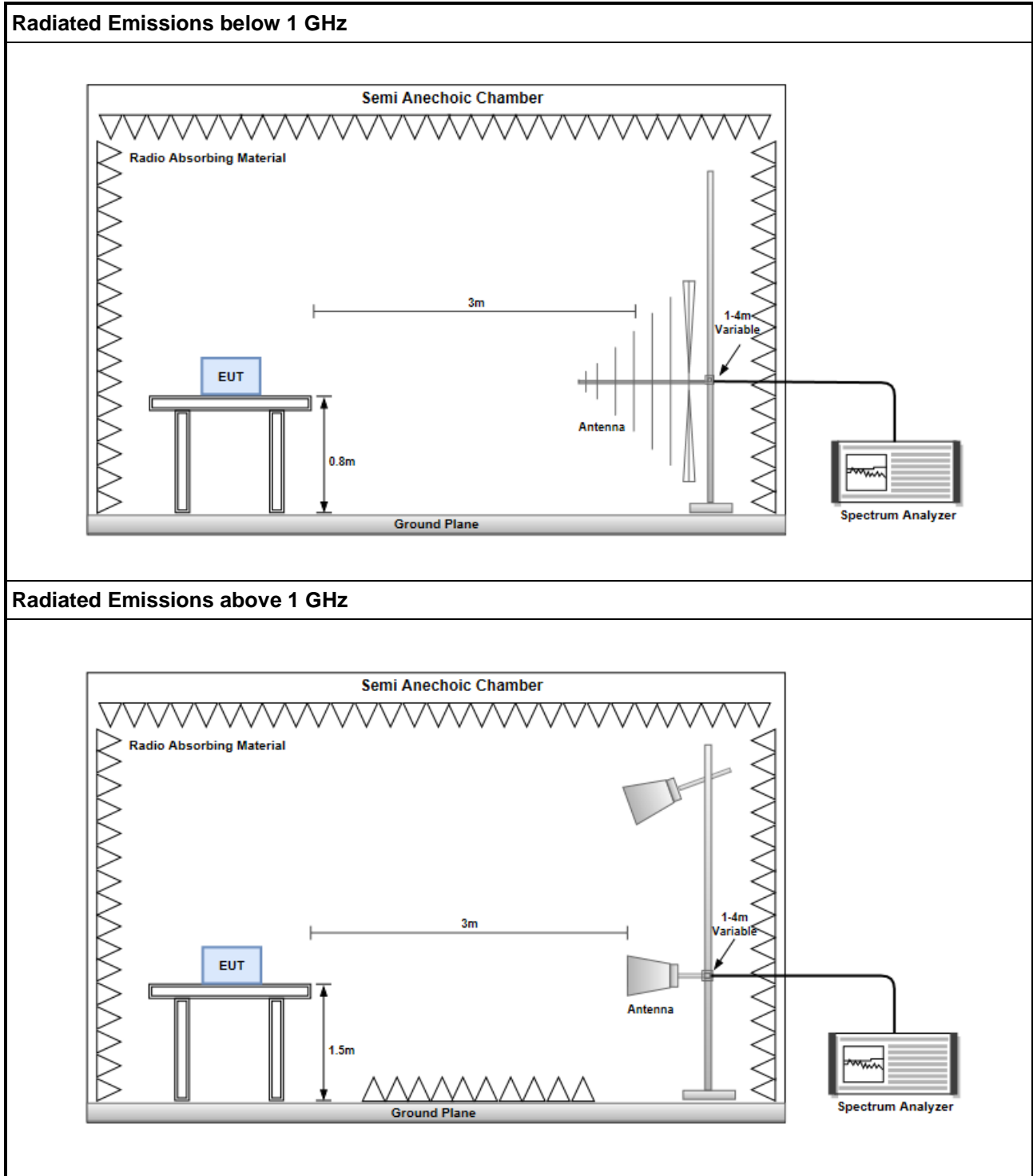
3.5.2 Test Procedures

1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

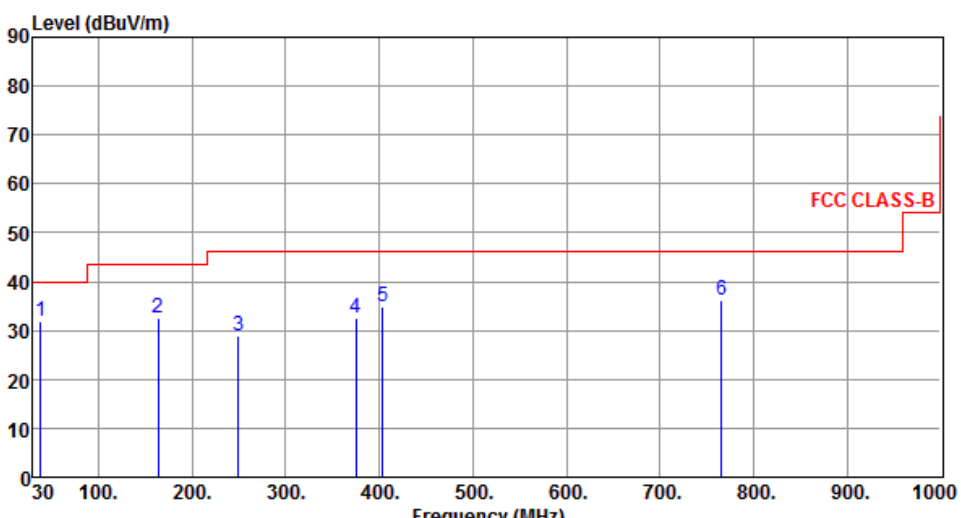
Note:

1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

3.5.3 Test Setup

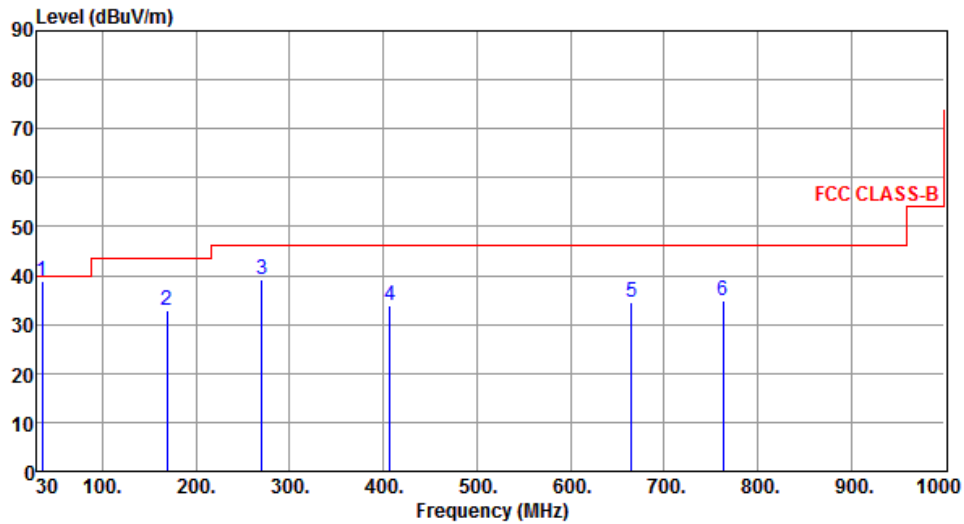


3.5.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

Modulation / SF	CSS / 12	Test Freq. (MHz)	923.3						
Polarization	Horizontal								
									
	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB		cm	deg
1	38.16	31.80	40.00	-8.20	40.10	-8.30	Peak	---	---
2	163.86	32.61	43.50	-10.89	40.98	-8.37	Peak	---	---
3	249.22	28.88	46.00	-17.12	38.26	-9.38	Peak	---	---
4	375.32	32.63	46.00	-13.37	38.30	-5.67	Peak	---	---
5	404.00	34.89	46.00	-11.11	39.75	-4.86	Peak	---	---
6	765.60	36.18	46.00	-9.82	34.27	1.91	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation / SF	CSS / 12	Test Freq. (MHz)	923.3
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	35.44	38.98	40.00	-1.02	47.47	-8.49	QP	100	195
2	168.71	32.77	43.50	-10.73	41.32	-8.55	Peak	---	---
3	270.40	39.27	46.00	-6.73	47.78	-8.51	Peak	---	---
4	407.20	33.99	46.00	-12.01	38.77	-4.78	Peak	---	---
5	665.25	34.62	46.00	-11.38	34.54	0.08	Peak	---	---
6	763.20	35.03	46.00	-10.97	33.14	1.89	Peak	---	---

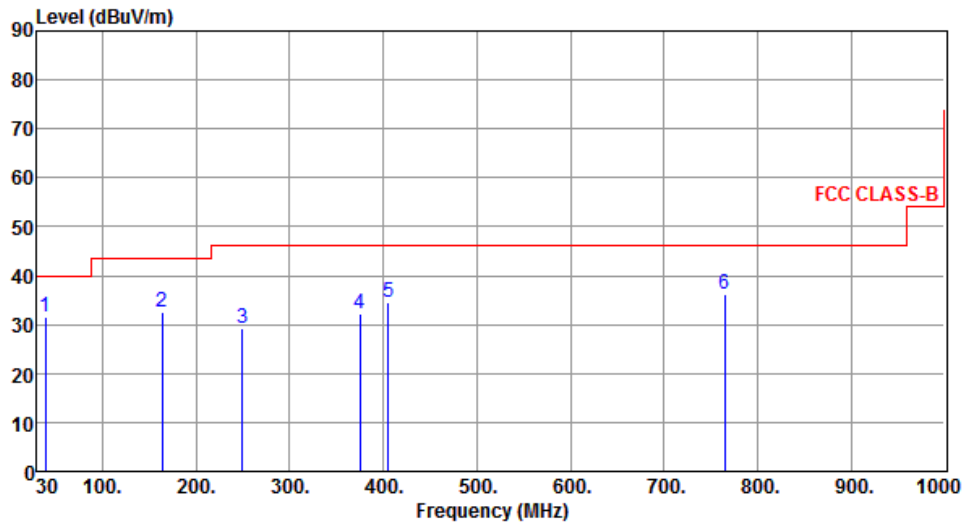
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation / SF	CSS / 12	Test Freq. (MHz)	927.5
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	38.62	31.53	40.00	-8.47	39.80	-8.27	Peak	---	---
2	164.13	32.66	43.50	-10.84	41.05	-8.39	Peak	---	---
3	249.71	29.27	46.00	-16.73	38.64	-9.37	Peak	---	---
4	375.06	32.25	46.00	-13.75	37.93	-5.68	Peak	---	---
5	405.22	34.47	46.00	-11.53	39.31	-4.84	Peak	---	---
6	765.00	36.33	46.00	-9.67	34.42	1.91	Peak	---	---

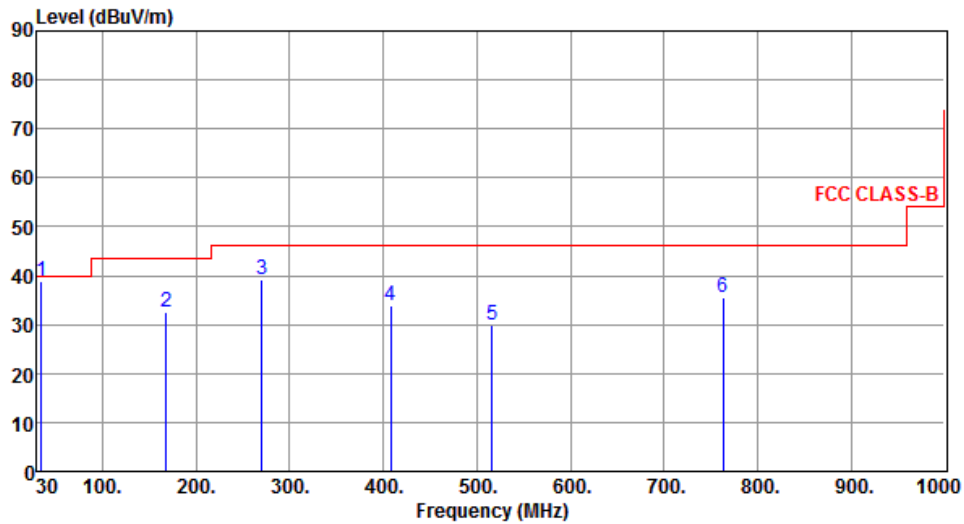
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation / SF	CSS / 12	Test Freq. (MHz)	927.5
Polarization	Vertical		



	Freq. MHz	Emission level dBUV/m	Limit dBUV/m	Margin dB	SA reading dBUV	Factor dB	Remark	ANT High cm	Turn Table deg
1	34.96	38.96	40.00	-1.04	47.49	-8.53	QP	100	182
2	168.34	32.58	43.50	-10.92	41.11	-8.53	Peak	---	---
3	270.69	39.17	46.00	-6.83	47.67	-8.50	Peak	---	---
4	407.75	33.74	46.00	-12.26	38.51	-4.77	Peak	---	---
5	516.58	29.85	46.00	-16.15	32.33	-2.48	Peak	---	---
6	763.45	35.42	46.00	-10.58	33.53	1.89	Peak	---	---

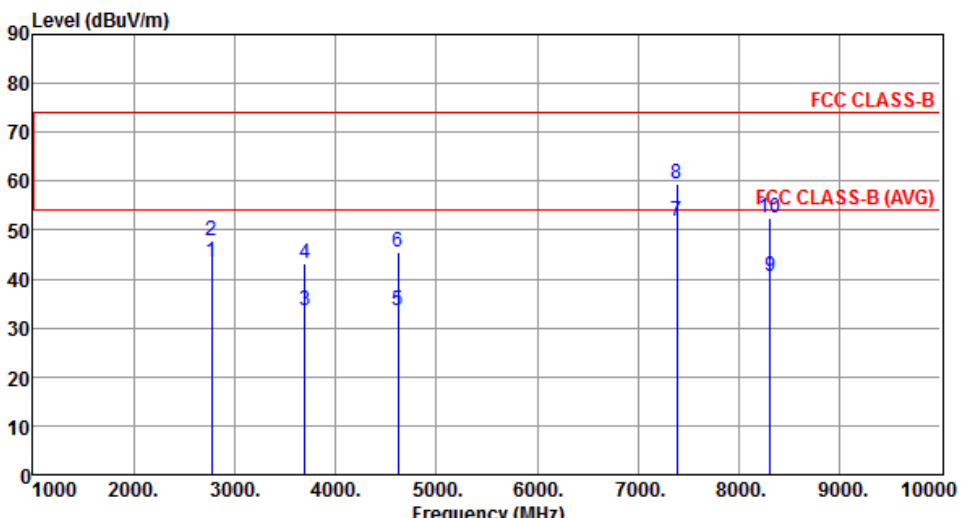
Note 1: Emission Level (dBUV/m) = SA Reading (dBUV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBUV/m) – Limit (dBUV/m).

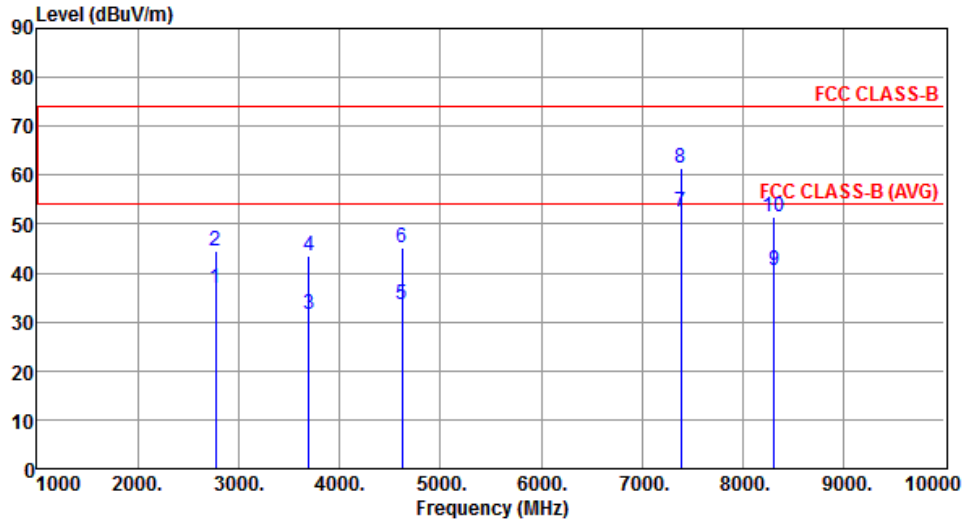
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.5.5 Transmitter Radiated Unwanted Emissions (Above 1GHz)

Modulation / SF	CSS / 12	Test Freq. (MHz)	923.3						
Polarization	Horizontal								
									
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2769.90	43.53	54.00	-10.47	45.35	-1.82	Average	136	219
2	2769.90	47.82	74.00	-26.18	49.64	-1.82	Peak	136	219
3	3693.20	33.52	54.00	-20.48	33.15	0.37	Average	262	314
4	3693.20	43.29	74.00	-30.71	42.92	0.37	Peak	262	314
5	4616.50	33.68	54.00	-20.32	30.44	3.24	Average	100	82
6	4616.50	45.52	74.00	-28.48	42.28	3.24	Peak	100	82
7	7386.40	51.71	54.00	-2.29	43.27	8.44	Average	102	61
8	7386.40	59.40	74.00	-14.60	50.96	8.44	Peak	102	61
9	8309.70	40.39	54.00	-13.61	30.87	9.52	Average	100	213
10	8309.70	52.34	74.00	-21.66	42.82	9.52	Peak	100	213

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation / SF	CSS / 12	Test Freq. (MHz)	923.3
Polarization	Vertical		



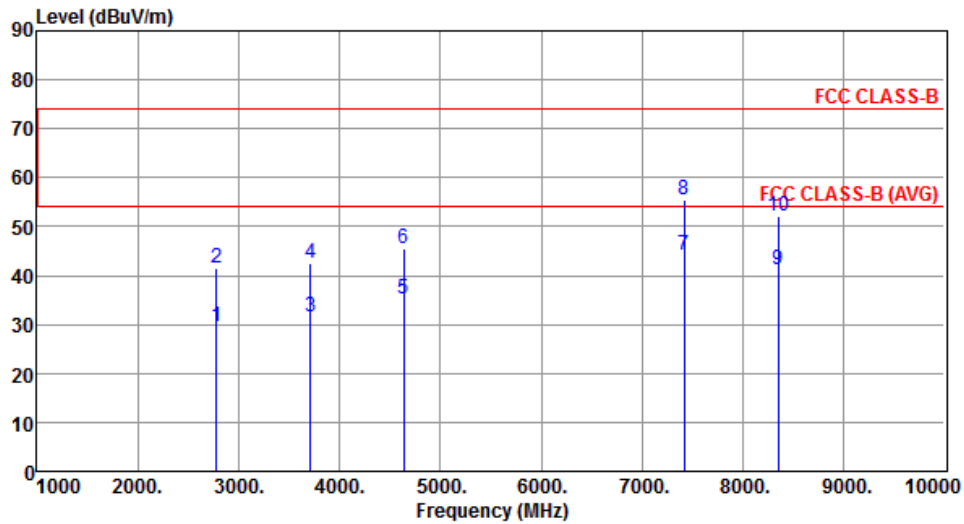
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2769.90	36.76	54.00	-17.24	38.58	-1.82	Average	124	16
2	2769.90	44.58	74.00	-29.42	46.40	-1.82	Peak	124	16
3	3693.20	31.59	54.00	-22.41	31.22	0.37	Average	100	234
4	3693.20	43.36	74.00	-30.64	42.99	0.37	Peak	100	234
5	4616.50	33.65	54.00	-20.35	30.41	3.24	Average	100	217
6	4616.50	45.29	74.00	-28.71	42.05	3.24	Peak	100	217
7	7386.40	52.55	54.00	-1.45	44.11	8.44	Average	275	321
8	7386.40	61.29	74.00	-12.71	52.85	8.44	Peak	275	321
9	8309.70	40.59	54.00	-13.41	31.07	9.52	Average	100	211
10	8309.70	51.49	74.00	-22.51	41.97	9.52	Peak	100	211

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation / SF	CSS / 12	Test Freq. (MHz)	927.5
Polarization	Horizontal		



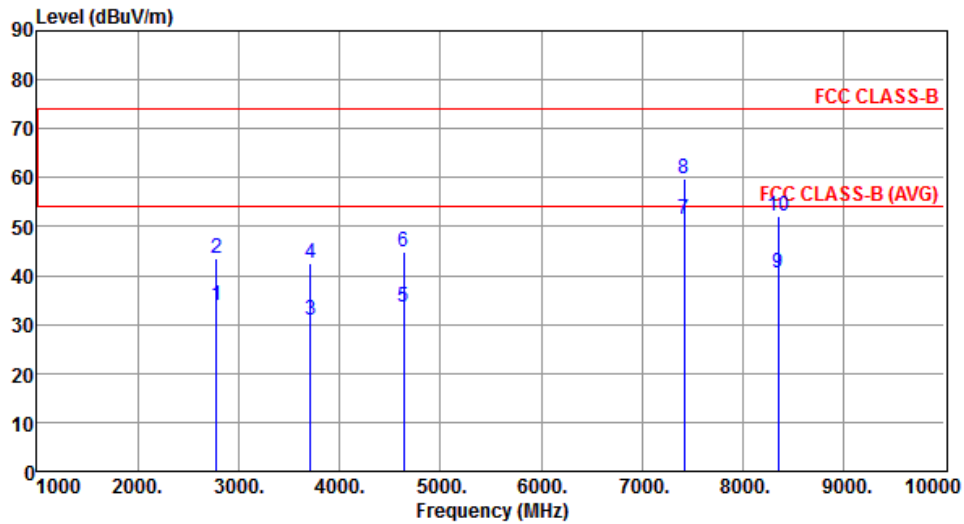
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2782.50	29.72	54.00	-24.28	31.50	-1.78	Average	100	47
2	2782.50	41.57	74.00	-32.43	43.35	-1.78	Peak	100	47
3	3710.00	31.63	54.00	-22.37	31.22	0.41	Average	100	308
4	3710.00	42.48	74.00	-31.52	42.07	0.41	Peak	100	308
5	4637.50	35.18	54.00	-18.82	31.89	3.29	Average	125	335
6	4637.50	45.60	74.00	-28.40	42.31	3.29	Peak	125	335
7	7420.00	44.02	54.00	-9.98	35.53	8.49	Average	125	6
8	7420.00	55.40	74.00	-18.60	46.91	8.49	Peak	125	6
9	8347.50	41.18	54.00	-12.82	31.67	9.51	Average	100	125
10	8347.50	52.22	74.00	-21.78	42.71	9.51	Peak	100	125

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation / SF	CSS / 12	Test Freq. (MHz)	927.5
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2782.50	33.85	54.00	-20.15	35.63	-1.78	Average	108	106
2	2782.50	43.49	74.00	-30.51	45.27	-1.78	Peak	108	106
3	3710.00	30.87	54.00	-23.13	30.46	0.41	Average	100	344
4	3710.00	42.37	74.00	-31.63	41.96	0.41	Peak	100	344
5	4637.50	33.70	54.00	-20.30	30.41	3.29	Average	100	288
6	4637.50	44.97	74.00	-29.03	41.68	3.29	Peak	100	288
7	7420.00	51.32	54.00	-2.68	42.83	8.49	Average	275	321
8	7420.00	59.83	74.00	-14.17	51.34	8.49	Peak	275	321
9	8347.50	40.61	54.00	-13.39	31.10	9.51	Average	100	325
10	8347.50	52.13	74.00	-21.87	42.62	9.51	Peak	100	325

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.6 Emissions in Non-Restricted Frequency Bands

3.6.1 Emissions in Non-Restricted Frequency Bands Limit

Peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz

3.6.2 Measuring Instruments

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

3.6.3 Test Procedures

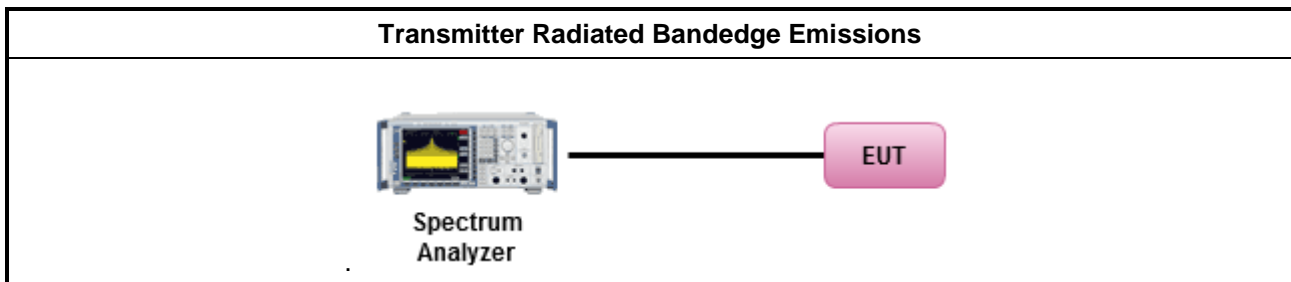
Reference level measurement

1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Use the peak marker function to determine the maximum PSD level

Emission level measurement

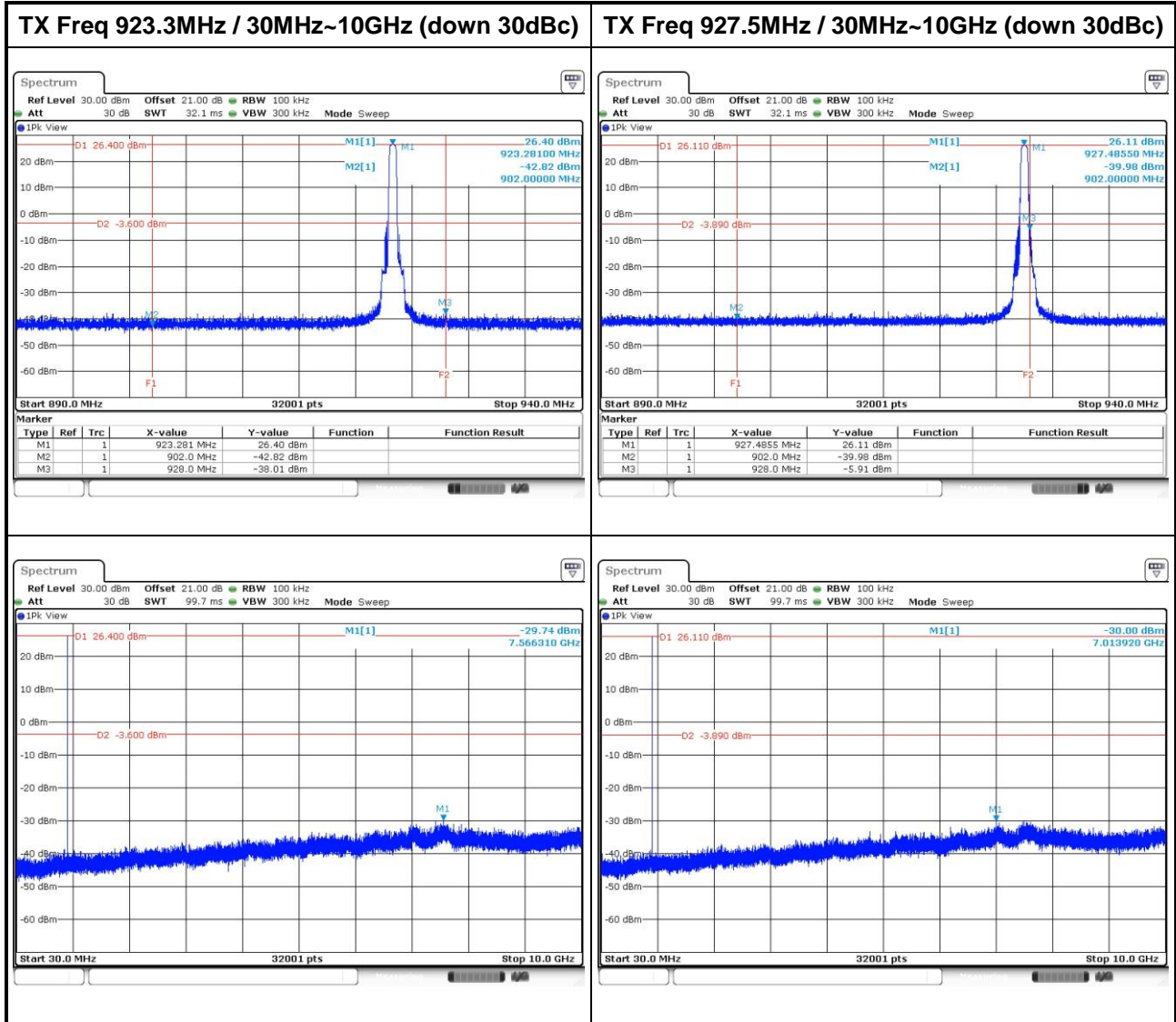
1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Scan Frequency range is up to 10GHz
4. Use the peak marker function to determine the maximum amplitude level

3.6.4 Test Setup

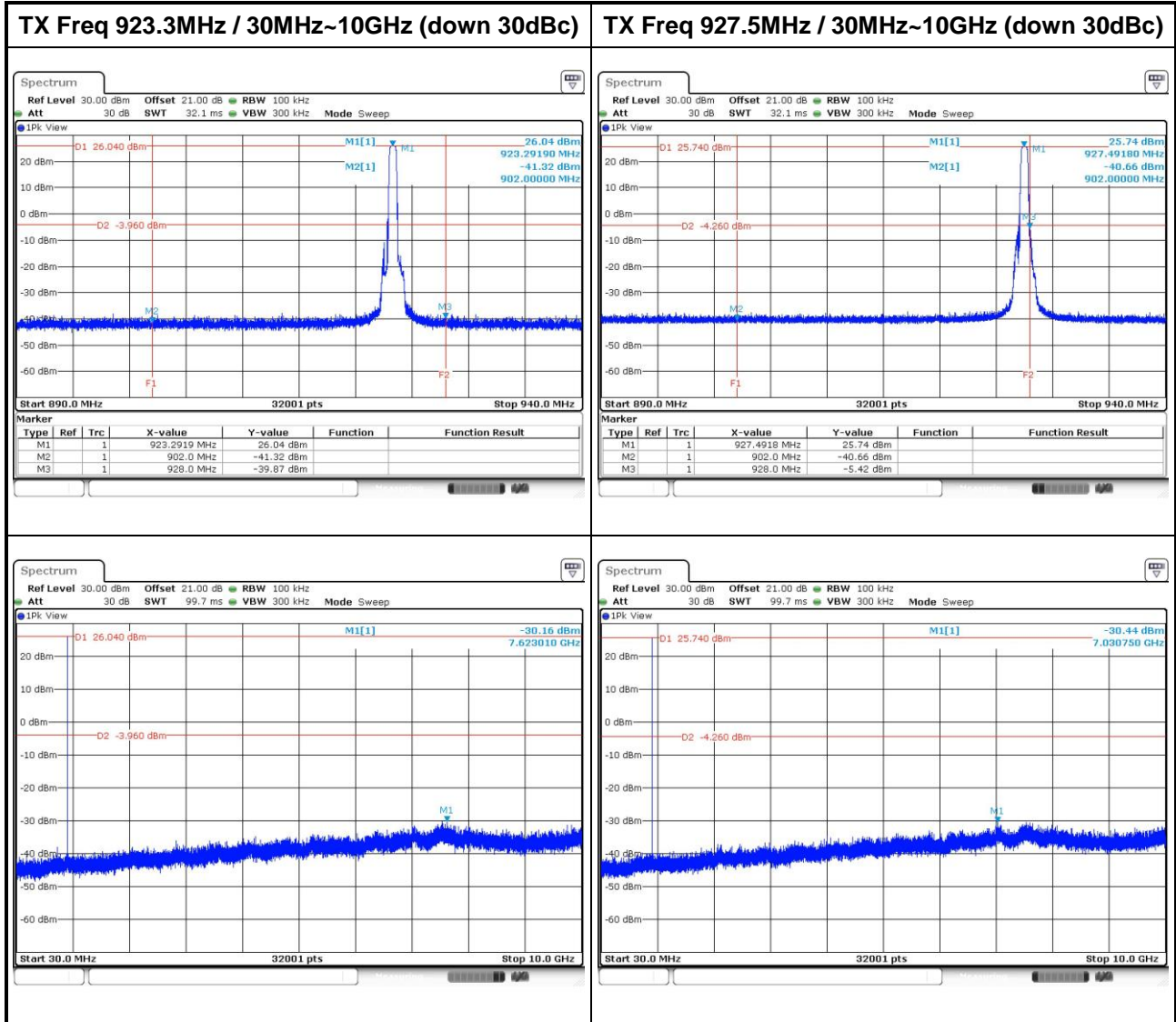


3.6.5 Unwanted Emissions into Non-Restricted Frequency Bands

Lora Card 0



Lora Card 1



4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website <http://www.icertifi.com.tw>.

Linkou

Tel: 886-2-2601-1640

No. 30-2, Ding Fwu Tsuen, Lin
Kou District, New Taipei City,
Taiwan, R.O.C.

Kwei Shan

Tel: 886-3-271-8666

No. 3-1, Lane 6, Wen San 3rd St.,
Kwei Shan District, Tao Yuan City
333, Taiwan, R.O.C.

Kwei Shan Site II

Tel: 886-3-271-8640

No. 14-1, Lane 19, Wen San 3rd
St., Kwei Shan District, Tao Yuan
City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information.

Tel: 886-3-271-8666

Fax: 886-3-318-0155

Email: ICC_Service@icertifi.com.tw

==END==