

FCC ID: 2A093-NM0824-I

FCC Test Report (Part 15 Subpart C)

Client Information:

Applicant: System Level Solutions (India) Pvt. Ltd.

Applicant add.: Plot no. 32, Zone-D4, Phase 1 GIDC Estate, V.U. Nagar, Anand – 388121,
Gujarat, India

Manufacturer: System Level Solutions (India) Pvt. Ltd.

Manufacturer add.: Plot no. 32, Zone-D4, Phase 1 GIDC Estate, V.U. Nagar, Anand – 388121,
Gujarat, India

Product Information:

Product Name: mPCIe LoRa Concentrator Board

Model No.: NM0824-I

Derivative model No.: N/A

Brand Name: SLS

Applied Standard:

FCC Part 15 Subpart C 15.247

Laboratory Details:

AA Electro Magnetic Test Laboratory Private Limited
PlotNo174, Udyog Vihar-Phase4, Sector18, Gurgaon, Haryana, India

Date of Receipt: Aug. 17, 2022

Date of Test: Aug. 17, 2022 ~ Nov. 24, 2022

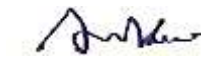
Date of Issue: Dec. 08, 2022

Test Result: In Compliance/Pass

This device has been tested and found to comply with the stated standard(s), which is (are) required by the council directive of 2014/53/EU and indicated in the test report and are applicable only to the tested sample identified in the report.

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Prepared By (+ signature) Ankur Kumar:



Reviewed & Approved by: (+ signature)



Dr. Lenin Raja (Authorized Representative)

(/ lenin83/)

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2 Test Summary

2.1 Compliance with FCC Part 15 subpart C

Test	Test Requirement	Standard Paragraph	Result
Antenna Requirement	FCC Part 15 C:2013	Section 15.247(c)	PASS
Conduction Emissions	FCC Part 15 C:2013	Section 15.207(a)	PASS
Radiated Emissions	FCC Part 15 C:2013	Section 15.247(d)	PASS
Maximum conducted (Average) output power	FCC Part 15 C:2013	Section 15.247(b)	PASS
Maximum Power Spectral Density	FCC Part 15 C:2013	Section 15.247(e)	PASS
DTS Bandwidth	FCC Part 15 C:2013	Section 15.247 (a) (2)	PASS
Band edge	FCC Part 15 C:2013	Section 15.247(d)	PASS
Conducted Spurious Emissions	FCC Part 15 C:2013	Section 15.247(d)	PASS
Note: N/A is an abbreviation for Not Applicable.			
Model description: N/A			
(1)	Reference to the FCC Public Notice DA 00-705		
(2)	Reference to ANSI C63.4:2013.		

2.2 Test Location

All tests were performed at:

AA Electro Magnetic Test Laboratory Private Limited

Plot No 174, Udyog Vihar - Phase 4, Sector 18, Gurgaon, Haryana, India

Tel.: +91-0124-4235350

2.3 Measurement Uncertainty

All measurements involve certain levels of uncertainties, The following measurements uncertainty Levels have estimated based on ANSI C63.4:2013, the maximum value of the uncertainty as below

No.	Item	Uncertainty
1	Conducted Emission Test	2.82dB
2	Radiated Emission Test	2.77dB

3 Test Facility

ILAC / NABL Accreditation No.: TC-8597

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by National Accreditation Board for Testing and Calibration Laboratories (NABL).

ILAC –A2LA Accreditation No.: 5593.01

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered American Association of Laboratory Accreditation (A2LA.)

FCC- Recognition No.: 137777

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Federal Communications Commission (FCC).

ISED Recognition No.: 26046

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Institute for Social and Economic Development.(ISED)

VCCI- Registration No: 4053

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Voluntary Control Council for Interference.(VCCI)

TEC Designation No.: IND063

Three 3m Semi-Anechoic Chamber, 1 full-Anechoic chamber and 2 Shielding Rooms of AA Electro Magnetic Test Laboratory Private Limited have been registered by Telecommunication Engineering (TEC) Center.

BIS Recognition No: 816586

BIS recognized as per CRS scheme for IT electronics, LED control gears, Lamp, Inverter / UPS are recognized as per LRS 2020.

3.1 Deviation from standard

None

3.2 Abnormalities from standard conditions

None

4 General Information

4.1 General Description of EUT

Manufacturer:	System Level Solutions (India) Pvt. Ltd.
Manufacturer Address:	Plot no. 32, Zone-D4, Phase 1 GIDC Estate, V.U. Nagar, Anand – 388121, Gujarat, India
EUT Name:	mPCIe LoRa Concentrator Board
Model No:	NM0824-I
Brand Name:	SLS
Derivative model No.:	N/A
Serial No:	1531221900004
Operation frequency:	902.3MHz to 914.9MHz 903.0MHz to 927.5MHz
Number Of Channel:	64+8+8
Modulation Technology:	CSS
Channel Spacing :	200kHz(DSS) 1.6MHz(DTS)
Antenna Gain:	2.7 dBi
H/W No.:	1A
S/W No.:	V2.1.0
Power Supply Range:	Input of EUT: Powered through Adapter Input for adapter: AC 100-240VAC,50/60Hz,0.8A Max Output: DC 5V, 6A Total (Each 2.4A Max)
Condition of Sample on receipt:	Good
Note:	1 .For a more detailed features description, please refer to the manufacturer’s specifications or the User's Manual. 2. Antenna gain and antenna type provided by manufacturer.

Description of Channel/frequency:

Frequency Band (GHz)	Channel No.	Frequency (MHz)
Sub-GHz (903 MHz – 927.5 MHz)	Low	903.0
	:	:
	Mid	923.5
	:	:
	High	927.5

Channel used for SubGHz testing

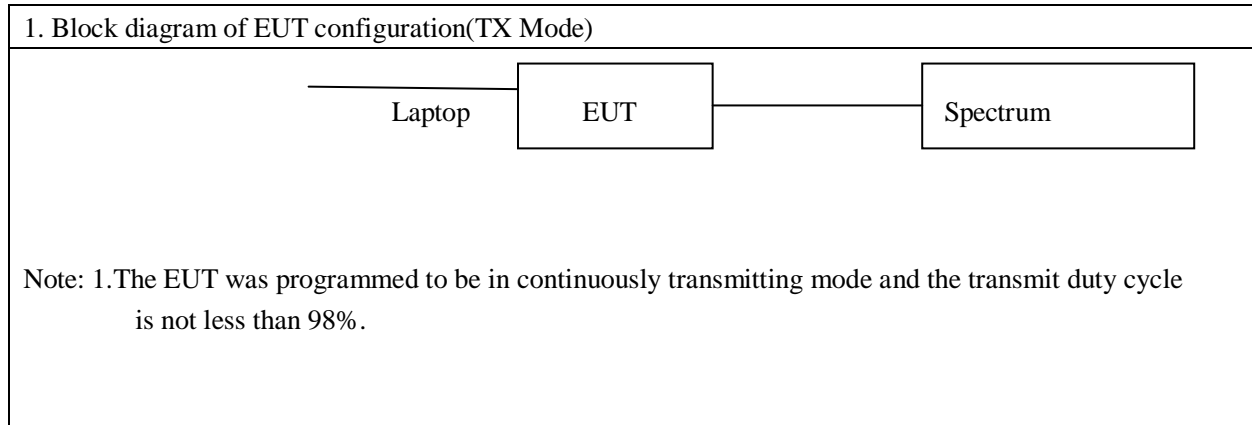
Channel Low : 903.0MHz

Channel Mid : 923.5MHz

Channel High : 927.5MHz

4.2 Description of Test conditions

- (1) EUT was tested in normal configuration (Please See following Block diagram)



- (2) E.U.T. test conditions:

15.31(e): For intentional radiators, measurements of the variation of the input power or the adiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

- (3) Test frequencies:

According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and. If required reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

- (4) Frequency range of radiated measurements:

According to the 15.33, the test range will be up to the tenth harmonic of the highest fundamental frequency.

- (5) Pre-test the EUT in all transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet and conducted to determine the worst-case mode, only the worst-case results(1Mbps/2Mbps/3Mbps) are recorded in this report.

4.3 Test Peripheral List

No.	Equipment	Manufacturer	EMC Compliance	Model No.	Serial No.	Power cord	signal cable
1	Laptop	DELL	Latitude 3490	5M2Z1W 2	2m unshielded	N/A	1

4.4 EUT Peripheral List

No.	Equipment	Manufacturer	Model No.	Serial No.	Power cord	signal cable
1.	N/A	N/A	N/A	N/A	N/A	N/A

5 Equipments List for All Test Items

No	Test Equipment	Manufacturer	Model No	Serial No	Cal. Date	Cal.Due Date
1	Spectrum Analyzer	Rohde and Schwarz	FSP40	101163	2020/12/11	2022/12/10
2	Loop antenna	DAZE Beijing	ZN30900C	18052	2021/01/29	2023/01/28
3	Hi power horn antenna	DAZE Beijing	ZN30700	18012	2021/01/30	2023/01/29
4	Horn antenna	DAZE Beijing	ZN30702	18006	2021/01/30	2023/01/29
5	Horn antenna	DAZE Beijing	ZN30703	18005	2021/01/30	2023/01/29
6	Pre amplifier	KELIANDA	LNA-0009295	-	2021/01/13	2023/01/13
7	Pre amplifier	KELIANDA	CF-00218	-	2021/01/13	2023/01/13
8	Biconical Antenna	DAZE Beijing	ZN30505C	17038	2021/01/13	2023/01/13
9	EMI-RECEIVER	Schwarzbeck	FCKL	1528194	2021/01/13	2023/01/13
10	Spectrum Analyzer	ADVANTEST	R3361	-	2021/01/13	2023/01/13
11	LISN	Kyoritsu	KNW-407	8-1789-5	2021/01/13	2023/01/13
12	Network-LISN	SCHWAR ZBECK	NNBM8125	81251314	2021/01/13	2023/01/13
13	Network-LISN	SCHWAR ZBECK	NNBM8125	81251315	2021/01/13	2023/01/13
14	PULSELIMITER	Rohde and Schwarz	ESH3-Z2	100681	2022/05/13	2023/05/12
15	50ΩCoaxialSwitch	DAIWA	1565157	-	2022/05/13	2023/05/12
16	50ΩCoaxialSwitch	-	-	-	2022/05/13	2023/05/12
17	Wireless signal power meter	DARE!!	RPR3006W	RFSW190220	2021/01/13	2023/01/13
18	Signal Generator	KEYSIGHT	N5181A	512071	2021/01/13	2023/01/13

19	RF Vector Signal Generator	Keysight	N5182B	512094	2021/01/13	2023/01/13
20	Spectrum analyzer	R&S	FSV-40N	101385	2021/01/13	2023/01/13
21	Radio Communication Tester	R&S	CMW 500	124589	2022/05/15	2023/05/14
22	Signal Generator	R&S	SMP02	837017/004 836593/005	2022/05/15	2023/05/14
23	DC Power Supply	Guanker	JK15040K	TNC/ET/C/0 01/15	2021/02/02	2023/02/01
24	Pro. Temp & Humi. Chamber	MENTEK	MHP-150-1C	MAA081125 01	2021/02/02	2023/02/01
25	Attenuators	AGILENT	8494B	-	-	-
26	Attenuators	AGILENT	8495B	-	-	-

6 Test Result

6.1 Antenna Requirement

6.1.1 Standard requirement

15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

15.247(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

6.1.2 EUT Antenna

The ANT-915-IPW1-RPS antenna is a hinged-whip IP67-rated dipole antenna designed for use in 915 MHz frequency bands for low-power, wide-area (LPWA) applications such as LoRaWAN® and WiFi HaLow™ as well as ISM and remote control applications.

The ANT-915-IPW1-RPS provides a ground plane independent dipole antenna solution. The hinged design allows for the antenna to be positioned for optimum performance and reduces the potential for damage from impact compared to a fixed whip design. The antenna attaches with an RP-SMA plug (female socket) connector.

6.2 Conduction Emissions Measurement

6.2.1 Applied procedures / Limit

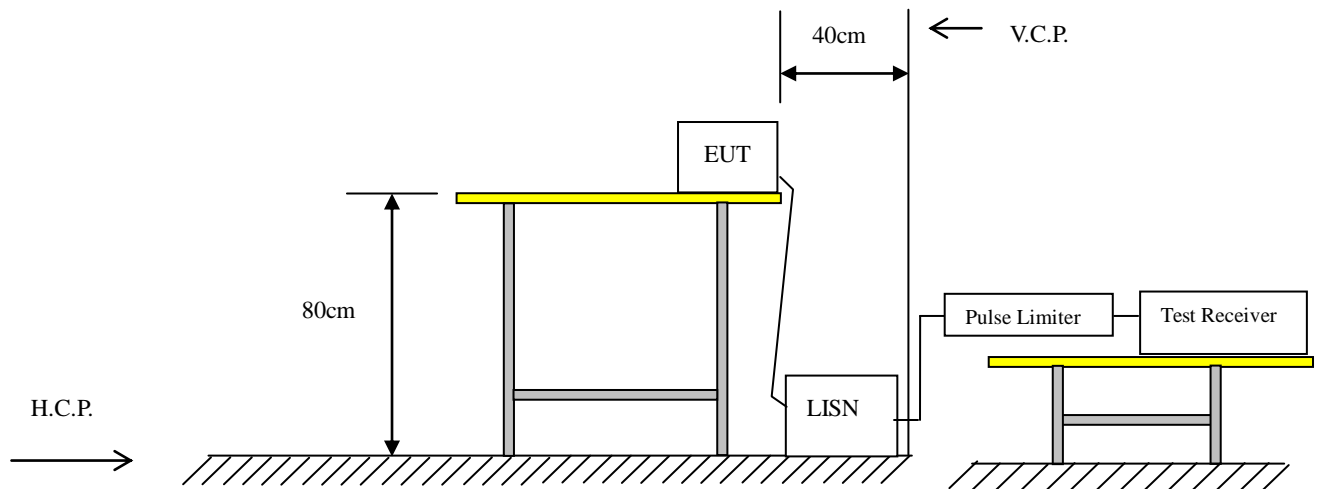
Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

Note: Decreases with the logarithm of the frequency.

6.2.2 Test procedure

EUT was placed upon a wooden test table 0.8m above the horizontal metal reference plane and 0.4m from the Vertical ground plane, and it was connected to an LISN/AMN. The closest distance between the boundary of the EUT and the surface of the LISN/AMN is 0.8m. All peripherals were connected to another LISN/AMN, and placed at a distance of 10cm from each other. A spectrum and receiver was connected to the RF output port of the LISN/AMN. Both average and quasi-peak value were detected.

6.2.3 Test setup

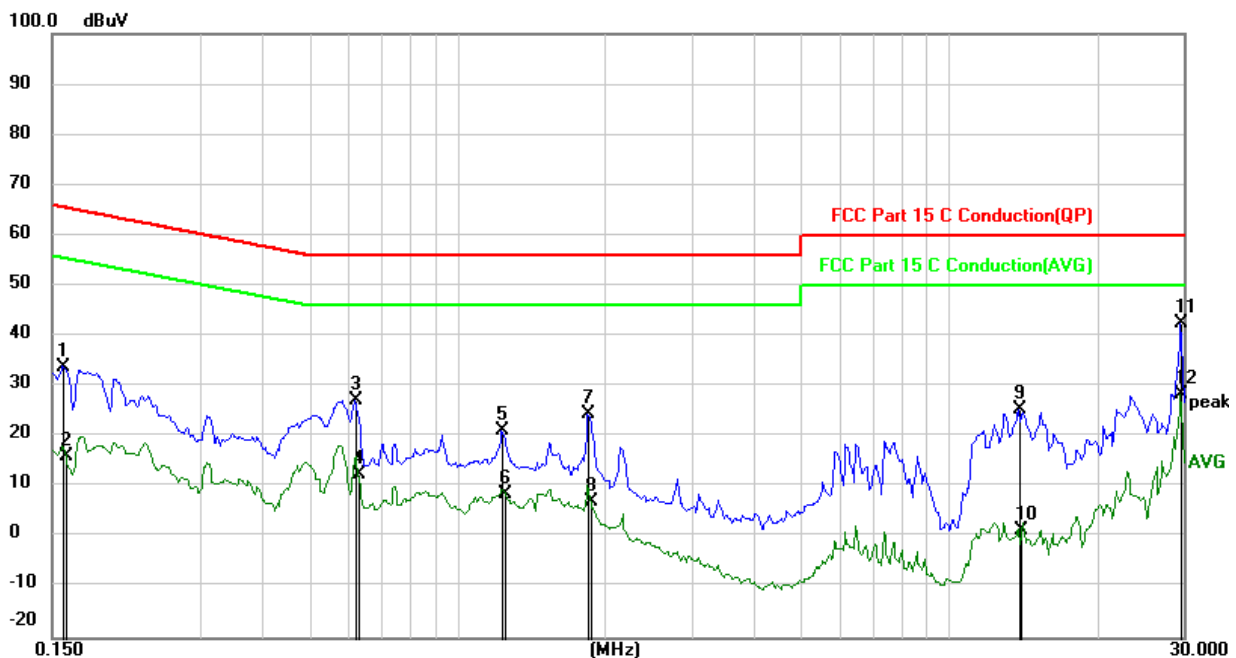


6.2.4 Test results

EUT:	mPCIe LoRa Concentrator Board	Model Name. :	NM0824-I
Temperature:	24°C	Relative Humidity:	52%
Pressure:	1010hPa	Test Date :	2022-09-29
Test Mode:	TX (worst case)	Phase :	Line
Test Voltage :	110Vac,60Hz		

	MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	0.1578	44.01	-10.01	34.00	65.57	-31.57	QP
2	0.1598	26.09	-10.00	16.09	55.47	-39.38	AVG
3	0.6180	37.11	-9.86	27.25	56.00	-28.75	QP
4	0.6297	22.36	-9.86	12.50	46.00	-33.50	AVG
5	1.2342	31.04	-9.82	21.22	56.00	-34.78	QP
6	1.2554	18.38	-9.82	8.56	46.00	-37.44	AVG
7	1.8426	34.33	-9.87	24.46	56.00	-31.54	QP
8	1.8680	16.96	-9.87	7.09	46.00	-38.91	AVG
9	13.8585	35.19	-9.86	25.33	60.00	-34.67	QP
10	14.0628	11.43	-9.86	1.57	50.00	-48.43	AVG
11 *	29.6067	34.14	8.51	42.65	60.00	-17.35	QP
12	29.6067	19.89	8.51	28.40	50.00	-21.60	AVG

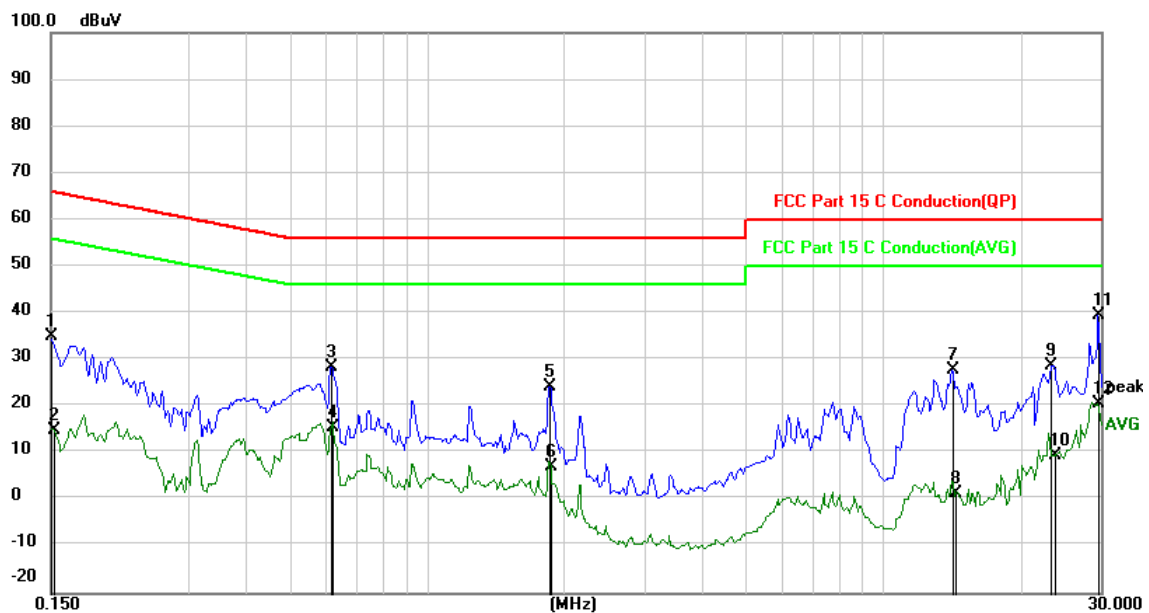
Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.



EUT:	mPCIe LoRa Concentrator Board	Model Name. :	NM0824-I
Temperature:	24°C	Relative Humidity:	52%
Pressure:	1010hPa	Test Date :	2022-09-29
Test Mode:	TX (worst case)	Phase :	Neutral
Test Voltage :	110Vac,60Hz		

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1500	45.06	-10.05	35.01	65.99	-30.98	QP
2		0.1524	24.85	-10.04	14.81	55.86	-41.05	AVG
3		0.6141	38.36	-9.86	28.50	56.00	-27.50	QP
4		0.6238	25.53	-9.86	15.67	46.00	-30.33	AVG
5		1.8543	34.10	-9.87	24.23	56.00	-31.77	QP
6		1.8698	17.09	-9.87	7.22	46.00	-38.78	AVG
7		14.1939	37.85	-9.86	27.99	60.00	-32.01	QP
8		14.4403	11.20	-9.87	1.33	50.00	-48.67	AVG
9		23.3745	38.95	-10.08	28.87	60.00	-31.13	QP
10		23.7021	19.69	-10.08	9.61	50.00	-40.39	AVG
11 *		29.6222	31.04	8.57	39.61	60.00	-20.39	QP
12		29.6222	12.07	8.57	20.64	50.00	-29.36	AVG

Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.



6.3 Radiated Emissions Measurement

6.3.1 Applied procedures / Limit

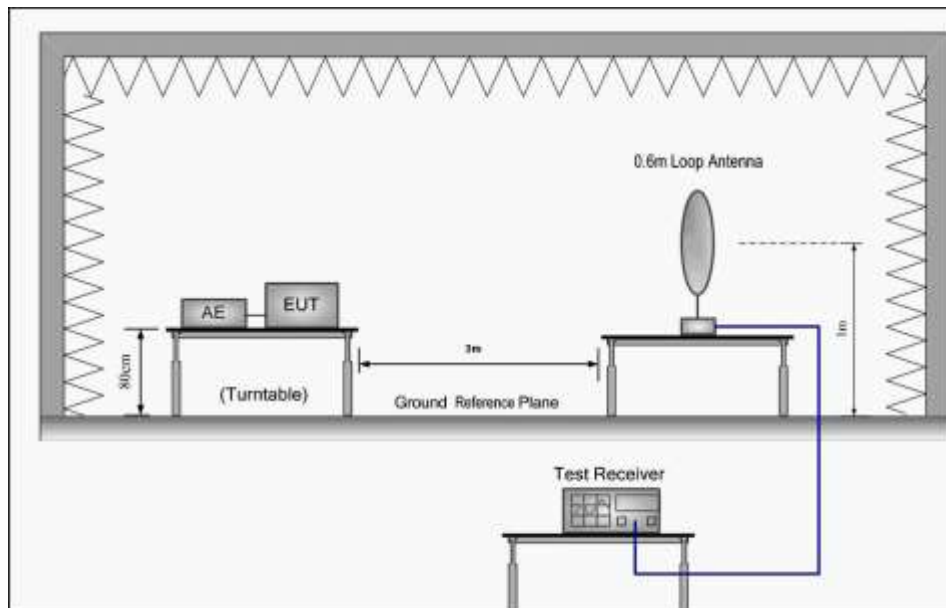
15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Frequency of Emission (MHz)	Field Strength		Measurement Distance (meters)
	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$	
0.009-0.49	2400/F(kHz)		300
0.49-1.705	24000/F(kHz)		30
1.705-30	30		30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

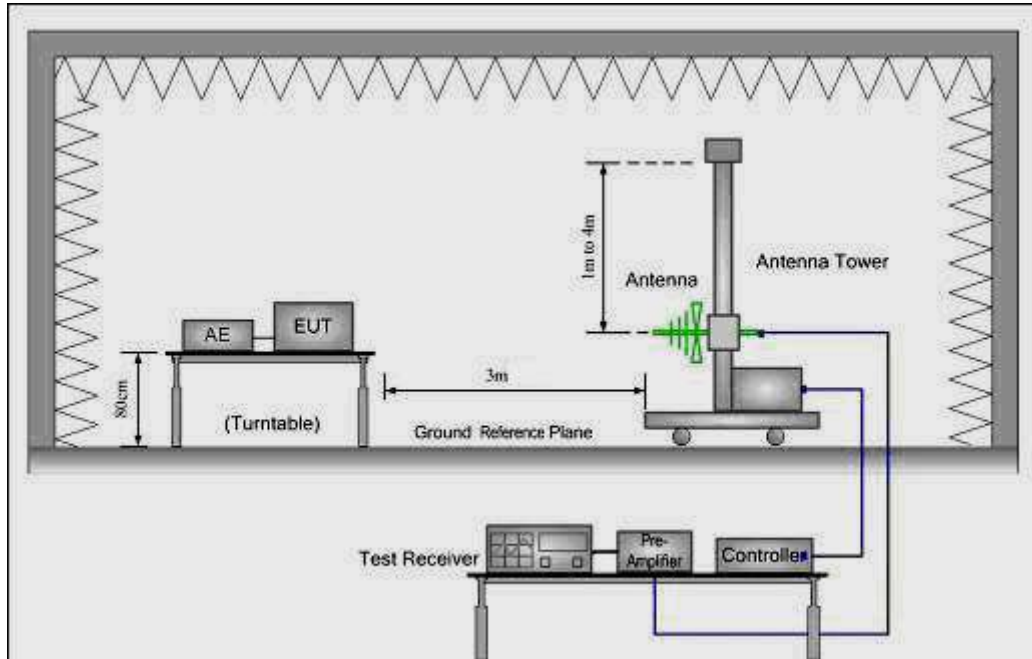
6.3.2 Test setup

Test Configuration:

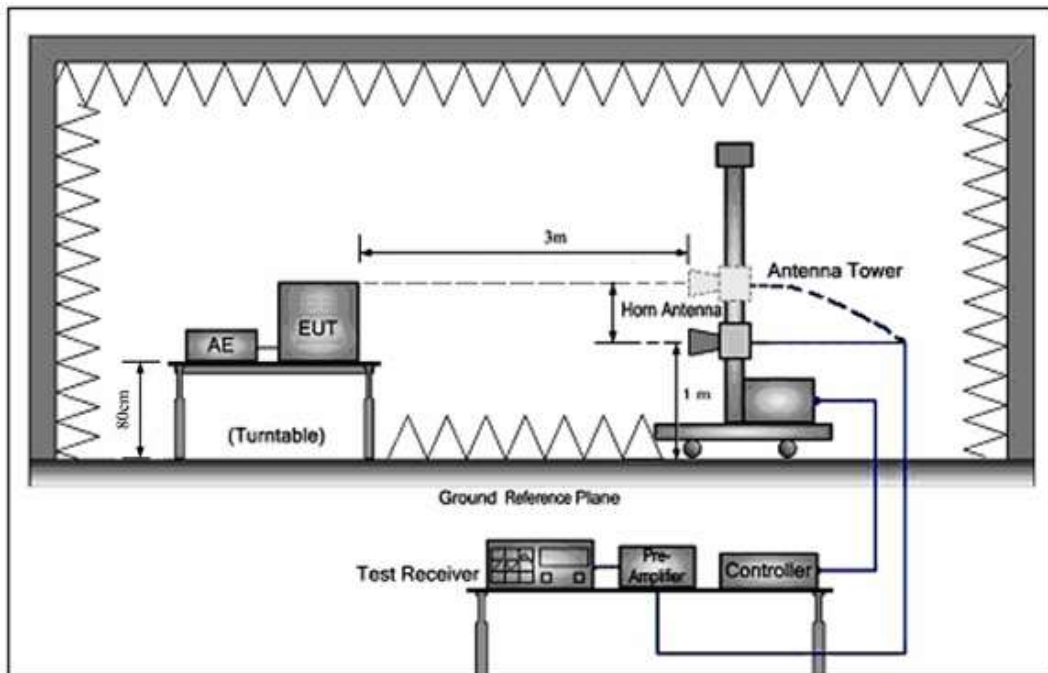
- 1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) Above 1 GHz emissions:



6.3.3 Test procedure

EUT was placed upon a wooden test table which was placed on the turn table 0.8m above the horizontal metal ground plane, and operating in the mode as mentioned above. A receiving antenna was placed 3m away from the EUT. During testing, turn around the turn table and move the antenna from 1m to 4m to find the maximum field-strength reading. All peripherals were placed at a distance of 10cm between each other. Both horizontal and Vertical antenna polarities were tested. The worst case emissions were reported.

For measurement at frequency above 1GHz

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

6.3.4 Test Result

Radiated Emissions Test Data Below 30MHz

EUT:	mPCIe LoRa Concentrator Board	Model Name. :	NM0824-I
Temperature:	24.5°C	Test Data	2022-08-17
Pressure:	1010hPa	Relative Humidity:	51%
Test Mode :	TX (worst case)	Test Voltage :	AC 110V, 60Hz
Measurement Distance	3 m	Frequency Range	9KHz to 30MHz
RBW/VBW	9KHz~150KHz/RB 200Hz for QP, 150KHz~30MHz/RB 9KHz for QP		

No emission found between lowest internal used/generated frequencies to 30MHz.



Radiated Emissions Test Data Below 1GHz

EUT:	mPCIe LoRa Concentrator Board	Model Name. :	NM0824-I
Temperature:	24.5°C	Test Data	2022-08-17
Pressure:	1010hPa	Relative Humidity:	51%
Test Mode :	TX (worst case)	Test Voltage :	AC 110V, 60Hz
Measurement Distance	3 m	Frequency Range	30MHz to 1GHz
RBW/VBW	100KHz / 300KHz for spectrum, RBW=120KHz for receiver.		

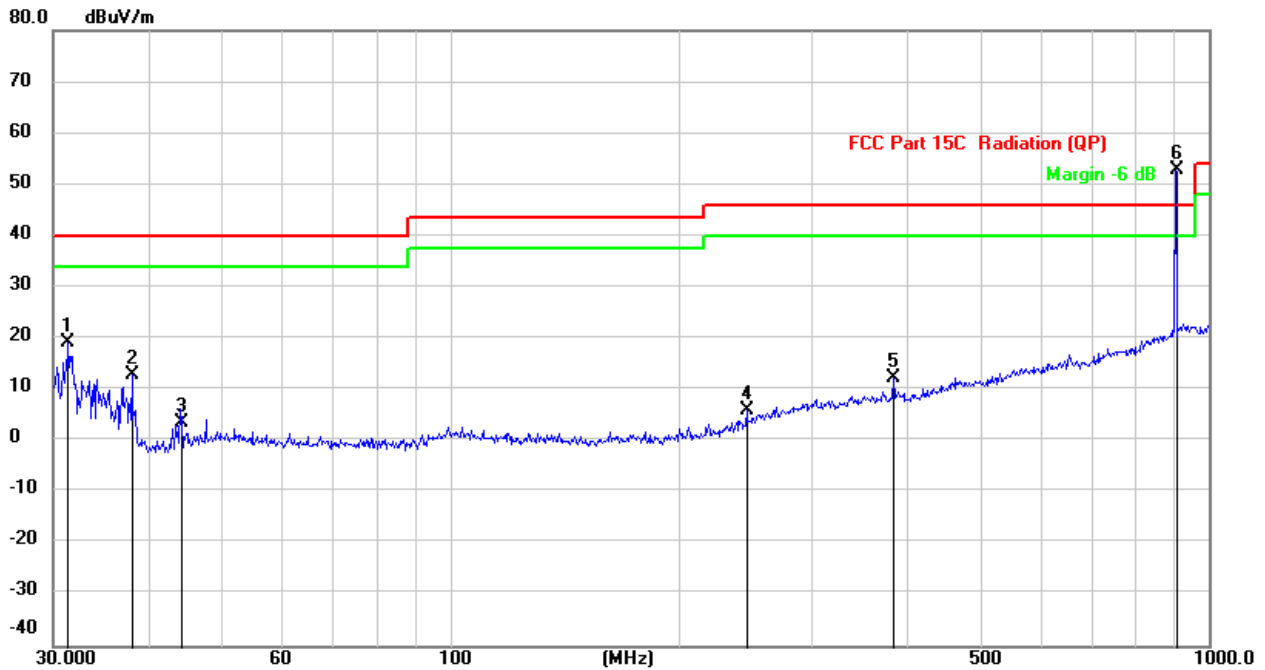
Test at Channel (903.0 MHz) in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		31.3992	30.69	-11.33	19.36	40.00	-20.64	QP
2		38.0783	30.15	-17.05	13.10	40.00	-26.90	QP
3		44.2752	20.98	-17.35	3.63	40.00	-36.37	QP
4		245.9509	17.07	-10.91	6.16	46.00	-39.84	QP
5		383.9318	18.73	-6.37	12.36	46.00	-33.64	QP
6	*	903.3094	46.51	6.43	52.94	46.00	6.94	QP

Note: ‘*’ means the worst case

Measurement Level = Reading Level + Factor

Factor= Ant Factor + Cable Loss - Pre-amplifier

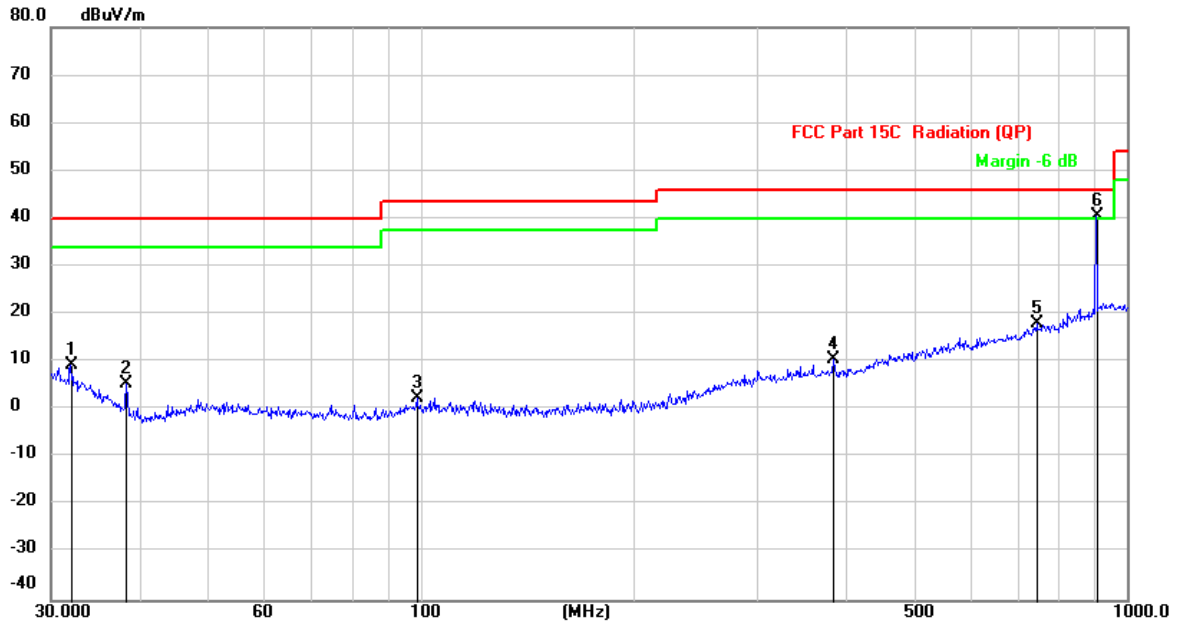
Note:-Marker 6 is intentional desired frequency of EUT Hence considered as PASS.

Test at Channel (903.0 MHz) in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan
Level (dB μ V/m)



Quasi-peak measurement

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		31.9546	20.98	-11.55	9.43	40.00	-30.57	QP
2		38.3462	22.65	-17.24	5.41	40.00	-34.59	QP
3		98.8326	16.43	-14.03	2.40	43.50	-41.10	QP
4		383.9318	16.40	-5.95	10.45	46.00	-35.55	QP
5		744.8661	15.84	2.18	18.02	46.00	-27.98	QP
6	*	903.3094	34.07	6.43	40.50	46.00	-5.50	QP

Note: ‘*’ means the worst case

Measurement Level = Reading Level + Factor
Factor= Ant Factor + Cable Loss - Pre-amplifier

Note:-Marker 6 is intentional desired frequency of EUT Hence considered as PASS.

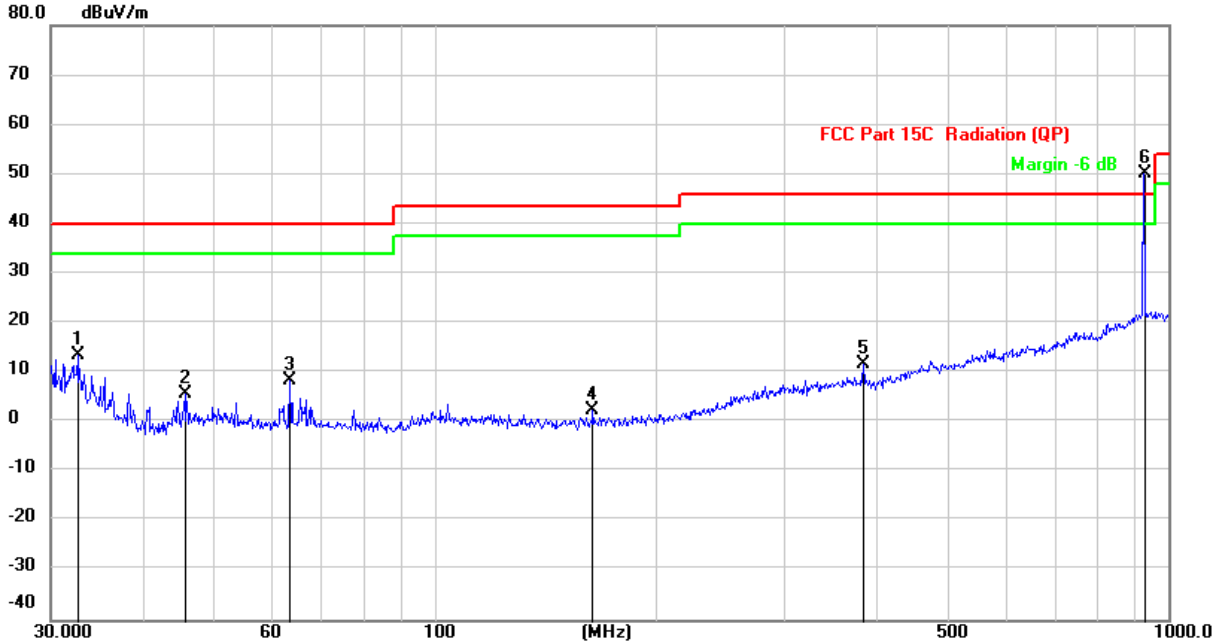
Test at Channel (923.5 MHz) in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan

Level (dB μ V/m)



Quasi-peak measurement

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		32.6340	25.89	-12.36	13.53	40.00	-26.47	QP
2		45.6948	22.53	-16.88	5.65	40.00	-34.35	QP
3		63.5356	24.73	-16.20	8.53	40.00	-31.47	QP
4		164.3301	16.68	-14.30	2.38	43.50	-41.12	QP
5		383.9318	18.24	-6.37	11.87	46.00	-34.13	QP
6	*	925.7563	43.72	6.48	50.20	46.00	4.20	QP

Note: ‘*’ means the worst case

Measurement Level = Reading Level + Factor

Factor= Ant Factor + Cable Loss - Pre-amplifier

Note:-Marker 6 is intentional desired frequency of EUT Hence considered as PASS.

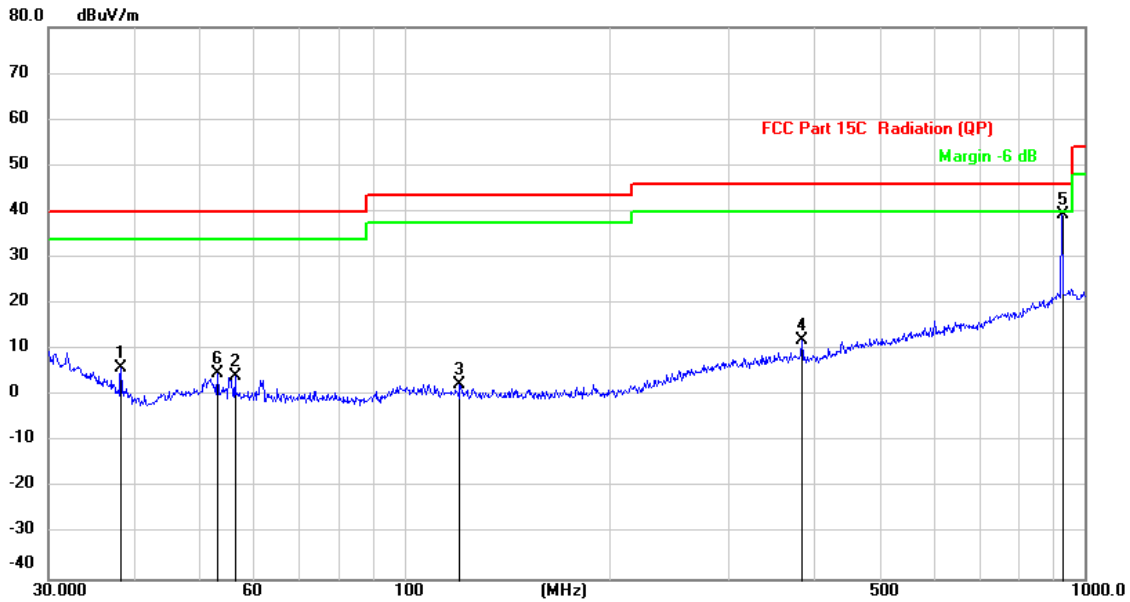
Test at Channel (923.5 MHz) in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		38.3462	23.38	-17.24	6.14	40.00	-33.86	QP
2		56.3948	19.90	-15.70	4.20	40.00	-35.80	QP
3		120.6991	17.23	-14.76	2.47	43.50	-41.03	QP
4		383.9318	17.88	-5.95	11.93	46.00	-34.07	QP
5	*	925.7563	32.74	6.48	39.22	46.00	-6.78	QP
6		53.1313	20.26	-15.48	4.78	40.00	-35.22	QP

Note: ‘*’ means the worst case

Measurement Level = Reading Level + Factor

Factor= Ant Factor + Cable Loss - Pre-amplifier

Note:-Marker 6 is intentional desired frequency of EUT Hence considered as PASS.

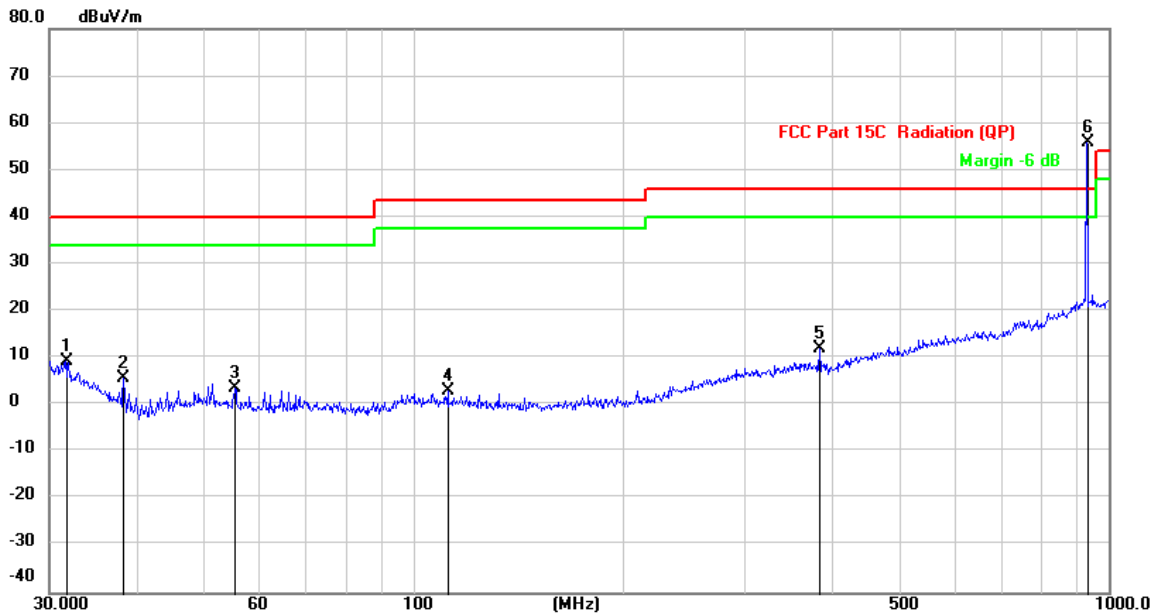
Test at Channel (927.5 MHz) in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Vertical:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		31.6202	20.86	-11.52	9.34	40.00	-30.66	QP
2		38.3462	23.04	-17.28	5.76	40.00	-34.24	QP
3		55.4147	19.62	-15.83	3.79	40.00	-36.21	QP
4		112.1305	18.09	-15.15	2.94	43.50	-40.56	QP
5		383.9318	18.33	-6.37	11.96	46.00	-34.04	QP
6	*	929.0082	49.32	6.49	55.81	46.00	9.81	QP

Note: ‘*’ means the worst case

Measurement Level = Reading Level + Factor

Factor= Ant Factor + Cable Loss - Pre-amplifier

Note:-Marker 6 is intentional desired frequency of EUT Hence considered as PASS.

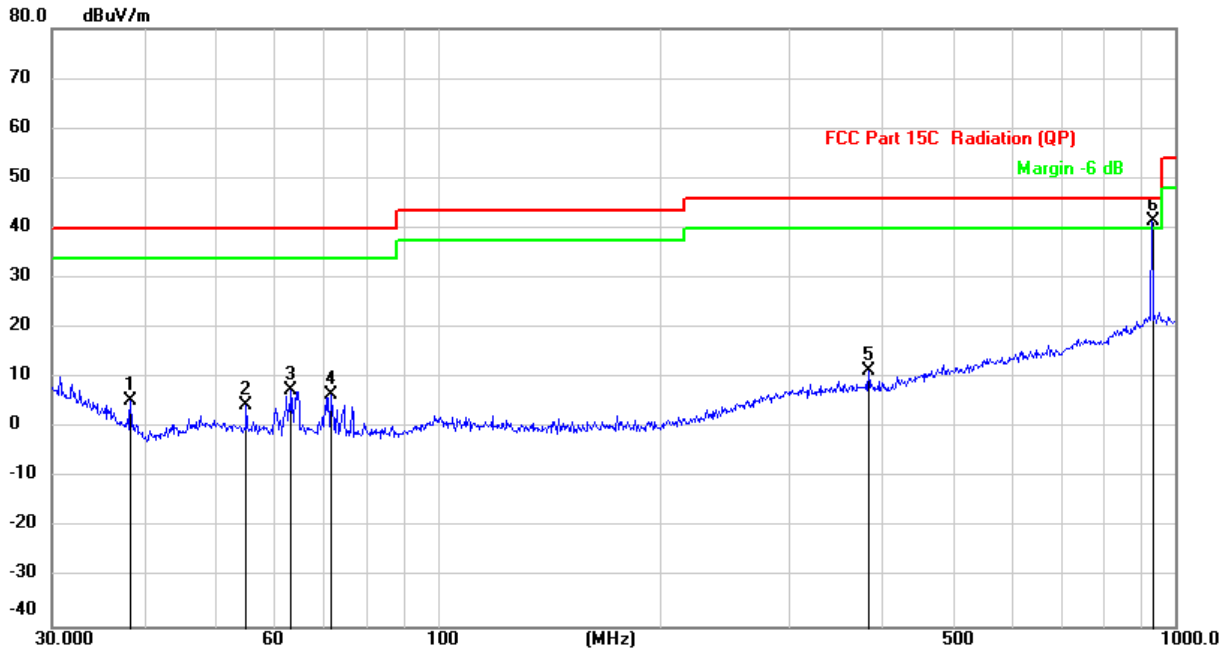
Test at Channel (927.5 MHz) in transmitting status

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement

Horizontal:

Peak scan

Level (dBμV/m)



Quasi-peak measurement

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		38.3462	22.72	-17.24	5.48	40.00	-34.52	QP
2		55.0274	20.10	-15.61	4.49	40.00	-35.51	QP
3		63.3132	23.62	-16.02	7.60	40.00	-32.40	QP
4		71.5806	22.73	-16.22	6.51	40.00	-33.49	QP
5		383.9318	17.53	-5.95	11.58	46.00	-34.42	QP
6	*	929.0082	34.97	6.49	41.46	46.00	-4.54	QP

Note: ‘*’ means the worst case

Measurement Level = Reading Level + Factor

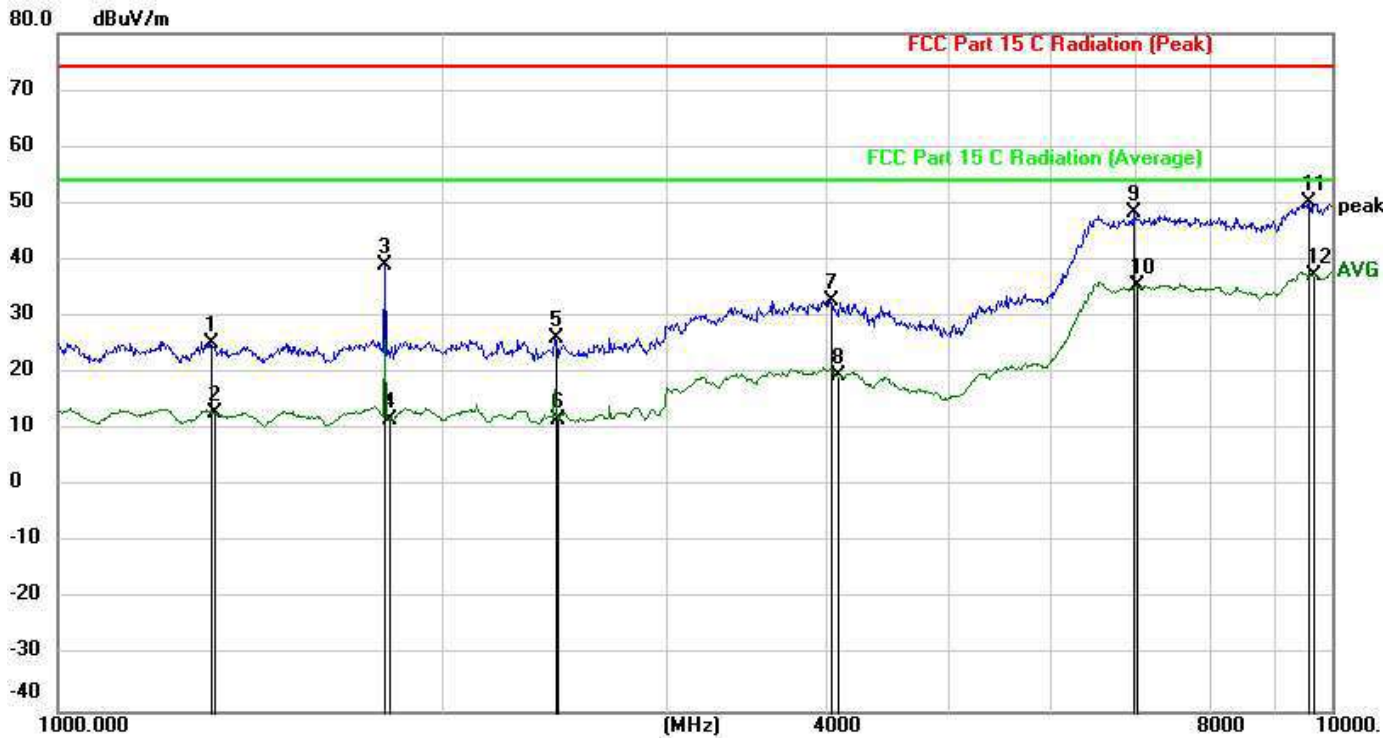
Factor= Ant Factor + Cable Loss - Pre-amplifier

Note:-Marker 6 is intentional desired frequency of EUT Hence considered as PASS.

Radiated Emissions Test Data Above 1GHz

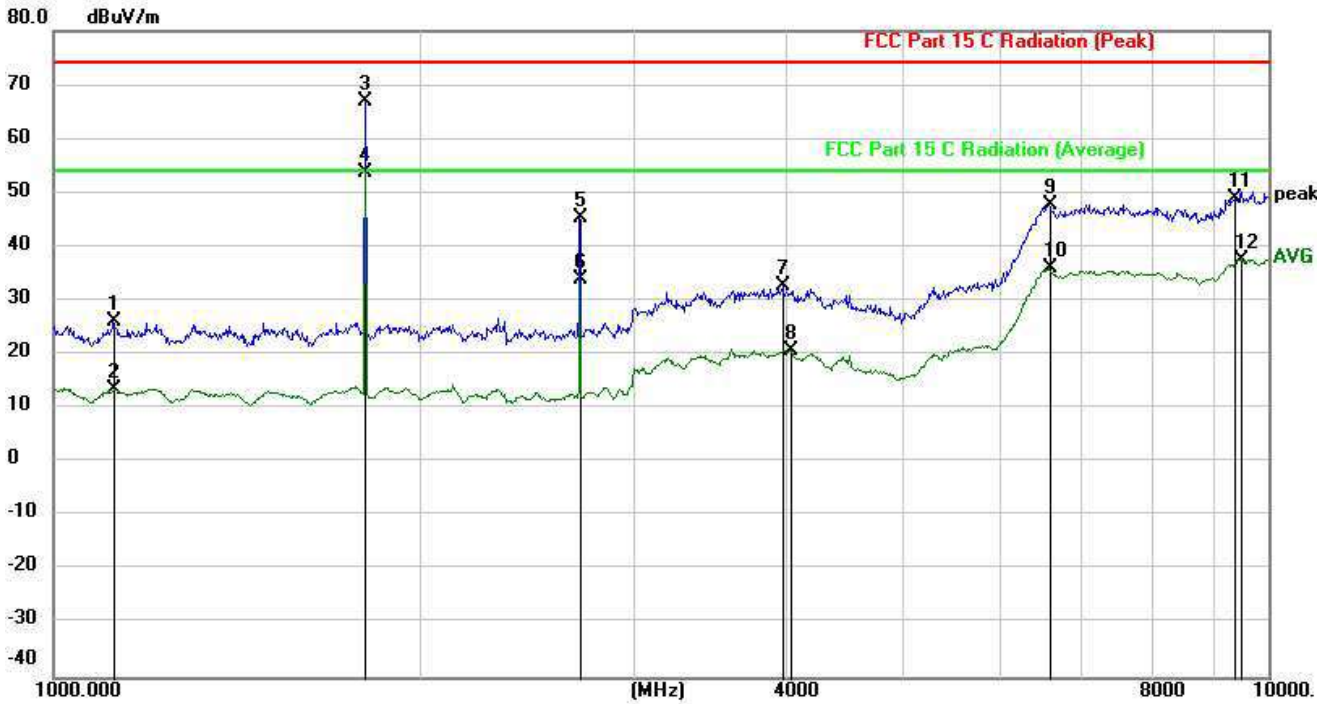
EUT:	mPCIe LoRa Concentrator Board	Model Name. :	NM0824-I
Temperature:	24.5°C	Test Data	2022-08-17
Pressure:	1010hPa	Relative Humidity:	51%
Test Mode :	TX (903MHz)	Test Voltage :	AC 110V, 60Hz
Measurement Distance	3 m	Frequency Range	1GHz to 25GHz
RBW/VBW	Spurious emission: 1MHz/1MHz for Peak, 1MHz/10Hz for Average. non-restricted band: 100KHz/300KHz for Peak.		

(a) Antenna polarization: Horizontal



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measurement dBuV/m	Limit dBuV/m	Over dB	Detector
1		1315.225	33.31	-8.17	25.14	74.00	-48.86	peak
2		1324.342	21.26	-8.21	13.05	54.00	-40.95	AVG
3		1803.018	48.07	-8.93	39.14	74.00	-34.86	peak
4		1815.516	20.75	-8.93	11.82	54.00	-42.18	AVG
5		2454.709	35.74	-9.54	26.20	74.00	-47.80	peak
6		2471.724	21.42	-9.55	11.87	54.00	-42.13	AVG
7		4036.454	38.07	-5.37	32.70	74.00	-41.30	peak
8		4083.194	25.19	-5.54	19.65	54.00	-34.35	AVG
9		6982.324	37.60	10.83	48.43	74.00	-25.57	peak
10		7030.723	24.57	10.85	35.42	54.00	-18.58	AVG
11		9594.006	36.01	14.09	50.10	74.00	-23.90	peak
12	*	9660.509	23.27	14.09	37.36	54.00	-16.64	AVG

(b) Antenna polarization: Vertical



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		1119.438	33.59	-7.49	26.10	74.00	-47.90	peak
2		1122.018	20.91	-7.50	13.41	54.00	-40.59	AVG
3		1803.018	75.81	-8.93	66.88	74.00	-7.12	peak
4	*	1803.018	62.73	-8.93	53.80	54.00	-0.20	AVG
5		2710.192	54.88	-9.40	45.48	74.00	-28.52	peak
6		2710.192	43.31	-9.40	33.91	54.00	-20.09	AVG
7		3981.072	37.92	-5.29	32.63	74.00	-41.37	peak
8		4036.454	26.27	-5.37	20.90	54.00	-33.10	AVG
9		6591.739	37.15	10.65	47.80	74.00	-26.20	peak
10		6591.739	25.36	10.65	36.01	54.00	-17.99	AVG
11		9375.620	35.66	13.26	48.92	74.00	-25.08	peak
12		9484.185	23.71	13.98	37.69	54.00	-16.31	AVG

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

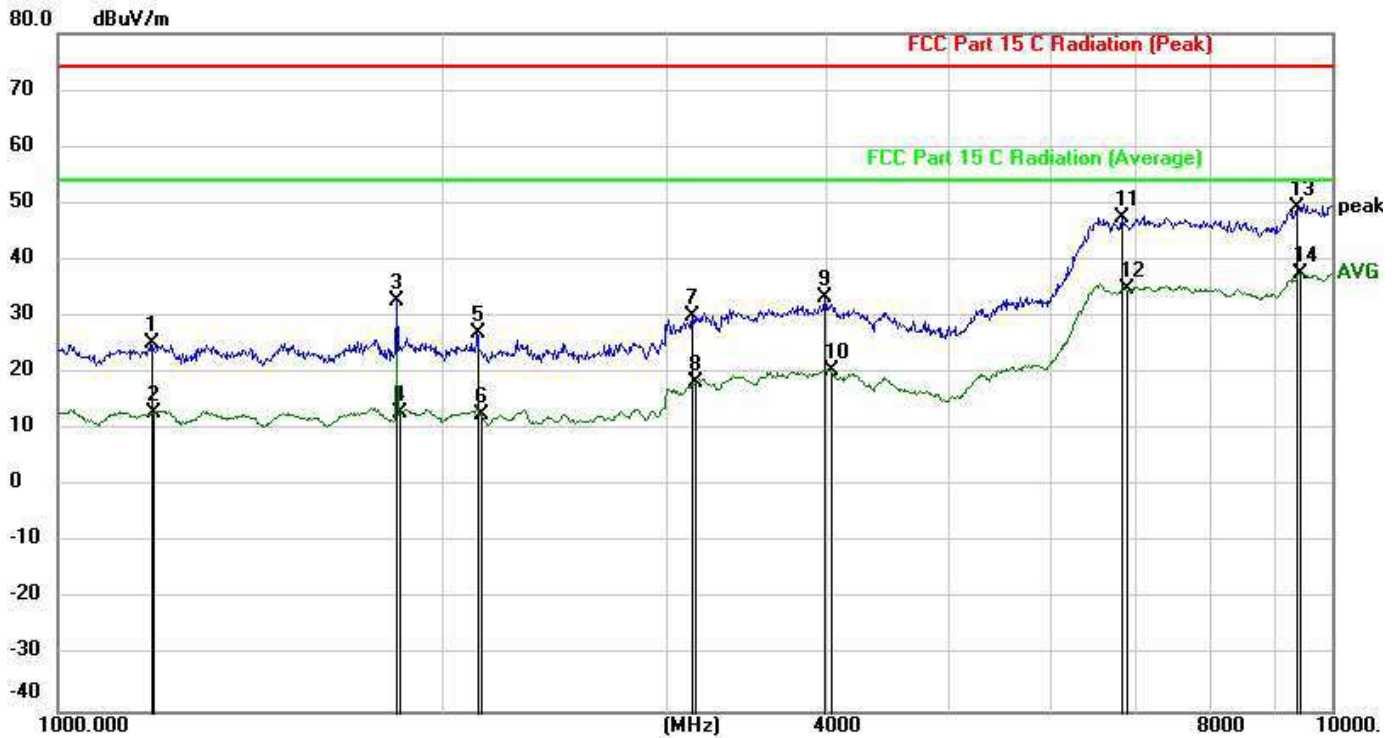
Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Highest channel: 903.0MHz

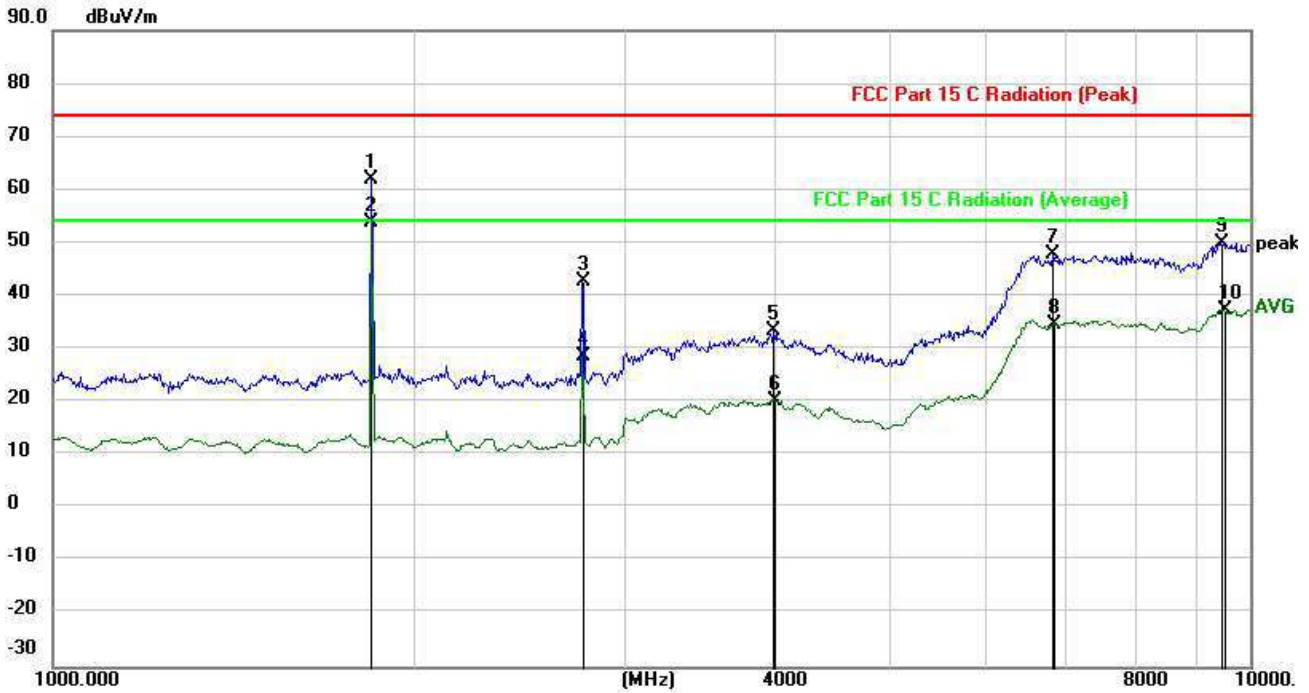
EUT:	mPCIe LoRa Concentrator Board	Model Name. :	NM0824-I
Temperature:	24.5°C	Test Data	2022-08-17
Pressure:	1010hPa	Relative Humidity:	51%
Test Mode :	TX (923.5MHz)	Test Voltage :	AC 110V, 60Hz
Measurement Distance	3 m	Frequency Range	1GHz to 25GHz
RBW/VBW	Spurious emission: 1MHz/1MHz for Peak, 1MHz/10Hz for Average. non-restricted band: 100KHz/300KHz for Peak.		

(a) Antenna polarization: Horizontal



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measurement dBuV/m	Limit dBuV/m	Over dB	Detector
1		1183.042	32.95	-7.71	25.24	74.00	-48.76	peak
2		1185.769	20.61	-7.72	12.89	54.00	-41.11	AVG
3		1845.015	41.57	-8.94	32.63	74.00	-41.37	peak
4		1857.804	22.00	-8.94	13.06	54.00	-40.94	AVG
5		2133.045	36.09	-9.15	26.94	74.00	-47.06	peak
6		2142.891	21.95	-9.17	12.78	54.00	-41.22	AVG
7		3147.748	38.56	-8.38	30.18	74.00	-43.82	peak
8		3169.567	26.75	-8.28	18.47	54.00	-35.53	AVG
9		3999.447	38.58	-5.23	33.35	74.00	-40.65	peak
10		4036.454	25.69	-5.37	20.32	54.00	-33.68	AVG
11		6839.116	36.71	10.76	47.47	74.00	-26.53	peak
12		6886.523	23.94	10.78	34.72	54.00	-19.28	AVG
13		9397.233	35.98	13.41	49.39	74.00	-24.61	peak

(b) Antenna polarization: Vertical



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		1845.015	70.97	-8.94	62.03	74.00	-11.97	peak
2	*	1845.015	62.94	-8.94	54.00	54.00	0.00	AVG
3		2766.942	52.09	-9.35	42.74	74.00	-31.26	peak
4		2766.942	38.13	-9.35	28.78	54.00	-25.22	AVG
5		3999.447	38.58	-5.23	33.35	74.00	-40.65	peak
6		4008.667	25.55	-5.27	20.28	54.00	-33.72	AVG
7		6839.116	36.96	10.76	47.72	74.00	-26.28	peak
8		6870.684	24.02	10.77	34.79	54.00	-19.21	AVG
9		9440.609	36.20	13.70	49.90	74.00	-24.10	peak
10		9506.048	23.29	14.08	37.37	54.00	-16.63	AVG

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

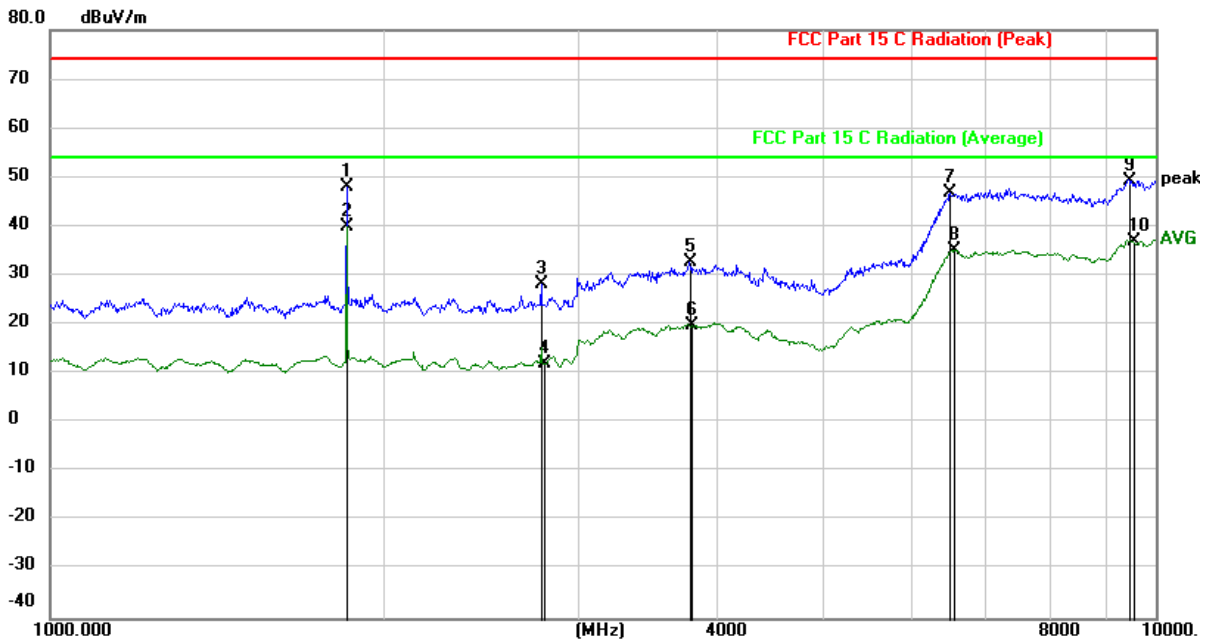
Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Highest channel: 923.5MHz

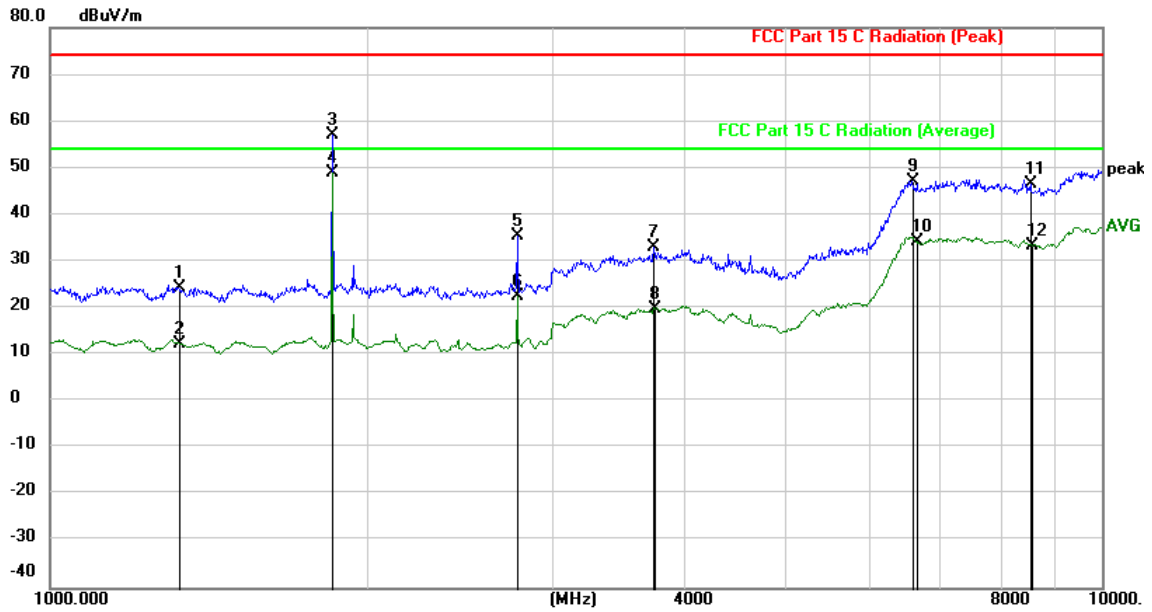
EUT:	mPCIe LoRa Concentrator Board	Model Name. :	NM0824-I
Temperature:	24.5°C	Test Data	2022-08-17
Pressure:	1010hPa	Relative Humidity:	51%
Test Mode :	TX (927.5MHz)	Test Voltage :	AC 110V, 60Hz
Measurement Distance	3 m	Frequency Range	1GHz to 25GHz
RBW/VBW	Spurious emission: 1MHz/1MHz for Peak, 1MHz/10Hz for Average. non-restricted band: 100KHz/300KHz for Peak.		

(a) Antenna polarization: Horizontal



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		1853.532	57.13	-8.95	48.18	74.00	-25.82	peak
2	*	1853.532	48.93	-8.95	39.98	54.00	-14.02	AVG
3		2779.713	37.62	-9.33	28.29	74.00	-45.71	peak
4		2798.981	21.30	-9.32	11.98	54.00	-42.02	AVG
5		3784.426	38.55	-5.84	32.71	74.00	-41.29	peak
6		3810.658	25.52	-5.77	19.75	54.00	-34.25	AVG
7		6516.284	36.17	10.61	46.78	74.00	-27.22	peak
8		6561.453	24.39	10.63	35.02	54.00	-18.98	AVG
9		9440.609	35.70	13.70	49.40	74.00	-24.60	peak
10		9527.962	22.86	14.09	36.95	54.00	-17.05	AVG

(b) Antenna polarization: Vertical



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		1324.342	32.66	-8.21	24.45	74.00	-49.55	peak
2		1327.394	20.63	-8.22	12.41	54.00	-41.59	AVG
3		1853.532	65.88	-8.95	56.93	74.00	-17.07	peak
4	*	1853.532	57.80	-8.95	48.85	54.00	-5.15	AVG
5		2779.713	44.81	-9.33	35.48	74.00	-38.52	peak
6		2779.713	31.78	-9.33	22.45	54.00	-31.55	AVG
7		3749.730	38.86	-5.93	32.93	74.00	-41.07	peak
8		3758.374	25.82	-5.91	19.91	54.00	-34.09	AVG
9		6591.739	36.45	10.65	47.10	74.00	-26.90	peak
10		6652.732	23.61	10.68	34.29	54.00	-19.71	AVG
11		8550.667	35.80	10.61	46.41	74.00	-27.59	peak
12		8590.135	22.85	10.62	33.47	54.00	-20.53	AVG

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss–Pre-amplifier

Highest channel: 927.5MHz

6.4 Occupied Bandwidth

6.4.1 Applied procedures / Limit

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz..

6.4.2 Test procedure

- The testing follows FCC KDB publication No. 558074 D01 DTS Meas. Guidance v03r03
- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- Spectrum Setting: RBW= 10KHz, VBW \geq 3 \times RBW, Sweep time = Auto, Detector Function = Peak, Mark the peak frequency and -6 dB points bandwidth.

6.4.3 Deviation from standard

No deviation.

6.4.4 Test setup



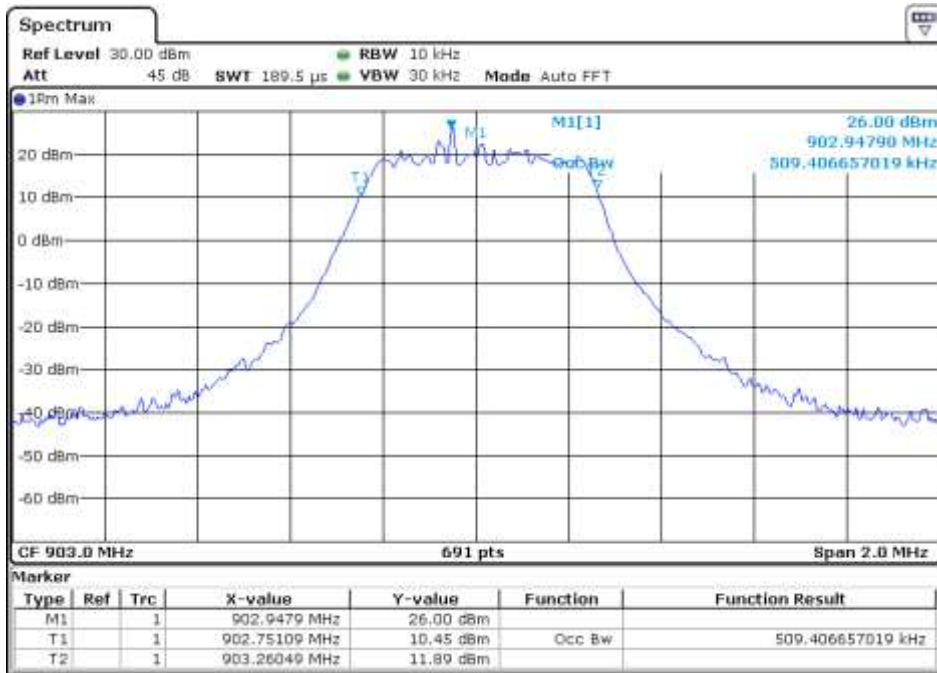
6.4.5 Test results

EUT:	mPCIe LoRa Concentrator Board	Model Name. :	NM0824-I
Temperature:	24.8 °C	Relative Humidity:	52%
Test Mode :	TX		

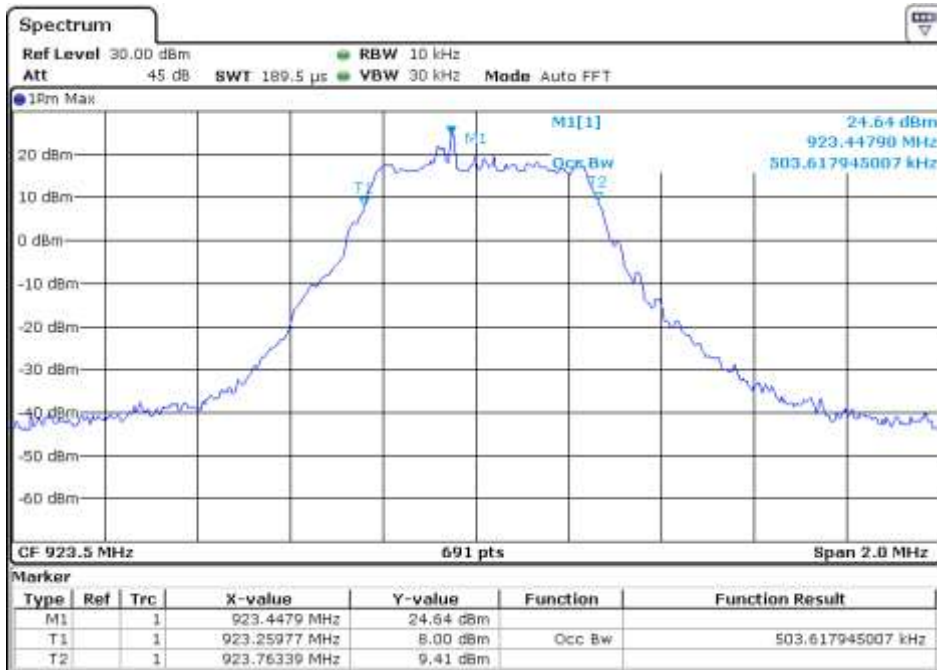
Channel	Channel frequency (MHz)	6dB bandwidth (KHz)	99% OBW (KHz)	Minimum 6dB Limit (KHz)	Conclusion
Low	903.0	671.50	509.40	≥500	Pass
Middle	923.5	564.40	503.61		Pass
High	927.5	593.30	526.77		Pass

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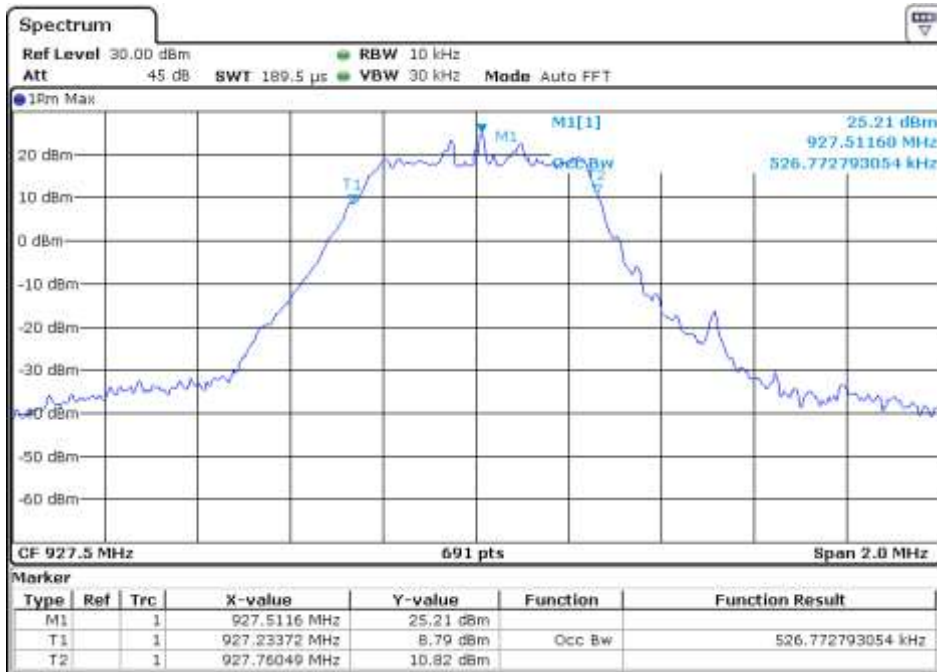
99% OBW @903.0MHz



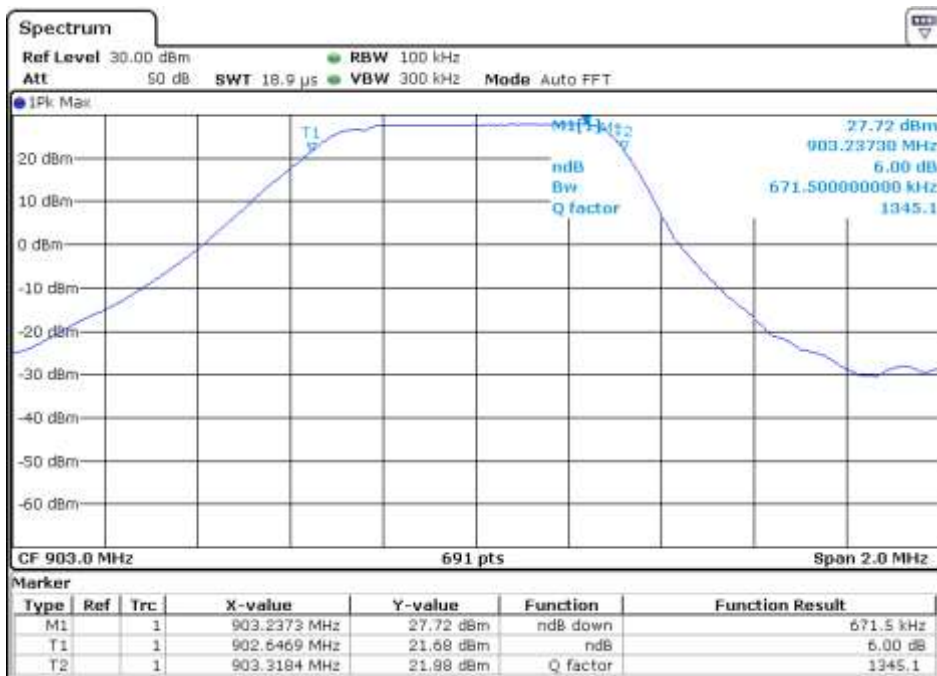
99% OBW @923.5MHz



99% OBW @927.5MHz

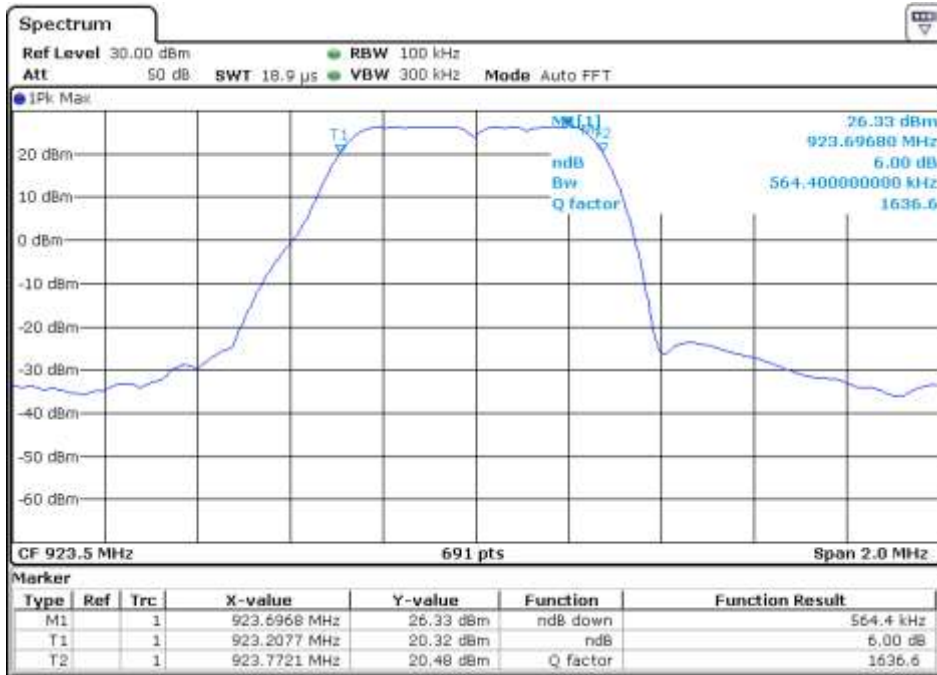


6dB Bandwidth @903.0MHz

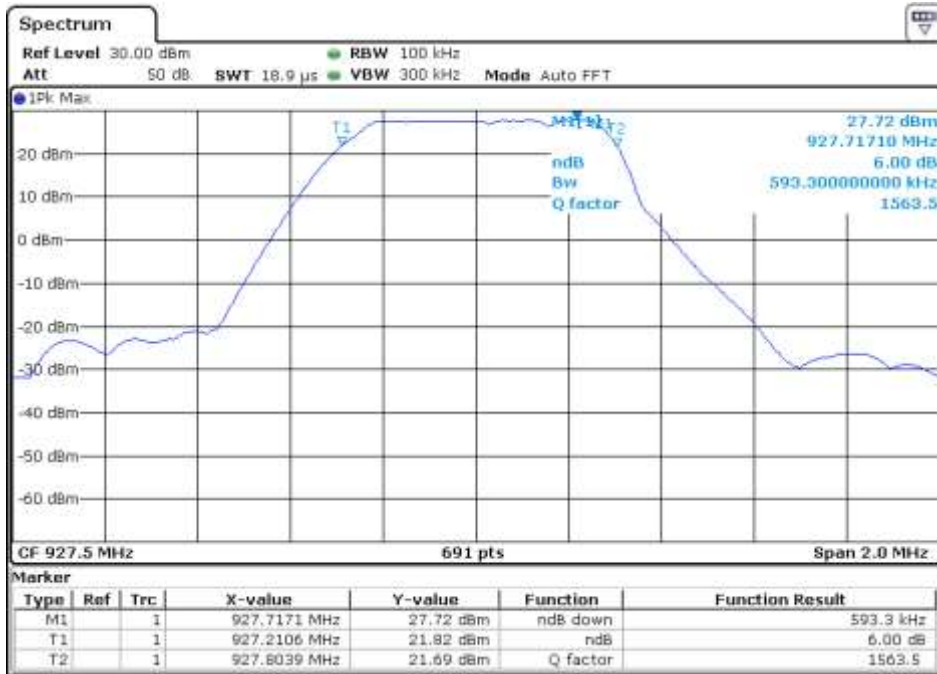


Report No.: AAEMT/EMC/220817-01-04

6dB Bandwidth @923.5MHz



6dB Bandwidth @927.5MHz



6.5 Power Spectral Density

6.5.1 Applied procedures / Limit

15.247(a) (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

6.5.2 Test procedure

- a. The testing follows Measurement procedure 10.2 Method PKPSD of FCC KDB publication No. 558074 D01 DTS Meas. Guidance v03r03
- b. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- c. Connected the antenna port to the Spectrum Analyzer, set the Spectrum Analyzer as center frequency to channel center frequency, span=1.5 times the bandwidth, detector = peak
 $3\text{kHz} \leq \text{RBW} \leq 100\text{kHz}$, $\text{VBW} \geq 3 \times \text{RBW}$ kHz, Sweep time=Auto.
- d. Trace mode = max hold. Mark the peak.
- e. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

□

6.5.3 Deviation from standard

No deviation.

6.5.4 Test setup



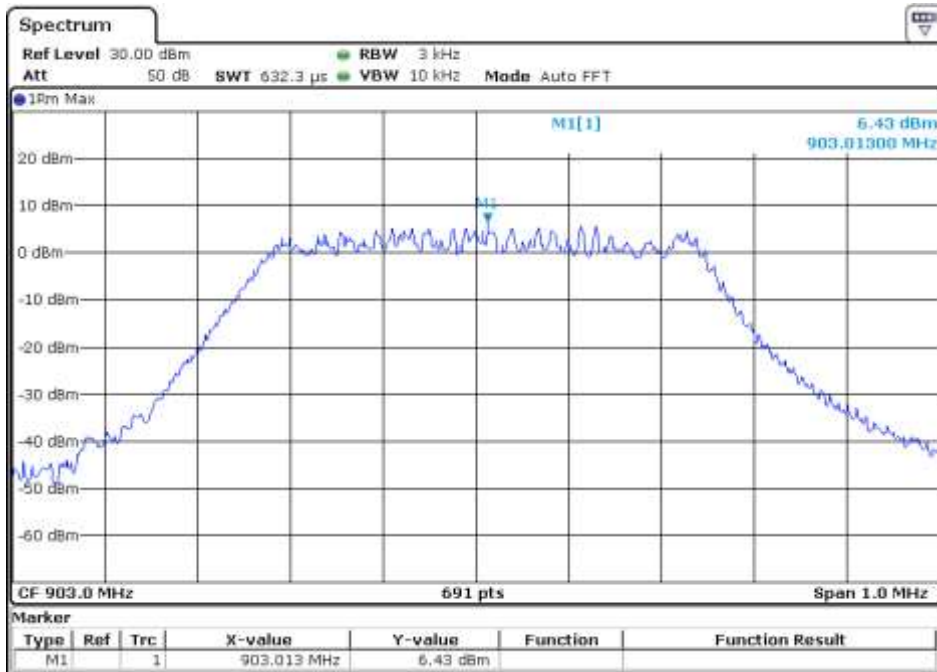
6.5.5 Test results

EUT:	mPCIe LoRa Concentrator Board	Model Name. :	NM0824-I
Temperature:	25.3 °C	Relative Humidity:	51%
Test Mode :	TX		

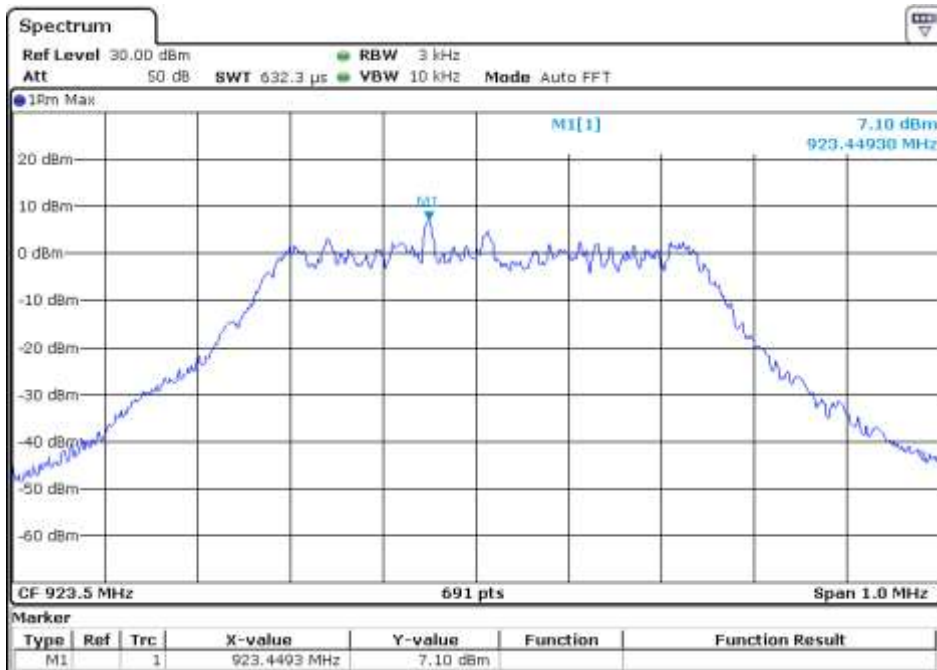
Test Mode	Channel frequency (MHz)	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
TX	903.0	6.43	8	Pass
	923.5	7.10	8	Pass
	927.5	6.75	8	Pass

Note: The cable loss is 0.9dB

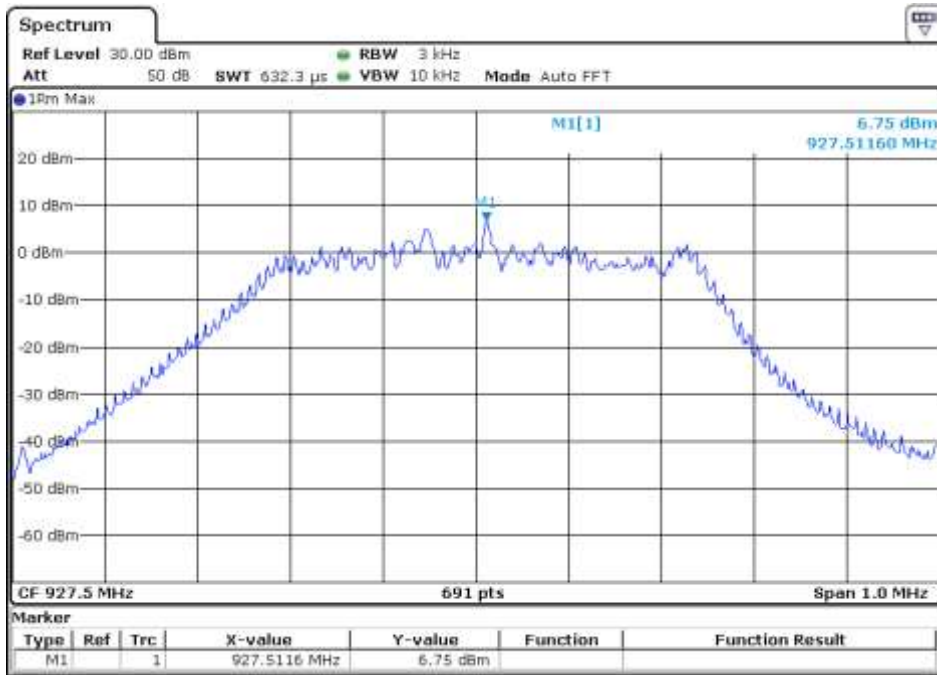
@903.0MHz



@923.5MHz



@927.5MHz



6.6 Maximum Average Conducted Output Power

6.6.1 Applied procedures / Limit

15.247(b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode

Requirement

Power \leq 1 W (30 dBm)

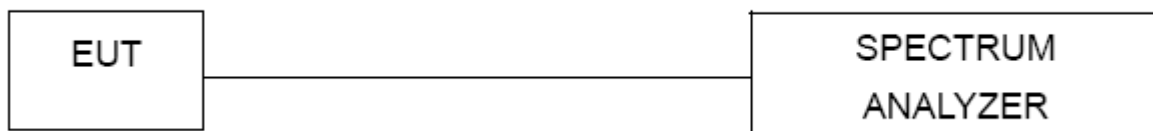
6.6.2 Test procedure

- a. The testing follows FCC KDB publication No. 558074 D01 DTS Meas. Guidance v03r03
- b. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- c. Spectrum Setting: RBW \geq Bandwidth, VBW \geq 3 \times RBW, Sweep time = Auto, Span \geq 3 \times RBW,
- d. Detector = peak. Trace mode = max hold.
- e. Use peak marker function to determine the peak amplitude level.

6.6.3 Deviation from standard

No deviation.

6.6.4 Test setup



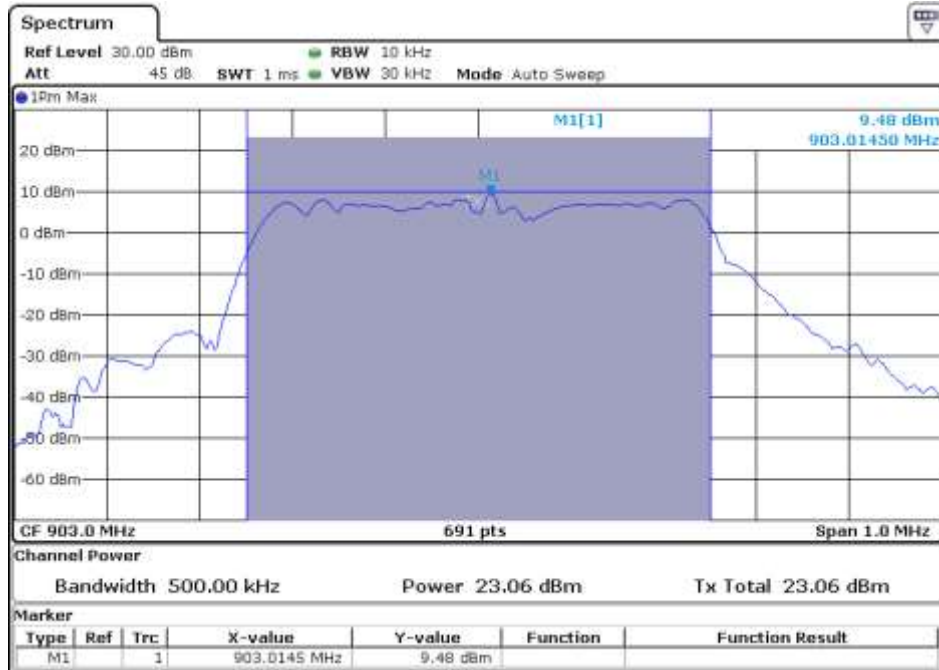
6.6.5 Test results

EUT:	mPCIe LoRa Concentrator Board	Model Name. :	NM0824-I
Temperature:	24.9°C	Relative Humidity:	51%
Test Mode :	TX		

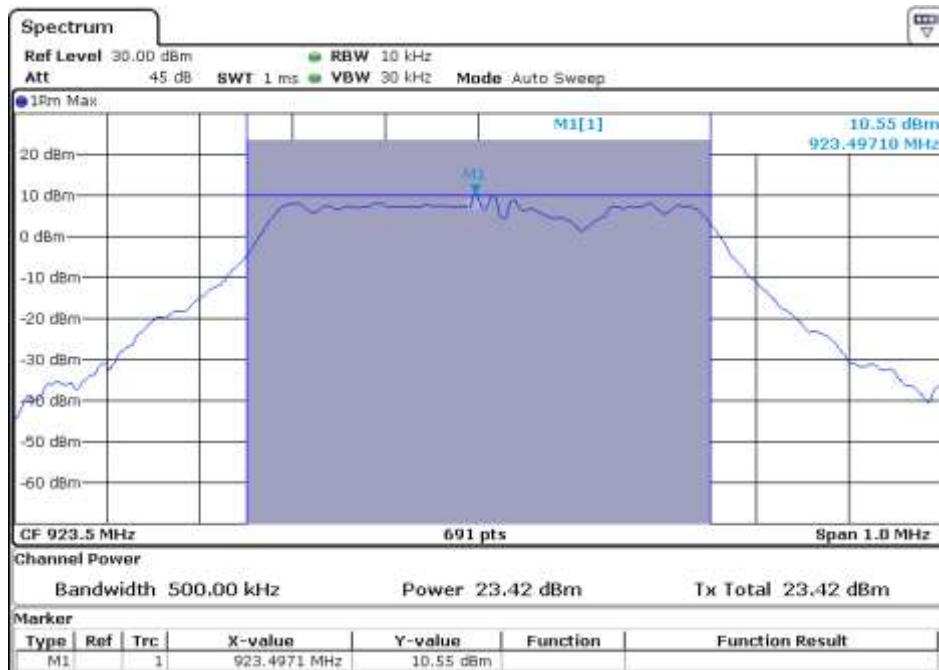
Channel	Channel frequency (MHz)	Measured Average Output Power (dBm)	Measured e.i.r.p (dBm)	Power Limit (dBm)	e.i.r.p Limit (dBm)	Result
Low	903.0	23.06	26.66	30	36	Pass
Middle	923.5	23.42	27.02	30	36	Pass
High	927.5	23.72	27.32	30	36	Pass
Cable loss = 0.9dBm						

Measured e.i.r.p (dBm)= Measured Average Output power (dBm) + Cable loss (0.9dB)+Antenna gain

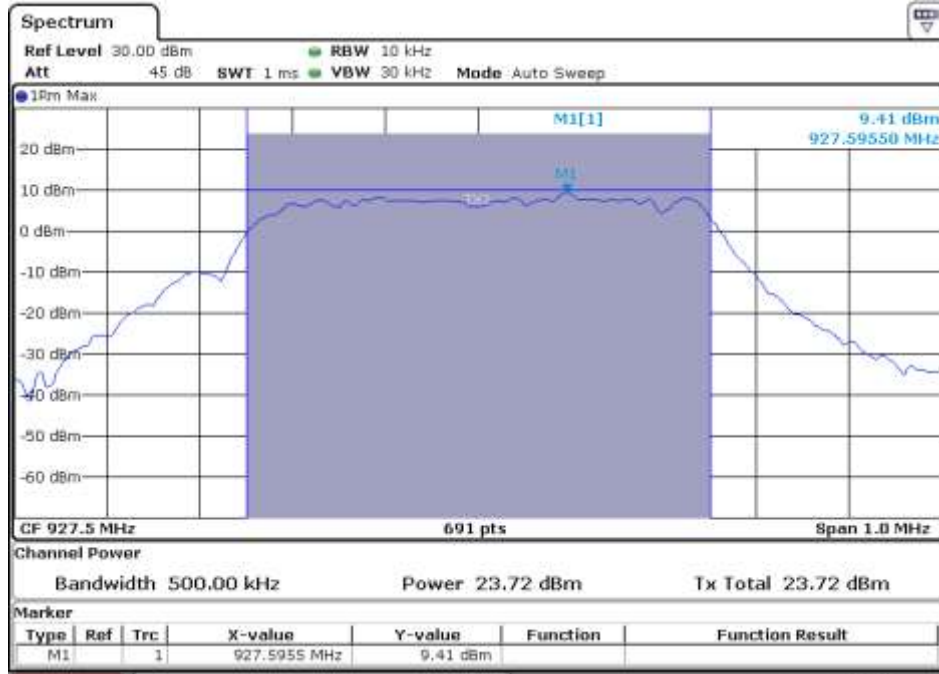
@903.0MHz



@923.5MHz



@927.5MHz



6.7 Band edge

6.7.1 Applied procedures / Limit

15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

6.7.2 Test procedure

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation, RBW \geq 1% of the span, VBW \geq RBW, Sweep = auto, Detector function = peak, Trace = max hold

6.7.3 Deviation from standard

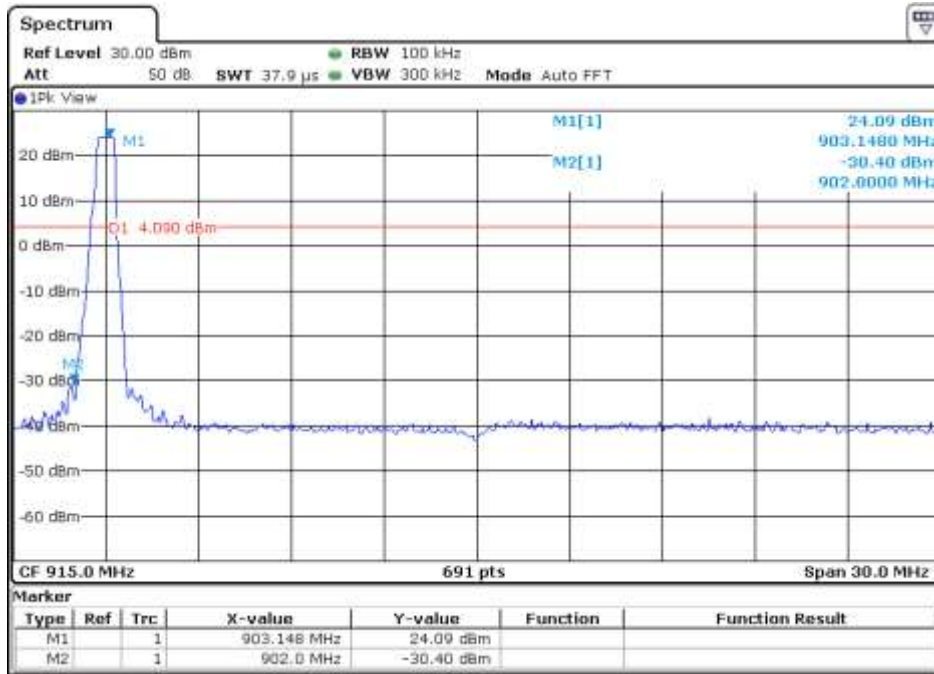
No deviation.

6.7.4 Test setup

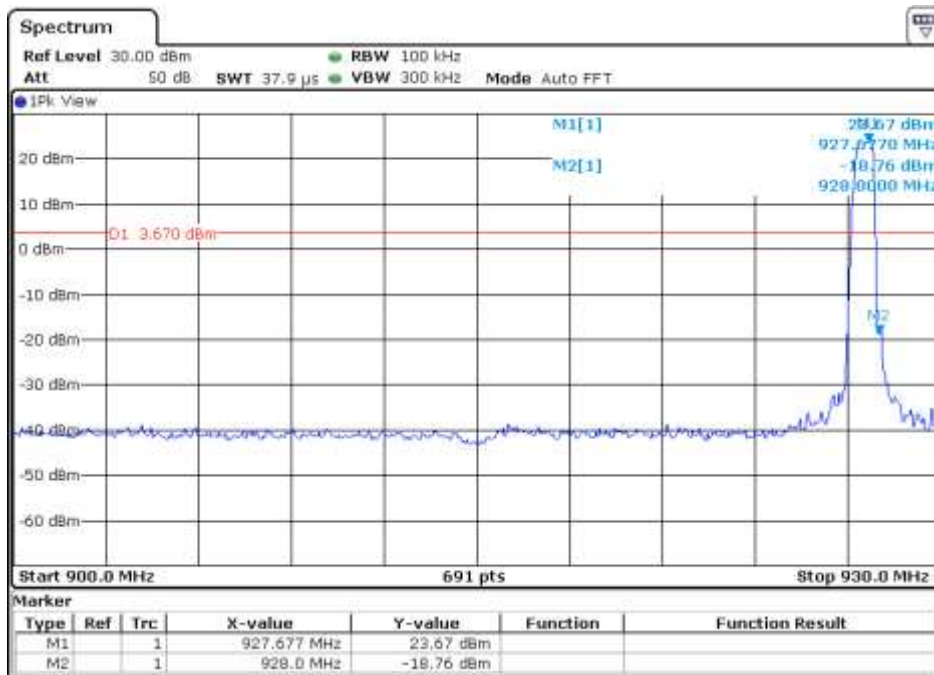


6.7.5 Test results

@903.0MHz



@927.5MHz



6.8 Conducted Spurious Emissions

6.8.1 Applied procedures / Limit

15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

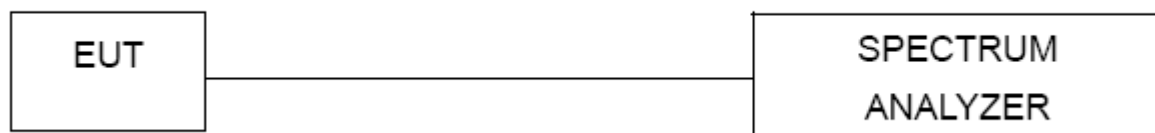
6.8.2 Test procedure

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span. RBW = 100 kHz
VBW \geq RBW, Sweep = auto, Detector function = peak, Trace = max hold
sweep points \geq investigated frequency range/RBW.

6.8.3 Deviation from standard

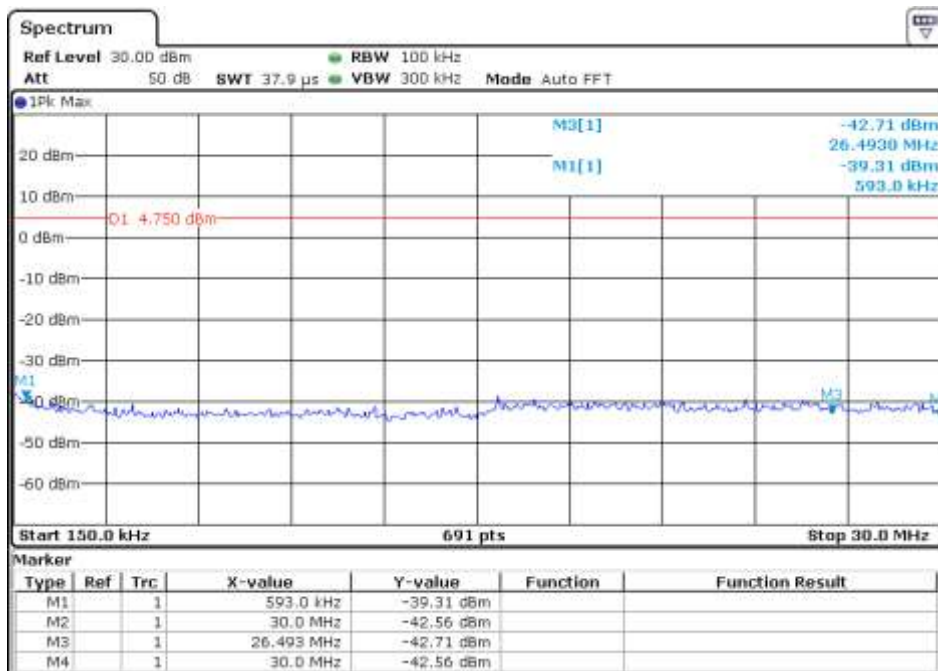
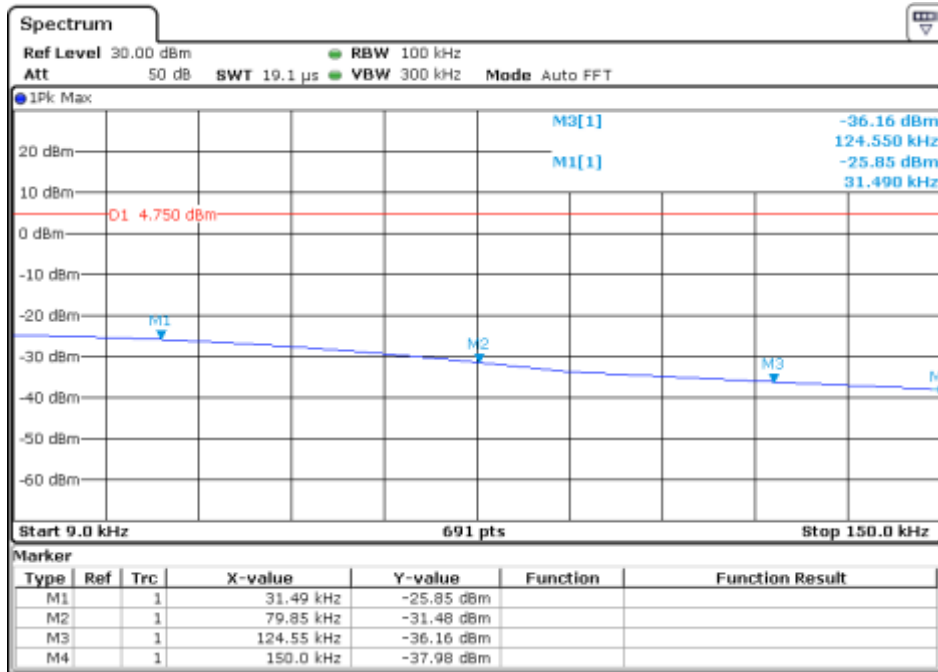
No deviation.

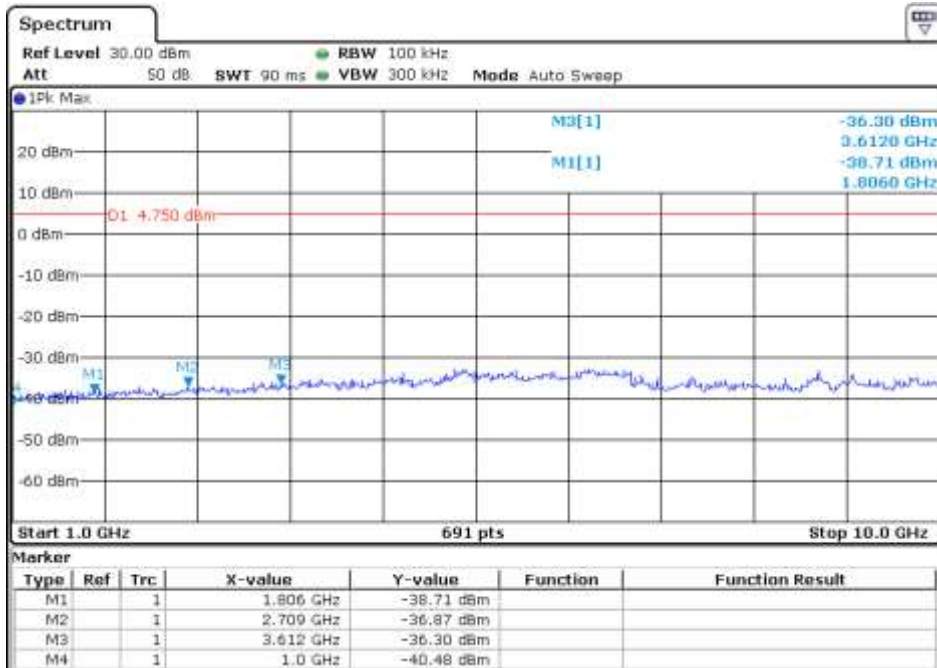
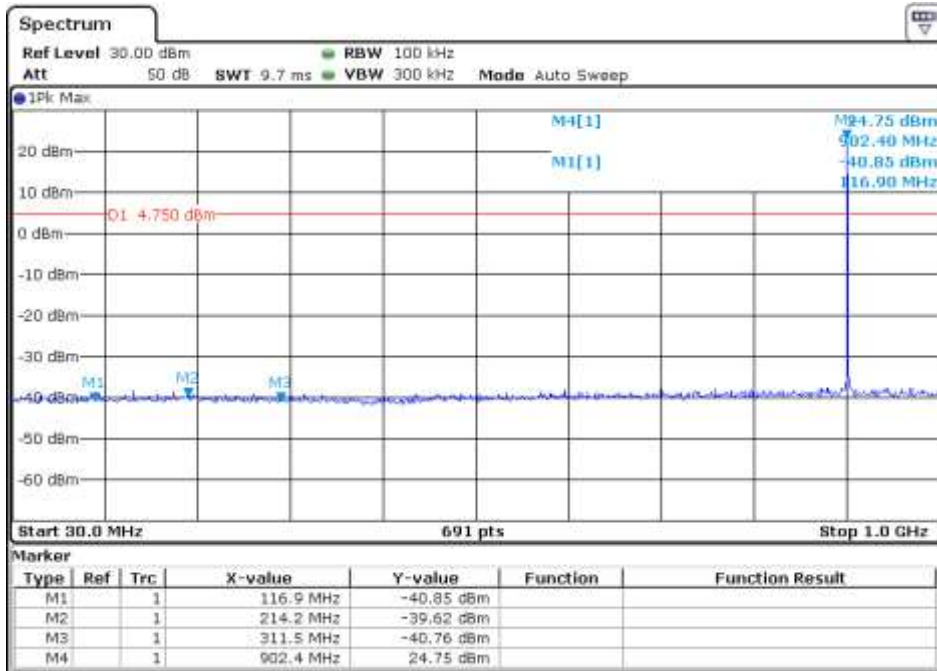
6.8.4 Test setup



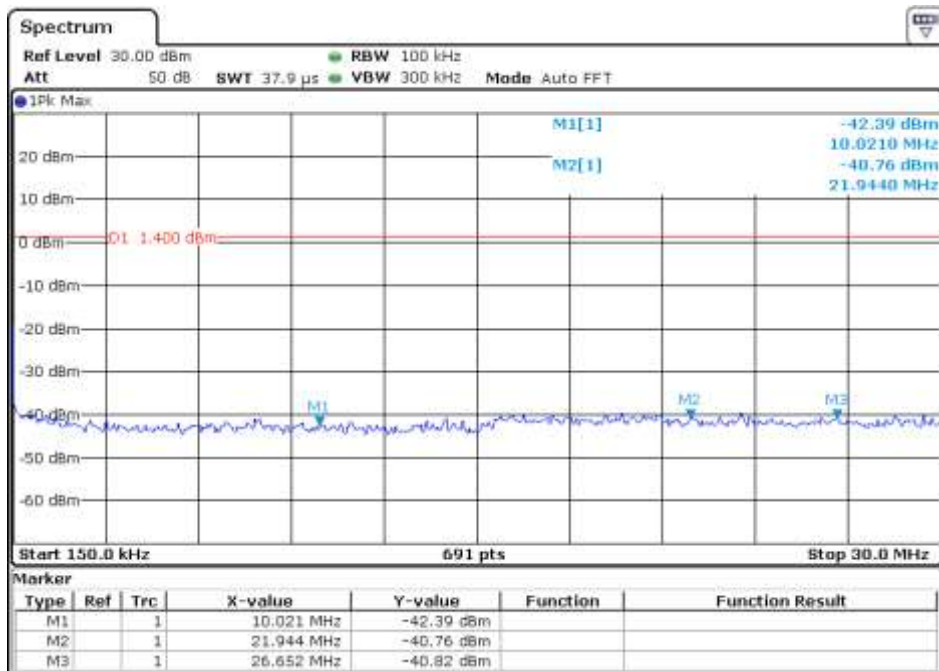
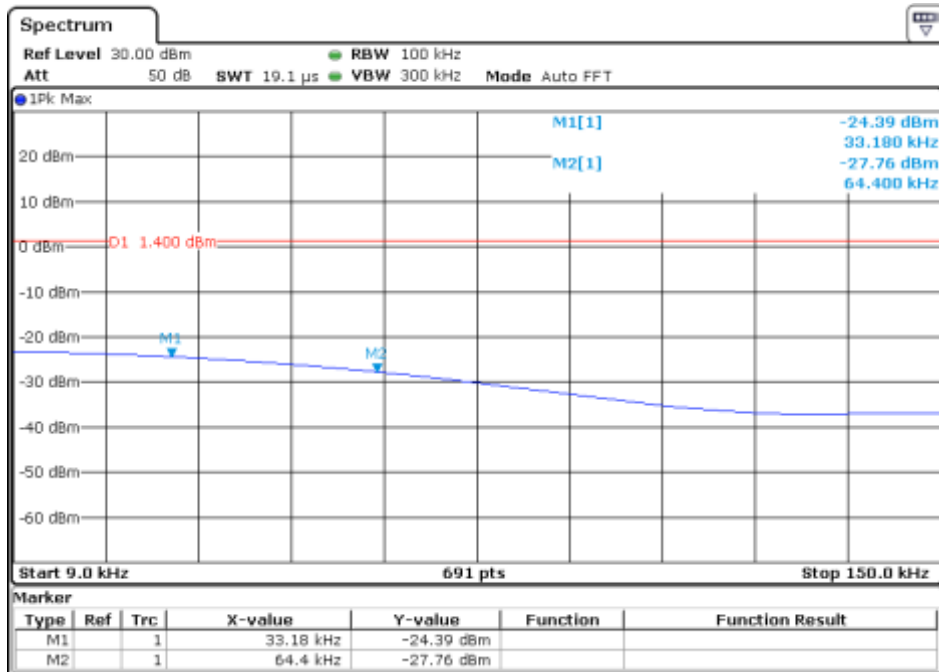
6.8.5 Test results

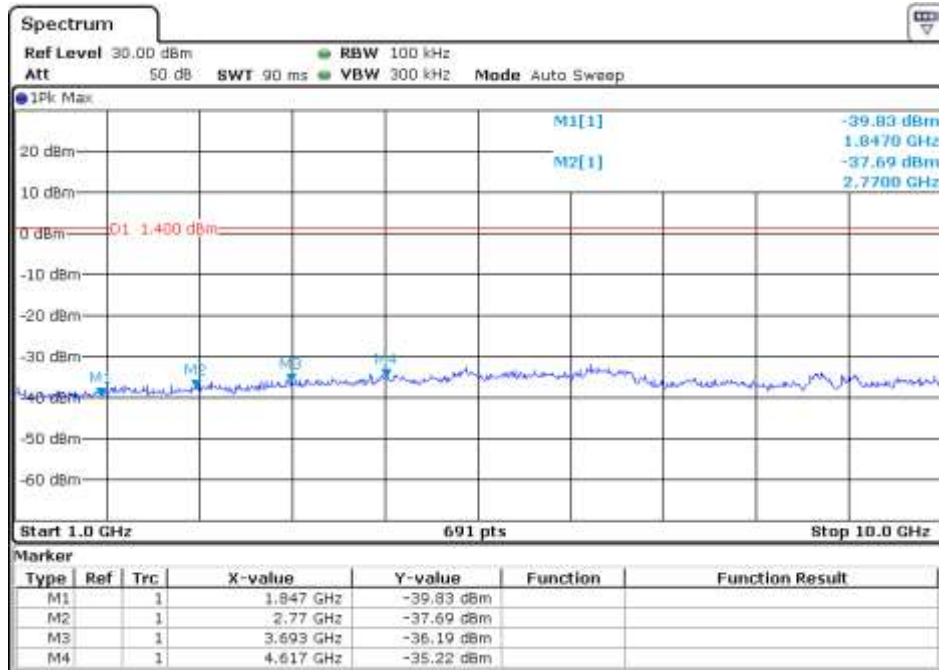
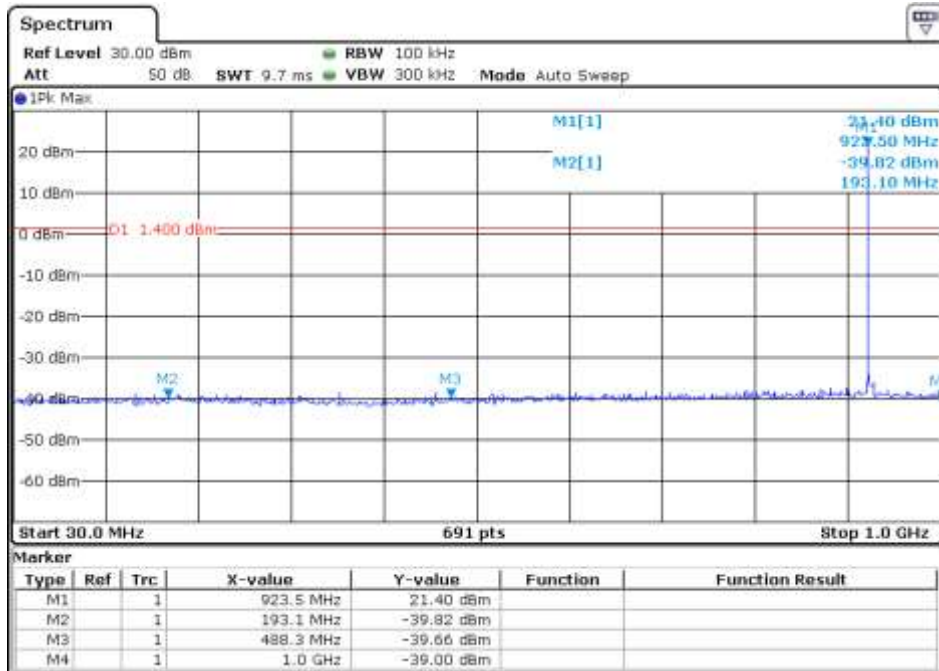
@903.0MHz



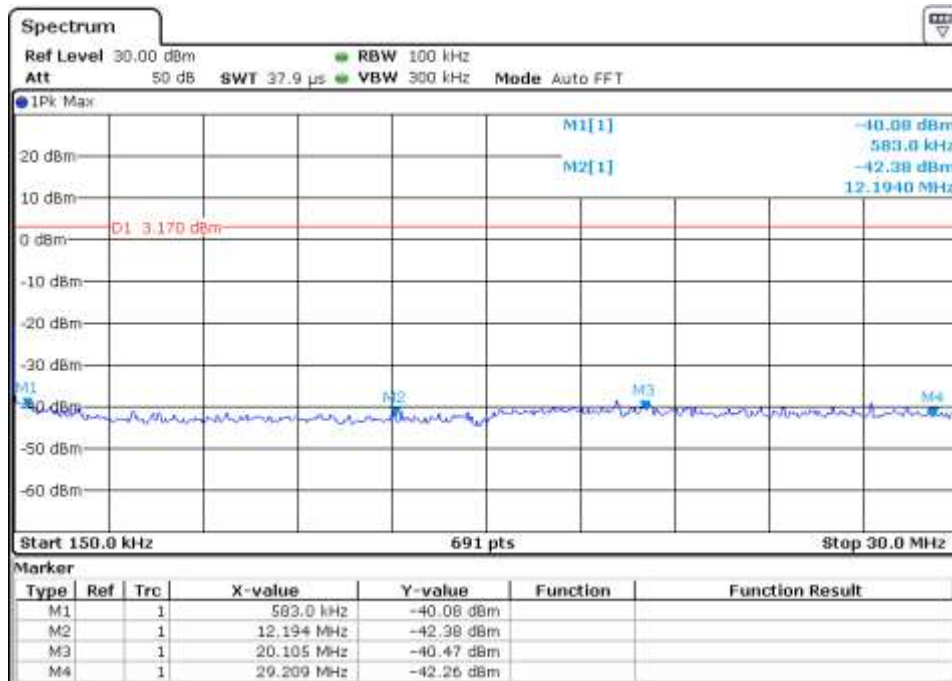
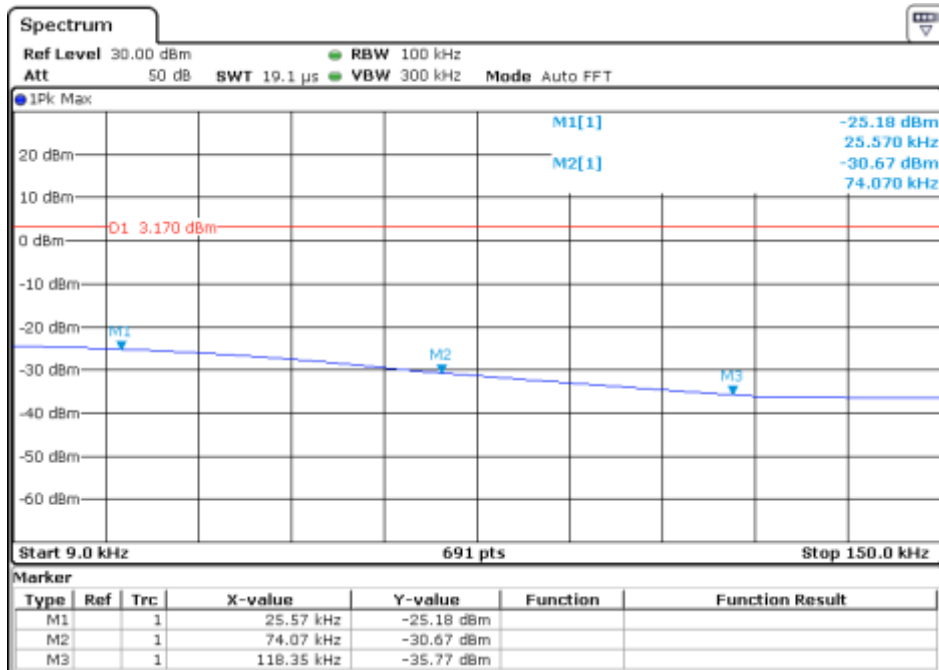


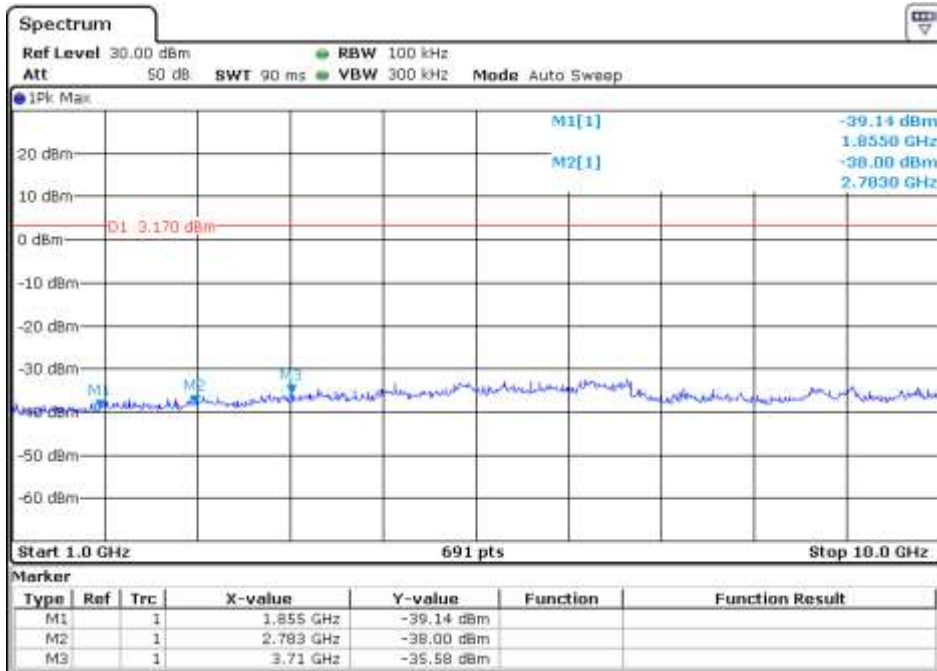
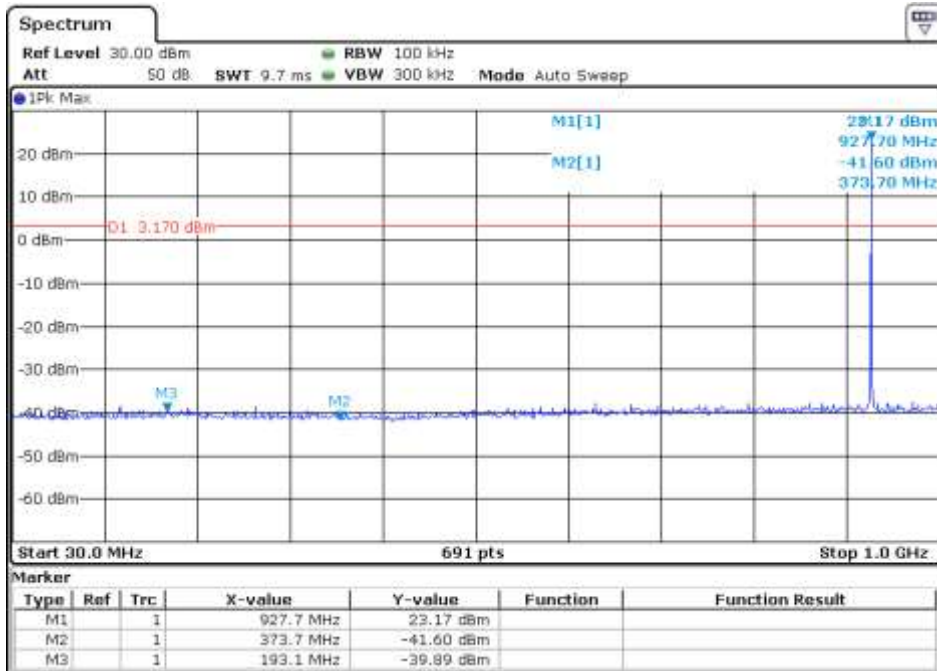
@923.5MHz





@927.5.MHz





****End of Report****