

FCC Test Report (Part 90 – Cat M1 B26)

Report No.: RFBFKV-WTW-P23050559-5

FCC ID: L6AITH100-1

Test Model: ITH100-1

Received Date: May 23, 2023

Test Date: May 31 ~ Jun. 07, 2023

Issued Date: Jul. 07, 2023

Applicant: BlackBerry Limited

Address: 2200 University Avenue Eest, Waterloo, Ontario, Canada N2K 0A7

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Lin Kou Laboratories

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

Test Location (1): No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City
33383, Taiwan

Test Location (2): No. 70, Wenming Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)

FCC Registration /

Designation Number(1): 788550 / TW0003

FCC Registration /

Designation Number(2): 281270 / TW0032



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Release Control Record

Issue No.	Description	Date Issued
RFBFKV-WTW-P23050559-5	Original Release	Jul. 07, 2023

1 Certificate of Conformity

Product: Radar H2M IS

Brand: BlackBerry

Test Model: ITH100-1

Sample Status: Engineering Sample

Applicant: BlackBerry Limited

Test Date: May 31 ~ Jun. 07, 2023

Standards: FCC Part 90, Subpart I, S

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

Prepared by : Pettie Chen, **Date:** Jul. 07, 2023
Pettie Chen / Senior Specialist

Approved by : Jeremy Lin, **Date:** Jul. 07, 2023
Jeremy Lin / Project Engineer

2 Summary of Test Results

Applied Standard: FCC Part 90 & Part 2			
FCC Clause	Test Item	Result	Remarks
2.1046 90.635 (b)	Effective Radiated Power	Pass	Meet the requirement of limit.
2.1047	Modulation Characteristics	Pass	Meet the requirement of limit.
2.1055 90.213	Frequency Stability	Pass	Meet the requirement of limit.
2.1049 90.209	Occupied Bandwidth	Pass	Meet the requirement of limit.
2.1051 90.691	Emission Masks	Pass	Meet the requirement of limit.
-	Band Edge Measurements	Pass	Meet the requirement of limit.
2.1051 90.691	Conducted Spurious Emissions	Pass	Meet the requirement of limit.
2.1053 90.691	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -28.81dB at 1638.00MHz.

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.00 dB
	30MHz ~ 200MHz	2.91 dB
	200MHz ~ 1000MHz	2.92 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	1.76 dB
	18GHz ~ 40GHz	1.77 dB

2.2 Test Site and Instruments

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower Max-Full	MFT-151SS-0.5T	NA	NA	NA
Turn Table Max-Full	MF-7802BS	NA	NA	NA
Turn Table Controller Max-Full	MF-7802BS	MF780208674	NA	NA
EMI Test Receiver R&S	ESR3	102782	2022/12/12	2023/12/11
Signal & Spectrum Analyzer R&S	FSW43	101866	2023/1/10	2024/1/9
Loop Antenna TESEQ	HLA 6121	45745	2022/7/27	2023/7/26
Loop Antenna Electro-Metrics	EM-6879	269	2022/9/19	2023/9/18
Preamplifier EMCI	EMC001340	980201	2022/9/23	2023/9/22
RF Coaxial Cable EMCI	5D-NM-BM	140903+140902	2023/1/7	2024/1/6
Preamplifier EMCI	EMC330N	980782	2023/1/16	2024/1/15
Bi_Log Antenna Schwarzbeck	VULB 9168	9168-1213	2022/10/20	2023/10/19
RF Coaxial Cable EMCI	EMCCFD400-NM-NM-500	201233	2023/1/16	2024/1/15
RF Coaxial Cable EMCI	EMCCFD400-NM-NM-3000	201235	2023/1/16	2024/1/15
RF Coaxial Cable EMCI	EMCCFD400-NM-NM-9000	201236(with PAD)	2023/1/16	2024/1/15
Horn Antenna RFSPIN	DRH18-E	210103A18E	2022/11/13	2023/11/12
Preamplifier EMCI	EMC118A45SE	980808	2022/12/29	2023/12/28
RF Coaxial Cable EMCI	EMC104-SM-SM-1000	210102	2023/1/16	2024/1/15
RF Coaxial Cable EMCI	EMC104-SM-SM-3000	201231	2023/1/16	2024/1/15
RF Coaxial Cable EMCI	EMC104-SM-SM-9000	201243	2023/1/16	2024/1/15
Preamplifier EMCI	EMC184045SE	980788	2023/1/16	2024/1/15
Horn Antenna Schwarzbeck	BBHA 9170	9170-1049	2022/11/13	2023/11/12
RF Coaxial Cable EMCI	EMC101G-KM-KM-5000	201260	2023/1/16	2024/1/15
RF Coaxial Cable EMCI	EMC101G-KM-KM-3000	201257	2023/1/16	2024/1/15
RF Coaxial Cable EMCI	EMC101G-KM-KM-2000	201254	2023/1/16	2024/1/15
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY55190004/ MY55190007/MY55210005	2022/7/13	2023/7/10
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in WM Chamber 8.

3 General Information

3.1 General Description of EUT

Product	Radar H2M IS		
Brand	BlackBerry		
Test Model	ITH100-1		
Sample Status	Engineering Sample		
Power Supply Rating	7.2Vdc from battery		
Modulation Type	QPSK, 16QAM		
Operating Frequency	Cat-M1 Band 26 (Channel Bandwidth: 1.4 MHz)	814.7MHz ~ 823.3MHz	
	Cat-M1 Band 26 (Channel Bandwidth: 3 MHz)	815.5MHz ~ 822.5MHz	
	Cat-M1 Band 26 (Channel Bandwidth: 5 MHz)	816.5MHz ~ 821.5MHz	
	Cat-M1 Band 26 (Channel Bandwidth: 10 MHz)	819.0MHz	
Max. ERP Power		QPSK	16QAM
	Cat-M1 Band 26 (Channel Bandwidth: 1.4 MHz)	182.390mW (22.61dBm)	144.877mW (21.61dBm)
	Cat-M1 Band 26 (Channel Bandwidth: 3 MHz)	184.502mW (22.66dBm)	149.624mW (21.75dBm)
	Cat-M1 Band 26 (Channel Bandwidth: 5 MHz)	173.780mW (22.40dBm)	169.044mW (22.28dBm)
	Cat-M1 Band 26 (Channel Bandwidth: 10 MHz)	187.932mW (22.74dBm)	167.494mW (22.24dBm)
		QPSK	16QAM
Emission Designator		QPSK	16QAM
	Cat-M1 Band 26 (Channel Bandwidth: 1.4 MHz)	1M08G7D	1M08D7W
	Cat-M1 Band 26 (Channel Bandwidth: 3 MHz)	1M08G7D	1M08D7W
	Cat-M1 Band 26 (Channel Bandwidth: 5 MHz)	1M09G7D	1M09D7W
	Cat-M1 Band 26 (Channel Bandwidth: 10 MHz)	1M09G7D	1M09D7W
Antenna Type	Refer to Note		
Antenna Connector	Refer to Note		
Accessory Device	Refer to Note		
Cable Supplied	Refer to Note		

Note:

1. The EUT consumes power from the following batteries.

Battery 1	
Brand	EVE
Model	BAT-63705-001
Power Rating	7.2V, 38Ah, 274 Wh

Battery 2	
Brand	Vitrocell
Model	BAT-63705-002
Power Rating	7.2V, 38Ah, 274 Wh

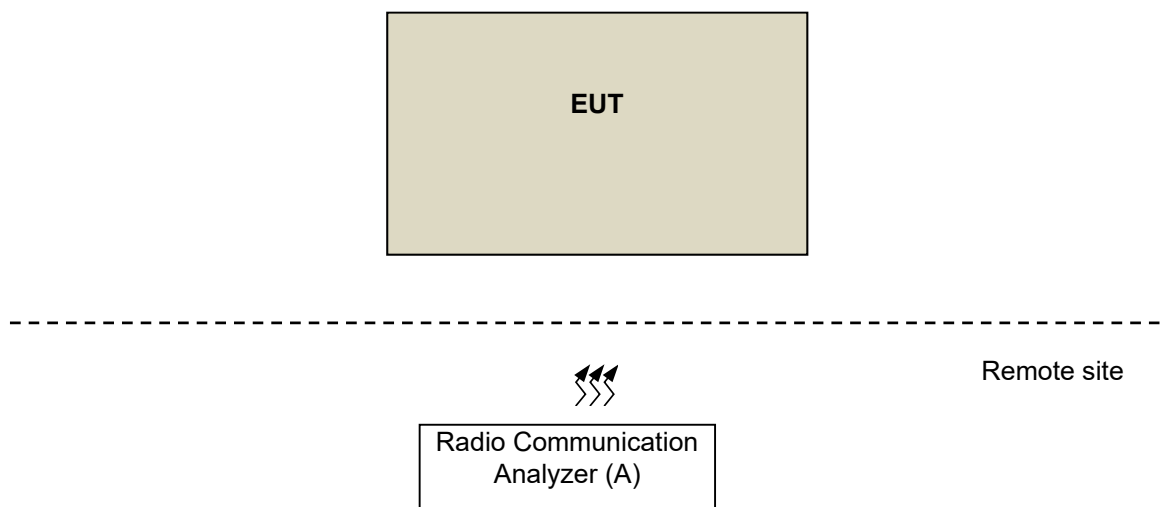
2. The antenna information for host is listed as below.

Type		Monopole with gnd resonator						
Connector		Murata MM8030-2610B/RJ3/RK0						
Antenna gain (dBi)								
Cat-M1 Band								
2	4	5	12	13	25	26	66	85
3.51	3.27	1.94	-0.33	0.69	3.51	1.94	3.84	-0.33

* Detail antenna specification please refer to antenna datasheet or an antenna gain measurement report.

3. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

3.2 Configuration of System under Test



3.2.1 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A	Radio Communication Analyzer	Anritsu	MT8821C	6201462755	N/A	Provided by Lab

3.3 Test Mode Applicability and Tested Channel Detail

Pre-Scan:	EUT can be used in the following ways: X-axis/ Y-axis/ Z-axis. Pre-scan these ways and find the worst case as a representative test condition.
Worst Case:	X-axis/ Y-axis/ Z-axis Worst Condition: X-axis

EUT Configure Mode	Mode	Power
	A	Power from battery 1
	B	Power from battery 2

Cat-M1 Band 26

EUT Configure Mode	Test item	Available channel	Tested channel	Channel Bandwidth	Modulation	Mode
A	ERP	26697 to 26783	26697 (814.7MHz), 26740 (819.0MHz), 26783 (823.3MHz)	1.4MHz	QPSK / 16QAM	1 Full
		26705 to 26775	26705 (815.5MHz), 26740 (819.0MHz), 26775 (822.5MHz)	3MHz	QPSK / 16QAM	1 Full
		26715 to 26765	26715 (816.5MHz), 26740 (819.0MHz), 26765 (821.5MHz)	5MHz	QPSK / 16QAM	1 Full
		26740	26740 (819.0MHz)	10MHz	QPSK / 16QAM	1 Full
A	Modulation Characteristics	26740	26740 (819.0MHz)	10MHz	QPSK / 16QAM	Full
A	Frequency Stability	26697 to 26783	26697 (814.7MHz), 26783 (823.3MHz)	1.4MHz	QPSK	Full
		26705 to 26775	26705 (815.5MHz), 26775 (822.5MHz)	3MHz	QPSK	Full
		26715 to 26765	26715 (816.5MHz), 26765 (821.5MHz)	5MHz	QPSK	Full
		26740	26740 (819.0MHz)	10MHz	QPSK	Full

EUT Configure Mode	Test item	Available channel	Tested channel	Channel Bandwidth	Modulation	Mode
A	Occupied Bandwidth	26697 to 26783	26697 (814.7MHz), 26740 (819.0MHz), 26783 (823.3MHz)	1.4MHz	QPSK / 16QAM	Full
		26705 to 26775	26705 (815.5MHz), 26740 (819.0MHz), 26775 (822.5MHz)	3MHz	QPSK / 16QAM	Full
		26715 to 26765	26715 (816.5MHz), 26740 (819.0MHz), 26765 (821.5MHz)	5MHz	QPSK / 16QAM	Full
		26740	26740 (819.0MHz)	10MHz	QPSK / 16QAM	Full
A	Emission Masks	26697 to 26783	26697 (814.7MHz), 26783 (823.3MHz)	1.4MHz	QPSK	1 Full
		26705 to 26775	26705 (815.5MHz), 26775 (822.5MHz)	3MHz	QPSK	1 Full
		26715 to 26765	26715 (816.5MHz), 26765 (821.5MHz)	5MHz	QPSK	1 Full
		26740	26740 (819.0MHz)	10MHz	QPSK	1 Full
A	Conducted Emission	26697 to 26783	26697 (814.7MHz), 26740 (819.0MHz), 26783 (823.3MHz)	1.4MHz	QPSK	1
		26705 to 26775	26705 (815.5MHz), 26740 (819.0MHz), 26775 (822.5MHz)	3MHz	QPSK	1
		26715 to 26765	26715 (816.5MHz), 26740 (819.0MHz), 26765 (821.5MHz)	5MHz	QPSK	1
		26740	26740 (819.0MHz)	10MHz	QPSK	1
A, B	Radiated Emission Below 1GHz	26740	26740 (819.0MHz)	10MHz	QPSK	1
A	Radiated Emission Above 1GHz	26697 to 26783	26697 (814.7MHz), 26740 (819.0MHz), 26783 (823.3MHz)	1.4MHz	QPSK	1
		26715 to 26765	26715 (816.5MHz), 26740 (819.0MHz), 26765 (821.5MHz)	5MHz	QPSK	1
		26740	26740 (819.0MHz)	10MHz	QPSK	1

Note:

1. This device was tested under all bandwidths, RB configurations and modulations. The worst case was found in QPSK modulation. Therefore, only ERP, modulation characteristics, occupied bandwidth and peak to average ratio items had been tested under QPSK, 16QAM mode, the other items were performed under QPSK mode only.
2. For radiated emission below 1GHz, select the worst radiated emission channel (above 1GHz) for final testing.
3. For radiated emission above 1GHz, according to 3GPP 36.521 Section 6.6.3.1.4, choose the lowest, 5MHz & highest channel bandwidth for final test.

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
ERP	25deg. C, 60%RH	7.2Vdc	Willy Cheng
Modulation characteristics	25deg. C, 60%RH	7.2Vdc	Willy Cheng
Frequency Stability	25deg. C, 60%RH	7.2Vdc	Willy Cheng
Occupied Bandwidth	25deg. C, 60%RH	7.2Vdc	Willy Cheng
Emission Mask	25deg. C, 60%RH	7.2Vdc	Willy Cheng
Conducted Emission	25deg. C, 60%RH	7.2Vdc	Willy Cheng
Radiated Emission Below 1GHz	25deg. C, 60%RH	7.2Vdc	Willy Cheng
Radiated Emission Above 1GHz	20deg. C, 64%RH	7.2Vdc	Edison Lee

3.4 EUT Operating Conditions

The EUT makes a call to the communication simulator. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency

3.5 General Description of Applied Standards and References

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test Standard:

FCC 47 CFR Part 2

FCC 47 CFR Part 90

ANSI/TIA/EIA-603-E 2016

ANSI 63.26-2015

All test items have been performed and recorded as per the above standards.

References Test Guidance:

KDB 971168 D01 Power Meas License Digital Systems v03r01

KDB 971168 D02 Misc Rev Approv License Devices v02r01

All test items have been performed as a reference to the above KDB test guidance.

4 Test Types and Results

4.1 Output Power Measurement

4.1.1 Limits of Output Power Measurement

The output power shall be according to the specific rule Part 90.635 that “Mobile station are limited to 100 watts e.r.p”.

4.1.2 Test Procedures

Conducted Power Measurement:

The EUT was set up for the maximum power with Cat-M1 link data modulation and link up with simulator (Built-in power meter). The average (rms) power measurement was performed on emulator and power value was measured from power function on emulator. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

Maximum EIRP / ERP

The relevant equation for determining the maximum ERP or EIRP from the measured RF output power is

given in Equation as follows:

$$\text{EIRP} = P_{\text{Meas}} + G_T$$

$$\text{ERP} = P_{\text{Meas}} + G_T - 2.15$$

where

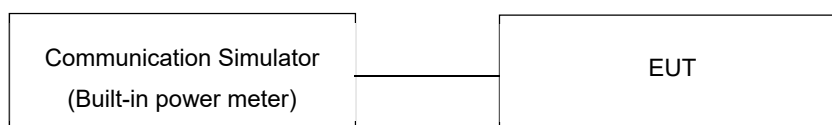
ERP or EIRP effective radiated power or equivalent isotropically radiated power, respectively
(expressed in the same units as P_{Meas} , e.g., dBm or dBW)

P_{Meas} measured transmitter output power or PSD, in dBm or dBW

G_T gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

4.1.3 Test Setup

Conducted Power Measurement:



4.1.4 Test Results

Conducted Output Power (dBm)

Cat-M1 Band 26						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		26697	26740	26783
		Frequency (MHz)		814.7	819	823.3
1.4M	QPSK	1	0	22.36	22.78	22.82
		1	5	22.27	22.60	22.71
		6	0	20.71	20.76	20.92
1.4M	16QAM	1	0	21.64	21.79	21.82
		1	5	21.28	21.69	21.73
		6	0	19.79	19.91	19.88
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		26705	26740	26775
		Frequency (MHz)		815.5	819	822.5
3M	QPSK	1	0	22.81	22.85	22.87
		1	5	22.71	22.76	22.77
		6	0	20.77	20.86	20.84
3M	16QAM	1	0	21.82	21.96	21.89
		1	5	21.83	21.88	21.77
		6	0	19.92	19.95	19.86
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		26715	26740	26765
		Frequency (MHz)		816.5	819	821.5
5M	QPSK	1	0	22.50	22.48	22.61
		1	5	22.44	22.51	22.53
		6	0	21.81	21.85	21.88
5M	16QAM	1	0	22.44	22.27	22.46
		1	5	22.41	22.39	22.49
		6	0	21.88	21.62	21.73
BW	MCS Index	RB Size	RB Offset	Mid		
		Channel		26740		
		Frequency (MHz)		819		
10M	QPSK	1	0	22.95		
		1	5	22.38		
		6	0	21.77		
10M	16QAM	1	0	22.45		
		1	5	22.36		
		6	0	21.69		

ERP Power (dBm)

Cat-M1 Band 26						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		26697	26740	26783
		Frequency (MHz)		814.7	819	823.3
1.4M	QPSK	1	0	22.15	22.57	22.61
		1	5	22.06	22.39	22.50
		6	0	20.50	20.55	20.71
1.4M	16QAM	1	0	21.43	21.58	21.61
		1	5	21.07	21.48	21.52
		6	0	19.58	19.70	19.67
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		26705	26740	26775
		Frequency (MHz)		815.5	819	822.5
3M	QPSK	1	0	22.60	22.64	22.66
		1	5	22.50	22.55	22.56
		6	0	20.56	20.65	20.63
3M	16QAM	1	0	21.61	21.75	21.68
		1	5	21.62	21.67	21.56
		6	0	19.71	19.74	19.65
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		26715	26740	26765
		Frequency (MHz)		816.5	819	821.5
5M	QPSK	1	0	22.29	22.27	22.40
		1	5	22.23	22.30	22.32
		6	0	21.60	21.64	21.67
5M	16QAM	1	0	22.23	22.06	22.25
		1	5	22.20	22.18	22.28
		6	0	21.67	21.41	21.52
BW	MCS Index	RB Size	RB Offset	Mid		
		Channel		26740		
		Frequency (MHz)		819		
10M	QPSK	1	0	22.74		
		1	5	22.17		
		6	0	21.56		
10M	16QAM	1	0	22.24		
		1	5	22.15		
		6	0	21.48		

*ERP = Conducted + antenna gain (1.94dBi) - 2.15

4.2 Modulation Characteristics Measurement

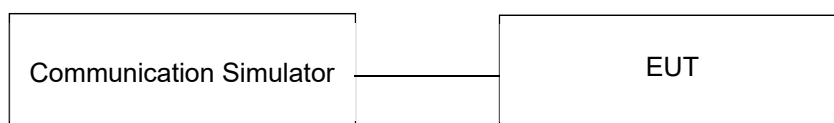
4.2.1 Limits of Modulation Characteristics

N/A

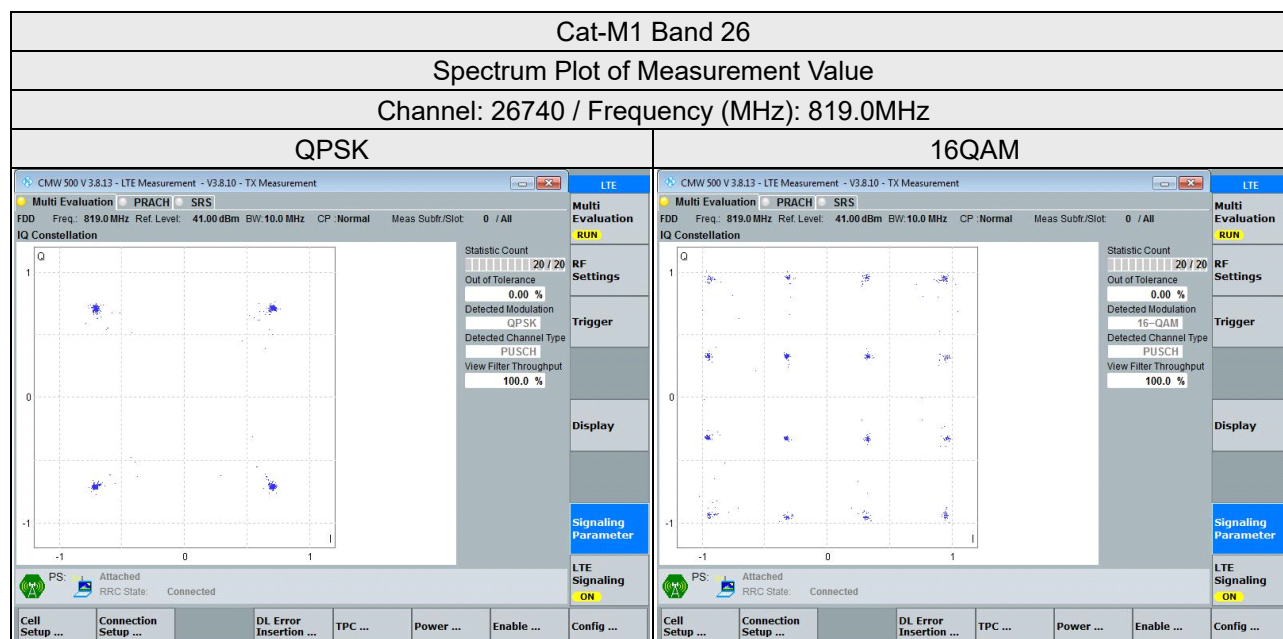
4.2.2 Test Procedure

Connect the EUT to Communication Simulator via the antenna connector, The frequency band is set as EUT supported Modulation and Channels, the EUT output is matched with 50 ohm load, the waveform quality and constellation of the EUT was tested.

4.2.3 Test Setup



4.2.4 Test Results



4.3 Frequency Stability Measurement

4.3.1 Limits of Frequency Stability Measurement

1.5 ppm is for base and fixed station. 2.5 ppm is for mobile station.

4.3.2 Test Procedure

- Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.
- EUT is connected the external power supply to control the DC input power. The test voltage range is from minimum to maximum working voltage. Each step shall be record the frequency error rate.
- The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the $\pm 0.5^{\circ}\text{C}$ during the measurement testing. The each temperature step shall be at least 0.5 hours, consider the EUT could be test under the stability condition.

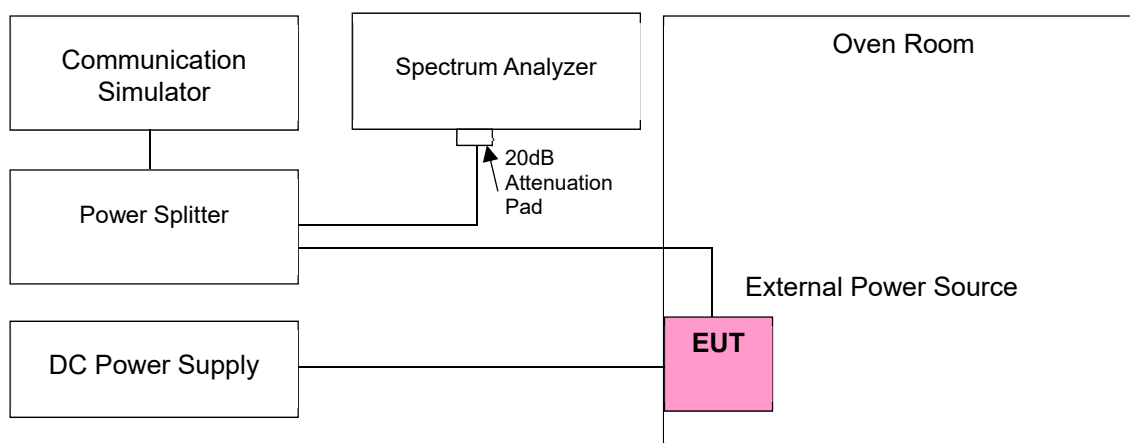
Note: The frequency error was recorded frequency error from the communication simulator.

4.3.3 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Radio Communication Analyzer Anritsu	MT8821C	6261806803	Feb. 18, 2023	Feb. 17, 2024
Temperature & Humidity Chamber TERCHY	HRM-120RF	931022	Dec. 27, 2022	Dec. 26, 2023
Digital Multimeter Fluke	87-III	70360742	Jun. 23, 2022	Jun. 22, 2023
DC Power Supply Topward	6306A	727263	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.3.4 Test Setup



4.3.5 Test Results

Frequency Error vs. Voltage

Voltage (Vdc)	Cat-M1 Band 26			
	Channel Bandwidth: 1.4 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
6.12	814.7000040	0.005	823.2999970	-0.004
7.2	814.7000030	0.004	823.3000010	0.001
8.28	814.6999990	-0.001	823.2999980	-0.002

Note: The applicant defined the normal working voltage is from 6.12Vdc to 8.28Vdc.

Frequency Error vs. Temperature

Temp. (°C)	Cat-M1 Band 26			
	Channel Bandwidth: 1.4 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-40	814.6999960	-0.005	823.3000020	0.002
-30	814.6999980	-0.002	823.3000010	0.001
-20	814.7000020	0.002	823.3000010	0.001
-10	814.6999960	-0.005	823.3000020	0.002
0	814.6999960	-0.005	823.2999980	-0.002
10	814.7000020	0.002	823.3000010	0.001
20	814.7000030	0.004	823.3000030	0.004
30	814.6999960	-0.005	823.3000010	0.001
40	814.7000010	0.001	823.2999980	-0.002
50	814.7000020	0.002	823.2999990	-0.001
60	814.6999980	-0.002	823.3000030	0.004
70	814.6999980	-0.002	823.3000010	0.001

Frequency Error vs. Voltage

Voltage (Vdc)	Cat-M1 Band 26			
	Channel Bandwidth: 3MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
6.12	815.4999990	-0.001	822.5000010	0.001
7.2	815.4999980	-0.002	822.5000040	0.005
8.28	815.5000020	0.002	822.5000030	0.004

Note: The applicant defined the normal working voltage is from 6.12Vdc to 8.28Vdc.

Frequency Error vs. Temperature

Temp. (°C)	Cat-M1 Band 26			
	Channel Bandwidth: 3MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-40	815.4999990	-0.001	822.4999970	-0.004
-30	815.4999970	-0.004	822.4999970	-0.004
-20	815.4999970	-0.004	822.5000020	0.002
-10	815.5000020	0.002	822.4999960	-0.005
0	815.4999980	-0.002	822.5000030	0.004
10	815.5000040	0.005	822.5000030	0.004
20	815.5000010	0.001	822.5000020	0.002
30	815.5000010	0.001	822.4999990	-0.001
40	815.4999960	-0.005	822.4999970	-0.004
50	815.5000010	0.001	822.5000040	0.005
60	815.4999960	-0.005	822.5000020	0.002
70	815.4999970	-0.004	822.4999960	-0.005

Frequency Error vs. Voltage

Voltage (Vdc)	Cat-M1 Band 26			
	Channel Bandwidth: 5MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
6.12	816.4999970	-0.004	821.5000010	0.001
7.2	816.5000030	0.004	821.5000040	0.005
8.28	816.4999980	-0.002	821.5000020	0.002

Note: The applicant defined the normal working voltage is from 6.12Vdc to 8.28Vdc.

Frequency Error vs. Temperature

Temp. (°C)	Cat-M1 Band 26			
	Channel Bandwidth: 5MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-40	816.4999970	-0.004	821.5000040	0.005
-30	816.5000040	0.005	821.4999990	-0.001
-20	816.5000030	0.004	821.5000030	0.004
-10	816.5000020	0.002	821.4999980	-0.002
0	816.5000040	0.005	821.5000040	0.005
10	816.4999980	-0.002	821.4999960	-0.005
20	816.5000010	0.001	821.4999990	-0.001
30	816.5000040	0.005	821.4999990	-0.001
40	816.4999960	-0.005	821.5000020	0.002
50	816.5000030	0.004	821.5000030	0.004
60	816.5000010	0.001	821.4999990	-0.001
70	816.5000030	0.004	821.4999970	-0.004

Frequency Error vs. Voltage

Voltage (Vdc)	Cat-M1 Band 26	
	Channel Bandwidth: 10 MHz	
	Frequency (MHz)	Frequency Error (ppm)
6.12	818.9999980	-0.002
7.2	819.0000030	0.004
8.28	819.0000030	0.004

Note: The applicant defined the normal working voltage is from 6.12Vdc to 8.28Vdc.

Frequency Error vs. Temperature

Temp. (°C)	Cat-M1 Band 26	
	Channel Bandwidth: 10 MHz	
	Frequency (MHz)	Frequency Error (ppm)
-40	818.9999970	-0.004
-30	818.9999990	-0.001
-20	819.0000020	0.002
-10	818.9999980	-0.002
0	818.9999970	-0.004
10	818.9999980	-0.002
20	818.9999990	-0.001
30	819.0000010	0.001
40	819.0000040	0.005
50	819.0000010	0.001
60	818.9999960	-0.005
70	819.0000040	0.005

4.4 Occupied Bandwidth Measurement

4.4.1 Limits of Occupied Bandwidth Measurement

The occupied bandwidth (OBW), that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 % of the total mean power radiated by a given emission.

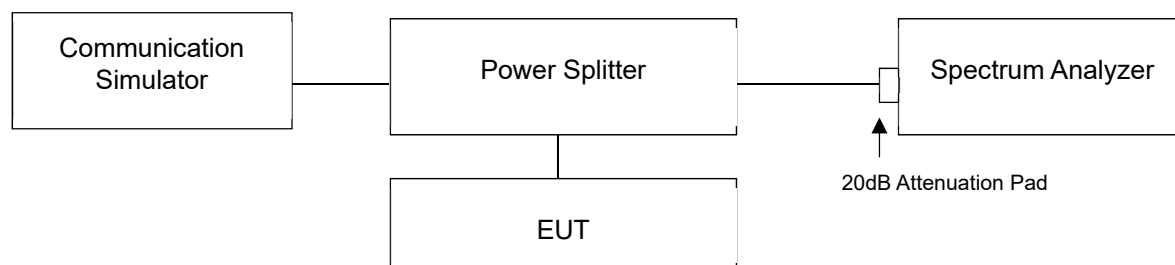
4.4.2 Test Procedure

For the 26dBc bandwidth measurement method, please refer to section 5.4.3 of ANSI C63.26.

- The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.
- The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set $\geq 3 \times \text{RBW}$.
- Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
- The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target “-X dB” requirement, i.e., if the requirement calls for measuring the -26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.
- Set spectrum analyzer detection mode to peak, and the trace mode to max hold.
- Determine the following reference values: Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
- Determine the “-X dB amplitude” as equal to (Reference Value - X). Alternatively, this calculation can be performed on the spectrum analyzer using the delta-marker measurement function.
- Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the “-X dB amplitude” determined in step f). If a marker is below this “-X dB amplitude” value it should be as close as possible to this value. The OBW is the positive frequency difference between the two markers.
- The OBW shall be reported by providing plot(s) of the measuring instrument display, to include markers depicting the relevant frequency and amplitude information (e.g., marker table). The frequency and amplitude axis and scale shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

For the occupied bandwidth measurement method, please refer to section 5.4.4 of ANSI C63.26.

4.4.3 Test Setup

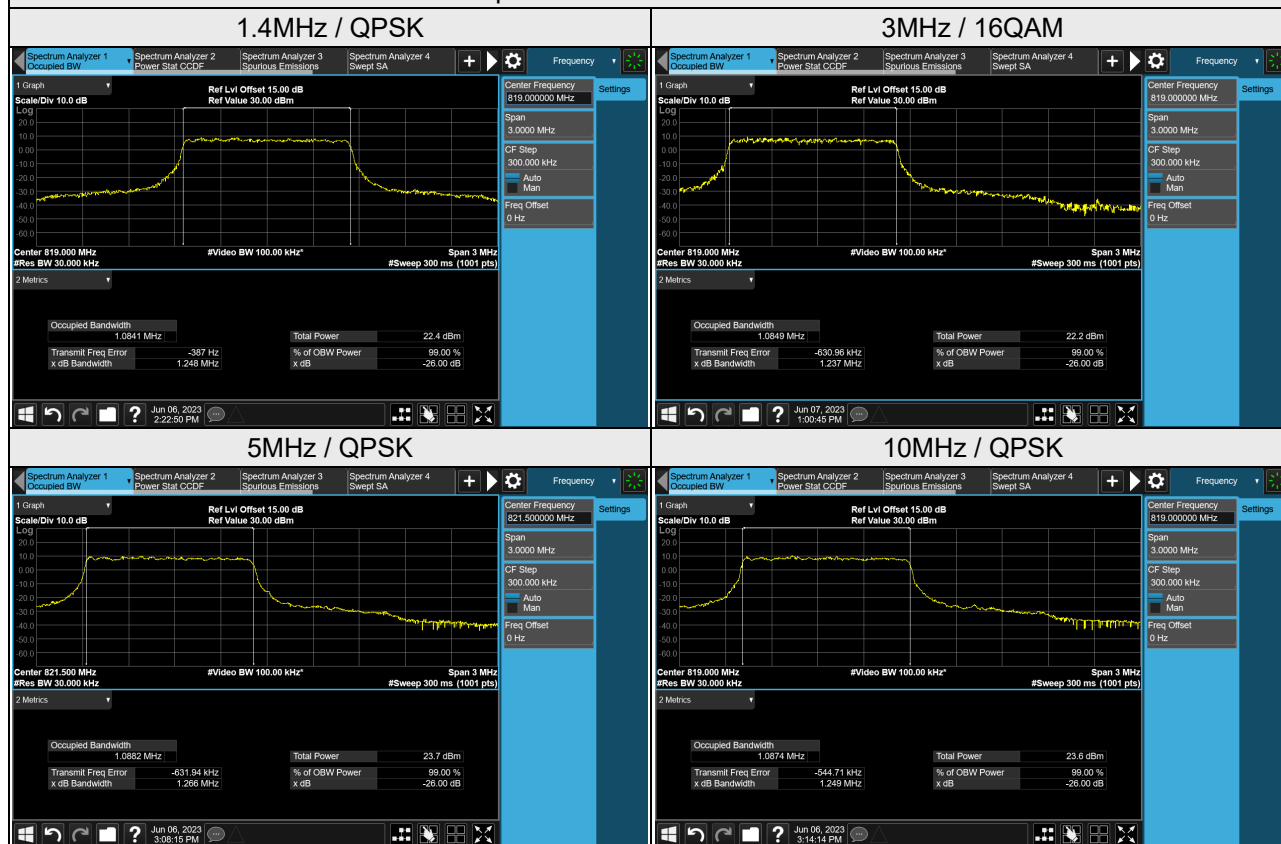


4.4.4 Test Result

Occupied Bandwidth

Cat-M1 Band 26, Channel Bandwidth 1.4MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
26697	814.7	1.0837	1.0833
26740	819.0	1.0841	1.0837
26783	823.3	1.0838	1.0839
Cat-M1 Band 26, Channel Bandwidth 3MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
26705	815.5	1.0839	1.0833
26740	819.0	1.0834	1.0849
26775	822.5	1.0842	1.0830
Cat-M1 Band 26, Channel Bandwidth 5MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
26715	816.5	1.0868	1.0842
26740	819.0	1.0878	1.0865
26765	821.5	1.0882	1.0858
Cat-M1 Band 26, Channel Bandwidth 10MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
26740	819.0	1.0874	1.0858

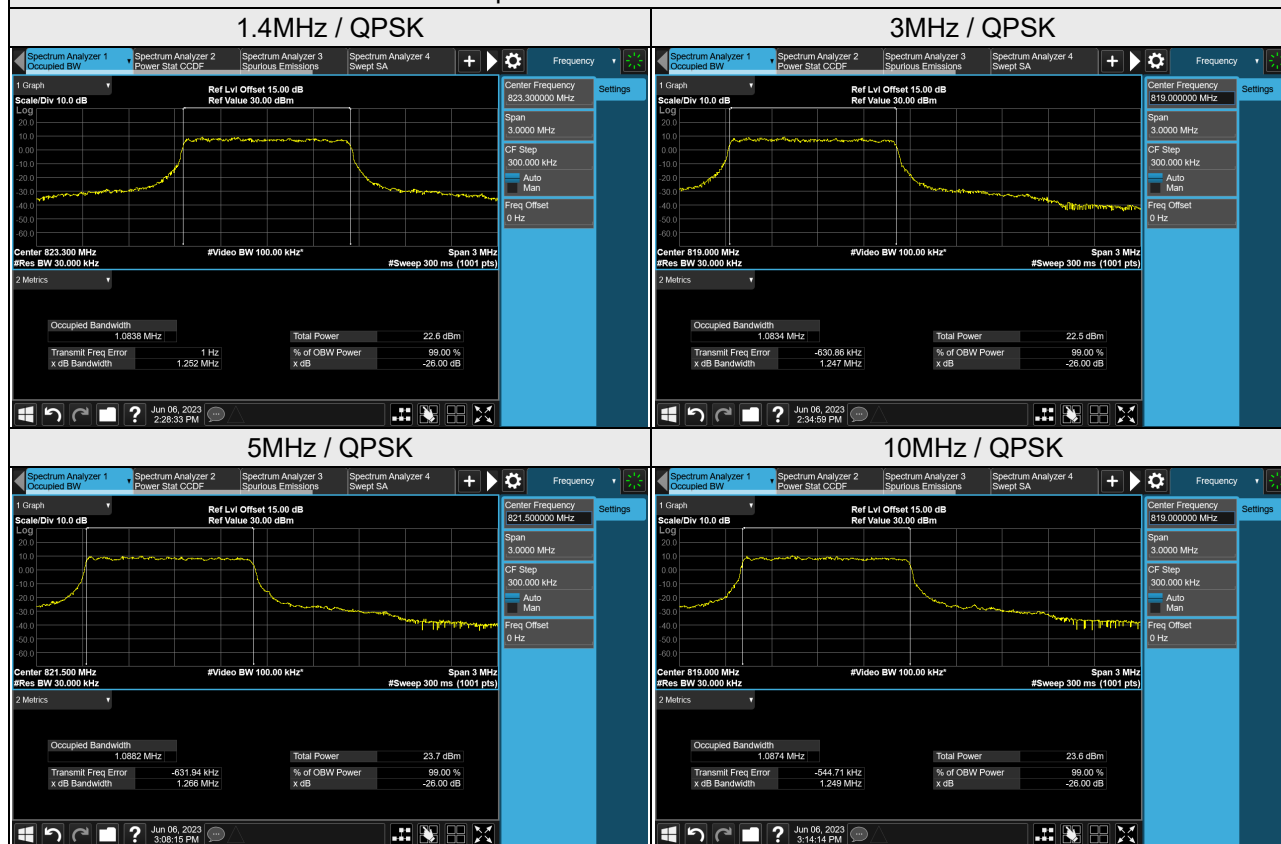
Spectrum Plot of Worst Value



26dB Bandwidth

Cat-M1 Band 26, Channel Bandwidth 1.4MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
26697	814.7	1.250	1.237
26740	819.0	1.248	1.238
26783	823.3	1.252	1.238
Cat-M1 Band 26, Channel Bandwidth 3MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
26705	815.5	1.242	1.240
26740	819.0	1.247	1.237
26775	822.5	1.244	1.233
Cat-M1 Band 26, Channel Bandwidth 5MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
26715	816.5	1.242	1.242
26740	819.0	1.253	1.251
26765	821.5	1.266	1.240
Cat-M1 Band 26, Channel Bandwidth 10MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
26740	819.0	1.249	1.245

Spectrum Plot of Worst Value



4.5 Emission Mask Measurement

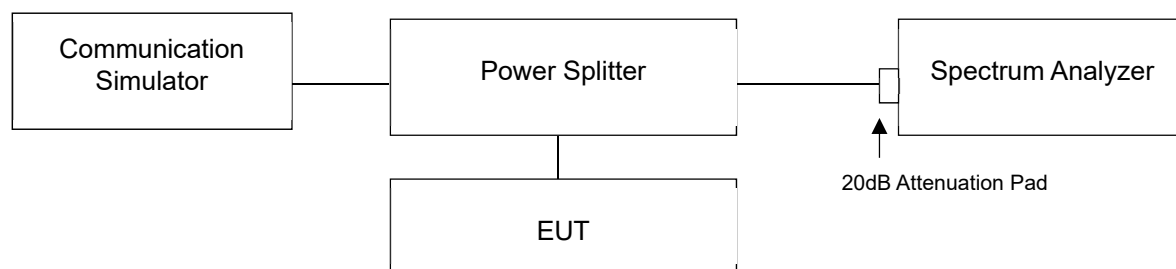
4.5.1 Limits of Emission Mask Measurement

According to FCC part 90.691 shall be tested the emission mask. For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

For § 90.691(a), RBW=300 Hz for offset less than 37.5 kHz from channel edge and RBW=100 kHz for offsets greater than 37.5 kHz is allowed, tested in accordance with FCC KDB 971168 D02 section VIII.

4.5.2 Test Setup

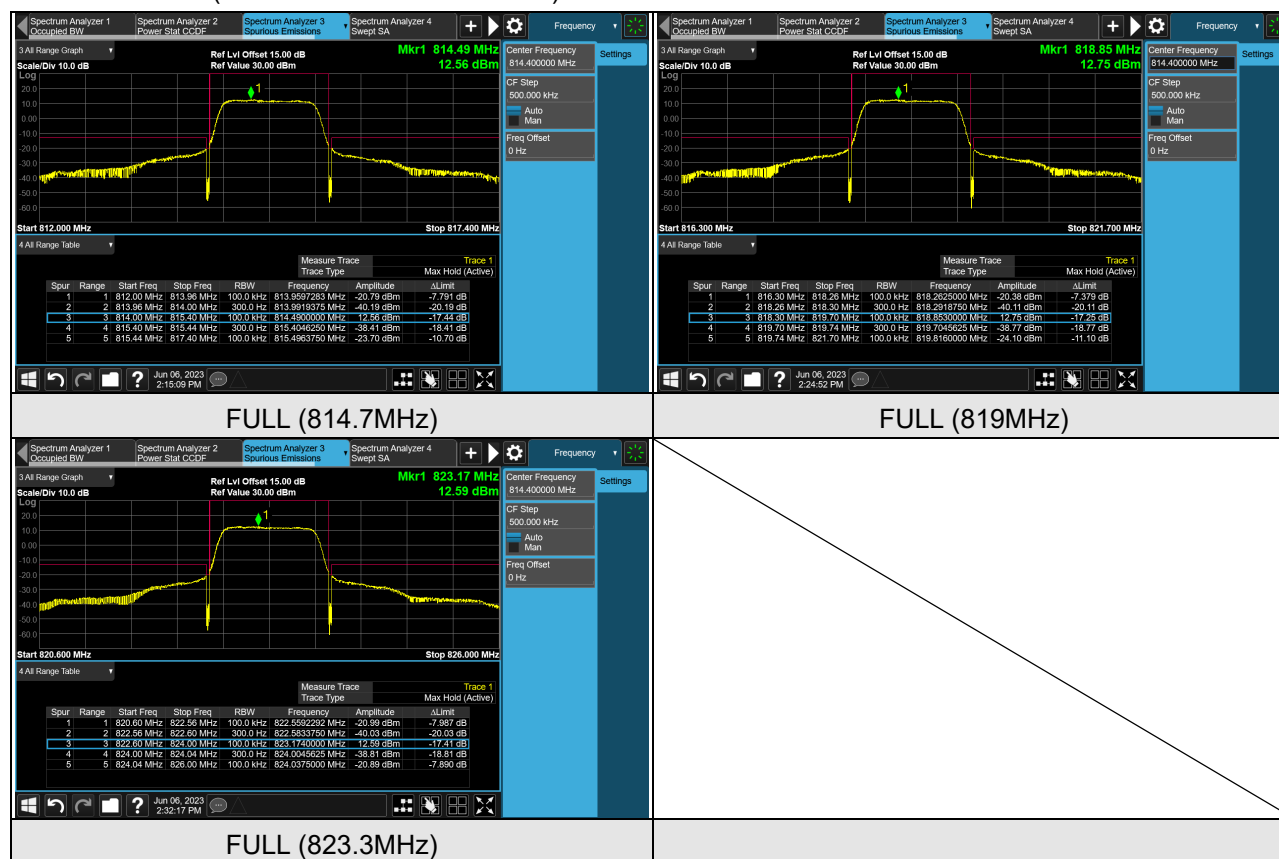


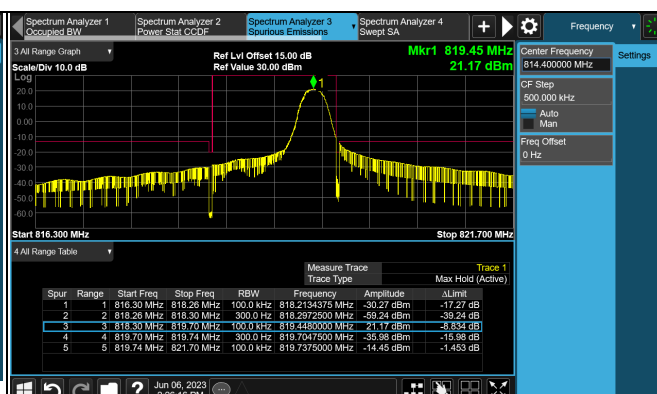
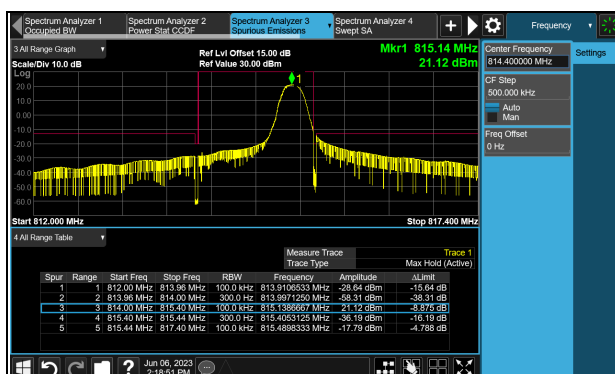
4.5.3 Test Procedures

- The measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
- Measurement refer to FCC part 90.691 and KDB 971168 D02 Misc Rev Approv License Devices v02r01 section VIII c).
- Record the test plot. 971168 D02 Misc Rev Approv License Devices v02r01

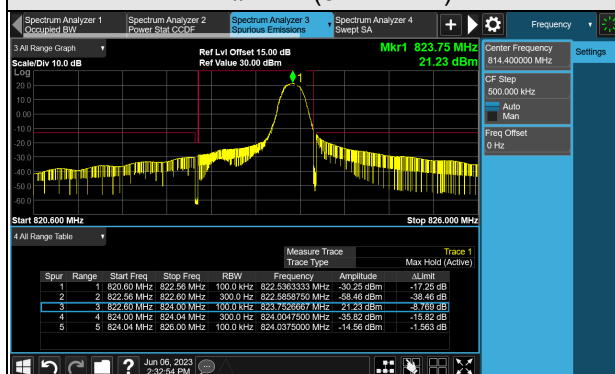
4.5.4 Test Results

Cat-M1 Band 26 (Channel Bandwidth 1.4MHz)



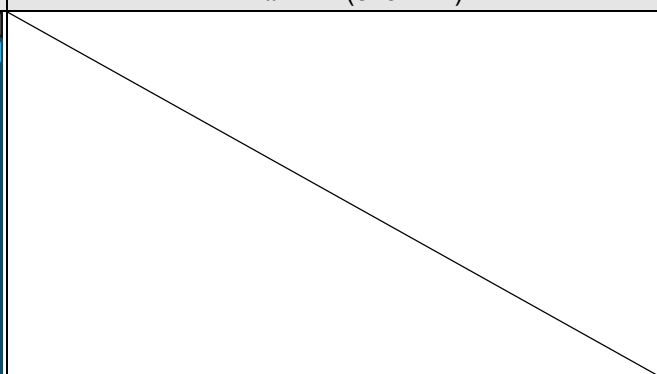


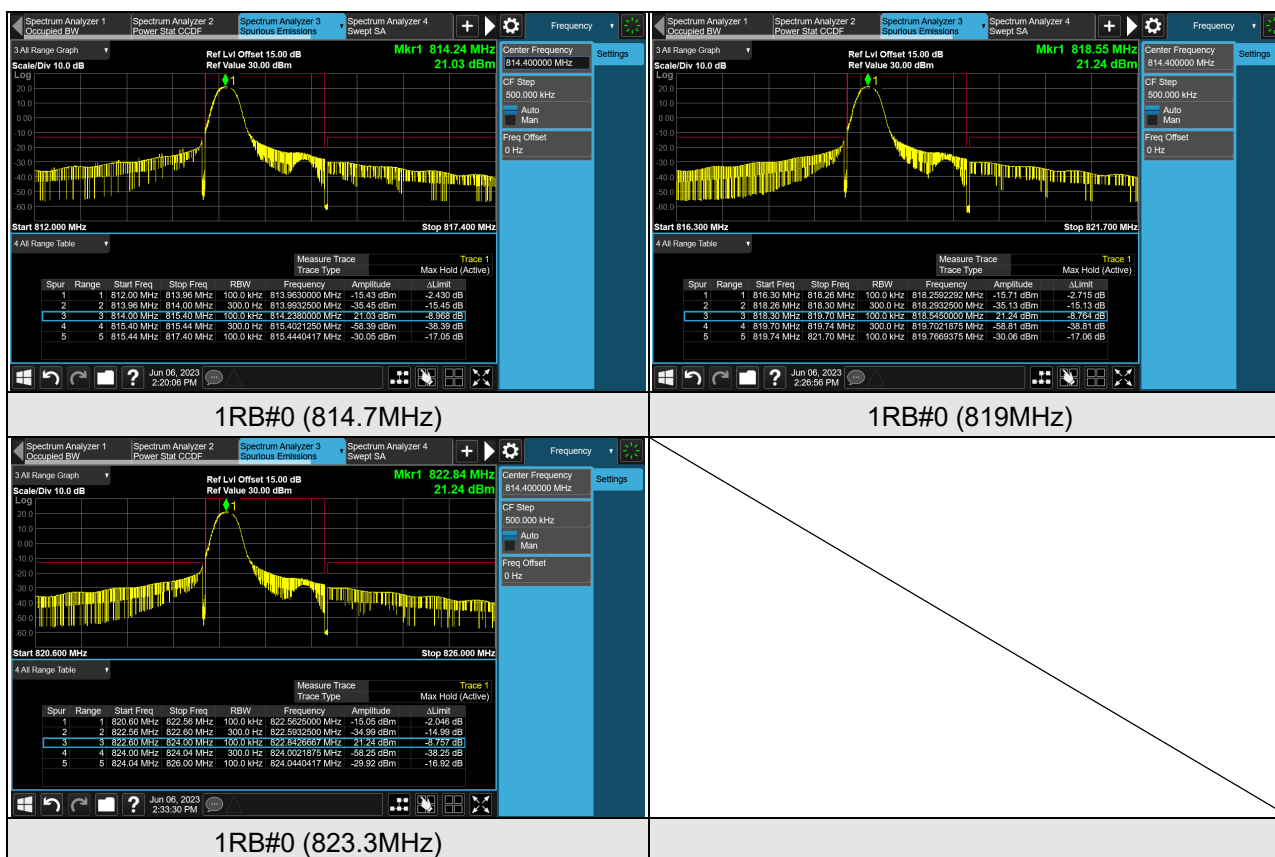
1RB#MAX (814.7MHz)



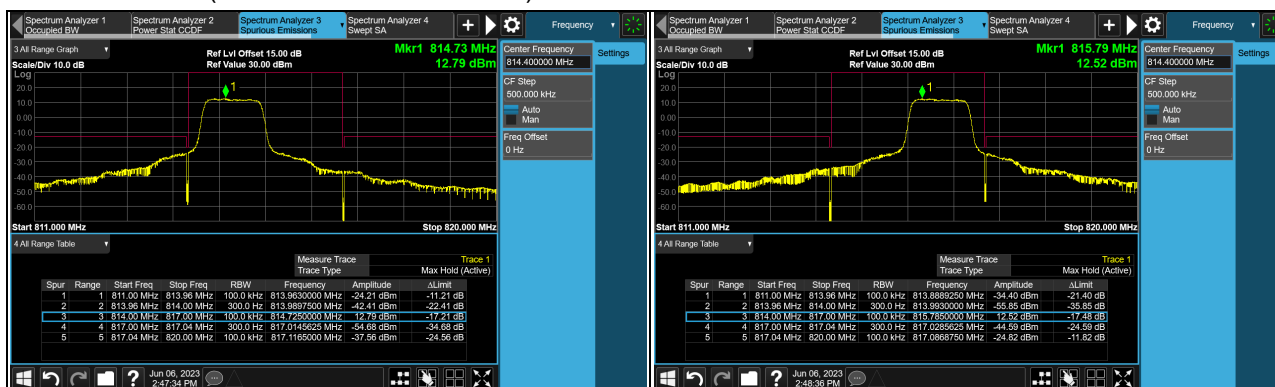
1RB#MAX (823.3MHz)

1RB#MAX (819MHz)

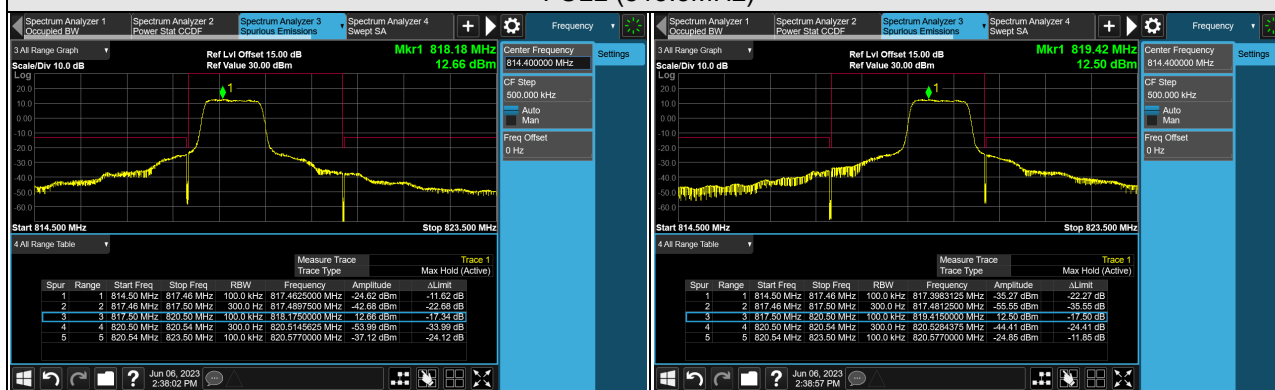




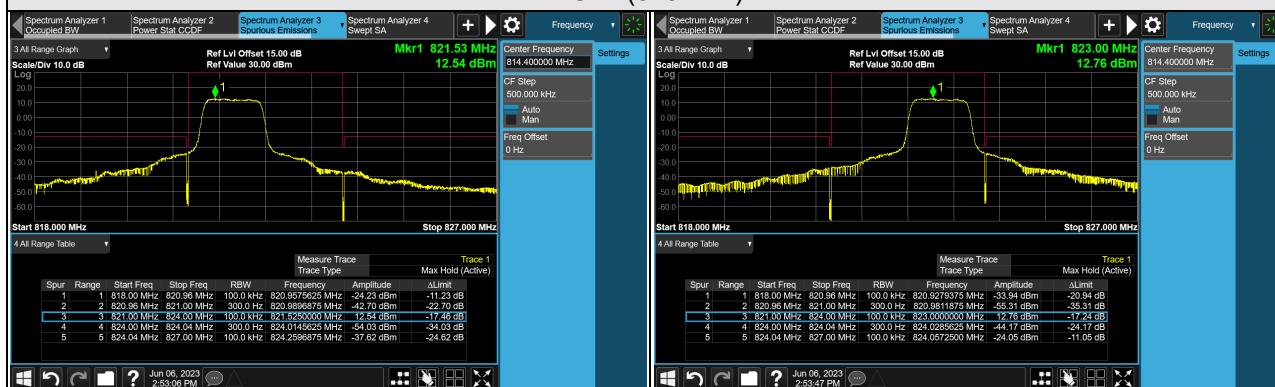
Cat-M1 Band 26 (Channel Bandwidth 3MHz)



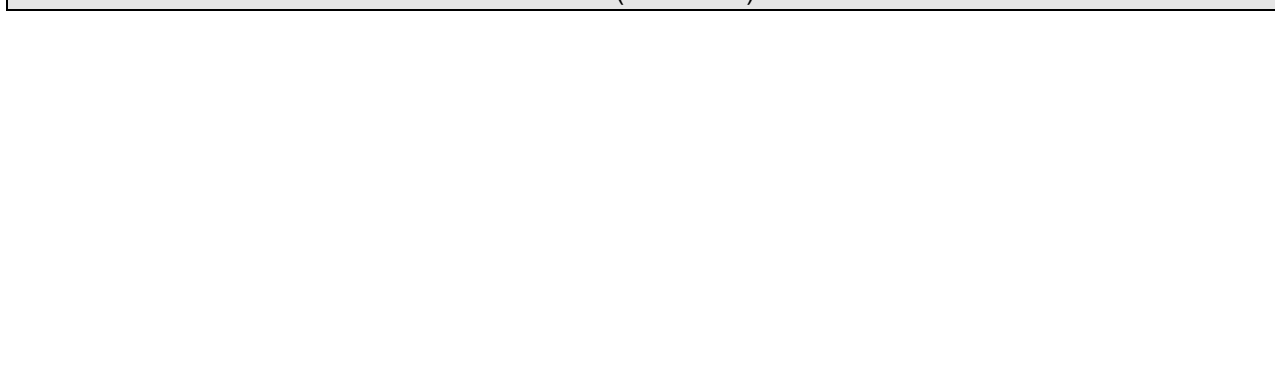
FULL (815.5MHz)

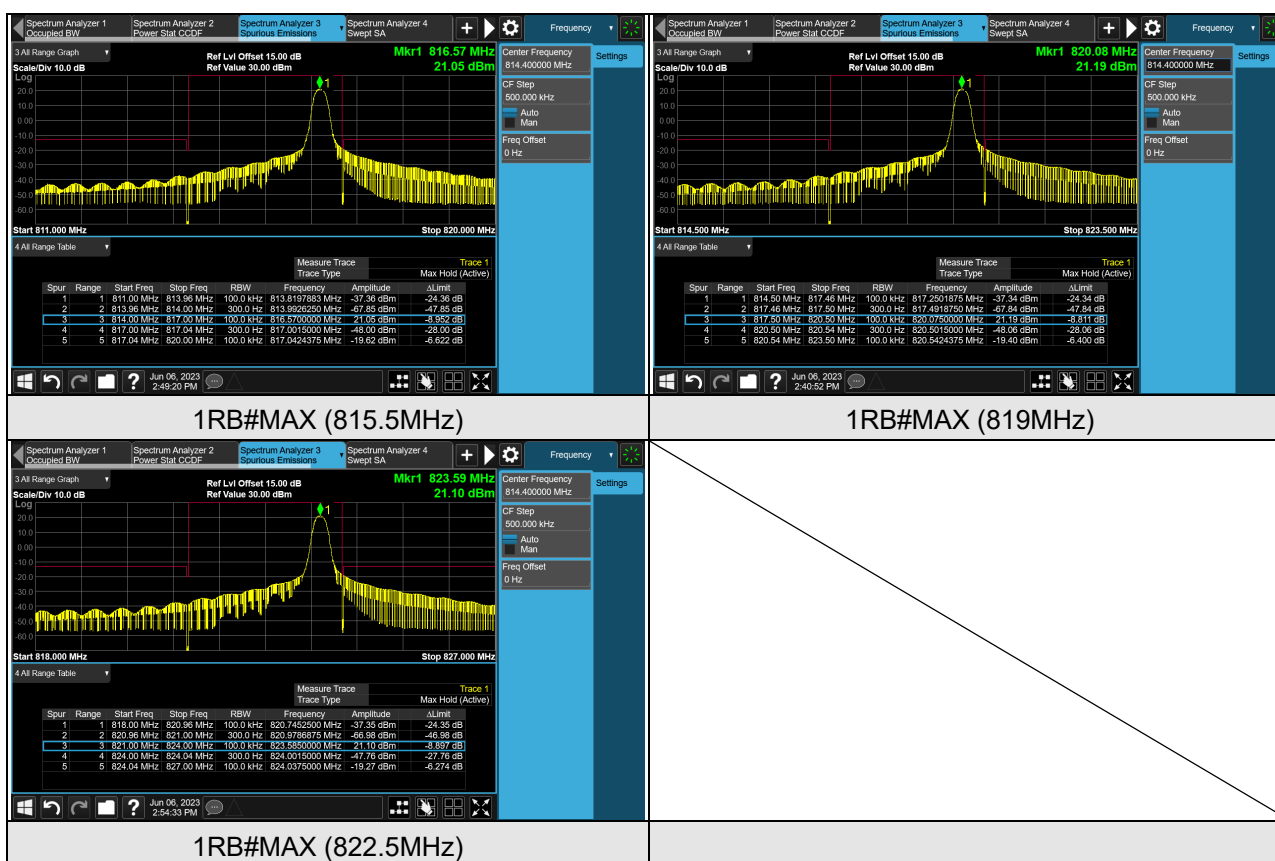


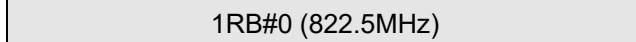
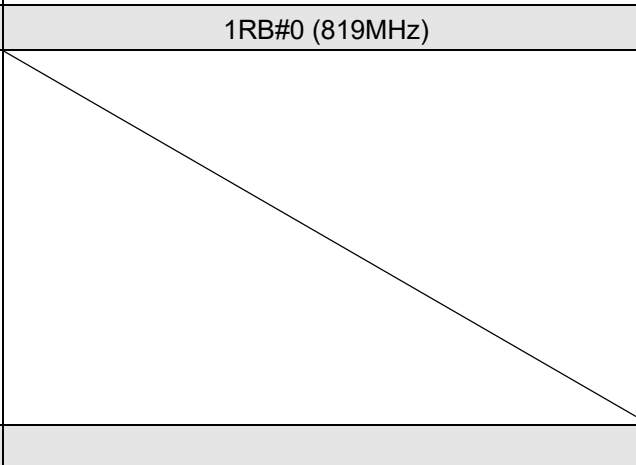
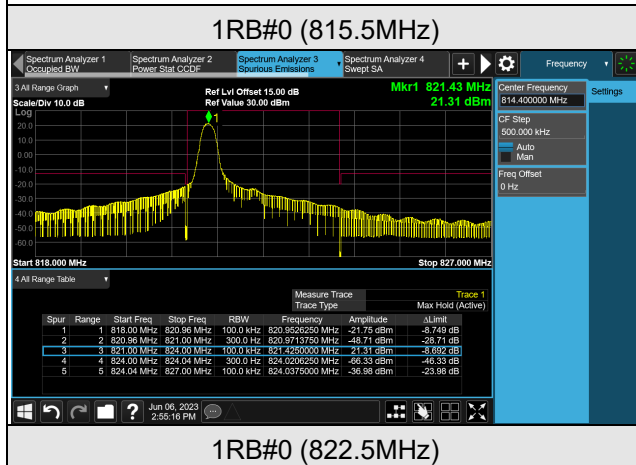
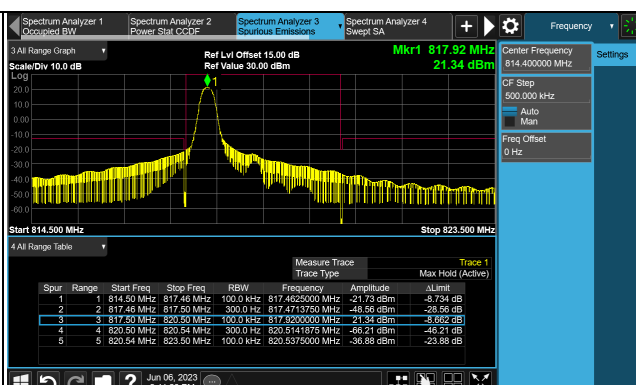
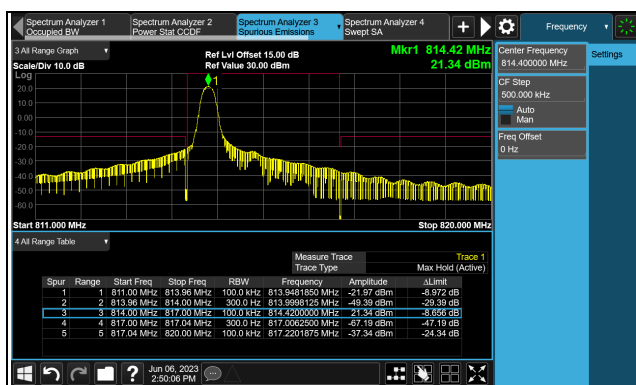
FULL (819MHz)



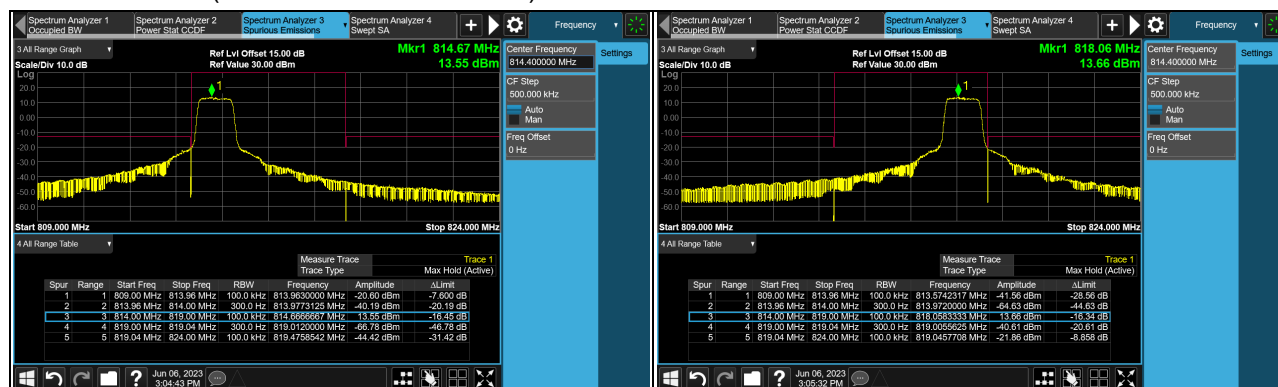
FULL (822.5MHz)



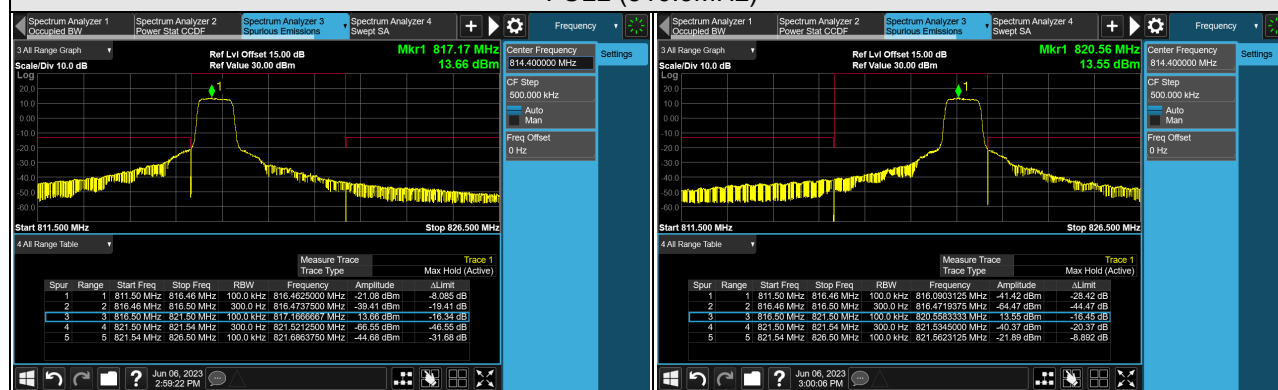




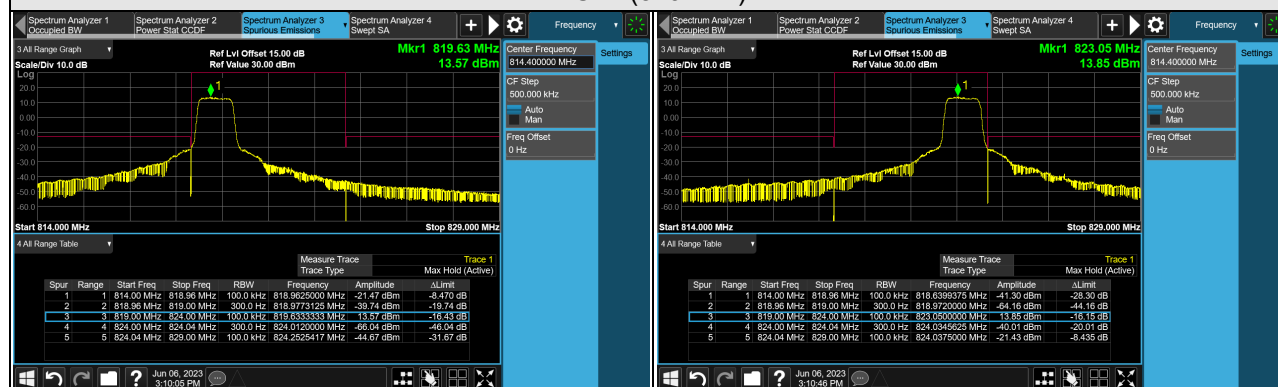
Cat-M1 Band 26 (Channel Bandwidth 5MHz)



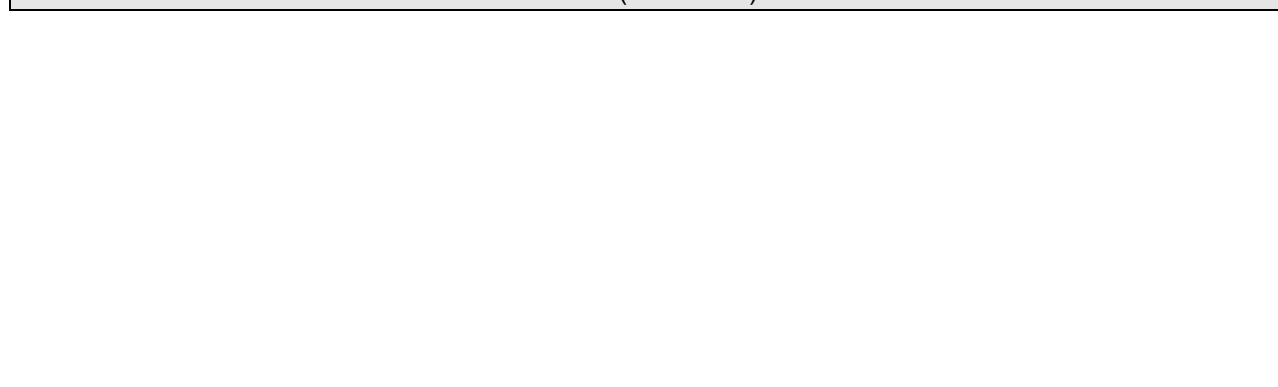
FULL (816.5MHz)

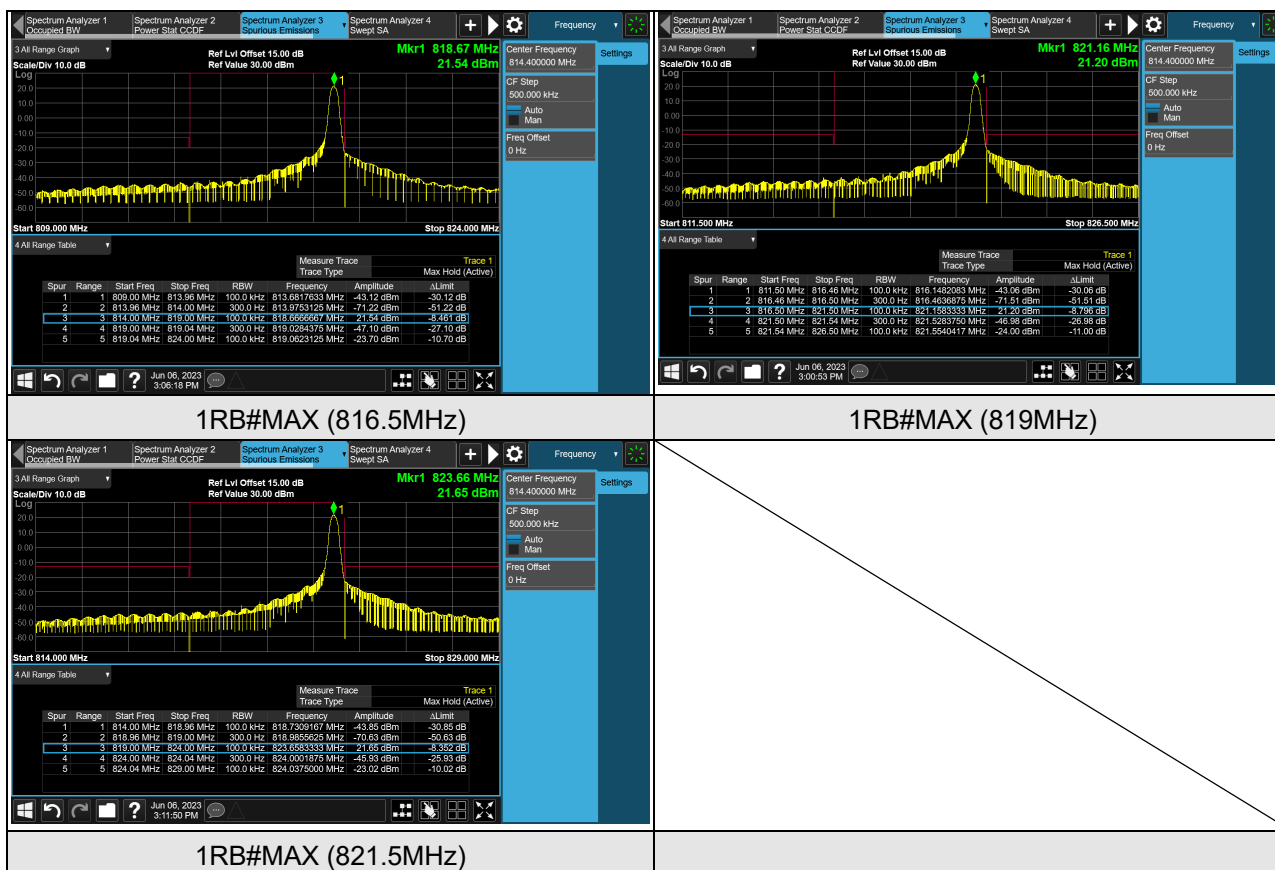


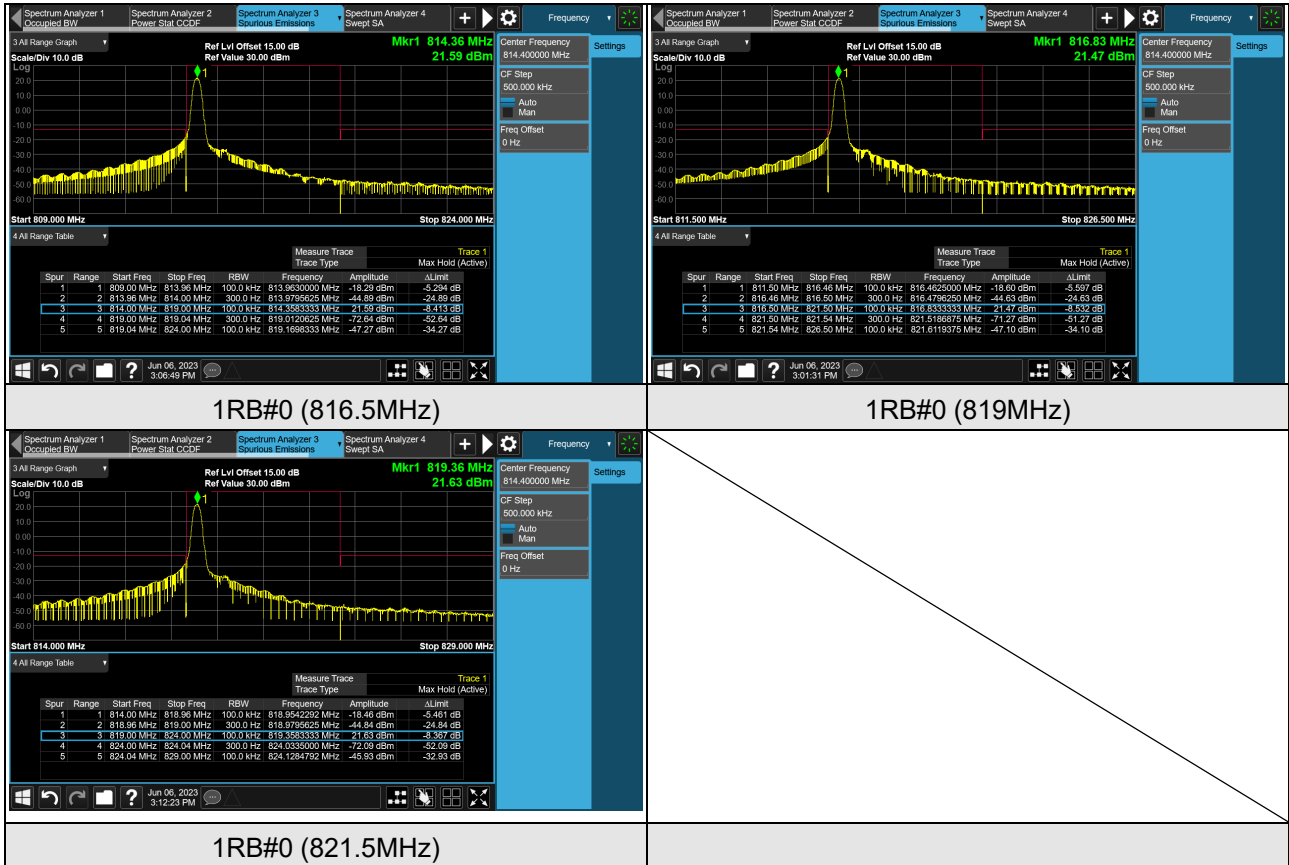
FULL (819MHz)



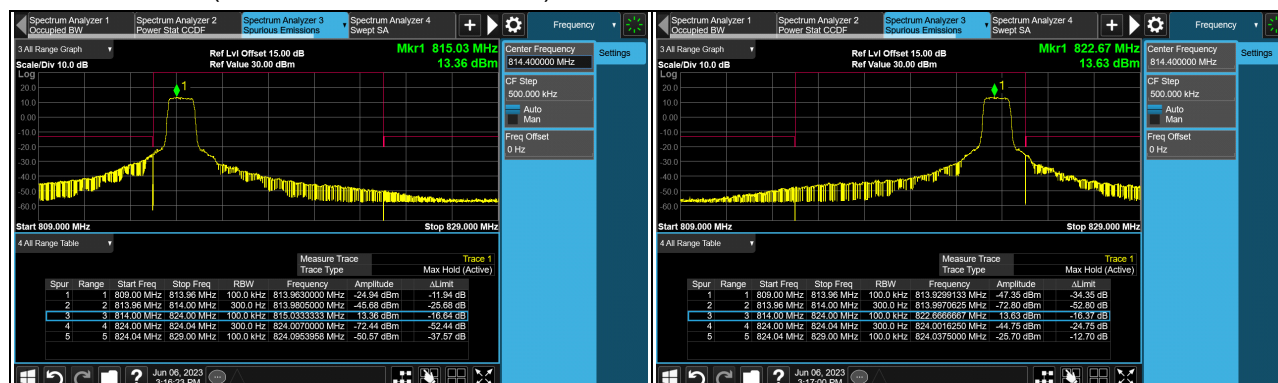
FULL (821.5MHz)



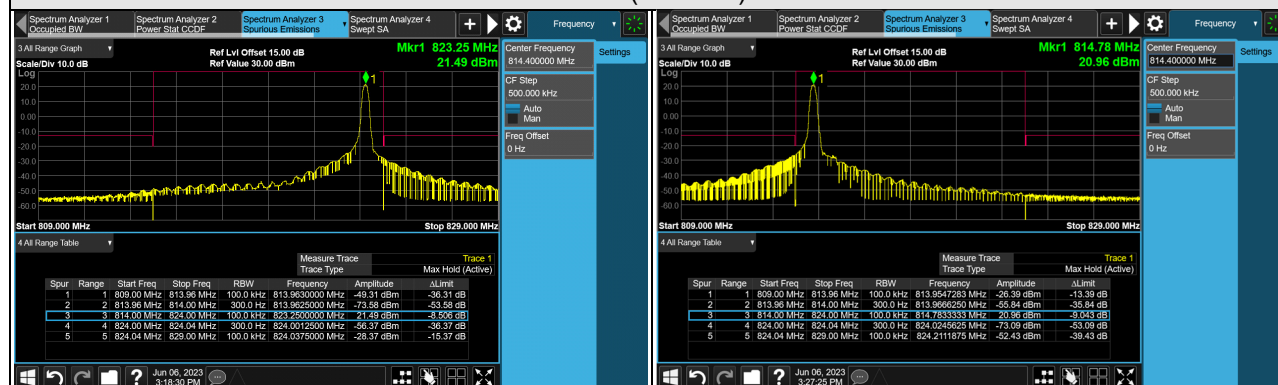




Cat-M1 Band 26 (Channel Bandwidth 10MHz)



FULL (819MHz)



1RB#MAX (819MHz)

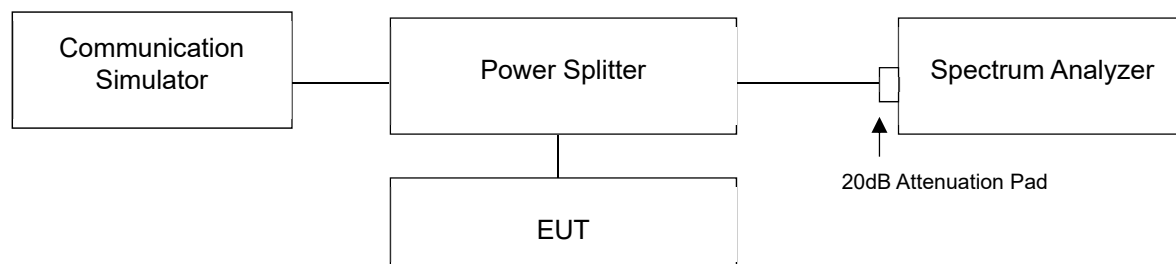
1RB#0 (819MHz)

4.6 Conducted Spurious Emissions

4.6.1 Limits of Conducted Spurious Emissions Measurement

The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10}(P)$ dB. The limit of emission equal to -13dBm .

4.6.2 Test Setup



4.6.3 Test Procedure

- The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range.
- Measuring frequency range is from 9kHz to 10GHz. 20dB attenuation pad is connected with spectrum. Detector = Average, RBW=1MHz and VBW=3MHz are used for Cat-M1 band conducted emission measurement.