



FCC TEST REPORT

Applicant : Atop Technologies, Inc.
Address : 1F, No. 30 R&D Rd. II, Science-Based Industrial Park, Hsinchu 30076, Taiwan, R.O.C.
Equipment : Industrial LTE Cat M1 Low Power IoT Gateway
Model No. : SE5201B-Q-T-M1-DB-US
SE5201B-Q-T-M1-TB-US
Trade Name : ATOP
FCC ID : RPV-SE5201B-M1

I HEREBY CERTIFY THAT :

The sample was received on Mar. 12, 2024 and the testing was completed on May. 17, 2024 at CerpPASS Technology Corp. The test result refers exclusively to the test presented test model / sample. Without written approval of CerpPASS Technology Corp., the test report shall not be reproduced except in full.

Approved by:

Mark Liao / Supervisor

Laboratory Accreditation:

CerpPASS Technology Corporation Test Laboratory





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History of this test report

Report No.	Issued Date	Description
24010312-TRFCC02	May. 23, 2024	Original



1. Summary of Test Procedure and Test Results

FCC 47 CFR PART 22 subpart H

ANSI C63.26: 2015

KDB 971168 Power Meas License Digital Systems

For Band V (824MHz ~ 849MHz)

FCC Rules	Test items	Measured	Result
2.1046 / 22.913 (a)(5)	Effective Radiated Power	Power[dBm]: 21.81	PASS
---	Equivalent Isotropically Radiated Power	Meet the requirement of limit	PASS
2.1053 / 22.917 (a)	Radiated Emissions	Meet the requirement of limit	PASS
2.1051 / 22.917 (a)	Conducted Emissions	Meet the requirement of limit	PASS
2.1051 / 22.917 (a)	Band Edge	Meet the requirement of limit	PASS
2.1049 / 22.917 (a)	Emission Bandwidth & Occupied Bandwidth	Meet the requirement of limit	PASS
22.913(d)	Peak to Average Ratio	Meet the requirement of limit	PASS
2.1055 / 22.355	Frequency Stability	Meet the requirement of limit	PASS

For Band 26 (824MHz ~ 849 MHz)

FCC Rules	Test items	Measured	Result
2.1046 / 22.913 (a)(5)	Effective Radiated power	Power[dBm]: 25.67	PASS
---	Equivalent Isotropically Radiated Power	Meet the requirement of limit	PASS
2.1053 / 22.917 (a)	Radiated Emissions	Meet the requirement of limit	PASS
2.1051 / 22.917 (a)	Conducted Emissions	Meet the requirement of limit	PASS
2.1051 / 22.917 (a)	Band Edge	Meet the requirement of limit	PASS
2.1049 / 22.917 (a)	Emission Bandwidth & Occupied Bandwidth	Meet the requirement of limit	PASS
22.913(d)	Peak To Average Ratio	Meet the requirement of limit	PASS
2.1055 / 22.355	Frequency Stability	Meet the requirement of limit	PASS



2. Test Configuration of Equipment under Test

2.1. Feature of Equipment under Test

Band	B2, B4, B5, B12, B13, B25, B26, B66, B85
Antenna Type	Dipole
Antenna Gain	LTE Cat M1 Band 2: 0.46dBi LTE Cat M1 Band 4: 0.46dBi LTE Cat M1 Band 5: -0.89dBi LTE Cat M1 Band 12: -0.89dBi LTE Cat M1 Band 13: -0.89dBi LTE Cat M1 Band 25: 0.46dBi LTE Cat M1 Band 26: -0.89dBi LTE Cat M1 Band 66: 0.46dBi LTE Cat M1 Band 85: -0.89dBi
Antenna Cable Loss	0.67dB
Antenna	Brand: Quectel /Model: YE0042AA

Note: For more details, please refer to the User’s manual of the EUT.

Difference description

Model	4G LTE Module	ANT Qty	GPS	LAN Ports	SIM Slot	Serial Port	SD
SE5201B-Q-T-M1-DB-US	BG95-M2	1	N/A	2	2	1*DB	1
SE5201B-Q-T-M1-TB-US	BG95-M2	1	N/A	2	2	1*TB	1



2.2. Carrier Frequency of Channels

Band	UL Frequency (MHz)	Modulation
LTE Cat M1 Band 5	824.7 ~ 848.3	QPSK, 16QAM
LTE Cat M1 Band 26	824.7 ~ 848.3	QPSK, 16QAM

2.3. Test Mode and Test Software

- a. During testing, the interface cables and equipment positions were varied according to ANSI C63.26.
- b. The complete test system included Remote workstation and EUT for RF test. The Remote workstation included Notebook.
- c. The following test modes were performed for the test:

Part22

Test Mode	Operating Description
1	LTE Cat M1 Band 5
2	LTE Cat M1 Band 26



2.4. Description of Test System

Radiated Emissions				
Equipment	Brand	Model	Length/Type	Power cord/Length/Type
Power Supply	MEAN WELL	SDR-120-24	N/A	N/A



2.5. General Information of Test

Test Site	CerpPASS Technology Corporation Test Laboratory Address: No.10, Ln. 2, Lianfu St., Luzhu Dist., Taoyuan City 33848, Taiwan (R.O.C.) Tel: +886-3-3226-888 Fax: +886-3-3226-881	
	FCC	TW1439, TW1079
	IC	4934E-1, 4934E-2
Frequency Range Investigated:	Radiation: from 30 MHz to 20,000MHz	
Test Distance:	The test distance of radiated emission from antenna to EUT is 3 M.	

Test Item	Test Site	Test Period	Environmental Conditions	Tested By
RF Conducted	RFCON01-NK	2024/04/25	25.6°C / 49%	Bart Tsai
RF Conducted	RFCON01-NK	2024/05/17	23.7°C / 37%	Bart Tsai
Radiated Emissions	3M02-NK	2024/05/03	21.9°C / 46%	Park Chen



2.6. 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 Item	Uncertainty
Equivalent Isotropically Radiated Power (Radiated)	±5.6dB
Conducted Spurious Emission	±2.2dB
Output Power(Conducted)	±1.07dB
Frequency Error	±0.22KHz
Occupied Channel Bandwidth	±4.4%
26dB Bandwidth	±4.4%
Peak to average ratio	±2.0dB
Temperature	±1.4°C
Humidity	±2.8%
Voltages(DC)	±2mV/V



3. Test Equipment and Ancillaries Used for Tests

Test Item	Radiated Emissions				
Test Site	Semi Anechoic Room(3M02-NK)				
Instrument	Manufacturer	Model No	Serial No	Calibration Date	Valid Date
Bilog Antenna	Schwarzbeck	VULB9168	369	2024/02/19	2025/02/18
Active Loop Antenna	Schwarzbeck	FMZB 1513	414	2024/01/16	2025/01/15
Horn Antenna	EMCO	3115	31601	2023/10/18	2024/10/17
Horn Antenna	EMCO	3116	31974	2023/10/16	2024/10/15
EMI Receiver	ROHDE & SCHWARZ	ESCI	101423	2023/07/05	2024/07/04
Spectrum Analyzer	ROHDE & SCHWARZ	FSV 40-N	102151	2023/08/15	2024/08/14
Preamplifier	Agilent	8449B	3008A01954	2024/03/01	2025/02/28
Preamplifier	EMC INSTRUMENTS	EMC184045	980065	2023/10/13	2024/10/12
Preamplifier	EM Electronics corp.	EM330	60659	2024/02/17	2025/02/16
Cable-6m(9k~300M)	NA	EMC5D-BM-B M-6	130606	2024/03/13	2025/03/12
Cable-3in1(30M-1G)	HARBOUR INDUSTRIES	LL142	CCE1315	2024/02/23	2025/02/22
Cable-0.5m(1G-40G)	HUBER SUHNER	SUCOFLEX 104	805443/4	2024/03/05	2025/03/04
Cable-3m(1G-40G)	HUBER SUHNER	SUCOFLEX 104	805796/4	2024/03/05	2025/03/04
Cable-8m(1G-26.5G)	WOKEN	WCBA-WCA20 3SM	CCE1374	2024/03/05	2025/03/04
Cable-1m(1G-40G)	HUBER SUHNER	HUBER SUHNER / SF102	552450	2023/06/08	2024/06/07
Cable-3m(1G-40G)	HUBER SUHNER	HUBER SUHNER / SF102	552451	2023/06/08	2024/06/07
E3	AUDIX	v8.2014-8-6	RK-000529	NA	NA
Highpass Filter	WOKEN	WFIL-H1400-10 000F	WR866WC2B1	2023/10/17	2024/10/16
Radio Communication Analyzer	Anritsu	MT8821C	6261830569	2024/02/17	2025/02/16



Test Item	RF Conducted				
Test Site	RFCON01-NK				
Instrument	Manufacturer	Model No	Serial No	Calibration Date	Valid Date
CAX Signal Analyzer	KEYSIGHT	N9000B	MY57100339	2023/11/06	2024/11/05
Radio Communication Analyzer	Anritsu	MT8821C	6261830569	2024/02/17	2025/02/16
TEMP & HUMI CHAMBER	T-MACHINE	TMJ-9712	T-12-040111	2023/08/07	2024/08/06



4. RF Output Power Test

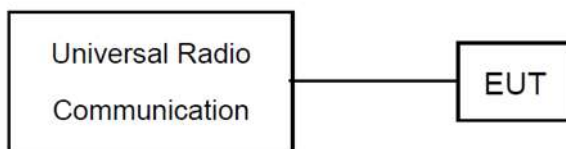
4.1 Test Limit

N/A

4.2 Test Procedures

1. The EUT was set up for the maximum power with simulator.
2. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

4.3 Test Setup



**4.4 Test Result and Data**

LTE Cat M1 Band 5

BW (MHz)	Opration Channel/ Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm)	
					Moduration	
					QPSK	16QAM
1.4	20407/824.7	0	1	0	21.27	19.87
		0	6	0	19	18.89
	20525/836.5	0	1	0	21.14	19.97
		0	6	0	18.86	18.73
	20643/848.3	0	1	5	21.2	19.96
		0	6	0	18.88	18.87

BW (MHz)	Opration Channel/ Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm)	
					Moduration	
					QPSK	16QAM
3	20415/825.5	0	1	0	21.22	19.97
		0	3	0	20.15	19.03
	20525/836.5	0	1	0	21.12	19.85
		0	3	0	19.9	18.86
	20635/847.5	1	1	5	21	19.95
		1	3	0	20.07	18.93

BW (MHz)	Opration Channel/ Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm)	
					Moduration	
					QPSK	16QAM
5	20425/826.5	1	1	0	21.15	21.26
		1	6	0	19.97	20.14
	20525/836.5	1	1	0	20.92	21.3
		1	6	0	19.85	19.8
	20625/846.5	3	1	5	21.08	21.22
		3	6	0	19.86	19.97

BW (MHz)	Opration Channel/ Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm)	
					Moduration	
					QPSK	16QAM
10	20450/829	0	1	0	20.98	21.26
		0	5	0	20.02	20.99
	20525/836.5	0	1	0	20.92	21.08
		0	5	0	19.87	20.95
	20600/844	7	1	5	20.95	21.11
		7	5	1	19.92	20.93



LTE Cat M1 Band 26

BW (MHz)	Operation Channel/Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm)	
					Moduration	
					QPSK	16QAM
1.4	26797/824.7	0	1	0	21.51	20.22
		0	6	0	19.31	19.21
	26915/836.5	0	1	0	21.49	20.24
		0	6	0	19.34	19.34
	27033/848.3	0	1	5	21.44	20.28
		0	6	0	19.33	19.38

BW (MHz)	Operation Channel/Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm)	
					Operation Channel/Frequency(MHz)	
					QPSK	16QAM
3	26805/825.5	0	1	0	21.55	20.53
		0	6	0	19.29	19.18
	26915/836.5	0	1	0	21.43	20.51
		0	6	0	19.27	19.34
	27025/847.5	1	1	5	21.48	20.47
		1	6	0	19.35	19.06

BW (MHz)	Operation Channel/Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm)	
					Operation Channel/Frequency(MHz)	
					QPSK	16QAM
5	26815/826.5	3	1	0	21.36	21.7
		0	6	0	20.26	20.27
	26915/836.5	0	1	0	21.45	21.66
		0	6	0	20.25	20.22
	27015/846.5	0	1	5	21.37	21.54
		3	6	0	20.31	20.18



BW (MHz)	Opration Channel/ Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm)	
					Opration Channel/Frequency(MHz)	
					QPSK	16QAM
10	26840/829	3	1	0	21.4	21.51
		0	4	0	21.01	20.92
	26915/836.5	0	1	0	21.42	21.44
		0	4	0	21.15	21.14
	26990/844	4	1	5	21.38	21.46
		7	4	2	21.22	21.11

BW (MHz)	Opration Channel/ Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm)	
					Opration Channel/Frequency(MHz)	
					QPSK	16QAM
15	26865/831.5	3	1	0	21.45	21.82
		0	6	0	21.34	21.4
	26915/836.5	0	1	0	21.27	21.52
		0	6	0	21.38	21.26
	26965/841.5	8	1	5	21.38	21.77
		11	6	0	21.33	21.34



5. Effective Radiated Power / Equivalent Isotropic Radiated Power Test

5.1. Test Limit

For FCC Part 22.913(a)(5): The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

5.2. Test Procedures

For Conducted power measurement:

1. The EUT links up with simulator and is set to maximum output power level at low / middel / high channel.
2. Measure the output power of low / middle / high channel of the EUT.

For ERP measurement:

ERP can be calculated by below formula from ANSI C63.26.

1. $EIRP = PT + GT - LC$

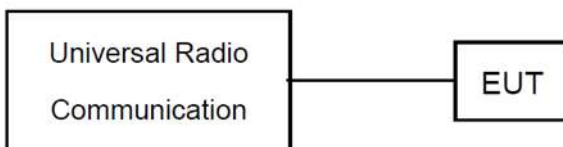
PT= transmitter output power, in dBm.

GT= gain of the transmitting antenna, in dBi (EIRP).

LC= signal attenuation in the connecting cable between the transmitter and antenna, in dB.

3. $ERP = EIRP - 2.15 \text{ dB}$.

5.3. Test Setup



**5.4. Test Result and Data**

Cat M1 Band5 1.4M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (W)	Margin (dB)
20407	824.7	1	21.27	-0.89	0.67	17.56	0.06	38.45	-20.89
		Full	19	-0.89	0.67	15.29	0.03	38.45	-23.16
20525	836.5	1	21.14	-0.89	0.67	17.43	0.06	38.45	-21.02
		Full	18.86	-0.89	0.67	15.15	0.03	38.45	-23.30
20643	848.3	1	21.2	-0.89	0.67	17.49	0.06	38.45	-20.96
		Full	18.88	-0.89	0.67	15.17	0.03	38.45	-23.28

Cat M1 Band5 1.4M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
20407	824.7	1	19.87	-0.89	0.67	16.16	0.04	38.45	-22.29
		Full	18.89	-0.89	0.67	15.18	0.03	38.45	-23.27
20525	836.5	1	19.97	-0.89	0.67	16.26	0.04	38.45	-22.19
		Full	18.73	-0.89	0.67	15.02	0.03	38.45	-23.43
20643	848.3	1	19.96	-0.89	0.67	16.25	0.04	38.45	-22.20
		Full	18.87	-0.89	0.67	15.16	0.03	38.45	-23.29

Cat M1 Band5 3M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
20415	825.5	1	21.22	-0.89	0.67	17.51	0.06	38.45	-20.94
		Full	20.15	-0.89	0.67	16.44	0.04	38.45	-22.01
20525	836.5	1	21.12	-0.89	0.67	17.41	0.06	38.45	-21.04
		Full	19.9	-0.89	0.67	16.19	0.04	38.45	-22.26
20635	847.5	1	21	-0.89	0.67	17.29	0.05	38.45	-21.16
		Full	20.07	-0.89	0.67	16.36	0.04	38.45	-22.09



Cat M1 Band5 3M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
20415	825.5	1	19.97	-0.89	0.67	16.26	0.04	38.45	-22.19
		Full	19.03	-0.89	0.67	15.32	0.03	38.45	-23.13
20525	836.5	1	19.85	-0.89	0.67	16.14	0.04	38.45	-22.31
		Full	18.86	-0.89	0.67	15.15	0.03	38.45	-23.30
20635	847.5	1	19.95	-0.89	0.67	16.24	0.04	38.45	-22.21
		Full	18.93	-0.89	0.67	15.22	0.03	38.45	-23.23

Cat M1 Band5 5M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
20425	826.5	1	21.15	-0.89	0.67	17.44	0.06	38.45	-21.01
		Full	19.97	-0.89	0.67	16.26	0.04	38.45	-22.19
20525	836.5	1	20.92	-0.89	0.67	17.21	0.05	38.45	-21.24
		Full	19.85	-0.89	0.67	16.14	0.04	38.45	-22.31
20625	846.5	1	21.08	-0.89	0.67	17.37	0.05	38.45	-21.08
		Full	19.86	-0.89	0.67	16.15	0.04	38.45	-22.30

Cat M1 Band5 5M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
20425	826.5	1	21.26	-0.89	0.67	17.55	0.06	38.45	-20.90
		Full	20.14	-0.89	0.67	16.43	0.04	38.45	-22.02
20525	836.5	1	21.3	-0.89	0.67	17.59	0.06	38.45	-20.86
		Full	19.8	-0.89	0.67	16.09	0.04	38.45	-22.36
20625	846.5	1	21.22	-0.89	0.67	17.51	0.06	38.45	-20.94
		Full	19.97	-0.89	0.67	16.26	0.04	38.45	-22.19



Cat M1 Band5 10M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
20450	829	1	20.98	-0.89	0.67	17.27	0.05	38.45	-21.18
		Full	20.02	-0.89	0.67	16.31	0.04	38.45	-22.14
20525	836.5	1	20.92	-0.89	0.67	17.21	0.05	38.45	-21.24
		Full	19.87	-0.89	0.67	16.16	0.04	38.45	-22.29
20600	844	1	20.95	-0.89	0.67	17.24	0.05	38.45	-21.21
		Full	19.92	-0.89	0.67	16.21	0.04	38.45	-22.24

Cat M1 Band5 10M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
20450	829	1	21.26	-0.89	0.67	17.55	0.06	38.45	-20.90
		Full	20.99	-0.89	0.67	17.28	0.05	38.45	-21.17
20525	836.5	1	21.08	-0.89	0.67	17.37	0.05	38.45	-21.08
		Full	20.95	-0.89	0.67	17.24	0.05	38.45	-21.21
20600	844	1	21.11	-0.89	0.67	17.4	0.05	38.45	-21.05
		Full	20.93	-0.89	0.67	17.22	0.05	38.45	-21.23

Cat M1 Band26 1.4M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26797	824.7	1	21.51	-0.89	0.67	17.8	0.06	38.45	-20.65
		Full	19.31	-0.89	0.67	15.6	0.04	38.45	-22.85
26915	836.5	1	21.49	-0.89	0.67	17.78	0.06	38.45	-20.67
		Full	19.34	-0.89	0.67	15.63	0.04	38.45	-22.82
27033	848.3	1	21.44	-0.89	0.67	17.73	0.06	38.45	-20.72
		Full	19.33	-0.89	0.67	15.62	0.04	38.45	-22.83



Cat M1 Band26 1.4M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26797	824.7	1	20.22	-0.89	0.67	16.51	0.04	38.45	-21.94
		Full	19.21	-0.89	0.67	15.5	0.04	38.45	-22.95
26915	836.5	1	20.24	-0.89	0.67	16.53	0.04	38.45	-21.92
		Full	19.34	-0.89	0.67	15.63	0.04	38.45	-22.82
27033	848.3	1	20.28	-0.89	0.67	16.57	0.05	38.45	-21.88
		Full	19.38	-0.89	0.67	15.67	0.04	38.45	-22.78

Cat M1 Band26 3M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26805	825.5	1	21.55	-0.89	0.67	17.84	0.06	38.45	-20.61
		Full	19.29	-0.89	0.67	15.58	0.04	38.45	-22.87
16915	836.5	1	21.43	-0.89	0.67	17.72	0.06	38.45	-20.73
		Full	19.27	-0.89	0.67	15.56	0.04	38.45	-22.89
27025	847.5	1	21.48	-0.89	0.67	17.77	0.06	38.45	-20.68
		Full	19.35	-0.89	0.67	15.64	0.04	38.45	-22.81

Cat M1 Band26 3M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26805	825.5	1	20.53	-0.89	0.67	16.82	0.05	38.45	-21.63
		Full	19.18	-0.89	0.67	15.47	0.04	38.45	-22.98
16915	836.5	1	20.51	-0.89	0.67	16.8	0.05	38.45	-21.65
		Full	19.34	-0.89	0.67	15.63	0.04	38.45	-22.82
27025	847.5	1	20.47	-0.89	0.67	16.76	0.05	38.45	-21.69
		Full	19.06	-0.89	0.67	15.35	0.03	38.45	-23.10



Cat M1 Band26 5M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26815	826.5	1	21.36	-0.89	0.67	17.65	0.06	38.45	-20.80
		Full	20.26	-0.89	0.67	16.55	0.05	38.45	-21.90
26915	836.5	1	21.45	-0.89	0.67	17.74	0.06	38.45	-20.71
		Full	20.25	-0.89	0.67	16.54	0.05	38.45	-21.91
27015	846.5	1	21.37	-0.89	0.67	17.66	0.06	38.45	-20.79
		Full	20.31	-0.89	0.67	16.6	0.05	38.45	-21.85

Cat M1 Band26 5M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26815	826.5	1	21.7	-0.89	0.67	17.99	0.06	38.45	-20.46
		Full	20.27	-0.89	0.67	16.56	0.05	38.45	-21.89
26915	836.5	1	21.66	-0.89	0.67	17.95	0.06	38.45	-20.50
		Full	20.22	-0.89	0.67	16.51	0.04	38.45	-21.94
27015	846.5	1	21.54	-0.89	0.67	17.83	0.06	38.45	-20.62
		Full	20.18	-0.89	0.67	16.47	0.04	38.45	-21.98

Cat M1 Band26 10M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26840	829	1	21.4	-0.89	0.67	17.69	0.06	38.45	-20.76
		Full	21.01	-0.89	0.67	17.3	0.05	38.45	-21.15
26915	836.5	1	21.42	-0.89	0.67	17.71	0.06	38.45	-20.74
		Full	21.15	-0.89	0.67	17.44	0.06	38.45	-21.01
26990	844	1	21.38	-0.89	0.67	17.67	0.06	38.45	-20.78
		Full	21.22	-0.89	0.67	17.51	0.06	38.45	-20.94



Cat M1 Band26 10M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26840	829	1	21.51	-0.89	0.67	17.8	0.06	38.45	-20.65
		Full	20.92	-0.89	0.67	17.21	0.05	38.45	-21.24
26915	836.5	1	21.44	-0.89	0.67	17.73	0.06	38.45	-20.72
		Full	21.14	-0.89	0.67	17.43	0.06	38.45	-21.02
26990	844	1	21.46	-0.89	0.67	17.75	0.06	38.45	-20.70
		Full	21.11	-0.89	0.67	17.4	0.05	38.45	-21.05

Cat M1 Band26 15M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26865	829	1	21.45	-0.89	0.67	17.74	0.06	38.45	-20.71
		Full	21.34	-0.89	0.67	17.63	0.06	38.45	-20.82
26915	836.5	1	21.27	-0.89	0.67	17.56	0.06	38.45	-20.89
		Full	21.38	-0.89	0.67	17.67	0.06	38.45	-20.78
26965	844	1	21.38	-0.89	0.67	17.67	0.06	38.45	-20.78
		Full	21.33	-0.89	0.67	17.62	0.06	38.45	-20.83

Cat M1 Band26 15M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	Cable Loss (dbm)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26865	829	1	21.82	-0.89	0.67	18.11	0.06	38.45	-20.34
		Full	21.4	-0.89	0.67	17.69	0.06	38.45	-20.76
26915	836.5	1	21.52	-0.89	0.67	17.81	0.06	38.45	-20.64
		Full	21.26	-0.89	0.67	17.55	0.06	38.45	-20.90
26965	844	1	21.77	-0.89	0.67	18.06	0.06	38.45	-20.39
		Full	21.34	-0.89	0.67	17.63	0.06	38.45	-20.82



6. Emission Bandwidth & Occupied Bandwidth Test

6.1. Test Limit

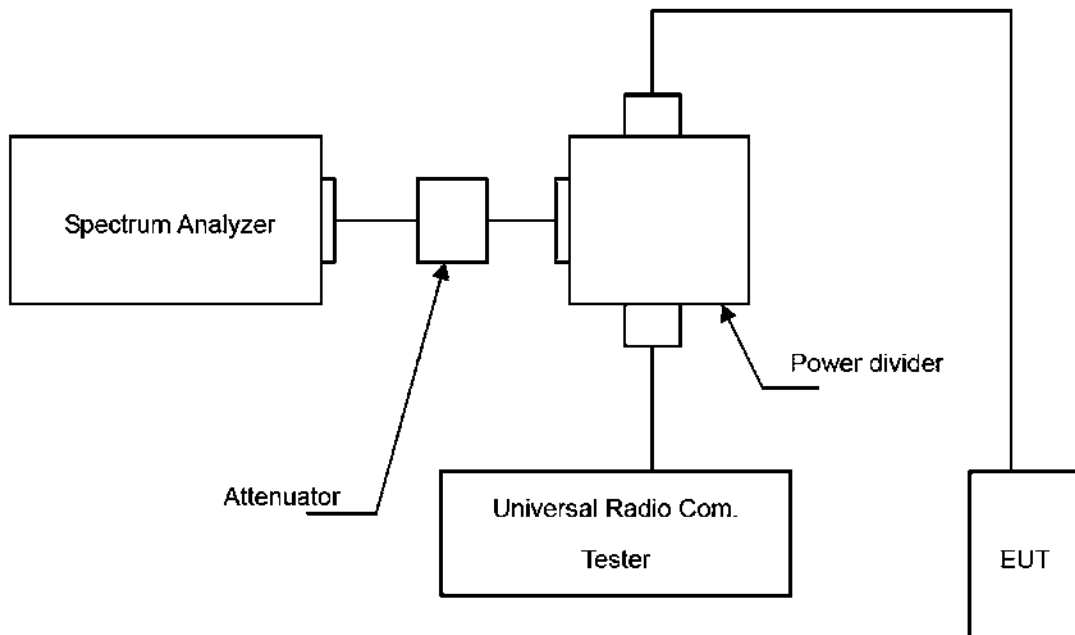
The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 %of the total mean power of a given emission.

The emission bandwidth is defined as the width of the signal between two points, located at the 2 sides of the carrier frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

6.2. Test Procedures

- The EUT makes a phone call to the communication simulator. The power was measured with R&S Spectrum Analyzer. All measurements were done at 3 channels. (low, middle and high operational frequency range.)
- The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
- The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth.

6.3. Test Setup





6.4. Test Result and Data

Cat M1 Band5

Moduration type	RB	Bandwidth (MHz)	Channel No.	Frequency (MHz)	-26dBc Occupied Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
QPSK	100%	1.4	20525	836.5	1.3720	1.1206
		3	20525	836.5	1.3990	1.1310
		5	20525	836.5	1.3930	1.1327
		10	20525	836.5	1.4280	1.1362
16QAM	100%	1.4	20525	836.5	1.1550	0.9516
		3	20525	836.5	1.1930	0.9618
		5	20525	836.5	1.1790	0.9608
		10	20525	836.5	1.1730	0.9766

Cat M1 Band26

Moduration type	RB	Bandwidth (MHz)	Channel No.	Frequency (MHz)	-26dBc Occupied Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
QPSK	100%	1.4	26915	836.5	1.3740	1.1181
		3	26915	836.5	1.4310	1.1309
		5	26915	836.5	1.3850	1.1301
		10	26915	836.5	1.3920	1.1292
		15	26915	836.5	1.4280	1.1539
16QAM	100%	1.4	26915	836.5	1.1690	0.9532
		3	26915	836.5	1.1860	0.9617
		5	26915	836.5	1.1860	0.9628
		10	26915	836.5	1.2370	0.9718
		15	26915	836.5	1.2630	0.9631



Test Mode: Band 5 QPSK 1.4MHz
CH20525



Test Mode: Band 5 QPSK 10MHz
CH20525



Test Mode: Band 5 QPSK 3MHz
CH20525



Test Mode: Band 5 QPSK 5MHz
CH20525





Test Mode: Band 5 16QAM 1.4MHz
CH20525



Test Mode: Band 5 16QAM 10MHz
CH20525



Test Mode: Band 5 16QAM 3MHz
CH20525



Test Mode: Band 5 16QAM 5MHz
CH20525

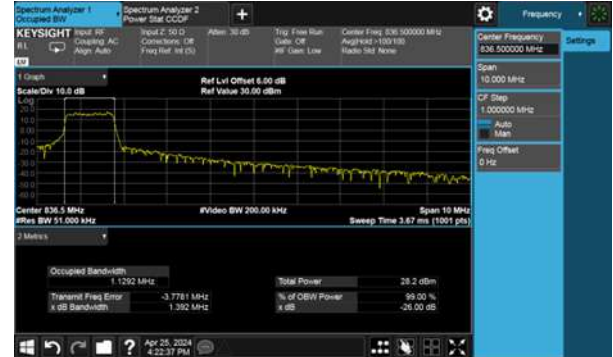




Test Mode: Band 26 QPSK 1.4MHz CH26915



Test Mode: Band 26 QPSK 10MHz CH26915



Test Mode: Band 26 QPSK 3MHz CH26915



Test Mode: Band 26 QPSK 15MHz CH26915



Test Mode: Band 26 QPSK 5MHz CH26915

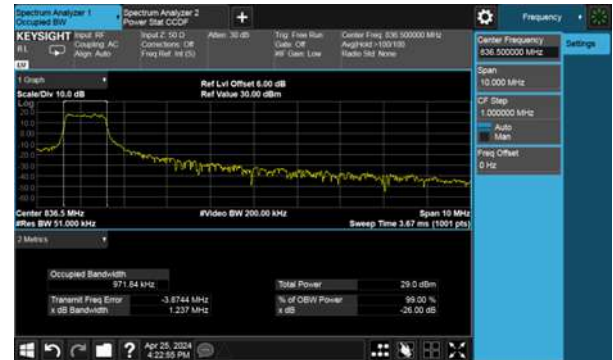




Test Mode: Band 26 16QAM 1.4MHz CH26915



Test Mode: Band 26 16QAM 10MHz CH26915



Test Mode: Band 26 16QAM 3MHz CH26915



Test Mode: LTE Band 26 16QAM 15MHz CH26915



Test Mode: Band 26 16QAM 5MHz CH26915





7. Peak to Average Ratio Test

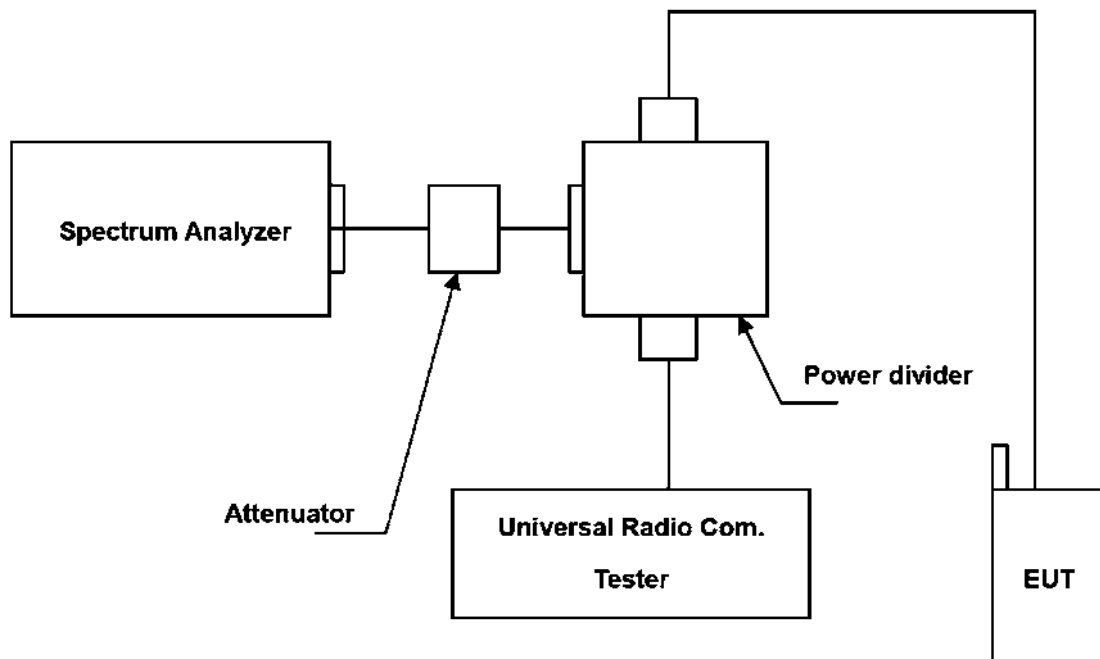
7.1. Test Limit

In measuring transmissions in this band using an average power technique, the peak to-average ratio (PAR) of the transmission may not exceed 13 dB.

7.2. Test Procedures

- a. Set resolution/measurement bandwidth signal's occupied bandwidth
- b. Set the number of counts to a value that stabilizes the measured CCDF curve
- c. Record the maximum PAPR level associated with a probability of 0.1%

7.3. Test Setup





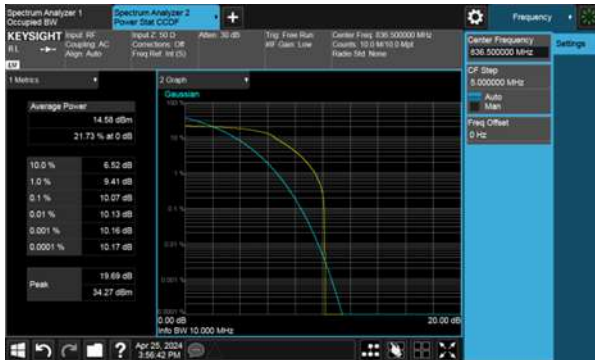
7.4. Test Result and Data

Band	Mode	Bandwidth (MHz)	RB size	Channel	Frequency (MHz)	PAR (dB)	Limit	Result
Cat M1 Band 5	QPSK	1.4	1RB	20525	836.5	10.07	13	Pass
	16QAM			20525	836.5	11.44	13	Pass
	QPSK	3		20525	836.5	9.58	13	Pass
	16QAM			20525	836.5	9.92	13	Pass
	QPSK	5		20525	836.5	8.79	13	Pass
	16QAM			20525	836.5	9.6	13	Pass
	QPSK	10		20525	836.5	9.23	13	Pass
	16QAM			20525	836.5	10.02	13	Pass

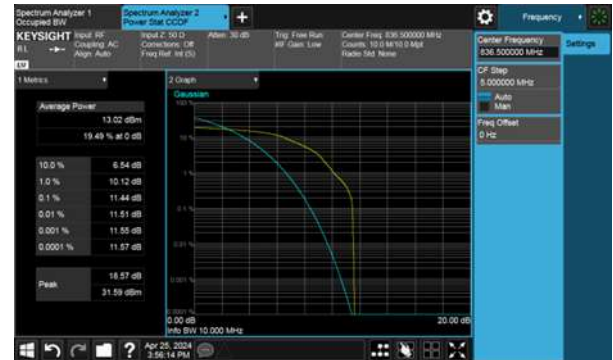
Band	Mode	Bandwidth (MHz)	RB size	Channel	Frequency (MHz)	PAR (dB)	Limit	Result
Cat M1 Band 26	QPSK	1.4	1RB	26915	836.5	10.99	13	Pass
	16QAM			26915	836.5	11.46	13	Pass
	QPSK	3		26915	836.5	9.05	13	Pass
	16QAM			26915	836.5	10.03	13	Pass
	QPSK	5		26915	836.5	8.63	13	Pass
	16QAM			26915	836.5	9.34	13	Pass
	QPSK	10		26915	836.5	8.7	13	Pass
	16QAM			26915	836.5	9.08	13	Pass
	QPSK	15		26915	836.5	9.02	13	Pass
	16QAM			26915	836.5	9.09	13	Pass



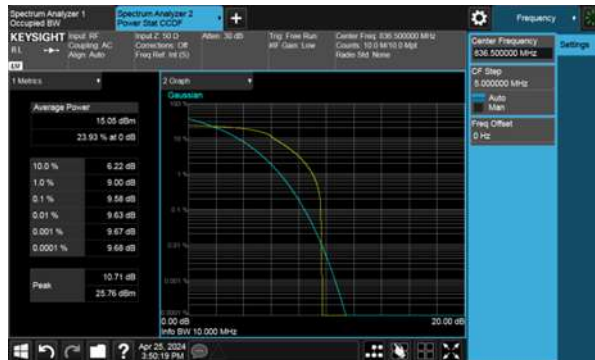
Test Mode: Band 5 QPSK 1.4MHz
CH20525



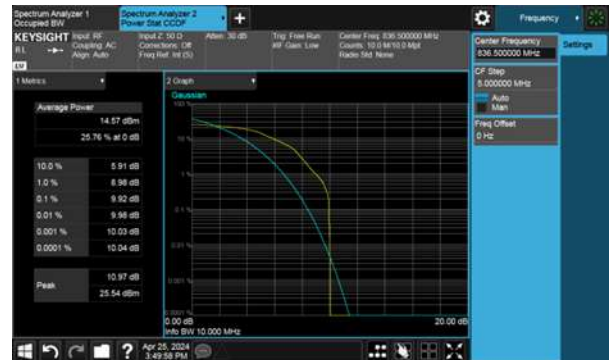
Test Mode: Band 5 16QAM 1.4MHz
CH20525



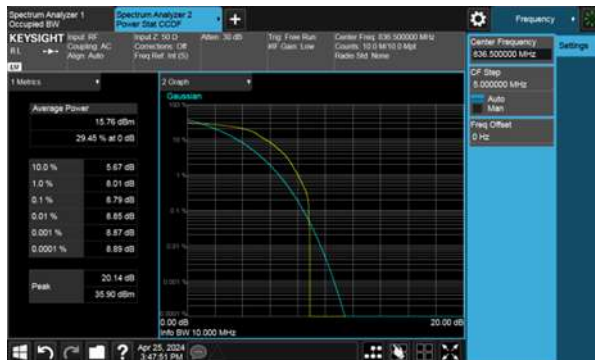
Test Mode: Band 5 QPSK 3MHz
CH20525



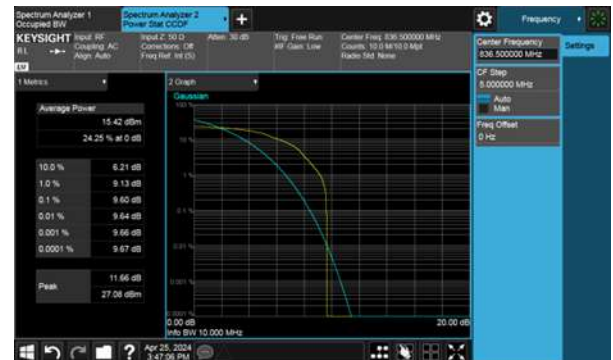
Test Mode: Band 5 16QAM 3MHz
CH20525



Test Mode: Band 5 QPSK 5MHz
CH20525

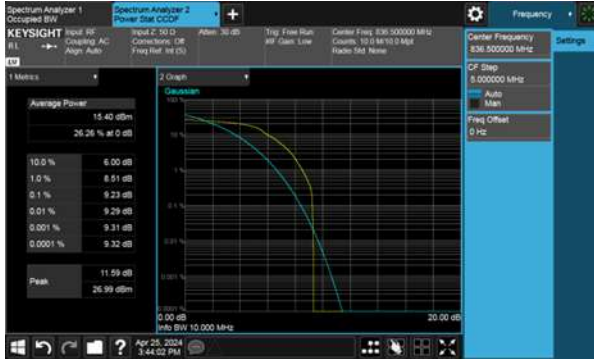


Test Mode: Band 5 16QAM 5MHz
CH20525

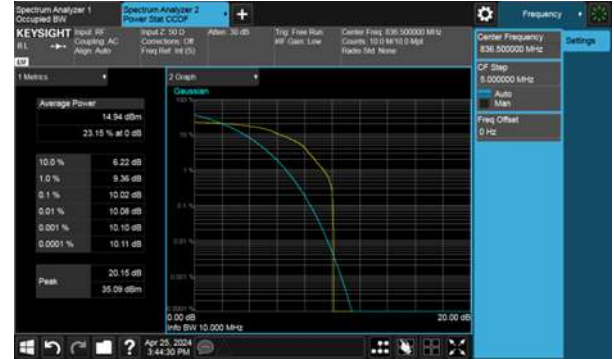




Test Mode: Band 5 QPSK 10MHz
CH20525

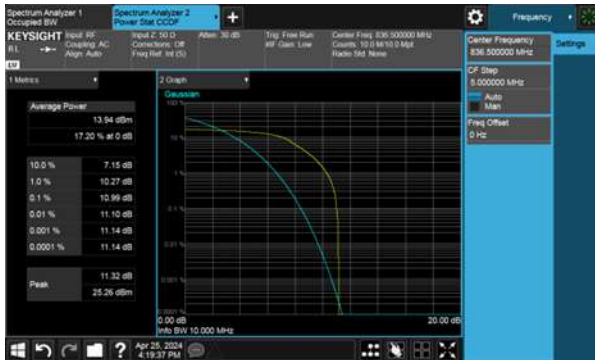


Test Mode: Band 5 16QAM 10MHz
CH20525

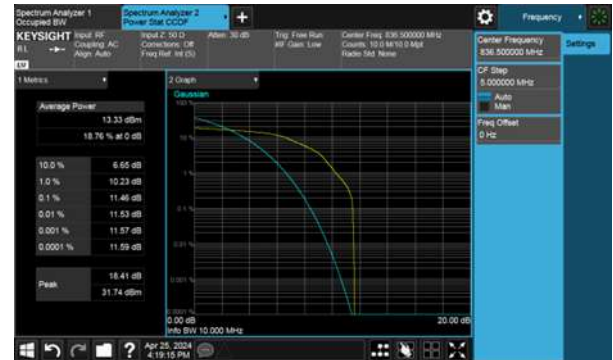




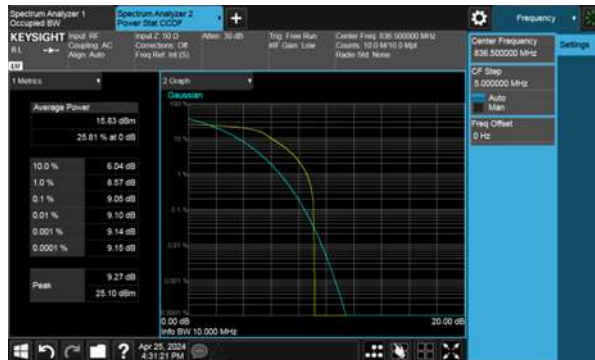
Test Mode: Band 26 QPSK 1.4MHz CH26915



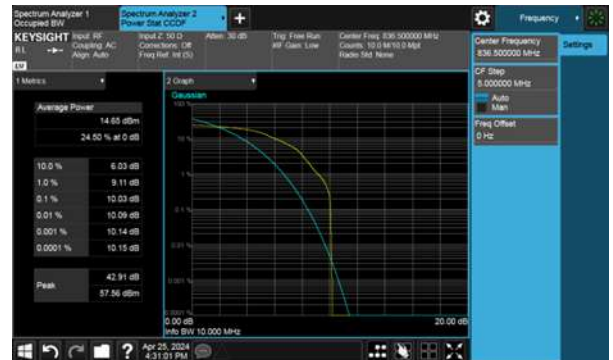
Test Mode: Band26 16QAM 1.4MHz CH26915



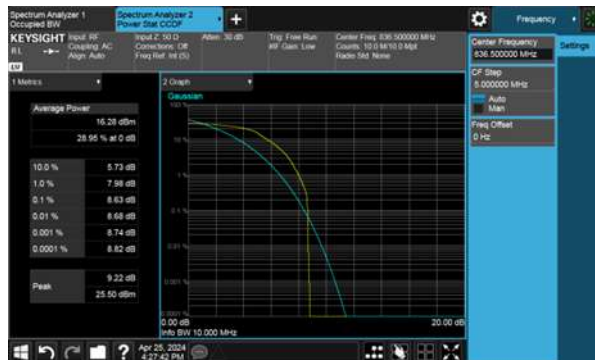
Test Mode: Band 26 QPSK 3MHz CH26915



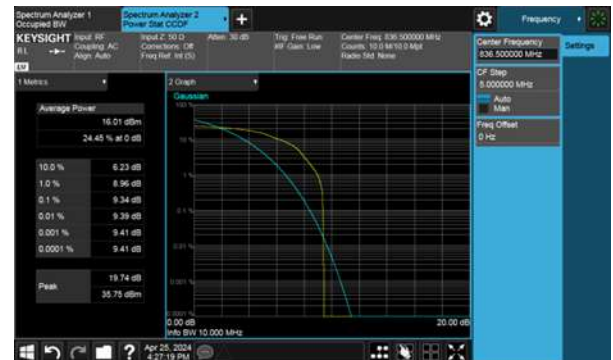
Test Mode: Band26 16QAM 3MHz CH26915



Test Mode: Band 26 QPSK 5MHz CH26915

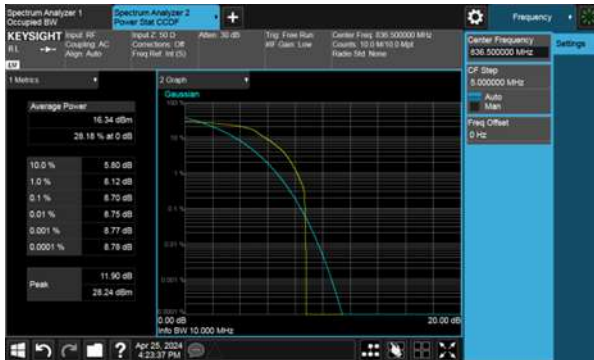


Test Mode: Band26 16QAM 5MHz CH26915

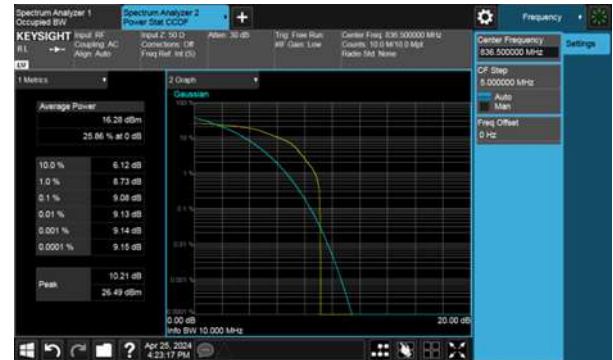




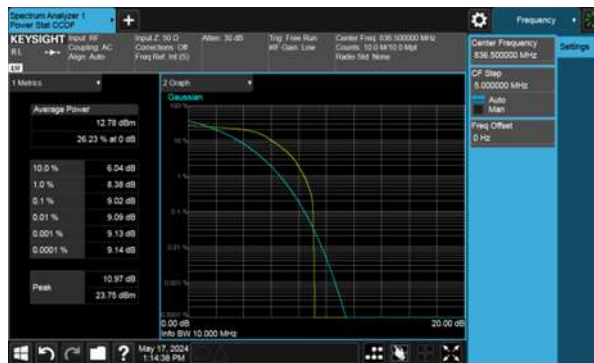
Test Mode: Band 26 QPSK 10MHz
CH26915



Test Mode: Band26 16QAM 10MHz
CH26915



Test Mode: Band 26 QPSK 15MHz
CH26915



Test Mode: Band26 16QAM 15MHz
CH26915





8. Band Edge

8.1. Test Limit

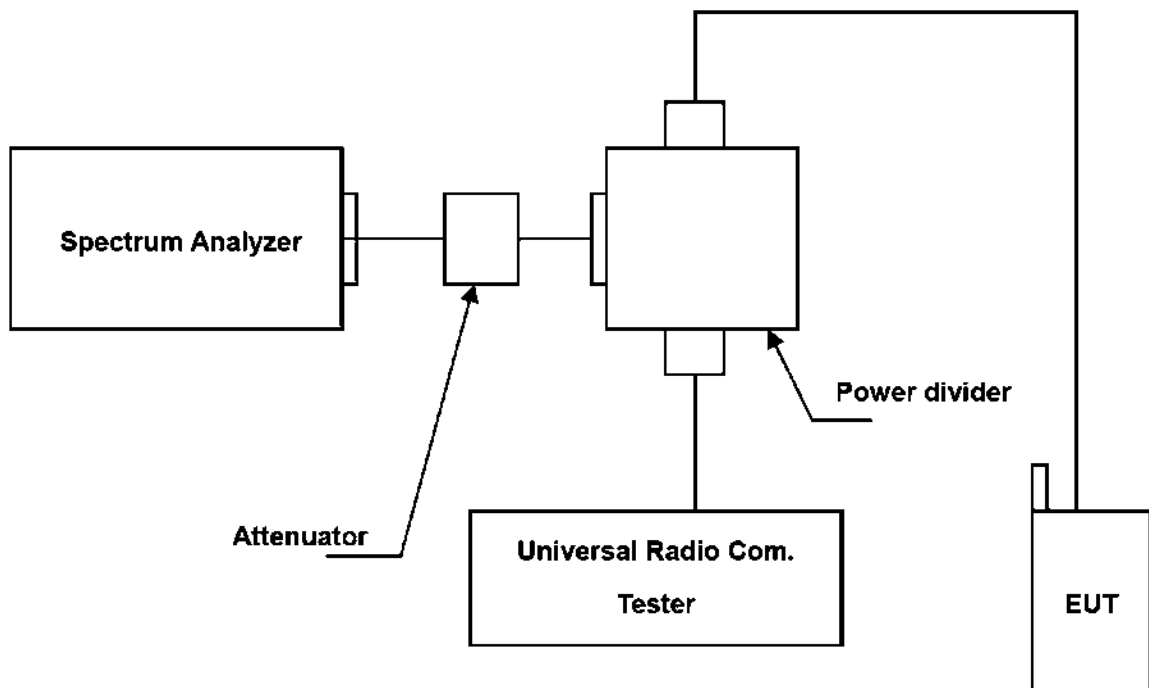
§22.917(a), §24.238(a)

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10\log(P)$ dB.

8.2. Test Procedures

- The EUT was set up for the maximum peak power with WWAN link data modulation. The power was measured with Spectrum Analyzer. All measurements were done at 2 channels (low and high operational frequency range.)
- The band edge measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer. This splitter loss and cable loss are the worst loss in the transmitted path track.
- The center frequency of spectrum is the band edge frequency and span is 10 MHz. RB of the resolution bandwidth of at least one percent of the emission bandwidth.
- Record the max trace plot into the test report.

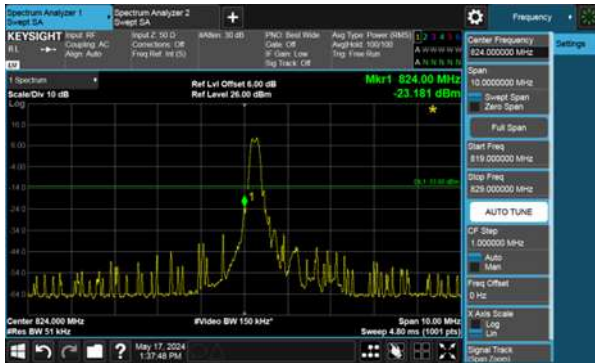
8.3. Test Setup





8.4. Test Result and Data

Test Mode: QPSK Band 5 1.4M CH20407-1 @0



Test Mode: QPSK 10M CH20450-1 @0



Test Mode: QPSK 1.4M CH20643-1 @MAX

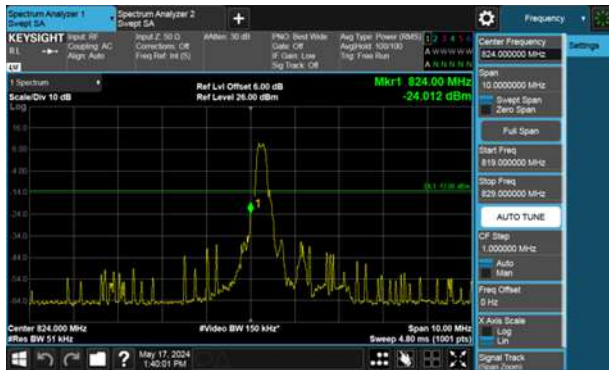


Test Mode: QPSK 10M CH20600-1 @MAX





Test Mode: LTE Band 26 1.4M CH26797-1@0



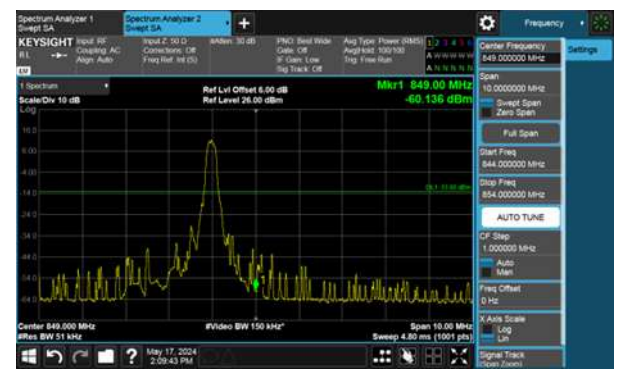
Test Mode: LTE Band 26 15M CH26865-1@0



Test Mode: LTE Band 26 1.4M CH 27033-1@MAX



Test Mode: LTE Band 26 15M CH26965-1@MAX





9. Conducted Spurious Emission Test

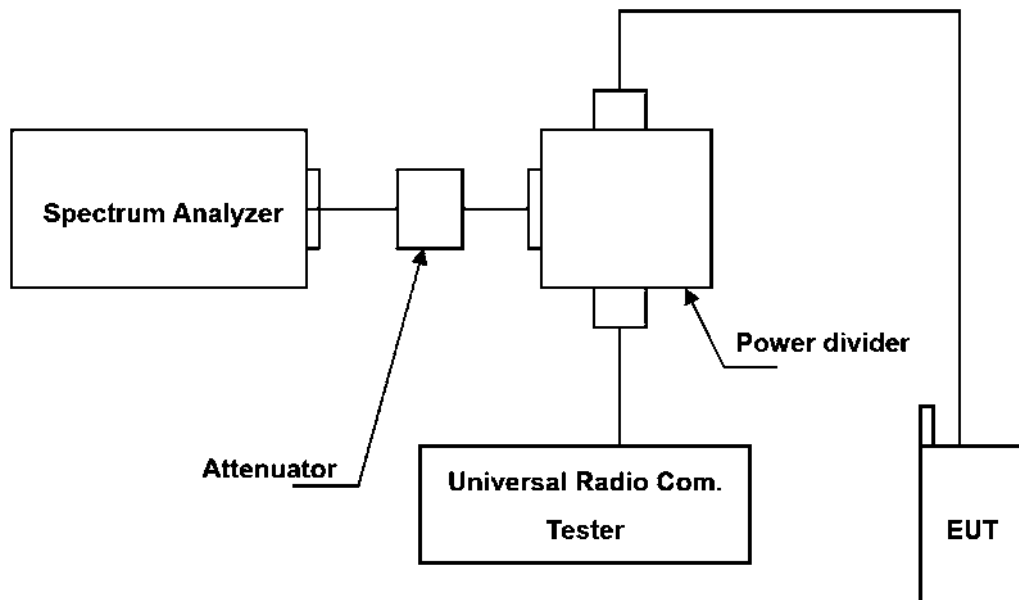
9.1. Test Limit

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

9.2. Test Procedures

- The EUT was set up for the maximum peak power with WWAN link data modulation. The power was measured with Spectrum Analyzer. All measurements were done at 3 channels (low, middle and high operational frequency range.)
- The conducted spurious emission used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
- When the spectrum scanned from 10MHz to 2.5GHz (Band 7 and Band 41: scanned from 10MHz to 4GHz), it shall be connected to the band reject filter attenuated the carried frequency. The spectrum set RB=1MHz, VB=1MHz.
- When the spectrum scanned from 2.5GHz to 10th harmonic (Band 7 and Band 41: scanned from 4GHz to 10th harmonic), it shall be connected to the high pass filter attenuated the carried frequency. The spectrum set RB=1MHz, VB=1MHz.

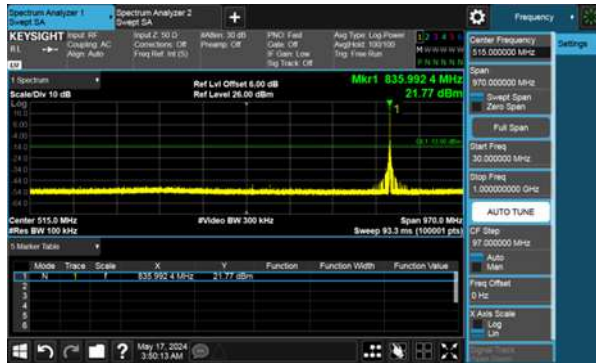
9.3. Test Setup





9.4. Test Result and Data

Test Mode: Band5 QPSK 1RB 1.4M CH20525-1



Test Mode: Band5 QPSK 1RB 1.4M CH20525-2



Test Mode: Band26 QPSK 1RB 1.4M CH26915-1



Test Mode: Band26 QPSK 1RB 1.4M CH26915-2





10. Radiation Emission Test

10.1. Test Limit

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10\log(P)$ dB.

10.2. Test Procedure

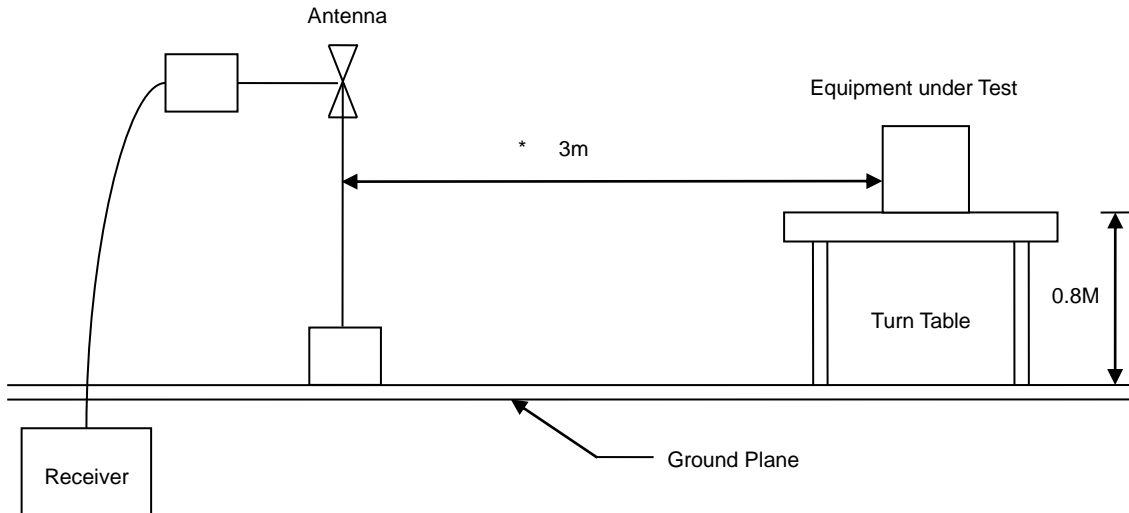
- a. The EUT was set up for the maximum power with wwan link data modulation. The power was measured with Spectrum Analyzer. All measurements were done at 3 channels (low, middle and high operational frequency range).
- b. E.I.R.P power measurement. In the semi-anechoic chamber, EUT placed on the 0.8m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power. The "Read Value" is the spectrum reading the maximum power value.
- c. The substitution antenna (Note:1 & 2) is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a TX cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to "Read Value" of step a. Record the power level of S.G.
- d. E.I.R.P. = Output power level of S.G - TX cable loss + Antenna gain of substitution horn
- e. E.R.P. = E.I.R.P.- 2.15 dB

Note: 1. Below 1GHz substituted method test: sleeve dipole antenna to Bi-Log Antenna.
2. Above 1GHz substituted method test: horn antenna to horn antenna.

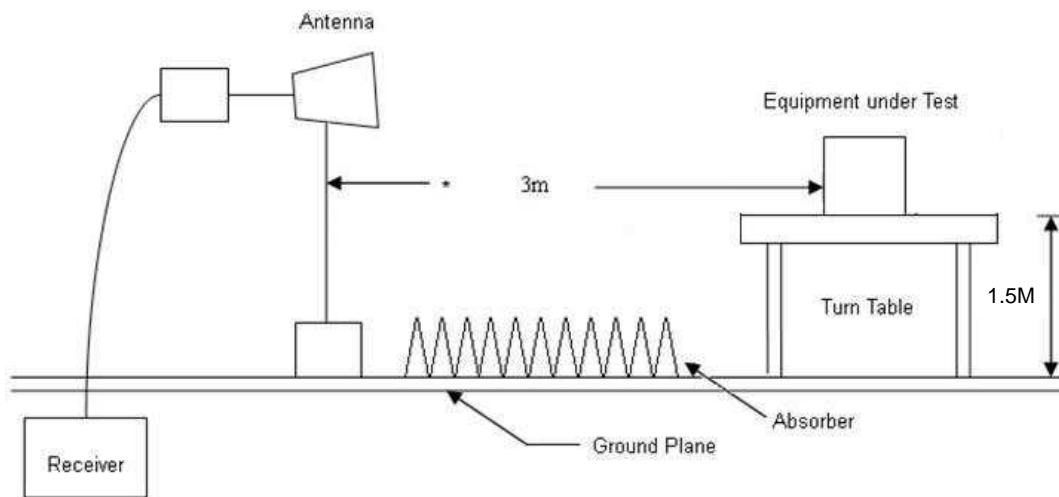


10.3. Test Setup

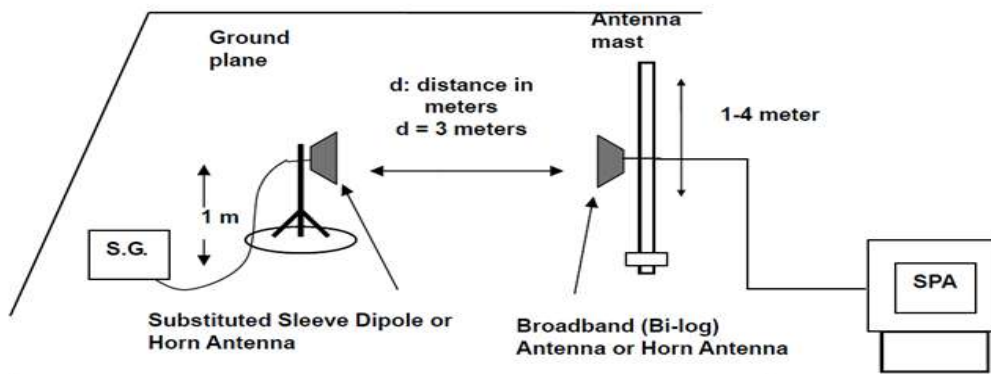
Below 1GHz test setup



Above 1GHz Test Setup



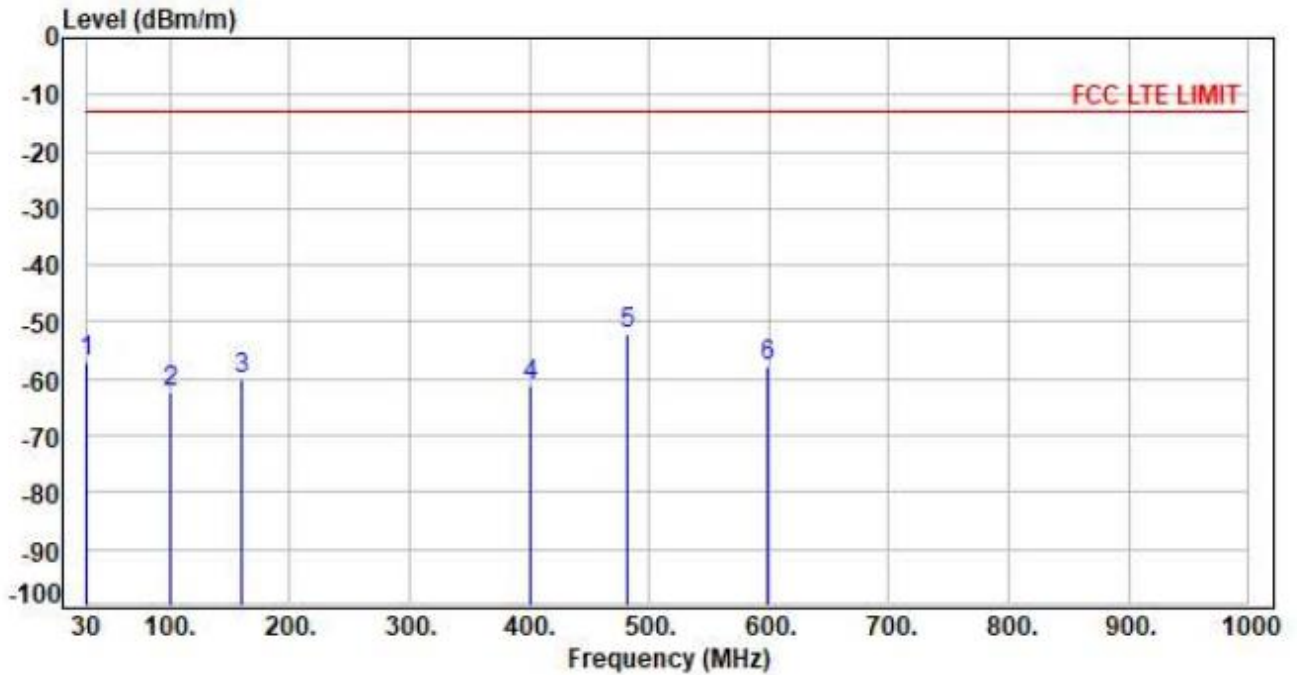
For Substituted Method Test Set-UP





10.1. Test Result and Data (30MHz ~ 1GHz)

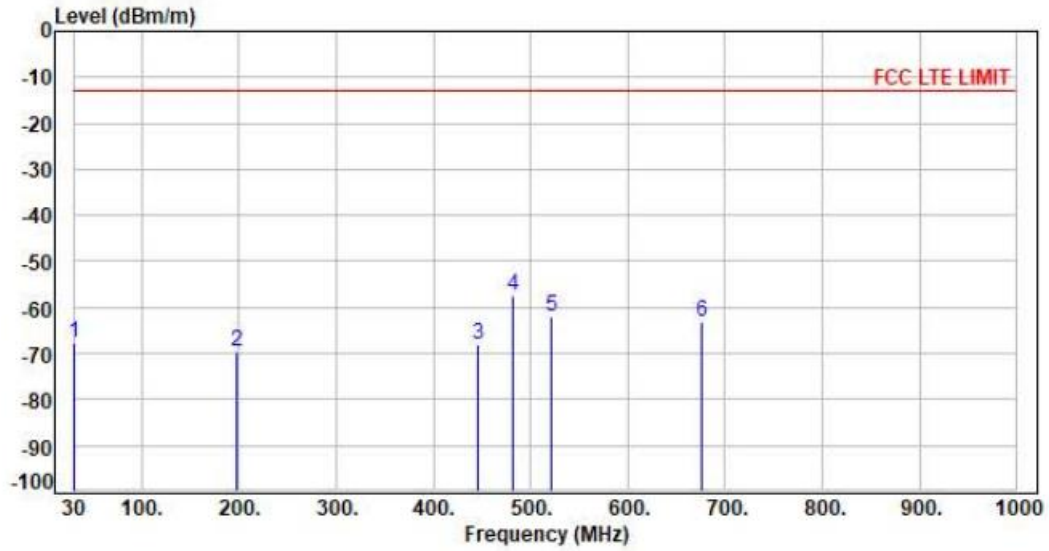
Test Mode	Cat M1, Band 26 15MHz, CH26865	Pol/Phase	VERTICAL
Power	AC 120V/60Hz		



Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
30	-58.74	V	-26.19	1.07	-27.45	-56.86	-13
99.84	-61.39	V	-52.89	1.52	-5.67	-62.23	-13
159.98	-59.28	V	-52.59	1.74	-3.7	-60.18	-13
400.54	-63.96	V	-57.31	2.64	0.75	-61.35	-13
482.02	-55.05	V	-47.95	2.61	0.62	-52.09	-13
598.42	-64.38	V	-54.22	2.89	1.55	-57.71	-13



Test Mode	Cat M1, Band 26 15MHz, CH 26865	Pol/Phase	HORIZONTAL
Power	AC 120V/60Hz		

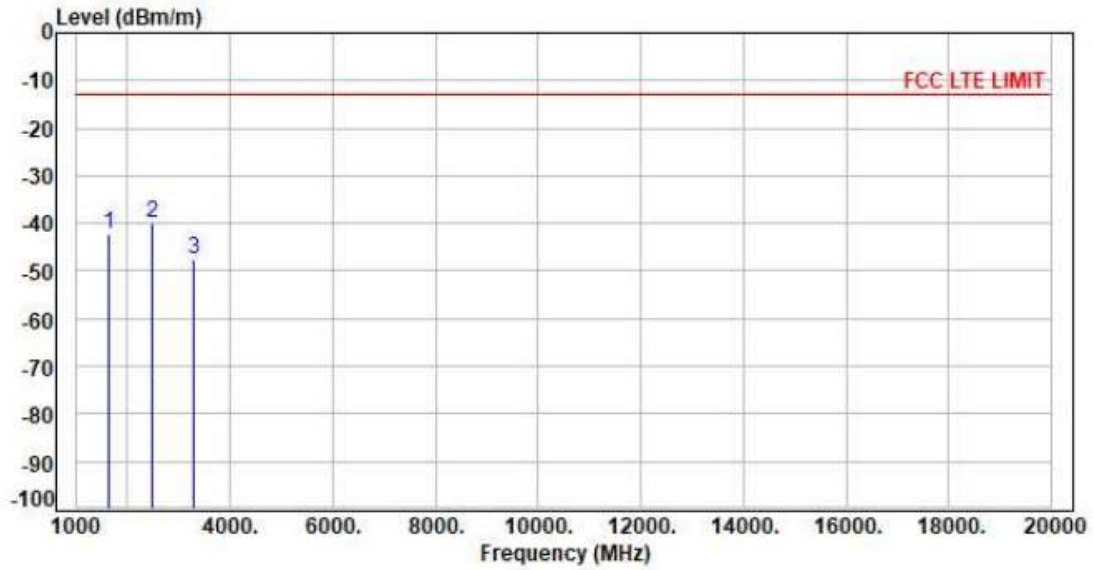


Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
30	-76.68	H	-37.04	1.07	-27.45	-67.71	-13
196.84	-66.45	H	-63.21	1.88	-2.47	-69.71	-13
445.16	-70.45	H	-64.08	2.52	0.68	-68.07	-13
482.02	-61.77	H	-53.21	2.61	0.62	-57.35	-13
520.82	-66.91	H	-57.93	2.7	0.79	-61.99	-13
676.02	-71.62	H	-58.88	3.11	1.07	-63.07	-13



10.2. Test Result and Data (1GHz ~ 20GHz)

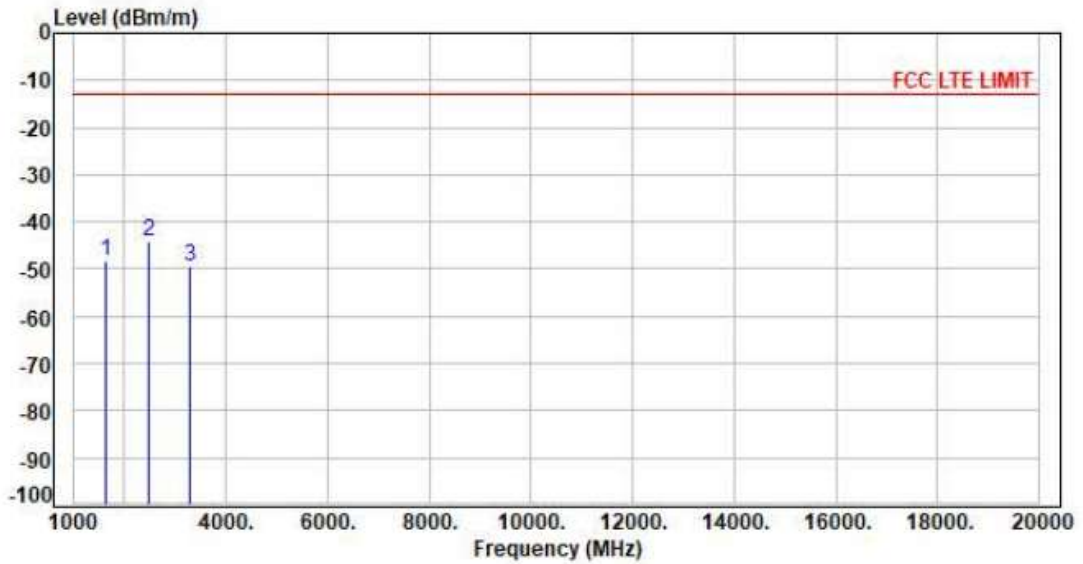
Test Mode	Band 26 15MHz, CH 26865	Pol/Phase	VERTICAL
Power	AC 120V/60Hz		



Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1656.5	-47.82	V	-44.33	4.52	8.8	-42.2	-13
2484.75	-49.45	V	-41.91	5.55	9.67	-39.94	-13
3313	-60.62	V	-48.83	6.62	9.95	-47.65	-13



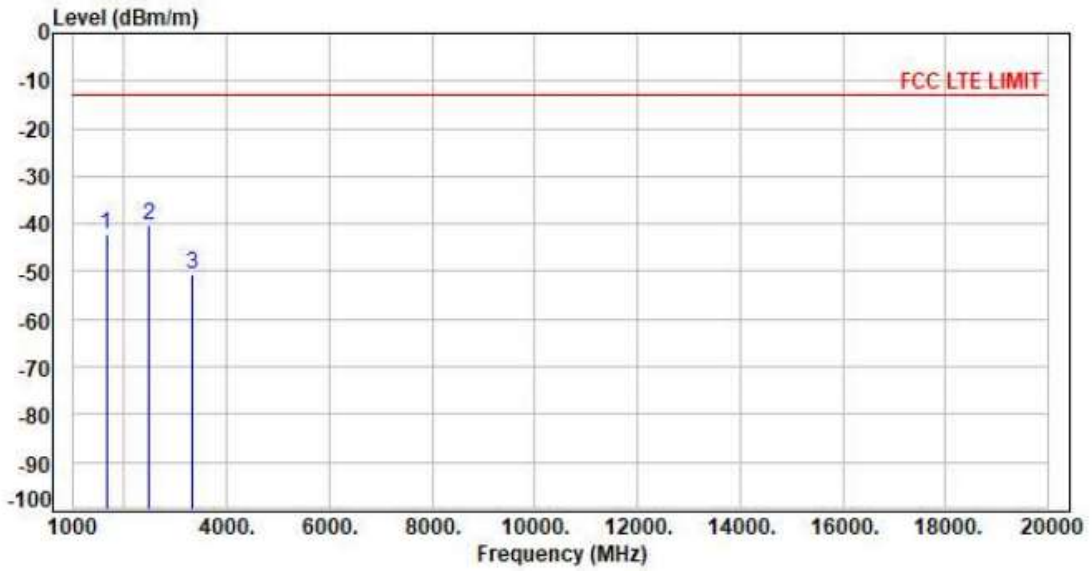
Test Mode	Band 26 15MHz, CH 26865	Pol/Phase	HORIZONTAL
Power	AC 120V/60Hz		



Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1656.5	-54.24	H	-50.36	4.52	8.8	-48.23	-13
2484.75	-53.92	H	-46.19	5.55	9.67	-44.22	-13
3313	-63.17	H	-50.49	6.62	9.95	-49.31	-13



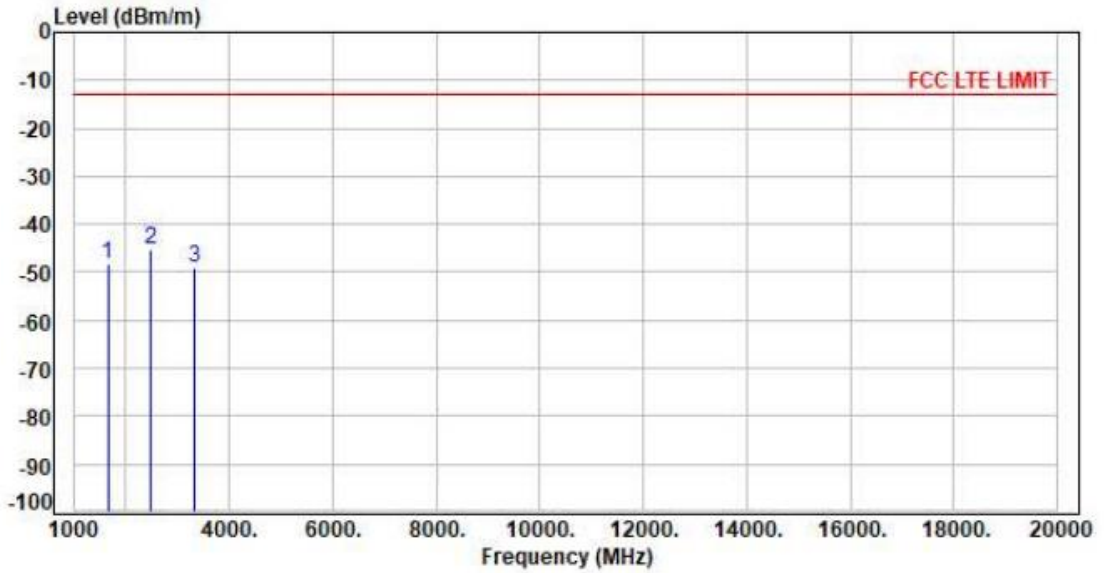
Test Mode	Band 26 15MHz, CH 26915	Pol/Phase	VERTICAL
Power	AC 120V/60Hz		



Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1660	-47.93	V	-44.43	4.52	8.8	-42.3	-13
2490	-49.99	V	-42.43	5.56	9.68	-40.46	-13
3320	-63.66	V	-51.85	6.63	9.96	-50.67	-13



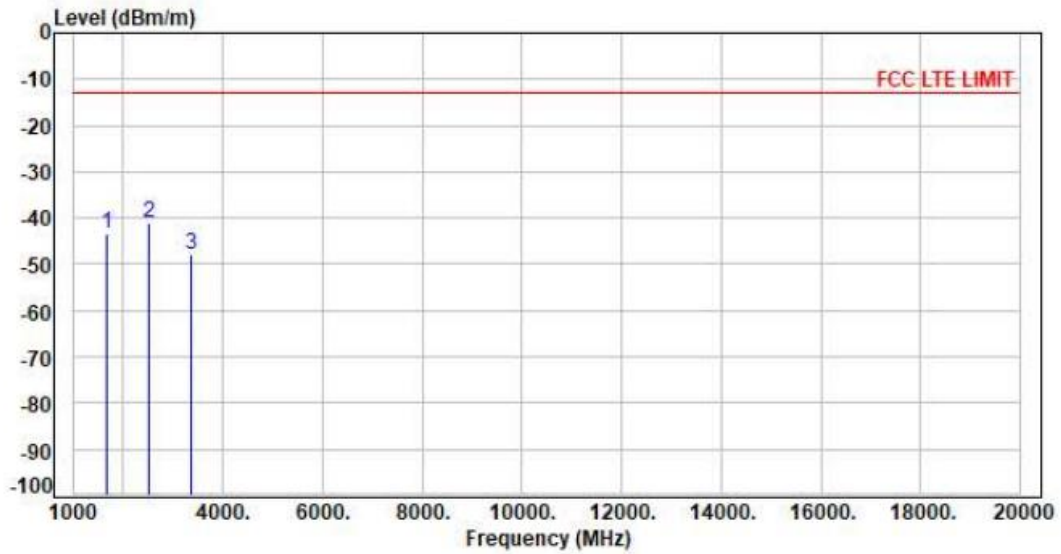
Test Mode	Band 26 15MHz, CH 26915	Pol/Phase	HORIZONTAL
Power	AC 120V/60Hz		



Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1660	-54.14	H	-50.25	4.52	8.8	-48.12	-13
2490	-54.96	H	-47.21	5.56	9.68	-45.24	-13
3320	-63.11	H	-50.4	6.63	9.96	-49.22	-13



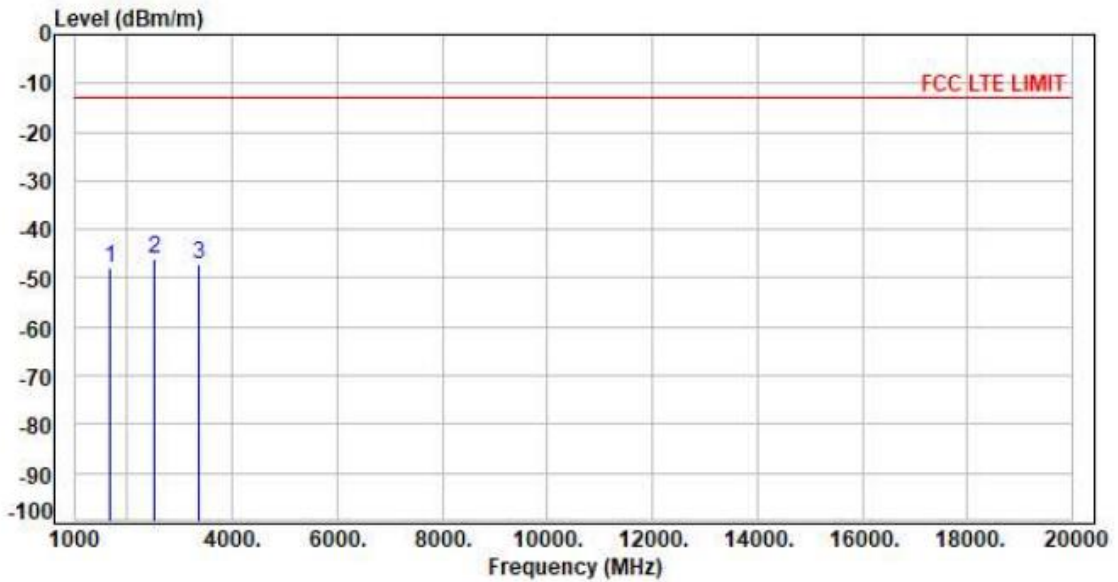
Test Mode	Band 26 15MHz, CH 26998	Pol/Phase	VERTICAL
Power	AC 120V/60Hz		



Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1689.5	-49.02	V	-45.26	4.56	8.8	-43.17	-13
2534.25	-50.85	V	-43.06	5.61	9.7	-41.12	-13
3379	-61.11	V	-49.09	6.71	10	-47.95	-13



Test Mode	Band 26 15MHz, CH 26965	Pol/Phase	HORIZONTAL
Power	AC 120V/60Hz		



Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1689.5	-54.21	H	-50.07	4.56	8.8	-47.98	-13
2534.25	-55.9	H	-47.9	5.61	9.7	-45.96	-13
3379	-61.46	H	-48.45	6.71	10	-47.31	-13



11. Frequency Stability (Temperature & Voltage Variation) Test

11.1. Test Limit

Mobile:

The frequency stability shall be measured by variation of ambient temperature and variation of primary supply voltage to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within $\pm 0.00025\%$ ($\pm 2.5\text{ppm}$) of the center frequency.

Fixed or Base:

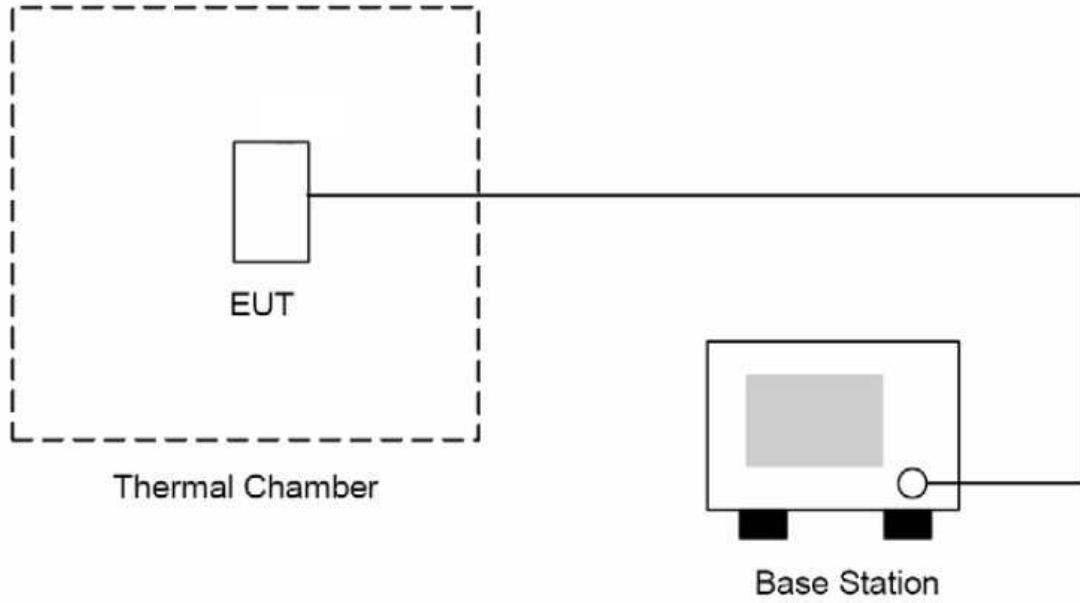
The frequency stability shall be measured by variation of ambient temperature and variation of primary supply voltage to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within $\pm 0.00015\%$ ($\pm 1.5\text{ppm}$) of the center frequency.

11.2. Test Procedure

1. The EUT and test equipment were set up as shown on the following section.
2. With all power removed, the temperature was decreased to -30°C and permitted to stabilize for three hours. Power was applied and the maximum change in frequency was noted within one minute.
3. With power OFF, the temperature was raised in 10°C steps. The sample was permitted to stabilize at each step for at least one-half hour. Power was applied and the maximum frequency change was noted within one minute.
4. The EUT was placed in a temperature chamber at $25 \pm 5^{\circ}\text{C}$ and connected as the following section.
5. The power supply voltage to the EUT was varied from BEP to 115% of the nominal value measured at the input to the EUT.
6. The temperature tests were performed for the worst case.
7. Test data was recorded.



11.3. Test Setup





11.4. Test Result and Data

LTE Cat M1 Band 5 QPSK 10M middle channel

Frequency Stability under Temperature				
Temperature Interval (°C)	Test Frequency (MHz)	Deviation (Hz)	Frequency error (ppm)	Limit (ppm)
75	836.5	-1.56	-0.002	2.5
60	836.5	-2.21	-0.003	2.5
50	836.5	-1.48	-0.002	2.5
40	836.5	-0.5	-0.001	2.5
30	836.5	-3.9	-0.005	2.5
20	836.5	4	0.005	2.5
10	836.5	2	0.002	2.5
0	836.5	5.3	0.006	2.5
-10	836.5	-9.2	-0.011	2.5
-20	836.5	5.1	0.006	2.5
-30	836.5	8.4	0.010	2.5

LTE Cat M1 Band 5 QPSK 10M middle channel

Frequency Stability under Voltage at 20°C				
DC Voltage (V)	Test Frequency (MHz)	Deviation (Hz)	Frequency error (ppm)	Limit (ppm)
55.2	836.5	3.5	0.004	2.5
48	836.5	-0.1	0.000	2.5
40.8	836.5	4	0.005	2.5



LTE Cat M1 Band 26 QPSK 15M middle channel

Frequency Stability under Temperature				
Temperature Interval (°C)	Test Frequency (MHz)	Deviation (Hz)	Frequency error (ppm)	Limit (ppm)
75	836.5	4.2	0.0050	2.5
60	836.5	4.6	0.0055	2.5
50	836.5	3.2	0.004	2.5
40	836.5	-4.4	-0.005	2.5
30	836.5	4.3	0.005	2.5
20	836.5	0.3	0.000	2.5
10	836.5	0.6	0.001	2.5
0	836.5	3.1	0.004	2.5
-10	836.5	3.2	0.004	2.5
-20	836.5	6.4	0.008	2.5
-30	836.5	3.4	0.004	2.5

LTE Cat M1 Band 26 QPSK 15M middle channel

Frequency Stability under Voltage at 20°C				
DC Voltage (V)	Test Frequency (MHz)	Deviation (Hz)	Frequency error (ppm)	Limit (ppm)
55.2	836.5	4.6	0.005	2.5
48	836.5	1.5	0.002	2.5
40.8	836.5	3.5	0.004	2.5