FCC TEST REPORT

Applicant	:	LEOTEK Electronics Corp.
Address	:	1955 Lundy Ave, San Jose, CA 95131 San Jose, California, United States
Equipment	:	Smart Node Control
Model No.	:	SN-NB10
Trade Name	:	Leotek
FCC ID.	:	2BAJFSN-NB10

I HEREBY CERTIFY THAT:

The sample was received on Mar. 06, 2023 and the testing was completed on Aug. 14, 2023 at Cerpass Technology Corp. The test result refers exclusively to the test presented test model / sample. Without written approval of Cerpass Technology Corp., the test report shall not be reproduced except in full.

Approved by:

Mark Liao / Supervisor

Laboratory Accreditation:

Cerpass Technology Corporation Test Laboratory

CONTENTS

History of this test report

Report No.	Issued Date	Description
22030345-TRFCC04	Aug. 18, 2023	Original

1. Summary of Test Procedure and Test Results

47 CFR FCC Part 90
ANSI C63.26:2015
KDB 971168 Power Meas License Digital Systems

FCC Rule	. Description of Test	Result
2.1046 / 90.635(b)	. Effective Radiated Power	Pass
2.1053 / 90.691	. Radiated Emissions	Pass
2.1051 / 90.691	. Conducted Emissions	Pass
2.1051 / 90.691	. Band Edge	Pass
2.1049 / 90.209	. Occupied Bandwidth	Pass
2.1055 / 90.213	. Frequency Stability	Pass

*The lab has reduced the uncertainty risk factor from test equipment, environment and staff technicians which according to the standard on contract. Therefore, the test result will only be determined by standard requirement, measurement uncertainty evaluation is not considered.
*This EUT has been also tested and compiled with the requirement of FCC Part 15, Subpart B, recorded in a separate test report(22030345-TEFV01).

2. Test Configuration of Equipment under Test

2.1. Feature of Equipment under Test

Band	B2, B4, B5, B12, B13, B26
Antenna Type	PIFA
Antenna Gain	LTE Band 2: 2.29dBi LTE Band 4: 2.31dBi LTE Band 5: -1.15dBi LTE Band 12: -0.62dBi LTE Band 13: -1.4dBi LTE Band 26(Part 22): -1.15dBi LTE Band 26(Part 90): -1.51dBi

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

2.2. Carrier Frequency of Channels

Cat M1

Band	Operation Frequency(MHz)	Modulation
LTE Band 26	814.7~823.3	QPSK, 16QAM

NB-IoT

Band	Operation Frequency(MHz)	Modulation
LTE Band 26	814.2~823.8	BPSK, QPSK

2.3. Test Mode and Test Software

a. During testing, the interface cables and equipment positions were varied according to ANSI C63.4.
b. The following test modes were performed for the test:

Radiated Emissions and RF Conducted	
Test Mode 1	Cat M1
Test Mode 2	NB-IoT

2.4. General Information of Test

Test Site	**Cerpass 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.	

Cat M1

Test Item	Test Site	Test period	Environmental Conditions	Tested By
RF Conducted	RFCON01-NK	2023/04/22~ 2023/08/01	23~26.5°C / 39~60%	Dian Chen
Radiated Emissions	3M02-NK	2023/06/02~ 2023/06/14	23~25°C / 30~32%	Leon Huang

NB-IoT

Test Item	Test Site	Test period	Environmental Conditions	Tested By
RF Conducted	RFCON02-NK	2023/05/03~ 2023/08/14	23.2~25.7°C / 45~56%	Dian Chen
Radiated Emissions	3M02-NK	2023/06/02	23°C / 32%	Leon Huang

2.5. 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).

Test date before 2023/05/03

Measurement Item	Uncertainty
Equivalent Isotropically Radiated Power (Radiated)	±5.5dB
Conducted Spurious Emission	±2.0dB
Output Power(Conducted)	±1.07dB
Frequency Error	±0.17KHz
Occupied Channel Bandwidth	±4.4%
26dB Bandwidth	±4.4%
Peak to average ratio	±2.0dB
Temperature	±1.3°C
Humidity	±2.7%
Voltages(DC)	±4mV/V

Test date after 2023/05/03

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 (Cat M1)				
Test Site	Semi Anechoic Room(3M02-NK)				
Instrument	Manufacturer	Model No	Serial No	Calibration Date	Valid Date
Bilog Antenna	Schwarzbeck	VULB9168	275	2022/11/18	2023/11/17
Active Loop Antenna	Schwarzbeck	FMZB 1513	414	2023/02/03	2024/02/02
Horn Antenna	EMCO	3115	31589	2023/03/23	2024/03/22
Horn Antenna	EMCO	3116	31970	2023/03/03	2024/03/02
EMI Receiver	ROHDE & SCHWARZ	ESCI	101423	2022/07/05	2023/07/04
Spectrum Analyzer	ROHDE & SCHWARZ	FSV 40-N	102151	2022/08/19	2023/08/18
Preamplifier	Agilent	8449B	3008A01954	2023/03/08	2024/03/07
Preamplifier	EMC INSTRUMENTS	EMC184045	980065	2022/11/11	2023/11/10
Preamplifier	EM Electronics corp.	EM330	60659	2023/03/10	2024/03/09
Cable-4m(9k-3G)	EMEC	RG-223	18274M	2022/07/27	2023/07/26
Cable-3in1 (30M-1G)	HARBOUR INDUSTRIES	LL142	CCE1315	2023/02/25	2024/02/24
Cable-0.5m (1G-40G)	HUBER SUHNER	SUCOFLEX 104	805443/4	2023/03/07	2024/03/06
Cable-3m (1G-40G)	HUBER SUHNER	SUCOFLEX 104	805796/4	2023/03/07	2024/03/06
Cable-8m (1G-26.5G)	WOKEN	WCBA-WCA203SM	CCE1374	2023/03/07	2024/03/06
Cable-0.5m (30M-40G)	HUBER SUHNER	SUCOFLEX 102	28420/2	2023/03/07	2024/03/06
Cable-3m (30M-40G)	HUBER SUHNER	SUCOFLEX 102	MY2608/2	2023/03/07	2024/03/06
Cable-0.5m (1G-40G)	Rapidtek	40GHZ 50CM	38MS-38MS50314	2023/03/07	2024/03/06
Cable-3m (1G-40G)	Rapidtek	40GHZ 300CM	38MS-38MS300314	2023/03/07	2024/03/06
E3	AUDIX	v8.2014-8-6	RK-000529	NA	NA
Radio Comnunication Analyzer	Anritsu	MT8821C	6261830569	2023/03/12	2024/03/11

Test Item	RF Conducted (Cat M1)				
Test Site	RFCON01-NK				
Instrument	Manufacturer	Model No	Serial No	Calibration Date	Valid Date
CAX Signal Analyzer	KEYSIGHT	N9000B	MY57100339	2022/11/29	2023/11/28
Radio Comnunication Analyzer	Anritsu	MT8821C	6261830569	2023/03/12	2024/03/11
TEMP & HUMI CHAMBER	T-MACHINE	TMJ-9712	T-12-040111	2022/08/15	2023/08/14

Test Item	Radiated Emissions (NB-IoT)				
Test Site	Semi Anechoic Room(3M02-NK)				
Instrument	Manufacturer	Model No	Serial No	Calibration Date	Valid Date
Bilog Antenna	Schwarzbeck	VULB9168	275	2022/11/18	2023/11/17
Active Loop Antenna	Schwarzbeck	FMZB 1513	414	2023/02/03	2024/02/02
Horn Antenna	EMCO	3115	31589	2023/03/23	2024/03/22
Horn Antenna	EMCO	3116	31970	2023/03/03	2024/03/02
EMI Receiver	ROHDE & SCHWARZ	ESCI	101423	2022/07/05	2023/07/04
Spectrum Analyzer	ROHDE & SCHWARZ	FSV 40-N	102151	2022/08/19	2023/08/18
Preamplifier	Agilent	8449B	3008A01954	2023/03/08	2024/03/07
Preamplifier	EMC INSTRUMENTS	EMC184045	980065	2022/11/11	2023/11/10
Preamplifier	EM Electronics corp.	EM330	60659	2023/03/10	2024/03/09
Cable-4m(9k-3G)	EMEC	RG-223	18274M	2022/07/27	2023/07/26
Cable-3in1 (30M-1G)	HARBOUR INDUSTRIES	LL142	CCE1315	2023/02/25	2024/02/24
Cable-0.5m (1G-40G)	HUBER SUHNER	SUCOFLEX 104	805443/4	2023/03/07	2024/03/06
Cable-3m (1G-40G)	HUBER SUHNER	SUCOFLEX 104	805796/4	2023/03/07	2024/03/06
Cable-8m (1G-26.5G)	WOKEN	WCBA-WCA203SM	CCE1374	2023/03/07	2024/03/06
Cable-0.5m (30M-40G)	HUBER SUHNER	SUCOFLEX 102	28420/2	2023/03/07	2024/03/06
Cable-3m (30M-40G)	HUBER SUHNER	SUCOFLEX 102	MY2608/2	2023/03/07	2024/03/06
Cable-0.5m (1G-40G)	Rapidtek	40GHZ 50CM	38MS-38MS50314	2023/03/07	2024/03/06
Cable-3m (1G-40G)	Rapidtek	40GHZ 300CM	38MS-38MS300314	2023/03/07	2024/03/06
E3	AUDIX	v8.2014-8-6	RK-000529	NA	NA
Radio Comnunication Analyzer	Anritsu	MT8821C	6261830569	2023/03/12	2024/03/11

Test Item	RF Conducted (NB-IoT)				
Test Site	RFCON01-NK				
Instrument	Manufacturer	Model No	Serial No	Calibration Date	Valid Date
CAX Signal Analyzer	KEYSIGHT	N9000B	MY57100339	2022/11/29	2023/11/28
Radio Comnunication Analyzer	Anritsu	MT8821C	6261830569	2023/03/12	2024/03/11
TEMP & HUMI CHAMBER	T-MACHINE	TMJ-9712	T-12-040111	2022/08/15	2023/08/14

4. RF Output Power Test

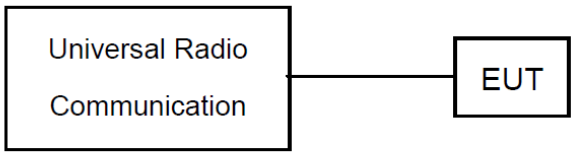
4.1 Test Limit

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

Cat M1

LTE Band 26

BW (MHz)	Opration Channel/ Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm) Moduration	
					QPSK	16QAM
1.4	26697/814.7	0	1	0	19.44	18.56
		0	6	0	17.54	17.64
	26740/819	0	1	0	19.85	18.76
		0	6	0	17.71	17.55
	26783/823.3	0	1	5	19.8	18.77
		0	6	0	17.71	17.57

BW (MHz)	Opration Channel/ Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm) Opration Channel/Frequency(MHz)	
					QPSK	16QAM
3	26705/815.5	0	1	0	19.76	18.72
		0	6	0	17.88	17.49
	26740/819	0	1	0	19.78	18.75
		0	6	0	17.72	17.58
	26775/822.5	0	1	5	19.63	18.71
		0	6	0	17.82	17.68

BW (MHz)	Opration Channel/ Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm) Opration Channel/Frequency(MHz)	
					QPSK	16QAM
5	26715/816.5	0	1	0	19.57	19.6
		0	6	0	18.75	18.76
	26740/819	0	1	0	19.63	19.46
		0	6	0	18.77	18.69
	26765/821.5	0	1	5	19.54	19.59
		0	6	0	18.75	18.74

Cat M1

LTE Band 26

BW (MHz)	Opration Channel/ Frequency(MHz)	Index	RB size	RB offset	Conducted Power (dBm)	
					Opration Channel/Frequency(MHz)	
					QPSK	16QAM
10	26740/819	0	1	0	19.67	19.52
		0	5	0	19.65	19.61

Note: All conducted measurements are based on a RMS detector.

NB-IoT

LTE Band 26

Modulation	Sub-carrier spacing (KHz)	Opration Channel/ Frequency(MHz)	Nltones	Conducted Power (dBm)
BPSK	3.75	26692/814.2	1@0	20.46
			1@47	20.29
	15		1@0	20.44
			1@11	20.36
QPSK	3.75		1@0	20.61
			1@47	20.59
	15		1@0	20.41
			1@11	20.38
	15		12@0	18.69
BPSK	3.75	26740/819	1@0	21.02
			1@47	20.87
	15		1@0	20.98
			1@11	20.89
QPSK	3.75		1@0	21.13
			1@47	21.11
	15		1@0	20.88
			1@11	20.87
	15		12@0	19.04
BPSK	3.75	26788/823.8	1@0	21.11
			1@47	20.96
	15		1@0	21.05
			1@11	20.90
QPSK	3.75		1@0	21.13
			1@47	21.00
	15		1@0	20.87
			1@11	20.85
	15		12@0	19.22

5. Effective Radiated Power

5.1. Test Limit

The ERP of the transmitter for mobile stations is 100 watts.

5.2. Test Procedures

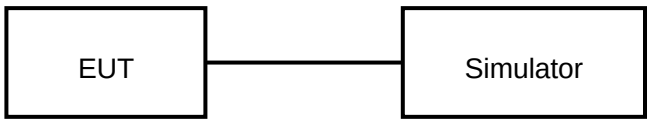
For Conducted power measurement:

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

For ERP measurement:
EPR can be calculated by below formula from ANSI C63.26.

1. EIRP = P_T + G_T - L_C
   P_T = transmitter output power, in dBm.
   G_T = gain of the transmitting antenna, in dBi (EIRP).
   L_C = signal attenuation in the connecting cable between the transmitter and antenna, in dB.
2. ERP = EIRP – 2.15 dB.

5.3. Test Setup



5.4. Test Result and Data

Cat M1

LTE Band26 1.4M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26697	814.7	1	19.44	-1.51	15.78	0.04	50	-34.22
		Full	17.54	-1.51	13.88	0.02	50	-36.12
26740	819	1	19.85	-1.51	16.19	0.04	50	-33.81
		Full	17.71	-1.51	14.05	0.03	50	-35.95
26783	823.3	1	19.8	-1.51	16.14	0.04	50	-33.86
		Full	17.71	-1.51	14.05	0.03	50	-35.95

LTE Band26 1.4M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26697	814.7	1	18.56	-1.51	14.9	0.03	50	-35.1
		Full	17.64	-1.51	13.98	0.03	50	-36.02
26740	819	1	18.76	-1.51	15.1	0.03	50	-34.9
		Full	17.55	-1.51	13.89	0.02	50	-36.11
26783	823.3	1	18.77	-1.51	15.11	0.03	50	-34.89
		Full	17.57	-1.51	13.91	0.02	50	-36.09

LTE Band26 3M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26705	815.5	1	19.76	-1.51	16.1	0.04	50	-33.9
		Full	17.88	-1.51	14.22	0.03	50	-35.78
26740	819	1	19.78	-1.51	16.12	0.04	50	-33.88
		Full	17.72	-1.51	14.06	0.03	50	-35.94
26775	822.5	1	19.63	-1.51	15.97	0.04	50	-34.03
		Full	17.82	-1.51	14.16	0.03	50	-35.84

Cat M1

LTE Band26 3M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26705	815.5	1	18.72	-1.51	15.06	0.03	50	-34.94
		Full	17.49	-1.51	13.83	0.02	50	-36.17
26740	819	1	18.75	-1.51	15.09	0.03	50	-34.91
		Full	17.58	-1.51	13.92	0.02	50	-36.08
26775	822.5	1	18.71	-1.51	15.05	0.03	50	-34.95
		Full	17.68	-1.51	14.02	0.03	50	-35.98

LTE Band26 5M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26715	816.5	1	19.57	-1.51	15.91	0.04	50	-34.09
		Full	18.75	-1.51	15.09	0.03	50	-34.91
26740	819	1	19.63	-1.51	15.97	0.04	50	-34.03
		Full	18.77	-1.51	15.11	0.03	50	-34.89
26765	821.5	1	19.54	-1.51	15.88	0.04	50	-34.12
		Full	18.75	-1.51	15.09	0.03	50	-34.91

LTE Band26 5M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26715	816.5	1	19.6	-1.51	15.94	0.04	50	-34.06
		Full	18.76	-1.51	15.1	0.03	50	-34.9
26740	819	1	19.46	-1.51	15.8	0.04	50	-34.2
		Full	18.69	-1.51	15.03	0.03	50	-34.97
26765	821.5	1	19.59	-1.51	15.93	0.04	50	-34.07
		Full	18.74	-1.51	15.08	0.03	50	-34.92

Cat M1

LTE Band26 10M QPSK

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26740	819	1	19.67	-1.51	16.01	0.04	50	-33.99
		Full	19.65	-1.51	15.99	0.04	50	-34.01

LTE Band26 10M 16QAM

Channel	Frequency (MHz)	RB size	Conducted Power (dBm)	Gain (dBi)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26740	819	1	19.52	-1.51	15.86	0.04	50	-34.14
		Full	19.61	-1.51	15.95	0.04	50	-34.05

NB-IoT
LTE Band26

Channel	Frequency (MHz)	Modulation	Sub-carrier spacing (KHz)	Nltones	Conducted Power (dBm)	Gain (dBi)	E.R.P. (dBm)	E.R.P. (W)	Limit (dBm)	Margin (dB)
26692	814.2	BPSK	3.75	1@0	20.46	-1.51	16.80	0.05	50.00	-33.20
		QPSK	3.75	1@0	20.61	-1.51	16.95	0.05	50.00	-33.05
		BPSK	15	1@0	20.44	-1.51	16.78	0.05	50.00	-33.22
		QPSK	15	1@0	20.41	-1.51	16.75	0.05	50.00	-33.25
26740	819	BPSK	3.75	1@0	21.02	-1.51	17.36	0.05	50.00	-32.64
		QPSK	3.75	1@0	21.13	-1.51	17.47	0.06	50.00	-32.53
		BPSK	15	1@0	20.98	-1.51	17.32	0.05	50.00	-32.68
		QPSK	15	1@0	20.88	-1.51	17.22	0.05	50.00	-32.78
26788	823.8	BPSK	3.75	1@0	21.11	-1.51	17.45	0.06	50.00	-32.55
		QPSK	3.75	1@0	21.13	-1.51	17.47	0.06	50.00	-32.53
		BPSK	15	1@0	21.05	-1.51	17.39	0.05	50.00	-32.61
		QPSK	15	1@0	20.87	-1.51	17.21	0.05	50.00	-32.79

6. Emission Bandwidth & Occupied Bandwidth Test

6.1. Test Procedures

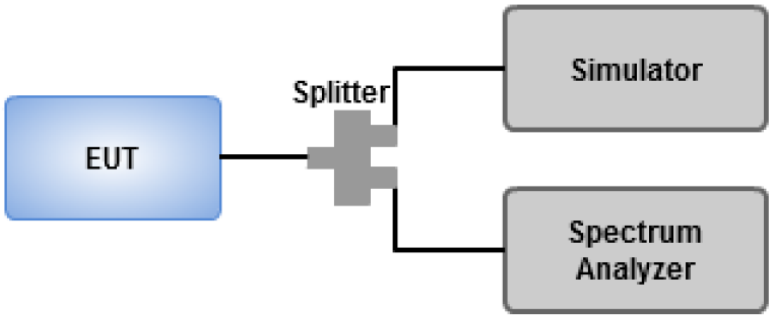
a. The EUT makes a phone call to the communication simulator. The power was measured with Spectrum Analyzer.

b. The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

c. 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.

6.2. Test Setup



6.3. Test Result and Data

Cat M1

LTE Band26

Moduration type	RB	Bandwidth (MHz)	Channel No.	Frequency (MHz)	-26dBc Occupied Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
QPSK	100%	1.4	26740	819	1.2540	1.1054
		3	26740	819	1.3010	1.1116
		5	26740	819	1.3470	1.1136
		10	26740	819	1.2780	1.1106
16QAM	100%	1.4	26740	819	1.1420	0.9393
		3	26740	819	1.1170	0.9504
		5	26740	819	1.1420	0.9407
		10	26740	819	1.1460	0.9582

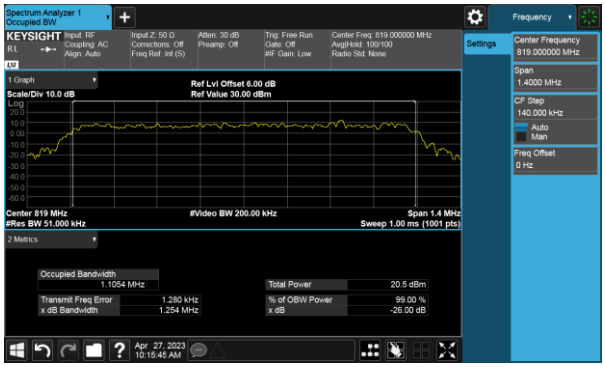
NB-IoT

LTE Band26

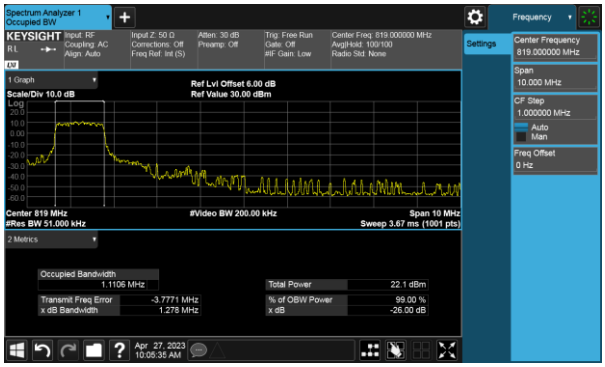
Moduration type	Sub-carrier spacing (KHz)	Nltones	Channel No.	Frequency (MHz)	-26dBc Occupied Bandwidth (KHz)	99% Occupied Bandwidth (KHz)
QPSK	3.75	1@0	26692	814.2	40.290	67.168
QPSK	15	1@0	26692	814.2	130.600	120.010
QPSK	15	12@0	26692	814.2	239.400	183.400
BPSK	3.75	1@0	26692	814.2	41.240	57.941
BPSK	15	1@0	26692	814.2	105.700	129.080
QPSK	3.75	1@0	26740	819	39.850	67.173
QPSK	15	1@0	26740	819	132.900	130.550
QPSK	15	12@0	26740	819	253.600	185.790
BPSK	3.75	1@0	26740	819	41.560	57.337
BPSK	15	1@0	26740	819	105.100	120.750
QPSK	3.75	1@0	26788	823.8	39.760	66.557
QPSK	15	1@0	26788	823.8	129.800	127.640
QPSK	15	12@0	26788	823.8	240.500	185.800
BPSK	3.75	1@0	26788	823.8	41.700	57.745
BPSK	15	1@0	26788	823.8	105.200	120.140

Cat M1

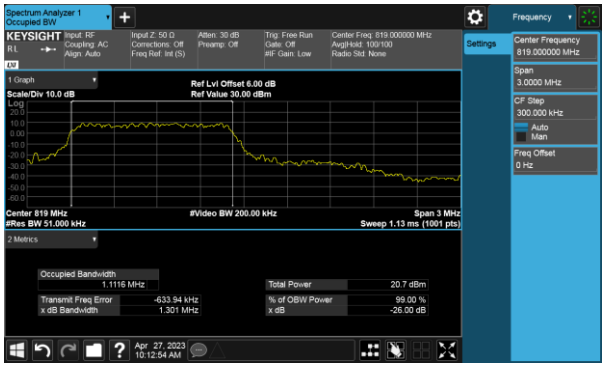
LTE Band 26 QPSK 1.4MHz, CH 26740



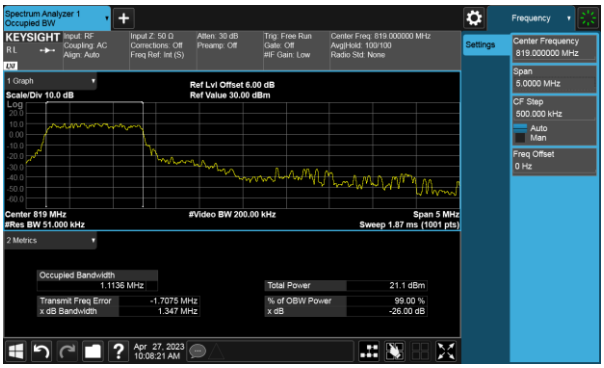
LTE Band 26 QPSK 10MHz, CH 26740



LTE Band 26 QPSK 3MHz, CH 26740

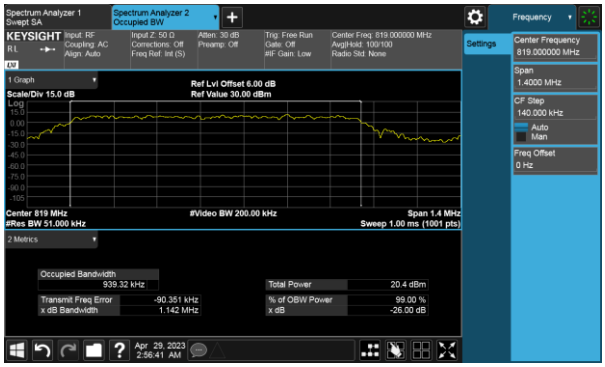


LTE Band 26 QPSK 5MHz, CH 26740

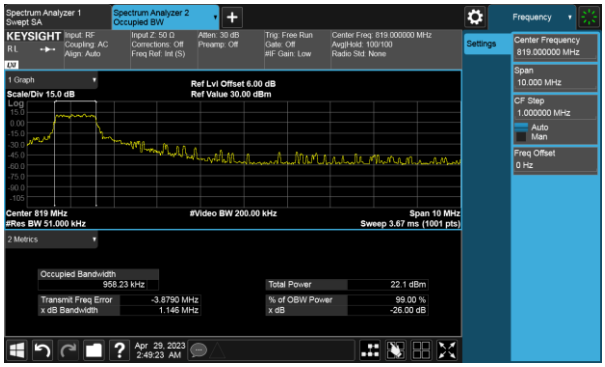


Cat M1

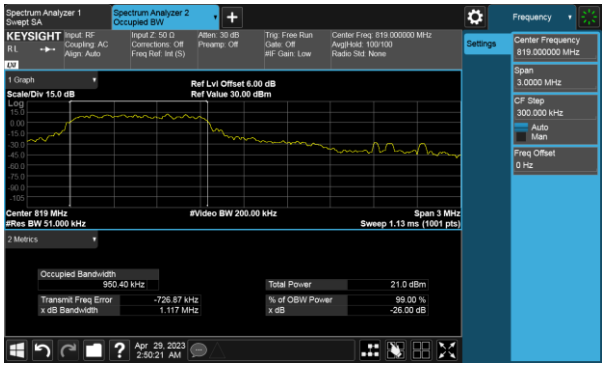
LTE Band 26 16QAM 1.4MHz, CH 26740



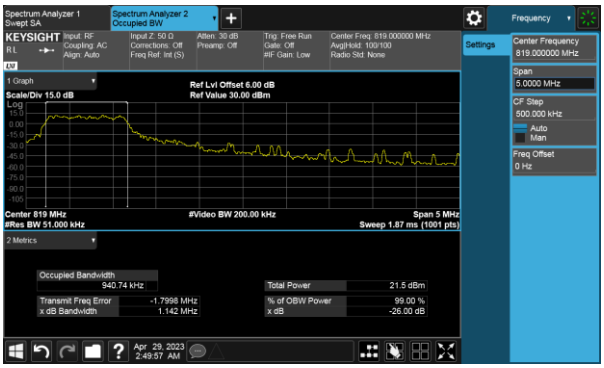
LTE Band 26 16QAM 10MHz, CH 26740



LTE Band 26 16QAM 3MHz, CH 26740



LTE Band 26 16QAM 5MHz, CH 26740



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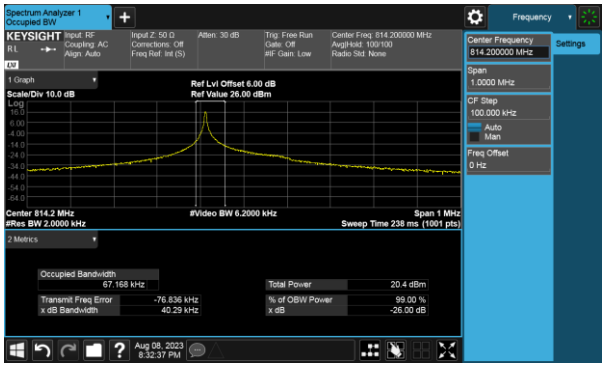
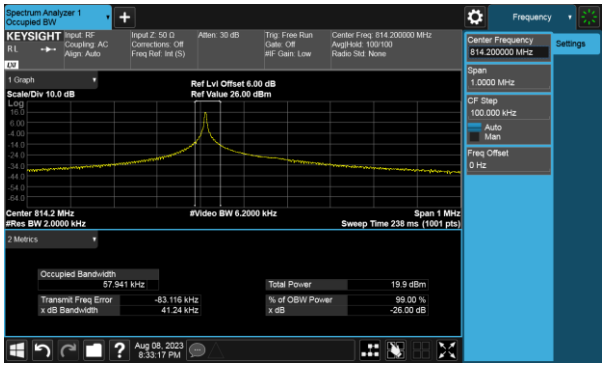
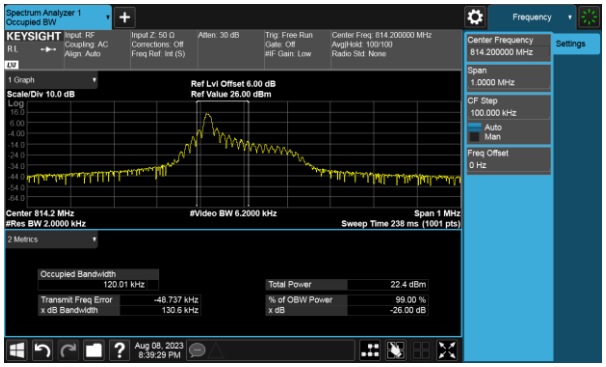
LTE Band 26 QPSK 3.75KHz 1@0 CH 26692



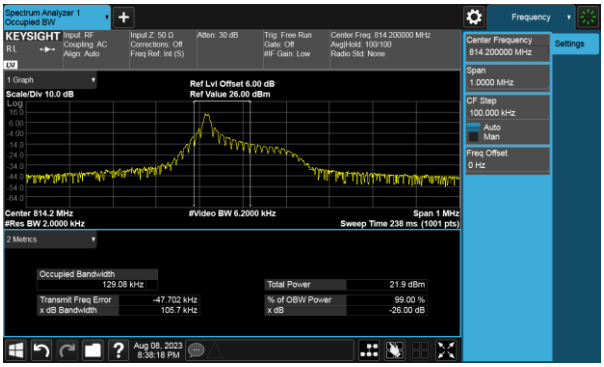
LTE Band 26 BPSK 3.75KHz 1@0 CH 26692



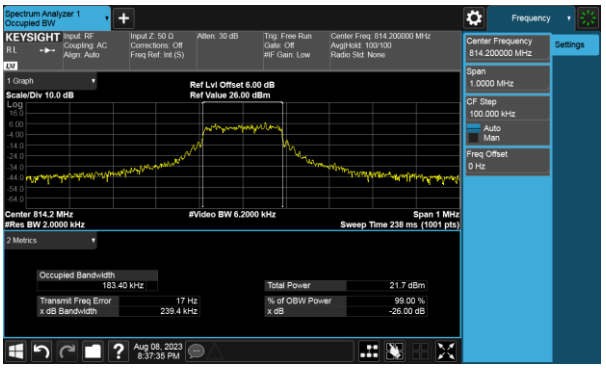
LTE Band 26 QPSK 15KHz 1@0 CH 26692



LTE Band 26 BPSK 15KHz 1@0 CH 26692

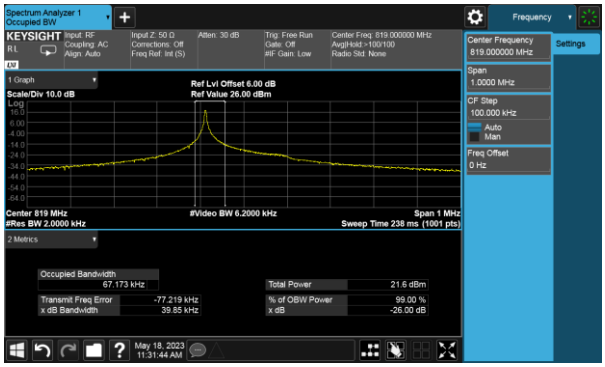


LTE Band 26 QPSK 15KHz 12@0 CH 26692

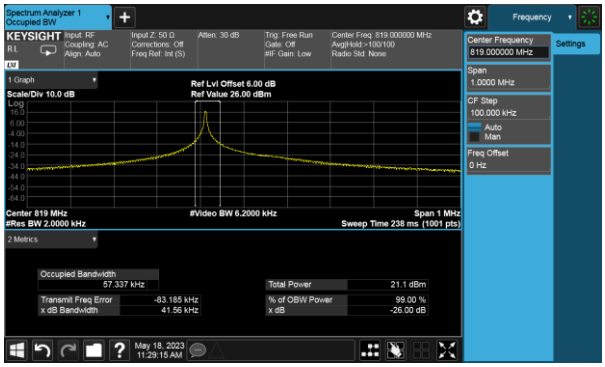


NB-IoT

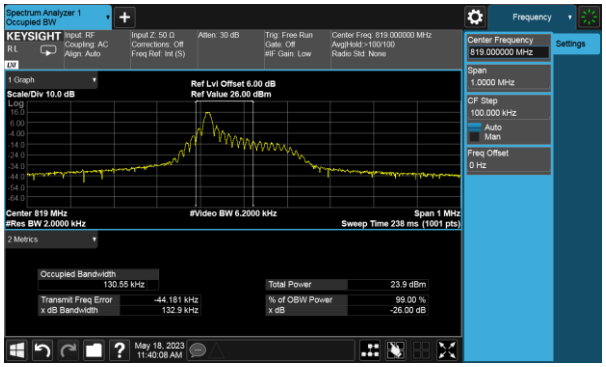
LTE Band 26 QPSK 3.75KHz 1@0 CH 26740



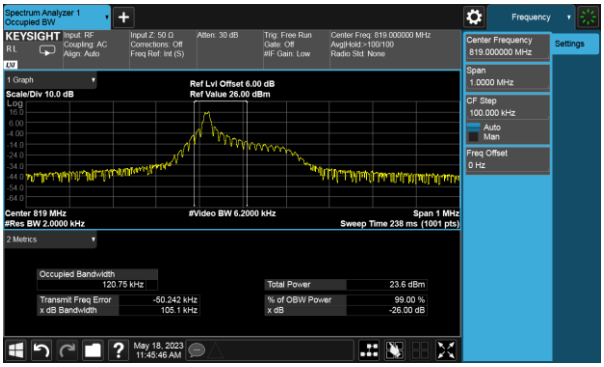
LTE Band 26 BPSK 3.75KHz 1@0 CH 26740



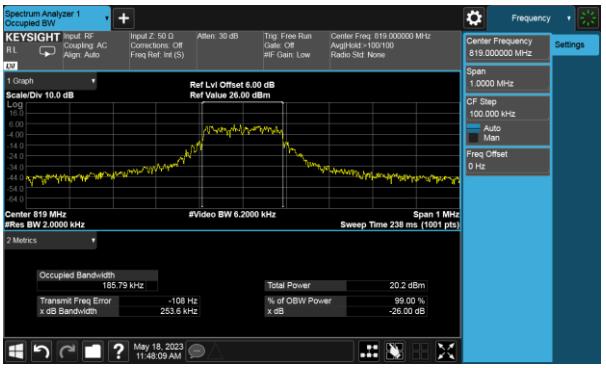
LTE Band 26 QPSK 15KHz 1@0 CH 26740



LTE Band 26 BPSK 15KHz 1@0 CH 26740

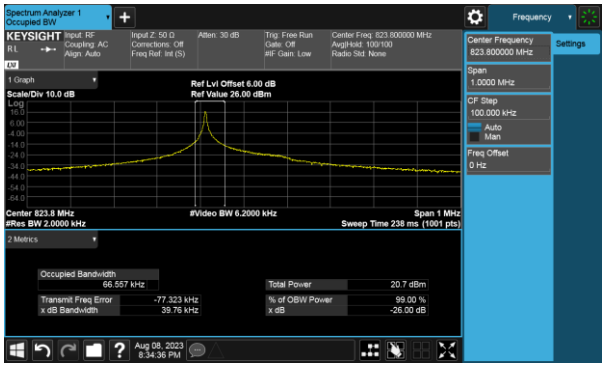


LTE Band 26 QPSK 15KHz 12@0 CH 26740

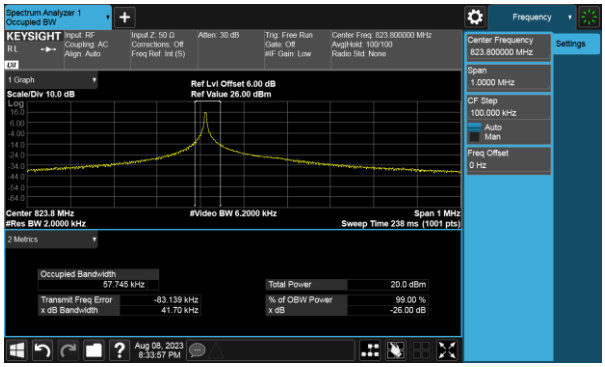


NB-IoT

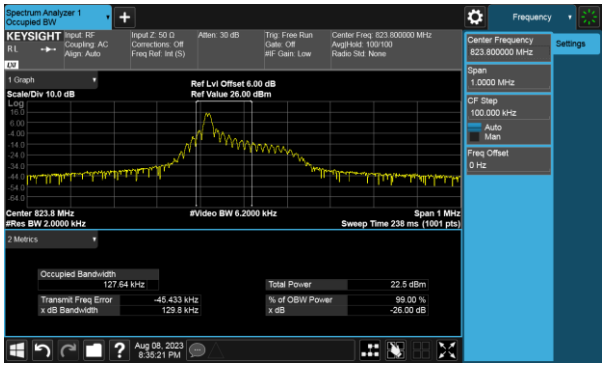
LTE Band 26 QPSK 3.75KHz 1@0 CH 26788



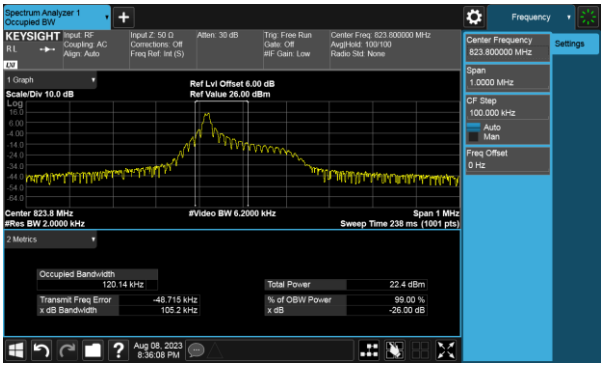
LTE Band 26 BPSK 3.75KHz 1@0 CH 26788



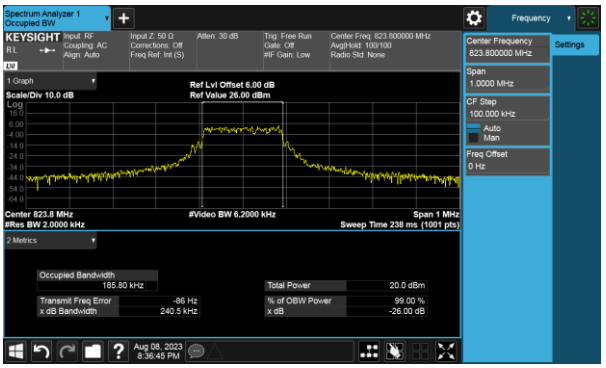
LTE Band 26 QPSK 15KHz 1@0 CH 26788



LTE Band 26 BPSK 15KHz 1@0 CH 26788



LTE Band 26 QPSK 15KHz 12@0 CH 26788



7. Peak to Average Ratio Test

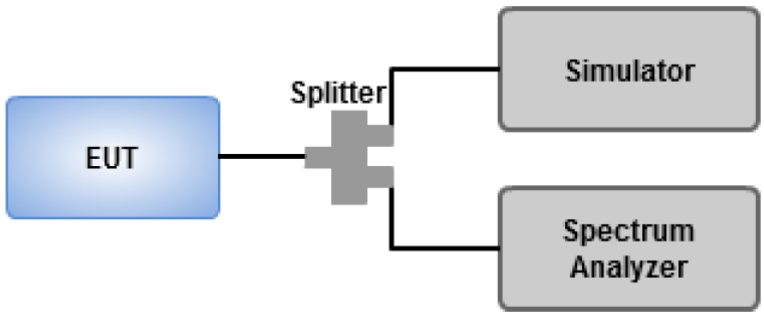
7.1. Test Limit

Peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

7.2. Test Procedures

1. Enable CCDF function of spectrum analyzer and set RBW = 10 MHz.
2. Set the number of counts to a value that stabilizes the measured CCDF curve.
3. Record the maximum PAPR level associated with a probability of 0.1%.

7.3. Test Setup



7.4. Test Result and Data

Cat M1

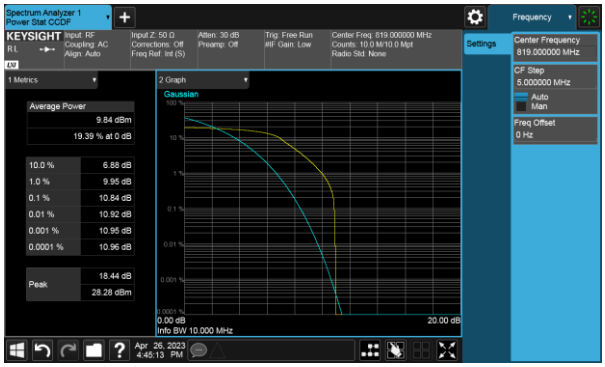
Band	Mode	Bandwidth (MHz)	RB size	Channel	Frequency (MHz)	PAR (dB)	Limit	Result
LTE Band 26	QPSK	1.4	1RB	26740	819	10.84	13	Pass
	16QAM			26740	819	11.82	13	Pass
	QPSK	3		26740	819	9.76	13	Pass
	16QAM			26740	819	8.93	13	Pass
	QPSK	5		26740	819	9.72	13	Pass
	16QAM			26740	819	9.29	13	Pass
	QPSK	10		26740	819	9.37	13	Pass
	16QAM			26740	819	9.56	13	Pass

NB-IoT

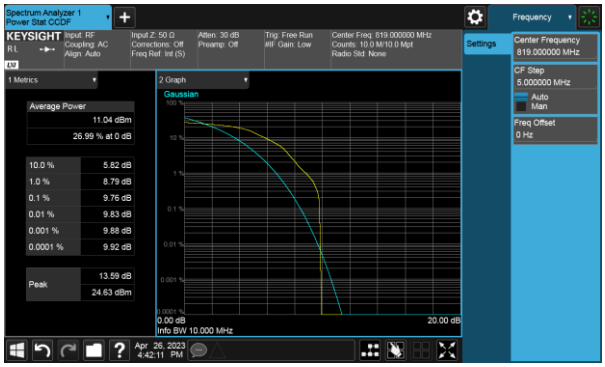
Band	Mode	Sub-carrier spacing (KHz)	Opration Channel/ Frequency(MHz)	PAR (dB)	Limit	Result
LTE Band 26	BPSK	3.75	26740/819	5.12	13	Pass
	QPSK	3.75	26740/819	4.68	13	Pass
	BPSK	15	26740/819	8.63	13	Pass
	QPSK	15	26740/819	8.63	13	Pass

Cat M1

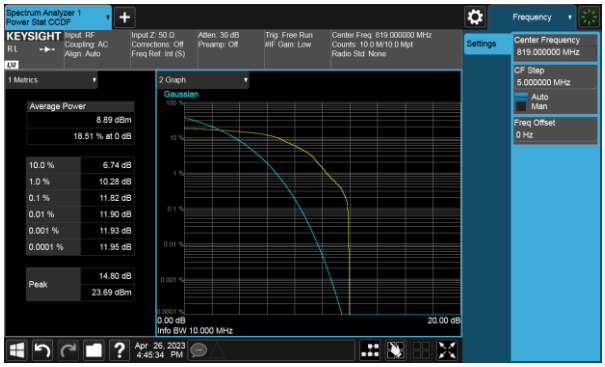
LTE Band 26 QPSK 1.4MHz, CH 26740



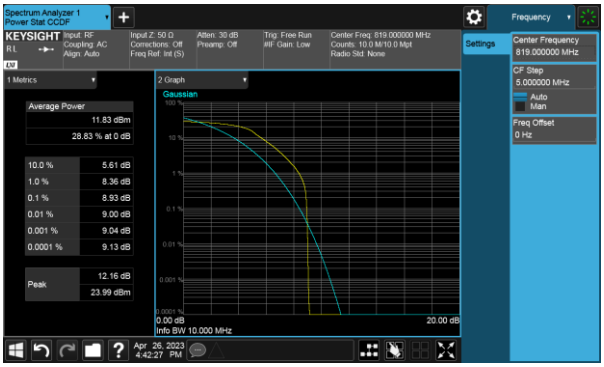
LTE Band 26 QPSK 3MHz, CH 26740



LTE Band 26 16QAM 1.4MHz, CH 26740

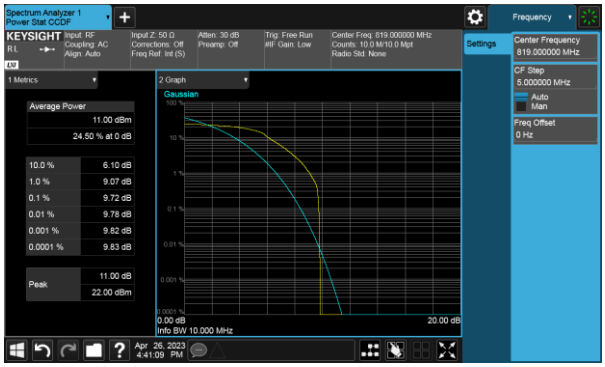


LTE Band 26 16QAM 3MHz, CH 26740

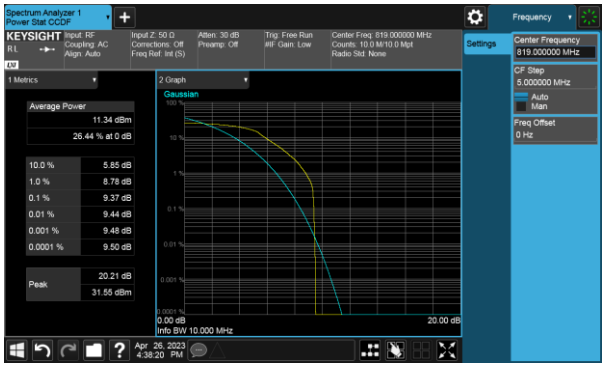


Cat M1

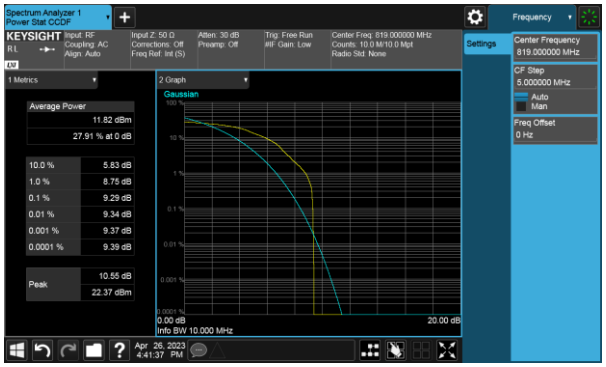
LTE Band 26 QPSK 5MHz, CH 26740



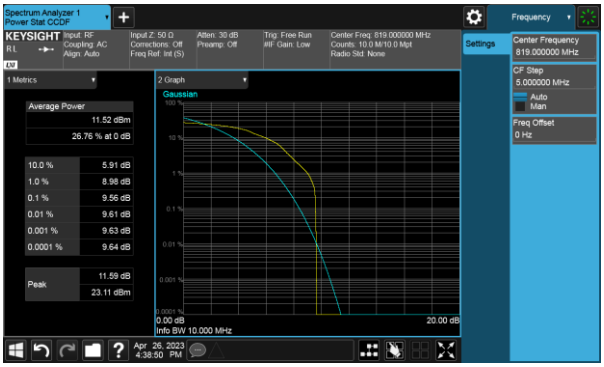
LTE Band 26 QPSK 10MHz, CH 26740



LTE Band 26 16QAM 5MHz, CH 26740



LTE Band 26 16QAM 10MHz, CH 26740



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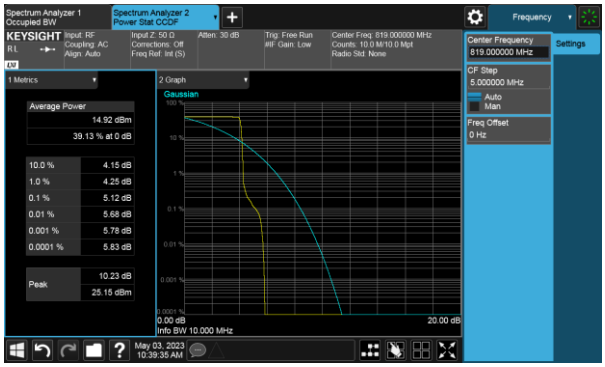
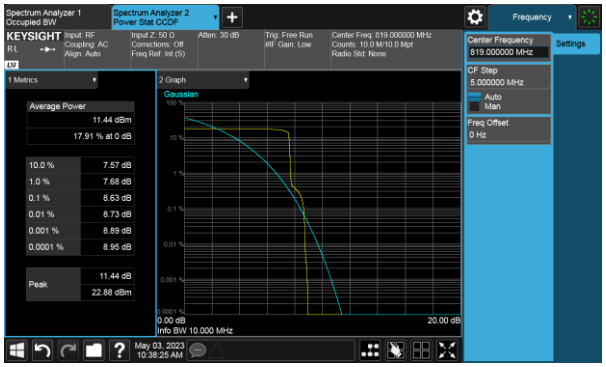
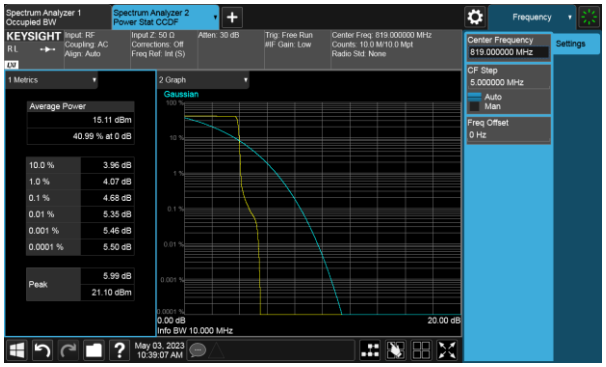
LTE Band 26 BPSK 3.75KHz, CH 26740



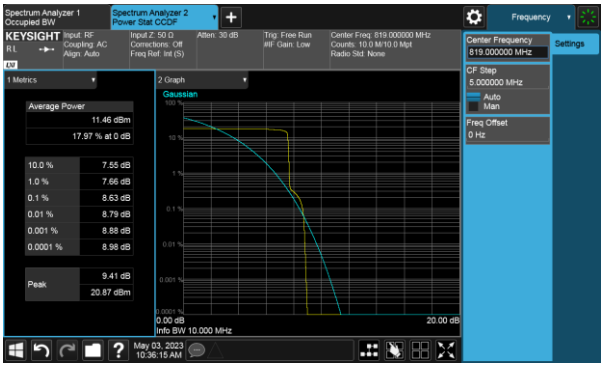
LTE Band 26 BPSK 15KHz, CH 26740



LTE Band 26 QPSK 3.75KHz, CH 26740



LTE Band 26 QPSK 15KHz, CH 26740



8. Band Edge

8.1. Test Limit

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 Log10(f/6.1) decibels or 50 + 10 Log10(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.

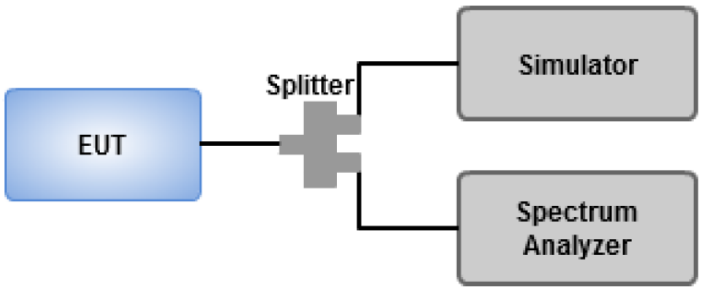
For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

8.2. Test Procedures

For out-of-band emission Lowest and highest operating channels are tested for this item.

Set RBW = at least 1% of 26dB bandwidth, VBW = 3 x RBW detector = RMS, sweep time = auto to measure trace.

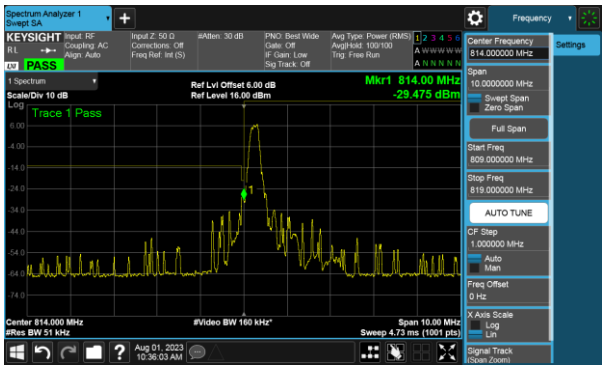
8.3. Test Setup



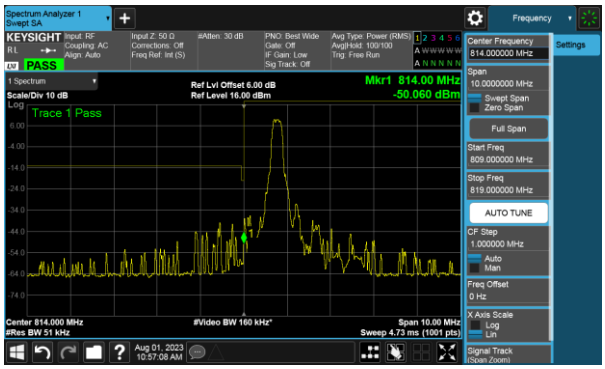
8.4. Test Result and Data

Cat M1

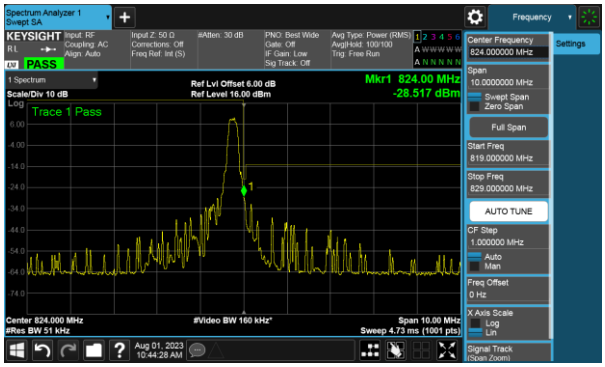
LTE Band 26 QPSK 1.4MHz 1@0, CH 26697



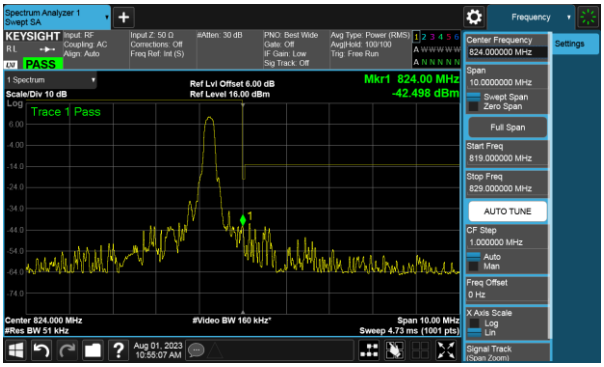
LTE Band 26 QPSK 10MHz 1@0, CH 26740



LTE Band 26 QPSK 1.4MHz 1@5, CH 26783

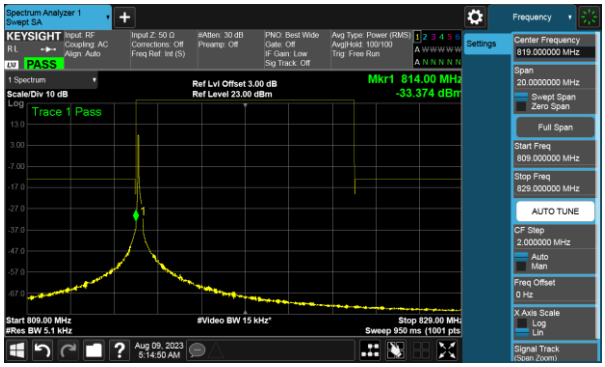


LTE Band 26 QPSK 10MHz 1@5, CH 26740

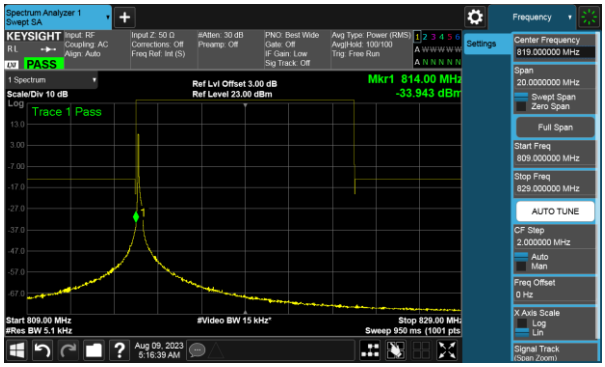


NB-IoT

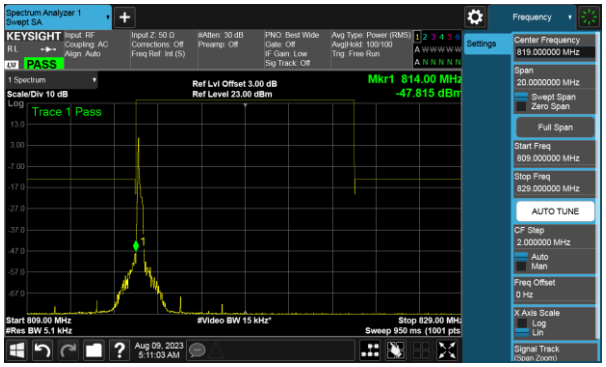
LTE Band 26 QPSK 3.75KHz 1@0 CH 26692



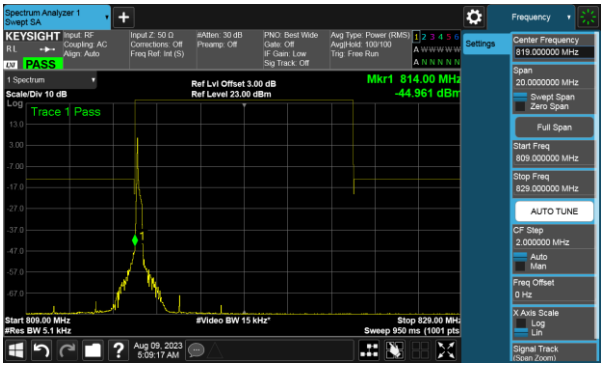
LTE Band 26 BPSK 3.75KHz 1@0 CH 26692



LTE Band 26 QPSK 15KHz 1@0 CH 26692



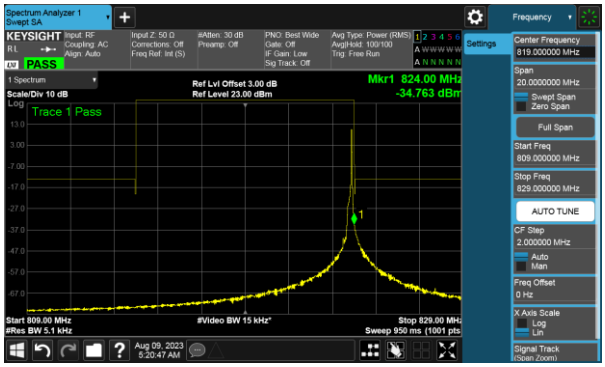
LTE Band 26 BPSK 15KHz 1@0 CH 26692



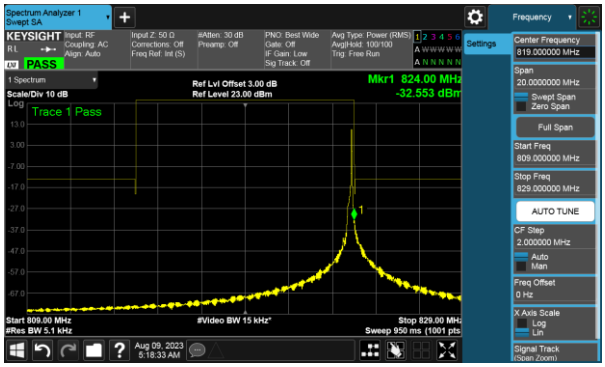
LTE Band 26 QPSK 15KHz 12@0 CH 26692

NB-IoT

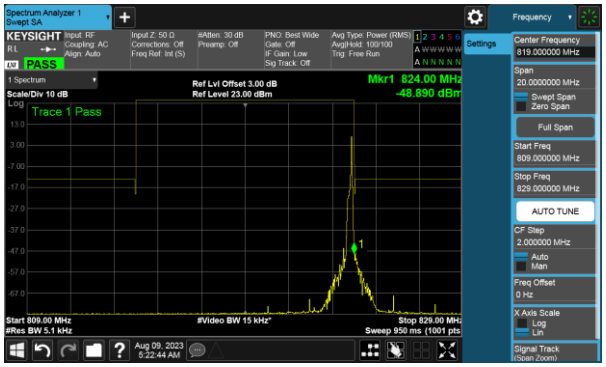
LTE Band 26 QPSK 3.75KHz 1@47 CH 26788



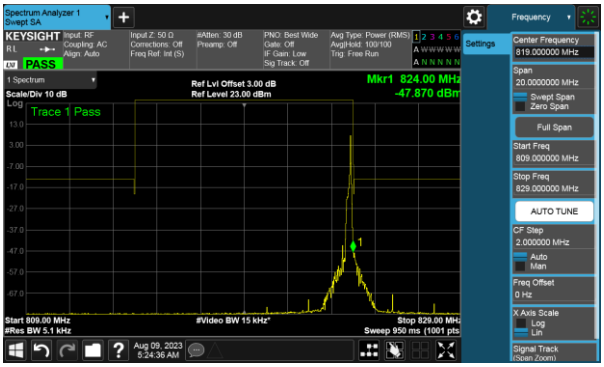
LTE Band 26 BPSK 3.75KHz 1@47 CH 26788



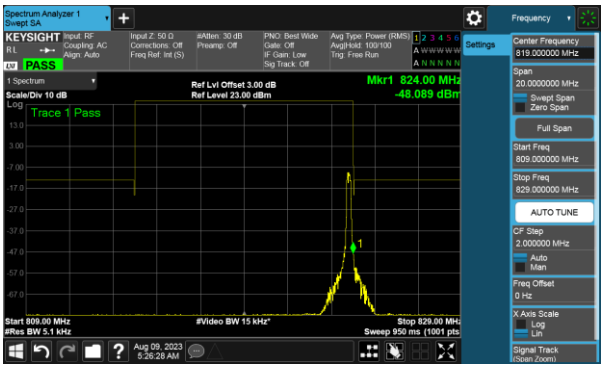
LTE Band 26 QPSK 15KHz 1@11 CH 26788



LTE Band 26 BPSK 15KHz 1@11 CH 26788



LTE Band 26 QPSK 15KHz 12@0 CH 26788



9. Conducted Spurious Emission Test

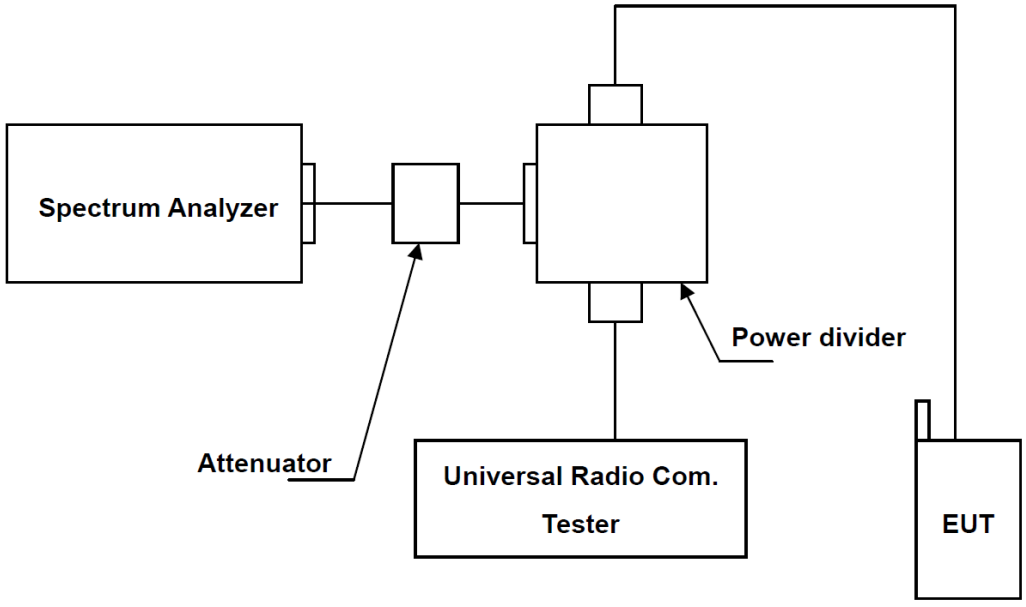
9.1. Test Limit

The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 +10 log10(P) dB. The limit of emission equal to -13dBm

9.2. Test Procedures

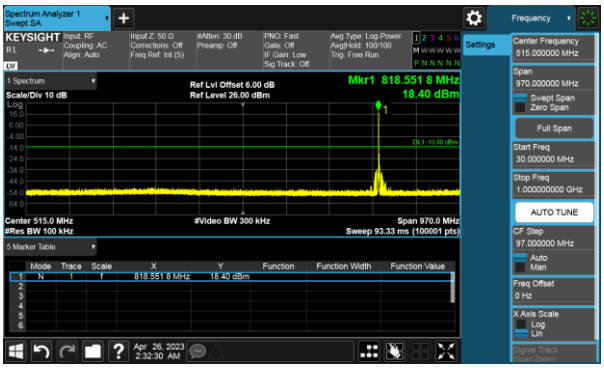
a. The EUT was set up for the maximum peak power with WWAN link data modulation. The power was measured with Spectrum Analyzer. All measurements were done at 3 channels (low, middle and high operational frequency range.)
b. The conducted spurious emission used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
c. When the spectrum scanned from 30MHz to 1GHz. The spectrum set RBW=100KHz, VBW=300KHz.
d. When the spectrum scanned from Above 1GHz. The spectrum set RBW=1MHz, VBW=3MHz.

9.3. Test Setup

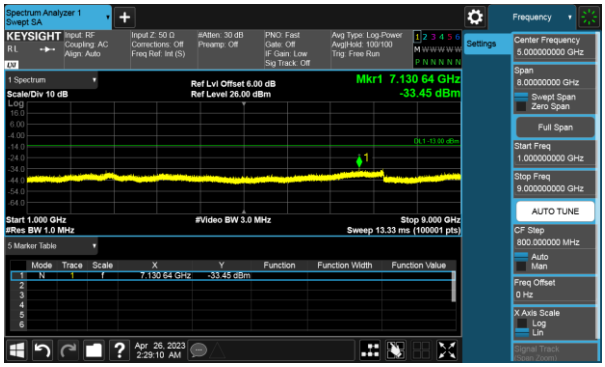


9.4. Test Result and Data

Cat M1
LTE Band 26 QPSK 1.4MHz, CH 26915

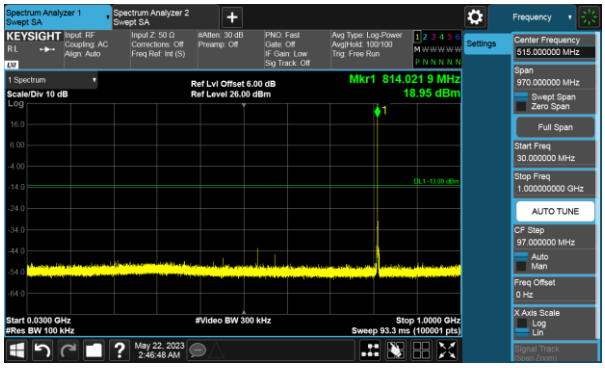


LTE Band 26 QPSK 1.4MHz, CH 26915

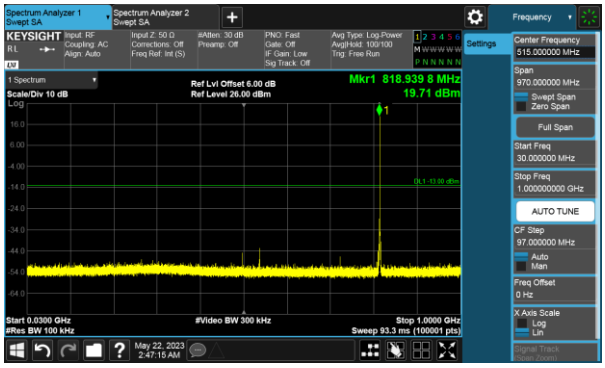


NB-IoT

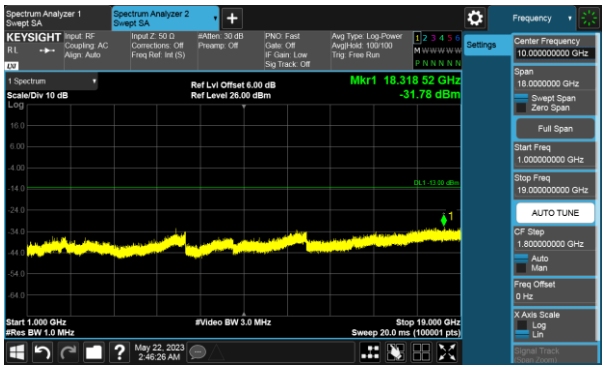
LTE Band 26 QPSK, CH 26692



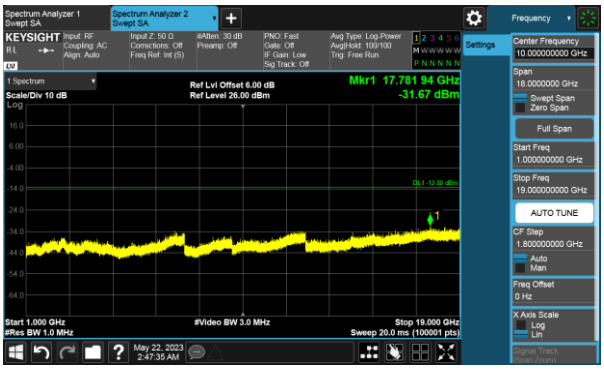
LTE Band 26 QPSK, CH 26740



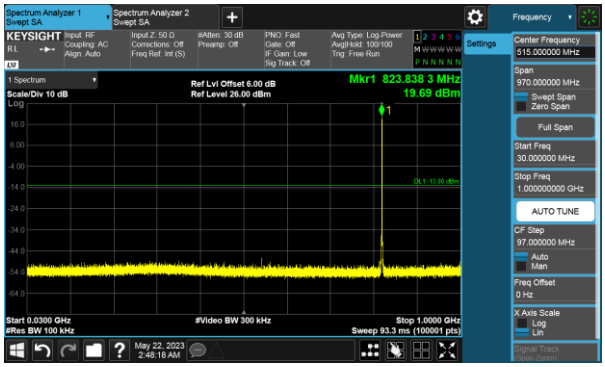
LTE Band 26 QPSK, CH 26692



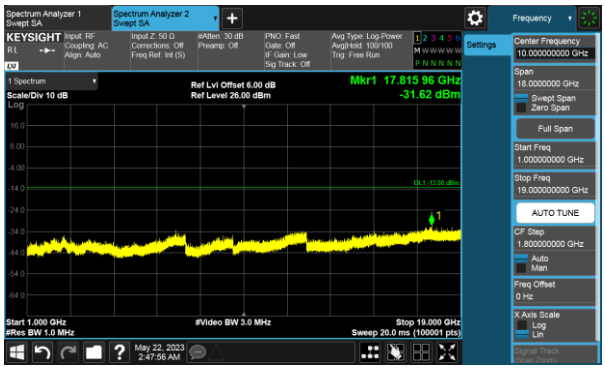
LTE Band 26 QPSK, CH 26740



NB-IoT
LTE Band 26 QPSK, CH 26788



LTE Band 26 QPSK, CH 26788



10. Radiation Emission Test

10.1. Test Limit

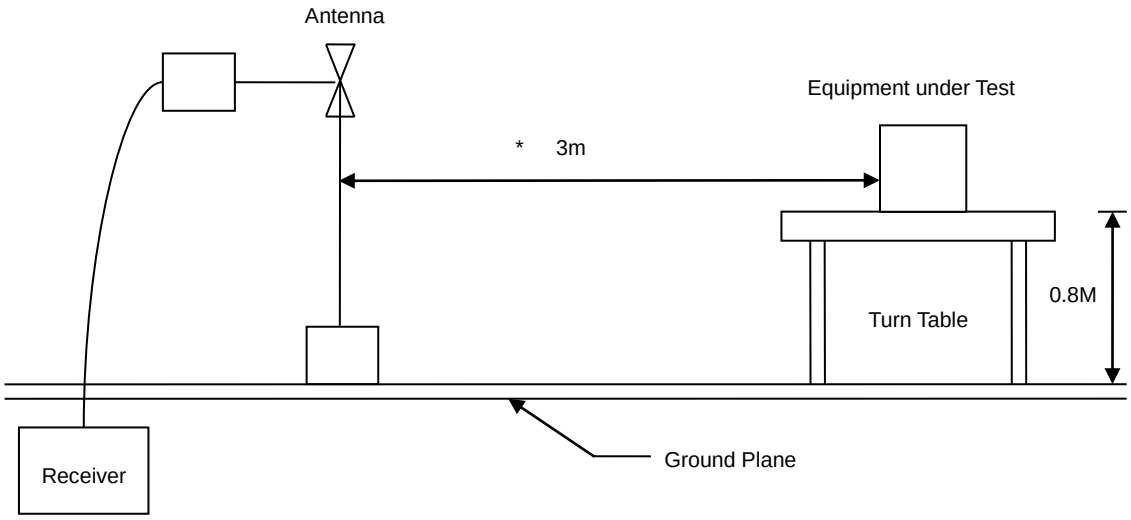
The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB equal to -13dBm.

10.2. Test Procedure

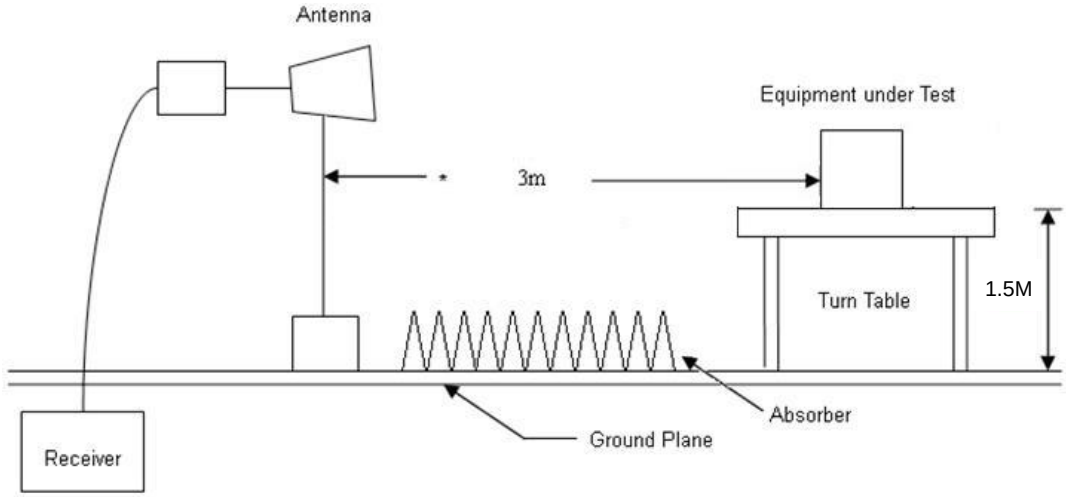
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.
4. After finding the max radiated emission, substitution method will be used for getting effective radiated power. EUT will be removed and substitution antenna will be placed at same position. Signal generator will output CW signal to substitution antenna through a RF cable. Rotate turntable and move antenna to find maximum radiated emission. Adjust output power of signal generator to let the maximum radiated emission is same as step 3. Record the output power level.
5. E.I.R.P = output power of step 4 + gain of substitution antenna – cable loss of RF cable. ERP can be calculated by below formula:
E.R.P= E.I.R.P – 2.15dB

10.3. Test Setup

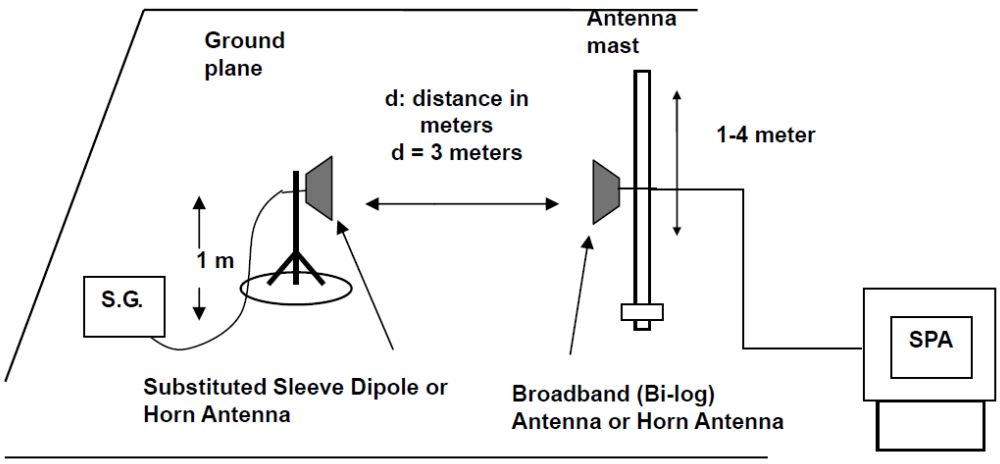
Below 1GHz test setup



Above 1GHz Test Setup

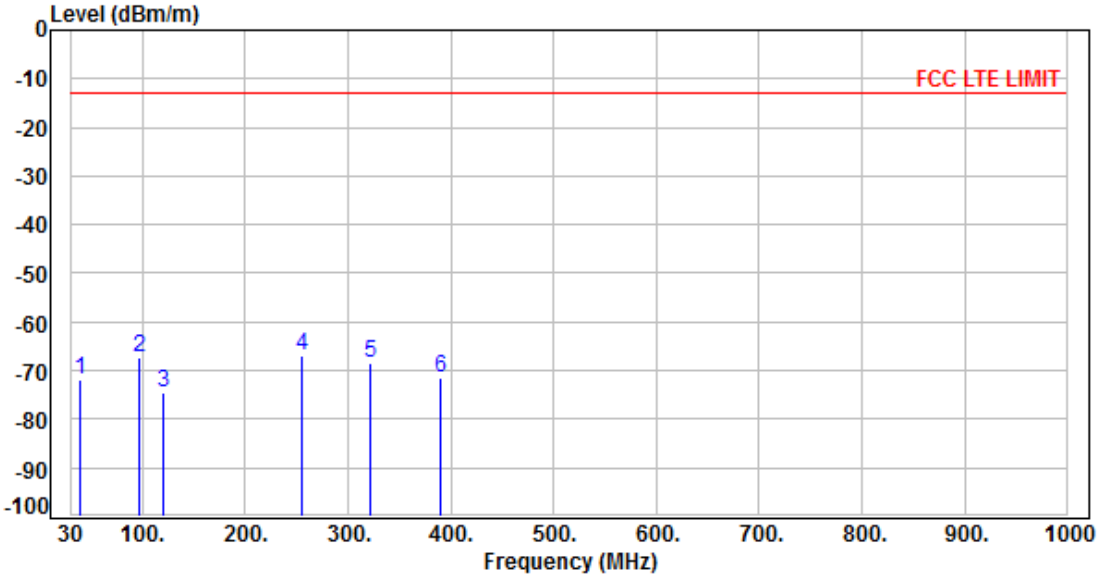


For Substituted Method Test Set-UP



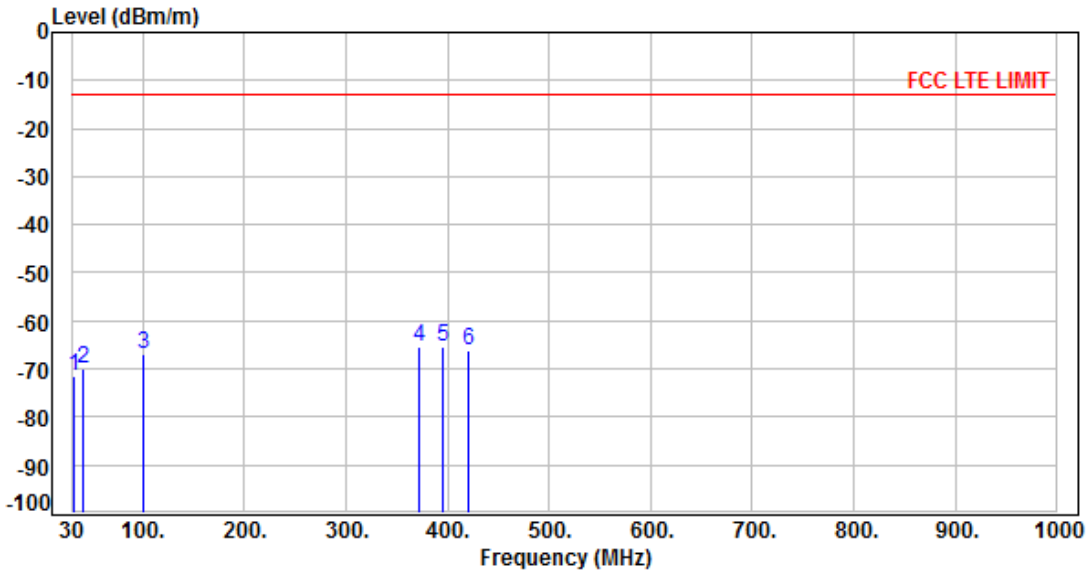
10.4. Test Result and Data (30MHz ~ 1GHz)

Test Mode	Cat M1, Band 26 1.4MHz, CH 26697	Pol/Phase	VERTICAL
Power	AC 120V/60Hz		



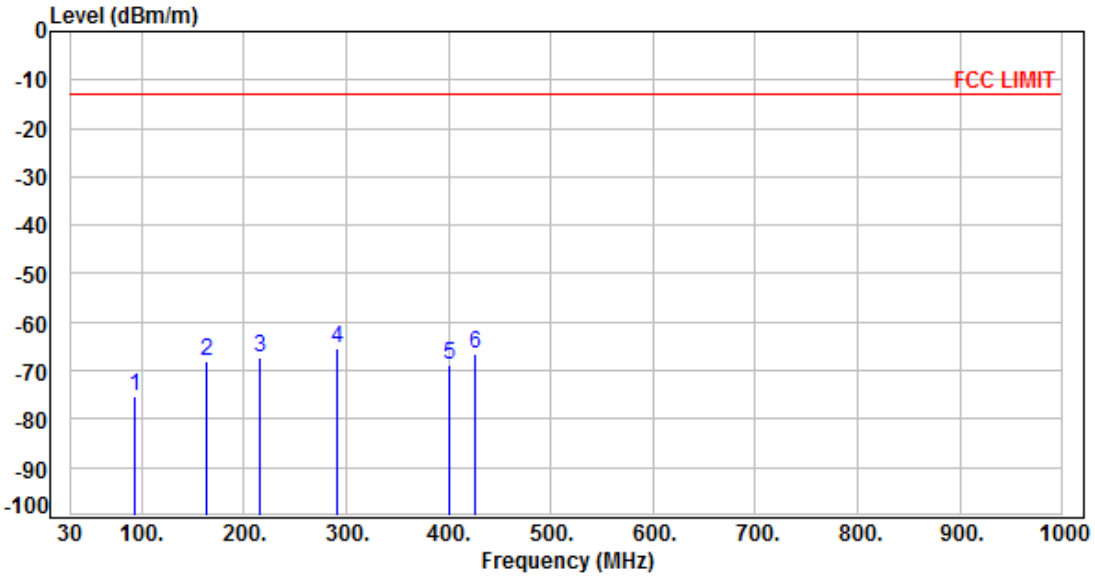
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
39.7	-66.82	V	-51.66	1.55	-16.63	-71.99	-13
96.74	-61.19	V	-59.62	1.51	-4.17	-67.45	-13
120.22	-69.04	V	-65.82	1.59	-4.85	-74.41	-13
255.1	-66.71	V	-63.59	2.15	0.84	-67.05	-13
321.14	-69.69	V	-64.59	2.3	0.6	-68.44	-13
390.84	-71.09	V	-67.57	2.42	0.73	-71.41	-13

Test Mode	Cat M1, Band 26 1.4MHz, CH 26697	Pol/Phase	HORIZONTAL
Power	AC 120V/60Hz		



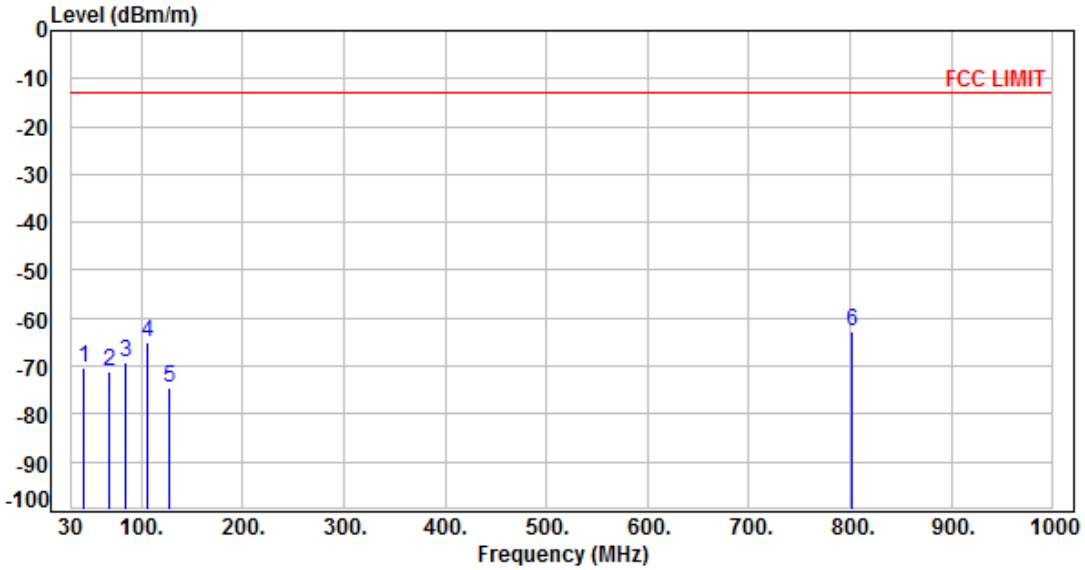
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
32.8	-74.39	H	-51.14	1.28	-17.03	-71.6	-13
40.69	-74.2	H	-49.87	1.64	-16.36	-70.02	-13
100.82	-65.79	H	-58.99	1.53	-4.44	-67.11	-13
371.44	-67.05	H	-61.6	2.41	0.75	-65.41	-13
394.72	-68.9	H	-61.38	2.42	0.74	-65.21	-13
419.94	-70.64	H	-62.19	2.49	0.67	-66.16	-13

Test Mode	NB-IoT, Band 26, CH 26740	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)
92.93	-68.7	V	-67.43	1.49	-4.2	-75.27	-13
163.97	-64.1	V	-59.79	1.77	-4.39	-68.1	-13
215.71	-65.3	V	-64.38	1.92	0.99	-67.46	-13
291.61	-66.6	V	-61.49	2.19	0.57	-65.26	-13
401.57	-68.4	V	-65.2	2.43	0.89	-68.89	-13
426.71	-68.8	V	-62.54	2.51	0.54	-66.66	-13

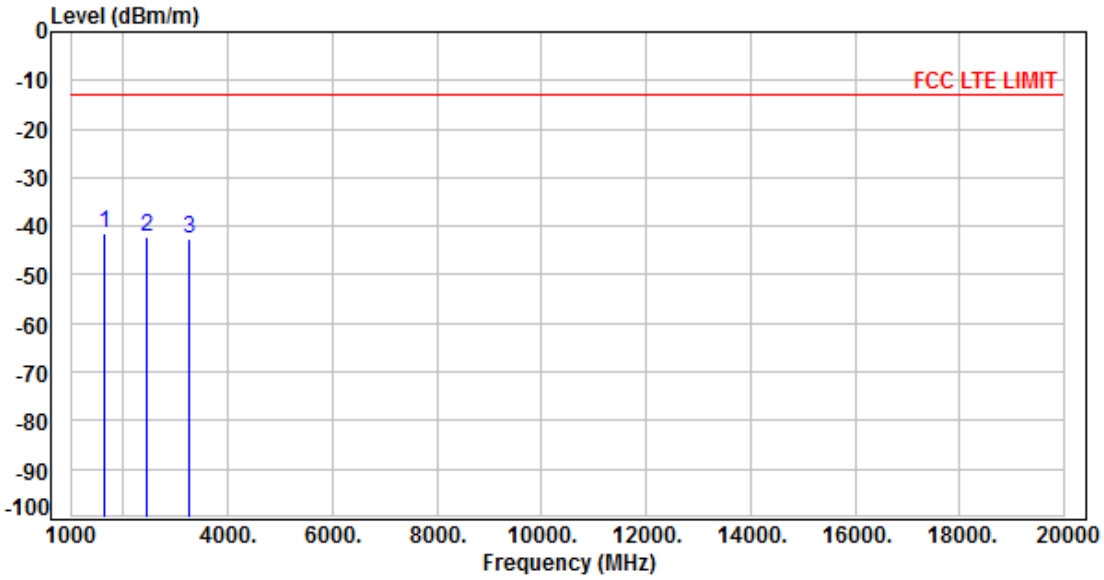
Test Mode	NB-IoT, Band 26, CH 26740	Pol/Phase	HORIZONTAL
Power	AC 120V/60Hz		



Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
42.86	-74.51	H	-49.9	1.87	-16.49	-70.41	-13
68.61	-71.51	H	-57.18	1.22	-10.54	-71.09	-13
83.91	-67.9	H	-60.52	1.38	-5.14	-69.19	-13
106.71	-63.42	H	73.73	1.59	-4.84	65.15	-13
127.64	-71.41	H	-65.92	1.69	-4.86	-74.62	-13
802.11	-77.02	H	-57.62	3.32	0.19	-62.9	-13

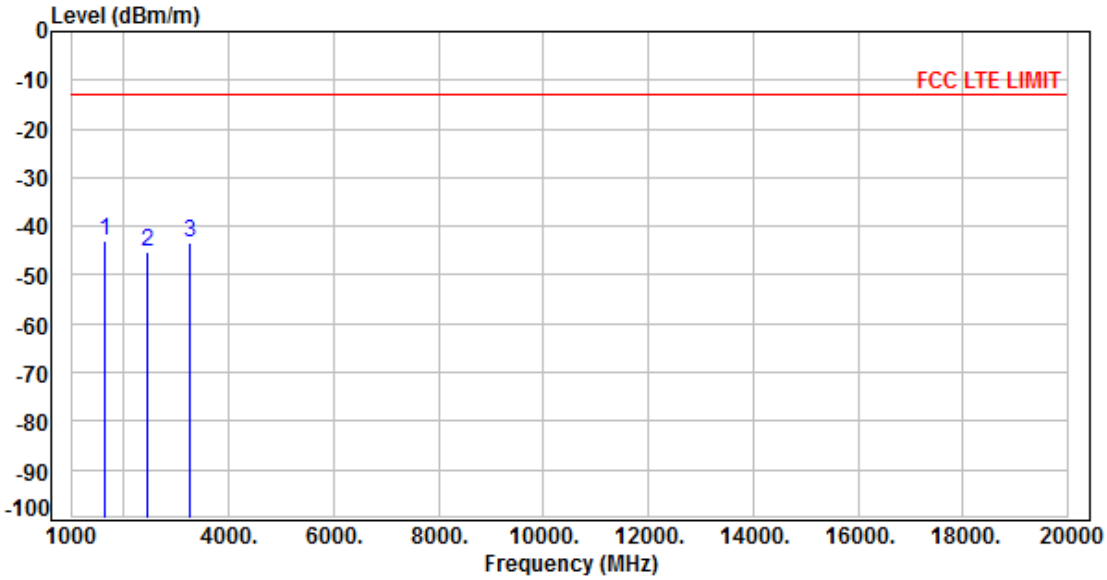
10.5. Test Result and Data (1GHz ~ 20GHz)

Test Mode	Cat M1, Band 26 1.4MHz, CH 26697	Pol/Phase	VERTICAL
Power	AC 120V/60Hz		



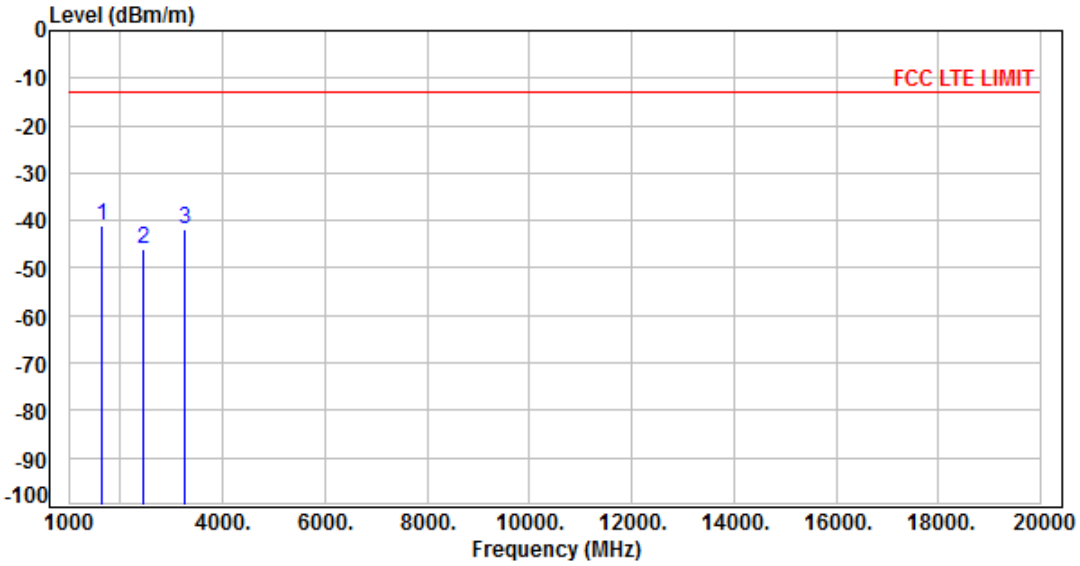
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1629.4	-46.78	V	-43.55	4.44	8.8	-41.34	-13
2444.1	-52.07	V	-44.31	5.47	9.7	-42.23	-13
3258.8	-55.93	V	-43.58	6.32	9.5	-42.55	-13

Test Mode	Cat M1, Band 26 1.4MHz, CH 26697	Pol/Phase	HORIZONTAL
Power	AC 120V/60Hz		



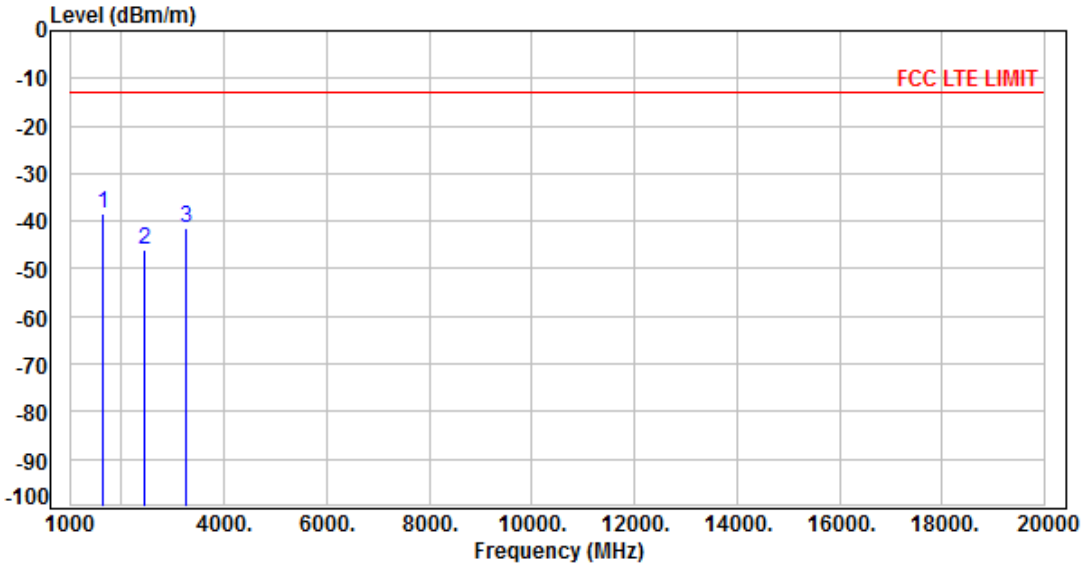
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1629.4	-48.71	H	-45.33	4.44	8.8	-43.12	-13
2444.1	-55.02	H	-47.47	5.47	9.7	-45.39	-13
3258.8	-56.45	H	-44.28	6.32	9.5	-43.25	-13

Test Mode	Cat M1, Band 26 1.4MHz, CH 26740	Pol/Phase	VERTICAL
Power	AC 120V/60Hz		



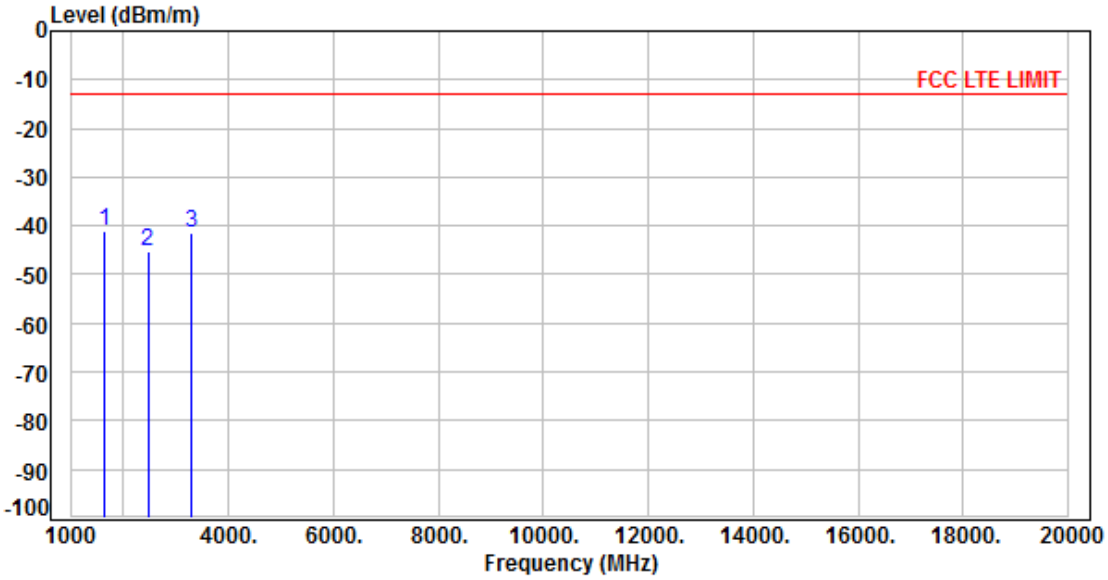
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1638	-46.75	V	-43.45	4.45	8.8	-41.25	-13
2457	-55.78	V	-47.95	5.49	9.7	-45.89	-13
3276	-55.45	V	-43.01	6.33	9.5	-41.99	-13

Test Mode	Cat M1, Band 26 1.4MHz, CH 26740	Pol/Phase	HORIZONTAL
Power	AC 120V/60Hz		



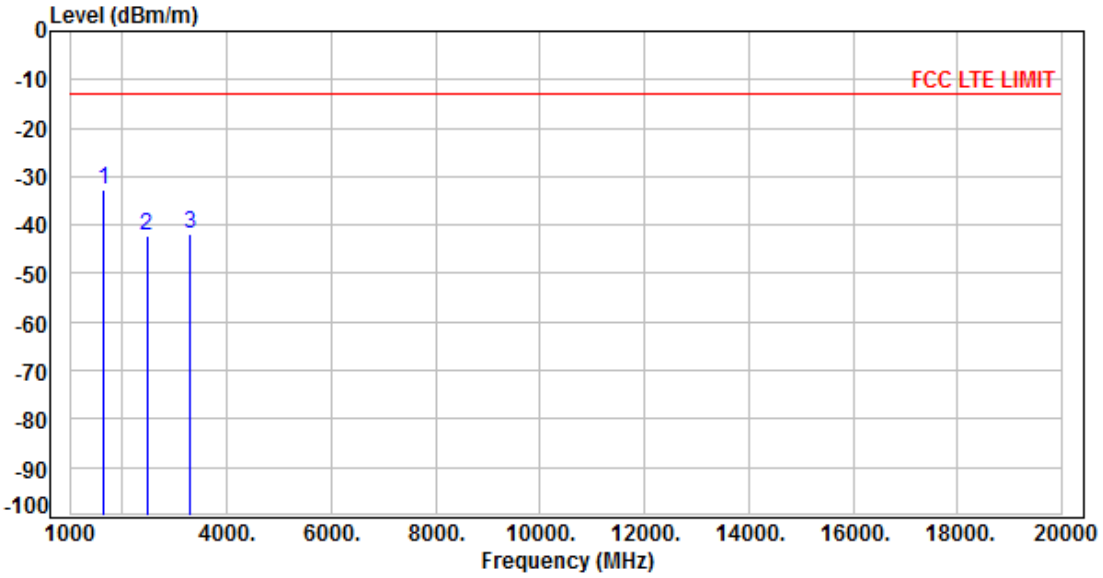
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1638	-43.91	H	-40.46	4.45	8.8	-38.26	-13
2457	-55.56	H	-47.95	5.49	9.7	-45.89	-13
3276	-54.64	H	-42.38	6.33	9.5	-41.36	-13

Test Mode	Cat M1, Band 26 1.4MHz, CH 26783	Pol/Phase	VERTICAL
Power	AC 120V/60Hz		



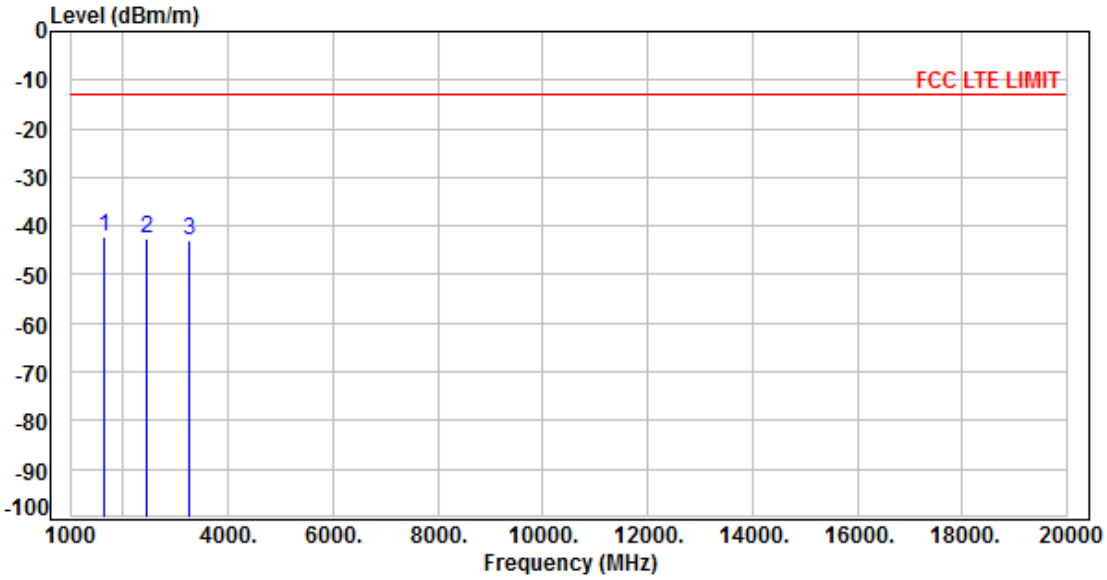
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1646.6	-46.73	V	-43.36	4.47	8.8	-41.18	-13
2469.9	-55.06	V	-47.17	5.5	9.7	-45.12	-13
3293.2	-55.09	V	-42.56	6.35	9.5	-41.56	-13

Test Mode	Cat M1, Band 2 1.4MHz, CH 26783	Pol/Phase	HORIZONTAL
Power	AC 120V/60Hz		



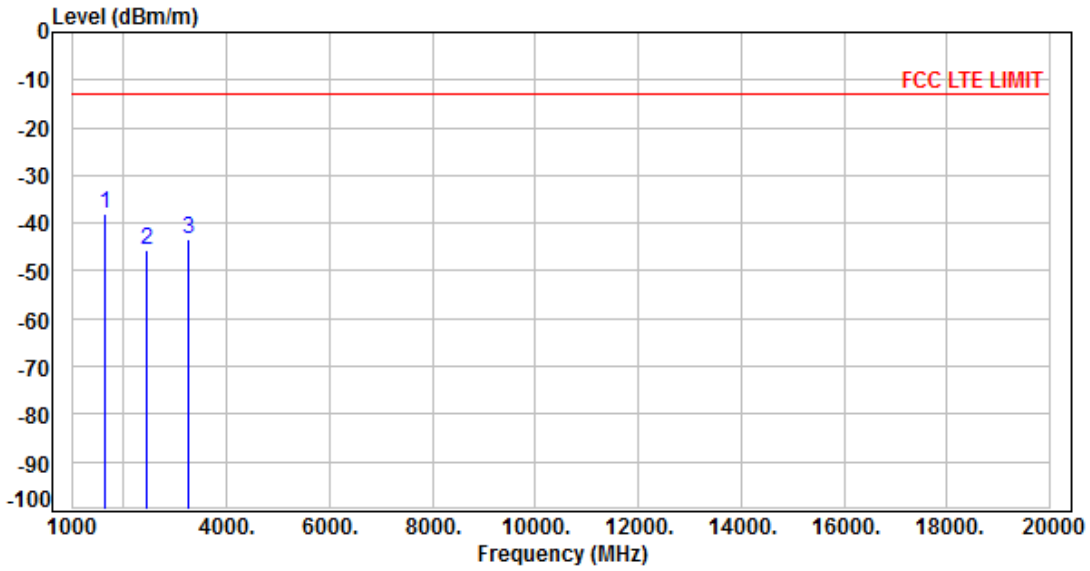
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1646.6	-38.27	H	-34.74	4.47	8.8	-32.56	-13
2469.9	-51.78	H	-44.13	5.5	9.7	-42.08	-13
3293.2	-55.17	H	-42.83	6.35	9.5	-41.83	-13

Test Mode	NB-IoT, Band 26, CH 26692	Pol/Phase	VERTICAL
Power	AC 120V/60Hz		



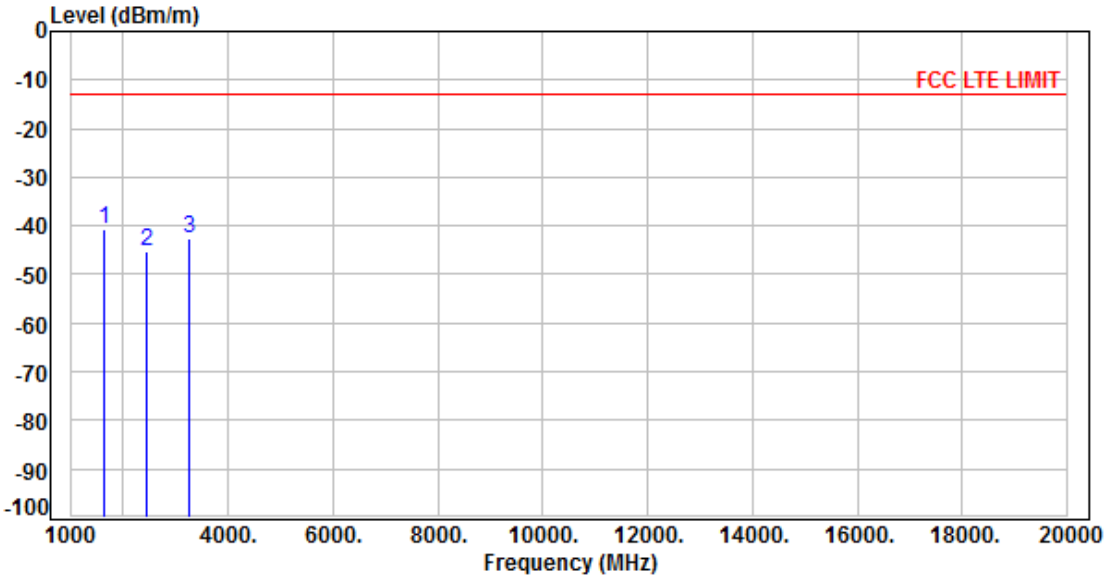
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1628.4	-47.58	V	-44.36	4.44	8.8	-42.15	-13
2442.6	-52.39	V	-44.64	5.47	9.7	-42.56	-13
3256.8	-56.22	V	-43.88	6.32	9.5	-42.85	-13

Test Mode	NB-IoT, Band 26, CH 26692	Pol/Phase	HORIZONTAL
Power	AC 120V/60Hz		



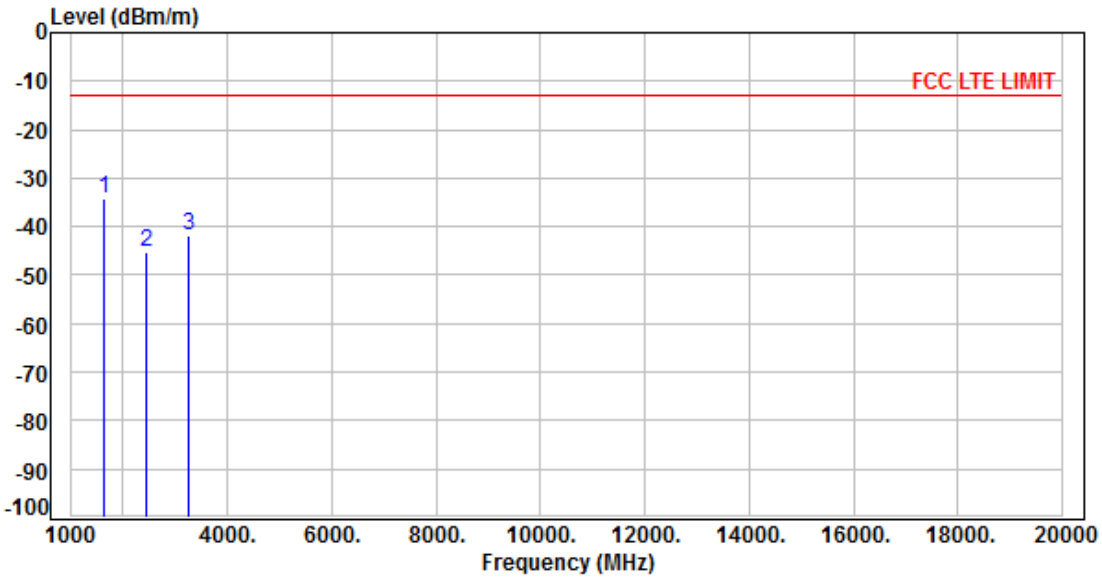
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1628.4	-43.74	H	-40.37	4.44	8.8	-38.16	-13
2442.6	-55.34	H	-47.79	5.47	9.7	-45.71	-13
3256.8	-56.57	H	-44.41	6.32	9.5	-43.38	-13

Test Mode	NB-IoT, Band 26, CH 26740	Pol/Phase	VERTICAL
Power	AC 120V/60Hz		



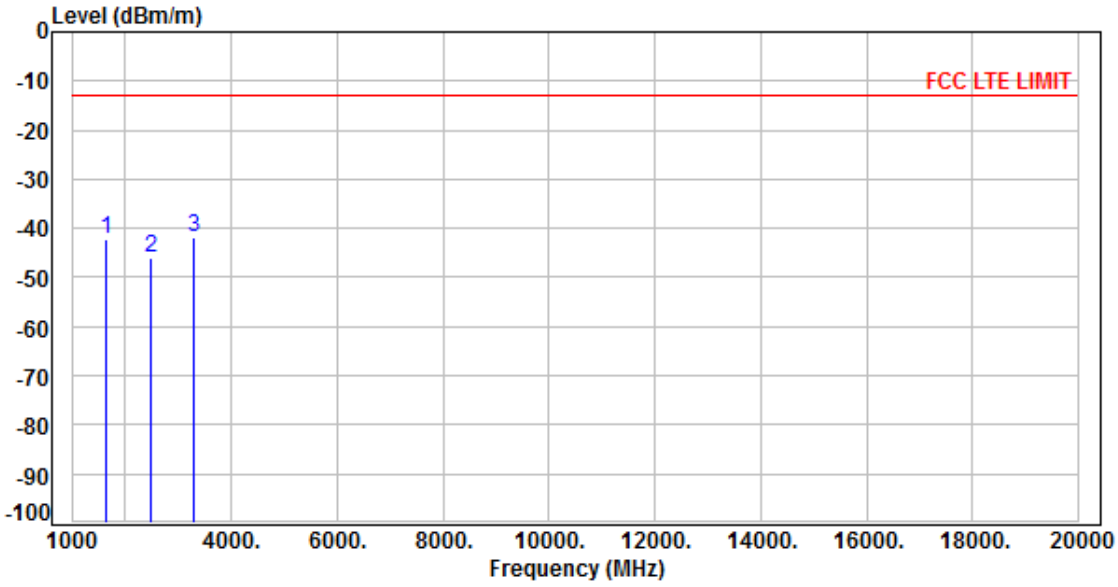
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1638	-46.21	V	-42.91	4.45	8.8	-40.71	-13
2457	-55.22	V	-47.39	5.49	9.7	-45.33	-13
3276	-56.01	V	-43.57	6.33	9.5	-42.55	-13

Test Mode	NB-IoT, Band 26, CH 26740	Pol/Phase	HORIZONTAL
Power	AC 120V/60Hz		



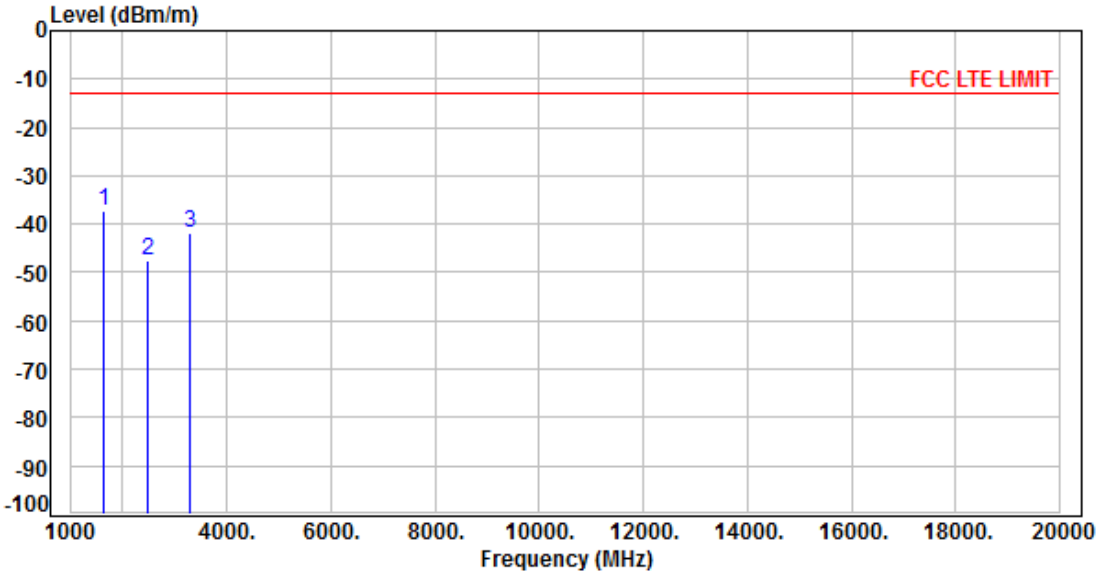
Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	ERP (dBm)	Limit (dBm)
1638	-39.73	H	-36.28	4.45	8.8	-34.08	-13
2457	-54.85	H	-47.24	5.49	9.7	-45.18	-13
3276	-55.13	H	-42.87	6.33	9.5	-41.85	-13

Test Mode	NB-IoT, Band 26, CH 26788	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)
1647.6	-47.72	V	-44.33	4.47	8.8	-42.15	-13
2471.4	-55.84	V	-47.95	5.51	9.72	-45.89	-13
3295.2	-55.19	V	-42.65	6.35	9.5	-41.65	-13

Test Mode	NB-IoT, Band 26, CH 26788	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)
1647.6	-42.84	H	-39.29	4.47	8.8	-37.11	-13
2471.4	-57.26	H	-49.61	5.51	9.72	-47.55	-13
3295.2	-55.24	H	-42.89	6.35	9.5	-41.89	-13

11. Frequency Stability

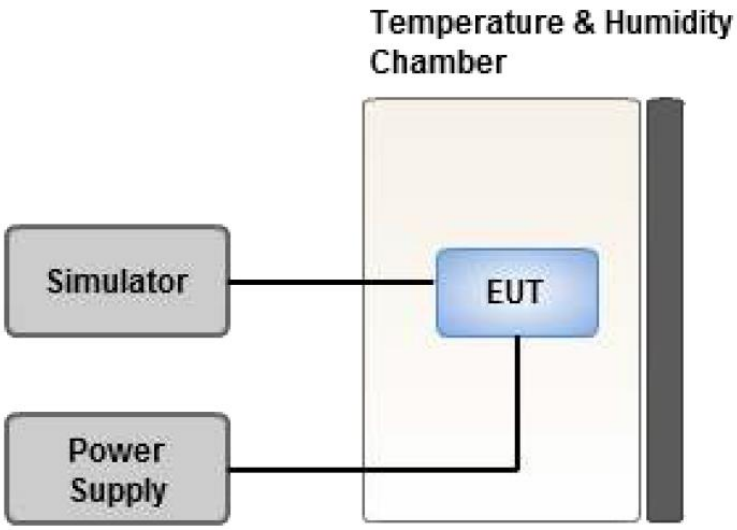
11.1. Test Limit

The frequency stability shall be less +/- 2.5ppm.

11.2. Test Procedure

1. EUT was placed at temperature chamber and connected to an external power supply.
2. Temperature and voltage condition shall be tested to confirm frequency stability.
3. Temperature range is from -40~85oC and voltage range is from lowest to highest working voltage.
4. Link up EUT and simulator. Confirm frequency drift value of simulator and record it.

11.3. Test Setup



11.4. Test Result and Data

Cat M1

LTE Band 26 QPSK 15M middle channel

Frequency Stability under Temperature				
Temperature Interval (°C)	Test Frequency (MHz)	Deviation (Hz)	Frequency error (ppm)	Limit (ppm)
50	819	2.49	0.003	2.5
40	819	2.85	0.003	2.5
30	819	1.67	0.002	2.5
20	819	1.54	0.002	2.5
10	819	1.22	0.001	2.5
0	819	0.97	0.001	2.5
-10	819	0.62	0.001	2.5
-20	819	0.23	0.000	2.5
-30	819	0.17	0.000	2.5

LTE 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)
138	819	1.44	0.002	2.5
120	819	0.52	0.001	2.5
102	819	-1.78	-0.002	2.5

NB-IoT

Band 26 QPSK middle channel

Frequency Stability under Temperature				
Temperature Interval (°C)	Test Frequency (MHz)	Deviation (Hz)	Frequency error (ppm)	Limit (ppm)
50	819	2.08	0.003	2.5
40	819	1.94	0.002	2.5
30	819	2.26	0.003	2.5
20	819	1.32	0.002	2.5
10	819	-0.51	-0.001	2.5
0	819	0.55	0.001	2.5
-10	819	-0.02	0.000	2.5
-20	819	3.14	0.004	2.5
-30	819	2.59	0.003	2.5

Band 26 QPSK middle channel

Frequency Stability under Voltage at 20°C				
DC Voltage (V)	Test Frequency (MHz)	Deviation (Hz)	Frequency error (ppm)	Limit (ppm)
138	819	3.59	0.004	2.5
120	819	1.63	0.002	2.5
102	819	2.88	0.004	2.5