

TEST REPORT

of

FCC Part 2 Subpart J, Part 24 Subpart E

FCC ID: BEJTM13LNNAHK1

Equipment Under Test : LTE Module
Model Name : TM13LNNAHK1
Variant Model Name(s) : -
Applicant : LG Electronics USA
Manufacturer : LG Electronics Inc.
Date of Receipt : 2021.07.28
Date of Test(s) : 2021.07.30 ~ 2021.08.20
Date of Issue : 2021.08.23

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

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Tested by:



Murphy Kim

Technical
Manager:



Jinhyoung Cho

SGS Korea Co., Ltd. Gunpo Laboratory



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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
 - 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
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 - Designation number: KR0150

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1.2. Details of Applicant

Applicant : LG Electronics USA
 Address : 111 Sylvan Avenue, North Building, Englewood Cliffs, New Jersey, United States, 07632
 Contact Person : Kim, Sung-soo
 Phone No. : +1 201 266 2215

1.3. Details of Manufacturer

Company : LG Electronics Inc.
 Address : 10, Magokjungang 10-ro, Gangseo-gu, Seoul, Korea, 07796

1.4. Description of EUT

Kind of Product	LTE Module
Model Name	TM13LNNAHK1
Variant Model	-
Serial Number	353261090013510
Power Supply	DC 4.0 V
Rated Power	CDMA BC1: 24 dB m LTE Band 2: 23 dB m
Frequency Range	CDMA BC1: 1 850 MHz ~ 1 910 MHz LTE Band 2: 1 850 MHz ~ 1 910 MHz
Modulation Technique	QPSK, 16QAM
Antenna Type	Shark Antenna
Antenna Gain*	1 850 MHz ~ 1 910 MHz: 3.12 dB i
H/W Version	Rev1.1
S/W Version	HMD6PN19

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMR40	100272	Jun. 16, 2021	Annual	Jun. 16, 2022
Signal Generator	R&S	SMVB100A	255834	May 31, 2021	Annual	May 31, 2022
Spectrum Analyzer	R&S	FSV30	103453	Nov. 04, 2020	Annual	Nov. 04, 2021
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 04, 2020	Annual	Sep. 04, 2021
Mobile Test Unit	R&S	CMW500	144034	Feb. 22, 2021	Annual	Feb. 22, 2022
Mobile Test Unit	Agilent	E5515C	GB43345198	Mar. 03, 2021	Annual	Mar. 03, 2022
Power Meter	Anritsu	ML2495A	1223004	Jun. 01, 2021	Annual	Jun. 01, 2022
Power Sensor	Anritsu	MA2411B	1207272	Jun. 01, 2021	Annual	Jun. 01, 2022
Temperature Chamber	ESPEC CORP.	PL-2J	15004184	Jun. 02, 2021	Annual	Jun. 02, 2022
Low Pass Filter	Mini-Circuits	NLP-1200+	V 8979400903-2	Feb. 08, 2021	Annual	Feb. 08, 2022
High Pass Filter	Wainwright Instrument GmbH	WHK3.0/18G-10SS	344	May 17, 2021	Annual	May 17, 2022
High Pass Filter	Wainwright Instrument GmbH	WHK7.5/26.5G-6SS	15	May 31, 2021	Annual	May 31, 2022
Directional Coupler	KRYTAR	152613	122660	Jun. 15, 2021	Annual	Jun. 15, 2022
DC Power Supply	Agilent	U8002A	MY49030063	Feb. 02, 2021	Annual	Feb. 02, 2022
Preamplifier	H.P.	8447F	2944A03909	Aug. 06, 2021	Annual	Aug. 06, 2022
Preamplifier	R&S	SCU-18	10117	Jun. 09, 2021	Annual	Jun. 09, 2022
Preamplifier	TESTEK	TK-PA1840H	130016	Jan. 07, 2021	Annual	Jan. 07, 2022
Test Receiver	R&S	ESU26	100109	Feb. 19, 2021	Annual	Feb. 19, 2022
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 22, 2019	Biennial	Aug. 22, 2021
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB9163	01126	Dec. 12, 2020	Biennial	Dec. 12, 2022
Horn Antenna	R&S	HF906	100326	Feb. 04, 2021	Annual	Feb. 04, 2022
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA9170	9170-540	Nov. 26, 2020	Annual	Nov. 26, 2021
Antenna Master	Innco systems GmbH	MA4640-XP-ET	MA4640/536/383 30516/L	N.C.R.	N/A	N.C.R.
Turn Table	Innco systems GmbH	DS 1200S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/383 30516/L	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L x W x H (9.6 m x 6.4 m x 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	RFONE	MWX221-NMSNMS (4 m)	J1023142	Jul. 05, 2021	Semi-annual	Jan. 05, 2022
Coaxial Cable	RFONE	PL520-NMNM-10M (10 m)	20200324001	Jul. 05, 2021	Semi-annual	Jan. 05, 2022
Coaxial Cable	RADIALL	TESTPRO 3	182287	Aug. 18, 2021	Semi-annual	Feb. 18, 2022
Coaxial Cable	RADIALL	TESTPRO 3	182288	Aug. 18, 2021	Semi-annual	Feb. 18, 2022
Coaxial Cable	RADIALL	TESTPRO 3	182291	Aug. 18, 2021	Semi-annual	Feb. 18, 2022

► Support Equipment

Description	Manufacturer	Model	Serial Number
N/A	-	-	-

1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 2 and 24		
Section	Test Item	Result
§24.232(c)	RF Radiated Output Power	Complied
§24.238(a)	Spurious Radiated Emission	Complied
§2.1046	Conducted Output Power	Complied
§2.1049	Occupied Bandwidth	Complied
§24.232(d)	Peak-Average Ratio	Complied
§24.238(a)	Spurious Emission at Antenna Terminal	Complied
§24.238(a)	Band Edge	Complied
§2.1055 §24.235	Frequency Stability	Complied

1.7. Sample Calculation for Offset

Where relevant, the following sample calculation is provided:

1.7.1. Conducted Test

Offset value (dB) = Directional Coupler (dB) + Cable loss (dB)

1.7.2. Radiation test

- E.I.R.P. (dB m) = Measured level (dB μ V) + Antenna factor (dB/m) + Cable loss (dB) + 20 Log D - 104.5;
 where D is the measurement distance in meters.

1.8. Worst Case Configuration and Mode

CDMA

Output power measurements were measured on 1xRTT and EV-DO Modulation. The worst-case is based on the conducted output power measurement investigation results. All testing was performed using 1xRTT, EV-DO modulations, except spurious radiated emission and spurious emission at antenna terminal were tested only EV-DO modulation as worst case.

The radiation test of the EUT was investigated in three orthogonal orientations X, Y, and Z, and the worst case data is reported.

LTE

The worst-case is based on the conducted output power measurement investigation results. All testing was performed using QPSK and 16QAM modulations. However, the spurious radiated emission and spurious at antenna terminal were only performed on bandwidth and RB offset(with RB size 1) with the highest conducted power in QPSK.

The peak to average ratio were tested only 16QAM modulation as worst case.

The radiation test of the EUT was investigated in three orthogonal orientations X, Y, and Z, and the worst case data is reported.

1.9. Measurement Configuration

CDMA BC1

Test Items	Test Channel			Modulation	
	L	M	H	1xRTT	EV-DO
RF Radiated Output Power	V	V	V	V	V
	V	V	V	V	V
Conducted Output Power	V	V	V	V	V
	V	V	V	V	V
Frequency Stability	-	V	-	-	V
	-	V	-	-	V
Occupied Bandwidth	-	V	-	V	V
	-	V	-	V	V
Peak to Average Ratio	V	V	V	V	V
	V	V	V	V	V
Band Edge	V	-	V	V	V
	V	-	V	V	V
Spurious Emission at Antenna Terminal	V	V	V	-	V
	V	V	V	-	V
Spurious Radiated Emission	V	V	V	-	V
	V	V	V	-	V

LTE Band 2

Test Items	Test Channel			Bandwidth (MHz)						Modulation		RB #		
	L	M	H	1.4	3	5	10	15	20	QPSK	16QAM	1	Half	Full
RF Radiated Output Power	V	V	V	-	-	-	V	-	-	V	V	V	-	-
Conducted Output Power	V	V	V	V	V	V	V	V	V	V	V	V	V	V
Frequency Stability	-	V	-	-	-	-	V	-	-	V	-	-	-	V
Occupied Bandwidth	-	V	-	V	V	V	V	V	V	V	V	-	-	V
Peak-to-Average Ratio	V	V	V	V	V	V	V	V	V	-	V	-	-	V
Band edge	V	-	V	V	V	V	V	V	V	V	V	V	-	V
Spurious at antenna terminal	V	V	V	-	-	-	V	-	-	V	-	V	-	-
Spurious Radiated Emission	V	V	V	-	-	-	V	-	-	V	-	V	-	-

1.10. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty	
RF Output Power	± 0.36 dB	
Occupied Bandwidth	± 13.12 kHz	
Conducted Spurious Emissions	± 0.63 dB	
Peak to Average Ratio	± 0.60 dB	
Frequency Stability	± 4.92 kHz	
Radiated Emission, 9 kHz to 30 MHz	H	± 3.66 dB
	V	± 3.66 dB
Radiated Emission, below 1 GHz	H	± 4.90 dB
	V	± 4.82 dB
Radiated Emission, above 1 GHz	H	± 3.62 dB
	V	± 3.64 dB

All measurement uncertainty values are shown with a coverage factor of $k=2$ to indicate a 95 % level of confidence.

1.11. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL002450	2021.08.23	Initial

1.12. Emission Designator and Max Power

EV-DO

Modulation	Low Freq. (MHz)	Upper Freq. (MHz)	Conducted Average (dB m)	Ant. Gain (dB i)	E.I.R.P. Average (dB m)	E.I.R.P. Average (W)	Emission Designator
1xRTT	1 851.25	1 908.75	24.03	3.12	27.15	0.519	1M27F9W
EV-DO			24.24		27.36	0.545	1M28F9W

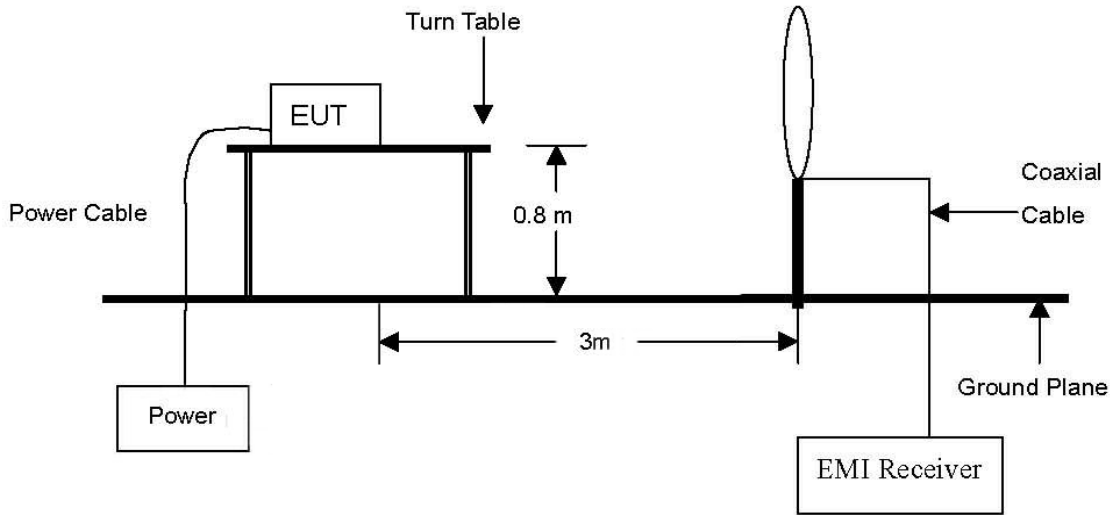
LTE Band 2

Band width (MHz)	Modulation	Low Freq. (MHz)	Upper Freq. (MHz)	Conducted Average (dB m)	Ant. Gain (dB i)	E.I.R.P. Average (dB m)	E.I.R.P. Average (W)	Emission Designator
1.4	QPSK	1 850.7	1 909.3	23.25	3.12	26.37	0.434	1M10G7D
	16QAM			22.32		25.44	0.350	1M10W7D
3	QPSK	1 851.5	1 908.5	23.20		26.32	0.429	2M69G7D
	16QAM			22.21		25.33	0.341	2M69W7D
5	QPSK	1 852.5	1 907.5	23.28		26.40	0.437	4M52G7D
	16QAM			21.93		25.05	0.320	4M50W7D
10	QPSK	1 855.0	1 905.0	23.42		26.54	0.451	8M93G7D
	16QAM			22.12		25.24	0.334	8M91W7D
15	QPSK	1 857.5	1 902.5	23.24		26.36	0.433	13M5G7D
	16QAM			22.14		25.26	0.336	13M5W7D
20	QPSK	1 860.0	1 900.0	23.18		26.30	0.427	17M9G7D
	16QAM			22.11		25.23	0.333	17M9W7D

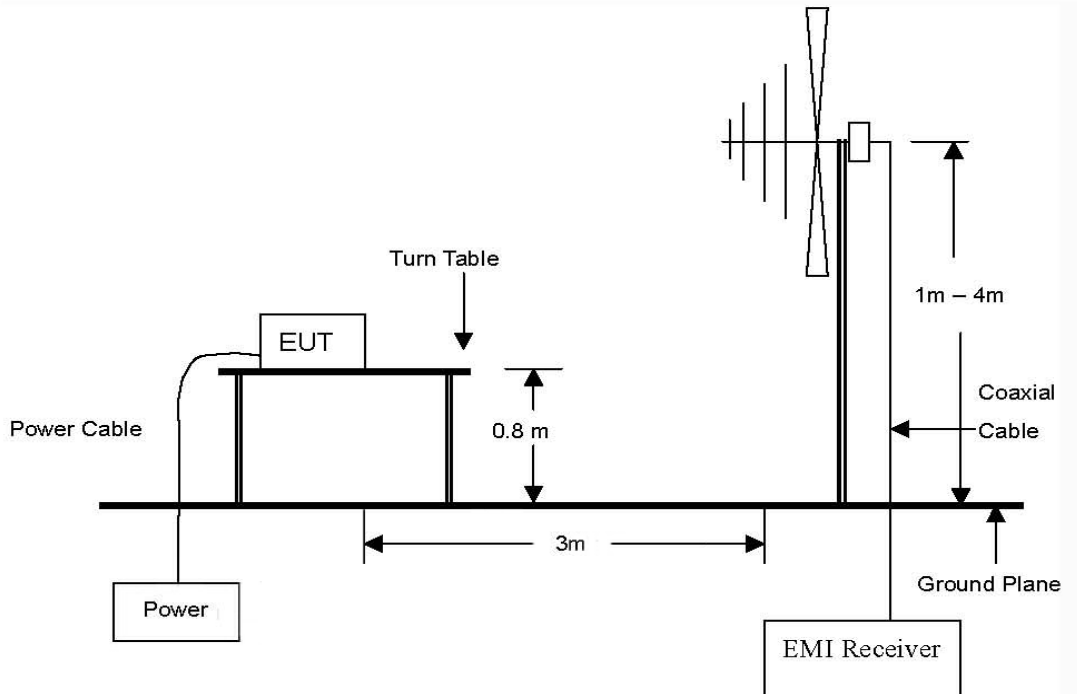
2. RF Radiated Output Power & Spurious Radiated Emission

2.1. Test setup

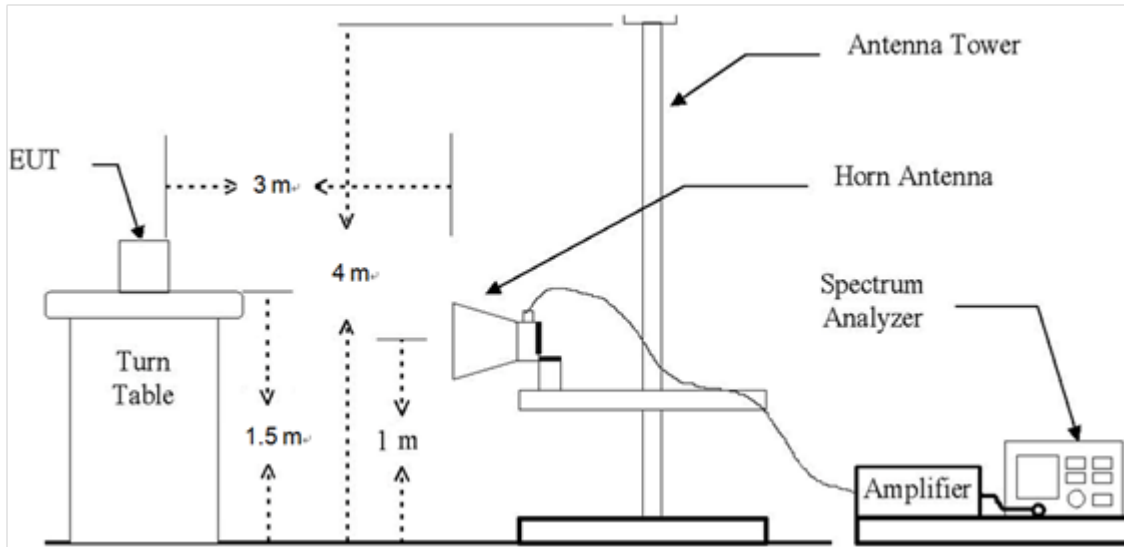
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 20 GHz Emissions.



2.2. Limit

2.2.1. Limit of RF Radiated Output Power

- §24.232(c), mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

2.2.2. Limit of Spurious Radiated Emission

- §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.

2.3. Test Procedure: Based on ANSI/TIA 603E: 2016 and ANSI C63.26-2015 and KDB 971168 D01 Power Meas License Digital Systems v03r01.

1. On a test site, the EUT shall be placed at 0.8 m or 1.5 m height on a turn table, and in the position close to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3 m from EUT to correspond to the fundamental frequency of the transmitter.
3. The output of the test antenna shall be connected to the measuring receiver and the peak detector is used for the measurement.
4. The maximized power level is recorded using the spectrum analyzer "Channel Power" function with the integration band set to the emissions occupied bandwidth, $RBW = 1-5\%$ of the OBW (not to exceed 1 MHz), $VBW \geq 3 \times RBW$, Detector = power averaging (rms), sweep time = auto, trace average at least 100 traces in power averaging (rms) mode, per the guidelines of KDB 971168 D01 Power Meas License Digital Systems v03r01.
5. Radiated spurious emissions measurement method was set as follows:
RBW = 100 kHz for emissions below 1 GHz and 1 MHz for emissions above 1 GHz, $VBW \geq 3 \times RBW$,
Detector = RMS, trace mode = max hold, per the guidelines of KDB 971168 D01 Power Meas License Digital Systems v03r01.
6. The transmitter shall be switched on, the measuring receiver shall be tuned to the frequency of the transmitter under test.
7. The test antenna shall be raised and lowered through the specified range of height until the maximum signal level is detected by the measuring receiver.
8. The transmitter shall be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.
9. The test antenna shall be raised and lowered again through the specified range of height until the maximum signal level is detected by the measuring receiver.
10. The maximum signal level detected by the measuring receiver shall be noted.
11. In necessary, the input attenuator setting on the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.
12. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
13. The measurement shall be repeated with the test antenna orientated for horizontal polarization.

2.4. Test results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

2.4.1. RF Radiated Output Power

CDMA BC1

Modulation	Frequency (MHz)	Measured Level (dBμV)	Ant. Pol.	AF (dB/m)	CL (dB)	E (dBμV/m)	CF (dB)	E.I.R.P.	
								(dB m)	(W)
1xRTT	1 851.25	83.18	H	27.60	6.29	117.07	-95.26	21.81	0.152
	1 851.25	82.94	V	27.60	6.29	116.83	-95.26	21.57	0.144
	1 880.00	82.11	H	27.54	6.44	116.09	-95.26	20.83	0.121
	1 880.00	83.77	V	27.54	6.44	117.75	-95.26	22.49	0.177
	1 908.75	78.18	H	27.50	6.26	111.94	-95.26	16.68	0.047
	1 908.75	80.70	V	27.50	6.26	114.46	-95.26	19.20	0.083
EV-DO	1 851.25	83.67	H	27.60	6.29	117.56	-95.26	22.30	0.170
	1 851.25	84.81	V	27.60	6.29	118.70	-95.26	23.44	0.221
	1 880.00	83.90	H	27.54	6.44	117.88	-95.26	22.62	0.183
	1 880.00	83.72	V	27.54	6.44	117.70	-95.26	22.44	0.175
	1 908.75	83.68	H	27.50	6.26	117.44	-95.26	22.18	0.165
	1 908.75	81.17	V	27.50	6.26	114.93	-95.26	19.67	0.093

LTE band 2

Band width (MHz)	Modulation	Frequency (MHz)	Measured Level (dBμV)	Ant. Pol.	AF (dB/m)	CL (dB)	E (dBμV/m)	CF (dB)	E.I.R.P.	
									(dB m)	(W)
10	QPSK	1 855.00	85.37	H	27.59	6.32	119.28	-95.26	24.02	0.252
		1 855.00	81.27	V	27.59	6.32	115.18	-95.26	19.92	0.098
		1 880.00	86.01	H	27.54	6.44	119.99	-95.26	24.73	0.297
		1 880.00	84.18	V	27.54	6.44	118.16	-95.26	22.90	0.195
		1 905.00	83.09	H	27.50	6.25	116.84	-95.26	21.58	0.144
		1 905.00	82.67	V	27.50	6.25	116.42	-95.26	21.16	0.131
	16QAM	1 855.00	84.51	H	27.59	6.32	118.42	-95.26	23.16	0.207
		1 855.00	80.29	V	27.59	6.32	114.20	-95.26	18.94	0.078
		1 880.00	85.69	H	27.54	6.44	119.67	-95.26	24.41	0.276
		1 880.00	83.93	V	27.54	6.44	117.91	-95.26	22.65	0.184
		1 905.00	81.80	H	27.50	6.25	115.55	-95.26	20.29	0.107
		1 905.00	81.95	V	27.50	6.25	115.70	-95.26	20.44	0.111

Remark;

1. AF = Antenna Factor, CL = Cable Loss, CF = Conversion Factor.
2. $E \text{ (dB}\mu\text{V/m)} = \text{Measured Level (dB}\mu\text{V)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)}$.
3. $\text{E.I.R.P. (dB m)} = E \text{ (dB}\mu\text{V/m)} + \text{CF (dB)}$.
4. $\text{CF (dB)} = 20 \log D - 104.8$; where D is the measurement distance in meters, According to ANSI C63.26-2015 5.2.7 and KDB 971168 D01 v03r01 5.8.4

2.4.2. Spurious radiated emission

CDMA BC1

Frequency (MHz)	Measured Level (dB μ V)	Ant. Pol.	AF (dB/m)	AMP+CL (dB)	E (dB μ V/m)	CF (dB)	E.I.R.P. (dB m)	Limit (dB m)	Margin (dB)
Low Channel (1 851.25 MHz)									
3 703.05	57.14	H	32.11	-33.78	55.47	-95.26	-39.79	-13	26.79
3 701.78	63.75	V	32.11	-33.80	62.06	-95.26	-33.20	-13	20.20
5 553.83	47.28	H	34.00	-30.06	51.22	-95.26	-44.04	-13	31.04
5 553.38	53.42	V	34.00	-30.05	57.37	-95.26	-37.89	-13	24.89
7 406.50	45.57	H	36.19	-29.58	52.18	-95.26	-43.08	-13	30.08
7 406.22	49.30	V	36.19	-29.58	55.91	-95.26	-39.35	-13	26.35
Above 7 500.00	Not detected	-	-	-	-	-	-	-	-
Middle Channel (1 880.00 MHz)									
3 760.79	59.14	H	32.28	-33.33	58.09	-95.26	-37.17	-13	24.17
3 760.78	62.67	V	32.28	-33.33	61.62	-95.26	-33.64	-13	20.64
5 639.05	47.93	H	34.00	-29.94	51.99	-95.26	-43.27	-13	30.27
5 640.85	51.98	V	34.00	-29.95	56.03	-95.26	-39.23	-13	26.23
7 518.84	44.42	H	36.06	-29.30	51.18	-95.26	-44.08	-13	31.08
7 518.59	45.17	V	36.06	-29.30	51.93	-95.26	-43.33	-13	30.33
Above 7 600.00	Not detected	-	-	-	-	-	-	-	-
High Channel (1 908.75 MHz)									
3 818.26	58.99	H	32.16	-32.59	58.56	-95.26	-36.70	-13	23.70
3 818.24	58.67	V	32.16	-32.59	58.24	-95.26	-37.02	-13	24.02
5 727.38	47.21	H	34.00	-29.58	51.63	-95.26	-43.63	-13	30.63
5 727.08	49.11	V	34.00	-29.58	53.53	-95.26	-41.73	-13	28.73
7 633.76	42.37	H	35.93	-29.77	48.53	-95.26	-46.73	-13	33.73
7 633.74	43.30	V	35.93	-29.77	49.46	-95.26	-45.80	-13	32.80
Above 7 700.00	Not detected	-	-	-	-	-	-	-	-

LTE band 2 (10 MHz - QPSK)

Frequency (MHz)	Measured Level (dB μ V)	Ant. Pol.	AF (dB/m)	AMP+CL (dB)	E (dB μ V/m)	CF (dB)	E.I.R.P. (dB m)	Limit (dB m)	Margin (dB)
Low Channel (1 855.0 MHz)									
3 710.32	62.96	H	32.14	-34.29	60.81	-95.26	-34.45	-13	21.45
3 710.15	69.50	V	32.14	-34.29	67.35	-95.26	-27.91	-13	14.91
5 565.18	49.35	H	34.00	-30.32	53.03	-95.26	-42.23	-13	29.23
5 565.26	51.71	V	34.00	-30.33	55.38	-95.26	-39.88	-13	26.88
7 420.58	46.98	H	36.16	-29.42	53.72	-95.26	-41.54	-13	28.54
7 420.46	53.13	V	36.16	-29.42	59.87	-95.26	-35.39	-13	22.39
Above 7 500.00	Not detected	-	-	-	-	-	-	-	-
Middle Channel (1 880.0 MHz)									
3 760.23	67.93	H	32.28	-33.66	66.55	-95.26	-28.71	-13	15.71
3 760.20	73.01	V	32.28	-33.66	71.63	-95.26	-23.63	-13	10.63
5 640.30	49.66	H	34.00	-30.10	53.56	-95.26	-41.70	-13	28.70
5 640.50	50.66	V	34.00	-30.10	54.56	-95.26	-40.70	-13	27.70
7 520.34	45.92	H	36.06	-29.34	52.64	-95.26	-42.62	-13	29.62
7 520.52	50.19	V	36.06	-29.34	56.91	-95.26	-38.35	-13	25.35
Above 7 600.00	Not detected	-	-	-	-	-	-	-	-
High Channel (1 905.0 MHz)									
3 810.20	68.52	H	32.18	-32.89	67.81	-95.26	-27.45	-13	14.45
3 810.26	71.08	V	32.18	-32.89	70.37	-95.26	-24.89	-13	11.89
5 714.90	48.03	H	34.00	-29.99	52.04	-95.26	-43.22	-13	30.22
5 715.18	49.56	V	34.00	-29.98	53.58	-95.26	-41.68	-13	28.68
7 620.32	44.12	H	35.96	-29.06	51.02	-95.26	-44.24	-13	31.24
7 620.36	50.55	V	35.96	-29.06	57.45	-95.26	-37.81	-13	24.81
Above 7 700.00	Not detected	-	-	-	-	-	-	-	-

Remark;

1. AF = Antenna Factor, CL = Cable Loss, CF = Conversion Factor.
2. E (dB μ V/m) = Measured Level (dB μ V) + Antenna Factor (dB/m) + AMP (dB) + Cable Loss (dB).
3. E.I.R.P. (dB m) = E (dB μ V/m) + CF (dB).
4. CF (dB) = 20 log D - 104.8; where D is the measurement distance in meters, According to KDB 971168 D01 v03r01 5.8.4.
5. The frequency spectrum is examined from 9 kHz to the 10th harmonic of the fundamental frequency of the transmitter. No other spurious and harmonic emissions were reported greater than listed emissions above table.

3. Conducted Output Power

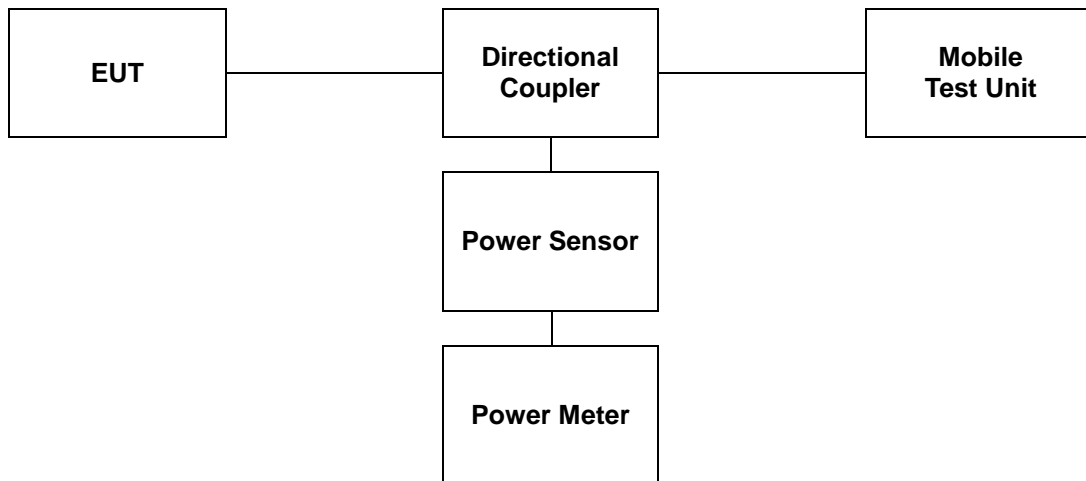
3.1. Limit

CFR 47, Section FCC §2.1046.

3.2. Test Procedure

Output power shall be measured at the RF output terminals for all configurations.

1. The RF output of the transmitter was connected to the input of the mobile test unit in order to establish communication with the EUT.
2. The EUT was set up for the max. output power with pseudo random data modulation by using mobile test unit parameters.
3. The measurement performed using a wideband RF power meter.
4. This EUT was tested under all configurations and the highest power was investigated and reported.



3.3. Test Result

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

1xRTT

CDMA BC1 1xRTT							
Radio Configuration	Service Option	Conducted Output Power					
		25 (1 851.25 MHz)		600 (1 880.00 MHz)		1175 (908.75 MHz)	
		(dB m)	(W)	(dB m)	(W)	(dB m)	(W)
RC1 (Fwd1, Rvs1)	2 (Loopback)	23.83	0.242	23.88	0.244	23.75	0.237
	55 (Loopback)	23.75	0.237	23.80	0.240	23.66	0.232
RC2 (Fwd2, Rvs2)	9 (Loopback)	23.83	0.242	23.90	0.245	23.71	0.235
	55 (Loopback)	23.79	0.239	23.85	0.243	23.77	0.238
RC3 (Fwd3, Rvs3)	2 (Loopback)	23.90	0.245	24.03	0.253	23.91	0.246
	55 (Loopback)	23.97	0.249	24.02	0.252	23.90	0.245
	32 (+F-SCH)	23.90	0.245	24.00	0.251	23.89	0.245
	32 (+SCH)	23.93	0.247	23.94	0.248	23.85	0.243
RC4 (Fwd4, Rvs3)	2 (Loopback)	23.94	0.248	23.99	0.251	23.88	0.244
	55 (Loopback)	23.92	0.247	23.96	0.249	23.87	0.244
	32 (+F-SCH)	23.69	0.234	23.81	0.240	23.63	0.231
	32 (+SCH)	23.68	0.233	23.65	0.232	23.63	0.231
RC5 (Fwd5, Rvs4)	9 (Loopback)	23.91	0.246	23.94	0.248	23.83	0.242
	55 (Loopback)	23.92	0.247	24.03	0.253	23.84	0.242

EV-DO

CDMA BC1 EV-DO							
Protocol Release	3GPP Release Version	Conducted Output Power					
		25 (1 851.25 MHz)		600 (1 880.00 MHz)		1175 (1 908.75 MHz)	
		(dB m)	(W)	(dB m)	(W)	(dB m)	(W)
Rel. 0	FTAP (307.2 kbps, QPSK)	24.14	0.259	24.17	0.261	24.02	0.252
	RTAP (153.6 kbps)	24.21	0.264	24.24	0.265	24.12	0.258
Rev. A	FETAP (307.2 kbps, QPSK)	24.12	0.258	24.14	0.259	24.01	0.252
	RETAP (4096 bits)	24.20	0.263	24.24	0.265	24.13	0.259

LTE Band 2 1.4 MHz Bandwidth								
Modulation	RB Size	RB Offset	Conducted Output Power					
			18607 (1 850.7 MHz)		18900 (1 880.0 MHz)		19193 (1 909.3 MHz)	
			(dB m)	(W)	(dB m)	(W)	(dB m)	(W)
QPSK	1	0	22.99	0.199	23.05	0.202	23.21	0.209
	1	3	23.15	0.207	23.06	0.202	23.25	0.211
	1	5	23.14	0.206	23.13	0.206	23.17	0.207
	3	0	23.23	0.210	22.99	0.199	23.08	0.203
	3	2	23.20	0.209	22.99	0.199	23.16	0.207
	3	3	23.17	0.207	23.05	0.202	23.22	0.210
	6	0	22.22	0.167	22.10	0.162	22.22	0.167
16QAM	1	0	21.94	0.156	21.99	0.158	21.99	0.158
	1	3	21.97	0.157	21.81	0.152	21.94	0.156
	1	5	22.01	0.159	21.86	0.153	21.89	0.155
	3	0	22.20	0.166	21.88	0.154	22.10	0.162
	3	2	22.32	0.171	21.88	0.154	22.31	0.170
	3	3	22.04	0.160	21.83	0.152	22.18	0.165
	6	0	21.15	0.130	20.91	0.123	21.09	0.129

LTE Band 2 3 MHz Bandwidth								
Modulation	RB Size	RB Offset	Conducted Output Power					
			18615 (1 851.5 MHz)		18900 (1 880.0 MHz)		19185 (1 908.5 MHz)	
			(dB m)	(W)	(dB m)	(W)	(dB m)	(W)
QPSK	1	0	23.17	0.207	23.07	0.203	23.02	0.200
	1	8	23.20	0.209	23.20	0.209	23.12	0.205
	1	14	23.19	0.208	23.13	0.206	22.95	0.197
	8	0	22.23	0.167	22.06	0.161	22.09	0.162
	8	4	22.24	0.167	22.01	0.159	22.04	0.160
	8	7	22.29	0.169	22.02	0.159	22.09	0.162
	15	0	22.20	0.166	22.08	0.161	22.03	0.160
16QAM	1	0	22.21	0.166	21.81	0.152	21.83	0.152
	1	8	21.91	0.155	21.75	0.150	21.63	0.146
	1	14	21.96	0.157	21.66	0.147	21.90	0.155
	8	0	20.89	0.123	21.15	0.130	21.01	0.126
	8	4	21.13	0.130	21.13	0.130	20.96	0.125
	8	7	20.96	0.125	21.13	0.130	21.12	0.129
	15	0	20.94	0.124	20.85	0.122	21.23	0.133

LTE Band 2 5 MHz Bandwidth								
Modulation	RB Size	RB Offset	Conducted Output Power					
			18625 (1 852.5 MHz)		18900 (1 880.0 MHz)		19175 (1 907.5 MHz)	
			(dB m)	(W)	(dB m)	(W)	(dB m)	(W)
QPSK	1	0	23.10	0.204	23.12	0.205	22.92	0.196
	1	12	23.28	0.213	23.06	0.202	23.22	0.210
	1	24	23.16	0.207	22.96	0.198	23.02	0.200
	12	0	22.15	0.164	22.11	0.163	22.04	0.160
	12	7	22.22	0.167	22.03	0.160	21.96	0.157
	12	13	22.11	0.163	22.07	0.161	21.99	0.158
	25	0	22.22	0.167	22.08	0.161	21.99	0.158
16QAM	1	0	21.90	0.155	21.89	0.155	21.70	0.148
	1	12	21.86	0.153	21.77	0.150	21.77	0.150
	1	24	21.93	0.156	21.72	0.149	21.72	0.149
	12	0	21.01	0.126	21.07	0.128	20.92	0.124
	12	7	21.26	0.134	21.09	0.129	20.90	0.123
	12	13	21.18	0.131	21.03	0.127	21.07	0.128
	25	0	21.21	0.132	21.24	0.133	21.07	0.128

LTE Band 2 10 MHz Bandwidth								
Modulation	RB Size	RB Offset	Conducted Output Power					
			18650 (1 855.0 MHz)		18900 (1 880.0 MHz)		19150 (1 905.0 MHz)	
			(dB m)	(W)	(dB m)	(W)	(dB m)	(W)
QPSK	1	0	23.28	0.213	23.26	0.212	23.07	0.203
	1	25	23.42	0.220	23.30	0.214	23.02	0.200
	1	49	23.05	0.202	23.14	0.206	23.15	0.207
	25	0	22.21	0.166	22.16	0.164	21.94	0.156
	25	12	22.25	0.168	22.17	0.165	21.98	0.158
	25	25	22.05	0.160	22.02	0.159	21.98	0.158
	50	0	22.09	0.162	22.14	0.164	21.94	0.156
16QAM	1	0	21.99	0.158	21.95	0.157	21.75	0.150
	1	25	22.12	0.163	22.09	0.162	21.94	0.156
	1	49	21.81	0.152	21.78	0.151	21.78	0.151
	25	0	21.17	0.131	21.21	0.132	21.01	0.126
	25	12	21.30	0.135	21.12	0.129	21.04	0.127
	25	25	21.11	0.129	21.08	0.128	21.06	0.128
	50	0	21.16	0.131	21.21	0.132	21.02	0.126

LTE Band 2 15 MHz Bandwidth								
Modulation	RB Size	RB Offset	Conducted Output Power					
			18675 (1 857.5 MHz)		18900 (1 880.0 MHz)		19125 (1 902.5 MHz)	
			(dB m)	(W)	(dB m)	(W)	(dB m)	(W)
QPSK	1	0	23.24	0.211	23.03	0.201	22.91	0.195
	1	25	23.20	0.209	23.14	0.206	22.95	0.197
	1	49	23.12	0.205	23.10	0.204	23.09	0.204
	25	0	22.26	0.168	22.23	0.167	22.01	0.159
	25	12	22.20	0.166	22.08	0.161	21.95	0.157
	25	25	22.06	0.161	22.09	0.162	21.95	0.157
	50	0	22.12	0.163	22.04	0.160	21.93	0.156
16QAM	1	0	22.14	0.164	21.71	0.148	21.80	0.151
	1	25	21.97	0.157	21.89	0.155	21.78	0.151
	1	49	21.80	0.151	21.87	0.154	21.91	0.155
	25	0	21.10	0.129	21.17	0.131	21.06	0.128
	25	12	21.14	0.130	21.13	0.130	20.90	0.123
	25	25	20.97	0.125	21.05	0.127	20.88	0.122
	50	0	21.13	0.130	21.19	0.132	20.98	0.125

LTE Band 2 20 MHz Bandwidth								
Modulation	RB Size	RB Offset	Conducted Output Power					
			18700 (1 860.0 MHz)		18900 (1 880.0 MHz)		19100 (1 900.0 MHz)	
			(dB m)	(W)	(dB m)	(W)	(dB m)	(W)
QPSK	1	0	23.12	0.205	22.94	0.197	23.13	0.206
	1	25	23.10	0.204	23.14	0.206	23.18	0.208
	1	49	22.95	0.197	23.10	0.204	23.14	0.206
	25	0	22.09	0.162	22.17	0.165	22.03	0.160
	25	12	22.21	0.166	22.15	0.164	21.89	0.155
	25	25	22.05	0.160	22.05	0.160	21.91	0.155
	50	0	22.15	0.164	22.13	0.163	21.95	0.157
16QAM	1	0	22.03	0.160	21.73	0.149	21.83	0.152
	1	25	22.09	0.162	22.11	0.163	22.01	0.159
	1	49	21.75	0.150	21.74	0.149	21.83	0.152
	25	0	21.04	0.127	21.21	0.132	20.99	0.126
	25	12	21.28	0.134	21.10	0.129	20.95	0.124
	25	25	20.93	0.124	20.92	0.124	20.77	0.119
	50	0	21.20	0.132	21.07	0.128	20.97	0.125

4. Occupied Bandwidth

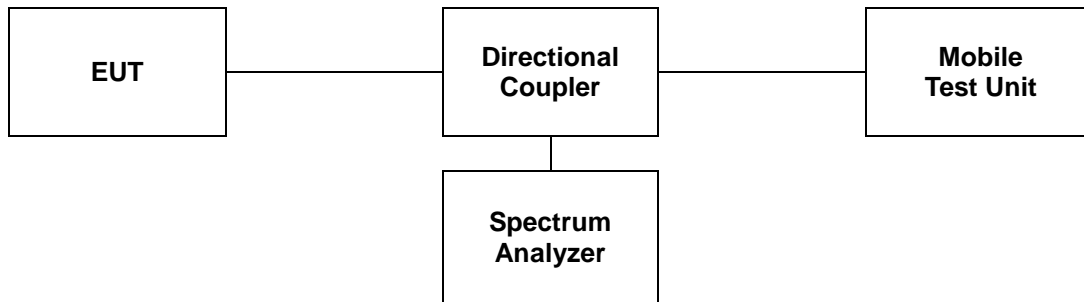
4.1. Limit

CFR 47, Section FCC §2.1049.

4.2. Test Procedure

The test follows section 5.4.4 of ANSI C63.26-2015.

- a. The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of $1.5 \times \text{OBW}$ is sufficient).
- b. The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be set $\geq 3 \times \text{RBW}$.
- c. Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
- d. Set the detection mode to peak, and the trace mode to max-hold.
- e. If the instrument does not have a 99 % OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5 % of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5 % of the total is reached and record that frequency as the upper OBW frequency. The 99 % power OBW can be determined by computing the difference these two frequencies.
- f. The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).



4.3 Test Results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

CDMA

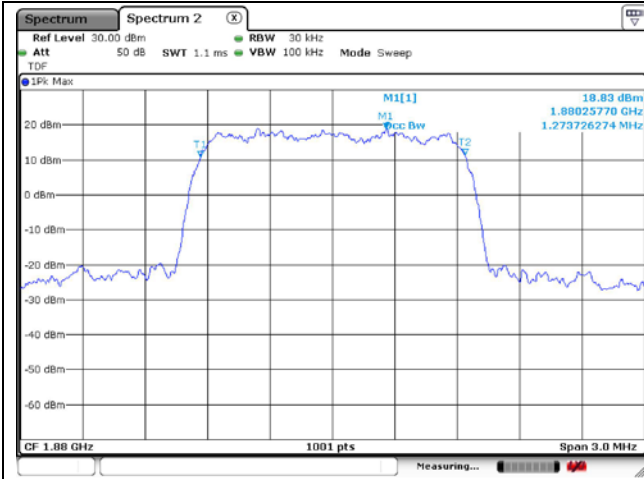
Band	Mode	Frequency (MHz)	Occupied Bandwidth (MHz)
BC1	1xRTT	1 880.00	1.274
	EV-DO	1 880.00	1.277

LTE

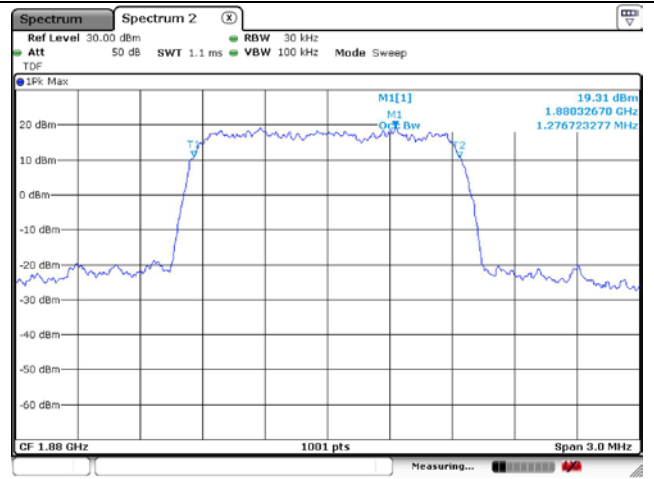
Band	Bandwidth (MHz)	Frequency (MHz)	Occupied Bandwidth (MHz)	
			QPSK	16QAM
2	1.4	1 880.0	1.100	1.103
	3		2.691	2.691
	5		4.515	4.496
	10		8.931	8.911
	15		13.487	13.487
	20		17.902	17.902

- Test plots

CDMA

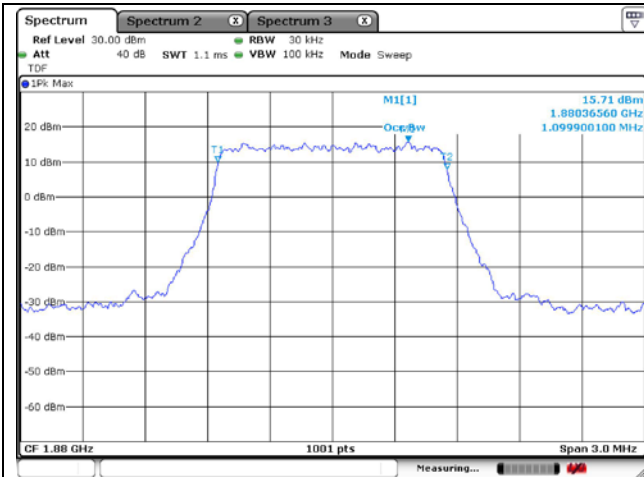


CDMA BC1 1XRTT Middle Channel

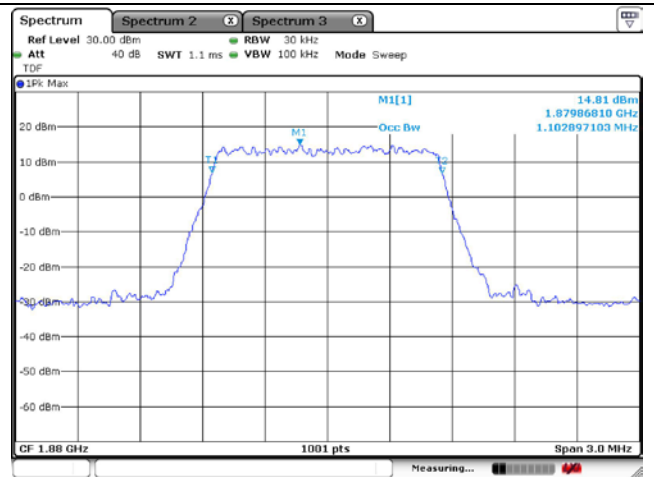


CDMA BC1 EV-DO Middle Channel

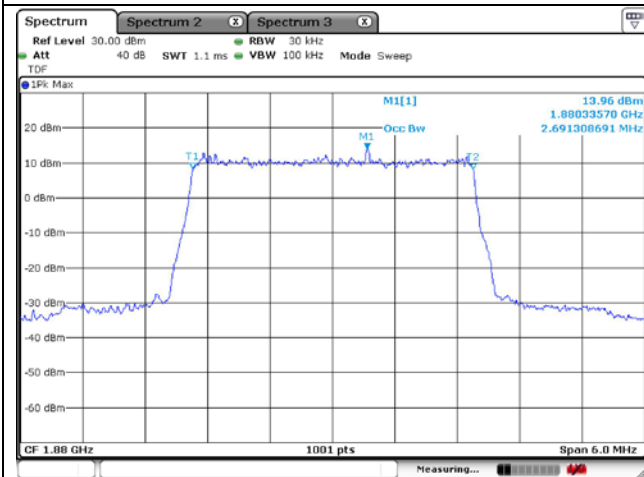
LTE Band 2



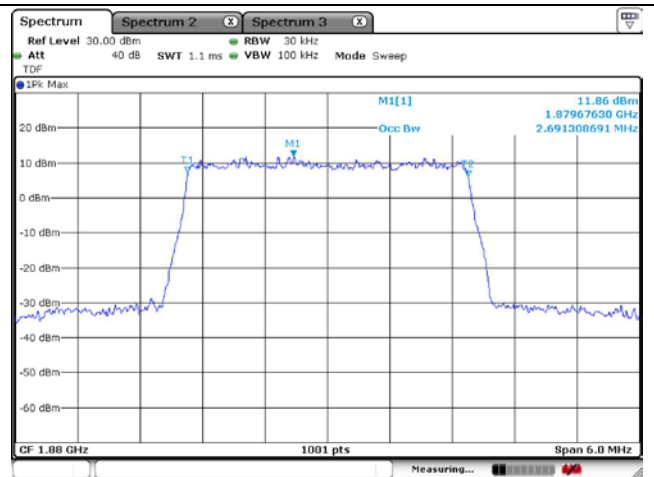
1.4 MHz QPSK Middle Channel - Full RB



1.4 MHz 16QAM Middle Channel - Full RB

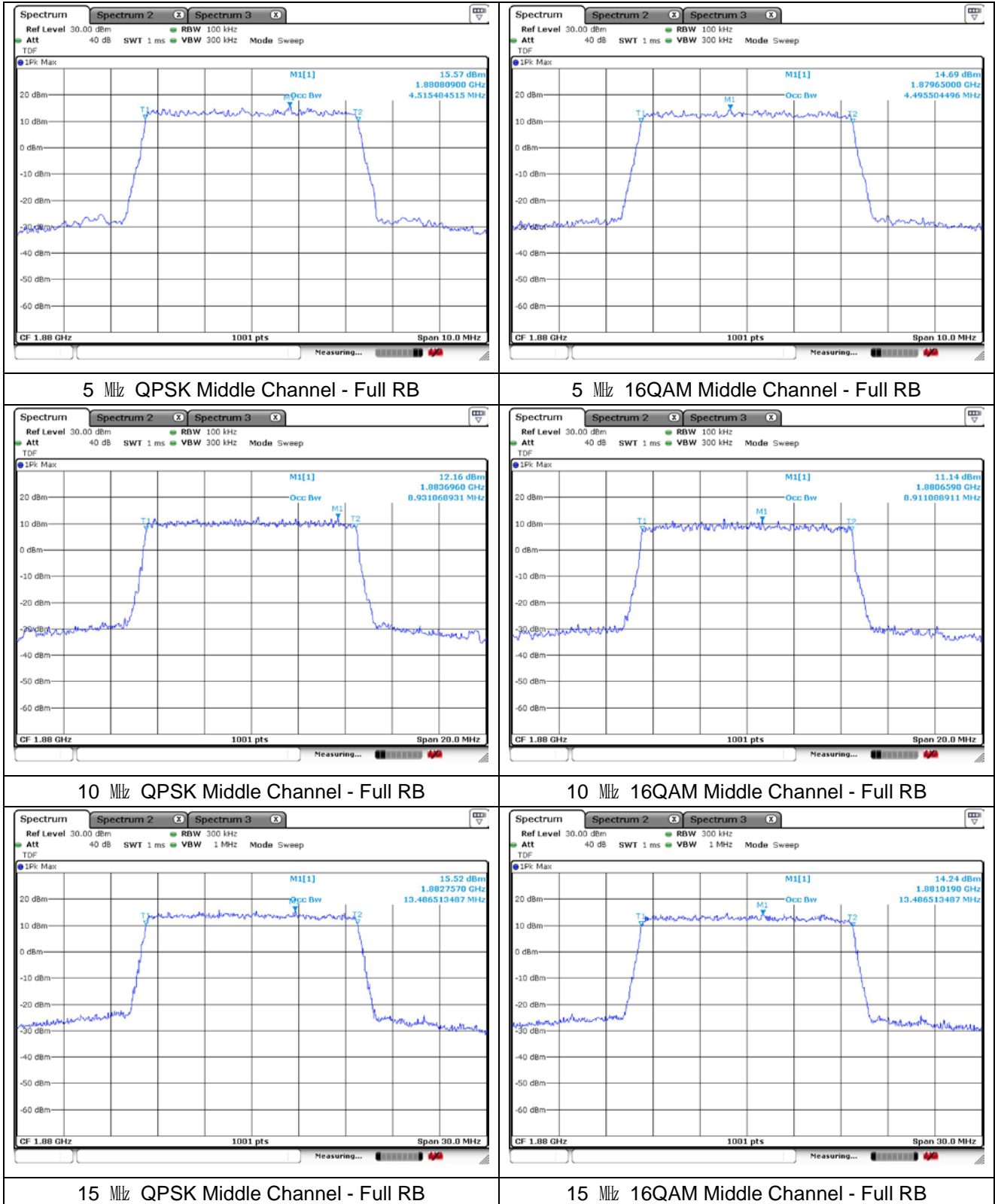


3 MHz QPSK Middle Channel - Full RB

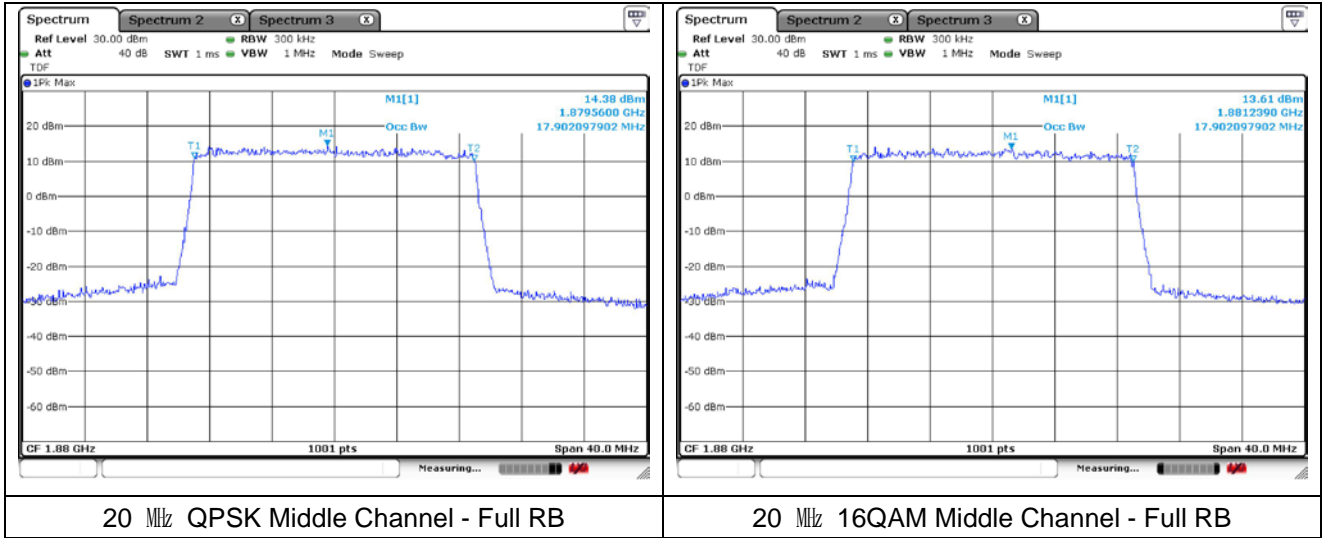


3 MHz 16QAM Middle Channel - Full RB

LTE Band 2



LTE Band 2



5. Peak-Average Ratio

5.1. Limit

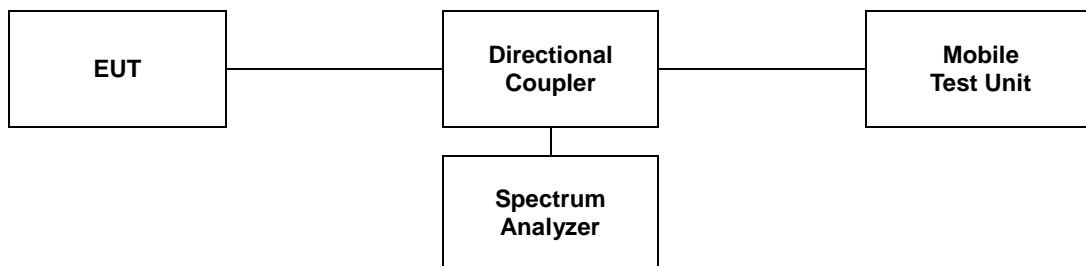
- §24.232(d), power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. 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.

5.2. Test Procedure

The test follows section 5.2.3.4 of ANSI C63.26-2015.

See instrumentation-specific application literature for further guidance regarding use of the CCDF capability. The following guidelines are offered for performing a CCDF measurement.

- a. Set resolution/measurement bandwidth \geq OBW or specified reference bandwidth.
- b. Set the number of counts to a value that stabilizes the measured CCDF curve.
- c. Set the measurement interval as follows:
 - 1) For continuous transmissions, set to greater of $[10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$ or 1 ms.
 - 2) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize. Set the measurement interval to a time that is less than or equal to the burst duration.
 - 3) If there are several carriers in a single antenna port, the peak power shall be determined for each individual carrier (by disabling the other carriers while measuring the required carrier) and the total peak power calculated from the sum of the individual carrier peak powers.
- d. Record the maximum PAPR level associated with a probability of 0.1 %.
- e. The peak power level is calculated from the sum of the PAPR value from step d) to the measured average power.



5.3. Test Results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

CDMA

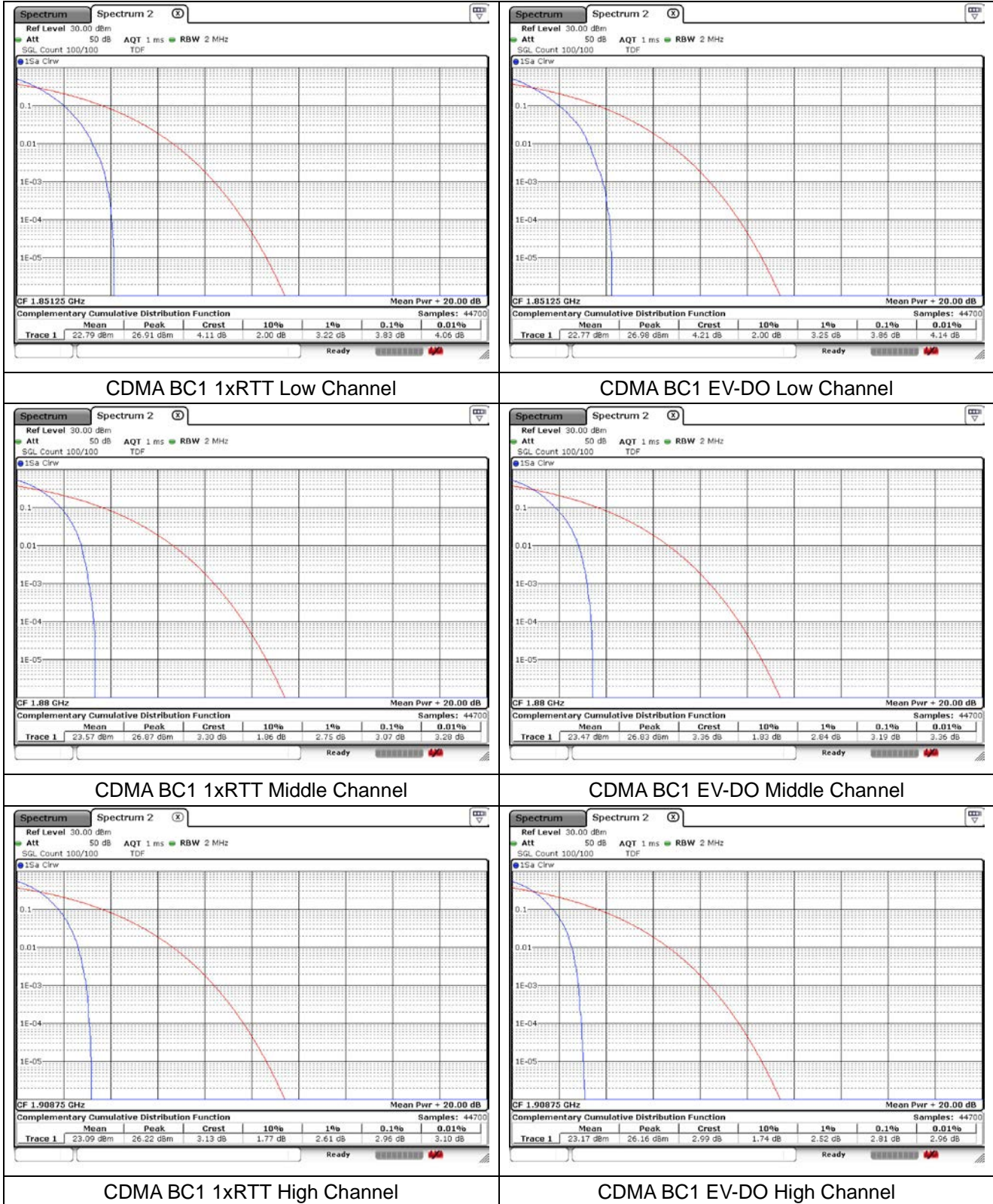
Band	Mode	Frequency (MHz)	PAR (dB)
BC1	1xRTT	1 851.25	3.83
		1 880.00	3.07
		1 908.75	2.96
	EV-DO	1 851.25	3.86
		1 880.00	3.19
		1 908.75	2.81

LTE

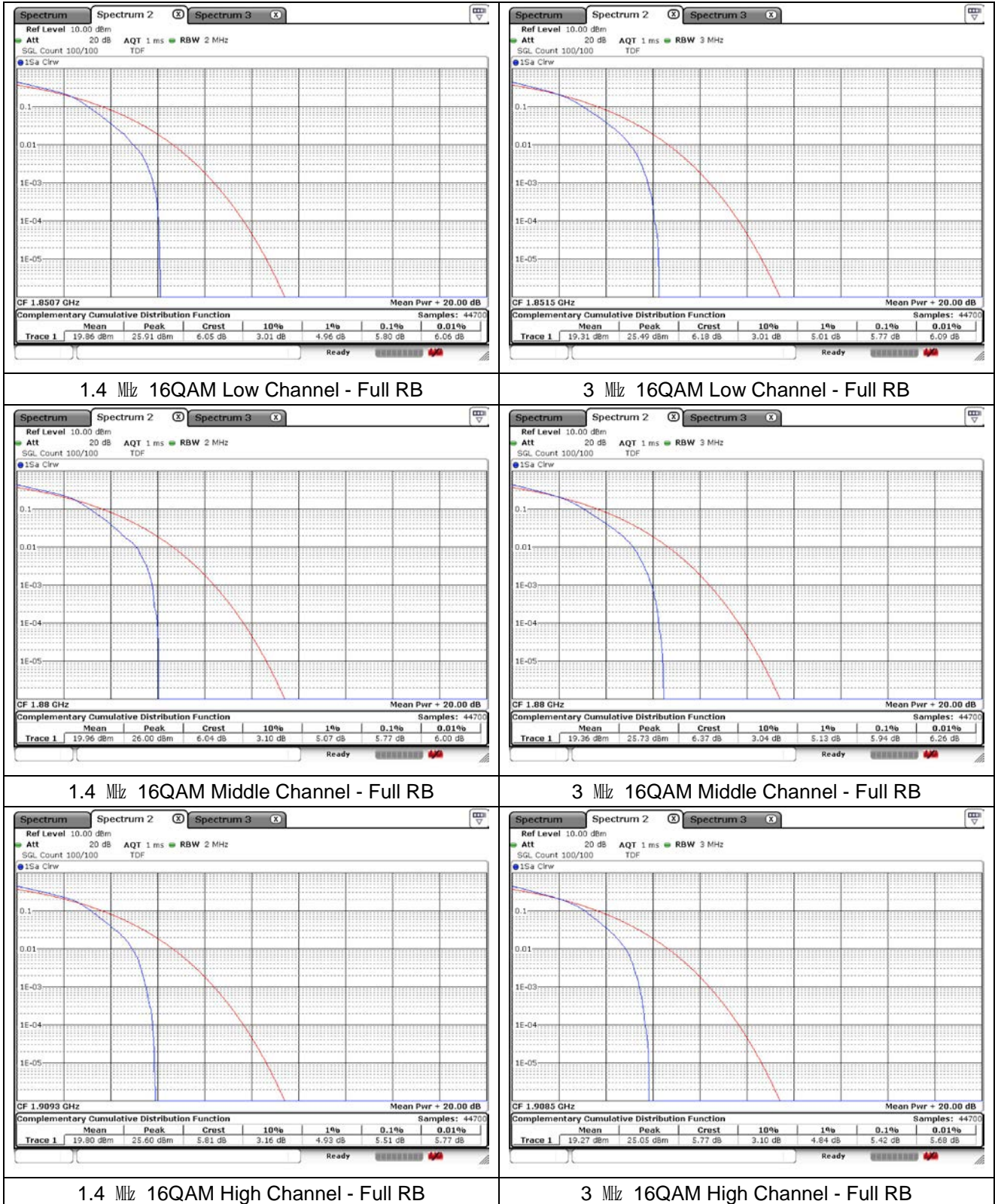
Band	Bandwidth (MHz)	Mode	Frequency (MHz)	PAR (dB)
2	1.4	16QAM	1 850.7	5.80
			1 880.0	5.77
			1 909.3	5.51
	3	16QAM	1 851.5	5.77
			1 880.0	5.94
			1 908.5	5.42
	5	16QAM	1 852.5	5.80
			1 880.0	5.77
			1 907.5	5.45
	10	16QAM	1 855.0	5.83
			1 880.0	5.80
			1 905.0	5.57
	15	16QAM	1 857.5	5.83
			1 880.0	5.88
			1 902.5	5.62
	20	16QAM	1 860.0	5.83
			1 880.0	5.80
			1 900.0	5.65

- Test plots

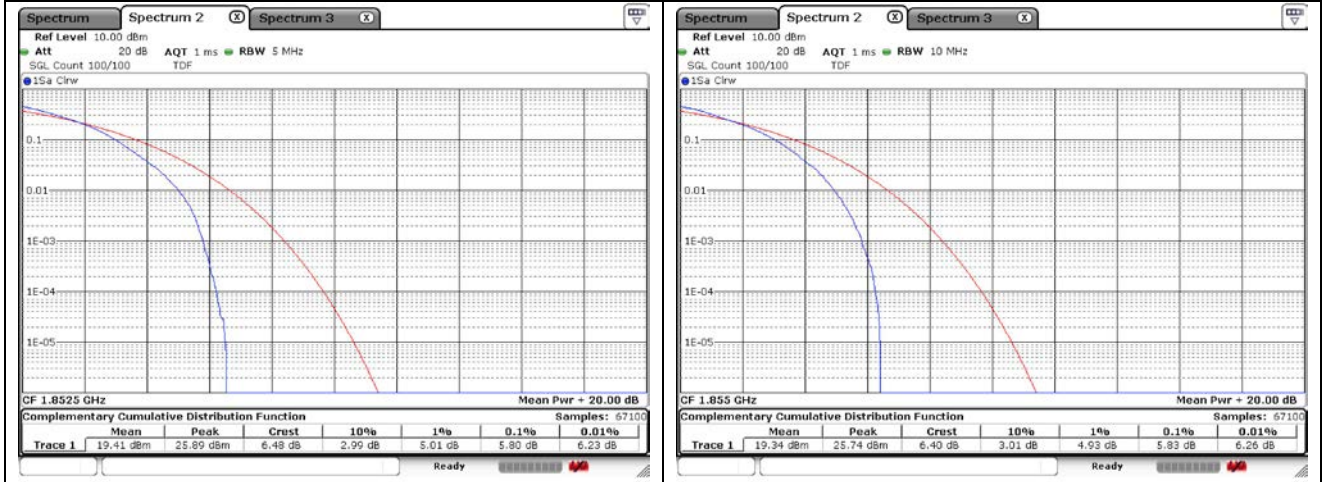
CDMA



LTE Band 2

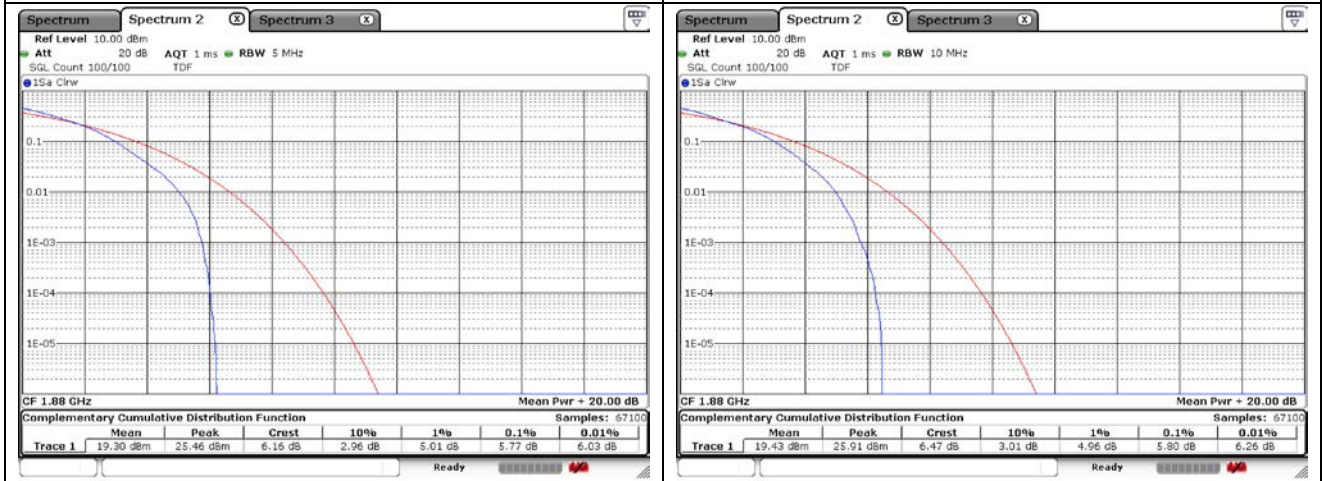


LTE Band 2



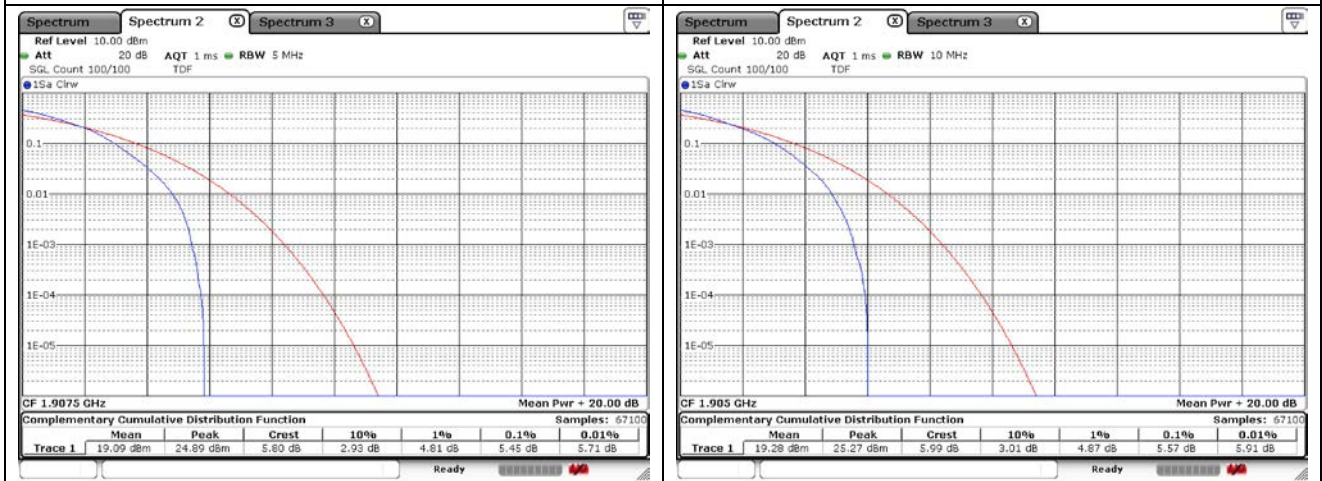
5 MHz 16QAM Low Channel - Full RB

10 MHz 16QAM Low Channel - Full RB



5 MHz 16QAM Middle Channel - Full RB

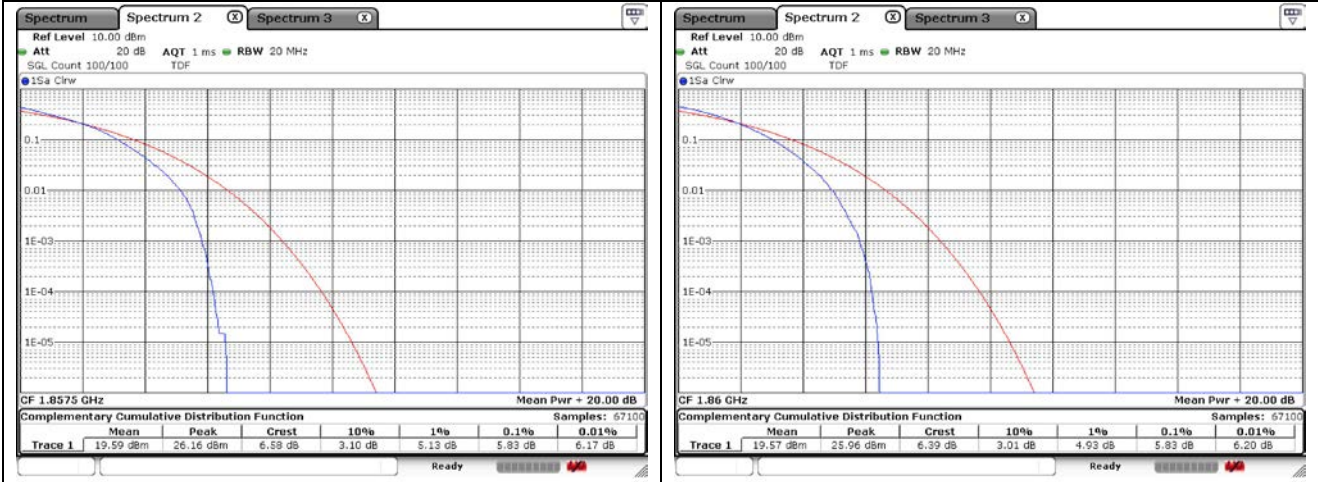
10 MHz 16QAM Middle Channel - Full RB



5 MHz 16QAM High Channel - Full RB

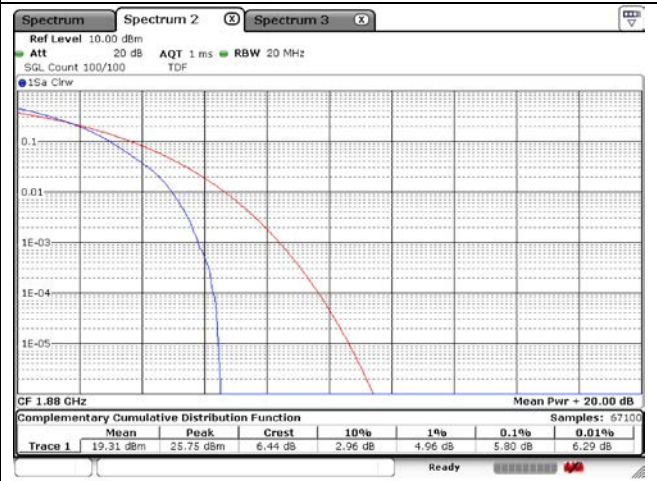
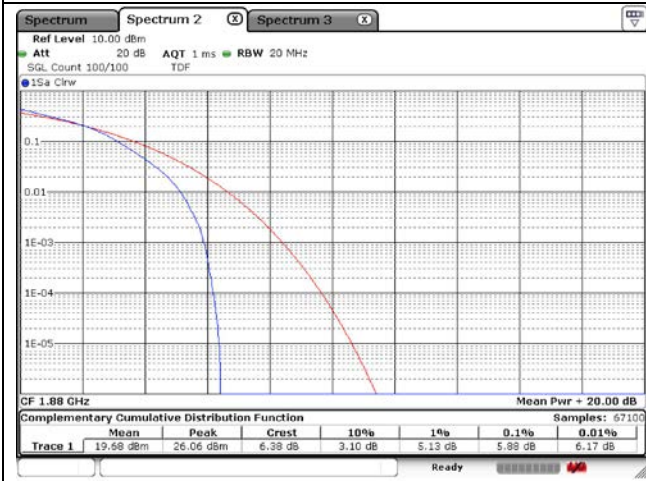
10 MHz 16QAM High Channel - Full RB

LTE Band 2



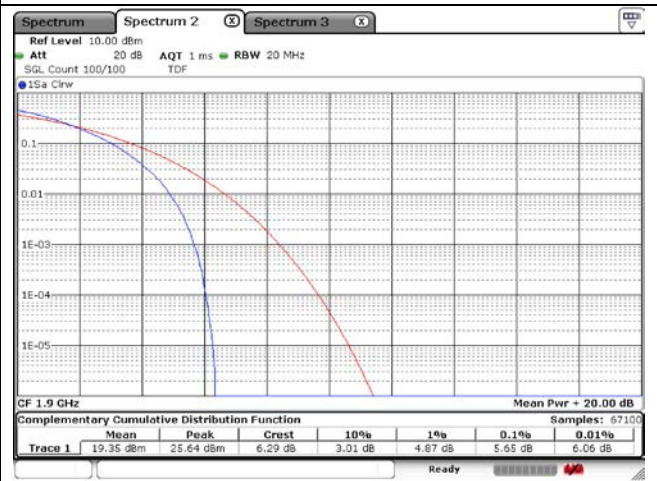
15 MHz 16QAM Low Channel - Full RB

20 MHz 16QAM Low Channel - Full RB



15 MHz 16QAM Middle Channel - Full RB

20 MHz 16QAM Middle Channel - Full RB



15 MHz 16QAM High Channel - Full RB

20 MHz 16QAM High Channel - Full RB

6. Spurious Emissions at Antenna Terminal

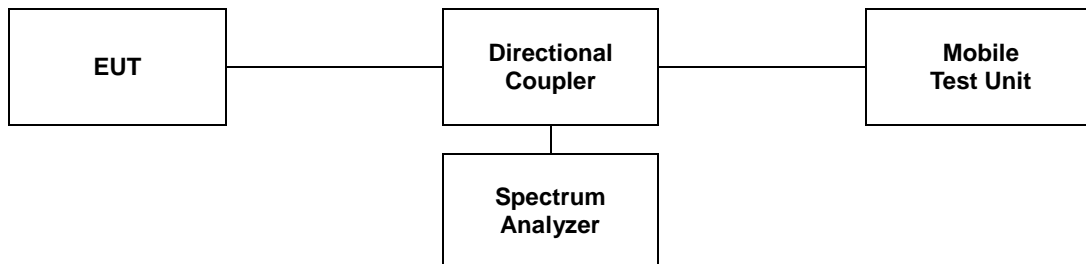
6.1. Limit

- §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.

6.2. Test Procedure

The test follows section 5.7 of ANSI C63.26-2015.

1. Start frequency was set to 9 kHz and stop frequency was set to at least 10* the fundamental frequency.
2. Detector = Peak.
3. Trace mode = Max hold.
4. Sweep time = Auto couple.
5. The trace was allowed to stabilize.
6. Please see notes below for RBW and VBW settings.
7. For plots showing conducted spurious emissions from 9 kHz to 20 GHz, all path loss of wide frequency range was investigated and compensated to spectrum analyzer as TDF function.



Note;

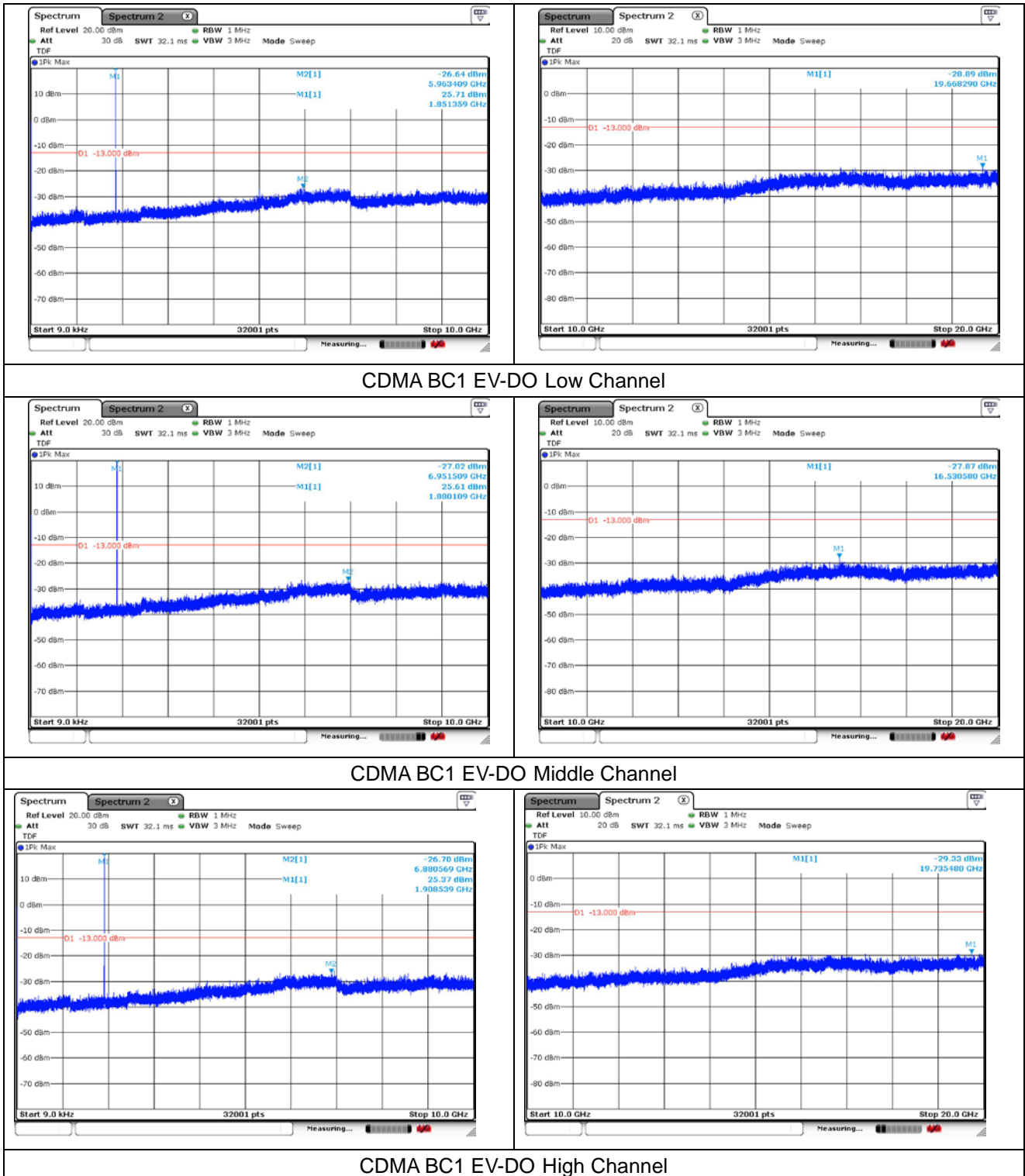
Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater for frequencies less than 1 GHz and frequencies greater than 1 GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two point, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

6.3. Test Results

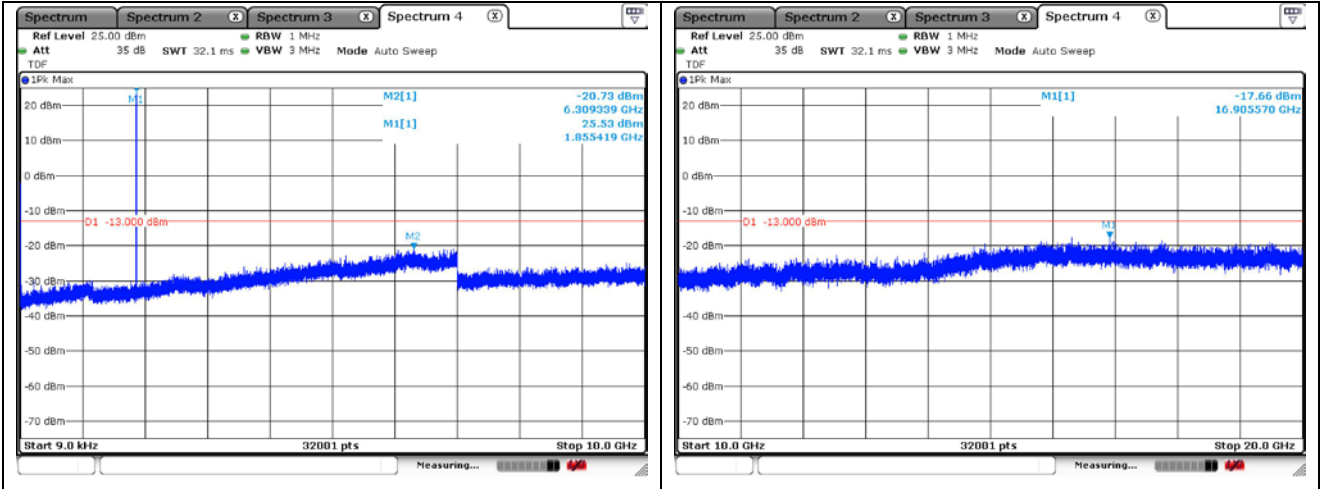
Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

- Test plots

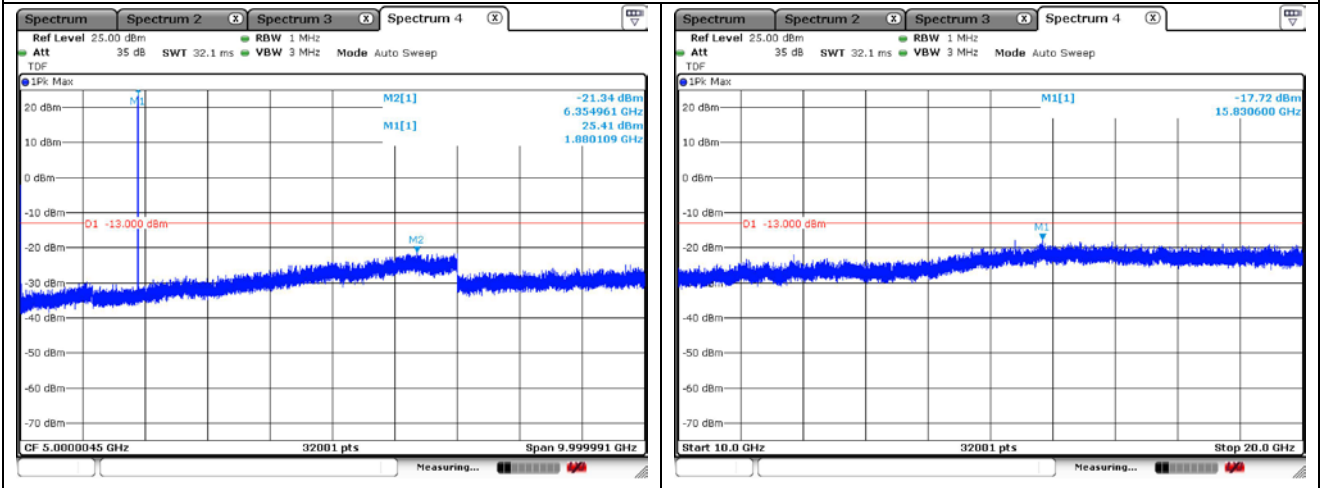
CDMA BC1



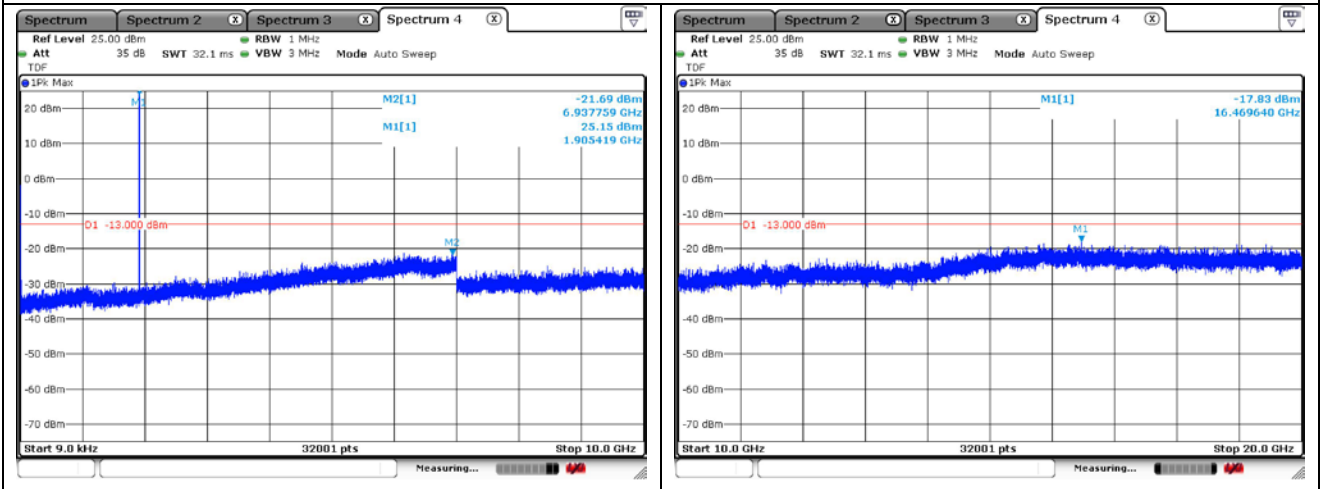
LTE band 2 (10 MHz)



QPSK Low Channel - 1 RB



QPSK Middle Channel - 1 RB



QPSK High Channel - 1 RB

7. Band Edge

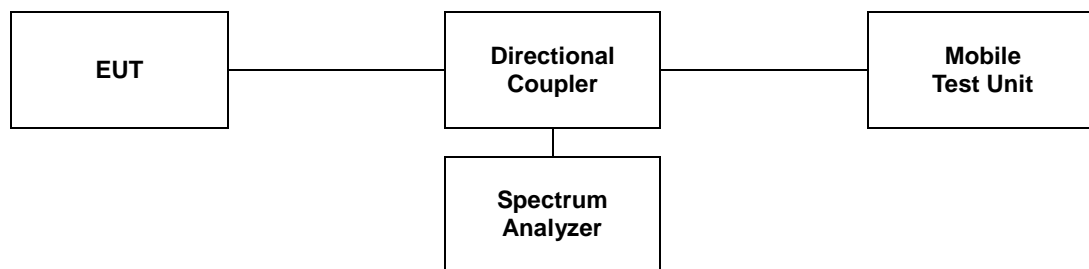
7.1. Limit

- §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.

7.2. Test Procedure

The test follows section 5.7 of ANSI C63.26-2015.

- a. Span was set large enough so as to capture all out of band emissions near the band edge.
- b. RBW ≥ 1 % of OBW
- c. VBW $\geq 3 \times$ RBW.
- d. Detector = RMS.
- e. Trace mode = Average.
- f. Sweep time = Auto.
- g. The trace was allowed to stabilize.
- h. All path loss of frequency range was investigated and compensated to spectrum analyzer as TDF function.

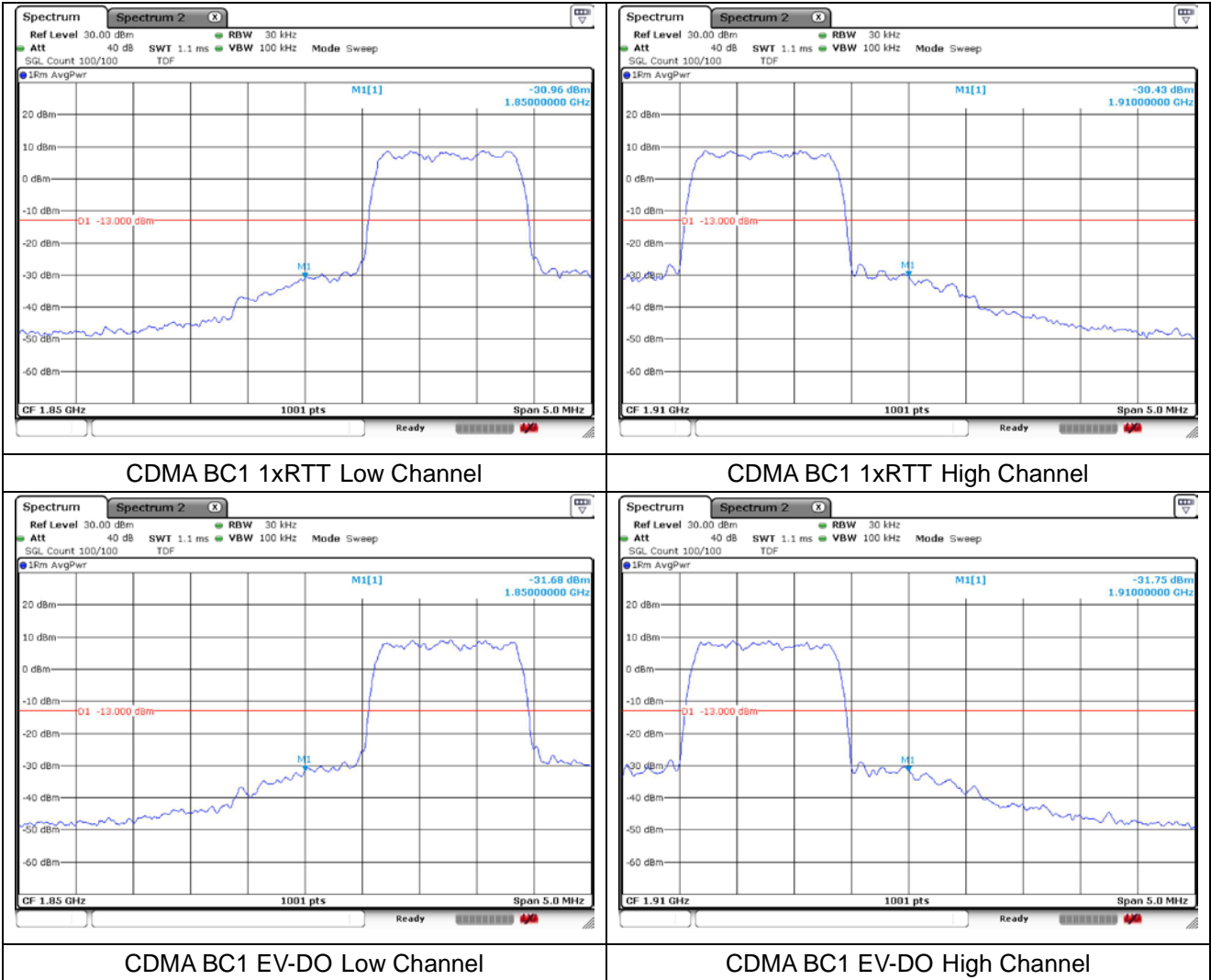


7.3. Test Results

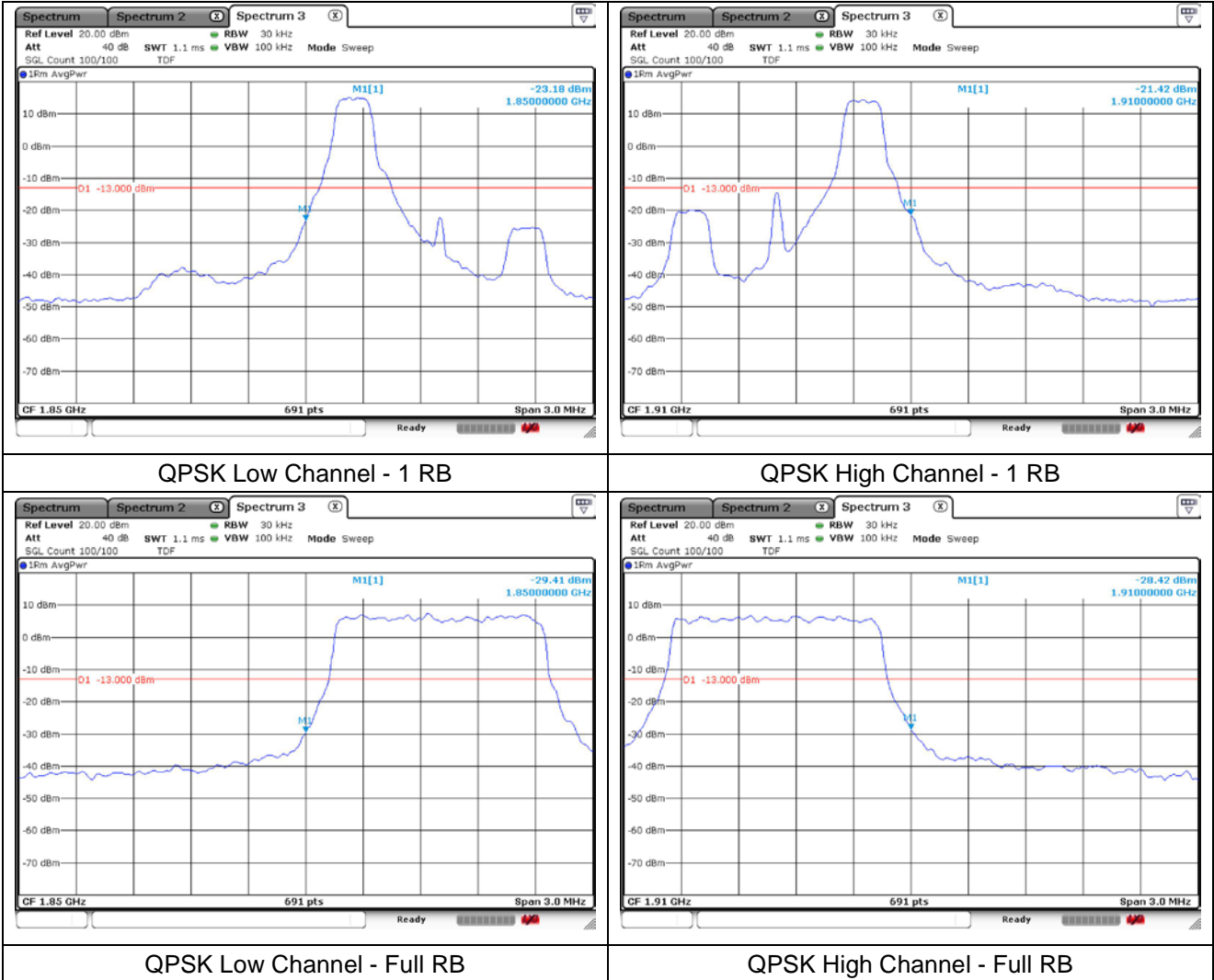
Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

- Test plots

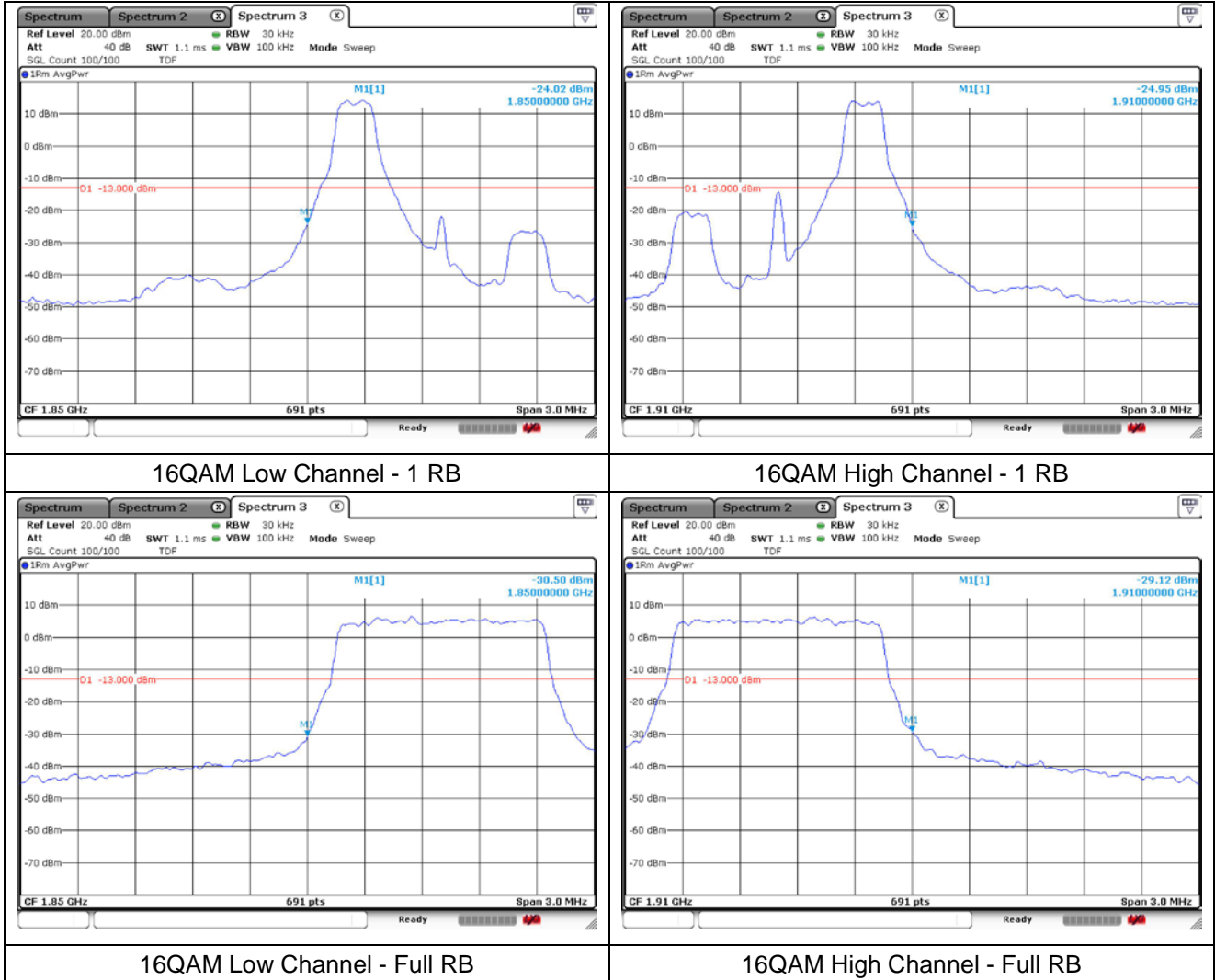
CDMA BC1



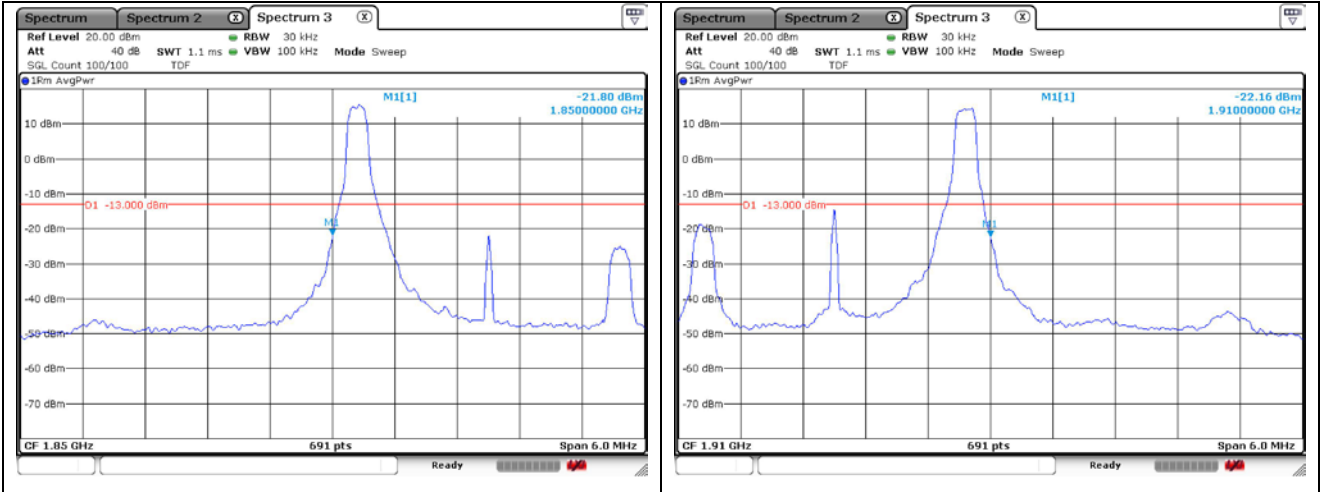
LTE band 2 (1.4 MHz)



LTE band 2 (1.4 MHz)

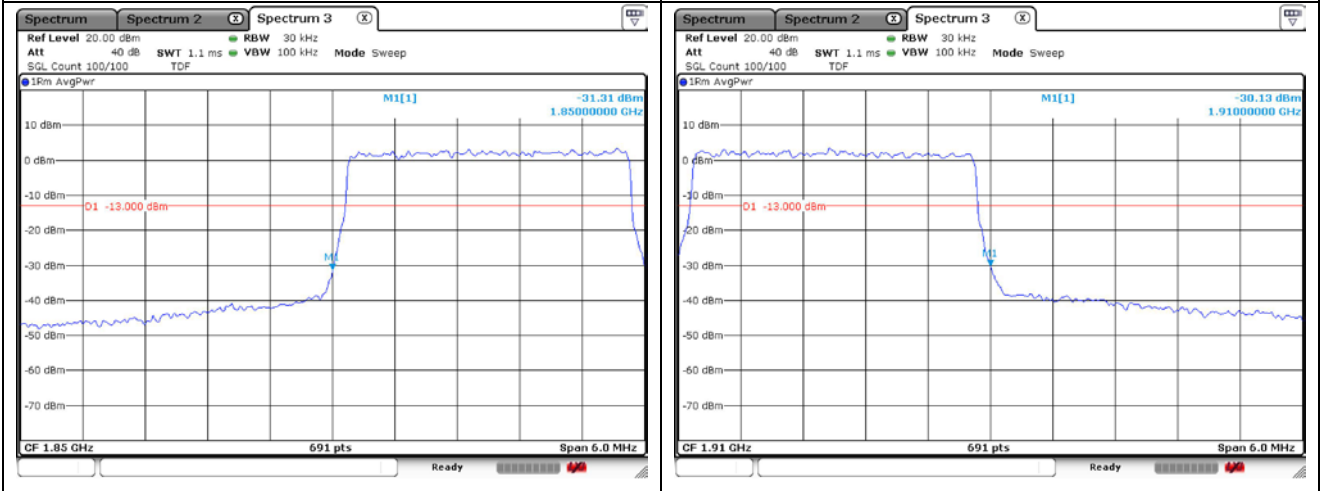


LTE band 2 (3 MHz)



QPSK Low Channel - 1 RB

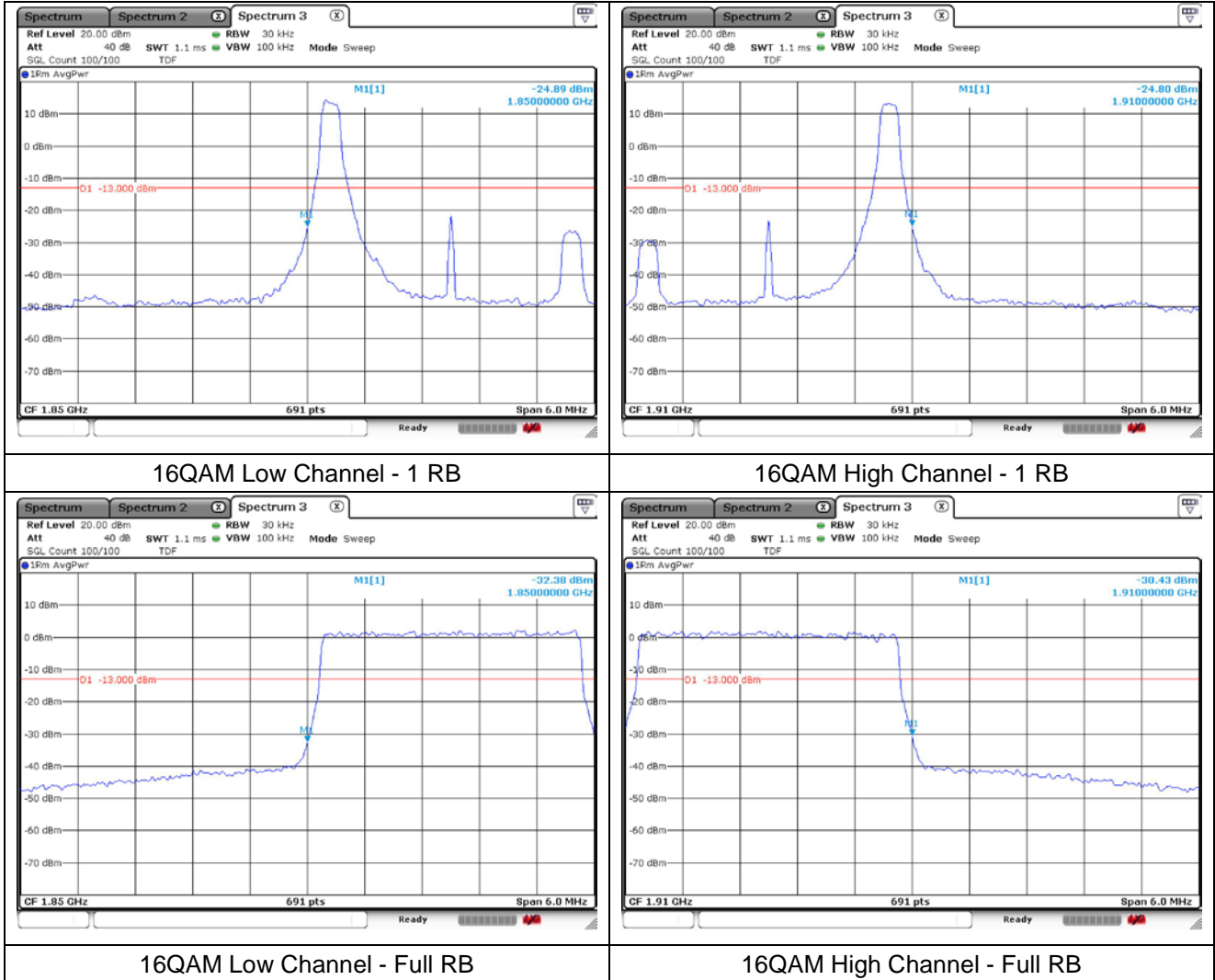
QPSK High Channel - 1 RB



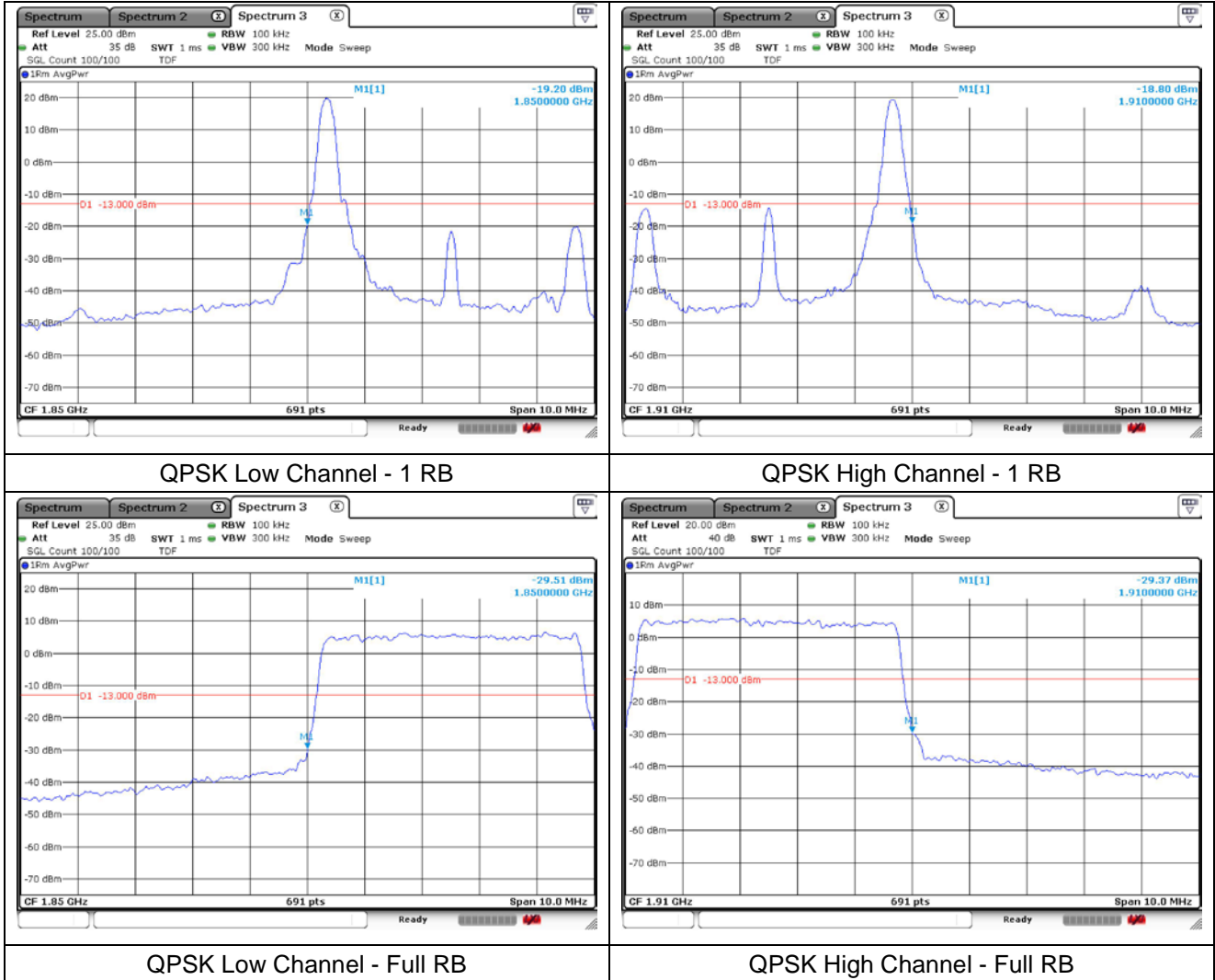
QPSK Low Channel - Full RB

QPSK High Channel - Full RB

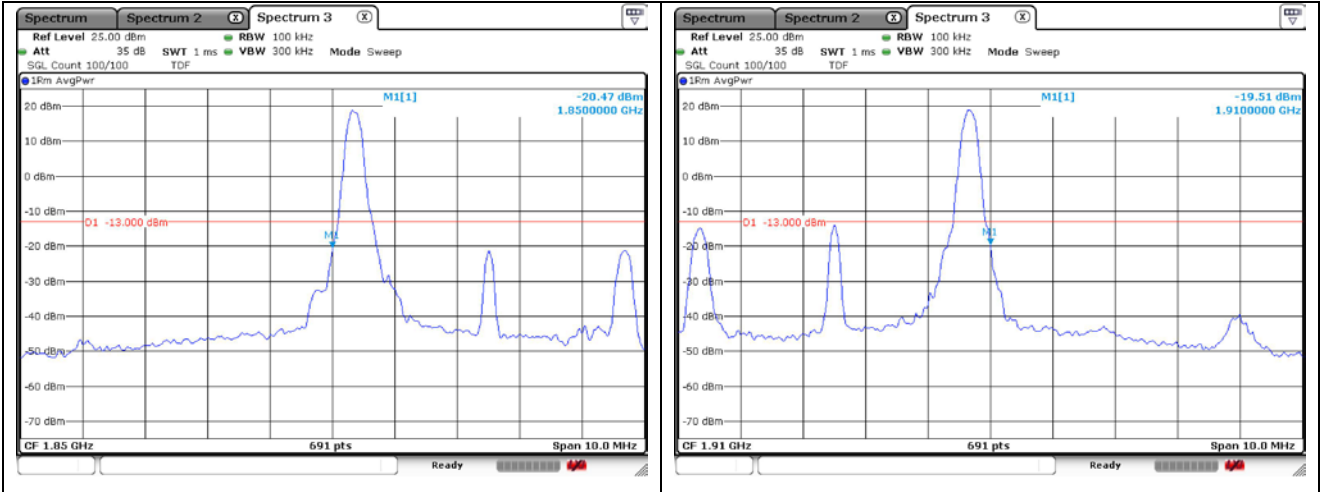
LTE band 2 (3 MHz)



LTE band 2 (5 MHz)

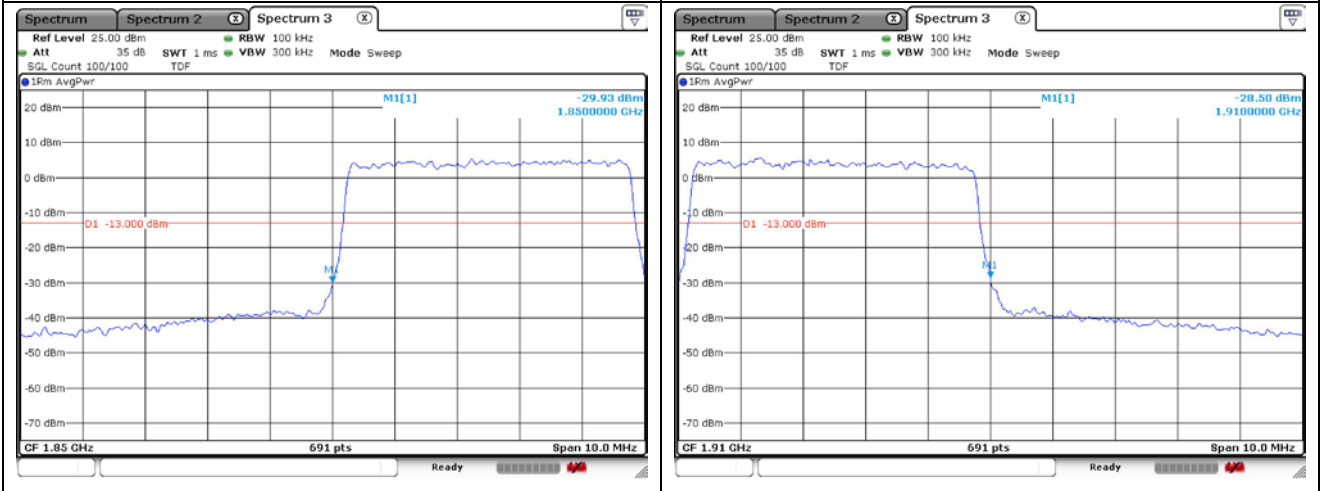


LTE band 2 (5 MHz)



16QAM Low Channel - 1 RB

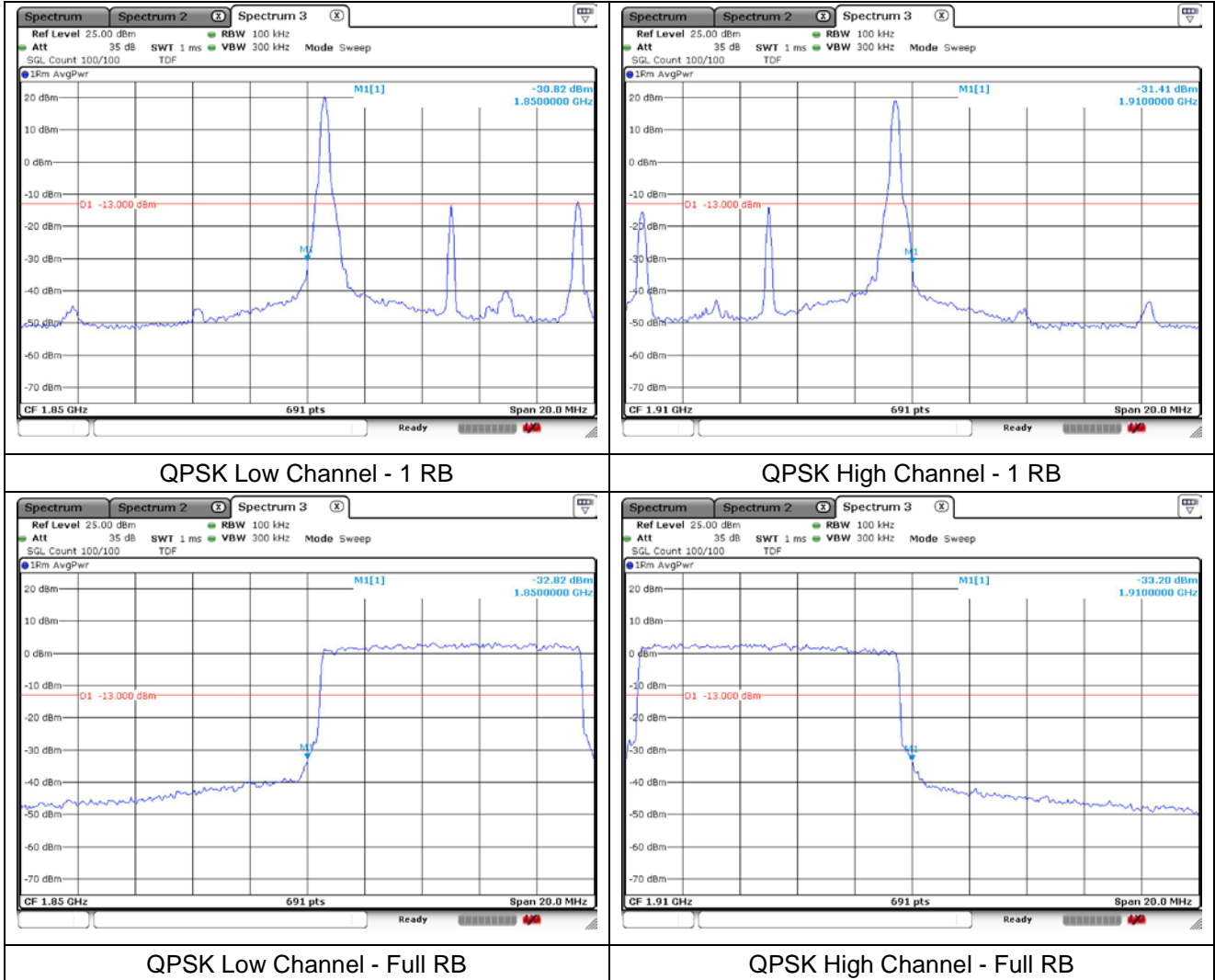
16QAM High Channel - 1 RB



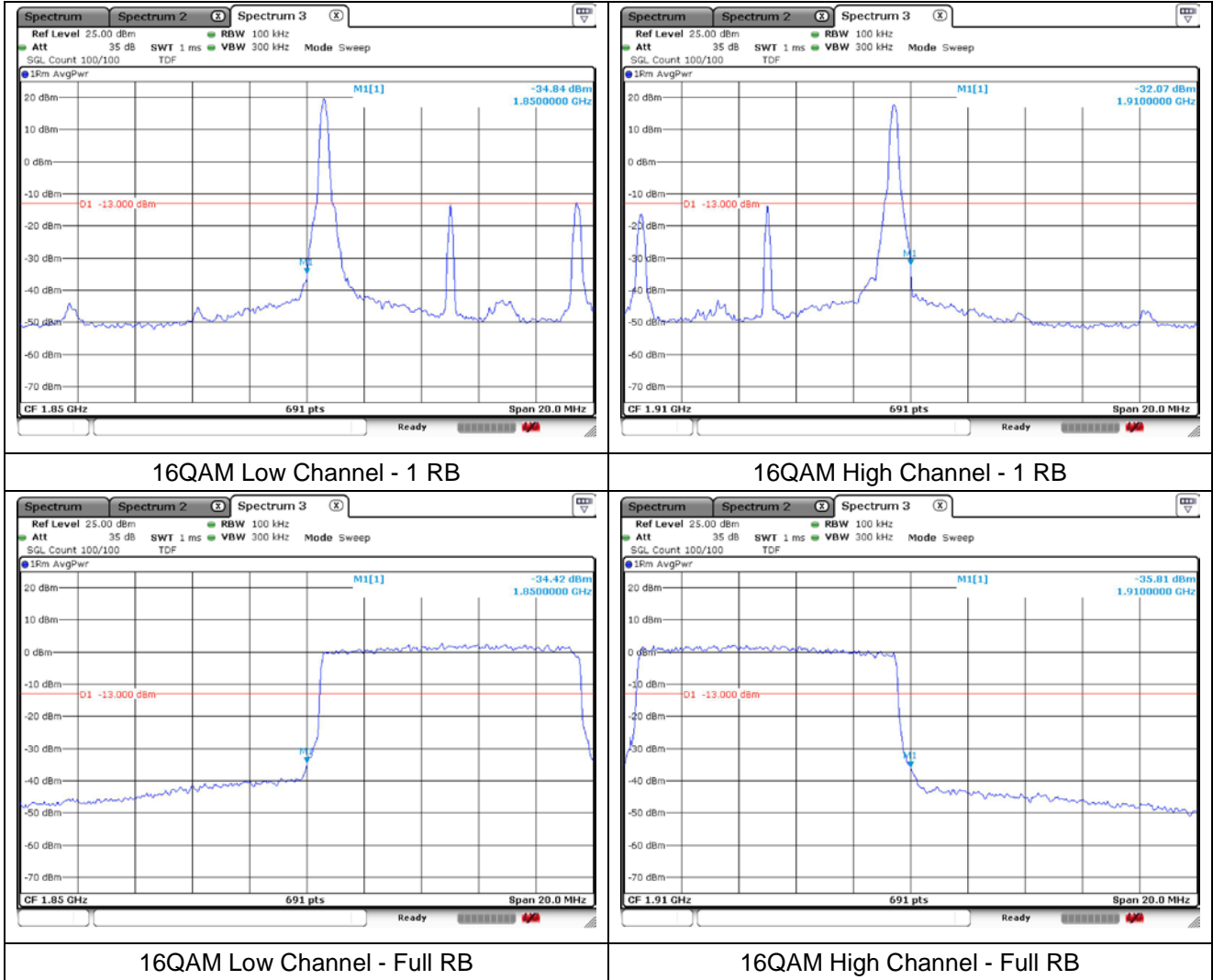
16QAM Low Channel - Full RB

16QAM High Channel - Full RB

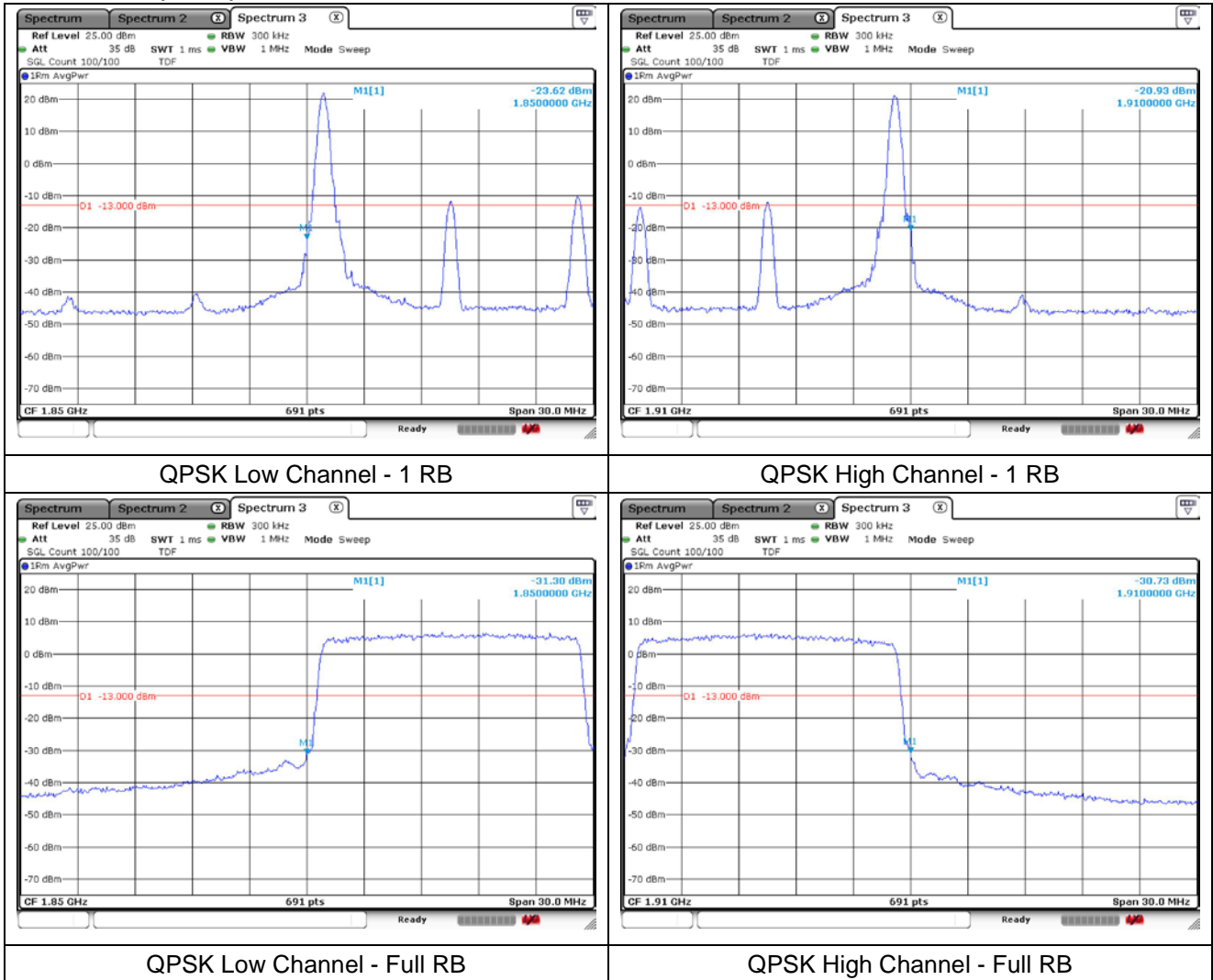
LTE band 2 (10 MHz)



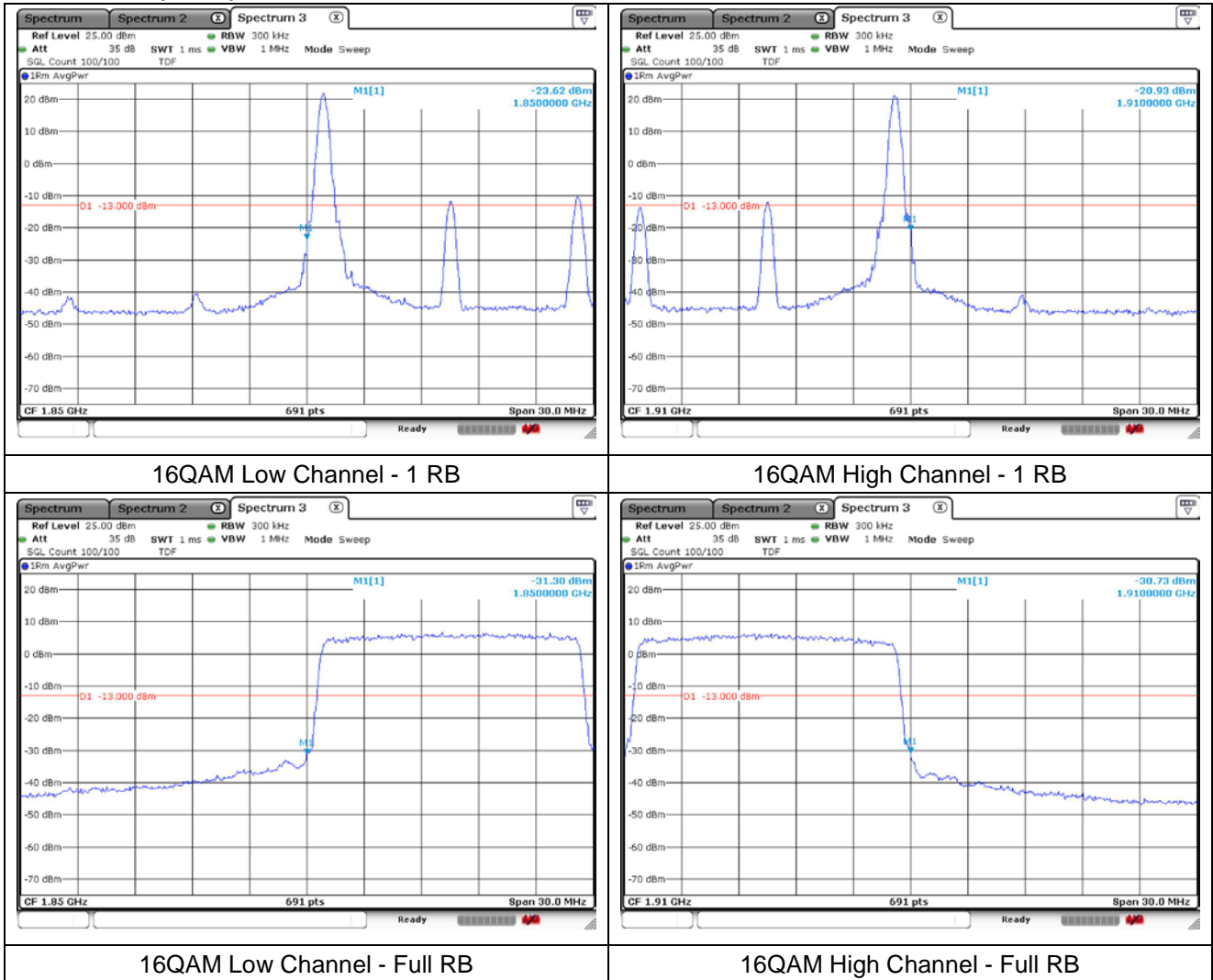
LTE band 2 (10 MHz)



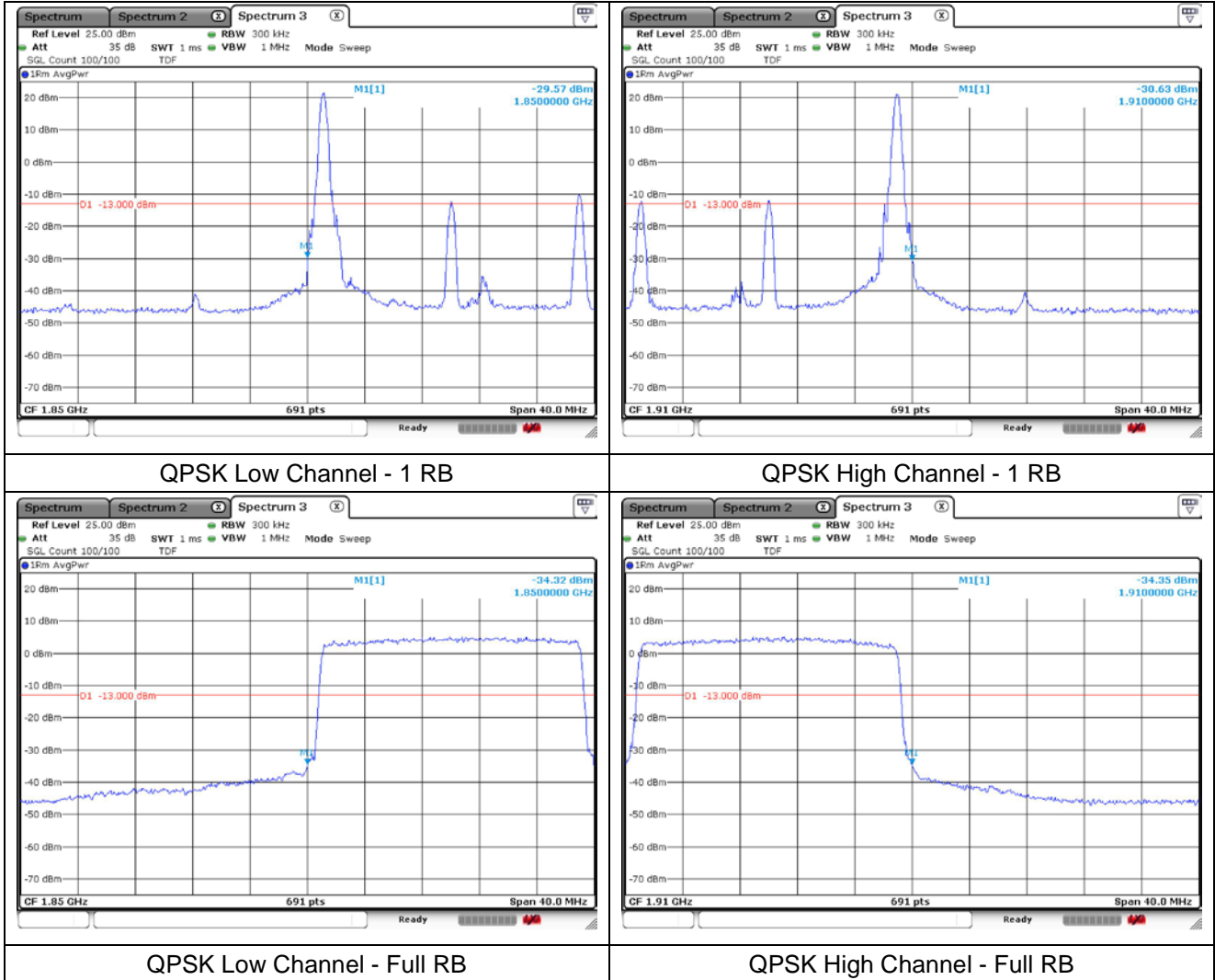
LTE band 2 (15 MHz)



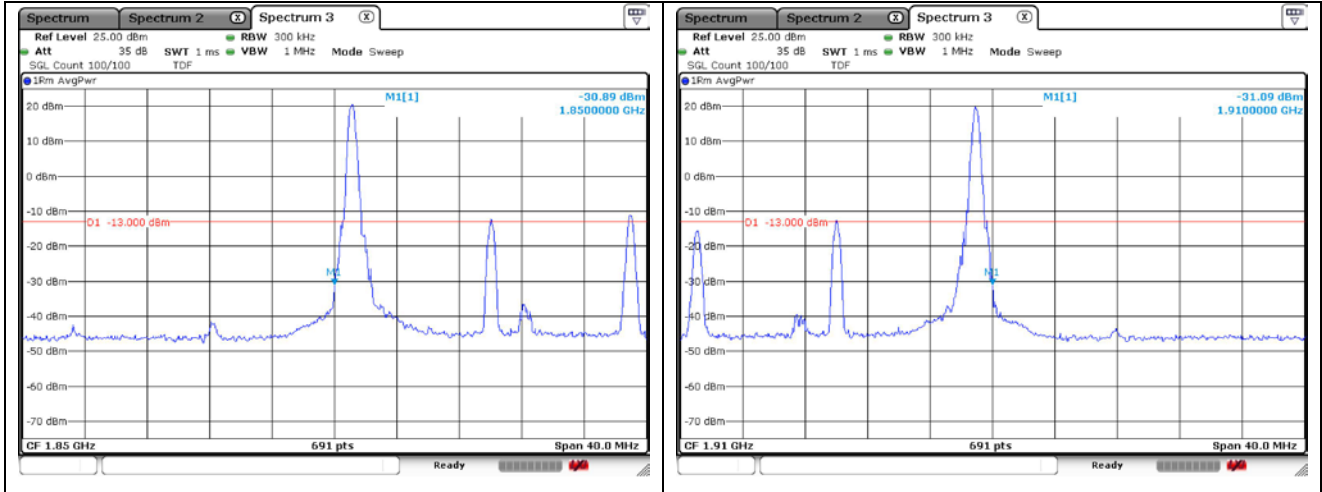
LTE band 2 (15 MHz)



LTE band 2 (20 MHz)

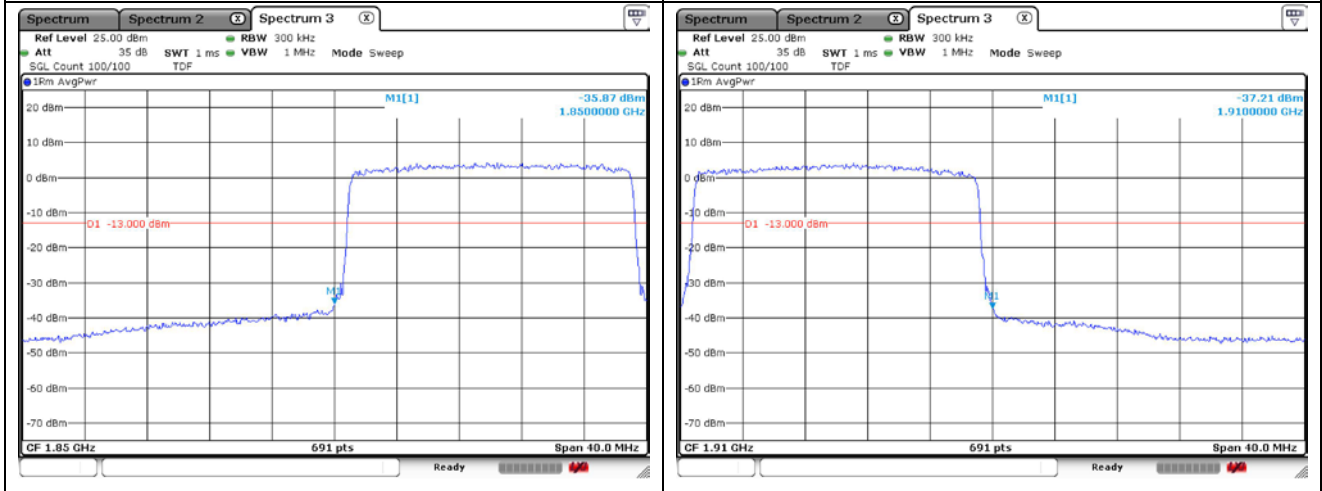


LTE band 2 (20 MHz)



16QAM Low Channel - 1 RB

16QAM High Channel - 1 RB



16QAM Low Channel - Full RB

16QAM High Channel - Full RB

8. Frequency Stability

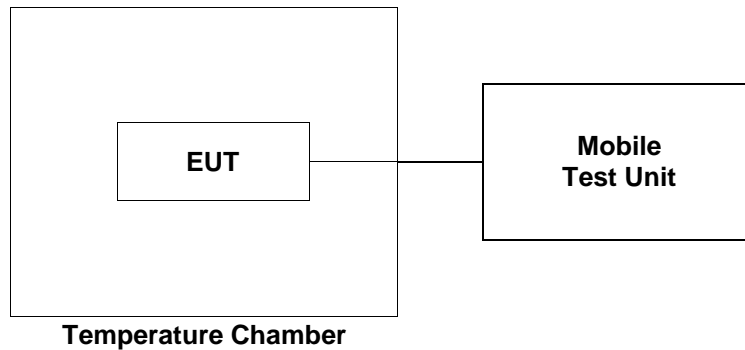
8.1. Limit

- § 2.1055 (a), § 2.1055 (d) & following:

- §24.235, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

8.2. Test Procedure

1. Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to a Mobile Test Unit via feed-through attenuators.
2. The EUT was placed inside the temperature chamber.
3. After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from Mobile Test Unit.



8.3. Test Results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

CDMA BC1 at middle channel

Reference Frequency: 1 880.0 MHz			
Frequency Stability versus Temperature			
Environment Temperature (°C)	Power Supplied (V)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
50	4.0	-3.41	0.000 521
40		-4.33	0.000 032
30		-2.49	0.001 011
20(Ref.)		-4.39	-
10		-2.14	0.001 197
0		-4.88	-0.000 261
-10		-5.31	-0.000 489
-20		-3.49	0.000 479
-30		-4.88	-0.000 261
Frequency Stability versus Power Supply			
Environment Temperature (°C)	Power Supplied (V)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
20	4.60 (115 %)	-4.12	0.000 144
	3.40 (85 %)	-3.89	0.000 266

LTE band 2 at middle channel

Reference Frequency: 1 880.0 MHz			
Frequency Stability versus Temperature			
Environment Temperature (°C)	Power Supplied (V)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
50	4.0	-3.29	0.000 319
40		-4.21	-0.000 170
30		-4.22	-0.000 176
20(Ref.)		-3.89	-
10		-4.21	-0.000 170
0		-3.12	0.000 410
-10		-2.49	0.000 745
-20		-4.32	-0.000 229
-30		-3.99	-0.000 053
Frequency Stability versus Power Supply			
Environment Temperature (°C)	Power Supplied (V)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
20	4.60 (115 %)	-3.99	-0.000 053
	3.40 (85 %)	-4.14	-0.000 133

- End of the Test Report -